for Preparation Click here

1.IGNITION SWITCH EXPRESSION

a. The type of ignition switch used on this model differs according to the specifications of the vehicle. The expressions listed in the table below are used in this section.

Expression	Ignition Switch (Position)	Engine Switch (Condition)
Ignition Switch off	LOCK	Off
Ignition Switch ACC	ACC	On (ACC)
Ignition Switch ON	ON	On (IG)
Engine Start	START	Start

2.INITIALIZATION

NOTICE:

Perform reset memory (AT initialization) when replacing the automatic transmission assembly, engine assembly or ECM (Click here).

HINT:

Initialization cannot be completed only by disconnecting the cable from the battery terminal.

3.FOR USING INTELLIGENT TESTER

CAUTION:

Observe the following items for safety reasons:

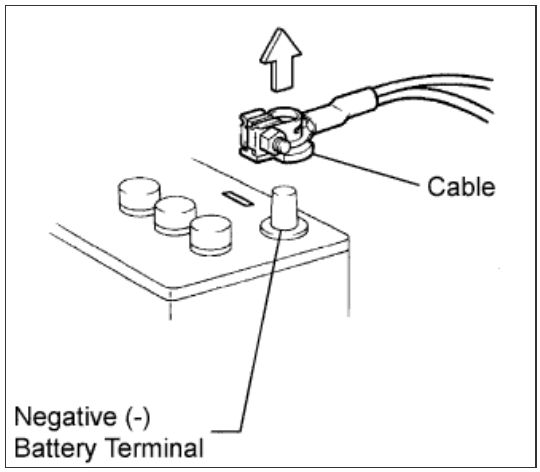
- Read its instruction books before using the tester.
- Prevent the tester cable from being caught on the pedals, shift lever and steering wheel when driving with the tester connected to the vehicle.
- When driving the vehicle for testing purposes using the tester, two persons are required. One person drives the vehicle, and the other operates the tester.

4.DISCONNECT AND RECONNECT CABLE OF NEGATIVE BATTERY TERMINAL

a. Before performing electronic work, disconnect the cable from the negative (-) battery terminal in order to prevent it from shorting and burning out.

b. Before disconnecting and reconnecting the battery cable, turn the ignition switch off and the headlight dimmer switch off. Then loosen the terminal nut completely. Do not damage the cable or terminal.

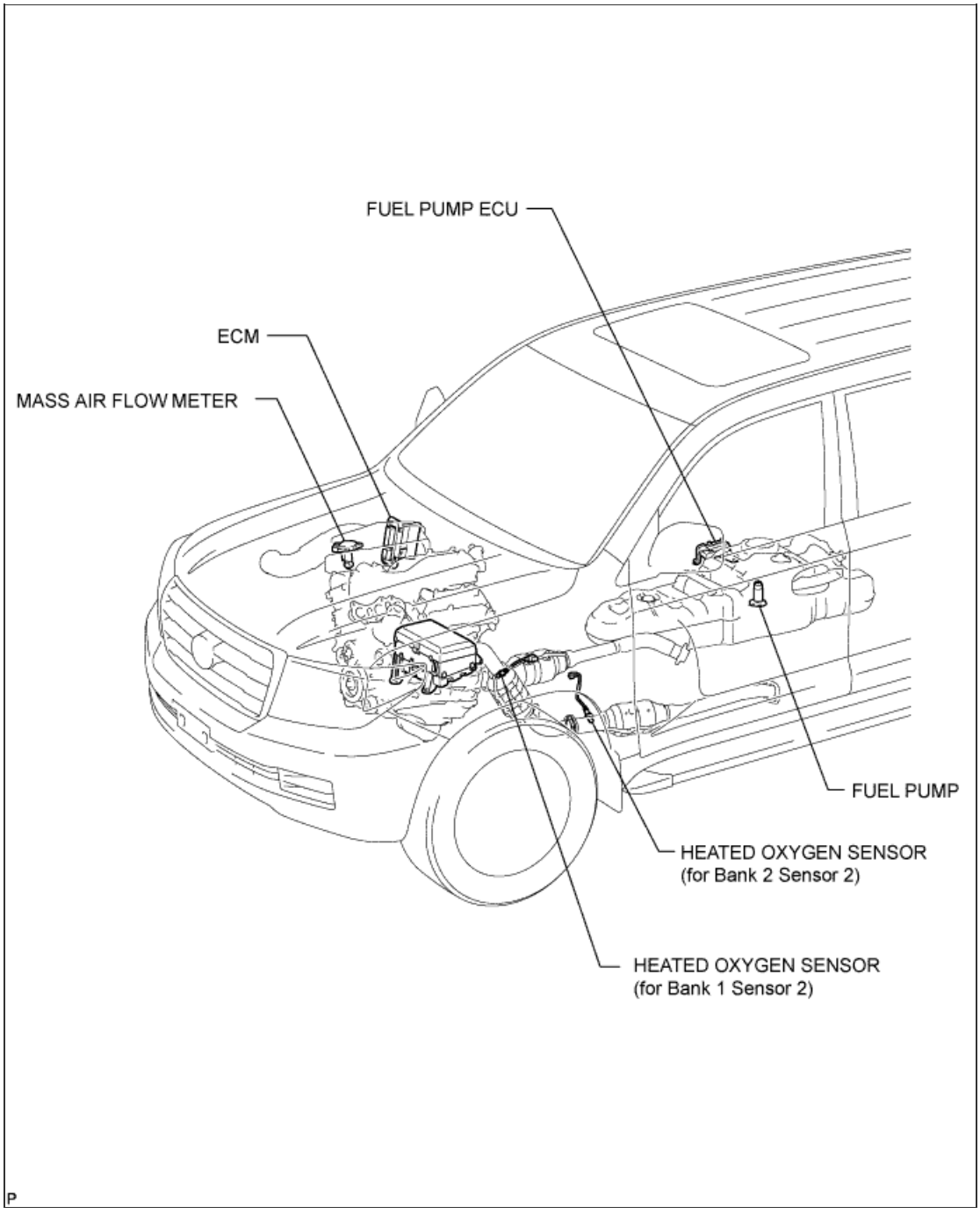
c. When the battery cable is disconnected, the clock and radio settings and stored DTCs are cleared. Therefore, before disconnecting the battery cable, make a note of the settings.

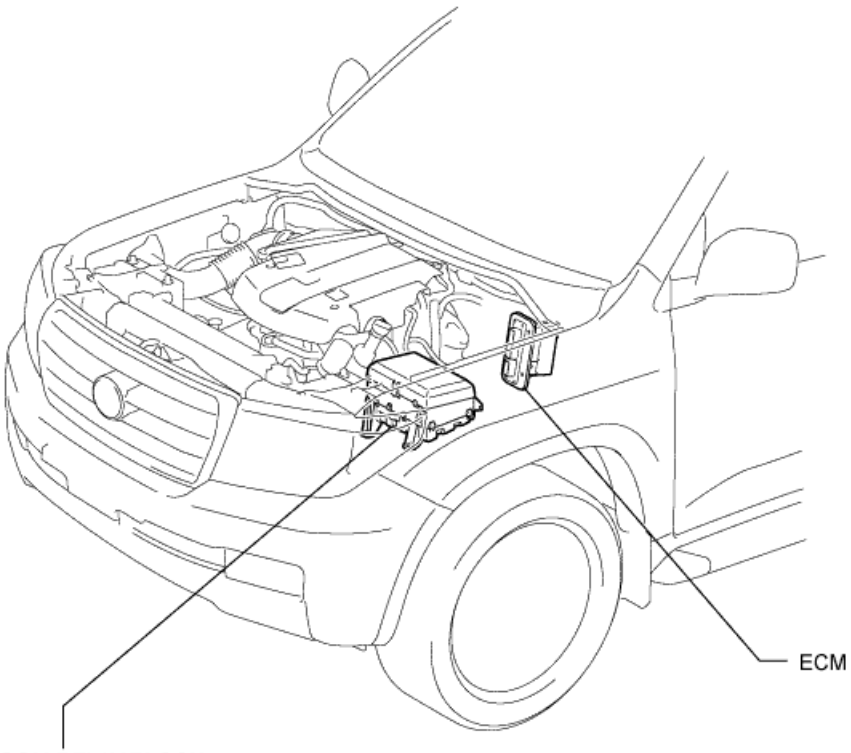


NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected.

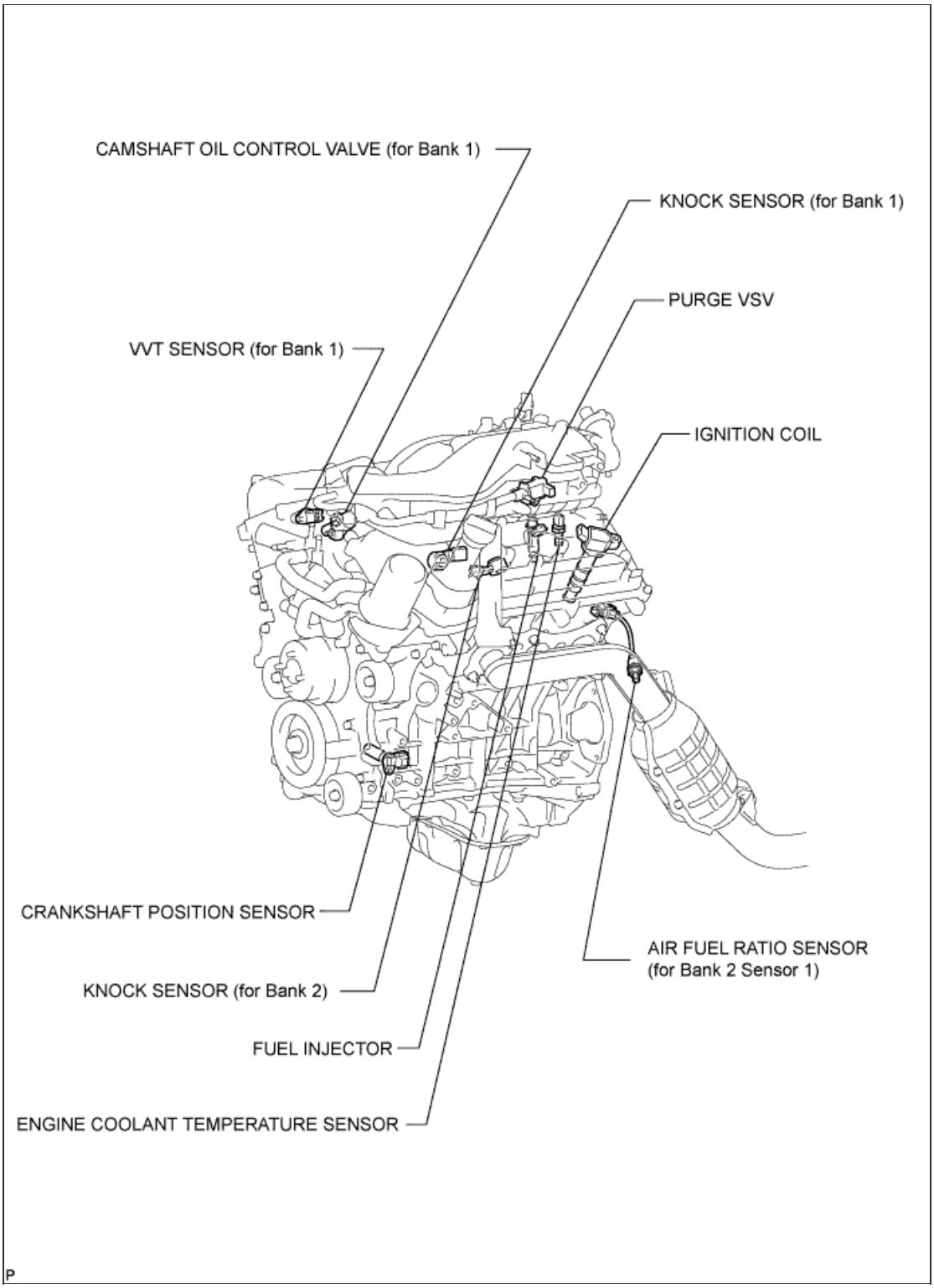
for Preparation Click here

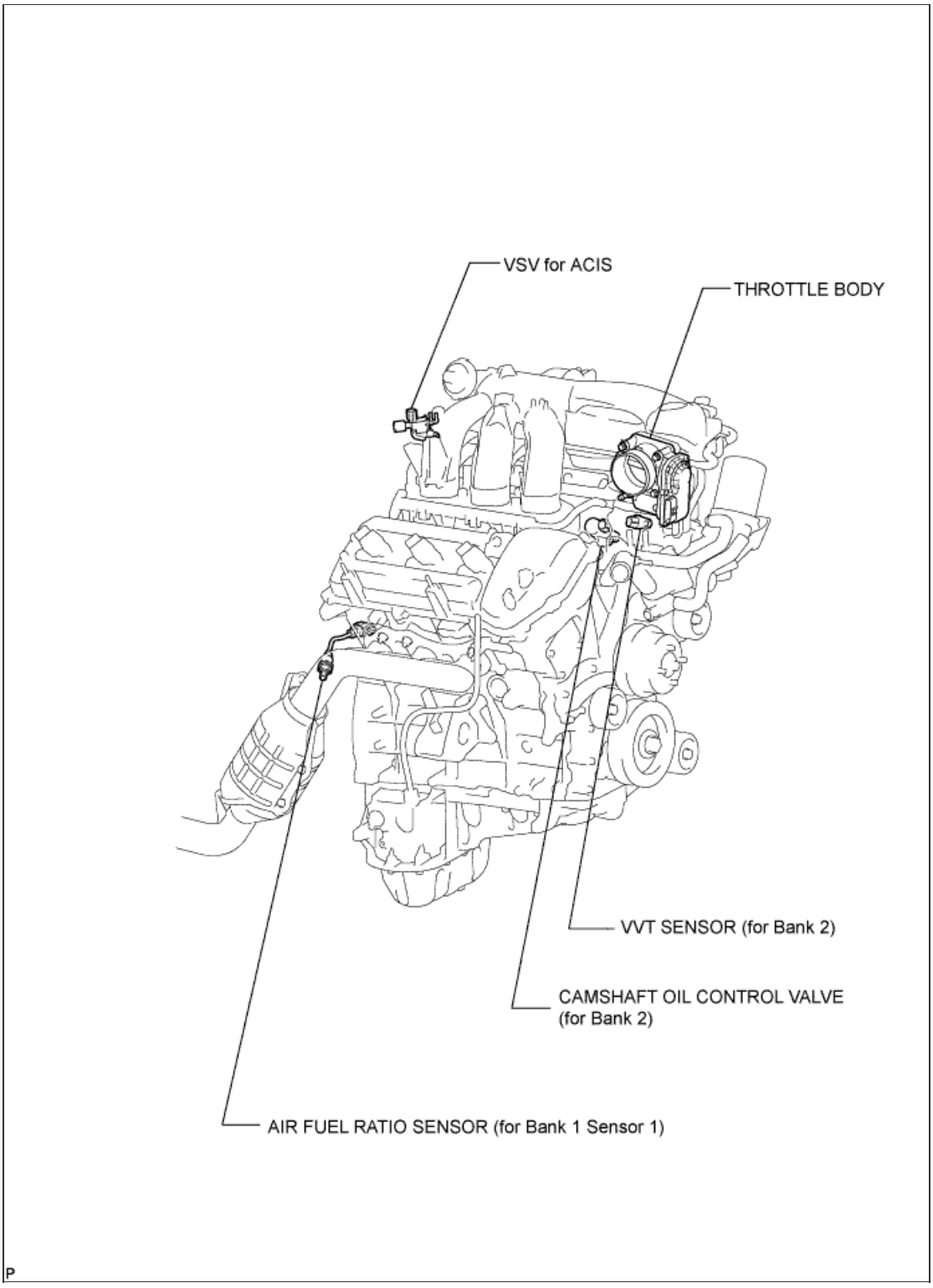




- CIRCUIT OPENING RELAY (C/OPN)
- IGNITION RELAY NO. 2 (IG2)
- EFI RELAY
- EFI NO. 2 RELAY
- A/F SENSOR HEATER RELAY (A/F)
- STARTER RELAY (ST)
- STARTER CUT RELAY (ST CUT)
- EFI NO. 2 FUSE
- IG2 MAIN FUSE
- EFI MAIN FUSE
- ST FUSE
- ETCS FUSE
- EFI MAIN 2 FUSE
- IGN FUSE
- INJ FUSE
- A/F FUSE

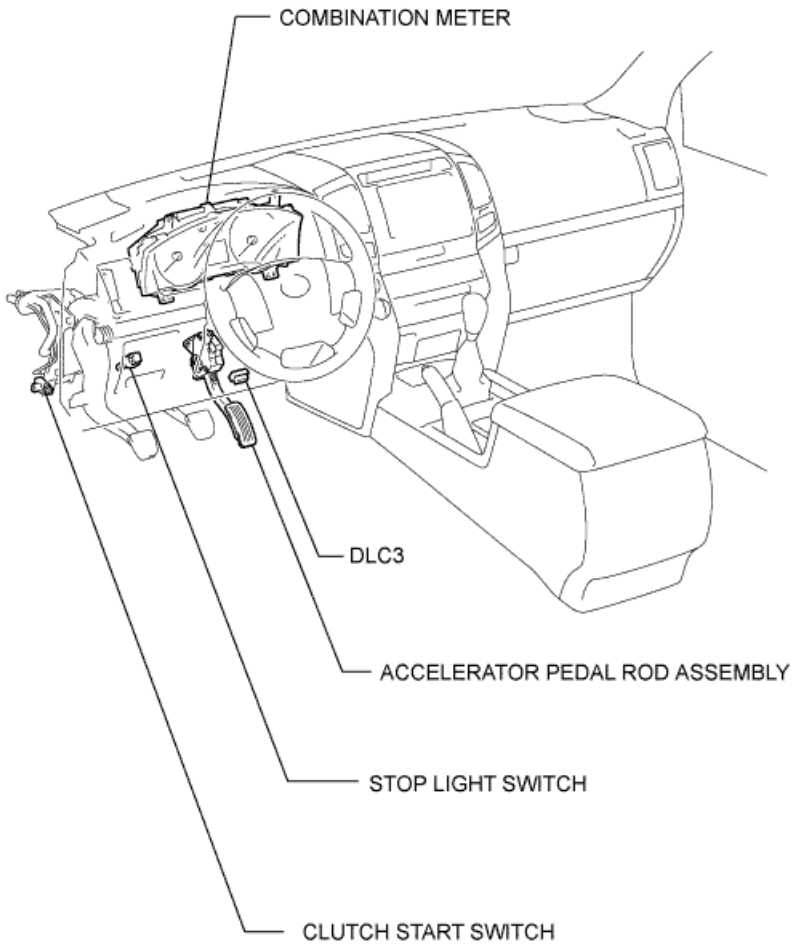
P


CAMSHAFT OIL CONTROL VALVE (for Bank 1)
KNOCK SENSOR (for Bank 1)
PURGE VSV
VVT SENSOR (for Bank 1)
IGNITION COIL
CRANKSHAFT POSITION SENSOR
AIR FUEL RATIO SENSOR
(for Bank 2 Sensor 1)
KNOCK SENSOR (for Bank 2)
FUEL INJECTOR
ENGINE COOLANT TEMPERATURE SENSOR
P


VSV for ACIS
THROTTLE BODY
VVT SENSOR (for Bank 2)
CAMSHAFT OIL CONTROL VALVE
(for Bank 2)
AIR FUEL RATIO SENSOR (for Bank 1 Sensor 1)

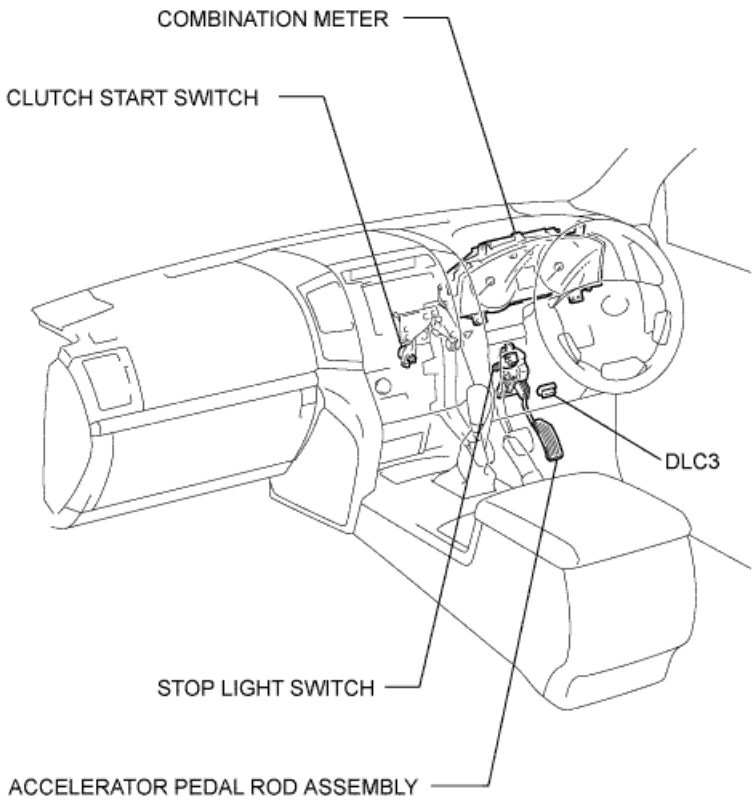
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for LHD:


COMBINATION METER
DLC3
ACCELERATOR PEDAL ROD ASSEMBLY
STOP LIGHT SWITCH
CLUTCH START SWITCH

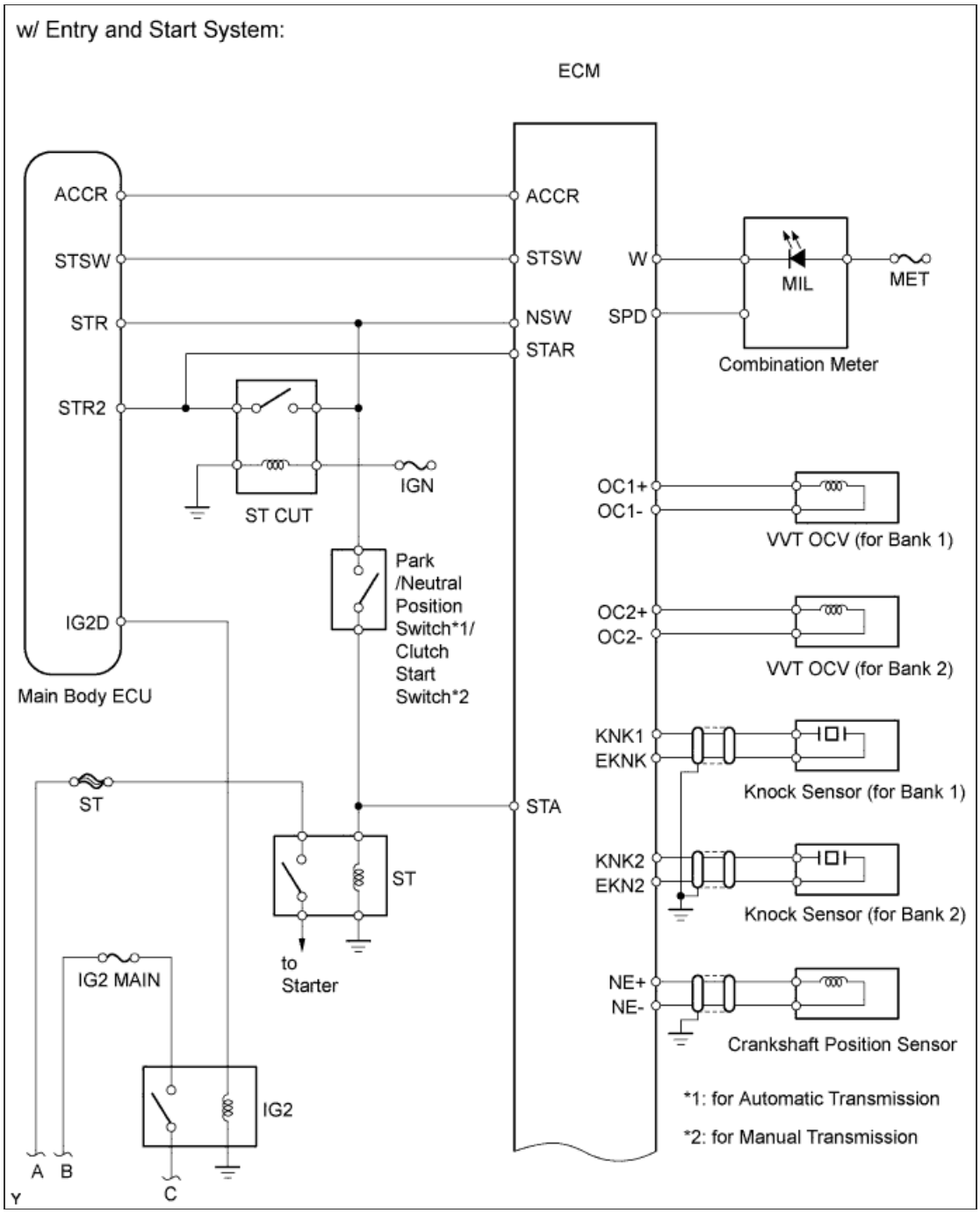
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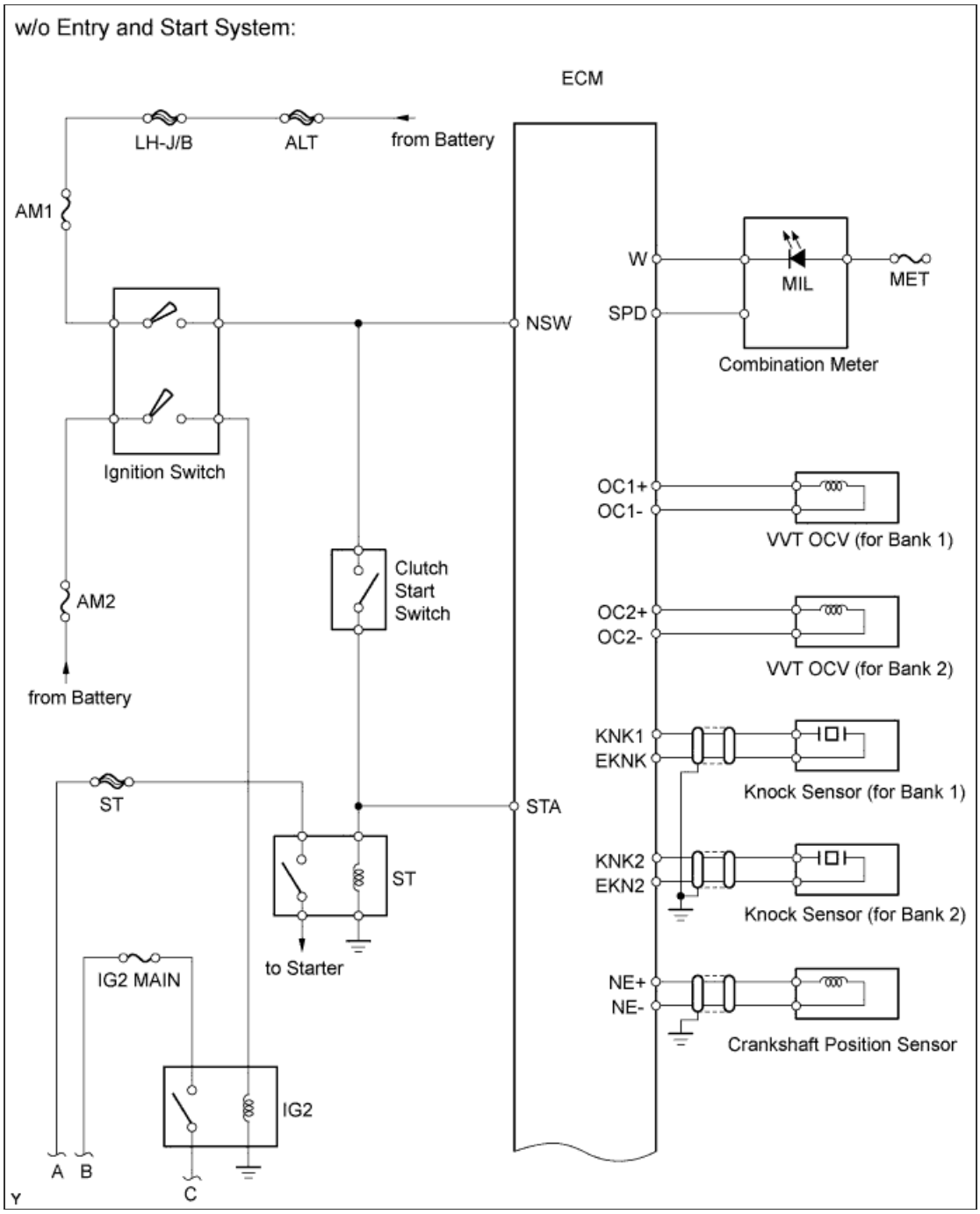
for RHD:

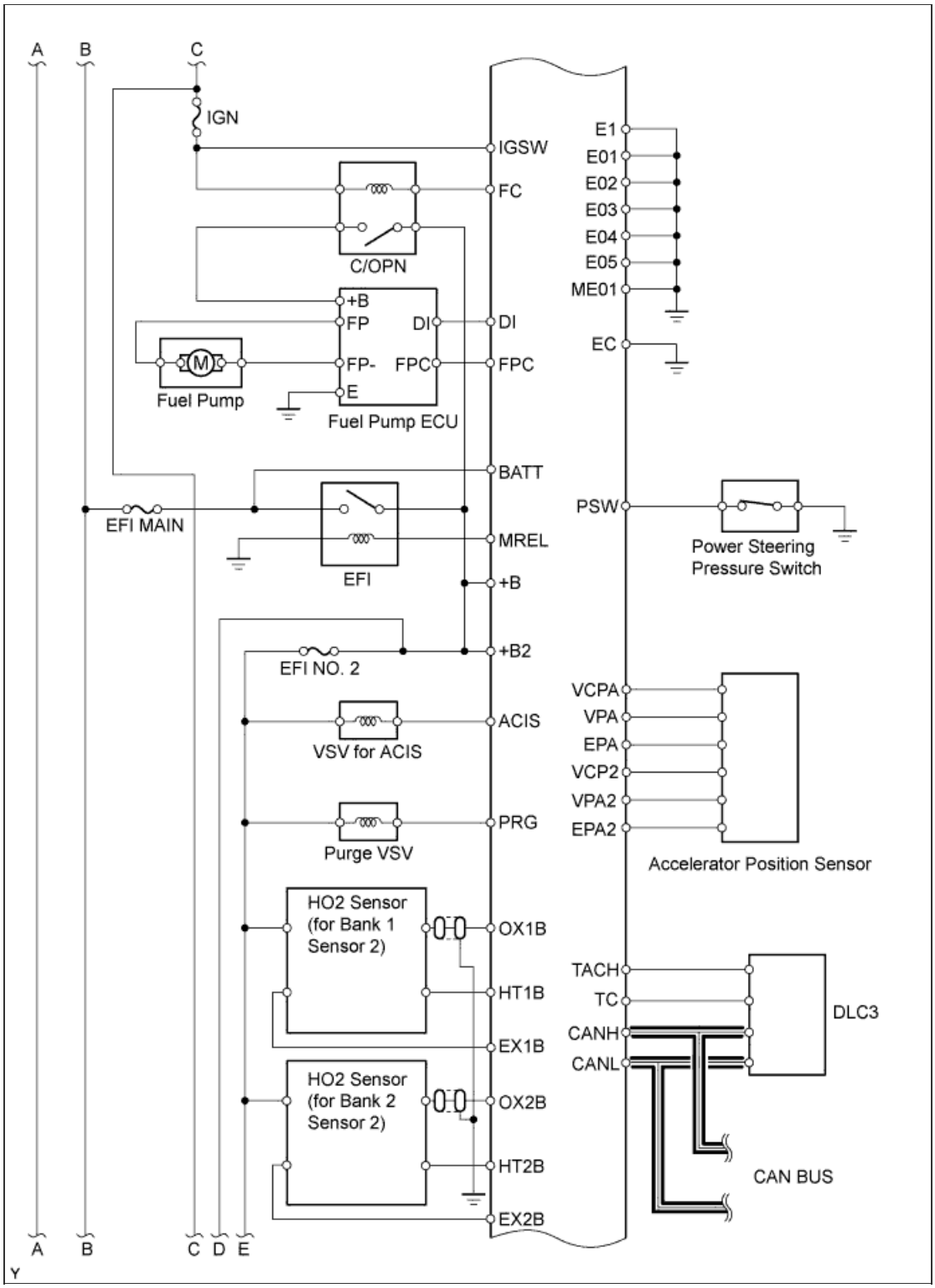

COMBINATION METER
CLUTCH START SWITCH
DLC3
STOP LIGHT SWITCH
ACCELERATOR PEDAL ROD ASSEMBLY

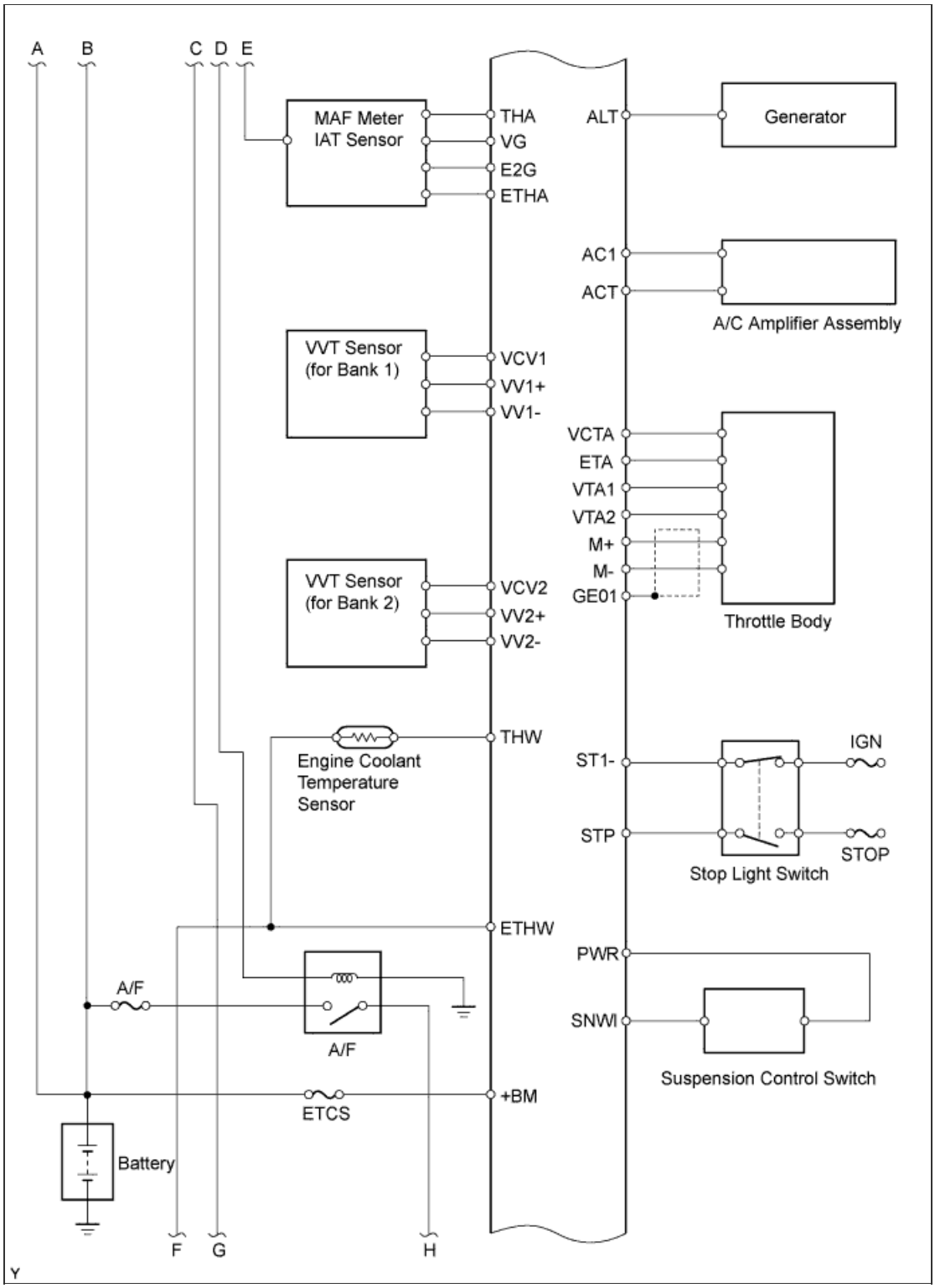
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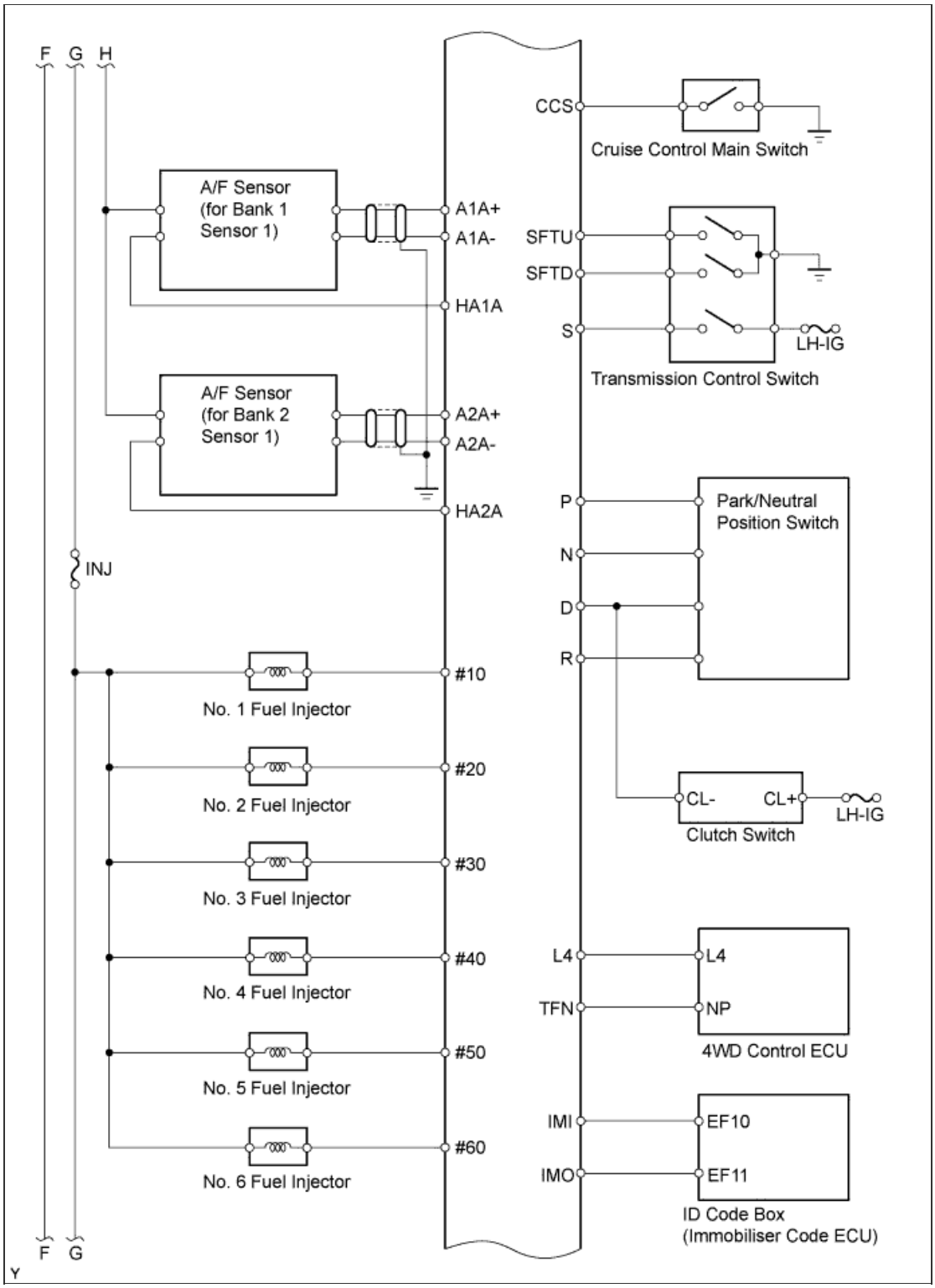
for Preparation Click here

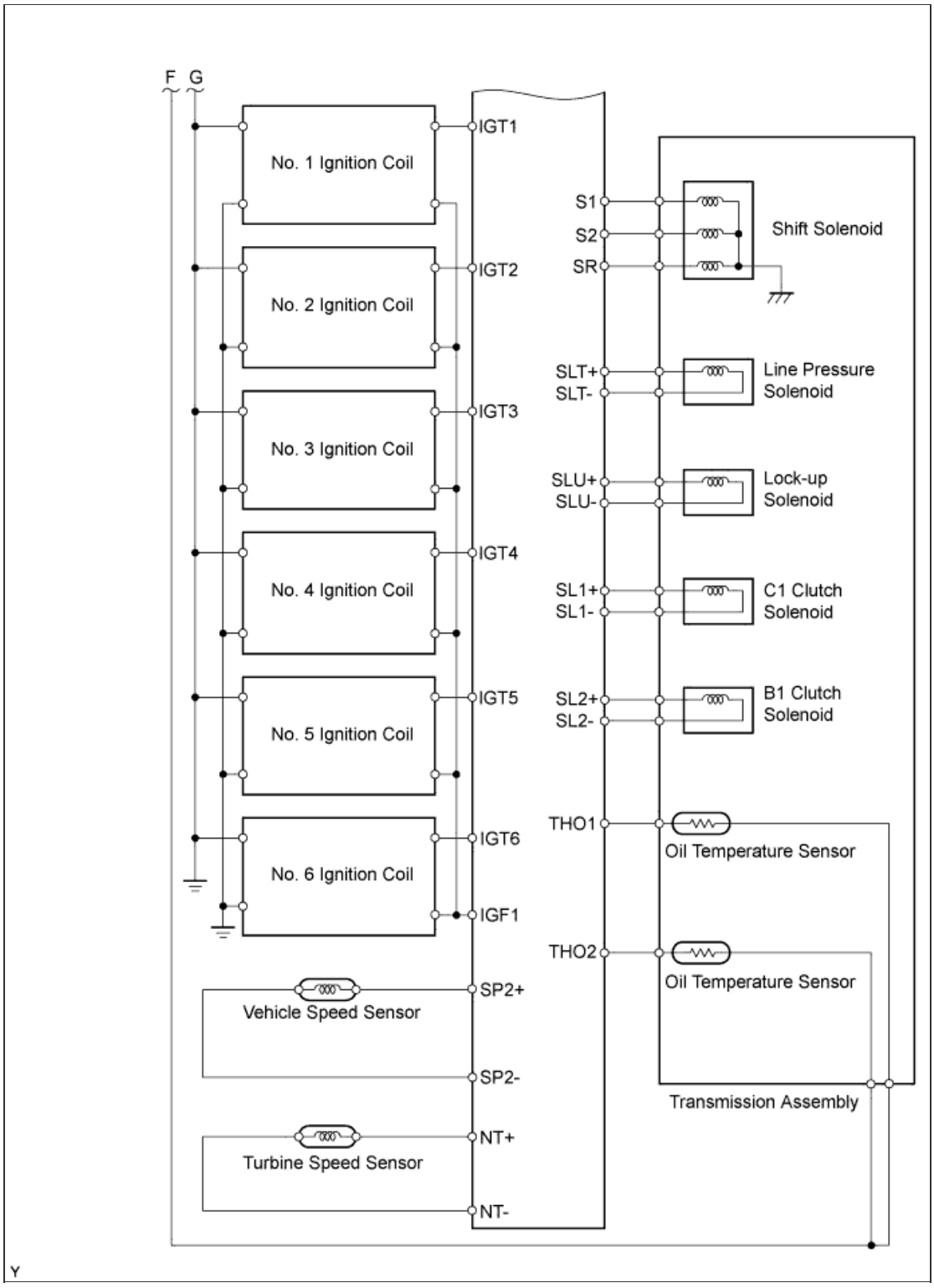



w/o Entry and Start System:
ECM
LH-J/B
ALT
from Battery
AM1
W
MIL
MET
SPD
NSW
Combination Meter
Ignition Switch
OC1+
OC1-
VVT OCV (for Bank 1)
Clutch
Start
Switch
AM2
OC2+
OC2-
VVT OCV (for Bank 2)
from Battery
KNK1
EKNK
Knock Sensor (for Bank 1)
ST
STA
ST
KNK2
EKN2
Knock Sensor (for Bank 2)
to Starter
IG2 MAIN
NE+
NE-
Crankshaft Position Sensor
IG2
A
B
C
Y


A
B
C
IGN
IGSW
FC
C/OPN
+B
FP
DI
DI
FP-
FPC
FPC
E
Fuel Pump
Fuel Pump ECU
BATT
EFI MAIN
MREL
EFI
+B
+B2
EFI NO. 2
ACIS
VSV for ACIS
PRG
Purge VSV
HO2 Sensor
(for Bank 1
Sensor 2)
OX1B
HT1B
EX1B
HO2 Sensor
(for Bank 2
Sensor 2)
OX2B
HT2B
EX2B
A
B
C
D
E
Y
E1
E01
E02
E03
E04
E05
ME01
EC
PSW
Power Steering
Pressure Switch
VCPA
VPA
EPA
VCP2
VPA2
EPA2
Accelerator Position Sensor
TACH
TC
CANH
CANL
DLC3
CAN BUS


A
B
C
D
E
MAF Meter
IAT Sensor
THA
VG
E2G
ETHA
ALT
Generator
AC1
ACT
A/C Amplifier Assembly
VVT Sensor
(for Bank 1)
VCV1
VV1+
VV1-
VCTA
ETA
VTA1
VTA2
M+
M-
GE01
Throttle Body
VVT Sensor
(for Bank 2)
VCV2
VV2+
VV2-
THW
Engine Coolant
Temperature
Sensor
IGN
ST1-
STP
STOP
Stop Light Switch
ETHW
PWR
A/F
A/F
SNWI
Suspension Control Switch
+BM
ETCS
Battery
F
G
H
Y


F G H
A/F Sensor
(for Bank 1
Sensor 1)
A1A+
A1A-
HA1A
A/F Sensor
(for Bank 2
Sensor 1)
A2A+
A2A-
HA2A
INJ
#10
No. 1 Fuel Injector
#20
No. 2 Fuel Injector
#30
No. 3 Fuel Injector
#40
No. 4 Fuel Injector
#50
No. 5 Fuel Injector
#60
No. 6 Fuel Injector
F G
Y
CCS
Cruise Control Main Switch
SFTU
SFTD
S
LH-IG
Transmission Control Switch
P
N
D
R
Park/Neutral
Position Switch
CL-
CL+
LH-IG
Clutch Switch
L4
TFN
L4
NP
4WD Control ECU
IMI
IMO
EF10
EF11
ID Code Box
(Immobiliser Code ECU)


F
G
No. 1 Ignition Coil
No. 2 Ignition Coil
No. 3 Ignition Coil
No. 4 Ignition Coil
No. 5 Ignition Coil
No. 6 Ignition Coil
IGT1
IGT2
IGT3
IGT4
IGT5
IGT6
IGF1
Vehicle Speed Sensor
SP2+
SP2-
Turbine Speed Sensor
NT+
NT-
S1
S2
SR
Shift Solenoid
SLT+
SLT-
Line Pressure Solenoid
SLU+
SLU-
Lock-up Solenoid
SL1+
SL1-
C1 Clutch Solenoid
SL2+
SL2-
B1 Clutch Solenoid
THO1
Oil Temperature Sensor
THO2
Oil Temperature Sensor
Transmission Assembly
Y

for Preparation Click here

HINT:

*: Use the intelligent tester.

1.VEHICLE BROUGHT TO WORKSHOP

NEXT

2.CUSTOMER PROBLEM ANALYSIS

NEXT

3.CONNECT INTELLIGENT TESTER TO DLC3

HINT:

If the display indicates a communication fault in the tester, inspect the DLC3.

NEXT

4.CHECK DTC AND FREEZE FRAME DATA*

HINT:

Record or print DTCs and freeze frame data, if necessary.

NEXT

5.CLEAR DTC AND FREEZE FRAME DATA*

NEXT

6.CONDUCT VISUAL INSPECTION

NEXT

7.SET CHECK MODE DIAGNOSIS*

NEXT

8.CONFIRM PROBLEM SYMPTOMS

HINT:

If the engine does not start, first perform the "Check DTC" procedures and "Conduct Basic Inspection" procedures below.

Result

Result	Proceed to
Malfunction does not occur	A
Malfunction occurs	B

B. GO TO STEP 10

A

9.SIMULATE SYMPTOMS

NEXT

10.CHECK DTC*

Result

Result	Proceed to
Trouble code output	A
No code output	B

B. GO TO STEP 12

A

11.REFER TO DTC CHART

NEXT

12.CONDUCT BASIC INSPECTION

Result

Result	Proceed to
Malfunctioning parts not confirmed	A
Malfunctioning parts confirmed	B

B. GO TO STEP 17

A

13.REFER TO PROBLEM SYMPTOMS TABLE

Result

Result	Proceed to
Malfunctioning circuit confirmed	A
Malfunctioning parts confirmed	B

B. GO TO STEP 17

A

14.CHECK ECM POWER SOURCE CIRCUIT

NEXT

15.CONDUCT CIRCUIT INSPECTION

Result

Result	Proceed to
Malfunction not confirmed	A
Malfunction confirmed	B

B. GO TO STEP 18

A

16.CHECK FOR INTERMITTENT PROBLEMS

NEXT

17.CONDUCT PARTS INSPECTION

NEXT

18.IDENTIFY PROBLEM

NEXT

19.ADJUST AND/OR REPAIR

NEXT

20.CONDUCT CONFIRMATION TEST

NEXT

END

for Preparation Click here

HINT:

Inspect the vehicle ECM using check mode. Intermittent problems are easier to detect with the intelligent tester when the ECM is in check mode. In check mode, the ECM uses 1 trip detection logic, which is more sensitive to malfunctions than normal mode (default), which uses 2 trip detection logic.

1. **Clear the DTCs (Click here).**
2. **Switch the ECM from normal mode to check mode using the intelligent tester (Click here).**
3. **Perform a simulation test.**
4. **Check and wiggle the harness(es), connector(s) and terminal(s).**

for Preparation Click here

When a malfunction is not confirmed by the DTC check, troubleshooting should be carried out in all circuits considered to be possible causes of the problem. In many cases, by carrying out the basic engine check shown in the following flowchart, the location of the problem can be found quickly and efficiently. Therefore, using this check is essential when engine troubleshooting.

1.CHECK BATTERY VOLTAGE

NOTICE:

Carry out this check with the engine stopped and the ignition switch off.

Result

Result	Proceed to
11 V or higher	OK
Below 11 V	NG

NG. → CHARGE OR REPLACE BATTERY

OK ↓

2.CHECK WHETHER ENGINE CRANKS

NG. → PROCEED TO PROBLEM SYMPTOMS TABLE

OK ↓

3.CHECK WHETHER ENGINE STARTS

NG. → GO TO STEP 6

OK ↓

4.CHECK AIR FILTER

a. Visually check that the air filter is not excessively contaminated with dirt or oil.

NG. → REPLACE AIR FILTER

OK ↓

5.CHECK IDLING SPEED

NG. → TROUBLESHOOT IDLING SPEED AND PROCEED TO NEXT STEP

OK ↓

6.CHECK FUEL PRESSURE

NG. → TROUBLESHOOT FUEL PRESSURE AND PROCEED TO NEXT STEP

OK

7.CHECK FOR SPARK

NG. → TROUBLESHOOT SPARK AND PROCEED TO NEXT STEP

OK

PROCEED TO PROBLEM SYMPTOMS TABLE

for Preparation Click here

HINT:

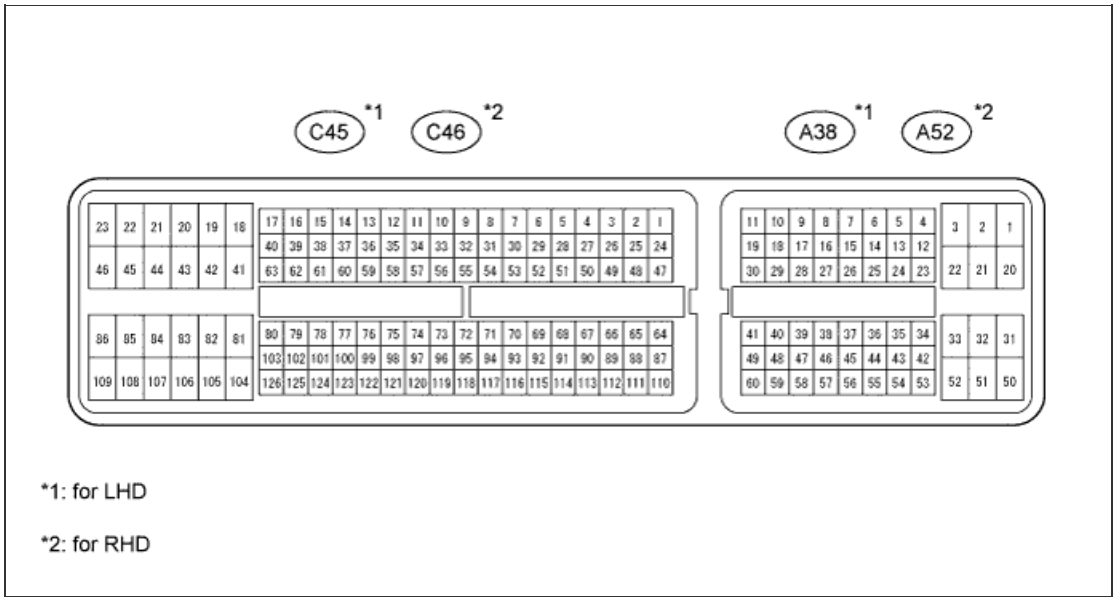
Use the table below to help determine the cause of problem symptoms. If multiple suspected areas are listed, the potential causes of the symptoms are listed in order of probability in the "Suspected Area" column of the table. Check each symptom by checking the suspected areas in the order they are listed. Replace parts as necessary.

SFI System

Symptom	Suspected Area	See page
Engine does not crank (Does not start)	Battery	Click here
	Starter (for 1.4 kW Type)	Click here
	Starter (for 2.0 kW Type)	Click here
	Starter relay	Click here
	Park/neutral position switch	Click here
	Clutch start switch (for LHD)	Click here
	Clutch start switch (for RHD)	Click here
	Entry and start system	Click here
	Immobiliser system	Click here
No initial combustion (Does not start)	ECM power source circuit	Click here
	Crankshaft position sensor	Click here
	VVT sensor	Click here
	Ignition system	Click here
	Fuel pump control circuit	Click here
	ECM	Click here
	Starter signal circuit	Click here
	Cranking holding function circuit	Click here
	VC output circuit	Click here
Engine cranks normally but difficult to start	Fuel pump control circuit	Click here
	Compression	Click here
Difficult to start with cold engine	Ignition system	Click here
	Spark plug	Click here
	Fuel pump control circuit	Click here
	Fuel injector	Click here
Difficult to start with warm engine	Fuel injector	Click here
	Ignition system	Click here
	Spark plug	Click here
	Fuel pump control circuit	Click here
High engine idle speed	Electronic throttle control system	Click here
	A/C signal circuit	Click here
	ECM power source circuit	Click here
	Acoustic Control Induction System (ACIS)	Click here
Low engine idle speed (Poor idling)	Electronic throttle control system	Click here
	A/C signal circuit	Click here
	Fuel pump control circuit	Click here
	Air induction system	Click here
	Acoustic Control Induction System (ACIS)	Click here
	PCV hose	Click here
Rough idling	Compression	Click here
	Spark plug	Click here
	Fuel injector	Click here
	Ignition system	Click here
	Fuel pump control circuit	Click here
	Electronic throttle control system	Click here

	Air induction system	Click here
	Acoustic Control Induction System (ACIS)	Click here
	PCV hose	Click here
	Mass air flow meter	Click here
Idle hunting	Electronic throttle control system	Click here
	Air induction system	Click here
	ECM power source circuit	Click here
	Acoustic Control Induction System (ACIS)	Click here
Hesitation/poor acceleration	Fuel pump control circuit	Click here
	Spark plug	Click here
	Ignition system	Click here
	Fuel injector	Click here
	Mass air flow meter	Click here
	Electronic throttle control system	Click here
	Air induction system	Click here
	Compression	Click here
	Air Intake Control System (ACIS)	Click here
	Brake override system	Click here
Surging (Poor driveability)	Spark plug	Click here
	Fuel pump control circuit	Click here
	Ignition system	Click here
	Fuel injector	Click here
	Mass air flow meter	Click here
	Variable valve timing system	Click here
	Compression	Click here
Engine stalls soon after starting	Fuel pump control circuit	Click here
	Spark plug	Click here
	Ignition system	Click here
	Fuel injector	Click here
	Variable valve timing system	Click here
	Electronic throttle control system	Click here
	Air induction system	Click here
	PCV hose	Click here
	Compression	Click here
Engine stalls only during A/C operation	A/C signal circuit	Click here
	ECM	Click here

for Preparation Click here



Measure the voltage according to the value(s) in the table below.

HINT:

The standard normal voltage between each pair of ECM terminals is shown in the table below. The appropriate conditions for checking each pair of terminals are also indicated.

The result of checks should be compared with the standard normal voltage for that pair of terminals, displayed in the Specified Condition column.

The illustration above can be used as a reference to identify the ECM terminal locations.

Terminal No. (Symbol)	Wiring Color	Terminal Description	Condition	Specified Condition
A38*1-20 (BATT) - C45*1-81 (E1) A52*2-20 (BATT) - C46*2-81 (E1)	L - BR	Battery (for measuring the battery voltage and for the ECM memory)	Always	11 to 14 V
A38*1-3 (+BM) - C45*1-81 (E1) A52*2-3 (+BM) - C46*2-81 (E1)	P-B - BR	Power source of throttle actuator	Always	11 to 14 V
A38*1-28 (IGSW) - C45*1-81 (E1) A52*2-28 (IGSW) - C46*2-81 (E1)	B - BR	Ignition switch	Ignition switch ON	11 to 14 V
A38*1-2 (+B) - C45*1-81 (E1) A52*2-2 (+B) - C46*2-81 (E1)	B - BR	Power source of ECM	Ignition switch ON	11 to 14 V
A38*1-1 (+B2) - C45*1-81 (E1) A52*2-1 (+B2) - C46*2-81 (E1)	B - BR	Power source of ECM	Ignition switch ON	11 to 14 V
C45*1-58 (OC1+) - C45*1-57 (OC1-) C46*2-58 (OC1+) - C46*2-57 (OC1-)	L-B - R-B	Camshaft timing oil control valve (OCV) (bank 1)	Ignition switch ON	Pulse generation (See waveform 1)
C45*1-52 (OC2+) - C45*1-51 (OC2-) C46*2-52 (OC2+) - C46*2-51 (OC2-)	B - B-L	Camshaft timing oil control valve (OCV) (bank 2)	Ignition switch ON	Pulse generation (See waveform 1)
A38*1-44 (MREL) - C45*1-81 (E1) A52*2-44 (MREL) - C46*2-81 (E1)	W-R - BR	EFI relay	Ignition switch ON	11 to 14 V
C45*1-115 (VCV1) - C45*1-78 (ETHW) C46*2-115 (VCV1) - C46*2-78 (ETHW)	L - BR	Power source of sensor (specific voltage)	Ignition switch ON	4.5 to 5.5 V
C45*1-113 (VCV2) - C45*1-74 (ETHA) C46*2-113 (VCV2) - C46*2-74 (ETHA)	L - BR	Power source of sensor (specific voltage)	Ignition switch ON	4.5 to 5.5 V
C45*1-72 (VG) - C45*1-73 (E2G)	L-Y - G-W	Mass air flow meter	Idling, shift lever in P or N,	0.5 to 3.0 V

C46*2-72 (VG) - C46*2-73 (E2G)			A/C switch off	
C45*1-71 (THA) - C45*1-74 (ETHA) C46*2-71 (THA) - C46*2-74 (ETHA)	Y-B - BR	Intake air temperature sensor	Idling, intake air temperature 20°C (68°F)	0.5 to 3.4 V
C45*1-79 (THW) - C45*1-78 (ETHW) C46*2-79 (THW) - C46*2-78 (ETHW)	G-B - BR	Engine coolant temperature sensor	Idling, engine coolant temperature 80°C (176°F)	0.2 to 1.0 V
C45*1-96 (VCTA) - C45*1-97 (ETA) C46*2-96 (VCTA) - C46*2-97 (ETA)	L - B	Power source of throttle position sensor (specific voltage)	Ignition switch ON	4.5 to 5.5 V
C45*1-98 (VTA1) - C45*1-97 (ETA) C46*2-98 (VTA1) - C46*2-97 (ETA)	R-Y - B	Throttle position sensor (for engine control)	Ignition switch ON, throttle valve fully closed	0.5 to 1.1 V
			Ignition switch ON, throttle valve fully open	3.2 to 4.8 V
C45*1-99 (VTA2) - C45*1-97 (ETA) C46*2-99 (VTA2) - C46*2-97 (ETA)	Y-B - B	Throttle position sensor (for sensor malfunction detection)	Ignition switch ON, throttle valve fully closed	2.1 to 3.1 V
			Ignition switch ON, throttle valve fully open	4.6 to 5.0 V
A38*1-55 (VPA) - A38*1-59 (EPA) A52*2-55 (VPA) - A52*2-59 (EPA)	R - W-L	Accelerator pedal position sensor (for engine control)	Ignition switch ON, accelerator pedal fully released	0.5 to 1.1 V
			Ignition switch ON, accelerator pedal fully depressed	2.6 to 4.5 V
A38*1-56 (VPA2) - A38*1-60 (EPA2) A52*2-56 (VPA2) - A52*2-60 (EPA2)	GR-G - BR	Accelerator pedal position sensor (for sensor malfunction detection)	Ignition switch ON, accelerator pedal fully released	1.2 to 2.0 V
			Ignition switch ON, accelerator pedal fully depressed	3.4 to 5.0 V
A38*1-57 (VCPA) - A38*1-59 (EPA) A52*2-57 (VCPA) - A52*2-59 (EPA)	L-W - W-L	Power source of accelerator pedal position sensor (for VPA)	Ignition switch ON	4.5 to 5.5 V
A38*1-58 (VCP2) - A38*1-60 (EPA2) A52*2-58 (VCP2) - A52*2-60 (EPA2)	V - BR	Power source of accelerator pedal position sensor (for VPA2)	Ignition switch ON	4.5 to 5.5 V
C45*1-86 (HA1A) - C45*1-23 (E04) C46*2-86 (HA1A) - C46*2-23 (E04)	L-R - W-B	Air fuel ratio (A/F) sensor heater	Idling	Below 3.0 V
C45*1-109 (HA2A) - C45*1-46 (E05) C46*2-109 (HA2A) - C46*2-46 (E05)	G - W-B		Ignition switch ON	11 to 14 V
C45*1-93 (A1A+) - C45*1-81 (E1) C46*2-93 (A1A+) - C46*2-81 (E1)	G - BR	A/F sensor	Ignition switch ON	3.3 V*3
C45*1-120 (A2A+) - C45*1-81 (E1) C46*2-120 (A2A+) - C46*2-81 (E1)	V - BR	A/F sensor	Ignition switch ON	3.3 V*3
C45*1-116 (A1A-) - C45*1-81 (E1) C46*2-116 (A1A-) - C46*2-81 (E1)	R - BR	A/F sensor	Ignition switch ON	2.9 V*3
C45*1-119 (A2A-) - C45*1-81 (E1) C46*2-119 (A2A-) - C46*2-81 (E1)	P - BR	A/F sensor	Ignition switch ON	2.9 V*3
C45*1-48 (HT1B) - C45*1-104 (E03) C46*2-48 (HT1B) - C46*2-104 (E03)	G - BR	Heated oxygen sensor heater	Idling	Below 3.0 V
C45*1-47 (HT2B) - C45*1-104 (E03) C46*2-47 (HT2B) - C46*2-104 (E03)	B - BR		Ignition switch ON	11 to 14 V
C45*1-88 (OX1B) - C45*1-65 (EX1B) C46*2-88 (OX1B) - C46*2-65 (EX1B)	W - BR	Heated oxygen sensor	Engine speed maintained at 2500 rpm for 2 minutes after warming up engine	Pulse generation (See waveform 2)
C45*1-87 (OX2B) - C45*1-64 (EX2B) C46*2-87 (OX2B) - C46*2-64 (EX2B)	B - BR			
C45*1-45 (#10) - C45*1-22 (E01) C46*2-45 (#10) - C46*2-22 (E01)	R-L - W-B		Ignition switch ON	11 to 14 V
C45*1-85 (#20) - C45*1-22 (E01) C46*2-85 (#20) - C46*2-22 (E01)	L - W-B			
C45*1-44 (#30) - C45*1-22 (E01) C46*2-44 (#30) - C46*2-22 (E01)	R-B - W-B			

C45*1-84 (#40) - C45*1-22 (E01) C46*2-84 (#40) - C46*2-22 (E01)	Y - W-B	Fuel injector	Idling	Pulse generation (See waveform 3)
C45*1-43 (#50) - C45*1-22 (E01) C46*2-43 (#50) - C46*2-22 (E01)	G - W-B			
C45*1-83 (#60) - C45*1-22 (E01) C46*2-83 (#60) - C46*2-22 (E01)	R - W-B			
C45*1-95 (KNK1) - C45*1-94 (EKNK) C46*2-95 (KNK1) - C46*2-94 (EKNK)	G - R	Knock sensor (bank 1)	Engine speed maintained at 4000 rpm after warming up engine	Pulse generation (See waveform 4)
C45*1-118 (KNK2) - C45*1-117 (EKN2) C46*2-118 (KNK2) - C46*2-117 (EKN2)	W - B	Knock sensor (bank 2)	Engine speed maintained at 4000 rpm after warming up engine	Pulse generation (See waveform 4)
C45*1-69 (VV1+) - C45*1-92 (VV1-) C46*2-69 (VV1+) - C46*2-92 (VV1-)	R - L-R	Variable Valve Timing (VVT) sensor (bank 1)	Idling	Pulse generation (See waveform 5)
C45*1-67 (VV2+) - C45*1-90 (VV2-) C46*2-67 (VV2+) - C46*2-90 (VV2-)	R - G	Variable Valve Timing (VVT) sensor (bank 2)	Idling	Pulse generation (See waveform 5)
C45*1-110 (NE+) - C45*1-111 (NE-) C46*2-110 (NE+) - C46*2-111 (NE-)	B - W	Crankshaft position sensor	Idling	Pulse generation (See waveform 5)
C45*1-40 (IGT1) - C45*1-81 (E1) C46*2-40 (IGT1) - C46*2-81 (E1)	B-R - BR	Ignition coil (ignition signal)	Idling	Pulse generation (See waveform 6)
C45*1-39 (IGT2) - C45*1-81 (E1) C46*2-39 (IGT2) - C46*2-81 (E1)	L-B - BR			
C45*1-38 (IGT3) - C45*1-81 (E1) C46*2-38 (IGT3) - C46*2-81 (E1)	B - BR			
C45*1-37 (IGT4) - C45*1-81 (E1) C46*2-37 (IGT4) - C46*2-81 (E1)	L-B - BR			
C45*1-36 (IGT5) - C45*1-81 (E1) C46*2-36 (IGT5) - C46*2-81 (E1)	G-R - BR			
C45*1-35 (IGT6) - C45*1-81 (E1) C46*2-35 (IGT6) - C46*2-81 (E1)	G - BR			
C45*1-106 (IGF1) - C45*1-81 (E1) C46*2-106 (IGF1) - C46*2-81 (E1)	G-B - BR	Ignition coil (ignition confirmation signal)	Ignition switch ON	4.5 to 5.5 V
			Idling	Pulse generation (See waveform 6)
C45*1-108 (PRG) - C45*1-81 (E1) C46*2-108 (PRG) - C46*2-81 (E1)	L-B - BR	Purge VSV	Ignition switch ON	11 to 14 V
			Idling	Pulse generation (See waveform 7)
A38*1-8 (SPD) - C45*1-81 (E1) A52*2-8 (SPD) - C46*2-81 (E1)	V-R - BR	Speed signal from combination meter	Ignition switch ON, wheel rotated slowly	Pulse generation (See waveform 8)
A38*1-48 (STA) - C45*1-81 (E1) A52*2-48 (STA) - C46*2-81 (E1)	R-B - BR	Starter signal	Cranking	11 to 14 V
A38*1-36 (STP) - C45*1-81 (E1) A52*2-36 (STP) - C46*2-81 (E1)	R - BR	Stop light switch	Brake pedal depressed	7.5 to 14 V
			Brake pedal released	Below 1.5 V
A38*1-35 (ST1-) - C45*1-81 (E1) A52*2-35 (ST1-) - C46*2-81 (E1)	R-W - BR	Stop light switch (opposite to STP terminal)	Ignition switch ON, brake pedal depressed	Below 1.5 V
			Ignition switch ON, brake pedal released	7.5 to 14 V
C45*1-62 (NSW) - C45*1-81 (E1) C46*2-62 (NSW) - C46*2-81 (E1)	L - BR	Park/neutral position switch	Ignition switch ON, shift lever in P or N	Below 3.0 V
			Ignition switch ON, shift lever in other than P or N	11 to 14 V
C45*1-19 (M+) - C45*1-20 (ME01) C46*2-19 (M+) - C46*2-20 (ME01)	R - W-B	Throttle actuator	Idling with warm engine	Pulse generation (See waveform 9)
C45*1-18 (M-) - C45*1-20 (ME01) C46*2-18 (M-) - C46*2-20 (ME01)	G - W-B	Throttle actuator	Idling with warm engine	Pulse generation (See waveform 10)
A38*1-7 (FC) - C45*1-81 (E1) A52*2-7 (FC) - C46*2-81 (E1)	L-R - BR	Fuel pump control	Ignition switch ON	11 to 14 V
A38*1-24 (W) - C46*2-81 (E1) A52*2-24 (W) - C46*2-81 (E1)	R-Y - BR	MIL	Ignition switch ON	Below 3.0 V
			Idling	11 to 14 V
A38*1-27 (TC) - C45*1-81 (E1) A52*2-27 (TC) - C46*2-81 (E1)	V-W - BR	Terminal TC of DLC3	Ignition switch ON	11 to 14 V
A38*1-15 (TACH) - C45*1-81 (E1) A52*2-15 (TACH) - C46*2-81 (E1)	W-G - BR	Engine speed	Idling	Pulse generation (See waveform 11)

C45*1-107 (ACIS) - C45*1-81 (E1) C46*2-107 (ACIS) - C46*2-81 (E1)	R-W - BR	VSV for ACIS	Ignition switch ON	11 to 14 V
C45*1-70 (PSW) - C45*1-81 (E1) C46*2-70 (PSW) - C46*2-81 (E1)	L - BR	P/S pressure switch	Ignition switch ON	11 to 14 V
A38*1-41 (CANH) - C45*1-81 (E1) A52*2-41 (CANH) - C46*2-81 (E1)	P - BR	CAN communication line	Ignition switch ON	Pulse generation (See waveform 12)
A38*1-49 (CANL) - C45*1-81 (E1) A52*2-49 (CANL) - C46*2-81 (E1)	B - BR	CAN communication line	Ignition switch ON	Pulse generation (See waveform 13)
C45*1-59 (FPC) - C45*1-81 (E1) C46*2-59 (FPC) - C46*2-81 (E1)	W-G - BR	Fuel pump control	Ignition switch ON	11 to 14 V
A38*1-19 (DI) - C45*1-81 (E1) A52*2-19 (DI) - C46*2-81 (E1)	G-Y - BR	Fuel pump control	Ignition switch ON	0 to 3.0 V
A38*1-14 (STSW) - C45*1-81 (E1) A52*2-14 (STSW) - C46*2-81 (E1)	R - BR	Ignition switch signal	Shift lever in P or N, engine cranking	6.0 V or more
A38*1-13 (ACCR) - C45*1-81 (E1) A52*2-13 (ACCR) - C46*2-81 (E1)	L-Y - BR	ACC (accessory) relay control signal	Cranking	Below 1.5 V
C45*1-63 (STAR) - C45*1-81 (E1) C46*2-63 (STAR) - C46*2-81 (E1)	L - BR	Starter relay control	Ignition switch ON	Below 1.5 V
			Cranking	6.0 V or more

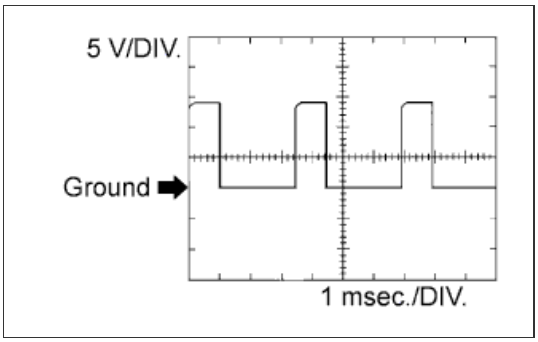
HINT:

- ***1: for LHD**
- ***2: for RHD**
- ***3: The ECM terminal voltage is constant regardless of the output voltage from the sensor.**

WAVEFORM 1

Camshaft Oil Control Valve (OCV)

ECM Terminal Name	Between OC1+ and OC1- or OC2+ and OC2-
Tester Range	5 V/DIV., 1 msec./DIV.,
Condition	Idling



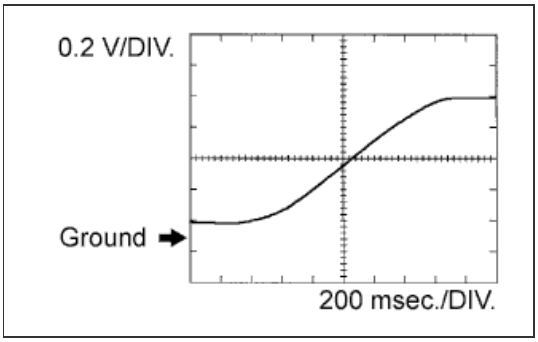
WAVEFORM 2

Heated Oxygen Sensor

ECM Terminal Name	Between OX1B and EX1B or OX2B and EX2B
Tester Range	0.2 V/DIV., 200 msec./DIV.
Condition	Engine speed maintained at 2500 rpm for 2 minutes after warming up engine

HINT:

In the Data List, item O2S B1S2 or O2S B2S2 shows the ECM input values from the heated oxygen sensor.



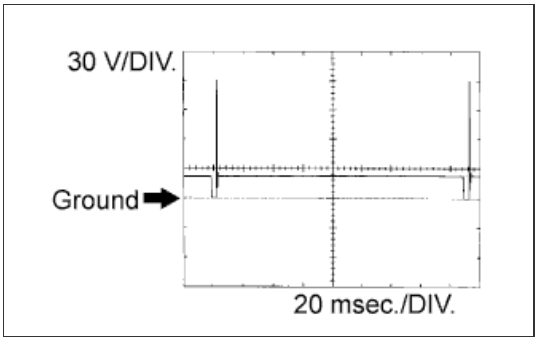
WAVEFORM 3

Fuel Injector

ECM Terminal Name	Between #10 (to #60) and E01
Tester Range	30 V/DIV., 20 msec./DIV.
Condition	Idling

HINT:

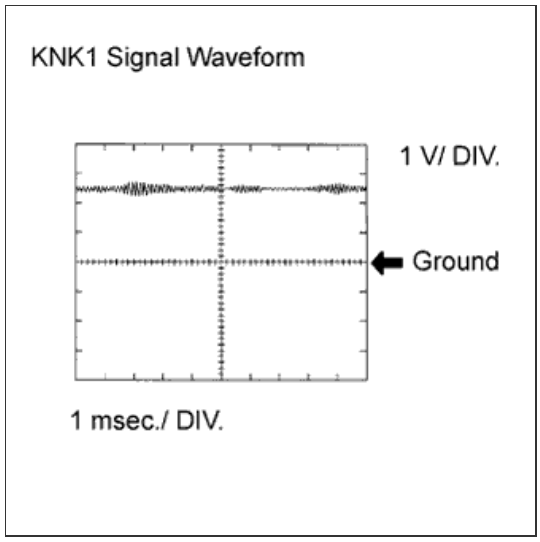
The wavelength becomes shorter as the engine speed increases.



WAVEFORM 4

Knock Sensor

ECM Terminal Name	Between KNK1 and EKNK or KNK2 and EKN2
Tester Range	1 V/DIV., 0.01 to 1 msec./DIV.
Condition	Engine speed maintained at 4000 rpm after warming up engine



HINT:

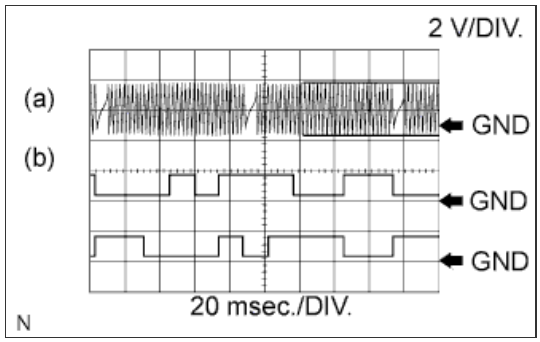
- **The wavelength becomes shorter as the engine speed increases.**
- **The waveforms and amplitudes displayed on the tester differ slightly depending on the vehicle.**

WAVEFORM 5

a. Crankshaft position sensor

b. VVT sensor

ECM Terminal Name	(a) Between NE+ and NE- (b) Between VV1+ and VV1- or VV2+ and VV2-
Tester Range	2 V/DIV., 20 msec./DIV.
Condition	Idling



HINT:

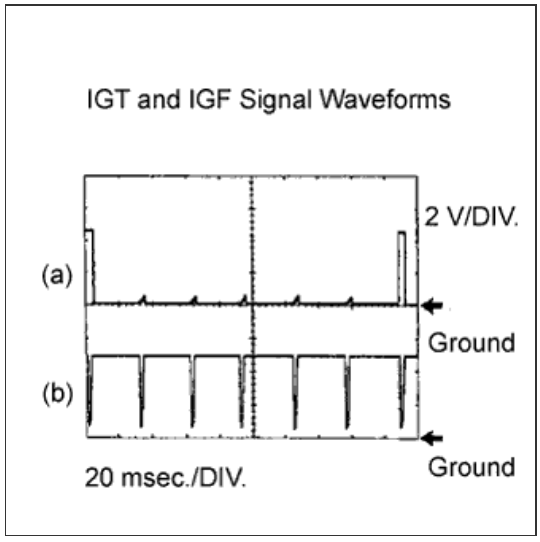
The wavelength becomes shorter as the engine speed increases.

WAVEFORM 6

a. Igniter IGT signal (from ECM to igniter)

b. Igniter IGF signal (from igniter to ECM)

ECM Terminal Name	(a) Between IGT (1 to 6) and E1 (b) Between IGF1 and E1
Tester Range	2 V/DIV., 20 msec./DIV.
Condition	Idling



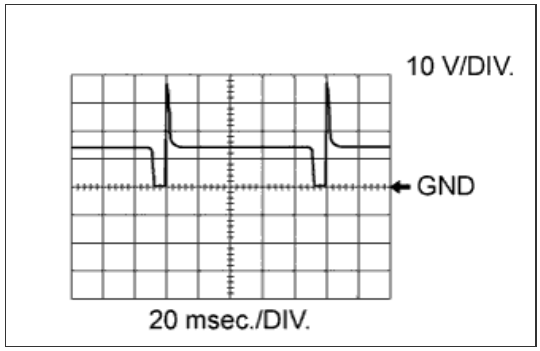
HINT:

The wavelength becomes shorter as the engine speed increases.

WAVEFORM 7

Purge VSV

ECM Terminal Name	Between PRG and E1
Tester Range	10 V/DIV., 10 to 100 msec./DIV.
Condition	Idling



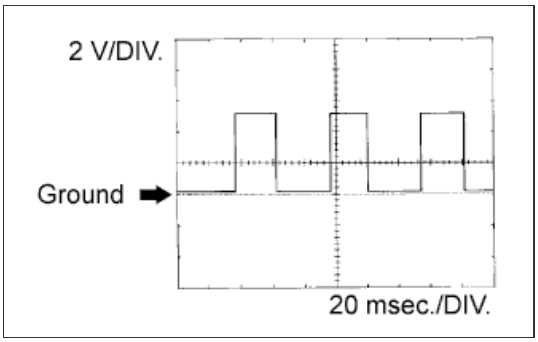
HINT:

If the waveform is not similar to the illustration, check the waveform again after idling for 10 minutes or more.

WAVEFORM 8

Vehicle Speed Signal

ECM Terminal Name	Between SPD and E1
Tester Range	2 V/DIV., 20 msec./DIV.
Condition	Ignition switch ON, wheel rotated slowly



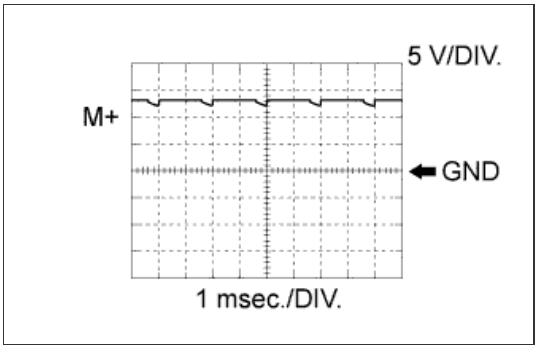
HINT:

The wavelength becomes shorter as the vehicle speed increases.

WAVEFORM 9

Throttle Actuator Positive Terminal

ECM Terminal Name	Between M+ and ME01
Tester Range	5 V/DIV., 1 msec./DIV.
Condition	Idling with warm engine



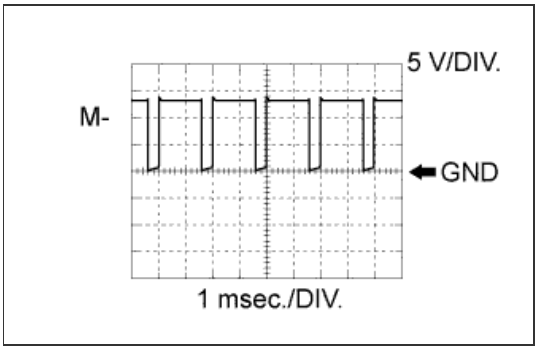
HINT:

The duty ratio varies depending on the throttle actuator operation.

WAVEFORM 10

Throttle Actuator Negative Terminal

ECM Terminal Name	Between M- and ME01
Tester Range	5 V/DIV., 1 msec./DIV.
Condition	Idling with warm engine



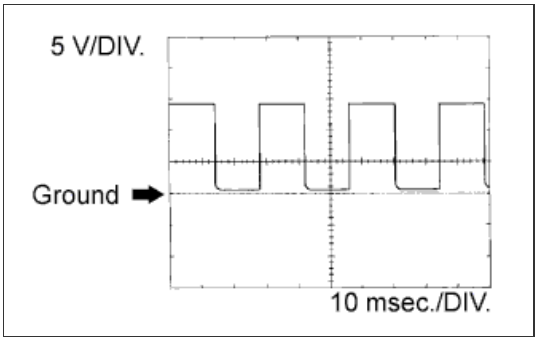
HINT:

The duty ratio varies depending on the throttle actuator operation.

WAVEFORM 11

Engine Speed Signal

ECM Terminal Name	Between TACH and E1
Tester Range	5 V/DIV., 10 msec./DIV.
Condition	Idling



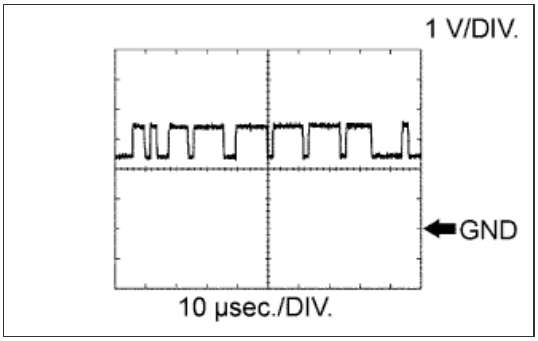
HINT:

The wavelength becomes shorter as the engine speed increases.

WAVEFORM 12

CAN Communication Signal (Reference)

ECM Terminal Name	Between CANH and E1
Tester Range	1 V/DIV., 10 µsec./DIV.
Condition	Ignition switch ON



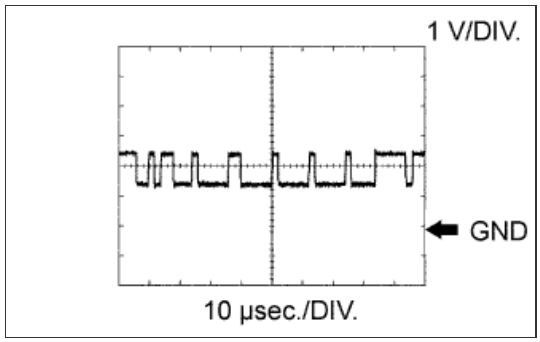
HINT:

The wavelength varies depending on the CAN communication signal.

WAVEFORM 13

CAN Communication Signal (Reference)

ECM Terminal Name	Between CANL and E1
Tester Range	1 V/DIV., 10 µsec./DIV.
Condition	Ignition switch ON



HINT:

The wavelength varies depending on the CAN communication signal.

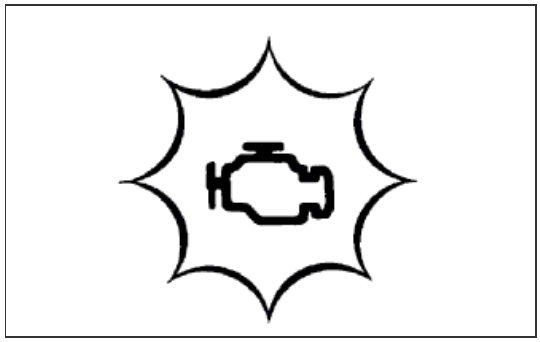
for Preparation Click here

M-OBD

When troubleshooting Multiplex On-Board Diagnostic (M-OBD) vehicle, the vehicle must be connected to the intelligent tester. Various data output from the ECM can then be read.
OBD regulations require that the vehicle on-board computer illuminates the MIL on the instrument panel when the computer detects a malfunction in:

1. The emission control system/components.
2. The powertrain control components (which affect vehicle emissions).
3. The computer.

In addition, the applicable DTCs are stored in the ECM memory. If the malfunction does not recur in 3 consecutive trips, the MIL turns off automatically but the DTCs remain recorded in the ECM memory.



NORMAL MODE AND CHECK MODE

The diagnosis system operates in normal mode during normal vehicle use. In normal mode, 2 trip detection logic is used to ensure accurate detection of malfunctions. Check mode is also available as an option for technicians. In check mode, 1 trip detection logic is used for simulating malfunction symptoms and increasing the ability of the system to detect malfunctions, including intermittent problems (intelligent tester only).

2 TRIP DETECTION LOGIC

When a malfunction is first detected, the malfunction is temporarily stored in the ECM memory (1st trip). If the same malfunction is detected during the next subsequent drive cycle, the MIL is illuminated (2nd trip).

FREEZE FRAME DATA

The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was moving or stationary, whether the engine was warmed up or not, whether the air fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.

BATTERY VOLTAGE

Standard voltage:
11 to 14 V

If voltage is below 11 V, replace or recharge the battery before proceeding.

MIL (Malfunction Indicator Lamp)

a. The MIL is illuminated when the ignition switch is first turned to ON (the engine is not running).

b. The MIL should turn off when the engine is started. If the MIL remains illuminated, the diagnosis system has detected a malfunction or abnormality in the system.

HINT:

If the MIL is not illuminated when the ignition switch is first turned to ON, check the MIL circuit (Click here).

ALL READINESS

HINT:

- **With "All Readiness" you can check whether or not the DTC judgment has been completed by using the intelligent tester.**
- **You should check "All Readiness" after simulating malfunction symptoms or for validation after finishing repairs.**

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Perform the DTC judgment driving pattern to run the DTC judgment.

f. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

g. Input the DTCs to be confirmed.

h. Check the DTC judgment result.

Result

Tester Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • You should perform driving pattern after confirming DTC enabling conditions
N/A	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

for Preparation Click here

NOTICE:

When the diagnosis system is changed from the normal mode to check mode or vice versa, all DTCs and freeze frame data stored in normal mode are cleared. Before changing modes, always check and make a note of DTCs and freeze frame data.

HINT:

- **DTCs which are stored in the ECM can be output to the intelligent tester. The intelligent tester can display the current and pending DTCs.**
- **Some DTCs are not stored if the ECM does not detect the same malfunction again during a second consecutive driving cycle. However, such malfunctions, detected on only one occasion, are stored as pending DTCs.**

CHECK DTC

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Check the DTC(s) and freeze frame data, and then write them down.

f. Check the details of the DTC(s) (Click here).

CLEAR DTC

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Clear the DTCs.

CLEAR DTC (Without using the intelligent tester)

a. Perform either of the following operations:

i. Disconnect the cable from the negative (-) battery terminal for more than 1 minute.

ii. Remove the EFI MAIN and ETCS fuses from the engine room relay block located inside the engine compartment for more than 1 minute.

for Preparation Click here

DESCRIPTION

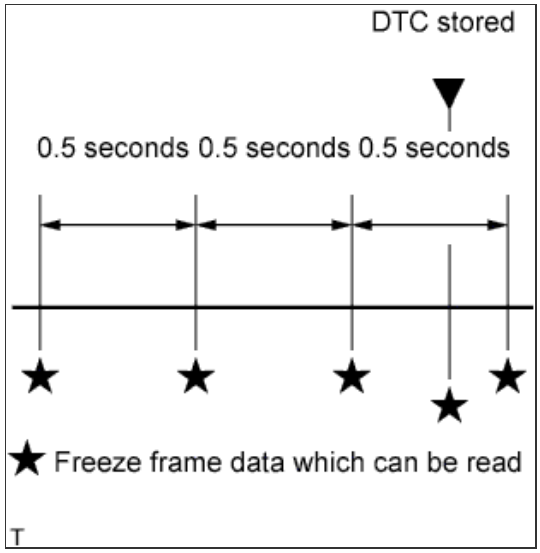
Freeze frame data records the engine conditions (fuel system, calculated load, engine coolant temperature, fuel trim, engine speed, vehicle speed, etc.) when a malfunction is detected. When troubleshooting, it can help determine if the vehicle was moving or stationary, the engine was warmed up or not, the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

HINT:

If it is impossible to duplicate the problem even though a DTC is output, confirm the freeze frame data.

The ECM records engine conditions in the form of freeze frame data every 0.5 seconds. Using the intelligent tester, 5 separate sets of freeze frame data can be checked.

- 3 data sets before the DTC was stored.
- 1 data set when the DTC was stored.
- 1 data set after the DTC was stored.
  These data sets can be used to simulate the condition of the vehicle around the time of the occurrence of the malfunction. The data may assist in identifying the cause of the malfunction, and in judging whether it was temporary or not.



LIST OF FREEZE FRAME DATA

LABEL (Tester Display)	Measurement Item	Diagnostic Note
Vehicle Speed	Vehicle speed	The speed indicated on the speedometer.
Engine Speed	Engine speed	-
Calculate Load	Calculated load	The load calculated by the ECM.
Vehicle Load	Vehicle load	-
MAF	Airflow rate from MAF meter	If the value is approximately 0.0 g/sec.: • The mass air flow meter power source circuit is open or shorted. • The VG circuit is open or shorted. If the value is 160.0 g/sec. or more: • The E2G circuit is open.
Atmosphere Pressure	Atmosphere pressure	-
Coolant Temp	Engine coolant temperature	If the value is -40°C (-40°F), the sensor circuit is open. If the value is 140°C (284°F) or higher, the sensor circuit is shorted.
Intake Air	Intake air temperature	If the value is -40°C (-40°F), the sensor circuit is open. If the value is 140°C (284°F) or higher, the sensor circuit is shorted.
Engine Run Time	Accumulated engine running time	-
Initial Engine Coolant Temp	Initial engine coolant temperature	-
Initial Intake Air Temp	Initial intake air temperature	-
Battery Voltage	Battery voltage	-
Accel Sens. No.1 Volt %	Absolute Accelerator Pedal Position (APP) No.	-

	1	
Accel Sens. No.2 Volt %	Absolute APP No. 2	-
Throttle Sensor Volt %	Absolute throttle position	-
Throttl Sensor #2 Volt %	Absolute throttle sensor positioning #2	-
Throttle Sensor Position	Throttle sensor positioning	-
Throttle Motor DUTY	Throttle actuator	-
Injector (Port)	Injection period of No. 1 cylinder	-
Injection Volum (Cylinder1)	Injection volume	-
Fuel Pump/Speed Status	Fuel pump/speed status	-
EVAP (Purge) VSV	EVAP purge VSV duty ratio	-
Evap Purge Flow	Ratio of evaporative purge flow to intake air volume	-
Purge Density Learn Value	Learning value of purge density	-
EVAP Purge VSV	EVAP purge VSV	-
Target Air-Fuel Ratio	Ratio compared to stoichiometric level	-
AF Lambda B1S1	Fuel trim at A/F sensor (bank 1 sensor 1)	-
AF Lambda B2S1	Fuel trim at A/F sensor (bank 2 sensor 1)	-
AFS Voltage B1S1	Air fuel ratio (A/F) sensor output voltage	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the output voltage of the sensor.
AFS Voltage B2S1	A/F sensor output voltage	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the output voltage of the sensor.
AFS Current B1S1	A/F sensor current (bank 1 sensor 1)	-
AFS Current B2S1	A/F sensor current	-
O2S B1S2	Heated oxygen sensor output voltage	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the output voltage of the sensor.
O2S B2S2	Heated oxygen sensor output voltage	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the output voltage of the sensor.
Short FT #1	Short-term fuel trim	Short-term fuel compensation is used to maintain the air fuel ratio at the stoichiometric air fuel ratio.
Long FT #1	Long-term fuel trim	Overall fuel compensation is carried out in the long-term to compensate for a continual deviation of the short-term fuel trim from the central value.
Total FT #1	Total fuel trim	-
Short FT #2	Short-term fuel trim	Short-term fuel compensation is used to maintain the air fuel ratio at the stoichiometric air fuel ratio.
Long FT #2	Long-term fuel trim	Overall fuel compensation is carried out in the long-term to compensate for a continual deviation of the short-term fuel trim from the central value.
Total FT #2	Total fuel trim	-
Fuel System Status #1	Fuel system status (bank 1)	• OL (Open Loop): Has not yet satisfied the conditions to go to closed loop. • CL (Closed Loop): Using the heated oxygen sensor as feedback for fuel control. • OLDrive: Open loop due to driving conditions (fuel enrichment). • OLFault: Open loop due to a detected system fault. • CLFault: Closed loop but the heated oxygen sensor, which is used for

		fuel control, is malfunctioning.
Fuel System Status #2	Fuel system status (bank 2)	• OL (Open Loop): Has not yet satisfied the conditions to go to closed loop. • CL (Closed Loop): Using the heated oxygen sensor as feedback for fuel control. • OLDrive: Open loop due to driving conditions (fuel enrichment). • OLFault: Open loop due to a detected system fault. • CLFault: Closed loop but the heated oxygen sensor, which is used for fuel control, is malfunctioning.
IGN Advance	Ignition advance	-
Knock Feedback Value	Feedback value of knocking	-
Knock Correct Learn Value	Correction learning value of knocking	-
ACIS VSV	VSV for Acoustic Control Induction System (ACIS)	-
VVT Control Status #1	VVT control status	-
VVT Control Status #2	VVT control status	-
Catalyst Temp B1S1	Estimated catalyst temperature (bank 1 sensor 1)	-
Catalyst Temp B2S1	Estimated catalyst temperature (bank 2 sensor 1)	-
Catalyst Temp B1S2	Estimated catalyst temperature (bank 1 sensor 2)	-
Catalyst Temp B2S2	Estimated catalyst temperature (bank 2 sensor 2)	-
Starter Signal	Starter switch signal	-
Starter Control	Starter switch status	-
Power Steering Signal Record	Power steering switch	-
Starter Relay	Starter relay status	-
Power Steer. Sig. Record	Power steering signal (history)	-
ACC Relay	ACC relay status	-
Neutral Position SW Signal	Park/Neutral Position (PNP) switch signal	-
Stop Light Switch	Stop light switch	-
A/C Signal	A/C signal	-
Closed Throttle Position SW	Closed throttle position switch	-
Fuel Cut Condition	Fuel cut condition	-
Immobiliser Communication	Immobiliser communication	-
Electrical Load Signal	Electrical load signal	-
Time after DTC Cleared	Cumulative time after DTC cleared	-
Distance from DTC Cleared	Accumulated distance from DTC cleared	-
Warmup Cycle Cleared DTC	Warm-up cycle after DTC cleared	-
TC and TE1	TC and CG (TE1) terminals of DLC3	-
Ignition Trig. Count	Ignition	-
Cylinder #1 Misfire Count	Cylinder #1 misfire count	Displayed only while idling.
Cylinder #2 Misfire Count	Cylinder #2 misfire count	Displayed only while idling.
Cylinder #3 Misfire Count	Cylinder #3 misfire count	Displayed only while idling.
Cylinder #4 Misfire Count	Cylinder #4 misfire count	Displayed only while idling.
Cylinder #5 Misfire Count	Cylinder #5 misfire count	Displayed only while idling.
Cylinder #6 Misfire Count	Cylinder #6 misfire count	Displayed only while idling.
All Cylinders Misfire Count	All cylinders misfire count	Displayed only while idling.
Misfire RPM	Misfire RPM	-
Misfire Load	Misfire load	-
Misfire Margin	Misfire monitoring	-
ACT VSV	A/C cut status for Active Test	-
Idle Fuel Cut	Fuel cut idle	ON: when the throttle valve is fully closed and the engine speed is more than 3500 rpm.

FC TAU	Fuel cut during very light load	Fuel cut is being performed under a very light load to prevent the engine combustion from becoming incomplete.

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HINT:

Intelligent tester:

Compared to the normal mode, check mode is more sensitive to malfunctions. Therefore, check mode can detect the malfunctions that cannot be detected in normal mode.

NOTICE:

All the stored DTCs and freeze frame data are cleared if: 1) the ECM is changed from normal mode to check mode or vice versa; or 2) the ignition switch is turned from ON to ACC or off while in check mode. Before changing modes, always check and note any DTCs and freeze frame data.

CHECK MODE PROCEDURE

a. Check and ensure the following conditions:

   i. Battery positive voltage 11 V or higher.

   ii. Throttle valve fully closed.

   iii. Transmission in the P or N position.

   iv. A/C switch off.

b. Turn the ignition switch off.

c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON.

e. Turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / Utility / Check Mode.

g. Switch the ECM from normal mode to check mode.

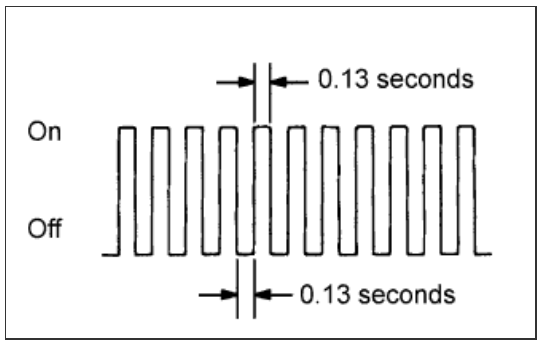
h. Make sure the MIL flashes as shown in the illustration.

i. Start the engine.

j. Make sure the MIL turns off.

k. Simulate the conditions of the malfunction described by the customer.

l. Check the DTCs and freeze frame data using the tester.



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If any of the following DTCs are stored, the ECM enters fail-safe mode to allow the vehicle to be driven temporarily.

DTCs	Component	Fail-Safe Operation	Fail-Safe Deactivation Condition
P0011 and P0021	Variable Valve Timing (VVT) System	• Idle up (control of combustion worsening) • Stopping fuel cut control	Pass condition detected
P0031, P0032, P0051 and P0052	Air Fuel Ratio (A/F) Sensor Heater	The ECM turns off the A/F sensor heater.	Ignition switch off
P0037, P0038, P0057 and P0058	Heated Oxygen (HO2) Sensor Heater	The ECM turns off the HO2 sensor heater.	Ignition switch off
P0102, P0103	Mass Air Flow (MAF) Meter	The ECM calculates the ignition timing according to the engine speed and throttle valve position.	Pass condition detected
P0110, P0112 and P0113	Intake Air Temperature (IAT) Sensor	The ECM estimates the IAT to be 20°C (68°F).	Pass condition detected
P0115, P0117 and P0118	Engine Coolant Temperature (ECT) Sensor	The ECM estimates the ECT to be 80°C (176°F).	Pass condition detected
P0120, P0121, P0122, P0123, P0220, P0222, P0223, P0604, P0606, P060A, P060D, P060E, P0657, P2102, P2103, P2111, P2112, P2118, P2119 and P2135	Electronic Throttle Control System (ETCS)	The ECM cuts off the throttle actuator current and the throttle valve returns to 6° throttle position by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at minimal speed.*1	Pass condition detected and then ignition switch turned off
P0300, P0301, P0302, P0303, P0304, P0305 and P0306*2	• Fuel Injector • Electronic Throttle Control System (ETCS)	When a misfire occurs, fuel cut is performed for catalyst overheat malfunction prevention. • During normal load and normal engine speed (MIL is blinking): - Fuel cut is performed on the malfunctioning cylinder. • During high load and high engine speed (MIL is blinking): - Throttle valve opening angle control is performed. - All cylinder fuel cut or malfunctioning cylinder fuel cut.	Pass condition detected and then ignition switch turned off
P0327, P0328, P0332 and P0333	Knock Sensor	The ECM sets the ignition timing to maximum retard.	Ignition switch off
P0351 to P0356	Igniter	The ECM cuts the fuel.	Pass condition detected
P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138	Accelerator Pedal Position (APP) Sensor	The APP sensor has 2 sensor circuits: Main and Sub. If either of the circuits malfunctions, the ECM controls the engine using the other circuit. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.	Pass condition detected and then ignition switch turned off

HINT:

- ***1: The vehicle can be driven slowly when the accelerator pedal is depressed firmly and slowly. If the accelerator pedal is**

depre ed ickl the vehicle a peed p and lo o n erraticall

- * : Mi fire related fail-safe operations occur when catalyst overheat malfunctions occur.

for Preparation Click here

DATA LIST

HINT:

Using the intelligent tester to read the Data List allows the values or states of switches, sensors, actuators and other items to be read without removing any parts. This non-intrusive inspection can be very useful because intermittent conditions or signals may be discovered before parts or wiring is disturbed. Reading the Data List information early in troubleshooting is one way to save diagnostic time

NOTICE:

In the table below, the values listed under "Normal Condition" are reference values. Do not depend solely on these reference values when deciding whether a part is faulty or not.

a. Warm up the engine.

b. Turn the ignition switch off.

c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON.

e. Turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data.

g. Check the values by referring to the table below.

Engine and ECT

Tester Display	Measurement Item/Range	Normal Condition	Diagnostic Note
Vehicle Speed	Vehicle speed: Min.: 0 km/h, Max.: 255 km/h	Actual vehicle speed	The speed indicated on the speedometer.
Engine Speed	Engine speed: Min.: 0 rpm, Max.: 16383.75 rpm	650 to 750 rpm: Idling	-
Calculate Load	Load calculated by ECM: Min.: 0%, Max.: 100%	11.4 to 16.4%: Idling 13.1 to 18.9%: Running without load (2000 rpm)	-
Vehicle Load	Vehicle load: Min.: 0%, Max.: 25700%	Actual vehicle load	The load percentage in terms of the maximum intake airflow amount.
MAF	Airflow rate from MAF meter: Min.: 0 g/sec., Max.: 655.35 g/sec.	3.2 to 4.7 g/sec.: Idling 13.1 to 18.9 g/sec.: 2000 rpm	If the value is approximately 0.0 g/sec.: • The mass air flow meter power source circuit is open or shorted. • The VG circuit is open or shorted. If the value is 271.0 g/sec. or more: • The E2G circuit is open.
Atmospheric Pressure	Atmospheric pressure: Min.: 0 kPa, Max.: 255 kPa	Equivalent to atmospheric pressure (absolute pressure)	-
Coolant Temp	Engine coolant temperature: Min.: -40°C, Max.: 140°C	80 to 100°C (176 to 212°F): After warming up	• If the value is -40°C (-40°F), the sensor circuit is open. • If the value is 140°C (284°F) or higher, the sensor circuit is shorted.
Intake Air	Intake air temperature: Min.: -40°C, Max.: 140°C	Equivalent to ambient air temperature	• If the value is -40°C (-40°F), the sensor circuit is open. • If the value is 140°C (284°F) or higher, the sensor circuit is shorted.
Engine Run Time	Engine run time: Min.: 0 s Max.: 65535 s	Time after engine start	-

Initial Engine Coolant Temp	Initial engine coolant temperature: Min.: -40°C, Max.: 120°C	Coolant temperature when engine started	Service data.
Initial Intake Air Temp	Initial intake air temperature: Min.: -40°C, Max.: 120°C	Intake air temperature when engine started	Service data.
Battery Voltage	Battery voltage: Min.: 0, Max.: 65.535 V	11 to 14 V: Idling	-
Accel Sens. No.1 Volt %	Accelerator Pedal Position (APP) No. 1: Min.: 0%, Max.: 100%	10 to 22%: Accelerator pedal released 54 to 86%: Accelerator pedal fully depressed	-
Accel Sens. No.2 Volt %	APP No. 2: Min.: 0%, Max.: 100%	12 to 42%: Accelerator pedal released 66 to 98%: Accelerator pedal fully depressed	-
Accel Sensor Out No.1	APP sensor No. 1 voltage: Min.: 0 V, Max.: 4.98 V	-	-
Accel Sensor Out No.2	APP sensor No. 2 voltage: Min.: 0 V, Max.: 4.98 V	-	-
Accel Sensor Out No.1	APP sensor No. 1 voltage: Min.: 0 V, Max.: 5 V	0.5 to 1.1 V: Accelerator pedal released 2.6 to 4.5 V: Accelerator pedal fully depressed	-
Accel Sensor Out No.2	APP sensor No. 2 voltage: Min.: 0 V, Max.: 5 V	1.2 to 2.0 V: Accelerator pedal released 3.4 to 5.0 V: Accelerator pedal fully depressed	-
Accelerator Idle Position	Whether or not accelerator pedal position sensor detecting idle: ON or OFF	ON: Idling	-
Accel Fully Close #1 (AD)	Accelerator fully closed value No. 1 (AD): Min.: 0 V, Max.: 4.98 V	-	The ETCS service data.
Accel Fully Close Learn #1	Accelerator fully closed learning value No. 1: Min.: 0 deg., Max.: 124.512 deg.	-	The ETCS service data.
Accel Fully Close Learn #2	Accelerator fully closed learning value No. 2: Min.: 0 deg., Max.: 124.512 deg.	-	The ETCS service data.
Throttle Sensor Volt %	Absolute throttle position sensor: Min.: 0%, Max.: 100%	• 10 to 22%: Throttle fully closed • 64 to 96%: Throttle fully open	Read the value with the non-intrusive operation (Active Test).
Throttl Sensor #2 Volt %	Absolute throttle sensor positioning #2: Min.: 0%, Max.: 100%	-	The calculated value based on VTA2.
ST1	Brake pedal signal: ON or OFF	ON: Brake pedal released	-
System Guard	System guard: ON or OFF	-	-
Open Side Malfunction	Open side malfunction: ON or OFF	-	-
Throttle Idle Position	Whether or not throttle position sensor detecting idle: ON or OFF	ON: Idling	-
Throttle Require Position	Throttle requirement position: Min.: 0 V, Max.: 5 V	0.5 to 1.1 V: Idling	-

Throttle Sensor Position*2	Throttle sensor positioning: Min.: 0%, Max.: 100%	0%: Accelerator pedal released 50 to 80%: Accelerator pedal fully depressed	Recognition value for throttle opening angle on ECM..
Throttle Position No.1	Throttle position sensor No. 1 output voltage: Min.: 0 V, Max.: 4.98 V	-	-
Throttle Position No.2	Throttle position sensor No. 2 output voltage: Min.: 0 V, Max.: 4.98 V	-	-
Throttle Position No.1	Throttle position No. 1: Min.: 0 V, Max.: 5 V	0.5 to 1.1 V: Throttle fully closed 3.2 to 4.8 V: Throttle fully open	-
Throttle Position No.2	Throttle position No. 2: Min.: 0 V, Max.: 5 V	2.1 to 3.1V: Throttle fully closed 4.6 to 5.0 V: Throttle fully open	-
Throttle Position Command	Throttle position command value: Min.: 0 V, Max.: 4.9804 V	0.5 to 4.8 V	The ETCS service data.
Throttle Sens Open Pos #1	Throttle sensor opener position No. 1: Min.: 0 V, Max.: 4.9804 V	0.6 to 1.4 V	The ETCS service data.
Throttle Sens Open Pos #2	Throttle sensor opener position No. 2: Min.: 0 V, Max.: 4.9804 V	1.7 to 2.5 V	The ETCS service data.
Throttle Sens Open #1 (AD)	Throttle sensor opener position No. 1 (AD): Min.: 0 V, Max.: 4.98 V	0.5 to 4.8 V	The ETCS service data.
Throttle Motor	Whether or not throttle actuator control permitted: ON or OFF	ON: Ignition switch ON. OFF: ETCS has failed	-
Throttle Motor Current	Throttle actuator current: Min.: 0 A, Max.: 20 A	0 to 3.0 A: Idling	The ETCS service data.
Throttle Motor DUTY	Throttle actuator: Min.: 0%, Max.: 100%	10 to 22%: Idling after engine warmed up	The ETCS service data.
Throttle Motor Open Duty	Throttle actuator opening duty ratio: Min.: 0%, Max.: 100%	0 to 40%: Idling	The ETCS service data.
Throttle Motor Close Duty	Throttle actuator closed duty ratio: Min.: 0%, Max.: 100%	0 to 40%: Idling	The ETCS service data.
Throttle Motor Duty (Open)	Throttle actuator duty ratio (open): Min.: 0%, Max.: 100%	-	-
Throttle Motor Duty (Close)	Throttle actuator duty ratio (close): Min.: 0%, Max.: 100%	-	-
Throttle Fully Closed Learn	Throttle valve fully closed (learned value): Min.: 0 V, Max.: 5 V	0.4 to 1.0 V (Accelerator pedal released)	-
ETCS Actuator Power	Whether or not electric throttle control system power input: ON or OFF	ON: Ignition switch ON and system normal OFF: ETCS has failed	-
+BM Voltage	+BM voltage: Min.: 0, Max.: 19.922	11 to 14: Ignition switch ON and system normal	-
Actuator Power Supply	Actuator power supply: ON or OFF	ON: Idling	-
Clutch Current	Clutch current: Min.: 0 A, Max.: 2.49 A	-	-
Fail Safe Drive	Whether or not fail-safe function executed: ON or OFF	ON: ETCS has failed OFF: ETCS normal	The ETCS service data.
Fail Safe Drive (Main CPU)	Whether or not fail-safe function executed: ON or OFF	ON: ETCS has failed OFF: ETCS normal	The ETCS service data.

Injector (Port)	Injection period of No. 1 cylinder: Min.: 0 ms, Max.: 32.64 ms	1.6 to 2.4 msec.: Idling	-
Injection Volum (Cylinder 1)	Injection volume (Cylinder 1): Min.: 0 ml, Max.: 2.048 ml	0.005 to 0.015 ml: Idling	The quantity of fuel injection volume for 10 times.
Fuel Pump/Speed Status	Fuel pump/status: ON or OFF	-	Active Test support data.
EVAP (Purge) VSV	EVAP (Purge) VSV control duty: Min.: 0%, Max.: 100%	0 to 100%: Idling	The order signal from the ECM.
Evap Purge Flow	Purge flow: Min.: 0%, Max.: 102.4%	0 to 100%: Idling	Service data.
Purge Destiny Learn Value	Learning value of purge density: Min.: -50, Max.: 350	-35 to 1: Idling	Service data.
EVAP Purge VSV	VSV status for EVAP control: ON or OFF	-	-
Target Air-Fuel Ratio	Air fuel ratio: Min.: 0, Max.: 1.999	0.8 to 1.2: Idling	-
AF Lambda B1S1	Short-term fuel trim associated with bank 1 sensor 1: Min.: 0, Max.: 1.999	Value less than 1 (0.000 to 0.999) = Rich Stoichiometric air fuel ratio = 1 Value more than 1 (1.001 to 1.999) = Lean	-
AF Lambda B2S1	Short-term fuel trim associated with bank 2 sensor 1: Min.: 0, Max.: 1.999	Value less than 1 (0.000 to 0.999) = Rich Stoichiometric air fuel ratio = 1 Value more than 1 (1.001 to 1.999) = Lean	-
AFS Voltage B1S1	A/F sensor output voltage bank 1 sensor 1: Min.: 0 V, Max.: 7.999 V	2.8 to 3.8 V: Idling	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the output voltage of the sensor.
AFS Voltage B2S1	A/F sensor output voltage bank 2 sensor 1: Min.: 0 V, Max.: 7.999 V	2.8 to 3.8 V: Idling	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the output voltage of the sensor.
AFS Current B1S1	A/F sensor output current bank 1 sensor 1: Min.: -128 mA, Max.: 127.99 mA	-0.5 to 0.5 mA: Idling	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the output voltage of the sensor.
AFS Current B2S1	A/F sensor output current bank 2 sensor 1: Min.: -128 mA, Max.: 127.99 mA	-0.5 to 0.5 mA: Idling	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the output voltage of the sensor.
O2S B1S2	Heated oxygen sensor output voltage bank 1 sensor 2: Min.: 0 V, Max.: 1.275 V	0.1 to 0.9 V: Driving at 70 km/h (44 mph)	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the output voltage of the sensor.
O2S B2S2	Heated oxygen sensor output voltage bank 2 sensor 2: Min.: 0 V, Max.: 1.275 V	0.1 to 0.9 V: Driving at 70 km/h (44 mph)	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the output voltage of the sensor.
Short FT #1	Short-term fuel trim of bank 1: Min.: -100%, Max.: 99.2%	-20 to 20%	Short-term fuel compensation is used to maintain the air fuel ratio at the stoichiometric air fuel ratio.
Long FT #1	Long-term fuel trim of bank 1: Min.: -100%, Max.: 99.2%	-30 to 30%	Overall fuel compensation is carried out in the long-term to compensate for a continual deviation of the short-term fuel trim from the central value.
Total FT #1	Total fuel trim of bank 1: Min.: -0.5, Max.: 0.496	-0.2 to 0.2: Idling	-
	Short-term fuel trim of bank 2:		Short-term fuel compensation is used to maintain the air fuel ratio at the

Short FT #2	Min.: -100%, Max.: 99.2%	-20 to 20%	stoichiometric air fuel ratio.
Long FT #2	Long-term fuel trim of bank 2: Min.: -100%, Max.: 99.2%	-30 to 30%	Overall fuel compensation is carried out in the long-term to compensate for a continual deviation of the short-term fuel trim from the central value.
Total FT #2	Total fuel trim of bank 2: Min.: -0.5, Max.: 0.496	-0.2 to 0.2: Idling	-
Fuel System Status #1	Fuel system status (bank 1): OL or CL or OLDrive or OLFault or CLFault	CL: Idling after warming up	• OL (Open Loop): Has not yet satisfied the conditions to go to closed loop. • CL (Closed Loop): Using the heated oxygen sensor as feedback for fuel control. • OLDrive: Open loop due to driving conditions (fuel enrichment). • OLFault: Open loop due to a detected system fault. • CLFault: Closed loop but the heated oxygen sensor, which is used for fuel control, is malfunctioning.
Fuel System Status #2	Fuel system status (bank 2): OL or CL or OLDrive or OLFault or CLFault	CL: Idling after warming up	• OL (Open Loop): Has not yet satisfied the conditions to go to closed loop. • CL (Closed Loop): Using the heated oxygen sensor as feedback for fuel control. • OLDrive: Open loop due to driving conditions (fuel enrichment). • OLFault: Open loop due to a detected system fault. • CLFault: Closed loop but the heated oxygen sensor, which is used for fuel control, is malfunctioning.
IGN Advance	Ignition timing advance for No. 1 cylinder: Min.: -64 deg., Max.: 63.5 deg.	BTDC 7 to 24°: Idling	-
Knock Feedback Value	Feedback value of knocking: Min: -64°CA, Max.: 1984°CA	-22 to 0°CA: Driving at 70 km/h (44 mph)	Service data.
Knock Correct Learn Value	Correction learning value of knocking: Min: -64°CA, Max.: 1984°CA	0 to 22°CA: Driving at 70 km/h (44 mph)	Service data.
ACIS VSV	VSV status for ACIS control: ON or OFF	-	-
VVT Control Status #2	VVT control (bank 2) status: ON or OFF	-	-
VVT Control Status #1	VVT control (bank 2) status: ON or OFF	-	-
VVT Aim Angle #1*1	VVT aim angle (bank 1): Min.: 0%, Max.: 100%	0 to 100%: Idling	The VVT duty signal value during the intrusive operation.
VVT Change Angle #1*1	VVT change angle (bank 1): Min.: 0°FR, Max.: 60°FR	0 to 56°FR: Idling	The displacement angle during the intrusive operation.
VVT OCV Duty #1*1	VVT OCV operation duty (bank 1): Min.: 0%, Max.: 100%	0 to 100%: Idling	The requested duty value for the intrusive operation.
VVT Aim Angle #2*1	VVT aim angle (bank 2): Min.: 0%, Max.: 100%	0 to 100%: Idling	The VVT duty signal value during the intrusive operation.
VVT Aim Angle #2*1	VVT change angle (bank 2): Min.: 0°FR, Max.: 60°FR	0 to 56°FR: Idling	The displacement angle during the intrusive operation.
VVT OCV Duty #2*1	VVT OCV operation duty (bank 2): Min.: 0%, Max.: 100%	0 to 100%: Idling	The requested duty value for the intrusive operation.
Catalyst Temp B1S1	Catalyst temperature (bank 1 sensor 1): Min.: -40°C, Max.: 6513.5°C	-	-
Catalyst Temp	Catalyst temperature (bank 2 sensor 1):		

B2S1	Min.: -40°C, Max.: 6513.5°C	-	-
Catalyst Temp B1S2	Catalyst temperature (bank 1 sensor 2): Min.: -40°C, Max.: 6513.5°C	-	-
Catalyst Temp B2S2	Catalyst temperature (bank 2 sensor 2): Min.: -40°C, Max.: 6513.5°C	-	-
Starter Signal	Starter signal: ON or OFF	ON: Cranking	-
Starter Control	Starter switch status: ON or OFF	ON: Cranking	-
Power Steering Signal Record	Power steering switch: ON or OFF	ON: Power steering operation	-
Starter Relay	Starter relay status: ON or OFF	ON: Cranking	-
Power Steer. Sig. Record	Power steering signal (history): ON or OFF	ON: When steering wheel first turned after battery terminals connected	This signal status is usually on until the cables are disconnected from the battery terminals.
ACC Relay	ACC relay status: ON or OFF	ON: Cranking	-
Neutral Position SW Signal	PNP switch status ON or OFF	ON: P or N position	-
Stop Light Switch	Stop light switch status: ON or OFF	ON: Brake pedal depressed	-
A/C Signal	A/C switch status: ON or OFF	ON: A/C ON	-
Closed Throttle Position SW	Closed throttle position switch: ON or OFF	ON: Throttle fully closed OFF: Throttle open	-
Fuel Cut Condition	Fuel cut condition: ON or OFF	ON: Fuel cut operating	-
Immobiliser Communication	Immobiliser communication: ON or OFF	ON: Normal	-
Electrical Load Signal	Electrical load signal: ON or OFF	ON: Headlights or defogger turned on	-
Check Mode	Check mode: ON or OFF	ON: Check mode on	(Click here)
SPD Test Result	Check mode result for vehicle speed sensor: Compl or Incmpl	-	-
Misfire Test Result	Check mode result for misfire monitor: 0: COMPL, 1: INCMPL	-	-
OXS1 Test Result	Check mode result for HO2 sensor (bank 1): Compl or Incmpl	-	-
OXS2 Test Result	Check mode result for HO2 sensor (bank 2): Compl or Incmpl	-	-
A/F Test Results #2	Check mode result for air fuel ratio sensor (bank 2): Compl or Incmpl	-	-
A/F Test Results #1	Check mode result for air fuel ratio sensor (bank 1): Compl or Incmpl	-	-
Complete Parts Monitor	Comprehensive component monitor: Not Avl or Avail	-	-
Fuel System Monitor	Fuel system monitor: Not Avl or Avail	-	-

Misfire Monitor	Misfire monitor: Not Avl or Avail	-	-
EGR/VVT Monitor	EGR/VVT monitor: Not Avl or Avail	-	-
EGR/VVT Monitor	EGR/VVT monitor: Compl or Incmpl	-	-
O2S (A/FS) Heater Monitor	O2S (A/FS) heater monitor: Not Avl or Avail	-	-
O2S (A/FS) Heater Monitor	O2S (A/FS) heater monitor: Compl or Incmpl	-	-
O2S (A/FS) Monitor	O2S (A/FS) monitor: Not Avl or Avail	-	-
O2S (A/FS) Monitor	O2S (A/FS) monitor: Compl or Incmpl	-	-
A/C Monitor	A/C monitor: Not Avl or Avail	-	-
A/C Monitor	A/C monitor: Compl or Incmpl	-	-
2nd Air Monitor	2nd Air monitor: Not Avl or Avail	-	-
2nd Air Monitor	2nd Air monitor: Compl or Incmpl	-	-
EVAP Monitor	EVAP monitor: Not Avl or Avail	-	-
EVAP Monitor	EVAP monitor: Compl or Incmpl	-	-
Heated Catalyst Monitor	Heated catalyst monitor: Not Avl or Avail		
Heated Catalyst Monitor	Heated catalyst monitor: Compl or Incmpl		
Catalyst Monitor	Catalyst monitor: Not Avl or Avail	-	-
Catalyst Monitor	Catalyst monitor: Compl or Incmpl	-	-
Component Monitor ENA	Comprehensive component monitor: Unable or Enable	-	-
# Codes (Include History)	Number of emission related DTCs	0: No emission related DTC stored	-
MIL	MIL status: ON or OFF	ON: MIL on	-
MIL ON Run Distance	MIL on run distance: Min.: 0 km Max.: 65535 km	Distance after DTC stored	-
Running Time from MIL ON	Running time from MIL on: Min.: 0 min. Max.: 65535 min.	Equivalent to running time after MIL on	-
Time after DTC Cleared	Time after DTC cleared: Min.: 0 min. Max.: 65535 min.	Equivalent to time after DTCs cleared	-
Distance from DTC Cleared	Distance after DTC cleared: Min.: 0 km, Max.: 65535 km	Equivalent to drive distance after DTCs cleared	-
Warmup Cycle Cleared DTC	Warm-up cycle after DTC cleared: Min.: 0, Max.: 255	-	The number of warm-up cycles after the DTC(s) are cleared.
OBD Requirements	OBD requirement	OBD2	-
Number of Emission DTC	Emission related DTCs	-	The number of emission related DTCs.
	TC and CG (TE1)		

TC and TE1	terminals of DLC3: ON or OFF	-	Active Test support data.
Ignition Trig. Count	Ignition counter: Min.: 0, Max.: 600	0 to 600	-
Cylinder #1 to 6 Misfire Count	Misfire count of cylinder 1 to 6: Min.: 0, Max.: 255	0	This item displayed only when idling.
All Cylinders Misfire Count	All cylinders misfire count: Min.: 0, Max.: 255	0 to 35	-
Misfire RPM	Engine speed for first misfire range: Min.: 0 rpm, Max.: 6375 rpm	0 rpm: Misfire 0	-
Misfire Load	Engine load for first misfire range: Min.: 0 g/rev, Max.: 3.98 g/rev	0 g/rev: Misfire 0	-
Misfire Margin	Misfire monitoring: Min.: -100%, Max.: 99.22%	-100 to 99.22%	Misfire detecting margin.
ACT VSV	A/C cut status for Active Test: ON or OFF	-	Active Test support data.
Idle Fuel Cut	Fuel cut idle: ON or OFF	ON: Fuel cut operating	Idle Fuel Cut is "ON" when the throttle valve is fully closed and the engine speed is more than 2800 rpm.
FC TAU	Fuel cut TAU (Fuel cut during very light load): ON or OFF	ON: Fuel cut operating	Fuel cut is being performed under a very light load to prevent the engine combustion from becoming incomplete.
Model Code	Model code	-	The identifying model code: GRJ2#
Engine Type	Engine type	-	The identifying engine type: 1GRFE
Cylinder Number	Cylinder number: Min.: 0, Max.: 255	-	The identifying cylinder number: 6
Transmission Type	Transmission type	-	The identifying transmission type: 5AT
Destination	Destination	-	The identifying destination: W
Model Year	Model year: Min.: 1900, Max.: 2155	-	The identifying model year: 200#
System Identification	System identification	-	The identifying engine system: Gasoline (gasoline engine)
Engine Speed of Cyl #1	Engine speed for cylinder 1: Min.: 0 rpm, Max.: 25600 rpm	-	Output only when Check the Cylinder Compression is performed using the Active Test.
Engine Speed of Cyl #2	Engine speed for cylinder 2: Min.: 0 rpm, Max.: 25600 rpm	-	Output only when Check the Cylinder Compression is performed using the Active Test.
Engine Speed of Cyl #3	Engine speed for cylinder 3: Min.: 0 rpm, Max.: 25600 rpm	-	Output only when Check the Cylinder Compression is performed using the Active Test.
Engine Speed of Cyl #4	Engine speed for cylinder 4: Min.: 0 rpm, Max.: 25600 rpm	-	Output only when Check the Cylinder Compression is performed using the Active Test.
Engine Speed of Cyl #5	Engine speed for cylinder 5: Min.: 0 rpm, Max.: 25600 rpm	-	Output only when Check the Cylinder Compression is performed using the Active Test.
Engine Speed of Cyl #6	Engine speed for cylinder 6: Min.: 0 rpm, Max.: 25600 rpm	-	Output only when Check the Cylinder Compression is performed using the Active Test.
	Engine speed for all		

Av Engine Speed of All Cyl	cylinders: Min.: 0 rpm, Max.: 25600 rpm	-	Output only when Check the Cylinder Compression is performed using the Active Test.

HINT:

- **Normal Condition: If no idling conditions are specified, the shift lever should be in N or P, and the A/C switch and all accessory switches should be off.**
- ***1: Data List values are only displayed when performing the following Active Tests: Control the VVT Linear (Bank1), Control the VVT Linear (Bank2), Control the VVT Exhaust Linear (Bank1) and Control the VVT Exhaust Linear (Bank2). For other Active Tests, the Data List value will be 0.**
- ***2: Excluding throttle valve opening percentage due to Idle Speed Control (ISC).**

ACTIVE TEST

HINT:

Using the intelligent tester to perform the Active Tests allows relays, VSVs and actuators and other items to be operated without removing any parts. This non-intrusive functional inspection can be very useful because intermittent operation may be discovered before parts or wiring is disturbed. Performing Active Tests early in troubleshooting is one way to save diagnostic time. Data List information can be displayed while performing Active Tests.

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test.

e. According to the display on the tester, perform the "Active Test".

Engine and ECT

Tester Display	Test Part	Control Range	Diagnostic Note
Control the Injection Volume	Change injection volume	-12.5 to 24.8%	• All the injectors are tested at the same time. • Perform the test at less than 3000 rpm. • The injection volume can be changed in 1% graduations within the control range.
Control the Injection Volume for A/F Sensor	Change injection volume	Lower by 12.5% or increase by 24.8%	• Perform the test at less than 3000 rpm. • Control the Injection Volume for A/F Sensor enables the checking and graphing of the A/F (Air Fuel ratio) sensor and Heated Oxygen (HO2) sensor voltage outputs. • To conduct the test, enter the following menus: Active Test / Control the Injection Volume for A/F Sensor / Data List / A/F Control System / AFS Voltage B1S1 and O2S B1S2.
Activate the VSV for Intake Control	Activate VSV for intake control	ON/OFF	-
Activate the VSV for Evap Control	Activate purge VSV control	ON/OFF	-
Control the A/C Cut Signal	Control the A/C cut signal	ON/OFF	-
Control the Fuel Pump / Speed	Activate fuel pump (C/OPN Relay)	ON/OFF	The test is possible when the following conditions are met: • The ignition switch is ON. • The engine is stopped.
Connect the TC and TE1	Turn on and off TC and CG (TE1) connection	ON/OFF	• ON: TC and TE1 are connected. • OFF: TC and TE1 are disconnected.
Control the Idle Fuel Cut Prohibit	Prohibit idling fuel cut control	ON/OFF	The idling fuel-cut is turned on when the throttle valve is fully closed and the engine speed is more than 2800 rpm.
Activate the Starter Relay	Activate starter relay	ON/OFF	-
Activate the ACC Cut Relay	Activate ACC cut relay	ON/OFF	The test is possible when the following conditions are met: • The ignition switch is ON. • The engine is stopped.
Control the ETCS			

Open/Close Slow Speed	Throttle actuator	Close/Open	The test is possible when the following conditions are met: • The ignition switch is ON. • The engine is stopped. • The accelerator pedal is fully depressed (APP: 58 degrees or more).
Control the ETCS Open/Close Fast Speed	Throttle actuator	Close/Open	
Control the VVT Linear (Bank1)	Control VVT (bank 1)	Between -128 and 127%	• The engine stalls or idles roughly when the VVT actuator is operated by 100%. • The test is possible during idle.
Control the VVT System (Bank1)	Turn on and off OCV (Oil Control Valve)	ON/OFF	• The engine stalls or idles roughly when the OCV is turned on. • The engine runs or idles normally when the OCV is off.
Control the VVT Linear (Bank2)	Control VVT (bank 2)	Between -128 and 127%	• The engine stalls or idles roughly when the VVT actuator is operated by 100%. • The test is possible during idle.
Control the VVT System (Bank2)	Turn on and off OCV (Oil Control Valve)	ON/OFF	• The engine stalls or idles roughly when the OCV is turned on. • The engine runs or idles normally when the OCV is off.
Control the Cylinder #1 Fuel Cut	No. 1 cylinder injector fuel cut	ON/OFF	The test is possible while the vehicle is stopped and the engine is idling.
Control the Cylinder #2 Fuel Cut	No. 2 cylinder injector fuel cut	ON/OFF	
Control the Cylinder #3 Fuel Cut	No. 3 cylinder injector fuel cut	ON/OFF	
Control the Cylinder #4 Fuel Cut	No. 4 cylinder injector fuel cut	ON/OFF	
Control the Cylinder #5 Fuel Cut	No. 5 cylinder injector fuel cut	ON/OFF	
Control the Cylinder #6 Fuel Cut	No. 6 cylinder injector fuel cut	ON/OFF	
Control the All Cylinder Fuel Cut	All cylinder fuel cut	ON/OFF	
Check the Cylinder Compression*	Check the cylinder compression pressure	ON/OFF	The fuel injection and ignition stop in all the cylinders.

HINT:

*: When cranking the engine, the Active Test measures the speed of each cylinder.

In this Active Test, the fuel of all cylinders is cut, and cranking occurs for approximately 10 seconds. At this time, the speed of each cylinder is measured. If the speed of one cylinder is higher than the other cylinders, the compression pressure of that cylinder is determined to be lower than the other cylinders.

1. Warm up the engine.
2. Turn the ignition switch off.
3. Connect the intelligent tester to the DLC3.
4. Turn the ignition switch to ON and turn the tester on.
5. Enter the following menus: Powertrain / Engine and ECT / Active Test / Check the Cylinder Compression.

   HINT:

   If the results are not displayed normally, select the display items from the Data List before performing the Active Test. Enter the following menus: Powertrain / Engine and ECT / Data List / Compression / Engine Speed of Cyl #1, Engine Speed of Cyl #2, Engine Speed of Cyl #3, Engine Speed of Cyl #4, Engine Speed of Cyl #5, Engine Speed of Cyl #6 and Av Engine Speed of All Cyl.

6. While the engine is not running, press the RIGHT or LEFT button to change the Check the Cylinder Compression to on.

   HINT:

   After performing the above procedure, Check the Cylinder Compression will start. Fuel injection for all cylinders is prohibited, and each cylinder engine speed measurement will enter standby mode.

7. Crank the engine for about 10 seconds.
8. Monitor the engine speed (Engine Speed of Cyl #1 to #6, Av Engine Speed of All Cyl) displayed on the tester.

   HINT:

At first, the tester display will show each cylinder engine speed measurement to be extremely high. After approximately 10 seconds of engine cranking, each cylinder engine speed measurement will change to the actual engine speed.

NOTICE:

- **After the Check the Cylinder Compression is turned on, it will automatically turn off after 255 seconds.**
- **When the Check the Cylinder Compression test is off and the engine is cranked, the engine will start.**
- **If the Check the Cylinder Compression test needs to be performed after it is turned on and performed once, press EXIT to return to the Active Test menu screen. Then perform the Check the Cylinder Compression test again.**
- **Use a fully-charged battery.**

for Preparation Click here

HINT:

Parameters listed in the chart may be different than your readings depending on the type of instruments and other factors.

If any DTCs are displayed during a check mode DTC check, check the circuit for the DTCs listed in the table below. For details of each DTC, refer to the "See page" indicated.

*1: MIL flashes when a catalyst damaged misfire is detected.

SFI System

DTC Code	Detection Item	MIL	Memory	See page
P0010	Camshaft Position "A" Actuator Circuit (Bank 1)	Comes on	DTC stored	Click here
P0011	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)	Comes on/-	DTC stored	Click here
P0012	Camshaft Position "A" - Timing Over-Retarded (Bank 1)	Comes on/-	DTC stored	Click here
P0016	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)	Comes on/-	DTC stored	Click here
P0018	Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor A)	Comes on/-	DTC stored	Click here
P0020	Camshaft Position "A" Actuator Circuit (Bank 2)	Comes on	DTC stored	Click here
P0021	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)	Comes on/-	DTC stored	Click here
P0022	Camshaft Position "A" - Timing Over-Retarded (Bank 2)	Comes on/-	DTC stored	Click here
P0031	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)	Comes on	DTC stored	Click here
P0032	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)	Comes on	DTC stored	Click here
P0037	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)	Comes on	DTC stored	Click here
P0038	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)	Comes on	DTC stored	Click here
P0051	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)	Comes on	DTC stored	Click here
P0052	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)	Comes on	DTC stored	Click here
P0057	Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)	Comes on	DTC stored	Click here
P0058	Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)	Comes on	DTC stored	Click here
P0102	Mass or Volume Air Flow Circuit Low Input	Comes on	DTC stored	Click here
P0103	Mass or Volume Air Flow Circuit High Input	Comes on	DTC stored	Click here
P0110	Intake Air Temperature Circuit Malfunction	Comes on	DTC stored	Click here
P0112	Intake Air Temperature Circuit Low Input	Comes on	DTC stored	Click here
P0113	Intake Air Temperature Circuit High Input	Comes on	DTC stored	Click here
P0115	Engine Coolant Temperature Circuit Malfunction	Comes on	DTC stored	Click here
P0116	Engine Coolant Temperature Circuit Range / Performance Problem	Comes on	DTC stored	Click here
P0117	Engine Coolant Temperature Circuit Low Input	Comes on	DTC stored	Click here
P0118	Engine Coolant Temperature Circuit High Input	Comes on	DTC stored	Click here
P0120	Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction	Comes on	DTC stored	Click here
P0121	Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem	Comes on	DTC stored	Click here
P0122	Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input	Comes on	DTC stored	Click here
P0123	Throttle / Pedal Position Sensor / Switch "A" Circuit High Input	Comes on	DTC stored	Click here
P0136	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)	Comes on	DTC stored	Click here
P0137	Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)	Comes on	DTC stored	Click here
P0138	Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)	Comes on	DTC stored	Click here
P0141	Oxygen Sensor Heater Circuit Malfunction (Bank 1 Sensor 2)	Comes on	DTC stored	Click here
P0156	Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)	Comes on	DTC stored	Click here
P0157	Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)	Comes on	DTC stored	Click here
P0158	Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)	Comes on	DTC stored	Click here
P0161	Oxygen Sensor Heater Circuit Malfunction (Bank 2 Sensor 2)	Comes on	DTC stored	Click here
P0171	System Too Lean (Bank 1)	Comes on	DTC stored	Click here
P0172	System Too Rich (Bank 1)	Comes on	DTC stored	Click here
P0174	System Too Lean (Bank 2)	Comes on	DTC stored	Click here
P0175	System Too Rich (Bank 2)	Comes on	DTC stored	Click here
P0220	Throttle / Pedal Position Sensor / Switch "B" Circuit	Comes on	DTC stored	Click here

P0222	Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input	Comes on	DTC stored	Click here
P0223	Throttle / Pedal Position Sensor / Switch "B" Circuit High Input	Comes on	DTC stored	Click here
P0230	Fuel Pump Primary Circuit	-	DTC stored	Click here
P0300	Random / Multiple Cylinder Misfire Detected	Comes on/Blinks*1	DTC stored	Click here
P0301	Cylinder 1 Misfire Detected	Comes on/Blinks*1	DTC stored	Click here
P0302	Cylinder 2 Misfire Detected	Comes on/Blinks*1	DTC stored	Click here
P0303	Cylinder 3 Misfire Detected	Comes on/Blinks*1	DTC stored	Click here
P0304	Cylinder 4 Misfire Detected	Comes on/Blinks*1	DTC stored	Click here
P0305	Cylinder 5 Misfire Detected	Comes on/Blinks*1	DTC stored	Click here
P0306	Cylinder 6 Misfire Detected	Comes on/Blinks*1	DTC stored	Click here
P0327	Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)	Comes on	DTC stored	Click here
P0328	Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)	Comes on	DTC stored	Click here
P0332	Knock Sensor 2 Circuit Low Input (Bank 2)	Comes on	DTC stored	Click here
P0333	Knock Sensor 2 Circuit High Input (Bank 2)	Comes on	DTC stored	Click here
P0335	Crankshaft Position Sensor "A" Circuit	Comes on	DTC stored	Click here
P0339	Crankshaft Position Sensor "A" Circuit Intermittent	-	DTC stored	Click here
P0340	Camshaft Position Sensor Circuit Malfunction	Comes on	DTC stored	Click here
P0342	Camshaft Position Sensor "A" Circuit Low Input (Bank 1 or Single Sensor)	Comes on	DTC stored	Click here
P0343	Camshaft Position Sensor "A" Circuit High Input (Bank 1 or Single Sensor)	Comes on	DTC stored	Click here
P0345	Camshaft Position Sensor "A" Circuit (Bank 2)	Comes on	DTC stored	Click here
P0347	Camshaft Position Sensor "A" Circuit Low Input (Bank 2)	Comes on	DTC stored	Click here
P0348	Camshaft Position Sensor "A" Circuit High Input (Bank 2)	Comes on	DTC stored	Click here
P0351	Ignition Coil "A" Primary / Secondary Circuit	Comes on	DTC stored	Click here
P0352	Ignition Coil "B" Primary / Secondary Circuit	Comes on	DTC stored	Click here
P0353	Ignition Coil "C" Primary / Secondary Circuit	Comes on	DTC stored	Click here
P0354	Ignition Coil "D" Primary / Secondary Circuit	Comes on	DTC stored	Click here
P0355	Ignition Coil "E" Primary / Secondary Circuit	Comes on	DTC stored	Click here
P0356	Ignition Coil "F" Primary / Secondary Circuit	Comes on	DTC stored	Click here
P0420	Catalyst System Efficiency Below Threshold (Bank 1)	Comes on	DTC stored	Click here
P0430	Catalyst System Efficiency Below Threshold (Bank 2)	Comes on	DTC stored	Click here
P0443	Evaporative Emission Control System Purge Control Valve Circuit	Comes on	DTC stored	Click here
P0500	Vehicle Speed Sensor "A"	Comes on	DTC stored	Click here
P0504	Brake Switch "A" / "B" Correlation	-	DTC stored	Click here
P0505	Idle Control System Malfunction	Comes on	DTC stored	Click here
P0560	System Voltage	Comes on	DTC stored	Click here
P0604	Random Access Memory (RAM)	Comes on	DTC stored	Click here
P0606	ECM / PCM Processor	Comes on	DTC stored	Click here
P060A	Internal Control Module Monitoring Processor Performance	Comes on	DTC stored	Click here
P060D	Internal Control Module Accelerator Pedal Position Performance	Comes on	DTC stored	Click here
P060E	Internal Control Module Throttle Position Performance	Comes on	DTC stored	Click here
P0617	Starter Relay Circuit High	Comes on	DTC stored	Click here
P0657	Actuator Supply Voltage Circuit / Open	Comes on	DTC stored	Click here
P0660	Intake Manifold Tuning Valve Control Circuit / Open (Bank 1)	Comes on	DTC stored	Click here
P0724	Brake Switch "B" Circuit High	Comes on	DTC stored	Click here
P1607	Cruise Control Input Processor	Comes on	DTC stored	Click here
P2102	Throttle Actuator Control Motor Circuit Low	Comes on	DTC stored	Click here
P2103	Throttle Actuator Control Motor Circuit High	Comes on	DTC stored	Click here
P2111	Throttle Actuator Control System - Stuck Open	Comes on	DTC stored	Click here
P2112	Throttle Actuator Control System - Stuck Closed	Comes on	DTC stored	Click here
P2118	Throttle Actuator Control Motor Current Range / Performance	Comes on	DTC stored	Click here
P2119	Throttle Actuator Control Throttle Body Range / Performance	Comes on	DTC stored	Click here
P2120	Throttle / Pedal Position Sensor / Switch "D" Circuit	Comes on	DTC stored	Click here
P2121	Throttle / Pedal Position Sensor / Switch "D" Circuit Range / Performance	Comes on	DTC stored	Click here
P2122	Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input	Comes on	DTC stored	Click here
P2123	Throttle / Pedal Position Sensor / Switch "D" Circuit High Input	Comes on	DTC stored	Click here
P2125	Throttle / Pedal Position Sensor / Switch "E" Circuit	Comes on	DTC stored	Click here
P2127	Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input	Comes on	DTC stored	Click here

P2128	Throttle / Pedal Position Sensor / Switch "E" Circuit High Input	Comes on	DTC stored	Click here
P2135	Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation	Comes on	DTC stored	Click here
P2138	Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation	Comes on	DTC stored	Click here
P2195	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)	Comes on	DTC stored	Click here
P2196	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)	Comes on	DTC stored	Click here
P2197	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 2 Sensor 1)	Comes on	DTC stored	Click here
P2198	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 2 Sensor 1)	Comes on	DTC stored	Click here
P2237	Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)	Comes on	DTC stored	Click here
P2238	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)	Comes on	DTC stored	Click here
P2239	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)	Comes on	DTC stored	Click here
P2240	Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)	Comes on	DTC stored	Click here
P2241	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)	Comes on	DTC stored	Click here
P2242	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)	Comes on	DTC stored	Click here
P2252	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)	Comes on	DTC stored	Click here
P2253	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)	Comes on	DTC stored	Click here
P2255	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)	Comes on	DTC stored	Click here
P2256	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)	Comes on	DTC stored	Click here
P2A00	A/F Sensor Circuit Slow Response (Bank 1 Sensor 1)	Comes on	DTC stored	Click here
P2A03	A/F Sensor Circuit Slow Response (Bank 2 Sensor 1)	Comes on	DTC stored	Click here

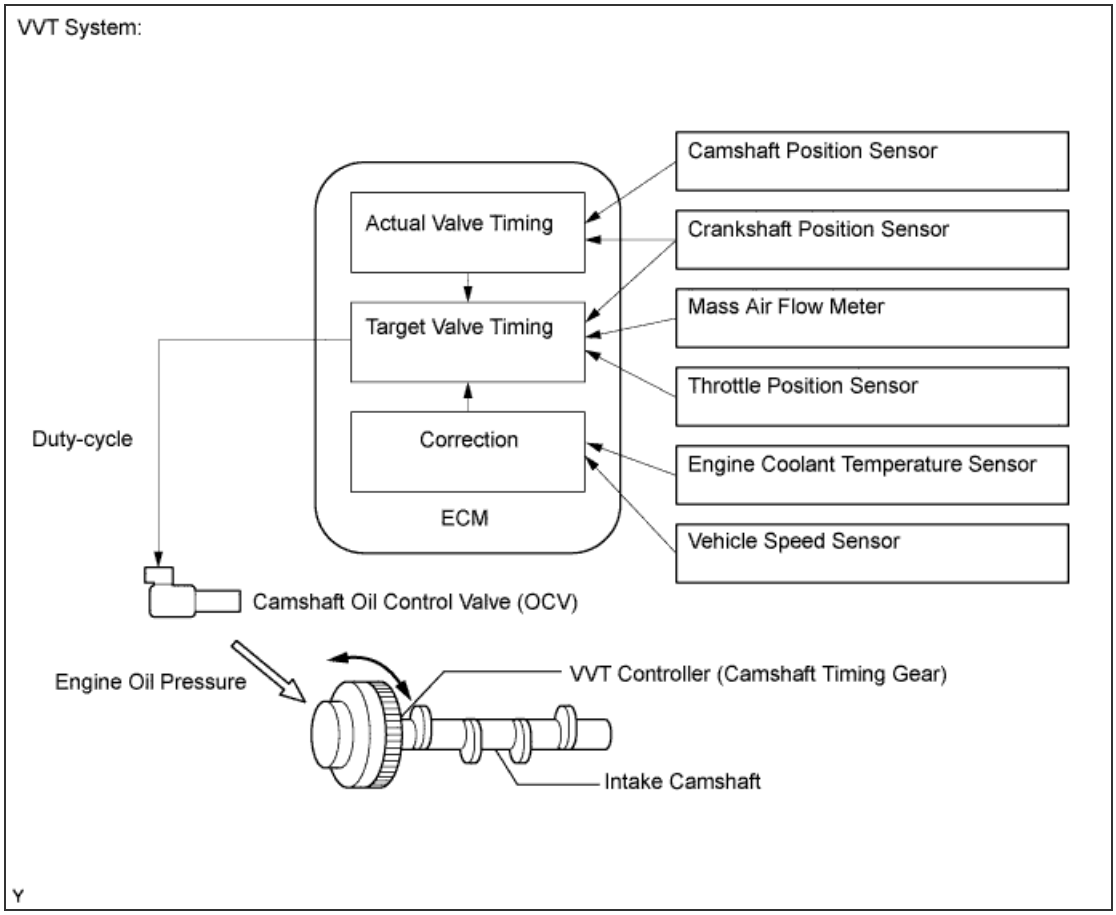
DTC P0010 Camshaft Position "A" Actuator Circuit (Bank 1)

DTC P0020 Camshaft Position "A" Actuator Circuit (Bank 2)

for Preparation Click here

DESCRIPTION

The VVT (Variable Valve Timing) system adjusts the intake valve timing to improve the driveability. The engine oil pressure turns the camshaft actuator to adjust the valve timing. The camshaft Oil Control Valve (OCV) is a solenoid valve and switches the engine oil line. The valve moves when the ECM applies 12 V to the solenoid. The ECM changes the energizing time to the solenoid (duty-cycle) in accordance with the camshaft position, crankshaft position, throttle position, etc.

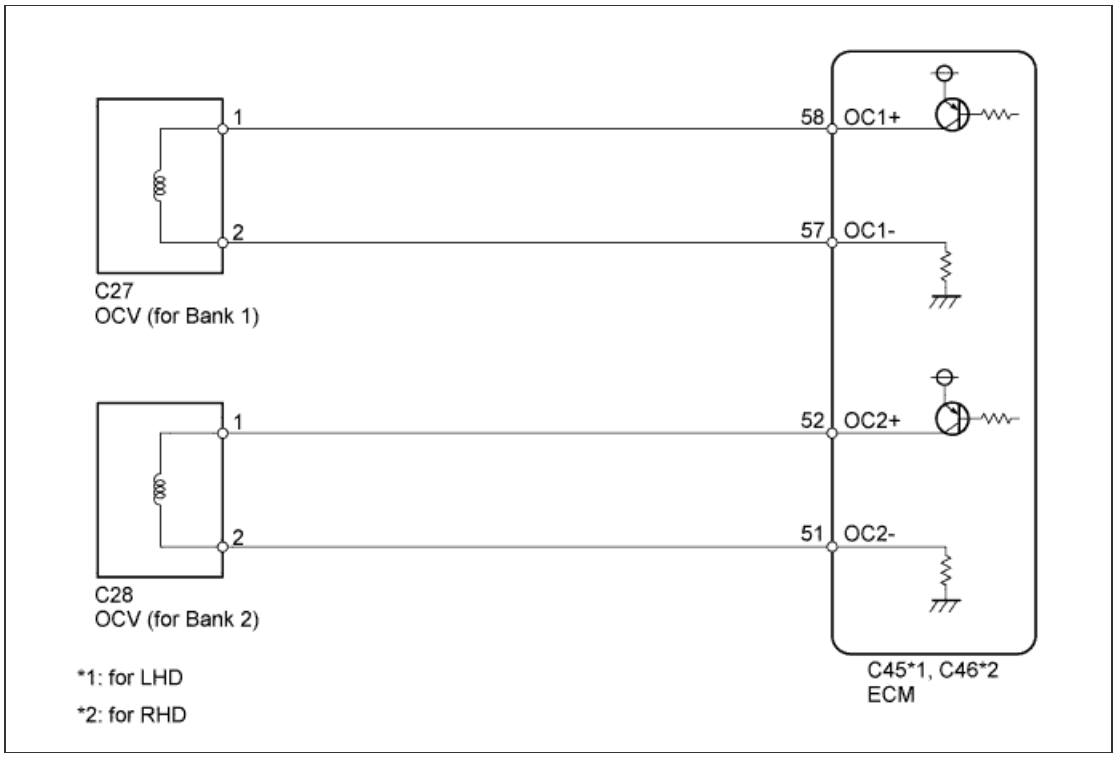


DTC Code	DTC Detection Condition	Trouble Area
P0010	An open or short in the camshaft Oil Control Valve (OCV) (for Bank 1) circuit (1 trip detection logic).	• Open or short in camshaft Oil Control Valve (OCV) (for Bank 1) circuit • OCV (for Bank 1) • ECM
P0020	An open or short in the OCV (for Bank 2) circuit (1 trip detection logic).	• Open or short in OCV (for Bank 2) circuit • OCV (for Bank 2) • ECM

MONITOR DESCRIPTION

This DTC is designed to detect opens or shorts in the camshaft Oil Control Valve (OCV) circuit. If the OCV duty-cycle is excessively high or low while the engine is running, the ECM will illuminate the MIL and store the DTC.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK DTC

a. Clear the DTC after recording the freeze frame data and DTC.

b. Turn the ignition switch off.

c. Allow the engine to idle and check for DTC.

d. Check that P0010 or P0020 is output.

OK:
P0010 or P0020 is output.

NG → CHECK FOR INTERMITTENT PROBLEMS (Click here)

OK

2.INSPECT CAMSHAFT OIL CONTROL VALVE ASSEMBLY

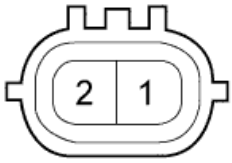
a. Disconnect the camshaft Oil Control Valve (OCV) connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

Component without harness connected:
(Oil Control Valve)



NG → REPLACE CAMSHAFT OIL CONTROL VALVE ASSEMBLY (Click here)

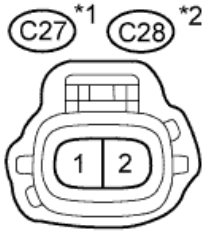
OK

3.CHECK HARNESS AND CONNECTOR (CAMSHAFT OIL CONTROL VALVE [OCV] - ECM)

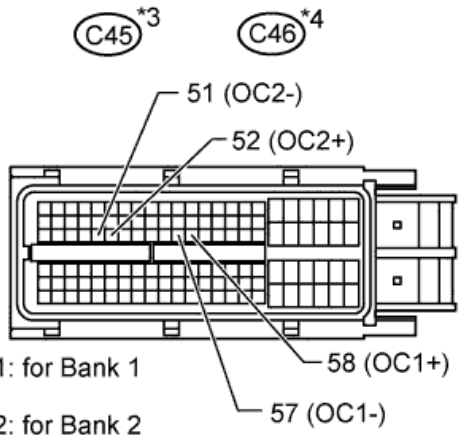
a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Oil Control Valve)



Front view of wire harness connector:
(to ECM)



*1: for Bank 1

*2: for Bank 2

*3: for LHD

*4: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C27-1 - C45-58 (OC1+)	Always	Below 1 Ω
C28-1 - C45-52 (OC2+)	Always	Below 1 Ω
C27-2 - C45-57 (OC1-)	Always	Below 1 Ω
C28-2 - C45-51 (OC2-)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C27-1 - C46-58 (OC1+)	Always	Below 1 Ω
C28-1 - C46-52 (OC2+)	Always	Below 1 Ω
C27-2 - C46-57 (OC1-)	Always	Below 1 Ω
C28-2 - C46-51 (OC2-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C27-1 or C45-58 (OC1+) - Body ground	Always	10 kΩ or higher
C28-1 or C45-52 (OC2+) - Body ground	Always	10 kΩ or higher
C27-2 or C45-57 (OC1-) - Body ground	Always	10 kΩ or higher
C28-2 or C45-51 (OC2-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C27-1 or C46-58 (OC1+) - Body ground	Always	10 kΩ or higher
C28-1 or C46-52 (OC2+) - Body ground	Always	10 kΩ or higher
C27-2 or C46-57 (OC1-) - Body ground	Always	10 kΩ or higher
C28-2 or C46-51 (OC2-) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P0340 Camshaft Position Sensor Circuit Malfunction

DTC P0342 Camshaft Position Sensor "A" Circuit Low Input (Bank 1 or Single Sensor)

DTC P0343 Camshaft Position Sensor "A" Circuit High Input (Bank 1 or Single Sensor)

DTC P0345 Camshaft Position Sensor "A" Circuit (Bank 2)

DTC P0347 Camshaft Position Sensor "A" Circuit Low Input (Bank 2)

DTC P0348 Camshaft Position Sensor "A" Circuit High Input (Bank 2)

for Preparation Click here

DESCRIPTION

The Variable Valve Timing (VVT) sensor (VV1, 2 signal) of the intake camshaft consists of a magnet and MRE (Magnetic Resistance Element).
The VVT camshaft drive gear has a sensor plate with 3 teeth on its outer circumference. When the gear rotates, changes occur in the air gaps between the sensor plate and MRE, which affects the magnetic field. As a result, the resistance of the MRE material fluctuates. The VVT sensor converts the gear rotation data to pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM.
The crankshaft angle sensor plate has 34 teeth. The pickup coil generates 34 signals for each revolution. Based on a combination of the VVT signal and NE signal, the ECM detects the crankshaft angle. Then the ECM uses this data to control fuel injection time and injection timing. Also, based on the NE signal, the ECM detects the engine speed.

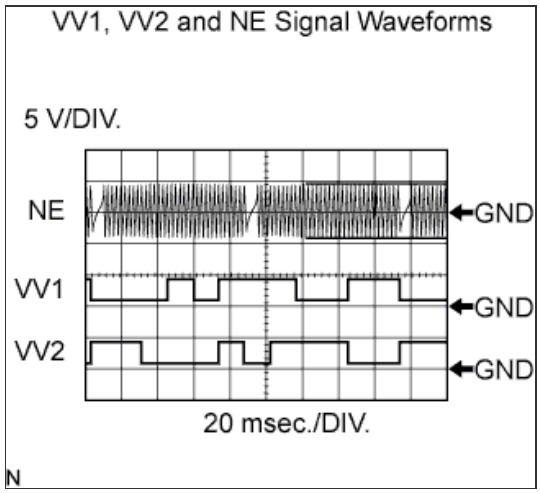
DTC Code	DTC Detection Condition	Trouble Area
P0340 P0345	When either condition below is met: • The input voltage to the ECM remains below 0.3 V or higher than 4.7 V for 4 seconds when 2 or more seconds have elapsed after turning the ignition switch ON (1 trip detection logic). • No VVT sensor signal is sent to the ECM during cranking (2 trip detection logic).	• Open or short in VVT sensor circuit • VVT sensor • Camshaft timing gear assembly • Jumped tooth of timing chain • ECM
P0342 P0347	The output voltage of the VVT sensor is below 0.3 V for 4 seconds (1 trip detection logic).	
P0343 P0348	The output voltage of the VVT sensor is higher than 4.7 V for 4 seconds (1 trip detection logic).	

Reference: Inspection using an oscilloscope

HINT:

- **The correct waveform is as shown.**
- **VV1+ and VV2+ stand for the VVT sensor signal, and NE+ stands for the CKP sensor signal.**

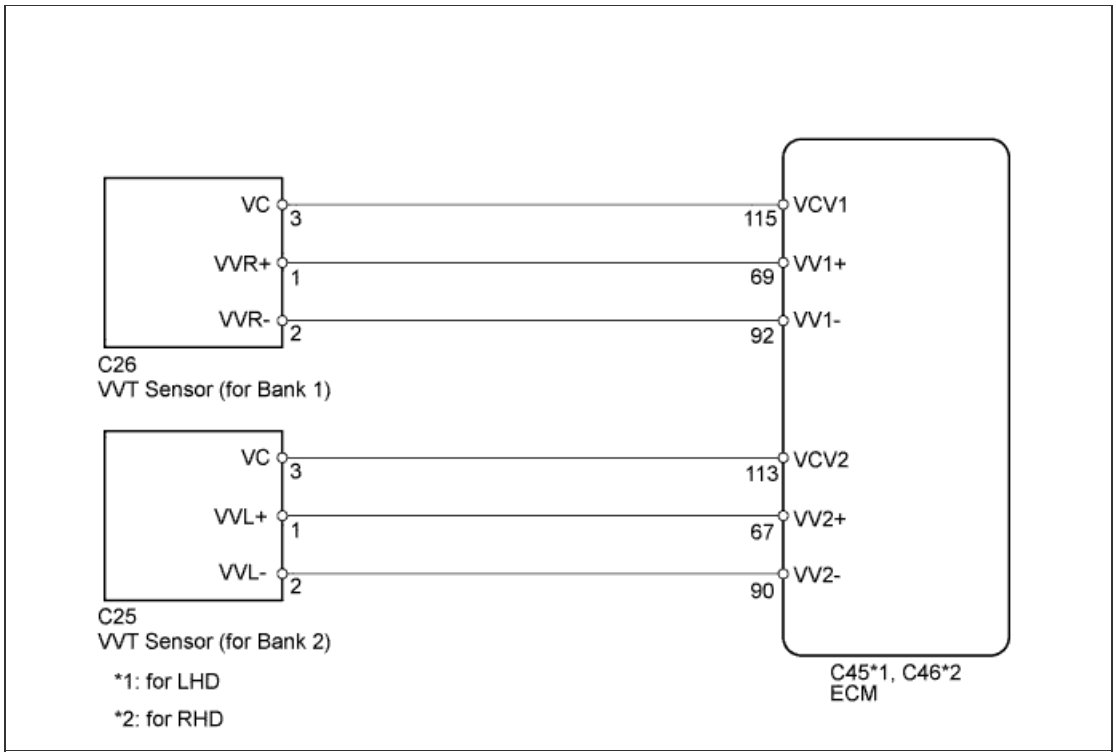
Item	Content
Terminal	NE+ - NE- VV1+ - VV1- VV2+ - VV2-
Equipment Setting	5 V/DIV. 20 msec./DIV.
Condition	Cranking or idling



MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine running, or the rotations of the camshaft and the crankshaft are not synchronized, the ECM interprets this as a malfunction of the sensor.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

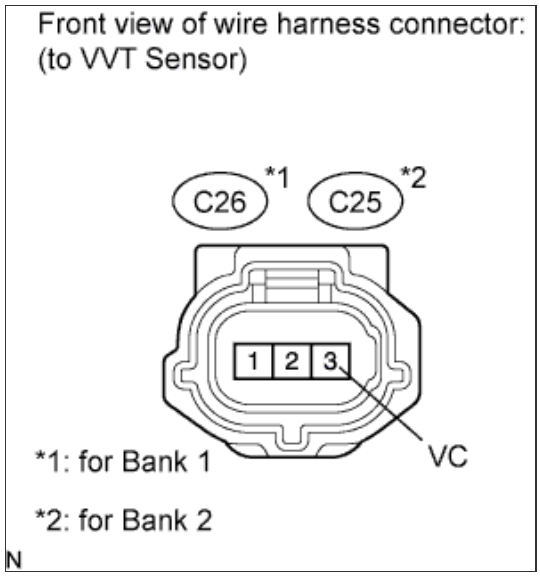
1.CHECK VVT SENSOR (SENSOR POWER SOURCE)

a. Disconnect the VVT sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
C25-3 (VC) - Body ground	Always	4.5 to 5.0 V
C26-3 (VC) - Body ground	Always	4.5 to 5.0 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

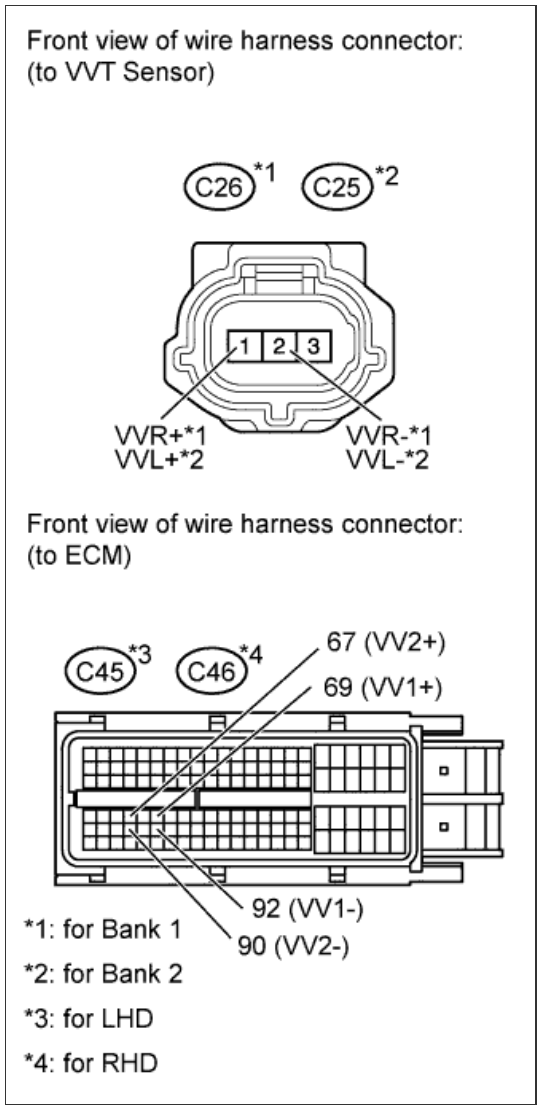
OK

2.CHECK HARNESS AND CONNECTOR (VVT SENSOR - ECM)

a. Disconnect the VVT sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C26-1 (VVR+) - C45-69 (VV1+)	Always	Below 1 Ω
C26-2 (VVR-) - C45-92 (VV1-)	Always	Below 1 Ω
C25-1 (VVL+) - C45-67 (VV2+)	Always	Below 1 Ω
C25-2 (VVL-) - C45-90 (VV2-)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C26-1 (VVR+) - C46-69 (VV1+)	Always	Below 1 Ω
C26-2 (VVR-) - C46-92 (VV1-)	Always	Below 1 Ω
C25-1 (VVL+) - C46-67 (VV2+)	Always	Below 1 Ω
C25-2 (VVL-) - C46-90 (VV2-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition

C26-1 (VVR+) or C45-69 (VV1+) - Body ground	Always	10 kΩ or higher
C26-2 (VVR-) or C45-92 (VV1-) - Body ground	Always	10 kΩ or higher
C25-1 (VVL+) or C45-67 (VV2+) - Body ground	Always	10 kΩ or higher
C25-2 (VVL-) or C45-90 (VV2-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C26-1 (VVR+) or C46-69 (VV1+) - Body ground	Always	10 kΩ or higher
C26-2 (VVR-) or C46-92 (VV1-) - Body ground	Always	10 kΩ or higher
C25-1 (VVL+) or C46-67 (VV2+) - Body ground	Always	10 kΩ or higher
C25-2 (VVL-) or C46-90 (VV2-) - Body ground	Always	10 kΩ or higher

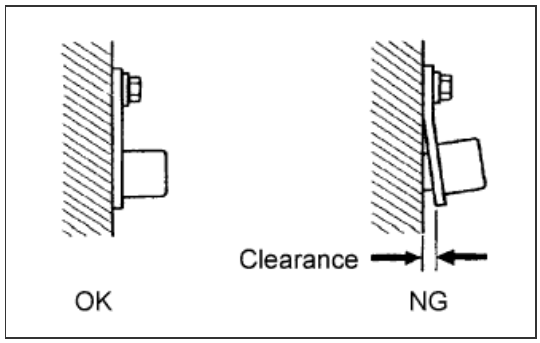
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK SENSOR INSTALLATION

a. Check the VVT sensor installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

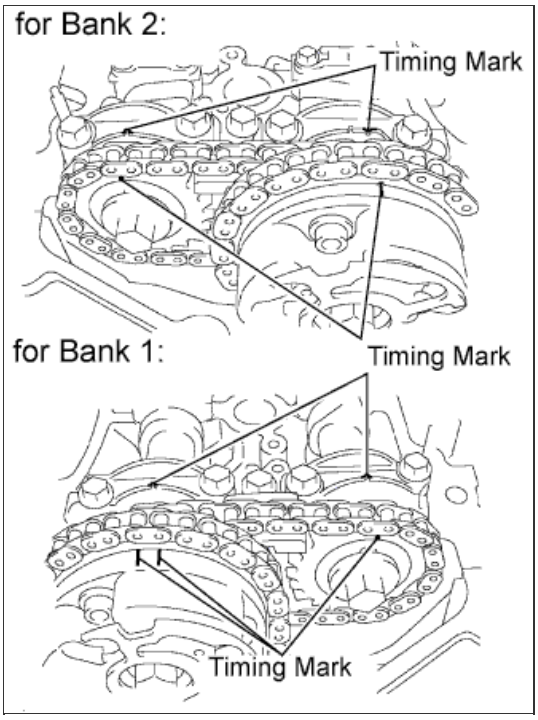
4.CHECK VALVE TIMING

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → ADJUST VALVE TIMING (Click here)

OK

5.CHECK CAMSHAFT TIMING GEAR ASSEMBLY (TEETH OF PLATE)

a. Check the teeth of the signal plate.

OK:
Sensor plate teeth do not have any cracks or deformation.

NG → REPLACE CAMSHAFT TIMING GEAR ASSEMBLY (Click here)

OK

6.REPLACE VVT SENSOR

a. Replace the VVT sensor (Click here).

NEXT

7.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read the DTCs.

Result

Result	Proceed to
No output	A
P0340, P0342, P0343, P0345, P0347 or P0348	B

HINT:

If the engine does not start, replace the ECM.

B	REPLACE ECM (Click here)

A

END

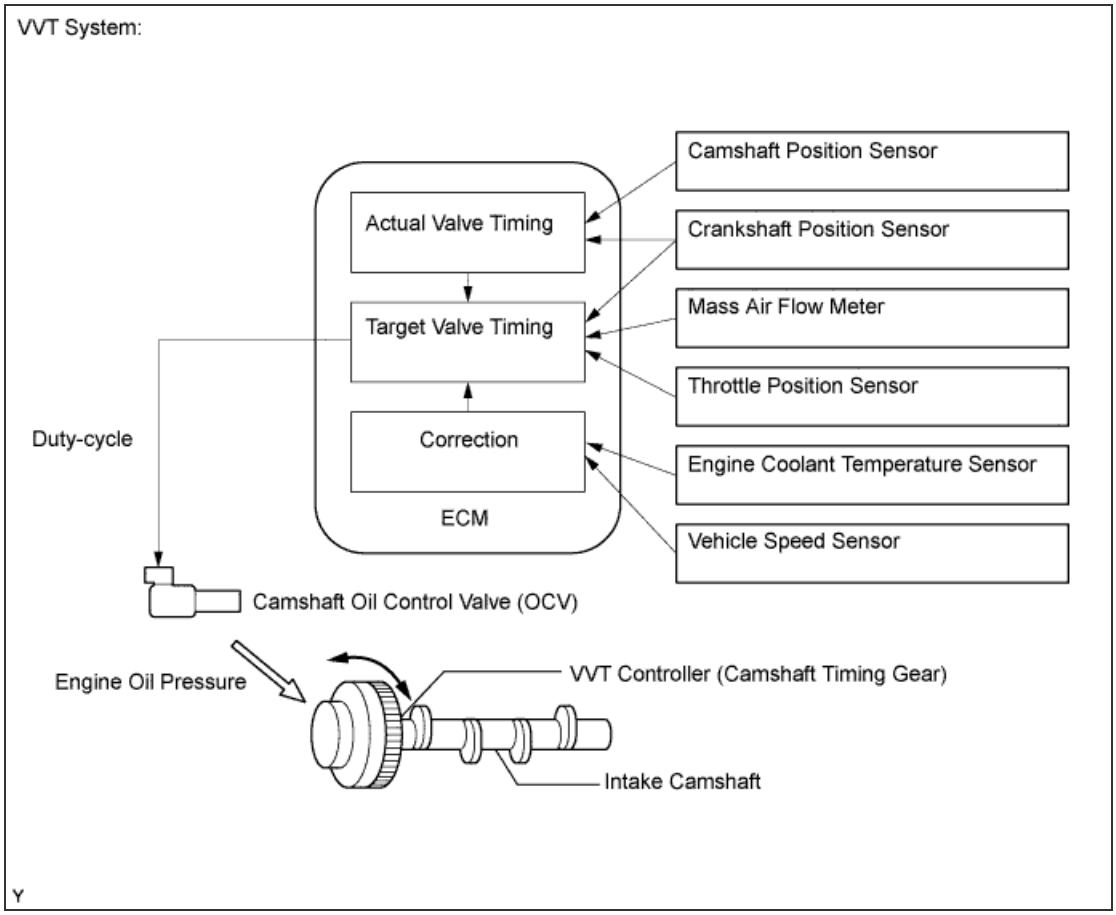
DTC P0010 Camshaft Position "A" Actuator Circuit (Bank 1)

DTC P0020 Camshaft Position "A" Actuator Circuit (Bank 2)

for Preparation Click here

DESCRIPTION

The VVT (Variable Valve Timing) system adjusts the intake valve timing to improve the driveability. The engine oil pressure turns the camshaft actuator to adjust the valve timing. The camshaft Oil Control Valve (OCV) is a solenoid valve and switches the engine oil line. The valve moves when the ECM applies 12 V to the solenoid. The ECM changes the energizing time to the solenoid (duty-cycle) in accordance with the camshaft position, crankshaft position, throttle position, etc.

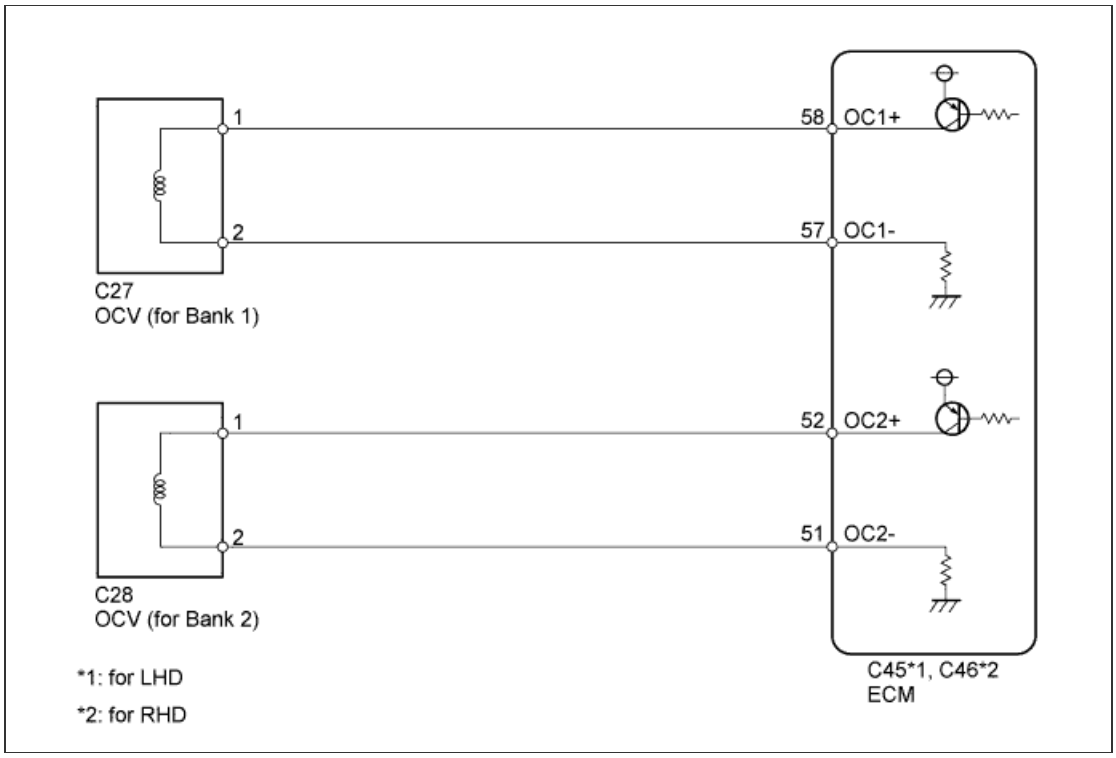


DTC Code	DTC Detection Condition	Trouble Area
P0010	An open or short in the camshaft Oil Control Valve (OCV) (for Bank 1) circuit (1 trip detection logic).	• Open or short in camshaft Oil Control Valve (OCV) (for Bank 1) circuit • OCV (for Bank 1) • ECM
P0020	An open or short in the OCV (for Bank 2) circuit (1 trip detection logic).	• Open or short in OCV (for Bank 2) circuit • OCV (for Bank 2) • ECM

MONITOR DESCRIPTION

This DTC is designed to detect opens or shorts in the camshaft Oil Control Valve (OCV) circuit. If the OCV duty-cycle is excessively high or low while the engine is running, the ECM will illuminate the MIL and store the DTC.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK DTC

a. Clear the DTC after recording the freeze frame data and DTC.

b. Turn the ignition switch off.

c. Allow the engine to idle and check for DTC.

d. Check that P0010 or P0020 is output.

OK:
P0010 or P0020 is output.

NG → CHECK FOR INTERMITTENT PROBLEMS (Click here)

OK

2.INSPECT CAMSHAFT OIL CONTROL VALVE ASSEMBLY

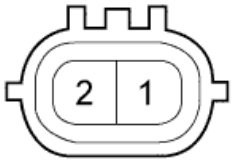
a. Disconnect the camshaft Oil Control Valve (OCV) connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

Component without harness connected:
(Oil Control Valve)



NG → REPLACE CAMSHAFT OIL CONTROL VALVE ASSEMBLY (Click here)

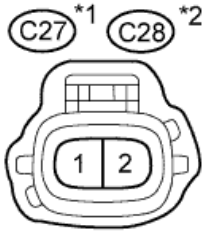
OK

3.CHECK HARNESS AND CONNECTOR (CAMSHAFT OIL CONTROL VALVE [OCV] - ECM)

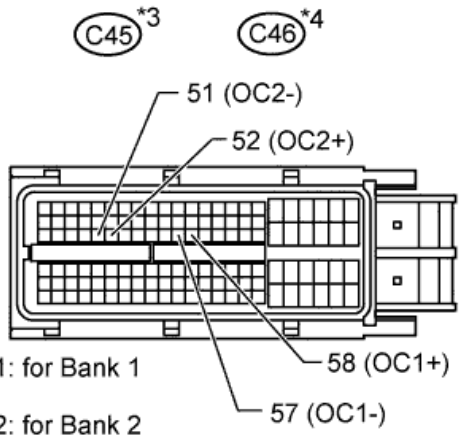
a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Oil Control Valve)



Front view of wire harness connector:
(to ECM)



*1: for Bank 1

*2: for Bank 2

*3: for LHD

*4: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C27-1 - C45-58 (OC1+)	Always	Below 1 Ω
C28-1 - C45-52 (OC2+)	Always	Below 1 Ω
C27-2 - C45-57 (OC1-)	Always	Below 1 Ω
C28-2 - C45-51 (OC2-)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C27-1 - C46-58 (OC1+)	Always	Below 1 Ω
C28-1 - C46-52 (OC2+)	Always	Below 1 Ω
C27-2 - C46-57 (OC1-)	Always	Below 1 Ω
C28-2 - C46-51 (OC2-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C27-1 or C45-58 (OC1+) - Body ground	Always	10 kΩ or higher
C28-1 or C45-52 (OC2+) - Body ground	Always	10 kΩ or higher
C27-2 or C45-57 (OC1-) - Body ground	Always	10 kΩ or higher
C28-2 or C45-51 (OC2-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C27-1 or C46-58 (OC1+) - Body ground	Always	10 kΩ or higher
C28-1 or C46-52 (OC2+) - Body ground	Always	10 kΩ or higher
C27-2 or C46-57 (OC1-) - Body ground	Always	10 kΩ or higher
C28-2 or C46-51 (OC2-) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P0340 Camshaft Position Sensor Circuit Malfunction

DTC P0342 Camshaft Position Sensor "A" Circuit Low Input (Bank 1 or Single Sensor)

DTC P0343 Camshaft Position Sensor "A" Circuit High Input (Bank 1 or Single Sensor)

DTC P0345 Camshaft Position Sensor "A" Circuit (Bank 2)

DTC P0347 Camshaft Position Sensor "A" Circuit Low Input (Bank 2)

DTC P0348 Camshaft Position Sensor "A" Circuit High Input (Bank 2)

for Preparation Click here

DESCRIPTION

The Variable Valve Timing (VVT) sensor (VV1, 2 signal) of the intake camshaft consists of a magnet and MRE (Magnetic Resistance Element).
The VVT camshaft drive gear has a sensor plate with 3 teeth on its outer circumference. When the gear rotates, changes occur in the air gaps between the sensor plate and MRE, which affects the magnetic field. As a result, the resistance of the MRE material fluctuates. The VVT sensor converts the gear rotation data to pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM.
The crankshaft angle sensor plate has 34 teeth. The pickup coil generates 34 signals for each revolution. Based on a combination of the VVT signal and NE signal, the ECM detects the crankshaft angle. Then the ECM uses this data to control fuel injection time and injection timing. Also, based on the NE signal, the ECM detects the engine speed.

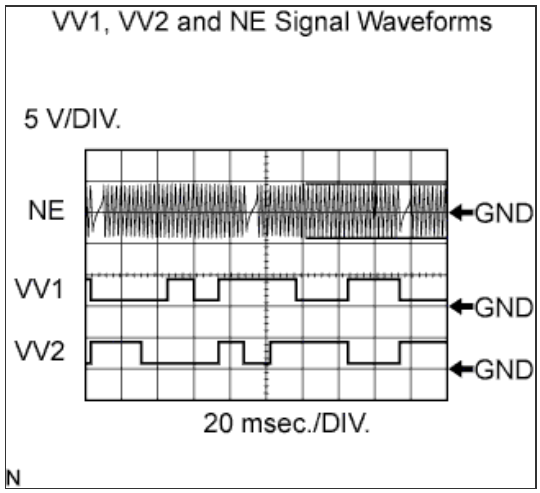
DTC Code	DTC Detection Condition	Trouble Area
P0340 P0345	When either condition below is met: • The input voltage to the ECM remains below 0.3 V or higher than 4.7 V for 4 seconds when 2 or more seconds have elapsed after turning the ignition switch ON (1 trip detection logic). • No VVT sensor signal is sent to the ECM during cranking (2 trip detection logic).	• Open or short in VVT sensor circuit • VVT sensor • Camshaft timing gear assembly • Jumped tooth of timing chain • ECM
P0342 P0347	The output voltage of the VVT sensor is below 0.3 V for 4 seconds (1 trip detection logic).	
P0343 P0348	The output voltage of the VVT sensor is higher than 4.7 V for 4 seconds (1 trip detection logic).	

Reference: Inspection using an oscilloscope

HINT:

- **The correct waveform is as shown.**
- **VV1+ and VV2+ stand for the VVT sensor signal, and NE+ stands for the CKP sensor signal.**

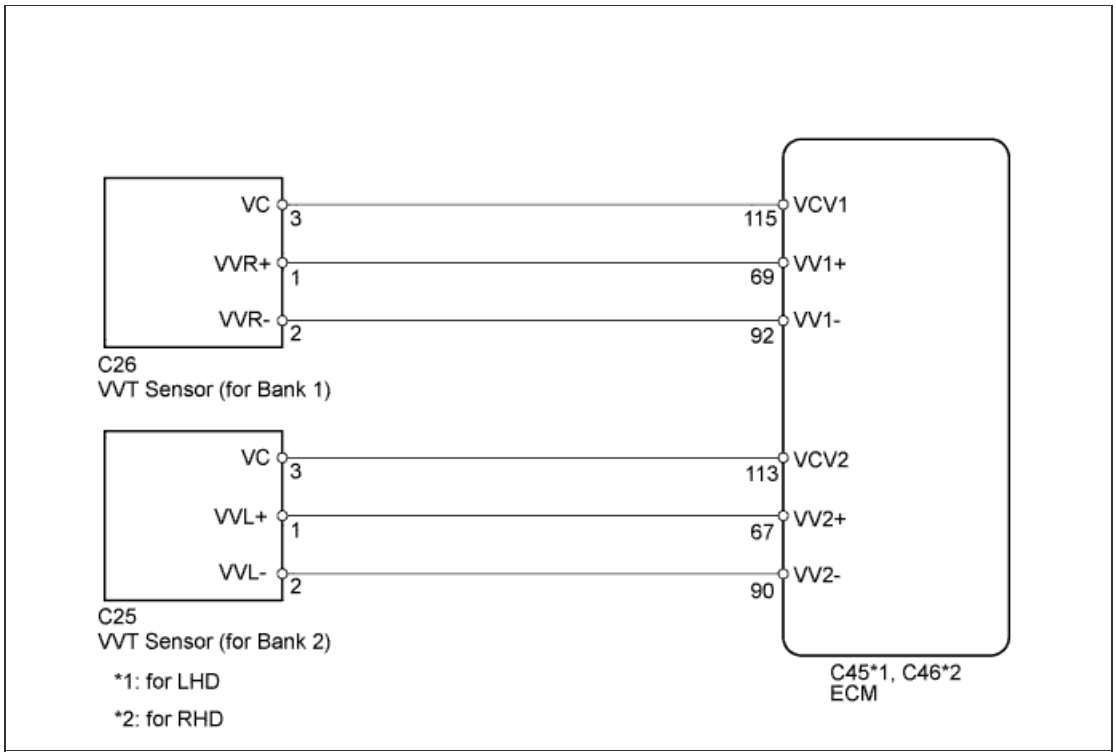
Item	Content
Terminal	NE+ - NE- VV1+ - VV1- VV2+ - VV2-
Equipment Setting	5 V/DIV. 20 msec./DIV.
Condition	Cranking or idling



MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine running, or the rotations of the camshaft and the crankshaft are not synchronized, the ECM interprets this as a malfunction of the sensor.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

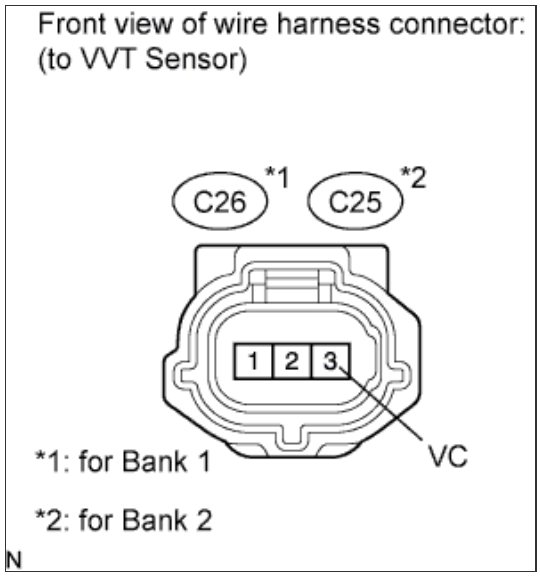
1.CHECK VVT SENSOR (SENSOR POWER SOURCE)

a. Disconnect the VVT sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
C25-3 (VC) - Body ground	Always	4.5 to 5.0 V
C26-3 (VC) - Body ground	Always	4.5 to 5.0 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

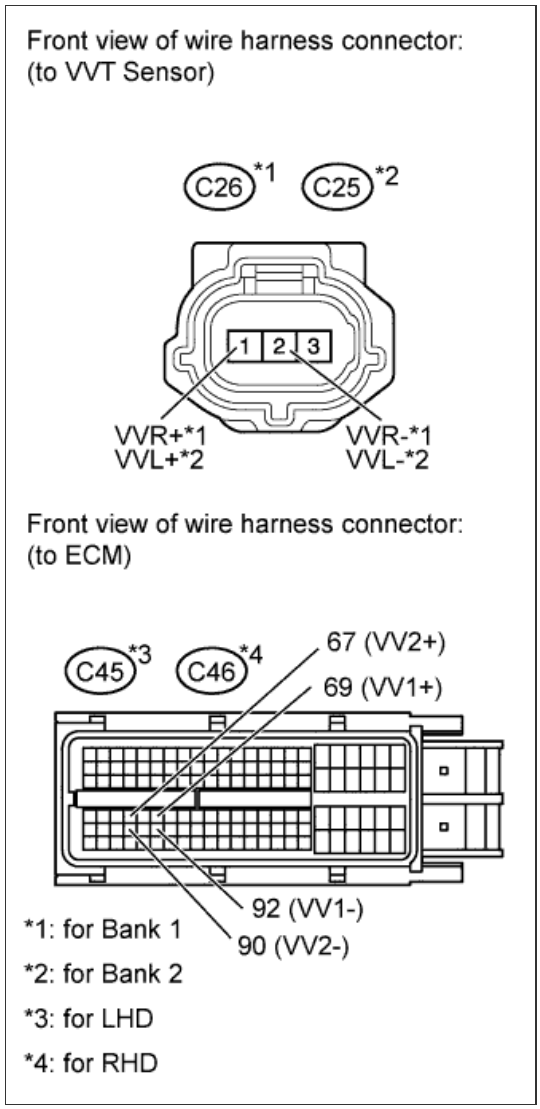
OK

2.CHECK HARNESS AND CONNECTOR (VVT SENSOR - ECM)

a. Disconnect the VVT sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C26-1 (VVR+) - C45-69 (VV1+)	Always	Below 1 Ω
C26-2 (VVR-) - C45-92 (VV1-)	Always	Below 1 Ω
C25-1 (VVL+) - C45-67 (VV2+)	Always	Below 1 Ω
C25-2 (VVL-) - C45-90 (VV2-)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C26-1 (VVR+) - C46-69 (VV1+)	Always	Below 1 Ω
C26-2 (VVR-) - C46-92 (VV1-)	Always	Below 1 Ω
C25-1 (VVL+) - C46-67 (VV2+)	Always	Below 1 Ω
C25-2 (VVL-) - C46-90 (VV2-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition

C26-1 (VVR+) or C45-69 (VV1+) - Body ground	Always	10 kΩ or higher
C26-2 (VVR-) or C45-92 (VV1-) - Body ground	Always	10 kΩ or higher
C25-1 (VVL+) or C45-67 (VV2+) - Body ground	Always	10 kΩ or higher
C25-2 (VVL-) or C45-90 (VV2-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C26-1 (VVR+) or C46-69 (VV1+) - Body ground	Always	10 kΩ or higher
C26-2 (VVR-) or C46-92 (VV1-) - Body ground	Always	10 kΩ or higher
C25-1 (VVL+) or C46-67 (VV2+) - Body ground	Always	10 kΩ or higher
C25-2 (VVL-) or C46-90 (VV2-) - Body ground	Always	10 kΩ or higher

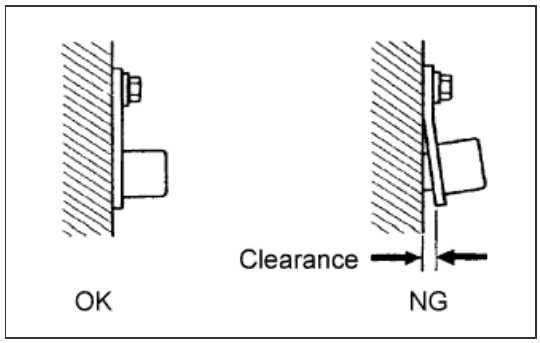
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK SENSOR INSTALLATION

a. Check the VVT sensor installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

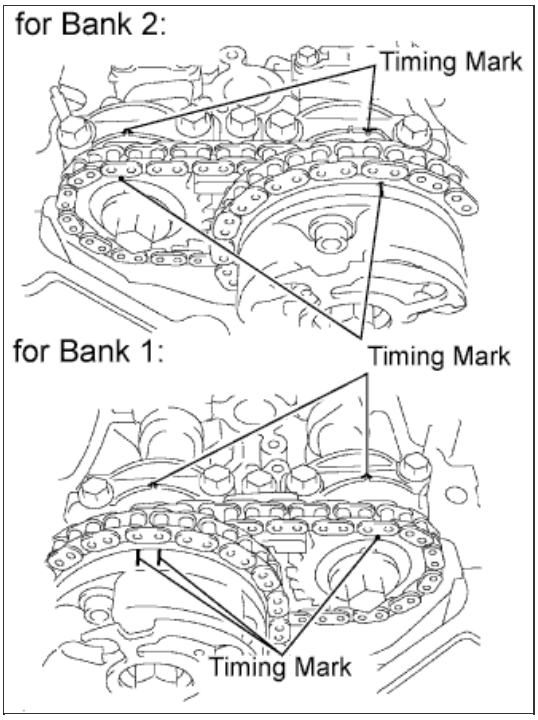
4.CHECK VALVE TIMING

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → ADJUST VALVE TIMING (Click here)

OK

5.CHECK CAMSHAFT TIMING GEAR ASSEMBLY (TEETH OF PLATE)

a. Check the teeth of the signal plate.

OK:
Sensor plate teeth do not have any cracks or deformation.

NG → REPLACE CAMSHAFT TIMING GEAR ASSEMBLY (Click here)

OK

6.REPLACE VVT SENSOR

a. Replace the VVT sensor (Click here).

NEXT

7.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read the DTCs.

Result

Result	Proceed to
No output	A
P0340, P0342, P0343, P0345, P0347 or P0348	B

HINT:

If the engine does not start, replace the ECM.

B	REPLACE ECM (Click here)

A

END

DTC P0011 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)

DTC P0012 Camshaft Position "A" - Timing Over-Retarded (Bank 1)

DTC P0021 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)

DTC P0022 Camshaft Position "A" - Timing Over-Retarded (Bank 2)

for Preparation Click here

DESCRIPTION

Refer to DTC P0010 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P0011 P0021	Valve timing is not adjusted in valve timing advance range (1 trip detection logic)	• Valve timing • Camshaft Oil Control Valve (OCV) • OCV filter • Camshaft timing gear assembly • ECM
P0012 P0022	Valve timing is not adjusted in valve timing retard range (2 trip detection logic)	

MONITOR DESCRIPTION

The ECM optimizes the intake valve timing using the VVT (Variable Valve Timing) system to control the intake camshaft. The VVT system includes the ECM, the camshaft Oil Control Valve (OCV) and the VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake camshaft.
If the difference between the target and actual intake valve timings is large, and changes in the actual intake valve timing are small, the ECM interprets this as the VVT controller stuck malfunction and stores a DTC.

Example:
A DTC is stored when conditions 1 and 2 are met:

1. It takes 5 seconds or more to change the valve timing by 5°CA.
2. After the above condition 1 is met, the OCV is forcibly activated 63 times or more (when the vehicle is idling, this takes approximately 100 seconds).

DTC P0011 and P0021 (Advanced Cam Timing) are subject to 1 trip detection logic.
DTC P0012 and P0022 (Retarded Cam Timing) are subject to 2 trip detection logic.
These DTCs indicate that the VVT controller cannot operate properly due to OCV malfunctions or the presence of foreign objects in the OCV.

WIRING DIAGRAM

Refer to DTC P0010 (Click here).

INSPECTION PROCEDURE

HINT:

Abnormal Bank	Advanced Timing Over (Valve Timing is Out of Specified Range)	Retarded Timing Over (Valve Timing is Out of Specified Range)
Bank 1	P0011	P0012
Bank 2	P0021	P0022

- **DTC P0011, P0012, P0021 or P0022 may be stored when foreign objects in the engine oil are caught in some parts of the system. The DTC will remain stored even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.**
- **If DTC P0011 or P0012 is output, check the right bank VVT system for the intake camshaft circuit (bank 1).**
- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **If DTC P0021 or P0022 is output, check the left bank VVT system for the intake camshaft circuit (bank 2).**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P0011, P0012, P0021 or P0022	A
P0011, P0012, P0021 or P0022 and other DTCs	B

HINT:

If any DTCs other than P0011, P0012, P0021 or P0022 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1) or Control the VVT System (Bank 2).

e. Check the engine speed while operating the camshaft Oil Control Valve (OCV) using the tester.

OK

Tester Operation	Specified Condition
OCV OFF	Normal engine speed
OCV ON	Engine idles roughly or stalls (soon after OCV switched from OFF to ON)

NG → Go to step 4

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. Drive the vehicle for more than 10 minutes.

g. Read the DTCs using the tester.

OK:
No DTC output.

NG → Go to step 4

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

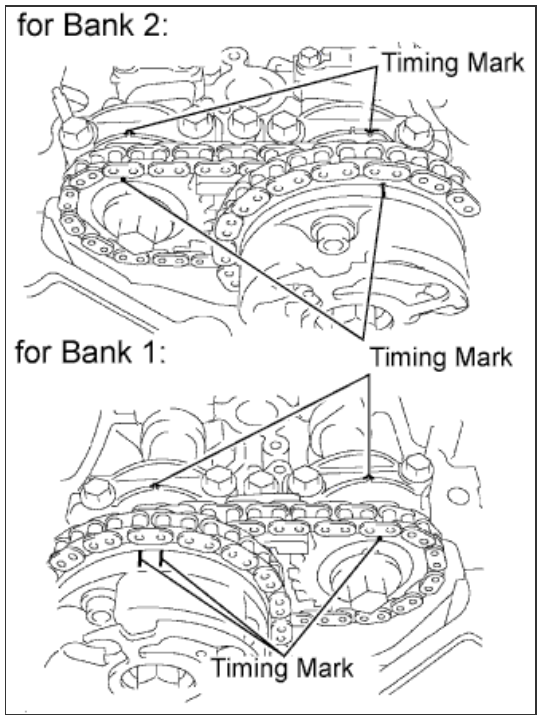
4.CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMPED TEETH ON TIMING CHAIN)

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → ADJUST VALVE TIMING (Click here)

OK

5.INSPECT CAMSHAFT OIL CONTROL VALVE ASSEMBLY

a. Remove the OCV (Click here).

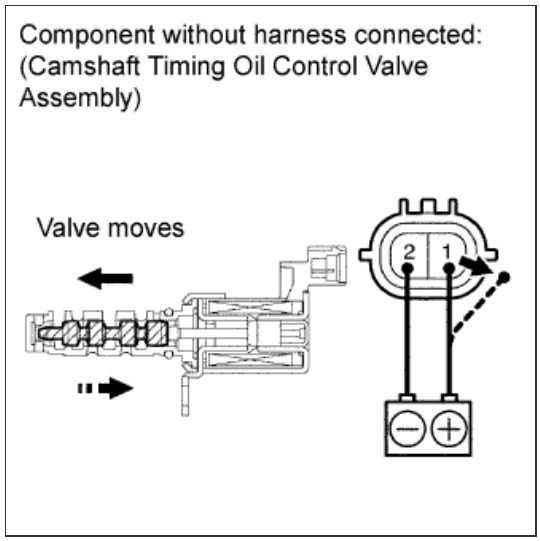
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

c. Apply positive battery voltage to terminal 1 and negative battery voltage to terminal 2. Check the valve operation.

OK:
Valve moves quickly.



NG → REPLACE CAMSHAFT OIL CONTROL VALVE ASSEMBLY (Click here)

OK

6.INSPECT OIL CONTROL VALVE FILTER

a. Remove the oil control valve filter (Click here).

b. Check that the filter is not clogged.

OK:
Filter is not clogged.

NG → CLEAN OIL CONTROL VALVE FILTER

OK

7.REPLACE CAMSHAFT TIMING GEAR ASSEMBLY

a. Replace the camshaft timing gear assembly (Click here).

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. Drive the vehicle for more than 10 minutes.

g. Read output DTCs using the tester.

OK:
No DTC output.

HINT:

DTC P0011, P0012, P0021 or P0022 is output when foreign objects in engine oil are caught in some parts of the system. These codes will stay stored even if the system returns to normal after a short time. These foreign objects are then captured by the oil filter, thus eliminating the source of the problem.

NG → REPLACE ECM (**Click here**)

OK

SYSTEM OK

DTC P0340 Camshaft Position Sensor Circuit Malfunction

DTC P0342 Camshaft Position Sensor "A" Circuit Low Input (Bank 1 or Single Sensor)

DTC P0343 Camshaft Position Sensor "A" Circuit High Input (Bank 1 or Single Sensor)

DTC P0345 Camshaft Position Sensor "A" Circuit (Bank 2)

DTC P0347 Camshaft Position Sensor "A" Circuit Low Input (Bank 2)

DTC P0348 Camshaft Position Sensor "A" Circuit High Input (Bank 2)

for Preparation Click here

DESCRIPTION

The Variable Valve Timing (VVT) sensor (VV1, 2 signal) of the intake camshaft consists of a magnet and MRE (Magnetic Resistance Element).
The VVT camshaft drive gear has a sensor plate with 3 teeth on its outer circumference. When the gear rotates, changes occur in the air gaps between the sensor plate and MRE, which affects the magnetic field. As a result, the resistance of the MRE material fluctuates. The VVT sensor converts the gear rotation data to pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM.
The crankshaft angle sensor plate has 34 teeth. The pickup coil generates 34 signals for each revolution. Based on a combination of the VVT signal and NE signal, the ECM detects the crankshaft angle. Then the ECM uses this data to control fuel injection time and injection timing. Also, based on the NE signal, the ECM detects the engine speed.

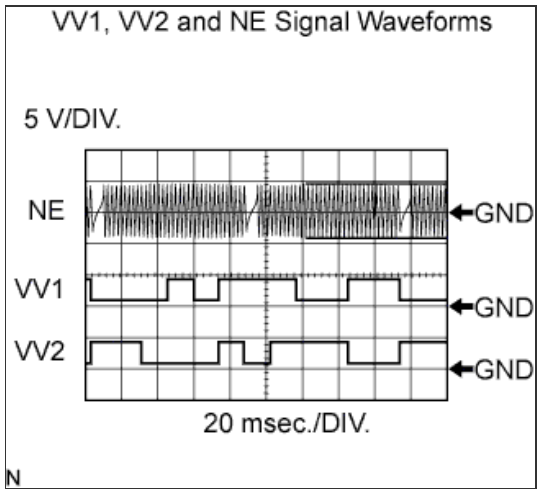
DTC Code	DTC Detection Condition	Trouble Area
P0340 P0345	When either condition below is met: • The input voltage to the ECM remains below 0.3 V or higher than 4.7 V for 4 seconds when 2 or more seconds have elapsed after turning the ignition switch ON (1 trip detection logic). • No VVT sensor signal is sent to the ECM during cranking (2 trip detection logic).	• Open or short in VVT sensor circuit • VVT sensor • Camshaft timing gear assembly • Jumped tooth of timing chain • ECM
P0342 P0347	The output voltage of the VVT sensor is below 0.3 V for 4 seconds (1 trip detection logic).	
P0343 P0348	The output voltage of the VVT sensor is higher than 4.7 V for 4 seconds (1 trip detection logic).	

Reference: Inspection using an oscilloscope

HINT:

- **The correct waveform is as shown.**
- **VV1+ and VV2+ stand for the VVT sensor signal, and NE+ stands for the CKP sensor signal.**

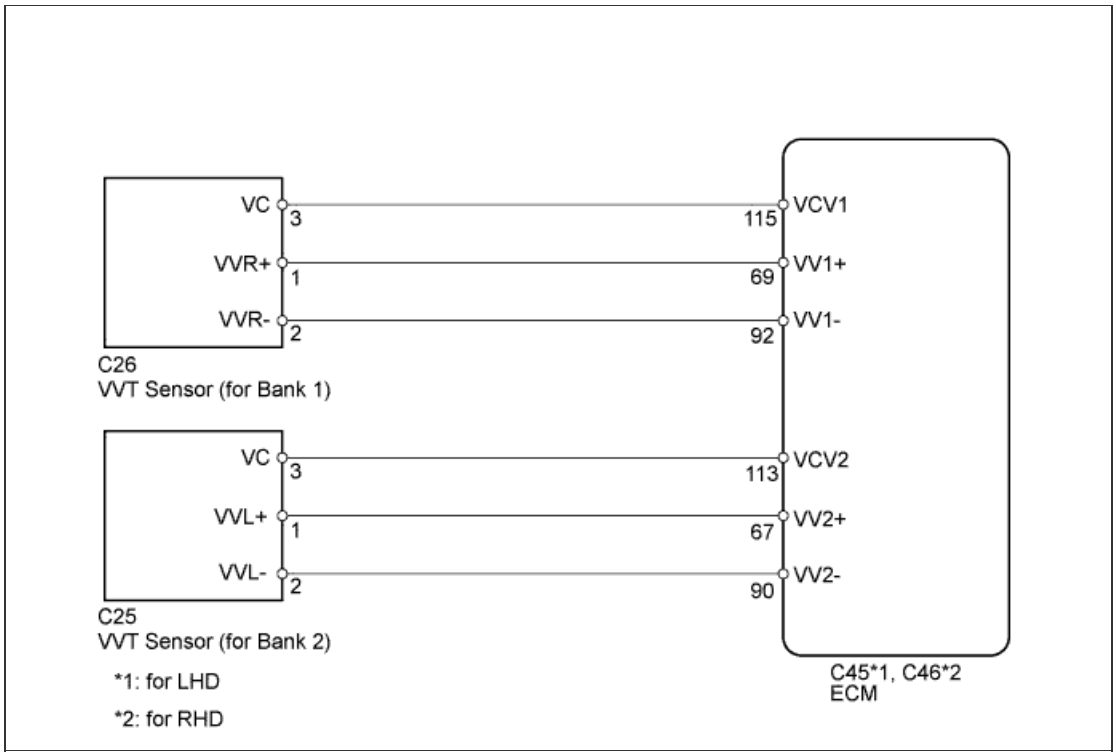
Item	Content
Terminal	NE+ - NE- VV1+ - VV1- VV2+ - VV2-
Equipment Setting	5 V/DIV. 20 msec./DIV.
Condition	Cranking or idling



MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine running, or the rotations of the camshaft and the crankshaft are not synchronized, the ECM interprets this as a malfunction of the sensor.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

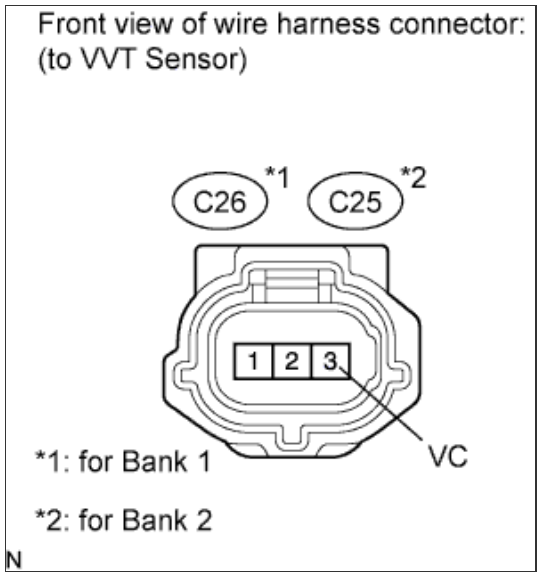
1.CHECK VVT SENSOR (SENSOR POWER SOURCE)

a. Disconnect the VVT sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
C25-3 (VC) - Body ground	Always	4.5 to 5.0 V
C26-3 (VC) - Body ground	Always	4.5 to 5.0 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

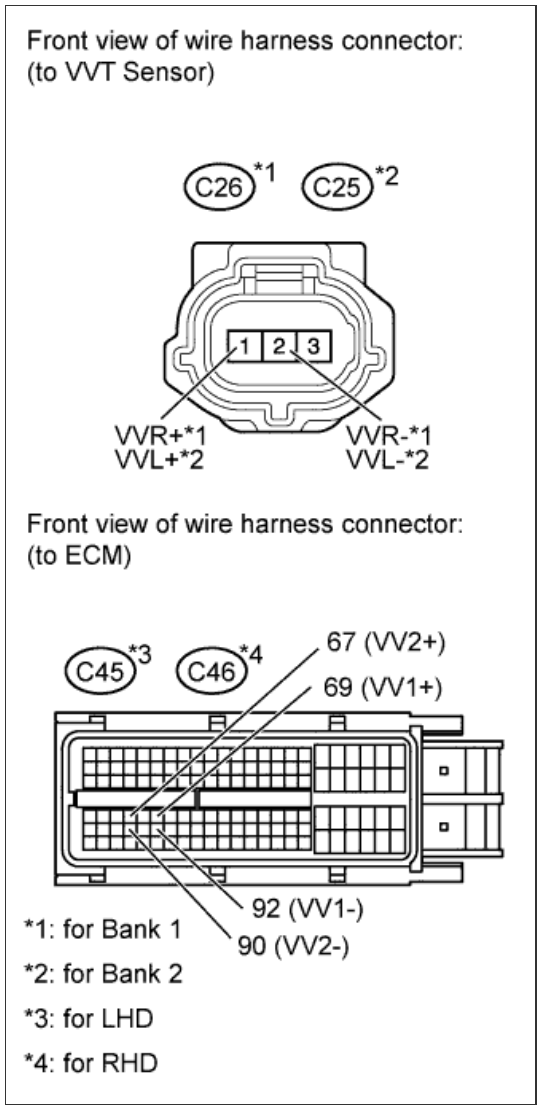
OK

2.CHECK HARNESS AND CONNECTOR (VVT SENSOR - ECM)

a. Disconnect the VVT sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C26-1 (VVR+) - C45-69 (VV1+)	Always	Below 1 Ω
C26-2 (VVR-) - C45-92 (VV1-)	Always	Below 1 Ω
C25-1 (VVL+) - C45-67 (VV2+)	Always	Below 1 Ω
C25-2 (VVL-) - C45-90 (VV2-)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C26-1 (VVR+) - C46-69 (VV1+)	Always	Below 1 Ω
C26-2 (VVR-) - C46-92 (VV1-)	Always	Below 1 Ω
C25-1 (VVL+) - C46-67 (VV2+)	Always	Below 1 Ω
C25-2 (VVL-) - C46-90 (VV2-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition

C26-1 (VVR+) or C45-69 (VV1+) - Body ground	Always	10 kΩ or higher
C26-2 (VVR-) or C45-92 (VV1-) - Body ground	Always	10 kΩ or higher
C25-1 (VVL+) or C45-67 (VV2+) - Body ground	Always	10 kΩ or higher
C25-2 (VVL-) or C45-90 (VV2-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C26-1 (VVR+) or C46-69 (VV1+) - Body ground	Always	10 kΩ or higher
C26-2 (VVR-) or C46-92 (VV1-) - Body ground	Always	10 kΩ or higher
C25-1 (VVL+) or C46-67 (VV2+) - Body ground	Always	10 kΩ or higher
C25-2 (VVL-) or C46-90 (VV2-) - Body ground	Always	10 kΩ or higher

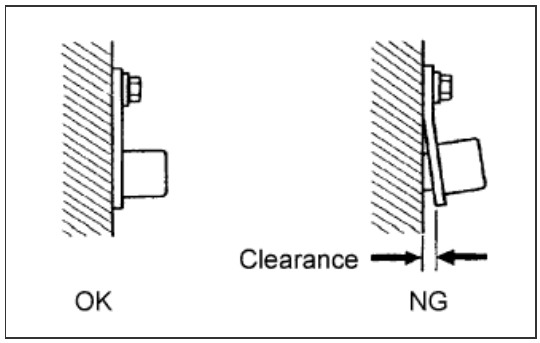
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK SENSOR INSTALLATION

a. Check the VVT sensor installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

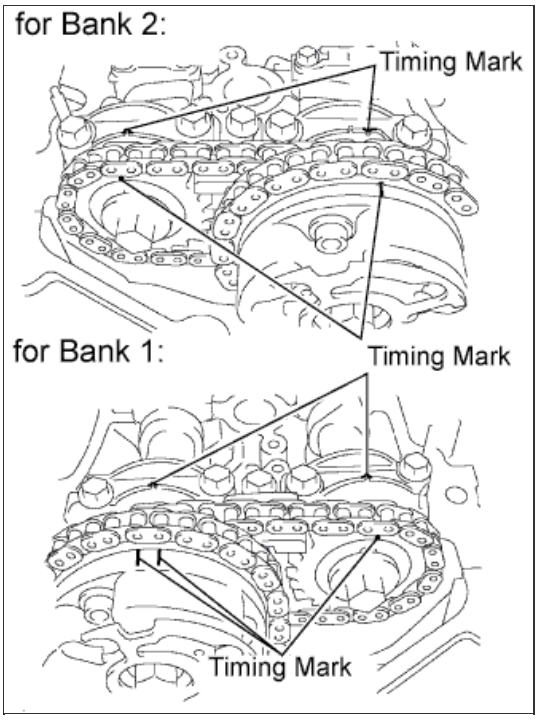
4.CHECK VALVE TIMING

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → ADJUST VALVE TIMING (Click here)

OK

5.CHECK CAMSHAFT TIMING GEAR ASSEMBLY (TEETH OF PLATE)

a. Check the teeth of the signal plate.

OK:
Sensor plate teeth do not have any cracks or deformation.

NG → REPLACE CAMSHAFT TIMING GEAR ASSEMBLY (Click here)

OK

6.REPLACE VVT SENSOR

a. Replace the VVT sensor (Click here).

NEXT

7.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read the DTCs.

Result

Result	Proceed to
No output	A
P0340, P0342, P0343, P0345, P0347 or P0348	B

HINT:

If the engine does not start, replace the ECM.

B	REPLACE ECM (Click here)

A

END

DTC P0011 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)

DTC P0012 Camshaft Position "A" - Timing Over-Retarded (Bank 1)

DTC P0021 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)

DTC P0022 Camshaft Position "A" - Timing Over-Retarded (Bank 2)

for Preparation Click here

DESCRIPTION

Refer to DTC P0010 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P0011 P0021	Valve timing is not adjusted in valve timing advance range (1 trip detection logic)	• Valve timing • Camshaft Oil Control Valve (OCV) • OCV filter • Camshaft timing gear assembly • ECM
P0012 P0022	Valve timing is not adjusted in valve timing retard range (2 trip detection logic)	

MONITOR DESCRIPTION

The ECM optimizes the intake valve timing using the VVT (Variable Valve Timing) system to control the intake camshaft. The VVT system includes the ECM, the camshaft Oil Control Valve (OCV) and the VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake camshaft.
If the difference between the target and actual intake valve timings is large, and changes in the actual intake valve timing are small, the ECM interprets this as the VVT controller stuck malfunction and stores a DTC.

Example:
A DTC is stored when conditions 1 and 2 are met:

1. It takes 5 seconds or more to change the valve timing by 5°CA.
2. After the above condition 1 is met, the OCV is forcibly activated 63 times or more (when the vehicle is idling, this takes approximately 100 seconds).

DTC P0011 and P0021 (Advanced Cam Timing) are subject to 1 trip detection logic.
DTC P0012 and P0022 (Retarded Cam Timing) are subject to 2 trip detection logic.
These DTCs indicate that the VVT controller cannot operate properly due to OCV malfunctions or the presence of foreign objects in the OCV.

WIRING DIAGRAM

Refer to DTC P0010 (Click here).

INSPECTION PROCEDURE

HINT:

Abnormal Bank	Advanced Timing Over (Valve Timing is Out of Specified Range)	Retarded Timing Over (Valve Timing is Out of Specified Range)
Bank 1	P0011	P0012
Bank 2	P0021	P0022

- **DTC P0011, P0012, P0021 or P0022 may be stored when foreign objects in the engine oil are caught in some parts of the system. The DTC will remain stored even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.**
- **If DTC P0011 or P0012 is output, check the right bank VVT system for the intake camshaft circuit (bank 1).**
- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **If DTC P0021 or P0022 is output, check the left bank VVT system for the intake camshaft circuit (bank 2).**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P0011, P0012, P0021 or P0022	A
P0011, P0012, P0021 or P0022 and other DTCs	B

HINT:

If any DTCs other than P0011, P0012, P0021 or P0022 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1) or Control the VVT System (Bank 2).

e. Check the engine speed while operating the camshaft Oil Control Valve (OCV) using the tester.

OK

Tester Operation	Specified Condition
OCV OFF	Normal engine speed
OCV ON	Engine idles roughly or stalls (soon after OCV switched from OFF to ON)

NG → Go to step 4

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. Drive the vehicle for more than 10 minutes.

g. Read the DTCs using the tester.

OK:
No DTC output.

NG → Go to step 4

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

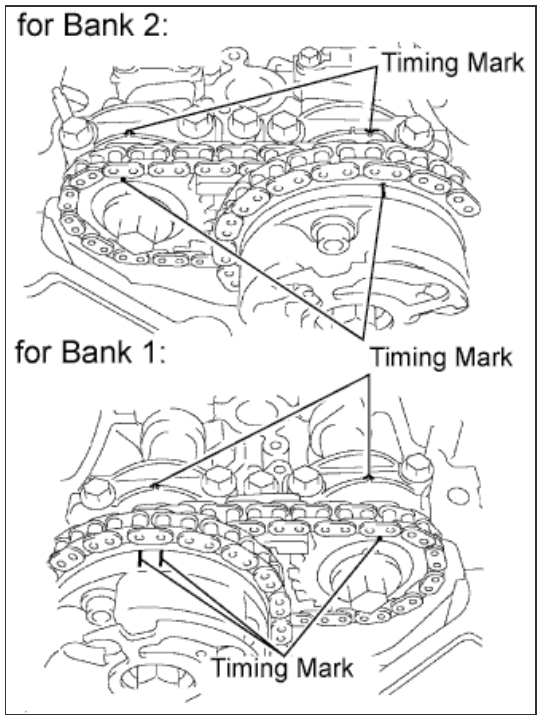
4.CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMPED TEETH ON TIMING CHAIN)

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → ADJUST VALVE TIMING (Click here)

OK

5.INSPECT CAMSHAFT OIL CONTROL VALVE ASSEMBLY

a. Remove the OCV (Click here).

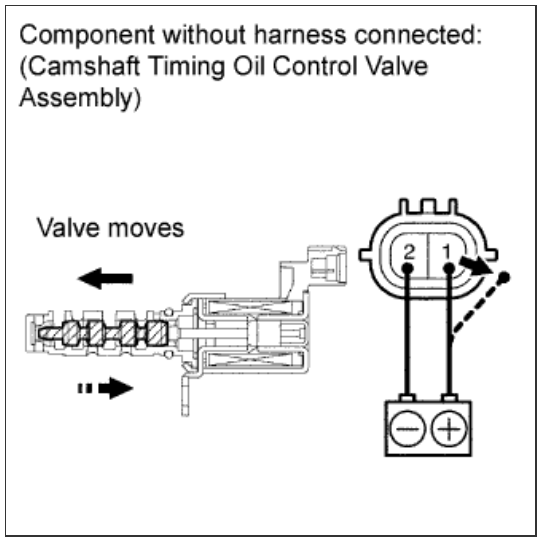
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

c. Apply positive battery voltage to terminal 1 and negative battery voltage to terminal 2. Check the valve operation.

OK:
Valve moves quickly.



NG → REPLACE CAMSHAFT OIL CONTROL VALVE ASSEMBLY (Click here)

OK

6.INSPECT OIL CONTROL VALVE FILTER

a. Remove the oil control valve filter (Click here).

b. Check that the filter is not clogged.

OK:
Filter is not clogged.

NG → CLEAN OIL CONTROL VALVE FILTER

OK

7.REPLACE CAMSHAFT TIMING GEAR ASSEMBLY

a. Replace the camshaft timing gear assembly (Click here).

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. Drive the vehicle for more than 10 minutes.

g. Read output DTCs using the tester.

OK:
No DTC output.

HINT:

DTC P0011, P0012, P0021 or P0022 is output when foreign objects in engine oil are caught in some parts of the system. These codes will stay stored even if the system returns to normal after a short time. These foreign objects are then captured by the oil filter, thus eliminating the source of the problem.

NG → REPLACE ECM (**Click here**)

OK

SYSTEM OK

DTC P0340 Camshaft Position Sensor Circuit Malfunction

DTC P0342 Camshaft Position Sensor "A" Circuit Low Input (Bank 1 or Single Sensor)

DTC P0343 Camshaft Position Sensor "A" Circuit High Input (Bank 1 or Single Sensor)

DTC P0345 Camshaft Position Sensor "A" Circuit (Bank 2)

DTC P0347 Camshaft Position Sensor "A" Circuit Low Input (Bank 2)

DTC P0348 Camshaft Position Sensor "A" Circuit High Input (Bank 2)

for Preparation Click here

DESCRIPTION

The Variable Valve Timing (VVT) sensor (VV1, 2 signal) of the intake camshaft consists of a magnet and MRE (Magnetic Resistance Element).
The VVT camshaft drive gear has a sensor plate with 3 teeth on its outer circumference. When the gear rotates, changes occur in the air gaps between the sensor plate and MRE, which affects the magnetic field. As a result, the resistance of the MRE material fluctuates. The VVT sensor converts the gear rotation data to pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM.
The crankshaft angle sensor plate has 34 teeth. The pickup coil generates 34 signals for each revolution. Based on a combination of the VVT signal and NE signal, the ECM detects the crankshaft angle. Then the ECM uses this data to control fuel injection time and injection timing. Also, based on the NE signal, the ECM detects the engine speed.

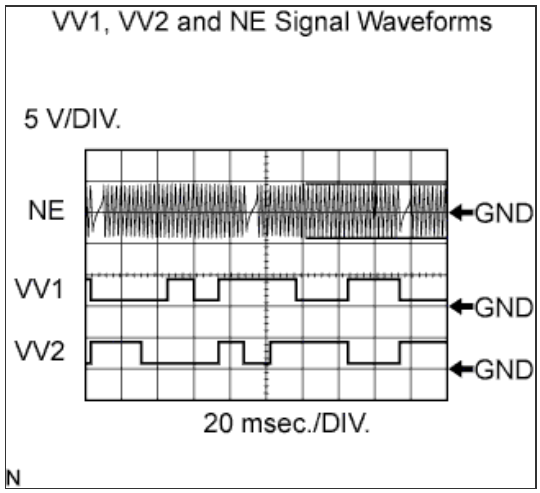
DTC Code	DTC Detection Condition	Trouble Area
P0340 P0345	When either condition below is met: • The input voltage to the ECM remains below 0.3 V or higher than 4.7 V for 4 seconds when 2 or more seconds have elapsed after turning the ignition switch ON (1 trip detection logic). • No VVT sensor signal is sent to the ECM during cranking (2 trip detection logic).	• Open or short in VVT sensor circuit • VVT sensor • Camshaft timing gear assembly • Jumped tooth of timing chain • ECM
P0342 P0347	The output voltage of the VVT sensor is below 0.3 V for 4 seconds (1 trip detection logic).	
P0343 P0348	The output voltage of the VVT sensor is higher than 4.7 V for 4 seconds (1 trip detection logic).	

Reference: Inspection using an oscilloscope

HINT:

- **The correct waveform is as shown.**
- **VV1+ and VV2+ stand for the VVT sensor signal, and NE+ stands for the CKP sensor signal.**

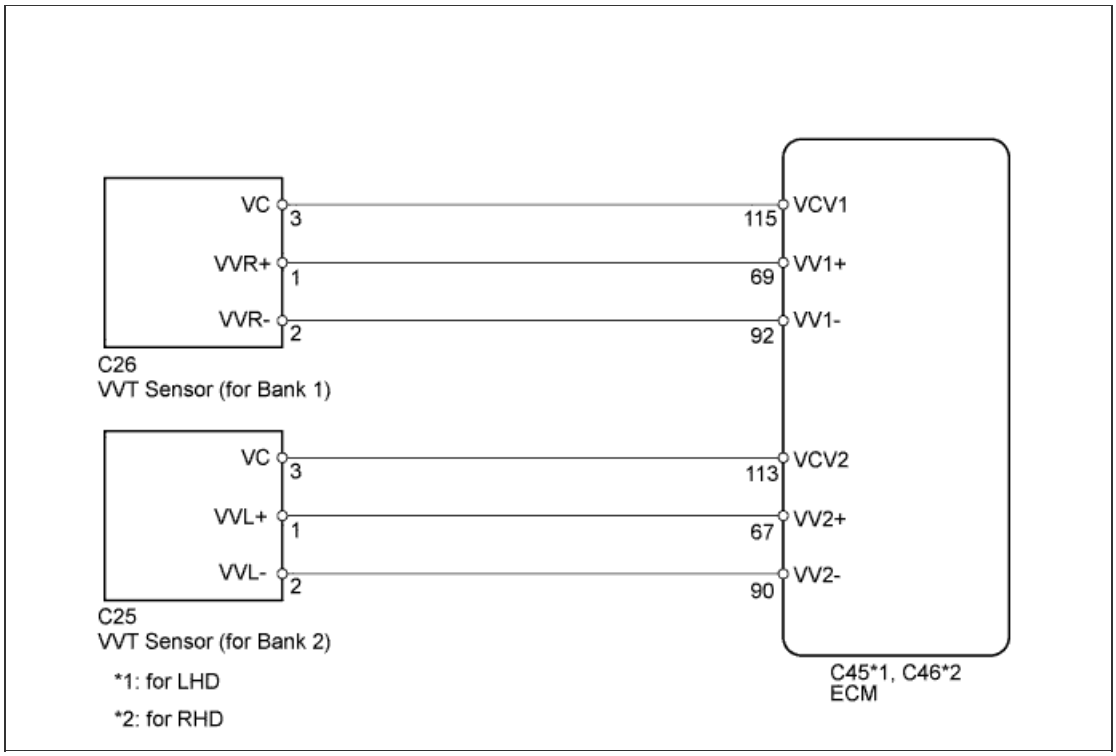
Item	Content
Terminal	NE+ - NE- VV1+ - VV1- VV2+ - VV2-
Equipment Setting	5 V/DIV. 20 msec./DIV.
Condition	Cranking or idling



MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine running, or the rotations of the camshaft and the crankshaft are not synchronized, the ECM interprets this as a malfunction of the sensor.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

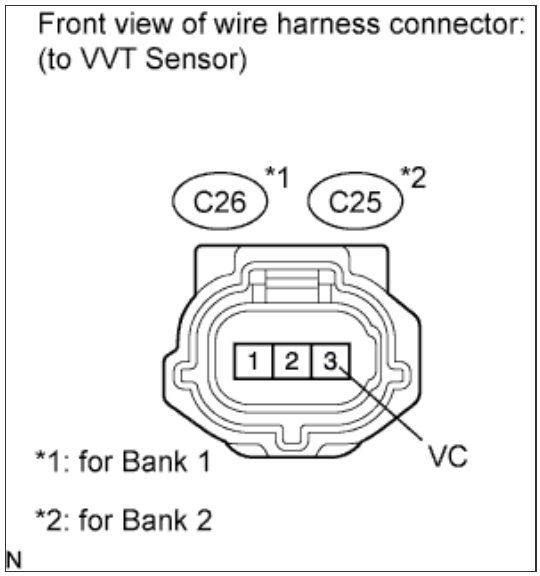
1.CHECK VVT SENSOR (SENSOR POWER SOURCE)

a. Disconnect the VVT sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
C25-3 (VC) - Body ground	Always	4.5 to 5.0 V
C26-3 (VC) - Body ground	Always	4.5 to 5.0 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

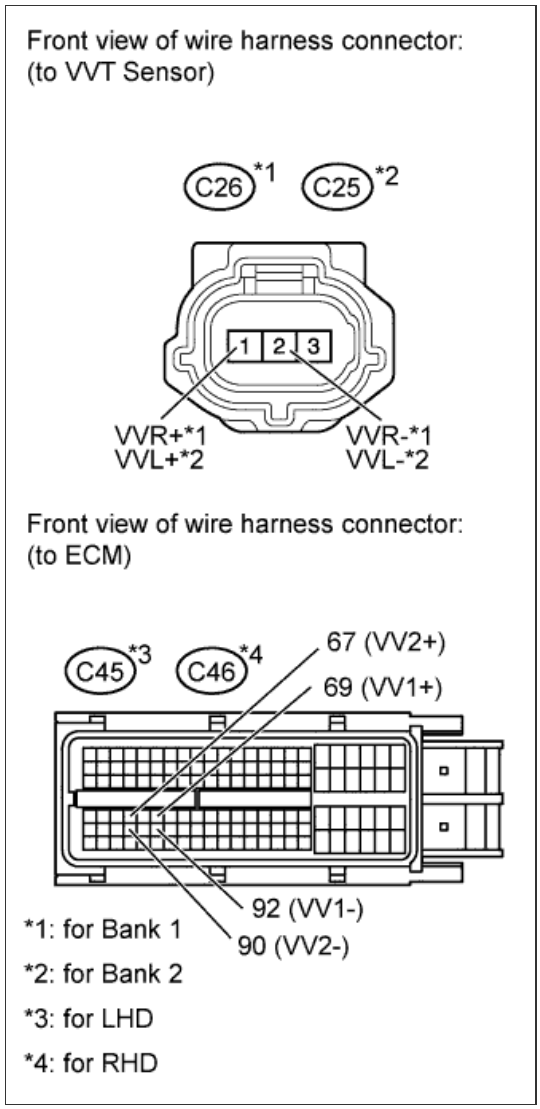
OK

2.CHECK HARNESS AND CONNECTOR (VVT SENSOR - ECM)

a. Disconnect the VVT sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C26-1 (VVR+) - C45-69 (VV1+)	Always	Below 1 Ω
C26-2 (VVR-) - C45-92 (VV1-)	Always	Below 1 Ω
C25-1 (VVL+) - C45-67 (VV2+)	Always	Below 1 Ω
C25-2 (VVL-) - C45-90 (VV2-)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C26-1 (VVR+) - C46-69 (VV1+)	Always	Below 1 Ω
C26-2 (VVR-) - C46-92 (VV1-)	Always	Below 1 Ω
C25-1 (VVL+) - C46-67 (VV2+)	Always	Below 1 Ω
C25-2 (VVL-) - C46-90 (VV2-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition

C26-1 (VVR+) or C45-69 (VV1+) - Body ground	Always	10 kΩ or higher
C26-2 (VVR-) or C45-92 (VV1-) - Body ground	Always	10 kΩ or higher
C25-1 (VVL+) or C45-67 (VV2+) - Body ground	Always	10 kΩ or higher
C25-2 (VVL-) or C45-90 (VV2-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C26-1 (VVR+) or C46-69 (VV1+) - Body ground	Always	10 kΩ or higher
C26-2 (VVR-) or C46-92 (VV1-) - Body ground	Always	10 kΩ or higher
C25-1 (VVL+) or C46-67 (VV2+) - Body ground	Always	10 kΩ or higher
C25-2 (VVL-) or C46-90 (VV2-) - Body ground	Always	10 kΩ or higher

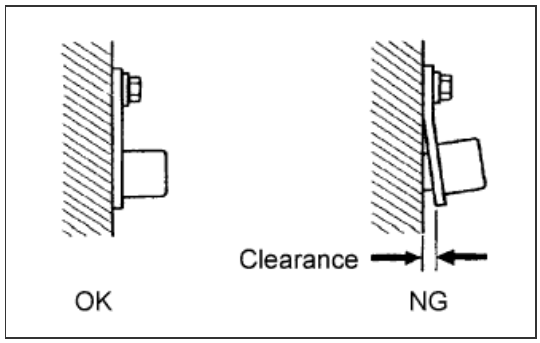
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK SENSOR INSTALLATION

a. Check the VVT sensor installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

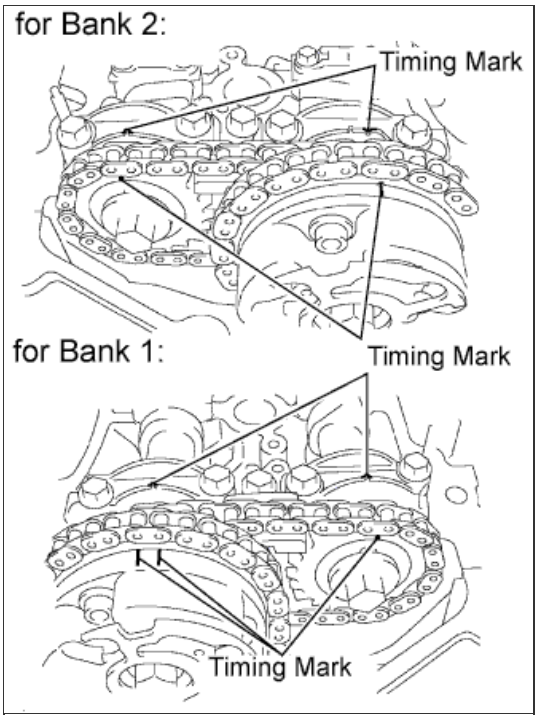
4.CHECK VALVE TIMING

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → ADJUST VALVE TIMING (Click here)

OK

5.CHECK CAMSHAFT TIMING GEAR ASSEMBLY (TEETH OF PLATE)

a. Check the teeth of the signal plate.

OK:
Sensor plate teeth do not have any cracks or deformation.

NG → REPLACE CAMSHAFT TIMING GEAR ASSEMBLY (Click here)

OK

6.REPLACE VVT SENSOR

a. Replace the VVT sensor (Click here).

NEXT

7.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read the DTCs.

Result

Result	Proceed to
No output	A
P0340, P0342, P0343, P0345, P0347 or P0348	B

HINT:

If the engine does not start, replace the ECM.

B	REPLACE ECM (Click here)

A

END

DTC P0011 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)

DTC P0012 Camshaft Position "A" - Timing Over-Retarded (Bank 1)

DTC P0021 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)

DTC P0022 Camshaft Position "A" - Timing Over-Retarded (Bank 2)

for Preparation Click here

DESCRIPTION

Refer to DTC P0010 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P0011 P0021	Valve timing is not adjusted in valve timing advance range (1 trip detection logic)	• Valve timing • Camshaft Oil Control Valve (OCV) • OCV filter • Camshaft timing gear assembly • ECM
P0012 P0022	Valve timing is not adjusted in valve timing retard range (2 trip detection logic)	

MONITOR DESCRIPTION

The ECM optimizes the intake valve timing using the VVT (Variable Valve Timing) system to control the intake camshaft. The VVT system includes the ECM, the camshaft Oil Control Valve (OCV) and the VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake camshaft.
If the difference between the target and actual intake valve timings is large, and changes in the actual intake valve timing are small, the ECM interprets this as the VVT controller stuck malfunction and stores a DTC.

Example:
A DTC is stored when conditions 1 and 2 are met:

1. It takes 5 seconds or more to change the valve timing by 5°CA.
2. After the above condition 1 is met, the OCV is forcibly activated 63 times or more (when the vehicle is idling, this takes approximately 100 seconds).

DTC P0011 and P0021 (Advanced Cam Timing) are subject to 1 trip detection logic.
DTC P0012 and P0022 (Retarded Cam Timing) are subject to 2 trip detection logic.
These DTCs indicate that the VVT controller cannot operate properly due to OCV malfunctions or the presence of foreign objects in the OCV.

WIRING DIAGRAM

Refer to DTC P0010 (Click here).

INSPECTION PROCEDURE

HINT:

Abnormal Bank	Advanced Timing Over (Valve Timing is Out of Specified Range)	Retarded Timing Over (Valve Timing is Out of Specified Range)
Bank 1	P0011	P0012
Bank 2	P0021	P0022

- **DTC P0011, P0012, P0021 or P0022 may be stored when foreign objects in the engine oil are caught in some parts of the system. The DTC will remain stored even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.**
- **If DTC P0011 or P0012 is output, check the right bank VVT system for the intake camshaft circuit (bank 1).**
- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **If DTC P0021 or P0022 is output, check the left bank VVT system for the intake camshaft circuit (bank 2).**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P0011, P0012, P0021 or P0022	A
P0011, P0012, P0021 or P0022 and other DTCs	B

HINT:

If any DTCs other than P0011, P0012, P0021 or P0022 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1) or Control the VVT System (Bank 2).

e. Check the engine speed while operating the camshaft Oil Control Valve (OCV) using the tester.

OK

Tester Operation	Specified Condition
OCV OFF	Normal engine speed
OCV ON	Engine idles roughly or stalls (soon after OCV switched from OFF to ON)

NG → Go to step 4

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. Drive the vehicle for more than 10 minutes.

g. Read the DTCs using the tester.

OK:
No DTC output.

NG → Go to step 4

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

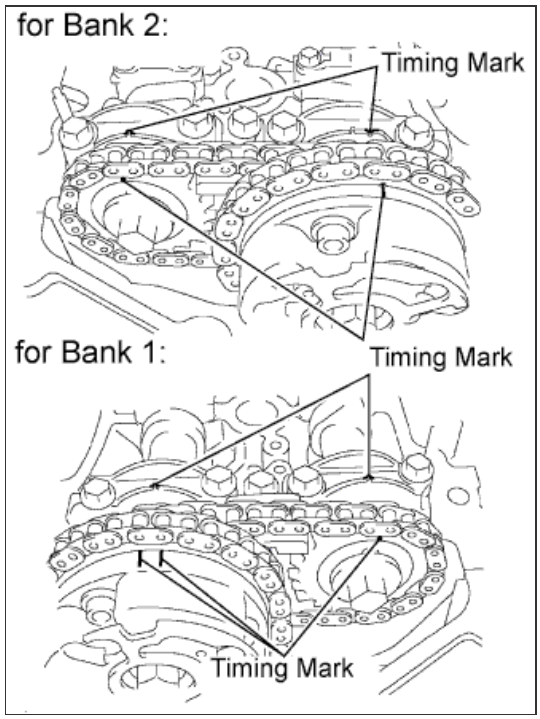
4.CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMPED TEETH ON TIMING CHAIN)

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → ADJUST VALVE TIMING (Click here)

OK

5.INSPECT CAMSHAFT OIL CONTROL VALVE ASSEMBLY

a. Remove the OCV (Click here).

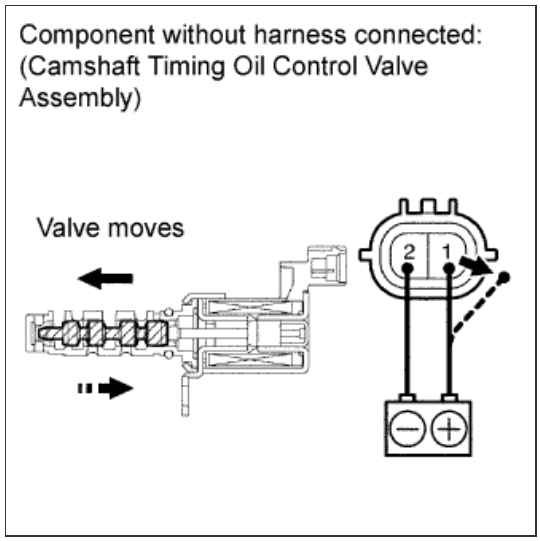
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

c. Apply positive battery voltage to terminal 1 and negative battery voltage to terminal 2. Check the valve operation.

OK:
Valve moves quickly.



NG → REPLACE CAMSHAFT OIL CONTROL VALVE ASSEMBLY (Click here)

OK

6.INSPECT OIL CONTROL VALVE FILTER

a. Remove the oil control valve filter (Click here).

b. Check that the filter is not clogged.

OK:
Filter is not clogged.

NG → CLEAN OIL CONTROL VALVE FILTER

OK

7.REPLACE CAMSHAFT TIMING GEAR ASSEMBLY

a. Replace the camshaft timing gear assembly (Click here).

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. Drive the vehicle for more than 10 minutes.

g. Read output DTCs using the tester.

OK:
No DTC output.

HINT:

DTC P0011, P0012, P0021 or P0022 is output when foreign objects in engine oil are caught in some parts of the system. These codes will stay stored even if the system returns to normal after a short time. These foreign objects are then captured by the oil filter, thus eliminating the source of the problem.

NG → REPLACE ECM (**Click here**)

OK

SYSTEM OK

DTC P0340 Camshaft Position Sensor Circuit Malfunction

DTC P0342 Camshaft Position Sensor "A" Circuit Low Input (Bank 1 or Single Sensor)

DTC P0343 Camshaft Position Sensor "A" Circuit High Input (Bank 1 or Single Sensor)

DTC P0345 Camshaft Position Sensor "A" Circuit (Bank 2)

DTC P0347 Camshaft Position Sensor "A" Circuit Low Input (Bank 2)

DTC P0348 Camshaft Position Sensor "A" Circuit High Input (Bank 2)

for Preparation Click here

DESCRIPTION

The Variable Valve Timing (VVT) sensor (VV1, 2 signal) of the intake camshaft consists of a magnet and MRE (Magnetic Resistance Element).
The VVT camshaft drive gear has a sensor plate with 3 teeth on its outer circumference. When the gear rotates, changes occur in the air gaps between the sensor plate and MRE, which affects the magnetic field. As a result, the resistance of the MRE material fluctuates. The VVT sensor converts the gear rotation data to pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM.
The crankshaft angle sensor plate has 34 teeth. The pickup coil generates 34 signals for each revolution. Based on a combination of the VVT signal and NE signal, the ECM detects the crankshaft angle. Then the ECM uses this data to control fuel injection time and injection timing. Also, based on the NE signal, the ECM detects the engine speed.

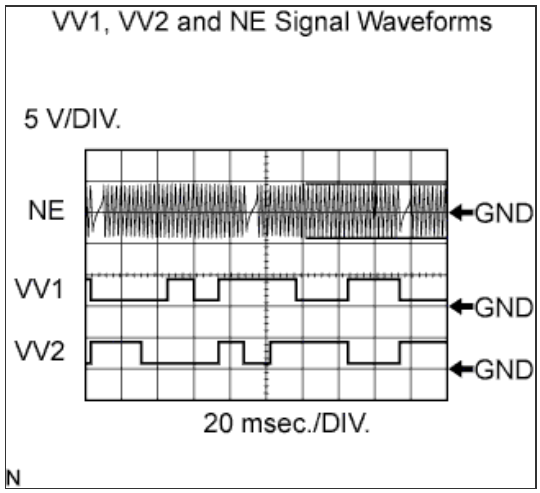
DTC Code	DTC Detection Condition	Trouble Area
P0340 P0345	When either condition below is met: • The input voltage to the ECM remains below 0.3 V or higher than 4.7 V for 4 seconds when 2 or more seconds have elapsed after turning the ignition switch ON (1 trip detection logic). • No VVT sensor signal is sent to the ECM during cranking (2 trip detection logic).	• Open or short in VVT sensor circuit • VVT sensor • Camshaft timing gear assembly • Jumped tooth of timing chain • ECM
P0342 P0347	The output voltage of the VVT sensor is below 0.3 V for 4 seconds (1 trip detection logic).	
P0343 P0348	The output voltage of the VVT sensor is higher than 4.7 V for 4 seconds (1 trip detection logic).	

Reference: Inspection using an oscilloscope

HINT:

- **The correct waveform is as shown.**
- **VV1+ and VV2+ stand for the VVT sensor signal, and NE+ stands for the CKP sensor signal.**

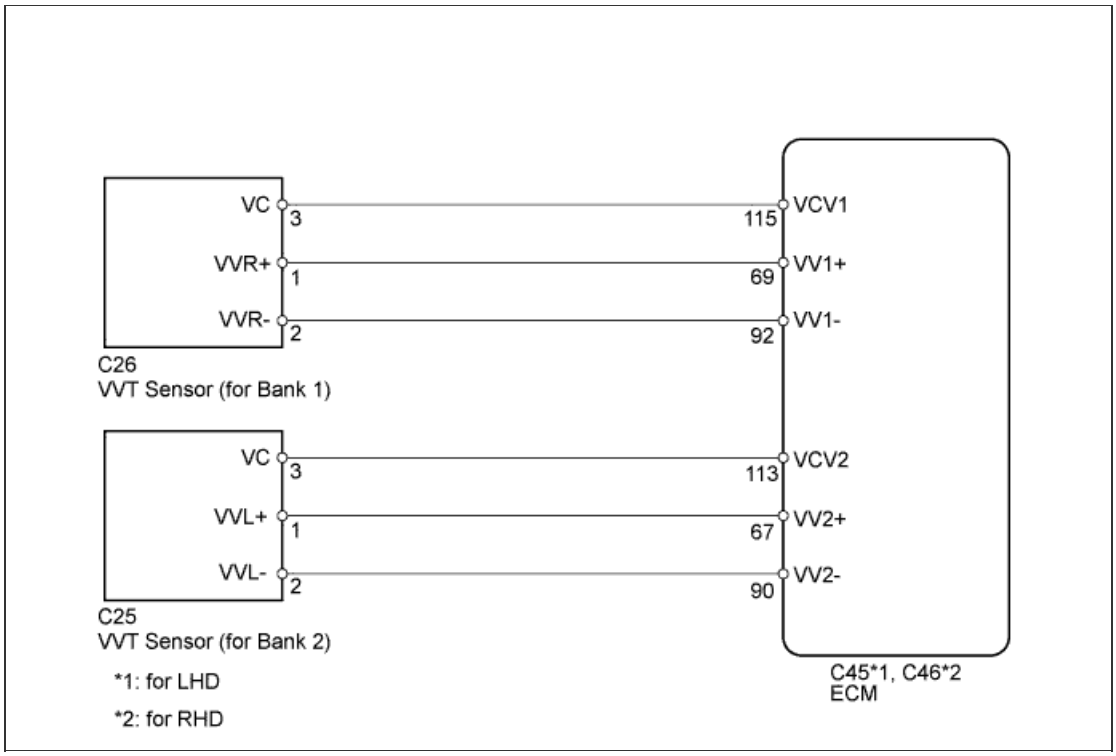
Item	Content
Terminal	NE+ - NE- VV1+ - VV1- VV2+ - VV2-
Equipment Setting	5 V/DIV. 20 msec./DIV.
Condition	Cranking or idling



MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine running, or the rotations of the camshaft and the crankshaft are not synchronized, the ECM interprets this as a malfunction of the sensor.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

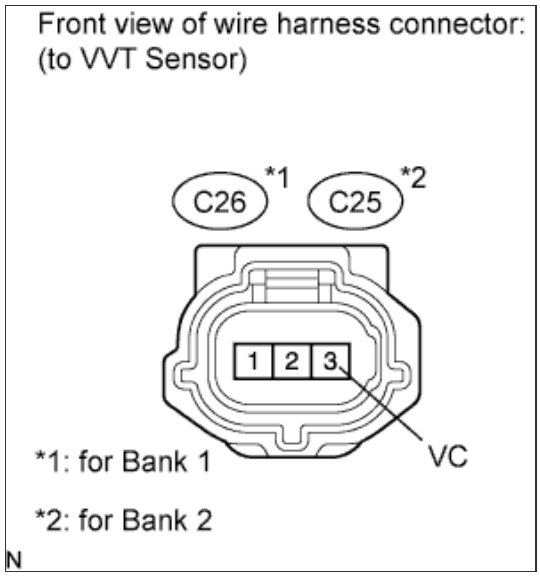
1.CHECK VVT SENSOR (SENSOR POWER SOURCE)

a. Disconnect the VVT sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
C25-3 (VC) - Body ground	Always	4.5 to 5.0 V
C26-3 (VC) - Body ground	Always	4.5 to 5.0 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

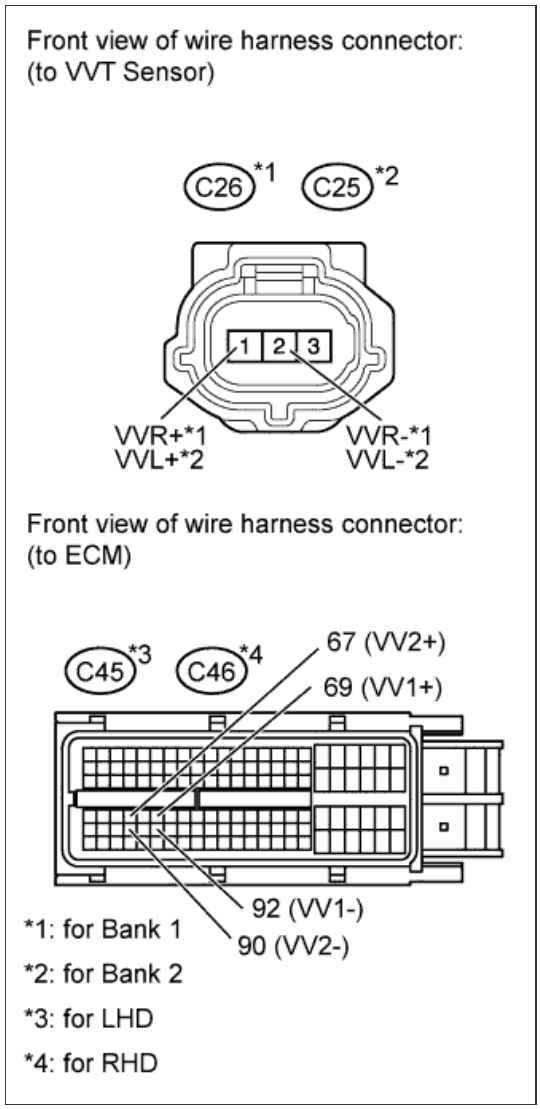
OK

2.CHECK HARNESS AND CONNECTOR (VVT SENSOR - ECM)

a. Disconnect the VVT sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C26-1 (VVR+) - C45-69 (VV1+)	Always	Below 1 Ω
C26-2 (VVR-) - C45-92 (VV1-)	Always	Below 1 Ω
C25-1 (VVL+) - C45-67 (VV2+)	Always	Below 1 Ω
C25-2 (VVL-) - C45-90 (VV2-)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C26-1 (VVR+) - C46-69 (VV1+)	Always	Below 1 Ω
C26-2 (VVR-) - C46-92 (VV1-)	Always	Below 1 Ω
C25-1 (VVL+) - C46-67 (VV2+)	Always	Below 1 Ω
C25-2 (VVL-) - C46-90 (VV2-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition

C26-1 (VVR+) or C45-69 (VV1+) - Body ground	Always	10 kΩ or higher
C26-2 (VVR-) or C45-92 (VV1-) - Body ground	Always	10 kΩ or higher
C25-1 (VVL+) or C45-67 (VV2+) - Body ground	Always	10 kΩ or higher
C25-2 (VVL-) or C45-90 (VV2-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C26-1 (VVR+) or C46-69 (VV1+) - Body ground	Always	10 kΩ or higher
C26-2 (VVR-) or C46-92 (VV1-) - Body ground	Always	10 kΩ or higher
C25-1 (VVL+) or C46-67 (VV2+) - Body ground	Always	10 kΩ or higher
C25-2 (VVL-) or C46-90 (VV2-) - Body ground	Always	10 kΩ or higher

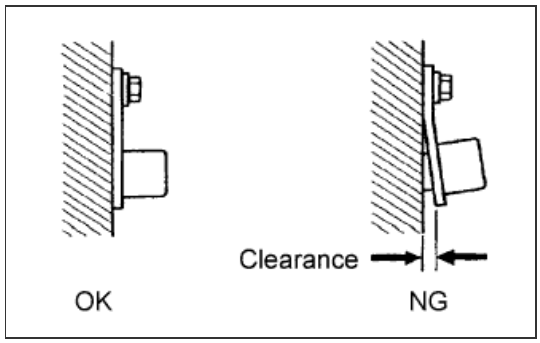
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK SENSOR INSTALLATION

a. Check the VVT sensor installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

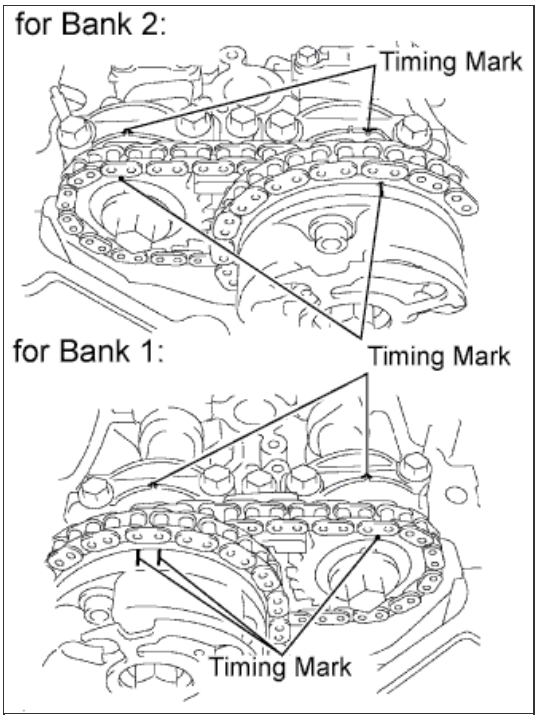
4.CHECK VALVE TIMING

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → ADJUST VALVE TIMING (Click here)

OK

5.CHECK CAMSHAFT TIMING GEAR ASSEMBLY (TEETH OF PLATE)

a. Check the teeth of the signal plate.

OK:
Sensor plate teeth do not have any cracks or deformation.

NG → REPLACE CAMSHAFT TIMING GEAR ASSEMBLY (Click here)

OK

6.REPLACE VVT SENSOR

a. Replace the VVT sensor (Click here).

NEXT

7.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read the DTCs.

Result

Result	Proceed to
No output	A
P0340, P0342, P0343, P0345, P0347 or P0348	B

HINT:

If the engine does not start, replace the ECM.

B	REPLACE ECM (Click here)

A

END

DTC P0011 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)

DTC P0012 Camshaft Position "A" - Timing Over-Retarded (Bank 1)

DTC P0021 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)

DTC P0022 Camshaft Position "A" - Timing Over-Retarded (Bank 2)

for Preparation Click here

DESCRIPTION

Refer to DTC P0010 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P0011 P0021	Valve timing is not adjusted in valve timing advance range (1 trip detection logic)	• Valve timing • Camshaft Oil Control Valve (OCV) • OCV filter • Camshaft timing gear assembly • ECM
P0012 P0022	Valve timing is not adjusted in valve timing retard range (2 trip detection logic)	

MONITOR DESCRIPTION

The ECM optimizes the intake valve timing using the VVT (Variable Valve Timing) system to control the intake camshaft. The VVT system includes the ECM, the camshaft Oil Control Valve (OCV) and the VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake camshaft.
If the difference between the target and actual intake valve timings is large, and changes in the actual intake valve timing are small, the ECM interprets this as the VVT controller stuck malfunction and stores a DTC.

Example:
A DTC is stored when conditions 1 and 2 are met:

1. It takes 5 seconds or more to change the valve timing by 5°CA.
2. After the above condition 1 is met, the OCV is forcibly activated 63 times or more (when the vehicle is idling, this takes approximately 100 seconds).

DTC P0011 and P0021 (Advanced Cam Timing) are subject to 1 trip detection logic.
DTC P0012 and P0022 (Retarded Cam Timing) are subject to 2 trip detection logic.
These DTCs indicate that the VVT controller cannot operate properly due to OCV malfunctions or the presence of foreign objects in the OCV.

WIRING DIAGRAM

Refer to DTC P0010 (Click here).

INSPECTION PROCEDURE

HINT:

Abnormal Bank	Advanced Timing Over (Valve Timing is Out of Specified Range)	Retarded Timing Over (Valve Timing is Out of Specified Range)
Bank 1	P0011	P0012
Bank 2	P0021	P0022

- **DTC P0011, P0012, P0021 or P0022 may be stored when foreign objects in the engine oil are caught in some parts of the system. The DTC will remain stored even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.**
- **If DTC P0011 or P0012 is output, check the right bank VVT system for the intake camshaft circuit (bank 1).**
- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **If DTC P0021 or P0022 is output, check the left bank VVT system for the intake camshaft circuit (bank 2).**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P0011, P0012, P0021 or P0022	A
P0011, P0012, P0021 or P0022 and other DTCs	B

HINT:

If any DTCs other than P0011, P0012, P0021 or P0022 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1) or Control the VVT System (Bank 2).

e. Check the engine speed while operating the camshaft Oil Control Valve (OCV) using the tester.

OK

Tester Operation	Specified Condition
OCV OFF	Normal engine speed
OCV ON	Engine idles roughly or stalls (soon after OCV switched from OFF to ON)

NG → Go to step 4

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. Drive the vehicle for more than 10 minutes.

g. Read the DTCs using the tester.

OK:
No DTC output.

NG → Go to step 4

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

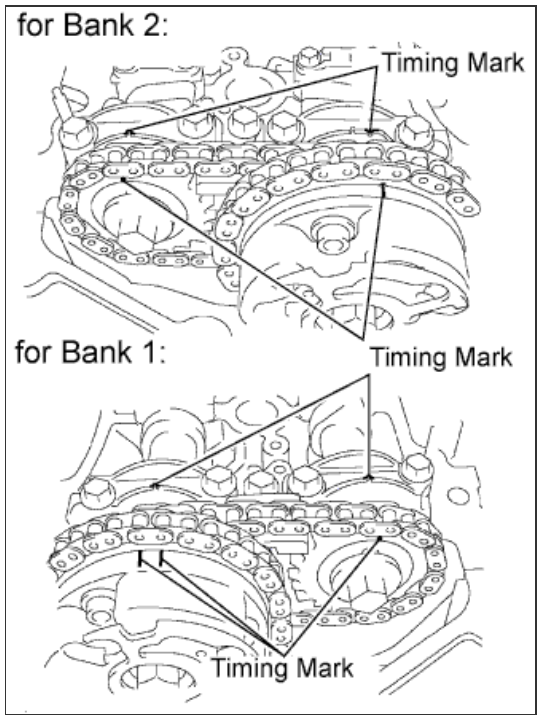
4.CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMPED TEETH ON TIMING CHAIN)

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → ADJUST VALVE TIMING (Click here)

OK

5.INSPECT CAMSHAFT OIL CONTROL VALVE ASSEMBLY

a. Remove the OCV (Click here).

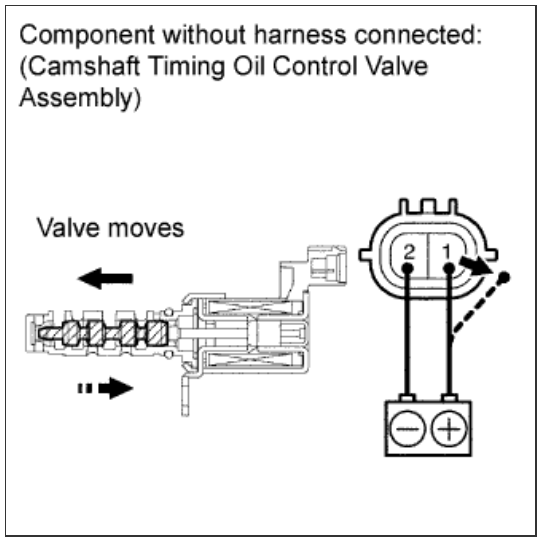
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

c. Apply positive battery voltage to terminal 1 and negative battery voltage to terminal 2. Check the valve operation.

OK:
Valve moves quickly.



NG → REPLACE CAMSHAFT OIL CONTROL VALVE ASSEMBLY (Click here)

OK

6.INSPECT OIL CONTROL VALVE FILTER

a. Remove the oil control valve filter (Click here).

b. Check that the filter is not clogged.

OK:
Filter is not clogged.

NG → CLEAN OIL CONTROL VALVE FILTER

OK

7.REPLACE CAMSHAFT TIMING GEAR ASSEMBLY

a. Replace the camshaft timing gear assembly (Click here).

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. Drive the vehicle for more than 10 minutes.

g. Read output DTCs using the tester.

OK:
No DTC output.

HINT:

DTC P0011, P0012, P0021 or P0022 is output when foreign objects in engine oil are caught in some parts of the system. These codes will stay stored even if the system returns to normal after a short time. These foreign objects are then captured by the oil filter, thus eliminating the source of the problem.

NG → REPLACE ECM (**Click here**)

OK

SYSTEM OK

DTC P0340 Camshaft Position Sensor Circuit Malfunction

DTC P0342 Camshaft Position Sensor "A" Circuit Low Input (Bank 1 or Single Sensor)

DTC P0343 Camshaft Position Sensor "A" Circuit High Input (Bank 1 or Single Sensor)

DTC P0345 Camshaft Position Sensor "A" Circuit (Bank 2)

DTC P0347 Camshaft Position Sensor "A" Circuit Low Input (Bank 2)

DTC P0348 Camshaft Position Sensor "A" Circuit High Input (Bank 2)

for Preparation Click here

DESCRIPTION

The Variable Valve Timing (VVT) sensor (VV1, 2 signal) of the intake camshaft consists of a magnet and MRE (Magnetic Resistance Element).
The VVT camshaft drive gear has a sensor plate with 3 teeth on its outer circumference. When the gear rotates, changes occur in the air gaps between the sensor plate and MRE, which affects the magnetic field. As a result, the resistance of the MRE material fluctuates. The VVT sensor converts the gear rotation data to pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM.
The crankshaft angle sensor plate has 34 teeth. The pickup coil generates 34 signals for each revolution. Based on a combination of the VVT signal and NE signal, the ECM detects the crankshaft angle. Then the ECM uses this data to control fuel injection time and injection timing. Also, based on the NE signal, the ECM detects the engine speed.

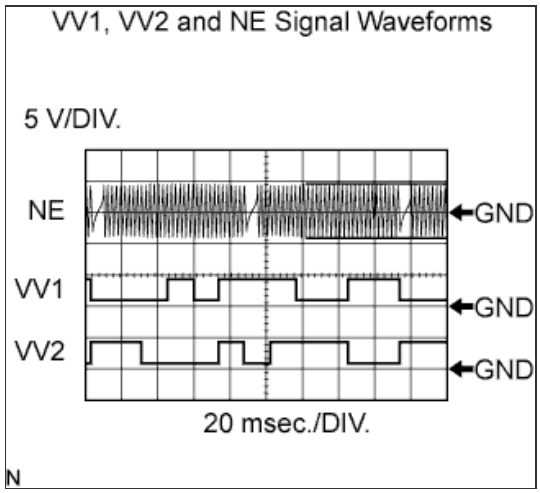
DTC Code	DTC Detection Condition	Trouble Area
P0340 P0345	When either condition below is met: • The input voltage to the ECM remains below 0.3 V or higher than 4.7 V for 4 seconds when 2 or more seconds have elapsed after turning the ignition switch ON (1 trip detection logic). • No VVT sensor signal is sent to the ECM during cranking (2 trip detection logic).	• Open or short in VVT sensor circuit • VVT sensor • Camshaft timing gear assembly • Jumped tooth of timing chain • ECM
P0342 P0347	The output voltage of the VVT sensor is below 0.3 V for 4 seconds (1 trip detection logic).	
P0343 P0348	The output voltage of the VVT sensor is higher than 4.7 V for 4 seconds (1 trip detection logic).	

Reference: Inspection using an oscilloscope

HINT:

- **The correct waveform is as shown.**
- **VV1+ and VV2+ stand for the VVT sensor signal, and NE+ stands for the CKP sensor signal.**

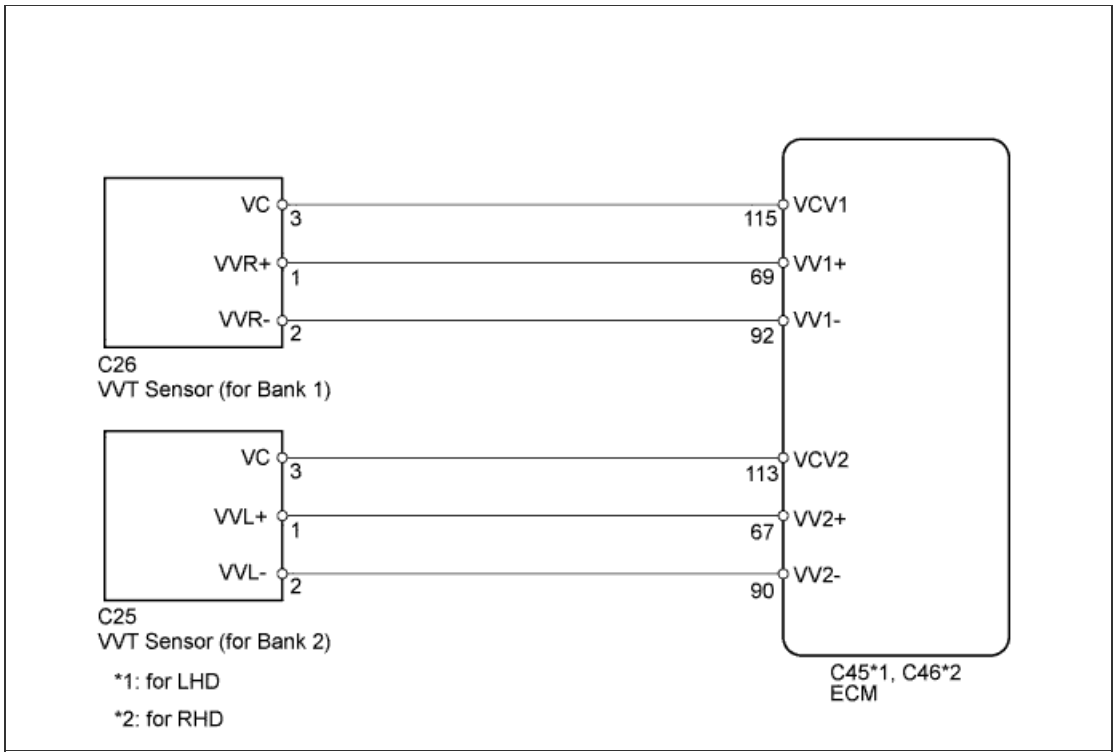
Item	Content
Terminal	NE+ - NE- VV1+ - VV1- VV2+ - VV2-
Equipment Setting	5 V/DIV. 20 msec./DIV.
Condition	Cranking or idling



MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine running, or the rotations of the camshaft and the crankshaft are not synchronized, the ECM interprets this as a malfunction of the sensor.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

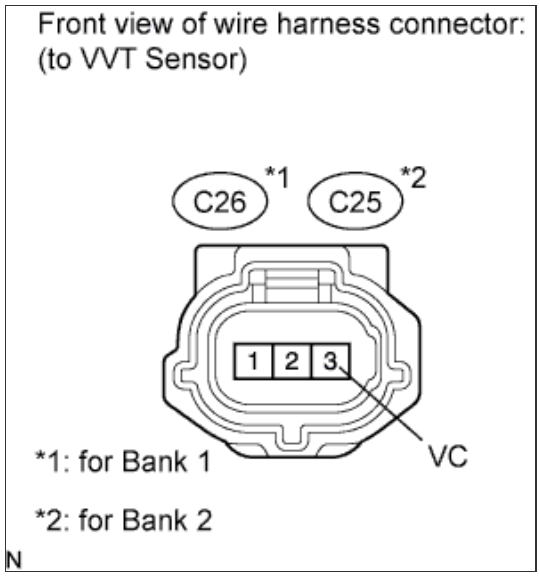
1.CHECK VVT SENSOR (SENSOR POWER SOURCE)

a. Disconnect the VVT sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
C25-3 (VC) - Body ground	Always	4.5 to 5.0 V
C26-3 (VC) - Body ground	Always	4.5 to 5.0 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

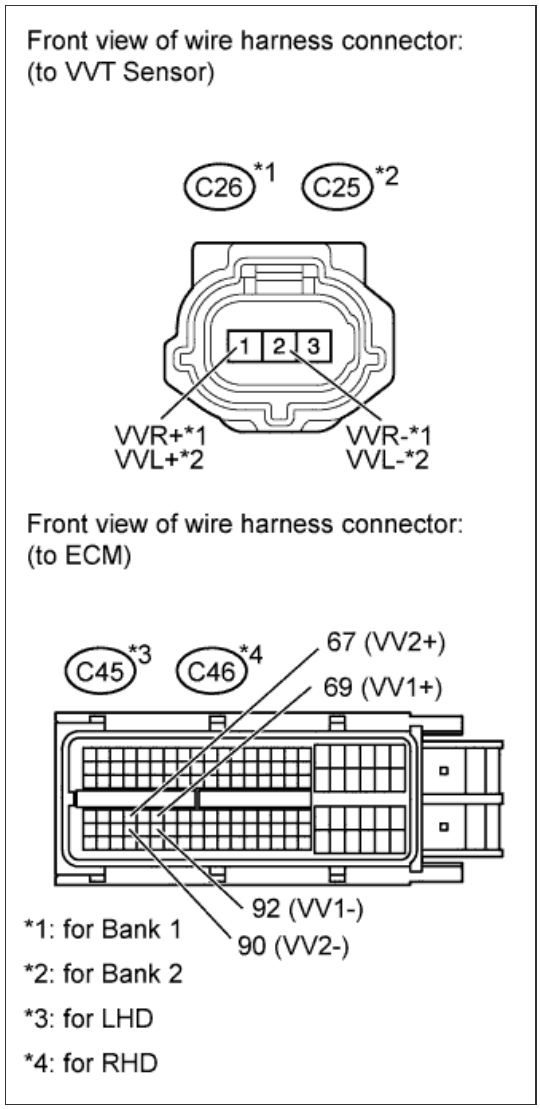
OK

2.CHECK HARNESS AND CONNECTOR (VVT SENSOR - ECM)

a. Disconnect the VVT sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C26-1 (VVR+) - C45-69 (VV1+)	Always	Below 1 Ω
C26-2 (VVR-) - C45-92 (VV1-)	Always	Below 1 Ω
C25-1 (VVL+) - C45-67 (VV2+)	Always	Below 1 Ω
C25-2 (VVL-) - C45-90 (VV2-)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C26-1 (VVR+) - C46-69 (VV1+)	Always	Below 1 Ω
C26-2 (VVR-) - C46-92 (VV1-)	Always	Below 1 Ω
C25-1 (VVL+) - C46-67 (VV2+)	Always	Below 1 Ω
C25-2 (VVL-) - C46-90 (VV2-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition

C26-1 (VVR+) or C45-69 (VV1+) - Body ground	Always	10 kΩ or higher
C26-2 (VVR-) or C45-92 (VV1-) - Body ground	Always	10 kΩ or higher
C25-1 (VVL+) or C45-67 (VV2+) - Body ground	Always	10 kΩ or higher
C25-2 (VVL-) or C45-90 (VV2-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C26-1 (VVR+) or C46-69 (VV1+) - Body ground	Always	10 kΩ or higher
C26-2 (VVR-) or C46-92 (VV1-) - Body ground	Always	10 kΩ or higher
C25-1 (VVL+) or C46-67 (VV2+) - Body ground	Always	10 kΩ or higher
C25-2 (VVL-) or C46-90 (VV2-) - Body ground	Always	10 kΩ or higher

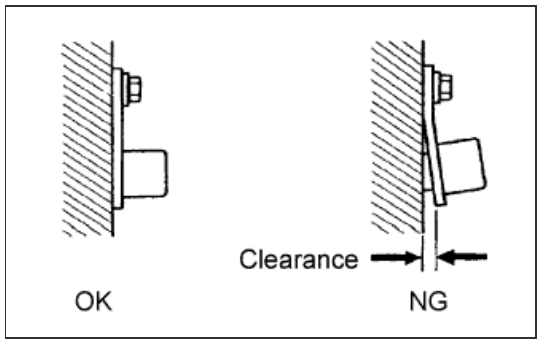
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK SENSOR INSTALLATION

a. Check the VVT sensor installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

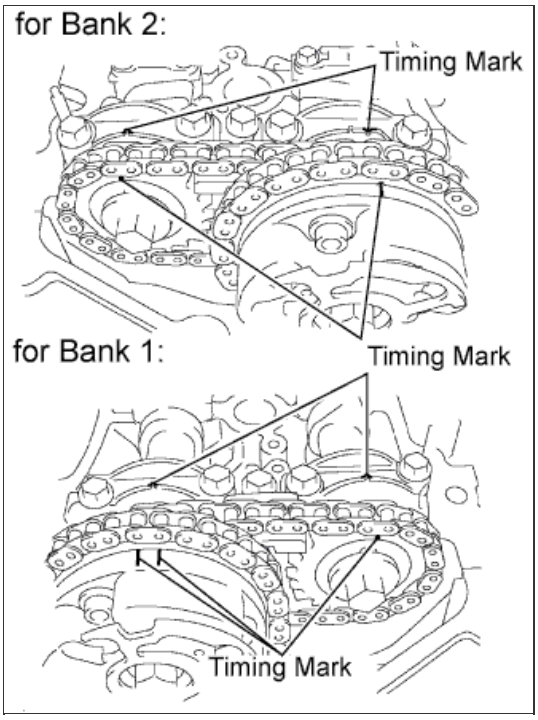
4.CHECK VALVE TIMING

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → ADJUST VALVE TIMING (Click here)

OK

5.CHECK CAMSHAFT TIMING GEAR ASSEMBLY (TEETH OF PLATE)

a. Check the teeth of the signal plate.

OK:
Sensor plate teeth do not have any cracks or deformation.

NG → REPLACE CAMSHAFT TIMING GEAR ASSEMBLY (Click here)

OK

6.REPLACE VVT SENSOR

a. Replace the VVT sensor (Click here).

NEXT

7.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read the DTCs.

Result

Result	Proceed to
No output	A
P0340, P0342, P0343, P0345, P0347 or P0348	B

HINT:

If the engine does not start, replace the ECM.

B	REPLACE ECM (Click here)

A

END

DTC P0016 Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)

DTC P0018 Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor A)

for Preparation Click here

DESCRIPTION

Refer to DTC P0335 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P0016	Deviations in the crankshaft and camshaft position sensor 1 signals (2 trip detection logic).	• Mechanical system (Timing chain has jumped tooth or chain stretched) • Camshaft Oil Control Valve (OCV) • OCV filter • Camshaft timing gear assembly • ECM
P0018	Deviations in the crankshaft and camshaft position sensor 2 signals (2 trip detection logic).	

MONITOR DESCRIPTION

The ECM optimizes the valve timing by using the VVT (Variable Valve Timing) system to control the intake camshaft. The VVT system includes the ECM, the camshaft Oil Control Valve (OCV) and the VVT controller.
The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake camshaft. The ECM calibrates the intake valve timing by setting the intake camshaft to the most retarded angle while the engine is idling. The ECM closes the OCV to retard the cam. The ECM stores this value as the VVT learning value. When the difference between the target and actual intake valve timings is 5°CA (Crankshaft Angle) or less, the ECM stores it.
If the VVT learning value matches the following conditions, the ECM determines the existence of a malfunction in the VVT system, and stores the DTC.

- VVT learning value: Less than 22.5°CA, or more than 45.2°CA.
- The above condition continues for 18 seconds or more.

This DTC indicates that the intake camshaft has been installed toward the crankshaft at an incorrect angle, caused by factors such as the timing chain having jumped a tooth.
This monitor begins to run after the engine has idled for 5 minutes.

WIRING DIAGRAM

Refer to DTC P0335 (Click here).
Refer to DTC P0340 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0016, P0017, P0018 OR P0019)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P0016, P0018	A
P0016, P0018 and other DTCs	B

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1) or Control the VVT System (Bank 2).

e. Check the engine speed while operating the camshaft Oil Control Valve (OCV) using the tester.

OK

Tester Operation	Specified Condition
OCV OFF	Normal engine speed
OCV ON	Engine idles roughly or stalls (soon after OCV switched from OFF to ON)

NG → **Go to step 4**

OK

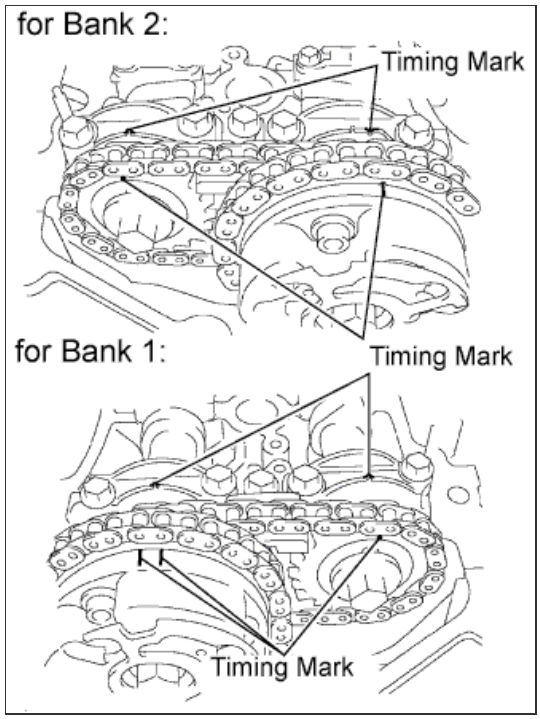
3.ADJUST VALVE TIMING

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NEXT → **Go to step 7**

4.INSPECT CAMSHAFT OIL CONTROL VALVE ASSEMBLY

a. Remove the OCV (Click here).

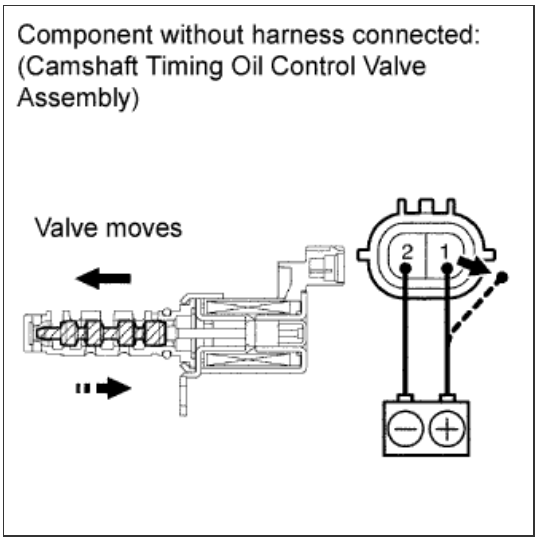
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

c. Apply positive battery voltage to terminal 1 and negative battery voltage to terminal 2. Check the valve operation.

OK:
Valve moves quickly.



NG → REPLACE CAMSHAFT OIL CONTROL VALVE ASSEMBLY (Click here)

OK

5.INSPECT OIL CONTROL VALVE FILTER

a. Remove the OCV filter (Click here).

b. Check that the filter is not clogged.

OK:
Filter is not clogged.

NG → CLEAN OIL CONTROL VALVE FILTER

OK

6.REPLACE CAMSHAFT TIMING GEAR ASSEMBLY

a. Replace the camshaft timing gear assembly (Click here).

NEXT

7.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. In order to clear the ECM learned values for valve timing, disconnect the cable from the negative (-) battery terminal for 1 minute.

b. Connect the cable to the negative (-) battery terminal.

c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Clear the DTCs (Click here).

f. Start the engine and idle it for 5 minutes.

g. Drive the vehicle in an urban area for approximately 10 minutes.

h. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

i. Read the DTCs.

Result:
DTCs are not output.

NG → REPLACE ECM (Click here)


OK
END

DTC P0351 Ignition Coil "A" Primary / Secondary Circuit

DTC P0352 Ignition Coil "B" Primary / Secondary Circuit

DTC P0353 Ignition Coil "C" Primary / Secondary Circuit

DTC P0354 Ignition Coil "D" Primary / Secondary Circuit

DTC P0355 Ignition Coil "E" Primary / Secondary Circuit

DTC P0356 Ignition Coil "F" Primary / Secondary Circuit

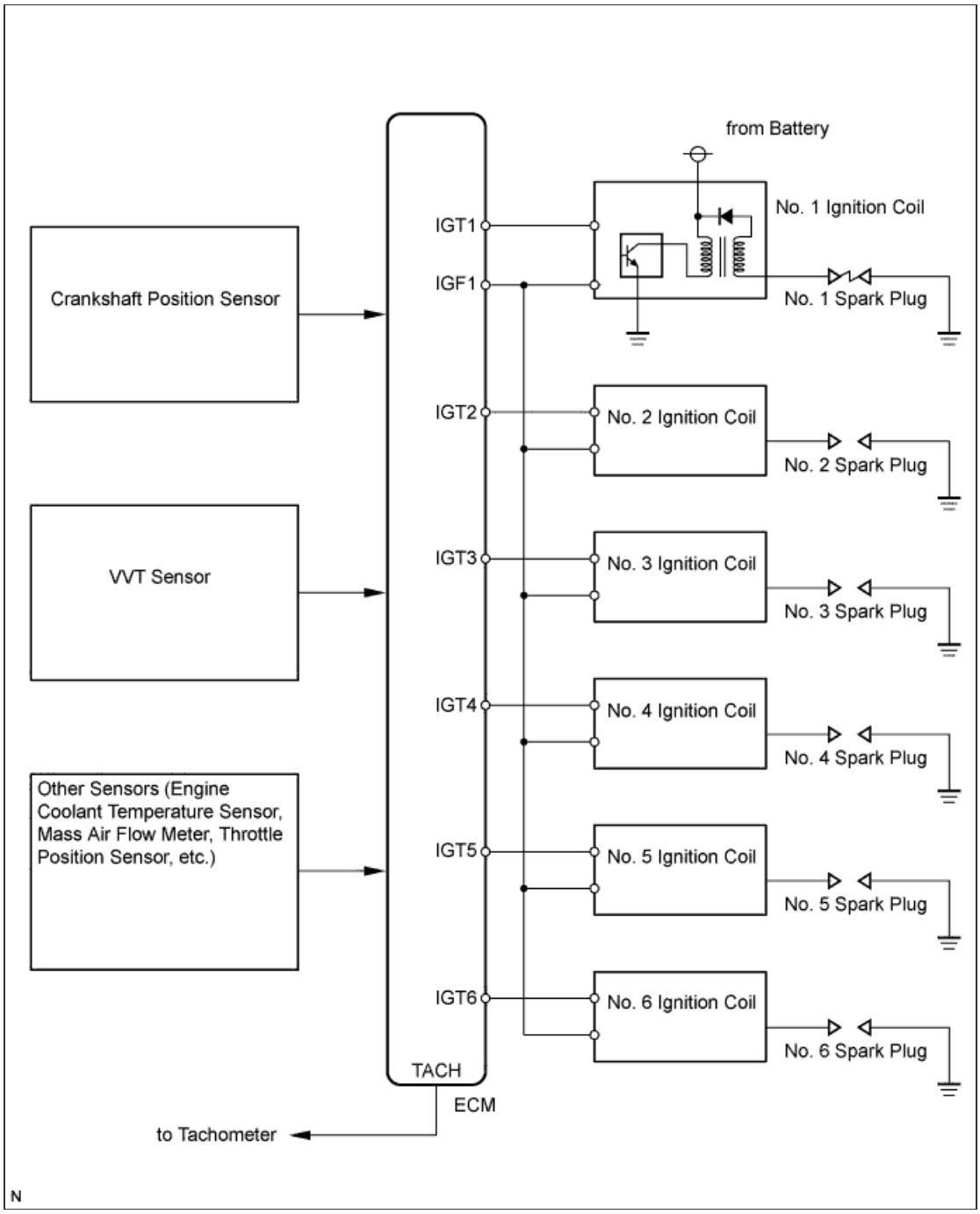
for Preparation Click here

DESCRIPTION

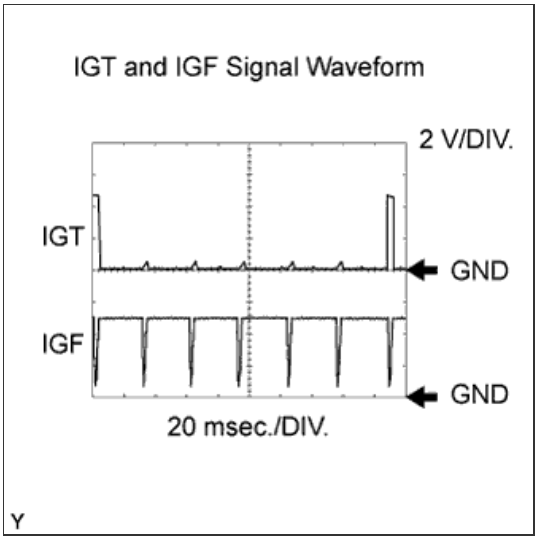
HINT:

- **These DTCs indicate malfunctions relating to the primary circuit.**
- **If DTC P0351 is output, check the No. 1 ignition coil circuit.**
- **If DTC P0352 is output, check the No. 2 ignition coil circuit.**
- **If DTC P0353 is output, check the No. 3 ignition coil circuit.**
- **If DTC P0354 is output, check the No. 4 ignition coil circuit.**
- **If DTC P0355 is output, check the No. 5 ignition coil circuit.**
- **If DTC P0356 is output, check the No. 6 ignition coil circuit.**

A Direct Ignition System (DIS) is used on this vehicle.
The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil, and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.
The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.



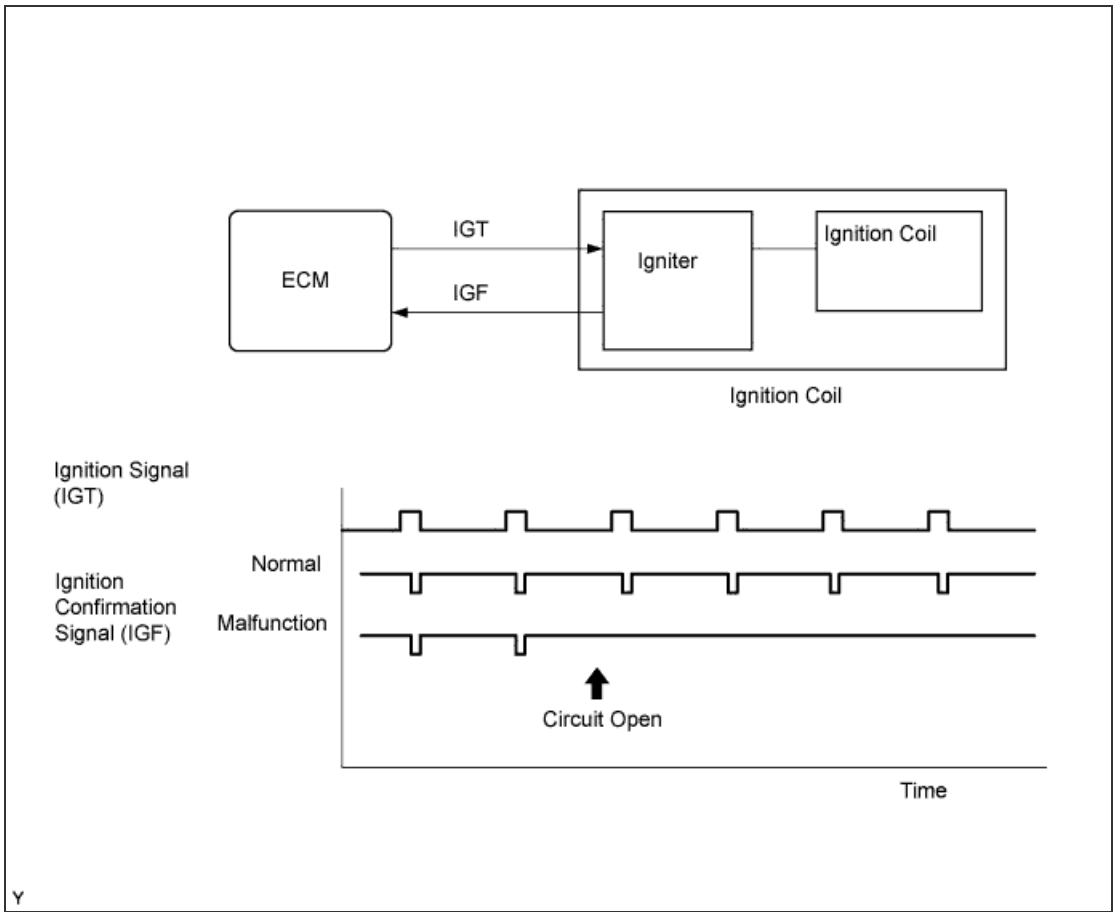
DTC Code	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356	No IGF signal is sent to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 6) between ignition coil and ECM • No. 1 to No. 6 ignition coils • ECM



Reference: Inspection using an oscilloscope.
While cranking or idling the engine, check the waveform between terminals IGT (1 to 6) and E1, and IGF1 and E1 of the ECM connector.

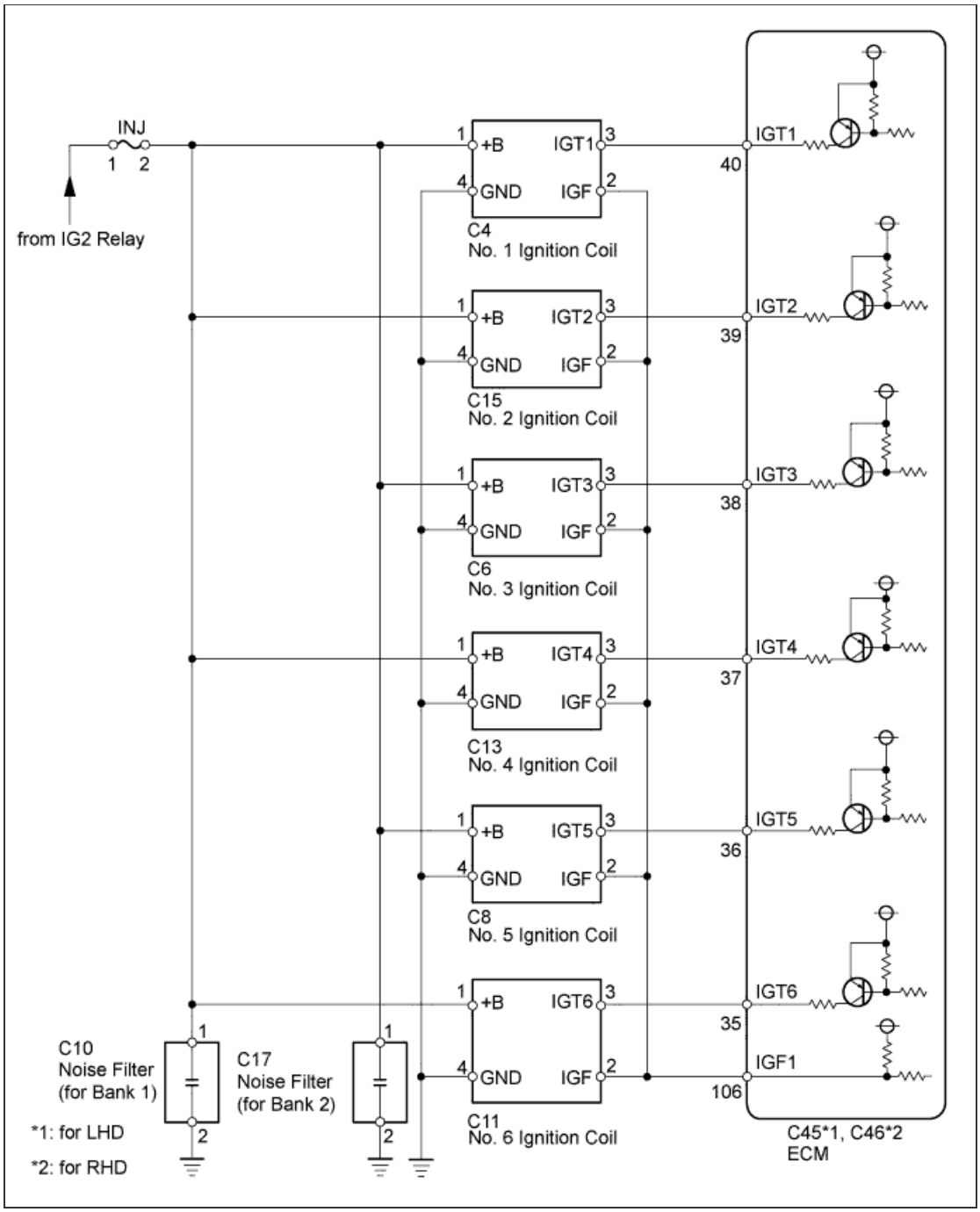
Item	Content
Terminal	CH1: IGT1, IGT2, IGT3, IGT4, IGT5, IGT6 - E1 CH2: IGF1 - E1
Equipment Setting	2 V/DIV. 20 msec./DIV.
Condition	Cranking or idling

MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)

a. Disconnect the ignition coil connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C4-4 (GND) - Body ground	Always	Below 1 Ω
C15-4 (GND) - Body ground	Always	Below 1 Ω
C6-4 (GND) - Body ground	Always	Below 1 Ω

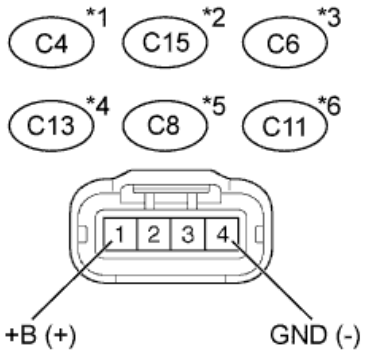
C13-4 (GND) - Body ground	Always	Below 1 Ω
C8-4 (GND) - Body ground	Always	Below 1 Ω
C11-4 (GND) - Body ground	Always	Below 1 Ω

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage (Check for Open):

Tester Connection	Switch Condition	Specified Condition
C4-1 (+B) - C4-4 (GND)	Ignition switch ON	11 to 14 V
C15-1 (+B) - C15-4 (GND)	Ignition switch ON	11 to 14 V
C6-1 (+B) - C6-4 (GND)	Ignition switch ON	11 to 14 V
C13-1 (+B) - C13-4 (GND)	Ignition switch ON	11 to 14 V
C8-1 (+B) - C8-4 (GND)	Ignition switch ON	11 to 14 V
C11-1 (+B) - C11-4 (GND)	Ignition switch ON	11 to 14 V

Front view of wire harness connector:
(to Ignition Coil)



*1: No. 1 Ignition Coil

*2: No. 2 Ignition Coil

*3: No. 3 Ignition Coil

*4: No. 4 Ignition Coil

*5: No. 5 Ignition Coil

*6: No. 6 Ignition Coil

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

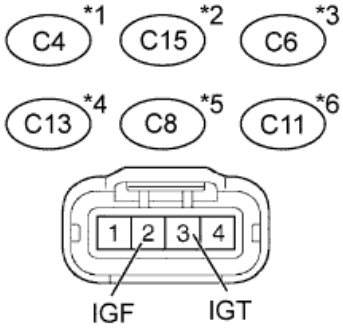
OK

2.CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

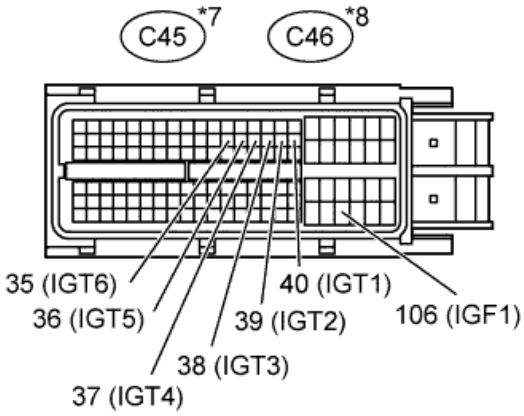
a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Ignition Coil)



Front view of wire harness connector:
(to ECM)



*1: No. 1 Ignition Coil

*2: No. 2 Ignition Coil

*3: No. 3 Ignition Coil

*4: No. 4 Ignition Coil

*5: No. 5 Ignition Coil

*6: No. 6 Ignition Coil

*7: for LHD

*8: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C15-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C6-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C13-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C8-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω

C11-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C4-3 (IGT1) - C45-40 (IGT1)	Always	Below 1 Ω
C15-3 (IGT2) - C45-39 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C45-38 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C45-37 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C45-36 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C45-35 (IGT6)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C15-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C6-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C13-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C8-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C11-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C4-3 (IGT1) - C46-40 (IGT1)	Always	Below 1 Ω
C15-3 (IGT2) - C46-39 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C46-38 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C46-37 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C46-36 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C46-35 (IGT6)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C6-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C13-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C11-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C45-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C45-39 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C45-38 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C45-37 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C45-36 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C45-35 (IGT6) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C6-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C13-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C11-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C46-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C46-39 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C46-38 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C46-37 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C46-36 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C46-35 (IGT6) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353, P0354, P0355 OR P0356)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Shuffle arrangement of the ignition coils (among No. 1 to No. 6 cylinders).

NOTICE:

Do not shuffle the connectors.

e. Perform a simulation test.

f. Check the output DTCs displayed on the tester.

Result

Result	Proceed to
Same DTC output	A
Different ignition coil DTC output	B

B → REPLACE IGNITION COIL ASSEMBLY (Click here)

A

REPLACE ECM (Click here)

DTC P0016 Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)

DTC P0018 Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor A)

for Preparation Click here

DESCRIPTION

Refer to DTC P0335 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P0016	Deviations in the crankshaft and camshaft position sensor 1 signals (2 trip detection logic).	• Mechanical system (Timing chain has jumped tooth or chain stretched) • Camshaft Oil Control Valve (OCV) • OCV filter • Camshaft timing gear assembly • ECM
P0018	Deviations in the crankshaft and camshaft position sensor 2 signals (2 trip detection logic).	

MONITOR DESCRIPTION

The ECM optimizes the valve timing by using the VVT (Variable Valve Timing) system to control the intake camshaft. The VVT system includes the ECM, the camshaft Oil Control Valve (OCV) and the VVT controller.
The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake camshaft. The ECM calibrates the intake valve timing by setting the intake camshaft to the most retarded angle while the engine is idling. The ECM closes the OCV to retard the cam. The ECM stores this value as the VVT learning value. When the difference between the target and actual intake valve timings is 5°CA (Crankshaft Angle) or less, the ECM stores it.
If the VVT learning value matches the following conditions, the ECM determines the existence of a malfunction in the VVT system, and stores the DTC.

- VVT learning value: Less than 22.5°CA, or more than 45.2°CA.
- The above condition continues for 18 seconds or more.

This DTC indicates that the intake camshaft has been installed toward the crankshaft at an incorrect angle, caused by factors such as the timing chain having jumped a tooth.
This monitor begins to run after the engine has idled for 5 minutes.

WIRING DIAGRAM

Refer to DTC P0335 (Click here).
Refer to DTC P0340 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0016, P0017, P0018 OR P0019)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P0016, P0018	A
P0016, P0018 and other DTCs	B

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1) or Control the VVT System (Bank 2).

e. Check the engine speed while operating the camshaft Oil Control Valve (OCV) using the tester.

OK

Tester Operation	Specified Condition
OCV OFF	Normal engine speed
OCV ON	Engine idles roughly or stalls (soon after OCV switched from OFF to ON)

NG → **Go to step 4**

OK

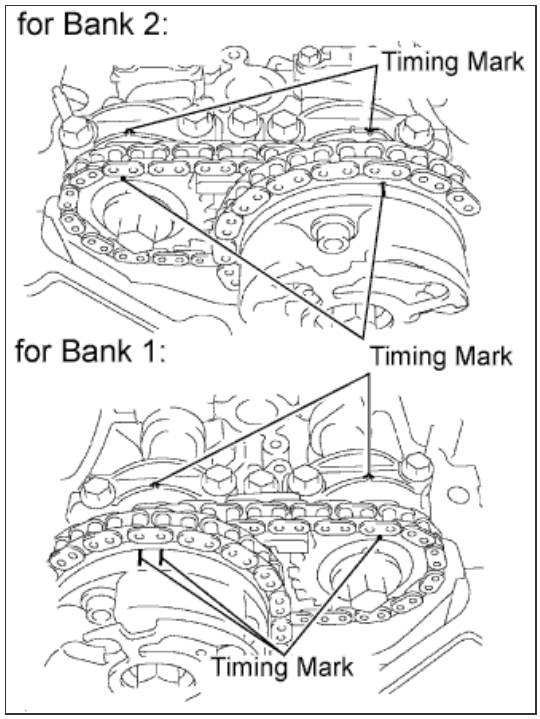
3.ADJUST VALVE TIMING

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NEXT → **Go to step 7**

4.INSPECT CAMSHAFT OIL CONTROL VALVE ASSEMBLY

a. Remove the OCV (Click here).

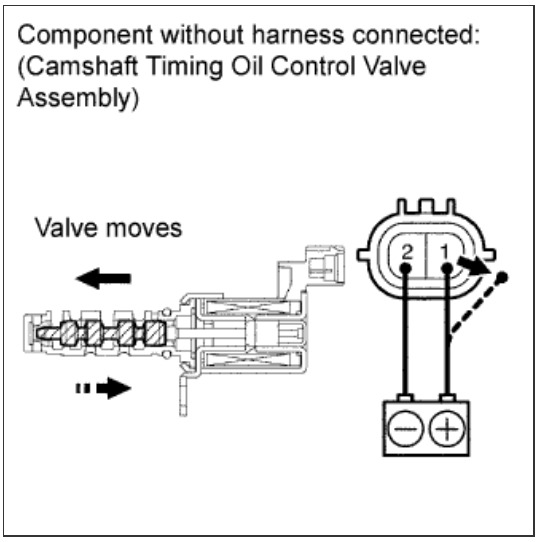
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

c. Apply positive battery voltage to terminal 1 and negative battery voltage to terminal 2. Check the valve operation.

OK:
Valve moves quickly.



NG → REPLACE CAMSHAFT OIL CONTROL VALVE ASSEMBLY (Click here)

OK

5.INSPECT OIL CONTROL VALVE FILTER

a. Remove the OCV filter (Click here).

b. Check that the filter is not clogged.

OK:
Filter is not clogged.

NG → CLEAN OIL CONTROL VALVE FILTER

OK

6.REPLACE CAMSHAFT TIMING GEAR ASSEMBLY

a. Replace the camshaft timing gear assembly (Click here).

NEXT

7.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. In order to clear the ECM learned values for valve timing, disconnect the cable from the negative (-) battery terminal for 1 minute.

b. Connect the cable to the negative (-) battery terminal.

c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Clear the DTCs (Click here).

f. Start the engine and idle it for 5 minutes.

g. Drive the vehicle in an urban area for approximately 10 minutes.

h. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

i. Read the DTCs.

Result:
DTCs are not output.

NG → REPLACE ECM (Click here)


OK
END

DTC P0351 Ignition Coil "A" Primary / Secondary Circuit

DTC P0352 Ignition Coil "B" Primary / Secondary Circuit

DTC P0353 Ignition Coil "C" Primary / Secondary Circuit

DTC P0354 Ignition Coil "D" Primary / Secondary Circuit

DTC P0355 Ignition Coil "E" Primary / Secondary Circuit

DTC P0356 Ignition Coil "F" Primary / Secondary Circuit

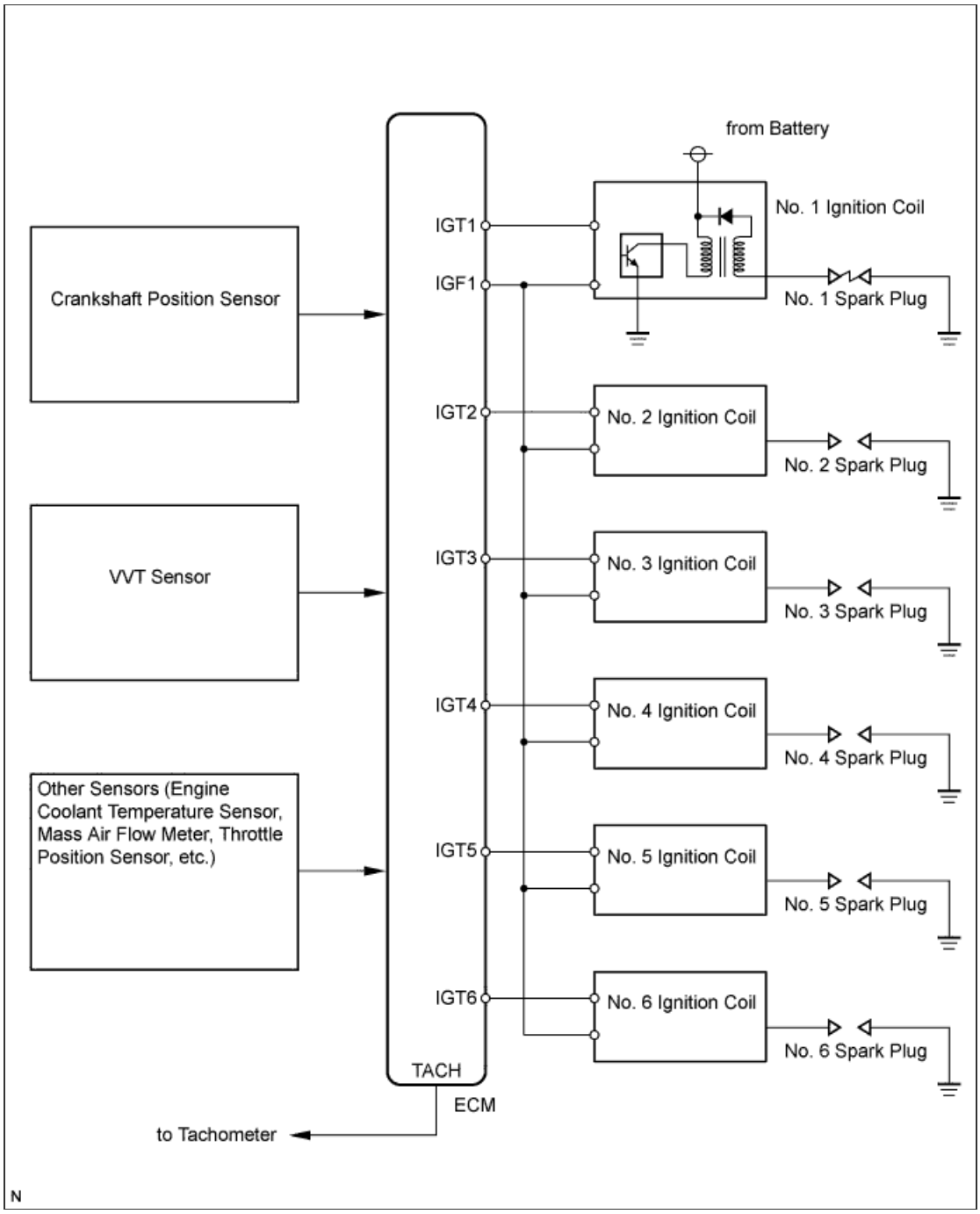
for Preparation Click here

DESCRIPTION

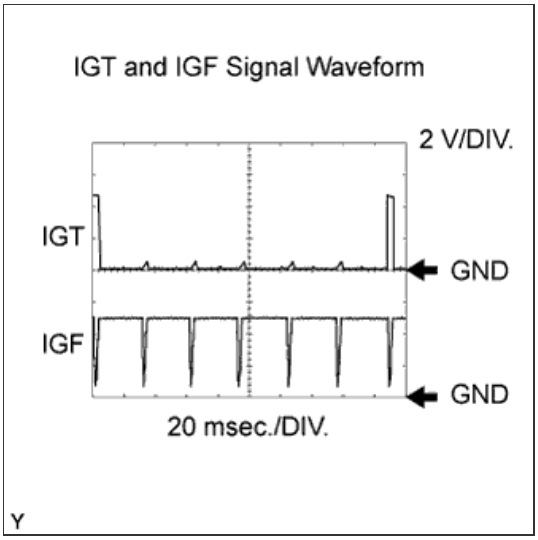
HINT:

- **These DTCs indicate malfunctions relating to the primary circuit.**
- **If DTC P0351 is output, check the No. 1 ignition coil circuit.**
- **If DTC P0352 is output, check the No. 2 ignition coil circuit.**
- **If DTC P0353 is output, check the No. 3 ignition coil circuit.**
- **If DTC P0354 is output, check the No. 4 ignition coil circuit.**
- **If DTC P0355 is output, check the No. 5 ignition coil circuit.**
- **If DTC P0356 is output, check the No. 6 ignition coil circuit.**

A Direct Ignition System (DIS) is used on this vehicle.
The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil, and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.
The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.



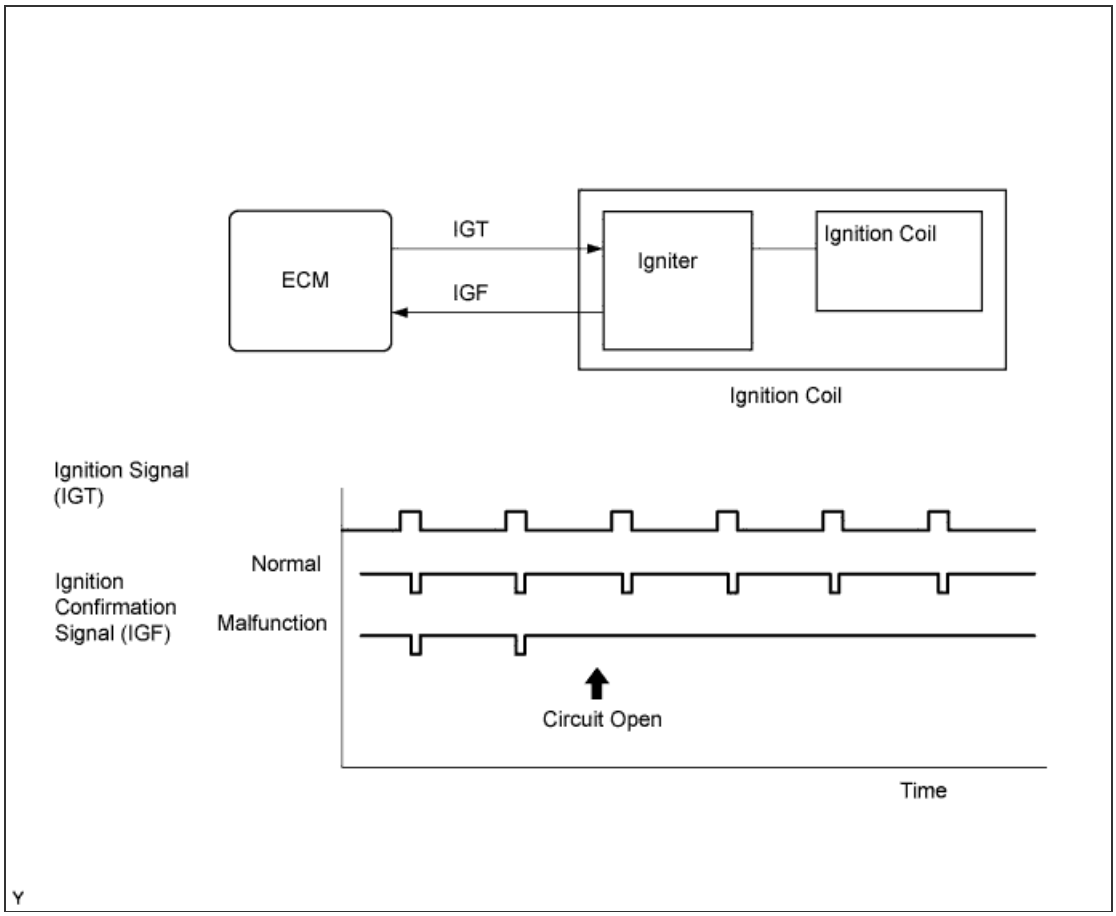
DTC Code	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356	No IGF signal is sent to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 6) between ignition coil and ECM • No. 1 to No. 6 ignition coils • ECM



Reference: Inspection using an oscilloscope.
While cranking or idling the engine, check the waveform between terminals IGT (1 to 6) and E1, and IGF1 and E1 of the ECM connector.

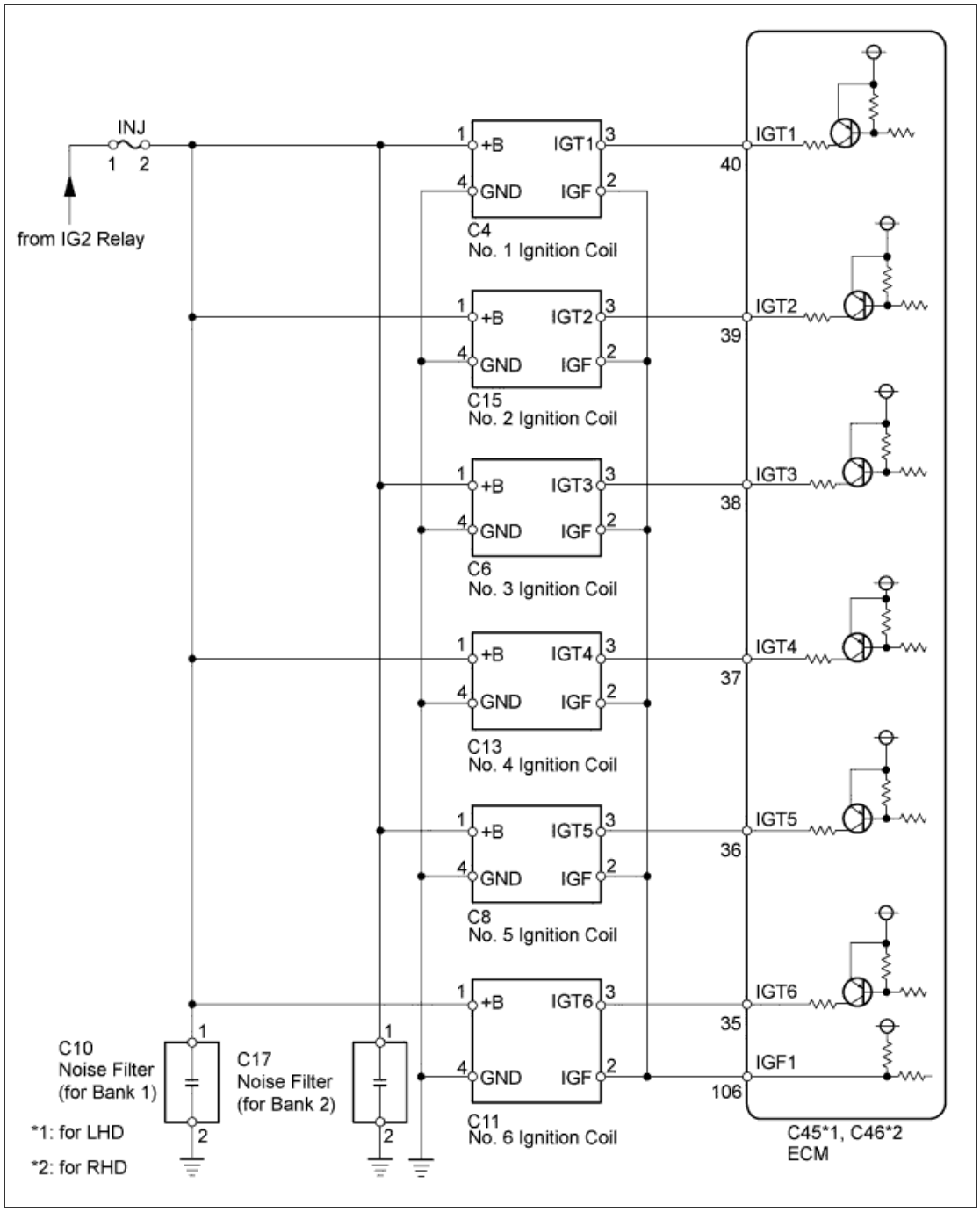
Item	Content
Terminal	CH1: IGT1, IGT2, IGT3, IGT4, IGT5, IGT6 - E1 CH2: IGF1 - E1
Equipment Setting	2 V/DIV. 20 msec./DIV.
Condition	Cranking or idling

MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)

a. Disconnect the ignition coil connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C4-4 (GND) - Body ground	Always	Below 1 Ω
C15-4 (GND) - Body ground	Always	Below 1 Ω
C6-4 (GND) - Body ground	Always	Below 1 Ω

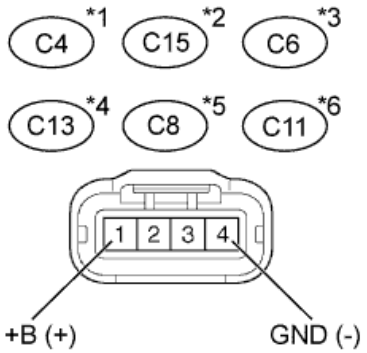
C13-4 (GND) - Body ground	Always	Below 1 Ω
C8-4 (GND) - Body ground	Always	Below 1 Ω
C11-4 (GND) - Body ground	Always	Below 1 Ω

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage (Check for Open):

Tester Connection	Switch Condition	Specified Condition
C4-1 (+B) - C4-4 (GND)	Ignition switch ON	11 to 14 V
C15-1 (+B) - C15-4 (GND)	Ignition switch ON	11 to 14 V
C6-1 (+B) - C6-4 (GND)	Ignition switch ON	11 to 14 V
C13-1 (+B) - C13-4 (GND)	Ignition switch ON	11 to 14 V
C8-1 (+B) - C8-4 (GND)	Ignition switch ON	11 to 14 V
C11-1 (+B) - C11-4 (GND)	Ignition switch ON	11 to 14 V

Front view of wire harness connector:
(to Ignition Coil)



*1: No. 1 Ignition Coil

*2: No. 2 Ignition Coil

*3: No. 3 Ignition Coil

*4: No. 4 Ignition Coil

*5: No. 5 Ignition Coil

*6: No. 6 Ignition Coil

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

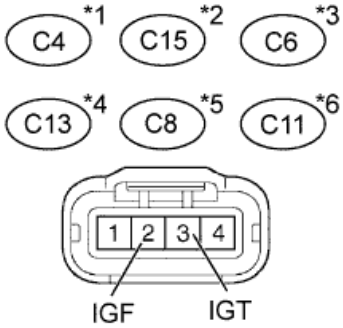
OK

2.CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

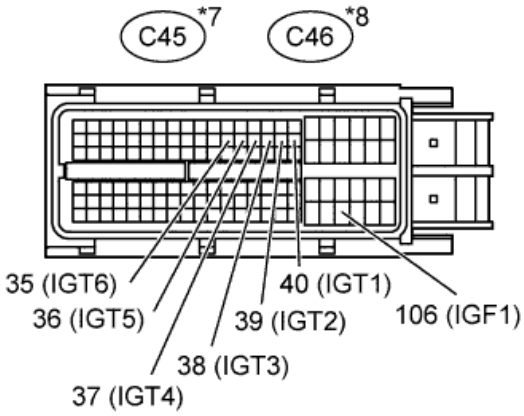
a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Ignition Coil)



Front view of wire harness connector:
(to ECM)



*1: No. 1 Ignition Coil

*2: No. 2 Ignition Coil

*3: No. 3 Ignition Coil

*4: No. 4 Ignition Coil

*5: No. 5 Ignition Coil

*6: No. 6 Ignition Coil

*7: for LHD

*8: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C15-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C6-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C13-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C8-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω

C11-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C4-3 (IGT1) - C45-40 (IGT1)	Always	Below 1 Ω
C15-3 (IGT2) - C45-39 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C45-38 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C45-37 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C45-36 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C45-35 (IGT6)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C15-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C6-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C13-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C8-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C11-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C4-3 (IGT1) - C46-40 (IGT1)	Always	Below 1 Ω
C15-3 (IGT2) - C46-39 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C46-38 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C46-37 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C46-36 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C46-35 (IGT6)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C6-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C13-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C11-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C45-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C45-39 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C45-38 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C45-37 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C45-36 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C45-35 (IGT6) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C6-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C13-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C11-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C46-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C46-39 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C46-38 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C46-37 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C46-36 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C46-35 (IGT6) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353, P0354, P0355 OR P0356)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Shuffle arrangement of the ignition coils (among No. 1 to No. 6 cylinders).

NOTICE:

Do not shuffle the connectors.

e. Perform a simulation test.

f. Check the output DTCs displayed on the tester.

Result

Result	Proceed to
Same DTC output	A
Different ignition coil DTC output	B

B → REPLACE IGNITION COIL ASSEMBLY (Click here)

A

REPLACE ECM (Click here)

DTC P0031 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)

DTC P0032 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)

DTC P0051 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)

DTC P0052 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)

for Preparation Click here

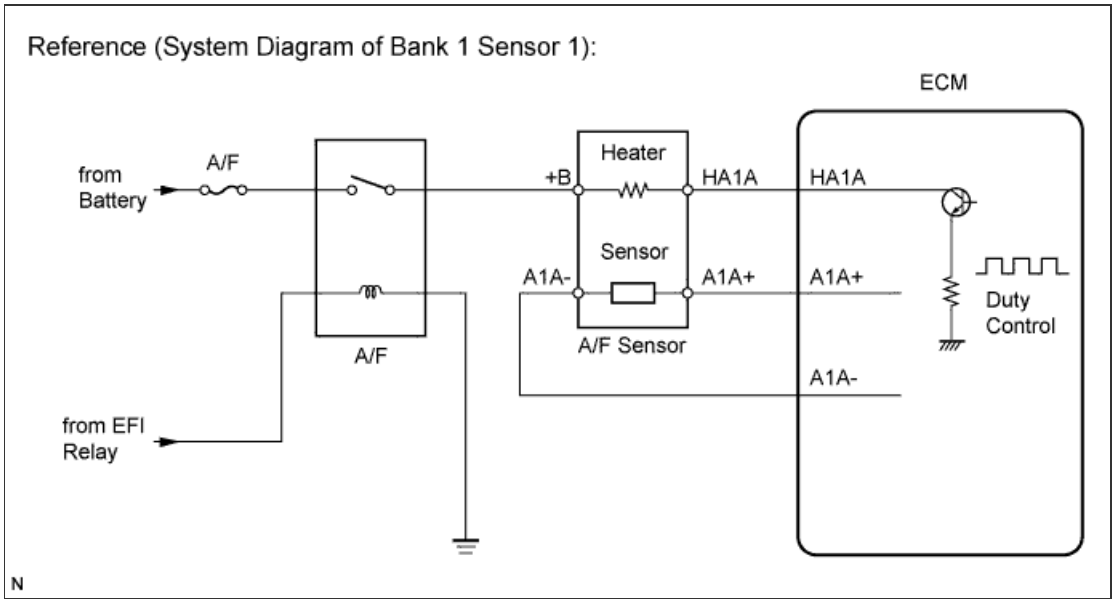
DESCRIPTION

Refer to DTC P2195 (Click here).

HINT:

- **When either of these DTCs are stored, the ECM enters fail-safe mode. The ECM turns off the A/F sensor heater in fail-safe mode. Fail-safe mode continues until the ignition switch is turned off.**
- **Although the DTC titles say the oxygen sensor, these DTCs relate to the Air Fuel Ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**

- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The A/F sensor heater circuit uses a relay on the +B side of the circuit.**



DTC Code	DTC Detection Condition	Trouble Area
P0031 P0051	The Air Fuel ratio (A/F) sensor heater current is below 0.8 A (1 trip detection logic).	• Open in Air Fuel Ratio (A/F) sensor heater circuit • A/F sensor heater (for Bank 1, 2 Sensor 1) • Integration relay (A/F relay) • ECM
P0032 P0052	An Air Fuel ratio (A/F) sensor heater current failure (1 trip detection logic).	• Short in A/F sensor heater circuit • A/F sensor heater (for Bank 1, 2 Sensor 1) • Integration relay (A/F relay) • ECM

HINT:

- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

MONITOR DESCRIPTION

The ECM uses information from the Air Fuel Ratio (A/F) sensor to regulate the air fuel ratio and keep it close to the stoichiometric level. This maximizes the ability of the Three-Way Catalytic Converter (TWC) to purify the exhaust gases.

The A/F sensor detects oxygen levels in the exhaust gas and transmits the information to the ECM. The inner surface of the sensor element is exposed to the outside air. The outer surface of the sensor element is exposed to the exhaust gas. The sensor element is made of platinum coated zirconia and includes an integrated heating element.
The zirconia element generates a small voltage when there is a large difference in the oxygen concentrations between the exhaust gas and outside air. The platinum coating amplifies this voltage generation.
The A/F sensor is more efficient when heated. When the exhaust gas temperature is low, the sensor cannot generate useful voltage signals without supplementary heating. The ECM regulates the supplementary heating using a duty-cycle approach to adjust the average current in the sensor heater element. If the heater current is outside the normal range, the signal transmitted by the A/F sensor becomes inaccurate, as a result, the ECM is unable to regulate air fuel ratio properly.
When the current in the A/F sensor heater is outside the normal operating range, the ECM interprets this as a malfunction in the sensor heater and stores a DTC.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

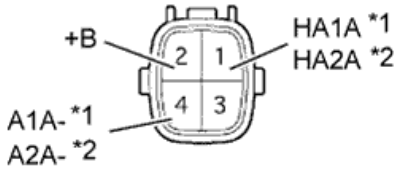
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

a. Disconnect the Air Fuel ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

Standard Resistance:

for Bank 1 Sensor 1

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher

for Bank 2 Sensor 1

Tester Connection	Condition	Specified Condition
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

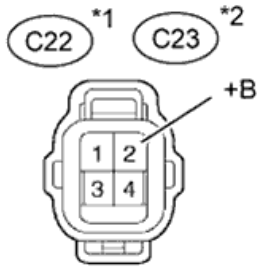
NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF A/F SENSOR)

a. Measure the voltage according to the value(s) in the table below.

Front view of wire harness connector:
(to A/F Sensor)



*1: for Bank 1

*2: for Bank 2

Standard Voltage:

for Bank 1 Sensor 1

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

for Bank 2 Sensor 1

Tester Connection	Switch Condition	Specified Condition
C23-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

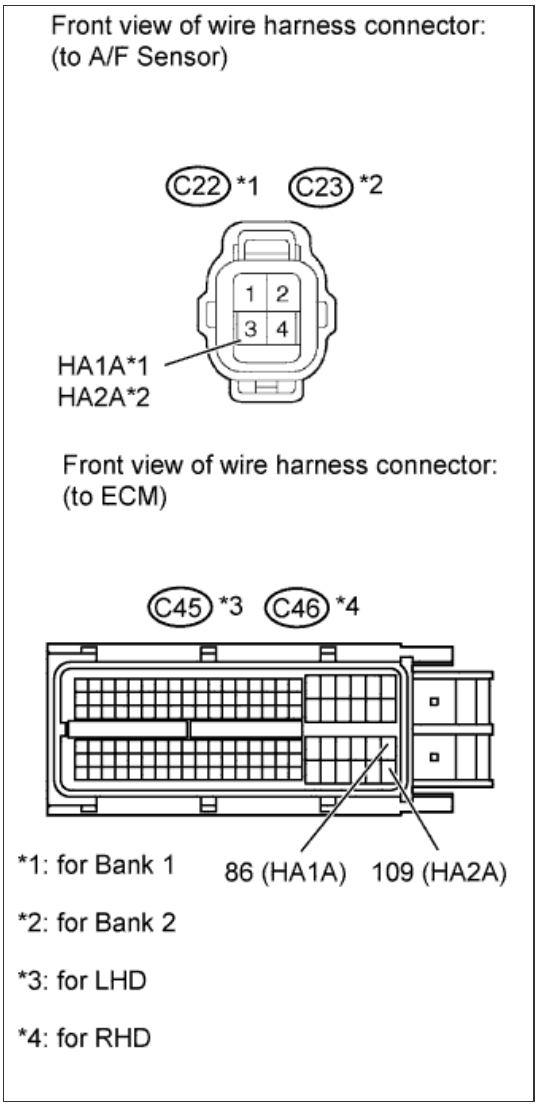
NG → Go to step 5

OK

3.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) -		10 kΩ or

Body ground	Always	higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Start the engine.

f. Allow the engine to idle for 1 minute or more.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read the DTCs.

Result

Result	Proceed to
No output	A
P0031, P0032, P0051 or P0052	B

B → REPLACE ECM (Click here)

A

CHECK FOR INTERMITTENT PROBLEMS (Click here)

5.INSPECT INTEGRATION NO.1 RELAY (A/F RELAY)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

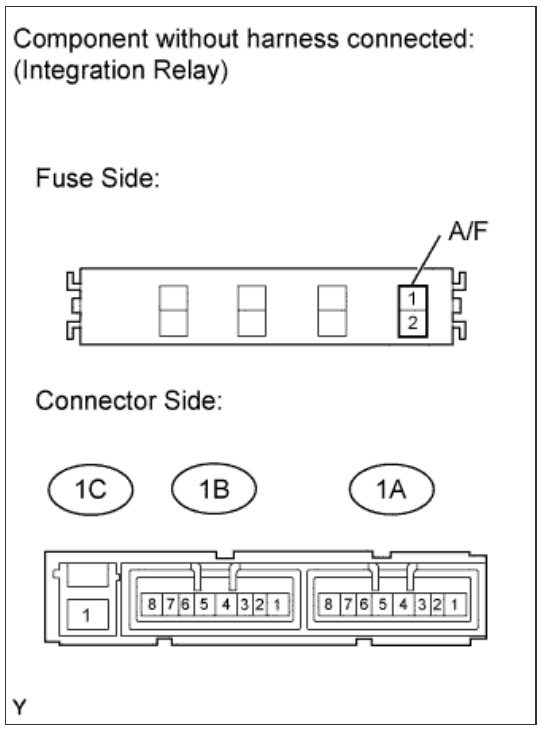
iii. Reinstall the A/F fuse.

c. Inspect the A/F relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1A-4 - 1C-1	Battery voltage not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω



NG → REPLACE INTEGRATION NO.1 RELAY

OK

6.CHECK HARNESS AND CONNECTOR (A/F SENSOR - INTEGRATION RELAY)

a. Remove the integration relay from the engine room relay block.

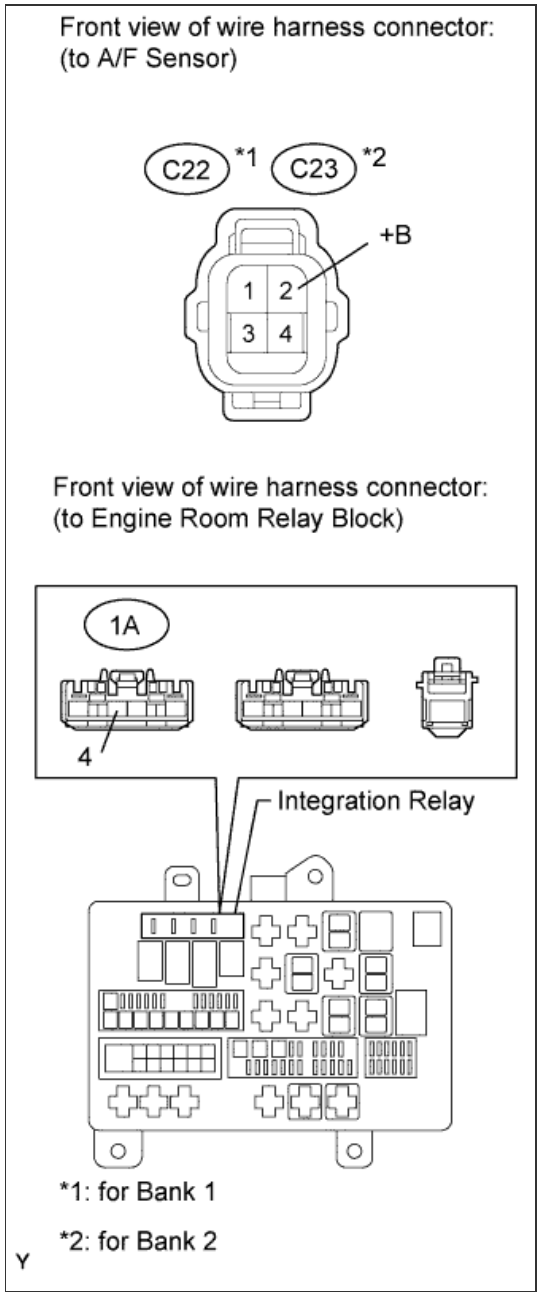
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C22-2 (+B) - 1A-4	Always	Below 1 Ω
C23-2 (+B) - 1A-4	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
C22-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher
C23-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

DTC P0351 Ignition Coil "A" Primary / Secondary Circuit

DTC P0352 Ignition Coil "B" Primary / Secondary Circuit

DTC P0353 Ignition Coil "C" Primary / Secondary Circuit

DTC P0354 Ignition Coil "D" Primary / Secondary Circuit

DTC P0355 Ignition Coil "E" Primary / Secondary Circuit

DTC P0356 Ignition Coil "F" Primary / Secondary Circuit

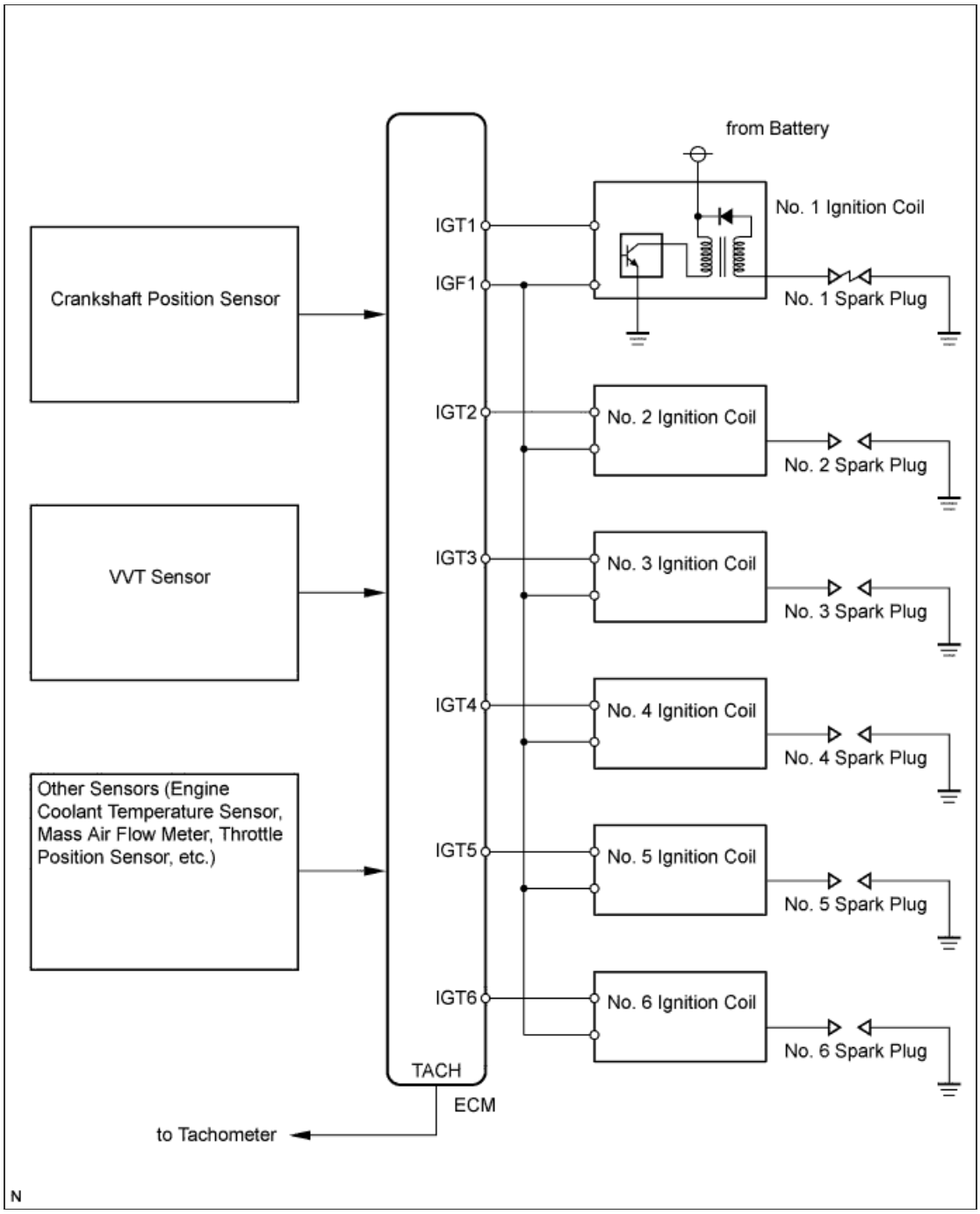
for Preparation Click here

DESCRIPTION

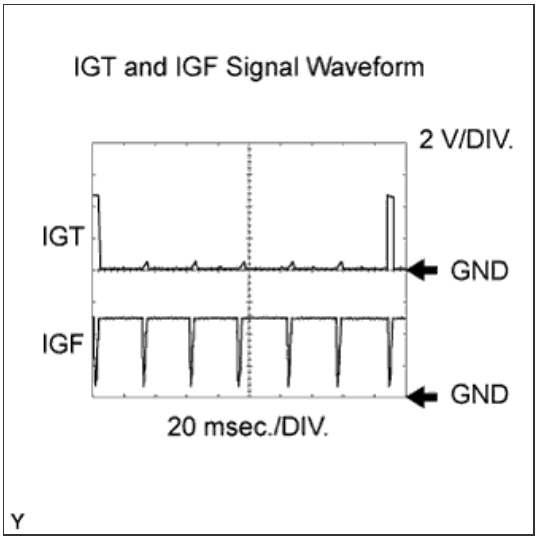
HINT:

- **These DTCs indicate malfunctions relating to the primary circuit.**
- **If DTC P0351 is output, check the No. 1 ignition coil circuit.**
- **If DTC P0352 is output, check the No. 2 ignition coil circuit.**
- **If DTC P0353 is output, check the No. 3 ignition coil circuit.**
- **If DTC P0354 is output, check the No. 4 ignition coil circuit.**
- **If DTC P0355 is output, check the No. 5 ignition coil circuit.**
- **If DTC P0356 is output, check the No. 6 ignition coil circuit.**

A Direct Ignition System (DIS) is used on this vehicle.
The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil, and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.
The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.



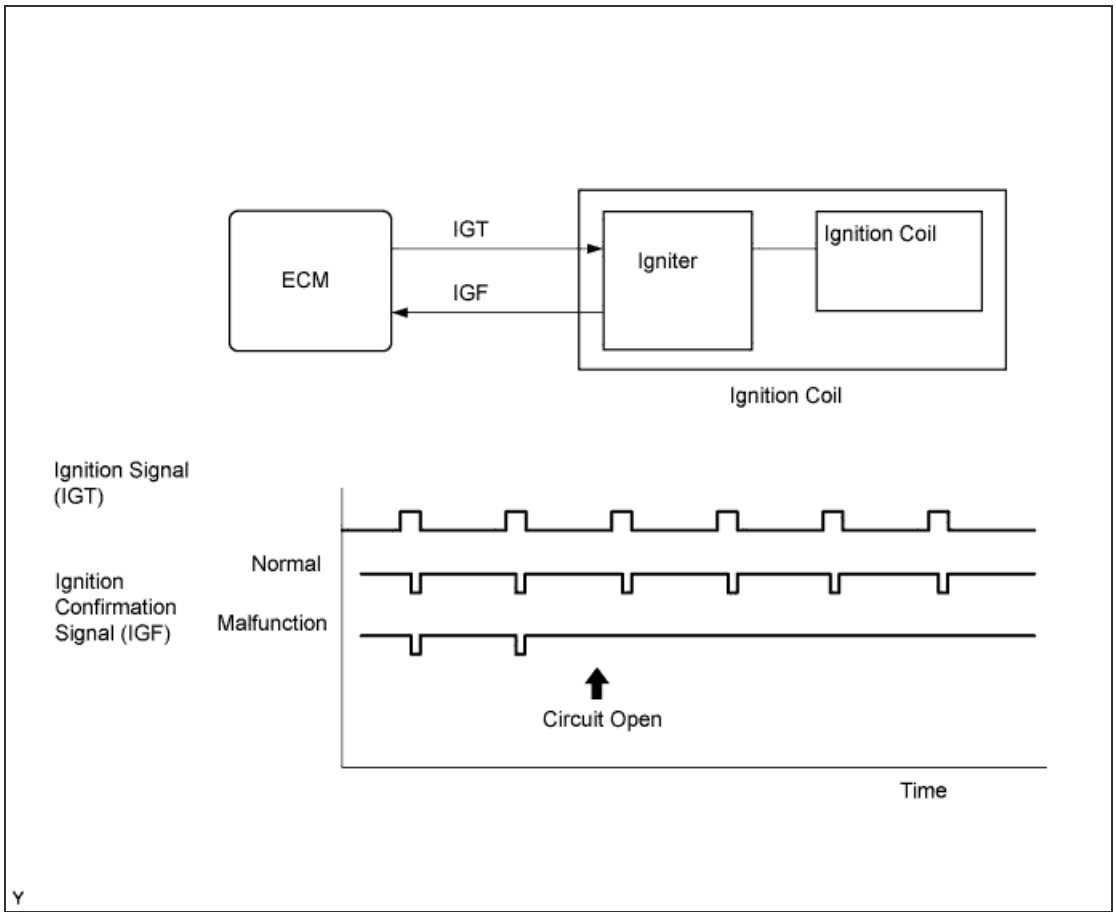
DTC Code	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356	No IGF signal is sent to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 6) between ignition coil and ECM • No. 1 to No. 6 ignition coils • ECM



Reference: Inspection using an oscilloscope.
While cranking or idling the engine, check the waveform between terminals IGT (1 to 6) and E1, and IGF1 and E1 of the ECM connector.

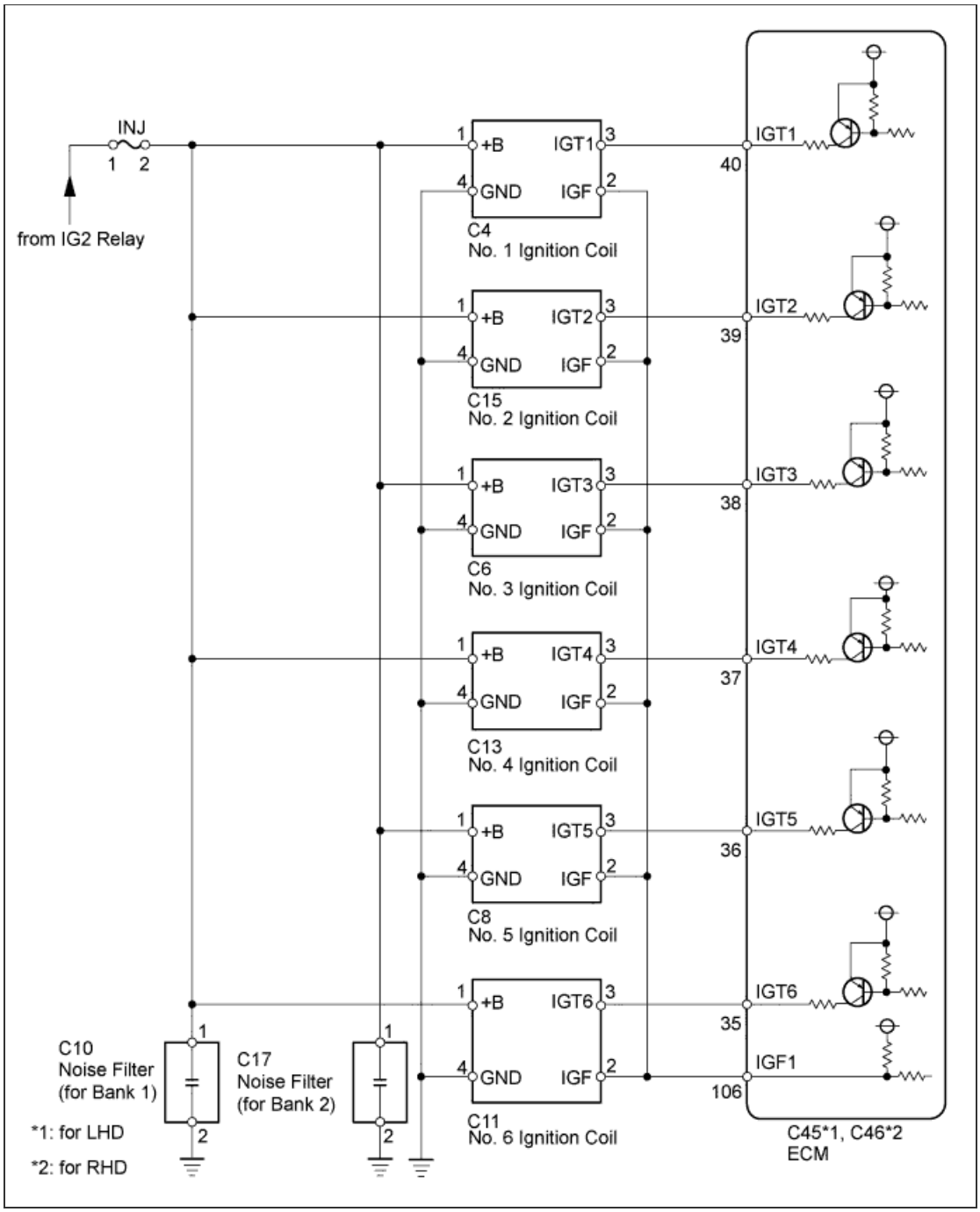
Item	Content
Terminal	CH1: IGT1, IGT2, IGT3, IGT4, IGT5, IGT6 - E1 CH2: IGF1 - E1
Equipment Setting	2 V/DIV. 20 msec./DIV.
Condition	Cranking or idling

MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)

a. Disconnect the ignition coil connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C4-4 (GND) - Body ground	Always	Below 1 Ω
C15-4 (GND) - Body ground	Always	Below 1 Ω
C6-4 (GND) - Body ground	Always	Below 1 Ω

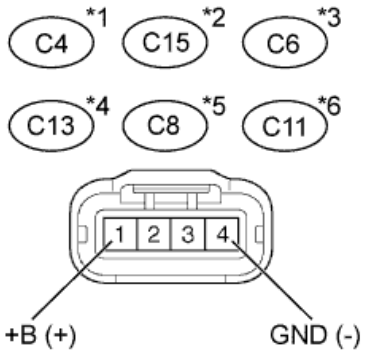
C13-4 (GND) - Body ground	Always	Below 1 Ω
C8-4 (GND) - Body ground	Always	Below 1 Ω
C11-4 (GND) - Body ground	Always	Below 1 Ω

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage (Check for Open):

Tester Connection	Switch Condition	Specified Condition
C4-1 (+B) - C4-4 (GND)	Ignition switch ON	11 to 14 V
C15-1 (+B) - C15-4 (GND)	Ignition switch ON	11 to 14 V
C6-1 (+B) - C6-4 (GND)	Ignition switch ON	11 to 14 V
C13-1 (+B) - C13-4 (GND)	Ignition switch ON	11 to 14 V
C8-1 (+B) - C8-4 (GND)	Ignition switch ON	11 to 14 V
C11-1 (+B) - C11-4 (GND)	Ignition switch ON	11 to 14 V

Front view of wire harness connector:
(to Ignition Coil)



*1: No. 1 Ignition Coil

*2: No. 2 Ignition Coil

*3: No. 3 Ignition Coil

*4: No. 4 Ignition Coil

*5: No. 5 Ignition Coil

*6: No. 6 Ignition Coil

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

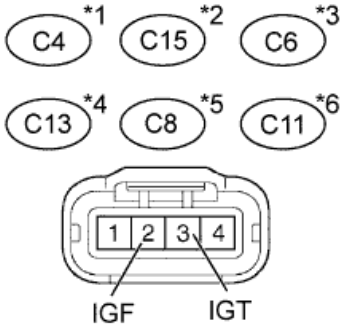
OK

2.CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

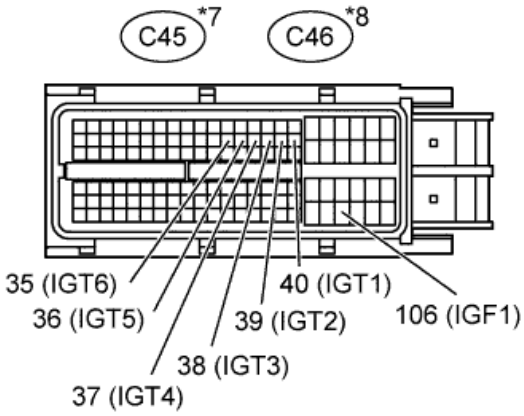
a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Ignition Coil)



Front view of wire harness connector:
(to ECM)



*1: No. 1 Ignition Coil

*2: No. 2 Ignition Coil

*3: No. 3 Ignition Coil

*4: No. 4 Ignition Coil

*5: No. 5 Ignition Coil

*6: No. 6 Ignition Coil

*7: for LHD

*8: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C15-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C6-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C13-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C8-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω

C11-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C4-3 (IGT1) - C45-40 (IGT1)	Always	Below 1 Ω
C15-3 (IGT2) - C45-39 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C45-38 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C45-37 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C45-36 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C45-35 (IGT6)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C15-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C6-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C13-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C8-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C11-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C4-3 (IGT1) - C46-40 (IGT1)	Always	Below 1 Ω
C15-3 (IGT2) - C46-39 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C46-38 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C46-37 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C46-36 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C46-35 (IGT6)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C6-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C13-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C11-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C45-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C45-39 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C45-38 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C45-37 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C45-36 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C45-35 (IGT6) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C6-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C13-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C11-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C46-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C46-39 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C46-38 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C46-37 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C46-36 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C46-35 (IGT6) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353, P0354, P0355 OR P0356)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Shuffle arrangement of the ignition coils (among No. 1 to No. 6 cylinders).

NOTICE:

Do not shuffle the connectors.

e. Perform a simulation test.

f. Check the output DTCs displayed on the tester.

Result

Result	Proceed to
Same DTC output	A
Different ignition coil DTC output	B

B → REPLACE IGNITION COIL ASSEMBLY (Click here)

A

REPLACE ECM (Click here)

DTC P0031 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)

DTC P0032 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)

DTC P0051 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)

DTC P0052 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)

for Preparation Click here

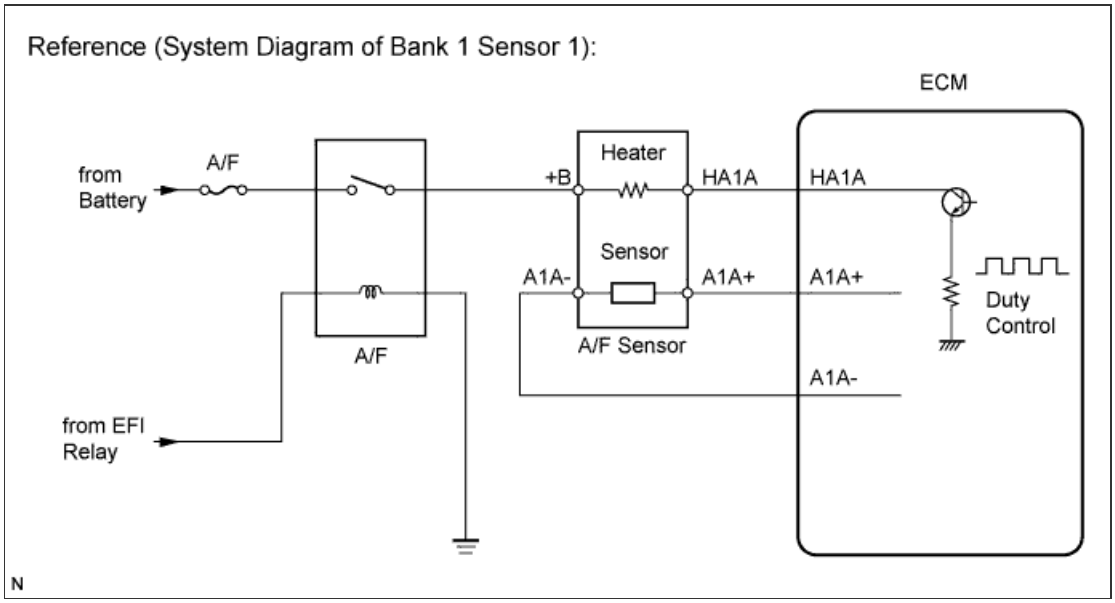
DESCRIPTION

Refer to DTC P2195 (Click here).

HINT:

- **When either of these DTCs are stored, the ECM enters fail-safe mode. The ECM turns off the A/F sensor heater in fail-safe mode. Fail-safe mode continues until the ignition switch is turned off.**
- **Although the DTC titles say the oxygen sensor, these DTCs relate to the Air Fuel Ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**

- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The A/F sensor heater circuit uses a relay on the +B side of the circuit.**



DTC Code	DTC Detection Condition	Trouble Area
P0031 P0051	The Air Fuel ratio (A/F) sensor heater current is below 0.8 A (1 trip detection logic).	• Open in Air Fuel Ratio (A/F) sensor heater circuit • A/F sensor heater (for Bank 1, 2 Sensor 1) • Integration relay (A/F relay) • ECM
P0032 P0052	An Air Fuel ratio (A/F) sensor heater current failure (1 trip detection logic).	• Short in A/F sensor heater circuit • A/F sensor heater (for Bank 1, 2 Sensor 1) • Integration relay (A/F relay) • ECM

HINT:

- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

MONITOR DESCRIPTION

The ECM uses information from the Air Fuel Ratio (A/F) sensor to regulate the air fuel ratio and keep it close to the stoichiometric level. This maximizes the ability of the Three-Way Catalytic Converter (TWC) to purify the exhaust gases.

The A/F sensor detects oxygen levels in the exhaust gas and transmits the information to the ECM. The inner surface of the sensor element is exposed to the outside air. The outer surface of the sensor element is exposed to the exhaust gas. The sensor element is made of platinum coated zirconia and includes an integrated heating element.
The zirconia element generates a small voltage when there is a large difference in the oxygen concentrations between the exhaust gas and outside air. The platinum coating amplifies this voltage generation.
The A/F sensor is more efficient when heated. When the exhaust gas temperature is low, the sensor cannot generate useful voltage signals without supplementary heating. The ECM regulates the supplementary heating using a duty-cycle approach to adjust the average current in the sensor heater element. If the heater current is outside the normal range, the signal transmitted by the A/F sensor becomes inaccurate, as a result, the ECM is unable to regulate air fuel ratio properly.
When the current in the A/F sensor heater is outside the normal operating range, the ECM interprets this as a malfunction in the sensor heater and stores a DTC.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

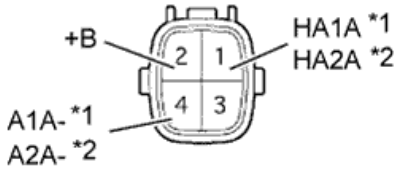
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

a. Disconnect the Air Fuel ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

Standard Resistance:

for Bank 1 Sensor 1

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher

for Bank 2 Sensor 1

Tester Connection	Condition	Specified Condition
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

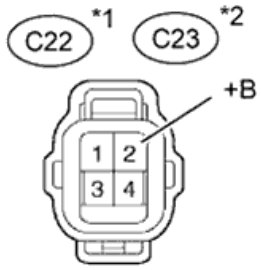
NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF A/F SENSOR)

a. Measure the voltage according to the value(s) in the table below.

Front view of wire harness connector:
(to A/F Sensor)



*1: for Bank 1

*2: for Bank 2

Standard Voltage:

for Bank 1 Sensor 1

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

for Bank 2 Sensor 1

Tester Connection	Switch Condition	Specified Condition
C23-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

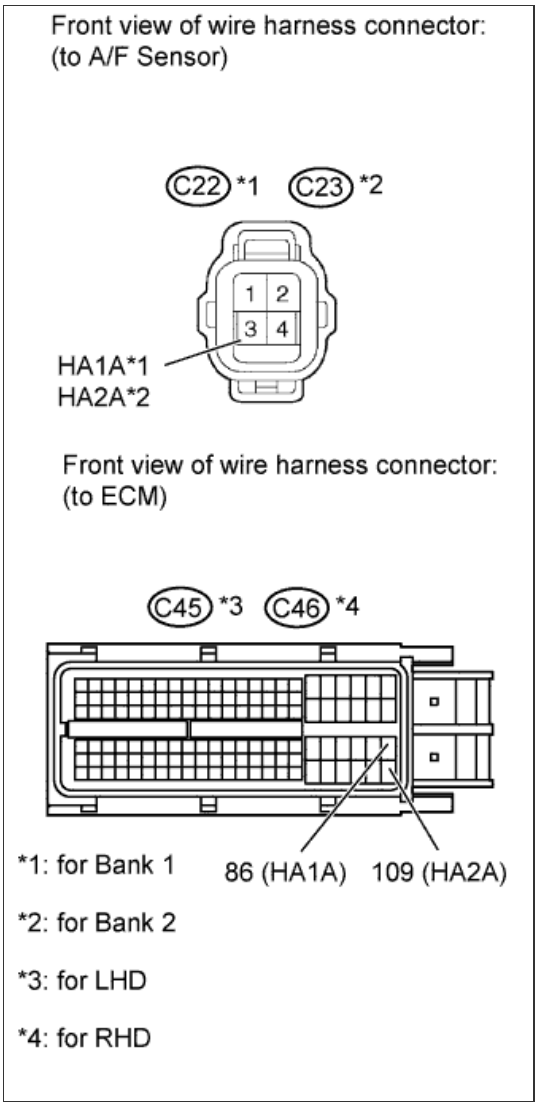
NG → Go to step 5

OK

3.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) -		10 kΩ or

Body ground	Always	higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Start the engine.

f. Allow the engine to idle for 1 minute or more.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read the DTCs.

Result

Result	Proceed to
No output	A
P0031, P0032, P0051 or P0052	B

B → REPLACE ECM (Click here)

A

CHECK FOR INTERMITTENT PROBLEMS (Click here)

5.INSPECT INTEGRATION NO.1 RELAY (A/F RELAY)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

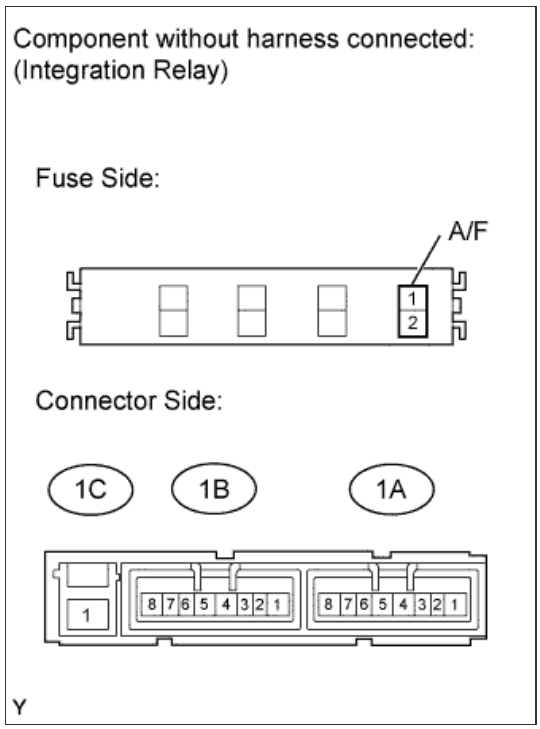
iii. Reinstall the A/F fuse.

c. Inspect the A/F relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1A-4 - 1C-1	Battery voltage not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω



NG → REPLACE INTEGRATION NO.1 RELAY

OK

6.CHECK HARNESS AND CONNECTOR (A/F SENSOR - INTEGRATION RELAY)

a. Remove the integration relay from the engine room relay block.

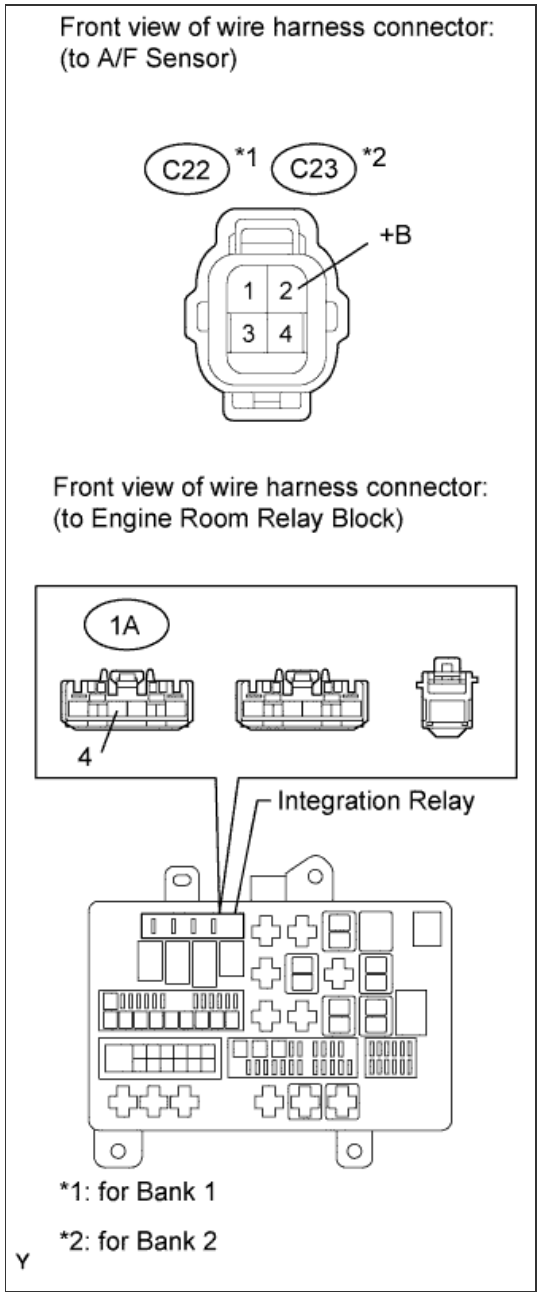
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C22-2 (+B) - 1A-4	Always	Below 1 Ω
C23-2 (+B) - 1A-4	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
C22-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher
C23-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

DTC P0351 Ignition Coil "A" Primary / Secondary Circuit

DTC P0352 Ignition Coil "B" Primary / Secondary Circuit

DTC P0353 Ignition Coil "C" Primary / Secondary Circuit

DTC P0354 Ignition Coil "D" Primary / Secondary Circuit

DTC P0355 Ignition Coil "E" Primary / Secondary Circuit

DTC P0356 Ignition Coil "F" Primary / Secondary Circuit

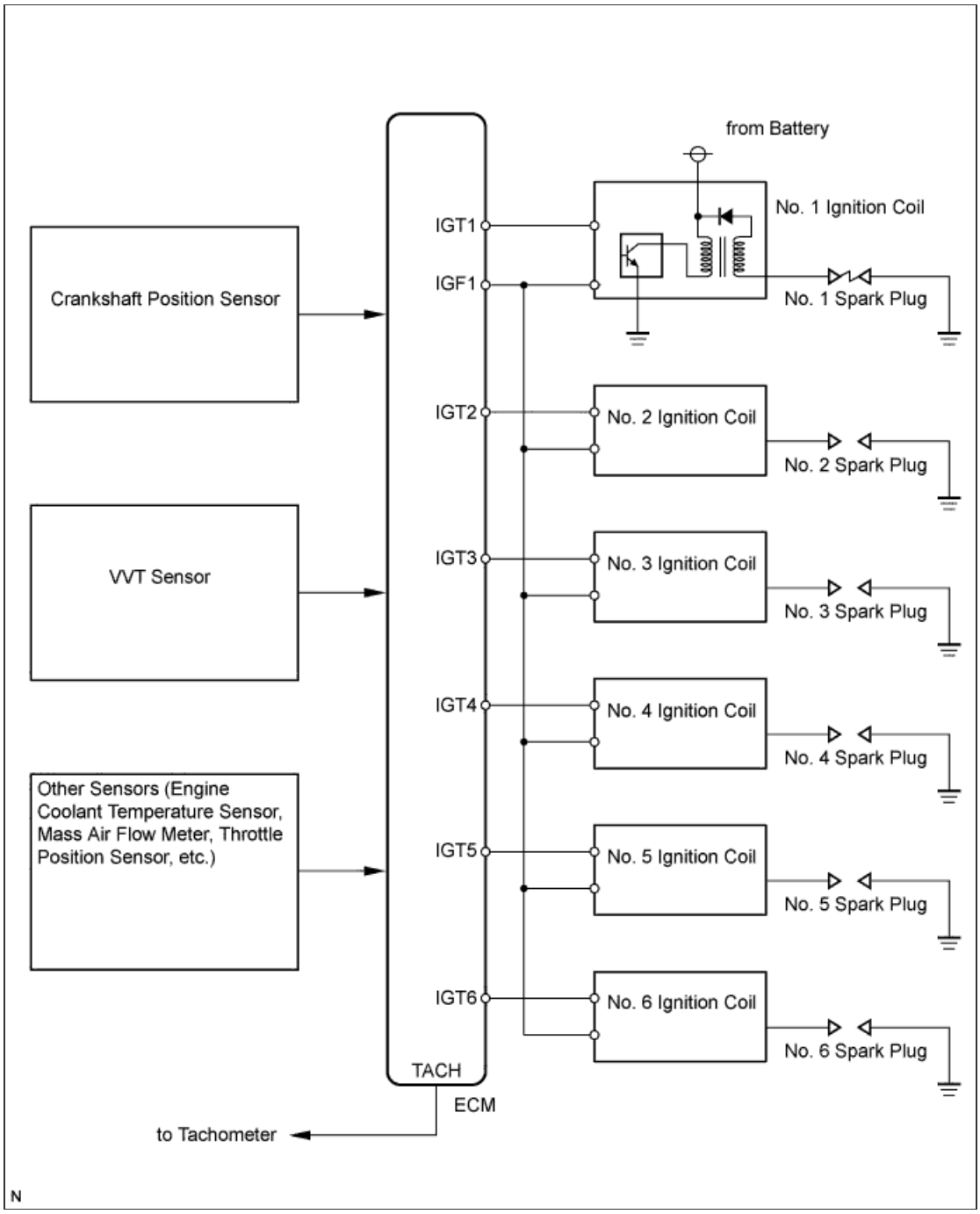
for Preparation Click here

DESCRIPTION

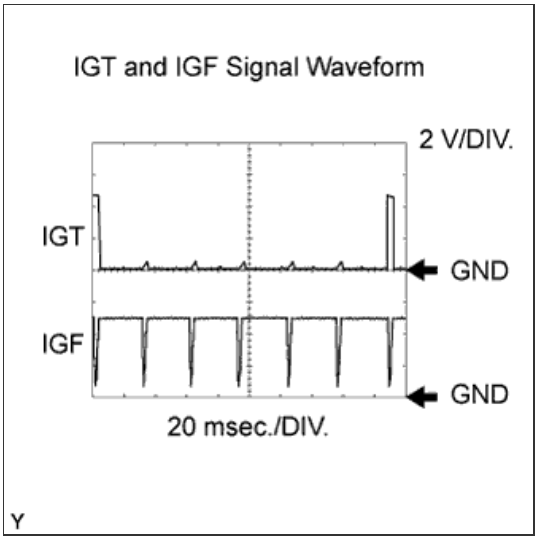
HINT:

- **These DTCs indicate malfunctions relating to the primary circuit.**
- **If DTC P0351 is output, check the No. 1 ignition coil circuit.**
- **If DTC P0352 is output, check the No. 2 ignition coil circuit.**
- **If DTC P0353 is output, check the No. 3 ignition coil circuit.**
- **If DTC P0354 is output, check the No. 4 ignition coil circuit.**
- **If DTC P0355 is output, check the No. 5 ignition coil circuit.**
- **If DTC P0356 is output, check the No. 6 ignition coil circuit.**

A Direct Ignition System (DIS) is used on this vehicle.
The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil, and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.
The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.



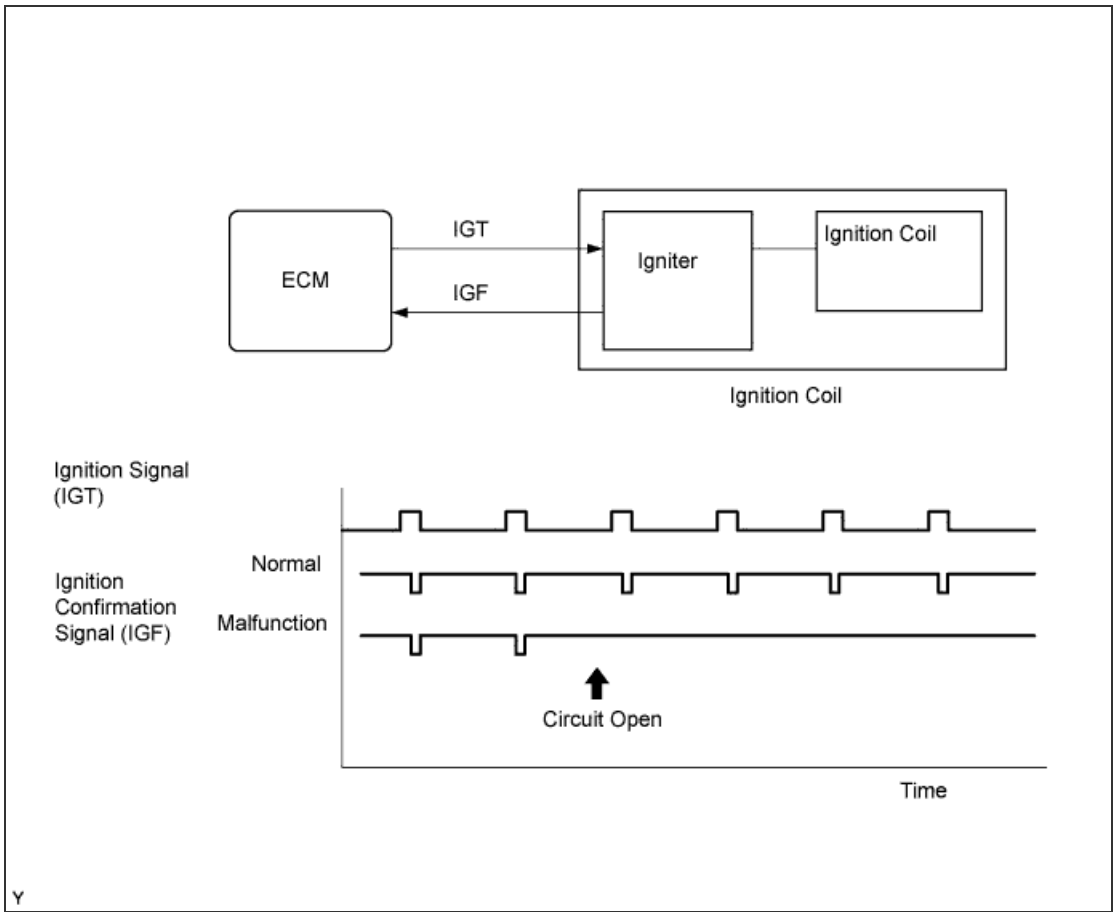
DTC Code	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356	No IGF signal is sent to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 6) between ignition coil and ECM • No. 1 to No. 6 ignition coils • ECM



Reference: Inspection using an oscilloscope.
While cranking or idling the engine, check the waveform between terminals IGT (1 to 6) and E1, and IGF1 and E1 of the ECM connector.

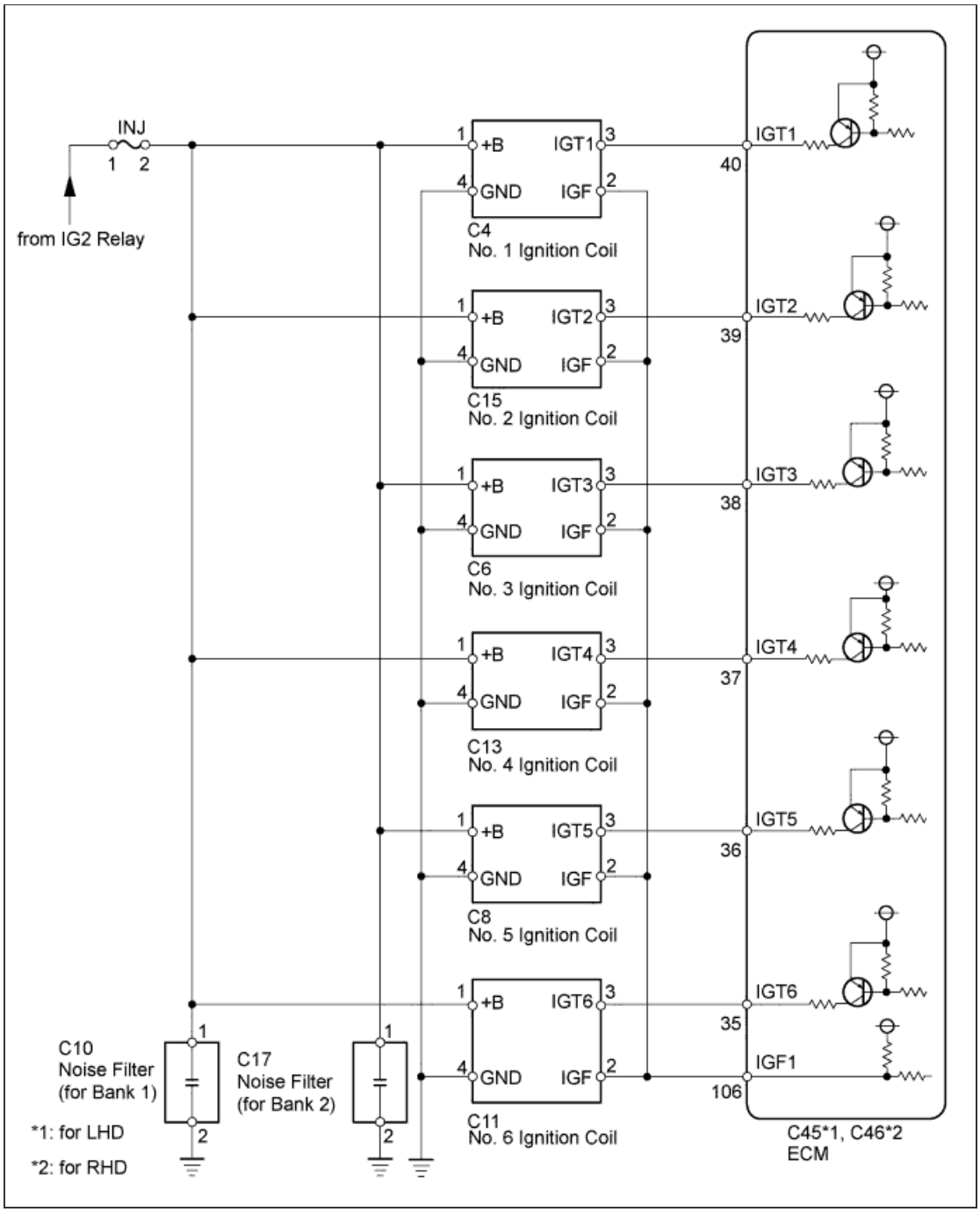
Item	Content
Terminal	CH1: IGT1, IGT2, IGT3, IGT4, IGT5, IGT6 - E1 CH2: IGF1 - E1
Equipment Setting	2 V/DIV. 20 msec./DIV.
Condition	Cranking or idling

MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)

a. Disconnect the ignition coil connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C4-4 (GND) - Body ground	Always	Below 1 Ω
C15-4 (GND) - Body ground	Always	Below 1 Ω
C6-4 (GND) - Body ground	Always	Below 1 Ω

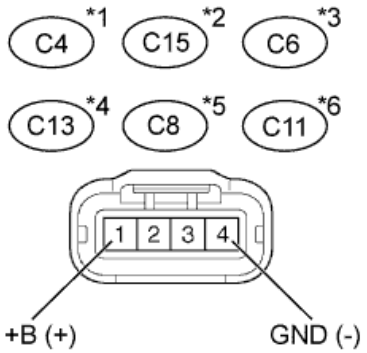
C13-4 (GND) - Body ground	Always	Below 1 Ω
C8-4 (GND) - Body ground	Always	Below 1 Ω
C11-4 (GND) - Body ground	Always	Below 1 Ω

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage (Check for Open):

Tester Connection	Switch Condition	Specified Condition
C4-1 (+B) - C4-4 (GND)	Ignition switch ON	11 to 14 V
C15-1 (+B) - C15-4 (GND)	Ignition switch ON	11 to 14 V
C6-1 (+B) - C6-4 (GND)	Ignition switch ON	11 to 14 V
C13-1 (+B) - C13-4 (GND)	Ignition switch ON	11 to 14 V
C8-1 (+B) - C8-4 (GND)	Ignition switch ON	11 to 14 V
C11-1 (+B) - C11-4 (GND)	Ignition switch ON	11 to 14 V

Front view of wire harness connector:
(to Ignition Coil)



*1: No. 1 Ignition Coil

*2: No. 2 Ignition Coil

*3: No. 3 Ignition Coil

*4: No. 4 Ignition Coil

*5: No. 5 Ignition Coil

*6: No. 6 Ignition Coil

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

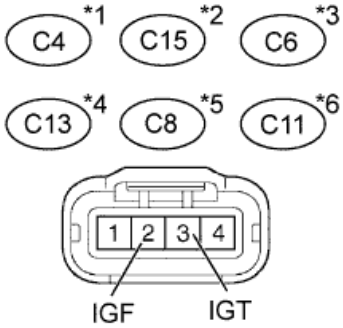
OK

2.CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

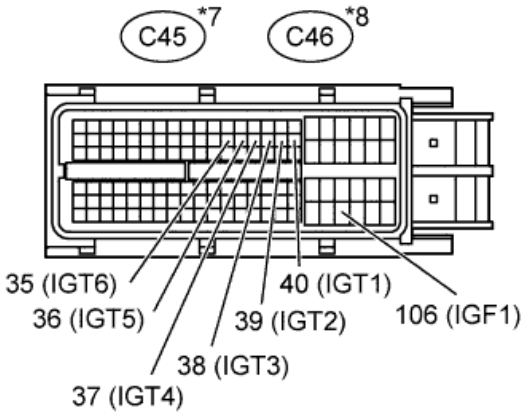
a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Ignition Coil)



Front view of wire harness connector:
(to ECM)



*1: No. 1 Ignition Coil

*2: No. 2 Ignition Coil

*3: No. 3 Ignition Coil

*4: No. 4 Ignition Coil

*5: No. 5 Ignition Coil

*6: No. 6 Ignition Coil

*7: for LHD

*8: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C15-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C6-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C13-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C8-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω

C11-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C4-3 (IGT1) - C45-40 (IGT1)	Always	Below 1 Ω
C15-3 (IGT2) - C45-39 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C45-38 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C45-37 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C45-36 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C45-35 (IGT6)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C15-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C6-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C13-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C8-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C11-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C4-3 (IGT1) - C46-40 (IGT1)	Always	Below 1 Ω
C15-3 (IGT2) - C46-39 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C46-38 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C46-37 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C46-36 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C46-35 (IGT6)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C6-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C13-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C11-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C45-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C45-39 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C45-38 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C45-37 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C45-36 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C45-35 (IGT6) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C6-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C13-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C11-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C46-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C46-39 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C46-38 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C46-37 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C46-36 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C46-35 (IGT6) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353, P0354, P0355 OR P0356)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Shuffle arrangement of the ignition coils (among No. 1 to No. 6 cylinders).

NOTICE:

Do not shuffle the connectors.

e. Perform a simulation test.

f. Check the output DTCs displayed on the tester.

Result

Result	Proceed to
Same DTC output	A
Different ignition coil DTC output	B

B → REPLACE IGNITION COIL ASSEMBLY (Click here)

A

REPLACE ECM (Click here)

DTC P0031 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)

DTC P0032 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)

DTC P0051 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)

DTC P0052 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)

for Preparation Click here

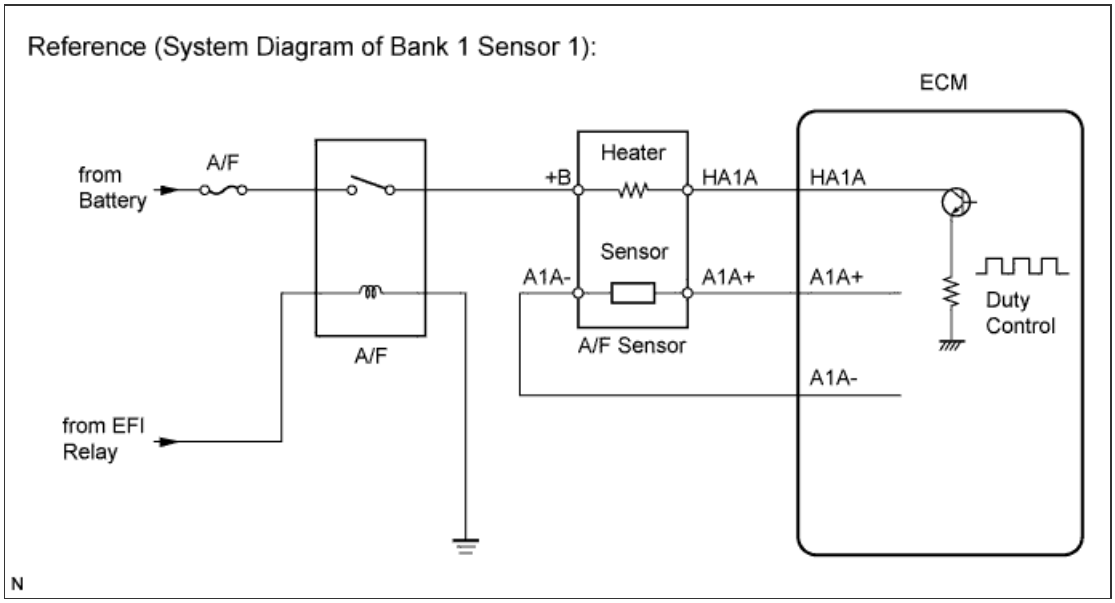
DESCRIPTION

Refer to DTC P2195 (Click here).

HINT:

- **When either of these DTCs are stored, the ECM enters fail-safe mode. The ECM turns off the A/F sensor heater in fail-safe mode. Fail-safe mode continues until the ignition switch is turned off.**
- **Although the DTC titles say the oxygen sensor, these DTCs relate to the Air Fuel Ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**

- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The A/F sensor heater circuit uses a relay on the +B side of the circuit.**



DTC Code	DTC Detection Condition	Trouble Area
P0031 P0051	The Air Fuel ratio (A/F) sensor heater current is below 0.8 A (1 trip detection logic).	• Open in Air Fuel Ratio (A/F) sensor heater circuit • A/F sensor heater (for Bank 1, 2 Sensor 1) • Integration relay (A/F relay) • ECM
P0032 P0052	An Air Fuel ratio (A/F) sensor heater current failure (1 trip detection logic).	• Short in A/F sensor heater circuit • A/F sensor heater (for Bank 1, 2 Sensor 1) • Integration relay (A/F relay) • ECM

HINT:

- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

MONITOR DESCRIPTION

The ECM uses information from the Air Fuel Ratio (A/F) sensor to regulate the air fuel ratio and keep it close to the stoichiometric level. This maximizes the ability of the Three-Way Catalytic Converter (TWC) to purify the exhaust gases.

The A/F sensor detects oxygen levels in the exhaust gas and transmits the information to the ECM. The inner surface of the sensor element is exposed to the outside air. The outer surface of the sensor element is exposed to the exhaust gas. The sensor element is made of platinum coated zirconia and includes an integrated heating element.
The zirconia element generates a small voltage when there is a large difference in the oxygen concentrations between the exhaust gas and outside air. The platinum coating amplifies this voltage generation.
The A/F sensor is more efficient when heated. When the exhaust gas temperature is low, the sensor cannot generate useful voltage signals without supplementary heating. The ECM regulates the supplementary heating using a duty-cycle approach to adjust the average current in the sensor heater element. If the heater current is outside the normal range, the signal transmitted by the A/F sensor becomes inaccurate, as a result, the ECM is unable to regulate air fuel ratio properly.
When the current in the A/F sensor heater is outside the normal operating range, the ECM interprets this as a malfunction in the sensor heater and stores a DTC.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

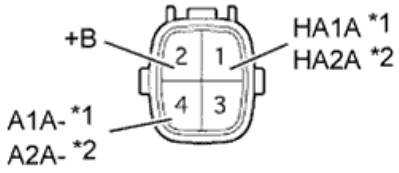
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

a. Disconnect the Air Fuel ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

Standard Resistance:

for Bank 1 Sensor 1

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher

for Bank 2 Sensor 1

Tester Connection	Condition	Specified Condition
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

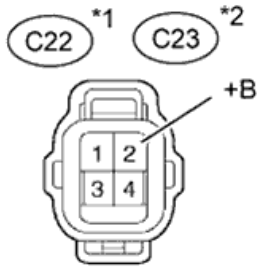
NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF A/F SENSOR)

a. Measure the voltage according to the value(s) in the table below.

Front view of wire harness connector:
(to A/F Sensor)



*1: for Bank 1

*2: for Bank 2

Standard Voltage:

for Bank 1 Sensor 1

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

for Bank 2 Sensor 1

Tester Connection	Switch Condition	Specified Condition
C23-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

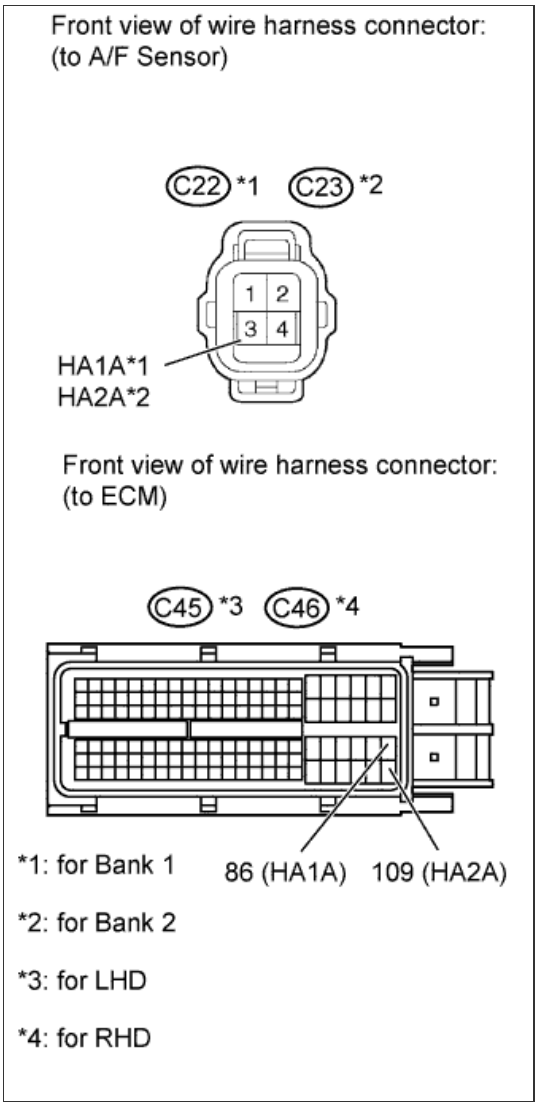
NG → Go to step 5

OK

3.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) -		10 kΩ or

Body ground	Always	higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Start the engine.

f. Allow the engine to idle for 1 minute or more.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read the DTCs.

Result

Result	Proceed to
No output	A
P0031, P0032, P0051 or P0052	B

B → REPLACE ECM (Click here)

A

CHECK FOR INTERMITTENT PROBLEMS (Click here)

5.INSPECT INTEGRATION NO.1 RELAY (A/F RELAY)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

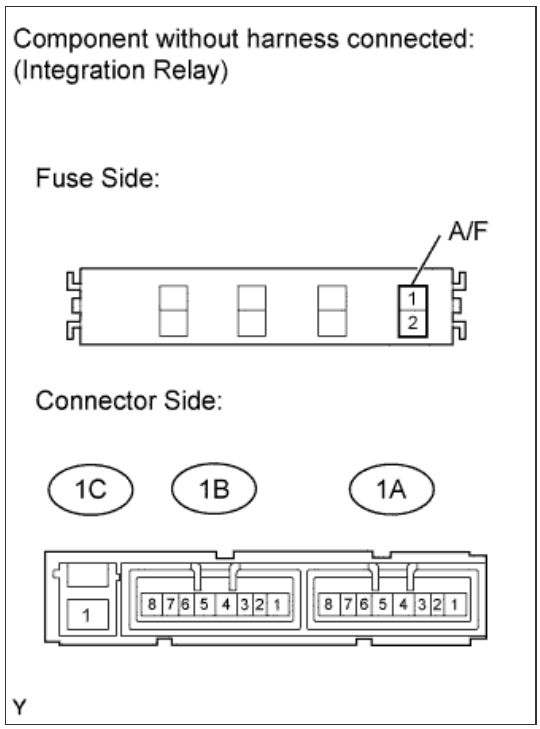
iii. Reinstall the A/F fuse.

c. Inspect the A/F relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1A-4 - 1C-1	Battery voltage not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω



NG → REPLACE INTEGRATION NO.1 RELAY

OK

6.CHECK HARNESS AND CONNECTOR (A/F SENSOR - INTEGRATION RELAY)

a. Remove the integration relay from the engine room relay block.

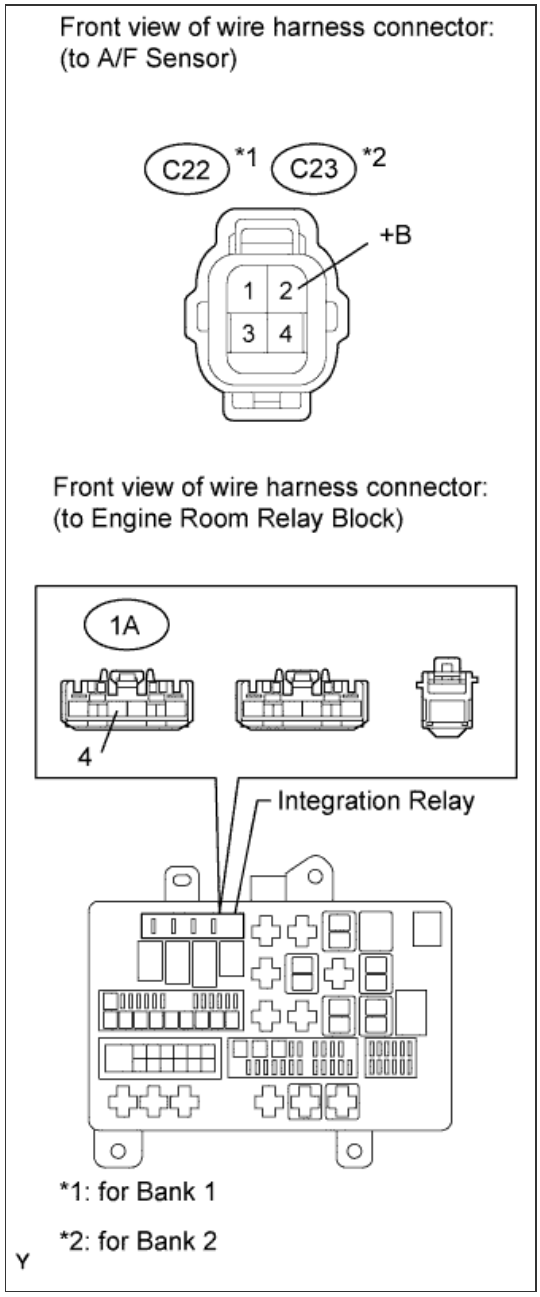
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C22-2 (+B) - 1A-4	Always	Below 1 Ω
C23-2 (+B) - 1A-4	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
C22-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher
C23-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

DTC P0351 Ignition Coil "A" Primary / Secondary Circuit

DTC P0352 Ignition Coil "B" Primary / Secondary Circuit

DTC P0353 Ignition Coil "C" Primary / Secondary Circuit

DTC P0354 Ignition Coil "D" Primary / Secondary Circuit

DTC P0355 Ignition Coil "E" Primary / Secondary Circuit

DTC P0356 Ignition Coil "F" Primary / Secondary Circuit

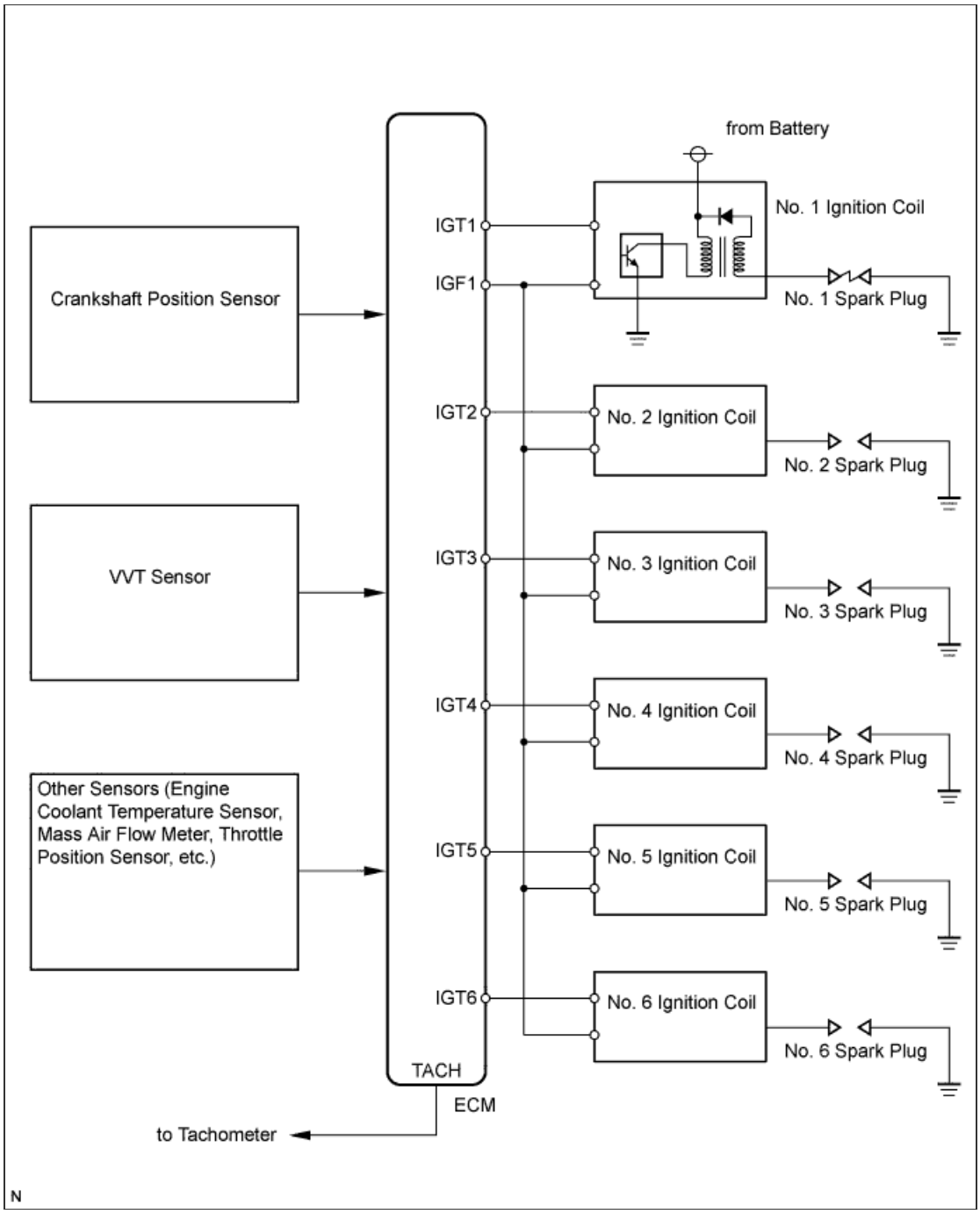
for Preparation Click here

DESCRIPTION

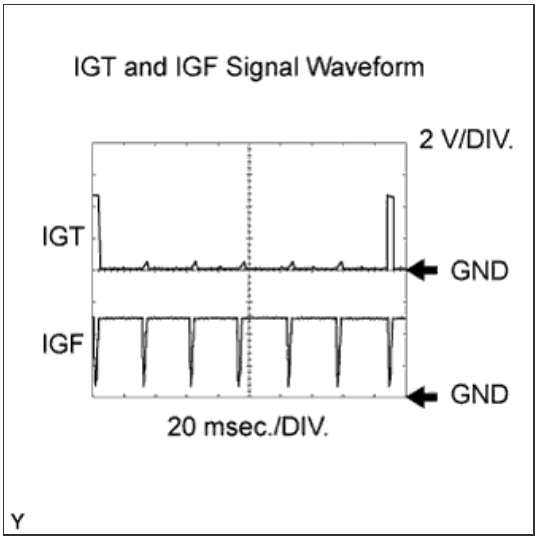
HINT:

- **These DTCs indicate malfunctions relating to the primary circuit.**
- **If DTC P0351 is output, check the No. 1 ignition coil circuit.**
- **If DTC P0352 is output, check the No. 2 ignition coil circuit.**
- **If DTC P0353 is output, check the No. 3 ignition coil circuit.**
- **If DTC P0354 is output, check the No. 4 ignition coil circuit.**
- **If DTC P0355 is output, check the No. 5 ignition coil circuit.**
- **If DTC P0356 is output, check the No. 6 ignition coil circuit.**

A Direct Ignition System (DIS) is used on this vehicle.
The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil, and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.
The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.



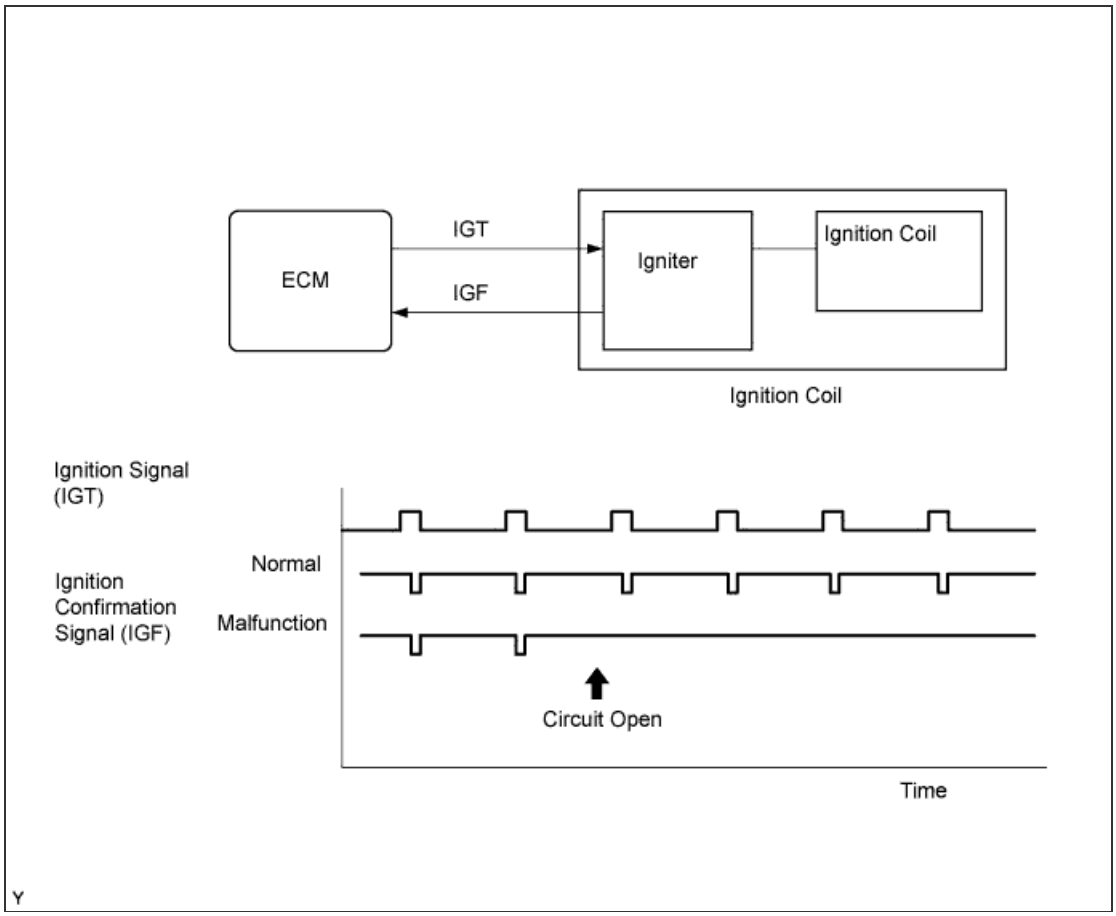
DTC Code	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356	No IGF signal is sent to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 6) between ignition coil and ECM • No. 1 to No. 6 ignition coils • ECM



Reference: Inspection using an oscilloscope.
While cranking or idling the engine, check the waveform between terminals IGT (1 to 6) and E1, and IGF1 and E1 of the ECM connector.

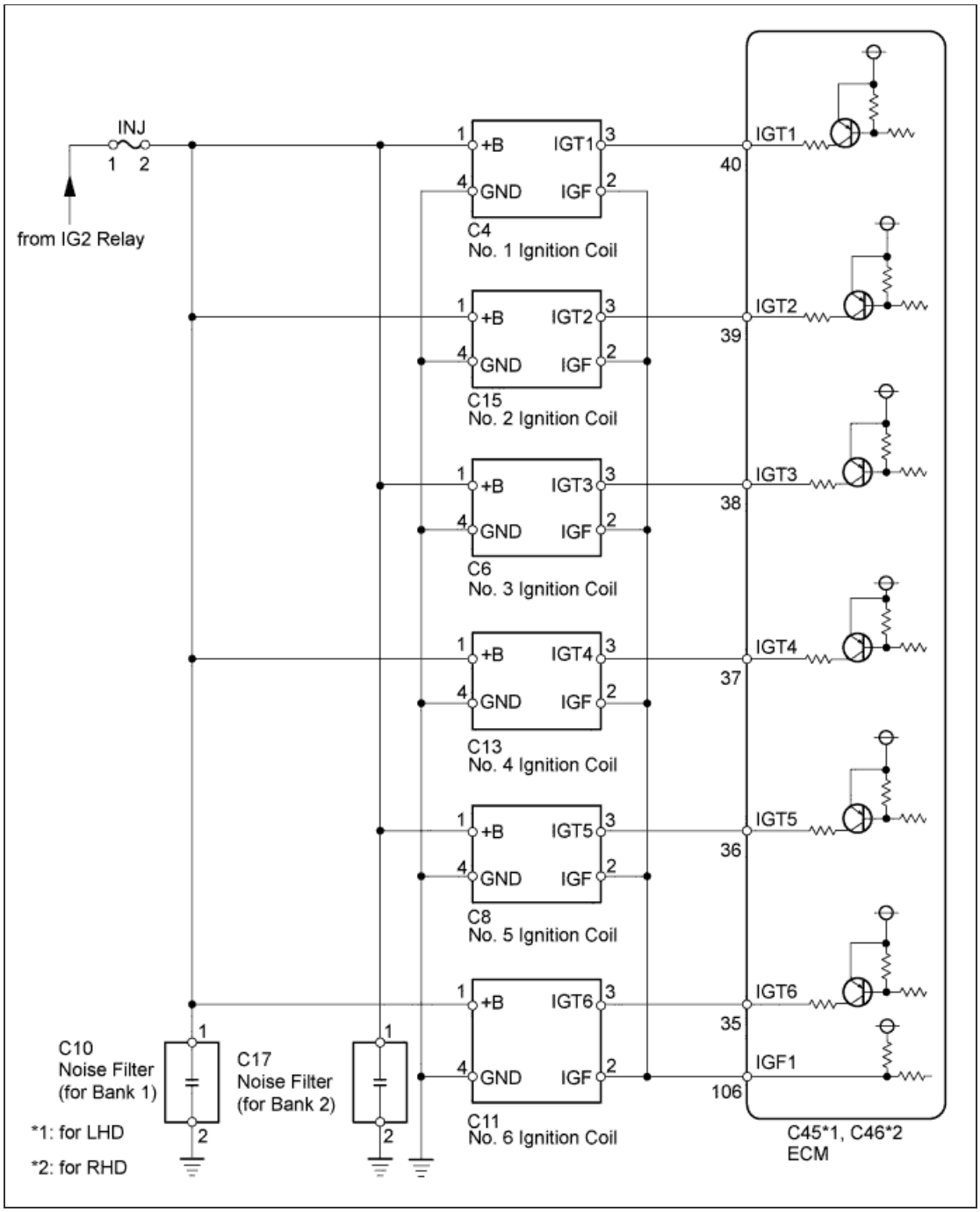
Item	Content
Terminal	CH1: IGT1, IGT2, IGT3, IGT4, IGT5, IGT6 - E1 CH2: IGF1 - E1
Equipment Setting	2 V/DIV. 20 msec./DIV.
Condition	Cranking or idling

MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)

a. Disconnect the ignition coil connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C4-4 (GND) - Body ground	Always	Below 1 Ω
C15-4 (GND) - Body ground	Always	Below 1 Ω
C6-4 (GND) - Body ground	Always	Below 1 Ω

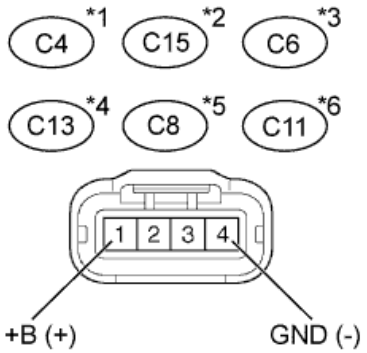
C13-4 (GND) - Body ground	Always	Below 1 Ω
C8-4 (GND) - Body ground	Always	Below 1 Ω
C11-4 (GND) - Body ground	Always	Below 1 Ω

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage (Check for Open):

Tester Connection	Switch Condition	Specified Condition
C4-1 (+B) - C4-4 (GND)	Ignition switch ON	11 to 14 V
C15-1 (+B) - C15-4 (GND)	Ignition switch ON	11 to 14 V
C6-1 (+B) - C6-4 (GND)	Ignition switch ON	11 to 14 V
C13-1 (+B) - C13-4 (GND)	Ignition switch ON	11 to 14 V
C8-1 (+B) - C8-4 (GND)	Ignition switch ON	11 to 14 V
C11-1 (+B) - C11-4 (GND)	Ignition switch ON	11 to 14 V

Front view of wire harness connector:
(to Ignition Coil)



*1: No. 1 Ignition Coil

*2: No. 2 Ignition Coil

*3: No. 3 Ignition Coil

*4: No. 4 Ignition Coil

*5: No. 5 Ignition Coil

*6: No. 6 Ignition Coil

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

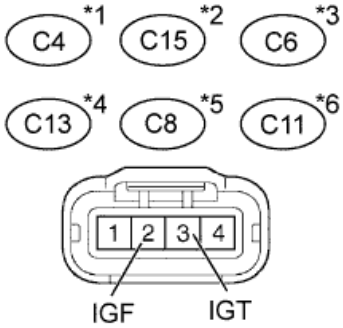
OK

2.CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

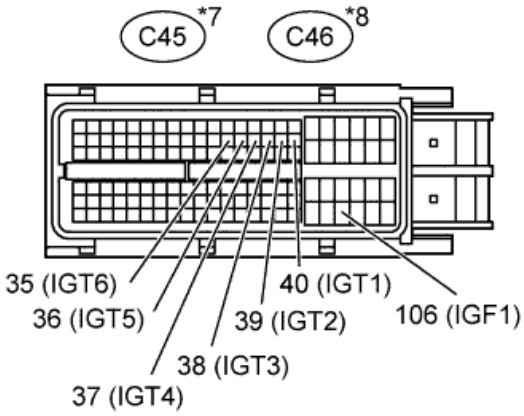
a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Ignition Coil)



Front view of wire harness connector:
(to ECM)



*1: No. 1 Ignition Coil

*2: No. 2 Ignition Coil

*3: No. 3 Ignition Coil

*4: No. 4 Ignition Coil

*5: No. 5 Ignition Coil

*6: No. 6 Ignition Coil

*7: for LHD

*8: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C15-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C6-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C13-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C8-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω

C11-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C4-3 (IGT1) - C45-40 (IGT1)	Always	Below 1 Ω
C15-3 (IGT2) - C45-39 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C45-38 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C45-37 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C45-36 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C45-35 (IGT6)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C15-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C6-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C13-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C8-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C11-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C4-3 (IGT1) - C46-40 (IGT1)	Always	Below 1 Ω
C15-3 (IGT2) - C46-39 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C46-38 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C46-37 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C46-36 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C46-35 (IGT6)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C6-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C13-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C11-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C45-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C45-39 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C45-38 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C45-37 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C45-36 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C45-35 (IGT6) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C6-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C13-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C11-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C46-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C46-39 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C46-38 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C46-37 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C46-36 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C46-35 (IGT6) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353, P0354, P0355 OR P0356)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Shuffle arrangement of the ignition coils (among No. 1 to No. 6 cylinders).

NOTICE:

Do not shuffle the connectors.

e. Perform a simulation test.

f. Check the output DTCs displayed on the tester.

Result

Result	Proceed to
Same DTC output	A
Different ignition coil DTC output	B

B → REPLACE IGNITION COIL ASSEMBLY (Click here)

A

REPLACE ECM (Click here)

DTC P0031 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)

DTC P0032 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)

DTC P0051 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)

DTC P0052 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)

for Preparation Click here

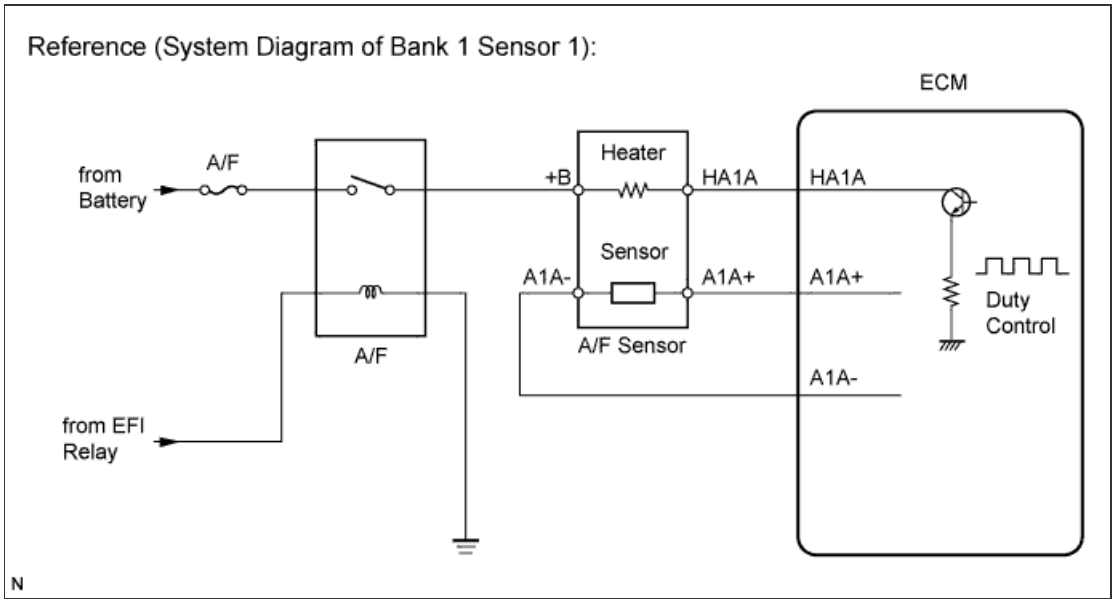
DESCRIPTION

Refer to DTC P2195 (Click here).

HINT:

- **When either of these DTCs are stored, the ECM enters fail-safe mode. The ECM turns off the A/F sensor heater in fail-safe mode. Fail-safe mode continues until the ignition switch is turned off.**
- **Although the DTC titles say the oxygen sensor, these DTCs relate to the Air Fuel Ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**

- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The A/F sensor heater circuit uses a relay on the +B side of the circuit.**



DTC Code	DTC Detection Condition	Trouble Area
P0031 P0051	The Air Fuel ratio (A/F) sensor heater current is below 0.8 A (1 trip detection logic).	• Open in Air Fuel Ratio (A/F) sensor heater circuit • A/F sensor heater (for Bank 1, 2 Sensor 1) • Integration relay (A/F relay) • ECM
P0032 P0052	An Air Fuel ratio (A/F) sensor heater current failure (1 trip detection logic).	• Short in A/F sensor heater circuit • A/F sensor heater (for Bank 1, 2 Sensor 1) • Integration relay (A/F relay) • ECM

HINT:

- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

MONITOR DESCRIPTION

The ECM uses information from the Air Fuel Ratio (A/F) sensor to regulate the air fuel ratio and keep it close to the stoichiometric level. This maximizes the ability of the Three-Way Catalytic Converter (TWC) to purify the exhaust gases.

The A/F sensor detects oxygen levels in the exhaust gas and transmits the information to the ECM. The inner surface of the sensor element is exposed to the outside air. The outer surface of the sensor element is exposed to the exhaust gas. The sensor element is made of platinum coated zirconia and includes an integrated heating element.
The zirconia element generates a small voltage when there is a large difference in the oxygen concentrations between the exhaust gas and outside air. The platinum coating amplifies this voltage generation.
The A/F sensor is more efficient when heated. When the exhaust gas temperature is low, the sensor cannot generate useful voltage signals without supplementary heating. The ECM regulates the supplementary heating using a duty-cycle approach to adjust the average current in the sensor heater element. If the heater current is outside the normal range, the signal transmitted by the A/F sensor becomes inaccurate, as a result, the ECM is unable to regulate air fuel ratio properly.
When the current in the A/F sensor heater is outside the normal operating range, the ECM interprets this as a malfunction in the sensor heater and stores a DTC.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

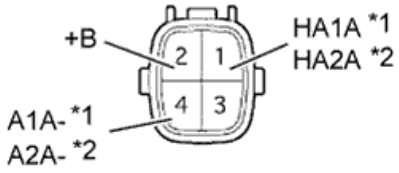
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

a. Disconnect the Air Fuel ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

Standard Resistance:

for Bank 1 Sensor 1

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher

for Bank 2 Sensor 1

Tester Connection	Condition	Specified Condition
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

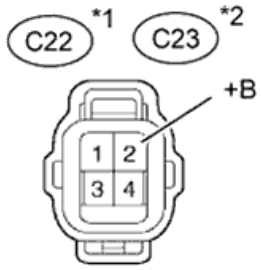
NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF A/F SENSOR)

a. Measure the voltage according to the value(s) in the table below.

Front view of wire harness connector:
(to A/F Sensor)



*1: for Bank 1

*2: for Bank 2

Standard Voltage:

for Bank 1 Sensor 1

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

for Bank 2 Sensor 1

Tester Connection	Switch Condition	Specified Condition
C23-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

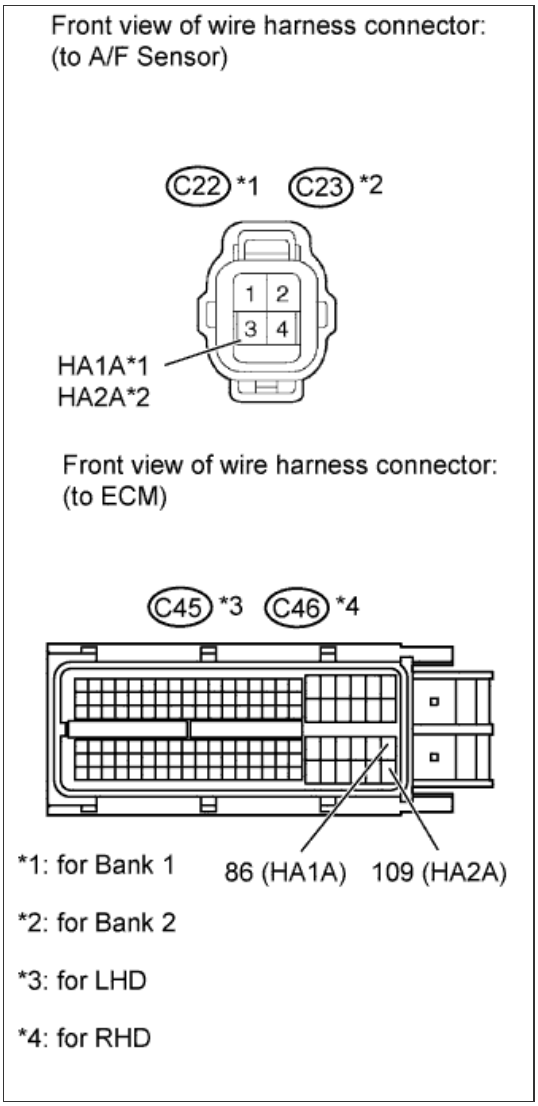
NG → Go to step 5

OK

3.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) -		10 kΩ or

Body ground	Always	higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Start the engine.

f. Allow the engine to idle for 1 minute or more.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read the DTCs.

Result

Result	Proceed to
No output	A
P0031, P0032, P0051 or P0052	B

B → REPLACE ECM (Click here)

A

CHECK FOR INTERMITTENT PROBLEMS (Click here)

5.INSPECT INTEGRATION NO.1 RELAY (A/F RELAY)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

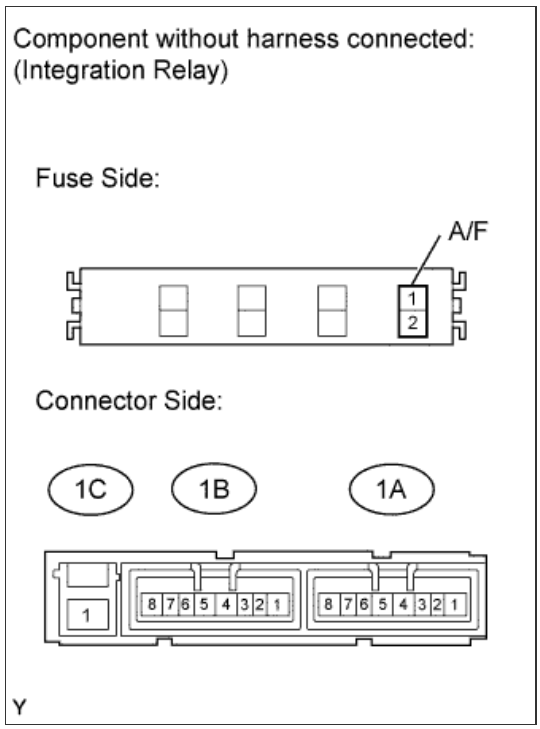
iii. Reinstall the A/F fuse.

c. Inspect the A/F relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1A-4 - 1C-1	Battery voltage not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω



NG → REPLACE INTEGRATION NO.1 RELAY

OK

6.CHECK HARNESS AND CONNECTOR (A/F SENSOR - INTEGRATION RELAY)

a. Remove the integration relay from the engine room relay block.

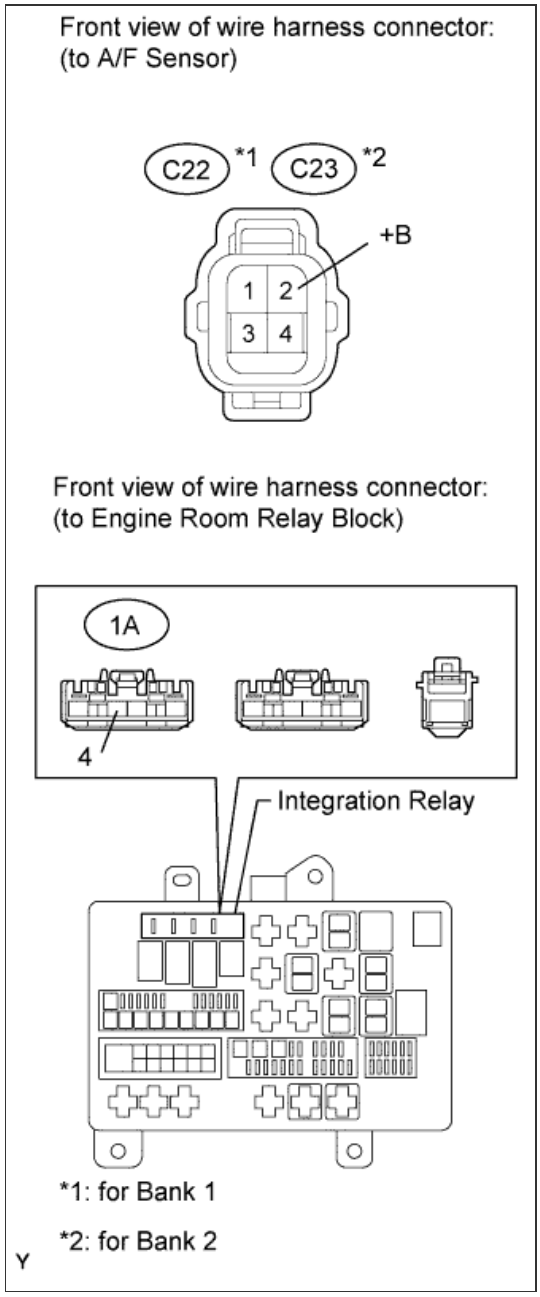
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C22-2 (+B) - 1A-4	Always	Below 1 Ω
C23-2 (+B) - 1A-4	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
C22-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher
C23-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

DTC P0351 Ignition Coil "A" Primary / Secondary Circuit

DTC P0352 Ignition Coil "B" Primary / Secondary Circuit

DTC P0353 Ignition Coil "C" Primary / Secondary Circuit

DTC P0354 Ignition Coil "D" Primary / Secondary Circuit

DTC P0355 Ignition Coil "E" Primary / Secondary Circuit

DTC P0356 Ignition Coil "F" Primary / Secondary Circuit

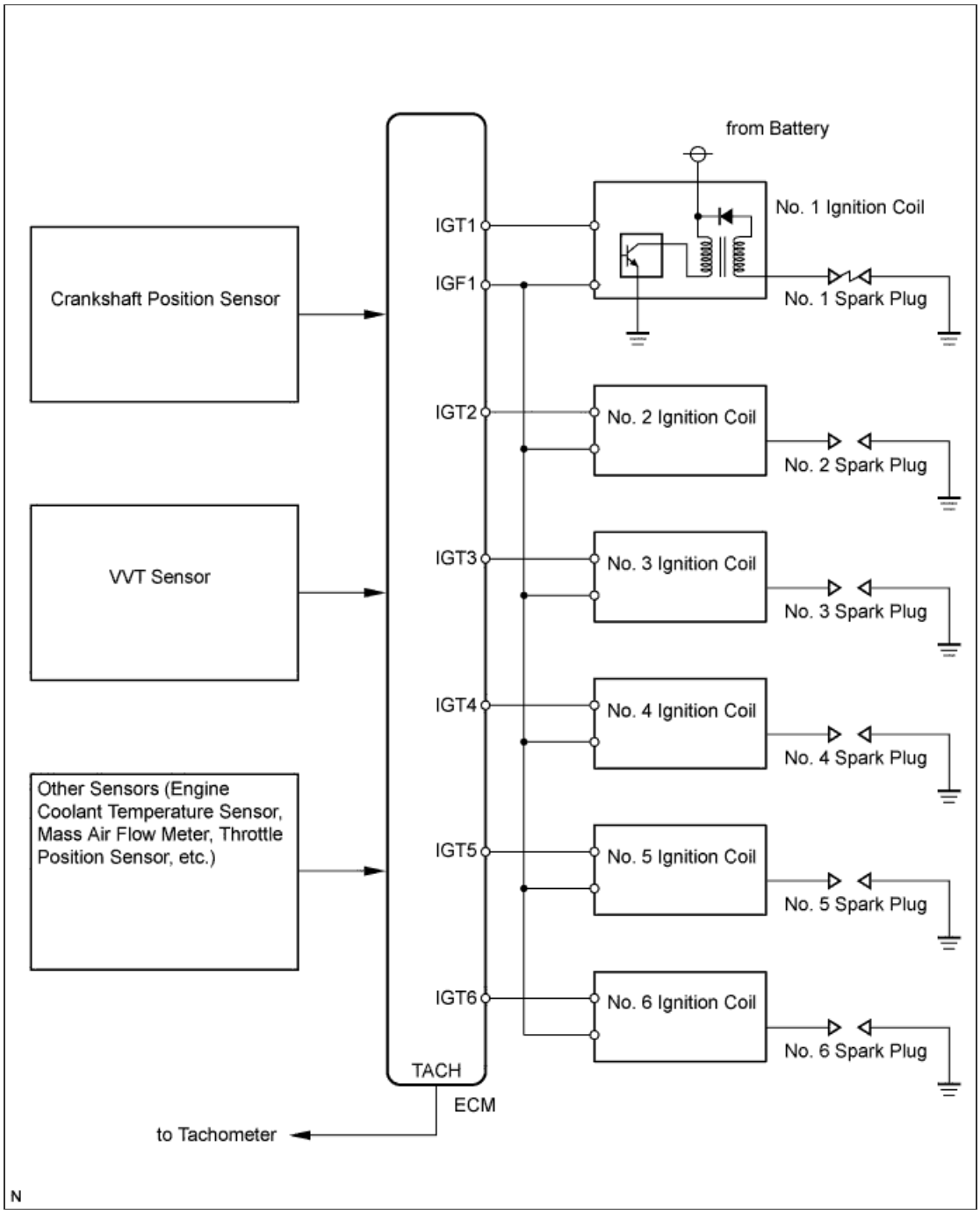
for Preparation Click here

DESCRIPTION

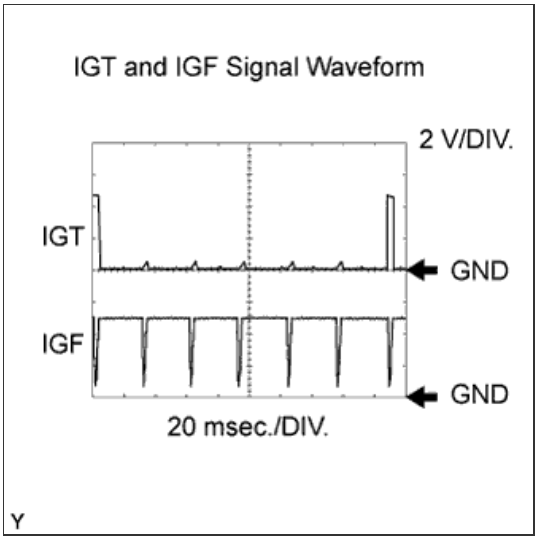
HINT:

- **These DTCs indicate malfunctions relating to the primary circuit.**
- **If DTC P0351 is output, check the No. 1 ignition coil circuit.**
- **If DTC P0352 is output, check the No. 2 ignition coil circuit.**
- **If DTC P0353 is output, check the No. 3 ignition coil circuit.**
- **If DTC P0354 is output, check the No. 4 ignition coil circuit.**
- **If DTC P0355 is output, check the No. 5 ignition coil circuit.**
- **If DTC P0356 is output, check the No. 6 ignition coil circuit.**

A Direct Ignition System (DIS) is used on this vehicle.
The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil, and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.
The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.



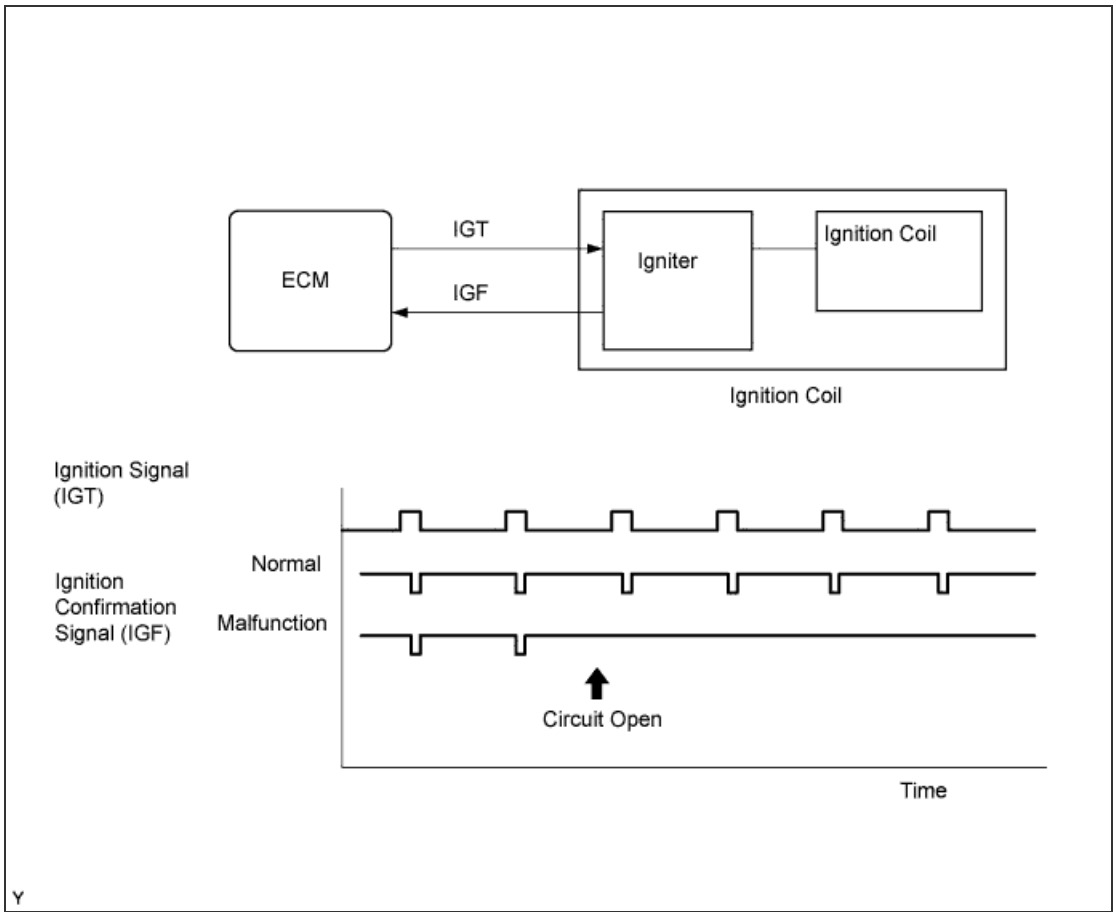
DTC Code	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356	No IGF signal is sent to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 6) between ignition coil and ECM • No. 1 to No. 6 ignition coils • ECM



Reference: Inspection using an oscilloscope.
While cranking or idling the engine, check the waveform between terminals IGT (1 to 6) and E1, and IGF1 and E1 of the ECM connector.

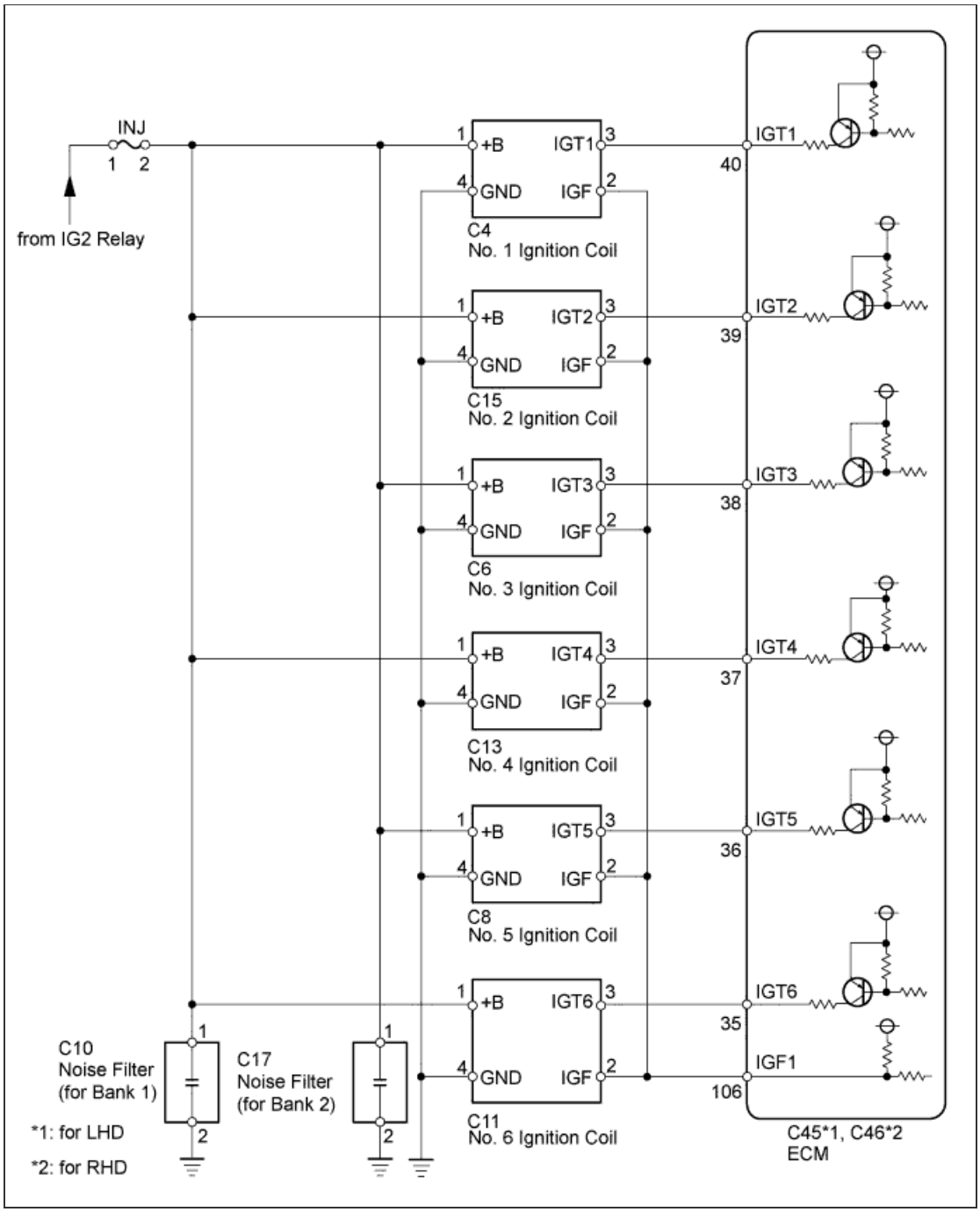
Item	Content
Terminal	CH1: IGT1, IGT2, IGT3, IGT4, IGT5, IGT6 - E1 CH2: IGF1 - E1
Equipment Setting	2 V/DIV. 20 msec./DIV.
Condition	Cranking or idling

MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)

a. Disconnect the ignition coil connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C4-4 (GND) - Body ground	Always	Below 1 Ω
C15-4 (GND) - Body ground	Always	Below 1 Ω
C6-4 (GND) - Body ground	Always	Below 1 Ω

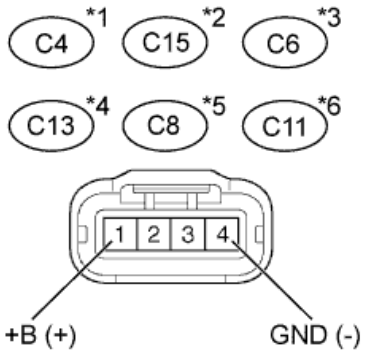
C13-4 (GND) - Body ground	Always	Below 1 Ω
C8-4 (GND) - Body ground	Always	Below 1 Ω
C11-4 (GND) - Body ground	Always	Below 1 Ω

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage (Check for Open):

Tester Connection	Switch Condition	Specified Condition
C4-1 (+B) - C4-4 (GND)	Ignition switch ON	11 to 14 V
C15-1 (+B) - C15-4 (GND)	Ignition switch ON	11 to 14 V
C6-1 (+B) - C6-4 (GND)	Ignition switch ON	11 to 14 V
C13-1 (+B) - C13-4 (GND)	Ignition switch ON	11 to 14 V
C8-1 (+B) - C8-4 (GND)	Ignition switch ON	11 to 14 V
C11-1 (+B) - C11-4 (GND)	Ignition switch ON	11 to 14 V

Front view of wire harness connector:
(to Ignition Coil)



*1: No. 1 Ignition Coil

*2: No. 2 Ignition Coil

*3: No. 3 Ignition Coil

*4: No. 4 Ignition Coil

*5: No. 5 Ignition Coil

*6: No. 6 Ignition Coil

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

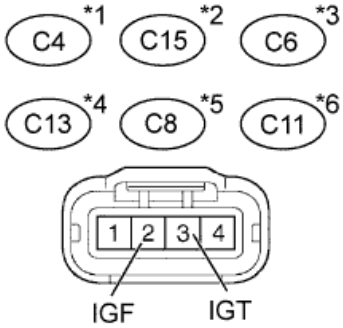
OK

2.CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

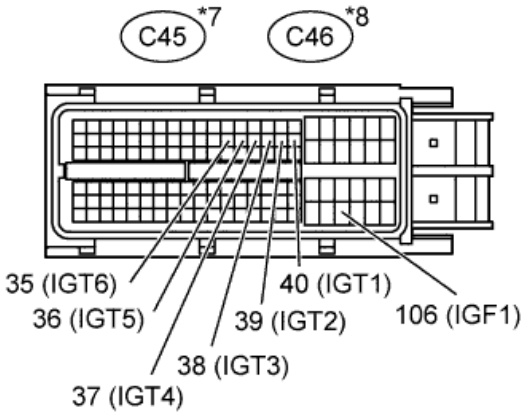
a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Ignition Coil)



Front view of wire harness connector:
(to ECM)



*1: No. 1 Ignition Coil

*2: No. 2 Ignition Coil

*3: No. 3 Ignition Coil

*4: No. 4 Ignition Coil

*5: No. 5 Ignition Coil

*6: No. 6 Ignition Coil

*7: for LHD

*8: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C15-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C6-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C13-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C8-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω

C11-2 (IGF) - C45-106 (IGF1)	Always	Below 1 Ω
C4-3 (IGT1) - C45-40 (IGT1)	Always	Below 1 Ω
C15-3 (IGT2) - C45-39 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C45-38 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C45-37 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C45-36 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C45-35 (IGT6)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C15-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C6-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C13-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C8-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C11-2 (IGF) - C46-106 (IGF1)	Always	Below 1 Ω
C4-3 (IGT1) - C46-40 (IGT1)	Always	Below 1 Ω
C15-3 (IGT2) - C46-39 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C46-38 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C46-37 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C46-36 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C46-35 (IGT6)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C6-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C13-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C11-2 (IGF) or C45-106 (IGF1) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C45-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C45-39 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C45-38 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C45-37 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C45-36 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C45-35 (IGT6) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C4-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C6-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C13-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C11-2 (IGF) or C46-106 (IGF1) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C46-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C46-39 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C46-38 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C46-37 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C46-36 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C46-35 (IGT6) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353, P0354, P0355 OR P0356)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Shuffle arrangement of the ignition coils (among No. 1 to No. 6 cylinders).

NOTICE:

Do not shuffle the connectors.

e. Perform a simulation test.

f. Check the output DTCs displayed on the tester.

Result

Result	Proceed to
Same DTC output	A
Different ignition coil DTC output	B

B → REPLACE IGNITION COIL ASSEMBLY (Click here)

A

REPLACE ECM (Click here)

DTC P0037 Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)

DTC P0038 Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)

DTC P0057 Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)

DTC P0058 Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)

DTC P0141 Oxygen Sensor Heater Circuit Malfunction (Bank 1 Sensor 2)

DTC P0161 Oxygen Sensor Heater Circuit Malfunction (Bank 2 Sensor 2)

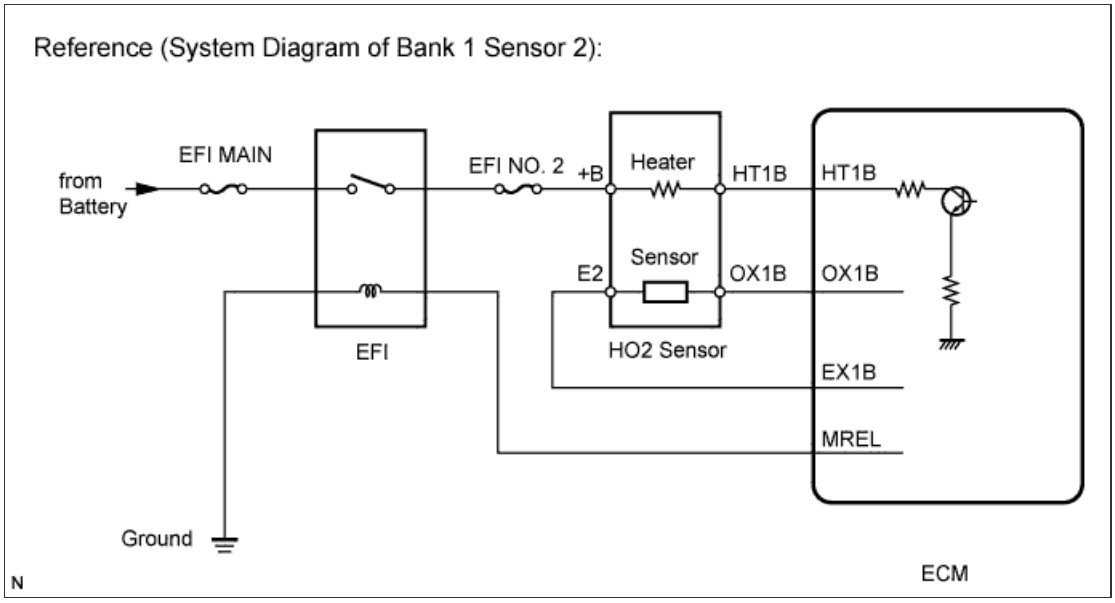
for Preparation Click here

DESCRIPTION

Refer to DTC P0136 (Click here).

HINT:

- **Sensor 2 refers to the sensor mounted behind the Three-Way Catalytic Converter (TWC) and located far from the engine assembly.**
- **When any of these DTCs are stored, the ECM enters fail-safe mode. The ECM turns off the Heated Oxygen (HO2) sensor heater in fail-safe mode. Fail-safe mode continues until the ignition switch is turned off.**
- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The HO2 sensor heater circuit uses a relay on the +B side of the circuit.**



DTC Code	DTC Detection Condition	Trouble Area
P0037 P0057	The Heated Oxygen (HO2) sensor heater (bank 1, 2 sensor 2) current is below 0.3 A (1 trip detection logic).	• **Open in Heated Oxygen (HO2) sensor heater (bank 1, 2 sensor 2) circuit** • **HO2 sensor heater (bank 1, 2 sensor 2)** • **EFI NO. 2 fuse** • **ECM**
P0038 P0058	The Heated Oxygen (HO2) sensor heater (bank 1, 2 sensor 2) current is higher than 2 A (1 trip detection logic).	• **Short in HO2 sensor heater (bank 1, 2 sensor 2) circuit** • **HO2 sensor heater (bank 1, 2 sensor 2)** • **EFI NO. 2 fuse** • **ECM**
P0141 P0161	The cumulative heater resistance correction value exceeds the acceptable threshold (2 trip detection logic).	• **Open or short in HO2 sensor heater (bank 1, 2 sensor 2) circuit** • **HO2 sensor heater (bank 1, 2 sensor 2)** • **EFI NO. 2 fuse** • **ECM**

HINT:

- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

MONITOR DESCRIPTION

The sensing portion of the Heated Oxygen (HO2) sensor has a zirconia element which is used to detect the oxygen concentration in the exhaust gas. If the zirconia element is at the appropriate temperature, and the difference between the oxygen concentrations surrounding the inside and outside surfaces of the sensor is large, the zirconia element generates voltage signals. In order to increase the oxygen concentration detecting capacity of the zirconia element, the ECM supplements the heat from the exhaust with heat from a heating element inside the sensor.

Heated oxygen sensor heater range check (P0037, P0038, P0057 and P0058):

The ECM monitors the current applied to the HO2 sensor heater to check the heater for malfunctions. If the current is below the threshold value, the ECM will determine that there is an open circuit in the heater. If the current is above the threshold value, the ECM will determine that there is a short circuit in the heater.

Example:

The ECM stores DTC P0038 or P0058 when the current in the HO2 sensor heater is higher than 2 A. Conversely, when the heater current is below 0.3 A, DTC P0037 or P0057 is stored.

Heated oxygen sensor heater performance (P0141 and P0161):

After the accumulated heater ON time exceeds 100 seconds, the ECM calculates the heater resistance using the battery voltage and the current applied to the heater. If the resistance is above the threshold value, the ECM will determine that there is a malfunction in the HO2 sensor heater and store DTCs P0141 and P0161.

WIRING DIAGRAM

Refer to DTC P0136 (Click here).

INSPECTION PROCEDURE

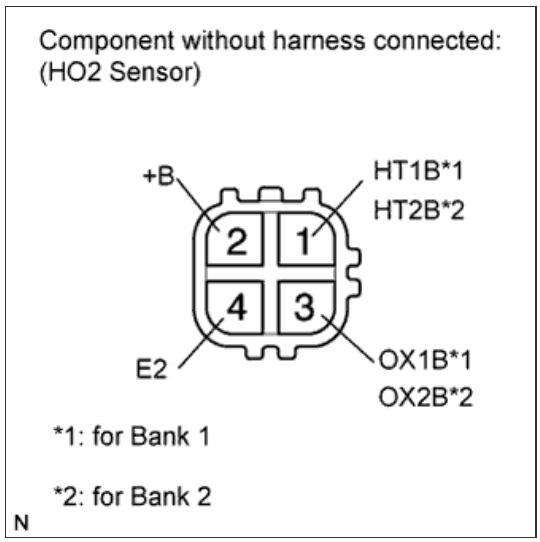
HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

a. Disconnect the heated oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for Bank 1 Sensor 2

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT1B) - 4 (E2)	Always	10 kΩ or higher

for Bank 2 Sensor 2

Tester Connection	Condition	Specified Condition
1 (HT2B) - 2 (+B)	20°C (68°F)	11 to 16 Ω

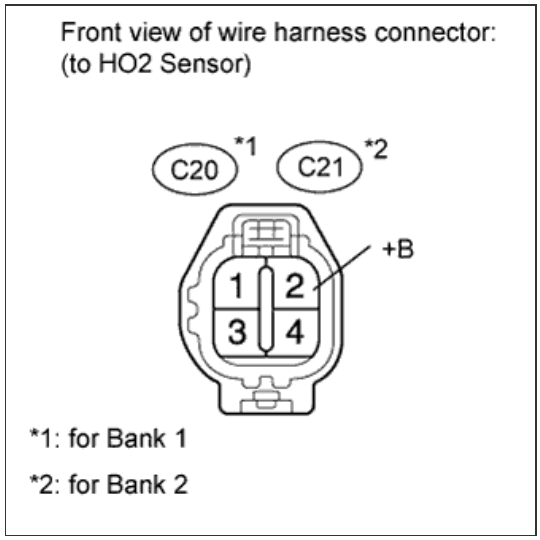
1 (HT2B) - 4 (E2)	Always	10 kΩ or higher

NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF HO2 SENSOR)

a. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for Bank 1 Sensor 1

Tester Connection	Switch Condition	Specified Condition
C20-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

for Bank 2 Sensor 1

Tester Connection	Switch Condition	Specified Condition
C21-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

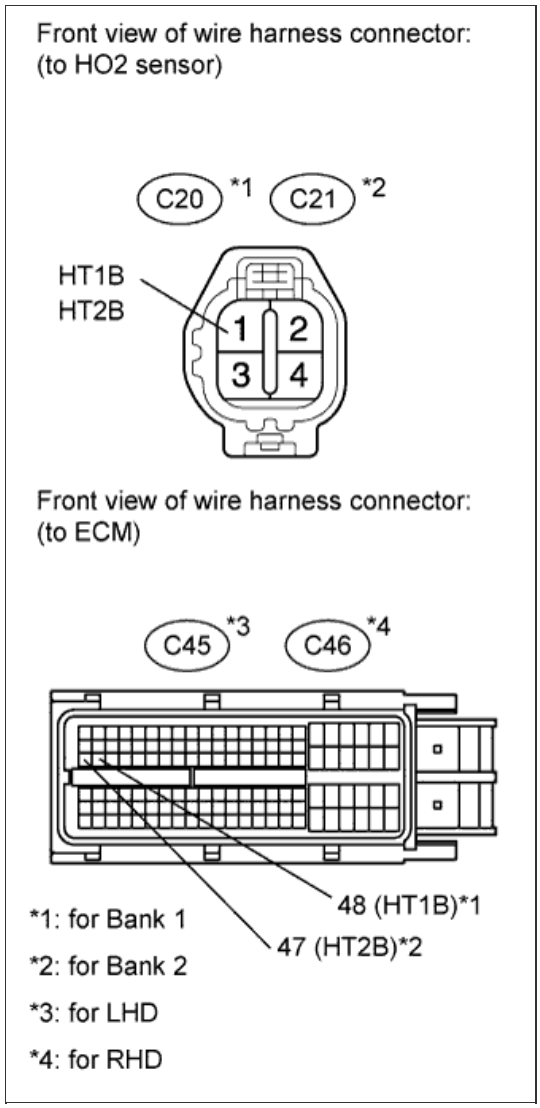
NG → Go to step 4

OK

3.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C45-48 (HT1B)	Always	Below 1 Ω
C21-1 (HT2B) - C45-47 (HT2B)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C46-48 (HT1B)	Always	Below 1 Ω
C21-1 (HT2B) - C46-47 (HT2B)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C45-48 (HT1B) - Body ground	Always	10 kΩ or higher
C21-1 (HT2B) or C45-47 (HT2B) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C46-48 (HT1B) -		10 kΩ or

Body ground	Always	higher
C21-1 (HT2B) or C46-47 (HT2B) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

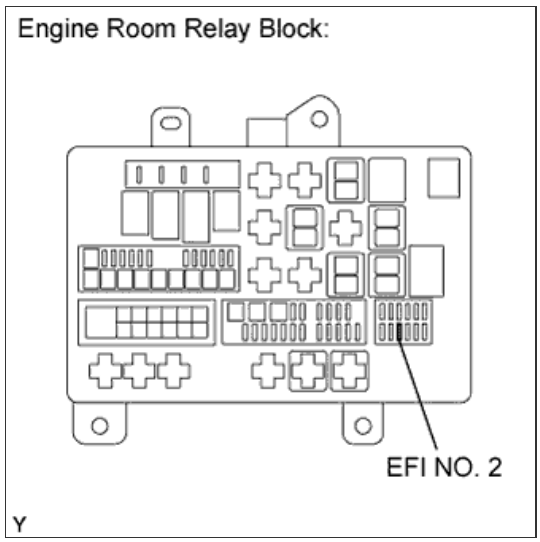
4.INSPECT FUSE (EFI NO. 2)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse	Always	Below 1 Ω



NG → CHECK FOR SHORT IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

OK

5.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - EFI NO. 2 FUSE)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

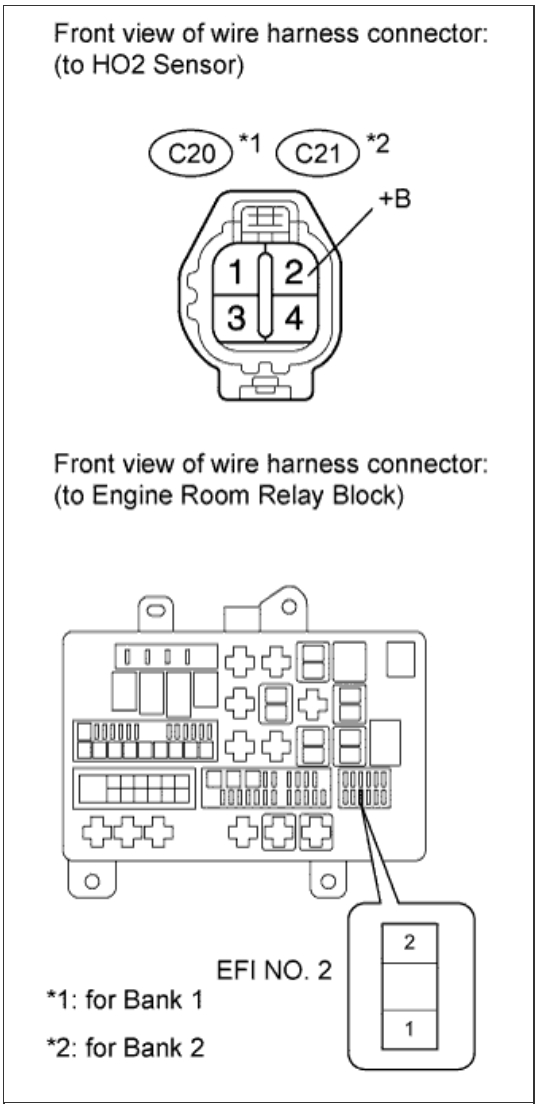
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C20-2 (+B) - EFI NO. 2 fuse (2)	Always	Below 1 Ω
C21-2 (+B) - EFI NO. 2 fuse (2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
C20-2 (+B) or EFI NO. 2 fuse (2) - Body ground	Always	10 kΩ or higher
C21-2 (+B) or EFI NO. 2 fuse (2) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6.CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - EFI NO. 2 FUSE)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

b. Remove the integration relay from the engine room relay block.

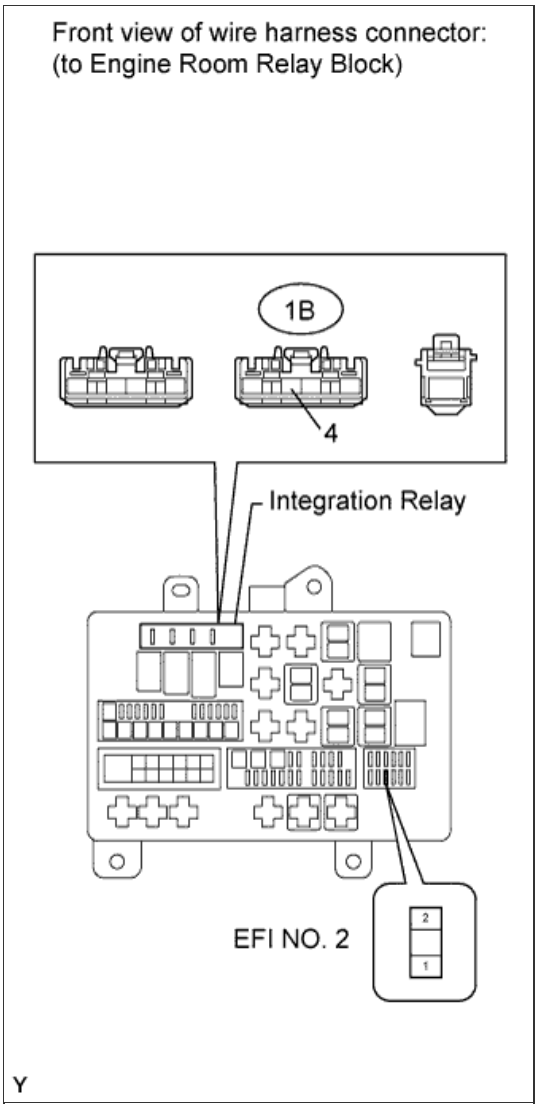
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse (1) - 1B-4	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse (1) or 1B-4 - Body ground	Always	10 kΩ or higher



NG → REPLACE ENGINE ROOM RELAY BLOCK

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

DTC P0420 Catalyst System Efficiency Below Threshold (Bank 1)

DTC P0430 Catalyst System Efficiency Below Threshold (Bank 2)

for Preparation Click here

MONITOR DESCRIPTION

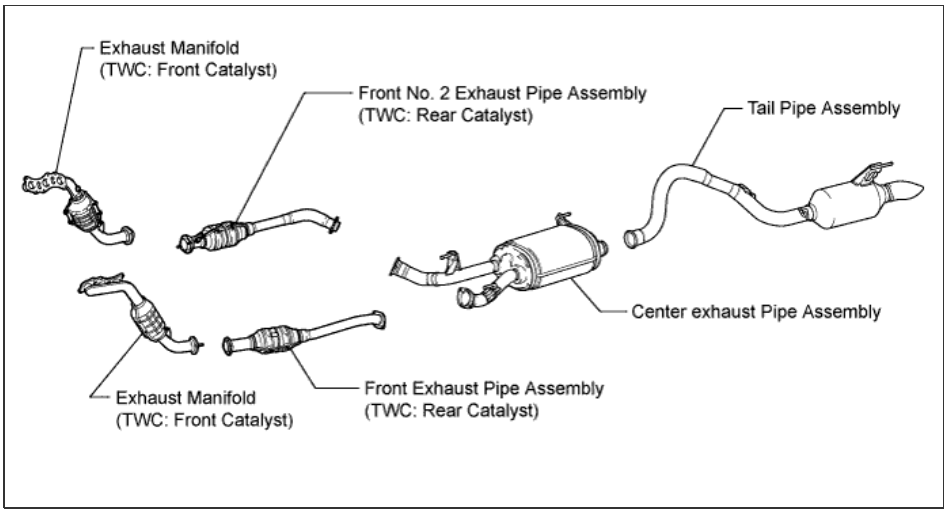
The ECM uses sensors mounted in front of and behind the Three-Way Catalytic Converter (TWC) to monitor its efficiency.
The first sensor, the Air Fuel Ratio (A/F) sensor, sends pre-catalyst information to the ECM. The second sensor, the Heated Oxygen (HO2) sensor, sends post-catalyst information to the ECM.
In order to detect any deterioration in the TWC, the ECM calculates the Oxygen Storage Capacity (OSC) of the TWC. This calculation is based on the voltage output of the HO2 sensor while performing active air fuel ratio control.
The OSC value is an indication of the oxygen storage capacity of the TWC. When the vehicle is being driven with a warm engine, active air fuel ratio control is performed for approximately 15 to 20 seconds. When it is performed, the ECM deliberately sets the air fuel ratio to lean or rich levels. If a rich-lean cycle of the HO2 sensor is long, the OSC becomes greater. There is a direct correlation between the OSCs of the HO2 sensor and the TWC.
The ECM uses the OSC value to determine the state of the TWC. If any deterioration has occurred, it illuminates the MIL and sets a DTC.

DTC Code	DTC Detection Condition	Trouble Area
P0420	The OSC value is smaller than the standard value under active air fuel ratio control (2 trip detection logic).	• Gas leakage from exhaust system • A/F sensor (bank 1 sensor 1) • HO2 sensor (bank 1 sensor 2) • Exhaust manifold (bank 1)(with TWC: front catalyst) • Front exhaust pipe assembly (with TWC: rear catalyst)
P0430	The OSC value is smaller than the standard value under active air fuel ratio control (2 trip detection logic).	• Gas leakage from exhaust system • A/F sensor (bank 2 sensor 1) • HO2 sensor (bank 2 sensor 2) • Exhaust manifold (bank 2)(with TWC: front catalyst) • Front No. 2 exhaust pipe assembly (with TWC: rear catalyst)

HINT:

- **Bank 1 refers to the bank that includes cylinder No. 1.**
- **Bank 2 refers to the bank that does not include cylinder No. 1.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

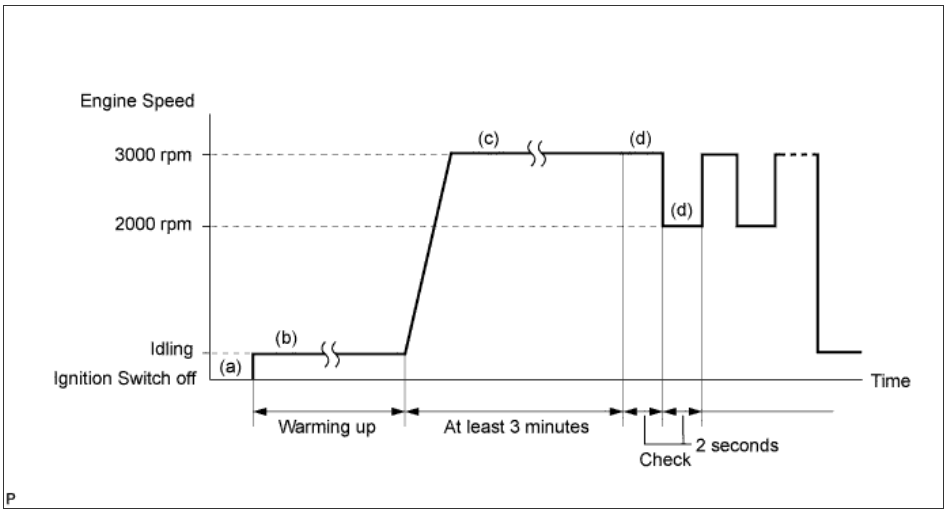
CATALYST LOCATION



CONDITIONING FOR SENSOR TESTING

HINT:

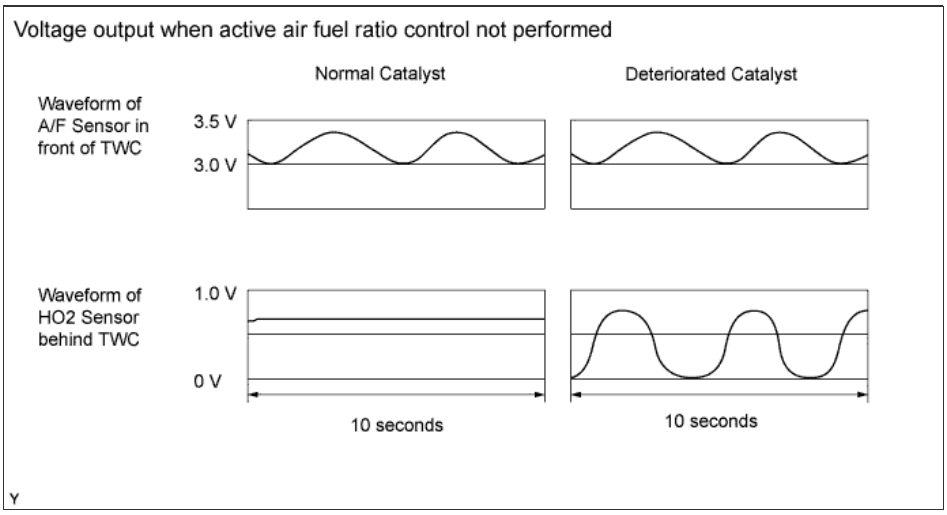
Perform the operation with the engine speeds and time durations described below prior to checking the waveforms of the A/F and HO2 sensors. This is in order to activate the sensors sufficiently to obtain the appropriate inspection results.



(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and warm it up with all the accessories switched OFF until the engine coolant temperature stabilizes.
(c) Run the engine at an engine speed of between 2500 rpm and 3000 rpm for at least 3 minutes.
(d) While alternately running the engine at 3000 rpm for 2 seconds and 2000 rpm for 2 seconds, check the waveforms of the A/F and HO2 sensors using the intelligent tester.

HINT:

- **If either voltage output of the Air Fuel Ratio (A/F) or Heated Oxygen (HO2) sensor does not fluctuate, or there is noise in the waveform of either sensor, the sensor may be malfunctioning.**
- **If the voltage outputs of both the sensors remain lean or rich, the air fuel ratio may be extremely lean or rich. In such cases, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
- **If the Three-Way Catalytic Converter (TWC) has deteriorated, the HO2 sensor (located behind the TWC) voltage output fluctuates up and down frequently, even under normal driving conditions (active air fuel ratio control is not performed).**



INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the intelligent tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **On the intelligent tester, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume.)**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2, or AFS Voltage B2S1 and O2S B2S2) displayed on the intelligent tester.**

HINT:

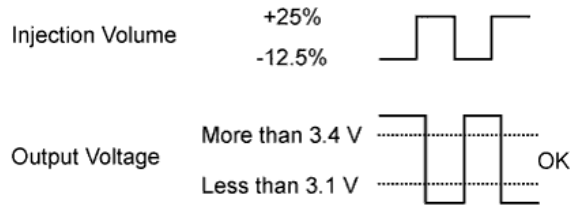
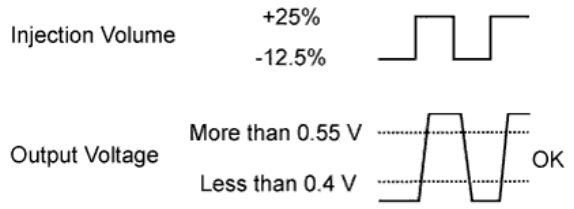
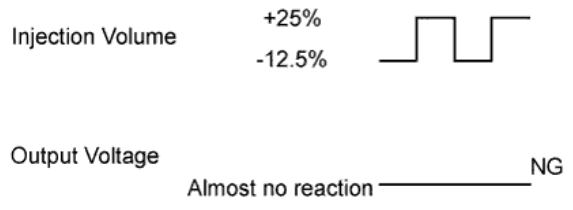
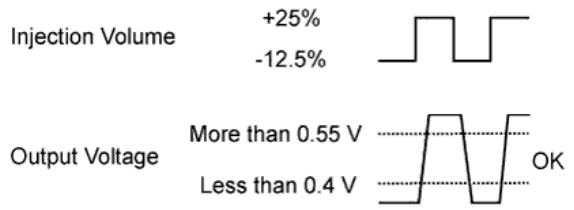
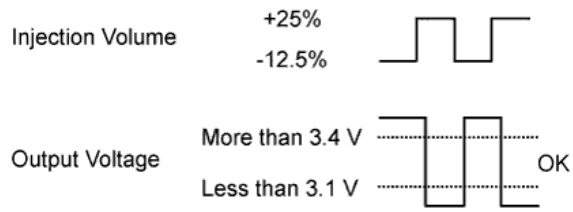
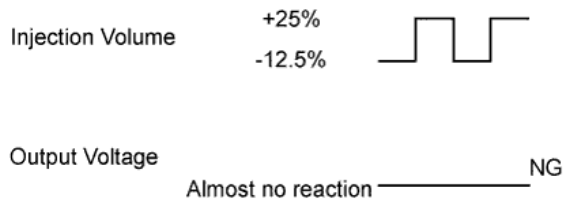
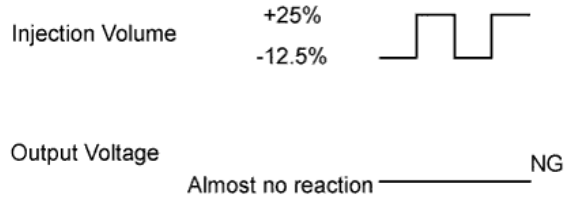
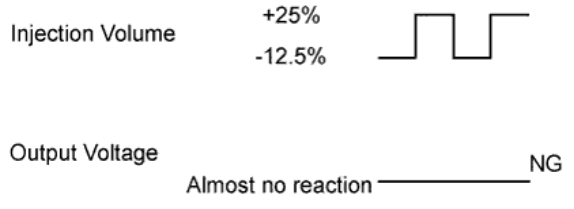
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1	+25%	Rich	Less than 3.1 V

(A/F)			
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0420 AND/OR P0430)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

d. Read DTCs.

Result

Display (DTC Output)	Proceed to
P0420 and/or P0430	A
P0420 and/or P0430 and other DTCs	B

HINT:

If any DTCs other than P0420 or P0430 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (CONTROL THE INJECTION VOLUME FOR A/F SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the intelligent tester on.

c. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.

e. Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).

f. Monitor the voltage outputs of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS, Voltage B2S1 and O2S B2S2) displayed on the intelligent tester.

HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	Less than 3.1
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4

Result:

Status AFS Voltage B1S1 or AFS Voltage B2S1	Status O2S B1S2 or O2S B2S2	A/F Condition and A/F and HO2 Sensors Condition	Misfire	Main Suspected Trouble Area	Proceed to
Lean/Rich	Lean/Rich	Normal	-	• **Three-Way Catalytic Converter (TWC)** • **Gas leakage from exhaust system**	A
Lean	Lean/Rich	A/F sensor malfunction	-	• **A/F sensor**	B
Rich	Lean/Rich	A/F sensor malfunction	-	• **A/F sensor**	
Lean/Rich	Lean	HO2 sensor malfunction	-	• **HO2 sensor** • **Gas leakage from exhaust system**	C
Lean/Rich	Rich	HO2 sensor malfunction	-	• **HO2 sensor** • **Gas leakage from exhaust system**	
Lean	Lean	Actual air fuel ratio lean	May occur	• **Extremely rich or lean actual air fuel ratio** • **Gas leakage from exhaust system**	A
Rich	Rich	Actual air fuel ratio rich	-	• **Extremely rich or lean actual air fuel ratio** • **Gas leakage from exhaust system**	

Lean: During Control the Injection Volume for A/F sensor, the A/F sensor output voltage (AFS) is consistently more than 3.4 V, and the HO2 sensor output voltage (O2S) is consistently less than 0.4 V.
Rich: During Control the Injection Volume for A/F sensor, the AFS is consistently less than 3.1 V, and the O2S is consistently more than 0.55 V.
Lean/Rich: During Control the Injection Volume for A/F sensor of the Active Test, the output voltage of the HO2 sensor alternates correctly.

B → REPLACE AIR FUEL RATIO SENSOR (Click here)

C → Go to step 4

D → CHECK CAUSE OF EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO, REPLACE FAULTY AREA AND GO TO NEXT STEP

A

3.INSPECT FOR EXHAUST GAS LEAK

a. Inspect for exhaust gas leakage from the exhaust manifold sub-assembly and exhaust pipe.

OK:
No gas leakage.

Result

Result	Proceed to
NG	A
OK	B

B → Go to step 5

A

REPAIR OR REPLACE EXHAUST GAS LEAK POINT

4.INSPECT EXHAUST GAS LEAK

a. Inspect for exhaust gas leakage from the exhaust manifold sub-assembly and exhaust pipe.

OK:
No gas leakage.

NG → REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT

OK

REPLACE HEATED OXYGEN SENSOR (Click here)

5.CHECK DTC OUTPUT (DTC P0420 AND/OR P0430)

a. According to the output DTCs in the step "Check Any Other DTCs Output", proceed to the next step by referring to the table below.

Result

Result	Proceed to
P0420	A
P0430	B
P0420 and P0430	A and B

B → Go to step 7

A

6.REPLACE EXHAUST MANIFOLD (BANK 1) (TWC: FRONT CATALYST)

a. Replace the exhaust manifold (Click here).

NEXT

REPLACE FRONT EXHAUST PIPE ASSEMBLY (TWC: REAR CATALYST) (Click here)

7.REPLACE EXHAUST MANIFOLD (BANK 2) (TWC: FRONT CATALYST)

a. Replace the exhaust manifold (Click here).

NEXT

REPLACE FRONT NO. 2 EXHAUST PIPE ASSEMBLY (TWC: REAR CATALYST) (Click here)

DTC P0037 Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)

DTC P0038 Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)

DTC P0057 Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)

DTC P0058 Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)

DTC P0141 Oxygen Sensor Heater Circuit Malfunction (Bank 1 Sensor 2)

DTC P0161 Oxygen Sensor Heater Circuit Malfunction (Bank 2 Sensor 2)

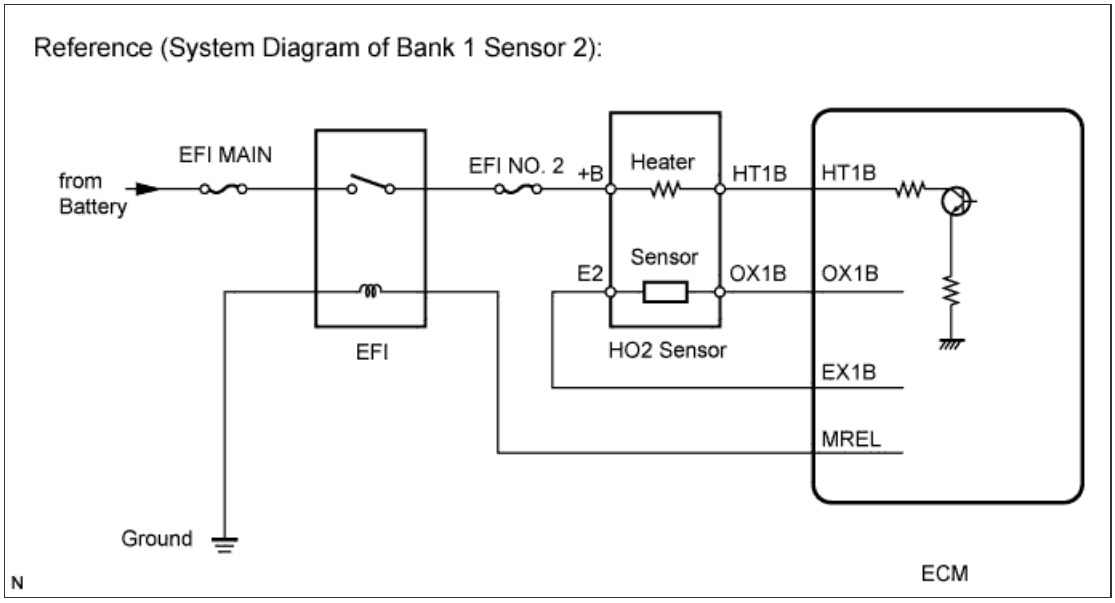
for Preparation Click here

DESCRIPTION

Refer to DTC P0136 (Click here).

HINT:

- **Sensor 2 refers to the sensor mounted behind the Three-Way Catalytic Converter (TWC) and located far from the engine assembly.**
- **When any of these DTCs are stored, the ECM enters fail-safe mode. The ECM turns off the Heated Oxygen (HO2) sensor heater in fail-safe mode. Fail-safe mode continues until the ignition switch is turned off.**
- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The HO2 sensor heater circuit uses a relay on the +B side of the circuit.**



DTC Code	DTC Detection Condition	Trouble Area
P0037 P0057	The Heated Oxygen (HO2) sensor heater (bank 1, 2 sensor 2) current is below 0.3 A (1 trip detection logic).	• **Open in Heated Oxygen (HO2) sensor heater (bank 1, 2 sensor 2) circuit** • **HO2 sensor heater (bank 1, 2 sensor 2)** • **EFI NO. 2 fuse** • **ECM**
P0038 P0058	The Heated Oxygen (HO2) sensor heater (bank 1, 2 sensor 2) current is higher than 2 A (1 trip detection logic).	• **Short in HO2 sensor heater (bank 1, 2 sensor 2) circuit** • **HO2 sensor heater (bank 1, 2 sensor 2)** • **EFI NO. 2 fuse** • **ECM**
P0141 P0161	The cumulative heater resistance correction value exceeds the acceptable threshold (2 trip detection logic).	• **Open or short in HO2 sensor heater (bank 1, 2 sensor 2) circuit** • **HO2 sensor heater (bank 1, 2 sensor 2)** • **EFI NO. 2 fuse** • **ECM**

HINT:

- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

MONITOR DESCRIPTION

The sensing portion of the Heated Oxygen (HO2) sensor has a zirconia element which is used to detect the oxygen concentration in the exhaust gas. If the zirconia element is at the appropriate temperature, and the difference between the oxygen concentrations surrounding the inside and outside surfaces of the sensor is large, the zirconia element generates voltage signals. In order to increase the oxygen concentration detecting capacity of the zirconia element, the ECM supplements the heat from the exhaust with heat from a heating element inside the sensor.

Heated oxygen sensor heater range check (P0037, P0038, P0057 and P0058):

The ECM monitors the current applied to the HO2 sensor heater to check the heater for malfunctions. If the current is below the threshold value, the ECM will determine that there is an open circuit in the heater. If the current is above the threshold value, the ECM will determine that there is a short circuit in the heater.

Example:

The ECM stores DTC P0038 or P0058 when the current in the HO2 sensor heater is higher than 2 A. Conversely, when the heater current is below 0.3 A, DTC P0037 or P0057 is stored.

Heated oxygen sensor heater performance (P0141 and P0161):

After the accumulated heater ON time exceeds 100 seconds, the ECM calculates the heater resistance using the battery voltage and the current applied to the heater. If the resistance is above the threshold value, the ECM will determine that there is a malfunction in the HO2 sensor heater and store DTCs P0141 and P0161.

WIRING DIAGRAM

Refer to DTC P0136 (Click here).

INSPECTION PROCEDURE

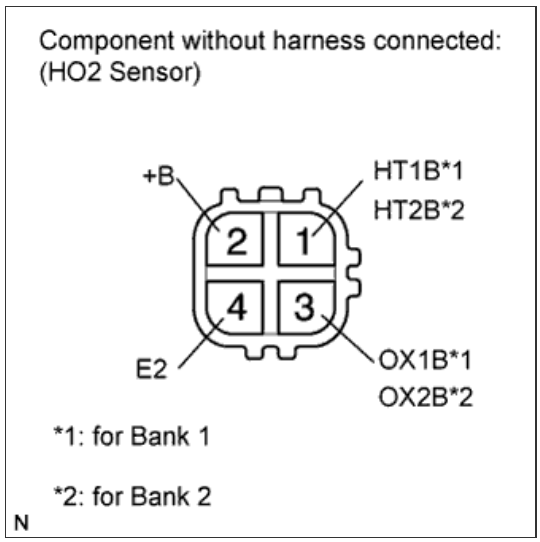
HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

a. Disconnect the heated oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for Bank 1 Sensor 2

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT1B) - 4 (E2)	Always	10 kΩ or higher

for Bank 2 Sensor 2

Tester Connection	Condition	Specified Condition
1 (HT2B) - 2 (+B)	20°C (68°F)	11 to 16 Ω

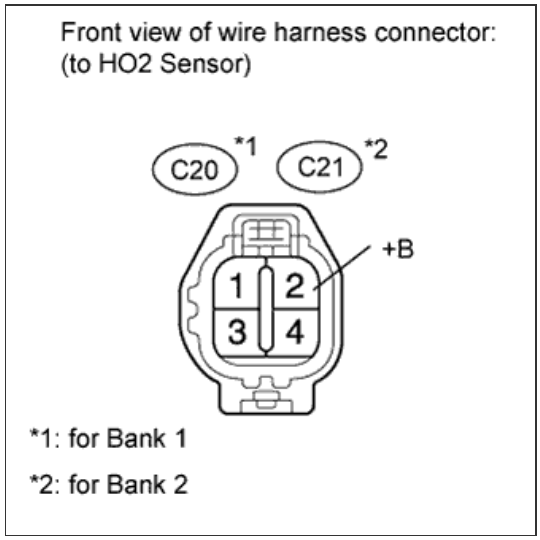
1 (HT2B) - 4 (E2)	Always	10 kΩ or higher

NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF HO2 SENSOR)

a. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for Bank 1 Sensor 1

Tester Connection	Switch Condition	Specified Condition
C20-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

for Bank 2 Sensor 1

Tester Connection	Switch Condition	Specified Condition
C21-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

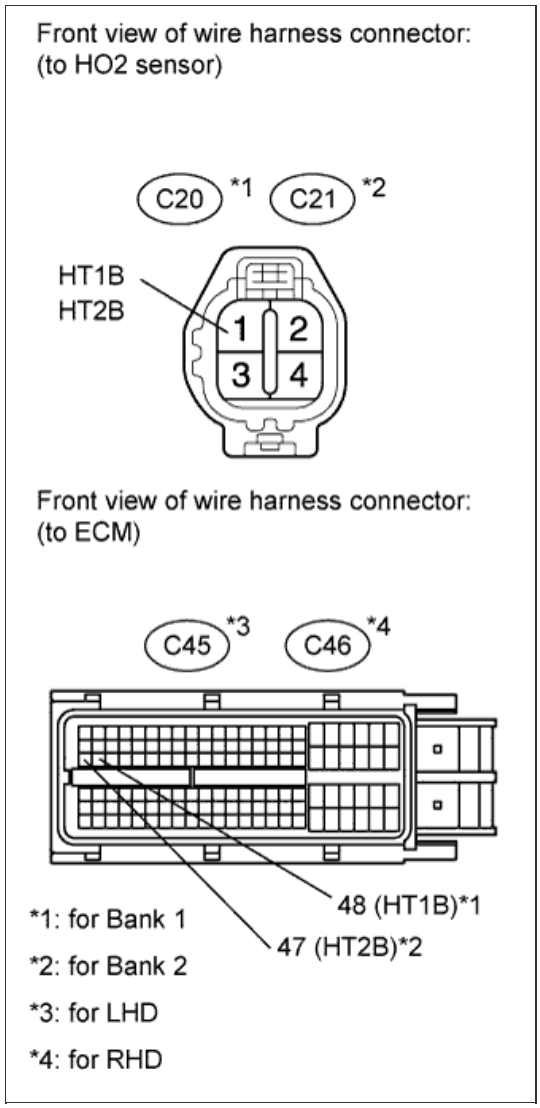
NG → Go to step 4

OK

3.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C45-48 (HT1B)	Always	Below 1 Ω
C21-1 (HT2B) - C45-47 (HT2B)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C46-48 (HT1B)	Always	Below 1 Ω
C21-1 (HT2B) - C46-47 (HT2B)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C45-48 (HT1B) - Body ground	Always	10 kΩ or higher
C21-1 (HT2B) or C45-47 (HT2B) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C46-48 (HT1B) -		10 kΩ or

Body ground	Always	higher
C21-1 (HT2B) or C46-47 (HT2B) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

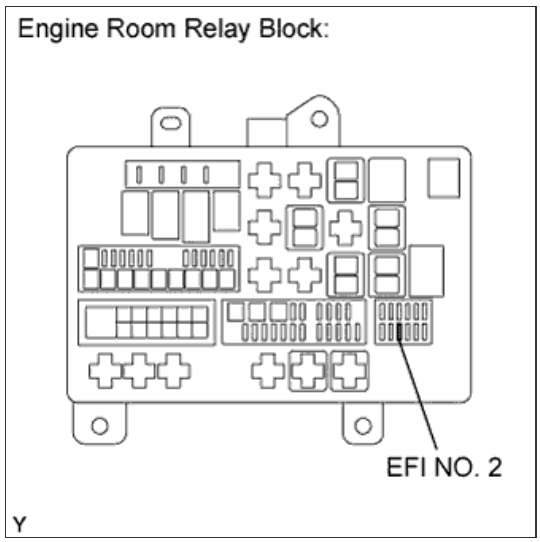
4.INSPECT FUSE (EFI NO. 2)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse	Always	Below 1 Ω



NG → CHECK FOR SHORT IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

OK

5.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - EFI NO. 2 FUSE)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

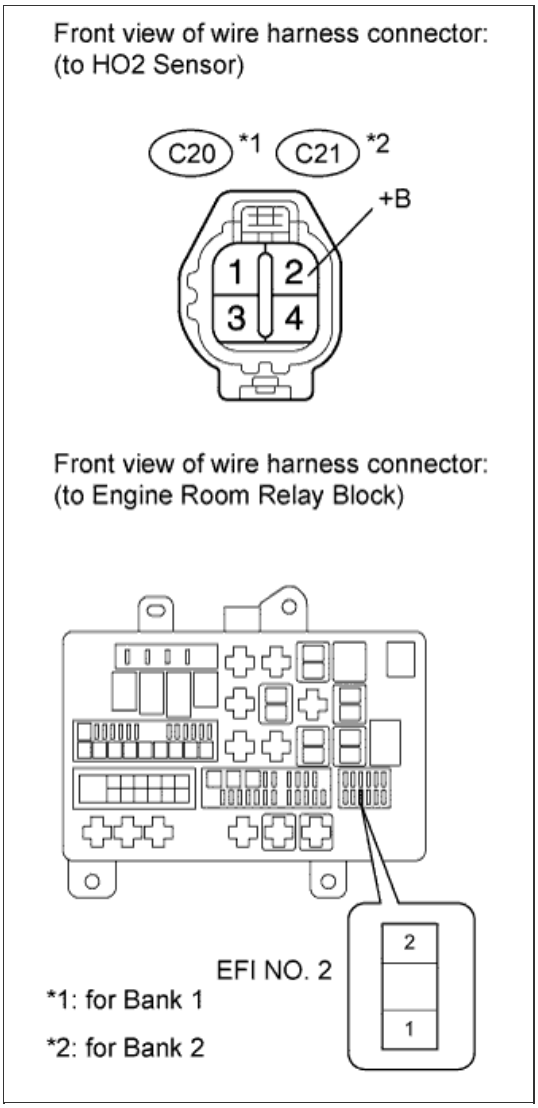
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C20-2 (+B) - EFI NO. 2 fuse (2)	Always	Below 1 Ω
C21-2 (+B) - EFI NO. 2 fuse (2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
C20-2 (+B) or EFI NO. 2 fuse (2) - Body ground	Always	10 kΩ or higher
C21-2 (+B) or EFI NO. 2 fuse (2) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6.CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - EFI NO. 2 FUSE)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

b. Remove the integration relay from the engine room relay block.

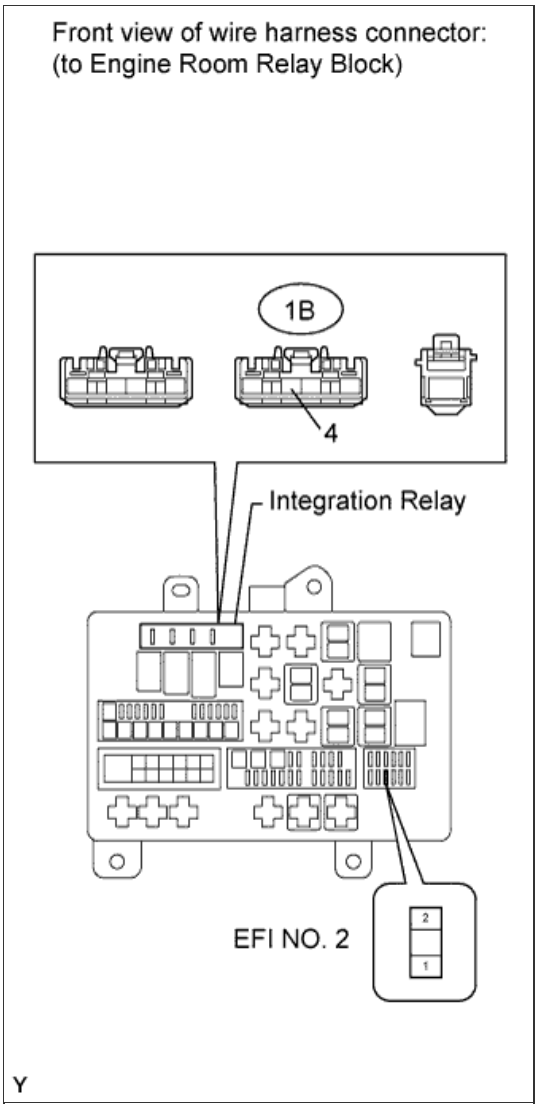
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse (1) - 1B-4	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse (1) or 1B-4 - Body ground	Always	10 kΩ or higher



NG → REPLACE ENGINE ROOM RELAY BLOCK

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

DTC P0420 Catalyst System Efficiency Below Threshold (Bank 1)

DTC P0430 Catalyst System Efficiency Below Threshold (Bank 2)

for Preparation Click here

MONITOR DESCRIPTION

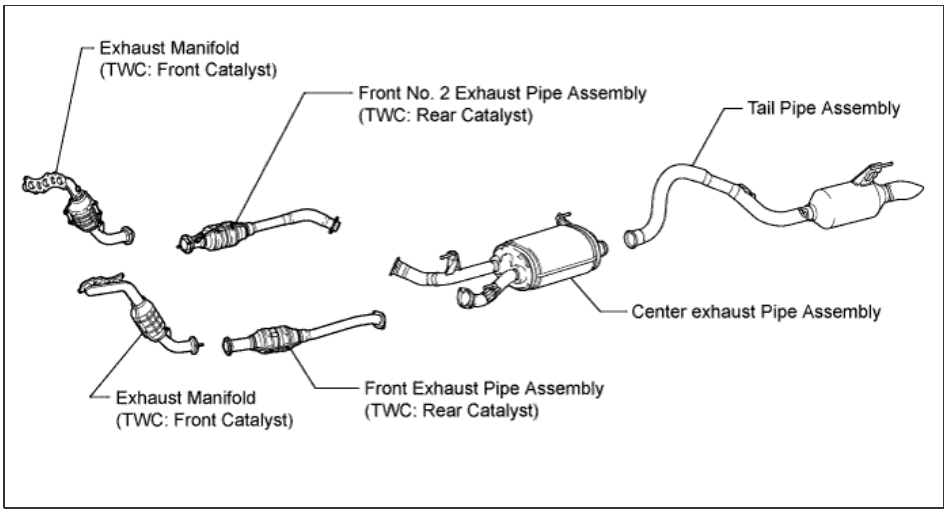
The ECM uses sensors mounted in front of and behind the Three-Way Catalytic Converter (TWC) to monitor its efficiency.
The first sensor, the Air Fuel Ratio (A/F) sensor, sends pre-catalyst information to the ECM. The second sensor, the Heated Oxygen (HO2) sensor, sends post-catalyst information to the ECM.
In order to detect any deterioration in the TWC, the ECM calculates the Oxygen Storage Capacity (OSC) of the TWC. This calculation is based on the voltage output of the HO2 sensor while performing active air fuel ratio control.
The OSC value is an indication of the oxygen storage capacity of the TWC. When the vehicle is being driven with a warm engine, active air fuel ratio control is performed for approximately 15 to 20 seconds. When it is performed, the ECM deliberately sets the air fuel ratio to lean or rich levels. If a rich-lean cycle of the HO2 sensor is long, the OSC becomes greater. There is a direct correlation between the OSCs of the HO2 sensor and the TWC.
The ECM uses the OSC value to determine the state of the TWC. If any deterioration has occurred, it illuminates the MIL and sets a DTC.

DTC Code	DTC Detection Condition	Trouble Area
P0420	The OSC value is smaller than the standard value under active air fuel ratio control (2 trip detection logic).	• Gas leakage from exhaust system • A/F sensor (bank 1 sensor 1) • HO2 sensor (bank 1 sensor 2) • Exhaust manifold (bank 1)(with TWC: front catalyst) • Front exhaust pipe assembly (with TWC: rear catalyst)
P0430	The OSC value is smaller than the standard value under active air fuel ratio control (2 trip detection logic).	• Gas leakage from exhaust system • A/F sensor (bank 2 sensor 1) • HO2 sensor (bank 2 sensor 2) • Exhaust manifold (bank 2)(with TWC: front catalyst) • Front No. 2 exhaust pipe assembly (with TWC: rear catalyst)

HINT:

- **Bank 1 refers to the bank that includes cylinder No. 1.**
- **Bank 2 refers to the bank that does not include cylinder No. 1.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

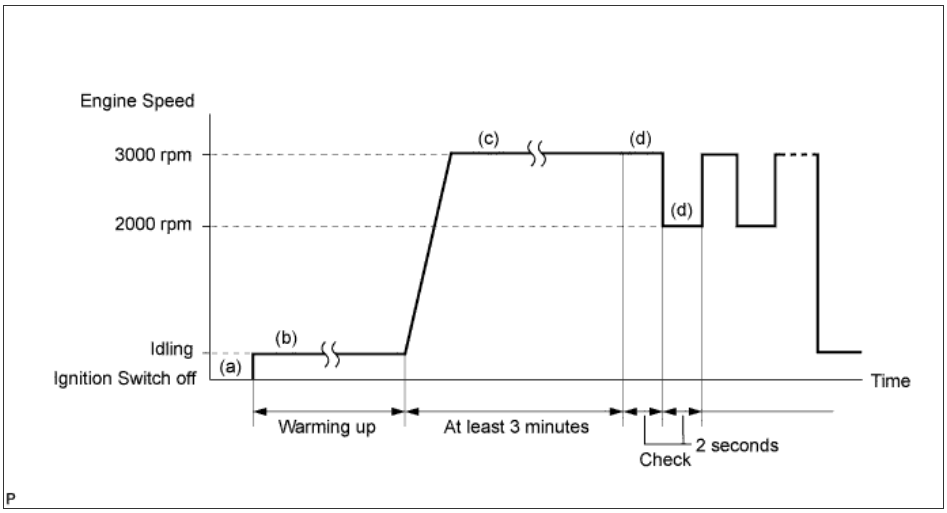
CATALYST LOCATION



CONDITIONING FOR SENSOR TESTING

HINT:

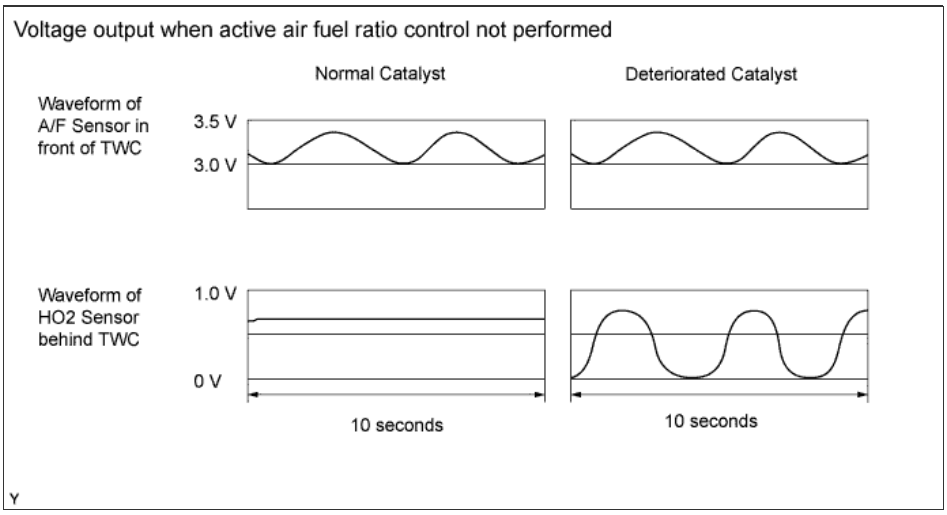
Perform the operation with the engine speeds and time durations described below prior to checking the waveforms of the A/F and HO2 sensors. This is in order to activate the sensors sufficiently to obtain the appropriate inspection results.



(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and warm it up with all the accessories switched OFF until the engine coolant temperature stabilizes.
(c) Run the engine at an engine speed of between 2500 rpm and 3000 rpm for at least 3 minutes.
(d) While alternately running the engine at 3000 rpm for 2 seconds and 2000 rpm for 2 seconds, check the waveforms of the A/F and HO2 sensors using the intelligent tester.

HINT:

- **If either voltage output of the Air Fuel Ratio (A/F) or Heated Oxygen (HO2) sensor does not fluctuate, or there is noise in the waveform of either sensor, the sensor may be malfunctioning.**
- **If the voltage outputs of both the sensors remain lean or rich, the air fuel ratio may be extremely lean or rich. In such cases, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
- **If the Three-Way Catalytic Converter (TWC) has deteriorated, the HO2 sensor (located behind the TWC) voltage output fluctuates up and down frequently, even under normal driving conditions (active air fuel ratio control is not performed).**



INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the intelligent tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **On the intelligent tester, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume.)**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2, or AFS Voltage B2S1 and O2S B2S2) displayed on the intelligent tester.**

HINT:

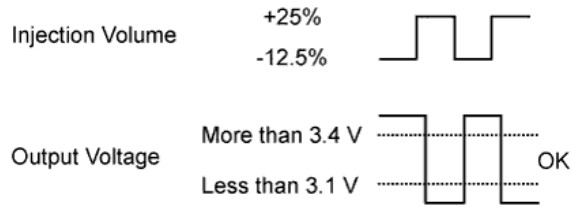
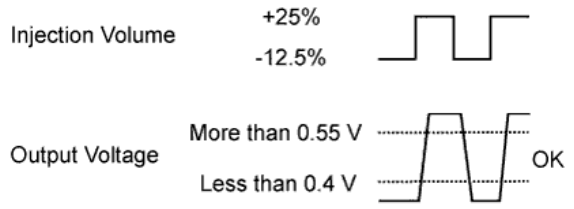
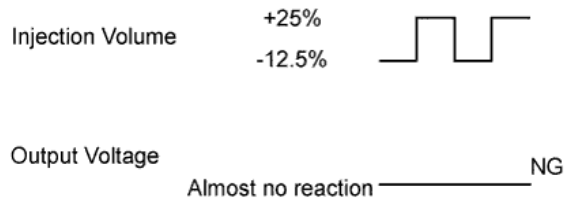
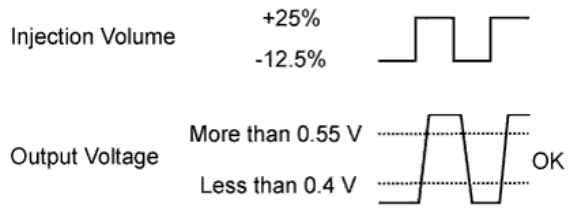
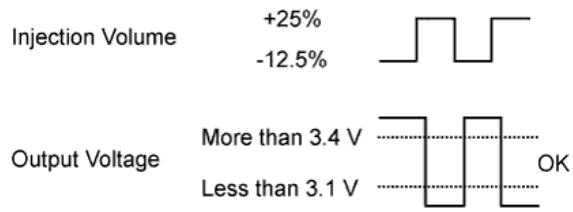
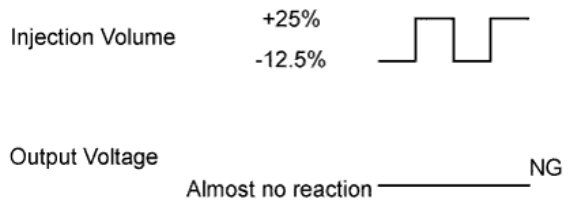
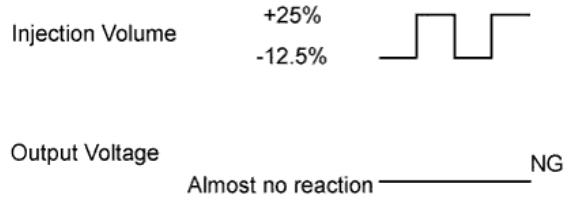
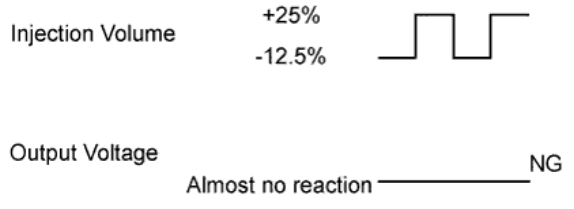
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1	+25%	Rich	Less than 3.1 V

(A/F)			
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0420 AND/OR P0430)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

d. Read DTCs.

Result

Display (DTC Output)	Proceed to
P0420 and/or P0430	A
P0420 and/or P0430 and other DTCs	B

HINT:

If any DTCs other than P0420 or P0430 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (CONTROL THE INJECTION VOLUME FOR A/F SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the intelligent tester on.

c. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.

e. Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).

f. Monitor the voltage outputs of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS, Voltage B2S1 and O2S B2S2) displayed on the intelligent tester.

HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	Less than 3.1
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4

Result:

Status AFS Voltage B1S1 or AFS Voltage B2S1	Status O2S B1S2 or O2S B2S2	A/F Condition and A/F and HO2 Sensors Condition	Misfire	Main Suspected Trouble Area	Proceed to
Lean/Rich	Lean/Rich	Normal	-	• **Three-Way Catalytic Converter (TWC)** • **Gas leakage from exhaust system**	A
Lean	Lean/Rich	A/F sensor malfunction	-	• **A/F sensor**	B
Rich	Lean/Rich	A/F sensor malfunction	-	• **A/F sensor**	
Lean/Rich	Lean	HO2 sensor malfunction	-	• **HO2 sensor** • **Gas leakage from exhaust system**	C
Lean/Rich	Rich	HO2 sensor malfunction	-	• **HO2 sensor** • **Gas leakage from exhaust system**	
Lean	Lean	Actual air fuel ratio lean	May occur	• **Extremely rich or lean actual air fuel ratio** • **Gas leakage from exhaust system**	A
Rich	Rich	Actual air fuel ratio rich	-	• **Extremely rich or lean actual air fuel ratio** • **Gas leakage from exhaust system**	

Lean: During Control the Injection Volume for A/F sensor, the A/F sensor output voltage (AFS) is consistently more than 3.4 V, and the HO2 sensor output voltage (O2S) is consistently less than 0.4 V.
Rich: During Control the Injection Volume for A/F sensor, the AFS is consistently less than 3.1 V, and the O2S is consistently more than 0.55 V.
Lean/Rich: During Control the Injection Volume for A/F sensor of the Active Test, the output voltage of the HO2 sensor alternates correctly.

B → REPLACE AIR FUEL RATIO SENSOR (Click here)

C → Go to step 4

D → CHECK CAUSE OF EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO, REPLACE FAULTY AREA AND GO TO NEXT STEP

A

3.INSPECT FOR EXHAUST GAS LEAK

a. Inspect for exhaust gas leakage from the exhaust manifold sub-assembly and exhaust pipe.

OK:
No gas leakage.

Result

Result	Proceed to
NG	A
OK	B

B → Go to step 5

A

REPAIR OR REPLACE EXHAUST GAS LEAK POINT

4.INSPECT EXHAUST GAS LEAK

a. Inspect for exhaust gas leakage from the exhaust manifold sub-assembly and exhaust pipe.

OK:
No gas leakage.

NG → REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT

OK

REPLACE HEATED OXYGEN SENSOR (Click here)

5.CHECK DTC OUTPUT (DTC P0420 AND/OR P0430)

a. According to the output DTCs in the step "Check Any Other DTCs Output", proceed to the next step by referring to the table below.

Result

Result	Proceed to
P0420	A
P0430	B
P0420 and P0430	A and B

B → Go to step 7

A

6.REPLACE EXHAUST MANIFOLD (BANK 1) (TWC: FRONT CATALYST)

a. Replace the exhaust manifold (Click here).

NEXT

REPLACE FRONT EXHAUST PIPE ASSEMBLY (TWC: REAR CATALYST) (Click here)

7.REPLACE EXHAUST MANIFOLD (BANK 2) (TWC: FRONT CATALYST)

a. Replace the exhaust manifold (Click here).

NEXT

REPLACE FRONT NO. 2 EXHAUST PIPE ASSEMBLY (TWC: REAR CATALYST) (Click here)

DTC P0037 Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)

DTC P0038 Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)

DTC P0057 Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)

DTC P0058 Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)

DTC P0141 Oxygen Sensor Heater Circuit Malfunction (Bank 1 Sensor 2)

DTC P0161 Oxygen Sensor Heater Circuit Malfunction (Bank 2 Sensor 2)

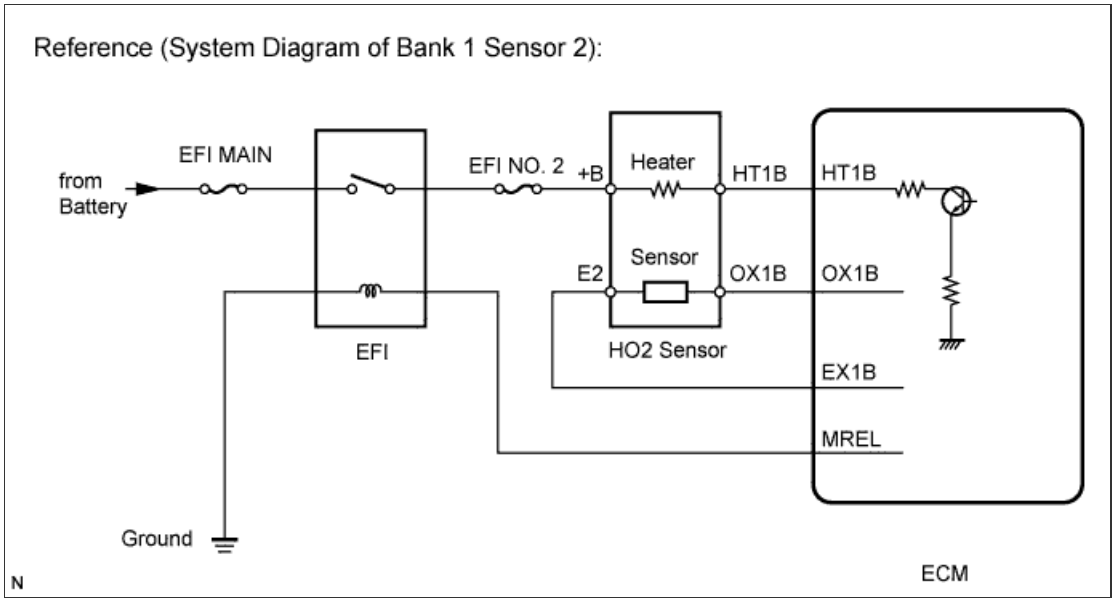
for Preparation Click here

DESCRIPTION

Refer to DTC P0136 (Click here).

HINT:

- **Sensor 2 refers to the sensor mounted behind the Three-Way Catalytic Converter (TWC) and located far from the engine assembly.**
- **When any of these DTCs are stored, the ECM enters fail-safe mode. The ECM turns off the Heated Oxygen (HO2) sensor heater in fail-safe mode. Fail-safe mode continues until the ignition switch is turned off.**
- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The HO2 sensor heater circuit uses a relay on the +B side of the circuit.**



DTC Code	DTC Detection Condition	Trouble Area
P0037 P0057	The Heated Oxygen (HO2) sensor heater (bank 1, 2 sensor 2) current is below 0.3 A (1 trip detection logic).	• **Open in Heated Oxygen (HO2) sensor heater (bank 1, 2 sensor 2) circuit** • **HO2 sensor heater (bank 1, 2 sensor 2)** • **EFI NO. 2 fuse** • **ECM**
P0038 P0058	The Heated Oxygen (HO2) sensor heater (bank 1, 2 sensor 2) current is higher than 2 A (1 trip detection logic).	• **Short in HO2 sensor heater (bank 1, 2 sensor 2) circuit** • **HO2 sensor heater (bank 1, 2 sensor 2)** • **EFI NO. 2 fuse** • **ECM**
P0141 P0161	The cumulative heater resistance correction value exceeds the acceptable threshold (2 trip detection logic).	• **Open or short in HO2 sensor heater (bank 1, 2 sensor 2) circuit** • **HO2 sensor heater (bank 1, 2 sensor 2)** • **EFI NO. 2 fuse** • **ECM**

HINT:

- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

MONITOR DESCRIPTION

The sensing portion of the Heated Oxygen (HO2) sensor has a zirconia element which is used to detect the oxygen concentration in the exhaust gas. If the zirconia element is at the appropriate temperature, and the difference between the oxygen concentrations surrounding the inside and outside surfaces of the sensor is large, the zirconia element generates voltage signals. In order to increase the oxygen concentration detecting capacity of the zirconia element, the ECM supplements the heat from the exhaust with heat from a heating element inside the sensor.

Heated oxygen sensor heater range check (P0037, P0038, P0057 and P0058):

The ECM monitors the current applied to the HO2 sensor heater to check the heater for malfunctions. If the current is below the threshold value, the ECM will determine that there is an open circuit in the heater. If the current is above the threshold value, the ECM will determine that there is a short circuit in the heater.

Example:

The ECM stores DTC P0038 or P0058 when the current in the HO2 sensor heater is higher than 2 A. Conversely, when the heater current is below 0.3 A, DTC P0037 or P0057 is stored.

Heated oxygen sensor heater performance (P0141 and P0161):

After the accumulated heater ON time exceeds 100 seconds, the ECM calculates the heater resistance using the battery voltage and the current applied to the heater. If the resistance is above the threshold value, the ECM will determine that there is a malfunction in the HO2 sensor heater and store DTCs P0141 and P0161.

WIRING DIAGRAM

Refer to DTC P0136 (Click here).

INSPECTION PROCEDURE

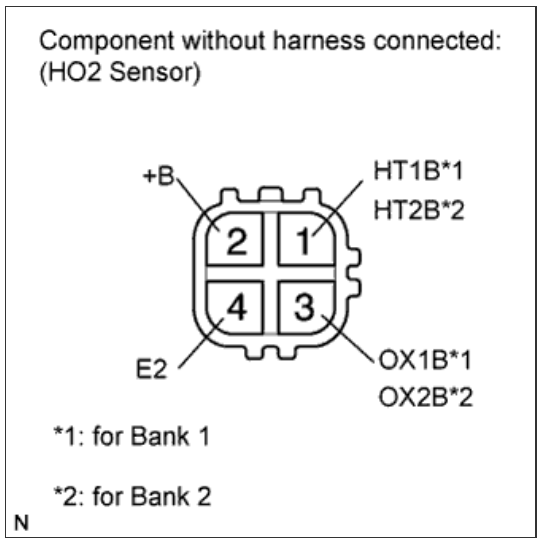
HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

a. Disconnect the heated oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for Bank 1 Sensor 2

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT1B) - 4 (E2)	Always	10 kΩ or higher

for Bank 2 Sensor 2

Tester Connection	Condition	Specified Condition
1 (HT2B) - 2 (+B)	20°C (68°F)	11 to 16 Ω

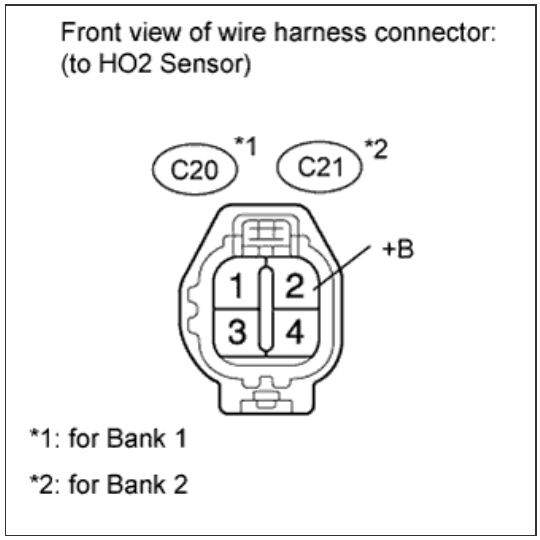
1 (HT2B) - 4 (E2)	Always	10 kΩ or higher

NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF HO2 SENSOR)

a. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for Bank 1 Sensor 1

Tester Connection	Switch Condition	Specified Condition
C20-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

for Bank 2 Sensor 1

Tester Connection	Switch Condition	Specified Condition
C21-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

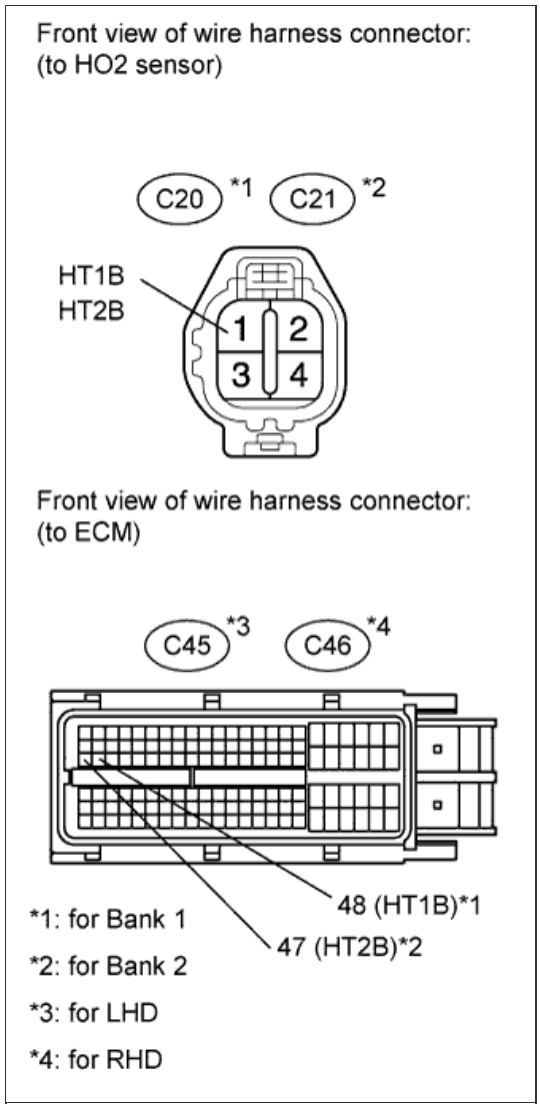
NG → Go to step 4

OK

3.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C45-48 (HT1B)	Always	Below 1 Ω
C21-1 (HT2B) - C45-47 (HT2B)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C46-48 (HT1B)	Always	Below 1 Ω
C21-1 (HT2B) - C46-47 (HT2B)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C45-48 (HT1B) - Body ground	Always	10 kΩ or higher
C21-1 (HT2B) or C45-47 (HT2B) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C46-48 (HT1B) -		10 kΩ or

Body ground	Always	higher
C21-1 (HT2B) or C46-47 (HT2B) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

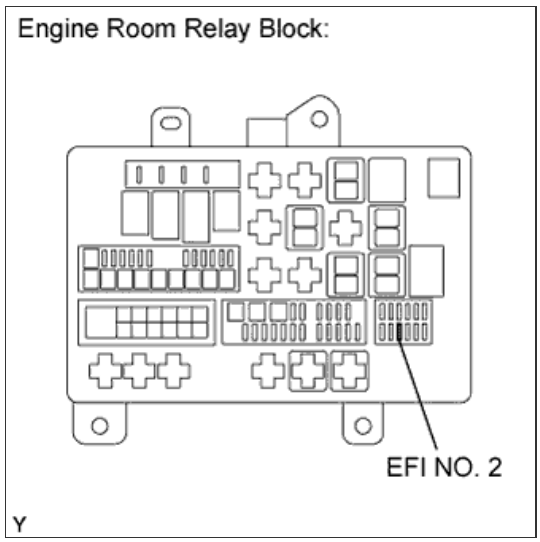
4.INSPECT FUSE (EFI NO. 2)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse	Always	Below 1 Ω



NG → CHECK FOR SHORT IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

OK

5.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - EFI NO. 2 FUSE)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

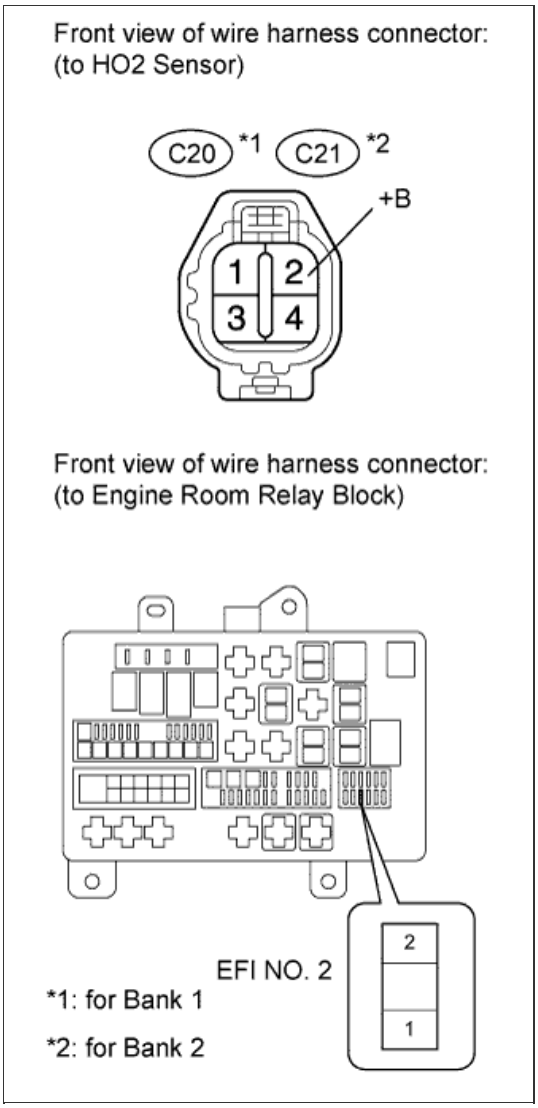
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C20-2 (+B) - EFI NO. 2 fuse (2)	Always	Below 1 Ω
C21-2 (+B) - EFI NO. 2 fuse (2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
C20-2 (+B) or EFI NO. 2 fuse (2) - Body ground	Always	10 kΩ or higher
C21-2 (+B) or EFI NO. 2 fuse (2) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6.CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - EFI NO. 2 FUSE)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

b. Remove the integration relay from the engine room relay block.

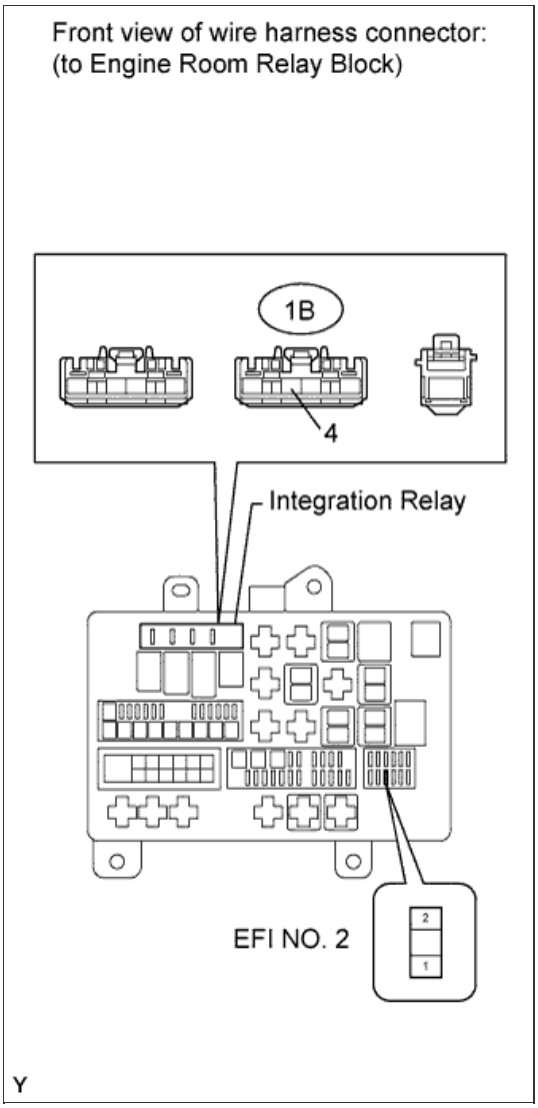
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse (1) - 1B-4	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse (1) or 1B-4 - Body ground	Always	10 kΩ or higher



NG → REPLACE ENGINE ROOM RELAY BLOCK

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

DTC P0443 Evaporative Emission Control System Purge Control Valve Circuit

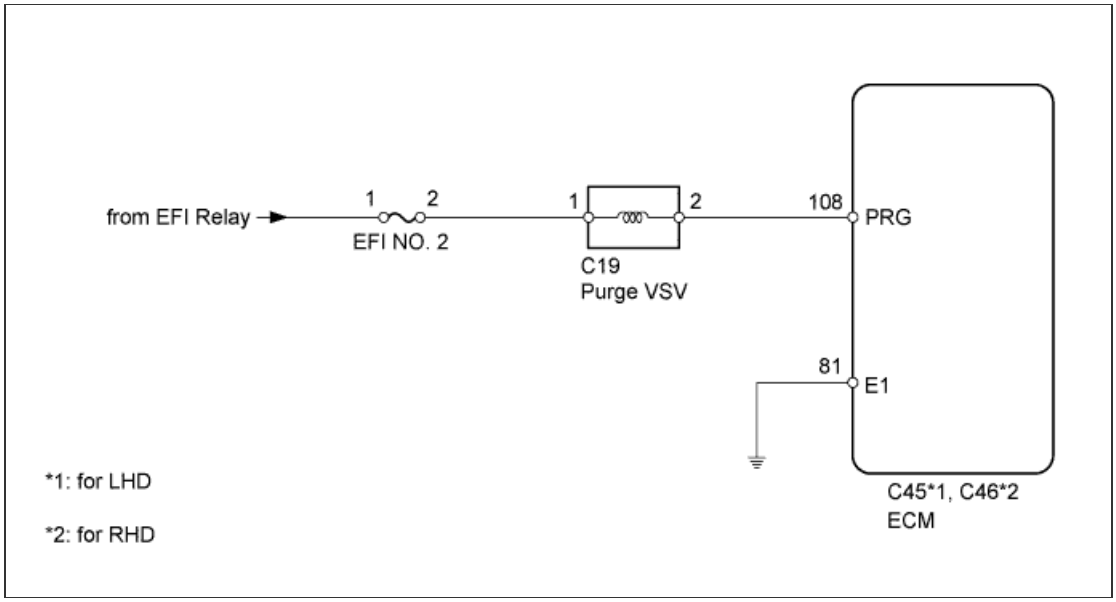
for Preparation Click here

DESCRIPTION

To reduce HC emissions, evaporated fuel from the fuel tank is routed through a charcoal canister to the intake manifold for combustion in the cylinders. The ECM changes the duty signals to the purge VSV so that the intake amount of HC emissions is appropriate for driving conditions (engine load, engine speed, vehicle speed, etc.) after the engine is warmed up.

DTC Code	DTC Detection Condition	Trouble Area
P0443	The terminal voltage of the ECM output circuit does not correspond with the drive signals from the ECM to the purge VSV (1 trip detection logic).	• Open or short in purge VSV circuit • Purge VSV • ECM

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (ACTIVATE THE VSV FOR EVAP CONTROL)

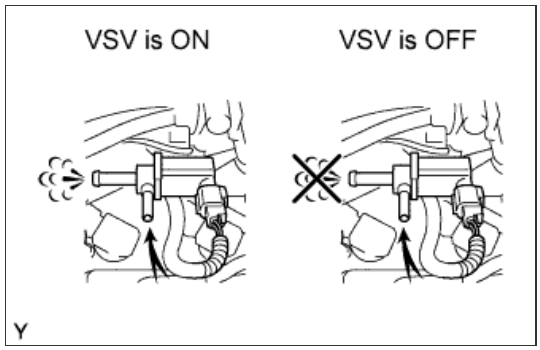
a. Connect the intelligent tester to the DLC3.

b. Remove the vacuum hose of the purge VSV from the charcoal canister.

c. Start the engine and turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the VSV for Evap Control.

e. When the purge VSV is operated using the intelligent tester, check whether the disconnected hose applies suction to your finger.



OK:

Tester Operation	Specified Condition
VSV is ON	Disconnected hose applies suction to finger
VSV is OFF	Disconnected hose applies no suction to finger

OK → CHECK FOR INTERMITTENT PROBLEMS (Click here)

NG

2.INSPECT PURGE VSV

a. Inspect the purge VSV (Click here).

NG → REPLACE PURGE VSV (Click here)

OK

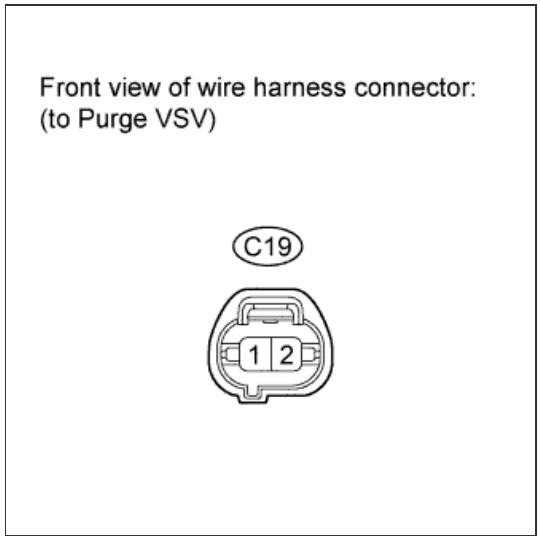
3.INSPECT PURGE VSV (POWER SOURCE VOLTAGE)

a. Disconnect the purge VSV connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C19-1 - Body ground	Ignition switch ON	11 to 14 V



OK → Go to step 5

NG

4.CHECK HARNESS AND CONNECTOR (PURGE VSV - EFI NO. 2 FUSE)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

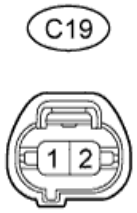
Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C19-1 - EFI NO. 2 fuse (2)	Always	Below 1 Ω

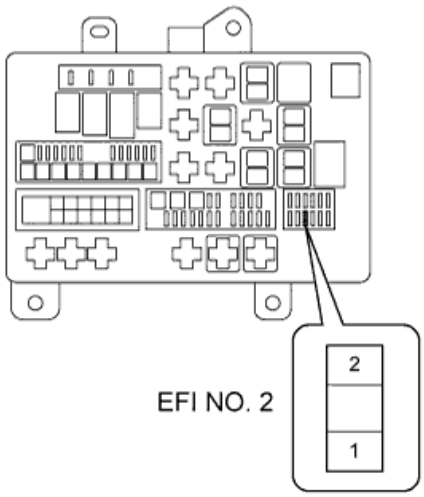
Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
C19-1 or EFI NO. 2 fuse (2) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Purge VSV)



Front view of wire harness connector:
(to Engine Room Relay Block)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPAIR OR REPLACE POWER SOURCE CIRCUIT COMPONENTS

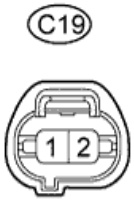
5.CHECK HARNESS AND CONNECTOR (PURGE VSV - ECM)

a. Disconnect the purge VSV connector.

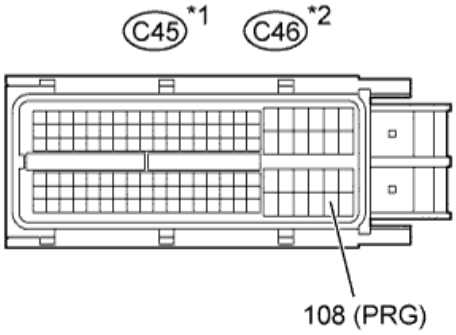
b. Disconnect the ECM connector.

c. Measure the resistance between the terminals of the wire harness side connectors.

Front view of wire harness connector:
(to Purge VSV)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C19-2 - PRG (C45-108)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C19-2 - PRG (C46-108)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C19-2 or PRG (C45-108) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C19-2 or PRG (C46-108) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P0037 Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)

DTC P0038 Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)

DTC P0057 Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)

DTC P0058 Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)

DTC P0141 Oxygen Sensor Heater Circuit Malfunction (Bank 1 Sensor 2)

DTC P0161 Oxygen Sensor Heater Circuit Malfunction (Bank 2 Sensor 2)

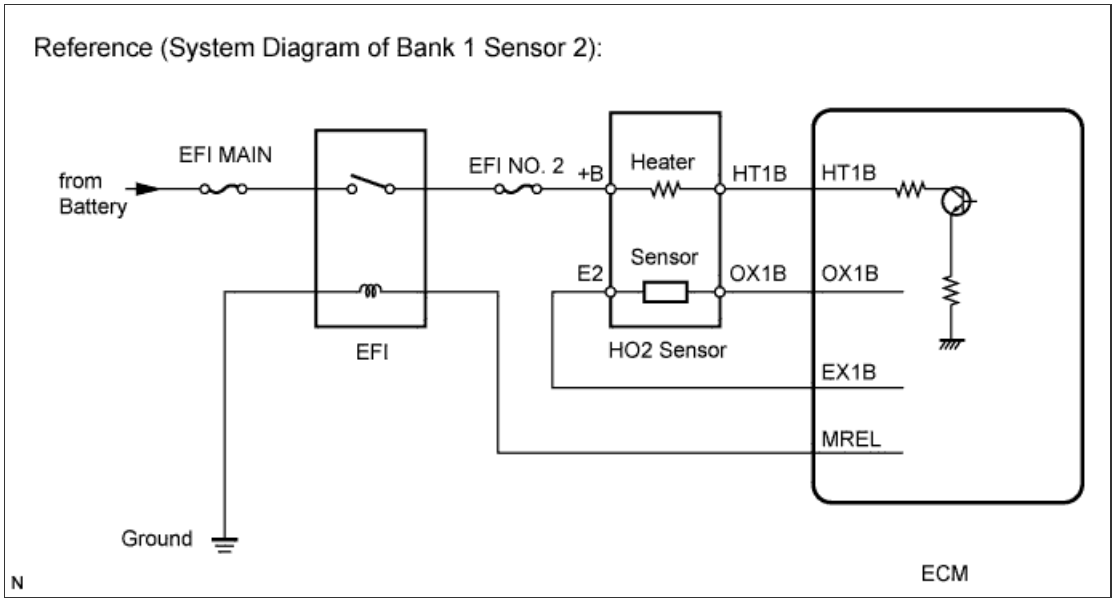
for Preparation Click here

DESCRIPTION

Refer to DTC P0136 (Click here).

HINT:

- **Sensor 2 refers to the sensor mounted behind the Three-Way Catalytic Converter (TWC) and located far from the engine assembly.**
- **When any of these DTCs are stored, the ECM enters fail-safe mode. The ECM turns off the Heated Oxygen (HO2) sensor heater in fail-safe mode. Fail-safe mode continues until the ignition switch is turned off.**
- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The HO2 sensor heater circuit uses a relay on the +B side of the circuit.**



DTC Code	DTC Detection Condition	Trouble Area
P0037 P0057	The Heated Oxygen (HO2) sensor heater (bank 1, 2 sensor 2) current is below 0.3 A (1 trip detection logic).	• **Open in Heated Oxygen (HO2) sensor heater (bank 1, 2 sensor 2) circuit** • **HO2 sensor heater (bank 1, 2 sensor 2)** • **EFI NO. 2 fuse** • **ECM**
P0038 P0058	The Heated Oxygen (HO2) sensor heater (bank 1, 2 sensor 2) current is higher than 2 A (1 trip detection logic).	• **Short in HO2 sensor heater (bank 1, 2 sensor 2) circuit** • **HO2 sensor heater (bank 1, 2 sensor 2)** • **EFI NO. 2 fuse** • **ECM**
P0141 P0161	The cumulative heater resistance correction value exceeds the acceptable threshold (2 trip detection logic).	• **Open or short in HO2 sensor heater (bank 1, 2 sensor 2) circuit** • **HO2 sensor heater (bank 1, 2 sensor 2)** • **EFI NO. 2 fuse** • **ECM**

HINT:

- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

MONITOR DESCRIPTION

The sensing portion of the Heated Oxygen (HO2) sensor has a zirconia element which is used to detect the oxygen concentration in the exhaust gas. If the zirconia element is at the appropriate temperature, and the difference between the oxygen concentrations surrounding the inside and outside surfaces of the sensor is large, the zirconia element generates voltage signals. In order to increase the oxygen concentration detecting capacity of the zirconia element, the ECM supplements the heat from the exhaust with heat from a heating element inside the sensor.

Heated oxygen sensor heater range check (P0037, P0038, P0057 and P0058):

The ECM monitors the current applied to the HO2 sensor heater to check the heater for malfunctions. If the current is below the threshold value, the ECM will determine that there is an open circuit in the heater. If the current is above the threshold value, the ECM will determine that there is a short circuit in the heater.

Example:

The ECM stores DTC P0038 or P0058 when the current in the HO2 sensor heater is higher than 2 A. Conversely, when the heater current is below 0.3 A, DTC P0037 or P0057 is stored.

Heated oxygen sensor heater performance (P0141 and P0161):

After the accumulated heater ON time exceeds 100 seconds, the ECM calculates the heater resistance using the battery voltage and the current applied to the heater. If the resistance is above the threshold value, the ECM will determine that there is a malfunction in the HO2 sensor heater and store DTCs P0141 and P0161.

WIRING DIAGRAM

Refer to DTC P0136 (Click here).

INSPECTION PROCEDURE

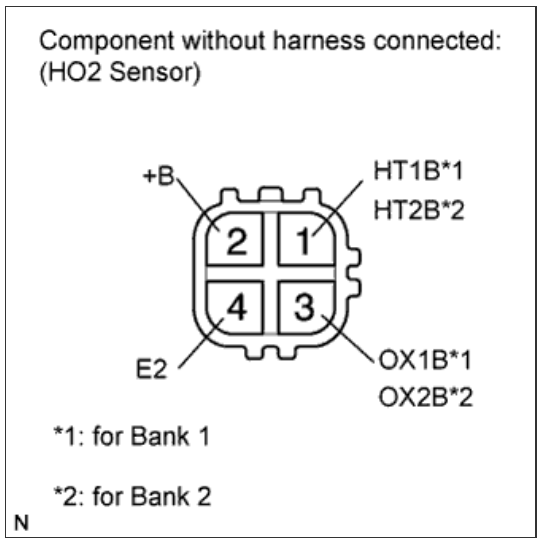
HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

a. Disconnect the heated oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for Bank 1 Sensor 2

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT1B) - 4 (E2)	Always	10 kΩ or higher

for Bank 2 Sensor 2

Tester Connection	Condition	Specified Condition
1 (HT2B) - 2 (+B)	20°C (68°F)	11 to 16 Ω

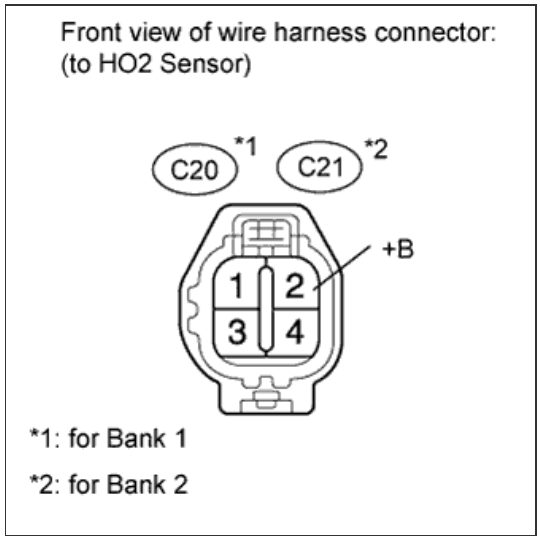
1 (HT2B) - 4 (E2)	Always	10 kΩ or higher

NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF HO2 SENSOR)

a. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for Bank 1 Sensor 1

Tester Connection	Switch Condition	Specified Condition
C20-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

for Bank 2 Sensor 1

Tester Connection	Switch Condition	Specified Condition
C21-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

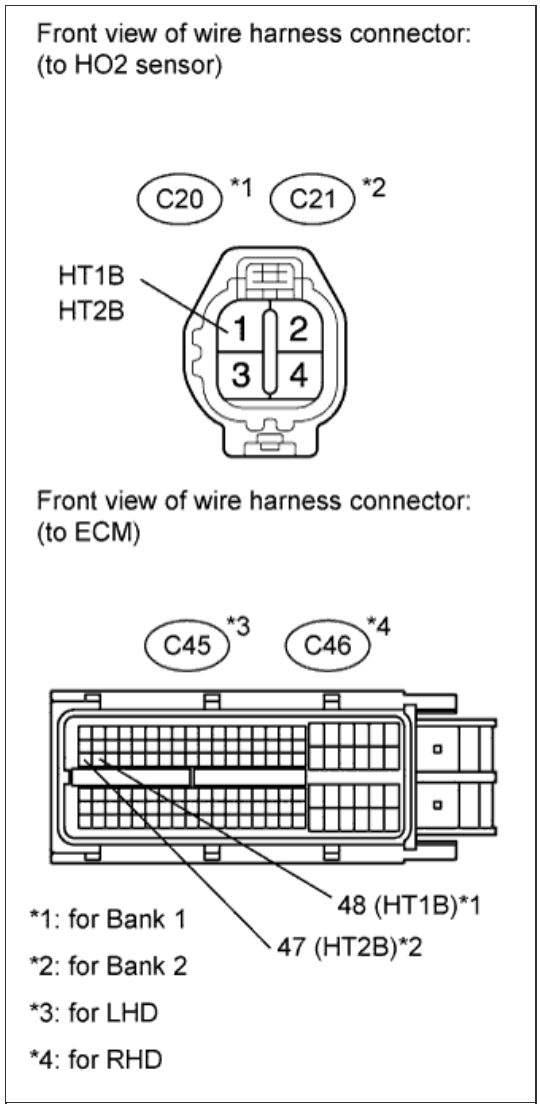
NG → Go to step 4

OK

3.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C45-48 (HT1B)	Always	Below 1 Ω
C21-1 (HT2B) - C45-47 (HT2B)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C46-48 (HT1B)	Always	Below 1 Ω
C21-1 (HT2B) - C46-47 (HT2B)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C45-48 (HT1B) - Body ground	Always	10 kΩ or higher
C21-1 (HT2B) or C45-47 (HT2B) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C46-48 (HT1B) -		10 kΩ or

Body ground	Always	higher
C21-1 (HT2B) or C46-47 (HT2B) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

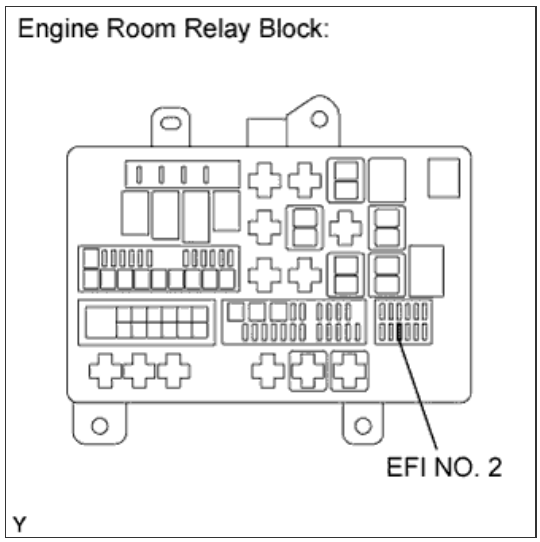
4.INSPECT FUSE (EFI NO. 2)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse	Always	Below 1 Ω



NG → CHECK FOR SHORT IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

OK

5.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - EFI NO. 2 FUSE)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

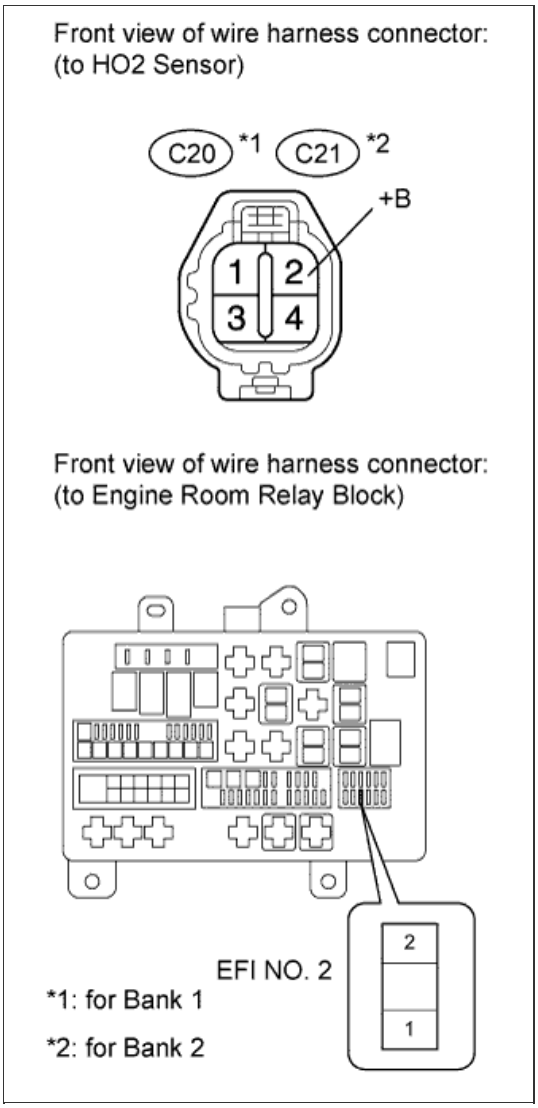
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C20-2 (+B) - EFI NO. 2 fuse (2)	Always	Below 1 Ω
C21-2 (+B) - EFI NO. 2 fuse (2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
C20-2 (+B) or EFI NO. 2 fuse (2) - Body ground	Always	10 kΩ or higher
C21-2 (+B) or EFI NO. 2 fuse (2) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6.CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - EFI NO. 2 FUSE)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

b. Remove the integration relay from the engine room relay block.

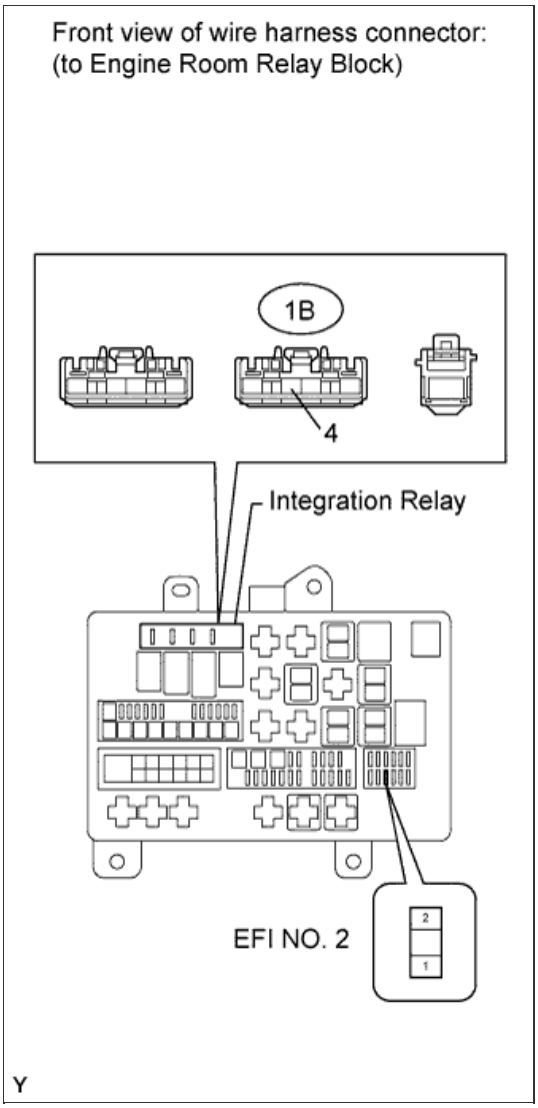
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse (1) - 1B-4	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse (1) or 1B-4 - Body ground	Always	10 kΩ or higher



NG → REPLACE ENGINE ROOM RELAY BLOCK

OK

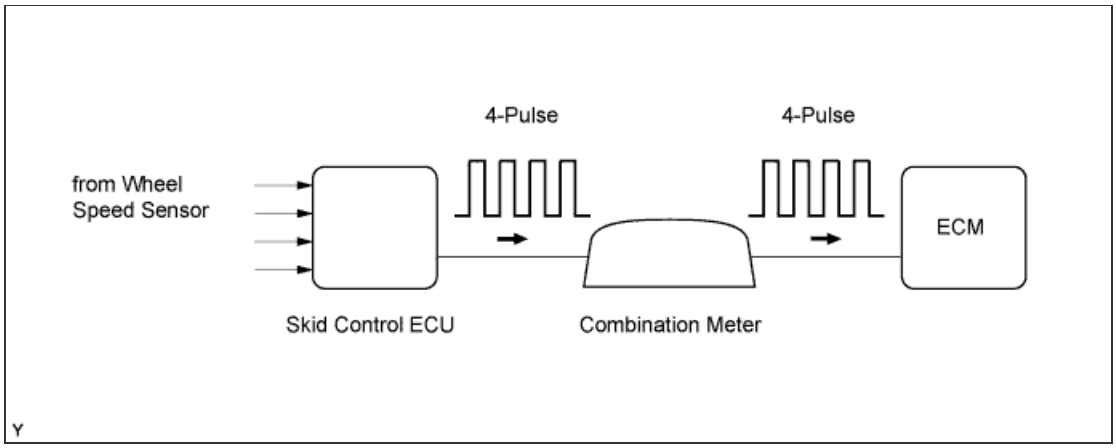
CHECK ECM POWER SOURCE CIRCUIT (Click here)

DTC P0500 Vehicle Speed Sensor "A"

for Preparation Click here

DESCRIPTION

The speed sensor detects the wheel speed and sends the appropriate signals to the skid control ECU. The skid control ECU converts these wheel speed signals into a 4-pulse signal and outputs it to the ECM via the combination meter. The ECM determines the vehicle speed based on the frequency of these pulse signals.

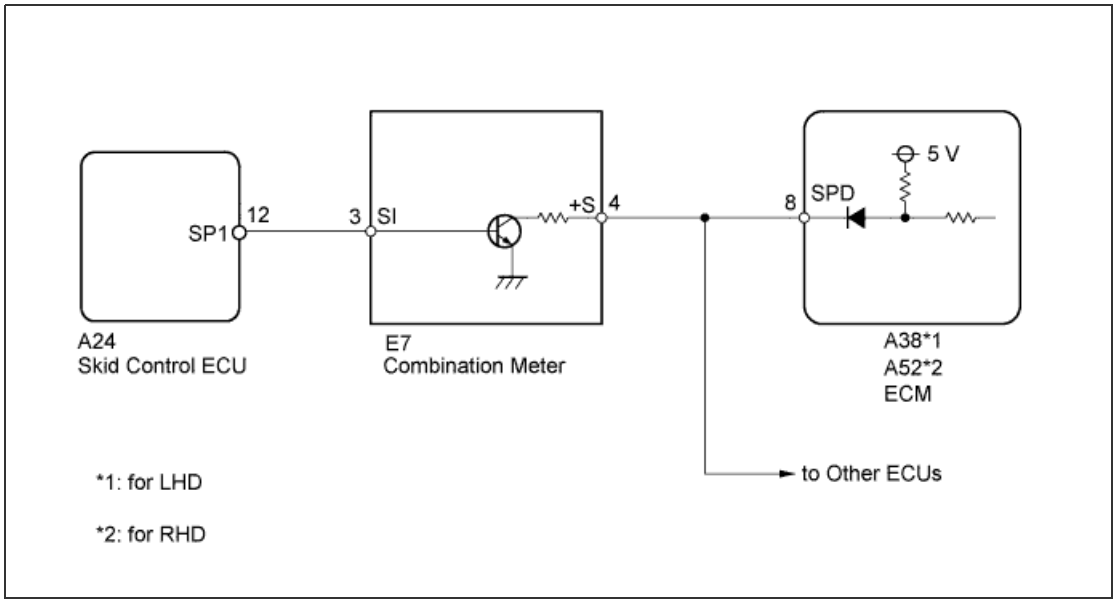


DTC Code	DTC Detection Condition	Trouble Area
P0500	While the vehicle is being driven, no vehicle speed sensor signal is transmitted to the ECM (2 trip detection logic).	• Open or short in speed signal circuit • Combination meter • ECM

MONITOR DESCRIPTION

The ECM assumes that the vehicle is being driven when the indicated engine speed is more than 2300 rpm and 30 seconds have elapsed since the Park/Neutral Position (PNP) switch was turned off. If there is no speed signal from the combination meter despite these conditions being met, the ECM interprets this as a malfunction in the speed signal circuit. The ECM then illuminates the MIL and stores the DTC.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When

troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK OPERATION OF SPEEDOMETER

a. Drive the vehicle and check whether the operation of the speedometer in the combination meter is normal.

HINT:

- **The vehicle speed sensor is operating normally if the speedometer reading is normal.**
- **If the speedometer does not operate, check it by following the procedure described in Speedometer Malfunction.**

NG → **GO TO MALFUNCTION IN SPEEDOMETER (Click here)**

OK

2.READ VALUE USING INTELLIGENT TESTER (VEHICLE SPEED)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Vehicle Speed.

e. Drive the vehicle.

f. Read the value displayed on the tester.

OK:
Vehicle speeds displayed on tester and speedometer display are equal.

NG → **Go to step 3**

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

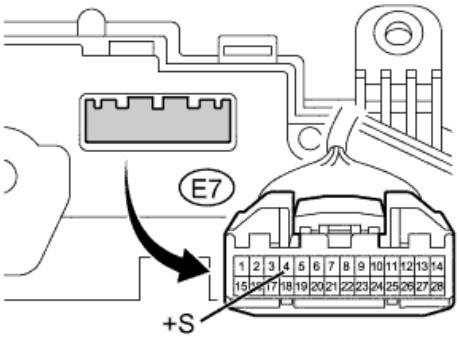
3.CHECK HARNESS AND CONNECTOR (COMBINATION METER ASSEMBLY - ECM)

a. Disconnect the combination meter connector.

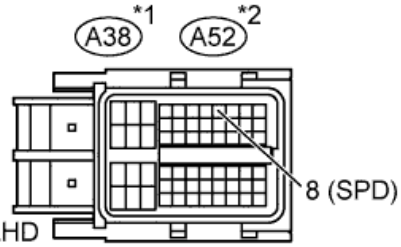
b. Disconnect the ECM connector.

c. Measure the resistance according the value(s) in the table below.

Front view of wire harness connector:
(to Combination Meter)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
E7-4 (+S) - A38-8 (SPD)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
E7-4 (+S) - A52-8 (SPD)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
E7-4 (+S) or A38-8 (SPD) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
E7-4 (+S) or A52-8 (SPD) - Body ground	Always	10 kΩ or higher

HINT:

If the wire has a short, check the speed signal circuit in other systems related to the vehicle speed signal (e.g. tire pressure warning system, audio system, etc.).

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (OTHER SYSTEMS RELATED TO SPEED SIGNAL)

OK

4.CHECK COMBINATION METER ASSEMBLY (+S VOLTAGE)

a. Disconnect the combination meter connector.

HINT:

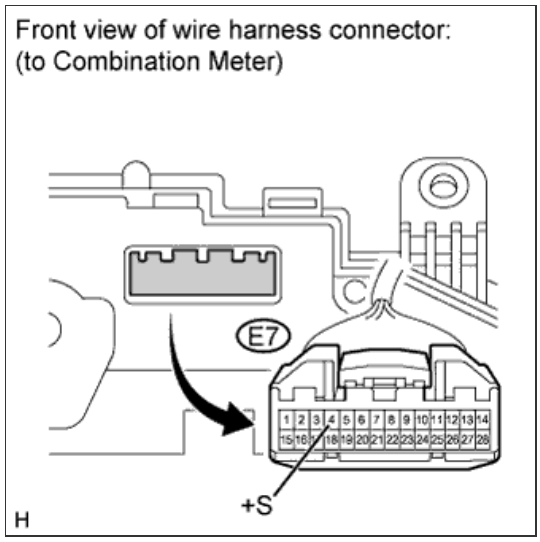
Disconnect the ECU connectors on the other systems related to the speed signal (but the ECM connectors must be connected).

b. Turn the ignition switch to ON.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
E7-4 (+S) - Body ground	Ignition switch ON	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

5.CHECK COMBINATION METER ASSEMBLY (SPD SIGNAL OUTPUT WAVEFORM)

a. Remove the combination meter.

b. Connect the combination meter connector.

c. Move the shift lever to the N.

d. Jack up the vehicle.

e. Turn the ignition switch to ON.

f. Check the voltage between the terminal of the combination meter and the body ground while a wheel is turned slowly.

Standard Voltage:

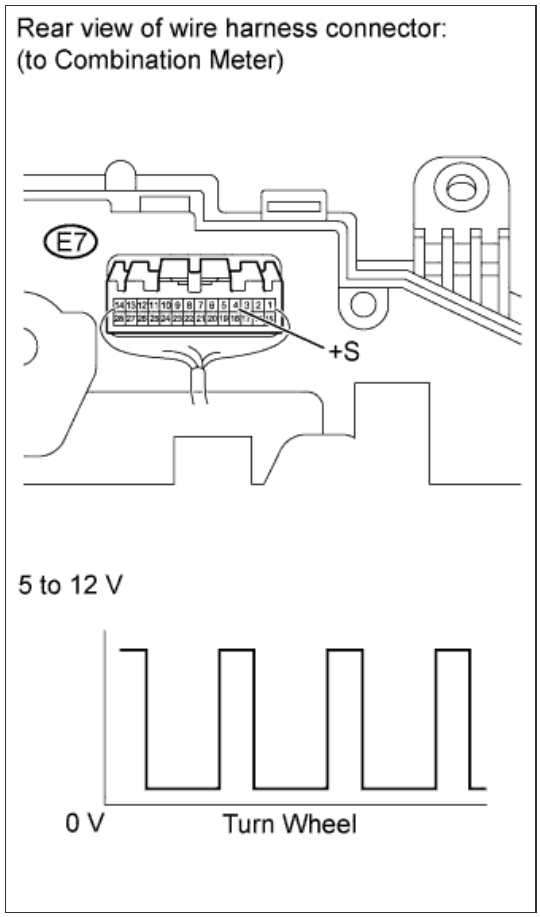
Tester Connection	Switch condition	Specified Condition
E7-4 (+S) - Body ground	Ignition switch ON	Voltage generated intermittently

HINT:

- **The output voltage should fluctuate up and down, similarly to the diagram, when a wheel is turned slowly.**
- **A voltage of 12 V or 5 V is output from each ECU and then input to the combination meter assembly.**

HINT:

The output voltage should fluctuate up and down, similarly to the diagram, when a wheel is turned slowly.



NG → Go to step 6

OK

REPLACE ECM (Click here)

6.CHECK COMBINATION METER ASSEMBLY (SPD SIGNAL INPUT WAVEFORM)

a. Remove the combination meter.

b. Connect the combination meter connector.

c. Move the shift lever to the N.

d. Jack up the vehicle.

e. Turn the ignition switch to ON.

f. Check the voltage between the terminal of the combination meter and the body ground while a wheel is turned slowly.

Standard Voltage:

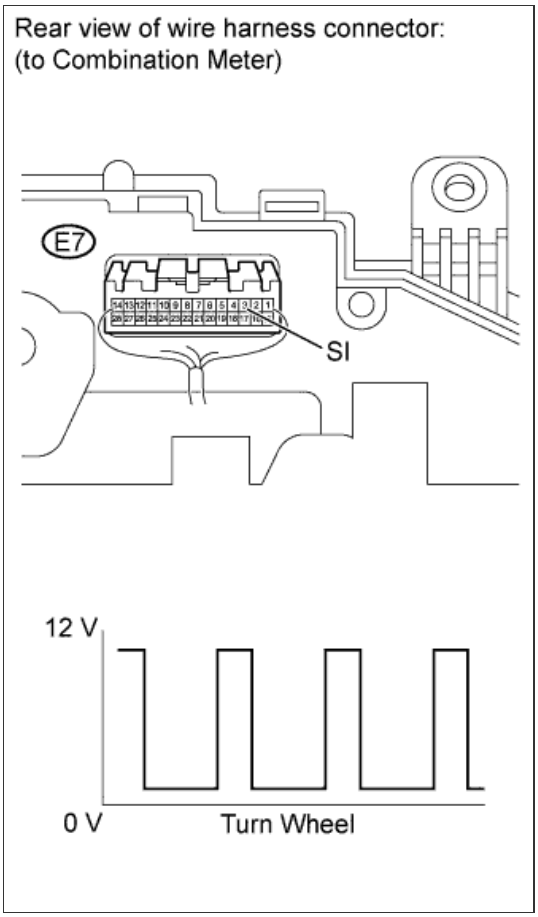
Tester Connection	Switch condition	Specified Condition
E7-4 (+S) - Body ground	Ignition switch ON	Voltage generated intermittently

HINT:

The output voltage should fluctuate up and down, similarly to the diagram, when a wheel is turned slowly.

Result

Result	Proceed to
NG (w/ Multi-information Display)	A
NG (w/o Multi-information Display)	B
OK	C



B → REPLACE COMBINATION METER ASSEMBLY (Click here)

C → Go to step 7

A

REPLACE COMBINATION METER ASSEMBLY (Click here)

7.CHECK HARNESS AND CONNECTOR (COMBINATION METER - SKID CONTROL ECU)

a. Disconnect the combination meter connector.

b. Disconnect the skid control ECU connector.

c. Measure the resistance according the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
E7-3 (SI) - A24-12 (SP1)	Always	Below 1 Ω

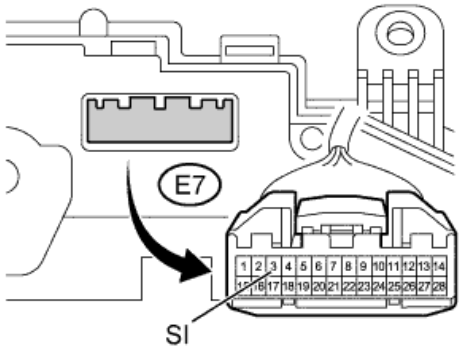
Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
E7-3 (SI) or A24-12 (SP1) - Body ground	Always	10 kΩ or higher

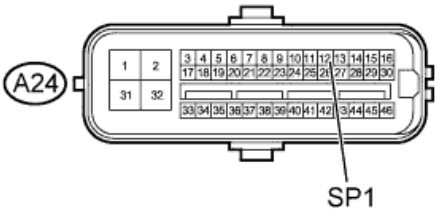
Result

Result	Proceed to
OK (for LHD)	A
OK (for RHD)	B
NG	C

Front view of wire harness connector:
(to Combination Meter)



Front view of wire harness connector:
(to Skid Control ECU)



B	REPLACE MASTER CYLINDER SOLENOID (Click here)
C	REPAIR OR REPLACE HARNESS OR CONNECTOR

A

REPLACE MASTER CYLINDER SOLENOID (Click here)

DTC P0037 Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)

DTC P0038 Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)

DTC P0057 Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)

DTC P0058 Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)

DTC P0141 Oxygen Sensor Heater Circuit Malfunction (Bank 1 Sensor 2)

DTC P0161 Oxygen Sensor Heater Circuit Malfunction (Bank 2 Sensor 2)

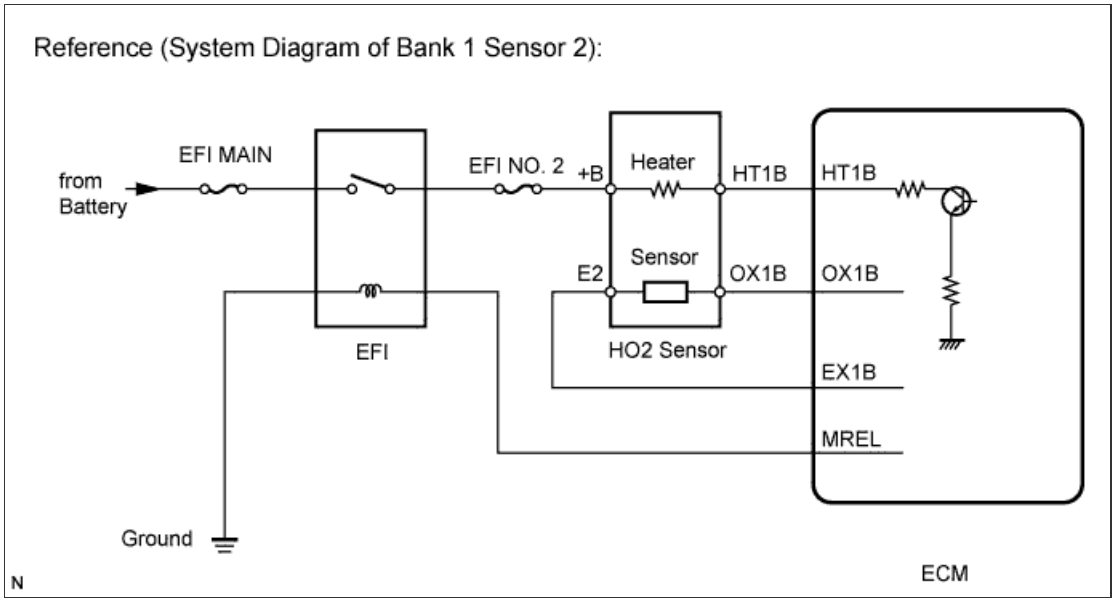
for Preparation Click here

DESCRIPTION

Refer to DTC P0136 (Click here).

HINT:

- **Sensor 2 refers to the sensor mounted behind the Three-Way Catalytic Converter (TWC) and located far from the engine assembly.**
- **When any of these DTCs are stored, the ECM enters fail-safe mode. The ECM turns off the Heated Oxygen (HO2) sensor heater in fail-safe mode. Fail-safe mode continues until the ignition switch is turned off.**
- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The HO2 sensor heater circuit uses a relay on the +B side of the circuit.**



DTC Code	DTC Detection Condition	Trouble Area
P0037 P0057	The Heated Oxygen (HO2) sensor heater (bank 1, 2 sensor 2) current is below 0.3 A (1 trip detection logic).	• **Open in Heated Oxygen (HO2) sensor heater (bank 1, 2 sensor 2) circuit** • **HO2 sensor heater (bank 1, 2 sensor 2)** • **EFI NO. 2 fuse** • **ECM**
P0038 P0058	The Heated Oxygen (HO2) sensor heater (bank 1, 2 sensor 2) current is higher than 2 A (1 trip detection logic).	• **Short in HO2 sensor heater (bank 1, 2 sensor 2) circuit** • **HO2 sensor heater (bank 1, 2 sensor 2)** • **EFI NO. 2 fuse** • **ECM**
P0141 P0161	The cumulative heater resistance correction value exceeds the acceptable threshold (2 trip detection logic).	• **Open or short in HO2 sensor heater (bank 1, 2 sensor 2) circuit** • **HO2 sensor heater (bank 1, 2 sensor 2)** • **EFI NO. 2 fuse** • **ECM**

HINT:

- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

MONITOR DESCRIPTION

The sensing portion of the Heated Oxygen (HO2) sensor has a zirconia element which is used to detect the oxygen concentration in the exhaust gas. If the zirconia element is at the appropriate temperature, and the difference between the oxygen concentrations surrounding the inside and outside surfaces of the sensor is large, the zirconia element generates voltage signals. In order to increase the oxygen concentration detecting capacity of the zirconia element, the ECM supplements the heat from the exhaust with heat from a heating element inside the sensor.

Heated oxygen sensor heater range check (P0037, P0038, P0057 and P0058):

The ECM monitors the current applied to the HO2 sensor heater to check the heater for malfunctions. If the current is below the threshold value, the ECM will determine that there is an open circuit in the heater. If the current is above the threshold value, the ECM will determine that there is a short circuit in the heater.

Example:

The ECM stores DTC P0038 or P0058 when the current in the HO2 sensor heater is higher than 2 A. Conversely, when the heater current is below 0.3 A, DTC P0037 or P0057 is stored.

Heated oxygen sensor heater performance (P0141 and P0161):

After the accumulated heater ON time exceeds 100 seconds, the ECM calculates the heater resistance using the battery voltage and the current applied to the heater. If the resistance is above the threshold value, the ECM will determine that there is a malfunction in the HO2 sensor heater and store DTCs P0141 and P0161.

WIRING DIAGRAM

Refer to DTC P0136 (Click here).

INSPECTION PROCEDURE

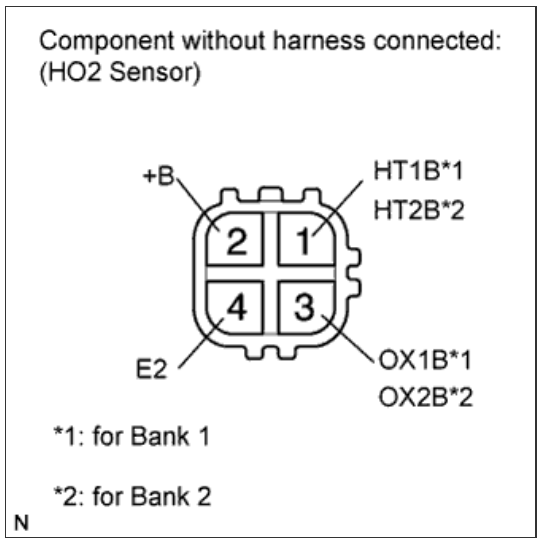
HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

a. Disconnect the heated oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for Bank 1 Sensor 2

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT1B) - 4 (E2)	Always	10 kΩ or higher

for Bank 2 Sensor 2

Tester Connection	Condition	Specified Condition
1 (HT2B) - 2 (+B)	20°C (68°F)	11 to 16 Ω

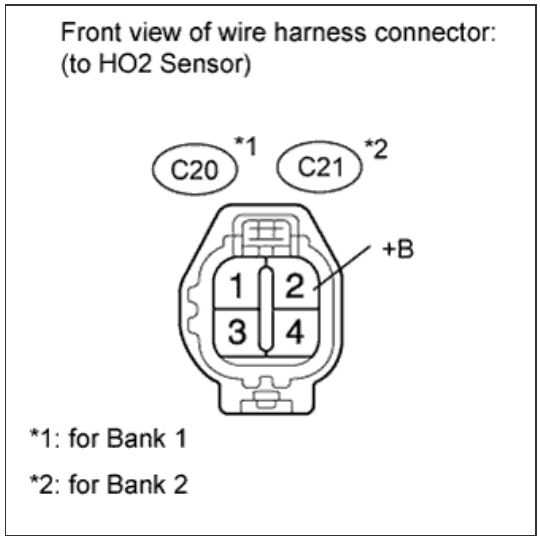
1 (HT2B) - 4 (E2)	Always	10 kΩ or higher

NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF HO2 SENSOR)

a. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for Bank 1 Sensor 1

Tester Connection	Switch Condition	Specified Condition
C20-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

for Bank 2 Sensor 1

Tester Connection	Switch Condition	Specified Condition
C21-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

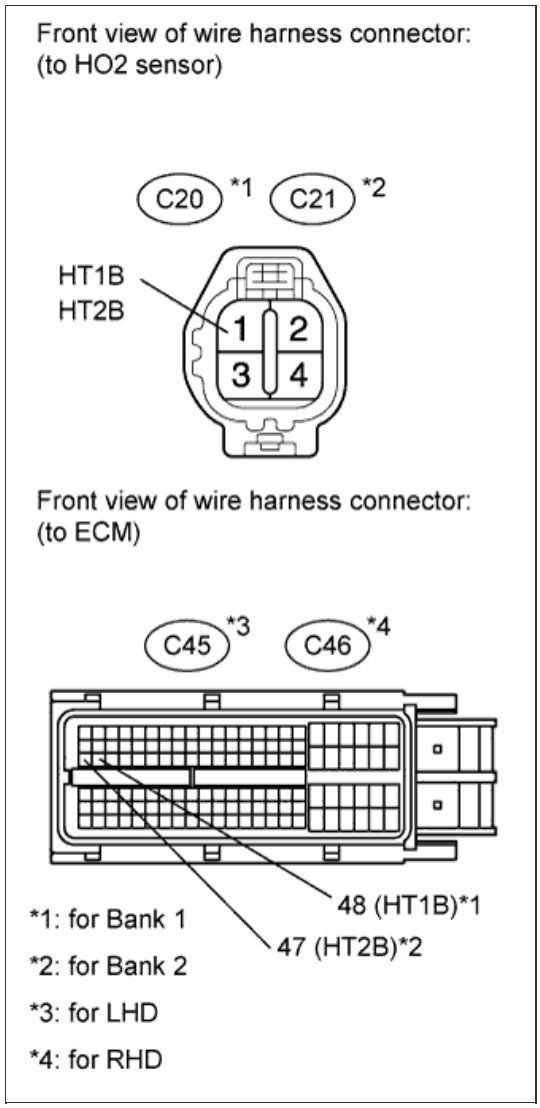
NG → Go to step 4

OK

3.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C45-48 (HT1B)	Always	Below 1 Ω
C21-1 (HT2B) - C45-47 (HT2B)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C46-48 (HT1B)	Always	Below 1 Ω
C21-1 (HT2B) - C46-47 (HT2B)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C45-48 (HT1B) - Body ground	Always	10 kΩ or higher
C21-1 (HT2B) or C45-47 (HT2B) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C46-48 (HT1B) -		10 kΩ or

Body ground	Always	higher
C21-1 (HT2B) or C46-47 (HT2B) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

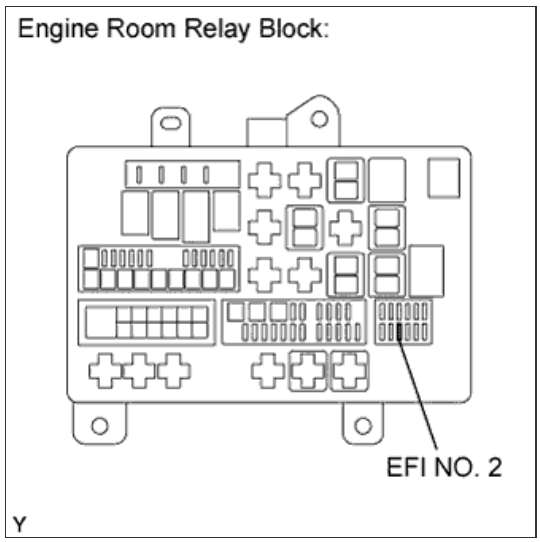
4.INSPECT FUSE (EFI NO. 2)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse	Always	Below 1 Ω



NG → CHECK FOR SHORT IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

OK

5.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - EFI NO. 2 FUSE)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

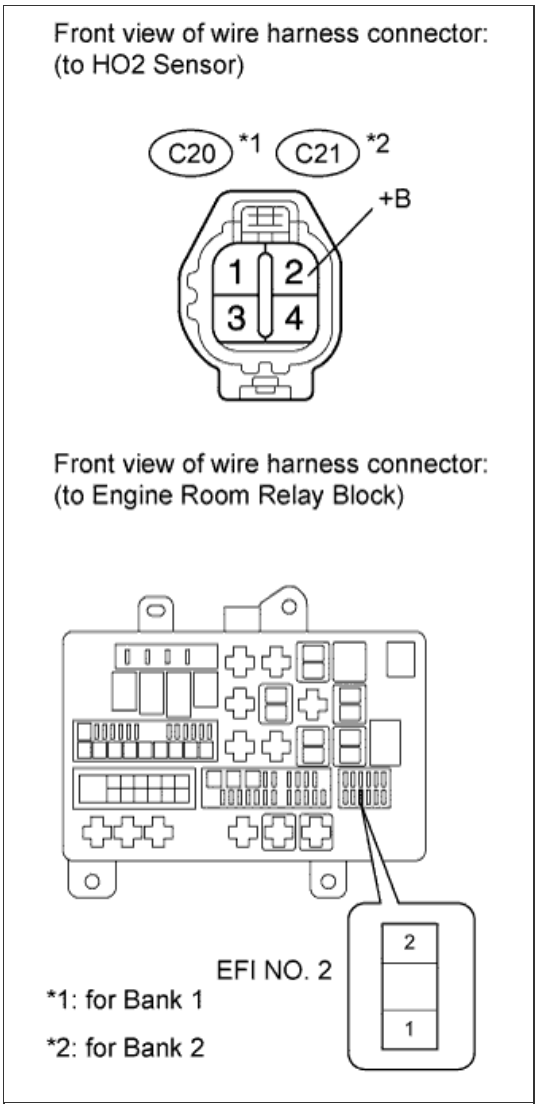
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C20-2 (+B) - EFI NO. 2 fuse (2)	Always	Below 1 Ω
C21-2 (+B) - EFI NO. 2 fuse (2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
C20-2 (+B) or EFI NO. 2 fuse (2) - Body ground	Always	10 kΩ or higher
C21-2 (+B) or EFI NO. 2 fuse (2) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6.CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - EFI NO. 2 FUSE)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

b. Remove the integration relay from the engine room relay block.

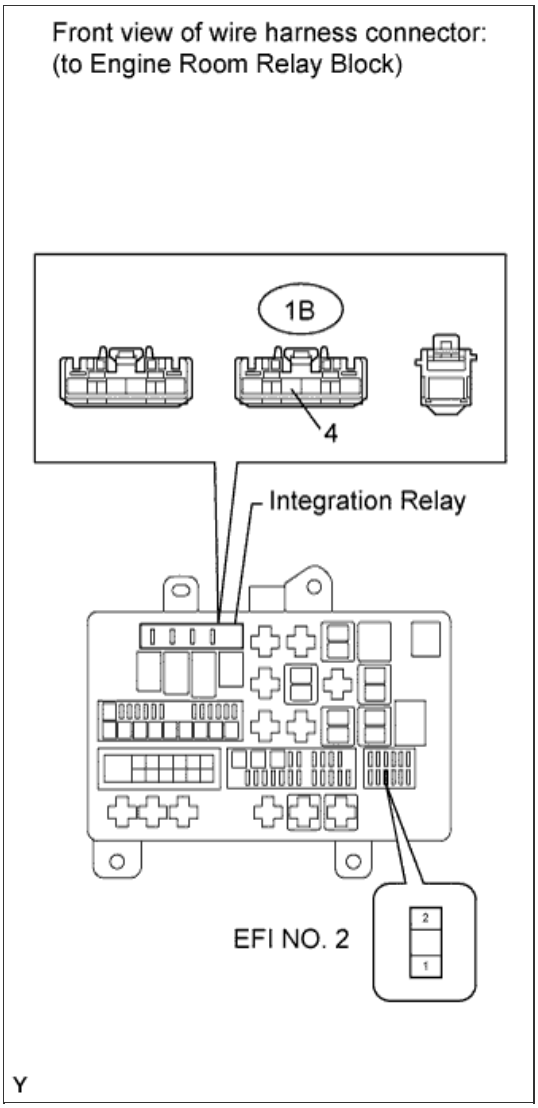
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse (1) - 1B-4	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse (1) or 1B-4 - Body ground	Always	10 kΩ or higher



NG → REPLACE ENGINE ROOM RELAY BLOCK

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

DTC P0504 Brake Switch "A" / "B" Correlation

for Preparation Click here

DESCRIPTION

The stop light switch is a duplex system that transmits two signals: STP and ST1-. These two signals are used by the ECM to monitor whether or not the brake system is working properly. If the signals, which indicate the brake pedal is being depressed and released, are detected simultaneously, the ECM interprets this as a malfunction in the stop light switch and stores the DTC.

HINT:

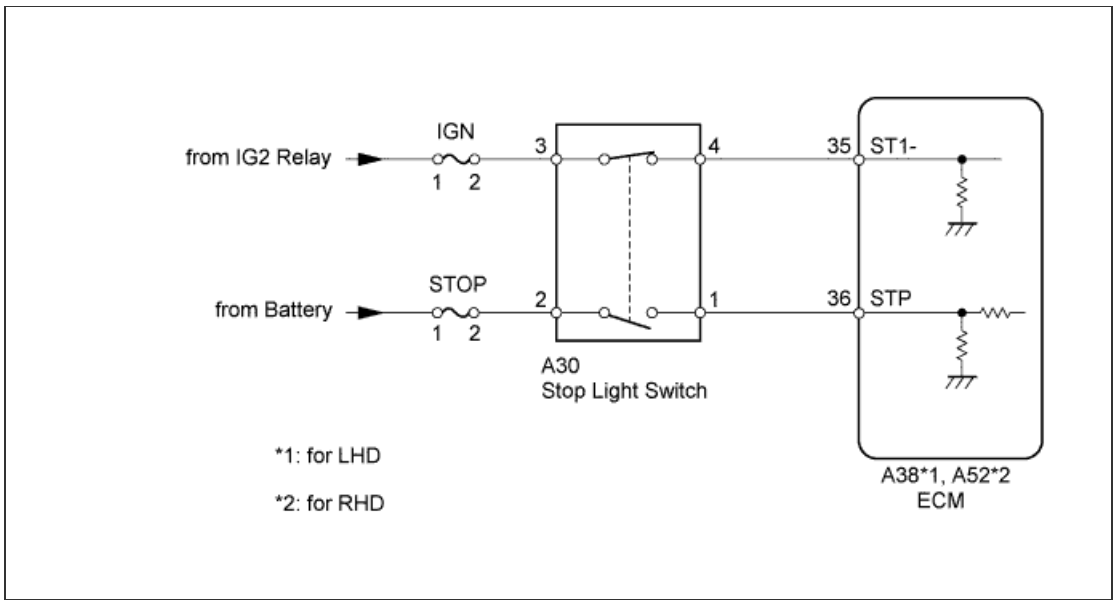
The normal signal conditions are as shown in the table below.

Signal (ECM Terminal)	Brake Pedal Released	In Transition	Brake Pedal Depressed
STP	OFF	ON	ON
ST1-	ON	ON	OFF

- [OFF] denotes ground potential.
- [ON] denotes battery potential (+B).
- On the intelligent tester, both the Data List items Stop Light Switch and ST1 are ON when the brake pedal is depressed because the characteristics of ST1 indication are the opposite of the Stop Light Switch indication.

DTC Code	DTC Detection Condition	Trouble Area
P0504	Conditions (a), (b) and (c) continue for 0.5 seconds or more (1 trip detection logic): (a) The ignition switch is ON. (b) The brake pedal is released. (c) The STP signal is OFF when the ST1- signal is OFF.	• Short in stop light switch signal circuit • STOP fuse • IGN fuse • Stop light switch • ECM

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **STP signal conditions can be checked using the intelligent tester.**
    1. **Connect the intelligent tester to the DLC3.**
    2. **Turn the ignition switch to ON.**
    3. **Turn the tester on.**
    4. **Enter the following menus: Powertrain / Engine and ECT / Data List / Stop Light Switch.**

5. Check the STP signal when the brake pedal is depressed and released.

Brake Pedal Operation	Specified Condition
Depressed	STP signal ON
Released	STP signal OFF

1.CHECK STOP LIGHT SWITCH ASSEMBLY (TERMINAL B VOLTAGE)

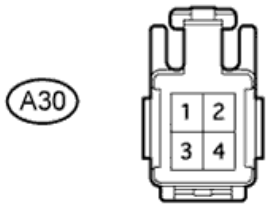
a. Disconnect the stop light switch connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
A30-2 - Body ground	Always	11 to 14 V
A30-3 - Body ground	Ignition switch ON	11 to 14 V

Front view of wire harness connector:
(to Stop Light Switch)



NG → Go to step 4

OK

2.INSPECT STOP LIGHT SWITCH ASSEMBLY

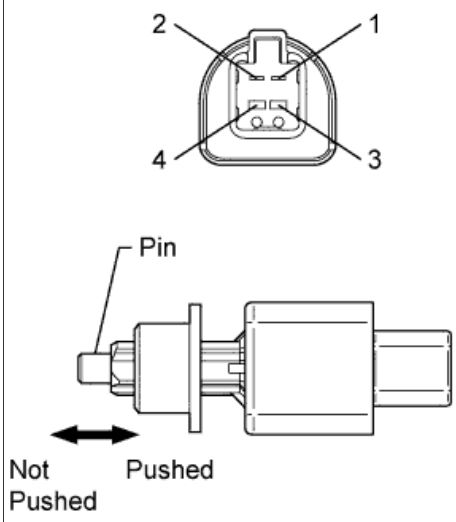
a. Remove the stop light switch.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Switch Condition	Specified Condition
1 - 2	Switch pin not pushed	Below 1 Ω
	Switch pin pushed	10 kΩ or higher
3 - 4	Switch pin not pushed	10 kΩ or higher
	Switch pin pushed	Below 1 Ω

Component without harness connected:
(Stop Light Switch)



NG → REPLACE STOP LIGHT SWITCH ASSEMBLY (Click here)

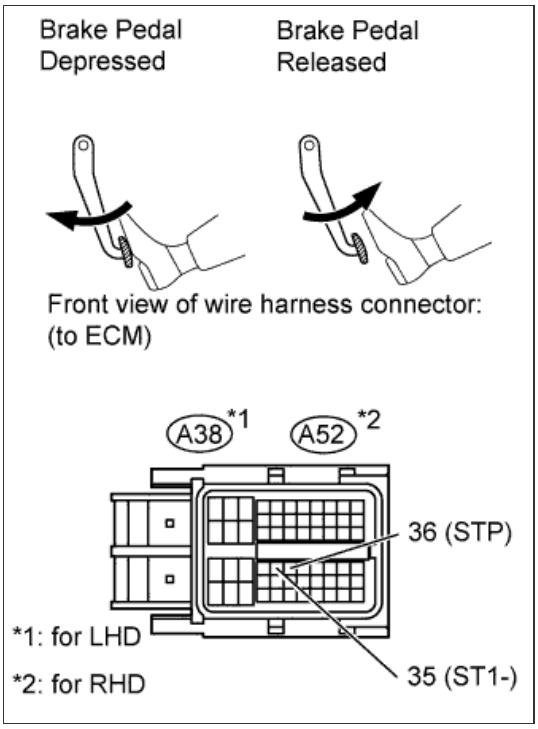
OK

3.CHECK ECM (STP AND ST1 - VOLTAGE)

a. Disconnect the ECM connector.

b. Turn the ignition switch to ON.

c. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for LHD

Tester Connection	Condition	Specified Condition
A38-35 (ST1-) - Body ground	Brake pedal released	11 to 14 V
	Brake pedal depressed	0 to 3 V
A38-36 (STP) - Body ground	Brake pedal released	0 to 3 V
	Brake pedal depressed	11 to 14 V

for RHD

Tester Connection	Condition	Specified Condition
A52-35 (ST1-) - Body ground	Brake pedal released	11 to 14 V
	Brake pedal depressed	0 to 3 V
A52-36 (STP) - Body ground	Brake pedal released	0 to 3 V
	Brake pedal depressed	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

4.INSPECT FUSE (STOP, IGN)

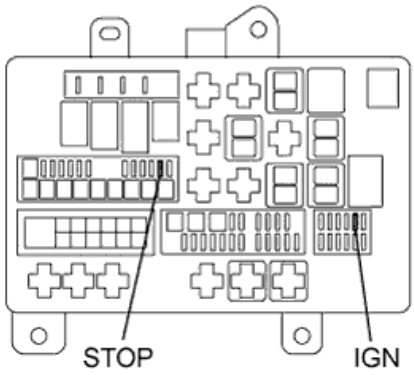
a. Remove the STOP and IGN fuses from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
STOP fuse	Always	Below 1 Ω
IGN fuse		

Engine Room Relay Block:



Y

NG → CHECK FOR SHORTS IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR

DTC P0037 Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)

DTC P0038 Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)

DTC P0057 Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)

DTC P0058 Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)

DTC P0141 Oxygen Sensor Heater Circuit Malfunction (Bank 1 Sensor 2)

DTC P0161 Oxygen Sensor Heater Circuit Malfunction (Bank 2 Sensor 2)

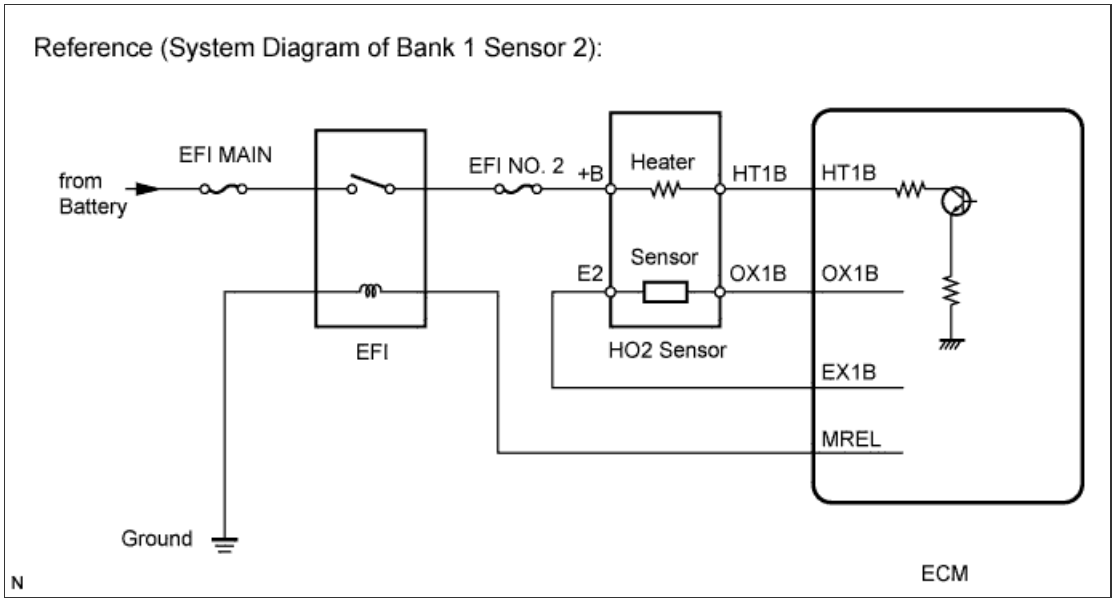
for Preparation Click here

DESCRIPTION

Refer to DTC P0136 (Click here).

HINT:

- **Sensor 2 refers to the sensor mounted behind the Three-Way Catalytic Converter (TWC) and located far from the engine assembly.**
- **When any of these DTCs are stored, the ECM enters fail-safe mode. The ECM turns off the Heated Oxygen (HO2) sensor heater in fail-safe mode. Fail-safe mode continues until the ignition switch is turned off.**
- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The HO2 sensor heater circuit uses a relay on the +B side of the circuit.**



DTC Code	DTC Detection Condition	Trouble Area
P0037 P0057	The Heated Oxygen (HO2) sensor heater (bank 1, 2 sensor 2) current is below 0.3 A (1 trip detection logic).	• **Open in Heated Oxygen (HO2) sensor heater (bank 1, 2 sensor 2) circuit** • **HO2 sensor heater (bank 1, 2 sensor 2)** • **EFI NO. 2 fuse** • **ECM**
P0038 P0058	The Heated Oxygen (HO2) sensor heater (bank 1, 2 sensor 2) current is higher than 2 A (1 trip detection logic).	• **Short in HO2 sensor heater (bank 1, 2 sensor 2) circuit** • **HO2 sensor heater (bank 1, 2 sensor 2)** • **EFI NO. 2 fuse** • **ECM**
P0141 P0161	The cumulative heater resistance correction value exceeds the acceptable threshold (2 trip detection logic).	• **Open or short in HO2 sensor heater (bank 1, 2 sensor 2) circuit** • **HO2 sensor heater (bank 1, 2 sensor 2)** • **EFI NO. 2 fuse** • **ECM**

HINT:

- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

MONITOR DESCRIPTION

The sensing portion of the Heated Oxygen (HO2) sensor has a zirconia element which is used to detect the oxygen concentration in the exhaust gas. If the zirconia element is at the appropriate temperature, and the difference between the oxygen concentrations surrounding the inside and outside surfaces of the sensor is large, the zirconia element generates voltage signals. In order to increase the oxygen concentration detecting capacity of the zirconia element, the ECM supplements the heat from the exhaust with heat from a heating element inside the sensor.

Heated oxygen sensor heater range check (P0037, P0038, P0057 and P0058):

The ECM monitors the current applied to the HO2 sensor heater to check the heater for malfunctions. If the current is below the threshold value, the ECM will determine that there is an open circuit in the heater. If the current is above the threshold value, the ECM will determine that there is a short circuit in the heater.

Example:

The ECM stores DTC P0038 or P0058 when the current in the HO2 sensor heater is higher than 2 A. Conversely, when the heater current is below 0.3 A, DTC P0037 or P0057 is stored.

Heated oxygen sensor heater performance (P0141 and P0161):

After the accumulated heater ON time exceeds 100 seconds, the ECM calculates the heater resistance using the battery voltage and the current applied to the heater. If the resistance is above the threshold value, the ECM will determine that there is a malfunction in the HO2 sensor heater and store DTCs P0141 and P0161.

WIRING DIAGRAM

Refer to DTC P0136 (Click here).

INSPECTION PROCEDURE

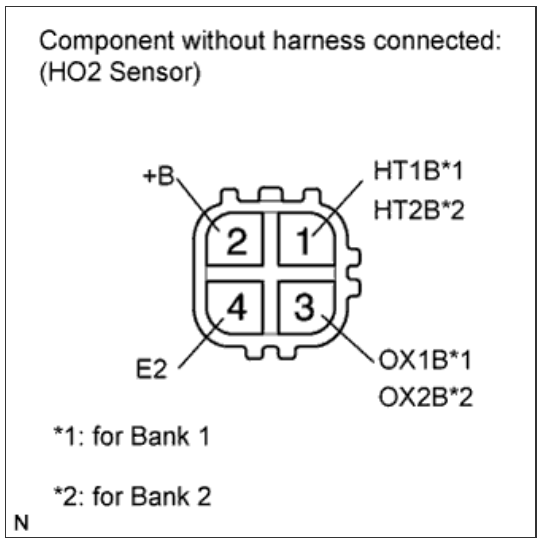
HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

a. Disconnect the heated oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for Bank 1 Sensor 2

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT1B) - 4 (E2)	Always	10 kΩ or higher

for Bank 2 Sensor 2

Tester Connection	Condition	Specified Condition
1 (HT2B) - 2 (+B)	20°C (68°F)	11 to 16 Ω

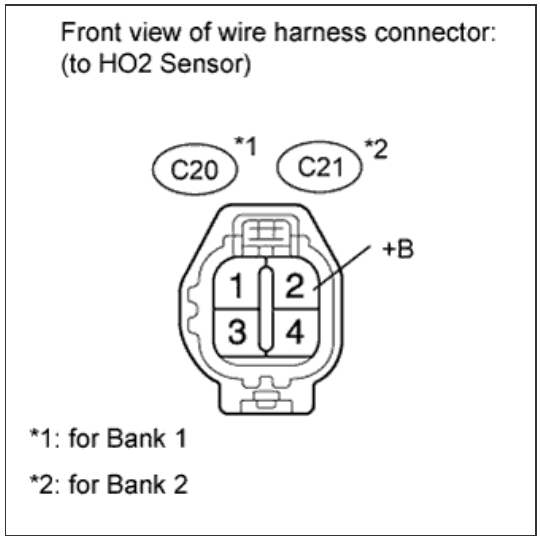
1 (HT2B) - 4 (E2)	Always	10 kΩ or higher

NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF HO2 SENSOR)

a. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for Bank 1 Sensor 1

Tester Connection	Switch Condition	Specified Condition
C20-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

for Bank 2 Sensor 1

Tester Connection	Switch Condition	Specified Condition
C21-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

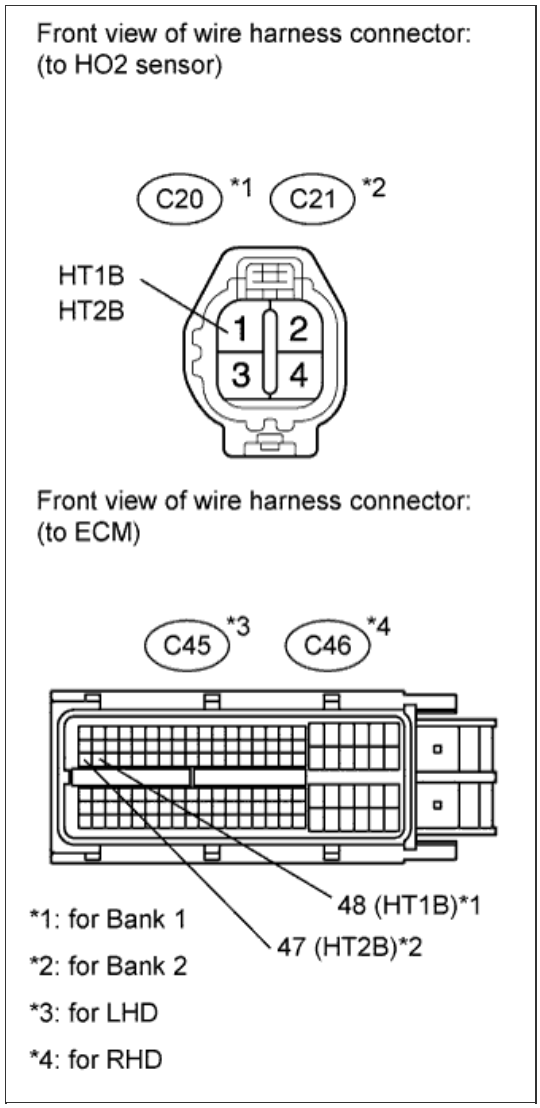
NG → Go to step 4

OK

3.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C45-48 (HT1B)	Always	Below 1 Ω
C21-1 (HT2B) - C45-47 (HT2B)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C46-48 (HT1B)	Always	Below 1 Ω
C21-1 (HT2B) - C46-47 (HT2B)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C45-48 (HT1B) - Body ground	Always	10 kΩ or higher
C21-1 (HT2B) or C45-47 (HT2B) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C46-48 (HT1B) -		10 kΩ or

Body ground	Always	higher
C21-1 (HT2B) or C46-47 (HT2B) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

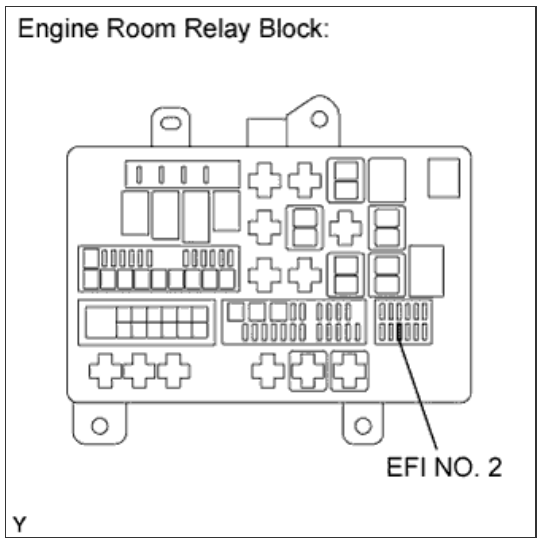
4.INSPECT FUSE (EFI NO. 2)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse	Always	Below 1 Ω



NG → CHECK FOR SHORT IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

OK

5.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - EFI NO. 2 FUSE)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

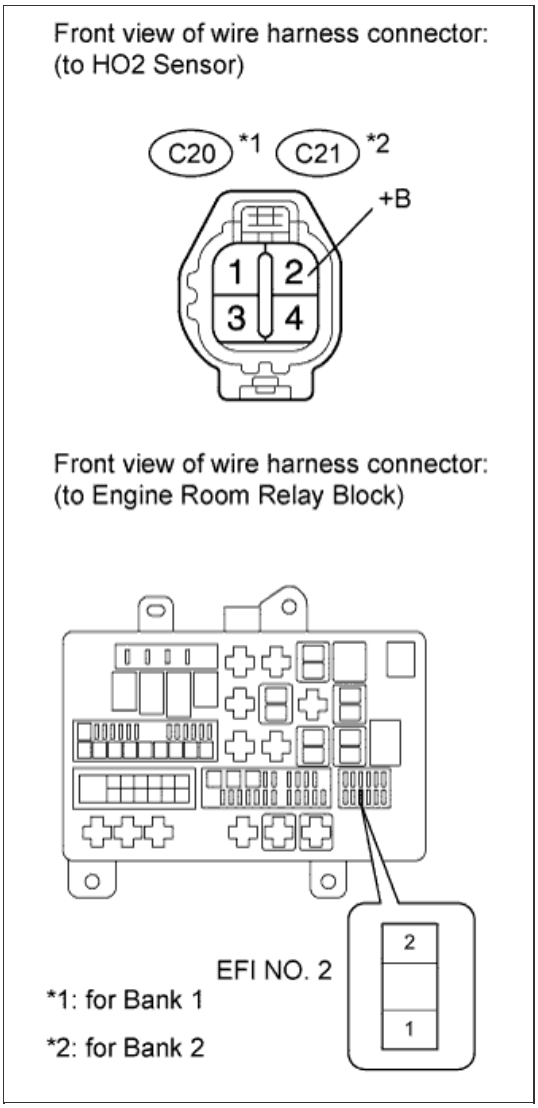
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C20-2 (+B) - EFI NO. 2 fuse (2)	Always	Below 1 Ω
C21-2 (+B) - EFI NO. 2 fuse (2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
C20-2 (+B) or EFI NO. 2 fuse (2) - Body ground	Always	10 kΩ or higher
C21-2 (+B) or EFI NO. 2 fuse (2) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6.CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - EFI NO. 2 FUSE)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

b. Remove the integration relay from the engine room relay block.

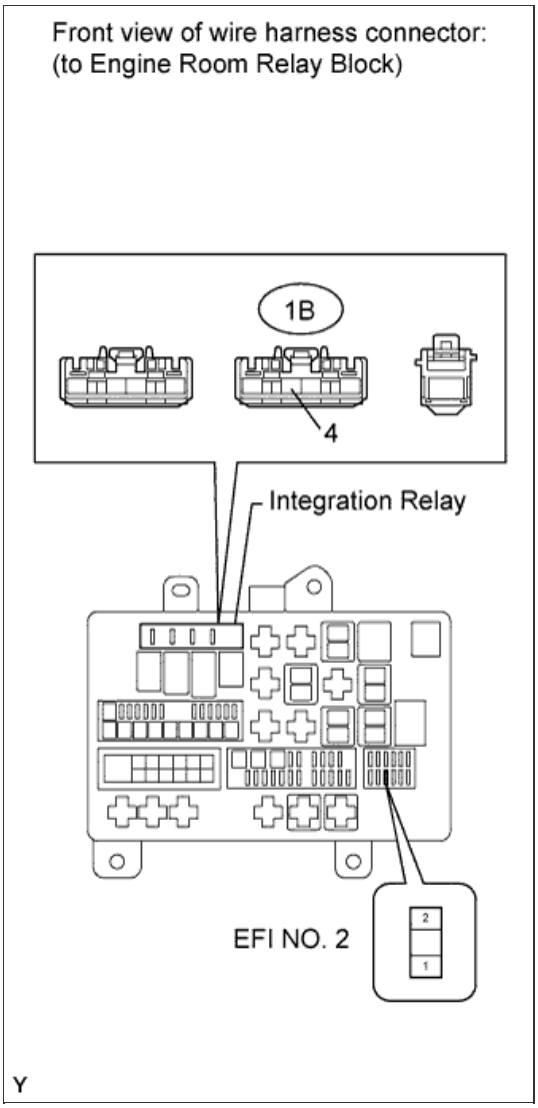
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse (1) - 1B-4	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse (1) or 1B-4 - Body ground	Always	10 kΩ or higher



NG → REPLACE ENGINE ROOM RELAY BLOCK

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

DTC P0505 Idle Control System Malfunction

for Preparation Click here

DESCRIPTION

The idling speed is controlled by the ETCS (Electronic Throttle Control System). The ETCS is comprised of: 1) a one-valve-type throttle body; 2) the throttle actuator, which operates the throttle valve; 3) the Throttle Position (TP) sensor, which detects the opening angle of the throttle valve; 4) the Accelerator Pedal Position (APP) sensor, which detects the accelerator pedal position; and 5) the ECM, which controls the ETCS. Based on the target idling speed, the ECM controls the throttle actuator to provide the proper throttle valve opening angle.

DTC Code	DTC Detection Conditions	Trouble Areas
P0505	The idling speed continues to vary greatly from the target idling speed (2 trip detection logic).	• ETCS • Air induction system • PCV hose connection • ECM

INSPECTION PROCEDURE

HINT:

- **The following conditions may also cause DTC P0505 to be stored:**
  1. **The floor carpet overlapping onto the accelerator pedal, causing the accelerator pedal to be slightly depressed and therefore the throttle valve position to be slightly open.**
  2. **The accelerator pedal being not fully released.**
- **Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was moving or stationary, whether the engine was warmed up or not, whether the air fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0505)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read the DTCs.

Result

Display (DTC Output)	Proceed to
P0505	A
P0505 and other DTCs	B

HINT:

If any DTCs other than P0505 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART

A

2.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:

PCV hose is connected correctly and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE

OK

3.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage.

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK ↓

4.CHECK THROTTLE VALVE

a. Check the throttle valve condition.

OK:
Throttle valve is not contaminated with foreign objects and moves smoothly.

NG → REPLACE THROTTLE WITH MOTOR BODY ASSEMBLY (Click here)

OK ↓

REPLACE ECM (Click here)

DTC P0102 Mass or Volume Air Flow Circuit Low Input

DTC P0103 Mass or Volume Air Flow Circuit High Input

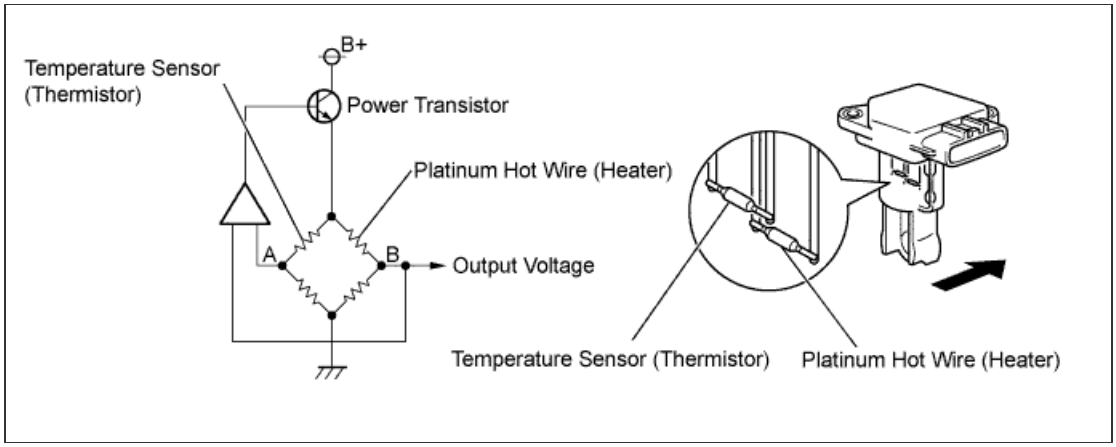
for Preparation Click here

DESCRIPTION

The Mass Air Flow (MAF) meter is a sensor that measures the amount of air flowing through the throttle valve.
The ECM uses this information to determine the fuel injection time and to provide the appropriate air fuel ratio.
Inside the MAF meter, there is a heated platinum wire which is exposed to the flow of intake air.
By applying a specific electrical current to the wire, the ECM heats it to a given temperature. The flow of incoming air cools both the wire and an internal thermistor, affecting their resistance. To maintain a constant current value, the ECM varies the voltage applied to the wire and internal thermistor. The voltage level is proportional to the airflow through the sensor, and the ECM uses it to calculate the intake air volume.
The circuit is constructed so that the platinum hot wire and the temperature sensor create a bridge circuit, and the power transistor is controlled so that the potentials of A and B remain equal to maintain the predetermined temperature.

HINT:

When any of these DTCs are stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is calculated by the ECM, according to the engine speed and throttle valve position. Fail-safe mode continues until a pass condition is detected.



DTC Code	DTC Detection Condition	Trouble Area
P0102	The Mass Air Flow (MAF) meter voltage is below 0.2 V for 3 seconds (1 trip detection logic).	• Open or short in Mass Air Flow (MAF) meter circuit • MAF meter • ECM
P0103	The MAF meter voltage is higher than 4.9 V for 3 seconds (1 trip detection logic).	• Open or short in MAF meter circuit • MAF meter • ECM

HINT:

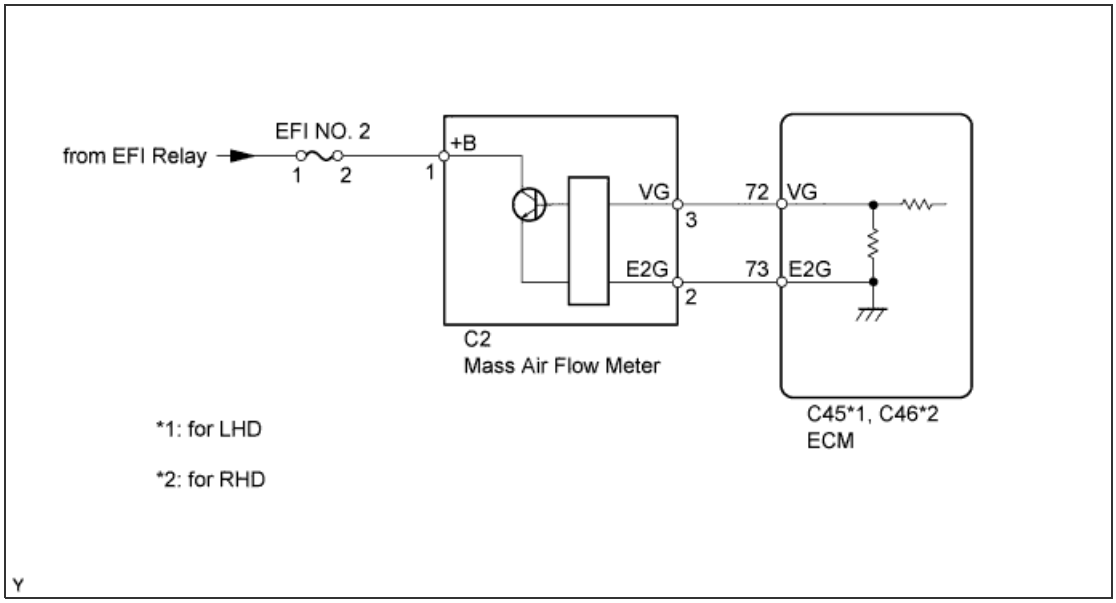
When any of these DTCs are output, check the airflow rate by entering the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF.

Mass Airflow Rate (g/sec.)	Malfunction
Approximately 0.0	• **Open in Mass Air Flow (MAF) meter power source circuit** • **Open or short in VG circuit**
271.0 or more	Open in E2G circuit

MONITOR DESCRIPTION

If there is a defect in the MAF meter or an open or short circuit, the voltage level deviates from the normal operating range. The ECM interprets this deviation as a malfunction in the MAF meter and stores a DTC.
Example:
When the sensor output voltage remains below 0.2 V, or higher than 4.9 V, for more than 3 seconds, the ECM stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored 3 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (MASS AIRFLOW RATE)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / MAF.

e. Read the values displayed on the tester.

Result

Mass Airflow Rate (g/sec.)	Proceed to
0.0	A
271.0 or more	B
Between 1.0 and 270.0*	C

HINT:

*: The value must change when the throttle valve is open or closed with the engine running.

B	Go to step 6
C	CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

2.INSPECT MASS AIR FLOW METER (POWER SOURCE VOLTAGE)

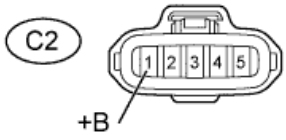
a. Disconnect the Mass Air Flow (MAF) meter connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C2-1 (+B) - Body ground	Ignition switch ON	11 to 14 V

Front view of wire harness connector:
(to MAF Meter)



Y

NG → Go to step 5

OK

3.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

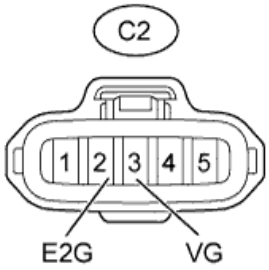
OK

4.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

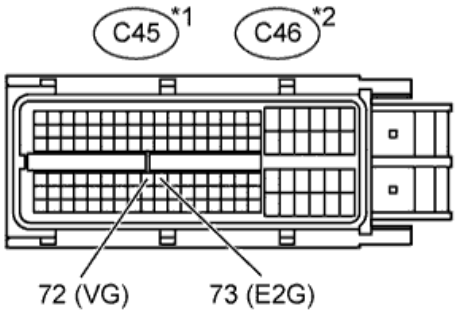
a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to MAF Meter)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C2-3 (VG) - C45-72 (VG)	Always	Below 1 Ω
C2-2 (E2G) - C45-73 (E2G)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C2-3 (VG) - C46-72 (VG)	Always	Below 1 Ω
C2-2 (E2G) - C46-73 (E2G)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C2-3 (VG) or C45-72 (VG) - Body ground	Always	10 kΩ or higher
C2-2 (E2G) or C45-73 (E2G) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C2-3 (VG) or C46-72 (VG) - Body ground	Always	10 kΩ or higher
C2-2 (E2G) or C46-73 (E2G) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

5.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - EFI NO. 2 FUSE)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

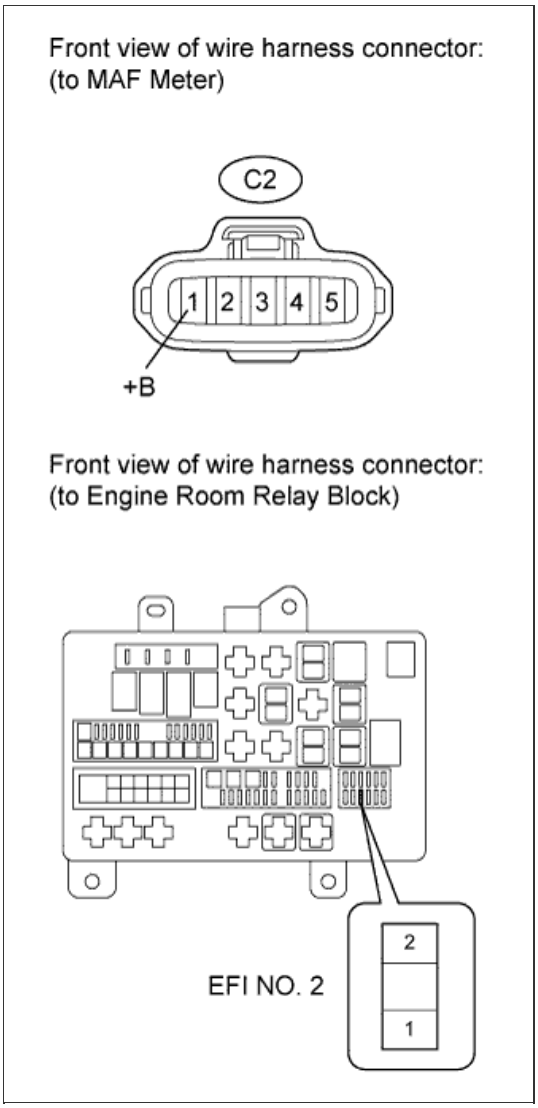
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C2-1 (+B) - EFI NO. 2 fuse (2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
C2-1 (+B) or EFI NO. 2 fuse (2) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

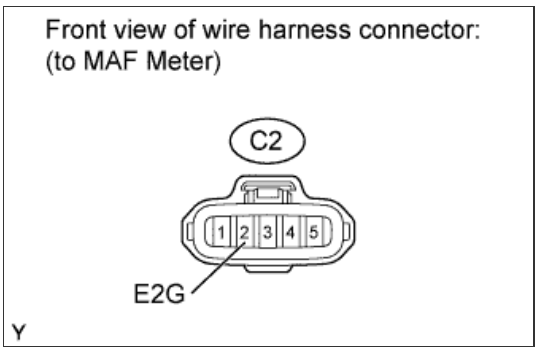
6.CHECK HARNESS AND CONNECTOR (SENSOR GROUND)

a. Disconnect the MAF meter connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C2-2 (E2G) - Body ground	Always	Below 1 Ω



NG → Go to step 7

OK

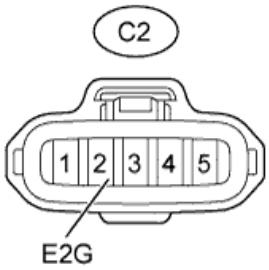
REPLACE MASS AIR FLOW METER (Click here)

7.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

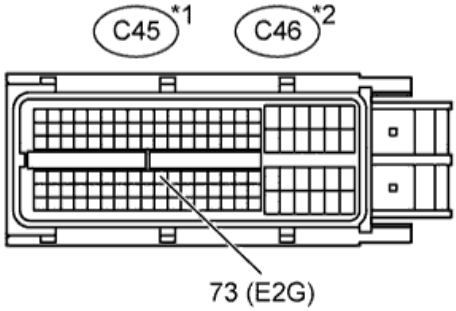
a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to MAF Meter)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C2-2 (E2G) - C45-73 (E2G)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C2-2 (E2G) - C46-73 (E2G)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C2-2 (E2G) or C45-73 (E2G) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C2-2 (E2G) or C46-73 (E2G) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

for Preparation Click here

DESCRIPTION

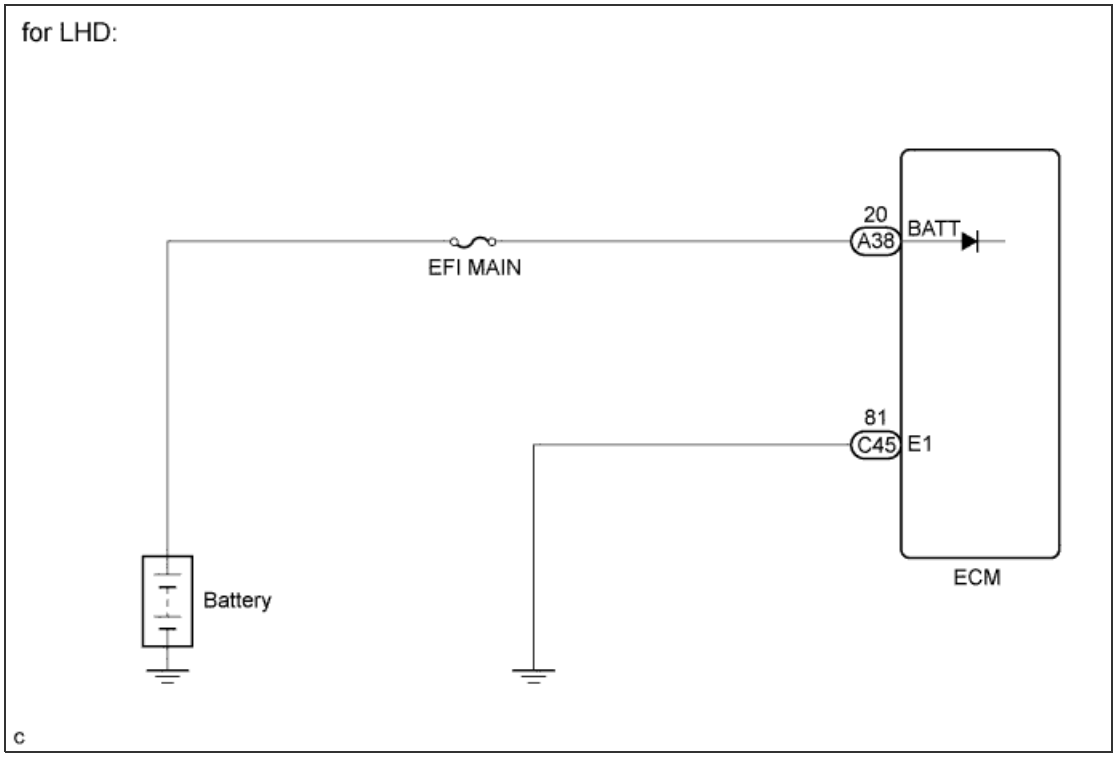
The battery supplies electricity to the ECM even when the ignition switch is off. This power allows the ECM to store data such as DTC history, freeze frame data and fuel trim values. If the battery voltage falls below a minimum level, the memory is cleared and the ECM determines that there is a malfunction in the power supply circuit. When the engine is next started, the ECM illuminates the MIL and stores the DTC.

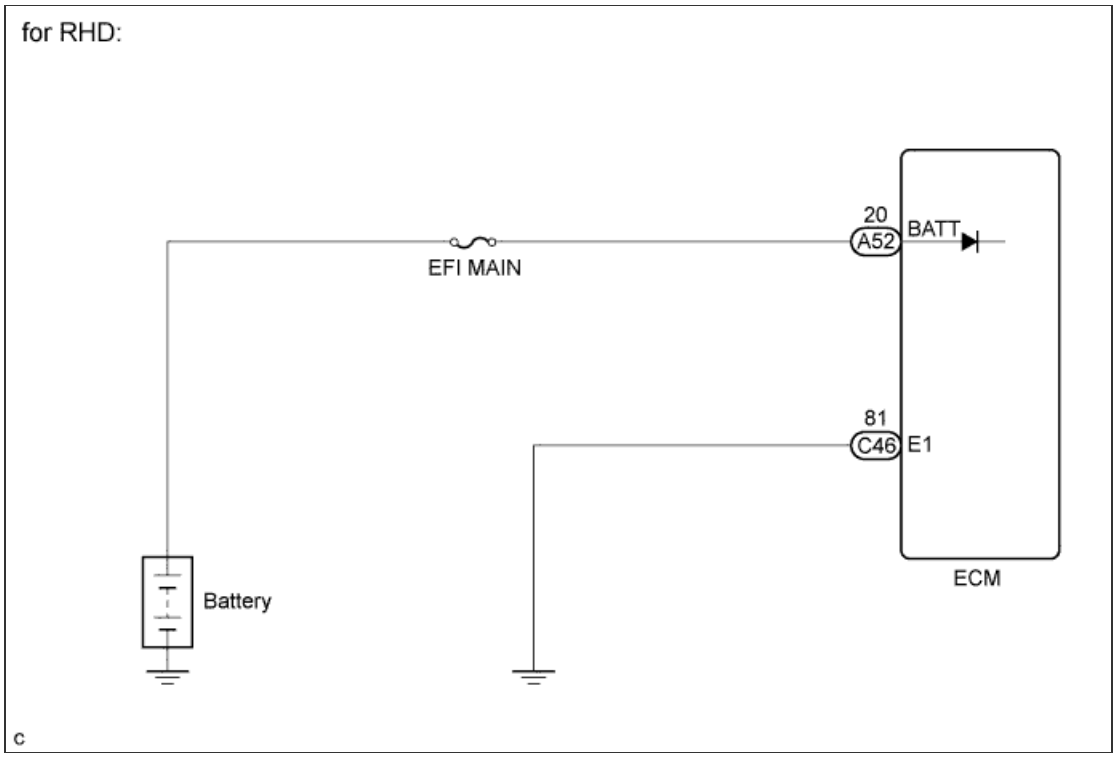
DTC Code	DTC Detection Condition	Trouble Area
P0560	An open in the ECM back up power source circuit (1 trip detection logic).	• Open in back up power source circuit • Battery • Battery terminals • EFI MAIN fuse • ECM

HINT:

If DTC P0560 is stored, the ECM does not store other DTCs or the data stored in the ECM is partly cleared.

WIRING DIAGRAM





INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

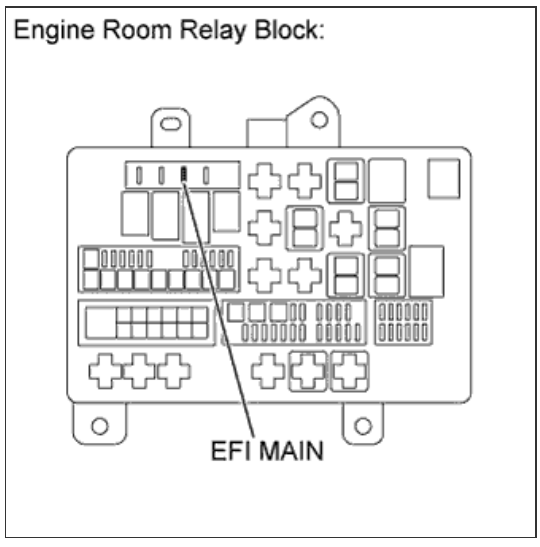
1.INSPECT FUSE (EFI MAIN)

a. Remove the EFI MAIN fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAIN fuse	Always	Below 1 Ω



NG → CHECK FOR SHORTS IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

OK

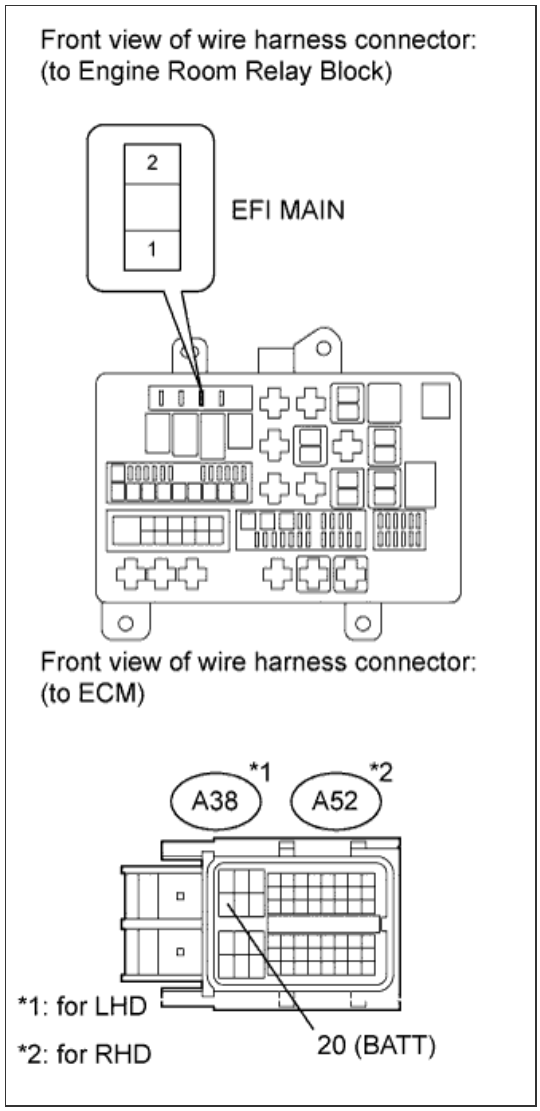
2.CHECK HARNESS AND CONNECTOR (ECM - EFI MAIN FUSE, EFI MAIN FUSE - BATTERY)

a. Check the harness and the connector between the EFI MAIN fuse and ECM.

i. Remove the EFI MAIN fuse from the engine room relay block.

ii. Disconnect the ECM connector.

iii. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
EFI MAIN fuse (2) - A38-20 (BATT)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
EFI MAIN fuse (2) - A52-20 (BATT)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
EFI MAIN fuse (2) or A38-20 (BATT) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
EFI MAIN fuse (2) or A52-20 (BATT) - Body ground	Always	10 kΩ or higher

b. Check the harness and the connector between the EFI MAIN fuse and battery.

i. Remove the EFI MAIN fuse from the engine room relay block.

ii. Disconnect the cable from the positive (+) battery terminal.

iii. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
Battery positive terminal - EFI MAIN fuse (1)	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
Battery positive terminal or EFI MAIN fuse (1) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT BATTERY

a. Check that the battery is not depleted.

OK:
Battery is not depleted.

NG → REPLACE BATTERY

OK

4.CHECK BATTERY TERMINAL

a. Check that the battery terminals are not loose or corroded.

OK:
Battery terminals are not loose or corroded.

NG → REPAIR OR REPLACE BATTERY TERMINAL

OK

5.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Turn the ignition switch off and turn the tester off.

e. Start the engine and turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read the DTCs.

Result

Result	Proceed to
P0560	A
No output	B

B

CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

REPLACE ECM (Click here)

DTC P0102 Mass or Volume Air Flow Circuit Low Input

DTC P0103 Mass or Volume Air Flow Circuit High Input

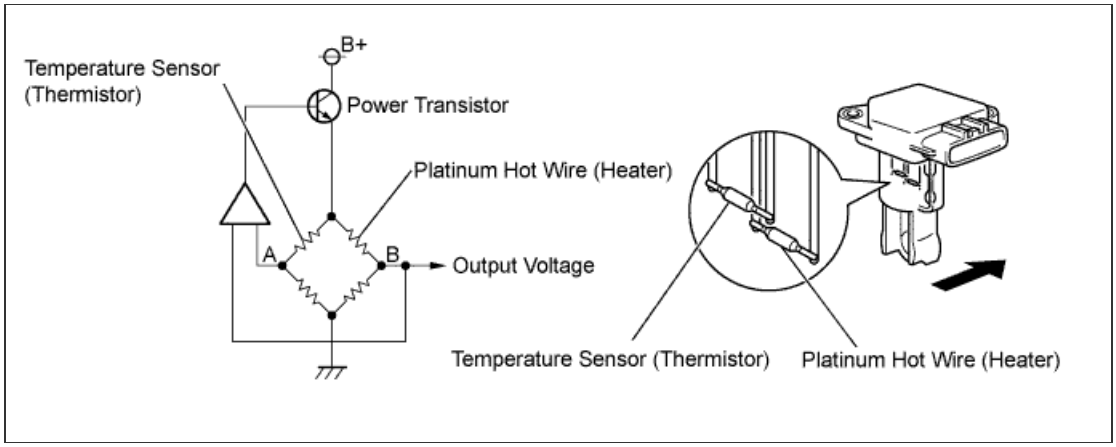
for Preparation Click here

DESCRIPTION

The Mass Air Flow (MAF) meter is a sensor that measures the amount of air flowing through the throttle valve.
The ECM uses this information to determine the fuel injection time and to provide the appropriate air fuel ratio.
Inside the MAF meter, there is a heated platinum wire which is exposed to the flow of intake air.
By applying a specific electrical current to the wire, the ECM heats it to a given temperature. The flow of incoming air cools both the wire and an internal thermistor, affecting their resistance. To maintain a constant current value, the ECM varies the voltage applied to the wire and internal thermistor. The voltage level is proportional to the airflow through the sensor, and the ECM uses it to calculate the intake air volume.
The circuit is constructed so that the platinum hot wire and the temperature sensor create a bridge circuit, and the power transistor is controlled so that the potentials of A and B remain equal to maintain the predetermined temperature.

HINT:

When any of these DTCs are stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is calculated by the ECM, according to the engine speed and throttle valve position. Fail-safe mode continues until a pass condition is detected.



DTC Code	DTC Detection Condition	Trouble Area
P0102	The Mass Air Flow (MAF) meter voltage is below 0.2 V for 3 seconds (1 trip detection logic).	• Open or short in Mass Air Flow (MAF) meter circuit • MAF meter • ECM
P0103	The MAF meter voltage is higher than 4.9 V for 3 seconds (1 trip detection logic).	• Open or short in MAF meter circuit • MAF meter • ECM

HINT:

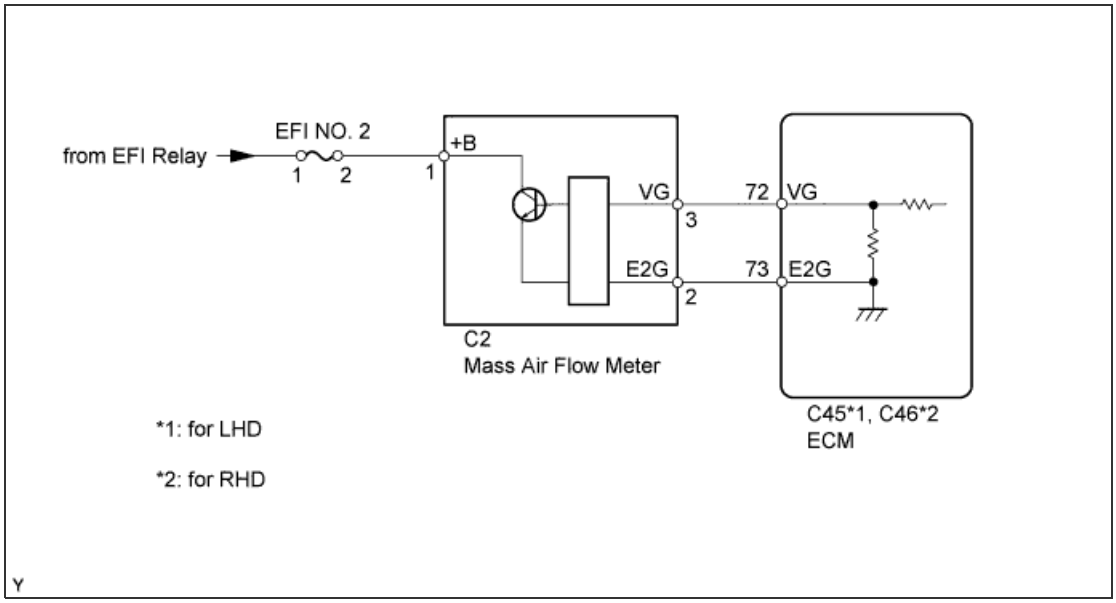
When any of these DTCs are output, check the airflow rate by entering the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF.

Mass Airflow Rate (g/sec.)	Malfunction
Approximately 0.0	• **Open in Mass Air Flow (MAF) meter power source circuit** • **Open or short in VG circuit**
271.0 or more	Open in E2G circuit

MONITOR DESCRIPTION

If there is a defect in the MAF meter or an open or short circuit, the voltage level deviates from the normal operating range. The ECM interprets this deviation as a malfunction in the MAF meter and stores a DTC.
Example:
When the sensor output voltage remains below 0.2 V, or higher than 4.9 V, for more than 3 seconds, the ECM stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored 3 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (MASS AIRFLOW RATE)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / MAF.

e. Read the values displayed on the tester.

Result

Mass Airflow Rate (g/sec.)	Proceed to
0.0	A
271.0 or more	B
Between 1.0 and 270.0*	C

HINT:

*: The value must change when the throttle valve is open or closed with the engine running.

B	Go to step 6
C	CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

2.INSPECT MASS AIR FLOW METER (POWER SOURCE VOLTAGE)

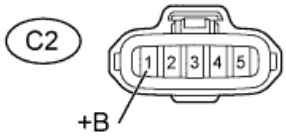
a. Disconnect the Mass Air Flow (MAF) meter connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C2-1 (+B) - Body ground	Ignition switch ON	11 to 14 V

Front view of wire harness connector:
(to MAF Meter)



Y

NG → Go to step 5

OK

3.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

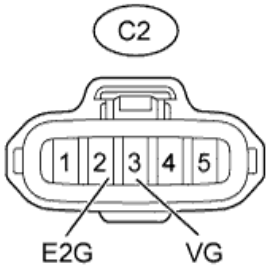
OK

4.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

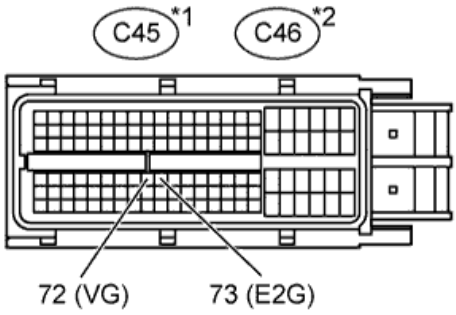
a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to MAF Meter)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C2-3 (VG) - C45-72 (VG)	Always	Below 1 Ω
C2-2 (E2G) - C45-73 (E2G)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C2-3 (VG) - C46-72 (VG)	Always	Below 1 Ω
C2-2 (E2G) - C46-73 (E2G)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C2-3 (VG) or C45-72 (VG) - Body ground	Always	10 kΩ or higher
C2-2 (E2G) or C45-73 (E2G) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C2-3 (VG) or C46-72 (VG) - Body ground	Always	10 kΩ or higher
C2-2 (E2G) or C46-73 (E2G) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

5.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - EFI NO. 2 FUSE)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

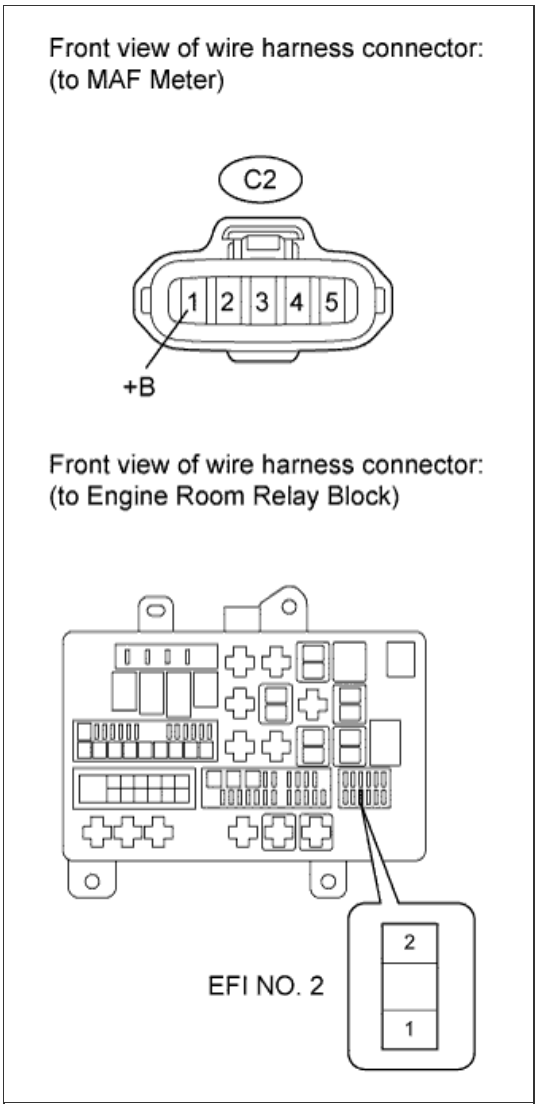
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C2-1 (+B) - EFI NO. 2 fuse (2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
C2-1 (+B) or EFI NO. 2 fuse (2) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

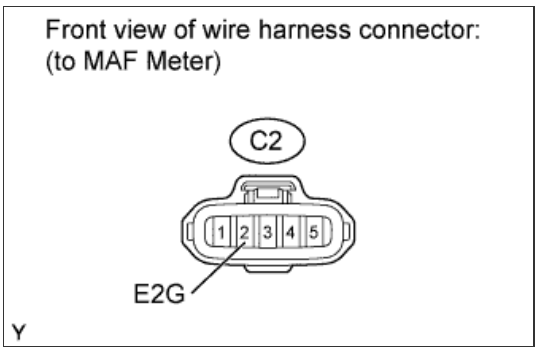
6.CHECK HARNESS AND CONNECTOR (SENSOR GROUND)

a. Disconnect the MAF meter connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C2-2 (E2G) - Body ground	Always	Below 1 Ω



NG → Go to step 7

OK

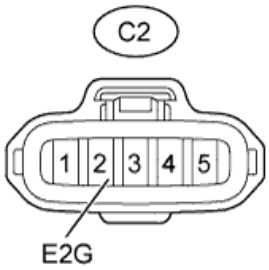
REPLACE MASS AIR FLOW METER (Click here)

7.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

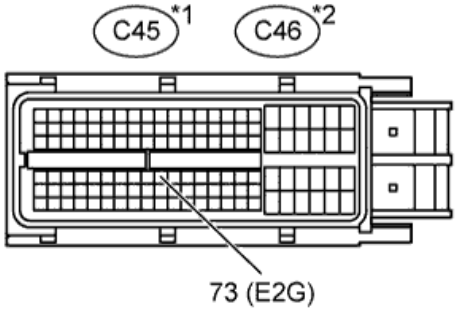
a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to MAF Meter)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C2-2 (E2G) - C45-73 (E2G)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C2-2 (E2G) - C46-73 (E2G)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C2-2 (E2G) or C45-73 (E2G) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C2-2 (E2G) or C46-73 (E2G) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P0604 Random Access Memory (RAM)

for Preparation Click here

DESCRIPTION

The ECM continuously monitors its internal memory status. This self-check ensures that the ECM is functioning properly. It is diagnosed by internal "mirroring" of the main CPU and sub CPU to detect Random Access Memory (RAM) errors. If outputs from these CPUs are different and deviate from the standard, the ECM will illuminate the MIL and store a DTC immediately.

DTC Code	DTC Detection Condition	Trouble Area
P0604	ECM RAM errors.	ECM

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK DTC

a. Clear the DTC (Click here).

b. Turn the ignition switch off.

c. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

d. Connect the cable to the negative (-) battery terminal.

e. Turn the ignition switch to ON.

f. Connect the intelligent tester to the DLC3.

g. Turn the tester on.

h. Enter the following menus: Powertrain / Engine and ECT / DTC.

i. Check for DTC.

OK:
P0604 is not output.

NG → **REPLACE ECM (Click here)**

OK →

CHECK FOR INTERMITTENT PROBLEMS (Click here)

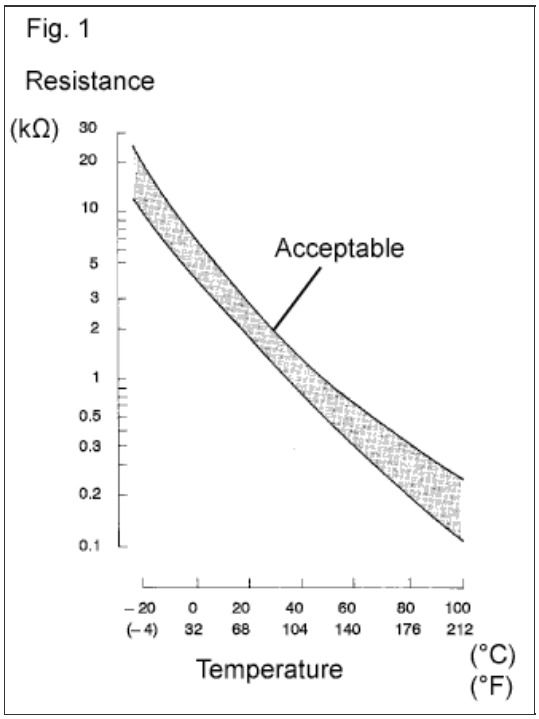
DTC P0110 Intake Air Temperature Circuit Malfunction

DTC P0112 Intake Air Temperature Circuit Low Input

DTC P0113 Intake Air Temperature Circuit High Input

for Preparation Click here

DESCRIPTION



The Intake Air Temperature (IAT) sensor, mounted on the Mass Air Flow (MAF) meter, monitors the IAT. The IAT sensor has a built-in thermistor with a resistance that varies according to the temperature of the intake air. When the IAT is low, the resistance of the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are transmitted to the ECM as voltage changes (see Fig. 1).
The IAT sensor is powered by a 5 V supply from the THA terminal of the ECM, via resistor R.
Resistor R and the IAT sensor are connected in series. When the resistance value of the IAT sensor changes, according to changes in the IAT, the voltage at terminal THA also varies. Based on this signal, the ECM increases the fuel injection volume when the engine is cold to improve driveability.

HINT:

When any of DTCs P0110, P0112 and P0113 are stored, the ECM enters fail-safe mode. During fail-safe mode, the IAT is estimated to be 20°C (68°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC Code	DTC Detection Condition	Trouble Area
P0110	An open or short in the Intake Air Temperature (IAT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in Intake Air Temperature (IAT) sensor circuit • IAT sensor (built into Mass Air Flow (MAF) meter) • ECM
P0112	A short in the IAT sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM
P0113	An open in the IAT sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM

HINT:

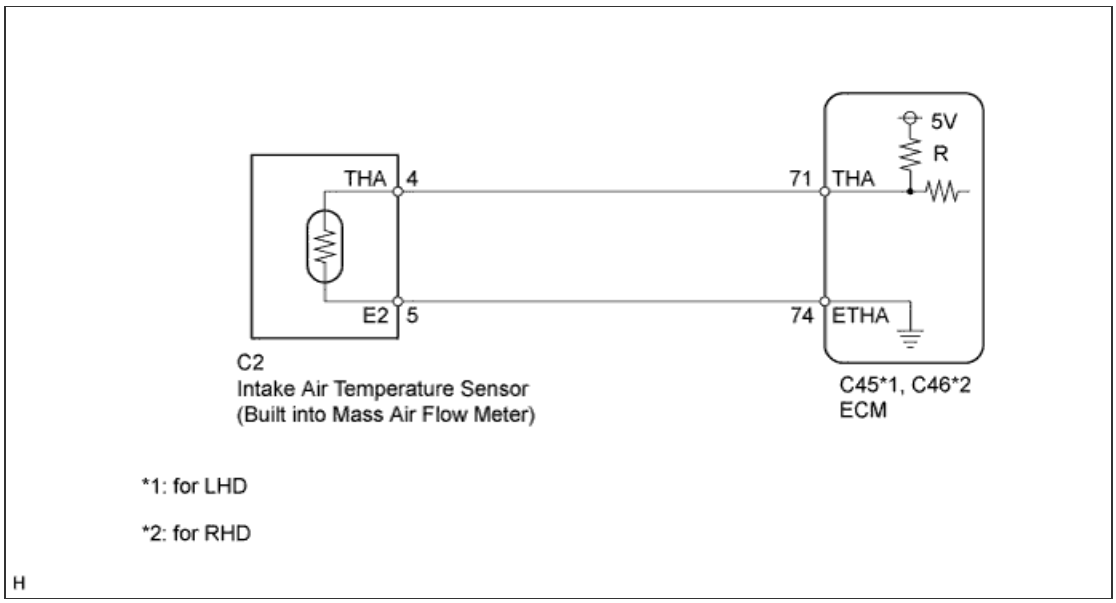
When any of these DTCs are output, check the IAT by entering the following menus: Powertrain / Engine and ECT / Data List / Intake Air.

Tester Display	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to calculate the IAT. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a malfunction in the IAT sensor and stores a DTC.
Example:
If the sensor output voltage is higher than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the IAT sensor circuit, and stores DTC P0113. Conversely, if the output voltage is below 0.18 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and stores DTC P0112.
If the malfunction is not repaired successfully, a DTC is stored 0.5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (INTAKE AIR TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / Intake Air.

e. Read the value displayed on the tester.

Result

Result	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
Same as actual IAT	C

HINT:

- **If there is an open circuit, the intelligent tester indicates -40°C (-40°F).**
- **If there is a short circuit, the intelligent tester indicates 140°C (284°F) or higher.**

B → Go to step 5

C → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the Mass Air Flow (MAF) meter connector.

b. Connect terminals 4 (THA) and 5 (E2) of the MAF meter wire harness side connector.

c. Connect the intelligent tester to the DLC3.

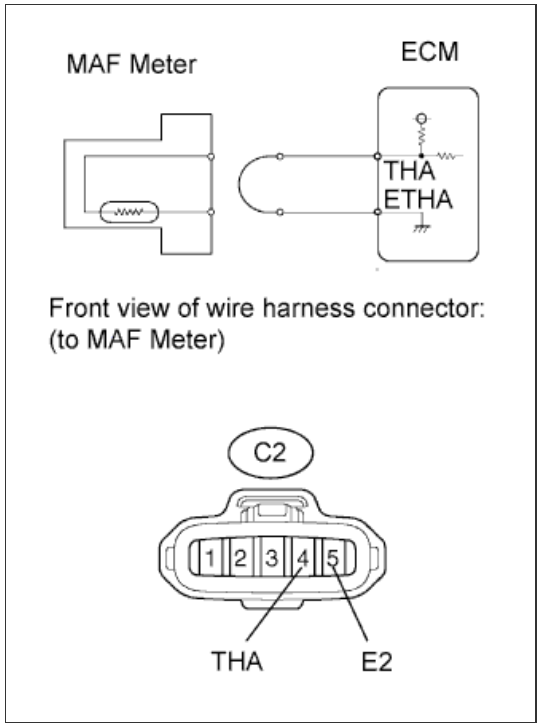
d. Turn the ignition switch to ON.

e. Turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / Data List / Intake Air.

g. Read the value displayed on the tester.

Standard value:
140°C (284°F) or higher



NG → Go to step 3

OK

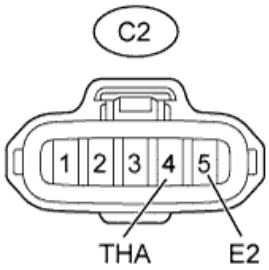
CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE MASS AIR FLOW METER (Click here)

3.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

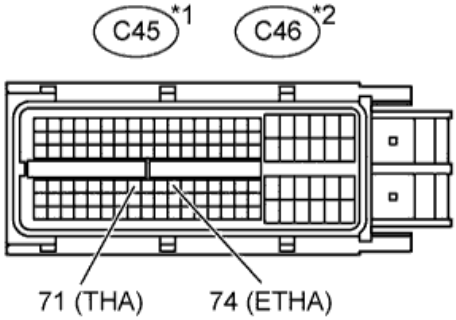
a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to MAF Meter)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance:

for LHD

Tester Connection	Condition	Specified Condition
C2-4 (THA) - C45-71 (THA)	Always	Below 1 Ω
C2-5 (E2) - C45-74 (ETHA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C2-4 (THA) - C46-71 (THA)	Always	Below 1 Ω
C2-5 (E2) - C46-74 (ETHA)	Always	Below 1 Ω

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM (Click here)

4.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the MAF meter connector.

b. Connect the intelligent tester to the DLC3.

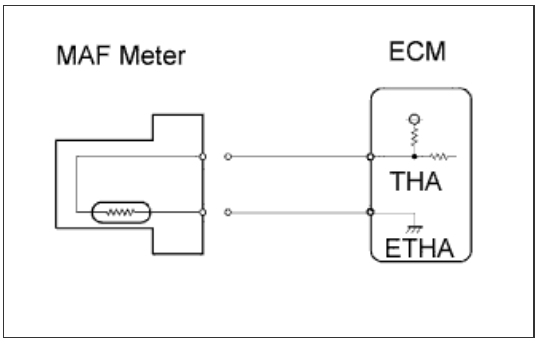
c. Turn the ignition switch to ON.

d. Turn the tester on.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Intake Air.

f. Read the value displayed on the tester.

Standard value:
-40°C (-40°F)



NG → Go to step 5

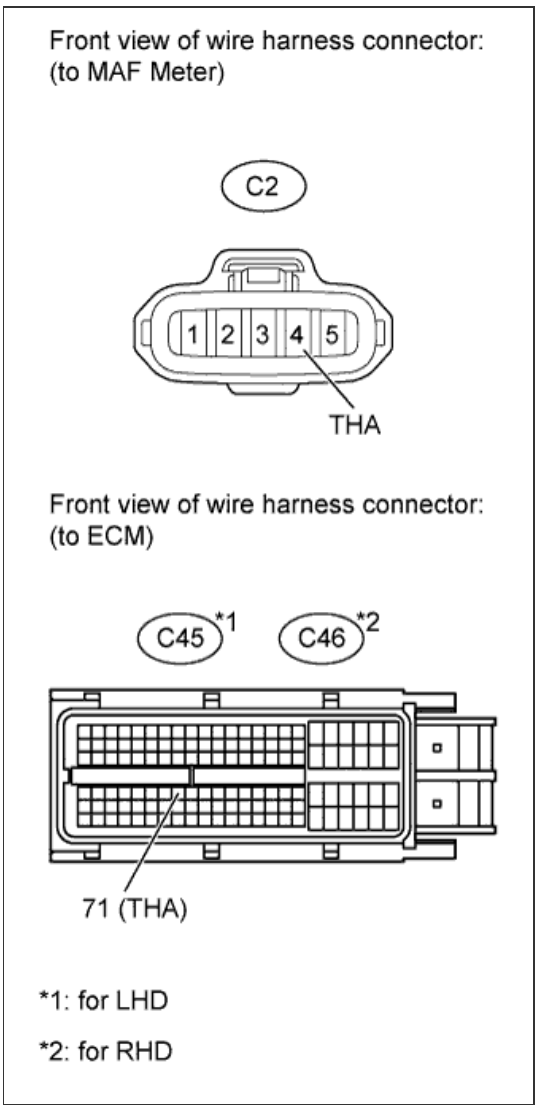
OK

REPLACE MASS AIR FLOW METER (Click here)

5.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for LHD

Tester Connection	Condition	Specified Condition
C2-4 (THA) or C45-71 (THA) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C2-4 (THA) or C46-71 (THA) -		10 kΩ or

Body ground	Always	higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P0606 ECM / PCM Processor

for Preparation Click here

DESCRIPTION

The ECM continuously monitors its main and sub CPUs. This self-check ensures that the ECM is functioning properly. If outputs from the CPUs are different and deviate from the standard, the ECM will illuminate the MIL and store a DTC immediately.

DTC Code	DTC Detection Condition	Trouble Area
P0606	When either condition below is met: • An ECM main CPU error. • An ECM sub CPU error.	ECM

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK DTC

a. Clear the DTC (Click here).

b. Turn the ignition switch off.

c. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

d. Connect the cable to the negative (-) battery terminal.

e. Turn the ignition switch to ON.

f. Check for DTC.

OK:
P0606 is not output.

NG → **REPLACE ECM (Click here)**

OK →

CHECK FOR INTERMITTENT PROBLEMS (Click here)

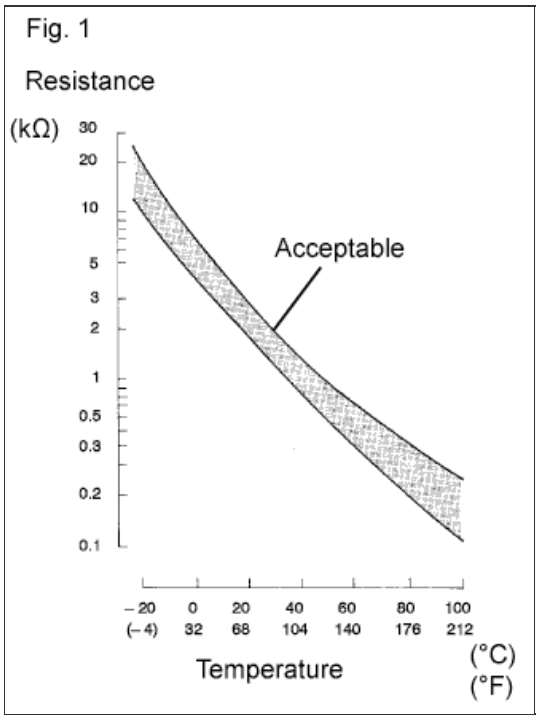
DTC P0110 Intake Air Temperature Circuit Malfunction

DTC P0112 Intake Air Temperature Circuit Low Input

DTC P0113 Intake Air Temperature Circuit High Input

for Preparation Click here

DESCRIPTION



The Intake Air Temperature (IAT) sensor, mounted on the Mass Air Flow (MAF) meter, monitors the IAT. The IAT sensor has a built-in thermistor with a resistance that varies according to the temperature of the intake air. When the IAT is low, the resistance of the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are transmitted to the ECM as voltage changes (see Fig. 1).
The IAT sensor is powered by a 5 V supply from the THA terminal of the ECM, via resistor R.
Resistor R and the IAT sensor are connected in series. When the resistance value of the IAT sensor changes, according to changes in the IAT, the voltage at terminal THA also varies. Based on this signal, the ECM increases the fuel injection volume when the engine is cold to improve driveability.

HINT:

When any of DTCs P0110, P0112 and P0113 are stored, the ECM enters fail-safe mode. During fail-safe mode, the IAT is estimated to be 20°C (68°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC Code	DTC Detection Condition	Trouble Area
P0110	An open or short in the Intake Air Temperature (IAT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in Intake Air Temperature (IAT) sensor circuit • IAT sensor (built into Mass Air Flow (MAF) meter) • ECM
P0112	A short in the IAT sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM
P0113	An open in the IAT sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM

HINT:

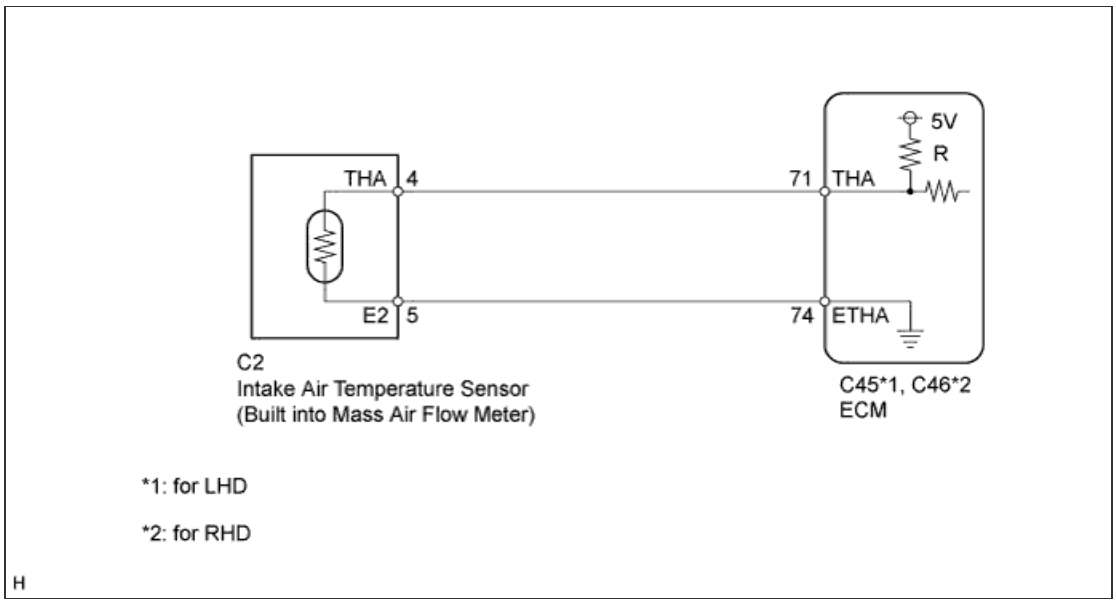
When any of these DTCs are output, check the IAT by entering the following menus: Powertrain / Engine and ECT / Data List / Intake Air.

Tester Display	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to calculate the IAT. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a malfunction in the IAT sensor and stores a DTC.
Example:
If the sensor output voltage is higher than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the IAT sensor circuit, and stores DTC P0113. Conversely, if the output voltage is below 0.18 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and stores DTC P0112.
If the malfunction is not repaired successfully, a DTC is stored 0.5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (INTAKE AIR TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / Intake Air.

e. Read the value displayed on the tester.

Result

Result	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
Same as actual IAT	C

HINT:

- **If there is an open circuit, the intelligent tester indicates -40°C (-40°F).**
- **If there is a short circuit, the intelligent tester indicates 140°C (284°F) or higher.**

B → Go to step 5

C → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the Mass Air Flow (MAF) meter connector.

b. Connect terminals 4 (THA) and 5 (E2) of the MAF meter wire harness side connector.

c. Connect the intelligent tester to the DLC3.

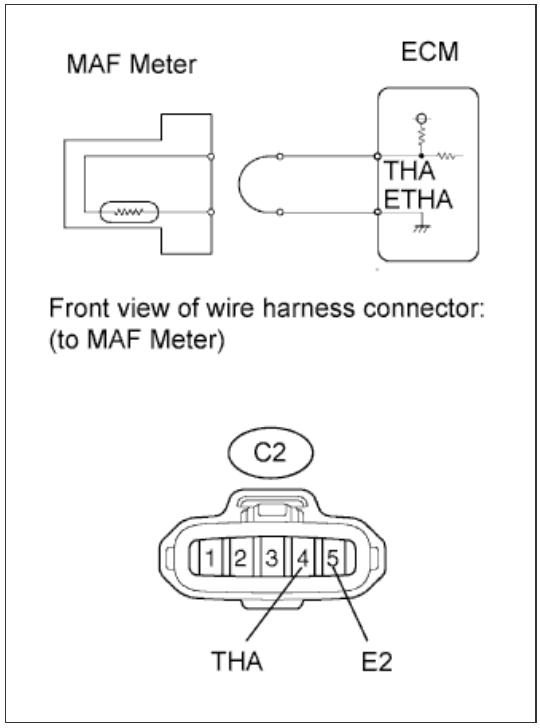
d. Turn the ignition switch to ON.

e. Turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / Data List / Intake Air.

g. Read the value displayed on the tester.

Standard value:
140°C (284°F) or higher



NG → Go to step 3

OK

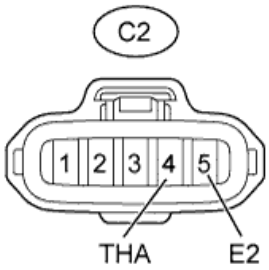
CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE MASS AIR FLOW METER (Click here)

3.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

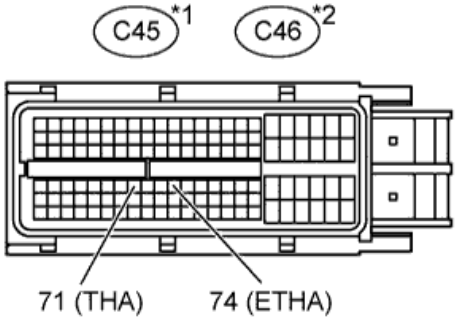
a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to MAF Meter)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance:

for LHD

Tester Connection	Condition	Specified Condition
C2-4 (THA) - C45-71 (THA)	Always	Below 1 Ω
C2-5 (E2) - C45-74 (ETHA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C2-4 (THA) - C46-71 (THA)	Always	Below 1 Ω
C2-5 (E2) - C46-74 (ETHA)	Always	Below 1 Ω

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM (Click here)

4.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the MAF meter connector.

b. Connect the intelligent tester to the DLC3.

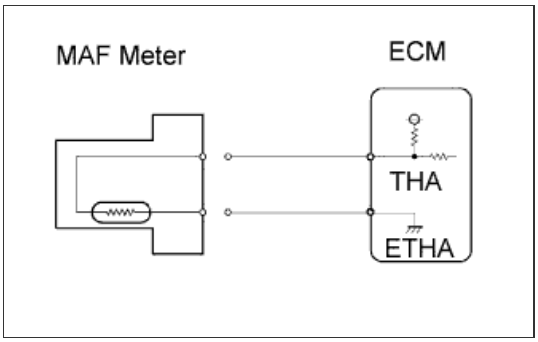
c. Turn the ignition switch to ON.

d. Turn the tester on.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Intake Air.

f. Read the value displayed on the tester.

Standard value:
-40°C (-40°F)



NG → Go to step 5

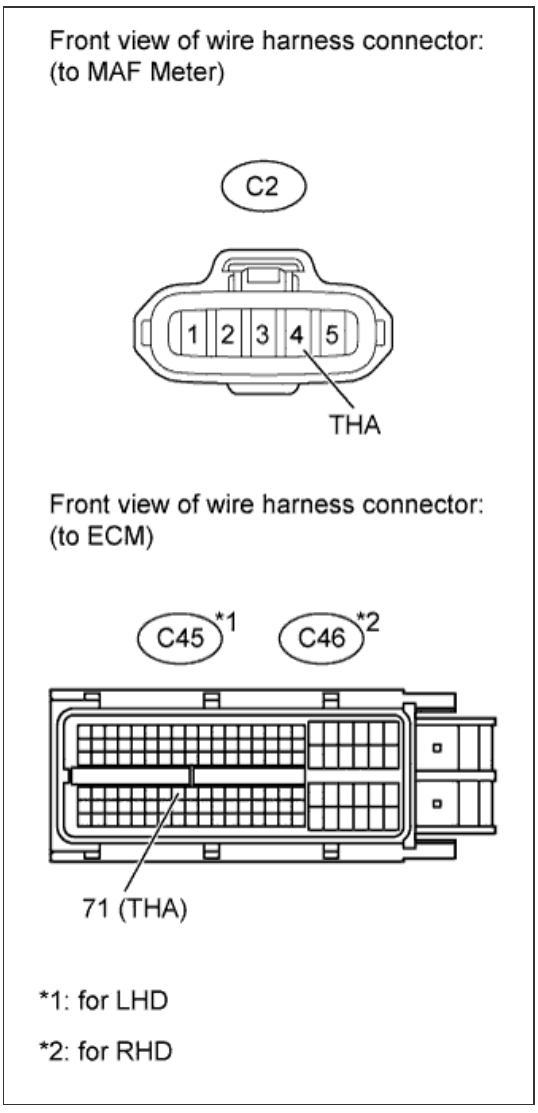
OK

REPLACE MASS AIR FLOW METER (Click here)

5.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for LHD

Tester Connection	Condition	Specified Condition
C2-4 (THA) or C45-71 (THA) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C2-4 (THA) or C46-71 (THA) -		10 kΩ or

Body ground	Always	higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P060A Internal Control Module Monitoring Processor Performance

for Preparation Click here

DESCRIPTION

The main CPU and sub CPU of the ECM perform data communication with each other. The main CPU monitors the communication signals from the sub CPU. When the signal malfunctions below are detected, a DTC is stored.

DTC Code	DTC Detection Condition	Trouble Area
P060A	An ECM sub CPU error.	ECM

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK DTC

a. Clear the DTC (Click here).

b. Turn the ignition switch off.

c. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

d. Connect the cable to the negative (-) battery terminal.

e. Turn the ignition switch to ON.

f. Check for DTC.

OK:
P060A is not output.

NG → **REPLACE ECM (Click here)**

OK ↓

CHECK FOR INTERMITTENT PROBLEMS (Click here)

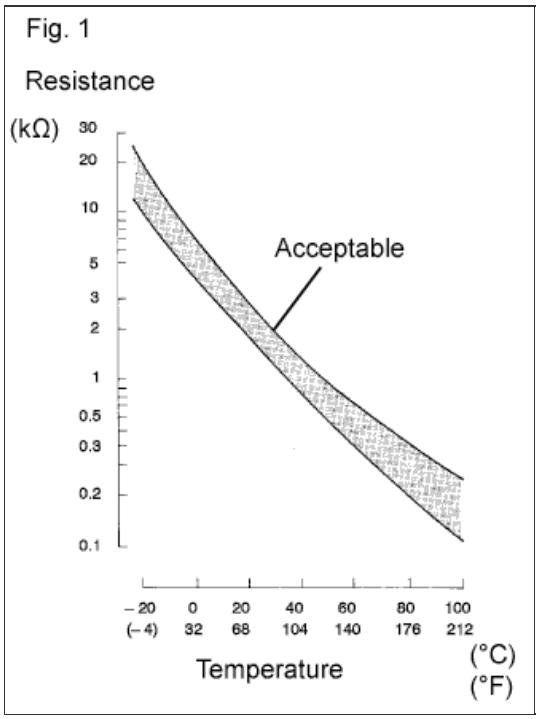
DTC P0110 Intake Air Temperature Circuit Malfunction

DTC P0112 Intake Air Temperature Circuit Low Input

DTC P0113 Intake Air Temperature Circuit High Input

for Preparation Click here

DESCRIPTION



The Intake Air Temperature (IAT) sensor, mounted on the Mass Air Flow (MAF) meter, monitors the IAT. The IAT sensor has a built-in thermistor with a resistance that varies according to the temperature of the intake air. When the IAT is low, the resistance of the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are transmitted to the ECM as voltage changes (see Fig. 1).
The IAT sensor is powered by a 5 V supply from the THA terminal of the ECM, via resistor R.
Resistor R and the IAT sensor are connected in series. When the resistance value of the IAT sensor changes, according to changes in the IAT, the voltage at terminal THA also varies. Based on this signal, the ECM increases the fuel injection volume when the engine is cold to improve driveability.

HINT:

When any of DTCs P0110, P0112 and P0113 are stored, the ECM enters fail-safe mode. During fail-safe mode, the IAT is estimated to be 20°C (68°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC Code	DTC Detection Condition	Trouble Area
P0110	An open or short in the Intake Air Temperature (IAT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in Intake Air Temperature (IAT) sensor circuit • IAT sensor (built into Mass Air Flow (MAF) meter) • ECM
P0112	A short in the IAT sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM
P0113	An open in the IAT sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM

HINT:

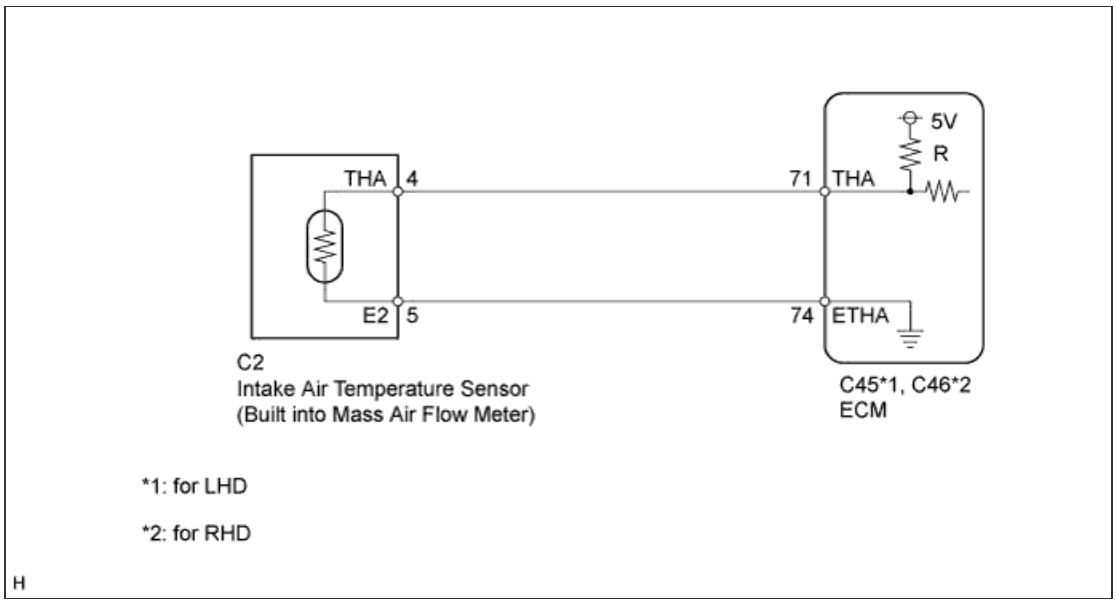
When any of these DTCs are output, check the IAT by entering the following menus: Powertrain / Engine and ECT / Data List / Intake Air.

Tester Display	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to calculate the IAT. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a malfunction in the IAT sensor and stores a DTC.
Example:
If the sensor output voltage is higher than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the IAT sensor circuit, and stores DTC P0113. Conversely, if the output voltage is below 0.18 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and stores DTC P0112.
If the malfunction is not repaired successfully, a DTC is stored 0.5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (INTAKE AIR TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / Intake Air.

e. Read the value displayed on the tester.

Result

Result	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
Same as actual IAT	C

HINT:

- **If there is an open circuit, the intelligent tester indicates -40°C (-40°F).**
- **If there is a short circuit, the intelligent tester indicates 140°C (284°F) or higher.**

B → Go to step 5

C → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the Mass Air Flow (MAF) meter connector.

b. Connect terminals 4 (THA) and 5 (E2) of the MAF meter wire harness side connector.

c. Connect the intelligent tester to the DLC3.

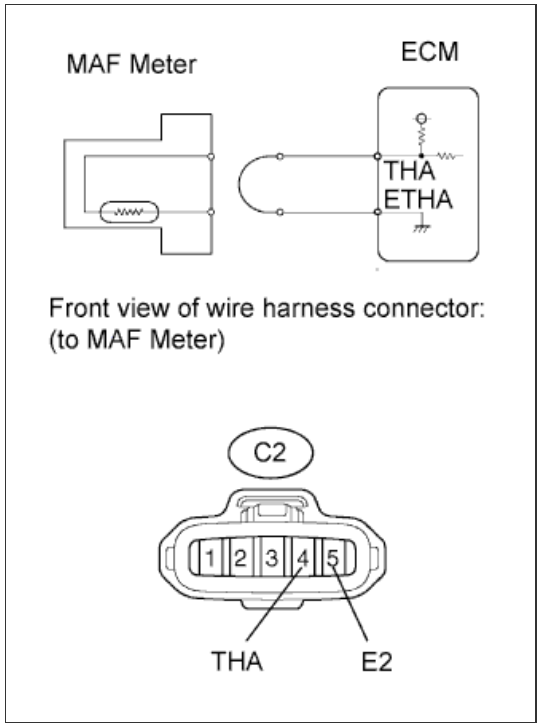
d. Turn the ignition switch to ON.

e. Turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / Data List / Intake Air.

g. Read the value displayed on the tester.

Standard value:
140°C (284°F) or higher



NG → Go to step 3

OK

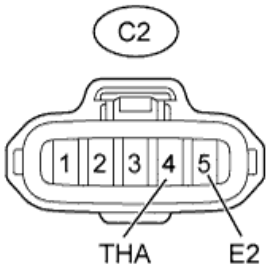
CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE MASS AIR FLOW METER (Click here)

3.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

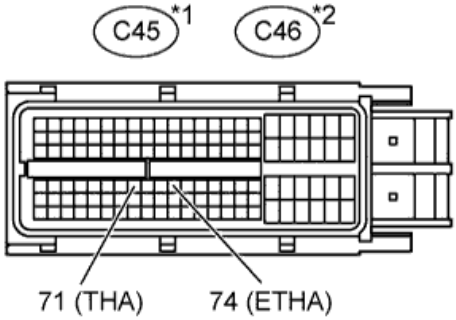
a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to MAF Meter)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance:

for LHD

Tester Connection	Condition	Specified Condition
C2-4 (THA) - C45-71 (THA)	Always	Below 1 Ω
C2-5 (E2) - C45-74 (ETHA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C2-4 (THA) - C46-71 (THA)	Always	Below 1 Ω
C2-5 (E2) - C46-74 (ETHA)	Always	Below 1 Ω

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM (Click here)

4.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the MAF meter connector.

b. Connect the intelligent tester to the DLC3.

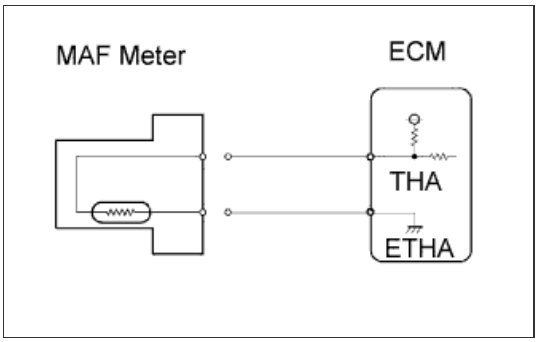
c. Turn the ignition switch to ON.

d. Turn the tester on.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Intake Air.

f. Read the value displayed on the tester.

Standard value:
-40°C (-40°F)



NG → Go to step 5

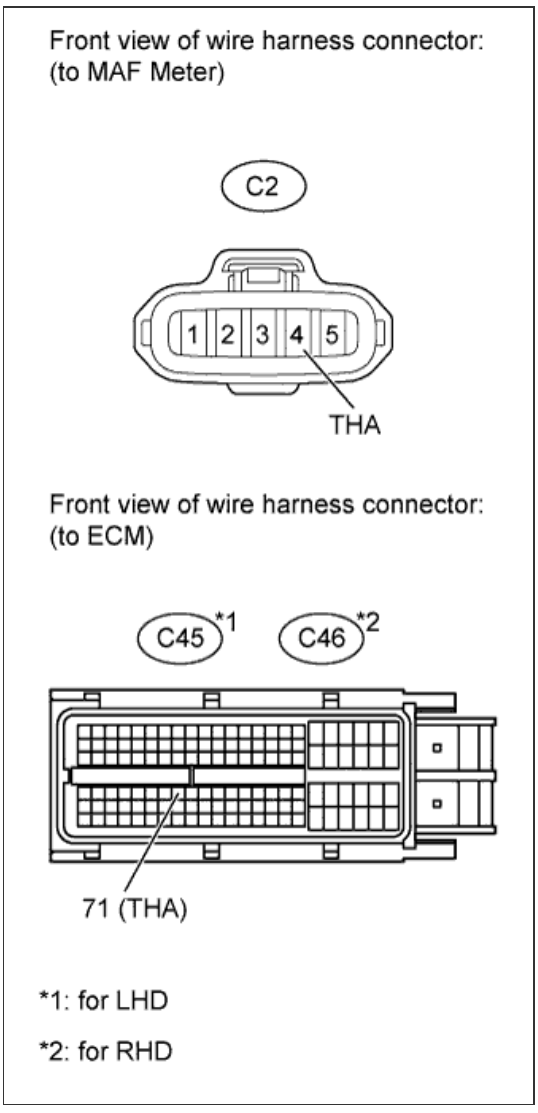
OK

REPLACE MASS AIR FLOW METER (Click here)

5.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for LHD

Tester Connection	Condition	Specified Condition
C2-4 (THA) or C45-71 (THA) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C2-4 (THA) or C46-71 (THA) -		10 kΩ or

Body ground	Always	higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P060D Internal Control Module Accelerator Pedal Position Performance

for Preparation Click here

DESCRIPTION

The ECM monitors the input signals of the Accelerator Pedal Position (APP) sensor No. 1. When the input signals and control signals are deviated, a DTC is stored.

DTC Code	DTC Detection Condition	Trouble Area
P060D	An ECM main CPU error.	ECM

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK DTC

a. Clear the DTC (Click here).

b. Turn the ignition switch off.

c. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

d. Connect the cable to the negative (-) battery terminal.

e. Turn the ignition switch to ON.

f. Check for DTC.

OK:
P060D is not output.

NG → **REPLACE ECM (Click here)**

OK ↓

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0115 Engine Coolant Temperature Circuit Malfunction

DTC P0117 Engine Coolant Temperature Circuit Low Input

DTC P0118 Engine Coolant Temperature Circuit High Input

for Preparation Click here

DESCRIPTION

A thermistor, whose resistance value varies according to the Engine Coolant Temperature (ECT), is built into the Engine Coolant Temperature (ECT) sensor.
The structure of the sensor and its connection to the ECM are the same as those of the Intake Air Temperature (IAT) sensor.

HINT:

When any of DTCs P0115, P0117 and P0118 are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECT is estimated to be 80°C (176°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC Code	DTC Detection Condition	Trouble Area
P0115	An open or short in the Engine Coolant Temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in Engine Coolant Temperature (ECT) sensor circuit • ECT sensor • ECM
P0117	A short in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in ECT sensor • ECT sensor • ECM
P0118	An open in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in ECT sensor circuit • ECT sensor • ECM

HINT:

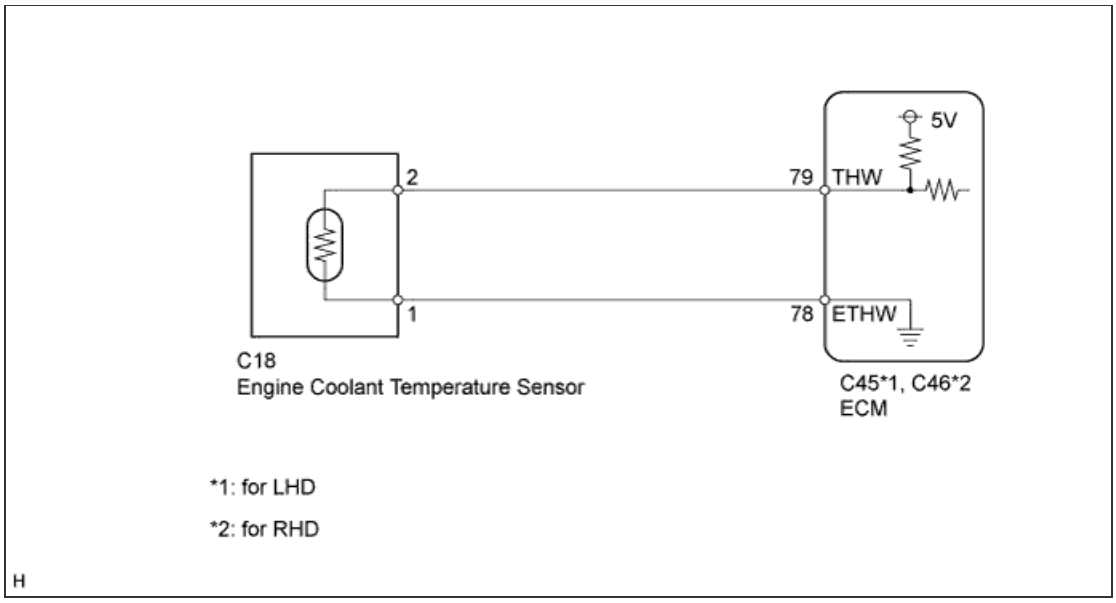
When any of these DTCs are output, check the ECT by entering the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

Tester Display	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

MONITOR DESCRIPTION

The Engine Coolant Temperature (ECT) sensor is used to monitor the ECT. The ECT sensor has a thermistor with a resistance that varies according to the temperature of the engine coolant. When the coolant temperature is low, the resistance in the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are reflected in the output voltage from the sensor. The ECM monitors the sensor voltage and uses this value to calculate the ECT. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a fault in the ECT sensor and stores a DTC.
Example:
If the sensor output voltage is higher than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the ECT sensor circuit, and stores DTC P0118. Conversely, if the voltage output is below 0.14 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and stores DTC P0117.
If the malfunction is not repaired successfully, a DTC is stored 0.5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (ENGINE COOLANT TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

e. Read the value displayed on the tester.

Result

Result	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
Between 80°C and 100°C (176°F and 212°F) with warm engine	C

HINT:

- **If there is an open circuit, the intelligent tester indicates -40°C (-40°F).**
- **If there is a short circuit, the intelligent tester indicates 140°C (284°F) or higher.**

B	Go to step 4
C	CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the Engine Coolant Temperature (ECT) sensor connector.

b. Connect terminals 1 and 2 of the ECT sensor connector on the wire harness side.

c. Connect the intelligent tester to the DLC3.

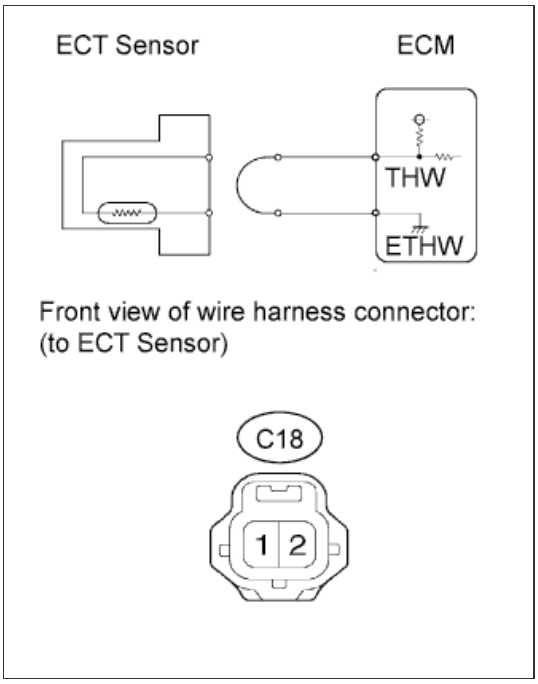
d. Turn the ignition switch to ON.

e. Turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

g. Read the value displayed on the tester.

Standard value:
140°C (284°F) or higher.



NG → Go to step 3

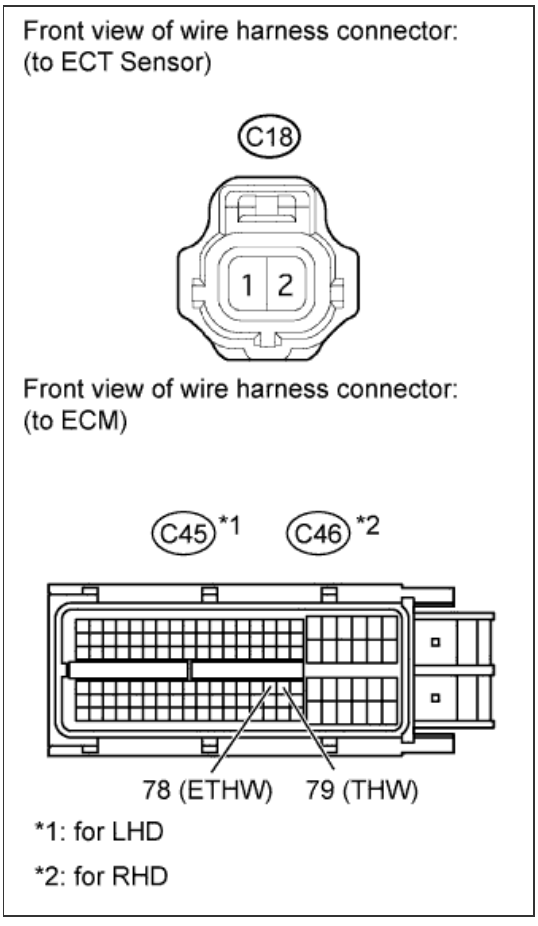
OK

CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

3.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for LHD

Tester Connection	Condition	Specified Condition
C18-2 - C45-79 (THW)	Always	Below 1 Ω
C18-1 - C45-78 (ETHW)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C18-2 - C46-79 (THW)	Always	Below 1 Ω
C18-1 - C46-78 (ETHW)	Always	Below 1 Ω

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM (Click here)

4.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the ECT sensor connector.

b. Connect the intelligent tester to the DLC3.

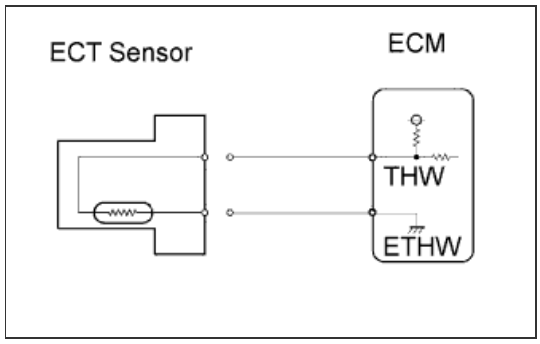
c. Turn the ignition switch to ON.

d. Turn the tester on.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

f. Read the value displayed on the tester.

Standard value:
-40°C (-40°F)



NG → Go to step 5

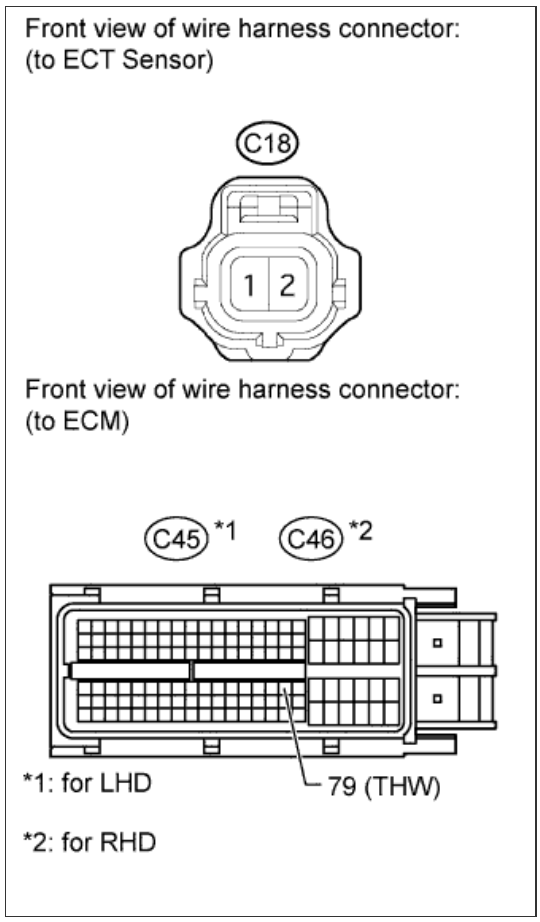
OK

REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

5.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for LHD

Tester Connection	Condition	Specified Condition
C18-2 or C45-79 (THW) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C18-2 or C46-79 (THW) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK → REPLACE ECM (Click here)

DTC P060E Internal Control Module Throttle Position Performance

for Preparation Click here

DESCRIPTION

The ECM monitors the input signals of the Throttle Position (TP) sensor No. 1 and stop light switch. As the ECM monitors the input signals of the TP sensor No. 1 and the STP signals of the stop light switch, if the input signals and control signals are deviated, a DTC is stored.

DTC Code	DTC Detection Condition	Trouble Area
P060E	An ECM main CPU error.	ECM

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK DTC

a. Clear the DTC (Click here).

b. Turn the ignition switch off.

c. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

d. Connect the cable to the negative (-) battery terminal.

e. Turn the ignition switch to ON.

f. Check for DTC.

OK:
P060E is not output.

NG → **REPLACE ECM (Click here)**

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0115 Engine Coolant Temperature Circuit Malfunction

DTC P0117 Engine Coolant Temperature Circuit Low Input

DTC P0118 Engine Coolant Temperature Circuit High Input

for Preparation Click here

DESCRIPTION

A thermistor, whose resistance value varies according to the Engine Coolant Temperature (ECT), is built into the Engine Coolant Temperature (ECT) sensor.
The structure of the sensor and its connection to the ECM are the same as those of the Intake Air Temperature (IAT) sensor.

HINT:

When any of DTCs P0115, P0117 and P0118 are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECT is estimated to be 80°C (176°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC Code	DTC Detection Condition	Trouble Area
P0115	An open or short in the Engine Coolant Temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in Engine Coolant Temperature (ECT) sensor circuit • ECT sensor • ECM
P0117	A short in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in ECT sensor • ECT sensor • ECM
P0118	An open in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in ECT sensor circuit • ECT sensor • ECM

HINT:

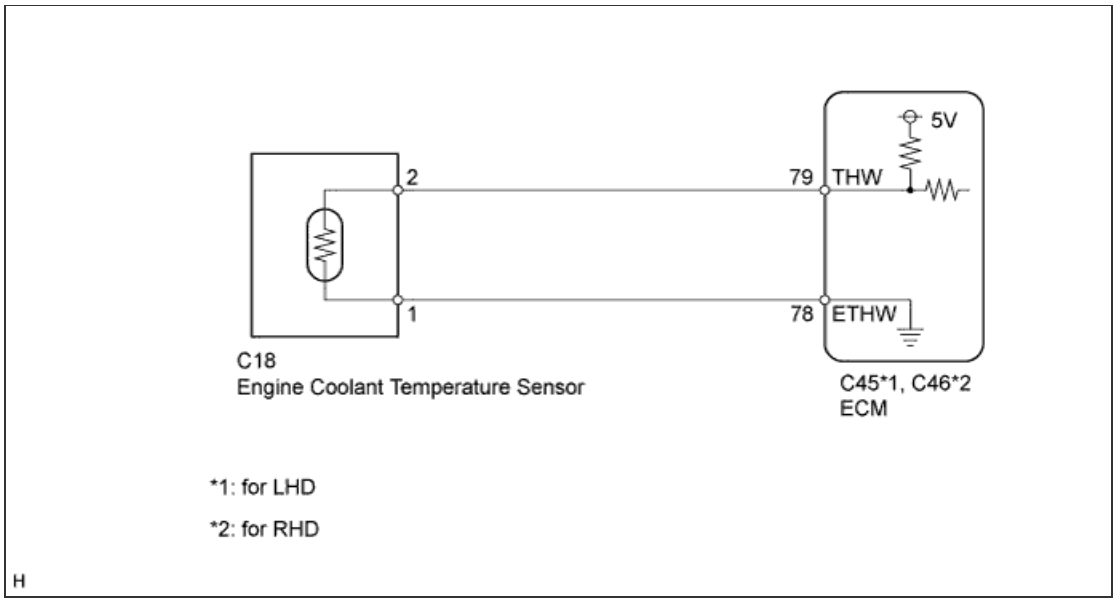
When any of these DTCs are output, check the ECT by entering the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

Tester Display	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

MONITOR DESCRIPTION

The Engine Coolant Temperature (ECT) sensor is used to monitor the ECT. The ECT sensor has a thermistor with a resistance that varies according to the temperature of the engine coolant. When the coolant temperature is low, the resistance in the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are reflected in the output voltage from the sensor. The ECM monitors the sensor voltage and uses this value to calculate the ECT. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a fault in the ECT sensor and stores a DTC.
Example:
If the sensor output voltage is higher than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the ECT sensor circuit, and stores DTC P0118. Conversely, if the voltage output is below 0.14 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and stores DTC P0117.
If the malfunction is not repaired successfully, a DTC is stored 0.5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (ENGINE COOLANT TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

e. Read the value displayed on the tester.

Result

Result	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
Between 80°C and 100°C (176°F and 212°F) with warm engine	C

HINT:

- **If there is an open circuit, the intelligent tester indicates -40°C (-40°F).**
- **If there is a short circuit, the intelligent tester indicates 140°C (284°F) or higher.**

B	Go to step 4
C	CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the Engine Coolant Temperature (ECT) sensor connector.

b. Connect terminals 1 and 2 of the ECT sensor connector on the wire harness side.

c. Connect the intelligent tester to the DLC3.

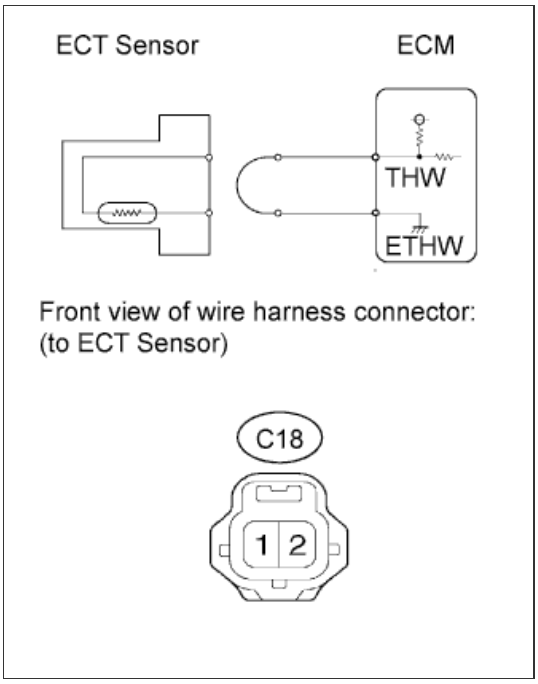
d. Turn the ignition switch to ON.

e. Turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

g. Read the value displayed on the tester.

Standard value:
140°C (284°F) or higher.



NG → Go to step 3

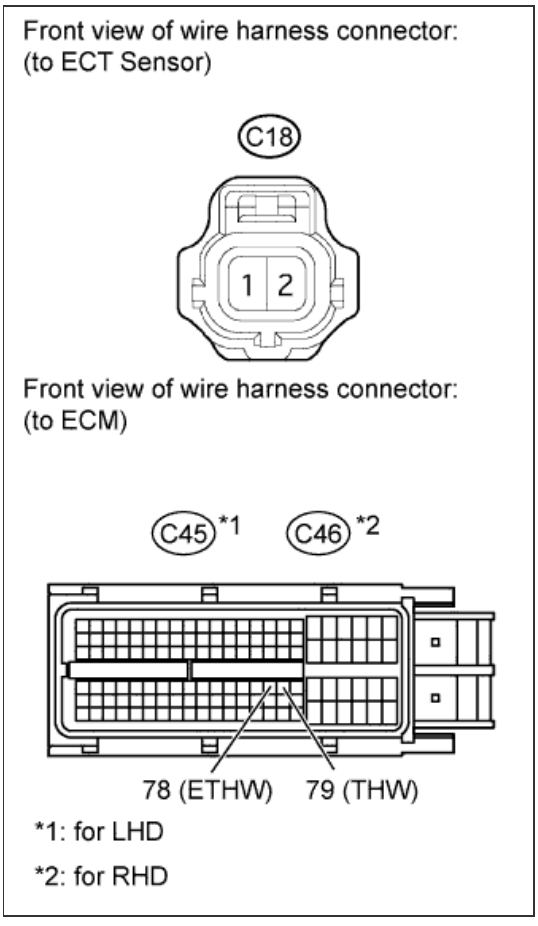
OK

CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

3.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for LHD

Tester Connection	Condition	Specified Condition
C18-2 - C45-79 (THW)	Always	Below 1 Ω
C18-1 - C45-78 (ETHW)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C18-2 - C46-79 (THW)	Always	Below 1 Ω
C18-1 - C46-78 (ETHW)	Always	Below 1 Ω

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM (Click here)

4.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the ECT sensor connector.

b. Connect the intelligent tester to the DLC3.

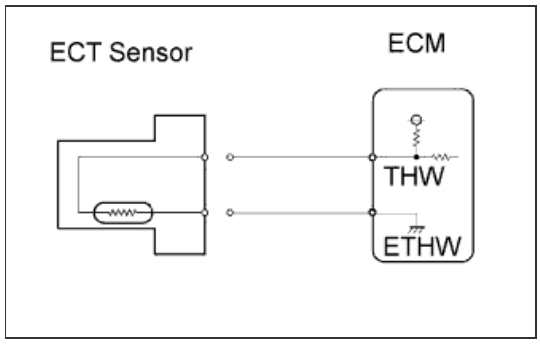
c. Turn the ignition switch to ON.

d. Turn the tester on.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

f. Read the value displayed on the tester.

Standard value:
-40°C (-40°F)



NG → Go to step 5

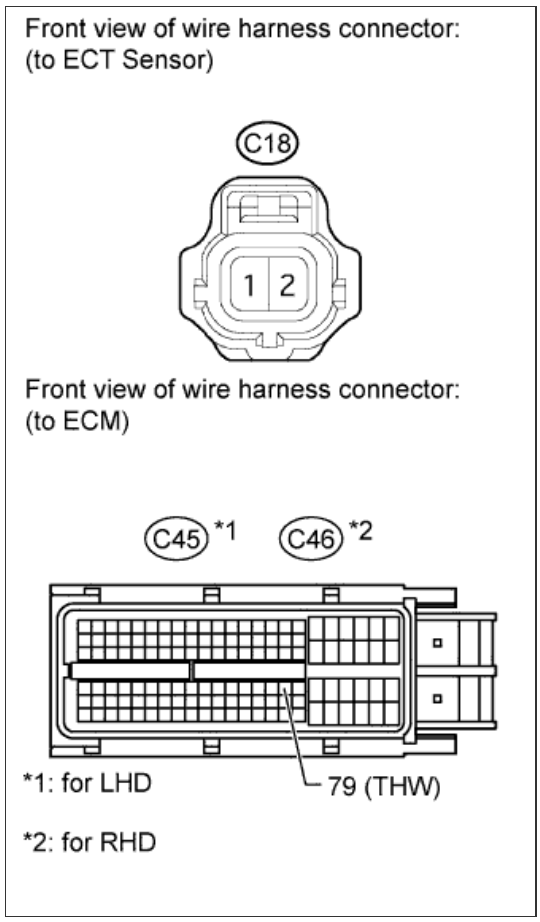
OK

REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

5.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for LHD

Tester Connection	Condition	Specified Condition
C18-2 or C45-79 (THW) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C18-2 or C46-79 (THW) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK → REPLACE ECM (Click here)

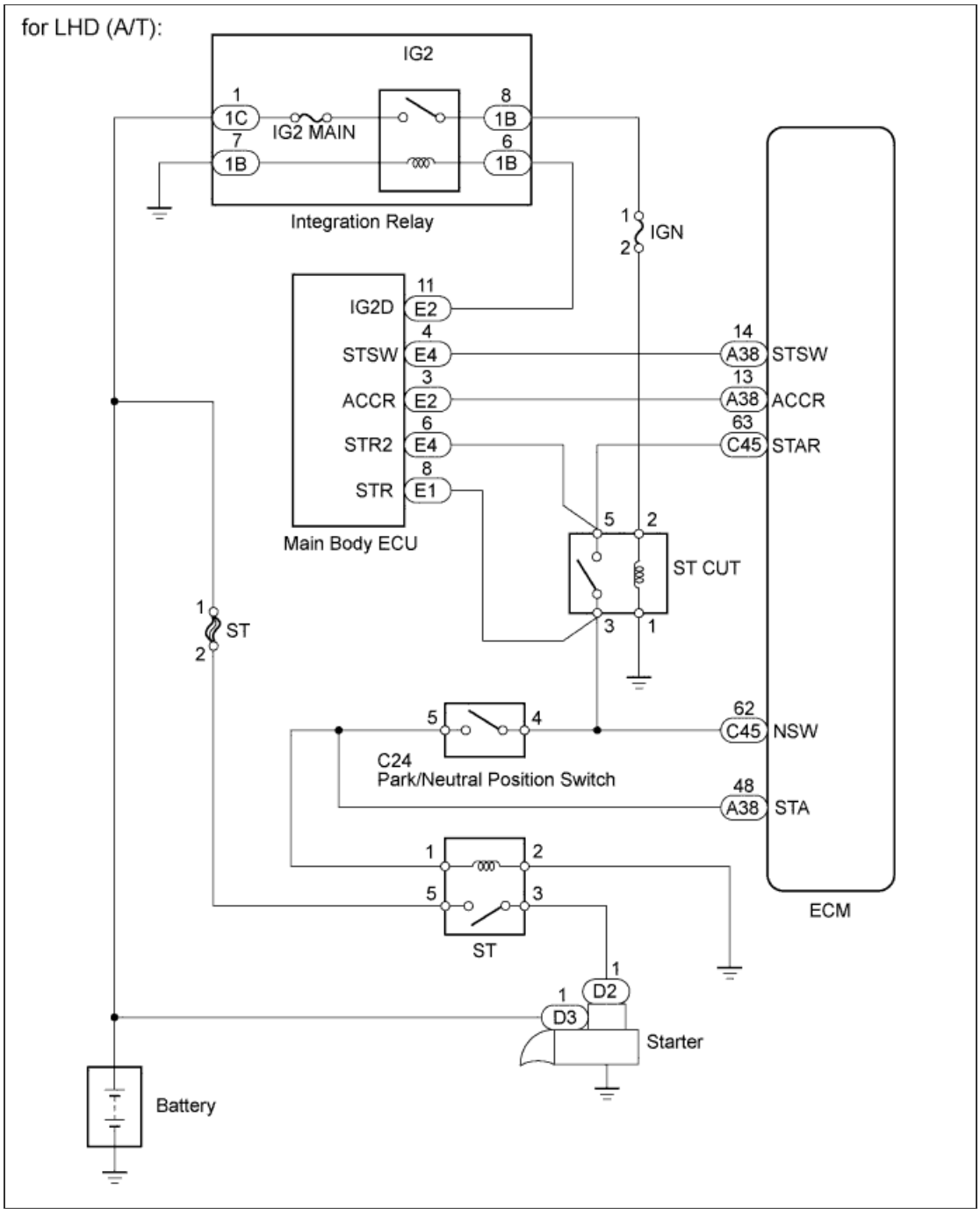
for Preparation Click here

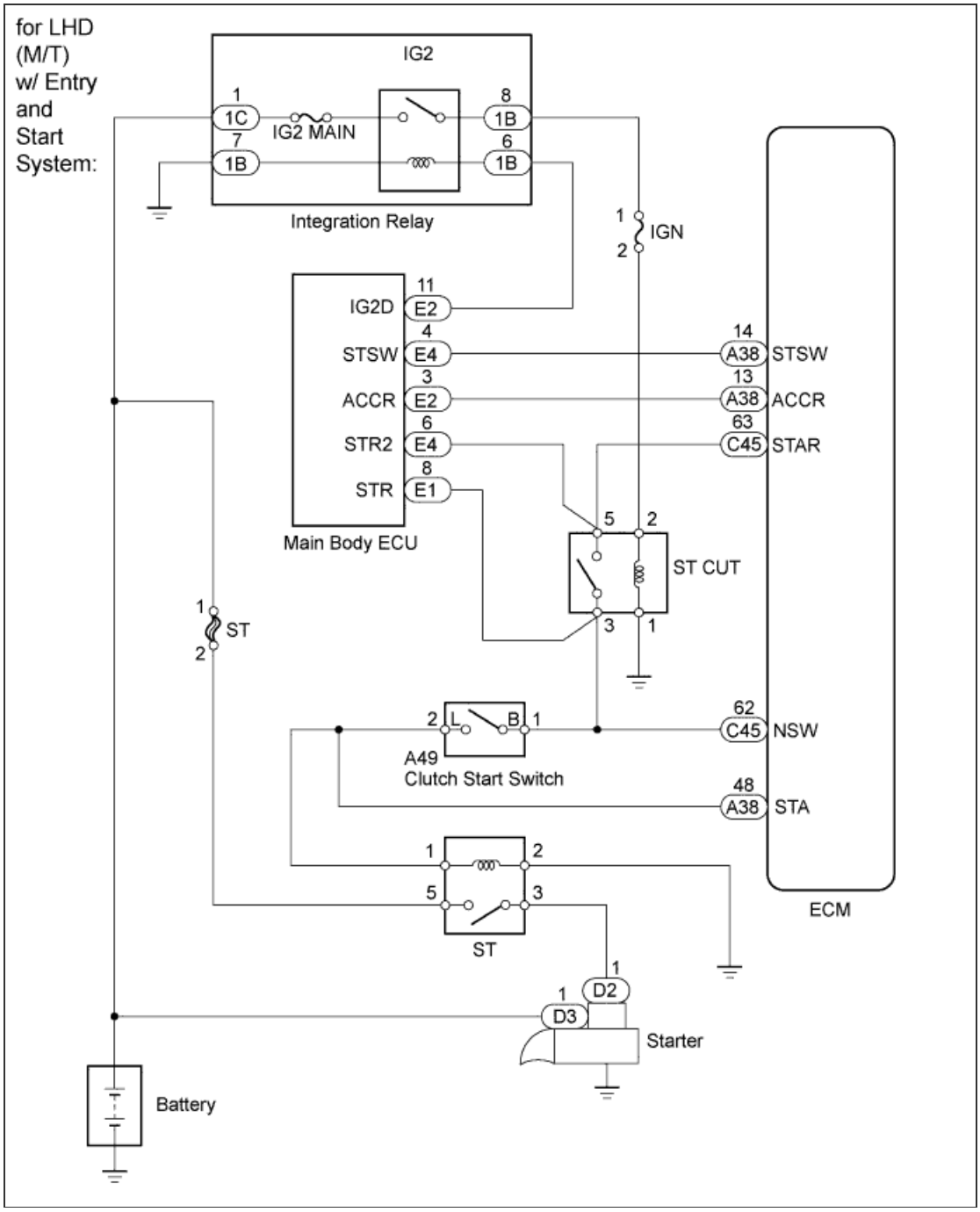
DESCRIPTION

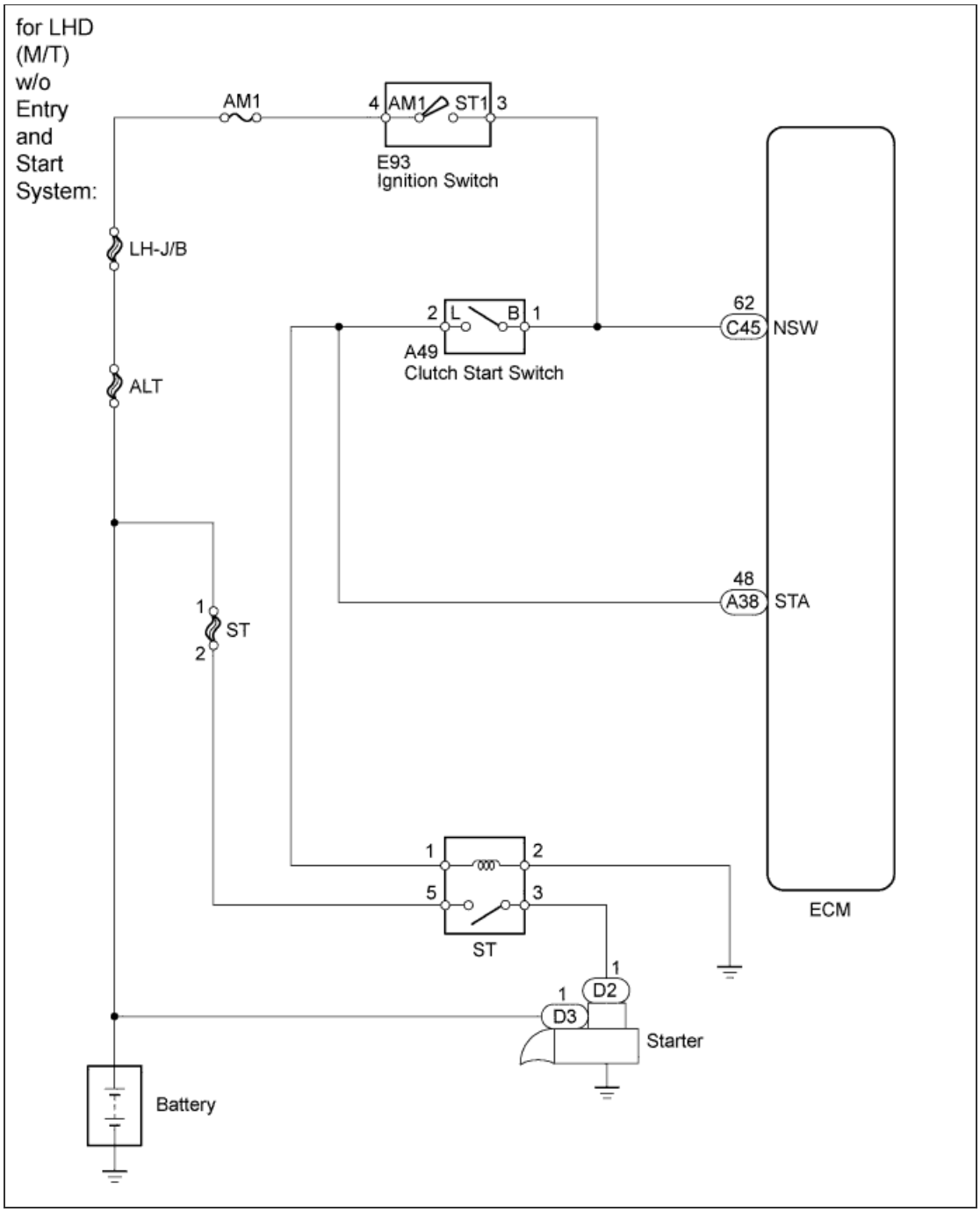
While the engine is being cranked, positive battery voltage is applied to terminal STA of the ECM. If the ECM detects the Starter Control (STA) signal while the vehicle is being driven, it determines that there is a malfunction in the STA circuit. The ECM then illuminates the MIL and stores the DTC. This monitor runs when the vehicle is driven at 20 km/h (12.4 mph) for over 20 seconds.

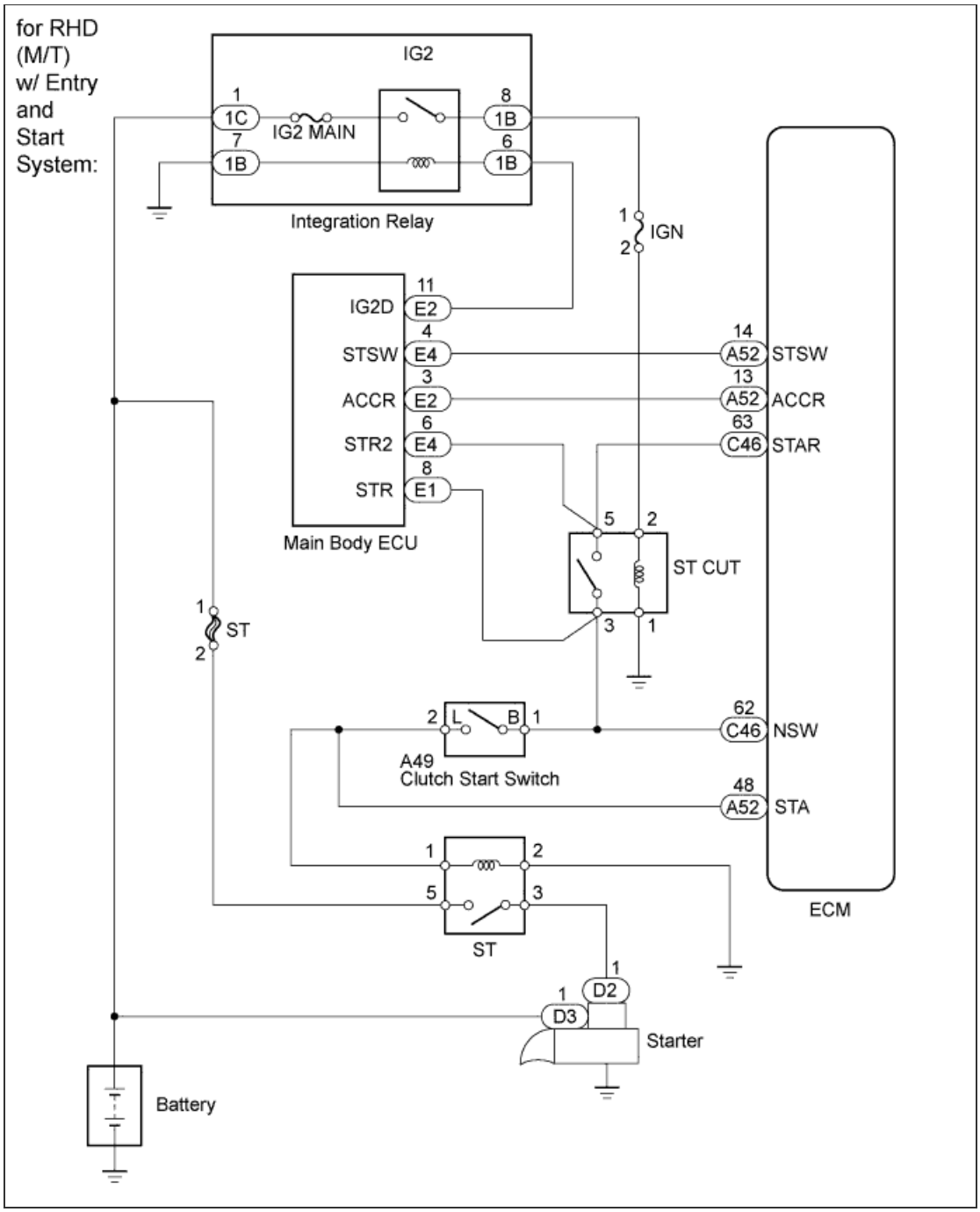
DTC Code	DTC Detection Condition	Trouble Area
P0617	When conditions (a), (b) and (c) are met, and a positive (+B) battery voltage of 10.5 V or higher is applied to the ECM for 20 seconds (1 trip detection logic). (a) The vehicle speed is 20 km/h (12.4 mph) or more. (b) The engine speed is 1000 rpm or more. (c) The STA signal is on.	• Park/Neutral Position (PNP) switch • ST relay circuit • Ignition switch • ECM

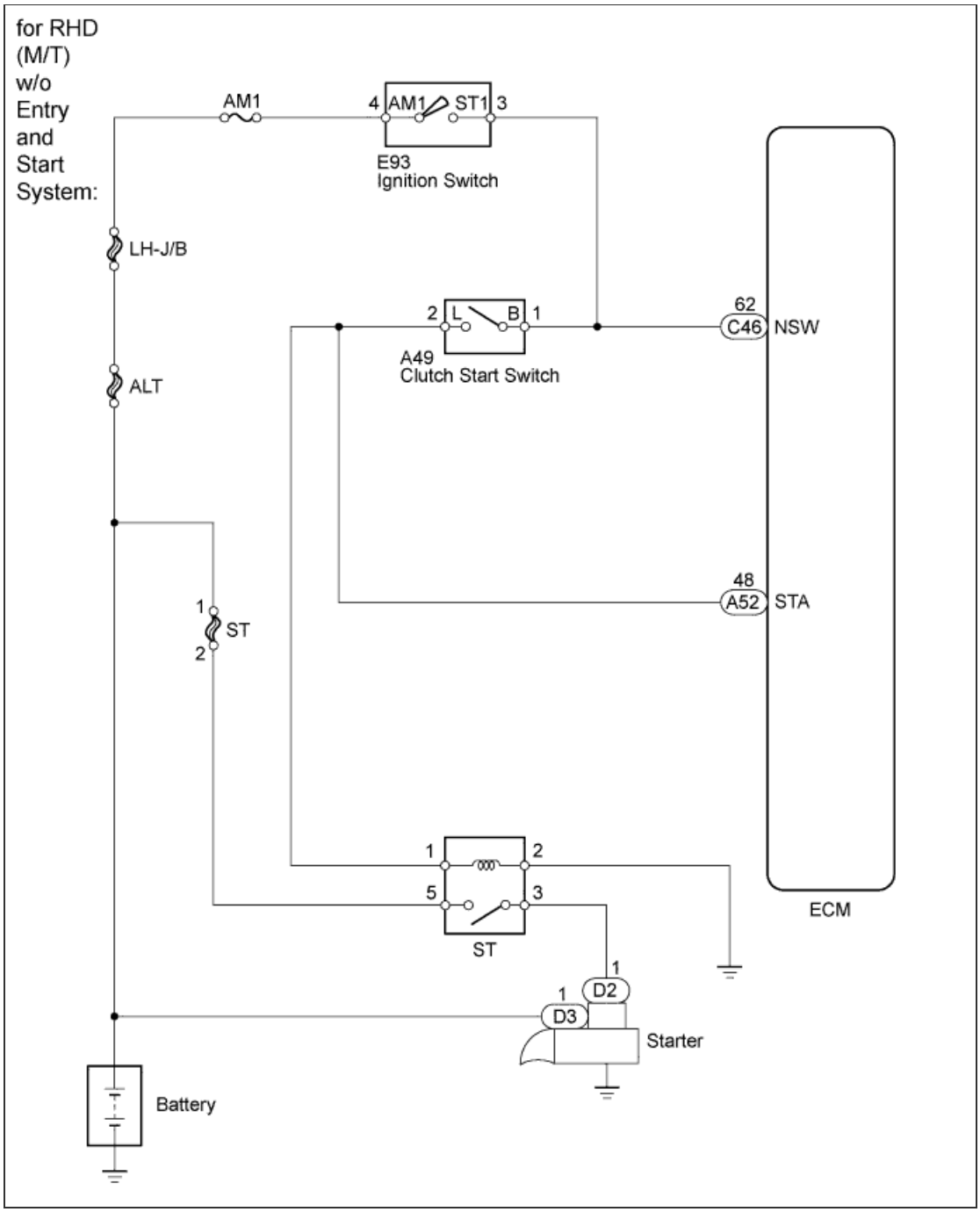
WIRING DIAGRAM




for LHD (M/T) w/ Entry and Start System:
IG2
1
1C
7
1B
IG2 MAIN
8
1B
6
1B
Integration Relay
1
IGN
2
11
IG2D
E2
4
STSW
E4
3
ACCR
E2
6
STR2
E4
8
STR
E1
Main Body ECU
14
A38
STSW
13
A38
ACCR
63
C45
STAR
5
2
ST CUT
3
1
1
ST
2
2
L
B
1
A49
Clutch Start Switch
62
C45
NSW
48
A38
STA
1
2
5
3
ST
1
1
D2
D3
Starter
Battery
ECM


for LHD
(M/T)
w/o
Entry
and
Start
System:
AM1
4
AM1
ST1
3
E93
Ignition Switch
LH-J/B
ALT
2
L
B
1
A49
Clutch Start Switch
62
C45
NSW
48
A38
STA
1
ST
2
ECM
1
2
5
3
ST
1
D2
1
D3
Starter
Battery


for RHD
(M/T)
w/ Entry
and
Start
System:
IG2
1
1C
IG2 MAIN
7
1B
8
1B
6
1B
Integration Relay
1
IGN
2
IG2D
11
E2
STSW
4
E4
ACCR
3
E2
STR2
6
E4
STR
8
E1
Main Body ECU
14
A52
STSW
13
A52
ACCR
63
C46
STAR
5
2
ST CUT
3
1
1
ST
2
2
L
B
1
A49
Clutch Start Switch
62
C46
NSW
48
A52
STA
1
2
5
3
ST
ECM
1
D2
1
D3
Starter
Battery



INSPECTION PROCEDURE

HINT:

- **The following troubleshooting flowchart is based on the premise that the engine is cranked normally.**
  If the engine will not crank, proceed to the Problem Symptoms Table (Click here).
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (STARTER SIGNAL)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Starter Signal.

d. Check the value displayed on the tester when the ignition switch is turned to ON and when the engine is started.

Standard:

Ignition Switch Condition	Display (Starter Signal)
ON	OFF

Engine is started	ON

Result

Result	Proceed to
NG (AT)	A
NG (MT)	B
OK	C

B → Go to step 4

C → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

2.INSPECT PARK/NEUTRAL POSITION SWITCH ASSEMBLY

a. Inspect the park/neutral position switch (Click here).

Result

Result	Proceed to
NG	A
OK	B

B → Go to step 7

A

3.REPLACE PARK/NEUTRAL POSITION SWITCH ASSEMBLY

a. Replace the park/neutral position switch (Click here).

NEXT → Go to step 6

4.INSPECT CLUTCH START SWITCH

a. Check the clutch start switch (for LHD) (Click here).

b. Check the clutch start switch (for RHD) (Click here).

Result

Result	Proceed to
NG	A
OK	B

B → Go to step 7

A

5.REPLACE CLUTCH START SWITCH

a. Replace the clutch start switch (for LHD) (Click here).

b. Replace the clutch start switch (for RHD) (Click here).

NEXT

6.READ VALUE USING INTELLIGENT TESTER (STARTER SIGNAL)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Starter Signal.

d. Check the value displayed on the tester when the ignition switch is turned to ON and when the engine is started.

Standard:

Ignition Switch Condition	Display (Starter Signal)
ON	OFF
Engine is started	ON

Result

Result	Proceed to
NG	A
OK	B

B → SYSTEM OK

A

7.CHECK HARNESS AND CONNECTOR (PNP SWITCH OR CLUTCH START SWITCH - STA TERMINAL OF ECM)

a. for Automatic transmission.

i. Disconnect the PNP switch connector.

ii. Disconnect the ECM connector.

iii. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C24-5 - A38-48 (STA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C24-5 - A52-48 (STA)	Always	Below 1 Ω

Standard Resistance (Check for Short):

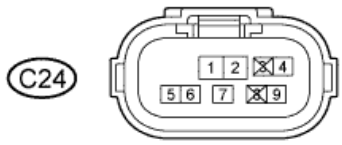
for LHD

Tester Connection	Condition	Specified Condition
C24-5 or A38-48 (STA) - Body ground	Always	10 kΩ or higher

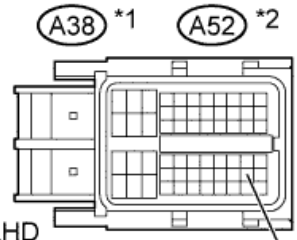
for RHD

Tester Connection	Condition	Specified Condition
C24-5 or A52-48 (STA) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Park/Neutral Position Switch)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

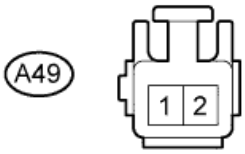
b. for Manual transmission.

i. Disconnect the clutch pedal switch connector.

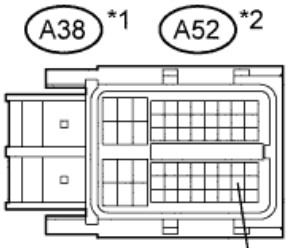
ii. Disconnect the ECM connector.

iii. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Clutch Pedal Switch)



Front view of wire harness connector:
(to ECM)



*1: for LHD

2 for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A49-2 - A38-48 (STA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
A49-2 - A52-48 (STA)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A49-2 or A38-48 (STA) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
A49-2 or A52-48 (STA) - Body ground	Always	10 kΩ or higher

NG → REPLACE HARNESS OR CONNECTOR

OK

8.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Drive the vehicle at more than 20 km/h (12.4 mph) for more than 20 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read the DTCs.

Result

Result	Proceed to
No DTC	A
P0617 (w/ Entry and Start System)	B
P0617 (w/o Entry and Start System)	C

B → GO TO CRANKING HOLDING FUNCTION CIRCUIT (Click here)

C → GO TO STARTER SIGNAL CIRCUIT (Click here)

A

SYSTEM OK

DTC P0115 Engine Coolant Temperature Circuit Malfunction

DTC P0117 Engine Coolant Temperature Circuit Low Input

DTC P0118 Engine Coolant Temperature Circuit High Input

for Preparation Click here

DESCRIPTION

A thermistor, whose resistance value varies according to the Engine Coolant Temperature (ECT), is built into the Engine Coolant Temperature (ECT) sensor.
The structure of the sensor and its connection to the ECM are the same as those of the Intake Air Temperature (IAT) sensor.

HINT:

When any of DTCs P0115, P0117 and P0118 are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECT is estimated to be 80°C (176°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC Code	DTC Detection Condition	Trouble Area
P0115	An open or short in the Engine Coolant Temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in Engine Coolant Temperature (ECT) sensor circuit • ECT sensor • ECM
P0117	A short in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in ECT sensor • ECT sensor • ECM
P0118	An open in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in ECT sensor circuit • ECT sensor • ECM

HINT:

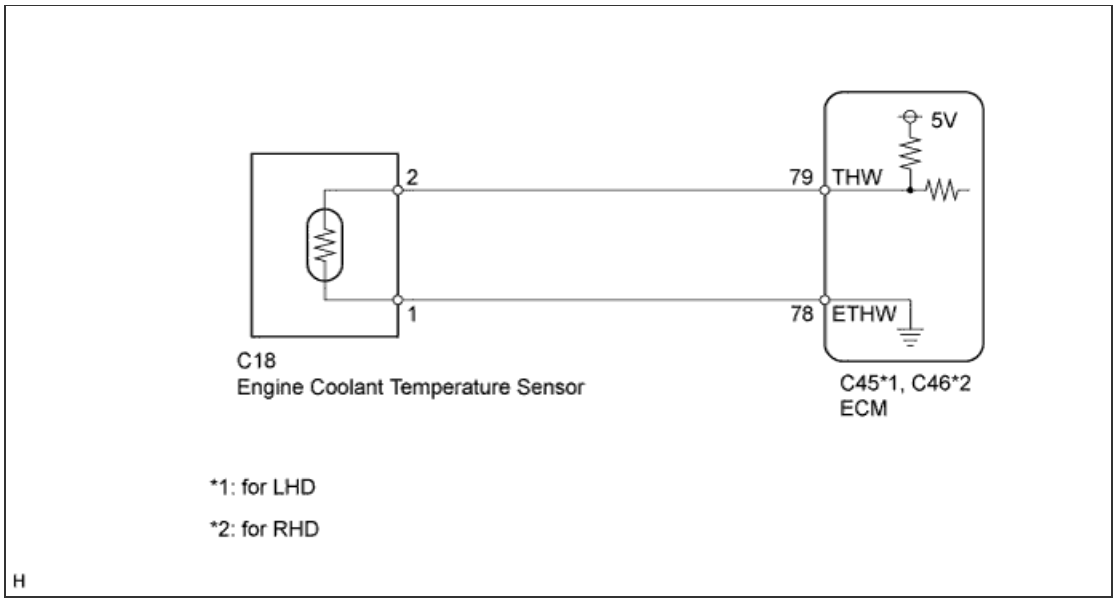
When any of these DTCs are output, check the ECT by entering the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

Tester Display	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

MONITOR DESCRIPTION

The Engine Coolant Temperature (ECT) sensor is used to monitor the ECT. The ECT sensor has a thermistor with a resistance that varies according to the temperature of the engine coolant. When the coolant temperature is low, the resistance in the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are reflected in the output voltage from the sensor. The ECM monitors the sensor voltage and uses this value to calculate the ECT. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a fault in the ECT sensor and stores a DTC.
Example:
If the sensor output voltage is higher than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the ECT sensor circuit, and stores DTC P0118. Conversely, if the voltage output is below 0.14 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and stores DTC P0117.
If the malfunction is not repaired successfully, a DTC is stored 0.5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (ENGINE COOLANT TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

e. Read the value displayed on the tester.

Result

Result	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
Between 80°C and 100°C (176°F and 212°F) with warm engine	C

HINT:

- **If there is an open circuit, the intelligent tester indicates -40°C (-40°F).**
- **If there is a short circuit, the intelligent tester indicates 140°C (284°F) or higher.**

B	Go to step 4
C	CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the Engine Coolant Temperature (ECT) sensor connector.

b. Connect terminals 1 and 2 of the ECT sensor connector on the wire harness side.

c. Connect the intelligent tester to the DLC3.

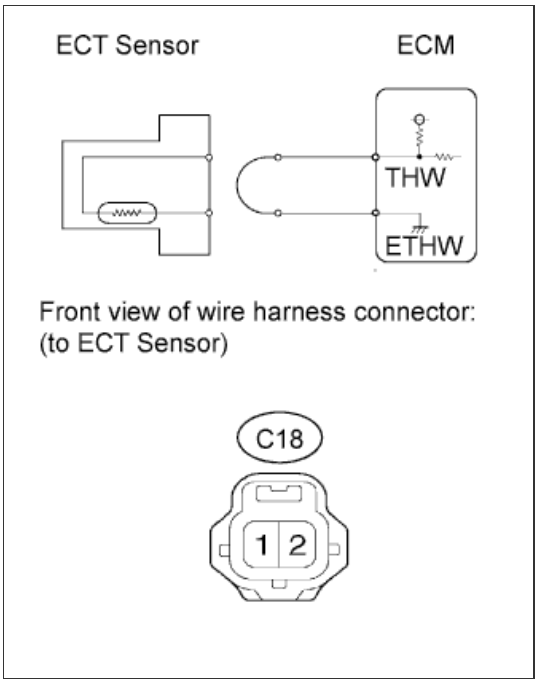
d. Turn the ignition switch to ON.

e. Turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

g. Read the value displayed on the tester.

Standard value:
140°C (284°F) or higher.



NG → Go to step 3

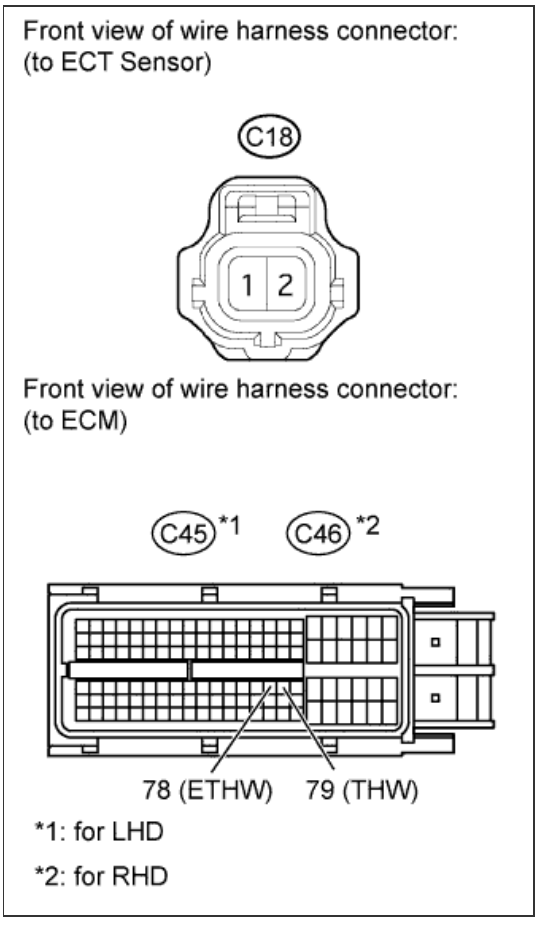
OK

CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

3.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for LHD

Tester Connection	Condition	Specified Condition
C18-2 - C45-79 (THW)	Always	Below 1 Ω
C18-1 - C45-78 (ETHW)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C18-2 - C46-79 (THW)	Always	Below 1 Ω
C18-1 - C46-78 (ETHW)	Always	Below 1 Ω

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM (Click here)

4.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the ECT sensor connector.

b. Connect the intelligent tester to the DLC3.

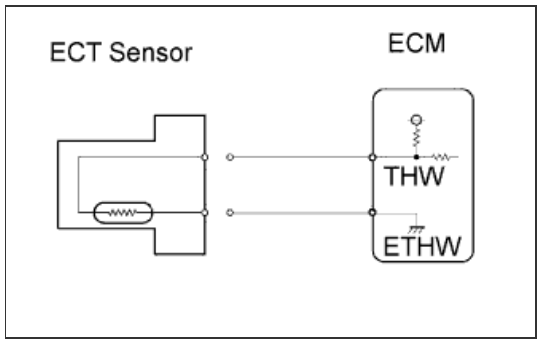
c. Turn the ignition switch to ON.

d. Turn the tester on.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

f. Read the value displayed on the tester.

Standard value:
-40°C (-40°F)



NG → Go to step 5

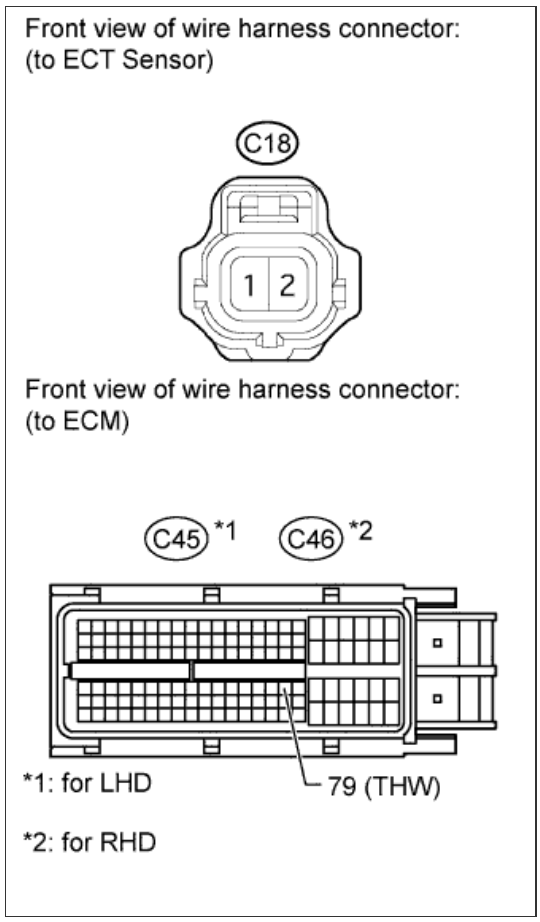
OK

REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

5.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for LHD

Tester Connection	Condition	Specified Condition
C18-2 or C45-79 (THW) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C18-2 or C46-79 (THW) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK → REPLACE ECM (Click here)

DTC P0657 Actuator Supply Voltage Circuit / Open

for Preparation Click here

DESCRIPTION

The ECM monitors the output voltage to the throttle actuator. This self-check ensures that the ECM is functioning properly. The output voltage is usually 0 V when the ignition switch is turned off. If the output voltage is higher than 7 volts when the ignition switch is turned off, the ECM will illuminate the MIL and store a DTC when the ignition switch is turned to ON.

DTC Code	DTC Detection Condition	Trouble Area
P0657	A throttle actuator power supply error.	ECM

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK DTC

a. Clear the DTC (Click here).

b. Turn the ignition switch off.

c. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

d. Connect the cable to the negative (-) battery terminal.

e. Turn the ignition switch to ON for 10 seconds.

f. Turn the ignition switch off.

g. Turn the ignition switch to ON.

h. Connect the intelligent tester to the DLC3.

i. Turn the tester on.

j. Enter the following menus: Powertrain / Engine and ECT / DTC.

k. Check for DTC.

OK:
P0657 is not output.

NG → **REPLACE ECM (Click here)**

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0116 Engine Coolant Temperature Circuit Range / Performance Problem

for Preparation Click here

DESCRIPTION

Refer to DTC P0115 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P0116	The Engine Coolant Temperature (ECT) is between 35°C and 60°C (95°F and 140°F) when the engine is started, and conditions (a) and (b) are met (2 trip detection logic): (a) The vehicle is driven at varying speeds (accelerated and decelerated). (b) The ECT remains within 3°C (5.4°F) of the initial ECT.	• Water inlet with thermostat • Engine Coolant Temperature (ECT) sensor

MONITOR DESCRIPTION

The ECT sensor is used to monitor the ECT. The ECT sensor has a built-in thermistor with a resistance that varies according to the temperature of the engine coolant. When the ECT is low, the resistance of the thermistor increases. When the temperature is high, the resistance drops. These variations in the resistance are reflected in the output voltage from the ECT sensor.
The ECM monitors the sensor voltage and uses this value to calculate the ECT. If the sensor output voltage deviates from the normal operating range, the ECM interprets this deviation as a malfunction in the ECT sensor and stores the DTC.
Example:
Upon starting the engine, the ECT is between 35°C and 60°C (95°F and 140°F). If after driving for 250 seconds, the ECT remains within 3°C (5.4°F) of the starting temperature, the DTC is stored (2 trip detection logic).

INSPECTION PROCEDURE

HINT:

- **If any of DTCs P0115, P0117, P0118 or P0125 are stored simultaneously with DTC P0116, the ECT sensor may have an open or a short circuit. Troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0116)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read the DTC.

Result

Result	Proceed to
P0116	A
P0116 and other DTCs	B

B → GO TO DTC CHART (**Click here**)

A

2.INSPECT WATER INLET WITH THERMOSTAT

a. Remove the water inlet with thermostat (Click here).

b. Measure the valve opening temperature of the thermostat.

Standard value:
80 to 84°C (176 to 183°F)

HINT:

In addition to the above check, confirm that the valve is completely closed when the temperature is below the standard.

NG → REPLACE WATER INLET WITH THERMOSTAT (Click here)

OK

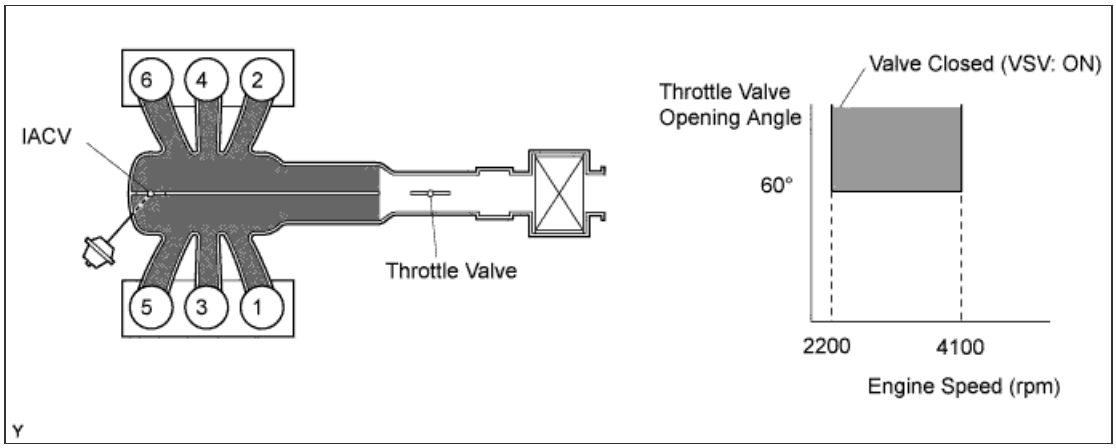
REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

DTC P0660 Intake Manifold Tuning Valve Control Circuit / Open (Bank 1)

for Preparation Click here

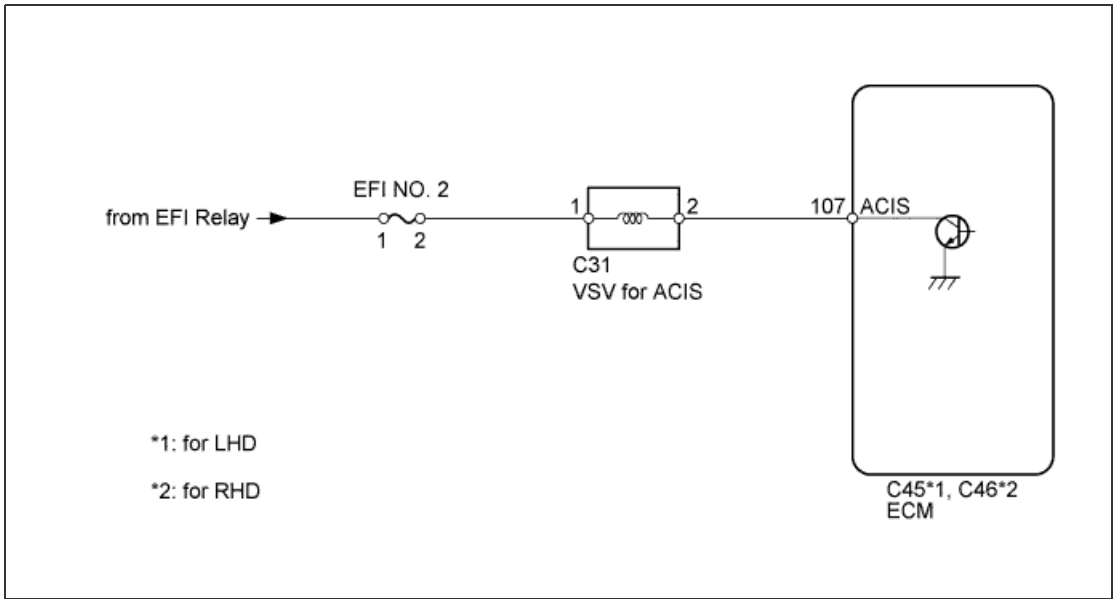
DESCRIPTION

This circuit opens and closes the Intake Air Control Valve (IACV) in response to changes in the engine load in order to increase the intake efficiency (ACIS: Acoustic Control Induction System).
When the engine speed is between 2200 rpm and 4100 rpm and the throttle valve opening angle is 60° or more, the ECM supplies current to the VSV (ON status), to close the IACV. Under other conditions, the VSV is usually OFF and the IACV is open.



DTC Code	DTC Detection Condition	Trouble Area
P0660	Conditions (a) and (b) are met for 0.5 sec. or more (2 trip detection logic): (a) The voltage of terminal ACIS of the ECM is low when the VSV is OFF. (b) The engine has started.	• Open or short in VSV for ACIS circuit • VSV for ACIS • ECM

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE VSV FOR ACIS)

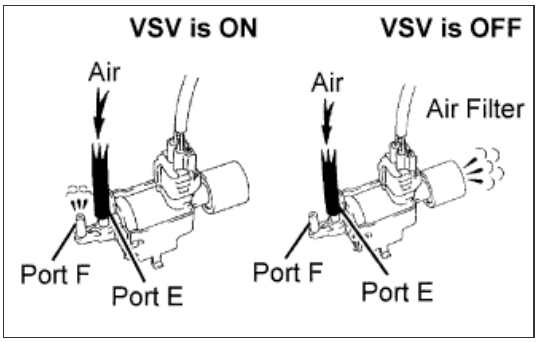
a. Disconnect the vacuum hose.

b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON and turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Active the VSV for Intake Control. Operate the VSV for ACIS.

e. Check the VSV operation when it is operated using the intelligent tester.



OK:

Tester Operation	Specified Condition
VSV ON	Air from port E flows out through port F
VSV OFF	Air from port E flows out through air filter

Result

Result	Proceed to
NG	A
OK	B

f. Reconnect the vacuum hose.

B → Go to step 4

A

2.INSPECT VSV FOR ACIS (OPERATION)

a. Inspect the VSV for ACIS (Click here).

NG → REPLACE VSV FOR ACIS (Click here)

OK

3.CHECK HARNESS AND CONNECTOR (VSV FOR ACIS - ECM, VSV FOR ACIS - EFI NO. 2 FUSE)

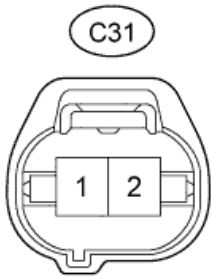
a. Check the wire harness and connectors between the VSV for ACIS and ECM.

i. Disconnect the VSV for ACIS connector.

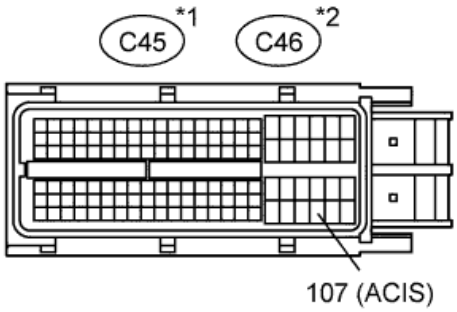
ii. Disconnect the ECM connector.

iii. Measure the resistance according to the value(s) in the table below.

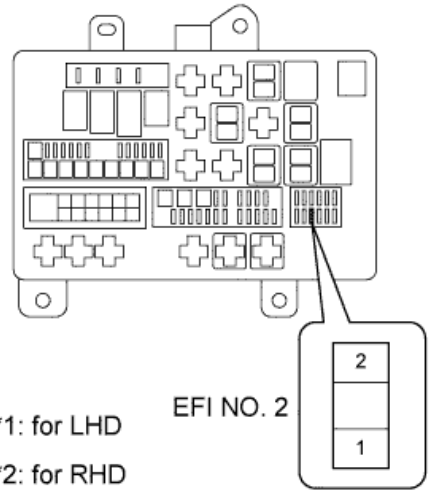
Front view of wire harness connector:
(to VSV for ACIS)



Front view of wire harness connector:
(to ECM)



Front view of wire harness connector:
(to Engine Room Relay Block)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C31-2 - C45-107 (ACIS)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C31-2 - C46-107 (ACIS)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C31-2 or C45-107 (ACIS) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C31-2 or C46-107 (ACIS) - Body ground	Always	10 kΩ or higher

b. Check the wire harness between the VSV for ACIS and EFI NO. 2 fuse.

i. Disconnect the VSV for ACIS connector.

ii. Remove the EFI NO. 2 fuse from the engine room relay block.

iii. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C31-1 - EFI NO. 2 fuse	Always	Below 1 Ω

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK ↓

4.CHECK VACUUM HOSE

a. Check that the vacuum hose is connected correctly, and that there are no cracks, holes, damage, or looseness.

OK:
Vacuum hose is normal.

NG → REPAIR OR REPLACE VACUUM HOSE

OK ↓

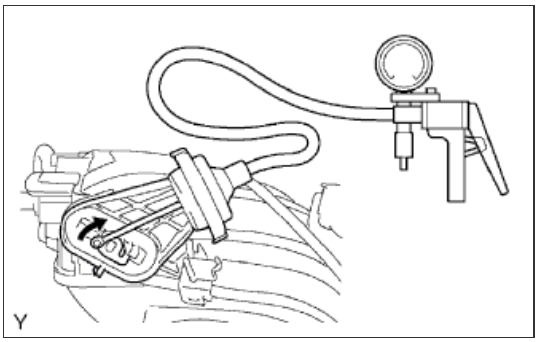
5.INSPECT INTAKE AIR SURGE TANK (INTAKE AIR CONTROL VALVE)

a. Check that the lever moves when a vacuum of 26.6 kPa (200 mmHg, 7.85 in.Hg) is applied with the vacuum gauge on.

OK:
Lever moves.

b. Check that the vacuum of 26.6 kPa (200 mmHg, 7.85 in.Hg) is sustained for 1 minute in the above state.

OK:
Vacuum is sustained.



NG → REPLACE INTAKE AIR SURGE TANK (INTAKE AIR CONTROL VALVE) (Click here)

OK ↓

REPLACE ECM (Click here)

DTC P0120 Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction

DTC P0121 Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0220 Throttle / Pedal Position Sensor / Switch "B" Circuit

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

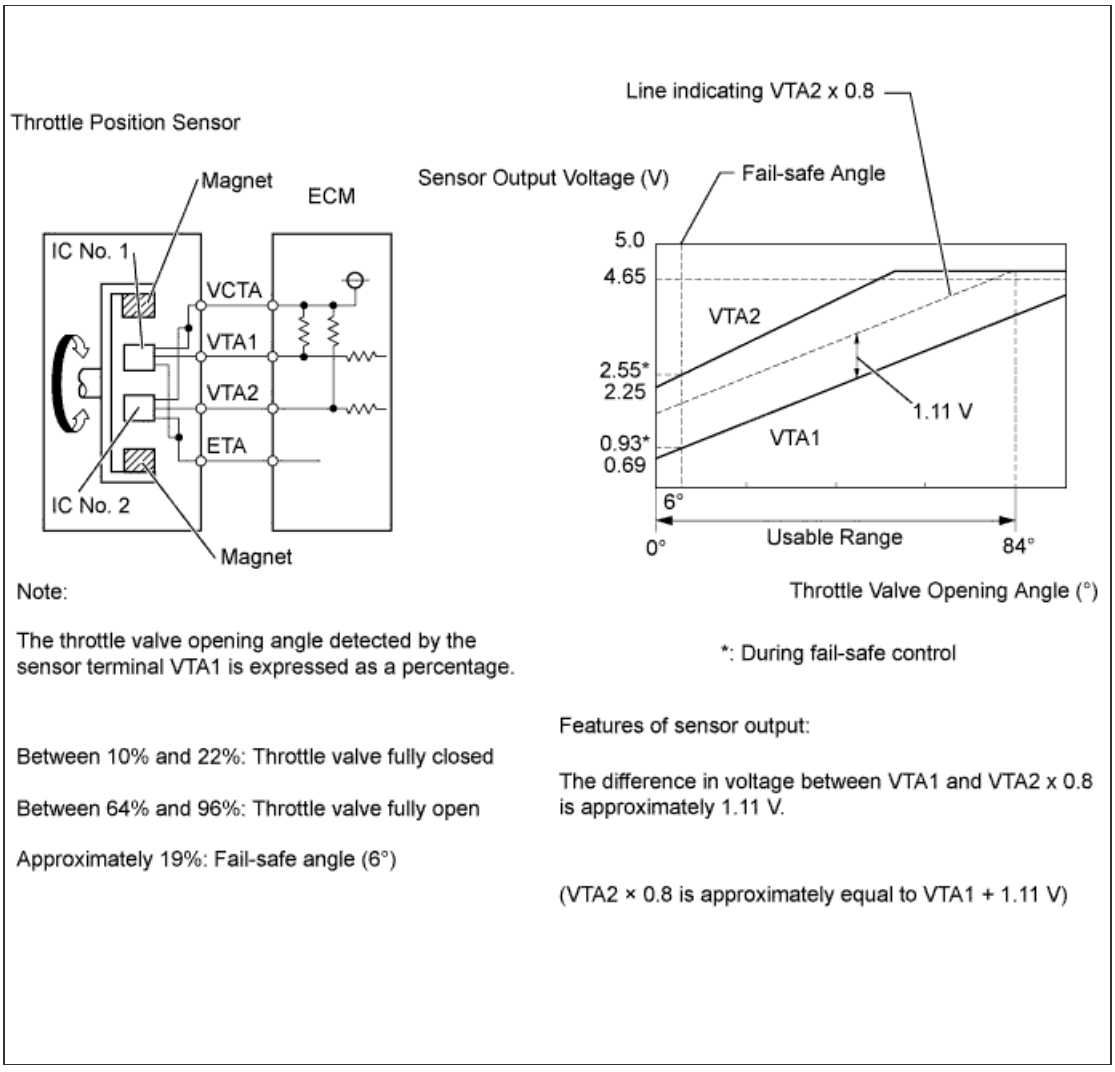
DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

DTC P2135 Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

for Preparation Click here

DESCRIPTION

The TP sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.
The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air fuel ratio correction, power increase correction and fuel-cut control.



DTC Code	DTC Detection Condition	Trouble Area
		• Throttle Position (TP) sensor (built into throttle

P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	body) • ECM
P0121	The difference between the VTA1 and VTA2 voltages is below 0.8 V, or higher than 1.6 V for 2 seconds (1 trip detection logic).	• TP sensor (built into throttle body) • TP sensor circuit • ECM
P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.535 V or higher for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher, and VTA1 is between 0.2 V and 2.02 V for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) is met (1 trip detection logic): (a) The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:

- **When any of these DTCs are output, check the throttle valve opening angle by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.**
- **Throttle Position No.1 is the VTA1 signal, and Throttle Position No.2 is the VTA2 signal.**

Reference (Normal Condition)

Tester Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No.1	0.5 to 1.1 V	3.2 to 4.8 V
Throttle Position No.2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

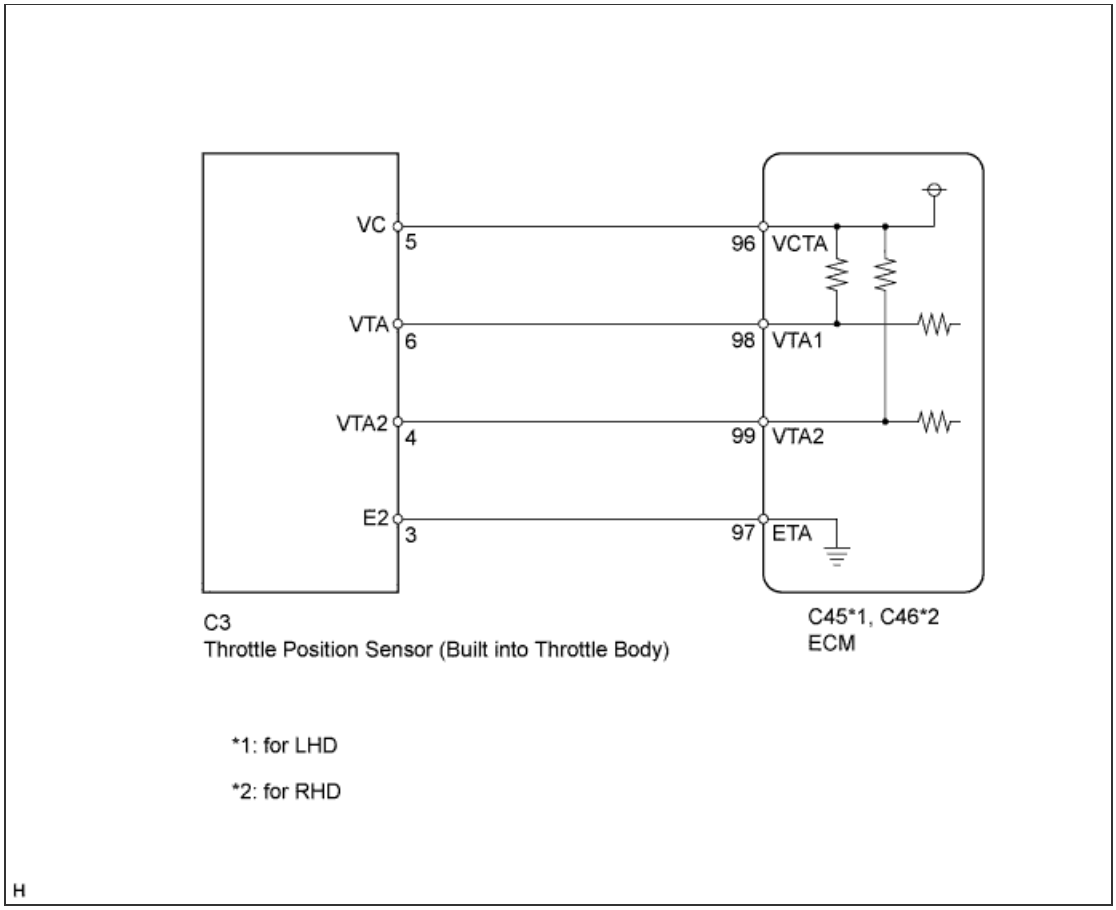
- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.

d. Check the values displayed on the tester.

Result

Throttle Position No.1	Throttle Position No.2	Throttle Position No.1	Throttle Position No.2	Trouble Area Proceed to	
When Accelerator Pedal Released		When Accelerator Pedal Depressed			
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	
0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	VTA1 circuit open or ground short	
0.5 to 1.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.5 to 1.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	
0.5 to 1.1 V	2.1 to 3.1 V	3.2 to 4.8 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

- **DTC P0121 is stored when the voltages output from VTA1 and VTA2 are not consistent with the characteristics of the sensors. Therefore, check the Freeze Frame Data when this DTC is output. Use the following formula to confirm relative fluctuations in voltage.**

Features of sensor output

VTA2 x 0.8 is approximately equal to VTA1 + 1.11 V

VTA1: Throttle Position No. 1

VTA2: Throttle Position No. 2

- **If DTC P0121 is output, proceed to the "CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)".**

B	Go to step 5

A

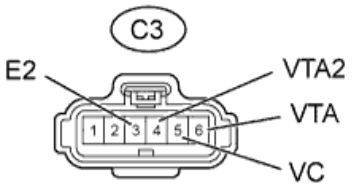
2.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the throttle body connector.

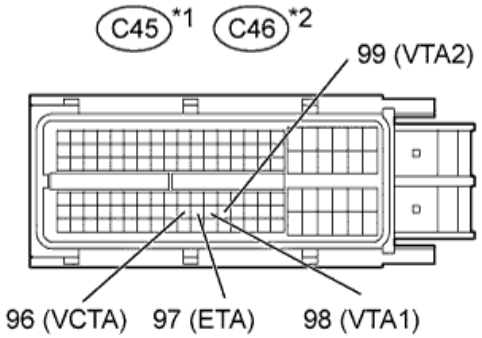
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Throttle Position Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C45-96 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C45-98 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C45-99 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C45-97 (ETA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C46-96 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C46-98 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C46-99 (VTA2)	Always	Below 1 Ω

C3-3 (E2) - C46-97 (ETA)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) or C45-96 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C45-98 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C45-99 (VTA2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) or C46-96 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C46-98 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C46-99 (VTA2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

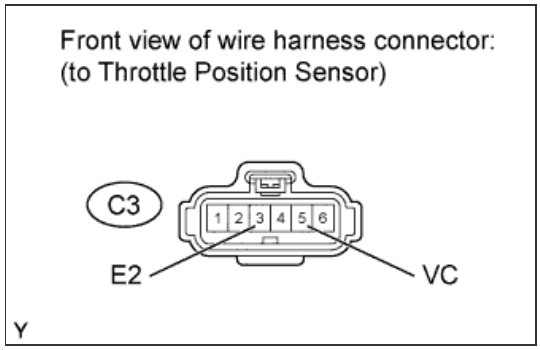
OK

3.INSPECT ECM (VC VOLTAGE)

a. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C3-5 (VC) - C3-3 (E2)	Ignition switch ON	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

4.REPLACE THROTTLE BODY ASSEMBLY

a. Replace the throttle body assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. With the vehicle stationary, fully depress and release the accelerator pedal.

f. Idle the engine for 2 seconds or more.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read the DTCs.

Result

Result	Proceed to
P0120, P0121, P0122, P0123, P0220, P0222, P0223 and/or P2135	A
No output	B

B → SYSTEM OK

A → REPLACE ECM (Click here)

DTC P0724 Brake Switch "B" Circuit High

for Preparation Click here

DESCRIPTION

The stop light switch assembly is a duplex system that transmits 2 signals: STP and ST1-. These 2 signals are used by the ECM to monitor whether or not the brake system is working properly.
The purpose of this circuit is to prevent the engine from stalling while driving with the lock-up torque converter clutch on when the brakes are suddenly applied.
When the brake pedal is depressed, the stop light switch sends a signal to the ECM. Then the ECM cancels the operation of the lock-up clutch while braking is in progress.

DTC Code	DTC Detection Condition	Trouble Area
P0724	The stop light switch remains on even when vehicle is driven in a GO (30 km/h (18.63 mph) or more) and STOP (less than 3 km/h (1.86 mph)) pattern 5 times (2 trip detection logic).	• Short in stop light switch signal circuit • Stop light switch assembly • ECM

WIRING DIAGRAM

Refer to DTC P0504 (Click here).

INSPECTION PROCEDURE

HINT:

- **Using the intelligent tester to read the Data List allows the values or states of switches, sensors, actuators and other items to be read without removing any parts. Reading the Data List information early in troubleshooting is one way to save diagnostic time.**
- **Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was moving or stationary, whether the engine was warmed up or not, whether the air fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.**

1.READ VALUE USING INTELLIGENT TESTER (STOP LIGHT SWITCH)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine / Data List / Stop Light Switch.

e. Read the value displayed on the tester when the brake pedal is depressed and released.

OK:

Brake Pedal	Display
Released	OFF
Depressed	ON

NG → Go to step 2

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

2.INSPECT STOP LIGHT SWITCH ASSEMBLY

a. Disconnect the stop light switch assembly connector.

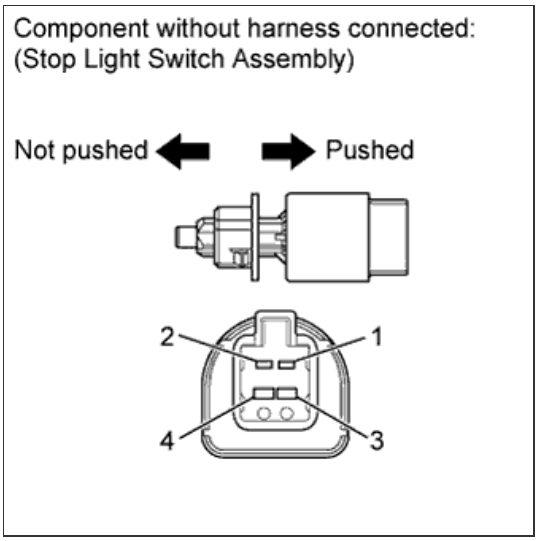
b. Remove the stop light switch assembly.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Switch Position	Specified Condition

1 - 2	Switch pin not pushed	Below 1 Ω
	Switch pin pushed	10 kΩ or higher
3 - 4	Switch pin not pushed	10 kΩ or higher
	Switch pin pushed	Below 1 Ω



d. Reinstall the stop light switch assembly.

e. Reconnect the stop light switch assembly connector.

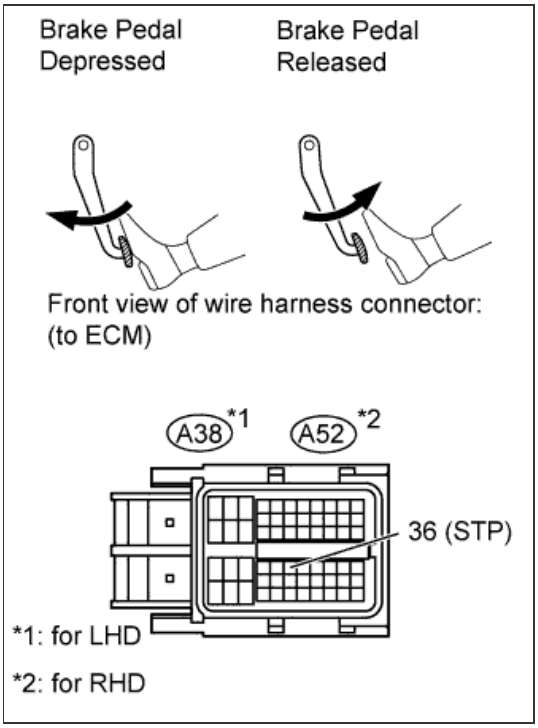
NG → REPLACE STOP LIGHT SWITCH ASSEMBLY (Click here)

OK

3.CHECK HARNESS AND CONNECTOR (ECM - STOP LIGHT SWITCH ASSEMBLY)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for LHD

Tester Connection	Condition	Specified Condition
A38-36 (STP) - Body ground	Brake pedal depressed	11 to 14 V
	Brake pedal released	0 to 3 V

for RHD

Tester Connection	Condition	Specified Condition
A52-36 (STP) - Body ground	Brake pedal depressed	11 to 14 V
	Brake pedal released	0 to 3 V

c. Reconnect the ECM connector.

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK → REPLACE ECM (Click here)

DTC P0120 Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction

DTC P0121 Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0220 Throttle / Pedal Position Sensor / Switch "B" Circuit

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

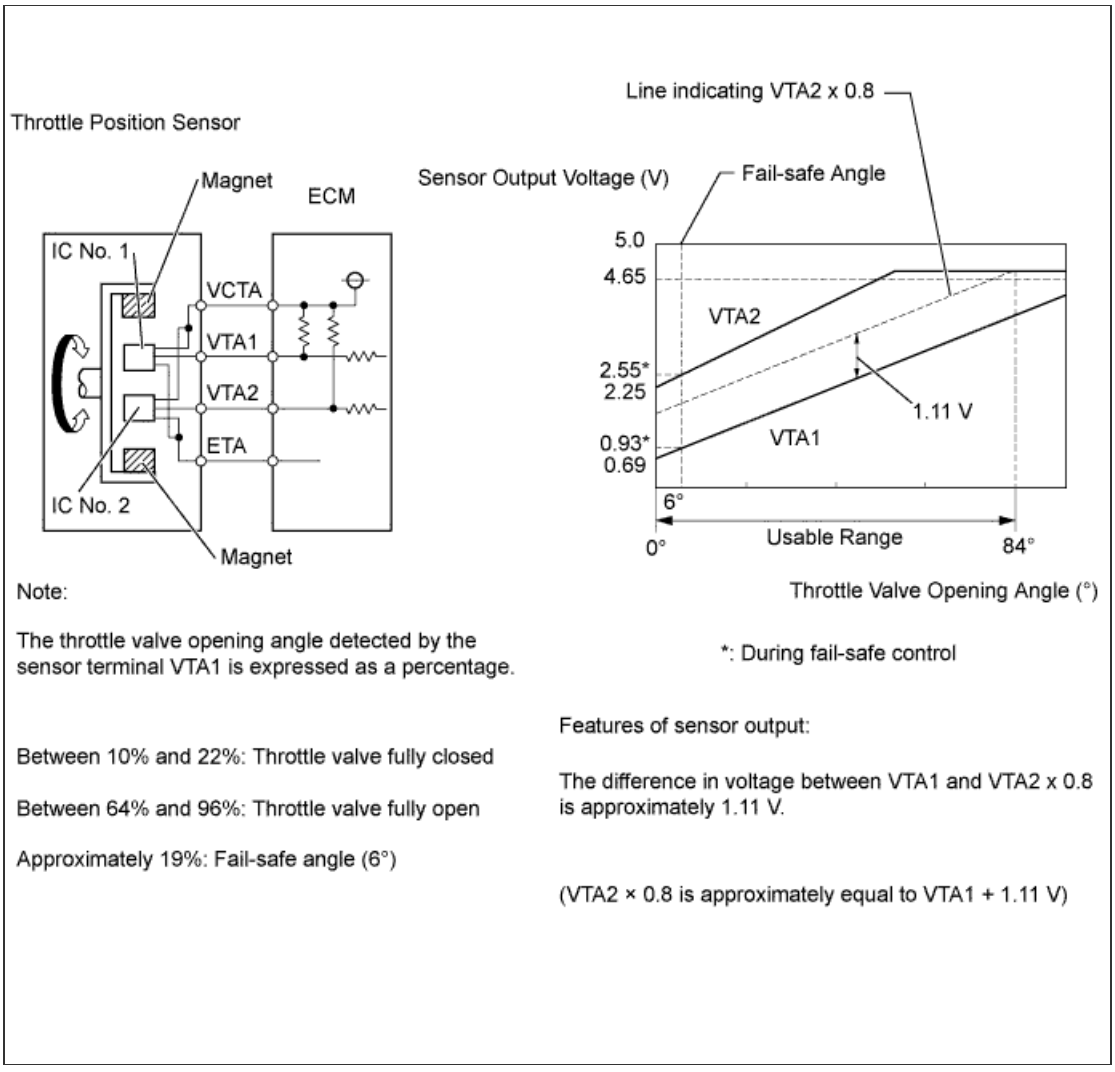
DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

DTC P2135 Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

for Preparation Click here

DESCRIPTION

The TP sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.
The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air fuel ratio correction, power increase correction and fuel-cut control.



DTC Code	DTC Detection Condition	Trouble Area
		• Throttle Position (TP) sensor (built into throttle

P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	body) • ECM
P0121	The difference between the VTA1 and VTA2 voltages is below 0.8 V, or higher than 1.6 V for 2 seconds (1 trip detection logic).	• TP sensor (built into throttle body) • TP sensor circuit • ECM
P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.535 V or higher for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher, and VTA1 is between 0.2 V and 2.02 V for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) is met (1 trip detection logic): (a) The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:

- **When any of these DTCs are output, check the throttle valve opening angle by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.**
- **Throttle Position No.1 is the VTA1 signal, and Throttle Position No.2 is the VTA2 signal.**

Reference (Normal Condition)

Tester Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No.1	0.5 to 1.1 V	3.2 to 4.8 V
Throttle Position No.2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

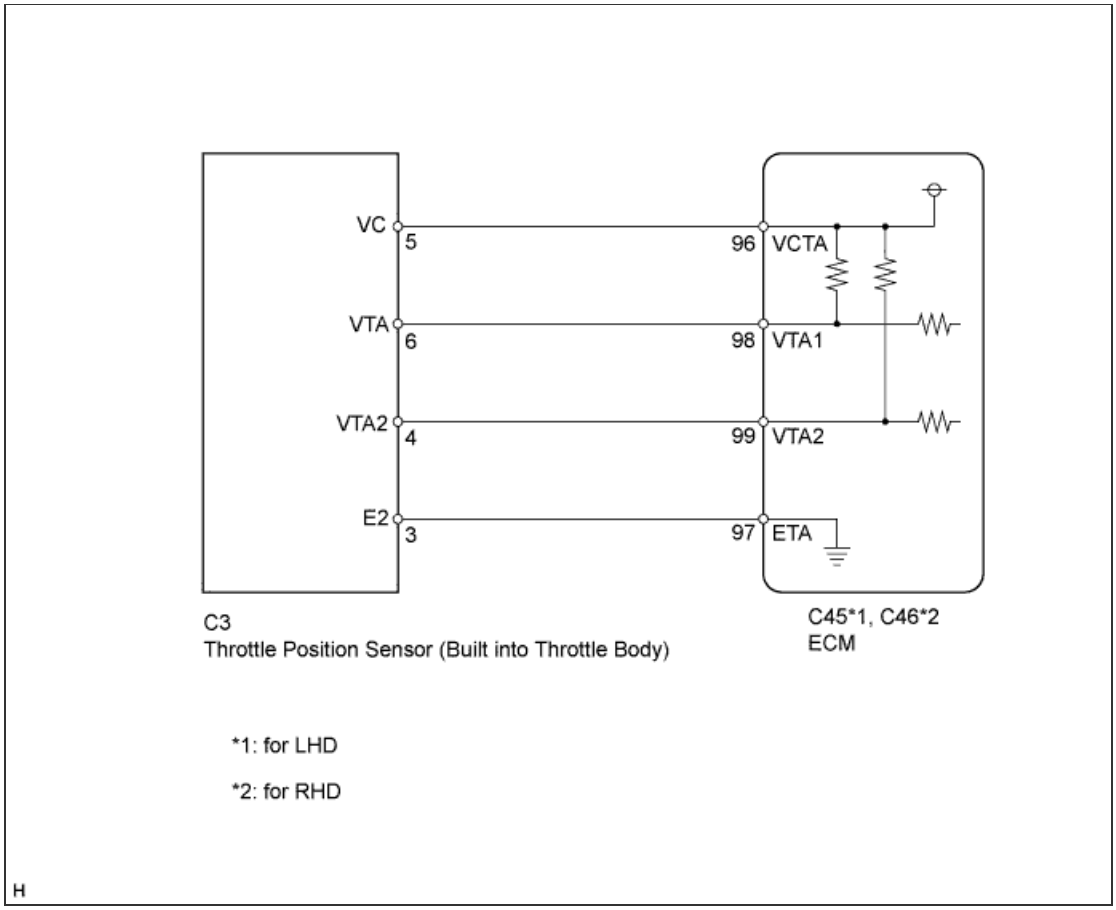
- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.

d. Check the values displayed on the tester.

Result

Throttle Position No.1	Throttle Position No.2	Throttle Position No.1	Throttle Position No.2	Trouble Area Proceed to	
When Accelerator Pedal Released		When Accelerator Pedal Depressed			
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	
0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	VTA1 circuit open or ground short	
0.5 to 1.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.5 to 1.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	
0.5 to 1.1 V	2.1 to 3.1 V	3.2 to 4.8 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

- **DTC P0121 is stored when the voltages output from VTA1 and VTA2 are not consistent with the characteristics of the sensors. Therefore, check the Freeze Frame Data when this DTC is output. Use the following formula to confirm relative fluctuations in voltage.**

Features of sensor output

VTA2 x 0.8 is approximately equal to VTA1 + 1.11 V

VTA1: Throttle Position No. 1

VTA2: Throttle Position No. 2

- **If DTC P0121 is output, proceed to the "CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)".**

B	Go to step 5

A

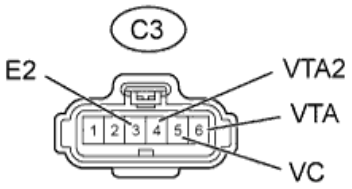
2.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the throttle body connector.

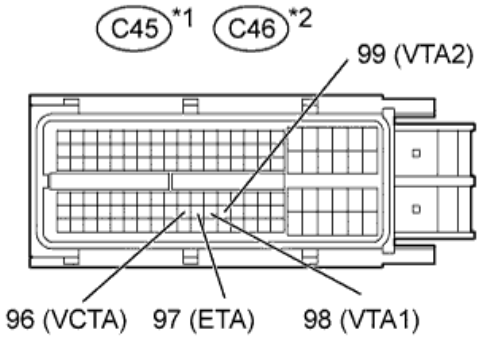
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Throttle Position Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C45-96 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C45-98 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C45-99 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C45-97 (ETA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C46-96 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C46-98 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C46-99 (VTA2)	Always	Below 1 Ω

C3-3 (E2) - C46-97 (ETA)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) or C45-96 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C45-98 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C45-99 (VTA2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) or C46-96 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C46-98 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C46-99 (VTA2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

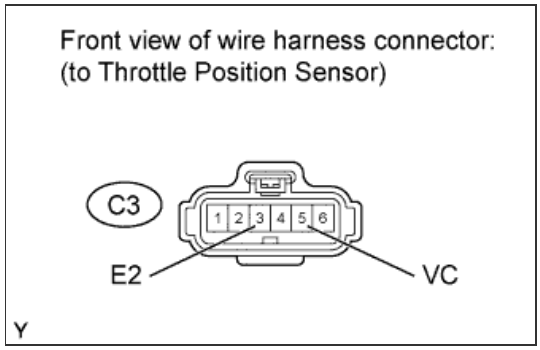
OK

3.INSPECT ECM (VC VOLTAGE)

a. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C3-5 (VC) - C3-3 (E2)	Ignition switch ON	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

4.REPLACE THROTTLE BODY ASSEMBLY

a. Replace the throttle body assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. With the vehicle stationary, fully depress and release the accelerator pedal.

f. Idle the engine for 2 seconds or more.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read the DTCs.

Result

Result	Proceed to
P0120, P0121, P0122, P0123, P0220, P0222, P0223 and/or P2135	A
No output	B

B → SYSTEM OK

A → REPLACE ECM (Click here)

DTC P1607 Cruise Control Input Processor

for Preparation Click here

DESCRIPTION

The ECM continuously monitors its main and sub CPUs. This self-check ensures that the ECM is functioning properly. If outputs from the CPUs are different and deviate from the standard, the ECM illuminates the MIL and stores a DTC immediately.

DTC Code	DTC Detection Condition	Trouble Area
P1607	When either condition below is met: • An ECM main CPU error. • An ECM sub CPU error.	ECM

INSPECTION PROCEDURE

1.CHECK DTC

a. Clear DTCs (Click here).

b. Turn the ignition switch off.

c. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

d. Connect the cable to the negative (-) battery terminal.

e. Turn the ignition switch to ON.

f. Check for DTCs.

OK:
P1607 is not present.

NG → **REPLACE ECM (Click here)**

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0120 Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction

DTC P0121 Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0220 Throttle / Pedal Position Sensor / Switch "B" Circuit

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

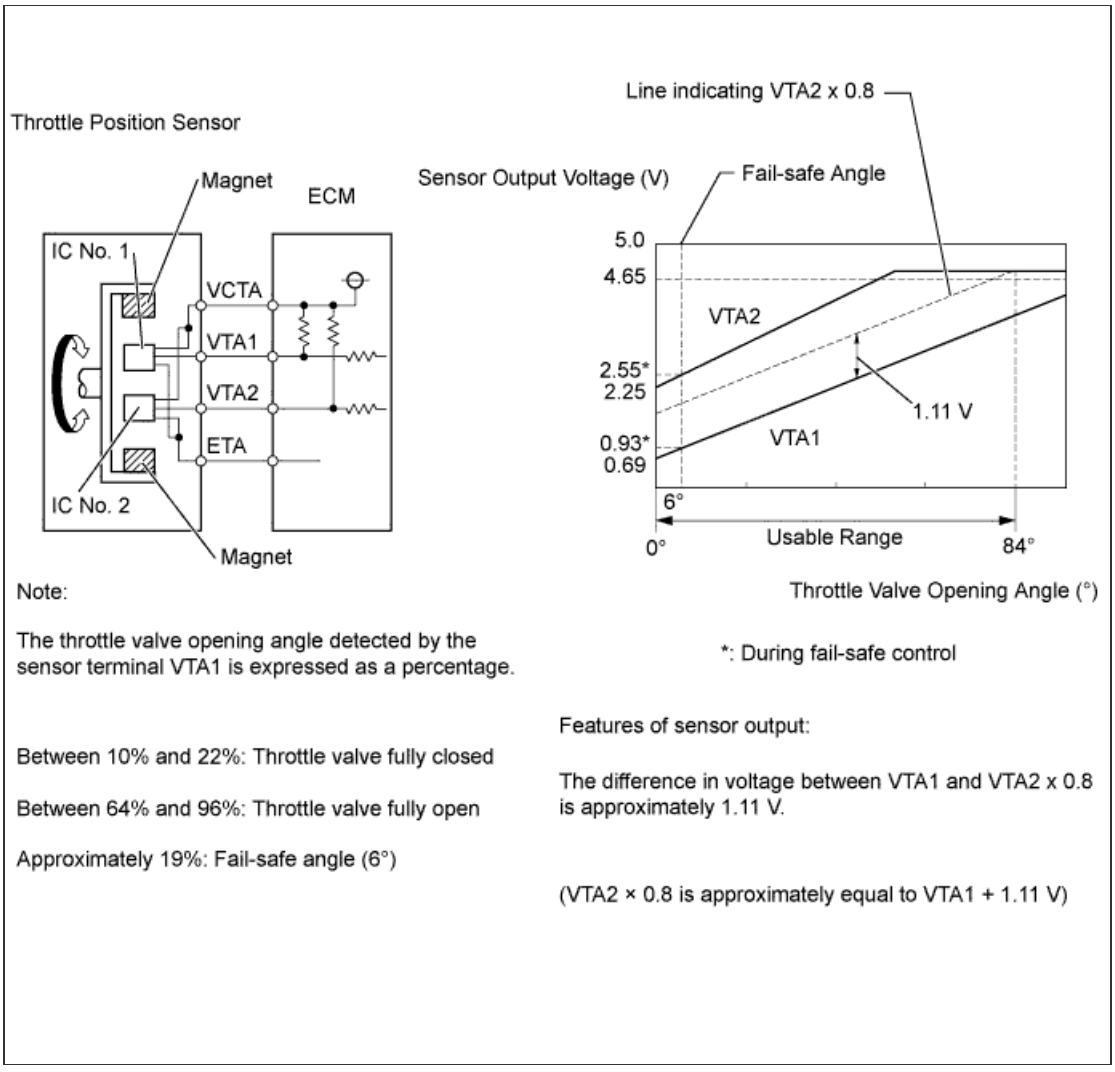
DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

DTC P2135 Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

for Preparation Click here

DESCRIPTION

The TP sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.
The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air fuel ratio correction, power increase correction and fuel-cut control.



DTC Code	DTC Detection Condition	Trouble Area
		• Throttle Position (TP) sensor (built into throttle

P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	body) • ECM
P0121	The difference between the VTA1 and VTA2 voltages is below 0.8 V, or higher than 1.6 V for 2 seconds (1 trip detection logic).	• TP sensor (built into throttle body) • TP sensor circuit • ECM
P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.535 V or higher for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher, and VTA1 is between 0.2 V and 2.02 V for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) is met (1 trip detection logic): (a) The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:

- **When any of these DTCs are output, check the throttle valve opening angle by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.**
- **Throttle Position No.1 is the VTA1 signal, and Throttle Position No.2 is the VTA2 signal.**

Reference (Normal Condition)

Tester Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No.1	0.5 to 1.1 V	3.2 to 4.8 V
Throttle Position No.2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

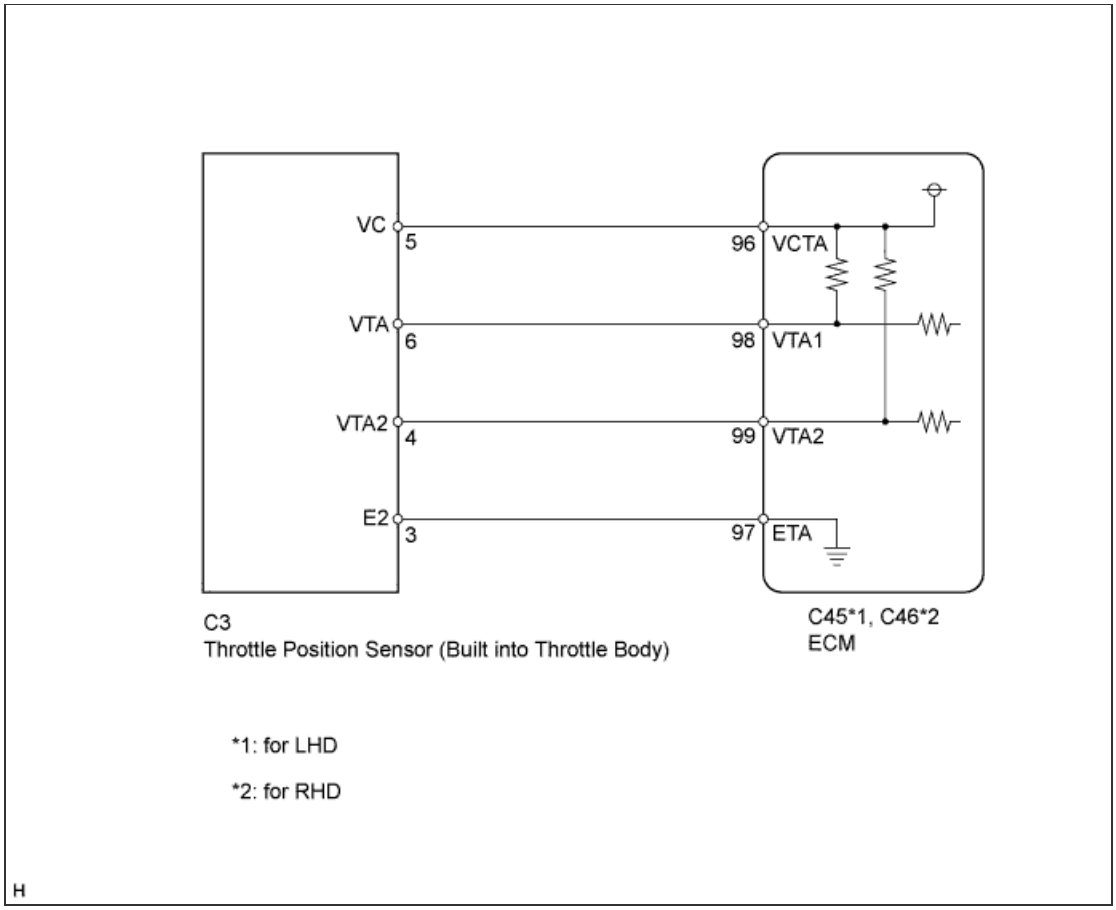
- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.

d. Check the values displayed on the tester.

Result

Throttle Position No.1	Throttle Position No.2	Throttle Position No.1	Throttle Position No.2	Trouble Area Proceed to	
When Accelerator Pedal Released		When Accelerator Pedal Depressed			
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	
0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	VTA1 circuit open or ground short	
0.5 to 1.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.5 to 1.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	
0.5 to 1.1 V	2.1 to 3.1 V	3.2 to 4.8 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

- **DTC P0121 is stored when the voltages output from VTA1 and VTA2 are not consistent with the characteristics of the sensors. Therefore, check the Freeze Frame Data when this DTC is output. Use the following formula to confirm relative fluctuations in voltage.**

Features of sensor output

VTA2 x 0.8 is approximately equal to VTA1 + 1.11 V

VTA1: Throttle Position No. 1

VTA2: Throttle Position No. 2

- **If DTC P0121 is output, proceed to the "CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)".**

B	Go to step 5

A

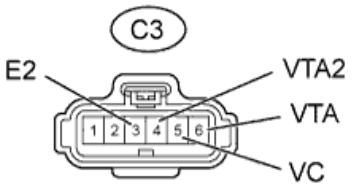
2.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the throttle body connector.

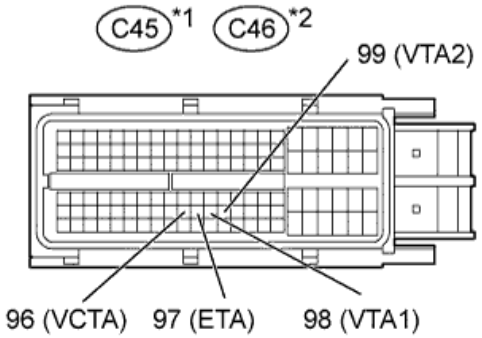
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Throttle Position Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C45-96 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C45-98 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C45-99 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C45-97 (ETA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C46-96 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C46-98 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C46-99 (VTA2)	Always	Below 1 Ω

C3-3 (E2) - C46-97 (ETA)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) or C45-96 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C45-98 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C45-99 (VTA2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) or C46-96 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C46-98 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C46-99 (VTA2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

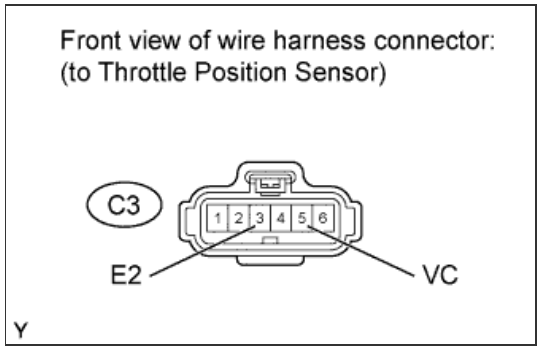
OK

3.INSPECT ECM (VC VOLTAGE)

a. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C3-5 (VC) - C3-3 (E2)	Ignition switch ON	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

4.REPLACE THROTTLE BODY ASSEMBLY

a. Replace the throttle body assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. With the vehicle stationary, fully depress and release the accelerator pedal.

f. Idle the engine for 2 seconds or more.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read the DTCs.

Result

Result	Proceed to
P0120, P0121, P0122, P0123, P0220, P0222, P0223 and/or P2135	A
No output	B

B → SYSTEM OK

A → REPLACE ECM (Click here)

DTC P2102 Throttle Actuator Control Motor Circuit Low

DTC P2103 Throttle Actuator Control Motor Circuit High

for Preparation Click here

DESCRIPTION

The throttle actuator is operated by the ECM and opens and closes the throttle valve using gears.
The opening angle of the throttle valve is detected by the Throttle Position (TP) sensor, which is mounted on the throttle body. The TP sensor provides feedback to the ECM. This feedback allows the ECM to appropriately control the throttle actuator and monitor the throttle opening angle as the ECM responds to driver inputs.

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

DTC Code	DTC Detection Condition	Trouble Area
P2102	Conditions (a) and (b) continue for 2.0 seconds (1 trip detection logic): (a) The throttle actuator duty ratio is 80% or more. (b) The throttle actuator current is 0.5 A or less.	• **Open in throttle actuator circuit** • **Throttle actuator** • **ECM**
P2103	Either of the following conditions is met (1 trip detection logic): • **A hybrid IC diagnosis signal failure.** • **A hybrid IC current limiter port failure.**	• **Short in throttle actuator circuit** • **Throttle actuator** • **Throttle valve** • **Throttle body assembly** • **ECM**

MONITOR DESCRIPTION

The ECM monitors the electrical current through the electronic actuator, and detects malfunctions and open circuits in the throttle actuator based on this value. If the current is outside the standard range, the ECM determines that there is a malfunction in the throttle actuator. In addition, if the throttle valve does not function properly (for example, stuck on), the ECM determines that there is a malfunction. The ECM then illuminates the MIL and stores a DTC.

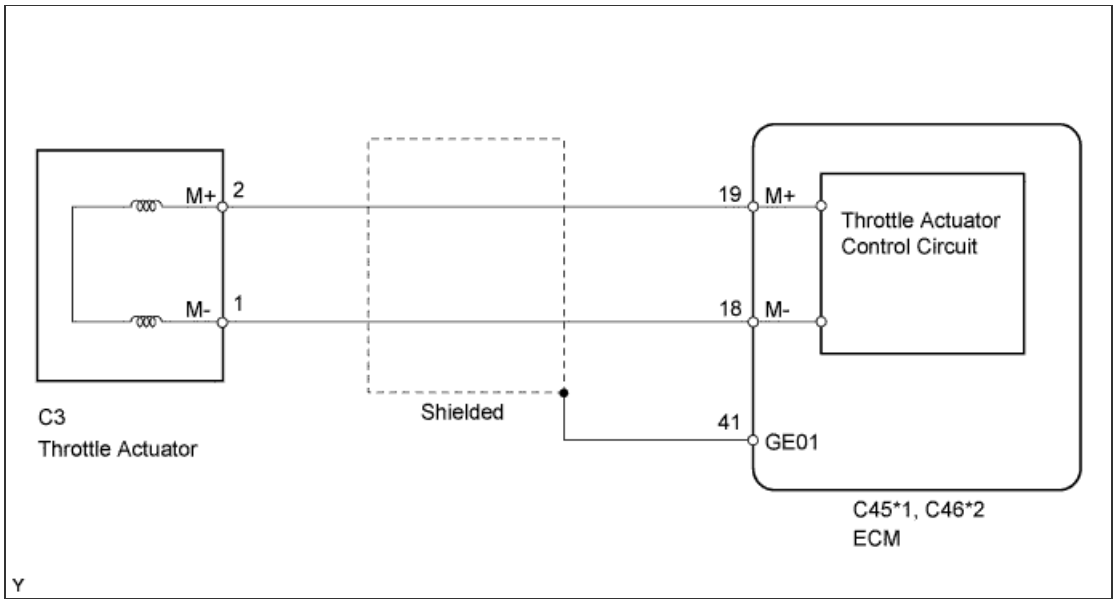
Example:

When the electrical current is 0.5 A or less and the throttle actuator duty ratio is 80% or more, the ECM interprets this as the current being outside the standard range, illuminates the MIL and stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored when the engine is quickly revved to a high rpm several times after the engine has idled for 5 seconds after engine start.

FAIL-SAFE

When either of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue running at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **The throttle actuator current (Throttle Motor Current) and the throttle actuator duty ratio (Throttle Motor Open Duty / Throttle Motor Close Duty) can be read using the intelligent tester. However, the ECM shuts off the throttle actuator current when the ETCS malfunctions.**

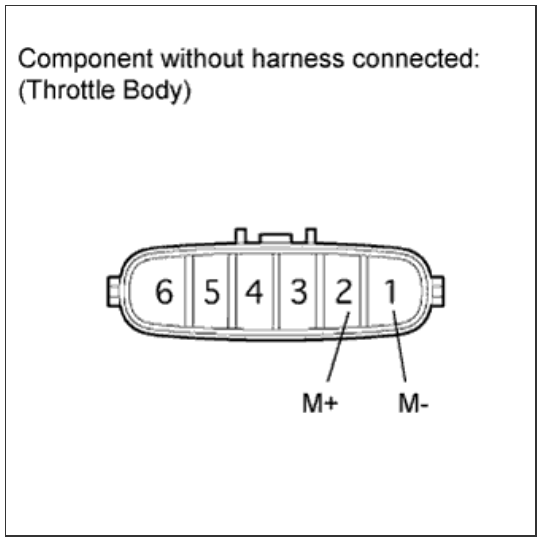
1.INSPECT THROTTLE BODY (RESISTANCE OF THROTTLE ACTUATOR)

a. Disconnect the throttle body connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
2 (M+) - 1 (M-)	20°C (68°F)	0.3 to 100 Ω



NG → REPLACE THROTTLE BODY (Click here)

OK

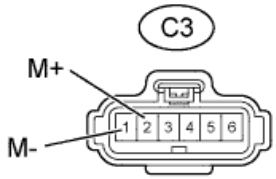
2.CHECK HARNESS AND CONNECTOR (THROTTLE ACTUATOR - ECM)

a. Disconnect the throttle body connector.

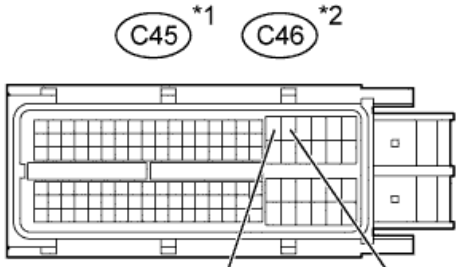
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Throttle Body)



Front view of wire harness connector:
(to ECM)



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C3-2 (M+) - C45-19 (M+)	Always	Below 1 Ω
C3-1 (M-) - C45-18 (M-)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C3-2 (M+) - C46-19 (M+)	Always	Below 1 Ω
C3-1 (M-) - C46-18 (M-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C3-2 (M+) or C45-19 (M+) - Body ground	Always	10 kΩ or higher
C3-1 (M-) or C45-18 (M-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C3-2 (M+) or C46-19 (M+) - Body ground	Always	10 kΩ or higher
C3-1 (M-) or C46-18 (M-) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT THROTTLE BODY (VISUALLY CHECK THROTTLE VALVE)

a. Check for foreign objects between the throttle valve and the housing.

OK:

No foreign objects between the throttle valve and the housing.

NG → REMOVE FOREIGN OBJECT AND CLEAN THROTTLE BODY

OK

4.INSPECT THROTTLE VALVE

a. Check if the throttle valve opens and closes smoothly.

OK:

Throttle valve opens and closes smoothly.

NG → REPLACE THROTTLE BODY (Click here)

OK

REPLACE ECM (Click here)

DTC P0120 Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction

DTC P0121 Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0220 Throttle / Pedal Position Sensor / Switch "B" Circuit

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

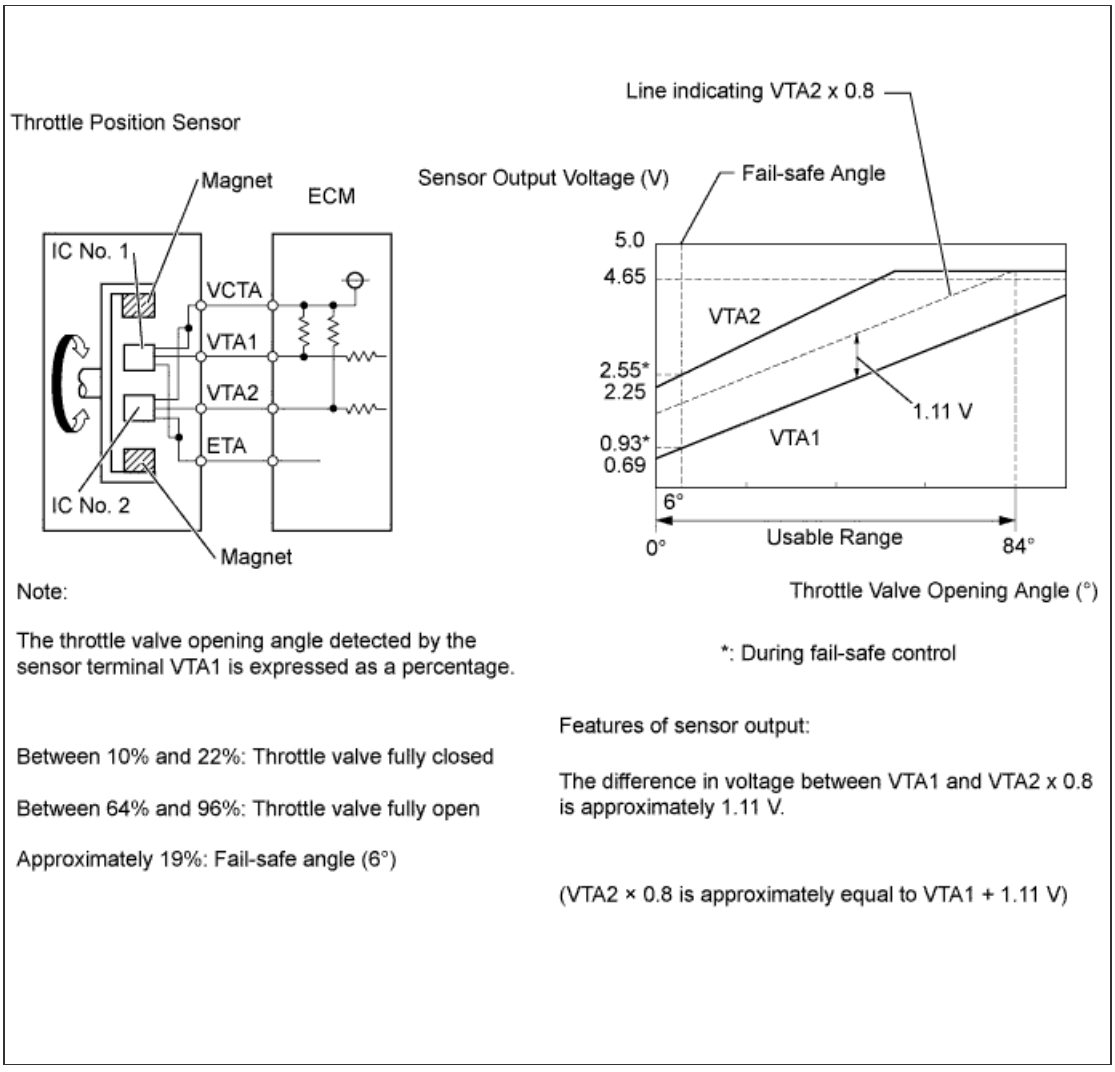
DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

DTC P2135 Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

for Preparation Click here

DESCRIPTION

The TP sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.
The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air fuel ratio correction, power increase correction and fuel-cut control.



DTC Code	DTC Detection Condition	Trouble Area
		• Throttle Position (TP) sensor (built into throttle

P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	body) • ECM
P0121	The difference between the VTA1 and VTA2 voltages is below 0.8 V, or higher than 1.6 V for 2 seconds (1 trip detection logic).	• TP sensor (built into throttle body) • TP sensor circuit • ECM
P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.535 V or higher for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher, and VTA1 is between 0.2 V and 2.02 V for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) is met (1 trip detection logic): (a) The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:

- **When any of these DTCs are output, check the throttle valve opening angle by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.**
- **Throttle Position No.1 is the VTA1 signal, and Throttle Position No.2 is the VTA2 signal.**

Reference (Normal Condition)

Tester Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No.1	0.5 to 1.1 V	3.2 to 4.8 V
Throttle Position No.2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

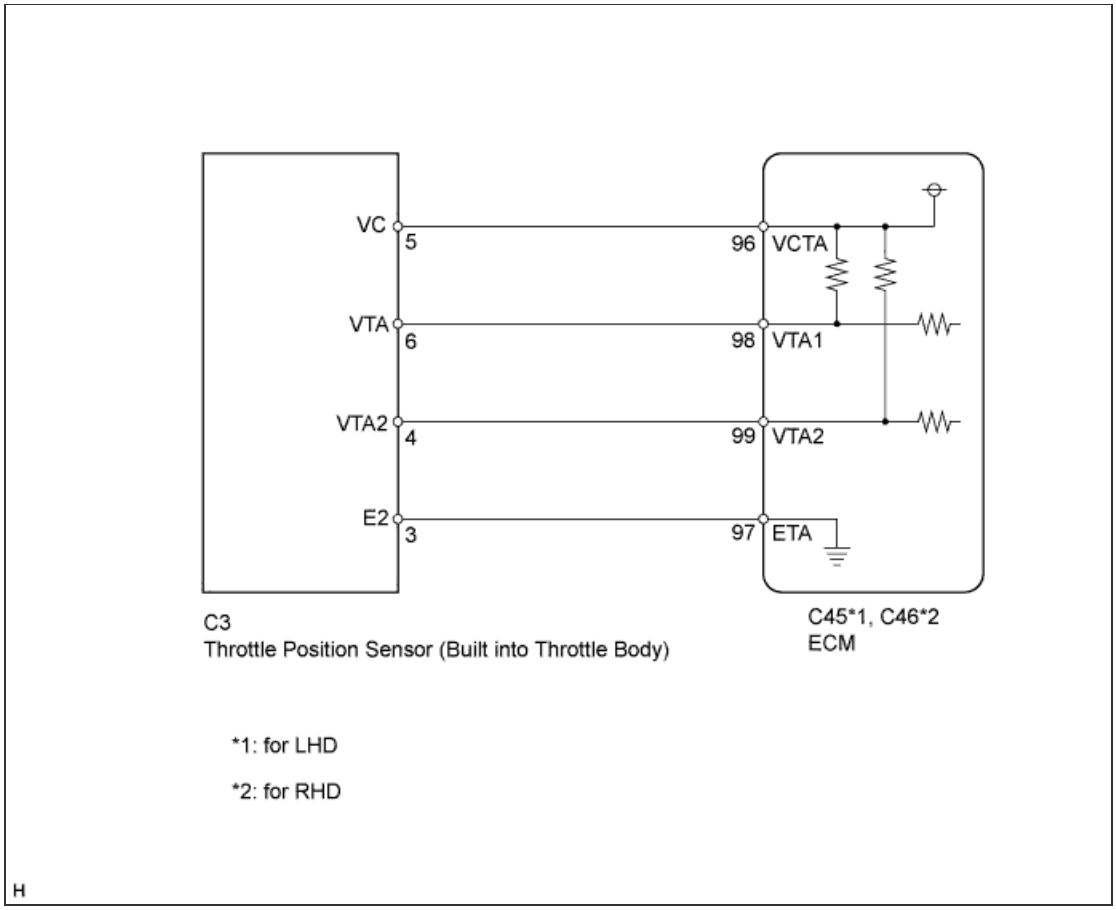
- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.

d. Check the values displayed on the tester.

Result

Throttle Position No.1	Throttle Position No.2	Throttle Position No.1	Throttle Position No.2	Trouble Area Proceed to	
When Accelerator Pedal Released		When Accelerator Pedal Depressed			
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	
0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	VTA1 circuit open or ground short	
0.5 to 1.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.5 to 1.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	
0.5 to 1.1 V	2.1 to 3.1 V	3.2 to 4.8 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

- **DTC P0121 is stored when the voltages output from VTA1 and VTA2 are not consistent with the characteristics of the sensors. Therefore, check the Freeze Frame Data when this DTC is output. Use the following formula to confirm relative fluctuations in voltage.**

Features of sensor output

VTA2 x 0.8 is approximately equal to VTA1 + 1.11 V

VTA1: Throttle Position No. 1

VTA2: Throttle Position No. 2

- **If DTC P0121 is output, proceed to the "CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)".**

B	Go to step 5

A

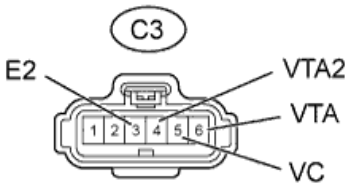
2.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the throttle body connector.

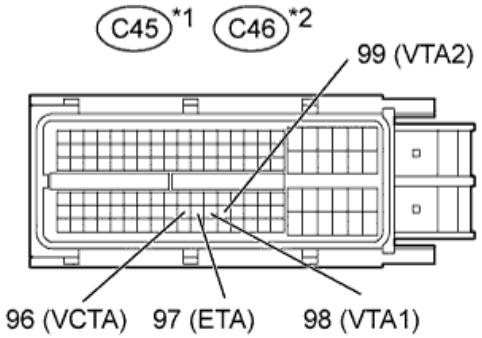
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Throttle Position Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C45-96 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C45-98 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C45-99 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C45-97 (ETA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C46-96 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C46-98 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C46-99 (VTA2)	Always	Below 1 Ω

C3-3 (E2) - C46-97 (ETA)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) or C45-96 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C45-98 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C45-99 (VTA2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) or C46-96 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C46-98 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C46-99 (VTA2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

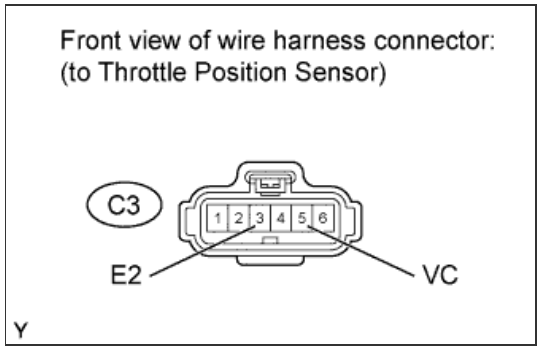
OK

3.INSPECT ECM (VC VOLTAGE)

a. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C3-5 (VC) - C3-3 (E2)	Ignition switch ON	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

4.REPLACE THROTTLE BODY ASSEMBLY

a. Replace the throttle body assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. With the vehicle stationary, fully depress and release the accelerator pedal.

f. Idle the engine for 2 seconds or more.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read the DTCs.

Result

Result	Proceed to
P0120, P0121, P0122, P0123, P0220, P0222, P0223 and/or P2135	A
No output	B

B → SYSTEM OK

A → REPLACE ECM (Click here)

DTC P2102 Throttle Actuator Control Motor Circuit Low

DTC P2103 Throttle Actuator Control Motor Circuit High

for Preparation Click here

DESCRIPTION

The throttle actuator is operated by the ECM and opens and closes the throttle valve using gears.
The opening angle of the throttle valve is detected by the Throttle Position (TP) sensor, which is mounted on the throttle body. The TP sensor provides feedback to the ECM. This feedback allows the ECM to appropriately control the throttle actuator and monitor the throttle opening angle as the ECM responds to driver inputs.

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

DTC Code	DTC Detection Condition	Trouble Area
P2102	Conditions (a) and (b) continue for 2.0 seconds (1 trip detection logic): (a) The throttle actuator duty ratio is 80% or more. (b) The throttle actuator current is 0.5 A or less.	• **Open in throttle actuator circuit** • **Throttle actuator** • **ECM**
P2103	Either of the following conditions is met (1 trip detection logic): • **A hybrid IC diagnosis signal failure.** • **A hybrid IC current limiter port failure.**	• **Short in throttle actuator circuit** • **Throttle actuator** • **Throttle valve** • **Throttle body assembly** • **ECM**

MONITOR DESCRIPTION

The ECM monitors the electrical current through the electronic actuator, and detects malfunctions and open circuits in the throttle actuator based on this value. If the current is outside the standard range, the ECM determines that there is a malfunction in the throttle actuator. In addition, if the throttle valve does not function properly (for example, stuck on), the ECM determines that there is a malfunction. The ECM then illuminates the MIL and stores a DTC.

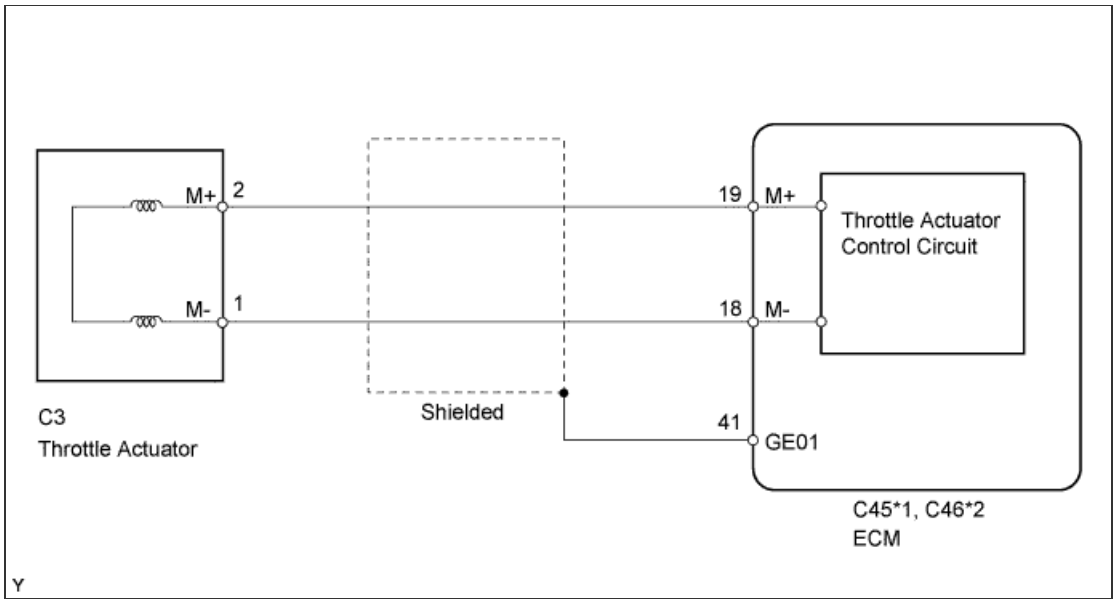
Example:

When the electrical current is 0.5 A or less and the throttle actuator duty ratio is 80% or more, the ECM interprets this as the current being outside the standard range, illuminates the MIL and stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored when the engine is quickly revved to a high rpm several times after the engine has idled for 5 seconds after engine start.

FAIL-SAFE

When either of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue running at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **The throttle actuator current (Throttle Motor Current) and the throttle actuator duty ratio (Throttle Motor Open Duty / Throttle Motor Close Duty) can be read using the intelligent tester. However, the ECM shuts off the throttle actuator current when the ETCS malfunctions.**

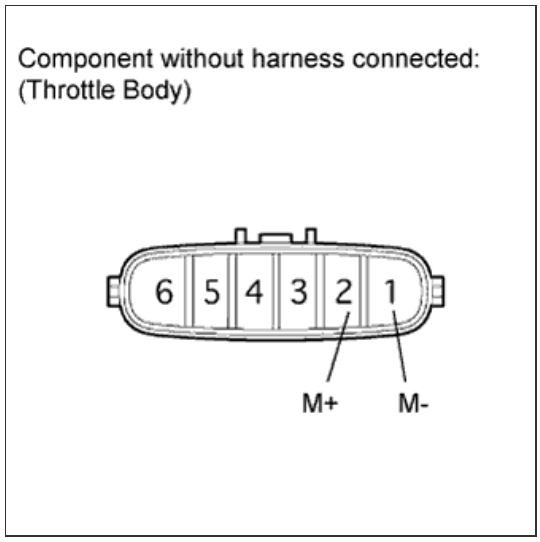
1.INSPECT THROTTLE BODY (RESISTANCE OF THROTTLE ACTUATOR)

a. Disconnect the throttle body connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
2 (M+) - 1 (M-)	20°C (68°F)	0.3 to 100 Ω



NG → REPLACE THROTTLE BODY (Click here)

OK

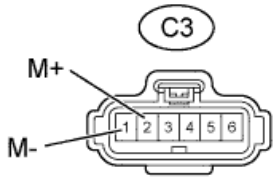
2.CHECK HARNESS AND CONNECTOR (THROTTLE ACTUATOR - ECM)

a. Disconnect the throttle body connector.

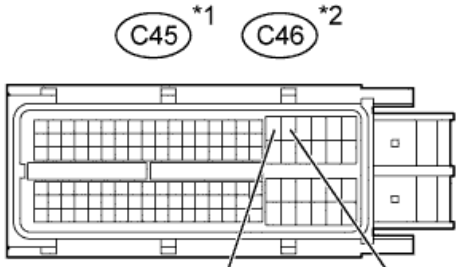
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Throttle Body)



Front view of wire harness connector:
(to ECM)



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C3-2 (M+) - C45-19 (M+)	Always	Below 1 Ω
C3-1 (M-) - C45-18 (M-)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C3-2 (M+) - C46-19 (M+)	Always	Below 1 Ω
C3-1 (M-) - C46-18 (M-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C3-2 (M+) or C45-19 (M+) - Body ground	Always	10 kΩ or higher
C3-1 (M-) or C45-18 (M-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C3-2 (M+) or C46-19 (M+) - Body ground	Always	10 kΩ or higher
C3-1 (M-) or C46-18 (M-) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT THROTTLE BODY (VISUALLY CHECK THROTTLE VALVE)

a. Check for foreign objects between the throttle valve and the housing.

OK:

No foreign objects between the throttle valve and the housing.

NG → REMOVE FOREIGN OBJECT AND CLEAN THROTTLE BODY

OK

4.INSPECT THROTTLE VALVE

a. Check if the throttle valve opens and closes smoothly.

OK:

Throttle valve opens and closes smoothly.

NG → REPLACE THROTTLE BODY (Click here)

OK

REPLACE ECM (Click here)

DTC P0120 Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction

DTC P0121 Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0220 Throttle / Pedal Position Sensor / Switch "B" Circuit

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

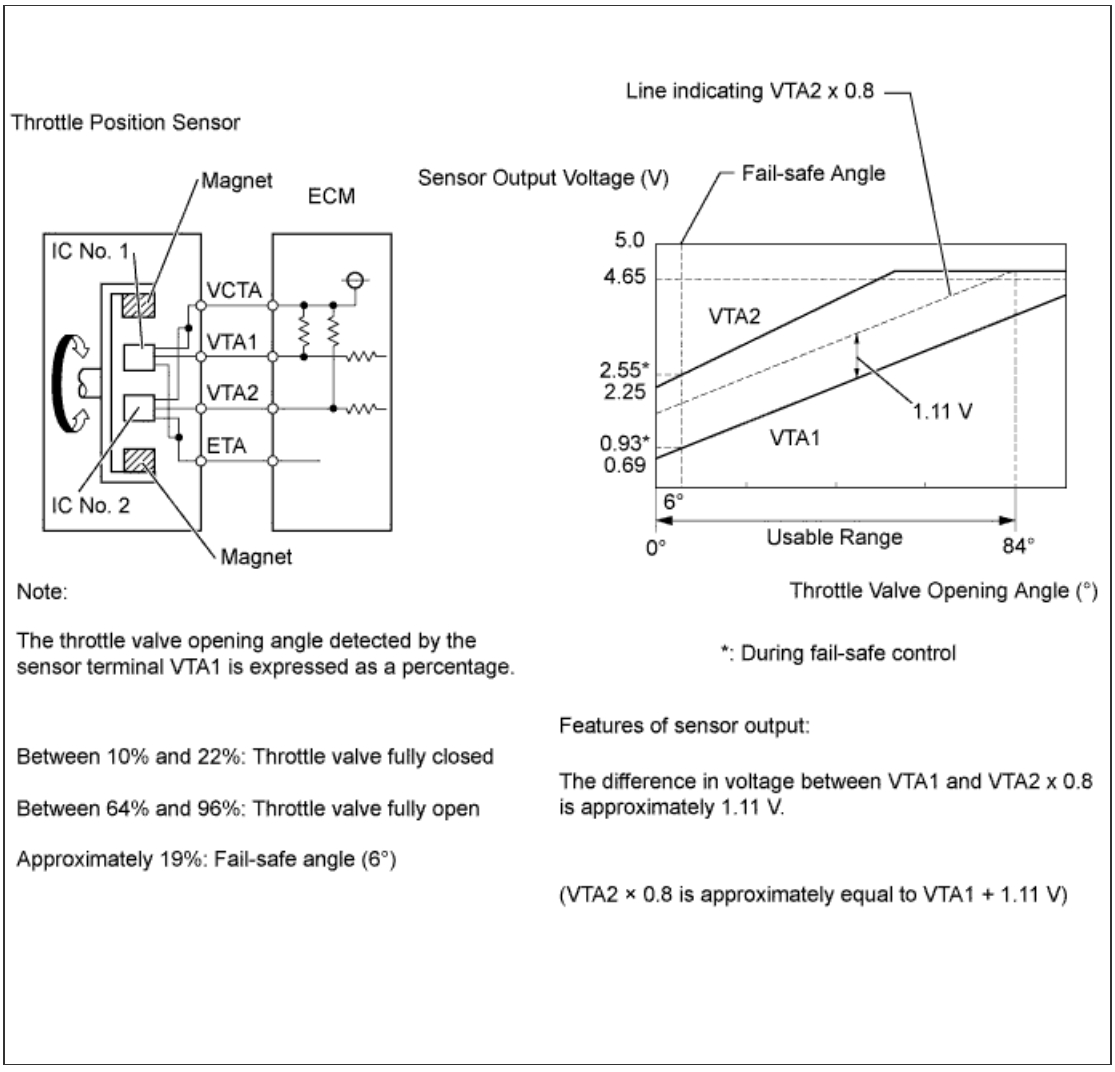
DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

DTC P2135 Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

for Preparation Click here

DESCRIPTION

The TP sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.
The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air fuel ratio correction, power increase correction and fuel-cut control.



DTC Code	DTC Detection Condition	Trouble Area
		• Throttle Position (TP) sensor (built into throttle

P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	body) • ECM
P0121	The difference between the VTA1 and VTA2 voltages is below 0.8 V, or higher than 1.6 V for 2 seconds (1 trip detection logic).	• TP sensor (built into throttle body) • TP sensor circuit • ECM
P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.535 V or higher for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher, and VTA1 is between 0.2 V and 2.02 V for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) is met (1 trip detection logic): (a) The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:

- **When any of these DTCs are output, check the throttle valve opening angle by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.**
- **Throttle Position No.1 is the VTA1 signal, and Throttle Position No.2 is the VTA2 signal.**

Reference (Normal Condition)

Tester Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No.1	0.5 to 1.1 V	3.2 to 4.8 V
Throttle Position No.2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

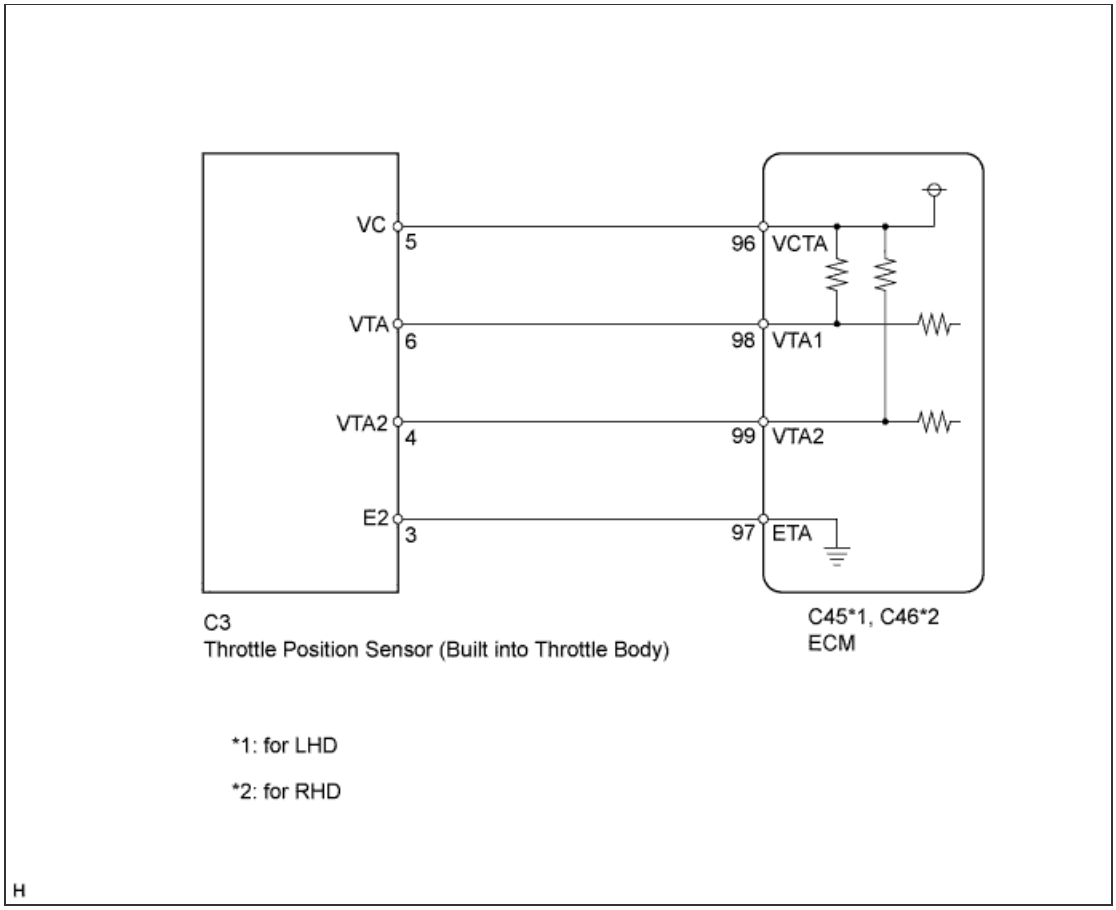
- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.

d. Check the values displayed on the tester.

Result

Throttle Position No.1	Throttle Position No.2	Throttle Position No.1	Throttle Position No.2	Trouble Area Proceed to	
When Accelerator Pedal Released		When Accelerator Pedal Depressed			
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	
0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	VTA1 circuit open or ground short	
0.5 to 1.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.5 to 1.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	
0.5 to 1.1 V	2.1 to 3.1 V	3.2 to 4.8 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

- **DTC P0121 is stored when the voltages output from VTA1 and VTA2 are not consistent with the characteristics of the sensors. Therefore, check the Freeze Frame Data when this DTC is output. Use the following formula to confirm relative fluctuations in voltage.**

Features of sensor output

VTA2 x 0.8 is approximately equal to VTA1 + 1.11 V

VTA1: Throttle Position No. 1

VTA2: Throttle Position No. 2

- **If DTC P0121 is output, proceed to the "CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)".**

B	Go to step 5

A

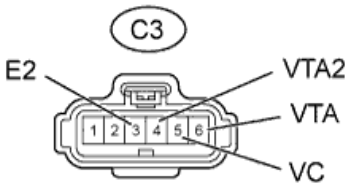
2.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the throttle body connector.

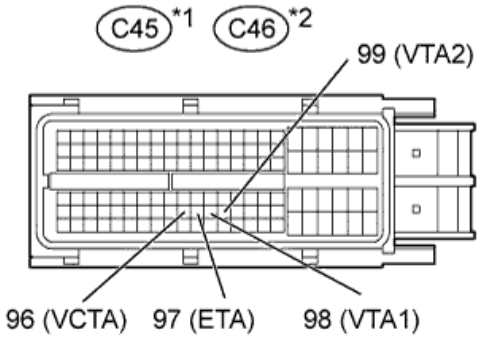
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Throttle Position Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C45-96 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C45-98 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C45-99 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C45-97 (ETA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C46-96 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C46-98 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C46-99 (VTA2)	Always	Below 1 Ω

C3-3 (E2) - C46-97 (ETA)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) or C45-96 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C45-98 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C45-99 (VTA2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) or C46-96 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C46-98 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C46-99 (VTA2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

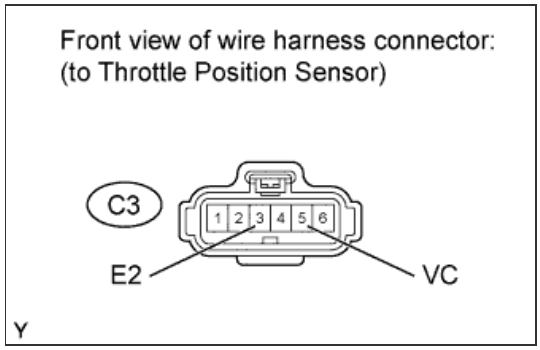
OK

3.INSPECT ECM (VC VOLTAGE)

a. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C3-5 (VC) - C3-3 (E2)	Ignition switch ON	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

4.REPLACE THROTTLE BODY ASSEMBLY

a. Replace the throttle body assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. With the vehicle stationary, fully depress and release the accelerator pedal.

f. Idle the engine for 2 seconds or more.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read the DTCs.

Result

Result	Proceed to
P0120, P0121, P0122, P0123, P0220, P0222, P0223 and/or P2135	A
No output	B

B → SYSTEM OK

A → REPLACE ECM (Click here)

DTC P2111 Throttle Actuator Control System - Stuck Open

DTC P2112 Throttle Actuator Control System - Stuck Closed

for Preparation Click here

SYSTEM DESCRIPTION

The throttle actuator is operated by the ECM, and opens and closes the throttle valve using gears. The opening angle of the throttle valve is detected by the Throttle Position (TP) sensor, which is mounted on the throttle body. The TP sensor provides feedback to the ECM. This feedback allows the ECM to appropriately control the throttle actuator and monitor the throttle opening angle as the ECM responds to driver inputs.

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

DTC Code	DTC Detection Condition	Trouble Area
P2111	The ECM signals the throttle actuator to close, but the valve is stuck (1 trip detection logic).	• **Throttle actuator** • **Throttle body** • **Throttle valve** • **ECM**
P2112	The ECM signals the throttle actuator to open, but the valve is stuck (1 trip detection logic).	• **Throttle actuator** • **Throttle body** • **Throttle valve** • **ECM**

MONITOR DESCRIPTION

The ECM determines that there is a malfunction in the ETCS when the throttle valve remains at a fixed angle despite a high drive current from the ECM. The ECM illuminates the MIL and stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored when the accelerator pedal is fully depressed and released quickly (to fully open and close the throttle valve) after the engine is next started.

FAIL-SAFE

When either of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue running at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM

Refer to DTC P2102 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT THROTTLE BODY (VISUALLY CHECK THROTTLE VALVE)

a. Check for contamination between the throttle valve and the housing. If necessary, clean the throttle body. And check that the throttle valve moves smoothly.

OK:
Throttle valve is not contaminated with foreign objects and moves smoothly.

NG → **REPLACE THROTTLE BODY ASSEMBLY (Click here)**

OK

2.CHECK WHETHER DTC OUTPUT RECURS (DTC P2111 OR P2112)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Start the engine, and fully depress and release the accelerator pedal quickly (to fully open and close the throttle valve).

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read the DTCs.

Result

Result	Proceed to
No DTC output	A
P2111 or P2112 is output	B

B → REPLACE ECM (Click here)

A → CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0120 Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction

DTC P0121 Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0220 Throttle / Pedal Position Sensor / Switch "B" Circuit

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

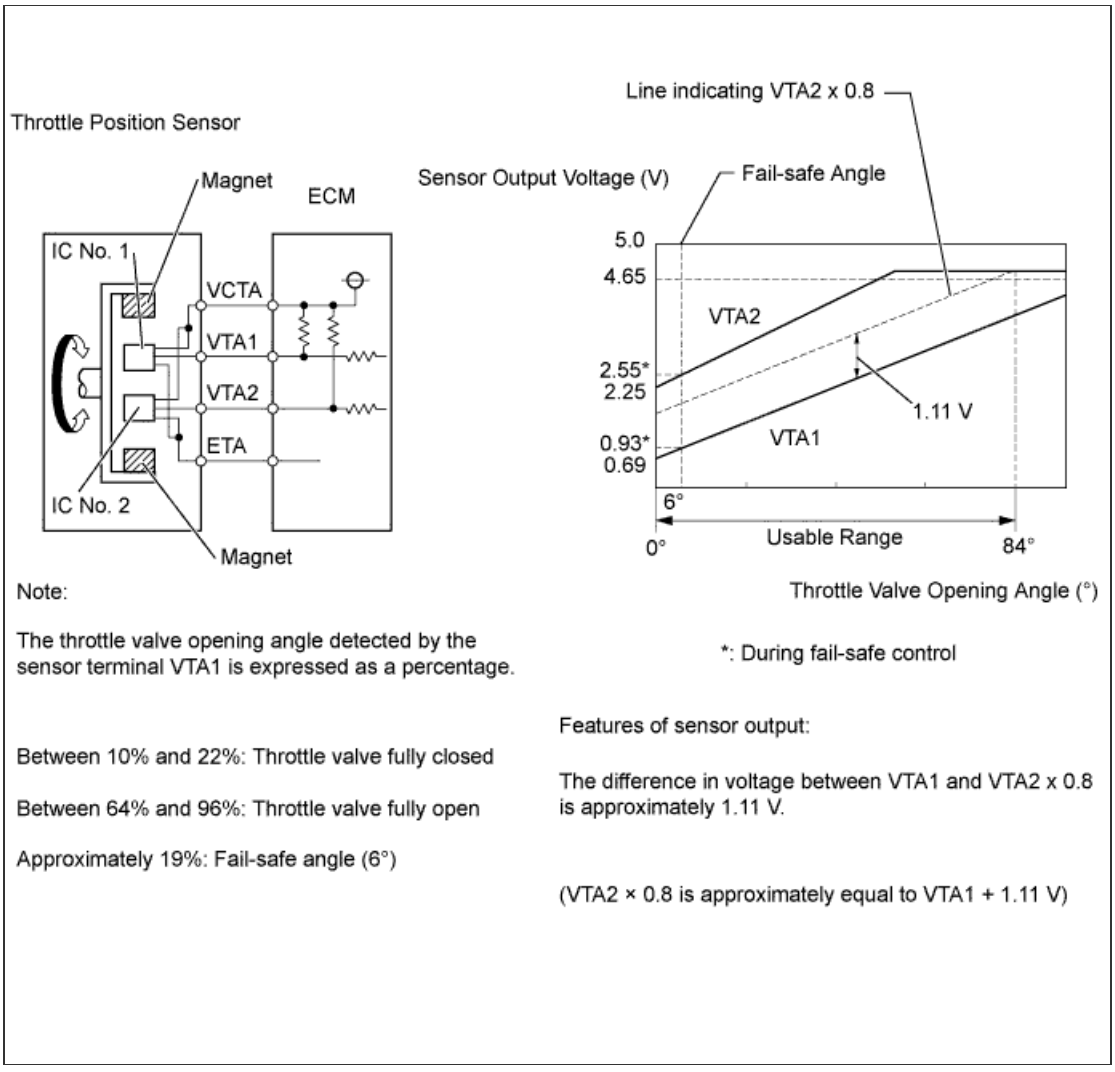
DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

DTC P2135 Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

for Preparation Click here

DESCRIPTION

The TP sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.
The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air fuel ratio correction, power increase correction and fuel-cut control.



DTC Code	DTC Detection Condition	Trouble Area
		• Throttle Position (TP) sensor (built into throttle

P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	body) • ECM
P0121	The difference between the VTA1 and VTA2 voltages is below 0.8 V, or higher than 1.6 V for 2 seconds (1 trip detection logic).	• TP sensor (built into throttle body) • TP sensor circuit • ECM
P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.535 V or higher for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher, and VTA1 is between 0.2 V and 2.02 V for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) is met (1 trip detection logic): (a) The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:

- **When any of these DTCs are output, check the throttle valve opening angle by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.**
- **Throttle Position No.1 is the VTA1 signal, and Throttle Position No.2 is the VTA2 signal.**

Reference (Normal Condition)

Tester Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No.1	0.5 to 1.1 V	3.2 to 4.8 V
Throttle Position No.2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

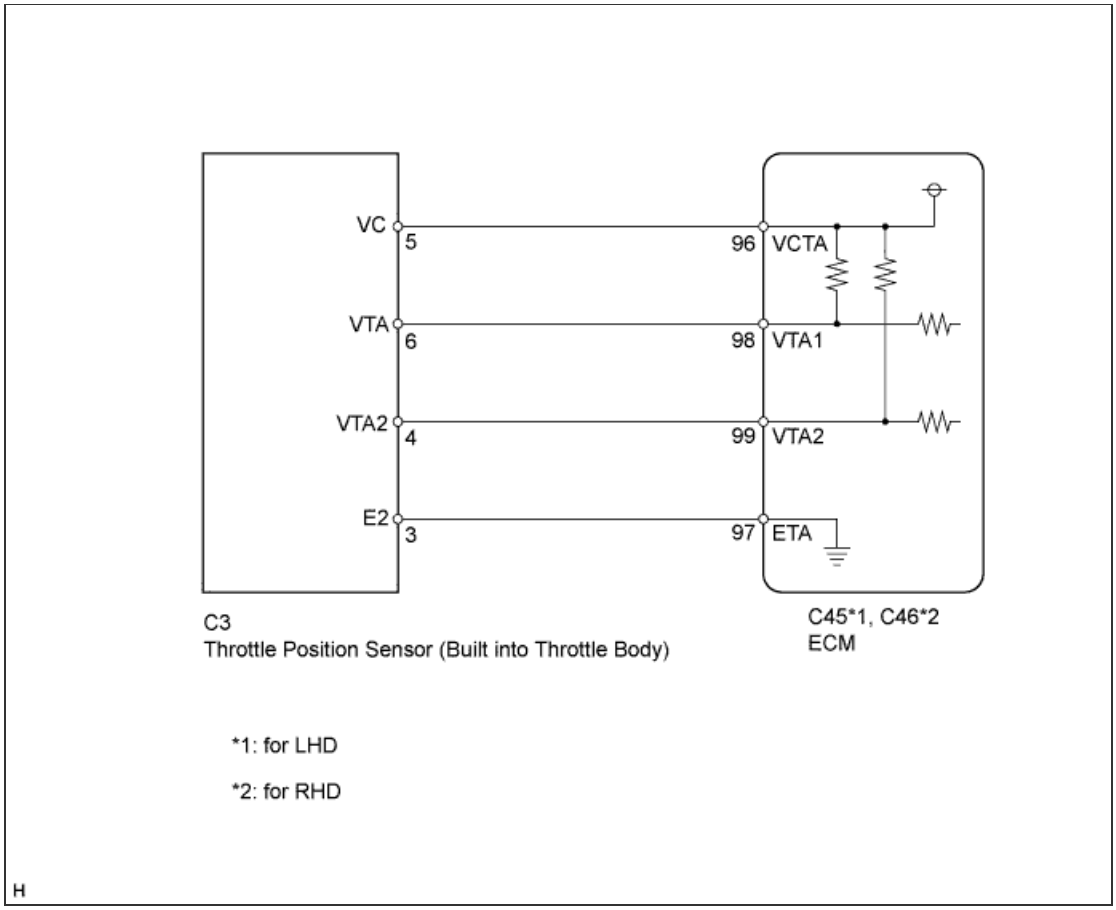
- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.

d. Check the values displayed on the tester.

Result

Throttle Position No.1	Throttle Position No.2	Throttle Position No.1	Throttle Position No.2	Trouble Area Proceed to	
When Accelerator Pedal Released		When Accelerator Pedal Depressed			
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	
0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	VTA1 circuit open or ground short	
0.5 to 1.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.5 to 1.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	
0.5 to 1.1 V	2.1 to 3.1 V	3.2 to 4.8 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

- **DTC P0121 is stored when the voltages output from VTA1 and VTA2 are not consistent with the characteristics of the sensors. Therefore, check the Freeze Frame Data when this DTC is output. Use the following formula to confirm relative fluctuations in voltage.**

Features of sensor output

VTA2 x 0.8 is approximately equal to VTA1 + 1.11 V

VTA1: Throttle Position No. 1

VTA2: Throttle Position No. 2

- **If DTC P0121 is output, proceed to the "CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)".**

B	Go to step 5

A

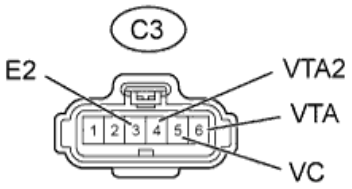
2.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the throttle body connector.

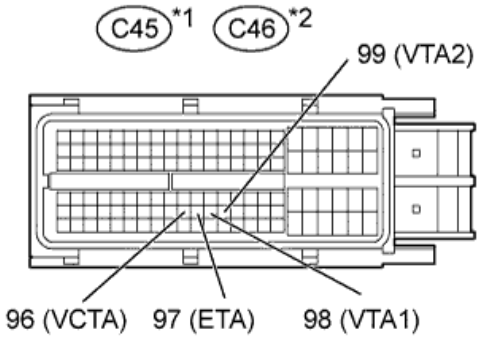
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Throttle Position Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C45-96 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C45-98 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C45-99 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C45-97 (ETA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C46-96 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C46-98 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C46-99 (VTA2)	Always	Below 1 Ω

C3-3 (E2) - C46-97 (ETA)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) or C45-96 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C45-98 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C45-99 (VTA2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) or C46-96 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C46-98 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C46-99 (VTA2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

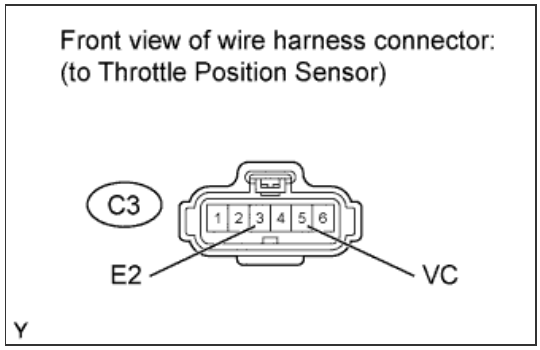
OK

3.INSPECT ECM (VC VOLTAGE)

a. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C3-5 (VC) - C3-3 (E2)	Ignition switch ON	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

4.REPLACE THROTTLE BODY ASSEMBLY

a. Replace the throttle body assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. With the vehicle stationary, fully depress and release the accelerator pedal.

f. Idle the engine for 2 seconds or more.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read the DTCs.

Result

Result	Proceed to
P0120, P0121, P0122, P0123, P0220, P0222, P0223 and/or P2135	A
No output	B

B → SYSTEM OK

A → REPLACE ECM (Click here)

DTC P2111 Throttle Actuator Control System - Stuck Open

DTC P2112 Throttle Actuator Control System - Stuck Closed

for Preparation Click here

SYSTEM DESCRIPTION

The throttle actuator is operated by the ECM, and opens and closes the throttle valve using gears. The opening angle of the throttle valve is detected by the Throttle Position (TP) sensor, which is mounted on the throttle body. The TP sensor provides feedback to the ECM. This feedback allows the ECM to appropriately control the throttle actuator and monitor the throttle opening angle as the ECM responds to driver inputs.

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

DTC Code	DTC Detection Condition	Trouble Area
P2111	The ECM signals the throttle actuator to close, but the valve is stuck (1 trip detection logic).	• **Throttle actuator** • **Throttle body** • **Throttle valve** • **ECM**
P2112	The ECM signals the throttle actuator to open, but the valve is stuck (1 trip detection logic).	• **Throttle actuator** • **Throttle body** • **Throttle valve** • **ECM**

MONITOR DESCRIPTION

The ECM determines that there is a malfunction in the ETCS when the throttle valve remains at a fixed angle despite a high drive current from the ECM. The ECM illuminates the MIL and stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored when the accelerator pedal is fully depressed and released quickly (to fully open and close the throttle valve) after the engine is next started.

FAIL-SAFE

When either of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue running at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM

Refer to DTC P2102 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT THROTTLE BODY (VISUALLY CHECK THROTTLE VALVE)

a. Check for contamination between the throttle valve and the housing. If necessary, clean the throttle body. And check that the throttle valve moves smoothly.

OK:
Throttle valve is not contaminated with foreign objects and moves smoothly.

NG → **REPLACE THROTTLE BODY ASSEMBLY (Click here)**

OK

2.CHECK WHETHER DTC OUTPUT RECURS (DTC P2111 OR P2112)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Start the engine, and fully depress and release the accelerator pedal quickly (to fully open and close the throttle valve).

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read the DTCs.

Result

Result	Proceed to
No DTC output	A
P2111 or P2112 is output	B

B → REPLACE ECM (Click here)

A → CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0120 Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction

DTC P0121 Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0220 Throttle / Pedal Position Sensor / Switch "B" Circuit

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

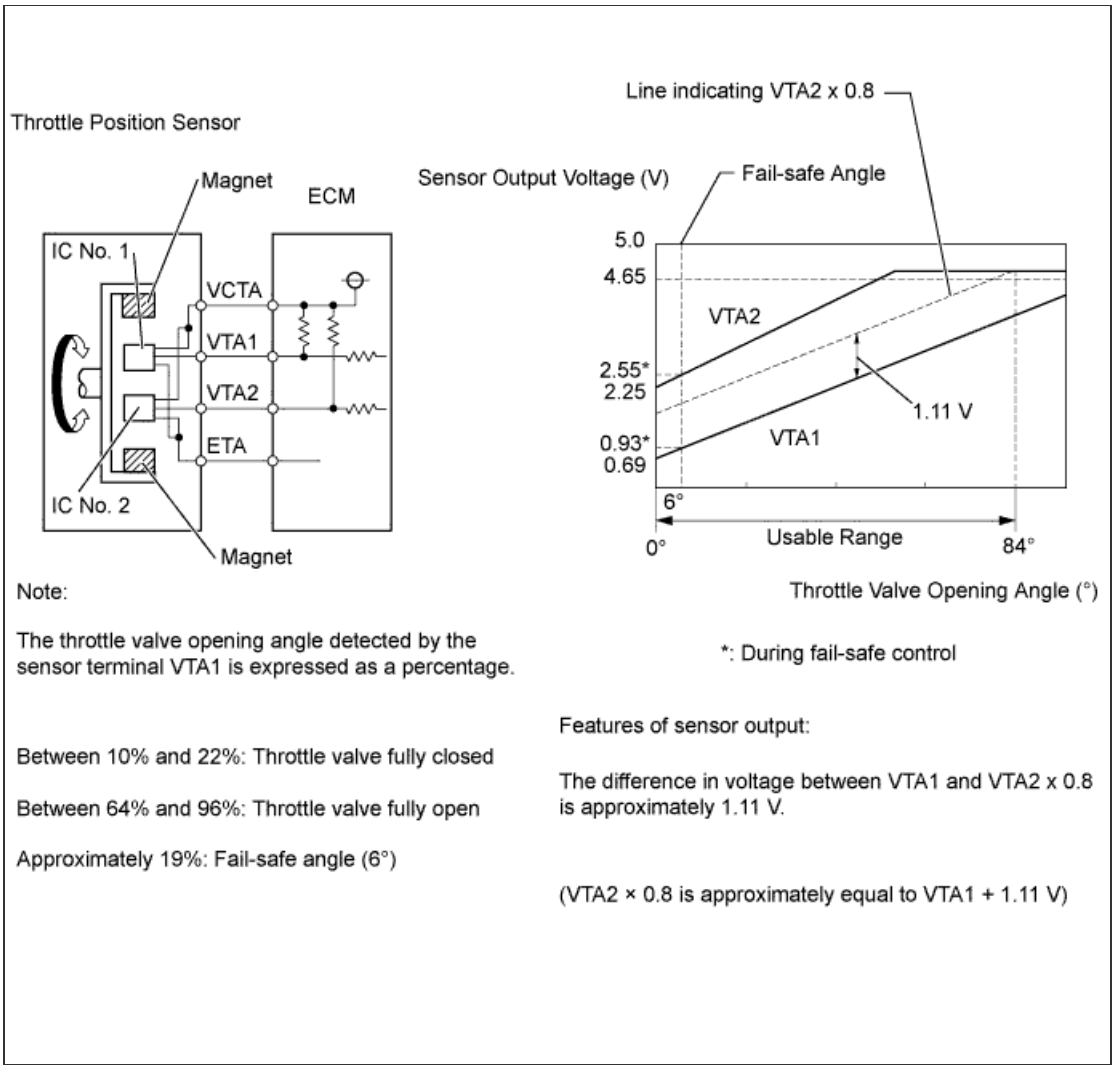
DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

DTC P2135 Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

for Preparation Click here

DESCRIPTION

The TP sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.
The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air fuel ratio correction, power increase correction and fuel-cut control.



DTC Code	DTC Detection Condition	Trouble Area
		• Throttle Position (TP) sensor (built into throttle

P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	body) • ECM
P0121	The difference between the VTA1 and VTA2 voltages is below 0.8 V, or higher than 1.6 V for 2 seconds (1 trip detection logic).	• TP sensor (built into throttle body) • TP sensor circuit • ECM
P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.535 V or higher for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher, and VTA1 is between 0.2 V and 2.02 V for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) is met (1 trip detection logic): (a) The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:

- **When any of these DTCs are output, check the throttle valve opening angle by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.**
- **Throttle Position No.1 is the VTA1 signal, and Throttle Position No.2 is the VTA2 signal.**

Reference (Normal Condition)

Tester Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No.1	0.5 to 1.1 V	3.2 to 4.8 V
Throttle Position No.2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

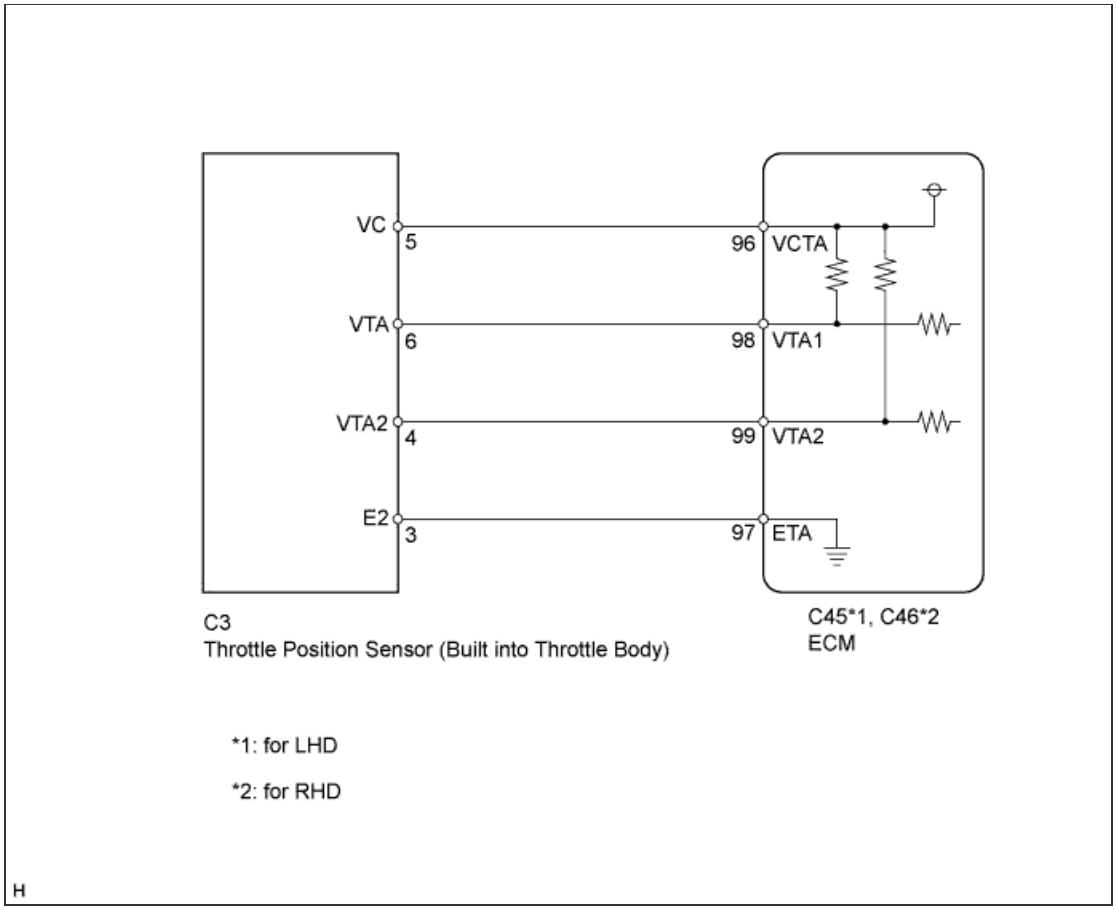
- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.

d. Check the values displayed on the tester.

Result

Throttle Position No.1	Throttle Position No.2	Throttle Position No.1	Throttle Position No.2	Trouble Area Proceed to	
When Accelerator Pedal Released		When Accelerator Pedal Depressed			
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	
0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	VTA1 circuit open or ground short	
0.5 to 1.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.5 to 1.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	
0.5 to 1.1 V	2.1 to 3.1 V	3.2 to 4.8 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

- **DTC P0121 is stored when the voltages output from VTA1 and VTA2 are not consistent with the characteristics of the sensors. Therefore, check the Freeze Frame Data when this DTC is output. Use the following formula to confirm relative fluctuations in voltage.**

Features of sensor output

VTA2 x 0.8 is approximately equal to VTA1 + 1.11 V

VTA1: Throttle Position No. 1

VTA2: Throttle Position No. 2

- **If DTC P0121 is output, proceed to the "CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)".**

B	Go to step 5

A

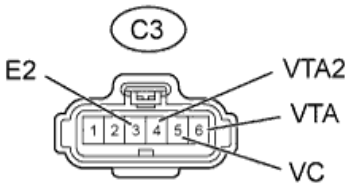
2.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the throttle body connector.

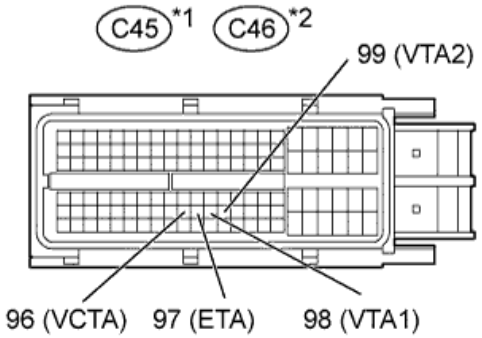
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Throttle Position Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C45-96 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C45-98 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C45-99 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C45-97 (ETA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C46-96 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C46-98 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C46-99 (VTA2)	Always	Below 1 Ω

C3-3 (E2) - C46-97 (ETA)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) or C45-96 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C45-98 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C45-99 (VTA2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) or C46-96 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C46-98 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C46-99 (VTA2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

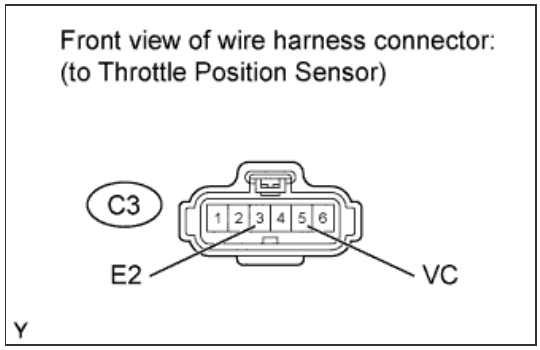
OK

3.INSPECT ECM (VC VOLTAGE)

a. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C3-5 (VC) - C3-3 (E2)	Ignition switch ON	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

4.REPLACE THROTTLE BODY ASSEMBLY

a. Replace the throttle body assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. With the vehicle stationary, fully depress and release the accelerator pedal.

f. Idle the engine for 2 seconds or more.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read the DTCs.

Result

Result	Proceed to
P0120, P0121, P0122, P0123, P0220, P0222, P0223 and/or P2135	A
No output	B

B → SYSTEM OK

A → REPLACE ECM (Click here)

DTC P2118 Throttle Actuator Control Motor Current Range / Performance

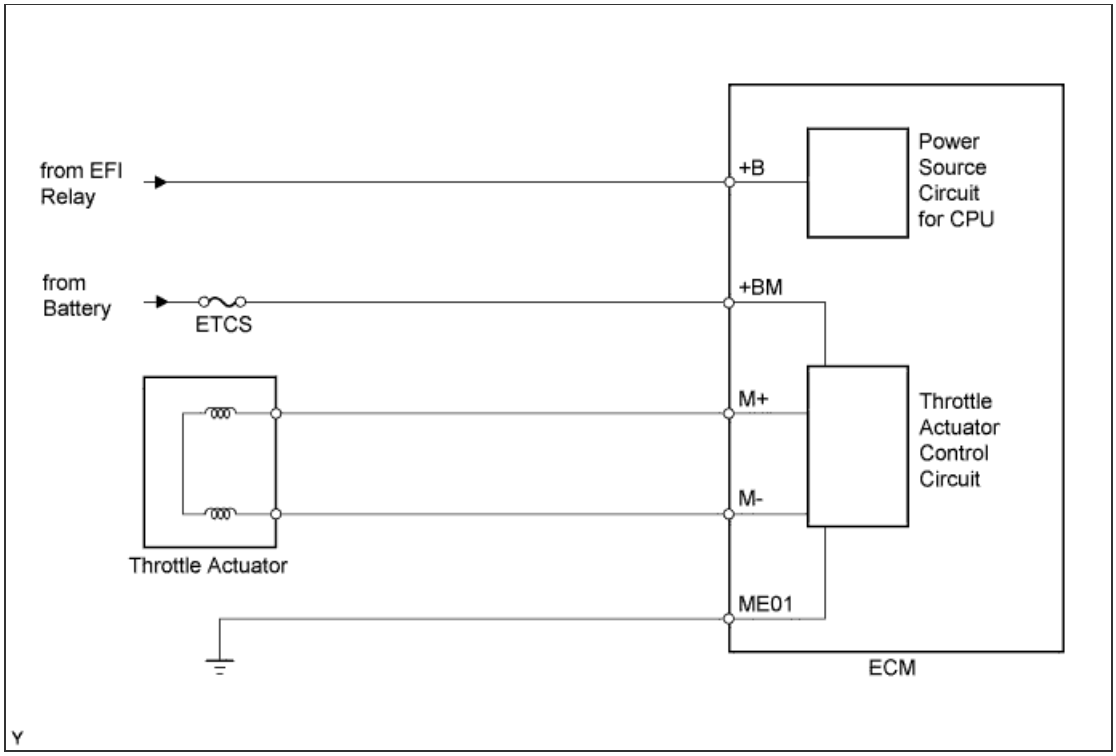
for Preparation Click here

DESCRIPTION

The ETCS (Electronic Throttle Control System) has a dedicated power supply circuit. The voltage (+BM) is monitored and when it is low (below 4 V), the ECM determines that there is a malfunction in the ETCS and cuts off the current to the throttle actuator.
When the voltage becomes unstable, the ETCS itself becomes unstable. For this reason, when the voltage is low, the current to the throttle actuator is cut. If repairs are made and the system returns to normal, turn the ignition switch off. The ECM then allows the current to flow to the throttle actuator so that it can be restarted.

HINT:

The ETCS does not use a throttle cable.



DTC Code	DTC Detection Condition	Trouble Area
P2118	An open in the ETCS power source (+BM) circuit (1 trip detection logic).	• Open in ETCS power source circuit • Battery • Battery terminals • ETCS fuse • ECM

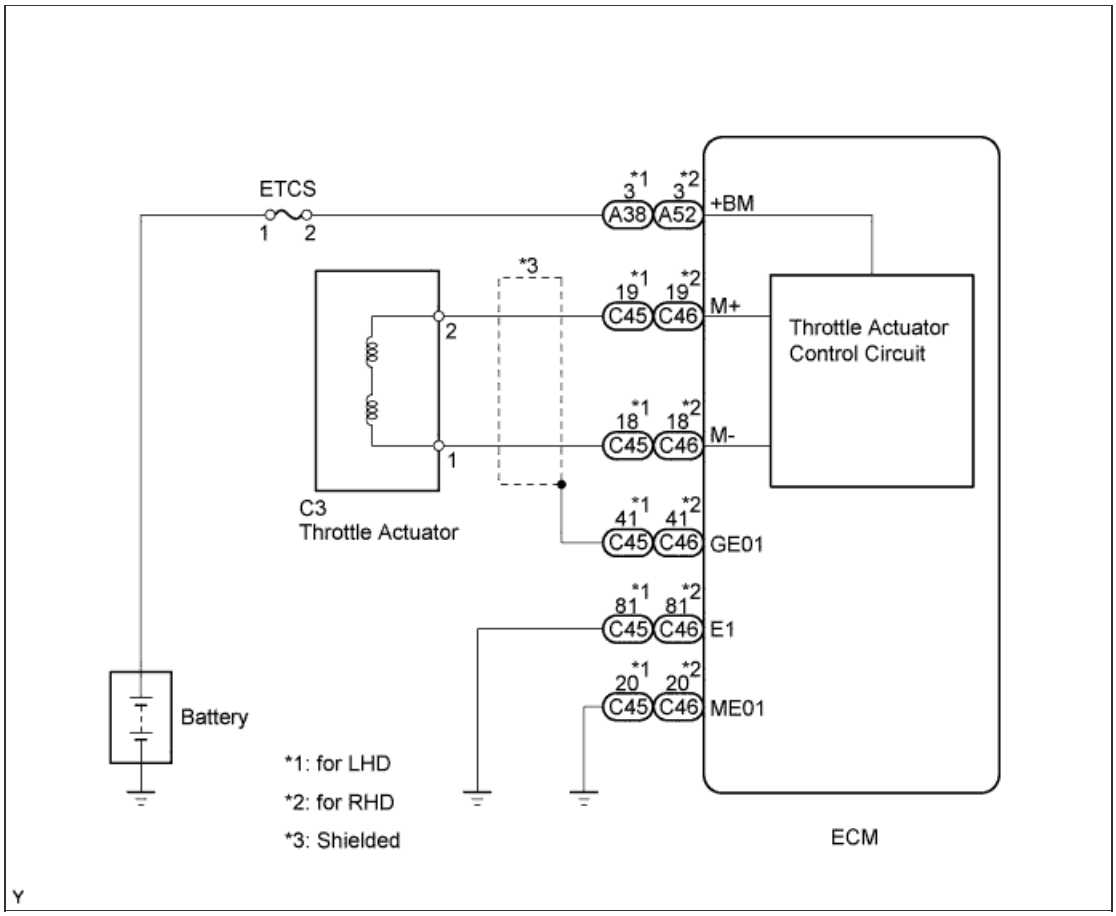
MONITOR DESCRIPTION

The ECM monitors the battery supply voltage applied to the throttle actuator.
When the power supply voltage (+BM) drops below 4 V for 0.8 seconds or more, the ECM interprets this as an open in the power supply circuit (+BM). The ECM illuminates the MIL and stores the DTC.
If the malfunction is not repaired successfully, the DTC is stored 5 seconds after the engine is next started.

FAIL-SAFE

When this DTC, or other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (+BM VOLTAGE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / +BM Voltage.

e. Read the value displayed on the tester.

Standard Voltage:
11 to 14 V

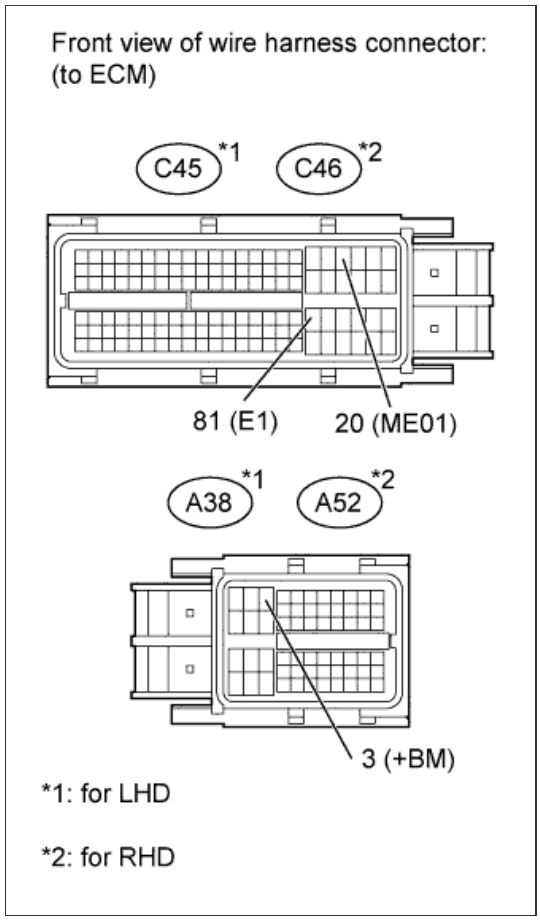
NG → CHECK FOR INTERMITTENT PROBLEMS (Click here)

OK

2.CHECK HARNESS AND CONNECTOR (ECM - BATTERY, BODY GROUND)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for LHD

Tester Connection	Condition	Specified Condition
A38-3 (+BM) - Body ground	Always	11 to 14 V

for RHD

Tester Connection	Condition	Specified Condition
A52-3 (+BM) - Body ground	Always	11 to 14 V

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

for LHD

Tester Connection	Condition	Specified Condition
C45-20 (ME01) - Body ground	Always	Below 1 Ω
C45-81 (E1) - Body ground	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C46-20 (ME01) - Body ground	Always	Below 1 Ω
C46-81 (E1) - Body ground	Always	Below 1 Ω

NG → REPLACE ECM (Click here)

OK → REPAIR OR REPLACE HARNESS OR CONNECTOR

DTC P0120 Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction

DTC P0121 Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0220 Throttle / Pedal Position Sensor / Switch "B" Circuit

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

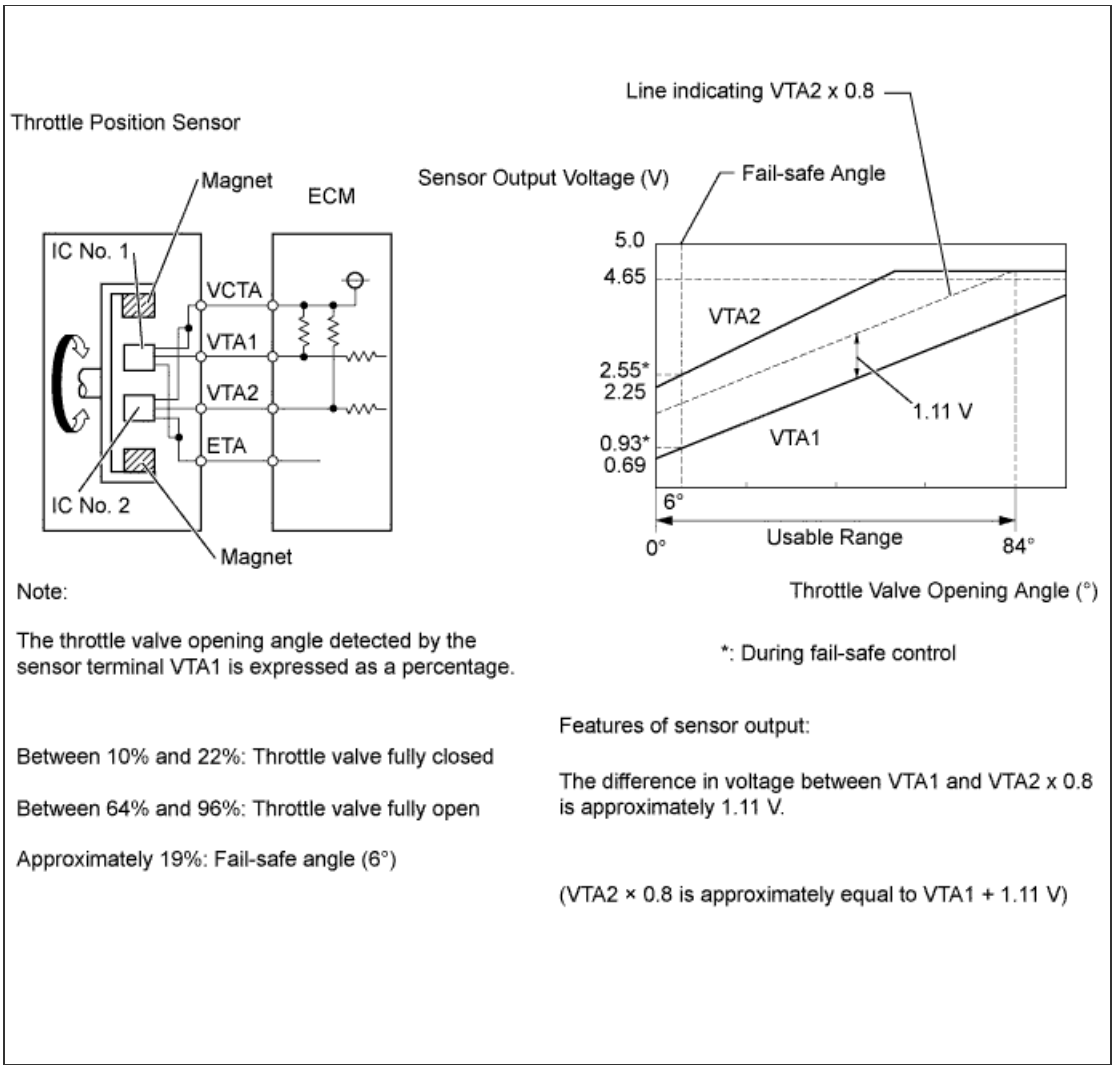
DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

DTC P2135 Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

for Preparation Click here

DESCRIPTION

The TP sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.
The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air fuel ratio correction, power increase correction and fuel-cut control.



DTC Code	DTC Detection Condition	Trouble Area
		• Throttle Position (TP) sensor (built into throttle

P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	body) • ECM
P0121	The difference between the VTA1 and VTA2 voltages is below 0.8 V, or higher than 1.6 V for 2 seconds (1 trip detection logic).	• TP sensor (built into throttle body) • TP sensor circuit • ECM
P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.535 V or higher for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher, and VTA1 is between 0.2 V and 2.02 V for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) is met (1 trip detection logic): (a) The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:

- **When any of these DTCs are output, check the throttle valve opening angle by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.**
- **Throttle Position No.1 is the VTA1 signal, and Throttle Position No.2 is the VTA2 signal.**

Reference (Normal Condition)

Tester Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No.1	0.5 to 1.1 V	3.2 to 4.8 V
Throttle Position No.2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

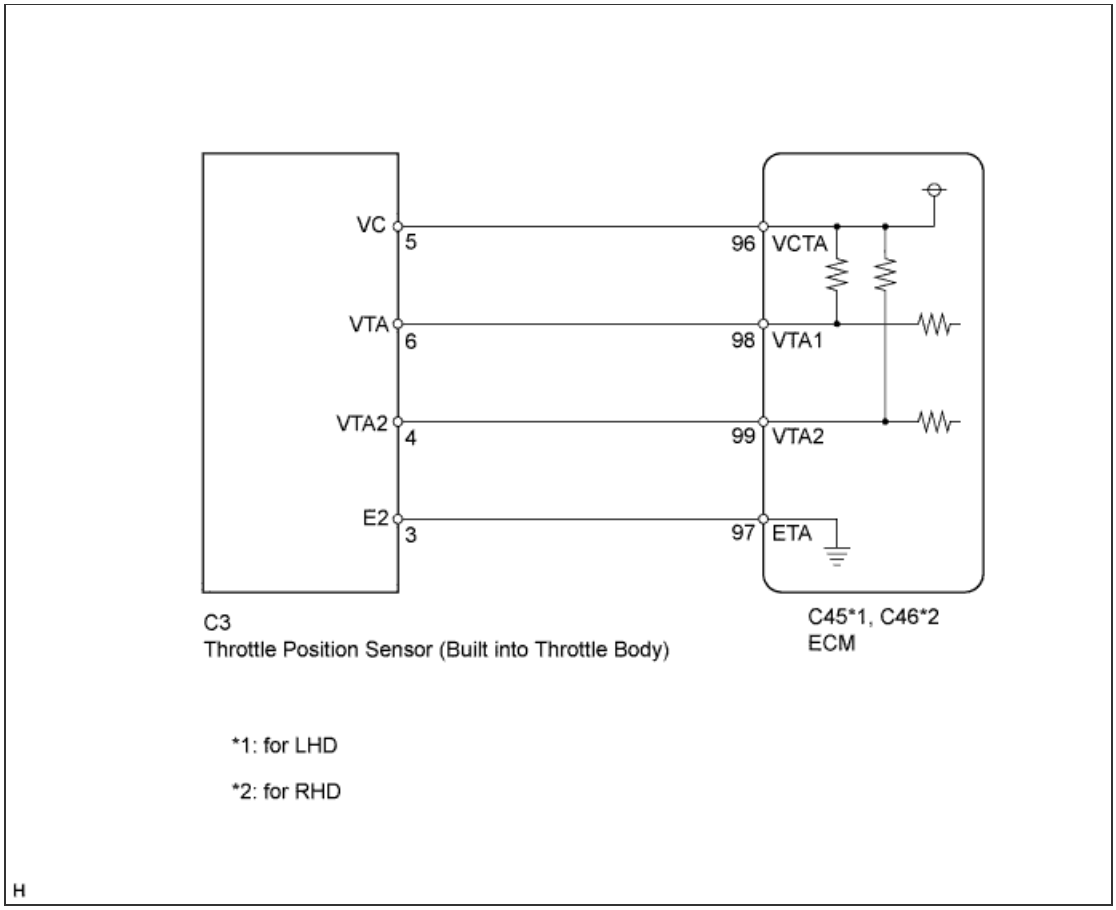
- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.

d. Check the values displayed on the tester.

Result

Throttle Position No.1	Throttle Position No.2	Throttle Position No.1	Throttle Position No.2	Trouble Area Proceed to	
When Accelerator Pedal Released		When Accelerator Pedal Depressed			
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	
0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	VTA1 circuit open or ground short	
0.5 to 1.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.5 to 1.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	
0.5 to 1.1 V	2.1 to 3.1 V	3.2 to 4.8 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

- **DTC P0121 is stored when the voltages output from VTA1 and VTA2 are not consistent with the characteristics of the sensors. Therefore, check the Freeze Frame Data when this DTC is output. Use the following formula to confirm relative fluctuations in voltage.**

Features of sensor output

VTA2 x 0.8 is approximately equal to VTA1 + 1.11 V

VTA1: Throttle Position No. 1

VTA2: Throttle Position No. 2

- **If DTC P0121 is output, proceed to the "CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)".**

B	Go to step 5

A

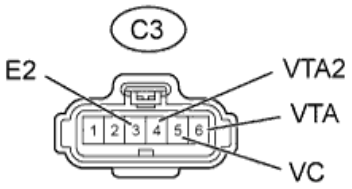
2.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the throttle body connector.

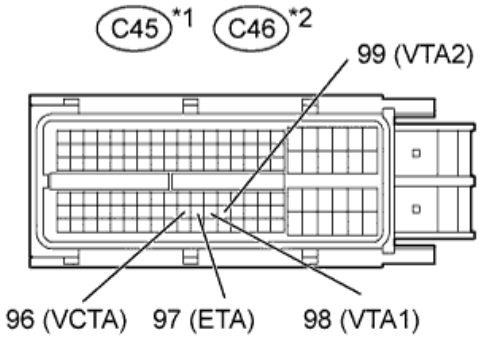
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Throttle Position Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C45-96 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C45-98 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C45-99 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C45-97 (ETA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C46-96 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C46-98 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C46-99 (VTA2)	Always	Below 1 Ω

C3-3 (E2) - C46-97 (ETA)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) or C45-96 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C45-98 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C45-99 (VTA2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C3-5 (VC) or C46-96 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C46-98 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C46-99 (VTA2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

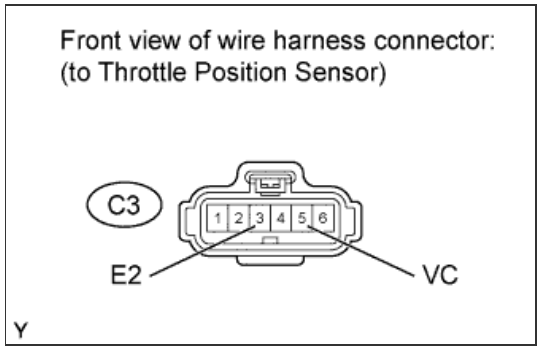
OK

3.INSPECT ECM (VC VOLTAGE)

a. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C3-5 (VC) - C3-3 (E2)	Ignition switch ON	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

4.REPLACE THROTTLE BODY ASSEMBLY

a. Replace the throttle body assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. With the vehicle stationary, fully depress and release the accelerator pedal.

f. Idle the engine for 2 seconds or more.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read the DTCs.

Result

Result	Proceed to
P0120, P0121, P0122, P0123, P0220, P0222, P0223 and/or P2135	A
No output	B

B → SYSTEM OK

A → REPLACE ECM (Click here)

DTC P2119 Throttle Actuator Control Throttle Body Range / Performance

for Preparation Click here

SYSTEM DESCRIPTION

The Electronic Throttle Control System (ETCS) is composed of the throttle actuator, Throttle Position (TP) sensor, Accelerator Pedal Position (APP) sensor, and ECM. The ECM operates the throttle actuator to regulate the throttle valve in response to driver inputs. The TP sensor detects the opening angle of the throttle valve, and provides the ECM with feedback so that the throttle valve can be appropriately controlled by the ECM.

DTC Code	DTC Detection Condition	Trouble Area
P2119	The throttle valve opening angle continues to vary greatly from the target opening angle. (1 trip detection logic)	• Electronic Throttle Control System (ETCS) • ECM

MONITOR DESCRIPTION

The ECM determines the actual opening angle of the throttle valve from the TP sensor signal. The actual opening angle is compared to the target opening angle commanded by the ECM. If the difference between these two values is outside the standard range, the ECM interprets this as a malfunction in the ETCS. The ECM then illuminates the MIL and stores the DTC.
If the malfunction is not repaired successfully, the DTC is stored when the accelerator pedal is quickly released (to close the throttle valve) after the engine speed reaches 5000 rpm by fully depressing the accelerator pedal (fully open the throttle valve).

FAIL-SAFE

When this DTC, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue running at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM

Refer to DTC P2102 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2119)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read the DTCs.

Result

Result	Proceed to
P2119	A
P2119 and other DTCs	B

HINT:

If any DTCs other than P2119 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.INSPECT THROTTLE BODY ASSEMBLY (RESISTANCE OF THROTTLE ACTUATOR)

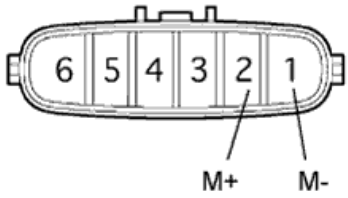
a. Disconnect the throttle body connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
2 (M+) - 1 (M-)	20°C (68°F)	0.3 to 100 Ω

Component without harness connected:
(Throttle Body)



NG → REPLACE THROTTLE BODY ASSEMBLY (Click here)

OK

3.REPLACE ECM

a. Replace the ECM (Click here).

NEXT

4.CHECK WHETHER DTC OUTPUT RECURS (DTC P2119)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Allow the engine to idle for 15 seconds.

CAUTION:

Exercise extreme care and take precautions at procedure "A" and "B" below. Failure to do so may result in the vehicle unexpectedly rolling away.

f. Securely apply the parking brake and move the shift lever to D (procedure "A").

g. While depressing the brake pedal securely, fully depress the accelerator pedal for 5 seconds (procedure "B").

h. Enter the following menus: Powertrain / Engine and ECT / DTC.

i. Read the DTCs.

OK:
No DTC output.

HINT:

The output voltage of the throttle position sensor can be checked during procedure "B" using the intelligent tester. Variations in the output voltage indicate that the throttle actuator is in operation. To check the output voltage using the intelligent tester, enter the following menus: Powertrain / Engine and ECT /Data List / ETCS / Throttle Position No.1.

NG → REPLACE THROTTLE BODY ASSEMBLY (Click here)

OK

END

DTC P0136 Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)

DTC P0137 Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)

DTC P0138 Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)

DTC P0156 Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)

DTC P0157 Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)

DTC P0158 Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)

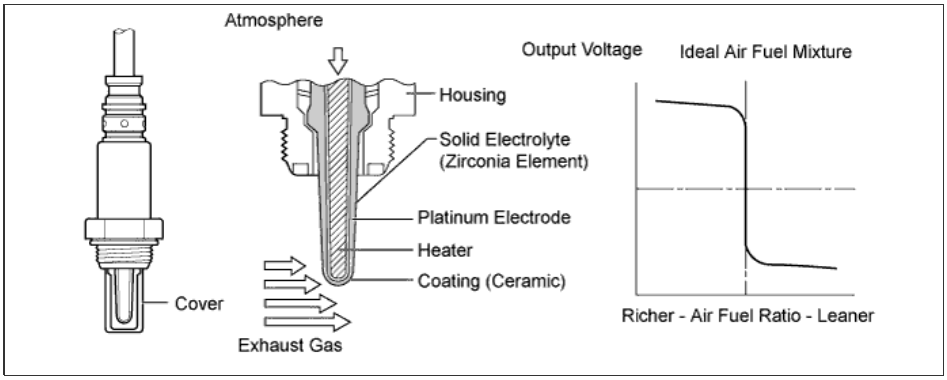
for Preparation Click here

DESCRIPTION

HINT:

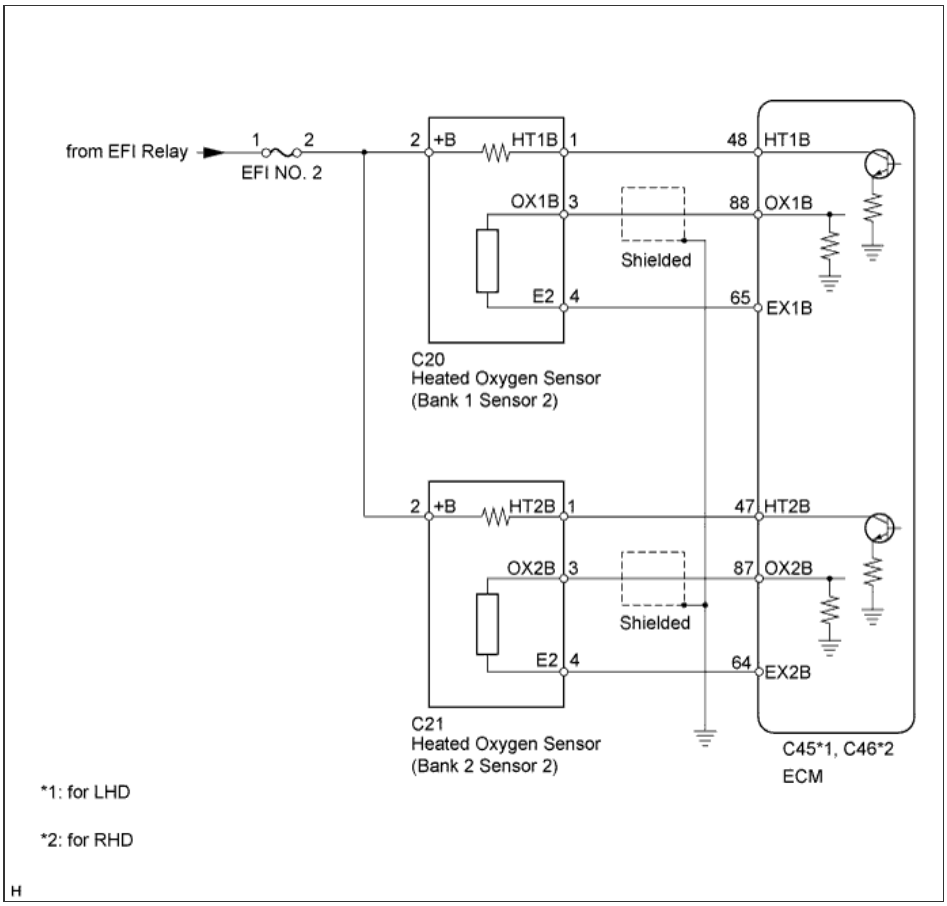
Sensor 2 refers to the sensor mounted behind the three-way catalytic converter and located far from the engine assembly.

A three-way catalyst converter is used in order to convert the carbon monoxide, hydrocarbons, and nitrogen oxide, into less harmful substances. To allow the three-way catalytic converter to function effectively, it is necessary to keep the air fuel ratio of the engine near the stoichiometric air fuel ratio. For the purpose of helping the ECM to deliver accurate air fuel ratio control, a heated oxygen sensor is used.
The heated oxygen sensor is located behind the three-way catalytic converter, and detects the oxygen concentration in the exhaust gas. Since the sensor is integrated with the heater that heats the sensing portion, it is possible to detect the oxygen concentration even when the intake air volume is low (the exhaust gas temperature is low).
When the air fuel ratio becomes lean, the oxygen concentration in the exhaust gas is rich. The heated oxygen sensor informs the ECM that the post-three way catalytic converter air fuel ratio is lean (low voltage, i.e. below 0.45 V).
Conversely, when the air fuel ratio is richer than the stoichiometric air fuel level, the oxygen concentration in the exhaust gas becomes lean. The heated oxygen sensor informs the ECM that the post-three way catalytic converter air fuel ratio is rich (high voltage, i.e. higher than 0.45 V). The heated oxygen sensor has the property of changing its output voltage drastically when the air fuel ratio is close to the stoichiometric level.
The ECM uses the supplementary information from the heated oxygen sensor to determine whether the air fuel ratio after the three-way catalytic converter is rich or lean, and adjusts the fuel injection time accordingly. Thus, if the heated oxygen sensor is working improperly due to internal malfunctions, the ECM is unable to compensate for deviations in the primary air fuel ratio control.

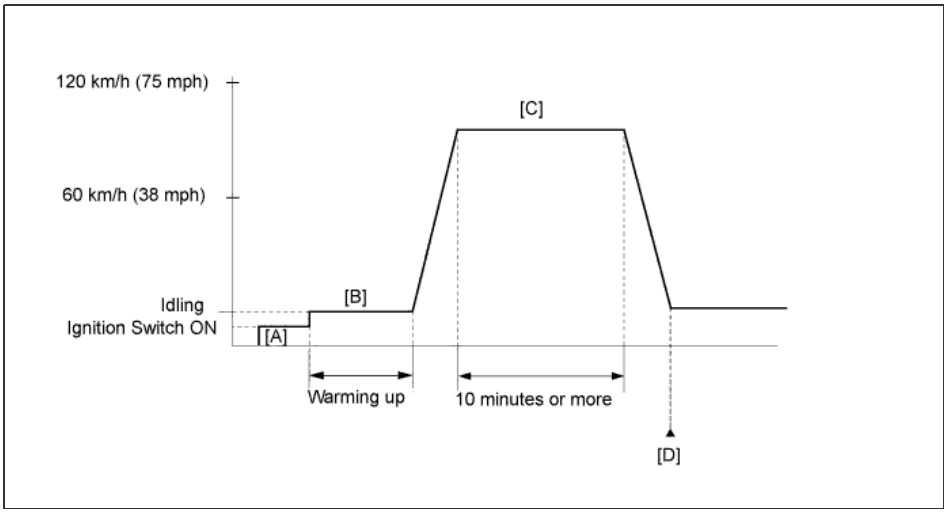


DTC Code	DTC Detection Condition	Trouble Area
P0136 P0156	• Abnormal voltage output: During active air fuel ratio control, the following conditions (a) and (b) are met for a certain period of time (2 trip detection logic): 1. The heated oxygen sensor voltage does not decrease to below 0.21 V. 2. The heated oxygen sensor voltage does not increase to higher than 0.59 V.	• Open or short in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • HO2 sensor heater (bank 1, 2 sensor 2) • Air fuel ratio (A/F) sensor (bank 1, 2 sensor 1) • Gas leak from exhaust system
P0137 P0157	• Low voltage (open): During active air fuel ratio control, the following conditions (a) and (b) are met for a certain period of time (2 trip detection logic): 1. The heated oxygen sensor voltage output is below 0.21 V. 2. The target air fuel ratio is rich.	• Open in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • HO2 sensor heater (bank 1, 2 sensor 2) • Gas leak from exhaust system
P0138 P0158	• High voltage (short): During active air fuel ratio control, the following conditions (a) and (b) are met for a certain period of time (2 trip detection logic): 1. The heated oxygen sensor voltage output is 0.59 V or higher. 2. The target air fuel ratio is lean.	• Short in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • A/F sensor (bank 1, 2 sensor 1) • ECM

WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN



1. Connect the intelligent tester to the DLC3 [A].
2. Turn the tester on.
3. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher [B].
4. Drive the vehicle at 60 to 120 km/h (38 to 75 mph) for at least 10 minutes [C].
5. Enter the following menus: Powertrain / Engine / Utility / All Readiness [D].
6. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.
7. Check that DTC MONITOR is NORMAL. If DTC MONITOR is INCOMPLETE, perform the drive pattern again by accelerating the vehicle and using the second gear to decelerate the vehicle.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the intelligent tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2, or AFS Voltage B2S1 and O2S B2S2) displayed on the intelligent**

tester.

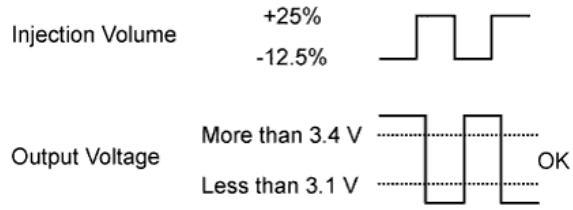
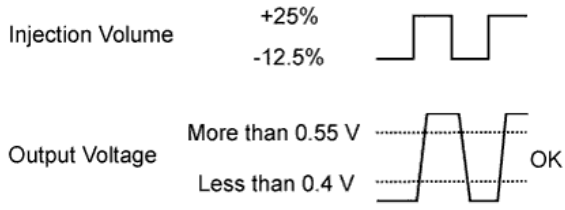
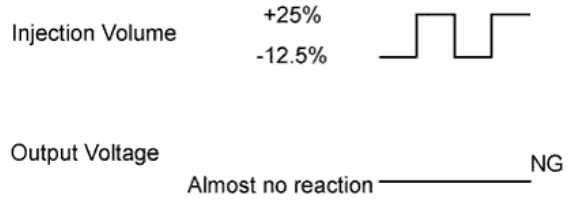
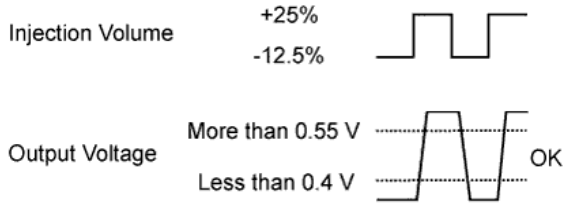
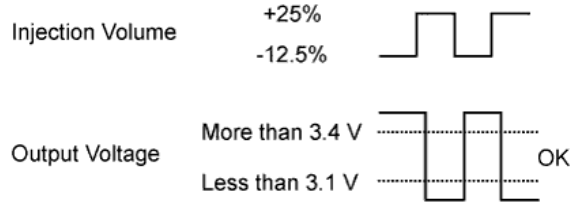
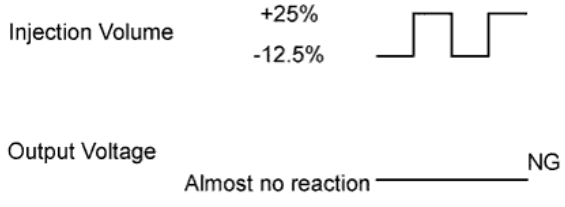
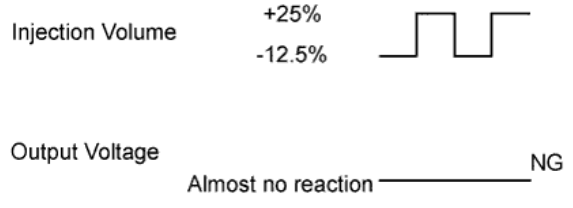
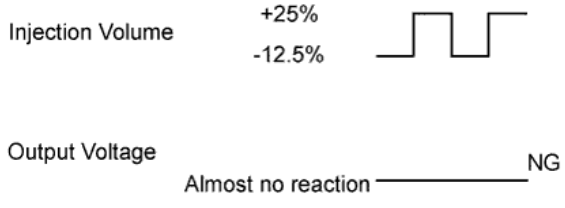
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	Less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ OUTPUT DTC (DTC P0136, P0137, P0138, P0156, P0157 OR P0158)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0138 or P0158	A
P0137 or P0157	B
P0136 or P0156	C

B → Go to step 9

C → Go to step 7

A

2.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1S2.

e. Allow the engine to idle.

f. Read the heated oxygen sensor output voltage while idling.

Result:

Result	Proceed to
Higher than 1.0 V	A
Below 1.0 V	B

B → Go to step 5

A

3.INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)

a. Disconnect the heated oxygen sensor connector.

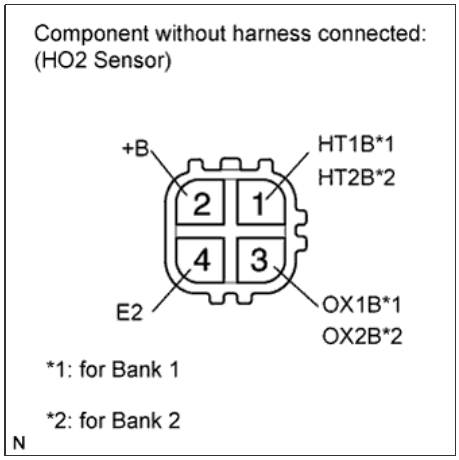
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Bank 1 Sensor 2):

Tester Connection	Condition	Specified Condition
2 (+B) - 4 (E2)	20°C (68°F)	10 kΩ or higher
2 (+B) - 3 (OX1B)	Always	10 kΩ or higher

Standard Resistance (Bank 2 Sensor 2):

Tester Connection	Condition	Specified Condition
2 (+B) - 4 (E2)	20°C (68°F)	10 kΩ or higher
2 (+B) - 3 (OX2B)	Always	10 kΩ or higher



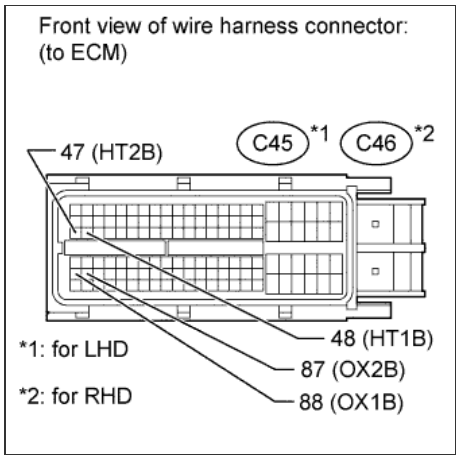
NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

4.CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for LHD

Tester Connection	Condition	Specified Condition
C45-48 (HT1B) - C45-88 (OX1B)	Always	10 kΩ or higher
C45-47 (HT2B) - C45-87 (OX2B)	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C46-48 (HT1B) - C46-88 (OX1B)	Always	10 kΩ or higher
C46-47 (HT2B) - C46-87 (OX2B)	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - HEATED OXYGEN SENSOR)

OK → REPLACE ECM (Click here)

5.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (INJECTION VOLUME)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Warm up the engine.

e. Enter the following menus: Powertrain / Engine / Active Test / Control the Injection Volume.

f. Change the fuel injection volume using the tester, and monitor the voltage output of the air fuel ratio sensor and heated oxygen sensor displayed on the tester.

HINT:

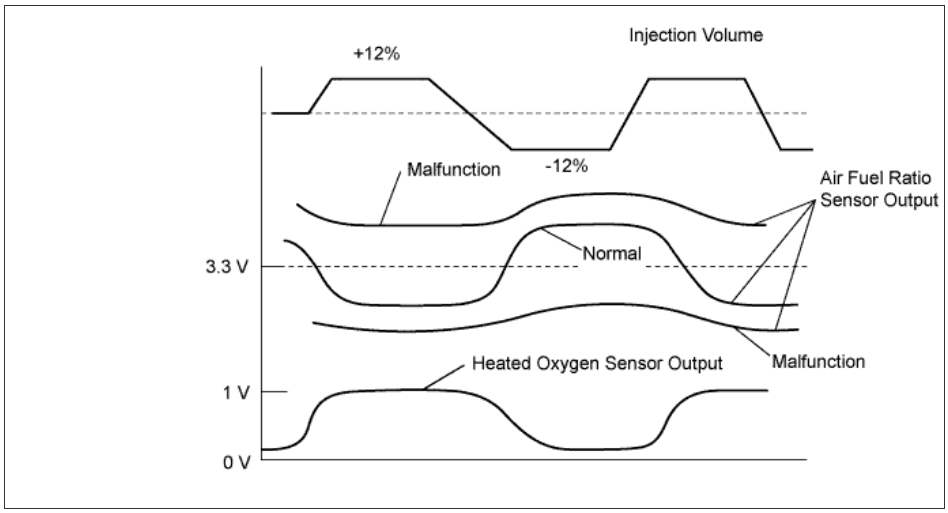
- **Change the fuel injection volume within the range of -12% and +12%. The injection volume can be changed in 1% graduations within this range.**
- **The air fuel ratio sensor is displayed as AFS Voltage B1S1, and the heated oxygen sensor is displayed as O2S B1S2 on the intelligent tester.**

Result:

Tester Display (Sensor)	Voltage Variation	Proceed to
AFS Voltage B1S1 (A/F)	Alternates between higher than and below 3.3 V	OK
AFS Voltage B1S1 (A/F)	Remains at higher than 3.3 V	NG
AFS Voltage B1S1 (A/F)	Remains at below 3.3 V	NG

HINT:

A normal heated oxygen sensor voltage (O2S B1S2) reacts in accordance with increases and decreases in fuel injection volumes. When the air fuel ratio sensor voltage remains at either less or higher than 3.3 V despite the heated oxygen sensor indicating a normal reaction, the air fuel ratio sensor is malfunctioning.



NG	Go to step 15

OK

6.CHECK AIR FUEL RATIO SENSOR

HINT:

This air fuel ratio sensor test is to check the air fuel ratio sensor current during the fuel-cut operation. When the sensor is normal, the sensor current will indicate below 3 mA in this test.

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC / Clear.

e. Clear DTCs.

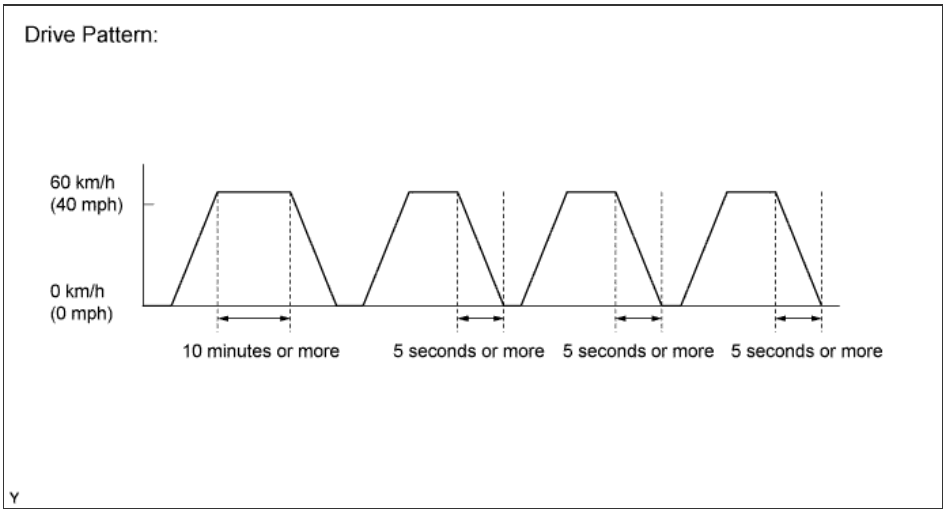
f. Drive the vehicle by the drive pattern as listed below:

i. Warm up the engine.

ii. Drive the vehicle at 60 km/h (40 mph) or more for 10 minutes or more.

iii. Stop the vehicle.

iv. Accelerate the vehicle to 60 km/h (40 mph) or more and then decelerate for 5 seconds or more. Repeat this process at least 3 times.



g. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS Current B1S1.

h. Read the value of the air fuel ratio sensor current while the fuel-cut operation is performing.

Standard current:

Below 3.0 mA

HINT:

- **To measure the air fuel ratio sensor current precisely, perform the fuel-cut operation as long as possible.**
- **If it is difficult to measure the air fuel ratio sensor current, use the snapshot function of the intelligent tester.**

Result

Result	Proceed to
Outside standard range	A
Within standard range	B

OK	Go to step 12
NG	Go to step 15

7.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Start the engine.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1S2.

f. After warming up the engine, run the engine at an engine speed of 2500 rpm for 3 minutes.

g. Read the output voltage of the heated oxygen sensor when the engine speed is suddenly increased.

HINT:

Quickly accelerate the engine to 4000 rpm 3 times using the accelerator pedal.

Standard voltage:
Fluctuates between 0.4 V or less and 0.55 V or higher.

NG	Go to step 9
OK	

8.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (INJECTION VOLUME)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Warm up the engine.

e. Enter the following menus: Powertrain / Engine / Active Test / Control the Injection Volume.

f. Change the fuel injection volume using the tester, and monitor the voltage output of the air fuel ratio sensor and heated oxygen sensor displayed on the tester.

HINT:

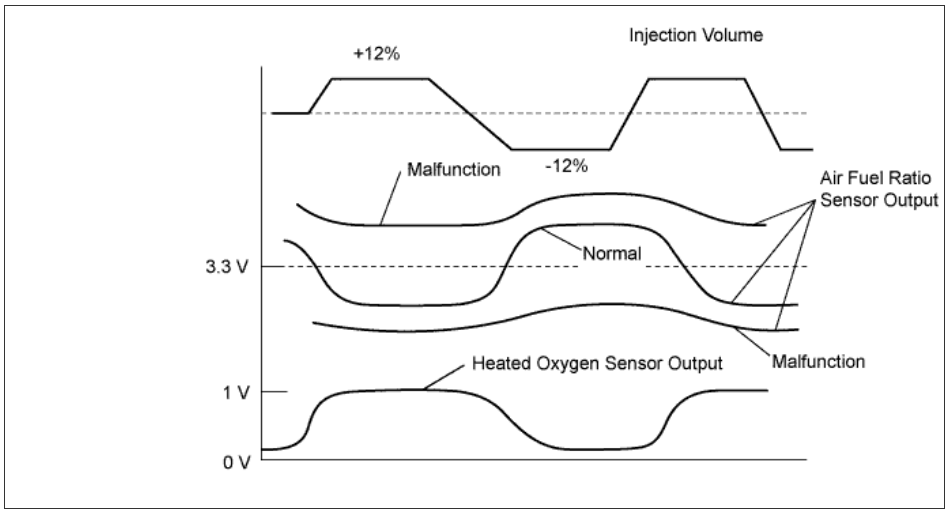
- **Change the fuel injection volume within the range of -12% and +12%. The injection volume can be changed in 1% graduations within this range.**
- **The air fuel ratio sensor is displayed as AFS Voltage B1S1, and the heated oxygen sensor is displayed as O2S B1S2 on the intelligent tester.**

Result:

Tester Display (Sensor)	Voltage Variation	Proceed to
AFS Voltage B1S1 (A/F)	Alternates between higher than and below 3.3 V	OK
AFS Voltage B1S1 (A/F)	Remains at higher than 3.3 V	NG
AFS Voltage B1S1 (A/F)	Remains at below 3.3 V	NG

HINT:

A normal heated oxygen sensor voltage (O2S B1S2) reacts in accordance with increases and decreases in fuel injection volumes. When the air fuel ratio sensor voltage remains at either less or higher than 3.3 V despite the heated oxygen sensor indicating a normal reaction, the air fuel ratio sensor is malfunctioning.



NG → Go to step 15

OK

CHECK EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO AND REPAIR CAUSE (FUEL INJECTOR , FUEL PRESSURE, GAS LEAK FROM SYSTEM, ETC.)

9.CHECK FOR EXHAUST GAS LEAK

a. Check for exhaust gas leakage.

OK:
No gas leak.

NG → REPAIR OR REPLACE EXHAUST GAS LEAK POINT

OK

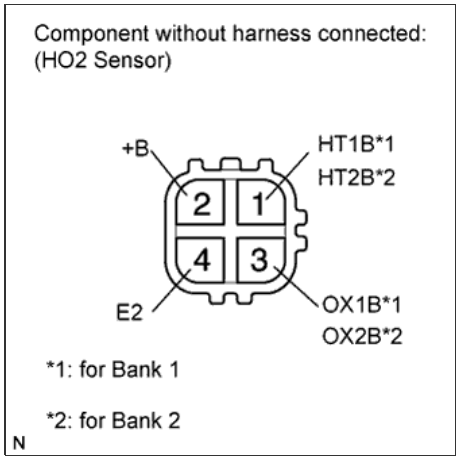
10.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

a. Disconnect the heated oxygen sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT1B) - 4 (E2)	Always	10 kΩ or higher



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

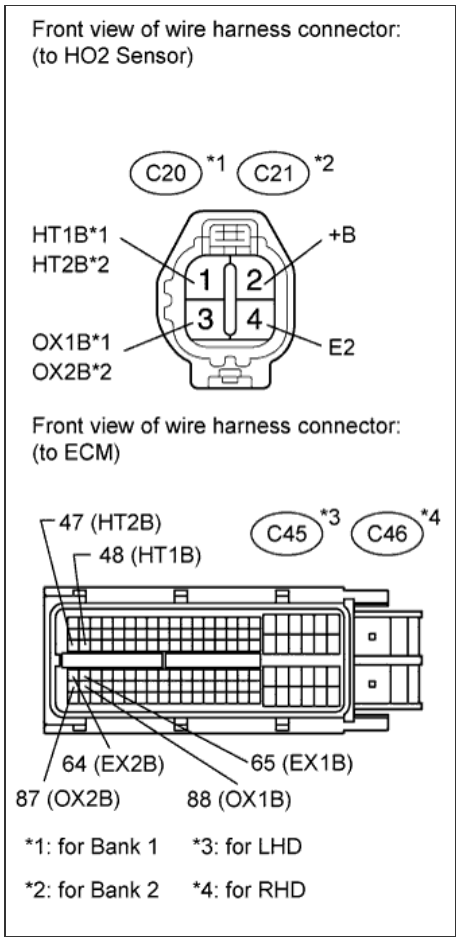
OK

11.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)

a. Disconnect the heated oxygen sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C45-48 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C45-88 (OX1B)	Always	Below 1 Ω
C20-4 (E2) - C45-65 (EX1B)	Always	Below 1 Ω
C21-1 (HT2B) - C45-47 (HT2B)	Always	Below 1 Ω
C21-3 (OX2B) - C45-87 (OX2B)	Always	Below 1 Ω
C21-4 (E2) - C45-64 (EX2B)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C46-48 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C46-88 (OX1B)	Always	Below 1 Ω
C20-4 (E2) - C46-65 (EX1B)	Always	Below 1 Ω
C21-1 (HT2B) - C46-47 (HT2B)	Always	Below 1 Ω
C21-3 (OX2B) - C46-87 (OX2B)	Always	Below 1 Ω
C21-4 (E2) - C46-64 (EX2B)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

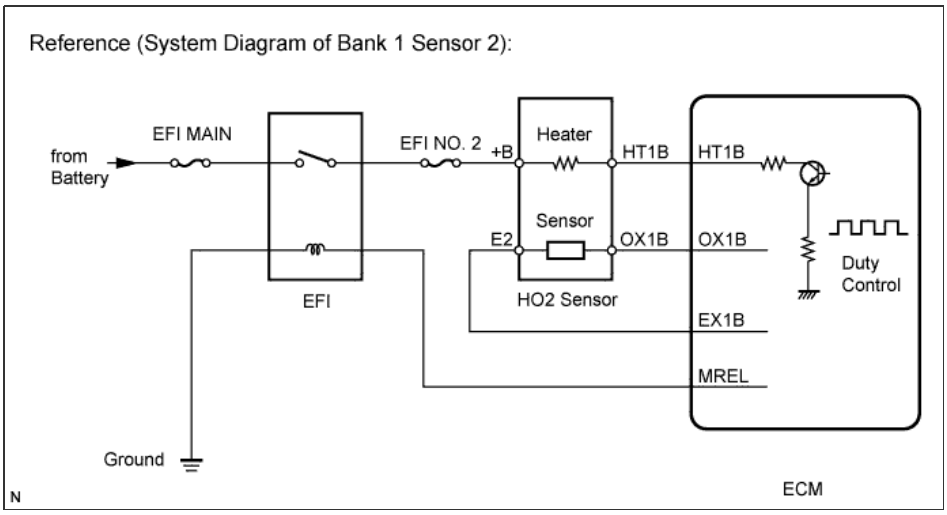
Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C45-48 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C45-88 (OX1B) - Body ground	Always	10 kΩ or higher

C20-4 (E2) or C45-65 (EX1B) - Body ground	Always	10 kΩ or higher
C21-1 (HT2B) or C45-47 (HT2B) - Body ground	Always	10 kΩ or higher
C21-3 (OX2B) or C45-87 (OX2B) - Body ground	Always	10 kΩ or higher
C21-4 (E2) or C45-64 (EX2B) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C46-48 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C46-88 (OX1B) - Body ground	Always	10 kΩ or higher
C20-4 (E2) or C46-65 (EX1B) - Body ground	Always	10 kΩ or higher
C21-1 (HT2B) or C46-47 (HT2B) - Body ground	Always	10 kΩ or higher
C21-3 (OX2B) or C46-87 (OX2B) - Body ground	Always	10 kΩ or higher
C21-4 (E2) or C46-64 (EX2B) - Body ground	Always	10 kΩ or higher

Reference (System Diagram of Bank 1 Sensor 2):



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - HEATED OXYGEN SENSOR)

OK

12.REPLACE HEATED OXYGEN SENSOR

a. Replace the heated oxygen sensor (Click here).

NEXT

13.PERFORM CONFIRMATION DRIVING PATTERN

HINT:

Refer to the CONFIRMATION DRIVING PATTERN.

NEXT

14.CHECK WHETHER DTC OUTPUT RECURS (DTC P0136, P0137, P0138, P0156, P0157 OR P0158)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

e. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

f. Check the DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern again by accelerating the vehicle and using the second gear to decelerate the vehicle.

Result

Result	Proceed to
NORMAL (No DTC output)	A
ABNORMAL (P0136, P0137, P0138, P0156, P0157 or P0158 detected)	B

B → REPLACE AIR FUEL RATIO SENSOR (Click here)

A

END

15.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

16.PERFORM CONFIRMATION DRIVING PATTERN

HINT:

Refer to the CONFIRMATION DRIVING PATTERN.

NEXT

17.CHECK WHETHER DTC OUTPUT RECURS (DTC P0136, P0137, P0138, P0156, P0157 OR P0158)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

e. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

f. Check the DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern again by accelerating the vehicle and using the second gear to decelerate the vehicle.

Result

Result	Proceed to
NORMAL (No DTC output)	A
ABNORMAL (P0136, P0137, P0138, P0156, P0157 or P0158 detected)	B

B → REPLACE HEATED OXYGEN SENSOR (Click here)

A

END

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

for Preparation Click here

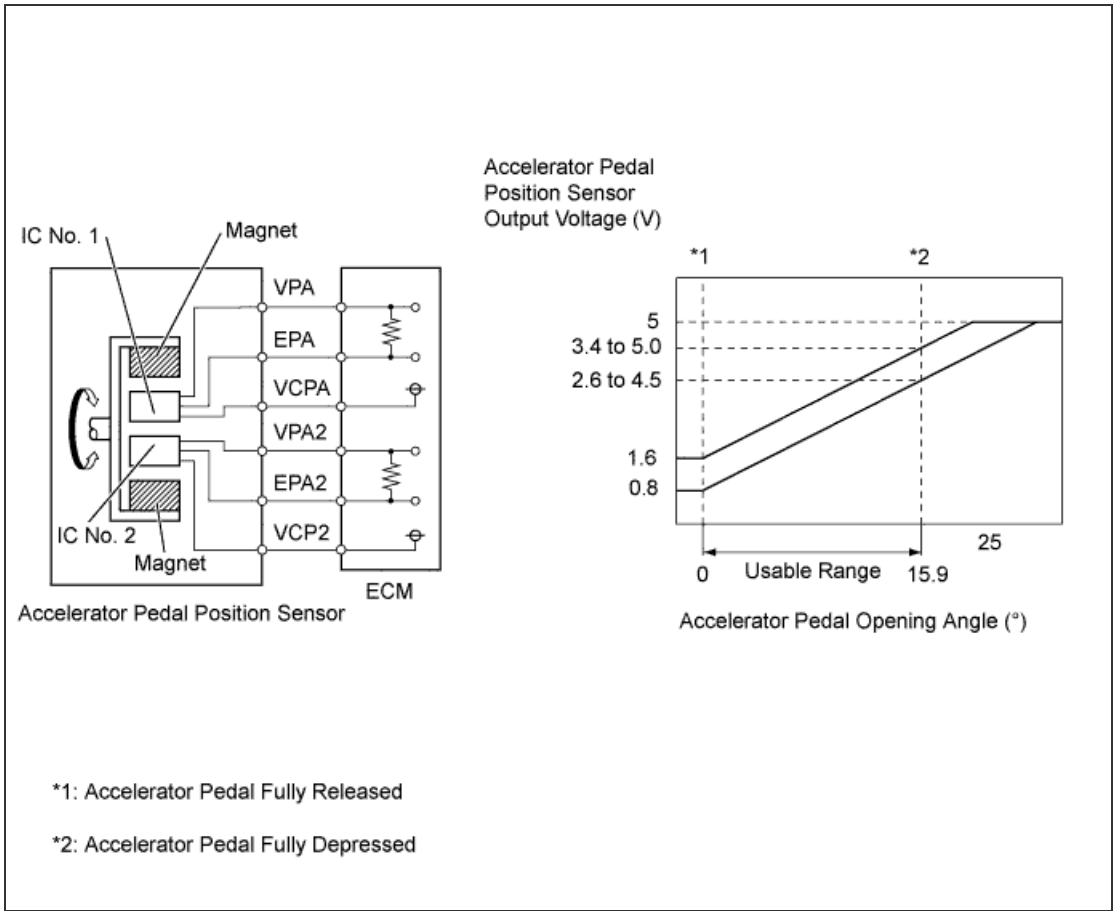
DESCRIPTION

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

The Accelerator Pedal Position (APP) sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC Code	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• Accelerator Pedal Position (APP) sensor • ECM

P2122	VPA is 0.4 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCPA circuit • Open or ground short in VPA circuit • ECM
P2123	VPA is 4.8 V or higher for 2.0 seconds or more (1 trip detection logic).	• APP sensor • Open in EPA circuit • ECM
P2125	VPA2 fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or higher. (b) VPA is between 0.4 V and 3.45 V.	• APP sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): (a) The difference between VPA and VPA2 is 0.02 V or less. (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less.	• Short between VPA and VPA2 circuits • APP sensor • ECM

HINT:

When any of these DTCs are output, check the APP sensor voltage by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No.1 and Accelerator Position No.2.

Trouble Area	Accelerator Position No. 1 When Accelerator Pedal Released	Accelerator Position No. 2 When Accelerator Pedal Released	Accelerator Position No. 1 When Accelerator Pedal Depressed	Accelerator Position No. 2 When Accelerator Pedal Depressed
VCP circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.0 V
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 5.0 V

HINT:

Accelerator pedal positions are expressed as voltages.

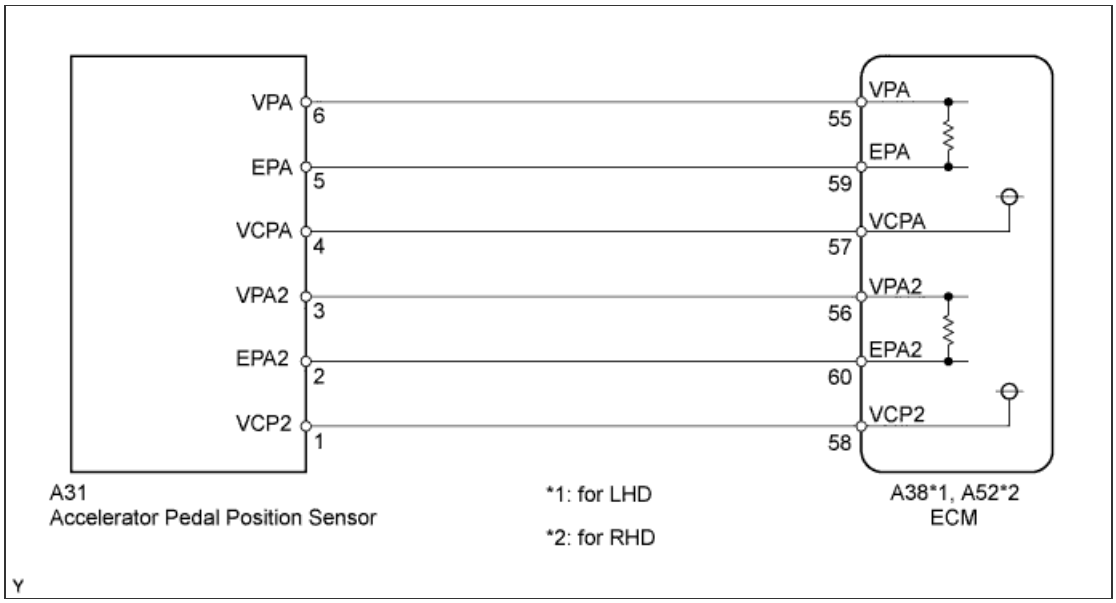
MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is below the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and stores a DTC.
Example:
When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is stored.
If the malfunction is not repaired successfully, a DTC is stored 2 seconds after the engine is next started.

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 are stored, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue to be driven. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.
Fail-safe mode continues until a pass condition is detected, and the ignition switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Accelerator Pedal Position (APP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

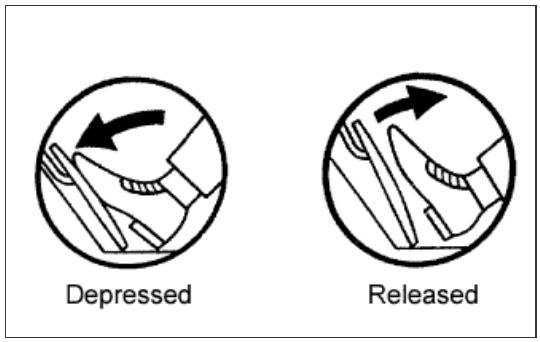
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No.1 and Accelerator Position No.2.

d. Read the value displayed on the tester.



Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2.6 to 4.5 V	3.4 to 5.0 V

Result

Result	Proceed to
OK	A
NG	B

A → Go to step 5

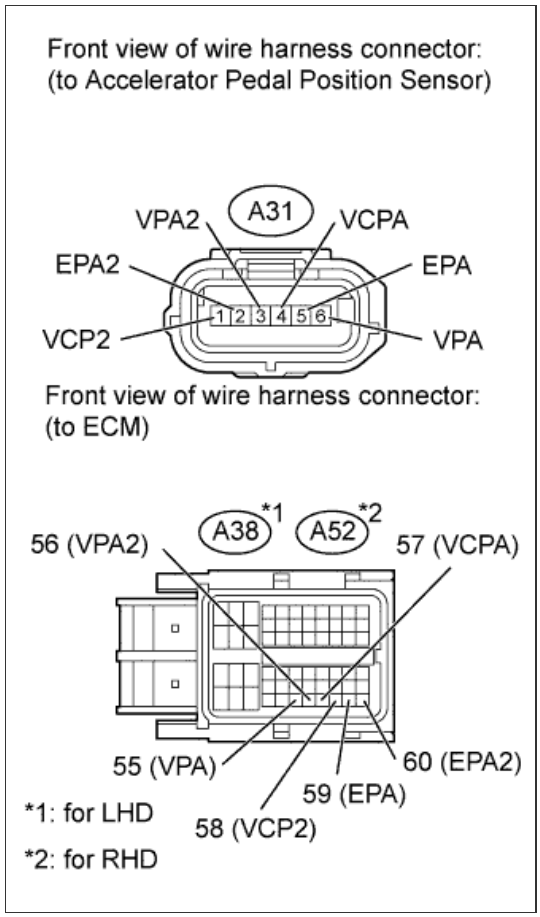
B

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the Accelerator Pedal Position (APP) sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A38-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-59 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A38-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A38-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A38-58 (VCP2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A52-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-59 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A52-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A52-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A52-58 (VCP2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) or A38-55 (VPA) -		10 kΩ or

Body ground	Always	higher
A31-5 (EPA) or A38-59 (EPA) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-57 (VCPA) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-56 (VPA2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A38-60 (EPA2) - Body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A38-58 (VCP2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) or A52-55 (VPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-59 (EPA) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-57 (VCPA) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-56 (VPA2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-60 (EPA2) - Body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A52-58 (VCP2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK ECM (VCPA AND VCP2 VOLTAGE)

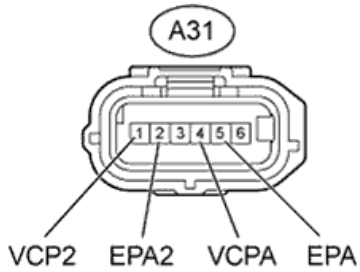
a. Disconnect the APP sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Ignition switch ON	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Ignition switch ON	4.5 to 5.5 V

Front view of wire harness connector:
(to Accelerator Pedal Position Sensor)



NG → REPLACE ECM (Click here)

OK

4.REPLACE ACCELERATOR PEDAL ROD ASSEMBLY

a. Replace the accelerator pedal rod assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read the DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138	A
No output	B

B → SYSTEM OK

A → REPLACE ECM (Click here)

DTC P0136 Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)

DTC P0137 Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)

DTC P0138 Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)

DTC P0156 Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)

DTC P0157 Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)

DTC P0158 Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)

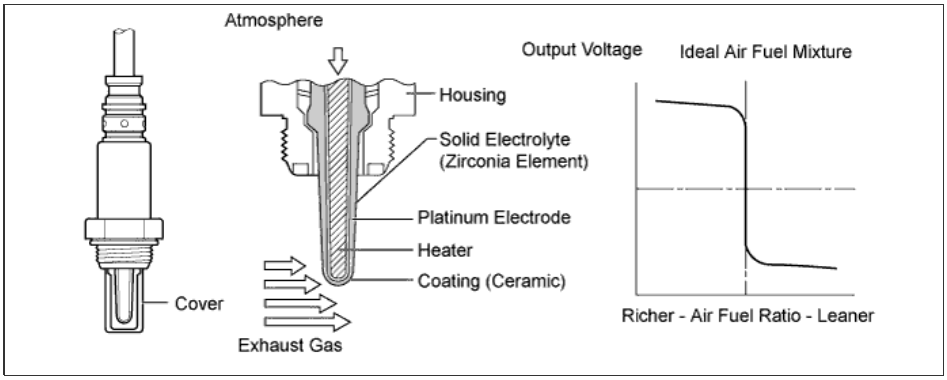
for Preparation Click here

DESCRIPTION

HINT:

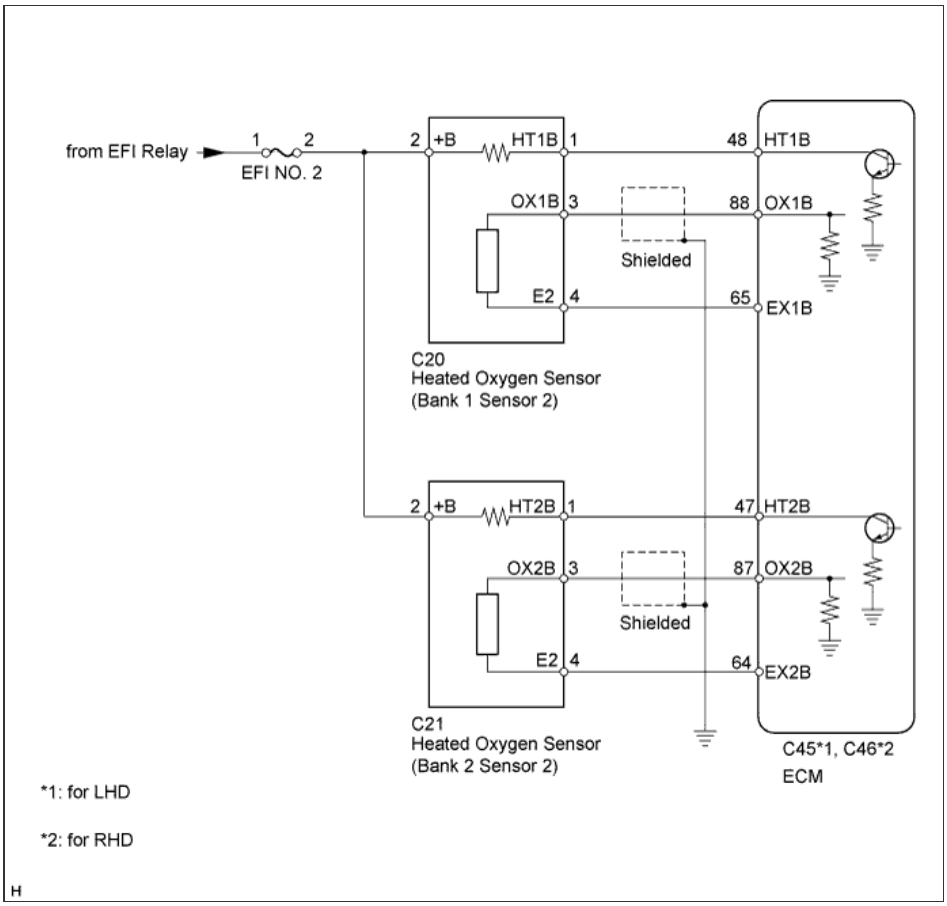
Sensor 2 refers to the sensor mounted behind the three-way catalytic converter and located far from the engine assembly.

A three-way catalyst converter is used in order to convert the carbon monoxide, hydrocarbons, and nitrogen oxide, into less harmful substances. To allow the three-way catalytic converter to function effectively, it is necessary to keep the air fuel ratio of the engine near the stoichiometric air fuel ratio. For the purpose of helping the ECM to deliver accurate air fuel ratio control, a heated oxygen sensor is used.
The heated oxygen sensor is located behind the three-way catalytic converter, and detects the oxygen concentration in the exhaust gas. Since the sensor is integrated with the heater that heats the sensing portion, it is possible to detect the oxygen concentration even when the intake air volume is low (the exhaust gas temperature is low).
When the air fuel ratio becomes lean, the oxygen concentration in the exhaust gas is rich. The heated oxygen sensor informs the ECM that the post-three way catalytic converter air fuel ratio is lean (low voltage, i.e. below 0.45 V).
Conversely, when the air fuel ratio is richer than the stoichiometric air fuel level, the oxygen concentration in the exhaust gas becomes lean. The heated oxygen sensor informs the ECM that the post-three way catalytic converter air fuel ratio is rich (high voltage, i.e. higher than 0.45 V). The heated oxygen sensor has the property of changing its output voltage drastically when the air fuel ratio is close to the stoichiometric level.
The ECM uses the supplementary information from the heated oxygen sensor to determine whether the air fuel ratio after the three-way catalytic converter is rich or lean, and adjusts the fuel injection time accordingly. Thus, if the heated oxygen sensor is working improperly due to internal malfunctions, the ECM is unable to compensate for deviations in the primary air fuel ratio control.

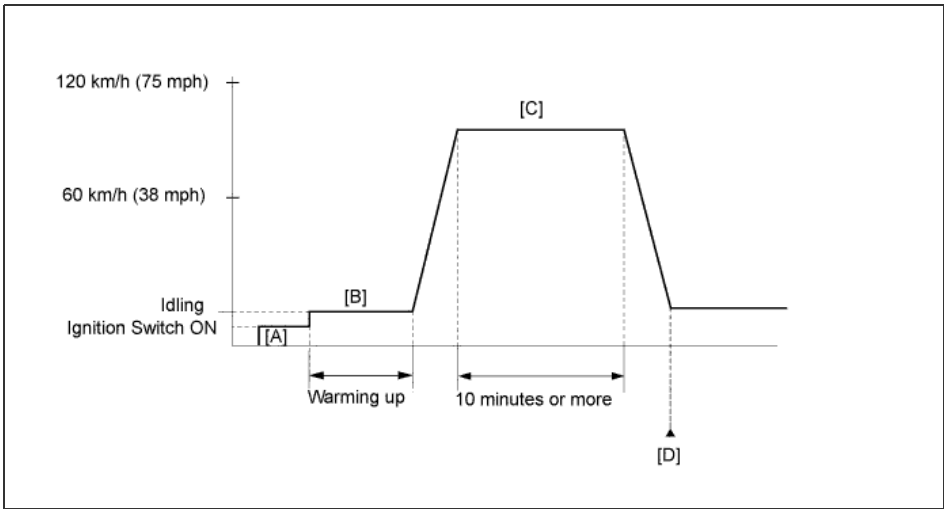


DTC Code	DTC Detection Condition	Trouble Area
P0136 P0156	• Abnormal voltage output: During active air fuel ratio control, the following conditions (a) and (b) are met for a certain period of time (2 trip detection logic): 1. The heated oxygen sensor voltage does not decrease to below 0.21 V. 2. The heated oxygen sensor voltage does not increase to higher than 0.59 V.	• Open or short in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • HO2 sensor heater (bank 1, 2 sensor 2) • Air fuel ratio (A/F) sensor (bank 1, 2 sensor 1) • Gas leak from exhaust system
P0137 P0157	• Low voltage (open): During active air fuel ratio control, the following conditions (a) and (b) are met for a certain period of time (2 trip detection logic): 1. The heated oxygen sensor voltage output is below 0.21 V. 2. The target air fuel ratio is rich.	• Open in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • HO2 sensor heater (bank 1, 2 sensor 2) • Gas leak from exhaust system
P0138 P0158	• High voltage (short): During active air fuel ratio control, the following conditions (a) and (b) are met for a certain period of time (2 trip detection logic): 1. The heated oxygen sensor voltage output is 0.59 V or higher. 2. The target air fuel ratio is lean.	• Short in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • A/F sensor (bank 1, 2 sensor 1) • ECM

WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN



1. Connect the intelligent tester to the DLC3 [A].
2. Turn the tester on.
3. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher [B].
4. Drive the vehicle at 60 to 120 km/h (38 to 75 mph) for at least 10 minutes [C].
5. Enter the following menus: Powertrain / Engine / Utility / All Readiness [D].
6. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.
7. Check that DTC MONITOR is NORMAL. If DTC MONITOR is INCOMPLETE, perform the drive pattern again by accelerating the vehicle and using the second gear to decelerate the vehicle.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the intelligent tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2, or AFS Voltage B2S1 and O2S B2S2) displayed on the intelligent**

tester.

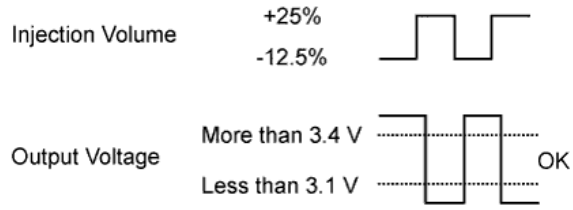
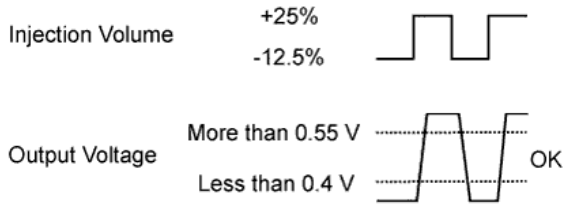
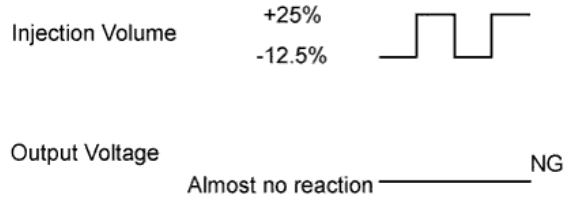
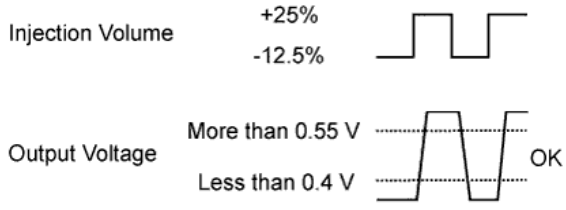
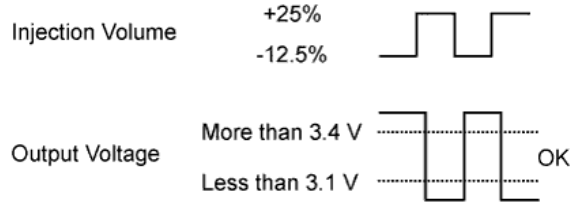
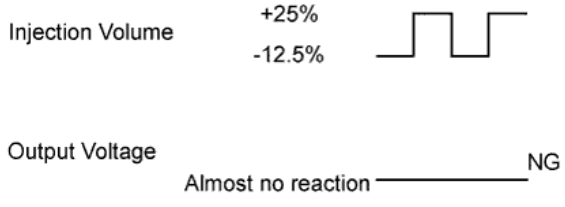
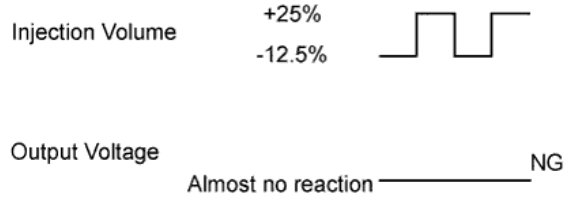
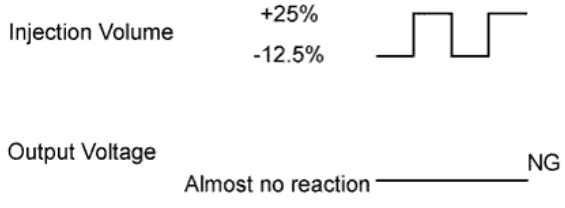
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	Less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ OUTPUT DTC (DTC P0136, P0137, P0138, P0156, P0157 OR P0158)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0138 or P0158	A
P0137 or P0157	B
P0136 or P0156	C

B → Go to step 9

C → Go to step 7

A

2.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1S2.

e. Allow the engine to idle.

f. Read the heated oxygen sensor output voltage while idling.

Result:

Result	Proceed to
Higher than 1.0 V	A
Below 1.0 V	B

B → Go to step 5

A

3.INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)

a. Disconnect the heated oxygen sensor connector.

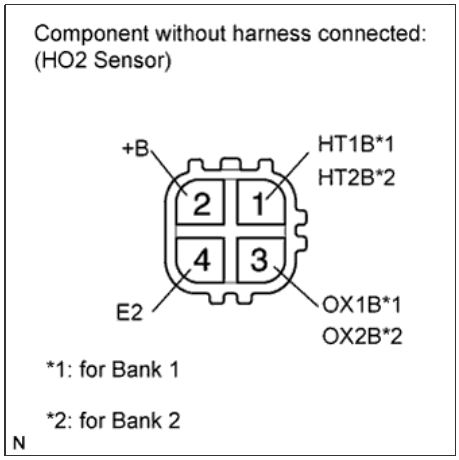
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Bank 1 Sensor 2):

Tester Connection	Condition	Specified Condition
2 (+B) - 4 (E2)	20°C (68°F)	10 kΩ or higher
2 (+B) - 3 (OX1B)	Always	10 kΩ or higher

Standard Resistance (Bank 2 Sensor 2):

Tester Connection	Condition	Specified Condition
2 (+B) - 4 (E2)	20°C (68°F)	10 kΩ or higher
2 (+B) - 3 (OX2B)	Always	10 kΩ or higher



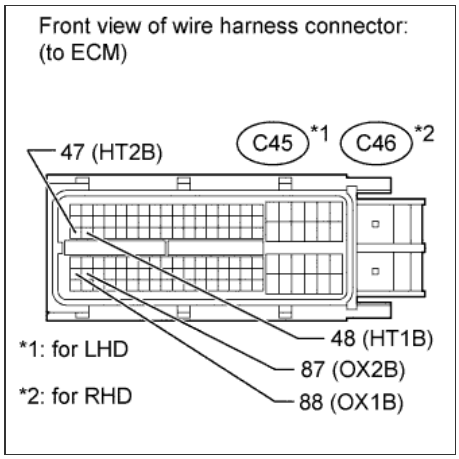
NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

4.CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for LHD

Tester Connection	Condition	Specified Condition
C45-48 (HT1B) - C45-88 (OX1B)	Always	10 kΩ or higher
C45-47 (HT2B) - C45-87 (OX2B)	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C46-48 (HT1B) - C46-88 (OX1B)	Always	10 kΩ or higher
C46-47 (HT2B) - C46-87 (OX2B)	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - HEATED OXYGEN SENSOR)

OK → REPLACE ECM (Click here)

5.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (INJECTION VOLUME)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Warm up the engine.

e. Enter the following menus: Powertrain / Engine / Active Test / Control the Injection Volume.

f. Change the fuel injection volume using the tester, and monitor the voltage output of the air fuel ratio sensor and heated oxygen sensor displayed on the tester.

HINT:

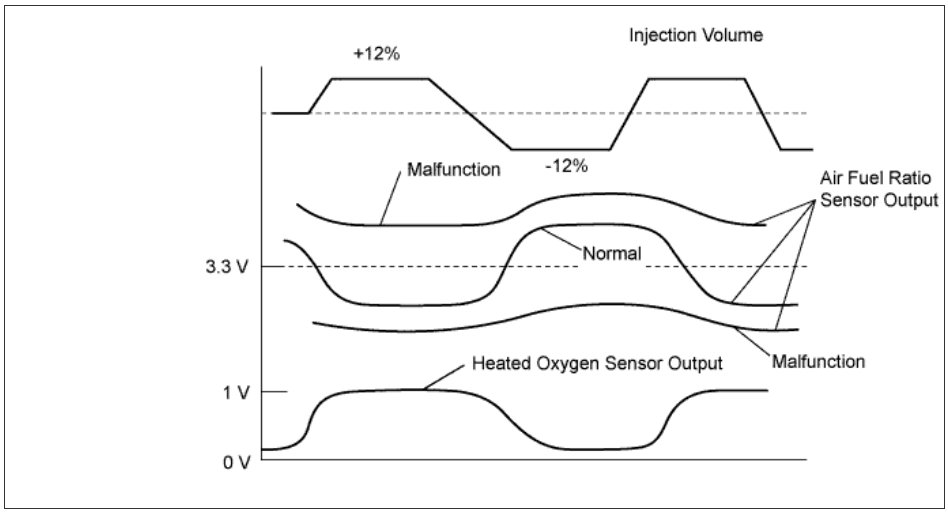
- **Change the fuel injection volume within the range of -12% and +12%. The injection volume can be changed in 1% graduations within this range.**
- **The air fuel ratio sensor is displayed as AFS Voltage B1S1, and the heated oxygen sensor is displayed as O2S B1S2 on the intelligent tester.**

Result:

Tester Display (Sensor)	Voltage Variation	Proceed to
AFS Voltage B1S1 (A/F)	Alternates between higher than and below 3.3 V	OK
AFS Voltage B1S1 (A/F)	Remains at higher than 3.3 V	NG
AFS Voltage B1S1 (A/F)	Remains at below 3.3 V	NG

HINT:

A normal heated oxygen sensor voltage (O2S B1S2) reacts in accordance with increases and decreases in fuel injection volumes. When the air fuel ratio sensor voltage remains at either less or higher than 3.3 V despite the heated oxygen sensor indicating a normal reaction, the air fuel ratio sensor is malfunctioning.



NG	Go to step 15

OK

6.CHECK AIR FUEL RATIO SENSOR

HINT:

This air fuel ratio sensor test is to check the air fuel ratio sensor current during the fuel-cut operation. When the sensor is normal, the sensor current will indicate below 3 mA in this test.

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC / Clear.

e. Clear DTCs.

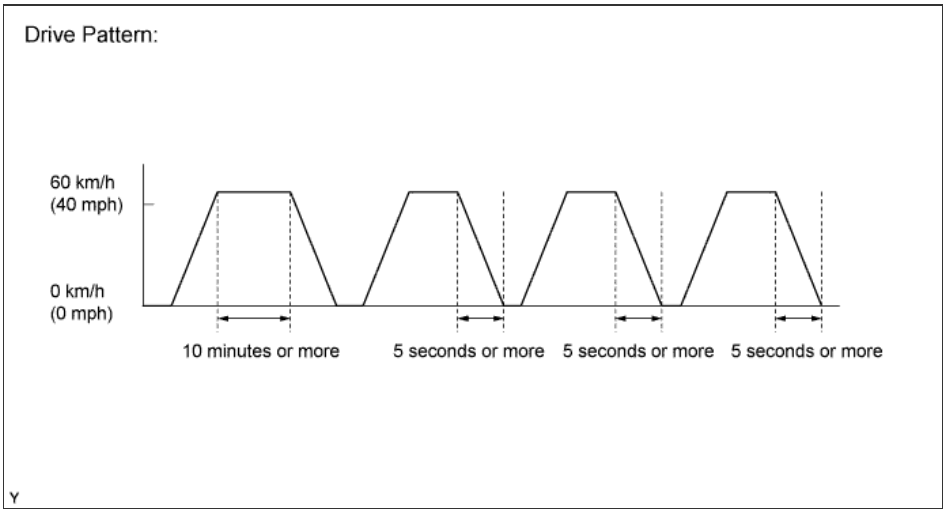
f. Drive the vehicle by the drive pattern as listed below:

i. Warm up the engine.

ii. Drive the vehicle at 60 km/h (40 mph) or more for 10 minutes or more.

iii. Stop the vehicle.

iv. Accelerate the vehicle to 60 km/h (40 mph) or more and then decelerate for 5 seconds or more. Repeat this process at least 3 times.



g. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS Current B1S1.

h. Read the value of the air fuel ratio sensor current while the fuel-cut operation is performing.

Standard current:

Below 3.0 mA

HINT:

- **To measure the air fuel ratio sensor current precisely, perform the fuel-cut operation as long as possible.**
- **If it is difficult to measure the air fuel ratio sensor current, use the snapshot function of the intelligent tester.**

Result

Result	Proceed to
Outside standard range	A
Within standard range	B

OK	Go to step 12
NG	Go to step 15

7.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Start the engine.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1S2.

f. After warming up the engine, run the engine at an engine speed of 2500 rpm for 3 minutes.

g. Read the output voltage of the heated oxygen sensor when the engine speed is suddenly increased.

HINT:

Quickly accelerate the engine to 4000 rpm 3 times using the accelerator pedal.

Standard voltage:
Fluctuates between 0.4 V or less and 0.55 V or higher.

NG	Go to step 9
OK	

8.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (INJECTION VOLUME)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Warm up the engine.

e. Enter the following menus: Powertrain / Engine / Active Test / Control the Injection Volume.

f. Change the fuel injection volume using the tester, and monitor the voltage output of the air fuel ratio sensor and heated oxygen sensor displayed on the tester.

HINT:

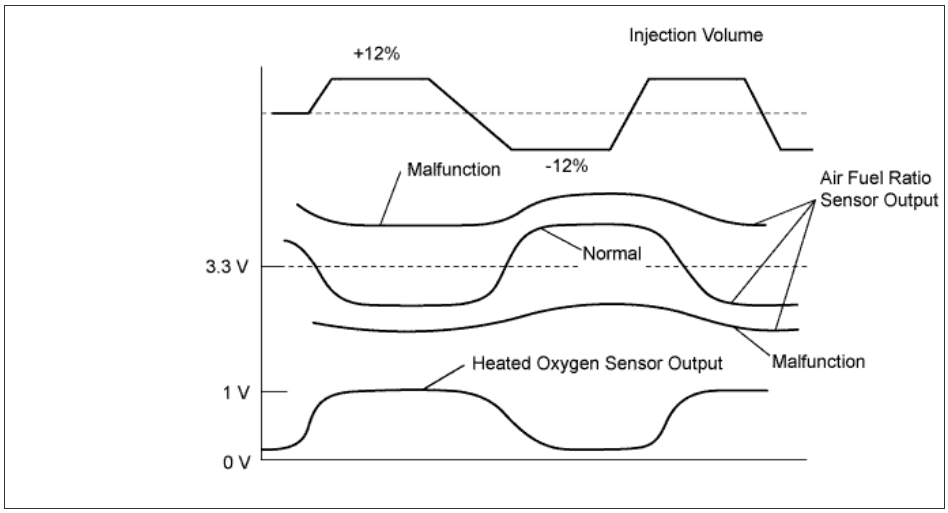
- **Change the fuel injection volume within the range of -12% and +12%. The injection volume can be changed in 1% graduations within this range.**
- **The air fuel ratio sensor is displayed as AFS Voltage B1S1, and the heated oxygen sensor is displayed as O2S B1S2 on the intelligent tester.**

Result:

Tester Display (Sensor)	Voltage Variation	Proceed to
AFS Voltage B1S1 (A/F)	Alternates between higher than and below 3.3 V	OK
AFS Voltage B1S1 (A/F)	Remains at higher than 3.3 V	NG
AFS Voltage B1S1 (A/F)	Remains at below 3.3 V	NG

HINT:

A normal heated oxygen sensor voltage (O2S B1S2) reacts in accordance with increases and decreases in fuel injection volumes. When the air fuel ratio sensor voltage remains at either less or higher than 3.3 V despite the heated oxygen sensor indicating a normal reaction, the air fuel ratio sensor is malfunctioning.



NG → Go to step 15

OK

CHECK EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO AND REPAIR CAUSE (FUEL INJECTOR , FUEL PRESSURE, GAS LEAK FROM SYSTEM, ETC.)

9.CHECK FOR EXHAUST GAS LEAK

a. Check for exhaust gas leakage.

OK:
No gas leak.

NG → REPAIR OR REPLACE EXHAUST GAS LEAK POINT

OK

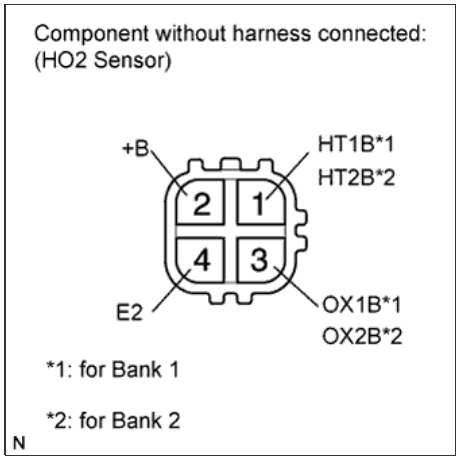
10.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

a. Disconnect the heated oxygen sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT1B) - 4 (E2)	Always	10 kΩ or higher



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

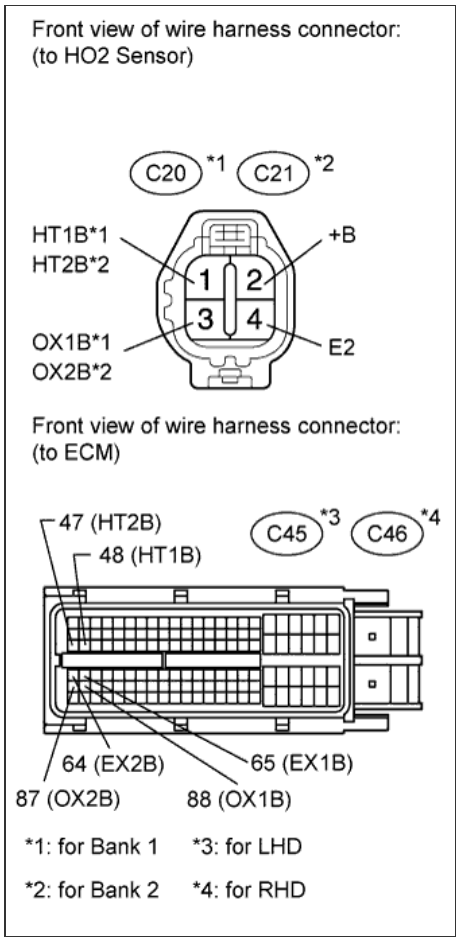
OK

11.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)

a. Disconnect the heated oxygen sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C45-48 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C45-88 (OX1B)	Always	Below 1 Ω
C20-4 (E2) - C45-65 (EX1B)	Always	Below 1 Ω
C21-1 (HT2B) - C45-47 (HT2B)	Always	Below 1 Ω
C21-3 (OX2B) - C45-87 (OX2B)	Always	Below 1 Ω
C21-4 (E2) - C45-64 (EX2B)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C46-48 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C46-88 (OX1B)	Always	Below 1 Ω
C20-4 (E2) - C46-65 (EX1B)	Always	Below 1 Ω
C21-1 (HT2B) - C46-47 (HT2B)	Always	Below 1 Ω
C21-3 (OX2B) - C46-87 (OX2B)	Always	Below 1 Ω
C21-4 (E2) - C46-64 (EX2B)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

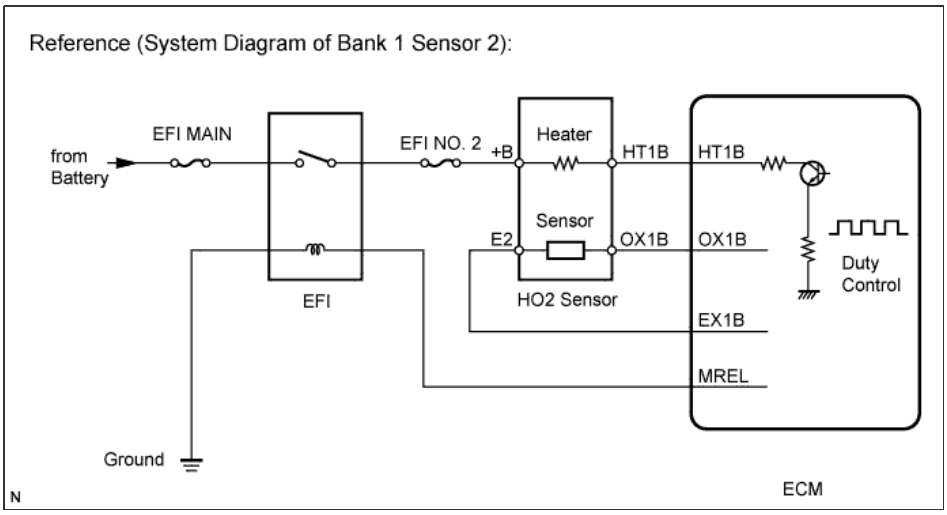
Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C45-48 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C45-88 (OX1B) - Body ground	Always	10 kΩ or higher

C20-4 (E2) or C45-65 (EX1B) - Body ground	Always	10 kΩ or higher
C21-1 (HT2B) or C45-47 (HT2B) - Body ground	Always	10 kΩ or higher
C21-3 (OX2B) or C45-87 (OX2B) - Body ground	Always	10 kΩ or higher
C21-4 (E2) or C45-64 (EX2B) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C46-48 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C46-88 (OX1B) - Body ground	Always	10 kΩ or higher
C20-4 (E2) or C46-65 (EX1B) - Body ground	Always	10 kΩ or higher
C21-1 (HT2B) or C46-47 (HT2B) - Body ground	Always	10 kΩ or higher
C21-3 (OX2B) or C46-87 (OX2B) - Body ground	Always	10 kΩ or higher
C21-4 (E2) or C46-64 (EX2B) - Body ground	Always	10 kΩ or higher

Reference (System Diagram of Bank 1 Sensor 2):



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - HEATED OXYGEN SENSOR)

OK

12.REPLACE HEATED OXYGEN SENSOR

a. Replace the heated oxygen sensor (Click here).

NEXT

13.PERFORM CONFIRMATION DRIVING PATTERN

HINT:

Refer to the CONFIRMATION DRIVING PATTERN.

NEXT

14.CHECK WHETHER DTC OUTPUT RECURS (DTC P0136, P0137, P0138, P0156, P0157 OR P0158)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

e. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

f. Check the DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern again by accelerating the vehicle and using the second gear to decelerate the vehicle.

Result

Result	Proceed to
NORMAL (No DTC output)	A
ABNORMAL (P0136, P0137, P0138, P0156, P0157 or P0158 detected)	B

B → REPLACE AIR FUEL RATIO SENSOR (Click here)

A

END

15.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

16.PERFORM CONFIRMATION DRIVING PATTERN

HINT:

Refer to the CONFIRMATION DRIVING PATTERN.

NEXT

17.CHECK WHETHER DTC OUTPUT RECURS (DTC P0136, P0137, P0138, P0156, P0157 OR P0158)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

e. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

f. Check the DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern again by accelerating the vehicle and using the second gear to decelerate the vehicle.

Result

Result	Proceed to
NORMAL (No DTC output)	A
ABNORMAL (P0136, P0137, P0138, P0156, P0157 or P0158 detected)	B

B → REPLACE HEATED OXYGEN SENSOR (Click here)

A

END

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

for Preparation Click here

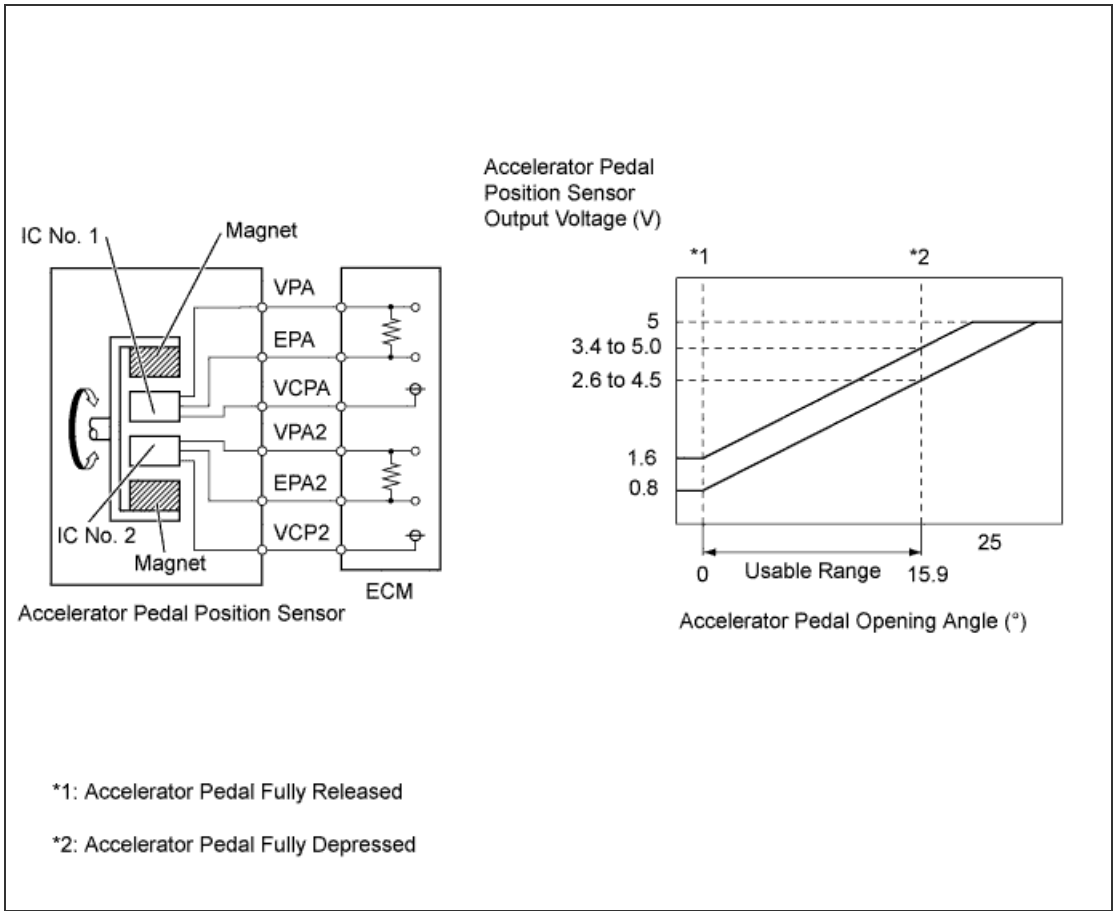
DESCRIPTION

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

The Accelerator Pedal Position (APP) sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC Code	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• Accelerator Pedal Position (APP) sensor • ECM

P2122	VPA is 0.4 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCPA circuit • Open or ground short in VPA circuit • ECM
P2123	VPA is 4.8 V or higher for 2.0 seconds or more (1 trip detection logic).	• APP sensor • Open in EPA circuit • ECM
P2125	VPA2 fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or higher. (b) VPA is between 0.4 V and 3.45 V.	• APP sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): (a) The difference between VPA and VPA2 is 0.02 V or less. (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less.	• Short between VPA and VPA2 circuits • APP sensor • ECM

HINT:

When any of these DTCs are output, check the APP sensor voltage by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No.1 and Accelerator Position No.2.

Trouble Area	Accelerator Position No. 1 When Accelerator Pedal Released	Accelerator Position No. 2 When Accelerator Pedal Released	Accelerator Position No. 1 When Accelerator Pedal Depressed	Accelerator Position No. 2 When Accelerator Pedal Depressed
VCP circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.0 V
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 5.0 V

HINT:

Accelerator pedal positions are expressed as voltages.

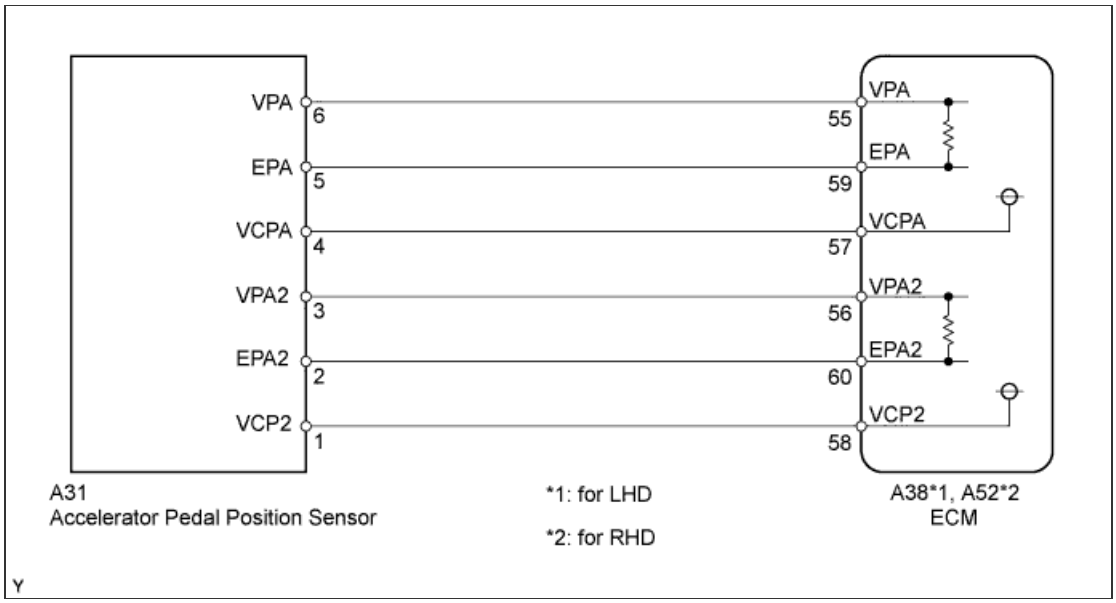
MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is below the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and stores a DTC.
Example:
When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is stored.
If the malfunction is not repaired successfully, a DTC is stored 2 seconds after the engine is next started.

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 are stored, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue to be driven. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.
Fail-safe mode continues until a pass condition is detected, and the ignition switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Accelerator Pedal Position (APP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

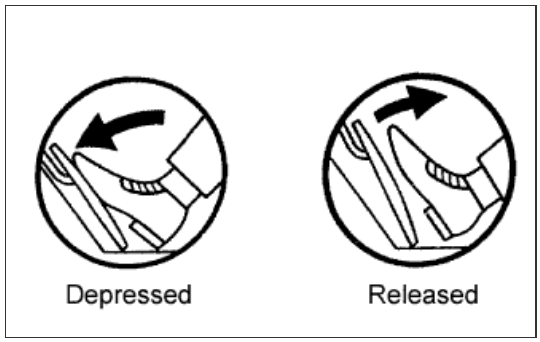
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No.1 and Accelerator Position No.2.

d. Read the value displayed on the tester.



Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2.6 to 4.5 V	3.4 to 5.0 V

Result

Result	Proceed to
OK	A
NG	B

A → Go to step 5

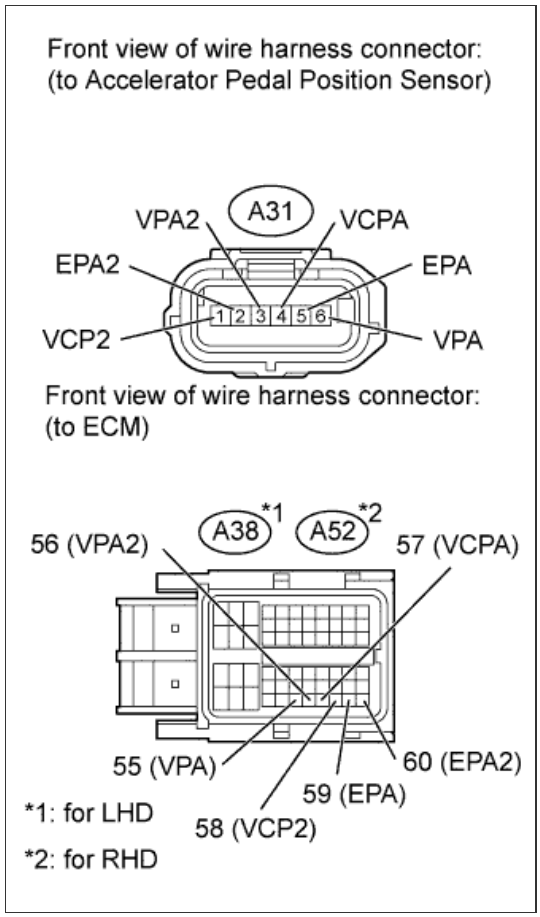
B

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the Accelerator Pedal Position (APP) sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A38-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-59 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A38-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A38-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A38-58 (VCP2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A52-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-59 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A52-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A52-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A52-58 (VCP2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) or A38-55 (VPA) -		10 kΩ or

Body ground	Always	higher
A31-5 (EPA) or A38-59 (EPA) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-57 (VCPA) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-56 (VPA2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A38-60 (EPA2) - Body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A38-58 (VCP2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) or A52-55 (VPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-59 (EPA) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-57 (VCPA) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-56 (VPA2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-60 (EPA2) - Body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A52-58 (VCP2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK ECM (VCPA AND VCP2 VOLTAGE)

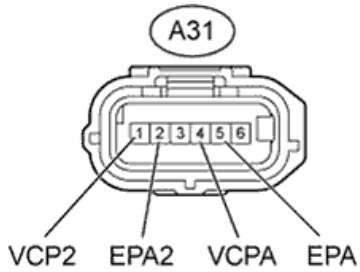
a. Disconnect the APP sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Ignition switch ON	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Ignition switch ON	4.5 to 5.5 V

Front view of wire harness connector:
(to Accelerator Pedal Position Sensor)



NG → REPLACE ECM (Click here)

OK

4.REPLACE ACCELERATOR PEDAL ROD ASSEMBLY

a. Replace the accelerator pedal rod assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read the DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138	A
No output	B

B → SYSTEM OK

A → REPLACE ECM (Click here)

DTC P0136 Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)

DTC P0137 Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)

DTC P0138 Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)

DTC P0156 Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)

DTC P0157 Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)

DTC P0158 Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)

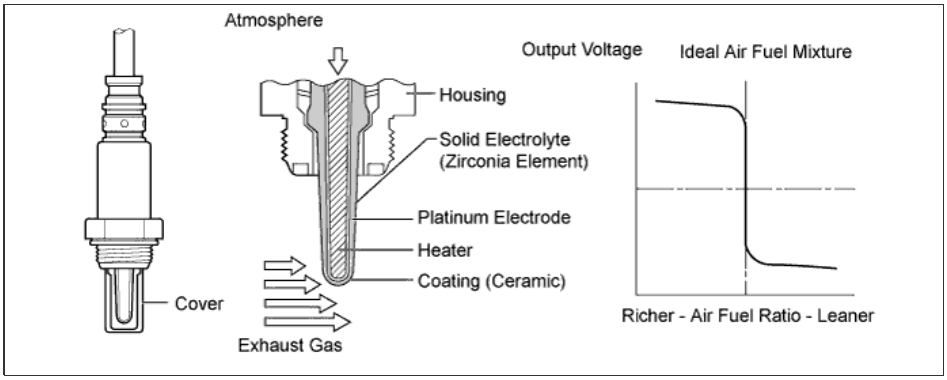
for Preparation Click here

DESCRIPTION

HINT:

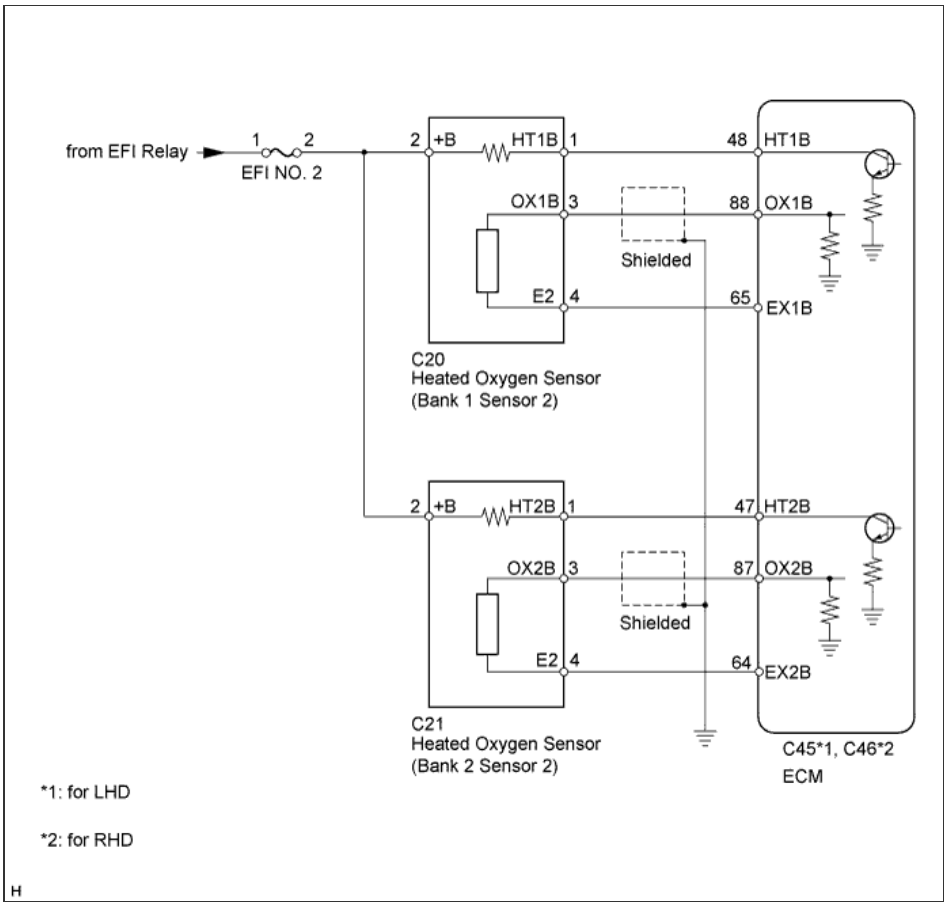
Sensor 2 refers to the sensor mounted behind the three-way catalytic converter and located far from the engine assembly.

A three-way catalyst converter is used in order to convert the carbon monoxide, hydrocarbons, and nitrogen oxide, into less harmful substances. To allow the three-way catalytic converter to function effectively, it is necessary to keep the air fuel ratio of the engine near the stoichiometric air fuel ratio. For the purpose of helping the ECM to deliver accurate air fuel ratio control, a heated oxygen sensor is used.
The heated oxygen sensor is located behind the three-way catalytic converter, and detects the oxygen concentration in the exhaust gas. Since the sensor is integrated with the heater that heats the sensing portion, it is possible to detect the oxygen concentration even when the intake air volume is low (the exhaust gas temperature is low).
When the air fuel ratio becomes lean, the oxygen concentration in the exhaust gas is rich. The heated oxygen sensor informs the ECM that the post-three way catalytic converter air fuel ratio is lean (low voltage, i.e. below 0.45 V).
Conversely, when the air fuel ratio is richer than the stoichiometric air fuel level, the oxygen concentration in the exhaust gas becomes lean. The heated oxygen sensor informs the ECM that the post-three way catalytic converter air fuel ratio is rich (high voltage, i.e. higher than 0.45 V). The heated oxygen sensor has the property of changing its output voltage drastically when the air fuel ratio is close to the stoichiometric level.
The ECM uses the supplementary information from the heated oxygen sensor to determine whether the air fuel ratio after the three-way catalytic converter is rich or lean, and adjusts the fuel injection time accordingly. Thus, if the heated oxygen sensor is working improperly due to internal malfunctions, the ECM is unable to compensate for deviations in the primary air fuel ratio control.

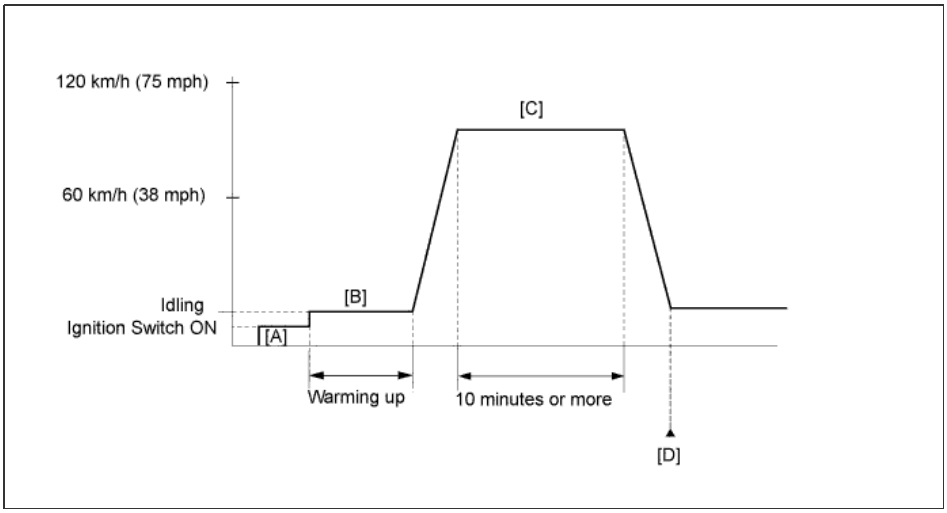


DTC Code	DTC Detection Condition	Trouble Area
P0136 P0156	• Abnormal voltage output: During active air fuel ratio control, the following conditions (a) and (b) are met for a certain period of time (2 trip detection logic): 1. The heated oxygen sensor voltage does not decrease to below 0.21 V. 2. The heated oxygen sensor voltage does not increase to higher than 0.59 V.	• Open or short in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • HO2 sensor heater (bank 1, 2 sensor 2) • Air fuel ratio (A/F) sensor (bank 1, 2 sensor 1) • Gas leak from exhaust system
P0137 P0157	• Low voltage (open): During active air fuel ratio control, the following conditions (a) and (b) are met for a certain period of time (2 trip detection logic): 1. The heated oxygen sensor voltage output is below 0.21 V. 2. The target air fuel ratio is rich.	• Open in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • HO2 sensor heater (bank 1, 2 sensor 2) • Gas leak from exhaust system
P0138 P0158	• High voltage (short): During active air fuel ratio control, the following conditions (a) and (b) are met for a certain period of time (2 trip detection logic): 1. The heated oxygen sensor voltage output is 0.59 V or higher. 2. The target air fuel ratio is lean.	• Short in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • A/F sensor (bank 1, 2 sensor 1) • ECM

WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN



1. Connect the intelligent tester to the DLC3 [A].
2. Turn the tester on.
3. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher [B].
4. Drive the vehicle at 60 to 120 km/h (38 to 75 mph) for at least 10 minutes [C].
5. Enter the following menus: Powertrain / Engine / Utility / All Readiness [D].
6. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.
7. Check that DTC MONITOR is NORMAL. If DTC MONITOR is INCOMPLETE, perform the drive pattern again by accelerating the vehicle and using the second gear to decelerate the vehicle.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the intelligent tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2, or AFS Voltage B2S1 and O2S B2S2) displayed on the intelligent**

tester.

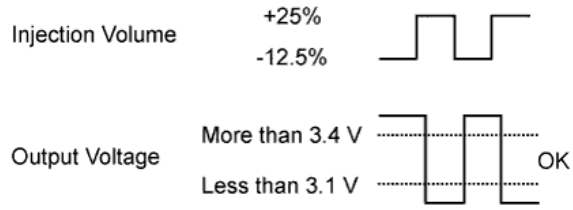
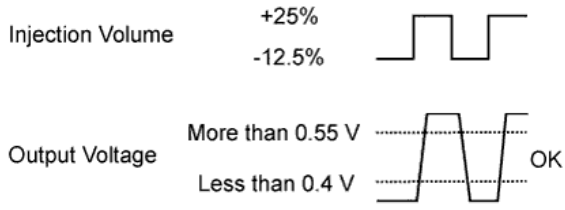
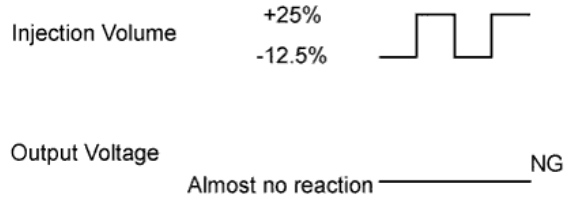
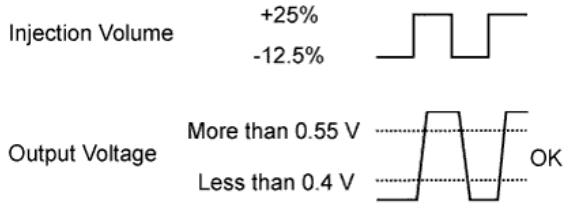
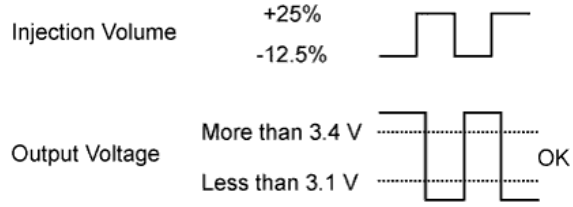
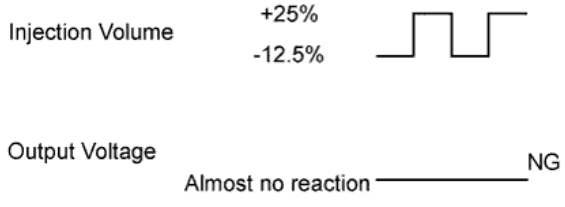
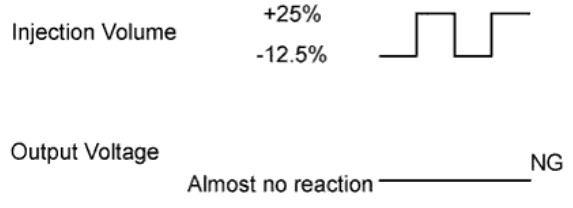
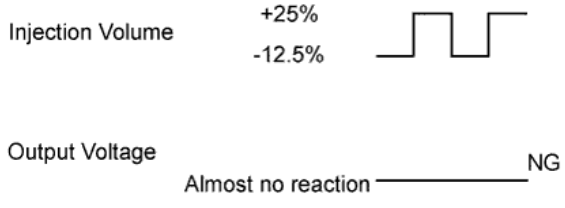
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	Less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ OUTPUT DTC (DTC P0136, P0137, P0138, P0156, P0157 OR P0158)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0138 or P0158	A
P0137 or P0157	B
P0136 or P0156	C

B → Go to step 9

C → Go to step 7

A

2.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1S2.

e. Allow the engine to idle.

f. Read the heated oxygen sensor output voltage while idling.

Result:

Result	Proceed to
Higher than 1.0 V	A
Below 1.0 V	B

B → Go to step 5

A

3.INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)

a. Disconnect the heated oxygen sensor connector.

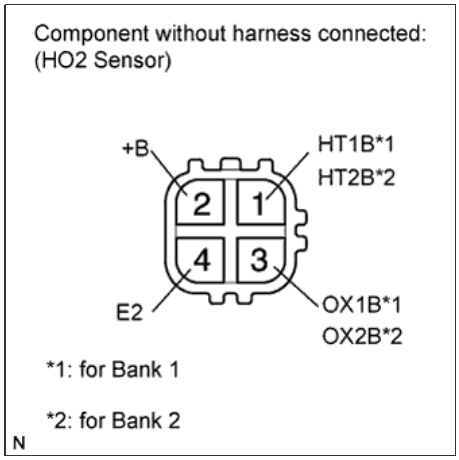
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Bank 1 Sensor 2):

Tester Connection	Condition	Specified Condition
2 (+B) - 4 (E2)	20°C (68°F)	10 kΩ or higher
2 (+B) - 3 (OX1B)	Always	10 kΩ or higher

Standard Resistance (Bank 2 Sensor 2):

Tester Connection	Condition	Specified Condition
2 (+B) - 4 (E2)	20°C (68°F)	10 kΩ or higher
2 (+B) - 3 (OX2B)	Always	10 kΩ or higher



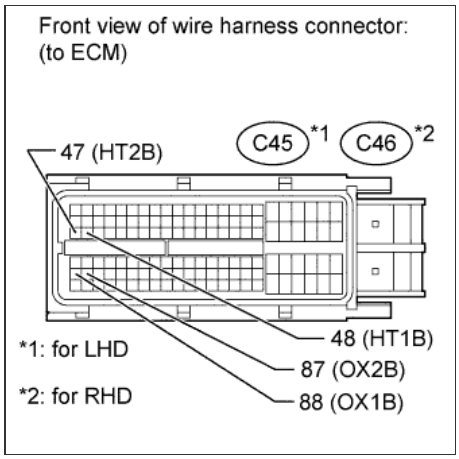
NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

4.CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for LHD

Tester Connection	Condition	Specified Condition
C45-48 (HT1B) - C45-88 (OX1B)	Always	10 kΩ or higher
C45-47 (HT2B) - C45-87 (OX2B)	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C46-48 (HT1B) - C46-88 (OX1B)	Always	10 kΩ or higher
C46-47 (HT2B) - C46-87 (OX2B)	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - HEATED OXYGEN SENSOR)

OK → REPLACE ECM (Click here)

5.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (INJECTION VOLUME)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Warm up the engine.

e. Enter the following menus: Powertrain / Engine / Active Test / Control the Injection Volume.

f. Change the fuel injection volume using the tester, and monitor the voltage output of the air fuel ratio sensor and heated oxygen sensor displayed on the tester.

HINT:

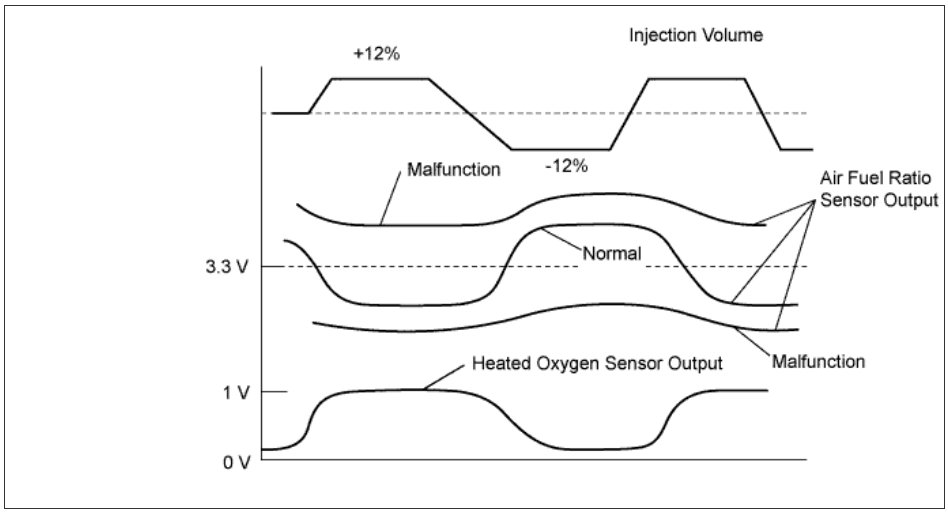
- **Change the fuel injection volume within the range of -12% and +12%. The injection volume can be changed in 1% graduations within this range.**
- **The air fuel ratio sensor is displayed as AFS Voltage B1S1, and the heated oxygen sensor is displayed as O2S B1S2 on the intelligent tester.**

Result:

Tester Display (Sensor)	Voltage Variation	Proceed to
AFS Voltage B1S1 (A/F)	Alternates between higher than and below 3.3 V	OK
AFS Voltage B1S1 (A/F)	Remains at higher than 3.3 V	NG
AFS Voltage B1S1 (A/F)	Remains at below 3.3 V	NG

HINT:

A normal heated oxygen sensor voltage (O2S B1S2) reacts in accordance with increases and decreases in fuel injection volumes. When the air fuel ratio sensor voltage remains at either less or higher than 3.3 V despite the heated oxygen sensor indicating a normal reaction, the air fuel ratio sensor is malfunctioning.



NG	Go to step 15

OK

6.CHECK AIR FUEL RATIO SENSOR

HINT:

This air fuel ratio sensor test is to check the air fuel ratio sensor current during the fuel-cut operation. When the sensor is normal, the sensor current will indicate below 3 mA in this test.

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC / Clear.

e. Clear DTCs.

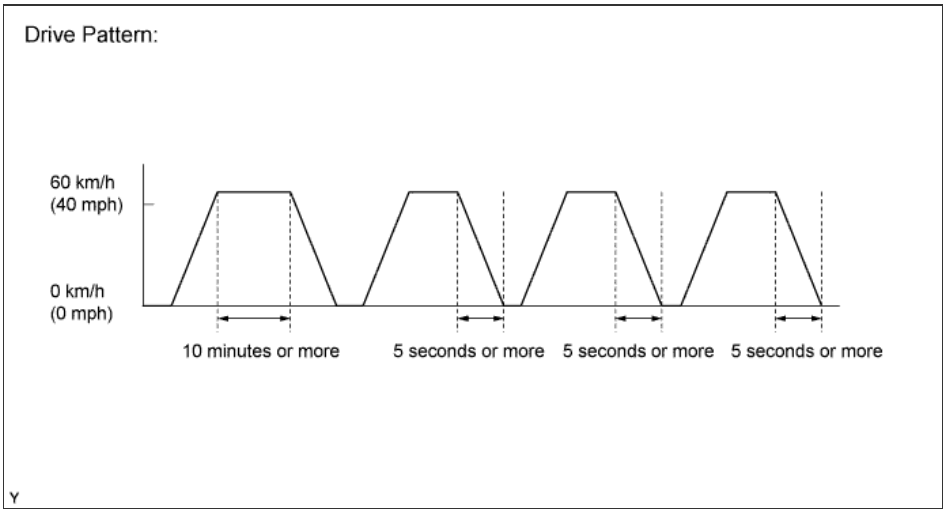
f. Drive the vehicle by the drive pattern as listed below:

i. Warm up the engine.

ii. Drive the vehicle at 60 km/h (40 mph) or more for 10 minutes or more.

iii. Stop the vehicle.

iv. Accelerate the vehicle to 60 km/h (40 mph) or more and then decelerate for 5 seconds or more. Repeat this process at least 3 times.



g. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS Current B1S1.

h. Read the value of the air fuel ratio sensor current while the fuel-cut operation is performing.

Standard current:

Below 3.0 mA

HINT:

- **To measure the air fuel ratio sensor current precisely, perform the fuel-cut operation as long as possible.**
- **If it is difficult to measure the air fuel ratio sensor current, use the snapshot function of the intelligent tester.**

Result

Result	Proceed to
Outside standard range	A
Within standard range	B

OK	Go to step 12
NG	Go to step 15

7.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Start the engine.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1S2.

f. After warming up the engine, run the engine at an engine speed of 2500 rpm for 3 minutes.

g. Read the output voltage of the heated oxygen sensor when the engine speed is suddenly increased.

HINT:

Quickly accelerate the engine to 4000 rpm 3 times using the accelerator pedal.

Standard voltage:
Fluctuates between 0.4 V or less and 0.55 V or higher.

NG	Go to step 9
OK	

8.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (INJECTION VOLUME)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Warm up the engine.

e. Enter the following menus: Powertrain / Engine / Active Test / Control the Injection Volume.

f. Change the fuel injection volume using the tester, and monitor the voltage output of the air fuel ratio sensor and heated oxygen sensor displayed on the tester.

HINT:

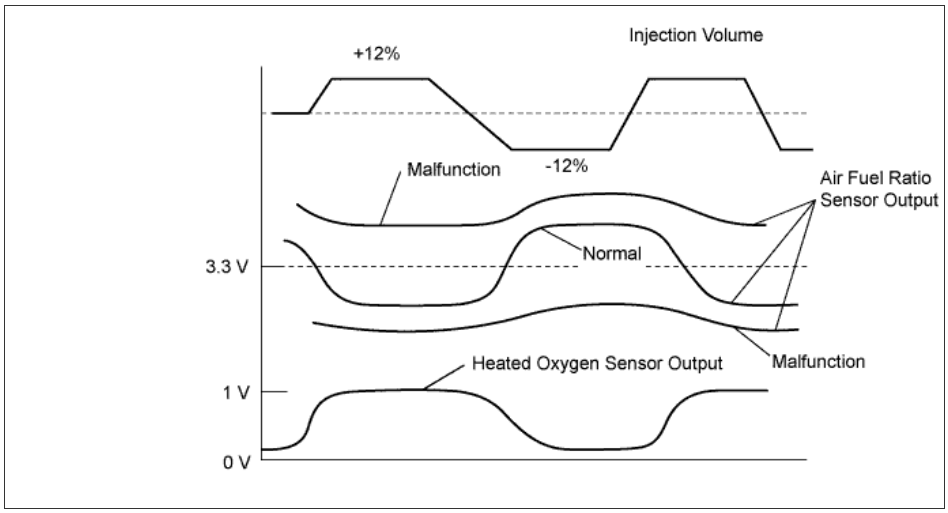
- **Change the fuel injection volume within the range of -12% and +12%. The injection volume can be changed in 1% graduations within this range.**
- **The air fuel ratio sensor is displayed as AFS Voltage B1S1, and the heated oxygen sensor is displayed as O2S B1S2 on the intelligent tester.**

Result:

Tester Display (Sensor)	Voltage Variation	Proceed to
AFS Voltage B1S1 (A/F)	Alternates between higher than and below 3.3 V	OK
AFS Voltage B1S1 (A/F)	Remains at higher than 3.3 V	NG
AFS Voltage B1S1 (A/F)	Remains at below 3.3 V	NG

HINT:

A normal heated oxygen sensor voltage (O2S B1S2) reacts in accordance with increases and decreases in fuel injection volumes. When the air fuel ratio sensor voltage remains at either less or higher than 3.3 V despite the heated oxygen sensor indicating a normal reaction, the air fuel ratio sensor is malfunctioning.



NG → Go to step 15

OK

CHECK EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO AND REPAIR CAUSE (FUEL INJECTOR , FUEL PRESSURE, GAS LEAK FROM SYSTEM, ETC.)

9.CHECK FOR EXHAUST GAS LEAK

a. Check for exhaust gas leakage.

OK:
No gas leak.

NG → REPAIR OR REPLACE EXHAUST GAS LEAK POINT

OK

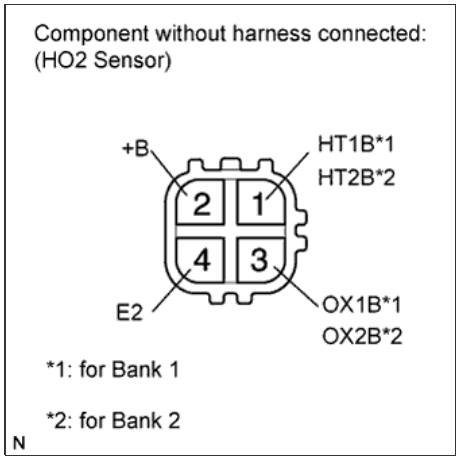
10.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

a. Disconnect the heated oxygen sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT1B) - 4 (E2)	Always	10 kΩ or higher



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

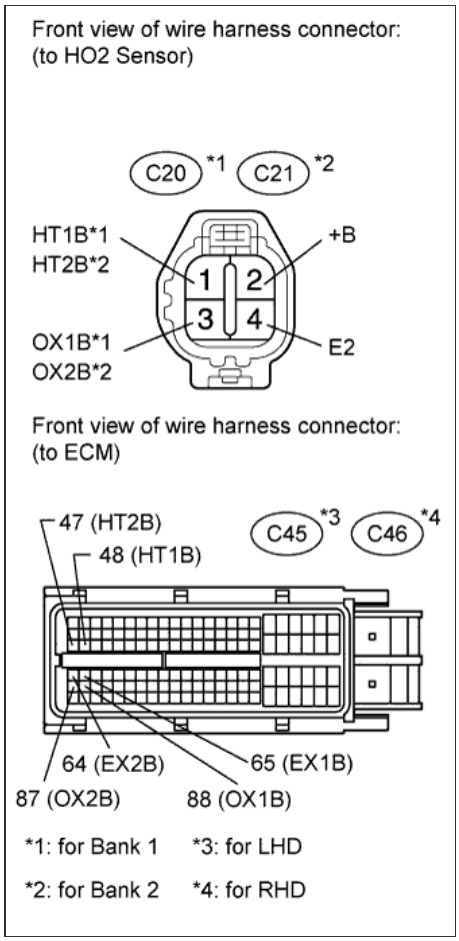
OK

11.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)

a. Disconnect the heated oxygen sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C45-48 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C45-88 (OX1B)	Always	Below 1 Ω
C20-4 (E2) - C45-65 (EX1B)	Always	Below 1 Ω
C21-1 (HT2B) - C45-47 (HT2B)	Always	Below 1 Ω
C21-3 (OX2B) - C45-87 (OX2B)	Always	Below 1 Ω
C21-4 (E2) - C45-64 (EX2B)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C46-48 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C46-88 (OX1B)	Always	Below 1 Ω
C20-4 (E2) - C46-65 (EX1B)	Always	Below 1 Ω
C21-1 (HT2B) - C46-47 (HT2B)	Always	Below 1 Ω
C21-3 (OX2B) - C46-87 (OX2B)	Always	Below 1 Ω
C21-4 (E2) - C46-64 (EX2B)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

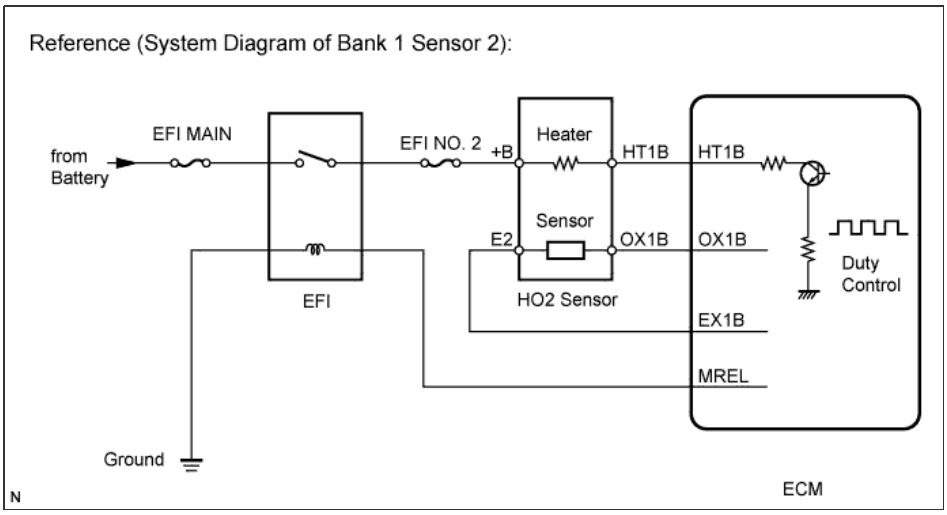
Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C45-48 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C45-88 (OX1B) - Body ground	Always	10 kΩ or higher

C20-4 (E2) or C45-65 (EX1B) - Body ground	Always	10 kΩ or higher
C21-1 (HT2B) or C45-47 (HT2B) - Body ground	Always	10 kΩ or higher
C21-3 (OX2B) or C45-87 (OX2B) - Body ground	Always	10 kΩ or higher
C21-4 (E2) or C45-64 (EX2B) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C46-48 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C46-88 (OX1B) - Body ground	Always	10 kΩ or higher
C20-4 (E2) or C46-65 (EX1B) - Body ground	Always	10 kΩ or higher
C21-1 (HT2B) or C46-47 (HT2B) - Body ground	Always	10 kΩ or higher
C21-3 (OX2B) or C46-87 (OX2B) - Body ground	Always	10 kΩ or higher
C21-4 (E2) or C46-64 (EX2B) - Body ground	Always	10 kΩ or higher

Reference (System Diagram of Bank 1 Sensor 2):



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - HEATED OXYGEN SENSOR)

OK

12.REPLACE HEATED OXYGEN SENSOR

a. Replace the heated oxygen sensor (Click here).

NEXT

13.PERFORM CONFIRMATION DRIVING PATTERN

HINT:

Refer to the CONFIRMATION DRIVING PATTERN.

NEXT

14.CHECK WHETHER DTC OUTPUT RECURS (DTC P0136, P0137, P0138, P0156, P0157 OR P0158)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

e. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

f. Check the DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern again by accelerating the vehicle and using the second gear to decelerate the vehicle.

Result

Result	Proceed to
NORMAL (No DTC output)	A
ABNORMAL (P0136, P0137, P0138, P0156, P0157 or P0158 detected)	B

B → REPLACE AIR FUEL RATIO SENSOR (Click here)

A

END

15.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

16.PERFORM CONFIRMATION DRIVING PATTERN

HINT:

Refer to the CONFIRMATION DRIVING PATTERN.

NEXT

17.CHECK WHETHER DTC OUTPUT RECURS (DTC P0136, P0137, P0138, P0156, P0157 OR P0158)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

e. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

f. Check the DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern again by accelerating the vehicle and using the second gear to decelerate the vehicle.

Result

Result	Proceed to
NORMAL (No DTC output)	A
ABNORMAL (P0136, P0137, P0138, P0156, P0157 or P0158 detected)	B

B → REPLACE HEATED OXYGEN SENSOR (Click here)

A

END

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

for Preparation Click here

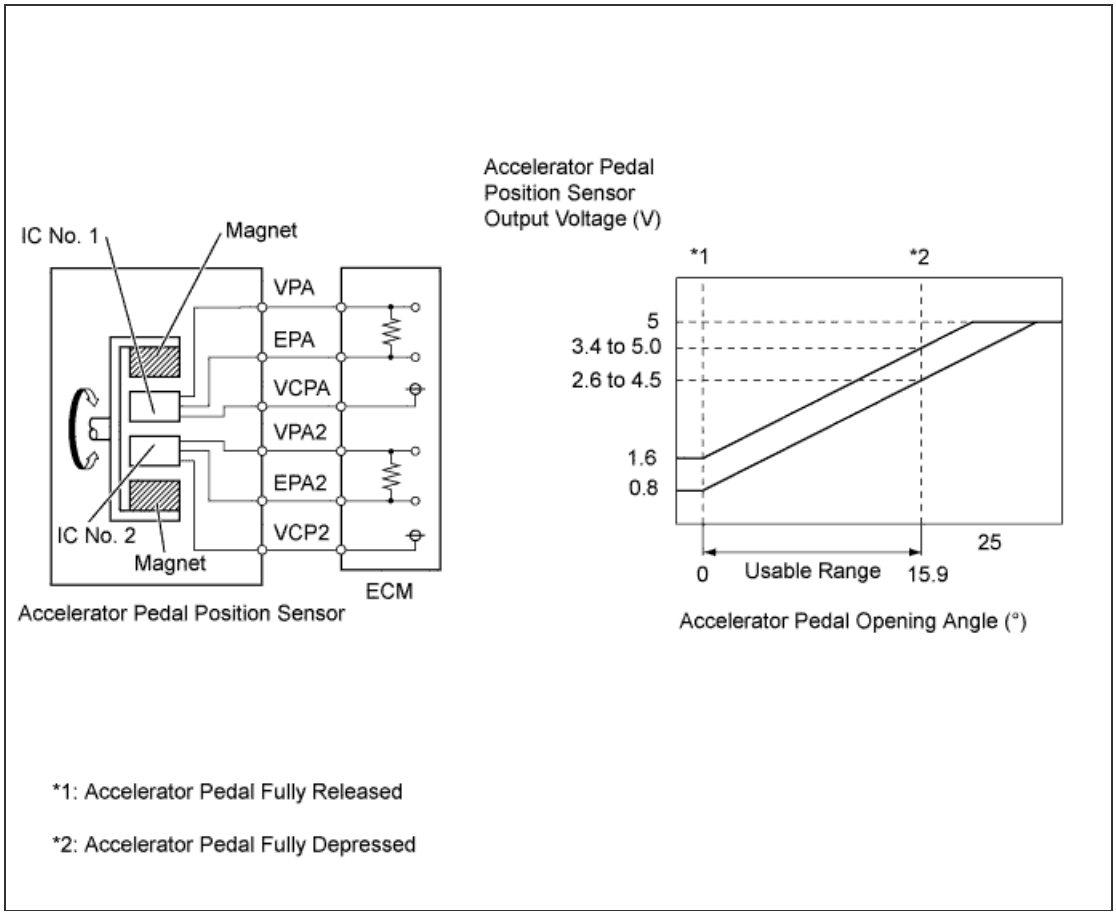
DESCRIPTION

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

The Accelerator Pedal Position (APP) sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC Code	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• Accelerator Pedal Position (APP) sensor • ECM

P2122	VPA is 0.4 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCPA circuit • Open or ground short in VPA circuit • ECM
P2123	VPA is 4.8 V or higher for 2.0 seconds or more (1 trip detection logic).	• APP sensor • Open in EPA circuit • ECM
P2125	VPA2 fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or higher. (b) VPA is between 0.4 V and 3.45 V.	• APP sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): (a) The difference between VPA and VPA2 is 0.02 V or less. (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less.	• Short between VPA and VPA2 circuits • APP sensor • ECM

HINT:

When any of these DTCs are output, check the APP sensor voltage by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No.1 and Accelerator Position No.2.

Trouble Area	Accelerator Position No. 1 When Accelerator Pedal Released	Accelerator Position No. 2 When Accelerator Pedal Released	Accelerator Position No. 1 When Accelerator Pedal Depressed	Accelerator Position No. 2 When Accelerator Pedal Depressed
VCP circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.0 V
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 5.0 V

HINT:

Accelerator pedal positions are expressed as voltages.

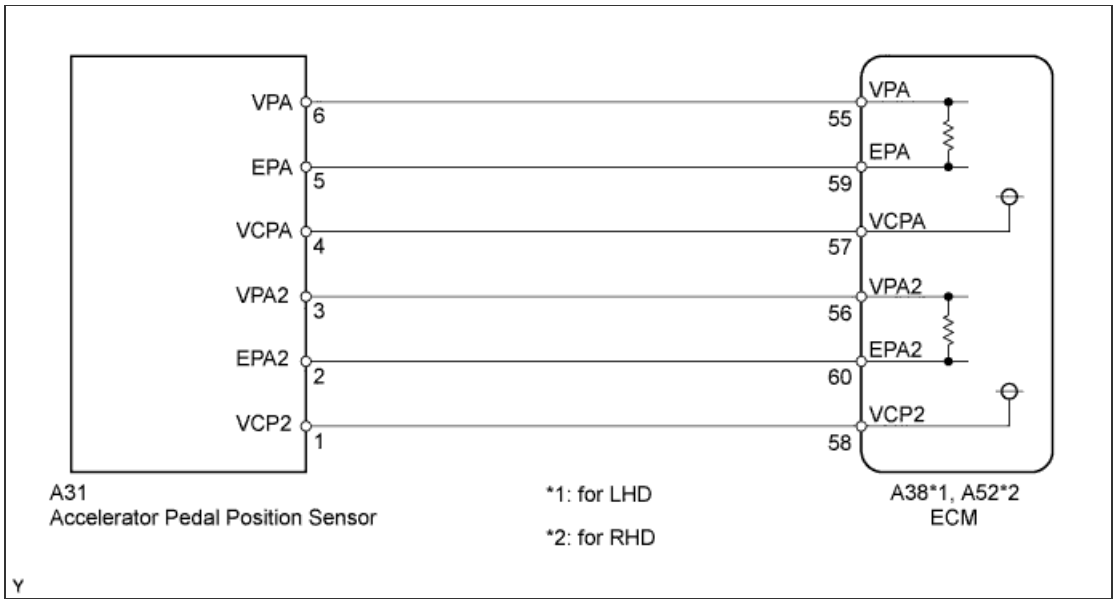
MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is below the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and stores a DTC.
Example:
When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is stored.
If the malfunction is not repaired successfully, a DTC is stored 2 seconds after the engine is next started.

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 are stored, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue to be driven. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.
Fail-safe mode continues until a pass condition is detected, and the ignition switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Accelerator Pedal Position (APP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

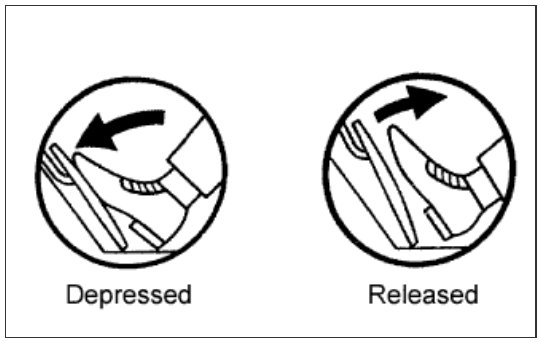
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No.1 and Accelerator Position No.2.

d. Read the value displayed on the tester.



Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2.6 to 4.5 V	3.4 to 5.0 V

Result

Result	Proceed to
OK	A
NG	B

A → Go to step 5

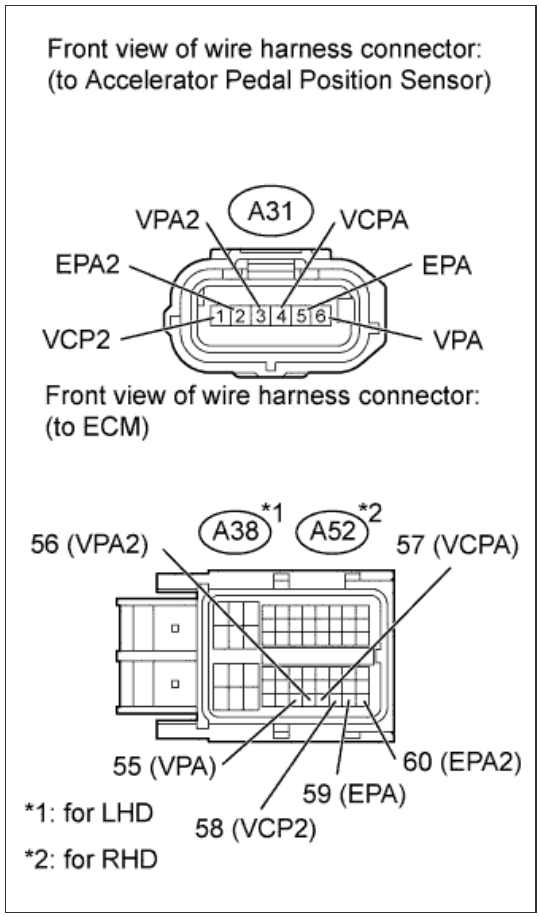
B

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the Accelerator Pedal Position (APP) sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A38-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-59 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A38-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A38-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A38-58 (VCP2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A52-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-59 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A52-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A52-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A52-58 (VCP2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) or A38-55 (VPA) -		10 kΩ or

Body ground	Always	higher
A31-5 (EPA) or A38-59 (EPA) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-57 (VCPA) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-56 (VPA2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A38-60 (EPA2) - Body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A38-58 (VCP2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) or A52-55 (VPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-59 (EPA) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-57 (VCPA) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-56 (VPA2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-60 (EPA2) - Body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A52-58 (VCP2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK ECM (VCPA AND VCP2 VOLTAGE)

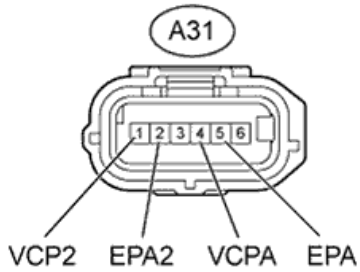
a. Disconnect the APP sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Ignition switch ON	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Ignition switch ON	4.5 to 5.5 V

Front view of wire harness connector:
(to Accelerator Pedal Position Sensor)



NG → REPLACE ECM (Click here)

OK

4.REPLACE ACCELERATOR PEDAL ROD ASSEMBLY

a. Replace the accelerator pedal rod assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read the DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138	A
No output	B

B → SYSTEM OK

A → REPLACE ECM (Click here)

DTC P0136 Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)

DTC P0137 Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)

DTC P0138 Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)

DTC P0156 Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)

DTC P0157 Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)

DTC P0158 Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)

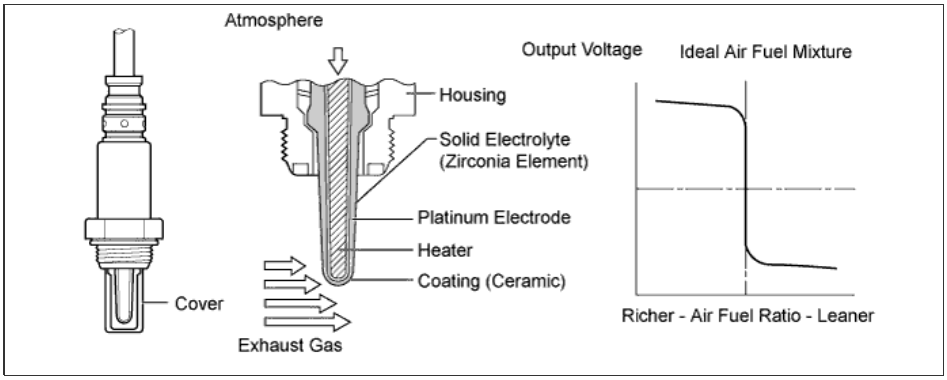
for Preparation Click here

DESCRIPTION

HINT:

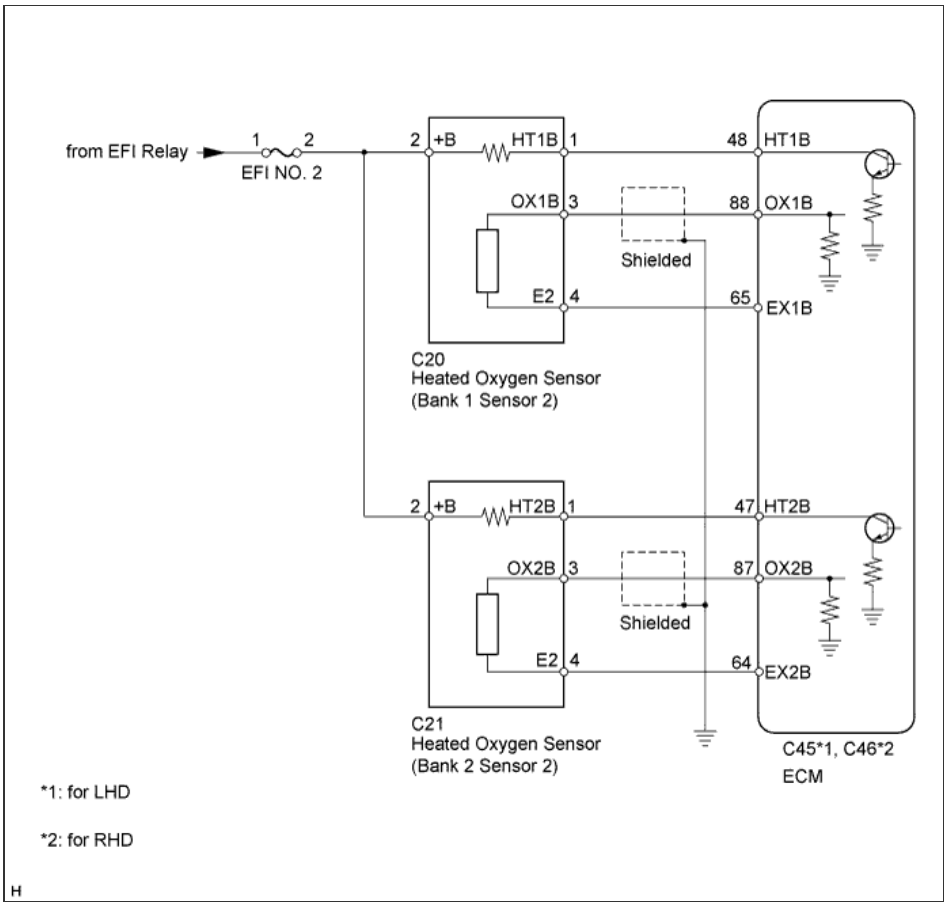
Sensor 2 refers to the sensor mounted behind the three-way catalytic converter and located far from the engine assembly.

A three-way catalyst converter is used in order to convert the carbon monoxide, hydrocarbons, and nitrogen oxide, into less harmful substances. To allow the three-way catalytic converter to function effectively, it is necessary to keep the air fuel ratio of the engine near the stoichiometric air fuel ratio. For the purpose of helping the ECM to deliver accurate air fuel ratio control, a heated oxygen sensor is used.
The heated oxygen sensor is located behind the three-way catalytic converter, and detects the oxygen concentration in the exhaust gas. Since the sensor is integrated with the heater that heats the sensing portion, it is possible to detect the oxygen concentration even when the intake air volume is low (the exhaust gas temperature is low).
When the air fuel ratio becomes lean, the oxygen concentration in the exhaust gas is rich. The heated oxygen sensor informs the ECM that the post-three way catalytic converter air fuel ratio is lean (low voltage, i.e. below 0.45 V).
Conversely, when the air fuel ratio is richer than the stoichiometric air fuel level, the oxygen concentration in the exhaust gas becomes lean. The heated oxygen sensor informs the ECM that the post-three way catalytic converter air fuel ratio is rich (high voltage, i.e. higher than 0.45 V). The heated oxygen sensor has the property of changing its output voltage drastically when the air fuel ratio is close to the stoichiometric level.
The ECM uses the supplementary information from the heated oxygen sensor to determine whether the air fuel ratio after the three-way catalytic converter is rich or lean, and adjusts the fuel injection time accordingly. Thus, if the heated oxygen sensor is working improperly due to internal malfunctions, the ECM is unable to compensate for deviations in the primary air fuel ratio control.

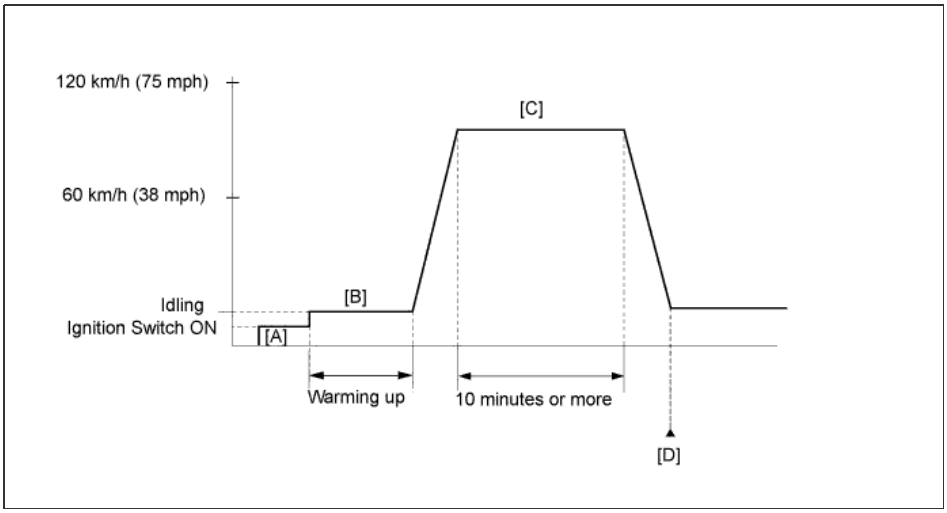


DTC Code	DTC Detection Condition	Trouble Area
P0136 P0156	• Abnormal voltage output: During active air fuel ratio control, the following conditions (a) and (b) are met for a certain period of time (2 trip detection logic): 1. The heated oxygen sensor voltage does not decrease to below 0.21 V. 2. The heated oxygen sensor voltage does not increase to higher than 0.59 V.	• Open or short in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • HO2 sensor heater (bank 1, 2 sensor 2) • Air fuel ratio (A/F) sensor (bank 1, 2 sensor 1) • Gas leak from exhaust system
P0137 P0157	• Low voltage (open): During active air fuel ratio control, the following conditions (a) and (b) are met for a certain period of time (2 trip detection logic): 1. The heated oxygen sensor voltage output is below 0.21 V. 2. The target air fuel ratio is rich.	• Open in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • HO2 sensor heater (bank 1, 2 sensor 2) • Gas leak from exhaust system
P0138 P0158	• High voltage (short): During active air fuel ratio control, the following conditions (a) and (b) are met for a certain period of time (2 trip detection logic): 1. The heated oxygen sensor voltage output is 0.59 V or higher. 2. The target air fuel ratio is lean.	• Short in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • A/F sensor (bank 1, 2 sensor 1) • ECM

WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN



1. Connect the intelligent tester to the DLC3 [A].
2. Turn the tester on.
3. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher [B].
4. Drive the vehicle at 60 to 120 km/h (38 to 75 mph) for at least 10 minutes [C].
5. Enter the following menus: Powertrain / Engine / Utility / All Readiness [D].
6. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.
7. Check that DTC MONITOR is NORMAL. If DTC MONITOR is INCOMPLETE, perform the drive pattern again by accelerating the vehicle and using the second gear to decelerate the vehicle.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the intelligent tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2, or AFS Voltage B2S1 and O2S B2S2) displayed on the intelligent**

tester.

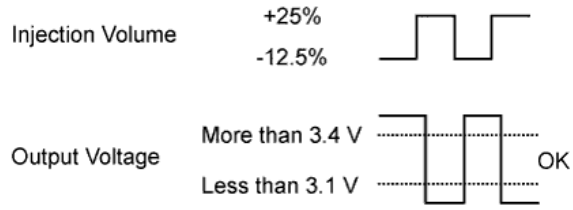
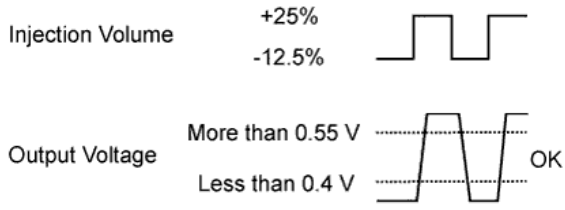
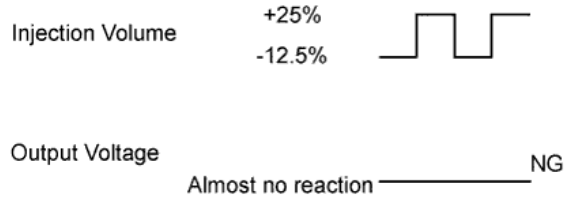
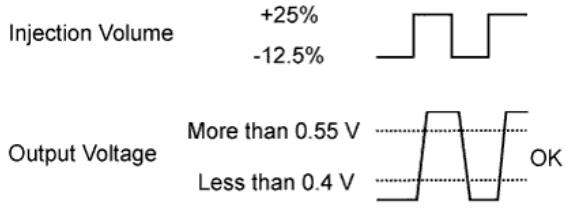
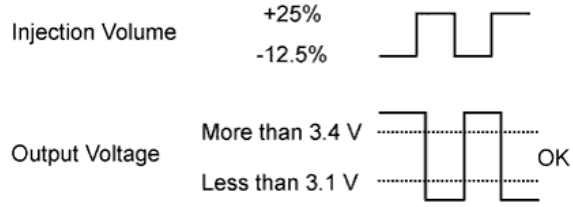
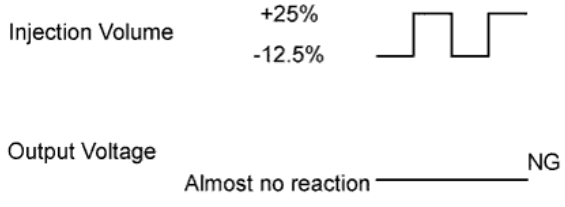
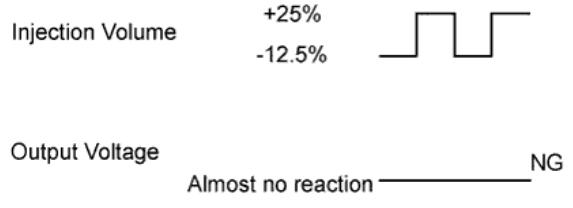
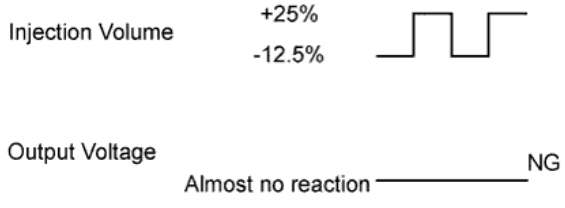
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	Less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ OUTPUT DTC (DTC P0136, P0137, P0138, P0156, P0157 OR P0158)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0138 or P0158	A
P0137 or P0157	B
P0136 or P0156	C

B → Go to step 9

C → Go to step 7

A

2.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1S2.

e. Allow the engine to idle.

f. Read the heated oxygen sensor output voltage while idling.

Result:

Result	Proceed to
Higher than 1.0 V	A
Below 1.0 V	B

B → Go to step 5

A

3.INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)

a. Disconnect the heated oxygen sensor connector.

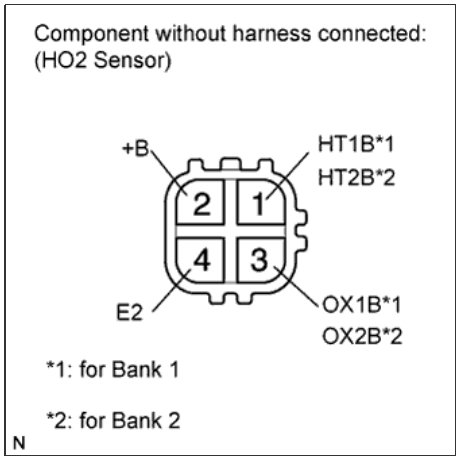
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Bank 1 Sensor 2):

Tester Connection	Condition	Specified Condition
2 (+B) - 4 (E2)	20°C (68°F)	10 kΩ or higher
2 (+B) - 3 (OX1B)	Always	10 kΩ or higher

Standard Resistance (Bank 2 Sensor 2):

Tester Connection	Condition	Specified Condition
2 (+B) - 4 (E2)	20°C (68°F)	10 kΩ or higher
2 (+B) - 3 (OX2B)	Always	10 kΩ or higher



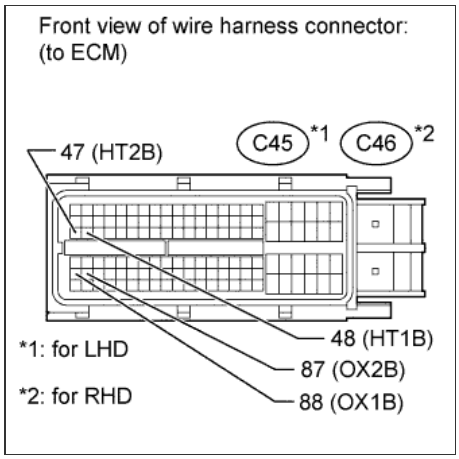
NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

4.CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for LHD

Tester Connection	Condition	Specified Condition
C45-48 (HT1B) - C45-88 (OX1B)	Always	10 kΩ or higher
C45-47 (HT2B) - C45-87 (OX2B)	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C46-48 (HT1B) - C46-88 (OX1B)	Always	10 kΩ or higher
C46-47 (HT2B) - C46-87 (OX2B)	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - HEATED OXYGEN SENSOR)

OK → REPLACE ECM (Click here)

5.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (INJECTION VOLUME)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Warm up the engine.

e. Enter the following menus: Powertrain / Engine / Active Test / Control the Injection Volume.

f. Change the fuel injection volume using the tester, and monitor the voltage output of the air fuel ratio sensor and heated oxygen sensor displayed on the tester.

HINT:

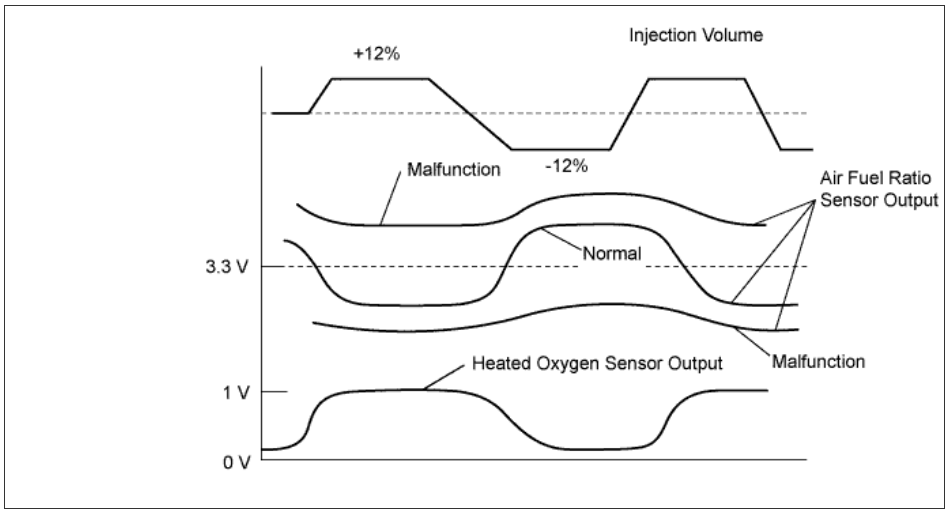
- **Change the fuel injection volume within the range of -12% and +12%. The injection volume can be changed in 1% graduations within this range.**
- **The air fuel ratio sensor is displayed as AFS Voltage B1S1, and the heated oxygen sensor is displayed as O2S B1S2 on the intelligent tester.**

Result:

Tester Display (Sensor)	Voltage Variation	Proceed to
AFS Voltage B1S1 (A/F)	Alternates between higher than and below 3.3 V	OK
AFS Voltage B1S1 (A/F)	Remains at higher than 3.3 V	NG
AFS Voltage B1S1 (A/F)	Remains at below 3.3 V	NG

HINT:

A normal heated oxygen sensor voltage (O2S B1S2) reacts in accordance with increases and decreases in fuel injection volumes. When the air fuel ratio sensor voltage remains at either less or higher than 3.3 V despite the heated oxygen sensor indicating a normal reaction, the air fuel ratio sensor is malfunctioning.



NG	Go to step 15

OK

6.CHECK AIR FUEL RATIO SENSOR

HINT:

This air fuel ratio sensor test is to check the air fuel ratio sensor current during the fuel-cut operation. When the sensor is normal, the sensor current will indicate below 3 mA in this test.

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC / Clear.

e. Clear DTCs.

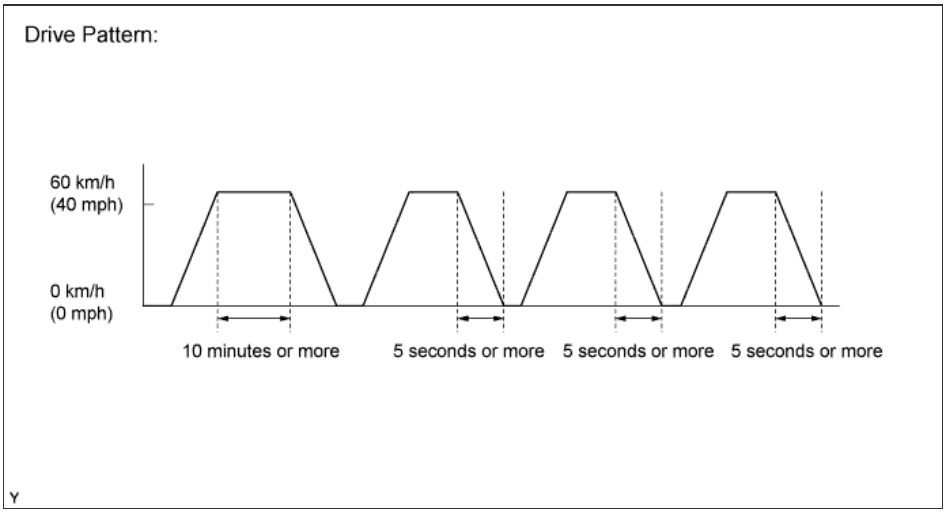
f. Drive the vehicle by the drive pattern as listed below:

i. Warm up the engine.

ii. Drive the vehicle at 60 km/h (40 mph) or more for 10 minutes or more.

iii. Stop the vehicle.

iv. Accelerate the vehicle to 60 km/h (40 mph) or more and then decelerate for 5 seconds or more. Repeat this process at least 3 times.



g. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS Current B1S1.

h. Read the value of the air fuel ratio sensor current while the fuel-cut operation is performing.

Standard current:

Below 3.0 mA

HINT:

- **To measure the air fuel ratio sensor current precisely, perform the fuel-cut operation as long as possible.**
- **If it is difficult to measure the air fuel ratio sensor current, use the snapshot function of the intelligent tester.**

Result

Result	Proceed to
Outside standard range	A
Within standard range	B

OK	Go to step 12
NG	Go to step 15

7.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Start the engine.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1S2.

f. After warming up the engine, run the engine at an engine speed of 2500 rpm for 3 minutes.

g. Read the output voltage of the heated oxygen sensor when the engine speed is suddenly increased.

HINT:

Quickly accelerate the engine to 4000 rpm 3 times using the accelerator pedal.

Standard voltage:
Fluctuates between 0.4 V or less and 0.55 V or higher.

NG	Go to step 9
OK	

8.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (INJECTION VOLUME)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Warm up the engine.

e. Enter the following menus: Powertrain / Engine / Active Test / Control the Injection Volume.

f. Change the fuel injection volume using the tester, and monitor the voltage output of the air fuel ratio sensor and heated oxygen sensor displayed on the tester.

HINT:

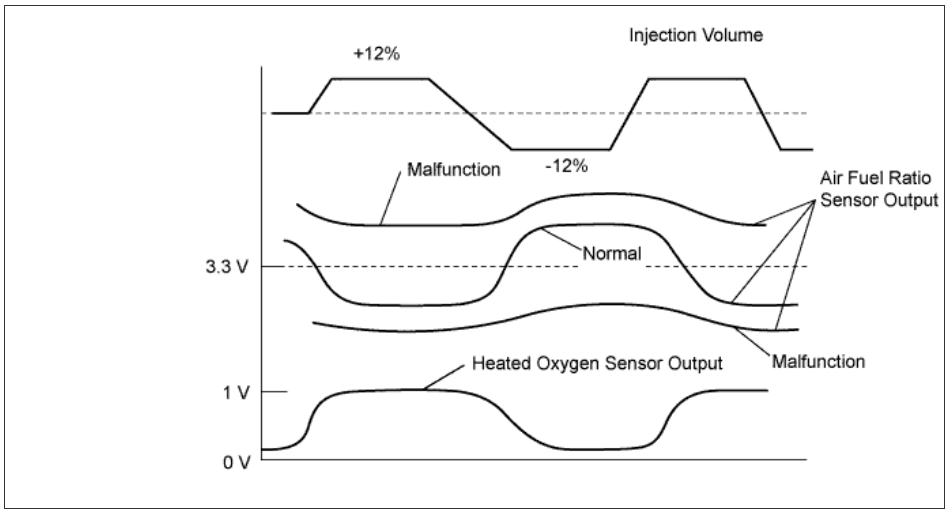
- **Change the fuel injection volume within the range of -12% and +12%. The injection volume can be changed in 1% graduations within this range.**
- **The air fuel ratio sensor is displayed as AFS Voltage B1S1, and the heated oxygen sensor is displayed as O2S B1S2 on the intelligent tester.**

Result:

Tester Display (Sensor)	Voltage Variation	Proceed to
AFS Voltage B1S1 (A/F)	Alternates between higher than and below 3.3 V	OK
AFS Voltage B1S1 (A/F)	Remains at higher than 3.3 V	NG
AFS Voltage B1S1 (A/F)	Remains at below 3.3 V	NG

HINT:

A normal heated oxygen sensor voltage (O2S B1S2) reacts in accordance with increases and decreases in fuel injection volumes. When the air fuel ratio sensor voltage remains at either less or higher than 3.3 V despite the heated oxygen sensor indicating a normal reaction, the air fuel ratio sensor is malfunctioning.



NG → Go to step 15

OK

CHECK EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO AND REPAIR CAUSE (FUEL INJECTOR , FUEL PRESSURE, GAS LEAK FROM SYSTEM, ETC.)

9.CHECK FOR EXHAUST GAS LEAK

a. Check for exhaust gas leakage.

OK:
No gas leak.

NG → REPAIR OR REPLACE EXHAUST GAS LEAK POINT

OK

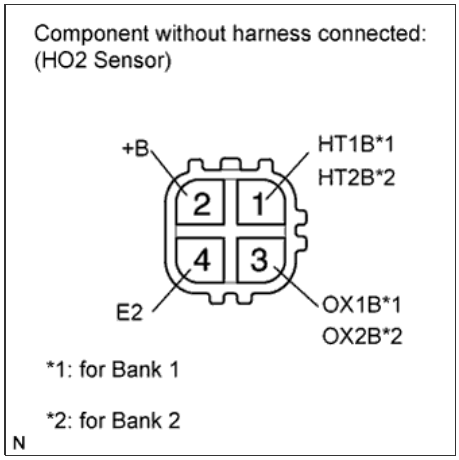
10.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

a. Disconnect the heated oxygen sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT1B) - 4 (E2)	Always	10 kΩ or higher



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

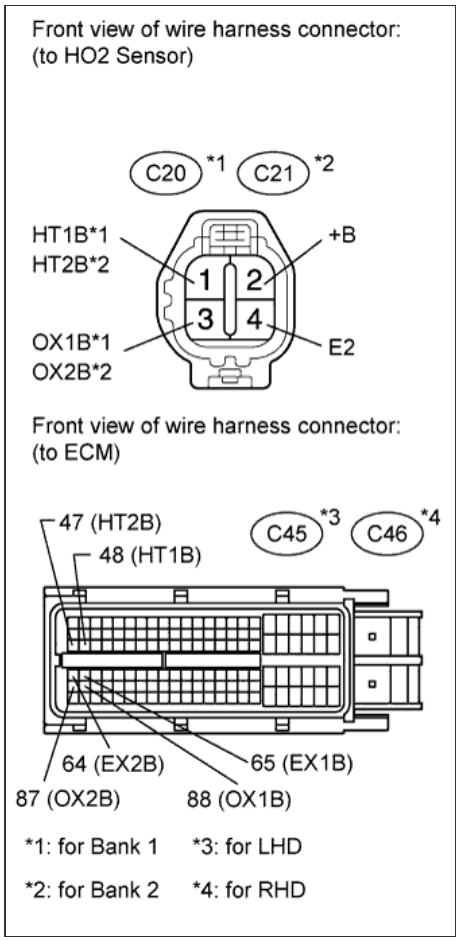
OK

11.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)

a. Disconnect the heated oxygen sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C45-48 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C45-88 (OX1B)	Always	Below 1 Ω
C20-4 (E2) - C45-65 (EX1B)	Always	Below 1 Ω
C21-1 (HT2B) - C45-47 (HT2B)	Always	Below 1 Ω
C21-3 (OX2B) - C45-87 (OX2B)	Always	Below 1 Ω
C21-4 (E2) - C45-64 (EX2B)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C46-48 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C46-88 (OX1B)	Always	Below 1 Ω
C20-4 (E2) - C46-65 (EX1B)	Always	Below 1 Ω
C21-1 (HT2B) - C46-47 (HT2B)	Always	Below 1 Ω
C21-3 (OX2B) - C46-87 (OX2B)	Always	Below 1 Ω
C21-4 (E2) - C46-64 (EX2B)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

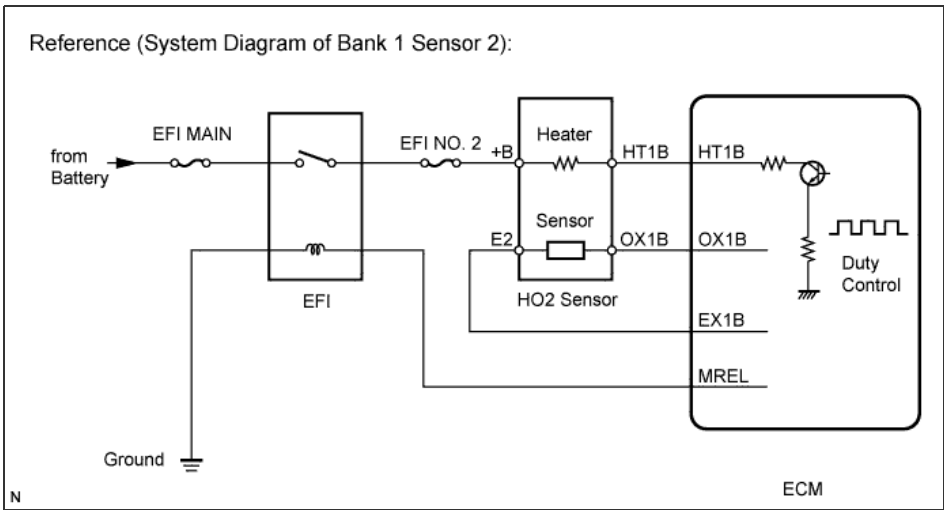
Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C45-48 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C45-88 (OX1B) - Body ground	Always	10 kΩ or higher

C20-4 (E2) or C45-65 (EX1B) - Body ground	Always	10 kΩ or higher
C21-1 (HT2B) or C45-47 (HT2B) - Body ground	Always	10 kΩ or higher
C21-3 (OX2B) or C45-87 (OX2B) - Body ground	Always	10 kΩ or higher
C21-4 (E2) or C45-64 (EX2B) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C46-48 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C46-88 (OX1B) - Body ground	Always	10 kΩ or higher
C20-4 (E2) or C46-65 (EX1B) - Body ground	Always	10 kΩ or higher
C21-1 (HT2B) or C46-47 (HT2B) - Body ground	Always	10 kΩ or higher
C21-3 (OX2B) or C46-87 (OX2B) - Body ground	Always	10 kΩ or higher
C21-4 (E2) or C46-64 (EX2B) - Body ground	Always	10 kΩ or higher

Reference (System Diagram of Bank 1 Sensor 2):



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - HEATED OXYGEN SENSOR)

OK

12.REPLACE HEATED OXYGEN SENSOR

a. Replace the heated oxygen sensor (Click here).

NEXT

13.PERFORM CONFIRMATION DRIVING PATTERN

HINT:

Refer to the CONFIRMATION DRIVING PATTERN.

NEXT

14.CHECK WHETHER DTC OUTPUT RECURS (DTC P0136, P0137, P0138, P0156, P0157 OR P0158)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

e. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

f. Check the DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern again by accelerating the vehicle and using the second gear to decelerate the vehicle.

Result

Result	Proceed to
NORMAL (No DTC output)	A
ABNORMAL (P0136, P0137, P0138, P0156, P0157 or P0158 detected)	B

B → REPLACE AIR FUEL RATIO SENSOR (Click here)

A

END

15.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

16.PERFORM CONFIRMATION DRIVING PATTERN

HINT:

Refer to the CONFIRMATION DRIVING PATTERN.

NEXT

17.CHECK WHETHER DTC OUTPUT RECURS (DTC P0136, P0137, P0138, P0156, P0157 OR P0158)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

e. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

f. Check the DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern again by accelerating the vehicle and using the second gear to decelerate the vehicle.

Result

Result	Proceed to
NORMAL (No DTC output)	A
ABNORMAL (P0136, P0137, P0138, P0156, P0157 or P0158 detected)	B

B → REPLACE HEATED OXYGEN SENSOR (Click here)

A

END

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

for Preparation Click here

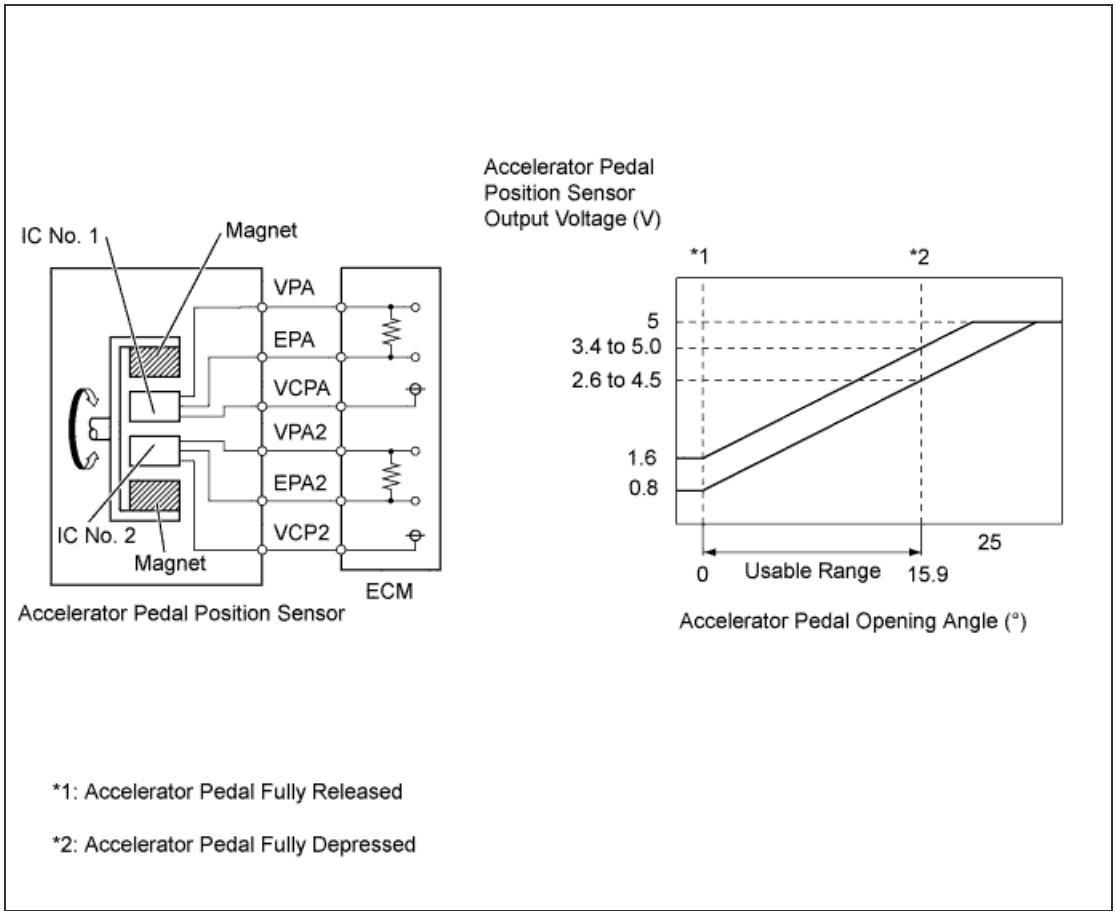
DESCRIPTION

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

The Accelerator Pedal Position (APP) sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC Code	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• Accelerator Pedal Position (APP) sensor • ECM

P2122	VPA is 0.4 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCPA circuit • Open or ground short in VPA circuit • ECM
P2123	VPA is 4.8 V or higher for 2.0 seconds or more (1 trip detection logic).	• APP sensor • Open in EPA circuit • ECM
P2125	VPA2 fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or higher. (b) VPA is between 0.4 V and 3.45 V.	• APP sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): (a) The difference between VPA and VPA2 is 0.02 V or less. (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less.	• Short between VPA and VPA2 circuits • APP sensor • ECM

HINT:

When any of these DTCs are output, check the APP sensor voltage by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No.1 and Accelerator Position No.2.

Trouble Area	Accelerator Position No. 1 When Accelerator Pedal Released	Accelerator Position No. 2 When Accelerator Pedal Released	Accelerator Position No. 1 When Accelerator Pedal Depressed	Accelerator Position No. 2 When Accelerator Pedal Depressed
VCP circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.0 V
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 5.0 V

HINT:

Accelerator pedal positions are expressed as voltages.

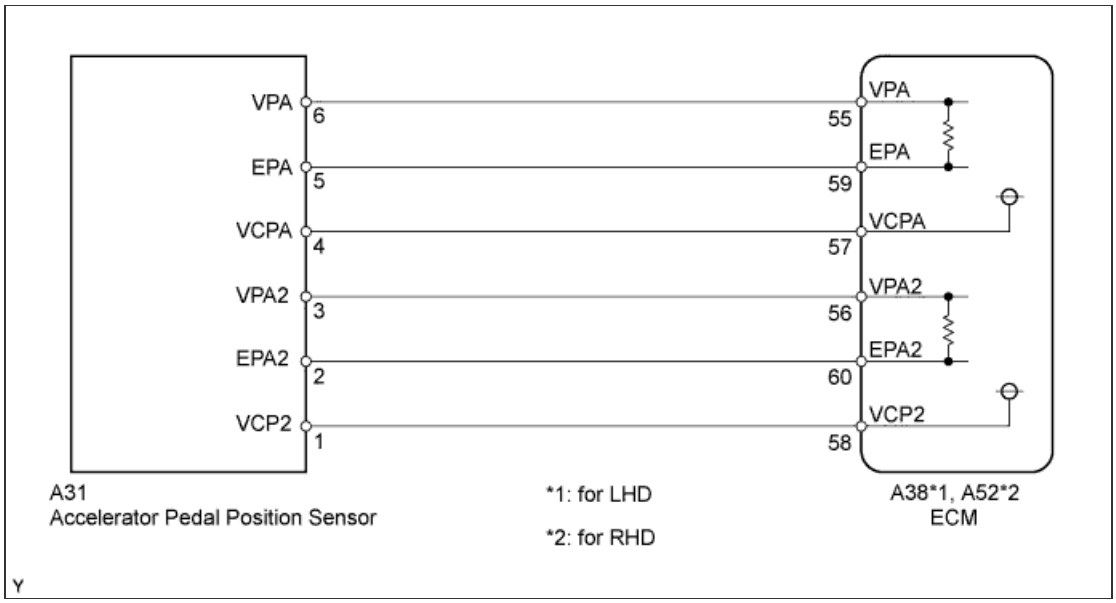
MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is below the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and stores a DTC.
Example:
When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is stored.
If the malfunction is not repaired successfully, a DTC is stored 2 seconds after the engine is next started.

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 are stored, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue to be driven. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.
Fail-safe mode continues until a pass condition is detected, and the ignition switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Accelerator Pedal Position (APP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

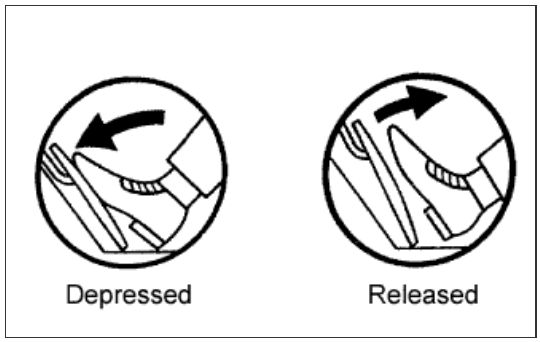
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No.1 and Accelerator Position No.2.

d. Read the value displayed on the tester.



Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2.6 to 4.5 V	3.4 to 5.0 V

Result

Result	Proceed to
OK	A
NG	B

A → Go to step 5

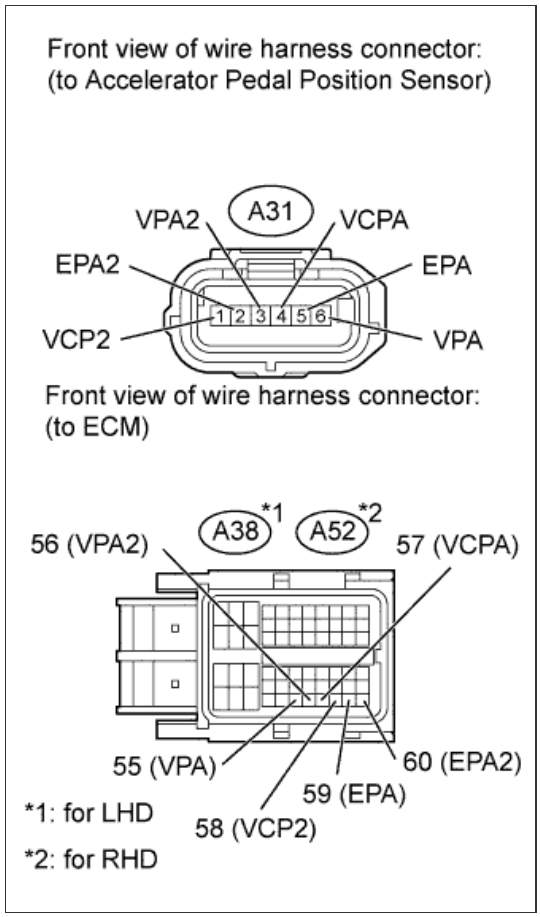
B

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the Accelerator Pedal Position (APP) sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A38-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-59 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A38-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A38-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A38-58 (VCP2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A52-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-59 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A52-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A52-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A52-58 (VCP2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) or A38-55 (VPA) -		10 kΩ or

Body ground	Always	higher
A31-5 (EPA) or A38-59 (EPA) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-57 (VCPA) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-56 (VPA2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A38-60 (EPA2) - Body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A38-58 (VCP2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) or A52-55 (VPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-59 (EPA) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-57 (VCPA) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-56 (VPA2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-60 (EPA2) - Body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A52-58 (VCP2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK ECM (VCPA AND VCP2 VOLTAGE)

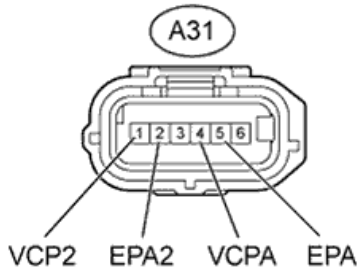
a. Disconnect the APP sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Ignition switch ON	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Ignition switch ON	4.5 to 5.5 V

Front view of wire harness connector:
(to Accelerator Pedal Position Sensor)



NG → REPLACE ECM (Click here)

OK

4.REPLACE ACCELERATOR PEDAL ROD ASSEMBLY

a. Replace the accelerator pedal rod assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read the DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138	A
No output	B

B → SYSTEM OK

A → REPLACE ECM (Click here)

DTC P0136 Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)

DTC P0137 Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)

DTC P0138 Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)

DTC P0156 Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)

DTC P0157 Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)

DTC P0158 Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)

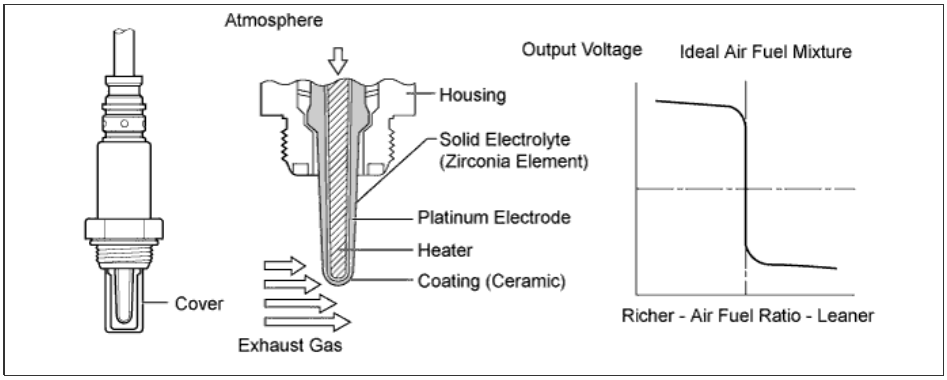
for Preparation Click here

DESCRIPTION

HINT:

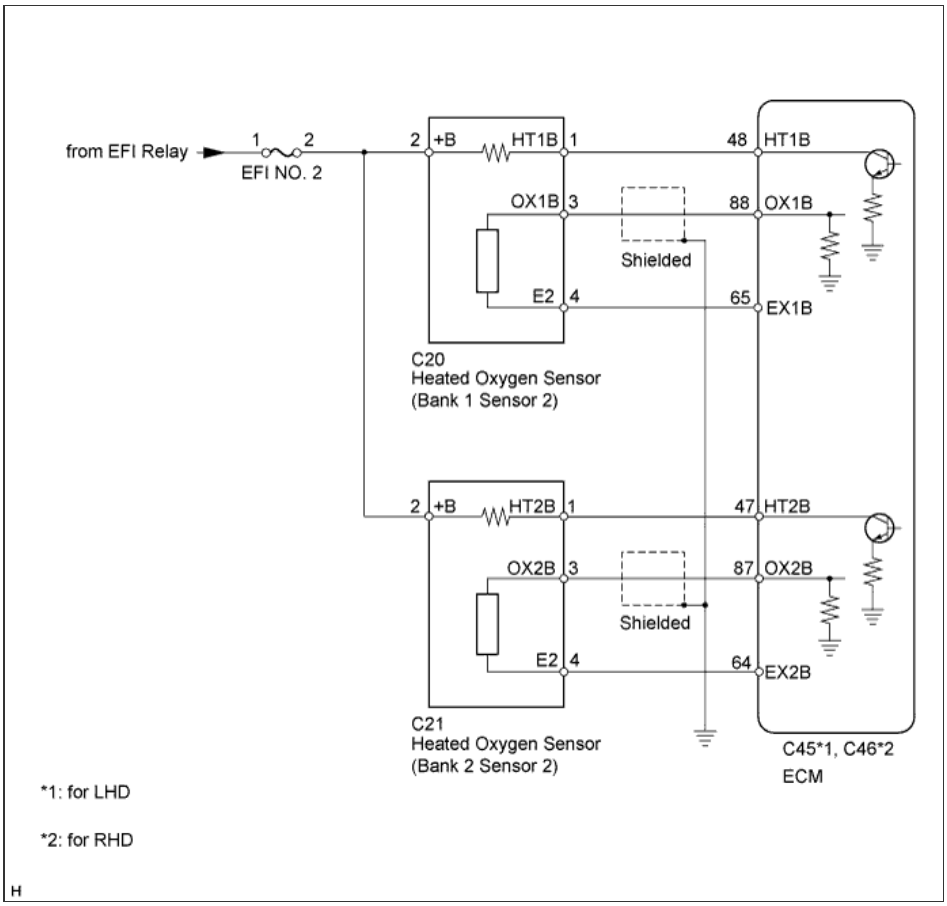
Sensor 2 refers to the sensor mounted behind the three-way catalytic converter and located far from the engine assembly.

A three-way catalyst converter is used in order to convert the carbon monoxide, hydrocarbons, and nitrogen oxide, into less harmful substances. To allow the three-way catalytic converter to function effectively, it is necessary to keep the air fuel ratio of the engine near the stoichiometric air fuel ratio. For the purpose of helping the ECM to deliver accurate air fuel ratio control, a heated oxygen sensor is used.
The heated oxygen sensor is located behind the three-way catalytic converter, and detects the oxygen concentration in the exhaust gas. Since the sensor is integrated with the heater that heats the sensing portion, it is possible to detect the oxygen concentration even when the intake air volume is low (the exhaust gas temperature is low).
When the air fuel ratio becomes lean, the oxygen concentration in the exhaust gas is rich. The heated oxygen sensor informs the ECM that the post-three way catalytic converter air fuel ratio is lean (low voltage, i.e. below 0.45 V).
Conversely, when the air fuel ratio is richer than the stoichiometric air fuel level, the oxygen concentration in the exhaust gas becomes lean. The heated oxygen sensor informs the ECM that the post-three way catalytic converter air fuel ratio is rich (high voltage, i.e. higher than 0.45 V). The heated oxygen sensor has the property of changing its output voltage drastically when the air fuel ratio is close to the stoichiometric level.
The ECM uses the supplementary information from the heated oxygen sensor to determine whether the air fuel ratio after the three-way catalytic converter is rich or lean, and adjusts the fuel injection time accordingly. Thus, if the heated oxygen sensor is working improperly due to internal malfunctions, the ECM is unable to compensate for deviations in the primary air fuel ratio control.

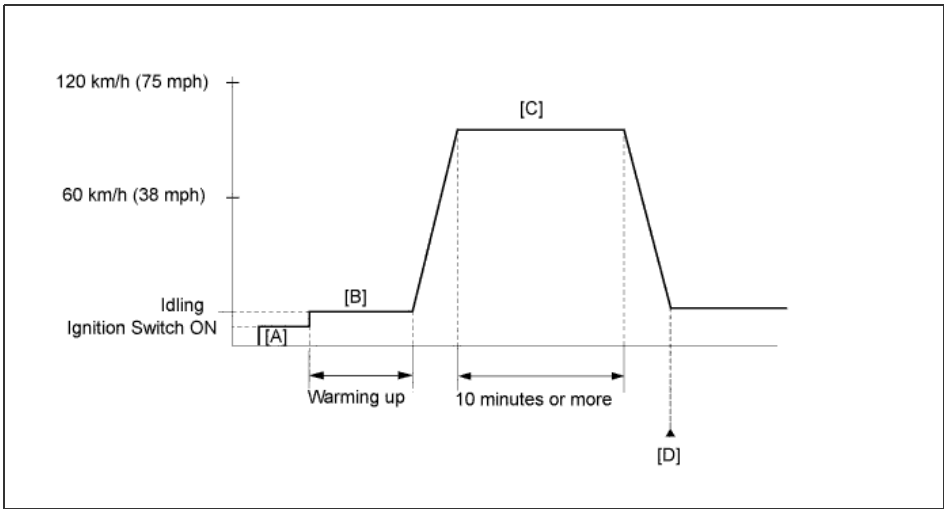


DTC Code	DTC Detection Condition	Trouble Area
P0136 P0156	• Abnormal voltage output: During active air fuel ratio control, the following conditions (a) and (b) are met for a certain period of time (2 trip detection logic): 1. The heated oxygen sensor voltage does not decrease to below 0.21 V. 2. The heated oxygen sensor voltage does not increase to higher than 0.59 V.	• Open or short in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • HO2 sensor heater (bank 1, 2 sensor 2) • Air fuel ratio (A/F) sensor (bank 1, 2 sensor 1) • Gas leak from exhaust system
P0137 P0157	• Low voltage (open): During active air fuel ratio control, the following conditions (a) and (b) are met for a certain period of time (2 trip detection logic): 1. The heated oxygen sensor voltage output is below 0.21 V. 2. The target air fuel ratio is rich.	• Open in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • HO2 sensor heater (bank 1, 2 sensor 2) • Gas leak from exhaust system
P0138 P0158	• High voltage (short): During active air fuel ratio control, the following conditions (a) and (b) are met for a certain period of time (2 trip detection logic): 1. The heated oxygen sensor voltage output is 0.59 V or higher. 2. The target air fuel ratio is lean.	• Short in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • A/F sensor (bank 1, 2 sensor 1) • ECM

WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN



1. Connect the intelligent tester to the DLC3 [A].
2. Turn the tester on.
3. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher [B].
4. Drive the vehicle at 60 to 120 km/h (38 to 75 mph) for at least 10 minutes [C].
5. Enter the following menus: Powertrain / Engine / Utility / All Readiness [D].
6. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.
7. Check that DTC MONITOR is NORMAL. If DTC MONITOR is INCOMPLETE, perform the drive pattern again by accelerating the vehicle and using the second gear to decelerate the vehicle.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the intelligent tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2, or AFS Voltage B2S1 and O2S B2S2) displayed on the intelligent**

tester.

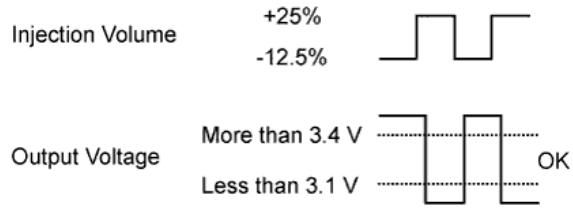
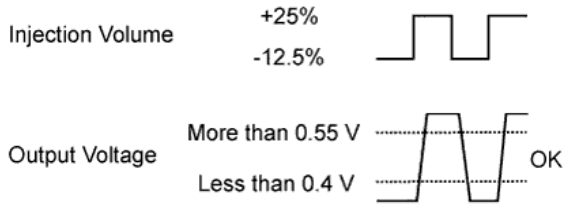
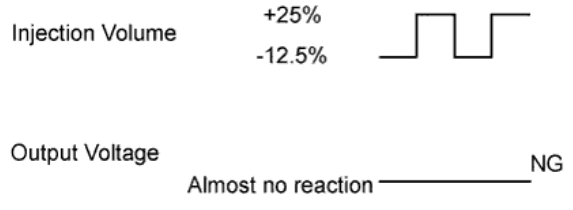
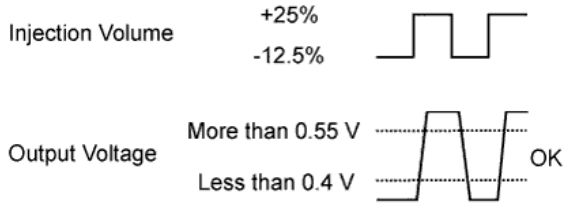
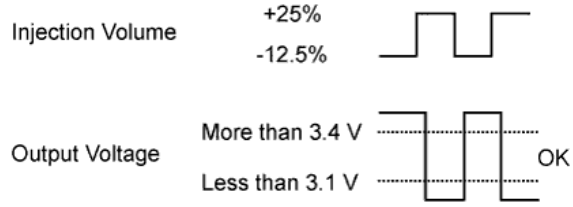
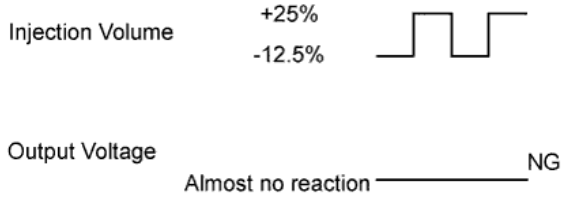
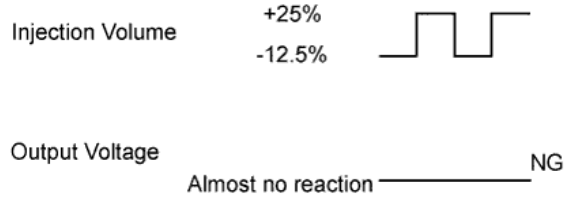
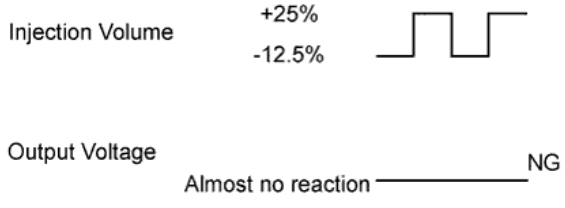
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	Less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ OUTPUT DTC (DTC P0136, P0137, P0138, P0156, P0157 OR P0158)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0138 or P0158	A
P0137 or P0157	B
P0136 or P0156	C

B → Go to step 9

C → Go to step 7

A

2.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1S2.

e. Allow the engine to idle.

f. Read the heated oxygen sensor output voltage while idling.

Result:

Result	Proceed to
Higher than 1.0 V	A
Below 1.0 V	B

B → Go to step 5

A

3.INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)

a. Disconnect the heated oxygen sensor connector.

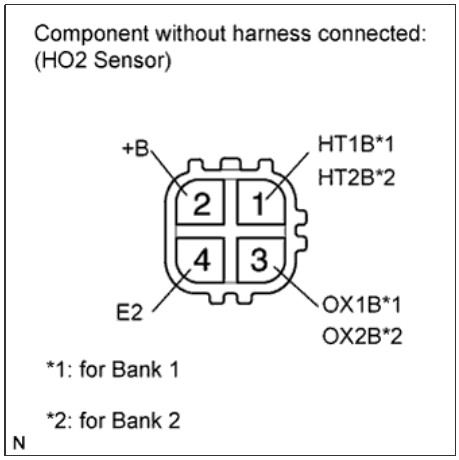
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Bank 1 Sensor 2):

Tester Connection	Condition	Specified Condition
2 (+B) - 4 (E2)	20°C (68°F)	10 kΩ or higher
2 (+B) - 3 (OX1B)	Always	10 kΩ or higher

Standard Resistance (Bank 2 Sensor 2):

Tester Connection	Condition	Specified Condition
2 (+B) - 4 (E2)	20°C (68°F)	10 kΩ or higher
2 (+B) - 3 (OX2B)	Always	10 kΩ or higher



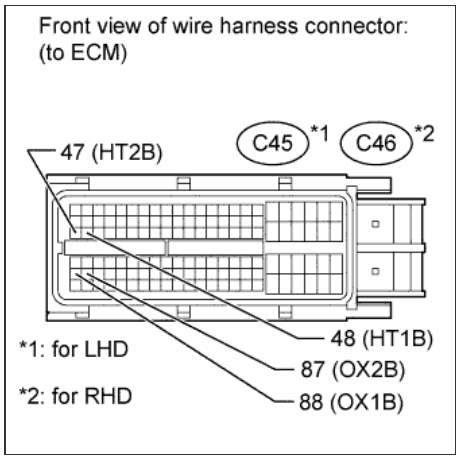
NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

4.CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for LHD

Tester Connection	Condition	Specified Condition
C45-48 (HT1B) - C45-88 (OX1B)	Always	10 kΩ or higher
C45-47 (HT2B) - C45-87 (OX2B)	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C46-48 (HT1B) - C46-88 (OX1B)	Always	10 kΩ or higher
C46-47 (HT2B) - C46-87 (OX2B)	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - HEATED OXYGEN SENSOR)

OK → REPLACE ECM (Click here)

5.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (INJECTION VOLUME)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Warm up the engine.

e. Enter the following menus: Powertrain / Engine / Active Test / Control the Injection Volume.

f. Change the fuel injection volume using the tester, and monitor the voltage output of the air fuel ratio sensor and heated oxygen sensor displayed on the tester.

HINT:

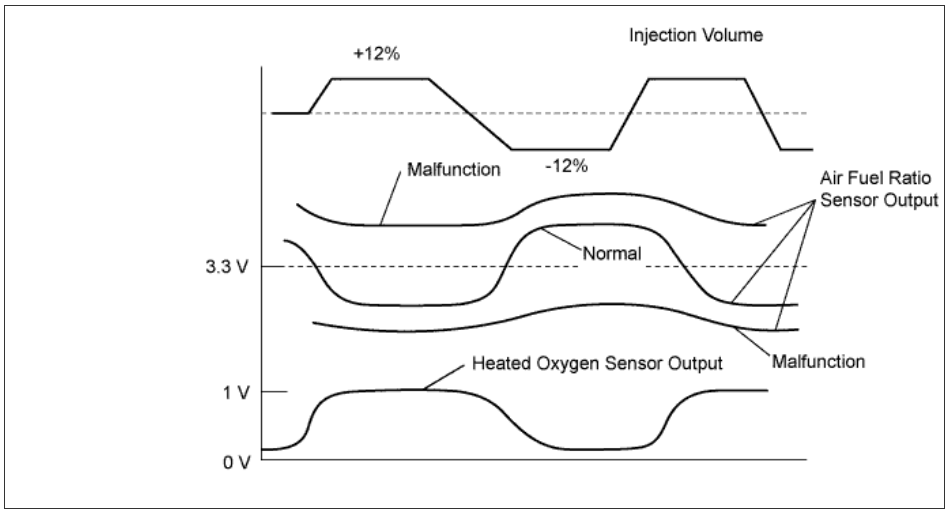
- **Change the fuel injection volume within the range of -12% and +12%. The injection volume can be changed in 1% graduations within this range.**
- **The air fuel ratio sensor is displayed as AFS Voltage B1S1, and the heated oxygen sensor is displayed as O2S B1S2 on the intelligent tester.**

Result:

Tester Display (Sensor)	Voltage Variation	Proceed to
AFS Voltage B1S1 (A/F)	Alternates between higher than and below 3.3 V	OK
AFS Voltage B1S1 (A/F)	Remains at higher than 3.3 V	NG
AFS Voltage B1S1 (A/F)	Remains at below 3.3 V	NG

HINT:

A normal heated oxygen sensor voltage (O2S B1S2) reacts in accordance with increases and decreases in fuel injection volumes. When the air fuel ratio sensor voltage remains at either less or higher than 3.3 V despite the heated oxygen sensor indicating a normal reaction, the air fuel ratio sensor is malfunctioning.



NG	Go to step 15

OK

6.CHECK AIR FUEL RATIO SENSOR

HINT:

This air fuel ratio sensor test is to check the air fuel ratio sensor current during the fuel-cut operation. When the sensor is normal, the sensor current will indicate below 3 mA in this test.

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC / Clear.

e. Clear DTCs.

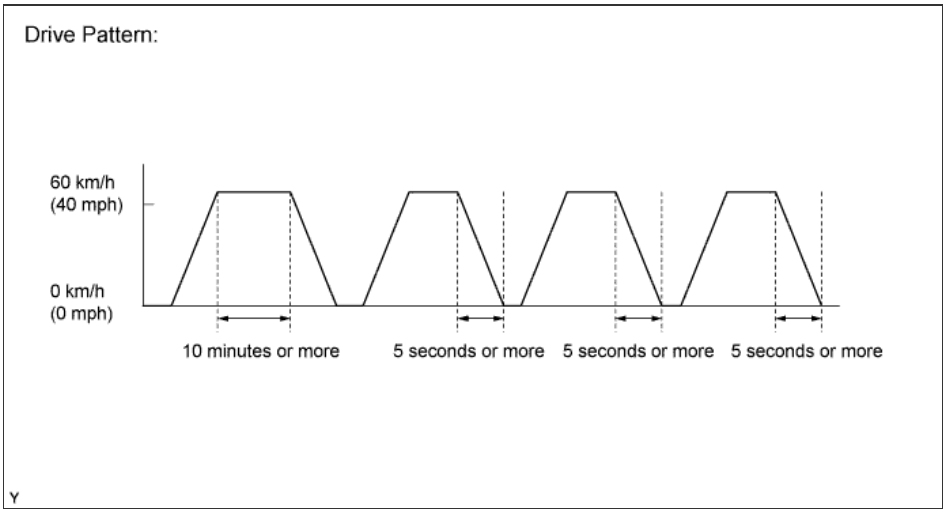
f. Drive the vehicle by the drive pattern as listed below:

i. Warm up the engine.

ii. Drive the vehicle at 60 km/h (40 mph) or more for 10 minutes or more.

iii. Stop the vehicle.

iv. Accelerate the vehicle to 60 km/h (40 mph) or more and then decelerate for 5 seconds or more. Repeat this process at least 3 times.



g. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS Current B1S1.

h. Read the value of the air fuel ratio sensor current while the fuel-cut operation is performing.

Standard current:

Below 3.0 mA

HINT:

- **To measure the air fuel ratio sensor current precisely, perform the fuel-cut operation as long as possible.**
- **If it is difficult to measure the air fuel ratio sensor current, use the snapshot function of the intelligent tester.**

Result

Result	Proceed to
Outside standard range	A
Within standard range	B

OK	Go to step 12
NG	Go to step 15

7.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Start the engine.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1S2.

f. After warming up the engine, run the engine at an engine speed of 2500 rpm for 3 minutes.

g. Read the output voltage of the heated oxygen sensor when the engine speed is suddenly increased.

HINT:

Quickly accelerate the engine to 4000 rpm 3 times using the accelerator pedal.

Standard voltage:
Fluctuates between 0.4 V or less and 0.55 V or higher.

NG	Go to step 9
OK	

8.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (INJECTION VOLUME)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Warm up the engine.

e. Enter the following menus: Powertrain / Engine / Active Test / Control the Injection Volume.

f. Change the fuel injection volume using the tester, and monitor the voltage output of the air fuel ratio sensor and heated oxygen sensor displayed on the tester.

HINT:

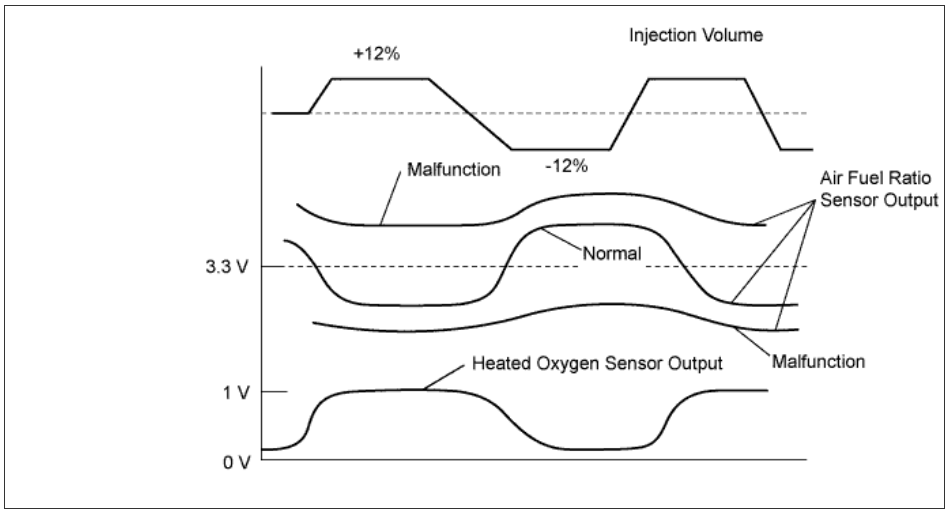
- **Change the fuel injection volume within the range of -12% and +12%. The injection volume can be changed in 1% graduations within this range.**
- **The air fuel ratio sensor is displayed as AFS Voltage B1S1, and the heated oxygen sensor is displayed as O2S B1S2 on the intelligent tester.**

Result:

Tester Display (Sensor)	Voltage Variation	Proceed to
AFS Voltage B1S1 (A/F)	Alternates between higher than and below 3.3 V	OK
AFS Voltage B1S1 (A/F)	Remains at higher than 3.3 V	NG
AFS Voltage B1S1 (A/F)	Remains at below 3.3 V	NG

HINT:

A normal heated oxygen sensor voltage (O2S B1S2) reacts in accordance with increases and decreases in fuel injection volumes. When the air fuel ratio sensor voltage remains at either less or higher than 3.3 V despite the heated oxygen sensor indicating a normal reaction, the air fuel ratio sensor is malfunctioning.



NG → Go to step 15

OK

CHECK EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO AND REPAIR CAUSE (FUEL INJECTOR , FUEL PRESSURE, GAS LEAK FROM SYSTEM, ETC.)

9.CHECK FOR EXHAUST GAS LEAK

a. Check for exhaust gas leakage.

OK:
No gas leak.

NG → REPAIR OR REPLACE EXHAUST GAS LEAK POINT

OK

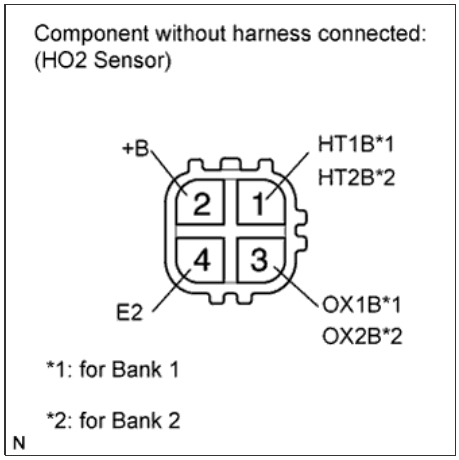
10.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

a. Disconnect the heated oxygen sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT1B) - 4 (E2)	Always	10 kΩ or higher



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

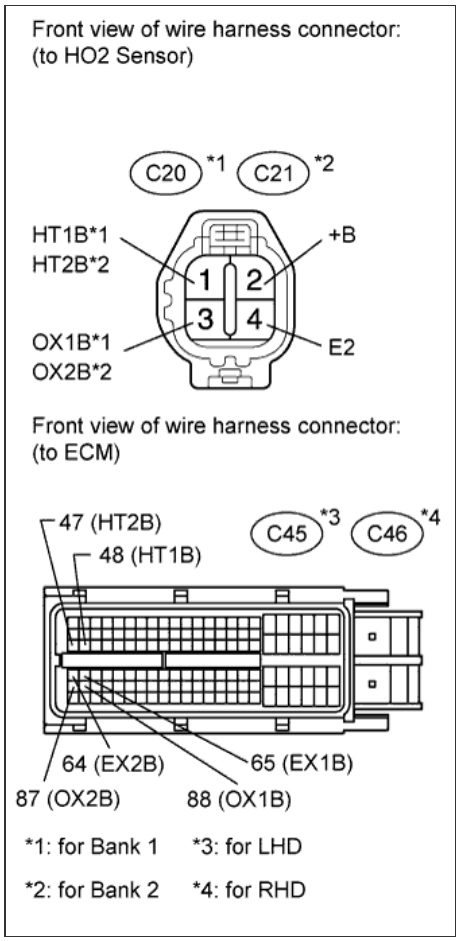
OK

11.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)

a. Disconnect the heated oxygen sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C45-48 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C45-88 (OX1B)	Always	Below 1 Ω
C20-4 (E2) - C45-65 (EX1B)	Always	Below 1 Ω
C21-1 (HT2B) - C45-47 (HT2B)	Always	Below 1 Ω
C21-3 (OX2B) - C45-87 (OX2B)	Always	Below 1 Ω
C21-4 (E2) - C45-64 (EX2B)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C46-48 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C46-88 (OX1B)	Always	Below 1 Ω
C20-4 (E2) - C46-65 (EX1B)	Always	Below 1 Ω
C21-1 (HT2B) - C46-47 (HT2B)	Always	Below 1 Ω
C21-3 (OX2B) - C46-87 (OX2B)	Always	Below 1 Ω
C21-4 (E2) - C46-64 (EX2B)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

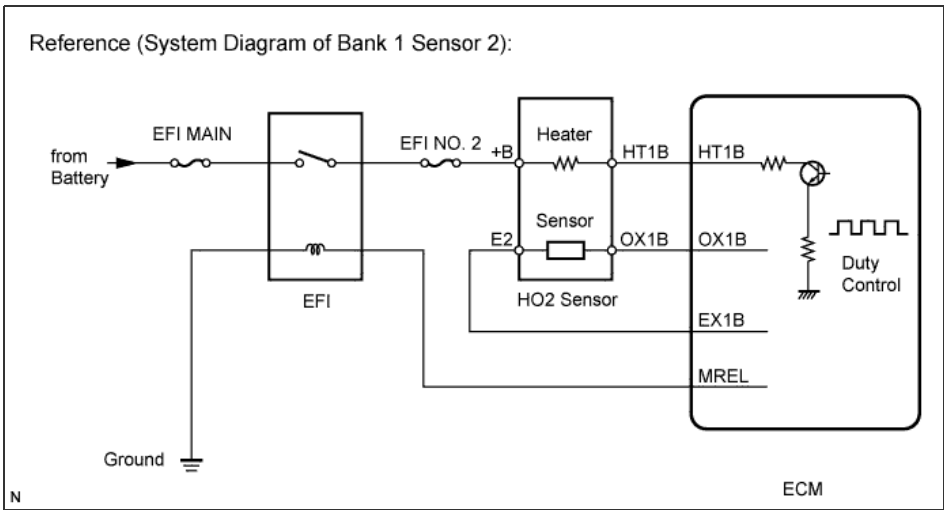
Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C45-48 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C45-88 (OX1B) - Body ground	Always	10 kΩ or higher

C20-4 (E2) or C45-65 (EX1B) - Body ground	Always	10 kΩ or higher
C21-1 (HT2B) or C45-47 (HT2B) - Body ground	Always	10 kΩ or higher
C21-3 (OX2B) or C45-87 (OX2B) - Body ground	Always	10 kΩ or higher
C21-4 (E2) or C45-64 (EX2B) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C46-48 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C46-88 (OX1B) - Body ground	Always	10 kΩ or higher
C20-4 (E2) or C46-65 (EX1B) - Body ground	Always	10 kΩ or higher
C21-1 (HT2B) or C46-47 (HT2B) - Body ground	Always	10 kΩ or higher
C21-3 (OX2B) or C46-87 (OX2B) - Body ground	Always	10 kΩ or higher
C21-4 (E2) or C46-64 (EX2B) - Body ground	Always	10 kΩ or higher

Reference (System Diagram of Bank 1 Sensor 2):



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - HEATED OXYGEN SENSOR)

OK

12.REPLACE HEATED OXYGEN SENSOR

a. Replace the heated oxygen sensor (Click here).

NEXT

13.PERFORM CONFIRMATION DRIVING PATTERN

HINT:

Refer to the CONFIRMATION DRIVING PATTERN.

NEXT

14.CHECK WHETHER DTC OUTPUT RECURS (DTC P0136, P0137, P0138, P0156, P0157 OR P0158)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

e. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

f. Check the DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern again by accelerating the vehicle and using the second gear to decelerate the vehicle.

Result

Result	Proceed to
NORMAL (No DTC output)	A
ABNORMAL (P0136, P0137, P0138, P0156, P0157 or P0158 detected)	B

B → REPLACE AIR FUEL RATIO SENSOR (Click here)

A

END

15.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

16.PERFORM CONFIRMATION DRIVING PATTERN

HINT:

Refer to the CONFIRMATION DRIVING PATTERN.

NEXT

17.CHECK WHETHER DTC OUTPUT RECURS (DTC P0136, P0137, P0138, P0156, P0157 OR P0158)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

e. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

f. Check the DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern again by accelerating the vehicle and using the second gear to decelerate the vehicle.

Result

Result	Proceed to
NORMAL (No DTC output)	A
ABNORMAL (P0136, P0137, P0138, P0156, P0157 or P0158 detected)	B

B → REPLACE HEATED OXYGEN SENSOR (Click here)

A

END

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

for Preparation Click here

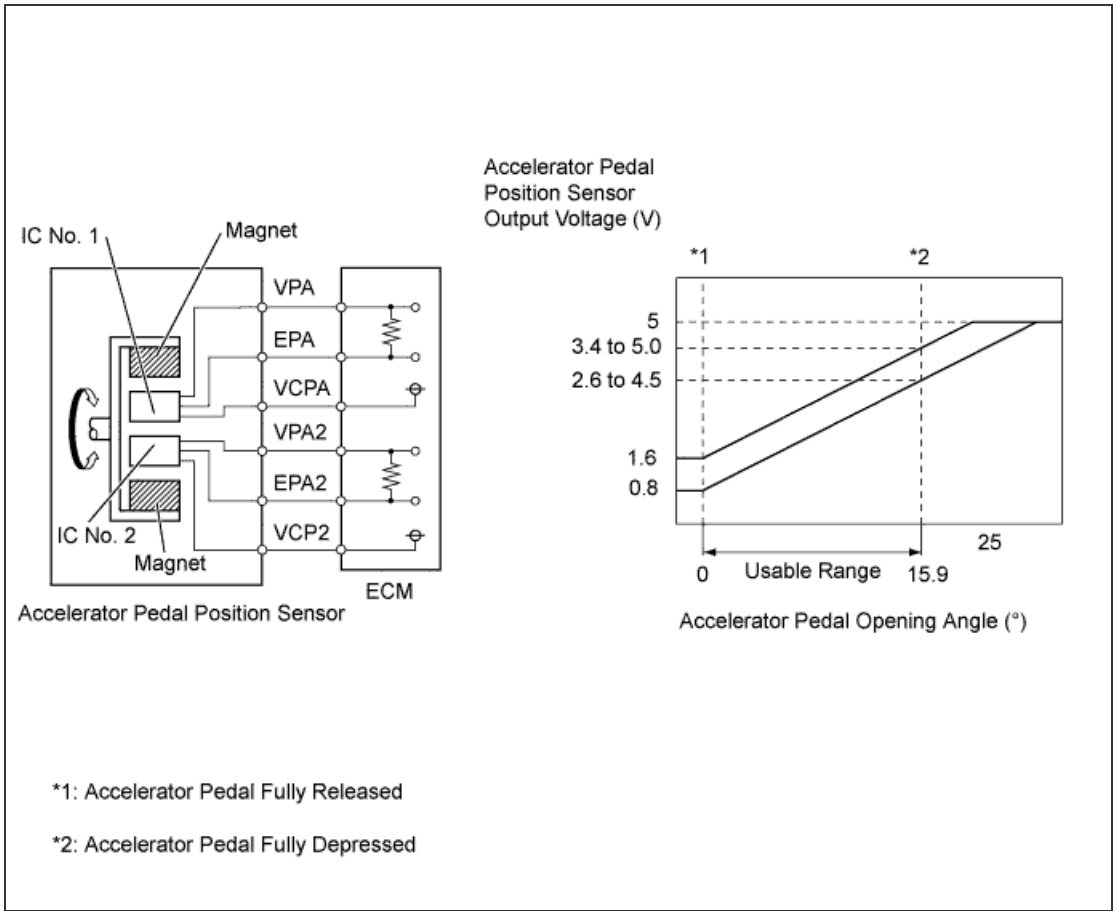
DESCRIPTION

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

The Accelerator Pedal Position (APP) sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC Code	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• Accelerator Pedal Position (APP) sensor • ECM

P2122	VPA is 0.4 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCPA circuit • Open or ground short in VPA circuit • ECM
P2123	VPA is 4.8 V or higher for 2.0 seconds or more (1 trip detection logic).	• APP sensor • Open in EPA circuit • ECM
P2125	VPA2 fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or higher. (b) VPA is between 0.4 V and 3.45 V.	• APP sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): (a) The difference between VPA and VPA2 is 0.02 V or less. (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less.	• Short between VPA and VPA2 circuits • APP sensor • ECM

HINT:

When any of these DTCs are output, check the APP sensor voltage by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No.1 and Accelerator Position No.2.

Trouble Area	Accelerator Position No. 1 When Accelerator Pedal Released	Accelerator Position No. 2 When Accelerator Pedal Released	Accelerator Position No. 1 When Accelerator Pedal Depressed	Accelerator Position No. 2 When Accelerator Pedal Depressed
VCP circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.0 V
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 5.0 V

HINT:

Accelerator pedal positions are expressed as voltages.

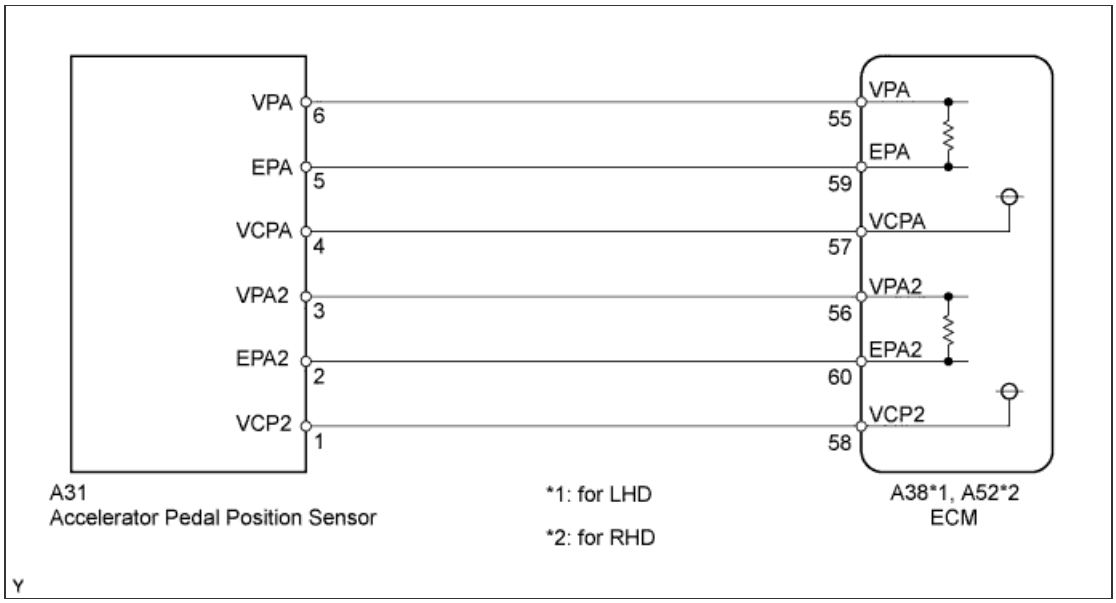
MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is below the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and stores a DTC.
Example:
When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is stored.
If the malfunction is not repaired successfully, a DTC is stored 2 seconds after the engine is next started.

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 are stored, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue to be driven. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.
Fail-safe mode continues until a pass condition is detected, and the ignition switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Accelerator Pedal Position (APP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

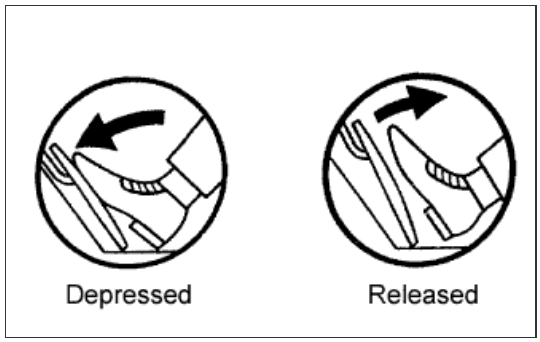
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No.1 and Accelerator Position No.2.

d. Read the value displayed on the tester.



Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2.6 to 4.5 V	3.4 to 5.0 V

Result

Result	Proceed to
OK	A
NG	B

A → Go to step 5

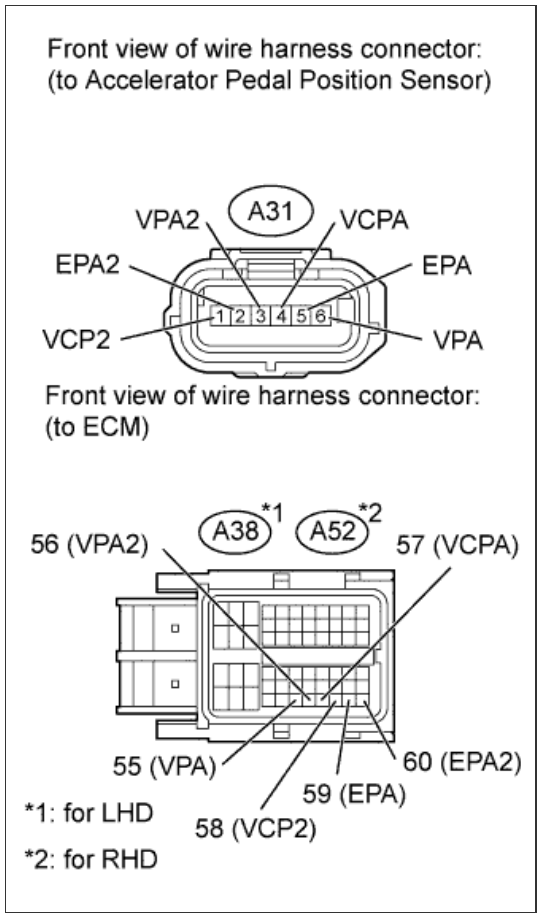
B

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the Accelerator Pedal Position (APP) sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A38-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-59 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A38-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A38-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A38-58 (VCP2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A52-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-59 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A52-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A52-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A52-58 (VCP2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) or A38-55 (VPA) -		10 kΩ or

Body ground	Always	higher
A31-5 (EPA) or A38-59 (EPA) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-57 (VCPA) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-56 (VPA2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A38-60 (EPA2) - Body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A38-58 (VCP2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) or A52-55 (VPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-59 (EPA) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-57 (VCPA) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-56 (VPA2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-60 (EPA2) - Body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A52-58 (VCP2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK ECM (VCPA AND VCP2 VOLTAGE)

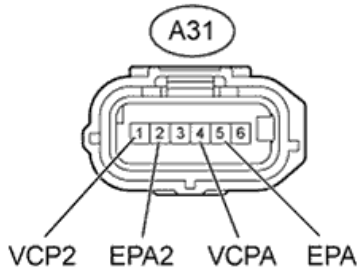
a. Disconnect the APP sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Ignition switch ON	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Ignition switch ON	4.5 to 5.5 V

Front view of wire harness connector:
(to Accelerator Pedal Position Sensor)



NG → REPLACE ECM (Click here)

OK

4.REPLACE ACCELERATOR PEDAL ROD ASSEMBLY

a. Replace the accelerator pedal rod assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read the DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138	A
No output	B

B → SYSTEM OK

A → REPLACE ECM (Click here)

DTC P0136 Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)

DTC P0137 Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)

DTC P0138 Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)

DTC P0156 Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)

DTC P0157 Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)

DTC P0158 Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)

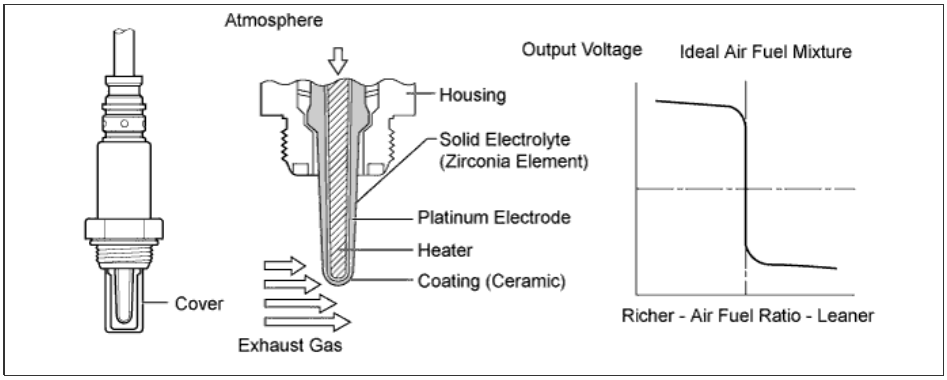
for Preparation Click here

DESCRIPTION

HINT:

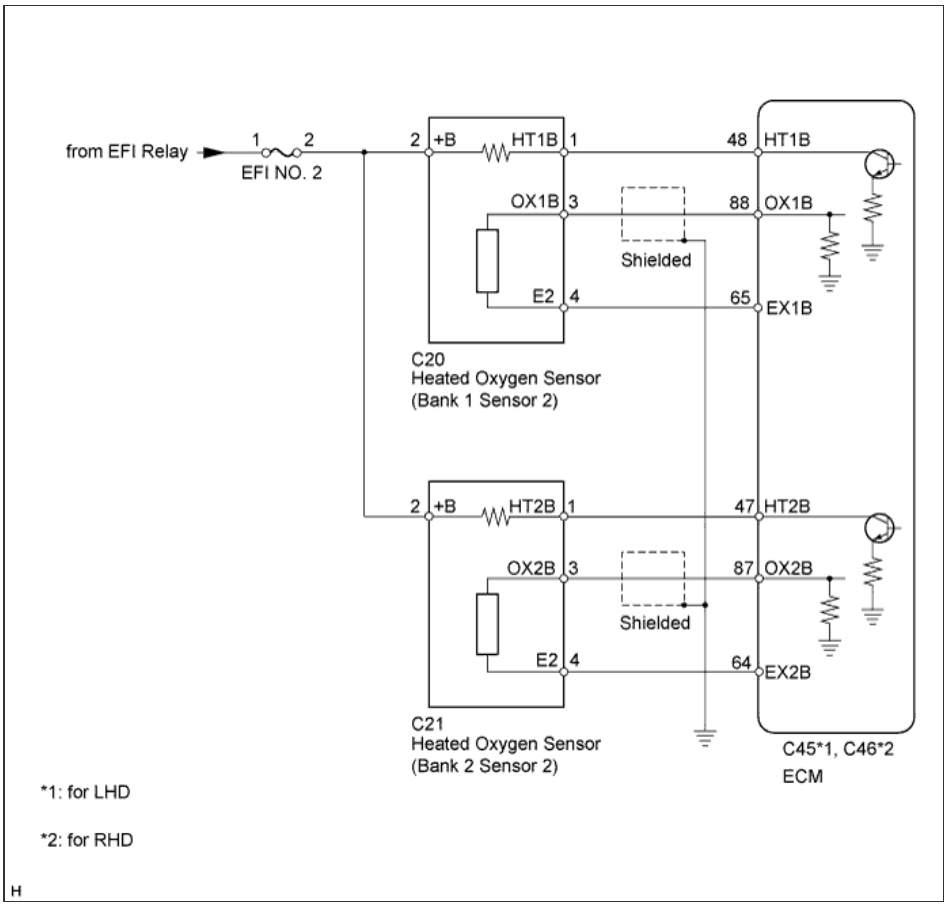
Sensor 2 refers to the sensor mounted behind the three-way catalytic converter and located far from the engine assembly.

A three-way catalyst converter is used in order to convert the carbon monoxide, hydrocarbons, and nitrogen oxide, into less harmful substances. To allow the three-way catalytic converter to function effectively, it is necessary to keep the air fuel ratio of the engine near the stoichiometric air fuel ratio. For the purpose of helping the ECM to deliver accurate air fuel ratio control, a heated oxygen sensor is used.
The heated oxygen sensor is located behind the three-way catalytic converter, and detects the oxygen concentration in the exhaust gas. Since the sensor is integrated with the heater that heats the sensing portion, it is possible to detect the oxygen concentration even when the intake air volume is low (the exhaust gas temperature is low).
When the air fuel ratio becomes lean, the oxygen concentration in the exhaust gas is rich. The heated oxygen sensor informs the ECM that the post-three way catalytic converter air fuel ratio is lean (low voltage, i.e. below 0.45 V).
Conversely, when the air fuel ratio is richer than the stoichiometric air fuel level, the oxygen concentration in the exhaust gas becomes lean. The heated oxygen sensor informs the ECM that the post-three way catalytic converter air fuel ratio is rich (high voltage, i.e. higher than 0.45 V). The heated oxygen sensor has the property of changing its output voltage drastically when the air fuel ratio is close to the stoichiometric level.
The ECM uses the supplementary information from the heated oxygen sensor to determine whether the air fuel ratio after the three-way catalytic converter is rich or lean, and adjusts the fuel injection time accordingly. Thus, if the heated oxygen sensor is working improperly due to internal malfunctions, the ECM is unable to compensate for deviations in the primary air fuel ratio control.

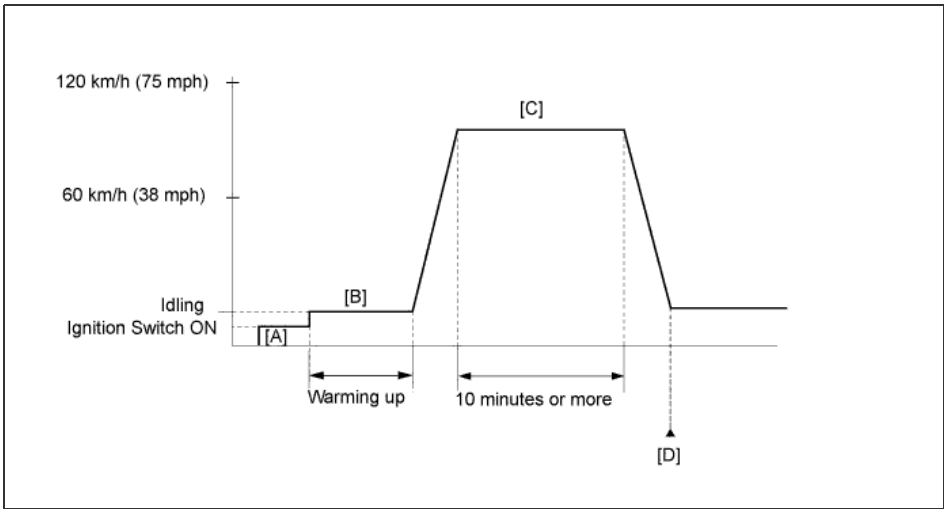


DTC Code	DTC Detection Condition	Trouble Area
P0136 P0156	• Abnormal voltage output: During active air fuel ratio control, the following conditions (a) and (b) are met for a certain period of time (2 trip detection logic): 1. The heated oxygen sensor voltage does not decrease to below 0.21 V. 2. The heated oxygen sensor voltage does not increase to higher than 0.59 V.	• Open or short in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • HO2 sensor heater (bank 1, 2 sensor 2) • Air fuel ratio (A/F) sensor (bank 1, 2 sensor 1) • Gas leak from exhaust system
P0137 P0157	• Low voltage (open): During active air fuel ratio control, the following conditions (a) and (b) are met for a certain period of time (2 trip detection logic): 1. The heated oxygen sensor voltage output is below 0.21 V. 2. The target air fuel ratio is rich.	• Open in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • HO2 sensor heater (bank 1, 2 sensor 2) • Gas leak from exhaust system
P0138 P0158	• High voltage (short): During active air fuel ratio control, the following conditions (a) and (b) are met for a certain period of time (2 trip detection logic): 1. The heated oxygen sensor voltage output is 0.59 V or higher. 2. The target air fuel ratio is lean.	• Short in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • A/F sensor (bank 1, 2 sensor 1) • ECM

WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN



1. Connect the intelligent tester to the DLC3 [A].
2. Turn the tester on.
3. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher [B].
4. Drive the vehicle at 60 to 120 km/h (38 to 75 mph) for at least 10 minutes [C].
5. Enter the following menus: Powertrain / Engine / Utility / All Readiness [D].
6. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.
7. Check that DTC MONITOR is NORMAL. If DTC MONITOR is INCOMPLETE, perform the drive pattern again by accelerating the vehicle and using the second gear to decelerate the vehicle.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the intelligent tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2, or AFS Voltage B2S1 and O2S B2S2) displayed on the intelligent**

tester.

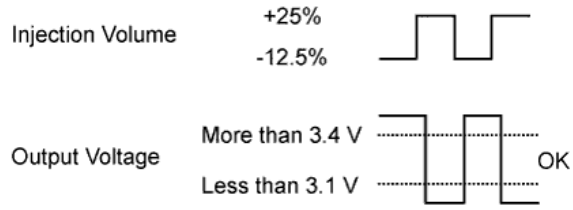
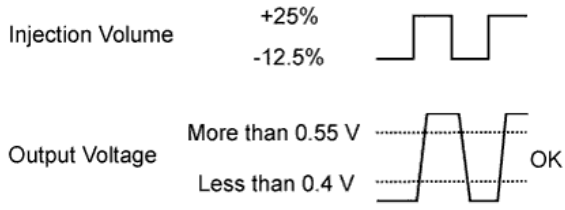
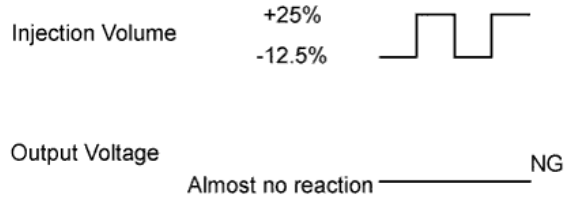
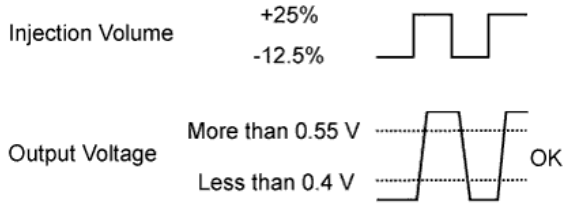
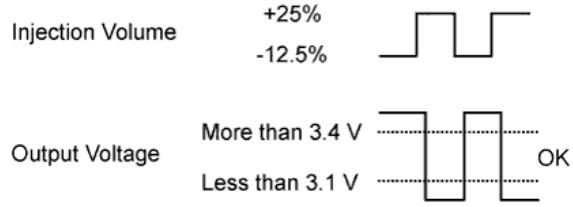
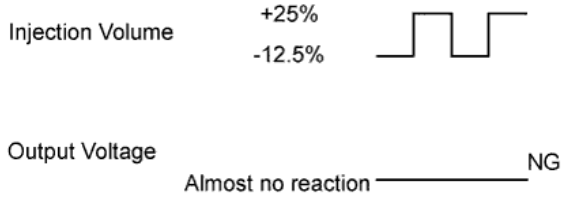
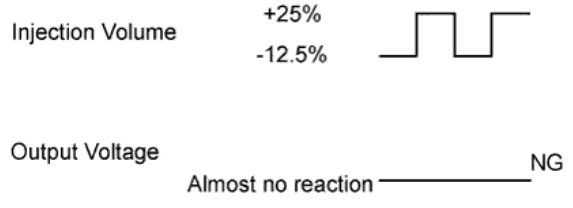
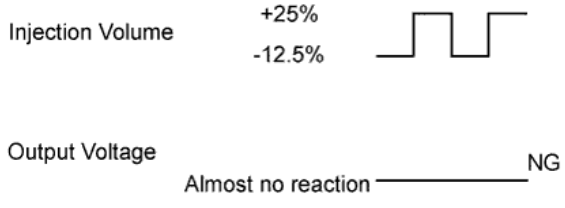
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	Less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ OUTPUT DTC (DTC P0136, P0137, P0138, P0156, P0157 OR P0158)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0138 or P0158	A
P0137 or P0157	B
P0136 or P0156	C

B → Go to step 9

C → Go to step 7

A

2.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1S2.

e. Allow the engine to idle.

f. Read the heated oxygen sensor output voltage while idling.

Result:

Result	Proceed to
Higher than 1.0 V	A
Below 1.0 V	B

B → Go to step 5

A

3.INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)

a. Disconnect the heated oxygen sensor connector.

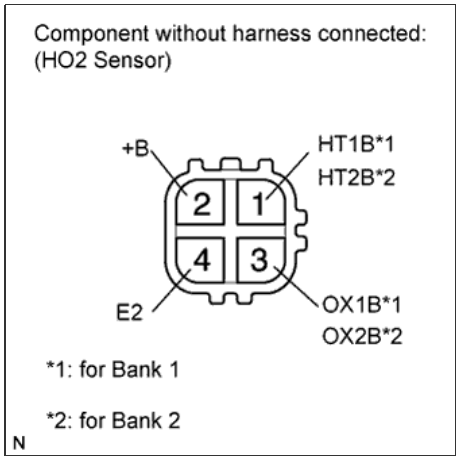
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Bank 1 Sensor 2):

Tester Connection	Condition	Specified Condition
2 (+B) - 4 (E2)	20°C (68°F)	10 kΩ or higher
2 (+B) - 3 (OX1B)	Always	10 kΩ or higher

Standard Resistance (Bank 2 Sensor 2):

Tester Connection	Condition	Specified Condition
2 (+B) - 4 (E2)	20°C (68°F)	10 kΩ or higher
2 (+B) - 3 (OX2B)	Always	10 kΩ or higher



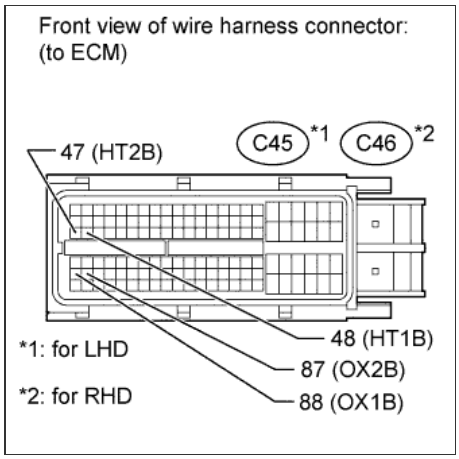
NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

4.CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for LHD

Tester Connection	Condition	Specified Condition
C45-48 (HT1B) - C45-88 (OX1B)	Always	10 kΩ or higher
C45-47 (HT2B) - C45-87 (OX2B)	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C46-48 (HT1B) - C46-88 (OX1B)	Always	10 kΩ or higher
C46-47 (HT2B) - C46-87 (OX2B)	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - HEATED OXYGEN SENSOR)

OK → REPLACE ECM (Click here)

5.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (INJECTION VOLUME)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Warm up the engine.

e. Enter the following menus: Powertrain / Engine / Active Test / Control the Injection Volume.

f. Change the fuel injection volume using the tester, and monitor the voltage output of the air fuel ratio sensor and heated oxygen sensor displayed on the tester.

HINT:

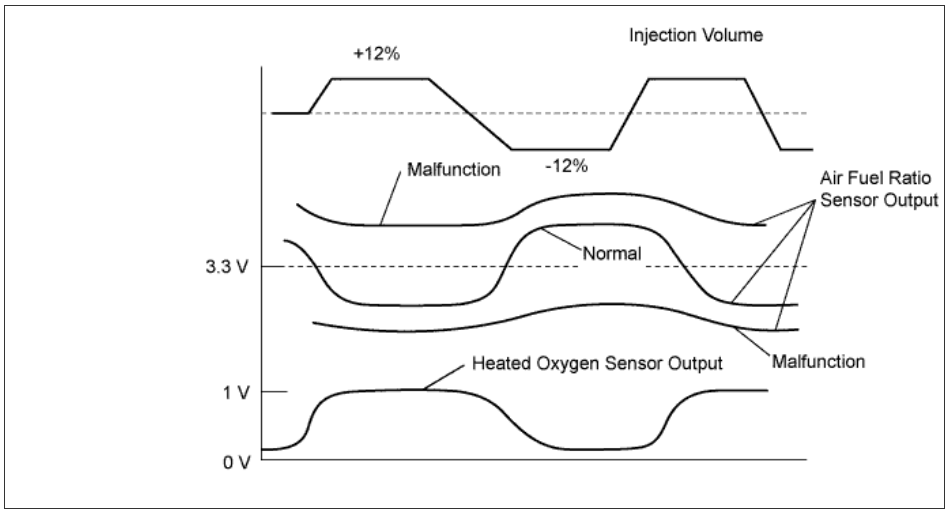
- **Change the fuel injection volume within the range of -12% and +12%. The injection volume can be changed in 1% graduations within this range.**
- **The air fuel ratio sensor is displayed as AFS Voltage B1S1, and the heated oxygen sensor is displayed as O2S B1S2 on the intelligent tester.**

Result:

Tester Display (Sensor)	Voltage Variation	Proceed to
AFS Voltage B1S1 (A/F)	Alternates between higher than and below 3.3 V	OK
AFS Voltage B1S1 (A/F)	Remains at higher than 3.3 V	NG
AFS Voltage B1S1 (A/F)	Remains at below 3.3 V	NG

HINT:

A normal heated oxygen sensor voltage (O2S B1S2) reacts in accordance with increases and decreases in fuel injection volumes. When the air fuel ratio sensor voltage remains at either less or higher than 3.3 V despite the heated oxygen sensor indicating a normal reaction, the air fuel ratio sensor is malfunctioning.



NG	Go to step 15

OK

6.CHECK AIR FUEL RATIO SENSOR

HINT:

This air fuel ratio sensor test is to check the air fuel ratio sensor current during the fuel-cut operation. When the sensor is normal, the sensor current will indicate below 3 mA in this test.

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC / Clear.

e. Clear DTCs.

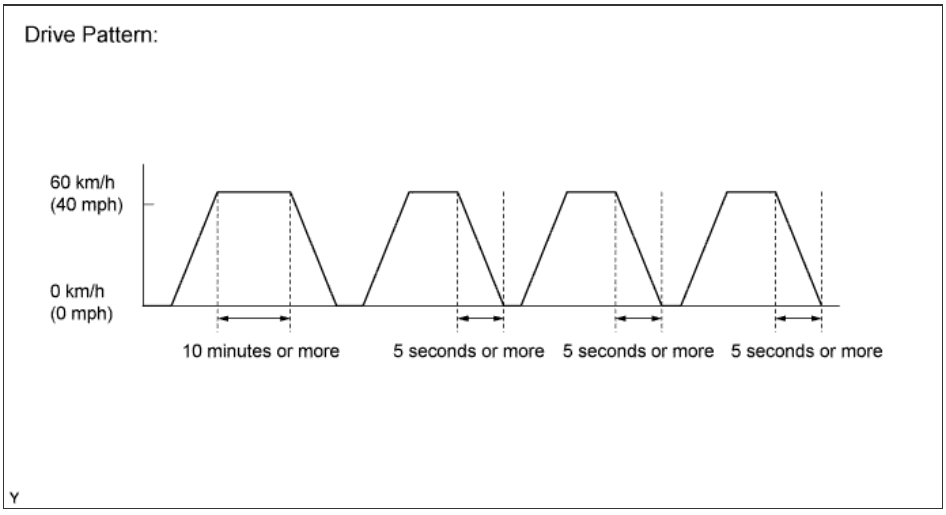
f. Drive the vehicle by the drive pattern as listed below:

i. Warm up the engine.

ii. Drive the vehicle at 60 km/h (40 mph) or more for 10 minutes or more.

iii. Stop the vehicle.

iv. Accelerate the vehicle to 60 km/h (40 mph) or more and then decelerate for 5 seconds or more. Repeat this process at least 3 times.



g. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS Current B1S1.

h. Read the value of the air fuel ratio sensor current while the fuel-cut operation is performing.

Standard current:

Below 3.0 mA

HINT:

- **To measure the air fuel ratio sensor current precisely, perform the fuel-cut operation as long as possible.**
- **If it is difficult to measure the air fuel ratio sensor current, use the snapshot function of the intelligent tester.**

Result

Result	Proceed to
Outside standard range	A
Within standard range	B

OK	Go to step 12
NG	Go to step 15

7.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Start the engine.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1S2.

f. After warming up the engine, run the engine at an engine speed of 2500 rpm for 3 minutes.

g. Read the output voltage of the heated oxygen sensor when the engine speed is suddenly increased.

HINT:

Quickly accelerate the engine to 4000 rpm 3 times using the accelerator pedal.

Standard voltage:
Fluctuates between 0.4 V or less and 0.55 V or higher.

NG	Go to step 9
OK	

8.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (INJECTION VOLUME)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Warm up the engine.

e. Enter the following menus: Powertrain / Engine / Active Test / Control the Injection Volume.

f. Change the fuel injection volume using the tester, and monitor the voltage output of the air fuel ratio sensor and heated oxygen sensor displayed on the tester.

HINT:

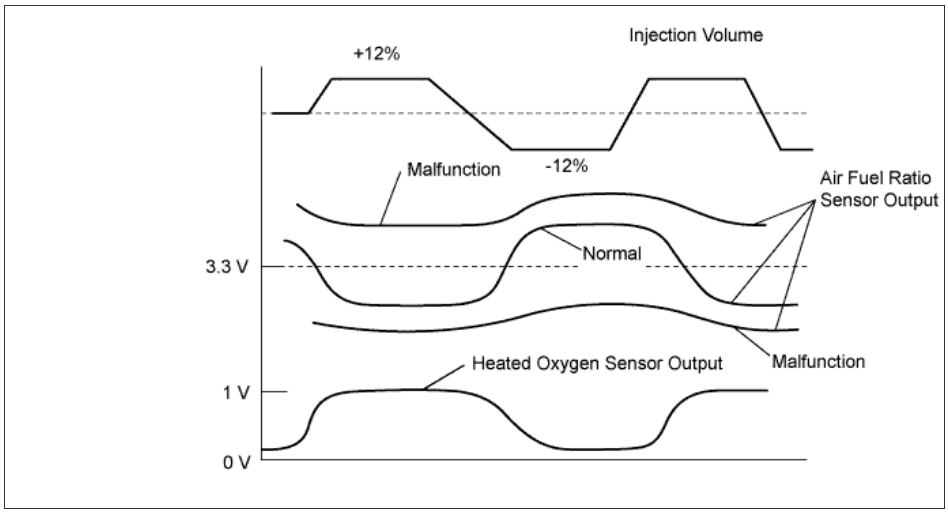
- **Change the fuel injection volume within the range of -12% and +12%. The injection volume can be changed in 1% graduations within this range.**
- **The air fuel ratio sensor is displayed as AFS Voltage B1S1, and the heated oxygen sensor is displayed as O2S B1S2 on the intelligent tester.**

Result:

Tester Display (Sensor)	Voltage Variation	Proceed to
AFS Voltage B1S1 (A/F)	Alternates between higher than and below 3.3 V	OK
AFS Voltage B1S1 (A/F)	Remains at higher than 3.3 V	NG
AFS Voltage B1S1 (A/F)	Remains at below 3.3 V	NG

HINT:

A normal heated oxygen sensor voltage (O2S B1S2) reacts in accordance with increases and decreases in fuel injection volumes. When the air fuel ratio sensor voltage remains at either less or higher than 3.3 V despite the heated oxygen sensor indicating a normal reaction, the air fuel ratio sensor is malfunctioning.



NG → Go to step 15

OK

CHECK EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO AND REPAIR CAUSE (FUEL INJECTOR , FUEL PRESSURE, GAS LEAK FROM SYSTEM, ETC.)

9.CHECK FOR EXHAUST GAS LEAK

a. Check for exhaust gas leakage.

OK:
No gas leak.

NG → REPAIR OR REPLACE EXHAUST GAS LEAK POINT

OK

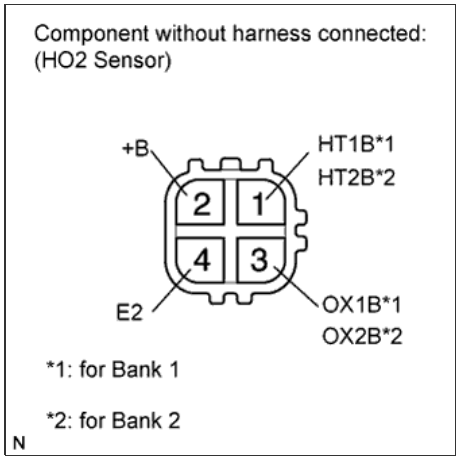
10.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

a. Disconnect the heated oxygen sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT1B) - 4 (E2)	Always	10 kΩ or higher



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

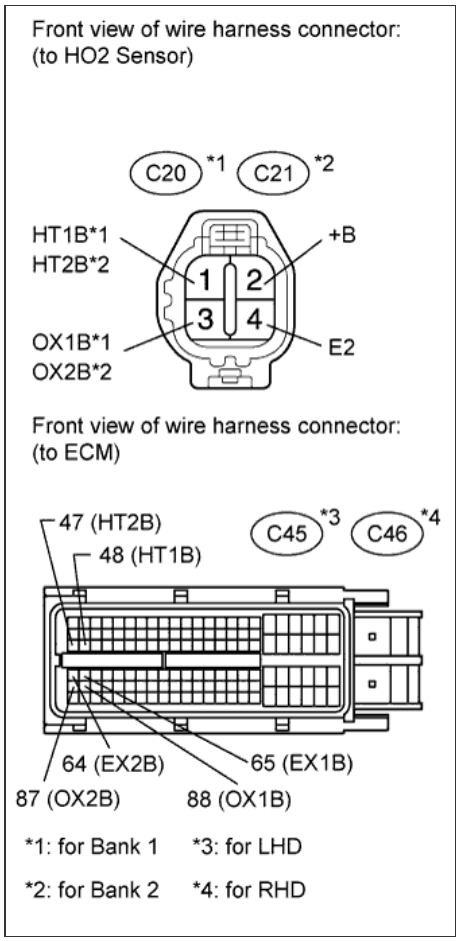
OK

11.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)

a. Disconnect the heated oxygen sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C45-48 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C45-88 (OX1B)	Always	Below 1 Ω
C20-4 (E2) - C45-65 (EX1B)	Always	Below 1 Ω
C21-1 (HT2B) - C45-47 (HT2B)	Always	Below 1 Ω
C21-3 (OX2B) - C45-87 (OX2B)	Always	Below 1 Ω
C21-4 (E2) - C45-64 (EX2B)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C46-48 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C46-88 (OX1B)	Always	Below 1 Ω
C20-4 (E2) - C46-65 (EX1B)	Always	Below 1 Ω
C21-1 (HT2B) - C46-47 (HT2B)	Always	Below 1 Ω
C21-3 (OX2B) - C46-87 (OX2B)	Always	Below 1 Ω
C21-4 (E2) - C46-64 (EX2B)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

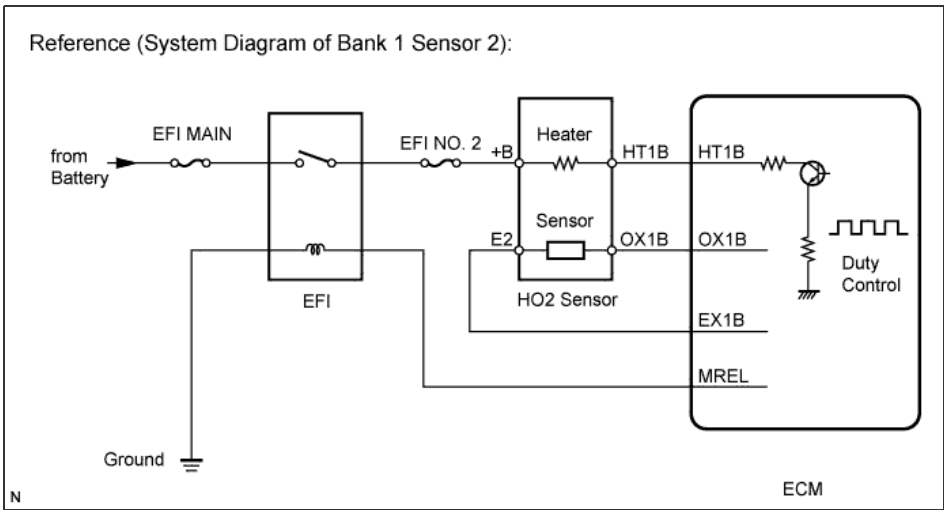
Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C45-48 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C45-88 (OX1B) - Body ground	Always	10 kΩ or higher

C20-4 (E2) or C45-65 (EX1B) - Body ground	Always	10 kΩ or higher
C21-1 (HT2B) or C45-47 (HT2B) - Body ground	Always	10 kΩ or higher
C21-3 (OX2B) or C45-87 (OX2B) - Body ground	Always	10 kΩ or higher
C21-4 (E2) or C45-64 (EX2B) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) or C46-48 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C46-88 (OX1B) - Body ground	Always	10 kΩ or higher
C20-4 (E2) or C46-65 (EX1B) - Body ground	Always	10 kΩ or higher
C21-1 (HT2B) or C46-47 (HT2B) - Body ground	Always	10 kΩ or higher
C21-3 (OX2B) or C46-87 (OX2B) - Body ground	Always	10 kΩ or higher
C21-4 (E2) or C46-64 (EX2B) - Body ground	Always	10 kΩ or higher

Reference (System Diagram of Bank 1 Sensor 2):



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - HEATED OXYGEN SENSOR)

OK

12.REPLACE HEATED OXYGEN SENSOR

a. Replace the heated oxygen sensor (Click here).

NEXT

13.PERFORM CONFIRMATION DRIVING PATTERN

HINT:

Refer to the CONFIRMATION DRIVING PATTERN.

NEXT

14.CHECK WHETHER DTC OUTPUT RECURS (DTC P0136, P0137, P0138, P0156, P0157 OR P0158)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

e. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

f. Check the DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern again by accelerating the vehicle and using the second gear to decelerate the vehicle.

Result

Result	Proceed to
NORMAL (No DTC output)	A
ABNORMAL (P0136, P0137, P0138, P0156, P0157 or P0158 detected)	B

B → REPLACE AIR FUEL RATIO SENSOR (Click here)

A

END

15.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

16.PERFORM CONFIRMATION DRIVING PATTERN

HINT:

Refer to the CONFIRMATION DRIVING PATTERN.

NEXT

17.CHECK WHETHER DTC OUTPUT RECURS (DTC P0136, P0137, P0138, P0156, P0157 OR P0158)

a. Connect an intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

e. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

f. Check the DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern again by accelerating the vehicle and using the second gear to decelerate the vehicle.

Result

Result	Proceed to
NORMAL (No DTC output)	A
ABNORMAL (P0136, P0137, P0138, P0156, P0157 or P0158 detected)	B

B → REPLACE HEATED OXYGEN SENSOR (Click here)

A

END

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

for Preparation Click here

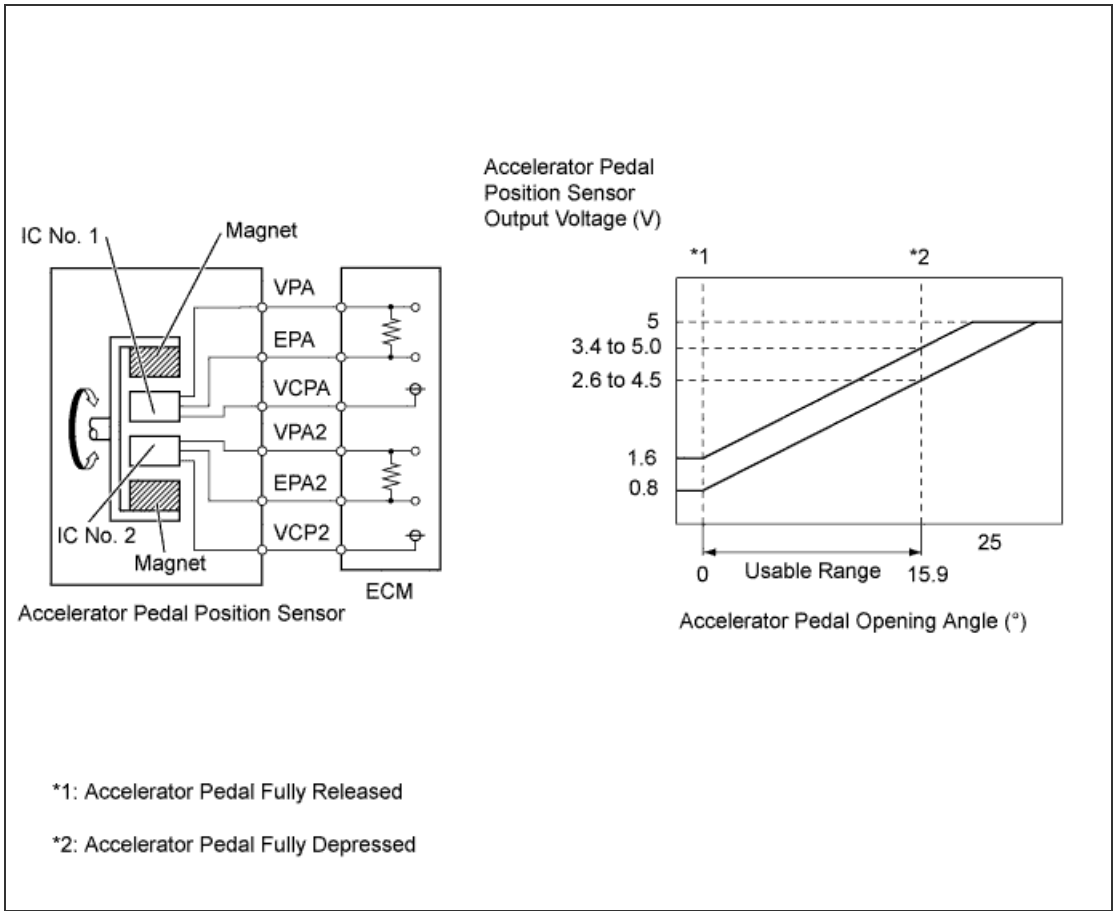
DESCRIPTION

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

The Accelerator Pedal Position (APP) sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC Code	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• Accelerator Pedal Position (APP) sensor • ECM

P2122	VPA is 0.4 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCPA circuit • Open or ground short in VPA circuit • ECM
P2123	VPA is 4.8 V or higher for 2.0 seconds or more (1 trip detection logic).	• APP sensor • Open in EPA circuit • ECM
P2125	VPA2 fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or higher. (b) VPA is between 0.4 V and 3.45 V.	• APP sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): (a) The difference between VPA and VPA2 is 0.02 V or less. (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less.	• Short between VPA and VPA2 circuits • APP sensor • ECM

HINT:

When any of these DTCs are output, check the APP sensor voltage by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No.1 and Accelerator Position No.2.

Trouble Area	Accelerator Position No. 1 When Accelerator Pedal Released	Accelerator Position No. 2 When Accelerator Pedal Released	Accelerator Position No. 1 When Accelerator Pedal Depressed	Accelerator Position No. 2 When Accelerator Pedal Depressed
VCP circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.0 V
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 5.0 V

HINT:

Accelerator pedal positions are expressed as voltages.

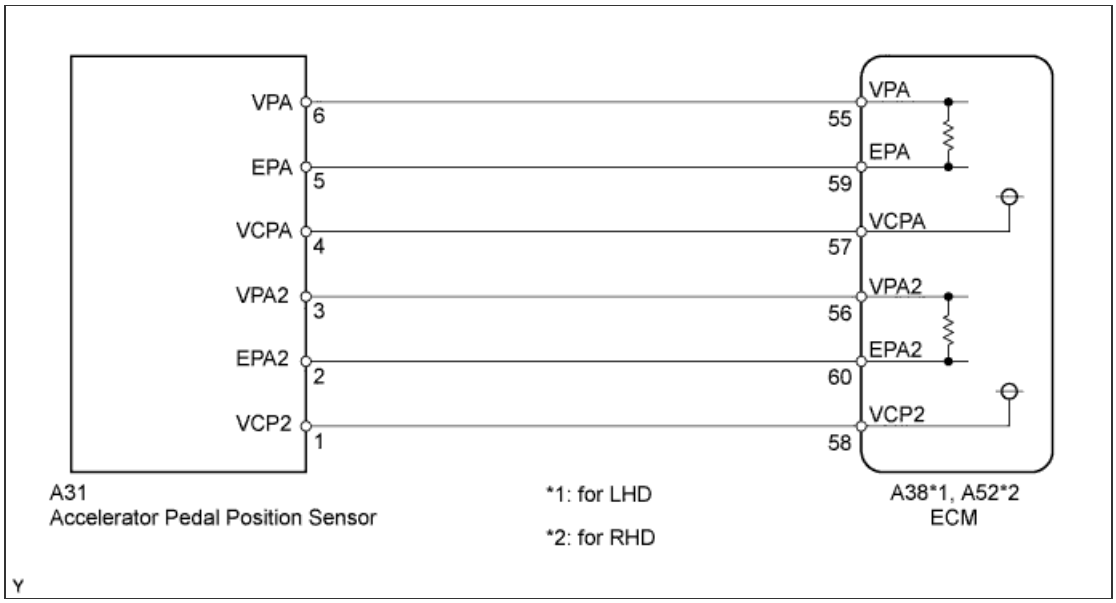
MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is below the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and stores a DTC.
Example:
When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is stored.
If the malfunction is not repaired successfully, a DTC is stored 2 seconds after the engine is next started.

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 are stored, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue to be driven. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.
Fail-safe mode continues until a pass condition is detected, and the ignition switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Accelerator Pedal Position (APP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

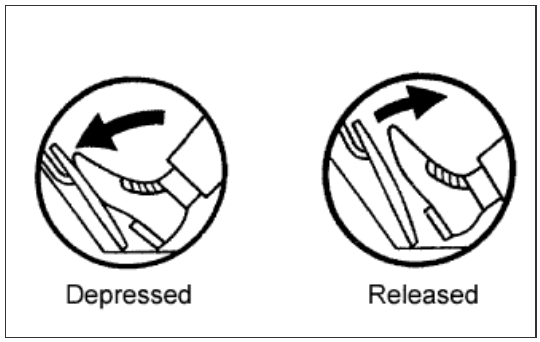
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No.1 and Accelerator Position No.2.

d. Read the value displayed on the tester.



Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2.6 to 4.5 V	3.4 to 5.0 V

Result

Result	Proceed to
OK	A
NG	B

A → Go to step 5

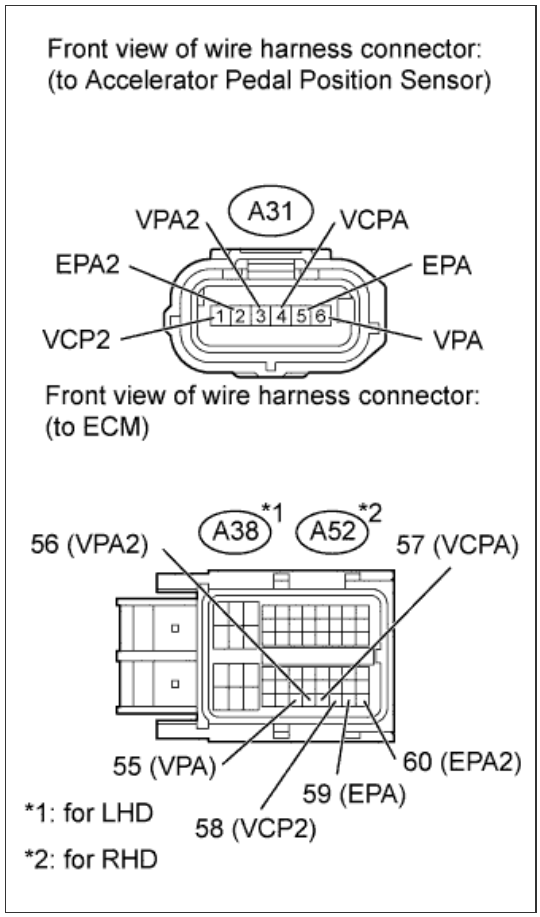
B

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the Accelerator Pedal Position (APP) sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A38-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-59 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A38-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A38-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A38-58 (VCP2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A52-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-59 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A52-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A52-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A52-58 (VCP2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) or A38-55 (VPA) -		10 kΩ or

Body ground	Always	higher
A31-5 (EPA) or A38-59 (EPA) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-57 (VCPA) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-56 (VPA2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A38-60 (EPA2) - Body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A38-58 (VCP2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) or A52-55 (VPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-59 (EPA) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-57 (VCPA) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-56 (VPA2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-60 (EPA2) - Body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A52-58 (VCP2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK ECM (VCPA AND VCP2 VOLTAGE)

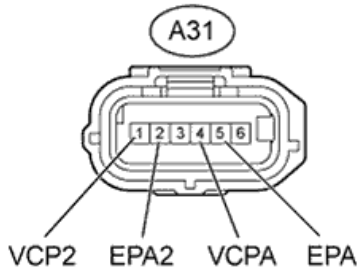
a. Disconnect the APP sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Ignition switch ON	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Ignition switch ON	4.5 to 5.5 V

Front view of wire harness connector:
(to Accelerator Pedal Position Sensor)



NG → REPLACE ECM (Click here)

OK

4.REPLACE ACCELERATOR PEDAL ROD ASSEMBLY

a. Replace the accelerator pedal rod assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read the DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138	A
No output	B

B → SYSTEM OK

A → REPLACE ECM (Click here)

DTC P0171 System Too Lean (Bank 1)

DTC P0172 System Too Rich (Bank 1)

DTC P0174 System Too Lean (Bank 2)

DTC P0175 System Too Rich (Bank 2)

for Preparation Click here

DESCRIPTION

The fuel trim is related to the feedback compensation value, not to the basic injection time. The fuel trim consists of both the short-term and long-term fuel trim.
The short-term fuel trim is fuel compensation that is used to constantly maintain the air fuel ratio at stoichiometric levels. The signal from the Air Fuel Ratio (A/F) sensor indicates whether the air fuel ratio is rich or lean compared to the stoichiometric ratio. This triggers a reduction in the fuel injection volume if the air fuel ratio is rich and an increase in the fuel injection volume if it is lean.
Factors such as individual engine differences, wear over time and changes in operating environment cause short-term fuel trim to vary from the central value. The long-term fuel trim, which controls overall fuel compensation, compensates for long-term deviations in the fuel trim from the central value caused by the short-term fuel trim compensation.
If both the short-term and long-term fuel trim are lean or rich beyond predetermined values, it is interpreted as a malfunction, and the ECM illuminates the MIL and sets a DTC.

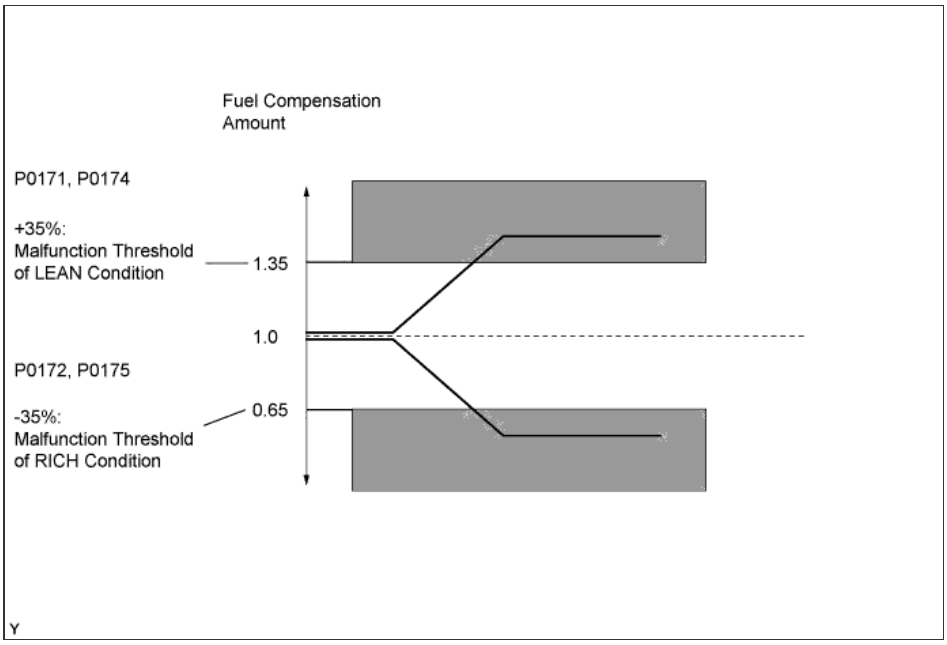
DTC Code	DTC Detection Condition	Trouble Area
P0171 P0174	With a warm engine and stable air fuel ratio feedback, the fuel trim is considerably in error to the lean side (2 trip detection logic).	• Air induction system • Injector blockage • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Fuel pressure • Gas leakage from exhaust system • Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor heater (bank 1, 2 sensor 1) • Integration relay (A/F relay) • A/F sensor heater circuits • PCV valve and hose • PCV hose connections • ECM
P0172 P0175	With a warm engine and stable air fuel ratio feedback, the fuel trim is considerably in error to the rich side (2 trip detection logic).	• Injector leakage or blockage • MAF meter • ECT sensor • Ignition system • Fuel pressure • Gas leakage from exhaust system • Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor heater (bank 1, 2 sensor 1) • Integration relay (A/F relay) • A/F sensor heater circuits • ECM

HINT:

- **When DTC P0171 or P0174 is stored, the actual air fuel ratio is on the lean side. When DTC P0172 or P0175 is stored, the actual air fuel ratio is on the rich side.**
- **If the vehicle runs out of fuel, the air fuel ratio becomes lean and DTC P0171 or P0174 may be stored. The MIL is then illuminated.**
- **When the total of the short-term and long-term fuel trim values is within the malfunction threshold (and the engine coolant temperature is more than 75°C [167°F]), the system is functioning normally.**

MONITOR DESCRIPTION

Under closed-loop fuel control, fuel injection volumes that deviate from those estimated by the ECM cause changes in the long-term fuel trim compensation value. The long-term fuel trim is adjusted when there are persistent deviations in the short-term fuel trim values. Deviations from the ECM's estimated fuel injection volumes also affect the average fuel trim learned value, which is a combination of the average short-term fuel trim (fuel feedback compensation value) and the average long-term fuel trim (learned value of the air fuel ratio).
If the average fuel trim learned value exceeds the malfunction thresholds, the ECM interprets this as a fault in the fuel system and stores a DTC.
Example:
If the average fuel trim learned value is more than +35% or less than -35%, the ECM interprets this as a fuel system malfunction.



WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the intelligent tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume.)**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2, or AFS Voltage B2S1 and O2S B2S2) displayed on the intelligent tester.**

HINT:

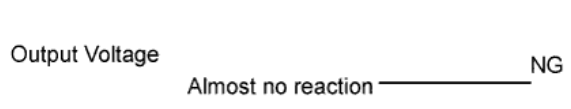
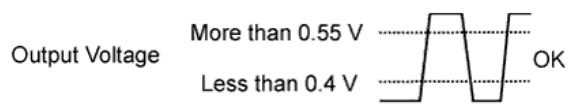
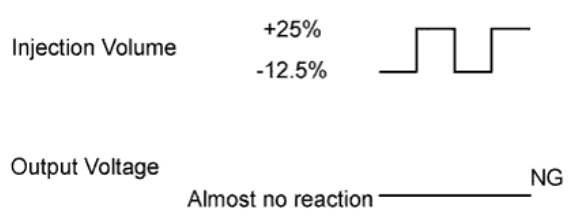
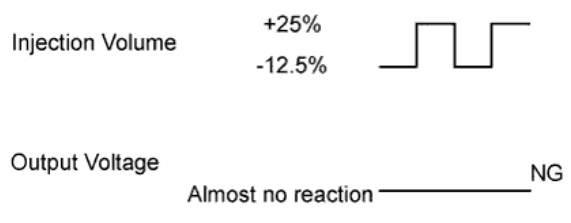
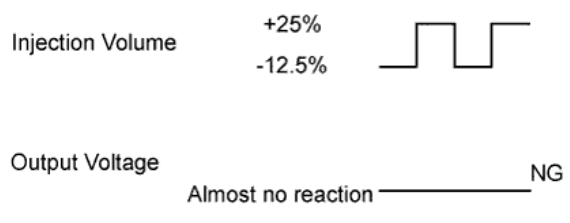
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	Less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1	Injection Volume: +25% / -12.5 Output Voltage: More than 3.4 V / Less than 3.1 V → OK	Injection Volume: +25% / -12.5 Output Voltage: More than 0.55 V / Less than 0.4 V → OK	-
	Injection Volume: +25% / -12.5	Injection Volume: +25% / -12.5	• A/F sensor • A/F sensor

2			• heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.**
- **A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0171, P0172, P0174 OR P0175)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

d. Read the DTCs.

Result

Display (DTC Output)	Proceed to
P0171, P0172, P0174 or P0175	A
P0171, P0172, P0174 or P0175 and other DTCs	B

HINT:

If any DTCs other than P0171, P0172, P0174 or P0175 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:

PCV hose is connected correctly and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE

OK

3.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage.

OK:

No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK

4.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (A/F CONTROL)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the intelligent tester on.

c. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor.

e. Perform the Control the Injection Volume for A/F Sensor operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).

f. Monitor the voltage outputs of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2, or AFS Voltage B2S1 and O2S B2S2) displayed on the intelligent tester.

HINT:

- **The Control the Injection Volume for A/F Sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	Less than 3.1
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4

Result:

Status AFS Voltage B1S1 or AFS Voltage B2S1	Status O2S B1S2 or O2S B2S2	A/F Condition and A/F Sensor Condition	Misfire	Suspected Trouble Area	Proceed to
Lean/Rich	Lean/Rich	Normal	-	-	C
Lean	Lean	Actual air fuel ratio lean	May occur	• PCV valve and hose • PCV hose connections • Injector blockage • Gas leakage from exhaust system • Air induction system • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor	A
Rich	Rich	Actual air fuel ratio rich	-	• Injector blockage or blockage • Gas leakage from exhaust system • Ignition system • Fuel pressure • MAF meter • ECT sensor	
Lean	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	B
Rich	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	

Lean: During Control the Injection Volume for A/F Sensor, the A/F sensor output voltage (AFS) is consistently more than 3.4 V, and the HO2 sensor output voltage (O2S) is consistently less than 0.4 V.
Rich: During Control the Injection Volume for A/F Sensor, the AFS is consistently less than 3.1 V, and the O2S is consistently more than 0.55 V.
Lean/Rich: During Control the Injection Volume for A/F Sensor of the Active Test, the output voltage of the heated oxygen sensor alternates correctly.

B → Go to step 11

C → Go to step 15

A

5.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Data List twice, when the engine is cold and when it is warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: 80 to 100°C (176 to 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

6.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

7.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → REPAIR OR REPLACE FUEL SYSTEM

OK

8.CHECK FOR EXHAUST GAS LEAK

a. Inspect for exhaust gas leakage from the exhaust manifold sub-assembly and exhaust pipes.

OK:
No gas leakage.

NG → REPAIR OR REPLACE EXHAUST SYSTEM

OK

9.CHECK SPARK AND IGNITION

a. Check the ignition system (Click here).

HINT:

If the spark plugs or ignition system malfunctions, engine misfires may occur. The misfire count can be read using the intelligent tester. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Cylinder #1 Misfire Rate (to Cylinder #6 Misfire Rate).

NG → REPAIR OR REPLACE IGNITION SYSTEM

OK

10.INSPECT FUEL INJECTOR ASSEMBLY (INJECTION AND VOLUME)

a. Inspect the fuel injector assembly (Click here).

HINT:

If the injectors malfunction, engine misfires may occur. The misfire count can be read using the intelligent tester. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Cylinder #1 Misfire Rate (to Cylinder #6 Misfire Rate).

NG → REPLACE FUEL INJECTOR ASSEMBLY (Click here)

OK

11.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

a. Disconnect the A/F sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for Bank 1 Sensor 1):

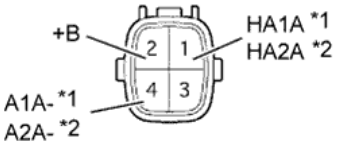
Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω

~~1 (HA1A) - 4 (A1A-)~~	~~Always~~	~~10 kΩ or higher~~

Standard Resistance (for Bank 2 Sensor 1):

Tester Connection	Condition	Specified Condition
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

12.INSPECT INTEGRATION RELAY (A/F RELAY)

a. Remove the integration relay from the engine room junction block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

iii. Reinstall the A/F fuse.

c. Inspect the A/F relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

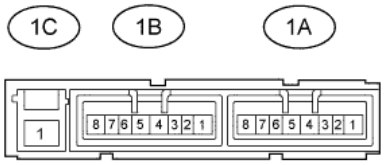
Tester Connection	Condition	Specified Condition
1A-4 - 1C-1	No battery voltage applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A- 2 and 1A-3	Below 1 Ω

Component without harness connected:
(Integration Relay)

Fuse Side:



Connector Side:



Y

NG → REPLACE INTEGRATION RELAY

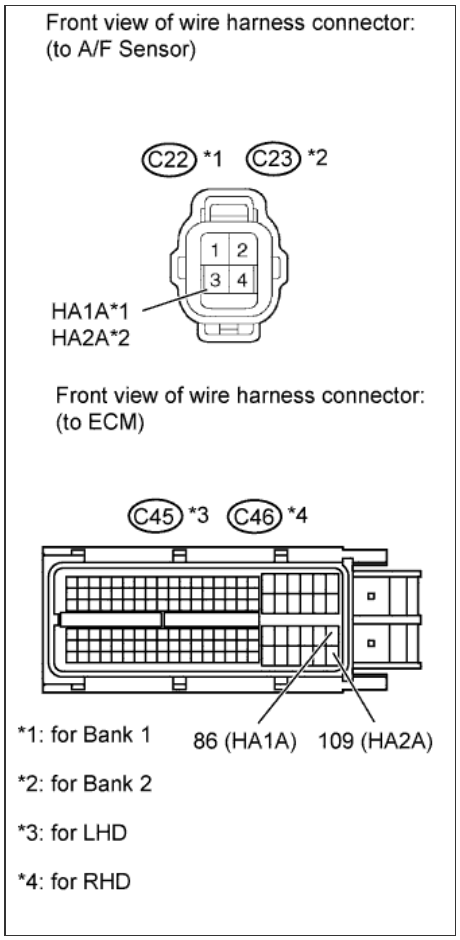
OK

13.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

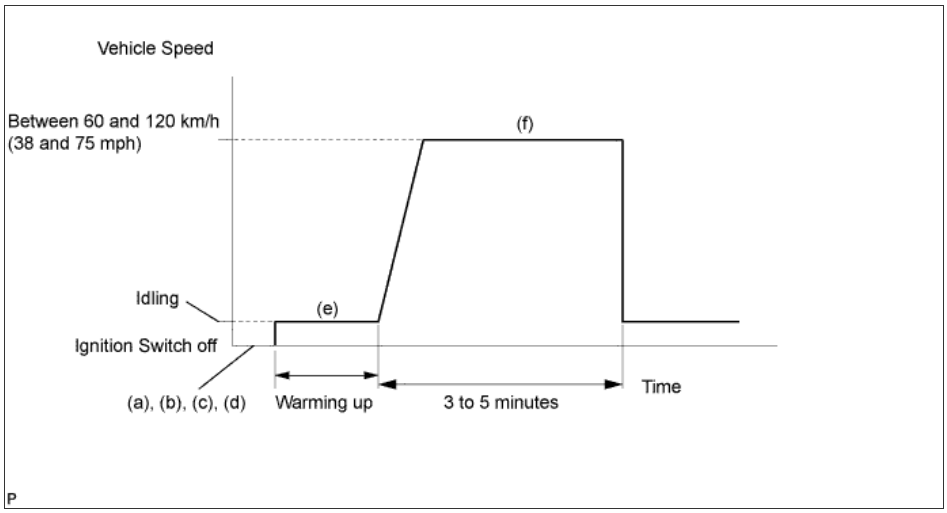
OK

14.REPLACE AIR FUEL RATIO SENSOR

a. Replace the A/F sensor (Click here).

NEXT

15.PERFORM CONFIRMATION DRIVING PATTERN



(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the intelligent tester on.
(c) Clear DTCs (Click here).
(d) Switch the ECM from normal mode to check mode using the intelligent tester (Click here).
(e) Start the engine and warm it up with all the accessories switched OFF.
(f) Drive the vehicle at between 60 km/h and 120 km/h (38 mph and 75 mph) and at an engine speed of between 1400 rpm and 3200 rpm for 3 to 5 minutes.

HINT:

If the system is still malfunctioning, the MIL is illuminated during step (f).

NOTICE:

If the conditions in this test are not strictly followed, no malfunction will be detected.

NEXT

16.CHECK WHETHER DTC OUTPUT RECURS (DTC P0171, P0172, P0174 OR P0175)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

d. Read the DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P0171, P0172, P0174 or P0175	B

B → **REPLACE ECM (Click here)**

A

END

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

for Preparation Click here

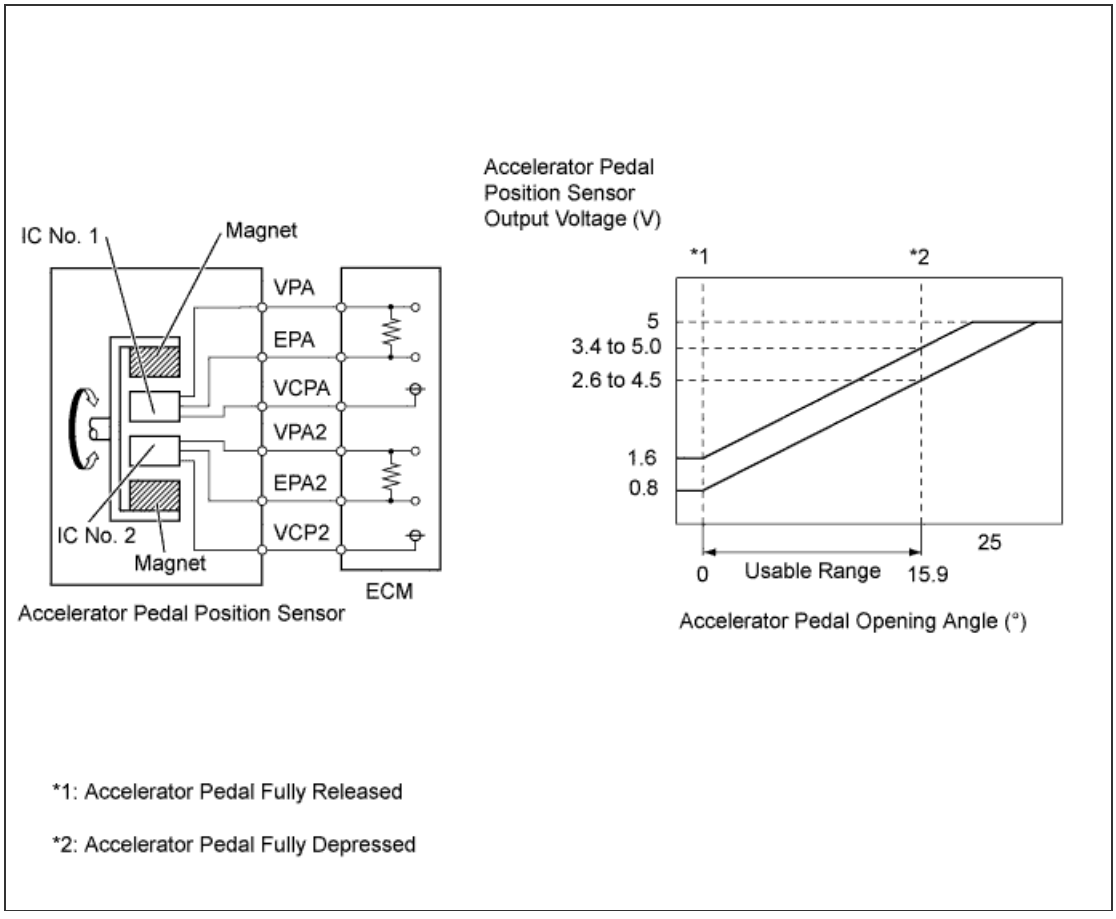
DESCRIPTION

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

The Accelerator Pedal Position (APP) sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC Code	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• Accelerator Pedal Position (APP) sensor • ECM

P2122	VPA is 0.4 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCPA circuit • Open or ground short in VPA circuit • ECM
P2123	VPA is 4.8 V or higher for 2.0 seconds or more (1 trip detection logic).	• APP sensor • Open in EPA circuit • ECM
P2125	VPA2 fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or higher. (b) VPA is between 0.4 V and 3.45 V.	• APP sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): (a) The difference between VPA and VPA2 is 0.02 V or less. (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less.	• Short between VPA and VPA2 circuits • APP sensor • ECM

HINT:

When any of these DTCs are output, check the APP sensor voltage by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No.1 and Accelerator Position No.2.

Trouble Area	Accelerator Position No. 1 When Accelerator Pedal Released	Accelerator Position No. 2 When Accelerator Pedal Released	Accelerator Position No. 1 When Accelerator Pedal Depressed	Accelerator Position No. 2 When Accelerator Pedal Depressed
VCP circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.0 V
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 5.0 V

HINT:

Accelerator pedal positions are expressed as voltages.

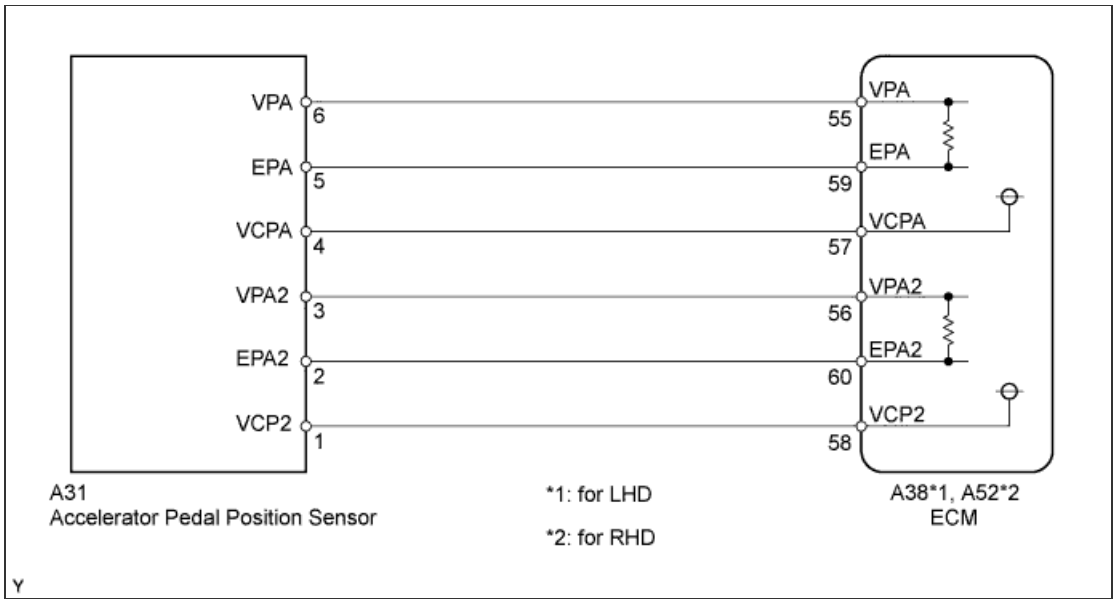
MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is below the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and stores a DTC.
Example:
When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is stored.
If the malfunction is not repaired successfully, a DTC is stored 2 seconds after the engine is next started.

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 are stored, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue to be driven. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.
Fail-safe mode continues until a pass condition is detected, and the ignition switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Accelerator Pedal Position (APP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

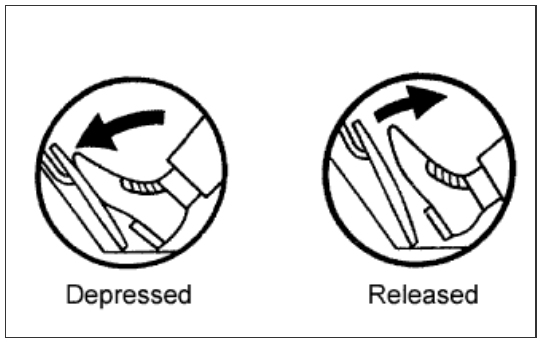
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No.1 and Accelerator Position No.2.

d. Read the value displayed on the tester.



Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2.6 to 4.5 V	3.4 to 5.0 V

Result

Result	Proceed to
OK	A
NG	B

A → Go to step 5

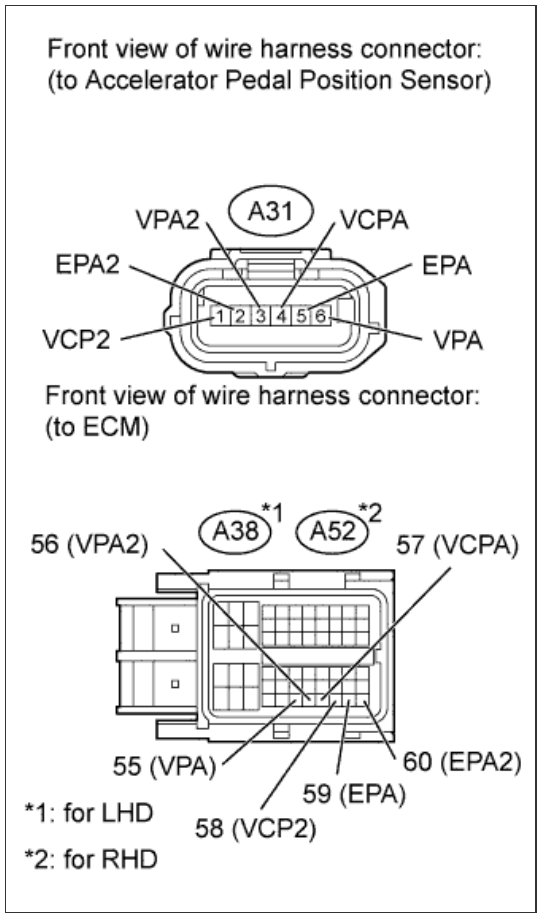
B

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the Accelerator Pedal Position (APP) sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A38-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-59 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A38-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A38-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A38-58 (VCP2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A52-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-59 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A52-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A52-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A52-58 (VCP2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) or A38-55 (VPA) -		10 kΩ or

Body ground	Always	higher
A31-5 (EPA) or A38-59 (EPA) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-57 (VCPA) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-56 (VPA2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A38-60 (EPA2) - Body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A38-58 (VCP2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) or A52-55 (VPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-59 (EPA) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-57 (VCPA) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-56 (VPA2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-60 (EPA2) - Body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A52-58 (VCP2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK ECM (VCPA AND VCP2 VOLTAGE)

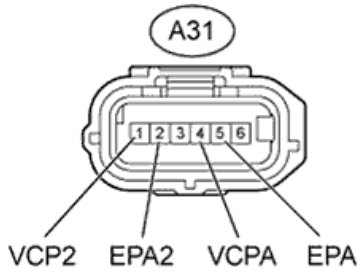
a. Disconnect the APP sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Ignition switch ON	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Ignition switch ON	4.5 to 5.5 V

Front view of wire harness connector:
(to Accelerator Pedal Position Sensor)



NG → REPLACE ECM (Click here)

OK

4.REPLACE ACCELERATOR PEDAL ROD ASSEMBLY

a. Replace the accelerator pedal rod assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read the DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138	A
No output	B

B → SYSTEM OK

A → REPLACE ECM (Click here)

DTC P0171 System Too Lean (Bank 1)

DTC P0172 System Too Rich (Bank 1)

DTC P0174 System Too Lean (Bank 2)

DTC P0175 System Too Rich (Bank 2)

for Preparation Click here

DESCRIPTION

The fuel trim is related to the feedback compensation value, not to the basic injection time. The fuel trim consists of both the short-term and long-term fuel trim.
The short-term fuel trim is fuel compensation that is used to constantly maintain the air fuel ratio at stoichiometric levels. The signal from the Air Fuel Ratio (A/F) sensor indicates whether the air fuel ratio is rich or lean compared to the stoichiometric ratio. This triggers a reduction in the fuel injection volume if the air fuel ratio is rich and an increase in the fuel injection volume if it is lean.
Factors such as individual engine differences, wear over time and changes in operating environment cause short-term fuel trim to vary from the central value. The long-term fuel trim, which controls overall fuel compensation, compensates for long-term deviations in the fuel trim from the central value caused by the short-term fuel trim compensation.
If both the short-term and long-term fuel trim are lean or rich beyond predetermined values, it is interpreted as a malfunction, and the ECM illuminates the MIL and sets a DTC.

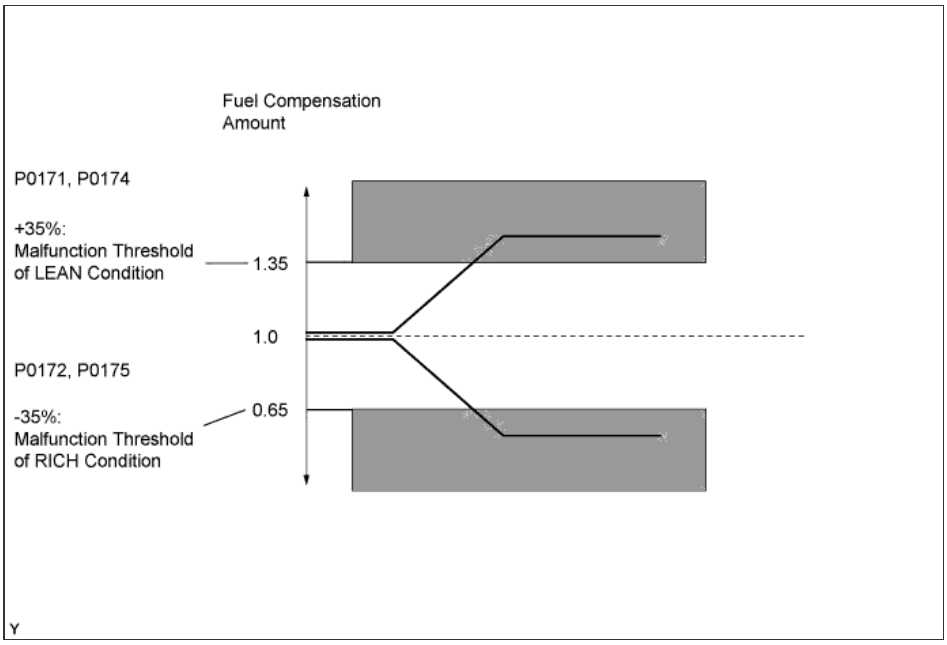
DTC Code	DTC Detection Condition	Trouble Area
P0171 P0174	With a warm engine and stable air fuel ratio feedback, the fuel trim is considerably in error to the lean side (2 trip detection logic).	• Air induction system • Injector blockage • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Fuel pressure • Gas leakage from exhaust system • Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor heater (bank 1, 2 sensor 1) • Integration relay (A/F relay) • A/F sensor heater circuits • PCV valve and hose • PCV hose connections • ECM
P0172 P0175	With a warm engine and stable air fuel ratio feedback, the fuel trim is considerably in error to the rich side (2 trip detection logic).	• Injector leakage or blockage • MAF meter • ECT sensor • Ignition system • Fuel pressure • Gas leakage from exhaust system • Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor heater (bank 1, 2 sensor 1) • Integration relay (A/F relay) • A/F sensor heater circuits • ECM

HINT:

- **When DTC P0171 or P0174 is stored, the actual air fuel ratio is on the lean side. When DTC P0172 or P0175 is stored, the actual air fuel ratio is on the rich side.**
- **If the vehicle runs out of fuel, the air fuel ratio becomes lean and DTC P0171 or P0174 may be stored. The MIL is then illuminated.**
- **When the total of the short-term and long-term fuel trim values is within the malfunction threshold (and the engine coolant temperature is more than 75°C [167°F]), the system is functioning normally.**

MONITOR DESCRIPTION

Under closed-loop fuel control, fuel injection volumes that deviate from those estimated by the ECM cause changes in the long-term fuel trim compensation value. The long-term fuel trim is adjusted when there are persistent deviations in the short-term fuel trim values. Deviations from the ECM's estimated fuel injection volumes also affect the average fuel trim learned value, which is a combination of the average short-term fuel trim (fuel feedback compensation value) and the average long-term fuel trim (learned value of the air fuel ratio).
If the average fuel trim learned value exceeds the malfunction thresholds, the ECM interprets this as a fault in the fuel system and stores a DTC.
Example:
If the average fuel trim learned value is more than +35% or less than -35%, the ECM interprets this as a fuel system malfunction.



WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the intelligent tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume.)**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2, or AFS Voltage B2S1 and O2S B2S2) displayed on the intelligent tester.**

HINT:

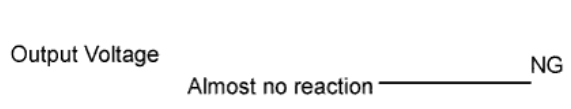
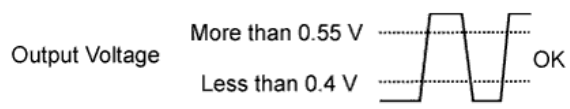
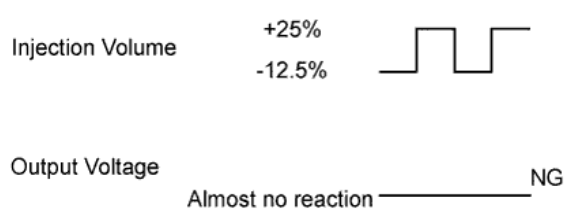
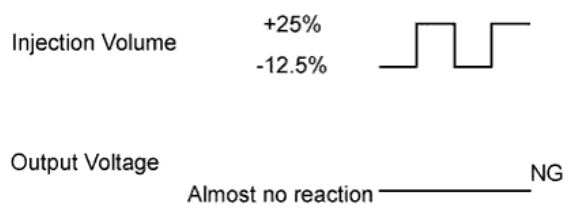
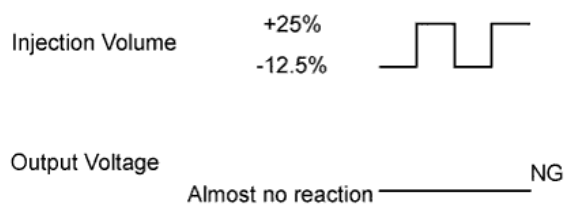
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	Less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1	Injection Volume: +25% / -12.5 Output Voltage: More than 3.4 V / Less than 3.1 V → OK	Injection Volume: +25% / -12.5 Output Voltage: More than 0.55 V / Less than 0.4 V → OK	-
	Injection Volume: +25% / -12.5	Injection Volume: +25% / -12.5	• A/F sensor • A/F sensor

2			• heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.**
- **A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0171, P0172, P0174 OR P0175)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

d. Read the DTCs.

Result

Display (DTC Output)	Proceed to
P0171, P0172, P0174 or P0175	A
P0171, P0172, P0174 or P0175 and other DTCs	B

HINT:

If any DTCs other than P0171, P0172, P0174 or P0175 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:

PCV hose is connected correctly and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE

OK

3.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage.

OK:

No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK

4.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (A/F CONTROL)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the intelligent tester on.

c. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor.

e. Perform the Control the Injection Volume for A/F Sensor operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).

f. Monitor the voltage outputs of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2, or AFS Voltage B2S1 and O2S B2S2) displayed on the intelligent tester.

HINT:

- **The Control the Injection Volume for A/F Sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	Less than 3.1
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4

Result:

Status AFS Voltage B1S1 or AFS Voltage B2S1	Status O2S B1S2 or O2S B2S2	A/F Condition and A/F Sensor Condition	Misfire	Suspected Trouble Area	Proceed to
Lean/Rich	Lean/Rich	Normal	-	-	C
Lean	Lean	Actual air fuel ratio lean	May occur	• PCV valve and hose • PCV hose connections • Injector blockage • Gas leakage from exhaust system • Air induction system • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor	A
Rich	Rich	Actual air fuel ratio rich	-	• Injector blockage or blockage • Gas leakage from exhaust system • Ignition system • Fuel pressure • MAF meter • ECT sensor	
Lean	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	B
Rich	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	

Lean: During Control the Injection Volume for A/F Sensor, the A/F sensor output voltage (AFS) is consistently more than 3.4 V, and the HO2 sensor output voltage (O2S) is consistently less than 0.4 V.
Rich: During Control the Injection Volume for A/F Sensor, the AFS is consistently less than 3.1 V, and the O2S is consistently more than 0.55 V.
Lean/Rich: During Control the Injection Volume for A/F Sensor of the Active Test, the output voltage of the heated oxygen sensor alternates correctly.

B → Go to step 11

C → Go to step 15

A

5.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Data List twice, when the engine is cold and when it is warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: 80 to 100°C (176 to 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

6.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

7.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → REPAIR OR REPLACE FUEL SYSTEM

OK

8.CHECK FOR EXHAUST GAS LEAK

a. Inspect for exhaust gas leakage from the exhaust manifold sub-assembly and exhaust pipes.

OK:
No gas leakage.

NG → REPAIR OR REPLACE EXHAUST SYSTEM

OK

9.CHECK SPARK AND IGNITION

a. Check the ignition system (Click here).

HINT:

If the spark plugs or ignition system malfunctions, engine misfires may occur. The misfire count can be read using the intelligent tester. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Cylinder #1 Misfire Rate (to Cylinder #6 Misfire Rate).

NG → REPAIR OR REPLACE IGNITION SYSTEM

OK

10.INSPECT FUEL INJECTOR ASSEMBLY (INJECTION AND VOLUME)

a. Inspect the fuel injector assembly (Click here).

HINT:

If the injectors malfunction, engine misfires may occur. The misfire count can be read using the intelligent tester. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Cylinder #1 Misfire Rate (to Cylinder #6 Misfire Rate).

NG → REPLACE FUEL INJECTOR ASSEMBLY (Click here)

OK

11.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

a. Disconnect the A/F sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for Bank 1 Sensor 1):

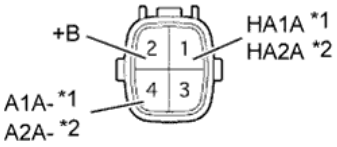
Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω

~~1 (HA1A) - 4 (A1A-)~~	~~Always~~	~~10 kΩ or higher~~

Standard Resistance (for Bank 2 Sensor 1):

Tester Connection	Condition	Specified Condition
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

12.INSPECT INTEGRATION RELAY (A/F RELAY)

a. Remove the integration relay from the engine room junction block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

iii. Reinstall the A/F fuse.

c. Inspect the A/F relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

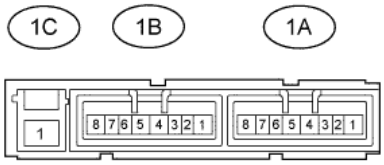
Tester Connection	Condition	Specified Condition
1A-4 - 1C-1	No battery voltage applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A- 2 and 1A-3	Below 1 Ω

Component without harness connected:
(Integration Relay)

Fuse Side:



Connector Side:



Y

NG → REPLACE INTEGRATION RELAY

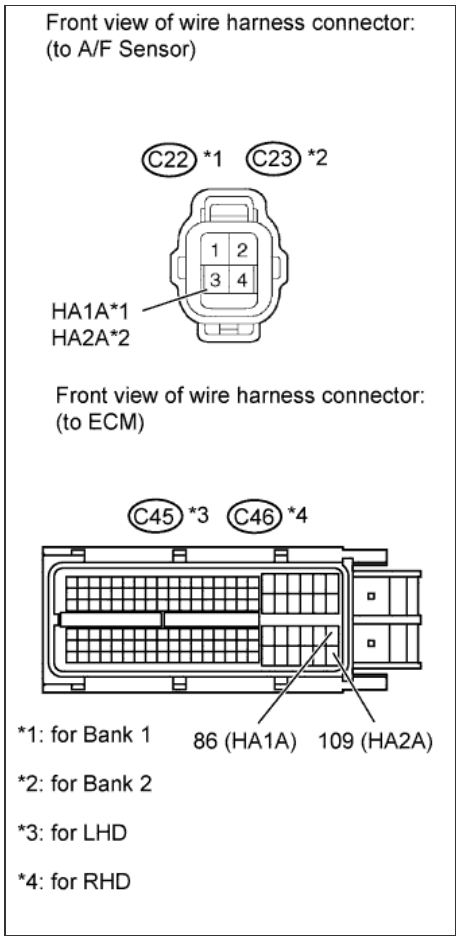
OK

13.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

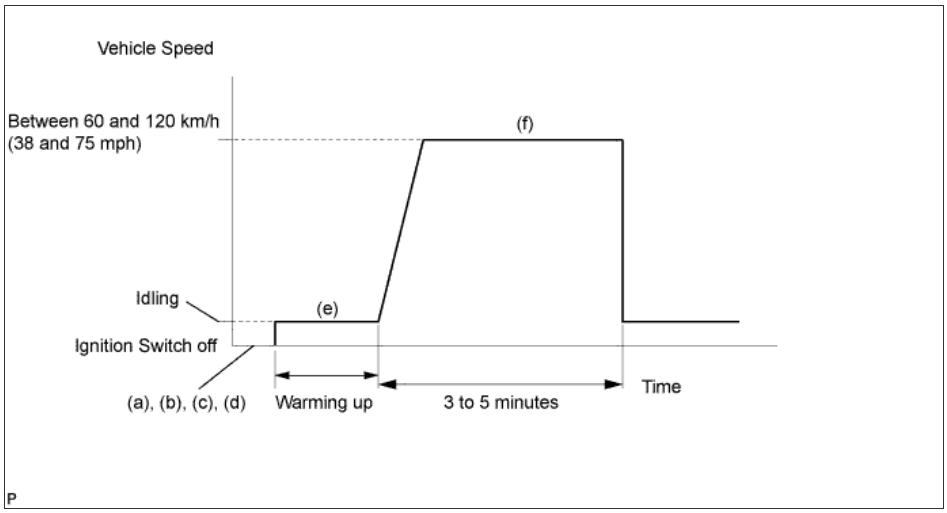
OK

14.REPLACE AIR FUEL RATIO SENSOR

a. Replace the A/F sensor (Click here).

NEXT

15.PERFORM CONFIRMATION DRIVING PATTERN



(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the intelligent tester on.
(c) Clear DTCs (Click here).
(d) Switch the ECM from normal mode to check mode using the intelligent tester (Click here).
(e) Start the engine and warm it up with all the accessories switched OFF.
(f) Drive the vehicle at between 60 km/h and 120 km/h (38 mph and 75 mph) and at an engine speed of between 1400 rpm and 3200 rpm for 3 to 5 minutes.

HINT:

If the system is still malfunctioning, the MIL is illuminated during step (f).

NOTICE:

If the conditions in this test are not strictly followed, no malfunction will be detected.

NEXT

16.CHECK WHETHER DTC OUTPUT RECURS (DTC P0171, P0172, P0174 OR P0175)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

d. Read the DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P0171, P0172, P0174 or P0175	B

B → **REPLACE ECM (Click here)**

A

END

for Preparation Click here

DESCRIPTION

Refer to DTC P2120 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2121	Either of following conditions 1 or 2 met for 0.5 seconds (1 trip detection logic) 1. Difference between VPA and VPA2 is less than 0.4 V, or more than 1.2 V. (learned value of accelerator off position) 2. Difference between VPA and VPA2 is greater than or equal to the specified value.	• Accelerator Pedal Position (APP) sensor • ECM

MONITOR DESCRIPTION

When the difference between the output voltages of VPA and VPA2 deviates from the standard, the ECM determines that the accelerator pedal position sensor is malfunctioning. The ECM turns on the MIL and stores the DTC.

FAIL-SAFE

The accelerator pedal position sensor has two (main and sub) sensor circuits. If a malfunction occurs in either of the sensor circuits, the ECM detects the abnormal signal voltage difference between the two sensor circuits and switches to limp mode. In limp mode, the functioning circuit is used to calculate the accelerator pedal opening angle to allow the vehicle to continue to be driven. If both circuits malfunction, the ECM regards the opening angle of the accelerator pedal as being fully closed. In this case, the throttle valve remains closed as if the engine is idling.
If a pass condition is detected and then the ignition switch is turned off, the fail-safe operation stops and the system returns to a normal condition.

WIRING DIAGRAM

Refer to DTC P2120 (Click here).

INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **This DTC relates to the Accelerator Pedal Position (APP) sensor.**

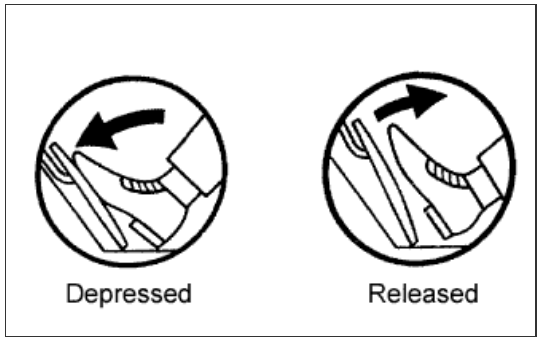
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No.1 and Accelerator Position No.2.

d. Read the value displayed on the tester.



Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2.6 to 4.5 V	3.4 to 5.0 V

Result

Result	Proceed to
OK	A
NG	B

A → Go to step 3

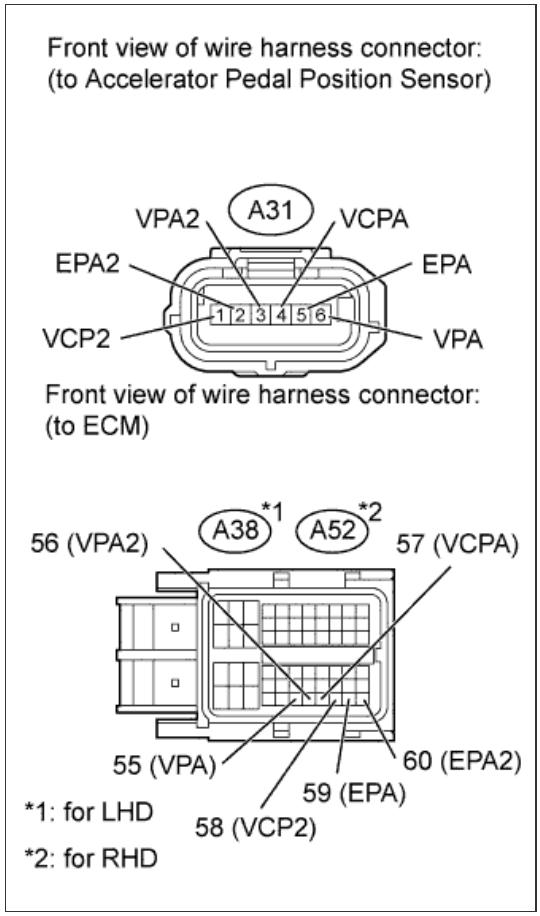
B

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the Accelerator Pedal Position (APP) sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A38-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-59 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A38-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A38-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A38-58 (VCP2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A52-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-59 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A52-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A52-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A52-58 (VCP2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition

A31-6 (VPA) or A38-55 (VPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-59 (EPA) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-57 (VCPA) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-56 (VPA2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A38-60 (EPA2) - Body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A38-58 (VCP2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
A31-6 (VPA) or A52-55 (VPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-59 (EPA) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-57 (VCPA) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-56 (VPA2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-60 (EPA2) - Body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A52-58 (VCP2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.REPLACE ACCELERATOR PEDAL ROD ASSEMBLY

a. Replace the accelerator pedal rod assembly (Click here).

NEXT

4.CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read the DTCs.

Result

Result	Proceed to
P2121	A
No output	B

B → SYSTEM OK

A

REPLACE ECM (Click here)

DTC P0171 System Too Lean (Bank 1)

DTC P0172 System Too Rich (Bank 1)

DTC P0174 System Too Lean (Bank 2)

DTC P0175 System Too Rich (Bank 2)

for Preparation Click here

DESCRIPTION

The fuel trim is related to the feedback compensation value, not to the basic injection time. The fuel trim consists of both the short-term and long-term fuel trim.
The short-term fuel trim is fuel compensation that is used to constantly maintain the air fuel ratio at stoichiometric levels. The signal from the Air Fuel Ratio (A/F) sensor indicates whether the air fuel ratio is rich or lean compared to the stoichiometric ratio. This triggers a reduction in the fuel injection volume if the air fuel ratio is rich and an increase in the fuel injection volume if it is lean.
Factors such as individual engine differences, wear over time and changes in operating environment cause short-term fuel trim to vary from the central value. The long-term fuel trim, which controls overall fuel compensation, compensates for long-term deviations in the fuel trim from the central value caused by the short-term fuel trim compensation.
If both the short-term and long-term fuel trim are lean or rich beyond predetermined values, it is interpreted as a malfunction, and the ECM illuminates the MIL and sets a DTC.

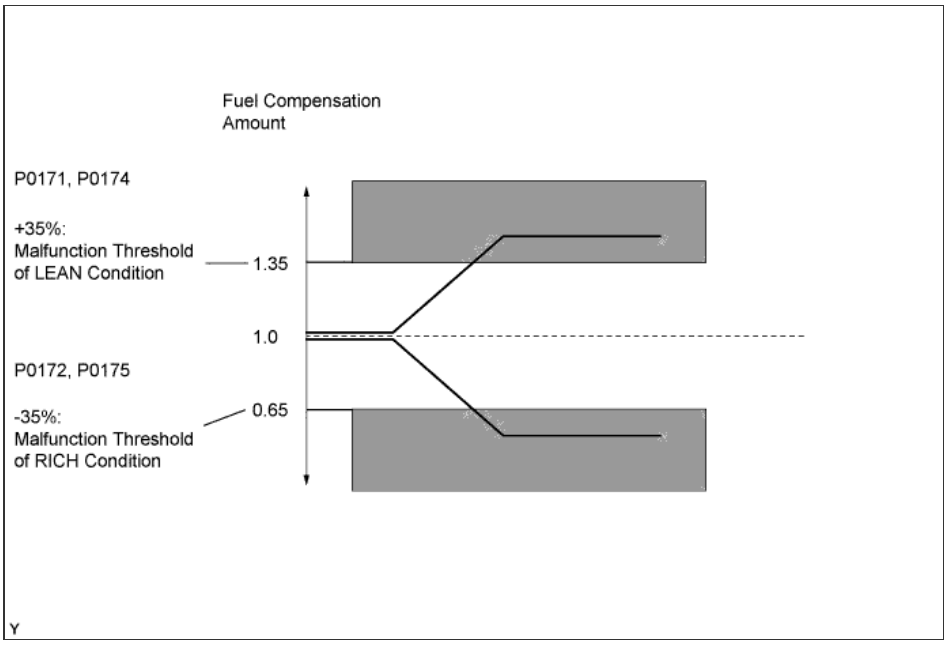
DTC Code	DTC Detection Condition	Trouble Area
P0171 P0174	With a warm engine and stable air fuel ratio feedback, the fuel trim is considerably in error to the lean side (2 trip detection logic).	• Air induction system • Injector blockage • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Fuel pressure • Gas leakage from exhaust system • Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor heater (bank 1, 2 sensor 1) • Integration relay (A/F relay) • A/F sensor heater circuits • PCV valve and hose • PCV hose connections • ECM
P0172 P0175	With a warm engine and stable air fuel ratio feedback, the fuel trim is considerably in error to the rich side (2 trip detection logic).	• Injector leakage or blockage • MAF meter • ECT sensor • Ignition system • Fuel pressure • Gas leakage from exhaust system • Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor heater (bank 1, 2 sensor 1) • Integration relay (A/F relay) • A/F sensor heater circuits • ECM

HINT:

- **When DTC P0171 or P0174 is stored, the actual air fuel ratio is on the lean side. When DTC P0172 or P0175 is stored, the actual air fuel ratio is on the rich side.**
- **If the vehicle runs out of fuel, the air fuel ratio becomes lean and DTC P0171 or P0174 may be stored. The MIL is then illuminated.**
- **When the total of the short-term and long-term fuel trim values is within the malfunction threshold (and the engine coolant temperature is more than 75°C [167°F]), the system is functioning normally.**

MONITOR DESCRIPTION

Under closed-loop fuel control, fuel injection volumes that deviate from those estimated by the ECM cause changes in the long-term fuel trim compensation value. The long-term fuel trim is adjusted when there are persistent deviations in the short-term fuel trim values. Deviations from the ECM's estimated fuel injection volumes also affect the average fuel trim learned value, which is a combination of the average short-term fuel trim (fuel feedback compensation value) and the average long-term fuel trim (learned value of the air fuel ratio).
If the average fuel trim learned value exceeds the malfunction thresholds, the ECM interprets this as a fault in the fuel system and stores a DTC.
Example:
If the average fuel trim learned value is more than +35% or less than -35%, the ECM interprets this as a fuel system malfunction.



WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the intelligent tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume.)**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2, or AFS Voltage B2S1 and O2S B2S2) displayed on the intelligent tester.**

HINT:

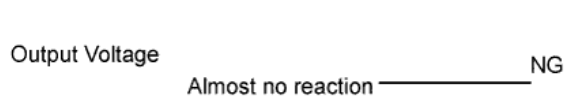
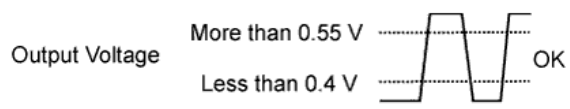
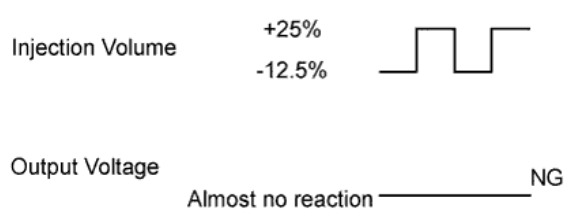
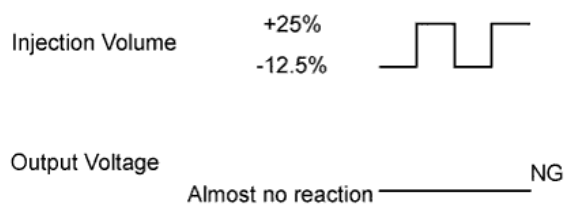
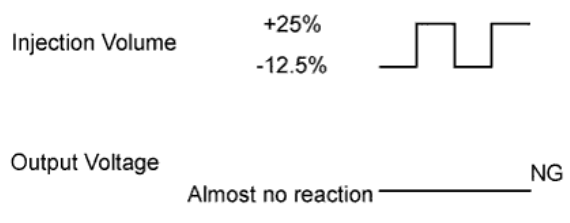
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	Less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1	Injection Volume: +25% / -12.5 Output Voltage: More than 3.4 V / Less than 3.1 V → OK	Injection Volume: +25% / -12.5 Output Voltage: More than 0.55 V / Less than 0.4 V → OK	-
	Injection Volume: +25% / -12.5	Injection Volume: +25% / -12.5	• A/F sensor • A/F sensor

2			• heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.**
- **A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0171, P0172, P0174 OR P0175)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

d. Read the DTCs.

Result

Display (DTC Output)	Proceed to
P0171, P0172, P0174 or P0175	A
P0171, P0172, P0174 or P0175 and other DTCs	B

HINT:

If any DTCs other than P0171, P0172, P0174 or P0175 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:

PCV hose is connected correctly and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE

OK

3.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage.

OK:

No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK

4.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (A/F CONTROL)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the intelligent tester on.

c. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor.

e. Perform the Control the Injection Volume for A/F Sensor operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).

f. Monitor the voltage outputs of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2, or AFS Voltage B2S1 and O2S B2S2) displayed on the intelligent tester.

HINT:

- **The Control the Injection Volume for A/F Sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	Less than 3.1
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4

Result:

Status AFS Voltage B1S1 or AFS Voltage B2S1	Status O2S B1S2 or O2S B2S2	A/F Condition and A/F Sensor Condition	Misfire	Suspected Trouble Area	Proceed to
Lean/Rich	Lean/Rich	Normal	-	-	C
Lean	Lean	Actual air fuel ratio lean	May occur	• PCV valve and hose • PCV hose connections • Injector blockage • Gas leakage from exhaust system • Air induction system • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor	A
Rich	Rich	Actual air fuel ratio rich	-	• Injector blockage or blockage • Gas leakage from exhaust system • Ignition system • Fuel pressure • MAF meter • ECT sensor	
Lean	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	B
Rich	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	

Lean: During Control the Injection Volume for A/F Sensor, the A/F sensor output voltage (AFS) is consistently more than 3.4 V, and the HO2 sensor output voltage (O2S) is consistently less than 0.4 V.
Rich: During Control the Injection Volume for A/F Sensor, the AFS is consistently less than 3.1 V, and the O2S is consistently more than 0.55 V.
Lean/Rich: During Control the Injection Volume for A/F Sensor of the Active Test, the output voltage of the heated oxygen sensor alternates correctly.

B → Go to step 11

C → Go to step 15

A

5.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Data List twice, when the engine is cold and when it is warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: 80 to 100°C (176 to 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

6.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

7.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → REPAIR OR REPLACE FUEL SYSTEM

OK

8.CHECK FOR EXHAUST GAS LEAK

a. Inspect for exhaust gas leakage from the exhaust manifold sub-assembly and exhaust pipes.

OK:
No gas leakage.

NG → REPAIR OR REPLACE EXHAUST SYSTEM

OK

9.CHECK SPARK AND IGNITION

a. Check the ignition system (Click here).

HINT:

If the spark plugs or ignition system malfunctions, engine misfires may occur. The misfire count can be read using the intelligent tester. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Cylinder #1 Misfire Rate (to Cylinder #6 Misfire Rate).

NG → REPAIR OR REPLACE IGNITION SYSTEM

OK

10.INSPECT FUEL INJECTOR ASSEMBLY (INJECTION AND VOLUME)

a. Inspect the fuel injector assembly (Click here).

HINT:

If the injectors malfunction, engine misfires may occur. The misfire count can be read using the intelligent tester. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Cylinder #1 Misfire Rate (to Cylinder #6 Misfire Rate).

NG → REPLACE FUEL INJECTOR ASSEMBLY (Click here)

OK

11.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

a. Disconnect the A/F sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for Bank 1 Sensor 1):

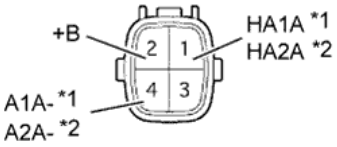
Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω

~~1 (HA1A) - 4 (A1A-)~~	~~Always~~	~~10 kΩ or higher~~

Standard Resistance (for Bank 2 Sensor 1):

Tester Connection	Condition	Specified Condition
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

12.INSPECT INTEGRATION RELAY (A/F RELAY)

a. Remove the integration relay from the engine room junction block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

iii. Reinstall the A/F fuse.

c. Inspect the A/F relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

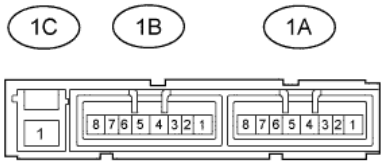
Tester Connection	Condition	Specified Condition
1A-4 - 1C-1	No battery voltage applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A- 2 and 1A-3	Below 1 Ω

Component without harness connected:
(Integration Relay)

Fuse Side:



Connector Side:



Y

NG → REPLACE INTEGRATION RELAY

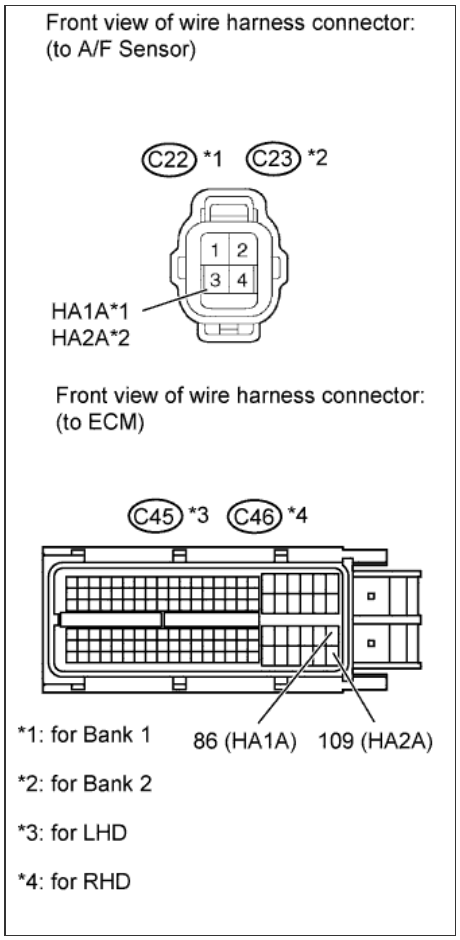
OK

13.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

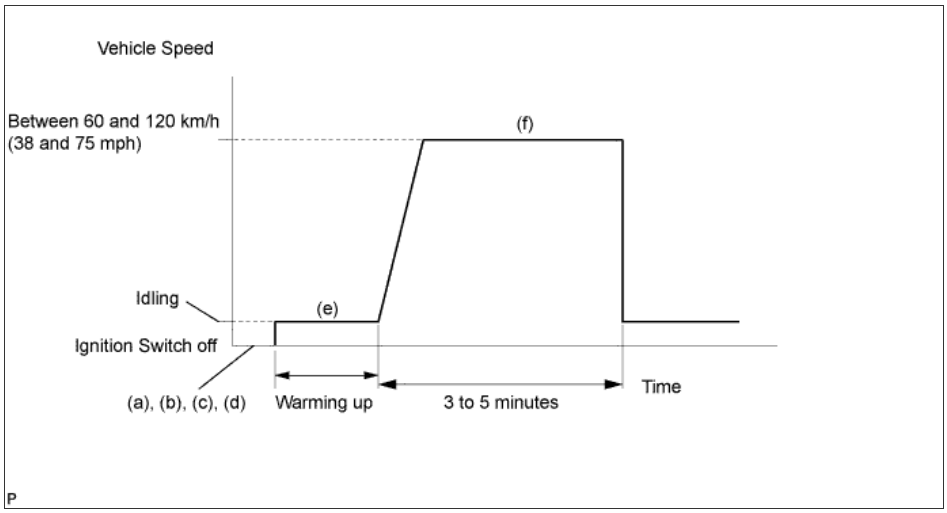
OK

14.REPLACE AIR FUEL RATIO SENSOR

a. Replace the A/F sensor (Click here).

NEXT

15.PERFORM CONFIRMATION DRIVING PATTERN



(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the intelligent tester on.
(c) Clear DTCs (Click here).
(d) Switch the ECM from normal mode to check mode using the intelligent tester (Click here).
(e) Start the engine and warm it up with all the accessories switched OFF.
(f) Drive the vehicle at between 60 km/h and 120 km/h (38 mph and 75 mph) and at an engine speed of between 1400 rpm and 3200 rpm for 3 to 5 minutes.

HINT:

If the system is still malfunctioning, the MIL is illuminated during step (f).

NOTICE:

If the conditions in this test are not strictly followed, no malfunction will be detected.

NEXT

16.CHECK WHETHER DTC OUTPUT RECURS (DTC P0171, P0172, P0174 OR P0175)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

d. Read the DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P0171, P0172, P0174 or P0175	B

B → **REPLACE ECM (Click here)**

A

END

DTC P2195 Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)

DTC P2196 Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)

DTC P2197 Oxygen (A/F) Sensor Signal Stuck Lean (Bank 2 Sensor 1)

DTC P2198 Oxygen (A/F) Sensor Signal Stuck Rich (Bank 2 Sensor 1)

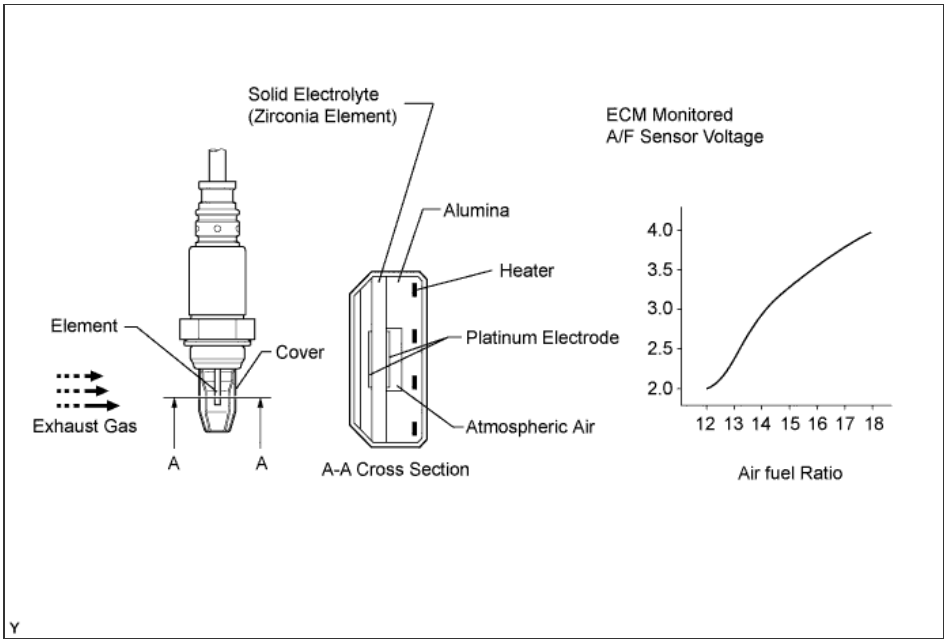
for Preparation Click here

DESCRIPTION

HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air Fuel Ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**

The A/F sensor generates a voltage* that corresponds to the actual air fuel ratio. This sensor voltage is used to provide the ECM with feedback so that it can control the air fuel ratio. The ECM determines the deviation from the stoichiometric air fuel ratio, and regulates the fuel injection time. If the A/F sensor malfunctions, the ECM is unable to control the air fuel ratio accurately.
The A/F sensor is the planar type and is integrated with a heater, which heats the solid electrolyte (zirconia element). This heater is controlled by the ECM. When the intake air volume is low (the exhaust gas temperature is low), a current flows into the heater to heat the sensor in order to facilitate accurate oxygen concentration detection. In addition, the sensor and heater portions are the narrow type. The heat generated by the heater is conducted to the solid electrolyte through the alumina, therefore the sensor activation is accelerated.
In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air fuel ratio must be precisely controlled so that it is always close to the stoichiometric level.
*: The value changes inside the ECM. Since the A/F sensor is a current output element, the current is converted into a voltage inside the ECM. Any measurements taken at the A/F sensor or ECM connectors will show a constant voltage.

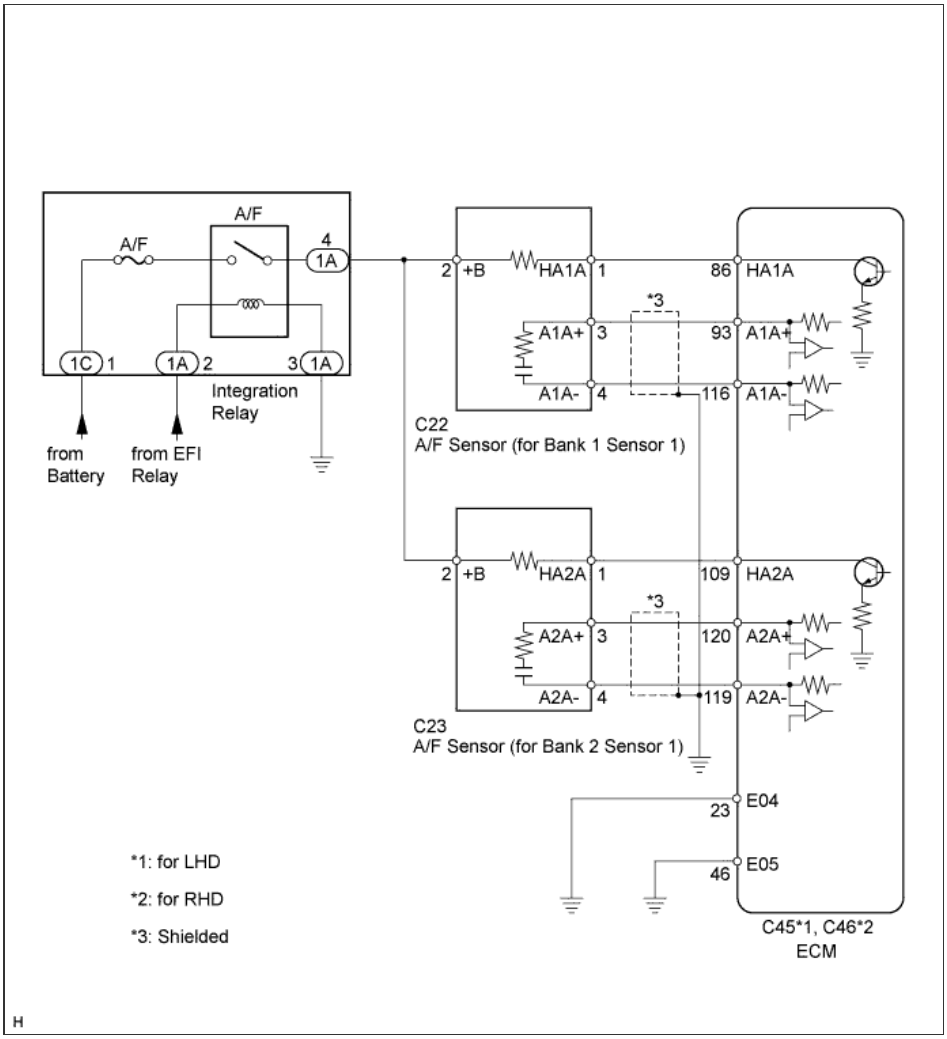


DTC Code	DTC Detection Condition	Trouble Area
P2195 P2197	Conditions (a) and (b) continue for 2 seconds or more (2 trip detection logic): (a) The Air Fuel Ratio (A/F) sensor voltage is more than 3.8 V. (b) The Heated Oxygen (HO2) sensor voltage is 0.15 V or more.	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor (bank 1, 2 sensor 1) heater • A/F sensor heater circuits • Integration relay • Air induction system circuits • Fuel pressure • Fuel injector • ECM
	While fuel-cut operation is performed (during vehicle deceleration), the air fuel ratio (A/F) sensor current is 3.6 mA or more for 3 seconds (2 trip detection logic).	• A/F sensor • ECM
P2196 P2198	Conditions (a) and (b) continue for 2 seconds or more (2 trip detection logic): (a) The A/F sensor voltage is less than 2.8 V. (b) The HO2 sensor voltage is less than 0.6 V.	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor (bank 1, 2 sensor 1) heater • A/F sensor heater circuits • Air induction system • Integration relay • Fuel pressure • Fuel injector • ECM
	While fuel-cut operation is performed (during vehicle deceleration), the air fuel ratio (A/F) sensor current is less than 1.4 mA for 3 seconds (2 trip detection logic).	• A/F sensor • ECM

HINT:

- **DTCs P2195 and P2196 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2197 and P2198 indicate malfunctions related to the bank 2 A/F sensor circuit.**
- **Bank 1 refers to the bank that includes cylinder No. 1.**
- **Bank 2 refers to the bank that includes cylinder No. 2.**
- **When any of these DTCs are stored, check the A/F sensor voltage output by entering the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS Voltage B1S1 or AFS Voltage B2S1.**
- **The short-term fuel trim values can also be read using the intelligent tester.**
- **The ECM regulates the voltages at the A1A+, A2A+, A1A- and A2A- terminals of the ECM to a constant level. Therefore, the A/F sensor voltage output cannot be confirmed without using the intelligent tester.**
- **If a A/F sensor malfunction is detected, the ECM stores a DTC.**

WIRING DIAGRAM



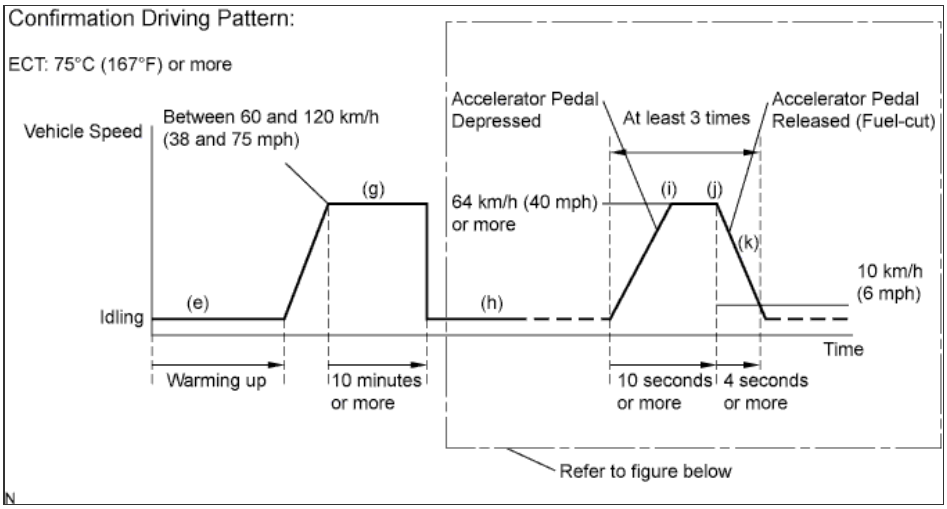
CONFIRMATION DRIVING PATTERN

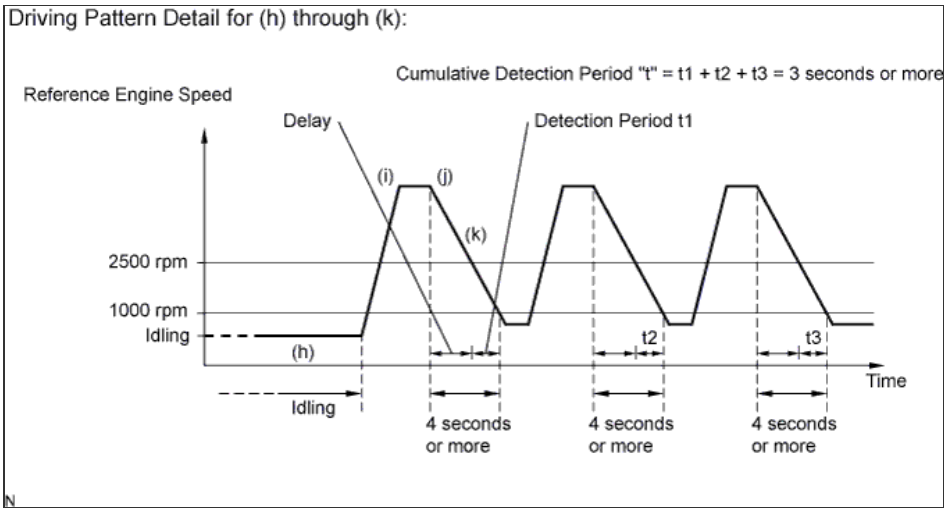
CAUTION:

Strictly observe posted speed limits, traffic laws, and road conditions when performing these drive patterns.

HINT:

This confirmation driving pattern is used in the "PERFORM CONFIRMATION DRIVING PATTERN" procedure of the following diagnostic troubleshooting procedure.





(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON.
(c) Turn the intelligent tester on.
(d) Clear DTCs (Click here).
(e) Start the engine, and warm it up until the ECT reaches 75°C (167°F) or higher.
(f) Enter the following menus to check the fuel-cut status: Powertrain / Engine and ECT / Data List / All Data / Idle Fuel Cut.
(g) Drive the vehicle at between 60 km/h (38 mph) and 120 km/h (75 mph) for at least 10 minutes.
(h) Shift the transmission to 2nd gear.
(i) Drive the vehicle at the proper vehicle speed to perform fuel-cut operation (refer to the following HINT).

HINT:

Fuel-cut is performed when the following conditions are met:

- **The accelerator pedal is fully released.**
- **The engine speed is 2500 rpm or more (fuel injection returns at 1000 rpm).**

(j) Accelerate the vehicle to 64 km/h (40 mph) or more by depressing the accelerator pedal for at least 10 seconds.
(k) Soon after performing step (j) above, release the accelerator pedal for at least 4 seconds without depressing the brake pedal in order to execute fuel-cut control.
(l) Allow the vehicle to decelerate until the vehicle speed decreases to less than 10 km/h (6 mph).
(m) Repeat steps (h) through (k) above at least 3 times in one driving cycle.

HINT:

Completion of all O2S (A/F) Monitor is required to change the value in Data List.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the air fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the intelligent tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **On the intelligent tester, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume.)**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2, or AFS Voltage B2S1 and O2S B2S2) displayed on the intelligent tester.**

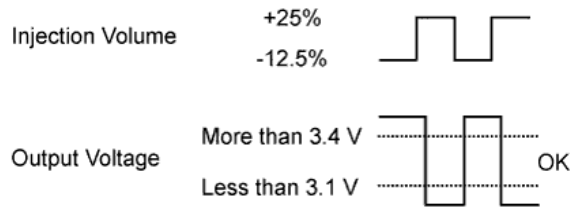
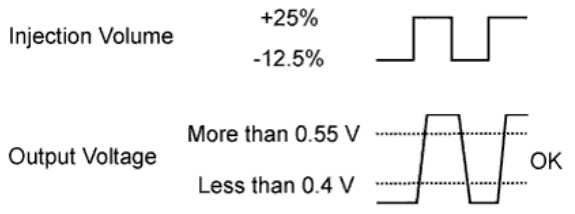
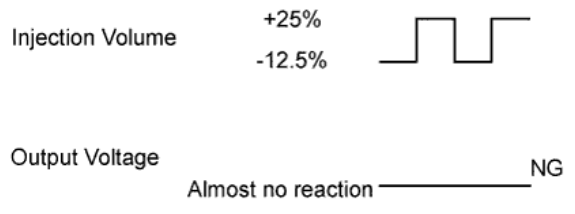
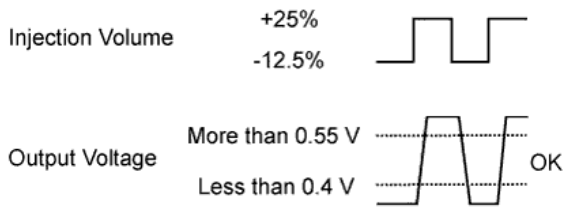
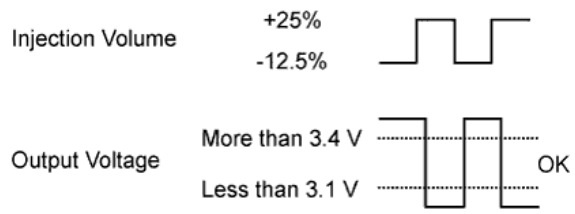
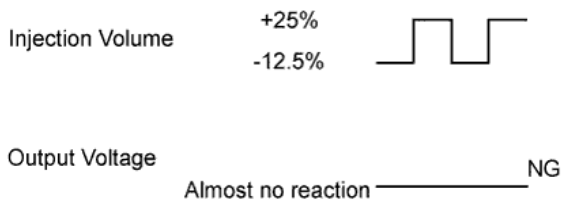
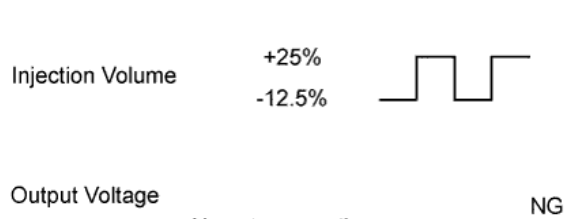
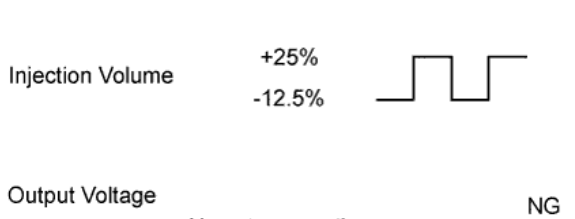
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	Less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.**
- **A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

e. Read DTCs.

Result

Display (DTC Output)	Proceed to
P2195, P2196, P2197 or P2198	A
P2195, P2196, P2197 or P2198 and other DTCs	B

HINT:

If any DTCs other than P2195, P2196, P2197 or P2198 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (TEST VALUE OF A/F SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Clear DTCs (Click here).

d. Drive the vehicle in accordance with the drive pattern described in the CONFIRMATION DRIVING PATTERN.

e. Enter the following menus: Powertrain / Engine and ECT / Monitor / O2 Sensor.

f. Check that the status of O2 Sensor is Complete.
If the status is still Incomplete, drive the vehicle according to the driving pattern again.

g. Enter the following menus: Powertrain / Engine and ECT / Monitor / O2 Sensor / Details / RANGE B1 S1.

h. Check the test value of the A/F sensor output current during fuel-cut.

Result

Test Value	Proceed to
Within normal range (1.4 mA or more, and less than 3.6 mA)	A
Outside normal range (Less than 1.4 mA, or 3.6 mA or more)	B

B → Go to step 20

A

3.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF A/F SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the intelligent tester on.

d. Warm up the air fuel ratio (A/F) sensor at an engine speed of 2500 rpm for 90 seconds.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / Snapshot / AFS Voltage B1S1 or AFS Voltage B2S1 and Engine Speed.

f. Check the A/F sensor voltage three times, once in each of the following conditions:

i. Engine idling (check for at least 30 seconds)

ii. Engine running at an engine speed of approximately 2500 rpm (without any sudden changes in engine speed)

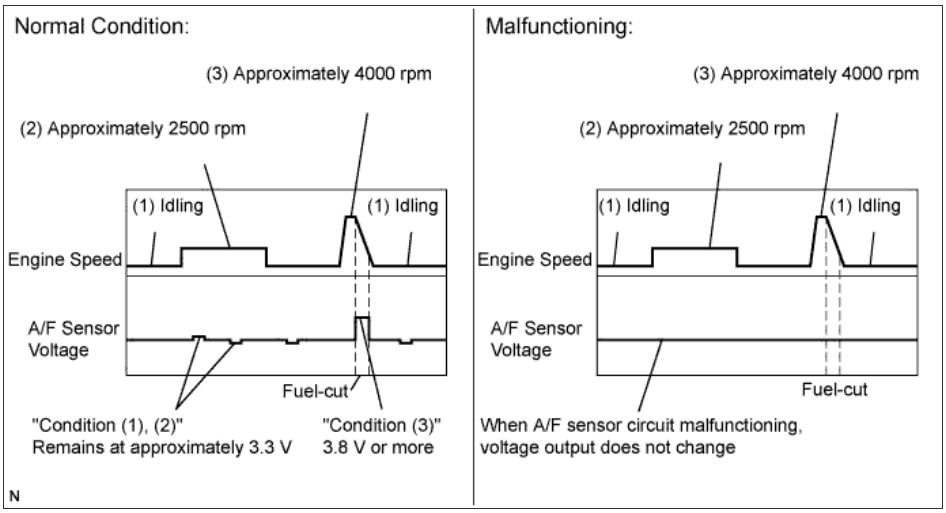
iii. Engine speed raised to 4000 rpm and then accelerator pedal quickly released so that the throttle valve is fully closed.

Standard:

Condition	A/F Sensor Voltage Variation	Reference
(1) and (2)	Changes at approximately 3.3 V	Between 3.1 V and 3.5 V
(3)	Increases to 3.8 V or more	This occurs during engine deceleration (when fuel-cut performed)

HINT:

For more information, see the diagrams below.



HINT:

- **If the output voltage of the A/F sensor remains at approximately 3.3 V (see "Malfunctioning" diagram) under any conditions, including those above, the A/F sensor may have an open circuit. (This will also happen if the A/F sensor heater has an open circuit.)**
- **If the output voltage of the A/F sensor remains at either approximately 3.8 V or more, or 2.8 V or less (see "Malfunctioning" diagram) under any conditions, including those above, the A/F sensor may have a short circuit.**
- **The ECM stops fuel injection (fuel cut) during engine deceleration. This causes a lean condition and results in a momentary increase in the A/F sensor output voltage.**
- **The ECM must establish a closed throttle valve position learned value to perform fuel cut. If the battery cable has been disconnected and reconnected, the vehicle must be driven over 16 km/h (10 mph) to allow the ECM to learn the closed throttle valve position.**
- **When the vehicle is driven:**
  The output voltage of the A/F sensor may be below 2.8 V during fuel enrichment. For the vehicle, this translates to a sudden increase in speed with the accelerator pedal fully depressed when trying to overtake another vehicle. The A/F sensor is functioning normally.
- **The A/F sensor is a current output element; therefore, the current is converted into a voltage inside the ECM. Measuring the voltage at the connectors of the A/F sensor or ECM will show a constant voltage.**

NG → Go to step 10

OK

4.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

d. Read the DTCs.

Result

Display (DTC Output)	Proceed to
P2195, P2196, P2197 or P2198	A
No output	B

B → Go to step 9

A

6.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

7.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

d. Read DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P2195, P2196, P2197 or P2198	B

B → REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN

A

9.CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

NO → CHECK FOR INTERMITTENT PROBLEMS (Click here)

YES

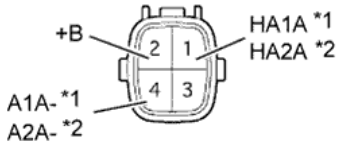
DTC CAUSED BY RUNNING OUT OF FUEL

10.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

a. Disconnect the Air Fuel ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

Standard Resistance:

for Bank 1 Sensor 1

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher

for Bank 2 Sensor 1

Tester Connection	Condition	Specified Condition
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

11.INSPECT INTEGRATION RELAY (A/F RELAY)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

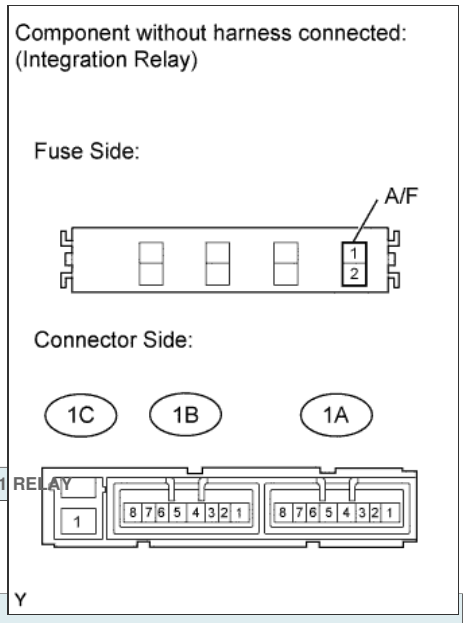
iii. Reinstall the A/F fuse.

c. Inspect the A/F relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1A-4 - 1C-1	Battery voltage not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω



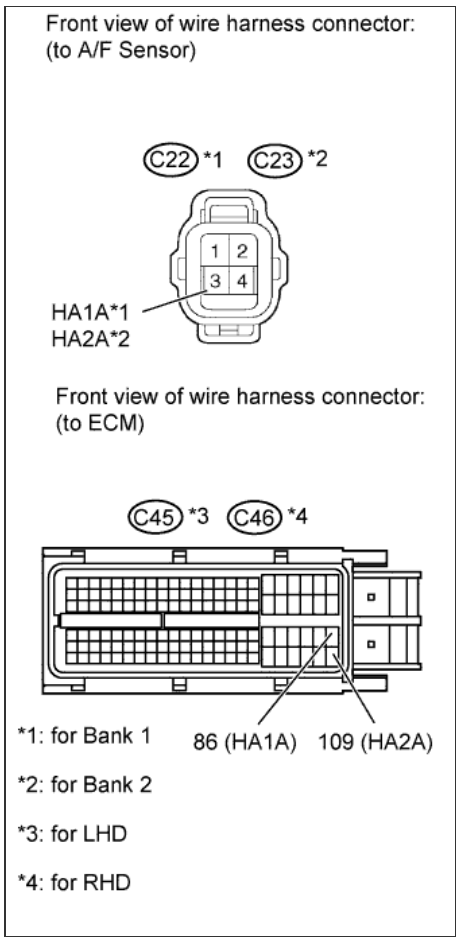
NG → REPLACE INTEGRATION NO.1 RELAY

OK

12.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body		

ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK ↓

13.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage.

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK ↓

14.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → REPAIR OR REPLACE FUEL SYSTEM

OK ↓

15.INSPECT FUEL INJECTOR

a. Check the injector injection (whether fuel volume is large or small, and whether injection pattern is poor) (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK ↓

16.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT ↓

17.PERFORM CONFIRMATION DRIVING PATTERN

NEXT ↓

18.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

d. Read DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P2195, P2196, P2197 or P2198	B

B → REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN

A

19.CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

NO → CHECK FOR INTERMITTENT PROBLEMS (Click here)

YES

DTC CAUSED BY RUNNING OUT OF FUEL

20.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

21.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

22.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

d. Read DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P2195, P2196, P2197 or P2198 (A/F sensor pending DTCs)	B

B → REPLACE ECM (Click here)

A

END

DTC P0171 System Too Lean (Bank 1)

DTC P0172 System Too Rich (Bank 1)

DTC P0174 System Too Lean (Bank 2)

DTC P0175 System Too Rich (Bank 2)

for Preparation Click here

DESCRIPTION

The fuel trim is related to the feedback compensation value, not to the basic injection time. The fuel trim consists of both the short-term and long-term fuel trim.
The short-term fuel trim is fuel compensation that is used to constantly maintain the air fuel ratio at stoichiometric levels. The signal from the Air Fuel Ratio (A/F) sensor indicates whether the air fuel ratio is rich or lean compared to the stoichiometric ratio. This triggers a reduction in the fuel injection volume if the air fuel ratio is rich and an increase in the fuel injection volume if it is lean.
Factors such as individual engine differences, wear over time and changes in operating environment cause short-term fuel trim to vary from the central value. The long-term fuel trim, which controls overall fuel compensation, compensates for long-term deviations in the fuel trim from the central value caused by the short-term fuel trim compensation.
If both the short-term and long-term fuel trim are lean or rich beyond predetermined values, it is interpreted as a malfunction, and the ECM illuminates the MIL and sets a DTC.

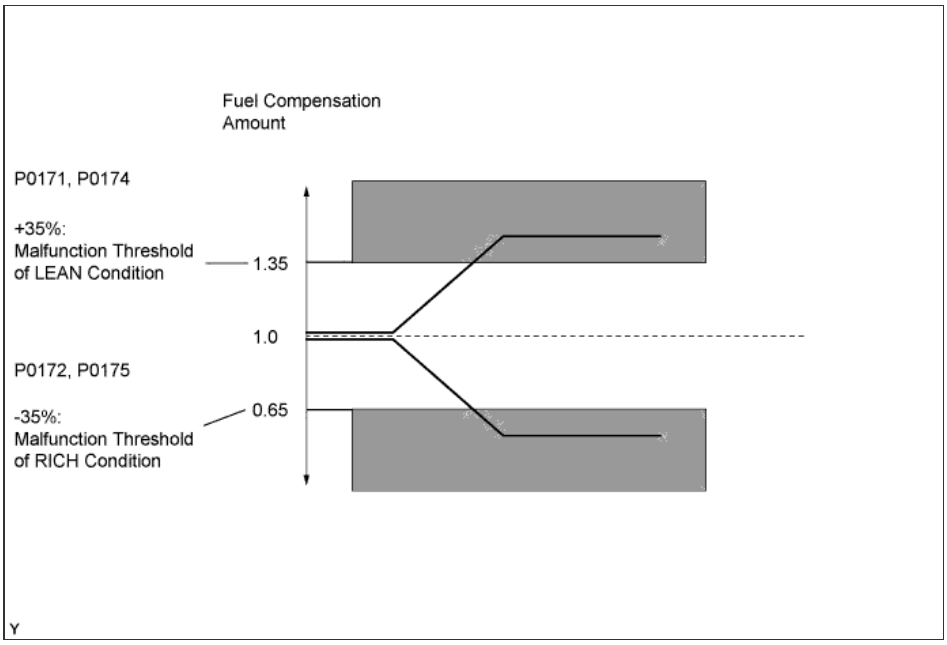
DTC Code	DTC Detection Condition	Trouble Area
P0171 P0174	With a warm engine and stable air fuel ratio feedback, the fuel trim is considerably in error to the lean side (2 trip detection logic).	• Air induction system • Injector blockage • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Fuel pressure • Gas leakage from exhaust system • Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor heater (bank 1, 2 sensor 1) • Integration relay (A/F relay) • A/F sensor heater circuits • PCV valve and hose • PCV hose connections • ECM
P0172 P0175	With a warm engine and stable air fuel ratio feedback, the fuel trim is considerably in error to the rich side (2 trip detection logic).	• Injector leakage or blockage • MAF meter • ECT sensor • Ignition system • Fuel pressure • Gas leakage from exhaust system • Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor heater (bank 1, 2 sensor 1) • Integration relay (A/F relay) • A/F sensor heater circuits • ECM

HINT:

- **When DTC P0171 or P0174 is stored, the actual air fuel ratio is on the lean side. When DTC P0172 or P0175 is stored, the actual air fuel ratio is on the rich side.**
- **If the vehicle runs out of fuel, the air fuel ratio becomes lean and DTC P0171 or P0174 may be stored. The MIL is then illuminated.**
- **When the total of the short-term and long-term fuel trim values is within the malfunction threshold (and the engine coolant temperature is more than 75°C [167°F]), the system is functioning normally.**

MONITOR DESCRIPTION

Under closed-loop fuel control, fuel injection volumes that deviate from those estimated by the ECM cause changes in the long-term fuel trim compensation value. The long-term fuel trim is adjusted when there are persistent deviations in the short-term fuel trim values. Deviations from the ECM's estimated fuel injection volumes also affect the average fuel trim learned value, which is a combination of the average short-term fuel trim (fuel feedback compensation value) and the average long-term fuel trim (learned value of the air fuel ratio).
If the average fuel trim learned value exceeds the malfunction thresholds, the ECM interprets this as a fault in the fuel system and stores a DTC.
Example:
If the average fuel trim learned value is more than +35% or less than -35%, the ECM interprets this as a fuel system malfunction.



WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the intelligent tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume.)**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2, or AFS Voltage B2S1 and O2S B2S2) displayed on the intelligent tester.**

HINT:

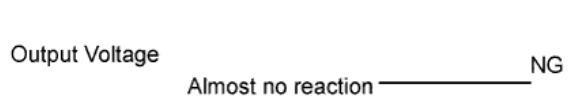
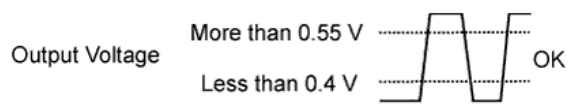
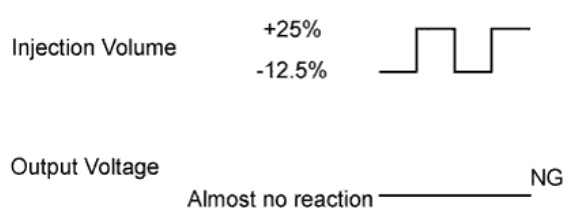
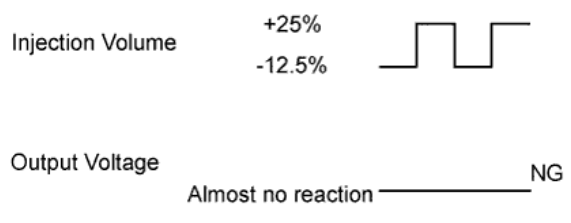
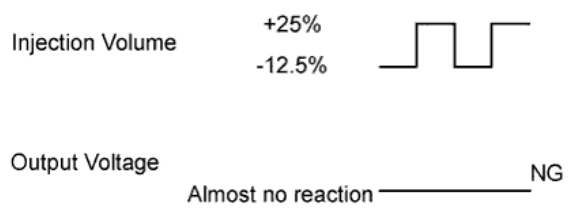
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	Less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1	Injection Volume: +25% / -12.5 Output Voltage: More than 3.4 V / Less than 3.1 V → OK	Injection Volume: +25% / -12.5 Output Voltage: More than 0.55 V / Less than 0.4 V → OK	-
	Injection Volume: +25% / -12.5	Injection Volume: +25% / -12.5	• A/F sensor • A/F sensor

2			• heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.**
- **A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0171, P0172, P0174 OR P0175)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

d. Read the DTCs.

Result

Display (DTC Output)	Proceed to
P0171, P0172, P0174 or P0175	A
P0171, P0172, P0174 or P0175 and other DTCs	B

HINT:

If any DTCs other than P0171, P0172, P0174 or P0175 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:

PCV hose is connected correctly and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE

OK

3.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage.

OK:

No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK

4.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (A/F CONTROL)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the intelligent tester on.

c. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor.

e. Perform the Control the Injection Volume for A/F Sensor operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).

f. Monitor the voltage outputs of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2, or AFS Voltage B2S1 and O2S B2S2) displayed on the intelligent tester.

HINT:

- **The Control the Injection Volume for A/F Sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	Less than 3.1
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4

Result:

Status AFS Voltage B1S1 or AFS Voltage B2S1	Status O2S B1S2 or O2S B2S2	A/F Condition and A/F Sensor Condition	Misfire	Suspected Trouble Area	Proceed to
Lean/Rich	Lean/Rich	Normal	-	-	C
Lean	Lean	Actual air fuel ratio lean	May occur	• PCV valve and hose • PCV hose connections • Injector blockage • Gas leakage from exhaust system • Air induction system • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor	A
Rich	Rich	Actual air fuel ratio rich	-	• Injector blockage or blockage • Gas leakage from exhaust system • Ignition system • Fuel pressure • MAF meter • ECT sensor	
Lean	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	B
Rich	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	

Lean: During Control the Injection Volume for A/F Sensor, the A/F sensor output voltage (AFS) is consistently more than 3.4 V, and the HO2 sensor output voltage (O2S) is consistently less than 0.4 V.
Rich: During Control the Injection Volume for A/F Sensor, the AFS is consistently less than 3.1 V, and the O2S is consistently more than 0.55 V.
Lean/Rich: During Control the Injection Volume for A/F Sensor of the Active Test, the output voltage of the heated oxygen sensor alternates correctly.

B → Go to step 11

C → Go to step 15

A

5.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Data List twice, when the engine is cold and when it is warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: 80 to 100°C (176 to 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

6.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

7.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → REPAIR OR REPLACE FUEL SYSTEM

OK

8.CHECK FOR EXHAUST GAS LEAK

a. Inspect for exhaust gas leakage from the exhaust manifold sub-assembly and exhaust pipes.

OK:
No gas leakage.

NG → REPAIR OR REPLACE EXHAUST SYSTEM

OK

9.CHECK SPARK AND IGNITION

a. Check the ignition system (Click here).

HINT:

If the spark plugs or ignition system malfunctions, engine misfires may occur. The misfire count can be read using the intelligent tester. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Cylinder #1 Misfire Rate (to Cylinder #6 Misfire Rate).

NG → REPAIR OR REPLACE IGNITION SYSTEM

OK

10.INSPECT FUEL INJECTOR ASSEMBLY (INJECTION AND VOLUME)

a. Inspect the fuel injector assembly (Click here).

HINT:

If the injectors malfunction, engine misfires may occur. The misfire count can be read using the intelligent tester. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Cylinder #1 Misfire Rate (to Cylinder #6 Misfire Rate).

NG → REPLACE FUEL INJECTOR ASSEMBLY (Click here)

OK

11.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

a. Disconnect the A/F sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for Bank 1 Sensor 1):

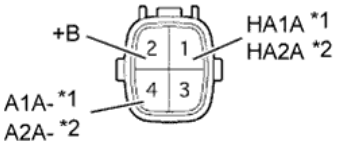
Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω

~~1 (HA1A) - 4 (A1A-)~~	~~Always~~	~~10 kΩ or higher~~

Standard Resistance (for Bank 2 Sensor 1):

Tester Connection	Condition	Specified Condition
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

12.INSPECT INTEGRATION RELAY (A/F RELAY)

a. Remove the integration relay from the engine room junction block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

iii. Reinstall the A/F fuse.

c. Inspect the A/F relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

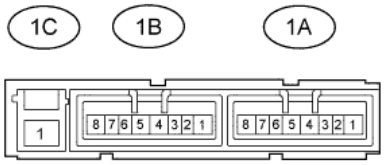
Tester Connection	Condition	Specified Condition
1A-4 - 1C-1	No battery voltage applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A- 2 and 1A-3	Below 1 Ω

Component without harness connected:
(Integration Relay)

Fuse Side:



Connector Side:



Y

NG → REPLACE INTEGRATION RELAY

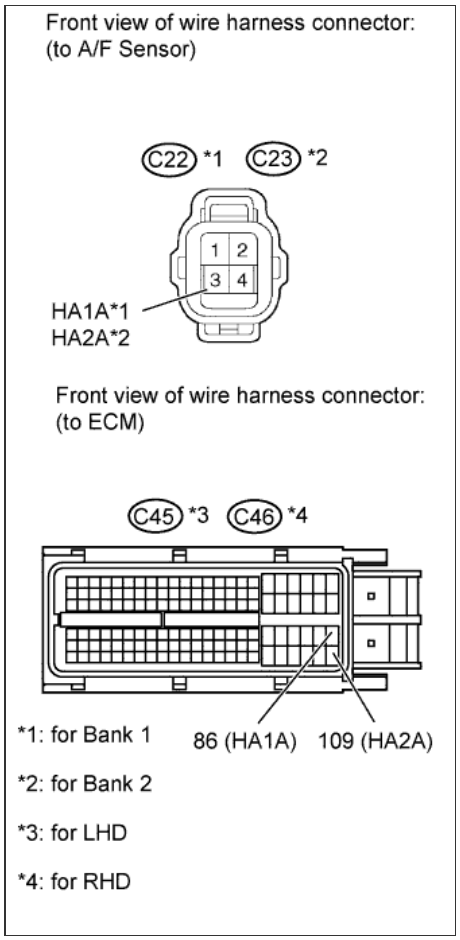
OK

13.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

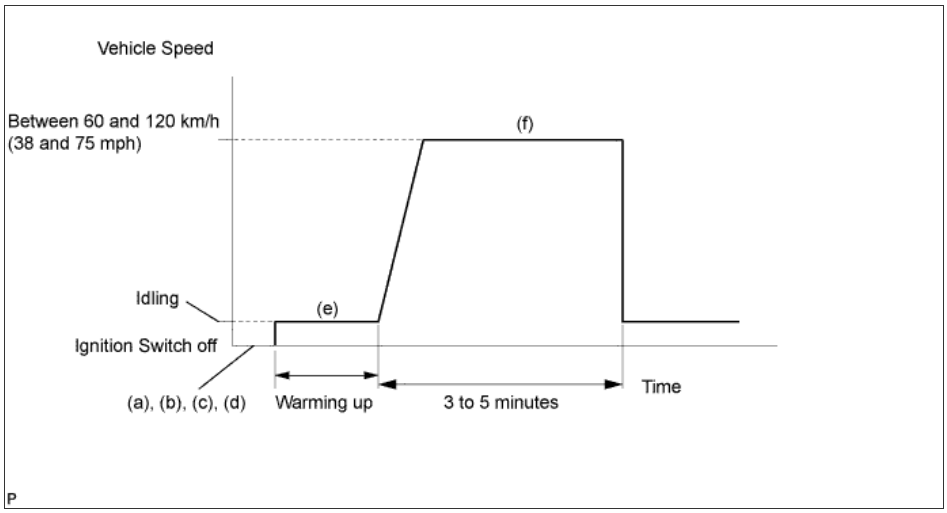
OK

14.REPLACE AIR FUEL RATIO SENSOR

a. Replace the A/F sensor (Click here).

NEXT

15.PERFORM CONFIRMATION DRIVING PATTERN



(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the intelligent tester on.
(c) Clear DTCs (Click here).
(d) Switch the ECM from normal mode to check mode using the intelligent tester (Click here).
(e) Start the engine and warm it up with all the accessories switched OFF.
(f) Drive the vehicle at between 60 km/h and 120 km/h (38 mph and 75 mph) and at an engine speed of between 1400 rpm and 3200 rpm for 3 to 5 minutes.

HINT:

If the system is still malfunctioning, the MIL is illuminated during step (f).

NOTICE:

If the conditions in this test are not strictly followed, no malfunction will be detected.

NEXT

16.CHECK WHETHER DTC OUTPUT RECURS (DTC P0171, P0172, P0174 OR P0175)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

d. Read the DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P0171, P0172, P0174 or P0175	B

B → **REPLACE ECM (Click here)**

A

END

DTC P2195 Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)

DTC P2196 Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)

DTC P2197 Oxygen (A/F) Sensor Signal Stuck Lean (Bank 2 Sensor 1)

DTC P2198 Oxygen (A/F) Sensor Signal Stuck Rich (Bank 2 Sensor 1)

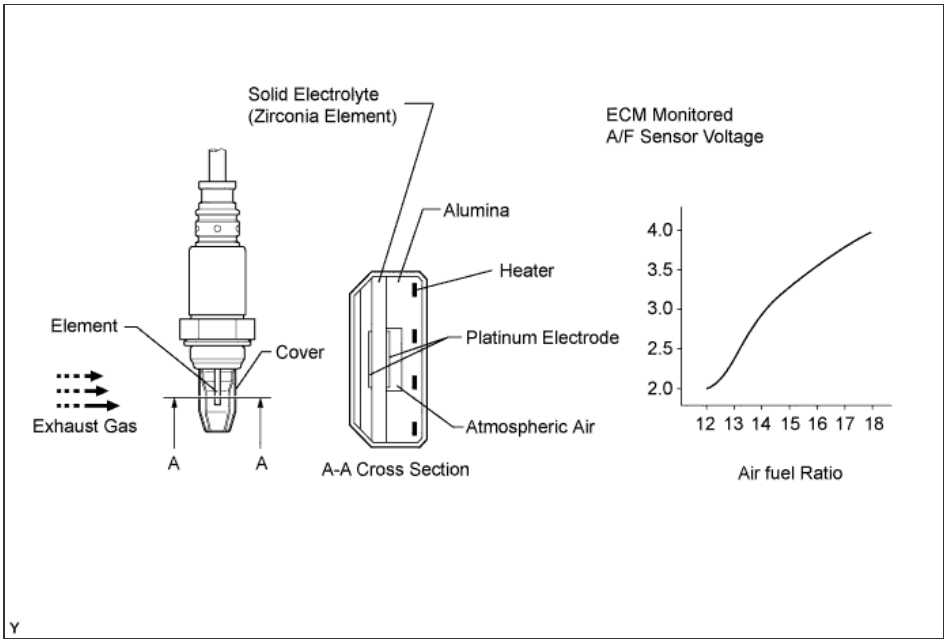
for Preparation Click here

DESCRIPTION

HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air Fuel Ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**

The A/F sensor generates a voltage* that corresponds to the actual air fuel ratio. This sensor voltage is used to provide the ECM with feedback so that it can control the air fuel ratio. The ECM determines the deviation from the stoichiometric air fuel ratio, and regulates the fuel injection time. If the A/F sensor malfunctions, the ECM is unable to control the air fuel ratio accurately.
The A/F sensor is the planar type and is integrated with a heater, which heats the solid electrolyte (zirconia element). This heater is controlled by the ECM. When the intake air volume is low (the exhaust gas temperature is low), a current flows into the heater to heat the sensor in order to facilitate accurate oxygen concentration detection. In addition, the sensor and heater portions are the narrow type. The heat generated by the heater is conducted to the solid electrolyte through the alumina, therefore the sensor activation is accelerated.
In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air fuel ratio must be precisely controlled so that it is always close to the stoichiometric level.
*: The value changes inside the ECM. Since the A/F sensor is a current output element, the current is converted into a voltage inside the ECM. Any measurements taken at the A/F sensor or ECM connectors will show a constant voltage.

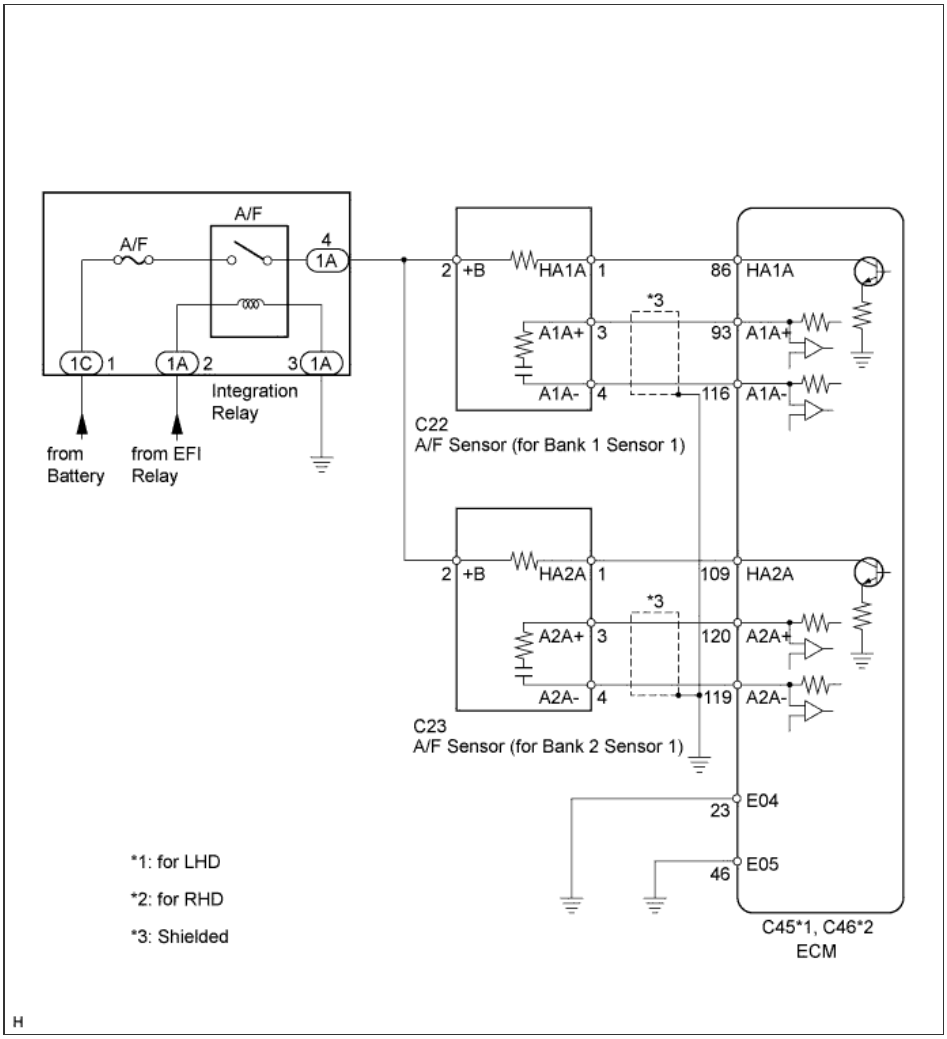


DTC Code	DTC Detection Condition	Trouble Area
P2195 P2197	Conditions (a) and (b) continue for 2 seconds or more (2 trip detection logic): (a) The Air Fuel Ratio (A/F) sensor voltage is more than 3.8 V. (b) The Heated Oxygen (HO2) sensor voltage is 0.15 V or more.	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor (bank 1, 2 sensor 1) heater • A/F sensor heater circuits • Integration relay • Air induction system circuits • Fuel pressure • Fuel injector • ECM
	While fuel-cut operation is performed (during vehicle deceleration), the air fuel ratio (A/F) sensor current is 3.6 mA or more for 3 seconds (2 trip detection logic).	• A/F sensor • ECM
P2196 P2198	Conditions (a) and (b) continue for 2 seconds or more (2 trip detection logic): (a) The A/F sensor voltage is less than 2.8 V. (b) The HO2 sensor voltage is less than 0.6 V.	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor (bank 1, 2 sensor 1) heater • A/F sensor heater circuits • Air induction system • Integration relay • Fuel pressure • Fuel injector • ECM
	While fuel-cut operation is performed (during vehicle deceleration), the air fuel ratio (A/F) sensor current is less than 1.4 mA for 3 seconds (2 trip detection logic).	• A/F sensor • ECM

HINT:

- **DTCs P2195 and P2196 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2197 and P2198 indicate malfunctions related to the bank 2 A/F sensor circuit.**
- **Bank 1 refers to the bank that includes cylinder No. 1.**
- **Bank 2 refers to the bank that includes cylinder No. 2.**
- **When any of these DTCs are stored, check the A/F sensor voltage output by entering the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS Voltage B1S1 or AFS Voltage B2S1.**
- **The short-term fuel trim values can also be read using the intelligent tester.**
- **The ECM regulates the voltages at the A1A+, A2A+, A1A- and A2A- terminals of the ECM to a constant level. Therefore, the A/F sensor voltage output cannot be confirmed without using the intelligent tester.**
- **If a A/F sensor malfunction is detected, the ECM stores a DTC.**

WIRING DIAGRAM



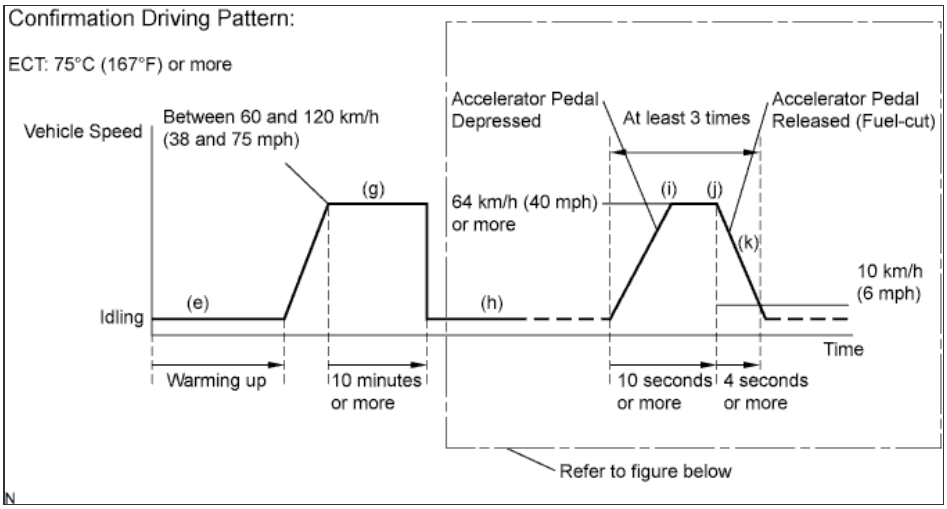
CONFIRMATION DRIVING PATTERN

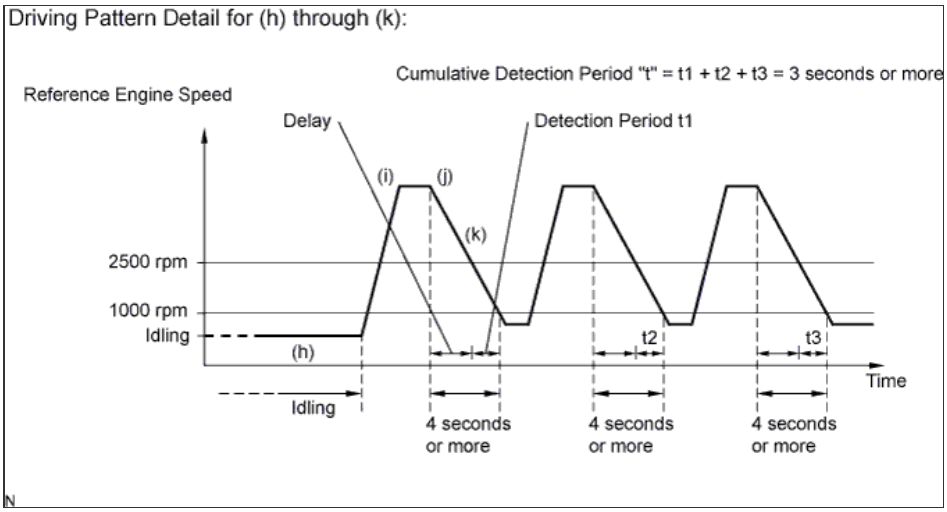
CAUTION:

Strictly observe posted speed limits, traffic laws, and road conditions when performing these drive patterns.

HINT:

This confirmation driving pattern is used in the "PERFORM CONFIRMATION DRIVING PATTERN" procedure of the following diagnostic troubleshooting procedure.





(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON.
(c) Turn the intelligent tester on.
(d) Clear DTCs (Click here).
(e) Start the engine, and warm it up until the ECT reaches 75°C (167°F) or higher.
(f) Enter the following menus to check the fuel-cut status: Powertrain / Engine and ECT / Data List / All Data / Idle Fuel Cut.
(g) Drive the vehicle at between 60 km/h (38 mph) and 120 km/h (75 mph) for at least 10 minutes.
(h) Shift the transmission to 2nd gear.
(i) Drive the vehicle at the proper vehicle speed to perform fuel-cut operation (refer to the following HINT).

HINT:

Fuel-cut is performed when the following conditions are met:

- **The accelerator pedal is fully released.**
- **The engine speed is 2500 rpm or more (fuel injection returns at 1000 rpm).**

(j) Accelerate the vehicle to 64 km/h (40 mph) or more by depressing the accelerator pedal for at least 10 seconds.
(k) Soon after performing step (j) above, release the accelerator pedal for at least 4 seconds without depressing the brake pedal in order to execute fuel-cut control.
(l) Allow the vehicle to decelerate until the vehicle speed decreases to less than 10 km/h (6 mph).
(m) Repeat steps (h) through (k) above at least 3 times in one driving cycle.

HINT:

Completion of all O2S (A/F) Monitor is required to change the value in Data List.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the air fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the intelligent tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **On the intelligent tester, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume.)**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2, or AFS Voltage B2S1 and O2S B2S2) displayed on the intelligent tester.**

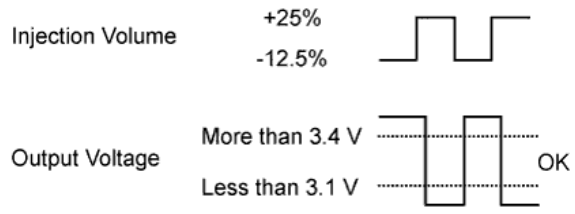
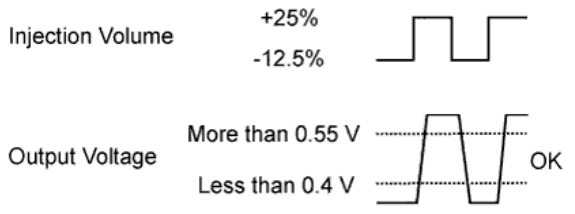
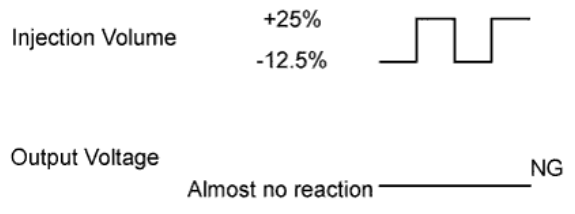
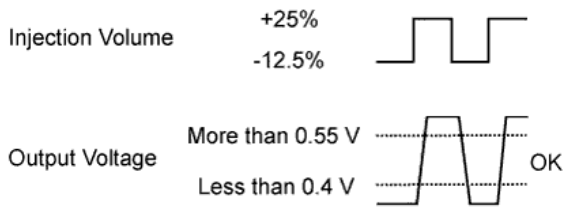
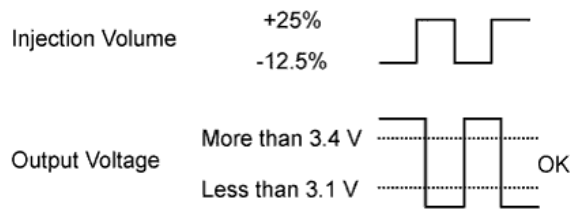
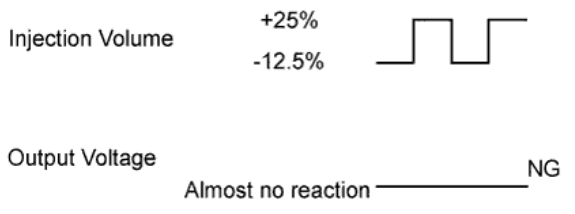
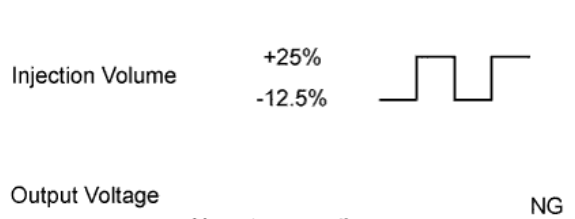
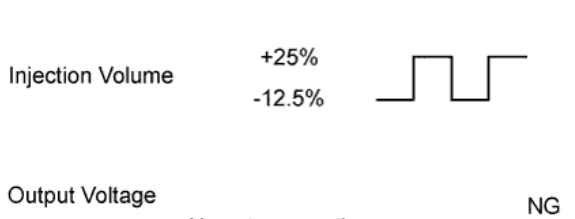
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	Less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.**
- **A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

e. Read DTCs.

Result

Display (DTC Output)	Proceed to
P2195, P2196, P2197 or P2198	A
P2195, P2196, P2197 or P2198 and other DTCs	B

HINT:

If any DTCs other than P2195, P2196, P2197 or P2198 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (TEST VALUE OF A/F SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Clear DTCs (Click here).

d. Drive the vehicle in accordance with the drive pattern described in the CONFIRMATION DRIVING PATTERN.

e. Enter the following menus: Powertrain / Engine and ECT / Monitor / O2 Sensor.

f. Check that the status of O2 Sensor is Complete.
If the status is still Incomplete, drive the vehicle according to the driving pattern again.

g. Enter the following menus: Powertrain / Engine and ECT / Monitor / O2 Sensor / Details / RANGE B1 S1.

h. Check the test value of the A/F sensor output current during fuel-cut.

Result

Test Value	Proceed to
Within normal range (1.4 mA or more, and less than 3.6 mA)	A
Outside normal range (Less than 1.4 mA, or 3.6 mA or more)	B

B → Go to step 20

A

3.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF A/F SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the intelligent tester on.

d. Warm up the air fuel ratio (A/F) sensor at an engine speed of 2500 rpm for 90 seconds.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / Snapshot / AFS Voltage B1S1 or AFS Voltage B2S1 and Engine Speed.

f. Check the A/F sensor voltage three times, once in each of the following conditions:

i. Engine idling (check for at least 30 seconds)

ii. Engine running at an engine speed of approximately 2500 rpm (without any sudden changes in engine speed)

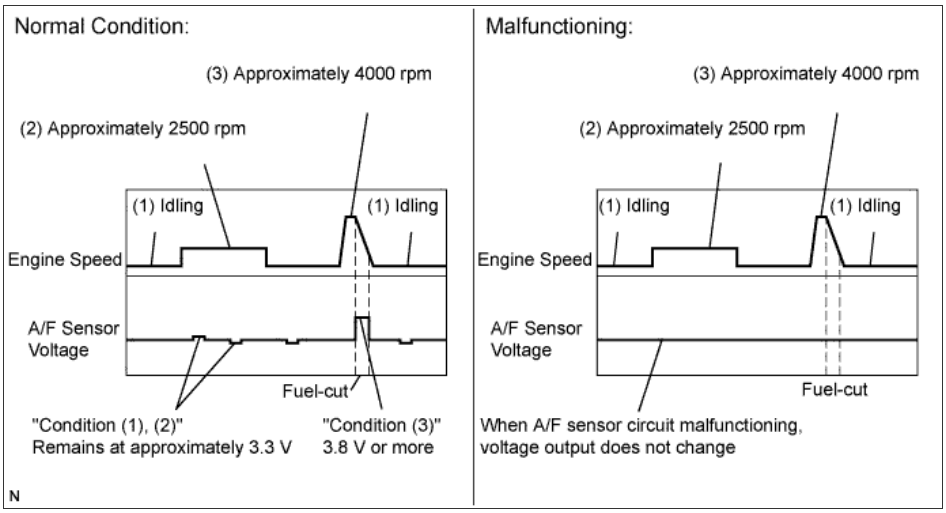
iii. Engine speed raised to 4000 rpm and then accelerator pedal quickly released so that the throttle valve is fully closed.

Standard:

Condition	A/F Sensor Voltage Variation	Reference
(1) and (2)	Changes at approximately 3.3 V	Between 3.1 V and 3.5 V
(3)	Increases to 3.8 V or more	This occurs during engine deceleration (when fuel-cut performed)

HINT:

For more information, see the diagrams below.



HINT:

- **If the output voltage of the A/F sensor remains at approximately 3.3 V (see "Malfunctioning" diagram) under any conditions, including those above, the A/F sensor may have an open circuit. (This will also happen if the A/F sensor heater has an open circuit.)**
- **If the output voltage of the A/F sensor remains at either approximately 3.8 V or more, or 2.8 V or less (see "Malfunctioning" diagram) under any conditions, including those above, the A/F sensor may have a short circuit.**
- **The ECM stops fuel injection (fuel cut) during engine deceleration. This causes a lean condition and results in a momentary increase in the A/F sensor output voltage.**
- **The ECM must establish a closed throttle valve position learned value to perform fuel cut. If the battery cable has been disconnected and reconnected, the vehicle must be driven over 16 km/h (10 mph) to allow the ECM to learn the closed throttle valve position.**
- **When the vehicle is driven:**
  The output voltage of the A/F sensor may be below 2.8 V during fuel enrichment. For the vehicle, this translates to a sudden increase in speed with the accelerator pedal fully depressed when trying to overtake another vehicle. The A/F sensor is functioning normally.
- **The A/F sensor is a current output element; therefore, the current is converted into a voltage inside the ECM. Measuring the voltage at the connectors of the A/F sensor or ECM will show a constant voltage.**

NG → Go to step 10

OK

4.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

d. Read the DTCs.

Result

Display (DTC Output)	Proceed to
P2195, P2196, P2197 or P2198	A
No output	B

B → Go to step 9

A

6.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

7.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

d. Read DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P2195, P2196, P2197 or P2198	B

B → REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN

A

9.CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

NO → CHECK FOR INTERMITTENT PROBLEMS (Click here)

YES

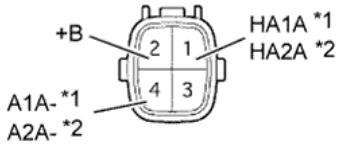
DTC CAUSED BY RUNNING OUT OF FUEL

10.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

a. Disconnect the Air Fuel ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

Standard Resistance:

for Bank 1 Sensor 1

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher

for Bank 2 Sensor 1

Tester Connection	Condition	Specified Condition
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

11.INSPECT INTEGRATION RELAY (A/F RELAY)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

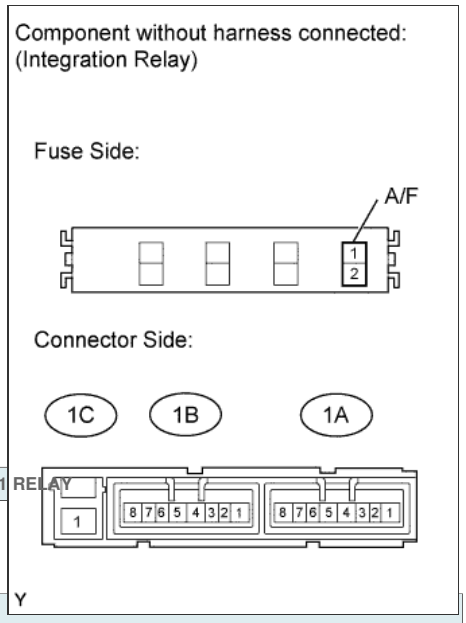
iii. Reinstall the A/F fuse.

c. Inspect the A/F relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1A-4 - 1C-1	Battery voltage not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω



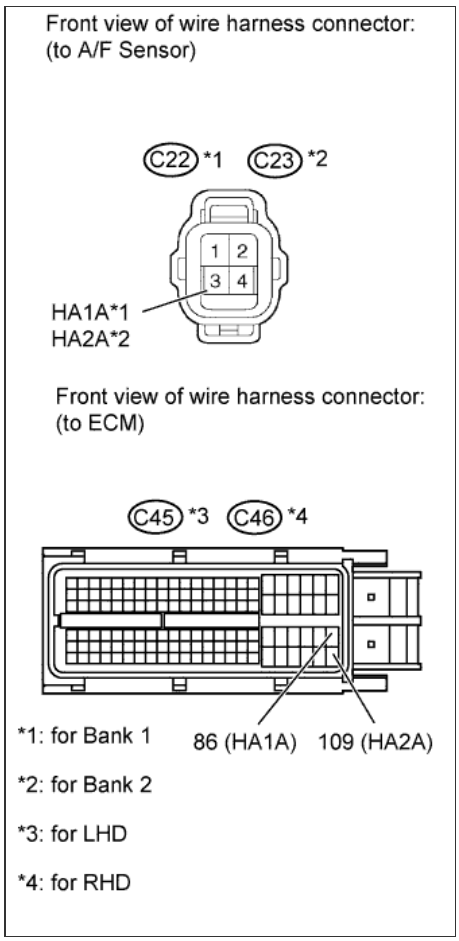
NG → REPLACE INTEGRATION NO.1 RELAY

OK

12.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body		

ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK ↓

13.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage.

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK ↓

14.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → REPAIR OR REPLACE FUEL SYSTEM

OK ↓

15.INSPECT FUEL INJECTOR

a. Check the injector injection (whether fuel volume is large or small, and whether injection pattern is poor) (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK ↓

16.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT ↓

17.PERFORM CONFIRMATION DRIVING PATTERN

NEXT ↓

18.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

d. Read DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P2195, P2196, P2197 or P2198	B

B → REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN

A

19.CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

NO → CHECK FOR INTERMITTENT PROBLEMS (Click here)

YES

DTC CAUSED BY RUNNING OUT OF FUEL

20.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

21.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

22.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

d. Read DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P2195, P2196, P2197 or P2198 (A/F sensor pending DTCs)	B

B → REPLACE ECM (Click here)

A

END

DTC P0230 Fuel Pump Primary Circuit

for Preparation Click here

DESCRIPTION

When a malfunction in the fuel pump circuit is detected, DTC P0230 is stored.
The fuel pump circuit consists of the ECM, fuel pump and fuel pump ECU (which operates the fuel pump). Based on the engine output, the ECM determines the fuel pump speed. The speed is then converted to a duty signal and sent to the fuel pump ECU. Based on the signal sent from the ECM, the fuel pump ECU adjusts the fuel pump operation speed between 3 settings. The fuel pump ECU also has a self-diagnosis function. Based on the fuel pump circuit condition, the fuel pump ECU outputs a diagnostic signal (DI) to the ECM, and the ECM determines if there is a malfunction in the fuel pump circuit.

DTC Code	DTC Detection Condition	Trouble Area

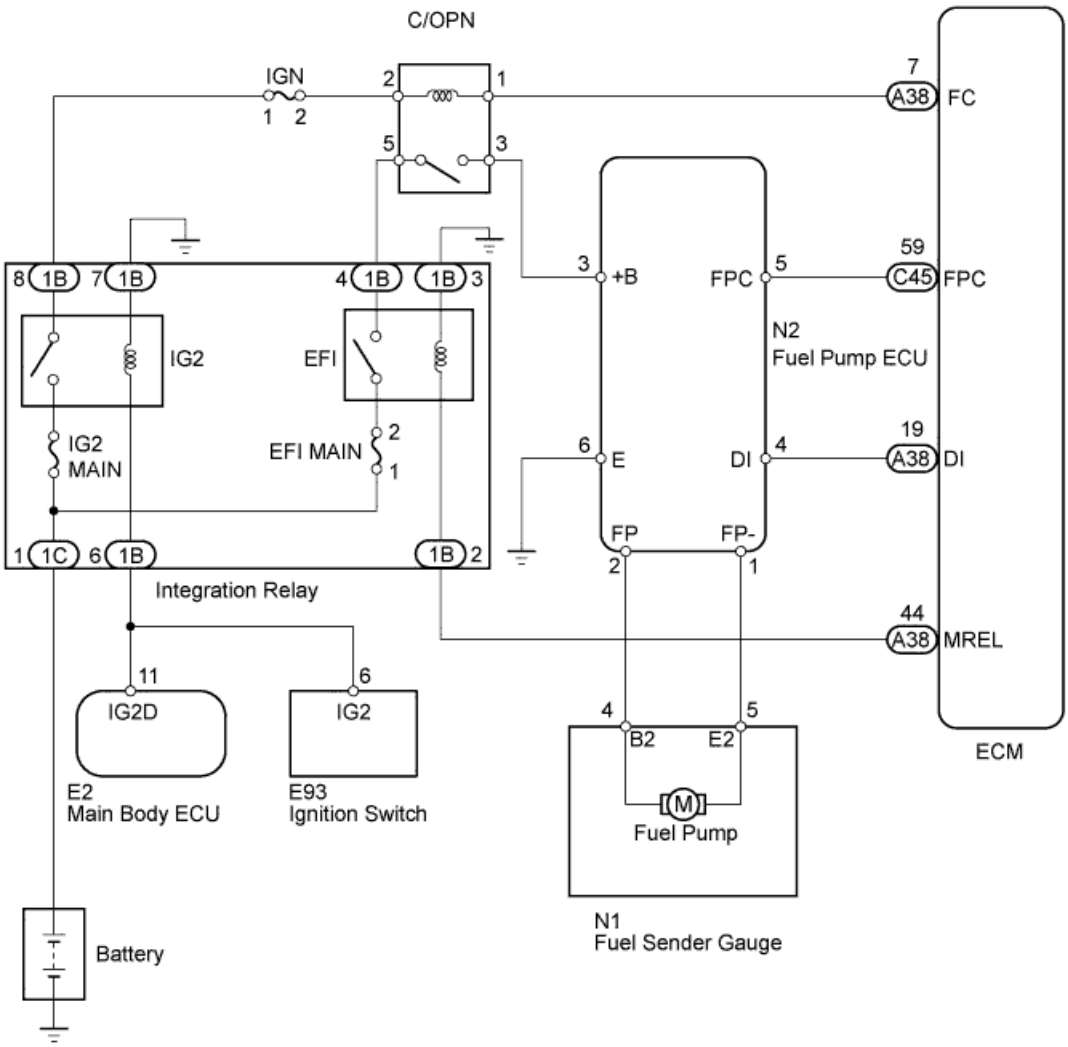
P0230	When either condition below is met (1 trip detection logic):
	• When the fuel pump is operating:
	  • The remaining fuel is 17 L or more.
	  • The DI terminal output is low.
	• When the fuel pump is not operating:
	  • The DI terminal output is high.
		• Open or short in fuel pump circuit
		• Fuel pump
		• Fuel pump ECU
		• ECM

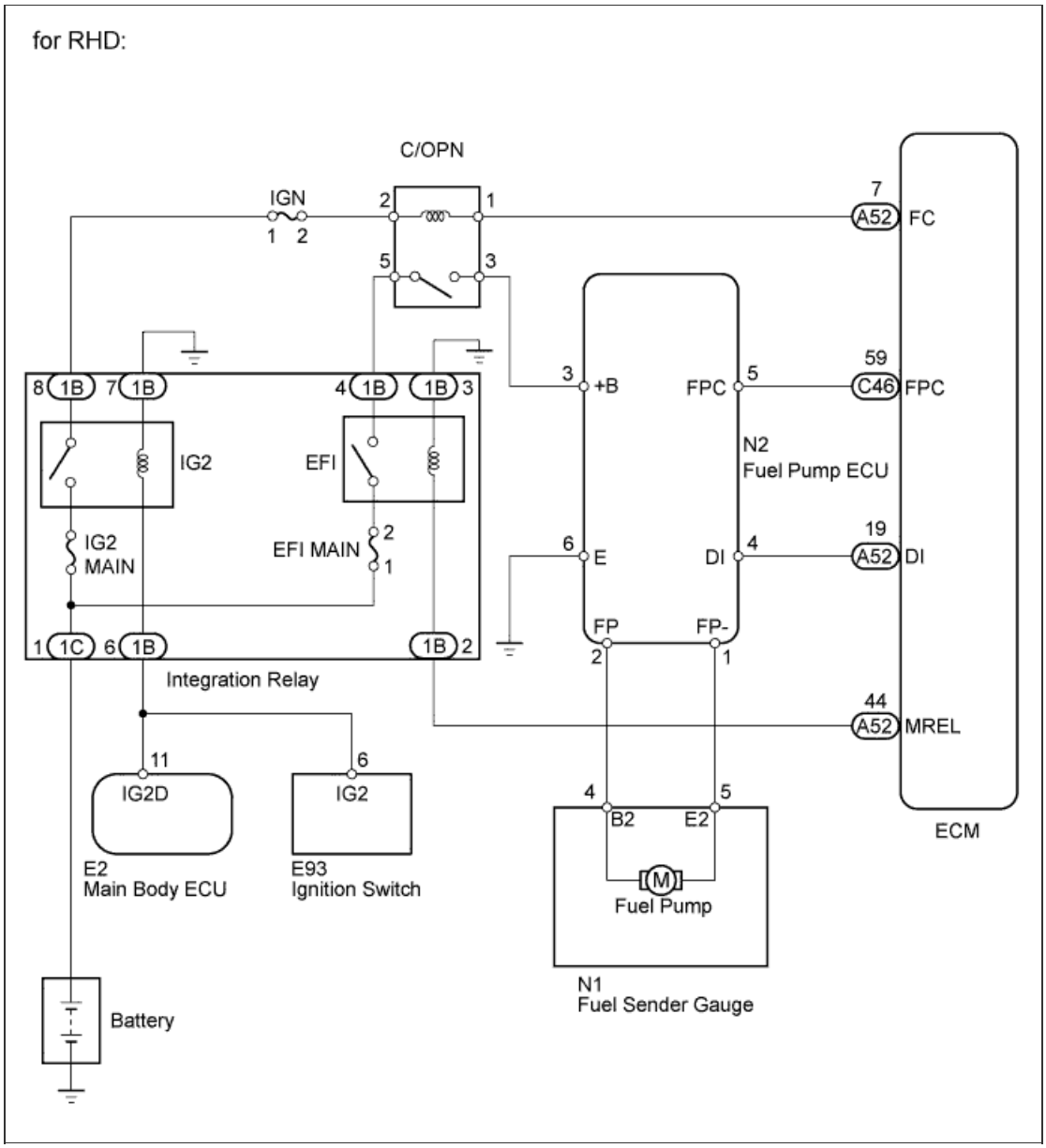
MONITOR DESCRIPTION

To monitor the fuel pump circuit, the ECM checks the fuel pump control signal (FPC) and diagnostic signal (DI). The FPC voltage varies between approximately 0 V to approximately 12 V (duty signal). Based on the condition of the fuel pump ECU malfunction, the DI voltage varies between approximately 0 V and approximately 12 V. The ECM then compares the variance of the FPC voltage and DI voltage, and determines if the fuel pump circuit is malfunctioning. When the ECM determines that the fuel pump circuit is malfunctioning, a DTC is stored immediately.

WIRING DIAGRAM

for LHD:


C/OPN
IGN
1 2
2
1
5
3
7
A38
FC
59
C45
FPC
3
+B
FPC
5
N2
Fuel Pump ECU
8 1B
7 1B
4 1B
1B 3
IG2
EFI
IG2
MAIN
EFI MAIN
2
1
6
E
DI
4
19
A38
DI
FP
FP-
2
1
1 1C
6 1B
1B 2
Integration Relay
44
A38
MREL
11
IG2D
6
IG2
4
5
B2
E2
M
Fuel Pump
ECM
E2
Main Body ECU
E93
Ignition Switch
N1
Fuel Sender Gauge
Battery



INSPECTION PROCEDURE

This troubleshooting procedure is based on the premise that the engine is started. If the engine is not started, proceed to the Problem Symptoms Table (Click here).

1.CHECK DTC OUTPUT

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Enter the following menus: Body / (desired system) / DTC.

d. Read the DTC.

Result

Result	Proceed to
DTC B1500 is not output	A
DTC B1500 is output	B

B → GO TO DTC B1500 (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the fuel pump / Speed.

d. Check whether operating sounds can be heard while operating the relay using the tester.

OK:

Operating sounds can be heard from circuit opening relay.

NG → Go to step 6

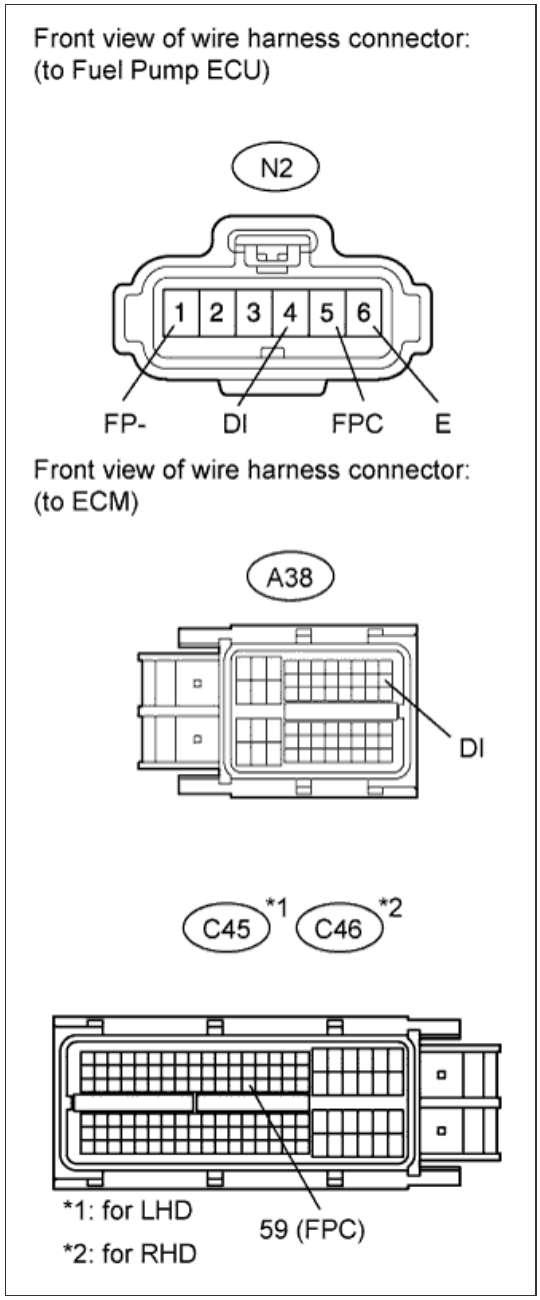
OK

3.CHECK HARNESS AND CONNECTOR (FUEL PUMP ECU - ECM, BODY GROUND)

a. Disconnect the fuel pump ECU connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
N2-5 (FPC) - C45-59 (FPC)	Always	Below 1 Ω
N2-4 (DI) - A38-19 (DI)	Always	Below 1 Ω
N2-6 (E) - Body ground	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
N2-5 (FPC) - C46-59 (FPC)	Always	Below 1 Ω

N2-4 (DI) - A52-19 (DI)	Always	Below 1 Ω
N2-6 (E) - Body ground	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
N2-1 (FP-) - Body ground	Always	10 kΩ or higher
N2-5 (FPC) or C45-59 (FPC) - Body ground	Always	10 kΩ or higher
N2-4 (DI) or A38-19 (DI) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
N2-1 (FP-) - Body ground	Always	10 kΩ or higher
N2-5 (FPC) or C46-59 (FPC) - Body ground	Always	10 kΩ or higher
N2-4 (DI) or A52-19 (DI) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.REPLACE FUEL PUMP ECU

a. Replace the fuel pump ECU (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS

a. Check that there are 17 liters or more of fuel remaining.

b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON.

d. Turn the tester on.

e. Clear the DTCs (Click here).

f. Start the engine and idle it for 5 minutes.

g. Drive the vehicle in an urban area for approximately 10 minutes.

h. Enter the following menus: Powertrain / Engine and ECT / DTC.

i. Read the DTCs.

Result

Result	Proceed to
No output	A
DTC P0230 is output	B

B → REPLACE ECM (**Click here**)

A

END

6.INSPECT CIRCUIT OPENING RELAY (C/OPN)

a. Inspect the circuit opening relay (C/OPN) (Click here).

NG → REPLACE CIRCUIT OPENING RELAY (C/OPN)

OK

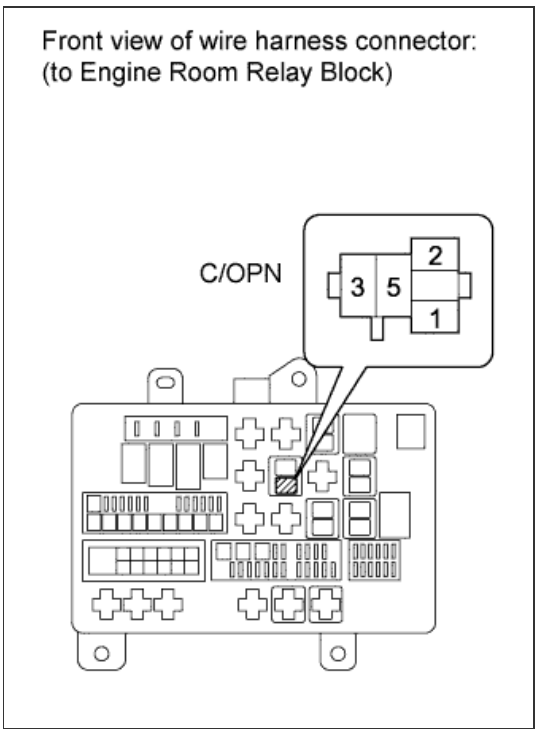
7.INSPECT CIRCUIT OPENING RELAY (C/OPN) (POWER SOURCE VOLTAGE)

a. Remove the circuit opening relay (C/OPN) from the engine room relay block.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C/OPN relay (2) - Body ground	Ignition switch ON	11 to 14 V
C/OPN relay (5) - Body ground	Ignition switch ON	11 to 14 V



NG → Go to step 14

OK

8.CHECK HARNESS AND CONNECTOR (C/OPN RELAY - ECM, FUEL PUMP ECU)

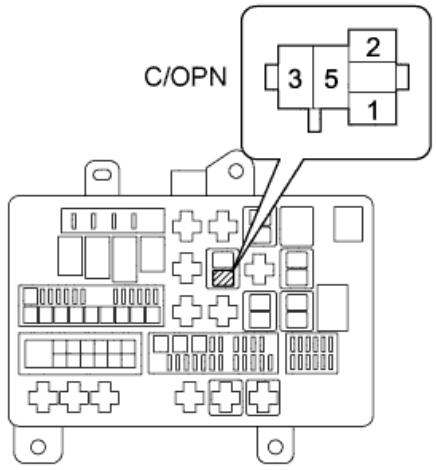
a. Remove the circuit opening relay (C/OPN) from the engine room relay block.

b. Disconnect the fuel pump ECU connector.

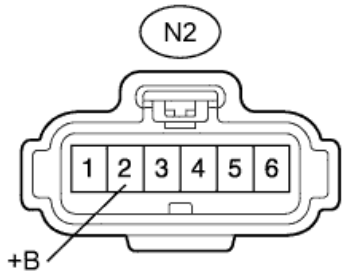
c. Disconnect the ECM connector.

d. Measure the resistance according to the value(s) in the table below.

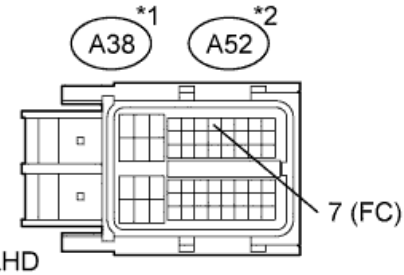
Front view of wire harness connector:
(to Engine Room Relay Block)



Front view of wire harness connector:
(to Fuel Pump ECU)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C/OPN relay (1) - A38-7 (FC)	Always	Below 1 Ω
C/OPN relay (3) - N2-3 (+B)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C/OPN relay (1) - A52-7 (FC)	Always	Below 1 Ω
C/OPN relay (3) - N2-3 (+B)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C/OPN relay (1) or A38-7 (FC) - Body ground	Always	10 kΩ or higher
C/OPN relay (3) or N2-3 (+B) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C/OPN relay (1) or A52-7 (FC) - Body ground	Always	10 kΩ or higher
C/OPN relay (3) or N2-3 (+B) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.CHECK HARNESS AND CONNECTOR (FUEL PUMP - FUEL PUMP ECU)

a. Disconnect the fuel sender gauge connector.

b. Disconnect the fuel pump ECU connector.

c. Measure the resistance according to the value(s) in the table below.

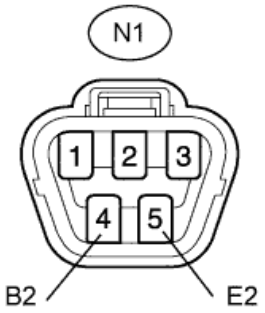
Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
N1-4 (B2) - N2-2 (FP)	Always	Below 1 Ω
N1-5 (E2) - N2-1 (FP-)	Always	Below 1 Ω

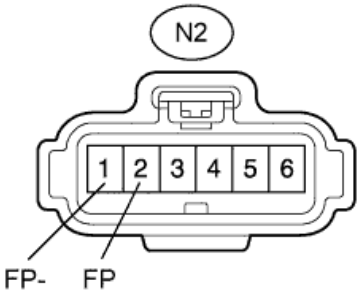
Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
N1-4 (B2) or N2-2 (FP) - Body ground	Always	10 kΩ or higher
N1-5 (E2) or N2-1 (FP-) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Fuel Sender Gauge)



Front view of wire harness connector:
(to Fuel Pump ECU)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

10.INSPECT FUEL PUMP

a. Inspect the fuel pump (for Single Tank Type) (Click here).

b. Inspect the fuel pump (for Double Tank Type) (Click here).

Result

Test Result	Proceed to
OK	A
NG (for Single Tank Type)	B
NG (for Double Tank Type)	C

B	REPLACE FUEL PUMP (Click here)
C	REPLACE FUEL PUMP (Click here)

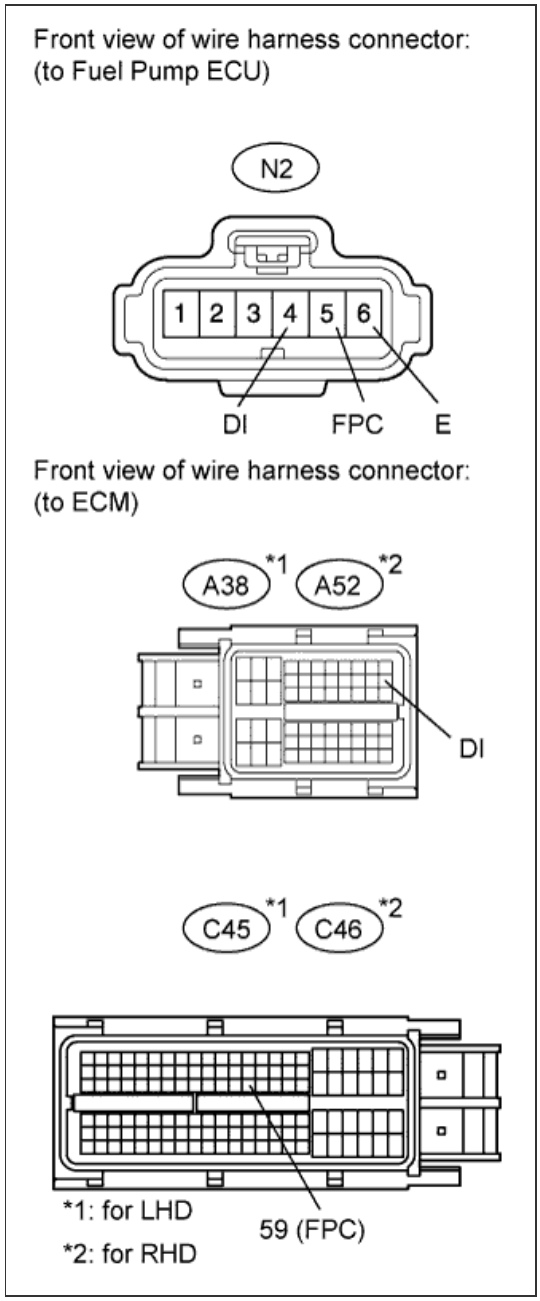
A

11.CHECK HARNESS AND CONNECTOR (FUEL PUMP ECU - ECM, BODY GROUND)

a. Disconnect the fuel pump ECU connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
N2-5 (FPC) - C45-59 (FPC)	Always	Below 1 Ω
N2-4 (DI) - A38-19 (DI)	Always	Below 1 Ω
N2-6 (E) - Body ground	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
N2-5 (FPC) - C46-59 (FPC)	Always	Below 1 Ω
N2-4 (DI) - A52-19 (DI)	Always	Below 1 Ω
N2-6 (E) - Body ground	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
N2-5 (FPC) or C45-59 (FPC) - Body ground	Always	10 kΩ or higher
N2-4 (DI) or A38-19 (DI) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
N2-5 (FPC) or C46-59 (FPC) - Body ground	Always	10 kΩ or higher
N2-4 (DI) or A52-19 (DI) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

12.REPLACE FUEL PUMP ECU

a. Replace the fuel pump ECU (Click here).

NEXT

13.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Start the engine and idle it for 5 minutes.

f. Drive the vehicle in an urban area for approximately 10 minutes.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read the DTCs.

Result

Result	Proceed to
No output	A
DTC P0230 is output	B

B → REPLACE ECM (**Click here**)

A

END

14.CHECK HARNESS AND CONNECTOR (CIRCUIT OPENING RELAY (C/OPN) - IGN FUSE, INTEGRATION RELAY)

a. Remove the circuit opening relay (C/OPN) from the engine room relay block.

b. Remove the IGN fuse from the engine room relay block.

c. Remove the integration relay from the engine room relay block.

d. Disconnect the 1B integration relay connector.

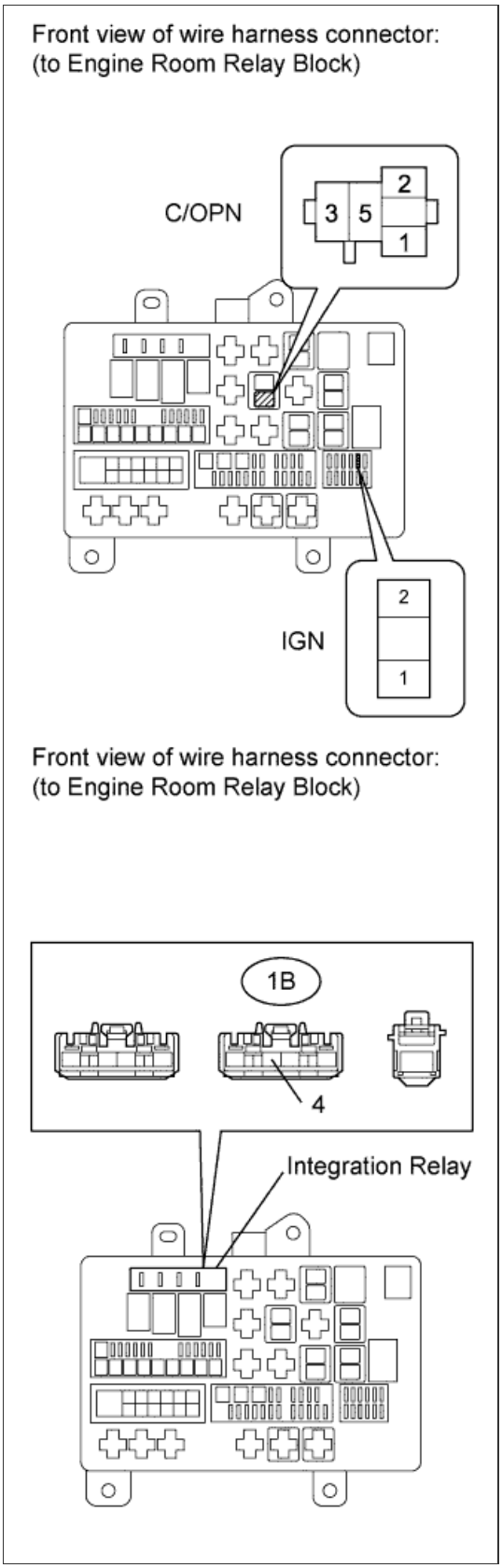
e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C/OPN relay (2) - IGN fuse (2)	Always	Below 1 Ω
C/OPN relay (5) - 1B-4	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
C/OPN relay (2) or IGN fuse (2) - Body ground	Always	10 kΩ or more
C/OPN relay (5) or 1B-4 - Body ground	Always	10 kΩ or more



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

GO TO ECM POWER SOURCE CIRCUIT (Click here)

DTC P2195 Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)

DTC P2196 Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)

DTC P2197 Oxygen (A/F) Sensor Signal Stuck Lean (Bank 2 Sensor 1)

DTC P2198 Oxygen (A/F) Sensor Signal Stuck Rich (Bank 2 Sensor 1)

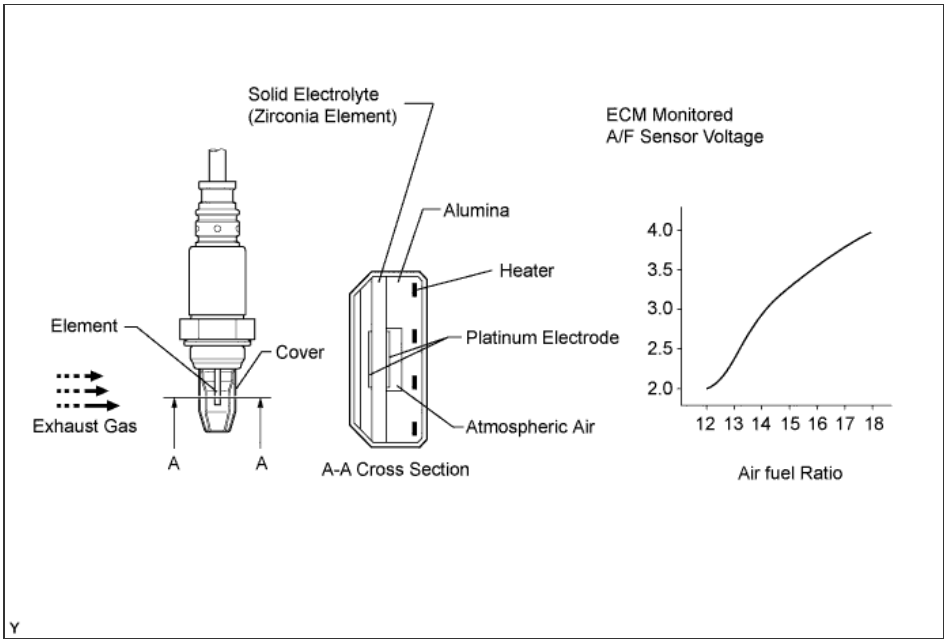
for Preparation Click here

DESCRIPTION

HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air Fuel Ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**

The A/F sensor generates a voltage* that corresponds to the actual air fuel ratio. This sensor voltage is used to provide the ECM with feedback so that it can control the air fuel ratio. The ECM determines the deviation from the stoichiometric air fuel ratio, and regulates the fuel injection time. If the A/F sensor malfunctions, the ECM is unable to control the air fuel ratio accurately.
The A/F sensor is the planar type and is integrated with a heater, which heats the solid electrolyte (zirconia element). This heater is controlled by the ECM. When the intake air volume is low (the exhaust gas temperature is low), a current flows into the heater to heat the sensor in order to facilitate accurate oxygen concentration detection. In addition, the sensor and heater portions are the narrow type. The heat generated by the heater is conducted to the solid electrolyte through the alumina, therefore the sensor activation is accelerated.
In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air fuel ratio must be precisely controlled so that it is always close to the stoichiometric level.
*: The value changes inside the ECM. Since the A/F sensor is a current output element, the current is converted into a voltage inside the ECM. Any measurements taken at the A/F sensor or ECM connectors will show a constant voltage.

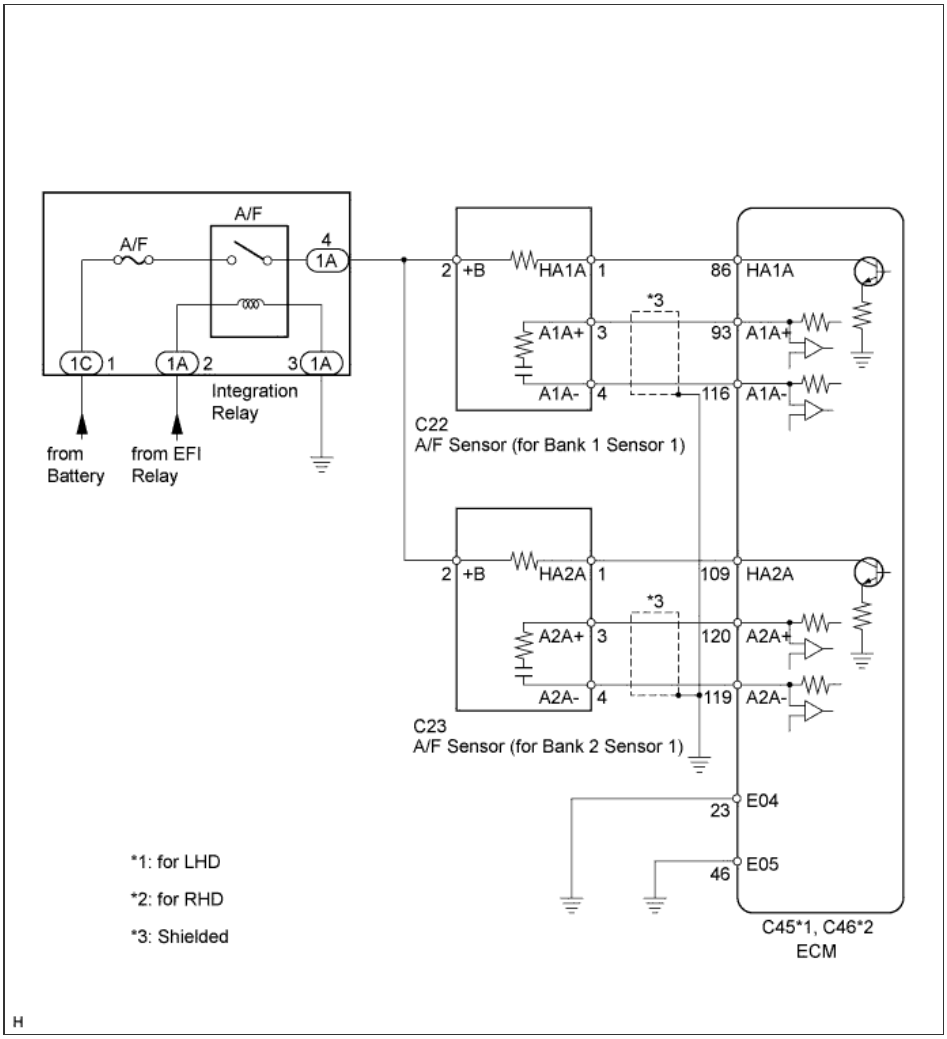


DTC Code	DTC Detection Condition	Trouble Area
P2195 P2197	Conditions (a) and (b) continue for 2 seconds or more (2 trip detection logic): (a) The Air Fuel Ratio (A/F) sensor voltage is more than 3.8 V. (b) The Heated Oxygen (HO2) sensor voltage is 0.15 V or more.	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor (bank 1, 2 sensor 1) heater • A/F sensor heater circuits • Integration relay • Air induction system circuits • Fuel pressure • Fuel injector • ECM
	While fuel-cut operation is performed (during vehicle deceleration), the air fuel ratio (A/F) sensor current is 3.6 mA or more for 3 seconds (2 trip detection logic).	• A/F sensor • ECM
P2196 P2198	Conditions (a) and (b) continue for 2 seconds or more (2 trip detection logic): (a) The A/F sensor voltage is less than 2.8 V. (b) The HO2 sensor voltage is less than 0.6 V.	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor (bank 1, 2 sensor 1) heater • A/F sensor heater circuits • Air induction system • Integration relay • Fuel pressure • Fuel injector • ECM
	While fuel-cut operation is performed (during vehicle deceleration), the air fuel ratio (A/F) sensor current is less than 1.4 mA for 3 seconds (2 trip detection logic).	• A/F sensor • ECM

HINT:

- **DTCs P2195 and P2196 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2197 and P2198 indicate malfunctions related to the bank 2 A/F sensor circuit.**
- **Bank 1 refers to the bank that includes cylinder No. 1.**
- **Bank 2 refers to the bank that includes cylinder No. 2.**
- **When any of these DTCs are stored, check the A/F sensor voltage output by entering the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS Voltage B1S1 or AFS Voltage B2S1.**
- **The short-term fuel trim values can also be read using the intelligent tester.**
- **The ECM regulates the voltages at the A1A+, A2A+, A1A- and A2A- terminals of the ECM to a constant level. Therefore, the A/F sensor voltage output cannot be confirmed without using the intelligent tester.**
- **If a A/F sensor malfunction is detected, the ECM stores a DTC.**

WIRING DIAGRAM



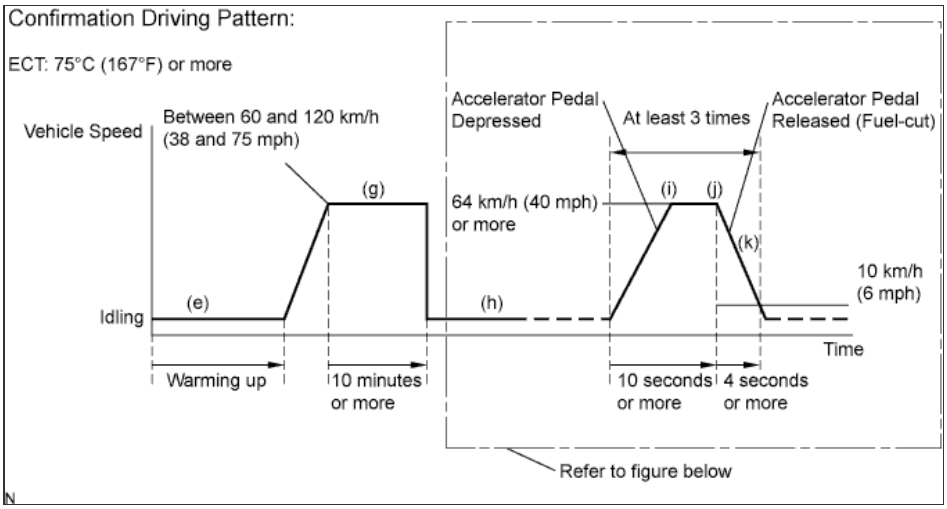
CONFIRMATION DRIVING PATTERN

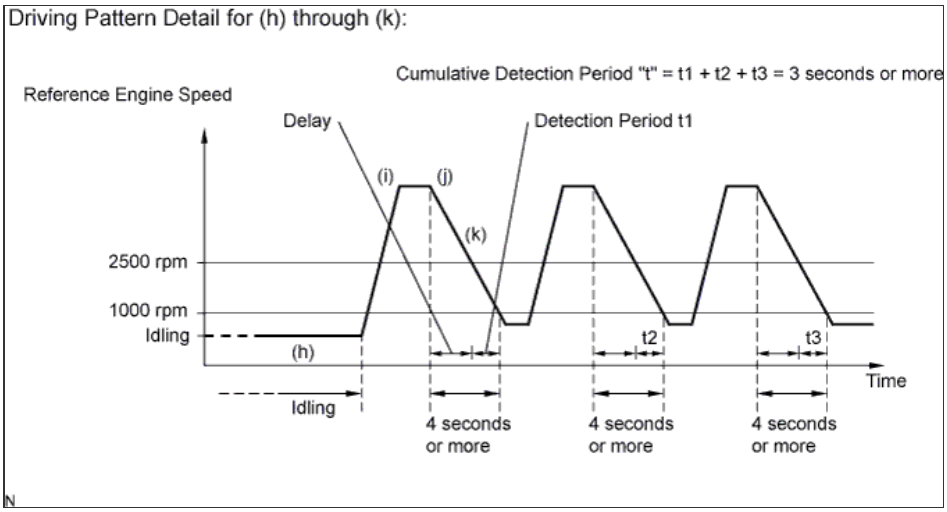
CAUTION:

Strictly observe posted speed limits, traffic laws, and road conditions when performing these drive patterns.

HINT:

This confirmation driving pattern is used in the "PERFORM CONFIRMATION DRIVING PATTERN" procedure of the following diagnostic troubleshooting procedure.





(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON.
(c) Turn the intelligent tester on.
(d) Clear DTCs (Click here).
(e) Start the engine, and warm it up until the ECT reaches 75°C (167°F) or higher.
(f) Enter the following menus to check the fuel-cut status: Powertrain / Engine and ECT / Data List / All Data / Idle Fuel Cut.
(g) Drive the vehicle at between 60 km/h (38 mph) and 120 km/h (75 mph) for at least 10 minutes.
(h) Shift the transmission to 2nd gear.
(i) Drive the vehicle at the proper vehicle speed to perform fuel-cut operation (refer to the following HINT).

HINT:

Fuel-cut is performed when the following conditions are met:

- **The accelerator pedal is fully released.**
- **The engine speed is 2500 rpm or more (fuel injection returns at 1000 rpm).**

(j) Accelerate the vehicle to 64 km/h (40 mph) or more by depressing the accelerator pedal for at least 10 seconds.
(k) Soon after performing step (j) above, release the accelerator pedal for at least 4 seconds without depressing the brake pedal in order to execute fuel-cut control.
(l) Allow the vehicle to decelerate until the vehicle speed decreases to less than 10 km/h (6 mph).
(m) Repeat steps (h) through (k) above at least 3 times in one driving cycle.

HINT:

Completion of all O2S (A/F) Monitor is required to change the value in Data List.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the air fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the intelligent tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **On the intelligent tester, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume.)**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2, or AFS Voltage B2S1 and O2S B2S2) displayed on the intelligent tester.**

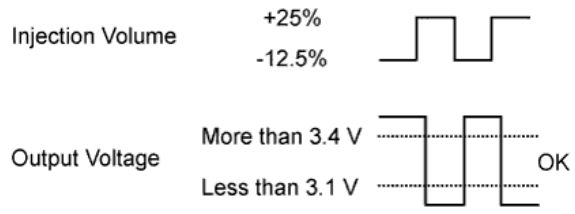
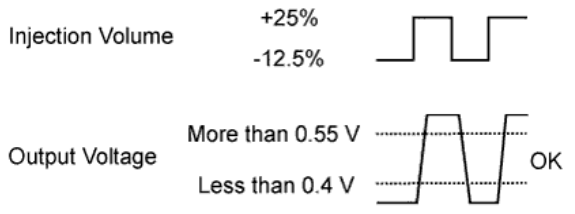
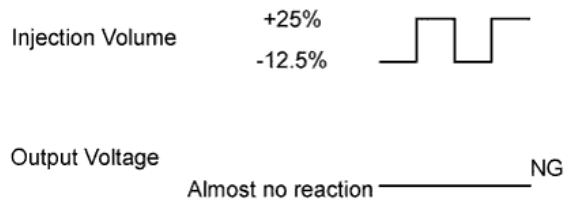
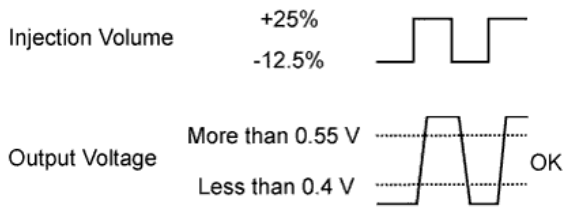
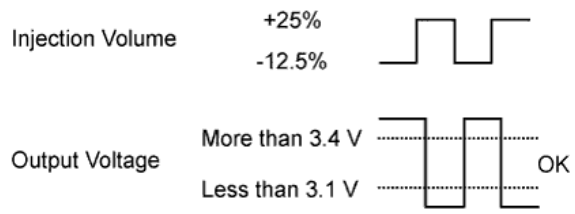
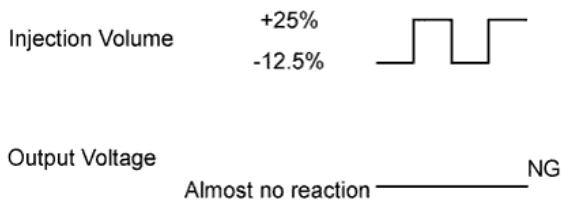
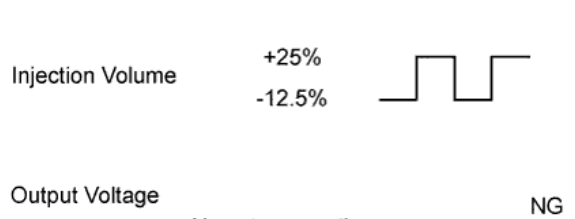
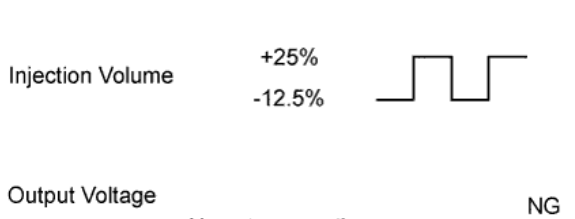
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	Less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.**
- **A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

e. Read DTCs.

Result

Display (DTC Output)	Proceed to
P2195, P2196, P2197 or P2198	A
P2195, P2196, P2197 or P2198 and other DTCs	B

HINT:

If any DTCs other than P2195, P2196, P2197 or P2198 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (TEST VALUE OF A/F SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Clear DTCs (Click here).

d. Drive the vehicle in accordance with the drive pattern described in the CONFIRMATION DRIVING PATTERN.

e. Enter the following menus: Powertrain / Engine and ECT / Monitor / O2 Sensor.

f. Check that the status of O2 Sensor is Complete.
If the status is still Incomplete, drive the vehicle according to the driving pattern again.

g. Enter the following menus: Powertrain / Engine and ECT / Monitor / O2 Sensor / Details / RANGE B1 S1.

h. Check the test value of the A/F sensor output current during fuel-cut.

Result

Test Value	Proceed to
Within normal range (1.4 mA or more, and less than 3.6 mA)	A
Outside normal range (Less than 1.4 mA, or 3.6 mA or more)	B

B → Go to step 20

A

3.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF A/F SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the intelligent tester on.

d. Warm up the air fuel ratio (A/F) sensor at an engine speed of 2500 rpm for 90 seconds.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / Snapshot / AFS Voltage B1S1 or AFS Voltage B2S1 and Engine Speed.

f. Check the A/F sensor voltage three times, once in each of the following conditions:

i. Engine idling (check for at least 30 seconds)

ii. Engine running at an engine speed of approximately 2500 rpm (without any sudden changes in engine speed)

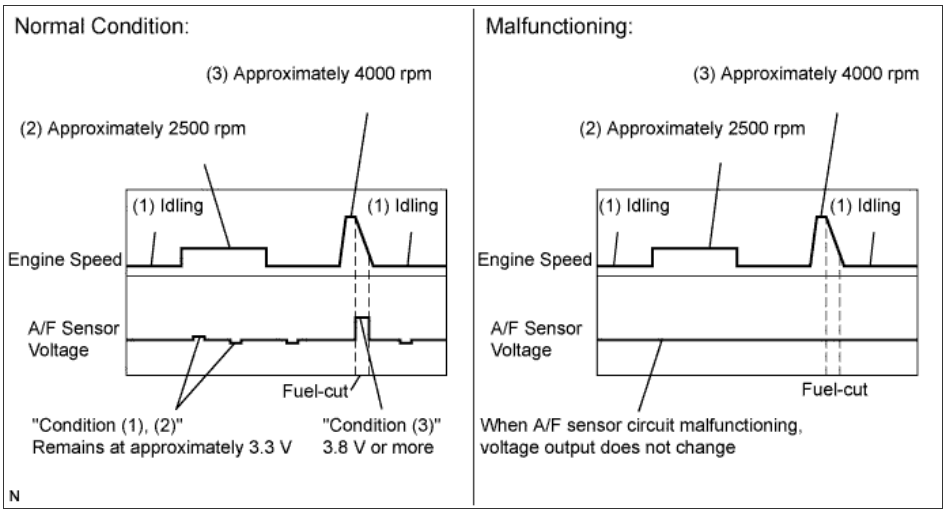
iii. Engine speed raised to 4000 rpm and then accelerator pedal quickly released so that the throttle valve is fully closed.

Standard:

Condition	A/F Sensor Voltage Variation	Reference
(1) and (2)	Changes at approximately 3.3 V	Between 3.1 V and 3.5 V
(3)	Increases to 3.8 V or more	This occurs during engine deceleration (when fuel-cut performed)

HINT:

For more information, see the diagrams below.



HINT:

- **If the output voltage of the A/F sensor remains at approximately 3.3 V (see "Malfunctioning" diagram) under any conditions, including those above, the A/F sensor may have an open circuit. (This will also happen if the A/F sensor heater has an open circuit.)**
- **If the output voltage of the A/F sensor remains at either approximately 3.8 V or more, or 2.8 V or less (see "Malfunctioning" diagram) under any conditions, including those above, the A/F sensor may have a short circuit.**
- **The ECM stops fuel injection (fuel cut) during engine deceleration. This causes a lean condition and results in a momentary increase in the A/F sensor output voltage.**
- **The ECM must establish a closed throttle valve position learned value to perform fuel cut. If the battery cable has been disconnected and reconnected, the vehicle must be driven over 16 km/h (10 mph) to allow the ECM to learn the closed throttle valve position.**
- **When the vehicle is driven:**
  The output voltage of the A/F sensor may be below 2.8 V during fuel enrichment. For the vehicle, this translates to a sudden increase in speed with the accelerator pedal fully depressed when trying to overtake another vehicle. The A/F sensor is functioning normally.
- **The A/F sensor is a current output element; therefore, the current is converted into a voltage inside the ECM. Measuring the voltage at the connectors of the A/F sensor or ECM will show a constant voltage.**

NG → Go to step 10

OK

4.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

d. Read the DTCs.

Result

Display (DTC Output)	Proceed to
P2195, P2196, P2197 or P2198	A
No output	B

B → Go to step 9

A

6.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

7.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

d. Read DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P2195, P2196, P2197 or P2198	B

B → REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN

A

9.CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

NO → CHECK FOR INTERMITTENT PROBLEMS (Click here)

YES

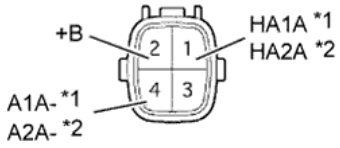
DTC CAUSED BY RUNNING OUT OF FUEL

10.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

a. Disconnect the Air Fuel ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

Standard Resistance:

for Bank 1 Sensor 1

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher

for Bank 2 Sensor 1

Tester Connection	Condition	Specified Condition
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

11.INSPECT INTEGRATION RELAY (A/F RELAY)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

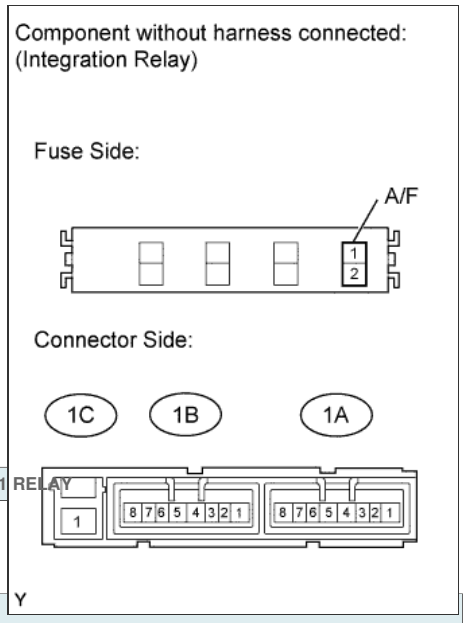
iii. Reinstall the A/F fuse.

c. Inspect the A/F relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1A-4 - 1C-1	Battery voltage not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω



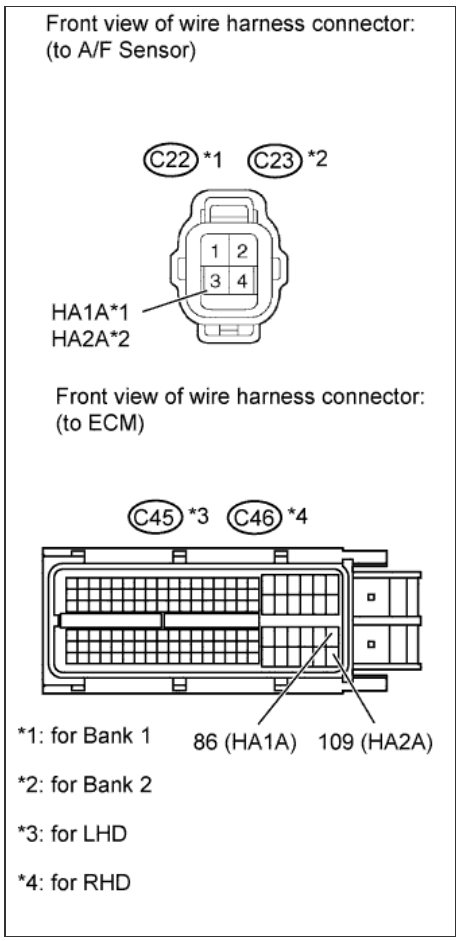
NG → REPLACE INTEGRATION NO.1 RELAY

OK

12.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body		

ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK ↓

13.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage.

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK ↓

14.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → REPAIR OR REPLACE FUEL SYSTEM

OK ↓

15.INSPECT FUEL INJECTOR

a. Check the injector injection (whether fuel volume is large or small, and whether injection pattern is poor) (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK ↓

16.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT ↓

17.PERFORM CONFIRMATION DRIVING PATTERN

NEXT ↓

18.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

d. Read DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P2195, P2196, P2197 or P2198	B

B → REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN

A

19.CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

NO → CHECK FOR INTERMITTENT PROBLEMS (Click here)

YES

DTC CAUSED BY RUNNING OUT OF FUEL

20.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

21.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

22.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

d. Read DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P2195, P2196, P2197 or P2198 (A/F sensor pending DTCs)	B

B → REPLACE ECM (Click here)

A

END

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

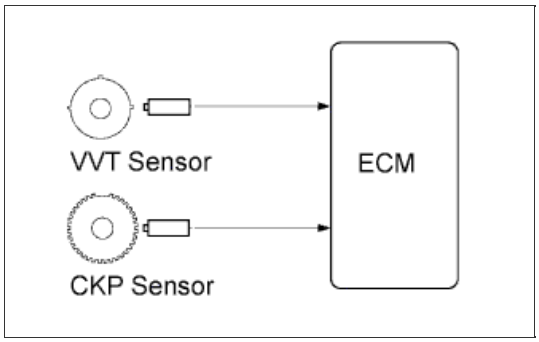
DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

DTC P0306 Cylinder 6 Misfire Detected

for Preparation Click here

DESCRIPTION

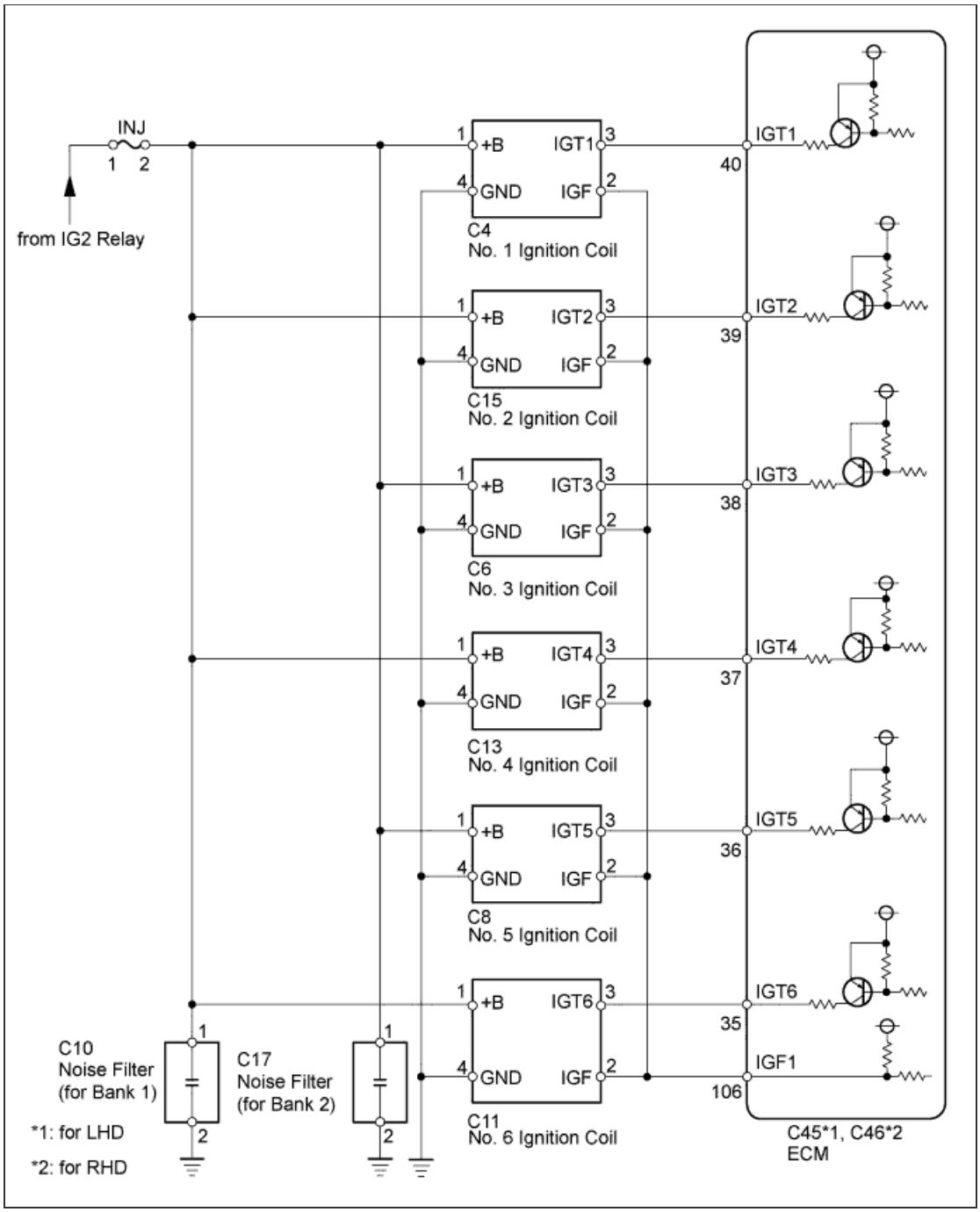


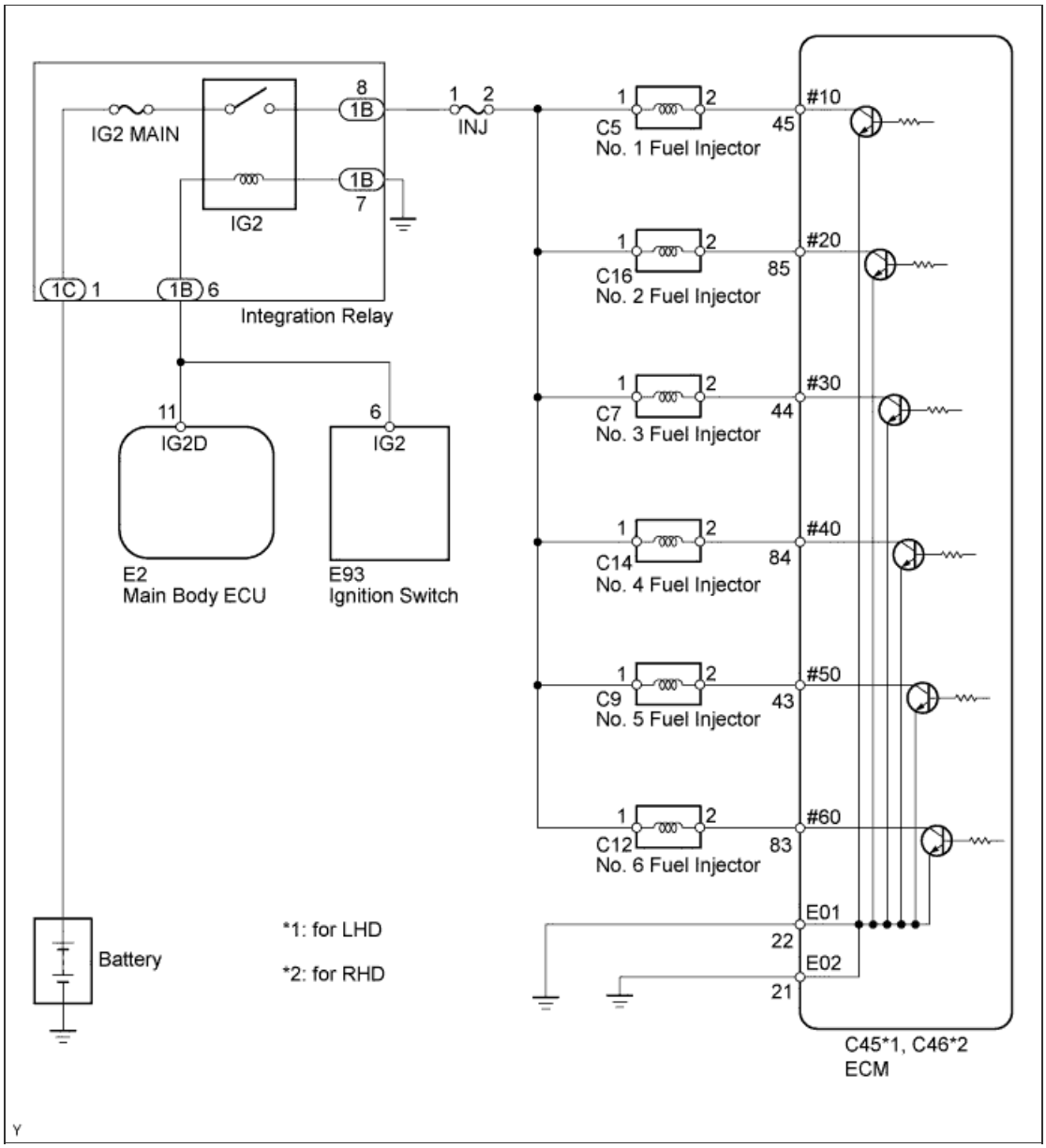
When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. High HC concentration levels can cause an increase in exhaust emission levels. Extremely high concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent this increase in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire count. When the temperature of the TWC reaches the point of thermal degradation, the ECM blinks the MIL. To monitor misfires, the ECM uses both the VVT sensor and the Crankshaft Position (CKP) sensor. The VVT sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted when the crankshaft rotation speed variations exceed predetermined thresholds. If the misfire count exceeds the threshold levels, the ECM illuminates the MIL and stores a DTC.

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A misfire occurs that may damage the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	• Open or short in engine wire harness • Connector connections • Vacuum hose connections • Ignition system • Injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve clearance • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306	Misfiring of specific cylinder occurs and one of following conditions below is detected (2 trip detection logic): • A misfire occurs that may damage the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

WIRING DIAGRAM


INJ
1 2
from IG2 Relay
1 +B
IGT1 3
4 GND
IGF 2
C4
No. 1 Ignition Coil
1 +B
IGT2 3
4 GND
IGF 2
C15
No. 2 Ignition Coil
1 +B
IGT3 3
4 GND
IGF 2
C6
No. 3 Ignition Coil
1 +B
IGT4 3
4 GND
IGF 2
C13
No. 4 Ignition Coil
1 +B
IGT5 3
4 GND
IGF 2
C8
No. 5 Ignition Coil
1 +B
IGT6 3
4 GND
IGF 2
C11
No. 6 Ignition Coil
IGT1
40
IGT2
39
IGT3
38
IGT4
37
IGT5
36
IGT6
35
IGF1
106
C45*1, C46*2
ECM
C10
Noise Filter
(for Bank 1)
C17
Noise Filter
(for Bank 2)
*1: for LHD
*2: for RHD



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the intelligent tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the intelligent tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire count of each cylinder (Cylinder #1 Misfire Count to Cylinder #6 Misfire Count) with the engine idling. If any misfire count is displayed, skip the following confirmation driving pattern.
7. If no misfire counts are displayed, drive the vehicle several times at the engine speed and engine load, etc., recorded in the freeze frame data.

HINT:

- **In order to store misfire DTCs, drive the vehicle at the engine speed and engine load, etc., recorded in the freeze frame data for the time specified in the table below.**

Engine Speed	Duration
Idling	3.5 minutes or more
1000	3 minutes or more
2000	1.5 minutes or more
3000	1 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

HINT:

Do not turn the ignition switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data are cleared.

9. Record the DTC(s), freeze frame data and misfire count.
10. Turn the ignition switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the ECM as freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the ECM as freeze frame data have been reproduced, one of the following factors can be considered to be a possible cause of the problem:**
    1. **There was insufficient fuel volume in the tank.**
    2. **Improper fuel was used.**
    3. **The spark plugs have been contaminated.**
- **After finishing repairs, check the misfire counts of the cylinders (Cylinder #1 Misfire Count to Cylinder #6 Misfire Count).**
- **Be sure to confirm that no misfiring cylinder DTCs are stored again by conducting the confirmation driving pattern after finishing repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speeds. If misfires occur only in high engine speed areas, only DTC P0300 is stored.**
  In the event of DTC P0300 being present, perform the following operations:
    1. **Clear the DTCs (Click here).**
    2. **Start the engine and conduct the confirmation driving pattern.**
    3. **Read the misfiring rates of each cylinder or DTC(s) using the intelligent tester.**
    4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
    5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not stored.**
- **When one of Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air fuel ratio may be Rich (-20% or less) or Lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is less than 75°C (167°F), the misfire may have occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel can cause body vibration, which may cause misfire DTC(s) to be stored.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

e. Read DTCs.

HINT:

Write down the DTCs.

Result

Display (DTC Output)	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305 and/or P0306	A
P0300, P0301, P0302, P0303, P0304, P0305 and/or P0306 and other DTCs	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305 and P0306 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

3.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is correctly connected and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE

OK

4.READ VALUE USING INTELLIGENT TESTER

(a) Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5 and #6.
(b) Read the value for Cylinder #1 Misfire Count to Cylinder #6 Misfire Count displayed on the intelligent tester. If no misfire counts occur in any cylinders, perform the following procedures:
(1) Start the engine and let it idle.
(2) Move the shift lever to D.
(3) Check the Cylinder #1 Misfire Count to Cylinder #6 Misfire Count.
(4) If misfire counts are still not displayed, perform steps (c) and (d).
(c) Drive the vehicle with the Misfire RPM and Misfire Load noted in the "Read value using intelligent tester (Misfire RPM and Misfire Load)" procedures above.
(d) Read the Cylinder #1 Misfire Count to Cylinder #6 Misfire Count or DTCs displayed on the intelligent tester.

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have equal misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data's record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data's record of Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → Go to step 17

A

5.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

b. Measure the spark plug electrode gap (Click here).

NG → REPLACE SPARK PLUG (Click here)

OK

6.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head.

c. Install the spark plug to the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check for sparks.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK HARNESS AND CONNECTOR (ECM - INJECTOR)

a. Disconnect the injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

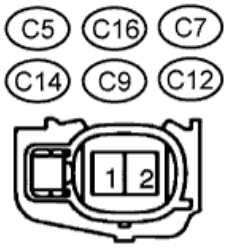
c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

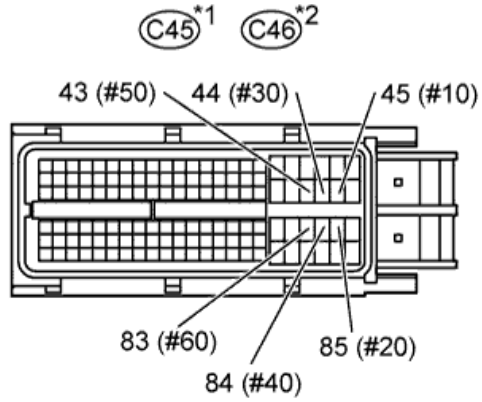
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Body ground	Ignition switch ON	11 to 14 V
No. 2	C16-1 - Body ground	Ignition switch ON	11 to 14 V
No. 3	C7-1 - Body ground	Ignition switch ON	11 to 14 V
No. 4	C14-1 - Body ground	Ignition switch ON	11 to 14 V
No. 5	C9-1 - Body ground	Ignition switch ON	11 to 14 V
No. 6	C12-1 - Body ground	Ignition switch ON	11 to 14 V

d. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance:

for LHD

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-45 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C45-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C45-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C45-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C45-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C45-83 (#60)	Always	Below 1 Ω

for RHD

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-45 (#10)	Always	Below 1 Ω
	C16-2 - Body		

No. 2	ground	Always	10 kΩ or higher
	C16-2 - C46-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C46-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C46-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C46-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C46-83 (#60)	Always	Below 1 Ω

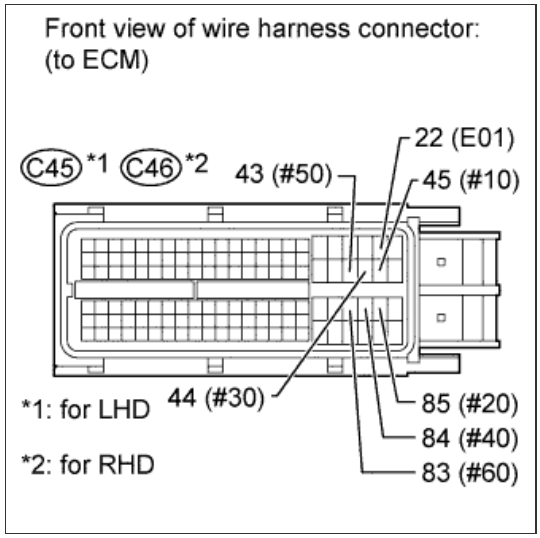
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50 AND/OR #60 VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for LHD

Tester Connection	Switch Condition	Specified Condition
C45-45 (#10) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-85 (#20) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-44 (#30) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-84 (#40) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-43 (#50) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-83 (#60) - C45-22 (E01)	Ignition switch ON	11 to 14 V

for RHD

Tester Connection	Switch Condition	Specified Condition
C46-45 (#10) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-85 (#20) - C46-22 (E01)	Ignition switch ON	11 to 14 V

C46-44 (#30) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-84 (#40) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-43 (#50) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-83 (#60) - C46-22 (E01)	Ignition switch ON	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection (whether fuel volume is large or small, and whether injection pattern is poor) (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (**Click here**)

OK

11.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

12.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK

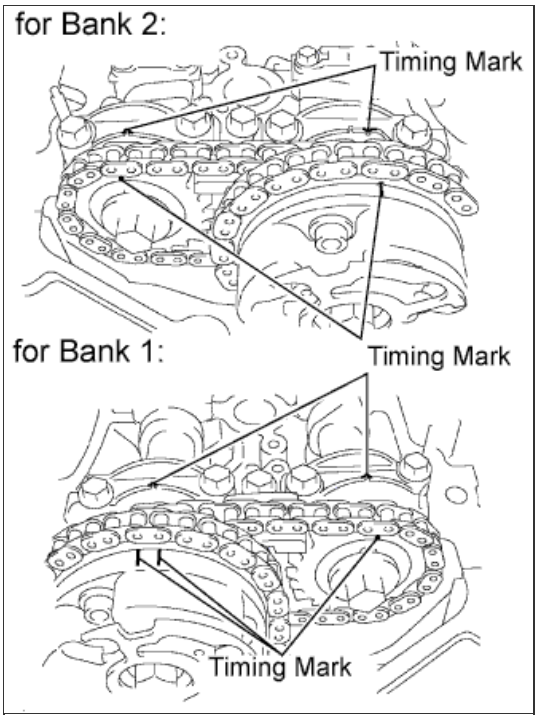
13.CHECK VALVE TIMING

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → ADJUST VALVE TIMING

OK

14.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER, AND REPLACE PARTS AS NECESSARY

OK

15.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Data List twice, when the engine is cold and when it is warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: 80 to 100°C (176 to 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

16.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

REPLACE ECM (Click here)

17.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

OK

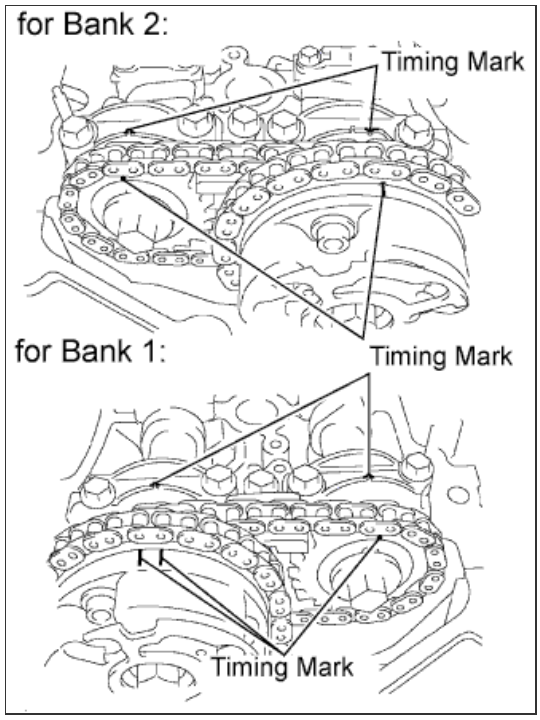
18.CHECK VALVE TIMING

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → **ADJUST VALVE TIMING**

OK

19.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → **CHECK FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER, AND REPLACE PARTS AS NECESSARY**

OK

20.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Data List twice, when the engine is cold and when it is warmed up.

Standard:
With cold engine: Same as ambient air temperature.

With warm engine: 80 to 100°C (176 to 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

21.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

22.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

b. Measure the spark plug electrode gap (Click here).

NG → REPLACE SPARK PLUG (Click here)

OK

23.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head.

c. Install the spark plug to the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check for sparks.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

24.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

25.CHECK HARNESS AND CONNECTOR (ECM - INJECTOR)

a. Disconnect the injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

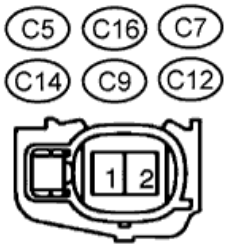
c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

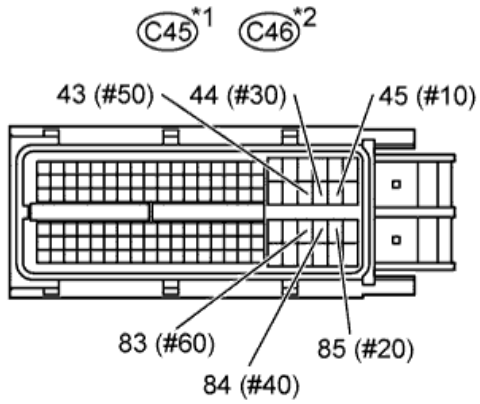
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Body ground	Ignition switch ON	11 to 14 V
No. 2	C16-1 - Body ground	Ignition switch ON	11 to 14 V
No. 3	C7-1 - Body ground	Ignition switch ON	11 to 14 V
No. 4	C14-1 - Body ground	Ignition switch ON	11 to 14 V
No. 5	C9-1 - Body ground	Ignition switch ON	11 to 14 V
No. 6	C12-1 - Body ground	Ignition switch ON	11 to 14 V

d. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector: (to Injector)



Front view of wire harness connector: (to ECM)



*1: for LHD

*2: for RHD

Standard Resistance:

for LHD

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-45 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C45-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C45-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C45-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C45-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C45-83 (#60)	Always	Below 1 Ω

for RHD

Cylinder	Tester Connection	Condition	Specified Condition

No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-45 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C46-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C46-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C46-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C46-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C46-83 (#60)	Always	Below 1 Ω

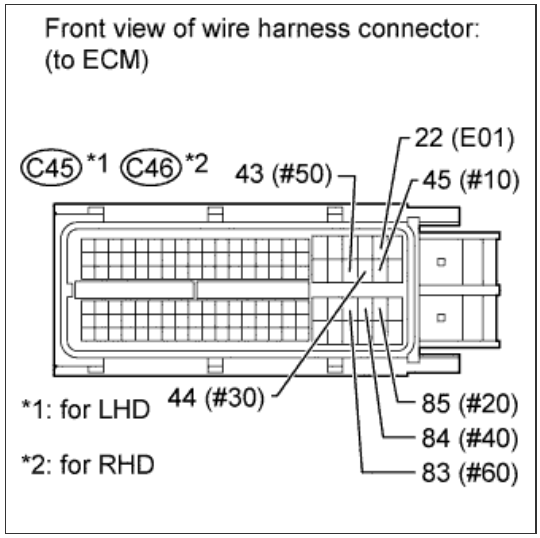
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50 AND/OR #60 VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for LHD

Tester Connection	Switch Condition	Specified Condition
C45-45 (#10) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-85 (#20) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-44 (#30) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-84 (#40) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-43 (#50) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-83 (#60) - C45-22 (E01)	Ignition switch ON	11 to 14 V

for RHD

Tester Connection	Switch Condition	Specified Condition
C46-45 (#10) - C46-22	Ignition switch	

(E01)	ON	11 to 14 V
C46-85 (#20) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-44 (#30) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-84 (#40) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-43 (#50) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-83 (#60) - C46-22 (E01)	Ignition switch ON	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

27.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection (whether fuel volume is large or small, and whether injection pattern is poor) (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (Click here)

OK

28.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (Click here)

OK

REPLACE ECM (Click here)

29.REPLACE SPARK PLUG WITH NORMAL ONE AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the installed spark plug with a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect all the injector connectors.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:

Sparks jump across electrode gap.

NG → Go to step 30

OK

REPLACE SPARK PLUG (Click here)

30.REPLACE IGNITION COIL WITH NORMAL ONE AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the installed ignition coil with a ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect all the injector connectors.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK → REPLACE IGNITION COIL (Click here)

DTC P2195 Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)

DTC P2196 Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)

DTC P2197 Oxygen (A/F) Sensor Signal Stuck Lean (Bank 2 Sensor 1)

DTC P2198 Oxygen (A/F) Sensor Signal Stuck Rich (Bank 2 Sensor 1)

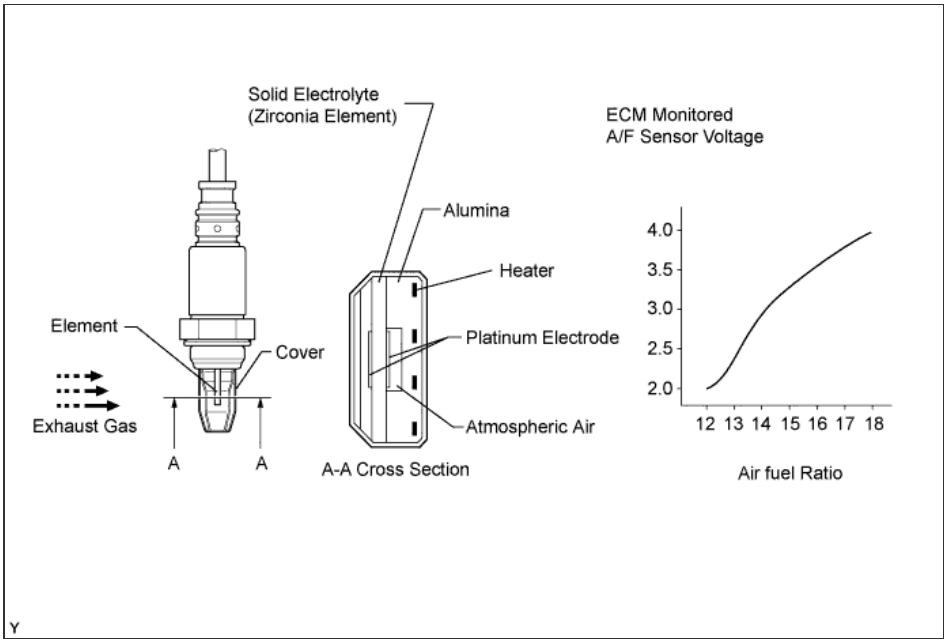
for Preparation Click here

DESCRIPTION

HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air Fuel Ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**

The A/F sensor generates a voltage* that corresponds to the actual air fuel ratio. This sensor voltage is used to provide the ECM with feedback so that it can control the air fuel ratio. The ECM determines the deviation from the stoichiometric air fuel ratio, and regulates the fuel injection time. If the A/F sensor malfunctions, the ECM is unable to control the air fuel ratio accurately.
The A/F sensor is the planar type and is integrated with a heater, which heats the solid electrolyte (zirconia element). This heater is controlled by the ECM. When the intake air volume is low (the exhaust gas temperature is low), a current flows into the heater to heat the sensor in order to facilitate accurate oxygen concentration detection. In addition, the sensor and heater portions are the narrow type. The heat generated by the heater is conducted to the solid electrolyte through the alumina, therefore the sensor activation is accelerated.
In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air fuel ratio must be precisely controlled so that it is always close to the stoichiometric level.
*: The value changes inside the ECM. Since the A/F sensor is a current output element, the current is converted into a voltage inside the ECM. Any measurements taken at the A/F sensor or ECM connectors will show a constant voltage.

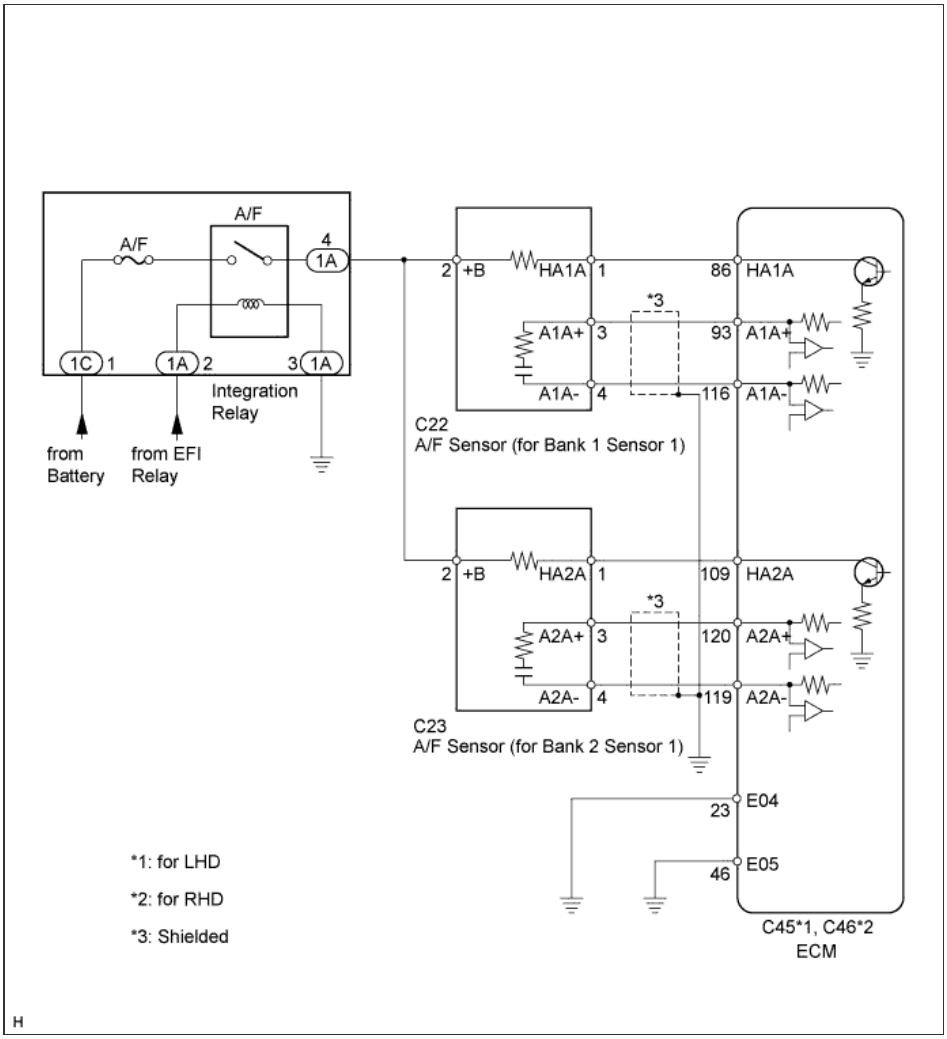


DTC Code	DTC Detection Condition	Trouble Area
P2195 P2197	Conditions (a) and (b) continue for 2 seconds or more (2 trip detection logic): (a) The Air Fuel Ratio (A/F) sensor voltage is more than 3.8 V. (b) The Heated Oxygen (HO2) sensor voltage is 0.15 V or more.	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor (bank 1, 2 sensor 1) heater • A/F sensor heater circuits • Integration relay • Air induction system circuits • Fuel pressure • Fuel injector • ECM
	While fuel-cut operation is performed (during vehicle deceleration), the air fuel ratio (A/F) sensor current is 3.6 mA or more for 3 seconds (2 trip detection logic).	• A/F sensor • ECM
P2196 P2198	Conditions (a) and (b) continue for 2 seconds or more (2 trip detection logic): (a) The A/F sensor voltage is less than 2.8 V. (b) The HO2 sensor voltage is less than 0.6 V.	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor (bank 1, 2 sensor 1) heater • A/F sensor heater circuits • Air induction system • Integration relay • Fuel pressure • Fuel injector • ECM
	While fuel-cut operation is performed (during vehicle deceleration), the air fuel ratio (A/F) sensor current is less than 1.4 mA for 3 seconds (2 trip detection logic).	• A/F sensor • ECM

HINT:

- **DTCs P2195 and P2196 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2197 and P2198 indicate malfunctions related to the bank 2 A/F sensor circuit.**
- **Bank 1 refers to the bank that includes cylinder No. 1.**
- **Bank 2 refers to the bank that includes cylinder No. 2.**
- **When any of these DTCs are stored, check the A/F sensor voltage output by entering the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS Voltage B1S1 or AFS Voltage B2S1.**
- **The short-term fuel trim values can also be read using the intelligent tester.**
- **The ECM regulates the voltages at the A1A+, A2A+, A1A- and A2A- terminals of the ECM to a constant level. Therefore, the A/F sensor voltage output cannot be confirmed without using the intelligent tester.**
- **If a A/F sensor malfunction is detected, the ECM stores a DTC.**

WIRING DIAGRAM



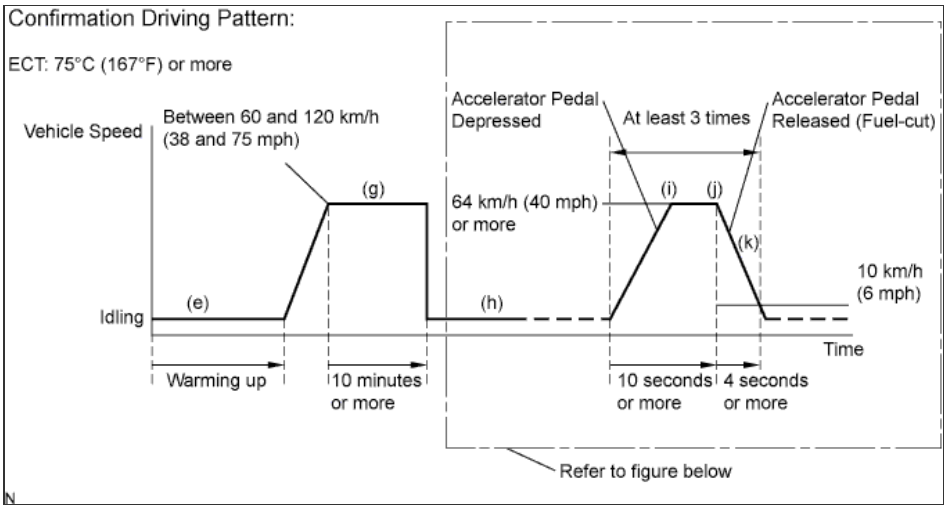
CONFIRMATION DRIVING PATTERN

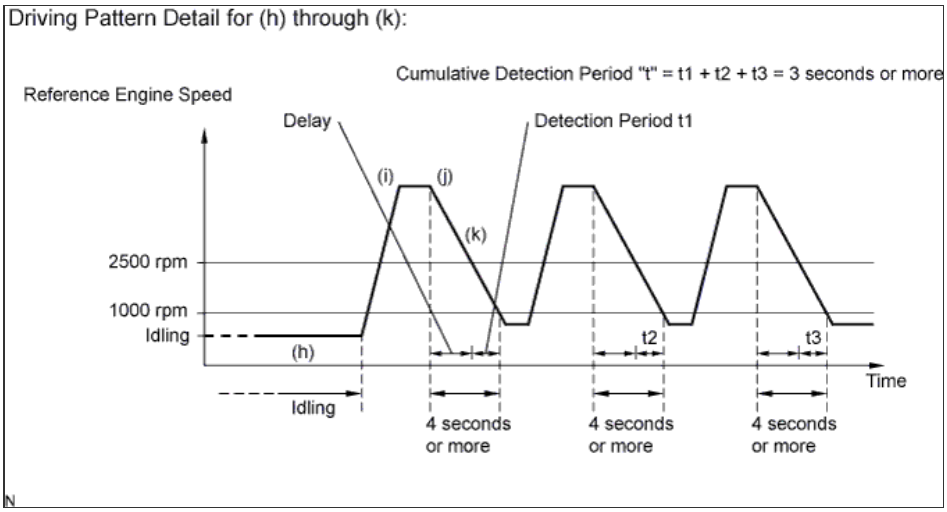
CAUTION:

Strictly observe posted speed limits, traffic laws, and road conditions when performing these drive patterns.

HINT:

This confirmation driving pattern is used in the "PERFORM CONFIRMATION DRIVING PATTERN" procedure of the following diagnostic troubleshooting procedure.





(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON.
(c) Turn the intelligent tester on.
(d) Clear DTCs (Click here).
(e) Start the engine, and warm it up until the ECT reaches 75°C (167°F) or higher.
(f) Enter the following menus to check the fuel-cut status: Powertrain / Engine and ECT / Data List / All Data / Idle Fuel Cut.
(g) Drive the vehicle at between 60 km/h (38 mph) and 120 km/h (75 mph) for at least 10 minutes.
(h) Shift the transmission to 2nd gear.
(i) Drive the vehicle at the proper vehicle speed to perform fuel-cut operation (refer to the following HINT).

HINT:

Fuel-cut is performed when the following conditions are met:

- **The accelerator pedal is fully released.**
- **The engine speed is 2500 rpm or more (fuel injection returns at 1000 rpm).**

(j) Accelerate the vehicle to 64 km/h (40 mph) or more by depressing the accelerator pedal for at least 10 seconds.
(k) Soon after performing step (j) above, release the accelerator pedal for at least 4 seconds without depressing the brake pedal in order to execute fuel-cut control.
(l) Allow the vehicle to decelerate until the vehicle speed decreases to less than 10 km/h (6 mph).
(m) Repeat steps (h) through (k) above at least 3 times in one driving cycle.

HINT:

Completion of all O2S (A/F) Monitor is required to change the value in Data List.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the air fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the intelligent tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **On the intelligent tester, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume.)**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2, or AFS Voltage B2S1 and O2S B2S2) displayed on the intelligent tester.**

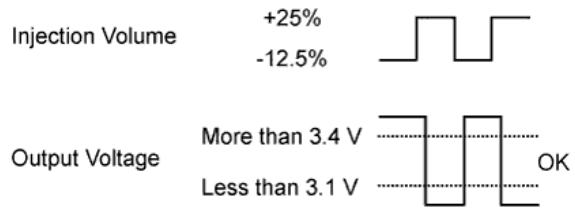
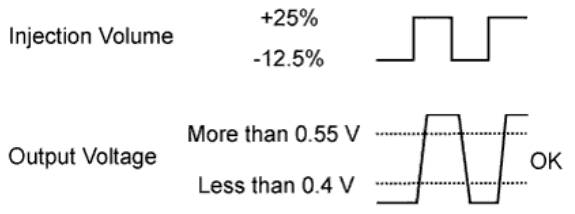
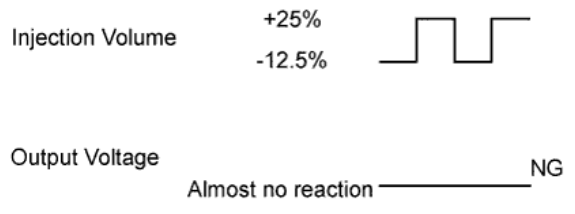
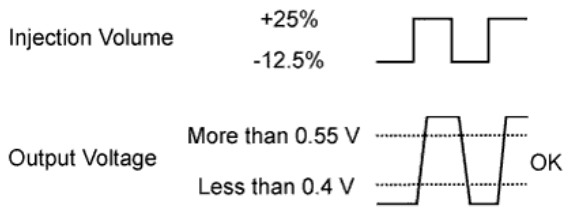
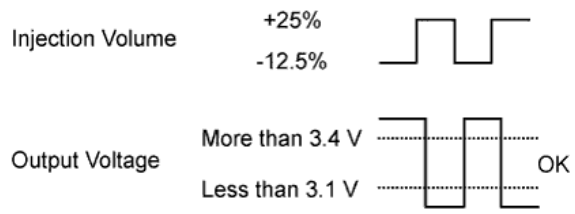
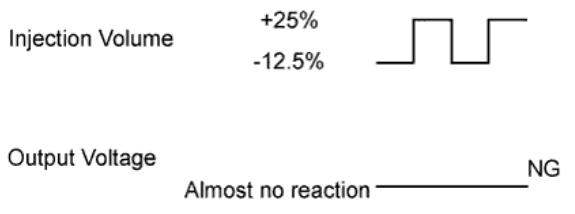
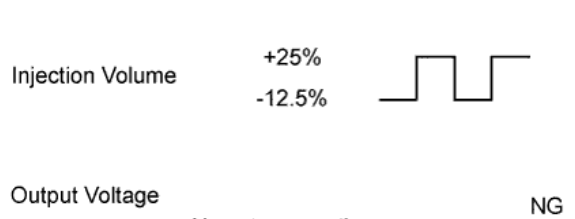
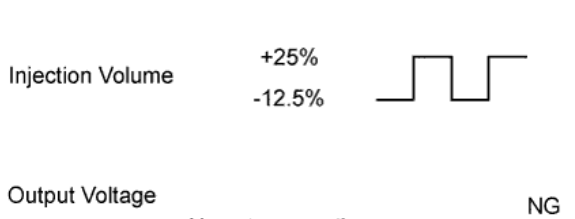
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	Less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.**
- **A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

e. Read DTCs.

Result

Display (DTC Output)	Proceed to
P2195, P2196, P2197 or P2198	A
P2195, P2196, P2197 or P2198 and other DTCs	B

HINT:

If any DTCs other than P2195, P2196, P2197 or P2198 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (TEST VALUE OF A/F SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Clear DTCs (Click here).

d. Drive the vehicle in accordance with the drive pattern described in the CONFIRMATION DRIVING PATTERN.

e. Enter the following menus: Powertrain / Engine and ECT / Monitor / O2 Sensor.

f. Check that the status of O2 Sensor is Complete.
If the status is still Incomplete, drive the vehicle according to the driving pattern again.

g. Enter the following menus: Powertrain / Engine and ECT / Monitor / O2 Sensor / Details / RANGE B1 S1.

h. Check the test value of the A/F sensor output current during fuel-cut.

Result

Test Value	Proceed to
Within normal range (1.4 mA or more, and less than 3.6 mA)	A
Outside normal range (Less than 1.4 mA, or 3.6 mA or more)	B

B → Go to step 20

A

3.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF A/F SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the intelligent tester on.

d. Warm up the air fuel ratio (A/F) sensor at an engine speed of 2500 rpm for 90 seconds.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / Snapshot / AFS Voltage B1S1 or AFS Voltage B2S1 and Engine Speed.

f. Check the A/F sensor voltage three times, once in each of the following conditions:

i. Engine idling (check for at least 30 seconds)

ii. Engine running at an engine speed of approximately 2500 rpm (without any sudden changes in engine speed)

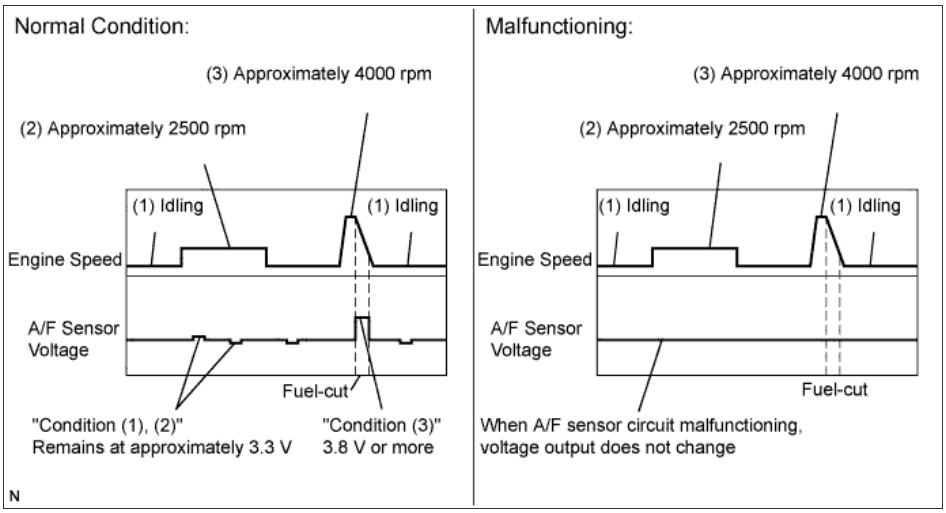
iii. Engine speed raised to 4000 rpm and then accelerator pedal quickly released so that the throttle valve is fully closed.

Standard:

Condition	A/F Sensor Voltage Variation	Reference
(1) and (2)	Changes at approximately 3.3 V	Between 3.1 V and 3.5 V
(3)	Increases to 3.8 V or more	This occurs during engine deceleration (when fuel-cut performed)

HINT:

For more information, see the diagrams below.



HINT:

- **If the output voltage of the A/F sensor remains at approximately 3.3 V (see "Malfunctioning" diagram) under any conditions, including those above, the A/F sensor may have an open circuit. (This will also happen if the A/F sensor heater has an open circuit.)**
- **If the output voltage of the A/F sensor remains at either approximately 3.8 V or more, or 2.8 V or less (see "Malfunctioning" diagram) under any conditions, including those above, the A/F sensor may have a short circuit.**
- **The ECM stops fuel injection (fuel cut) during engine deceleration. This causes a lean condition and results in a momentary increase in the A/F sensor output voltage.**
- **The ECM must establish a closed throttle valve position learned value to perform fuel cut. If the battery cable has been disconnected and reconnected, the vehicle must be driven over 16 km/h (10 mph) to allow the ECM to learn the closed throttle valve position.**
- **When the vehicle is driven:**
  The output voltage of the A/F sensor may be below 2.8 V during fuel enrichment. For the vehicle, this translates to a sudden increase in speed with the accelerator pedal fully depressed when trying to overtake another vehicle. The A/F sensor is functioning normally.
- **The A/F sensor is a current output element; therefore, the current is converted into a voltage inside the ECM. Measuring the voltage at the connectors of the A/F sensor or ECM will show a constant voltage.**

NG → Go to step 10

OK

4.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

d. Read the DTCs.

Result

Display (DTC Output)	Proceed to
P2195, P2196, P2197 or P2198	A
No output	B

B → Go to step 9

A

6.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

7.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

d. Read DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P2195, P2196, P2197 or P2198	B

B → REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN

A

9.CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

NO → CHECK FOR INTERMITTENT PROBLEMS (Click here)

YES

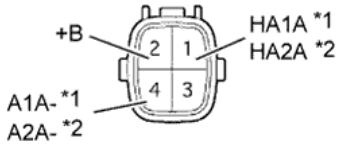
DTC CAUSED BY RUNNING OUT OF FUEL

10.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

a. Disconnect the Air Fuel ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

Standard Resistance:

for Bank 1 Sensor 1

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher

for Bank 2 Sensor 1

Tester Connection	Condition	Specified Condition
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

11.INSPECT INTEGRATION RELAY (A/F RELAY)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

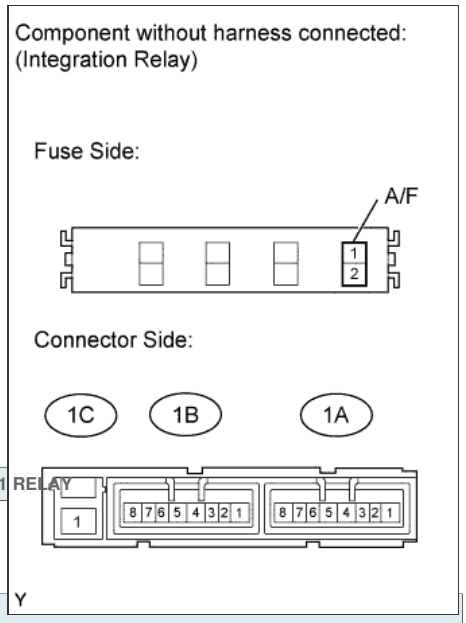
iii. Reinstall the A/F fuse.

c. Inspect the A/F relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1A-4 - 1C-1	Battery voltage not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω



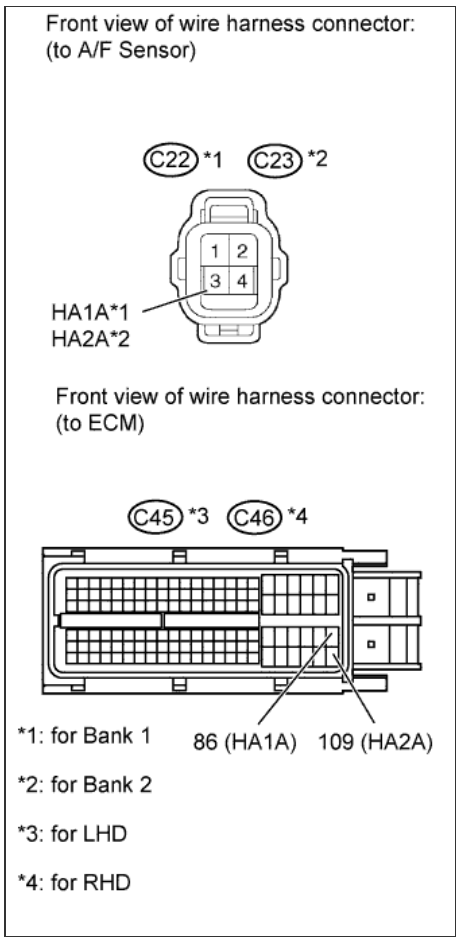
NG → REPLACE INTEGRATION NO.1 RELAY

OK

12.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body		

ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK ↓

13.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage.

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK ↓

14.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → REPAIR OR REPLACE FUEL SYSTEM

OK ↓

15.INSPECT FUEL INJECTOR

a. Check the injector injection (whether fuel volume is large or small, and whether injection pattern is poor) (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK ↓

16.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT ↓

17.PERFORM CONFIRMATION DRIVING PATTERN

NEXT ↓

18.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

d. Read DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P2195, P2196, P2197 or P2198	B

B → REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN

A

19.CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

NO → CHECK FOR INTERMITTENT PROBLEMS (Click here)

YES

DTC CAUSED BY RUNNING OUT OF FUEL

20.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

21.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

22.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

d. Read DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P2195, P2196, P2197 or P2198 (A/F sensor pending DTCs)	B

B → REPLACE ECM (Click here)

A

END

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

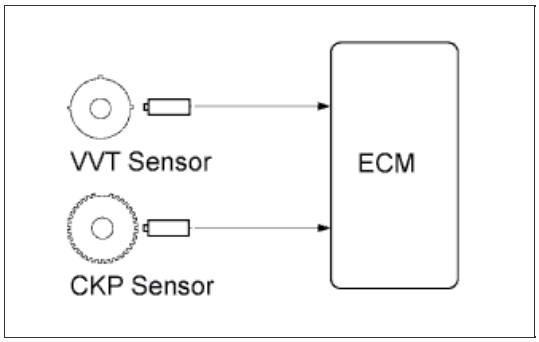
DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

DTC P0306 Cylinder 6 Misfire Detected

for Preparation Click here

DESCRIPTION

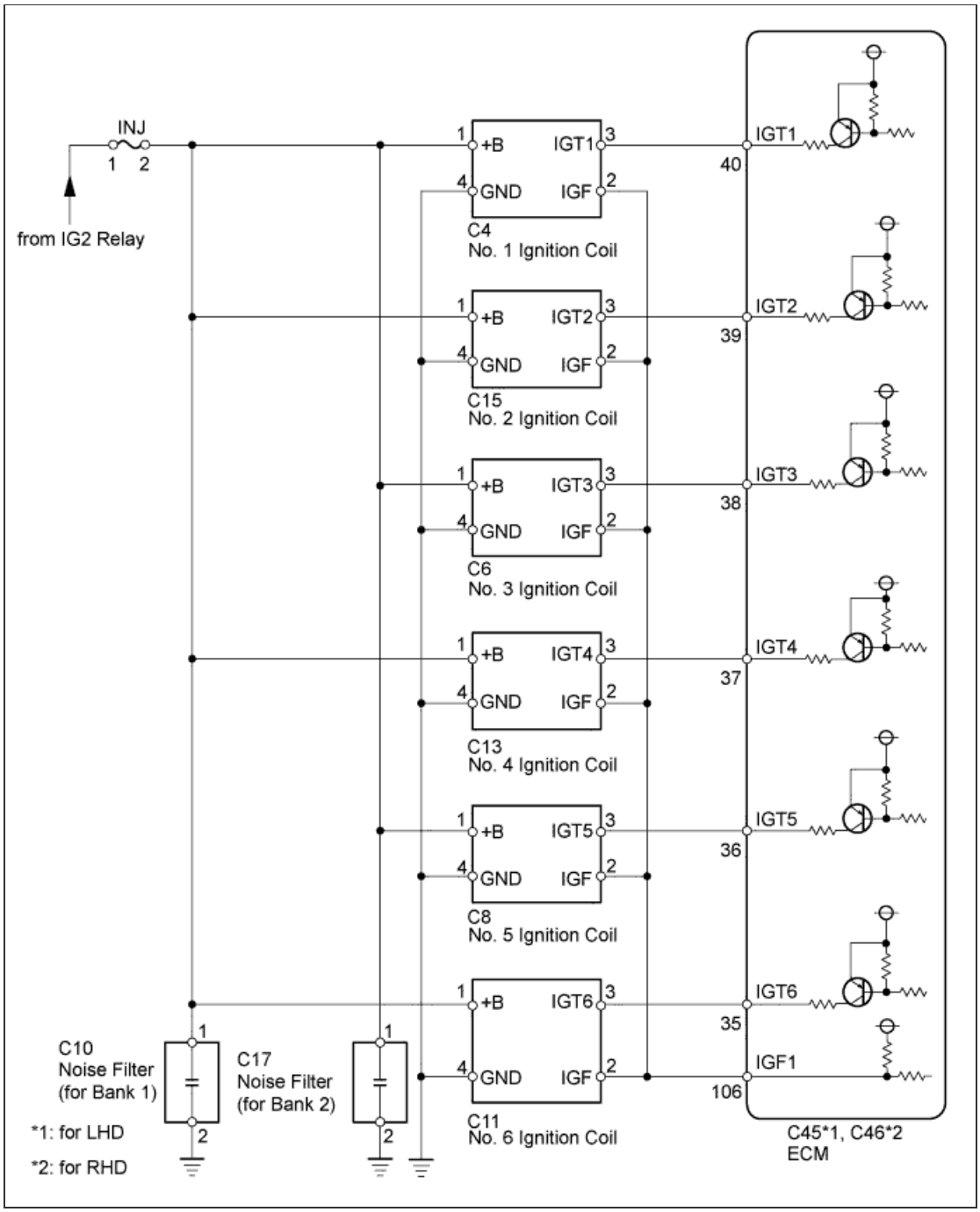


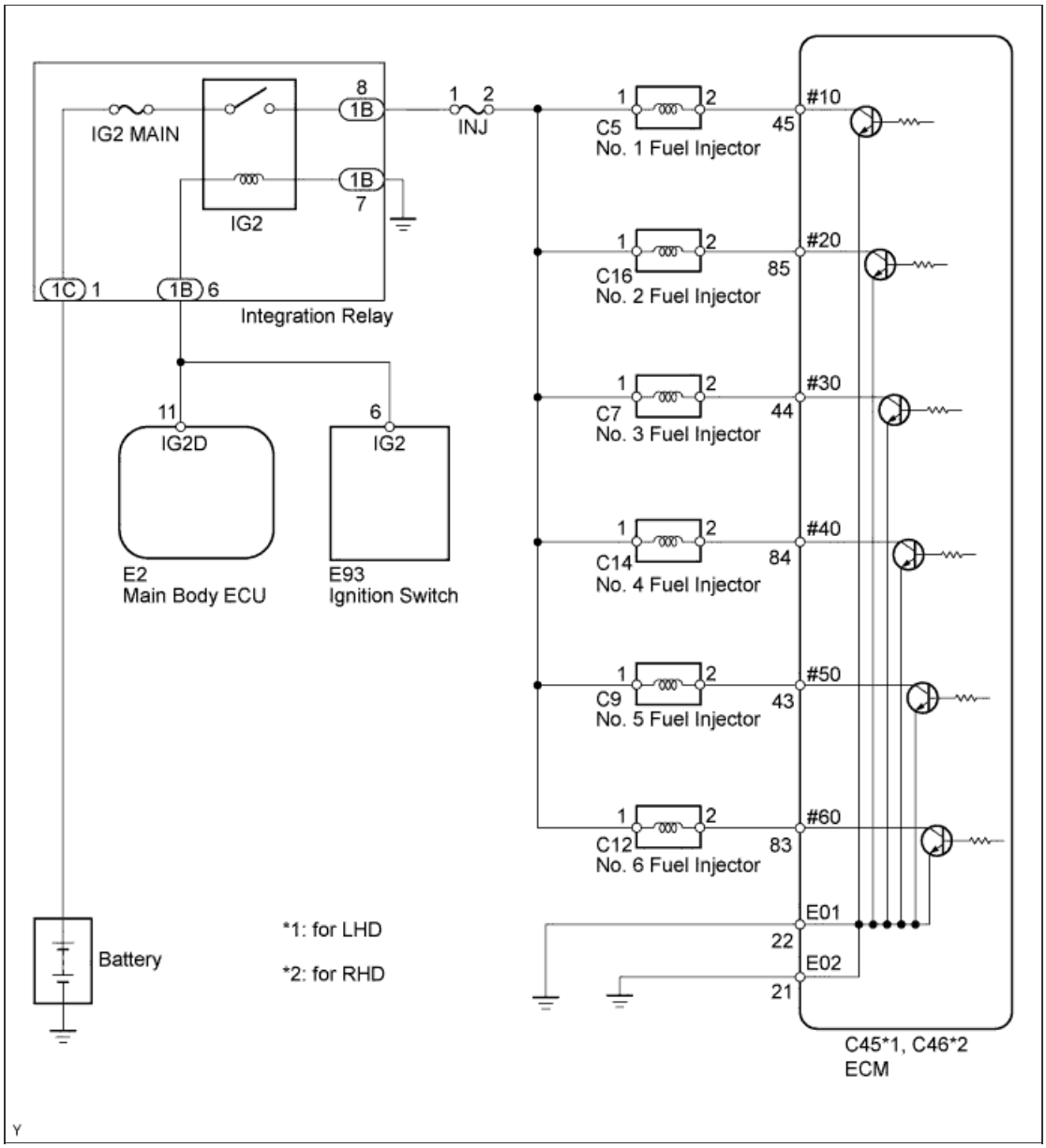
When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. High HC concentration levels can cause an increase in exhaust emission levels. Extremely high concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent this increase in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire count. When the temperature of the TWC reaches the point of thermal degradation, the ECM blinks the MIL. To monitor misfires, the ECM uses both the VVT sensor and the Crankshaft Position (CKP) sensor. The VVT sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted when the crankshaft rotation speed variations exceed predetermined thresholds. If the misfire count exceeds the threshold levels, the ECM illuminates the MIL and stores a DTC.

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A misfire occurs that may damage the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	• Open or short in engine wire harness • Connector connections • Vacuum hose connections • Ignition system • Injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve clearance • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306	Misfiring of specific cylinder occurs and one of following conditions below is detected (2 trip detection logic): • A misfire occurs that may damage the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

WIRING DIAGRAM


INJ
1 2
from IG2 Relay
1 +B
IGT1 3
4 GND
IGF 2
C4
No. 1 Ignition Coil
1 +B
IGT2 3
4 GND
IGF 2
C15
No. 2 Ignition Coil
1 +B
IGT3 3
4 GND
IGF 2
C6
No. 3 Ignition Coil
1 +B
IGT4 3
4 GND
IGF 2
C13
No. 4 Ignition Coil
1 +B
IGT5 3
4 GND
IGF 2
C8
No. 5 Ignition Coil
1 +B
IGT6 3
4 GND
IGF 2
C11
No. 6 Ignition Coil
IGT1
40
IGT2
39
IGT3
38
IGT4
37
IGT5
36
IGT6
35
IGF1
106
C45*1, C46*2
ECM
C10
Noise Filter
(for Bank 1)
C17
Noise Filter
(for Bank 2)
*1: for LHD
*2: for RHD



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the intelligent tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the intelligent tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire count of each cylinder (Cylinder #1 Misfire Count to Cylinder #6 Misfire Count) with the engine idling. If any misfire count is displayed, skip the following confirmation driving pattern.
7. If no misfire counts are displayed, drive the vehicle several times at the engine speed and engine load, etc., recorded in the freeze frame data.

HINT:

- **In order to store misfire DTCs, drive the vehicle at the engine speed and engine load, etc., recorded in the freeze frame data for the time specified in the table below.**

Engine Speed	Duration
Idling	3.5 minutes or more
1000	3 minutes or more
2000	1.5 minutes or more
3000	1 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

HINT:

Do not turn the ignition switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data are cleared.

9. Record the DTC(s), freeze frame data and misfire count.
10. Turn the ignition switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the ECM as freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the ECM as freeze frame data have been reproduced, one of the following factors can be considered to be a possible cause of the problem:**
    1. **There was insufficient fuel volume in the tank.**
    2. **Improper fuel was used.**
    3. **The spark plugs have been contaminated.**
- **After finishing repairs, check the misfire counts of the cylinders (Cylinder #1 Misfire Count to Cylinder #6 Misfire Count).**
- **Be sure to confirm that no misfiring cylinder DTCs are stored again by conducting the confirmation driving pattern after finishing repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speeds. If misfires occur only in high engine speed areas, only DTC P0300 is stored.**
  In the event of DTC P0300 being present, perform the following operations:
    1. **Clear the DTCs (Click here).**
    2. **Start the engine and conduct the confirmation driving pattern.**
    3. **Read the misfiring rates of each cylinder or DTC(s) using the intelligent tester.**
    4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
    5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not stored.**
- **When one of Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air fuel ratio may be Rich (-20% or less) or Lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is less than 75°C (167°F), the misfire may have occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel can cause body vibration, which may cause misfire DTC(s) to be stored.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

e. Read DTCs.

HINT:

Write down the DTCs.

Result

Display (DTC Output)	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305 and/or P0306	A
P0300, P0301, P0302, P0303, P0304, P0305 and/or P0306 and other DTCs	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305 and P0306 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

3.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is correctly connected and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE

OK

4.READ VALUE USING INTELLIGENT TESTER

(a) Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5 and #6.
(b) Read the value for Cylinder #1 Misfire Count to Cylinder #6 Misfire Count displayed on the intelligent tester. If no misfire counts occur in any cylinders, perform the following procedures:
(1) Start the engine and let it idle.
(2) Move the shift lever to D.
(3) Check the Cylinder #1 Misfire Count to Cylinder #6 Misfire Count.
(4) If misfire counts are still not displayed, perform steps (c) and (d).
(c) Drive the vehicle with the Misfire RPM and Misfire Load noted in the "Read value using intelligent tester (Misfire RPM and Misfire Load)" procedures above.
(d) Read the Cylinder #1 Misfire Count to Cylinder #6 Misfire Count or DTCs displayed on the intelligent tester.

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have equal misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data's record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data's record of Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → Go to step 17

A

5.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

b. Measure the spark plug electrode gap (Click here).

NG → REPLACE SPARK PLUG (Click here)

OK

6.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head.

c. Install the spark plug to the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check for sparks.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK HARNESS AND CONNECTOR (ECM - INJECTOR)

a. Disconnect the injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

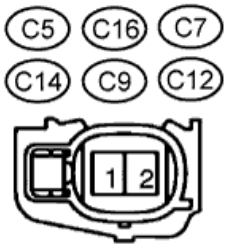
c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

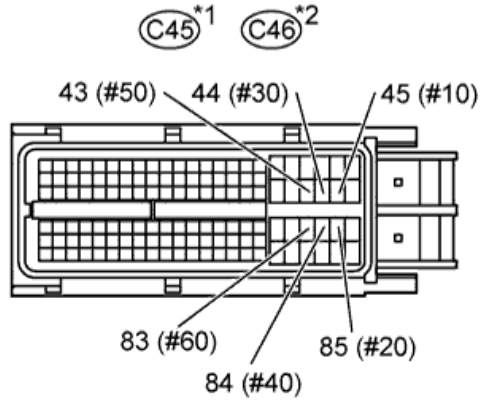
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Body ground	Ignition switch ON	11 to 14 V
No. 2	C16-1 - Body ground	Ignition switch ON	11 to 14 V
No. 3	C7-1 - Body ground	Ignition switch ON	11 to 14 V
No. 4	C14-1 - Body ground	Ignition switch ON	11 to 14 V
No. 5	C9-1 - Body ground	Ignition switch ON	11 to 14 V
No. 6	C12-1 - Body ground	Ignition switch ON	11 to 14 V

d. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance:

for LHD

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-45 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C45-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C45-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C45-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C45-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C45-83 (#60)	Always	Below 1 Ω

for RHD

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-45 (#10)	Always	Below 1 Ω
	C16-2 - Body		

No. 2	ground	Always	10 kΩ or higher
	C16-2 - C46-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C46-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C46-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C46-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C46-83 (#60)	Always	Below 1 Ω

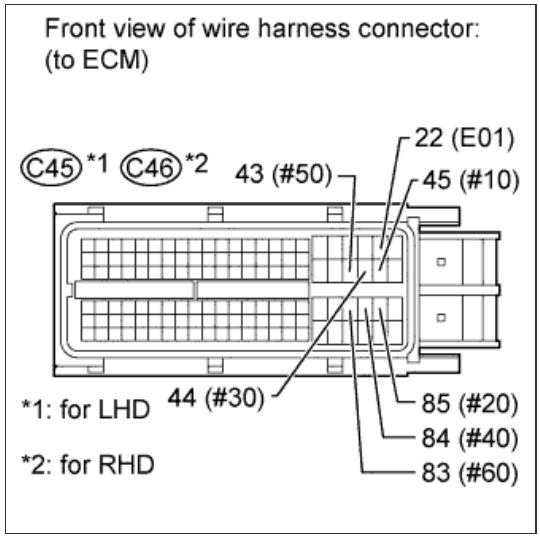
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50 AND/OR #60 VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for LHD

Tester Connection	Switch Condition	Specified Condition
C45-45 (#10) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-85 (#20) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-44 (#30) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-84 (#40) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-43 (#50) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-83 (#60) - C45-22 (E01)	Ignition switch ON	11 to 14 V

for RHD

Tester Connection	Switch Condition	Specified Condition
C46-45 (#10) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-85 (#20) - C46-22 (E01)	Ignition switch ON	11 to 14 V

C46-44 (#30) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-84 (#40) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-43 (#50) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-83 (#60) - C46-22 (E01)	Ignition switch ON	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection (whether fuel volume is large or small, and whether injection pattern is poor) (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (**Click here**)

OK

11.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

12.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK

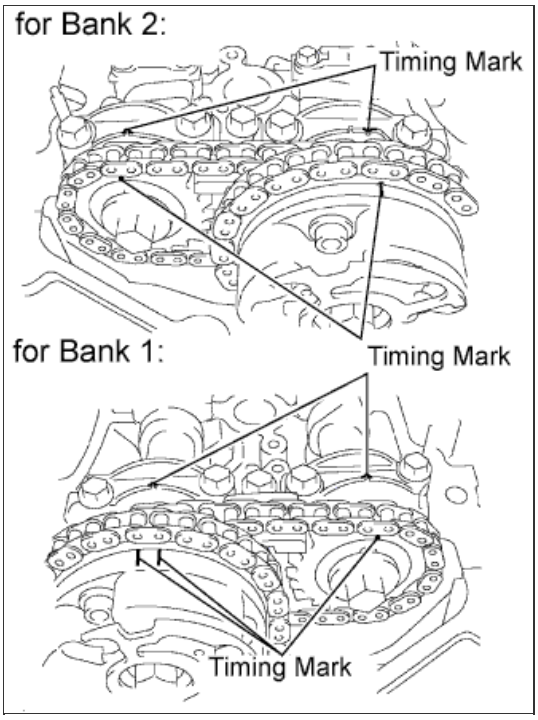
13.CHECK VALVE TIMING

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → ADJUST VALVE TIMING

OK

14.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER, AND REPLACE PARTS AS NECESSARY

OK

15.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Data List twice, when the engine is cold and when it is warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: 80 to 100°C (176 to 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

16.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

REPLACE ECM (Click here)

17.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

OK

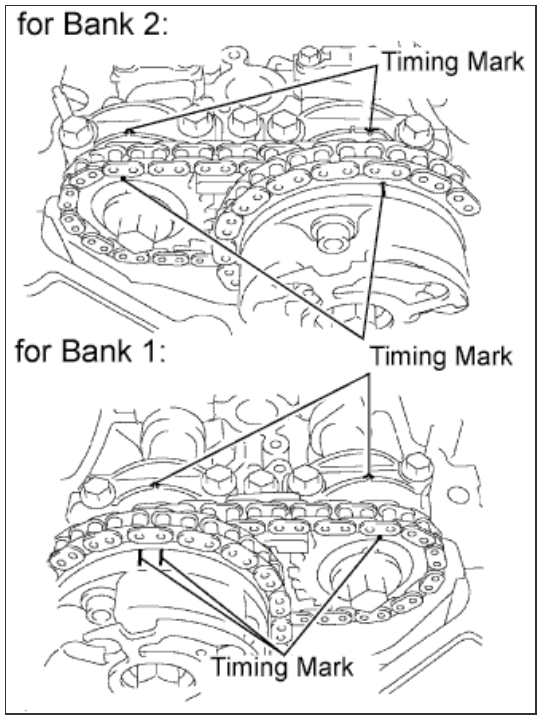
18.CHECK VALVE TIMING

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → **ADJUST VALVE TIMING**

OK

19.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → **CHECK FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER, AND REPLACE PARTS AS NECESSARY**

OK

20.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Data List twice, when the engine is cold and when it is warmed up.

Standard:
With cold engine: Same as ambient air temperature.

With warm engine: 80 to 100°C (176 to 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

21.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

22.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

b. Measure the spark plug electrode gap (Click here).

NG → REPLACE SPARK PLUG (Click here)

OK

23.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head.

c. Install the spark plug to the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check for sparks.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

24.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

25.CHECK HARNESS AND CONNECTOR (ECM - INJECTOR)

a. Disconnect the injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

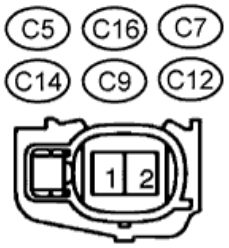
c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

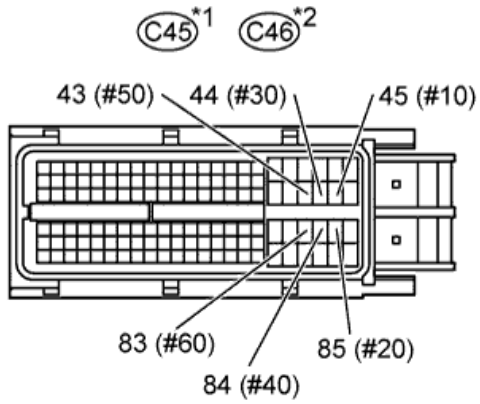
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Body ground	Ignition switch ON	11 to 14 V
No. 2	C16-1 - Body ground	Ignition switch ON	11 to 14 V
No. 3	C7-1 - Body ground	Ignition switch ON	11 to 14 V
No. 4	C14-1 - Body ground	Ignition switch ON	11 to 14 V
No. 5	C9-1 - Body ground	Ignition switch ON	11 to 14 V
No. 6	C12-1 - Body ground	Ignition switch ON	11 to 14 V

d. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector: (to Injector)



Front view of wire harness connector: (to ECM)



*1: for LHD

*2: for RHD

Standard Resistance:

for LHD

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-45 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C45-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C45-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C45-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C45-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C45-83 (#60)	Always	Below 1 Ω

for RHD

Cylinder	Tester Connection	Condition	Specified Condition

No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-45 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C46-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C46-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C46-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C46-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C46-83 (#60)	Always	Below 1 Ω

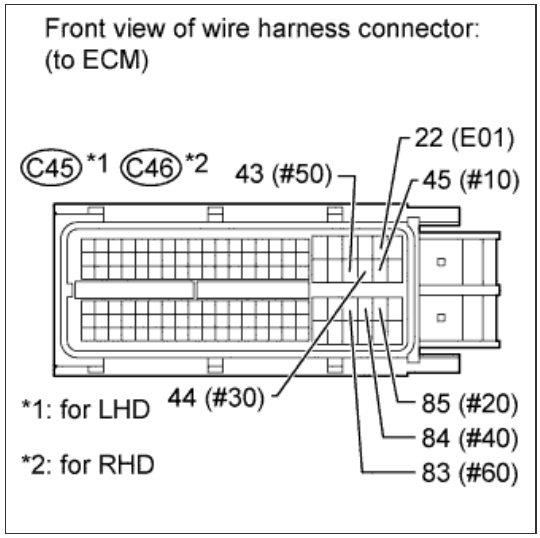
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50 AND/OR #60 VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for LHD

Tester Connection	Switch Condition	Specified Condition
C45-45 (#10) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-85 (#20) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-44 (#30) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-84 (#40) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-43 (#50) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-83 (#60) - C45-22 (E01)	Ignition switch ON	11 to 14 V

for RHD

Tester Connection	Switch Condition	Specified Condition
C46-45 (#10) - C46-22	Ignition switch	

(E01)	ON	11 to 14 V
C46-85 (#20) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-44 (#30) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-84 (#40) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-43 (#50) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-83 (#60) - C46-22 (E01)	Ignition switch ON	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

27.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection (whether fuel volume is large or small, and whether injection pattern is poor) (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (Click here)

OK

28.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (Click here)

OK

REPLACE ECM (Click here)

29.REPLACE SPARK PLUG WITH NORMAL ONE AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the installed spark plug with a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect all the injector connectors.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:

Sparks jump across electrode gap.

NG → Go to step 30

OK

REPLACE SPARK PLUG (Click here)

30.REPLACE IGNITION COIL WITH NORMAL ONE AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the installed ignition coil with a ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect all the injector connectors.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK → REPLACE IGNITION COIL (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

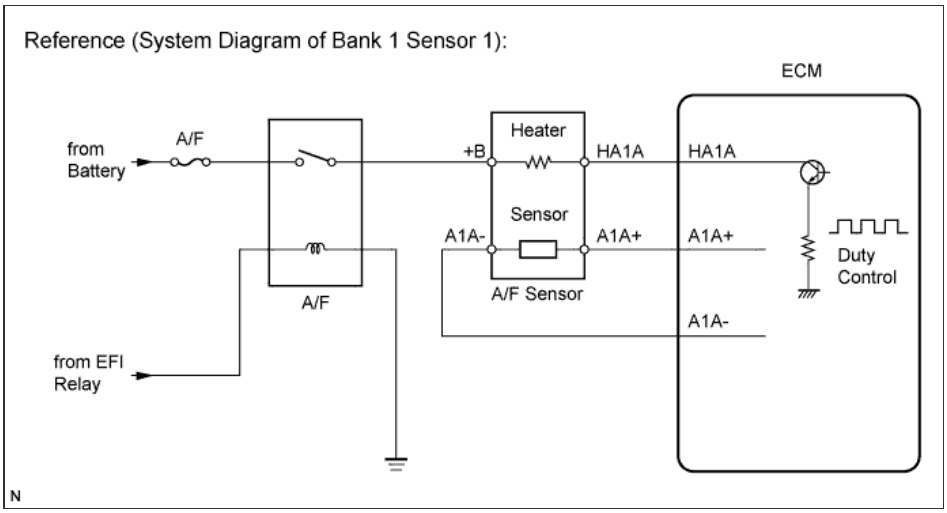
for Preparation Click here

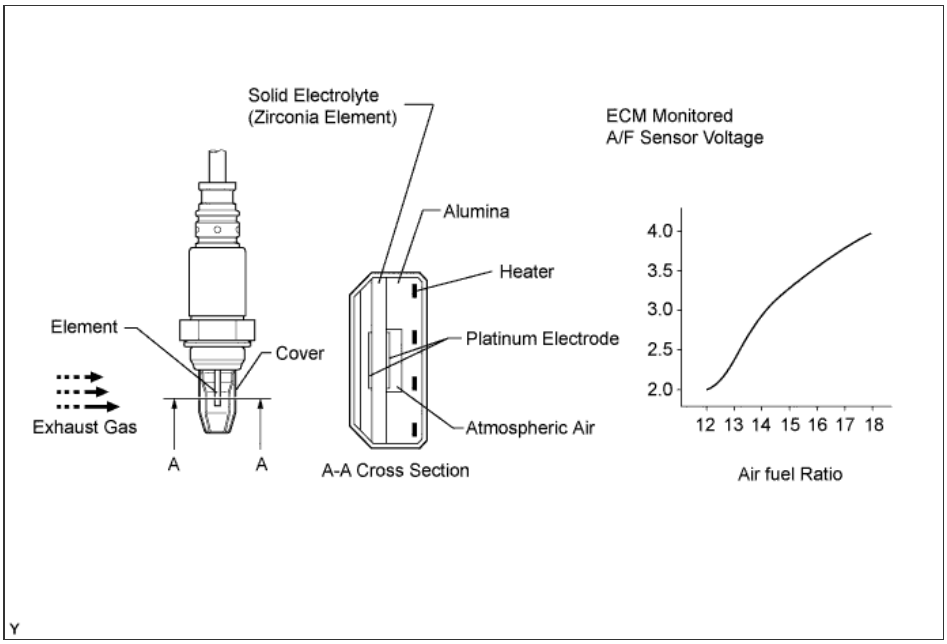
DESCRIPTION

HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air Fuel ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**

The A/F sensor, which is located between the exhaust manifold and catalyst, consists of alloyed metal elements and a heater.
Depending on the engine operating conditions, the heater heats the sensor elements to activate them. Battery voltage is applied to the heater, and the sensor ground is controlled by the ECM using a duty ratio.
The sensor elements convert the oxygen concentration in the exhaust gas into voltage values to output. Based on the voltage, the ECM determines the air fuel ratio and regulates the fuel injection volume depending on the air fuel ratio and engine operating conditions. The voltage changes between 0.6 V and 4.5 V while the engine is running. If the air fuel ratio is lean, which means the oxygen concentration in the exhaust gas is high, the voltage is high. If the air fuel ratio is rich, which means the oxygen concentration in the exhaust gas is low, the voltage is low.





DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals A1A+/A2A+ and A1A-/A2A- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2238 P2241	Any of the following conditions are met (2 trip detection logic): • The A/F sensor output drops while the engine is running. • The voltage at terminal A1A+/A2A+ is 0.5 V or less. • The voltage difference between terminals A1A+/A2A+ and A1A-/A2A- is 0.1 V or less.	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2239 P2242	The A1A+/A2A+ voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2252 P2255	The A1A-/A2A- voltage is 0.5 V or less (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2253 P2256	The A1A-/A2A- voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM

MONITOR DESCRIPTION

These DTCs are stored when there is an open or short in the A/F sensor circuit, or if A/F sensor output drops. To detect these problems, the voltage of the A/F sensor is monitored when turning the ignition switch to ON, and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is out of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in next driving cycle, the MIL will be illuminated and a DTC will be stored.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

CONFIRMATION DRIVING PATTERN

1. Start the engine and wait for 5 minutes or more.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **On the tester, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.**

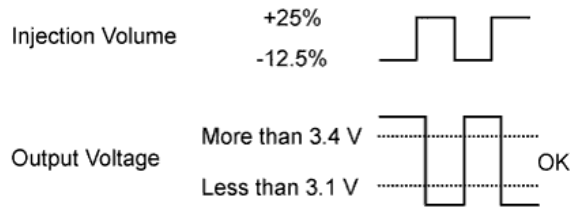
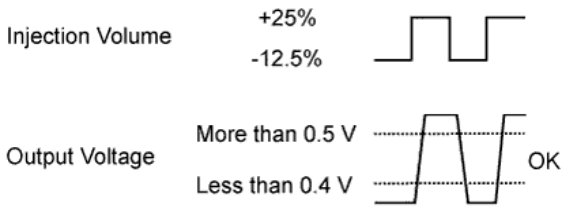
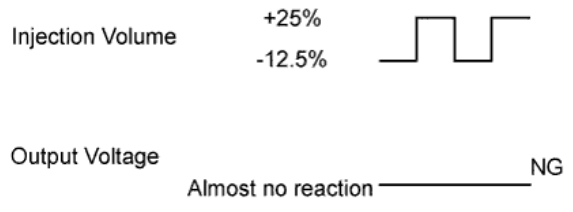
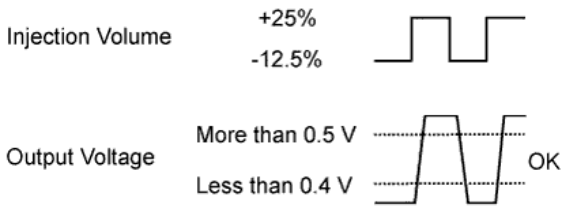
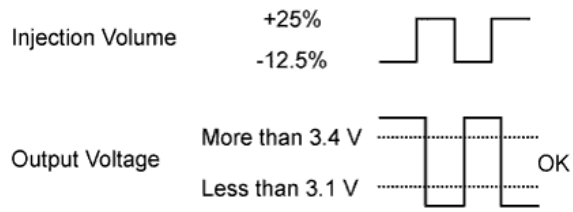
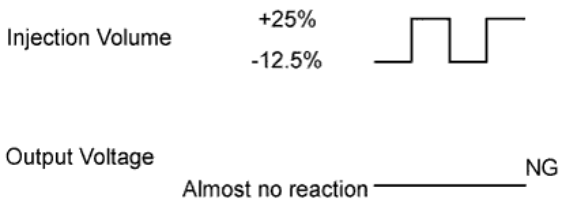
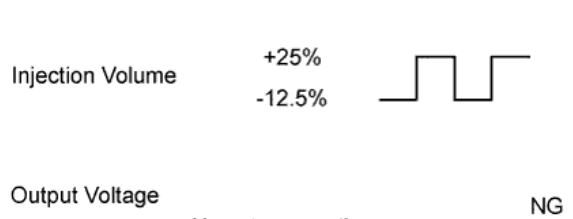
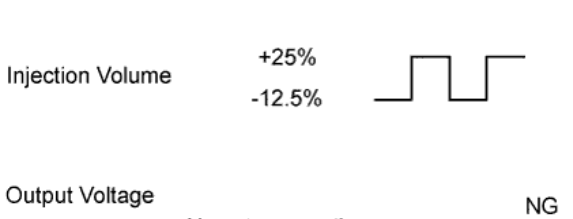
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	more than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	more than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	less than 0.4 V

NOTICE:

The Air Fuel ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the Air Fuel ratio (A/F) sensor connector.

b. Turn the ignition switch to ON.

c. Measure the voltage according to the value(s) in the table below.

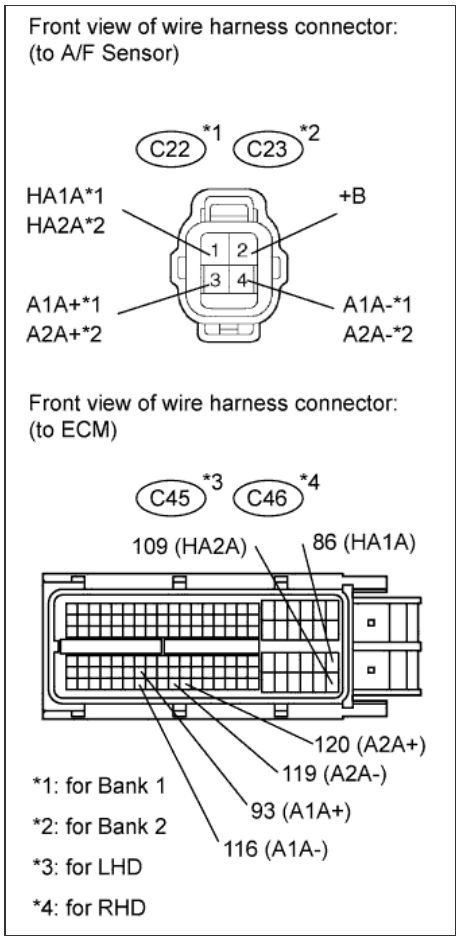
Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Ignition switch ON	11 to 14 V
C23-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

d. Turn the ignition switch off.

e. Disconnect the ECM connector.

f. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-93 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-116 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-120 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-119 (A2A-)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω

C22-3 (A1A+) - C46-93 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-116 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-120 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-119 (A2A-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-93 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-116 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-120 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-119 (A2A-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-93 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-116 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-120 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-119 (A2A-) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

4.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read the pending DTCs.

Result

Result	Proceed to
No output	A
P2237, P2240, P2238, P2241, P2239, P2242, P2252, P2255, P2253 or P2256 output	B

B

REPLACE ECM (Click here)

A

END

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

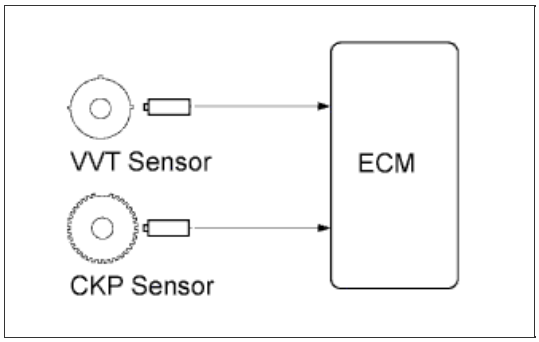
DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

DTC P0306 Cylinder 6 Misfire Detected

for Preparation Click here

DESCRIPTION

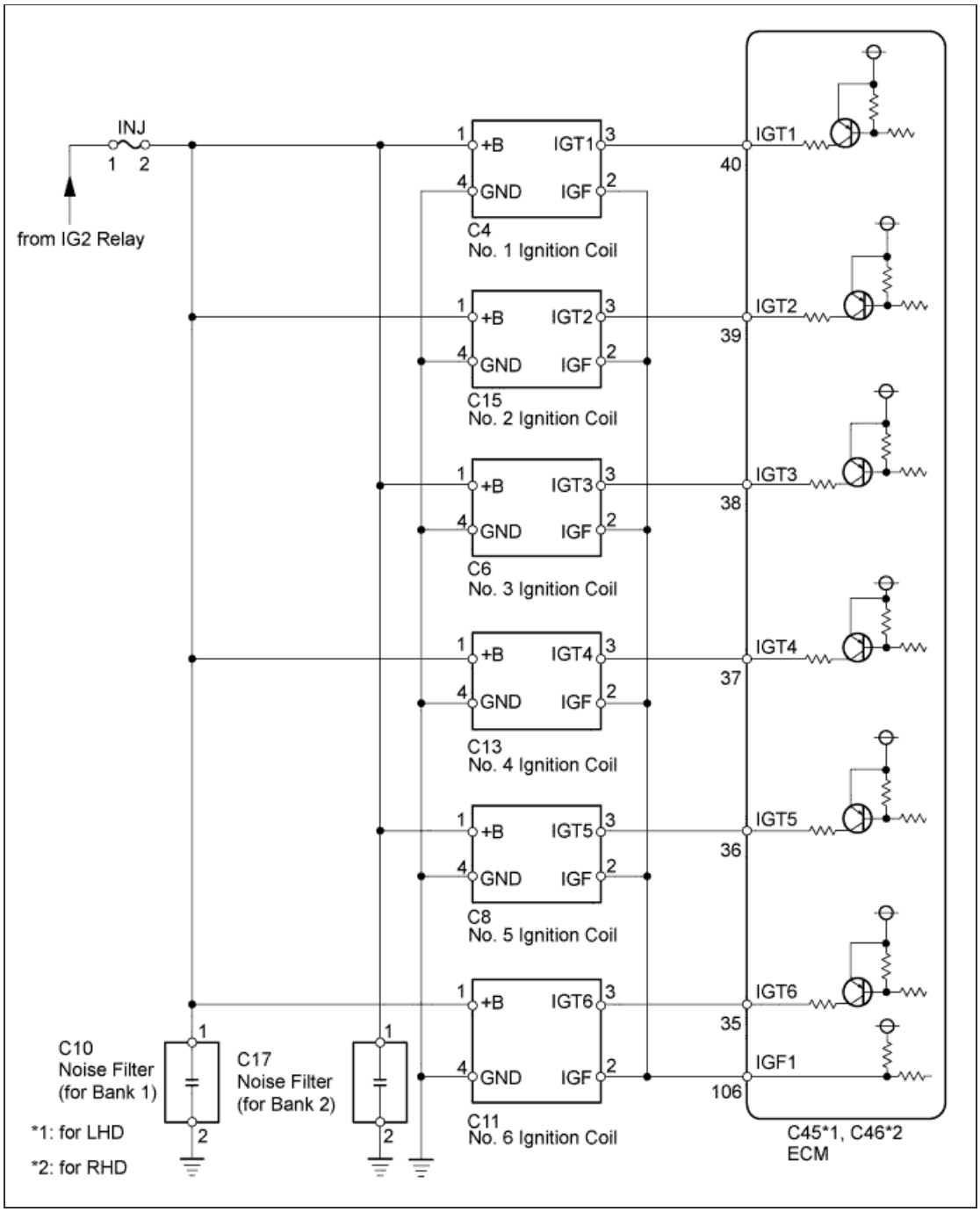


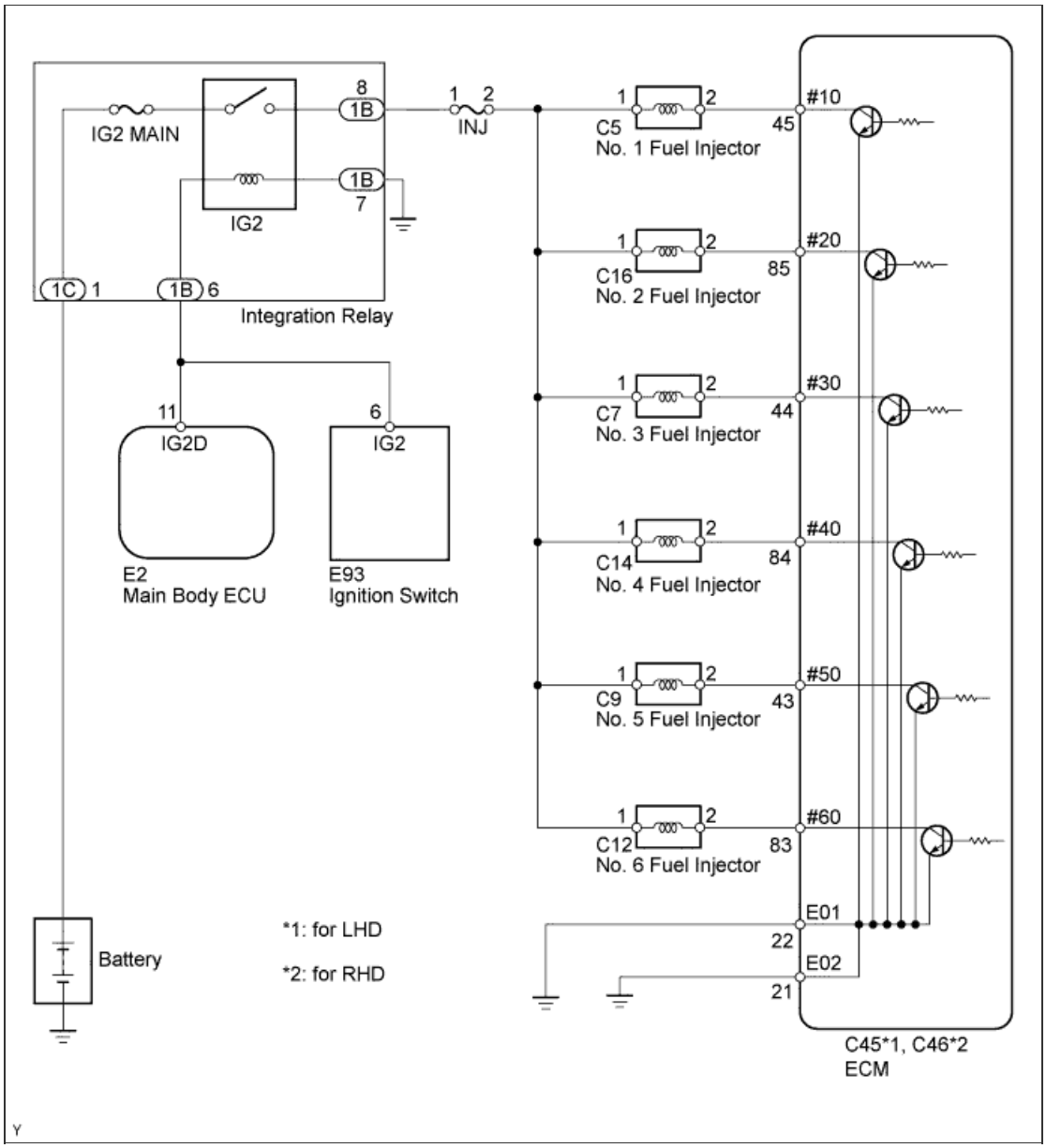
When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. High HC concentration levels can cause an increase in exhaust emission levels. Extremely high concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent this increase in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire count. When the temperature of the TWC reaches the point of thermal degradation, the ECM blinks the MIL. To monitor misfires, the ECM uses both the VVT sensor and the Crankshaft Position (CKP) sensor. The VVT sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted when the crankshaft rotation speed variations exceed predetermined thresholds. If the misfire count exceeds the threshold levels, the ECM illuminates the MIL and stores a DTC.

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A misfire occurs that may damage the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	• Open or short in engine wire harness • Connector connections • Vacuum hose connections • Ignition system • Injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve clearance • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306	Misfiring of specific cylinder occurs and one of following conditions below is detected (2 trip detection logic): • A misfire occurs that may damage the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

WIRING DIAGRAM


INJ
1 2
from IG2 Relay
1 +B
IGT1 3
4 GND
IGF 2
C4
No. 1 Ignition Coil
1 +B
IGT2 3
4 GND
IGF 2
C15
No. 2 Ignition Coil
1 +B
IGT3 3
4 GND
IGF 2
C6
No. 3 Ignition Coil
1 +B
IGT4 3
4 GND
IGF 2
C13
No. 4 Ignition Coil
1 +B
IGT5 3
4 GND
IGF 2
C8
No. 5 Ignition Coil
1 +B
IGT6 3
4 GND
IGF 2
C11
No. 6 Ignition Coil
IGT1
40
IGT2
39
IGT3
38
IGT4
37
IGT5
36
IGT6
35
IGF1
106
C45*1, C46*2
ECM
C10
Noise Filter
(for Bank 1)
C17
Noise Filter
(for Bank 2)
*1: for LHD
*2: for RHD



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the intelligent tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the intelligent tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire count of each cylinder (Cylinder #1 Misfire Count to Cylinder #6 Misfire Count) with the engine idling. If any misfire count is displayed, skip the following confirmation driving pattern.
7. If no misfire counts are displayed, drive the vehicle several times at the engine speed and engine load, etc., recorded in the freeze frame data.

HINT:

- **In order to store misfire DTCs, drive the vehicle at the engine speed and engine load, etc., recorded in the freeze frame data for the time specified in the table below.**

Engine Speed	Duration
Idling	3.5 minutes or more
1000	3 minutes or more
2000	1.5 minutes or more
3000	1 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

HINT:

Do not turn the ignition switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data are cleared.

9. Record the DTC(s), freeze frame data and misfire count.
10. Turn the ignition switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the ECM as freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the ECM as freeze frame data have been reproduced, one of the following factors can be considered to be a possible cause of the problem:**
    1. **There was insufficient fuel volume in the tank.**
    2. **Improper fuel was used.**
    3. **The spark plugs have been contaminated.**
- **After finishing repairs, check the misfire counts of the cylinders (Cylinder #1 Misfire Count to Cylinder #6 Misfire Count).**
- **Be sure to confirm that no misfiring cylinder DTCs are stored again by conducting the confirmation driving pattern after finishing repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speeds. If misfires occur only in high engine speed areas, only DTC P0300 is stored.**
  In the event of DTC P0300 being present, perform the following operations:
    1. **Clear the DTCs (Click here).**
    2. **Start the engine and conduct the confirmation driving pattern.**
    3. **Read the misfiring rates of each cylinder or DTC(s) using the intelligent tester.**
    4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
    5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not stored.**
- **When one of Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air fuel ratio may be Rich (-20% or less) or Lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is less than 75°C (167°F), the misfire may have occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel can cause body vibration, which may cause misfire DTC(s) to be stored.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

e. Read DTCs.

HINT:

Write down the DTCs.

Result

Display (DTC Output)	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305 and/or P0306	A
P0300, P0301, P0302, P0303, P0304, P0305 and/or P0306 and other DTCs	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305 and P0306 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

3.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is correctly connected and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE

OK

4.READ VALUE USING INTELLIGENT TESTER

(a) Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5 and #6.
(b) Read the value for Cylinder #1 Misfire Count to Cylinder #6 Misfire Count displayed on the intelligent tester. If no misfire counts occur in any cylinders, perform the following procedures:
(1) Start the engine and let it idle.
(2) Move the shift lever to D.
(3) Check the Cylinder #1 Misfire Count to Cylinder #6 Misfire Count.
(4) If misfire counts are still not displayed, perform steps (c) and (d).
(c) Drive the vehicle with the Misfire RPM and Misfire Load noted in the "Read value using intelligent tester (Misfire RPM and Misfire Load)" procedures above.
(d) Read the Cylinder #1 Misfire Count to Cylinder #6 Misfire Count or DTCs displayed on the intelligent tester.

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have equal misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data's record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data's record of Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → Go to step 17

A

5.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

b. Measure the spark plug electrode gap (Click here).

NG → REPLACE SPARK PLUG (Click here)

OK

6.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head.

c. Install the spark plug to the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check for sparks.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK HARNESS AND CONNECTOR (ECM - INJECTOR)

a. Disconnect the injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

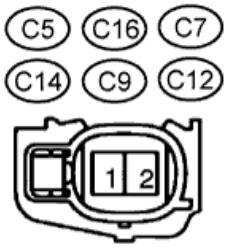
c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

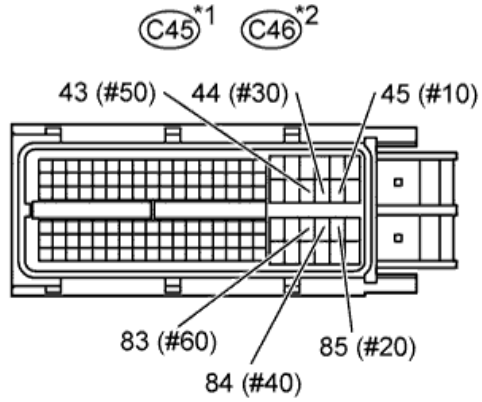
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Body ground	Ignition switch ON	11 to 14 V
No. 2	C16-1 - Body ground	Ignition switch ON	11 to 14 V
No. 3	C7-1 - Body ground	Ignition switch ON	11 to 14 V
No. 4	C14-1 - Body ground	Ignition switch ON	11 to 14 V
No. 5	C9-1 - Body ground	Ignition switch ON	11 to 14 V
No. 6	C12-1 - Body ground	Ignition switch ON	11 to 14 V

d. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance:

for LHD

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-45 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C45-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C45-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C45-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C45-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C45-83 (#60)	Always	Below 1 Ω

for RHD

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-45 (#10)	Always	Below 1 Ω
	C16-2 - Body		

No. 2	ground	Always	10 kΩ or higher
	C16-2 - C46-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C46-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C46-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C46-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C46-83 (#60)	Always	Below 1 Ω

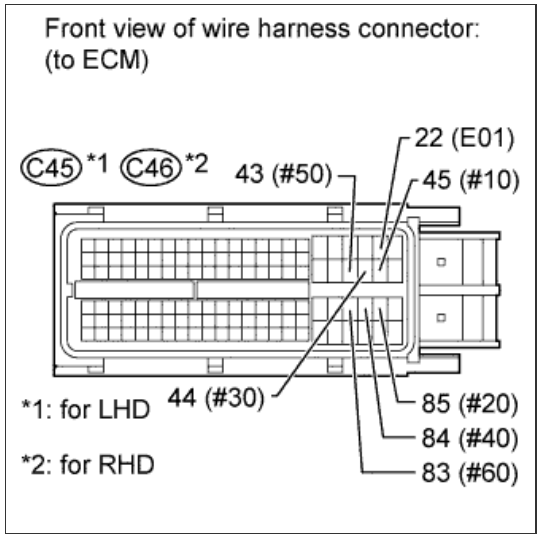
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50 AND/OR #60 VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for LHD

Tester Connection	Switch Condition	Specified Condition
C45-45 (#10) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-85 (#20) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-44 (#30) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-84 (#40) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-43 (#50) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-83 (#60) - C45-22 (E01)	Ignition switch ON	11 to 14 V

for RHD

Tester Connection	Switch Condition	Specified Condition
C46-45 (#10) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-85 (#20) - C46-22 (E01)	Ignition switch ON	11 to 14 V

C46-44 (#30) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-84 (#40) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-43 (#50) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-83 (#60) - C46-22 (E01)	Ignition switch ON	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection (whether fuel volume is large or small, and whether injection pattern is poor) (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (**Click here**)

OK

11.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

12.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK

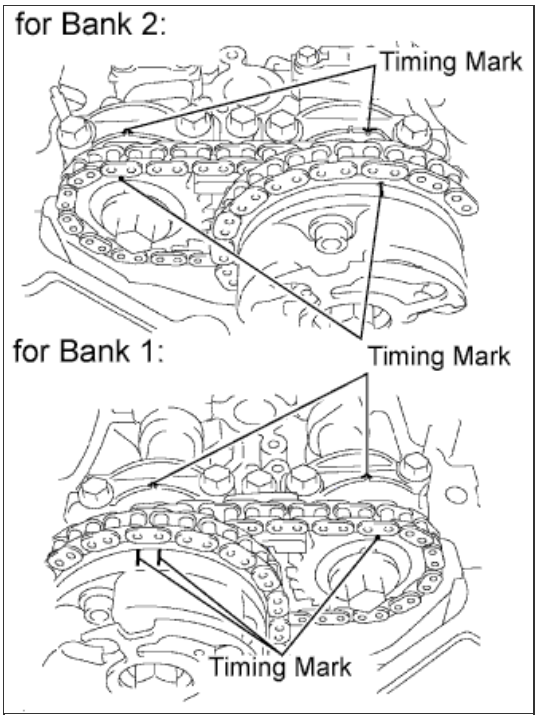
13.CHECK VALVE TIMING

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → ADJUST VALVE TIMING

OK

14.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER, AND REPLACE PARTS AS NECESSARY

OK

15.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Data List twice, when the engine is cold and when it is warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: 80 to 100°C (176 to 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

16.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

REPLACE ECM (Click here)

17.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

OK

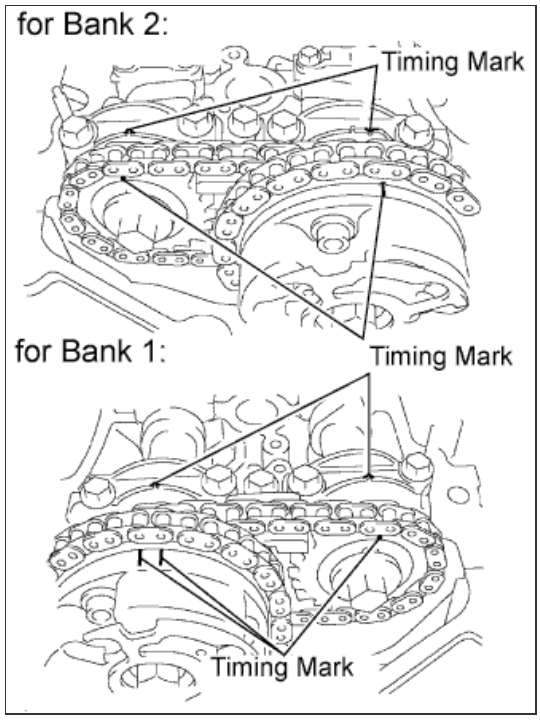
18.CHECK VALVE TIMING

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → **ADJUST VALVE TIMING**

OK

19.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → **CHECK FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER, AND REPLACE PARTS AS NECESSARY**

OK

20.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Data List twice, when the engine is cold and when it is warmed up.

Standard:
With cold engine: Same as ambient air temperature.

With warm engine: 80 to 100°C (176 to 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

21.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

22.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

b. Measure the spark plug electrode gap (Click here).

NG → REPLACE SPARK PLUG (Click here)

OK

23.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head.

c. Install the spark plug to the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check for sparks.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

24.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

25.CHECK HARNESS AND CONNECTOR (ECM - INJECTOR)

a. Disconnect the injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

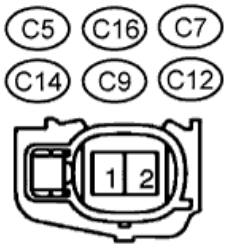
c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

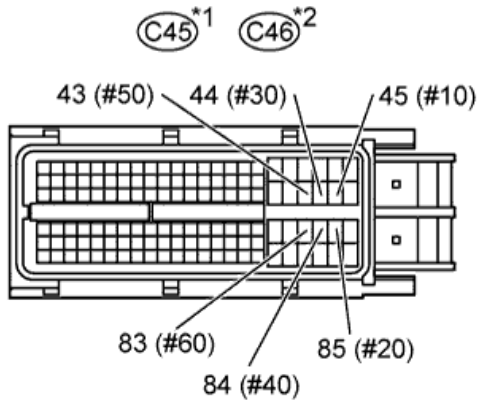
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Body ground	Ignition switch ON	11 to 14 V
No. 2	C16-1 - Body ground	Ignition switch ON	11 to 14 V
No. 3	C7-1 - Body ground	Ignition switch ON	11 to 14 V
No. 4	C14-1 - Body ground	Ignition switch ON	11 to 14 V
No. 5	C9-1 - Body ground	Ignition switch ON	11 to 14 V
No. 6	C12-1 - Body ground	Ignition switch ON	11 to 14 V

d. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector: (to Injector)



Front view of wire harness connector: (to ECM)



*1: for LHD

*2: for RHD

Standard Resistance:

for LHD

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-45 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C45-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C45-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C45-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C45-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C45-83 (#60)	Always	Below 1 Ω

for RHD

Cylinder	Tester Connection	Condition	Specified Condition

No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-45 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C46-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C46-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C46-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C46-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C46-83 (#60)	Always	Below 1 Ω

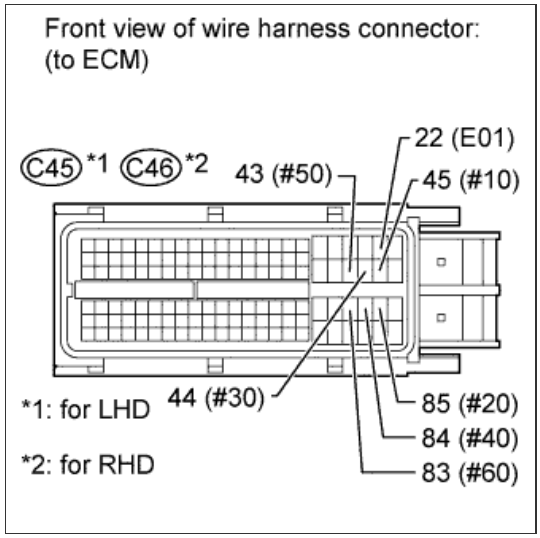
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50 AND/OR #60 VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for LHD

Tester Connection	Switch Condition	Specified Condition
C45-45 (#10) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-85 (#20) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-44 (#30) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-84 (#40) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-43 (#50) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-83 (#60) - C45-22 (E01)	Ignition switch ON	11 to 14 V

for RHD

Tester Connection	Switch Condition	Specified Condition
C46-45 (#10) - C46-22	Ignition switch	

(E01)	ON	11 to 14 V
C46-85 (#20) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-44 (#30) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-84 (#40) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-43 (#50) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-83 (#60) - C46-22 (E01)	Ignition switch ON	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

27.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection (whether fuel volume is large or small, and whether injection pattern is poor) (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (Click here)

OK

28.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (Click here)

OK

REPLACE ECM (Click here)

29.REPLACE SPARK PLUG WITH NORMAL ONE AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the installed spark plug with a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect all the injector connectors.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:

Sparks jump across electrode gap.

NG → Go to step 30

OK

REPLACE SPARK PLUG (Click here)

30.REPLACE IGNITION COIL WITH NORMAL ONE AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the installed ignition coil with a ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect all the injector connectors.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK → REPLACE IGNITION COIL (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

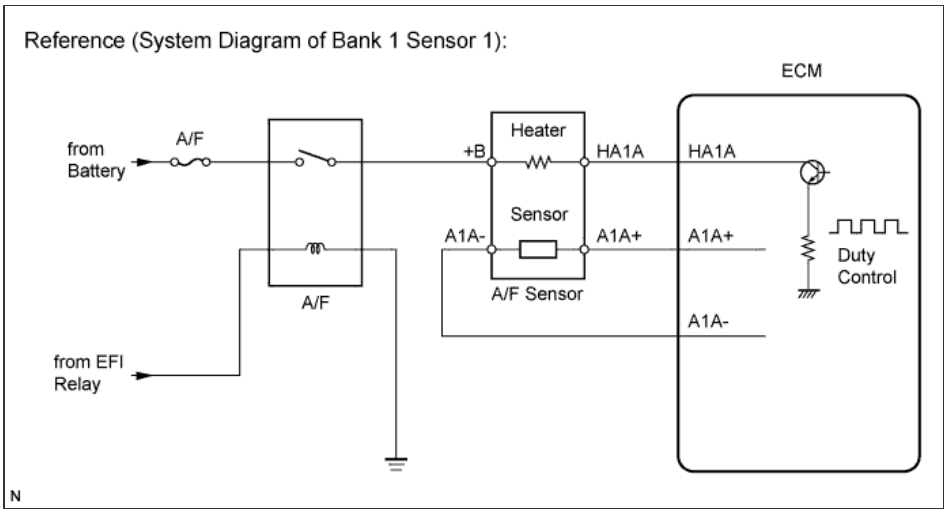
for Preparation Click here

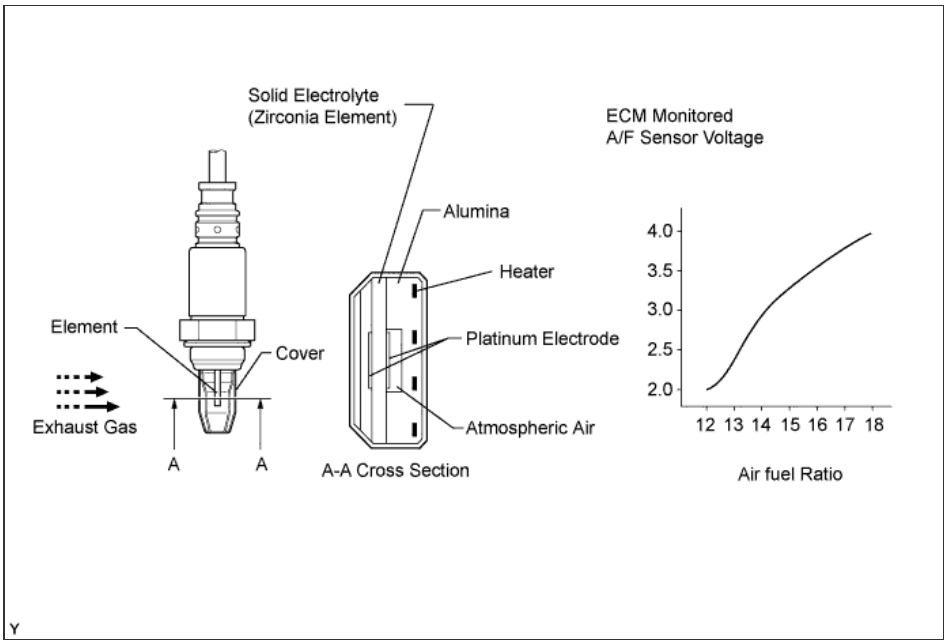
DESCRIPTION

HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air Fuel ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**

The A/F sensor, which is located between the exhaust manifold and catalyst, consists of alloyed metal elements and a heater.
Depending on the engine operating conditions, the heater heats the sensor elements to activate them. Battery voltage is applied to the heater, and the sensor ground is controlled by the ECM using a duty ratio.
The sensor elements convert the oxygen concentration in the exhaust gas into voltage values to output. Based on the voltage, the ECM determines the air fuel ratio and regulates the fuel injection volume depending on the air fuel ratio and engine operating conditions. The voltage changes between 0.6 V and 4.5 V while the engine is running. If the air fuel ratio is lean, which means the oxygen concentration in the exhaust gas is high, the voltage is high. If the air fuel ratio is rich, which means the oxygen concentration in the exhaust gas is low, the voltage is low.





DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals A1A+/A2A+ and A1A-/A2A- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2238 P2241	Any of the following conditions are met (2 trip detection logic): • The A/F sensor output drops while the engine is running. • The voltage at terminal A1A+/A2A+ is 0.5 V or less. • The voltage difference between terminals A1A+/A2A+ and A1A-/A2A- is 0.1 V or less.	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2239 P2242	The A1A+/A2A+ voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2252 P2255	The A1A-/A2A- voltage is 0.5 V or less (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2253 P2256	The A1A-/A2A- voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM

MONITOR DESCRIPTION

These DTCs are stored when there is an open or short in the A/F sensor circuit, or if A/F sensor output drops. To detect these problems, the voltage of the A/F sensor is monitored when turning the ignition switch to ON, and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is out of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in next driving cycle, the MIL will be illuminated and a DTC will be stored.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

CONFIRMATION DRIVING PATTERN

1. Start the engine and wait for 5 minutes or more.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **On the tester, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.**

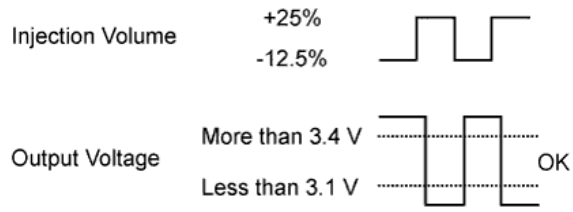
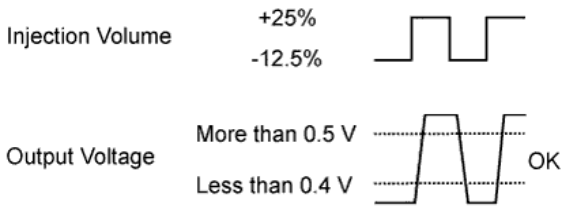
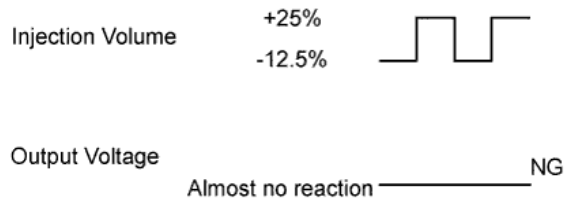
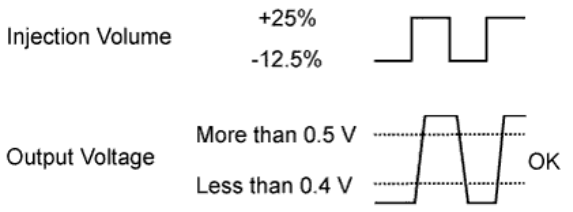
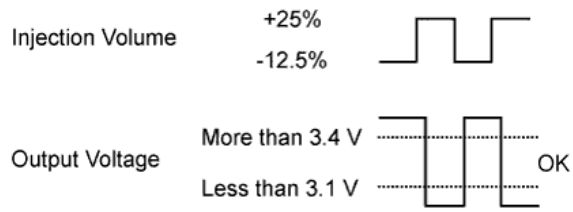
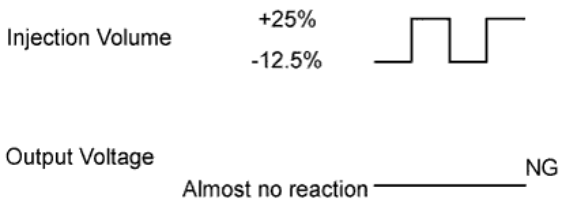
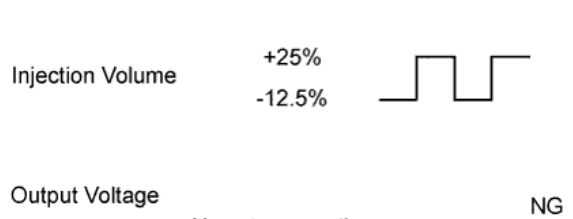
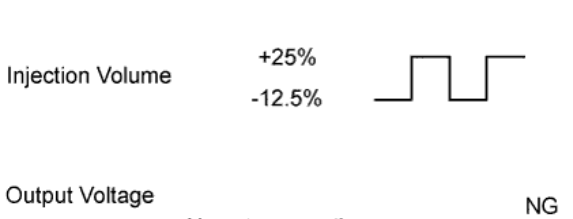
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	more than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	more than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	less than 0.4 V

NOTICE:

The Air Fuel ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the Air Fuel ratio (A/F) sensor connector.

b. Turn the ignition switch to ON.

c. Measure the voltage according to the value(s) in the table below.

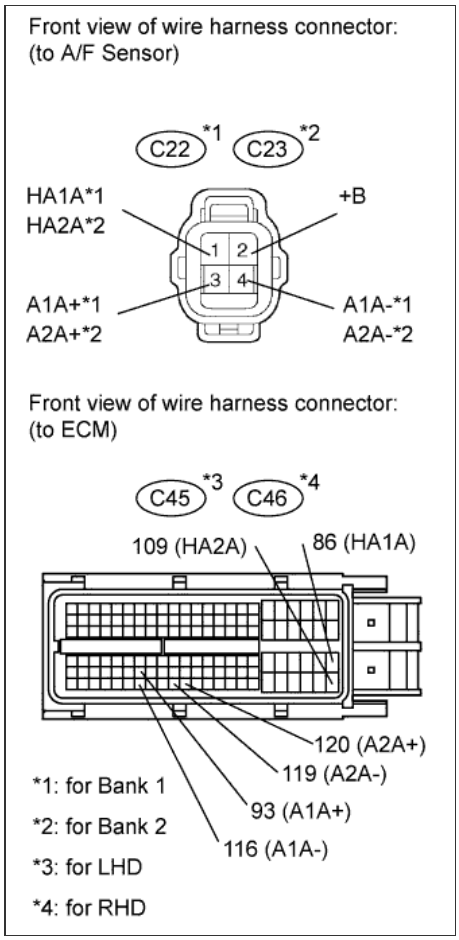
Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Ignition switch ON	11 to 14 V
C23-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

d. Turn the ignition switch off.

e. Disconnect the ECM connector.

f. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-93 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-116 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-120 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-119 (A2A-)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω

C22-3 (A1A+) - C46-93 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-116 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-120 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-119 (A2A-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-93 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-116 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-120 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-119 (A2A-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-93 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-116 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-120 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-119 (A2A-) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

4.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read the pending DTCs.

Result

Result	Proceed to
No output	A
P2237, P2240, P2238, P2241, P2239, P2242, P2252, P2255, P2253 or P2256 output	B

B

REPLACE ECM (Click here)

A

END

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

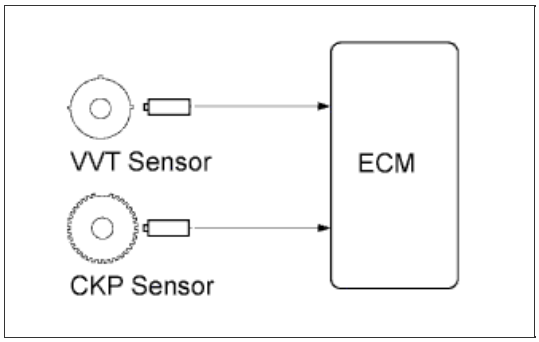
DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

DTC P0306 Cylinder 6 Misfire Detected

for Preparation Click here

DESCRIPTION

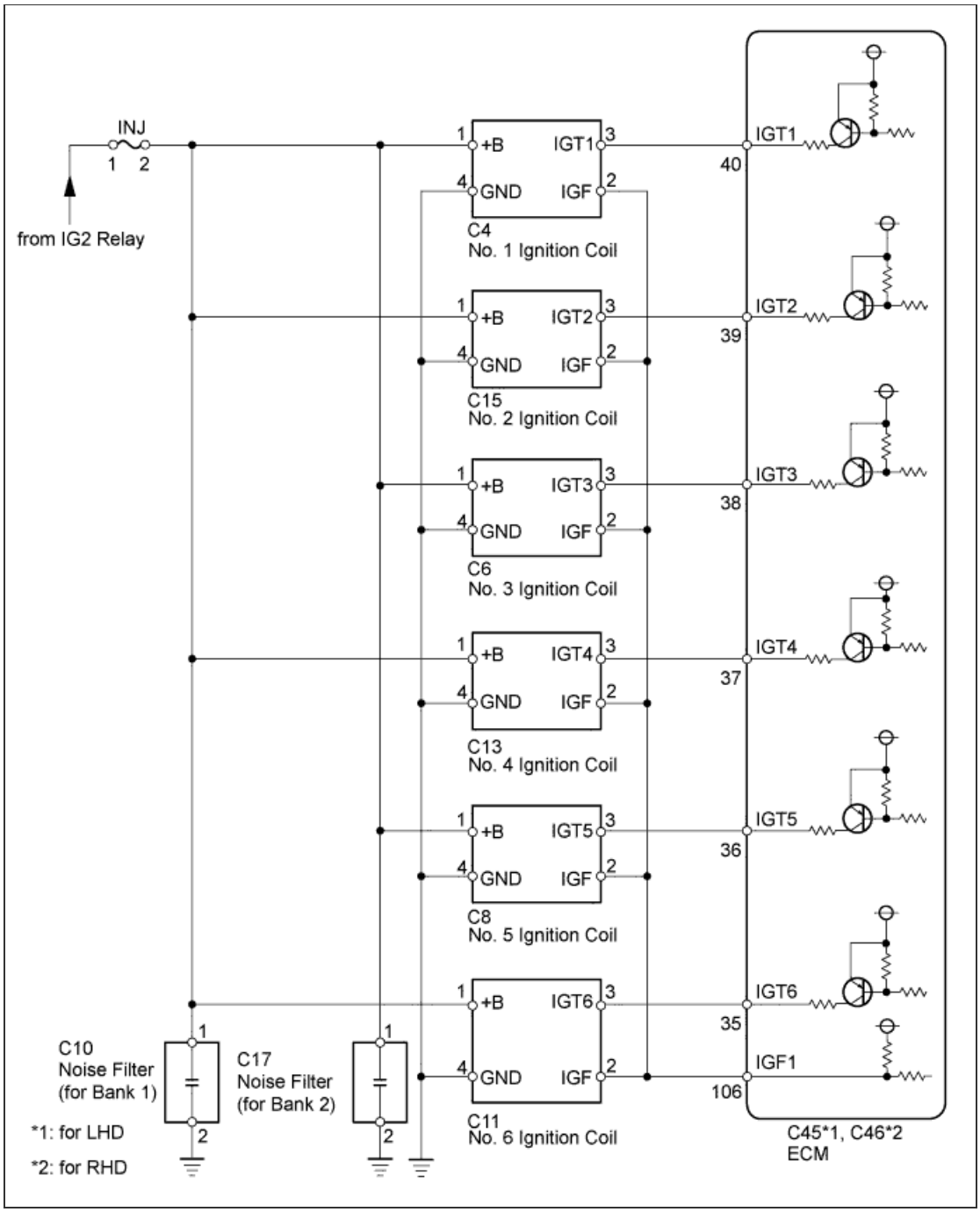


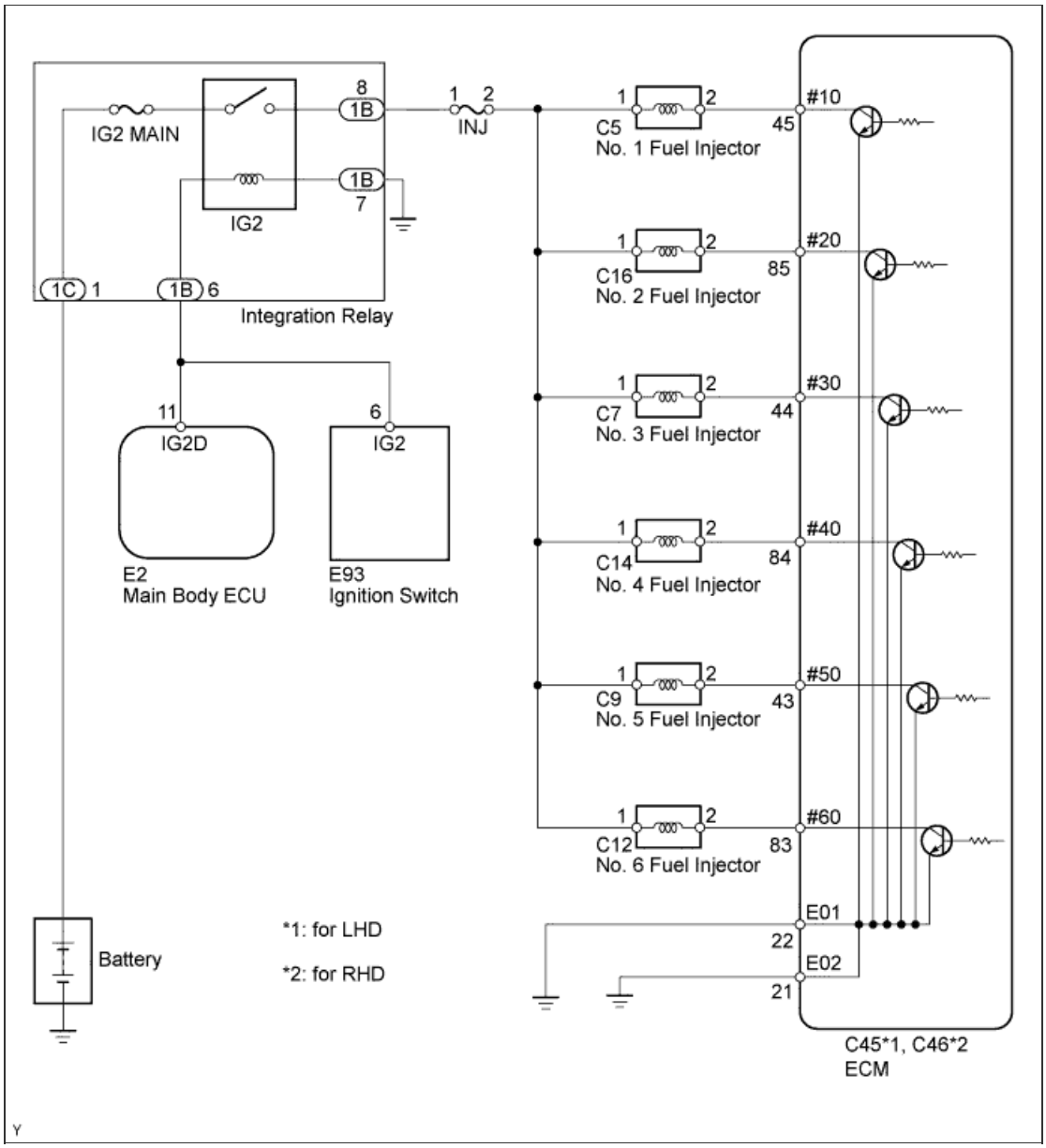
When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. High HC concentration levels can cause an increase in exhaust emission levels. Extremely high concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent this increase in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire count. When the temperature of the TWC reaches the point of thermal degradation, the ECM blinks the MIL. To monitor misfires, the ECM uses both the VVT sensor and the Crankshaft Position (CKP) sensor. The VVT sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted when the crankshaft rotation speed variations exceed predetermined thresholds. If the misfire count exceeds the threshold levels, the ECM illuminates the MIL and stores a DTC.

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A misfire occurs that may damage the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	• Open or short in engine wire harness • Connector connections • Vacuum hose connections • Ignition system • Injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve clearance • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306	Misfiring of specific cylinder occurs and one of following conditions below is detected (2 trip detection logic): • A misfire occurs that may damage the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

WIRING DIAGRAM


INJ
1 2
from IG2 Relay
1 +B
IGT1 3
4 GND
IGF 2
C4
No. 1 Ignition Coil
1 +B
IGT2 3
4 GND
IGF 2
C15
No. 2 Ignition Coil
1 +B
IGT3 3
4 GND
IGF 2
C6
No. 3 Ignition Coil
1 +B
IGT4 3
4 GND
IGF 2
C13
No. 4 Ignition Coil
1 +B
IGT5 3
4 GND
IGF 2
C8
No. 5 Ignition Coil
1 +B
IGT6 3
4 GND
IGF 2
C11
No. 6 Ignition Coil
IGT1
40
IGT2
39
IGT3
38
IGT4
37
IGT5
36
IGT6
35
IGF1
106
C45*1, C46*2
ECM
C10
Noise Filter
(for Bank 1)
C17
Noise Filter
(for Bank 2)
*1: for LHD
*2: for RHD



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the intelligent tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the intelligent tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire count of each cylinder (Cylinder #1 Misfire Count to Cylinder #6 Misfire Count) with the engine idling. If any misfire count is displayed, skip the following confirmation driving pattern.
7. If no misfire counts are displayed, drive the vehicle several times at the engine speed and engine load, etc., recorded in the freeze frame data.

HINT:

- **In order to store misfire DTCs, drive the vehicle at the engine speed and engine load, etc., recorded in the freeze frame data for the time specified in the table below.**

Engine Speed	Duration
Idling	3.5 minutes or more
1000	3 minutes or more
2000	1.5 minutes or more
3000	1 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

HINT:

Do not turn the ignition switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data are cleared.

9. Record the DTC(s), freeze frame data and misfire count.
10. Turn the ignition switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the ECM as freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the ECM as freeze frame data have been reproduced, one of the following factors can be considered to be a possible cause of the problem:**
    1. **There was insufficient fuel volume in the tank.**
    2. **Improper fuel was used.**
    3. **The spark plugs have been contaminated.**
- **After finishing repairs, check the misfire counts of the cylinders (Cylinder #1 Misfire Count to Cylinder #6 Misfire Count).**
- **Be sure to confirm that no misfiring cylinder DTCs are stored again by conducting the confirmation driving pattern after finishing repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speeds. If misfires occur only in high engine speed areas, only DTC P0300 is stored.**
  In the event of DTC P0300 being present, perform the following operations:
    1. **Clear the DTCs (Click here).**
    2. **Start the engine and conduct the confirmation driving pattern.**
    3. **Read the misfiring rates of each cylinder or DTC(s) using the intelligent tester.**
    4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
    5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not stored.**
- **When one of Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air fuel ratio may be Rich (-20% or less) or Lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is less than 75°C (167°F), the misfire may have occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel can cause body vibration, which may cause misfire DTC(s) to be stored.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

e. Read DTCs.

HINT:

Write down the DTCs.

Result

Display (DTC Output)	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305 and/or P0306	A
P0300, P0301, P0302, P0303, P0304, P0305 and/or P0306 and other DTCs	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305 and P0306 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

3.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is correctly connected and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE

OK

4.READ VALUE USING INTELLIGENT TESTER

(a) Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5 and #6.
(b) Read the value for Cylinder #1 Misfire Count to Cylinder #6 Misfire Count displayed on the intelligent tester. If no misfire counts occur in any cylinders, perform the following procedures:
(1) Start the engine and let it idle.
(2) Move the shift lever to D.
(3) Check the Cylinder #1 Misfire Count to Cylinder #6 Misfire Count.
(4) If misfire counts are still not displayed, perform steps (c) and (d).
(c) Drive the vehicle with the Misfire RPM and Misfire Load noted in the "Read value using intelligent tester (Misfire RPM and Misfire Load)" procedures above.
(d) Read the Cylinder #1 Misfire Count to Cylinder #6 Misfire Count or DTCs displayed on the intelligent tester.

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have equal misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data's record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data's record of Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → Go to step 17

A

5.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

b. Measure the spark plug electrode gap (Click here).

NG → REPLACE SPARK PLUG (Click here)

OK

6.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head.

c. Install the spark plug to the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check for sparks.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK HARNESS AND CONNECTOR (ECM - INJECTOR)

a. Disconnect the injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

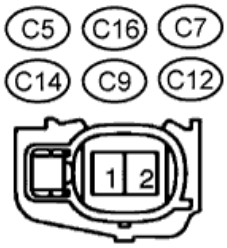
c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

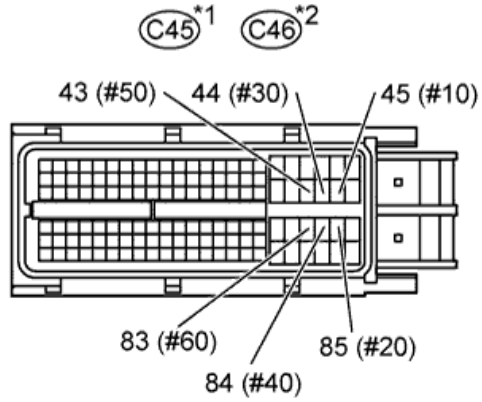
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Body ground	Ignition switch ON	11 to 14 V
No. 2	C16-1 - Body ground	Ignition switch ON	11 to 14 V
No. 3	C7-1 - Body ground	Ignition switch ON	11 to 14 V
No. 4	C14-1 - Body ground	Ignition switch ON	11 to 14 V
No. 5	C9-1 - Body ground	Ignition switch ON	11 to 14 V
No. 6	C12-1 - Body ground	Ignition switch ON	11 to 14 V

d. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance:

for LHD

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-45 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C45-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C45-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C45-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C45-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C45-83 (#60)	Always	Below 1 Ω

for RHD

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-45 (#10)	Always	Below 1 Ω
	C16-2 - Body		

No. 2	ground	Always	10 kΩ or higher
	C16-2 - C46-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C46-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C46-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C46-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C46-83 (#60)	Always	Below 1 Ω

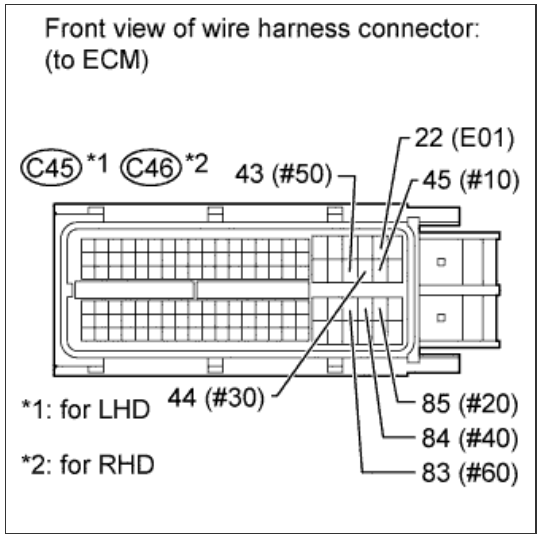
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50 AND/OR #60 VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for LHD

Tester Connection	Switch Condition	Specified Condition
C45-45 (#10) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-85 (#20) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-44 (#30) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-84 (#40) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-43 (#50) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-83 (#60) - C45-22 (E01)	Ignition switch ON	11 to 14 V

for RHD

Tester Connection	Switch Condition	Specified Condition
C46-45 (#10) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-85 (#20) - C46-22 (E01)	Ignition switch ON	11 to 14 V

C46-44 (#30) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-84 (#40) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-43 (#50) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-83 (#60) - C46-22 (E01)	Ignition switch ON	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection (whether fuel volume is large or small, and whether injection pattern is poor) (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (**Click here**)

OK

11.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

12.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK

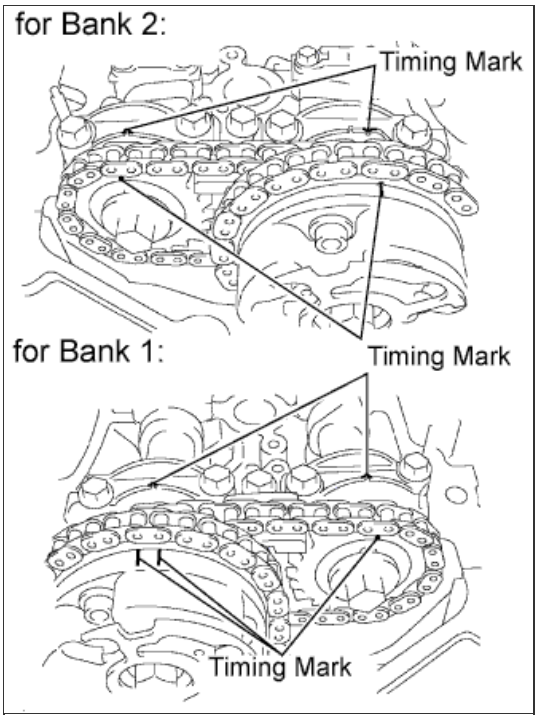
13.CHECK VALVE TIMING

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → ADJUST VALVE TIMING

OK

14.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER, AND REPLACE PARTS AS NECESSARY

OK

15.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Data List twice, when the engine is cold and when it is warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: 80 to 100°C (176 to 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

16.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

REPLACE ECM (Click here)

17.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

OK

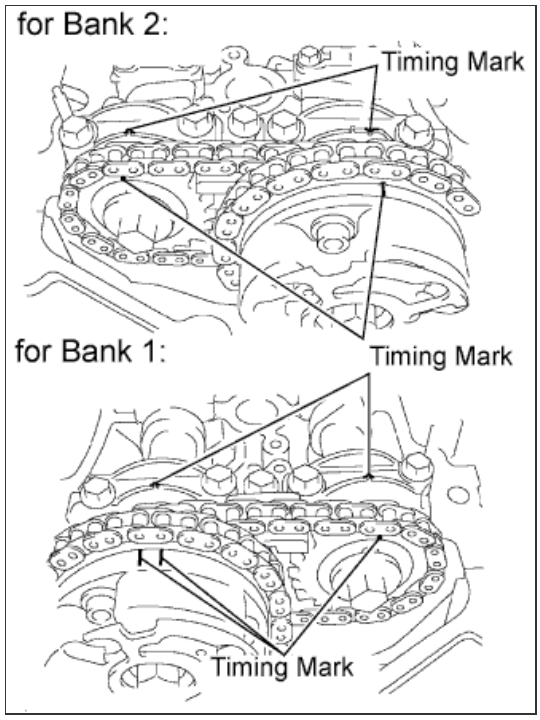
18.CHECK VALVE TIMING

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → **ADJUST VALVE TIMING**

OK

19.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → **CHECK FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER, AND REPLACE PARTS AS NECESSARY**

OK

20.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Data List twice, when the engine is cold and when it is warmed up.

Standard:
With cold engine: Same as ambient air temperature.

With warm engine: 80 to 100°C (176 to 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

21.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

22.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

b. Measure the spark plug electrode gap (Click here).

NG → REPLACE SPARK PLUG (Click here)

OK

23.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head.

c. Install the spark plug to the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check for sparks.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

24.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

25.CHECK HARNESS AND CONNECTOR (ECM - INJECTOR)

a. Disconnect the injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

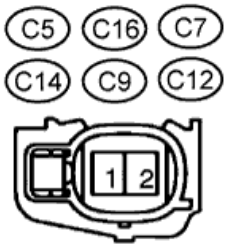
c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

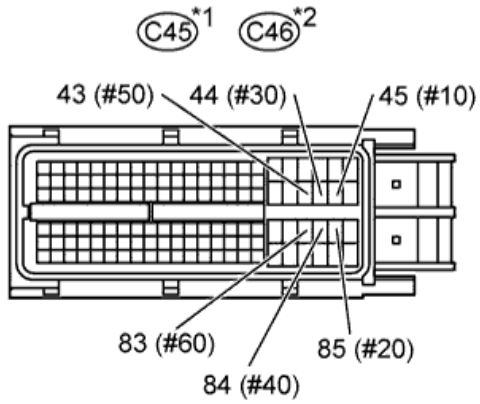
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Body ground	Ignition switch ON	11 to 14 V
No. 2	C16-1 - Body ground	Ignition switch ON	11 to 14 V
No. 3	C7-1 - Body ground	Ignition switch ON	11 to 14 V
No. 4	C14-1 - Body ground	Ignition switch ON	11 to 14 V
No. 5	C9-1 - Body ground	Ignition switch ON	11 to 14 V
No. 6	C12-1 - Body ground	Ignition switch ON	11 to 14 V

d. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector: (to Injector)



Front view of wire harness connector: (to ECM)



*1: for LHD

*2: for RHD

Standard Resistance:

for LHD

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-45 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C45-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C45-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C45-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C45-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C45-83 (#60)	Always	Below 1 Ω

for RHD

Cylinder	Tester Connection	Condition	Specified Condition

No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-45 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C46-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C46-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C46-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C46-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C46-83 (#60)	Always	Below 1 Ω

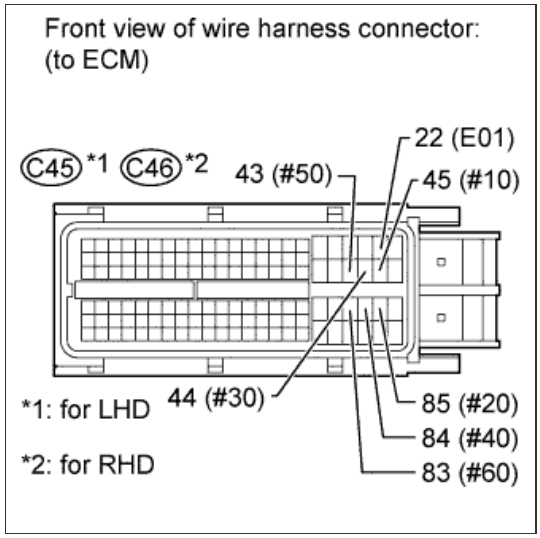
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50 AND/OR #60 VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for LHD

Tester Connection	Switch Condition	Specified Condition
C45-45 (#10) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-85 (#20) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-44 (#30) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-84 (#40) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-43 (#50) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-83 (#60) - C45-22 (E01)	Ignition switch ON	11 to 14 V

for RHD

Tester Connection	Switch Condition	Specified Condition
C46-45 (#10) - C46-22	Ignition switch	

(E01)	ON	11 to 14 V
C46-85 (#20) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-44 (#30) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-84 (#40) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-43 (#50) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-83 (#60) - C46-22 (E01)	Ignition switch ON	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

27.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection (whether fuel volume is large or small, and whether injection pattern is poor) (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (Click here)

OK

28.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (Click here)

OK

REPLACE ECM (Click here)

29.REPLACE SPARK PLUG WITH NORMAL ONE AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the installed spark plug with a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect all the injector connectors.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:

Sparks jump across electrode gap.

NG → Go to step 30

OK

REPLACE SPARK PLUG (Click here)

30.REPLACE IGNITION COIL WITH NORMAL ONE AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the installed ignition coil with a ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect all the injector connectors.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK → REPLACE IGNITION COIL (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

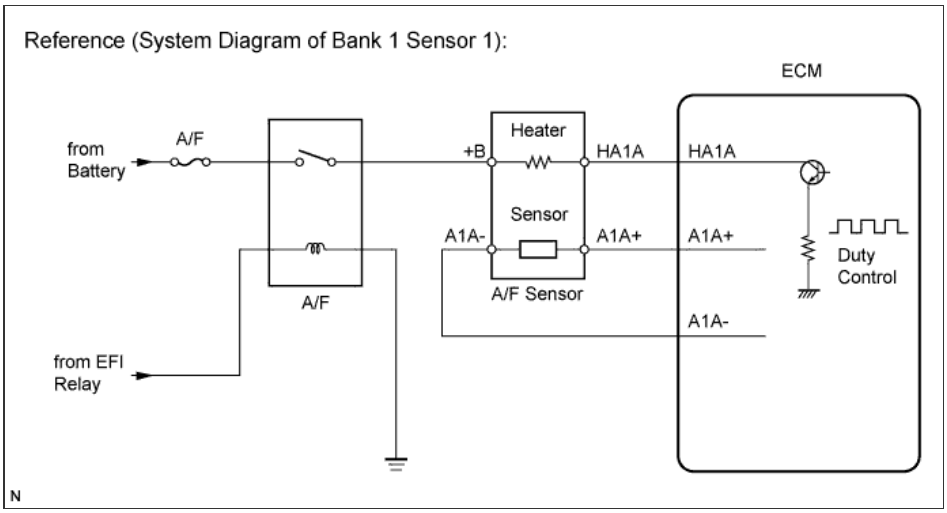
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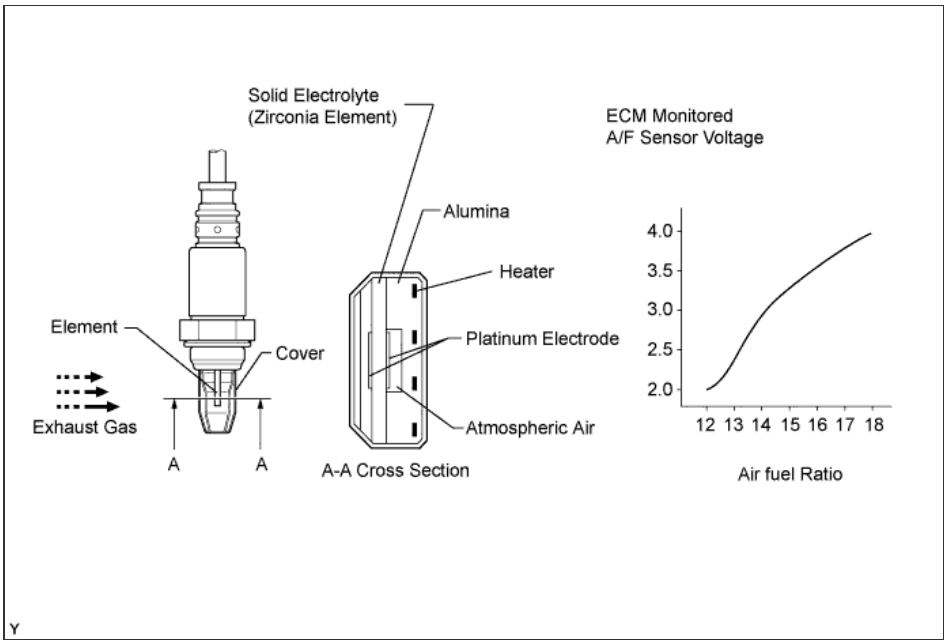
DESCRIPTION

HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air Fuel ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**

The A/F sensor, which is located between the exhaust manifold and catalyst, consists of alloyed metal elements and a heater.
Depending on the engine operating conditions, the heater heats the sensor elements to activate them. Battery voltage is applied to the heater, and the sensor ground is controlled by the ECM using a duty ratio.
The sensor elements convert the oxygen concentration in the exhaust gas into voltage values to output. Based on the voltage, the ECM determines the air fuel ratio and regulates the fuel injection volume depending on the air fuel ratio and engine operating conditions. The voltage changes between 0.6 V and 4.5 V while the engine is running. If the air fuel ratio is lean, which means the oxygen concentration in the exhaust gas is high, the voltage is high. If the air fuel ratio is rich, which means the oxygen concentration in the exhaust gas is low, the voltage is low.





DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals A1A+/A2A+ and A1A-/A2A- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2238 P2241	Any of the following conditions are met (2 trip detection logic): • The A/F sensor output drops while the engine is running. • The voltage at terminal A1A+/A2A+ is 0.5 V or less. • The voltage difference between terminals A1A+/A2A+ and A1A-/A2A- is 0.1 V or less.	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2239 P2242	The A1A+/A2A+ voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2252 P2255	The A1A-/A2A- voltage is 0.5 V or less (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2253 P2256	The A1A-/A2A- voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM

MONITOR DESCRIPTION

These DTCs are stored when there is an open or short in the A/F sensor circuit, or if A/F sensor output drops. To detect these problems, the voltage of the A/F sensor is monitored when turning the ignition switch to ON, and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is out of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in next driving cycle, the MIL will be illuminated and a DTC will be stored.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

CONFIRMATION DRIVING PATTERN

1. Start the engine and wait for 5 minutes or more.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **On the tester, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.**

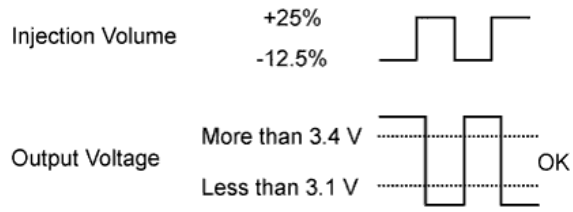
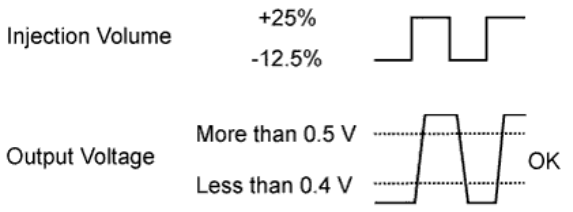
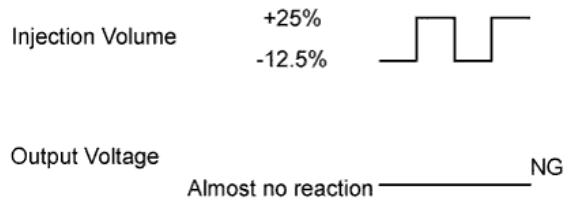
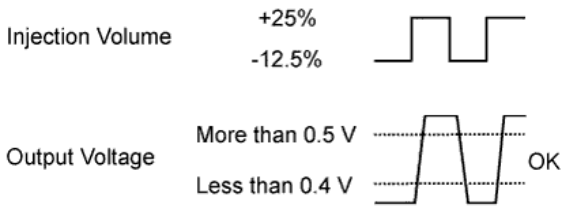
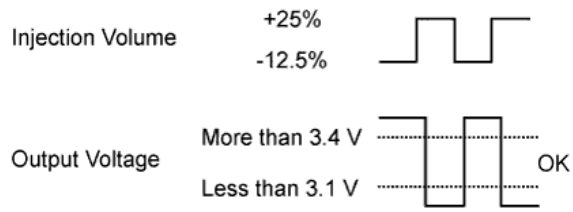
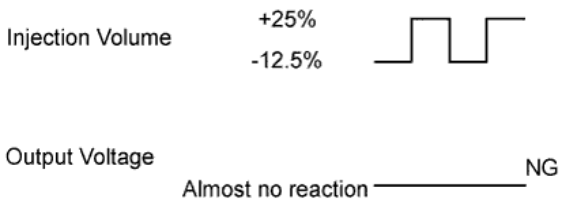
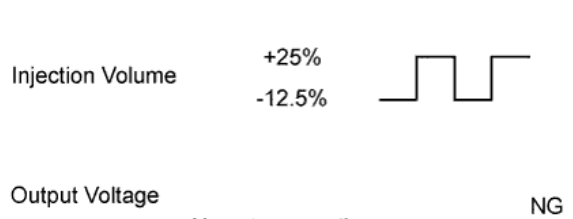
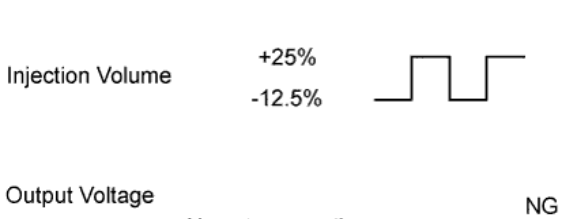
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	more than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	more than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	less than 0.4 V

NOTICE:

The Air Fuel ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the Air Fuel ratio (A/F) sensor connector.

b. Turn the ignition switch to ON.

c. Measure the voltage according to the value(s) in the table below.

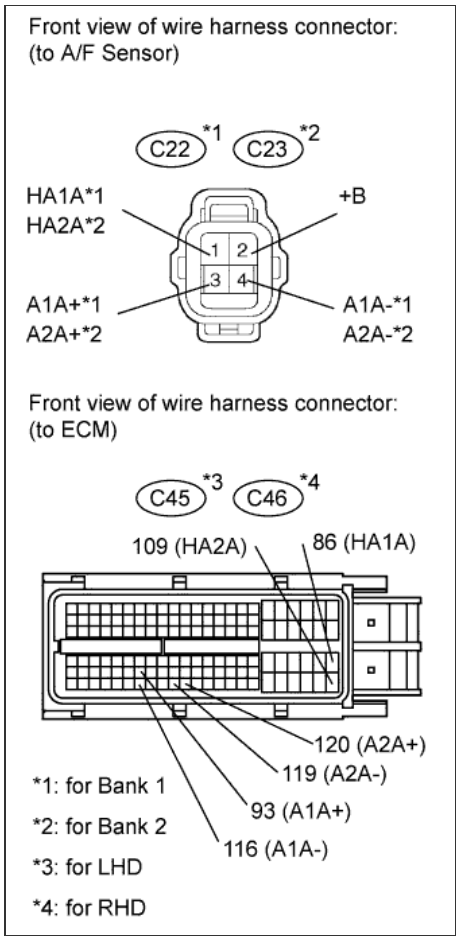
Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Ignition switch ON	11 to 14 V
C23-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

d. Turn the ignition switch off.

e. Disconnect the ECM connector.

f. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-93 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-116 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-120 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-119 (A2A-)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω

C22-3 (A1A+) - C46-93 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-116 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-120 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-119 (A2A-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-93 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-116 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-120 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-119 (A2A-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-93 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-116 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-120 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-119 (A2A-) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

4.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read the pending DTCs.

Result

Result	Proceed to
No output	A
P2237, P2240, P2238, P2241, P2239, P2242, P2252, P2255, P2253 or P2256 output	B

B

REPLACE ECM (Click here)

A

END

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

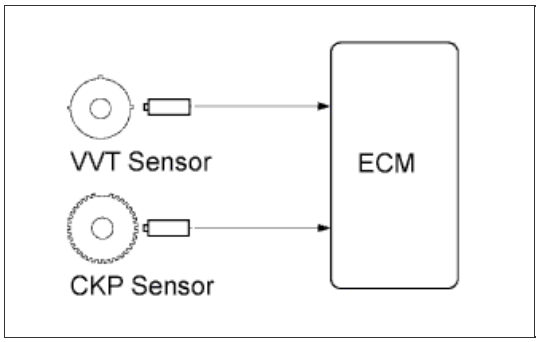
DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

DTC P0306 Cylinder 6 Misfire Detected

for Preparation Click here

DESCRIPTION

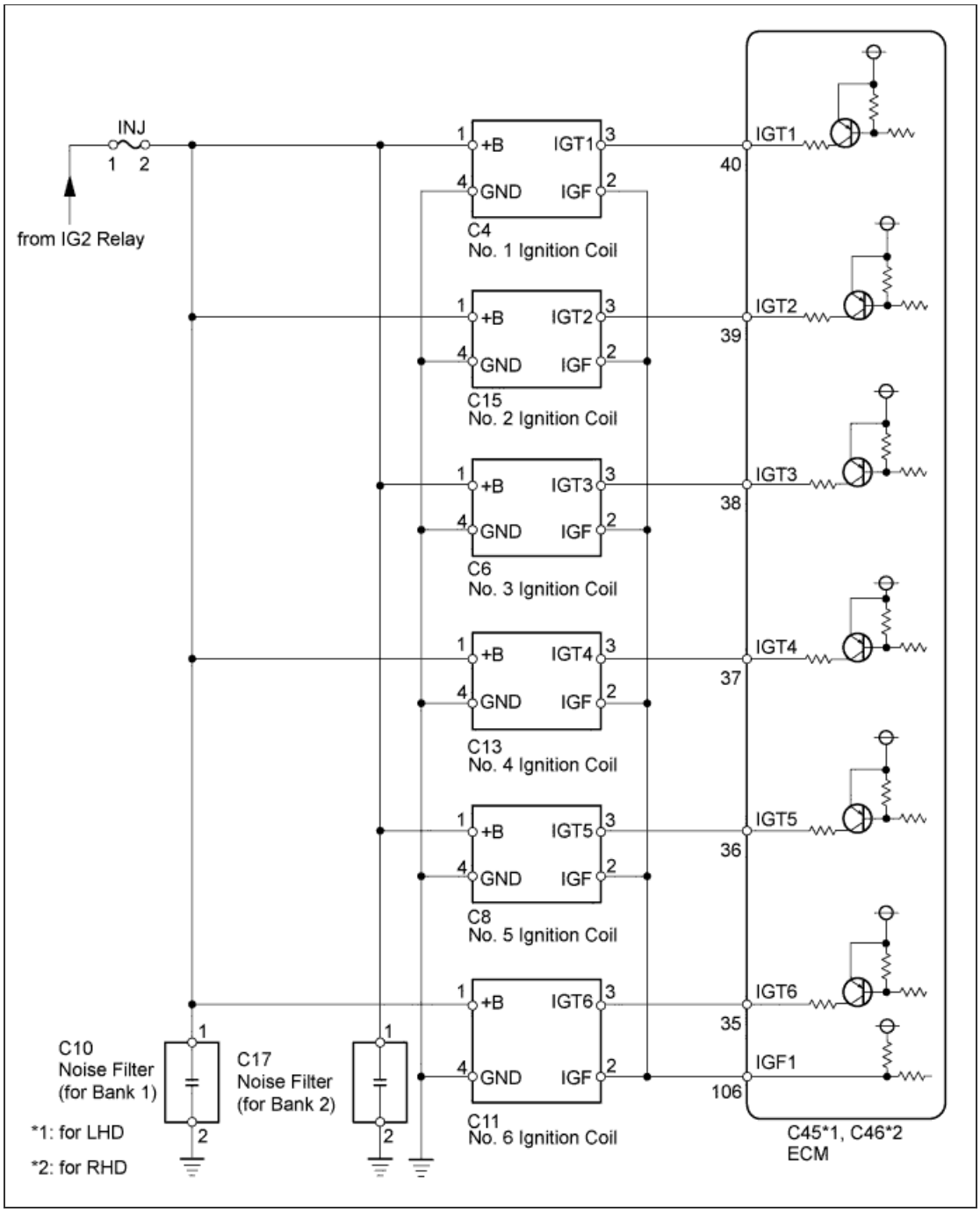


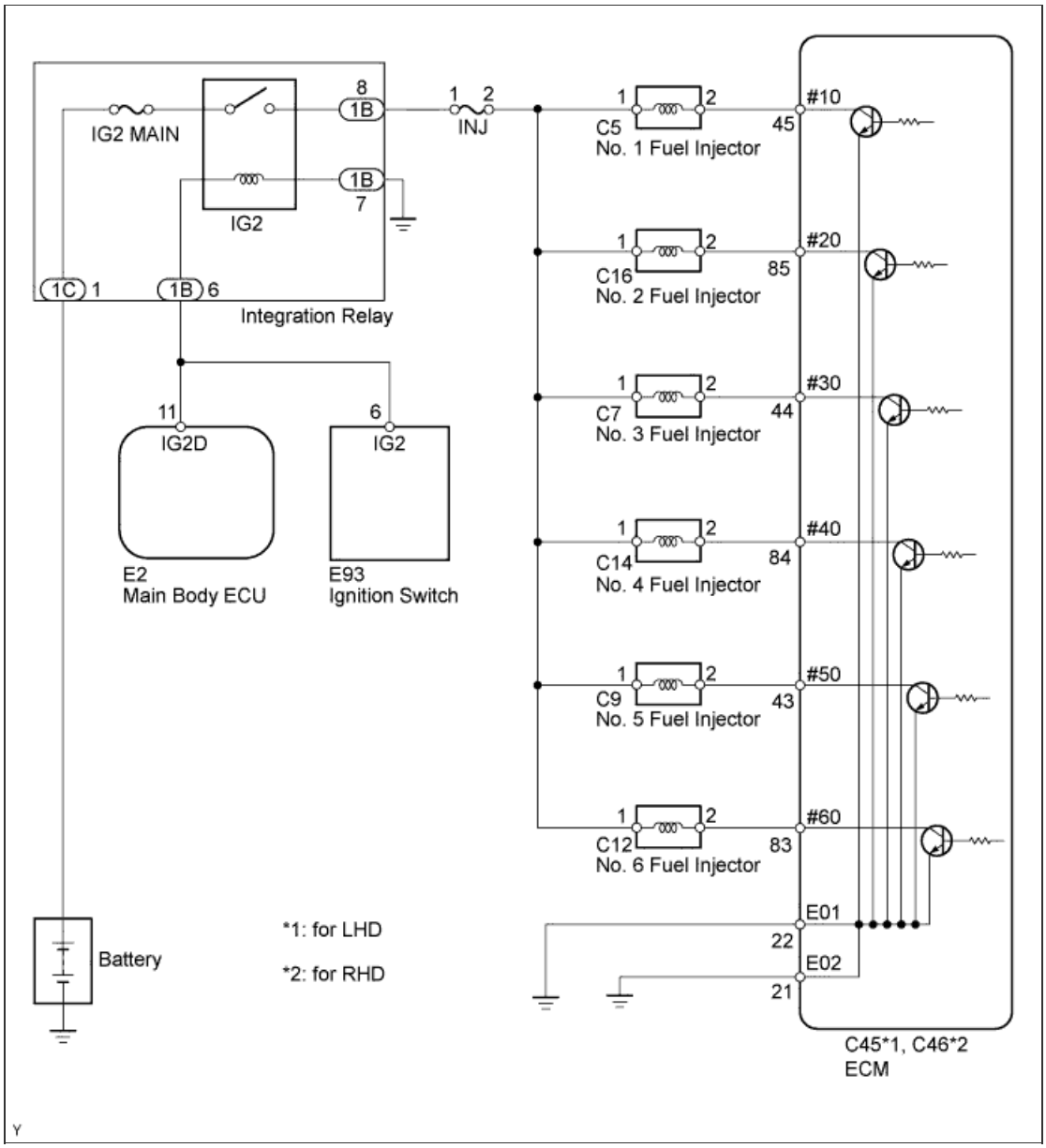
When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. High HC concentration levels can cause an increase in exhaust emission levels. Extremely high concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent this increase in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire count. When the temperature of the TWC reaches the point of thermal degradation, the ECM blinks the MIL. To monitor misfires, the ECM uses both the VVT sensor and the Crankshaft Position (CKP) sensor. The VVT sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted when the crankshaft rotation speed variations exceed predetermined thresholds. If the misfire count exceeds the threshold levels, the ECM illuminates the MIL and stores a DTC.

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A misfire occurs that may damage the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	• Open or short in engine wire harness • Connector connections • Vacuum hose connections • Ignition system • Injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve clearance • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306	Misfiring of specific cylinder occurs and one of following conditions below is detected (2 trip detection logic): • A misfire occurs that may damage the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

WIRING DIAGRAM


INJ
1 2
from IG2 Relay
1 +B
IGT1 3
4 GND
IGF 2
C4
No. 1 Ignition Coil
1 +B
IGT2 3
4 GND
IGF 2
C15
No. 2 Ignition Coil
1 +B
IGT3 3
4 GND
IGF 2
C6
No. 3 Ignition Coil
1 +B
IGT4 3
4 GND
IGF 2
C13
No. 4 Ignition Coil
1 +B
IGT5 3
4 GND
IGF 2
C8
No. 5 Ignition Coil
1 +B
IGT6 3
4 GND
IGF 2
C11
No. 6 Ignition Coil
IGT1
40
IGT2
39
IGT3
38
IGT4
37
IGT5
36
IGT6
35
IGF1
106
C45*1, C46*2
ECM
C10
Noise Filter
(for Bank 1)
C17
Noise Filter
(for Bank 2)
*1: for LHD
*2: for RHD



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the intelligent tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the intelligent tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire count of each cylinder (Cylinder #1 Misfire Count to Cylinder #6 Misfire Count) with the engine idling. If any misfire count is displayed, skip the following confirmation driving pattern.
7. If no misfire counts are displayed, drive the vehicle several times at the engine speed and engine load, etc., recorded in the freeze frame data.

HINT:

- **In order to store misfire DTCs, drive the vehicle at the engine speed and engine load, etc., recorded in the freeze frame data for the time specified in the table below.**

Engine Speed	Duration
Idling	3.5 minutes or more
1000	3 minutes or more
2000	1.5 minutes or more
3000	1 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

HINT:

Do not turn the ignition switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data are cleared.

9. Record the DTC(s), freeze frame data and misfire count.
10. Turn the ignition switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the ECM as freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the ECM as freeze frame data have been reproduced, one of the following factors can be considered to be a possible cause of the problem:**
    1. **There was insufficient fuel volume in the tank.**
    2. **Improper fuel was used.**
    3. **The spark plugs have been contaminated.**
- **After finishing repairs, check the misfire counts of the cylinders (Cylinder #1 Misfire Count to Cylinder #6 Misfire Count).**
- **Be sure to confirm that no misfiring cylinder DTCs are stored again by conducting the confirmation driving pattern after finishing repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speeds. If misfires occur only in high engine speed areas, only DTC P0300 is stored.**
  In the event of DTC P0300 being present, perform the following operations:
    1. **Clear the DTCs (Click here).**
    2. **Start the engine and conduct the confirmation driving pattern.**
    3. **Read the misfiring rates of each cylinder or DTC(s) using the intelligent tester.**
    4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
    5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not stored.**
- **When one of Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air fuel ratio may be Rich (-20% or less) or Lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is less than 75°C (167°F), the misfire may have occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel can cause body vibration, which may cause misfire DTC(s) to be stored.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

e. Read DTCs.

HINT:

Write down the DTCs.

Result

Display (DTC Output)	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305 and/or P0306	A
P0300, P0301, P0302, P0303, P0304, P0305 and/or P0306 and other DTCs	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305 and P0306 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

3.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is correctly connected and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE

OK

4.READ VALUE USING INTELLIGENT TESTER

(a) Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5 and #6.
(b) Read the value for Cylinder #1 Misfire Count to Cylinder #6 Misfire Count displayed on the intelligent tester. If no misfire counts occur in any cylinders, perform the following procedures:
(1) Start the engine and let it idle.
(2) Move the shift lever to D.
(3) Check the Cylinder #1 Misfire Count to Cylinder #6 Misfire Count.
(4) If misfire counts are still not displayed, perform steps (c) and (d).
(c) Drive the vehicle with the Misfire RPM and Misfire Load noted in the "Read value using intelligent tester (Misfire RPM and Misfire Load)" procedures above.
(d) Read the Cylinder #1 Misfire Count to Cylinder #6 Misfire Count or DTCs displayed on the intelligent tester.

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have equal misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data's record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data's record of Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → Go to step 17

A

5.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

b. Measure the spark plug electrode gap (Click here).

NG → REPLACE SPARK PLUG (Click here)

OK

6.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head.

c. Install the spark plug to the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check for sparks.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK HARNESS AND CONNECTOR (ECM - INJECTOR)

a. Disconnect the injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

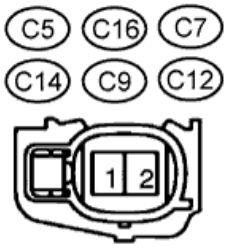
c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

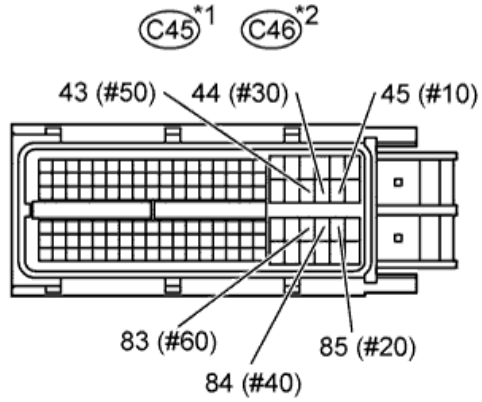
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Body ground	Ignition switch ON	11 to 14 V
No. 2	C16-1 - Body ground	Ignition switch ON	11 to 14 V
No. 3	C7-1 - Body ground	Ignition switch ON	11 to 14 V
No. 4	C14-1 - Body ground	Ignition switch ON	11 to 14 V
No. 5	C9-1 - Body ground	Ignition switch ON	11 to 14 V
No. 6	C12-1 - Body ground	Ignition switch ON	11 to 14 V

d. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance:

for LHD

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-45 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C45-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C45-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C45-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C45-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C45-83 (#60)	Always	Below 1 Ω

for RHD

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-45 (#10)	Always	Below 1 Ω
	C16-2 - Body		

No. 2	ground	Always	10 kΩ or higher
	C16-2 - C46-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C46-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C46-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C46-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C46-83 (#60)	Always	Below 1 Ω

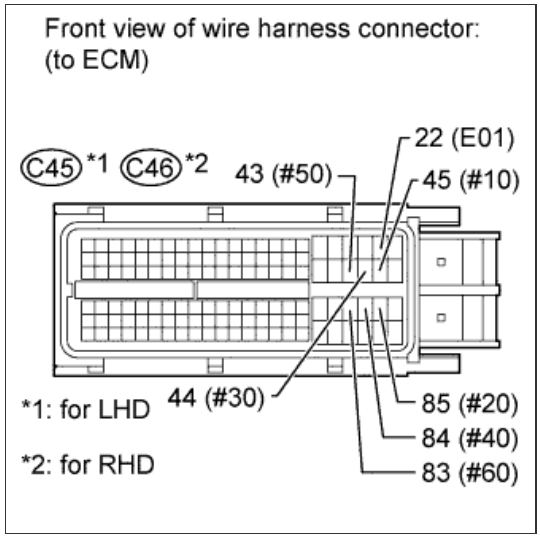
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50 AND/OR #60 VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for LHD

Tester Connection	Switch Condition	Specified Condition
C45-45 (#10) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-85 (#20) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-44 (#30) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-84 (#40) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-43 (#50) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-83 (#60) - C45-22 (E01)	Ignition switch ON	11 to 14 V

for RHD

Tester Connection	Switch Condition	Specified Condition
C46-45 (#10) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-85 (#20) - C46-22 (E01)	Ignition switch ON	11 to 14 V

C46-44 (#30) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-84 (#40) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-43 (#50) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-83 (#60) - C46-22 (E01)	Ignition switch ON	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection (whether fuel volume is large or small, and whether injection pattern is poor) (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (**Click here**)

OK

11.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

12.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK

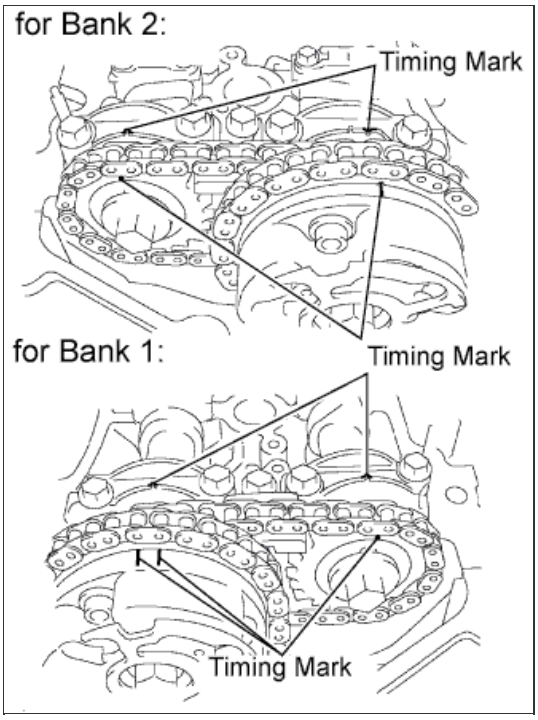
13.CHECK VALVE TIMING

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → ADJUST VALVE TIMING

OK

14.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER, AND REPLACE PARTS AS NECESSARY

OK

15.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Data List twice, when the engine is cold and when it is warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: 80 to 100°C (176 to 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

16.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

REPLACE ECM (Click here)

17.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

OK

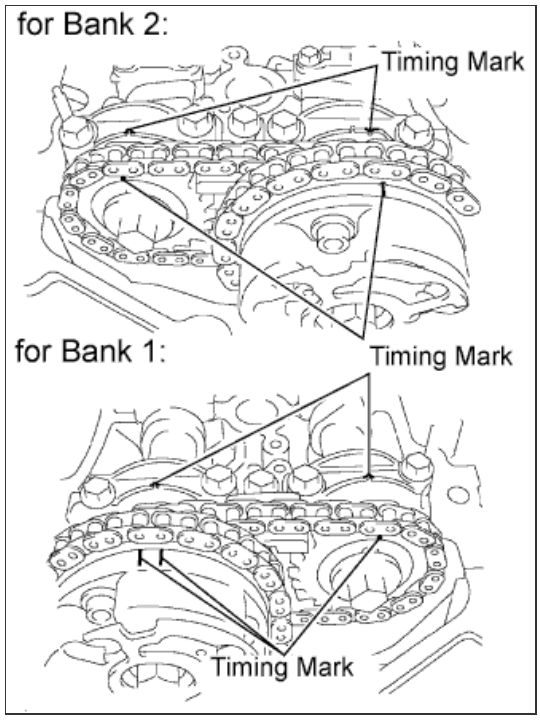
18.CHECK VALVE TIMING

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → **ADJUST VALVE TIMING**

OK

19.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → **CHECK FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER, AND REPLACE PARTS AS NECESSARY**

OK

20.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Data List twice, when the engine is cold and when it is warmed up.

Standard:
With cold engine: Same as ambient air temperature.

With warm engine: 80 to 100°C (176 to 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

21.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

22.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

b. Measure the spark plug electrode gap (Click here).

NG → REPLACE SPARK PLUG (Click here)

OK

23.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head.

c. Install the spark plug to the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check for sparks.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

24.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

25.CHECK HARNESS AND CONNECTOR (ECM - INJECTOR)

a. Disconnect the injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

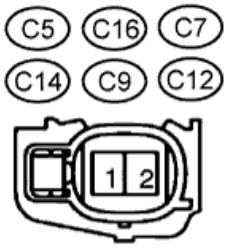
c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

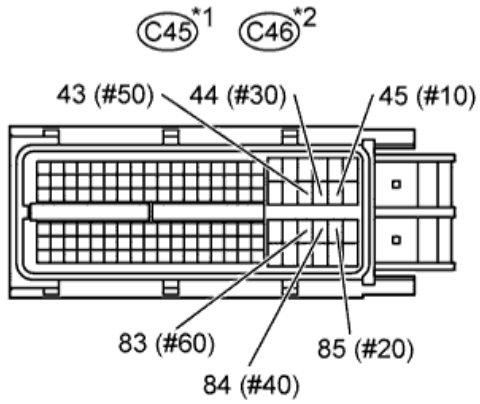
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Body ground	Ignition switch ON	11 to 14 V
No. 2	C16-1 - Body ground	Ignition switch ON	11 to 14 V
No. 3	C7-1 - Body ground	Ignition switch ON	11 to 14 V
No. 4	C14-1 - Body ground	Ignition switch ON	11 to 14 V
No. 5	C9-1 - Body ground	Ignition switch ON	11 to 14 V
No. 6	C12-1 - Body ground	Ignition switch ON	11 to 14 V

d. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector: (to Injector)



Front view of wire harness connector: (to ECM)



*1: for LHD

*2: for RHD

Standard Resistance:

for LHD

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-45 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C45-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C45-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C45-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C45-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C45-83 (#60)	Always	Below 1 Ω

for RHD

Cylinder	Tester Connection	Condition	Specified Condition

No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-45 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C46-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C46-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C46-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C46-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C46-83 (#60)	Always	Below 1 Ω

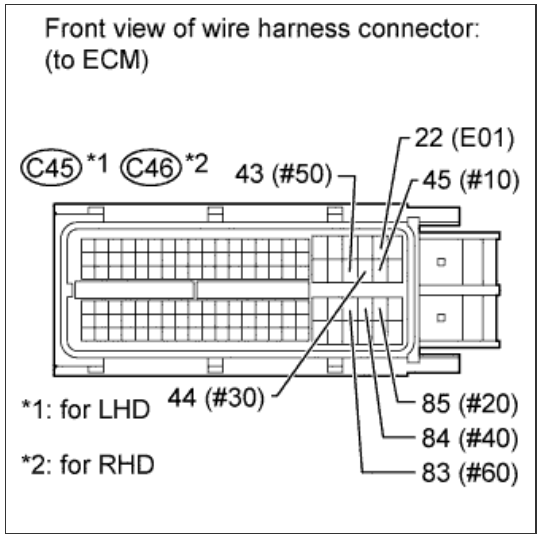
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50 AND/OR #60 VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for LHD

Tester Connection	Switch Condition	Specified Condition
C45-45 (#10) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-85 (#20) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-44 (#30) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-84 (#40) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-43 (#50) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-83 (#60) - C45-22 (E01)	Ignition switch ON	11 to 14 V

for RHD

Tester Connection	Switch Condition	Specified Condition
C46-45 (#10) - C46-22	Ignition switch	

(E01)	ON	11 to 14 V
C46-85 (#20) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-44 (#30) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-84 (#40) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-43 (#50) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-83 (#60) - C46-22 (E01)	Ignition switch ON	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

27.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection (whether fuel volume is large or small, and whether injection pattern is poor) (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (Click here)

OK

28.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (Click here)

OK

REPLACE ECM (Click here)

29.REPLACE SPARK PLUG WITH NORMAL ONE AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the installed spark plug with a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect all the injector connectors.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:

Sparks jump across electrode gap.

NG → Go to step 30

OK

REPLACE SPARK PLUG (Click here)

30.REPLACE IGNITION COIL WITH NORMAL ONE AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the installed ignition coil with a ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect all the injector connectors.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK → REPLACE IGNITION COIL (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

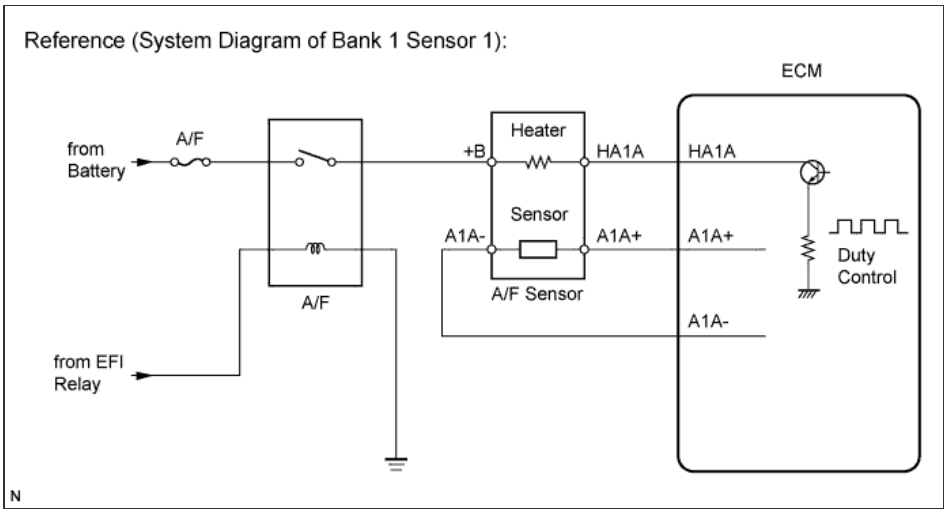
for Preparation Click here

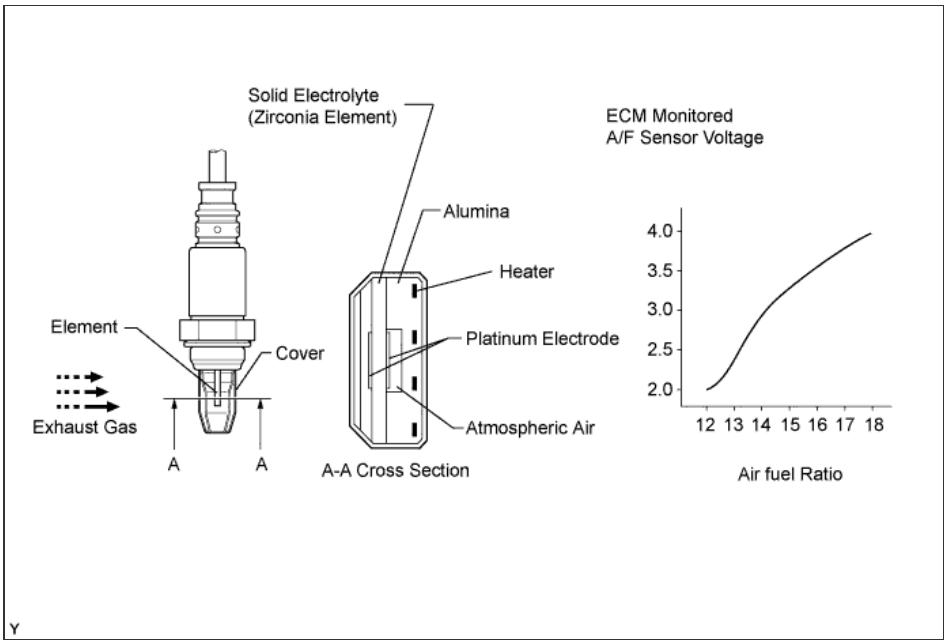
DESCRIPTION

HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air Fuel ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**

The A/F sensor, which is located between the exhaust manifold and catalyst, consists of alloyed metal elements and a heater.
Depending on the engine operating conditions, the heater heats the sensor elements to activate them. Battery voltage is applied to the heater, and the sensor ground is controlled by the ECM using a duty ratio.
The sensor elements convert the oxygen concentration in the exhaust gas into voltage values to output. Based on the voltage, the ECM determines the air fuel ratio and regulates the fuel injection volume depending on the air fuel ratio and engine operating conditions. The voltage changes between 0.6 V and 4.5 V while the engine is running. If the air fuel ratio is lean, which means the oxygen concentration in the exhaust gas is high, the voltage is high. If the air fuel ratio is rich, which means the oxygen concentration in the exhaust gas is low, the voltage is low.





DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals A1A+/A2A+ and A1A-/A2A- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2238 P2241	Any of the following conditions are met (2 trip detection logic): • The A/F sensor output drops while the engine is running. • The voltage at terminal A1A+/A2A+ is 0.5 V or less. • The voltage difference between terminals A1A+/A2A+ and A1A-/A2A- is 0.1 V or less.	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2239 P2242	The A1A+/A2A+ voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2252 P2255	The A1A-/A2A- voltage is 0.5 V or less (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2253 P2256	The A1A-/A2A- voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM

MONITOR DESCRIPTION

These DTCs are stored when there is an open or short in the A/F sensor circuit, or if A/F sensor output drops. To detect these problems, the voltage of the A/F sensor is monitored when turning the ignition switch to ON, and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is out of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in next driving cycle, the MIL will be illuminated and a DTC will be stored.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

CONFIRMATION DRIVING PATTERN

1. Start the engine and wait for 5 minutes or more.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **On the tester, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.**

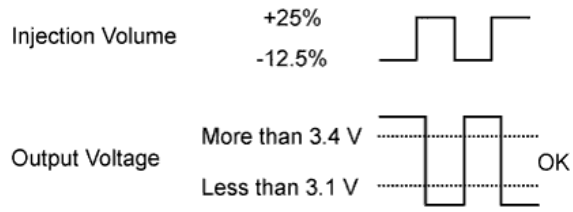
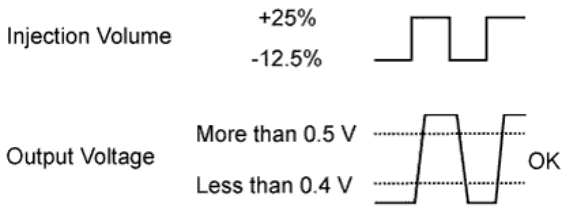
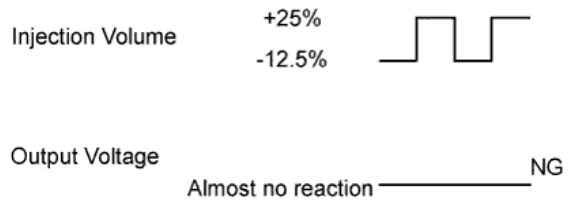
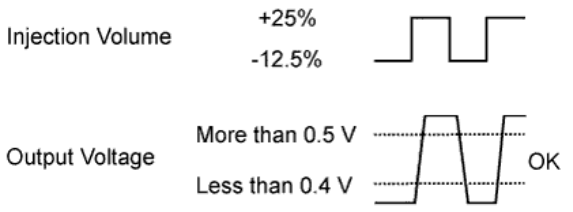
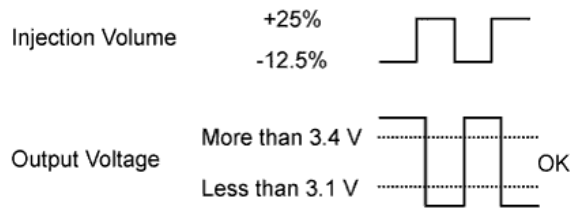
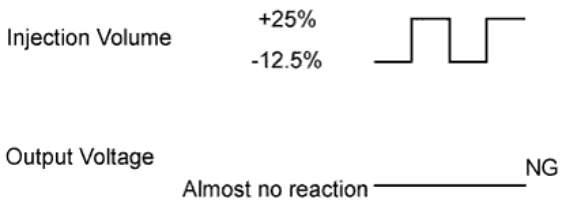
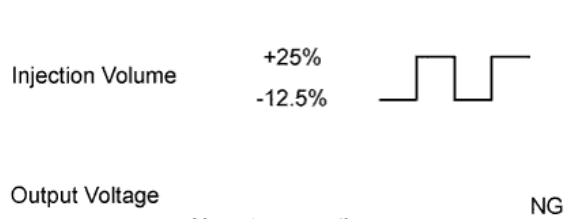
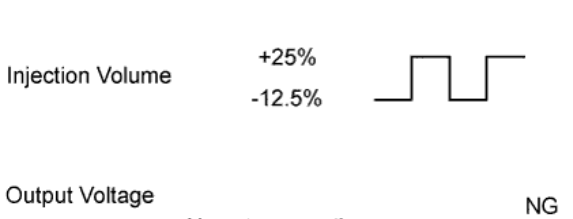
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	more than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	more than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	less than 0.4 V

NOTICE:

The Air Fuel ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the Air Fuel ratio (A/F) sensor connector.

b. Turn the ignition switch to ON.

c. Measure the voltage according to the value(s) in the table below.

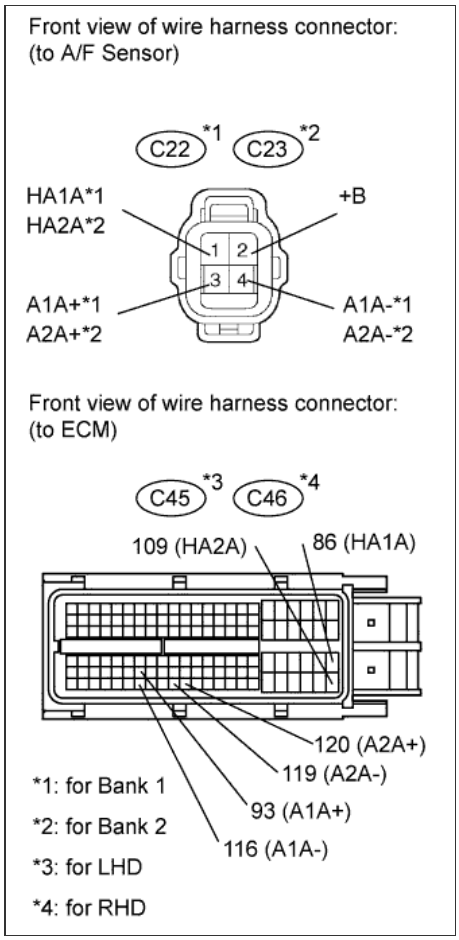
Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Ignition switch ON	11 to 14 V
C23-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

d. Turn the ignition switch off.

e. Disconnect the ECM connector.

f. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-93 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-116 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-120 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-119 (A2A-)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω

C22-3 (A1A+) - C46-93 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-116 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-120 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-119 (A2A-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-93 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-116 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-120 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-119 (A2A-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-93 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-116 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-120 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-119 (A2A-) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

4.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read the pending DTCs.

Result

Result	Proceed to
No output	A
P2237, P2240, P2238, P2241, P2239, P2242, P2252, P2255, P2253 or P2256 output	B

B

REPLACE ECM (Click here)

A

END

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

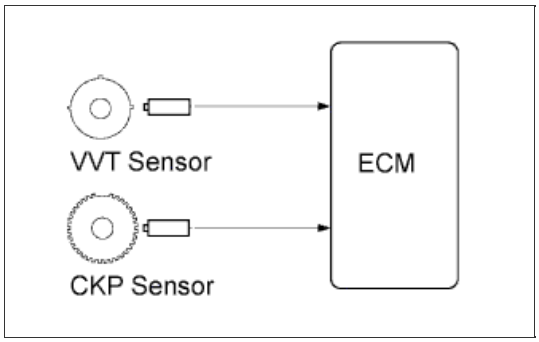
DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

DTC P0306 Cylinder 6 Misfire Detected

for Preparation Click here

DESCRIPTION

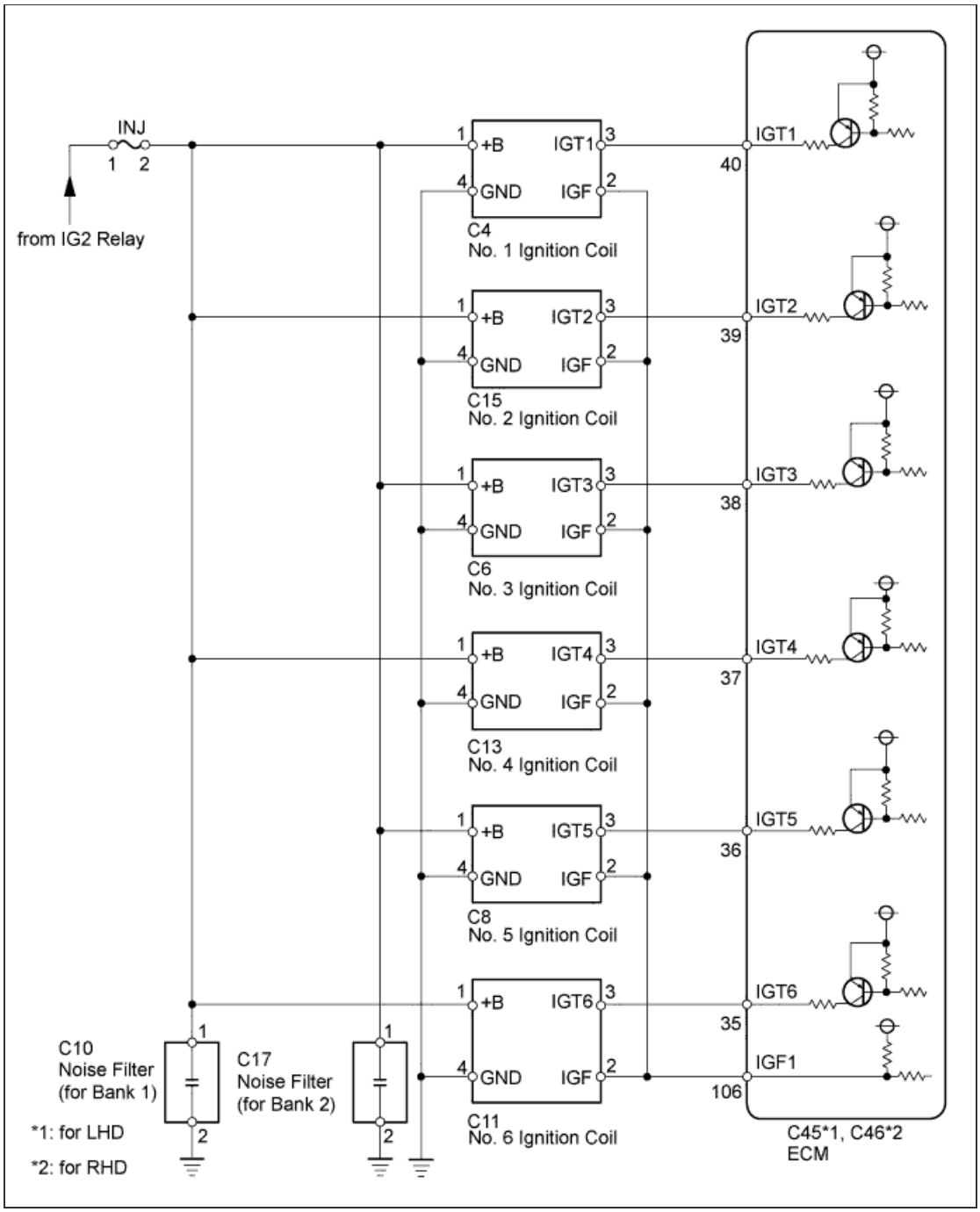


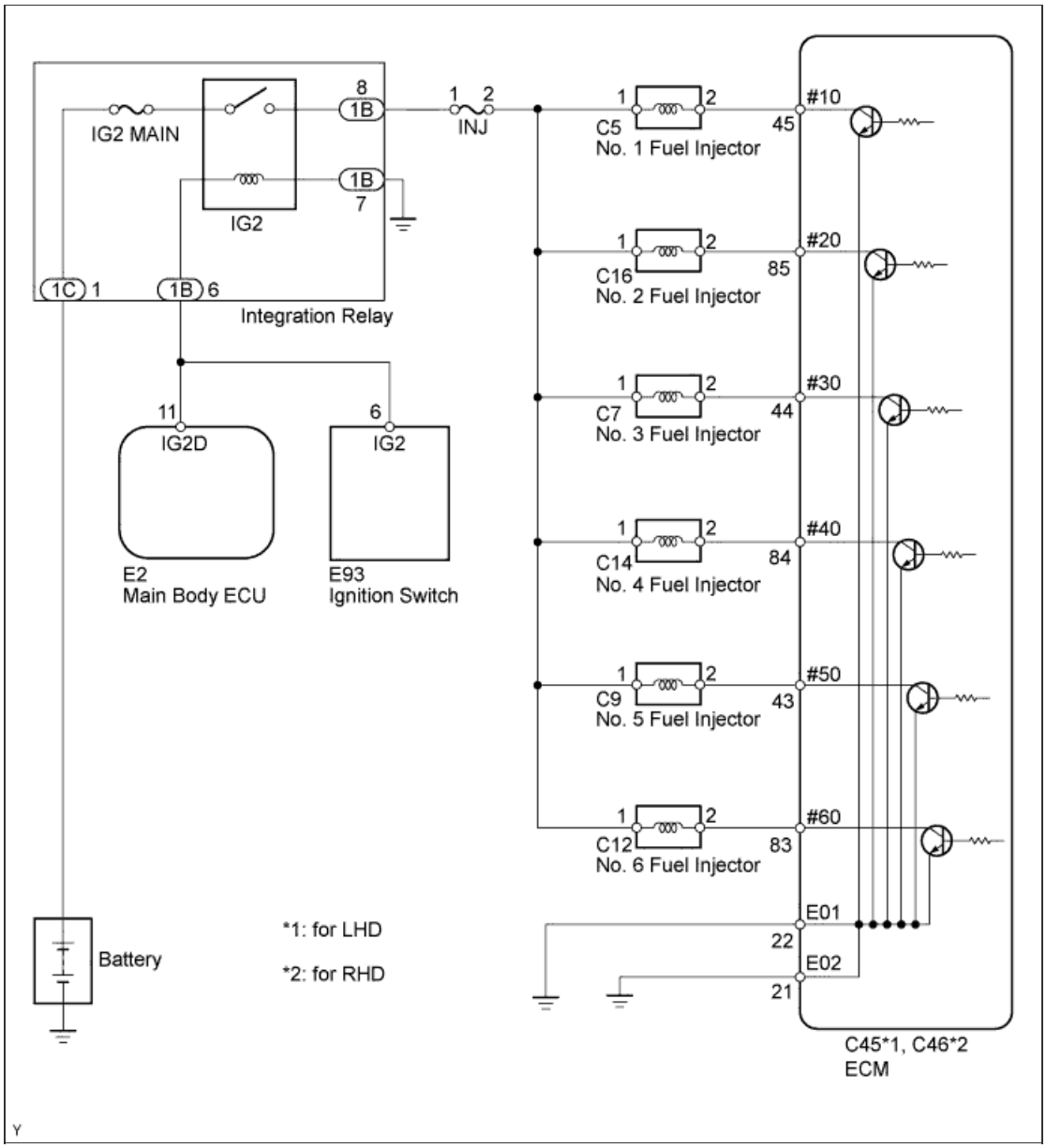
When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. High HC concentration levels can cause an increase in exhaust emission levels. Extremely high concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent this increase in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire count. When the temperature of the TWC reaches the point of thermal degradation, the ECM blinks the MIL. To monitor misfires, the ECM uses both the VVT sensor and the Crankshaft Position (CKP) sensor. The VVT sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted when the crankshaft rotation speed variations exceed predetermined thresholds. If the misfire count exceeds the threshold levels, the ECM illuminates the MIL and stores a DTC.

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A misfire occurs that may damage the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	• Open or short in engine wire harness • Connector connections • Vacuum hose connections • Ignition system • Injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve clearance • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306	Misfiring of specific cylinder occurs and one of following conditions below is detected (2 trip detection logic): • A misfire occurs that may damage the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

WIRING DIAGRAM


INJ
1 2
from IG2 Relay
1 +B
IGT1 3
4 GND
IGF 2
C4
No. 1 Ignition Coil
1 +B
IGT2 3
4 GND
IGF 2
C15
No. 2 Ignition Coil
1 +B
IGT3 3
4 GND
IGF 2
C6
No. 3 Ignition Coil
1 +B
IGT4 3
4 GND
IGF 2
C13
No. 4 Ignition Coil
1 +B
IGT5 3
4 GND
IGF 2
C8
No. 5 Ignition Coil
1 +B
IGT6 3
4 GND
IGF 2
C11
No. 6 Ignition Coil
IGT1
40
IGT2
39
IGT3
38
IGT4
37
IGT5
36
IGT6
35
IGF1
106
C45*1, C46*2
ECM
C10
Noise Filter
(for Bank 1)
C17
Noise Filter
(for Bank 2)
*1: for LHD
*2: for RHD



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the intelligent tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the intelligent tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire count of each cylinder (Cylinder #1 Misfire Count to Cylinder #6 Misfire Count) with the engine idling. If any misfire count is displayed, skip the following confirmation driving pattern.
7. If no misfire counts are displayed, drive the vehicle several times at the engine speed and engine load, etc., recorded in the freeze frame data.

HINT:

- **In order to store misfire DTCs, drive the vehicle at the engine speed and engine load, etc., recorded in the freeze frame data for the time specified in the table below.**

Engine Speed	Duration
Idling	3.5 minutes or more
1000	3 minutes or more
2000	1.5 minutes or more
3000	1 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

HINT:

Do not turn the ignition switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data are cleared.

9. Record the DTC(s), freeze frame data and misfire count.
10. Turn the ignition switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the ECM as freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the ECM as freeze frame data have been reproduced, one of the following factors can be considered to be a possible cause of the problem:**
    1. **There was insufficient fuel volume in the tank.**
    2. **Improper fuel was used.**
    3. **The spark plugs have been contaminated.**
- **After finishing repairs, check the misfire counts of the cylinders (Cylinder #1 Misfire Count to Cylinder #6 Misfire Count).**
- **Be sure to confirm that no misfiring cylinder DTCs are stored again by conducting the confirmation driving pattern after finishing repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speeds. If misfires occur only in high engine speed areas, only DTC P0300 is stored.**
  In the event of DTC P0300 being present, perform the following operations:
    1. **Clear the DTCs (Click here).**
    2. **Start the engine and conduct the confirmation driving pattern.**
    3. **Read the misfiring rates of each cylinder or DTC(s) using the intelligent tester.**
    4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
    5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not stored.**
- **When one of Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air fuel ratio may be Rich (-20% or less) or Lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is less than 75°C (167°F), the misfire may have occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel can cause body vibration, which may cause misfire DTC(s) to be stored.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

e. Read DTCs.

HINT:

Write down the DTCs.

Result

Display (DTC Output)	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305 and/or P0306	A
P0300, P0301, P0302, P0303, P0304, P0305 and/or P0306 and other DTCs	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305 and P0306 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

3.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is correctly connected and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE

OK

4.READ VALUE USING INTELLIGENT TESTER

(a) Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5 and #6.
(b) Read the value for Cylinder #1 Misfire Count to Cylinder #6 Misfire Count displayed on the intelligent tester. If no misfire counts occur in any cylinders, perform the following procedures:
(1) Start the engine and let it idle.
(2) Move the shift lever to D.
(3) Check the Cylinder #1 Misfire Count to Cylinder #6 Misfire Count.
(4) If misfire counts are still not displayed, perform steps (c) and (d).
(c) Drive the vehicle with the Misfire RPM and Misfire Load noted in the "Read value using intelligent tester (Misfire RPM and Misfire Load)" procedures above.
(d) Read the Cylinder #1 Misfire Count to Cylinder #6 Misfire Count or DTCs displayed on the intelligent tester.

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have equal misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data's record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data's record of Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → Go to step 17

A

5.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

b. Measure the spark plug electrode gap (Click here).

NG → REPLACE SPARK PLUG (Click here)

OK

6.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head.

c. Install the spark plug to the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check for sparks.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK HARNESS AND CONNECTOR (ECM - INJECTOR)

a. Disconnect the injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

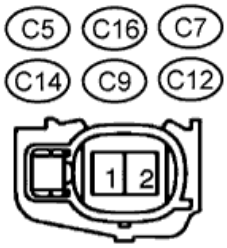
c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

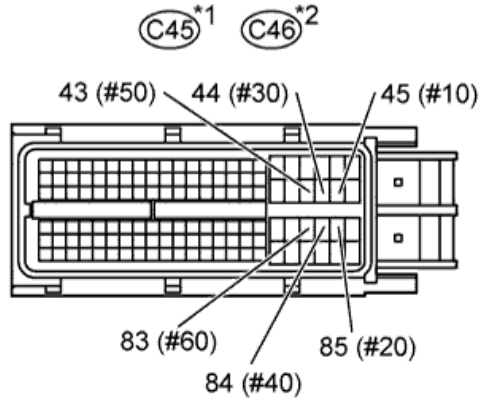
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Body ground	Ignition switch ON	11 to 14 V
No. 2	C16-1 - Body ground	Ignition switch ON	11 to 14 V
No. 3	C7-1 - Body ground	Ignition switch ON	11 to 14 V
No. 4	C14-1 - Body ground	Ignition switch ON	11 to 14 V
No. 5	C9-1 - Body ground	Ignition switch ON	11 to 14 V
No. 6	C12-1 - Body ground	Ignition switch ON	11 to 14 V

d. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance:

for LHD

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-45 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C45-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C45-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C45-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C45-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C45-83 (#60)	Always	Below 1 Ω

for RHD

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-45 (#10)	Always	Below 1 Ω
	C16-2 - Body		

No. 2	ground	Always	10 kΩ or higher
	C16-2 - C46-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C46-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C46-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C46-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C46-83 (#60)	Always	Below 1 Ω

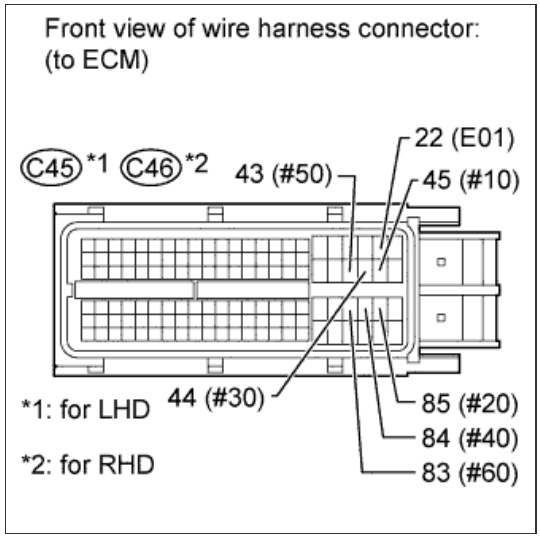
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50 AND/OR #60 VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for LHD

Tester Connection	Switch Condition	Specified Condition
C45-45 (#10) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-85 (#20) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-44 (#30) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-84 (#40) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-43 (#50) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-83 (#60) - C45-22 (E01)	Ignition switch ON	11 to 14 V

for RHD

Tester Connection	Switch Condition	Specified Condition
C46-45 (#10) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-85 (#20) - C46-22 (E01)	Ignition switch ON	11 to 14 V

C46-44 (#30) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-84 (#40) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-43 (#50) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-83 (#60) - C46-22 (E01)	Ignition switch ON	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection (whether fuel volume is large or small, and whether injection pattern is poor) (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (**Click here**)

OK

11.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

12.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK

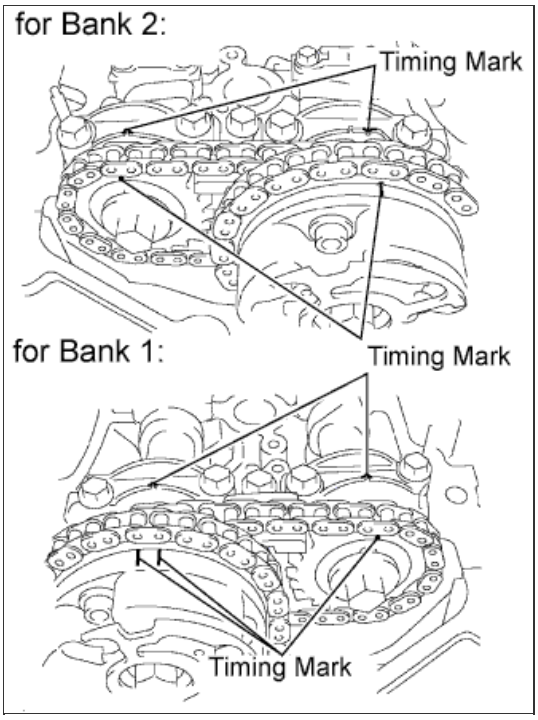
13.CHECK VALVE TIMING

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → ADJUST VALVE TIMING

OK

14.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER, AND REPLACE PARTS AS NECESSARY

OK

15.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Data List twice, when the engine is cold and when it is warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: 80 to 100°C (176 to 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

16.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

REPLACE ECM (Click here)

17.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

OK

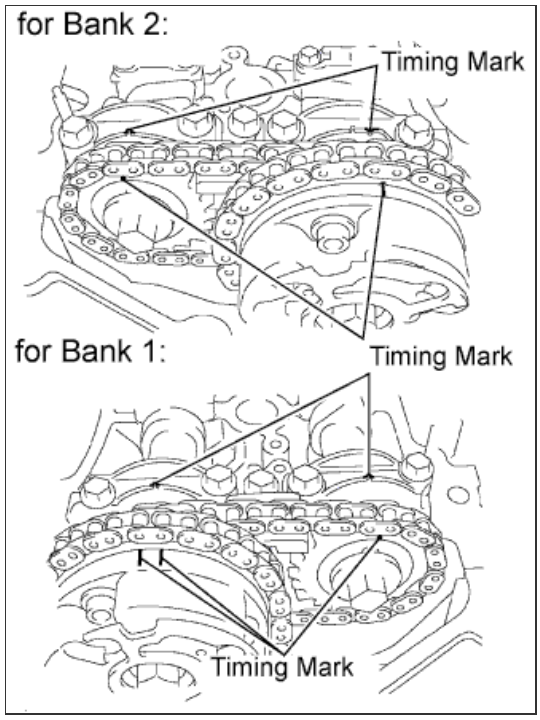
18.CHECK VALVE TIMING

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → **ADJUST VALVE TIMING**

OK

19.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → **CHECK FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER, AND REPLACE PARTS AS NECESSARY**

OK

20.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Data List twice, when the engine is cold and when it is warmed up.

Standard:
With cold engine: Same as ambient air temperature.

With warm engine: 80 to 100°C (176 to 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

21.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

22.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

b. Measure the spark plug electrode gap (Click here).

NG → REPLACE SPARK PLUG (Click here)

OK

23.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head.

c. Install the spark plug to the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check for sparks.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

24.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

25.CHECK HARNESS AND CONNECTOR (ECM - INJECTOR)

a. Disconnect the injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

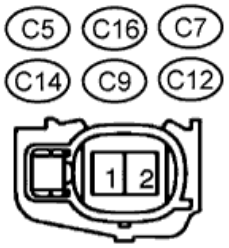
c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

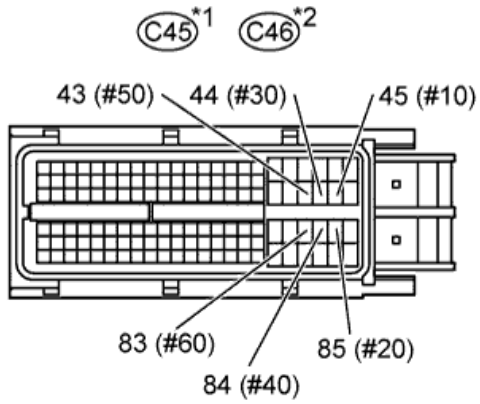
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Body ground	Ignition switch ON	11 to 14 V
No. 2	C16-1 - Body ground	Ignition switch ON	11 to 14 V
No. 3	C7-1 - Body ground	Ignition switch ON	11 to 14 V
No. 4	C14-1 - Body ground	Ignition switch ON	11 to 14 V
No. 5	C9-1 - Body ground	Ignition switch ON	11 to 14 V
No. 6	C12-1 - Body ground	Ignition switch ON	11 to 14 V

d. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector: (to Injector)



Front view of wire harness connector: (to ECM)



*1: for LHD

*2: for RHD

Standard Resistance:

for LHD

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-45 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C45-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C45-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C45-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C45-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C45-83 (#60)	Always	Below 1 Ω

for RHD

Cylinder	Tester Connection	Condition	Specified Condition

No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-45 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C46-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C46-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C46-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C46-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C46-83 (#60)	Always	Below 1 Ω

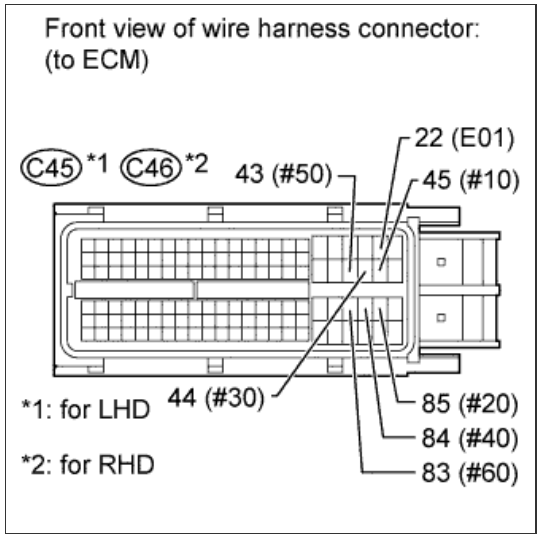
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50 AND/OR #60 VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for LHD

Tester Connection	Switch Condition	Specified Condition
C45-45 (#10) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-85 (#20) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-44 (#30) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-84 (#40) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-43 (#50) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-83 (#60) - C45-22 (E01)	Ignition switch ON	11 to 14 V

for RHD

Tester Connection	Switch Condition	Specified Condition
C46-45 (#10) - C46-22	Ignition switch	

(E01)	ON	11 to 14 V
C46-85 (#20) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-44 (#30) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-84 (#40) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-43 (#50) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-83 (#60) - C46-22 (E01)	Ignition switch ON	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

27.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection (whether fuel volume is large or small, and whether injection pattern is poor) (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (Click here)

OK

28.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (Click here)

OK

REPLACE ECM (Click here)

29.REPLACE SPARK PLUG WITH NORMAL ONE AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the installed spark plug with a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect all the injector connectors.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:

Sparks jump across electrode gap.

NG → Go to step 30

OK

REPLACE SPARK PLUG (Click here)

30.REPLACE IGNITION COIL WITH NORMAL ONE AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the installed ignition coil with a ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect all the injector connectors.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK → REPLACE IGNITION COIL (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

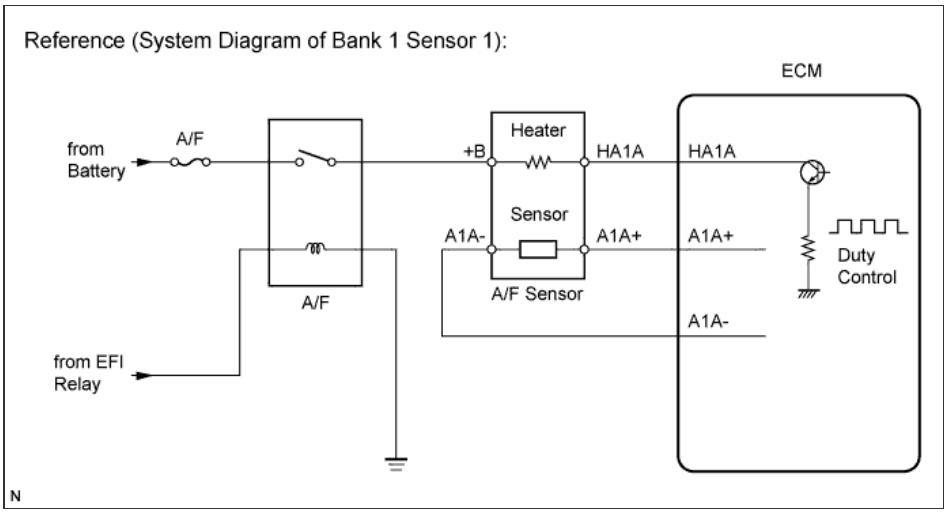
for Preparation Click here

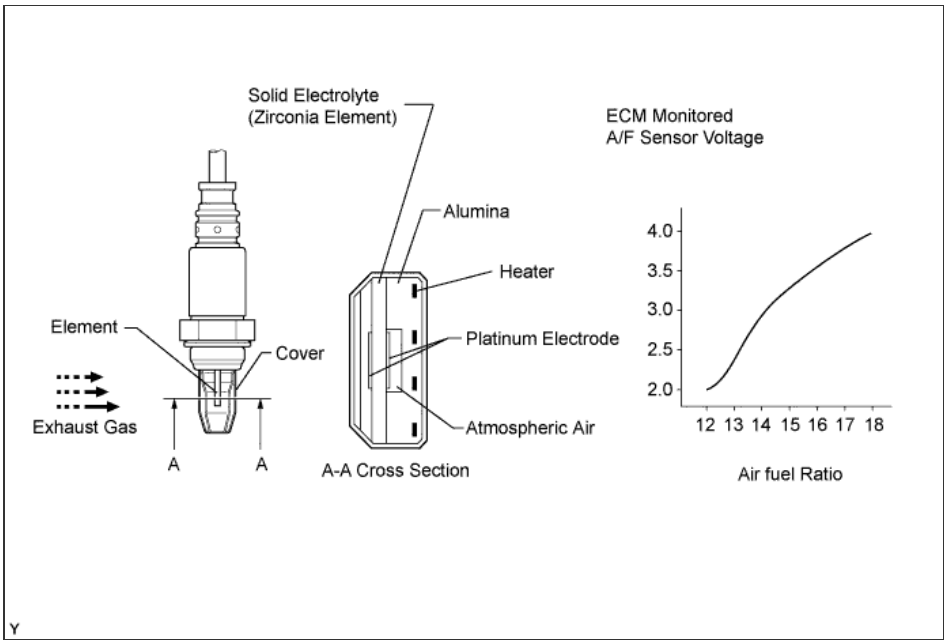
DESCRIPTION

HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air Fuel ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**

The A/F sensor, which is located between the exhaust manifold and catalyst, consists of alloyed metal elements and a heater.
Depending on the engine operating conditions, the heater heats the sensor elements to activate them. Battery voltage is applied to the heater, and the sensor ground is controlled by the ECM using a duty ratio.
The sensor elements convert the oxygen concentration in the exhaust gas into voltage values to output. Based on the voltage, the ECM determines the air fuel ratio and regulates the fuel injection volume depending on the air fuel ratio and engine operating conditions. The voltage changes between 0.6 V and 4.5 V while the engine is running. If the air fuel ratio is lean, which means the oxygen concentration in the exhaust gas is high, the voltage is high. If the air fuel ratio is rich, which means the oxygen concentration in the exhaust gas is low, the voltage is low.





DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals A1A+/A2A+ and A1A-/A2A- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2238 P2241	Any of the following conditions are met (2 trip detection logic): • The A/F sensor output drops while the engine is running. • The voltage at terminal A1A+/A2A+ is 0.5 V or less. • The voltage difference between terminals A1A+/A2A+ and A1A-/A2A- is 0.1 V or less.	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2239 P2242	The A1A+/A2A+ voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2252 P2255	The A1A-/A2A- voltage is 0.5 V or less (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2253 P2256	The A1A-/A2A- voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM

MONITOR DESCRIPTION

These DTCs are stored when there is an open or short in the A/F sensor circuit, or if A/F sensor output drops. To detect these problems, the voltage of the A/F sensor is monitored when turning the ignition switch to ON, and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is out of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in next driving cycle, the MIL will be illuminated and a DTC will be stored.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

CONFIRMATION DRIVING PATTERN

1. Start the engine and wait for 5 minutes or more.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **On the tester, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.**

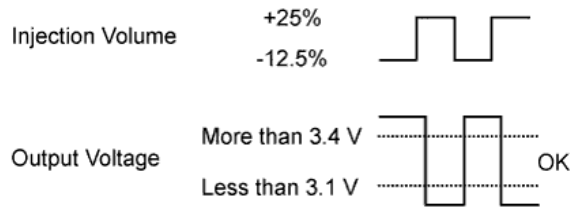
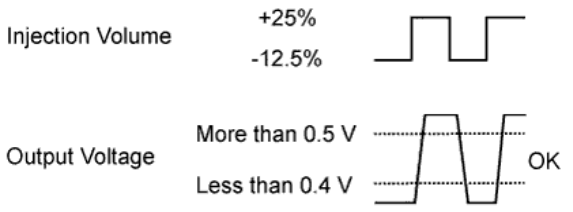
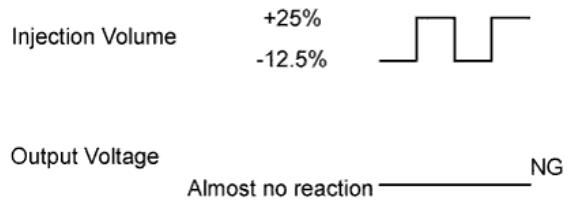
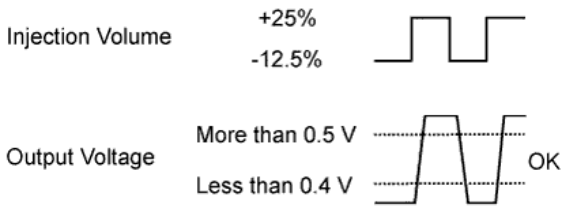
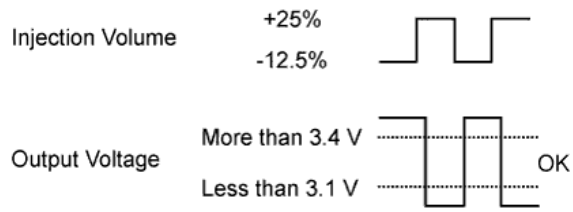
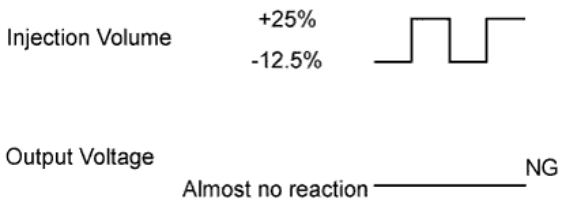
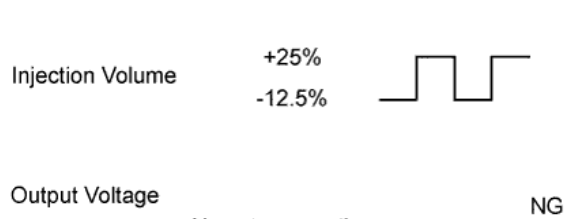
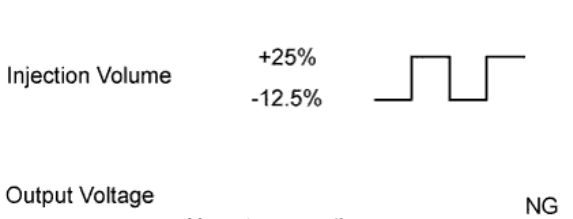
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	more than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	more than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	less than 0.4 V

NOTICE:

The Air Fuel ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the Air Fuel ratio (A/F) sensor connector.

b. Turn the ignition switch to ON.

c. Measure the voltage according to the value(s) in the table below.

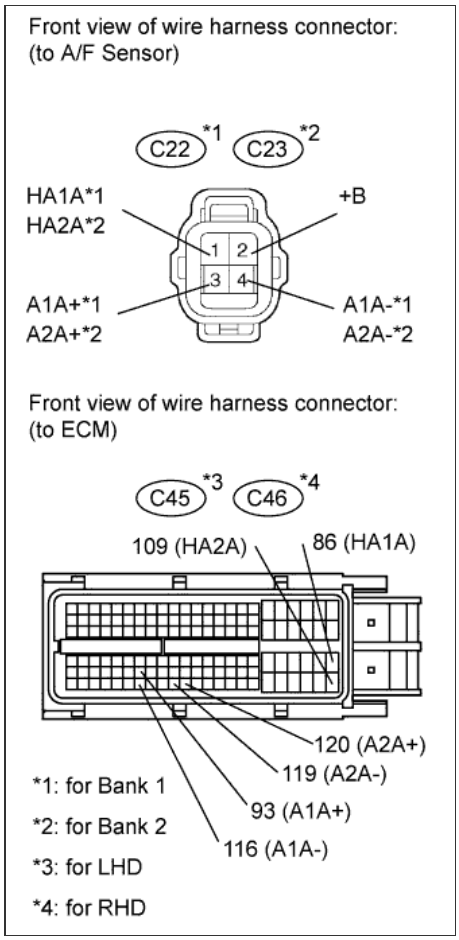
Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Ignition switch ON	11 to 14 V
C23-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

d. Turn the ignition switch off.

e. Disconnect the ECM connector.

f. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-93 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-116 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-120 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-119 (A2A-)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω

C22-3 (A1A+) - C46-93 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-116 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-120 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-119 (A2A-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-93 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-116 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-120 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-119 (A2A-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-93 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-116 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-120 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-119 (A2A-) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

4.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read the pending DTCs.

Result

Result	Proceed to
No output	A
P2237, P2240, P2238, P2241, P2239, P2242, P2252, P2255, P2253 or P2256 output	B

B

REPLACE ECM (Click here)

A

END

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

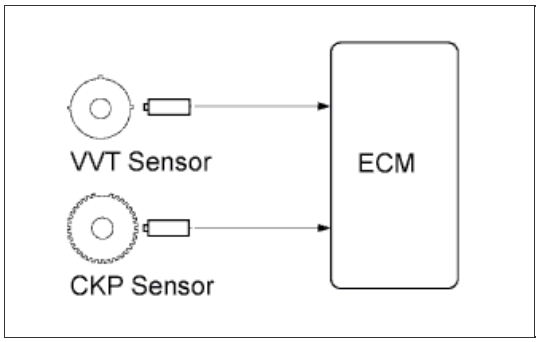
DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

DTC P0306 Cylinder 6 Misfire Detected

for Preparation Click here

DESCRIPTION

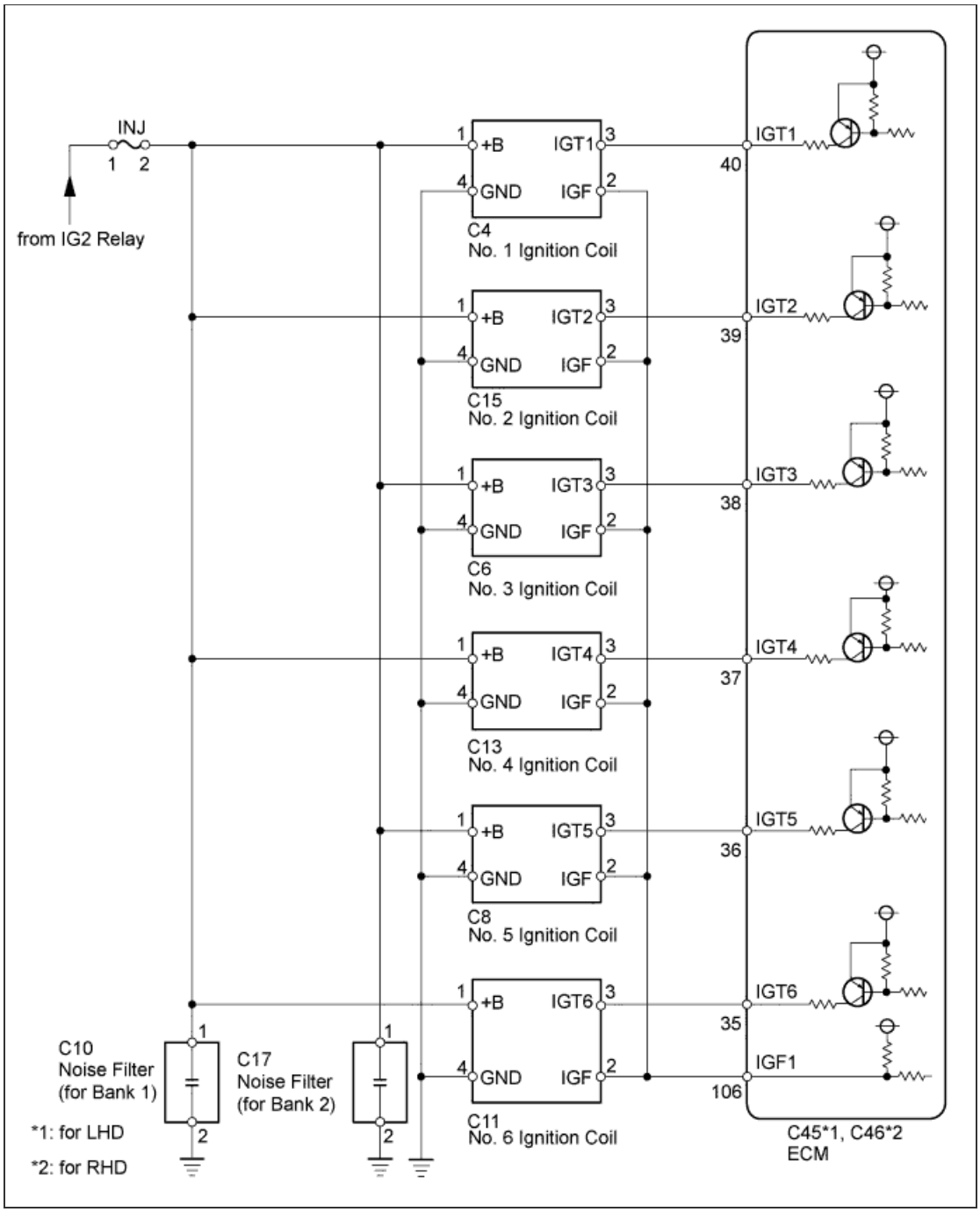


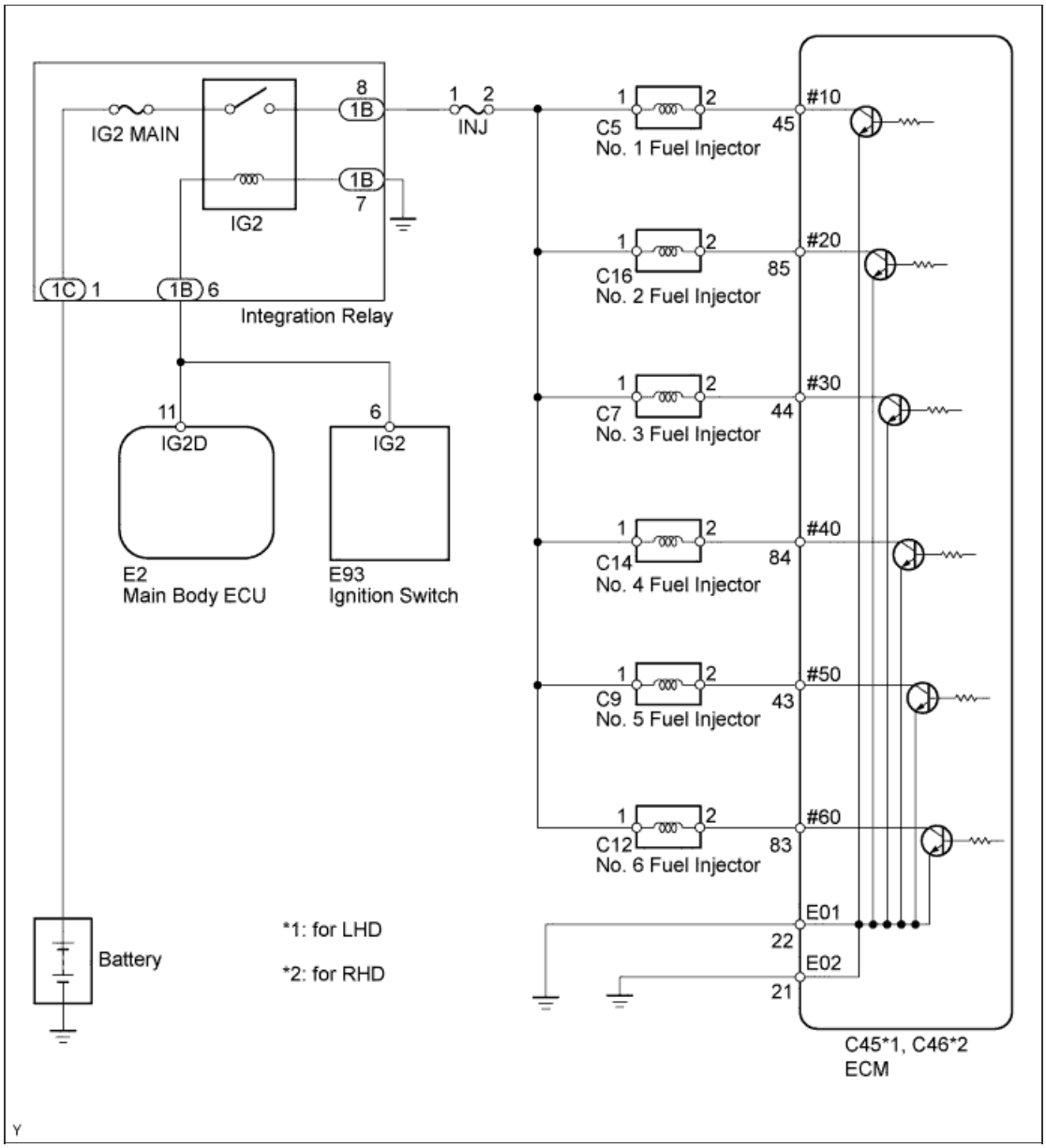
When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. High HC concentration levels can cause an increase in exhaust emission levels. Extremely high concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent this increase in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire count. When the temperature of the TWC reaches the point of thermal degradation, the ECM blinks the MIL. To monitor misfires, the ECM uses both the VVT sensor and the Crankshaft Position (CKP) sensor. The VVT sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted when the crankshaft rotation speed variations exceed predetermined thresholds. If the misfire count exceeds the threshold levels, the ECM illuminates the MIL and stores a DTC.

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A misfire occurs that may damage the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	• Open or short in engine wire harness • Connector connections • Vacuum hose connections • Ignition system • Injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve clearance • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306	Misfiring of specific cylinder occurs and one of following conditions below is detected (2 trip detection logic): • A misfire occurs that may damage the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

WIRING DIAGRAM


INJ
1 2
from IG2 Relay
1 +B
IGT1 3
4 GND
IGF 2
C4
No. 1 Ignition Coil
1 +B
IGT2 3
4 GND
IGF 2
C15
No. 2 Ignition Coil
1 +B
IGT3 3
4 GND
IGF 2
C6
No. 3 Ignition Coil
1 +B
IGT4 3
4 GND
IGF 2
C13
No. 4 Ignition Coil
1 +B
IGT5 3
4 GND
IGF 2
C8
No. 5 Ignition Coil
1 +B
IGT6 3
4 GND
IGF 2
C11
No. 6 Ignition Coil
IGT1
40
IGT2
39
IGT3
38
IGT4
37
IGT5
36
IGT6
35
IGF1
106
C45*1, C46*2
ECM
C10
Noise Filter
(for Bank 1)
C17
Noise Filter
(for Bank 2)
*1: for LHD
*2: for RHD



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the intelligent tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the intelligent tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire count of each cylinder (Cylinder #1 Misfire Count to Cylinder #6 Misfire Count) with the engine idling. If any misfire count is displayed, skip the following confirmation driving pattern.
7. If no misfire counts are displayed, drive the vehicle several times at the engine speed and engine load, etc., recorded in the freeze frame data.

HINT:

- **In order to store misfire DTCs, drive the vehicle at the engine speed and engine load, etc., recorded in the freeze frame data for the time specified in the table below.**

Engine Speed	Duration
Idling	3.5 minutes or more
1000	3 minutes or more
2000	1.5 minutes or more
3000	1 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

HINT:

Do not turn the ignition switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data are cleared.

9. Record the DTC(s), freeze frame data and misfire count.
10. Turn the ignition switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the ECM as freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the ECM as freeze frame data have been reproduced, one of the following factors can be considered to be a possible cause of the problem:**
    1. **There was insufficient fuel volume in the tank.**
    2. **Improper fuel was used.**
    3. **The spark plugs have been contaminated.**
- **After finishing repairs, check the misfire counts of the cylinders (Cylinder #1 Misfire Count to Cylinder #6 Misfire Count).**
- **Be sure to confirm that no misfiring cylinder DTCs are stored again by conducting the confirmation driving pattern after finishing repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speeds. If misfires occur only in high engine speed areas, only DTC P0300 is stored.**
  In the event of DTC P0300 being present, perform the following operations:
    1. **Clear the DTCs (Click here).**
    2. **Start the engine and conduct the confirmation driving pattern.**
    3. **Read the misfiring rates of each cylinder or DTC(s) using the intelligent tester.**
    4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
    5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not stored.**
- **When one of Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air fuel ratio may be Rich (-20% or less) or Lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is less than 75°C (167°F), the misfire may have occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel can cause body vibration, which may cause misfire DTC(s) to be stored.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

e. Read DTCs.

HINT:

Write down the DTCs.

Result

Display (DTC Output)	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305 and/or P0306	A
P0300, P0301, P0302, P0303, P0304, P0305 and/or P0306 and other DTCs	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305 and P0306 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

3.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is correctly connected and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE

OK

4.READ VALUE USING INTELLIGENT TESTER

(a) Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5 and #6.
(b) Read the value for Cylinder #1 Misfire Count to Cylinder #6 Misfire Count displayed on the intelligent tester. If no misfire counts occur in any cylinders, perform the following procedures:
(1) Start the engine and let it idle.
(2) Move the shift lever to D.
(3) Check the Cylinder #1 Misfire Count to Cylinder #6 Misfire Count.
(4) If misfire counts are still not displayed, perform steps (c) and (d).
(c) Drive the vehicle with the Misfire RPM and Misfire Load noted in the "Read value using intelligent tester (Misfire RPM and Misfire Load)" procedures above.
(d) Read the Cylinder #1 Misfire Count to Cylinder #6 Misfire Count or DTCs displayed on the intelligent tester.

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have equal misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data's record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data's record of Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → Go to step 17

A

5.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

b. Measure the spark plug electrode gap (Click here).

NG → REPLACE SPARK PLUG (Click here)

OK

6.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head.

c. Install the spark plug to the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check for sparks.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK HARNESS AND CONNECTOR (ECM - INJECTOR)

a. Disconnect the injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

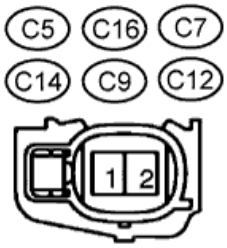
c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

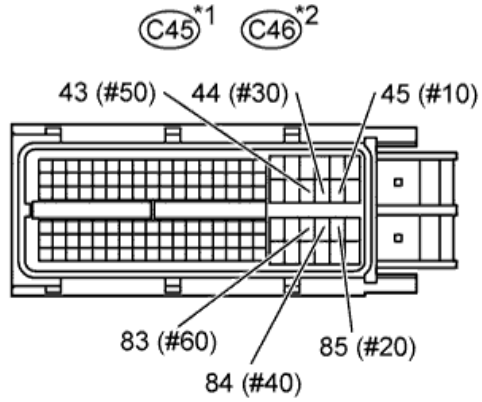
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Body ground	Ignition switch ON	11 to 14 V
No. 2	C16-1 - Body ground	Ignition switch ON	11 to 14 V
No. 3	C7-1 - Body ground	Ignition switch ON	11 to 14 V
No. 4	C14-1 - Body ground	Ignition switch ON	11 to 14 V
No. 5	C9-1 - Body ground	Ignition switch ON	11 to 14 V
No. 6	C12-1 - Body ground	Ignition switch ON	11 to 14 V

d. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance:

for LHD

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-45 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C45-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C45-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C45-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C45-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C45-83 (#60)	Always	Below 1 Ω

for RHD

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-45 (#10)	Always	Below 1 Ω
	C16-2 - Body		

No. 2	ground	Always	10 kΩ or higher
	C16-2 - C46-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C46-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C46-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C46-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C46-83 (#60)	Always	Below 1 Ω

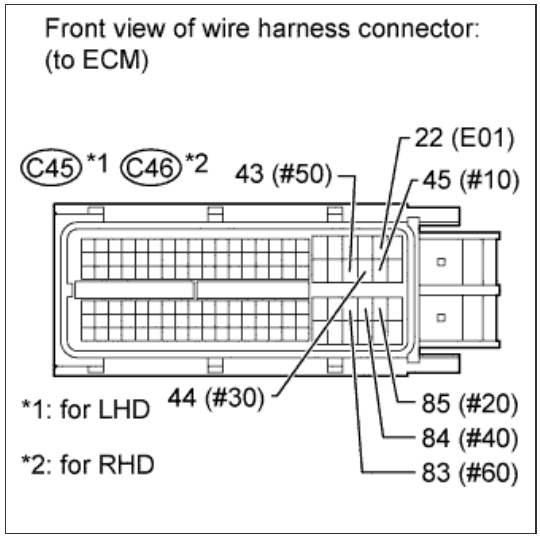
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50 AND/OR #60 VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for LHD

Tester Connection	Switch Condition	Specified Condition
C45-45 (#10) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-85 (#20) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-44 (#30) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-84 (#40) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-43 (#50) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-83 (#60) - C45-22 (E01)	Ignition switch ON	11 to 14 V

for RHD

Tester Connection	Switch Condition	Specified Condition
C46-45 (#10) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-85 (#20) - C46-22 (E01)	Ignition switch ON	11 to 14 V

C46-44 (#30) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-84 (#40) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-43 (#50) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-83 (#60) - C46-22 (E01)	Ignition switch ON	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection (whether fuel volume is large or small, and whether injection pattern is poor) (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (**Click here**)

OK

11.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

12.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK

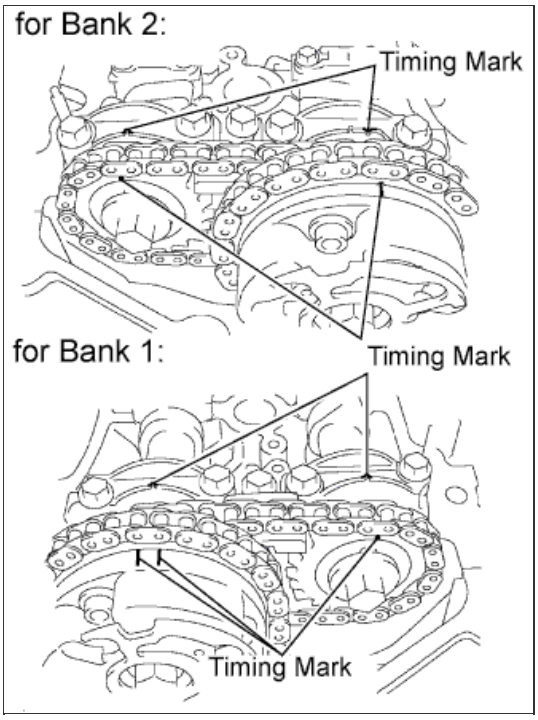
13.CHECK VALVE TIMING

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → ADJUST VALVE TIMING

OK

14.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER, AND REPLACE PARTS AS NECESSARY

OK

15.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Data List twice, when the engine is cold and when it is warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: 80 to 100°C (176 to 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

16.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

REPLACE ECM (Click here)

17.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

OK

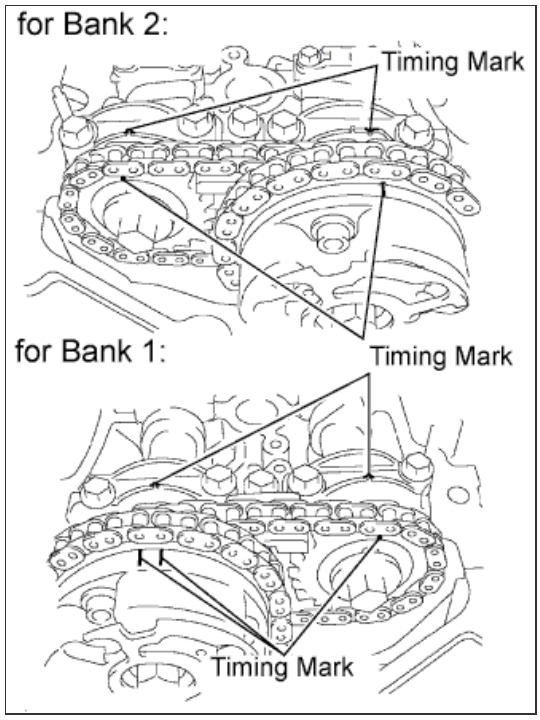
18.CHECK VALVE TIMING

a. Remove the cylinder head cover (for bank 1, Click here, or for bank 2, Click here).

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.



NG → **ADJUST VALVE TIMING**

OK

19.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → **CHECK FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER, AND REPLACE PARTS AS NECESSARY**

OK

20.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Data List twice, when the engine is cold and when it is warmed up.

Standard:
With cold engine: Same as ambient air temperature.

With warm engine: 80 to 100°C (176 to 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

21.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

22.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

b. Measure the spark plug electrode gap (Click here).

NG → REPLACE SPARK PLUG (Click here)

OK

23.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head.

c. Install the spark plug to the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check for sparks.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

24.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

25.CHECK HARNESS AND CONNECTOR (ECM - INJECTOR)

a. Disconnect the injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

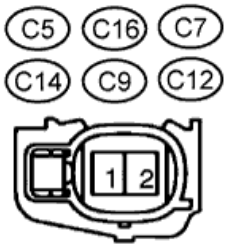
c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

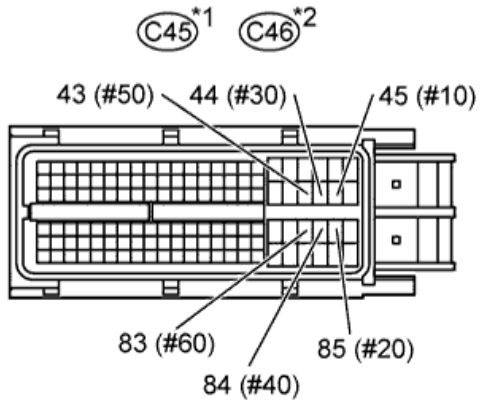
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Body ground	Ignition switch ON	11 to 14 V
No. 2	C16-1 - Body ground	Ignition switch ON	11 to 14 V
No. 3	C7-1 - Body ground	Ignition switch ON	11 to 14 V
No. 4	C14-1 - Body ground	Ignition switch ON	11 to 14 V
No. 5	C9-1 - Body ground	Ignition switch ON	11 to 14 V
No. 6	C12-1 - Body ground	Ignition switch ON	11 to 14 V

d. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector: (to Injector)



Front view of wire harness connector: (to ECM)



*1: for LHD

*2: for RHD

Standard Resistance:

for LHD

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-45 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C45-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C45-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C45-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C45-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C45-83 (#60)	Always	Below 1 Ω

for RHD

Cylinder	Tester Connection	Condition	Specified Condition

No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-45 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C46-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C46-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C46-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C46-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C46-83 (#60)	Always	Below 1 Ω

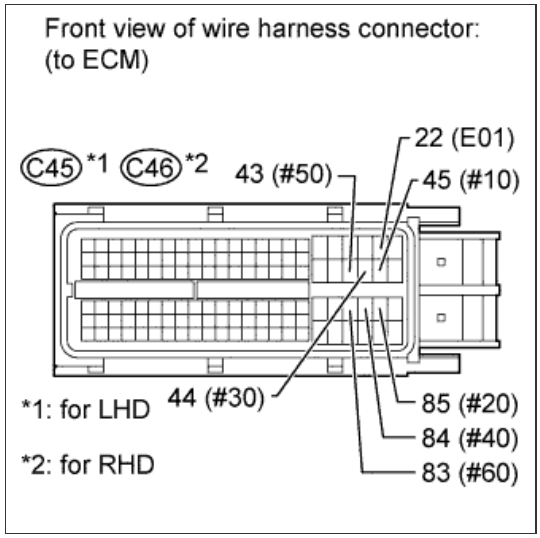
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50 AND/OR #60 VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for LHD

Tester Connection	Switch Condition	Specified Condition
C45-45 (#10) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-85 (#20) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-44 (#30) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-84 (#40) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-43 (#50) - C45-22 (E01)	Ignition switch ON	11 to 14 V
C45-83 (#60) - C45-22 (E01)	Ignition switch ON	11 to 14 V

for RHD

Tester Connection	Switch Condition	Specified Condition
C46-45 (#10) - C46-22	Ignition switch	

(E01)	ON	11 to 14 V
C46-85 (#20) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-44 (#30) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-84 (#40) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-43 (#50) - C46-22 (E01)	Ignition switch ON	11 to 14 V
C46-83 (#60) - C46-22 (E01)	Ignition switch ON	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

27.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection (whether fuel volume is large or small, and whether injection pattern is poor) (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (Click here)

OK

28.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (Click here)

OK

REPLACE ECM (Click here)

29.REPLACE SPARK PLUG WITH NORMAL ONE AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the installed spark plug with a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect all the injector connectors.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:

Sparks jump across electrode gap.

NG → Go to step 30

OK

REPLACE SPARK PLUG (Click here)

30.REPLACE IGNITION COIL WITH NORMAL ONE AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the installed ignition coil with a ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect all the injector connectors.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK → REPLACE IGNITION COIL (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

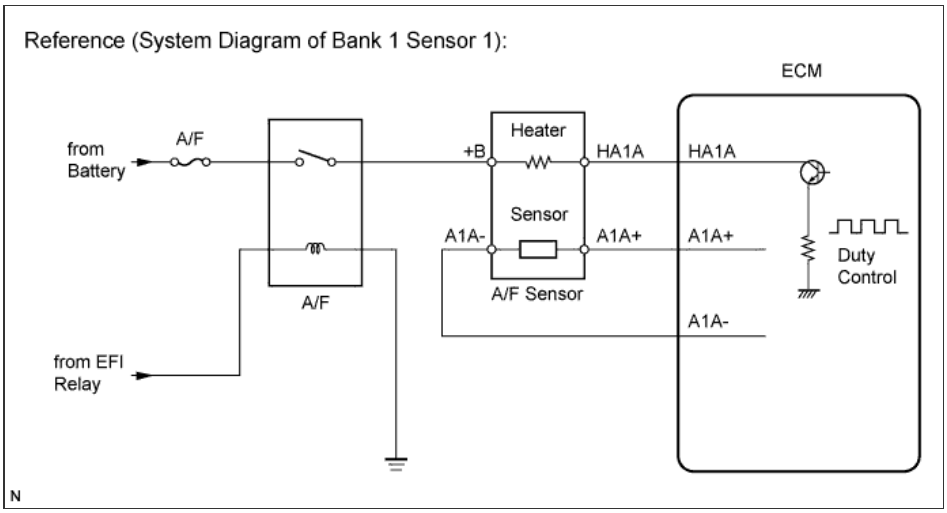
for Preparation Click here

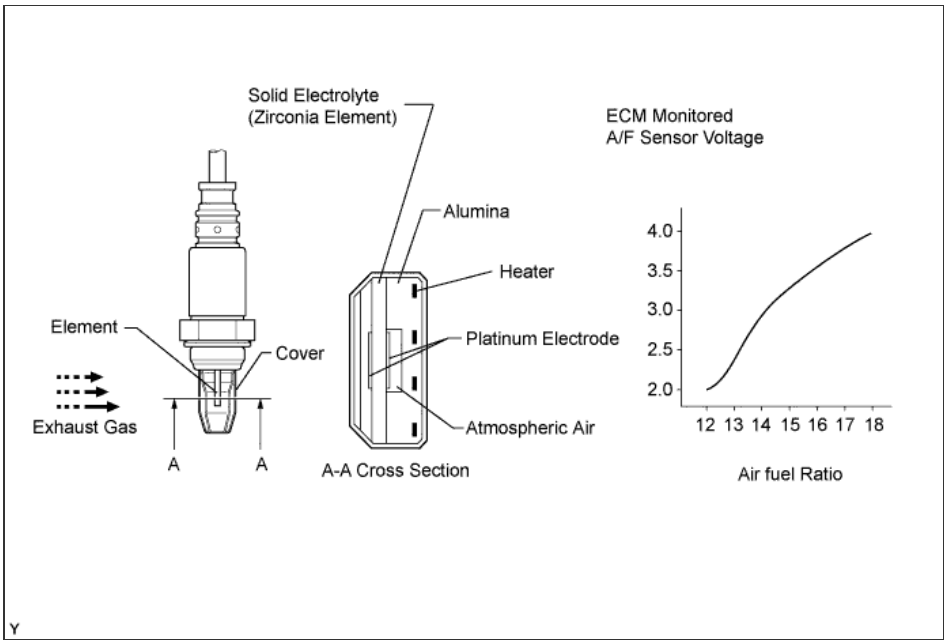
DESCRIPTION

HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air Fuel ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**

The A/F sensor, which is located between the exhaust manifold and catalyst, consists of alloyed metal elements and a heater.
Depending on the engine operating conditions, the heater heats the sensor elements to activate them. Battery voltage is applied to the heater, and the sensor ground is controlled by the ECM using a duty ratio.
The sensor elements convert the oxygen concentration in the exhaust gas into voltage values to output. Based on the voltage, the ECM determines the air fuel ratio and regulates the fuel injection volume depending on the air fuel ratio and engine operating conditions. The voltage changes between 0.6 V and 4.5 V while the engine is running. If the air fuel ratio is lean, which means the oxygen concentration in the exhaust gas is high, the voltage is high. If the air fuel ratio is rich, which means the oxygen concentration in the exhaust gas is low, the voltage is low.





DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals A1A+/A2A+ and A1A-/A2A- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2238 P2241	Any of the following conditions are met (2 trip detection logic): • The A/F sensor output drops while the engine is running. • The voltage at terminal A1A+/A2A+ is 0.5 V or less. • The voltage difference between terminals A1A+/A2A+ and A1A-/A2A- is 0.1 V or less.	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2239 P2242	The A1A+/A2A+ voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2252 P2255	The A1A-/A2A- voltage is 0.5 V or less (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2253 P2256	The A1A-/A2A- voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM

MONITOR DESCRIPTION

These DTCs are stored when there is an open or short in the A/F sensor circuit, or if A/F sensor output drops. To detect these problems, the voltage of the A/F sensor is monitored when turning the ignition switch to ON, and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is out of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in next driving cycle, the MIL will be illuminated and a DTC will be stored.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

CONFIRMATION DRIVING PATTERN

1. Start the engine and wait for 5 minutes or more.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **On the tester, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.**

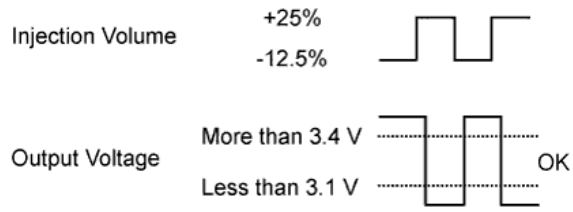
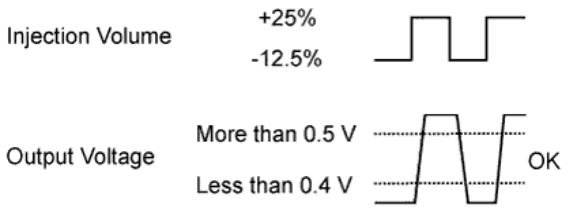
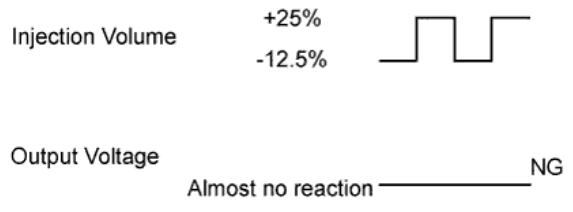
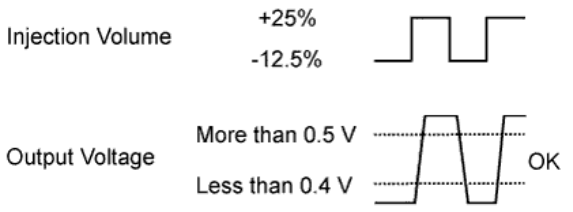
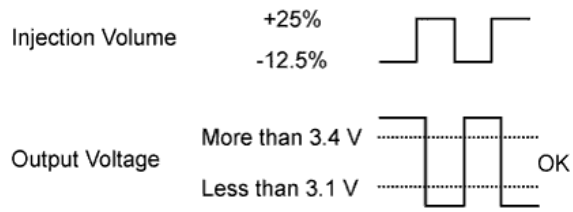
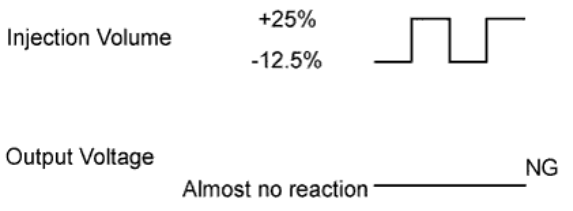
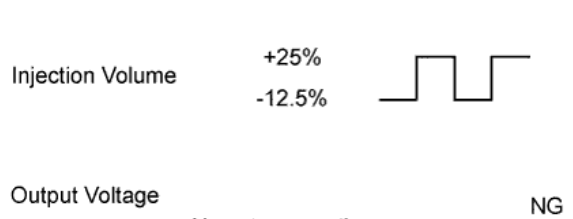
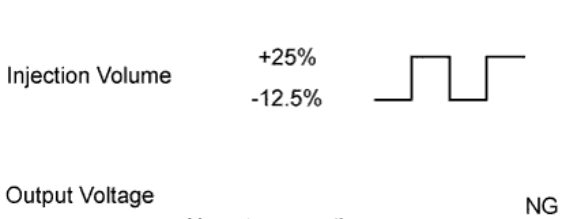
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	more than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	more than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	less than 0.4 V

NOTICE:

The Air Fuel ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the Air Fuel ratio (A/F) sensor connector.

b. Turn the ignition switch to ON.

c. Measure the voltage according to the value(s) in the table below.

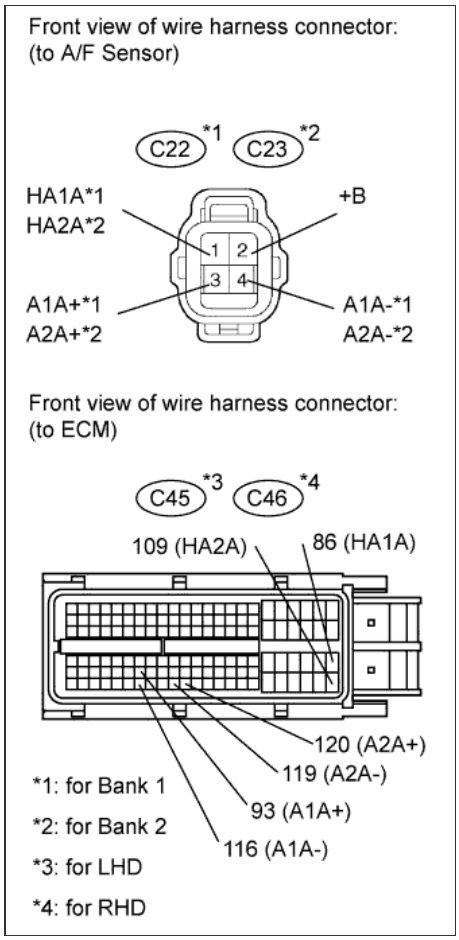
Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Ignition switch ON	11 to 14 V
C23-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

d. Turn the ignition switch off.

e. Disconnect the ECM connector.

f. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-93 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-116 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-120 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-119 (A2A-)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω

C22-3 (A1A+) - C46-93 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-116 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-120 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-119 (A2A-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-93 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-116 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-120 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-119 (A2A-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-93 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-116 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-120 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-119 (A2A-) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

4.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read the pending DTCs.

Result

Result	Proceed to
No output	A
P2237, P2240, P2238, P2241, P2239, P2242, P2252, P2255, P2253 or P2256 output	B

B

REPLACE ECM (Click here)

A

END

DTC P0327 Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)

DTC P0328 Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)

DTC P0332 Knock Sensor 2 Circuit Low Input (Bank 2)

DTC P0333 Knock Sensor 2 Circuit High Input (Bank 2)

for Preparation Click here

DESCRIPTION

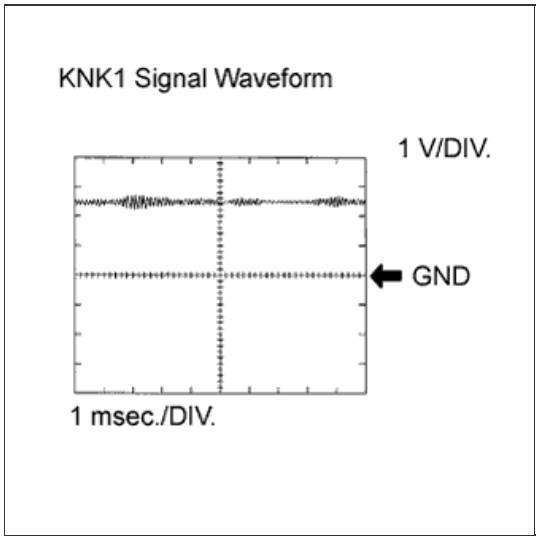
Flat type knock sensors (non-resonant type) have structures that can detect vibrations between approximately 6 kHz and 15 kHz.
A knock sensor is fitted onto the engine block to detect engine knocking.
The knock sensor contains a piezoelectric element which generates a voltage when it becomes deformed.
The voltage is generated when the engine block vibrates due to knocking. Any occurrence of engine knocking can be suppressed by delaying the ignition timing.

DTC Code	DTC Detection Condition	Trouble Area
P0327 P0332	The output voltage of the knock sensor is below 0.5 V (1 trip detection logic).	• Short in knock sensor circuit • Knock sensor • ECM
P0328 P0333	The output voltage of the knock sensor is higher than 4.5 V (1 trip detection logic).	• Open in knock sensor circuit • Knock sensor • ECM

HINT:

When any of DTCs P0327, P0328, P0332 and P0333 are stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is delayed to its maximum retardation. Fail-safe mode continues until the ignition switch is turned off.

Reference: Inspection using an oscilloscope



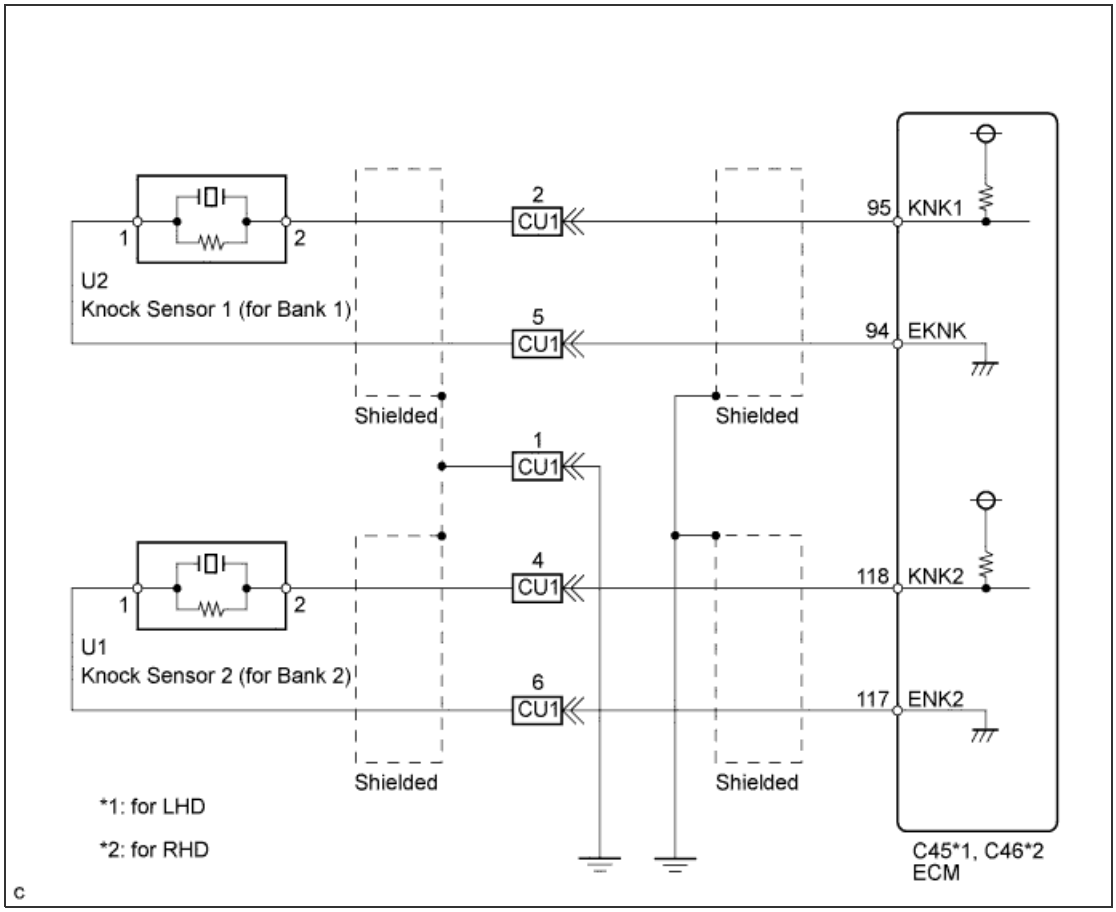
The correct waveform is as shown.

Item	Content
Terminal	KNK1 - EKNK KNK2 - EKN2
Equipment Setting	1 V/DIV. 1 msec./DIV.
Condition	Engine speed maintained at 4000 rpm with warm engine

MONITOR DESCRIPTION

If the output voltage transmitted by the knock sensor remains low or high for more than 1 second, the ECM interprets this as a malfunction in the sensor circuit, and stores a DTC.
The monitor for DTCs P0327, P0328, P0332 and P0333 begins to run when 5 seconds have elapsed since the engine was started.
If the malfunction is not repaired successfully, DTC P0327, P0328, P0332 or P0333 is stored 5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **DTCs P0327 and P0328 are for the bank 1 knock sensor circuit.**
- **DTCs P0332 and P0333 are for the bank 2 knock sensor circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ DTC OUTPUT (CHECK KNOCK SENSOR CIRCUIT)

a. Disconnect the CU1 connector.

b. Using lead wires, connect the connectors as follows:

Male Connector - Female Connector
Terminal 2 - Terminal 4
Terminal 5 - Terminal 6
Terminal 4 - Terminal 2
Terminal 6 - Terminal 5

c. Warm up the engine.

d. Run the engine at 3000 rpm for 10 seconds or more.

e. Connect the intelligent tester to the DLC3.

f. Turn the tester on.

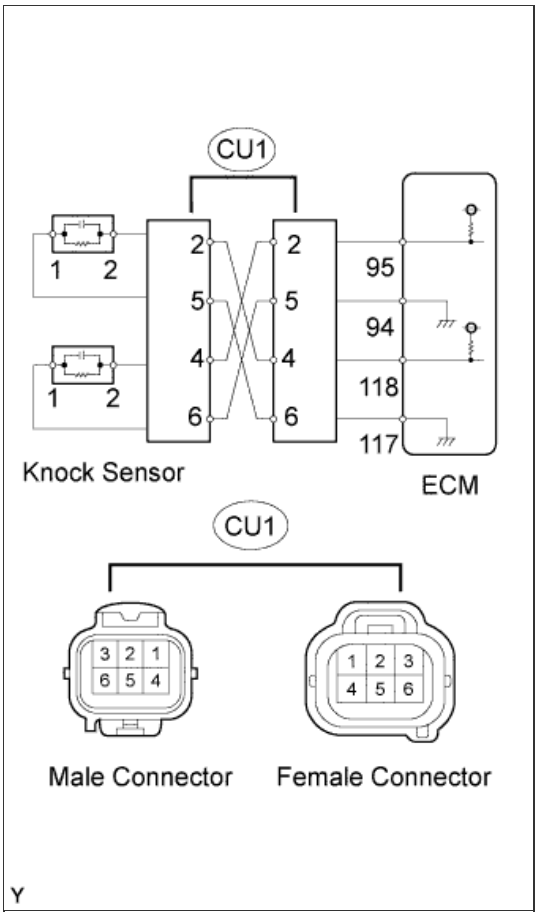
g. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

h. Read the DTCs.

Result

Result	Proceed to
DTC is same as when vehicle brought in (for example, P0327 and P0328 are output again, or	A

P0332 and P0333 are output again)	
DTC is different from when vehicle brought in (for example, P0327 and P0328 are output at first, but then P0332 and P0333 are output, or vice versa)	B



B → Go to step 4

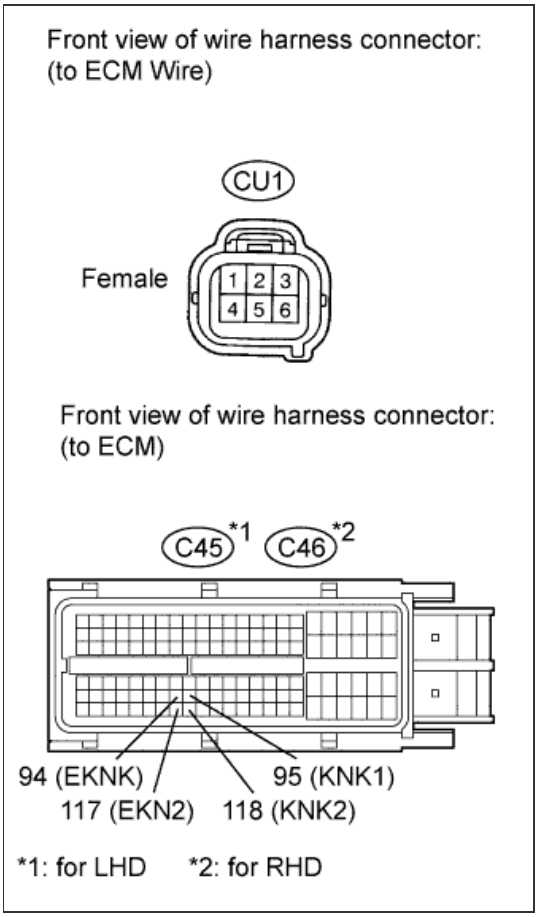
A

2.CHECK HARNESS AND CONNECTOR (CONNECTOR - ECM)

a. Disconnect the CU1 connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
CU1 female connector 2 - C45-95 (KNK1)	Always	Below 1 Ω
CU1 female connector 5 - C45-94 (EKNK)	Always	Below 1 Ω
CU1 female connector 4 - C45-118 (KNK2)	Always	Below 1 Ω
CU1 female connector 6 - C45-117 (EKN2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
CU1 female connector 2 - C46-95 (KNK1)	Always	Below 1 Ω
CU1 female connector 5 - C46-94 (EKNK)	Always	Below 1 Ω
CU1 female connector 4 - C46-118 (KNK2)	Always	Below 1 Ω
CU1 female connector 6 - C46-117 (EKN2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
CU1 female connector 2 or C45-95 (KNK1) - Body ground	Always	10 kΩ or higher
CU1 female connector 5 or C45-94 (EKNK) - Body ground	Always	10 kΩ or higher
CU1 female connector 4 or C45-118 (KNK2) - Body ground	Always	10 kΩ or higher
CU1 female connector 6 or C45-117 (EKN2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
CU1 female connector 2 or C46-95 (KNK1) - Body ground	Always	10 kΩ or higher
CU1 female connector 5 or C46-94 (EKNK) - Body ground	Always	10 kΩ or higher
CU1 female connector 4 or C46-118 (KNK2) - Body ground	Always	10 kΩ or higher
CU1 female connector 6 or C46-117 (EKN2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT ECM (VOLTAGE)

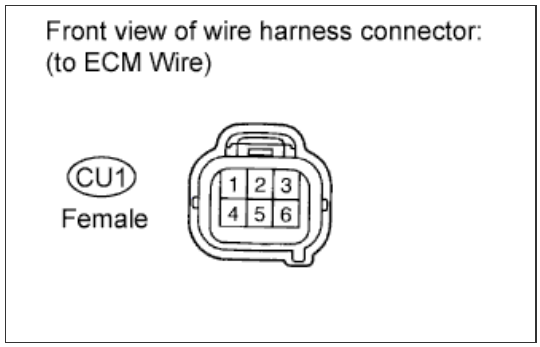
a. Disconnect the CU1 connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
CU1 female connector 2 - 5	Ignition switch ON	4.5 to 5.5 V

CU1 female connector 4 - 6	Ignition switch ON	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

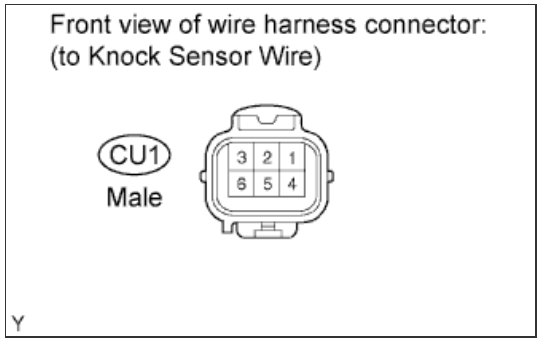
4.INSPECT KNOCK SENSOR

a. Disconnect the CU1 connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
CU1 male connector 2 - 5	20°C (68°F)	120 to 280 kΩ
CU1 male connector 4 - 6	20°C (68°F)	120 to 280 kΩ



NG → Go to step 5

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

5.CHECK HARNESS AND CONNECTOR (CONNECTOR - KNOCK SENSOR)

HINT:

- **If DTC P0327 or P0328 has changed to P0332 or P0333, check the knock sensor circuit on the right bank side.**
- **If DTC P0332 or P0333 has changed to P0327 or P0328, check the knock sensor circuit on the left bank side.**

a. Disconnect the CU1 connector.

b. Disconnect the knock sensor connectors.

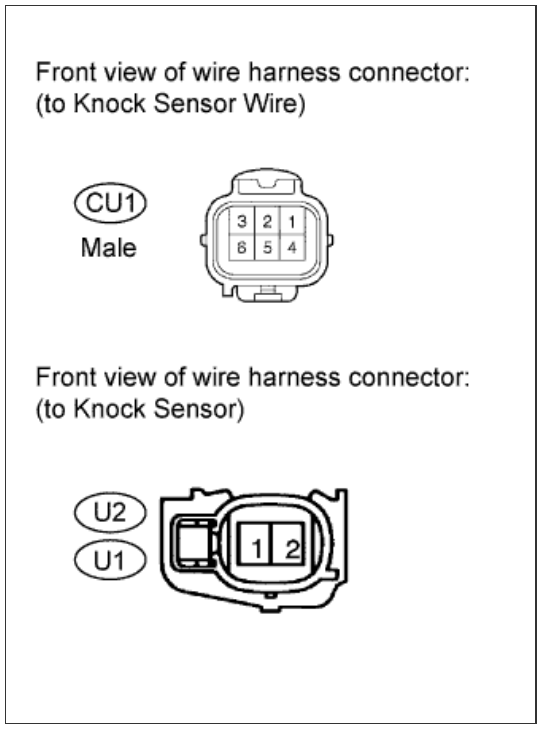
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
CU1 male connector 2 - U2-2	Always	Below 1 Ω
CU1 male connector 5 - U2-1	Always	Below 1 Ω
CU1 male connector 4 - U1-2	Always	Below 1 Ω
CU1 male connector 6 - U1-1	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
CU1 male		



connector 2 or U2-2 - Body ground	Always	10 kΩ or higher
CU1 male connector 5 or U2-1 - Body ground	Always	10 kΩ or higher
CU1 male connector 4 or U1-2 - Body ground	Always	10 kΩ or higher
CU1 male connector 6 or U1-1 - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE KNOCK SENSOR (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

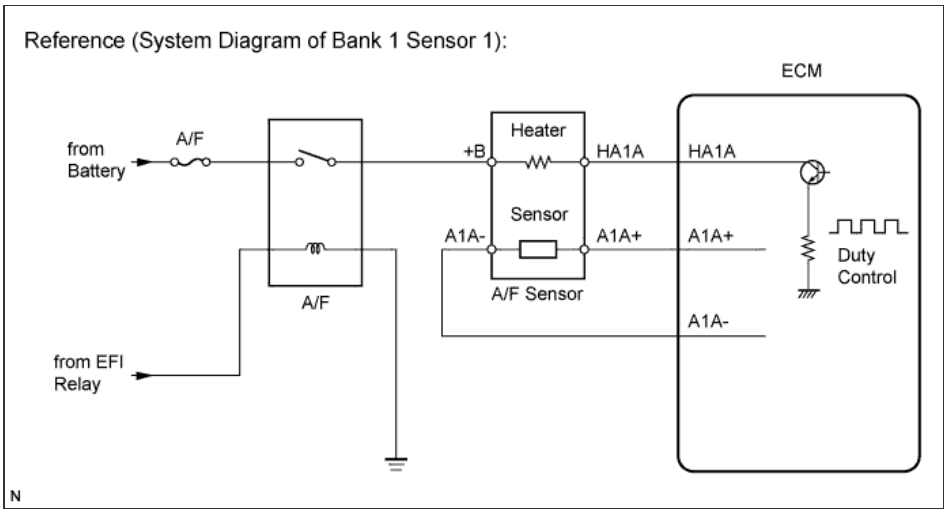
for Preparation Click here

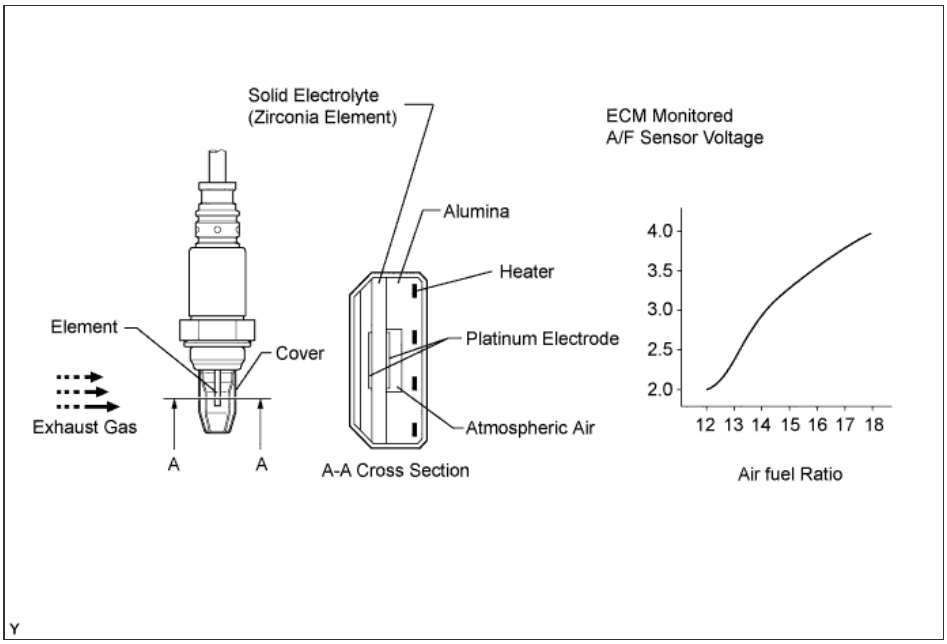
DESCRIPTION

HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air Fuel ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**

The A/F sensor, which is located between the exhaust manifold and catalyst, consists of alloyed metal elements and a heater.
Depending on the engine operating conditions, the heater heats the sensor elements to activate them. Battery voltage is applied to the heater, and the sensor ground is controlled by the ECM using a duty ratio.
The sensor elements convert the oxygen concentration in the exhaust gas into voltage values to output. Based on the voltage, the ECM determines the air fuel ratio and regulates the fuel injection volume depending on the air fuel ratio and engine operating conditions. The voltage changes between 0.6 V and 4.5 V while the engine is running. If the air fuel ratio is lean, which means the oxygen concentration in the exhaust gas is high, the voltage is high. If the air fuel ratio is rich, which means the oxygen concentration in the exhaust gas is low, the voltage is low.





DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals A1A+/A2A+ and A1A-/A2A- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2238 P2241	Any of the following conditions are met (2 trip detection logic): • The A/F sensor output drops while the engine is running. • The voltage at terminal A1A+/A2A+ is 0.5 V or less. • The voltage difference between terminals A1A+/A2A+ and A1A-/A2A- is 0.1 V or less.	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2239 P2242	The A1A+/A2A+ voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2252 P2255	The A1A-/A2A- voltage is 0.5 V or less (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2253 P2256	The A1A-/A2A- voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM

MONITOR DESCRIPTION

These DTCs are stored when there is an open or short in the A/F sensor circuit, or if A/F sensor output drops. To detect these problems, the voltage of the A/F sensor is monitored when turning the ignition switch to ON, and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is out of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in next driving cycle, the MIL will be illuminated and a DTC will be stored.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

CONFIRMATION DRIVING PATTERN

1. Start the engine and wait for 5 minutes or more.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **On the tester, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.**

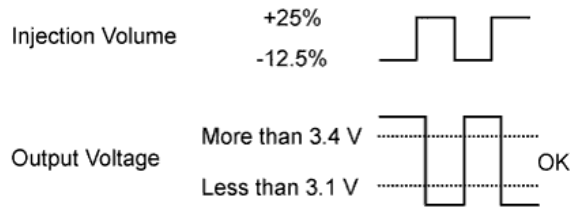
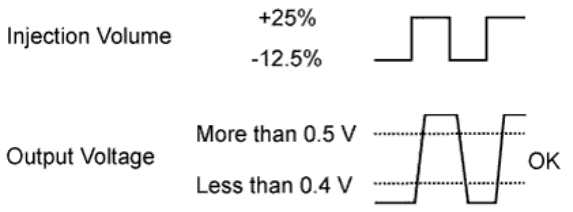
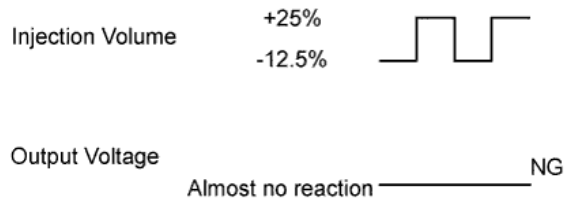
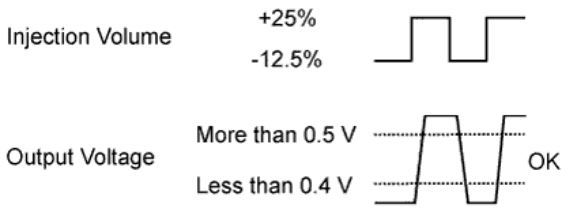
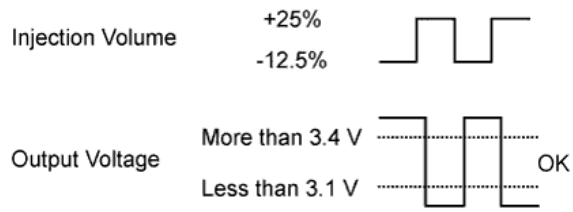
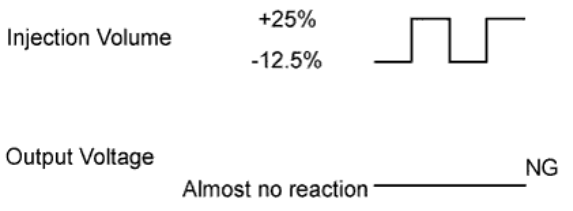
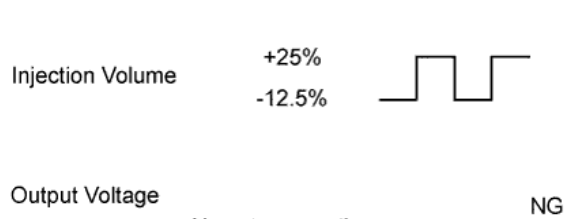
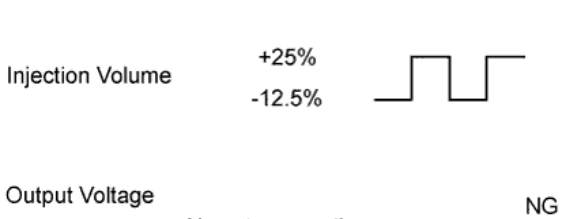
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	more than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	more than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	less than 0.4 V

NOTICE:

The Air Fuel ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the Air Fuel ratio (A/F) sensor connector.

b. Turn the ignition switch to ON.

c. Measure the voltage according to the value(s) in the table below.

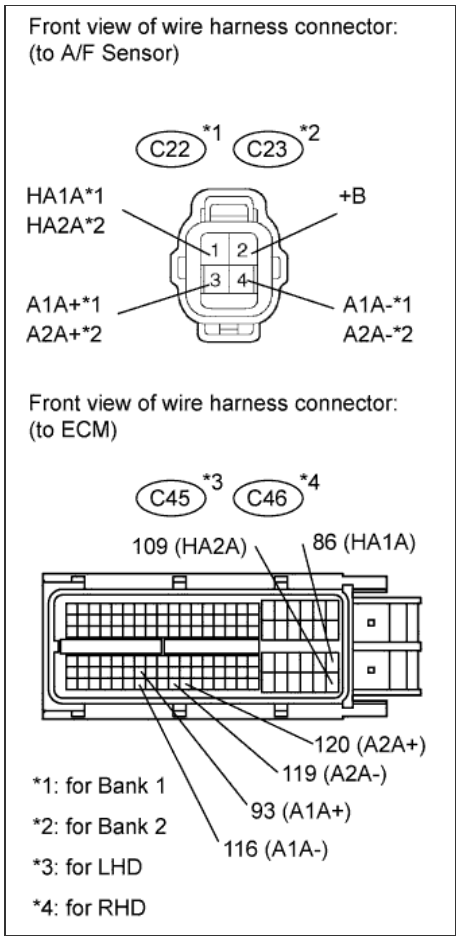
Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Ignition switch ON	11 to 14 V
C23-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

d. Turn the ignition switch off.

e. Disconnect the ECM connector.

f. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-93 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-116 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-120 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-119 (A2A-)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω

C22-3 (A1A+) - C46-93 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-116 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-120 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-119 (A2A-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-93 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-116 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-120 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-119 (A2A-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-93 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-116 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-120 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-119 (A2A-) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

4.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read the pending DTCs.

Result

Result	Proceed to
No output	A
P2237, P2240, P2238, P2241, P2239, P2242, P2252, P2255, P2253 or P2256 output	B

B

REPLACE ECM (Click here)

A

END

DTC P0327 Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)

DTC P0328 Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)

DTC P0332 Knock Sensor 2 Circuit Low Input (Bank 2)

DTC P0333 Knock Sensor 2 Circuit High Input (Bank 2)

for Preparation Click here

DESCRIPTION

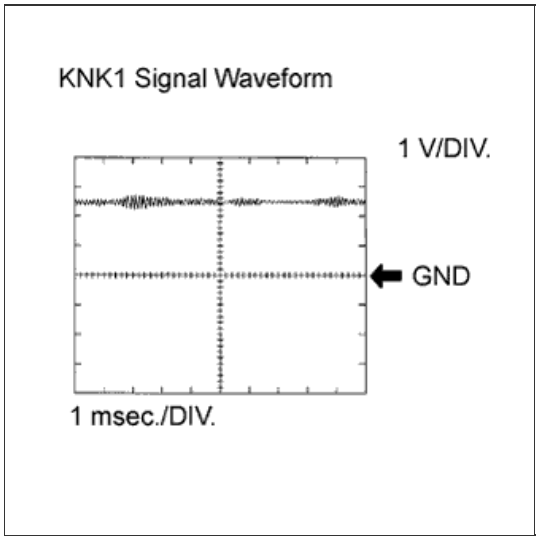
Flat type knock sensors (non-resonant type) have structures that can detect vibrations between approximately 6 kHz and 15 kHz.
A knock sensor is fitted onto the engine block to detect engine knocking.
The knock sensor contains a piezoelectric element which generates a voltage when it becomes deformed.
The voltage is generated when the engine block vibrates due to knocking. Any occurrence of engine knocking can be suppressed by delaying the ignition timing.

DTC Code	DTC Detection Condition	Trouble Area
P0327 P0332	The output voltage of the knock sensor is below 0.5 V (1 trip detection logic).	• Short in knock sensor circuit • Knock sensor • ECM
P0328 P0333	The output voltage of the knock sensor is higher than 4.5 V (1 trip detection logic).	• Open in knock sensor circuit • Knock sensor • ECM

HINT:

When any of DTCs P0327, P0328, P0332 and P0333 are stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is delayed to its maximum retardation. Fail-safe mode continues until the ignition switch is turned off.

Reference: Inspection using an oscilloscope



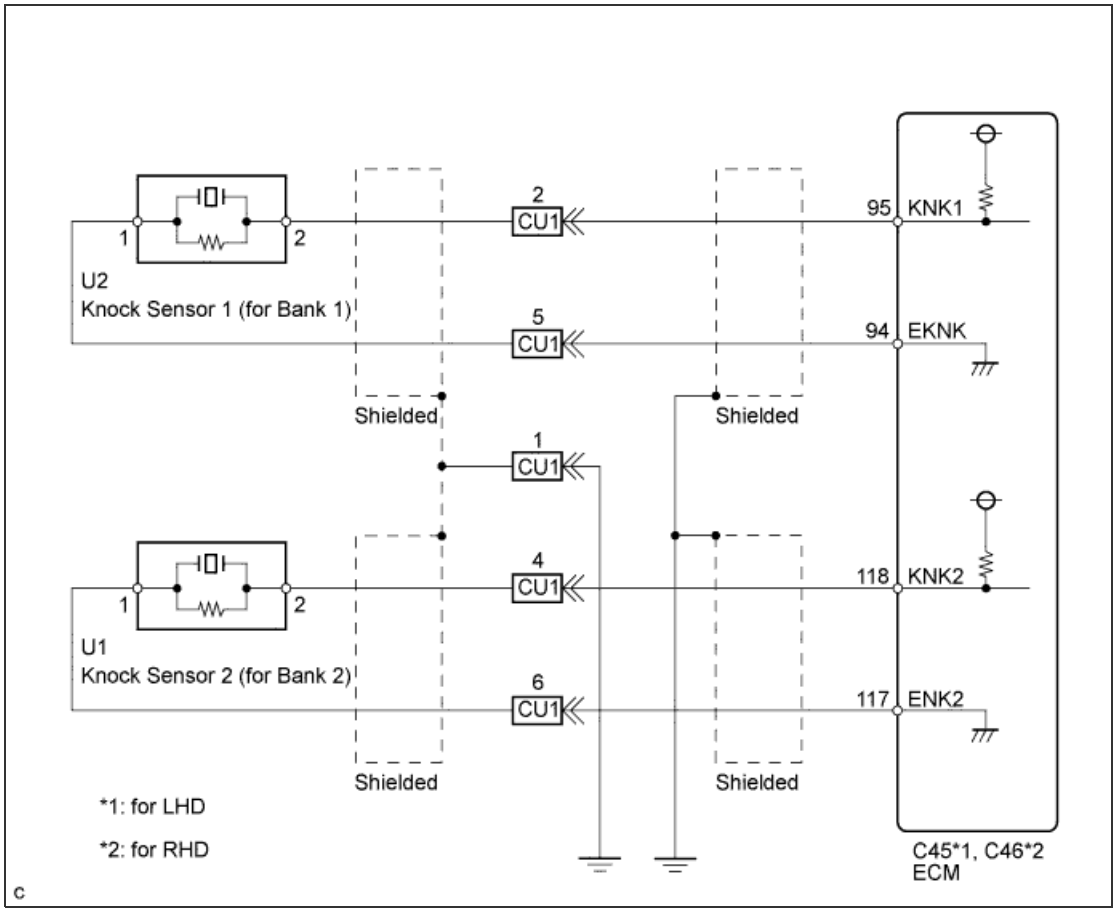
The correct waveform is as shown.

Item	Content
Terminal	KNK1 - EKNK KNK2 - EKN2
Equipment Setting	1 V/DIV. 1 msec./DIV.
Condition	Engine speed maintained at 4000 rpm with warm engine

MONITOR DESCRIPTION

If the output voltage transmitted by the knock sensor remains low or high for more than 1 second, the ECM interprets this as a malfunction in the sensor circuit, and stores a DTC.
The monitor for DTCs P0327, P0328, P0332 and P0333 begins to run when 5 seconds have elapsed since the engine was started.
If the malfunction is not repaired successfully, DTC P0327, P0328, P0332 or P0333 is stored 5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **DTCs P0327 and P0328 are for the bank 1 knock sensor circuit.**
- **DTCs P0332 and P0333 are for the bank 2 knock sensor circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ DTC OUTPUT (CHECK KNOCK SENSOR CIRCUIT)

a. Disconnect the CU1 connector.

b. Using lead wires, connect the connectors as follows:

Male Connector - Female Connector
Terminal 2 - Terminal 4
Terminal 5 - Terminal 6
Terminal 4 - Terminal 2
Terminal 6 - Terminal 5

c. Warm up the engine.

d. Run the engine at 3000 rpm for 10 seconds or more.

e. Connect the intelligent tester to the DLC3.

f. Turn the tester on.

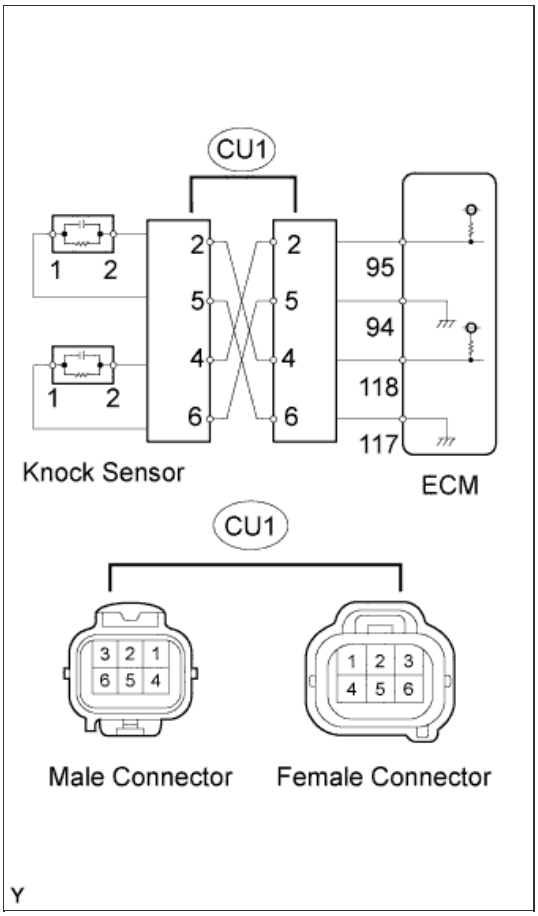
g. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

h. Read the DTCs.

Result

Result	Proceed to
DTC is same as when vehicle brought in (for example, P0327 and P0328 are output again, or	A

P0332 and P0333 are output again)	
DTC is different from when vehicle brought in (for example, P0327 and P0328 are output at first, but then P0332 and P0333 are output, or vice versa)	B



B → Go to step 4

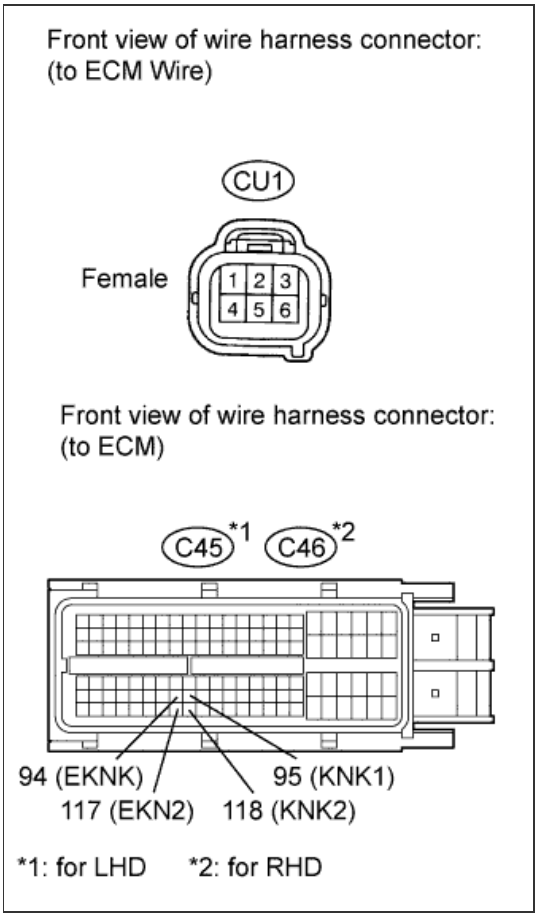
A

2.CHECK HARNESS AND CONNECTOR (CONNECTOR - ECM)

a. Disconnect the CU1 connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
CU1 female connector 2 - C45-95 (KNK1)	Always	Below 1 Ω
CU1 female connector 5 - C45-94 (EKNK)	Always	Below 1 Ω
CU1 female connector 4 - C45-118 (KNK2)	Always	Below 1 Ω
CU1 female connector 6 - C45-117 (EKN2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
CU1 female connector 2 - C46-95 (KNK1)	Always	Below 1 Ω
CU1 female connector 5 - C46-94 (EKNK)	Always	Below 1 Ω
CU1 female connector 4 - C46-118 (KNK2)	Always	Below 1 Ω
CU1 female connector 6 - C46-117 (EKN2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
CU1 female connector 2 or C45-95 (KNK1) - Body ground	Always	10 kΩ or higher
CU1 female connector 5 or C45-94 (EKNK) - Body ground	Always	10 kΩ or higher
CU1 female connector 4 or C45-118 (KNK2) - Body ground	Always	10 kΩ or higher
CU1 female connector 6 or C45-117 (EKN2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
CU1 female connector 2 or C46-95 (KNK1) - Body ground	Always	10 kΩ or higher
CU1 female connector 5 or C46-94 (EKNK) - Body ground	Always	10 kΩ or higher
CU1 female connector 4 or C46-118 (KNK2) - Body ground	Always	10 kΩ or higher
CU1 female connector 6 or C46-117 (EKN2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT ECM (VOLTAGE)

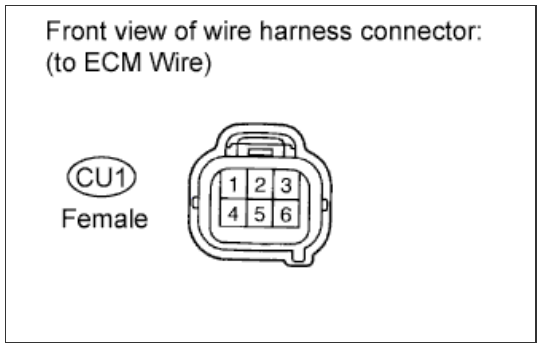
a. Disconnect the CU1 connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
CU1 female connector 2 - 5	Ignition switch ON	4.5 to 5.5 V

CU1 female connector 4 - 6	Ignition switch ON	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

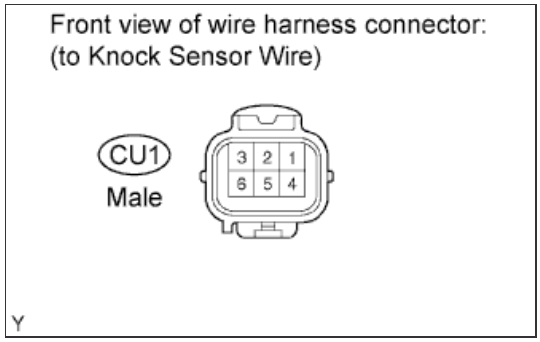
4.INSPECT KNOCK SENSOR

a. Disconnect the CU1 connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
CU1 male connector 2 - 5	20°C (68°F)	120 to 280 kΩ
CU1 male connector 4 - 6	20°C (68°F)	120 to 280 kΩ



NG → Go to step 5

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

5.CHECK HARNESS AND CONNECTOR (CONNECTOR - KNOCK SENSOR)

HINT:

- **If DTC P0327 or P0328 has changed to P0332 or P0333, check the knock sensor circuit on the right bank side.**
- **If DTC P0332 or P0333 has changed to P0327 or P0328, check the knock sensor circuit on the left bank side.**

a. Disconnect the CU1 connector.

b. Disconnect the knock sensor connectors.

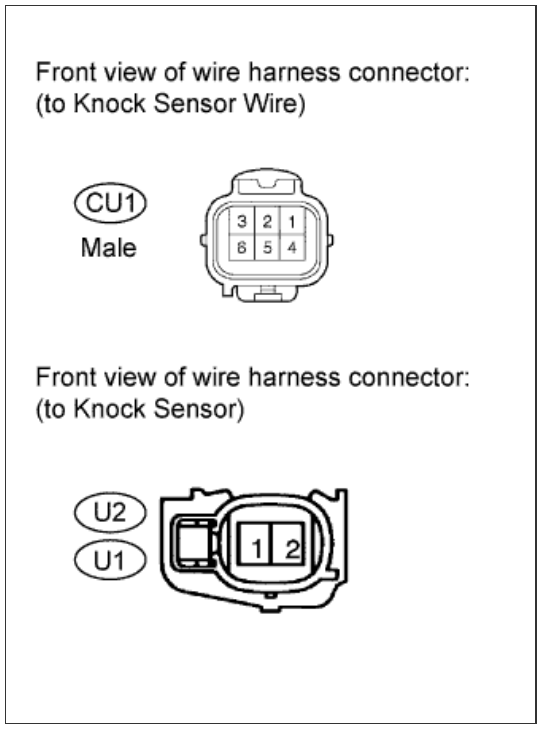
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
CU1 male connector 2 - U2-2	Always	Below 1 Ω
CU1 male connector 5 - U2-1	Always	Below 1 Ω
CU1 male connector 4 - U1-2	Always	Below 1 Ω
CU1 male connector 6 - U1-1	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
CU1 male		



connector 2 or U2-2 - Body ground	Always	10 kΩ or higher
CU1 male connector 5 or U2-1 - Body ground	Always	10 kΩ or higher
CU1 male connector 4 or U1-2 - Body ground	Always	10 kΩ or higher
CU1 male connector 6 or U1-1 - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE KNOCK SENSOR (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

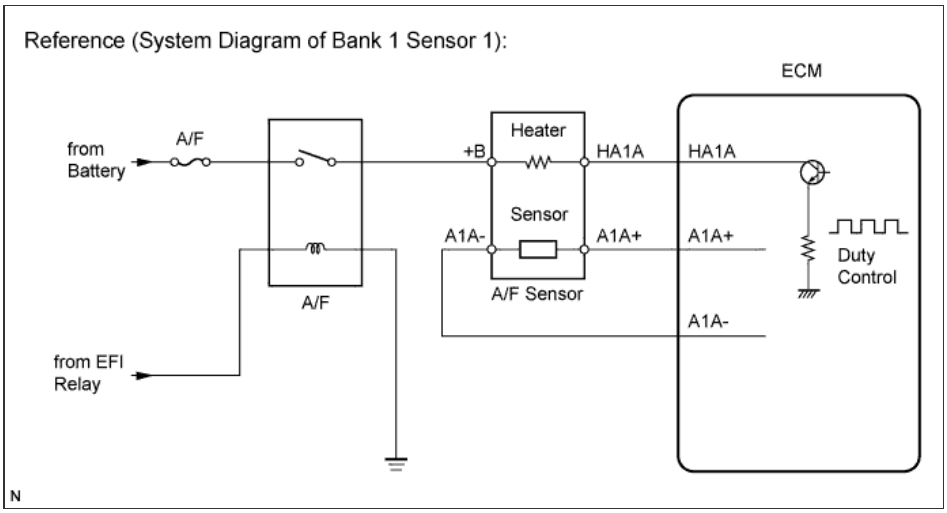
for Preparation Click here

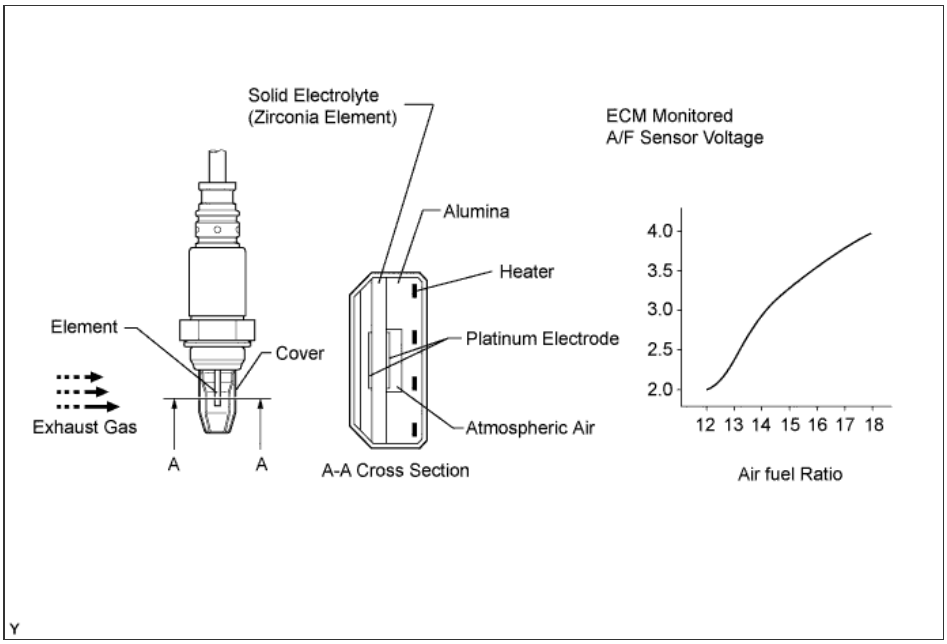
DESCRIPTION

HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air Fuel ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**

The A/F sensor, which is located between the exhaust manifold and catalyst, consists of alloyed metal elements and a heater.
Depending on the engine operating conditions, the heater heats the sensor elements to activate them. Battery voltage is applied to the heater, and the sensor ground is controlled by the ECM using a duty ratio.
The sensor elements convert the oxygen concentration in the exhaust gas into voltage values to output. Based on the voltage, the ECM determines the air fuel ratio and regulates the fuel injection volume depending on the air fuel ratio and engine operating conditions. The voltage changes between 0.6 V and 4.5 V while the engine is running. If the air fuel ratio is lean, which means the oxygen concentration in the exhaust gas is high, the voltage is high. If the air fuel ratio is rich, which means the oxygen concentration in the exhaust gas is low, the voltage is low.





DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals A1A+/A2A+ and A1A-/A2A- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2238 P2241	Any of the following conditions are met (2 trip detection logic): • The A/F sensor output drops while the engine is running. • The voltage at terminal A1A+/A2A+ is 0.5 V or less. • The voltage difference between terminals A1A+/A2A+ and A1A-/A2A- is 0.1 V or less.	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2239 P2242	The A1A+/A2A+ voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2252 P2255	The A1A-/A2A- voltage is 0.5 V or less (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2253 P2256	The A1A-/A2A- voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM

MONITOR DESCRIPTION

These DTCs are stored when there is an open or short in the A/F sensor circuit, or if A/F sensor output drops. To detect these problems, the voltage of the A/F sensor is monitored when turning the ignition switch to ON, and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is out of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in next driving cycle, the MIL will be illuminated and a DTC will be stored.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

CONFIRMATION DRIVING PATTERN

1. Start the engine and wait for 5 minutes or more.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **On the tester, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.**

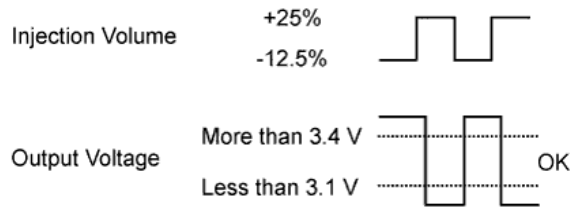
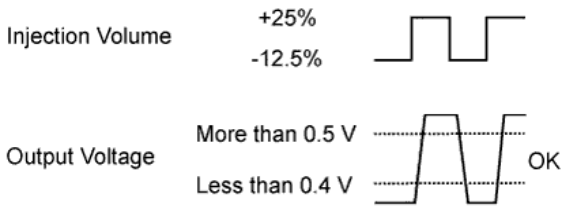
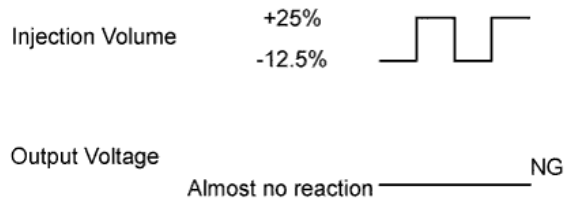
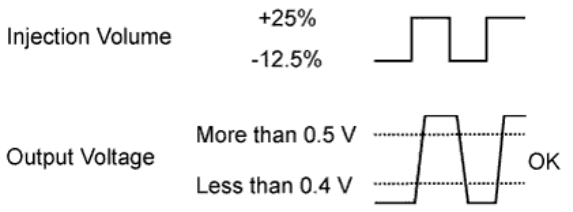
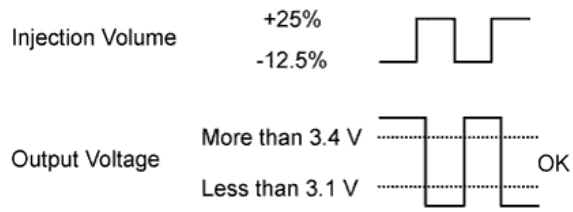
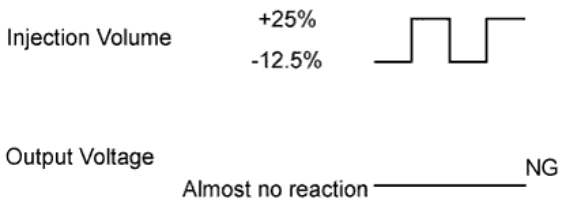
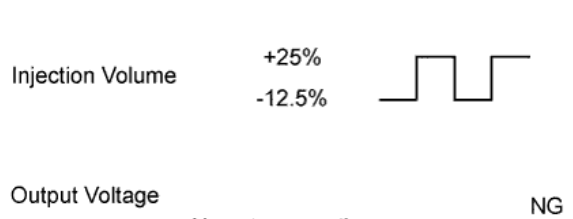
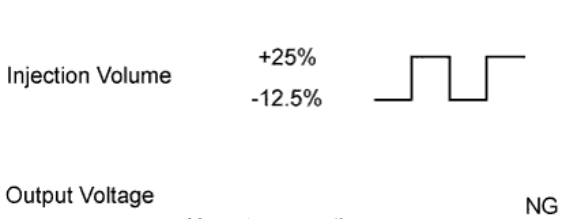
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	more than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	more than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	less than 0.4 V

NOTICE:

The Air Fuel ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the Air Fuel ratio (A/F) sensor connector.

b. Turn the ignition switch to ON.

c. Measure the voltage according to the value(s) in the table below.

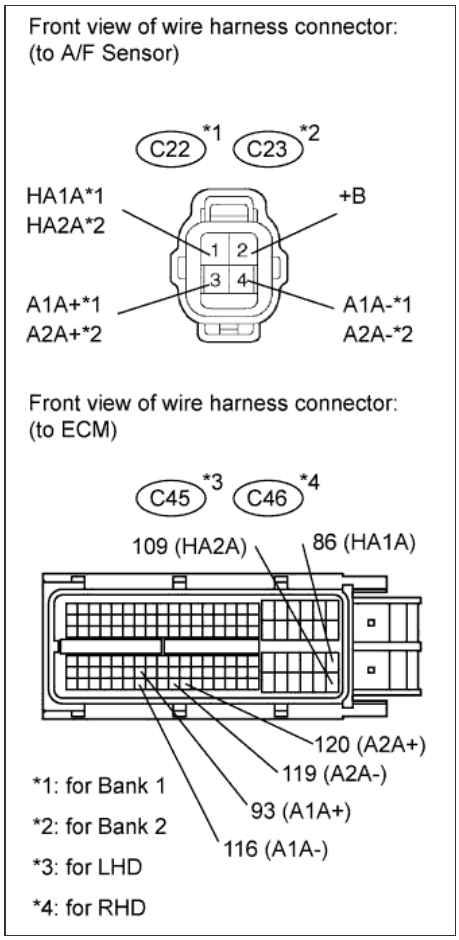
Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Ignition switch ON	11 to 14 V
C23-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

d. Turn the ignition switch off.

e. Disconnect the ECM connector.

f. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-93 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-116 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-120 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-119 (A2A-)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω

C22-3 (A1A+) - C46-93 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-116 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-120 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-119 (A2A-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-93 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-116 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-120 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-119 (A2A-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-93 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-116 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-120 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-119 (A2A-) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

4.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read the pending DTCs.

Result

Result	Proceed to
No output	A
P2237, P2240, P2238, P2241, P2239, P2242, P2252, P2255, P2253 or P2256 output	B

B

REPLACE ECM (Click here)

A

END

DTC P0327 Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)

DTC P0328 Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)

DTC P0332 Knock Sensor 2 Circuit Low Input (Bank 2)

DTC P0333 Knock Sensor 2 Circuit High Input (Bank 2)

for Preparation Click here

DESCRIPTION

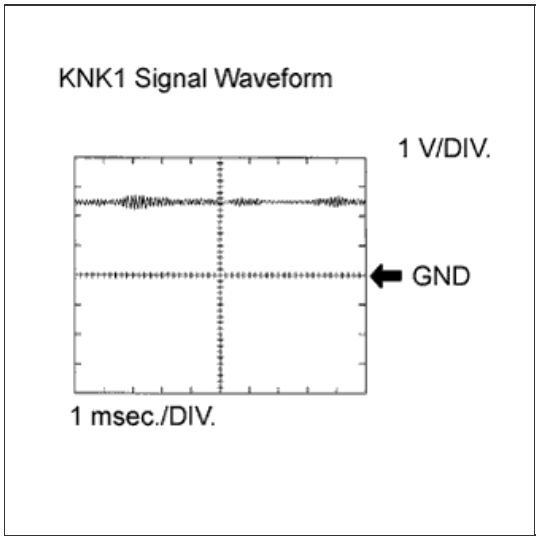
Flat type knock sensors (non-resonant type) have structures that can detect vibrations between approximately 6 kHz and 15 kHz.
A knock sensor is fitted onto the engine block to detect engine knocking.
The knock sensor contains a piezoelectric element which generates a voltage when it becomes deformed.
The voltage is generated when the engine block vibrates due to knocking. Any occurrence of engine knocking can be suppressed by delaying the ignition timing.

DTC Code	DTC Detection Condition	Trouble Area
P0327 P0332	The output voltage of the knock sensor is below 0.5 V (1 trip detection logic).	• Short in knock sensor circuit • Knock sensor • ECM
P0328 P0333	The output voltage of the knock sensor is higher than 4.5 V (1 trip detection logic).	• Open in knock sensor circuit • Knock sensor • ECM

HINT:

When any of DTCs P0327, P0328, P0332 and P0333 are stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is delayed to its maximum retardation. Fail-safe mode continues until the ignition switch is turned off.

Reference: Inspection using an oscilloscope



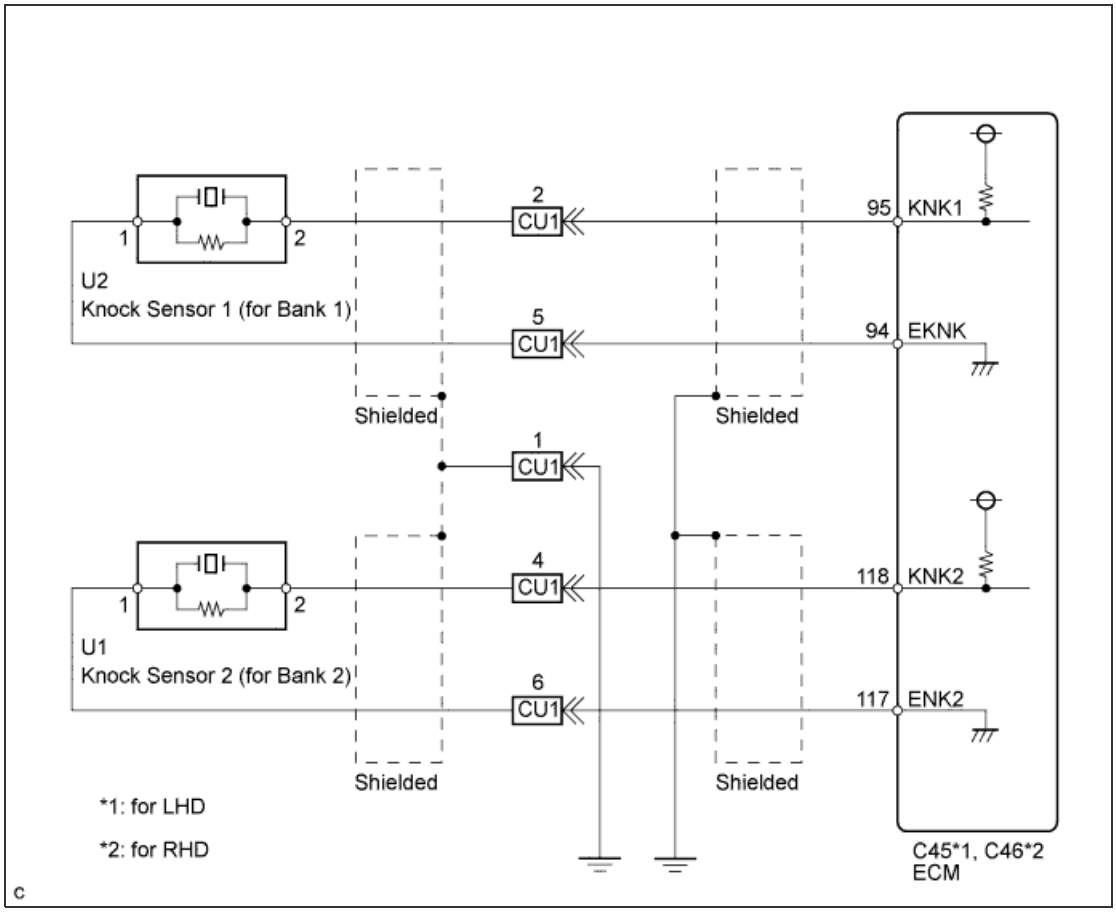
The correct waveform is as shown.

Item	Content
Terminal	KNK1 - EKNK KNK2 - EKN2
Equipment Setting	1 V/DIV. 1 msec./DIV.
Condition	Engine speed maintained at 4000 rpm with warm engine

MONITOR DESCRIPTION

If the output voltage transmitted by the knock sensor remains low or high for more than 1 second, the ECM interprets this as a malfunction in the sensor circuit, and stores a DTC.
The monitor for DTCs P0327, P0328, P0332 and P0333 begins to run when 5 seconds have elapsed since the engine was started.
If the malfunction is not repaired successfully, DTC P0327, P0328, P0332 or P0333 is stored 5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **DTCs P0327 and P0328 are for the bank 1 knock sensor circuit.**
- **DTCs P0332 and P0333 are for the bank 2 knock sensor circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ DTC OUTPUT (CHECK KNOCK SENSOR CIRCUIT)

a. Disconnect the CU1 connector.

b. Using lead wires, connect the connectors as follows:

Male Connector - Female Connector
Terminal 2 - Terminal 4
Terminal 5 - Terminal 6
Terminal 4 - Terminal 2
Terminal 6 - Terminal 5

c. Warm up the engine.

d. Run the engine at 3000 rpm for 10 seconds or more.

e. Connect the intelligent tester to the DLC3.

f. Turn the tester on.

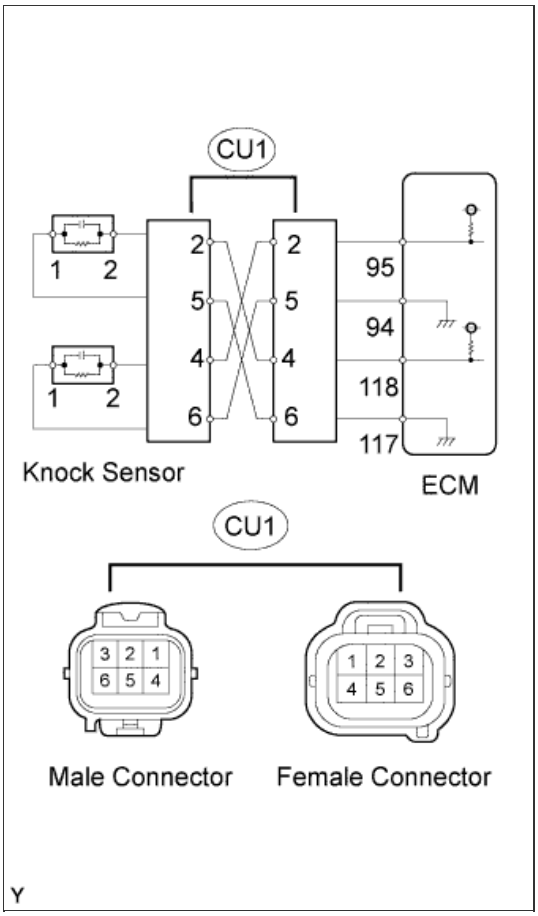
g. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

h. Read the DTCs.

Result

Result	Proceed to
DTC is same as when vehicle brought in (for example, P0327 and P0328 are output again, or	A

P0332 and P0333 are output again)	
DTC is different from when vehicle brought in (for example, P0327 and P0328 are output at first, but then P0332 and P0333 are output, or vice versa)	B



B → Go to step 4

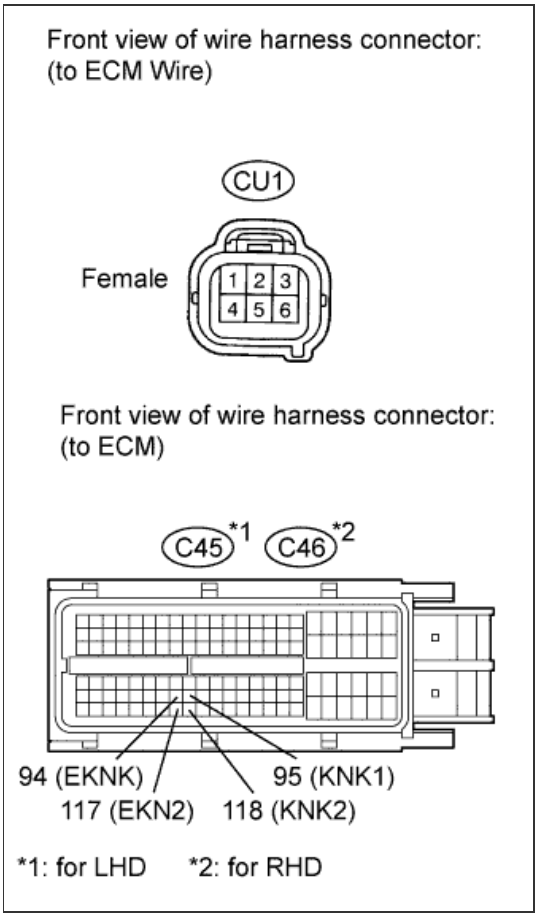
A

2.CHECK HARNESS AND CONNECTOR (CONNECTOR - ECM)

a. Disconnect the CU1 connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
CU1 female connector 2 - C45-95 (KNK1)	Always	Below 1 Ω
CU1 female connector 5 - C45-94 (EKNK)	Always	Below 1 Ω
CU1 female connector 4 - C45-118 (KNK2)	Always	Below 1 Ω
CU1 female connector 6 - C45-117 (EKN2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
CU1 female connector 2 - C46-95 (KNK1)	Always	Below 1 Ω
CU1 female connector 5 - C46-94 (EKNK)	Always	Below 1 Ω
CU1 female connector 4 - C46-118 (KNK2)	Always	Below 1 Ω
CU1 female connector 6 - C46-117 (EKN2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
CU1 female connector 2 or C45-95 (KNK1) - Body ground	Always	10 kΩ or higher
CU1 female connector 5 or C45-94 (EKNK) - Body ground	Always	10 kΩ or higher
CU1 female connector 4 or C45-118 (KNK2) - Body ground	Always	10 kΩ or higher
CU1 female connector 6 or C45-117 (EKN2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
CU1 female connector 2 or C46-95 (KNK1) - Body ground	Always	10 kΩ or higher
CU1 female connector 5 or C46-94 (EKNK) - Body ground	Always	10 kΩ or higher
CU1 female connector 4 or C46-118 (KNK2) - Body ground	Always	10 kΩ or higher
CU1 female connector 6 or C46-117 (EKN2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT ECM (VOLTAGE)

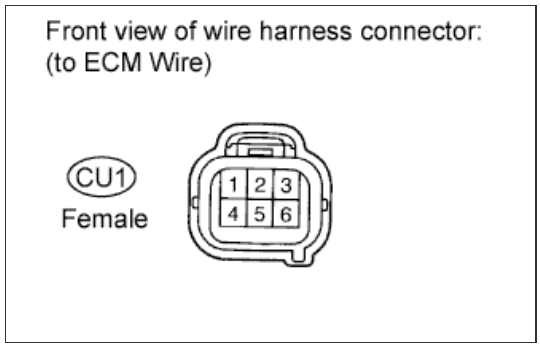
a. Disconnect the CU1 connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
CU1 female connector 2 - 5	Ignition switch ON	4.5 to 5.5 V

CU1 female connector 4 - 6	Ignition switch ON	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

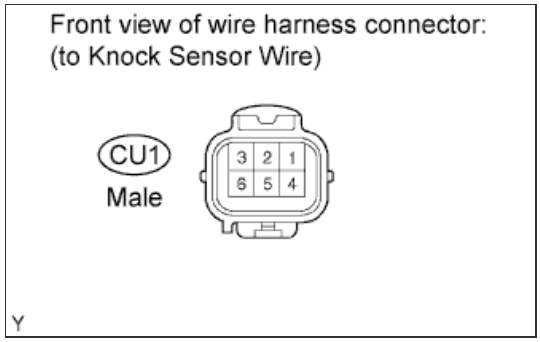
4.INSPECT KNOCK SENSOR

a. Disconnect the CU1 connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
CU1 male connector 2 - 5	20°C (68°F)	120 to 280 kΩ
CU1 male connector 4 - 6	20°C (68°F)	120 to 280 kΩ



NG → Go to step 5

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

5.CHECK HARNESS AND CONNECTOR (CONNECTOR - KNOCK SENSOR)

HINT:

- **If DTC P0327 or P0328 has changed to P0332 or P0333, check the knock sensor circuit on the right bank side.**
- **If DTC P0332 or P0333 has changed to P0327 or P0328, check the knock sensor circuit on the left bank side.**

a. Disconnect the CU1 connector.

b. Disconnect the knock sensor connectors.

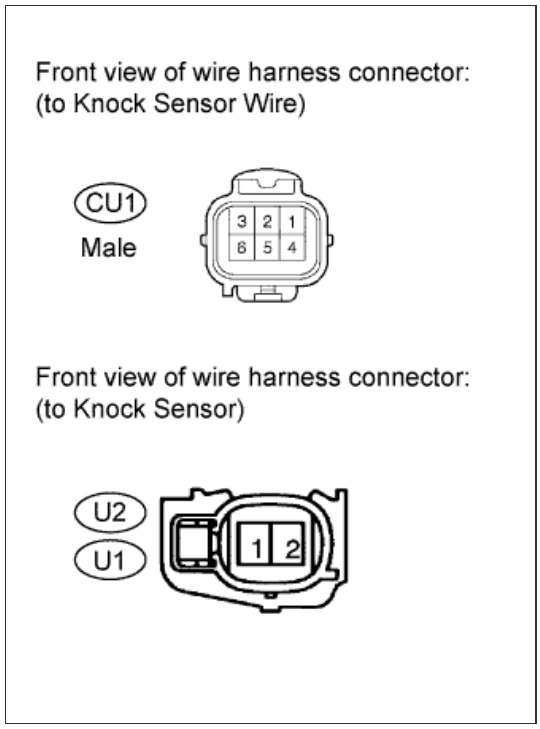
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
CU1 male connector 2 - U2-2	Always	Below 1 Ω
CU1 male connector 5 - U2-1	Always	Below 1 Ω
CU1 male connector 4 - U1-2	Always	Below 1 Ω
CU1 male connector 6 - U1-1	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
CU1 male		



connector 2 or U2-2 - Body ground	Always	10 kΩ or higher
CU1 male connector 5 or U2-1 - Body ground	Always	10 kΩ or higher
CU1 male connector 4 or U1-2 - Body ground	Always	10 kΩ or higher
CU1 male connector 6 or U1-1 - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE KNOCK SENSOR (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

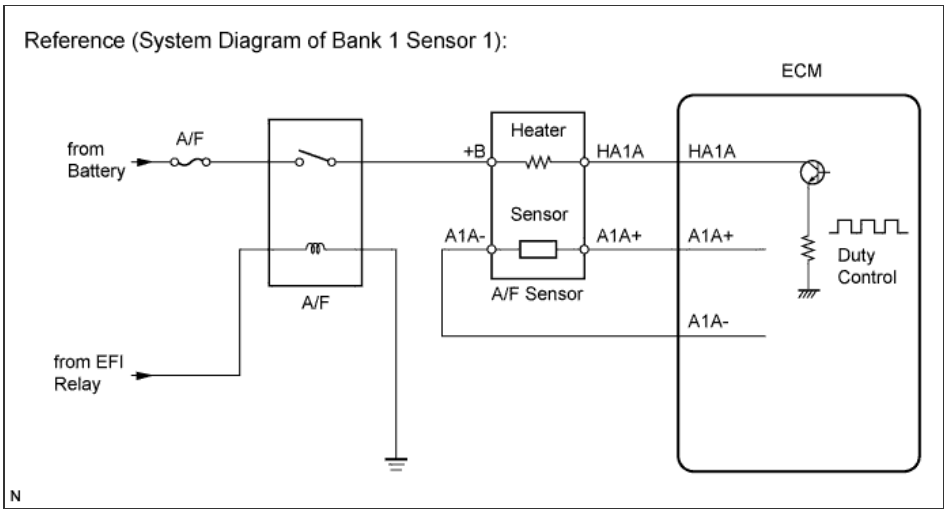
for Preparation Click here

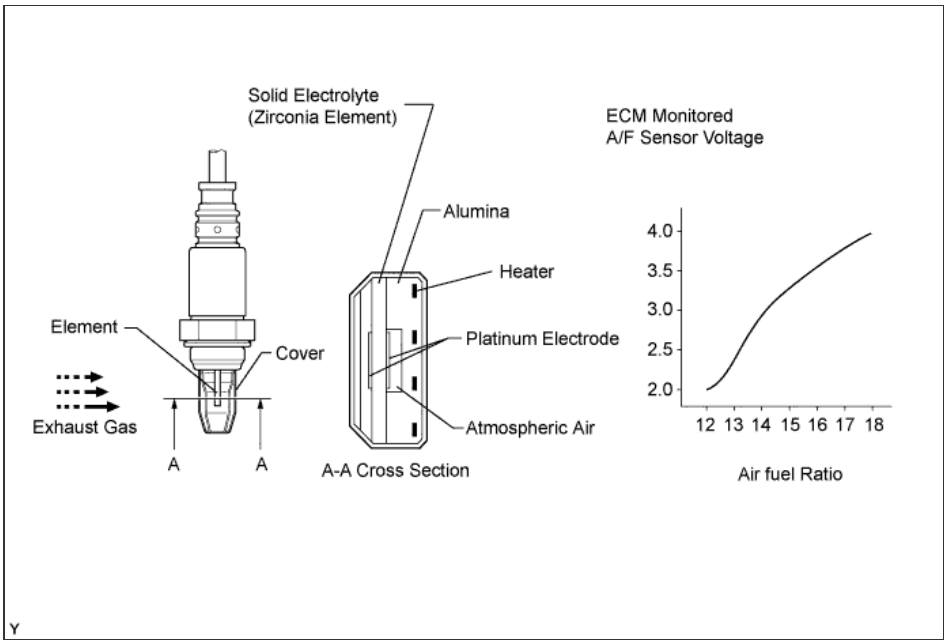
DESCRIPTION

HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air Fuel ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**

The A/F sensor, which is located between the exhaust manifold and catalyst, consists of alloyed metal elements and a heater.
Depending on the engine operating conditions, the heater heats the sensor elements to activate them. Battery voltage is applied to the heater, and the sensor ground is controlled by the ECM using a duty ratio.
The sensor elements convert the oxygen concentration in the exhaust gas into voltage values to output. Based on the voltage, the ECM determines the air fuel ratio and regulates the fuel injection volume depending on the air fuel ratio and engine operating conditions. The voltage changes between 0.6 V and 4.5 V while the engine is running. If the air fuel ratio is lean, which means the oxygen concentration in the exhaust gas is high, the voltage is high. If the air fuel ratio is rich, which means the oxygen concentration in the exhaust gas is low, the voltage is low.





DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals A1A+/A2A+ and A1A-/A2A- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2238 P2241	Any of the following conditions are met (2 trip detection logic): • The A/F sensor output drops while the engine is running. • The voltage at terminal A1A+/A2A+ is 0.5 V or less. • The voltage difference between terminals A1A+/A2A+ and A1A-/A2A- is 0.1 V or less.	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2239 P2242	The A1A+/A2A+ voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2252 P2255	The A1A-/A2A- voltage is 0.5 V or less (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2253 P2256	The A1A-/A2A- voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM

MONITOR DESCRIPTION

These DTCs are stored when there is an open or short in the A/F sensor circuit, or if A/F sensor output drops. To detect these problems, the voltage of the A/F sensor is monitored when turning the ignition switch to ON, and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is out of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in next driving cycle, the MIL will be illuminated and a DTC will be stored.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

CONFIRMATION DRIVING PATTERN

1. Start the engine and wait for 5 minutes or more.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **On the tester, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.**

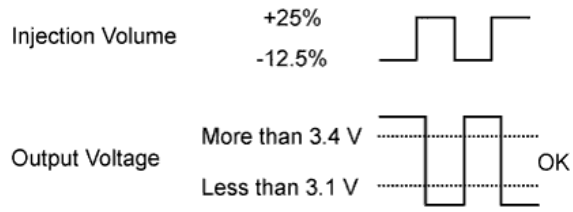
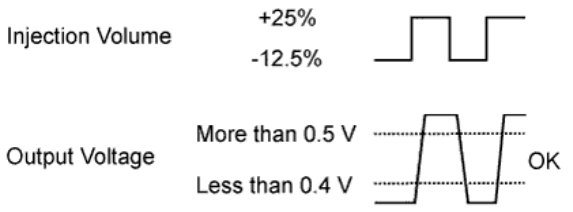
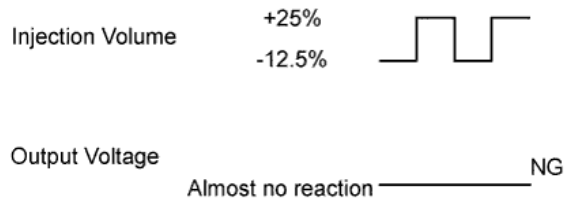
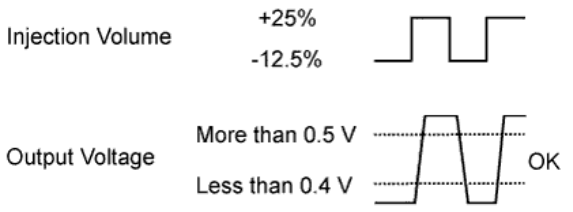
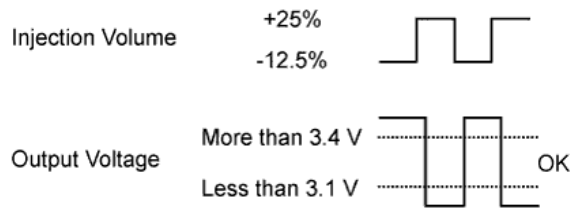
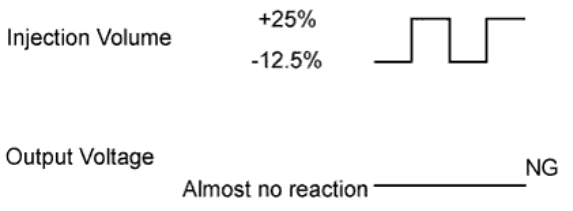
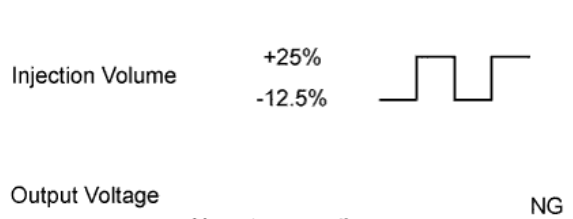
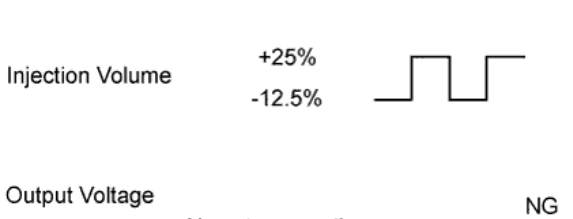
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	more than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	more than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	less than 0.4 V

NOTICE:

The Air Fuel ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the Air Fuel ratio (A/F) sensor connector.

b. Turn the ignition switch to ON.

c. Measure the voltage according to the value(s) in the table below.

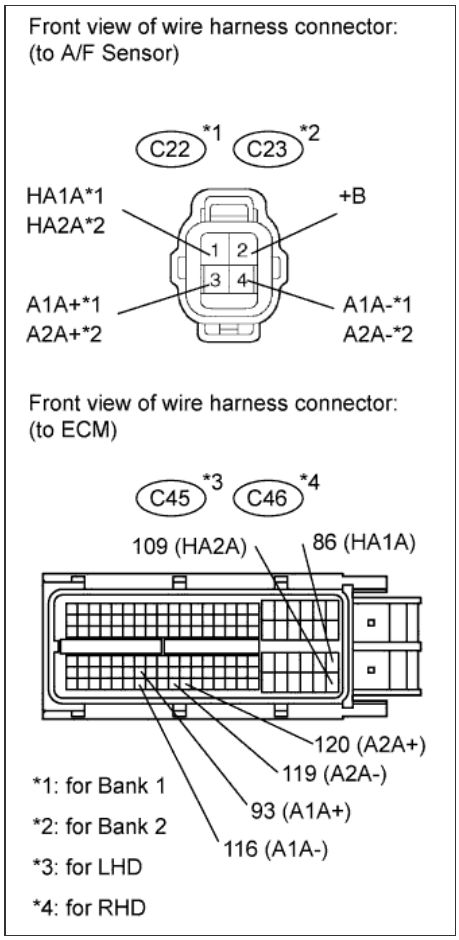
Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Ignition switch ON	11 to 14 V
C23-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

d. Turn the ignition switch off.

e. Disconnect the ECM connector.

f. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-93 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-116 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-120 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-119 (A2A-)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω

C22-3 (A1A+) - C46-93 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-116 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-120 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-119 (A2A-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-93 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-116 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-120 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-119 (A2A-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-93 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-116 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-120 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-119 (A2A-) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

4.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read the pending DTCs.

Result

Result	Proceed to
No output	A
P2237, P2240, P2238, P2241, P2239, P2242, P2252, P2255, P2253 or P2256 output	B

B

REPLACE ECM (Click here)

A

END

DTC P0327 Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)

DTC P0328 Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)

DTC P0332 Knock Sensor 2 Circuit Low Input (Bank 2)

DTC P0333 Knock Sensor 2 Circuit High Input (Bank 2)

for Preparation Click here

DESCRIPTION

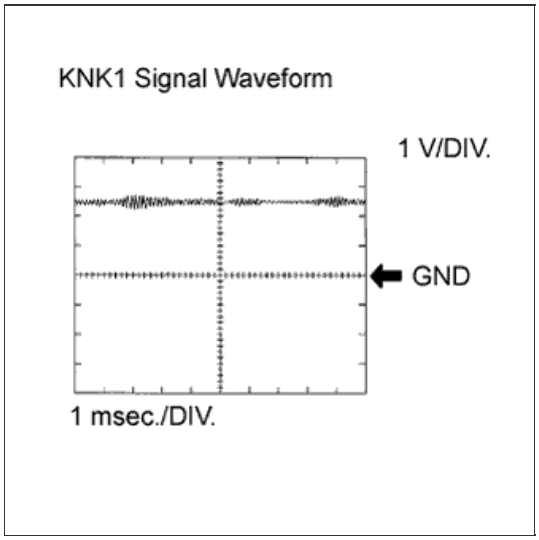
Flat type knock sensors (non-resonant type) have structures that can detect vibrations between approximately 6 kHz and 15 kHz.
A knock sensor is fitted onto the engine block to detect engine knocking.
The knock sensor contains a piezoelectric element which generates a voltage when it becomes deformed.
The voltage is generated when the engine block vibrates due to knocking. Any occurrence of engine knocking can be suppressed by delaying the ignition timing.

DTC Code	DTC Detection Condition	Trouble Area
P0327 P0332	The output voltage of the knock sensor is below 0.5 V (1 trip detection logic).	• Short in knock sensor circuit • Knock sensor • ECM
P0328 P0333	The output voltage of the knock sensor is higher than 4.5 V (1 trip detection logic).	• Open in knock sensor circuit • Knock sensor • ECM

HINT:

When any of DTCs P0327, P0328, P0332 and P0333 are stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is delayed to its maximum retardation. Fail-safe mode continues until the ignition switch is turned off.

Reference: Inspection using an oscilloscope



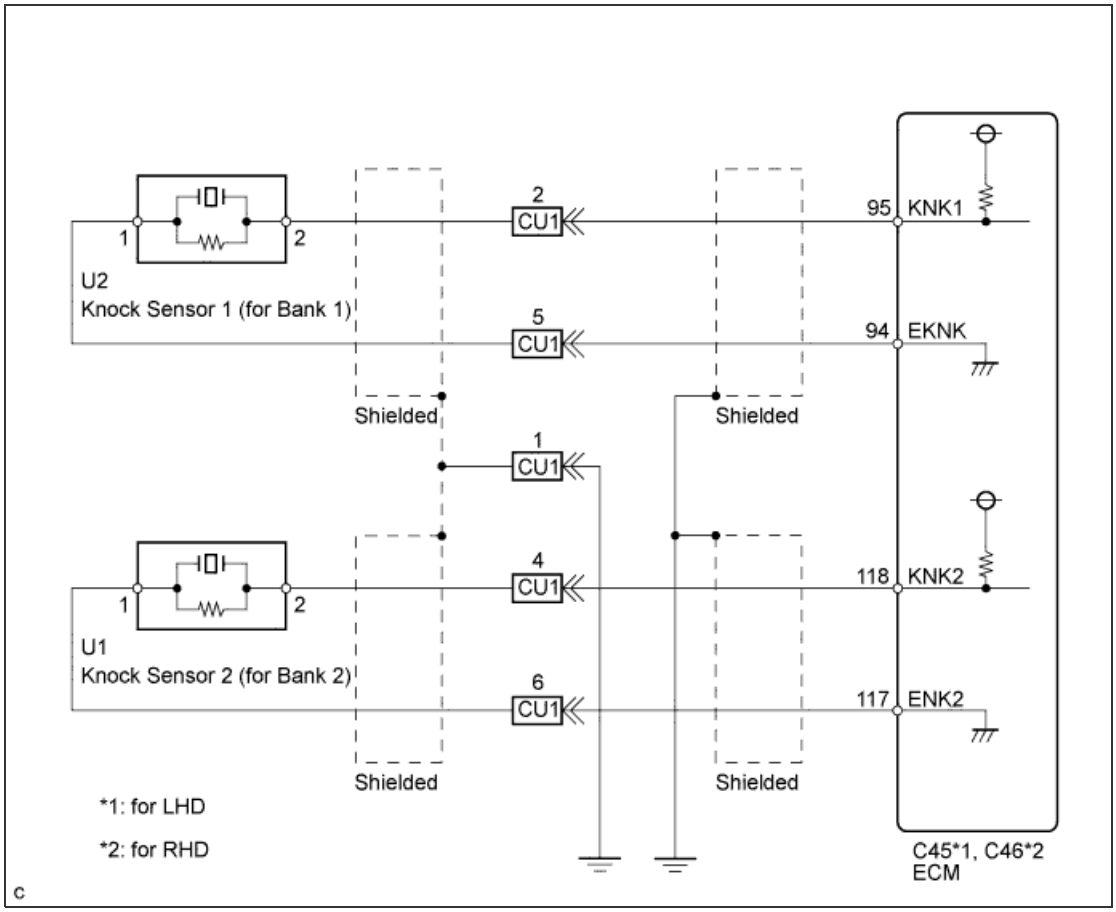
The correct waveform is as shown.

Item	Content
Terminal	KNK1 - EKNK KNK2 - EKN2
Equipment Setting	1 V/DIV. 1 msec./DIV.
Condition	Engine speed maintained at 4000 rpm with warm engine

MONITOR DESCRIPTION

If the output voltage transmitted by the knock sensor remains low or high for more than 1 second, the ECM interprets this as a malfunction in the sensor circuit, and stores a DTC.
The monitor for DTCs P0327, P0328, P0332 and P0333 begins to run when 5 seconds have elapsed since the engine was started.
If the malfunction is not repaired successfully, DTC P0327, P0328, P0332 or P0333 is stored 5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **DTCs P0327 and P0328 are for the bank 1 knock sensor circuit.**
- **DTCs P0332 and P0333 are for the bank 2 knock sensor circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ DTC OUTPUT (CHECK KNOCK SENSOR CIRCUIT)

a. Disconnect the CU1 connector.

b. Using lead wires, connect the connectors as follows:

Male Connector - Female Connector
Terminal 2 - Terminal 4
Terminal 5 - Terminal 6
Terminal 4 - Terminal 2
Terminal 6 - Terminal 5

c. Warm up the engine.

d. Run the engine at 3000 rpm for 10 seconds or more.

e. Connect the intelligent tester to the DLC3.

f. Turn the tester on.

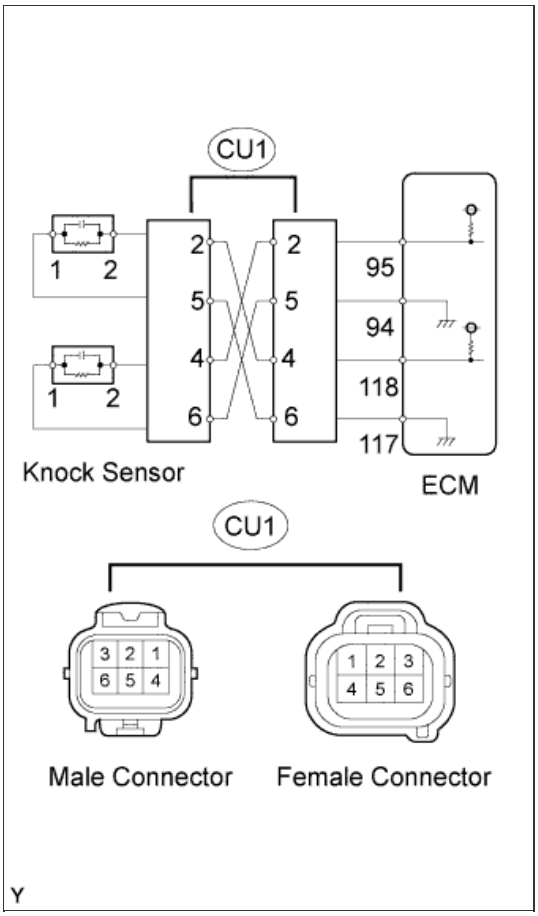
g. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

h. Read the DTCs.

Result

Result	Proceed to
DTC is same as when vehicle brought in (for example, P0327 and P0328 are output again, or	A

P0332 and P0333 are output again)	
DTC is different from when vehicle brought in (for example, P0327 and P0328 are output at first, but then P0332 and P0333 are output, or vice versa)	B



B → Go to step 4

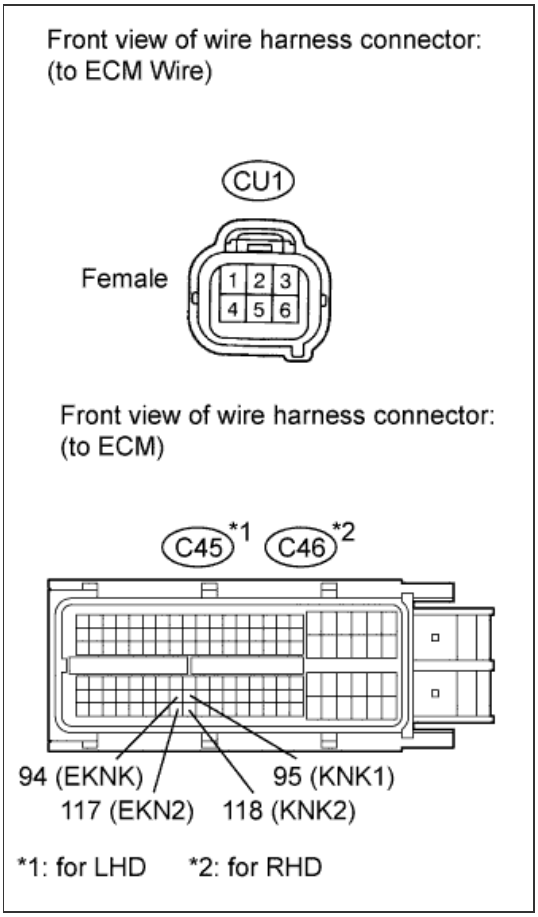
A

2.CHECK HARNESS AND CONNECTOR (CONNECTOR - ECM)

a. Disconnect the CU1 connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
CU1 female connector 2 - C45-95 (KNK1)	Always	Below 1 Ω
CU1 female connector 5 - C45-94 (EKNK)	Always	Below 1 Ω
CU1 female connector 4 - C45-118 (KNK2)	Always	Below 1 Ω
CU1 female connector 6 - C45-117 (EKN2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
CU1 female connector 2 - C46-95 (KNK1)	Always	Below 1 Ω
CU1 female connector 5 - C46-94 (EKNK)	Always	Below 1 Ω
CU1 female connector 4 - C46-118 (KNK2)	Always	Below 1 Ω
CU1 female connector 6 - C46-117 (EKN2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
CU1 female connector 2 or C45-95 (KNK1) - Body ground	Always	10 kΩ or higher
CU1 female connector 5 or C45-94 (EKNK) - Body ground	Always	10 kΩ or higher
CU1 female connector 4 or C45-118 (KNK2) - Body ground	Always	10 kΩ or higher
CU1 female connector 6 or C45-117 (EKN2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
CU1 female connector 2 or C46-95 (KNK1) - Body ground	Always	10 kΩ or higher
CU1 female connector 5 or C46-94 (EKNK) - Body ground	Always	10 kΩ or higher
CU1 female connector 4 or C46-118 (KNK2) - Body ground	Always	10 kΩ or higher
CU1 female connector 6 or C46-117 (EKN2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT ECM (VOLTAGE)

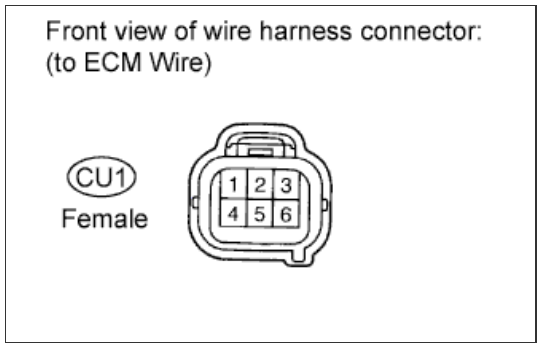
a. Disconnect the CU1 connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
CU1 female connector 2 - 5	Ignition switch ON	4.5 to 5.5 V

CU1 female connector 4 - 6	Ignition switch ON	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

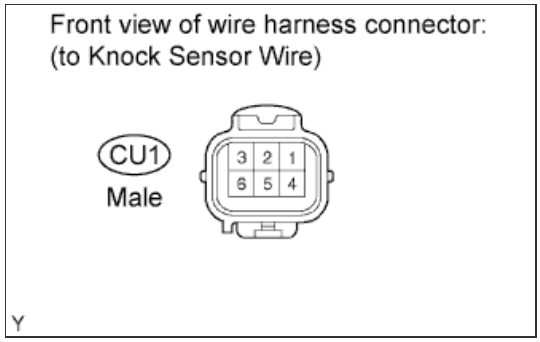
4.INSPECT KNOCK SENSOR

a. Disconnect the CU1 connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
CU1 male connector 2 - 5	20°C (68°F)	120 to 280 kΩ
CU1 male connector 4 - 6	20°C (68°F)	120 to 280 kΩ



NG → Go to step 5

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

5.CHECK HARNESS AND CONNECTOR (CONNECTOR - KNOCK SENSOR)

HINT:

- **If DTC P0327 or P0328 has changed to P0332 or P0333, check the knock sensor circuit on the right bank side.**
- **If DTC P0332 or P0333 has changed to P0327 or P0328, check the knock sensor circuit on the left bank side.**

a. Disconnect the CU1 connector.

b. Disconnect the knock sensor connectors.

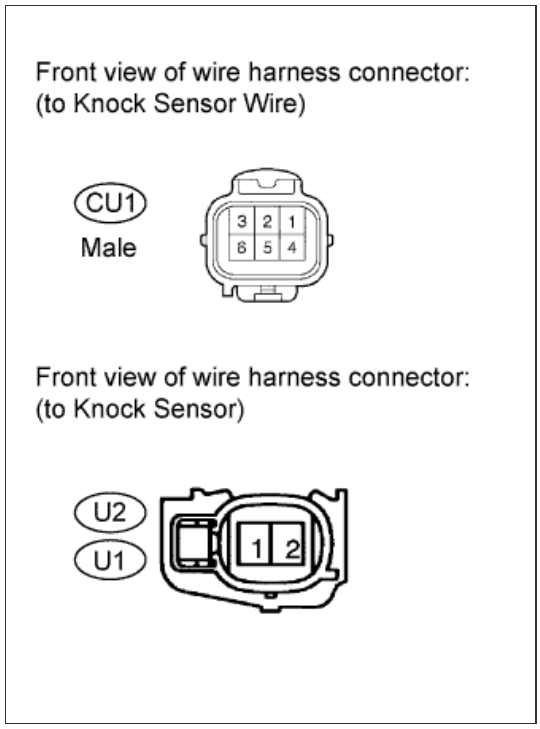
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
CU1 male connector 2 - U2-2	Always	Below 1 Ω
CU1 male connector 5 - U2-1	Always	Below 1 Ω
CU1 male connector 4 - U1-2	Always	Below 1 Ω
CU1 male connector 6 - U1-1	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
CU1 male		



connector 2 or U2-2 - Body ground	Always	10 kΩ or higher
CU1 male connector 5 or U2-1 - Body ground	Always	10 kΩ or higher
CU1 male connector 4 or U1-2 - Body ground	Always	10 kΩ or higher
CU1 male connector 6 or U1-1 - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE KNOCK SENSOR (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

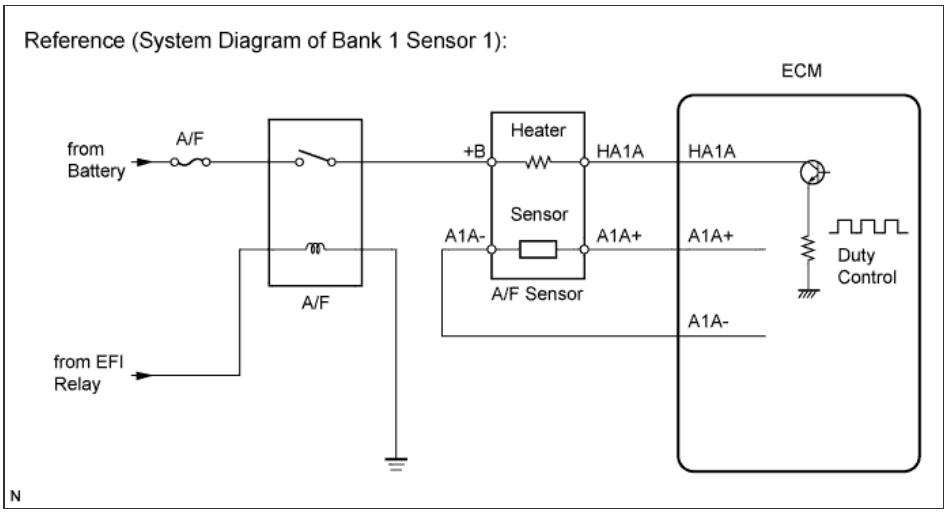
for Preparation Click here

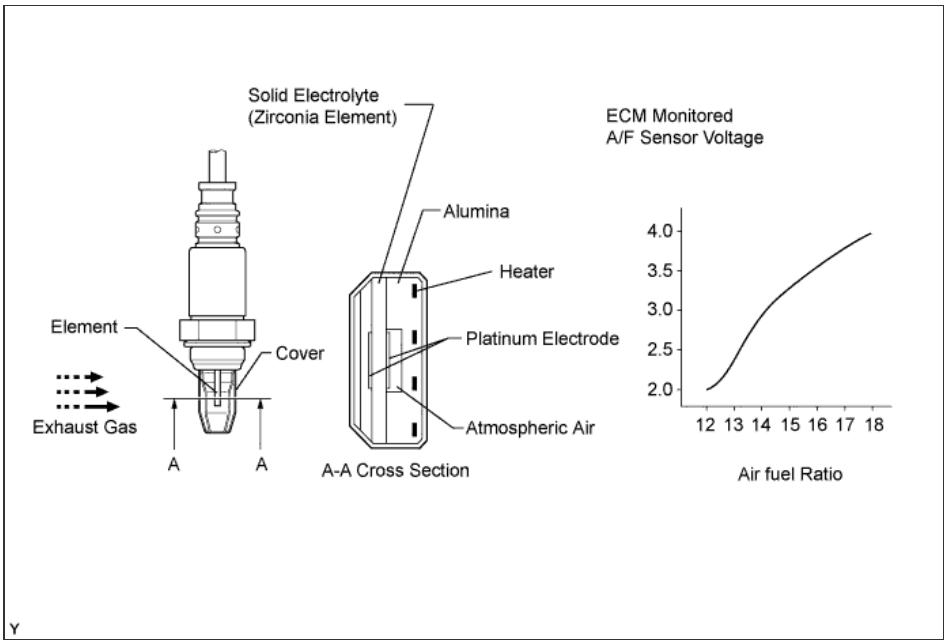
DESCRIPTION

HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air Fuel ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**

The A/F sensor, which is located between the exhaust manifold and catalyst, consists of alloyed metal elements and a heater.
Depending on the engine operating conditions, the heater heats the sensor elements to activate them. Battery voltage is applied to the heater, and the sensor ground is controlled by the ECM using a duty ratio.
The sensor elements convert the oxygen concentration in the exhaust gas into voltage values to output. Based on the voltage, the ECM determines the air fuel ratio and regulates the fuel injection volume depending on the air fuel ratio and engine operating conditions. The voltage changes between 0.6 V and 4.5 V while the engine is running. If the air fuel ratio is lean, which means the oxygen concentration in the exhaust gas is high, the voltage is high. If the air fuel ratio is rich, which means the oxygen concentration in the exhaust gas is low, the voltage is low.





DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals A1A+/A2A+ and A1A-/A2A- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2238 P2241	Any of the following conditions are met (2 trip detection logic): • The A/F sensor output drops while the engine is running. • The voltage at terminal A1A+/A2A+ is 0.5 V or less. • The voltage difference between terminals A1A+/A2A+ and A1A-/A2A- is 0.1 V or less.	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2239 P2242	The A1A+/A2A+ voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2252 P2255	The A1A-/A2A- voltage is 0.5 V or less (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM
P2253 P2256	The A1A-/A2A- voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • ECM

MONITOR DESCRIPTION

These DTCs are stored when there is an open or short in the A/F sensor circuit, or if A/F sensor output drops. To detect these problems, the voltage of the A/F sensor is monitored when turning the ignition switch to ON, and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is out of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in next driving cycle, the MIL will be illuminated and a DTC will be stored.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

CONFIRMATION DRIVING PATTERN

1. Start the engine and wait for 5 minutes or more.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **On the tester, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.**

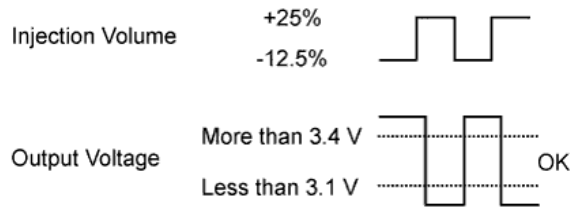
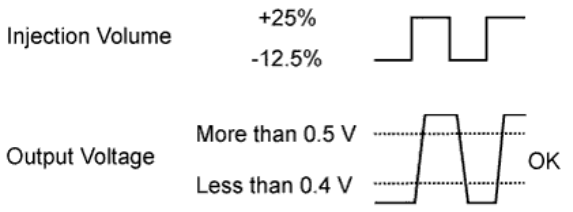
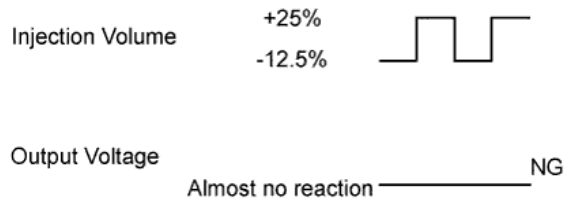
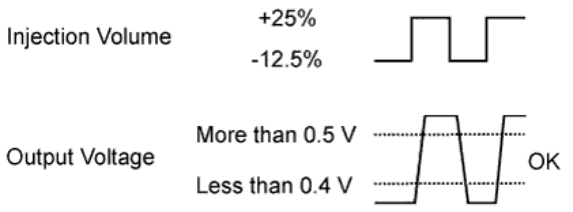
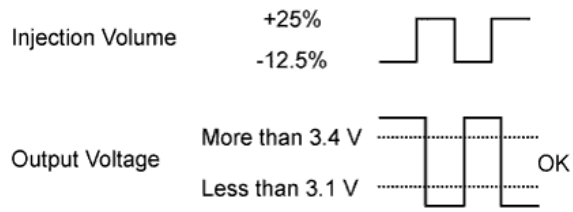
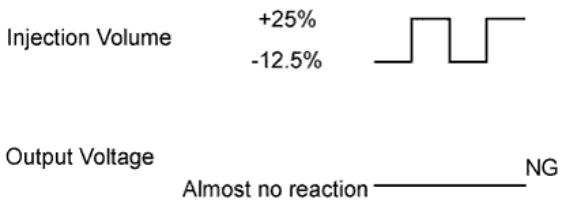
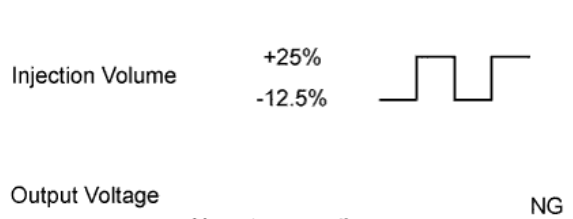
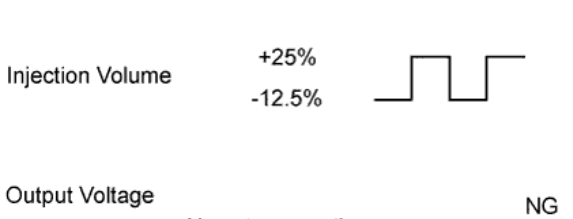
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	more than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	more than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	less than 0.4 V

NOTICE:

The Air Fuel ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the Air Fuel ratio (A/F) sensor connector.

b. Turn the ignition switch to ON.

c. Measure the voltage according to the value(s) in the table below.

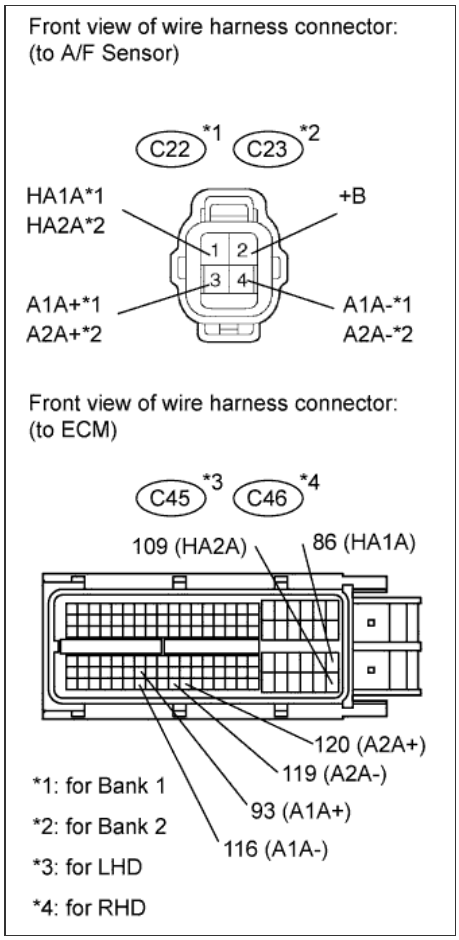
Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Ignition switch ON	11 to 14 V
C23-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

d. Turn the ignition switch off.

e. Disconnect the ECM connector.

f. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-93 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-116 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-120 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-119 (A2A-)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω

C22-3 (A1A+) - C46-93 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-116 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-120 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-119 (A2A-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-93 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-116 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-120 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-119 (A2A-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-93 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-116 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-120 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-119 (A2A-) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

4.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read the pending DTCs.

Result

Result	Proceed to
No output	A
P2237, P2240, P2238, P2241, P2239, P2242, P2252, P2255, P2253 or P2256 output	B

B

REPLACE ECM (Click here)

A

END

DTC P0335 Crankshaft Position Sensor "A" Circuit

DTC P0339 Crankshaft Position Sensor "A" Circuit Intermittent

for Preparation Click here

DESCRIPTION

The Crankshaft Position (CKP) sensor system consists of a CKP sensor plate and a pickup coil.
The sensor plate has 34 teeth and is installed on the crankshaft. The pickup coil is made of wound copper wire, an iron core and magnet. The sensor plate rotates and, as each tooth passes by the pickup coil, a pulse signal is created. The pickup coil generates 34 signals per revolution. Based on these signals, the ECM calculates the crankshaft position and engine speed. Using these calculations, the fuel injection time and ignition timing are controlled.

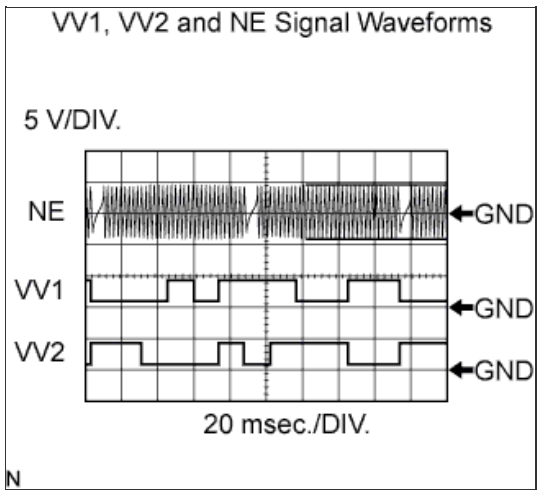
DTC Code	DTC Detection Condition	Trouble Area
P0335	When either condition below is met: • No Crankshaft Position (CKP) sensor signal is sent to the ECM while cranking (1 trip detection logic). • No CKP sensor signal is sent to the ECM at an engine speed of 600 rpm or more (1 trip detection logic).	• Open or short in Crankshaft Position (CKP) sensor circuit • CKP sensor • Crankshaft (crank angle sensor plate) • ECM
P0339	Under conditions (a), (b) and (c), no CKP sensor signal is sent to the ECM for 0.05 seconds or more (1 trip detection logic): (a) The engine speed is 1000 rpm or more. (b) The starter signal is off. (c) 3 seconds or more have elapsed since the starter signal switched from on to off.	• Open or short in CKP sensor circuit • CKP sensor • Crankshaft (crank angle sensor plate) • ECM

Reference: Inspection using an oscilloscope.

HINT:

- **The correct waveform is as shown.**
- **VV1+ and VV2+ stand for the VVT sensor signal, and NE+ stands for the CKP sensor signal.**
- **Grounding failure of the shielded wire may cause noise in the waveforms.**

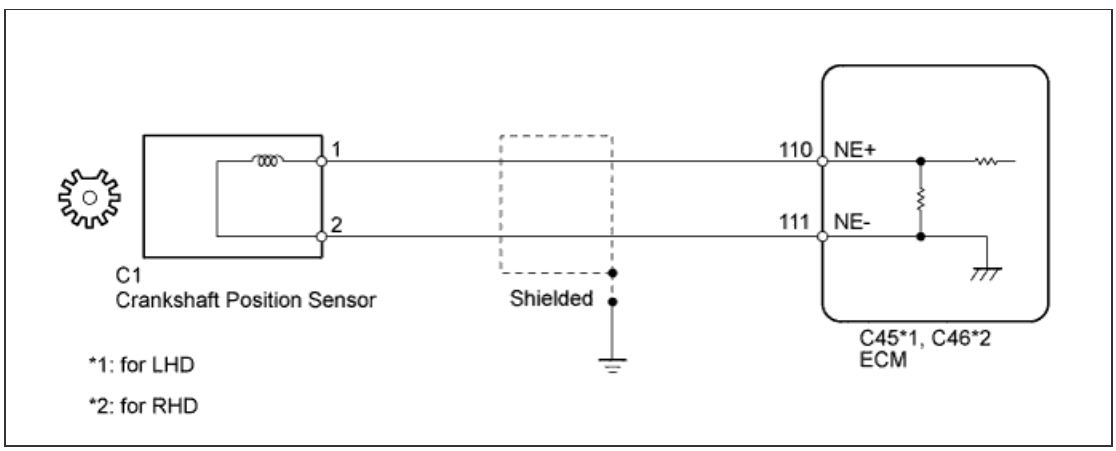
Item	Content
Terminal	VV1+ - VV1- VV2+ - VV2- NE+ - NE-
Equipment Setting	5 V/DIV., 20 msec./DIV.
Condition	Cranking or idling



MONITOR DESCRIPTION

If there is no signal from the CKP sensor despite the engine running, the ECM interprets this as a malfunction of the sensor.
If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Check the engine speed. The engine speed can be checked by using the intelligent tester. To check, follow the operation below:**
  1. **Connect the intelligent tester to the DLC3.**
  2. **Start the engine.**
  3. **Turn the tester on.**
  4. **Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Engine Speed.**
     The engine speed may be indicated as zero despite the engine running normally. This is caused by a lack of NE signals from the Crankshaft Position (CKP) sensor. Alternatively, the engine speed may be indicated as lower than the actual engine speed if the CKP sensor output voltage is insufficient.
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (ENGINE SPEED)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Engine Speed.

e. Start the engine.

f. Read the values displayed on the tester while the engine is running.

OK:
Correct values are displayed.

HINT:

- **To check the engine speed change, display the graph on the tester.**
- **If the engine does not start, check the engine speed while cranking.**
- **If the engine speed indicated on the tester remains at zero (0), there may be an open or short in the Crankshaft Position (CKP) sensor circuit.**

NG → Go to step 2

OK →

CHECK FOR INTERMITTENT PROBLEMS (Click here)

2.INSPECT CRANKSHAFT POSITION SENSOR (RESISTANCE)

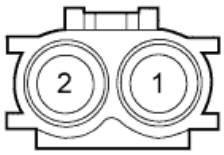
a. Disconnect the Crankshaft Position (CKP) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	Cold	1630 to 2740 Ω
1 - 2	Hot	2065 to 3225 Ω

Component without harness connected:
(Crankshaft Position Sensor)



HINT:

The terms "Cold" and "Hot" refer to the temperature of the sensor. Cold means approximately -10 to 50°C (14 to 122°F). Hot means approximately 50 to 100°C (122 to 212°F).

NG → REPLACE CRANKSHAFT POSITION SENSOR (Click here)

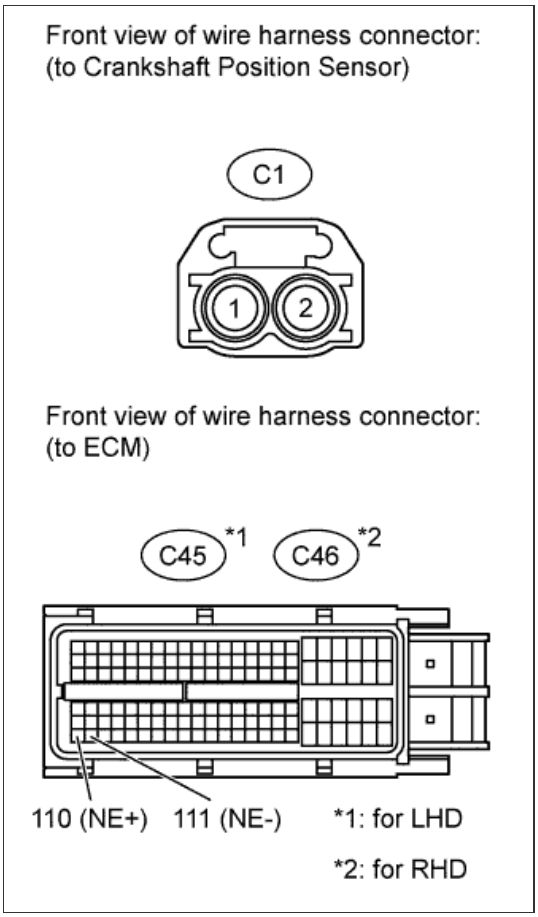
OK →

3.CHECK HARNESS AND CONNECTOR (CRANKSHAFT POSITION SENSOR - ECM)

a. Disconnect the CKP sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C1-1 - C45-110 (NE+)	Always	Below 1 Ω
C1-2 - C45-111 (NE-)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C1-1 - C46-110 (NE+)	Always	Below 1 Ω
C1-2 - C46-111 (NE-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C1-1 or C45-110 (NE+) - Body ground	Always	10 kΩ or higher
C1-2 or C45-111 (NE-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C1-1 or C46-110 (NE+) - Body ground	Always	10 kΩ or higher
C1-2 or C46-111 (NE-) - Body ground	Always	10 kΩ or higher

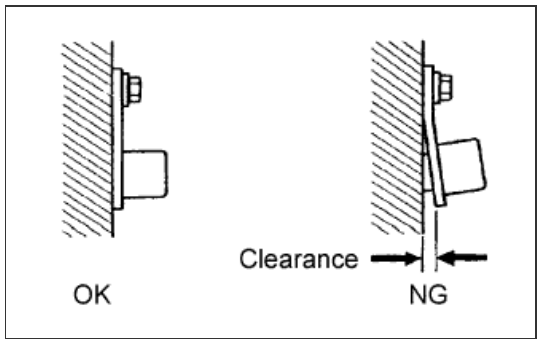
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.CHECK SENSOR INSTALLATION (CRANKSHAFT POSITION SENSOR)

a. Check the CKP sensor installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

5.CHECK CRANK ANGLE SENSOR PLATE (TEETH OF SENSOR PLATE)

a. Check the teeth of the sensor plate.

OK:
Sensor plate does not have any cracks or deformation.

NG → REPLACE CRANKSHAFT (Click here)

OK

6.REPLACE CRANKSHAFT POSITION SENSOR

a. Replace the crankshaft position sensor (Click here).

NEXT

7.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read the DTCs.

Result

Result	Proceed to
No output	A
P0335 or P0339	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

DTC P2A00 A/F Sensor Circuit Slow Response (Bank 1 Sensor 1)

DTC P2A03 A/F Sensor Circuit Slow Response (Bank 2 Sensor 1)

for Preparation Click here

DESCRIPTION

Refer to DTC P2195 (Click here).

HINT:

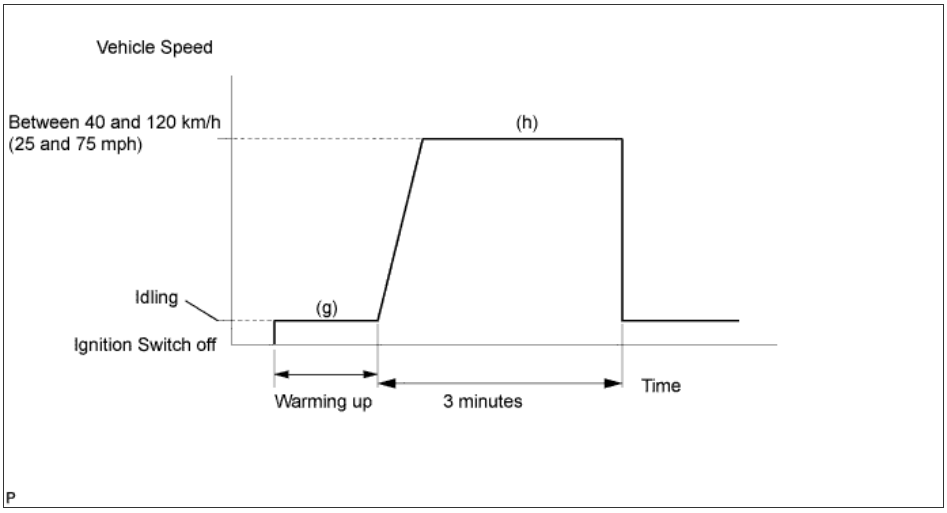
- **DTC P2A00 indicates malfunctions related to the bank 1 A/F sensor.**
- **DTC P2A03 indicates malfunctions related to the bank 2 A/F sensor.**
- **Bank 1 refers to the bank that includes cylinder No. 1.**
- **Bank 2 refers to the bank that includes cylinder No. 2.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**

DTC Code	DTC Detection Condition	Trouble Area
P2A00 P2A03	The calculated value for the air fuel ratio (A/F) sensor response rate deterioration level is less than threshold.	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor • A/F sensor heater • ECM

CONFIRMATION DRIVING PATTERN

HINT:

Performing this confirmation pattern will activate the A/F sensor response monitor.



(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON.
(c) Turn the intelligent tester on.
(d) Clear DTCs (Click here).
(e) Enter the following menus: Powertrain / Engine / Utility / Monitor Status.
(f) Check that O2S (A/FS) Monitor is Incmpl.
(g) Start the engine and warm it up.
(h) Drive the vehicle at a constant speed between 40 km/h and 120 km/h (25 mph and 75 mph) for 3 minutes.
(i) Check that O2S (A/FS) Monitor is Compl. If the Monitor Status is Incmpl, perform the driving pattern again increasing the vehicle speed and using second gear to decelerate the vehicle.
(j) Enter the following menus: Powertrain / Engine / DTC / Pending.
(k) Check if any DTCs (any pending DTCs) are stored.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the intelligent tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **On the intelligent tester, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**

5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume.)**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the intelligent tester.**

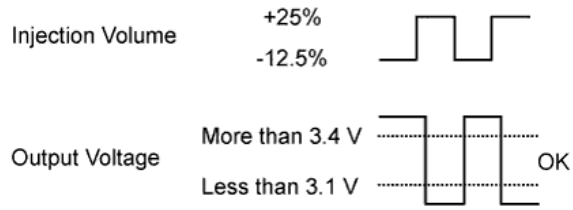
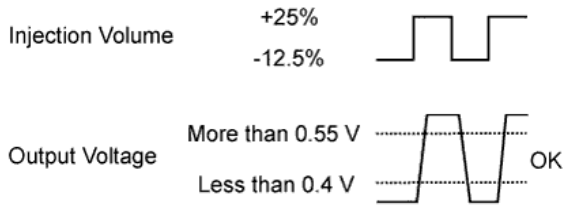
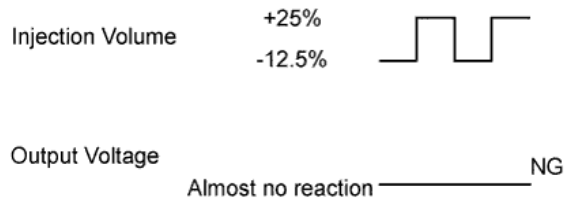
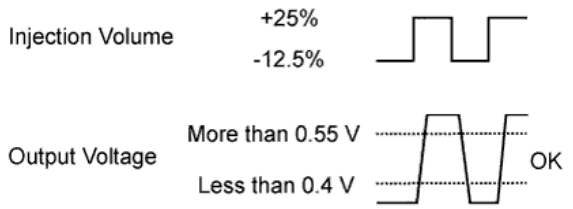
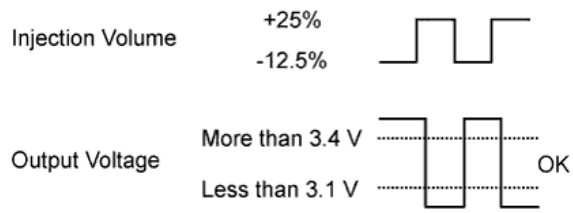
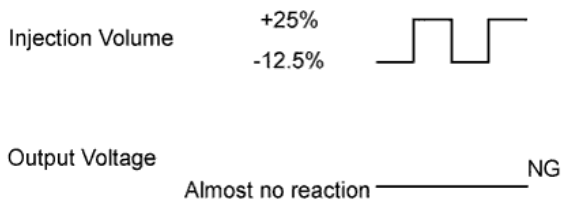
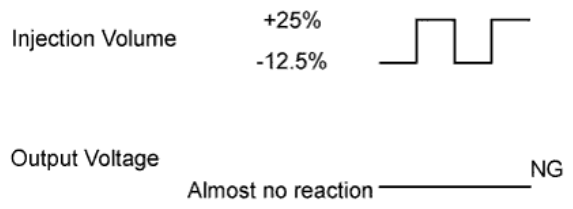
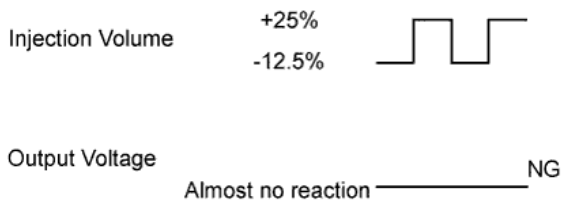
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	Less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

- **DTC P2A00 or P2A03 may be also stored, when the air fuel ratio is stuck rich or lean.**
- **A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.**
- **A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.**

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2A00 AND/OR P2A03)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

e. Read DTCs.

Result

Display (DTC Output)	Proceed to
P2A00 and/or P2A03	A
P2A00 and/or P2A03 and other DTCs	B

HINT:

If any DTCs other than P2A00 or P2A03 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

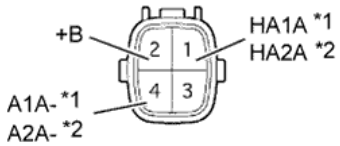
A

2.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

a. Disconnect the Air Fuel ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

Standard Resistance:

for Bank 1 Sensor 1

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher

for Bank 2 Sensor 1

Tester Connection	Condition	Specified Condition
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

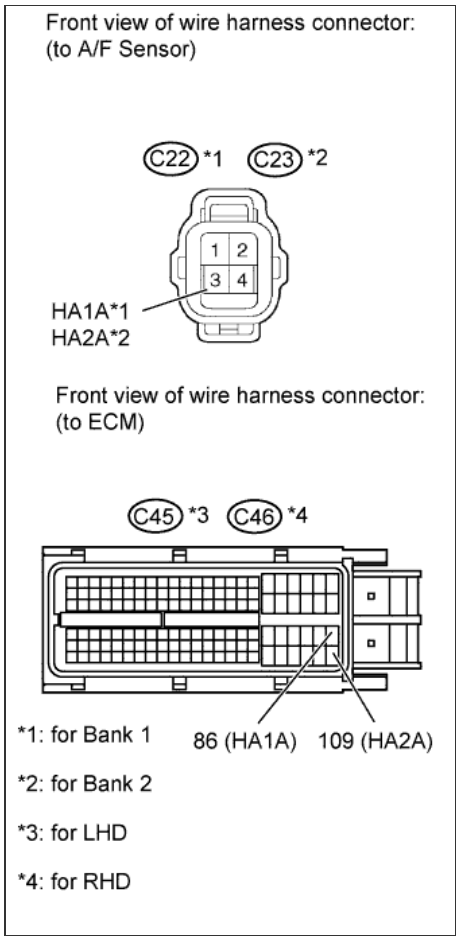
NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

3.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body ground	Always	10 kΩ or higher

C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (DTC P2A00 AND/OR P2A03)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

d. Read DTCs.

Result

Display (DTC Output)	Proceed to
P2A00 and/or P2A03	A
No output	B

B → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

6.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

7.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS (DTC P2A00 AND/OR P2A03)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

d. Read DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P2A00 and/or P2A03	B

B → CHECK EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO (REFER TO DTC P0171) (Click here)

A

END

DTC P0335 Crankshaft Position Sensor "A" Circuit

DTC P0339 Crankshaft Position Sensor "A" Circuit Intermittent

for Preparation Click here

DESCRIPTION

The Crankshaft Position (CKP) sensor system consists of a CKP sensor plate and a pickup coil.
The sensor plate has 34 teeth and is installed on the crankshaft. The pickup coil is made of wound copper wire, an iron core and magnet. The sensor plate rotates and, as each tooth passes by the pickup coil, a pulse signal is created. The pickup coil generates 34 signals per revolution. Based on these signals, the ECM calculates the crankshaft position and engine speed. Using these calculations, the fuel injection time and ignition timing are controlled.

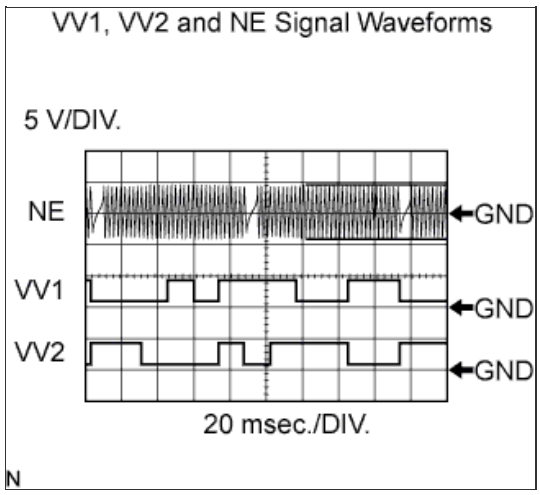
DTC Code	DTC Detection Condition	Trouble Area
P0335	When either condition below is met: • No Crankshaft Position (CKP) sensor signal is sent to the ECM while cranking (1 trip detection logic). • No CKP sensor signal is sent to the ECM at an engine speed of 600 rpm or more (1 trip detection logic).	• Open or short in Crankshaft Position (CKP) sensor circuit • CKP sensor • Crankshaft (crank angle sensor plate) • ECM
P0339	Under conditions (a), (b) and (c), no CKP sensor signal is sent to the ECM for 0.05 seconds or more (1 trip detection logic): (a) The engine speed is 1000 rpm or more. (b) The starter signal is off. (c) 3 seconds or more have elapsed since the starter signal switched from on to off.	• Open or short in CKP sensor circuit • CKP sensor • Crankshaft (crank angle sensor plate) • ECM

Reference: Inspection using an oscilloscope.

HINT:

- **The correct waveform is as shown.**
- **VV1+ and VV2+ stand for the VVT sensor signal, and NE+ stands for the CKP sensor signal.**
- **Grounding failure of the shielded wire may cause noise in the waveforms.**

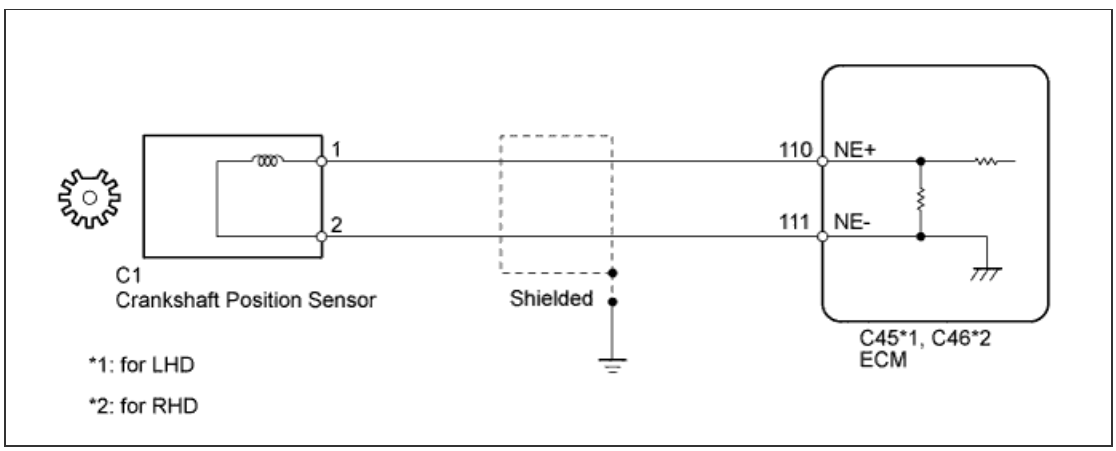
Item	Content
Terminal	VV1+ - VV1- VV2+ - VV2- NE+ - NE-
Equipment Setting	5 V/DIV., 20 msec./DIV.
Condition	Cranking or idling



MONITOR DESCRIPTION

If there is no signal from the CKP sensor despite the engine running, the ECM interprets this as a malfunction of the sensor.
If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Check the engine speed. The engine speed can be checked by using the intelligent tester. To check, follow the operation below:**
  1. **Connect the intelligent tester to the DLC3.**
  2. **Start the engine.**
  3. **Turn the tester on.**
  4. **Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Engine Speed.**
     The engine speed may be indicated as zero despite the engine running normally. This is caused by a lack of NE signals from the Crankshaft Position (CKP) sensor. Alternatively, the engine speed may be indicated as lower than the actual engine speed if the CKP sensor output voltage is insufficient.
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (ENGINE SPEED)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Engine Speed.

e. Start the engine.

f. Read the values displayed on the tester while the engine is running.

OK:
Correct values are displayed.

HINT:

- **To check the engine speed change, display the graph on the tester.**
- **If the engine does not start, check the engine speed while cranking.**
- **If the engine speed indicated on the tester remains at zero (0), there may be an open or short in the Crankshaft Position (CKP) sensor circuit.**

NG → Go to step 2

OK →

CHECK FOR INTERMITTENT PROBLEMS (Click here)

2.INSPECT CRANKSHAFT POSITION SENSOR (RESISTANCE)

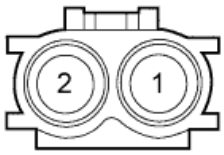
a. Disconnect the Crankshaft Position (CKP) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	Cold	1630 to 2740 Ω
1 - 2	Hot	2065 to 3225 Ω

Component without harness connected:
(Crankshaft Position Sensor)



HINT:

The terms "Cold" and "Hot" refer to the temperature of the sensor. Cold means approximately -10 to 50°C (14 to 122°F). Hot means approximately 50 to 100°C (122 to 212°F).

NG → REPLACE CRANKSHAFT POSITION SENSOR (Click here)

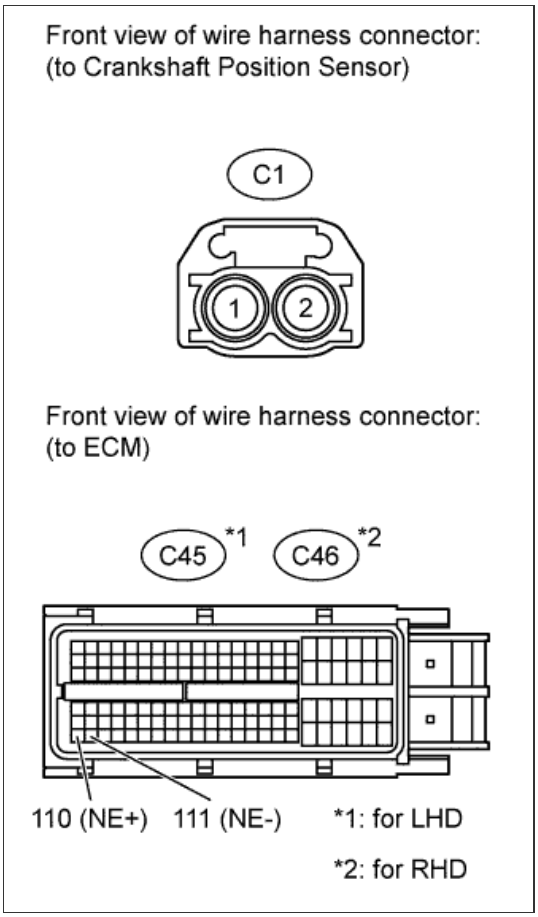
OK →

3.CHECK HARNESS AND CONNECTOR (CRANKSHAFT POSITION SENSOR - ECM)

a. Disconnect the CKP sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C1-1 - C45-110 (NE+)	Always	Below 1 Ω
C1-2 - C45-111 (NE-)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C1-1 - C46-110 (NE+)	Always	Below 1 Ω
C1-2 - C46-111 (NE-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C1-1 or C45-110 (NE+) - Body ground	Always	10 kΩ or higher
C1-2 or C45-111 (NE-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C1-1 or C46-110 (NE+) - Body ground	Always	10 kΩ or higher
C1-2 or C46-111 (NE-) - Body ground	Always	10 kΩ or higher

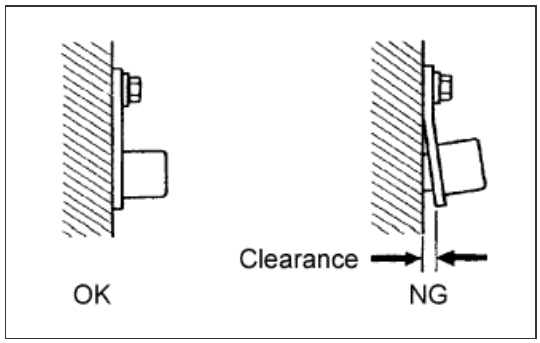
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.CHECK SENSOR INSTALLATION (CRANKSHAFT POSITION SENSOR)

a. Check the CKP sensor installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

5.CHECK CRANK ANGLE SENSOR PLATE (TEETH OF SENSOR PLATE)

a. Check the teeth of the sensor plate.

OK:
Sensor plate does not have any cracks or deformation.

NG → REPLACE CRANKSHAFT (Click here)

OK

6.REPLACE CRANKSHAFT POSITION SENSOR

a. Replace the crankshaft position sensor (Click here).

NEXT

7.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read the DTCs.

Result

Result	Proceed to
No output	A
P0335 or P0339	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

DTC P2A00 A/F Sensor Circuit Slow Response (Bank 1 Sensor 1)

DTC P2A03 A/F Sensor Circuit Slow Response (Bank 2 Sensor 1)

for Preparation Click here

DESCRIPTION

Refer to DTC P2195 (Click here).

HINT:

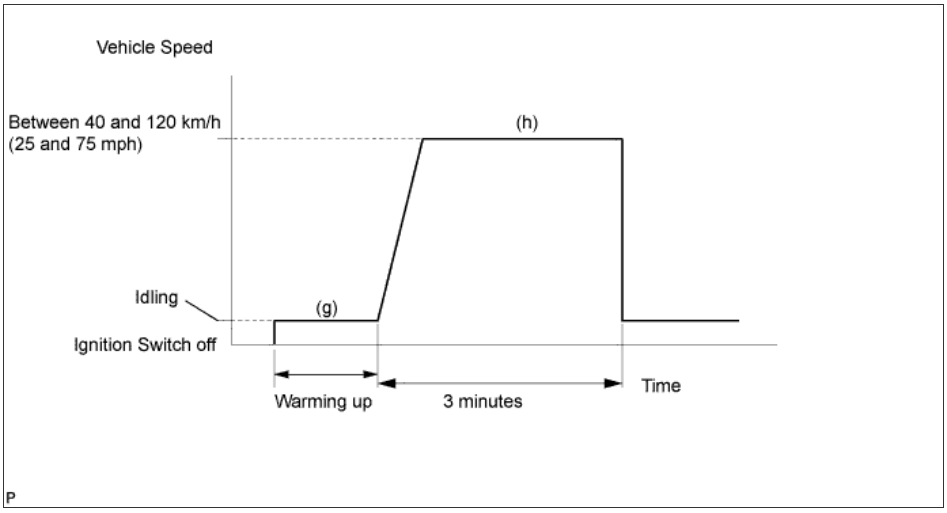
- **DTC P2A00 indicates malfunctions related to the bank 1 A/F sensor.**
- **DTC P2A03 indicates malfunctions related to the bank 2 A/F sensor.**
- **Bank 1 refers to the bank that includes cylinder No. 1.**
- **Bank 2 refers to the bank that includes cylinder No. 2.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**

DTC Code	DTC Detection Condition	Trouble Area
P2A00 P2A03	The calculated value for the air fuel ratio (A/F) sensor response rate deterioration level is less than threshold.	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor • A/F sensor heater • ECM

CONFIRMATION DRIVING PATTERN

HINT:

Performing this confirmation pattern will activate the A/F sensor response monitor.



(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON.
(c) Turn the intelligent tester on.
(d) Clear DTCs (Click here).
(e) Enter the following menus: Powertrain / Engine / Utility / Monitor Status.
(f) Check that O2S (A/FS) Monitor is Incmpl.
(g) Start the engine and warm it up.
(h) Drive the vehicle at a constant speed between 40 km/h and 120 km/h (25 mph and 75 mph) for 3 minutes.
(i) Check that O2S (A/FS) Monitor is Compl. If the Monitor Status is Incmpl, perform the driving pattern again increasing the vehicle speed and using second gear to decelerate the vehicle.
(j) Enter the following menus: Powertrain / Engine / DTC / Pending.
(k) Check if any DTCs (any pending DTCs) are stored.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the intelligent tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **On the intelligent tester, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**

5. **Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume.)**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the intelligent tester.**

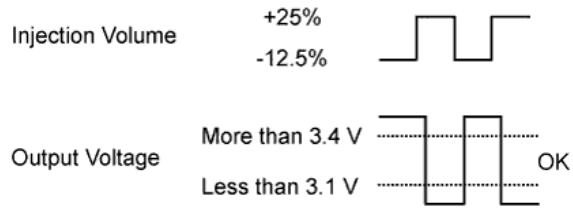
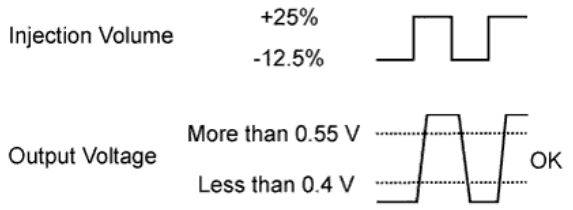
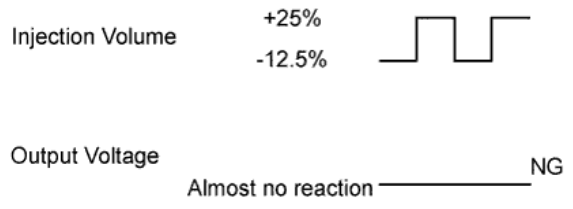
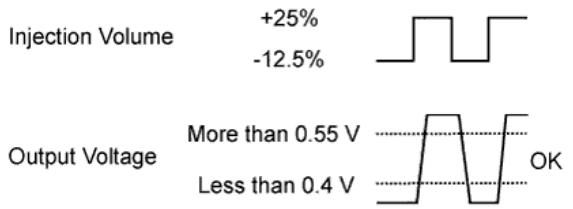
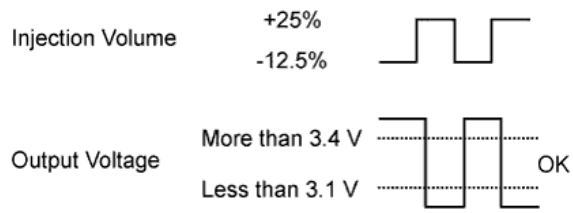
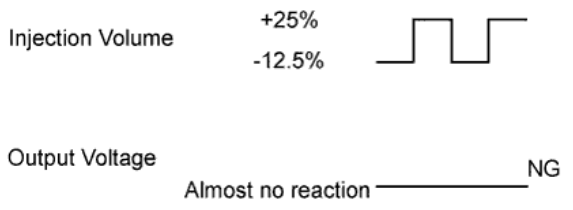
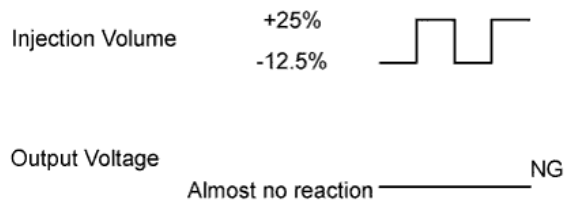
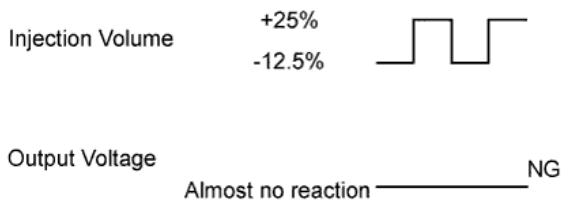
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	+25%	Rich	Less than 3.1 V
AFS Voltage B1S1 or AFS Voltage B2S1 (A/F)	-12.5%	Lean	More than 3.4 V
O2S B1S2 or O2S B2S2 (HO2)	+25%	Rich	More than 0.55 V
O2S B1S2 or O2S B2S2 (HO2)	-12.5%	Lean	Less than 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

- **DTC P2A00 or P2A03 may be also stored, when the air fuel ratio is stuck rich or lean.**
- **A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.**
- **A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.**

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2A00 AND/OR P2A03)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

e. Read DTCs.

Result

Display (DTC Output)	Proceed to
P2A00 and/or P2A03	A
P2A00 and/or P2A03 and other DTCs	B

HINT:

If any DTCs other than P2A00 or P2A03 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

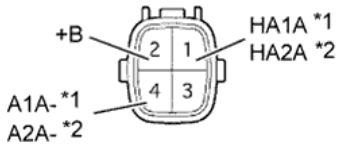
A

2.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

a. Disconnect the Air Fuel ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

Standard Resistance:

for Bank 1 Sensor 1

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher

for Bank 2 Sensor 1

Tester Connection	Condition	Specified Condition
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

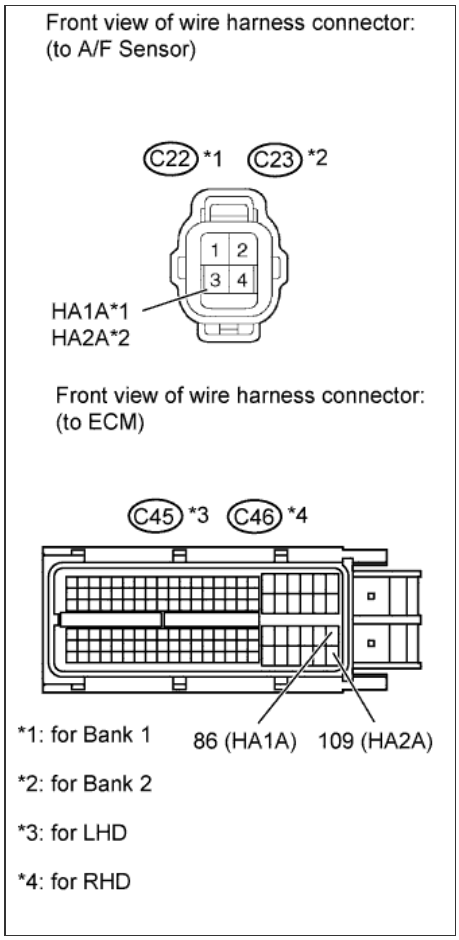
NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

3.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C45-109 (HA2A)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-86 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C46-109 (HA2A)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C45-86 (HA1A) - Body ground	Always	10 kΩ or higher

C23-1 (HA2A) or C45-109 (HA2A) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) or C46-86 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-109 (HA2A) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (DTC P2A00 AND/OR P2A03)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

d. Read DTCs.

Result

Display (DTC Output)	Proceed to
P2A00 and/or P2A03	A
No output	B

B → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

6.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

7.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS (DTC P2A00 AND/OR P2A03)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

d. Read DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P2A00 and/or P2A03	B

B → CHECK EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO (REFER TO DTC P0171) (Click here)

A

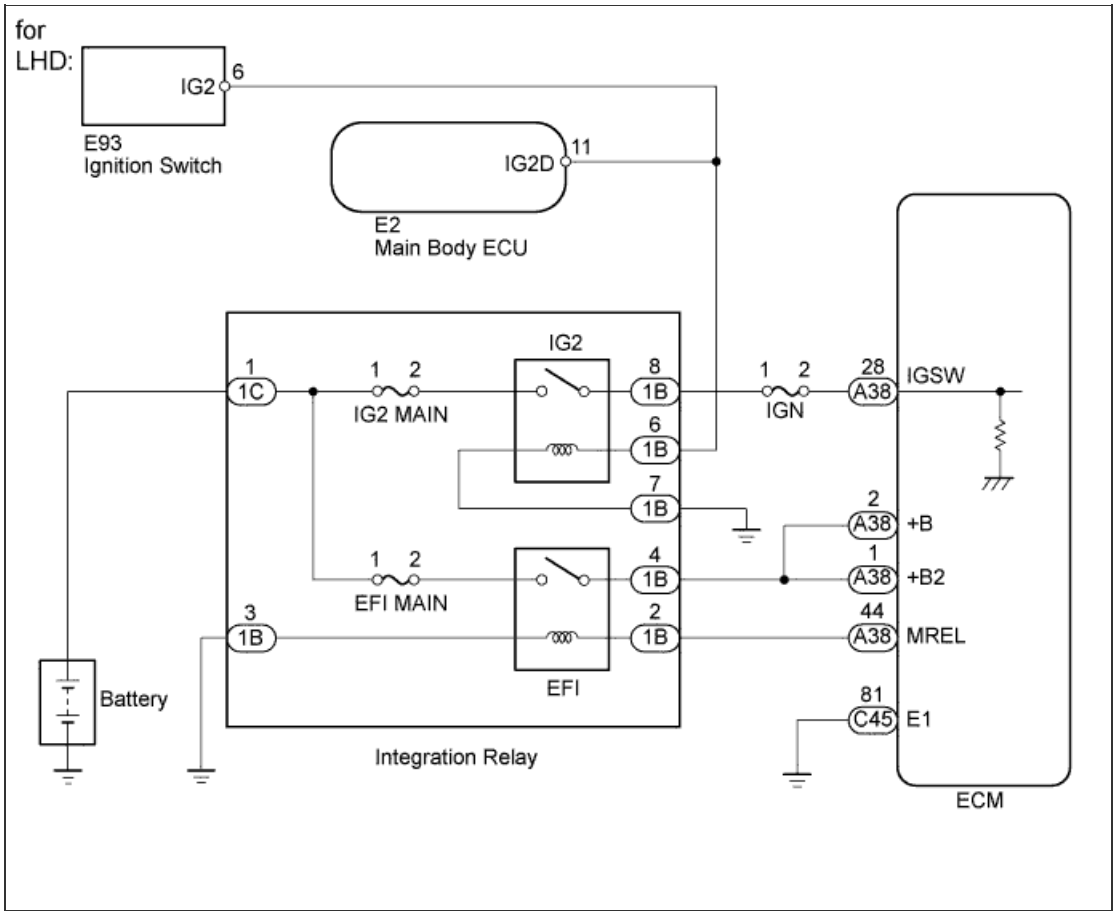
END

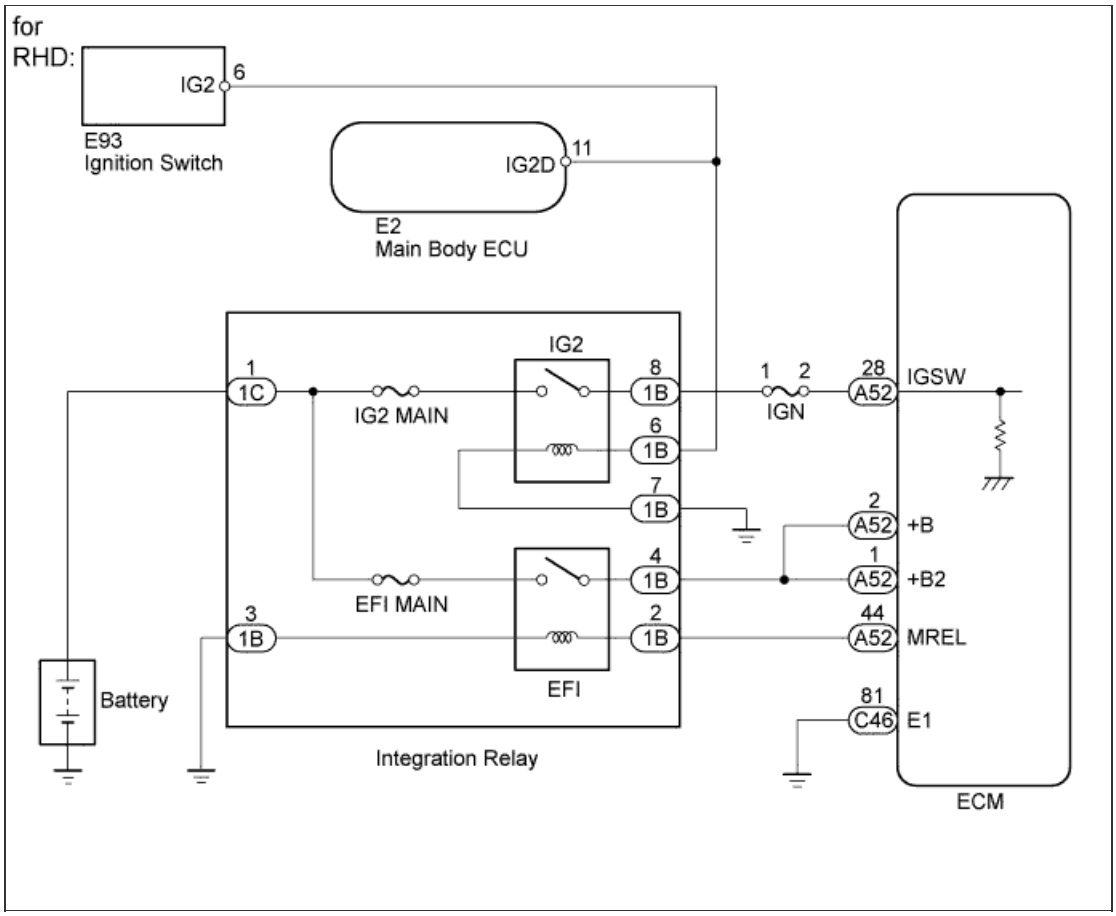
for Preparation Click here

DESCRIPTION

When the ignition switch is turned to ON, battery voltage is applied to the IGSW of the ECM. The output signal from the MREL terminal of the ECM causes a current to flow to the coil, closing the contacts of the integration relay (EFI relay) and supplying power to either terminal +B or +B2 of the ECM.

WIRING DIAGRAM





INSPECTION PROCEDURE

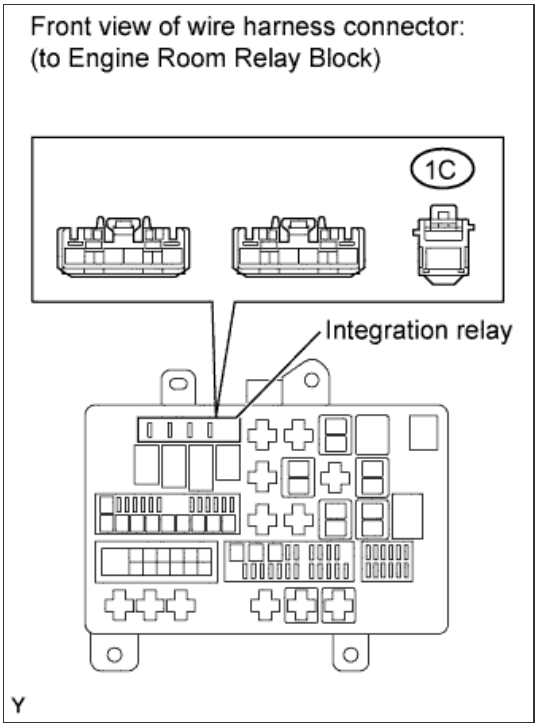
1.CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - BATTERY)

a. Remove the integration relay from the engine room relay block.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
1C-1 - Body ground	Always	11 to 14 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.INSPECT INTEGRATION RELAY (EFI RELAY AND IG2 RELAY)

a. Remove the integration relay from the engine room relay block.

b. Inspect the EFI MAIN fuse and the IG2 MAIN fuse.

i. Remove the EFI MAIN fuse and IG2 MAIN fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

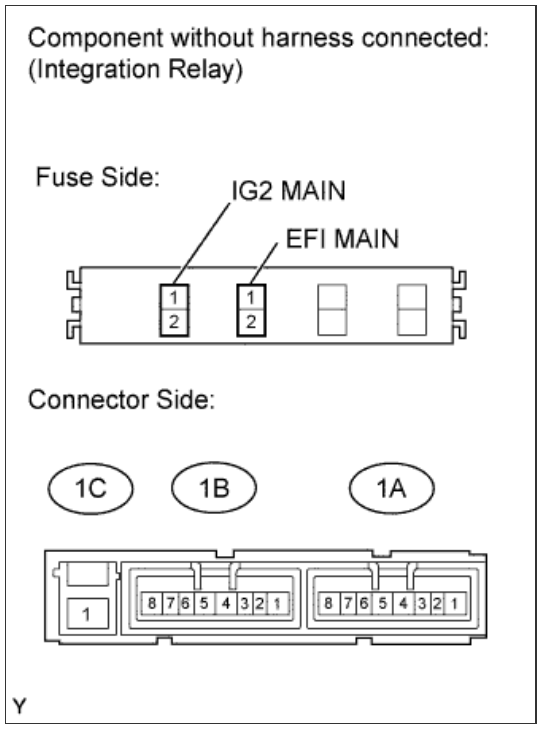
Tester Connection	Condition	Specified Condition
EFI MAIN fuse	Always	Below 1 Ω
IG2 MAIN fuse	Always	Below 1 Ω

c. Inspect the EFI relay and the IG2 relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1B-4	Battery voltage is not applied to terminals 1B-2 and 1B-3	10 kΩ or higher
	Battery voltage is applied to terminals 1B-2 and 1B-3	Below 1 Ω
1C-1 - 1B-8	Battery voltage is not applied to terminals 1B-7 and 1B-6	10 kΩ or higher
	Battery voltage is applied to terminals 1B-7 and 1B-6	Below 1 Ω



NG → REPLACE INTEGRATION RELAY

OK

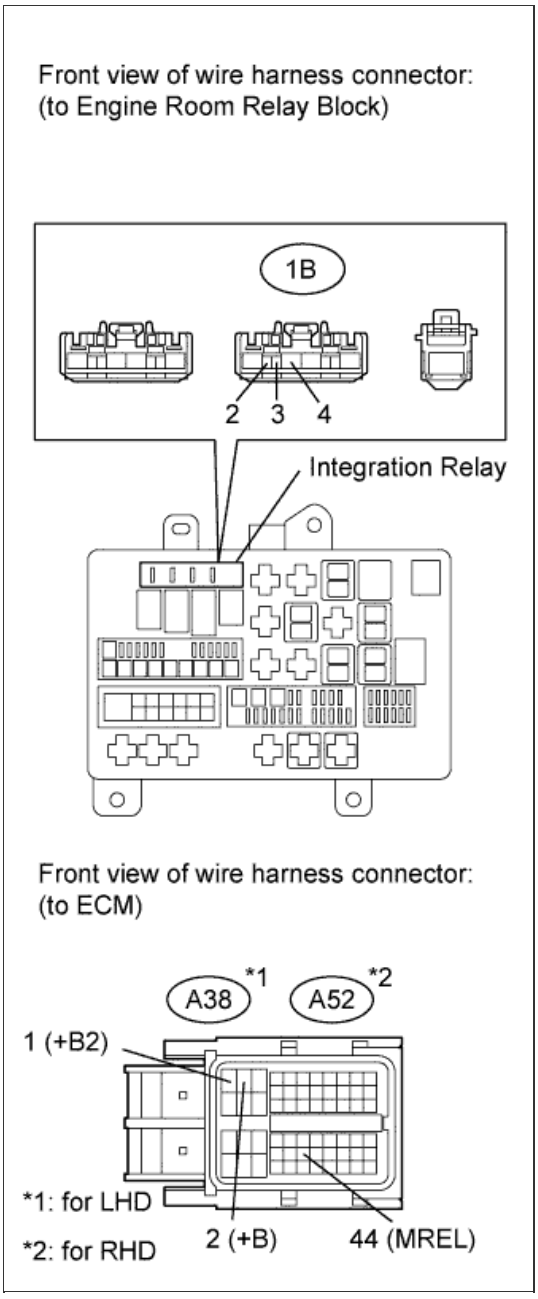
3.CHECK HARNESS AND CONNECTOR (+B, +B2 AND MREL CIRCUIT)

a. Check the harness and the connectors between the integration relay and the ECM.

i. Remove the integration relay from the engine room relay block.

ii. Disconnect the ECM connector.

iii. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A38-44 (MREL) - 1B-2	Always	Below 1 Ω
A38-2 (+B) - 1B-4	Always	Below 1 Ω
A38-1 (+B2) - 1B-4	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
A52-44 (MREL) - 1B-2	Always	Below 1 Ω
A52-2 (+B) - 1B-4	Always	Below 1 Ω
A52-1 (+B2) - 1B-4	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A38-44 (MREL) or 1B-2 - Body ground	Always	10 kΩ or higher

A38-2 (+B) or 1B-4 - Body ground	Always	10 kΩ or higher
A38-1 (+B2) or 1B-4 - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
A52-44 (MREL) or 1B-2 - Body ground	Always	10 kΩ or higher
A52-2 (+B) or 1B-4 - Body ground	Always	10 kΩ or higher
A52-1 (+B2) or 1B-4 - Body ground	Always	10 kΩ or higher

b. Check the harness and connectors between the integration relay and body ground.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
1B-3 - Body ground	Always	Below 1 Ω

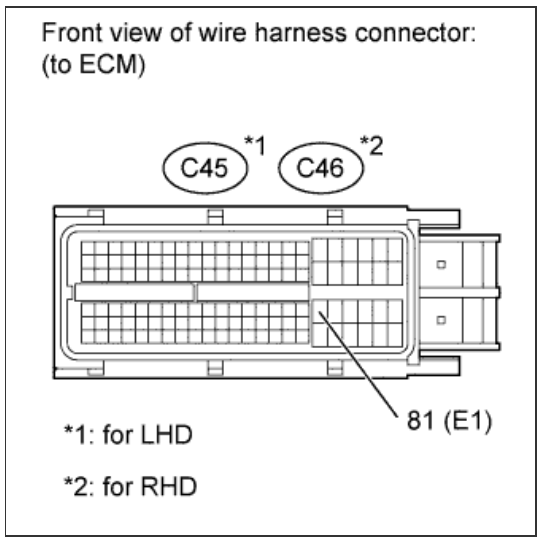
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.CHECK HARNESS AND CONNECTOR (ECM - BODY GROUND)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C45-81 (E1) - Body ground	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C46-81 (E1) - Body ground	Always	Below 1 Ω

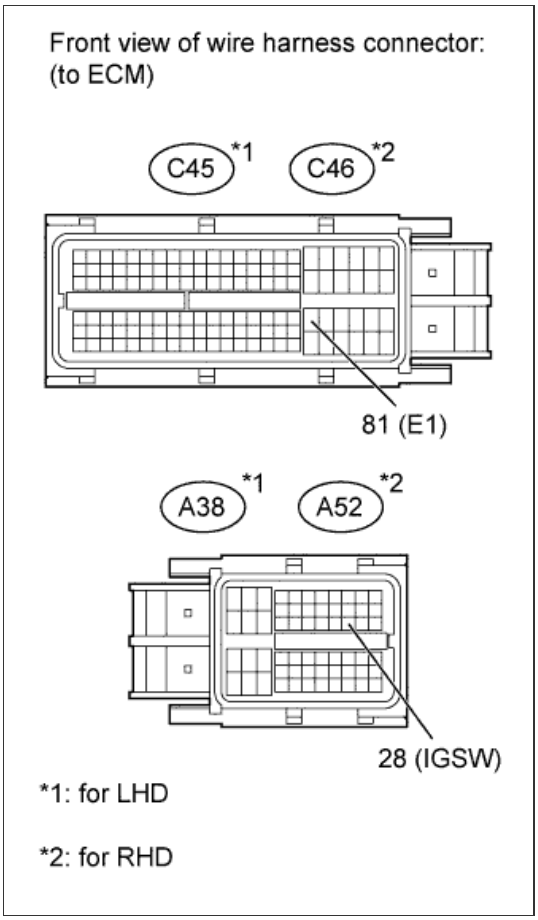
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

5.INSPECT ECM (IGSW VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for LHD

Tester Connection	Switch Condition	Specified Condition
A38-28 (IGSW) - C45-81 (E1)	Ignition switch ON	11 to 14 V

for RHD

Tester Connection	Switch Condition	Specified Condition
A52-28 (IGSW) - C46-81 (E1)	Ignition switch ON	11 to 14 V

NG → Go to step 6

OK

REPLACE ECM (Click here)

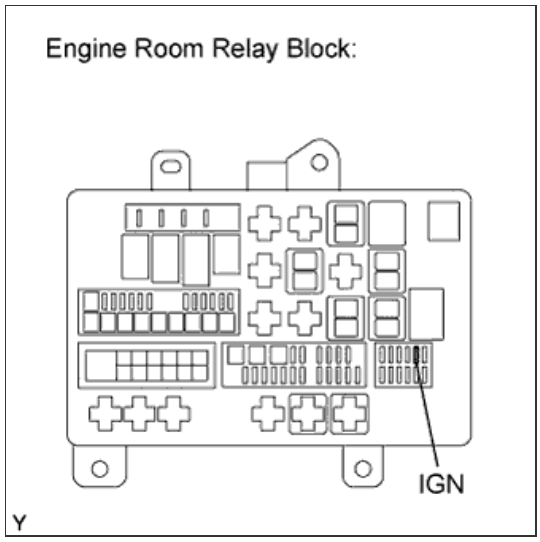
6.INSPECT FUSE (IGN)

a. Remove the IGN fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
IGN fuse	Always	Below 1 Ω



NG → CHECK FOR SHORT IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

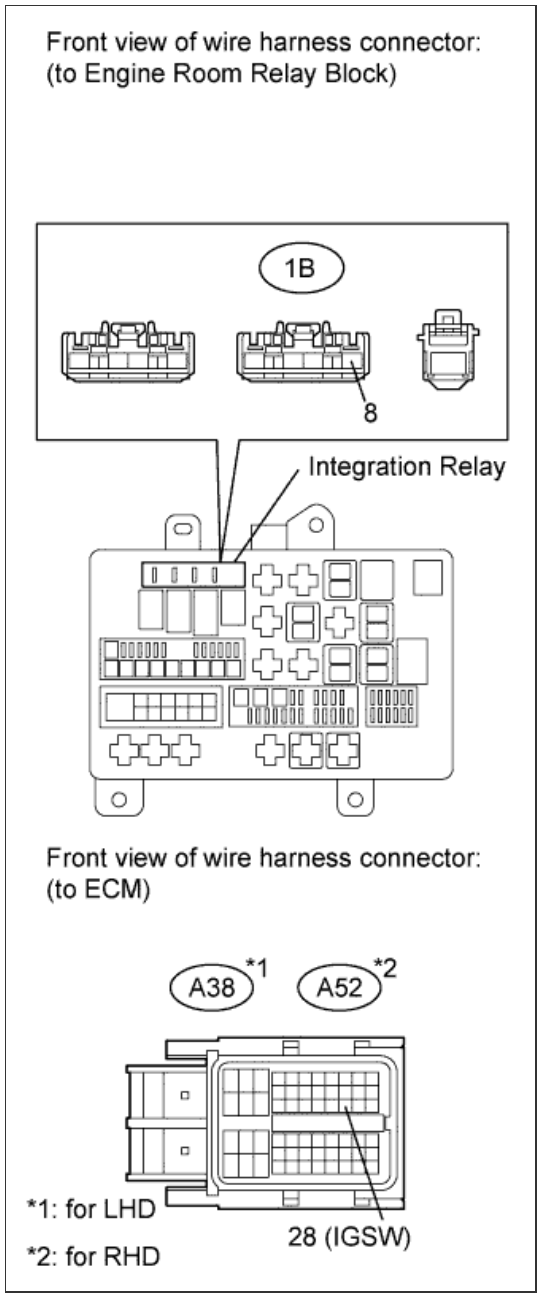
OK

7.CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - ECM, INTEGRATION RELAY - BODY GROUND)

a. Remove the integration relay from the engine room relay block.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
1B-8 - A38-28 (IGSW)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
1B-8 - A52-28 (IGSW)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
1B-8 or A38-28 (IGSW) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
1B-8 or A52-28 (IGSW) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

8.CHECK IF VEHICLE IS EQUIPPED WITH ENTRY AND START SYSTEM

Result

Result	Proceed to
w/ Entry and Start System	A
w/o Entry and Start System	B

B → Go to step 11

A

9.CHECK HARNESS AND CONNECTOR (MAIN BODY ECU - ENGINE ROOM RELAY BLOCK)

a. Remove the integration relay from the engine room relay block.

b. Disconnect the E2 main body ECU connector.

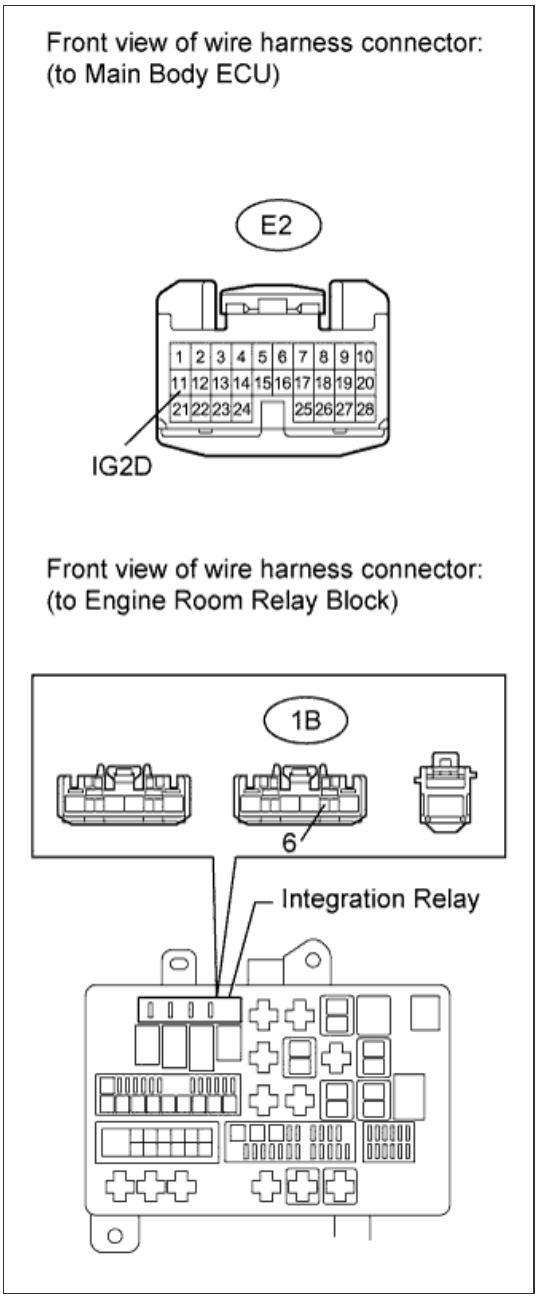
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
E2-11 (IG2D) - 1B-6	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
E2-11 (IG2D) or 1B-6 - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

10.CHECK ENTRY AND START SYSTEM (POWER SOURCE MODE DOES NOT CHANGE)

a. Check the entry and start system (Click here).

NG → REPAIR ENTRY AND START SYSTEM (Click here)

OK

REPLACE ECM (Click here)

11.CHECK HARNESS AND CONNECTOR (IGNITION SWITCH - ENGINE ROOM RELAY BLOCK)

a. Remove the integration relay from the engine room relay block.

b. Disconnect the E93 ignition switch connector.

c. Measure the resistance according to the value(s) in the table below.

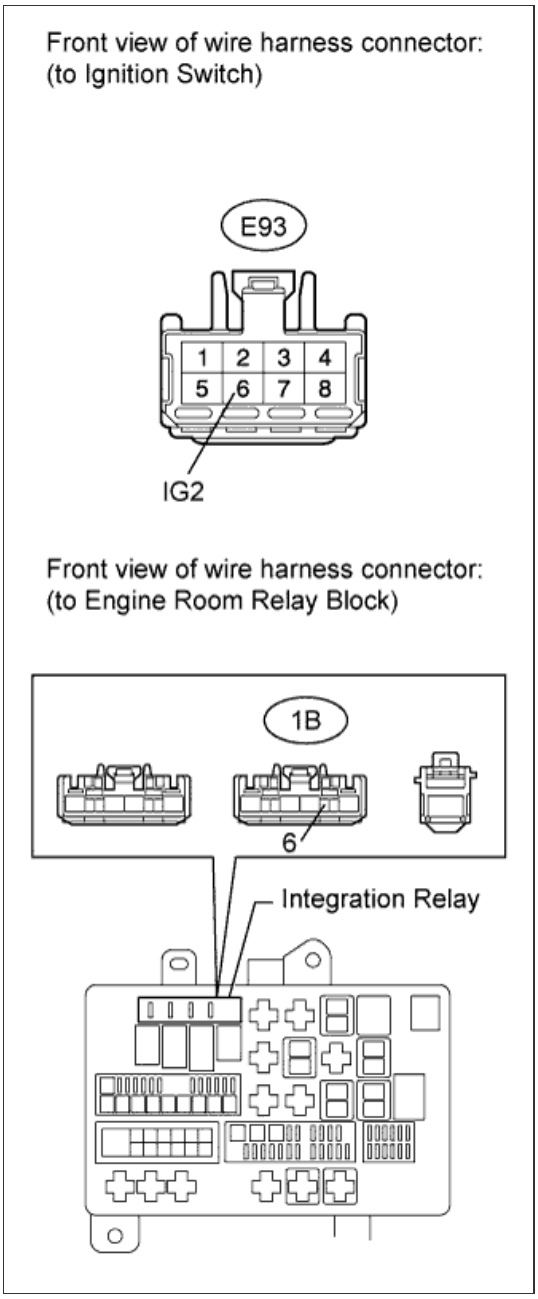
Standard Resistance (Check for Open):

		Specified

Tester Connection	Condition	Condition
E93-6 (IG2) - 1B-6	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
E93-6 (IG2) or 1B-6 - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

12.INSPECT IGNITION SWITCH ASSEMBLY

a. Inspect the ignition switch assembly (Click here).

NG → REPLACE IGNITION SWITCH ASSEMBLY (Click here)

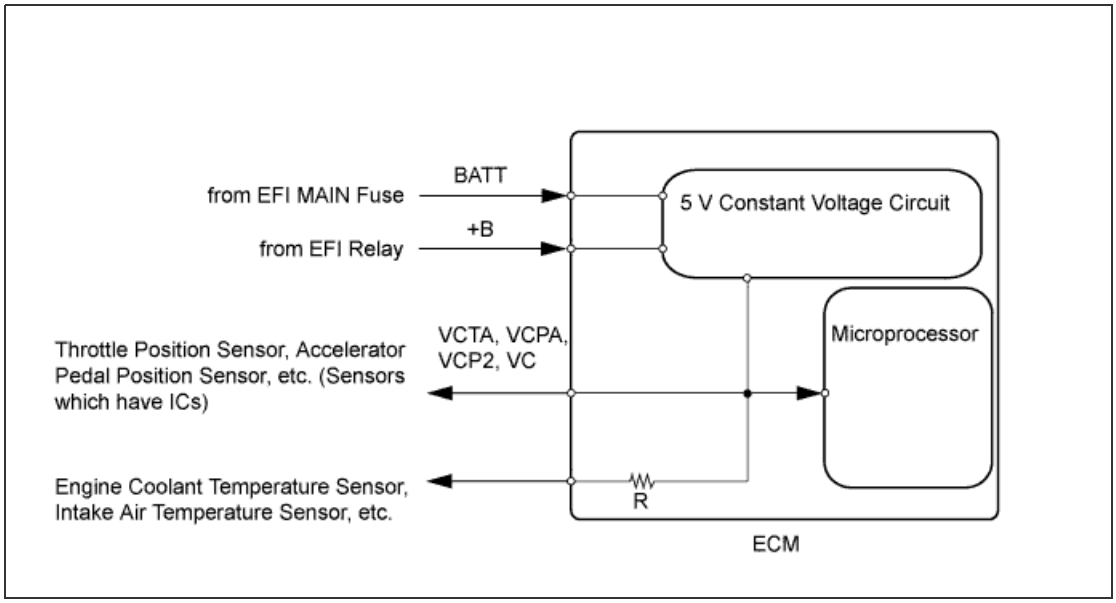
OK

REPAIR OR REPLACE HARNESS OR CONNECTOR (IGNITION SWITCH - BATTERY)

for Preparation Click here

DESCRIPTION

The ECM constantly generates 5 V of power from the battery voltages supplied to the +B (BATT) terminal to operate the microprocessor. The ECM also provides this power to the sensors through the VC output circuit.



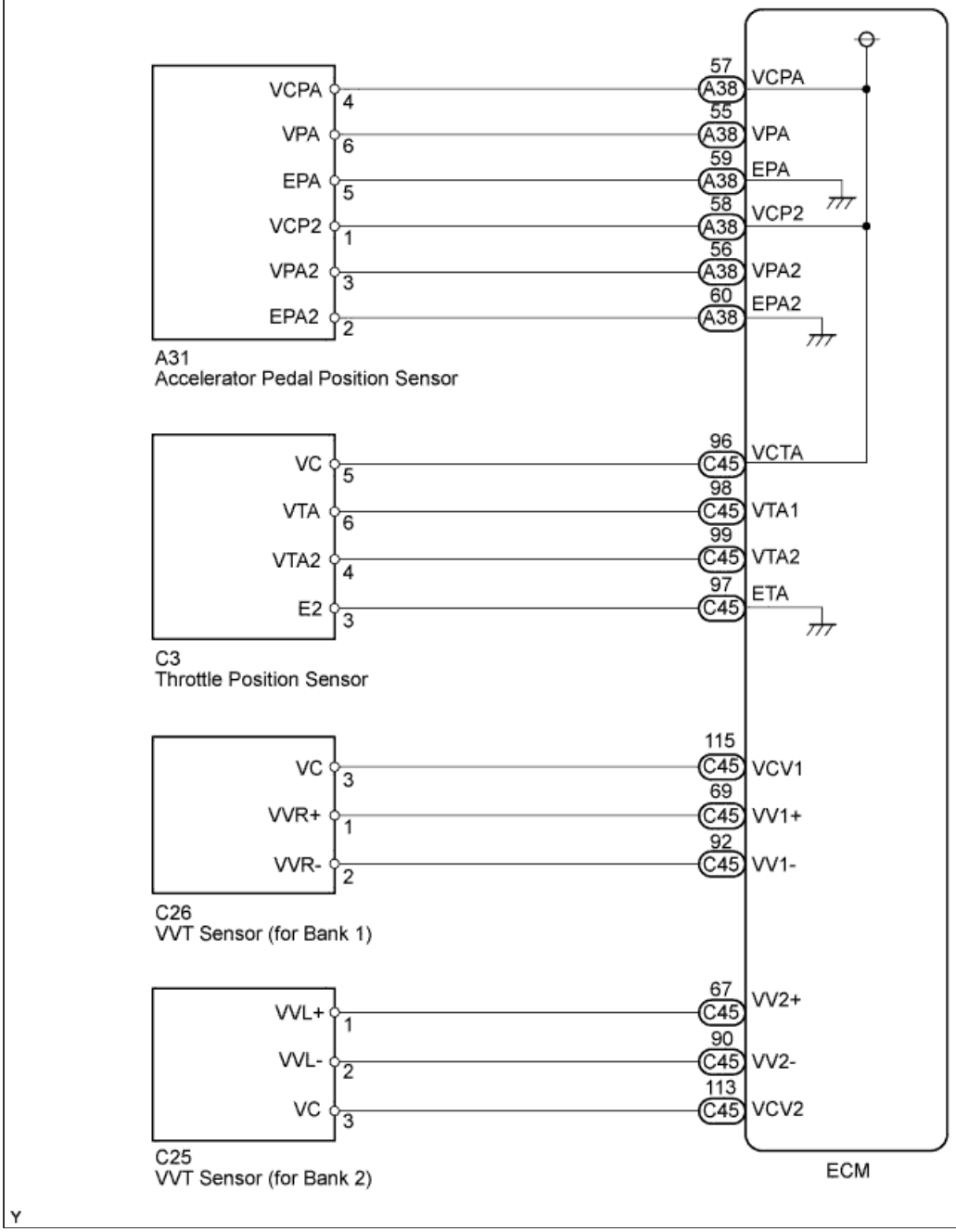
When the VC circuit is short-circuited, the microprocessor in the ECM and sensors that are supplied with power through the VC circuit are inactivated because the power is not supplied from the VC circuit. Under this condition, the system does not start up and the MIL does not illuminate even if the system malfunctions.

HINT:

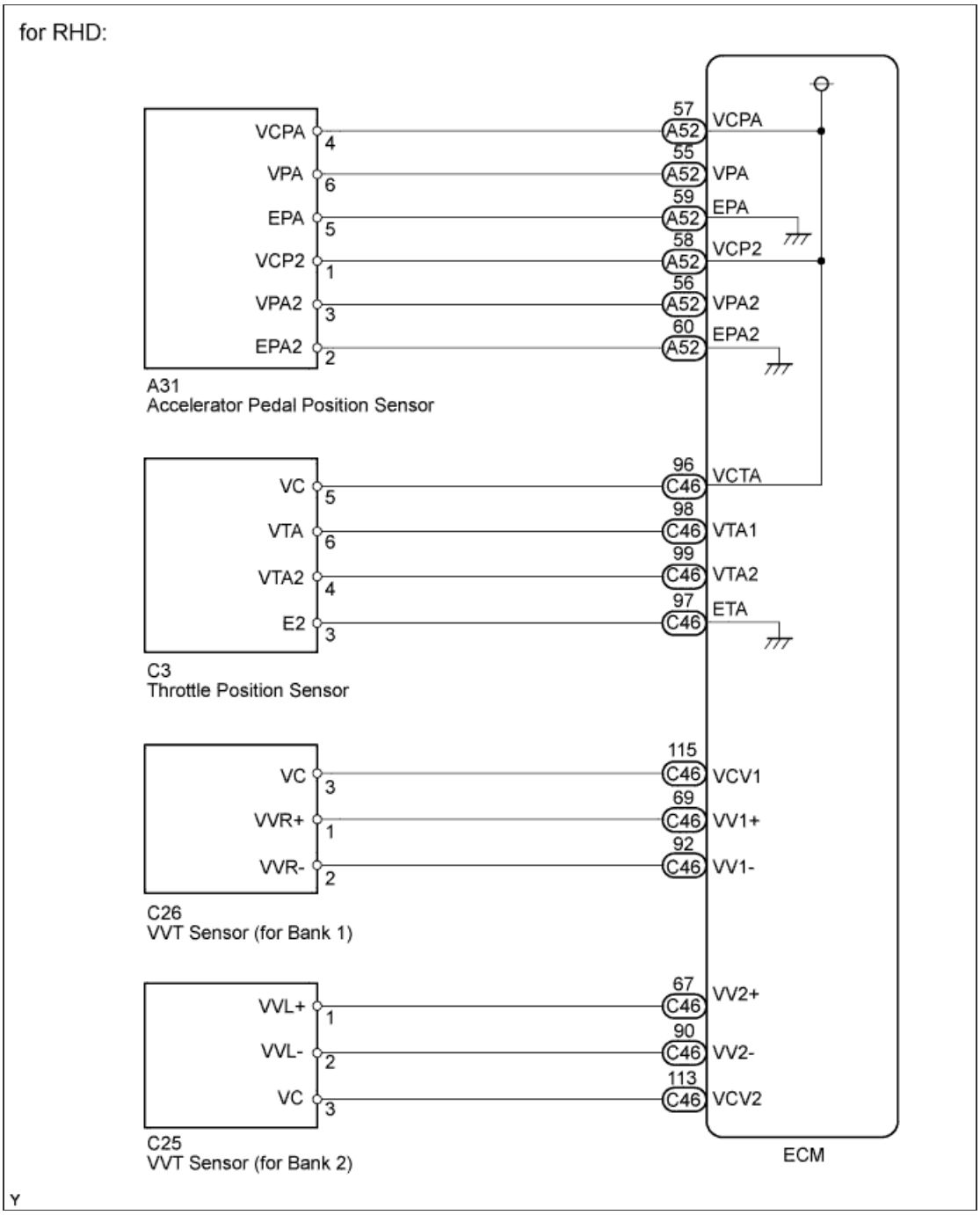
Under normal conditions, the MIL is illuminated for several seconds when the ignition switch is first turned to ON. The MIL goes off when the engine is started.

WIRING DIAGRAM

for LHD:


VCPA
4
VPA
6
EPA
5
VCP2
1
VPA2
3
EPA2
2
A31
Accelerator Pedal Position Sensor
57
A38
VCPA
55
A38
VPA
59
A38
EPA
58
A38
VCP2
56
A38
VPA2
60
A38
EPA2
VC
5
VTA
6
VTA2
4
E2
3
C3
Throttle Position Sensor
96
C45
VCTA
98
C45
VTA1
99
C45
VTA2
97
C45
ETA
VC
3
VVR+
1
VVR-
2
C26
VVT Sensor (for Bank 1)
115
C45
VCV1
69
C45
VV1+
92
C45
VV1-
VVL+
1
VVL-
2
VC
3
C25
VVT Sensor (for Bank 2)
67
C45
VV2+
90
C45
VV2-
113
C45
VCV2
ECM

Y



INSPECTION PROCEDURE

HINT:

When viewed from the rear of the engine assembly, Bank 1 is on the right side and Bank 2 is on the left side.

1.CHECK MIL

a. Check that the Malfunction Indicator Lamp (MIL) lights up when turning the ignition switch to ON.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

A → SYSTEM OK

B

2.CHECK COMMUNICATION BETWEEN INTELLIGENT TESTER AND ECM

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and tester on.

c. Check the communication between the tester and ECM.

Result

Result	Proceed to
Communication is possible	A
Communication is not possible	B

A → GO TO MIL CIRCUIT (Click here)

B

3.CHECK MIL (THROTTLE BODY)

a. Disconnect the throttle body connector.

b. Turn the ignition switch to ON.

c. Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

d. Reconnect the throttle body connector.

A → REPLACE THROTTLE BODY ASSEMBLY (Click here)

B

4.CHECK MIL (ACCELERATOR PEDAL POSITION SENSOR)

a. Disconnect the accelerator pedal position sensor connector.

b. Turn the ignition switch to ON.

c. Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

d. Reconnect the accelerator pedal position sensor connector.

A → REPLACE ACCELERATOR PEDAL ASSEMBLY (Click here)

B

5.CHECK MIL (VVT SENSOR FOR BANK 1)

a. Disconnect the air cleaner assembly with element (Click here).

b. Disconnect the VVT sensor (bank 1) connector.

c. Turn the ignition switch to ON.

d. Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

e. Reconnect the VVT sensor (bank 1) connector.

A → REPLACE VVT SENSOR (BANK 1) (Click here)

B

6.CHECK MIL (VVT SENSOR FOR BANK 2)

a. Disconnect the VVT sensor (bank 2) connector.

b. Turn the ignition switch to ON.

c. Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

d. Reconnect the VVT sensor (bank 2) connector.

A → REPLACE VVT SENSOR (BANK 2) (Click here)

B

7.CHECK HARNESS AND CONNECTOR

a. Disconnect the throttle body connector.

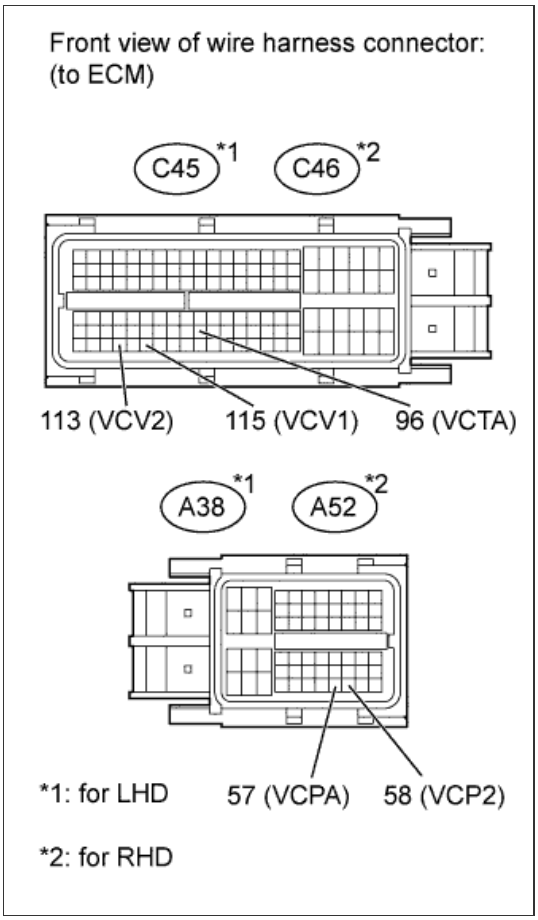
b. Disconnect the accelerator pedal position sensor connector.

c. Disconnect the VVT sensor (bank 1) connector.

d. Disconnect the VVT sensor (bank 2) connector.

e. Disconnect the ECM connectors.

f. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A38-57 (VCPA) - Body ground	Always	10 kΩ or higher
A38-58 (VCP2) - Body ground	Always	10 kΩ or higher
C45-96 (VCTA) - Body ground	Always	10 kΩ or higher
C45-115 (VCV1) - Body ground	Always	10 kΩ or higher
C45-113 (VCV2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
A52-57 (VCPA) - Body ground	Always	10 kΩ or higher
A52-58 (VCP2) - Body ground	Always	10 kΩ or higher
C46-96 (VCTA) - Body ground	Always	10 kΩ or higher
C46-115 (VCV1) - Body ground	Always	10 kΩ or higher
C46-113 (VCV2) - Body ground	Always	10 kΩ or higher

g. Reconnect the ECM connectors.

h. Reconnect the throttle body connector.

i. Reconnect the accelerator pedal position sensor connector.

j. Reconnect the VVT sensor (bank 1) connector.

k. Reconnect the VVT sensor (bank 2) connector.

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

for Preparation Click here

DESCRIPTION

The fuel pump circuit consists of the ECM, fuel pump and fuel pump ECU (which operates the fuel pump). Based on the engine output, the ECM determines the fuel pump speed. The speed is then converted to a duty signal and sent to the fuel pump ECU. Based on the signal sent from the ECM, the fuel pump ECU adjusts the fuel pump operation speed between 3 settings.

WIRING DIAGRAM

Refer to DTC P0230 (Click here).

INSPECTION PROCEDURE

This troubleshooting procedure is based on the premise that the engine is started. If the engine is not started, proceed to the Problem Symptoms Table (Click here).

1.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (FUEL PUMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Fuel Pump / Speed.

d. Check whether operating sounds can be heard while operating the relay using the tester.

OK:
Operating sounds can be heard from relay.

NG → **Go to step 5**

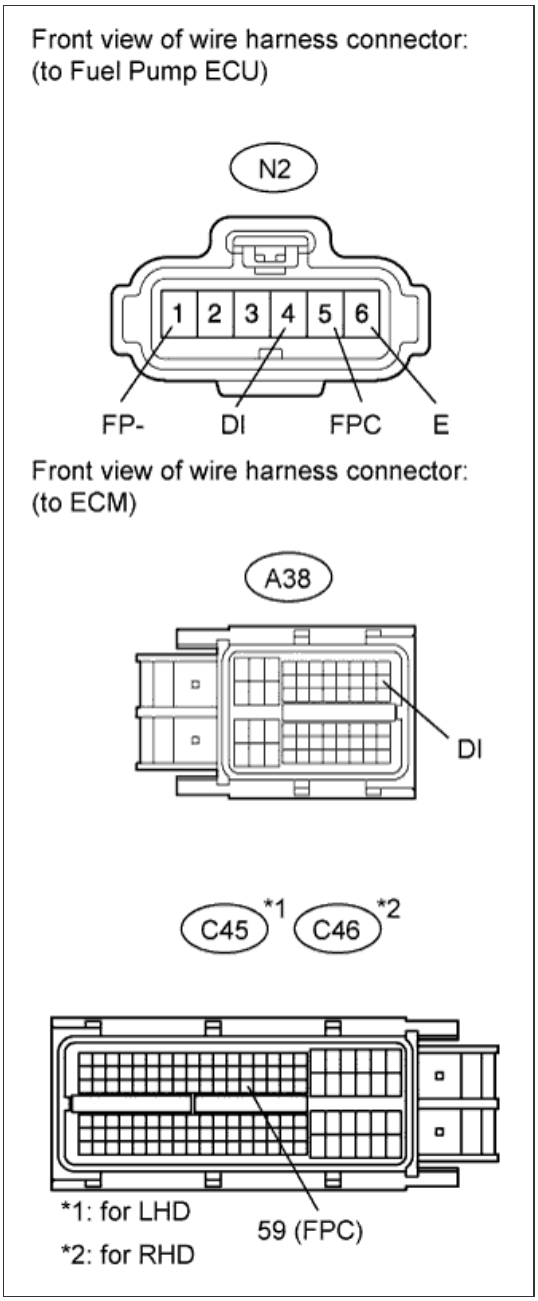
OK

2.CHECK HARNESS AND CONNECTOR (FUEL PUMP ECU - ECM, BODY GROUND)

a. Disconnect the fuel pump ECU connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
N2-5 (FPC) - C45-59 (FPC)	Always	Below 1 Ω
N2-4 (DI) - A38-19 (DI)	Always	Below 1 Ω
N2-6 (E) - Body ground	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
N2-5 (FPC) - C46-59 (FPC)	Always	Below 1 Ω
N2-4 (DI) - A52-19 (DI)	Always	Below 1 Ω
N2-6 (E) - Body ground	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
N2-1 (FP-) - Body ground	Always	10 kΩ or higher
N2-5 (FPC) or C45-59 (FPC) - Body ground	Always	10 kΩ or higher
N2-4 (DI) or A38-19 (DI) - Body		10 kΩ or

ground	Always	higher

for RHD

Tester Connection	Condition	Specified Condition
N2-1 (FP-) - Body ground	Always	10 kΩ or higher
N2-5 (FPC) or C46-59 (FPC) - Body ground	Always	10 kΩ or higher
N2-4 (DI) or A52-19 (DI) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.REPLACE FUEL PUMP ECU

a. Replace the fuel pump ECU (Click here).

NEXT

4.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Check the fuel pump operation.

OK:
Malfunction has been repaired successfully.

NG → REPLACE ECM (**Click here**)

OK

END

5.INSPECT CIRCUIT OPENING RELAY (C/OPN)

a. Inspect the circuit opening relay (C/OPN) (Click here).

NG → REPLACE CIRCUIT OPENING RELAY (C/OPN)

OK

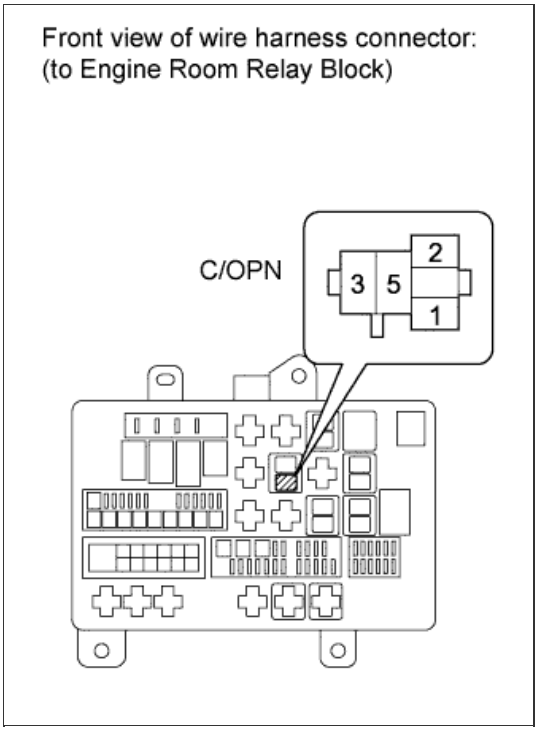
6.INSPECT CIRCUIT OPENING RELAY (POWER SOURCE VOLTAGE)

a. Remove the circuit opening relay (C/OPN) from the engine room relay block.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C/OPN relay (2) - Body ground	Ignition switch ON	11 to 14 V
C/OPN relay (5) - Body ground	Ignition switch ON	11 to 14 V



NG → Go to step 13

OK

7.CHECK HARNESS AND CONNECTOR (CIRCUIT OPENING RELAY (C/OPN) - ECU, FUEL PUMP ECU)

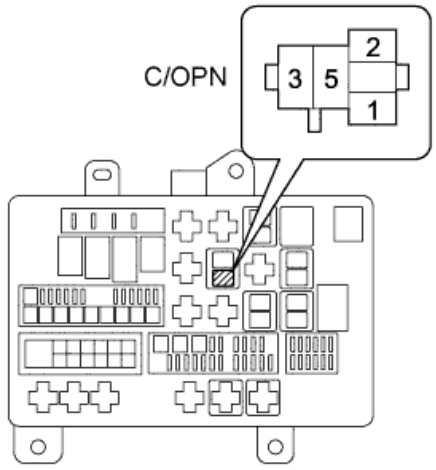
a. Remove the circuit opening relay (C/OPN) from the engine room relay block.

b. Disconnect the fuel pump ECU connector.

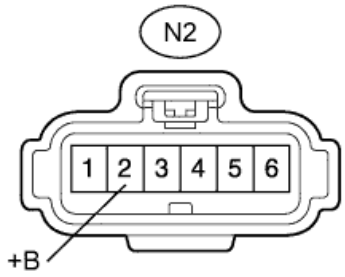
c. Disconnect the ECM connector.

d. Measure the resistance according to the value(s) in the table below.

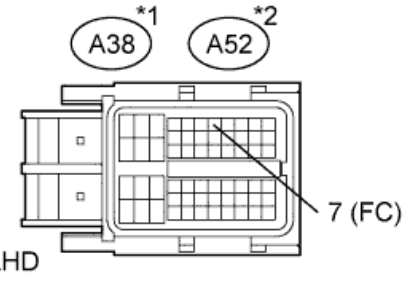
Front view of wire harness connector:
(to Engine Room Relay Block)



Front view of wire harness connector:
(to Fuel Pump ECU)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C/OPN relay (1) - A38-7 (FC)	Always	Below 1 Ω
C/OPN relay (3) - N2-3 (+B)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C/OPN relay (1) - A52-7 (FC)	Always	Below 1 Ω
C/OPN relay (3) - N2-3 (+B)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C/OPN relay (1) or A38-7 (FC) - Body ground	Always	10 kΩ or higher
C/OPN relay (3) or N2-3 (+B) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C/OPN relay (1) or A52-7 (FC) - Body ground	Always	10 kΩ or higher
C/OPN relay (3) or N2-3 (+B) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

8.CHECK HARNESS AND CONNECTOR (FUEL PUMP - FUEL PUMP ECU)

a. Disconnect the fuel sender gauge connector.

b. Disconnect the fuel pump ECU connector.

c. Measure the resistance according to the value(s) in the table below.

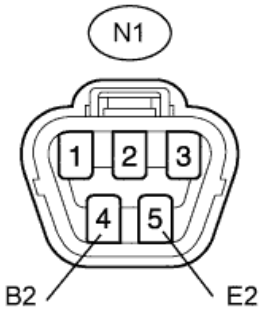
Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
N1-4 (B2) - N2-2 (FP)	Always	Below 1 Ω
N1-5 (E2) - N2-1 (FP-)	Always	Below 1 Ω

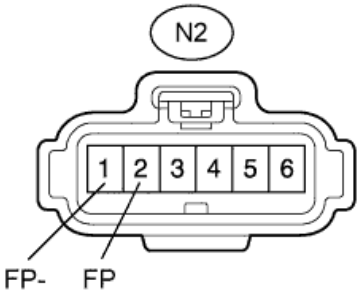
Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
N1-4 (B2) or N2-2 (FP) - Body ground	Always	10 kΩ or higher
N1-5 (E2) or N2-1 (FP-) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector: (to Fuel Sender Gauge)



Front view of wire harness connector: (to Fuel Pump ECU)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.INSPECT FUEL PUMP

a. Inspect the fuel pump (for Single Tank Type) (Click here).

b. Inspect the fuel pump (for Double Tank Type) (Click here).

Result

Test Result	Proceed to
OK	A
NG (for Single Tank Type)	B

NG (for Double Tank Type)	C

B → REPLACE FUEL PUMP (Click here)

C → REPLACE FUEL PUMP (Click here)

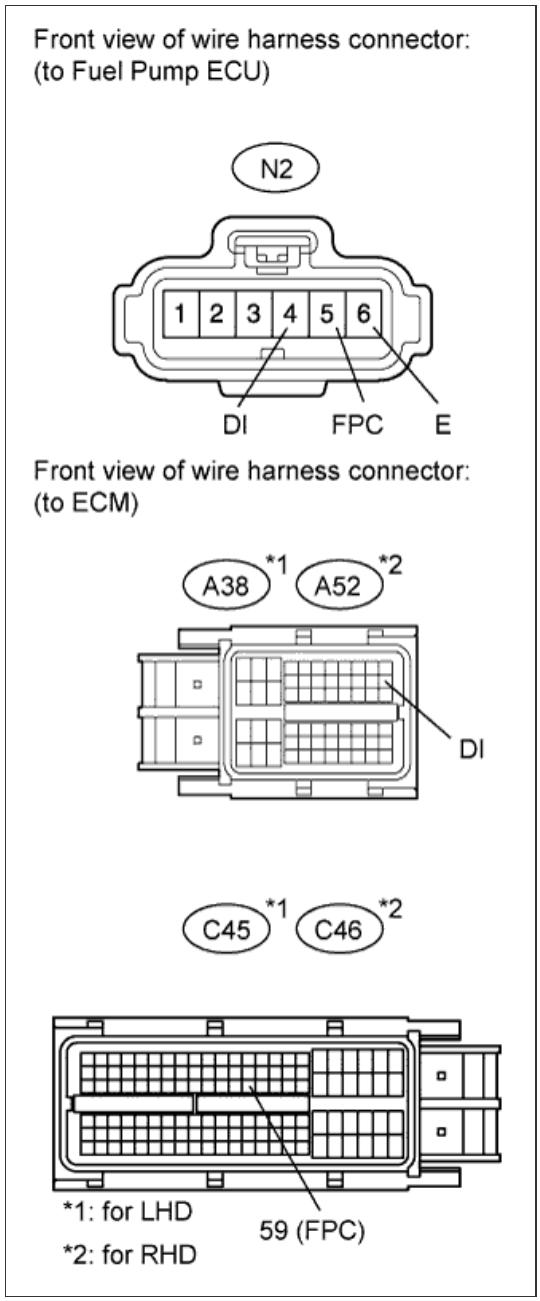
A

10.CHECK HARNESS AND CONNECTOR (FUEL PUMP ECU - ECM, BODY GROUND)

a. Disconnect the fuel pump ECU connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
N2-5 (FPC) - C45-59 (FPC)	Always	Below 1 Ω
N2-4 (DI) - A38-19 (DI)	Always	Below 1 Ω
N2-6 (E) - Body ground	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
N2-5 (FPC) - C46-59 (FPC)	Always	Below 1 Ω
N2-4 (DI) - A52-19 (DI)	Always	Below 1 Ω
N2-6 (E) - Body ground	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
N2-5 (FPC) or C45-59 (FPC) - Body ground	Always	10 kΩ or higher
N2-4 (DI) or A38-19 (DI) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
N2-5 (FPC) or C46-59 (FPC) - Body ground	Always	10 kΩ or higher
N2-4 (DI) or A52-19 (DI) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

11.REPLACE FUEL PUMP ECU

a. Replace the fuel pump ECU (Click here).

NEXT

12.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Check the fuel pump operation.

OK:

Malfunction has been repaired successfully.

NG → REPLACE ECM (Click here)

OK

END

13.CHECK HARNESS AND CONNECTOR (CIRCUIT OPENING RELAY (C/OPN) - IGN FUSE, INTEGRATION RELAY)

a. Remove the circuit opening relay (C/OPN) from the engine room relay block.

b. Remove the IGN fuse from the engine room relay block.

c. Remove the integration relay from the engine room relay block.

d. Disconnect the 1B integration relay connector.

e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

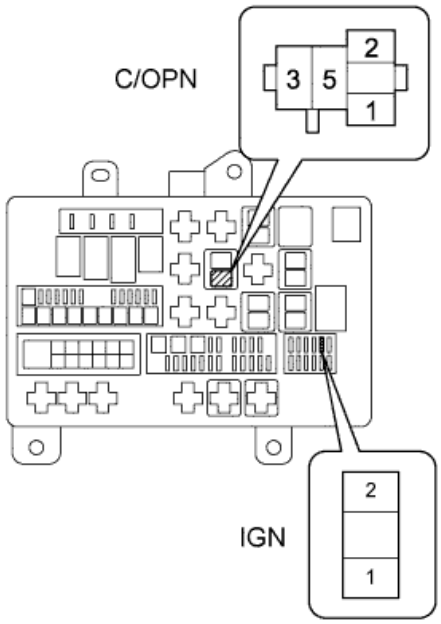
Tester Connection	Condition	Specified Condition
C/OPN relay (2) - IGN fuse (2)	Always	Below 1 Ω
C/OPN relay (5) - 1B-4	Always	Below 1 Ω

Standard Resistance (Check for Short):

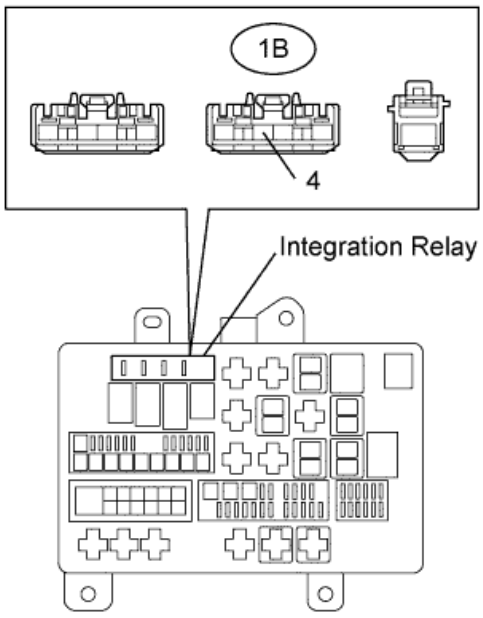
Tester Connection	Condition	Specified Condition
C/OPN relay (2) or		

IGN fuse (2) - Body ground	Always	10 kΩ or more
C/OPN relay (5) or 1B-4 - Body ground	Always	10 kΩ or more

Front view of wire harness connector:
(to Engine Room Relay Block)



Front view of wire harness connector:
(to Engine Room Relay Block)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

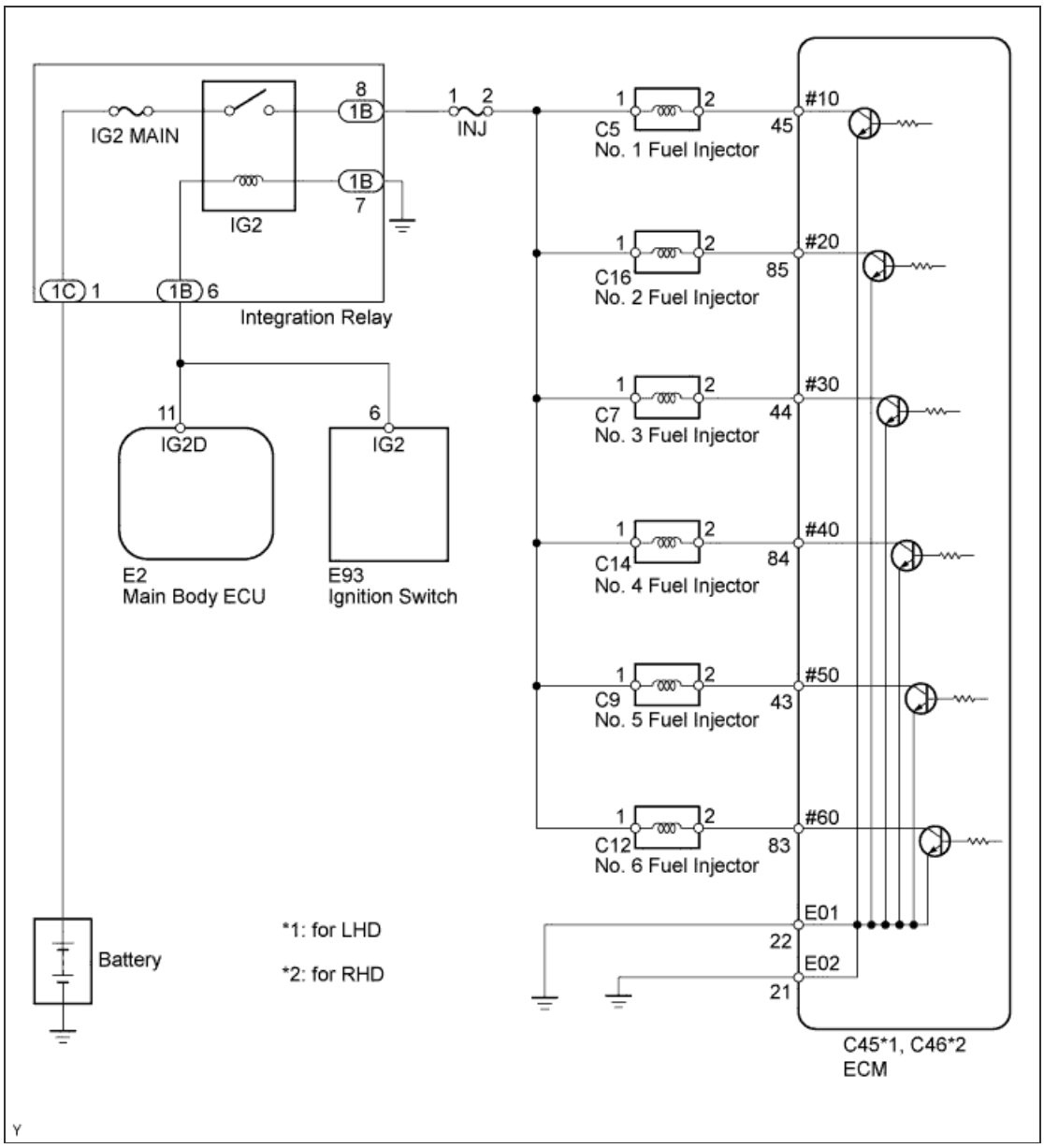
GO TO ECM POWER SOURCE CIRCUIT (Click here)

for Preparation Click here

DESCRIPTION

The fuel injectors are located on the intake manifold. They inject fuel into the cylinders based on the signals from the ECM.

WIRING DIAGRAM



INSPECTION PROCEDURE

1.CHECK FUEL INJECTOR ASSEMBLY (POWER SOURCE)

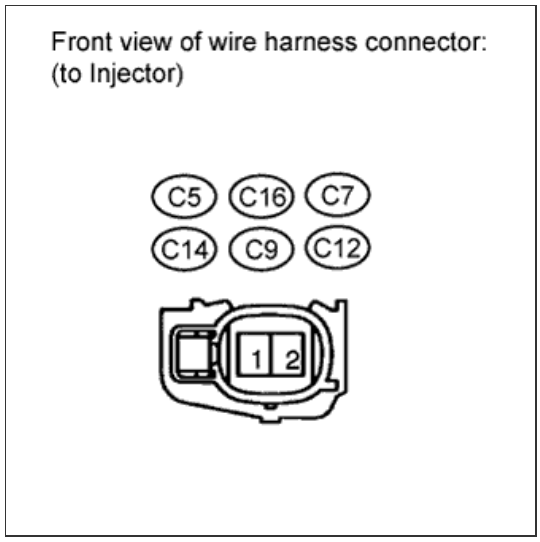
a. Disconnect the fuel injector connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Ground	Ignition switch ON	11 to 14 V
No. 2	C16-1 - Ground	Ignition switch ON	11 to 14 V
No. 3	C7-1 - Ground	Ignition switch ON	11 to 14 V

No. 4	C14-1 - Ground	Ignition switch ON	11 to 14 V
No. 5	C9-1 - Ground	Ignition switch ON	11 to 14 V
No. 6	C12-1 - Ground	Ignition switch ON	11 to 14 V



NG → Go to step 4

OK

2.INSPECT FUEL INJECTOR ASSEMBLY

a. Inspect the fuel injector (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (Click here)

OK

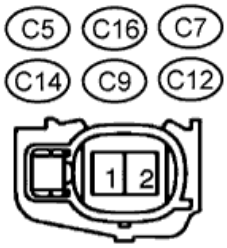
3.CHECK HARNESS AND CONNECTOR (FUEL INJECTOR ASSEMBLY - ECM)

a. Disconnect the fuel injector connector.

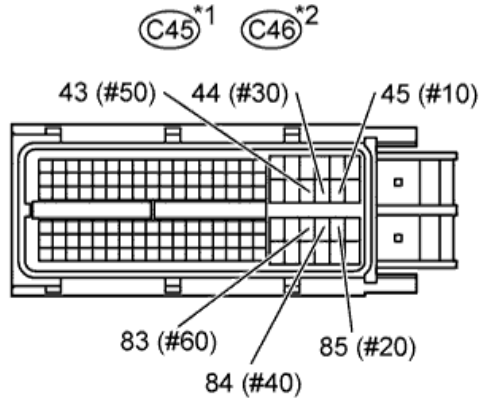
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance:

for LHD

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-45 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C45-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C45-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C45-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C45-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C45-83 (#60)	Always	Below 1 Ω

for RHD

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-45 (#10)	Always	Below 1 Ω
	C16-2 - Body		

No. 2	ground	Always	10 kΩ or higher
	C16-2 - C46-85 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C46-44 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C46-84 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C46-43 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C46-83 (#60)	Always	Below 1 Ω

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

4.INSPECT FUSE (INJ, IG2 MAIN)

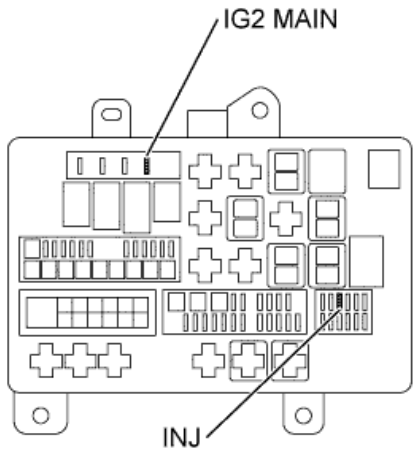
a. Remove the INJ fuse and IG2 MAIN fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
INJ fuse	Always	Below 1 Ω
IG2 MAIN fuse	Always	Below 1 Ω

Engine Room Relay Block:



NG → CHECK FOR SHORT IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

OK

5.INSPECT INTEGRATION NO.1 RELAY (IG2)

a. Inspect the integration relay (Click here).

NG → REPLACE INTEGRATION NO.1 RELAY

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR (INTEGRATION RELAY - FUEL INJECTOR ASSEMBLY)

for Preparation Click here

DESCRIPTION

While the engine is being cranked, current flows from terminal ST1 of the ignition switch*1 or terminal STAR of the main body ECU*2 to the park/neutral position switch (for automatic transmission) or clutch start switch (for manual transmission) and also flows to terminal STA of the ECM (STA Signal).

WIRING DIAGRAM

Refer to DTC P0617 (Click here).

INSPECTION PROCEDURE

1.READ VALUE USING INTELLIGENT TESTER (STARTER SIGNAL)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / Starter Signal.

e. Read values.

f. Check the result when the ignition switch is turned to ON and when the engine is started.

OK:

Condition	Display (Starter Signal)
Ignition switch ON	OFF
Engine is started	ON

NG → Go to step 6

OK ↓

2.INSPECT STARTER RELAY (ST)

a. Inspect the starter relay (ST) (Click here).

NG → REPLACE STARTER RELAY (ST)

OK ↓

3.CHECK HARNESS AND CONNECTOR (ST RELAY - CLUTCH START SWITCH)

a. Disconnect the clutch start switch.

b. Remove the ST relay from the engine room relay block.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
ST relay (1) - A49-2*1	Always	Below 1 Ω
ST relay (1) - e1-2*2	Always	Below 1 Ω

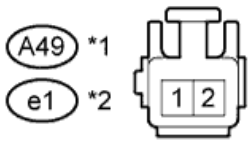
Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
ST relay (1) or A49-2*1 - Body ground	Always	10 kΩ or higher

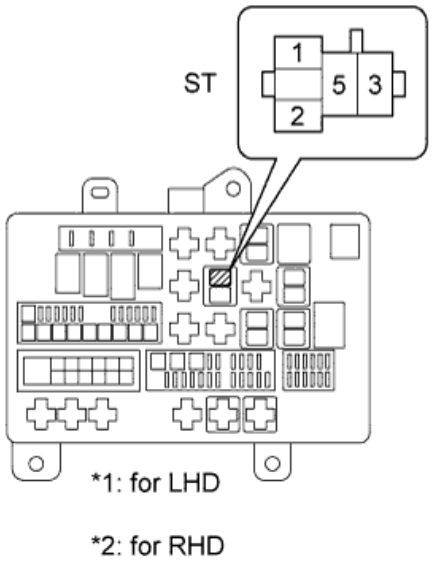
ST relay (1) or e1-2*2 - Body ground	Always	10 kΩ or higher

*1: for LHD
*2: for RHD

Front view of wire harness connector:
(to Clutch Start Switch)



Front view of wire harness connector:
(to Engine Room Relay Block)



*1: for LHD

*2: for RHD

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.CHECK HARNESS AND CONNECTOR (POWER SOURCE)

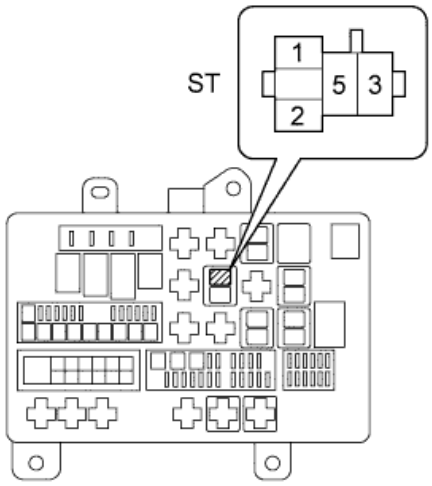
a. Remove the ST relay from the engine room relay block.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
ST relay (2) - ST relay (5)	Always	11 to 14 V

Front view of wire harness connector:
(to Engine Room Relay Block)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (STARTER RELAY (ST) - BATTERY, BODY GROUND)

OK

5.INSPECT STARTER

a. Inspect the starter (for 1.4 kW Type) (Click here).

b. Inspect the starter (for 2.0 kW Type) (Click here).

Result

Result	Proceed to
OK	A
NG (for 1.4 kW Type)	B
NG (for 2.0 kW Type)	C

B → REPLACE STARTER (**Click here**)

C → REPLACE STARTER (**Click here**)

A

REPAIR OR REPLACE HARNESS OR CONNECTOR (STARTER - STARTER RELAY (ST), BATTERY)

6.INSPECT CLUTCH START SWITCH ASSEMBLY

a. Inspect the clutch start switch (for LHD) (Click here).

b. Inspect the clutch start switch (for RHD) (Click here).

Result

Result	Proceed to
OK	A
NG (for LHD)	B
NG (for RHD)	C

B → REPLACE CLUTCH START SWITCH ASSEMBLY (**Click here**)

C → REPLACE CLUTCH START SWITCH ASSEMBLY (**Click here**)

A

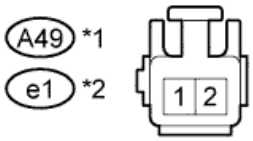
7.CHECK HARNESS AND CONNECTOR (CLUTCH START SWITCH - ECM)

a. Disconnect the clutch start switch connector.

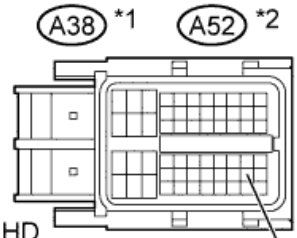
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Clutch Start Switch)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A49-2 - A38-48 (STA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
e1-2 - A52-48 (STA)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A49-2 or A38-48 (STA) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
e1-2 or A52-48 (STA) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

8.CHECK IF VEHICLE IS EQUIPPED WITH ENTRY AND START SYSTEM

Result

Result	Proceed to
w/ Entry and Start System	A
w/o Entry and Start System	B

B → Go to step 11

A

9.REPLACE ECM

a. Replace the ECM (Click here).

NEXT

10.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Check the starter operation.

OK:
Malfunction has been repaired successfully.

NG → GO TO ENTRY AND START SYSTEM (ENGINE DOES NOT START) (**Click here**)

OK

END

11.INSPECT IGNITION SWITCH ASSEMBLY

a. Inspect the ignition switch assembly (Click here).

NG → REPLACE IGNITION SWITCH ASSEMBLY (**Click here**)

OK

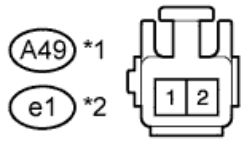
12.CHECK HARNESS AND CONNECTOR (CLUTCH START SWITCH - IGNITION SWITCH)

a. Disconnect the clutch start switch connector.

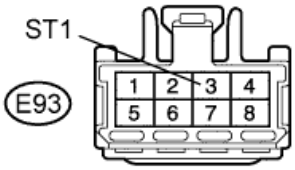
b. Disconnect the ignition switch connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Clutch Start Switch)



Front view of wire harness connector:
(to Ignition Switch)



N

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A49-1 - E93-3 (ST1)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
e1-1 - E93-3 (ST1)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A49-1 or E93-3 (ST1) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
e1-1 or E93-3 (ST1) - Body ground	Always	10 kΩ or higher

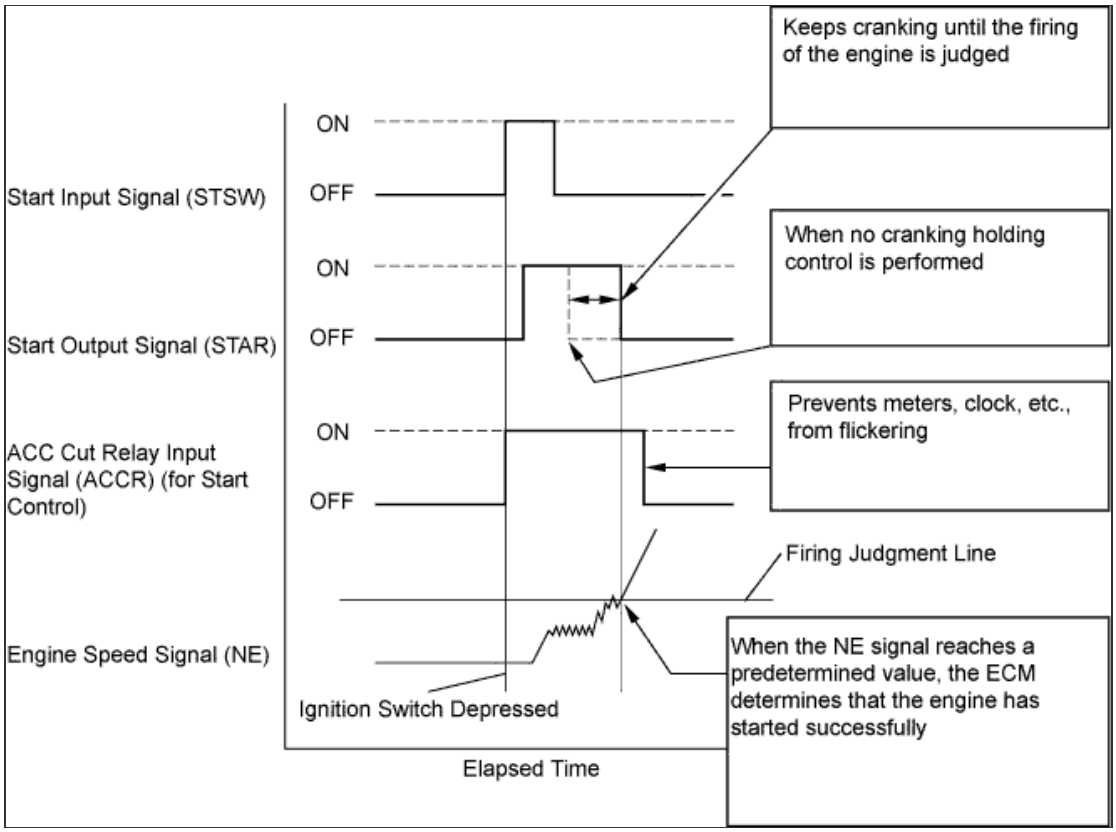
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK → REPAIR OR REPLACE HARNESS OR CONNECTOR (IGNITION SWITCH - BATTERY)

for Preparation Click here

DESCRIPTION

The cranking holding control system provides current to the starter when the ECM detects the ignition switch start signal (STSW). When the ECM performs a firing judgment, the system cuts current to the starter. When an ECM receives the STSW signal, it turns on the ST CUT relay, which prevents flickering of the combination meter, clock, audio system, etc. Also, the ECM sends a signal to the STAR terminal of the ECM. Then the STAR output signal travels through the Park/Neutral Position (PNP) switch to the ST relay, causing the starter to activate.
When the engine is cranking, the starter operation signal is sent to the STA terminal of the ECM.



WIRING DIAGRAM

Refer to DTC P0617 (Click here).

INSPECTION PROCEDURE

1.CHECK CRANKING

a. Check the cranking of the engine.

Result

Test Result	Proceed to
Cranking possible and holding control operates	A
Does not crank	B
Cranking possible but holding control does not operate (for automatic transmission)	C
Cranking possible but holding control does not operate (for manual transmission)	D

B → Go to step 2

C → Go to step 11

D → Go to step 17

A

PROCEED TO NEXT CIRCUIT INSPECTION SHOWN IN PROBLEM SYMPTOMS TABLE (Click here)

2.READ VALUE USING INTELLIGENT TESTER (STARTER SIGNAL)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / Starter Signal.

e. Read values.

f. Check the result when the ignition switch is turned to ON and when the engine is started.

OK:

Condition	Display (Starter Signal)
Ignition switch ON	OFF
Engine is started	ON

Result

Result	Proceed to
OK	A
NG (for automatic transmission)	B
NG (for manual transmission)	C

B → Go to step 7

C → Go to step 13

A

3.INSPECT STARTER RELAY (ST)

a. Inspect the starter relay (ST) (Click here).

NG → REPLACE STARTER RELAY (ST)

OK

4.CHECK HARNESS AND CONNECTOR (ST RELAY - PNP SWITCH, CLUTCH START SWITCH)

a. Disconnect the Park/Neutral Position (PNP) switch (for automatic transmission).

b. Disconnect the clutch start switch (for manual transmission).

c. Remove the ST relay from the engine room relay block.

d. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):
for automatic transmission:

Tester Connection	Condition	Specified Condition
ST relay (1) - C24-5	Always	Below 1 Ω

Standard Resistance (Check for Short):
for automatic transmission:

Tester Connection	Condition	Specified Condition
ST relay (1) or C24-5 - Body ground	Always	10 kΩ or higher

Standard Resistance (Check for Open):
for manual transmission:

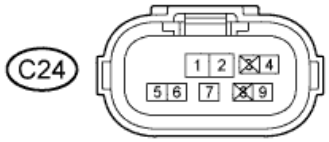
Tester Connection	Condition	Specified Condition
ST relay (1) - A49-2*1	Always	Below 1 Ω
ST relay (1) - e1-2*2	Always	Below 1 Ω

Standard Resistance (Check for Short):
for manual transmission:

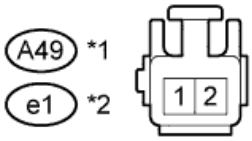
Tester Connection	Condition	Specified Condition
ST relay (1) or A49-2*1 - Body ground	Always	10 kΩ or higher
ST relay (1) or e1-2*2 - Body ground	Always	10 kΩ or higher

*1: for LHD
*2: for RHD

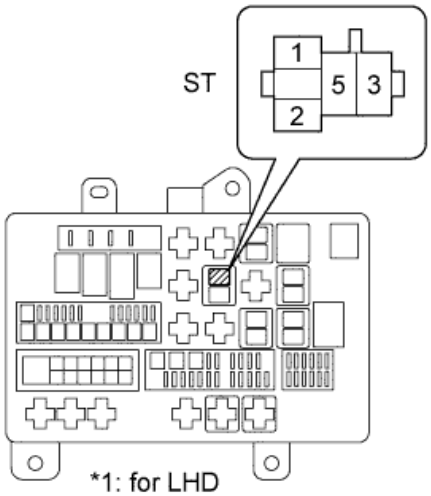
Front view of wire harness connector:
(to PNP Switch)



Front view of wire harness connector:
(to Clutch Start Switch)



Front view of wire harness connector:
(to Engine Room Relay Block)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

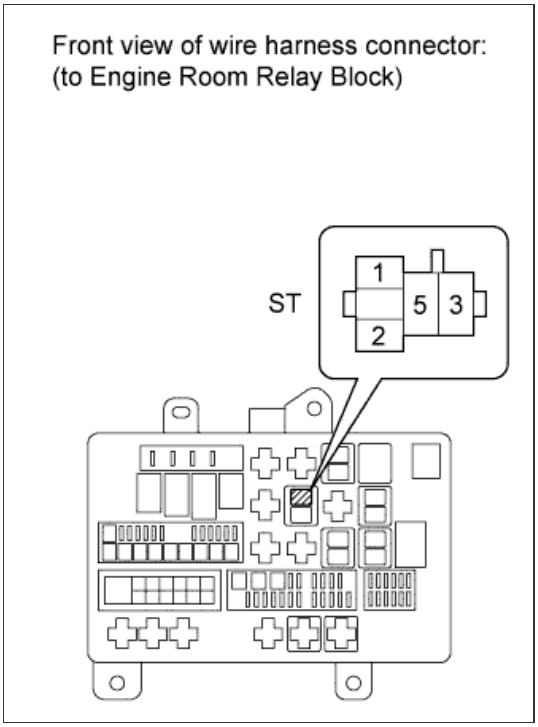
5.CHECK HARNESS AND CONNECTOR (POWER SOURCE)

a. Remove the ST relay from the engine room relay block.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
ST relay (2) - ST relay (5)	Always	11 to 14 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (STARTER RELAY (ST) - BATTERY, BODY GROUND)

OK

6.INSPECT STARTER

a. Inspect the starter (for 1.4 kW Type) (Click here).

b. Inspect the starter (for 2.0 kW Type) (Click here).

Result

Result	Proceed to
OK	A
NG (for 1.4 kW Type)	B
NG (for 2.0 kW Type)	C

B → REPLACE STARTER (**Click here**)

C → REPLACE STARTER (**Click here**)

A

REPAIR OR REPLACE HARNESS OR CONNECTOR (STARTER - STARTER RELAY (ST), BATTERY)

7.INSPECT STARTER CUT RELAY (ST CUT)

a. Inspect the starter cut relay (ST CUT) (Click here).

NG → REPLACE STARTER CUT RELAY (ST CUT)

OK

8.CHECK HARNESS AND CONNECTOR (ST CUT RELAY - PNP SWITCH, ECM)

a. Remove the starter cut relay (ST CUT) from the engine room relay block.

b. Disconnect the PNP switch connector.

c. Disconnect the ECM connector.

d. Measure the resistance according to the value(s) in the table below.

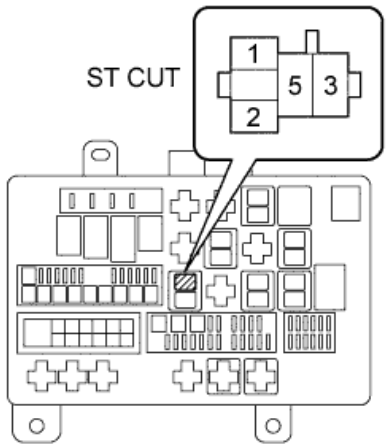
Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
ST CUT relay (5) - C45-63 (STAR)	Always	Below 1 Ω
ST CUT relay (3) - C24-4	Always	Below 1 Ω

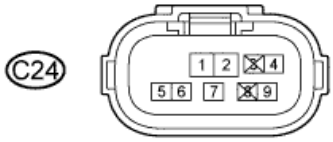
Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
ST CUT relay (5) or C45-63 (STAR) - Body ground	Always	10 kΩ or higher
ST CUT relay (3) or C24-4 - Body ground	Always	10 kΩ or higher

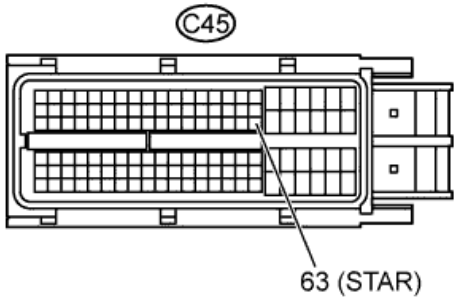
Engine Room Relay Block



Front view of wire harness connector: (to PNP Switch)



Front view of wire harness connector: (to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.INSPECT PARK/NEUTRAL POSITION SWITCH

a. Inspect the Park/Neutral Position (PNP) switch.

i. Disconnect the PNP switch connector.

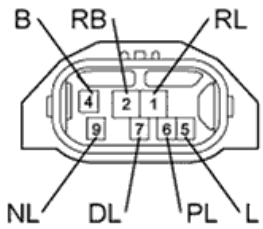
ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
4 (B) - 5 (L)	Shift lever in P	Below 1 Ω

	Shift lever in N	Below 1 Ω

Component without harness connected:
(Park/Neutral Position Switch)



NG → REPLACE PARK/NEUTRAL POSITION SWITCH ASSEMBLY (Click here)

OK

10.CHECK HARNESS AND CONNECTOR (PNP SWITCH - ECM)

a. Disconnect the PNP switch connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C24-5 - A38-48 (STA)	Always	Below 1 Ω

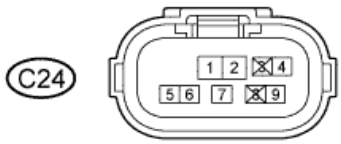
Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
C24-5 or A38-48 (STA) - Body ground	Always	10 kΩ or higher

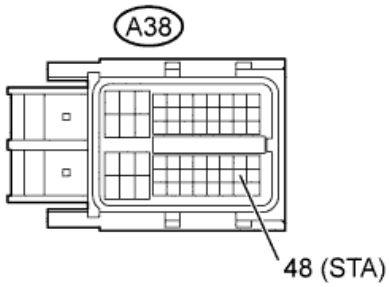
Result

Result	Proceed to
NG	A
OK	B

Front view of wire harness connector:
(to Park/Neutral Position Switch)



Front view of wire harness connector:
(to ECM)

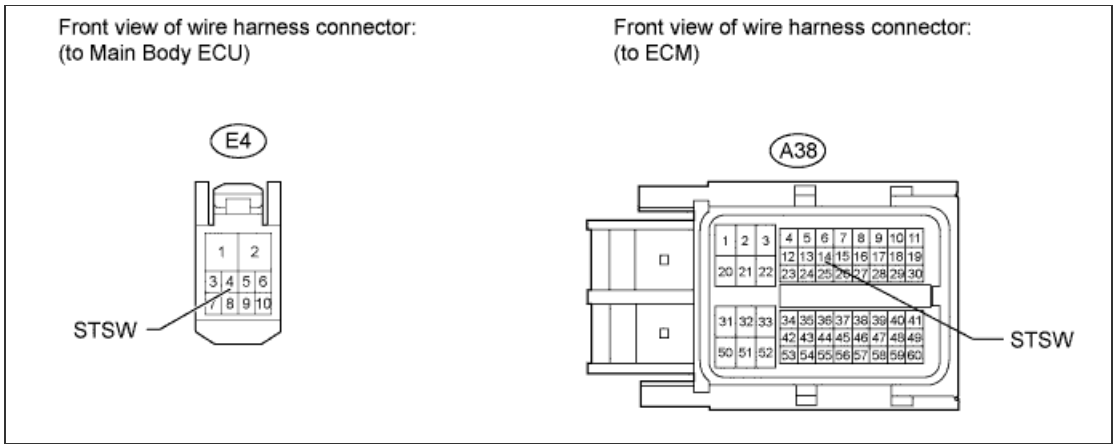


B → Go to step 19

A

REPAIR OR REPLACE HARNESS OR CONNECTOR

11.CHECK HARNESS AND CONNECTOR (MAIN BODY ECU - ECM)



a. Disconnect the main body ECU connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
E4-4 (STSW) - A38-14 (STSW)	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
E4-4 (STSW) or A38-14 (STSW) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

12.CHECK HARNESS AND CONNECTOR (ST CUT RELAY - PNP SWITCH, ECM)

a. Remove the starter cut relay (ST CUT) from the engine room relay block.

b. Disconnect the PNP switch connector.

c. Disconnect the ECM connector.

d. Measure the resistance according to the value(s) in the table below.

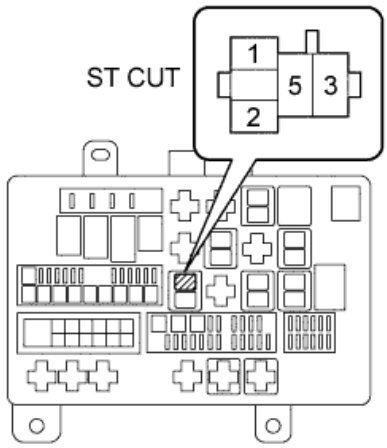
Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
ST CUT relay (5) - C45-63 (STAR)	Always	Below 1 Ω
ST CUT relay (3) - C24-4	Always	Below 1 Ω

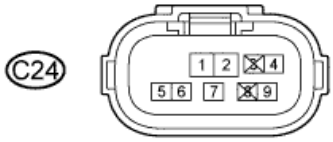
Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
ST CUT relay (5) or C45-63 (STAR) - Body ground	Always	10 kΩ or higher
ST CUT relay (3) or C24-4 - Body ground	Always	10 kΩ or higher

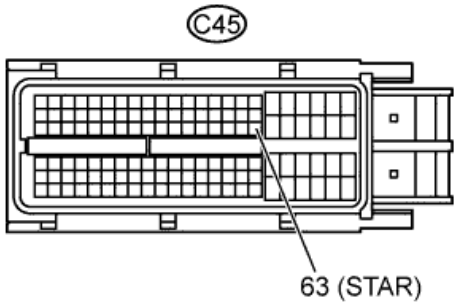
Engine Room Relay Block



Front view of wire harness connector:
(to PNP Switch)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

13.INSPECT STARTER CUT RELAY (ST CUT)

a. Inspect the starter cut relay (ST CUT) (Click here).

NG → REPLACE STARTER CUT RELAY (ST CUT)

OK

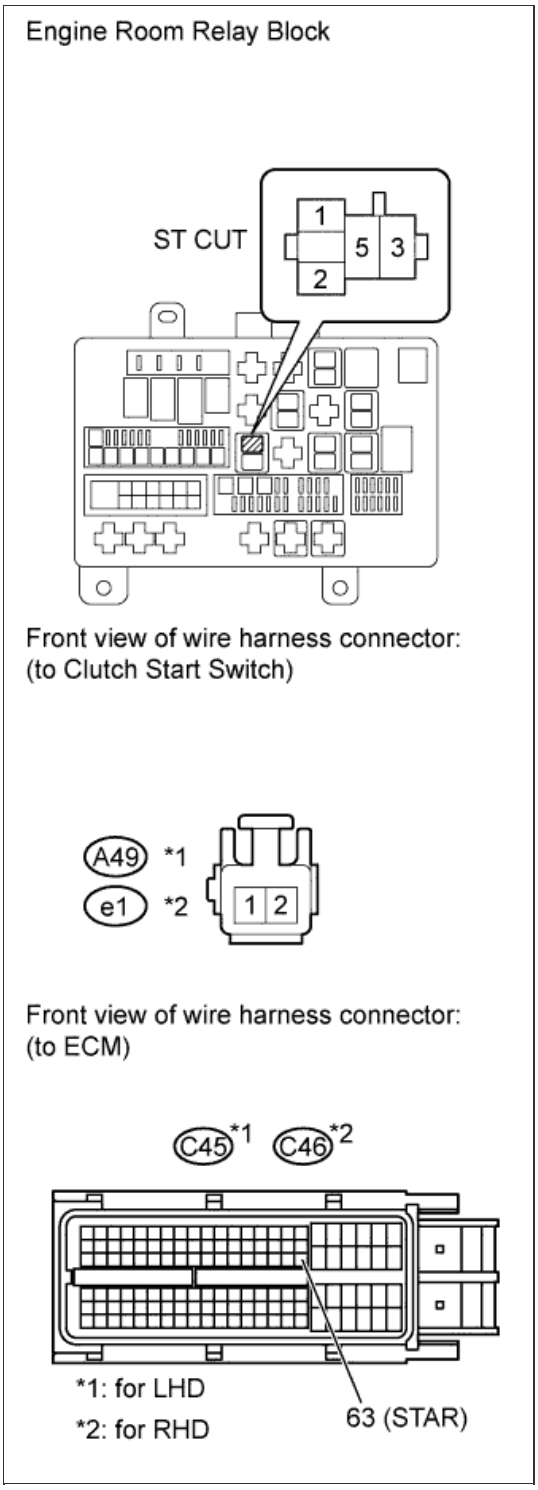
14.CHECK HARNESS AND CONNECTOR (ST CUT RELAY - CLUTCH START SWITCH, ECM)

a. Remove the starter cut relay (ST CUT) from the engine room relay block.

b. Disconnect the clutch start switch connector.

c. Disconnect the ECM connector.

d. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
ST CUT relay (5) - C45-63 (STAR)	Always	Below 1 Ω
ST CUT relay (3) - A49-1	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
ST CUT relay (5) - C46-63 (STAR)	Always	Below 1 Ω
ST CUT relay (3) - e1-1	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
ST CUT relay (5) or C45-63 (STAR) - Body ground	Always	10 kΩ or higher
ST CUT relay (3) or A49-1 - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
ST CUT relay (5) or C46-63 (STAR) - Body ground	Always	10 kΩ or higher
ST CUT relay (3) or e1-1 - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

15.INSPECT CLUTCH START SWITCH ASSEMBLY

a. Inspect the clutch start switch (for LHD) (Click here).

b. Inspect the clutch start switch (for RHD) (Click here).

Result

Result	Proceed to
OK	A
NG (for LHD)	B
NG (for RHD)	C

B → REPLACE CLUTCH START SWITCH ASSEMBLY (Click here)

C → REPLACE CLUTCH START SWITCH ASSEMBLY (Click here)

A

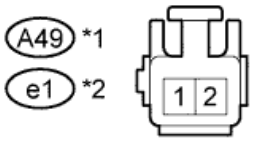
16.CHECK HARNESS AND CONNECTOR (CLUTCH START SWITCH - ECM)

a. Disconnect the clutch start switch connector.

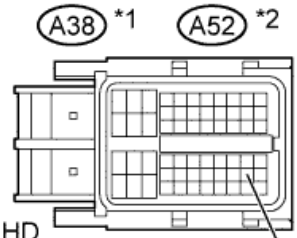
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Clutch Start Switch)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A49-2 - A38-48 (STA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
e1-2 - A52-48 (STA)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A49-2 or A38-48 (STA) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
e1-2 or A52-48 (STA) - Body ground	Always	10 kΩ or higher

Result

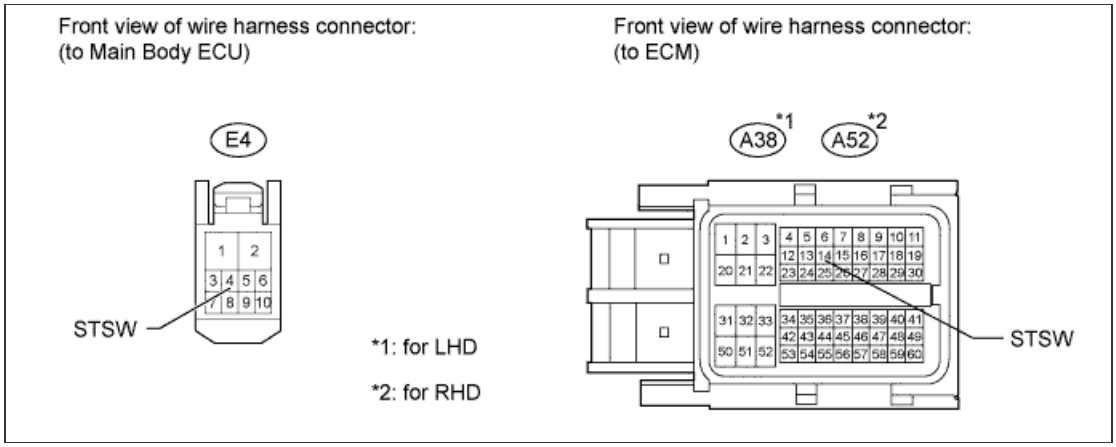
Result	Proceed to
NG	A
OK	B

B → Go to step 19

A

REPAIR OR REPLACE HARNESS OR CONNECTOR

17.CHECK HARNESS AND CONNECTOR (MAIN BODY ECU - ECM)



a. Disconnect the main body ECU connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
E4-4 (STSW) - A38-14 (STSW)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
E4-4 (STSW) - A52-14 (STSW)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
E4-4 (STSW) or A38-14 (STSW) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
E4-4 (STSW) or A52-14 (STSW) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

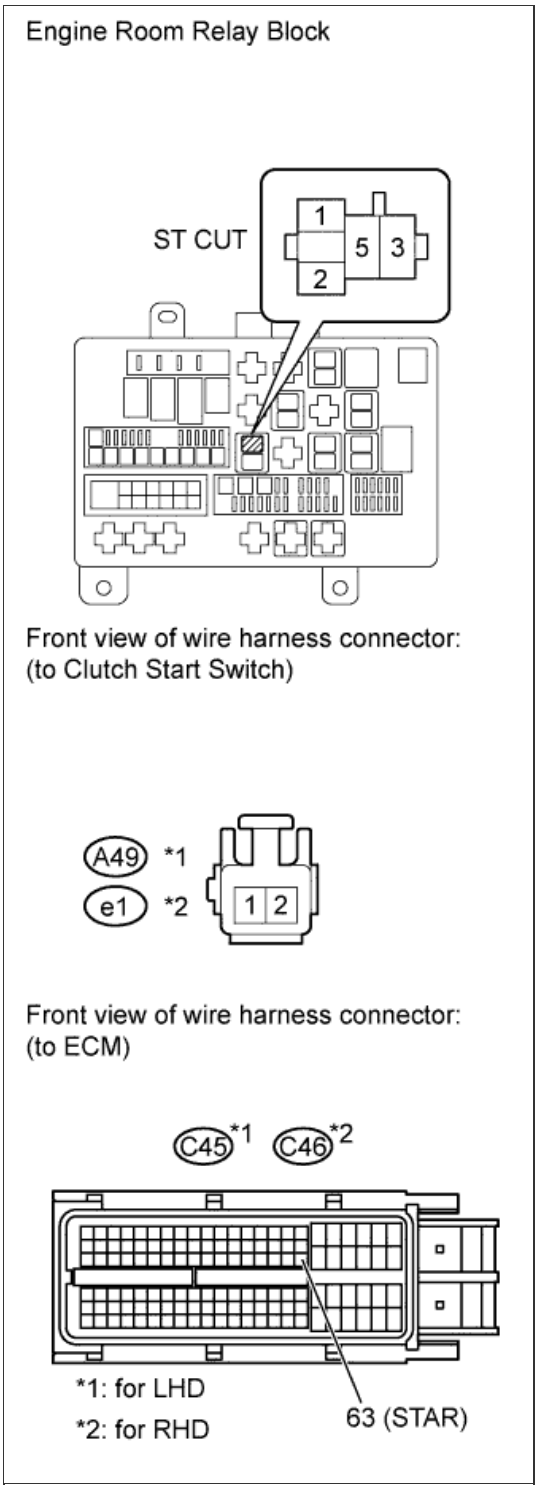
18.CHECK HARNESS AND CONNECTOR (ST CUT RELAY - CLUTCH START SWITCH SWITCH, ECM)

a. Remove the starter cut relay (ST CUT) from the engine room relay block.

b. Disconnect the clutch start switch connector.

c. Disconnect the ECM connector.

d. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
ST CUT relay (5) - C45-63 (STAR)	Always	Below 1 Ω
ST CUT relay (3) - A49-1	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
ST CUT relay (5) - C46-63 (STAR)	Always	Below 1 Ω
ST CUT relay (3) - e1-1	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
ST CUT relay (5) or C45-63 (STAR) - Body ground	Always	10 kΩ or higher
ST CUT relay (3) or A49-1 - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
ST CUT relay (5) or C46-63 (STAR) - Body ground	Always	10 kΩ or higher
ST CUT relay (3) or e1-1 - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (**Click here**)

19.REPLACE ECM

a. Replace the ECM (Click here).

NEXT

20.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Check the starter operation.

OK:
Malfunction has been repaired successfully.

NG → GO TO ENTRY AND START SYSTEM (ENGINE DOES NOT START) (**Click here**)

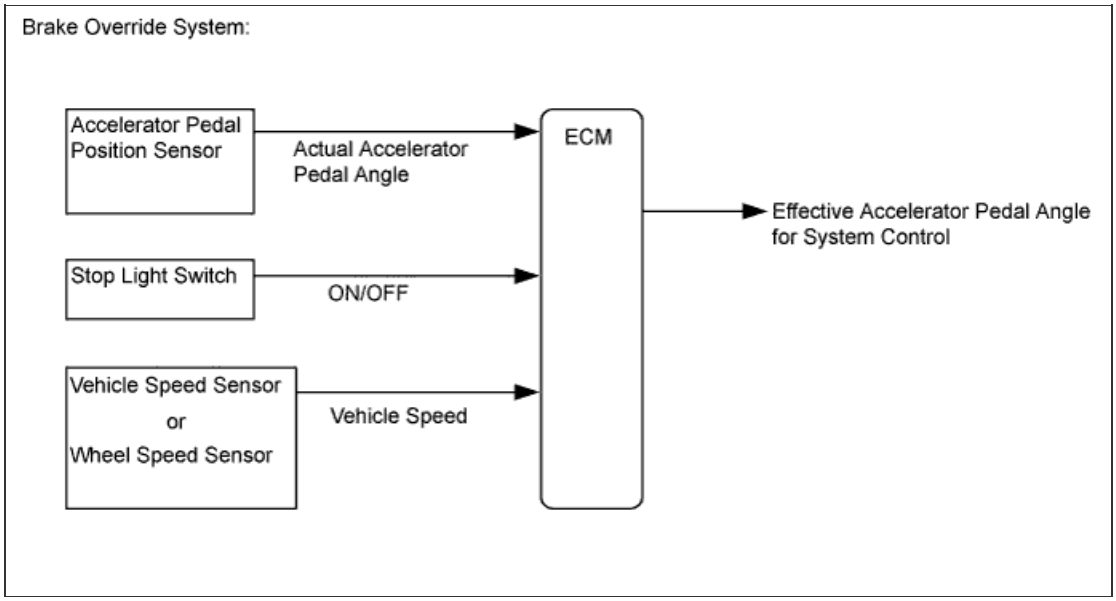
OK

END

for Preparation Click here

DESCRIPTION

When the vehicle is being driven with the accelerator pedal depressed, depressing the brake pedal without releasing the accelerator pedal will activate the brake override system to restrict driving torque. The conditions for activating the brake override system as well as the items that are controlled are explained below.



Activation Conditions:

- Vehicle is running at or above the specified speed.
- The accelerator pedal is depressed beyond a specified level, and then the brake pedal is depressed.

NOTICE:

The vehicle may not enter the brake override system control due to the relation of the accelerator pedal angle and the vehicle's speed.

Items Controlled:

- Driving torque is restricted.

HINT:

During brake override system control, the value for the accelerator pedal angle (which is used for engine control) is forcibly reduced to a specified value. For this reason, the Data List value for Accelerator Position will be replaced with a specified value regardless of the actual accelerator pedal angle (Accel Sens. No. 1 Volt %, Accel Sens. No. 2 Volt %)

Deactivation Conditions:

- When the Stop Light Switch turns OFF or the actual accelerator pedal angle increases or decreases beyond the specified range.

INSPECTION PROCEDURE

Inspection Method

Drive at 10 km/h (6.25 mph), depress the accelerator pedal by 1/2 to 3/4 and keep it in that position. Under these conditions, if the engine speed decreases to 1000 rpm when the brake pedal is depressed, then the brake override system has been activated.

CAUTION:

When carrying out the inspection, use a place where you are able to carry it out safely and also pay close attention to your surroundings.

Also, when driving, make absolutely sure that all road traffic laws, such as speed limits, are observed.

HINT:

- **Under normal conditions, the Accelerator Position value changes in response to the Accel Sens. No. 1 Volt % value. For more information on the numerical values, refer to the Data List (Click here).**
- **If the Data List values of Accelerator Position and Accel Sens. No. 1 Volt % do not match, and the value of Accelerator Position changes but the value of Accel Sens. No. 1 Volt % is constant, this confirms that brake override system has activated. (Data can be captured relatively easily by using the snapshot function in the Data List. Confirm the data after performing the drive test.)**

NOTICE:

The brake override system restricts driving torque if the brake pedal is depressed when driving with the accelerator pedal depressed. If a customer reports experiencing loss of torque after the accelerator and brake pedals have both been intentionally depressed, explain to the customer that this is not a malfunction, and that the customer should avoid depressing both the accelerator and brake pedals at the same time.

Example: While operating the accelerator pedal, the customer uses their left foot to operate the brake pedal.

1.CHECK DTC OUTPUT

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Utility / All Codes.

d. Check DTCs.

Result

Result	Proceed to
No DTC output	A
DTC output	B

B → **GO TO DTC CHART**

A

2.READ VALUE USING INTELLIGENT TESTER (STOP LIGHT SWITCH AND ST1)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Stop Light Switch and ST1.

d. Check the Data List indication when the brake pedal is depressed and released.

OK:

Tester Display	Condition	Specified Condition
Stop Light Switch	Brake pedal released	OFF
	Brake pedal depressed	ON
ST1	Brake pedal released	OFF
	Brake pedal depressed	ON

NG → **INSPECT STOP LIGHT SWITCH ASSEMBLY (Click here)**

OK

3.INSPECT BRAKE PEDAL

a. Inspect and adjust the brake pedal (for LHD) (Click here).

b. Inspect and adjust the brake pedal (for RHD) (Click here)

HINT:

If the stop light switch turns ON too late, the start of brake override system control may be delayed; if it turns ON too soon, brake override system control may begin too early, so conduct inspection of the brake pedal and stop light switch assembly.

Result	Proceed to
OK	A
NG (for LHD)	B
NG (for RHD)	C

B → **REPAIR OR REPLACE BRAKE PEDAL (Click here)**

C → REPAIR OR REPLACE BRAKE PEDAL (Click here)

A

4.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR PEDAL POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Accel Sens. No. 1 Volt % and Accel Sens. No. 2 Volt %.

d. Read the value displayed on the tester.

OK:

Tester Display	Condition	Specified Condition
Accel Sens. No. 1 Volt %	Accelerator Pedal Released → Depressed → Released	Values smoothly change following accelerator pedal operation
Accel Sens. No. 2 Volt %		

HINT:

For numerical values of Accel Sens. No. 1 Volt % and Accel Sens. No. 2 Volt %, refer to the Data List (Click here).

NG → REPLACE ACCELERATOR PEDAL SENSOR ASSEMBLY (Click here)

OK

5.READ VALUE USING INTELLIGENT TESTER (VEHICLE SPEED)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Start the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / Vehicle Speed.

e. Read the value displayed on the tester.

Standard:

Tester Display	Condition	Specified Condition
Vehicle Speed	Vehicle stopped, engine running	0 km/h (0 mph)
	Vehicle running at constant speed between 16.1 to 64.4 km/h (10 to 40 mph)	No large fluctuations when driving at a constant speed

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

Data can be captured relatively easily by using the snapshot function in the Data List. Confirm the data after performing the drive test.

NG → GO TO VEHICLE SPEED SENSOR "A" (Click here)

OK

6.READ VALUE USING INTELLIGENT TESTER (FR, FL, RR, RL WHEEL SPEED)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Start the engine.

d. Enter the following menus: Chassis / ABS/VSC/TRC / Data List / FR Wheel Speed, FL Wheel Speed, RR Wheel Speed and RL Wheel Speed.

e. Read the value displayed on the tester.

Standard:

Tester Display	Condition	Specified Condition
FR Wheel Speed FL Wheel Speed RR Wheel Speed RL Wheel Speed	Vehicle stopped, engine running	0 km/h (0 mph)
	Vehicle running at constant speed between 16.1 to 64.4 km/h (10 to 40 mph)	No large fluctuations when driving at a constant speed

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

Data can be captured relatively easily by using the snapshot function in the Data List. Confirm the data after performing the drive test.

NG → INSPECT FRONT OR REAR SPEED SENSOR

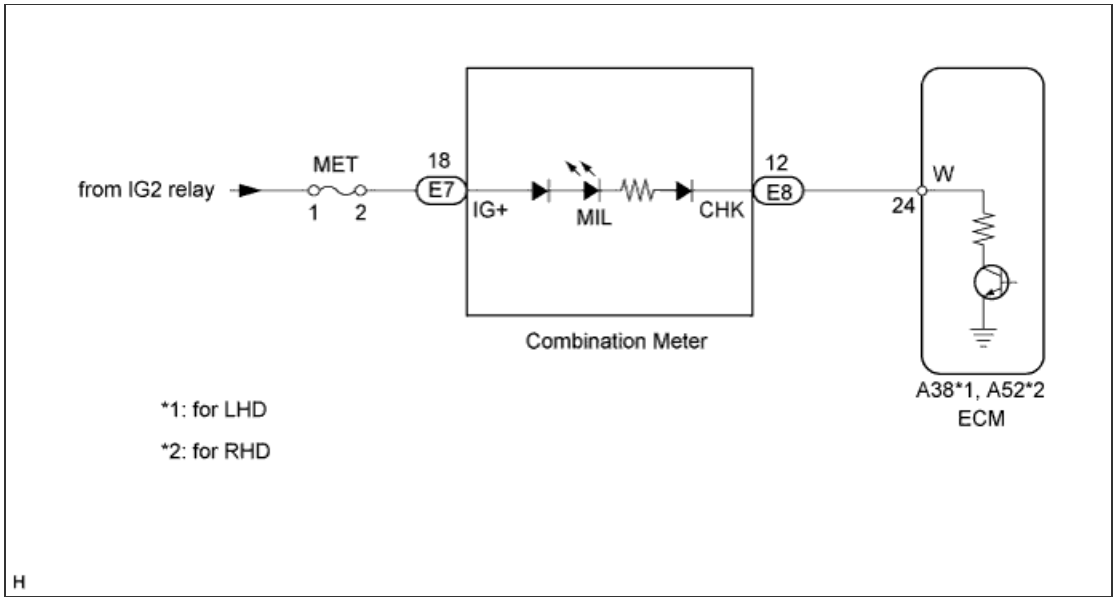
OK → END

for Preparation Click here

DESCRIPTION

The MIL (Malfunction Indicator Lamp) is used to indicate vehicle malfunction detections by the ECM. When the ignition switch is turned to ON, power is supplied to the MIL circuit, and the ECM provides the circuit ground which illuminates the MIL.
The MIL operation can be checked visually: When the ignition switch is first turned to ON, the MIL should be illuminated and should then turn off when the engine is started. If the MIL remains illuminated or is not illuminated, conduct the following troubleshooting procedure using the intelligent tester.

WIRING DIAGRAM



INSPECTION PROCEDURE

1.CHECK THAT MIL IS ILLUMINATED

a. Check that the MIL is illuminated.

Result

Result	Proceed to
MIL remains on	A
MIL does not illuminate	B

B → Go to step 5

A

2.CHECK WHETHER MIL TURNS OFF

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Check for DTCs (Click here). If DTCs are output, write them down.

d. Clear the DTCs (Click here).

e. Check that the MIL turns off.

OK:
MIL turns off.

NG → Go to step 3

OK

REPAIR CIRCUITS INDICATED BY OUTPUT DTCS (Click here)

3.CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT IN WIRE HARNESS)

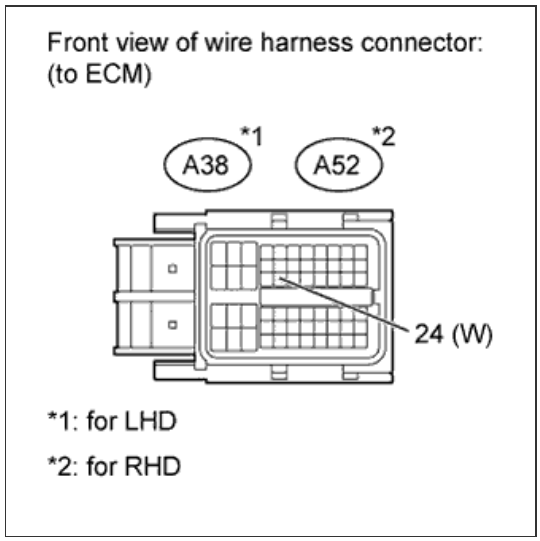
a. Disconnect the ECM connector.

b. Turn the ignition switch to ON.

c. Check that the MIL is not illuminated.

OK:
MIL is not illuminated.

d. Reconnect the ECM connector.



NG → Go to step 4

OK

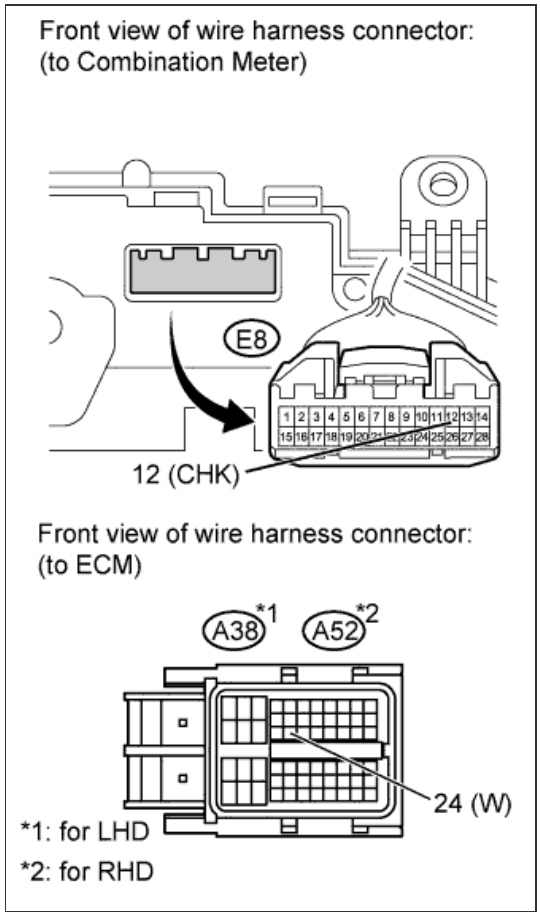
REPLACE ECM (Click here)

4.CHECK HARNESS AND CONNECTOR (COMBINATION METER - ECM)

a. Disconnect the ECM connector.

b. Disconnect the combination meter connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
E8-5 (CHK) - A38-24 (W)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
E8-5 (CHK) - A52-24 (W)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
E8-5 (CHK) or A38-24 (W) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
E8-5 (CHK) or A52-24 (W) - Body ground	Always	10 kΩ or higher

d. Reconnect the ECM connector.

e. Reconnect the combination meter connector.

Result

Result	Proceed to
OK (w/ Multi-information Display)	A
OK (w/o Multi-information Display)	B
NG	C

A → REPLACE COMBINATION METER ASSEMBLY (Click here)

B → REPLACE COMBINATION METER ASSEMBLY (Click here)

C → REPAIR OR REPLACE HARNESS OR CONNECTOR

5.CHECK THAT MIL IS ILLUMINATED

a. Check if the MIL is illuminated when the ignition switch is turned to ON.

OK:
MIL is illuminated.

NG → Go to step 6

OK → SYSTEM OK

6.CHECK THAT ENGINE STARTS

a. Turn the ignition switch to ON.

b. Start the engine.

Result

Result	Proceed to
Engine starts	A
Engine does not start*	B

HINT:

*: The intelligent tester cannot communicate with the ECM.

B → GO TO VC OUTPUT CIRCUIT (Click here)

A

7.INSPECT COMBINATION METER ASSEMBLY (MIL CIRCUIT)

a. See the combination meter troubleshooting procedure (Click here).

Result

Result	Proceed to
OK	A
NG (w/ Multi-information Display)	B
NG (w/o Multi-information Display)	C

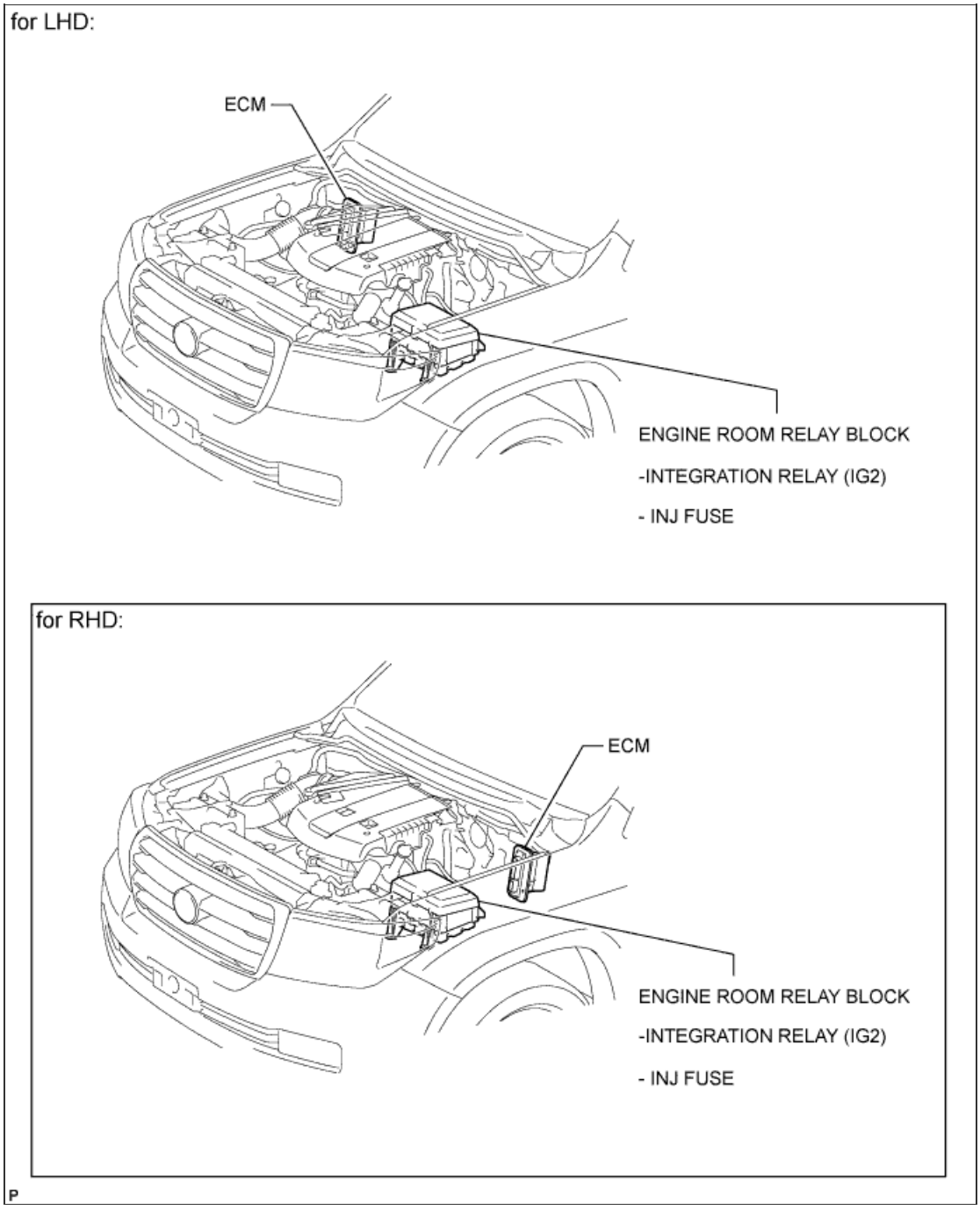
B → REPLACE COMBINATION METER ASSEMBLY (**Click here**)

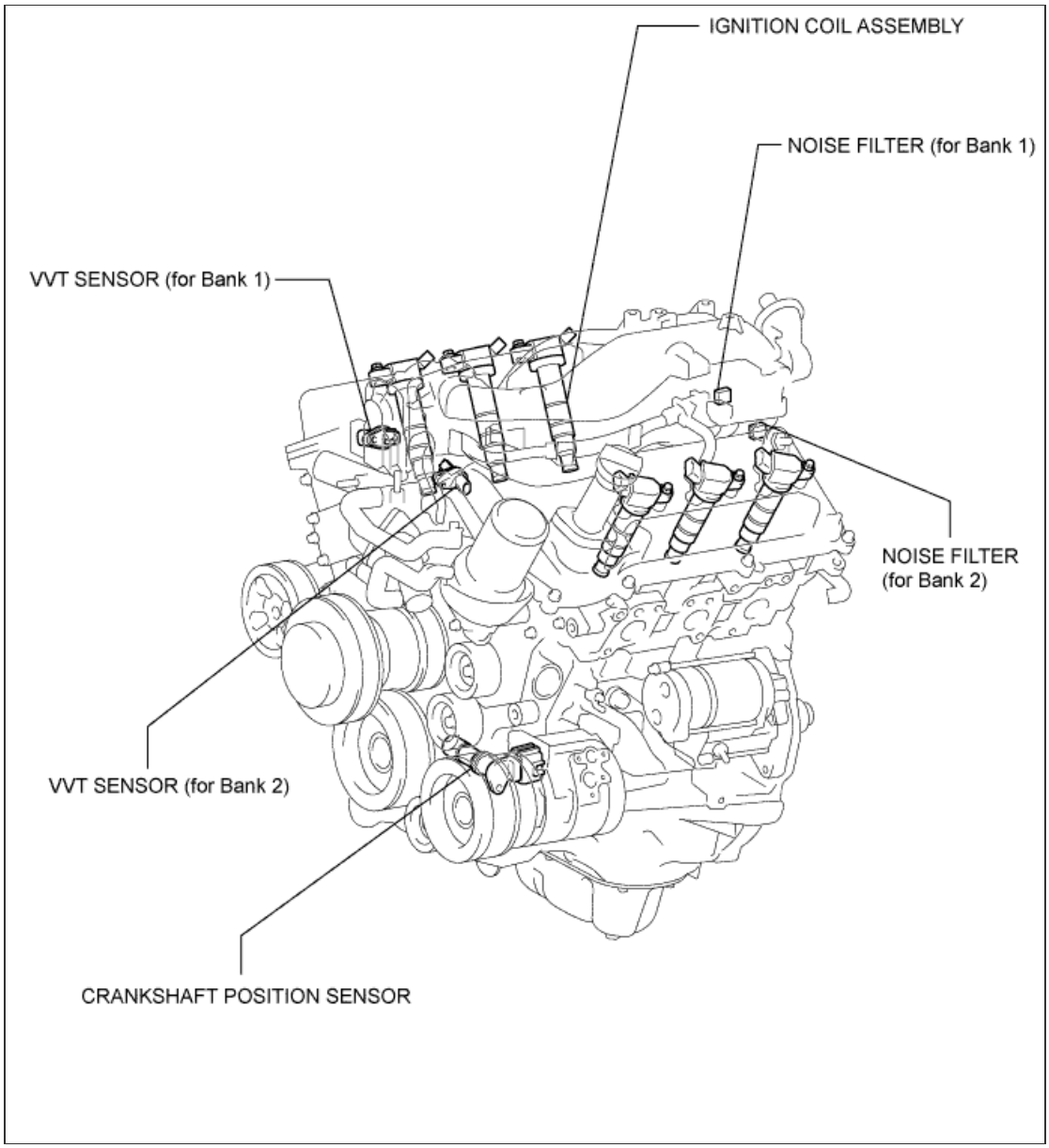
C → REPLACE COMBINATION METER ASSEMBLY (**Click here**)

A

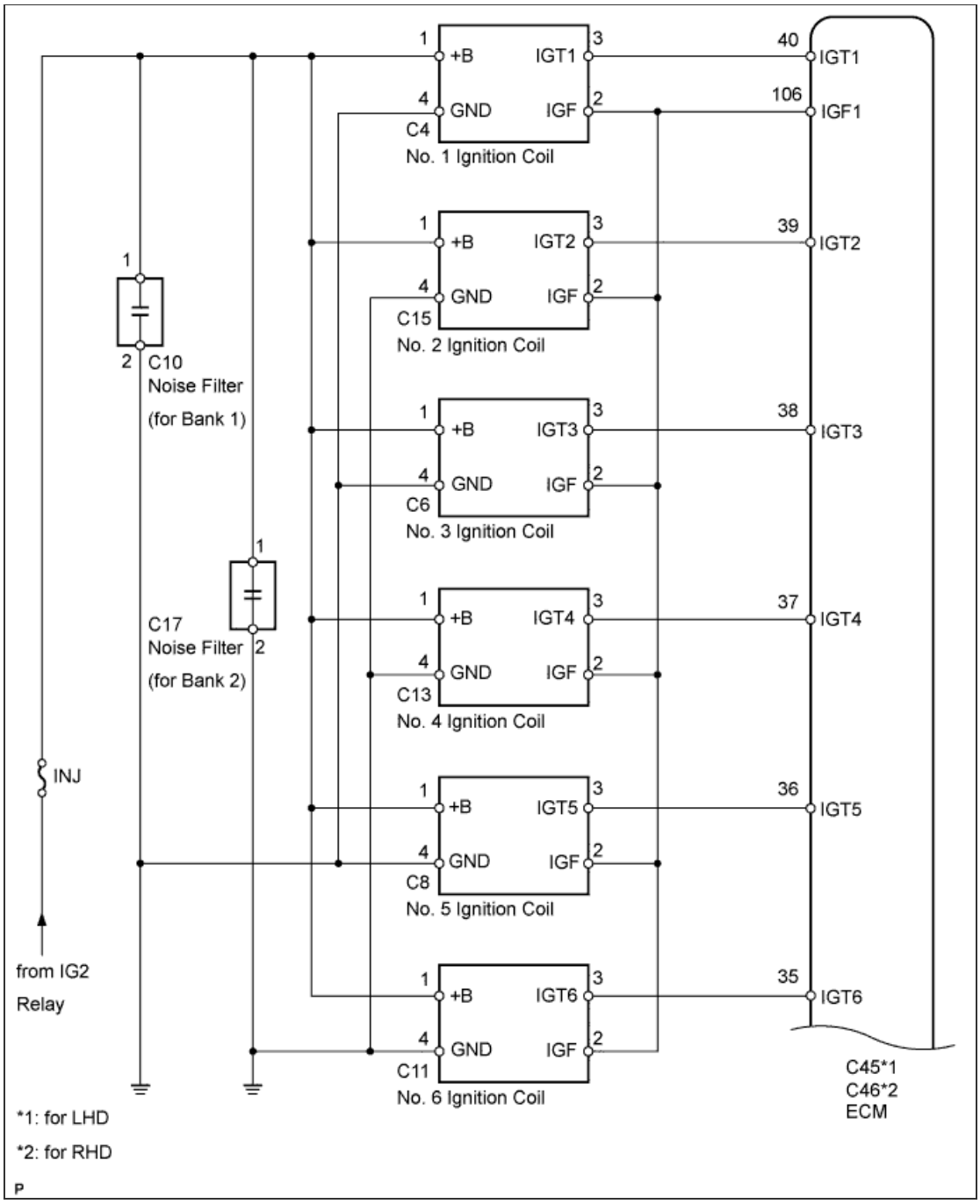
REPAIR OR REPLACE HARNESS OR CONNECTOR (COMBINATION METER - ECM)

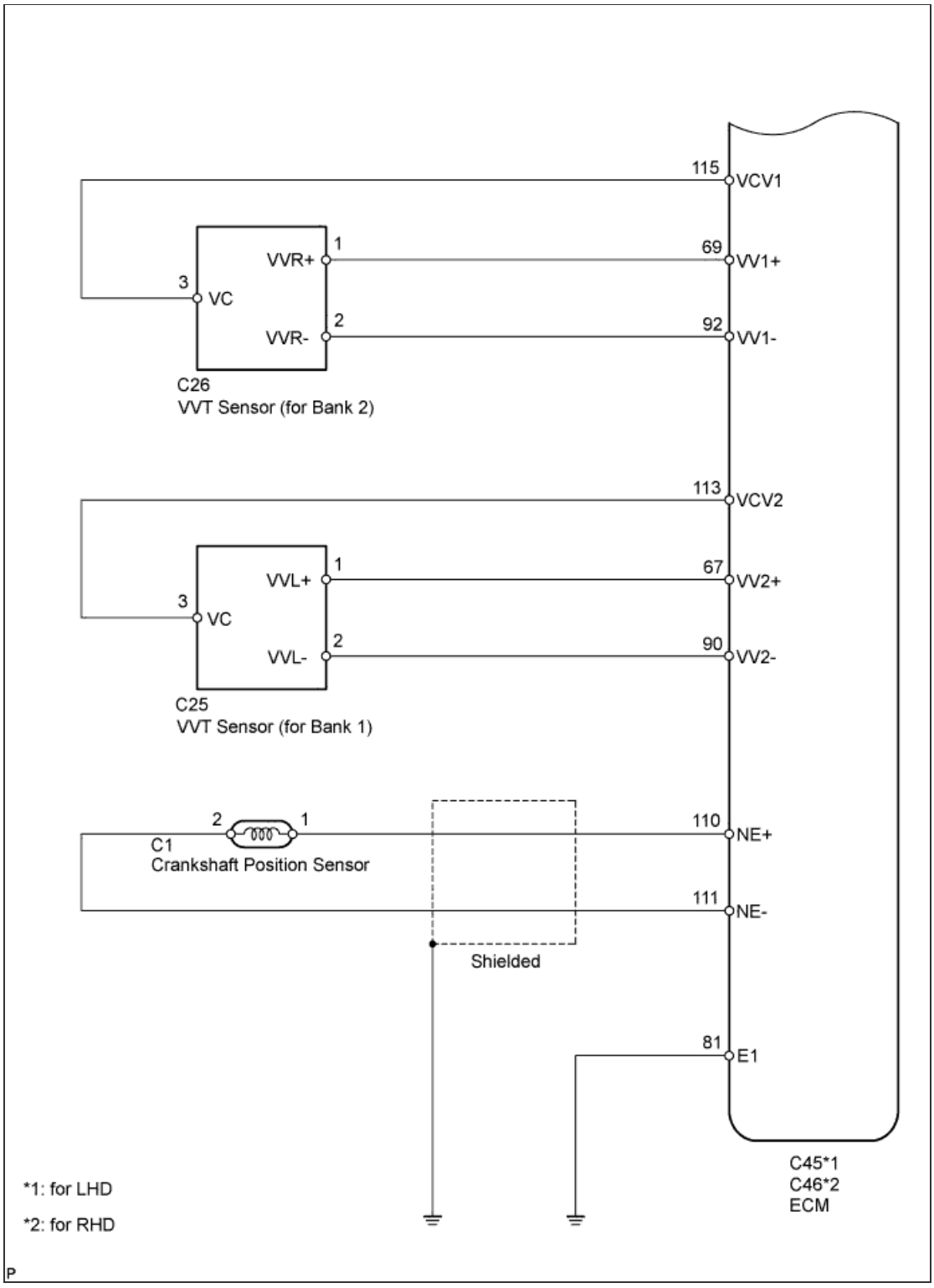
for Preparation Click here




IGNITION COIL ASSEMBLY
NOISE FILTER (for Bank 1)
VVT SENSOR (for Bank 1)
NOISE FILTER
(for Bank 2)
VVT SENSOR (for Bank 2)
CRANKSHAFT POSITION SENSOR

for Preparation Click here




115
VCV1
1
VVR+
69
VV1+
3
VC
2
VVR-
92
VV1-
C26
VVT Sensor (for Bank 2)
113
VCV2
1
VVL+
67
VV2+
3
VC
2
VVL-
90
VV2-
C25
VVT Sensor (for Bank 1)
2
1
110
NE+
C1
Crankshaft Position Sensor
111
NE-
Shielded
81
E1
C45*1
C46*2
ECM
*1: for LHD
*2: for RHD
P

for Preparation Click here

1. PERFORM SPARK TEST

a. Check for DTCs (Click here).

NOTICE:

If any DTC is output, perform troubleshooting procedures for that DTC.

b. Check if sparks occur.

i. Remove the 6 spark plugs (Click here).

ii. Install the spark plug to the ignition coil and connect the ignition coil connector.

iii. Remove the engine room relay block cover.

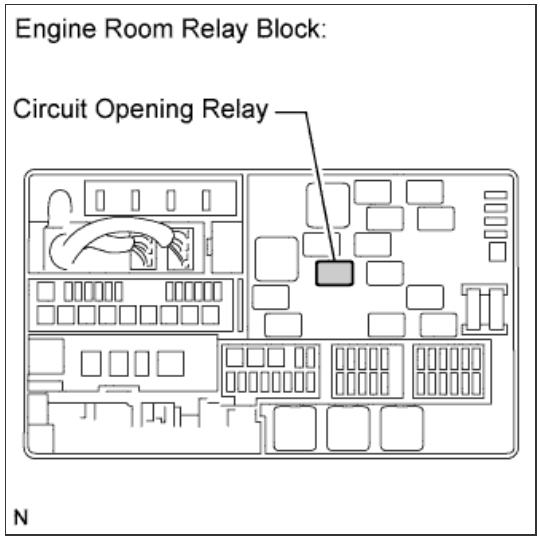
iv. Remove the circuit opening relay (C/OPN).

v. Ground the spark plug.

vi. Visually check that sparks occur while the engine is being cranked.

NOTICE:

- **Be sure to ground the spark plug when checking.**
- **Replace the ignition coil if it receives an impact.**
- **Do not crank the engine for more than 2 seconds.**



c. Check that the wire harness side connector of the ignition coil with igniter is securely connected.

Result

Result	Proceed to
NG	Connect securely
OK	Go to next step

d. Perform a spark test on each ignition coil with igniter.

i. If there is a cylinder where sparks do not occur, replace its ignition coil with the ignition coil of a cylinder where sparks occur normally.

ii. Crank the engine and visually check that sparks occur at the cylinder with the normally operating ignition coil.

Result

Result	Proceed to
OK	Replace ignition coil with igniter
NG	Go to next step

e. Inspect the spark plug.

i. Replace the spark plug with a normal one.

ii. Perform spark test again.

Result

Result	Proceed to
OK	Replace spark plug
NG	Go to next step

f. Check power supply to ignition coil with igniter.

i. Turn the ignition switch on (IG).

ii. Check that there is battery voltage at ignition coil positive (+) terminal.

Result

Result	Proceed to
NG	Check wiring between ignition switch and ignition coil with igniter
OK	Go to next step

g. Check the VVT sensor (Click here).

h. Check the crankshaft position sensor (Click here).

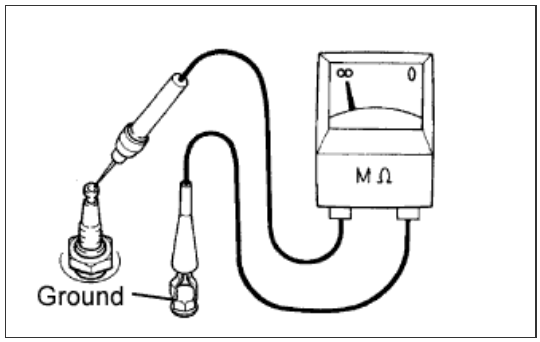
i. Install the 6 spark plugs (Click here).

j. Install the circuit opening relay.

k. Install the engine room relay block cover.

2. INSPECT SPARK PLUG

a. Check the electrode.



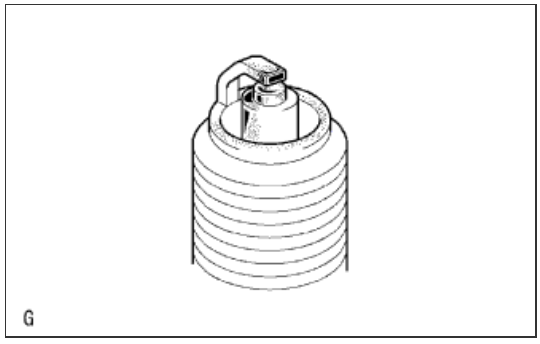
i. Using a megohmmeter, measure the insulation resistance.

Standard Insulation Resistance:

Tester Connection	Condition	Specified Condition
Spark Plug (terminal part) - Body Ground	Always	10 MΩ or higher

If a megohmmeter is not available, perform the following simple inspection.

b. Alternative inspection method:



i. Quickly accelerate the engine to 4000 rpm 5 times.

ii. Remove the spark plug.

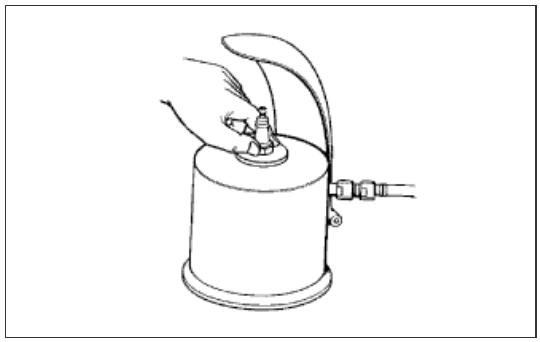
iii. Visually check the spark plug.
If the electrode is dry, the spark plug is functioning properly. If the electrode is damp, proceed to the next step.

c. Check the spark plug for any damage on its threads and insulator.
If there is damage, replace the spark plug. If not, reinstall the spark plug.

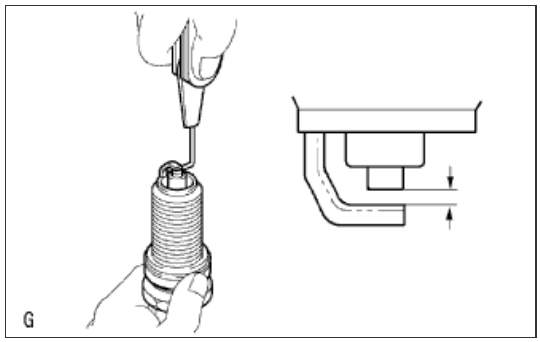
Recommended Spark Plug:

Manufacturer	Product
DENSO made	K20HR-U11
NGK made	LFR6C11

d. Clean the spark plugs.



e. Check the spark plug electrode gap.

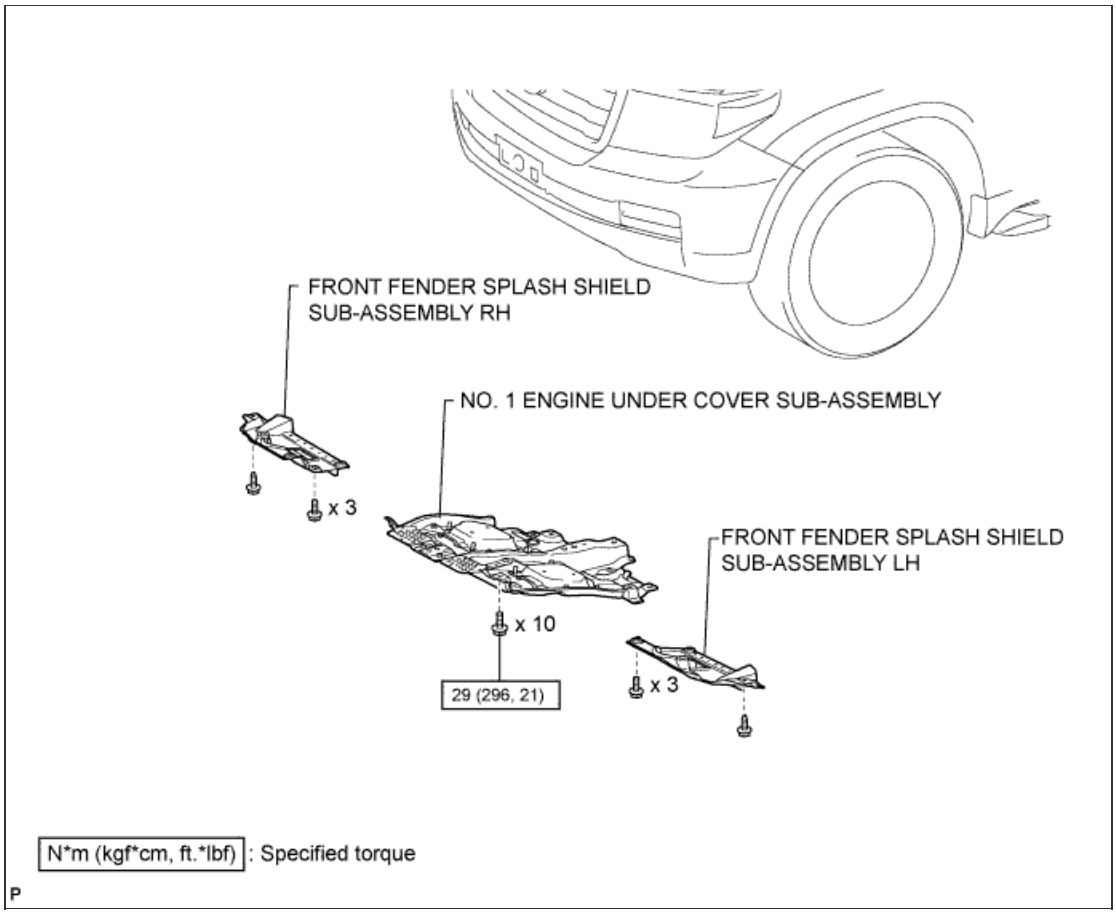


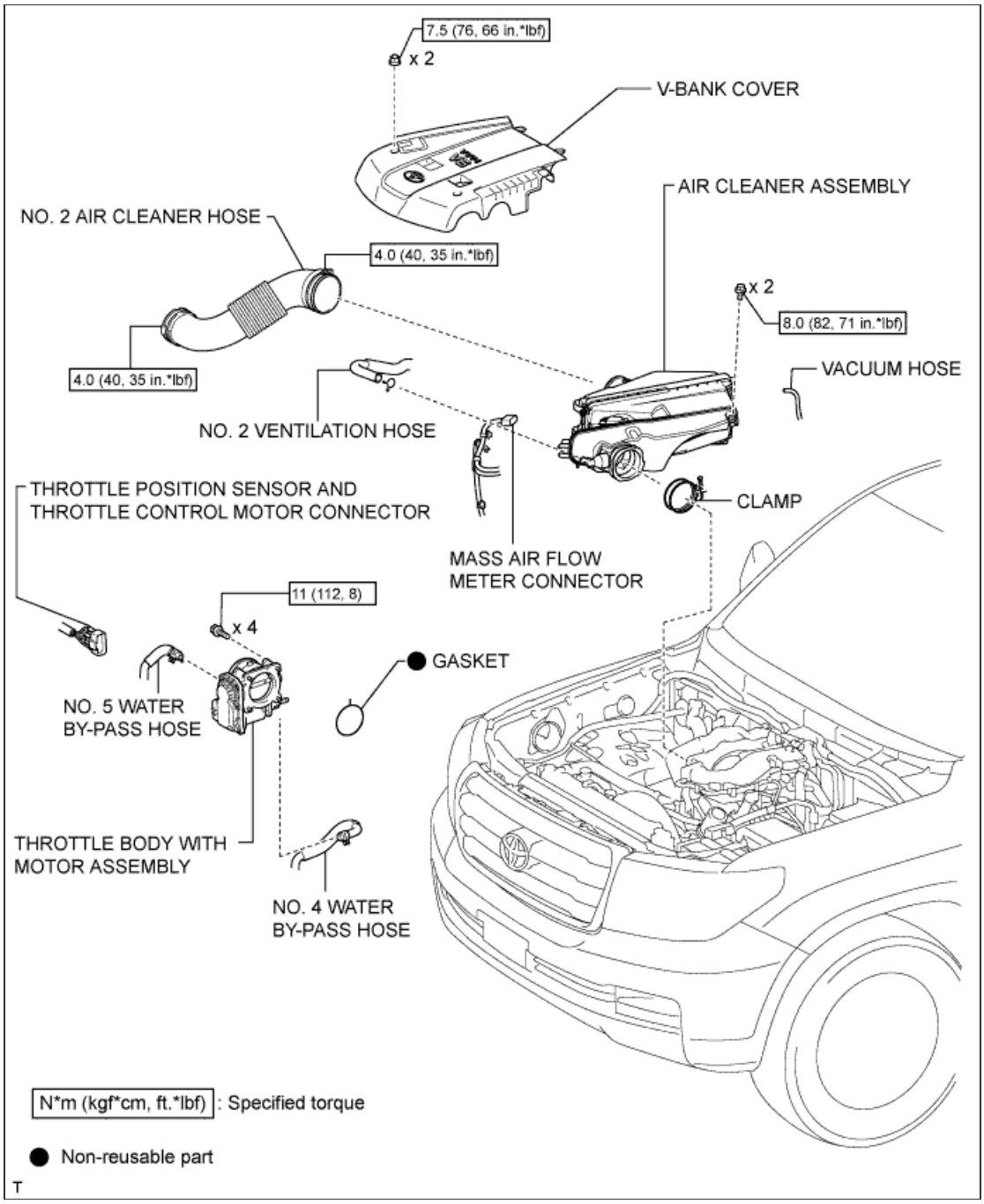
Maximum electrode gap for used spark plug:
1.3 mm (0.0512 in.)

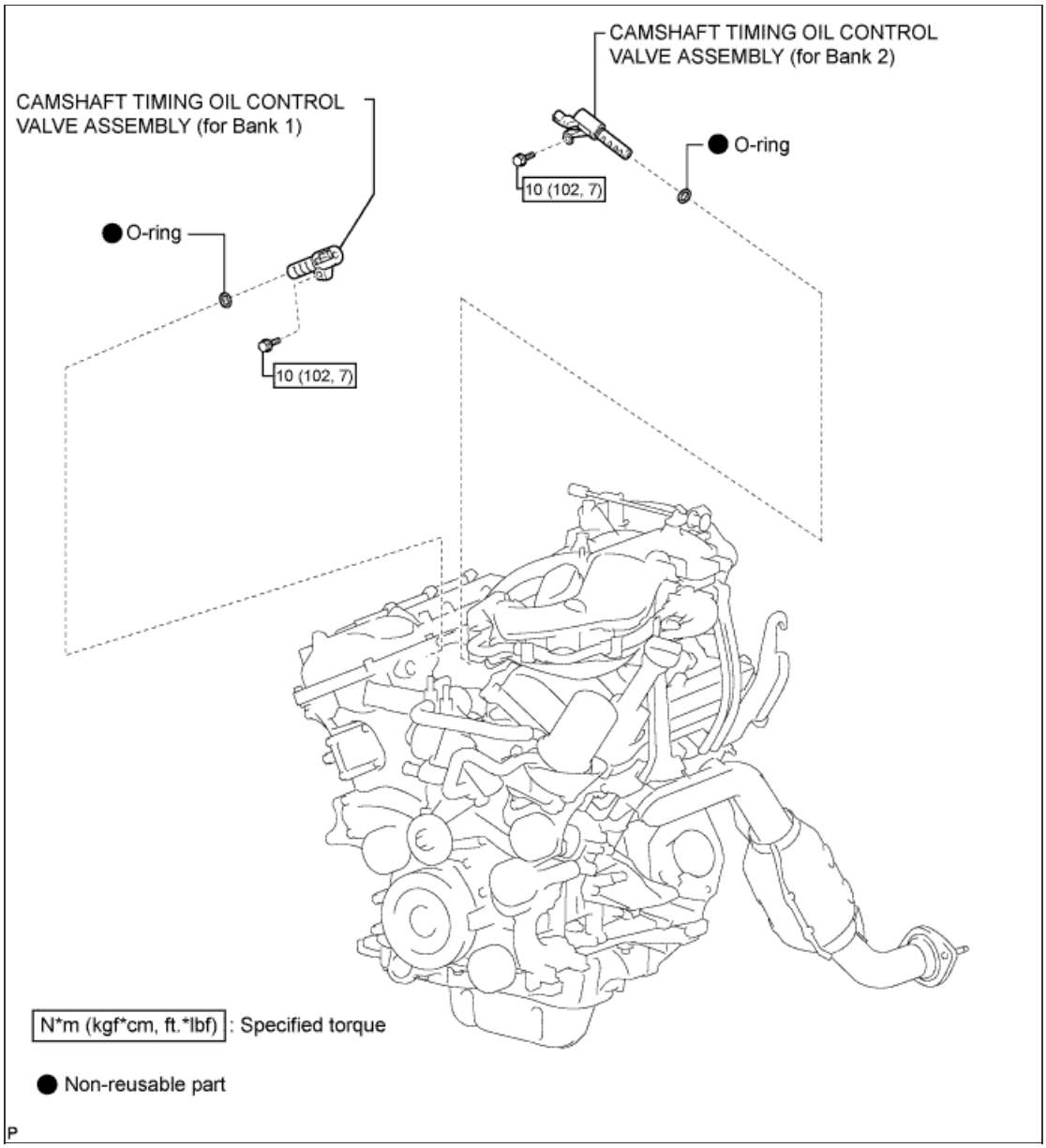
If the gap is more than the maximum, replace the spark plug.

Electrode gap for new spark plug:
1.0 to 1.1 mm (0.0394 to 0.0433 in.)

for Preparation Click here




7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER
AIR CLEANER ASSEMBLY
NO. 2 AIR CLEANER HOSE
4.0 (40, 35 in.*lbf)
x 2
8.0 (82, 71 in.*lbf)
4.0 (40, 35 in.*lbf)
VACUUM HOSE
NO. 2 VENTILATION HOSE
THROTTLE POSITION SENSOR AND
THROTTLE CONTROL MOTOR CONNECTOR
CLAMP
MASS AIR FLOW
METER CONNECTOR
11 (112, 8)
x 4
GASKET
NO. 5 WATER
BY-PASS HOSE
THROTTLE BODY WITH
MOTOR ASSEMBLY
NO. 4 WATER
BY-PASS HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
T


CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Bank 2)
CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Bank 1)
O-ring
O-ring
10 (102, 7)
10 (102, 7)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

for Preparation Click here

1. INSPECT CAMSHAFT OIL CONTROL VALVE

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the intelligent tester on.

c. Warm up the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1) or Control the VVT System (Bank 2).

e. Check the engine speed while operating the Oil Control Valve (OCV) using the tester.

OK:

Tester Operation	Specified Condition
OCV OFF	Normal engine speed
OCV ON	Soon after OCV switched from OFF to ON, engine idles roughly or stalls

If the result is not as specified, check the oil control valve, wirings and camshaft timing gear.

for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

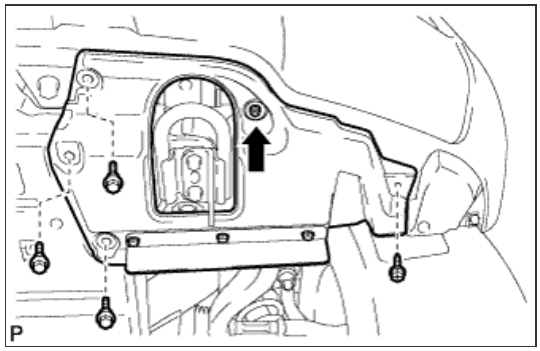
HINT:

Use the same procedures described for the LH side.

2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and engine under cover.

4. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug and 2 cylinder block drain cock plugs.

b. Remove the radiator cap. Then drain the coolant.

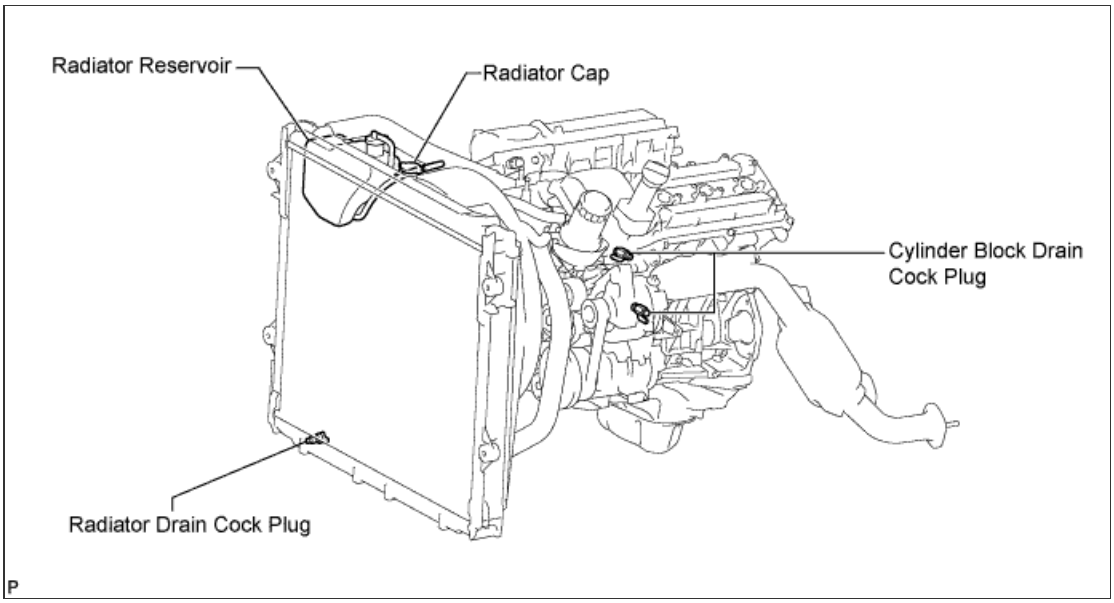
HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Tighten the 2 cylinder block drain cock plugs.

Torque:

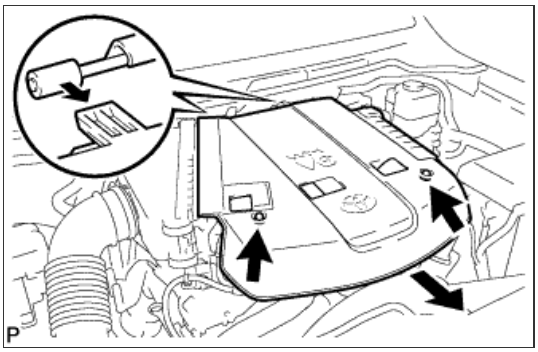
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



d. Tighten the radiator drain cock plug by hand.

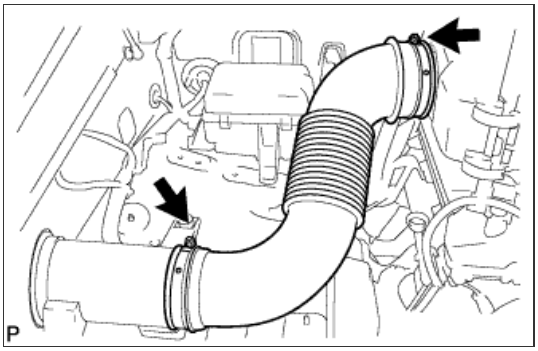
5. REMOVE V-BANK COVER

a. Remove the 2 cap nuts and V-bank cover.



6. REMOVE NO. 2 AIR CLEANER HOSE

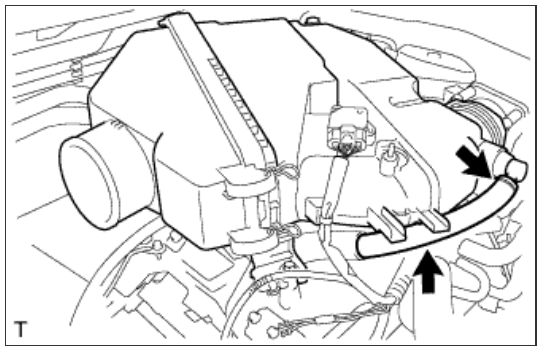
a. Loosen the 2 hose clamps and remove the air cleaner hose.



7. REMOVE AIR CLEANER ASSEMBLY

a. Disconnect the No. 2 ventilation hose.

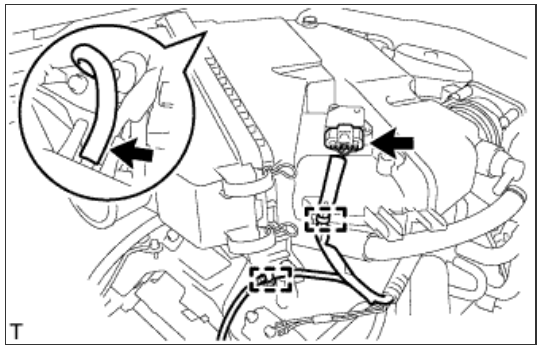
b. Detach the hose clamp.



c. Disconnect the vacuum hose.

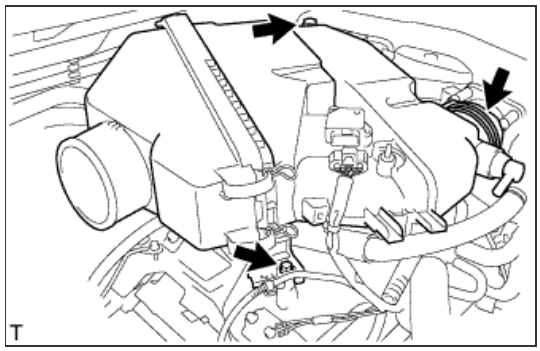
d. Disconnect the MAF meter connector.

e. Using a clip remover, detach the 2 wire harness clamps.



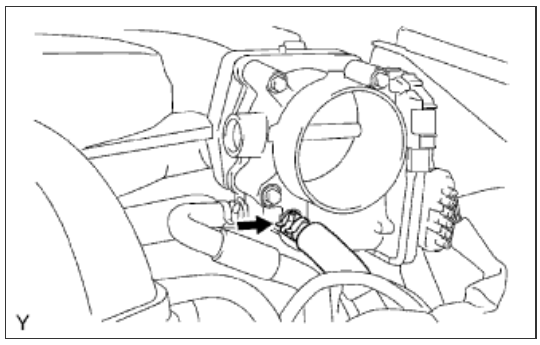
f. Loosen the hose clamp.

g. Remove the 2 bolts and air cleaner assembly.

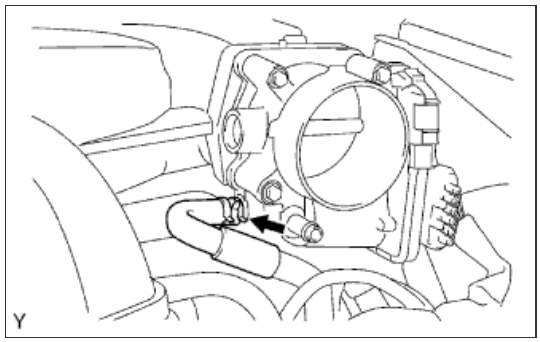


8. REMOVE THROTTLE BODY WITH MOTOR ASSEMBLY

a. Disconnect the No. 5 water by-pass hose.

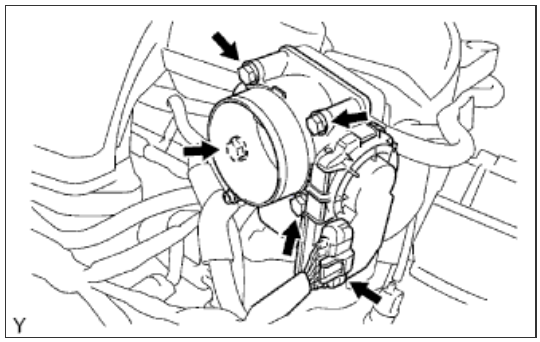


b. Disconnect the No. 4 water by-pass hose.



c. Disconnect the throttle position sensor and throttle control motor connector.

d. Remove the 4 bolts, then remove the throttle body with motor and gasket.

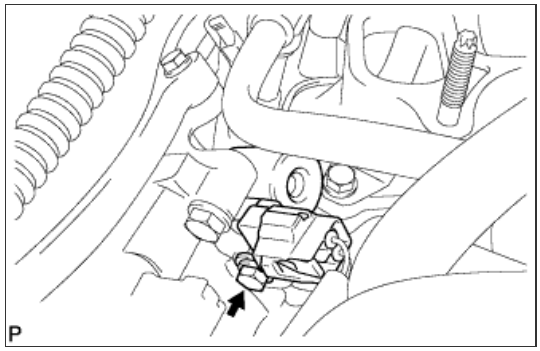


9. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Bank 1)

a. Disconnect the oil control valve connector.

b. Remove the bolt and oil control valve.

c. Remove the O-ring from the oil control valve.

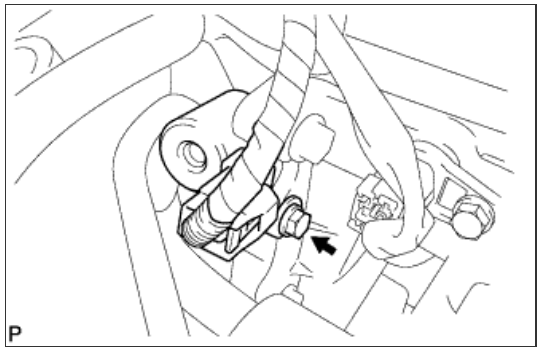


10. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Bank 2)

a. Disconnect the oil control valve connector.

b. Remove the bolt and oil control valve.

c. Remove the O-ring from the oil control valve.



for Preparation Click here

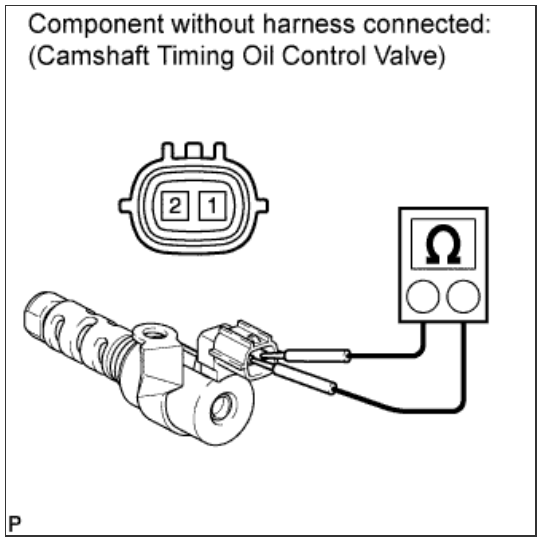
1. INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

If the result is not as specified, replace the oil control valve assembly.

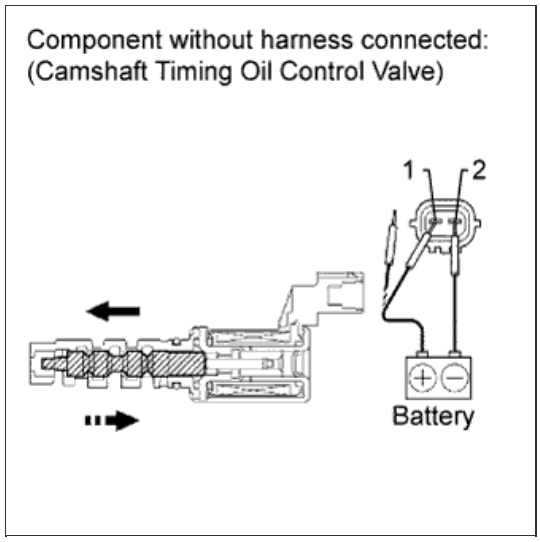


b. Connect the positive (+) lead of the battery to terminal 1 and the negative (-) lead to terminal 2, and check the movement of the valve.

OK:

Tester Connection	Condition	Specified Condition
1 - 2	Battery positive (+) voltage is applied	Valve moves in direction of left arrow shown in the illustration
	Battery positive (+) voltage is cut off	Valve moves in direction of right arrow shown in the illustration

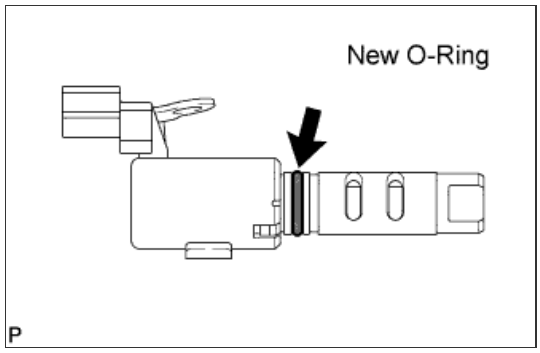
If the result is not as specified, replace the oil control valve assembly.
If the valve cannot return properly because of foreign matter, a small pressure leak in the advanced direction may occur and a DTC may be output.



for Preparation Click here

1. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Bank 1)

a. Apply a light coat of engine oil to a new O-ring and install it to the oil control valve.



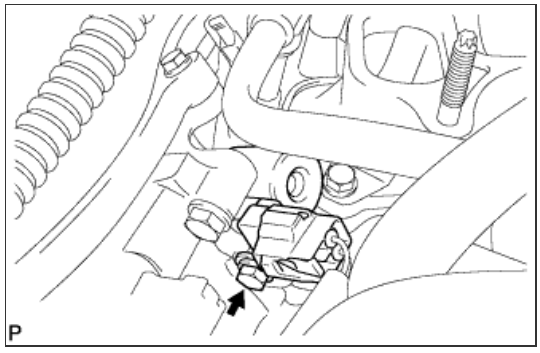
b. Install the oil control valve with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

NOTICE:

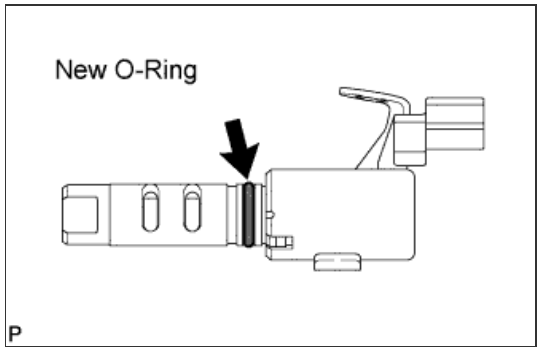
- **Do not allow foreign matter to contact the oil seal face of the oil control valve (connecting surface with cylinder head).**
- **Be careful that the O-ring is not cracked when installing the oil control valve.**

c. Connect the camshaft timing oil control valve connector.



2. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Bank 2)

a. Apply a light coat of engine oil to a new O-ring and install it to the oil control valve.



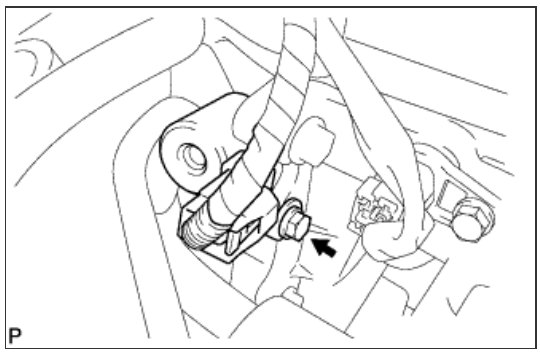
b. Install the oil control valve with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

NOTICE:

- **Do not allow foreign matter to contact the oil seal face of the oil control valve (connecting surface with cylinder head).**
- **Be careful that the O-ring is not cracked when installing the oil control valve.**

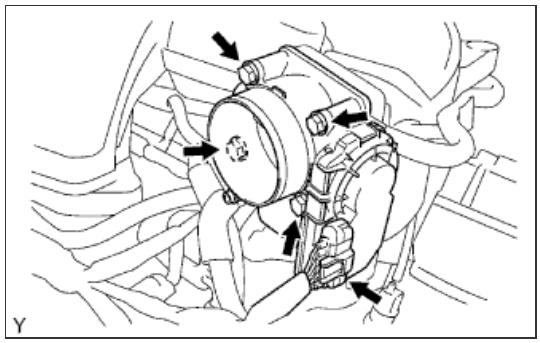
c. Connect the oil control valve connector.



3. INSTALL THROTTLE BODY WITH MOTOR ASSEMBLY

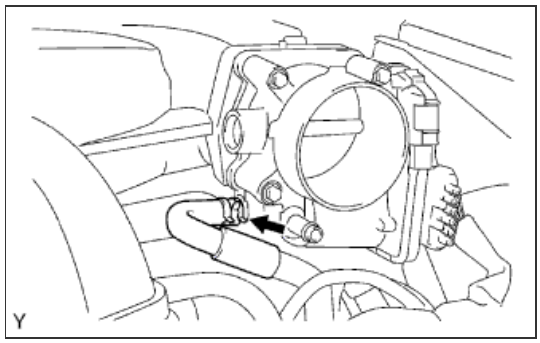
a. Install a new gasket and the throttle body with motor with the 4 bolts.

Torque:
11 N*m{ 112 kgf*cm , 8 ft.*lbf }

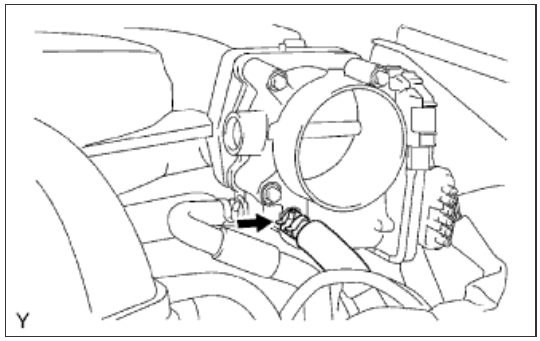


b. Connect the throttle position sensor and throttle control motor connector.

c. Connect the No. 4 water by-pass hose.



d. Connect the No. 5 water by-pass hose.



4. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner assembly with the 2 bolts.

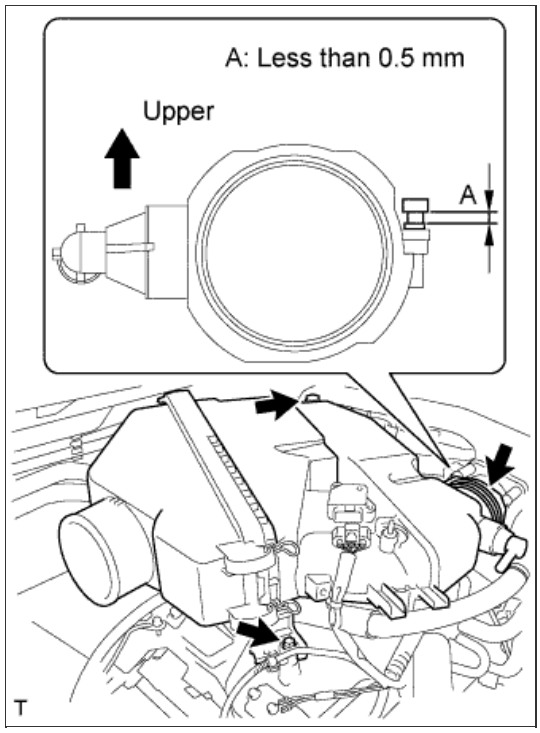
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

b. Tighten the hose clamp.

HINT:

Tighten the hose clamp until it reaches the specified protrusion height labeled A shown in the illustration.

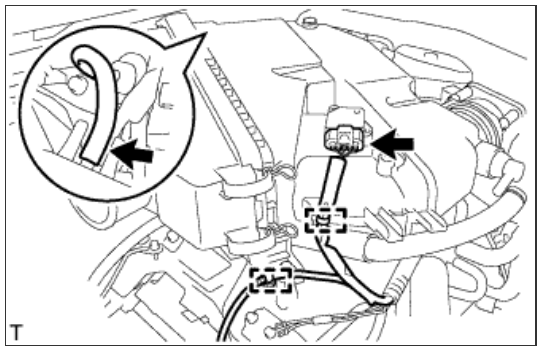
Standard protrusion height:
Less than 0.5 mm (0.0197 in.)



c. Connect the MAF meter connector.

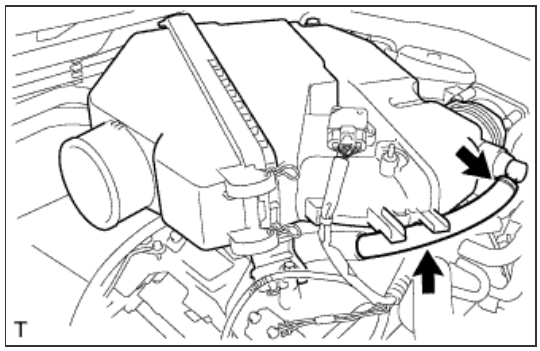
d. Attach the 2 wire harness clamps.

e. Connect the vacuum hose.



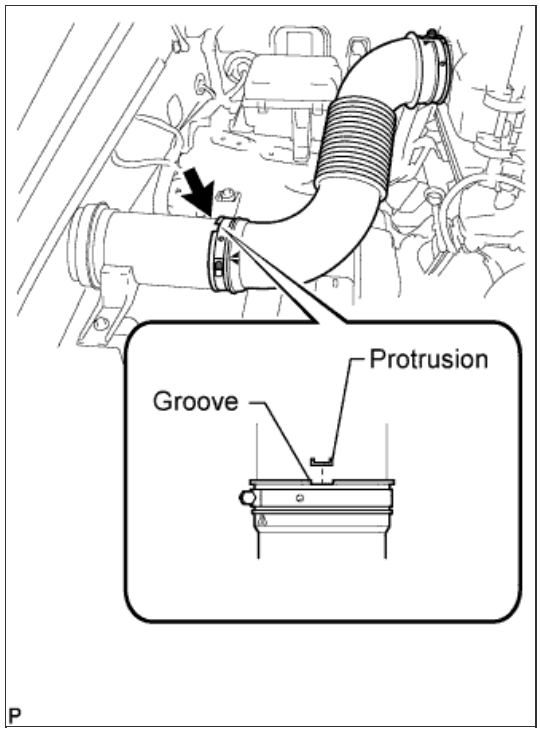
f. Attach the hose clamp.

g. Connect the No. 2 ventilation hose.



5. INSTALL NO. 2 AIR CLEANER HOSE

a. Align the protrusion of the pre-cleaner with the groove of the No. 2 air cleaner hose as shown in the illustration.

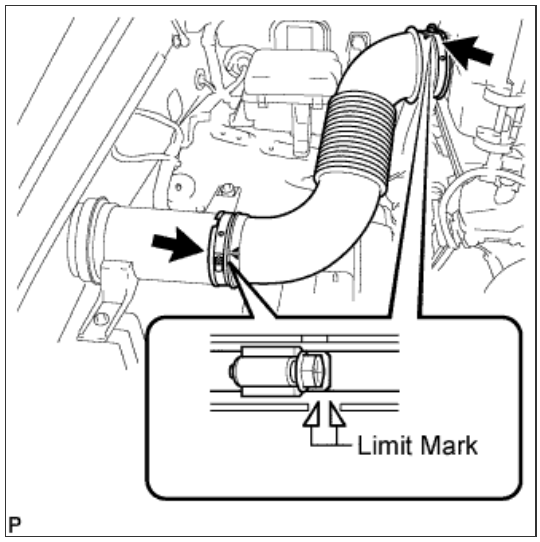


b. Tighten the 2 hose clamps.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }

HINT:

Tighten the clamp until the end of the clamp band is within both limit marks.



6. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item		Specified condition
for Automatic transmission	w/o Rear Heater	11.2 liters (11.8 US qts, 9.9 Imp. qts)
	w/ Rear Heater	14.4 liters (15.2 US qts, 12.7 Imp. qts)
for Manual transmission	w/o Rear Heater	12.0 liters (12.7 US qts, 10.6 Imp. qts)
	w/ Rear Heater	14.6 liters (15.4 US qts, 12.8 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

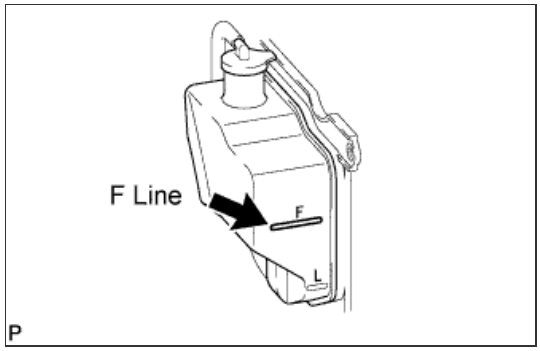
TO OTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.



f. Set the air conditioning as follows while warming up the engine.

Item	Condition
Fan speed	Any setting except off
Temperature	Toward WARM
Air conditioning switch	Off

g. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

h. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

i. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

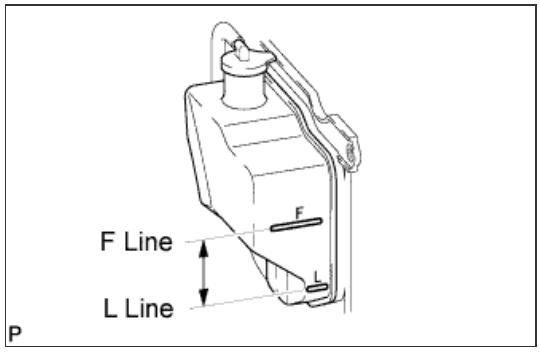
- **Wear protective gloves. Heat areas on the parts may injure your hands.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the fan.**

j. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

k. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.



7. INSPECT FOR ENGINE COOLANT LEAK

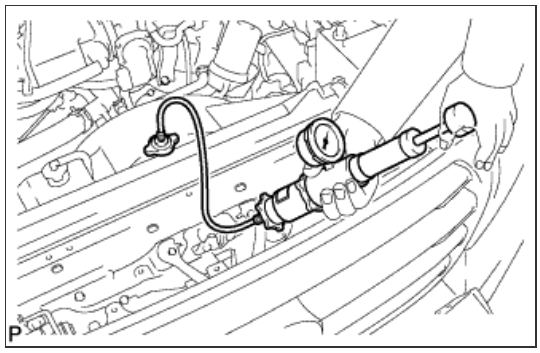
CAUTION:

o not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



8. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

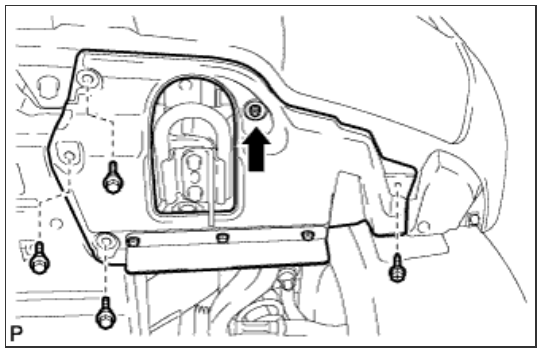
a. Install the engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

9. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



10. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

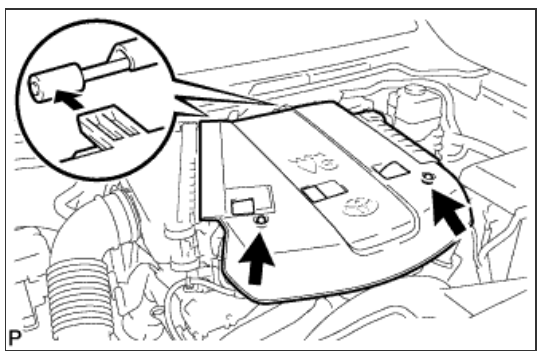
HINT:

Use the same procedures described for the LH side.

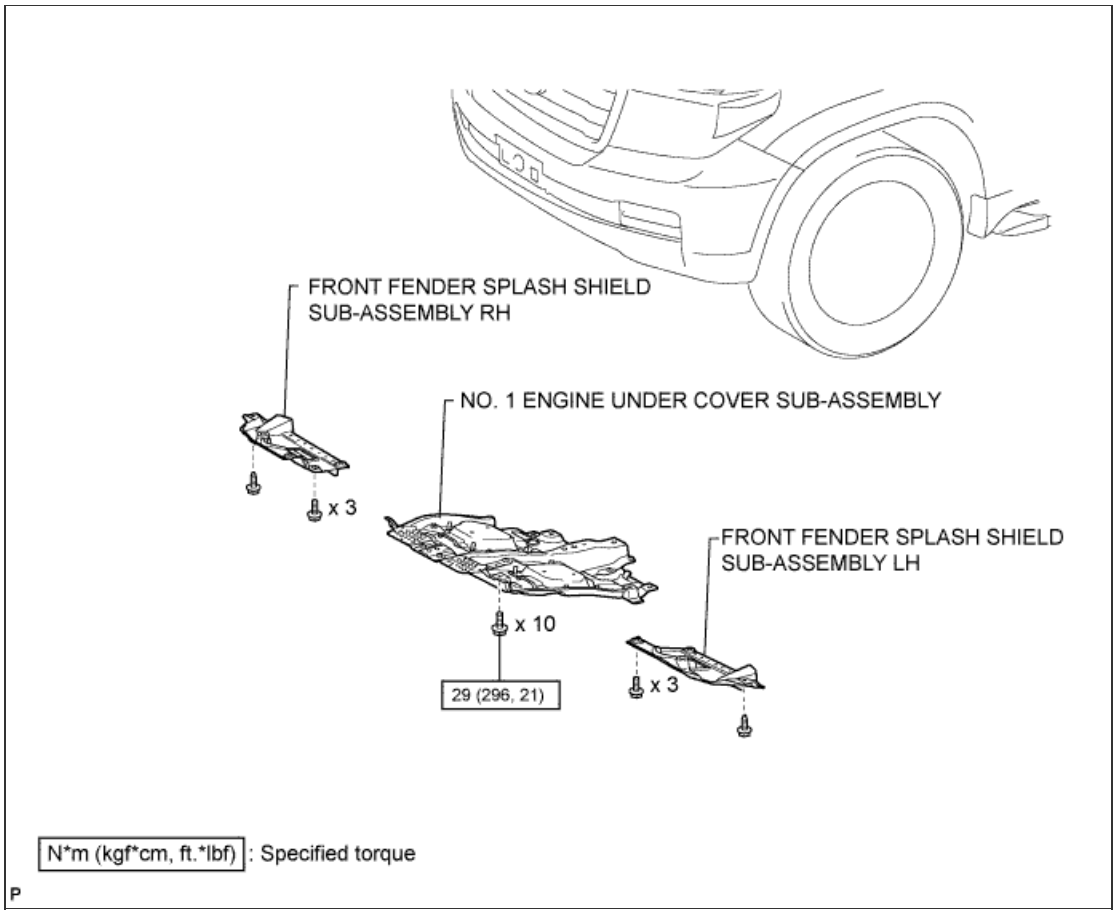
11. INSTALL V-BANK COVER

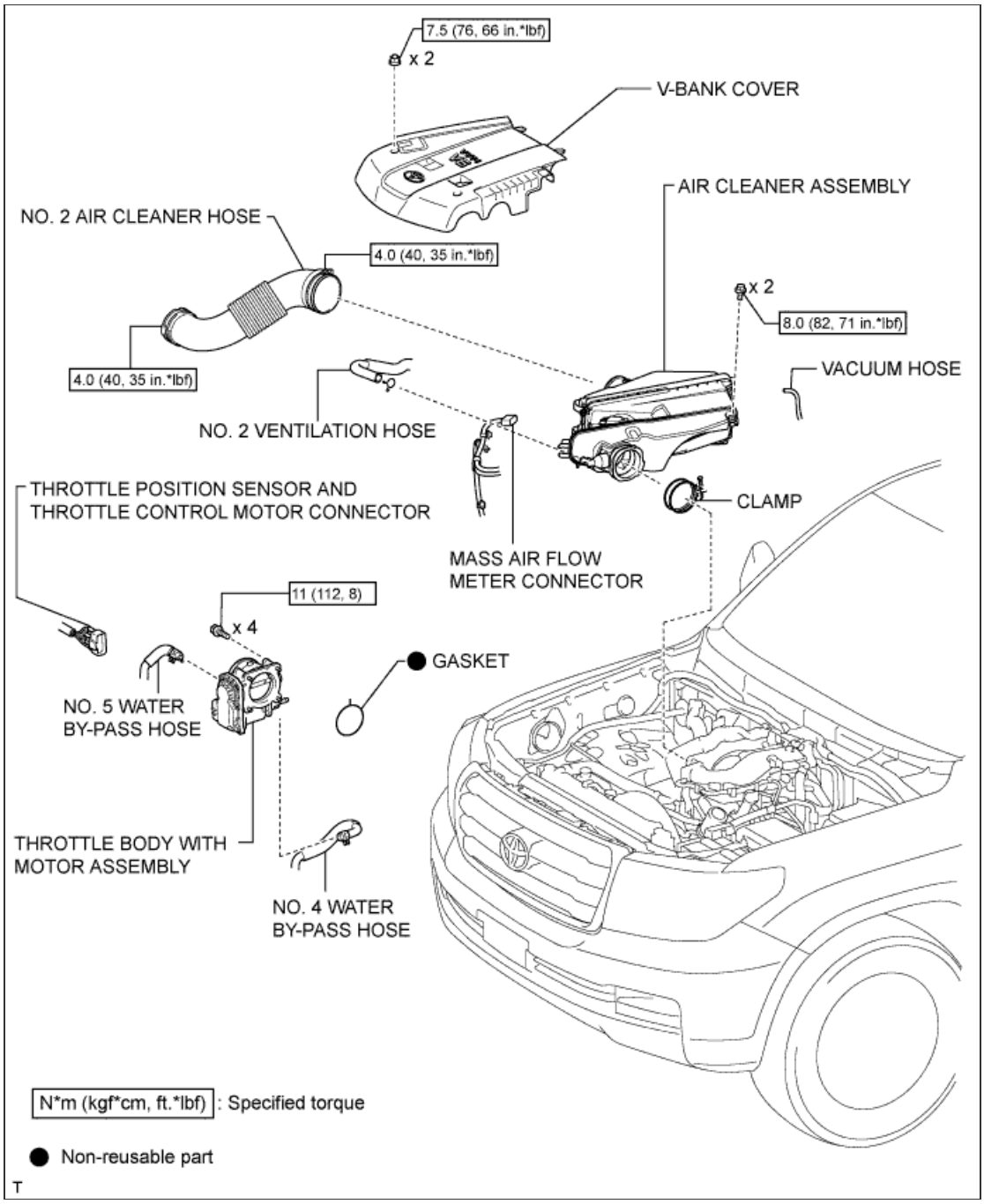
a. Install the V-bank cover with the 2 cap nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



for Preparation Click here




7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER
AIR CLEANER ASSEMBLY
NO. 2 AIR CLEANER HOSE
4.0 (40, 35 in.*lbf)
x 2
8.0 (82, 71 in.*lbf)
4.0 (40, 35 in.*lbf)
VACUUM HOSE
NO. 2 VENTILATION HOSE
THROTTLE POSITION SENSOR AND
THROTTLE CONTROL MOTOR CONNECTOR
CLAMP
MASS AIR FLOW
METER CONNECTOR
11 (112, 8)
x 4
GASKET
NO. 5 WATER
BY-PASS HOSE
THROTTLE BODY WITH
MOTOR ASSEMBLY
NO. 4 WATER
BY-PASS HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
T

for Preparation Click here

1. CHECK THROTTLE BODY WITH MOTOR ASSEMBLY

a. Check the throttle control motor operating sounds.

i. Turn the ignition switch on (IG).

ii. When depressing the accelerator pedal, check the operating sound of the running motor. Make sure that no friction noises emit from the motor. If friction noise exists, replace the throttle body.

b. Check the throttle position sensor.

i. Connect the intelligent tester to the DLC3.

ii. Turn the ignition switch on (IG).

iii. Turn the intelligent tester on.

iv. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Throttle Sensor Position.

v. Depress the accelerator pedal. When the throttle valve is fully opened, check that the value of the "Throttle Sensor Position" is within the specification.

Standard throttle valve opening percentage:
60% or more

HINT:

When checking the standard throttle valve opening percentage, the shift lever should be in N.

If the percentage is less than 60%, replace the throttle body.

for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

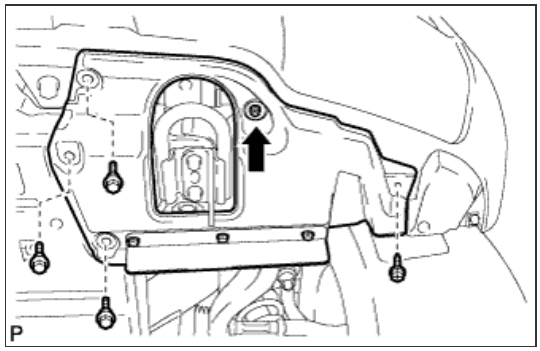
HINT:

Use the same procedures described for the LH side.

2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and engine under cover.

4. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug and 2 cylinder block drain cock plugs.

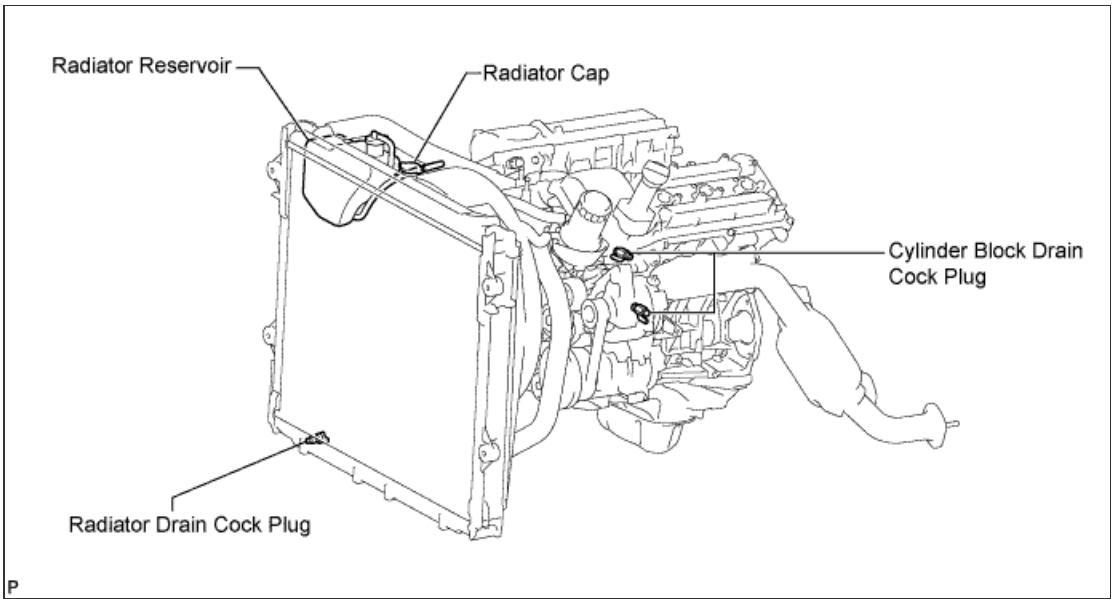
b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Tighten the 2 cylinder block drain cock plugs.

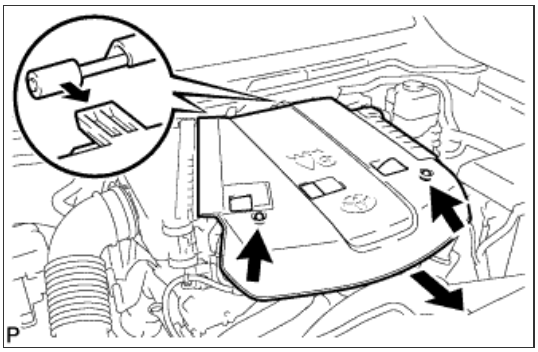
Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



d. Tighten the radiator drain cock plug by hand.

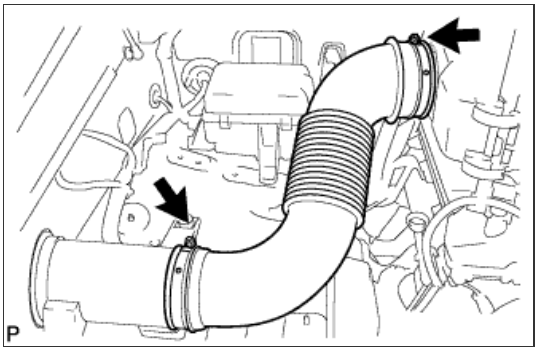
5. REMOVE V-BANK COVER

a. Remove the 2 cap nuts and V-bank cover.



6. REMOVE NO. 2 AIR CLEANER HOSE

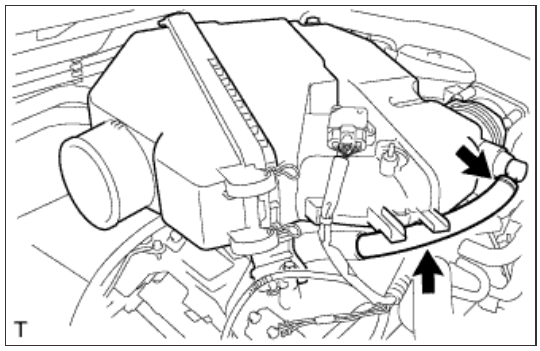
a. Loosen the 2 hose clamps and remove the air cleaner hose.



7. REMOVE AIR CLEANER ASSEMBLY

a. Disconnect the No. 2 ventilation hose.

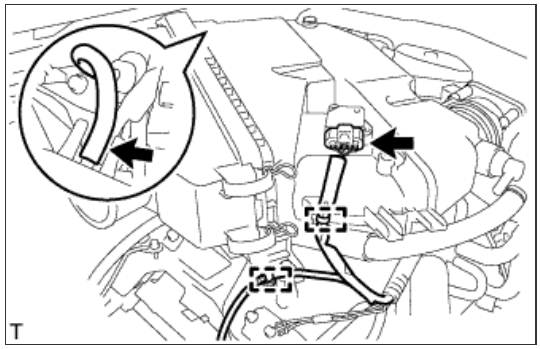
b. Detach the hose clamp.



c. Disconnect the vacuum hose.

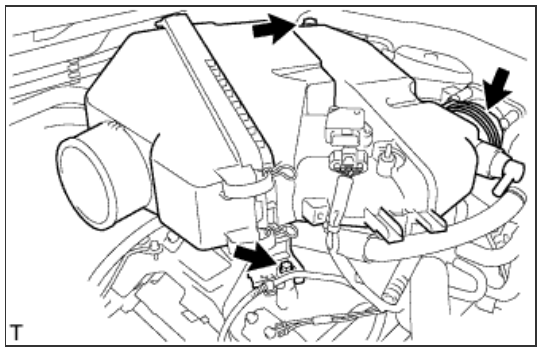
d. Disconnect the MAF meter connector.

e. Using a clip remover, detach the 2 wire harness clamps.



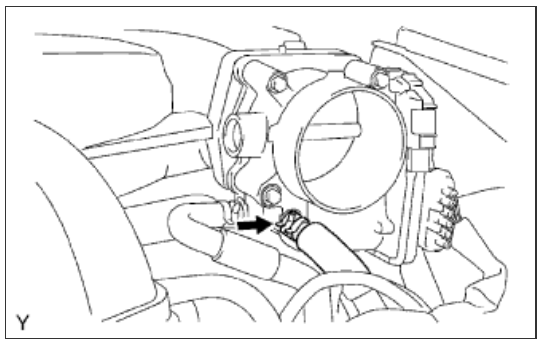
f. Loosen the hose clamp.

g. Remove the 2 bolts and air cleaner assembly.

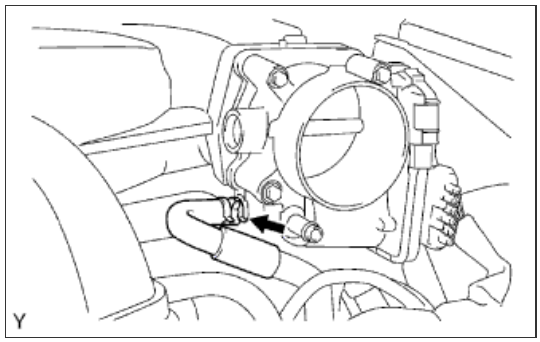


8. REMOVE THROTTLE BODY WITH MOTOR ASSEMBLY

a. Disconnect the No. 5 water by-pass hose.

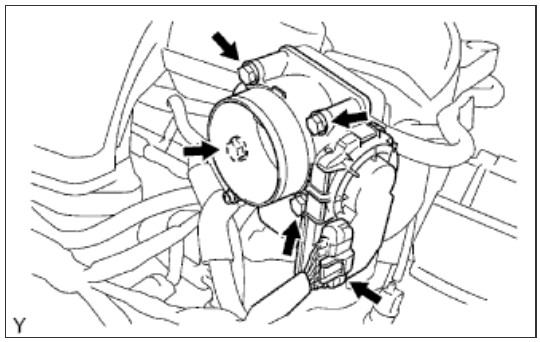


b. Disconnect the No. 4 water by-pass hose.



c. Disconnect the throttle position sensor and throttle control motor connector.

d. Remove the 4 bolts, then remove the throttle body with motor and gasket.



for Preparation Click here

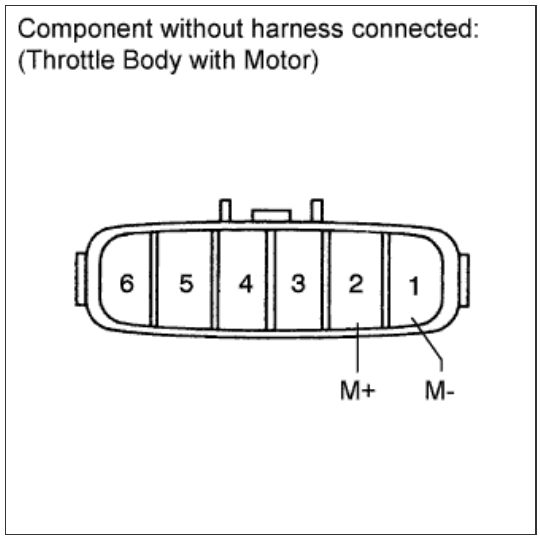
1. INSPECT THROTTLE BODY WITH MOTOR ASSEMBLY

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
2 (M+) - 1 (M-)	20°C (68°F)	0.3 to 100 Ω

If the result is not as specified, replace the throttle body with motor assembly.

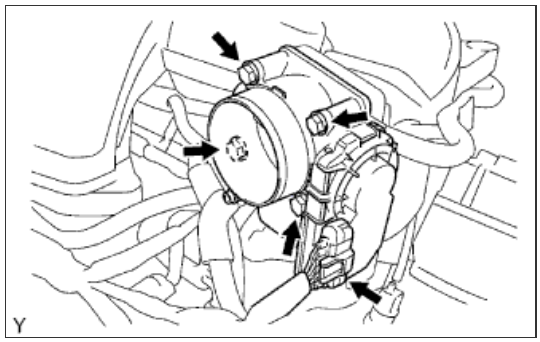


for Preparation Click here

1. INSTALL THROTTLE BODY WITH MOTOR ASSEMBLY

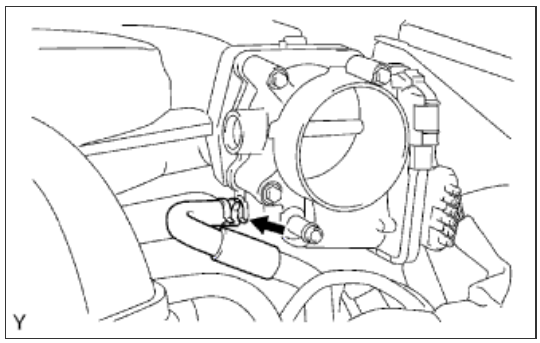
a. Install a new gasket and the throttle body with motor with the 4 bolts.

Torque:
11 N*m{ 112 kgf*cm , 8 ft.*lbf }

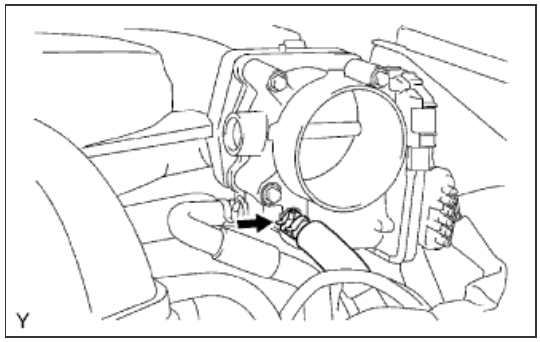


b. Connect the throttle position sensor and throttle control motor connector.

c. Connect the No. 4 water by-pass hose.



d. Connect the No. 5 water by-pass hose.



2. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner assembly with the 2 bolts.

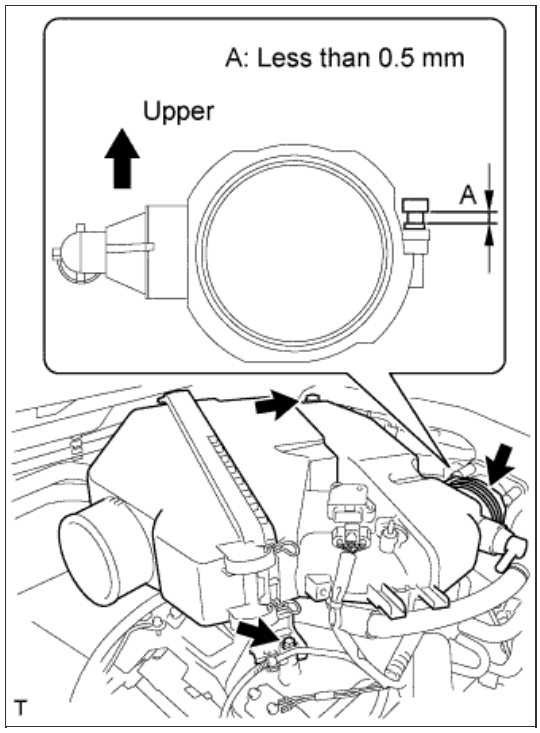
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

b. Tighten the hose clamp.

HINT:

Tighten the hose clamp until it reaches the specified protrusion height labeled A shown in the illustration.

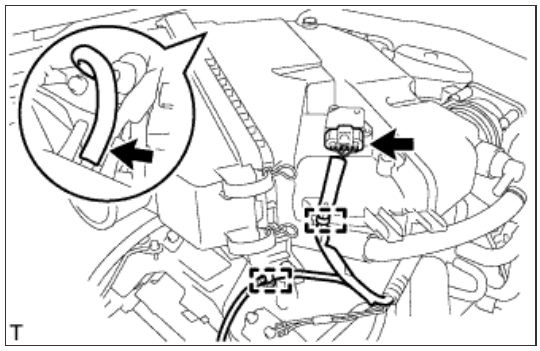
Standard protrusion height:
Less than 0.5 mm (0.0197 in.)



c. Connect the MAF meter connector.

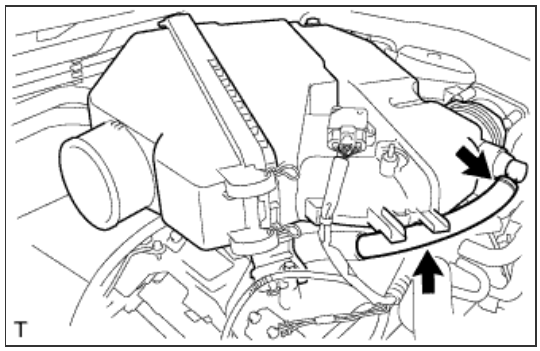
d. Attach the 2 wire harness clamps.

e. Connect the vacuum hose.



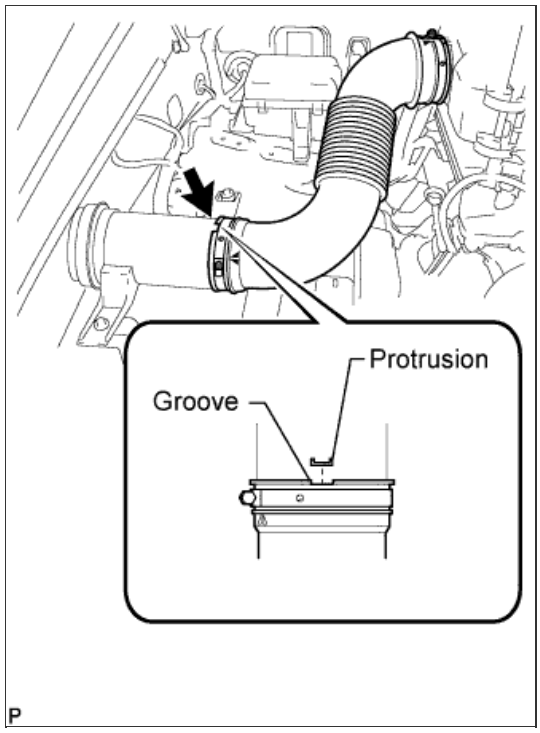
f. Attach the hose clamp.

g. Connect the No. 2 ventilation hose.



3. INSTALL NO. 2 AIR CLEANER HOSE

a. Align the protrusion of the pre-cleaner with the groove of the No. 2 air cleaner hose as shown in the illustration.

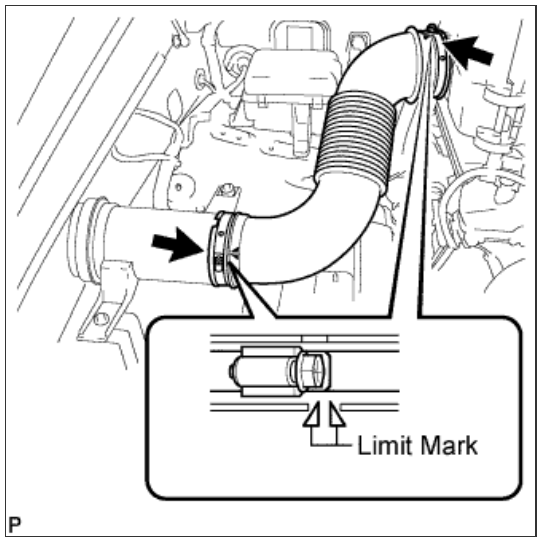


b. Tighten the 2 hose clamps.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }

HINT:

Tighten the clamp until the end of the clamp band is within both limit marks.



4. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item		Specified condition
for Automatic transmission	w/o Rear Heater	11.2 liters (11.8 US qts, 9.9 Imp. qts)
	w/ Rear Heater	14.4 liters (15.2 US qts, 12.7 Imp. qts)
for Manual transmission	w/o Rear Heater	12.0 liters (12.7 US qts, 10.6 Imp. qts)
	w/ Rear Heater	14.6 liters (15.4 US qts, 12.8 Imp. qts)

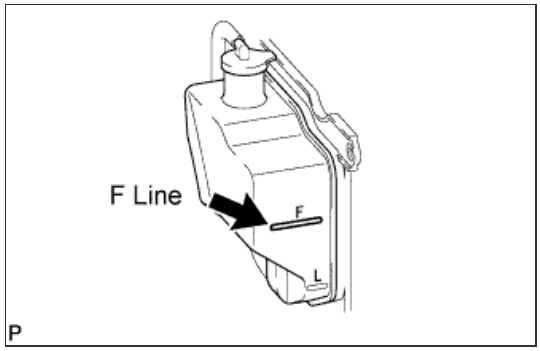
NOTICE:

Do not substitute plain water for engine coolant.

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.



c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Set the air conditioning as follows while warming up the engine.

Item	Condition
Fan speed	Any setting except off
Temperature	Toward WARM
Air conditioning switch	Off

g. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

h. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

i. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

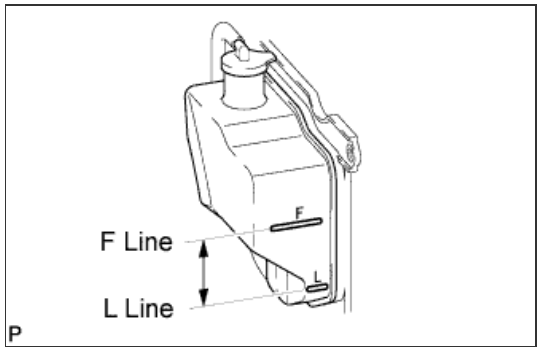
- **Wear protective gloves. Heat areas on the parts may injure your hands.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the fan.**

j. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

k. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.



5. INSPECT FOR ENGINE COOLANT LEAK

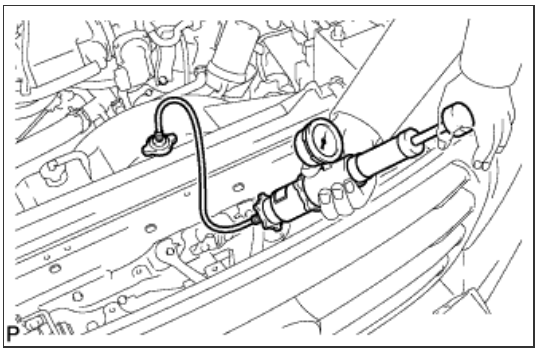
CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



6. CHECK THROTTLE BODY WITH MOTOR ASSEMBLY

a. Check the throttle control motor operating sounds.

i. Turn the ignition switch on (IG).

ii. When depressing the accelerator pedal, check the operating sound of the running motor. Make sure that no friction noises emit from the motor. If friction noise exists, replace the throttle body.

b. Check the throttle position sensor.

i. Connect the intelligent tester to the DLC3.

ii. Turn the ignition switch on (IG).

iii. Turn the intelligent tester on.

iv. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Throttle Sensor Position.

v. Depress the accelerator pedal. When the throttle valve is fully opened, check that the value of the "Throttle Sensor Position" is within the specification.

Standard throttle valve opening percentage:
60% or more

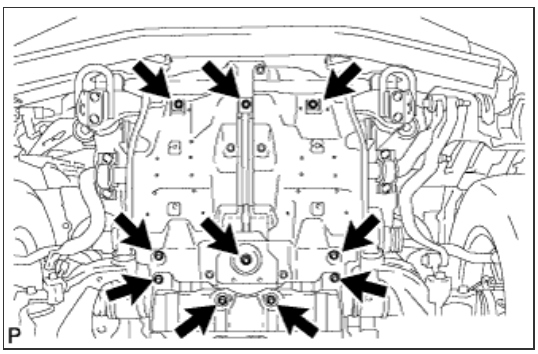
HINT:

When checking the standard throttle valve opening percentage, the shift lever should be in N.

If the percentage is less than 60%, replace the throttle body.

7. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

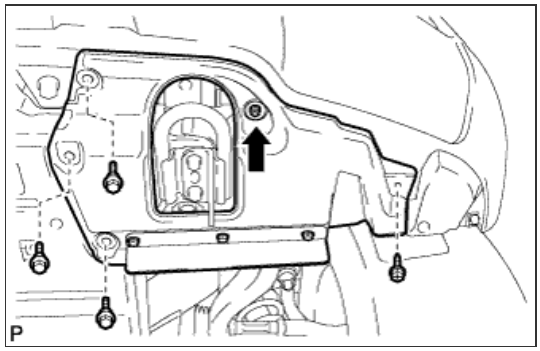
a. Install the under cover with the 10 bolts.



8. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



9. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

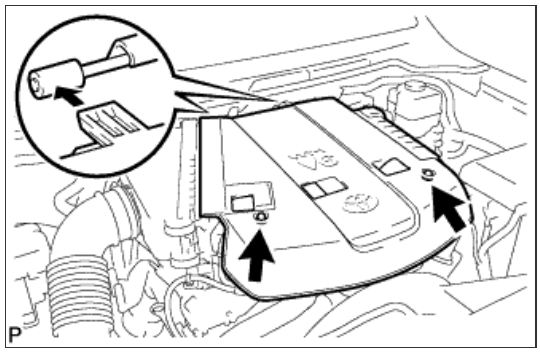
HINT:

Use the same procedures described for the LH side.

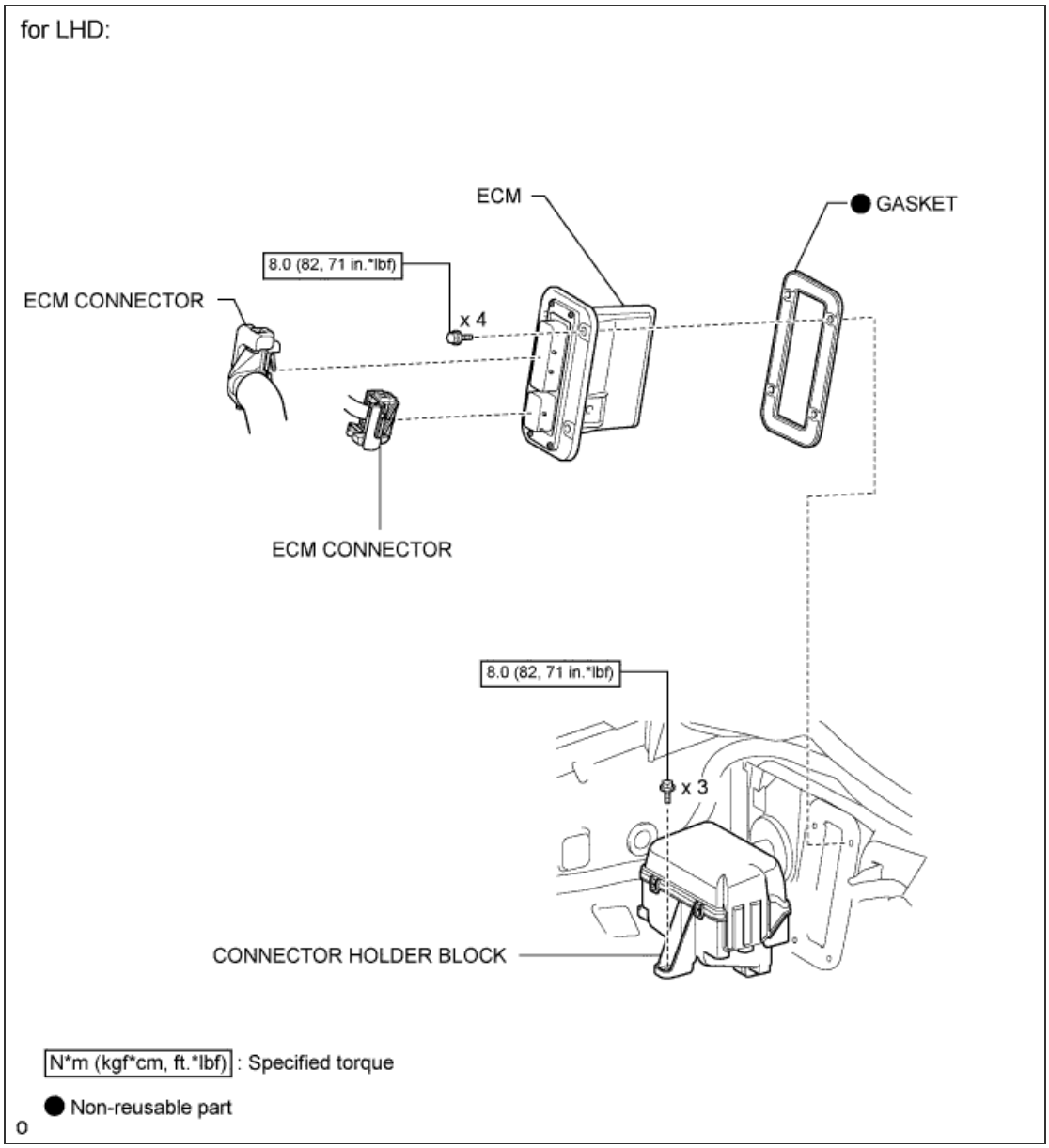
10. INSTALL V-BANK COVER

a. Install the V-bank cover with the 2 cap nuts.

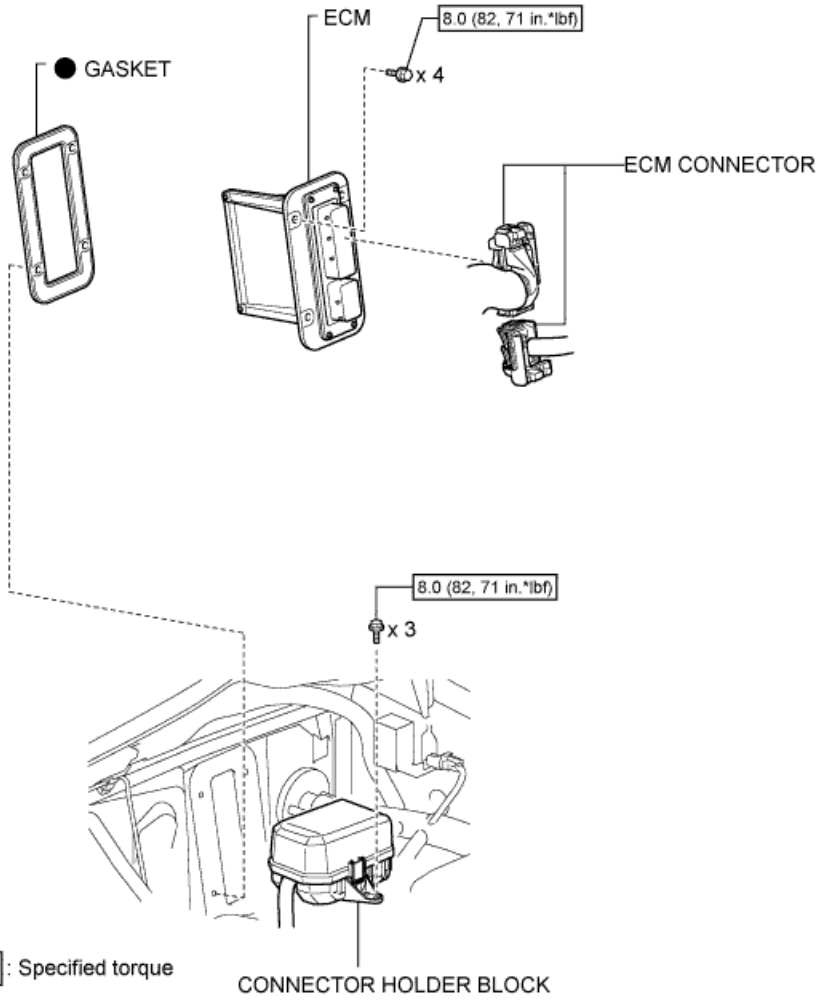
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



for Preparation Click here



for RHD:



N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

o

for Preparation Click here

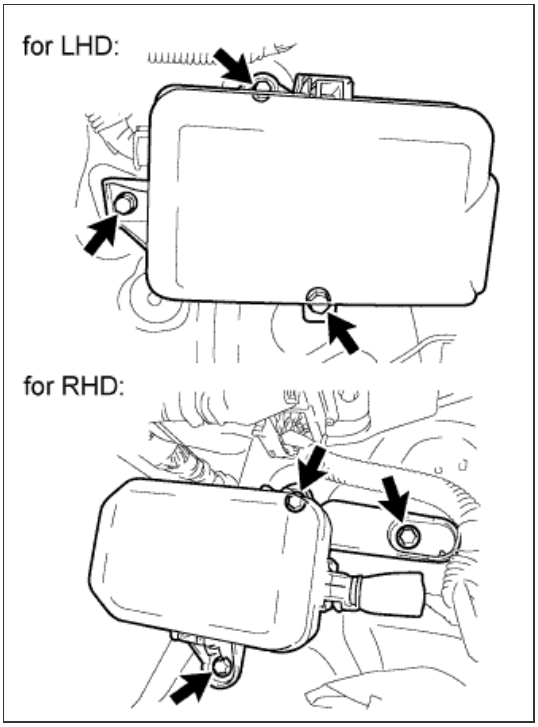
1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

2. DISCONNECT CONNECTOR HOLDER BLOCK

a. Remove the 3 bolts and move the connector holder block so that the ECM can be removed in the next step.



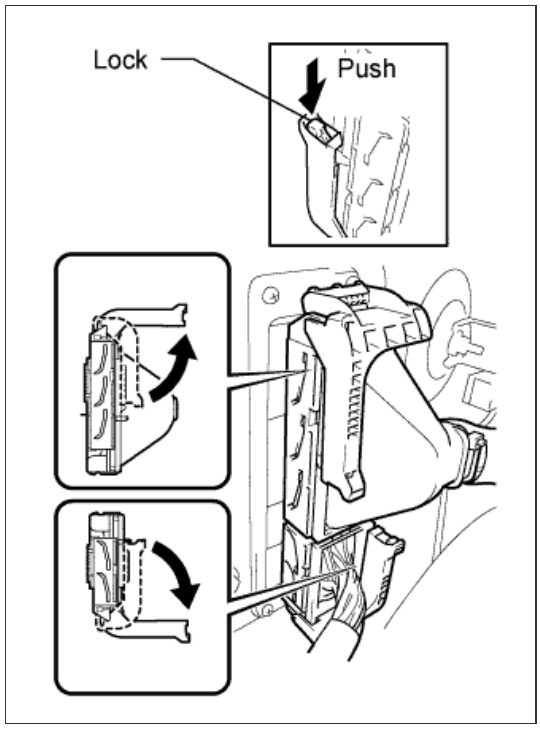
3. REMOVE ECM

a. Raise the 2 levers while pushing the locks on the 2 levers.

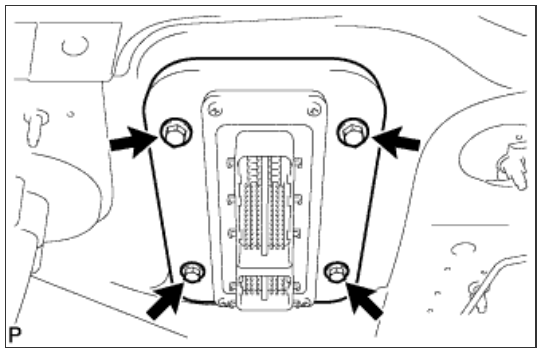
NOTICE:

Make sure that the lock levers are raised 90° as shown in the illustration before disconnecting the ECM connectors. Failure to do this may cause the ECM connectors to break.

b. Disconnect the 2 connectors.

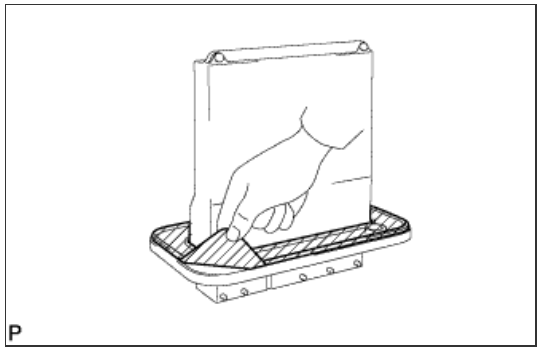


c. Remove the 4 bolts and ECM.



4. REMOVE GASKET

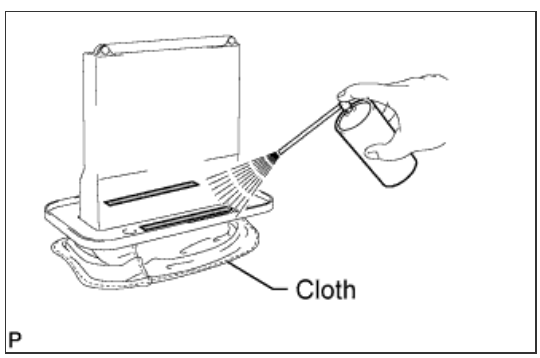
a. Peel off the gasket.



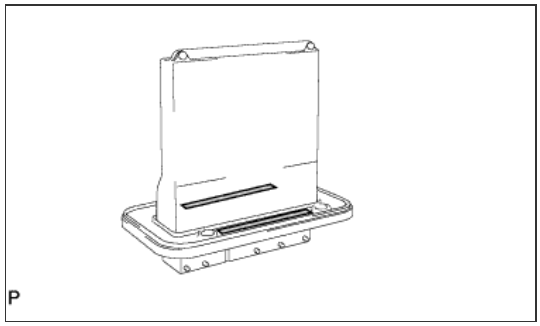
b. Spray gasket remover or equivalent on the remaining tape of the gasket.

NOTICE:

When using gasket remover or equivalent, cover the ECM connectors with a cloth.



c. Remove the tape of the gasket without using bladed objects.



P

for Preparation Click here

1. INSTALL GASKET

a. Clean the ECM seal surface with non-residue solvent.

b. Attach a new gasket to the ECM.

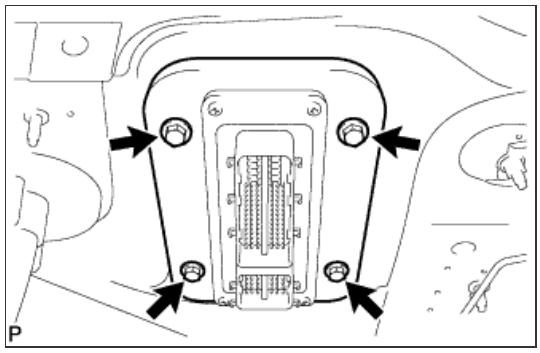
2. INSTALL ECM

a. Install the ECM with the 4 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

NOTICE:

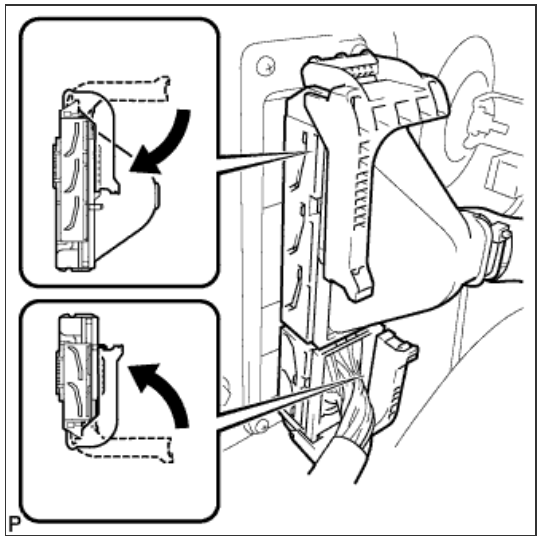
- **Make sure the gasket is not folded or caught on any area of the surrounding part.**
- **Make sure there is no foreign matter caught between the gasket and surrounding part.**
- **Do not damage the gasket.**



b. Connect the 2 ECM connectors and push each lock lever down to lock the ECM connectors.

NOTICE:

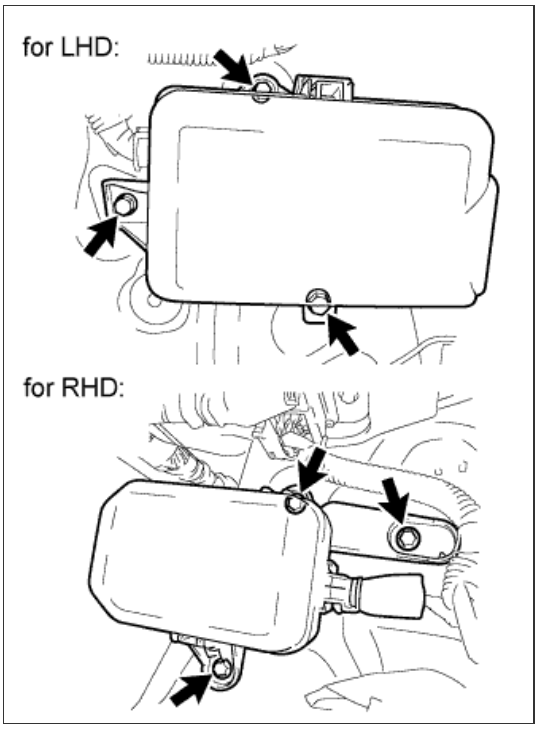
- **Be careful not to allow dirt, water, or other foreign matter to adhere to the connecting parts when connecting the connectors.**
- **Do not twist the wire harness when connecting the ECM connectors.**
- **Make sure that the lock levers are raised 90° before connecting the ECM connectors. Failure to do this may cause the lock lever and terminals to break.**
- **Make sure that the levers are securely locked.**



3. CONNECT CONNECTOR HOLDER BLOCK

a. Connect the connector holder block with the 3 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

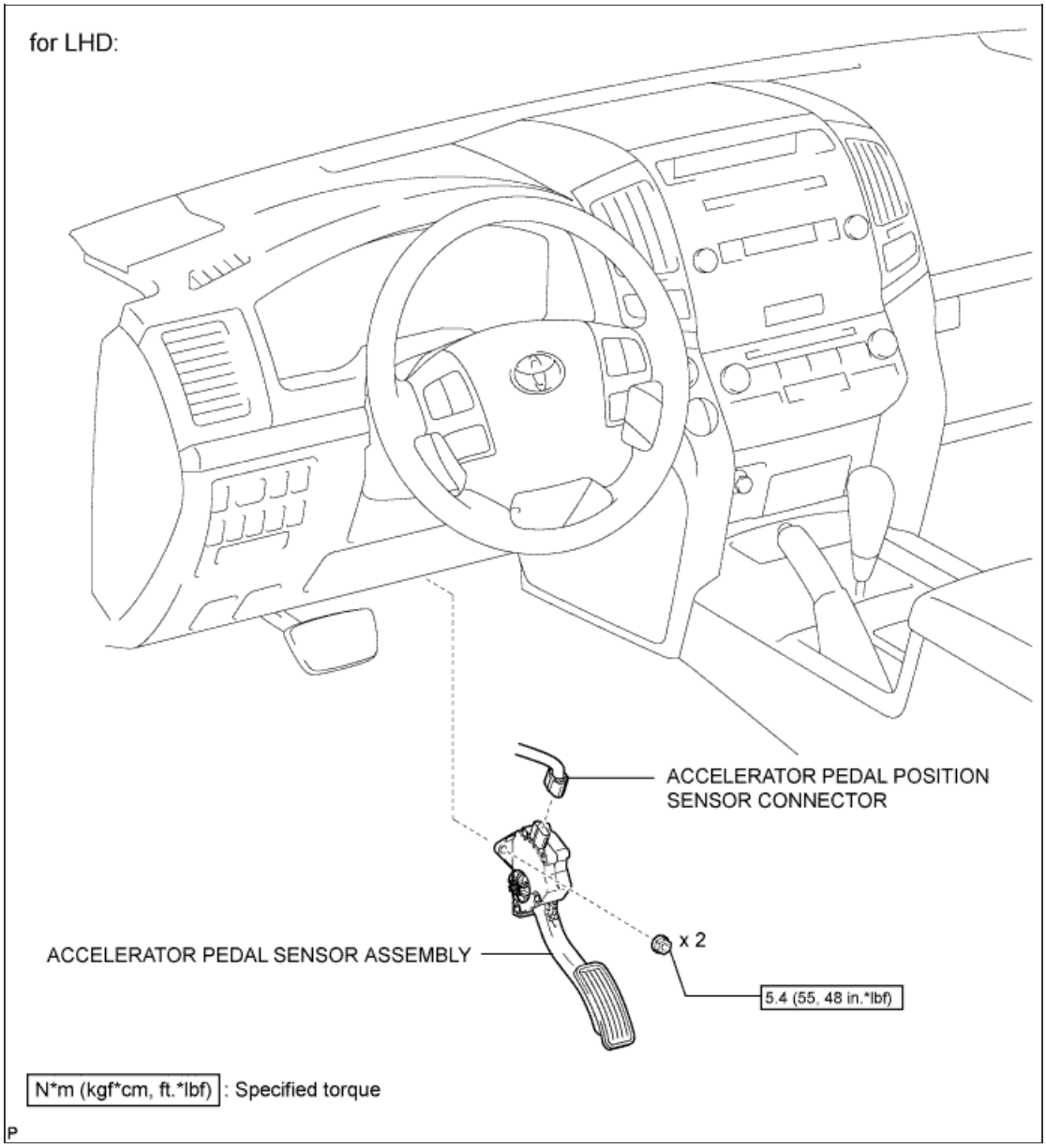


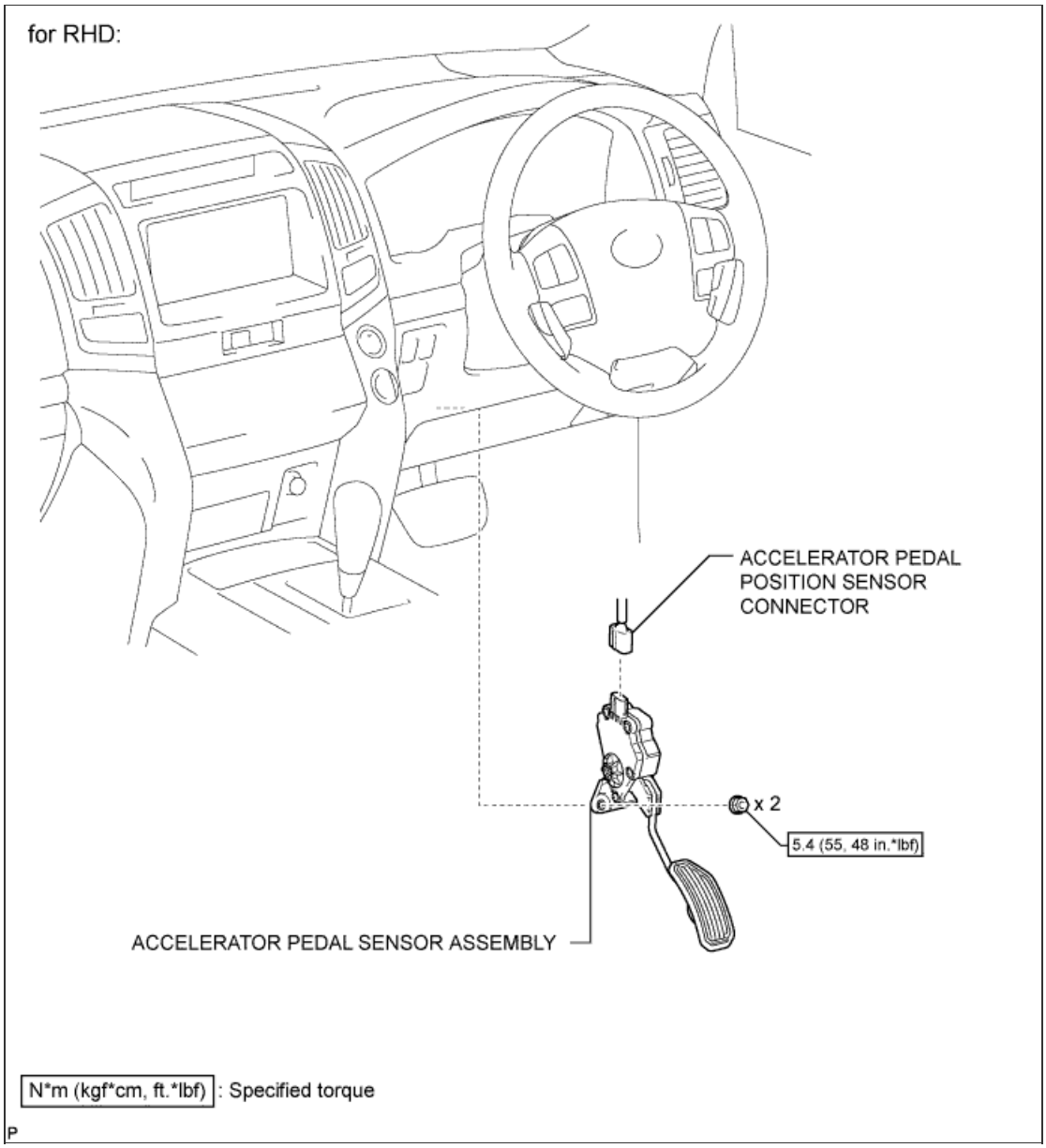
4. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

for Preparation Click here




for RHD:
ACCELERATOR PEDAL POSITION SENSOR CONNECTOR
x 2
5.4 (55, 48 in.*lbf)
ACCELERATOR PEDAL SENSOR ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
P

for Preparation Click here

1. INSPECT ACCELERATOR PEDAL SENSOR ASSEMBLY

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch on (IG).

c. Turn the intelligent tester on.

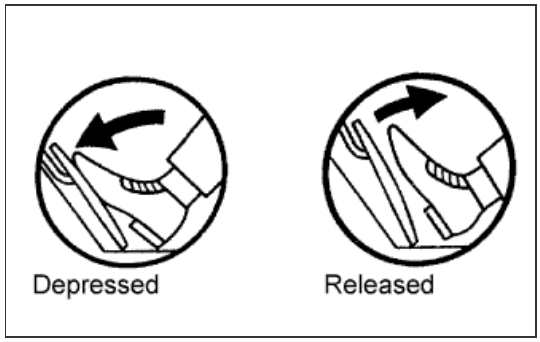
d. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

e. Read the value displayed on the intelligent tester.

Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2.6 to 4.5 V	3.4 to 5.0 V

If the result is not as specified, check the accelerator pedal, wire harness or ECM.

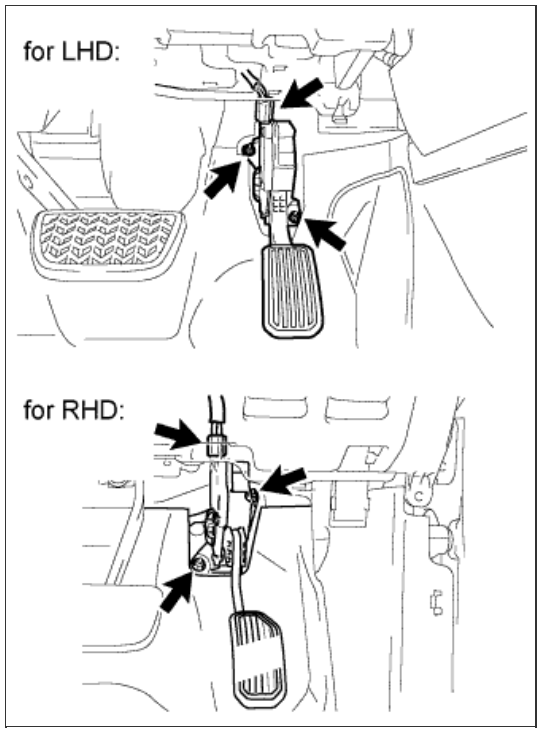


for Preparation Click here

1. REMOVE ACCELERATOR PEDAL SENSOR ASSEMBLY

a. Disconnect the accelerator pedal position sensor connector.

b. Remove the 2 nuts and accelerator pedal sensor.



for Preparation Click here

1. INSTALL ACCELERATOR PEDAL SENSOR ASSEMBLY

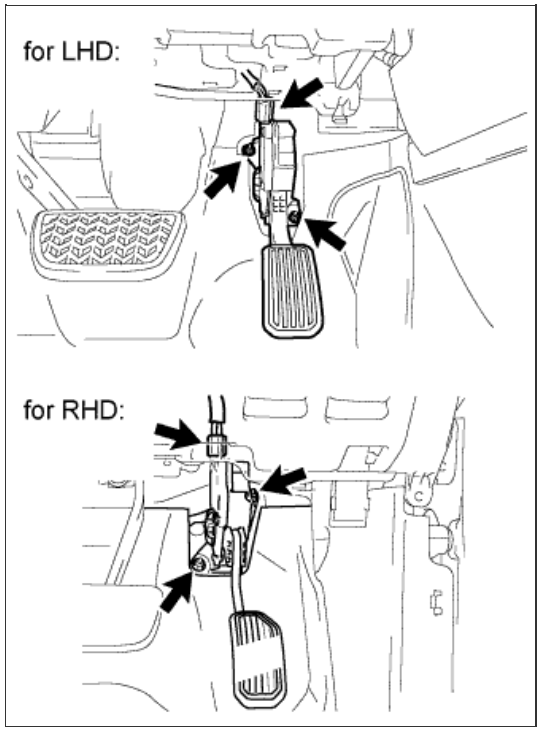
NOTICE:

- **Avoid physical shocks to the accelerator pedal sensor assembly.**
- **Do not disassemble the accelerator pedal sensor assembly.**

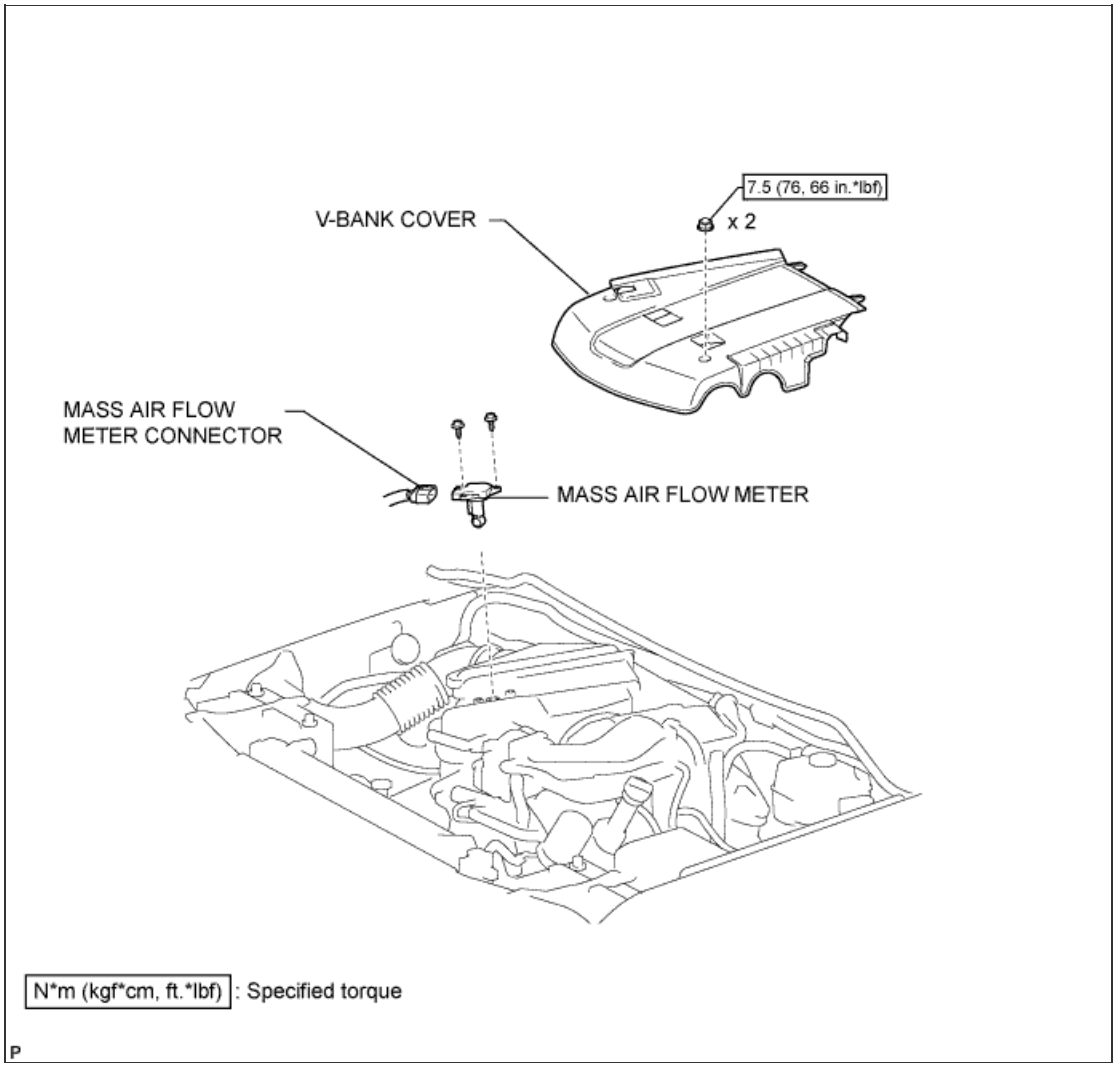
a. Install the accelerator pedal sensor with the 2 nuts.

Torque:
5.4 N*m{ 55 kgf*cm , 48 in.*lbf }

b. Connect the accelerator pedal position sensor connector.



for Preparation [Click here]



for Preparation Click here

NOTICE:

- **Perform the MAF meter inspection according to the procedures below.**
- **Only replace the MAF meter when the MAF value in the Data List (with the engine stopped) is not within the normal operating range or there is foreign matter on the MAF meter platinum hot wire (heater).**

1. INSPECT MASS AIR FLOW METER

a. Read the value using the intelligent tester.

NOTICE:

- **Perform the inspection with the vehicle indoors and on a level surface.**
- **Perform the inspection of the MAF meter while it is installed to the air cleaner case (installed to the vehicle).**
- **During the test, do not use the exhaust air duct to apply suction to the exhaust pipe.**

i. Turn the ignition switch on (IG).

ii. Turn the intelligent tester on.

iii. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF.

iv. Wait 30 seconds, and read the values on the intelligent tester.

Standard:

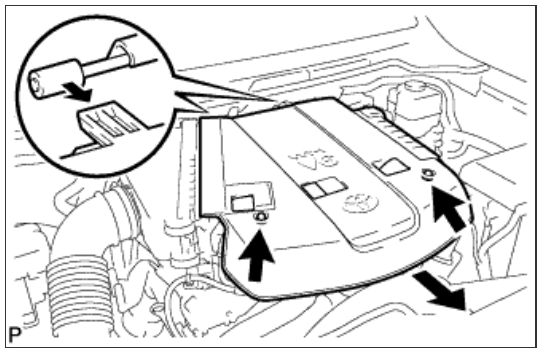
Item	Condition	Specified Condition
MAF	• Engine not running • 30 seconds after ignition switch is turned on (IG)	Less than 0.69 g/sec.

If the result is not as specified, replace the MAF meter.
If the result is within the specified range, inspect the MAF meter (Click here).

for Preparation Click here

1. REMOVE V-BANK COVER

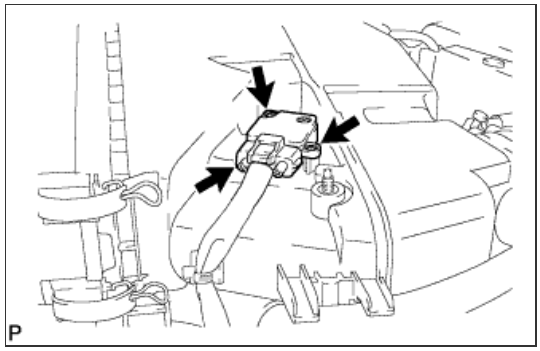
a. Remove the 2 cap nuts and V-bank cover.



2. REMOVE MASS AIR FLOW METER

a. Disconnect the MAF meter connector.

b. Remove the 2 screws and MAF meter.



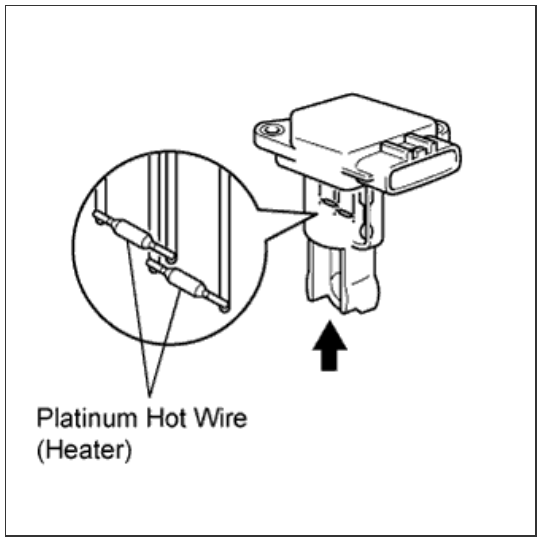
for Preparation Click here

1. INSPECT MASS AIR FLOW METER

a. Perform a visual check for any foreign matter on the platinum hot wire (heater) of the mass air flow meter shown in the illustration.

OK:
There is no foreign matter.

If the result is not as specified, replace the mass air flow meter.

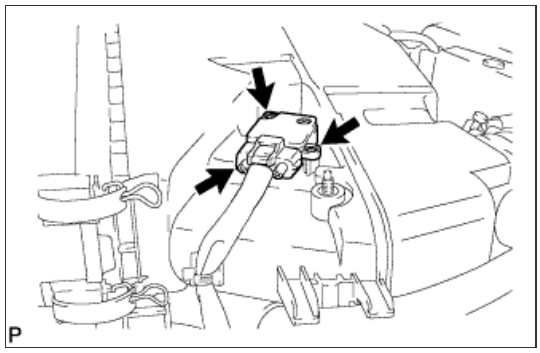


for Preparation Click here

1. INSTALL MASS AIR FLOW METER

a. Install the MAF meter with the 2 screws.

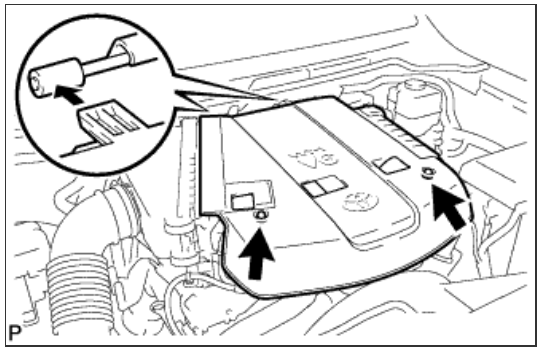
b. Connect the MAF meter connector.



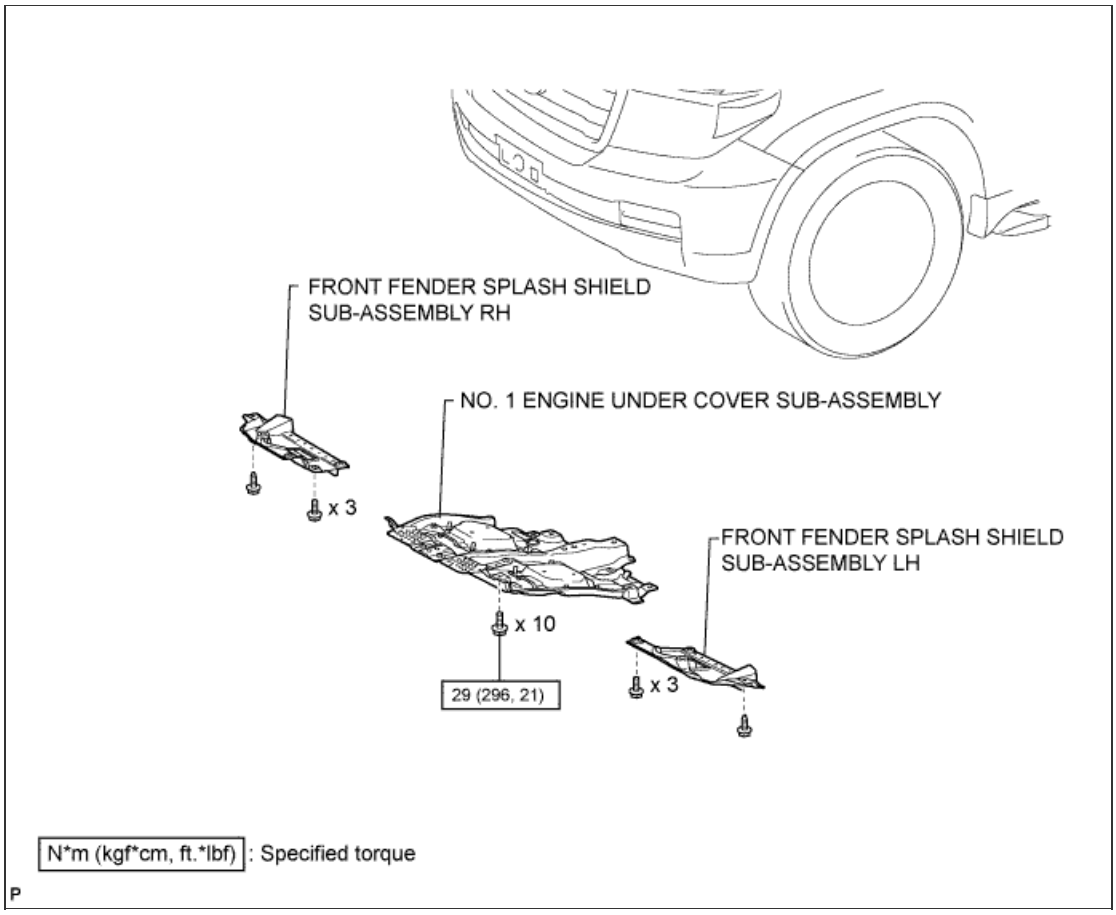
2. INSTALL V-BANK COVER

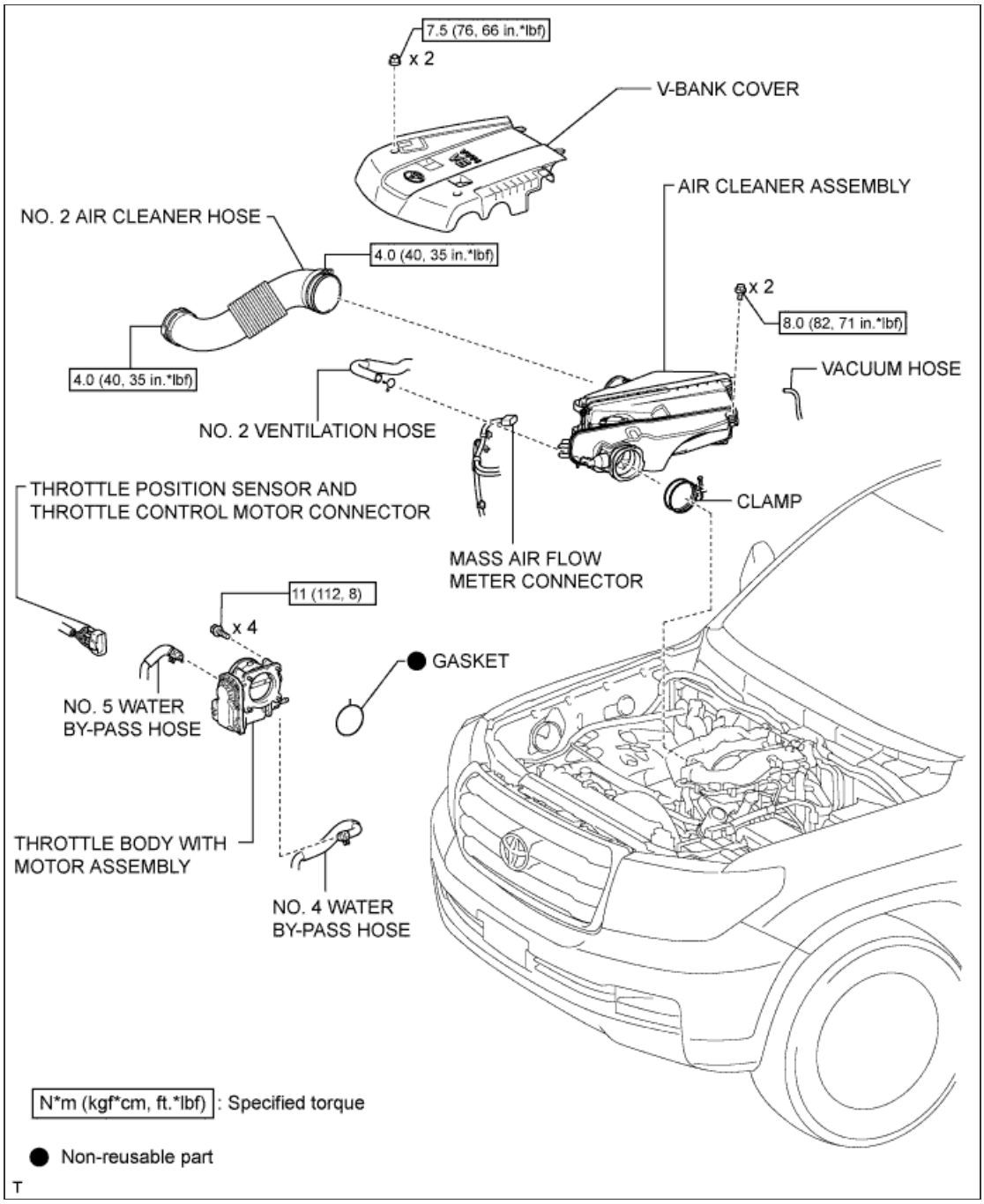
a. Install the V-bank cover with the 2 cap nuts.

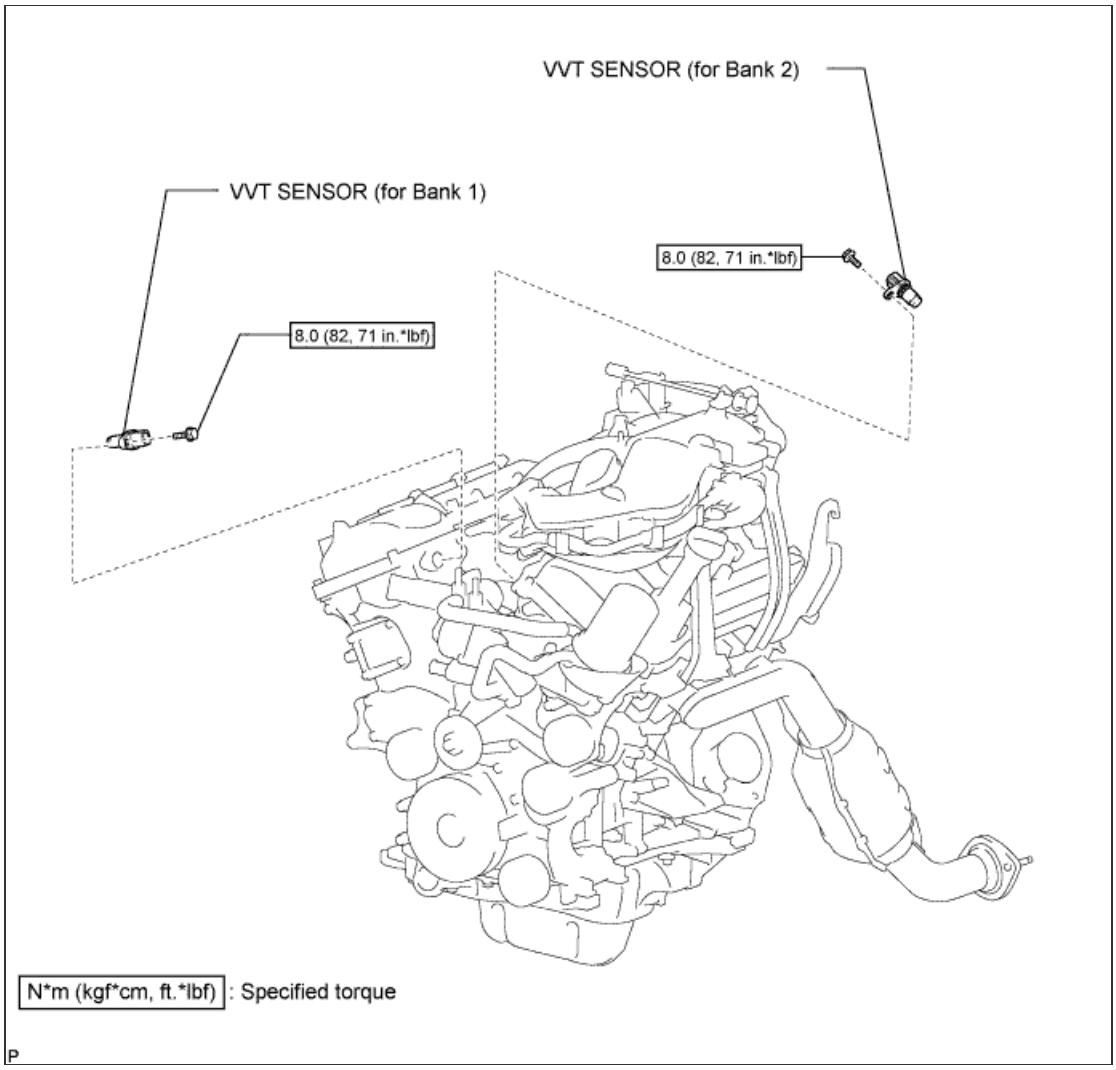
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



for Preparation Click here




7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER
AIR CLEANER ASSEMBLY
NO. 2 AIR CLEANER HOSE
4.0 (40, 35 in.*lbf)
x 2
8.0 (82, 71 in.*lbf)
4.0 (40, 35 in.*lbf)
VACUUM HOSE
NO. 2 VENTILATION HOSE
THROTTLE POSITION SENSOR AND
THROTTLE CONTROL MOTOR CONNECTOR
CLAMP
MASS AIR FLOW
METER CONNECTOR
11 (112, 8)
x 4
GASKET
NO. 5 WATER
BY-PASS HOSE
THROTTLE BODY WITH
MOTOR ASSEMBLY
NO. 4 WATER
BY-PASS HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
T

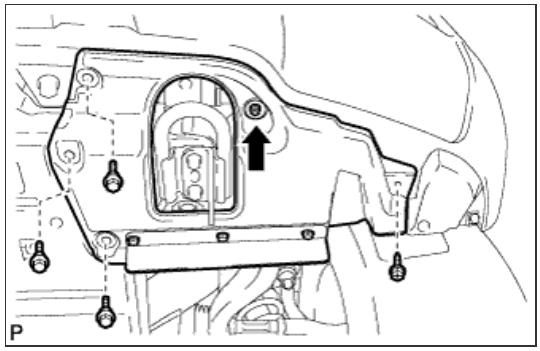

VVT SENSOR (for Bank 2)
VVT SENSOR (for Bank 1)
8.0 (82, 71 in.*lbf)
8.0 (82, 71 in.*lbf)
N*m (kgf*cm, ft.*lbf) : Specified torque
P

for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



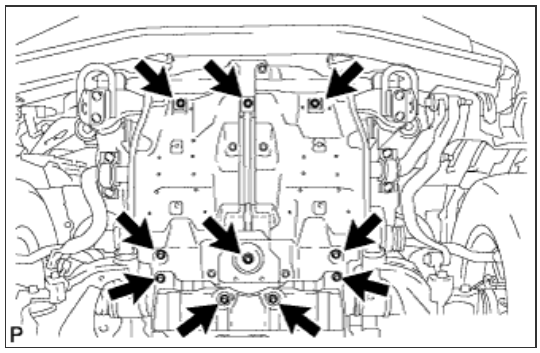
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

HINT:

Use the same procedures described for the LH side.

3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



4. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug and 2 cylinder block drain cock plugs.

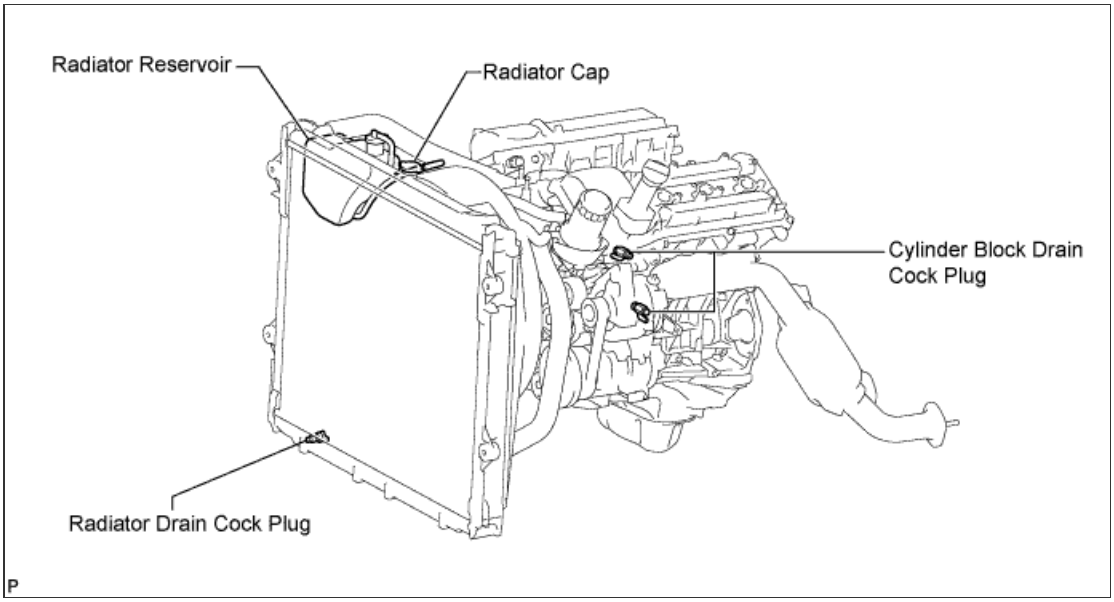
b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Tighten the 2 cylinder block drain cock plugs.

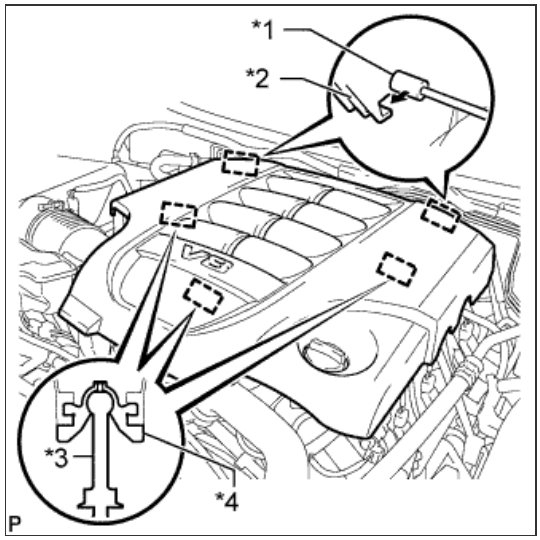
Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



d. Tighten the radiator drain cock plug by hand.

5. REMOVE V-BANK COVER

a. Raise the front of the V-bank cover to detach the 3 pins. Then remove the 2 V-bank cover hooks from the bracket, and remove the V-bank cover.

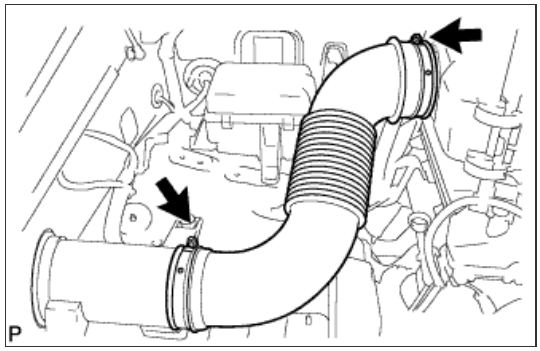


Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet

6. REMOVE NO. 2 AIR CLEANER HOSE

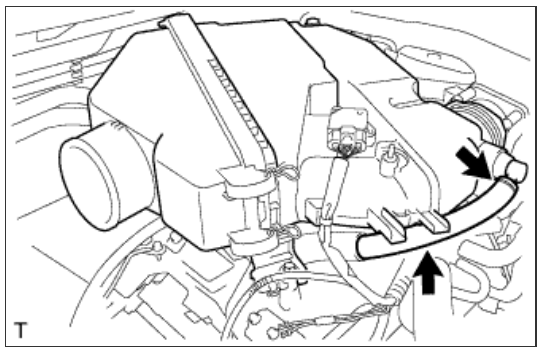
a. Loosen the 2 hose clamps and remove the air cleaner hose.



7. REMOVE AIR CLEANER ASSEMBLY

a. Disconnect the No. 2 ventilation hose.

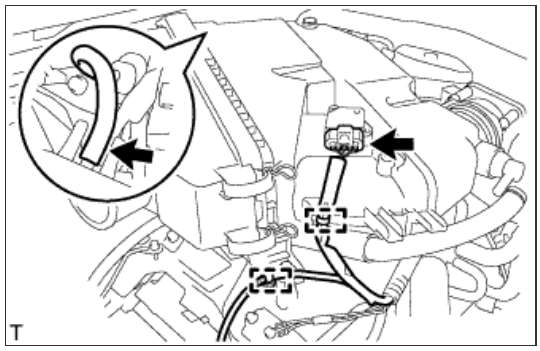
b. Detach the hose clamp.



c. Disconnect the vacuum hose.

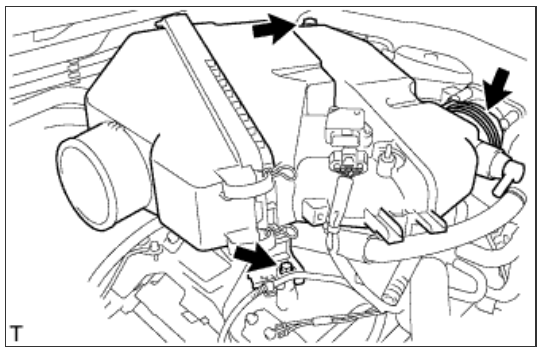
d. Disconnect the MAF meter connector.

e. Using a clip remover, detach the 2 wire harness clamps.



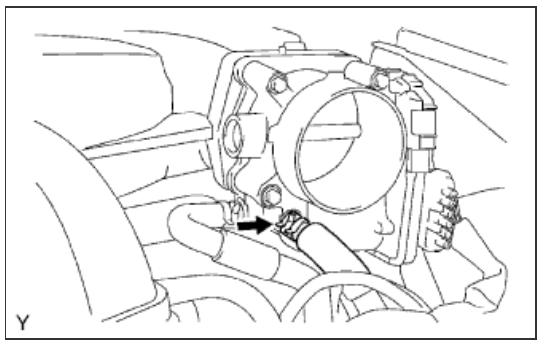
f. Loosen the hose clamp.

g. Remove the 2 bolts and air cleaner assembly.

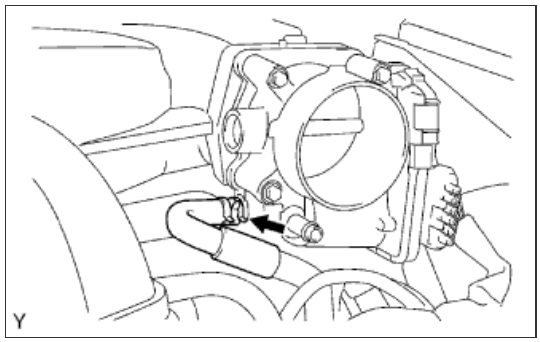


8. REMOVE THROTTLE BODY WITH MOTOR ASSEMBLY

a. Disconnect the No. 5 water by-pass hose.

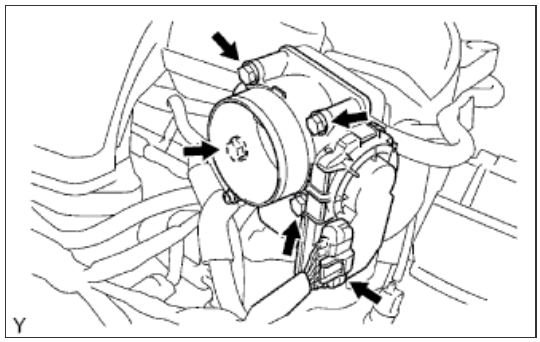


b. Disconnect the No. 4 water by-pass hose.



c. Disconnect the throttle position sensor and throttle control motor connector.

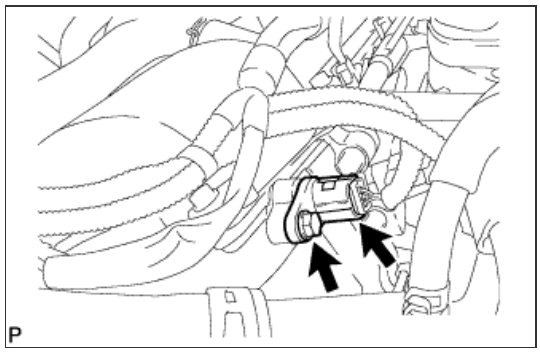
d. Remove the 4 bolts, then remove the throttle body with motor and gasket.



9. REMOVE VVT SENSOR (for Bank 1)

a. Disconnect the sensor connector.

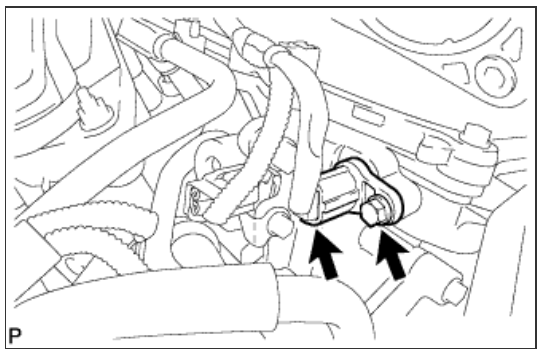
b. Remove the bolt and sensor.



10. REMOVE VVT SENSOR (for Bank 2)

a. Disconnect the sensor connector.

b. Remove the bolt and sensor.



for Preparation Click here

1. INSTALL VVT SENSOR (for Bank 2)

a. Apply a light coat of engine oil to the O-ring of the VVT sensor.

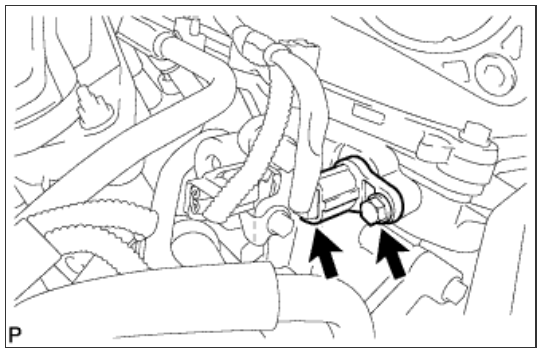
NOTICE:

- **When reusing the sensor, inspect the O-ring.**
- **If the O-ring has scratches or cuts, replace the sensor.**

b. Install the VVT sensor with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

c. Connect the sensor connector.



2. INSTALL VVT SENSOR (for Bank 1)

a. Apply a light coat of engine oil to the O-ring of the sensor.

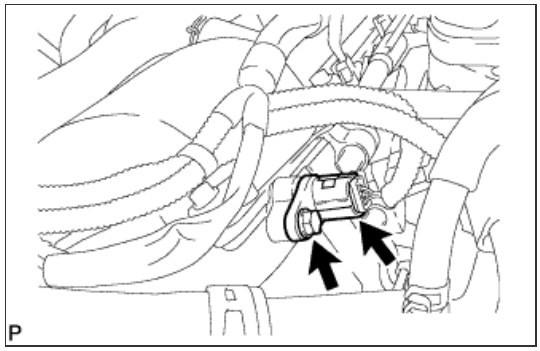
NOTICE:

- **When reusing the sensor, inspect the O-ring.**
- **If the O-ring has scratches or cuts, replace the sensor.**

b. Install the sensor with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

c. Connect the sensor connector.

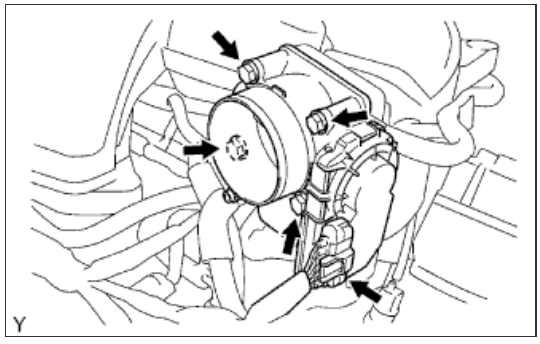


3. INSTALL THROTTLE BODY WITH MOTOR ASSEMBLY

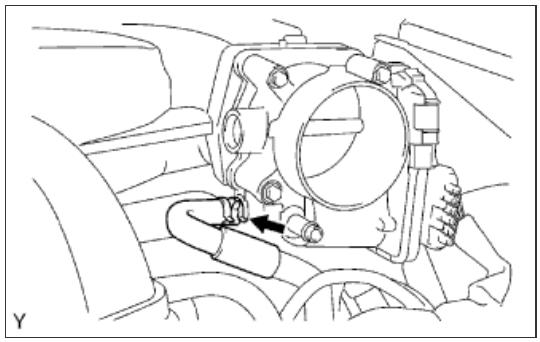
a. Install a new gasket and the throttle body with motor with the 4 bolts.

Torque:
11 N*m{ 112 kgf*cm , 8 ft.*lbf }

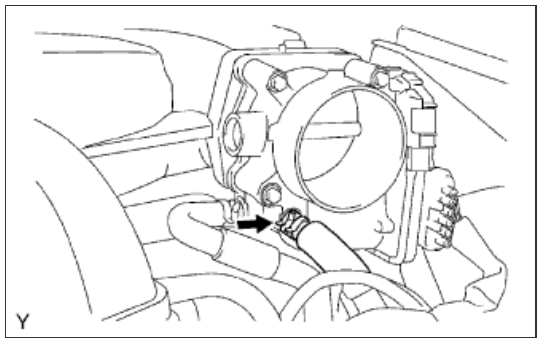
b. Connect the throttle position sensor and throttle control motor connector.



c. Connect the No. 4 water by-pass hose.



d. Connect the No. 5 water by-pass hose.



4. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner assembly with the 2 bolts.

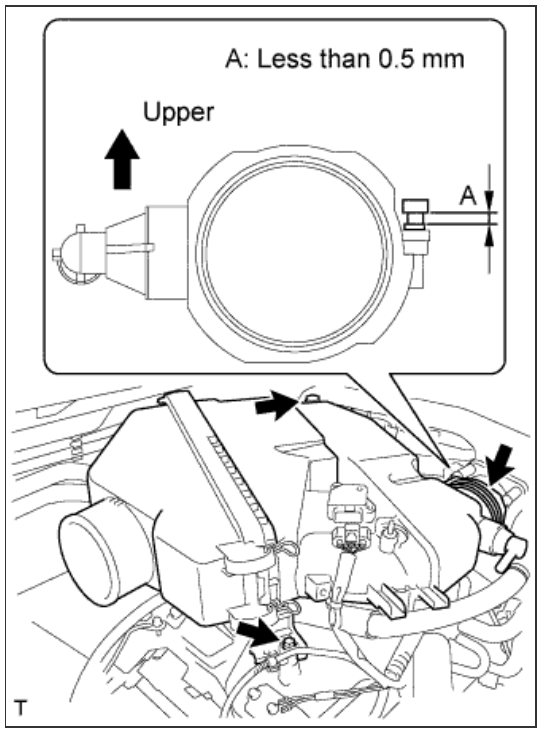
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

b. Tighten the hose clamp.

HINT:

Tighten the hose clamp until it reaches the specified protrusion height labeled A shown in the illustration.

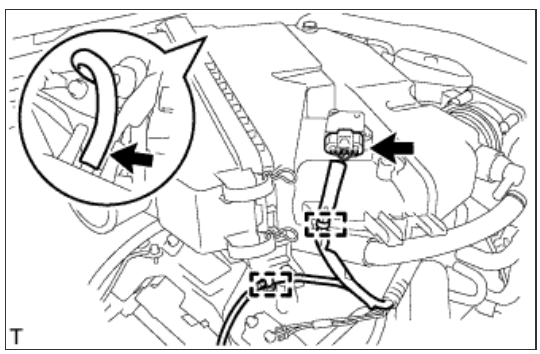
Standard protrusion height:
Less than 0.5 mm (0.0197 in.)



c. Connect the MAF meter connector.

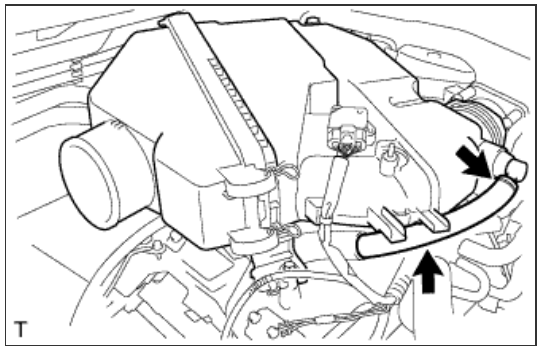
d. Attach the 2 wire harness clamps.

e. Connect the vacuum hose.



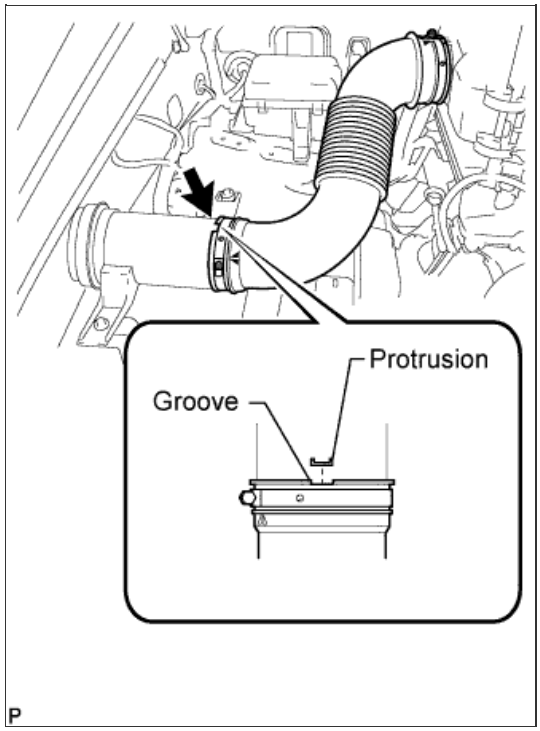
f. Attach the hose clamp.

g. Connect the No. 2 ventilation hose.



5. INSTALL NO. 2 AIR CLEANER HOSE

a. Align the protrusion of the pre-cleaner with the groove of the No. 2 air cleaner hose as shown in the illustration.

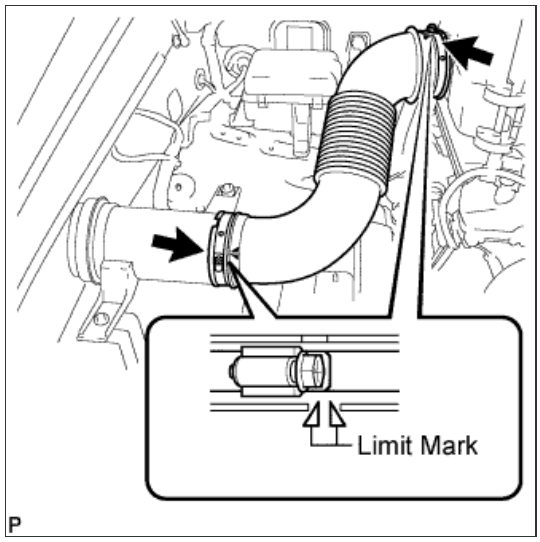


b. Tighten the 2 hose clamps.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }

HINT:

Tighten the clamp until the end of the clamp band is within both limit marks.



6. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item		Specified condition
for Automatic transmission	w/o Rear Heater	11.2 liters (11.8 US qts, 9.9 Imp. qts)
	w/ Rear Heater	14.4 liters (15.2 US qts, 12.7 Imp. qts)
for Manual transmission	w/o Rear Heater	12.0 liters (12.7 US qts, 10.6 Imp. qts)
	w/ Rear Heater	14.6 liters (15.4 US qts, 12.8 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

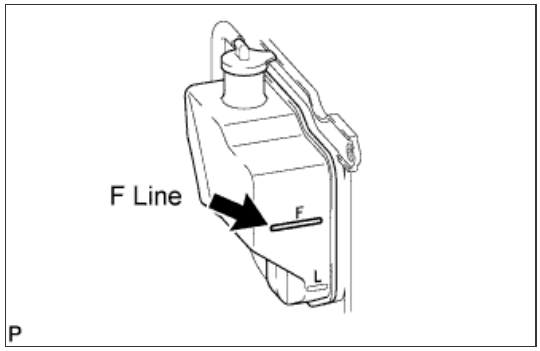
TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.



f. Set the air conditioning as follows while warming up the engine.

Item	Condition
Fan speed	Any setting except off
Temperature	Toward WARM
Air conditioning switch	Off

g. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

h. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

i. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

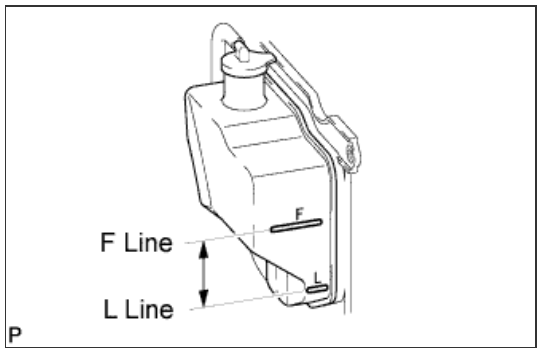
- **Wear protective gloves. Heat areas on the parts may injure your hands.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the fan.**

j. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

k. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.



7. INSPECT FOR ENGINE COOLANT LEAK

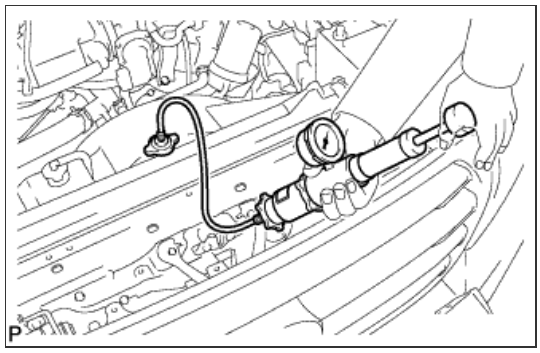
CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



8. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

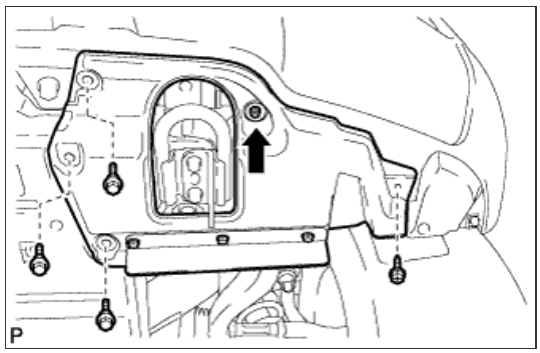
a. Install the engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

9. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



10. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

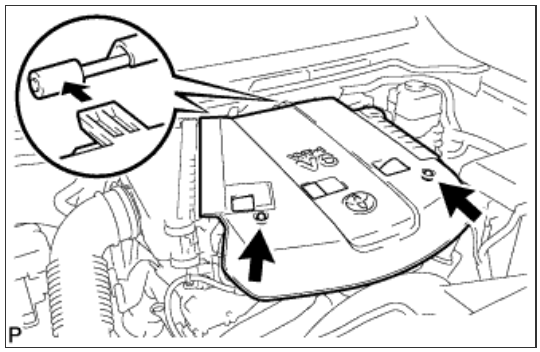
HINT:

Use the same procedures described for the LH side.

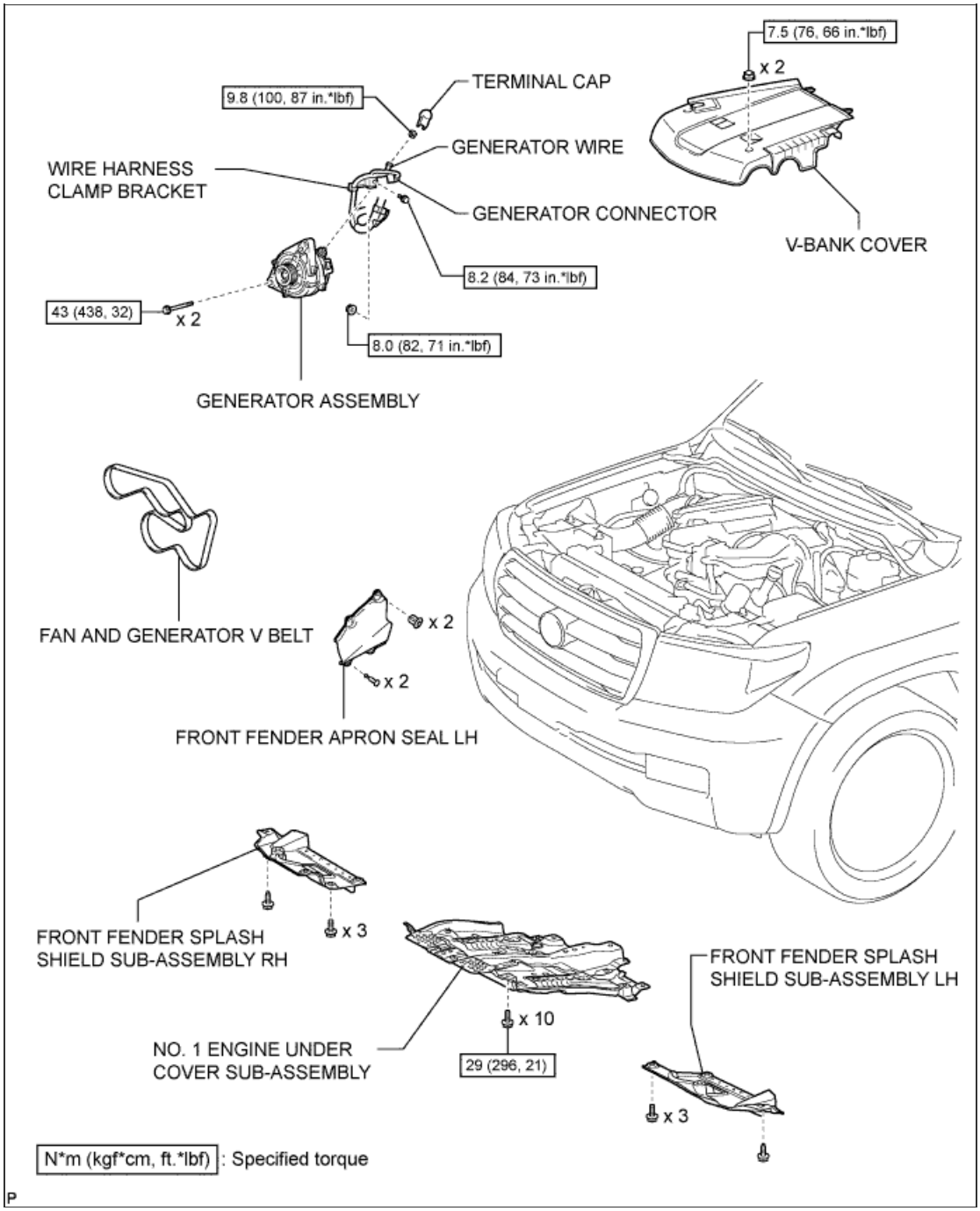
11. INSTALL V-BANK COVER

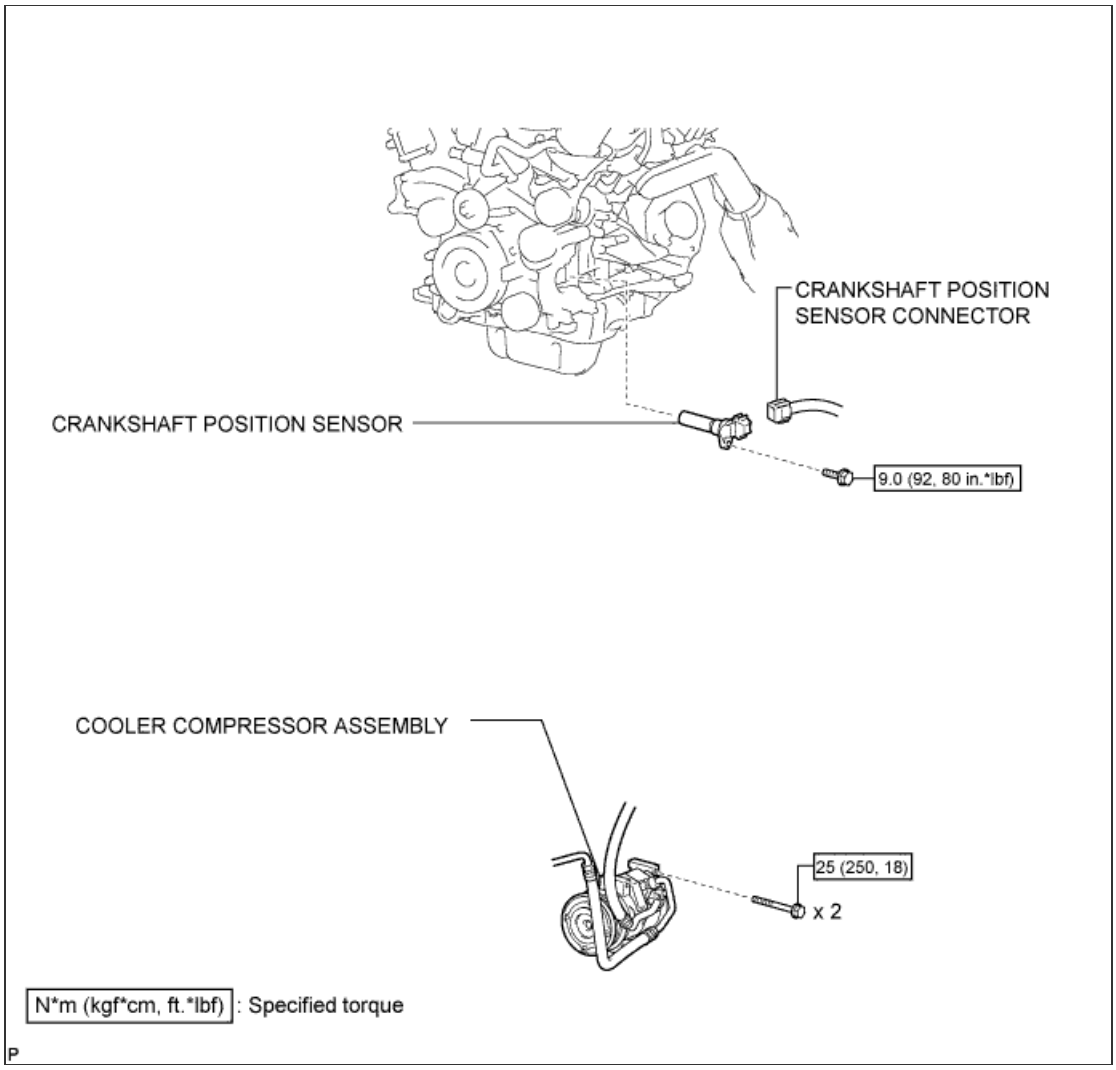
a. Install the V-bank cover with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



for Preparation [Click here]




CRANKSHAFT POSITION SENSOR CONNECTOR
CRANKSHAFT POSITION SENSOR
9.0 (92, 80 in.*lbf)
COOLER COMPRESSOR ASSEMBLY
25 (250, 18)
x 2
N*m (kgf*cm, ft.*lbf) : Specified torque
P

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here)

2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

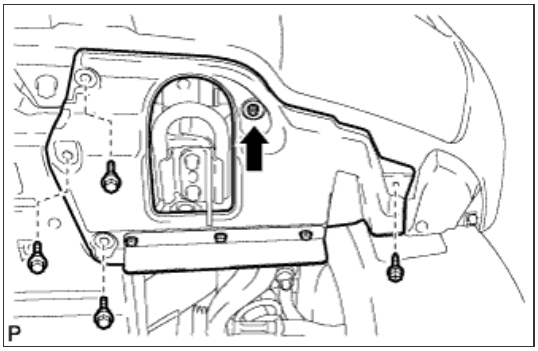
HINT:

Use the same procedures described for the LH side.

3. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

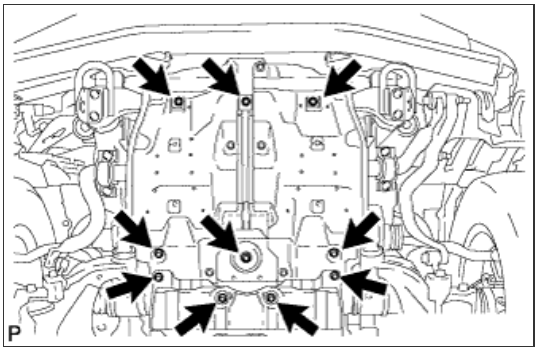
a. Remove the 3 bolts and screw.

b. urn the clip indicated by the arrow in the illustration to remove the fender splash shield.



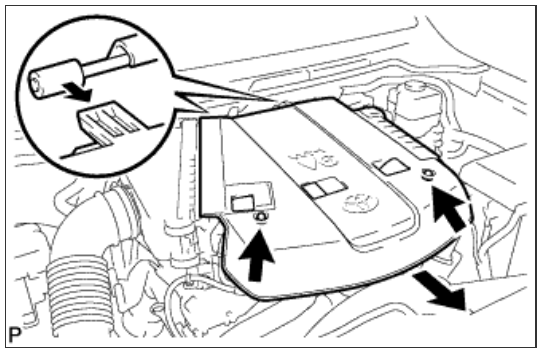
4. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



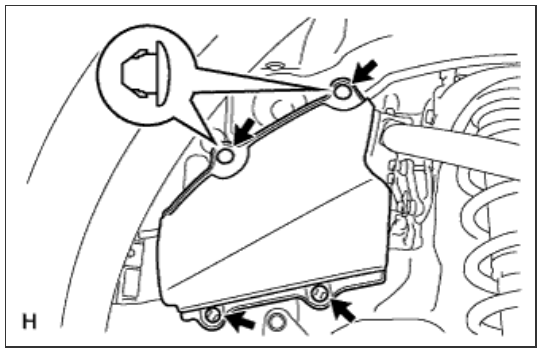
5. REMOVE V-BANK COVER

a. Remove the 2 cap nuts and bank cover.



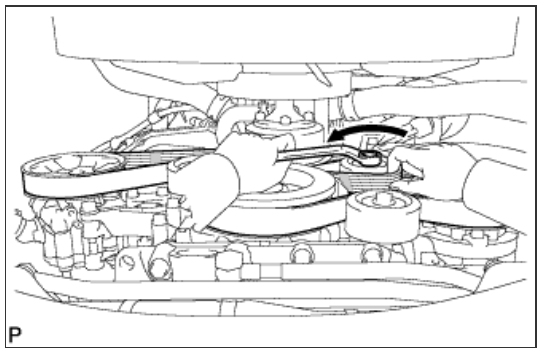
6. REMOVE FRONT FENDER APRON SEAL LH

a. Remove the clips and seal.



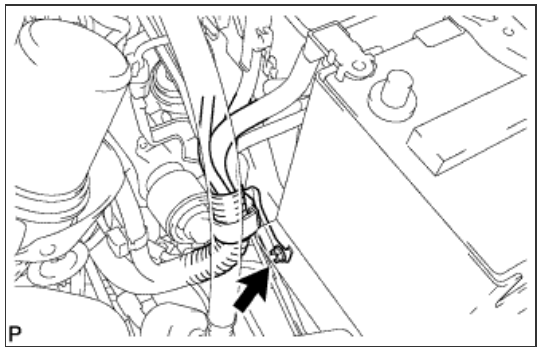
7. REMOVE FAN & GENERATOR V BELT

a. While releasing the belt tension by turning the belt tensioner counterclockwise, remove the fan and generator belt from the belt tensioner.



8. REMOVE GENERATOR ASSEMBLY

a. Remove the nut and disconnect the wire harness clamp bracket.



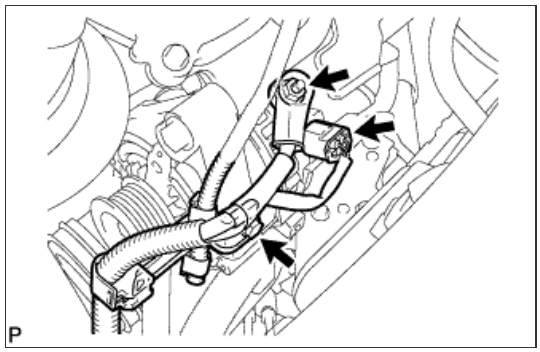
b. isconnect the generator connector.

c. Remove the terminal cap.

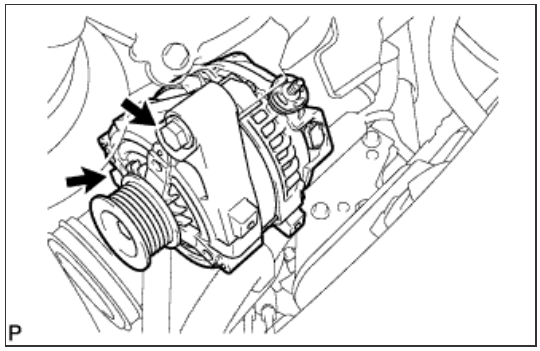
d. Remove the nut and disconnect the generator wire.

e. Remove the wire harness clamp.

f. Remove the bolt and disconnect the wire harness clamp bracket.



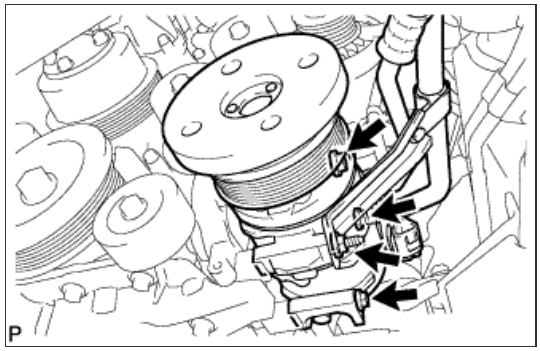
g. Remove the 2 bolts and generator.



9. DISCONNECT COOLER COMPRESSOR ASSEMBLY

a. isconnect the cooler compressor connector.

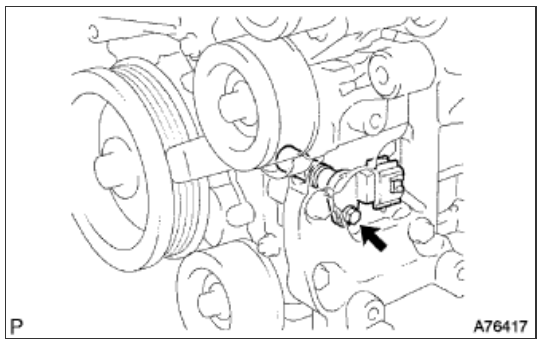
b. Remove the nut, 3 bolts and stud bolt, and disconnect the cooler compressor.



10. REMOVE CRANKSHAFT POSITION SENSOR

a. isconnect the sensor connector.

b. Remove the bolt and sensor.



for Preparation Click here

1. INSPECT CRANKSHAFT POSITION SENSOR

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	Cold	1 to 2 Ω
	ot	20 to 3225 Ω

NOTICE:

In the table above, the terms Cold and ot refer to the temperature of the sensor. Cold as appro i ately -10 to 50 C (1 to 122). ot as appro i ately 50 to 100 C (122 to 212).

If the resistance is not as specified, replace the sensor.

Component without harness connected:
(Crankshaft Position Sensor)



for Preparation Click here

1. INSTALL CRANKSHAFT POSITION SENSOR

a. Apply a light coat of engine oil to the O-ring of the sensor.

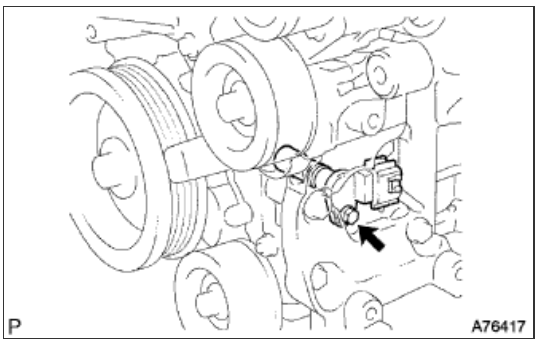
NOTICE:

- **When reusing the sensor, inspect the O-ring.**
- **If the O-ring has scratches or cuts, replace the sensor.**

b. Install the sensor with the bolt.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }

c. Connect the sensor connector.



2. CONNECT COOLER COMPRESSOR ASSEMBLY

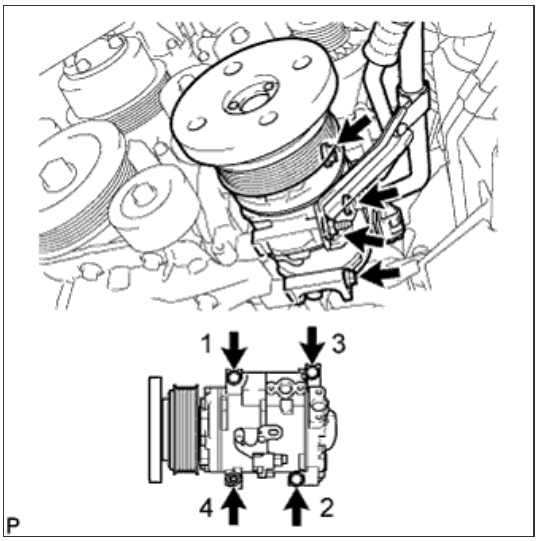
a. Fix the cooler compressor in place with the stud bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Install the cooler compressor with the nut and 3 bolts in several steps in the sequence shown in the illustration.

Torque:
24 N*m{ 250 kgf*cm , 18 ft.*lbf }

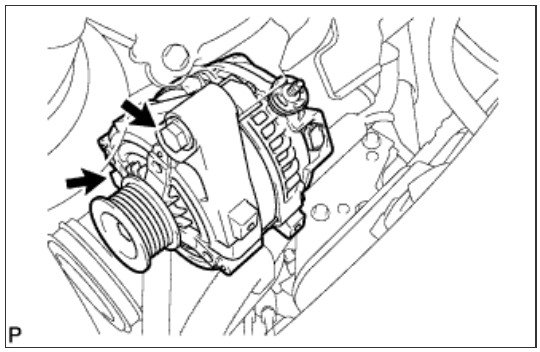
c. Connect the cooler compressor connector.



3. INSTALL GENERATOR ASSEMBLY

a. Install the generator with the 2 bolts.

Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }



b. Connect the wire harness clamp bracket with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

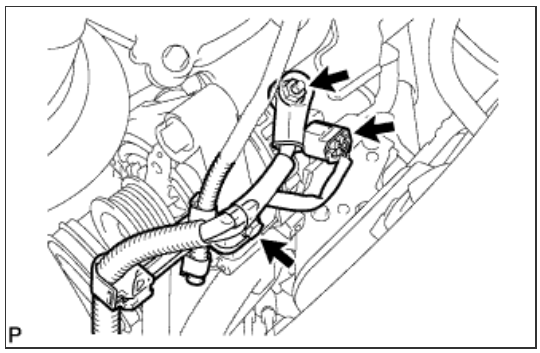
c. Install the wire harness clamp to the bracket.

d. Connect the generator wire with the nut.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }

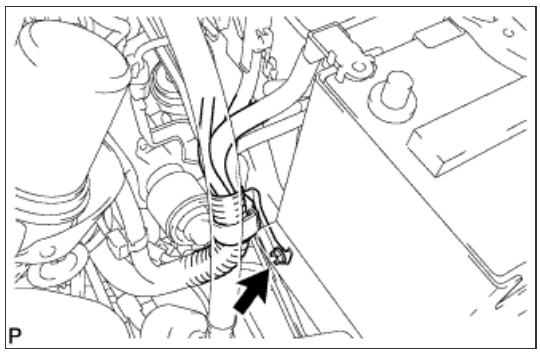
e. Install the terminal cap.

f. Connect the generator connector.



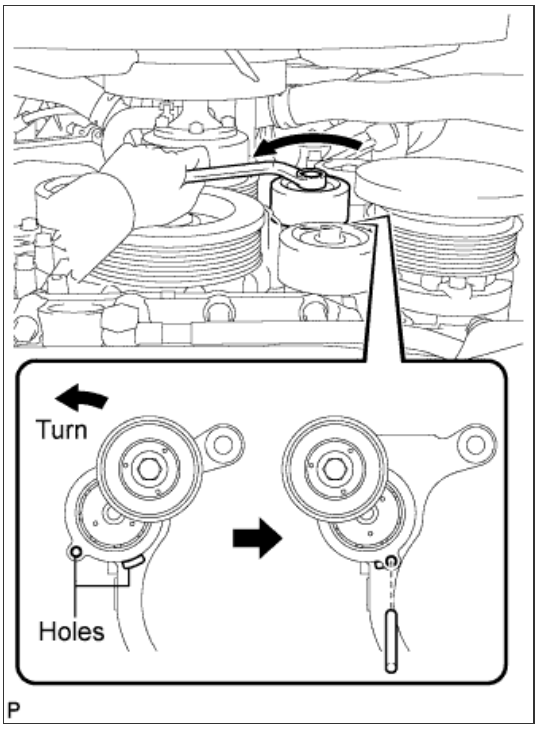
g. Connect the wire harness clamp bracket with the nut.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }



4. INSTALL FAN & GENERATOR V BELT

a. While turning the belt tensioner counterclockwise, align the holes, and then insert a bar of φ6 mm (0.236 in.) into the holes to fix the belt tensioner in place.



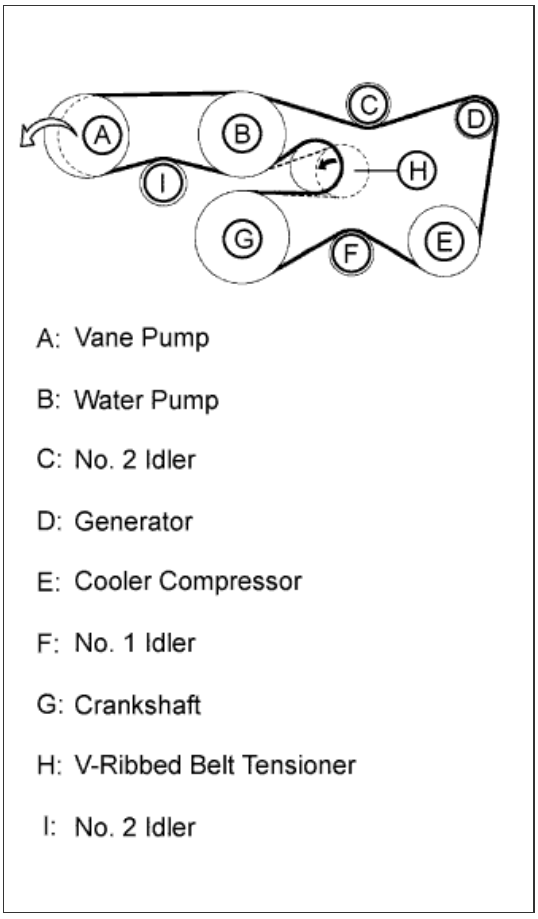
b. Install the fan and generator V belt.

HINT:

If it is hard to install the fan and generator V belt, perform the following procedures.

1. **Put the fan and generator V belt on all parts except the vane pump, as shown in the illustration.**
2. **While releasing the belt tension by turning the belt tensioner counterclockwise, put the fan and generator V belt on the vane pump.**

c. While turning the belt tensioner counterclockwise, remove the bar.



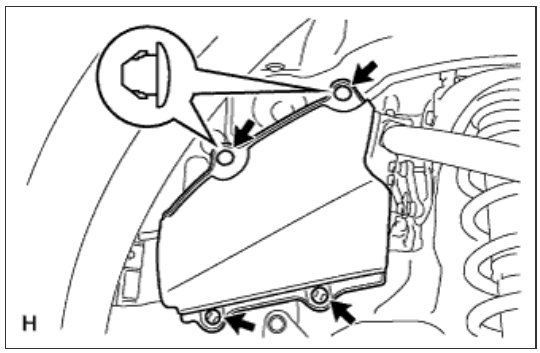
5. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

6. INSTALL FRONT FENDER APRON SEAL LH

a. Install the seal with the 4 clips.



7. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

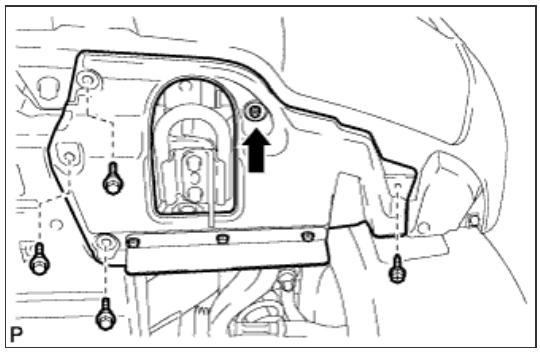
HINT:

Use the same procedures described for the LH side.

8. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

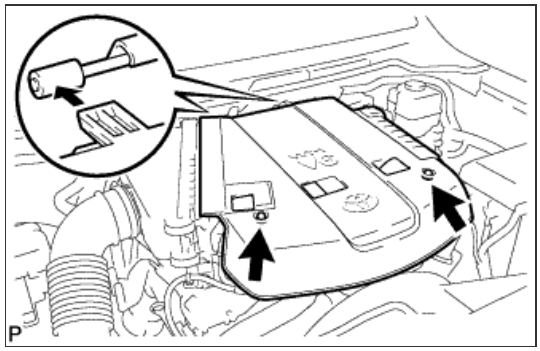
b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



9. INSTALL V-BANK COVER

a. Install the V-bank cover with the 2 cap nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

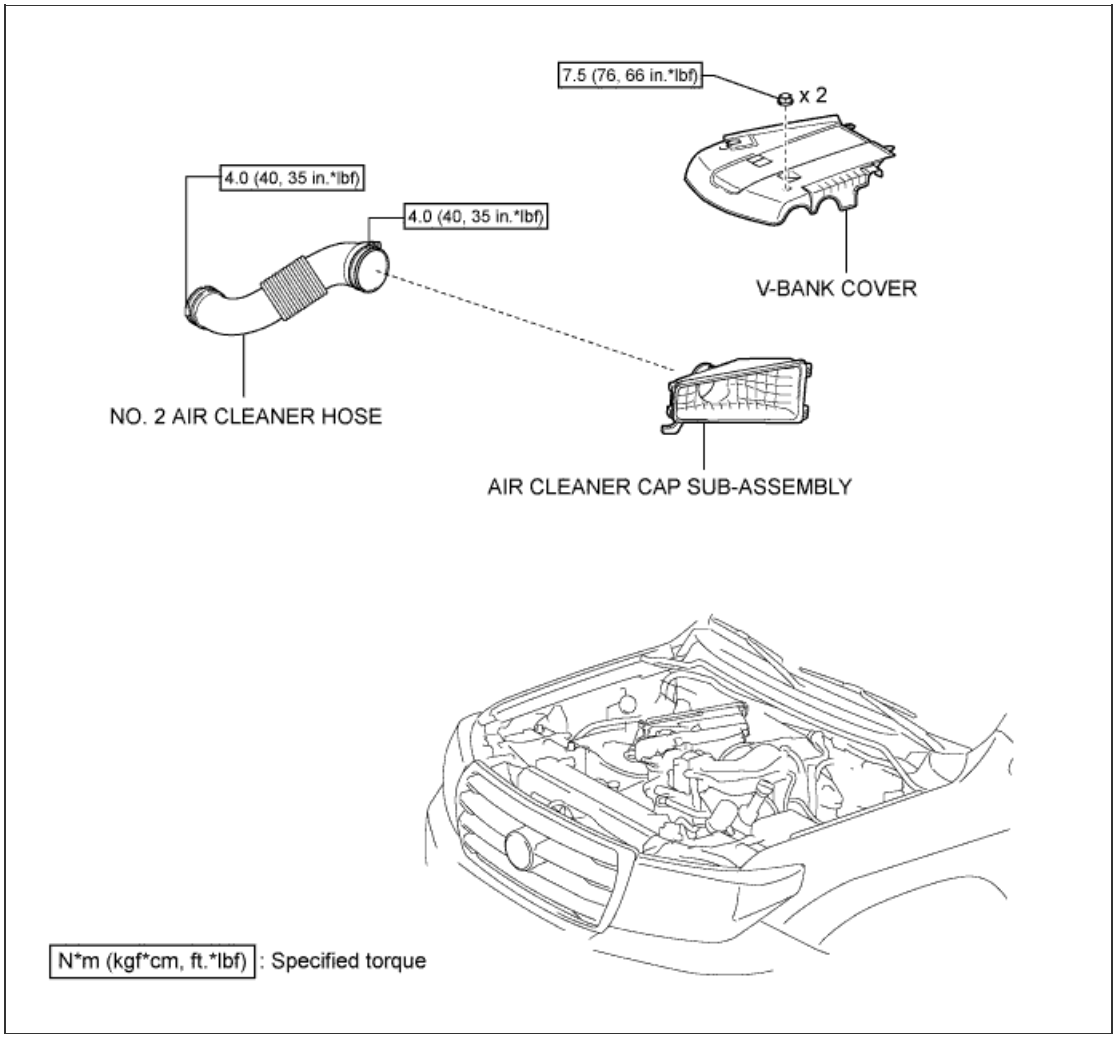


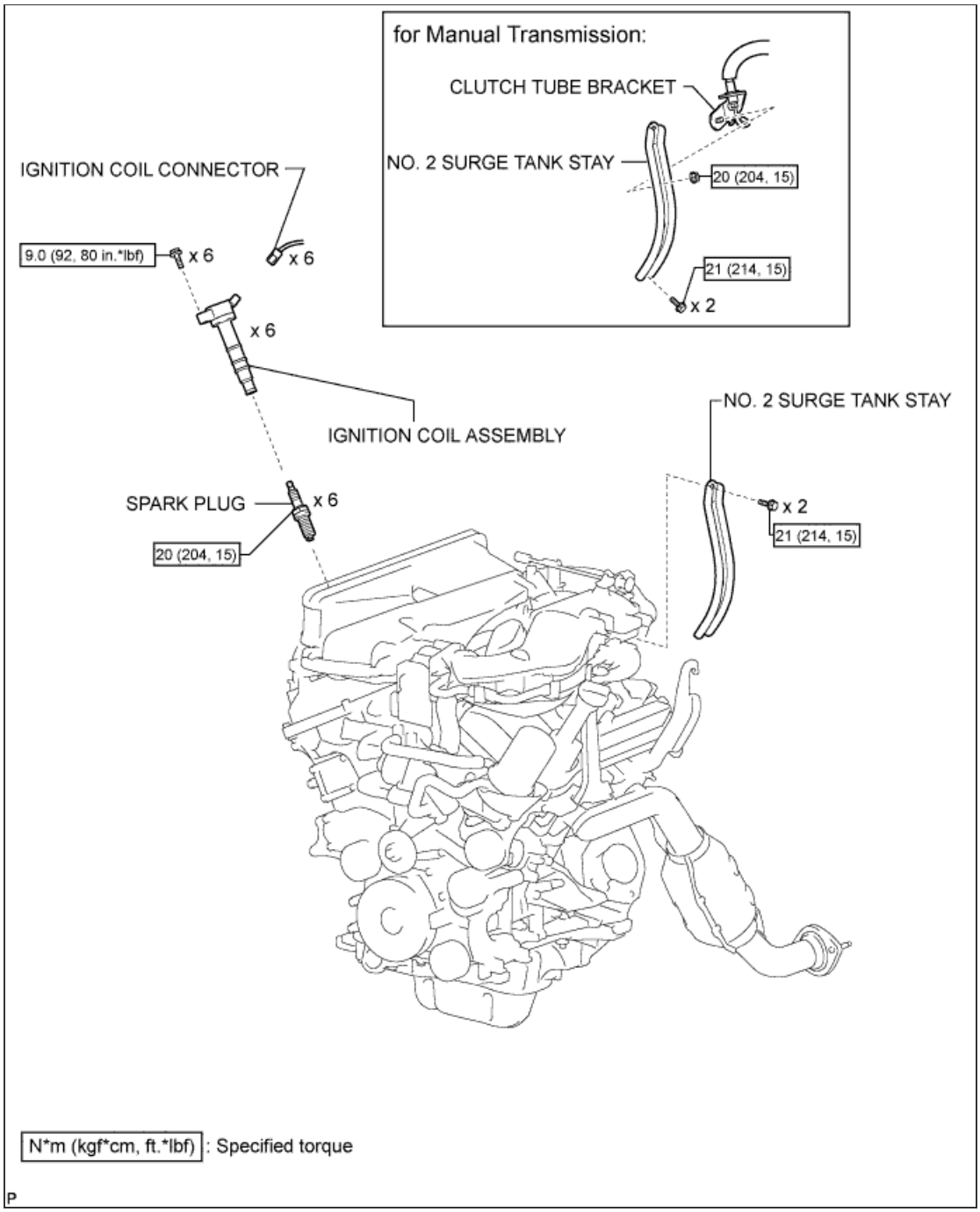
10. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

for Preparation Click here

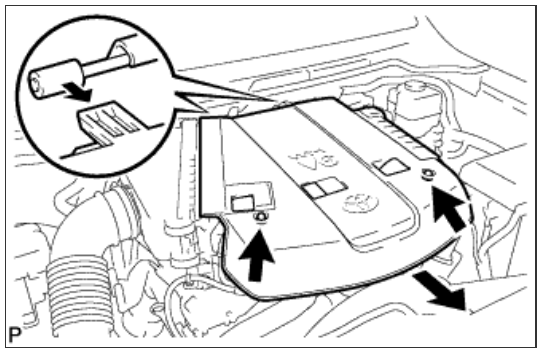



for Manual Transmission:
CLUTCH TUBE BRACKET
NO. 2 SURGE TANK STAY
20 (204, 15)
21 (214, 15)
x 2
IGNITION COIL CONNECTOR
9.0 (92, 80 in.*lbf)
x 6
x 6
x 6
IGNITION COIL ASSEMBLY
NO. 2 SURGE TANK STAY
SPARK PLUG
x 6
20 (204, 15)
x 2
21 (214, 15)
N*m (kgf*cm, ft.*lbf) : Specified torque
P

for Preparation Click here

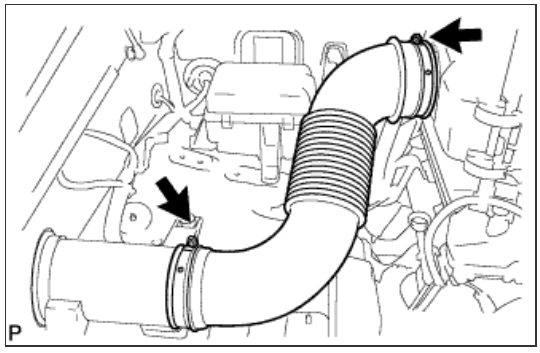
1. REMOVE V-BANK COVER

a. Remove the 2 cap nuts and V-bank cover.



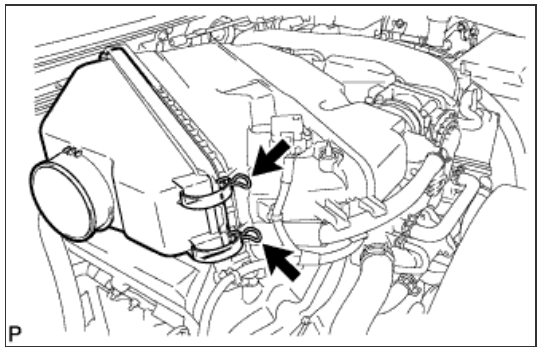
2. REMOVE NO. 2 AIR CLEANER HOSE

a. oosen the 2 hose clamps and remove the a cleaner hose.



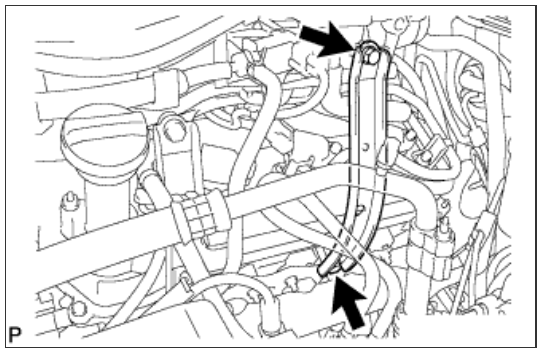
3. REMOVE AIR CLEANER CAP SUB-ASSEMBLY

a. Unfasten the 2 hook clamps and then remove the a cleaner cap.

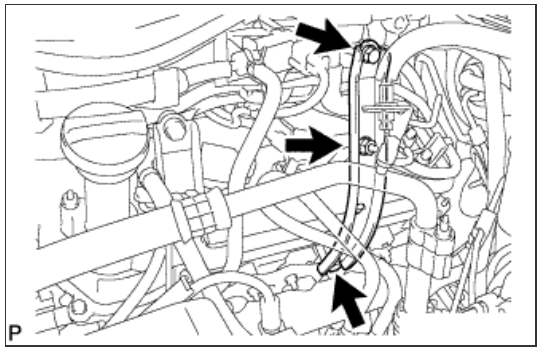


4. REMOVE NO. 2 SURGE TANK STAY

a. for Automat dTransm ss on:
Remove the 2 bolts and o. 2 surge tank stay.



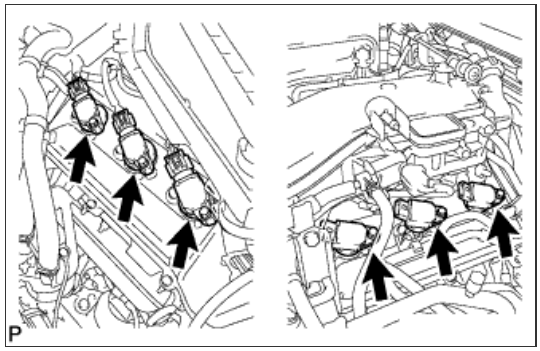
b. for Manual Transm ss on:
Remove the 2 bolts, nut and o. 2 surge tank stay.



5. REMOVE IGNITION COIL ASSEMBLY

a. D sconnect the 6 n t on co connectors.

b. Remove the 6 bolts and 6 n t on co s.



6. REMOVE SPARK PLUG

a. Remove the 6 spark plugs.

for Preparation Click here

1. INSTALL SPARK PLUG

a. Install the 6 spark plugs.

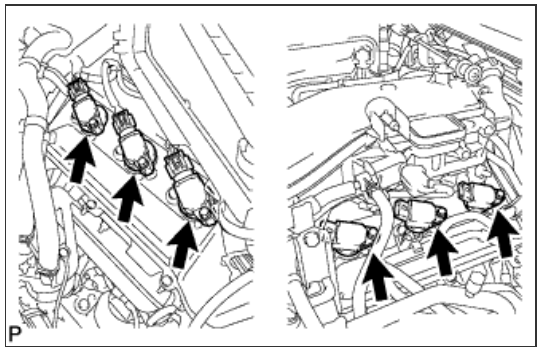
Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

2. INSTALL IGNITION COIL ASSEMBLY

a. Install the 6 ignition coils with the 6 bolts.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }

b. Connect the 6 ignition coil connectors.



3. INSTALL NO. 2 SURGE TANK STAY

a. for Manual Transmission:

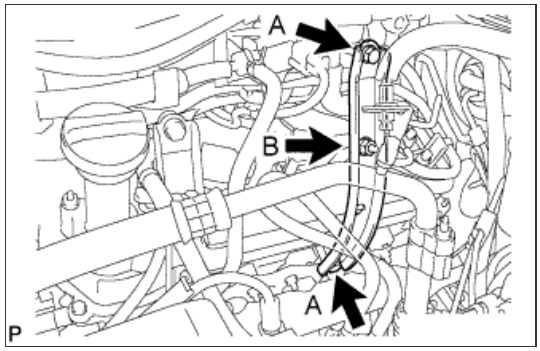
i. Temporarily install the No. 2 surge tank stay with the 2 bolts labeled A and nut labeled B.

ii. Tighten the bolts labeled A.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

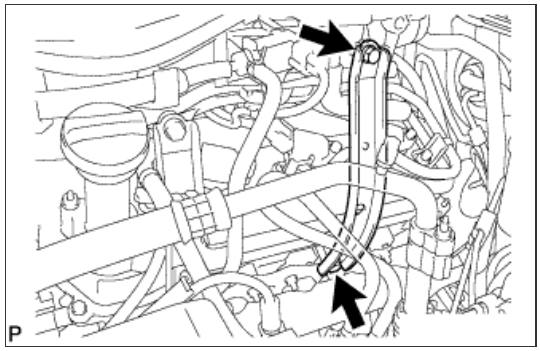
iii. Tighten the nut labeled B.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }



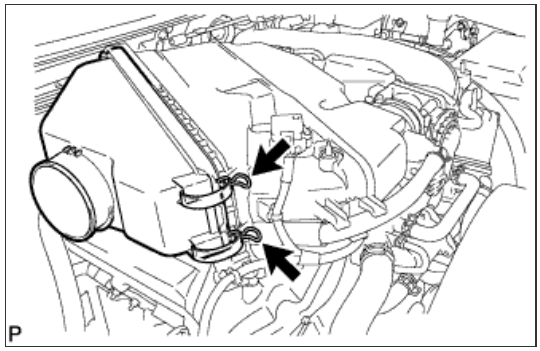
b. for Automatic Transmission:
Install the No. 2 surge tank stay with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



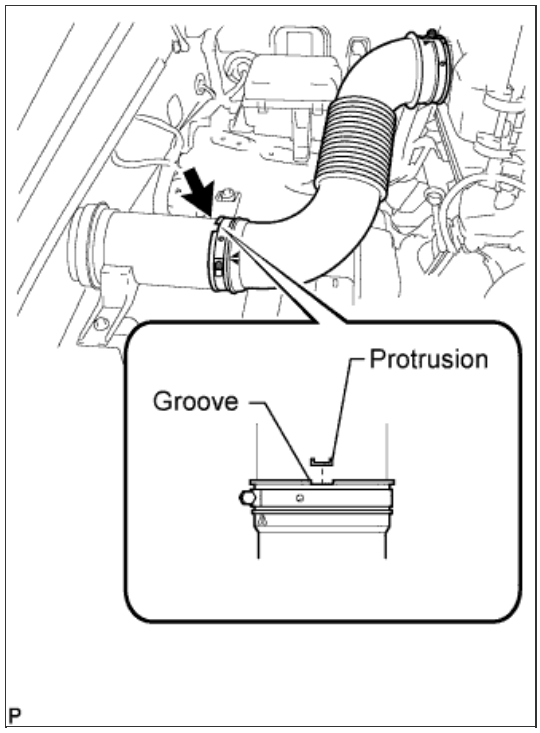
4. INSTALL AIR CLEANER CAP SUB-ASSEMBLY

a. Install the air cleaner cap and fasten the 2 hook clamps.



5. INSTALL NO. 2 AIR CLEANER HOSE

a. Align the protrusion of the pre-cleaner with the groove of the No. 2 air cleaner hose as shown in the illustration.

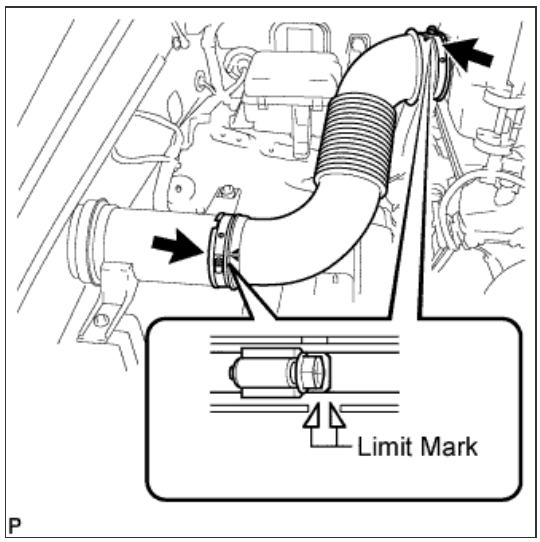


b. Tighten the 2 hose clamps.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }

HINT:

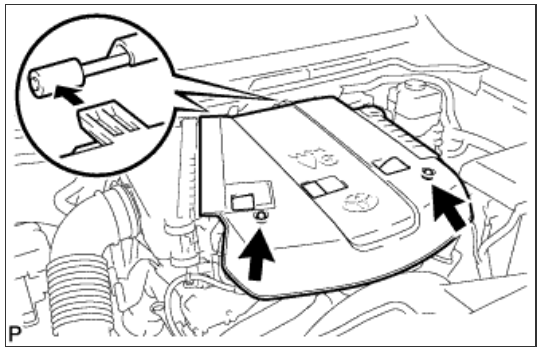
Tighten the clamp until the end of the clamp band is within both limit marks.



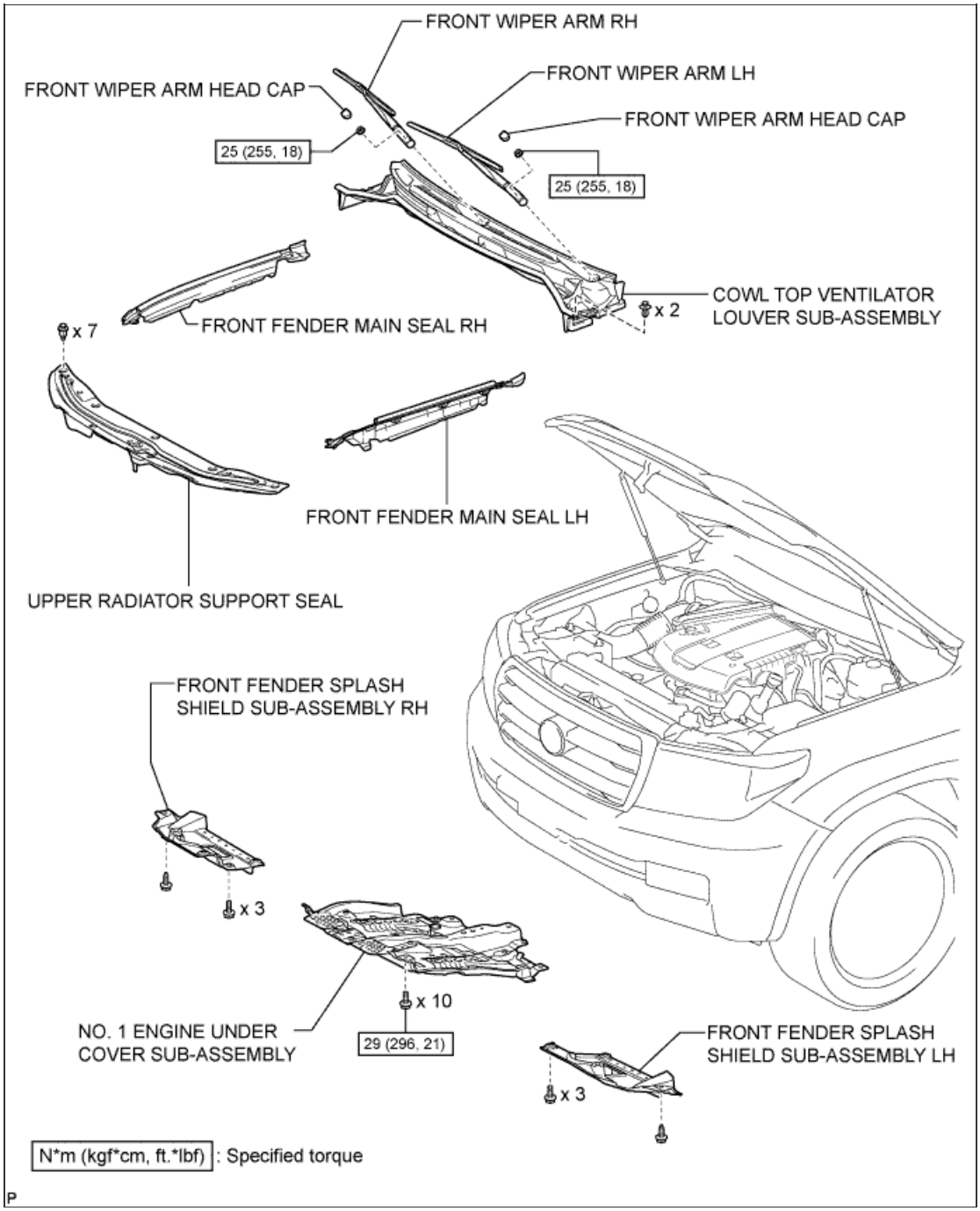
6. INSTALL V-BANK COVER

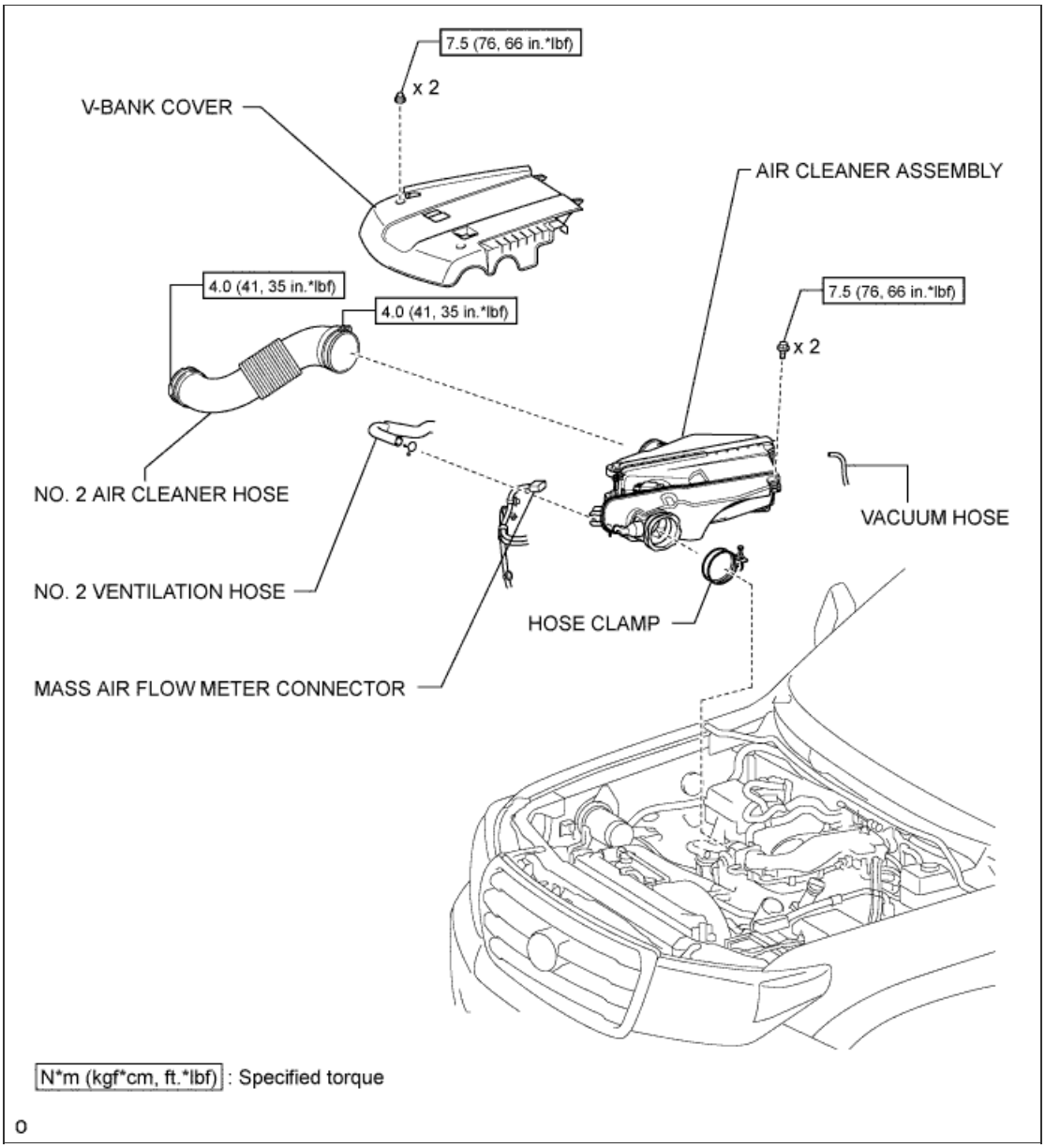
a. Install the V-bank cover with the 2 cap nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

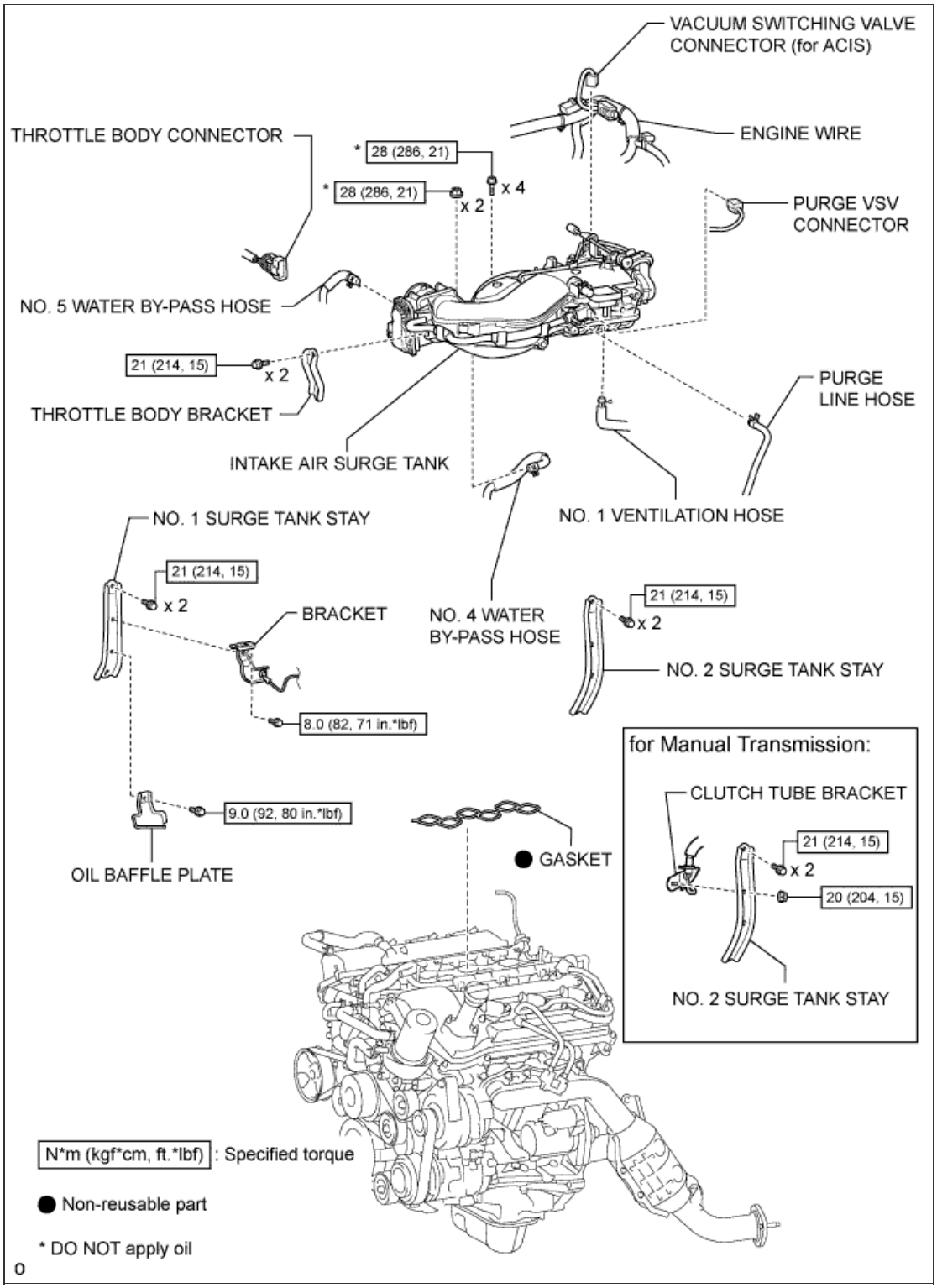


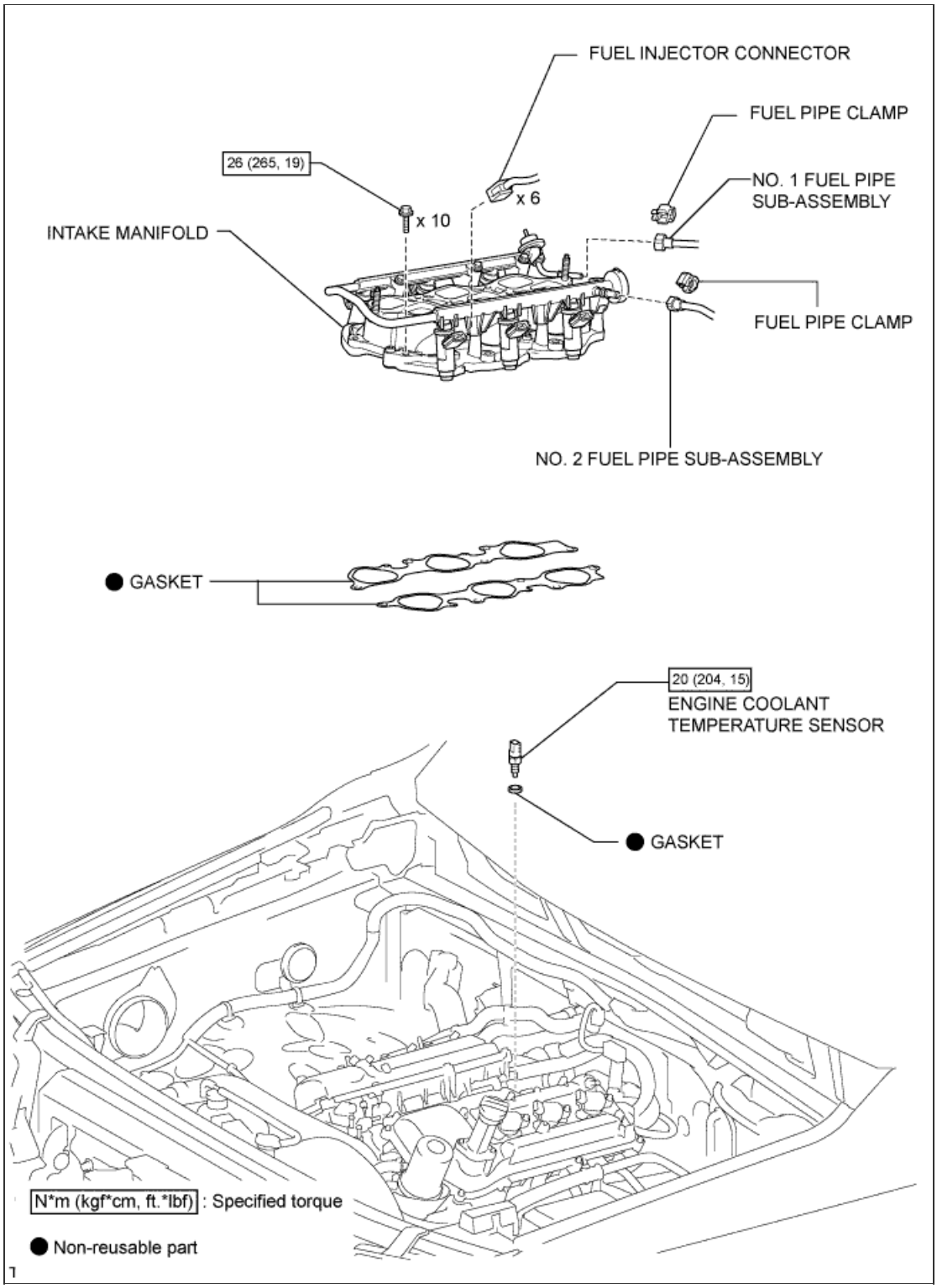
for Preparation Click here




7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER
AIR CLEANER ASSEMBLY
4.0 (41, 35 in.*lbf)
4.0 (41, 35 in.*lbf)
7.5 (76, 66 in.*lbf)
x 2
NO. 2 AIR CLEANER HOSE
VACUUM HOSE
NO. 2 VENTILATION HOSE
HOSE CLAMP
MASS AIR FLOW METER CONNECTOR
N*m (kgf*cm, ft.*lbf) : Specified torque

o


VACUUM SWITCHING VALVE CONNECTOR (for ACIS)
ENGINE WIRE
THROTTLE BODY CONNECTOR
* 28 (286, 21)
* 28 (286, 21)
x 2
x 4
PURGE VSV CONNECTOR
NO. 5 WATER BY-PASS HOSE
21 (214, 15)
x 2
THROTTLE BODY BRACKET
PURGE LINE HOSE
INTAKE AIR SURGE TANK
NO. 1 VENTILATION HOSE
NO. 1 SURGE TANK STAY
21 (214, 15)
x 2
BRACKET
NO. 4 WATER BY-PASS HOSE
21 (214, 15)
x 2
NO. 2 SURGE TANK STAY
8.0 (82, 71 in.*lbf)
for Manual Transmission:
CLUTCH TUBE BRACKET
21 (214, 15)
x 2
20 (204, 15)
NO. 2 SURGE TANK STAY
9.0 (92, 80 in.*lbf)
OIL BAFFLE PLATE
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
* DO NOT apply oil


FUEL INJECTOR CONNECTOR
FUEL PIPE CLAMP
26 (265, 19)
x 6
x 10
NO. 1 FUEL PIPE SUB-ASSEMBLY
INTAKE MANIFOLD
FUEL PIPE CLAMP
NO. 2 FUEL PIPE SUB-ASSEMBLY
GASKET
20 (204, 15)
ENGINE COOLANT TEMPERATURE SENSOR
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

ENGINE COOLANT TEMPERATURE SENSOR > REMOVAL

for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

a. Discharge the fuel system pressure (Click here).

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

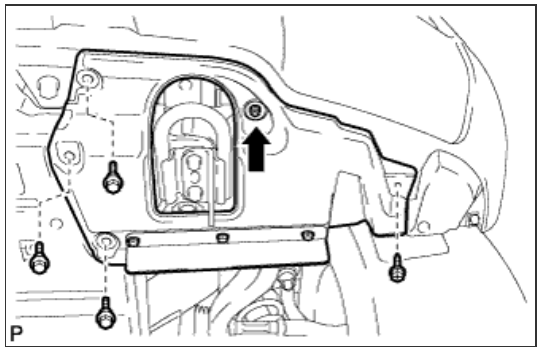
HINT:

Use the same procedures described for the LH side.

4. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

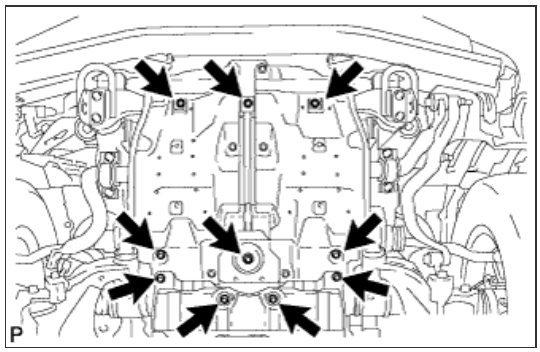
a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



5. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



6. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug and 2 cylinder block drain cock plugs.

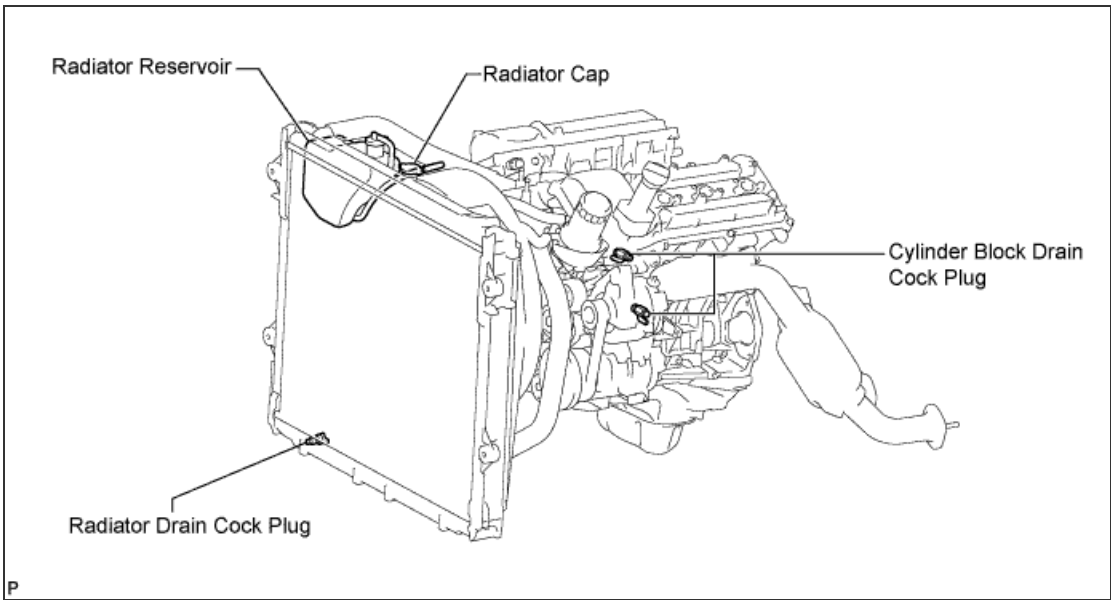
b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Tighten the 2 cylinder block drain cock plugs.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



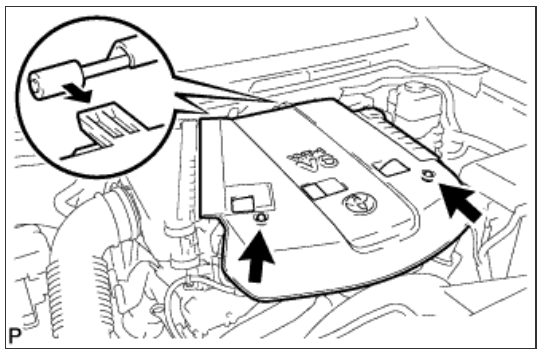
d. Tighten the radiator drain cock plug by hand.

7. REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Remove the cowl top ventilator louver (Click here).

8. REMOVE V-BANK COVER

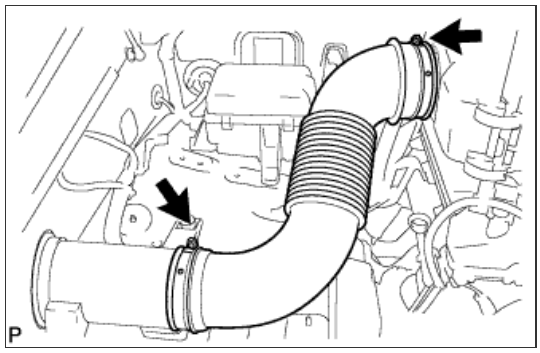
a. Remove the 2 nuts and V-bank cover.



9. REMOVE NO. 2 AIR CLEANER HOSE

a. Loosen the 2 hose clamps and remove the air cleaner hose.

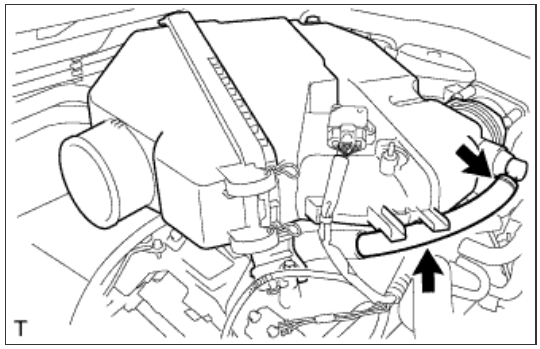
a. Loosen the 2 hose clamps and remove the air cleaner hose.



10. REMOVE AIR CLEANER ASSEMBLY

a. Disconnect the No. 2 ventilation hose.

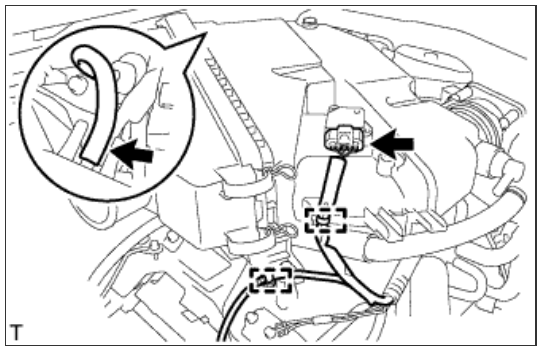
b. Detach the hose clamp.



c. Disconnect the vacuum hose.

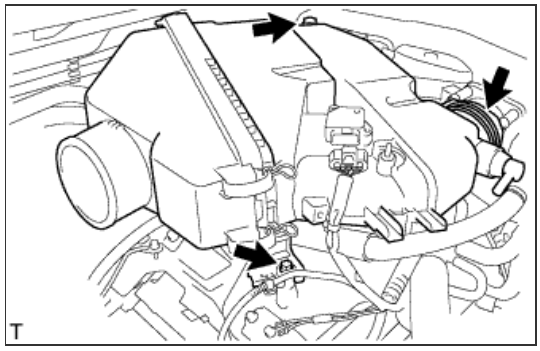
d. Disconnect the MAF meter connector.

e. Using a clip remover, detach the 2 wire harness clamps.



f. Loosen the hose clamp.

g. Remove the 2 bolts and air cleaner assembly.

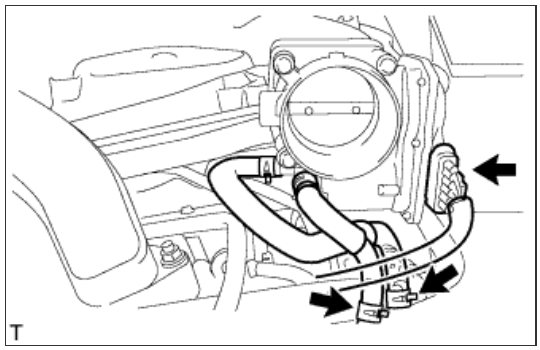


11. REMOVE INTAKE AIR SURGE TANK

a. Disconnect the throttle body connector.

b. Disconnect the No. 4 water by-pass hose.

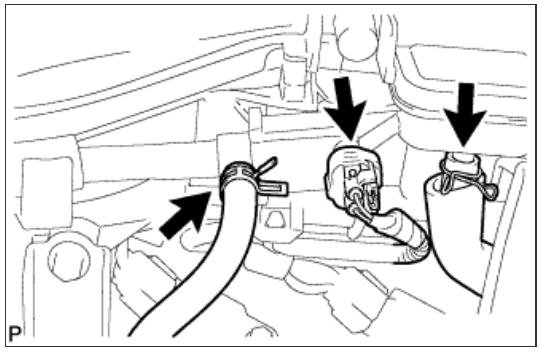
c. Disconnect the No. 5 water by-pass hose.



d. Disconnect the purge line hose.

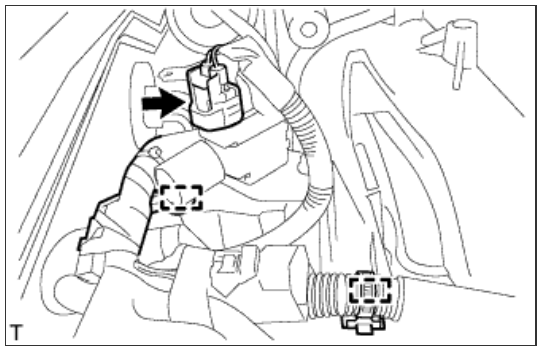
e. Disconnect the purge VSV connector.

f. Disconnect the No. 1 ventilation hose.

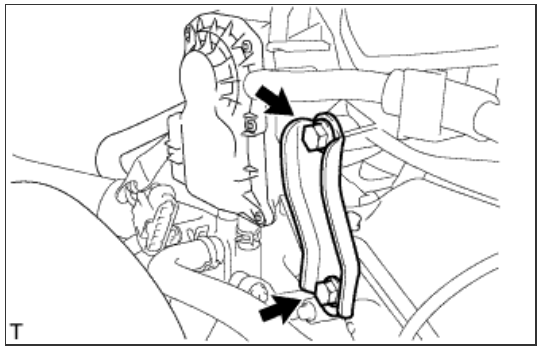


g. Disconnect the vacuum switching valve (for ACIS) connector.

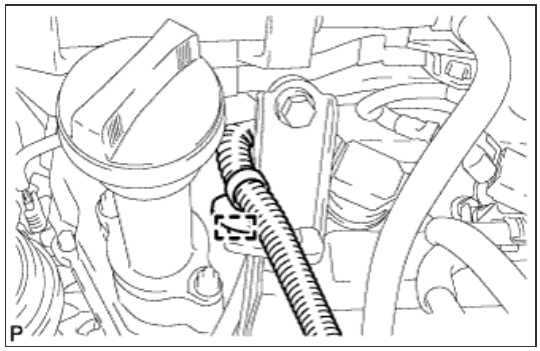
h. Using a clip remover, detach the 2 wire harness clamps.



i. Remove the 2 bolts and throttle body bracket.

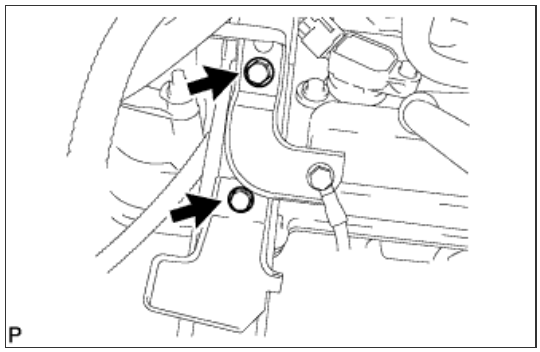


j. Using a clip remover, detach the wire harness clamp.

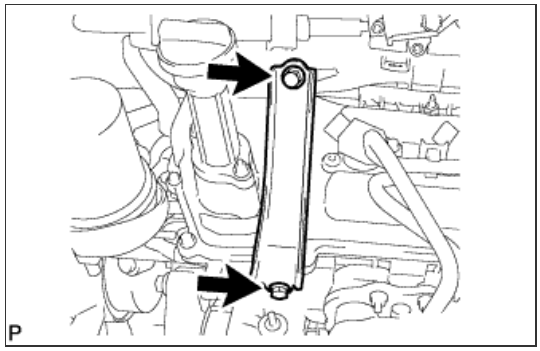


k. Remove the bolt and bracket from the No. 1 surge tank stay.

l. Remove the bolt and oil baffle plate.

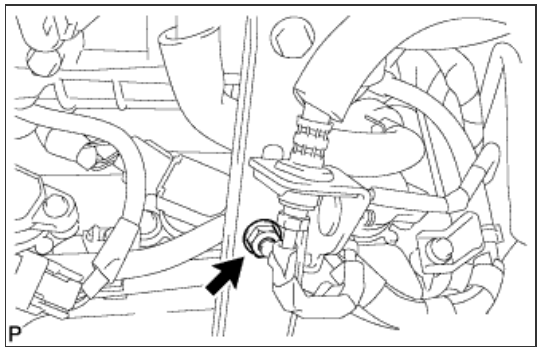


m. Remove the 2 bolts and No. 1 surge tank stay.

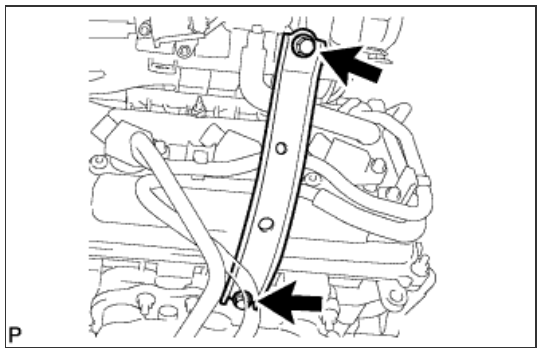


n. for Manual Transmission:

i. Remove the nut.

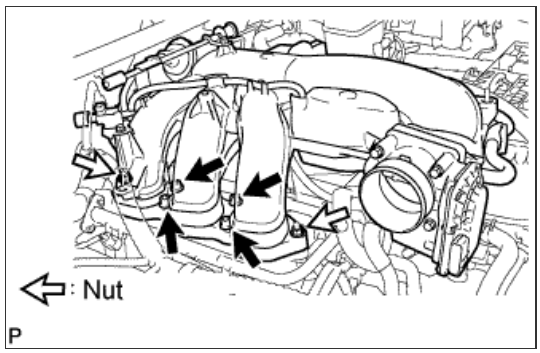


o. Remove the 2 bolts and No. 2 surge tank stay.



p. Remove the 2 nuts.

q. Using an 8 mm hexagon wrench, remove the 4 bolts. Then remove the intake air surge tank and gasket.



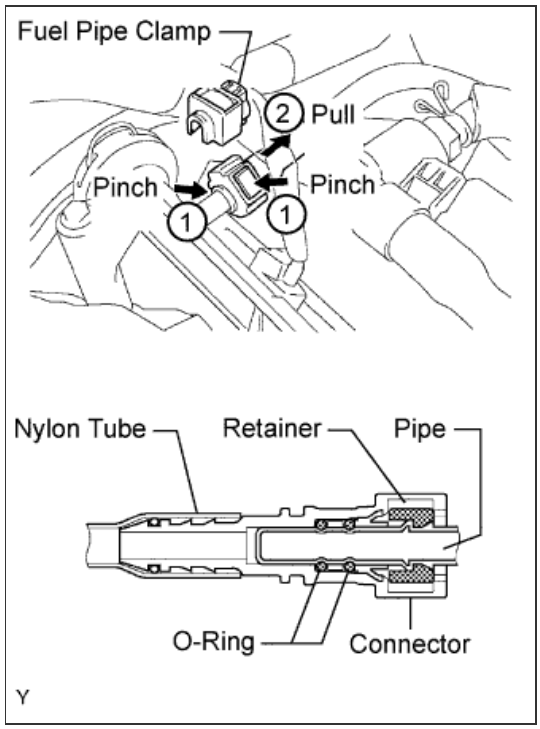
12. DISCONNECT NO. 1 FUEL PIPE SUB-ASSEMBLY

a. Remove the fuel pipe clamp.

b. Pinch the tube connector, and then pull the fuel pipe out of the delivery pipe as shown in the illustration.

NOTICE:

- **Remove any dirt and foreign objects from the fuel tube connector before performing this work.**
- **Do not allow any scratches or foreign objects on the parts when disconnecting, as the fuel tube connector has the O-ring that seals the pipe.**
- **Perform this work by hand. Do not use any tools.**
- **Do not forcibly bend, twist or turn the nylon tube.**
- **Keep the plug free from foreign objects.**
- **Protect the disconnected part by covering it with a plastic bag after disconnecting the fuel tube.**
- **If the fuel tube connector and pipe are stuck, push and pull to release them.**



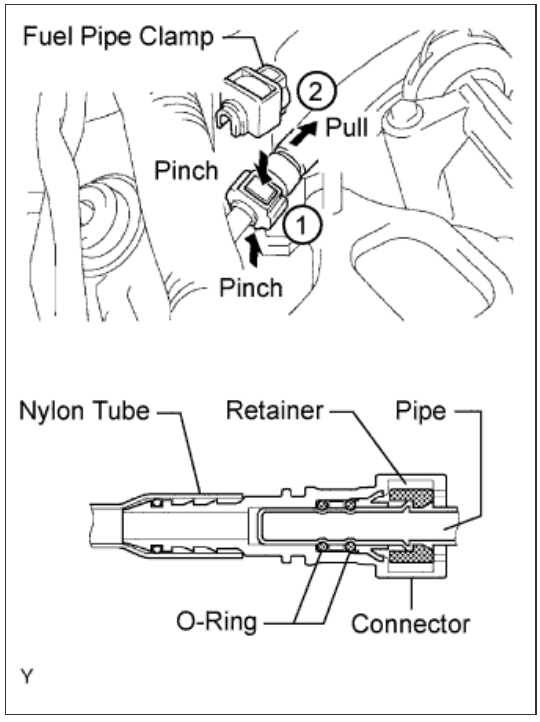
13. DISCONNECT NO. 2 FUEL PIPE SUB-ASSEMBLY

a. Remove the fuel pipe clamp.

b. Pinch the tube connector, and then pull the fuel pipe out of the pipe as shown in the illustration.

NOTICE:

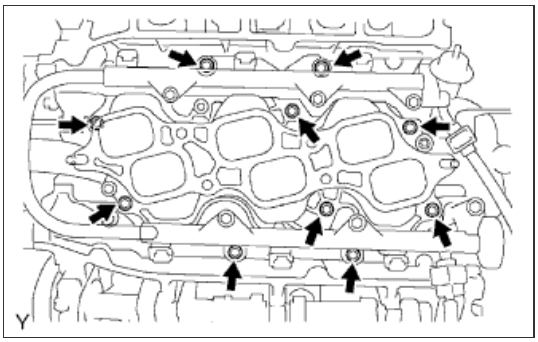
- **Remove any dirt and foreign objects from the fuel tube connector before performing this work.**
- **Do not allow any scratches or foreign objects on the parts when disconnecting, as the fuel tube connector has the O-ring that seals the pipe.**
- **Perform this work by hand. Do not use any tools.**
- **Do not forcibly bend, twist or turn the nylon tube.**
- **Keep the plug free from foreign objects.**
- **Protect the disconnected part by covering it with a plastic bag after disconnecting the fuel tube.**
- **If the fuel tube connector and pipe are stuck, push and pull to release them.**



14. REMOVE INTAKE MANIFOLD

a. Disconnect the 6 fuel injector connectors.

b. Remove the 10 bolts, intake manifold and 2 gaskets.

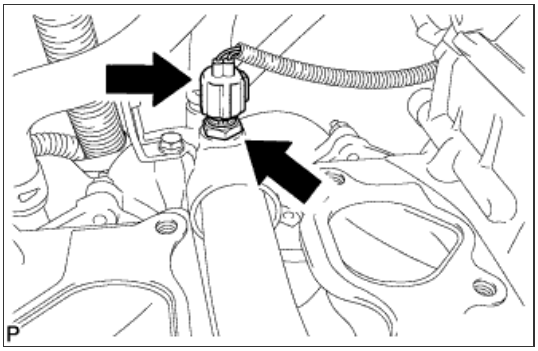


15. REMOVE ENGINE COOLANT TEMPERATURE SENSOR

a. Disconnect the sensor connector.

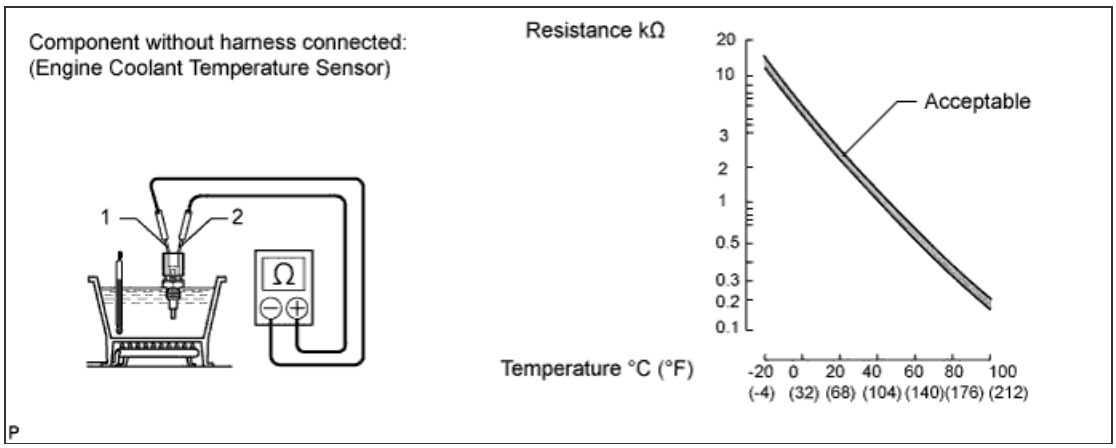
b. Using a 19 mm deep socket wrench, remove the sensor.

c. Remove the gasket from the sensor.



for Preparation Click here

1. INSPECT ENGINE COOLANT TEMPERATURE SENSOR



a. Partially immerse the sensor in water and warm up the water.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	Approx. 20°C (68°F)	2.32 to 2.59 kΩ
	Approx. 80°C (176°F)	0.310 to 0.326 kΩ

If the result is not as specified, replace the sensor.

NOTICE:

When checking the sensor in water, keep the terminals dry. After the check, wipe the sensor dry.

for Preparation Click here

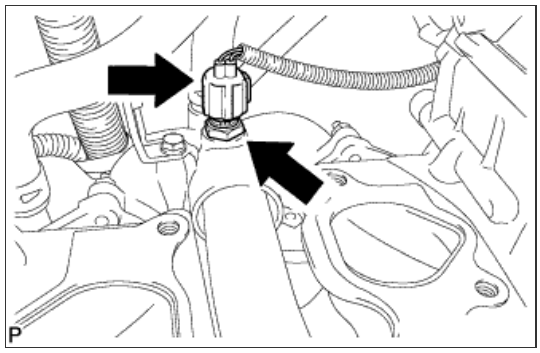
1. INSTALL ENGINE COOLANT TEMPERATURE SENSOR

a. Install a new gasket to the sensor.

b. Using a 19 mm deep socket wrench, install the sensor.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

c. Connect the sensor connector.



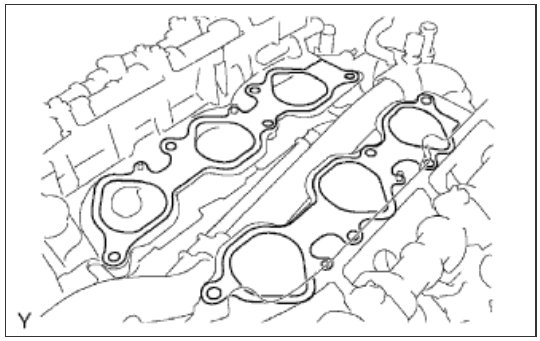
2. INSTALL INTAKE MANIFOLD

a. Set a new gasket on each cylinder head.

NOTICE:

- **Align the port holes of the gasket and cylinder head.**
- **Be careful of the installation direction.**

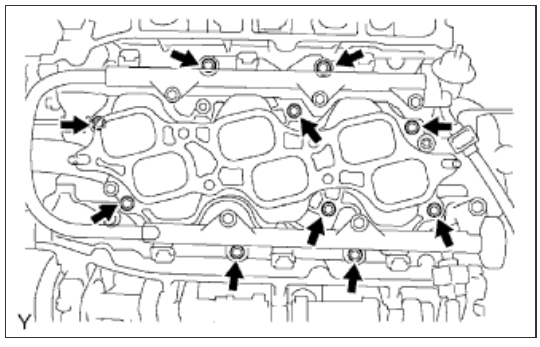
b. Set the intake manifold on the cylinder heads.



c. Install and uniformly tighten the 10 bolts in several passes.

Torque:
26 N*m{ 265 kgf*cm , 19 ft.*lbf }

d. Connect the 6 fuel injector connectors.



3. INSTALL INTAKE AIR SURGE TANK

NOTICE:
Do not apply oil to the bolts and nuts listed below: :

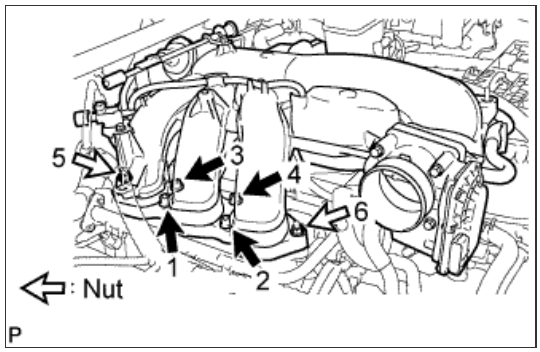
Oil Application Prohibited Bolt/Nut
Bolt for surge tank and intake manifold
Nut for surge tank and intake manifold

a. Install a new gasket to the intake air surge tank.

b. Using an 8 mm hexagon wrench, install the intake air surge tank with the 4 bolts

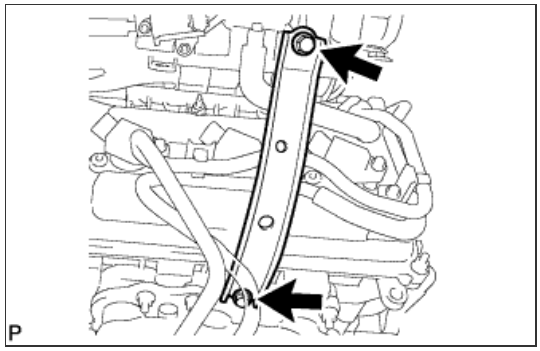
and 2 nuts in the order shown in the illustration.

Torque:
28 N*m{ 286 kgf*cm , 21 ft.*lbf }



c. Install the No. 2 surge tank stay with the 2 bolts.

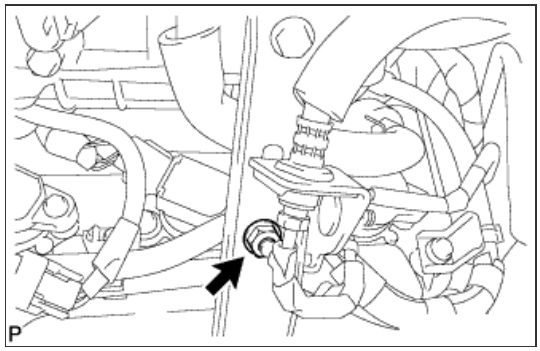
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



d. for Manual Transmission:

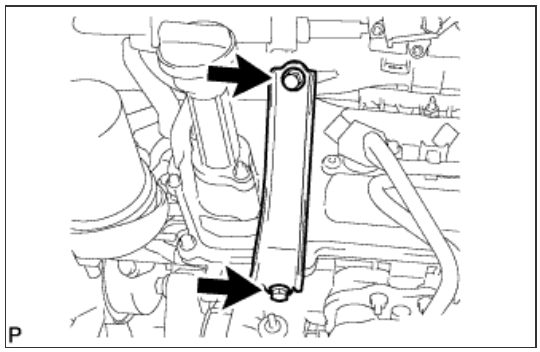
i. Install the bracket to the No. 2 surge tank stay with the nut.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }



e. Install the No. 1 surge tank stay with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

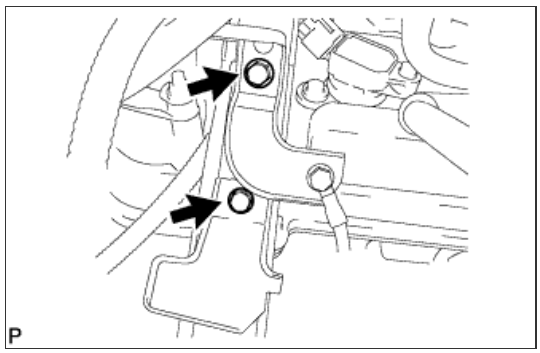


f. Install the oil baffle plate with the bolt.

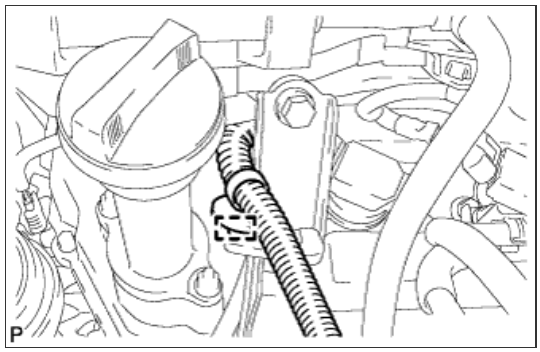
Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }

g. Install the bracket to the No. 1 surge tank stay with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

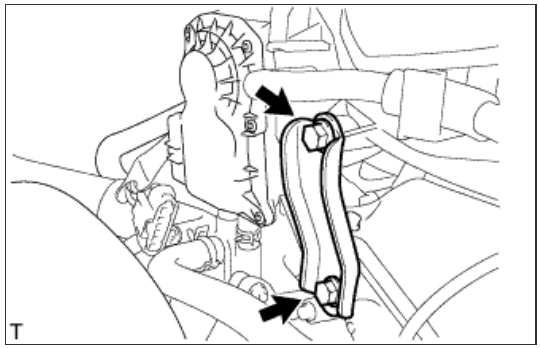


h. Attach the wire harness clamp.



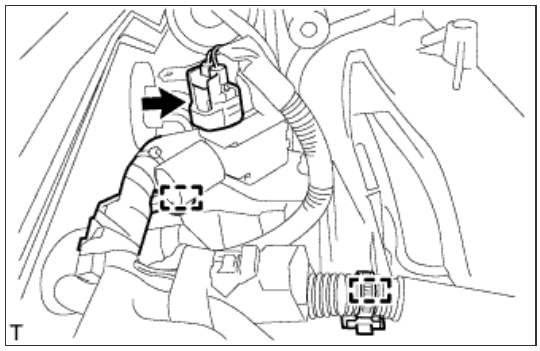
i. Install the throttle body bracket with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



j. Connect the vacuum switching valve (for ACIS) connector.

k. Attach the 2 wire harness clamps.



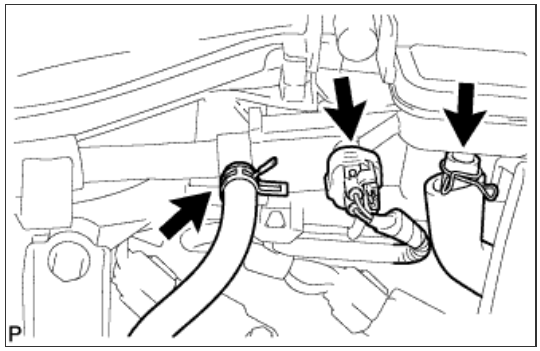
l. Connect the No. 1 ventilation hose.

m. Connect the purge VSV connector.

n. Connect the purge line hose.

HINT:

Connect the hose so that the direction of the hose clamp is as indicated in the illustration.

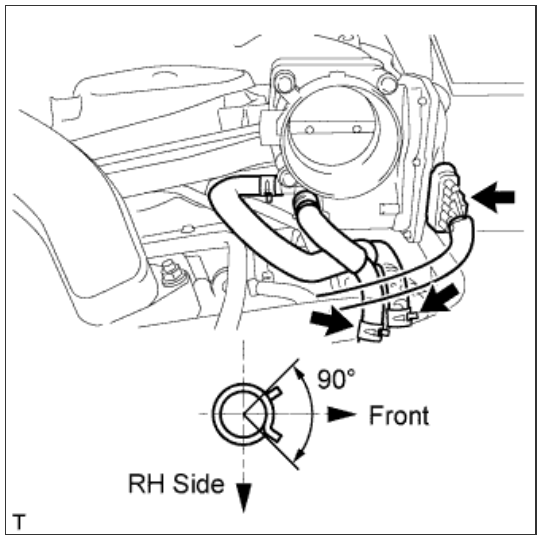


o. Connect the No. 4 and No. 5 water by-pass hose.

HINT:

Connect the hoses so that the direction of the hose clamps is as shown in the illustration.

p. Connect the throttle body connector.



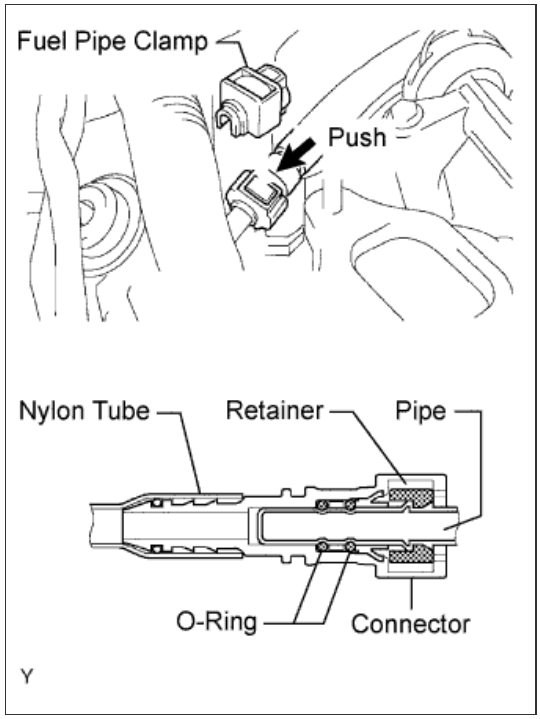
4. CONNECT NO. 2 FUEL PIPE SUB-ASSEMBLY

a. Push the tube connector into the pipe until the tube connector makes a "click" sound.

NOTICE:

- **Check if there is any damage or foreign objects on the connected part of the fuel pipe.**
- **After connecting, check that the pipe and connector are securely connected by pulling them.**

b. Install the fuel pipe clamp.



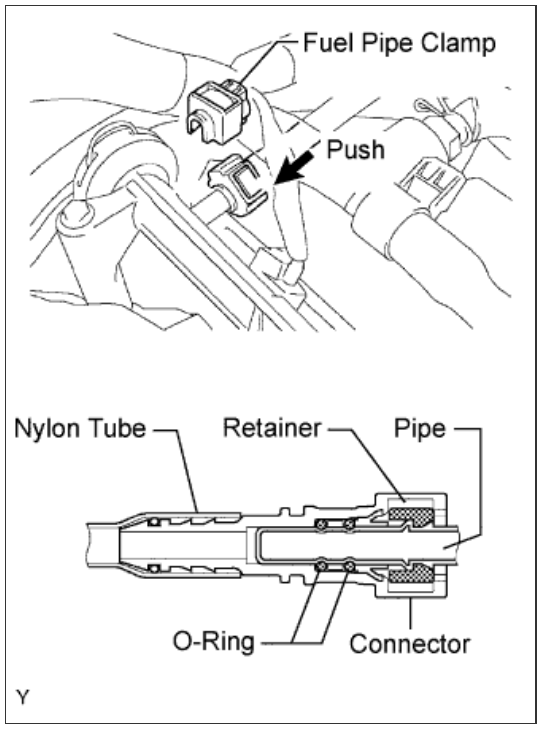
5. CONNECT NO. 1 FUEL PIPE SUB-ASSEMBLY

a. Push the tube connector into the pipe until the tube connector makes a "click" sound.

NOTICE:

- **Check if there is any damage or foreign objects on the connected part of the fuel pipe.**
- **After connecting, check that the pipe and connector are securely connected by pulling them.**

b. Install the fuel pipe clamp.



6. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner assembly with the 2 bolts.

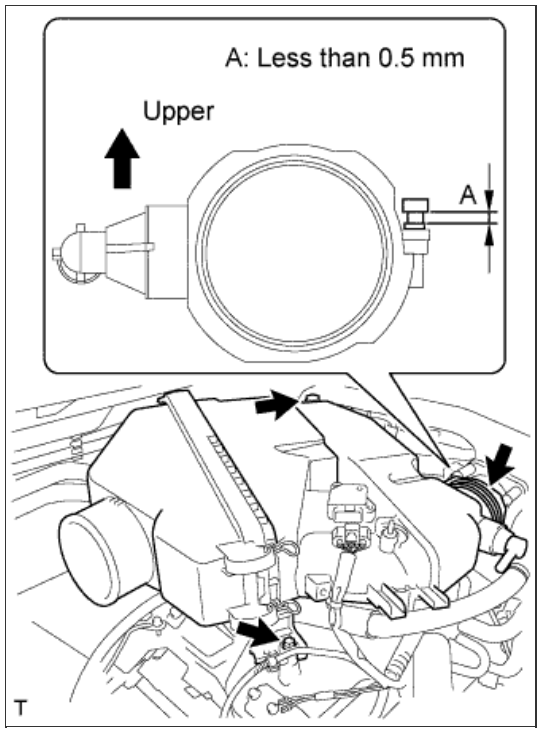
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

b. Tighten the hose clamp.

HINT:

Tighten the hose clamp until it reaches the specified protrusion height labeled A shown in the illustration.

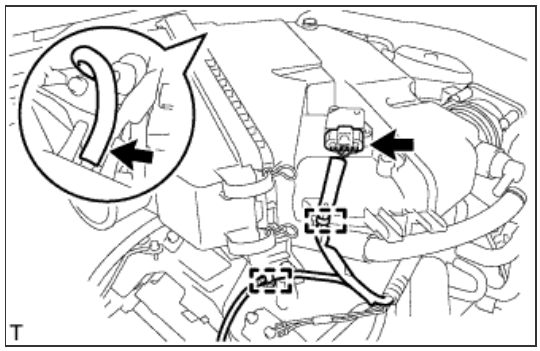
Standard protrusion height:
Less than 0.5 mm (0.0197 in.)



c. Connect the MAF meter connector.

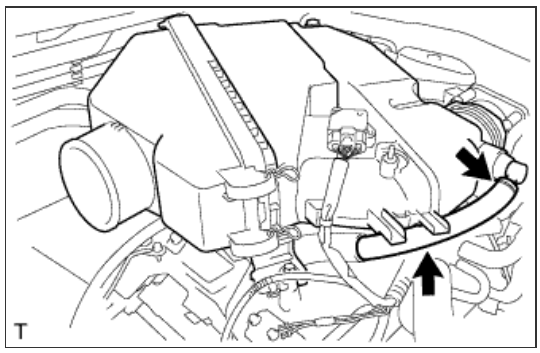
d. Attach the 2 wire harness clamps.

e. Connect the vacuum hose.



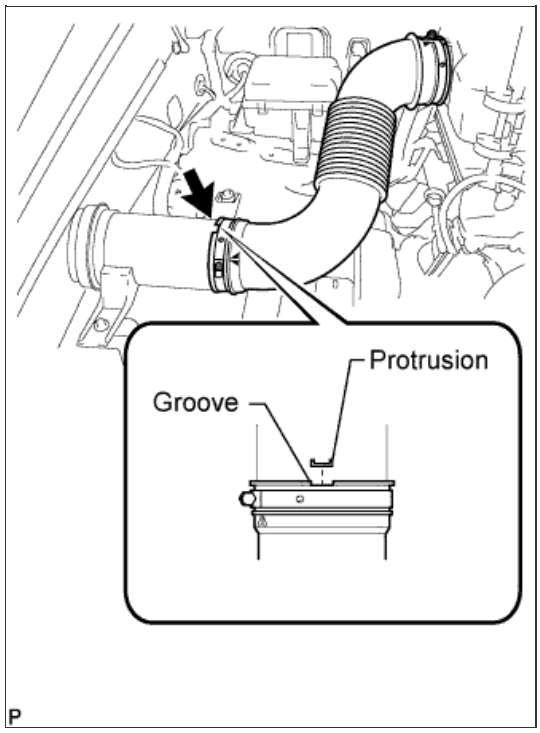
f. Attach the hose clamp.

g. Connect the No. 2 ventilation hose.



7. INSTALL NO. 2 AIR CLEANER HOSE

a. Align the protrusion of the pre-cleaner with the groove of the No. 2 air cleaner hose as shown in the illustration.

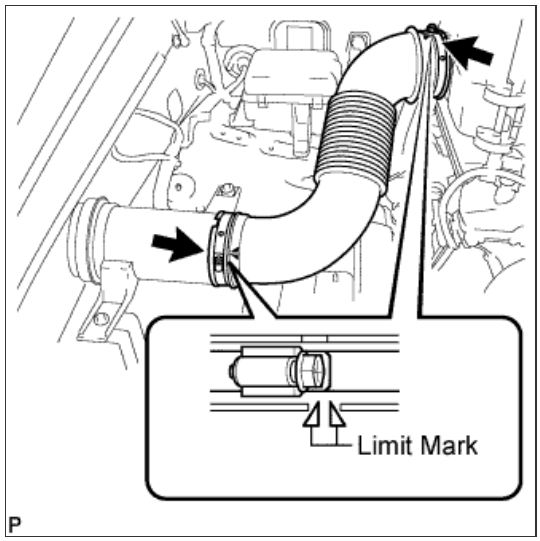


b. Tighten the 2 hose clamps.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }

HINT:

Tighten the clamp until the end of the clamp band is within both limit marks.



8. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

9. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item		Specified condition
for Automatic transmission	w/o Rear Heater	11.2 liters (11.8 US qts, 9.9 Imp. qts)
	w/ Rear Heater	14.4 liters (15.2 US qts, 12.7 Imp. qts)
for Manual transmission	w/o Rear Heater	12.0 liters (12.7 US qts, 10.6 Imp. qts)
	w/ Rear Heater	14.6 liters (15.4 US qts, 12.8 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

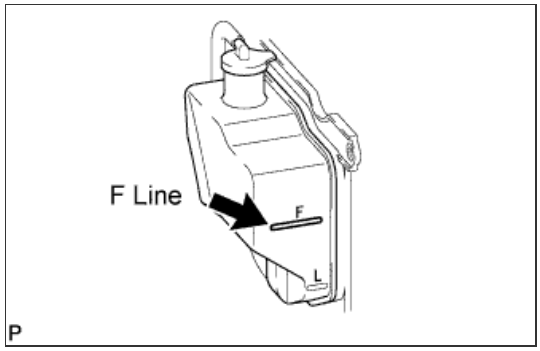
TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.



f. Set the air conditioning as follows while warming up the engine.

Item	Condition
Fan speed	Any setting except off
Temperature	Toward WARM
Air conditioning switch	Off

g. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

h. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

i. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

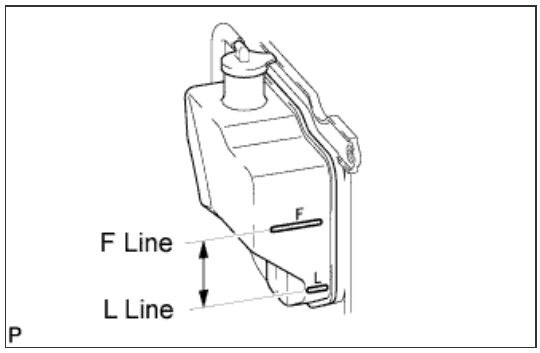
- **Wear protective gloves. Heat areas on the parts may injure your hands.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the fan.**

j. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

k. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.



10. INSPECT FOR ENGINE COOLANT LEAK

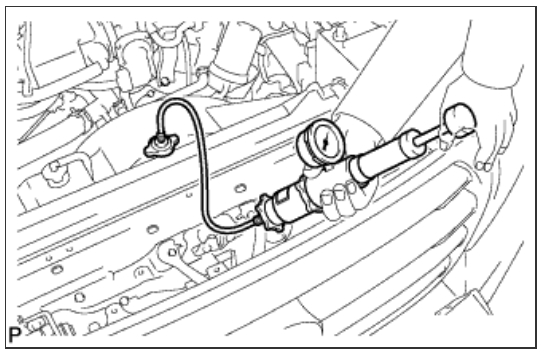
CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



11. INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and intelligent tester on.

NOTICE:

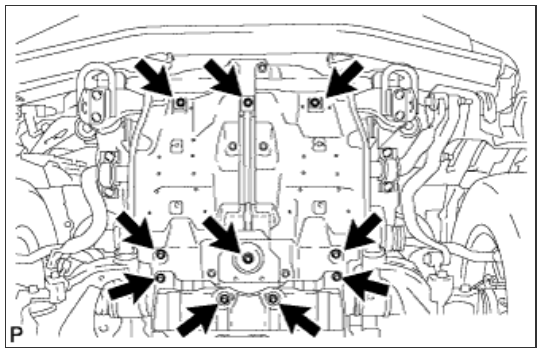
Do not start the engine.

c. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the Fuel Pump Speed Control.

d. Check that there are no fuel leaks after doing maintenance anywhere on the fuel system.

12. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the under cover with the 10 bolts.



13. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

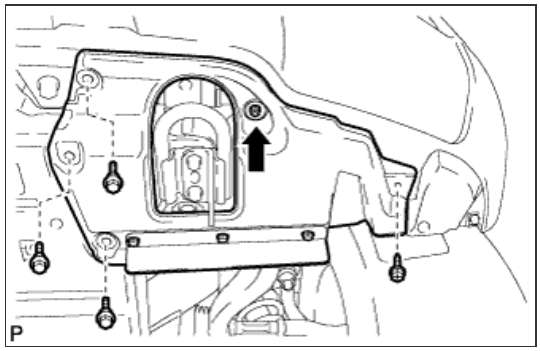
HINT:

Use the same procedures described for the LH side.

14. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



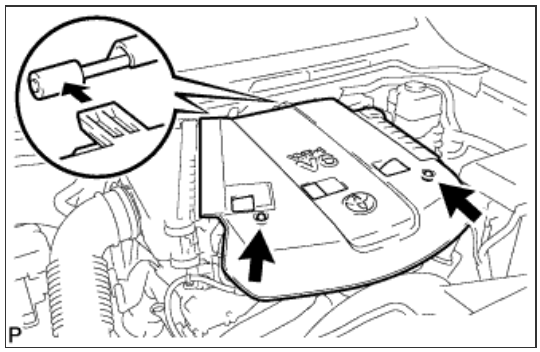
15. INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Install the cowl top ventilator louver (Click here).

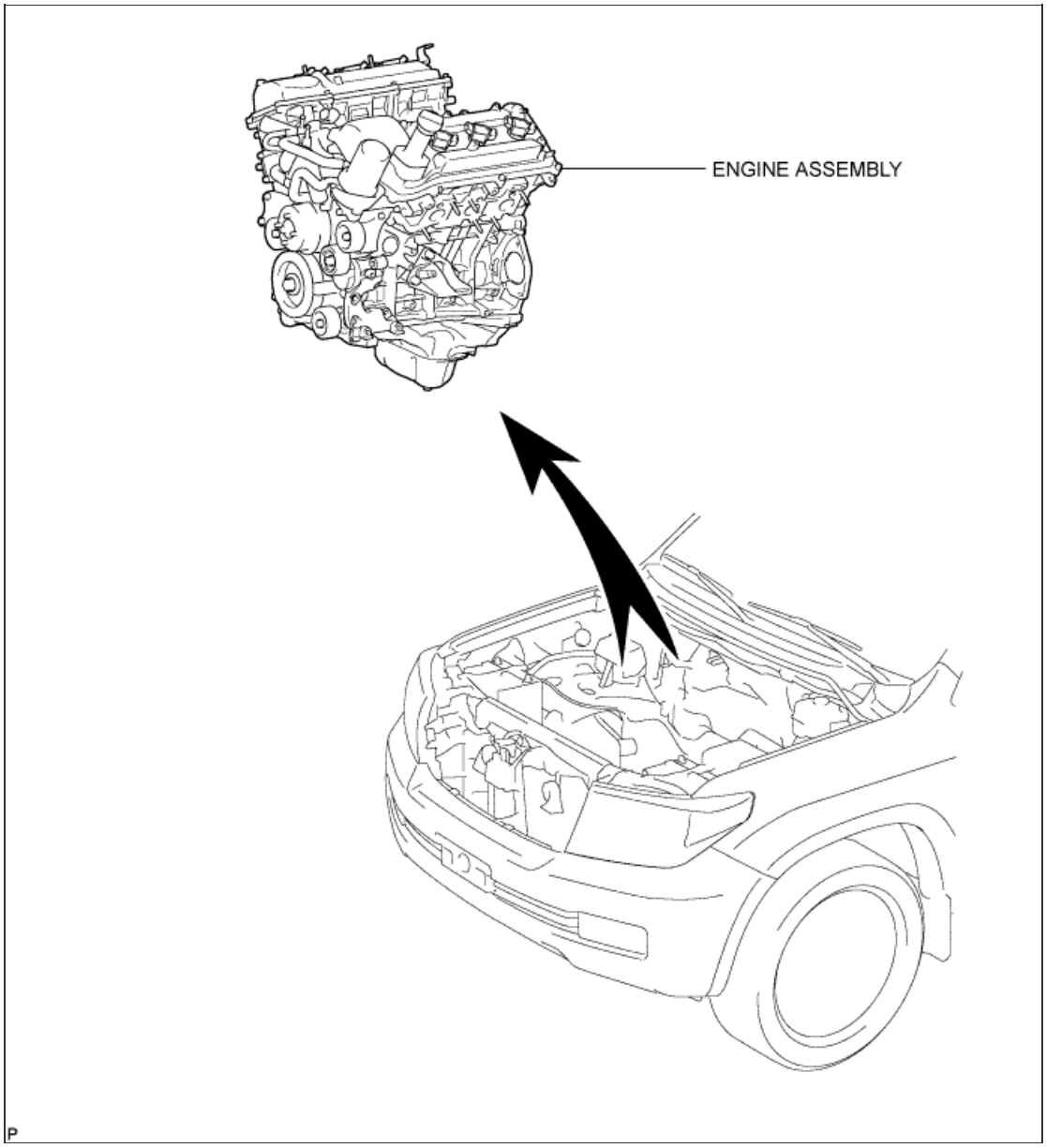
16. INSTALL V-BANK COVER

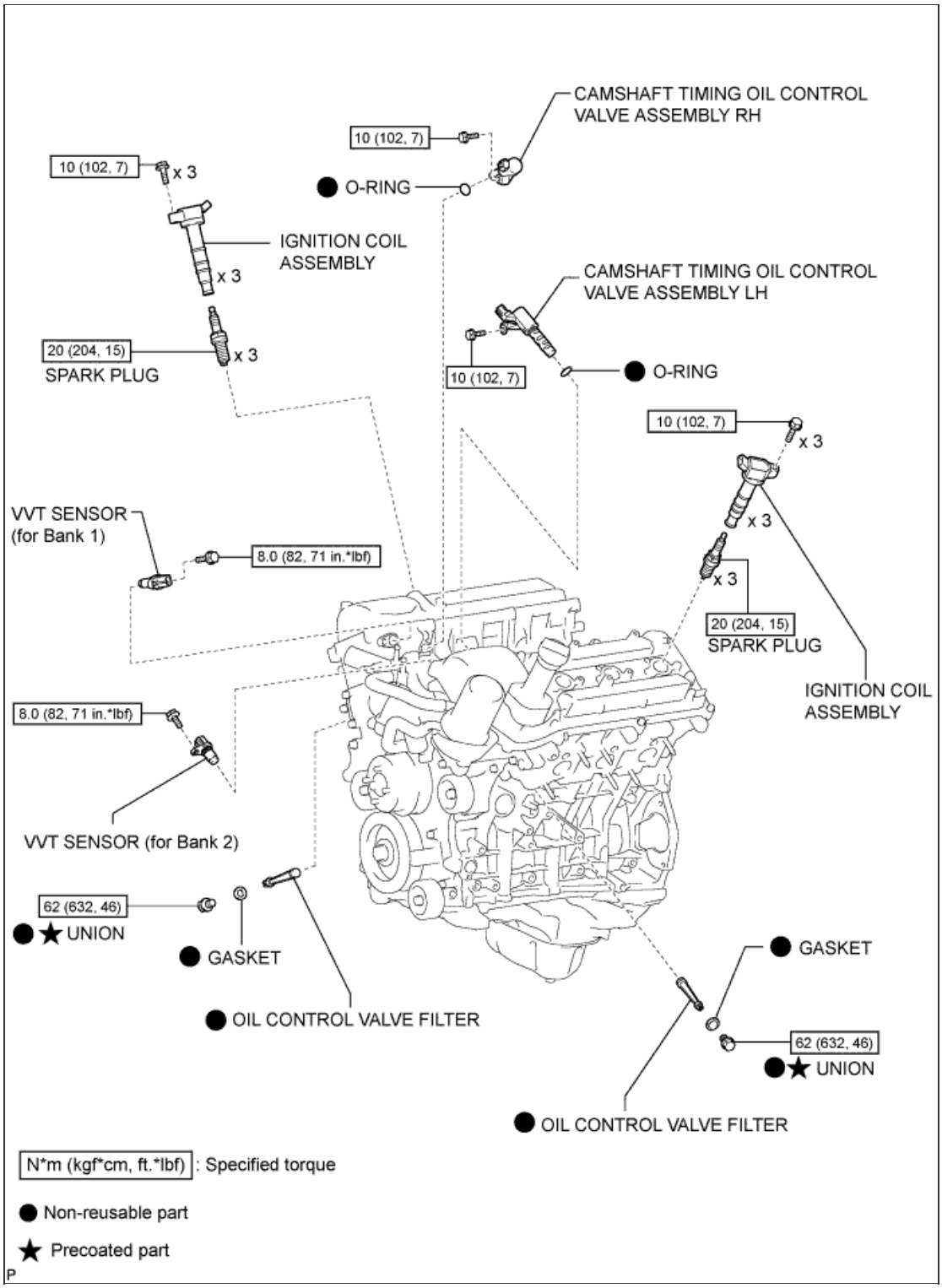
a. Install the V-bank cover with the 2 nuts.

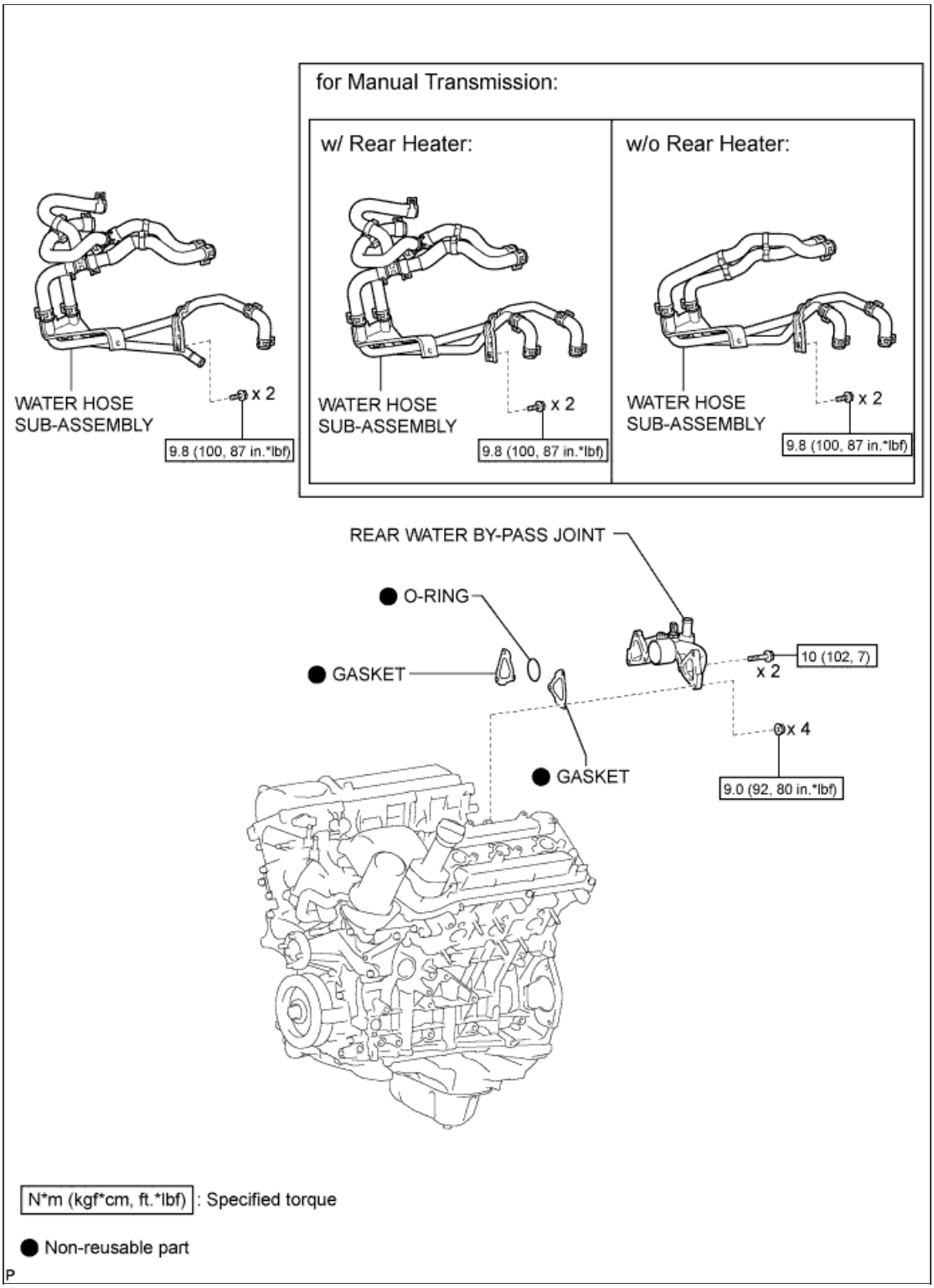
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



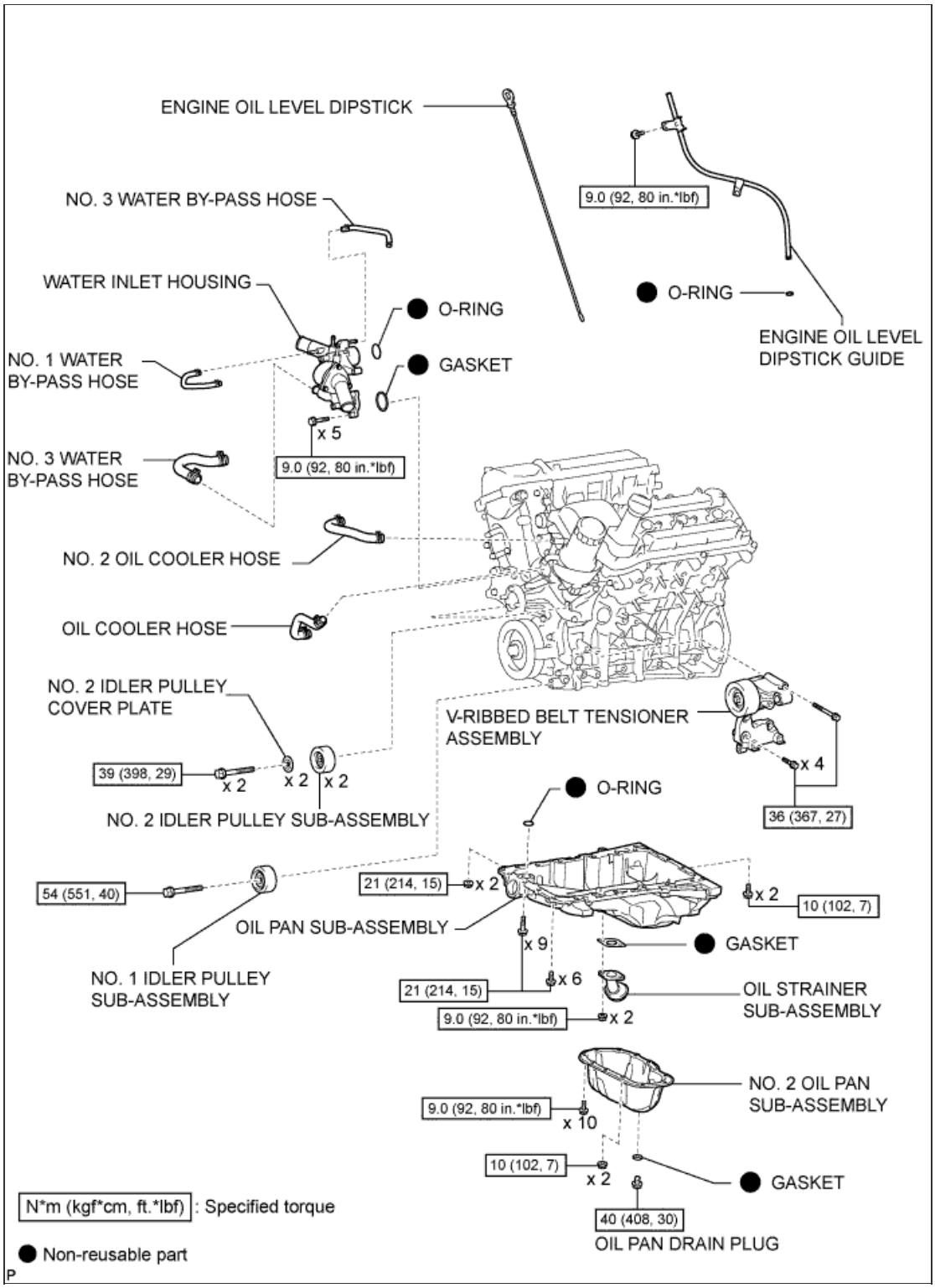
for Preparation [Click here]

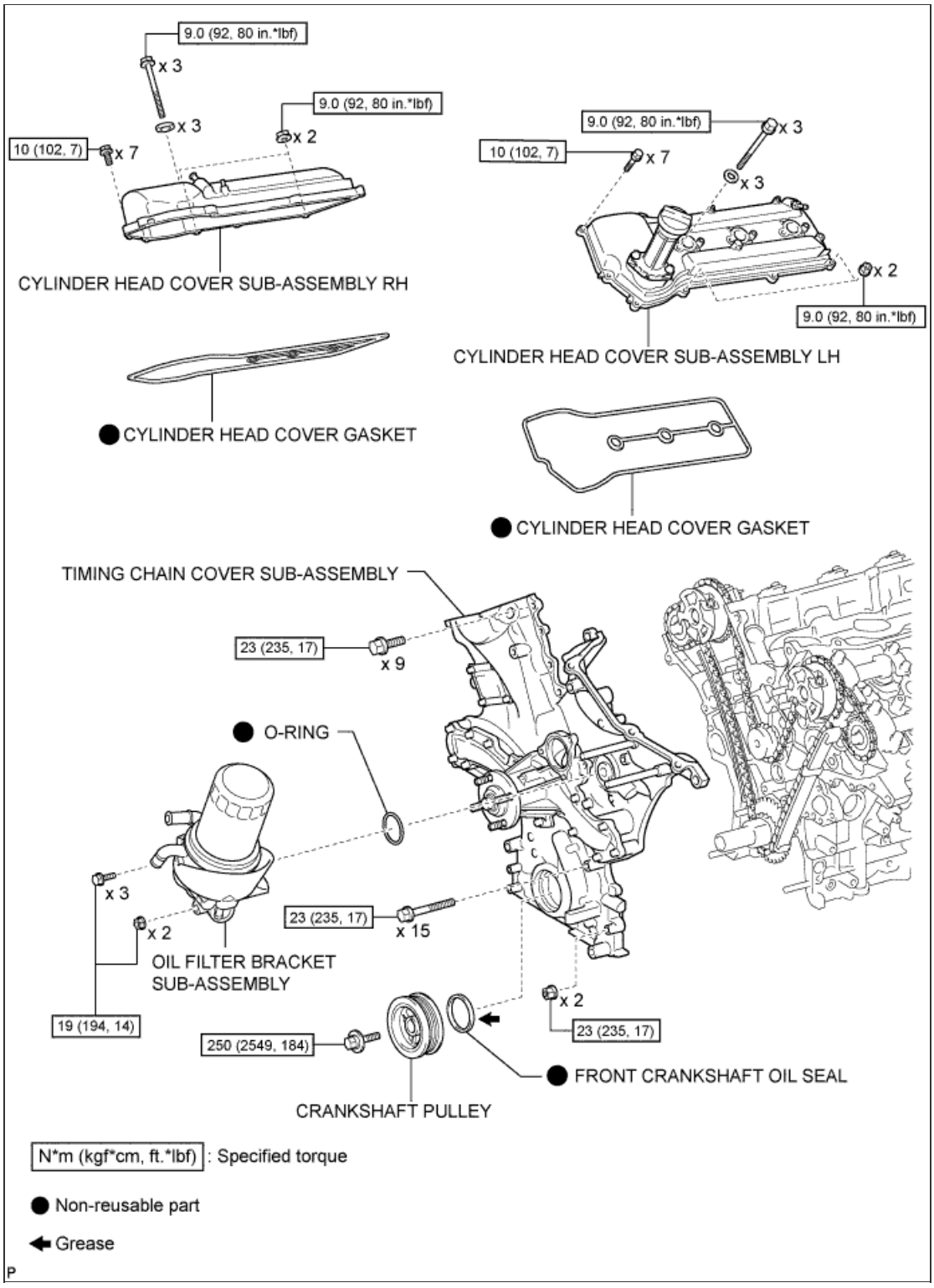


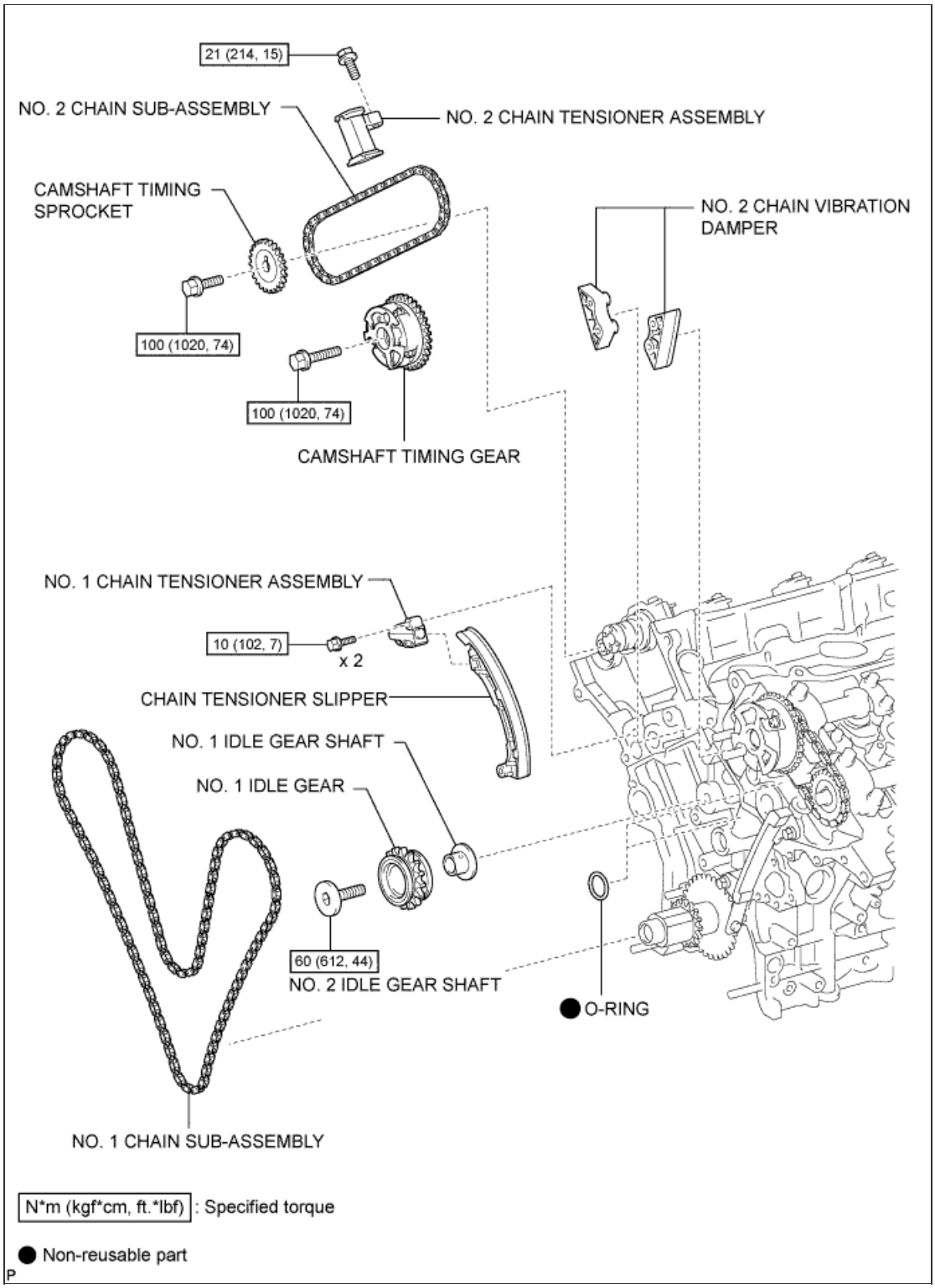

CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY RH
10 (102, 7)
O-RING
10 (102, 7) x 3
IGNITION COIL ASSEMBLY
x 3
CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY LH
20 (204, 15)
SPARK PLUG
x 3
10 (102, 7)
O-RING
10 (102, 7)
x 3
x 3
VVT SENSOR (for Bank 1)
8.0 (82, 71 in.*lbf)
x 3
20 (204, 15)
SPARK PLUG
IGNITION COIL ASSEMBLY
8.0 (82, 71 in.*lbf)
VVT SENSOR (for Bank 2)
62 (632, 46)
UNION
GASKET
OIL CONTROL VALVE FILTER
GASKET
62 (632, 46)
UNION
OIL CONTROL VALVE FILTER
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
Precoated part
P


for Manual Transmission:
w/ Rear Heater:
w/o Rear Heater:
WATER HOSE SUB-ASSEMBLY
x 2
9.8 (100, 87 in.*lbf)
WATER HOSE SUB-ASSEMBLY
x 2
9.8 (100, 87 in.*lbf)
WATER HOSE SUB-ASSEMBLY
x 2
9.8 (100, 87 in.*lbf)
REAR WATER BY-PASS JOINT
O-RING
GASKET
GASKET
10 (102, 7)
x 2
x 4
9.0 (92, 80 in.*lbf)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

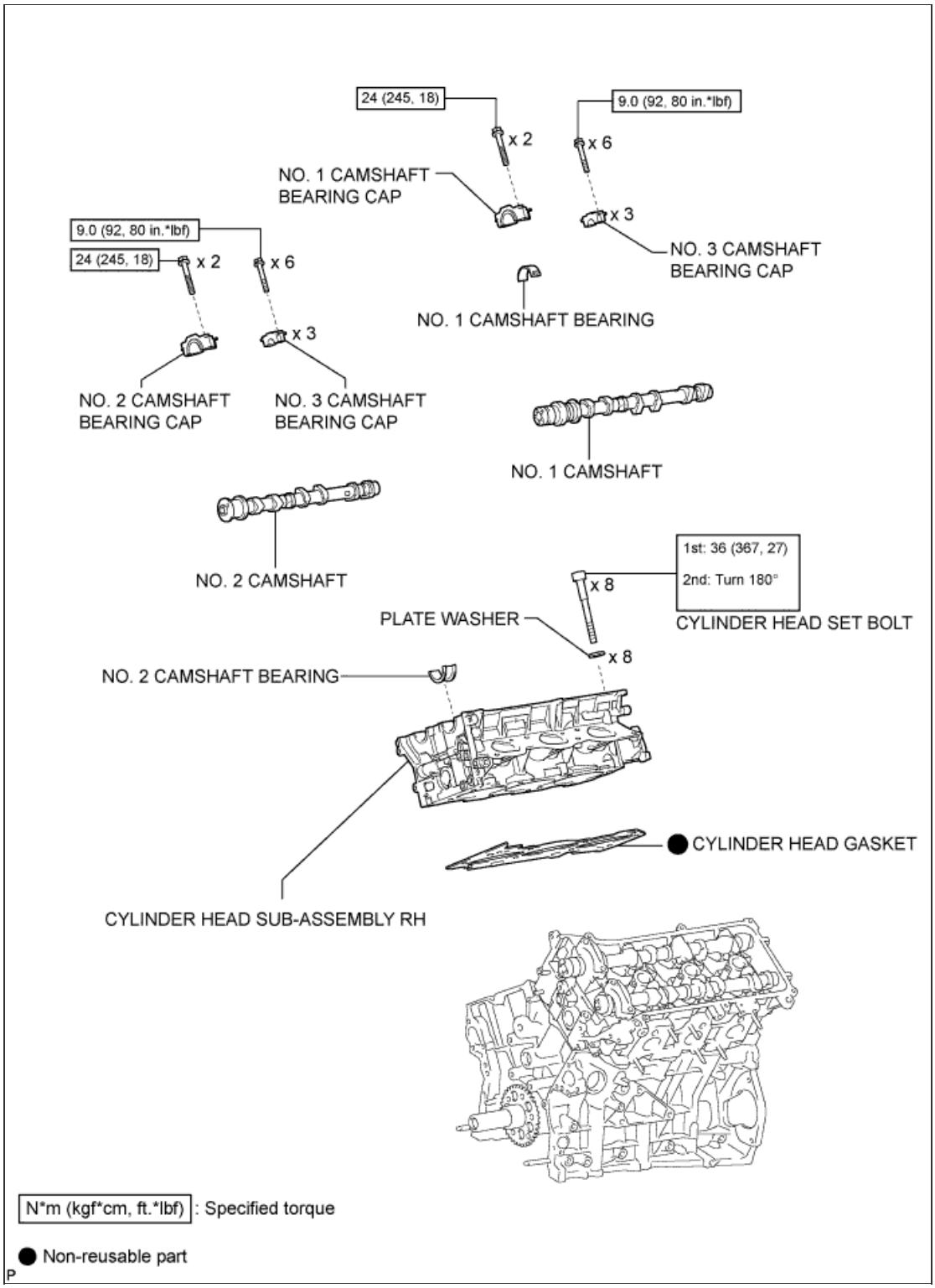
P


ENGINE OIL LEVEL DIPSTICK
9.0 (92, 80 in.*lbf)
NO. 3 WATER BY-PASS HOSE
WATER INLET HOUSING
O-RING
O-RING
ENGINE OIL LEVEL DIPSTICK GUIDE
NO. 1 WATER BY-PASS HOSE
GASKET
x 5
9.0 (92, 80 in.*lbf)
NO. 3 WATER BY-PASS HOSE
NO. 2 OIL COOLER HOSE
OIL COOLER HOSE
NO. 2 IDLER PULLEY COVER PLATE
V-RIBBED BELT TENSIONER ASSEMBLY
x 4
39 (398, 29)
x 2
x 2
x 2
36 (367, 27)
O-RING
NO. 2 IDLER PULLEY SUB-ASSEMBLY
54 (551, 40)
21 (214, 15)
x 2
x 2
10 (102, 7)
OIL PAN SUB-ASSEMBLY
x 9
GASKET
NO. 1 IDLER PULLEY SUB-ASSEMBLY
21 (214, 15)
x 6
OIL STRAINER SUB-ASSEMBLY
9.0 (92, 80 in.*lbf)
x 2
NO. 2 OIL PAN SUB-ASSEMBLY
9.0 (92, 80 in.*lbf)
x 10
10 (102, 7)
x 2
GASKET
40 (408, 30)
OIL PAN DRAIN PLUG
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

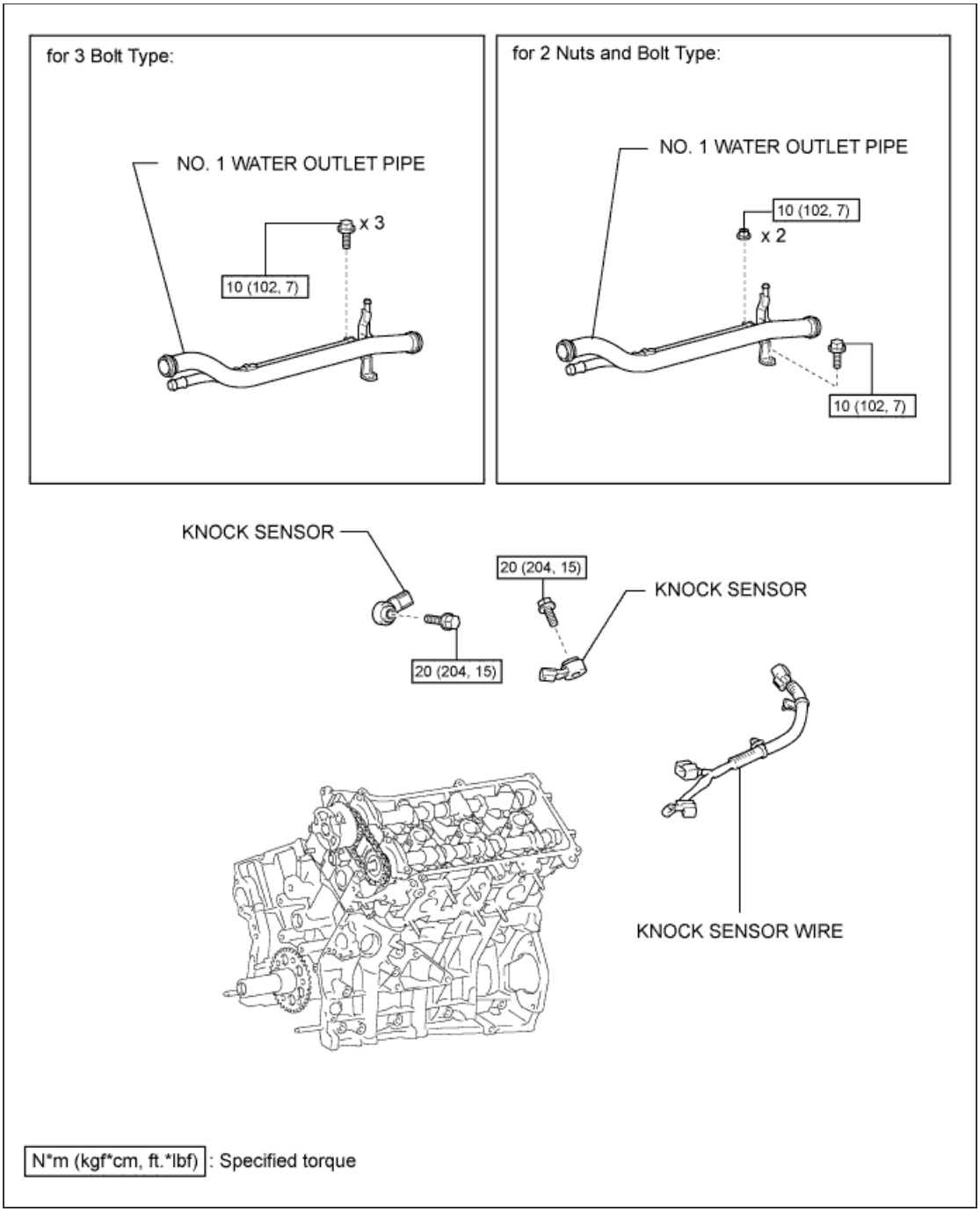

9.0 (92, 80 in.*lbf)
x 3
x 3
9.0 (92, 80 in.*lbf)
x 2
10 (102, 7)
x 7
CYLINDER HEAD COVER SUB-ASSEMBLY RH
9.0 (92, 80 in.*lbf)
x 3
10 (102, 7)
x 7
x 3
x 2
9.0 (92, 80 in.*lbf)
CYLINDER HEAD COVER SUB-ASSEMBLY LH
CYLINDER HEAD COVER GASKET
CYLINDER HEAD COVER GASKET
TIMING CHAIN COVER SUB-ASSEMBLY
23 (235, 17)
x 9
O-RING
x 3
x 2
OIL FILTER BRACKET
SUB-ASSEMBLY
19 (194, 14)
23 (235, 17)
x 15
x 2
23 (235, 17)
250 (2549, 184)
FRONT CRANKSHAFT OIL SEAL
CRANKSHAFT PULLEY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
Grease
P


21 (214, 15)
NO. 2 CHAIN SUB-ASSEMBLY
NO. 2 CHAIN TENSIONER ASSEMBLY
CAMSHAFT TIMING SPROCKET
NO. 2 CHAIN VIBRATION DAMPER
100 (1020, 74)
100 (1020, 74)
CAMSHAFT TIMING GEAR
NO. 1 CHAIN TENSIONER ASSEMBLY
10 (102, 7)
x 2
CHAIN TENSIONER SLIPPER
NO. 1 IDLE GEAR SHAFT
NO. 1 IDLE GEAR
60 (612, 44)
NO. 2 IDLE GEAR SHAFT
O-RING
NO. 1 CHAIN SUB-ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P


24 (245, 18)
x 2
9.0 (92, 80 in.*lbf)
x 6
NO. 1 CAMSHAFT BEARING CAP
x 3
NO. 3 CAMSHAFT BEARING CAP
9.0 (92, 80 in.*lbf)
24 (245, 18)
x 2
x 6
NO. 1 CAMSHAFT BEARING
x 3
NO. 2 CAMSHAFT BEARING CAP
NO. 3 CAMSHAFT BEARING CAP
NO. 1 CAMSHAFT
NO. 2 CAMSHAFT
1st: 36 (367, 27)
2nd: Turn 180°
x 8
CYLINDER HEAD SET BOLT
PLATE WASHER
x 8
NO. 2 CAMSHAFT BEARING
CYLINDER HEAD GASKET
CYLINDER HEAD SUB-ASSEMBLY RH
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P


for 3 Bolt Type:
NO. 1 WATER OUTLET PIPE
x 3
10 (102, 7)
for 2 Nuts and Bolt Type:
NO. 1 WATER OUTLET PIPE
10 (102, 7)
x 2
10 (102, 7)
KNOCK SENSOR
20 (204, 15)
KNOCK SENSOR
20 (204, 15)
KNOCK SENSOR WIRE
N*m (kgf*cm, ft.*lbf) : Specified torque

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, so e syste s need to be initiali ed after the cable is reconnected (ick here).

2. REMOVE ENGINE ASSEMBLY

a. e ove the engine (ick here).

3. REMOVE CYLINDER HEAD SUB-ASSEMBLY RH (for Bank 1)

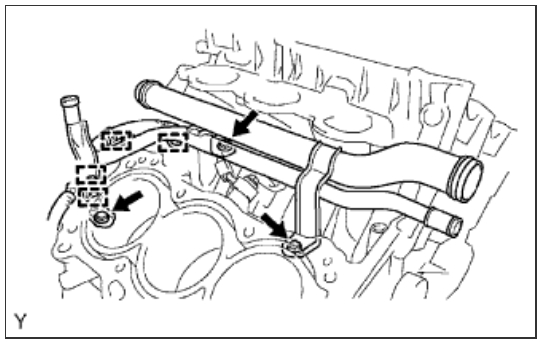
a. e ove the cylinder head (ick here).

4. REMOVE NO. 1 WATER OUTLET PIPE

a. Disconnect the wire harness cla s.

b. for 3 Bolts Type
e ove the 3 bolts and water o et pipe.

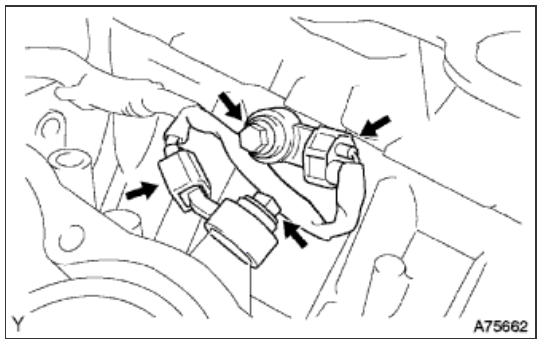
c. for 2 N s and Bolt Type
e ove the 2 n s, bolt and water o et pipe.



5. REMOVE KNOCK SENSOR

a. Disconnect the 2 sensor connectors.

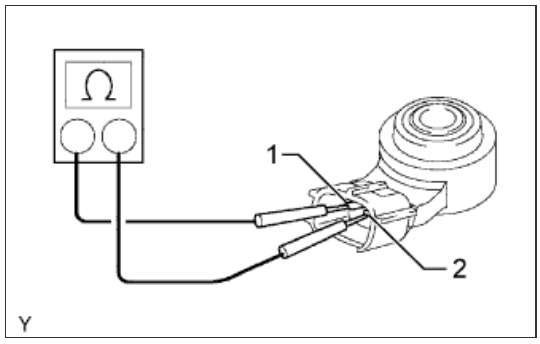
b. e ove the 2 bolts and 2 sensors.



for Preparation Click here

1. INSPECT KNOCK SENSOR

a. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	120 to 280 kΩ

the resistance is not as specified, replace the sensor.

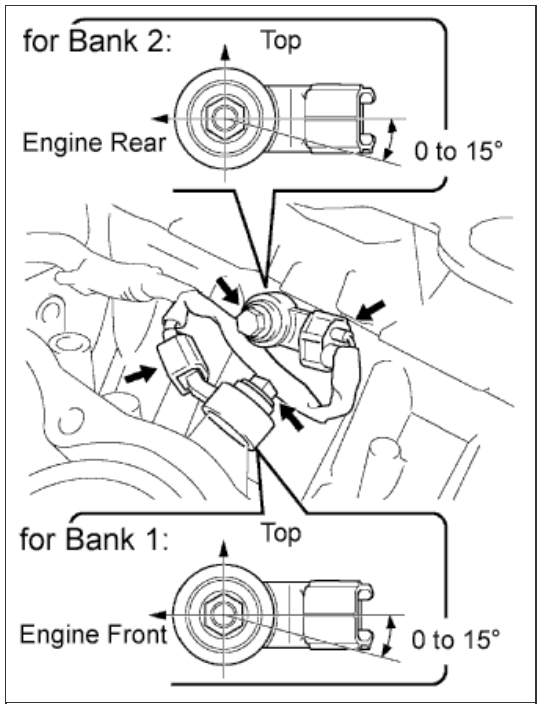
for Preparation Click here

1. INSTALL KNOCK SENSOR

a. Install the 2 sensors with the 2 bolts as shown in the illustration.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

b. Connect the 2 sensor connectors.



2. INSTALL NO. 1 WATER OUTLET PIPE

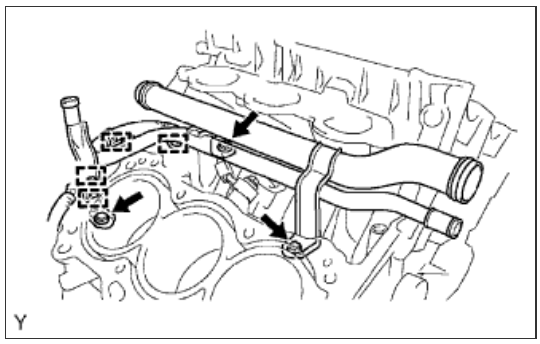
a. for 2 Nuts and Bolt Type
Install the water outlet pipe with the 2 nuts and bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. for 3 Bolts Type
Install the water outlet pipe with the 3 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

c. Connect the 4 wire harness clamps.



3. INSTALL CYLINDER HEAD SUB-ASSEMBLY RH (for Bank 1)

a. Install the cylinder head RH (Click here).

4. INSTALL ENGINE ASSEMBLY

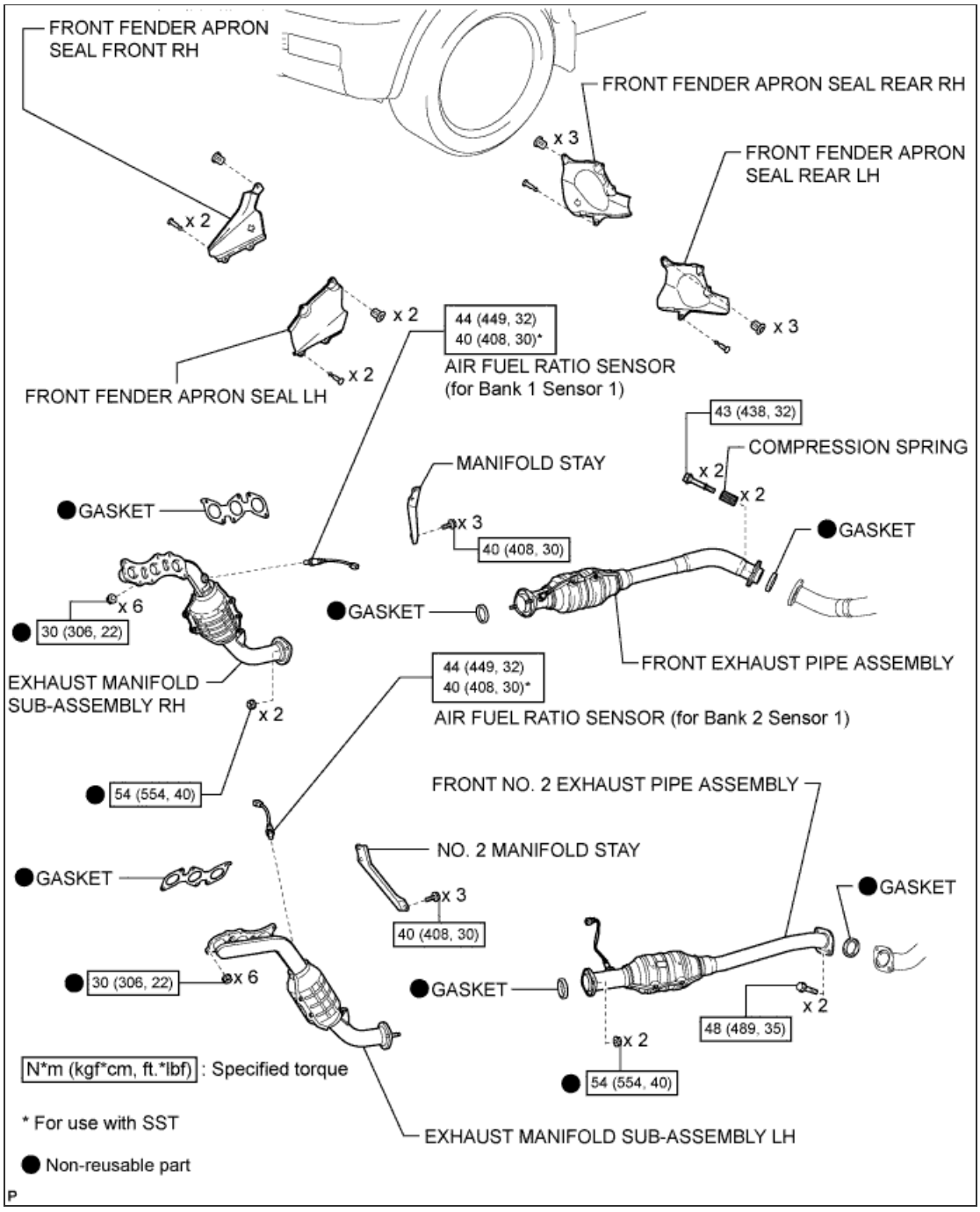
a. Install the engine (Click here).

5. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

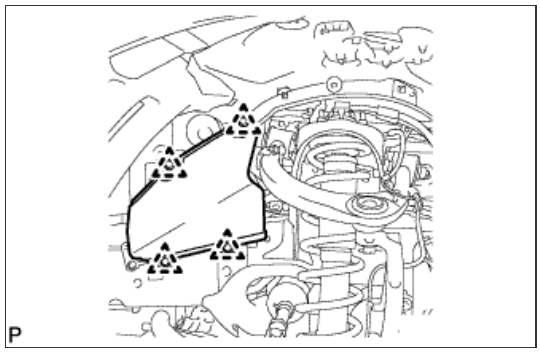
for Preparation Click here



for Preparation Click here

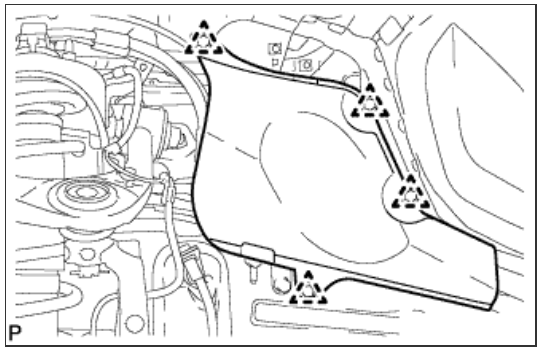
1. REMOVE FRONT FENDER APRON SEAL LH

a. Using a clip remover, remove clips and fender apron seal.



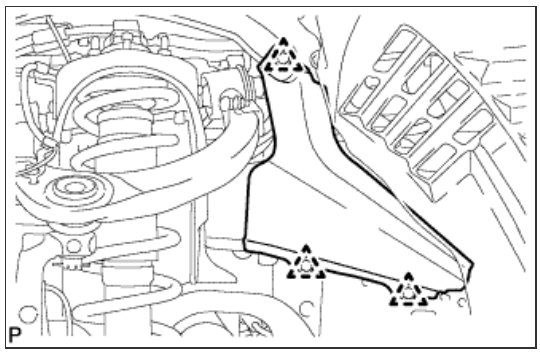
2. REMOVE FRONT FENDER APRON SEAL REAR LH

a. Using a clip remover, remove clips and fender apron seal.



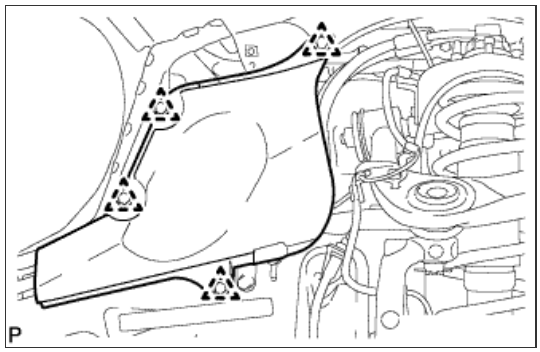
3. REMOVE FRONT FENDER APRON SEAL FRONT RH

a. Using a clip remover, remove 3 clips and fender apron seal.



4. REMOVE FRONT FENDER APRON SEAL REAR RH

a. Using a clip remover, remove clips and fender apron seal.



5. REMOVE FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Disconnec hea oxygen sensor connec

b. 2 bol s from cen exha s pipe.

c. Remove 2 bol s, 2 n s and fron o. 2 exha s pipe.

d. Remove 2 gaske s from fron o. 2 exha s pipe.

6. REMOVE FRONT EXHAUST PIPE ASSEMBLY

a. Disconnec hea oxygen sensor connec

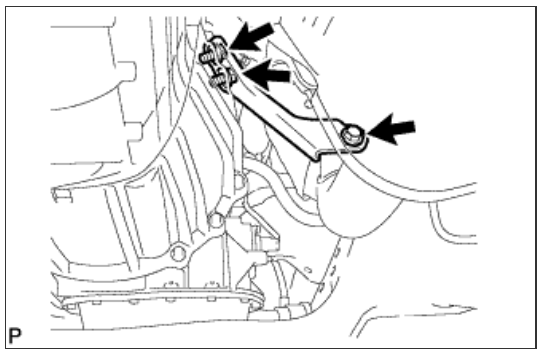
b. 2 bol s wi 2 compression springs from cen exha s pipe.

c. Remove 2 n s and fron exha s pipe.

d. Remove 2 gaske s from fron exha s pipe.

7. REMOVE MANIFOLD STAY

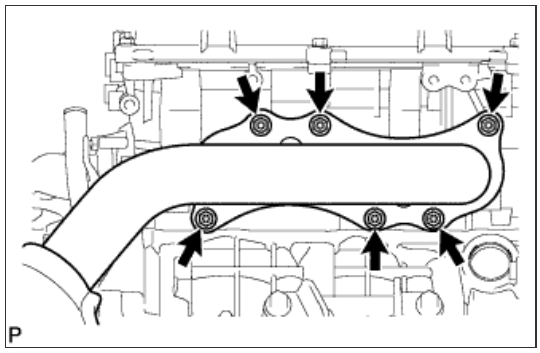
a. Remove 3 bol s and o. 1 manifold s ay.



8. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY RH

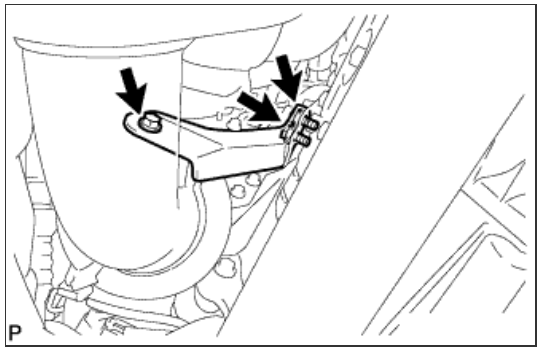
a. Disconnec air f el ra io sensor connec

b. n s, exha s manifold and gaske from cylinder head R .



9. REMOVE NO. 2 MANIFOLD STAY

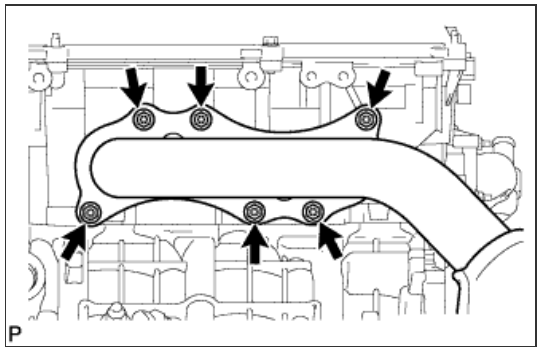
a. Remove 3 bol s and o. 2 manifold s ay.



10. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY LH

a. Disconnec air f el ra io sensor connec

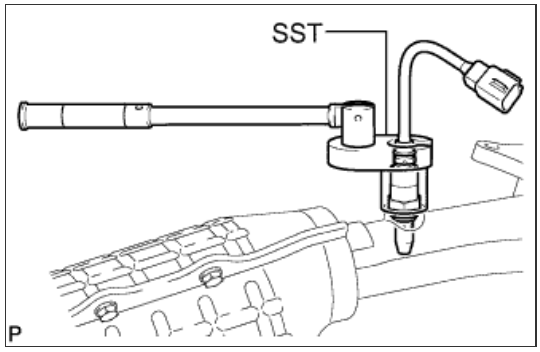
b. n s, exha s manifold and gaske from cylinder head L .



11. REMOVE AIR FUEL RATIO SENSOR (for Bank 1 Sensor 1)

a. Using SS , remove sensor.

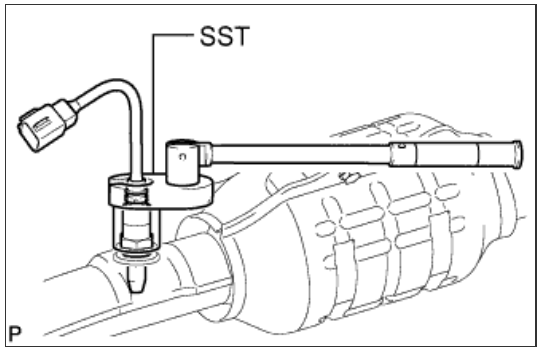
SST
09224-00010



12. REMOVE AIR FUEL RATIO SENSOR (for Bank 2 Sensor 1)

a. Using SS , remove sensor.

SST
09224-00010



for Preparation Click here

1. INSPECT AIR FUEL RATIO SENSOR

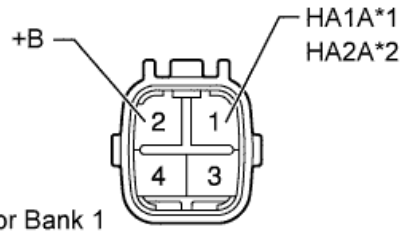
a. Measure the heater resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (2 (r Ban 1	20°C (68°F)	1.8 to 3.4 Ω
1 (2 (r Ban 2	20°C (68°F)	1.8 to 3.4 Ω

If the result is not as specified replace the air fuel ratio sensor.

Component without harness connected:
(Air Fuel Ratio Sensor)



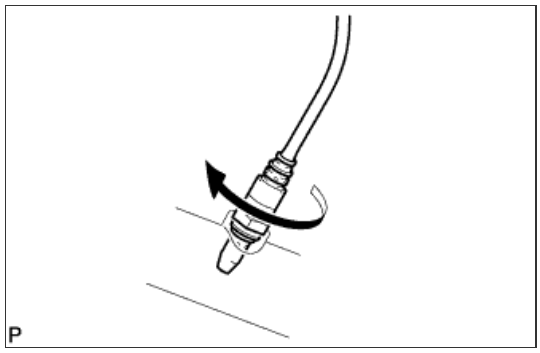
*1: for Bank 1

*2: for Bank 2

for Preparation Click here

1. INSTALL AIR FUEL RATIO SENSOR (for Bank 2 Sensor 1)

a. Temporarily install the sensor to the exhaust manifold by hand.



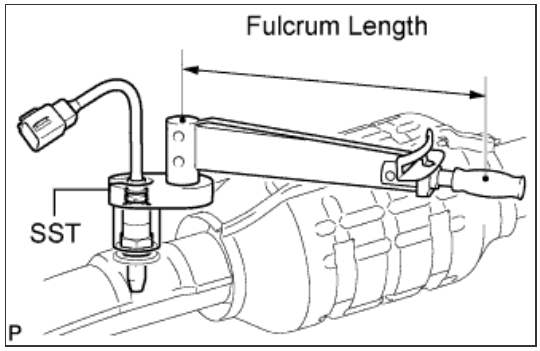
b. Using SST, tighten the sensor.

SST
09224-00010

Torque:
without SST:
44 N*m{ 449 kgf*cm , 32 ft.*lbf }
with SST:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

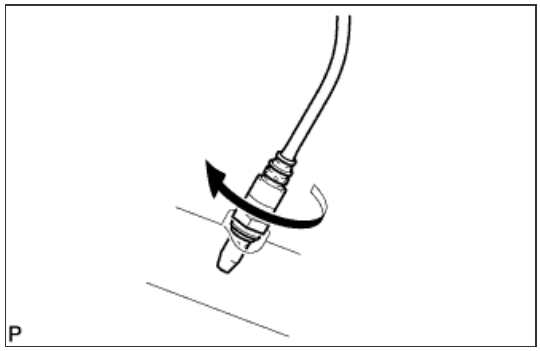
HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.). If using a torque wrench with a length that is not 30 cm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the "without SST" torque specification (Click here).**
- **Make sure SST and the wrench are connected in a straight line.**



2. INSTALL AIR FUEL RATIO SENSOR (for Bank 1 Sensor 1)

a. Temporarily install the sensor to the exhaust manifold by hand.



b. Using SST, tighten the sensor.

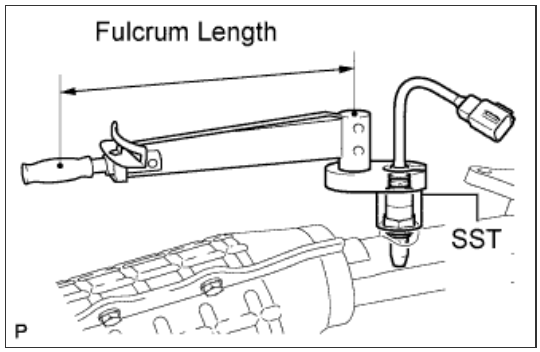
SST
09224-00010

Torque:
without SST:
44 N*m{ 449 kgf*cm , 32 ft.*lbf }
with SST:

40 N*m{ 408 kgf*cm , 30 ft.*lbf }

HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.). If using a torque wrench with a length that is not 30 cm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the "without SST" torque specification (Click here).**
- **Make sure SST and the wrench are connected in a straight line.**

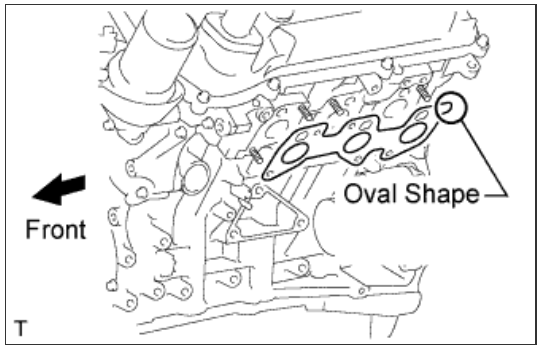


3. INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY LH

a. Set a new gasket to the cylinder head LH with the oval shape facing rearward.

NOTICE:

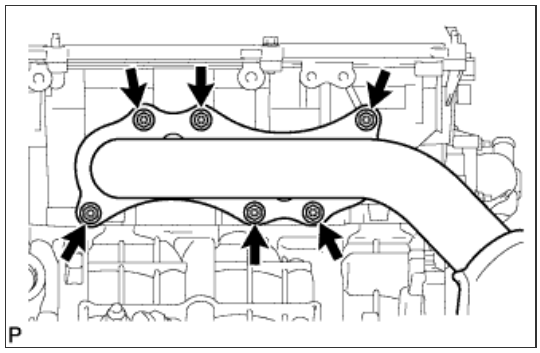
Be careful of the installation direction.



b. Install the exhaust manifold with 6 new nuts.

Torque:
30 N*m{ 306 kgf*cm , 22 ft.*lbf }

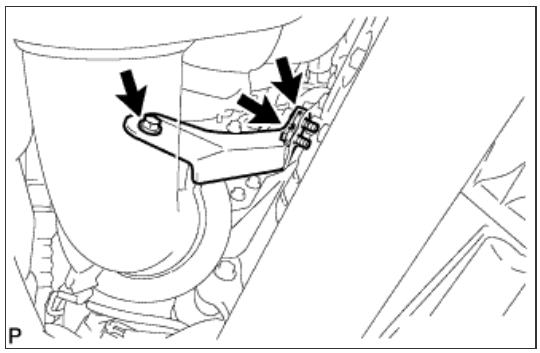
c. Connect the air fuel ratio sensor connector.



4. INSTALL NO. 2 MANIFOLD STAY

a. Install the No. 2 manifold stay with the 3 bolts.

Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

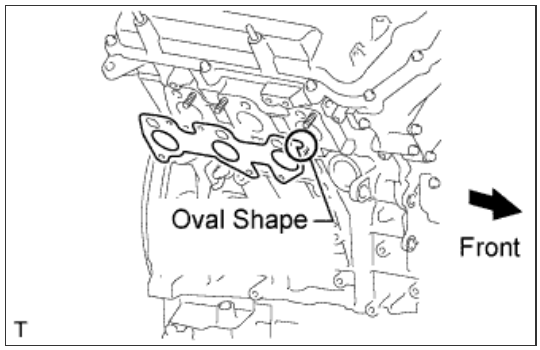


5. INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY RH

a. Set a new gasket to the cylinder head RH with the oval shape facing forward.

NOTICE:

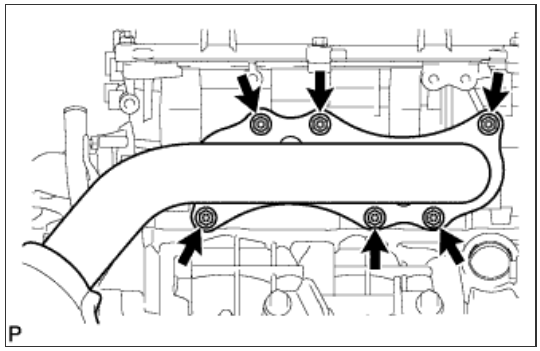
Be careful of the installation direction.



b. Install the exhaust manifold with 6 new nuts.

Torque:
30 N*m{ 306 kgf*cm , 22 ft.*lbf }

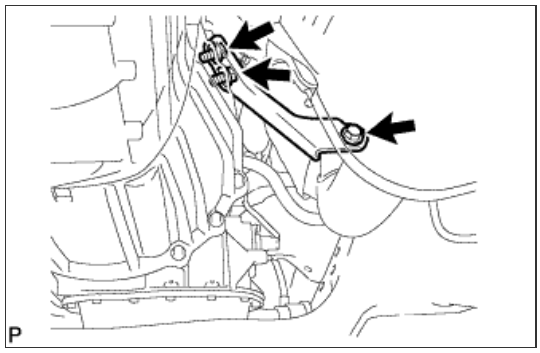
c. Connect the air fuel ratio sensor connector.



6. INSTALL MANIFOLD STAY

a. Install the No. 1 manifold stay with the 3 bolts.

Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }



7. INSTALL FRONT EXHAUST PIPE ASSEMBLY

a. Install 2 new gaskets to the front exhaust pipe.

b. Install the front exhaust pipe to the exhaust manifold RH with 2 new nuts.

Torque:
54 N*m{ 554 kgf*cm , 40 ft.*lbf }

c. Install the 2 compression springs and 2 bolts to the center exhaust pipe.

Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }

d. Connect the heated oxygen sensor connector.

8. INSTALL FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Install 2 new gaskets to the front No. 2 exhaust pipe.

b. Install the front No. 2 exhaust pipe to the exhaust manifold LH with 2 new nuts.

Torque:
54 N*m{ 554 kgf*cm , 40 ft.*lbf }

c. Install the 2 bolts to the center exhaust pipe.

Torque:
48 N*m{ 489 kgf*cm , 35 ft.*lbf }

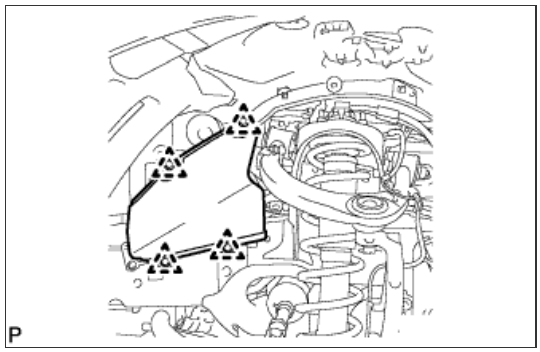
d. Connect the heated oxygen sensor connector.

9. INSPECT FOR EXHAUST GAS LEAK

If gas is leaking, tighten the areas necessary to stop the leak. Replace damaged parts as necessary.

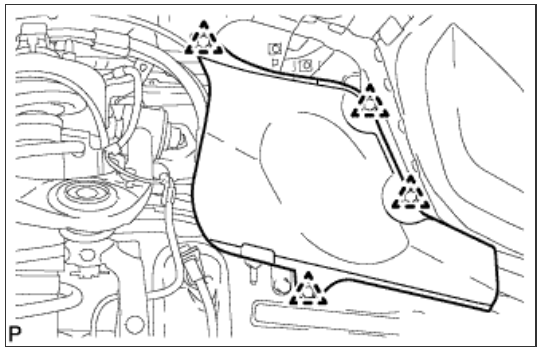
10. INSTALL FRONT FENDER APRON SEAL LH

a. Install the fender apron seal with the 4 clips.



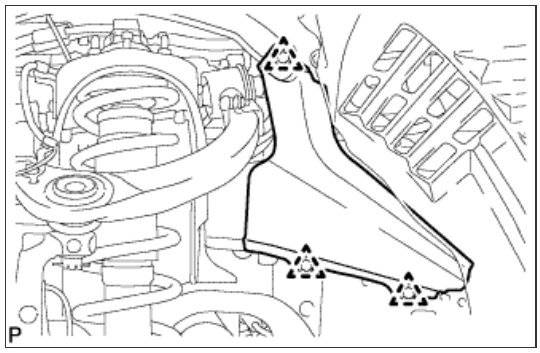
11. INSTALL FRONT FENDER APRON SEAL REAR LH

a. Install the fender apron seal with the 4 clips.



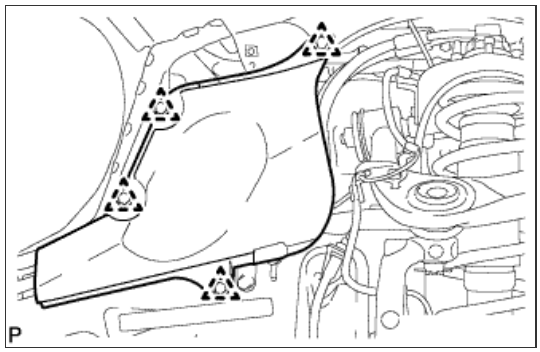
12. INSTALL FRONT FENDER APRON SEAL FRONT RH

a. Install the fender apron seal with the 3 clips.

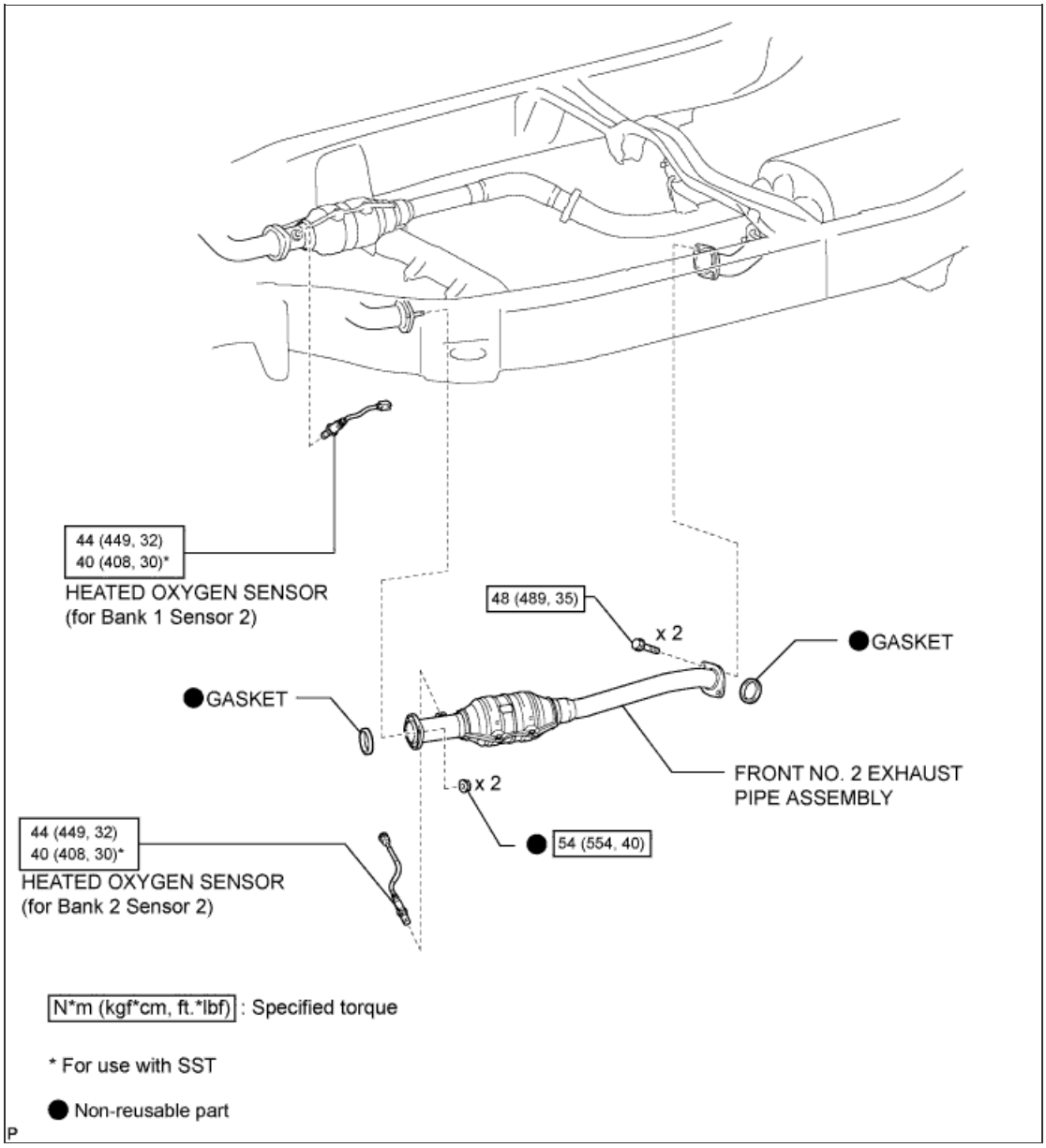


13. INSTALL FRONT FENDER APRON SEAL REAR RH

a. Install the fender apron seal with the 4 clips.



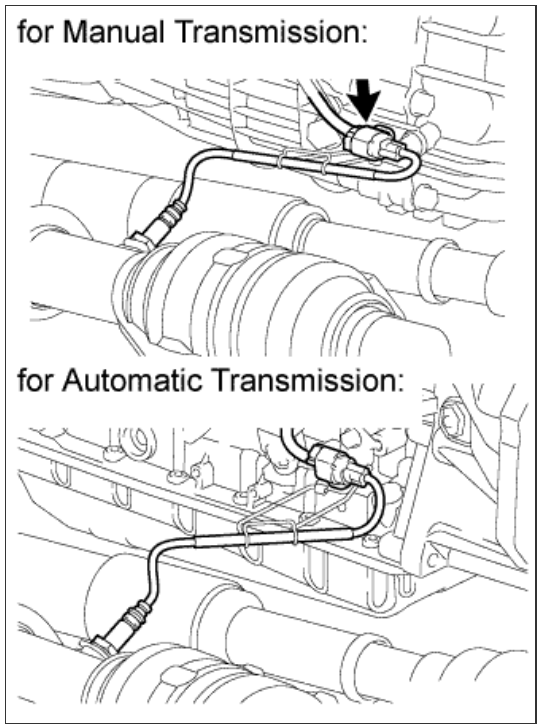
for Preparation Click here



for Preparation Click here

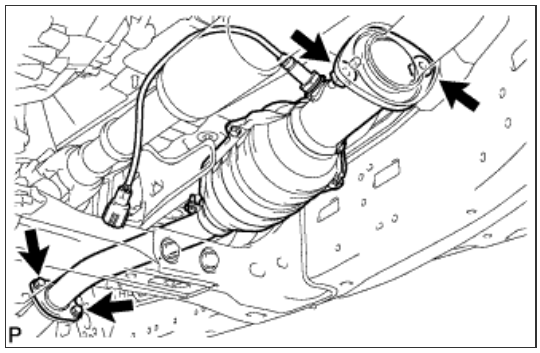
1. REMOVE FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Disconnect the sensor connector



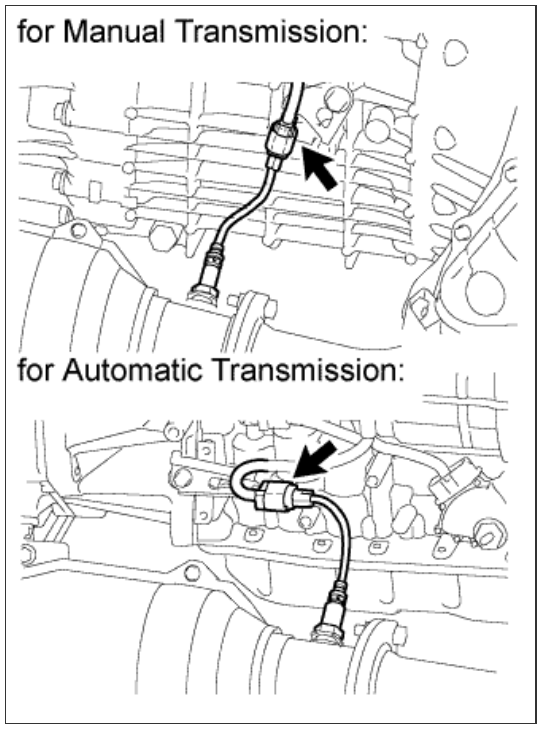
b. emove the 2 bo ts, 2 nuts and o2 e haust i assemb

c. emove the 2 askets rom the ront o2 e haust i e



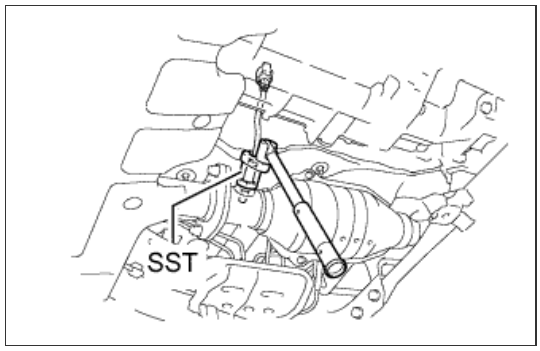
2. REMOVE HEATED OXYGEN SENSOR (for Bank 1 Sensor 2)

a. Disconnect the sensor connector.



b. Using SST, remove the sensor.

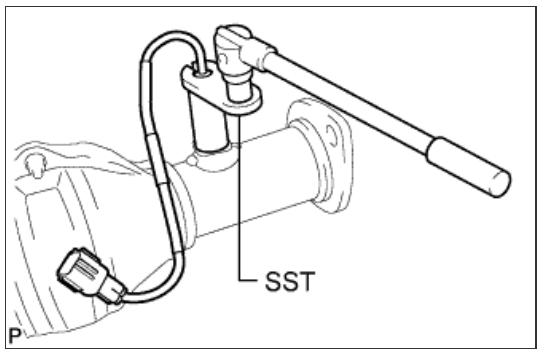
SST
0 22 10



3. REMOVE HEATED OXYGEN SENSOR (for Bank 2 Sensor 2)

a. Using SST, remove the sensor.

SST
09224-00010



for Preparation Click here

1. INSPECT HEATED OXYGEN SENSOR

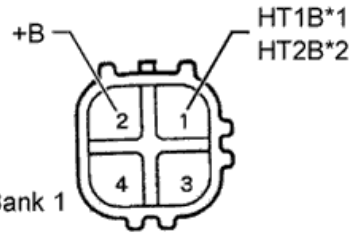
a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B) for Bank 1	20°C (68°F)	11 to 16 Ω
1 (HT2B) - 2 (+B) for Bank 2	20°C (68°F)	11 to 16 Ω

If the result is not as specified, replace the sensor.

Component without harness connected:
(Heated Oxygen Sensor)



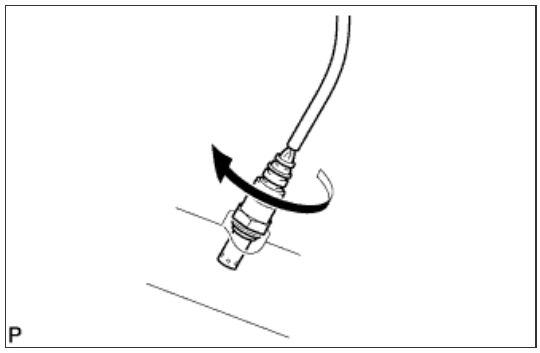
*1: for Bank 1

*2: for Bank 2

for Preparation Click here

1. INSTALL HEATED OXYGEN SENSOR (for Bank 1 Sensor 2)

a. Temporarily install the sensor to the exhaust pipe by hand.



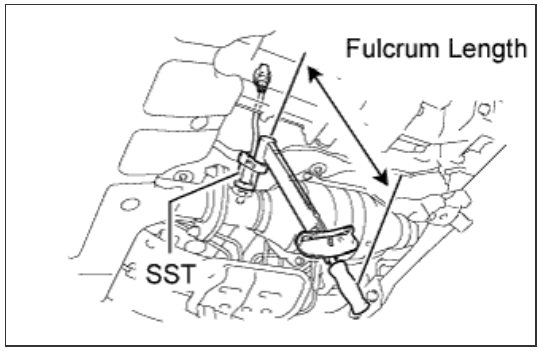
b. Using SST, tighten the sensor.

SST
09224-00010

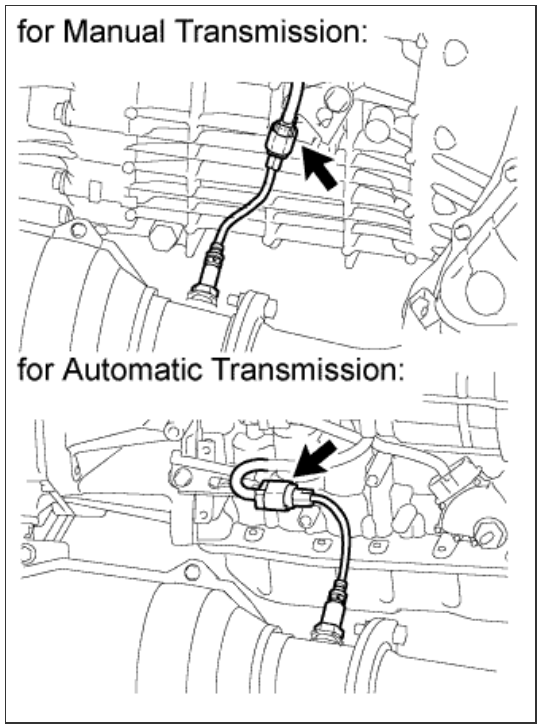
Torque:
without SST:
44 N*m{ 449 kgf*cm , 32 ft.*lbf }
with SST:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.). If using a torque wrench with a length that is not 30 cm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the "without SST" torque specification (Click here).**
- **Make sure SST and the wrench are connected in a straight line.**

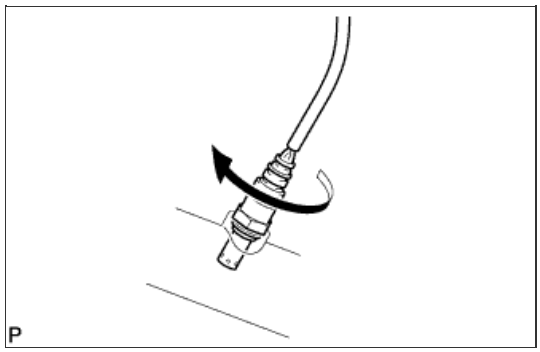


c. Connect the sensor connector.



2. INSTALL HEATED OXYGEN SENSOR (for Bank 2 Sensor 2)

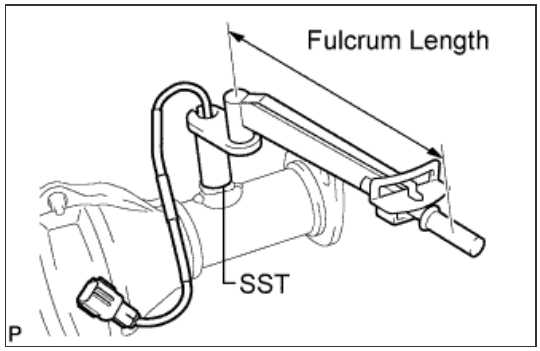
a. Temporarily install the sensor to the exhaust pipe by hand.



b. Using SST, tighten the sensor.

SST
09224-00010

Torque:
without SST:
44 N*m{ 449 kgf*cm , 32 ft.*lbf }
with SST:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }



HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.). If using a torque wrench with a length that is not 30 cm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the "without SST" torque specification (Click here).**
- **Make sure SST and the wrench are connected in a straight line.**

3. INSTALL FRONT NO. 2 EXHAUST PIPE ASSEMBLY

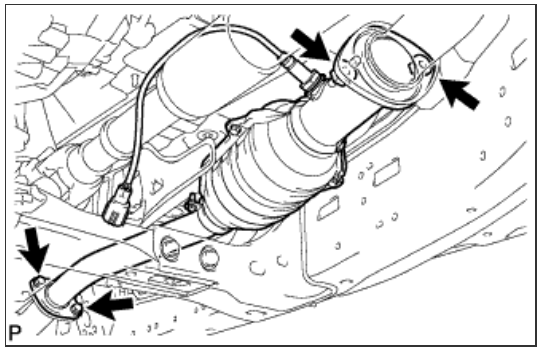
a. Install 2 new gaskets to the ront o2 exhaust pipe.

b. Connect the ront o2 exhaust pipe to the exhaust mani ol with 2 new nuts.

Torque:
54 N*m{ 554 kgf*cm , 40 ft.*lbf }

c. Connect the ront o2 exhaust pipe to the center exhaust pipe with the 2 bolts.

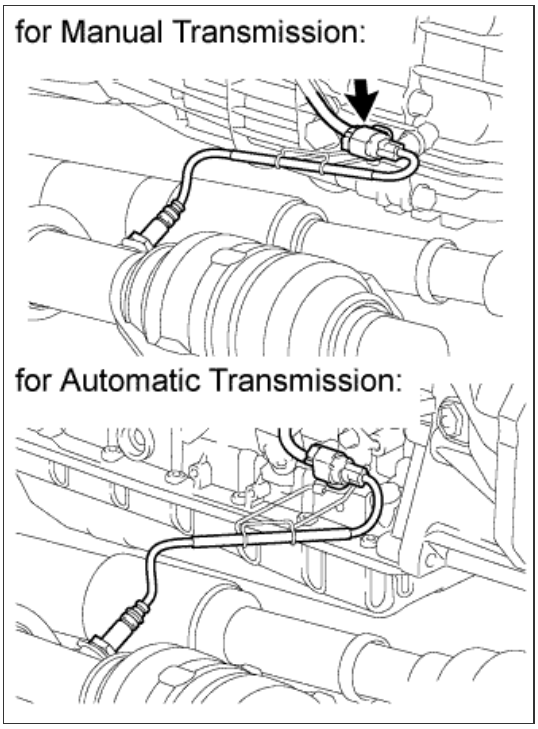
Torque:
48 N*m{ 489 kgf*cm , 35 ft.*lbf }



d. Connect the heated oxygen sensor connector.

HINT:

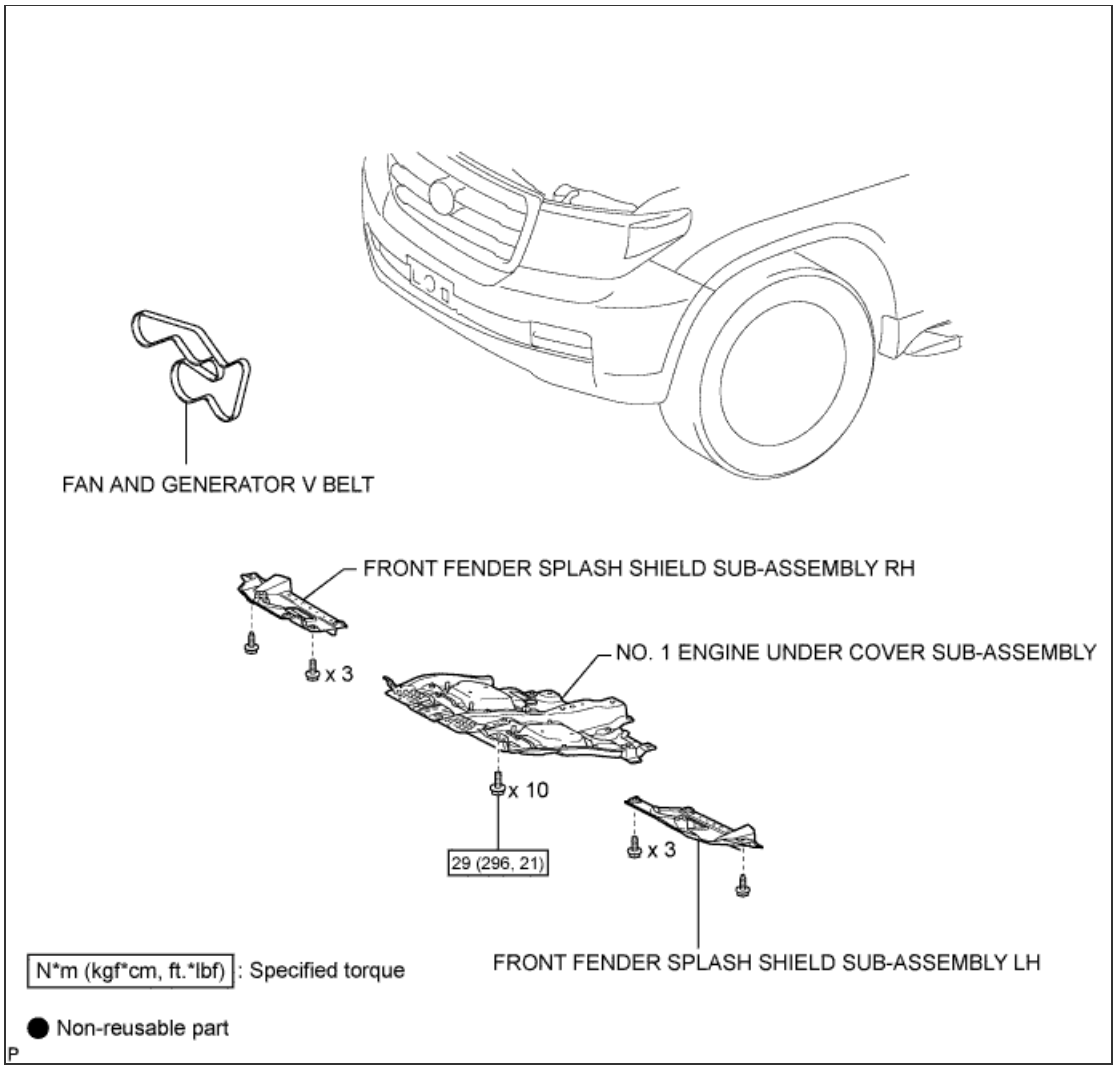
ol the wire harness to the bracket.

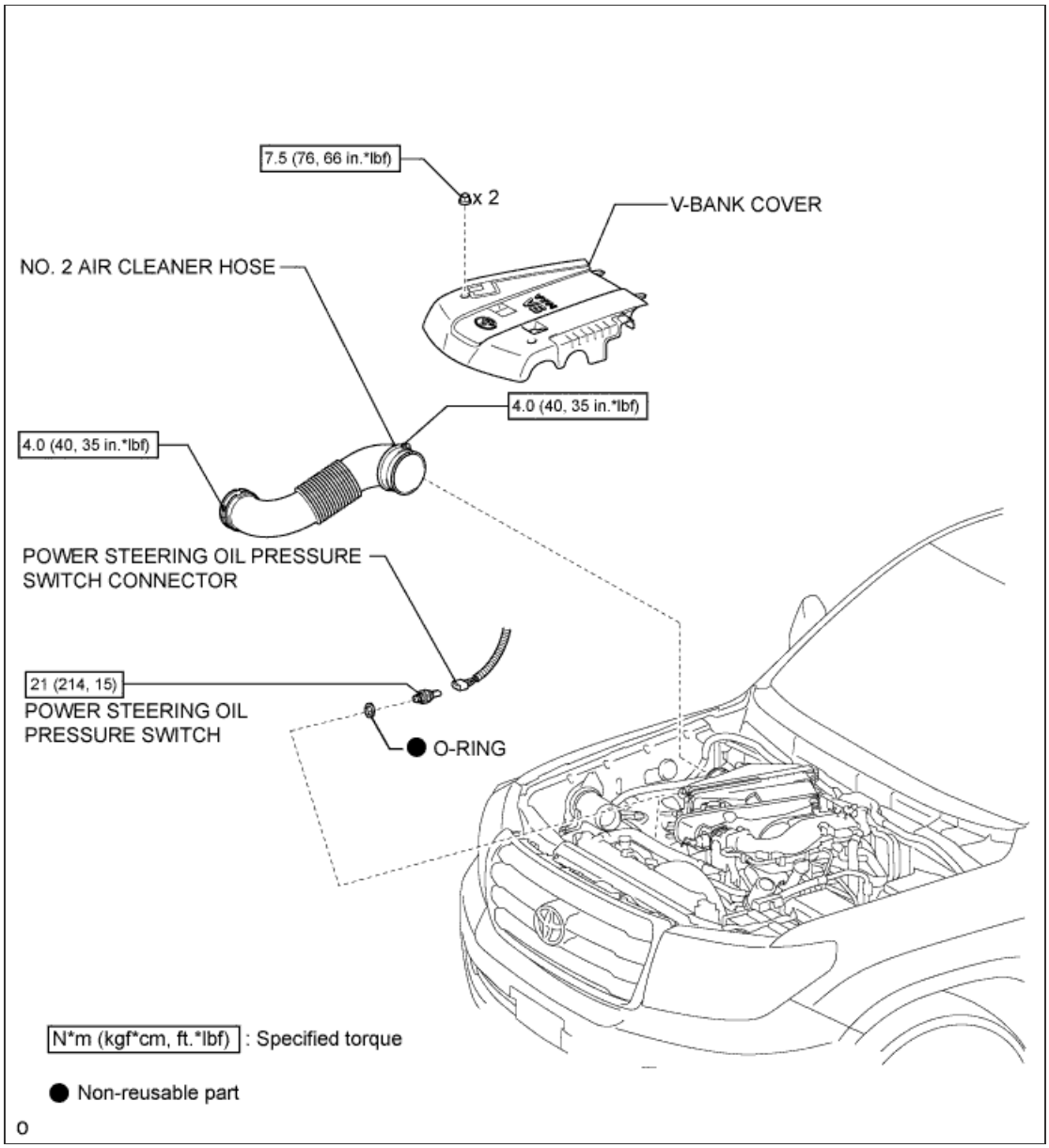


4. INSPECT FOR EXHAUST GAS LEAK

I gas is leaking, tighten the areas necessary to stop the leak. eplace damaged parts as necessary.

for Preparation Click here




7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER
NO. 2 AIR CLEANER HOSE
4.0 (40, 35 in.*lbf)
4.0 (40, 35 in.*lbf)
POWER STEERING OIL PRESSURE SWITCH CONNECTOR
21 (214, 15)
POWER STEERING OIL PRESSURE SWITCH
O-RING
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

for Preparation Click here

1. INSPECT POWER STEERING OIL PRESSURE SWITCH

a. Check the oil pressure switch.

i. Connect the intelligent tester to the DLC3.

ii. Turn the ignition switch on (IG).

iii. Turn the intelligent tester on.

iv. Enter the following menus: Powertrain / Engine and ECT / Data List / Power Steering Switch.

v. Start the engine.

vi. Operate the steering wheel while idling, and read the value on the Techstream.

Standard:

Condition	Specified Condition
Power steering not operating	0 to 2 MPa
Power steering operating	Values change from above value

If not as specified, check for DTCs (Click here). If the power steering system inspection results are normal and a DTC is not output, replace the power steering oil pressure switch.
Inspect the power steering system (Click here). If the power steering system inspection results are normal and a DTC is not output, replace the power steering oil pressure switch.

for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

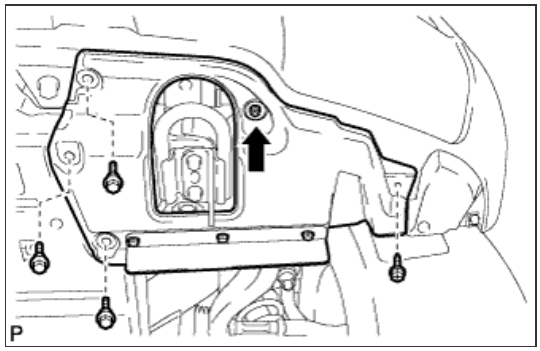
HINT:

Use the same procedures described for the LH side.

2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.

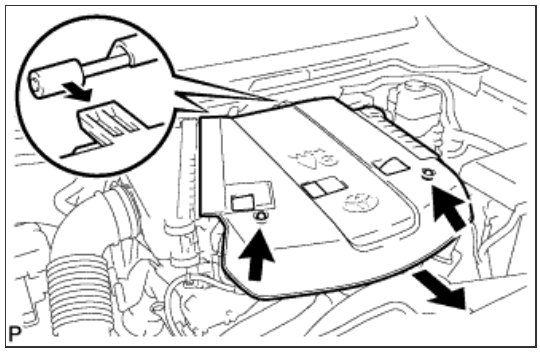


3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and engine under cover.

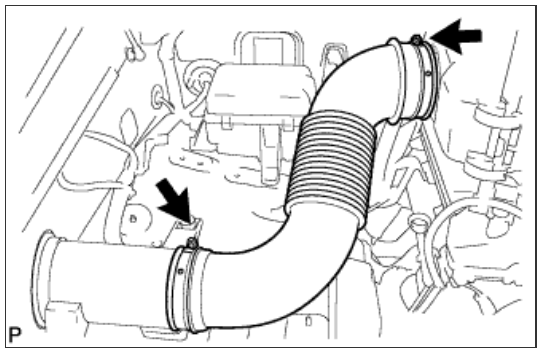
4. REMOVE V-BANK COVER

a. Remove the 2 cap nuts and ban cover.



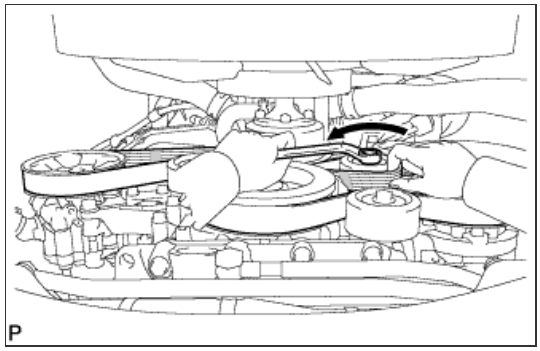
5. REMOVE NO. 2 AIR CLEANER HOSE

a. Loosen the 2 hose clamps and remove the air cleaner hose.



6. REMOVE FAN & GENERATOR V BELT

a. While releasing the belt tension by turning the belt tensioner countercloc wise, remove the fan and generator belt from the belt tensioner.

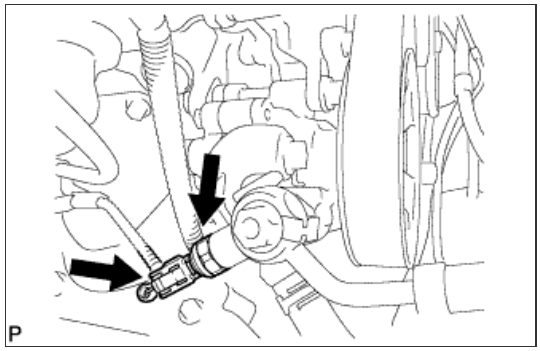


7. DRAIN POWER STEERING FLUID

8. REMOVE POWER STEERING OIL PRESSURE SWITCH

a. Disconnect the oil pressure switch connector.

b. Using a 1 mm deep soc et wrench, remove the oil pressure switch.



for Preparation Click here

1. INSTALL POWER STEERING OIL PRESSURE SWITCH

a. Install a new O-ring to the oil pressure switch.

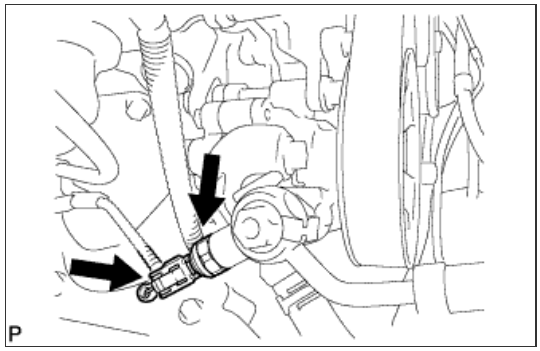
b. Apply a light coat of engine oil to the O-ring of the oil pressure switch.

c. Using a 19 mm deep socket wrench, install the oil pressure switch.

Torque:
21 N*m{ 210 kgf*cm , 15 ft.*lbf }

NOTICE:

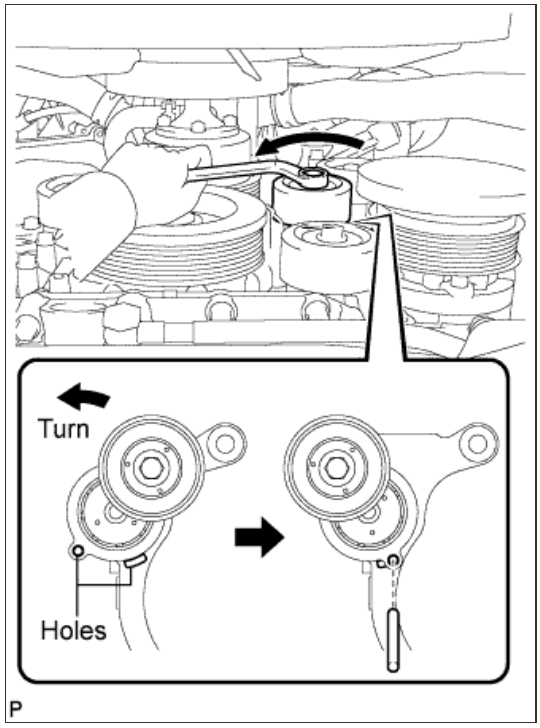
- **Do not allow foreign matter to contact the oil seal face of the power steering oil pressure switch (connecting surface with pressure feed tube).**
- **Be careful not to damage the O-ring when installing the power steering oil pressure switch**



d. Connect the oil pressure switch connector.

2. INSTALL FAN & GENERATOR V BELT

a. While turning the belt tensioner counterclockwise, align the holes, and then insert a bar of φ6 mm (0.236 in.) into the holes to fix the belt tensioner in place.



b. Install the fan and generator V belt.

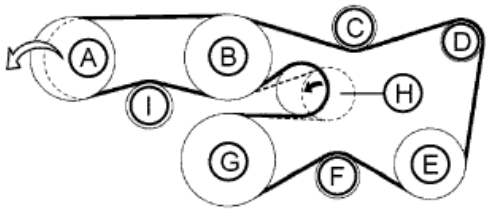
HINT:

If it is hard to install the fan and generator V belt, perform the following procedures.

1. **Put the fan and generator V belt on all parts except the vane pump, as shown in the illustration.**

2. **While releasing the belt tension by turning the belt tensioner counterclockwise, put the fan and generator V belt on the vane pump.**

c. While turning the belt tensioner counterclockwise, remove the bar.



A: Vane Pump

B: Water Pump

C: No. 2 Idler

D: Generator

E: Cooler Compressor

F: No. 1 Idler

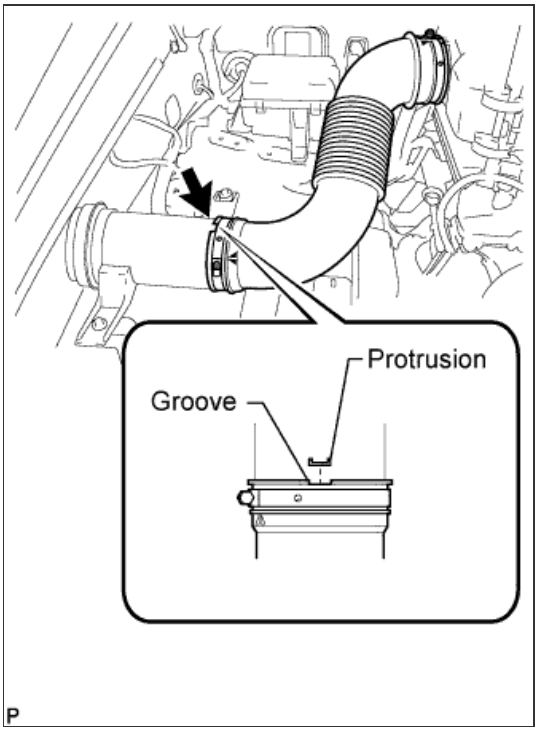
G: Crankshaft

H: V-Ribbed Belt Tensioner

I: No. 2 Idler

3. INSTALL NO. 2 AIR CLEANER HOSE

a. Align the protrusion of the pre-cleaner with the groove of the No. 2 air cleaner hose as shown in the illustration.

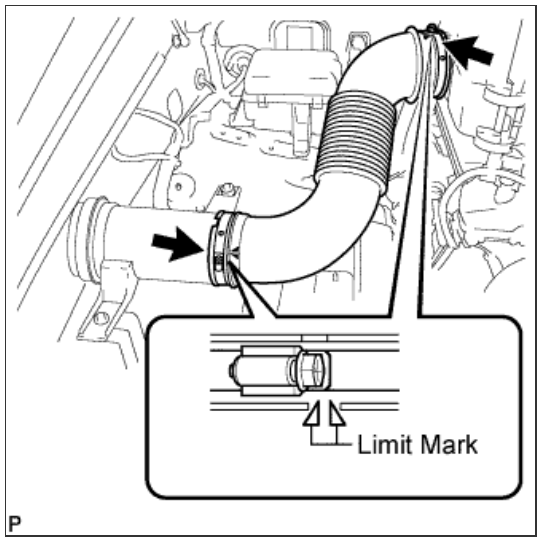


b. Tighten the 2 hose clamps.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }

HINT:

Tighten the clamp until the end of the clamp band is within both limit marks.



4. ADD POWER STEERING FLUID

5. INSPECT FOR POWER STEERING FLUID LEAK

6. BLEED POWER STEERING FLUID

a. Check the fluid level.

b. Jack up the front of the vehicle and support it with stands.

c. Turn the steering wheel.

i. With the engine stopped, turn the wheel slowly from lock to lock several times.

d. Lower the vehicle.

e. Start the engine.

f. Idle the engine for a few minutes.

g. Turn the steering wheel.

i. With the engine idling, turn the wheel left or right to the full lock position and keep it there for 2 to 3 seconds, then turn the wheel to the opposite full lock position and keep it there for 2 to 3 seconds. *1

ii. Repeat *1 several times.

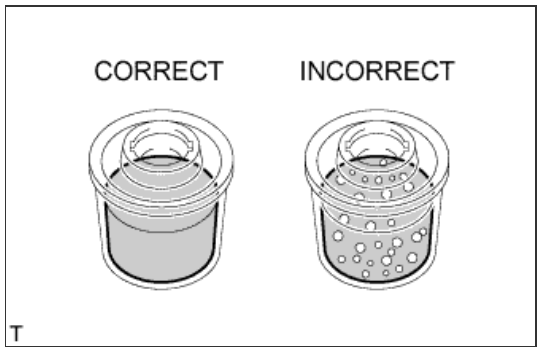
NOTICE:

For vehicles with VGRS, if the steering wheel is turned from lock to lock repeatedly, the system may stop operating and the amount of rotation before the steering wheel locks may increase due to operation of the overheating prevention function. When the system temperature drops, the system operation automatically returns to normal.

h. Stop the engine.

i. Check for foaming or emulsification.
If the system has to be bled twice because of foaming or emulsification, check for fluid leaks in the system.

j. Check the fluid level.



7. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

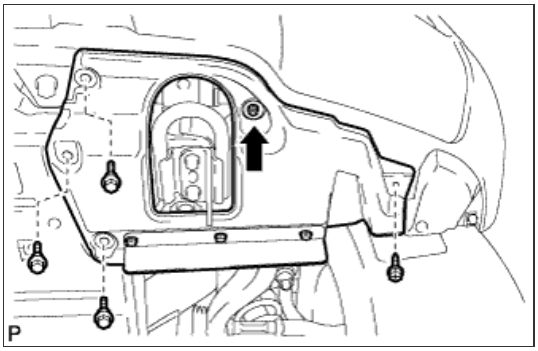
a. Install the engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

8. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



9. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

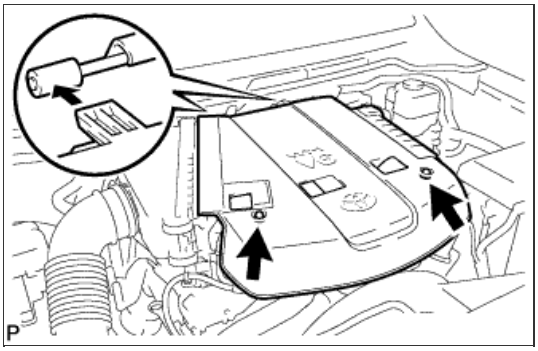
HINT:

Use the same procedures described for the LH side.

10. INSTALL V-BANK COVER

a. Install the V-bank cover with the 2 cap nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



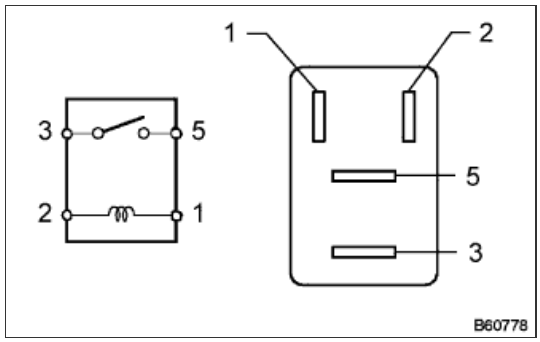
for Preparation Click here

1. INSPECT CIRCUIT OPENING RELAY (C/OPN)

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage is not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage is applied to terminals 1 and 2	Below 1 Ω



If the result is not as specified, replace the relay.

2. INSPECT INTEGRATION RELAY (IG2)

a. Measure the resistance of the IG2 MAIN fuse.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
IG2 MAIN fuse	Always	Below 1 Ω

If the result is not as specified, replace the IG2 MAIN fuse.

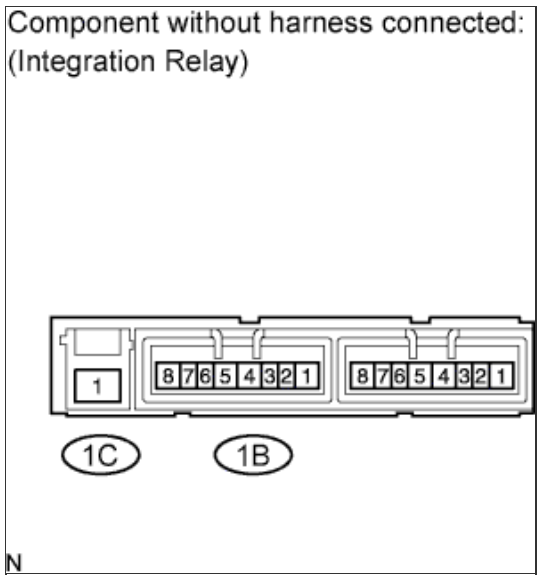
b. Measure the resistance of the ignition relay No. 2 (IG2) circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1B-8	Battery voltage is not applied to terminals 1B-6 and 1B-7	10 kΩ or higher
	Battery voltage is applied to terminals 1B-6 and 1B-7	Below 1 Ω

If the result is not as specified, replace the integration relay.



3. INSPECT INTEGRATION RELAY (EFI)

a. Measure the resistance of the EFI MAIN fuse.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAIN fuse	Always	Below 1 Ω

If the result is not as specified, replace the EFI MAIN fuse.

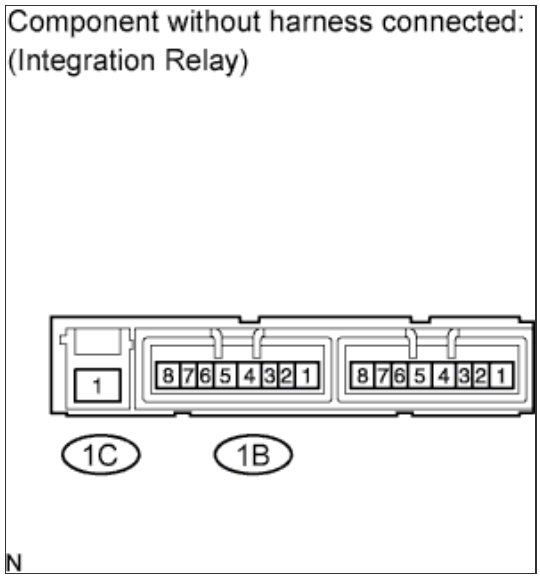
b. Measure the resistance of the EFI relay circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1B-4	Battery voltage is not applied to terminals 1B-2 and 1B-3	10 kΩ or higher
	Battery voltage is applied to terminals 1B-2 and 1B-3	Below 1 Ω

If the result is not as specified, replace the integration relay.



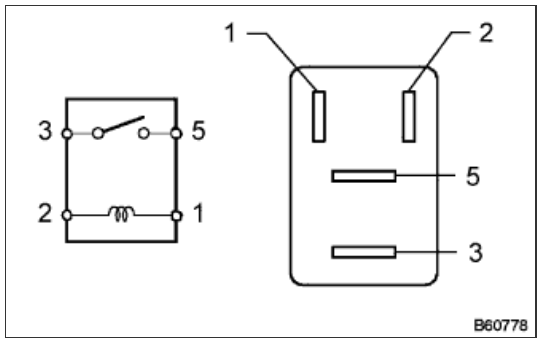
4. INSPECT EFI NO. 2 RELAY (EFI NO. 2)

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage is not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage is applied to terminals 1 and 2	Below 1 Ω

If the result is not as specified, replace the relay.



5. INSPECT INTEGRATION RELAY (A/F)

a. Measure the resistance of the A/F fuse.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

If the result is not as specified, replace the A/F fuse.

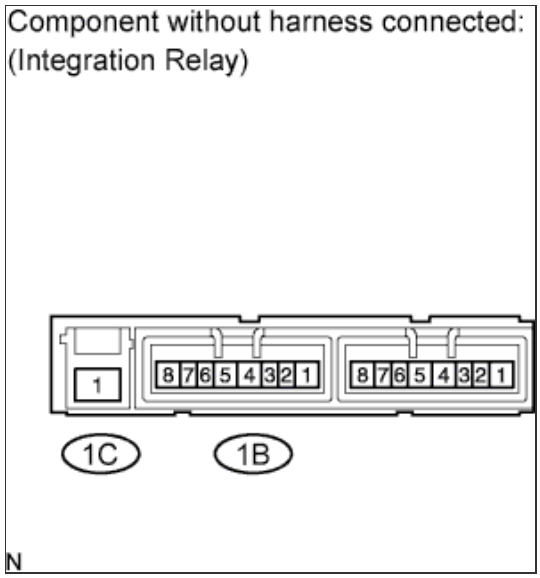
b. Measure the resistance of the A/F sensor heater relay circuit.

i. Measure the resistance according to the value(s) in the table below.

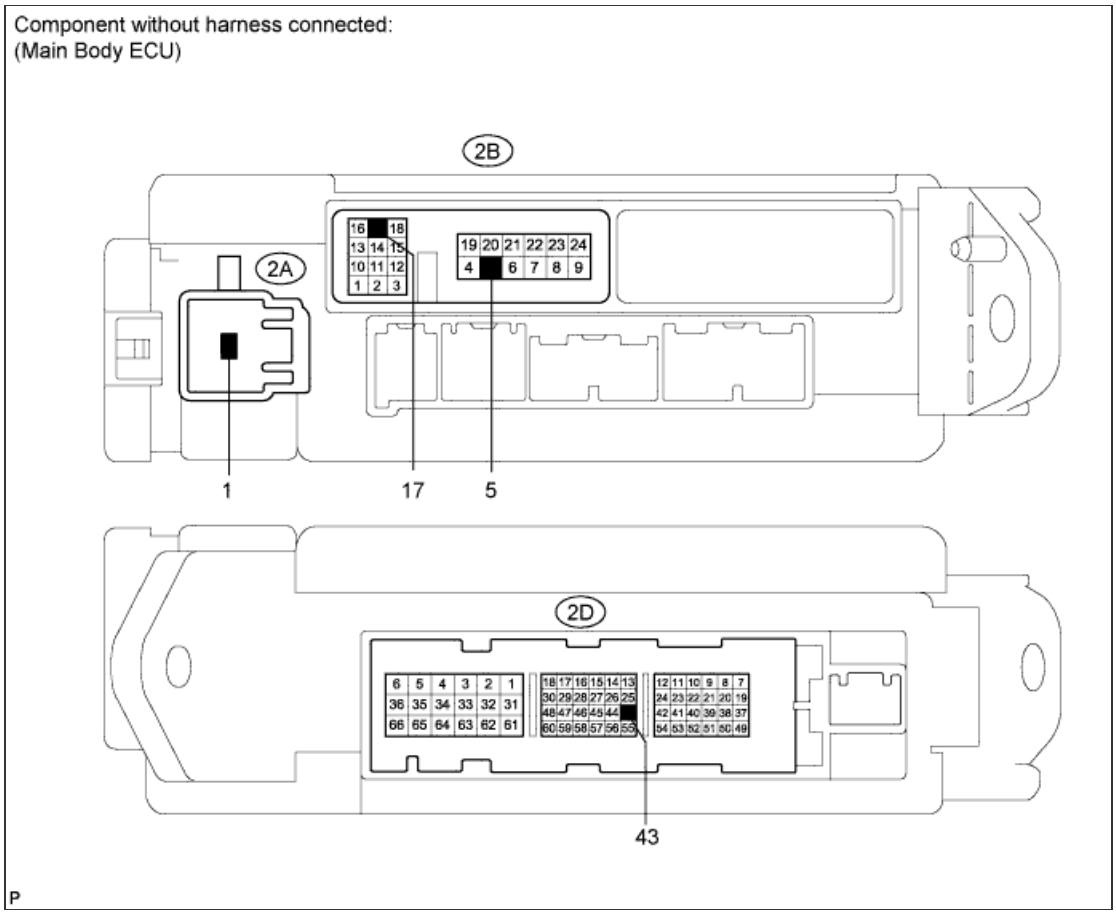
Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1A-4	Battery voltage is not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage is applied to terminals 1 A-2 and 1A-3	Below 1 Ω

If the result is not as specified, replace the integration relay.



6. INSPECT MAIN BODY ECU (IG1 NO. 1)



a. Measure the resistance according to the value(s) in the table below.

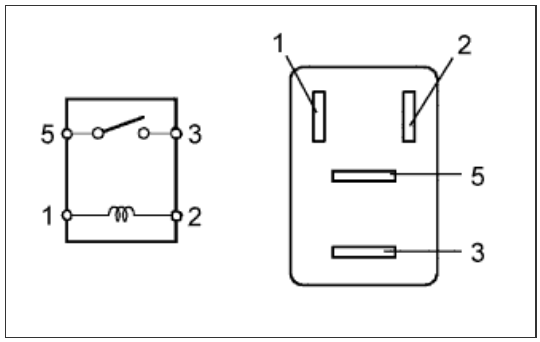
Standard Resistance:

Tester Connection	Condition	Specified Condition
2A-1 - 2B-17	Battery voltage is not applied to terminals 2B-5 and 2D-43	10 kΩ or higher
	Battery voltage is applied to terminals 2B-5 and 2D-43	Below 1 Ω

If the result is not as specified, replace the cowl side junction block LH.

7. INSPECT STARTER RELAY (ST)

a. Measure the resistance according to the value(s) in the table below.



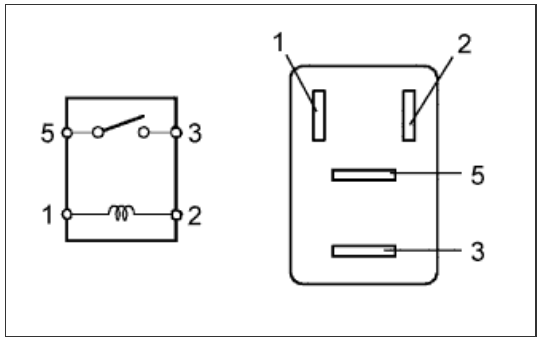
Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage applied to terminals 1 and 2	Below 1 Ω

If the result is not as specified, replace the relay.

8. INSPECT STARTER CUT RELAY (ST CUT)

a. Measure the resistance according to the value(s) in the table below.



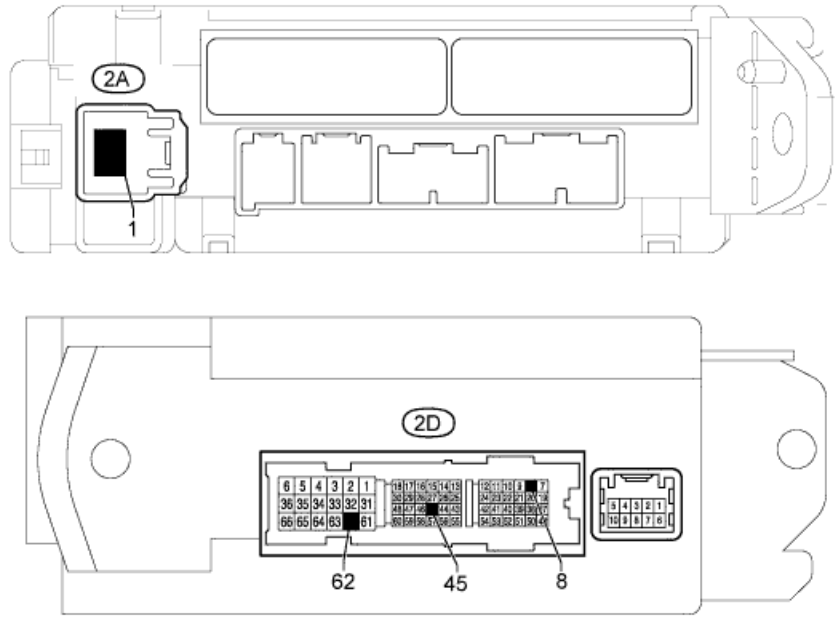
Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage applied to terminals 1 and 2	Below 1 Ω

If the result is not as specified, replace the relay.

9. INSPECT MAIN BODY ECU (ACC RELAY)

Component without harness connected: (Main Body ECU)



P

a. Measure the resistance of the ACC relay circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
2A-1 - 2D-8	Battery voltage not applied between 2D-45 and 2D-62	10 kΩ or higher
	Battery voltage applied between 2D-45 and 2D-62	Below 1 Ω

If the result is not as specified, replace the main body ECU.

for Preparation Click here

CAUTION:

When using the intelligent tester, observe the following items for safety reasons:

- **Read its instruction books before using the tester.**
- **Prevent the tester cable from being caught on the pedals, shift lever and steering wheel when driving with the tester connected to the vehicle.**
- **When driving the vehicle for testing purposes using the tester, 2 persons are required. One person drives the vehicle, and the other operates the tester.**

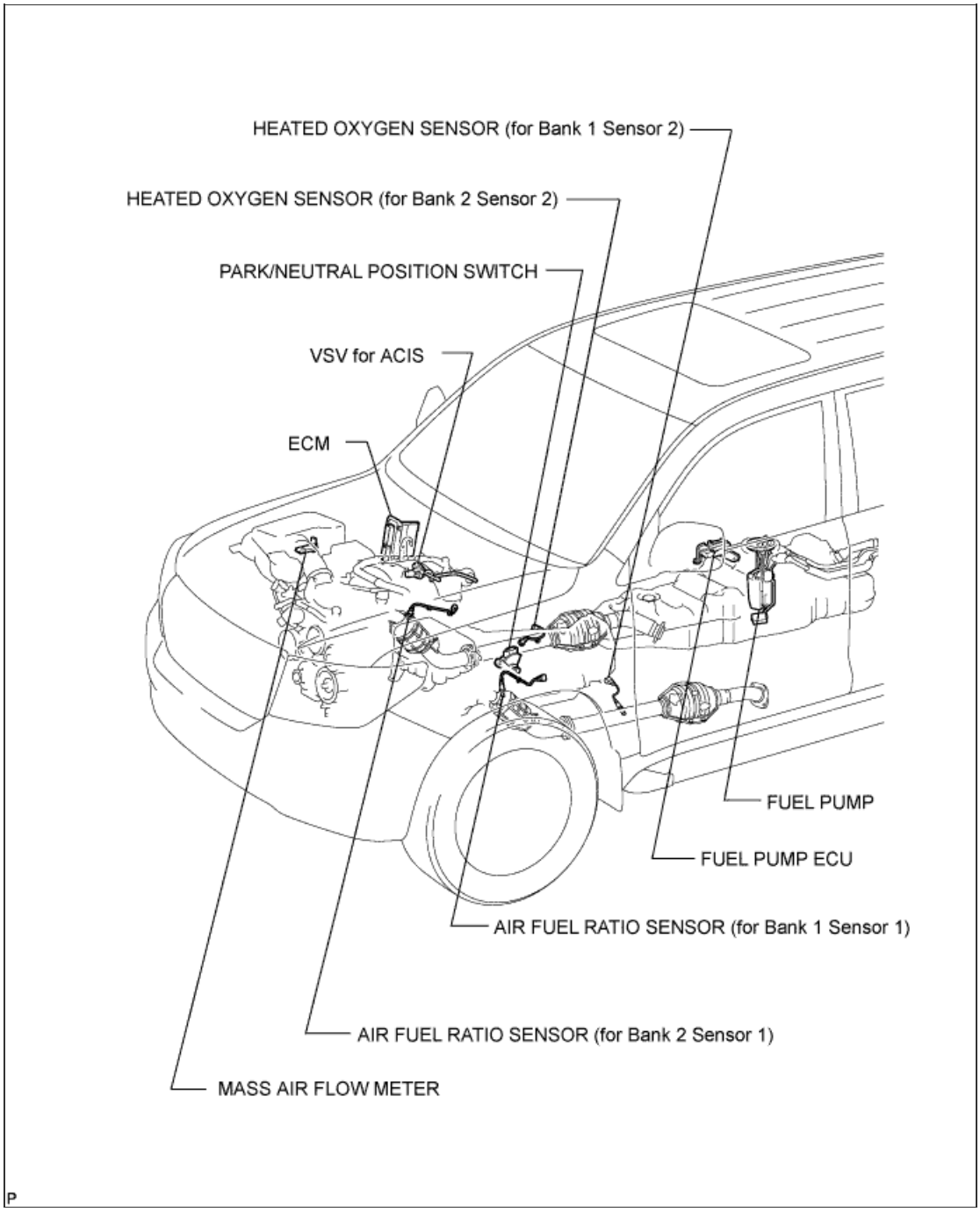
NOTICE:

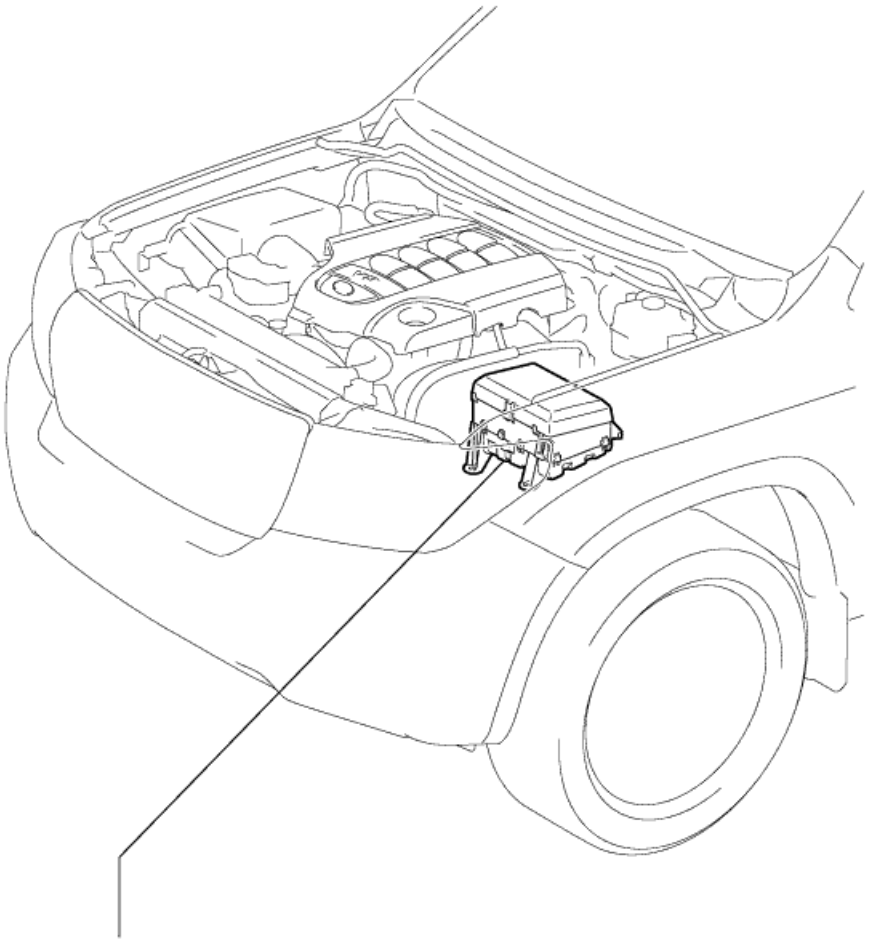
Perform eset Memory (AT initialization) for VD when repla ing the automati transmission assembly, engine assembly or ECM (Cli here)

HINT:

eset Memory annot be ompleted by only removing the battery

for Preparation Click here

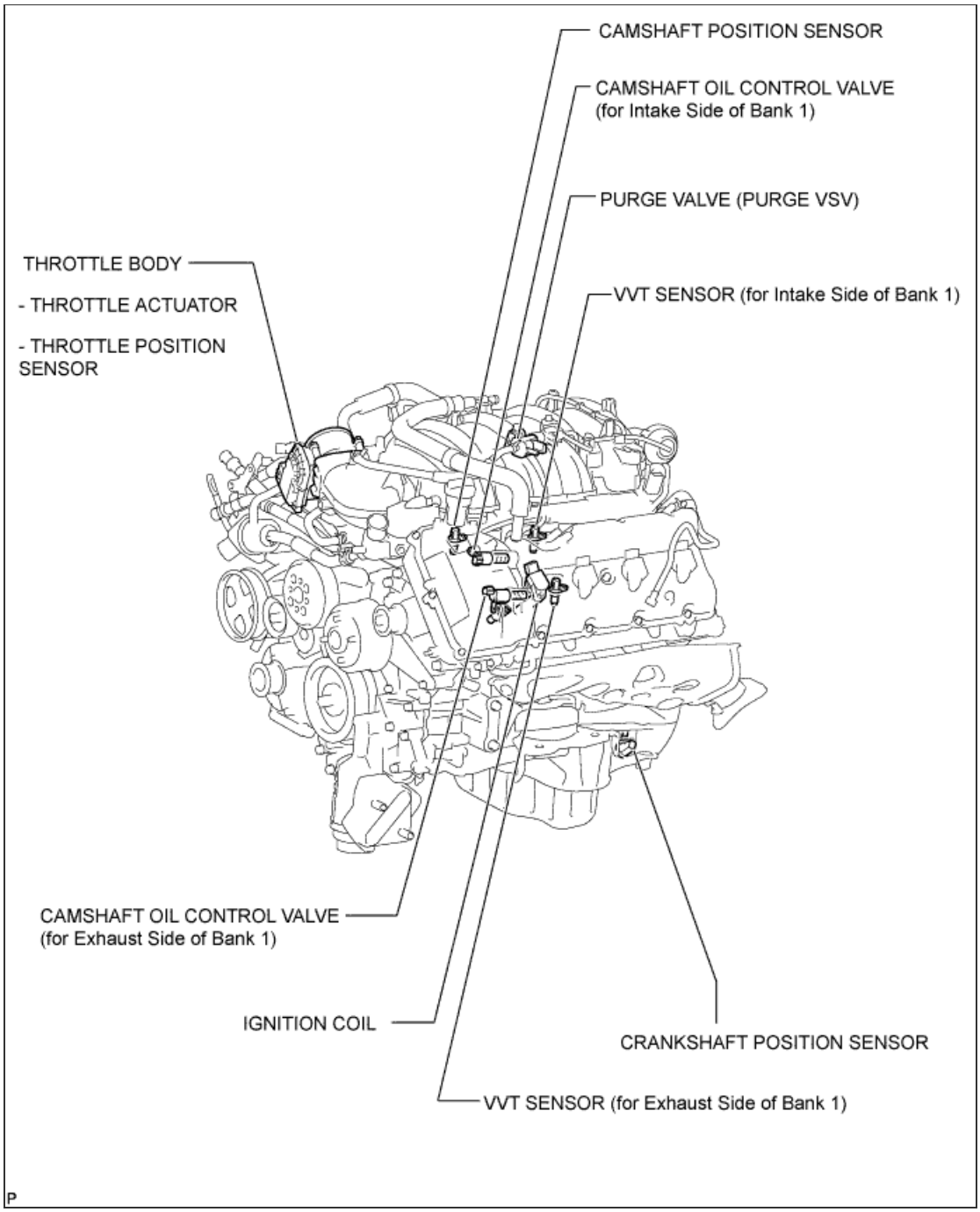


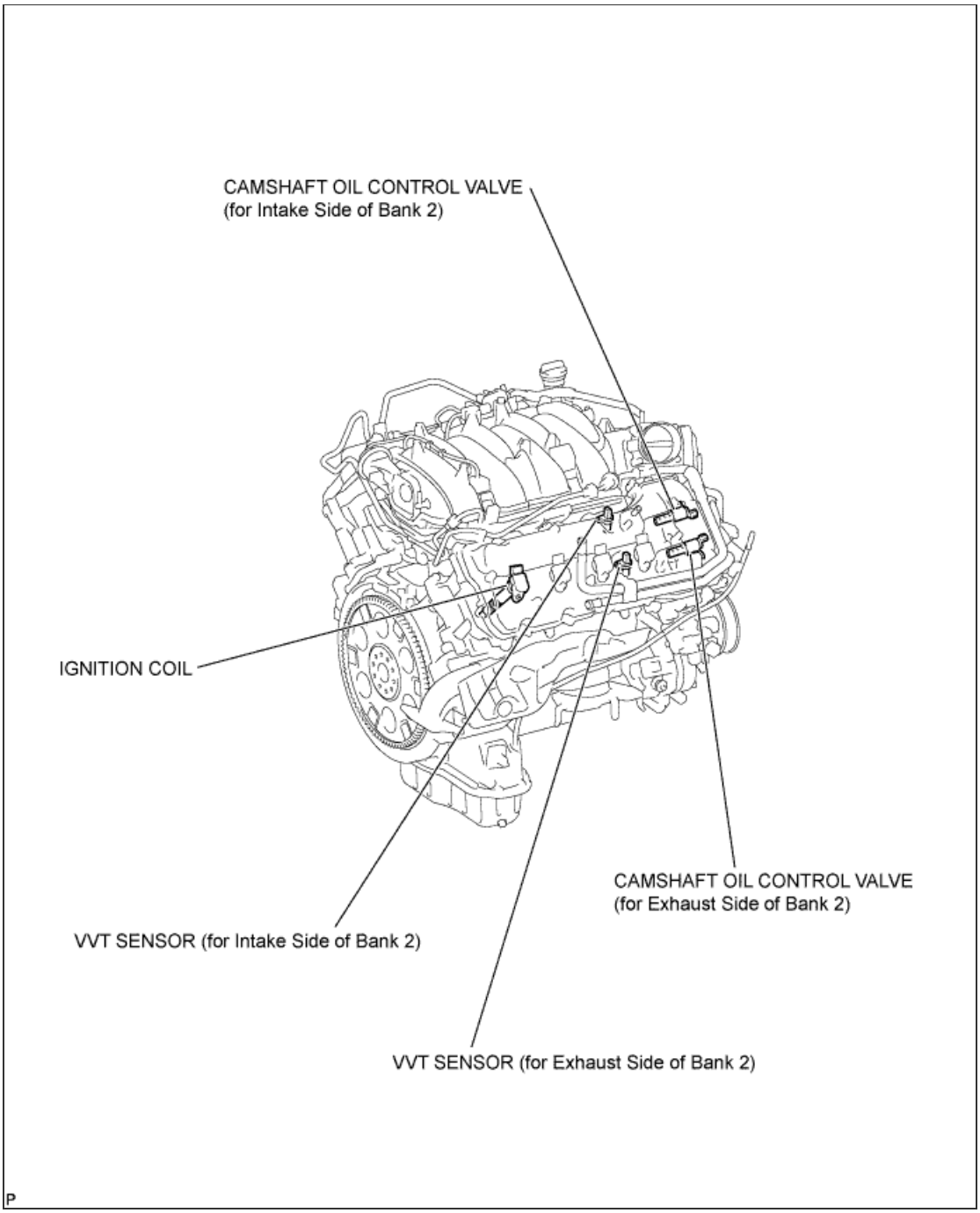


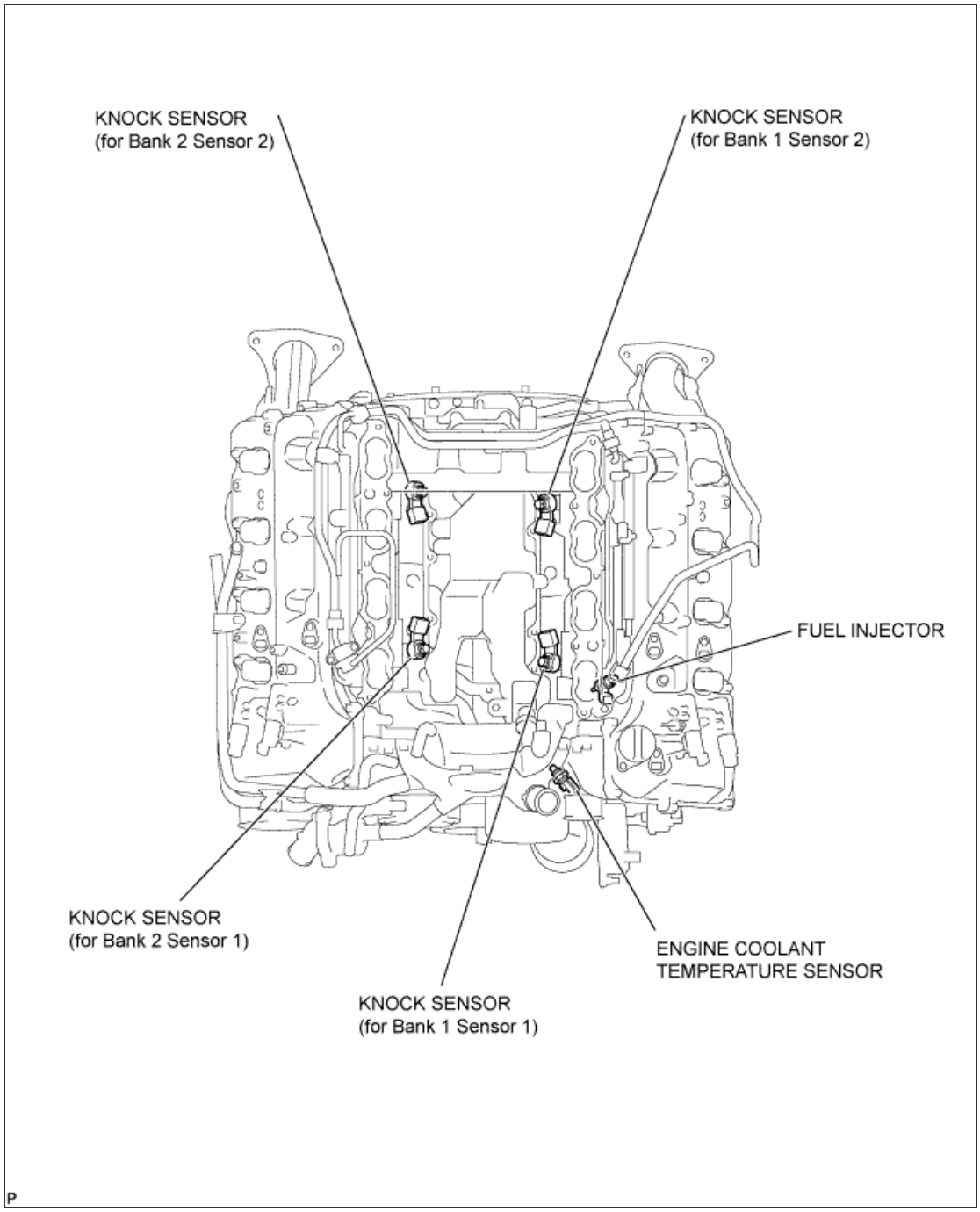
ENGINE ROOM RELAY BLOCK

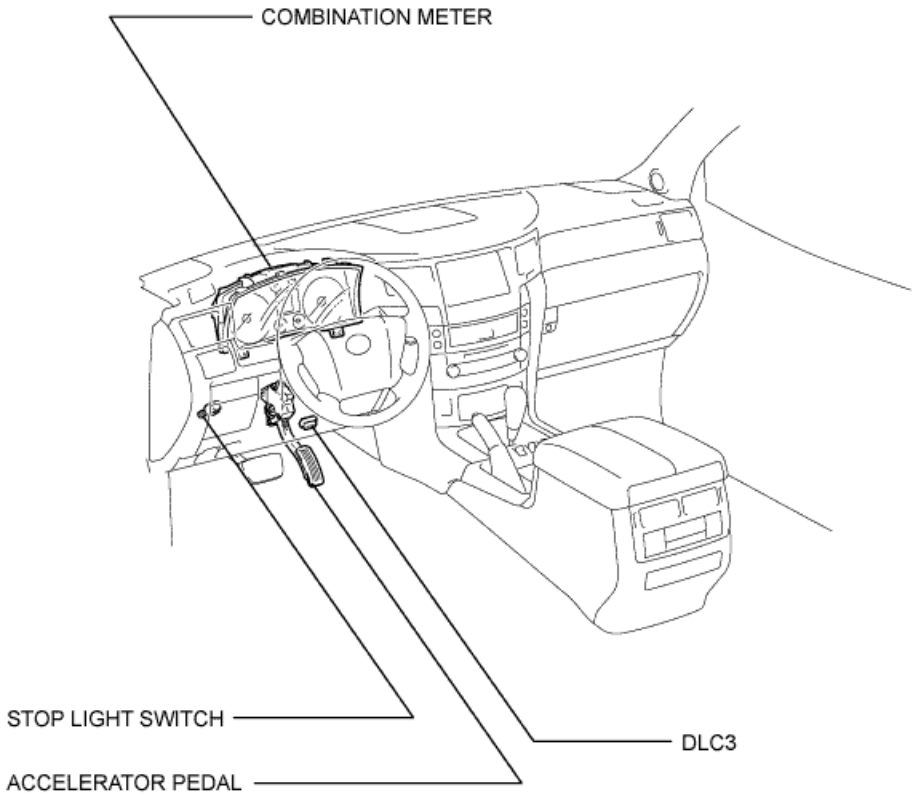
- CIRCUIT OPENING RELAY (C/OPN)
- IGNITION RELAY NO. 2 (IG2)
- EFI RELAY
- EFI NO. 2 RELAY
- A/F SENSOR HEATER RELAY (A/F)
- STARTER RELAY (ST)
- STARTER CUT RELAY (ST CUT)
- ETCS FUSE
- EFI MAIN 2 FUSE
- EFI NO. 2 FUSE
- A/F FUSE
- EFI MAIN FUSE
- STOP FUSE
- IG2 MAIN FUSE
- INJ FUSE
- IGN FUSE

P


CAMSHAFT POSITION SENSOR
CAMSHAFT OIL CONTROL VALVE
(for Intake Side of Bank 1)
PURGE VALVE (PURGE VSV)
THROTTLE BODY
- THROTTLE ACTUATOR
- THROTTLE POSITION SENSOR
VVT SENSOR (for Intake Side of Bank 1)
CAMSHAFT OIL CONTROL VALVE
(for Exhaust Side of Bank 1)
IGNITION COIL
CRANKSHAFT POSITION SENSOR
VVT SENSOR (for Exhaust Side of Bank 1)
P

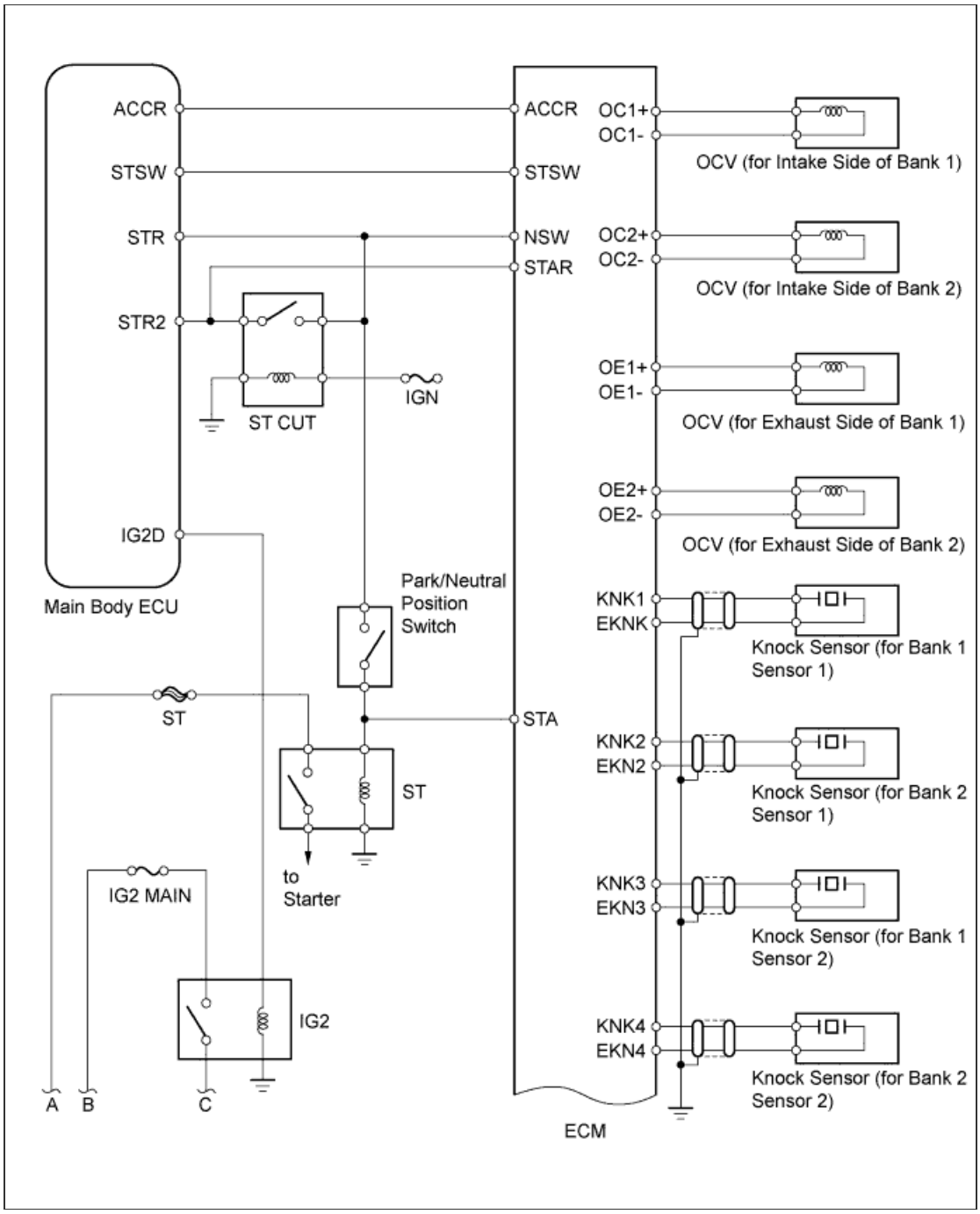

CAMSHAFT OIL CONTROL VALVE
(for Intake Side of Bank 2)
IGNITION COIL
CAMSHAFT OIL CONTROL VALVE
(for Exhaust Side of Bank 2)
VVT SENSOR (for Intake Side of Bank 2)
VVT SENSOR (for Exhaust Side of Bank 2)
P

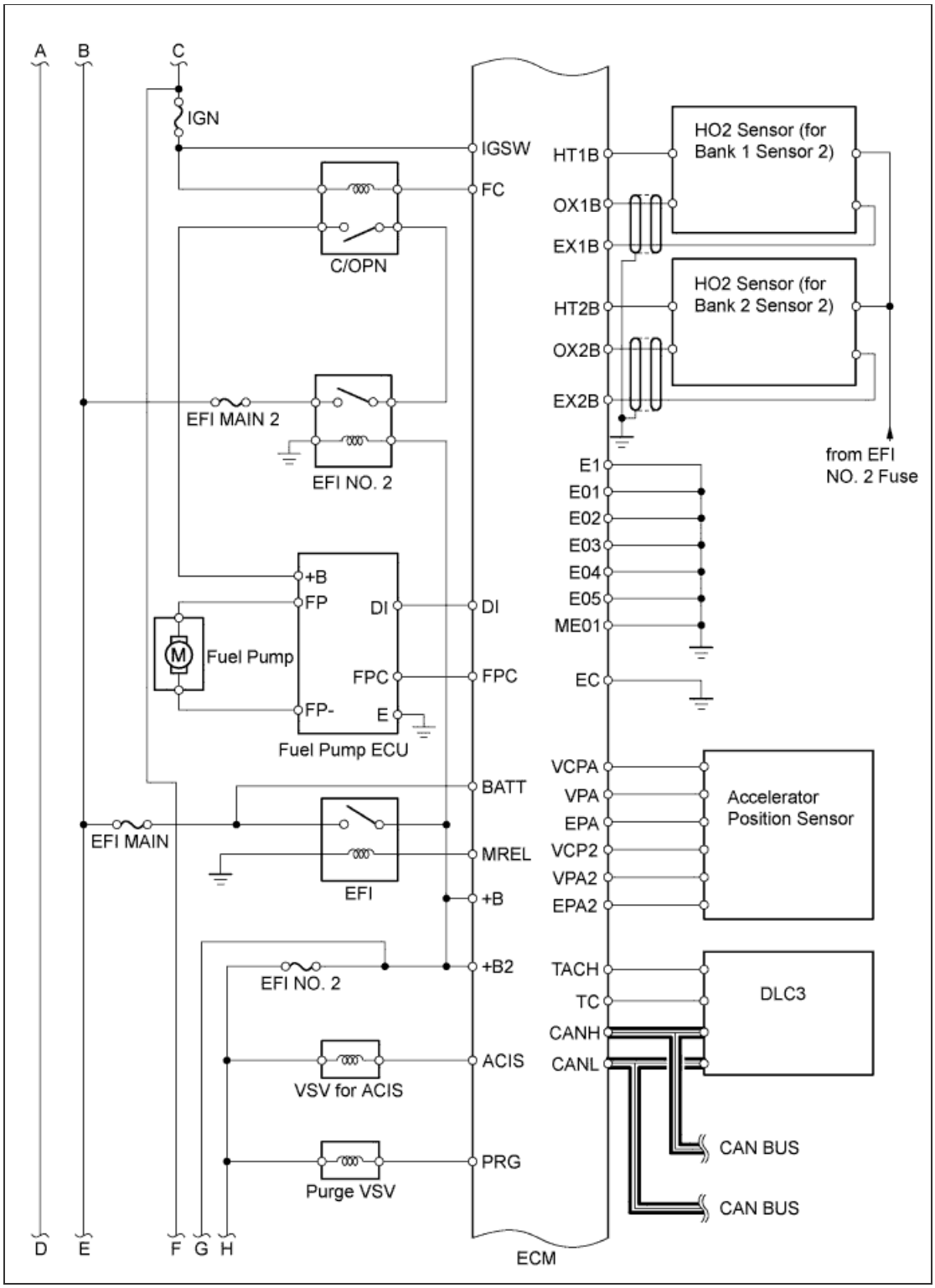

KNOCK SENSOR
(for Bank 2 Sensor 2)
KNOCK SENSOR
(for Bank 1 Sensor 2)
FUEL INJECTOR
KNOCK SENSOR
(for Bank 2 Sensor 1)
ENGINE COOLANT
TEMPERATURE SENSOR
KNOCK SENSOR
(for Bank 1 Sensor 1)
P

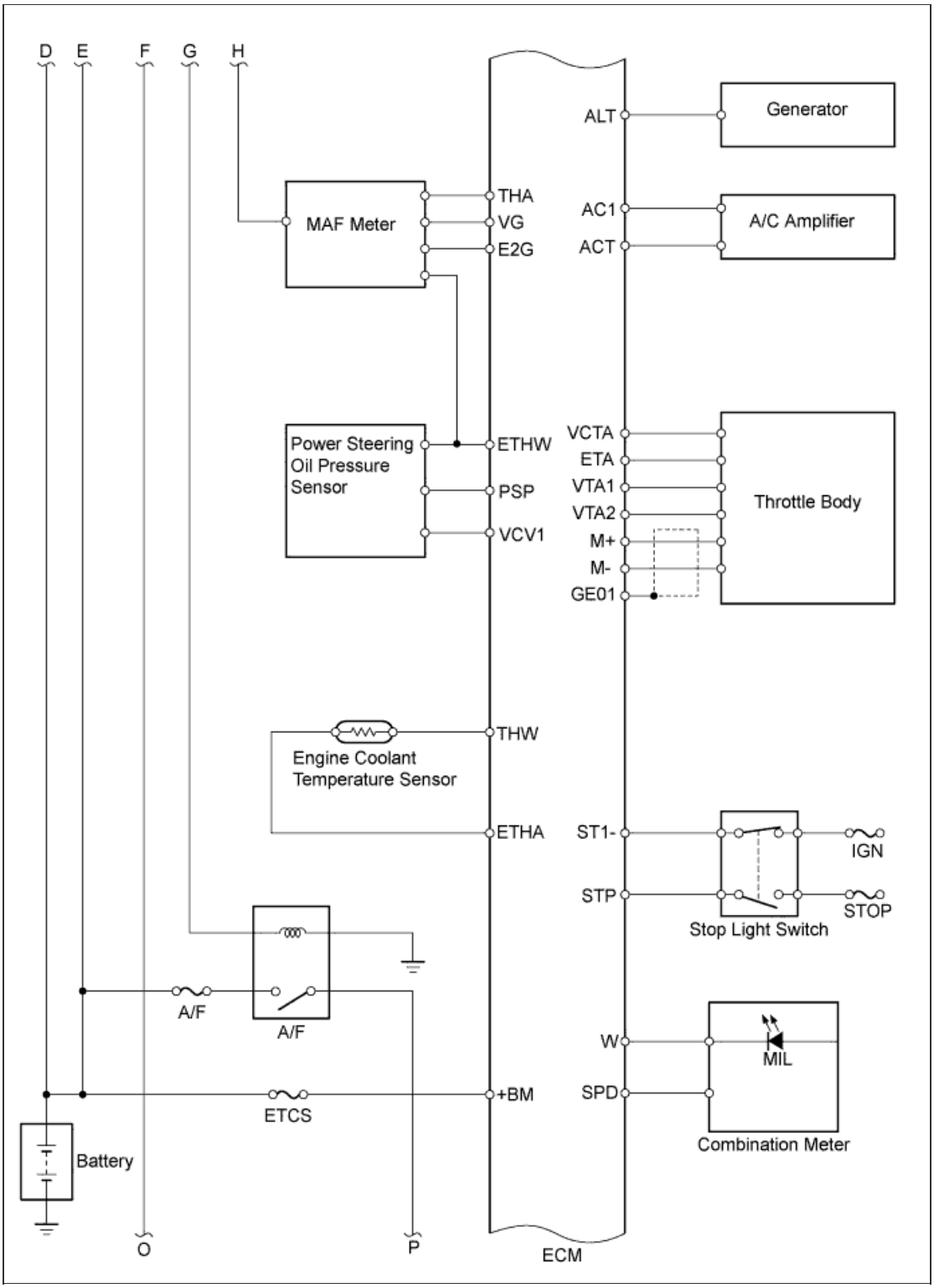

COMBINATION METER
STOP LIGHT SWITCH
ACCELERATOR PEDAL
DLC3

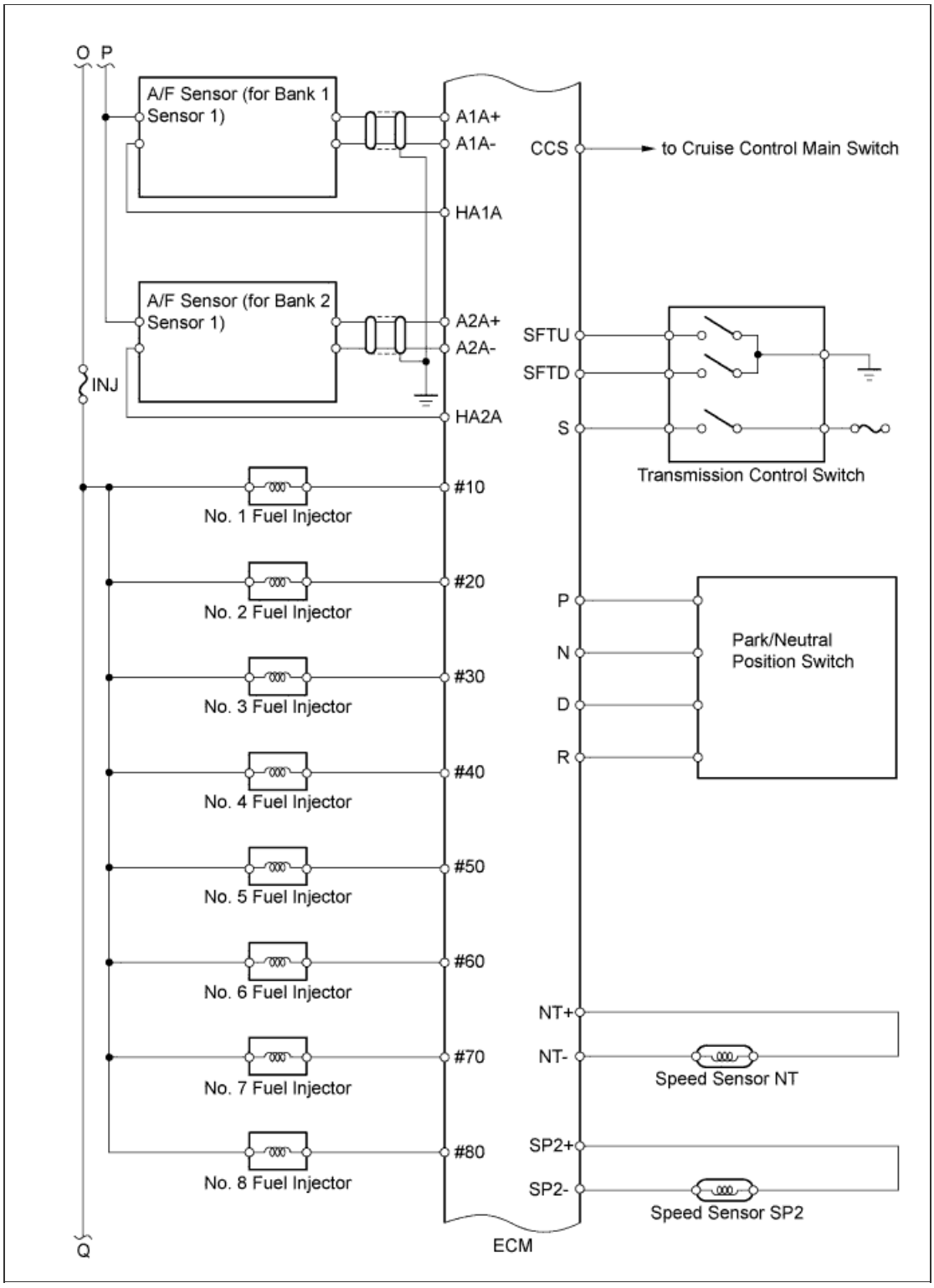
P

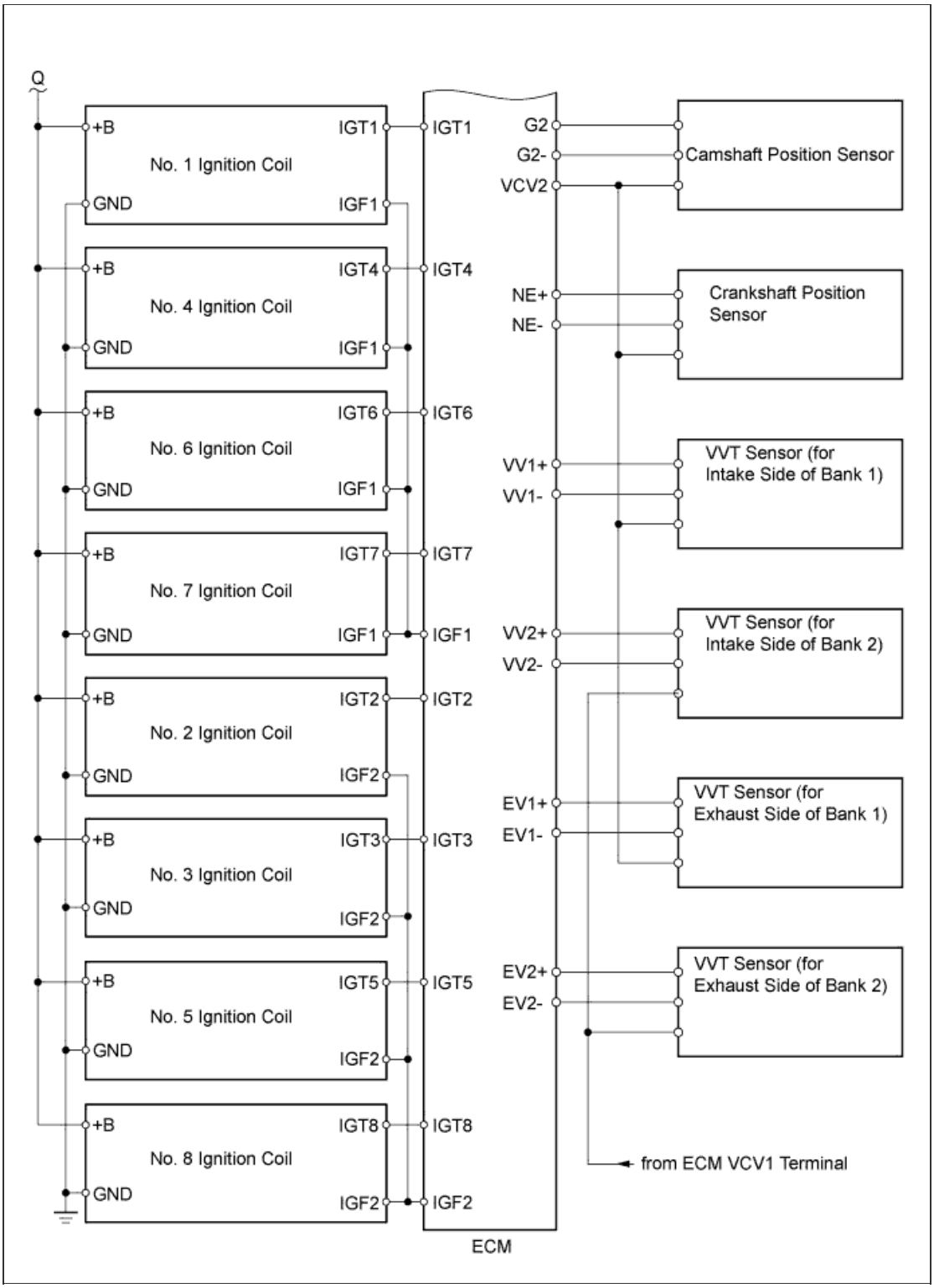
for Preparation Click here




A
B
C
IGN
IGSW
FC
C/OPN
EFI MAIN 2
EFI NO. 2
+B
FP
DI
DI
Fuel Pump
FPC
FPC
FP-
E
Fuel Pump ECU
BATT
EFI MAIN
MREL
EFI
+B
+B2
EFI NO. 2
ACIS
VSV for ACIS
PRG
Purge VSV
D
E
F
G
H
ECM
HT1B
OX1B
EX1B
HO2 Sensor (for Bank 1 Sensor 2)
HT2B
OX2B
EX2B
HO2 Sensor (for Bank 2 Sensor 2)
from EFI NO. 2 Fuse
E1
E01
E02
E03
E04
E05
ME01
EC
VCPA
VPA
EPA
VCP2
VPA2
EPA2
Accelerator Position Sensor
TACH
TC
CANH
CANL
DLC3
CAN BUS
CAN BUS


D
E
F
G
H
ALT
Generator
MAF Meter
THA
VG
E2G
AC1
ACT
A/C Amplifier
Power Steering
Oil Pressure
Sensor
ETHW
PSP
VCV1
VCTA
ETA
VTA1
VTA2
M+
M-
GE01
Throttle Body
Engine Coolant
Temperature Sensor
THW
ETHA
ST1-
IGN
STP
STOP
Stop Light Switch
A/F
A/F
W
MIL
SPD
+BM
ETCS
Battery
Combination Meter
O
P
ECM


O
P
A/F Sensor (for Bank 1 Sensor 1)
A1A+
A1A-
HA1A
A/F Sensor (for Bank 2 Sensor 1)
A2A+
A2A-
HA2A
INJ
Q
No. 1 Fuel Injector
#10
No. 2 Fuel Injector
#20
No. 3 Fuel Injector
#30
No. 4 Fuel Injector
#40
No. 5 Fuel Injector
#50
No. 6 Fuel Injector
#60
No. 7 Fuel Injector
#70
No. 8 Fuel Injector
#80
ECM
CCS
to Cruise Control Main Switch
SFTU
SFTD
S
Transmission Control Switch
P
N
D
R
Park/Neutral Position Switch
NT+
NT-
Speed Sensor NT
SP2+
SP2-
Speed Sensor SP2


Q
+B
GND
IGT1
IGF1
No. 1 Ignition Coil
+B
GND
IGT4
IGF1
No. 4 Ignition Coil
+B
GND
IGT6
IGF1
No. 6 Ignition Coil
+B
GND
IGT7
IGF1
No. 7 Ignition Coil
+B
GND
IGT2
IGF2
No. 2 Ignition Coil
+B
GND
IGT3
IGF2
No. 3 Ignition Coil
+B
GND
IGT5
IGF2
No. 5 Ignition Coil
+B
GND
IGT8
IGF2
No. 8 Ignition Coil
IGT1
IGT4
IGT6
IGT7
IGF1
IGT2
IGT3
IGT5
IGT8
IGF2
ECM
G2
G2-
VCV2
Camshaft Position Sensor
NE+
NE-
Crankshaft Position Sensor
VV1+
VV1-
VVT Sensor (for Intake Side of Bank 1)
VV2+
VV2-
VVT Sensor (for Intake Side of Bank 2)
EV1+
EV1-
VVT Sensor (for Exhaust Side of Bank 1)
EV2+
EV2-
VVT Sensor (for Exhaust Side of Bank 2)
from ECM VCV1 Terminal

for Preparation Click here

HINT:

*: Use the intelligent tester.

1.VEHICLE BROUGHT TO WORKSHOP

NEXT

2.CUSTOMER PROBLEM ANALYSIS

NEXT

3.CONNECT INTELLIGENT TESTER TO DLC3

HINT:

If the display indicates a communication fault in the intelligent tester, inspect the DLC3.

NEXT

4.CHECK DTC AND FREEZE FRAME DATA*

HINT:

Record or print DTCs and freeze frame data, if necessary.

NEXT

5.CLEAR DTC AND FREEZE FRAME DATA*

NEXT

6.CONDUCT VISUAL INSPECTION

NEXT

7.SET CHECK MODE DIAGNOSIS*

NEXT

8.CONFIRM PROBLEM SYMPTOMS

HINT:

If the engine does not start, first perform the "Check DTC" procedures and "Conduct Basic Inspection" procedures below.

Result

Result	Proceed to
Malfunction does not occur	A
Malfunction occurs	B

B. Go to step 10

A

9.SIMULATE SYMPTOMS

NEXT

10.CHECK DTC*

Result

Result	Proceed to
Trouble code	A
No code	B

B. Go to step 12

A

11.REFER TO DTC CHART

NEXT

Go to step 14

12.CONDUCT BASIC INSPECTION

Result

Result	Proceed to
Malfunctioning parts not confirmed	A
Malfunctioning parts confirmed	B

B. Go to step 17

A

13.REFER TO PROBLEM SYMPTOMS TABLE

Result

Result	Proceed to
Malfunctioning circuit confirmed	A
Malfunctioning parts confirmed	B

B. Go to step 17

A

14.CHECK ECM POWER SOURCE CIRCUIT

NEXT

15.CONDUCT CIRCUIT INSPECTION

Result

Result	Proceed to
Malfunction not confirmed	A
Malfunction confirmed	B

B. Go to step 18

A

16.CHECK FOR INTERMITTENT PROBLEMS

NEXT

Go to step 18

17.CONDUCT PARTS INSPECTION

NEXT

18.IDENTIFY PROBLEM

NEXT

19.ADJUST AND/OR REPAIR

NEXT

20.CONDUCT CONFIRMATION TEST

NEXT

END

for Preparation Click here

HINT:

Inspect the vehicle ECM using check mode. Intermittent problems are easier to detect with the intelligent tester when the ECM is in check mode. In check mode, the ECM uses 1 trip detection logic, which is more sensitive to malfunctions than normal mode (default), which uses 2 trip detection logic.

1. **Clear the DTCs (Click here).**
2. **Switch the ECM from normal mode to check mode using the tester (Click here).**
3. **Perform a simulation test.**
4. **Check and wiggle the harness(es), connector(s) and terminal(s).**

for Preparation Click here

When a malfunction is not confirmed by the DTC check, troubleshooting should be carried out in all circuits considered to be possible causes of the problem. In many cases, by carrying out the basic engine check shown in the following flowchart, the location of the problem can be found quickly and efficiently. Therefore, using this check is essential when performing engine troubleshooting.

1.CHECK BATTERY VOLTAGE

NOTICE:

Conduct this check with the engine stopped and engine switch off.

Result

Result	Proceed to
11 V or higher	OK
Below 11 V	NG

NG. → CHARGE OR REPLACE BATTERY

OK ↓

2.CHECK WHETHER ENGINE WILL CRANK

NG. → PROCEED TO PROBLEM SYMPTOMS TABLE

OK ↓

3.CHECK WHETHER ENGINE STARTS

NG. → Go to step 6

OK ↓

4.CHECK AIR FILTER

a. Visually check that the air filter is not excessively contaminated with dirt or oil.

NG. → REPLACE AIR FILTER

OK ↓

5.CHECK IDLING SPEED

NG. → TROUBLESHOOT IDLING SPEED AND PROCEED TO NEXT STEP

OK ↓

6.CHECK FUEL PRESSURE

NG. → TROUBLESHOOT FUEL PRESSURE AND PROCEED TO NEXT STEP

OK

7.CHECK FOR SPARK

NG. → TROUBLESHOOT SPARK AND PROCEED TO NEXT STEP

OK

PROCEED TO PROBLEM SYMPTOMS TABLE

for Preparation Click here

HINT:

Use the table below to help determine the cause of problem symptoms. If multiple suspected areas are listed, the potential causes of the symptoms are listed in order of probability in the "Suspected Area" column of the table. Check each symptom by checking the suspected areas in the order they are listed. Replace parts as necessary.

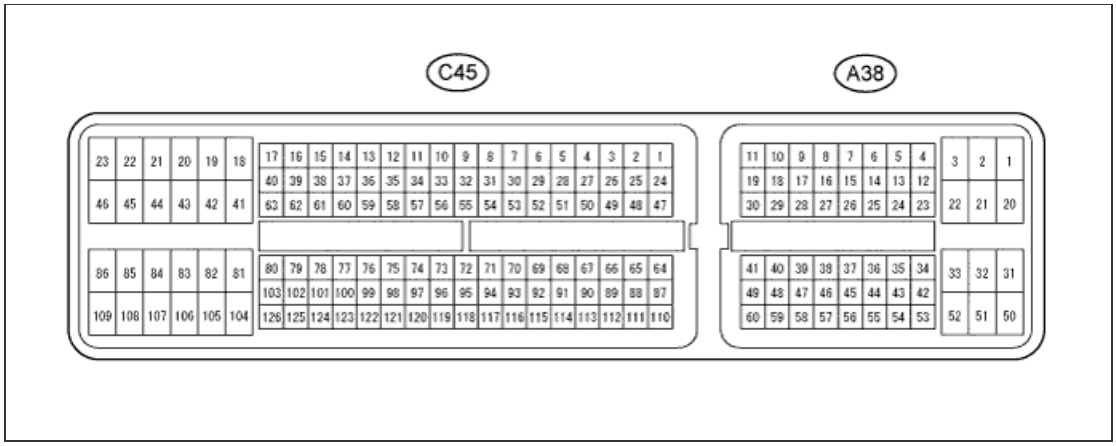
SFI System

Symptom	Suspected Area	See page
Engine does not crank (Does not start)	Battery	Click here
	Starter	Click here
	Starter relay	Click here
	Park/neutral position switch	Click here
	Immobiliser system	Click here
	Entry and start system	Click here
No initial combustion (Does not start)	ECM power source circuit	Click here
	Crankshaft position sensor	Click here
	Camshaft position sensor	Click here
	Ignition system	Click here
	Fuel pump control circuit	Click here
	ECM	Click here
	VC output circuit	Click here
Engine cranks normally but difficult to start	Fuel pump control circuit	Click here
	Compression	Click here
	ECM Power Source Circuit	Click here
Difficult to start with cold engine	Ignition system	Click here
	Spark plug	Click here
	Fuel pump control circuit	Click here
	Fuel injector	Click here
	Cranking holding function circuit	Click here
Difficult to start with warm engine	Fuel injector	Click here
	Ignition system	Click here
	Spark plug	Click here
	Fuel pump control circuit	Click here
	Cranking holding function circuit	Click here
gh engine idle speed	Electronic throttle control system	Click here
	A/C signal circuit	Click here
	ECM power source circuit	Click here
	Acoustic Control Induction System (ACIS)	Click here
Low engine idle speed (Poor idling)	Electronic throttle control system	Click here
	A/C signal circuit	Click here
	Fuel pump control circuit	Click here
	Acoustic Control Induction System (ACIS)	Click here
	PCV hose	Click here
Rough idling	Compression	Click here
	Spark plug	Click here
	Fuel injector	Click here
	Ignition system	Click here
	Fuel pump control circuit	Click here
	Electronic throttle control system	Click here
	Acoustic Control Induction System (ACIS)	Click here
	PCV hose	Click here
	Mass air flow meter	Click here

Idle hunting	Electronic throttle control system	Click here
	ECM power source circuit	Click here
	Acoustic Control Induction System (ACIS)	Click here
esitation/Poor acceleration	A/T faulty	Click here
	Fuel pump control circuit	Click here
	Spark plug	Click here
	Ignition system	Click here
	Fuel injector	Click here
	Mass air flow meter	Click here
	Electronic throttle control system	Click here
	Compression	Click here
	Brake o erride system	Click here
Surging (Poor dri eability)	Spark plug	Click here
	Fuel pump control circuit	Click here
	Ignition system	Click here
	Fuel injector	Click here
	Mass air flow meter	Click here
	Variable al e timing system	Click here
	Compression	Click here
Engine stalls soon after starting	Fuel pump control circuit	Click here
	Spark plug	Click here
	Ignition system	Click here
	Fuel injector	Click here
	Variable al e timing system	Click here
	Electronic throttle control system	Click here
	PCV hose	Click here
	Compression	Click here
Engine stalls only during A/C operation	A/C signal circuit	Click here
	ECM	Click here

for Preparation Click here

CHECK ECM



HINT:

The standard normal voltage between each pair of ECM terminals is shown in the table below. The appropriate conditions for checking each pair of terminals are also indicated. The result of checks should be compared with the standard normal voltage for that pair of terminals, displayed in the Specified Condition column. The illustration above can be used as a reference to identify the ECM terminal locations.

Terminal No. (Symbol)	Wiring Color	Terminal Description	Condition	Specified Condition
A38-1 (BATT) - C45-81 (E1)	L - W-B	Battery (for measuring battery voltage and for ECM memory)	Always	11 to 14 V
C45-41 (+BM) - C45-81 (E1)	P - W-B	Power source of throttle actuator	Always	11 to 14 V
A38-28 (IGSW) - C45-81 (E1)	B - W-B	Engine switch	Engine switch on (IG)	11 to 14 V
A38-3 (+B) - C45-81 (E1)	B - W-B	Power source of ECM	Engine switch on (IG)	11 to 14 V
A38-2 (+B2) - C45-81 (E1)	B - W-B	Power source of ECM	Engine switch on (IG)	11 to 14 V
C45-58 (OC1+) - C45-57 (OC1-)	B - B-L	Camshaft oil control valve (OCV) (for Intake Side of Bank 1)	Idling	Pulse generation (See waveform 1)
C45-52 (OC2+) - C45-51 (OC2-)	L-B - R-B	Camshaft oil control valve (OCV) (for Intake Side of Bank 2)	Idling	Pulse generation (See waveform 1)
C45-56 (OE1+) - C45-55 (OE1-)	L-W - L-B	Camshaft oil control valve (OCV) (for Exhaust Side of Bank 1)	Idling	Pulse generation (See waveform 1)
C45-50 (OE2+) - C45-49 (OE2-)	L-R - L-B	Camshaft oil control valve (OCV) (for Exhaust Side of Bank 2)	Idling	Pulse generation (See waveform 1)
A38-34 (MREL) - C45-81 (E1)	W-R - W-B	EFI relay	Engine switch on (IG)	11 to 14 V
C45-74 (VG) - C45-75 (E2G)	L-Y - G-W	Mass air flow meter	Idling, Shift lever in P or N, A/C switch off	0.5 to 3.0 V
C45-73 (THA) - C45-97 (ETHW)	Y-B - BR	Intake air temperature sensor	Idling, Intake air temperature 20°C (68°F)	0.5 to 3.4 V
C45-76 (THW) - C45-98 (ETHA)	G-B - BR	Engine coolant temperature sensor	Idling, Engine coolant temperature 80°C (176°F)	0.2 to 1.0 V
C45-80 (VCTA) - C45-79 (ETA)	Y - B	Power source of throttle position sensor (specific voltage)	Engine switch on (IG)	4.5 to 5.5 V
C45-78 (VTA1) - C45-79 (ETA)	B-L - B	Throttle position sensor (for engine control)	Engine switch on (IG), Accelerator pedal fully released	0.5 to 1.1 V
			Engine switch on (IG), Accelerator pedal fully depressed	3.2 to 4.8 V

C45-77 (VTA2) - C45-79 (ETA)	B-R - B	Throttle position sensor (for sensor malfunction detection)	Engine switch on (IG), Accelerator pedal fully released	2.1 to 3.1 V
			Engine switch on (IG), Accelerator pedal fully depressed	4.6 to 5.0 V
A38-55 (VPA) - A38-58 (EPA)	R - W-L	Accelerator pedal position sensor (for engine control)	Engine switch on (IG), Accelerator pedal released	0.5 to 1.1 V
			Engine switch on (IG), Accelerator pedal fully depressed	2.6 to 4.5 V
A38-56 (VPA2) - A38-60 (EPA2)	GR-G - BR	Accelerator pedal position sensor (for sensor malfunctioning detection)	Engine switch on (IG), Accelerator pedal released	1.2 to 2.0 V
			Engine switch on (IG), Accelerator pedal fully depressed	3.4 to 5.0 V
A38-57 (VCPA) - A38-58 (EPA)	L-W - W-L	Power source of accelerator pedal position sensor (for VPA)	Engine switch on (IG)	4.5 to 5.5 V
A38-59 (VCP2) - A38-60 (EPA2)	V - BR	Power source of accelerator pedal position sensor (for VPA2)	Engine switch on (IG)	4.5 to 5.5 V
C45-22 (HA1A) - C45-23 (E04)	L - W-B	A/F sensor heater	Idling with warm engine	Pulse generation (See waveform 2)
			Engine switch on (IG)	11 to 14 V
C45-20 (HA2A) - C45-21 (E05)	G - W-B	A/F sensor heater	Idling with warm engine	Pulse generation (See waveform 2)
			Engine switch on (IG)	11 to 14 V
C45-126 (A1A+) - C45-81 (E1)	G - W-B	A/F sensor	Engine switch on (IG)	3.3 V*
C45-125 (A1A-) - C45-81 (E1)	R - W-B	A/F sensor	Engine switch on (IG)	2.9 V*
C45-103 (A2A+) - C45-81 (E1)	P - W-B	A/F sensor	Engine switch on (IG)	3.3 V*
C45-102 (A2A-) - C45-81 (E1)	L - W-B	A/F sensor	Engine switch on (IG)	2.9 V*
C45-45 (HT1B) - C45-46 (E03)	G-B - W-B	Heated oxygen sensor heater	Idling	Below 3.0 V
			Engine switch on (IG)	11 to 14 V
C45-44 (HT2B) - C45-46 (E03)	B - W-B	Heated oxygen sensor heater	Idling	Below 3.0 V
			Engine switch on (IG)	11 to 14 V
C45-114 (OX1B) - C45-115 (EX1B)	G - L	Heated oxygen sensor	Engine speed maintained at 2500 rpm for 2 minutes after warming up sensor	Pulse generation (See waveform 3)
C45-112 (OX2B) - C45-113 (EX2B)	R - W	Heated oxygen sensor	Engine speed maintained at 2500 rpm for 2 minutes after warming up sensor	Pulse generation (See waveform 3)
C45-86 (#10) - C45-43 (E01)	R-L - W-B	Fuel injector	Engine switch on (IG)	11 to 14 V
			Idling	Pulse generation (See waveform 4)
C45-109 (#20) - C45-43 (E01)	L - W-B	Fuel injector	Engine switch on (IG)	11 to 14 V
			Idling	Pulse generation (See waveform 4)
C45-85 (#30) - C45-43 (E01)	R-B - W-B	Fuel injector	Engine switch on (IG)	11 to 14 V
			Idling	Pulse generation (See waveform 4)
C45-108 (#40) - C45-43 (E01)	Y - W-B	Fuel injector	Engine switch on (IG)	11 to 14 V
			Idling	Pulse generation (See waveform 4)
C45-84 (#50) - C45-43 (E01)	G - W-B	Fuel injector	Engine switch on (IG)	11 to 14 V
			Idling	Pulse generation (See waveform 4)
C45-107 (#60) - C45-43 (E01)	R - W-B	Fuel injector	Engine switch on (IG)	11 to 14 V
			Idling	Pulse generation (See waveform 4)
C45-83 (#70) - C45-43 (E01)	W - W-B	Fuel injector	Engine switch on (IG)	11 to 14 V
			Idling	Pulse generation (See waveform 4)

C45-106 (#80) - C45-43 (E01)	R-B - W-B	Fuel injector	Engine switch on (IG)	11 to 14 V
			Idling	Pulse generation (See waveform 4)
C45-94 (KNK1) - C45-93 (EKNK)	R - G	Knock sensor	Engine speed maintained at 4000 rpm after warming up engine	Pulse generation (See waveform 5)
C45-117 (KNK2) - C45-116 (EKN2)	W - B	Knock sensor	Engine speed maintained at 4000 rpm after warming up engine	Pulse generation (See waveform 5)
C45-96 (KNK3) - C45-95 (EKN3)	W - B	Knock sensor	Engine speed maintained at 4000 rpm after warming up engine	Pulse generation (See waveform 5)
C45-119 (KNK4) - C45-118 (EKN4)	R - G	Knock sensor	Engine speed maintained at 4000 rpm after warming up engine	Pulse generation (See waveform 5)
C45-92 (VV1+) - C45-91 (VV1-)	R - Y	Variable valve timing (VVT) sensor (for Intake Side of Bank 1)	Idling	Pulse generation (See waveform 6)
C45-87 (VV2+) - C45-88 (VV2-)	R - Y	Variable valve timing (VVT) sensor (for Intake Side for Bank 2)	Idling	Pulse generation (See waveform 6)
C45-69 (EV1+) - C45-68 (EV1-)	R-L - Y	Variable valve timing (VVT) sensor (for Exhaust Side of Bank 1)	Idling	Pulse generation (See waveform 16)
C45-64 (EV2+) - C45-65 (EV2-)	R-L - Y	Variable valve timing (VVT) sensor (for Exhaust Side of Bank 2)	Idling	Pulse generation (See waveform 16)
C45-110 (NE+) - C45-111 (NE-)	W - G-W	Crankshaft position sensor	Idling	Pulse generation (See waveform 6)
C45-40 (IGT1) - C45-81 (E1)	B-Y - W-B	Ignition coil (ignition signal)	Idling	Pulse generation (See waveform 7)
C45-33 (IGT2) - C45-81 (E1)	L-B - W-B	Ignition coil (ignition signal)	Idling	Pulse generation (See waveform 7)
C45-37 (IGT3) - C45-81 (E1)	B - W-B	Ignition coil (ignition signal)	Idling	Pulse generation (See waveform 7)
C45-34 (IGT4) - C45-81 (E1)	L-B - W-B	Ignition coil (ignition signal)	Idling	Pulse generation (See waveform 7)
C45-35 (IGT5) - C45-81 (E1)	G-R - W-B	Ignition coil (ignition signal)	Idling	Pulse generation (See waveform 7)
C45-36 (IGT6) - C45-81 (E1)	G - W-B	Ignition coil (ignition signal)	Idling	Pulse generation (See waveform 7)
C45-38 (IGT7) - C45-81 (E1)	G-W - W-B	Ignition coil (ignition signal)	Idling	Pulse generation (See waveform 7)
C45-39 (IGT8) - C45-81 (E1)	G-B - W-B	Ignition coil (ignition signal)	Idling	Pulse generation (See waveform 7)
C45-104 (IGF1) - C45-81 (E1)	G-B - W-B	Ignition coil (ignition confirmation signal)	Engine switch on (IG)	4.5 to 5.5 V
			Idling	Pulse generation (See waveform 7)
C45-105 (IGF2) - C45-81 (E1)	R - W-B	Ignition coil (ignition confirmation signal)	Engine switch on (IG)	4.5 to 5.5 V
			Idling	Pulse generation (See waveform 7)
C45-63 (PRG) - C45-81 (E1)	L-B - W-B	Purge VSV	Engine switch on (IG)	11 to 14 V
			Idling	Pulse generation (See waveform 8)
A38-13 (SPD) - C45-81 (E1)	V-R - W-B	Speed signal from combination meter	Driving at 20 km/h (12 mph)	Pulse generation (See waveform 9)
A38-46 (STA) - C45-81 (E1)	R-B - W-B	Starter signal	Cranking	5.5 V or higher
C45-120 (NSW) - C45-81 (E1)	L - W-B	Park/neutral position switch	Engine switch on (IG), Shift lever in other than P and N	11 to 14 V
			Engine switch on (IG), Shift lever in P or N	Below 3.0 V
A38-36 (STP) - C45-81 (E1)	R - W-B	Stop light switch	Brake pedal depressed	7.5 to 14 V
			Brake pedal released	Below 1.5 V
A38-35 (ST1-) - C45-81 (E1)	R-W - W-B	Stop light switch (opposite to STP	Engine switch on (IG), Brake pedal depressed	Below 1.5 V

		terminal)	Engine switch on (IG), Brake pedal released	7.5 to 14 V
C45-19 (M+) - C45-82 (ME01)	R - W-B	Throttle actuator	Idling with warm engine	Pulse generation (See waveform 10)
C45-18 (M-) - C45-82 (ME01)	G - W-B	Throttle actuator	Idling with warm engine	Pulse generation (See waveform 11)
A38-48 (FC) - C45-81 (E1)	L-R - W-B	Fuel pump control	Engine switch on (IG)	11 to 14 V
A38-52 (FPC) - C45-81 (E1)	W - W-B	Fuel pump control	Engine switch on (IG)	Below 1.5 V
A38-24 (W) - C45-81 (E1)	R-Y - W-B	MIL	Engine switch on (IG)	Below 3.0 V
			Idling	11 to 14 V
A38-16 (TC) - C45-81 (E1)	V-W - W-B	Terminal TC of DLC3	Engine switch on (IG)	11 to 14 V
A38-15 (TACH) - C45-81 (E1)	W-G - W-B	Engine speed	Idling	Pulse generation (See waveform 12)
C45-67 (VCV1) - C45-97 (ETHW)	L - BR	Power source for sensor (specific voltage)	Engine switch on (IG)	4.5 to 5.5 V
C45-66 (VCV2) - C45-97 (ETHW)	L - BR	Power source for sensor (specific voltage)	Engine switch on (IG)	4.5 to 5.5 V
C45-32 (ALT) - C45-81 (E1)	R - W-B	Generator	Engine switch on (IG)	11 to 14 V
A38-10 (CANH) - C45-81 (E1)	P - W-B	CAN communication line	Engine switch on (IG)	Pulse generation (See waveform 13)
A38-11 (CANL) - C45-81 (E1)	B - W-B	CAN communication line	Engine switch on (IG)	Pulse generation (See waveform 14)
C45-62 (ACIS) - C45-81 (E1)	L-Y - W-B	VSV for ACIS (Acoustic Control Induction System) operation signal	Engine switch on (IG)	11 to 14 V
C45-90 (G2) - C45- 89 (G2-)	G - Y	Camshaft position sensor	Idling	Pulse generation (See waveform 15)
A38-18 (DI) - C45-81 (E1)	G-Y - W-B	Fuel pump control	Engine switch on (IG)	0 to 3.0 V
A38-14 (STSW) - C45-81 (E1)	R - W-B	Starter switch	Shift lever in P or N, Cranking	6.0 V or higher
A38-41 (ACCR) - C45-81 (E1)	L-Y - W-B	ACC relay control signal	Engine switch on (IG) → Cranking	11 to 14 V → Below 1 V
C45-16 (STAR) - C45-81 (E1)	L - W-B	Starter relay control	Engine switch on (IG)	Below 1.5 V
			Cranking	5.5 V or higher
C45-72 (PSP) - C45-81 (E1)	G - W-B	Power steering oil pressure sensor	Engine switch on (IG)	0.5 to 4.5 V

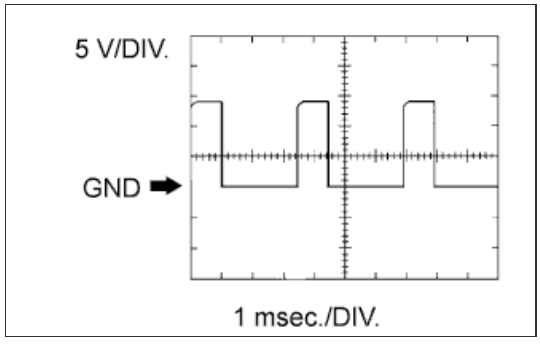
HINT:

*: The ECM terminal voltage is constant regardless of the output voltage from the sensor.

a. WAVEFORM 1:

Camshaft Oil Control Valve (OCV)

Terminal No. (Symbol)	Tool Setting	Condition
C45-58 (OC1+) - C45-57 (OC1-)	5 V/DIV., 1 msec./DIV.	Idling
C45-52 (OC2+) - C45-51 (OC2-)	5 V/DIV., 1 msec./DIV.	Idling
C45-56 (OE1+) - C45-55 (OE1-)	5 V/DIV., 1 msec./DIV.	Idling
C45-50 (OE2+) - C45-49 (OE2-)	5 V/DIV., 1 msec./DIV.	Idling



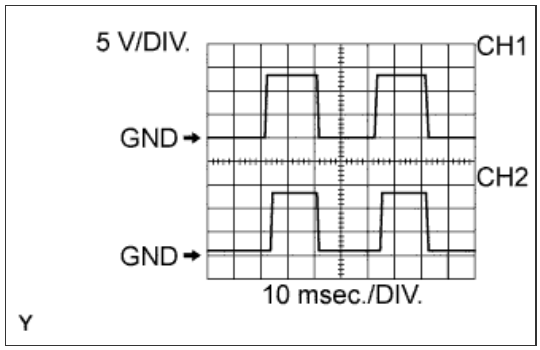
b. WAVEFORM 2:

A/F Sensor Signal

Terminal No. (Symbol)	Tool Setting	Condition
C45-22 (HA1A) - C45-23 (E04)	5 V/DIV., 10 msec./DIV.	Idling with warm engine
C45-20 (HA2A) - C45-21 (E05)	5 V/DIV., 10 msec./DIV.	Idling with warm engine

HINT:

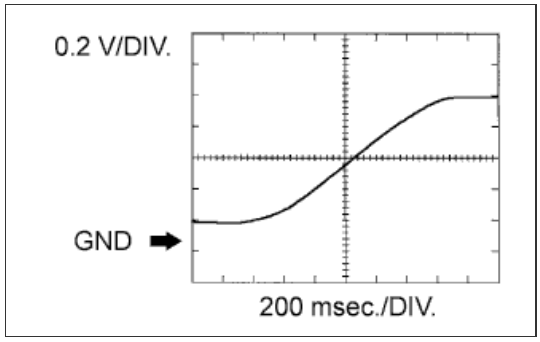
The wavelength varies in accordance with the engine operating condition.



c. WAVEFORM 3:

Heated Oxygen Sensor

Terminal No. (Symbol)	Tool Setting	Condition
C45-114 (OX1B) - C45-115 (EX1B)	0.2 V/DIV., 200 msec./DIV.	Engine speed maintained at 2500 rpm for 2 minutes after warming up sensor
C45-112 (OX2B) - C45-113 (EX2B)	0.2 V/DIV., 200 msec./DIV.	Engine speed maintained at 2500 rpm for 2 minutes after warming up sensor



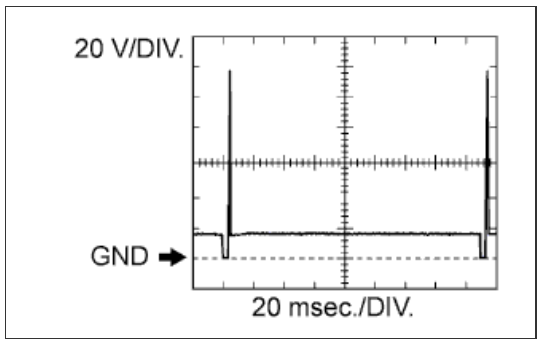
HINT:

In the Data List, item O2S B1S2 or O2S B2S2 shows the ECM input values from the heated oxygen sensor.

d. WAVEFORM 4:

Injector No. 1 (to No. 8) Injection Signal

Terminal No. (Symbol)	Tool Setting	Condition
C45-86 (#10) - C45-43 (E01)	20 V/DIV., 20 msec./DIV.	Idling
C45-109 (#20) - C45-43 (E01)	20 V/DIV., 20 msec./DIV.	Idling
C45-85 (#30) - C45-43 (E01)	20 V/DIV., 20 msec./DIV.	Idling
C45-108 (#40) - C45-43 (E01)	20 V/DIV., 20 msec./DIV.	Idling
C45-84 (#50) - C45-43 (E01)	20 V/DIV., 20 msec./DIV.	Idling
C45-107 (#60) - C45-43 (E01)	20 V/DIV., 20 msec./DIV.	Idling
C45-83 (#70) - C45-43 (E01)	20 V/DIV., 20 msec./DIV.	Idling
C45-106 (#80) - C45-43 (E01)	20 V/DIV., 20 msec./DIV.	Idling



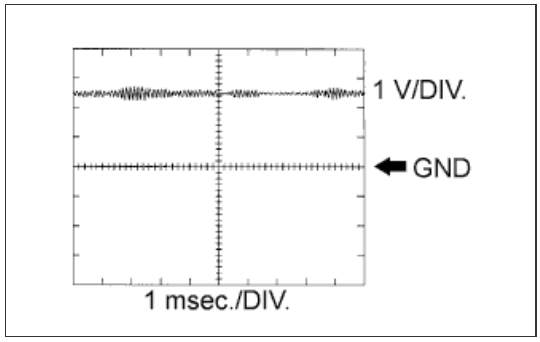
HINT:

The wavelength becomes shorter as the engine speed increases.

e. WAVEFORM 5:

Knock Sensor

Terminal No. (Symbol)	Tool Setting	Condition
C45-94 (KNK1) - C45-93 (EKNK)	1 V/DIV., 1 msec./DIV.	Engine speed maintained at 4000 rpm after warming up engine
C45-117 (KNK2) - C45-116 (EKN2)	1 V/DIV., 1 msec./DIV.	Engine speed maintained at 4000 rpm after warming up engine
		Engine speed maintained at



C45-96 (KNK3) - C45-95 (EKN3)	1 V/DIV., 1 msec./DIV.	4000 rpm after warming up engine
C45-119 (KNK4) - C45-118 (EKN4)	1 V/DIV., 1 msec./DIV.	Engine speed maintained at 4000 rpm after warming up engine

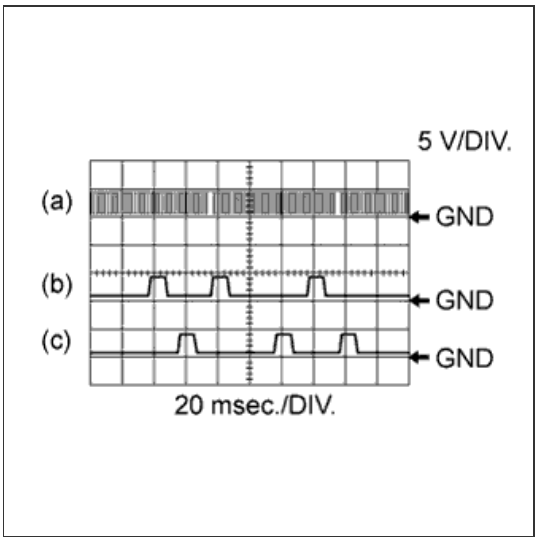
HINT:

- **The wavelength becomes shorter as the engine speed increases.**
- **The waveforms and amplitudes displayed differ slightly depending on the vehicle.**

f. WAVEFORM 6:

Crankshaft Position Sensor and VVT Sensor for Intake Side

Terminal No. (Symbol)	Tool Setting	Condition
(a) C45-110 (NE+) - C45-111 (NE-)	5 V/DIV., 20 msec./DIV.	Idle after engine warmed up
(b) C45-92 (VV1+) - C45-91 (VV1-)	5 V/DIV., 20 msec./DIV.	Idle after engine warmed up
(c) C45-87 (VV2+) - C45-88 (VV2-)	5 V/DIV., 20 msec./DIV.	Idle after engine warmed up



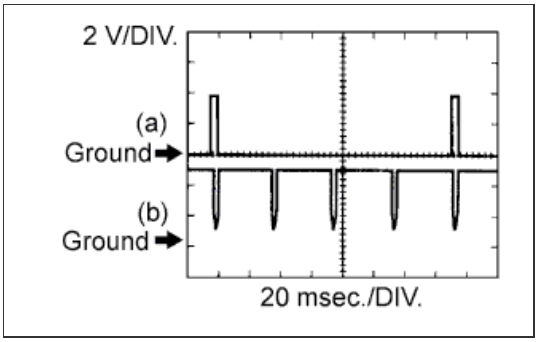
HINT:

The wavelength becomes shorter as engine speed increases.

g. WAVEFORM 7:

Igniter IGT Signal (from ECM to Igniter) and Igniter IGF Signal (from Igniter to ECM)

Terminal No. (Symbol)	Tool Setting	Condition
(a) C45-40 (IGT1) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling
(a) C45-33 (IGT2) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling
(a) C45-37 (IGT3) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling
(a) C45-34 (IGT4) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling
(a) C45-35 (IGT5) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling
(a) C45-36 (IGT6) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling
(a) C45-38 (IGT7) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling
(a) C45-39 (IGT8) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling
(b) C45-104 (IGF1) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling
(b) C45-105 (IGF2) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling



HINT:

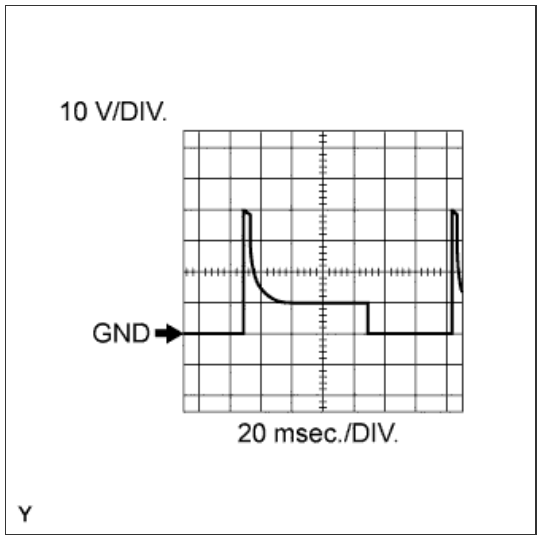
The wavelength becomes shorter as engine speed increases.

h. WAVEFORM 8:

Purge VSV

Terminal No. (Symbol)	Tool Setting	Condition

C45-63 (PRG) - C45-81 (E1)	10 V/DIV., 20 msec./DIV.	Idling



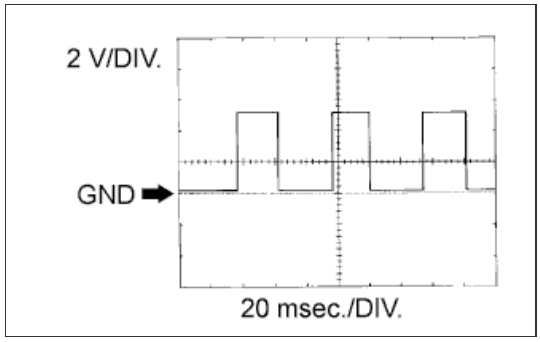
HINT:

If the waveform is not similar to the illustration, check the waveform again after idling for 10 minutes or more.

i. WAVEFORM 9:

Vehicle Speed Signal

Terminal No. (Symbol)	Tool Setting	Condition
A38-13 (SPD) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Driving at 20 km/h (12 mph)



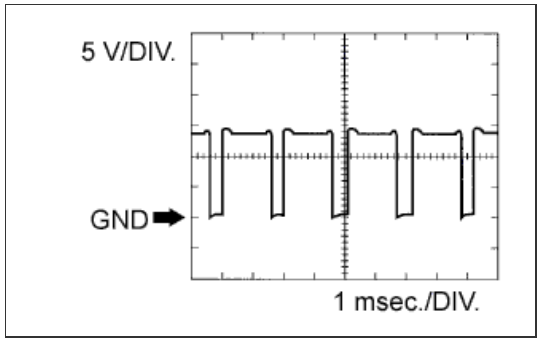
HINT:

The wavelength becomes shorter as the vehicle speed increases.

j. WAVEFORM 10:

Throttle Actuator Positive Terminal

Terminal No. (Symbol)	Tool Setting	Condition
C45-19 (M+) - C45-82 (ME01)	5 V/DIV., 1 msec./DIV.	Idling with warm engine



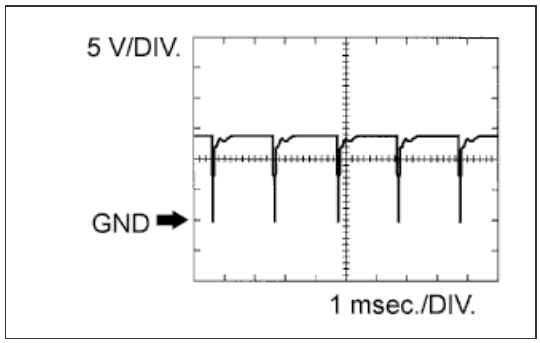
HINT:

The duty ratio varies depending on the throttle actuator operation.

k. WAVEFORM 11:

Throttle Actuator Negative Terminal

Terminal No. (Symbol)	Tool Setting	Condition
C45-18 (M-) - C45-82 (ME01)	5 V/DIV., 1 msec./DIV.	Idling with warm engine



HINT:

The duty ratio varies depending on the throttle actuator operation.

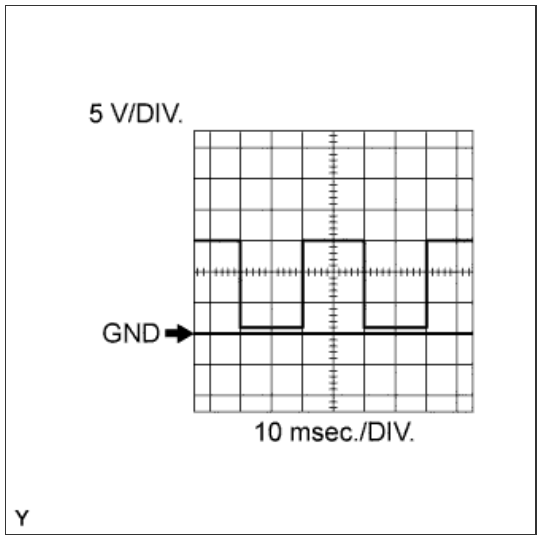
l. WAVEFORM 12:

Engine Speed Signal

Terminal No. (Symbol)	Tool Setting	Condition
A38-15 (TACH) - C45-81 (E1)	5 V/DIV., 10 msec./DIV.	Idling

HINT:

The wavelength becomes shorter as the engine speed increases.



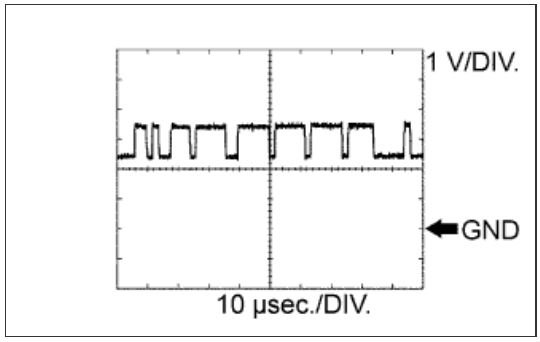
m. WAVEFORM 13:

CAN Communication Signal (Reference)

Terminal No. (Symbol)	Tool Setting	Condition
A38-10 (CANH) - C45-81 (E1)	1 V/DIV., 10 µsec./DIV.	Engine stops and engine switch on (IG)

HINT:

The waveform varies depending on the CAN communication signal.



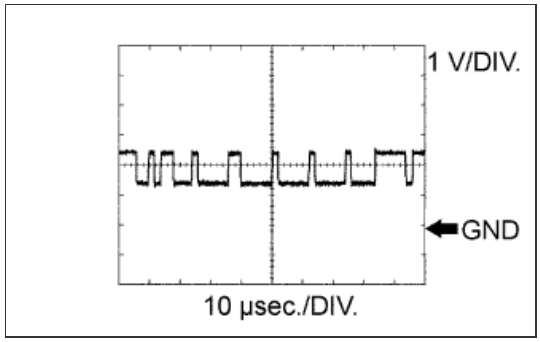
n. WAVEFORM 14:

CAN Communication Signal (Reference)

Terminal No. (Symbol)	Tool Setting	Condition
A38-11 (CANL) - C45-81 (E1)	1 V/DIV., 10 µsec./DIV.	Engine stops and engine switch on (IG)

HINT:

The waveform varies depending on the CAN communication signal.



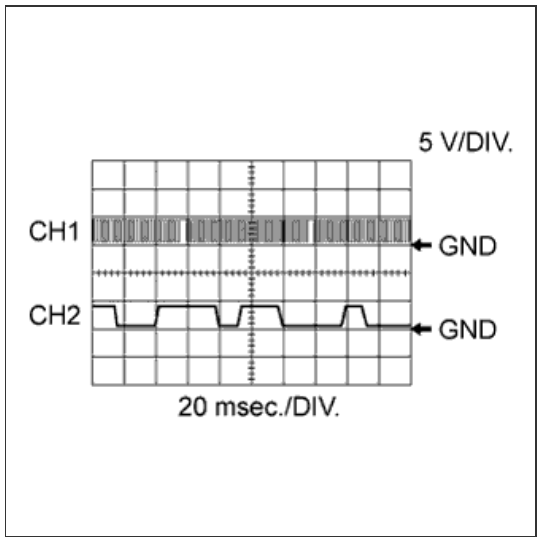
o. WAVEFORM 15:

Crankshaft Position Sensor and Camshaft Position Sensor

Terminal No. (Symbol)	Tool Setting	Condition
CH1: C45-110 (NE+) - C45-111 (NE-)	5 V/DIV., 20 msec./DIV.	Idle after engine warmed up
CH2: C45-90 (G2) - C45-89 (G2-)	5 V/DIV., 20 msec./DIV.	Idle after engine warmed up

HINT:

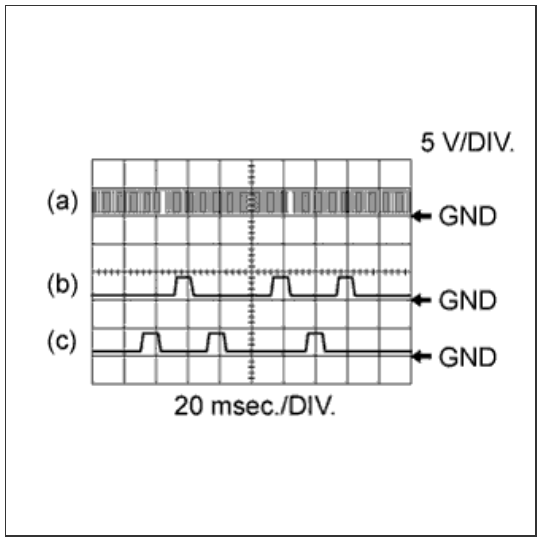
The wavelength becomes shorter as the engine speed increases.



p. WAVEFORM 16:

Crankshaft Position Sensor and VVT Sensor for Exhaust Side

Terminal No. (Symbol)	Tool Setting	Condition
(a) C45-110 (NE+) - C45-111 (NE-)	5 V/DIV., 20 msec./DIV.	Idle after engine warmed up
(b) C45-69 (EV1+) - C45-68 (EV1-)	5 V/DIV., 20 msec./DIV.	Idle after engine warmed up
(c) C45-64 (EV2+) - C45-65 (EV2-)	5 V/DIV., 20 msec./DIV.	Idle after engine warmed up



HINT:

The wavelength becomes shorter as engine speed increases.

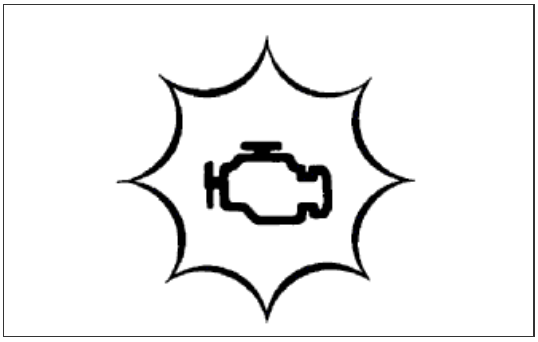
for Preparation Click here

EURO-OBD (EUROPE)

When troubleshooting Europe On-Board Diagnostic (Euro-OBD) vehicles, the vehicle must be connected to an OBD scan tool (complying with ISO 15765-4). Various data output from the vehicle ECM can then be read.

Euro-OBD regulations require that the on-board computer of the vehicle illuminate the Malfunction Indicator Lamp (MIL) on the instrument panel when the computer detects a malfunction in:

1. The emission control system components
2. The powertrain control components (which affect vehicle emissions)
3. The computer itself



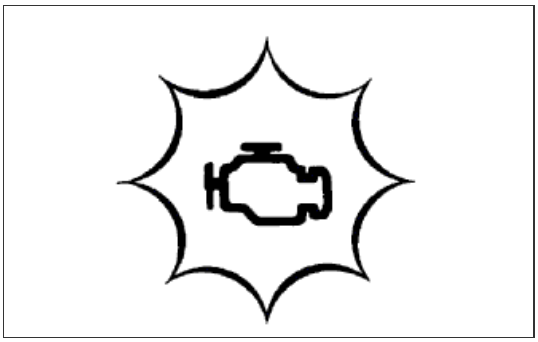
In addition, the applicable Diagnostic Trouble Codes (DTCs) prescribed by ISO 15765-4 are stored in the ECM memory. If the malfunction does not reoccur in 3 consecutive trips, the MIL turns off automatically but the DTCs remain stored in the ECM memory.

To check the DTCs, connect the intelligent tester to the Data Link Connector 3 (DLC3) of the vehicle. The scan tool displays DTCs, the freeze frame data and a variety of the engine data. The DTCs and freeze frame data can be cleared with the scan tool.

M-OBD (EXCEPT EUROPEAN SPEC.)

When troubleshooting Multiplex On-Board Diagnostic (M-OBD) vehicle, the vehicle must be connected to the intelligent tester. Various data output from the ECM can then be read.
OBD regulations require that the on-board computer of the vehicle illuminate the MIL on the instrument panel when the computer detects a malfunction in:

1. The emission control system components
2. The powertrain control components (which affect vehicle emissions)
3. The computer



In addition, the applicable DTCs are stored in the ECM memory. If the malfunction does not recur in 3 consecutive trips, the MIL turns off automatically but the DTCs remain stored in the ECM memory.

NORMAL MODE AND CHECK MODE

The diagnosis system operates in normal mode during normal vehicle use. In normal mode, 2 trip detection logic is used to ensure accurate detection of malfunctions. Check mode is also available as an option for technicians. In check mode, 1 trip detection logic is used for simulating malfunction symptoms and increasing the ability of the system to detect malfunctions, including intermittent problems (intelligent tester only).

2 TRIP DETECTION LOGIC

When a malfunction is first detected, the malfunction is temporarily stored in the ECM memory (1st trip). If the same malfunction is detected during the next subsequent driving cycle, the MIL is illuminated (2nd trip).

FREEZE FRAME DATA

The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.

BATTERY VOLTAGE

Standard voltage:
11 to 14 V

If voltage is below 11 V, replace or recharge the battery before proceeding.

MIL (Malfunction Indicator Lamp)

a. The MIL is illuminated when the engine switch is first turned on (IG) (the engine is not running).

b. The MIL should turn off when the engine is started. If the MIL remains illuminated, the diagnosis system has detected a malfunction or abnormality in the system.

HINT:

If the MIL is not illuminated when the engine switch is first turned on (IG), check the MIL circuit (Click here).

ALL READINESS

HINT:

- **With "All Readiness" it is possible to check whether or not the DTC judgment has been completed by using the intelligent tester.**
- **Check "All Readiness" after simulating malfunction symptoms or for validation after finishing repairs.**

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Perform the DTC judgment driving pattern to run the DTC judgment.

f. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

g. Input the DTCs to be confirmed.

h. Check the DTC judgment result.

Result

Tester Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

for Preparation Click here

NOTICE:

When the diagnosis system is changed from the normal mode to check mode or vice versa, all DTCs and freeze frame data recorded in normal mode are cleared. Before changing modes, always check and make a note of DTCs and freeze frame data.

HINT:

- **DTCs which are stored in the ECM can be output to the intelligent tester. The tester can display the current and pending output DTCs.**
- **Same DTCs are not set if the ECM does not detect the same malfunction again during a second consecutive driving cycle. However, such malfunctions, detected on only one occasion, are stored as pending DTCs.**

CHECK DTC

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Check the DTC(s) and freeze frame data, and then write them down.

f. Check the details of the DTC(s) (Click here).

CLEAR DTC

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Clear the DTCs.

CLEAR DTC (Without using the intelligent tester)

a. Perform either of the following operations:

i. Disconnect the cable from the negative (-) battery terminal for more than 1 minute.

ii. Remove the EFI MAIN fuse from the engine room relay block located inside the engine compartment for more than 1 minute.

for Preparation Click here

DESCRIPTION

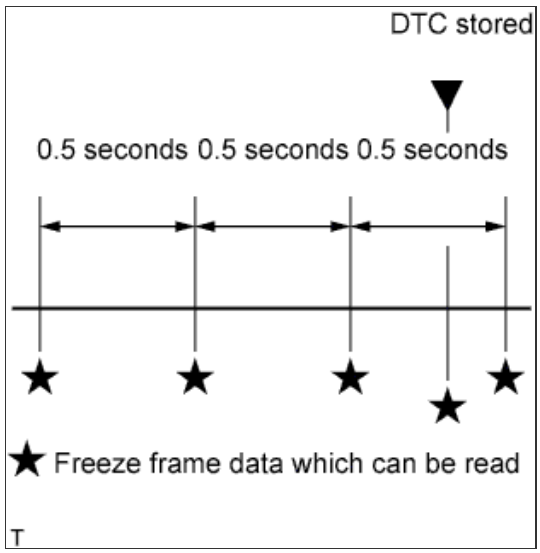
Freeze frame data records the engine conditions (fuel system, calculated load, engine coolant temperature, fuel trim, engine speed, vehicle speed, etc.) when a malfunction is detected. When troubleshooting, it can help determine if the vehicle was running or stopped, the engine was warmed up or not, the air-fuel ratio was Lean or Rich, and other data from the time the malfunction occurred.

HINT:

If it is impossible to duplicate the problem even though a DTC is output, confirm the freeze frame data.

The ECM records engine conditions in the form of freeze frame data every 0.5 seconds. Using the intelligent tester, 5 separate sets of freeze frame data can be checked.

- 3 data sets before the DTC was stored.
- 1 data set when the DTC was stored.
- 1 data set after the DTC was stored.
  These data sets can be used to simulate the condition of the vehicle around the time of the occurrence of the malfunction. The data may assist in identifying the cause of the malfunction, and in judging whether it was temporary or not.



LIST OF FREEZE FRAME DATA

Tester Display	Measurement Item	Diagnostic Note
Vehicle Speed	Vehicle speed	Speed indicated on speedometer.
Engine Speed	Engine speed	-
Calculate Load	Calculated load	Calculated load by ECM.
Vehicle Load	Vehicle load	-
MAF	Mass air flow volume	If approximately 0.0 gm/s: • Mass air flow meter power source circuit open or short. • VG circuit open or short. If 160.0 gm/s or more: • E2G circuit open.
Atmosphere Pressure	Atmosphere pressure	-
Coolant Temp	Engine coolant temperature	If -40°C (-40°F), sensor circuit open. If 140°C (284°F) or more, sensor circuit shorted.
Intake Air	Intake air temperature	If -40°C (-40°F), sensor circuit open. If 140°C (284°F) or more, sensor circuit shorted.
Engine Run Time	Accumulated engine running time	-
Initial Engine Coolant Temp	Engine coolant temperature at engine start	-
Initial Intake Air Temp	Intake air temperature at engine start	-
Battery Voltage	Battery voltage	-
Accel Sens. No.1 Volt %	Absolute Accelerator Pedal Position (APP) No. 1	-
Accel Sens. No.2 Volt %	Absolute APP No. 2	-

Throttle Sensor Volt %	Throttle sensor positioning	-
Throttl Sensor #2 Volt %	Throttle sensor positioning #2	-
Throttle Sensor Position	Throttle position	-
Throttle Motor DUTY	Throttle motor	-
Injector (Port)	Injection period of No. 1 cylinder	-
Injection Volum (Cylinder 1)	Injection volume	-
Fuel Pump/Speed Status	Fuel pump/speed status	-
EVAP (Purge) VSV	EVAP purge VSV duty ratio	-
Evap Purge Flow	Ratio of evaporative purge flow to intake air volume	-
Purge Density Learn Value	Learning value of purge density	-
EVAP Purge VSV	EVAP Purge VSV	-
Target Air-Fuel Ratio	Ratio compared to stoichiometric level	-
AF Lambda B1S1	Fuel trim at A/F sensor	-
AF Lambda B2S1	Fuel trim at A/F sensor	-
AFS Voltage B1S1 AFS Voltage B2S1	A/F sensor output	Performing Control the Injection Volume or Control the Injection Volume for A/F Sensor function of Active Test enables technician to check output voltage of sensor.
AFS Current B1S1	A/F sensor current	-
AFS Current B2S1	A/F sensor current	-
O2S B1S2 O2S B2S2	Heated oxygen sensor output	Performing Control the Injection Volume or Control the Injection Volume for A/F Sensor function of Active Test enables technician to check output voltage of sensor.
Short FT #1	Short-term fuel trim	Short-term fuel compensation used to maintain air-fuel ratio at stoichiometric air-fuel ratio.
Long FT #1	Long-term fuel trim	Overall fuel compensation carried out in long-term to compensate a continual deviation of short-term fuel trim from central value.
Total FT #1	Total fuel trim	-
Short FT #2	Short-term fuel trim	Short-term fuel compensation used to maintain air-fuel ratio at stoichiometric air-fuel ratio.
Long FT #2	Long-term fuel trim	Overall fuel compensation carried out in long-term to compensate a continual deviation of short-term fuel trim from central value.
Total FT #2	Total fuel trim	-
Fuel System Status #1	Fuel system status (for Bank 1)	• OL (Open Loop): Has not yet satisfied conditions to go closed loop. • CL (Closed Loop): Using heated oxygen sensor as feedback for fuel control. • OL Drive: Open loop due to driving conditions (fuel enrichment). • OL Fault: Open loop due to detected system fault. • CL Fault: Closed loop but heated oxygen sensor, which used for fuel control, malfunctioning.
Fuel System Status #2	Fuel system status (for Bank 2)	• OL (Open Loop): Has not yet satisfied conditions to go closed loop. • CL (Closed Loop): Using heated oxygen sensor as feedback for fuel control. • OL Drive: Open loop due to driving conditions (fuel enrichment). • OL Fault: Open loop due to detected system fault. • CL Fault: Closed loop but heated oxygen sensor, which used for fuel control, malfunctioning.
IGN Advance	Ignition advance	-
Knock Feedback Value	Feedback value of knocking	-

Knock Correct Learn Value	Correction learning value of knocking	-
ACIS VSV	VSV for Acoustic Control Induction System (ACIS)	-
VVT Control Status #1	VVT control status	-
VVT Control Status #2	VVT control status	-
Catalyst Temp B1S1	Estimated catalyst temperature (for Sensor 1)	-
Catalyst Temp B2S1	Estimated catalyst temperature (for Sensor 1)	-
Catalyst Temp B1S2	Estimated catalyst temperature (for Sensor 2)	-
Catalyst Temp B2S2	Estimated catalyst temperature (for Sensor 2)	-
Starter Signal	Starter switch (STSW) signal	-
Starter Control	Starter switch status	-
Power Steering Signal	Power steering switch status	-
Starter Relay	Starter relay status	-
Power Steer. Sig. Record	Power steering signal (history)	This signal status is usually ON until the cables are disconnected from the battery terminals.
ACC Relay	ACC relay status	-
Neutral Position SW Signal	Park/Neutral position (PNP) switch signal	-
Stop Light Switch	Stop light switch	-
A/C Signal	A/C signal	-
Closed Throttle Position SW	Closed throttle position switch	-
Fuel Cut Condition	Fuel cut condition	-
Immobiliser Communication	Immobiliser communication	-
Electrical Load Signal	Electrical load signal	-
Time after DTC Cleared	Cumulative time after DTC cleared	-
Distance from DTC Cleared	Accumulated distance from DTC cleared	-
Warmup Cycle Cleared DTC	Warm-up cycle after DTC cleared	-
TC and TE1	TC and CG (TE1) terminals of DLC3	-
Ignition Trig. Count	Ignition counter	-
Cylinder #1 Misfire Count	Cylinder #1 misfire	-
Cylinder #2 Misfire Count	Cylinder #2 misfire	-
Cylinder #3 Misfire Count	Cylinder #3 misfire	-
Cylinder #4 Misfire Count	Cylinder #4 misfire	-
Cylinder #5 Misfire Count	Cylinder #5 misfire	-
Cylinder #6 Misfire Count	Cylinder #6 misfire	-
Cylinder #7 Misfire Count	Cylinder #7 misfire	-
Cylinder #8 Misfire Count	Cylinder #8 misfire	-
All Cylinders Misfire Count	All cylinders misfire	-
Multi Cylinders Misfire Count	Multiple cylinder misfire	-
Misfire RPM	Engine speed when misfire occurred	-
Misfire Load	Engine load when misfire occurred	-
Misfire Margin	Margin to detect engine misfire	-
Catalyst OT MF F/C	Catalyst over temperature misfire prevention F/C	-
Cat OT MF F/C History	Catalyst over temperature misfire prevention F/C history	-
Cat OT MF F/C Cylinder#1	Display of fuel cut operation in No. 1 cylinder (if certain level of misfire malfunction is detected)	-
Cat OT MF F/C Cylinder#2	Display of fuel cut operation in No. 2 cylinder (if certain level of misfire malfunction is detected)	-
Cat OT MF F/C Cylinder#3	Display of fuel cut operation in No. 3 cylinder (if certain level of misfire malfunction is detected)	-
Cat OT MF F/C Cylinder#4	Display of fuel cut operation in No. 4 cylinder (if certain level of misfire malfunction is detected)	-
Cat OT MF F/C Cylinder#5	Display of fuel cut operation in No. 5 cylinder (if certain level of misfire malfunction is detected)	-
Cat OT MF F/C Cylinder#6	Display of fuel cut operation in No. 6 cylinder (if certain level of misfire malfunction is detected)	-
Cat OT MF F/C Cylinder#7	Display of fuel cut operation in No. 7 cylinder (if certain level of misfire malfunction is detected)	-
Cat OT MF F/C Cylinder#8	Display of fuel cut operation in No. 8 cylinder (if	-

	certain level of misfire malfunction is detected)	
Power Steering Pressure	Power steering pressure sensor	-
ACT VSV	A/C cut status for Active Test	-
Idle Fuel Cut	Fuel cut idle	ON: when throttle valve fully closed and engine speed over 3500 rpm.
FC TAU	Fuel cut during very light load	Fuel cut being performed under very light load to prevent engine combustion from becoming incomplete.
SPD (NT)	Input shaft speed	Data is displayed in increments of 50 rpm.
SPD (SP2)	Output shaft speed	-

for Preparation Click here

HINT:

Intelligent tester:

Compared to the normal mode, check mode is more sensitive to malfunctions. Therefore, check mode can detect the malfunctions that cannot be detected in normal mode.

NOTICE:

All the stored DTCs and freeze frame data are cleared if: 1) the ECM is changed from normal mode to check mode or vice versa; or 2) the engine switch is turned from on (IG) to on (ACC) or off while in check mode. Before changing modes, always check and note any DTCs and freeze frame data.

CHECK MODE PROCEDURE

a. Check and ensure the following conditions:

   i. Battery positive voltage 11 V or higher.

   ii. Throttle valve fully closed.

   iii. Transmission in the P or position.

   iv. A C switch off.

b. Turn the engine switch off.

c. Connect the intelligent tester to the DLC3.

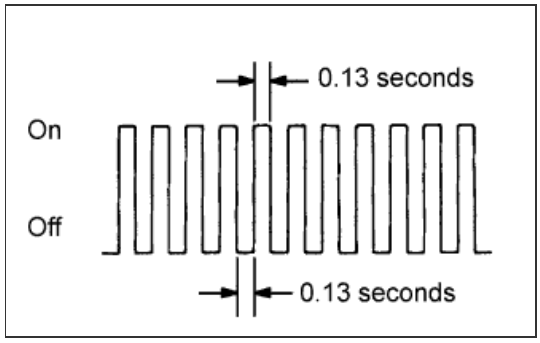
d. Turn the engine switch on (IG).

e. Turn the tester on.

f. Enter the following menus: Powertrain Engine and ECT Utility Check Mode.

g. witch the ECM from normal mode to check mode.

h. Make sure the MIL flashes as shown in the illustration.



i. tart the engine.

j. Make sure the MIL turns off.

k. imulate the conditions of the malfunction described by the customer.

l. Check the DTCs and freeze frame data using the tester.

for Preparation Click here

If any of the following DTCs are stored, the ECM enters fail-safe mode to allow the vehicle to be driven temporarily.

DTC	Component	Fail-Safe Operation	Fail-Safe Deactivation Condition
P0011, P0021, P0015 and P0025*3	Camshaft oil control valve (OCV)	lsen a misfire occ rs, f el c ts performed for catalyst overheat malf nction prevention. • ith a normal load and normal engine speed (MIL is blin ing): - F el c ts performed on the malf nctioning cylinder. • ith a high load and high engine speed driving (MIL is blin ing): - Throttle valve opening angle control is performed. - F el c ts performed on all cylinders or the malf nction cylinder.	Pass condition detected and then engine switch t rned off
P0031, P0032, P0051 and P0052	Air F el ratio (A F) Sensor eater	The ECM t rns off the A F sensor heater.	Engine switch off
P003 P0038, P005 and P0058	eated O ygen (O2) Sensor eater	The ECM t rns off the O2 sensor heater.	Engine switch off
P0102 and P0103	Mass Air Flow (MAF) Meter	The ECM calc lates ignition timing according to the engine speed and throttle valve position.	Pass condition detected
P0110, P0112 and P0113	Inta e Air Temperat re (IAT) Sensor	The ECM estimates the IAT to be 20 C (68 F).	Pass condition detected
P0115, P011 and P0118	Engine Coolant Temperat re (ECT) Sensor	The ECM estimates the ECT to be 80 C (1 F).	Pass condition detected
P0120, P0121, P0122, P0123, P0220, P0222, P0223, P0604, P0606, P060A, P060 P060D, P060E, P065 P2102, P2103, P2111, P2112, P2118, P211 and P2135	Electronic Throttle Control System (ETCS)	The ECM c st off throttle act ator c rrent and the throttle valve is ret rned to a throttle position by the ret rn spring. The ECM then ad sts the engine o t by controlling f el in ection (intermittent f el c t and ignition timing in accordance with the accelerator pedal opening angle to allow the vehicle to contin e at minimal speed*1.	Pass condition detected and then engine switch t rned off
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P030 and P0308*2	• F el in ector • Electronic Throttle Control System (ETCS)	lsen a misfire occ rs, f el c ts performed for catalyst overheat malf nction prevention. • ith a normal load and normal engine speed (MIL is blin ing): - F el c ts performed on the malf nctioning cylinder. • ith a high load and high engine speed driving (MIL is blin ing): - Throttle valve opening angle control is performed. - F el c ts performed on all cylinders or the malf nction cylinder.	Pass condition detected and then engine switch t rned off
P032 P0328, P032C, P032D, P0332, P0333, P033C and P033D	Knoc Sensor	The ECM sets the ignition timing to ma im m retard.	Engine switch off

P0351 to P0358	Ignition Coil	The ECM c st f el.	Pass condition detected
P0504	Stop Light Switch	The accelerator pedal angle is fi ed.	Accelerator pedal angle is fi ed
P2120, P2121, P2122, P2123, P2125, P212 P2128 and P2138	Accelerator Pedal Position (APP) Sensor	The APP sensor has 2 sensor circ its: Main and S b. If either circ it malf nctions, the ECM controls the engine sing the other circ it. If both circ its malf nction, the ECM regards the accelerator pedal as being released. As a res lt, the throttle valve is closed and the engine idles.	Pass condition detected and then engine switch t rned off

HINT:

- ***1: The vehicle can be driven slo l hen the accelerator pedal is depressed fir l and slo l f the accelerator pedal is depressed ickl the vehicle a speed up and slo do n erraticall**
- *** : Misfire related fail-safe operations occur hen catal soverheat alfunctions occur.**
- ***3: nl for M-**

for Preparation Click here

DATA LIST

HINT:

Using the intelligent tester to read the Data List allows the values or states of switches, sensors, actuators and other items to be read without removing any parts. This non-intrusive inspection can be very useful because intermittent conditions or signals may be discovered before parts or wiring is disturbed. Reading the Data List information early in troubleshooting is one way to save diagnostic time.

NOTICE:

In the table below, the values listed under "Normal Condition" are reference values. Do not depend solely on these reference values when deciding whether a part is faulty or not.

a. Warm up the engine.

b. Turn the engine switch off.

c. Connect the intelligent tester to the DLC3.

d. Turn the engine switch on (IG).

e. Turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data.

g. According to the display on the intelligent tester, read the Data List.

Tester Display	Measurement Item/Range	Normal Condition	Diagnostic Note
Vehicle Speed	Vehicle speed/ Min.: 0 km/h (0 mph), Max.: 255 km/h (158 mph)	Actual vehicle speed	The speed is indicated on speedometer.
Engine Speed	Engine speed/ Min.: 0 rpm, Max.: 16383 rpm	650 to 750 rpm: Idling	-
Calculate Load	Calculated load by ECM/ Min.: 0%, Max.: 100%	• 11 to 25%: Idling • 12 to 26%: Running without load (2500 rpm)	-
Vehicle Load	Vehicle load/ Min.: 0%, Max.: 25700%	Actual vehicle load	-
MAF	Air flow rate from Mass Air Flow (MAF) meter/ Min.: 0 gm/s, Max.: 655.35 gm/s	4.0 to 8.0 gm/s.: Idling	If the mass air flow volume is approximately 0.0 gm/s.: • The mass air flow meter power source circuit is open or short. • The VG circuit is open or short. If the mass air flow volume is 271.0 gm/s. or more: • The E2G circuit is open.
Atmosphere Pressure	Atmospheric pressure/ Min.: 0 kPa, Max.: 255 kPa	Equivalent to atmospheric pressure (absolute pressure)	-
Coolant Temp	Engine coolant temperature/ Min.: -40°C, Max.: 215°C	75 to 100°C (167 to 212°F): After warming up	If the value is -40°C (-40°F): the sensor circuit is open. If the value is 140°C (284°F): the sensor circuit is shorted.
Intake Air	Intake air temperature/ Min.: -40°C, Max.: 140°C	Equivalent to ambient air temperature	If the value is -40°C (-40°F): the sensor circuit is open. If the value is 140°C (284°F): the sensor circuit is shorted.
Engine Run Time	Engine run time/ Min.: 0 s, Max.: 65535 s	Time after engine start	Service data.
Initial Engine Coolant Temp	Initial engine coolant temperature/ Min.: -40°C, Max.: 119.3°C	Coolant temperature when engine started	Service data.
Initial Intake Air Temp	Initial intake air temperature/ Min.: -40°C, Max.: 119.3°C	Intake air temperature when engine started	Service data.

Battery Voltage	Battery voltage/ Min.: 0 V, Max.: 65.535 V	11 to 14 V: Idling	-
Accel Sens. No.1 Volt %	Absolute Accelerator Pedal Position (APP) No. 1/ Min.: 0%, Max.: 100%	10 to 22%: accelerator pedal released 54 to 86%: accelerator pedal fully depressed	-
Accel Sens. No.2 Volt %	Absolute APP No. 2/ Min.: 0%, Max.: 100%	12 to 42%: accelerator pedal released 66 to 98%: accelerator pedal fully depressed	-
Accel Sensor Out No.1	APP sensor No. 1 voltage/ Min.: 0 V, Max.: 4.980 V	-	ECT Service data.
Accel Sensor Out No.2	APP sensor No. 2 voltage/ Min.: 0 V, Max.: 4.980 V	-	ECT Service data.
Accel Sensor Out No.1	APP sensor No. 1 voltage/ Min.: 0 V, Max.: 4.980 V	0.5 to 1.1 V: accelerator pedal is released 2.6 to 4.5 V: accelerator pedal is fully depressed	-
Accel Sensor Out No.2	APP sensor No. 2 voltage/ Min.: 0 V, Max.: 4.980 V	1.2 to 2.0 V: accelerator pedal is released 3.4 to 5.0 V: accelerator pedal is fully depressed	-
Accelerator Idle Position	Whether or not accelerator pedal position sensor detecting idle/ ON or OFF	ON: Idling	-
Accel Fully Close #1 (AD)	Accelerator fully closed value No. 1 (AD)/ Min.: 0, Max.: 4.98 V	-	ETCS service data
Accel Fully Close Learn #1	Accelerator fully closed learning value No. 1/ Min.: 0 deg, Max.: 124.5 deg	-	ETCS service data.
Accel Fully Close Learn #2	Accelerator fully closed learning value No. 2/ Min.: 0 deg, Max.: 124.5 deg	-	ETCS service data.
Throttle Sensor Volt %	Throttle valve opening percentage according to throttle position sensor/ Min.: 0%, Max.: 100%	• 10 to 22%: Accelerator pedal released • 64 to 96%: Accelerator pedal fully depressed	Value calculated based on the voltage at terminal VTA1.
Throttl Sensor #2 Volt %	Throttle valve opening percentage according to throttle position sensor No. 2/ Min.: 0%, Max.: 100%	• 42 to 62%: Accelerator pedal released • 92 to 100%: Accelerator pedal fully depressed	Value calculated based on the voltage at terminal VTA2.
ST1	Brake pedal signal/ ON or OFF	ON: Brake pedal depressed	-
System Guard	System guard/ ON or OFF	-	ETCS service data.
Open Side Malfunction	Open side malfunction/ ON or OFF	-	ETCS service data.
Throttle Idle Position	Whether or not throttle position sensor detecting idling/ ON or OFF	• ON: Accelerator pedal released • OFF: Accelerator pedal fully depressed	-
Throttle Require Position	Required throttle position/ Min.: 0 V, Max.: 4.9 V	0.5 to 1.1 V: Idling	-
Throttle Sensor Position*1	Throttle position sensor/ Min.: 0%, Max.: 100%	• 0%: Accelerator pedal released • 50 to 80%: Accelerator pedal fully depressed	Recognition value for throttle opening angle on ECM.
Throttle Position No. 1	Throttle position sensor No. 1 output voltage/ Min.: 0 V, Max.: 4.98 V	-	ETCS freeze data
Throttle Position No. 2	Throttle position sensor No. 2 output voltage/ Min.: 0 V, Max.: 4.98 V	-	ETCS freeze data
Throttle Position	Throttle position No. 1/	• 0.5 to 1.1 V: Accelerator pedal released • 3.2 to 4.8 V:	-

No. 1	Min.: 0 V, Max.: 4.98 V	Accelerator pedal fully depressed • 0.6 to 1.4 V: Fail-safe operating	
Throttle Position No. 2	Throttle position No. 2/ Min.: 0 V, Max.: 4.98 V	• 2.1 to 3.1 V: Accelerator pedal released • 4.6 to 5.0 V: Accelerator pedal fully depressed • 2.1 to 3.1 V: Fail-safe operating	-
Throttle Position Command	Throttle position command value/ Min.: 0 V, Max.: 4.980 V	0.5 to 4.8 V	-
Throttle Sens Open Pos #1	Throttle sensor opener position No. 1/ Min.: 0 V, Max.: 4.980 V	0.6 to 1.4 V	ETCS service data.
Throttle Sens Open Pos #2	Throttle sensor opener position No. 2/ Min.: 0 V, Max.: 4.980 V	1.7 to 2.5 V	ETCS service data.
Throttle Sens Open #1(AD)	Throttle sensor opener position No. 1 (AD)/ Min.: 0 V, Max.: 4.98 V	0.5 to 4.8 V	-
Throttle Motor	Whether or not throttle actuator control permitted/ ON or OFF	• ON: Ignition switch ON • OFF: ETCS has failed	-
Throttle Motor Current	Throttle motor current/ Min.: 0 A, Max.: 19.9 A	0 to 3.0 A: Idling	ETCS service data.
Throttle Motor DUTY	Throttle actuator/ Min.: 0%, Max.: 100%	10 to 22%: Idling after engine warmed up	ETCS service data.
Throttle Motor Current	Throttle actuator current/ Min.: 0 A, Max.: 19.92 A	0 to 3.0 A: Idling	-
Throttle Motor Open Duty	Throttle actuator opening duty ratio/ Min.: 0%, Max.: 255%	0 to 40%: During idling	When accelerator pedal depressed, duty ratio increased.
Throttle Motor Close Duty	Throttle actuator closed duty ratio/ Min.: 0%, Max.: 255%	0 to 40%: During idling	When accelerator pedal released quickly, duty ratio increased.
Throttle Motor Duty (Open)	Throttle actuator duty ratio (open)/ Min.: 0%, Max.: 255%	0 to 40%: Idling	ETCS service data.
Throttle Motor Duty (Close)	Throttle actuator duty ratio (closed)/ Min.: 0%, Max.: 255%	0 to 40%: Idling	ETCS service data.
Throttle Fully Close Learn	Throttle valve fully closed (learned value)/ Min.: 0 V, Max.: 4.98 V	0.4 to 1.0 V: Accelerator pedal released	-
ETCS Actuator Power	Whether or not electric throttle control system power inputted/ ON or OFF	• ON: Ignition switch ON and system normal • OFF: ETCS has failed	-
+BM Voltage	+BM voltage/ Min.: 0 V, Max.: 79.998 V	11 to 14 V: Engine switch on (IG) and system normal	ETCS service data.
Actuator Power Supply	Actuator power supply/ ON or OFF	ON: Idling	ETCS service data.
Clutch Current	Clutch current/ Min.: 0 A, Max.: 2.49 A	-	-
Fail Safe Drive	Whether or not fail-safe function executed/ ON or OFF	• ON: ETCS has failed • OFF: ETCS normal	ETCS service data.
Fail Safe Drive (Main CPU)	Whether or not fail-safe function executed/ ON or OFF	• ON: ETCS has failed • OFF: ETCS normal	ETCS service data.
Injector (Port)	Injection period of the No. 1 cylinder/ Min.: 0 µs, Max.: 65535 µs	2000 to 4000 µs: idling	-
Injection Volum (Cylinder 1)	Injection volume (cylinder 1)/ Min.: 0 ml, Max.: 2.047 ml	0 to 0.5 ml	Quantity of fuel injection volume for 10 times.
Fuel Pump/Speed Status	Fuel pump/speed status/ ON or OFF	-	-
EVAP (Purge) VSV	Purge VSV control duty/ Min.: 0%, Max.: 100%	0 to 100%: During idling	Order signal from ECM.
Evap Purge Flow	Purge flow/	0 to 100%: Idling	-

	Min.: 0%, Max.: 399.9%		
Purge Density Learn Value	Learning value of purge density/ Min.: -200%, Max.: 199.993%	Idling: -40 to 0%	Service data.
EVAP Purge VSV	VSV status for EVAP control/ ON or OFF	-	-
Target Air-Fuel Ratio	Air fuel ratio: Min.: 0, Max.: 1.999	0.8 to 1.2: During idling	-
AF Lambda B1S1	Short-term fuel trim associated with the Bank 1 Sensor 1/ Min.: 0, Max.: 1.999	• Value less than 1 (0.000 to 0.999) = Rich • Stoichiometric air fuel ratio = 1 • Value more than 1 (1.001 to 1.999) = Lean	-
AF Lambda B2S1	Short-term fuel trim associated with the Bank 2 Sensor 1/ Min.: 0, Max.: 1.999	• Value less than 1 (0.000 to 0.999) = Rich • Stoichiometric air fuel ratio = 1 • Value more than 1 (1.001 to 1.999) = Lean	-
AFS Voltage B1S1	Air fuel ratio sensor output voltage (for Bank 1 Sensor 1)/ Min.: 0 V, Max.: 7.999 V	2.8 to 3.8 V: Idling	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the voltage output of the sensor.
AFS Voltage B2S1	Air fuel ratio sensor output voltage (for Bank 2 Sensor 1)/ Min.: 0 V, Max.: 7.999 V	2.8 to 3.8 V: Idling	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the voltage output of the sensor.
AFS Current B1S1	Air fuel ratio sensor current Bank 1 Sensor 1/ Min.: -128 mA, Max.: 127.99 mA	-0.5 to 0.5 mA: Idling	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the output current of the sensor.
AFS Current B2S1	Air fuel ratio sensor current (for Bank 2 Sensor 1)/ Min.: -128 mA, Max.: 127.99 mA	-0.5 to 0.5 mA: Idling	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the output current of the sensor.
O2S B1S2	Heated oxygen sensor output voltage (for Bank 1 Sensor 2)/ Min.: 0 V, Max.: 1.275 V	0.1 to 0.9 V: Driving 70 km/h (44 mph)	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the voltage output of the sensor.
O2S B2S2	Heated oxygen sensor output voltage (for Bank 2 Sensor 2)/ Min.: 0 V, Max.: 1.275 V	0.1 to 0.9 V: Driving 70 km/h (44 mph)	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the voltage output of the sensor.
Short FT #1	Short-term fuel trim of Bank 1/ Min.: -100%, Max.: 99.2%	-20 to 20%	This item refers to the short-term fuel compensation used to maintain the air fuel ratio at the stoichiometric air-fuel ratio.
Long FT #1	Long-term fuel trim of Bank 1/ Min.: -100%, Max.: 99.2%	-20 to 20%	This item refers to the overall fuel compensation carried out in the long-term to compensate for a continual deviation of the short-term fuel trim from the central value.
Short FT #2	Short-term fuel trim of Bank 2/ Min.: -100%, Max.: 99.2%	-20 to 20%	This item refers to the short-term fuel compensation used to maintain the air fuel ratio at the stoichiometric air-fuel ratio.
	Long-term fuel trim of Bank 2/		This item refers to the overall fuel compensation carried out in the long-term to compensate for a

Long FT #2	Min.: -100%, Max.: 99.2%	-20 to 20%	continual deviation of the short-term fuel trim from the central value.
Fuel System Status #1	Fuel system status (Bank 1)/ OL, CL, OLDrive, OLFault or CLFault	CL: Idling after warming up	• OL (Open Loop): Has not yet satisfied the conditions to go to closed loop. • CL (Closed Loop): Using the heated oxygen sensor as feedback for fuel control. • OLDrive: Open loop due to driving conditions (fuel enrichment). • OLFault: Open loop due to a detected system fault. • CLFault: Closed loop but the heated oxygen sensor, which is used for fuel control, is malfunctioning.
Fuel System Status #2	Fuel system status (Bank 2)/ OL, CL, OLDrive, OLFault or CLFault	CL: Idling after warming up	• OL (Open Loop): Has not yet satisfied the conditions to go to closed loop. • CL (Closed Loop): Using the heated oxygen sensor as feedback for fuel control. • OLDrive: Open loop due to driving conditions (fuel enrichment). • OLFault: Open loop due to a detected system fault. • CLFault: Closed loop but the heated oxygen sensor, which is used for fuel control, is malfunctioning.
IGN Advance	Ignition timing advance for No. 1 cylinder/ Min.: -64 deg, Max.: 63.5 deg	BTDC 5 to 15 deg: Idling	-
Knock Feedback Value	Feedback value of knocking/ Min.: -1024°CA, Max.: 1023.9°CA	-22 to 0° CA: Driving, 70 km/h (44 mph)	Service data.
Knock Correct Learn Value	Correction learning value of knocking/ Min.: -1024°CA, Max.: 1023.9°CA	0 to 22° CA: Driving, 70 km/h (44 mph)	Service data.
ACIS VSV	VSV status for ACIS control/ ON or OFF	-	-
VVT Control Status #1	Variable valve timing (VVT) control status (Bank 1)/ ON or OFF	-	-
VVT Control Status #2	VVT control status (Bank 2)/ ON or OFF	-	-
VVT Aim Angle #1*2	VVT aim angle (Bank 1)/ Min.: 0%, Max.: 399.9%	0 to 80%	VVT duty signal value during intrusive operation.
VVT Change Angle #1*2	VVT change angle (Bank 1)/ Min.: 0 DegFR, Max.: 639.9 DegFR	0 to 5 DegFR: Idling	Displacement angle during intrusive operation.
VVT OCV Duty #1*2	VVT OCV operation duty (Bank 1)/ Min.: 0%, Max.: 399.9%	0 to 100%	Requested duty value for intrusive operation.
VVT Aim Angle #2*2	VVT aim angle (Bank 2)/ Min.: 0%, Max.: 399.9%	0 to 80%	VVT duty signal value during intrusive operation.
VVT Change Angle #2*2	VVT change angle (Bank 2)/ Min.: 0 DegFR, Max.: 639.9 DegFR	0 to 5 DegFR: Idling	Displacement angle during intrusive operation.
VVT OCV Duty	VVT OCV operation duty (Bank 2)/		Requested duty value for intrusive

#2*2	Min.: 0%, Max.: 399.9%	0 to 100%	operation.
VVT Ex Hold Lrn Val #1*2	VVT exhaust hold duty ratio learning value (Bank 1)/ Min.: 0%, Max.: 399.9%	0 to 80%	VVT duty signal value during intrusive operation.
VVT Ex Chg Angle #1*2	VVT exhaust change angle (Bank 1)/ Min.: 0 DegFR, Max.: 639.9 DegFR	0 to 5 DegFR: Idling	Displacement angle during intrusive operation.
VVT Ex OCV Duty #1*2	VVT exhaust OCV duty (Bank 1)/ Min.: 0%, Max.: 399.9%	0 to 100%	Requested duty value for intrusive operation.
VVT Ex Hold Lrn Val #2*2	VVT exhaust hold duty ratio learning value (Bank 2)/ Min.: 0%, Max.: 399.9%	0 to 80%	VVT duty signal value during intrusive operation.
VVT Ex Chg Angle #2*2	VVT exhaust change angle (Bank 2)/ Min.: 0 DegFR, Max.: 639.9 DegFR	0 to 5 DegFR: Idling	Displacement angle during intrusive operation.
VVT Ex OCV Duty #2*2	VVT exhaust OCV duty (Bank 2)/ Min.: 0%, Max.: 399.9%	0 to 100%	Requested duty value for intrusive operation.
Catalyst Temp B1S1	Catalyst temperature (Bank 1, Sensor 1)/ Min.: -40°C, Max.: 6513.5°C	-	-
Catalyst Temp B2S1	Catalyst temperature (Bank 2, Sensor 1)/ Min.: -40°C, Max.: 6513.5°C	-	-
Catalyst Temp B1S2	Catalyst temperature (Bank 1, Sensor 2)/ Min.: -40°C, Max.: 6513.5°C	-	-
Catalyst Temp B2S2	Catalyst temperature (Bank 2, Sensor 2)/ Min.: -40°C, Max.: 6513.5°C	-	-
Starter Signal	Starter signal/ Open or Close	Open: Cranking	-
Starter Control	Starter switch status/ ON or OFF	ON: Cranking	-
Power Steering Signal Record	Power steering switch signal/ ON or OFF	ON: Power steering operation	-
Starter Relay	Starter relay status/ ON or OFF	ON: Cranking	-
Power Steer. Sig. Record	Power steering signal (history)/ ON or OFF	ON: When steering wheel first turned after battery terminals connected	This signal status is usually ON until the cables are disconnected from the battery terminals.
ACC Relay	Acc relay status/ ON or OFF	ON: Cranking	-
Neutral Position SW Signal	PNP switch status/ ON or OFF	ON: Shift lever in P or N	-
Stop Light Switch	Stop light switch/ ON or OFF	ON: Brake pedal depressed	-
A/C Signal	A/C switch status/ ON or OFF	ON: A/C ON	-
Closed Throttle Position SW	Closed throttle position switch/ ON or OFF	• ON: Throttle fully closed • OFF: Throttle open	-
Fuel Cut Condition	Fuel cut condition/ ON or OFF	ON: Fuel cut operating	-
Immobiliser Communication	Immobiliser communication/ ON or OFF	ON: Normal	-
Electrical Load Signal	Electrical load signal/ ON or OFF	ON: Headlights or defogger is turned ON	-
Check Mode	Check mode/ ON or OFF	ON: Check mode ON	Refer to the Check Mode Procedure (Click here).
SPD Test Result	Check mode result for vehicle speed sensor/ Compl or Incmpl	-	-
Misfire Test Result	Check mode result for misfire monitor/ Compl or Incmpl	-	-
	Check mode result for heated		

OXS1 Test Result	oxygen sensor (Bank 1)/ Compl or Incmpl	-	-
OXS2 Test Result	Check mode result for heated oxygen sensor (Bank 2)/ Compl or Incmpl	-	-
A/F Test Results #2	Check mode result for air fuel ratio sensor (Bank 2)/ Compl or Incmpl	-	-
A/F Test Results #1	Check mode result for air fuel ratio sensor (Bank 1)/ Compl or Incmpl	-	-
Complete Parts Monitor	Comprehensive component monitor/ Not Avl or Avail	-	-
Fuel System Monitor	Fuel system monitor/ Not Avl or Avail	-	-
Misfire Monitor	Misfire monitor/ Not Avl or Avail	-	-
EGR/VVT Monitor	EGR/VVT monitor/ Not Avl or Avail	-	-
EGR/VVT Monitor	EGR/VVT monitor/ Compl or Incmpl	-	-
O2S(A/FS) Heater Monitor	O2S (A/FS) heater monitor/ Not Avl or Avail	-	-
O2S(A/FS) Heater Monitor	O2S (A/FS) heater monitor/ Compl or Incmpl	-	-
O2S(A/FS) Monitor	O2S (A/FS) monitor/ Not Avl or Avail	-	-
O2S(A/FS) Monitor	O2S (A/FS) monitor/ Compl or Incmpl	-	-
A/C Monitor	A/C Monitor/ Not Avl or Avail	-	-
A/C Monitor	A/C Monitor/ Compl or Incmpl	-	-
2nd Air Monitor	2nd air monitor/ Not Avl or Avail	-	-
2nd Air Monitor	2nd air monitor/ Compl or Incmpl	-	-
EVAP Monitor	EVAP monitor/ Not Avl or Avail	-	-
EVAP Monitor	EVAP monitor/ Compl or Incmpl	-	-
Heated Catalyst Monitor	Heated catalyst monitor/ Not Avl or Avail	-	-
Heated Catalyst Monitor	Heated catalyst monitor/ Compl or Incmpl	-	-
Catalyst Monitor	Catalyst monitor/ Not Avl or Avail	-	-
Catalyst Monitor	Catalyst monitor/ Compl or Incmpl	-	-
# Codes (Include History)	Number of codes/ Min.: 0, Max.: 255	-	Number of stored DTCs.
MIL	MIL status/ ON or OFF	ON: MIL on	-
MIL ON Run Distance	MIL on run distance/ Min.: 0 km, Max.: 65535 km	Distance after DTC stored	-
Running Time from MIL ON	Running time from MIL on/ Min.: 0 min, Max.: 65535 min	Equivalent to running time after MIL on	-
Time after DTC Cleared	Time after DTC cleared/ Min.: 0 minutes, Max.: 65535 minutes	Equivalent to time after DTCs cleared	-
Distance from DTC Cleared	Distance after DTC cleared/ Min.: 0 km, Max.: 65535 km	Equivalent to drive distance after DTCs cleared	-
Warmup Cycle Cleared DTC	Warm-up cycle after DTC cleared/ Min.: 0, Max.: 255	-	Number of warm-up cycles after the DTC is cleared.
OBD Requirements	OBD requirement	OBD2	-

Number of Emission DTC	Emission related DTCs	-	Number of emission related DTCs.
TC and TE1	TC and TE1 terminal of DLC3/ ON or OFF	-	-
Ignition Trig. Count	Ignition counter/ Min.: 0, Max.: 65535	0 to 800	-
Cylinder #1 Misfire Count to Cylinder #8 Misfire Count	Misfire count of the cylinder 1 to 8/ Min.: 0, Max.: 255	0	-
All Cylinders Misfire Count	All cylinders misfire count/ Min.: 0, Max.: 255	0 to 35	-
Multi Cylinders Misfire Count	Multiple cylinder misfire count/ Min.: 0 Max.: 65535	0 to 65535	-
Misfire RPM	Engine speed for first misfire range/ Min.: 0 rpm, Max.: 6375 rpm	0 rpm: Misfire 0	-
Misfire Load	Engine load for first misfire range/ Min.: 0 g/rev, Max.: 3.98 g/rev	0 g/rev: Misfire 0	-
Misfire Margin	Misfire monitoring/ Min.: -128%, Max.: 127%	-100 to 99.2%	Misfire detecting margin
Catalyst OT MF F/C	Catalyst over temperature misfire prevention F/C/ Not Avl or Avail	Avail: Cat OT MF F/C available Not Avl: Cat OT MF F/C not available	-
Cat OT MF F/C History	Catalyst over temperature misfire prevention F/C history/ ON or OFF	OFF: Fuel cut operation not exists	-
Cat OT MF F/C Cylinder #1	Display of fuel cut operation in No. 1 cylinder (if certain level of misfire malfunction is detected)/ ON or OFF	ON: Fuel cut operating	-
Cat OT MF F/C Cylinder #2	Display of fuel cut operation in No. 2 cylinder (if certain level of misfire malfunction is detected)/ ON or OFF	ON: Fuel cut operating	-
Cat OT MF F/C Cylinder #3	Display of fuel cut operation in No. 3 cylinder (if certain level of misfire malfunction is detected)/ ON or OFF	ON: Fuel cut operating	-
Cat OT MF F/C Cylinder #4	Display of fuel cut operation in No. 4 cylinder (if certain level of misfire malfunction is detected)/ ON or OFF	ON: Fuel cut operating	-
Cat OT MF F/C Cylinder #5	Display of fuel cut operation in No. 5 cylinder (if certain level of misfire malfunction is detected)/ ON or OFF	ON: Fuel cut operating	-
Cat OT MF F/C Cylinder #6	Display of fuel cut operation in No. 6 cylinder (if certain level of misfire malfunction is detected)/ ON or OFF	ON: Fuel cut operating	-
Cat OT MF F/C Cylinder #7	Display of fuel cut operation in No. 7 cylinder (if certain level of misfire malfunction is detected)/ ON or OFF	ON: Fuel cut operating	-
Cat OT MF F/C Cylinder #8	Display of fuel cut operation in No. 8 cylinder (if certain level of misfire malfunction is detected)/ ON or OFF	ON: Fuel cut operating	-
Power Steering Pressure	Power steering oil pressure/ Min.: 0 MPa, Max.: 25.599 MPa	-	-
ACT VSV	A/C cut status for Active Test/ ON or OFF	-	-
Idle Fuel Cut	Fuel cut idle/ ON or OFF	ON: Fuel cut operation	Idle Fuel Cut is "ON" when the throttle valve is fully closed and the engine speed is more than 2800 rpm.
FC TAU	Fuel cut TAU: Fuel cut during very light load/	ON: Fuel cut operation	The fuel cut being performed under a very light load to prevent the

	ON or OFF		engine combustion from becoming incomplete.
Model Code	Model code	-	Identifying the model code: URJ2###.
Engine Type	Engine type	-	Identifying the engine type: 3URFE.
Cylinder Number	Number of cylinders/ Min.: 0, Max.: 255	-	Identifying the number of cylinders: 8.
Transmission Type	Transmission type	-	Identifying the transmission type: ECT 6th.
Destination	Destination	-	Identifying the destination: W.
Model Year	Model year/ Min.: 1900, Max.: 2155	-	Identifying the model year: 20##.
Engine Speed of Cyl #1	Engine speed for cylinder 1/ Min.: 0 rpm, Max.: 51199 rpm	-	Output only when Check the Cylinder Compression is performed using Active Test.
Engine Speed of Cyl #2	Engine speed for cylinder 2/ Min.: 0 rpm, Max.: 51199 rpm	-	Output only when Check the Cylinder Compression is performed using Active Test.
Engine Speed of Cyl #3	Engine speed for cylinder 3/ Min.: 0 rpm, Max.: 51199 rpm	-	Output only when Check the Cylinder Compression is performed using Active Test.
Engine Speed of Cyl #4	Engine speed for cylinder 4/ Min.: 0 rpm, Max.: 51199 rpm	-	Output only when Check the Cylinder Compression is performed using Active Test.
Engine Speed of Cyl #5	Engine speed for cylinder 5/ Min.: 0 rpm, Max.: 51199 rpm	-	Output only when Check the Cylinder Compression is performed using Active Test.
Engine Speed of Cyl #6	Engine speed for cylinder 6/ Min.: 0 rpm, Max.: 51199 rpm	-	Output only when Check the Cylinder Compression is performed using Active Test.
Engine Speed of Cyl #7	Engine speed for cylinder 7/ Min.: 0 rpm, Max.: 51199 rpm	-	Output only when Check the Cylinder Compression is performed using Active Test.
Engine Speed of Cyl #8	Engine speed for cylinder 8/ Min.: 0 rpm, Max.: 51199 rpm	-	Output only when Check the Cylinder Compression is performed using Active Test.
Av Engine Speed of All Cyl	Engine speed for all cylinders/ Min.: 0 rpm, Max.: 51199 rpm	-	Output only when Check the Cylinder Compression is performed using Active Test.
SPD (NT)	Input shaft speed/ Min.: 0 rpm, Max.: 12750 rpm	Lock-up is • ON (after warming up engine): Input turbine speed (NT) equal to engine speed • OFF (idling with shift lever in N): Input turbine speed (NT) nearly equal to engine speed	Data is displayed in increments of 50 rpm.
SPD (SP2)	Output shaft speed/ Min.: 0 km/h (0 mph), Max.: 255 km/h (158 mph)	Vehicle stopped: 0 km/h (0 mph) (output shaft speed is equal to vehicle speed)	-

HINT:

- **Normal Condition: If no conditions are specifically stated for "idling", the shift lever is in N or P, the A/C switch is off and all accessory switches are off.**
- ***1: Excluding throttle valve opening percentage due to Idle Speed Control (ISC).**
- ***2: Data List values are only displayed when performing the following Active Tests: Control the VVT Linear (Bank 1), Control the VVT Linear (Bank 2), Control the VVT Exhaust Linear (Bank 1) and Control the VVT Exhaust Linear (Bank 2). For other Active Tests, the Data List value will be 0.**

ACTIVE TEST

HINT:

Using the intelligent tester to perform Active Tests allows relays, VSVs, actuators and other items to be operated without removing any parts. This non-intrusive functional inspection can be very useful because intermittent operation may be discovered before parts or wiring is disturbed. Performing

Active Tests early in troubleshooting is one way to save diagnostic time. Data List information can be displayed while performing Active Tests.

a. Warm up the engine.

b. Turn the engine switch off.

c. Connect the intelligent tester to the DLC3.

d. Turn the engine switch on (IG).

e. Turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / Active Test.

g. According to the display on the intelligent tester, perform the Active Test.

Tester Display	Test Part	Control Range	Diagnostic Note
Control the Injection Volume	Change injection volume	Between -12.5% and 24.8%	• All the injectors are tested at the same time. • Perform the test at 3000 rpm or less. • The injection volume can be changed in 0.1 or 0.2% graduations within the control range.
Control the Injection Volume for A/F Sensor	Change injection volume	Lower by 12.5% or increase 24.8%	• Perform the test at 3000 rpm or less. • Control the Injection Volume for A/F Sensor enables the checking and graphing of the A/F (Air Fuel Ratio) sensor voltage outputs. • To conduct the test, enter the following menus: Active Test / Control the Injection Volume for A/F Sensor / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S1.
Activate the VSV for Intake Control	Activate VSV for intake control	ON/OFF	-
Activate the VSV for Evap Control	Activate purge VSV control	ON/OFF	-
Control the A/C Cut Signal	Control A/C cut signal	ON/OFF	Test possible when • Engine switch is on (IG). • Engine is stopped.
Control the Fuel Pump / Speed	Activate fuel pump	ON/OFF	Test possible when • Engine switch is on (IG). • Engine is stopped.
Connect the TC and TE1	Turn on and off TC and TE1 connection	ON/OFF	• ON: TC and TE1 connected. • OFF: TC and TE1 disconnected.
Control the Idle Fuel Cut Prohibit	Prohibit idling fuel cut control	ON/OFF	-
Prohibit the Catalyst OT Misfire prevent F/C	Prohibit catalyst overheat malfunction prevention fuel cut operation during misfire	ON/OFF ON: Fuel cut is prohibited	Confirm that the vehicle is stopped and the engine speed is 3000 rpm or less.
Activate the Starter Relay	Activate the starter relay	ON/OFF	Engine is stopped.
Activate the ACC Cut Relay	Activate the ACC CUT relay	ON/OFF	Engine is stopped.

Control the ETCS Open/Close Slow Speed	Throttle actuator	Close/Open Open: throttle valve opens slowly	This test is possible when the following conditions are met: • The engine switch is on (IG). • The engine does not starts. • Fully depressing the accelerator pedal (APP: 58 degrees or more).
Control the ETCS Open/Close Fast Speed	Throttle actuator	Close/Open Open: throttle valve opens fast	Same as above.
Control the VVT Linear (Bank 1)	Control Variable Valve Timing (VVT) [Bank 1]	-128 to 127% This valve added to present OCV control duty 100%: Maximum advance -100%: Maximum retard	• Engine stalls or idles roughly when VVT actuator is operated by 100%. • Test is possible during idle.
Control the VVT System (Bank 1)	Turn on and off Oil Control Valve (OCV)	ON/OFF	• Engine stalls or idles roughly when OCV is turned on. • Engine runs or idles normally when OCV is OFF.
Control the VVT Linear (Bank 2)	Control Variable Valve Timing (VVT) [Bank 2]	-128 to 127% This valve added to present OCV control duty 100%: Maximum advance -100%: Maximum retard	• Engine stalls or idles roughly when VVT actuator is operated by 100%. • Test is possible during idle.
Control the VVT System (Bank 2)	Turn on and off Oil Control Valve (OCV)	ON/OFF	• Engine stalls or idles roughly when OCV is turned on. • Engine runs or idles normally when OCV is OFF.
Control the VVT Exhaust Linear (Bank 1)	Control VVT (Bank 1)	128 to 127% This valve added to present OCV control duty 100%: Maximum advance -100%: Maximum retard	• Engine stalls or idles roughly when VVT actuator is operated by 100%. • Test is possible while engine is idling.
Control the VVT Exhaust Linear (Bank 2)	Control VVT (Bank 2)	128 to 127% This valve added to present OCV control duty 100%: Maximum advance -100%: Maximum retard	• Engine stalls or idles roughly when VVT actuator is operated by 100%. • Test is possible while engine is idling.
Control the Cylinder #1 Fuel Cut	Cylinder #1 injector fuel cut	ON/OFF	Test is possible while vehicle is stopped and engine is idling.*1
Control the Cylinder #2 Fuel Cut	Cylinder #2 injector fuel cut	ON/OFF	Test is possible while vehicle is stopped and engine is idling.*1
Control the Cylinder #3 Fuel Cut	Cylinder #3 injector fuel cut	ON/OFF	Test is possible while vehicle is stopped and engine is idling.*1
Control the Cylinder #4 Fuel Cut	Cylinder #4 injector fuel cut	ON/OFF	Test is possible while vehicle is stopped and engine is idling.*1
Control the Cylinder #5 Fuel Cut	Cylinder #5 injector fuel cut	ON/OFF	Test is possible while vehicle is stopped and engine is idling.*1
Control the Cylinder #6 Fuel Cut	Cylinder #6 injector fuel cut	ON/OFF	Test is possible while vehicle is stopped and engine is idling.*1
Control the Cylinder #7 Fuel Cut	Cylinder #7 injector fuel cut	ON/OFF	Test is possible while vehicle is stopped and engine is idling.*1
Control the Cylinder #8 Fuel Cut	Cylinder #8 injector fuel cut	ON/OFF	Test is possible while vehicle is stopped and engine is idling.*1
Control the All Cylinders Fuel Cut	All cylinder fuel cut	ON/OFF	Test is possible while vehicle is stopped and engine is idling.*1
Check the Cylinder Compression*2	Check the cylinder compression pressure	ON/OFF	Fuel injection and ignition stop in all cylinders.

NOTICE:

- ***1: If the display of the Data List Catalyst OT MF F/C item is Not Avl, perform this Active Test with the vehicle stopped and the engine idling.**
- ***1: If the display of the Data List Catalyst OT MF F/C item is Avail, perform this Active Test as described below.**
    1. **Stop the engine and turn the engine switch on (IG) to turn Control the Cylinder#1 Fuel Cut (to Control the Cylinder#8 Fuel Cut) on.**
    2. **Start the engine.**

HINT:

*2: When cranking the engine, each cylinder measures the engine speed.

In this Active Test, the fuel and ignition of all cylinders is cut. The engine must then be cranked for approximately 10 seconds. At this time, the speed of each cylinder is measured. If the speed of one cylinder is more than the other cylinders, it can be determined that the compression pressure of that cylinder is lower than the other cylinders.

1. Warm up the engine.
2. Turn the engine switch off.
3. Connect the intelligent tester to the DLC3.
4. Turn the engine switch on (IG).
5. Turn the tester on.
6. Enter the following menus: Powertrain / Engine and ECT / Active Test / Check the Cylinder Compression.

    HINT:

    To display the entire Data List, press the pull down menu button next to Primary. Then select Compression.

7. Push the snapshot button to turn the snapshot function on.

    HINT:

    Using the snapshot function, data can be recorded during the Active Test.

8. While the engine is not running, press the RIGHT or LEFT button to change Check the Cylinder Compression to ON.

    HINT:

    After performing the above procedure, Check the Cylinder Compression will start. Fuel injection for all cylinders is prohibited and each cylinder engine speed measurement enters standby mode.

9. Crank the engine for about 10 seconds.

    HINT:

    Continue to crank the engine until the values change from the default value (51199 rpm).

10. Monitor the engine speed (Engine Speed of Cyl #1 to #8) displayed on the intelligent tester.

    HINT:

    At first, the intelligent tester displays extremely high cylinder engine speed values. After approximately 10 seconds of engine cranking, each cylinder engine speed measurement will change to the actual engine speed.

    NOTICE:

    - **Do not crank the engine continuously for 20 seconds or more.**
    - **If it is necessary to crank the engine again after Check the Cylinder Compression has been changed to ON and the engine has been cranked once, press Exit to return to the Active Test menu screen. Then change Check the Cylinder Compression to ON and crank the engine.**
    - **Use a fully-charged battery.**

11. Stop cranking the engine, and then change "Check the Cylinder Compression" to OFF after the engine stops.

    NOTICE:

    If the Active Test is changed to OFF while the engine is being cranked, the engine will start.

12. Push the snapshot button to turn the snapshot function off.
13. Select "Stored Data" on the intelligent tester screen, select the recorded data and display the data as a graph.

    HINT:

    If the data is not displayed as a graph, the change of the values cannot be observed.

14. Check the change in engine speed values.

    HINT:

    As the data values of the Active Test return to their default values when cranking is stopped, the engine speed value of each cylinder cannot be observed. Therefore, it is necessary to use the data recorded with the snapshot function to check the engine speed values recorded during cranking.

for Preparation Click here

HINT:

Parameters listed in the chart may be different than your readings depending on the type of instrument and other factors.

For details of each DTC, refer to the "See page" below.

SFI System

DTC Code	Detection Item	Trouble Areas	MIL	Memory	See page
P0010	Camshaft Position "A" Actuator Circuit (Bank 1)	- Open or short in OCV for intake camshaft (for Bank 1) circuit - OCV for intake camshaft (for Bank 1) - ECM	Comes on	DTC stored	Click here
P0011	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)	- Valve timing - OCV for intake camshaft - OCV filter - Intake camshaft timing gear - ECM	Comes on (Euro-OBD) Does not come on (M-OBD)	DTC stored	Click here
P0012	Camshaft Position "A" - Timing Over-Retarded (Bank 1)	- Valve timing - OCV for intake camshaft - OCV filter - Intake camshaft timing gear - ECM	Comes on (Euro-OBD) Does not come on (M-OBD)	DTC stored	Click here
P0013	Camshaft Position "B" Actuator Circuit / Open (Bank 1)	circuit	Comes on	DTC stored	Click here
P0014	Camshaft Position "B" - Timing Over-Advanced or System Performance (Bank 1)	- Valve timing - Oil control valve (OCV) for exhaust camshaft - OCV filter - Camshaft timing exhaust gear - ECM	Comes on (Euro-OBD) Does not come on (M-OBD)	DTC stored	Click here
P0015	Camshaft Position "B" - Timing Over-Retarded (Bank 1)	- Valve timing - OCV for exhaust camshaft - OCV filter - Camshaft timing exhaust gear - ECM	Comes on (Euro-OBD) Does not come on (M-OBD)	DTC stored	Click here
P0016	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)	- Mechanical system (Timing chain has jumped tooth or chain stretched) - ECM	Comes on (Euro-OBD) Does not come on (M-OBD)	DTC stored	Click here
P0017	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor B)	- Mechanical system (Timing chain has jumped tooth or chain stretched) - ECM	Comes on (Euro-OBD) Does not come on (M-OBD)	DTC stored	Click here
		- Mechanical system	Comes on (Euro-		

P0018	Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor A)	(Timing chain has jumped tooth or chain stretched) - ECM	OBD) Does not come on (M-OBD)	DTC stored	Click here
P0019	Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor B)	- Mechanical system (Timing chain has jumped tooth or chain stretched) - ECM	Comes on (Euro-OBD) Does not come on (M-OBD)	DTC stored	Click here
P0020	Camshaft Position "A" Actuator Circuit (Bank 2)	- Open or short in OCV for intake camshaft (for Bank 2) circuit - OCV for intake camshaft (for Bank 2) - ECM	Comes on	DTC stored	Click here
P0021	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)	- Valve timing - OCV for intake camshaft - OCV filter - Intake camshaft timing gear - ECM	Comes on (Euro-OBD) Does not come on (M-OBD)	DTC stored	Click here
P0022	Camshaft Position "A" - Timing Over-Retarded (Bank 2)	- Valve timing - OCV for intake camshaft - OCV filter - Intake camshaft timing gear - ECM	Comes on (Euro-OBD) Does not come on (M-OBD)	DTC stored	Click here
P0023	Camshaft Position "B" Actuator Circuit / Open (Bank 2)	- Open or short in OCV for exhaust camshaft (for Bank 2) circuit - OCV for exhaust camshaft (for Bank 2) - ECM	Comes on	DTC stored	Click here
P0024	Camshaft Position "B" - Timing Over-Advanced or System Performance (Bank 2)	- Valve timing - Oil control valve (OCV) for exhaust camshaft - OCV filter - Camshaft timing exhaust gear - ECM	Comes on (Euro-OBD) Does not come on (M-OBD)	DTC stored	Click here
P0025	Camshaft Position "B" - Timing Over-Retarded (Bank 2)	- Valve timing - OCV for exhaust camshaft - OCV filter - Camshaft timing exhaust gear - ECM	Comes on (Euro-OBD) Does not come on (M-OBD)	DTC stored	Click here
P0031	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)	- Open in A/F sensor heater circuit - A/F sensor heater (for Sensor 1) - Integration relay - ECM	Comes on	DTC stored	Click here
P0032	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)	- Short in A/F sensor heater circuit - A/F sensor heater (for Sensor 1) - Integration relay - ECM	Comes on	DTC stored	Click here

P0037	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)	- Open in HO2 sensor heater circuit - HO2 sensor heater (for Sensor 2) - Integration relay - ECM	Comes on	DTC stored	Click here
P0038	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)	- Short in HO2 sensor heater circuit - HO2 sensor heater (for Sensor 2) - Integration relay - ECM	Comes on	DTC stored	Click here
P0051	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)	- Open in A/F sensor heater circuit - A/F sensor heater (for Sensor 1) - Integration relay - ECM	Comes on	DTC stored	Click here
P0052	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)	- Short in A/F sensor heater circuit - A/F sensor heater (for Sensor 1) - Integration relay - ECM	Comes on	DTC stored	Click here
P0057	Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)	- Open in HO2 sensor heater circuit - HO2 sensor heater (for Sensor 2) - Integration relay - ECM	Comes on	DTC stored	Click here
P0058	Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)	- Short in HO2 sensor heater circuit - HO2 sensor heater (for Sensor 2) - Integration relay - ECM	Comes on	DTC stored	Click here
P0102	Mass or Volume Air Flow Circuit Low Input	- Open or short in MAF meter circuit - MAF meter - ECM	Comes on	DTC stored	Click here
P0103	Mass or Volume Air Flow Circuit High Input	- Open or short in MAF meter circuit - MAF meter - ECM	Comes on	DTC stored	Click here
P0110	Intake Air Temperature Circuit Malfunction	- Open or short in Intake Air Temperature (IAT) sensor circuit - IAT sensor (built into MAF meter) - ECM	Comes on	DTC stored	Click here
P0112	Intake Air Temperature Circuit Low Input	- Short in IAT sensor circuit - IAT sensor (built into MAF meter) - ECM	Comes on	DTC stored	Click here
P0113	Intake Air Temperature Circuit High Input	- Open in IAT sensor circuit - IAT sensor (built	Comes on	DTC	Click

		into MAF meter) - ECM		stored	here
P0115	Engine Coolant Temperature Circuit Malfunction	- Open or short in Engine Coolant Temperature (ECT) sensor circuit - ECT sensor - ECM	Comes on	DTC stored	Click here
P0116	Engine Coolant Temperature Circuit Range / Performance Problem	- Thermostat - ECT sensor	Comes on	DTC stored	Click here
P0117	Engine Coolant Temperature Circuit Low Input	- Short in ECT sensor - ECT sensor - ECM	Comes on	DTC stored	Click here
P0118	Engine Coolant Temperature Circuit High Input	- Open in ECT sensor circuit - ECT sensor - ECM	Comes on	DTC stored	Click here
P0120	Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction	- Throttle Position (TP) sensor (built into throttle body) - ECM	Comes on	DTC stored	Click here
P0121	Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem	TP sensor (built into throttle body)	Comes on	DTC stored	Click here
P0122	Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input	- TP sensor (built into throttle body) - Short in VTA1 circuit - Open in VC circuit - ECM	Comes on	DTC stored	Click here
P0123	Throttle / Pedal Position Sensor / Switch "A" Circuit High Input	- TP sensor (built into throttle body) - Open in VTA1 circuit - Open in E2 circuit - Short between VC and VTA1 circuits - ECM	Comes on	DTC stored	Click here
P0137	Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)	- Open in HO2 sensor (for Bank 1) circuit - HO2 sensor (for Bank 1) - HO2 sensor heater (for Bank 1) - Integration relay - Gas leakage from exhaust system	Comes on	DTC stored	Click here
P0157	Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)	- Open in HO2 sensor (for Bank 2) circuit - HO2 sensor (for Bank 2) - HO2 sensor heater (for Bank 2) - Integration relay - Gas leakage from exhaust system	Comes on	DTC stored	Click here
P0220	Throttle / Pedal Position Sensor / Switch "B" Circuit	- TP sensor (built into throttle body) - ECM	Comes on	DTC stored	Click here
		- TP sensor (built into			

P0222	Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input	throttle body) - Short in VTA2 circuit - Open in VC circuit - ECM	Comes on	DTC stored	Click here
P0223	Throttle / Pedal Position Sensor / Switch "B" Circuit High Input	- TP sensor (built into throttle body) - Open in VTA2 circuit - Open in E2 circuit - Short between VC and VTA2 circuits - ECM	Comes on	DTC stored	Click here
P0230	Fuel Pump Primary Circuit	- Open or short in fuel pump circuit - Fuel pump - Fuel pump ECU - ECM	-	DTC stored	Click here
P0300	Random / Multiple Cylinder Misfire Detected	- Open or short in Engine wire harness - Connector connection - Vacuum hose connections - Ignition system - Fuel injector - Fuel pressure - Mass Air Flow (MAF) meter - Engine Coolant Temperature (ECT) sensor - Compression pressure - Valve timing - PCV Valve and hose - PCV hose connections - Air induction system - ECM	Does not comes on	DTC stored	Click here
P0301	Cylinder 1 Misfire Detected	- Open or short in Engine wire harness - Connector connection - Vacuum hose connections - Ignition system - Fuel injector - Fuel pressure - Mass Air Flow (MAF) meter - Engine Coolant Temperature (ECT) sensor - Compression pressure - Valve timing - PCV Valve and hose - PCV hose connections - Air induction system - ECM	Does not comes on	DTC stored	Click here
		Engine wire harness - Connector connection - Vacuum hose			

P0302	Cylinder 2 Misfire Detected	connections - Ignition system - Injector - Fuel pressure - Mass Air Flow (MAF) meter - Engine Coolant Temperature (ECT) sensor - Compression pressure - Valve timing - PCV Valve and hose - PCV hose connections - Air induction system - ECM	Does not comes on	DTC stored	Click here
P0303	Cylinder 3 Misfire Detected	- Open or short in Engine wire harness - Connector connection - Vacuum hose connections - Ignition system - Fuel injector - Fuel pressure - Mass Air Flow (MAF) meter - Engine Coolant Temperature (ECT) sensor - Compression pressure - Valve timing - PCV Valve and hose - PCV hose connections - Air induction system - ECM	Does not comes on	DTC stored	Click here
P0304	Cylinder 4 Misfire Detected	- Open or short in Engine wire harness - Connector connection - Vacuum hose connections - Ignition system - Fuel injector - Fuel pressure - Mass Air Flow (MAF) meter - Engine Coolant Temperature (ECT) sensor - Compression pressure - Valve timing - PCV Valve and hose - PCV hose connections - Air induction system - ECM	Does not comes on	DTC stored	Click here
		- Open or short in Engine wire harness - Connector connection - Vacuum hose			

P0305	Cylinder 5 Misfire Detected	connections - Ignition system - Fuel injector - Fuel pressure - Mass Air Flow (MAF) meter - Engine Coolant Temperature (ECT) sensor - Compression pressure - Valve timing - PCV Valve and hose - PCV hose connections - Air induction system - ECM	Does not comes on	DTC stored	Click here
P0306	Cylinder 6 Misfire Detected	- Open or short in Engine wire harness - Connector connection - Vacuum hose connections - Ignition system - Fuel injector - Fuel pressure - Mass Air Flow (MAF) meter - Engine Coolant Temperature (ECT) sensor - Compression pressure - Valve timing - PCV Valve and hose - PCV hose connections - Air induction system - ECM	Does not comes on	DTC stored	Click here
P0307	Cylinder 7 Misfire Detected	- Open or short in Engine wire harness - Connector connection - Vacuum hose connections - Ignition system - Fuel injector - Fuel pressure - Mass Air Flow (MAF) meter - Engine Coolant Temperature (ECT) sensor - Compression pressure - Valve timing - PCV Valve and hose - PCV hose connections - Air induction system - ECM	Does not comes on	DTC stored	Click here
		- Open or short in Engine wire harness - Connector connection - Vacuum hose			

P0308	Cylinder 8 Misfire Detected	connections - Ignition system - Fuel injector - Fuel pressure - Mass Air Flow (MAF) meter - Engine Coolant Temperature (ECT) sensor - Compression pressure - Valve timing - PCV Valve and hose - PCV hose connections - Air induction system - ECM	Does not comes on	DTC stored	Click here
P0327	Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)	- Short in knock sensor (for Bank 1 Sensor 1) circuit - Knock sensor (for Bank 1 Sensor 1) - ECM	Comes on	DTC stored	Click here
P0328	Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)	- Open in knock sensor (for Bank 1 Sensor 1) circuit - Knock sensor (for Bank 1 Sensor 1) - ECM	Comes on	DTC stored	Click here
P032C	Knock Sensor 3 Circuit Low	- Short in knock sensor (for Bank 1 Sensor 2) circuit - Knock sensor (for Bank 1 Sensor 2) - ECM	Comes on	DTC stored	Click here
P032D	Knock Sensor 3 Circuit High	- Open in knock sensor (for Bank 1 Sensor 2) circuit - Knock sensor (for Bank 1 Sensor 2) - ECM	Comes on	DTC stored	Click here
P0332	Knock Sensor 2 Circuit Low Input (Bank 2)	- Short in knock sensor (for Bank 2 Sensor1) circuit - Knock sensor (for Bank 2 Sensor 1) - ECM	Comes on	DTC stored	Click here
P0333	Knock Sensor 2 Circuit High Input (Bank 2)	- Open in knock sensor (for Bank 2 Sensor1) circuit - Knock sensor (for Bank 2 Sensor 1) - ECM	Comes on	DTC stored	Click here
P0335	Crankshaft Position Sensor "A" Circuit	- Open or short in CKP sensor circuit - CKP sensor - CKP sensor plate - ECM	Comes on	DTC stored	Click here
P0337	Crankshaft Position Sensor "A" Circuit Low Input	- Open or short in CKP sensor circuit - CKP sensor - CKP sensor plate - ECM	Comes on	DTC stored	Click here
P0338	Crankshaft Position Sensor "A" Circuit High Input	- Open or short in CKP sensor circuit - CKP sensor - CKP sensor plate - ECM	Comes on	DTC stored	Click here
		- Open or short in CKP sensor circuit		DTC	Click

P0339	Crankshaft Position Sensor "A" Circuit Intermittent	- CKP sensor - CKP sensor plate - ECM	-	stored	here
P033C	Knock Sensor 4 Circuit Low Input	- Short in knock sensor (for Bank 2 Sensor 2) circuit - Knock sensor (for Bank 2 Sensor 2) - ECM	Comes on	DTC stored	Click here
P033D	Knock Sensor 4 Circuit High Input	- Open in knock sensor (for Bank 2 Sensor 2) circuit - Knock sensor (for Bank 2 Sensor 2) - ECM	Comes on	DTC stored	Click here
P0340	Camshaft Position Sensor Circuit Malfunction	- Open or short in VVT sensor circuit for intake camshaft - VVT sensor for intake camshaft - Camshaft timing gear for intake camshaft - Jumped tooth of timing chain for intake camshaft - ECM	Comes on	DTC stored	Click here
P0342	Camshaft Position Sensor "A" Circuit Low Input (Bank 1 or Single Sensor)	- Open or short in VVT sensor circuit for intake camshaft - VVT sensor for intake camshaft - Camshaft timing gear for intake camshaft - Jumped tooth of timing chain for intake camshaft - ECM	Comes on	DTC stored	Click here
P0343	Camshaft Position Sensor "A" Circuit High Input (Bank 1 or Single Sensor)	- Open or short in VVT sensor for intake camshaft circuit - VVT sensor for intake camshaft - Camshaft timing gear for intake camshaft - Jumped tooth of timing chain for intake camshaft - ECM	Comes on	DTC stored	Click here
P0345	Camshaft Position Sensor "A" Circuit (Bank 2)	- Open or short in VVT sensor circuit for intake camshaft - VVT sensor for intake camshaft - Camshaft timing gear for intake camshaft - Jumped tooth of timing chain for intake camshaft - ECM	Comes on	DTC stored	Click here
P0347	Camshaft Position Sensor "A" Circuit Low Input (Bank 2)	- Open or short in VVT sensor circuit for intake camshaft - VVT sensor for intake camshaft - Camshaft timing	Comes on	DTC	Click

		gear for intake camshaft - Jumped tooth of timing chain for intake camshaft - ECM		stored	here
P0348	Camshaft Position Sensor "A" Circuit High Input (Bank 2)	- Open or short in VVT sensor for intake camshaft circuit - VVT sensor for intake camshaft - Camshaft timing gear for intake camshaft - Jumped tooth of timing chain for intake camshaft - ECM	Comes on	DTC stored	Click here
P0351	Ignition Coil "A" Primary / Secondary Circuit	- Ignition system - Open or short in IGF1 or IGT1 circuit between ignition coil and ECM - No. 1 ignition coil - ECM	Comes on	DTC stored	Click here
P0352	Ignition Coil "B" Primary / Secondary Circuit	- Ignition system - Open or short in IGF2 or IGT2 circuit between ignition coil and ECM - No. 2 ignition coil - ECM	Comes on	DTC stored	Click here
P0353	Ignition Coil "C" Primary / Secondary Circuit	- Ignition system - Open or short in IGF2 or IGT3 circuit between ignition coil and ECM - No. 3 ignition coil - ECM	Comes on	DTC stored	Click here
P0354	Ignition Coil "D" Primary / Secondary Circuit	- Ignition system - Open or short in IGF1 or IGT4 circuit between ignition coil and ECM - No. 4 ignition coil - ECM	Comes on	DTC stored	Click here
P0355	Ignition Coil "E" Primary / Secondary Circuit	- Ignition system - Open or short in IGF2 or IGT5 circuit between ignition coil and ECM - No. 5 ignition coil - ECM	Comes on	DTC stored	Click here
P0356	Ignition Coil "F" Primary / Secondary Circuit	- Ignition system - Open or short in IGF1 or IGT6 circuit between ignition coil and ECM - No. 6 ignition coil - ECM	Comes on	DTC stored	Click here
P0357	Ignition Coil "G" Primary / Secondary Circuit	- Ignition system - Open or short in IGF1 or IGT7 circuit between ignition coil and ECM - No. 7 ignition coil	Comes on	DTC stored	Click here

		- ECM			
P0358	Ignition Coil "H" Primary / Secondary Circuit	- Ignition system - Open or short in IGF2 or IGT8 circuit between ignition coil and ECM - No. 8 ignition coil - ECM	Comes on	DTC stored	Click here
P0365	Camshaft Position Sensor "B" Circuit (Bank 1)	- Open or short in VVT sensor for exhaust camshaft circuit - VVT sensor for exhaust camshaft - Exhaust camshaft - Jumped tooth of timing chain - ECM	Comes on	DTC stored	Click here
P0367	Camshaft Position Sensor "B" Circuit Low Input (Bank 1)	- Open or short in VVT sensor for exhaust camshaft circuit - VVT sensor for exhaust camshaft - Exhaust camshaft - Jumped tooth of timing chain - ECM	Comes on	DTC stored	Click here
P0368	Camshaft Position Sensor "B" Circuit High Input (Bank 1)	- Open or short in VVT sensor for exhaust camshaft circuit - VVT sensor for exhaust camshaft - Exhaust camshaft - Jumped tooth of timing chain - ECM	Comes on	DTC stored	Click here
P0390	Camshaft Position Sensor "B" Circuit (Bank 2)	- Open or short in VVT sensor for exhaust camshaft circuit - VVT sensor for exhaust camshaft - Exhaust camshaft - Jumped tooth of timing chain - ECM	Comes on	DTC stored	Click here
P0392	Camshaft Position Sensor "B" Circuit Low Input (Bank 2)	- Open or short in VVT sensor for exhaust camshaft circuit - VVT sensor for exhaust camshaft - Exhaust camshaft - Jumped tooth of timing chain - ECM	Comes on	DTC stored	Click here
P0393	Camshaft Position Sensor "B" Circuit High Input (Bank 2)	- Open or short in VVT sensor for exhaust camshaft circuit - VVT sensor for exhaust camshaft - Exhaust camshaft - Jumped tooth of timing chain - ECM	Comes on	DTC stored	Click here
P0443	Evaporative Emission Control System Purge Control Valve Circuit	- Open or short in purge VSV circuit - Purge VSV - ECM	Comes on	DTC stored	Click here

P0500	Vehicle Speed Sensor "A"	- Open or short in speed signal circuit - Combination meter - ECM	Comes on	DTC stored	Click here
P0504	Brake Switch "A" / "B" Correlation	- Short in stop light switch signal circuit - STOP fuse - IGN fuse - Stop light switch - ECM	-	DTC stored	Click here
P0550	Power Steering Pressure Sensor Circuit Malfunction	- Open or short in power steering oil pressure sensor circuit - Power steering oil pressure sensor - ECM	Comes on	DTC stored	Click here
P0552	Power Steering Pressure Sensor Circuit Low Input	- Open or short in power steering oil pressure sensor circuit - Power steering oil pressure sensor - ECM	Comes on	DTC stored	Click here
P0553	Power Steering Pressure Sensor Circuit High Input	- Open or short in power steering oil pressure sensor circuit - Power steering oil pressure sensor - ECM	Comes on	DTC stored	Click here
P0560	System Voltage	- Open in back up power source circuit - Battery - Battery terminals - EFI NO. 1 fuse - ECM	Comes on	DTC stored	Click here
P0604	Random Access Memory (RAM)	ECM	Comes on	DTC stored	Click here
P0606	ECM / PCM Processor	ECM	Comes on	DTC stored	Click here
P060A	Internal Control Module Monitoring Processor Performance	ECM	Comes on	DTC stored	Click here
P060B	Internal Control Module A/D Processing Performance	ECM	Comes on	DTC stored	Click here
P060D	Internal Control Module Accelerator Pedal Position Performance	ECM	Comes on	DTC stored	Click here
P060E	Internal Control Module Throttle Position Performance	ECM	Comes on	DTC stored	Click here
P0617	Starter Relay Circuit High	- Park/Neutral Position (PNP) switch - Starter relay circuit - Engine switch - ECM	Comes on	DTC stored	Click here
P0657	Actuator Supply Voltage Circuit / Open	ECM	Comes on	DTC stored	Click here
P0660	Intake Manifold Tuning Valve Control Circuit / Open (Bank 1)	- Open or short in VSV for ACIS circuit - VSV for ACIS - ECM	Comes on	DTC stored	Click here
P0724	Brake Switch "B" Circuit High	- Short in stop light switch signal circuit - Stop light switch - ECM	Comes on	DTC stored	Click here
		- Open or short in			

P1340	Camshaft Position Sensor "A" (Bank 1 Sensor 2)	camshaft position sensor circuit - Camshaft position sensor - Camshaft timing plate LH - ECM	Comes on	DTC stored	Click here
P1342	Camshaft Position Sensor "A" Low Input (MRE)	- Open or short in camshaft position sensor circuit - Camshaft position sensor - Camshaft timing plate LH - ECM	Comes on	DTC stored	Click here
P1343	Camshaft Position Sensor "A" High Input (MRE)	- Open or short in camshaft position sensor circuit - Camshaft position sensor - Camshaft timing plate LH - ECM	Comes on	DTC stored	Click here
P1607	Cruise Control Input Processor	ECM	Comes on	DTC stored	Click here
P2102	Throttle Actuator Control Motor Circuit Low	- Open in throttle actuator circuit - Throttle actuator - ECM	Comes on	DTC stored	Click here
P2103	Throttle Actuator Control Motor Circuit High	- Short in throttle actuator circuit - Throttle actuator - Throttle valve - Throttle body assembly - ECM	Comes on	DTC stored	Click here
P2111	Throttle Actuator Control System - Stuck Open	- Throttle actuator - Throttle body assembly - Throttle valve	Comes on	DTC stored	Click here
P2112	Throttle Actuator Control System - Stuck Closed	- Throttle actuator - Throttle body assembly - Throttle valve	Comes on	DTC stored	Click here
P2118	Throttle Actuator Control Motor Current Range / Performance	- Open in ETCS power source circuit - Battery - Battery terminals - ETCS fuse - ECM	Comes on	DTC stored	Click here
P2119	Throttle Actuator Control Throttle Body Range / Performance	- ETCS - ECM	Comes on	DTC stored	Click here
P2120	Throttle / Pedal Position Sensor / Switch "D" Circuit	- APP sensor - ECM	Comes on	DTC stored	Click here
P2121	Throttle / Pedal Position Sensor / Switch "D" Circuit Range / Performance	- Accelerator Pedal Position (APP) sensor - ECM	Comes on	DTC stored	Click here
P2122	Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input	- APP sensor - Open in VCPA circuit - Open or ground short in VPA circuit - ECM	Comes on	DTC stored	Click here
P2123	Throttle / Pedal Position Sensor / Switch "D" Circuit High Input	- APP sensor - Open in EPA circuit - ECM	Comes on	DTC stored	Click here
P2125	Throttle / Pedal Position Sensor / Switch "E" Circuit	- APP sensor - ECM	Comes on	DTC stored	Click here

P2127	Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input	- APP sensor - Open in VCP2 circuit - Open or ground short in VPA2 circuit - ECM	Comes on	DTC stored	Click here
P2128	Throttle / Pedal Position Sensor / Switch "E" Circuit High Input	- APP sensor - Open in EPA2 circuit - ECM	Comes on	DTC stored	Click here
P2135	Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation	- Short between VTA1 and VTA2 circuits - TP sensor (built into throttle body) - ECM	Comes on	DTC stored	Click here
P2138	Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation	- Short between VPA and VPA2 circuits - APP sensor - ECM	Comes on	DTC stored	Click here
P2237	Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)	- Open in Air Fuel ratio (A/F) sensor (for Bank 1 Sensor 1) circuit - Air Fuel ratio (A/F) sensor (for Bank 1 Sensor 1) - ECM	Comes on	DTC stored	Click here
P2238	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)	- Open or short in A/F sensor (for Bank 1 Sensor 1) circuit - A/F sensor (for Bank 1 Sensor 1) - ECM	Comes on	DTC stored	Click here
P2239	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)	- Open or short in A/F sensor (for Bank 1 Sensor 1) circuit - A/F sensor (for Bank 1 Sensor 1) - ECM	Comes on	DTC stored	Click here
P2240	Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)	- Open in Air Fuel Ratio (A/F) sensor (for Bank 2 Sensor 1) circuit - Air Fuel ratio (A/F) sensor (for Bank 2 Sensor 1) - ECM	Comes on	DTC stored	Click here
P2241	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)	- Open or short in A/F sensor (for Bank 2 Sensor 1) circuit - A/F sensor (for Bank 2 Sensor 1) - ECM	Comes on	DTC stored	Click here
P2242	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)	- Open or short in A/F sensor (for Bank 2 Sensor 1) circuit - A/F sensor (for Bank 2 Sensor 1) - ECM	Comes on	DTC stored	Click here
P2252	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)	- Open or short in A/F sensor (for Bank 1 Sensor 1) circuit - A/F sensor (for	Comes on	DTC stored	Click here

		Bank 1 Sensor 1) - ECM			
P2253	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)	- Open or short in A/F sensor (for Bank 1 Sensor 1) circuit - A/F sensor (for Bank 1 Sensor 1) - ECM	Comes on	DTC stored	Click here
P2255	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)	- Open or short in A/F sensor (for Bank 2 Sensor 1) circuit - A/F sensor (for Bank 2 Sensor 1) - ECM	Comes on	DTC stored	Click here
P2256	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)	- Open or short in A/F sensor (for Bank 2 Sensor 1) circuit - A/F sensor (for Bank 2 Sensor 1) - ECM	Comes on	DTC stored	Click here

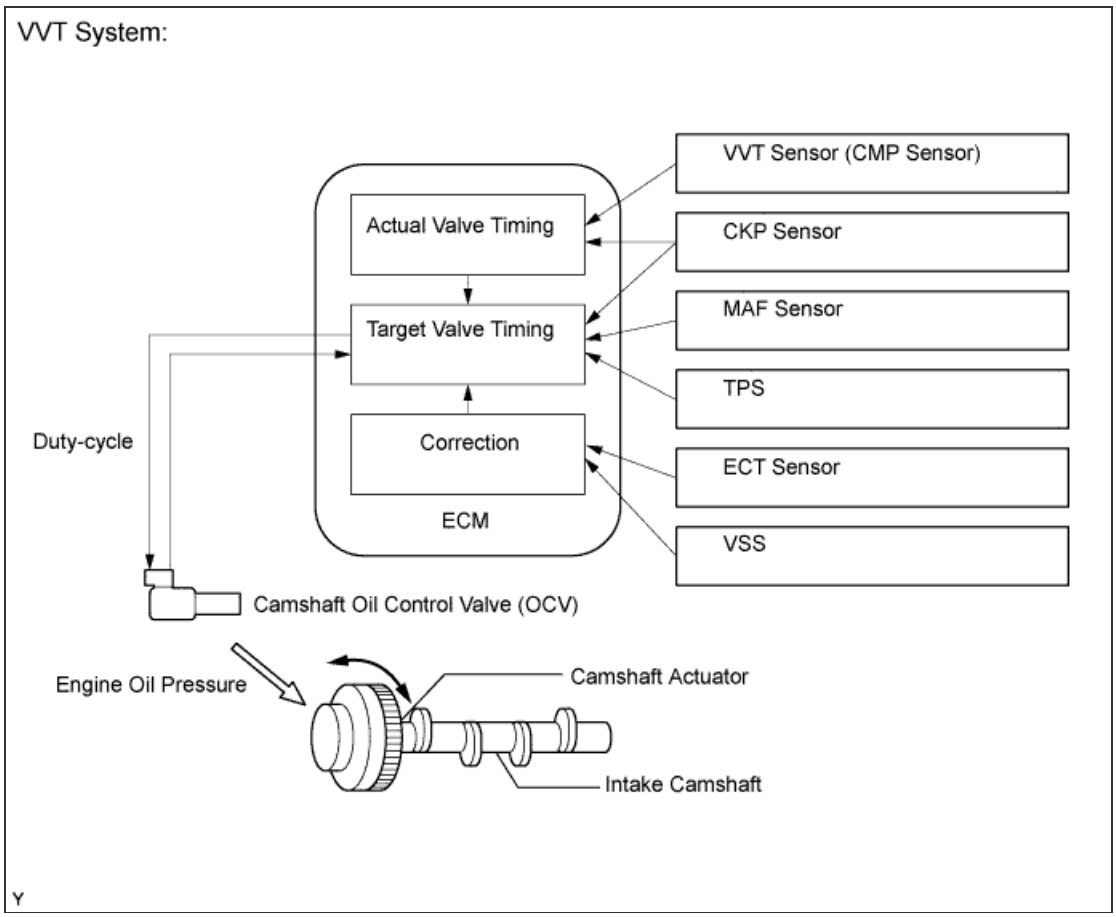
DTC P0010 Camshaft Position "A" Actuator Circuit (Bank 1)

DTC P0020 Camshaft Position "A" Actuator Circuit (Bank 2)

for Preparation Click here

DESCRIPTION

- This DTC is designed to detect opens or shorts in the camshaft oil control valve (OCV) circuit. If the OCV duty-cycle is excessively high or low while the engine is running, the ECM will illuminate the MIL and store the DTC.
- The VVT (variable valve timing) system adjusts the intake valve timing to improve the driveability. The engine oil pressure turns the camshaft actuator to adjust the valve timing. The OCV is a solenoid valve and switches the engine oil line. The valve moves when the ECM applies 12 V to the solenoid. The ECM changes the energizing time to the solenoid (duty-cycle) in accordance with the camshaft position, crankshaft position, throttle position, etc.



DTC Code	DTC Detection Condition	Trouble Area
P0010	An open or short in the Camshaft Oil Control Valve (OCV) for intake side (for Bank 1) circuit (1 trip detection logic).	• Open or short in Camshaft Oil Control Valve (OCV) (for intake side of Bank 1) circuit • OCV (for intake side of Bank 1) • ECM
P0020	An open or short in the OCV for intake side (for Bank 2) circuit (1 trip detection logic).	• Open or short in OCV (for intake side of Bank 2) circuit • OCV (for intake side of Bank 2) • ECM

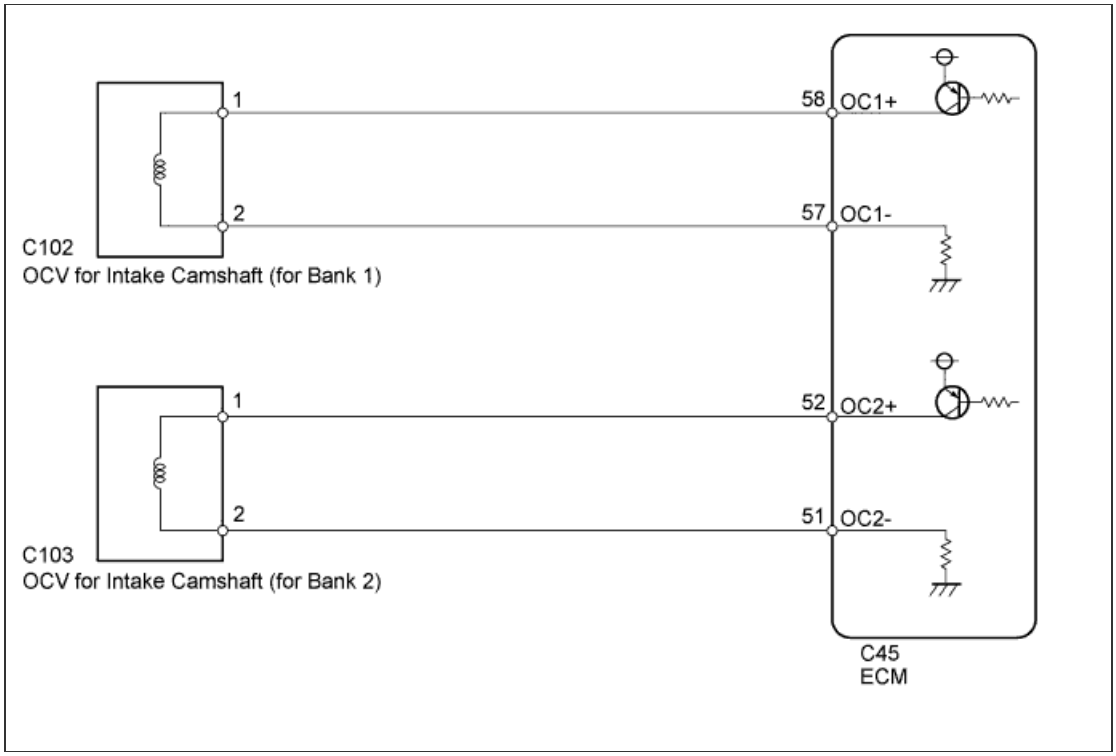
HINT:

This DTC relates to the Camshaft Oil Control Valve (OCV).

MONITOR DESCRIPTION

This DTC is designed to detect opens or shorts in the camshaft oil control valve (OCV) circuit. If the OCV duty-cycle is excessively high or low while the engine is running, the ECM will illuminate the MIL and store the DTC.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

1.CHECK DTC

a. Clear DTC after recording the freeze frame data and DTC (Click here).

b. Turn the engine switch off.

c. Allow the engine to idle and check DTC.

d. Check that P0010 or P0020 is not output.

OK:
P0010 or P0020 is not output.

NG → Go to step 2

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

2.INSPECT CAMSHAFT OIL CONTROL VALVE ASSEMBLY

a. Disconnect the C102 or C103 camshaft oil control valve (OCV) connector.

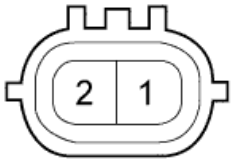
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition

1 - 2	20°C (68°F)	6.9 to 7.9 Ω

Component without harness connected:
(Oil Control Valve)



NG → REP ACE CAMSHAFT OI CONTRO A E ASSEMBLY (Click here)

OK

3.CHECK HARNESS AND CONNECTOR (OCV - ECM)

a. Disconnect the C102 or C103 OCV connector.

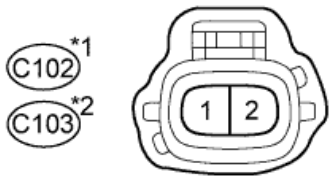
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

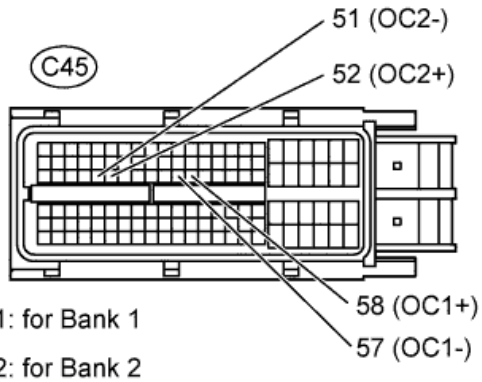
Standard Resistance:

Tester Connection	Condition	Specified Condition
C102-1 - C45-58 (OC1+)	Always	Below 1 Ω
C103-1 - C45-52 (OC2+)	Always	Below 1 Ω
C102-2 - C45-57 (OC1-)	Always	Below 1 Ω
C103-2 - C45-51 (OC2-)	Always	Below 1 Ω
C102-1 or C45-58 (OC1+) - Body ground	Always	10 kΩ or higher
C103-1 or C45-52 (OC2+) - Body ground	Always	10 kΩ or higher
C102-2 or C45-57 (OC1-) - Body ground	Always	10 kΩ or higher
C103-2 or C45-51 (OC2-) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Oil Control Valve)



Front view of wire harness connector:
(to ECM)



*1: for Bank 1

*2: for Bank 2

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P0340 Camshaft Position Sensor Circuit Malfunction

DTC P0342 Camshaft Position Sensor "A" Circuit Low Input (Bank 1 or Single Sensor)

DTC P0343 Camshaft Position Sensor "A" Circuit High Input (Bank 1 or Single Sensor)

DTC P0345 Camshaft Position Sensor "A" Circuit (Bank 2)

DTC P0347 Camshaft Position Sensor "A" Circuit Low Input (Bank 2)

DTC P0348 Camshaft Position Sensor "A" Circuit High Input (Bank 2)

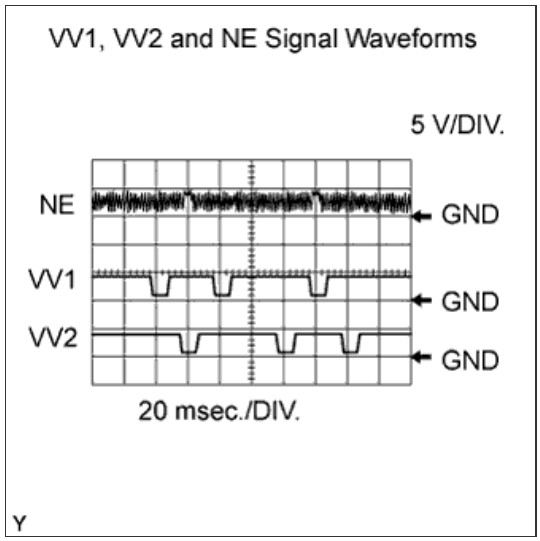
for Preparation Click here

DESCRIPTION

The intake camshaft Variable Valve Timing (VVT) sensor (VV1, 2 signal) consists of a magnet and MRE (Magnetic Resistance Element).
The intake camshaft has 3 teeth on its outer circumference. When the intake camshaft rotates, changes occur in the air gaps between the teeth and MRE, which affects the magnetic field. As a result, the resistance of the MRE material fluctuates. The VVT sensor converts the intake camshaft rotation data into pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM.
The crankshaft position sensor plate has 34 teeth. The crankshaft position sensor generates 34 signals for each revolution. Based on a combination of the VVT signal and NE signal, the ECM detects the crankshaft angle. Then the ECM uses this data to control fuel injection time and injection timing. Also, based on the NE signal, the ECM detects the engine speed.

DTC Code	DTC Detection Condition	Trouble Area
P0340 P0345	When either condition below is met: • The input voltage to the ECM remains at below 0.3 V or higher than 4.7 V for 4 seconds when 2 or more seconds have elapsed after turning the engine switch on (IG) (1 trip detection logic). • No VVT sensor (for intake side of Bank 1, 2) signal is sent to the ECM during cranking (2 trip detection logic).	• Open or short in VVT sensor (for intake side) circuit • VVT sensor (for intake side) • Intake camshaft (for Bank 1, 2) • Jumped tooth of timing chain • ECM
P0342 P0347	The output voltage of the VVT sensor (for intake side of Bank 1, 2) is below 0.3 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for intake side) circuit • VVT sensor (for intake side) • Intake camshaft (for Bank 1, 2) • Jumped tooth of timing chain • ECM
P0343 P0348	The output voltage of the VVT sensor (for intake side of Bank 1, 2) is higher than 4.7 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for intake side) circuit • VVT sensor (for intake side) • Intake camshaft (for Bank 1, 2) • Jumped tooth of timing chain • ECM

Reference: Inspection using an oscilloscope



Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-110 (NE+) - C45-111 (NE-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-92 (VV1+) - C45-91 (VV1-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-87 (VV2+) - C45-88 (VV2-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown

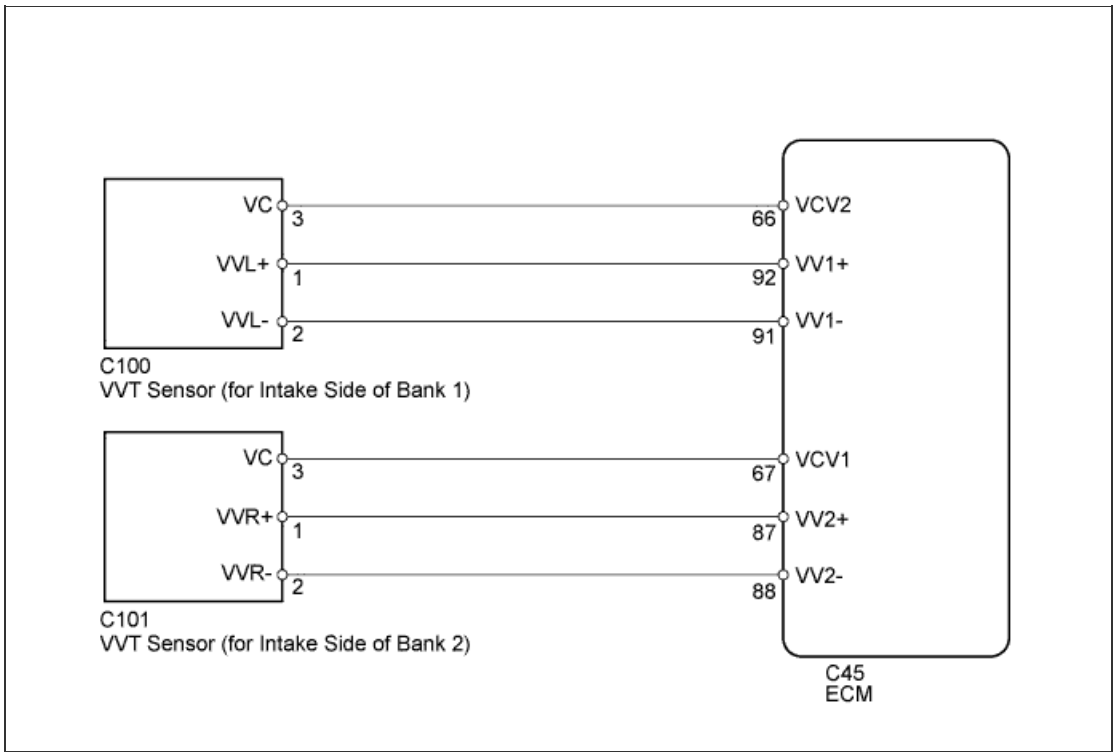
HINT:

VV1+ and VV2+ stand for the VVT sensor (for intake side) signal, and NE+ stands for the CKP sensor signal.

MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine revolving, or the rotations of the camshaft and the crankshaft are not synchronized, the ECM interprets this as a malfunction of the sensor.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

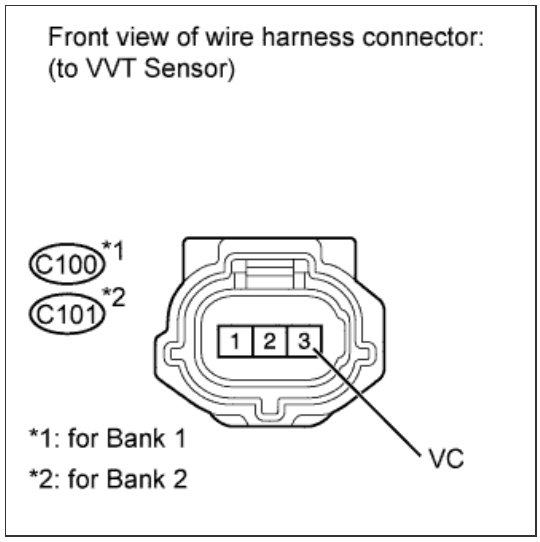
1.CHECK HARNESS AND CONNECTOR (SENSOR POWER SOURCE)

a. Disconnect the C100 or C101 VVT sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
C100-3 (VC) - Body ground	Engine switch on (IG)	4.5 to 5.0 V
C101-3 (VC) - Body ground	Engine switch on (IG)	4.5 to 5.0 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (VVT SENSOR FOR INTAKE SIDE - ECM)

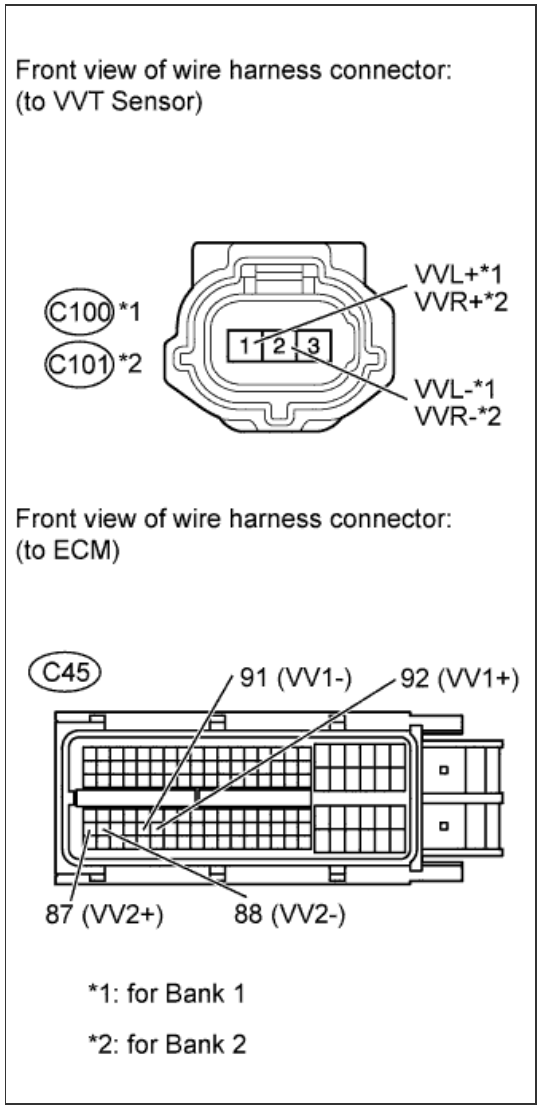
a. Disconnect the C100 or C101 VVT sensor connector.

b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C100-1 (VVL+) - C45-92 (VV1+)	Always	Below 1 Ω
C100-2 (VVL-) - C45-91 (VV1-)	Always	Below 1 Ω
C101-1 (VVR+) - C45-87 (VV2+)	Always	Below 1 Ω
C101-2 (VVR-) - C45-88 (VV2-)	Always	Below 1 Ω
C100-1 (VVL+) or C45-92 (VV1+) - Body ground	Always	10 kΩ or higher
C100-2 (VVL-) or C45-91 (VV1-) - Body ground	Always	10 kΩ or higher
C101-1 (VVR+) or C45-87 (VV2+) - Body ground	Always	10 kΩ or higher
C101-2 (VVR-) or C45-88 (VV2-) - Body ground	Always	10 kΩ or higher



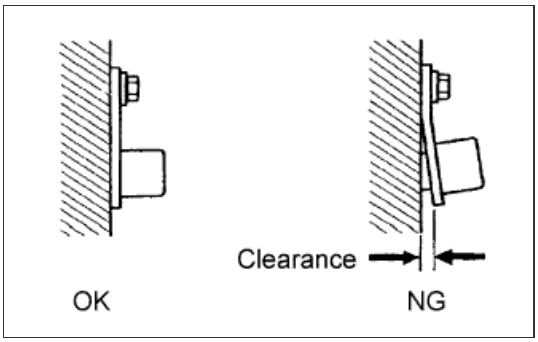
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK SENSOR INSTALLATION

a. Check the VVT sensor (for intake side) installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

4.CHECK INTAKE CAMSHAFT (TEETH)

a. Check the teeth of the camshaft.

OK:
Teeth do not have any cracks or deformation.

NG → REPLACE INTAKE CAMSHAFT (Click here)

OK

5.REPLACE VVT SENSOR (for Intake Side)

a. Replace the VVT sensor (for Intake Side) (Click here).

NEXT

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs.

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No output	A
P0340, P0342, P0343, P0345, P0347 or P0348	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

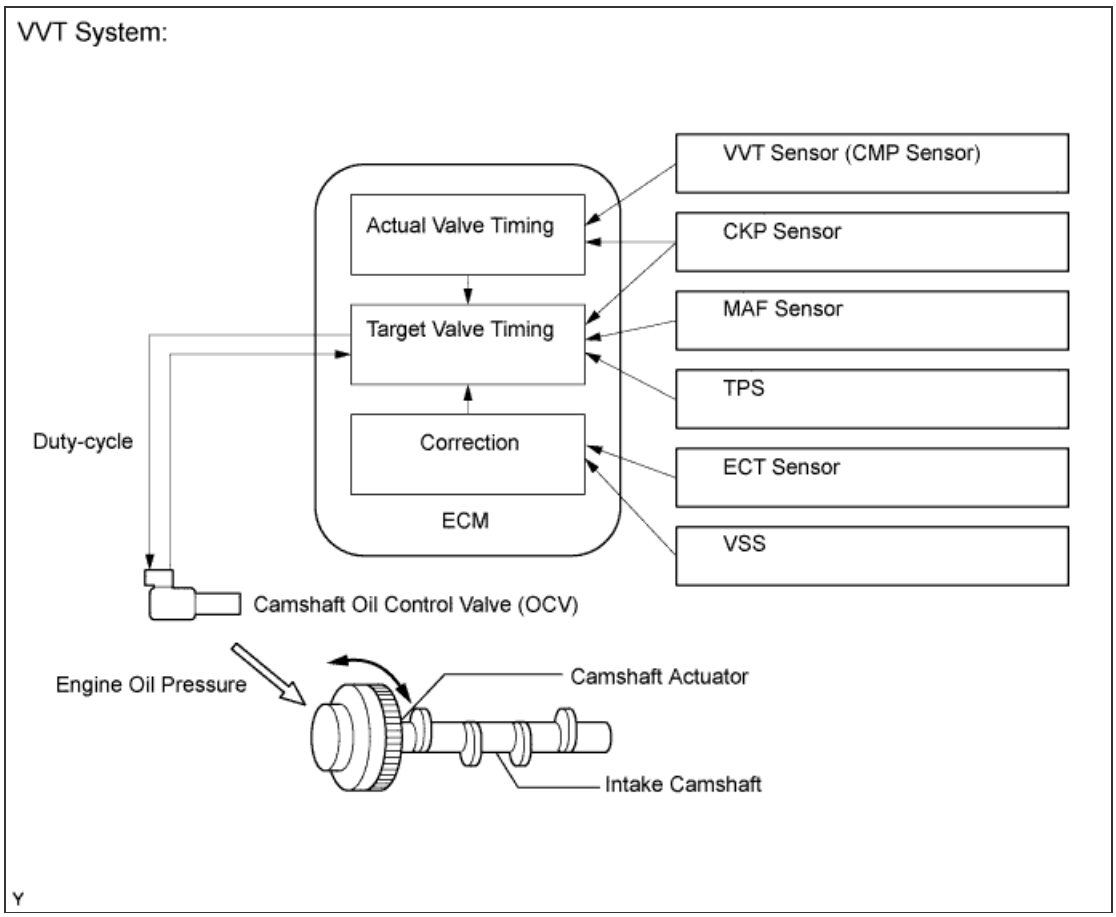
DTC P0010 Camshaft Position "A" Actuator Circuit (Bank 1)

DTC P0020 Camshaft Position "A" Actuator Circuit (Bank 2)

for Preparation Click here

DESCRIPTION

- This DTC is designed to detect opens or shorts in the camshaft oil control valve (OCV) circuit. If the OCV duty-cycle is excessively high or low while the engine is running, the ECM will illuminate the MIL and store the DTC.
- The VVT (variable valve timing) system adjusts the intake valve timing to improve the driveability. The engine oil pressure turns the camshaft actuator to adjust the valve timing. The OCV is a solenoid valve and switches the engine oil line. The valve moves when the ECM applies 12 V to the solenoid. The ECM changes the energizing time to the solenoid (duty-cycle) in accordance with the camshaft position, crankshaft position, throttle position, etc.



DTC Code	DTC Detection Condition	Trouble Area
P0010	An open or short in the Camshaft Oil Control Valve (OCV) for intake side (for Bank 1) circuit (1 trip detection logic).	• Open or short in Camshaft Oil Control Valve (OCV) (for intake side of Bank 1) circuit • OCV (for intake side of Bank 1) • ECM
P0020	An open or short in the OCV for intake side (for Bank 2) circuit (1 trip detection logic).	• Open or short in OCV (for intake side of Bank 2) circuit • OCV (for intake side of Bank 2) • ECM

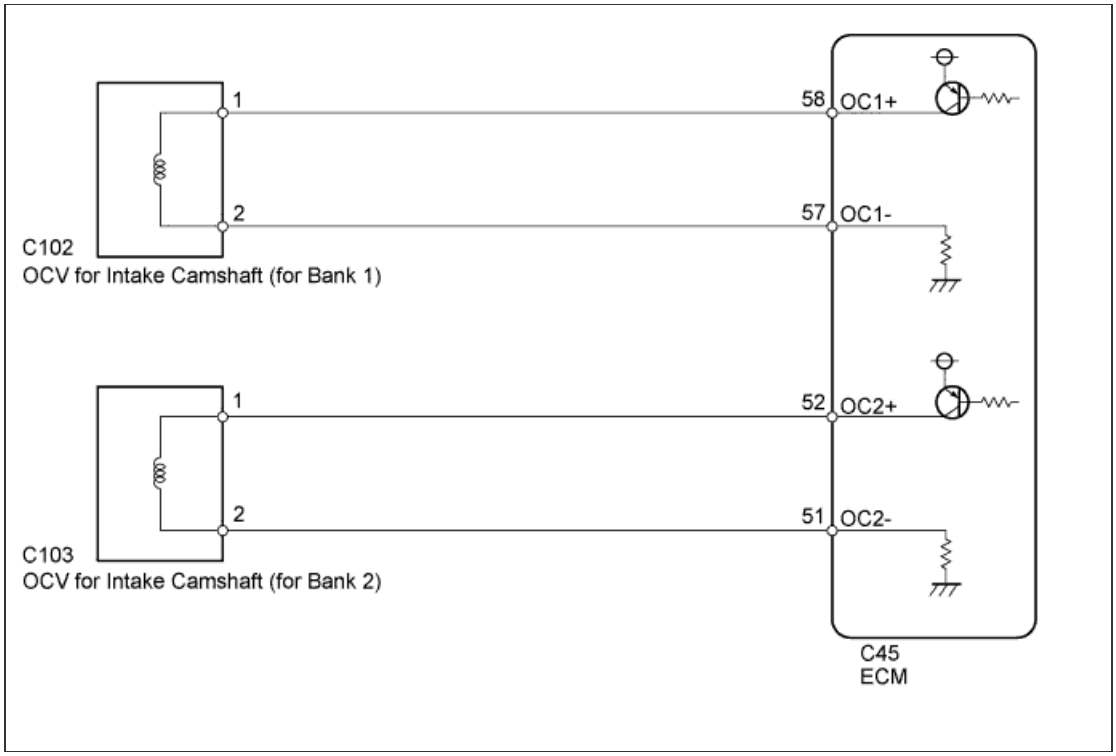
HINT:

This DTC relates to the Camshaft Oil Control Valve (OCV).

MONITOR DESCRIPTION

This DTC is designed to detect opens or shorts in the camshaft oil control valve (OCV) circuit. If the OCV duty-cycle is excessively high or low while the engine is running, the ECM will illuminate the MIL and store the DTC.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

1.CHECK DTC

a. Clear DTC after recording the freeze frame data and DTC (Click here).

b. Turn the engine switch off.

c. Allow the engine to idle and check DTC.

d. Check that P0010 or P0020 is not output.

OK:
P0010 or P0020 is not output.

NG → Go to step 2

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

2.INSPECT CAMSHAFT OIL CONTROL VALVE ASSEMBLY

a. Disconnect the C102 or C103 camshaft oil control valve (OCV) connector.

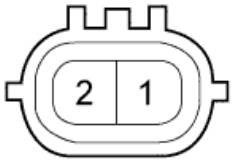
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition

1 - 2	20°C (68°F)	6.9 to 7.9 Ω

Component without harness connected:
(Oil Control Valve)



NG → REP ACE CAMSHAFT OI CONTRO A E ASSEMBLY (Click here)

OK

3.CHECK HARNESS AND CONNECTOR (OCV - ECM)

a. Disconnect the C102 or C103 OCV connector.

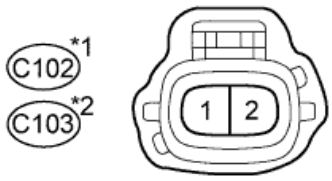
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

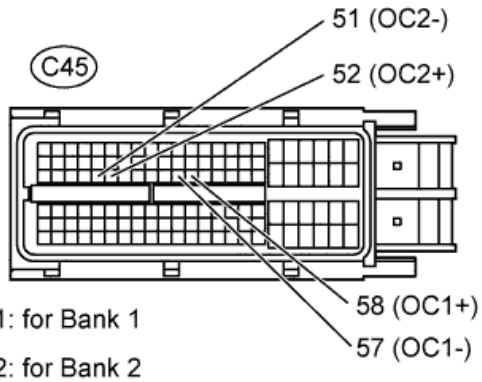
Standard Resistance:

Tester Connection	Condition	Specified Condition
C102-1 - C45-58 (OC1+)	Always	Below 1 Ω
C103-1 - C45-52 (OC2+)	Always	Below 1 Ω
C102-2 - C45-57 (OC1-)	Always	Below 1 Ω
C103-2 - C45-51 (OC2-)	Always	Below 1 Ω
C102-1 or C45-58 (OC1+) - Body ground	Always	10 kΩ or higher
C103-1 or C45-52 (OC2+) - Body ground	Always	10 kΩ or higher
C102-2 or C45-57 (OC1-) - Body ground	Always	10 kΩ or higher
C103-2 or C45-51 (OC2-) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Oil Control Valve)



Front view of wire harness connector:
(to ECM)



*1: for Bank 1

*2: for Bank 2

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P0340 Camshaft Position Sensor Circuit Malfunction

DTC P0342 Camshaft Position Sensor "A" Circuit Low Input (Bank 1 or Single Sensor)

DTC P0343 Camshaft Position Sensor "A" Circuit High Input (Bank 1 or Single Sensor)

DTC P0345 Camshaft Position Sensor "A" Circuit (Bank 2)

DTC P0347 Camshaft Position Sensor "A" Circuit Low Input (Bank 2)

DTC P0348 Camshaft Position Sensor "A" Circuit High Input (Bank 2)

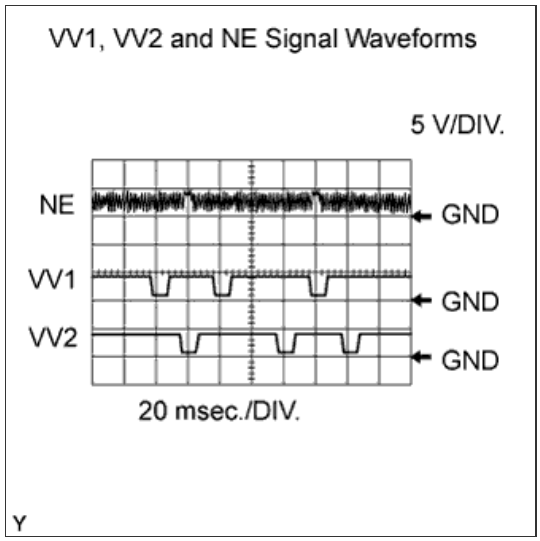
for Preparation Click here

DESCRIPTION

The intake camshaft Variable Valve Timing (VVT) sensor (VV1, 2 signal) consists of a magnet and MRE (Magnetic Resistance Element).
The intake camshaft has 3 teeth on its outer circumference. When the intake camshaft rotates, changes occur in the air gaps between the teeth and MRE, which affects the magnetic field. As a result, the resistance of the MRE material fluctuates. The VVT sensor converts the intake camshaft rotation data into pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM.
The crankshaft position sensor plate has 34 teeth. The crankshaft position sensor generates 34 signals for each revolution. Based on a combination of the VVT signal and NE signal, the ECM detects the crankshaft angle. Then the ECM uses this data to control fuel injection time and injection timing. Also, based on the NE signal, the ECM detects the engine speed.

DTC Code	DTC Detection Condition	Trouble Area
P0340 P0345	When either condition below is met: • The input voltage to the ECM remains at below 0.3 V or higher than 4.7 V for 4 seconds when 2 or more seconds have elapsed after turning the engine switch on (IG) (1 trip detection logic). • No VVT sensor (for intake side of Bank 1, 2) signal is sent to the ECM during cranking (2 trip detection logic).	• Open or short in VVT sensor (for intake side) circuit • VVT sensor (for intake side) • Intake camshaft (for Bank 1, 2) • Jumped tooth of timing chain • ECM
P0342 P0347	The output voltage of the VVT sensor (for intake side of Bank 1, 2) is below 0.3 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for intake side) circuit • VVT sensor (for intake side) • Intake camshaft (for Bank 1, 2) • Jumped tooth of timing chain • ECM
P0343 P0348	The output voltage of the VVT sensor (for intake side of Bank 1, 2) is higher than 4.7 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for intake side) circuit • VVT sensor (for intake side) • Intake camshaft (for Bank 1, 2) • Jumped tooth of timing chain • ECM

Reference: Inspection using an oscilloscope



Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-110 (NE+) - C45-111 (NE-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-92 (VV1+) - C45-91 (VV1-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-87 (VV2+) - C45-88 (VV2-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown

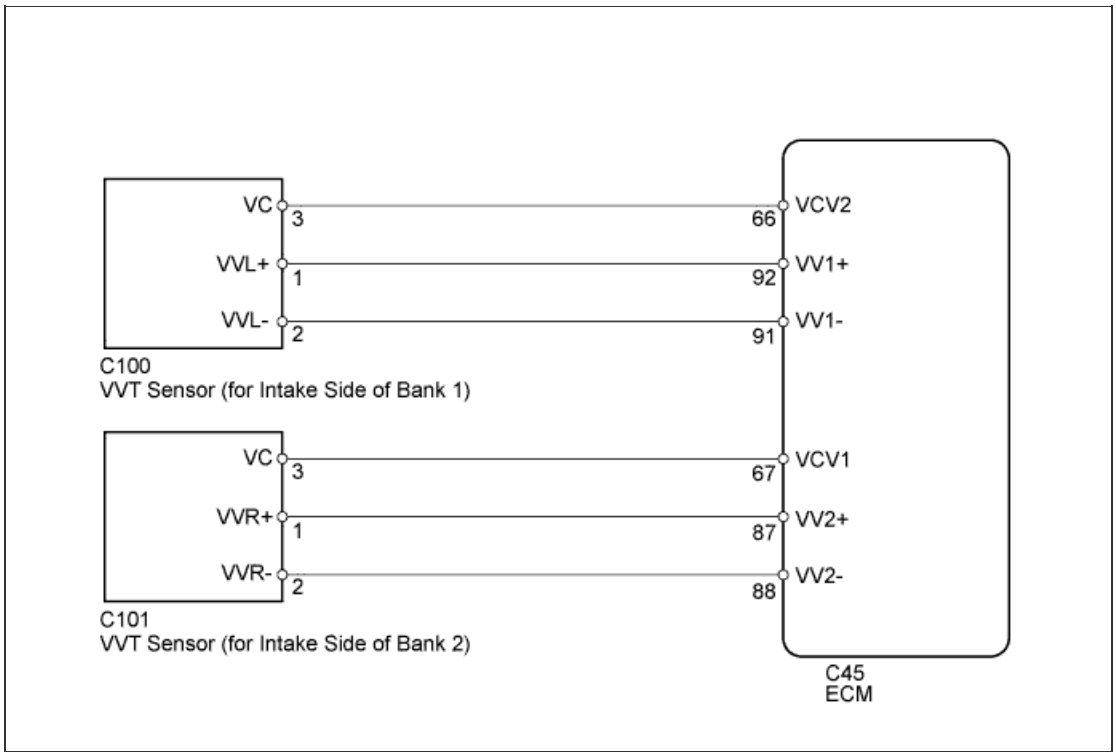
HINT:

VV1+ and VV2+ stand for the VVT sensor (for intake side) signal, and NE+ stands for the CKP sensor signal.

MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine revolving, or the rotations of the camshaft and the crankshaft are not synchronized, the ECM interprets this as a malfunction of the sensor.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

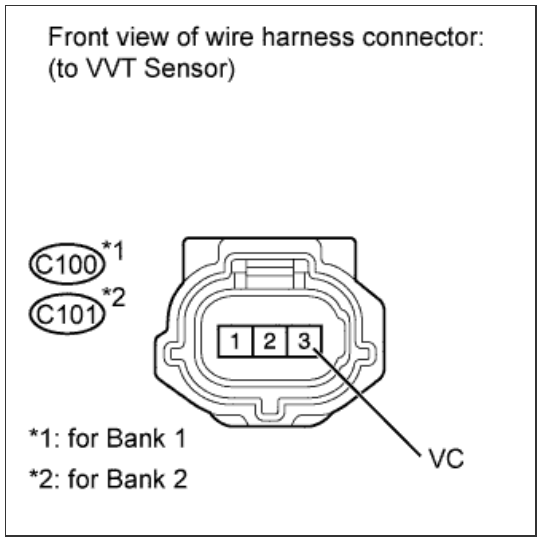
1.CHECK HARNESS AND CONNECTOR (SENSOR POWER SOURCE)

a. Disconnect the C100 or C101 VVT sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
C100-3 (VC) - Body ground	Engine switch on (IG)	4.5 to 5.0 V
C101-3 (VC) - Body ground	Engine switch on (IG)	4.5 to 5.0 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (VVT SENSOR FOR INTAKE SIDE - ECM)

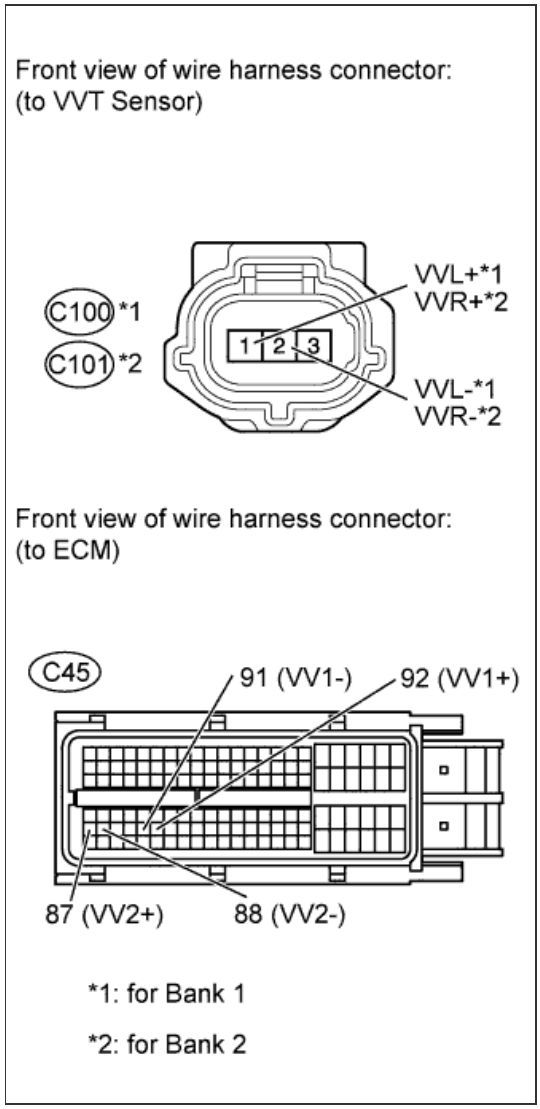
a. Disconnect the C100 or C101 VVT sensor connector.

b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C100-1 (VVL+) - C45-92 (VV1+)	Always	Below 1 Ω
C100-2 (VVL-) - C45-91 (VV1-)	Always	Below 1 Ω
C101-1 (VVR+) - C45-87 (VV2+)	Always	Below 1 Ω
C101-2 (VVR-) - C45-88 (VV2-)	Always	Below 1 Ω
C100-1 (VVL+) or C45-92 (VV1+) - Body ground	Always	10 kΩ or higher
C100-2 (VVL-) or C45-91 (VV1-) - Body ground	Always	10 kΩ or higher
C101-1 (VVR+) or C45-87 (VV2+) - Body ground	Always	10 kΩ or higher
C101-2 (VVR-) or C45-88 (VV2-) - Body ground	Always	10 kΩ or higher



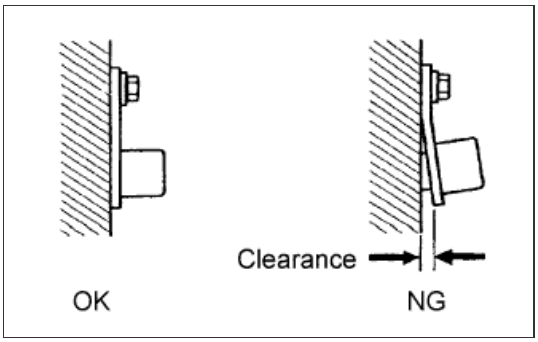
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK SENSOR INSTALLATION

a. Check the VVT sensor (for intake side) installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

4.CHECK INTAKE CAMSHAFT (TEETH)

a. Check the teeth of the camshaft.

OK:
Teeth do not have any cracks or deformation.

NG → REPLACE INTAKE CAMSHAFT (Click here)

OK

5.REPLACE VVT SENSOR (for Intake Side)

a. Replace the VVT sensor (for Intake Side) (Click here).

NEXT

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs.

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No output	A
P0340, P0342, P0343, P0345, P0347 or P0348	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

DTC P0011 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)

DTC P0012 Camshaft Position "A" - Timing Over-Retarded (Bank 1)

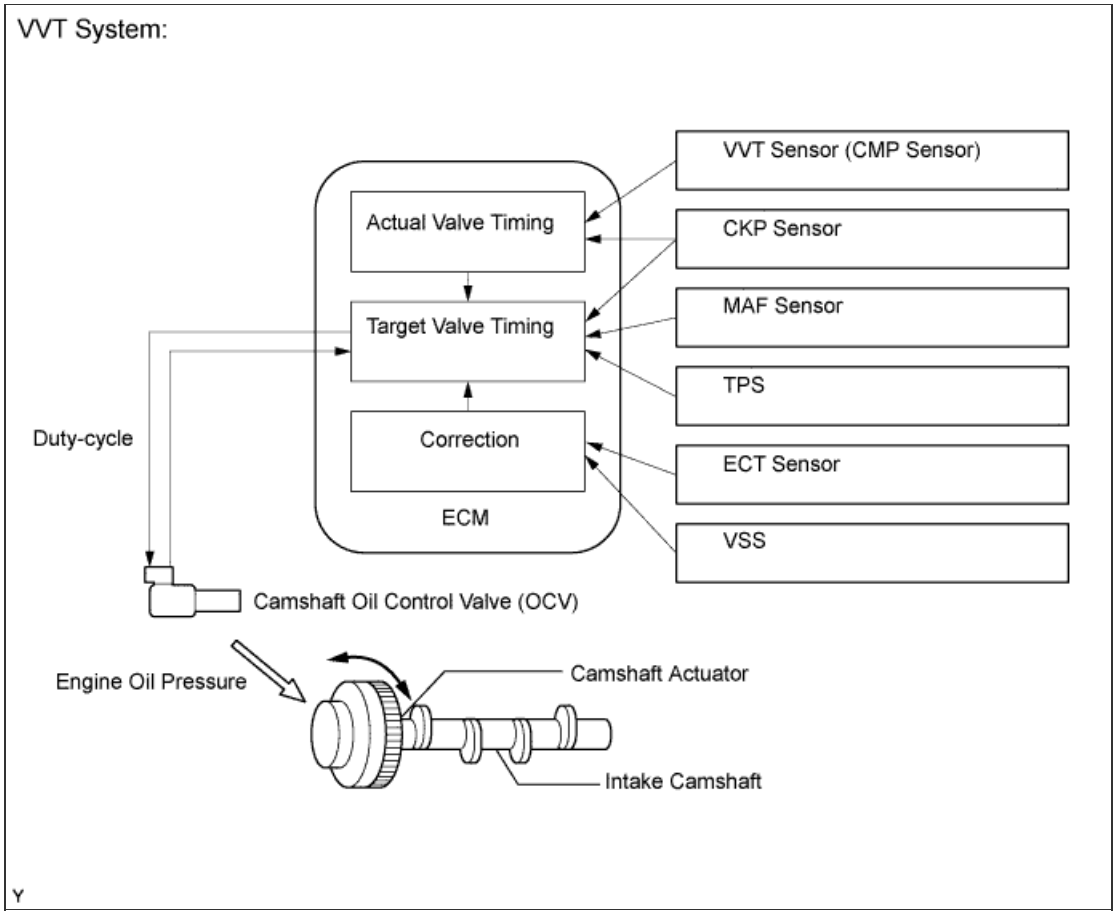
DTC P0021 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)

DTC P0022 Camshaft Position "A" - Timing Over-Retarded (Bank 2)

for Preparation Click here

DESCRIPTION

The VVT system includes the ECM, Camshaft Oil Control Valve (OCV) and VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. Camshaft timing control is performed according to engine operating conditions such as the intake air volume, throttle valve position and engine coolant temperature. The ECM controls the OCV based on the signals transmitted by several sensors. The VVT controller regulates the intake camshaft angle using oil pressure through the OCV. As a result, the relative positions of the camshaft and crankshaft are optimized, the engine torque and fuel economy improve, and the exhaust emissions decrease under overall driving conditions. The ECM detects the actual intake valve timing using signals from the camshaft and crankshaft position sensors, and performs feedback control. This is how the target intake valve timing is verified by the ECM.



DTC Code	DTC Detection Condition	Trouble Area
P0011 P0021	The intake valve timing is not adjusted in the valve timing advance range (1 trip detection logic).	• Valve timing • Camshaft Oil Control Valve (OCV) (for intake side of Bank 1, 2) • OCV filter • Camshaft timing gear • ECM
P0012 P0022	The intake valve timing is not adjusted in the valve timing retard range (2 trip detection logic).	• Valve timing • OCV (for intake side of Bank 1, 2) • OCV filter • Camshaft timing gear • ECM

MONITOR DESCRIPTION

The ECM optimizes the intake valve timing using the VVT (Variable Valve Timing) system to control the intake camshaft. The VVT system includes the ECM, Camshaft Oil Control Valve (OCV) and VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake camshaft.
If the difference between the target and actual intake valve timings is large, and changes in the actual intake valve timing are small, the ECM interprets this as the VVT controller stuck malfunction and stores DTC(s).

Example:
A DTC is stored when the following conditions 1, 2 and 3 are met:

1. The difference between the target and actual intake valve timing is more than 5° CA (Crankshaft Angle) and the condition continues for more than 4.5 seconds.
2. It takes 5 seconds or more to change the valve timing by 5° CA.
3. After above conditions 1 and 2 are met, the OCV is forcibly activated during 10 seconds.

DTC P0011 and P0021 (Advanced Cam Timing) are subject to 1 trip detection logic.
DTC P0012 and P0022 (Retarded Cam Timing) are subject to 2 trip detection logic.
These DTCs indicate that the VVT controller cannot operate properly due to OCV malfunctions or the presence of foreign objects in the OCV.
The monitor will run if all of the following conditions are met:

- The engine is warm (the engine coolant temperature is 75°C [167°F] or higher).
- The vehicle has been driven at more than 64 km/h (40 mph) for 3 minutes.
- The engine has idled for 3 minutes.

WIRING DIAGRAM

Refer to DTC P0010 (Click here).

INSPECTION PROCEDURE

HINT:

DTC P0011, P0012, P0021 or P0022 may be stored when foreign objects in the engine oil are caught in some parts of the system. The DTC will remain stored even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

HINT:

Abnormal Bank	Advanced Timing Over (Valve Timing is Out of Specified Range)	Retarded Timing Over (Valve Timing is Out of Specified Range)
Bank 1	P0011	P0012
Bank 2	P0021	P0022

- **If DTC P0011 or P0012 is output, check the left bank VVT system for intake side circuit (for Bank 1).**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **If DTC P0021 or P0022 is output, check the right bank VVT system for intake side circuit (for Bank 2).**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0011, P0012, P0021 or P0022 is output	A
P0011, P0012, P0021 or P0022 and other DTCs are output	B

HINT:

If any DTCs other than P0011, P0012, P0021 or P0022 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Warm up the engine.

e. Turn the A/C on.

f. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT Linear (Bank 1) or Control the VVT Linear (Bank 2).

g. Check the engine speed while operating the Camshaft Oil Control Valve (OCV) using the tester.

OK:

Operation	Specified Condition
0%	Normal engine speed
100%	Engine idles roughly or stalls

HINT:

Refer to "Data List / Active Test" [VVT OCV Duty #1, VVT Change Angle #1, VVT OCV Duty #2 and VVT Change Angle #2] (Click here).

NG → Go to step 4

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester.

f. Drive the vehicle for more than 10 minutes.

g. Read DTCs using the tester.

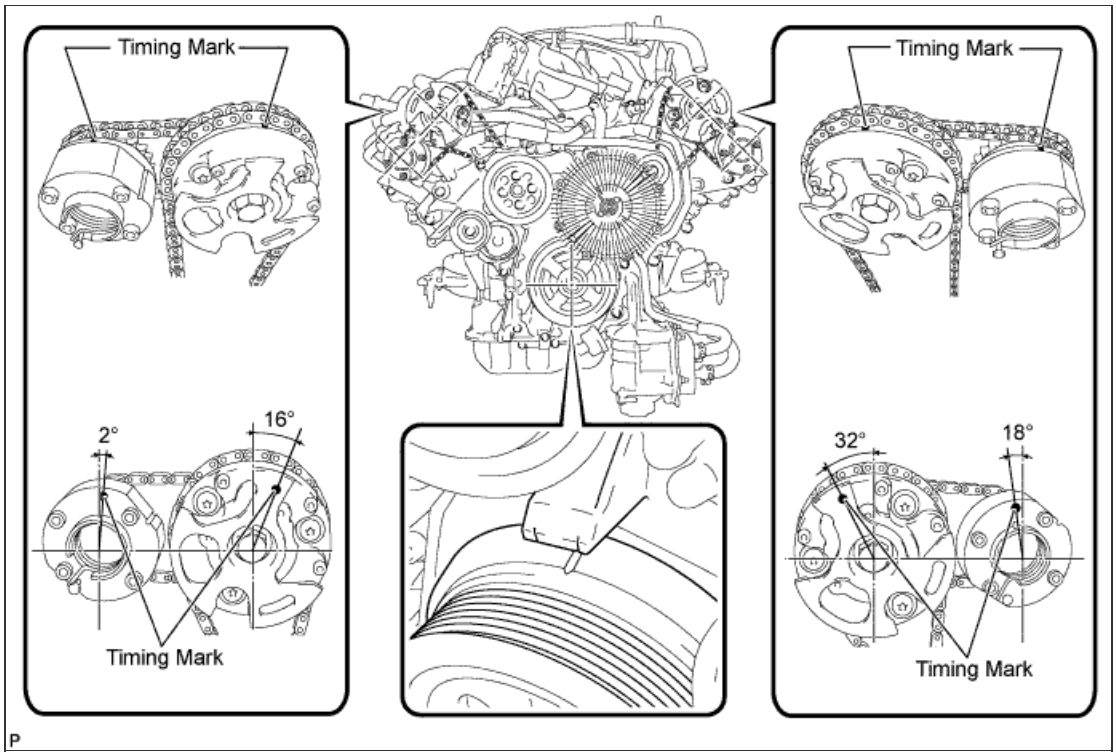
OK:
No DTC output.

NG → Go to step 4

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

4.CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMPED TOOTH OF TIMING CHAIN)



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:

Timing marks on camshaft timing gears are aligned as shown in the illustration.

NG → ADJUST VALVE TIMING (Click here)

OK

5.INSPECT CAMSHAFT OIL CONTROL VALVE ASSEMBLY

a. Remove the OCV.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

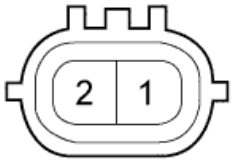
Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

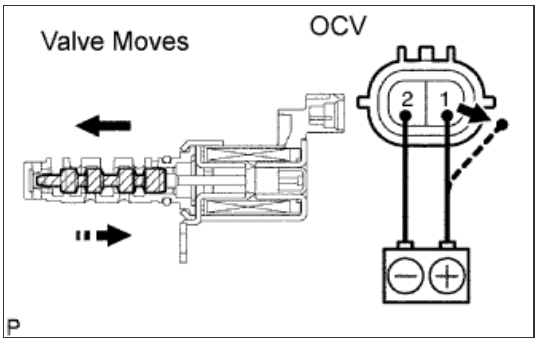
c. Check the valve operation.

OK:

Measurement Condition	Specified Condition
No battery voltage applied to terminals 1 and 2 → Battery voltage applied to terminals 1 and 2	Valve moves quickly

Component without harness connected:
(Oil Control Valve)





NG → REPLACE CAMSHAFT OIL CONTROL VALVE ASSEMBLY (Click here)

OK

6.INSPECT OIL CONTROL VALVE FILTER

a. Remove the OCV filter (Click here).

b. Check that the filter is not clogged.

OK:
Filter is not clogged.

NG → CLEAN OIL CONTROL VALVE FILTER

OK

7.REPLACE INTAKE CAMSHAFT TIMING GEAR

a. Replace the intake camshaft timing gear (Click here).

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester.

f. Drive the vehicle for more than 10 minutes.

g. Read the output DTCs using the tester.

OK:
No DTC is output.

HINT:

DTC P0011, P0012, P0021 or P0022 is output when foreign objects in the engine oil are caught in some parts of the system. These codes will stay stored even if the system returns to normal after a short time. These foreign objects are then captured by the oil filter, thus eliminating the source of the problem.

NG → REPLACE ECM (Click here)

OK

SYSTEM OK

DTC P0340 Camshaft Position Sensor Circuit Malfunction

DTC P0342 Camshaft Position Sensor "A" Circuit Low Input (Bank 1 or Single Sensor)

DTC P0343 Camshaft Position Sensor "A" Circuit High Input (Bank 1 or Single Sensor)

DTC P0345 Camshaft Position Sensor "A" Circuit (Bank 2)

DTC P0347 Camshaft Position Sensor "A" Circuit Low Input (Bank 2)

DTC P0348 Camshaft Position Sensor "A" Circuit High Input (Bank 2)

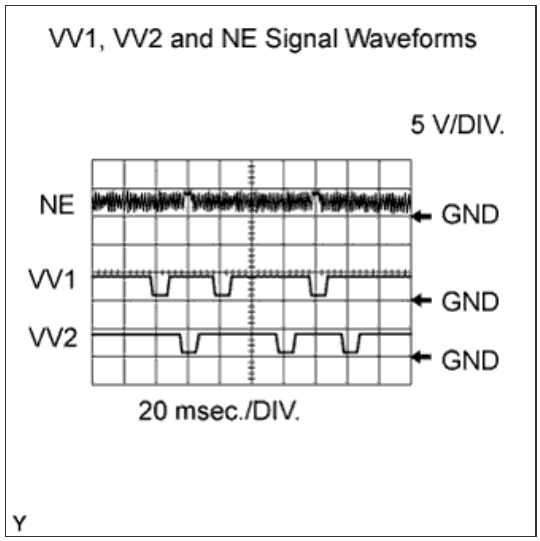
for Preparation Click here

DESCRIPTION

The intake camshaft Variable Valve Timing (VVT) sensor (VV1, 2 signal) consists of a magnet and MRE (Magnetic Resistance Element).
The intake camshaft has 3 teeth on its outer circumference. When the intake camshaft rotates, changes occur in the air gaps between the teeth and MRE, which affects the magnetic field. As a result, the resistance of the MRE material fluctuates. The VVT sensor converts the intake camshaft rotation data into pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM.
The crankshaft position sensor plate has 34 teeth. The crankshaft position sensor generates 34 signals for each revolution. Based on a combination of the VVT signal and NE signal, the ECM detects the crankshaft angle. Then the ECM uses this data to control fuel injection time and injection timing. Also, based on the NE signal, the ECM detects the engine speed.

DTC Code	DTC Detection Condition	Trouble Area
P0340 P0345	When either condition below is met: • The input voltage to the ECM remains at below 0.3 V or higher than 4.7 V for 4 seconds when 2 or more seconds have elapsed after turning the engine switch on (IG) (1 trip detection logic). • No VVT sensor (for intake side of Bank 1, 2) signal is sent to the ECM during cranking (2 trip detection logic).	• Open or short in VVT sensor (for intake side) circuit • VVT sensor (for intake side) • Intake camshaft (for Bank 1, 2) • Jumped tooth of timing chain • ECM
P0342 P0347	The output voltage of the VVT sensor (for intake side of Bank 1, 2) is below 0.3 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for intake side) circuit • VVT sensor (for intake side) • Intake camshaft (for Bank 1, 2) • Jumped tooth of timing chain • ECM
P0343 P0348	The output voltage of the VVT sensor (for intake side of Bank 1, 2) is higher than 4.7 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for intake side) circuit • VVT sensor (for intake side) • Intake camshaft (for Bank 1, 2) • Jumped tooth of timing chain • ECM

Reference: Inspection using an oscilloscope



Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-110 (NE+) - C45-111 (NE-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-92 (VV1+) - C45-91 (VV1-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-87 (VV2+) - C45-88 (VV2-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown

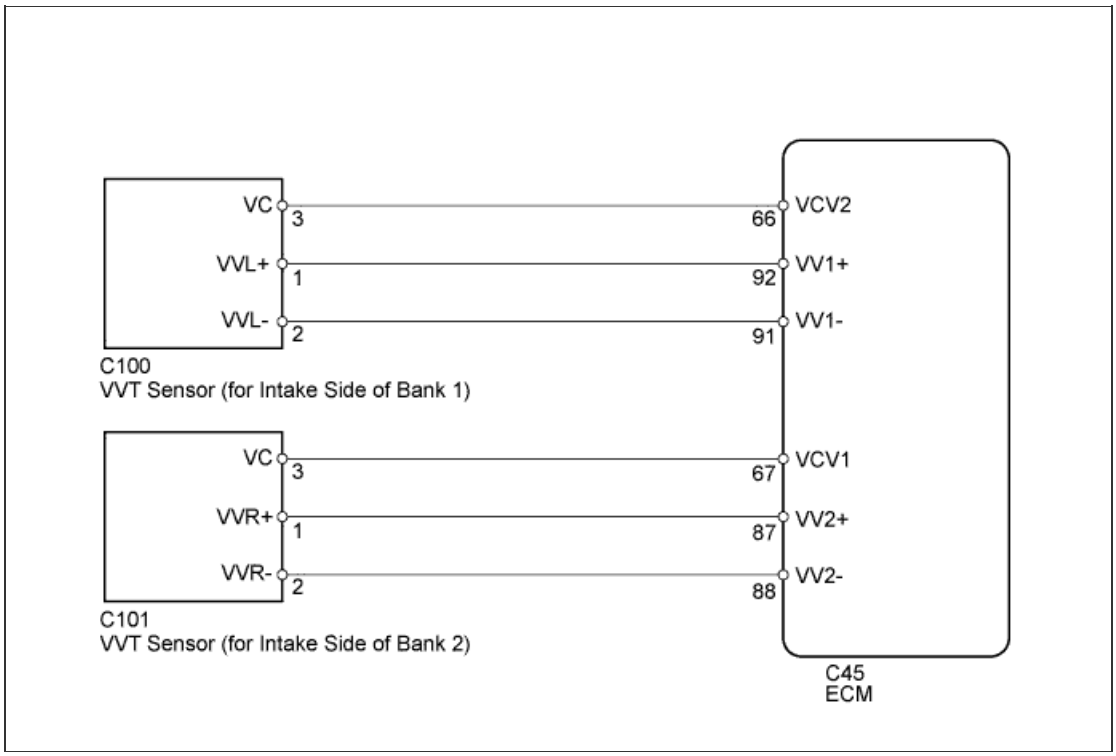
HINT:

VV1+ and VV2+ stand for the VVT sensor (for intake side) signal, and NE+ stands for the CKP sensor signal.

MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine revolving, or the rotations of the camshaft and the crankshaft are not synchronized, the ECM interprets this as a malfunction of the sensor.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

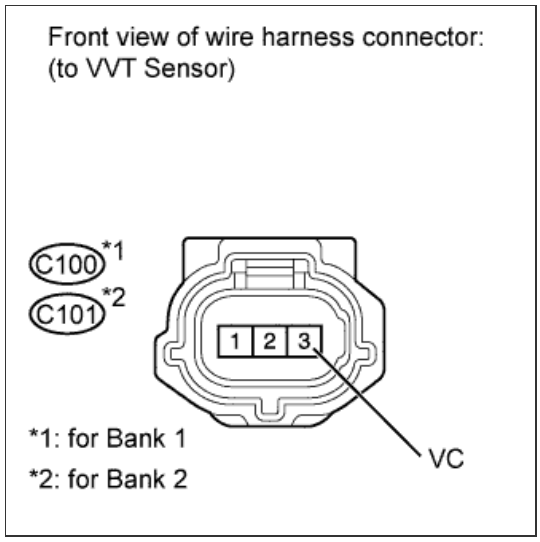
1.CHECK HARNESS AND CONNECTOR (SENSOR POWER SOURCE)

a. Disconnect the C100 or C101 VVT sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
C100-3 (VC) - Body ground	Engine switch on (IG)	4.5 to 5.0 V
C101-3 (VC) - Body ground	Engine switch on (IG)	4.5 to 5.0 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (VVT SENSOR FOR INTAKE SIDE - ECM)

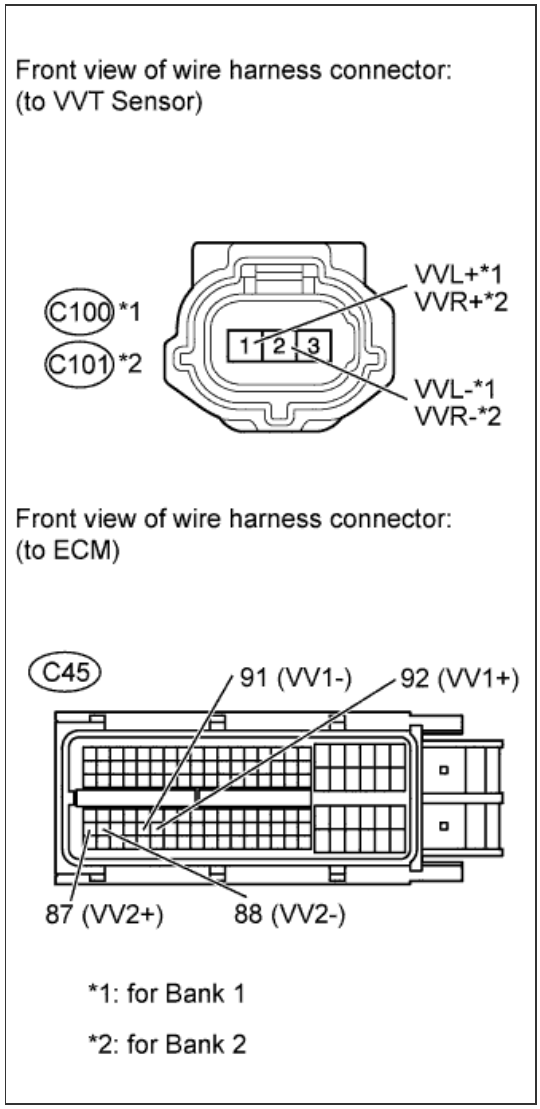
a. Disconnect the C100 or C101 VVT sensor connector.

b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C100-1 (VVL+) - C45-92 (VV1+)	Always	Below 1 Ω
C100-2 (VVL-) - C45-91 (VV1-)	Always	Below 1 Ω
C101-1 (VVR+) - C45-87 (VV2+)	Always	Below 1 Ω
C101-2 (VVR-) - C45-88 (VV2-)	Always	Below 1 Ω
C100-1 (VVL+) or C45-92 (VV1+) - Body ground	Always	10 kΩ or higher
C100-2 (VVL-) or C45-91 (VV1-) - Body ground	Always	10 kΩ or higher
C101-1 (VVR+) or C45-87 (VV2+) - Body ground	Always	10 kΩ or higher
C101-2 (VVR-) or C45-88 (VV2-) - Body ground	Always	10 kΩ or higher



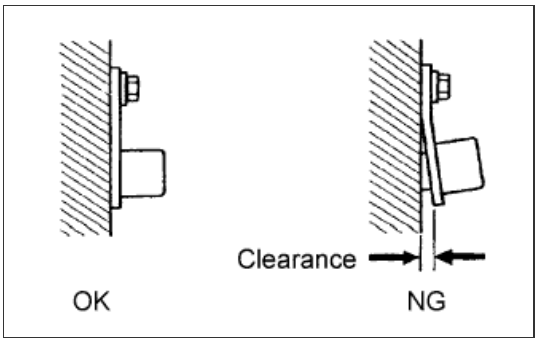
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK SENSOR INSTALLATION

a. Check the VVT sensor (for intake side) installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

4.CHECK INTAKE CAMSHAFT (TEETH)

a. Check the teeth of the camshaft.

OK:
Teeth do not have any cracks or deformation.

NG → REPLACE INTAKE CAMSHAFT (Click here)

OK

5.REPLACE VVT SENSOR (for Intake Side)

a. Replace the VVT sensor (for Intake Side) (Click here).

NEXT

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs.

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No output	A
P0340, P0342, P0343, P0345, P0347 or P0348	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

DTC P0011 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)

DTC P0012 Camshaft Position "A" - Timing Over-Retarded (Bank 1)

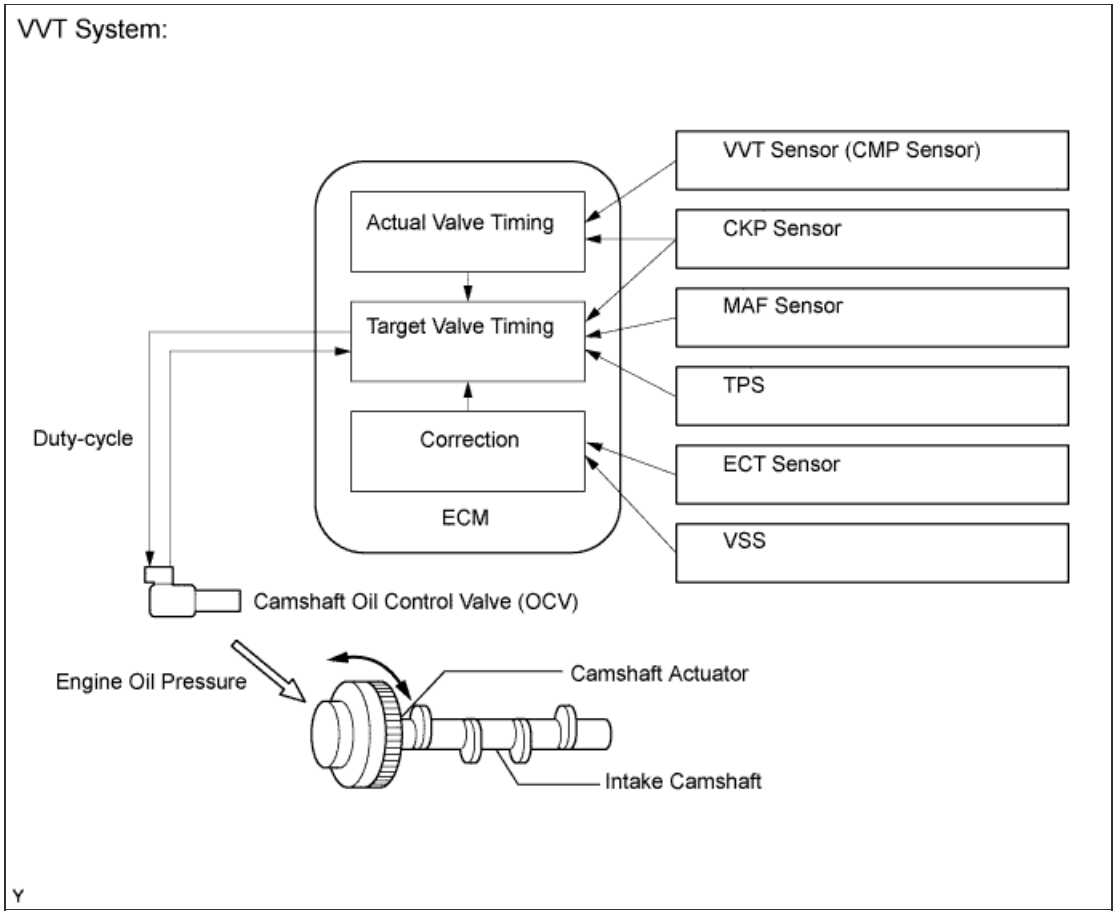
DTC P0021 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)

DTC P0022 Camshaft Position "A" - Timing Over-Retarded (Bank 2)

for Preparation Click here

DESCRIPTION

The VVT system includes the ECM, Camshaft Oil Control Valve (OCV) and VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. Camshaft timing control is performed according to engine operating conditions such as the intake air volume, throttle valve position and engine coolant temperature. The ECM controls the OCV based on the signals transmitted by several sensors. The VVT controller regulates the intake camshaft angle using oil pressure through the OCV. As a result, the relative positions of the camshaft and crankshaft are optimized, the engine torque and fuel economy improve, and the exhaust emissions decrease under overall driving conditions. The ECM detects the actual intake valve timing using signals from the camshaft and crankshaft position sensors, and performs feedback control. This is how the target intake valve timing is verified by the ECM.



DTC Code	DTC Detection Condition	Trouble Area
P0011 P0021	The intake valve timing is not adjusted in the valve timing advance range (1 trip detection logic).	• Valve timing • Camshaft Oil Control Valve (OCV) (for intake side of Bank 1, 2) • OCV filter • Camshaft timing gear • ECM
P0012 P0022	The intake valve timing is not adjusted in the valve timing retard range (2 trip detection logic).	• Valve timing • OCV (for intake side of Bank 1, 2) • OCV filter • Camshaft timing gear • ECM

MONITOR DESCRIPTION

The ECM optimizes the intake valve timing using the VVT (Variable Valve Timing) system to control the intake camshaft. The VVT system includes the ECM, Camshaft Oil Control Valve (OCV) and VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake camshaft.
If the difference between the target and actual intake valve timings is large, and changes in the actual intake valve timing are small, the ECM interprets this as the VVT controller stuck malfunction and stores DTC(s).

Example:
A DTC is stored when the following conditions 1, 2 and 3 are met:

1. The difference between the target and actual intake valve timing is more than 5° CA (Crankshaft Angle) and the condition continues for more than 4.5 seconds.
2. It takes 5 seconds or more to change the valve timing by 5° CA.
3. After above conditions 1 and 2 are met, the OCV is forcibly activated during 10 seconds.

DTC P0011 and P0021 (Advanced Cam Timing) are subject to 1 trip detection logic.
DTC P0012 and P0022 (Retarded Cam Timing) are subject to 2 trip detection logic.
These DTCs indicate that the VVT controller cannot operate properly due to OCV malfunctions or the presence of foreign objects in the OCV.
The monitor will run if all of the following conditions are met:

- The engine is warm (the engine coolant temperature is 75°C [167°F] or higher).
- The vehicle has been driven at more than 64 km/h (40 mph) for 3 minutes.
- The engine has idled for 3 minutes.

WIRING DIAGRAM

Refer to DTC P0010 (Click here).

INSPECTION PROCEDURE

HINT:

DTC P0011, P0012, P0021 or P0022 may be stored when foreign objects in the engine oil are caught in some parts of the system. The DTC will remain stored even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

HINT:

Abnormal Bank	Advanced Timing Over (Valve Timing is Out of Specified Range)	Retarded Timing Over (Valve Timing is Out of Specified Range)
Bank 1	P0011	P0012
Bank 2	P0021	P0022

- **If DTC P0011 or P0012 is output, check the left bank VVT system for intake side circuit (for Bank 1).**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **If DTC P0021 or P0022 is output, check the right bank VVT system for intake side circuit (for Bank 2).**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0011, P0012, P0021 or P0022 is output	A
P0011, P0012, P0021 or P0022 and other DTCs are output	B

HINT:

If any DTCs other than P0011, P0012, P0021 or P0022 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Warm up the engine.

e. Turn the A/C on.

f. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT Linear (Bank 1) or Control the VVT Linear (Bank 2).

g. Check the engine speed while operating the Camshaft Oil Control Valve (OCV) using the tester.

OK:

Operation	Specified Condition
0%	Normal engine speed
100%	Engine idles roughly or stalls

HINT:

Refer to "Data List / Active Test" [VVT OCV Duty #1, VVT Change Angle #1, VVT OCV Duty #2 and VVT Change Angle #2] (Click here).

NG → Go to step 4

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester.

f. Drive the vehicle for more than 10 minutes.

g. Read DTCs using the tester.

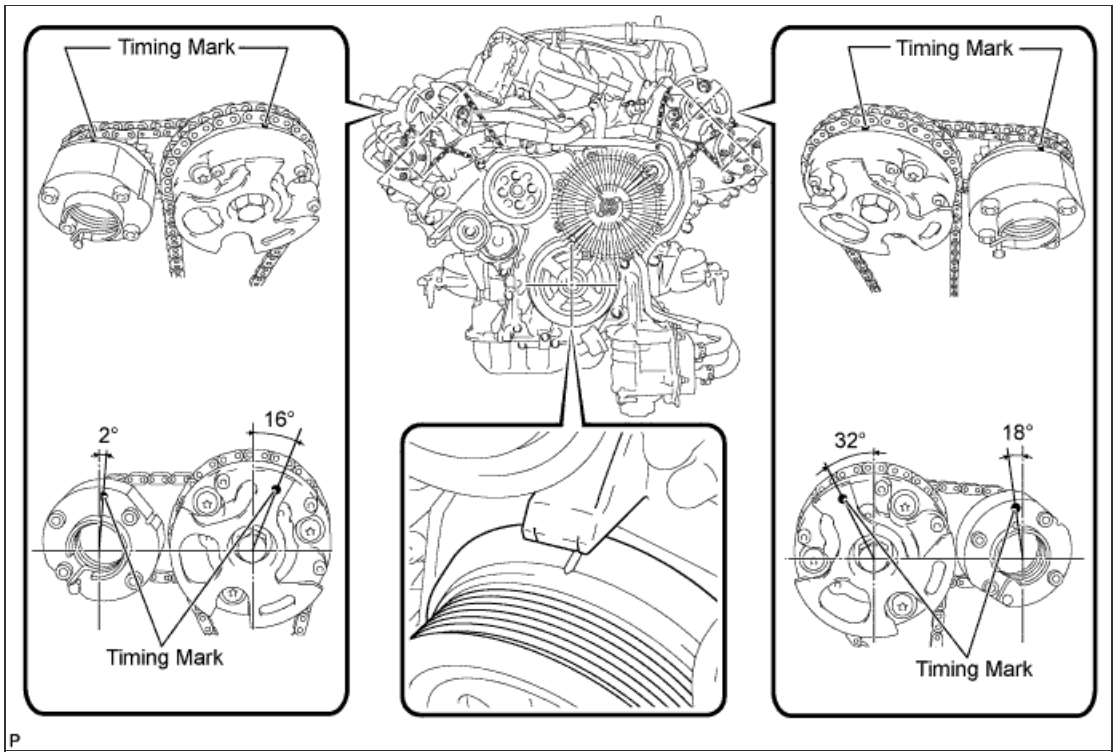
OK:
No DTC output.

NG → Go to step 4

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

4.CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMPED TOOTH OF TIMING CHAIN)



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:

Timing marks on camshaft timing gears are aligned as shown in the illustration.

NG → ADJUST VALVE TIMING (Click here)

OK

5.INSPECT CAMSHAFT OIL CONTROL VALVE ASSEMBLY

a. Remove the OCV.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

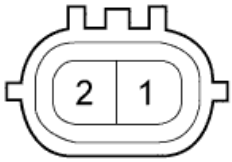
Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

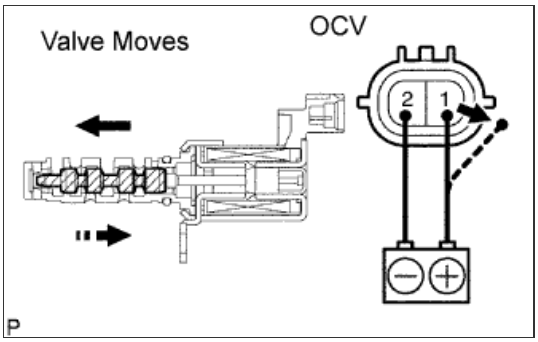
c. Check the valve operation.

OK:

Measurement Condition	Specified Condition
No battery voltage applied to terminals 1 and 2 → Battery voltage applied to terminals 1 and 2	Valve moves quickly

Component without harness connected:
(Oil Control Valve)





NG → REPLACE CAMSHAFT OIL CONTROL VALVE ASSEMBLY (Click here)

OK

6.INSPECT OIL CONTROL VALVE FILTER

a. Remove the OCV filter (Click here).

b. Check that the filter is not clogged.

OK:
Filter is not clogged.

NG → CLEAN OIL CONTROL VALVE FILTER

OK

7.REPLACE INTAKE CAMSHAFT TIMING GEAR

a. Replace the intake camshaft timing gear (Click here).

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester.

f. Drive the vehicle for more than 10 minutes.

g. Read the output DTCs using the tester.

OK:
No DTC is output.

HINT:

DTC P0011, P0012, P0021 or P0022 is output when foreign objects in the engine oil are caught in some parts of the system. These codes will stay stored even if the system returns to normal after a short time. These foreign objects are then captured by the oil filter, thus eliminating the source of the problem.

NG → REPLACE ECM (Click here)

OK

SYSTEM OK

DTC P0340 Camshaft Position Sensor Circuit Malfunction

DTC P0342 Camshaft Position Sensor "A" Circuit Low Input (Bank 1 or Single Sensor)

DTC P0343 Camshaft Position Sensor "A" Circuit High Input (Bank 1 or Single Sensor)

DTC P0345 Camshaft Position Sensor "A" Circuit (Bank 2)

DTC P0347 Camshaft Position Sensor "A" Circuit Low Input (Bank 2)

DTC P0348 Camshaft Position Sensor "A" Circuit High Input (Bank 2)

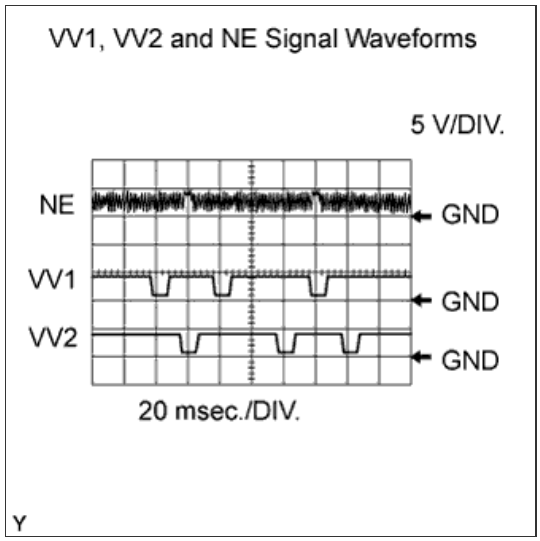
for Preparation Click here

DESCRIPTION

The intake camshaft Variable Valve Timing (VVT) sensor (VV1, 2 signal) consists of a magnet and MRE (Magnetic Resistance Element).
The intake camshaft has 3 teeth on its outer circumference. When the intake camshaft rotates, changes occur in the air gaps between the teeth and MRE, which affects the magnetic field. As a result, the resistance of the MRE material fluctuates. The VVT sensor converts the intake camshaft rotation data into pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM.
The crankshaft position sensor plate has 34 teeth. The crankshaft position sensor generates 34 signals for each revolution. Based on a combination of the VVT signal and NE signal, the ECM detects the crankshaft angle. Then the ECM uses this data to control fuel injection time and injection timing. Also, based on the NE signal, the ECM detects the engine speed.

DTC Code	DTC Detection Condition	Trouble Area
P0340 P0345	When either condition below is met: • The input voltage to the ECM remains at below 0.3 V or higher than 4.7 V for 4 seconds when 2 or more seconds have elapsed after turning the engine switch on (IG) (1 trip detection logic). • No VVT sensor (for intake side of Bank 1, 2) signal is sent to the ECM during cranking (2 trip detection logic).	• Open or short in VVT sensor (for intake side) circuit • VVT sensor (for intake side) • Intake camshaft (for Bank 1, 2) • Jumped tooth of timing chain • ECM
P0342 P0347	The output voltage of the VVT sensor (for intake side of Bank 1, 2) is below 0.3 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for intake side) circuit • VVT sensor (for intake side) • Intake camshaft (for Bank 1, 2) • Jumped tooth of timing chain • ECM
P0343 P0348	The output voltage of the VVT sensor (for intake side of Bank 1, 2) is higher than 4.7 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for intake side) circuit • VVT sensor (for intake side) • Intake camshaft (for Bank 1, 2) • Jumped tooth of timing chain • ECM

Reference: Inspection using an oscilloscope



Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-110 (NE+) - C45-111 (NE-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-92 (VV1+) - C45-91 (VV1-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-87 (VV2+) - C45-88 (VV2-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown

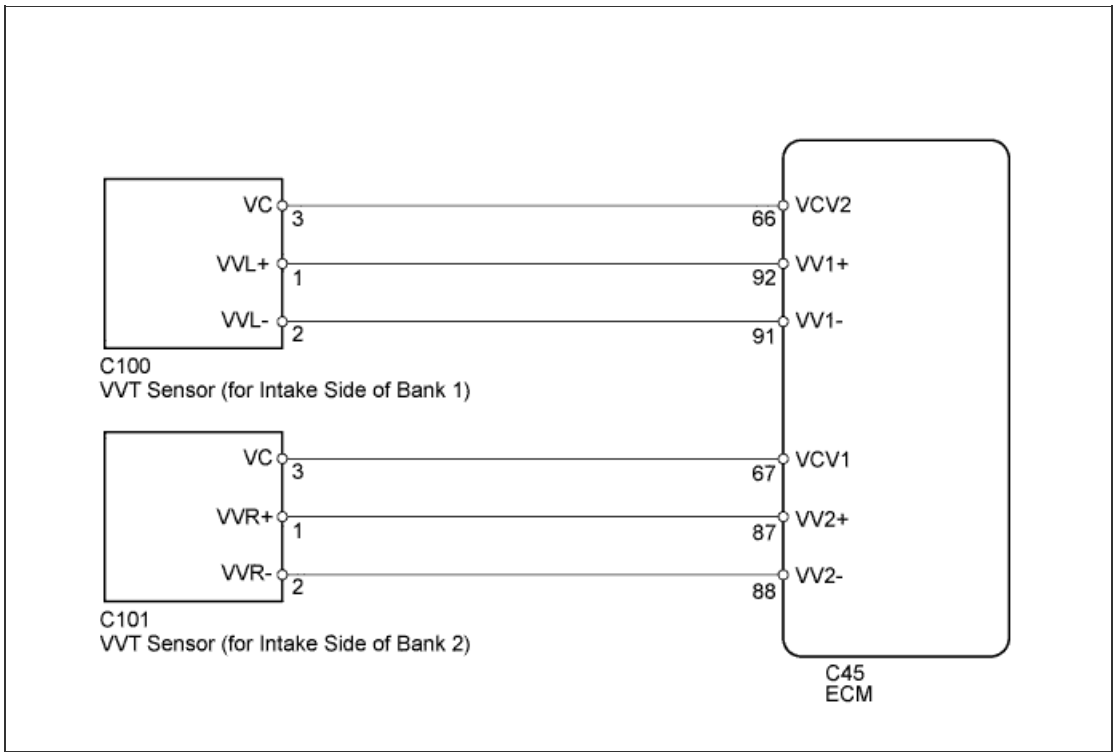
HINT:

VV1+ and VV2+ stand for the VVT sensor (for intake side) signal, and NE+ stands for the CKP sensor signal.

MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine revolving, or the rotations of the camshaft and the crankshaft are not synchronized, the ECM interprets this as a malfunction of the sensor.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

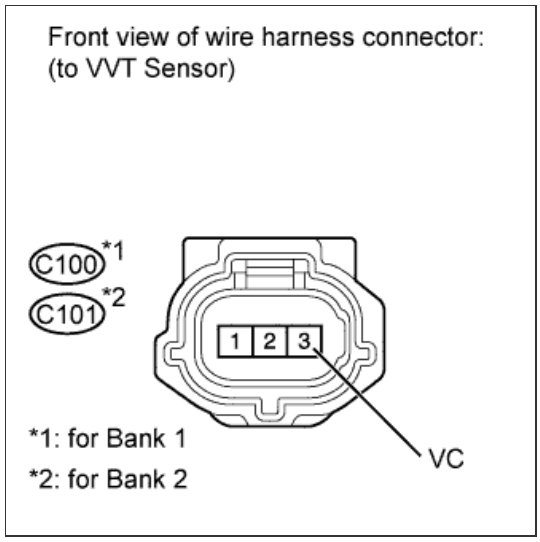
1.CHECK HARNESS AND CONNECTOR (SENSOR POWER SOURCE)

a. Disconnect the C100 or C101 VVT sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
C100-3 (VC) - Body ground	Engine switch on (IG)	4.5 to 5.0 V
C101-3 (VC) - Body ground	Engine switch on (IG)	4.5 to 5.0 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (VVT SENSOR FOR INTAKE SIDE - ECM)

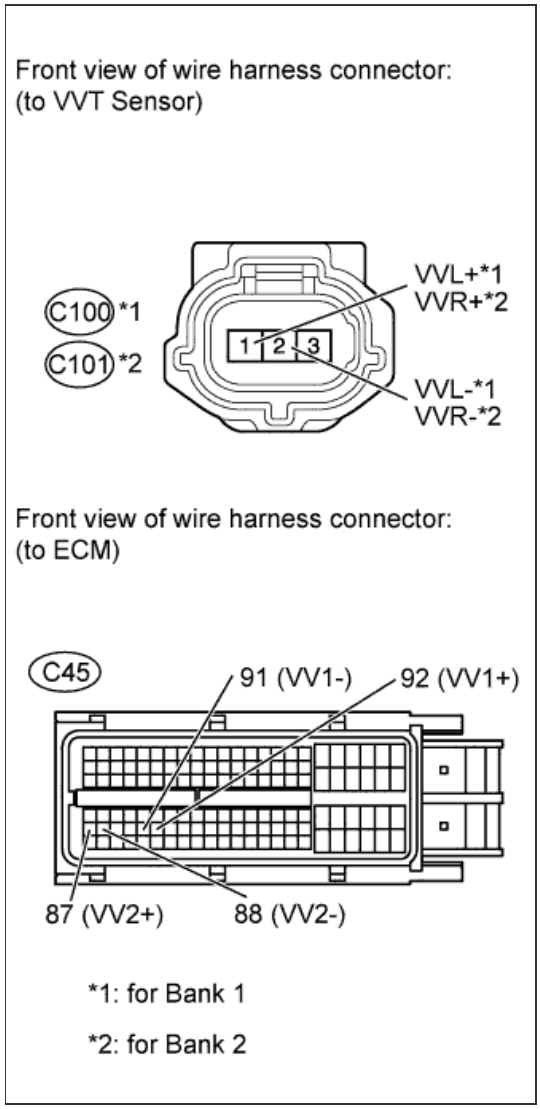
a. Disconnect the C100 or C101 VVT sensor connector.

b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C100-1 (VVL+) - C45-92 (VV1+)	Always	Below 1 Ω
C100-2 (VVL-) - C45-91 (VV1-)	Always	Below 1 Ω
C101-1 (VVR+) - C45-87 (VV2+)	Always	Below 1 Ω
C101-2 (VVR-) - C45-88 (VV2-)	Always	Below 1 Ω
C100-1 (VVL+) or C45-92 (VV1+) - Body ground	Always	10 kΩ or higher
C100-2 (VVL-) or C45-91 (VV1-) - Body ground	Always	10 kΩ or higher
C101-1 (VVR+) or C45-87 (VV2+) - Body ground	Always	10 kΩ or higher
C101-2 (VVR-) or C45-88 (VV2-) - Body ground	Always	10 kΩ or higher



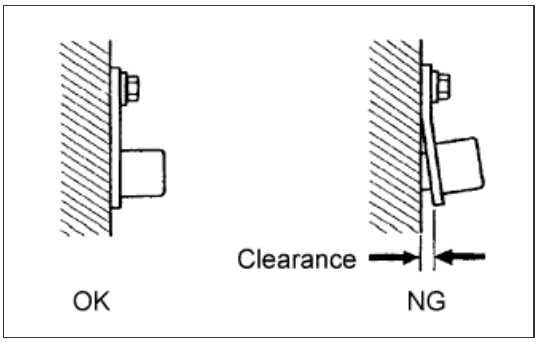
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK SENSOR INSTALLATION

a. Check the VVT sensor (for intake side) installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

4.CHECK INTAKE CAMSHAFT (TEETH)

a. Check the teeth of the camshaft.

OK:
Teeth do not have any cracks or deformation.

NG → REPLACE INTAKE CAMSHAFT (Click here)

OK

5.REPLACE VVT SENSOR (for Intake Side)

a. Replace the VVT sensor (for Intake Side) (Click here).

NEXT

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs.

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No output	A
P0340, P0342, P0343, P0345, P0347 or P0348	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

DTC P0011 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)

DTC P0012 Camshaft Position "A" - Timing Over-Retarded (Bank 1)

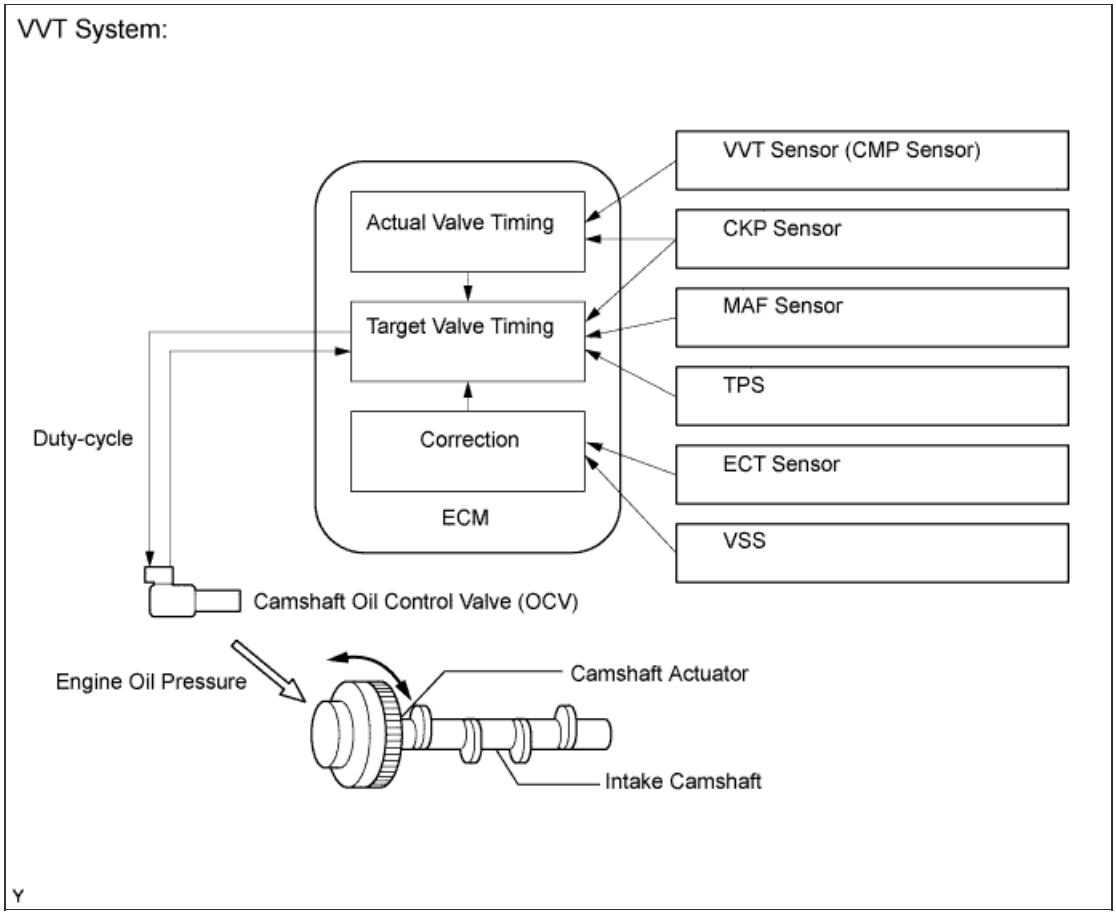
DTC P0021 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)

DTC P0022 Camshaft Position "A" - Timing Over-Retarded (Bank 2)

for Preparation Click here

DESCRIPTION

The VVT system includes the ECM, Camshaft Oil Control Valve (OCV) and VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. Camshaft timing control is performed according to engine operating conditions such as the intake air volume, throttle valve position and engine coolant temperature. The ECM controls the OCV based on the signals transmitted by several sensors. The VVT controller regulates the intake camshaft angle using oil pressure through the OCV. As a result, the relative positions of the camshaft and crankshaft are optimized, the engine torque and fuel economy improve, and the exhaust emissions decrease under overall driving conditions. The ECM detects the actual intake valve timing using signals from the camshaft and crankshaft position sensors, and performs feedback control. This is how the target intake valve timing is verified by the ECM.



DTC Code	DTC Detection Condition	Trouble Area
P0011 P0021	The intake valve timing is not adjusted in the valve timing advance range (1 trip detection logic).	• Valve timing • Camshaft Oil Control Valve (OCV) (for intake side of Bank 1, 2) • OCV filter • Camshaft timing gear • ECM
P0012 P0022	The intake valve timing is not adjusted in the valve timing retard range (2 trip detection logic).	• Valve timing • OCV (for intake side of Bank 1, 2) • OCV filter • Camshaft timing gear • ECM

MONITOR DESCRIPTION

The ECM optimizes the intake valve timing using the VVT (Variable Valve Timing) system to control the intake camshaft. The VVT system includes the ECM, Camshaft Oil Control Valve (OCV) and VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake camshaft.
If the difference between the target and actual intake valve timings is large, and changes in the actual intake valve timing are small, the ECM interprets this as the VVT controller stuck malfunction and stores DTC(s).

Example:
A DTC is stored when the following conditions 1, 2 and 3 are met:

1. The difference between the target and actual intake valve timing is more than 5° CA (Crankshaft Angle) and the condition continues for more than 4.5 seconds.
2. It takes 5 seconds or more to change the valve timing by 5° CA.
3. After above conditions 1 and 2 are met, the OCV is forcibly activated during 10 seconds.

DTC P0011 and P0021 (Advanced Cam Timing) are subject to 1 trip detection logic.
DTC P0012 and P0022 (Retarded Cam Timing) are subject to 2 trip detection logic.
These DTCs indicate that the VVT controller cannot operate properly due to OCV malfunctions or the presence of foreign objects in the OCV.
The monitor will run if all of the following conditions are met:

- The engine is warm (the engine coolant temperature is 75°C [167°F] or higher).
- The vehicle has been driven at more than 64 km/h (40 mph) for 3 minutes.
- The engine has idled for 3 minutes.

WIRING DIAGRAM

Refer to DTC P0010 (Click here).

INSPECTION PROCEDURE

HINT:

DTC P0011, P0012, P0021 or P0022 may be stored when foreign objects in the engine oil are caught in some parts of the system. The DTC will remain stored even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

HINT:

Abnormal Bank	Advanced Timing Over (Valve Timing is Out of Specified Range)	Retarded Timing Over (Valve Timing is Out of Specified Range)
Bank 1	P0011	P0012
Bank 2	P0021	P0022

- **If DTC P0011 or P0012 is output, check the left bank VVT system for intake side circuit (for Bank 1).**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **If DTC P0021 or P0022 is output, check the right bank VVT system for intake side circuit (for Bank 2).**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0011, P0012, P0021 or P0022 is output	A
P0011, P0012, P0021 or P0022 and other DTCs are output	B

HINT:

If any DTCs other than P0011, P0012, P0021 or P0022 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Warm up the engine.

e. Turn the A/C on.

f. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT Linear (Bank 1) or Control the VVT Linear (Bank 2).

g. Check the engine speed while operating the Camshaft Oil Control Valve (OCV) using the tester.

OK:

Operation	Specified Condition
0%	Normal engine speed
100%	Engine idles roughly or stalls

HINT:

Refer to "Data List / Active Test" [VVT OCV Duty #1, VVT Change Angle #1, VVT OCV Duty #2 and VVT Change Angle #2] (Click here).

NG → Go to step 4

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester.

f. Drive the vehicle for more than 10 minutes.

g. Read DTCs using the tester.

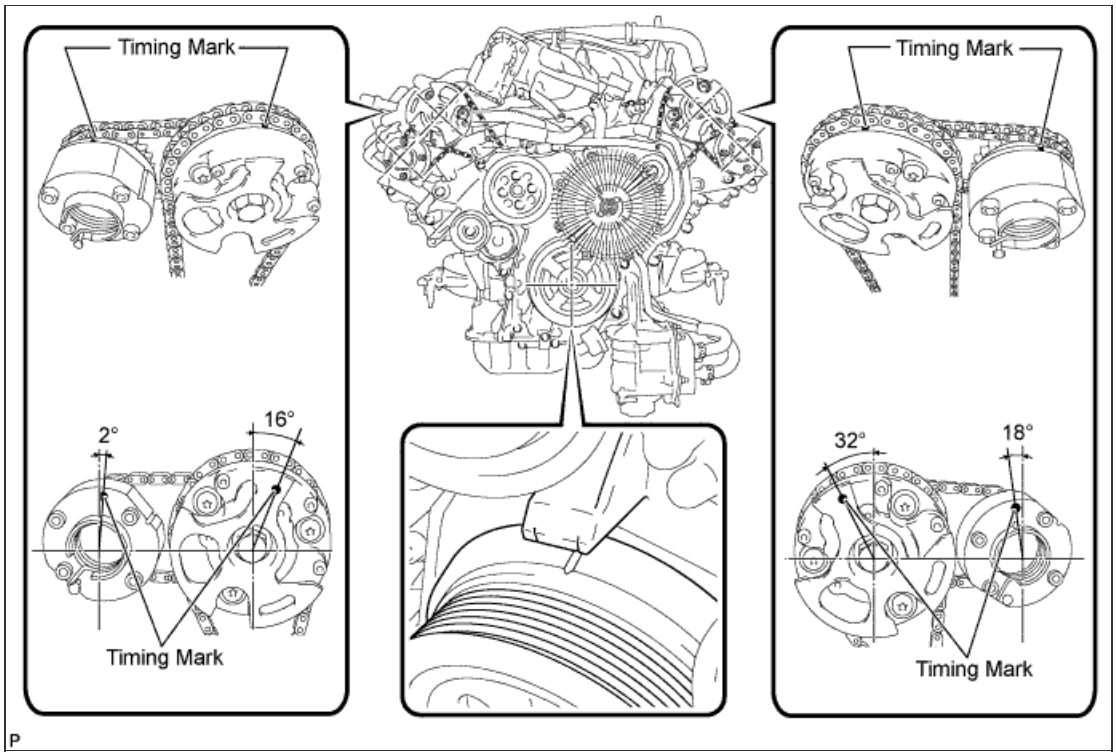
OK:
No DTC output.

NG → Go to step 4

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

4.CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMPED TOOTH OF TIMING CHAIN)



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:

Timing marks on camshaft timing gears are aligned as shown in the illustration.

NG → ADJUST VALVE TIMING (Click here)

OK

5.INSPECT CAMSHAFT OIL CONTROL VALVE ASSEMBLY

a. Remove the OCV.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

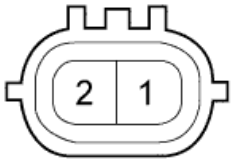
Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

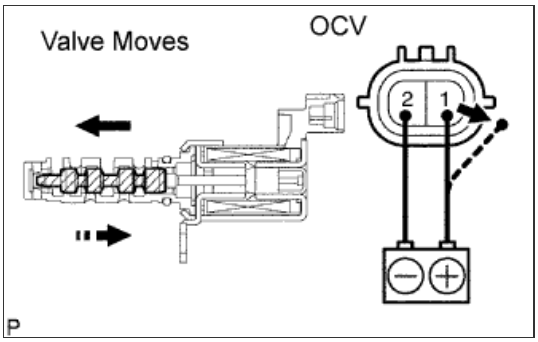
c. Check the valve operation.

OK:

Measurement Condition	Specified Condition
No battery voltage applied to terminals 1 and 2 → Battery voltage applied to terminals 1 and 2	Valve moves quickly

Component without harness connected:
(Oil Control Valve)





NG → REPLACE CAMSHAFT OIL CONTROL VALVE ASSEMBLY (Click here)

OK

6.INSPECT OIL CONTROL VALVE FILTER

a. Remove the OCV filter (Click here).

b. Check that the filter is not clogged.

OK:
Filter is not clogged.

NG → CLEAN OIL CONTROL VALVE FILTER

OK

7.REPLACE INTAKE CAMSHAFT TIMING GEAR

a. Replace the intake camshaft timing gear (Click here).

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester.

f. Drive the vehicle for more than 10 minutes.

g. Read the output DTCs using the tester.

OK:
No DTC is output.

HINT:

DTC P0011, P0012, P0021 or P0022 is output when foreign objects in the engine oil are caught in some parts of the system. These codes will stay stored even if the system returns to normal after a short time. These foreign objects are then captured by the oil filter, thus eliminating the source of the problem.

NG → REPLACE ECM (Click here)

OK

SYSTEM OK

DTC P0340 Camshaft Position Sensor Circuit Malfunction

DTC P0342 Camshaft Position Sensor "A" Circuit Low Input (Bank 1 or Single Sensor)

DTC P0343 Camshaft Position Sensor "A" Circuit High Input (Bank 1 or Single Sensor)

DTC P0345 Camshaft Position Sensor "A" Circuit (Bank 2)

DTC P0347 Camshaft Position Sensor "A" Circuit Low Input (Bank 2)

DTC P0348 Camshaft Position Sensor "A" Circuit High Input (Bank 2)

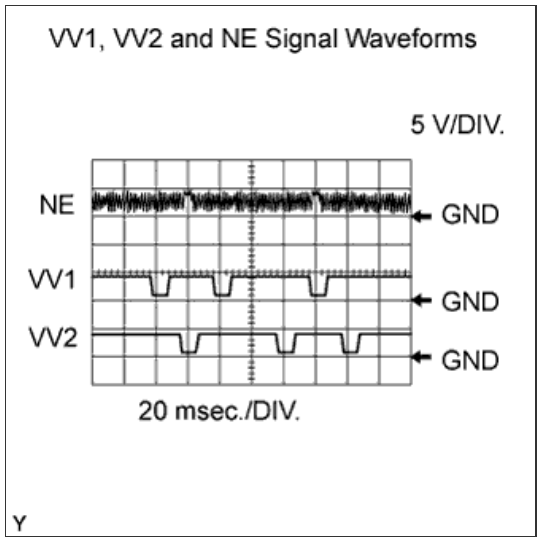
for Preparation Click here

DESCRIPTION

The intake camshaft Variable Valve Timing (VVT) sensor (VV1, 2 signal) consists of a magnet and MRE (Magnetic Resistance Element).
The intake camshaft has 3 teeth on its outer circumference. When the intake camshaft rotates, changes occur in the air gaps between the teeth and MRE, which affects the magnetic field. As a result, the resistance of the MRE material fluctuates. The VVT sensor converts the intake camshaft rotation data into pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM.
The crankshaft position sensor plate has 34 teeth. The crankshaft position sensor generates 34 signals for each revolution. Based on a combination of the VVT signal and NE signal, the ECM detects the crankshaft angle. Then the ECM uses this data to control fuel injection time and injection timing. Also, based on the NE signal, the ECM detects the engine speed.

DTC Code	DTC Detection Condition	Trouble Area
P0340 P0345	When either condition below is met: • The input voltage to the ECM remains at below 0.3 V or higher than 4.7 V for 4 seconds when 2 or more seconds have elapsed after turning the engine switch on (IG) (1 trip detection logic). • No VVT sensor (for intake side of Bank 1, 2) signal is sent to the ECM during cranking (2 trip detection logic).	• Open or short in VVT sensor (for intake side) circuit • VVT sensor (for intake side) • Intake camshaft (for Bank 1, 2) • Jumped tooth of timing chain • ECM
P0342 P0347	The output voltage of the VVT sensor (for intake side of Bank 1, 2) is below 0.3 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for intake side) circuit • VVT sensor (for intake side) • Intake camshaft (for Bank 1, 2) • Jumped tooth of timing chain • ECM
P0343 P0348	The output voltage of the VVT sensor (for intake side of Bank 1, 2) is higher than 4.7 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for intake side) circuit • VVT sensor (for intake side) • Intake camshaft (for Bank 1, 2) • Jumped tooth of timing chain • ECM

Reference: Inspection using an oscilloscope



Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-110 (NE+) - C45-111 (NE-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-92 (VV1+) - C45-91 (VV1-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-87 (VV2+) - C45-88 (VV2-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown

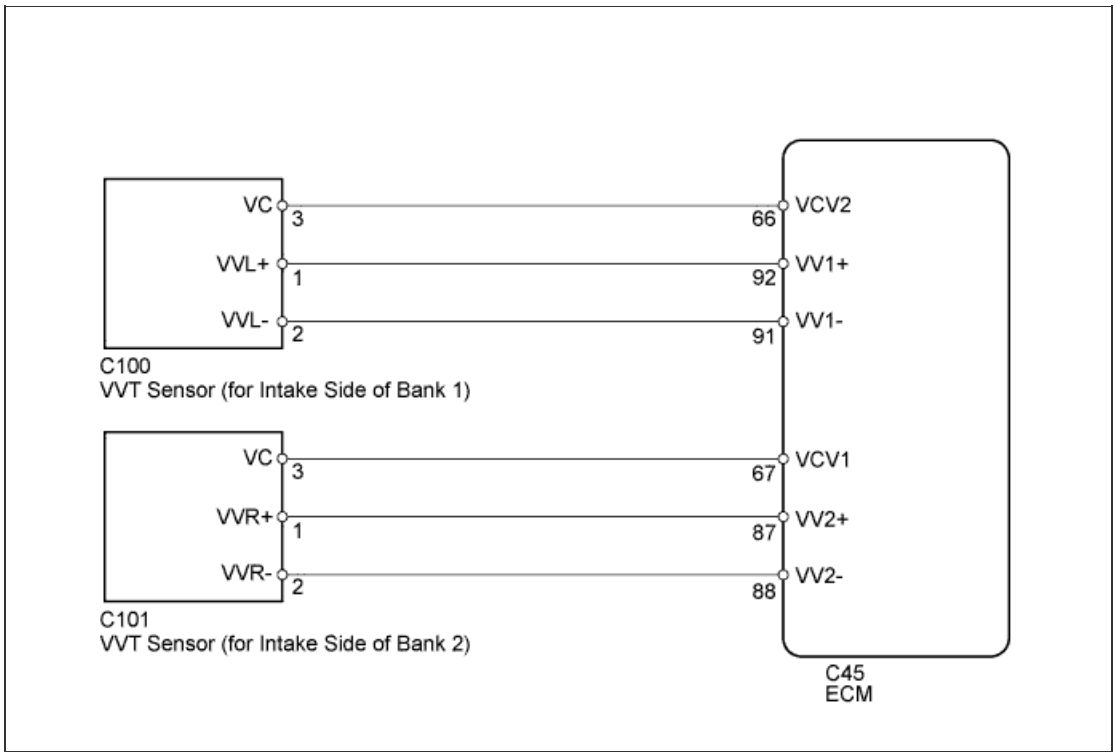
HINT:

VV1+ and VV2+ stand for the VVT sensor (for intake side) signal, and NE+ stands for the CKP sensor signal.

MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine revolving, or the rotations of the camshaft and the crankshaft are not synchronized, the ECM interprets this as a malfunction of the sensor.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

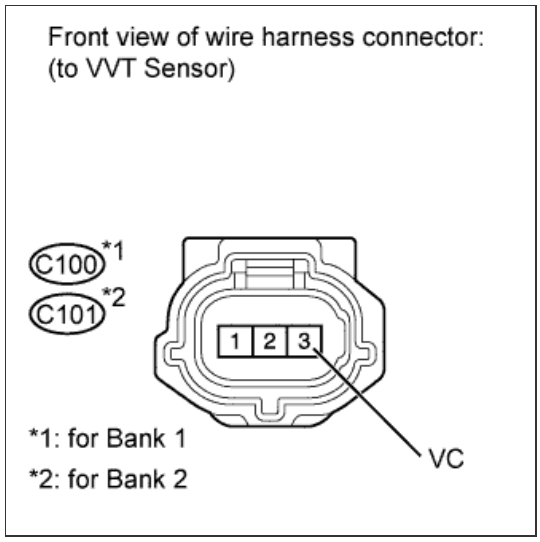
1.CHECK HARNESS AND CONNECTOR (SENSOR POWER SOURCE)

a. Disconnect the C100 or C101 VVT sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
C100-3 (VC) - Body ground	Engine switch on (IG)	4.5 to 5.0 V
C101-3 (VC) - Body ground	Engine switch on (IG)	4.5 to 5.0 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (VVT SENSOR FOR INTAKE SIDE - ECM)

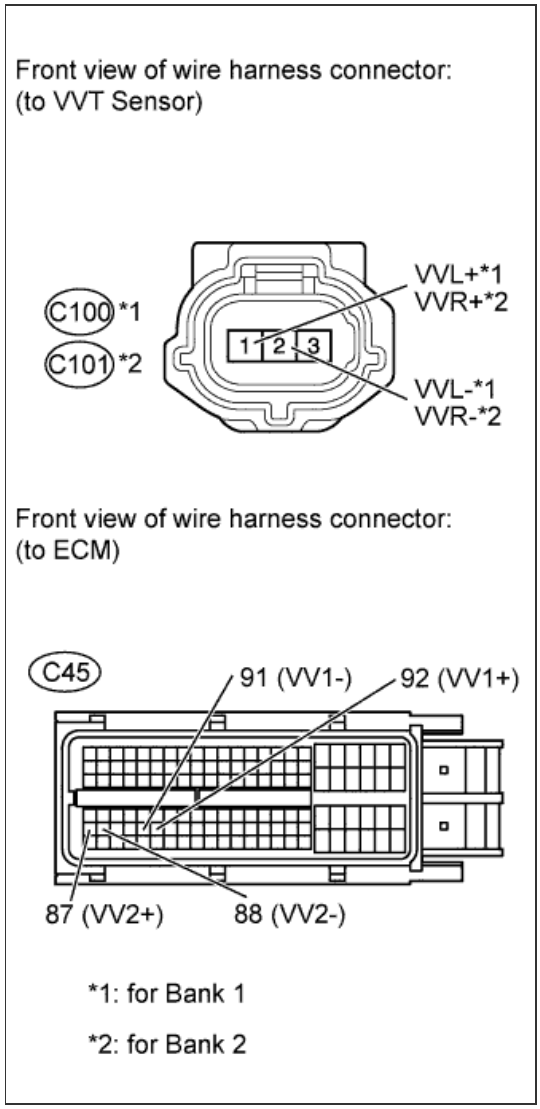
a. Disconnect the C100 or C101 VVT sensor connector.

b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C100-1 (VVL+) - C45-92 (VV1+)	Always	Below 1 Ω
C100-2 (VVL-) - C45-91 (VV1-)	Always	Below 1 Ω
C101-1 (VVR+) - C45-87 (VV2+)	Always	Below 1 Ω
C101-2 (VVR-) - C45-88 (VV2-)	Always	Below 1 Ω
C100-1 (VVL+) or C45-92 (VV1+) - Body ground	Always	10 kΩ or higher
C100-2 (VVL-) or C45-91 (VV1-) - Body ground	Always	10 kΩ or higher
C101-1 (VVR+) or C45-87 (VV2+) - Body ground	Always	10 kΩ or higher
C101-2 (VVR-) or C45-88 (VV2-) - Body ground	Always	10 kΩ or higher



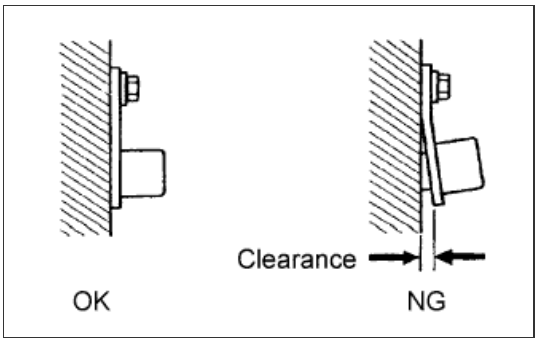
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK SENSOR INSTALLATION

a. Check the VVT sensor (for intake side) installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

4.CHECK INTAKE CAMSHAFT (TEETH)

a. Check the teeth of the camshaft.

OK:
Teeth do not have any cracks or deformation.

NG → REPLACE INTAKE CAMSHAFT (Click here)

OK

5.REPLACE VVT SENSOR (for Intake Side)

a. Replace the VVT sensor (for Intake Side) (Click here).

NEXT

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs.

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No output	A
P0340, P0342, P0343, P0345, P0347 or P0348	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

DTC P0011 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)

DTC P0012 Camshaft Position "A" - Timing Over-Retarded (Bank 1)

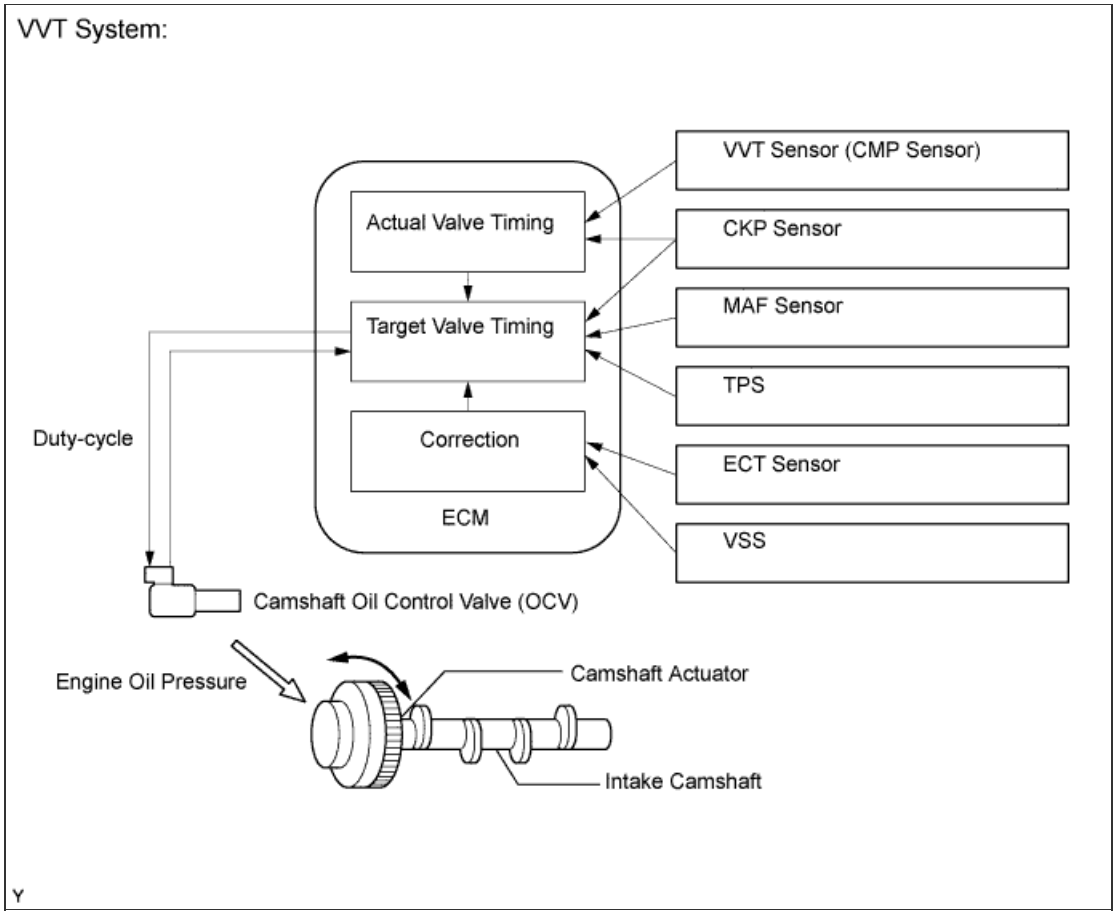
DTC P0021 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)

DTC P0022 Camshaft Position "A" - Timing Over-Retarded (Bank 2)

for Preparation Click here

DESCRIPTION

The VVT system includes the ECM, Camshaft Oil Control Valve (OCV) and VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. Camshaft timing control is performed according to engine operating conditions such as the intake air volume, throttle valve position and engine coolant temperature. The ECM controls the OCV based on the signals transmitted by several sensors. The VVT controller regulates the intake camshaft angle using oil pressure through the OCV. As a result, the relative positions of the camshaft and crankshaft are optimized, the engine torque and fuel economy improve, and the exhaust emissions decrease under overall driving conditions. The ECM detects the actual intake valve timing using signals from the camshaft and crankshaft position sensors, and performs feedback control. This is how the target intake valve timing is verified by the ECM.



DTC Code	DTC Detection Condition	Trouble Area
P0011 P0021	The intake valve timing is not adjusted in the valve timing advance range (1 trip detection logic).	• Valve timing • Camshaft Oil Control Valve (OCV) (for intake side of Bank 1, 2) • OCV filter • Camshaft timing gear • ECM
P0012 P0022	The intake valve timing is not adjusted in the valve timing retard range (2 trip detection logic).	• Valve timing • OCV (for intake side of Bank 1, 2) • OCV filter • Camshaft timing gear • ECM

MONITOR DESCRIPTION

The ECM optimizes the intake valve timing using the VVT (Variable Valve Timing) system to control the intake camshaft. The VVT system includes the ECM, Camshaft Oil Control Valve (OCV) and VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake camshaft.
If the difference between the target and actual intake valve timings is large, and changes in the actual intake valve timing are small, the ECM interprets this as the VVT controller stuck malfunction and stores DTC(s).

Example:
A DTC is stored when the following conditions 1, 2 and 3 are met:

1. The difference between the target and actual intake valve timing is more than 5° CA (Crankshaft Angle) and the condition continues for more than 4.5 seconds.
2. It takes 5 seconds or more to change the valve timing by 5° CA.
3. After above conditions 1 and 2 are met, the OCV is forcibly activated during 10 seconds.

DTC P0011 and P0021 (Advanced Cam Timing) are subject to 1 trip detection logic.
DTC P0012 and P0022 (Retarded Cam Timing) are subject to 2 trip detection logic.
These DTCs indicate that the VVT controller cannot operate properly due to OCV malfunctions or the presence of foreign objects in the OCV.
The monitor will run if all of the following conditions are met:

- The engine is warm (the engine coolant temperature is 75°C [167°F] or higher).
- The vehicle has been driven at more than 64 km/h (40 mph) for 3 minutes.
- The engine has idled for 3 minutes.

WIRING DIAGRAM

Refer to DTC P0010 (Click here).

INSPECTION PROCEDURE

HINT:

DTC P0011, P0012, P0021 or P0022 may be stored when foreign objects in the engine oil are caught in some parts of the system. The DTC will remain stored even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

HINT:

Abnormal Bank	Advanced Timing Over (Valve Timing is Out of Specified Range)	Retarded Timing Over (Valve Timing is Out of Specified Range)
Bank 1	P0011	P0012
Bank 2	P0021	P0022

- **If DTC P0011 or P0012 is output, check the left bank VVT system for intake side circuit (for Bank 1).**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **If DTC P0021 or P0022 is output, check the right bank VVT system for intake side circuit (for Bank 2).**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0011, P0012, P0021 or P0022 is output	A
P0011, P0012, P0021 or P0022 and other DTCs are output	B

HINT:

If any DTCs other than P0011, P0012, P0021 or P0022 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Warm up the engine.

e. Turn the A/C on.

f. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT Linear (Bank 1) or Control the VVT Linear (Bank 2).

g. Check the engine speed while operating the Camshaft Oil Control Valve (OCV) using the tester.

OK:

Operation	Specified Condition
0%	Normal engine speed
100%	Engine idles roughly or stalls

HINT:

Refer to "Data List / Active Test" [VVT OCV Duty #1, VVT Change Angle #1, VVT OCV Duty #2 and VVT Change Angle #2] (Click here).

NG → Go to step 4

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester.

f. Drive the vehicle for more than 10 minutes.

g. Read DTCs using the tester.

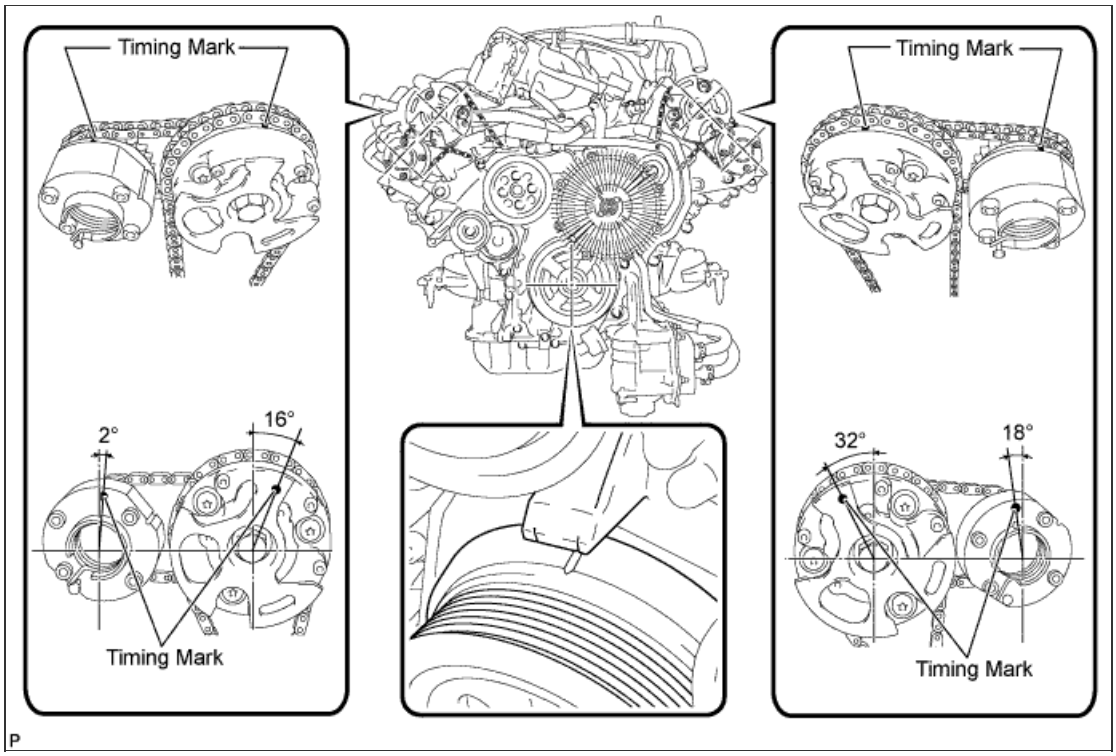
OK:
No DTC output.

NG → Go to step 4

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

4.CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMPED TOOTH OF TIMING CHAIN)



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:

Timing marks on camshaft timing gears are aligned as shown in the illustration.

NG → ADJUST VALVE TIMING (Click here)

OK

5.INSPECT CAMSHAFT OIL CONTROL VALVE ASSEMBLY

a. Remove the OCV.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

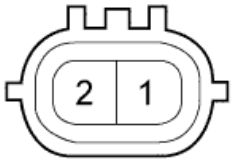
Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

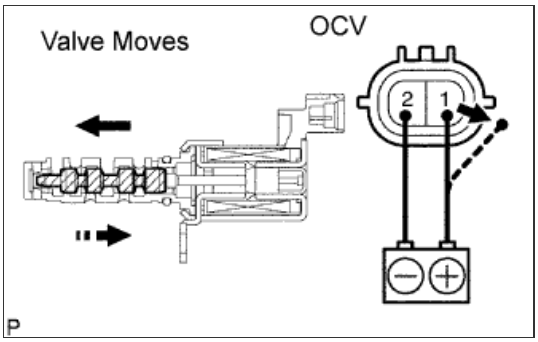
c. Check the valve operation.

OK:

Measurement Condition	Specified Condition
No battery voltage applied to terminals 1 and 2 → Battery voltage applied to terminals 1 and 2	Valve moves quickly

Component without harness connected:
(Oil Control Valve)





NG → REPLACE CAMSHAFT OIL CONTROL VALVE ASSEMBLY (Click here)

OK

6.INSPECT OIL CONTROL VALVE FILTER

a. Remove the OCV filter (Click here).

b. Check that the filter is not clogged.

OK:
Filter is not clogged.

NG → CLEAN OIL CONTROL VALVE FILTER

OK

7.REPLACE INTAKE CAMSHAFT TIMING GEAR

a. Replace the intake camshaft timing gear (Click here).

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester.

f. Drive the vehicle for more than 10 minutes.

g. Read the output DTCs using the tester.

OK:
No DTC is output.

HINT:

DTC P0011, P0012, P0021 or P0022 is output when foreign objects in the engine oil are caught in some parts of the system. These codes will stay stored even if the system returns to normal after a short time. These foreign objects are then captured by the oil filter, thus eliminating the source of the problem.

NG → REPLACE ECM (Click here)

OK

SYSTEM OK

DTC P0340 Camshaft Position Sensor Circuit Malfunction

DTC P0342 Camshaft Position Sensor "A" Circuit Low Input (Bank 1 or Single Sensor)

DTC P0343 Camshaft Position Sensor "A" Circuit High Input (Bank 1 or Single Sensor)

DTC P0345 Camshaft Position Sensor "A" Circuit (Bank 2)

DTC P0347 Camshaft Position Sensor "A" Circuit Low Input (Bank 2)

DTC P0348 Camshaft Position Sensor "A" Circuit High Input (Bank 2)

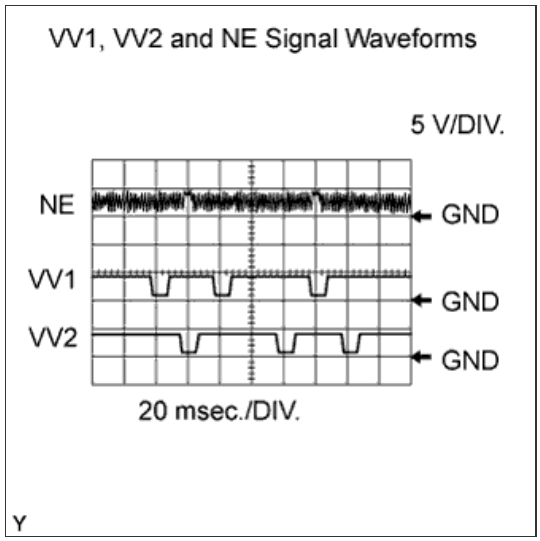
for Preparation Click here

DESCRIPTION

The intake camshaft Variable Valve Timing (VVT) sensor (VV1, 2 signal) consists of a magnet and MRE (Magnetic Resistance Element).
The intake camshaft has 3 teeth on its outer circumference. When the intake camshaft rotates, changes occur in the air gaps between the teeth and MRE, which affects the magnetic field. As a result, the resistance of the MRE material fluctuates. The VVT sensor converts the intake camshaft rotation data into pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM.
The crankshaft position sensor plate has 34 teeth. The crankshaft position sensor generates 34 signals for each revolution. Based on a combination of the VVT signal and NE signal, the ECM detects the crankshaft angle. Then the ECM uses this data to control fuel injection time and injection timing. Also, based on the NE signal, the ECM detects the engine speed.

DTC Code	DTC Detection Condition	Trouble Area
P0340 P0345	When either condition below is met: • The input voltage to the ECM remains at below 0.3 V or higher than 4.7 V for 4 seconds when 2 or more seconds have elapsed after turning the engine switch on (IG) (1 trip detection logic). • No VVT sensor (for intake side of Bank 1, 2) signal is sent to the ECM during cranking (2 trip detection logic).	• Open or short in VVT sensor (for intake side) circuit • VVT sensor (for intake side) • Intake camshaft (for Bank 1, 2) • Jumped tooth of timing chain • ECM
P0342 P0347	The output voltage of the VVT sensor (for intake side of Bank 1, 2) is below 0.3 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for intake side) circuit • VVT sensor (for intake side) • Intake camshaft (for Bank 1, 2) • Jumped tooth of timing chain • ECM
P0343 P0348	The output voltage of the VVT sensor (for intake side of Bank 1, 2) is higher than 4.7 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for intake side) circuit • VVT sensor (for intake side) • Intake camshaft (for Bank 1, 2) • Jumped tooth of timing chain • ECM

Reference: Inspection using an oscilloscope



Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-110 (NE+) - C45-111 (NE-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-92 (VV1+) - C45-91 (VV1-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-87 (VV2+) - C45-88 (VV2-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown

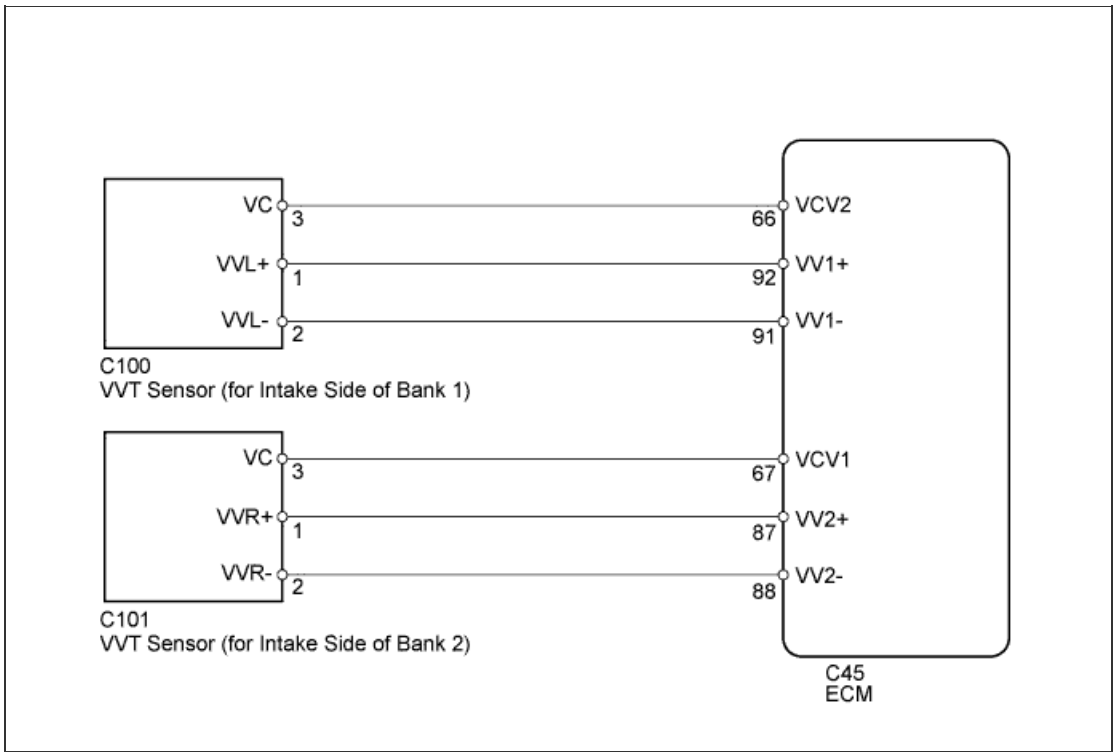
HINT:

VV1+ and VV2+ stand for the VVT sensor (for intake side) signal, and NE+ stands for the CKP sensor signal.

MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine revolving, or the rotations of the camshaft and the crankshaft are not synchronized, the ECM interprets this as a malfunction of the sensor.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

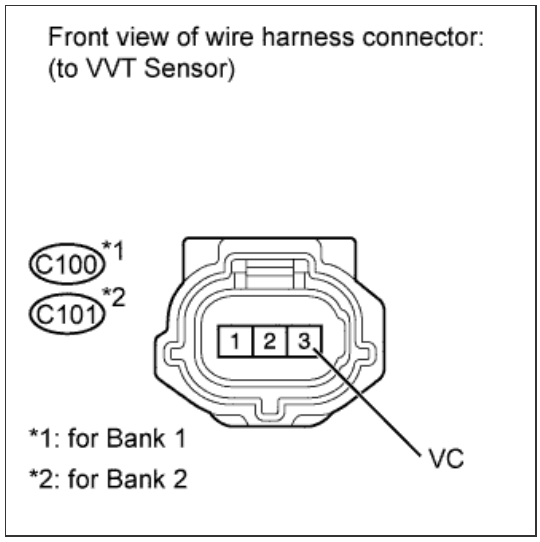
1.CHECK HARNESS AND CONNECTOR (SENSOR POWER SOURCE)

a. Disconnect the C100 or C101 VVT sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
C100-3 (VC) - Body ground	Engine switch on (IG)	4.5 to 5.0 V
C101-3 (VC) - Body ground	Engine switch on (IG)	4.5 to 5.0 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (VVT SENSOR FOR INTAKE SIDE - ECM)

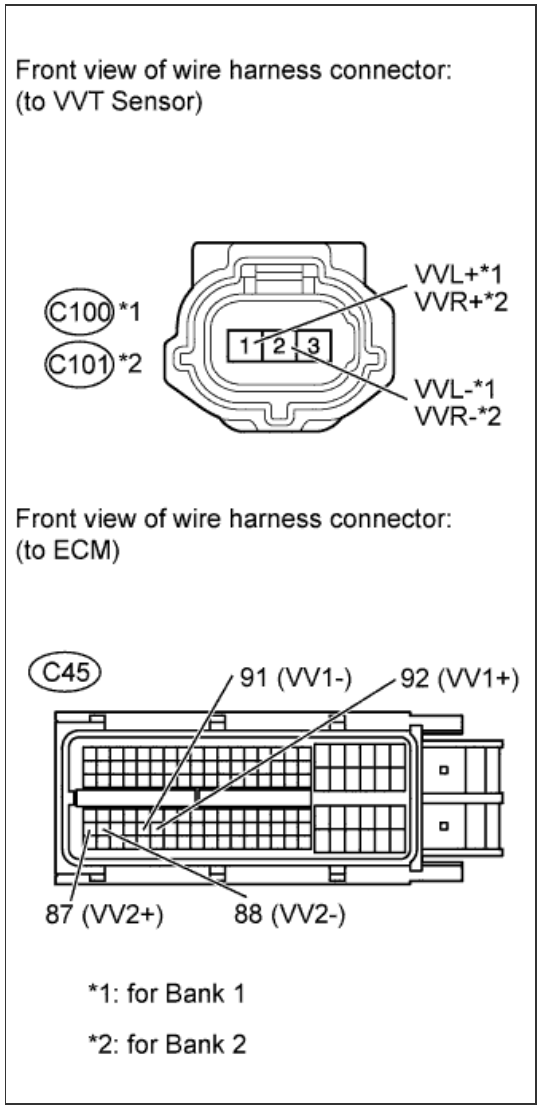
a. Disconnect the C100 or C101 VVT sensor connector.

b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C100-1 (VVL+) - C45-92 (VV1+)	Always	Below 1 Ω
C100-2 (VVL-) - C45-91 (VV1-)	Always	Below 1 Ω
C101-1 (VVR+) - C45-87 (VV2+)	Always	Below 1 Ω
C101-2 (VVR-) - C45-88 (VV2-)	Always	Below 1 Ω
C100-1 (VVL+) or C45-92 (VV1+) - Body ground	Always	10 kΩ or higher
C100-2 (VVL-) or C45-91 (VV1-) - Body ground	Always	10 kΩ or higher
C101-1 (VVR+) or C45-87 (VV2+) - Body ground	Always	10 kΩ or higher
C101-2 (VVR-) or C45-88 (VV2-) - Body ground	Always	10 kΩ or higher



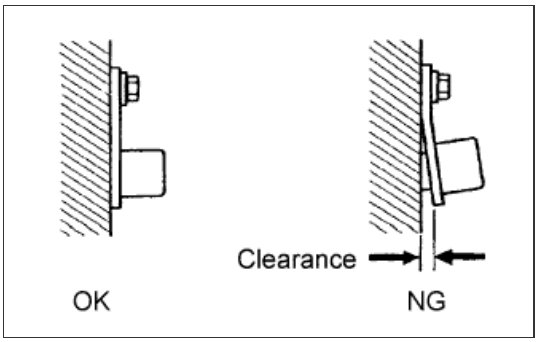
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK SENSOR INSTALLATION

a. Check the VVT sensor (for intake side) installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

4.CHECK INTAKE CAMSHAFT (TEETH)

a. Check the teeth of the camshaft.

OK:
Teeth do not have any cracks or deformation.

NG → REPLACE INTAKE CAMSHAFT (Click here)

OK

5.REPLACE VVT SENSOR (for Intake Side)

a. Replace the VVT sensor (for Intake Side) (Click here).

NEXT

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs.

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No output	A
P0340, P0342, P0343, P0345, P0347 or P0348	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

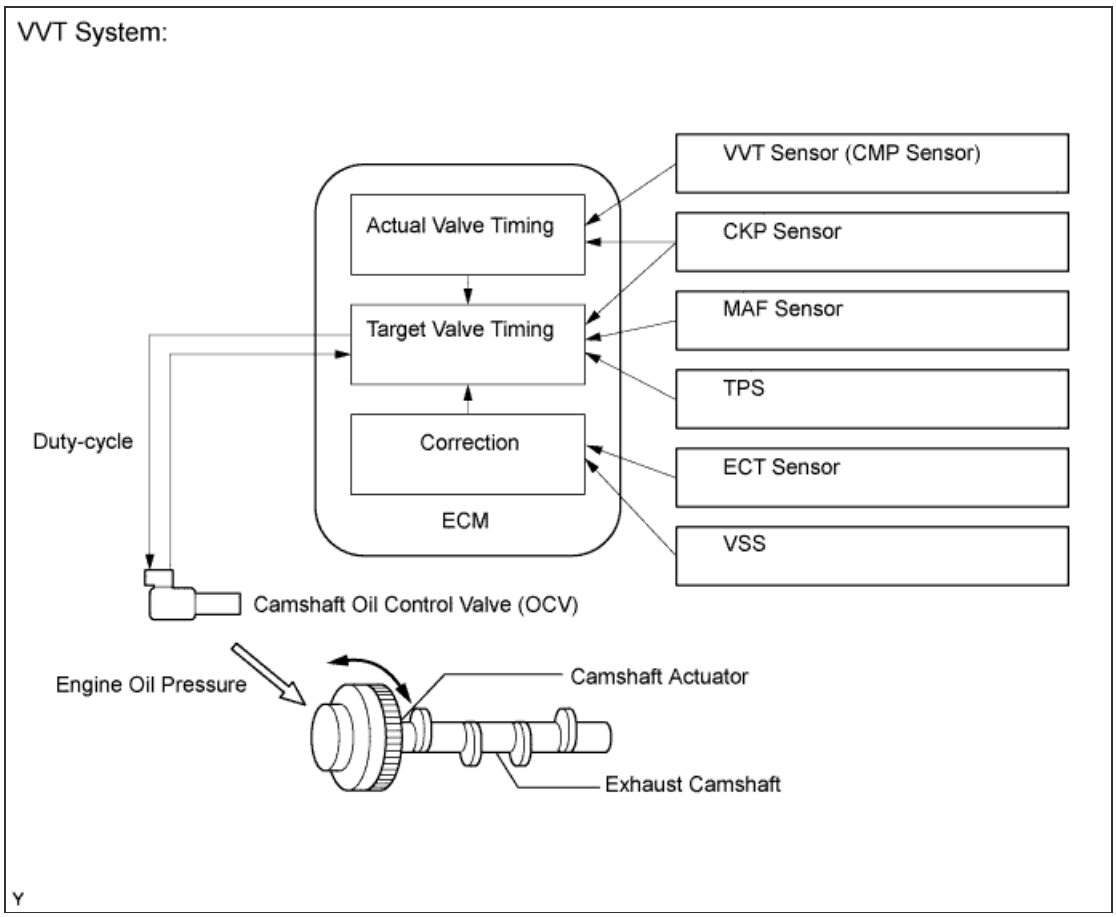
DTC P0013 Camshaft Position "B" Actuator Circuit / Open (Bank 1)

DTC P0023 Camshaft Position "B" Actuator Circuit / Open (Bank 2)

for Preparation Click here

DESCRIPTION

- This DTC is designed to detect opens or shorts in the Camshaft Oil Control Valve (OCV) circuit. If the OCV duty-cycle is excessively high or low while the engine is running, the ECM will illuminate the MIL and store the DTC.
- The VVT (variable valve timing) system adjusts the intake valve timing to improve the driveability. The engine oil pressure turns the camshaft actuator to adjust the valve timing. The OCV is a solenoid valve and switches the engine oil line. The valve moves when the ECM applies 12 volts to the solenoid. The ECM changes the energizing time to the solenoid (duty-cycle) in accordance with the camshaft position, crankshaft position, throttle position, etc.

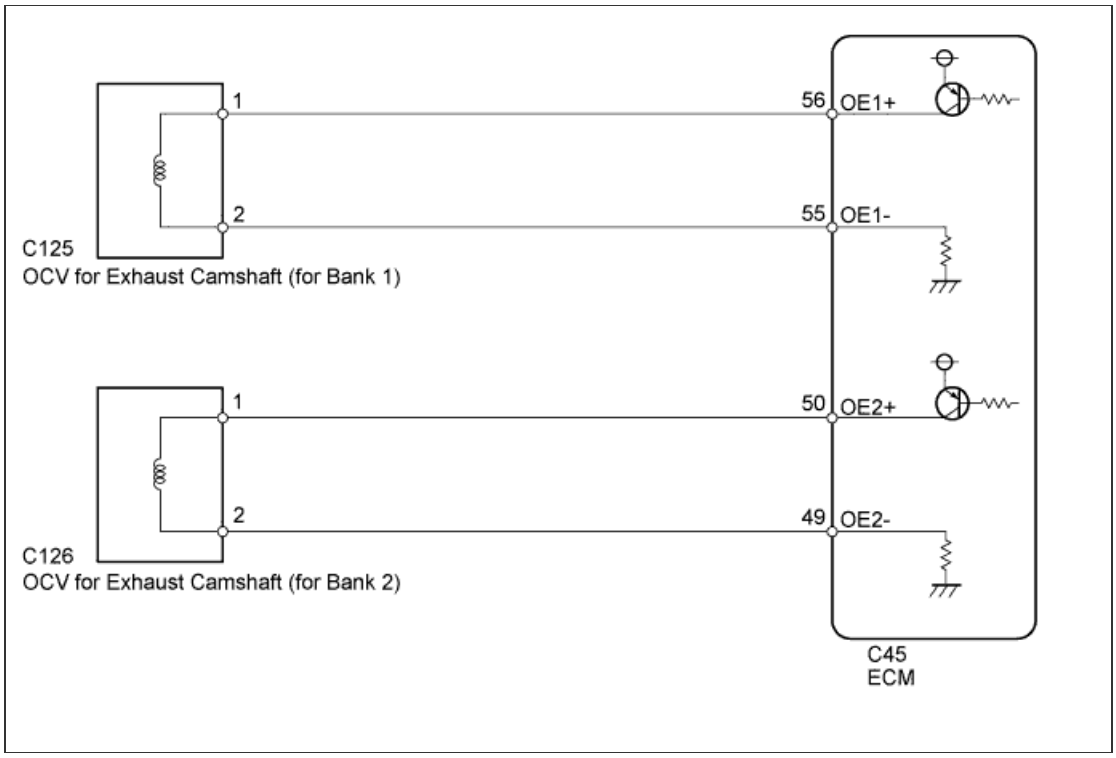


DTC Code	DTC Detection Condition	Trouble Area
P0013	An open or short in the Camshaft Oil Control Valve (OCV) for exhaust side (for Bank 1) circuit (1 trip detection logic).	• Open or short in Camshaft Oil Control Valve (OCV) (for exhaust side of Bank 1) circuit • OCV (for exhaust side of Bank 1) • ECM
P0023	An open or short in the OCV for exhaust side (for Bank 2) circuit (1 trip detection logic).	• Open or short in OCV (for exhaust side of Bank 2) circuit • OCV (for exhaust side of Bank 2) • ECM

MONITOR DESCRIPTION

This DTC is designed to detect opens or shorts in the camshaft oil control valve (OCV) circuit. If the OCV duty-cycle is excessively high or low while the engine is running, the ECM will illuminate the MIL and store the DTC.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **If DTC P0013 is output, check the bank 1 VVT system for exhaust side circuit.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **If DTC P0023 is output, check the bank 2 VVT system for exhaust side circuit.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK DTC (DTC P0013 OR P0023)

a. Connect the intelligent tester to the DLC3.

b. Clear DTC after recording the freeze frame data and DTC.

c. Turn the engine switch off.

d. Allow the engine to idle and check DTC.

e. Check that P0013 or P0023 is not output.

OK:
P0013 or P0023 is not output.

NG → **Go to step 2**

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

2.INSPECT CAMSHAFT OIL CONTROL VALVE ASSEMBLY

a. Disconnect the C125 or C126 OCV connector.

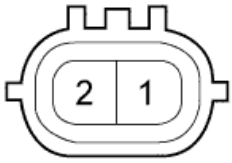
b. Remove the camshaft oil control valve (OCV) (Click here).

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

Component without harness connected:
(Oil Control Valve)



NG → REPLACE CAMSHAFT OIL CONTROL VALVE ASSEMBLY (Click here)

OK →

3.CHECK HARNESS AND CONNECTOR (OCV - ECM)

a. Disconnect the C125 or C126 OCV connector.

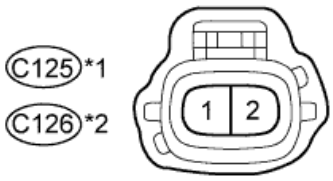
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

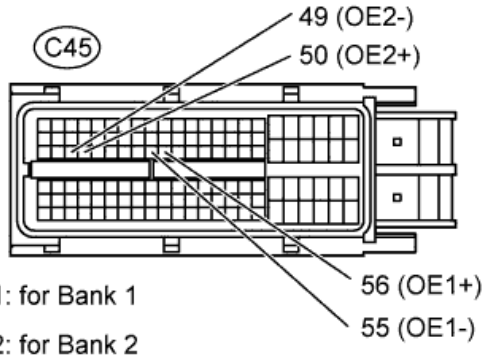
Standard Resistance:

Tester Connection	Condition	Specified Condition
C125-1 - C45-56 (OE1+)	Always	Below 1 Ω
C125-2 - C45-55 (OE1-)	Always	Below 1 Ω
C126-1 - C45-50 (OE2+)	Always	Below 1 Ω
C126-2 - C45-49 (OE2-)	Always	Below 1 Ω
C125-1 or C45-56 (OE1+) - Body ground	Always	10 kΩ or higher
C125-2 or C45-55 (OE1-) - Body ground	Always	10 kΩ or higher
C126-1 or C45-50 (OE2+) - Body ground	Always	10 kΩ or higher
C126-2 or C45-49 (OE2-) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Oil Control Valve)



Front view of wire harness connector:
(to ECM)



*1: for Bank 1

*2: for Bank 2

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK →

REPLACE ECM (Click here)

DTC P0351 Ignition Coil "A" Primary / Secondary Circuit

DTC P0352 Ignition Coil "B" Primary / Secondary Circuit

DTC P0353 Ignition Coil "C" Primary / Secondary Circuit

DTC P0354 Ignition Coil "D" Primary / Secondary Circuit

DTC P0355 Ignition Coil "E" Primary / Secondary Circuit

DTC P0356 Ignition Coil "F" Primary / Secondary Circuit

DTC P0357 Ignition Coil "G" Primary / Secondary Circuit

DTC P0358 Ignition Coil "H" Primary / Secondary Circuit

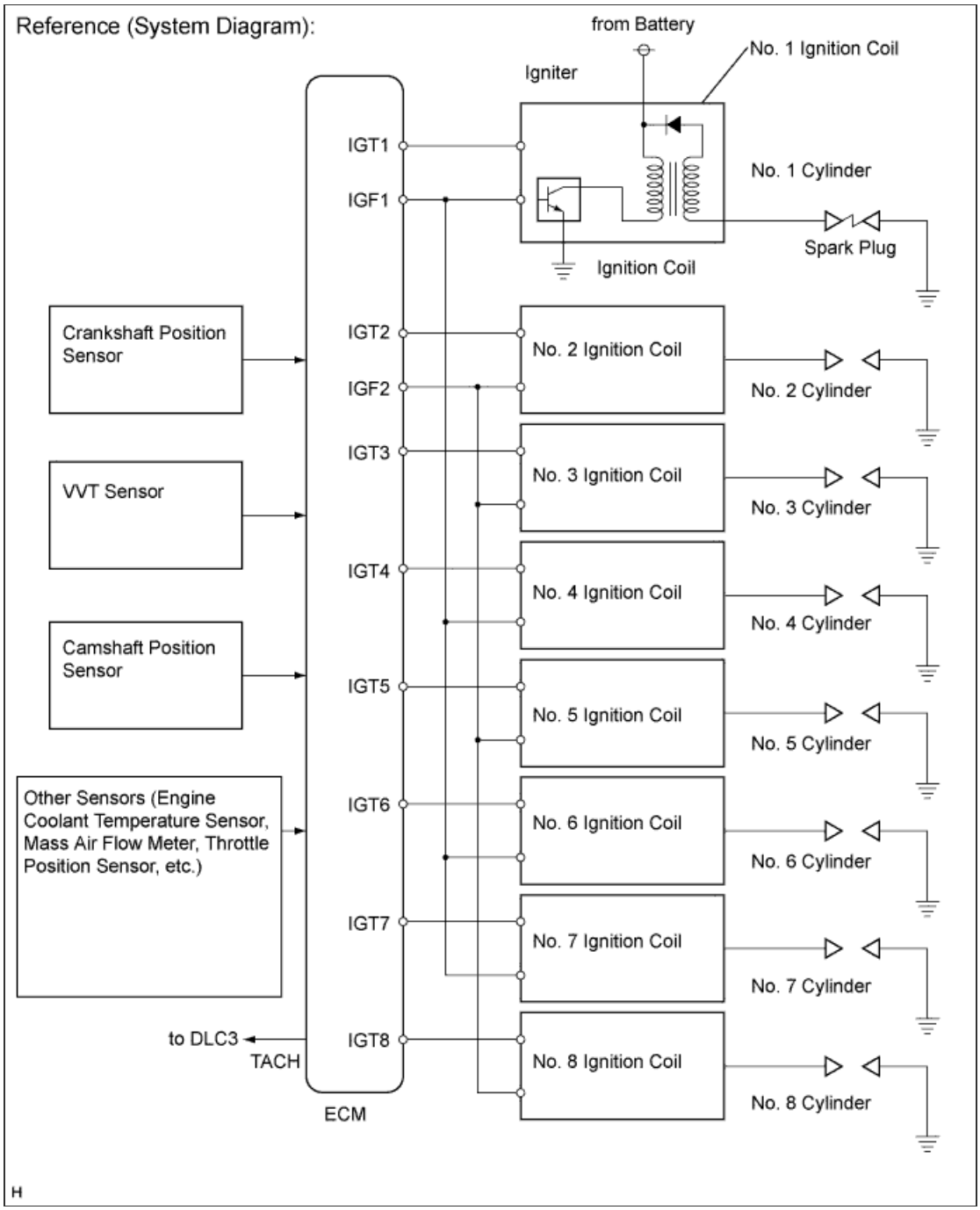
for Preparation Click here

DESCRIPTION

HINT:

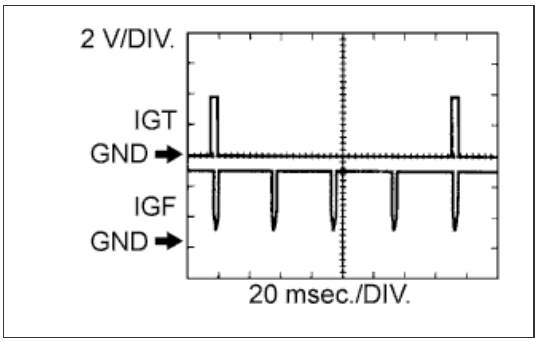
- **These DTCs indicate malfunctions relating to the primary circuit.**
- **If DTC P0351 is output, check the No. 1 ignition coil circuit.**
- **If DTC P0352 is output, check the No. 2 ignition coil circuit.**
- **If DTC P0353 is output, check the No. 3 ignition coil circuit.**
- **If DTC P0354 is output, check the No. 4 ignition coil circuit.**
- **If DTC P0355 is output, check the No. 5 ignition coil circuit.**
- **If DTC P0356 is output, check the No. 6 ignition coil circuit.**
- **If DTC P0357 is output, check the No. 7 ignition coil circuit.**
- **If DTC P0358 is output, check the No. 8 ignition coil circuit.**

A Direct Ignition System (DIS) is used on this vehicle.
The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.
The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.



DTC Code	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356 P0357 P0358	No IGF signal is sent to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 8) between ignition coil and ECM • No. 1 to No. 8 ignition coils • ECM

Reference: Inspection using an oscilloscope.



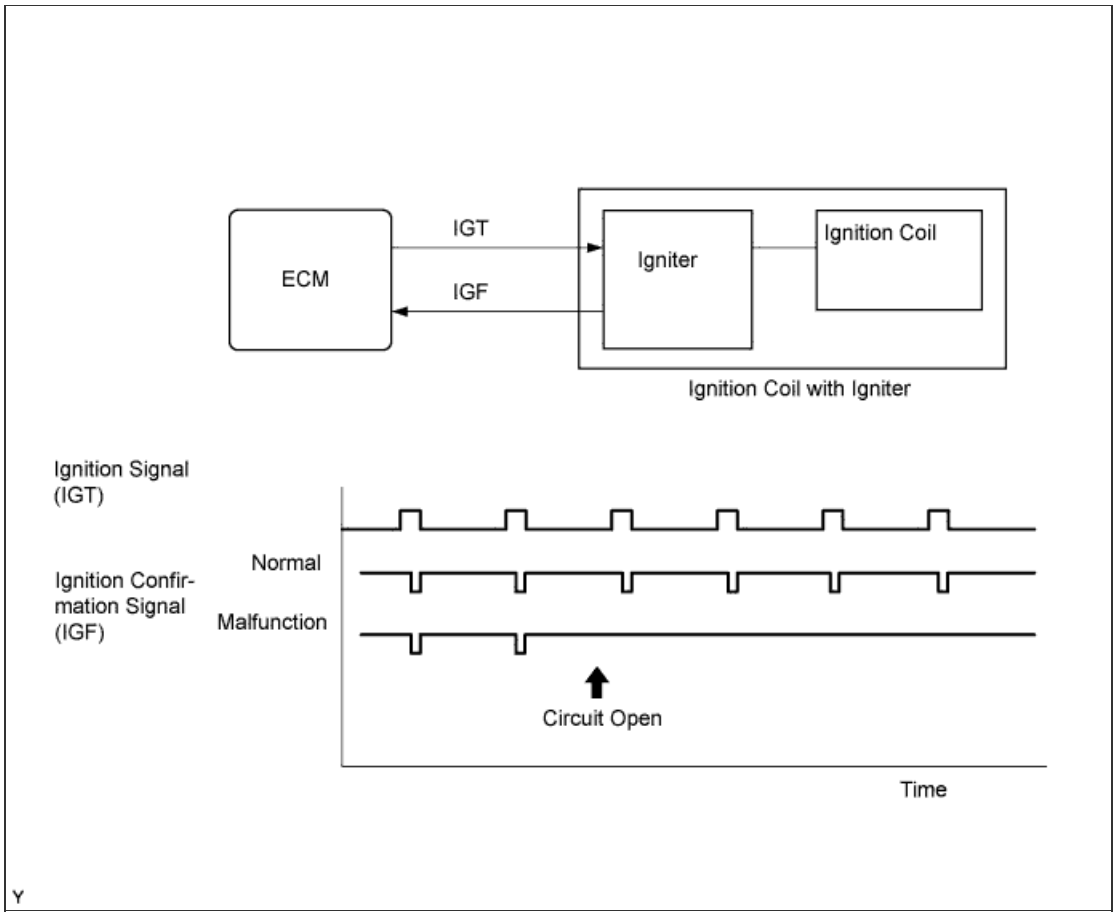
Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-40 (IGT1) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-33 (IGT2) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-37 (IGT3) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-34 (IGT4) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-35 (IGT5) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-36 (IGT6) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-38 (IGT7) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-39 (IGT8) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-104 (IGF1) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-105 (IGF2) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown

HINT:

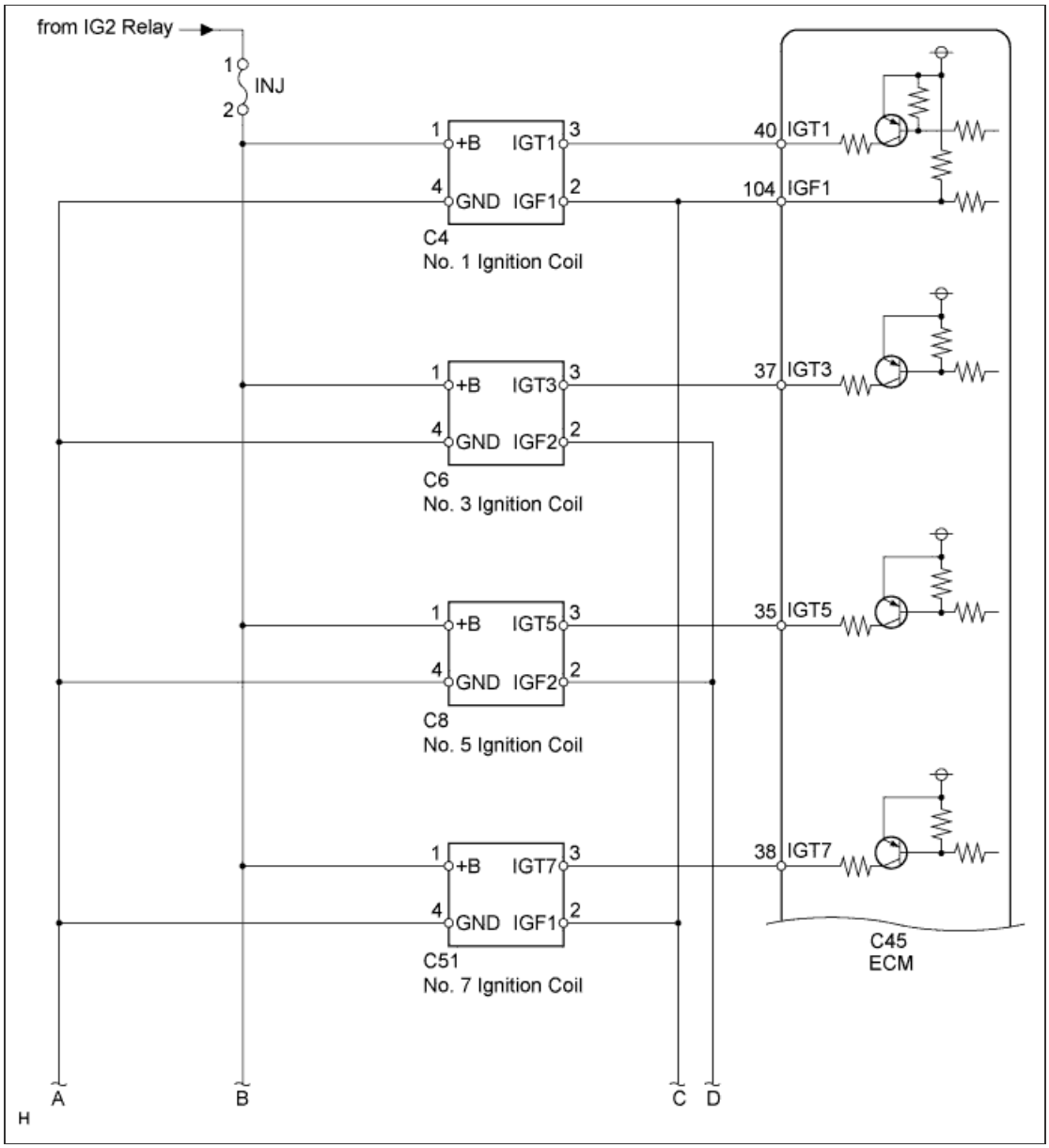
While cranking or idling the engine, check the waveform between terminals IGT (1 to 8) and E1, and IGF1 or IGF2 and E1 of the ECM connector.

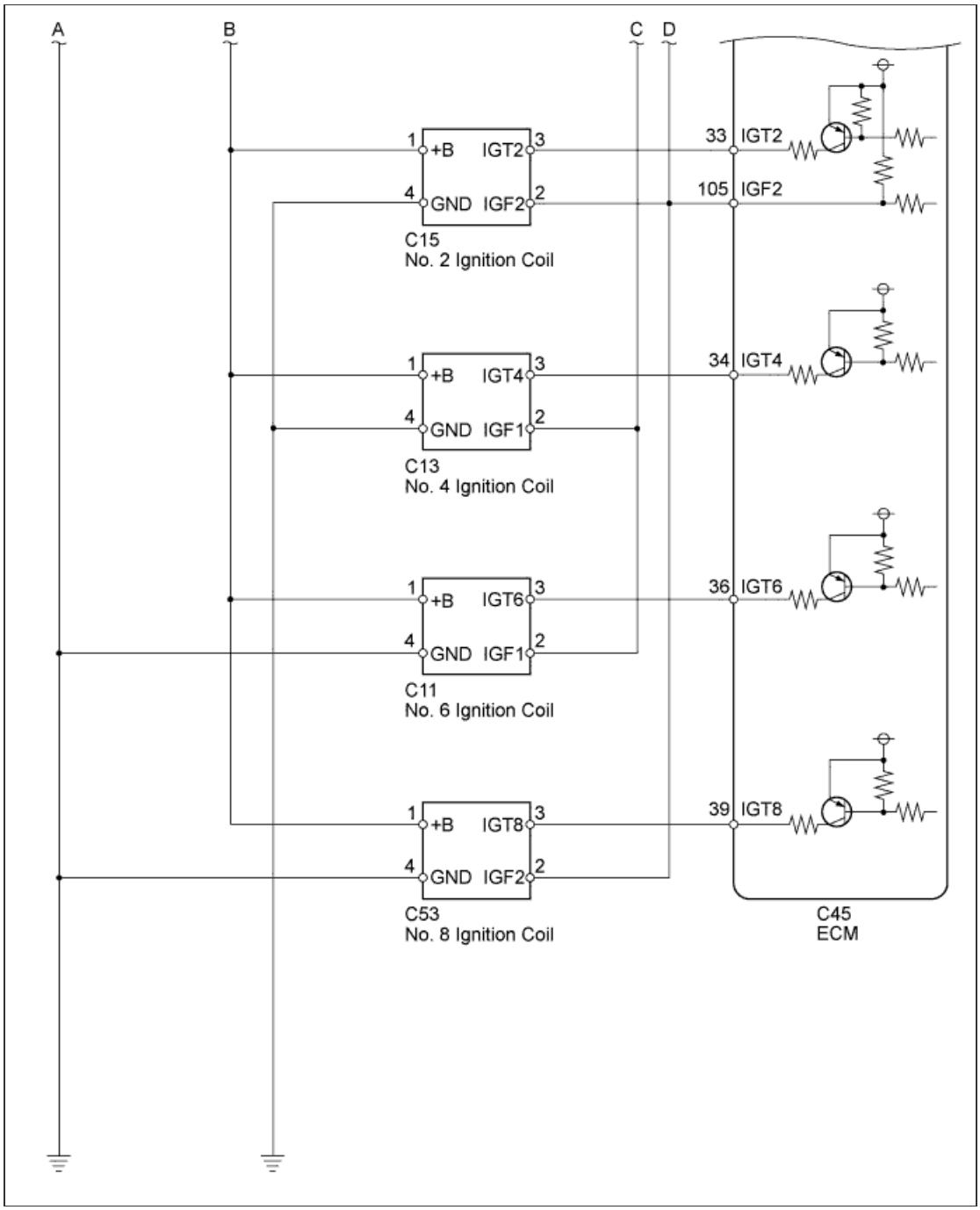
MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores DTC(s).
If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

WIRING DIAGRAM


from IG2 Relay
1
INJ
2
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
38
IGT7
C45
ECM
A
B
C
D
H



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)

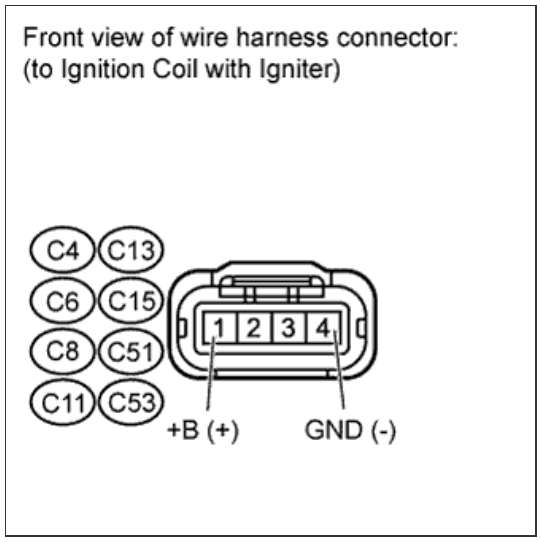
a. Disconnect the C4, C6, C8, C11, C13, C15, C51 or C53 ignition coil connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C4-4 (GND) - Body ground	Always	Below 1 Ω
C15-4 (GND) - Body ground	Always	Below 1 Ω
C6-4 (GND) - Body ground	Always	Below 1 Ω

C13-4 (GND) - Body ground	Always	Below 1 Ω
C8-4 (GND) - Body ground	Always	Below 1 Ω
C11-4 (GND) - Body ground	Always	Below 1 Ω
C51-4 (GND) - Body ground	Always	Below 1 Ω
C53-4 (GND) - Body ground	Always	Below 1 Ω



c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C4-1 (+B) - C4-4 (GND)	Engine switch on (IG)	11 to 14 V
C15-1 (+B) - C15-4 (GND)	Engine switch on (IG)	11 to 14 V
C6-1 (+B) - C6-4 (GND)	Engine switch on (IG)	11 to 14 V
C13-1 (+B) - C13-4 (GND)	Engine switch on (IG)	11 to 14 V
C8-1 (+B) - C8-4 (GND)	Engine switch on (IG)	11 to 14 V
C11-1 (+B) - C11-4 (GND)	Engine switch on (IG)	11 to 14 V
C51-1 (+B) - C51-4 (GND)	Engine switch on (IG)	11 to 14 V
C53-1 (+B) - C53-4 (GND)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

a. Disconnect the C4, C6, C8, C11, C13, C15, C51 or C53 ignition coil connector.

b. Disconnect the C45 ECM connector.

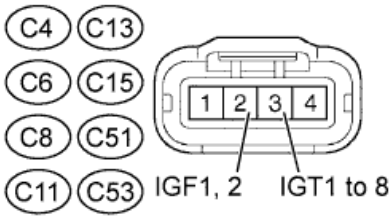
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

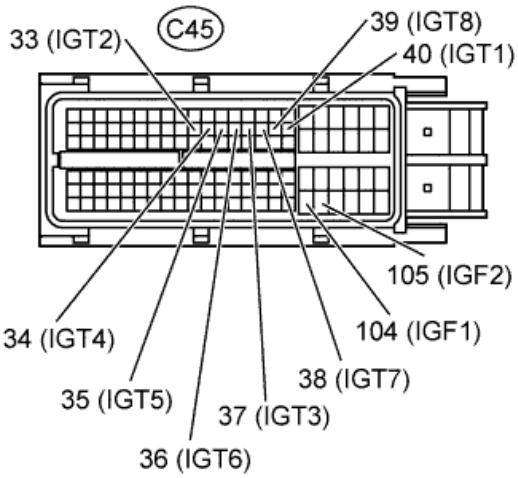
Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C15-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C45-40 (IGT1)	Always	Below 1 Ω

C15-3 (IGT2) - C45-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C45-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C45-34 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C45-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C45-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C45-38 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C45-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C45-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C45-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C45-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C45-34 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C45-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C45-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C45-38 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C45-39 (IGT8) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Ignition Coil with Igniter)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353, P0354, P0355, P0356, P0357 OR P0358)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Shuffle the arrangement of the ignition coils (among No. 1 to No. 8 cylinders).

NOTICE:

Do not shuffle the connectors.

e. Perform a simulation test.

f. Check DTCs displayed on the tester.

Result

Result	Proceed to
Same DTC is output	A
Different ignition coil DTC is output	B

B → REPLACE IGNITION COIL ASSEMBLY (Click here)

A → REPLACE ECM (Click here)

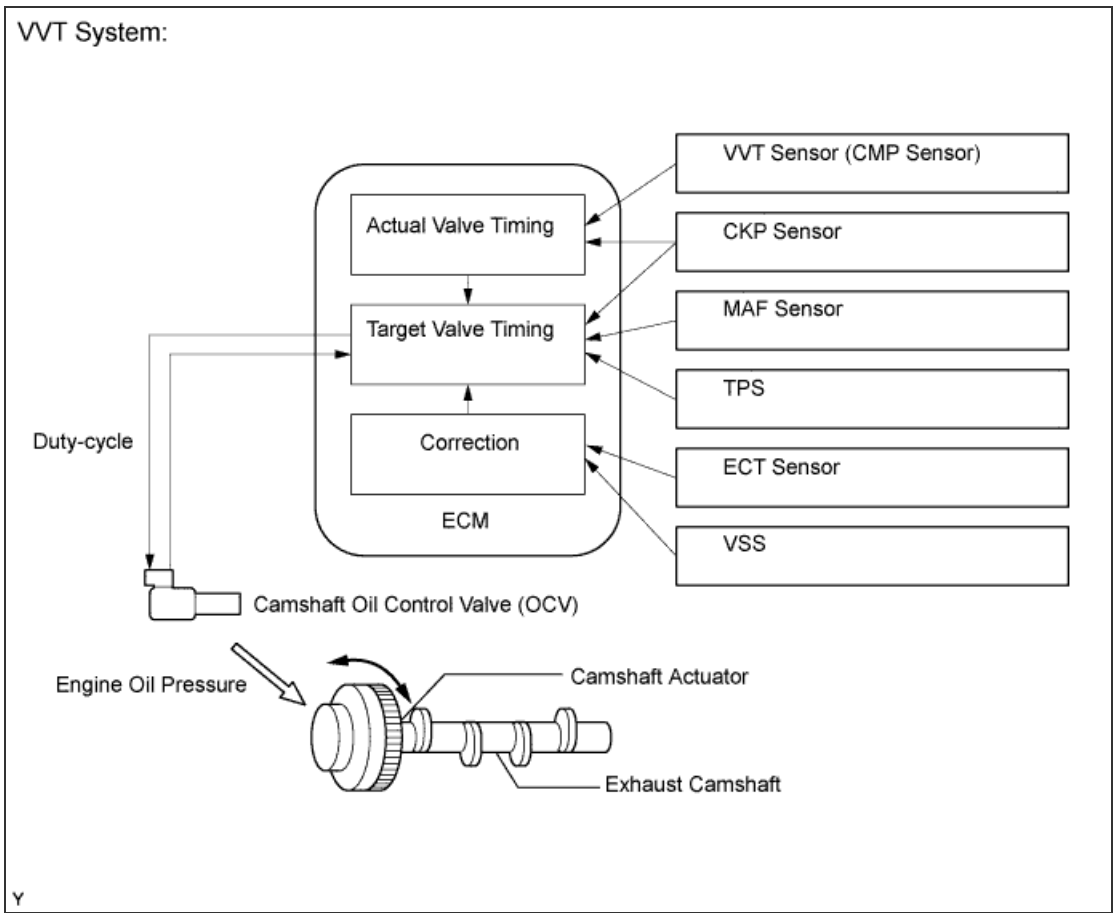
DTC P0013 Camshaft Position "B" Actuator Circuit / Open (Bank 1)

DTC P0023 Camshaft Position "B" Actuator Circuit / Open (Bank 2)

for Preparation Click here

DESCRIPTION

- This DTC is designed to detect opens or shorts in the Camshaft Oil Control Valve (OCV) circuit. If the OCV duty-cycle is excessively high or low while the engine is running, the ECM will illuminate the MIL and store the DTC.
- The VVT (variable valve timing) system adjusts the intake valve timing to improve the driveability. The engine oil pressure turns the camshaft actuator to adjust the valve timing. The OCV is a solenoid valve and switches the engine oil line. The valve moves when the ECM applies 12 volts to the solenoid. The ECM changes the energizing time to the solenoid (duty-cycle) in accordance with the camshaft position, crankshaft position, throttle position, etc.

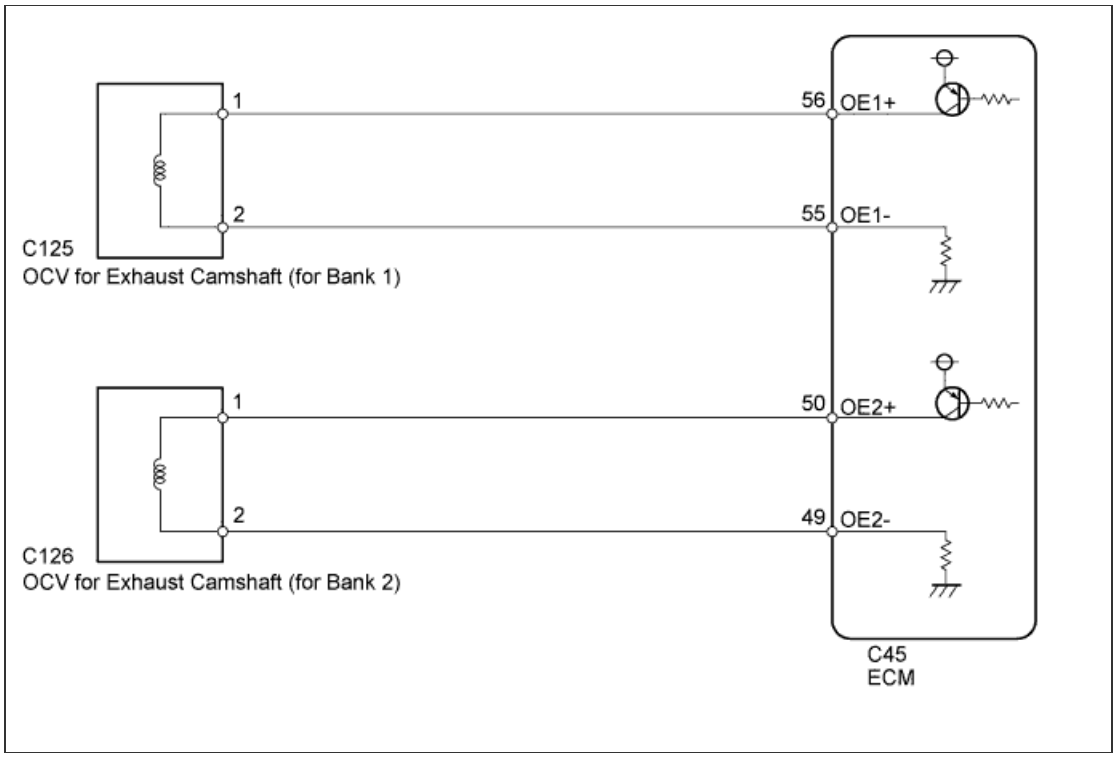


DTC Code	DTC Detection Condition	Trouble Area
P0013	An open or short in the Camshaft Oil Control Valve (OCV) for exhaust side (for Bank 1) circuit (1 trip detection logic).	• Open or short in Camshaft Oil Control Valve (OCV) (for exhaust side of Bank 1) circuit • OCV (for exhaust side of Bank 1) • ECM
P0023	An open or short in the OCV for exhaust side (for Bank 2) circuit (1 trip detection logic).	• Open or short in OCV (for exhaust side of Bank 2) circuit • OCV (for exhaust side of Bank 2) • ECM

MONITOR DESCRIPTION

This DTC is designed to detect opens or shorts in the camshaft oil control valve (OCV) circuit. If the OCV duty-cycle is excessively high or low while the engine is running, the ECM will illuminate the MIL and store the DTC.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **If DTC P0013 is output, check the bank 1 VVT system for exhaust side circuit.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **If DTC P0023 is output, check the bank 2 VVT system for exhaust side circuit.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK DTC (DTC P0013 OR P0023)

a. Connect the intelligent tester to the DLC3.

b. Clear DTC after recording the freeze frame data and DTC.

c. Turn the engine switch off.

d. Allow the engine to idle and check DTC.

e. Check that P0013 or P0023 is not output.

OK:
P0013 or P0023 is not output.

NG → **Go to step 2**

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

2.INSPECT CAMSHAFT OIL CONTROL VALVE ASSEMBLY

a. Disconnect the C125 or C126 OCV connector.

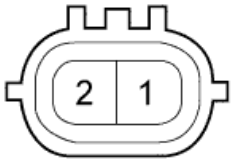
b. Remove the camshaft oil control valve (OCV) (Click here).

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

Component without harness connected:
(Oil Control Valve)



NG → REPLACE CAMSHAFT OIL CONTROL VALVE ASSEMBLY (Click here)

OK →

3.CHECK HARNESS AND CONNECTOR (OCV - ECM)

a. Disconnect the C125 or C126 OCV connector.

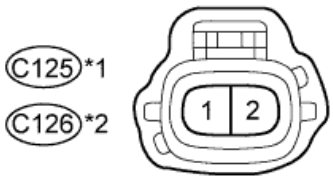
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

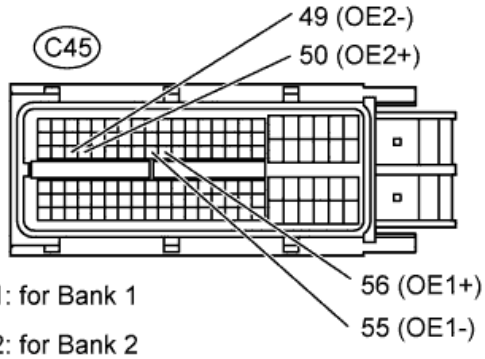
Standard Resistance:

Tester Connection	Condition	Specified Condition
C125-1 - C45-56 (OE1+)	Always	Below 1 Ω
C125-2 - C45-55 (OE1-)	Always	Below 1 Ω
C126-1 - C45-50 (OE2+)	Always	Below 1 Ω
C126-2 - C45-49 (OE2-)	Always	Below 1 Ω
C125-1 or C45-56 (OE1+) - Body ground	Always	10 kΩ or higher
C125-2 or C45-55 (OE1-) - Body ground	Always	10 kΩ or higher
C126-1 or C45-50 (OE2+) - Body ground	Always	10 kΩ or higher
C126-2 or C45-49 (OE2-) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Oil Control Valve)



Front view of wire harness connector:
(to ECM)



*1: for Bank 1

*2: for Bank 2

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK →

REPLACE ECM (Click here)

DTC P0351 Ignition Coil "A" Primary / Secondary Circuit

DTC P0352 Ignition Coil "B" Primary / Secondary Circuit

DTC P0353 Ignition Coil "C" Primary / Secondary Circuit

DTC P0354 Ignition Coil "D" Primary / Secondary Circuit

DTC P0355 Ignition Coil "E" Primary / Secondary Circuit

DTC P0356 Ignition Coil "F" Primary / Secondary Circuit

DTC P0357 Ignition Coil "G" Primary / Secondary Circuit

DTC P0358 Ignition Coil "H" Primary / Secondary Circuit

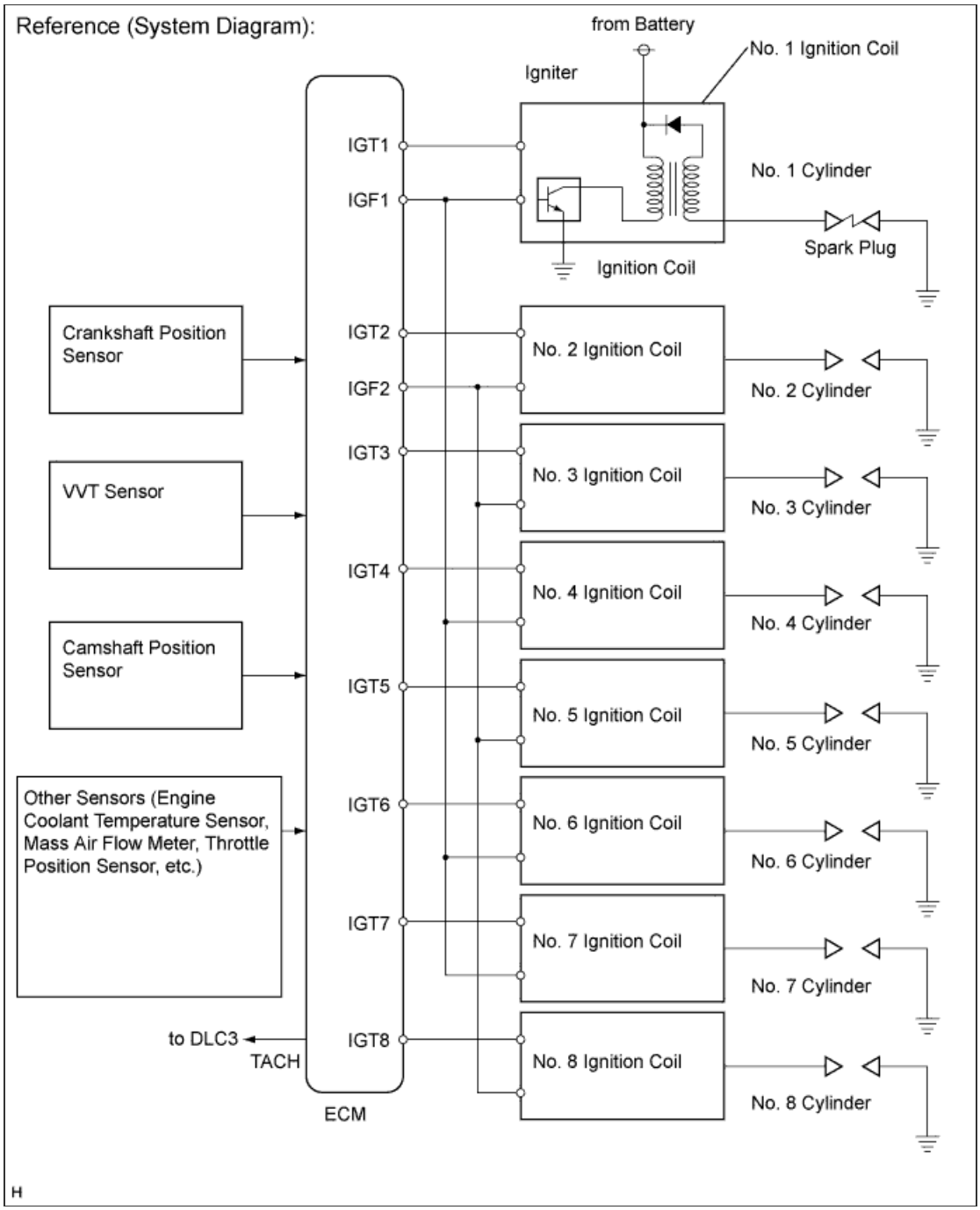
for Preparation Click here

DESCRIPTION

HINT:

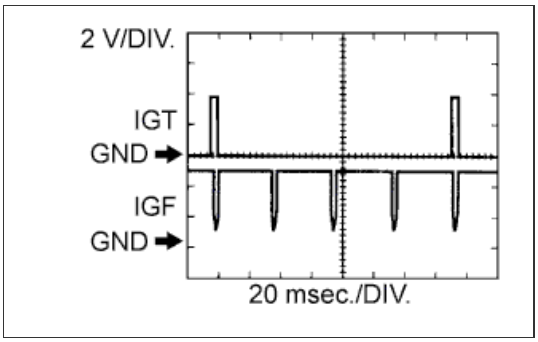
- **These DTCs indicate malfunctions relating to the primary circuit.**
- **If DTC P0351 is output, check the No. 1 ignition coil circuit.**
- **If DTC P0352 is output, check the No. 2 ignition coil circuit.**
- **If DTC P0353 is output, check the No. 3 ignition coil circuit.**
- **If DTC P0354 is output, check the No. 4 ignition coil circuit.**
- **If DTC P0355 is output, check the No. 5 ignition coil circuit.**
- **If DTC P0356 is output, check the No. 6 ignition coil circuit.**
- **If DTC P0357 is output, check the No. 7 ignition coil circuit.**
- **If DTC P0358 is output, check the No. 8 ignition coil circuit.**

A Direct Ignition System (DIS) is used on this vehicle.
The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.
The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.



DTC Code	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356 P0357 P0358	No IGF signal is sent to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 8) between ignition coil and ECM • No. 1 to No. 8 ignition coils • ECM

Reference: Inspection using an oscilloscope.



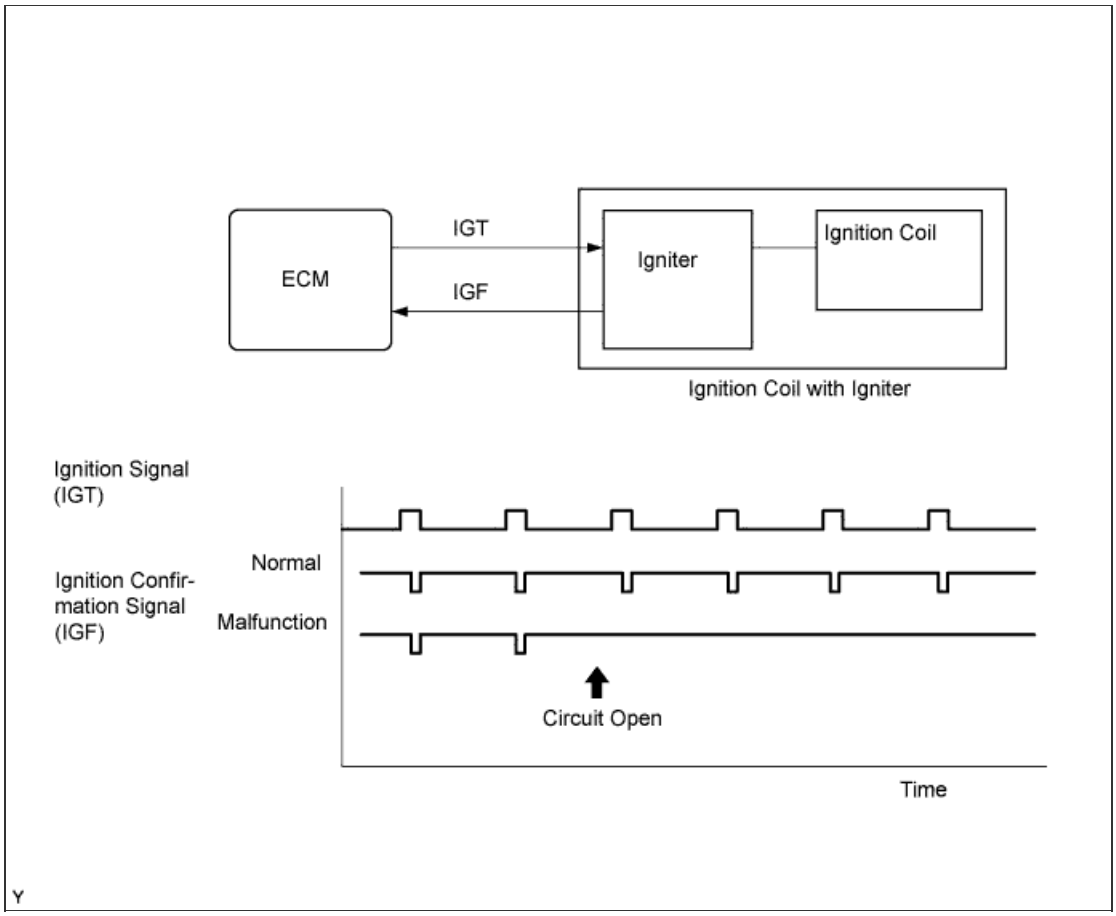
Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-40 (IGT1) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-33 (IGT2) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-37 (IGT3) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-34 (IGT4) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-35 (IGT5) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-36 (IGT6) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-38 (IGT7) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-39 (IGT8) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-104 (IGF1) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-105 (IGF2) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown

HINT:

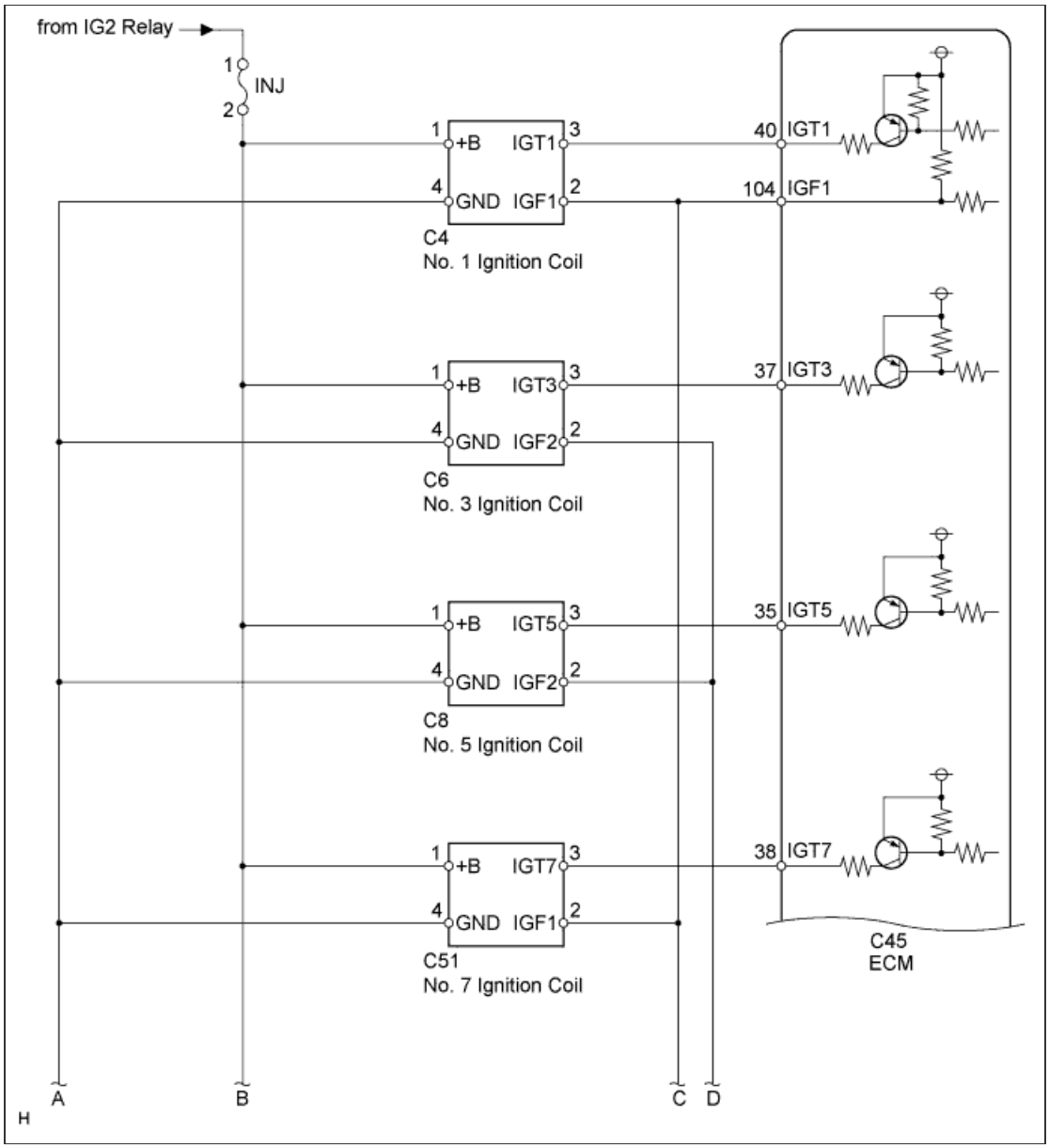
While cranking or idling the engine, check the waveform between terminals IGT (1 to 8) and E1, and IGF1 or IGF2 and E1 of the ECM connector.

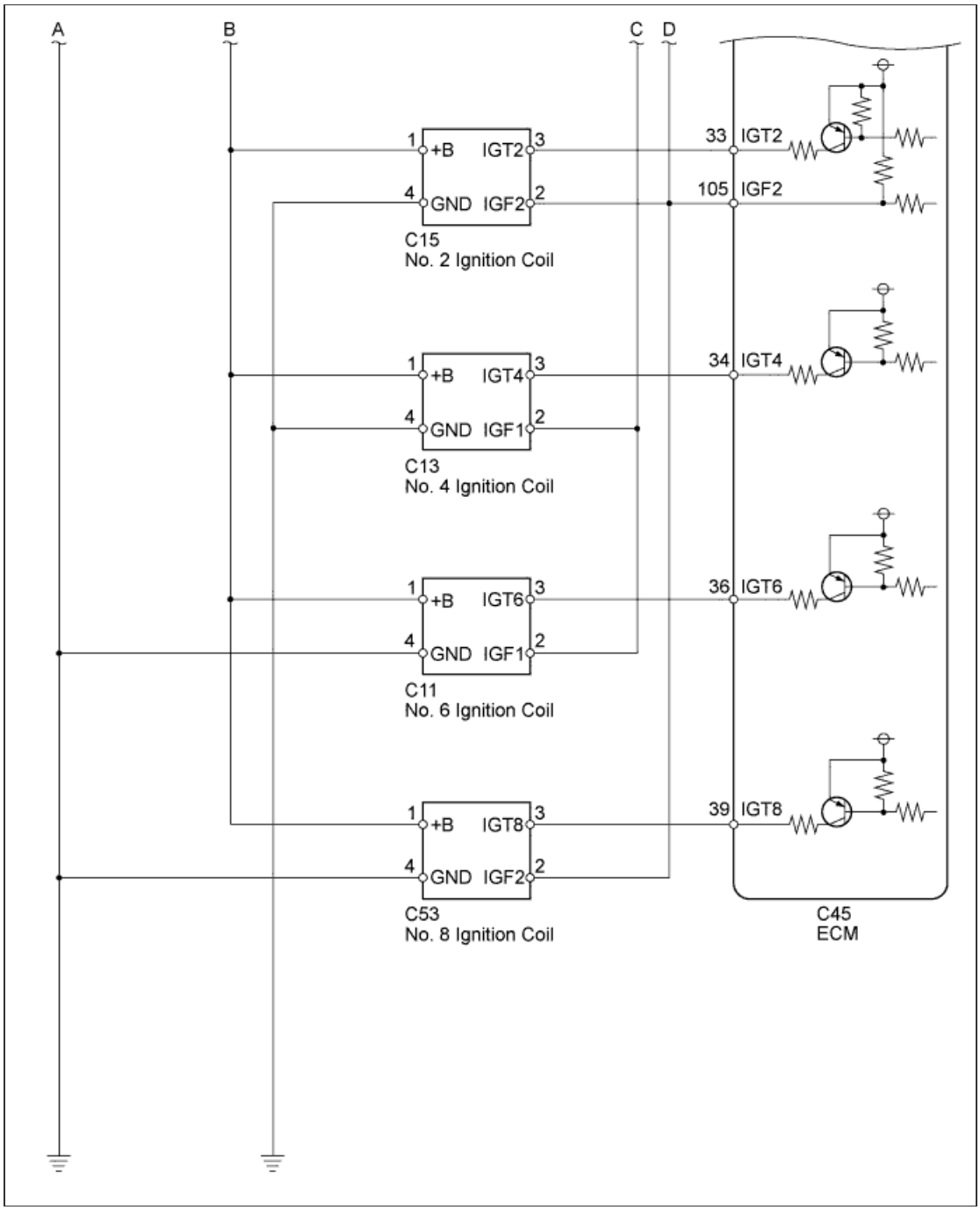
MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores DTC(s).
If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

WIRING DIAGRAM


from IG2 Relay
1
INJ
2
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
38
IGT7
C45
ECM
A
B
C
D
H



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)

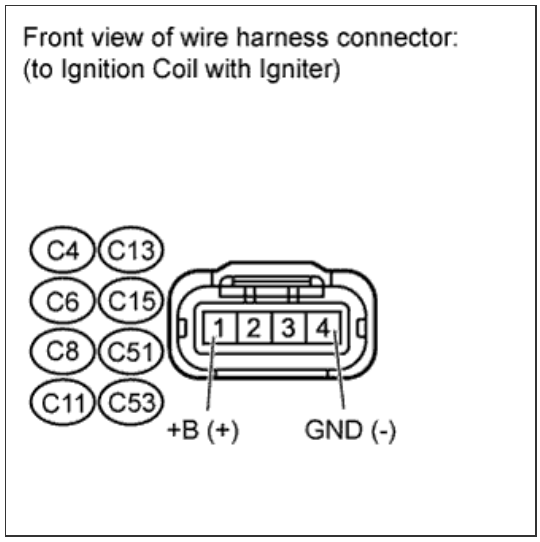
a. Disconnect the C4, C6, C8, C11, C13, C15, C51 or C53 ignition coil connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C4-4 (GND) - Body ground	Always	Below 1 Ω
C15-4 (GND) - Body ground	Always	Below 1 Ω
C6-4 (GND) - Body ground	Always	Below 1 Ω

C13-4 (GND) - Body ground	Always	Below 1 Ω
C8-4 (GND) - Body ground	Always	Below 1 Ω
C11-4 (GND) - Body ground	Always	Below 1 Ω
C51-4 (GND) - Body ground	Always	Below 1 Ω
C53-4 (GND) - Body ground	Always	Below 1 Ω



c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C4-1 (+B) - C4-4 (GND)	Engine switch on (IG)	11 to 14 V
C15-1 (+B) - C15-4 (GND)	Engine switch on (IG)	11 to 14 V
C6-1 (+B) - C6-4 (GND)	Engine switch on (IG)	11 to 14 V
C13-1 (+B) - C13-4 (GND)	Engine switch on (IG)	11 to 14 V
C8-1 (+B) - C8-4 (GND)	Engine switch on (IG)	11 to 14 V
C11-1 (+B) - C11-4 (GND)	Engine switch on (IG)	11 to 14 V
C51-1 (+B) - C51-4 (GND)	Engine switch on (IG)	11 to 14 V
C53-1 (+B) - C53-4 (GND)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

a. Disconnect the C4, C6, C8, C11, C13, C15, C51 or C53 ignition coil connector.

b. Disconnect the C45 ECM connector.

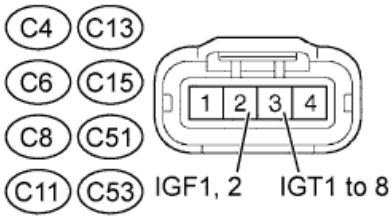
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

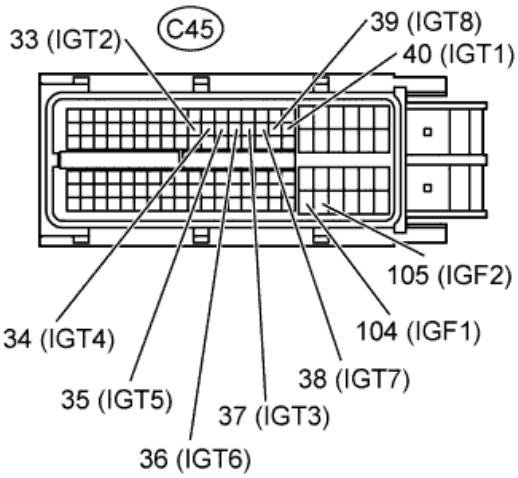
Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C15-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C45-40 (IGT1)	Always	Below 1 Ω

C15-3 (IGT2) - C45-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C45-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C45-34 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C45-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C45-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C45-38 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C45-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C45-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C45-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C45-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C45-34 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C45-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C45-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C45-38 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C45-39 (IGT8) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Ignition Coil with Igniter)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353, P0354, P0355, P0356, P0357 OR P0358)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Shuffle the arrangement of the ignition coils (among No. 1 to No. 8 cylinders).

NOTICE:

Do not shuffle the connectors.

e. Perform a simulation test.

f. Check DTCs displayed on the tester.

Result

Result	Proceed to
Same DTC is output	A
Different ignition coil DTC is output	B

B → REPLACE IGNITION COIL ASSEMBLY (Click here)

A → REPLACE ECM (Click here)

DTC P0014 Camshaft Position "B" - Timing Over-Advanced or System Performance (Bank 1)

DTC P0015 Camshaft Position "B" - Timing Over-Retarded (Bank 1)

DTC P0024 Camshaft Position "B" - Timing Over-Advanced or System Performance (Bank 2)

DTC P0025 Camshaft Position "B" - Timing Over-Retarded (Bank 2)

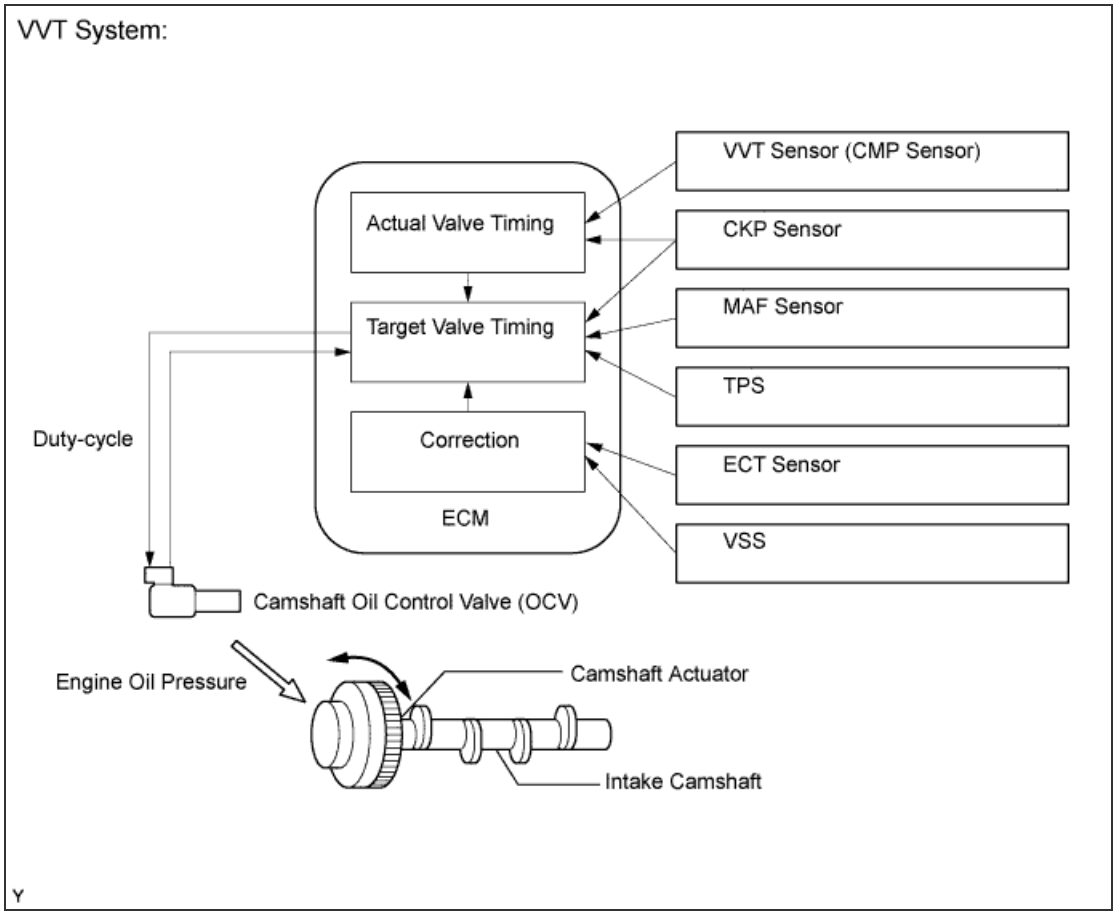
for Preparation Click here

DESCRIPTION

HINT:

If DTC P0014, P0015, P0024 or P0025 is output, check the VVT (Variable Valve Timing) system.

The Variable Valve Timing (VVT) system includes the ECM, OCV and VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. Camshaft timing control is performed according to engine operating conditions such as the intake air volume, throttle valve position and engine coolant temperature. The ECM controls the OCV based on the signals transmitted by several sensors. The VVT controller regulates the exhaust camshaft angle using oil pressure through the OCV. As a result, the relative positions of the camshaft and crankshaft are optimized, the engine torque and fuel economy improve, and the exhaust emissions decrease under overall driving conditions. The ECM detects the actual exhaust valve timing using signals from the camshaft and crankshaft position sensors, and performs feedback control. This is how the target exhaust valve timing is verified by the ECM.



DTC Code	DTC Detection Condition	Trouble Area
P0014 P0024	The exhaust valve timing is not adjusted in the valve timing advance range (2 trip detection logic).	• Valve timing • Camshaft Oil Control Valve (OCV) (for exhaust side of Bank 1, 2) • OCV filter • Camshaft timing exhaust gear • ECM
P0015 P0025	The exhaust valve timing is not adjusted in the valve timing retard range (1 trip detection logic).	• Valve timing • OCV (for exhaust side of Bank 1, 2) • OCV filter • Camshaft timing exhaust gear • ECM

MONITOR DESCRIPTION

1. The ECM optimizes the exhaust valve timing using the VVT (Variable Valve Timing) system to control the exhaust camshaft. The VVT system includes the ECM, Camshaft Oil Control Valve (OCV) and VVT controller.
2. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the exhaust camshaft.
   If the difference between the target and actual exhaust valve timing is large, and changes in actual exhaust valve timing are small, the ECM interprets this as the VVT controller stuck malfunction and stores DTC(s).
   Example:
   A DTC is stored when the following conditions 1 and 2 are met for 10 seconds or more:
   1. It takes 5 seconds or more to change the valve timing by 5°CA.
   2. After the above condition 1 is met, the camshaft timing oil control valve is forcibly activated during 10 seconds.
3. DTCs P0014 and P0024 (Advanced Cam Timing) are subject to 2 trip detection logic.
4. DTCs P0015 and P0025 (Retarded Cam Timing) are subject to 1 trip detection logic.
   These DTCs indicate that the VVT controller cannot operate properly due to OCV malfunctions or the presence of foreign objects in the OCV.
5. The monitor will not run unless the following conditions are met:
   1. The engine is warm (the engine coolant temperature is 75°C [167°F] or higher).
   2. The vehicle has been driven at more than 64 km/h (40 mph) for 3 minutes.
   3. The engine has idled for 3 minutes.

WIRING DIAGRAM

Refer to DTC P0013 (Click here).

INSPECTION PROCEDURE

HINT:

Abnormal Bank	Advanced Timing Over (Valve Timing is Out of Specified Range)	Retarded Timing Over (Valve Timing is Out of Specified Range)
Bank 1	P0014	P0015
Bank 2	P0024	P0025

- **If DTC P0014 or P0015 is output, check the bank 1 VVT system for exhaust side circuit.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **If DTC P0024 or P0025 is output, check the bank 2 VVT system for exhaust side circuit.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0014, P0015, P0024 OR P0025)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0014, P0015, P0024 or P0025	A
P0014, P0015, P0024 or P0025 and other DTCs	B

HINT:

If any DTCs other than P0014, P0015, P0024 or P0025 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)

a. Connect the intelligent tester to the DLC3.

b. Turn the tester on.

c. Warm up the engine.

d. Turn the A/C on.

e. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT Exhaust Linear (Bank 1) or Control the VVT Exhaust Linear (Bank 2).

f. Check the engine speed while operating the camshaft timing oil control valve using the tester.

OK:

Operation	Specified Condition
0%	Normal engine speed
100%	Engine idles roughly or stalls

HINT:

Refer to "Data List / Active Test" [VVT Ex OCV Duty #1, VVT Ex Chg Angle #1, VVT Ex OCV Duty #2 and VVT Ex Chg Angle #2] (Click here).

NG → **Go to step 4**

OK ↓

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0014, P0015, P0024 OR P0025)

a. Connect the intelligent tester to the DLC3.

b. Turn the tester on.

c. Clear the DTCs (Click here).

d. Warm up the engine.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. With the engine warmed up, idle it for 1 minute. Then drive the vehicle for 5 minutes.

g. Read DTCs using the tester.

OK:

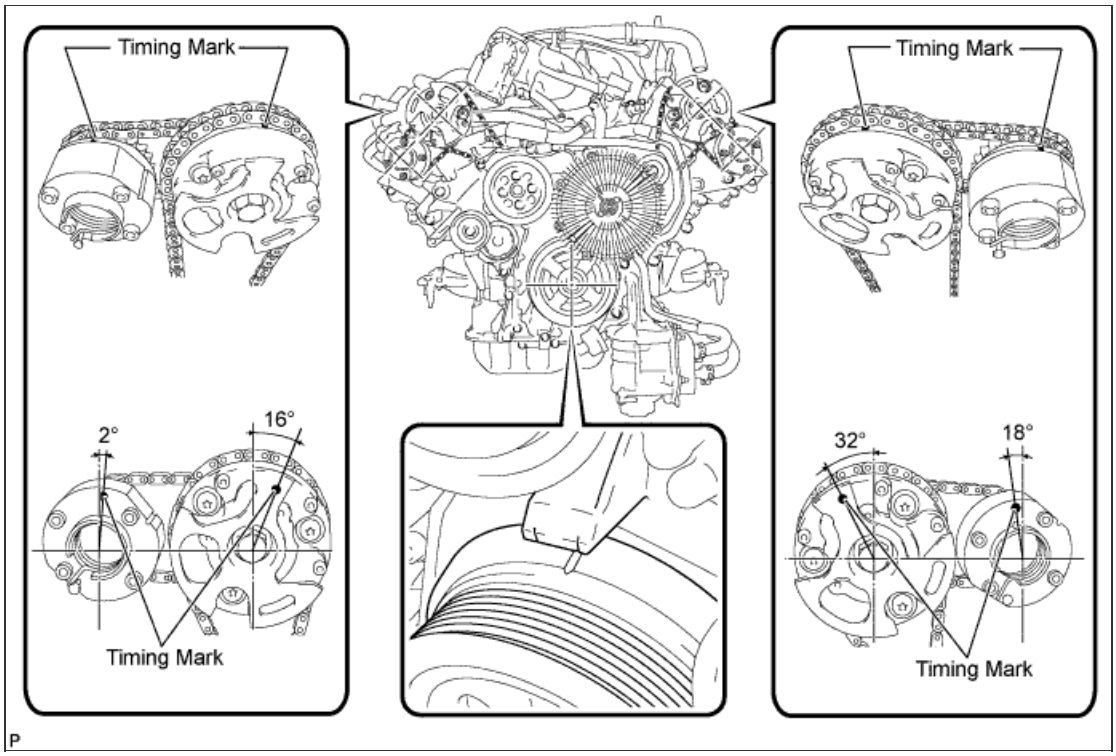
No DTC output.

NG → **Go to step 4**

OK ↓

CHECK FOR INTERMITTENT PROBLEMS (Click here)

4.CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMPED TEETH ON TIMING CHAIN)



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:

Timing marks on camshaft timing gears are aligned as shown in the illustration.

NG → **ADJUST VALVE TIMING (Click here)**

OK

5.INSPECT CAMSHAFT OIL CONTROL VALVE ASSEMBLY (OCV FOR EXHAUST CAMSHAFT)

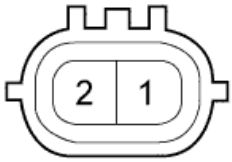
a. Remove the OCV (Click here).

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

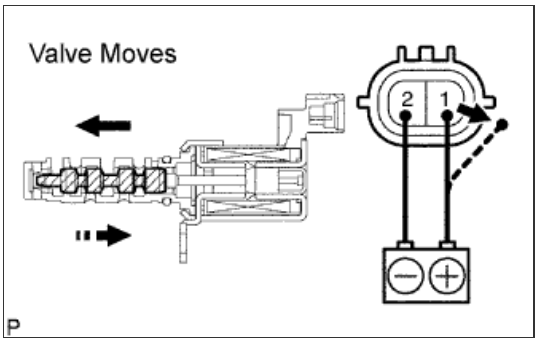
Component without harness connected:
(Oil Control Valve)



c. Check the valve operation.

OK:

Measurement Condition	Specified Condition
No battery voltage applied to terminals 1 and 2 → Battery voltage applied to terminals 1 and 2	Valve moves quickly



NG → REPLACE CAMSHAFT OIL CONTROL VALVE ASSEMBLY (Click here)

OK

6.INSPECT OIL CONTROL VALVE FILTER

a. Remove the oil control valve filter (Click here).

b. Check that the filter is not clogged.

OK:
Filter is not clogged.

NG → CLEAN OIL CONTROL VALVE FILTER

OK

7.REPLACE CAMSHAFT TIMING EXHAUST GEAR

a. Replace the camshaft timing exhaust gear (Click here).

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the tester on.

c. Clear the DTCs (Click here).

d. Warm up the engine.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. With the engine warmed up, idle it for 1 minute. Then drive the vehicle for 5 minutes.

g. Read the output DTCs using the tester.

OK:
No DTC output.

HINT:

DTC P0014, P0015, P0024 or P0025 is output when foreign objects in the engine oil are caught in some parts of the system. These codes will stay stored even if the system returns to normal after a short time. These foreign objects are then captured by the oil filter, thus eliminating the source of the problem.

NG → REPLACE ECM (Click here)

OK

SYSTEM IS OK

DTC P0351 Ignition Coil "A" Primary / Secondary Circuit

DTC P0352 Ignition Coil "B" Primary / Secondary Circuit

DTC P0353 Ignition Coil "C" Primary / Secondary Circuit

DTC P0354 Ignition Coil "D" Primary / Secondary Circuit

DTC P0355 Ignition Coil "E" Primary / Secondary Circuit

DTC P0356 Ignition Coil "F" Primary / Secondary Circuit

DTC P0357 Ignition Coil "G" Primary / Secondary Circuit

DTC P0358 Ignition Coil "H" Primary / Secondary Circuit

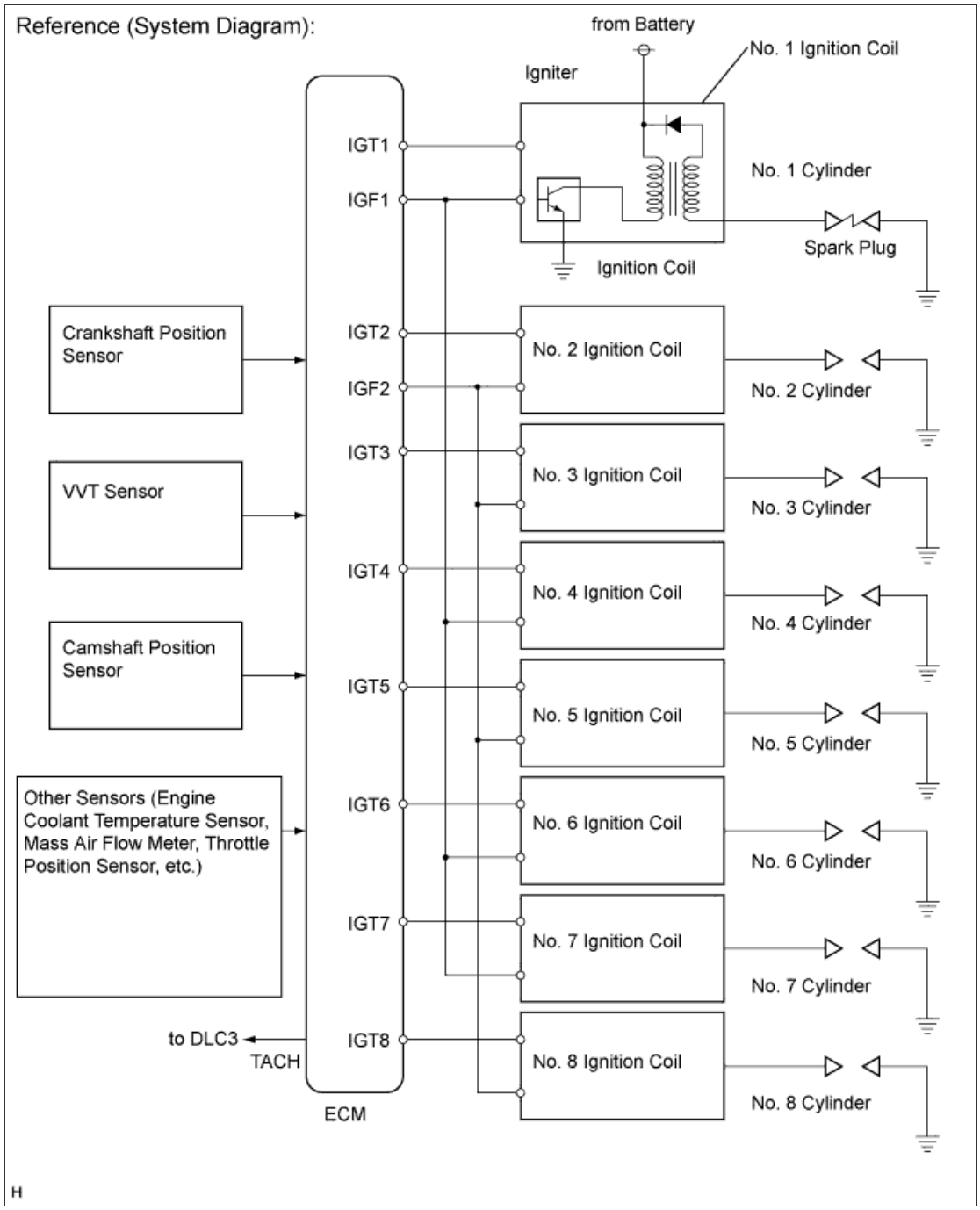
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DESCRIPTION

HINT:

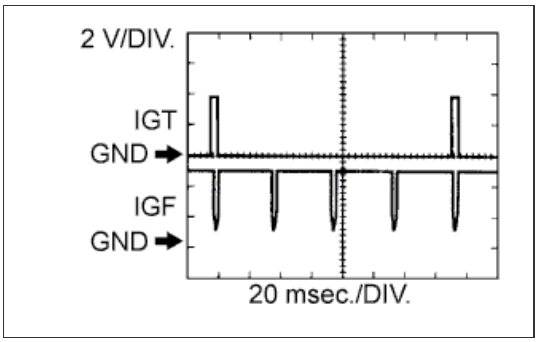
- **These DTCs indicate malfunctions relating to the primary circuit.**
- **If DTC P0351 is output, check the No. 1 ignition coil circuit.**
- **If DTC P0352 is output, check the No. 2 ignition coil circuit.**
- **If DTC P0353 is output, check the No. 3 ignition coil circuit.**
- **If DTC P0354 is output, check the No. 4 ignition coil circuit.**
- **If DTC P0355 is output, check the No. 5 ignition coil circuit.**
- **If DTC P0356 is output, check the No. 6 ignition coil circuit.**
- **If DTC P0357 is output, check the No. 7 ignition coil circuit.**
- **If DTC P0358 is output, check the No. 8 ignition coil circuit.**

A Direct Ignition System (DIS) is used on this vehicle.
The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.
The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.



DTC Code	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356 P0357 P0358	No IGF signal is sent to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 8) between ignition coil and ECM • No. 1 to No. 8 ignition coils • ECM

Reference: Inspection using an oscilloscope.



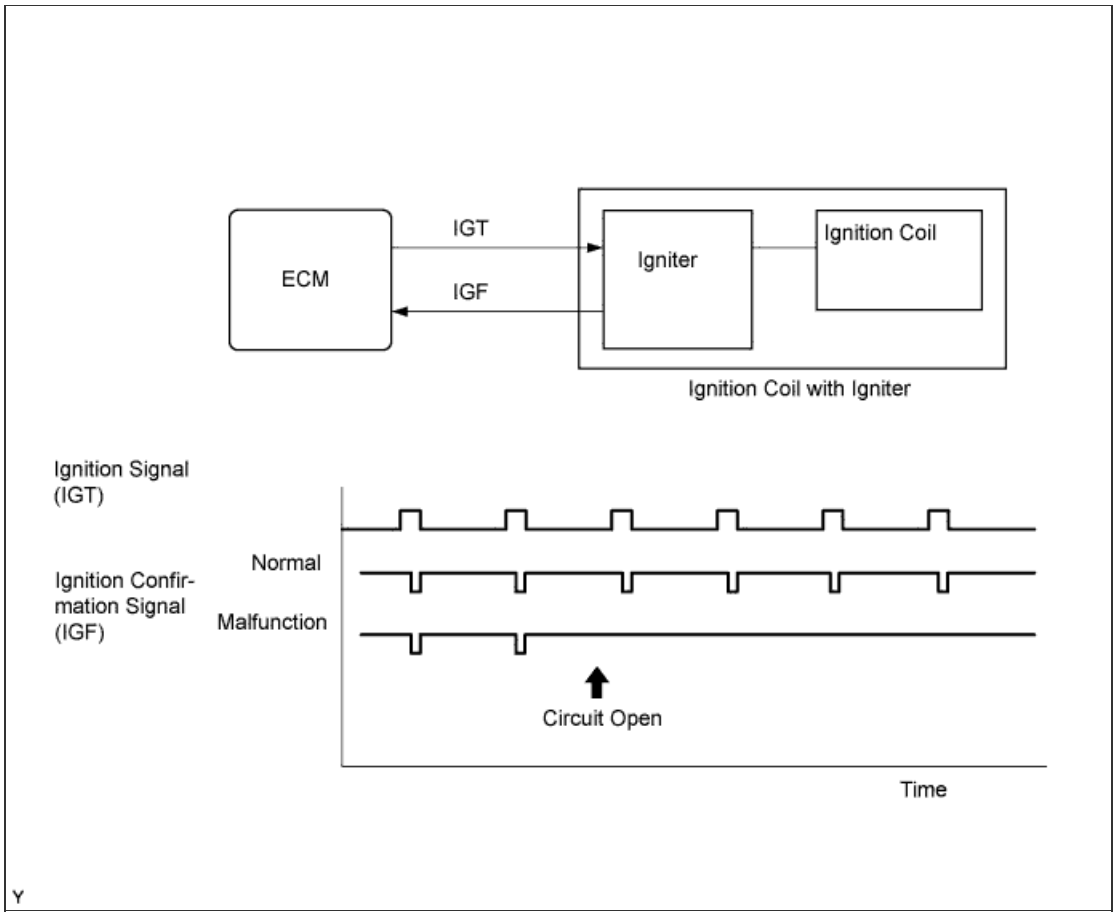
Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-40 (IGT1) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-33 (IGT2) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-37 (IGT3) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-34 (IGT4) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-35 (IGT5) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-36 (IGT6) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-38 (IGT7) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-39 (IGT8) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-104 (IGF1) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-105 (IGF2) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown

HINT:

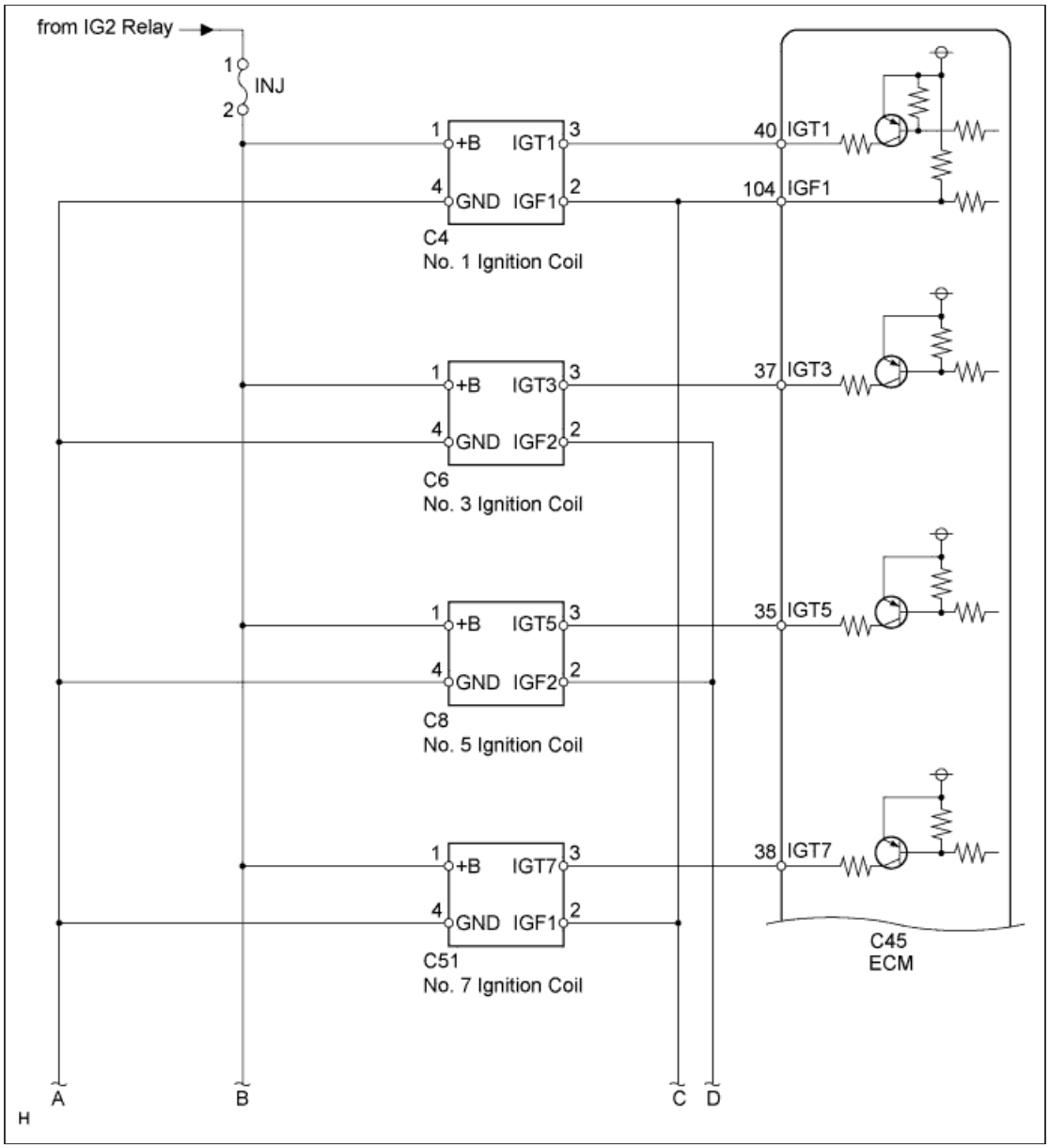
While cranking or idling the engine, check the waveform between terminals IGT (1 to 8) and E1, and IGF1 or IGF2 and E1 of the ECM connector.

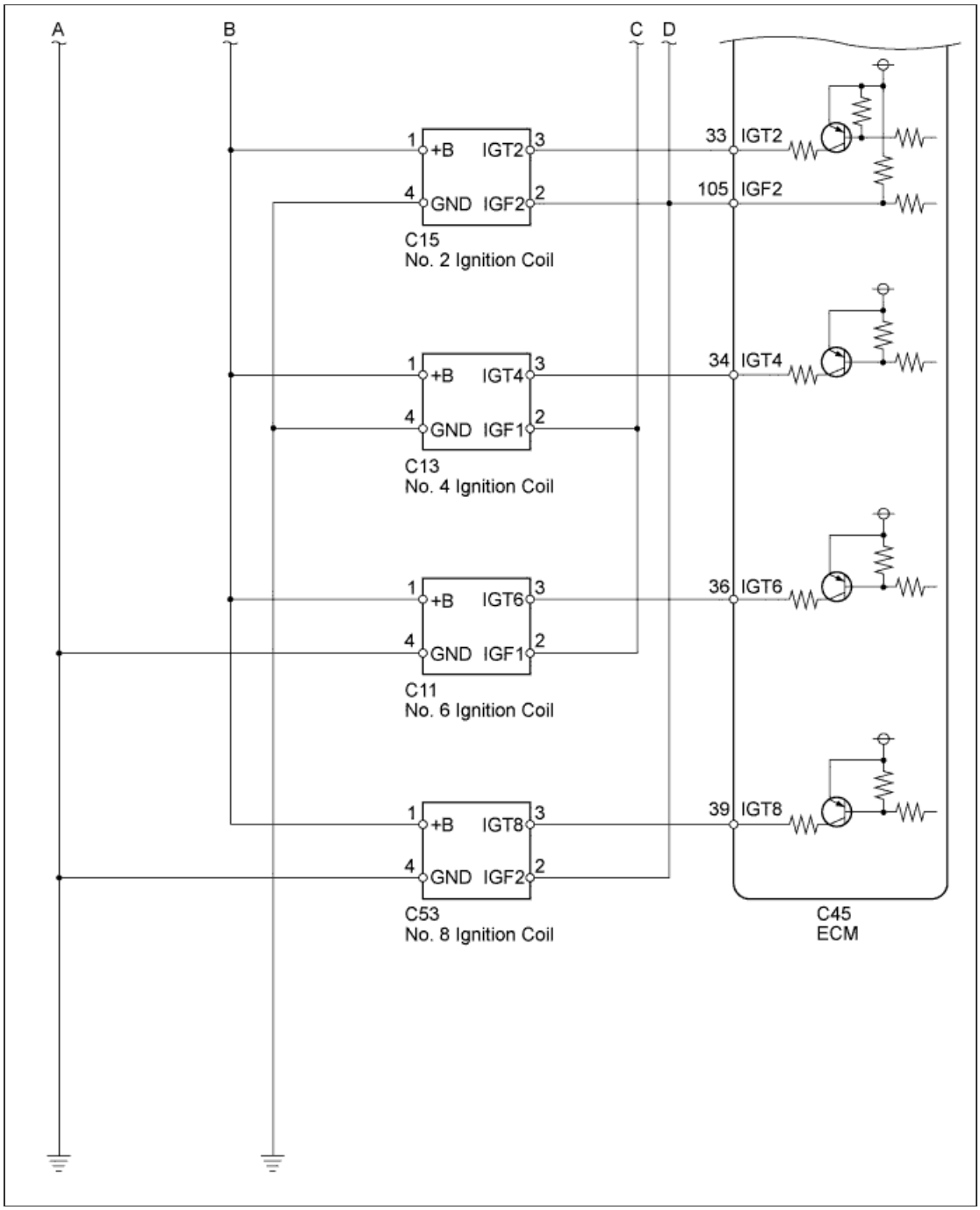
MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores DTC(s).
If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

WIRING DIAGRAM


from IG2 Relay
1
INJ
2
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
38
IGT7
C45
ECM
A
B
C
D
H



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)

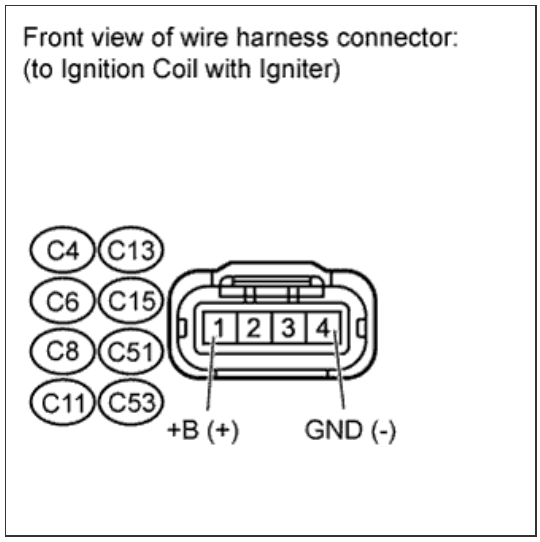
a. Disconnect the C4, C6, C8, C11, C13, C15, C51 or C53 ignition coil connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C4-4 (GND) - Body ground	Always	Below 1 Ω
C15-4 (GND) - Body ground	Always	Below 1 Ω
C6-4 (GND) - Body ground	Always	Below 1 Ω

C13-4 (GND) - Body ground	Always	Below 1 Ω
C8-4 (GND) - Body ground	Always	Below 1 Ω
C11-4 (GND) - Body ground	Always	Below 1 Ω
C51-4 (GND) - Body ground	Always	Below 1 Ω
C53-4 (GND) - Body ground	Always	Below 1 Ω



c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C4-1 (+B) - C4-4 (GND)	Engine switch on (IG)	11 to 14 V
C15-1 (+B) - C15-4 (GND)	Engine switch on (IG)	11 to 14 V
C6-1 (+B) - C6-4 (GND)	Engine switch on (IG)	11 to 14 V
C13-1 (+B) - C13-4 (GND)	Engine switch on (IG)	11 to 14 V
C8-1 (+B) - C8-4 (GND)	Engine switch on (IG)	11 to 14 V
C11-1 (+B) - C11-4 (GND)	Engine switch on (IG)	11 to 14 V
C51-1 (+B) - C51-4 (GND)	Engine switch on (IG)	11 to 14 V
C53-1 (+B) - C53-4 (GND)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

a. Disconnect the C4, C6, C8, C11, C13, C15, C51 or C53 ignition coil connector.

b. Disconnect the C45 ECM connector.

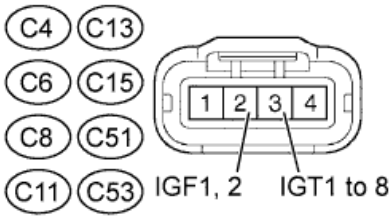
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

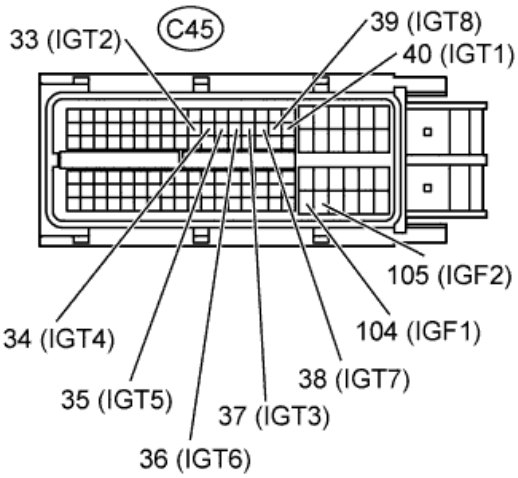
Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C15-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C45-40 (IGT1)	Always	Below 1 Ω

C15-3 (IGT2) - C45-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C45-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C45-34 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C45-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C45-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C45-38 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C45-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C45-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C45-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C45-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C45-34 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C45-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C45-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C45-38 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C45-39 (IGT8) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Ignition Coil with Igniter)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353, P0354, P0355, P0356, P0357 OR P0358)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Shuffle the arrangement of the ignition coils (among No. 1 to No. 8 cylinders).

NOTICE:

Do not shuffle the connectors.

e. Perform a simulation test.

f. Check DTCs displayed on the tester.

Result

Result	Proceed to
Same DTC is output	A
Different ignition coil DTC is output	B

B → REPLACE IGNITION COIL ASSEMBLY (Click here)

A → REPLACE ECM (Click here)

DTC P0014 Camshaft Position "B" - Timing Over-Advanced or System Performance (Bank 1)

DTC P0015 Camshaft Position "B" - Timing Over-Retarded (Bank 1)

DTC P0024 Camshaft Position "B" - Timing Over-Advanced or System Performance (Bank 2)

DTC P0025 Camshaft Position "B" - Timing Over-Retarded (Bank 2)

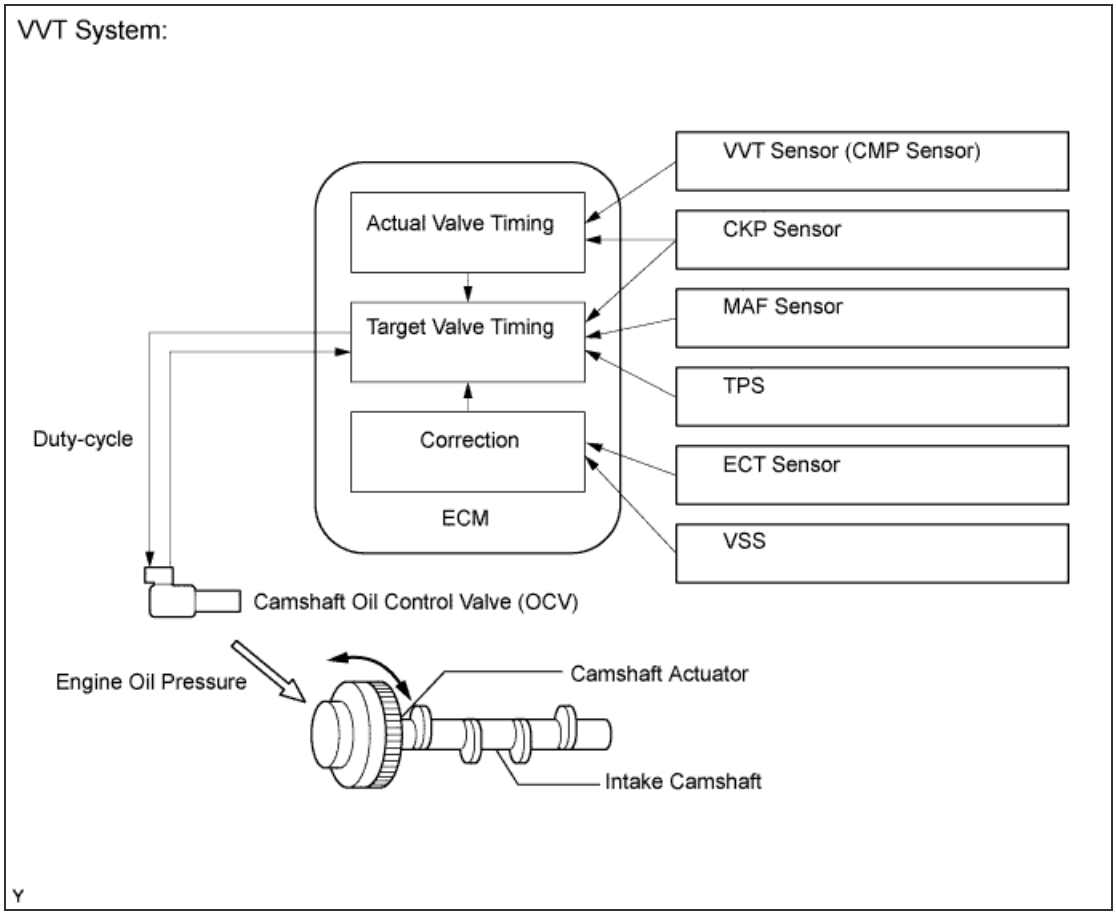
for Preparation Click here

DESCRIPTION

HINT:

If DTC P0014, P0015, P0024 or P0025 is output, check the VVT (Variable Valve Timing) system.

The Variable Valve Timing (VVT) system includes the ECM, OCV and VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. Camshaft timing control is performed according to engine operating conditions such as the intake air volume, throttle valve position and engine coolant temperature. The ECM controls the OCV based on the signals transmitted by several sensors. The VVT controller regulates the exhaust camshaft angle using oil pressure through the OCV. As a result, the relative positions of the camshaft and crankshaft are optimized, the engine torque and fuel economy improve, and the exhaust emissions decrease under overall driving conditions. The ECM detects the actual exhaust valve timing using signals from the camshaft and crankshaft position sensors, and performs feedback control. This is how the target exhaust valve timing is verified by the ECM.



DTC Code	DTC Detection Condition	Trouble Area
P0014 P0024	The exhaust valve timing is not adjusted in the valve timing advance range (2 trip detection logic).	• Valve timing • Camshaft Oil Control Valve (OCV) (for exhaust side of Bank 1, 2) • OCV filter • Camshaft timing exhaust gear • ECM
P0015 P0025	The exhaust valve timing is not adjusted in the valve timing retard range (1 trip detection logic).	• Valve timing • OCV (for exhaust side of Bank 1, 2) • OCV filter • Camshaft timing exhaust gear • ECM

MONITOR DESCRIPTION

1. The ECM optimizes the exhaust valve timing using the VVT (Variable Valve Timing) system to control the exhaust camshaft. The VVT system includes the ECM, Camshaft Oil Control Valve (OCV) and VVT controller.
2. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the exhaust camshaft.
   If the difference between the target and actual exhaust valve timing is large, and changes in actual exhaust valve timing are small, the ECM interprets this as the VVT controller stuck malfunction and stores DTC(s).
   Example:
   A DTC is stored when the following conditions 1 and 2 are met for 10 seconds or more:
   1. It takes 5 seconds or more to change the valve timing by 5°CA.
   2. After the above condition 1 is met, the camshaft timing oil control valve is forcibly activated during 10 seconds.
3. DTCs P0014 and P0024 (Advanced Cam Timing) are subject to 2 trip detection logic.
4. DTCs P0015 and P0025 (Retarded Cam Timing) are subject to 1 trip detection logic.
   These DTCs indicate that the VVT controller cannot operate properly due to OCV malfunctions or the presence of foreign objects in the OCV.
5. The monitor will not run unless the following conditions are met:
   1. The engine is warm (the engine coolant temperature is 75°C [167°F] or higher).
   2. The vehicle has been driven at more than 64 km/h (40 mph) for 3 minutes.
   3. The engine has idled for 3 minutes.

WIRING DIAGRAM

Refer to DTC P0013 (Click here).

INSPECTION PROCEDURE

HINT:

Abnormal Bank	Advanced Timing Over (Valve Timing is Out of Specified Range)	Retarded Timing Over (Valve Timing is Out of Specified Range)
Bank 1	P0014	P0015
Bank 2	P0024	P0025

- **If DTC P0014 or P0015 is output, check the bank 1 VVT system for exhaust side circuit.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **If DTC P0024 or P0025 is output, check the bank 2 VVT system for exhaust side circuit.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0014, P0015, P0024 OR P0025)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0014, P0015, P0024 or P0025	A
P0014, P0015, P0024 or P0025 and other DTCs	B

HINT:

If any DTCs other than P0014, P0015, P0024 or P0025 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)

a. Connect the intelligent tester to the DLC3.

b. Turn the tester on.

c. Warm up the engine.

d. Turn the A/C on.

e. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT Exhaust Linear (Bank 1) or Control the VVT Exhaust Linear (Bank 2).

f. Check the engine speed while operating the camshaft timing oil control valve using the tester.

OK:

Operation	Specified Condition
0%	Normal engine speed
100%	Engine idles roughly or stalls

HINT:

Refer to "Data List / Active Test" [VVT Ex OCV Duty #1, VVT Ex Chg Angle #1, VVT Ex OCV Duty #2 and VVT Ex Chg Angle #2] (Click here).

NG → **Go to step 4**

OK ↓

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0014, P0015, P0024 OR P0025)

a. Connect the intelligent tester to the DLC3.

b. Turn the tester on.

c. Clear the DTCs (Click here).

d. Warm up the engine.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. With the engine warmed up, idle it for 1 minute. Then drive the vehicle for 5 minutes.

g. Read DTCs using the tester.

OK:

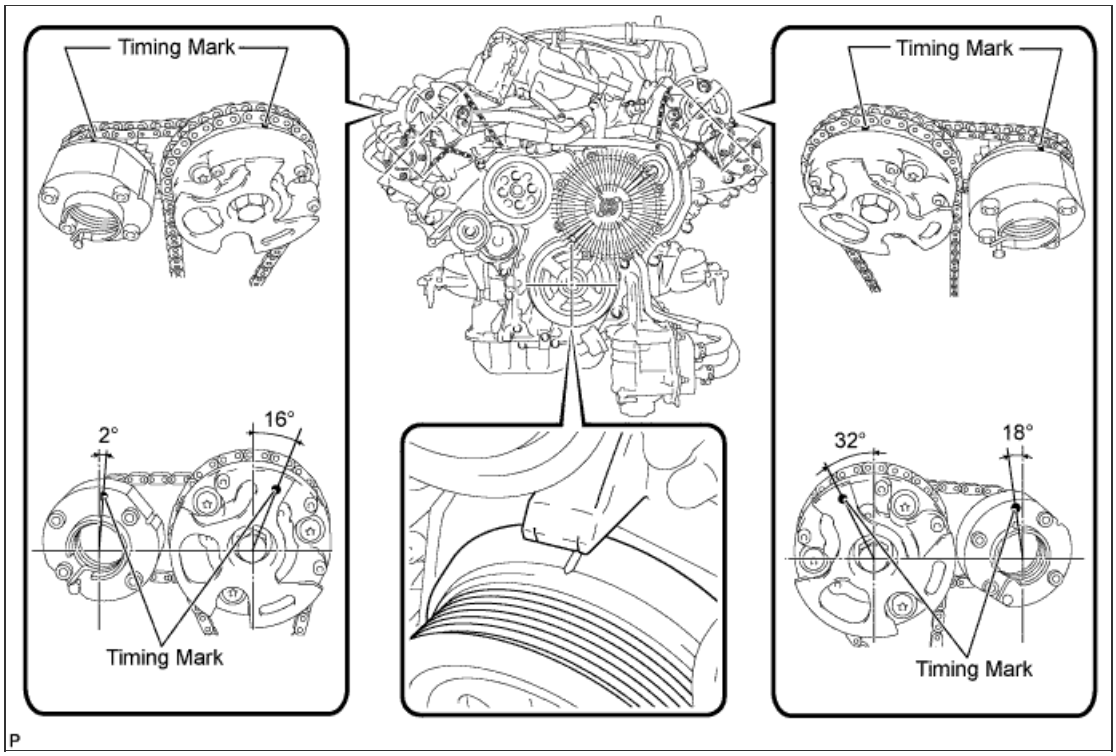
No DTC output.

NG → **Go to step 4**

OK ↓

CHECK FOR INTERMITTENT PROBLEMS (Click here)

4.CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMPED TEETH ON TIMING CHAIN)



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:

Timing marks on camshaft timing gears are aligned as shown in the illustration.

NG → **ADJUST VALVE TIMING (Click here)**

OK

5.INSPECT CAMSHAFT OIL CONTROL VALVE ASSEMBLY (OCV FOR EXHAUST CAMSHAFT)

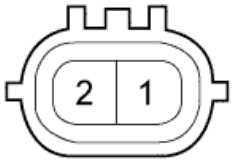
a. Remove the OCV (Click here).

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

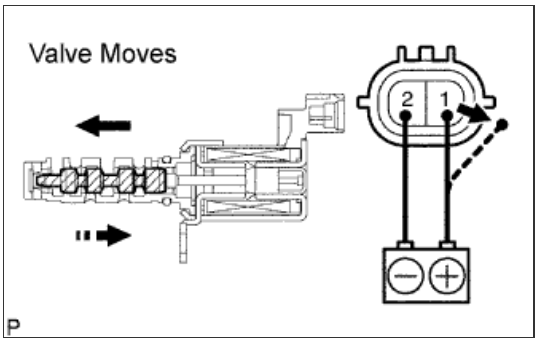
Component without harness connected:
(Oil Control Valve)



c. Check the valve operation.

OK:

Measurement Condition	Specified Condition
No battery voltage applied to terminals 1 and 2 → Battery voltage applied to terminals 1 and 2	Valve moves quickly



NG → REPLACE CAMSHAFT OIL CONTROL VALVE ASSEMBLY (Click here)

OK

6.INSPECT OIL CONTROL VALVE FILTER

a. Remove the oil control valve filter (Click here).

b. Check that the filter is not clogged.

OK:
Filter is not clogged.

NG → CLEAN OIL CONTROL VALVE FILTER

OK

7.REPLACE CAMSHAFT TIMING EXHAUST GEAR

a. Replace the camshaft timing exhaust gear (Click here).

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the tester on.

c. Clear the DTCs (Click here).

d. Warm up the engine.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. With the engine warmed up, idle it for 1 minute. Then drive the vehicle for 5 minutes.

g. Read the output DTCs using the tester.

OK:
No DTC output.

HINT:

DTC P0014, P0015, P0024 or P0025 is output when foreign objects in the engine oil are caught in some parts of the system. These codes will stay stored even if the system returns to normal after a short time. These foreign objects are then captured by the oil filter, thus eliminating the source of the problem.

NG → REPLACE ECM (Click here)

OK

SYSTEM IS OK

DTC P0351 Ignition Coil "A" Primary / Secondary Circuit

DTC P0352 Ignition Coil "B" Primary / Secondary Circuit

DTC P0353 Ignition Coil "C" Primary / Secondary Circuit

DTC P0354 Ignition Coil "D" Primary / Secondary Circuit

DTC P0355 Ignition Coil "E" Primary / Secondary Circuit

DTC P0356 Ignition Coil "F" Primary / Secondary Circuit

DTC P0357 Ignition Coil "G" Primary / Secondary Circuit

DTC P0358 Ignition Coil "H" Primary / Secondary Circuit

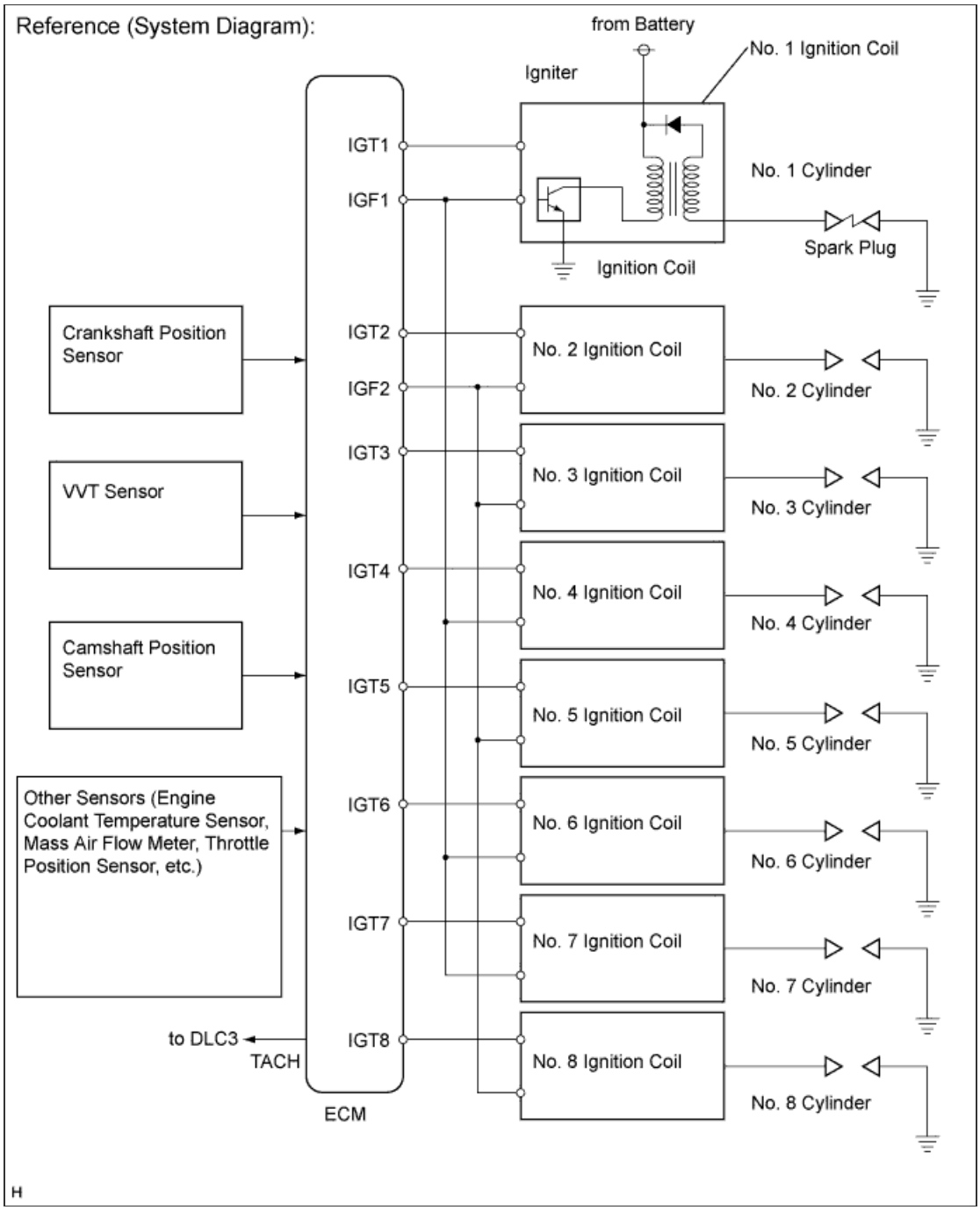
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DESCRIPTION

HINT:

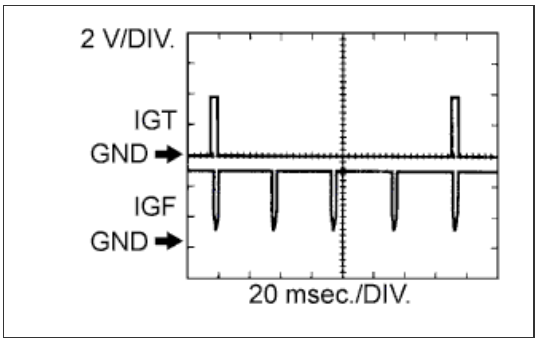
- **These DTCs indicate malfunctions relating to the primary circuit.**
- **If DTC P0351 is output, check the No. 1 ignition coil circuit.**
- **If DTC P0352 is output, check the No. 2 ignition coil circuit.**
- **If DTC P0353 is output, check the No. 3 ignition coil circuit.**
- **If DTC P0354 is output, check the No. 4 ignition coil circuit.**
- **If DTC P0355 is output, check the No. 5 ignition coil circuit.**
- **If DTC P0356 is output, check the No. 6 ignition coil circuit.**
- **If DTC P0357 is output, check the No. 7 ignition coil circuit.**
- **If DTC P0358 is output, check the No. 8 ignition coil circuit.**

A Direct Ignition System (DIS) is used on this vehicle.
The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.
The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.



DTC Code	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356 P0357 P0358	No IGF signal is sent to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 8) between ignition coil and ECM • No. 1 to No. 8 ignition coils • ECM

Reference: Inspection using an oscilloscope.



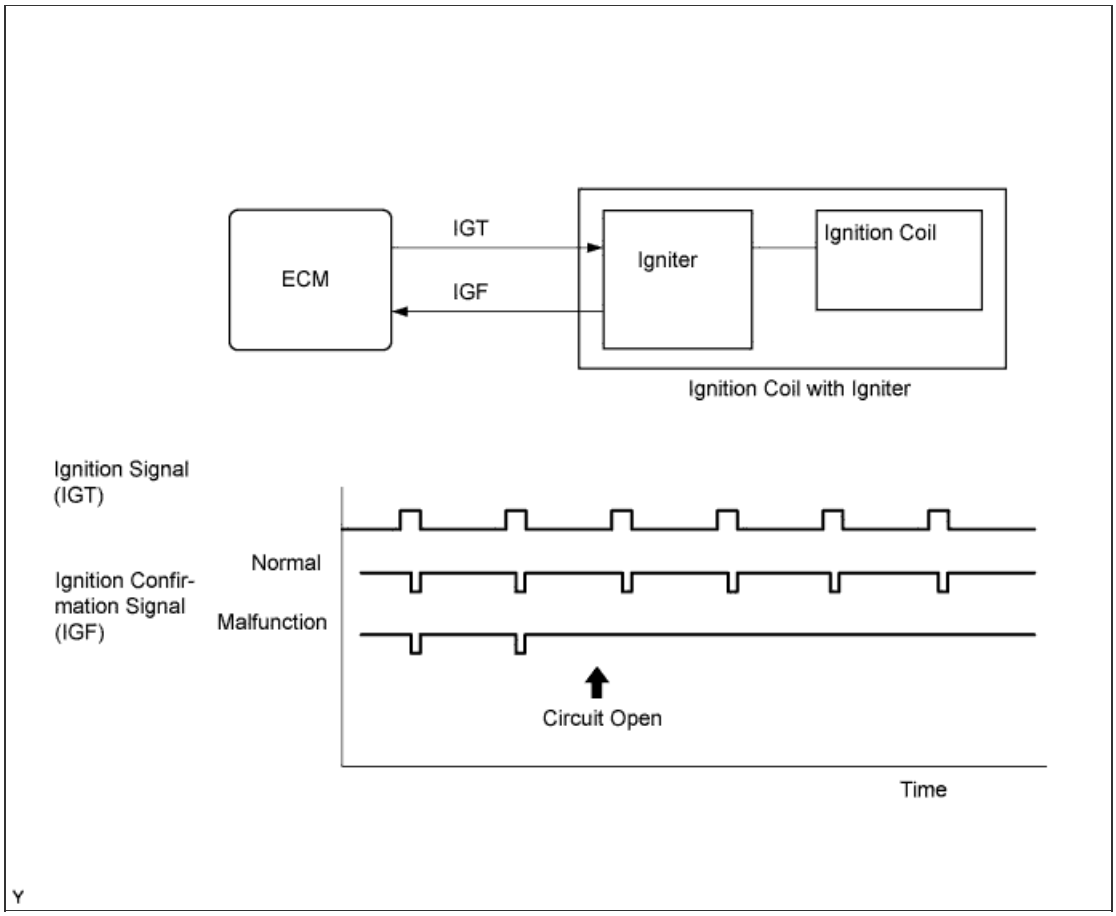
Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-40 (IGT1) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-33 (IGT2) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-37 (IGT3) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-34 (IGT4) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-35 (IGT5) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-36 (IGT6) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-38 (IGT7) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-39 (IGT8) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-104 (IGF1) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-105 (IGF2) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown

HINT:

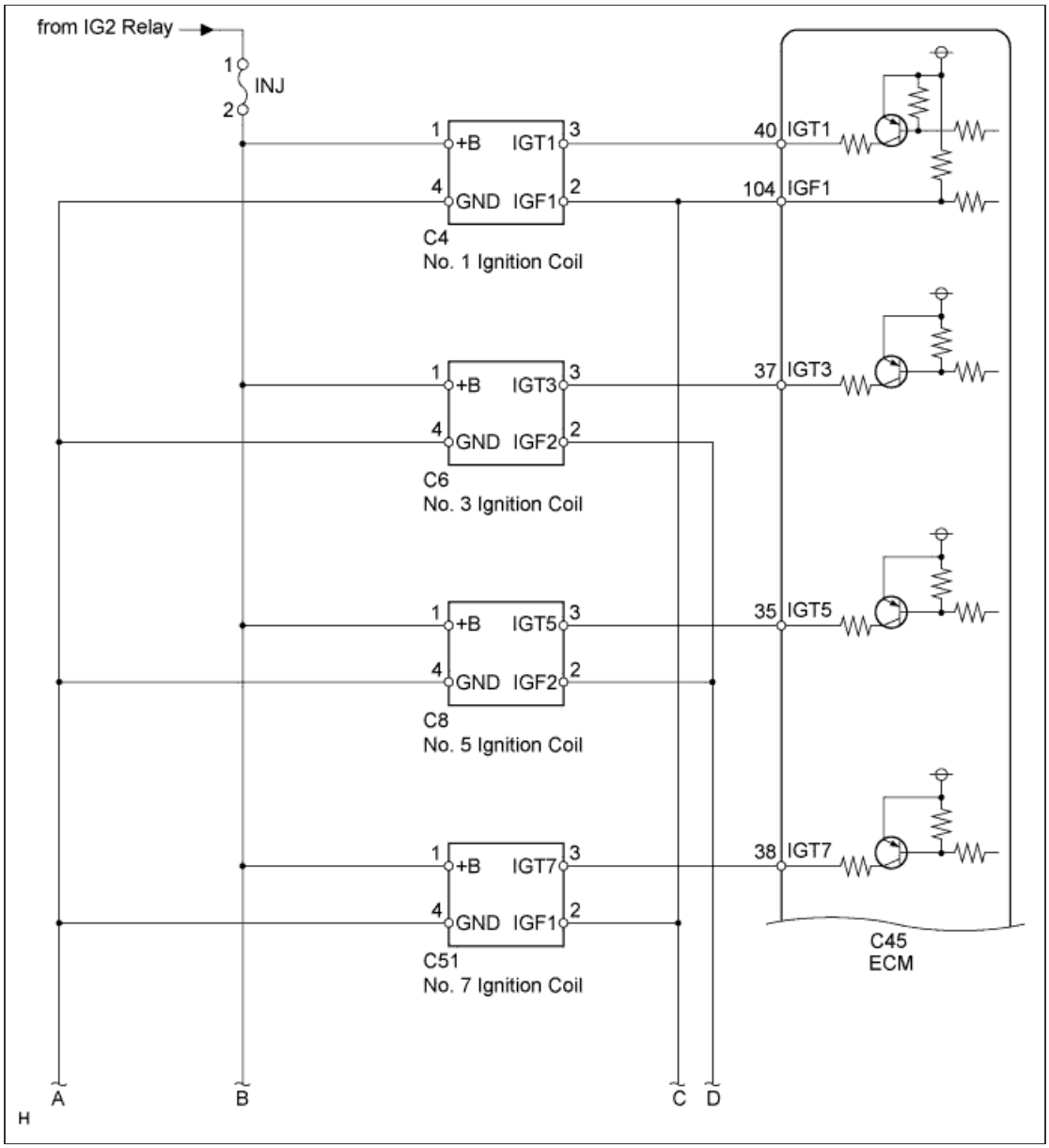
While cranking or idling the engine, check the waveform between terminals IGT (1 to 8) and E1, and IGF1 or IGF2 and E1 of the ECM connector.

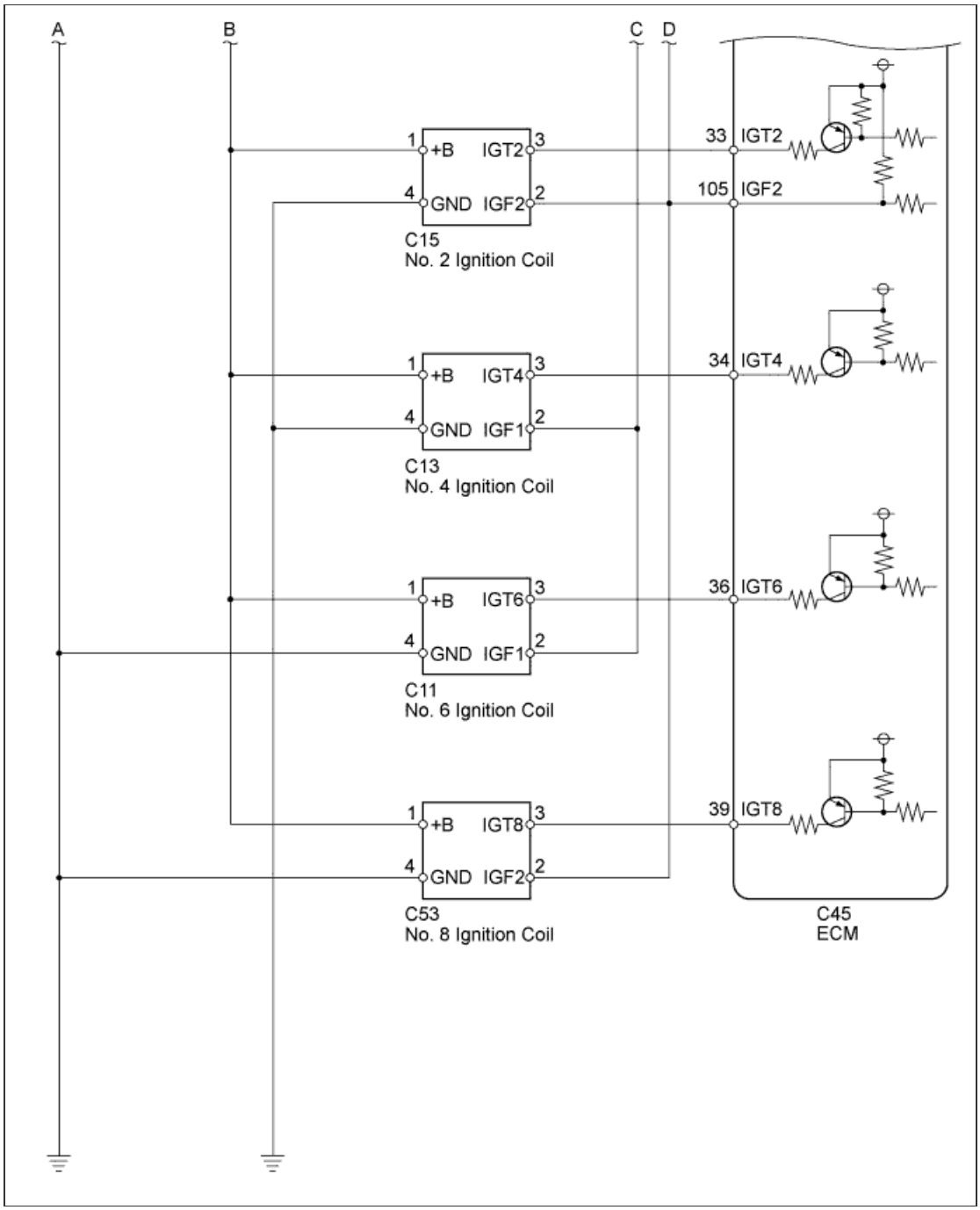
MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores DTC(s).
If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

WIRING DIAGRAM


from IG2 Relay
1
INJ
2
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
38
IGT7
C45
ECM
A
B
C
D
H



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)

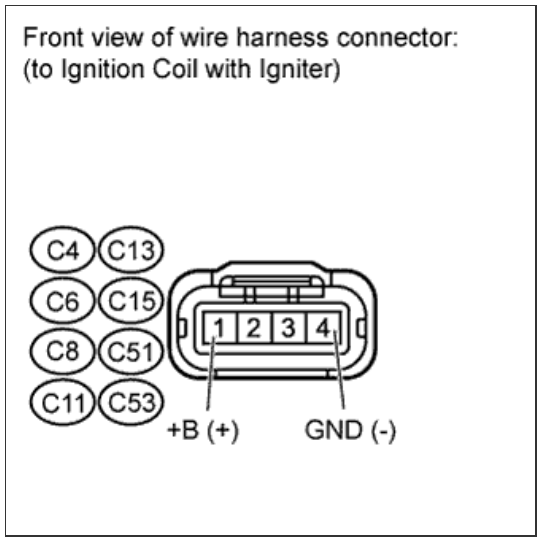
a. Disconnect the C4, C6, C8, C11, C13, C15, C51 or C53 ignition coil connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C4-4 (GND) - Body ground	Always	Below 1 Ω
C15-4 (GND) - Body ground	Always	Below 1 Ω
C6-4 (GND) - Body ground	Always	Below 1 Ω

C13-4 (GND) - Body ground	Always	Below 1 Ω
C8-4 (GND) - Body ground	Always	Below 1 Ω
C11-4 (GND) - Body ground	Always	Below 1 Ω
C51-4 (GND) - Body ground	Always	Below 1 Ω
C53-4 (GND) - Body ground	Always	Below 1 Ω



c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C4-1 (+B) - C4-4 (GND)	Engine switch on (IG)	11 to 14 V
C15-1 (+B) - C15-4 (GND)	Engine switch on (IG)	11 to 14 V
C6-1 (+B) - C6-4 (GND)	Engine switch on (IG)	11 to 14 V
C13-1 (+B) - C13-4 (GND)	Engine switch on (IG)	11 to 14 V
C8-1 (+B) - C8-4 (GND)	Engine switch on (IG)	11 to 14 V
C11-1 (+B) - C11-4 (GND)	Engine switch on (IG)	11 to 14 V
C51-1 (+B) - C51-4 (GND)	Engine switch on (IG)	11 to 14 V
C53-1 (+B) - C53-4 (GND)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

a. Disconnect the C4, C6, C8, C11, C13, C15, C51 or C53 ignition coil connector.

b. Disconnect the C45 ECM connector.

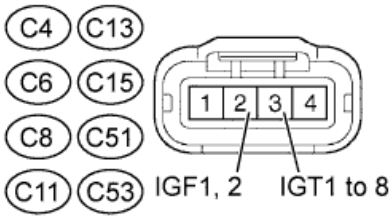
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

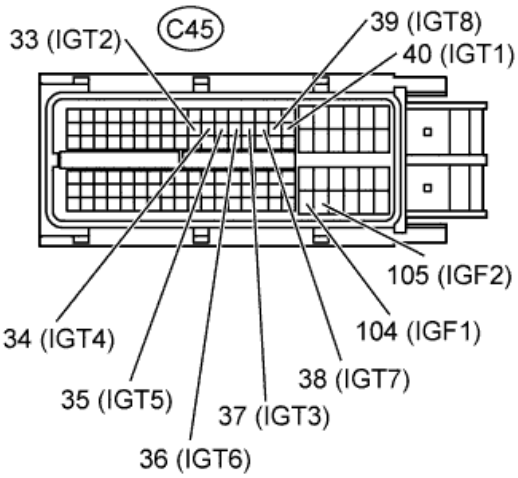
Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C15-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C45-40 (IGT1)	Always	Below 1 Ω

C15-3 (IGT2) - C45-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C45-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C45-34 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C45-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C45-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C45-38 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C45-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C45-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C45-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C45-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C45-34 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C45-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C45-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C45-38 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C45-39 (IGT8) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Ignition Coil with Igniter)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353, P0354, P0355, P0356, P0357 OR P0358)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Shuffle the arrangement of the ignition coils (among No. 1 to No. 8 cylinders).

NOTICE:

Do not shuffle the connectors.

e. Perform a simulation test.

f. Check DTCs displayed on the tester.

Result

Result	Proceed to
Same DTC is output	A
Different ignition coil DTC is output	B

B → REPLACE IGNITION COIL ASSEMBLY (Click here)

A → REPLACE ECM (Click here)

DTC P0014 Camshaft Position "B" - Timing Over-Advanced or System Performance (Bank 1)

DTC P0015 Camshaft Position "B" - Timing Over-Retarded (Bank 1)

DTC P0024 Camshaft Position "B" - Timing Over-Advanced or System Performance (Bank 2)

DTC P0025 Camshaft Position "B" - Timing Over-Retarded (Bank 2)

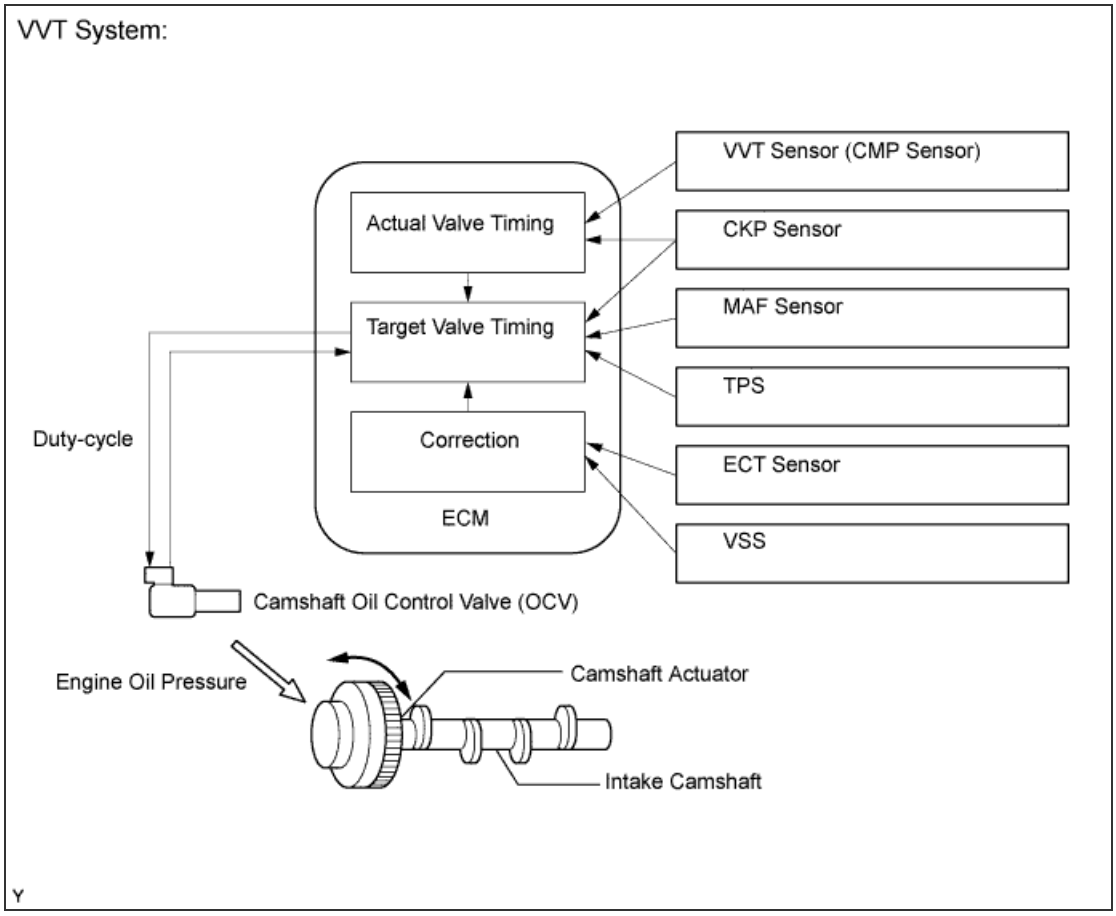
for Preparation Click here

DESCRIPTION

HINT:

If DTC P0014, P0015, P0024 or P0025 is output, check the VVT (Variable Valve Timing) system.

The Variable Valve Timing (VVT) system includes the ECM, OCV and VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. Camshaft timing control is performed according to engine operating conditions such as the intake air volume, throttle valve position and engine coolant temperature. The ECM controls the OCV based on the signals transmitted by several sensors. The VVT controller regulates the exhaust camshaft angle using oil pressure through the OCV. As a result, the relative positions of the camshaft and crankshaft are optimized, the engine torque and fuel economy improve, and the exhaust emissions decrease under overall driving conditions. The ECM detects the actual exhaust valve timing using signals from the camshaft and crankshaft position sensors, and performs feedback control. This is how the target exhaust valve timing is verified by the ECM.



DTC Code	DTC Detection Condition	Trouble Area
P0014 P0024	The exhaust valve timing is not adjusted in the valve timing advance range (2 trip detection logic).	• Valve timing • Camshaft Oil Control Valve (OCV) (for exhaust side of Bank 1, 2) • OCV filter • Camshaft timing exhaust gear • ECM
P0015 P0025	The exhaust valve timing is not adjusted in the valve timing retard range (1 trip detection logic).	• Valve timing • OCV (for exhaust side of Bank 1, 2) • OCV filter • Camshaft timing exhaust gear • ECM

MONITOR DESCRIPTION

1. The ECM optimizes the exhaust valve timing using the VVT (Variable Valve Timing) system to control the exhaust camshaft. The VVT system includes the ECM, Camshaft Oil Control Valve (OCV) and VVT controller.
2. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the exhaust camshaft.
   If the difference between the target and actual exhaust valve timing is large, and changes in actual exhaust valve timing are small, the ECM interprets this as the VVT controller stuck malfunction and stores DTC(s).
   Example:
   A DTC is stored when the following conditions 1 and 2 are met for 10 seconds or more:
   1. It takes 5 seconds or more to change the valve timing by 5°CA.
   2. After the above condition 1 is met, the camshaft timing oil control valve is forcibly activated during 10 seconds.
3. DTCs P0014 and P0024 (Advanced Cam Timing) are subject to 2 trip detection logic.
4. DTCs P0015 and P0025 (Retarded Cam Timing) are subject to 1 trip detection logic.
   These DTCs indicate that the VVT controller cannot operate properly due to OCV malfunctions or the presence of foreign objects in the OCV.
5. The monitor will not run unless the following conditions are met:
   1. The engine is warm (the engine coolant temperature is 75°C [167°F] or higher).
   2. The vehicle has been driven at more than 64 km/h (40 mph) for 3 minutes.
   3. The engine has idled for 3 minutes.

WIRING DIAGRAM

Refer to DTC P0013 (Click here).

INSPECTION PROCEDURE

HINT:

Abnormal Bank	Advanced Timing Over (Valve Timing is Out of Specified Range)	Retarded Timing Over (Valve Timing is Out of Specified Range)
Bank 1	P0014	P0015
Bank 2	P0024	P0025

- **If DTC P0014 or P0015 is output, check the bank 1 VVT system for exhaust side circuit.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **If DTC P0024 or P0025 is output, check the bank 2 VVT system for exhaust side circuit.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0014, P0015, P0024 OR P0025)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0014, P0015, P0024 or P0025	A
P0014, P0015, P0024 or P0025 and other DTCs	B

HINT:

If any DTCs other than P0014, P0015, P0024 or P0025 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)

a. Connect the intelligent tester to the DLC3.

b. Turn the tester on.

c. Warm up the engine.

d. Turn the A/C on.

e. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT Exhaust Linear (Bank 1) or Control the VVT Exhaust Linear (Bank 2).

f. Check the engine speed while operating the camshaft timing oil control valve using the tester.

OK:

Operation	Specified Condition
0%	Normal engine speed
100%	Engine idles roughly or stalls

HINT:

Refer to "Data List / Active Test" [VVT Ex OCV Duty #1, VVT Ex Chg Angle #1, VVT Ex OCV Duty #2 and VVT Ex Chg Angle #2] (Click here).

NG → **Go to step 4**

OK ↓

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0014, P0015, P0024 OR P0025)

a. Connect the intelligent tester to the DLC3.

b. Turn the tester on.

c. Clear the DTCs (Click here).

d. Warm up the engine.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. With the engine warmed up, idle it for 1 minute. Then drive the vehicle for 5 minutes.

g. Read DTCs using the tester.

OK:

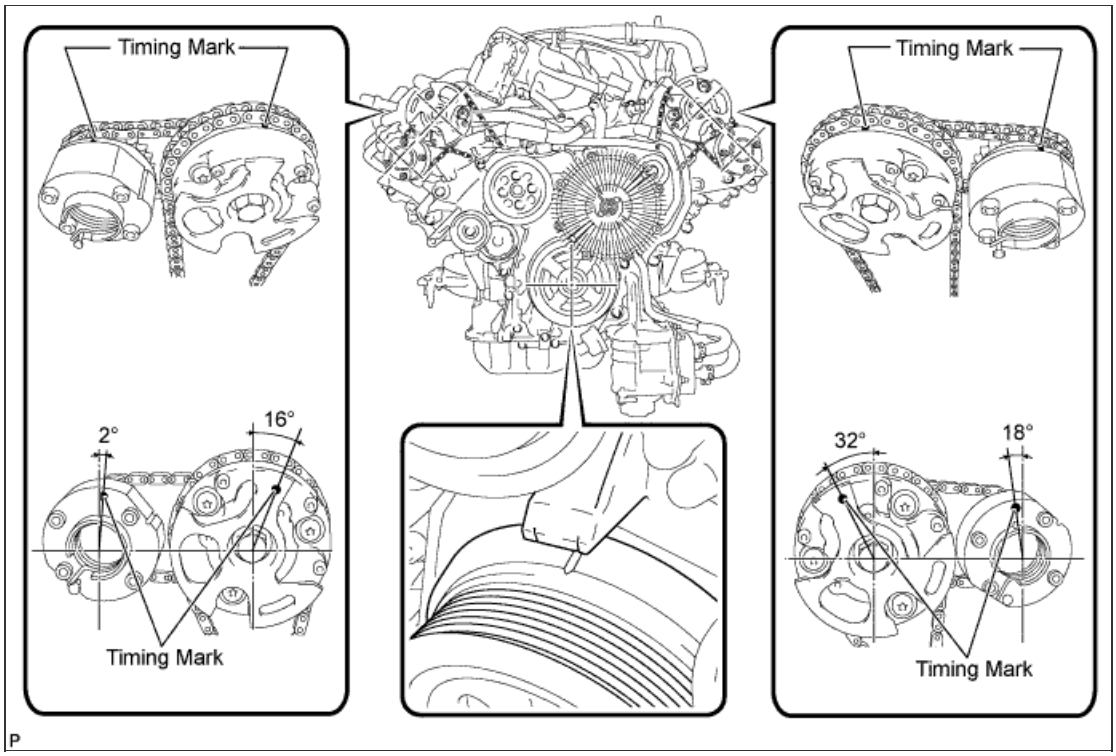
No DTC output.

NG → **Go to step 4**

OK ↓

CHECK FOR INTERMITTENT PROBLEMS (Click here)

4.CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMPED TEETH ON TIMING CHAIN)



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:

Timing marks on camshaft timing gears are aligned as shown in the illustration.

NG → **ADJUST VALVE TIMING (Click here)**

OK

5.INSPECT CAMSHAFT OIL CONTROL VALVE ASSEMBLY (OCV FOR EXHAUST CAMSHAFT)

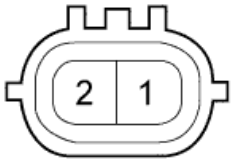
a. Remove the OCV (Click here).

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

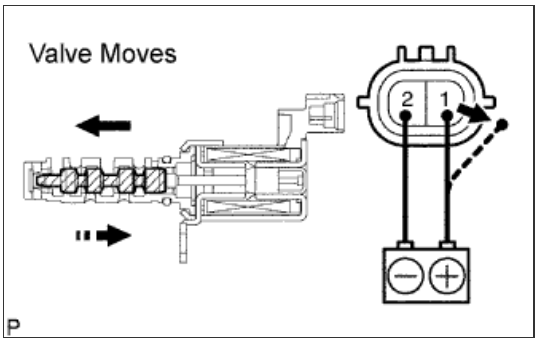
Component without harness connected:
(Oil Control Valve)



c. Check the valve operation.

OK:

Measurement Condition	Specified Condition
No battery voltage applied to terminals 1 and 2 → Battery voltage applied to terminals 1 and 2	Valve moves quickly



NG → REPLACE CAMSHAFT OIL CONTROL VALVE ASSEMBLY (Click here)

OK

6.INSPECT OIL CONTROL VALVE FILTER

a. Remove the oil control valve filter (Click here).

b. Check that the filter is not clogged.

OK:
Filter is not clogged.

NG → CLEAN OIL CONTROL VALVE FILTER

OK

7.REPLACE CAMSHAFT TIMING EXHAUST GEAR

a. Replace the camshaft timing exhaust gear (Click here).

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the tester on.

c. Clear the DTCs (Click here).

d. Warm up the engine.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. With the engine warmed up, idle it for 1 minute. Then drive the vehicle for 5 minutes.

g. Read the output DTCs using the tester.

OK:
No DTC output.

HINT:

DTC P0014, P0015, P0024 or P0025 is output when foreign objects in the engine oil are caught in some parts of the system. These codes will stay stored even if the system returns to normal after a short time. These foreign objects are then captured by the oil filter, thus eliminating the source of the problem.

NG → REPLACE ECM (Click here)

OK

SYSTEM IS OK

DTC P0351 Ignition Coil "A" Primary / Secondary Circuit

DTC P0352 Ignition Coil "B" Primary / Secondary Circuit

DTC P0353 Ignition Coil "C" Primary / Secondary Circuit

DTC P0354 Ignition Coil "D" Primary / Secondary Circuit

DTC P0355 Ignition Coil "E" Primary / Secondary Circuit

DTC P0356 Ignition Coil "F" Primary / Secondary Circuit

DTC P0357 Ignition Coil "G" Primary / Secondary Circuit

DTC P0358 Ignition Coil "H" Primary / Secondary Circuit

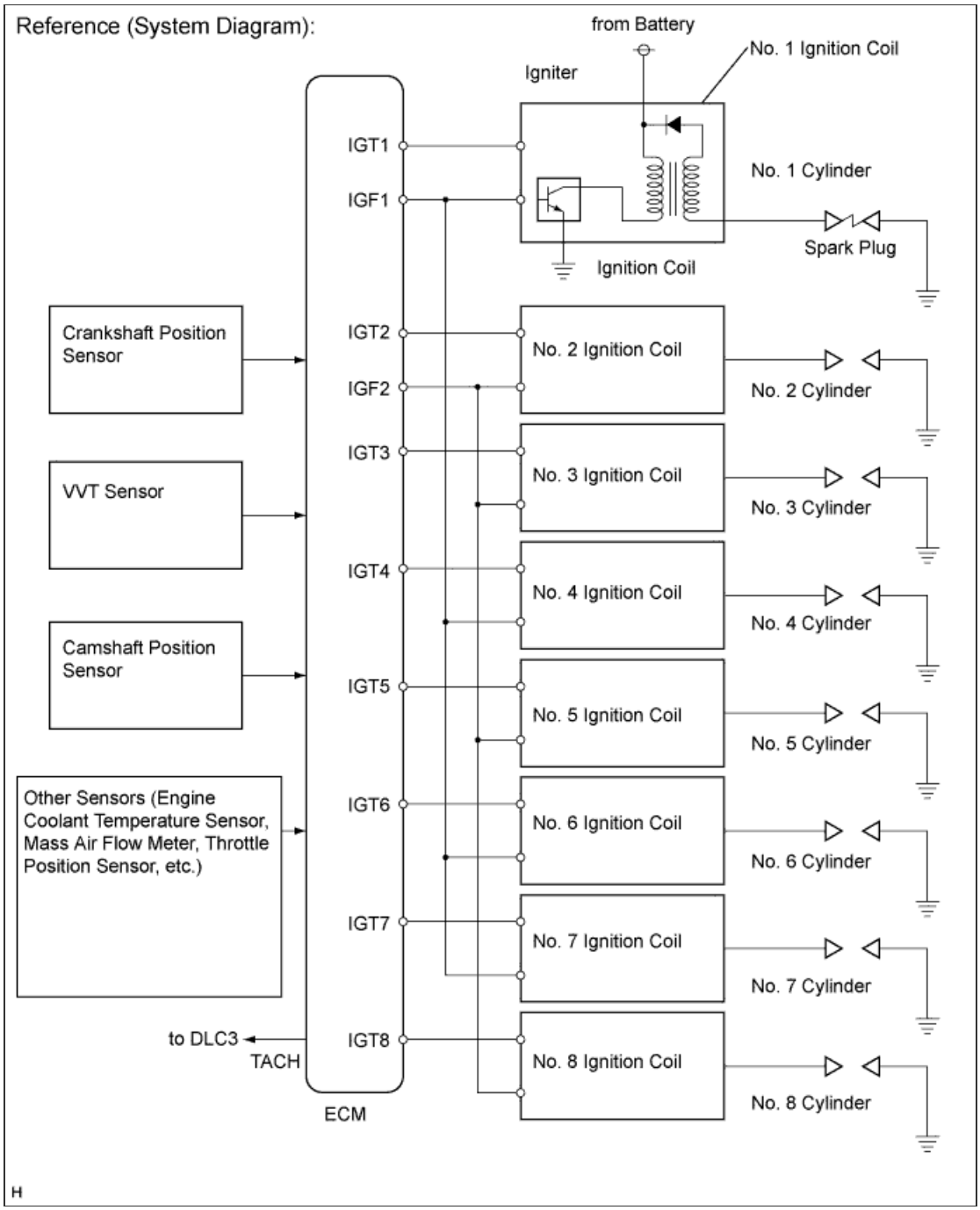
for Preparation Click here

DESCRIPTION

HINT:

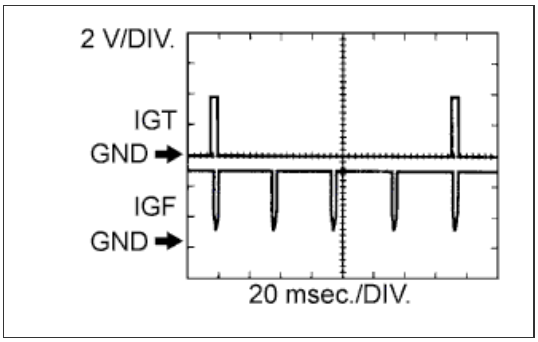
- **These DTCs indicate malfunctions relating to the primary circuit.**
- **If DTC P0351 is output, check the No. 1 ignition coil circuit.**
- **If DTC P0352 is output, check the No. 2 ignition coil circuit.**
- **If DTC P0353 is output, check the No. 3 ignition coil circuit.**
- **If DTC P0354 is output, check the No. 4 ignition coil circuit.**
- **If DTC P0355 is output, check the No. 5 ignition coil circuit.**
- **If DTC P0356 is output, check the No. 6 ignition coil circuit.**
- **If DTC P0357 is output, check the No. 7 ignition coil circuit.**
- **If DTC P0358 is output, check the No. 8 ignition coil circuit.**

A Direct Ignition System (DIS) is used on this vehicle.
The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.
The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.



DTC Code	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356 P0357 P0358	No IGF signal is sent to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 8) between ignition coil and ECM • No. 1 to No. 8 ignition coils • ECM

Reference: Inspection using an oscilloscope.



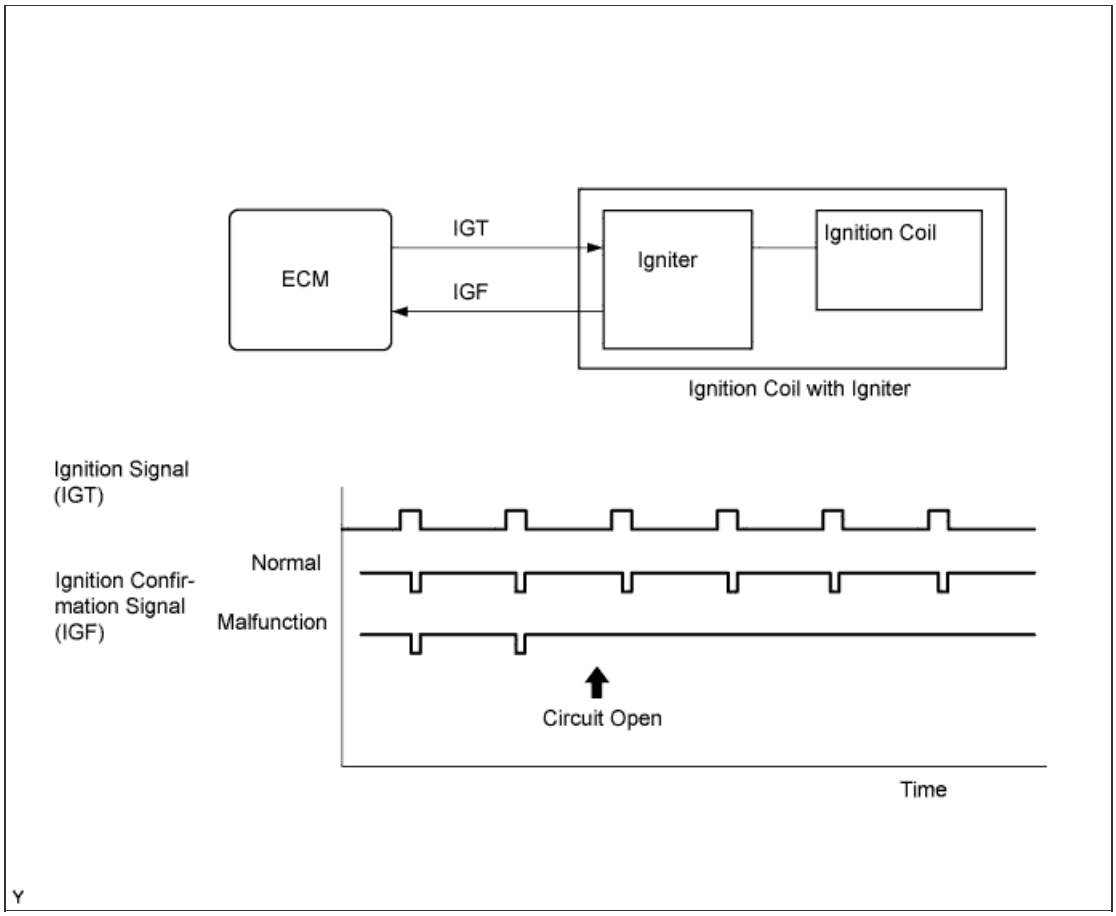
Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-40 (IGT1) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-33 (IGT2) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-37 (IGT3) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-34 (IGT4) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-35 (IGT5) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-36 (IGT6) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-38 (IGT7) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-39 (IGT8) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-104 (IGF1) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-105 (IGF2) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown

HINT:

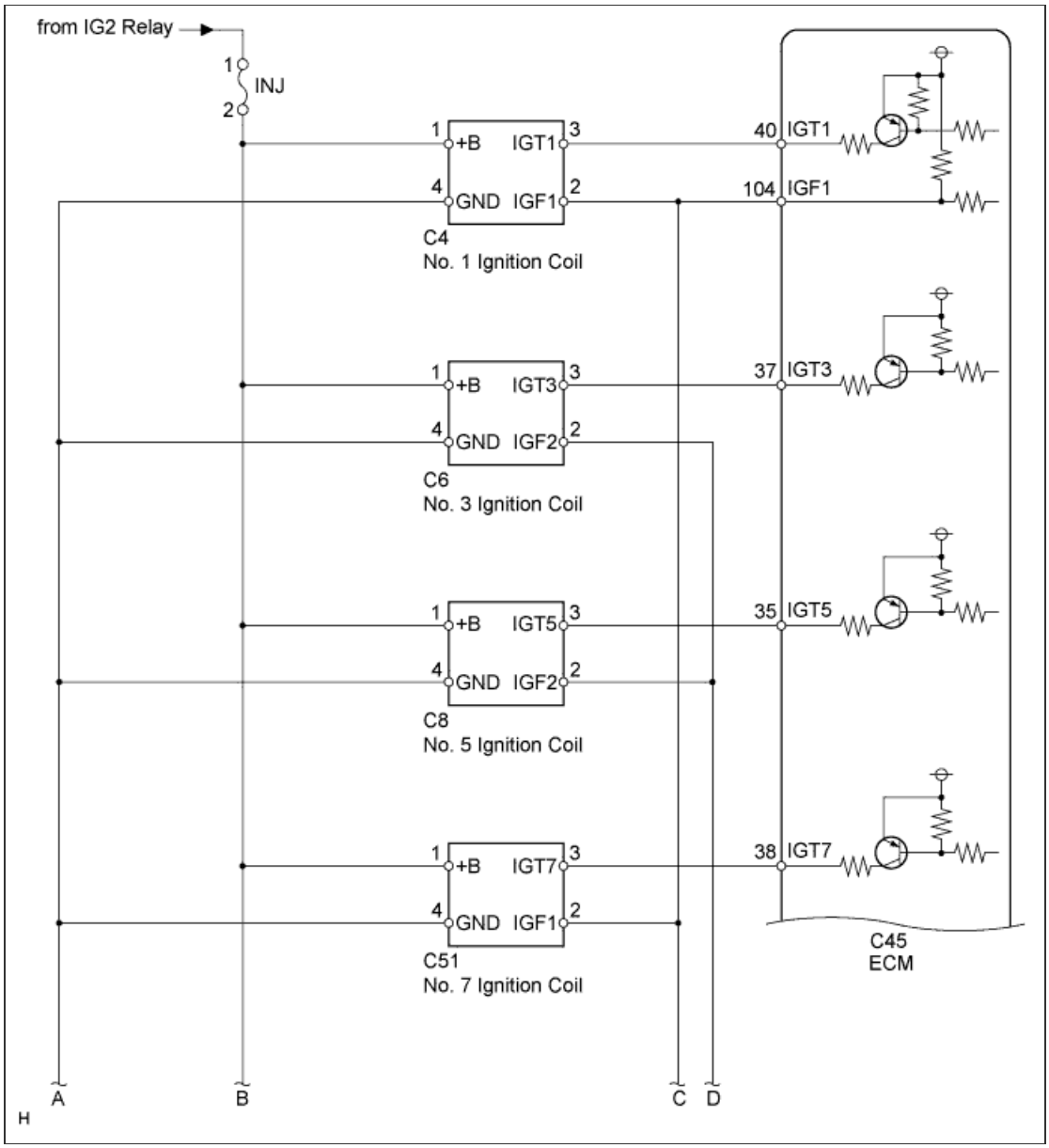
While cranking or idling the engine, check the waveform between terminals IGT (1 to 8) and E1, and IGF1 or IGF2 and E1 of the ECM connector.

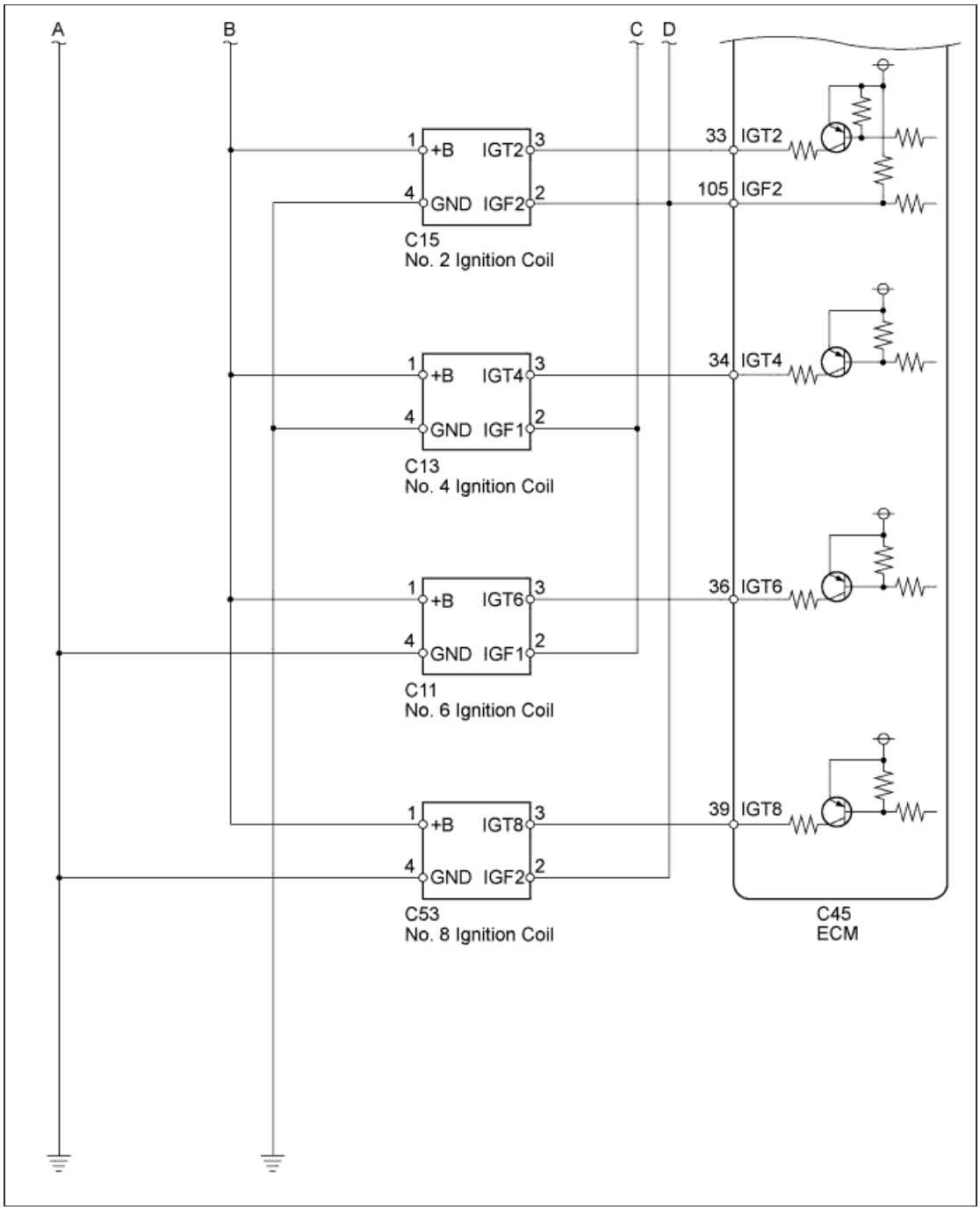
MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores DTC(s).
If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

WIRING DIAGRAM


from IG2 Relay
1
INJ
2
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
38
IGT7
C45
ECM
A
B
C
D
H



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)

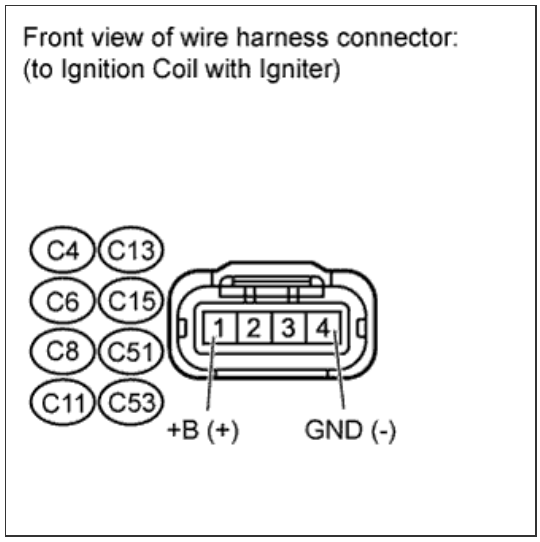
a. Disconnect the C4, C6, C8, C11, C13, C15, C51 or C53 ignition coil connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C4-4 (GND) - Body ground	Always	Below 1 Ω
C15-4 (GND) - Body ground	Always	Below 1 Ω
C6-4 (GND) - Body ground	Always	Below 1 Ω

C13-4 (GND) - Body ground	Always	Below 1 Ω
C8-4 (GND) - Body ground	Always	Below 1 Ω
C11-4 (GND) - Body ground	Always	Below 1 Ω
C51-4 (GND) - Body ground	Always	Below 1 Ω
C53-4 (GND) - Body ground	Always	Below 1 Ω



c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C4-1 (+B) - C4-4 (GND)	Engine switch on (IG)	11 to 14 V
C15-1 (+B) - C15-4 (GND)	Engine switch on (IG)	11 to 14 V
C6-1 (+B) - C6-4 (GND)	Engine switch on (IG)	11 to 14 V
C13-1 (+B) - C13-4 (GND)	Engine switch on (IG)	11 to 14 V
C8-1 (+B) - C8-4 (GND)	Engine switch on (IG)	11 to 14 V
C11-1 (+B) - C11-4 (GND)	Engine switch on (IG)	11 to 14 V
C51-1 (+B) - C51-4 (GND)	Engine switch on (IG)	11 to 14 V
C53-1 (+B) - C53-4 (GND)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

a. Disconnect the C4, C6, C8, C11, C13, C15, C51 or C53 ignition coil connector.

b. Disconnect the C45 ECM connector.

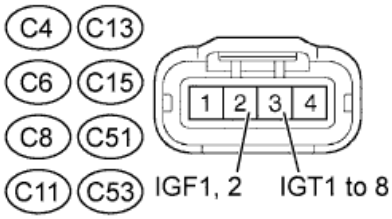
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

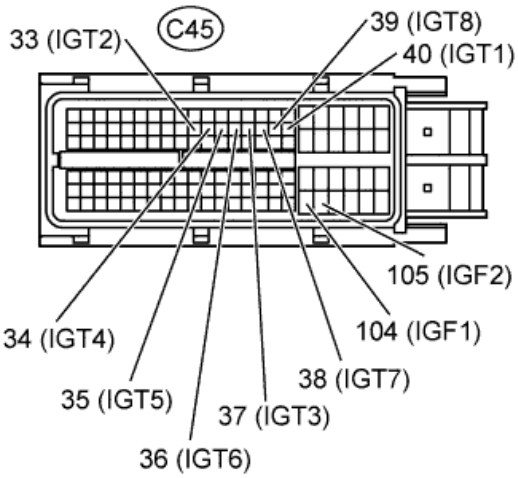
Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C15-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C45-40 (IGT1)	Always	Below 1 Ω

C15-3 (IGT2) - C45-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C45-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C45-34 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C45-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C45-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C45-38 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C45-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C45-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C45-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C45-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C45-34 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C45-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C45-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C45-38 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C45-39 (IGT8) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Ignition Coil with Igniter)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353, P0354, P0355, P0356, P0357 OR P0358)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Shuffle the arrangement of the ignition coils (among No. 1 to No. 8 cylinders).

NOTICE:

Do not shuffle the connectors.

e. Perform a simulation test.

f. Check DTCs displayed on the tester.

Result

Result	Proceed to
Same DTC is output	A
Different ignition coil DTC is output	B

B → REPLACE IGNITION COIL ASSEMBLY (Click here)

A → REPLACE ECM (Click here)

DTC P0014 Camshaft Position "B" - Timing Over-Advanced or System Performance (Bank 1)

DTC P0015 Camshaft Position "B" - Timing Over-Retarded (Bank 1)

DTC P0024 Camshaft Position "B" - Timing Over-Advanced or System Performance (Bank 2)

DTC P0025 Camshaft Position "B" - Timing Over-Retarded (Bank 2)

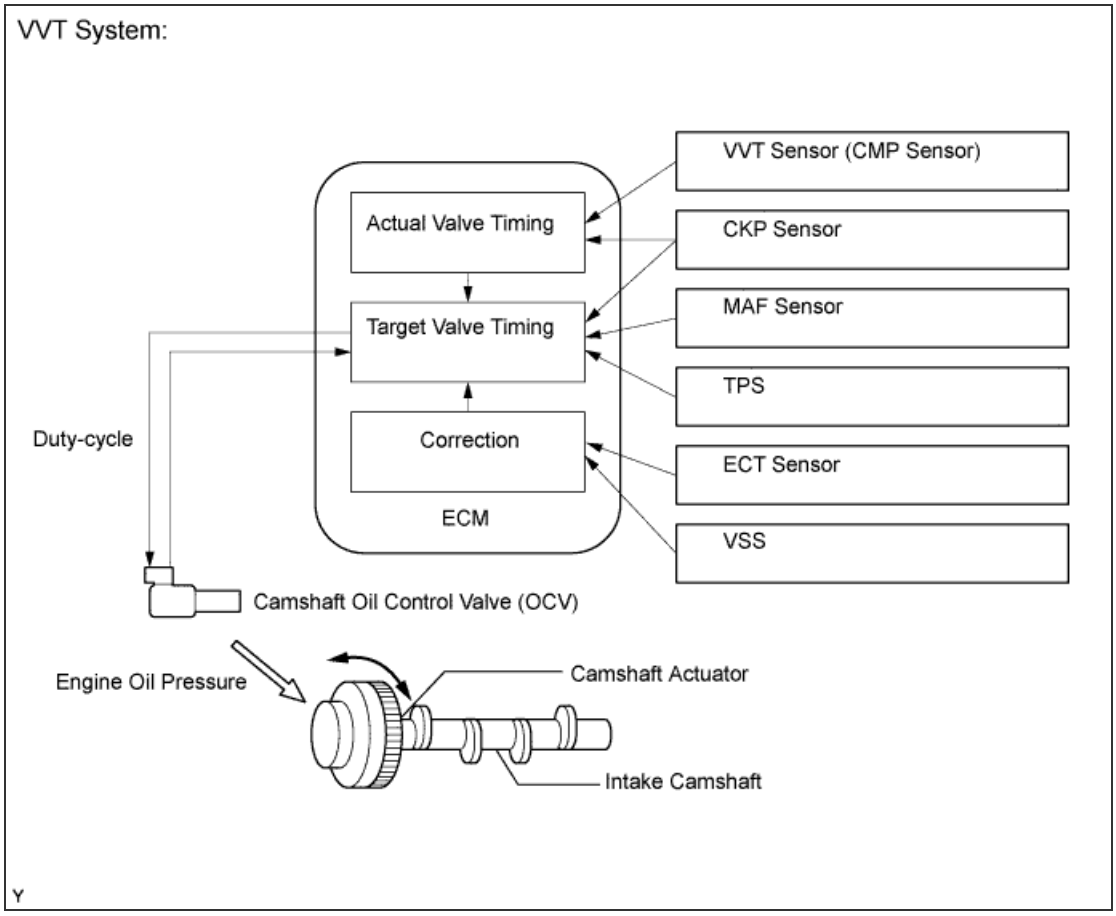
for Preparation Click here

DESCRIPTION

HINT:

If DTC P0014, P0015, P0024 or P0025 is output, check the VVT (Variable Valve Timing) system.

The Variable Valve Timing (VVT) system includes the ECM, OCV and VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. Camshaft timing control is performed according to engine operating conditions such as the intake air volume, throttle valve position and engine coolant temperature. The ECM controls the OCV based on the signals transmitted by several sensors. The VVT controller regulates the exhaust camshaft angle using oil pressure through the OCV. As a result, the relative positions of the camshaft and crankshaft are optimized, the engine torque and fuel economy improve, and the exhaust emissions decrease under overall driving conditions. The ECM detects the actual exhaust valve timing using signals from the camshaft and crankshaft position sensors, and performs feedback control. This is how the target exhaust valve timing is verified by the ECM.



DTC Code	DTC Detection Condition	Trouble Area
P0014 P0024	The exhaust valve timing is not adjusted in the valve timing advance range (2 trip detection logic).	• Valve timing • Camshaft Oil Control Valve (OCV) (for exhaust side of Bank 1, 2) • OCV filter • Camshaft timing exhaust gear • ECM
P0015 P0025	The exhaust valve timing is not adjusted in the valve timing retard range (1 trip detection logic).	• Valve timing • OCV (for exhaust side of Bank 1, 2) • OCV filter • Camshaft timing exhaust gear • ECM

MONITOR DESCRIPTION

1. The ECM optimizes the exhaust valve timing using the VVT (Variable Valve Timing) system to control the exhaust camshaft. The VVT system includes the ECM, Camshaft Oil Control Valve (OCV) and VVT controller.
2. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the exhaust camshaft.
   If the difference between the target and actual exhaust valve timing is large, and changes in actual exhaust valve timing are small, the ECM interprets this as the VVT controller stuck malfunction and stores DTC(s).
   Example:
   A DTC is stored when the following conditions 1 and 2 are met for 10 seconds or more:
   1. It takes 5 seconds or more to change the valve timing by 5°CA.
   2. After the above condition 1 is met, the camshaft timing oil control valve is forcibly activated during 10 seconds.
3. DTCs P0014 and P0024 (Advanced Cam Timing) are subject to 2 trip detection logic.
4. DTCs P0015 and P0025 (Retarded Cam Timing) are subject to 1 trip detection logic.
   These DTCs indicate that the VVT controller cannot operate properly due to OCV malfunctions or the presence of foreign objects in the OCV.
5. The monitor will not run unless the following conditions are met:
   1. The engine is warm (the engine coolant temperature is 75°C [167°F] or higher).
   2. The vehicle has been driven at more than 64 km/h (40 mph) for 3 minutes.
   3. The engine has idled for 3 minutes.

WIRING DIAGRAM

Refer to DTC P0013 (Click here).

INSPECTION PROCEDURE

HINT:

Abnormal Bank	Advanced Timing Over (Valve Timing is Out of Specified Range)	Retarded Timing Over (Valve Timing is Out of Specified Range)
Bank 1	P0014	P0015
Bank 2	P0024	P0025

- **If DTC P0014 or P0015 is output, check the bank 1 VVT system for exhaust side circuit.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **If DTC P0024 or P0025 is output, check the bank 2 VVT system for exhaust side circuit.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0014, P0015, P0024 OR P0025)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0014, P0015, P0024 or P0025	A
P0014, P0015, P0024 or P0025 and other DTCs	B

HINT:

If any DTCs other than P0014, P0015, P0024 or P0025 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)

a. Connect the intelligent tester to the DLC3.

b. Turn the tester on.

c. Warm up the engine.

d. Turn the A/C on.

e. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT Exhaust Linear (Bank 1) or Control the VVT Exhaust Linear (Bank 2).

f. Check the engine speed while operating the camshaft timing oil control valve using the tester.

OK:

Operation	Specified Condition
0%	Normal engine speed
100%	Engine idles roughly or stalls

HINT:

Refer to "Data List / Active Test" [VVT Ex OCV Duty #1, VVT Ex Chg Angle #1, VVT Ex OCV Duty #2 and VVT Ex Chg Angle #2] (Click here).

NG → **Go to step 4**

OK ↓

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0014, P0015, P0024 OR P0025)

a. Connect the intelligent tester to the DLC3.

b. Turn the tester on.

c. Clear the DTCs (Click here).

d. Warm up the engine.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. With the engine warmed up, idle it for 1 minute. Then drive the vehicle for 5 minutes.

g. Read DTCs using the tester.

OK:

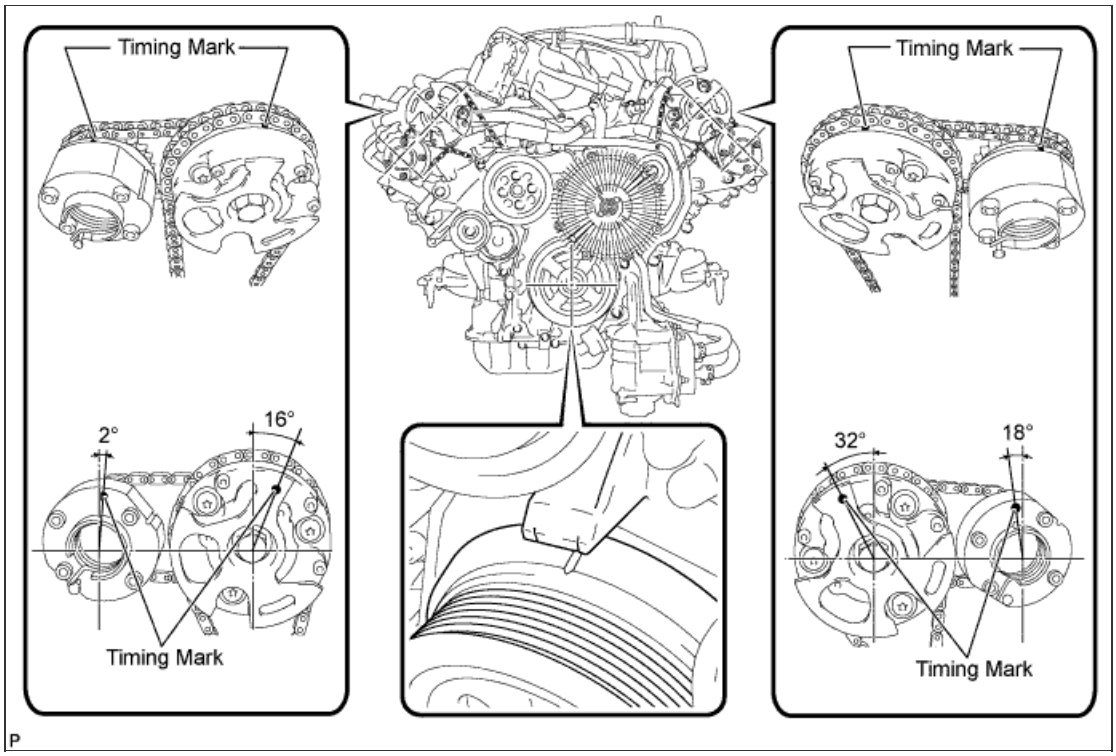
No DTC output.

NG → **Go to step 4**

OK ↓

CHECK FOR INTERMITTENT PROBLEMS (Click here)

4.CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMPED TEETH ON TIMING CHAIN)



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:

Timing marks on camshaft timing gears are aligned as shown in the illustration.

NG → **ADJUST VALVE TIMING (Click here)**

OK

5.INSPECT CAMSHAFT OIL CONTROL VALVE ASSEMBLY (OCV FOR EXHAUST CAMSHAFT)

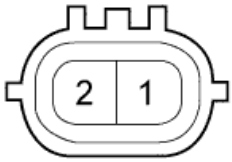
a. Remove the OCV (Click here).

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

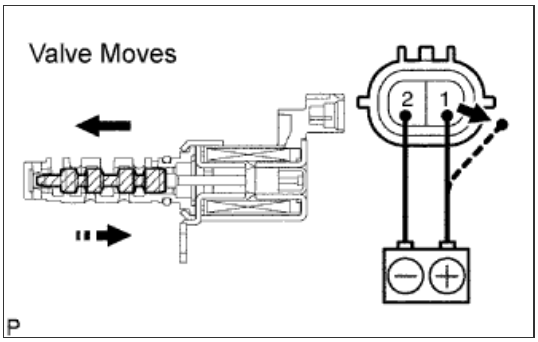
Component without harness connected:
(Oil Control Valve)



c. Check the valve operation.

OK:

Measurement Condition	Specified Condition
No battery voltage applied to terminals 1 and 2 → Battery voltage applied to terminals 1 and 2	Valve moves quickly



NG → REPLACE CAMSHAFT OIL CONTROL VALVE ASSEMBLY (Click here)

OK

6.INSPECT OIL CONTROL VALVE FILTER

a. Remove the oil control valve filter (Click here).

b. Check that the filter is not clogged.

OK:
Filter is not clogged.

NG → CLEAN OIL CONTROL VALVE FILTER

OK

7.REPLACE CAMSHAFT TIMING EXHAUST GEAR

a. Replace the camshaft timing exhaust gear (Click here).

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the tester on.

c. Clear the DTCs (Click here).

d. Warm up the engine.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. With the engine warmed up, idle it for 1 minute. Then drive the vehicle for 5 minutes.

g. Read the output DTCs using the tester.

OK:
No DTC output.

HINT:

DTC P0014, P0015, P0024 or P0025 is output when foreign objects in the engine oil are caught in some parts of the system. These codes will stay stored even if the system returns to normal after a short time. These foreign objects are then captured by the oil filter, thus eliminating the source of the problem.

NG → REPLACE ECM (Click here)

OK

SYSTEM IS OK

DTC P0351 Ignition Coil "A" Primary / Secondary Circuit

DTC P0352 Ignition Coil "B" Primary / Secondary Circuit

DTC P0353 Ignition Coil "C" Primary / Secondary Circuit

DTC P0354 Ignition Coil "D" Primary / Secondary Circuit

DTC P0355 Ignition Coil "E" Primary / Secondary Circuit

DTC P0356 Ignition Coil "F" Primary / Secondary Circuit

DTC P0357 Ignition Coil "G" Primary / Secondary Circuit

DTC P0358 Ignition Coil "H" Primary / Secondary Circuit

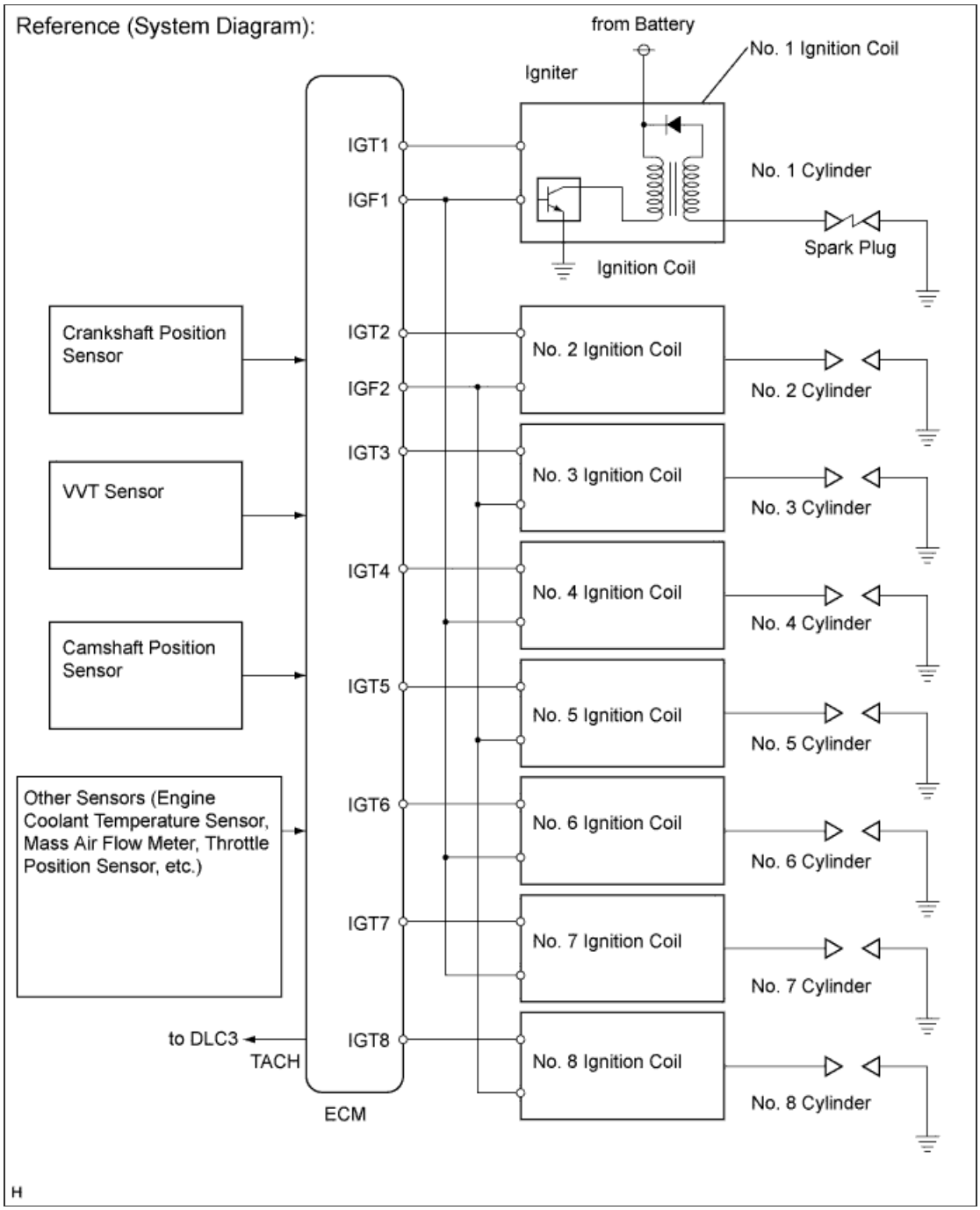
for Preparation Click here

DESCRIPTION

HINT:

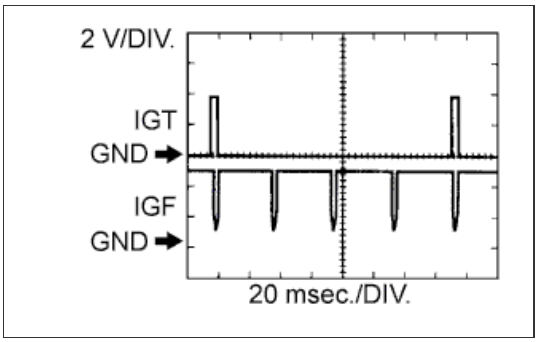
- **These DTCs indicate malfunctions relating to the primary circuit.**
- **If DTC P0351 is output, check the No. 1 ignition coil circuit.**
- **If DTC P0352 is output, check the No. 2 ignition coil circuit.**
- **If DTC P0353 is output, check the No. 3 ignition coil circuit.**
- **If DTC P0354 is output, check the No. 4 ignition coil circuit.**
- **If DTC P0355 is output, check the No. 5 ignition coil circuit.**
- **If DTC P0356 is output, check the No. 6 ignition coil circuit.**
- **If DTC P0357 is output, check the No. 7 ignition coil circuit.**
- **If DTC P0358 is output, check the No. 8 ignition coil circuit.**

A Direct Ignition System (DIS) is used on this vehicle.
The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.
The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.



DTC Code	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356 P0357 P0358	No IGF signal is sent to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 8) between ignition coil and ECM • No. 1 to No. 8 ignition coils • ECM

Reference: Inspection using an oscilloscope.



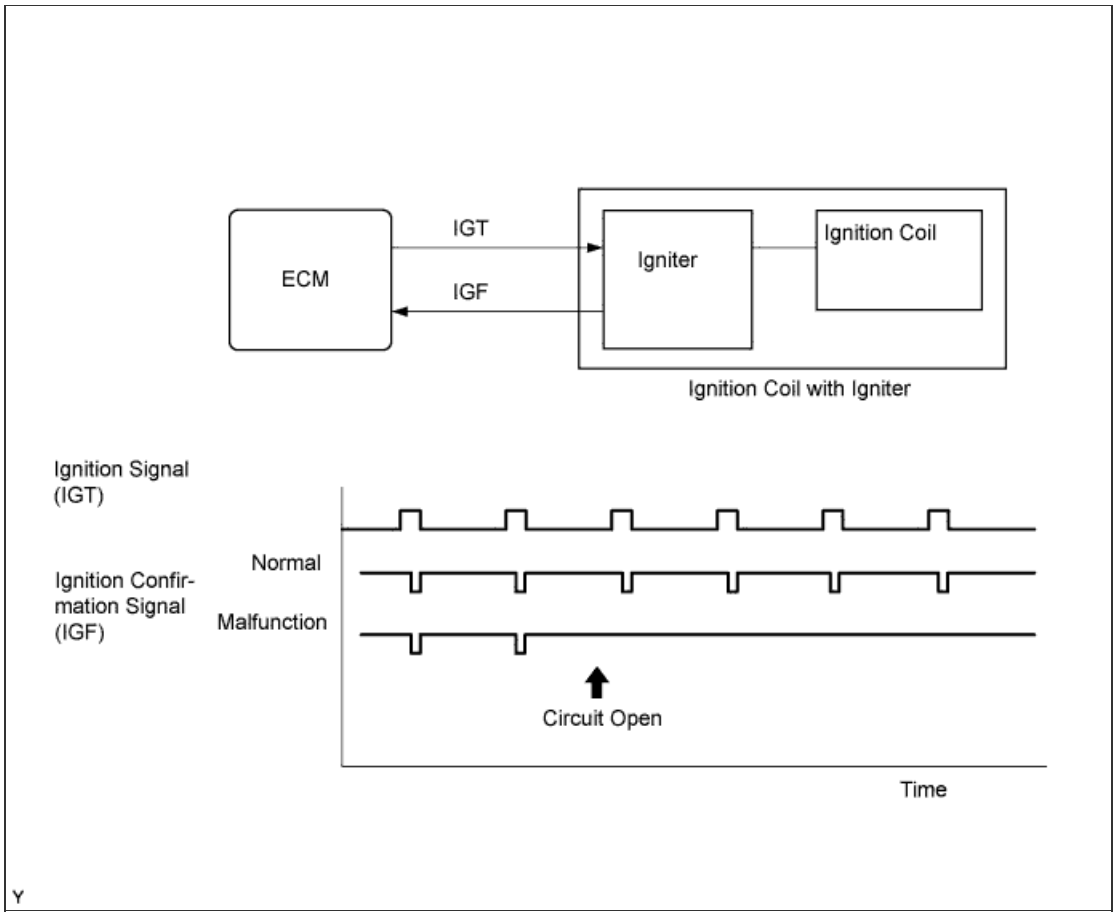
Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-40 (IGT1) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-33 (IGT2) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-37 (IGT3) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-34 (IGT4) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-35 (IGT5) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-36 (IGT6) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-38 (IGT7) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-39 (IGT8) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-104 (IGF1) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-105 (IGF2) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown

HINT:

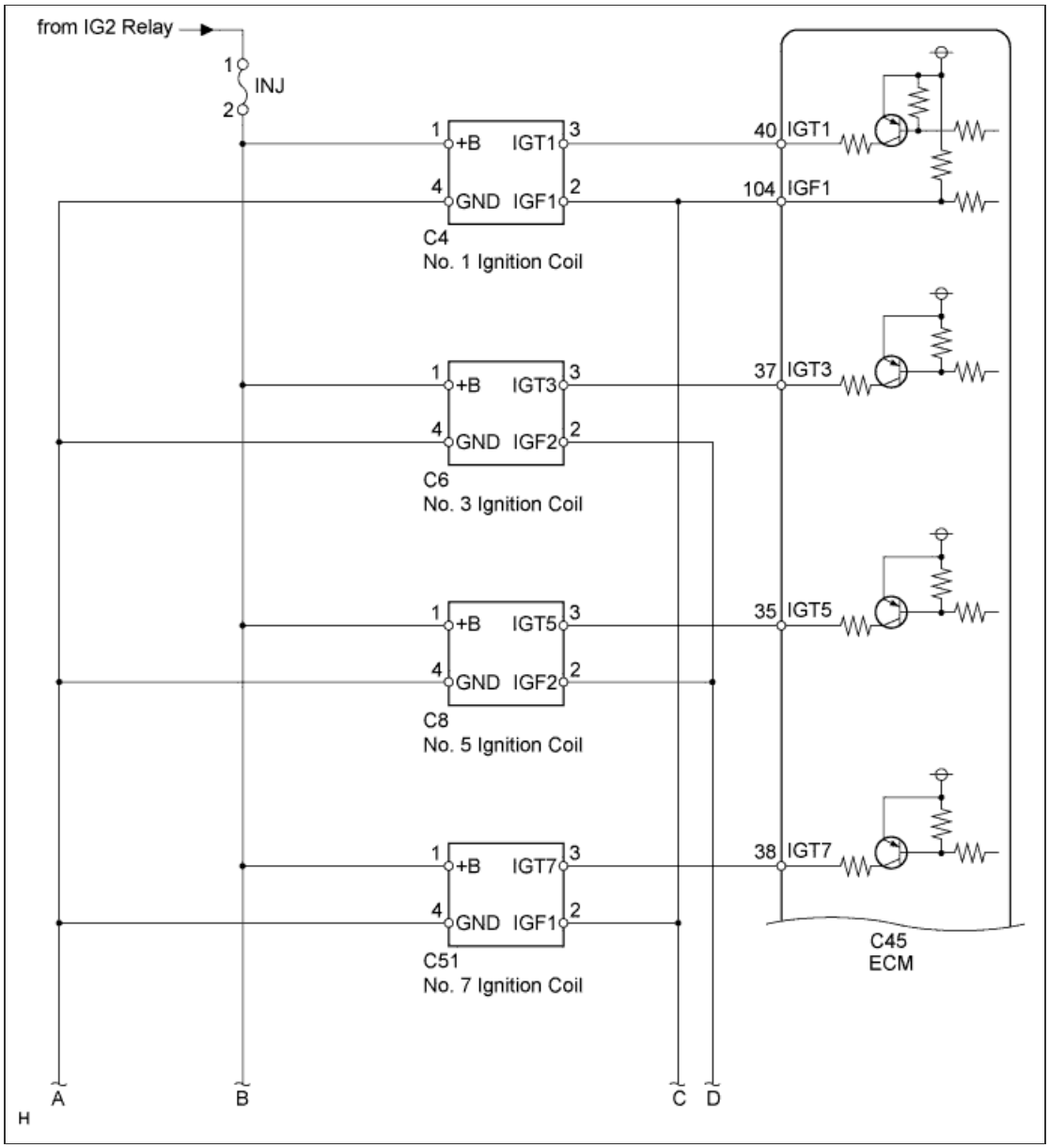
While cranking or idling the engine, check the waveform between terminals IGT (1 to 8) and E1, and IGF1 or IGF2 and E1 of the ECM connector.

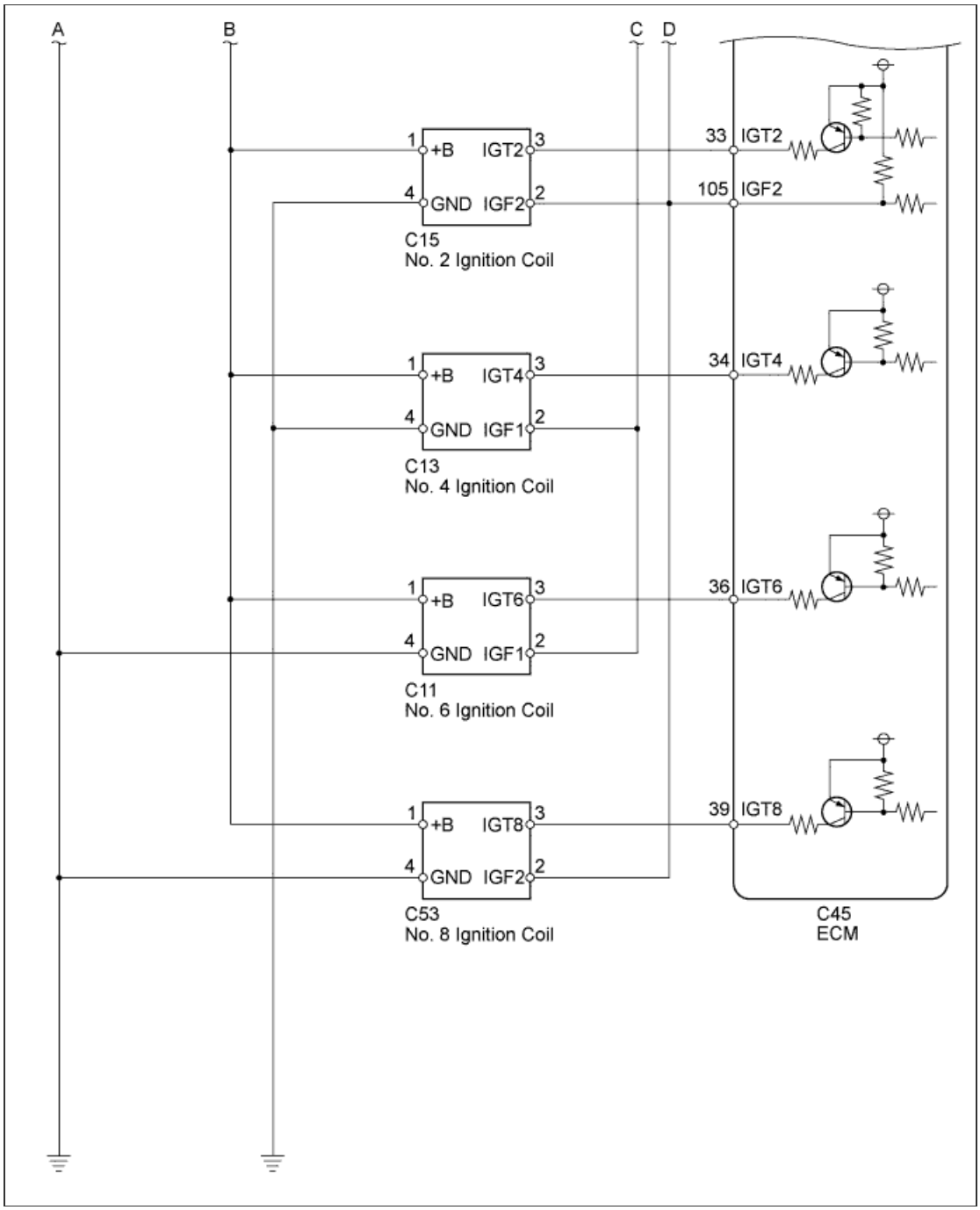
MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores DTC(s).
If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

WIRING DIAGRAM


from IG2 Relay
1
INJ
2
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
38
IGT7
C45
ECM
A
B
C
D
H



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)

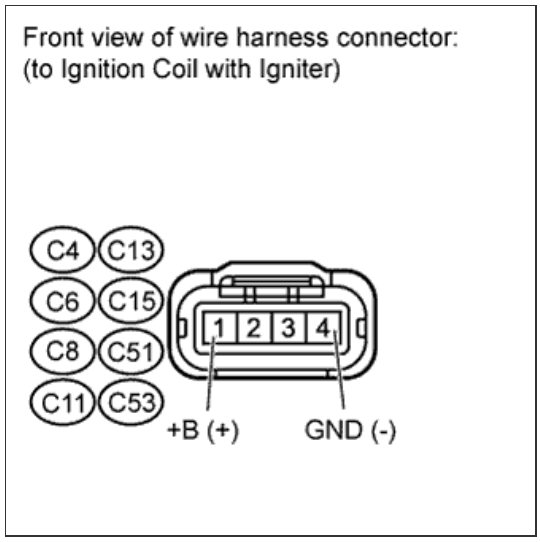
a. Disconnect the C4, C6, C8, C11, C13, C15, C51 or C53 ignition coil connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C4-4 (GND) - Body ground	Always	Below 1 Ω
C15-4 (GND) - Body ground	Always	Below 1 Ω
C6-4 (GND) - Body ground	Always	Below 1 Ω

C13-4 (GND) - Body ground	Always	Below 1 Ω
C8-4 (GND) - Body ground	Always	Below 1 Ω
C11-4 (GND) - Body ground	Always	Below 1 Ω
C51-4 (GND) - Body ground	Always	Below 1 Ω
C53-4 (GND) - Body ground	Always	Below 1 Ω



c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C4-1 (+B) - C4-4 (GND)	Engine switch on (IG)	11 to 14 V
C15-1 (+B) - C15-4 (GND)	Engine switch on (IG)	11 to 14 V
C6-1 (+B) - C6-4 (GND)	Engine switch on (IG)	11 to 14 V
C13-1 (+B) - C13-4 (GND)	Engine switch on (IG)	11 to 14 V
C8-1 (+B) - C8-4 (GND)	Engine switch on (IG)	11 to 14 V
C11-1 (+B) - C11-4 (GND)	Engine switch on (IG)	11 to 14 V
C51-1 (+B) - C51-4 (GND)	Engine switch on (IG)	11 to 14 V
C53-1 (+B) - C53-4 (GND)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

a. Disconnect the C4, C6, C8, C11, C13, C15, C51 or C53 ignition coil connector.

b. Disconnect the C45 ECM connector.

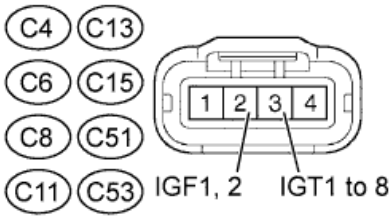
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

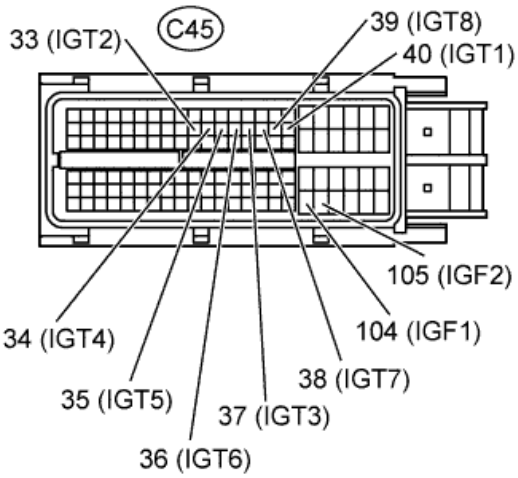
Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C15-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C45-40 (IGT1)	Always	Below 1 Ω

C15-3 (IGT2) - C45-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C45-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C45-34 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C45-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C45-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C45-38 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C45-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C45-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C45-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C45-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C45-34 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C45-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C45-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C45-38 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C45-39 (IGT8) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Ignition Coil with Igniter)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353, P0354, P0355, P0356, P0357 OR P0358)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Shuffle the arrangement of the ignition coils (among No. 1 to No. 8 cylinders).

NOTICE:

Do not shuffle the connectors.

e. Perform a simulation test.

f. Check DTCs displayed on the tester.

Result

Result	Proceed to
Same DTC is output	A
Different ignition coil DTC is output	B

B → REPLACE IGNITION COIL ASSEMBLY (Click here)

A → REPLACE ECM (Click here)

DTC P0016 Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)

DTC P0017 Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor B)

DTC P0018 Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor A)

DTC P0019 Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor B)

for Preparation Click here

DESCRIPTION

In the VVT (Variable Valve Timing) system, the appropriate intake and exhaust valve open and close timing is controlled by the ECM. The ECM performs intake and exhaust valve control by performing the following: 1) controlling the camshaft and camshaft timing oil control valve, and operating the camshaft timing gear; and 2) changing the relative positions of the camshaft and crankshaft.

DTC Code	DTC Detection Condition	Trouble Area
P0016	Deviation in the crankshaft position sensor signal and VVT sensor (for Intake side of Bank 1) signal (2 trip detection logic).	• Mechanical system (Timing chain has jumped tooth or chain stretched) • Camshaft oil control valve (OCV) (for intake side of bank 1) • Camshaft timing gear assembly • ECM
P0017	Deviation in the crankshaft position sensor signal and VVT sensor (for Exhaust side of Bank 1) signal (2 trip detection logic).	• Mechanical system (Timing chain has jumped tooth or chain stretched) • OCV (for exhaust side of bank 1) • Camshaft timing exhaust gear assembly • ECM
P0018	Deviation in the crankshaft position sensor signal and VVT sensor (for Intake side of Bank 2) signal (2 trip detection logic).	• Mechanical system (Timing chain has jumped tooth or chain stretched) • OCV (for intake side of bank 2) • Camshaft timing gear assembly • ECM
P0019	Deviation in the crankshaft position sensor signal and VVT sensor (for Exhaust side of Bank 2) signal (2 trip detection logic).	• Mechanical system (Timing chain has jumped tooth or chain stretched) • OCV (for exhaust side of bank 2) • Camshaft timing exhaust gear assembly • ECM

MONITOR DESCRIPTION

To monitor the correlation of the intake camshaft position and crankshaft position, the ECM checks the VVT learning value while the engine is idling. The VVT learning value is calibrated based on the camshaft position and crankshaft position. The intake valve timing is set to the most retarded angle while the engine is idling. If the VVT learning value is out of the specified range in consecutive driving cycles, the ECM illuminates the MIL and stores DTC P0016 (Bank 1) or P0018 (Bank 2).
To monitor the correlation of the exhaust camshaft position and crankshaft position, the ECM checks the VVT learning value while the engine is idling. The VVT learning value is calibrated based on the camshaft position and crankshaft position. The exhaust valve timing is set to the most advanced angle while the engine is idling. If the VVT learning value is out of the specified range in consecutive driving cycles, the ECM illuminates the MIL and stores DTC P0017 (Bank 1) or P0019 (Bank 2).

WIRING DIAGRAM

Refer to DTC P0335 (Click here).
Refer to DTC P0340 (Click here).
Refer to DTC P0365 (Click here).

INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0016, P0017, P0018 OR P0019)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0016, P0017, P0018 or P0019 is output	A
P0016, P0017, P0018 or P0019 and other DTCs are output	B

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)

HINT:

If the VVT system can be operated through the Active Test, it can be assumed that the VVT system is operating normally.

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the A/C on.

d. Turn the tester on

e. Warm up the engine.

f. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT Linear (Bank 1) or Control the VVT Linear (Bank 2) or Control the VVT Exhaust Linear (Bank 1) or Control the Exhaust VVT Linear (Bank 2) / All Data / VVT Change Angle #1, VVT Change Angle #2, VVT Ex Chg Angle #1, VVT Ex Chg Angle #2.

g. Perform the Active Test. Check that the displacement angle varies.

OK:

Displacement angle varies.

NG → Go to step 4

OK

3.ADJUST VALVE TIMING

a. Adjust the valve timing (Click here).

NEXT → Go to step 6

4.INSPECT CAMSHAFT OIL CONTROL VALVE (FOR INTAKE SIDE OR EXHAUST SIDE)

a. Remove the OCV.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

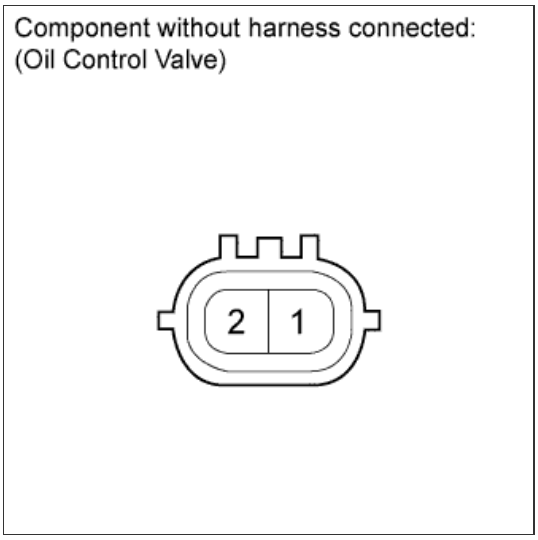
Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

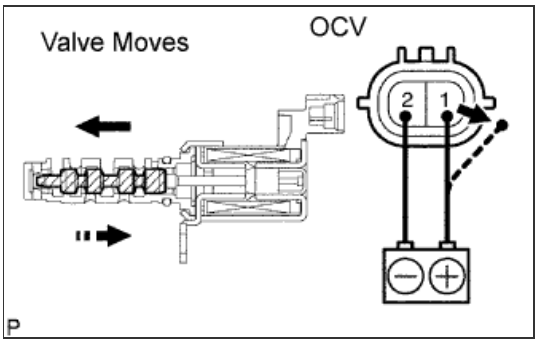
c. Check the valve operation.

OK:

Measurement Condition	Specified Condition

No battery voltage applied to terminals 1 and 2 → Battery voltage applied to terminals 1 and 2	Valve moves quickly





NG → REPLACE CAMSHAFT OIL CONTROL VALVE (Click here)

OK

5.REPLACE CAMSHAFT TIMING GEAR OR CAMSHAFT TIMING EXHAUST GEAR

a. Replace the camshaft timing gear (Click here).

b. Replace the camshaft timing exhaust gear (Click here).

NEXT

6.CONFIRM WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear the DTC (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. Drive the vehicle in an urban area for approximately 10 minutes.

g. Read DTCs using the tester.

OK:
No DTC is output.

NG → GO TO DTC CHART (Click here)

OK

END

DTC P0351 Ignition Coil "A" Primary / Secondary Circuit

DTC P0352 Ignition Coil "B" Primary / Secondary Circuit

DTC P0353 Ignition Coil "C" Primary / Secondary Circuit

DTC P0354 Ignition Coil "D" Primary / Secondary Circuit

DTC P0355 Ignition Coil "E" Primary / Secondary Circuit

DTC P0356 Ignition Coil "F" Primary / Secondary Circuit

DTC P0357 Ignition Coil "G" Primary / Secondary Circuit

DTC P0358 Ignition Coil "H" Primary / Secondary Circuit

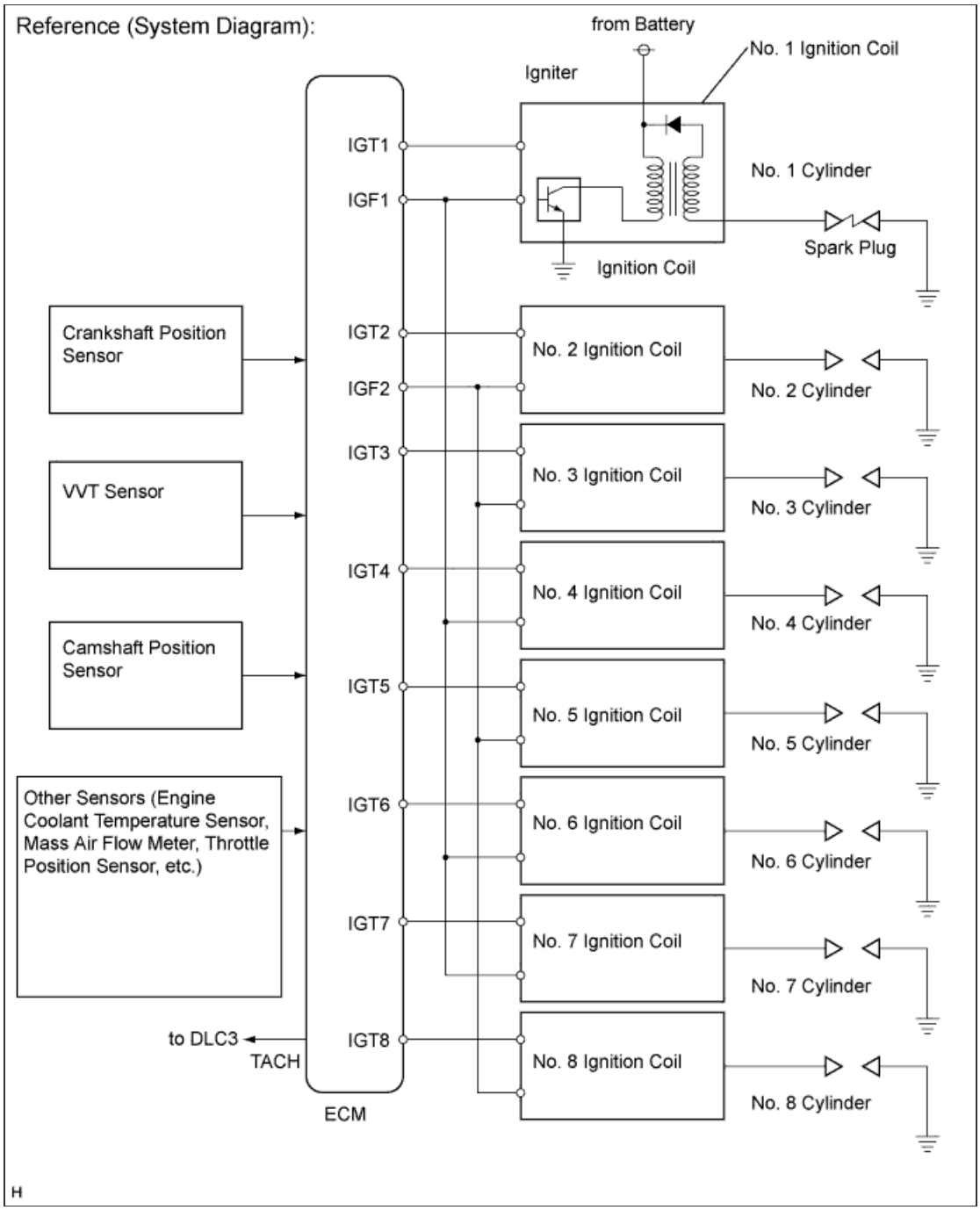
for Preparation Click here

DESCRIPTION

HINT:

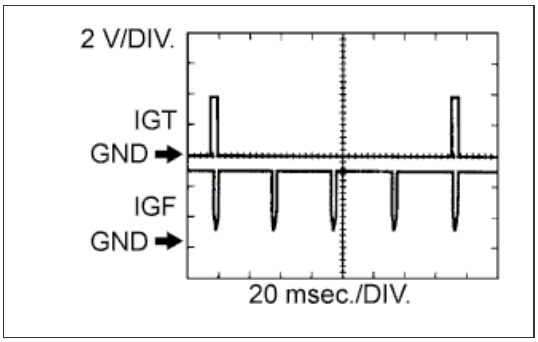
- **These DTCs indicate malfunctions relating to the primary circuit.**
- **If DTC P0351 is output, check the No. 1 ignition coil circuit.**
- **If DTC P0352 is output, check the No. 2 ignition coil circuit.**
- **If DTC P0353 is output, check the No. 3 ignition coil circuit.**
- **If DTC P0354 is output, check the No. 4 ignition coil circuit.**
- **If DTC P0355 is output, check the No. 5 ignition coil circuit.**
- **If DTC P0356 is output, check the No. 6 ignition coil circuit.**
- **If DTC P0357 is output, check the No. 7 ignition coil circuit.**
- **If DTC P0358 is output, check the No. 8 ignition coil circuit.**

A Direct Ignition System (DIS) is used on this vehicle.
The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.
The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.



DTC Code	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356 P0357 P0358	No IGF signal is sent to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 8) between ignition coil and ECM • No. 1 to No. 8 ignition coils • ECM

Reference: Inspection using an oscilloscope.



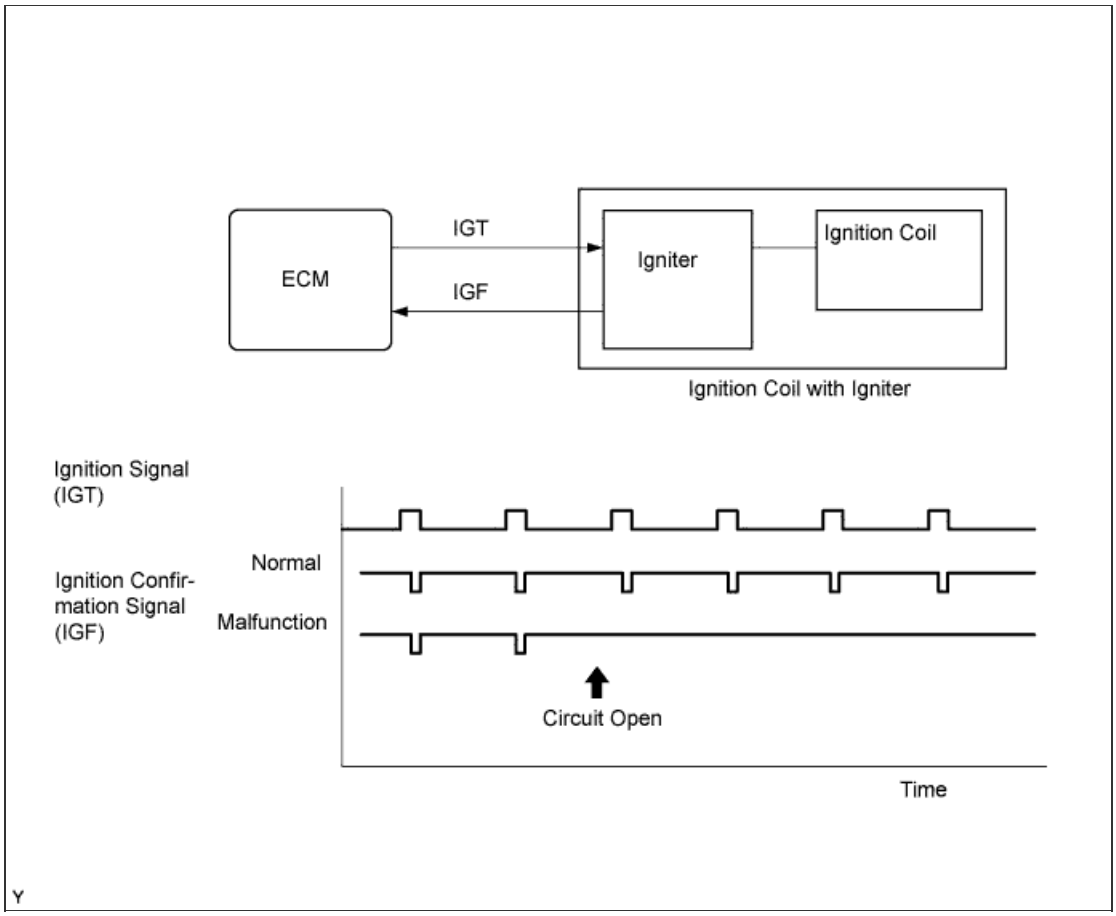
Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-40 (IGT1) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-33 (IGT2) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-37 (IGT3) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-34 (IGT4) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-35 (IGT5) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-36 (IGT6) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-38 (IGT7) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-39 (IGT8) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-104 (IGF1) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-105 (IGF2) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown

HINT:

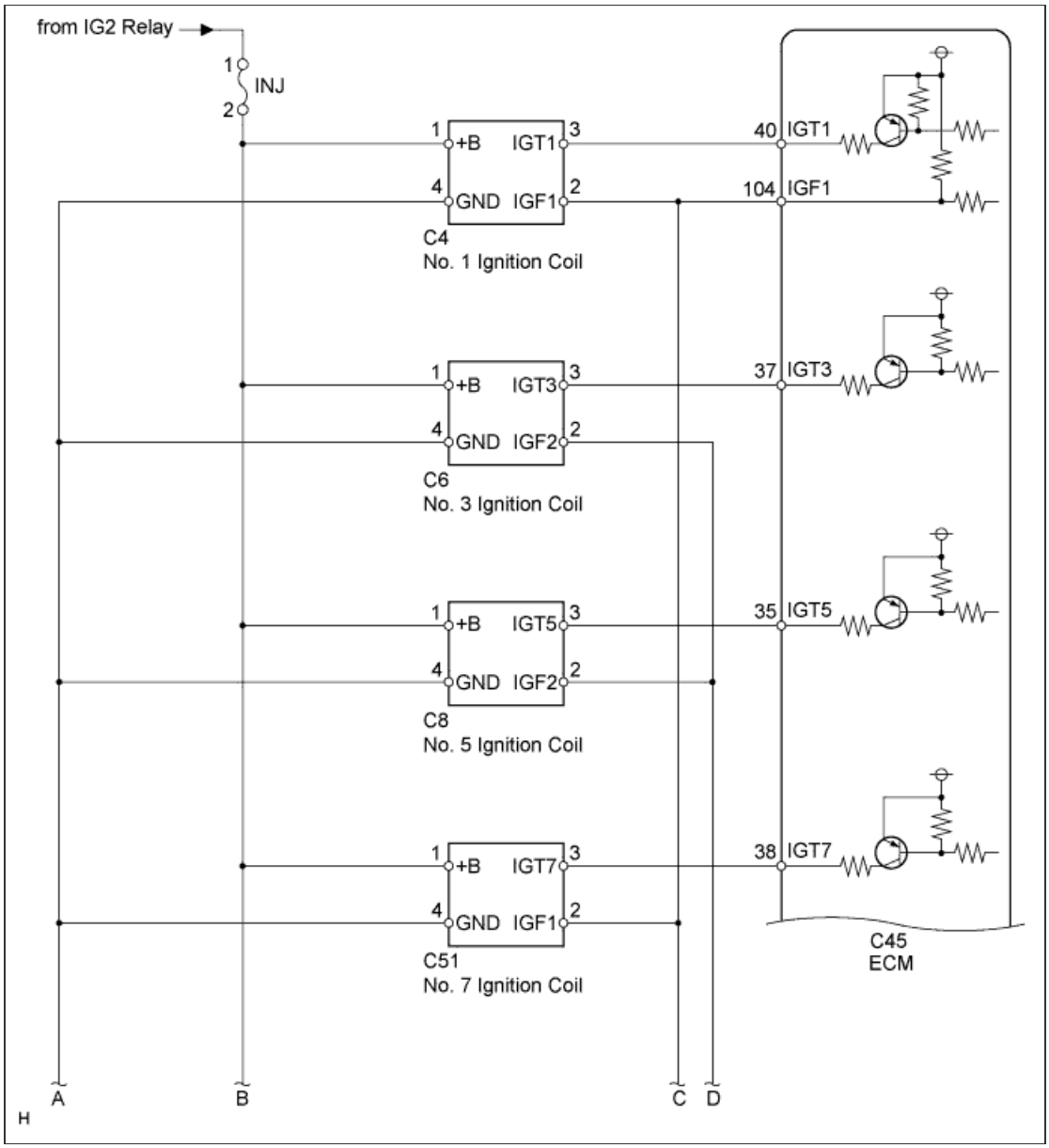
While cranking or idling the engine, check the waveform between terminals IGT (1 to 8) and E1, and IGF1 or IGF2 and E1 of the ECM connector.

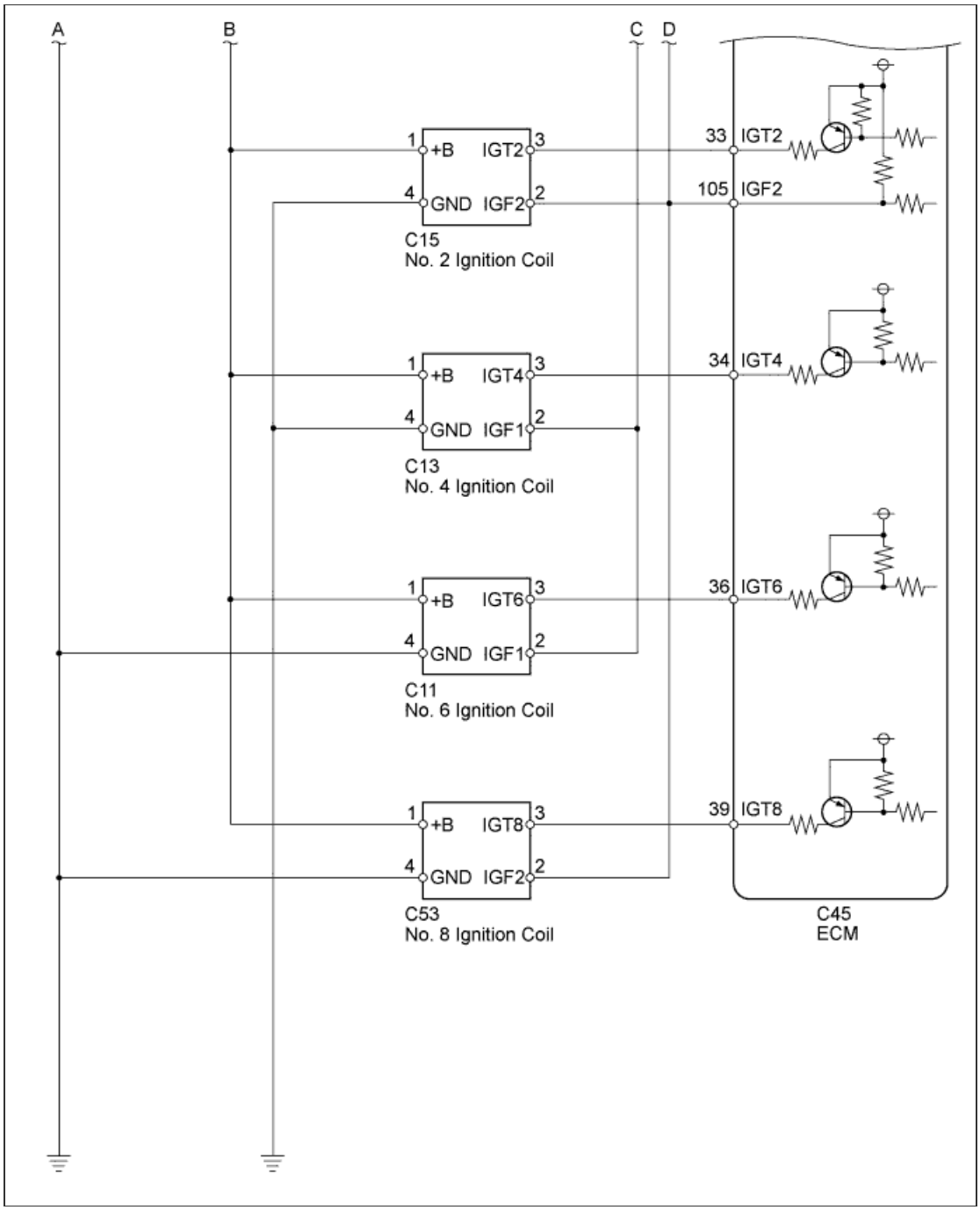
MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores DTC(s).
If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

WIRING DIAGRAM


from IG2 Relay
1
INJ
2
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
38
IGT7
C45
ECM
A
B
C
D
H



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)

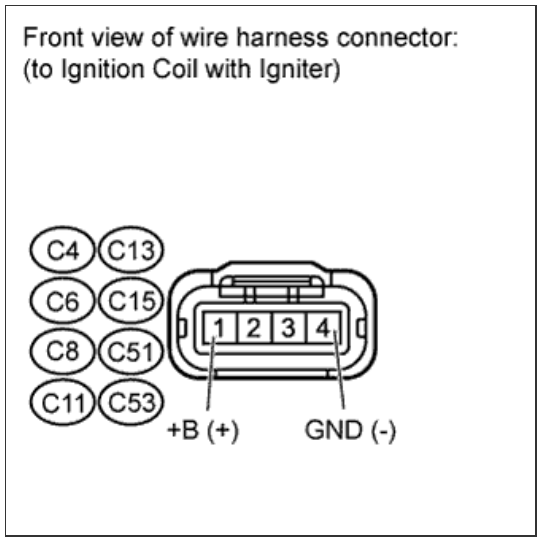
a. Disconnect the C4, C6, C8, C11, C13, C15, C51 or C53 ignition coil connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C4-4 (GND) - Body ground	Always	Below 1 Ω
C15-4 (GND) - Body ground	Always	Below 1 Ω
C6-4 (GND) - Body ground	Always	Below 1 Ω

C13-4 (GND) - Body ground	Always	Below 1 Ω
C8-4 (GND) - Body ground	Always	Below 1 Ω
C11-4 (GND) - Body ground	Always	Below 1 Ω
C51-4 (GND) - Body ground	Always	Below 1 Ω
C53-4 (GND) - Body ground	Always	Below 1 Ω



c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C4-1 (+B) - C4-4 (GND)	Engine switch on (IG)	11 to 14 V
C15-1 (+B) - C15-4 (GND)	Engine switch on (IG)	11 to 14 V
C6-1 (+B) - C6-4 (GND)	Engine switch on (IG)	11 to 14 V
C13-1 (+B) - C13-4 (GND)	Engine switch on (IG)	11 to 14 V
C8-1 (+B) - C8-4 (GND)	Engine switch on (IG)	11 to 14 V
C11-1 (+B) - C11-4 (GND)	Engine switch on (IG)	11 to 14 V
C51-1 (+B) - C51-4 (GND)	Engine switch on (IG)	11 to 14 V
C53-1 (+B) - C53-4 (GND)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

a. Disconnect the C4, C6, C8, C11, C13, C15, C51 or C53 ignition coil connector.

b. Disconnect the C45 ECM connector.

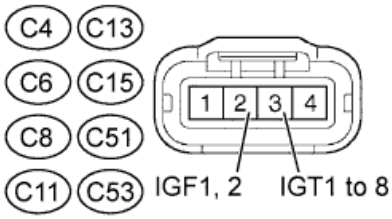
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

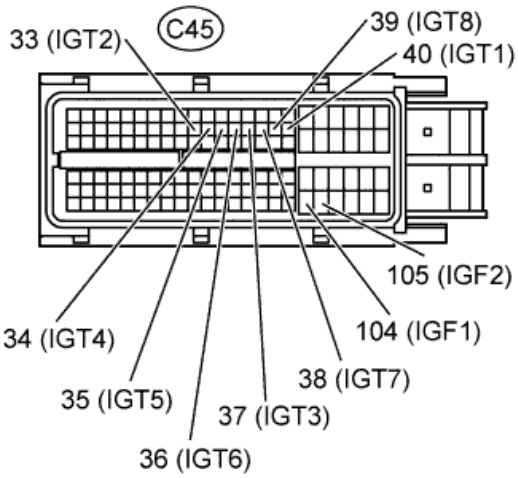
Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C15-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C45-40 (IGT1)	Always	Below 1 Ω

C15-3 (IGT2) - C45-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C45-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C45-34 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C45-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C45-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C45-38 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C45-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C45-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C45-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C45-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C45-34 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C45-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C45-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C45-38 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C45-39 (IGT8) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Ignition Coil with Igniter)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353, P0354, P0355, P0356, P0357 OR P0358)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Shuffle the arrangement of the ignition coils (among No. 1 to No. 8 cylinders).

NOTICE:

Do not shuffle the connectors.

e. Perform a simulation test.

f. Check DTCs displayed on the tester.

Result

Result	Proceed to
Same DTC is output	A
Different ignition coil DTC is output	B

B → REPLACE IGNITION COIL ASSEMBLY (Click here)

A → REPLACE ECM (Click here)

DTC P0016 Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)

DTC P0017 Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor B)

DTC P0018 Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor A)

DTC P0019 Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor B)

for Preparation Click here

DESCRIPTION

In the VVT (Variable Valve Timing) system, the appropriate intake and exhaust valve open and close timing is controlled by the ECM. The ECM performs intake and exhaust valve control by performing the following: 1) controlling the camshaft and camshaft timing oil control valve, and operating the camshaft timing gear; and 2) changing the relative positions of the camshaft and crankshaft.

DTC Code	DTC Detection Condition	Trouble Area
P0016	Deviation in the crankshaft position sensor signal and VVT sensor (for Intake side of Bank 1) signal (2 trip detection logic).	• Mechanical system (Timing chain has jumped tooth or chain stretched) • Camshaft oil control valve (OCV) (for intake side of bank 1) • Camshaft timing gear assembly • ECM
P0017	Deviation in the crankshaft position sensor signal and VVT sensor (for Exhaust side of Bank 1) signal (2 trip detection logic).	• Mechanical system (Timing chain has jumped tooth or chain stretched) • OCV (for exhaust side of bank 1) • Camshaft timing exhaust gear assembly • ECM
P0018	Deviation in the crankshaft position sensor signal and VVT sensor (for Intake side of Bank 2) signal (2 trip detection logic).	• Mechanical system (Timing chain has jumped tooth or chain stretched) • OCV (for intake side of bank 2) • Camshaft timing gear assembly • ECM
P0019	Deviation in the crankshaft position sensor signal and VVT sensor (for Exhaust side of Bank 2) signal (2 trip detection logic).	• Mechanical system (Timing chain has jumped tooth or chain stretched) • OCV (for exhaust side of bank 2) • Camshaft timing exhaust gear assembly • ECM

MONITOR DESCRIPTION

To monitor the correlation of the intake camshaft position and crankshaft position, the ECM checks the VVT learning value while the engine is idling. The VVT learning value is calibrated based on the camshaft position and crankshaft position. The intake valve timing is set to the most retarded angle while the engine is idling. If the VVT learning value is out of the specified range in consecutive driving cycles, the ECM illuminates the MIL and stores DTC P0016 (Bank 1) or P0018 (Bank 2).
To monitor the correlation of the exhaust camshaft position and crankshaft position, the ECM checks the VVT learning value while the engine is idling. The VVT learning value is calibrated based on the camshaft position and crankshaft position. The exhaust valve timing is set to the most advanced angle while the engine is idling. If the VVT learning value is out of the specified range in consecutive driving cycles, the ECM illuminates the MIL and stores DTC P0017 (Bank 1) or P0019 (Bank 2).

WIRING DIAGRAM

Refer to DTC P0335 (Click here).
Refer to DTC P0340 (Click here).
Refer to DTC P0365 (Click here).

INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0016, P0017, P0018 OR P0019)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0016, P0017, P0018 or P0019 is output	A
P0016, P0017, P0018 or P0019 and other DTCs are output	B

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)

HINT:

If the VVT system can be operated through the Active Test, it can be assumed that the VVT system is operating normally.

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the A/C on.

d. Turn the tester on

e. Warm up the engine.

f. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT Linear (Bank 1) or Control the VVT Linear (Bank 2) or Control the VVT Exhaust Linear (Bank 1) or Control the Exhaust VVT Linear (Bank 2) / All Data / VVT Change Angle #1, VVT Change Angle #2, VVT Ex Chg Angle #1, VVT Ex Chg Angle #2.

g. Perform the Active Test. Check that the displacement angle varies.

OK:

Displacement angle varies.

NG → Go to step 4

OK

3.ADJUST VALVE TIMING

a. Adjust the valve timing (Click here).

NEXT → Go to step 6

4.INSPECT CAMSHAFT OIL CONTROL VALVE (FOR INTAKE SIDE OR EXHAUST SIDE)

a. Remove the OCV.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

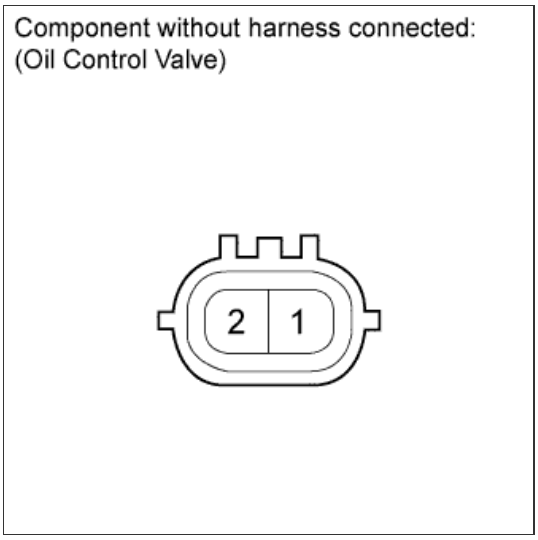
Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

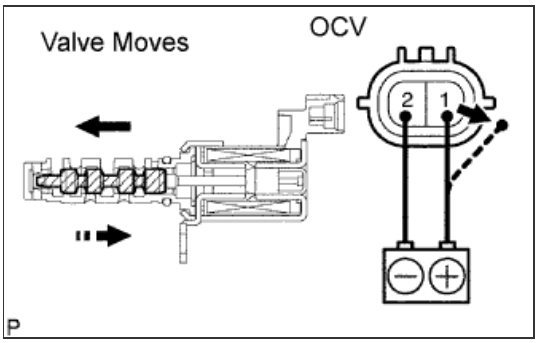
c. Check the valve operation.

OK:

Measurement Condition	Specified Condition

No battery voltage applied to terminals 1 and 2 → Battery voltage applied to terminals 1 and 2	Valve moves quickly





NG → REPLACE CAMSHAFT OIL CONTROL VALVE (Click here)

OK

5.REPLACE CAMSHAFT TIMING GEAR OR CAMSHAFT TIMING EXHAUST GEAR

a. Replace the camshaft timing gear (Click here).

b. Replace the camshaft timing exhaust gear (Click here).

NEXT

6.CONFIRM WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear the DTC (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. Drive the vehicle in an urban area for approximately 10 minutes.

g. Read DTCs using the tester.

OK:
No DTC is output.

NG → GO TO DTC CHART (Click here)

OK

END

DTC P0351 Ignition Coil "A" Primary / Secondary Circuit

DTC P0352 Ignition Coil "B" Primary / Secondary Circuit

DTC P0353 Ignition Coil "C" Primary / Secondary Circuit

DTC P0354 Ignition Coil "D" Primary / Secondary Circuit

DTC P0355 Ignition Coil "E" Primary / Secondary Circuit

DTC P0356 Ignition Coil "F" Primary / Secondary Circuit

DTC P0357 Ignition Coil "G" Primary / Secondary Circuit

DTC P0358 Ignition Coil "H" Primary / Secondary Circuit

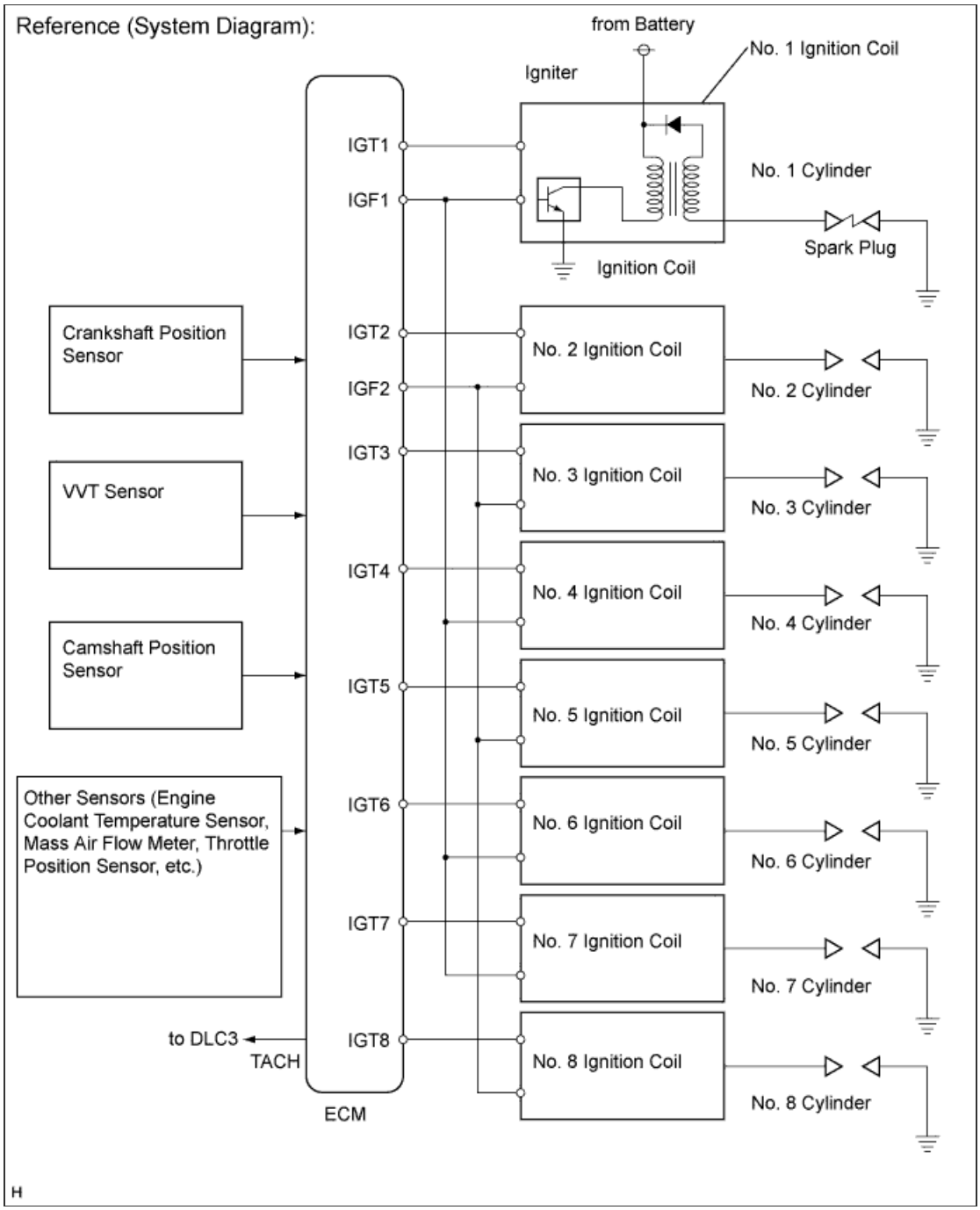
for Preparation Click here

DESCRIPTION

HINT:

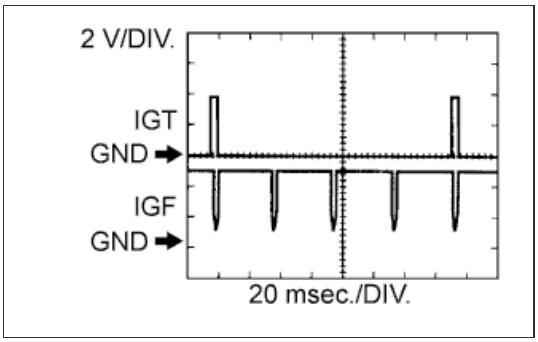
- **These DTCs indicate malfunctions relating to the primary circuit.**
- **If DTC P0351 is output, check the No. 1 ignition coil circuit.**
- **If DTC P0352 is output, check the No. 2 ignition coil circuit.**
- **If DTC P0353 is output, check the No. 3 ignition coil circuit.**
- **If DTC P0354 is output, check the No. 4 ignition coil circuit.**
- **If DTC P0355 is output, check the No. 5 ignition coil circuit.**
- **If DTC P0356 is output, check the No. 6 ignition coil circuit.**
- **If DTC P0357 is output, check the No. 7 ignition coil circuit.**
- **If DTC P0358 is output, check the No. 8 ignition coil circuit.**

A Direct Ignition System (DIS) is used on this vehicle.
The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.
The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.



DTC Code	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356 P0357 P0358	No IGF signal is sent to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 8) between ignition coil and ECM • No. 1 to No. 8 ignition coils • ECM

Reference: Inspection using an oscilloscope.



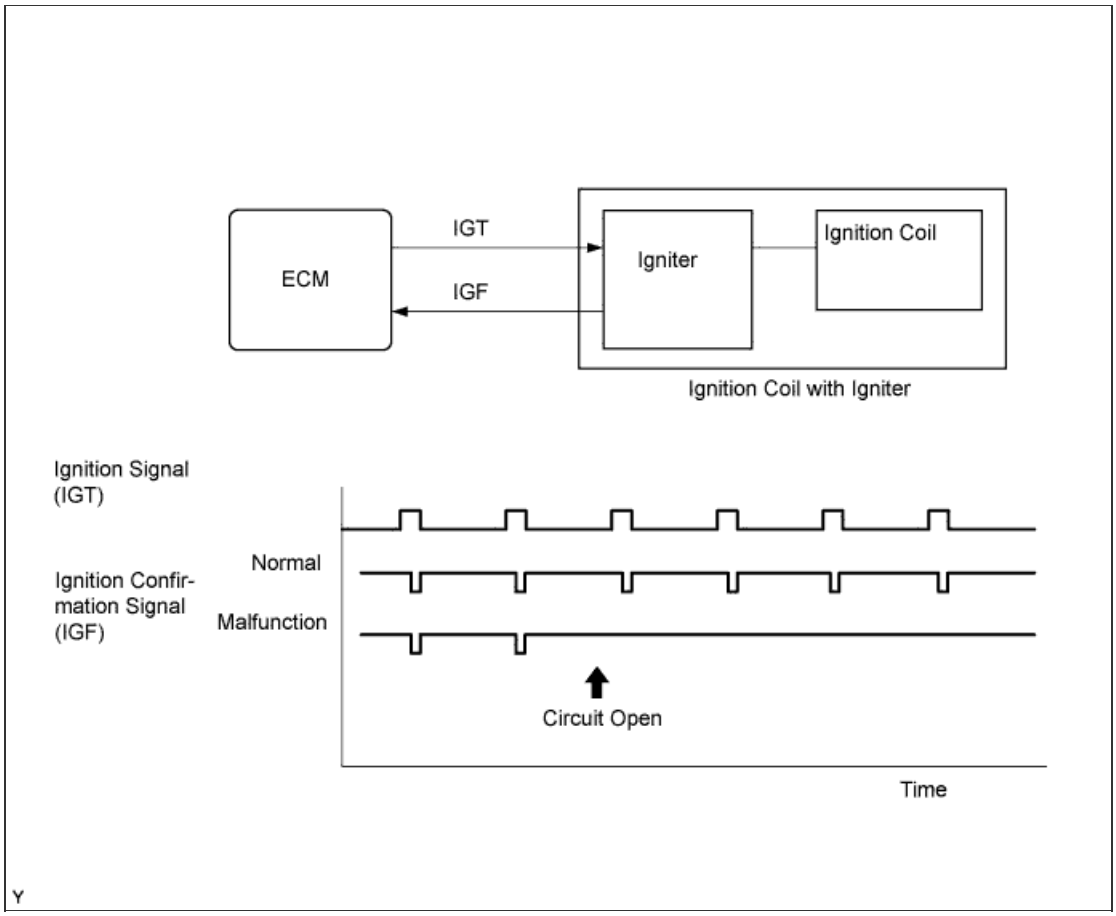
Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-40 (IGT1) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-33 (IGT2) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-37 (IGT3) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-34 (IGT4) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-35 (IGT5) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-36 (IGT6) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-38 (IGT7) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-39 (IGT8) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-104 (IGF1) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown
C45-105 (IGF2) - C45-81 (E1)	2 V/DIV., 20 msec./DIV.	Idling	The correct waveform is as shown

HINT:

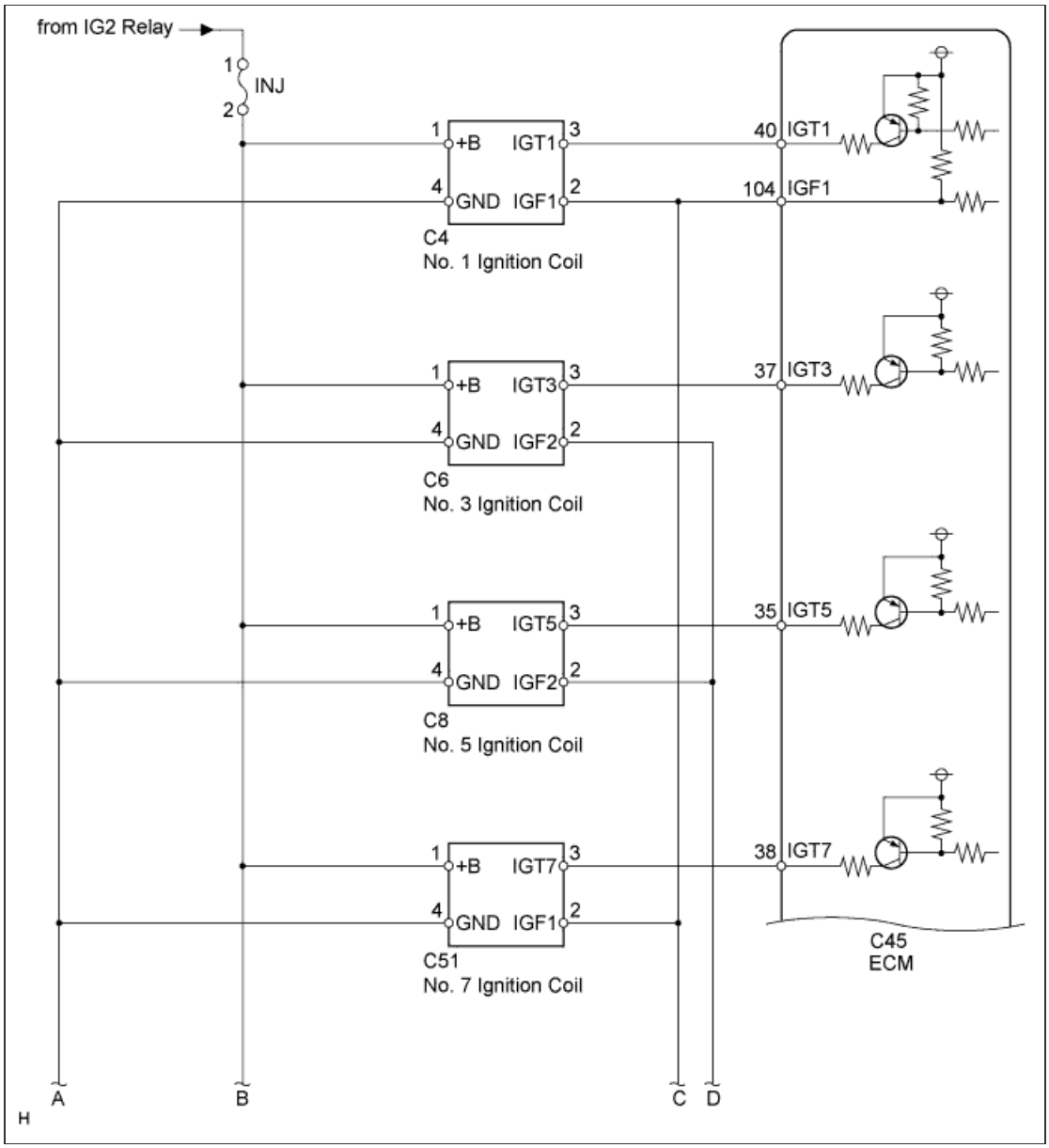
While cranking or idling the engine, check the waveform between terminals IGT (1 to 8) and E1, and IGF1 or IGF2 and E1 of the ECM connector.

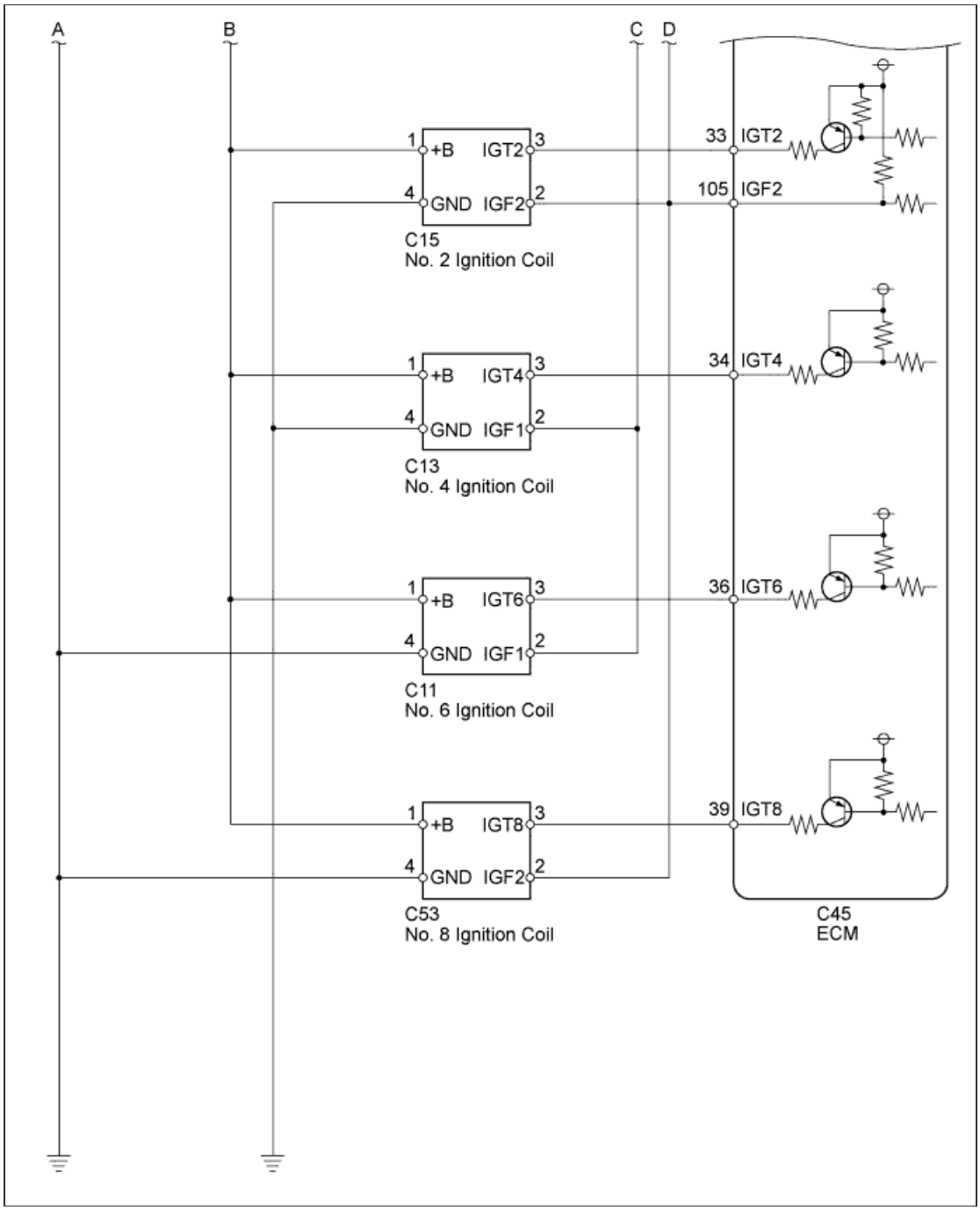
MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores DTC(s).
If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

WIRING DIAGRAM


from IG2 Relay
1
INJ
2
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
38
IGT7
C45
ECM
A
B
C
D
H



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)

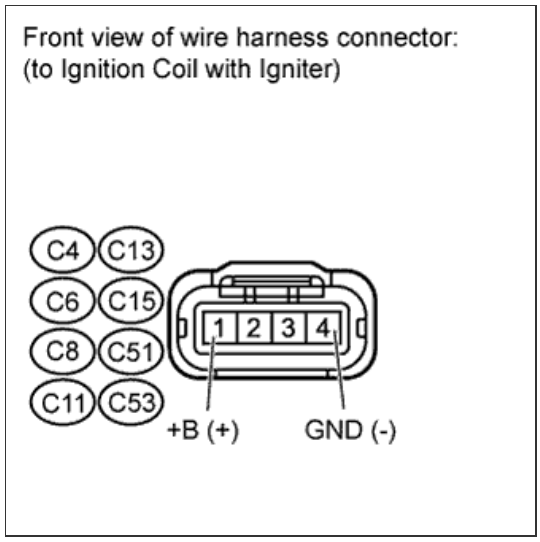
a. Disconnect the C4, C6, C8, C11, C13, C15, C51 or C53 ignition coil connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C4-4 (GND) - Body ground	Always	Below 1 Ω
C15-4 (GND) - Body ground	Always	Below 1 Ω
C6-4 (GND) - Body ground	Always	Below 1 Ω

C13-4 (GND) - Body ground	Always	Below 1 Ω
C8-4 (GND) - Body ground	Always	Below 1 Ω
C11-4 (GND) - Body ground	Always	Below 1 Ω
C51-4 (GND) - Body ground	Always	Below 1 Ω
C53-4 (GND) - Body ground	Always	Below 1 Ω



c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C4-1 (+B) - C4-4 (GND)	Engine switch on (IG)	11 to 14 V
C15-1 (+B) - C15-4 (GND)	Engine switch on (IG)	11 to 14 V
C6-1 (+B) - C6-4 (GND)	Engine switch on (IG)	11 to 14 V
C13-1 (+B) - C13-4 (GND)	Engine switch on (IG)	11 to 14 V
C8-1 (+B) - C8-4 (GND)	Engine switch on (IG)	11 to 14 V
C11-1 (+B) - C11-4 (GND)	Engine switch on (IG)	11 to 14 V
C51-1 (+B) - C51-4 (GND)	Engine switch on (IG)	11 to 14 V
C53-1 (+B) - C53-4 (GND)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

a. Disconnect the C4, C6, C8, C11, C13, C15, C51 or C53 ignition coil connector.

b. Disconnect the C45 ECM connector.

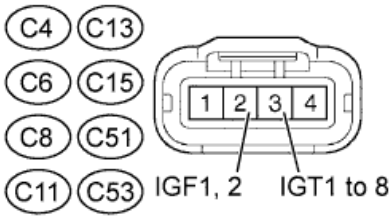
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

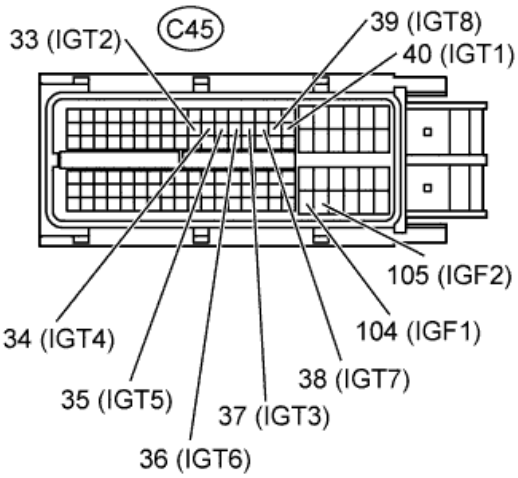
Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C15-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C45-40 (IGT1)	Always	Below 1 Ω

C15-3 (IGT2) - C45-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C45-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C45-34 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C45-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C45-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C45-38 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C45-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C45-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C45-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C45-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C45-34 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C45-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C45-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C45-38 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C45-39 (IGT8) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Ignition Coil with Igniter)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353, P0354, P0355, P0356, P0357 OR P0358)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Shuffle the arrangement of the ignition coils (among No. 1 to No. 8 cylinders).

NOTICE:

Do not shuffle the connectors.

e. Perform a simulation test.

f. Check DTCs displayed on the tester.

Result

Result	Proceed to
Same DTC is output	A
Different ignition coil DTC is output	B

B → REPLACE IGNITION COIL ASSEMBLY (Click here)

A → REPLACE ECM (Click here)

DTC P0016 Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)

DTC P0017 Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor B)

DTC P0018 Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor A)

DTC P0019 Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor B)

for Preparation Click here

DESCRIPTION

In the VVT (Variable Valve Timing) system, the appropriate intake and exhaust valve open and close timing is controlled by the ECM. The ECM performs intake and exhaust valve control by performing the following: 1) controlling the camshaft and camshaft timing oil control valve, and operating the camshaft timing gear; and 2) changing the relative positions of the camshaft and crankshaft.

DTC Code	DTC Detection Condition	Trouble Area
P0016	Deviation in the crankshaft position sensor signal and VVT sensor (for Intake side of Bank 1) signal (2 trip detection logic).	• Mechanical system (Timing chain has jumped tooth or chain stretched) • Camshaft oil control valve (OCV) (for intake side of bank 1) • Camshaft timing gear assembly • ECM
P0017	Deviation in the crankshaft position sensor signal and VVT sensor (for Exhaust side of Bank 1) signal (2 trip detection logic).	• Mechanical system (Timing chain has jumped tooth or chain stretched) • OCV (for exhaust side of bank 1) • Camshaft timing exhaust gear assembly • ECM
P0018	Deviation in the crankshaft position sensor signal and VVT sensor (for Intake side of Bank 2) signal (2 trip detection logic).	• Mechanical system (Timing chain has jumped tooth or chain stretched) • OCV (for intake side of bank 2) • Camshaft timing gear assembly • ECM
P0019	Deviation in the crankshaft position sensor signal and VVT sensor (for Exhaust side of Bank 2) signal (2 trip detection logic).	• Mechanical system (Timing chain has jumped tooth or chain stretched) • OCV (for exhaust side of bank 2) • Camshaft timing exhaust gear assembly • ECM

MONITOR DESCRIPTION

To monitor the correlation of the intake camshaft position and crankshaft position, the ECM checks the VVT learning value while the engine is idling. The VVT learning value is calibrated based on the camshaft position and crankshaft position. The intake valve timing is set to the most retarded angle while the engine is idling. If the VVT learning value is out of the specified range in consecutive driving cycles, the ECM illuminates the MIL and stores DTC P0016 (Bank 1) or P0018 (Bank 2).
To monitor the correlation of the exhaust camshaft position and crankshaft position, the ECM checks the VVT learning value while the engine is idling. The VVT learning value is calibrated based on the camshaft position and crankshaft position. The exhaust valve timing is set to the most advanced angle while the engine is idling. If the VVT learning value is out of the specified range in consecutive driving cycles, the ECM illuminates the MIL and stores DTC P0017 (Bank 1) or P0019 (Bank 2).

WIRING DIAGRAM

Refer to DTC P0335 (Click here).
Refer to DTC P0340 (Click here).
Refer to DTC P0365 (Click here).

INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0016, P0017, P0018 OR P0019)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0016, P0017, P0018 or P0019 is output	A
P0016, P0017, P0018 or P0019 and other DTCs are output	B

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)

HINT:

If the VVT system can be operated through the Active Test, it can be assumed that the VVT system is operating normally.

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the A/C on.

d. Turn the tester on

e. Warm up the engine.

f. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT Linear (Bank 1) or Control the VVT Linear (Bank 2) or Control the VVT Exhaust Linear (Bank 1) or Control the Exhaust VVT Linear (Bank 2) / All Data / VVT Change Angle #1, VVT Change Angle #2, VVT Ex Chg Angle #1, VVT Ex Chg Angle #2.

g. Perform the Active Test. Check that the displacement angle varies.

OK:

Displacement angle varies.

NG → Go to step 4

OK

3.ADJUST VALVE TIMING

a. Adjust the valve timing (Click here).

NEXT → Go to step 6

4.INSPECT CAMSHAFT OIL CONTROL VALVE (FOR INTAKE SIDE OR EXHAUST SIDE)

a. Remove the OCV.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

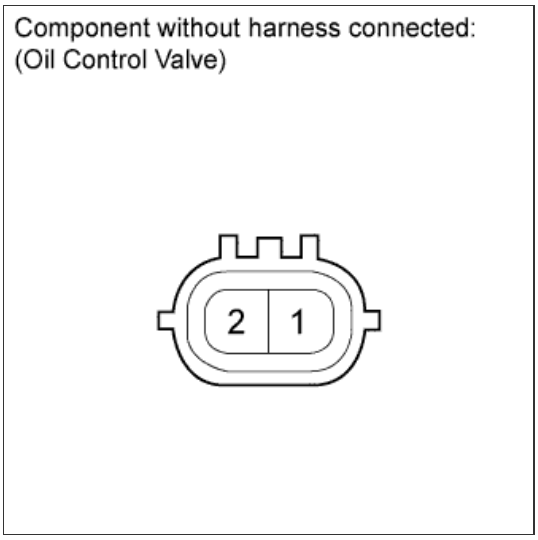
Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

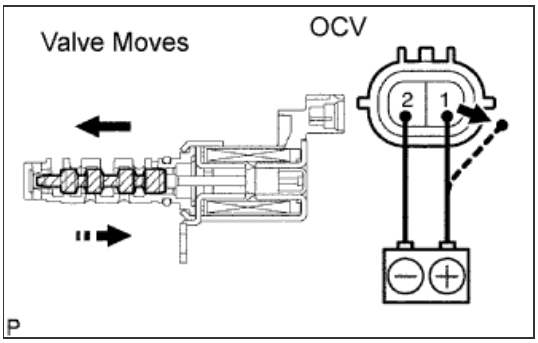
c. Check the valve operation.

OK:

Measurement Condition	Specified Condition

No battery voltage applied to terminals 1 and 2 → Battery voltage applied to terminals 1 and 2	Valve moves quickly





NG → REPLACE CAMSHAFT OIL CONTROL VALVE (Click here)

OK

5.REPLACE CAMSHAFT TIMING GEAR OR CAMSHAFT TIMING EXHAUST GEAR

a. Replace the camshaft timing gear (Click here).

b. Replace the camshaft timing exhaust gear (Click here).

NEXT

6.CONFIRM WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear the DTC (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. Drive the vehicle in an urban area for approximately 10 minutes.

g. Read DTCs using the tester.

OK:
No DTC is output.

NG → GO TO DTC CHART (Click here)

OK

END

DTC P0365 Camshaft Position Sensor "B" Circuit (Bank 1)

DTC P0367 Camshaft Position Sensor "B" Circuit Low Input (Bank 1)

DTC P0368 Camshaft Position Sensor "B" Circuit High Input (Bank 1)

DTC P0390 Camshaft Position Sensor "B" Circuit (Bank 2)

DTC P0392 Camshaft Position Sensor "B" Circuit Low Input (Bank 2)

DTC P0393 Camshaft Position Sensor "B" Circuit High Input (Bank 2)

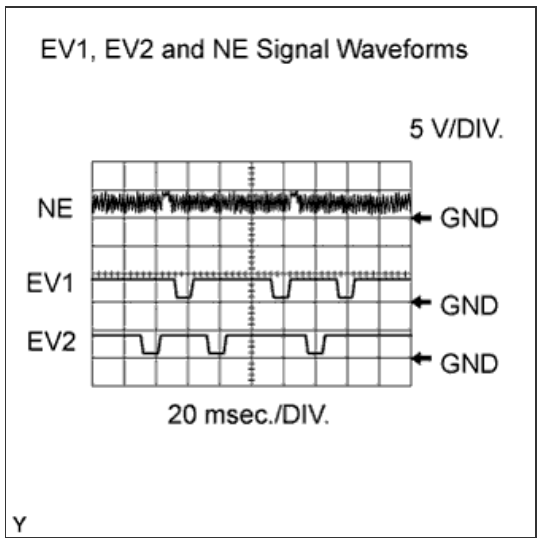
for Preparation Click here

DESCRIPTION

The exhaust camshaft Variable Valve Timing (VVT) sensor (EV1, 2 signal) consists of a magnet and MRE (Magnetic Resistance Element).
The exhaust camshaft has a sensor plate with 3 teeth on its outer circumference. When the exhaust camshaft rotates, changes occur in the air gaps between the 3 teeth and MRE, which affects the magnet. As a result, the resistance of the MRE material fluctuates. The VVT sensor converts the exhaust camshaft rotation data into pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM.

DTC Code	DTC Detection Condition	Trouble Area
P0365 P0390	When either condition below is met: • The input voltage to the ECM remains at below 0.3 V or higher than 4.7 V for more than 4 seconds when 2 or more seconds have elapsed after turning the engine switch on (IG) (1 trip detection logic). • No VVT sensor signal is sent to the ECM during cranking (1 trip detection logic).	• Open or short in VVT sensor (for exhaust side) circuit • VVT sensor (for exhaust side) • Exhaust camshaft • Jumped tooth of timing chain • ECM
P0367 P0392	The output voltage of the VVT sensor is below 0.3 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for exhaust side) circuit • VVT sensor (for exhaust side) • Exhaust camshaft • Jumped tooth of timing chain • ECM
P0368 P0393	The output voltage of the VVT sensor is higher than 4.7 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for exhaust side) circuit • VVT sensor (for exhaust side) • Exhaust camshaft • Jumped tooth of timing chain • ECM

Reference: Inspection using an oscilloscope.



Standard:

Tester Connection	Tool Setting	Condition	Specified Condition

C45 110 (NE+) - C45-111 (NE-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-69 (EV1+) - C45-68 (EV1-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-64 (EV2+) - C45-65 (EV2-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown

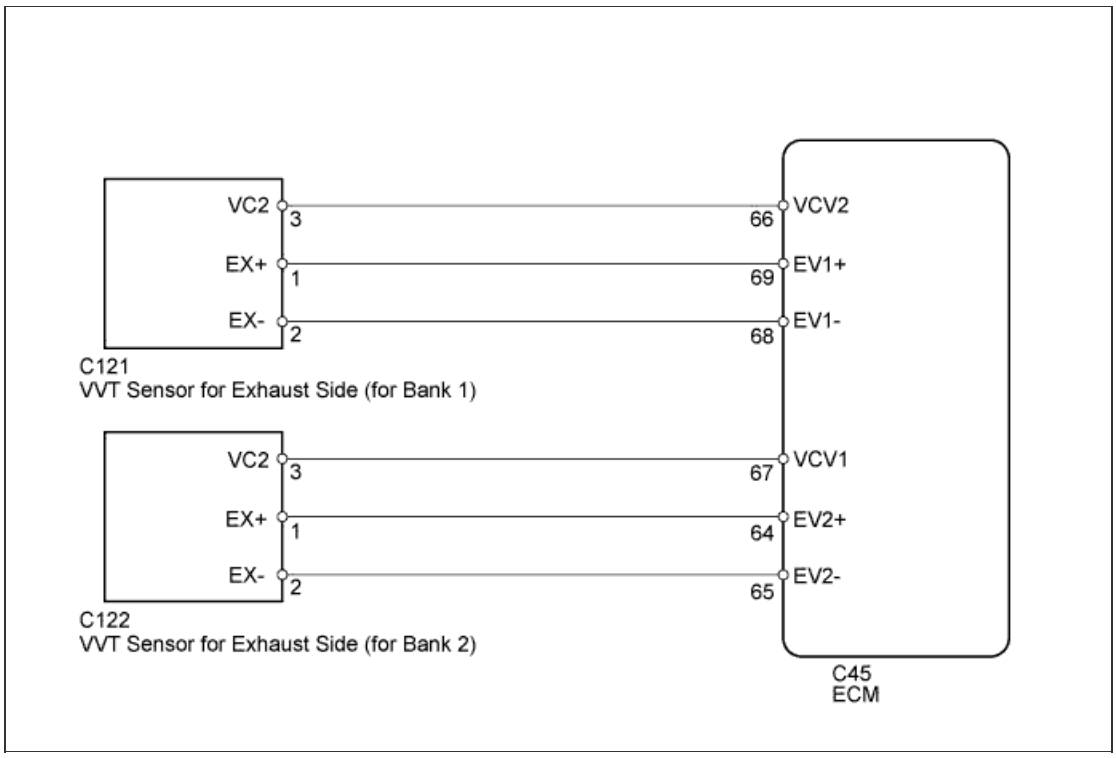
HINT:

EV1+ and EV2+ stand for the VVT sensor (for exhaust side) signal, and NE+ stands for the CKP sensor signal.

MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine revolving, or the rotations of the camshaft and the crankshaft are not synchronized, the ECM interprets this as a malfunction of the sensor.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

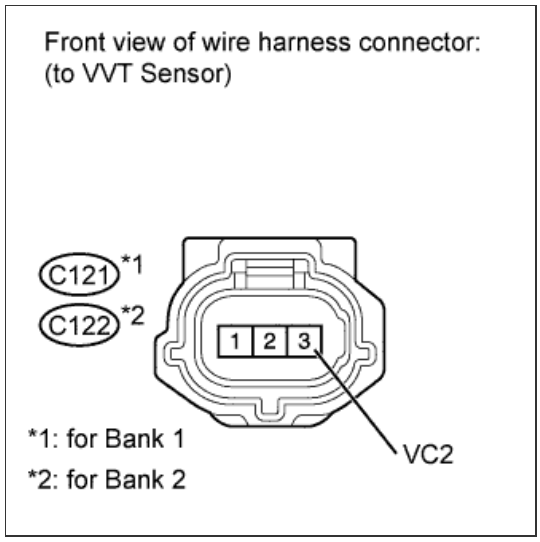
1.CHECK HARNESS AND CONNECTOR (SENSOR POWER SOURCE)

a. Disconnect the C121 or C122 VVT sensor (for exhaust side) connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
C121-3 (VC2) - Body ground	Engine switch on (IG)	4.5 to 5.0 V
C122-3 (VC2) - Body ground	Engine switch on (IG)	4.5 to 5.0 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (VVT SENSOR (for Exhaust Side) - ECM)

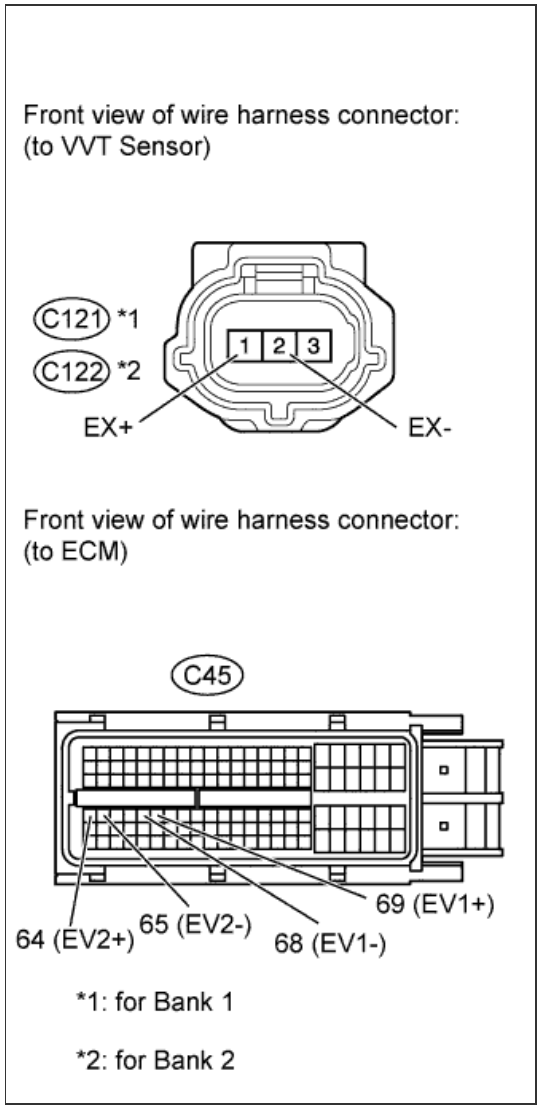
a. Disconnect the C121 or C122 VVT (for exhaust side) sensor connector.

b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C121-1 (EX+) - C45-69 (EV1+)	Always	Below 1 Ω
C121-2 (EX-) - C45-68 (EV1-)	Always	Below 1 Ω
C122-1 (EX+) - C45-64 (EV2+)	Always	Below 1 Ω
C122-2 (EX-) - C45-65 (EV2-)	Always	Below 1 Ω
C121-1 (EX+) or C45-69 (EV1+) - Body ground	Always	10 kΩ or higher
C121-2 (EX-) or C45-68 (EV1-) - Body ground	Always	10 kΩ or higher
C122-1 (EX+) or C45-64 (EV2+) - Body ground	Always	10 kΩ or higher
C122-2 (EX-) or C45-65 (EV2-) - Body ground	Always	10 kΩ or higher



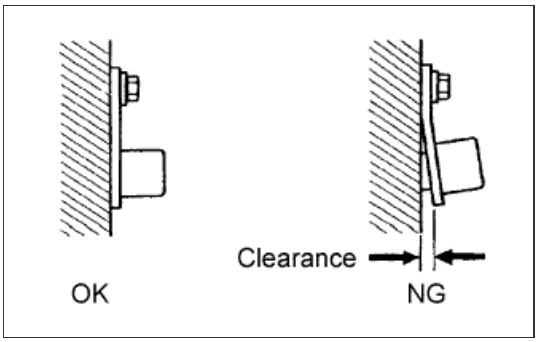
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK SENSOR INSTALLATION

a. Chec the VVT sensor (for exhaust side) installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

4.CHECK EXHAUST CAMSHAFT

a. Check the teeth of the camshaft.

OK:
Teeth do not have any cracks or deformation.

NG → REPLACE EXHAUST CAMSHAFT (Click here)

OK

5.REPLACE VVT SENSOR (for Exhaust Side)

a. Replace the VVT sensor (for exhaust side) (Click here).

NEXT

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No output	A
P0365, P0367, P0368, P0390, P0392 or P0393	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

DTC P0016 Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)

DTC P0017 Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor B)

DTC P0018 Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor A)

DTC P0019 Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor B)

for Preparation Click here

DESCRIPTION

In the VVT (Variable Valve Timing) system, the appropriate intake and exhaust valve open and close timing is controlled by the ECM. The ECM performs intake and exhaust valve control by performing the following: 1) controlling the camshaft and camshaft timing oil control valve, and operating the camshaft timing gear; and 2) changing the relative positions of the camshaft and crankshaft.

DTC Code	DTC Detection Condition	Trouble Area
P0016	Deviation in the crankshaft position sensor signal and VVT sensor (for Intake side of Bank 1) signal (2 trip detection logic).	• Mechanical system (Timing chain has jumped tooth or chain stretched) • Camshaft oil control valve (OCV) (for intake side of bank 1) • Camshaft timing gear assembly • ECM
P0017	Deviation in the crankshaft position sensor signal and VVT sensor (for Exhaust side of Bank 1) signal (2 trip detection logic).	• Mechanical system (Timing chain has jumped tooth or chain stretched) • OCV (for exhaust side of bank 1) • Camshaft timing exhaust gear assembly • ECM
P0018	Deviation in the crankshaft position sensor signal and VVT sensor (for Intake side of Bank 2) signal (2 trip detection logic).	• Mechanical system (Timing chain has jumped tooth or chain stretched) • OCV (for intake side of bank 2) • Camshaft timing gear assembly • ECM
P0019	Deviation in the crankshaft position sensor signal and VVT sensor (for Exhaust side of Bank 2) signal (2 trip detection logic).	• Mechanical system (Timing chain has jumped tooth or chain stretched) • OCV (for exhaust side of bank 2) • Camshaft timing exhaust gear assembly • ECM

MONITOR DESCRIPTION

To monitor the correlation of the intake camshaft position and crankshaft position, the ECM checks the VVT learning value while the engine is idling. The VVT learning value is calibrated based on the camshaft position and crankshaft position. The intake valve timing is set to the most retarded angle while the engine is idling. If the VVT learning value is out of the specified range in consecutive driving cycles, the ECM illuminates the MIL and stores DTC P0016 (Bank 1) or P0018 (Bank 2).
To monitor the correlation of the exhaust camshaft position and crankshaft position, the ECM checks the VVT learning value while the engine is idling. The VVT learning value is calibrated based on the camshaft position and crankshaft position. The exhaust valve timing is set to the most advanced angle while the engine is idling. If the VVT learning value is out of the specified range in consecutive driving cycles, the ECM illuminates the MIL and stores DTC P0017 (Bank 1) or P0019 (Bank 2).

WIRING DIAGRAM

Refer to DTC P0335 (Click here).
Refer to DTC P0340 (Click here).
Refer to DTC P0365 (Click here).

INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0016, P0017, P0018 OR P0019)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0016, P0017, P0018 or P0019 is output	A
P0016, P0017, P0018 or P0019 and other DTCs are output	B

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)

HINT:

If the VVT system can be operated through the Active Test, it can be assumed that the VVT system is operating normally.

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the A/C on.

d. Turn the tester on

e. Warm up the engine.

f. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT Linear (Bank 1) or Control the VVT Linear (Bank 2) or Control the VVT Exhaust Linear (Bank 1) or Control the Exhaust VVT Linear (Bank 2) / All Data / VVT Change Angle #1, VVT Change Angle #2, VVT Ex Chg Angle #1, VVT Ex Chg Angle #2.

g. Perform the Active Test. Check that the displacement angle varies.

OK:

Displacement angle varies.

NG → Go to step 4

OK

3.ADJUST VALVE TIMING

a. Adjust the valve timing (Click here).

NEXT → Go to step 6

4.INSPECT CAMSHAFT OIL CONTROL VALVE (FOR INTAKE SIDE OR EXHAUST SIDE)

a. Remove the OCV.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

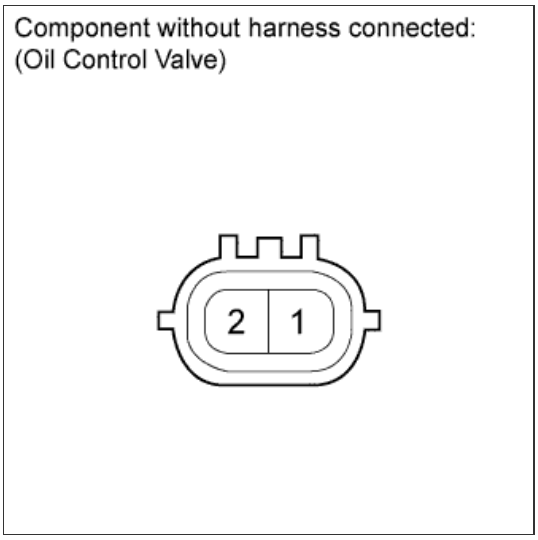
Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

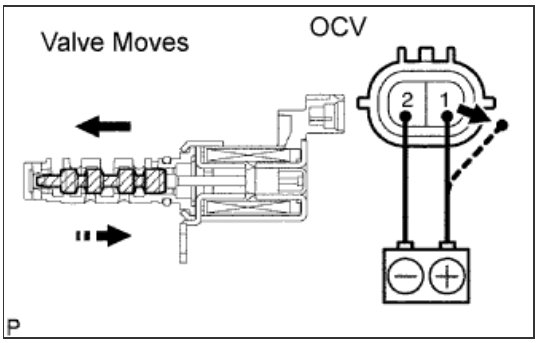
c. Check the valve operation.

OK:

Measurement Condition	Specified Condition

No battery voltage applied to terminals 1 and 2 → Battery voltage applied to terminals 1 and 2	Valve moves quickly





NG → REPLACE CAMSHAFT OIL CONTROL VALVE (Click here)

OK

5.REPLACE CAMSHAFT TIMING GEAR OR CAMSHAFT TIMING EXHAUST GEAR

a. Replace the camshaft timing gear (Click here).

b. Replace the camshaft timing exhaust gear (Click here).

NEXT

6.CONFIRM WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear the DTC (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. Drive the vehicle in an urban area for approximately 10 minutes.

g. Read DTCs using the tester.

OK:
No DTC is output.

NG → GO TO DTC CHART (Click here)

OK

END

DTC P0365 Camshaft Position Sensor "B" Circuit (Bank 1)

DTC P0367 Camshaft Position Sensor "B" Circuit Low Input (Bank 1)

DTC P0368 Camshaft Position Sensor "B" Circuit High Input (Bank 1)

DTC P0390 Camshaft Position Sensor "B" Circuit (Bank 2)

DTC P0392 Camshaft Position Sensor "B" Circuit Low Input (Bank 2)

DTC P0393 Camshaft Position Sensor "B" Circuit High Input (Bank 2)

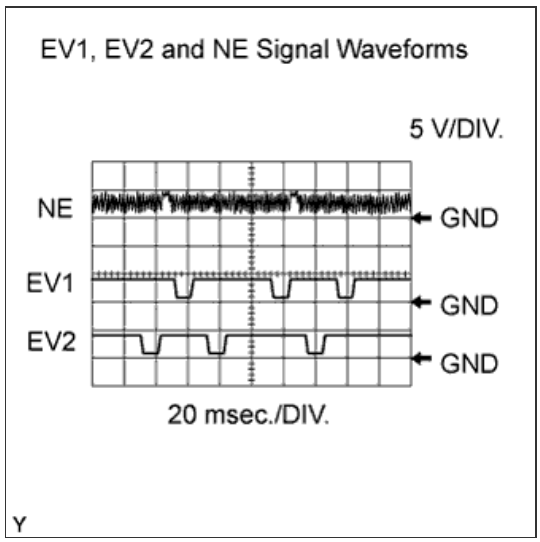
for Preparation Click here

DESCRIPTION

The exhaust camshaft Variable Valve Timing (VVT) sensor (EV1, 2 signal) consists of a magnet and MRE (Magnetic Resistance Element).
The exhaust camshaft has a sensor plate with 3 teeth on its outer circumference. When the exhaust camshaft rotates, changes occur in the air gaps between the 3 teeth and MRE, which affects the magnet. As a result, the resistance of the MRE material fluctuates. The VVT sensor converts the exhaust camshaft rotation data into pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM.

DTC Code	DTC Detection Condition	Trouble Area
P0365 P0390	When either condition below is met: • The input voltage to the ECM remains at below 0.3 V or higher than 4.7 V for more than 4 seconds when 2 or more seconds have elapsed after turning the engine switch on (IG) (1 trip detection logic). • No VVT sensor signal is sent to the ECM during cranking (1 trip detection logic).	• Open or short in VVT sensor (for exhaust side) circuit • VVT sensor (for exhaust side) • Exhaust camshaft • Jumped tooth of timing chain • ECM
P0367 P0392	The output voltage of the VVT sensor is below 0.3 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for exhaust side) circuit • VVT sensor (for exhaust side) • Exhaust camshaft • Jumped tooth of timing chain • ECM
P0368 P0393	The output voltage of the VVT sensor is higher than 4.7 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for exhaust side) circuit • VVT sensor (for exhaust side) • Exhaust camshaft • Jumped tooth of timing chain • ECM

Reference: Inspection using an oscilloscope.



Standard:

Tester Connection	Tool Setting	Condition	Specified Condition

C45 110 (NE+) - C45-111 (NE-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-69 (EV1+) - C45-68 (EV1-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-64 (EV2+) - C45-65 (EV2-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown

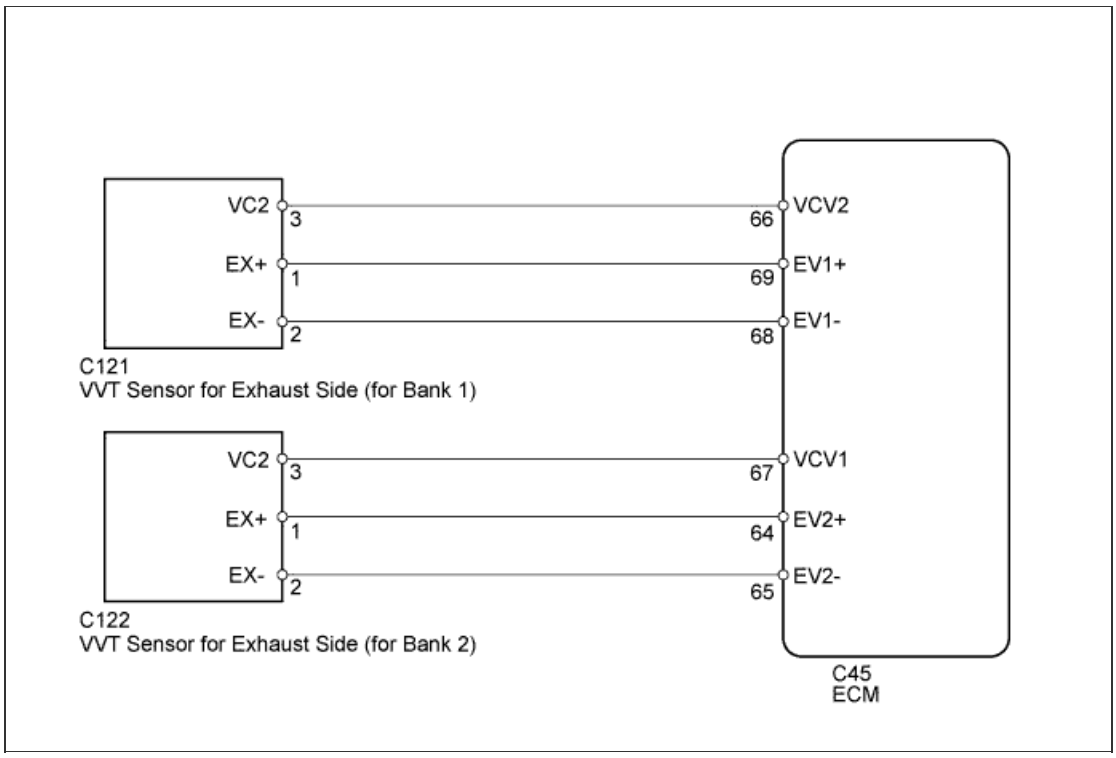
HINT:

EV1+ and EV2+ stand for the VVT sensor (for exhaust side) signal, and NE+ stands for the CKP sensor signal.

MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine revolving, or the rotations of the camshaft and the crankshaft are not synchronized, the ECM interprets this as a malfunction of the sensor.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

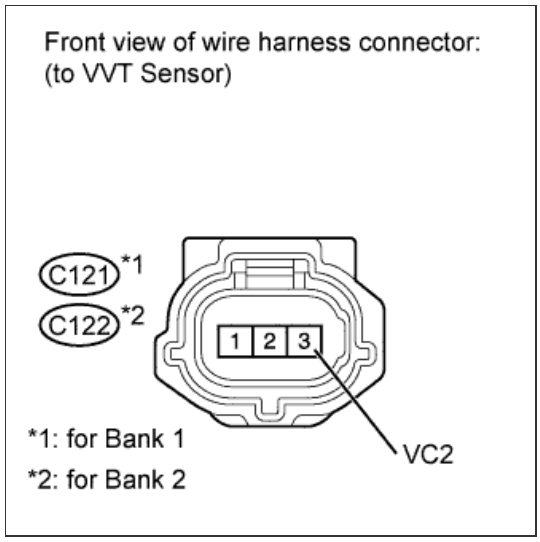
1.CHECK HARNESS AND CONNECTOR (SENSOR POWER SOURCE)

a. Disconnect the C121 or C122 VVT sensor (for exhaust side) connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
C121-3 (VC2) - Body ground	Engine switch on (IG)	4.5 to 5.0 V
C122-3 (VC2) - Body ground	Engine switch on (IG)	4.5 to 5.0 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (VVT SENSOR (for Exhaust Side) - ECM)

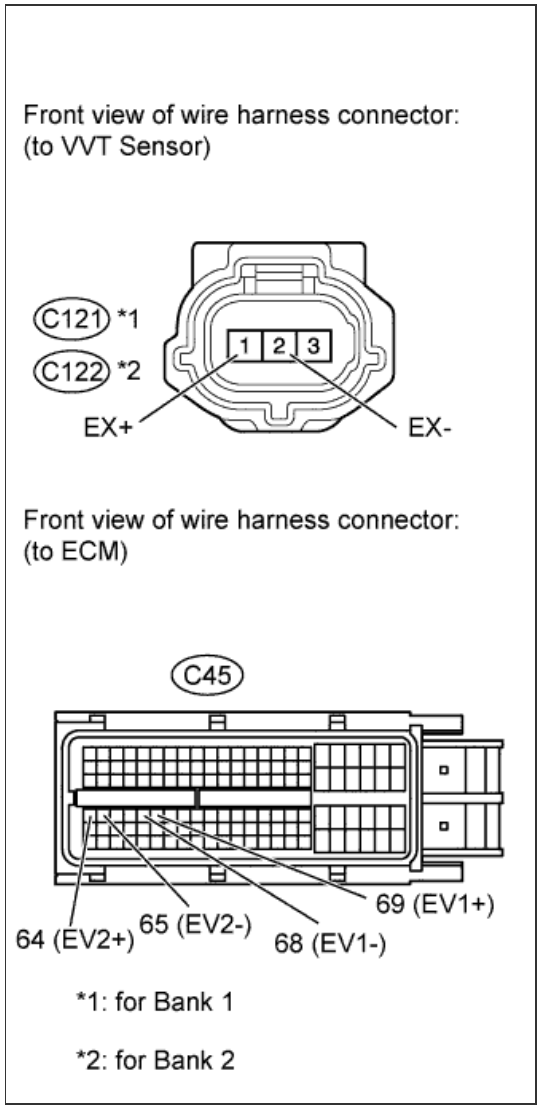
a. Disconnect the C121 or C122 VVT (for exhaust side) sensor connector.

b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C121-1 (EX+) - C45-69 (EV1+)	Always	Below 1 Ω
C121-2 (EX-) - C45-68 (EV1-)	Always	Below 1 Ω
C122-1 (EX+) - C45-64 (EV2+)	Always	Below 1 Ω
C122-2 (EX-) - C45-65 (EV2-)	Always	Below 1 Ω
C121-1 (EX+) or C45-69 (EV1+) - Body ground	Always	10 kΩ or higher
C121-2 (EX-) or C45-68 (EV1-) - Body ground	Always	10 kΩ or higher
C122-1 (EX+) or C45-64 (EV2+) - Body ground	Always	10 kΩ or higher
C122-2 (EX-) or C45-65 (EV2-) - Body ground	Always	10 kΩ or higher



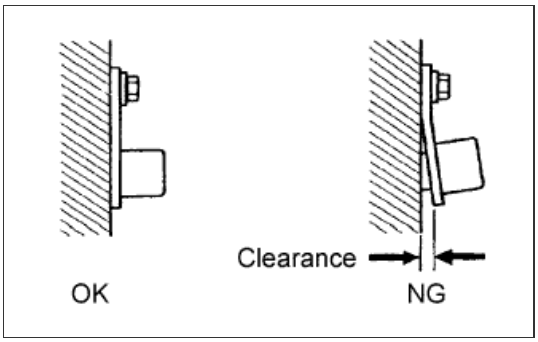
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK SENSOR INSTALLATION

a. Chec the VVT sensor (for exhaust side) installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

4.CHECK EXHAUST CAMSHAFT

a. Check the teeth of the camshaft.

OK:
Teeth do not have any cracks or deformation.

NG → REPLACE EXHAUST CAMSHAFT (Click here)

OK

5.REPLACE VVT SENSOR (for Exhaust Side)

a. Replace the VVT sensor (for exhaust side) (Click here).

NEXT

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No output	A
P0365, P0367, P0368, P0390, P0392 or P0393	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

DTC P0031 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)

DTC P0032 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)

DTC P0051 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)

DTC P0052 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)

for Preparation Click here

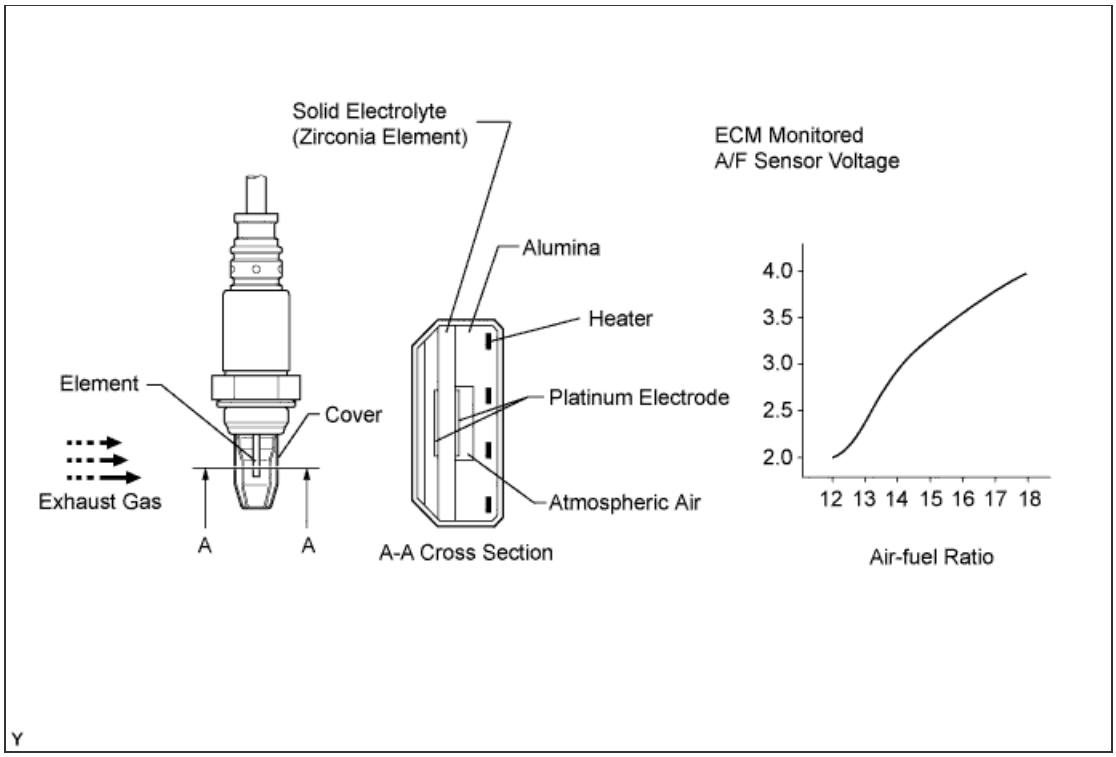
DESCRIPTION

The A/F sensor generates a voltage* that corresponds to the actual air-fuel ratio. This sensor voltage is used to provide the ECM with feedback so that it can control the air-fuel ratio. The ECM determines the deviation from the stoichiometric air-fuel ratio level, and regulates the fuel injection time. If the A/F sensor malfunctions, the ECM is unable to control the air-fuel ratio accurately.

The A/F sensor is the planar type and is integrated with the heater, which heats the solid electrolyte (zirconia element). This heater is controlled by the ECM. When the intake air volume is low (the exhaust gas temperature is low), a current flows into the heater to heat the sensor in order to facilitate accurate airfuel ratio detection. In addition, the sensor and heater portions are the narrow type. The heat generated by the heater is conducted to the solid electrolyte through the alumina, therefore the sensor activation is accelerated.

In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric level.

*: Value changes inside the ECM. Since the A/F sensor is the current output element, a current is converted into a voltage inside the ECM. Any measurements taken at the A/F sensor or ECM connectors will show a constant voltage.

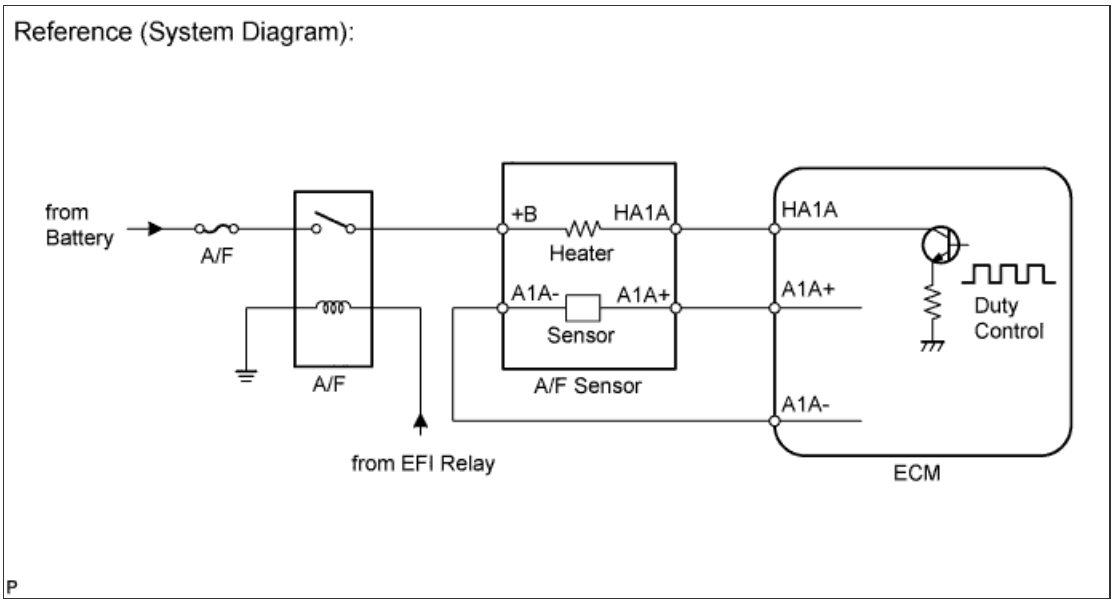


HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air Fuel ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**
- **When one of these DTCs is stored, the EC enters fail-safe mode. The EC turns off the A/F sensor heater in fail-safe mode. Fail-safe mode continues until the engine switch is turned off.**

- **The EC provides a pulse width modulated control circuit to adjust the current through the heater. The A/F sensor heater circuit uses a relay on the +B side of the circuit.**

Reference (System Diagram):



P

DTC Code	DTC Detection Condition	Trouble Area
P0031 P0051	The Air Fuel ratio (A/F) sensor heater current is below 0.8 A (1 trip detection logic).	• Open in Air Fuel ratio (A/F) sensor heater circuit • A/F sensor heater (for Sensor 1) • Integration relay • ECM
P0032 P0052	An Air Fuel ratio (A/F) sensor heater current failure (1 trip detection logic).	• Short in A/F sensor heater circuit • A/F sensor heater (for Sensor 1) • Integration relay • ECM

ONITOR DESCRIPTION

The ECM uses information from the Air Fuel ratio (A/F) sensor to regulate the air-fuel ratio and keep it close to the stoichiometric level. This maximizes the ability of the Three-Way Catalytic Converter (TWC) to purify the exhaust gases.

The A/F sensor detects oxygen levels in the exhaust gas and transmits the information to the ECM. The inner surface of the sensor element is exposed to the outside air. The outer surface of the sensor element is exposed to the exhaust gas. The sensor element is made of platinum coated zirconia and includes an integrated heating element.

The zirconia element generates a small voltage when there is a large difference in the oxygen concentrations between the exhaust gas and outside air. The platinum coating amplifies this voltage generation.

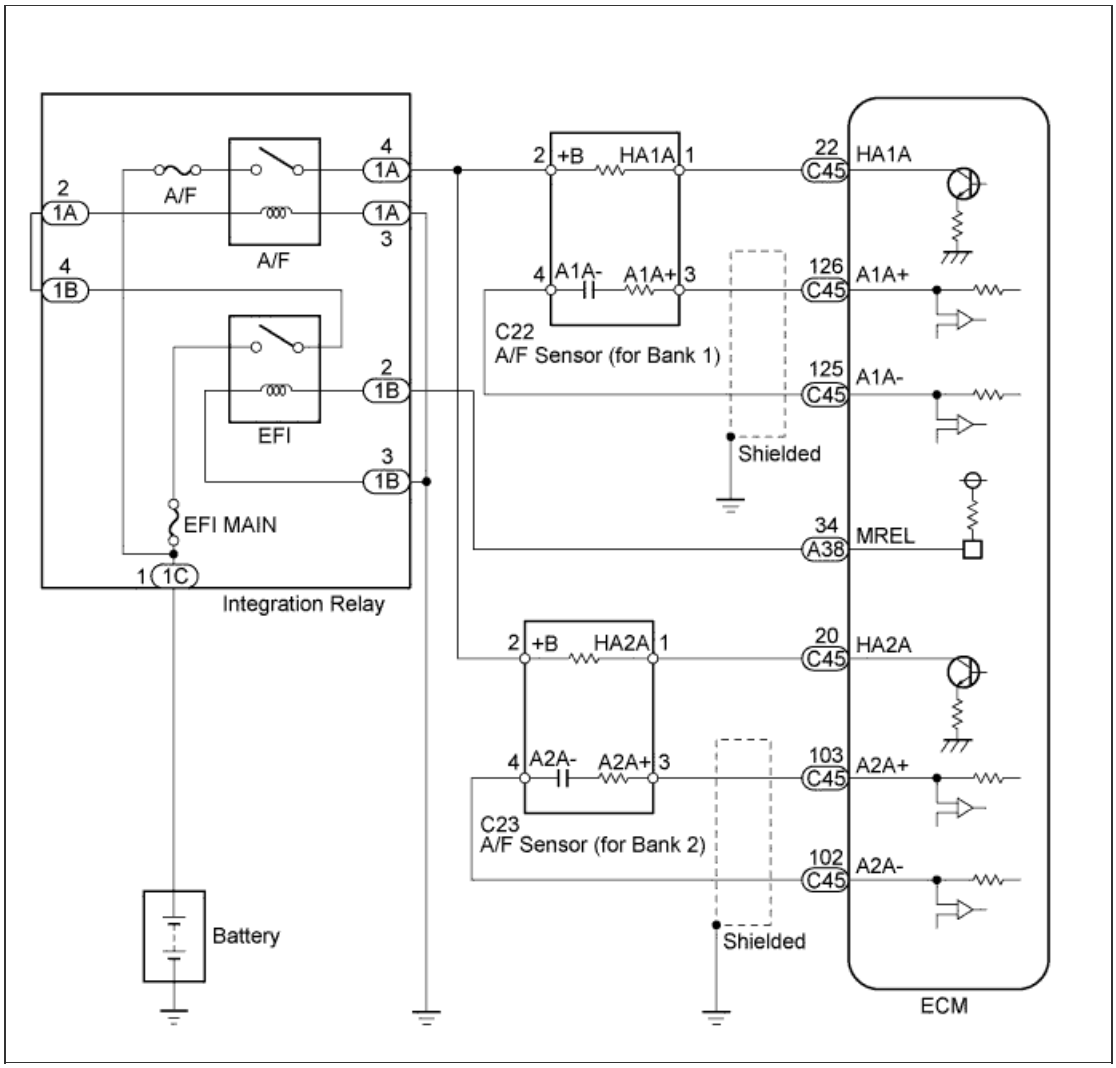
The A/F sensor is more efficient when heated. When the exhaust gas temperature is low, the sensor cannot generate useful voltage signals without supplementary heating. The ECM regulates the supplementary heating using a duty-cycle approach to adjust the average current in the sensor heater element. If the heater current is outside the normal range, the signal transmitted by the A/F sensor becomes inaccurate. As a result, the ECM is unable to regulate the air-fuel ratio properly.

When the current in the A/F sensor heater is outside the normal operating range, the ECM interprets this as a malfunction in the sensor heater and stores DTC(s).

Example:

The ECM stores DTC P0032 or P0052 when the current in the A/F sensor heater is more than 10 A. Conversely, when the heater current is below 0.8 A, DTC P0031 or P0051 is stored.

WIRING DIAGRA



INSPECTION PROCEDURE

HINT:

- **Read free e frame data using the intelligent tester. Free e frame data records the engine condition when malfunctions are detected. When troubleshooting, free e frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

1.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

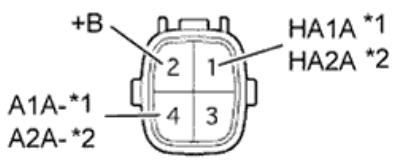
a. Disconnect the C22 or C23 Air Fuel ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

2.CHECK TER INAL VOLTAGE (+B OF A/F SENSOR)

a. Disconnect the C22 or C23 A/F sensor connector.

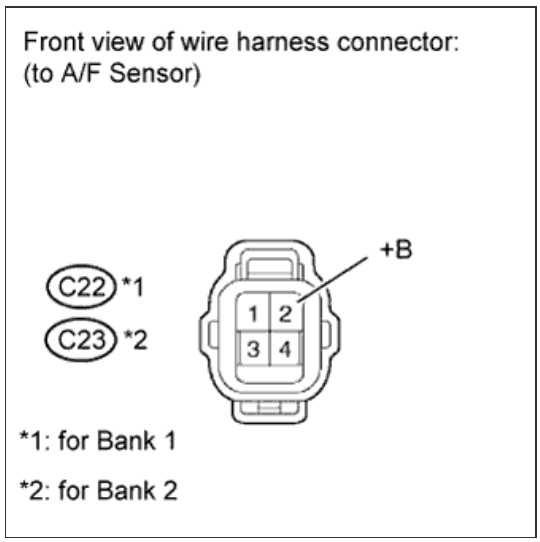
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

Result

Result	Proceed to
NG	A
OK	B



B → Go to step 5

A

3.INSPECT INTEGRATION NO.1 RELAY (A/F)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

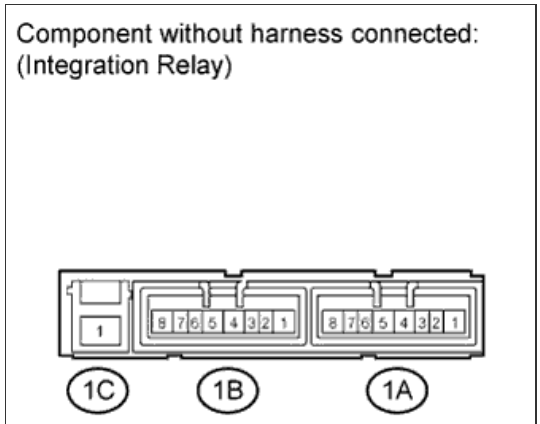
iii. Reinstall the A/F fuse.

c. Inspect the integration relay (A/F).

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1A-4	No battery voltage applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω



NG → REPLACE INTEGRATION NO.1 RELAY (A/F)

OK

4.CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - A/F SENSOR AND BODY GROUND)

a. Disconnect the C22 or C23 A/F sensor connector.

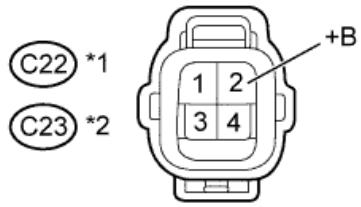
b. Remove the integration relay from the engine room relay block.

c. Measure the resistance according to the value(s) in the table below.

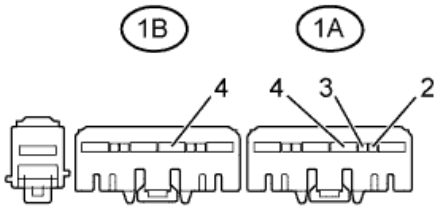
Standard Resistance:

Tester Connection	Condition	Specified Condition
C22-2 (+B) - 1A-4	Always	Below 1 Ω
C23-2 (+B) - 1A-4	Always	Below 1 Ω
1A-2 - 1B-4	Always	Below 1 Ω
1A-3 - Body ground	Always	Below 1 Ω
C22-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher
C23-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher
1A-2 or 1B-4 - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:



Front view of wire harness connector:



*1: for Bank 1

*2: for Bank 2

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK EC POWER SOURCE CIRCUIT (Click here)

5.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

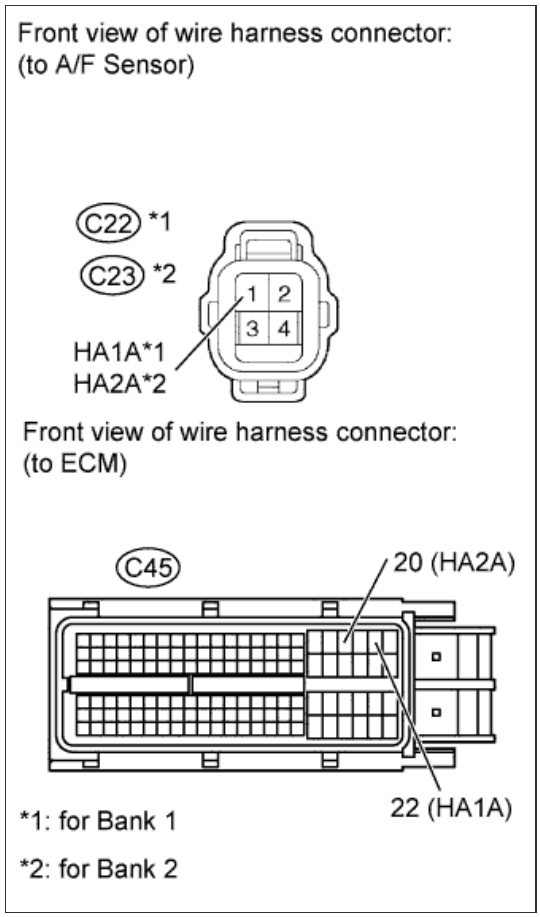
a. Disconnect the C22 or C23 A/F sensor connector.

b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Allow the engine to idle for 1 minute or more.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P0031, P0032, P0051 or P0052 is output	B

B → REPLACE ECM (Click here)

A

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0365 Camshaft Position Sensor "B" Circuit (Bank 1)

DTC P0367 Camshaft Position Sensor "B" Circuit Low Input (Bank 1)

DTC P0368 Camshaft Position Sensor "B" Circuit High Input (Bank 1)

DTC P0390 Camshaft Position Sensor "B" Circuit (Bank 2)

DTC P0392 Camshaft Position Sensor "B" Circuit Low Input (Bank 2)

DTC P0393 Camshaft Position Sensor "B" Circuit High Input (Bank 2)

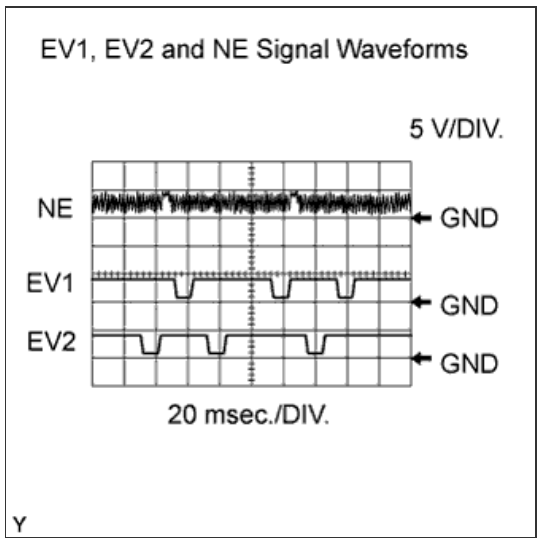
for Preparation Click here

DESCRIPTION

The exhaust camshaft Variable Valve Timing (VVT) sensor (EV1, 2 signal) consists of a magnet and MRE (Magnetic Resistance Element).
The exhaust camshaft has a sensor plate with 3 teeth on its outer circumference. When the exhaust camshaft rotates, changes occur in the air gaps between the 3 teeth and MRE, which affects the magnet. As a result, the resistance of the MRE material fluctuates. The VVT sensor converts the exhaust camshaft rotation data into pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM.

DTC Code	DTC Detection Condition	Trouble Area
P0365 P0390	When either condition below is met: • The input voltage to the ECM remains at below 0.3 V or higher than 4.7 V for more than 4 seconds when 2 or more seconds have elapsed after turning the engine switch on (IG) (1 trip detection logic). • No VVT sensor signal is sent to the ECM during cranking (1 trip detection logic).	• Open or short in VVT sensor (for exhaust side) circuit • VVT sensor (for exhaust side) • Exhaust camshaft • Jumped tooth of timing chain • ECM
P0367 P0392	The output voltage of the VVT sensor is below 0.3 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for exhaust side) circuit • VVT sensor (for exhaust side) • Exhaust camshaft • Jumped tooth of timing chain • ECM
P0368 P0393	The output voltage of the VVT sensor is higher than 4.7 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for exhaust side) circuit • VVT sensor (for exhaust side) • Exhaust camshaft • Jumped tooth of timing chain • ECM

Reference: Inspection using an oscilloscope.



Standard:

Tester Connection	Tool Setting	Condition	Specified Condition

C45 110 (NE+) - C45-111 (NE-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-69 (EV1+) - C45-68 (EV1-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-64 (EV2+) - C45-65 (EV2-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown

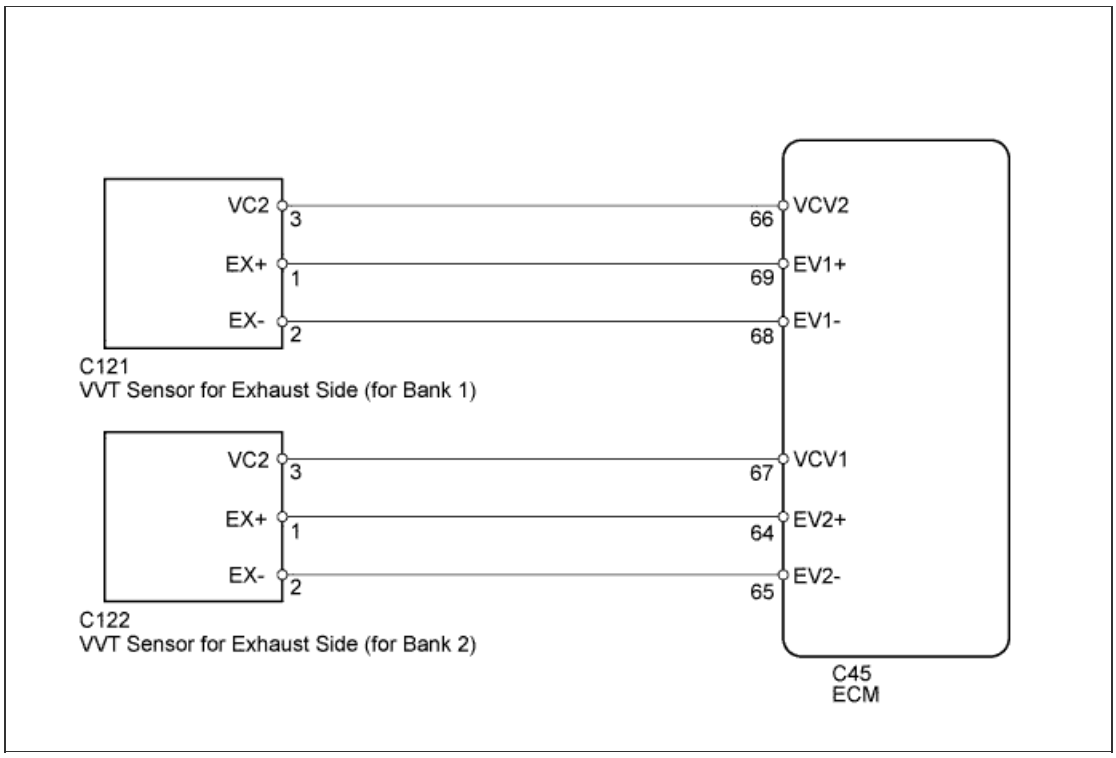
HINT:

EV1+ and EV2+ stand for the VVT sensor (for exhaust side) signal, and NE+ stands for the CKP sensor signal.

MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine revolving, or the rotations of the camshaft and the crankshaft are not synchronized, the ECM interprets this as a malfunction of the sensor.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

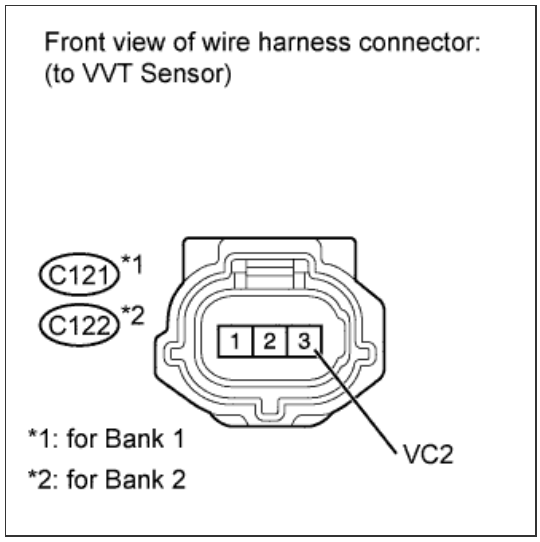
1.CHECK HARNESS AND CONNECTOR (SENSOR POWER SOURCE)

a. Disconnect the C121 or C122 VVT sensor (for exhaust side) connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
C121-3 (VC2) - Body ground	Engine switch on (IG)	4.5 to 5.0 V
C122-3 (VC2) - Body ground	Engine switch on (IG)	4.5 to 5.0 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (VVT SENSOR (for Exhaust Side) - ECM)

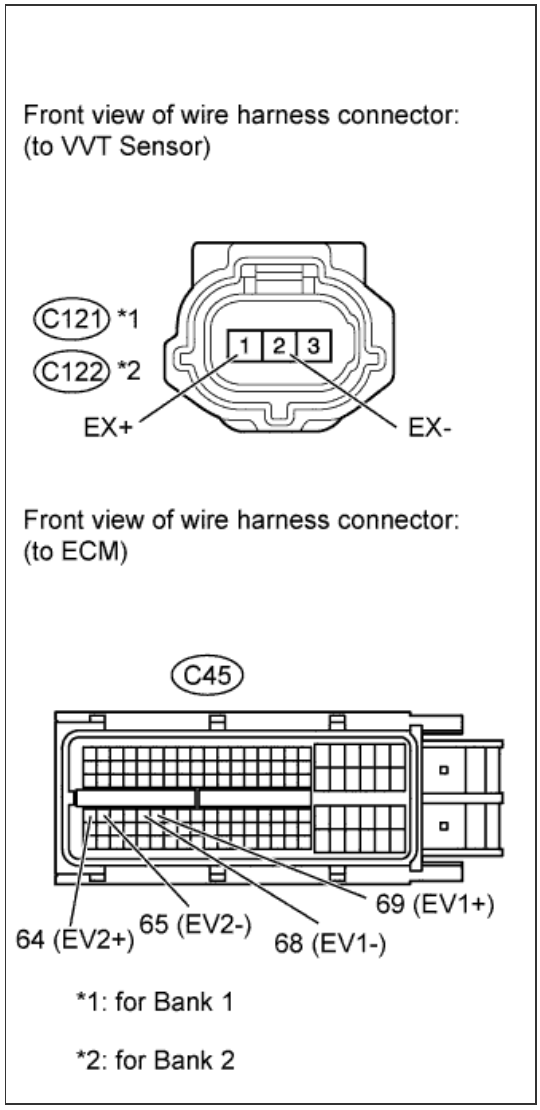
a. Disconnect the C121 or C122 VVT (for exhaust side) sensor connector.

b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C121-1 (EX+) - C45-69 (EV1+)	Always	Below 1 Ω
C121-2 (EX-) - C45-68 (EV1-)	Always	Below 1 Ω
C122-1 (EX+) - C45-64 (EV2+)	Always	Below 1 Ω
C122-2 (EX-) - C45-65 (EV2-)	Always	Below 1 Ω
C121-1 (EX+) or C45-69 (EV1+) - Body ground	Always	10 kΩ or higher
C121-2 (EX-) or C45-68 (EV1-) - Body ground	Always	10 kΩ or higher
C122-1 (EX+) or C45-64 (EV2+) - Body ground	Always	10 kΩ or higher
C122-2 (EX-) or C45-65 (EV2-) - Body ground	Always	10 kΩ or higher



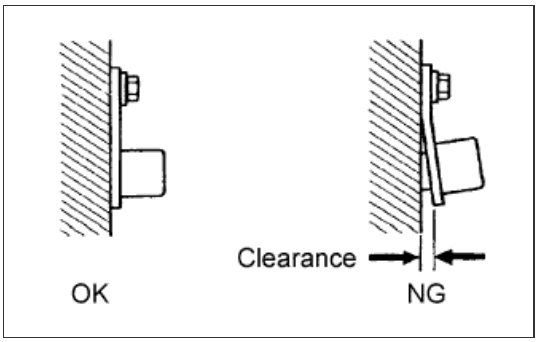
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK SENSOR INSTALLATION

a. Chec the VVT sensor (for exhaust side) installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

4.CHECK EXHAUST CAMSHAFT

a. Check the teeth of the camshaft.

OK:
Teeth do not have any cracks or deformation.

NG → REPLACE EXHAUST CAMSHAFT (Click here)

OK

5.REPLACE VVT SENSOR (for Exhaust Side)

a. Replace the VVT sensor (for exhaust side) (Click here).

NEXT

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No output	A
P0365, P0367, P0368, P0390, P0392 or P0393	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

DTC P0031 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)

DTC P0032 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)

DTC P0051 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)

DTC P0052 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)

for Preparation Click here

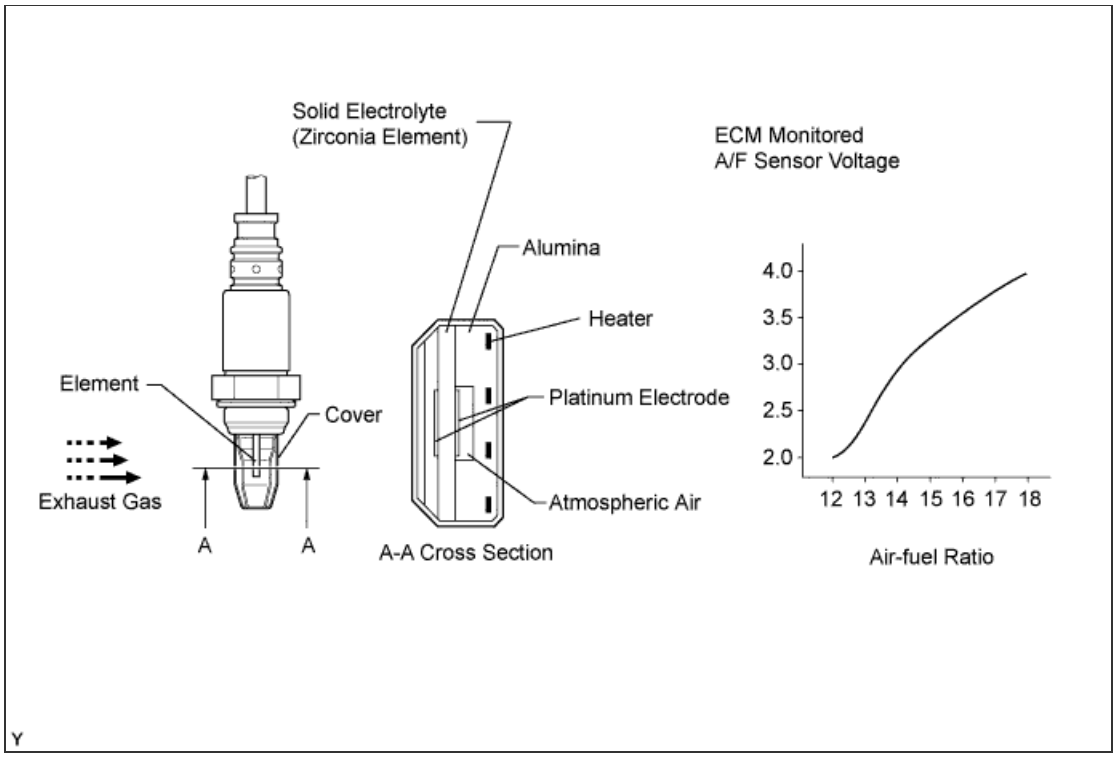
DESCRIPTION

The A/F sensor generates a voltage* that corresponds to the actual air-fuel ratio. This sensor voltage is used to provide the ECM with feedback so that it can control the air-fuel ratio. The ECM determines the deviation from the stoichiometric air-fuel ratio level, and regulates the fuel injection time. If the A/F sensor malfunctions, the ECM is unable to control the air-fuel ratio accurately.

The A/F sensor is the planar type and is integrated with the heater, which heats the solid electrolyte (zirconia element). This heater is controlled by the ECM. When the intake air volume is low (the exhaust gas temperature is low), a current flows into the heater to heat the sensor in order to facilitate accurate airfuel ratio detection. In addition, the sensor and heater portions are the narrow type. The heat generated by the heater is conducted to the solid electrolyte through the alumina, therefore the sensor activation is accelerated.

In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric level.

*: Value changes inside the ECM. Since the A/F sensor is the current output element, a current is converted into a voltage inside the ECM. Any measurements taken at the A/F sensor or ECM connectors will show a constant voltage.

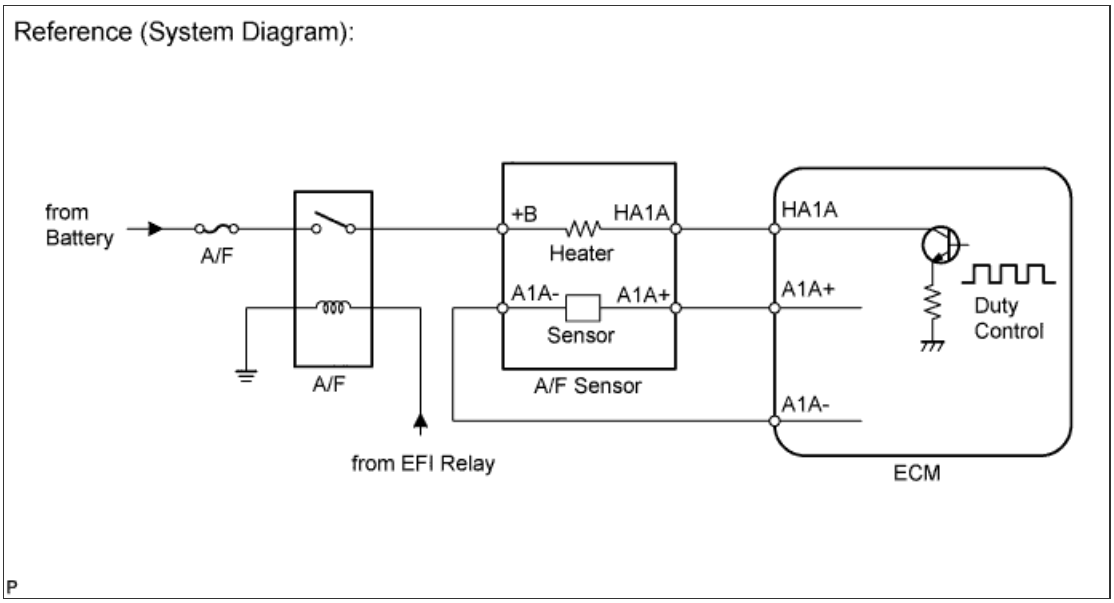


HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air Fuel ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**
- **When one of these DTCs is stored, the ECM enters fail-safe mode. The ECM turns off the A/F sensor heater in fail-safe mode. Fail-safe mode continues until the engine switch is turned off.**

- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The A/F sensor heater circuit uses a relay on the +B side of the circuit.**

Reference (System Diagram):



P

DTC Code	DTC Detection Condition	Trouble Area
P0031 P0051	The Air Fuel ratio (A/F) sensor heater current is below 0.8 A (1 trip detection logic).	• Open in Air Fuel ratio (A/F) sensor heater circuit • A/F sensor heater (for Sensor 1) • Integration relay • ECM
P0032 P0052	An Air Fuel ratio (A/F) sensor heater current failure (1 trip detection logic).	• Short in A/F sensor heater circuit • A/F sensor heater (for Sensor 1) • Integration relay • ECM

MONITOR DESCRIPTION

The ECM uses information from the Air Fuel ratio (A/F) sensor to regulate the air-fuel ratio and keep it close to the stoichiometric level. This maximizes the ability of the Three-Way Catalytic Converter (TWC) to purify the exhaust gases.

The A/F sensor detects oxygen levels in the exhaust gas and transmits the information to the ECM. The inner surface of the sensor element is exposed to the outside air. The outer surface of the sensor element is exposed to the exhaust gas. The sensor element is made of platinum coated zirconia and includes an integrated heating element.

The zirconia element generates a small voltage when there is a large difference in the oxygen concentrations between the exhaust gas and outside air. The platinum coating amplifies this voltage generation.

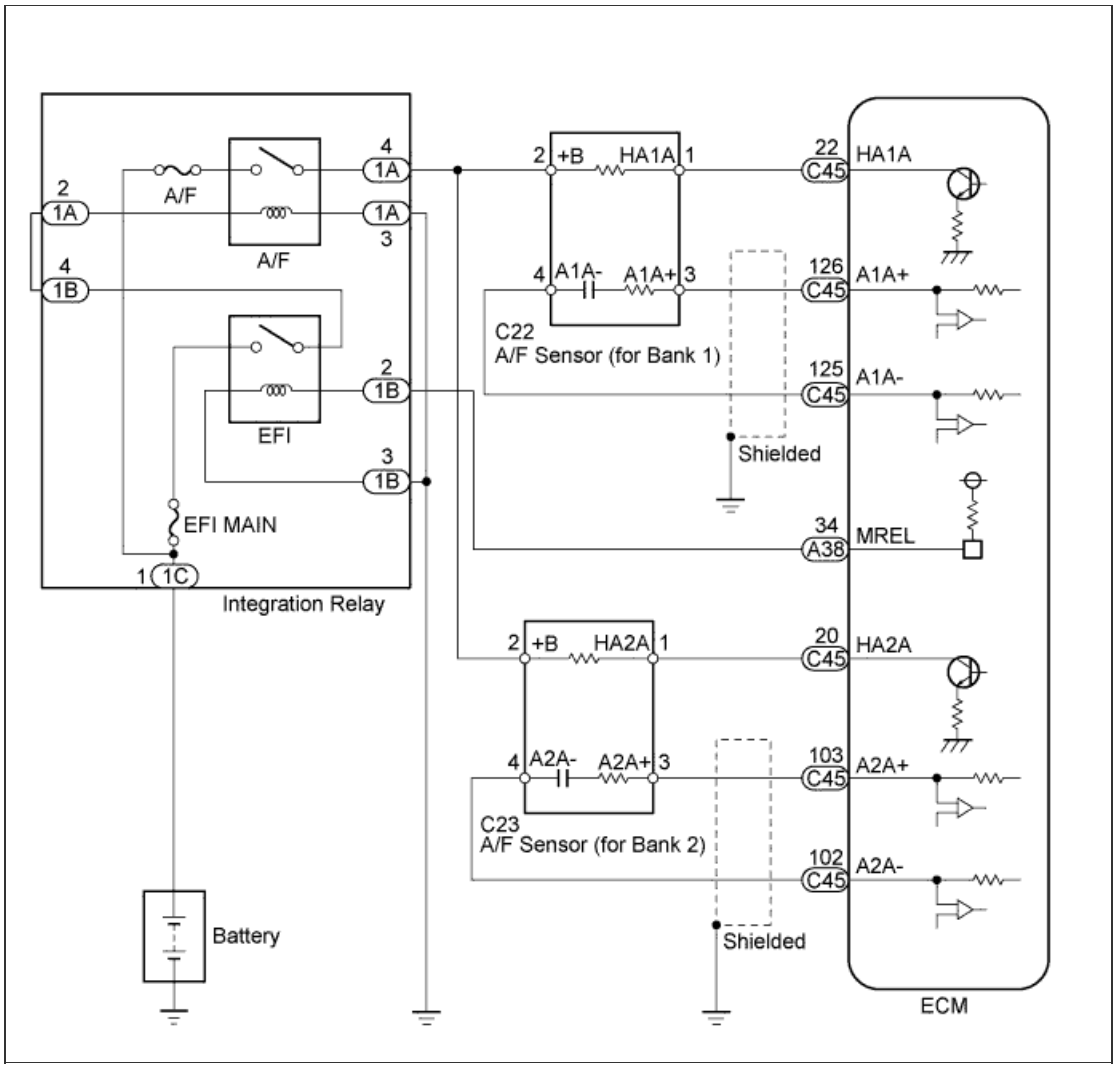
The A/F sensor is more efficient when heated. When the exhaust gas temperature is low, the sensor cannot generate useful voltage signals without supplementary heating. The ECM regulates the supplementary heating using a duty-cycle approach to adjust the average current in the sensor heater element. If the heater current is outside the normal range, the signal transmitted by the A/F sensor becomes inaccurate. As a result, the ECM is unable to regulate the air-fuel ratio properly.

When the current in the A/F sensor heater is outside the normal operating range, the ECM interprets this as a malfunction in the sensor heater and stores DTC(s).

Example:

The ECM stores DTC P0032 or P0052 when the current in the A/F sensor heater is more than 10 A. Conversely, when the heater current is below 0.8 A, DTC P0031 or P0051 is stored.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

1.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

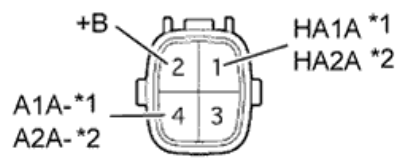
a. Disconnect the C22 or C23 Air Fuel ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF A/F SENSOR)

a. Disconnect the C22 or C23 A/F sensor connector.

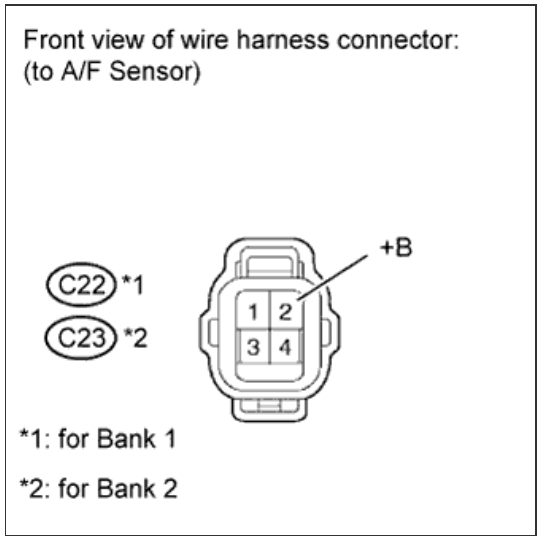
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

Result

Result	Proceed to
NG	A
OK	B



B → Go to step 5

A

3.INSPECT INTEGRATION NO.1 RELAY (A/F)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

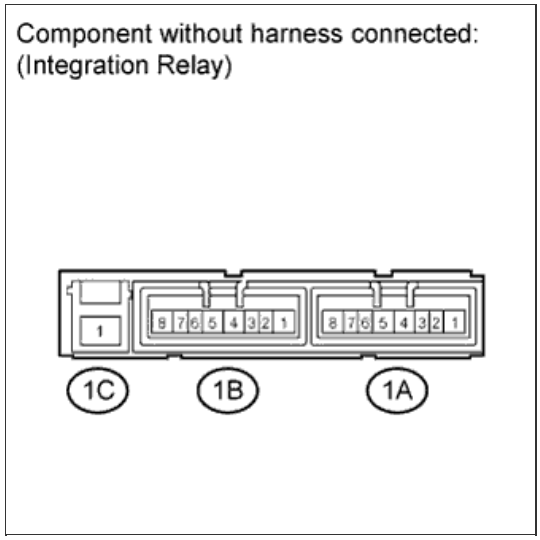
iii. Reinstall the A/F fuse.

c. Inspect the integration relay (A/F).

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1A-4	No battery voltage applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω



NG → REPLACE INTEGRATION NO.1 RELAY (A/F)

OK

4.CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - A/F SENSOR AND BODY GROUND)

a. Disconnect the C22 or C23 A/F sensor connector.

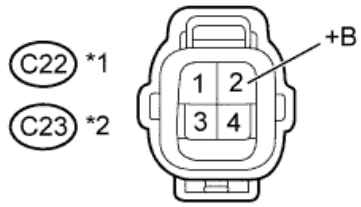
b. Remove the integration relay from the engine room relay block.

c. Measure the resistance according to the value(s) in the table below.

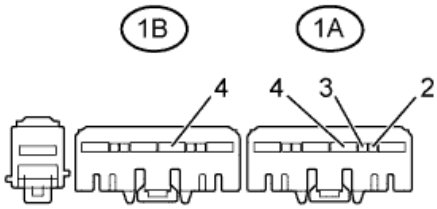
Standard Resistance:

Tester Connection	Condition	Specified Condition
C22-2 (+B) - 1A-4	Always	Below 1 Ω
C23-2 (+B) - 1A-4	Always	Below 1 Ω
1A-2 - 1B-4	Always	Below 1 Ω
1A-3 - Body ground	Always	Below 1 Ω
C22-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher
C23-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher
1A-2 or 1B-4 - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:



Front view of wire harness connector:



*1: for Bank 1

*2: for Bank 2

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

5.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

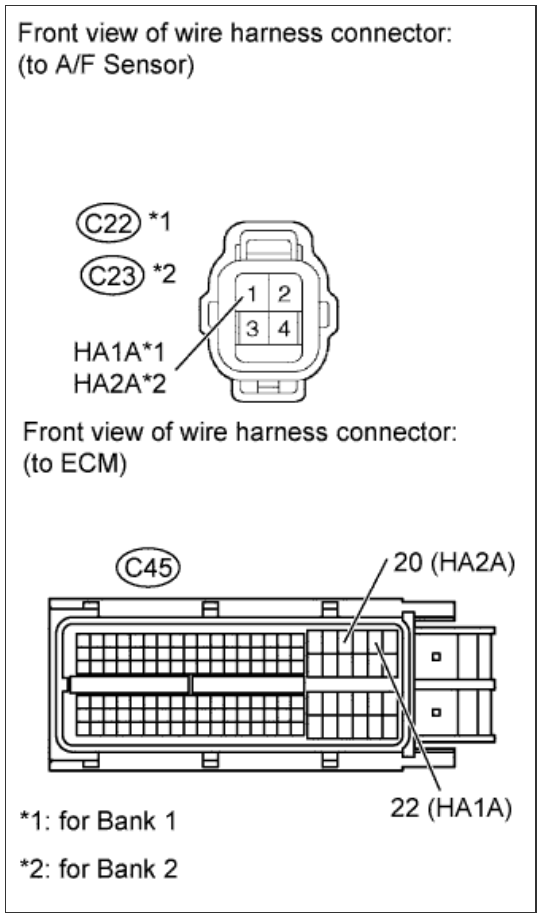
a. Disconnect the C22 or C23 A/F sensor connector.

b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Allow the engine to idle for 1 minute or more.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P0031, P0032, P0051 or P0052 is output	B

B → REPLACE ECM (Click here)

A

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0365 Camshaft Position Sensor "B" Circuit (Bank 1)

DTC P0367 Camshaft Position Sensor "B" Circuit Low Input (Bank 1)

DTC P0368 Camshaft Position Sensor "B" Circuit High Input (Bank 1)

DTC P0390 Camshaft Position Sensor "B" Circuit (Bank 2)

DTC P0392 Camshaft Position Sensor "B" Circuit Low Input (Bank 2)

DTC P0393 Camshaft Position Sensor "B" Circuit High Input (Bank 2)

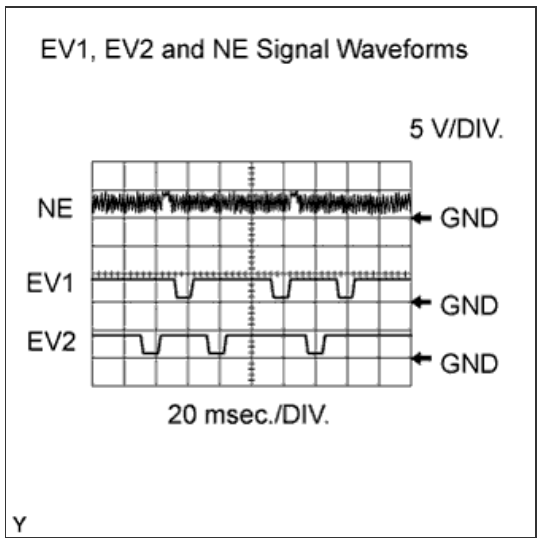
for Preparation Click here

DESCRIPTION

The exhaust camshaft Variable Valve Timing (VVT) sensor (EV1, 2 signal) consists of a magnet and MRE (Magnetic Resistance Element).
The exhaust camshaft has a sensor plate with 3 teeth on its outer circumference. When the exhaust camshaft rotates, changes occur in the air gaps between the 3 teeth and MRE, which affects the magnet. As a result, the resistance of the MRE material fluctuates. The VVT sensor converts the exhaust camshaft rotation data into pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM.

DTC Code	DTC Detection Condition	Trouble Area
P0365 P0390	When either condition below is met: • The input voltage to the ECM remains at below 0.3 V or higher than 4.7 V for more than 4 seconds when 2 or more seconds have elapsed after turning the engine switch on (IG) (1 trip detection logic). • No VVT sensor signal is sent to the ECM during cranking (1 trip detection logic).	• Open or short in VVT sensor (for exhaust side) circuit • VVT sensor (for exhaust side) • Exhaust camshaft • Jumped tooth of timing chain • ECM
P0367 P0392	The output voltage of the VVT sensor is below 0.3 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for exhaust side) circuit • VVT sensor (for exhaust side) • Exhaust camshaft • Jumped tooth of timing chain • ECM
P0368 P0393	The output voltage of the VVT sensor is higher than 4.7 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for exhaust side) circuit • VVT sensor (for exhaust side) • Exhaust camshaft • Jumped tooth of timing chain • ECM

Reference: Inspection using an oscilloscope.



Standard:

Tester Connection	Tool Setting	Condition	Specified Condition

C45 110 (NE+) - C45-111 (NE-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-69 (EV1+) - C45-68 (EV1-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-64 (EV2+) - C45-65 (EV2-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown

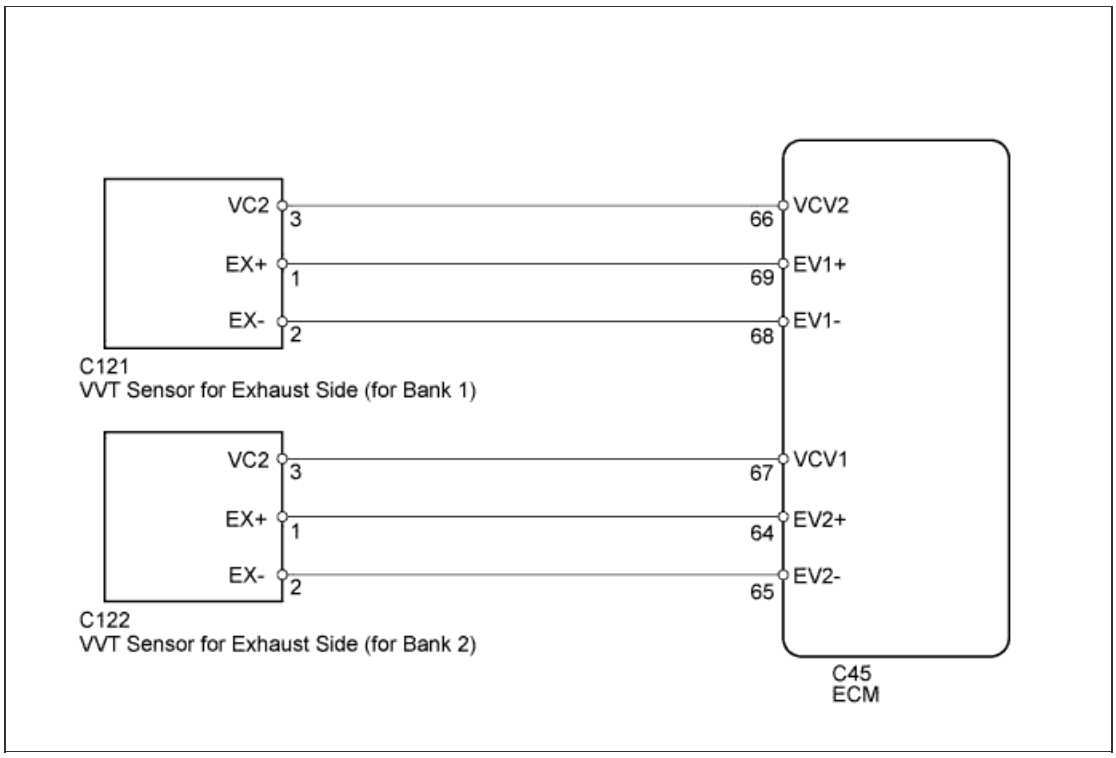
HINT:

EV1+ and EV2+ stand for the VVT sensor (for exhaust side) signal, and NE+ stands for the CKP sensor signal.

MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine revolving, or the rotations of the camshaft and the crankshaft are not synchronized, the ECM interprets this as a malfunction of the sensor.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

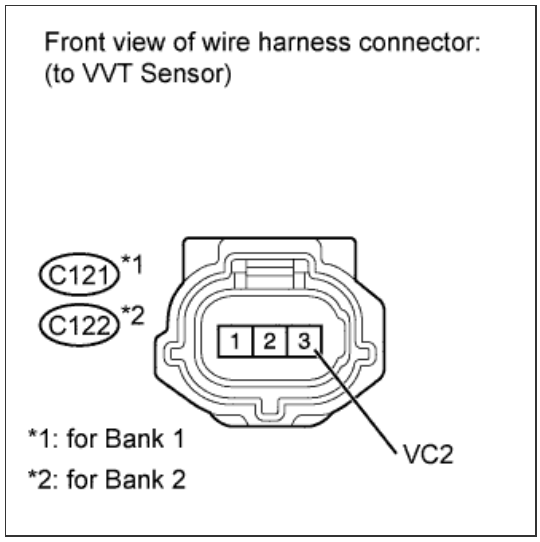
1.CHECK HARNESS AND CONNECTOR (SENSOR POWER SOURCE)

a. Disconnect the C121 or C122 VVT sensor (for exhaust side) connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
C121-3 (VC2) - Body ground	Engine switch on (IG)	4.5 to 5.0 V
C122-3 (VC2) - Body ground	Engine switch on (IG)	4.5 to 5.0 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (VVT SENSOR (for Exhaust Side) - ECM)

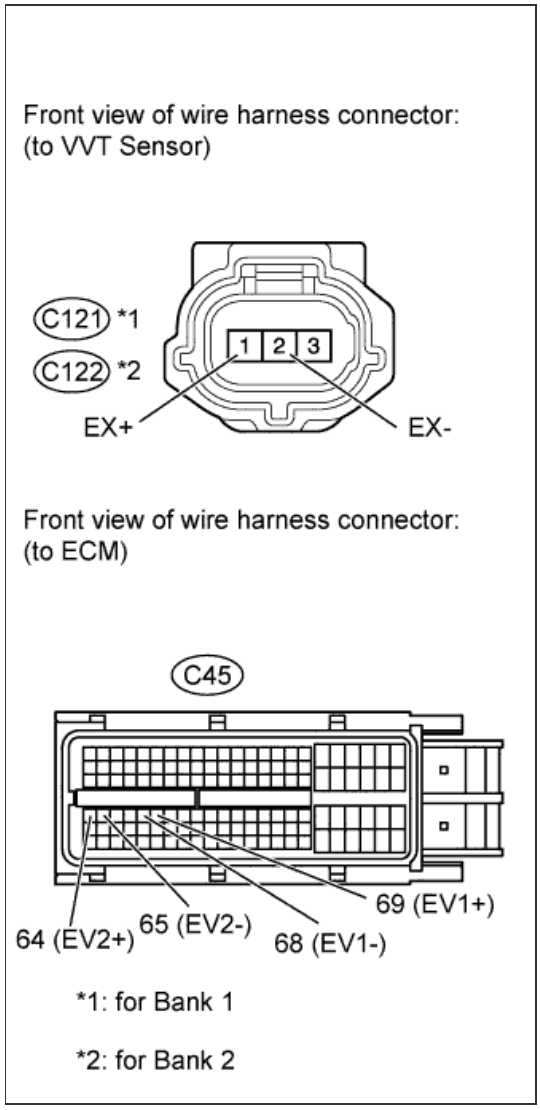
a. Disconnect the C121 or C122 VVT (for exhaust side) sensor connector.

b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C121-1 (EX+) - C45-69 (EV1+)	Always	Below 1 Ω
C121-2 (EX-) - C45-68 (EV1-)	Always	Below 1 Ω
C122-1 (EX+) - C45-64 (EV2+)	Always	Below 1 Ω
C122-2 (EX-) - C45-65 (EV2-)	Always	Below 1 Ω
C121-1 (EX+) or C45-69 (EV1+) - Body ground	Always	10 kΩ or higher
C121-2 (EX-) or C45-68 (EV1-) - Body ground	Always	10 kΩ or higher
C122-1 (EX+) or C45-64 (EV2+) - Body ground	Always	10 kΩ or higher
C122-2 (EX-) or C45-65 (EV2-) - Body ground	Always	10 kΩ or higher



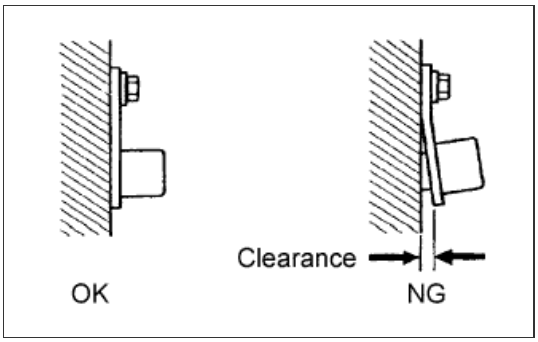
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK SENSOR INSTALLATION

a. Chec the VVT sensor (for exhaust side) installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

4.CHECK EXHAUST CAMSHAFT

a. Check the teeth of the camshaft.

OK:
Teeth do not have any cracks or deformation.

NG → REPLACE EXHAUST CAMSHAFT (Click here)

OK

5.REPLACE VVT SENSOR (for Exhaust Side)

a. Replace the VVT sensor (for exhaust side) (Click here).

NEXT

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No output	A
P0365, P0367, P0368, P0390, P0392 or P0393	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

DTC P0031 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)

DTC P0032 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)

DTC P0051 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)

DTC P0052 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)

for Preparation Click here

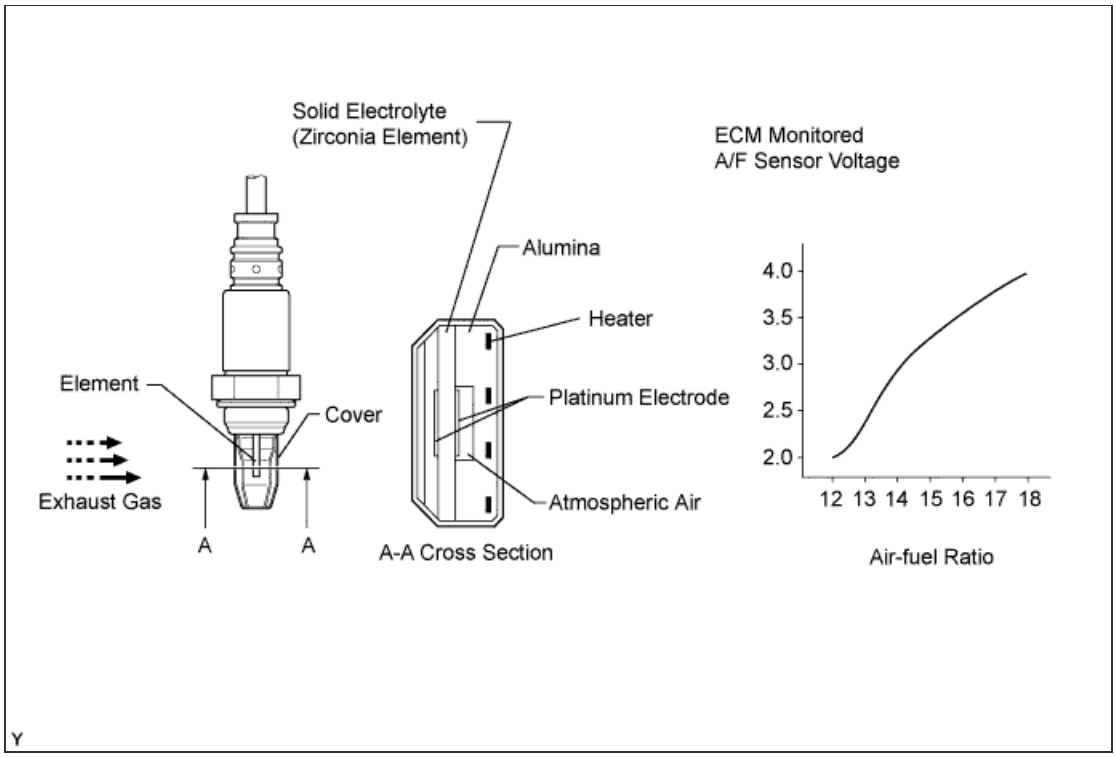
DESCRIPTION

The A/F sensor generates a voltage* that corresponds to the actual air-fuel ratio. This sensor voltage is used to provide the ECM with feedback so that it can control the air-fuel ratio. The ECM determines the deviation from the stoichiometric air-fuel ratio level, and regulates the fuel injection time. If the A/F sensor malfunctions, the ECM is unable to control the air-fuel ratio accurately.

The A/F sensor is the planar type and is integrated with the heater, which heats the solid electrolyte (zirconia element). This heater is controlled by the ECM. When the intake air volume is low (the exhaust gas temperature is low), a current flows into the heater to heat the sensor in order to facilitate accurate airfuel ratio detection. In addition, the sensor and heater portions are the narrow type. The heat generated by the heater is conducted to the solid electrolyte through the alumina, therefore the sensor activation is accelerated.

In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric level.

*: Value changes inside the ECM. Since the A/F sensor is the current output element, a current is converted into a voltage inside the ECM. Any measurements taken at the A/F sensor or ECM connectors will show a constant voltage.

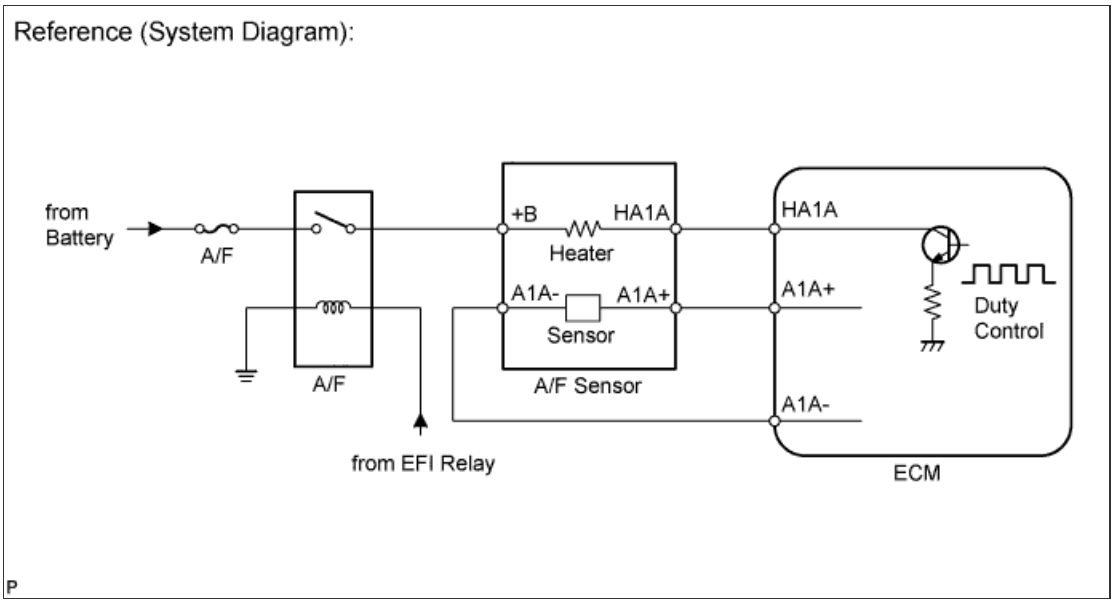


HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air Fuel ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**
- **When one of these DTCs is stored, the ECM enters fail-safe mode. The ECM turns off the A/F sensor heater in fail-safe mode. Fail-safe mode continues until the engine switch is turned off.**

- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The A/F sensor heater circuit uses a relay on the +B side of the circuit.**

Reference (System Diagram):



P

DTC Code	DTC Detection Condition	Trouble Area
P0031 P0051	The Air Fuel ratio (A/F) sensor heater current is below 0.8 A (1 trip detection logic).	• Open in Air Fuel ratio (A/F) sensor heater circuit • A/F sensor heater (for Sensor 1) • Integration relay • ECM
P0032 P0052	An Air Fuel ratio (A/F) sensor heater current failure (1 trip detection logic).	• Short in A/F sensor heater circuit • A/F sensor heater (for Sensor 1) • Integration relay • ECM

MONITOR DESCRIPTION

The ECM uses information from the Air Fuel ratio (A/F) sensor to regulate the air-fuel ratio and keep it close to the stoichiometric level. This maximizes the ability of the Three-Way Catalytic Converter (TWC) to purify the exhaust gases.

The A/F sensor detects oxygen levels in the exhaust gas and transmits the information to the ECM. The inner surface of the sensor element is exposed to the outside air. The outer surface of the sensor element is exposed to the exhaust gas. The sensor element is made of platinum coated zirconia and includes an integrated heating element.

The zirconia element generates a small voltage when there is a large difference in the oxygen concentrations between the exhaust gas and outside air. The platinum coating amplifies this voltage generation.

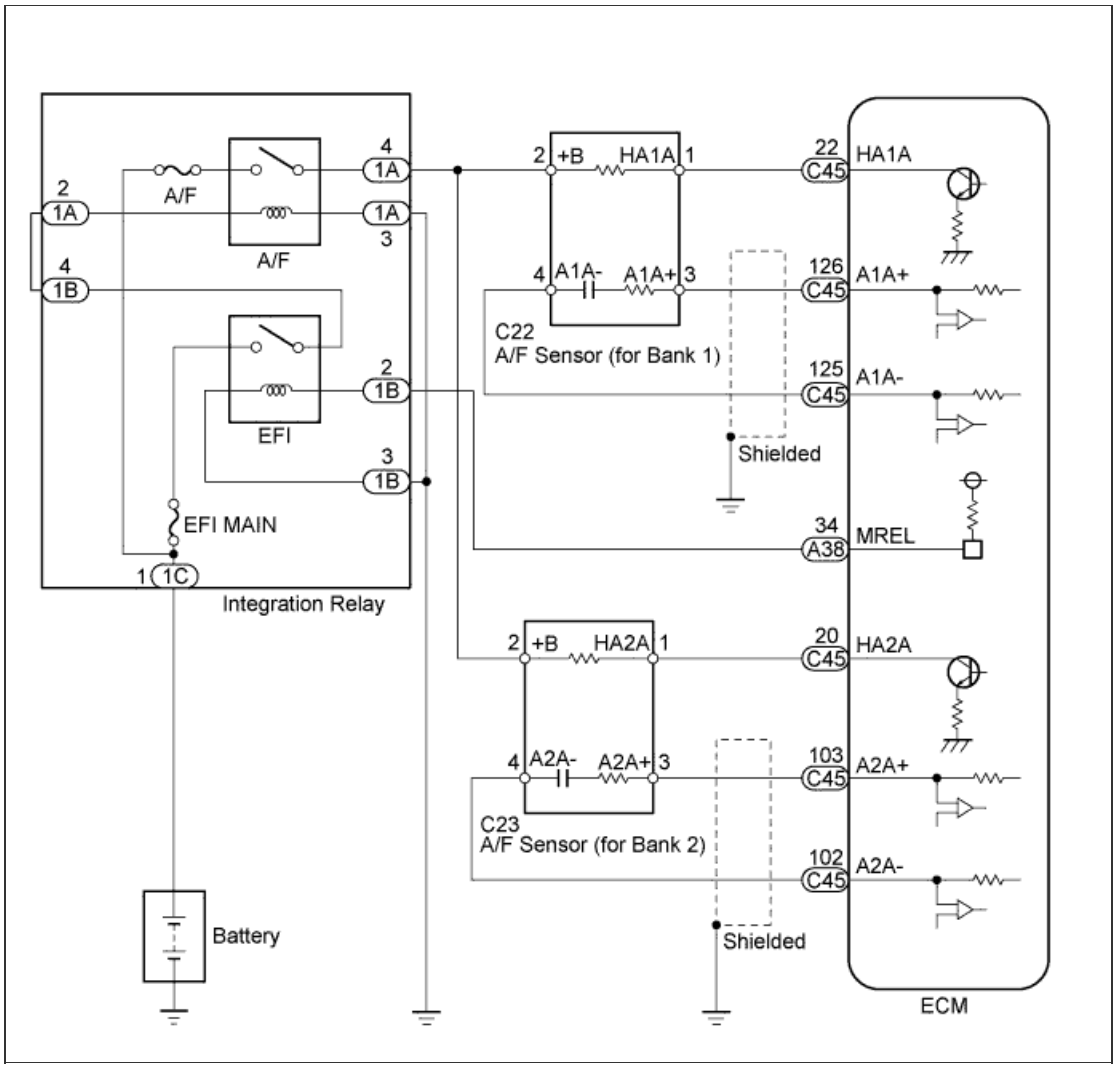
The A/F sensor is more efficient when heated. When the exhaust gas temperature is low, the sensor cannot generate useful voltage signals without supplementary heating. The ECM regulates the supplementary heating using a duty-cycle approach to adjust the average current in the sensor heater element. If the heater current is outside the normal range, the signal transmitted by the A/F sensor becomes inaccurate. As a result, the ECM is unable to regulate the air-fuel ratio properly.

When the current in the A/F sensor heater is outside the normal operating range, the ECM interprets this as a malfunction in the sensor heater and stores DTC(s).

Example:

The ECM stores DTC P0032 or P0052 when the current in the A/F sensor heater is more than 10 A. Conversely, when the heater current is below 0.8 A, DTC P0031 or P0051 is stored.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

1.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

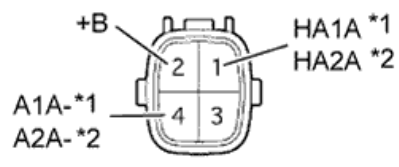
a. Disconnect the C22 or C23 Air Fuel ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF A/F SENSOR)

a. Disconnect the C22 or C23 A/F sensor connector.

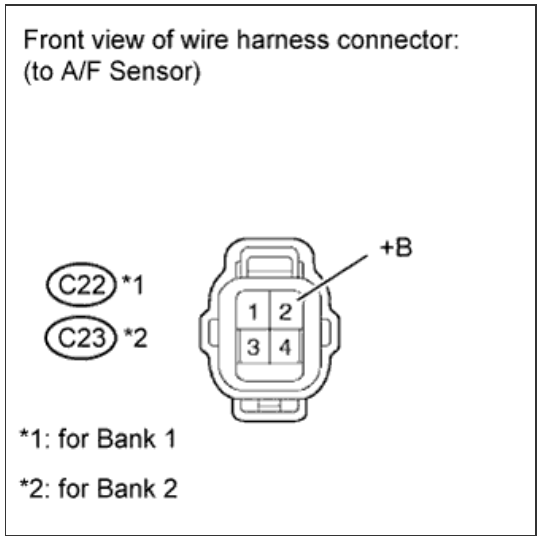
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

Result

Result	Proceed to
NG	A
OK	B



B → Go to step 5

A

3.INSPECT INTEGRATION NO.1 RELAY (A/F)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

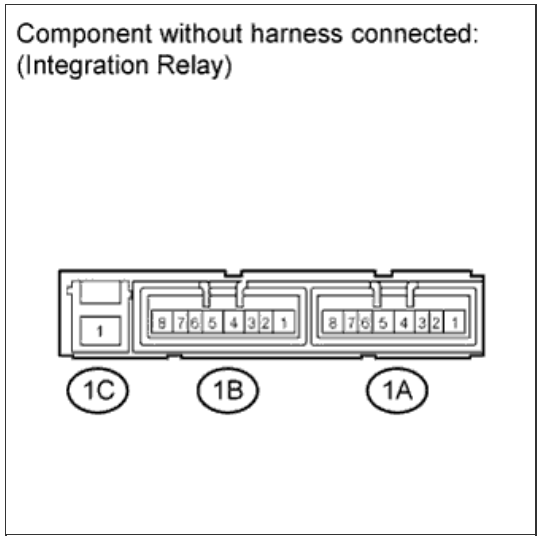
iii. Reinstall the A/F fuse.

c. Inspect the integration relay (A/F).

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1A-4	No battery voltage applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω



NG → REPLACE INTEGRATION NO.1 RELAY (A/F)

OK

4.CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - A/F SENSOR AND BODY GROUND)

a. Disconnect the C22 or C23 A/F sensor connector.

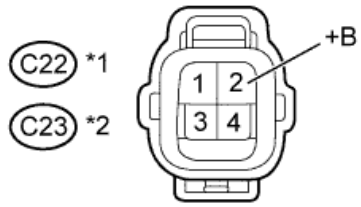
b. Remove the integration relay from the engine room relay block.

c. Measure the resistance according to the value(s) in the table below.

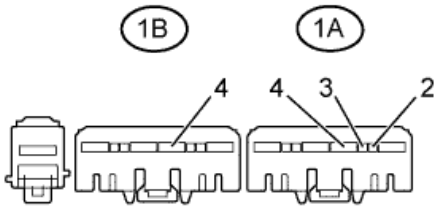
Standard Resistance:

Tester Connection	Condition	Specified Condition
C22-2 (+B) - 1A-4	Always	Below 1 Ω
C23-2 (+B) - 1A-4	Always	Below 1 Ω
1A-2 - 1B-4	Always	Below 1 Ω
1A-3 - Body ground	Always	Below 1 Ω
C22-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher
C23-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher
1A-2 or 1B-4 - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:



Front view of wire harness connector:



*1: for Bank 1

*2: for Bank 2

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

5.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

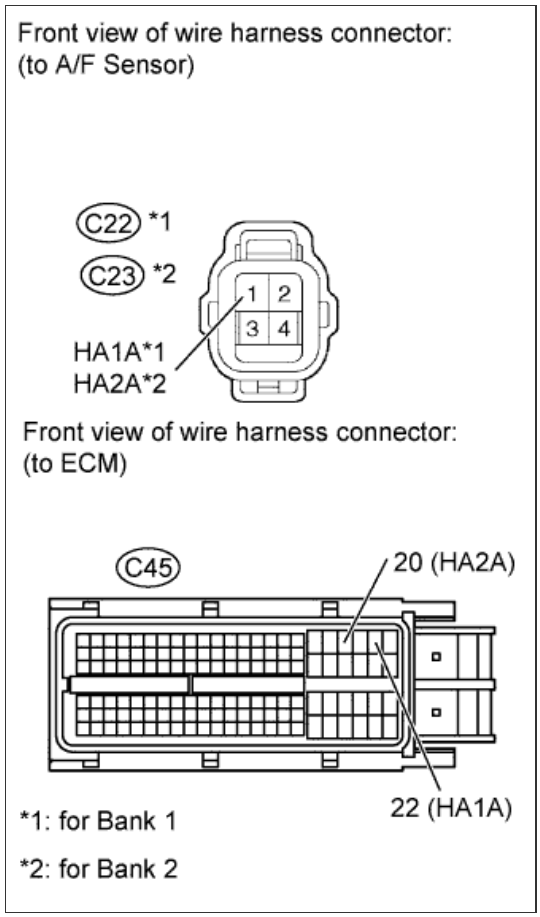
a. Disconnect the C22 or C23 A/F sensor connector.

b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Allow the engine to idle for 1 minute or more.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P0031, P0032, P0051 or P0052 is output	B

B → REPLACE ECM (Click here)

A

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0365 Camshaft Position Sensor "B" Circuit (Bank 1)

DTC P0367 Camshaft Position Sensor "B" Circuit Low Input (Bank 1)

DTC P0368 Camshaft Position Sensor "B" Circuit High Input (Bank 1)

DTC P0390 Camshaft Position Sensor "B" Circuit (Bank 2)

DTC P0392 Camshaft Position Sensor "B" Circuit Low Input (Bank 2)

DTC P0393 Camshaft Position Sensor "B" Circuit High Input (Bank 2)

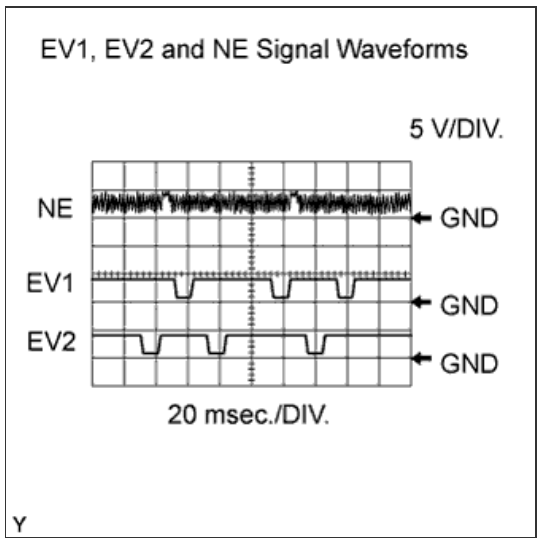
for Preparation Click here

DESCRIPTION

The exhaust camshaft Variable Valve Timing (VVT) sensor (EV1, 2 signal) consists of a magnet and MRE (Magnetic Resistance Element).
The exhaust camshaft has a sensor plate with 3 teeth on its outer circumference. When the exhaust camshaft rotates, changes occur in the air gaps between the 3 teeth and MRE, which affects the magnet. As a result, the resistance of the MRE material fluctuates. The VVT sensor converts the exhaust camshaft rotation data into pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM.

DTC Code	DTC Detection Condition	Trouble Area
P0365 P0390	When either condition below is met: • The input voltage to the ECM remains at below 0.3 V or higher than 4.7 V for more than 4 seconds when 2 or more seconds have elapsed after turning the engine switch on (IG) (1 trip detection logic). • No VVT sensor signal is sent to the ECM during cranking (1 trip detection logic).	• Open or short in VVT sensor (for exhaust side) circuit • VVT sensor (for exhaust side) • Exhaust camshaft • Jumped tooth of timing chain • ECM
P0367 P0392	The output voltage of the VVT sensor is below 0.3 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for exhaust side) circuit • VVT sensor (for exhaust side) • Exhaust camshaft • Jumped tooth of timing chain • ECM
P0368 P0393	The output voltage of the VVT sensor is higher than 4.7 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for exhaust side) circuit • VVT sensor (for exhaust side) • Exhaust camshaft • Jumped tooth of timing chain • ECM

Reference: Inspection using an oscilloscope.



Standard:

Tester Connection	Tool Setting	Condition	Specified Condition

C45 110 (NE+) - C45-111 (NE-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-69 (EV1+) - C45-68 (EV1-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-64 (EV2+) - C45-65 (EV2-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown

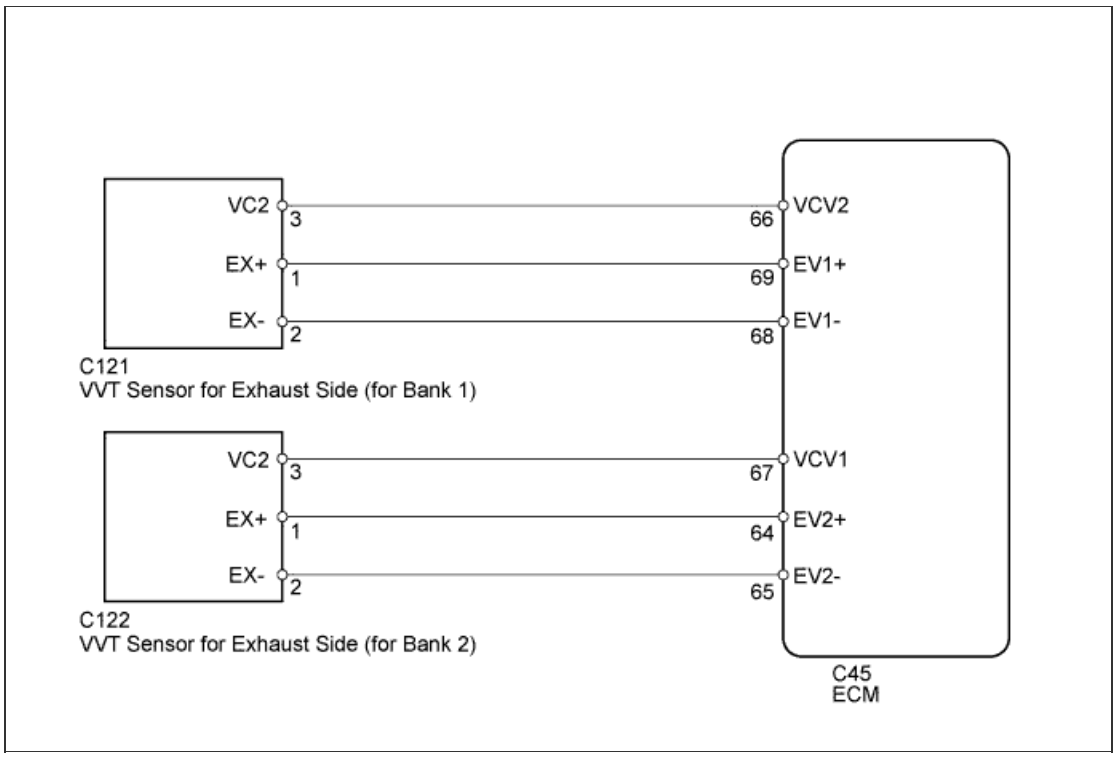
HINT:

EV1+ and EV2+ stand for the VVT sensor (for exhaust side) signal, and NE+ stands for the CKP sensor signal.

MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine revolving, or the rotations of the camshaft and the crankshaft are not synchronized, the ECM interprets this as a malfunction of the sensor.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

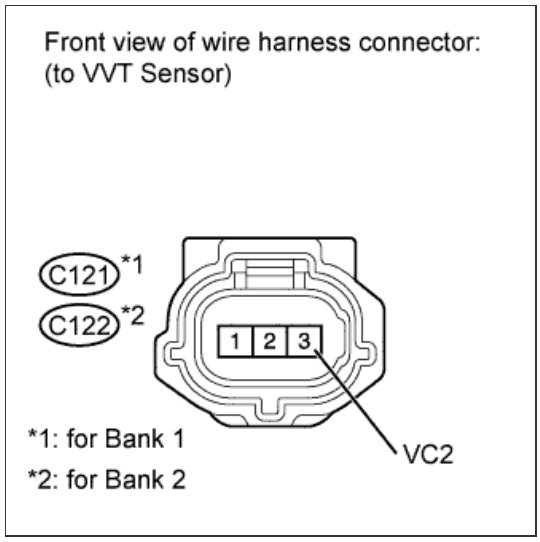
1.CHECK HARNESS AND CONNECTOR (SENSOR POWER SOURCE)

a. Disconnect the C121 or C122 VVT sensor (for exhaust side) connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
C121-3 (VC2) - Body ground	Engine switch on (IG)	4.5 to 5.0 V
C122-3 (VC2) - Body ground	Engine switch on (IG)	4.5 to 5.0 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (VVT SENSOR (for Exhaust Side) - ECM)

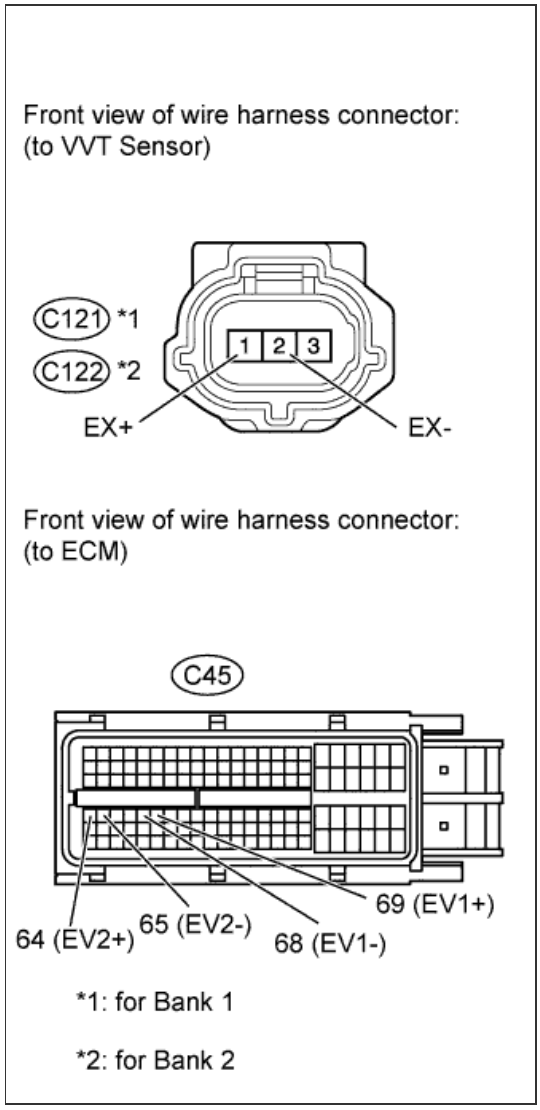
a. Disconnect the C121 or C122 VVT (for exhaust side) sensor connector.

b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C121-1 (EX+) - C45-69 (EV1+)	Always	Below 1 Ω
C121-2 (EX-) - C45-68 (EV1-)	Always	Below 1 Ω
C122-1 (EX+) - C45-64 (EV2+)	Always	Below 1 Ω
C122-2 (EX-) - C45-65 (EV2-)	Always	Below 1 Ω
C121-1 (EX+) or C45-69 (EV1+) - Body ground	Always	10 kΩ or higher
C121-2 (EX-) or C45-68 (EV1-) - Body ground	Always	10 kΩ or higher
C122-1 (EX+) or C45-64 (EV2+) - Body ground	Always	10 kΩ or higher
C122-2 (EX-) or C45-65 (EV2-) - Body ground	Always	10 kΩ or higher



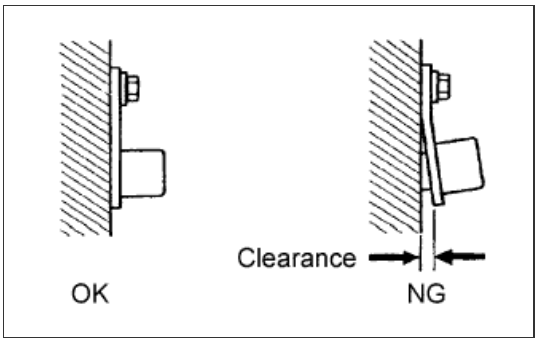
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK SENSOR INSTALLATION

a. Chec the VVT sensor (for exhaust side) installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

4.CHECK EXHAUST CAMSHAFT

a. Check the teeth of the camshaft.

OK:
Teeth do not have any cracks or deformation.

NG → REPLACE EXHAUST CAMSHAFT (Click here)

OK

5.REPLACE VVT SENSOR (for Exhaust Side)

a. Replace the VVT sensor (for exhaust side) (Click here).

NEXT

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No output	A
P0365, P0367, P0368, P0390, P0392 or P0393	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

DTC P0031 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)

DTC P0032 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)

DTC P0051 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)

DTC P0052 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)

for Preparation Click here

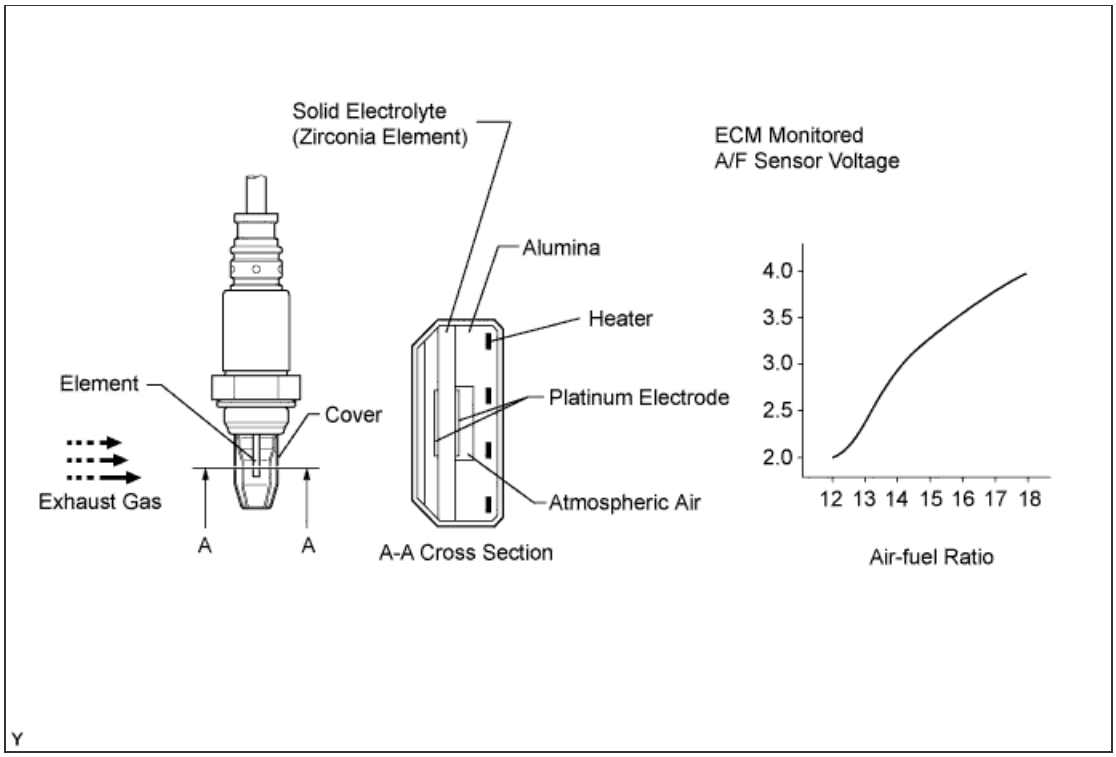
DESCRIPTION

The A/F sensor generates a voltage* that corresponds to the actual air-fuel ratio. This sensor voltage is used to provide the ECM with feedback so that it can control the air-fuel ratio. The ECM determines the deviation from the stoichiometric air-fuel ratio level, and regulates the fuel injection time. If the A/F sensor malfunctions, the ECM is unable to control the air-fuel ratio accurately.

The A/F sensor is the planar type and is integrated with the heater, which heats the solid electrolyte (zirconia element). This heater is controlled by the ECM. When the intake air volume is low (the exhaust gas temperature is low), a current flows into the heater to heat the sensor in order to facilitate accurate airfuel ratio detection. In addition, the sensor and heater portions are the narrow type. The heat generated by the heater is conducted to the solid electrolyte through the alumina, therefore the sensor activation is accelerated.

In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric level.

*: Value changes inside the ECM. Since the A/F sensor is the current output element, a current is converted into a voltage inside the ECM. Any measurements taken at the A/F sensor or ECM connectors will show a constant voltage.

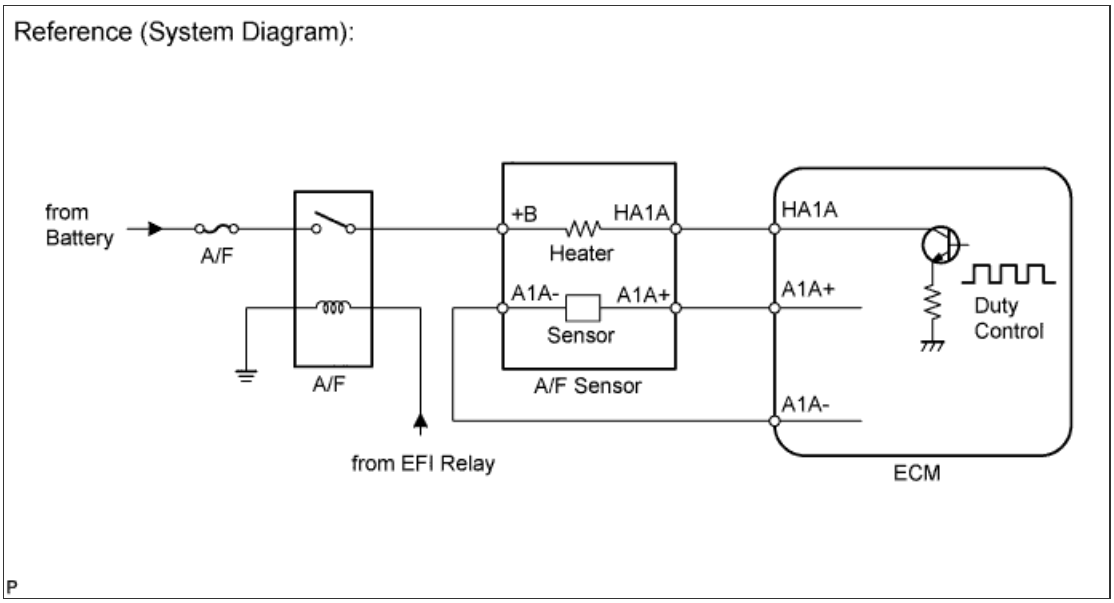


HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air Fuel ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**
- **When one of these DTCs is stored, the ECM enters fail-safe mode. The ECM turns off the A/F sensor heater in fail-safe mode. Fail-safe mode continues until the engine switch is turned off.**

- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The A/F sensor heater circuit uses a relay on the +B side of the circuit.**

Reference (System Diagram):



P

DTC Code	DTC Detection Condition	Trouble Area
P0031 P0051	The Air Fuel ratio (A/F) sensor heater current is below 0.8 A (1 trip detection logic).	• Open in Air Fuel ratio (A/F) sensor heater circuit • A/F sensor heater (for Sensor 1) • Integration relay • ECM
P0032 P0052	An Air Fuel ratio (A/F) sensor heater current failure (1 trip detection logic).	• Short in A/F sensor heater circuit • A/F sensor heater (for Sensor 1) • Integration relay • ECM

MONITOR DESCRIPTION

The ECM uses information from the Air Fuel ratio (A/F) sensor to regulate the air-fuel ratio and keep it close to the stoichiometric level. This maximizes the ability of the Three-Way Catalytic Converter (TWC) to purify the exhaust gases.

The A/F sensor detects oxygen levels in the exhaust gas and transmits the information to the ECM. The inner surface of the sensor element is exposed to the outside air. The outer surface of the sensor element is exposed to the exhaust gas. The sensor element is made of platinum coated zirconia and includes an integrated heating element.

The zirconia element generates a small voltage when there is a large difference in the oxygen concentrations between the exhaust gas and outside air. The platinum coating amplifies this voltage generation.

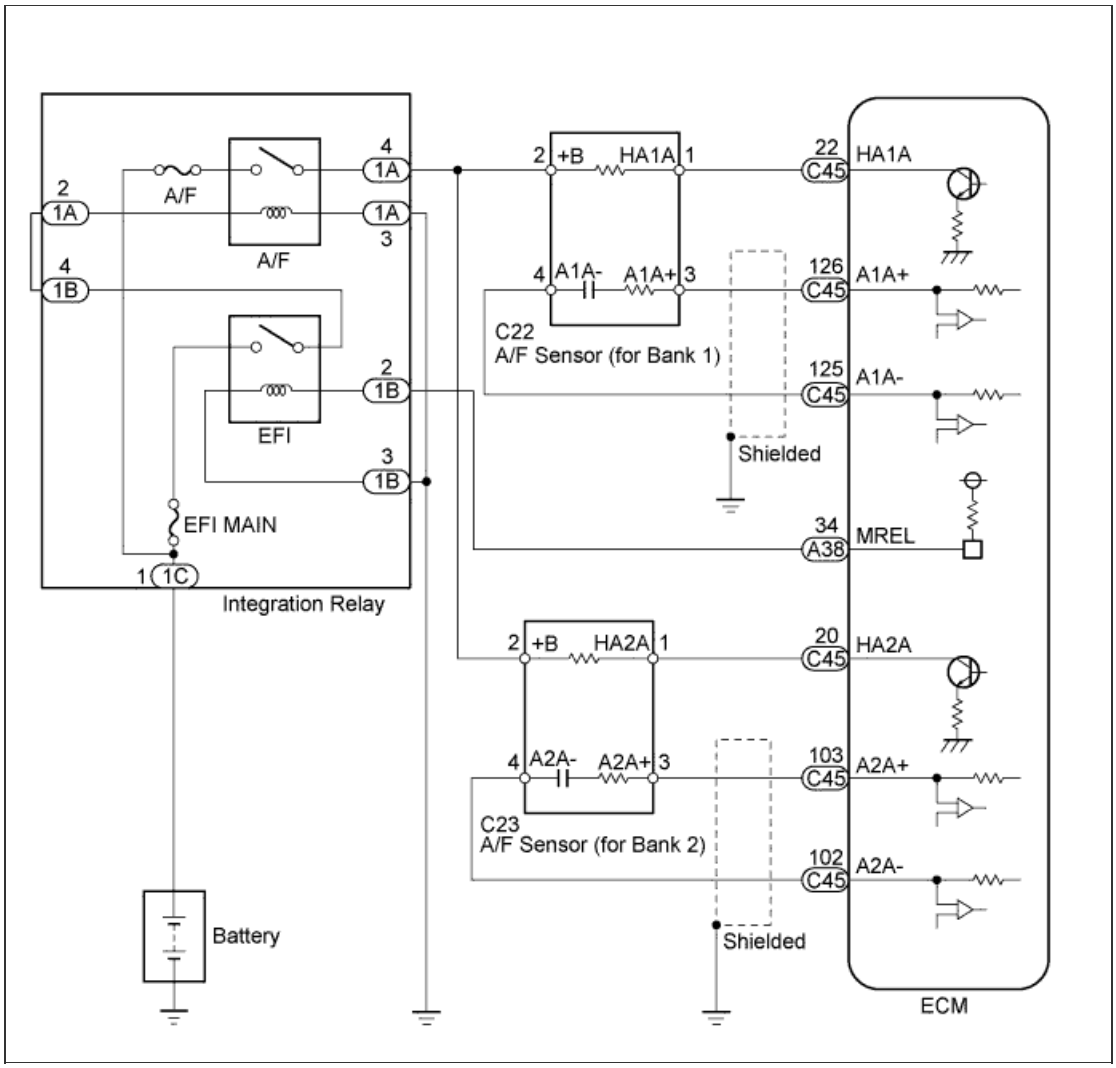
The A/F sensor is more efficient when heated. When the exhaust gas temperature is low, the sensor cannot generate useful voltage signals without supplementary heating. The ECM regulates the supplementary heating using a duty-cycle approach to adjust the average current in the sensor heater element. If the heater current is outside the normal range, the signal transmitted by the A/F sensor becomes inaccurate. As a result, the ECM is unable to regulate the air-fuel ratio properly.

When the current in the A/F sensor heater is outside the normal operating range, the ECM interprets this as a malfunction in the sensor heater and stores DTC(s).

Example:

The ECM stores DTC P0032 or P0052 when the current in the A/F sensor heater is more than 10 A. Conversely, when the heater current is below 0.8 A, DTC P0031 or P0051 is stored.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

1.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

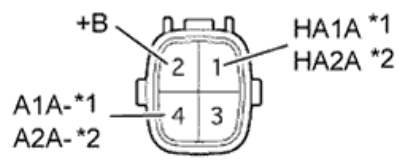
a. Disconnect the C22 or C23 Air Fuel ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF A/F SENSOR)

a. Disconnect the C22 or C23 A/F sensor connector.

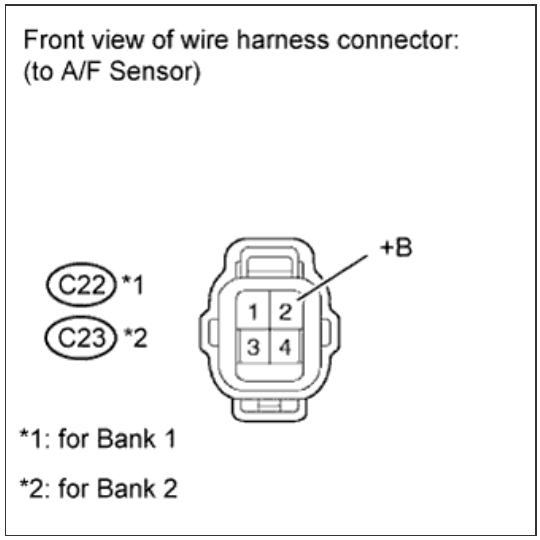
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

Result

Result	Proceed to
NG	A
OK	B



B → Go to step 5

A

3.INSPECT INTEGRATION NO.1 RELAY (A/F)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

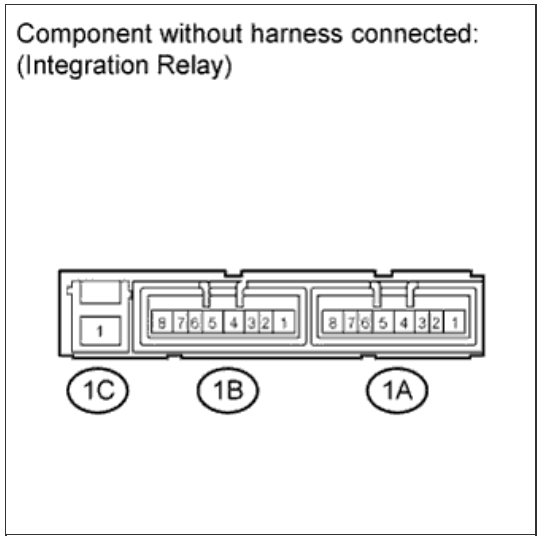
iii. Reinstall the A/F fuse.

c. Inspect the integration relay (A/F).

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1A-4	No battery voltage applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω



NG → REPLACE INTEGRATION NO.1 RELAY (A/F)

OK

4.CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - A/F SENSOR AND BODY GROUND)

a. Disconnect the C22 or C23 A/F sensor connector.

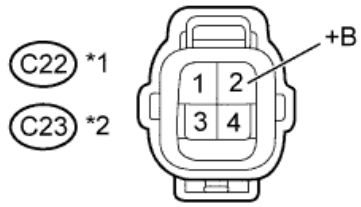
b. Remove the integration relay from the engine room relay block.

c. Measure the resistance according to the value(s) in the table below.

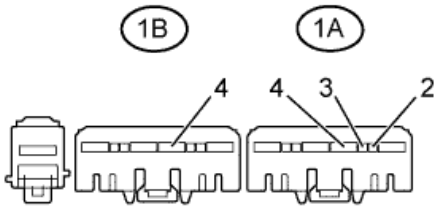
Standard Resistance:

Tester Connection	Condition	Specified Condition
C22-2 (+B) - 1A-4	Always	Below 1 Ω
C23-2 (+B) - 1A-4	Always	Below 1 Ω
1A-2 - 1B-4	Always	Below 1 Ω
1A-3 - Body ground	Always	Below 1 Ω
C22-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher
C23-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher
1A-2 or 1B-4 - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:



Front view of wire harness connector:



*1: for Bank 1

*2: for Bank 2

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

5.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

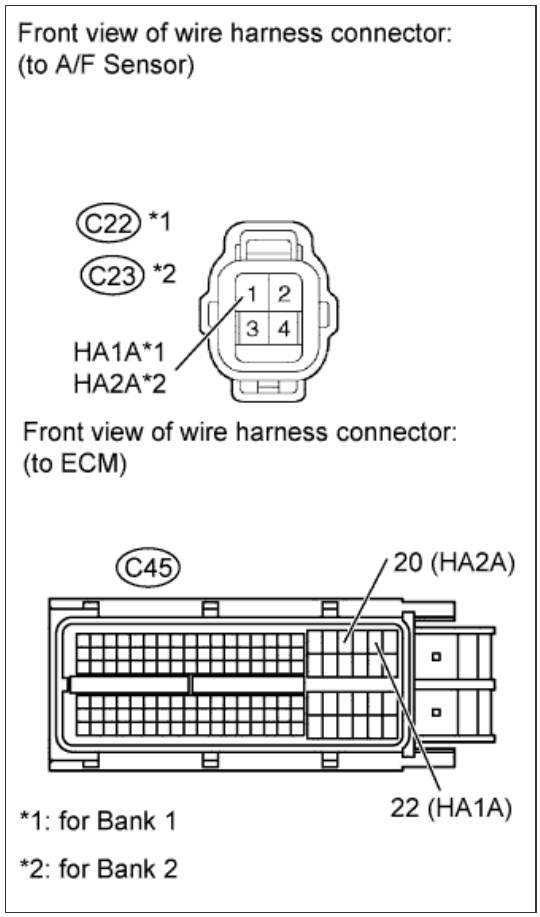
a. Disconnect the C22 or C23 A/F sensor connector.

b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Allow the engine to idle for 1 minute or more.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P0031, P0032, P0051 or P0052 is output	B

B → REPLACE ECM (Click here)

A

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0365 Camshaft Position Sensor "B" Circuit (Bank 1)

DTC P0367 Camshaft Position Sensor "B" Circuit Low Input (Bank 1)

DTC P0368 Camshaft Position Sensor "B" Circuit High Input (Bank 1)

DTC P0390 Camshaft Position Sensor "B" Circuit (Bank 2)

DTC P0392 Camshaft Position Sensor "B" Circuit Low Input (Bank 2)

DTC P0393 Camshaft Position Sensor "B" Circuit High Input (Bank 2)

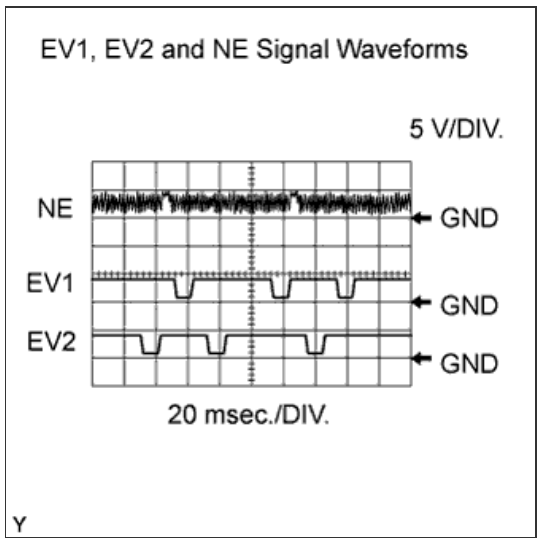
for Preparation Click here

DESCRIPTION

The exhaust camshaft Variable Valve Timing (VVT) sensor (EV1, 2 signal) consists of a magnet and MRE (Magnetic Resistance Element).
The exhaust camshaft has a sensor plate with 3 teeth on its outer circumference. When the exhaust camshaft rotates, changes occur in the air gaps between the 3 teeth and MRE, which affects the magnet. As a result, the resistance of the MRE material fluctuates. The VVT sensor converts the exhaust camshaft rotation data into pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM.

DTC Code	DTC Detection Condition	Trouble Area
P0365 P0390	When either condition below is met: • The input voltage to the ECM remains at below 0.3 V or higher than 4.7 V for more than 4 seconds when 2 or more seconds have elapsed after turning the engine switch on (IG) (1 trip detection logic). • No VVT sensor signal is sent to the ECM during cranking (1 trip detection logic).	• Open or short in VVT sensor (for exhaust side) circuit • VVT sensor (for exhaust side) • Exhaust camshaft • Jumped tooth of timing chain • ECM
P0367 P0392	The output voltage of the VVT sensor is below 0.3 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for exhaust side) circuit • VVT sensor (for exhaust side) • Exhaust camshaft • Jumped tooth of timing chain • ECM
P0368 P0393	The output voltage of the VVT sensor is higher than 4.7 V for 4 seconds (1 trip detection logic).	• Open or short in VVT sensor (for exhaust side) circuit • VVT sensor (for exhaust side) • Exhaust camshaft • Jumped tooth of timing chain • ECM

Reference: Inspection using an oscilloscope.



Standard:

Tester Connection	Tool Setting	Condition	Specified Condition

C45 110 (NE+) - C45-111 (NE-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-69 (EV1+) - C45-68 (EV1-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown
C45-64 (EV2+) - C45-65 (EV2-)	5 V/DIV. 20 msec./DIV.	Cranking or idling	The correct waveform is as shown

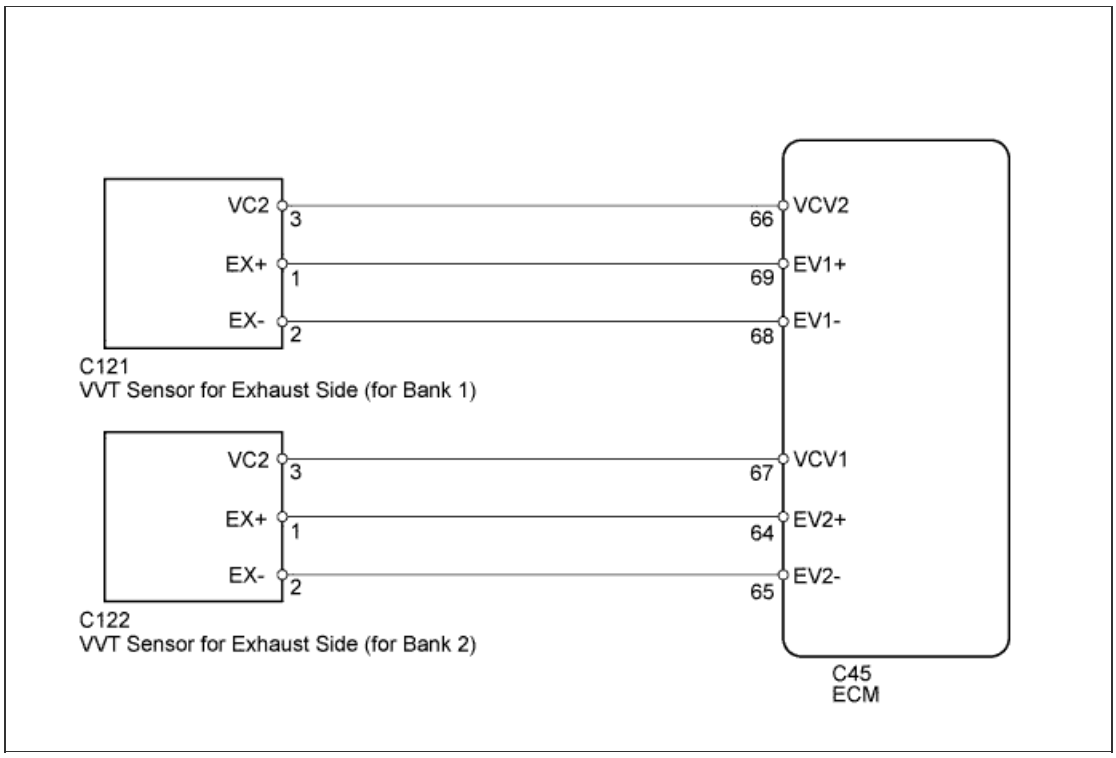
HINT:

EV1+ and EV2+ stand for the VVT sensor (for exhaust side) signal, and NE+ stands for the CKP sensor signal.

MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine revolving, or the rotations of the camshaft and the crankshaft are not synchronized, the ECM interprets this as a malfunction of the sensor.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

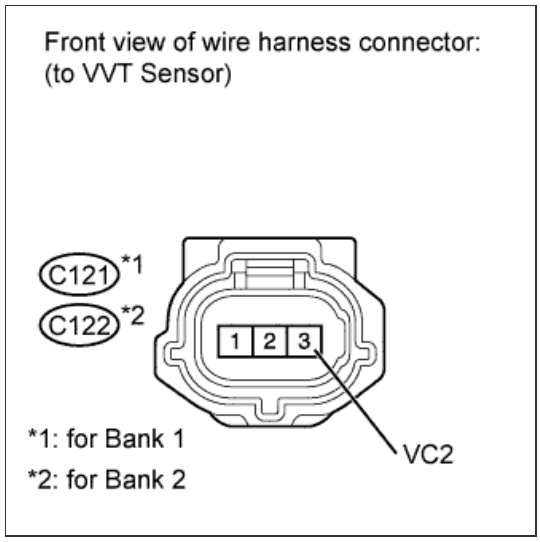
1.CHECK HARNESS AND CONNECTOR (SENSOR POWER SOURCE)

a. Disconnect the C121 or C122 VVT sensor (for exhaust side) connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
C121-3 (VC2) - Body ground	Engine switch on (IG)	4.5 to 5.0 V
C122-3 (VC2) - Body ground	Engine switch on (IG)	4.5 to 5.0 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (VVT SENSOR (for Exhaust Side) - ECM)

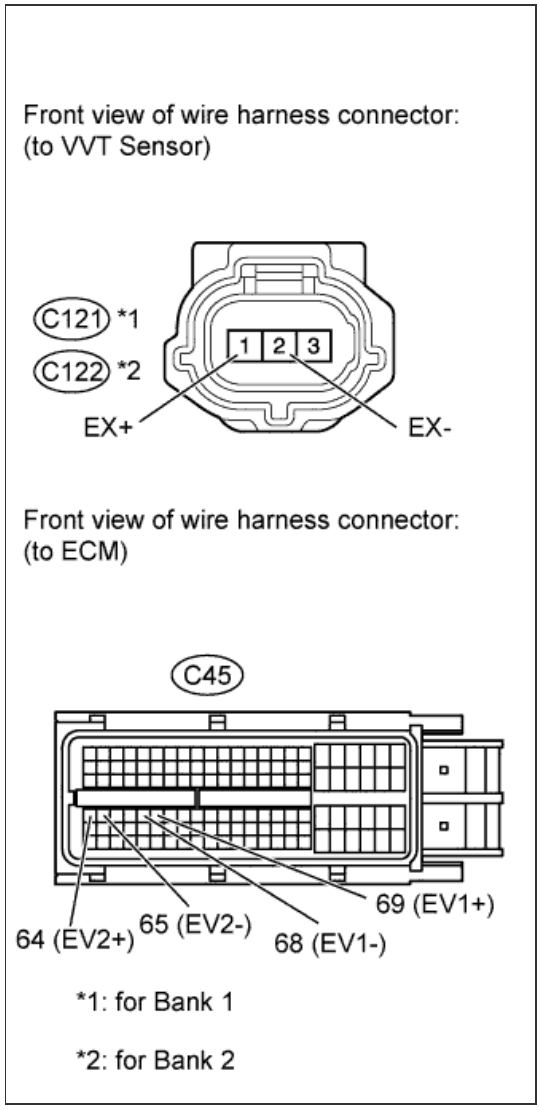
a. Disconnect the C121 or C122 VVT (for exhaust side) sensor connector.

b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C121-1 (EX+) - C45-69 (EV1+)	Always	Below 1 Ω
C121-2 (EX-) - C45-68 (EV1-)	Always	Below 1 Ω
C122-1 (EX+) - C45-64 (EV2+)	Always	Below 1 Ω
C122-2 (EX-) - C45-65 (EV2-)	Always	Below 1 Ω
C121-1 (EX+) or C45-69 (EV1+) - Body ground	Always	10 kΩ or higher
C121-2 (EX-) or C45-68 (EV1-) - Body ground	Always	10 kΩ or higher
C122-1 (EX+) or C45-64 (EV2+) - Body ground	Always	10 kΩ or higher
C122-2 (EX-) or C45-65 (EV2-) - Body ground	Always	10 kΩ or higher



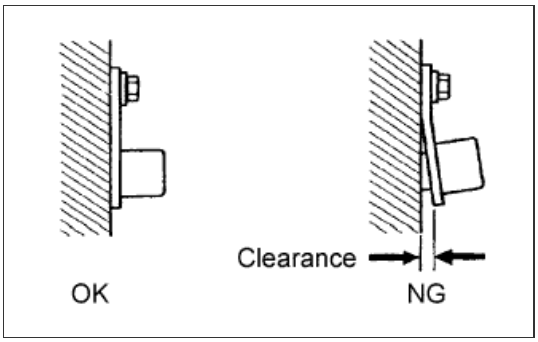
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK SENSOR INSTALLATION

a. Chec the VVT sensor (for exhaust side) installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

4.CHECK EXHAUST CAMSHAFT

a. Check the teeth of the camshaft.

OK:
Teeth do not have any cracks or deformation.

NG → REPLACE EXHAUST CAMSHAFT (Click here)

OK

5.REPLACE VVT SENSOR (for Exhaust Side)

a. Replace the VVT sensor (for exhaust side) (Click here).

NEXT

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No output	A
P0365, P0367, P0368, P0390, P0392 or P0393	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

DTC P0037 Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)

DTC P0038 Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)

DTC P0057 Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)

DTC P0058 Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)

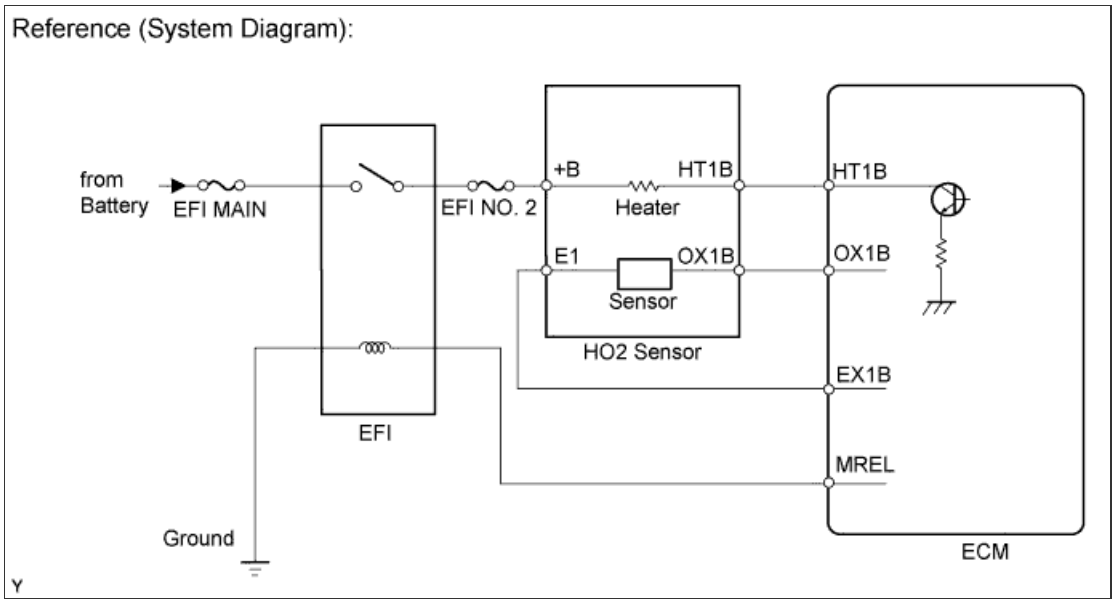
for Preparation Click here

DESCRIPTION

Refer to DTC P0136 (Click here).

HINT:

- **When any of these DTCs is stored, the ECM enters fail-safe mode. The ECM turns off the Heated Oxygen (HO2) Sensor heater in fail-safe mode. Fail-safe mode continues until the engine switch is turned off.**
- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The HO2 sensor heater circuit uses a relay on the +B side of the circuit.**



DTC Code	DTC Detection Condition	Trouble Area
P0037 P0057	The Heated Oxygen (HO2) sensor heater current is below 0.3 A (1 trip detection logic).	• Open in Heated Oxygen (HO2) sensor heater circuit • HO2 sensor heater (for Sensor 2) • ntegration relay • CM
P0038 P0058	The Heated Oxygen (HO2) sensor heater current is higher than 2 A (1 trip detection logic).	• Short in HO2 sensor heater circuit • HO2 sensor heater (for Sensor 2) • ntegration relay • CM

MONITOR DESCRIPTION

The sensing portion of the Heated Oxygen (HO2) sensor has a zirconia element which is used to detect the oxygen concentration in the exhaust gas. f the zirconia element is at the appropriate temperature and the difference between the oxygen concentrations surrounding the inside and outside surfaces of the sensor is large the zirconia element generates oltage signals. n order to increase the oxygen concentration detecting capacity of the zirconia element the CM supplements the heat from the exhaust with heat from a heating element inside the sensor.

Heated oxygen sensor heater range check (P0037 P0038 P0057 and P0058):

The CM monitors the current applied to the O2 sensor heater to check the heater for malfunctions. f the current is below the threshold alue the CM determines that there is an open circuit in the heater. f the current is higher than the threshold alue the CM determines that there is a short circuit in the heater.

The CM constantly monitors the current applied to the heater. f the CM detects an open or short circuit the CM turns the M on and stores a DTC.

f a malfunction is detected the CM cuts off the current applied to the heater.
 xample:
The CM stores DTC P0038 or P0058 when the current in the HO2 sensor heater is higher than 2 A. Con esely when the heater current is below 0.3 A DTC P0037 or P0057 is stored.

WIRING DIAGRAM

Refer to DTC P0136 (Click here).

CONFIRMATION DRIVING PATTERN

These DTCs are stored when the engine idles for 110 seconds or more.

INSPECTION PROCEDURE

HINT:

- **Sensor 2 refers to the sensor mounted behind the Three-Way Catalytic Converter (TWC) and located far from the engine assembly.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

1.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

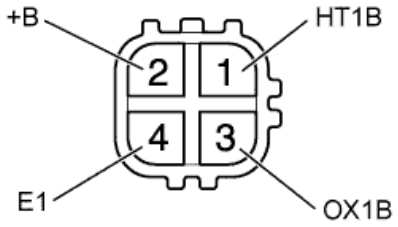
a. Disconnect the C20 or C56 heated oxygen (HO2) sensor connector.

b. Measure the resistance according to the alue(s) in the table below.

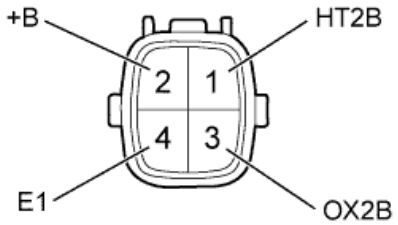
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1) - 2 (+)	20 C (68)	11 to 16 Ω
1 (HT1) - 4 (1)	Always	10 kΩ or higher
1 (HT2) - 2 (+)	20 C (68)	11 to 16 Ω
1 (HT2) - 4 (1)	Always	10 kΩ or higher

Component without harness connected
(HO2 Sensor for Bank 1)



Component without harness connected
(HO2 Sensor for Bank 2)



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF HO2 SENSOR)

a. Disconnect the C20 or C56 HO2 sensor connector.

b. Measure the oltage according to the alue(s) in the table below.

Standard Voltage:

		Specified

Tester Connection	Switch Condition	Condition
C20-2 (+) - ody ground	ngine switch on ( )	11 to 14 V
C56-2 (+) - ody ground	ngine switch on ( )	11 to 14 V

Result

Result	Proceed to
	A
OK	

Front view of wire harness connector:
(to HO2 Sensor for Bank 1)



Front view of wire harness connector:
(to HO2 Sensor for Bank 2)



B → Go to step 5

A

3.INSPECT INTEGRATION NO.1 RELAY (EFI)

a. Re o e the integration relay from the engine room relay block.

b. nspect the MA fuse.

i. Remo e the MA fuse from the integration relay.

ii. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
MA fuse	Always	e low 1 Ω

iii. Reinstall the MA fuse.

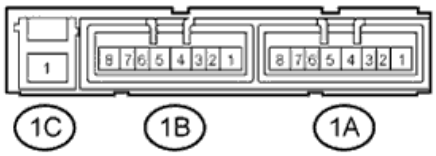
c. nspect the relay.

i. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1	o battery oltage applied to terminals 1 2 and 1 3	10 kΩ or higher
	attery oltage applied to terminals 1 2 and 1 3	e low 1 Ω

Component without harness connected:
(Integration Relay)



NG → REPLACE INTEGRATION NO.1 RELAY (EFI)

OK

4.CHECK HARNESS AND CONNECTOR (HO2 SENSOR - INTEGRATION RELAY)

a. Check the O. 2 fuse.

i. Remo the O. 2 fuse from the engine room relay block.

ii. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
O. 2 fuse	Always	dw 1 Ω

iii. Reinstall the O. 2 fuse.

b. Disconnect the C20 or C56 HO2 sensor connector.

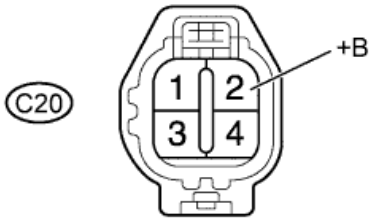
c. Remo the integration relay from the engine room relay block.

d. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C20-2 (+) - 1	Always	dw 1 Ω
C56-2 (+) - 1	Always	dw 1 Ω
C20-2 (+) or 1 ody ground	Always	10 kΩ or higher
C56-2 (+) or 1 ody ground	Always	10 kΩ or higher

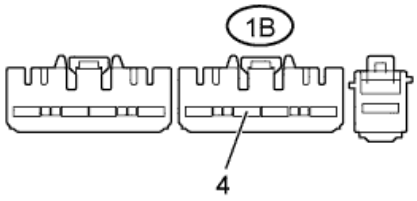
Front view of wire harness connector:
(to HO2 Sensor for Bank 1)



Front view of wire harness connector:
(to HO2 Sensor for Bank 2)



Front view of wire harness connector:
(to Integration Relay)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

5.CHECK HARNESS AND CONNECTOR (HO2 SENSOR - ECM)

a. Disconnect the C20 or C56 HO2 sensor connector.

b. Disconnect the C45 CM connector.

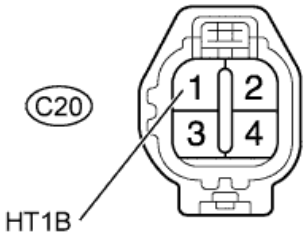
c. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

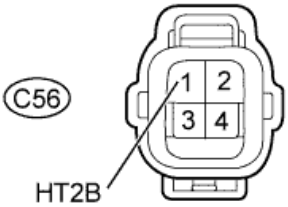
Tester Connection	Condition	Specified Condition
C20-1 (HT1) - C45-45 (HT1)	Always	dw 1 Ω
C56-1 (HT2) - C45-44 (HT2)	Always	dw 1 Ω

C20-1 (HT1) or C45-45 (HT1) - ody ground	Always	10 kΩ or higher
C56-1 (HT2) or C45-44 (HT2) - ody ground	Always	10 kΩ or higher

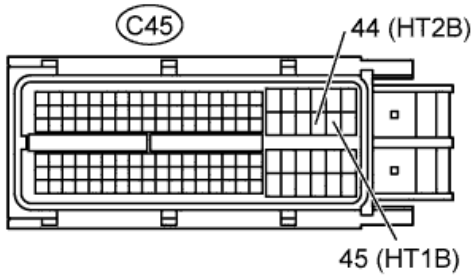
Front view of wire harness connector:
(to HO2 Sensor for Bank 1)



Front view of wire harness connector:
(to HO2 Sensor for Bank 2)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on ( ).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Allow the engine to idle for 2 minutes or more.

g. nter the following menus: Powertrain ngine and CT DTC.

h. Read DTCs.

Result

Result	Proceed to
o DTC is output	A
P0037 P0038 P0057 and or P0058 are output	

B

REPLACE ECM (Click here)

A

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0443 Evaporative Emission Control System Purge Control Valve Circuit

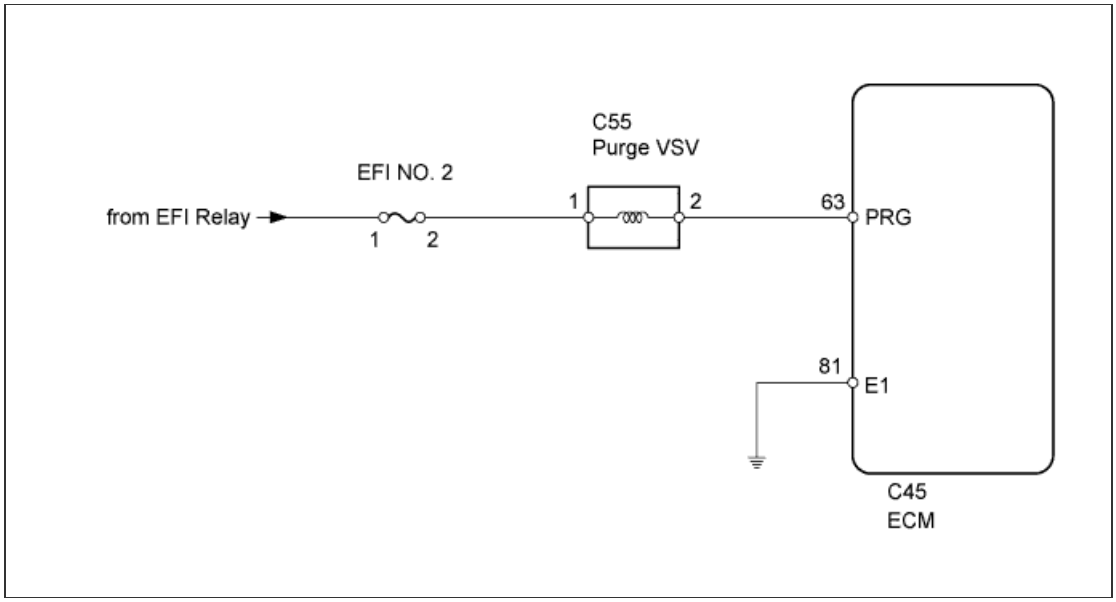
for Preparation Click here

DESCRIPTION

To reduce HC emissions, evaporated fuel from the fuel tank is routed through a charcoal canister to the intake manifold for combustion in the cylinders. The ECM changes the duty signals to the purge VSV so that the intake amount of HC emissions is appropriate for driving conditions (engine load, engine speed, vehicle speed, etc.) after the engine is warmed up.

DTC Code	DTC Detection Condition	Trouble Area
P0443	The terminal voltage of the ECM output circuit does not correspond with the drive signals from the ECM to the purge VSV (1 trip detection logic).	• Open or short in purge VSV circuit • Purge VSV • ECM

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (ACTIVATE THE VSV FOR EVAP CONTROL)

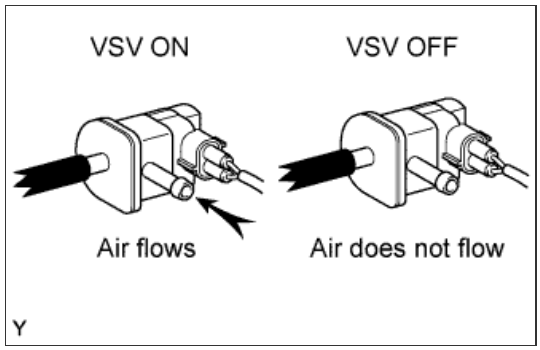
a. Connect the intelligent tester to the D C3.

b. Remove the vacuum hose of the purge VSV from the charcoal canister.

c. Start the engine and turn the tester on.

d. Enter the following menus: Powertrain Engine and ECT Active Test Activate the VSV for Evap Control.

e. When the purge VSV is operated using the tester, check whether the disconnected hose applies suction to your finger.



OK:

Tester Operation	Specified Condition
VSV is ON	Disconnected hose applies suction to finger
VSV is OFF	Disconnected hose applies no suction to finger

OK → CHECK FOR INTERMITTENT PROBLEMS (Click here)

NG

2.INSPECT PURGE VSV

a. Inspect the purge VSV (Click here).

NG → REPLACE PURGE VSV (Click here)

OK

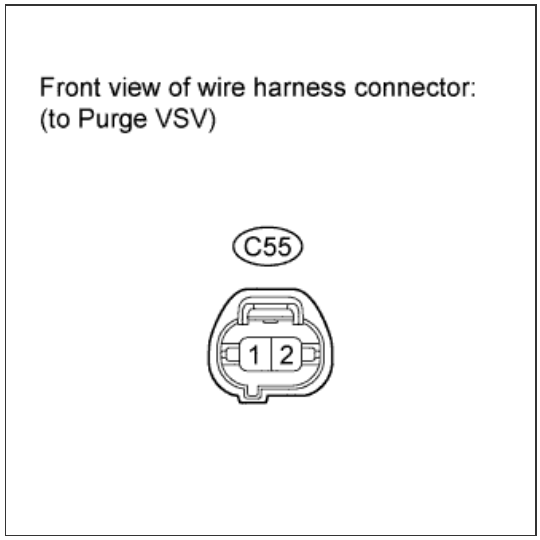
3.INSPECT PURGE VSV (POWER SOURCE VOLTAGE)

a. Disconnect the purge VSV connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
C55-1 - Body ground	Engine switch on (IG)	11 to 14 V



OK → Go to step 5

NG

4.CHECK HARNESS AND CONNECTOR (PURGE VSV - EFI NO. 2 FUSE)

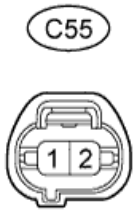
a. Remove the EFI NO. fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

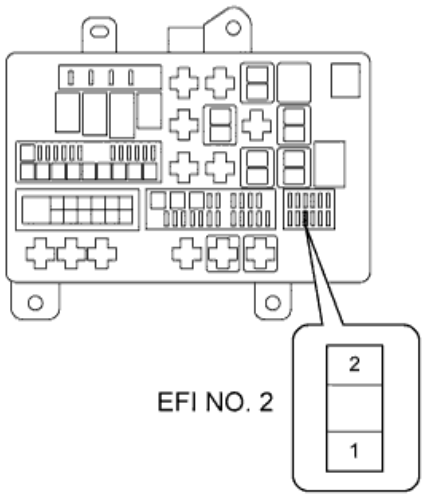
Standard Resistance:

Tester Connection	Condition	Specified Condition
C55-1 - EFI NO. fuse ( )	Always	Below 1 Ω
C55-1 or EFI NO. fuse ( ) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Purge VSV)



Front view of wire harness connector:
(to Engine Room Relay Block)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPAIR OR REPLACE POWER SOURCE CIRCUIT COMPONENTS

5.CHECK HARNESS AND CONNECTOR (PURGE VSV - ECM)

a. Disconnect the purge VSV connector.

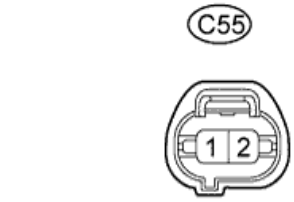
b. Disconnect the ECM connector.

c. Measure the resistance between the terminals of the wire harness side connectors.

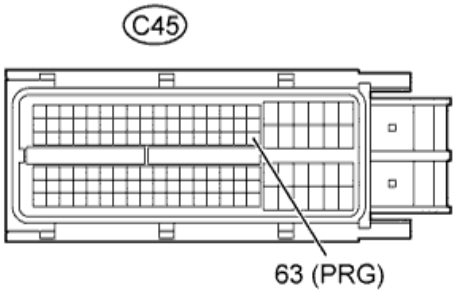
Standard Resistance:

Tester Connection	Condition	Specified Condition
C55- - C53-63 (PRG)	Always	Below 1 Ω
C55- or C53-63 (PRG) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Purge VSV)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P0037 Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)

DTC P0038 Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)

DTC P0057 Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)

DTC P0058 Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)

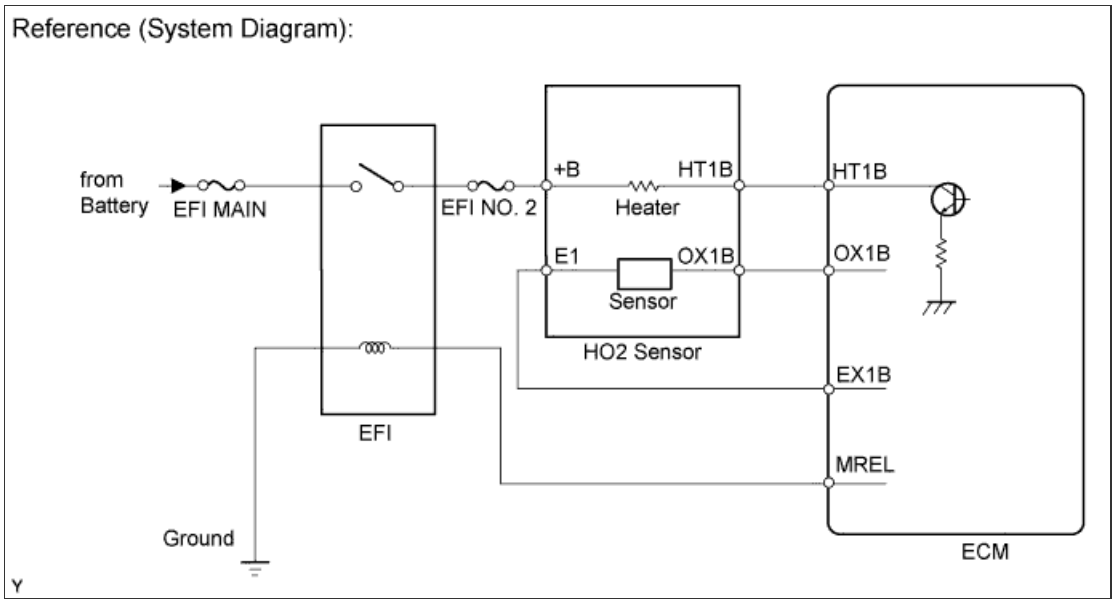
for Preparation Click here

DESCRIPTION

Refer to DTC P0136 (Click here).

HINT:

- **When any of these DTCs is stored, the ECM enters fail-safe mode. The ECM turns off the Heated Oxygen (HO2) Sensor heater in fail-safe mode. Fail-safe mode continues until the engine switch is turned off.**
- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The HO2 sensor heater circuit uses a relay on the +B side of the circuit.**



DTC Code	DTC Detection Condition	Trouble Area
P0037 P0057	The Heated Oxygen (HO2) sensor heater current is below 0.3 A (1 trip detection logic).	• Open in Heated Oxygen (HO2) sensor heater circuit • HO2 sensor heater (for Sensor 2) • ntegration relay • CM
P0038 P0058	The Heated Oxygen (HO2) sensor heater current is higher than 2 A (1 trip detection logic).	• Short in HO2 sensor heater circuit • HO2 sensor heater (for Sensor 2) • ntegration relay • CM

MONITOR DESCRIPTION

The sensing portion of the Heated Oxygen (HO2) sensor has a zirconia element which is used to detect the oxygen concentration in the exhaust gas. f the zirconia element is at the appropriate temperature and the difference between the oxygen concentrations surrounding the inside and outside surfaces of the sensor is large the zirconia element generates oltage signals. n order to increase the oxygen concentration detecting capacity of the zirconia element the CM supplements the heat from the exhaust with heat from a heating element inside the sensor.

Heated oxygen sensor heater range check (P0037 P0038 P0057 and P0058):

The CM monitors the current applied to the O2 sensor heater to check the heater for malfunctions. f the current is below the threshold alue the CM determines that there is an open circuit in the heater. f the current is higher than the threshold alue the CM determines that there is a short circuit in the heater.

The CM constantly monitors the current applied to the heater. f the CM detects an open or short circuit the CM turns the M on and stores a DTC.

f a malfunction is detected the CM cuts off the current applied to the heater.
 xample:
The CM stores DTC P0038 or P0058 when the current in the HO2 sensor heater is higher than 2 A. Con esely when the heater current is below 0.3 A DTC P0037 or P0057 is stored.

WIRING DIAGRAM

Refer to DTC P0136 (Click here).

CONFIRMATION DRIVING PATTERN

These DTCs are stored when the engine idles for 110 seconds or more.

INSPECTION PROCEDURE

HINT:

- **Sensor 2 refers to the sensor mounted behind the Three-Way Catalytic Converter (TWC) and located far from the engine assembly.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

1.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

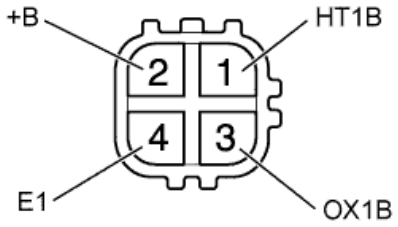
a. Disconnect the C20 or C56 heated oxygen (HO2) sensor connector.

b. Measure the resistance according to the alue(s) in the table below.

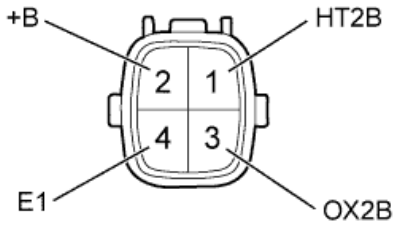
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1) - 2 (+)	20 C (68)	11 to 16 Ω
1 (HT1) - 4 (1)	Always	10 kΩ or higher
1 (HT2) - 2 (+)	20 C (68)	11 to 16 Ω
1 (HT2) - 4 (1)	Always	10 kΩ or higher

Component without harness connected
(HO2 Sensor for Bank 1)



Component without harness connected
(HO2 Sensor for Bank 2)



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF HO2 SENSOR)

a. Disconnect the C20 or C56 HO2 sensor connector.

b. Measure the oltage according to the alue(s) in the table below.

Standard Voltage:

		Specified

Tester Connection	Switch Condition	Condition
C20-2 (+) - ody ground	ngine switch on ( )	11 to 14 V
C56-2 (+) - ody ground	ngine switch on ( )	11 to 14 V

Result

Result	Proceed to
	A
OK	

Front view of wire harness connector:
(to HO2 Sensor for Bank 1)



Front view of wire harness connector:
(to HO2 Sensor for Bank 2)



B → Go to step 5

A

3.INSPECT INTEGRATION NO.1 RELAY (EFI)

a. Re o e the integration relay from the engine room relay block.

b. nspect the MA fuse.

i. Remo e the MA fuse from the integration relay.

ii. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
MA fuse	Always	e low 1 Ω

iii. Reinstall the MA fuse.

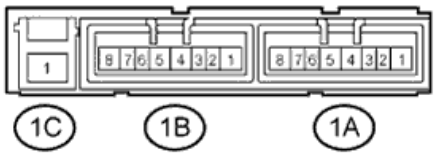
c. nspect the relay.

i. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1	o battery oltage applied to terminals 1 2 and 1 3	10 kΩ or higher
	attery oltage applied to terminals 1 2 and 1 3	e low 1 Ω

Component without harness connected:
(Integration Relay)



NG → REPLACE INTEGRATION NO.1 RELAY (EFI)

OK

4.CHECK HARNESS AND CONNECTOR (HO2 SENSOR - INTEGRATION RELAY)

a. Check the O. 2 fuse.

i. Remo the O. 2 fuse from the engine room relay block.

ii. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
O. 2 fuse	Always	dw 1 Ω

iii. Reinstall the O. 2 fuse.

b. Disconnect the C20 or C56 HO2 sensor connector.

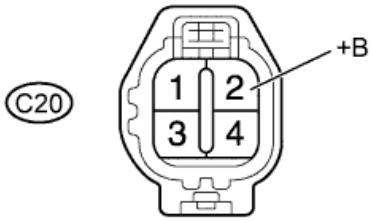
c. Remo the integration relay from the engine room relay block.

d. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C20-2 (+) - 1	Always	dw 1 Ω
C56-2 (+) - 1	Always	dw 1 Ω
C20-2 (+) or 1 ody ground	Always	10 kΩ or higher
C56-2 (+) or 1 ody ground	Always	10 kΩ or higher

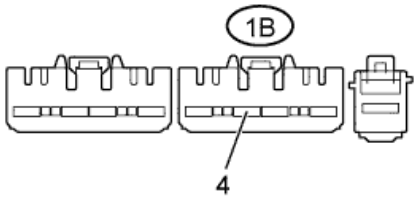
Front view of wire harness connector:
(to HO2 Sensor for Bank 1)



Front view of wire harness connector:
(to HO2 Sensor for Bank 2)



Front view of wire harness connector:
(to Integration Relay)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

5.CHECK HARNESS AND CONNECTOR (HO2 SENSOR - ECM)

a. Disconnect the C20 or C56 HO2 sensor connector.

b. Disconnect the C45 CM connector.

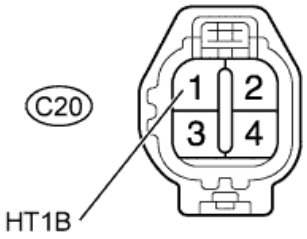
c. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

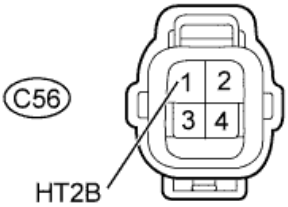
Tester Connection	Condition	Specified Condition
C20-1 (HT1) - C45-45 (HT1)	Always	dw 1 Ω
C56-1 (HT2) - C45-44 (HT2)	Always	dw 1 Ω

C20-1 (HT1) or C45-45 (HT1) - ody ground	Always	10 kΩ or higher
C56-1 (HT2) or C45-44 (HT2) - ody ground	Always	10 kΩ or higher

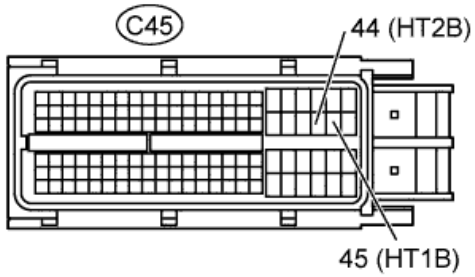
Front view of wire harness connector:
(to HO2 Sensor for Bank 1)



Front view of wire harness connector:
(to HO2 Sensor for Bank 2)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on ( ).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Allow the engine to idle for 2 minutes or more.

g. nter the following menus: Powertrain ngine and CT DTC.

h. Read DTCs.

Result

Result	Proceed to
o DTC is output	A
P0037 P0038 P0057 and or P0058 are output	

B

REPLACE ECM (Click here)

A

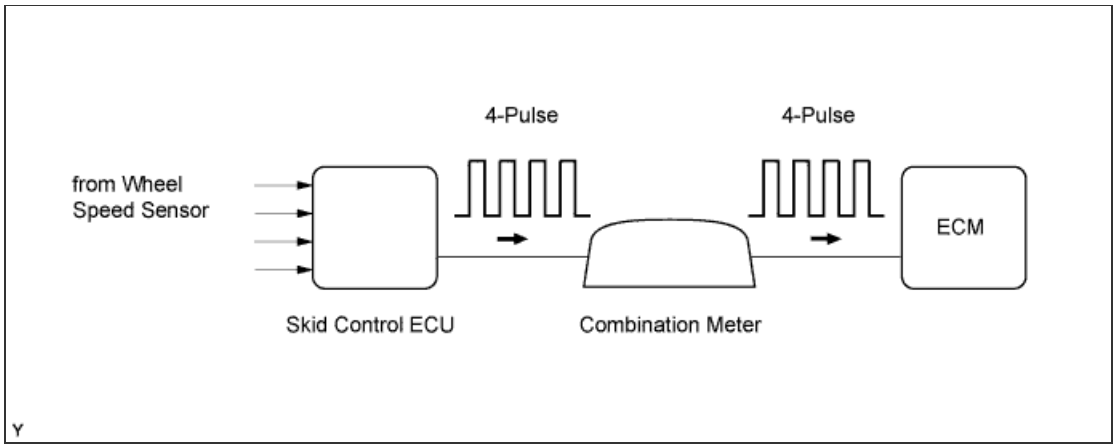
CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0500 Vehicle Speed Sensor "A"

for Preparation Click here

DESCRIPTION

The speed sensor detects the wheel speed and sends the appropriate signals to the skid control ECU. The skid control ECU converts these wheel speed signals into a 4-pulse signal and outputs it to the ECM via the combination meter. The ECM determines the vehicle speed based on the frequency of these pulse signals.

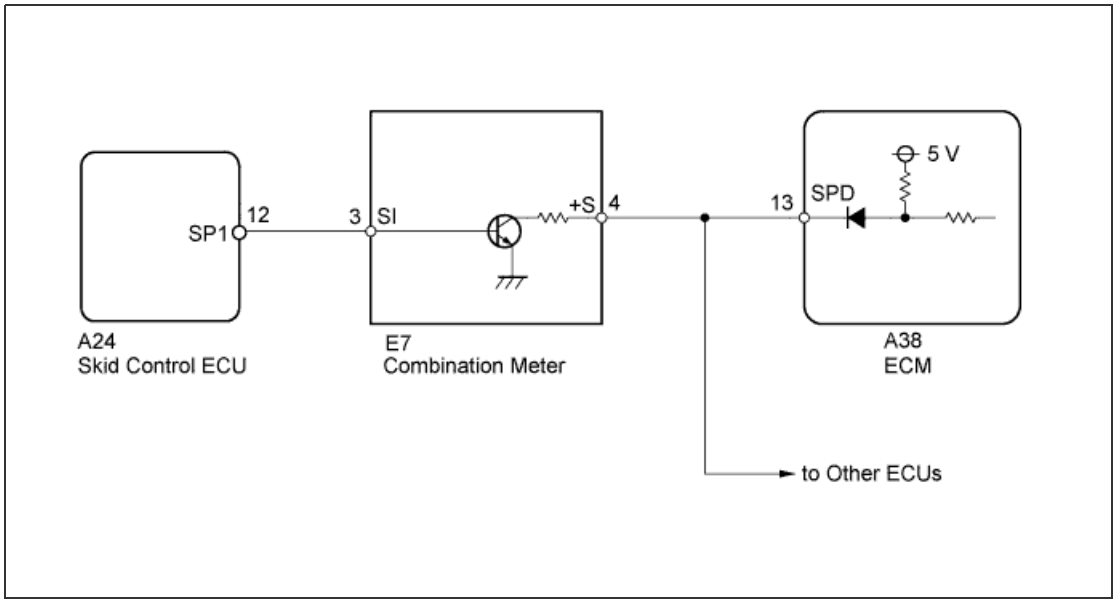


DTC Code	DTC Detection Condition	Trouble Area
P0500	While the vehicle is being driven, no vehicle speed sensor signal is transmitted to the ECM (2 trip detection logic).	• Open or short in speed signal circuit • Combination meter • ECM

MONITOR DESCRIPTION

The ECM assumes that the vehicle is being driven when the indicated vehicle speed is more than km h (5.6 mph). If there is no speed signal from the combination meter despite these conditions being met, the ECM interprets this as a malfunction in the speed signal circuit. The ECM then illuminates the MIL and stores the DTC.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When

troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK OPERATION OF SPEEDOMETER

a. Drive the vehicle and check whether the operation of the speedometer in the combination meter is normal.

HINT:

- **The vehicle speed sensor is operating normally if the speedometer reading is normal.**
- **If the speedometer does not operate, check it by following the procedure described in Speedometer Malfunction (Click here).**

NG → **GO TO MALFUNCTION IN SPEEDOMETER (Click here)**

OK

2.READ VALUE USING INTELLIGENT TESTER (VEHICLE SPD)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Vehicle Speed.

e. Drive the vehicle.

f. Read the value displayed on the tester.

OK:
Vehicle speeds displayed on tester and speedometer display are equal.

NG → **Go to step 3**

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

3.CHECK HARNESS AND CONNECTOR (COMBINATION METER - ECM)

a. Disconnect the E combination meter connector.

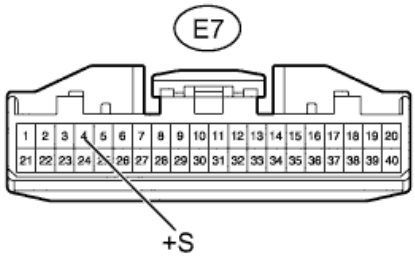
b. Disconnect the A38 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

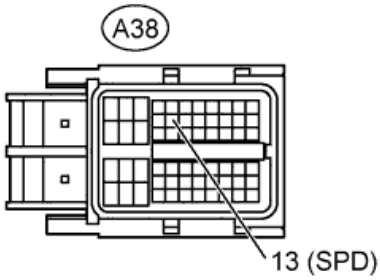
Standard Resistance:

Tester Connection	Condition	Specified Condition
E -4 (+S) - A38-(SPD)	Always	Below Ω
E -4 (+S) or A38-(SPD) - Body ground	Always	0 kΩ or higher

Front view of wire harness connector:
(to Combination Meter)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.CHECK COMBINATION METER ASSEMBLY (+S VOLTAGE)

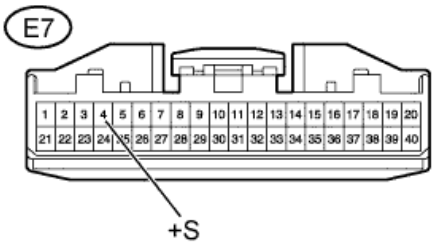
a. Disconnect the E combination meter connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
E -4 (+S) - Body ground	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to Combination Meter)



T

NG → REPLACE ECM (Click here)

OK

5.CHECK COMBINATION METER ASSEMBLY (SPD SIGNAL OUTPUT WAVEFORM)

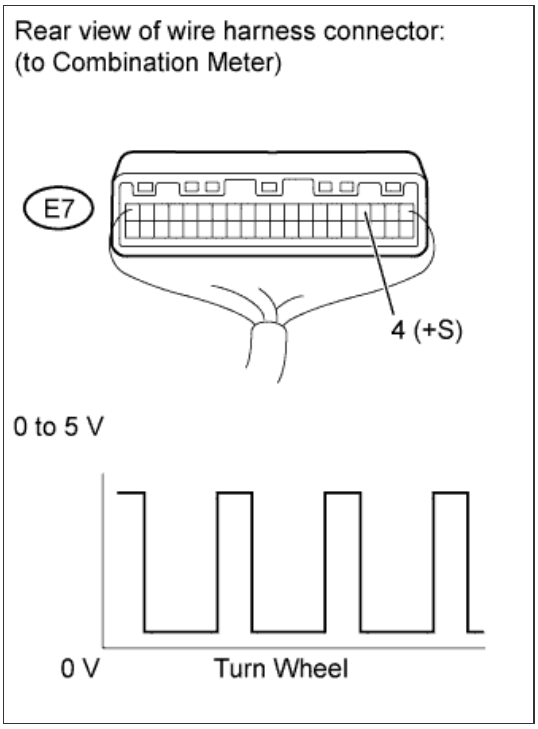
a. Move the shift lever to .

b. ack up the vehicle.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
E -4 (+S) - Body ground	• Engine switch on (IG) • Wheel turned slowly	Voltage generated intermittently



HINT:

The output voltage should fluctuate up and down, similarly to the diagram, when the wheel is turned slowly.

NG → CHECK COMBINATION METER ASSEMBLY (SPD SIGNAL INPUT WAVEFORM)

OK

6.CHECK COMBINATION METER ASSEMBLY (SPD SIGNAL INPUT WAVEFORM)

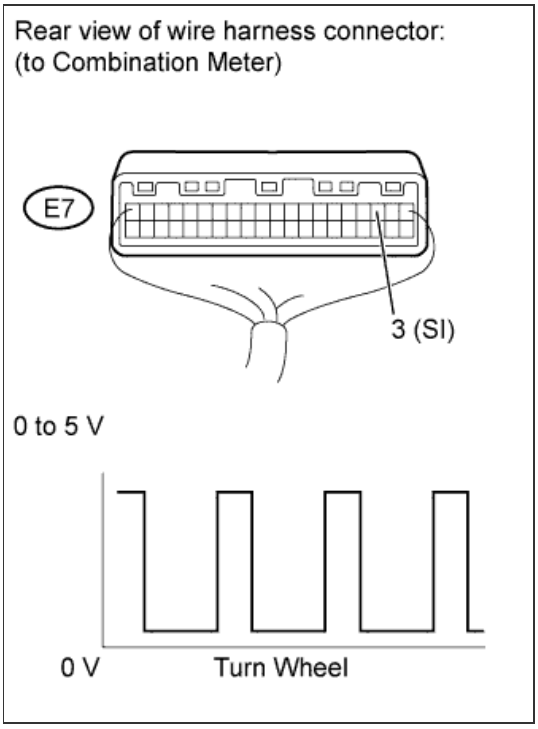
a. Move the shift lever to .

b. ack up the vehicle.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
E -3 (SI) - Body ground	• Engine switch on (IG) • Wheel turned slowly	Voltage generated intermittently



HINT:

The output voltage should fluctuate up and down, similarly to the diagram, when the wheel is turned slowly.

NG → Go to step 7

OK

REPLACE COMBINATION METER ASSEMBLY

7.CHECK HARNESS AND CONNECTOR (COMBINATION METER - SKID CONTROL ECU)

a. Disconnect the combination meter connector.

b. Disconnect the skid control ECU connector.

c. Measure the resistance according the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
E -5 (SI) - A24- 2 (SP	Always	Below Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
E -5 (SI) or A24- 2 (SP - Body ground	Always	0 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE MASTER CYLINDER SOLENOID

DTC P0037 Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)

DTC P0038 Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)

DTC P0057 Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)

DTC P0058 Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)

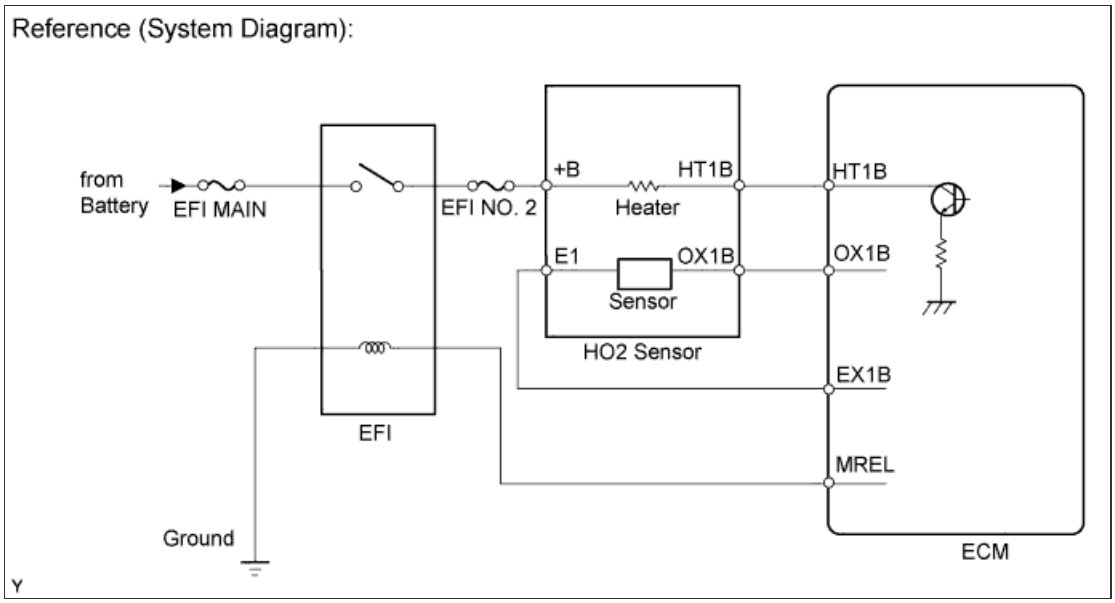
for Preparation Click here

DESCRIPTION

Refer to DTC P0136 (Click here).

HINT:

- **When any of these DTCs is stored, the ECM enters fail-safe mode. The ECM turns off the Heated Oxygen (HO2) Sensor heater in fail-safe mode. Fail-safe mode continues until the engine switch is turned off.**
- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The HO2 sensor heater circuit uses a relay on the +B side of the circuit.**



DTC Code	DTC Detection Condition	Trouble Area
P0037 P0057	The Heated Oxygen (HO2) sensor heater current is below 0.3 A (1 trip detection logic).	• Open in Heated Oxygen (HO2) sensor heater circuit • HO2 sensor heater (for Sensor 2) • ntegration relay • CM
P0038 P0058	The Heated Oxygen (HO2) sensor heater current is higher than 2 A (1 trip detection logic).	• Short in HO2 sensor heater circuit • HO2 sensor heater (for Sensor 2) • ntegration relay • CM

MONITOR DESCRIPTION

The sensing portion of the Heated Oxygen (HO2) sensor has a zirconia element which is used to detect the oxygen concentration in the exhaust gas. f the zirconia element is at the appropriate temperature and the difference between the oxygen concentrations surrounding the inside and outside surfaces of the sensor is large the zirconia element generates oltage signals. n order to increase the oxygen concentration detecting capacity of the zirconia element the CM supplements the heat from the exhaust with heat from a heating element inside the sensor.

Heated oxygen sensor heater range check (P0037 P0038 P0057 and P0058):

The CM monitors the current applied to the O2 sensor heater to check the heater for malfunctions. f the current is below the threshold alue the CM determines that there is an open circuit in the heater. f the current is higher than the threshold alue the CM determines that there is a short circuit in the heater.

The CM constantly monitors the current applied to the heater. f the CM detects an open or short circuit the CM turns the M on and stores a DTC.

f a malfunction is detected the CM cuts off the current applied to the heater.
 xample:
The CM stores DTC P0038 or P0058 when the current in the HO2 sensor heater is higher than 2 A. Con esely when the heater current is below 0.3 A DTC P0037 or P0057 is stored.

WIRING DIAGRAM

Refer to DTC P0136 (Click here).

CONFIRMATION DRIVING PATTERN

These DTCs are stored when the engine idles for 110 seconds or more.

INSPECTION PROCEDURE

HINT:

- **Sensor 2 refers to the sensor mounted behind the Three-Way Catalytic Converter (TWC) and located far from the engine assembly.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

1.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

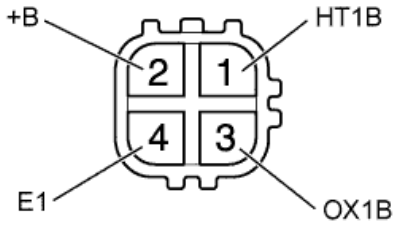
a. Disconnect the C20 or C56 heated oxygen (HO2) sensor connector.

b. Measure the resistance according to the alue(s) in the table below.

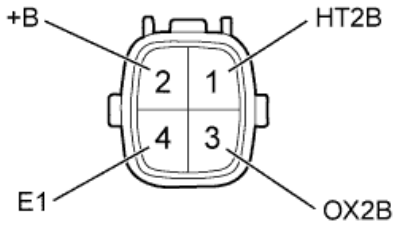
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1) - 2 (+)	20 C (68)	11 to 16 Ω
1 (HT1) - 4 (1)	Always	10 kΩ or higher
1 (HT2) - 2 (+)	20 C (68)	11 to 16 Ω
1 (HT2) - 4 (1)	Always	10 kΩ or higher

Component without harness connected
(HO2 Sensor for Bank 1)



Component without harness connected
(HO2 Sensor for Bank 2)



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF HO2 SENSOR)

a. Disconnect the C20 or C56 HO2 sensor connector.

b. Measure the oltage according to the alue(s) in the table below.

Standard Voltage:

		Specified

Tester Connection	Switch Condition	Condition
C20-2 (+) - ody ground	ngine switch on ( )	11 to 14 V
C56-2 (+) - ody ground	ngine switch on ( )	11 to 14 V

Result

Result	Proceed to
	A
OK	

Front view of wire harness connector:
(to HO2 Sensor for Bank 1)



Front view of wire harness connector:
(to HO2 Sensor for Bank 2)



B → Go to step 5

A

3.INSPECT INTEGRATION NO.1 RELAY (EFI)

a. Re o e the integration relay from the engine room relay block.

b. nspect the MA fuse.

i. Remo e the MA fuse from the integration relay.

ii. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
MA fuse	Always	e low 1 Ω

iii. Reinstall the MA fuse.

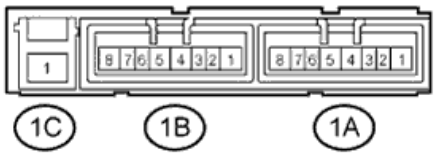
c. nspect the relay.

i. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1	o battery oltage applied to terminals 1 2 and 1 3	10 kΩ or higher
	attery oltage applied to terminals 1 2 and 1 3	e low 1 Ω

Component without harness connected:
(Integration Relay)



NG → REPLACE INTEGRATION NO.1 RELAY (EFI)

OK

4.CHECK HARNESS AND CONNECTOR (HO2 SENSOR - INTEGRATION RELAY)

a. Check the O. 2 fuse.

i. Remo the O. 2 fuse from the engine room relay block.

ii. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
O. 2 fuse	Always	dw 1 Ω

iii. Reinstall the O. 2 fuse.

b. Disconnect the C20 or C56 HO2 sensor connector.

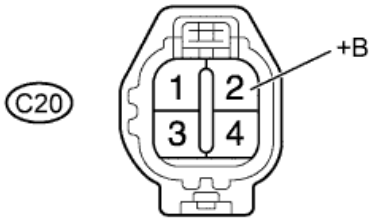
c. Remo the integration relay from the engine room relay block.

d. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C20-2 (+) - 1	Always	dw 1 Ω
C56-2 (+) - 1	Always	dw 1 Ω
C20-2 (+) or 1 ody ground	Always	10 kΩ or higher
C56-2 (+) or 1 ody ground	Always	10 kΩ or higher

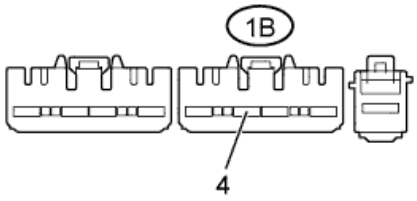
Front view of wire harness connector:
(to HO2 Sensor for Bank 1)



Front view of wire harness connector:
(to HO2 Sensor for Bank 2)



Front view of wire harness connector:
(to Integration Relay)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

5.CHECK HARNESS AND CONNECTOR (HO2 SENSOR - ECM)

a. Disconnect the C20 or C56 HO2 sensor connector.

b. Disconnect the C45 CM connector.

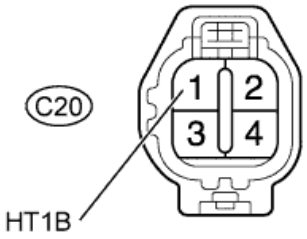
c. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

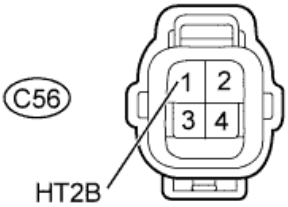
Tester Connection	Condition	Specified Condition
C20-1 (HT1) - C45-45 (HT1)	Always	dw 1 Ω
C56-1 (HT2) - C45-44 (HT2)	Always	dw 1 Ω

C20-1 (HT1) or C45-45 (HT1) - ody ground	Always	10 kΩ or higher
C56-1 (HT2) or C45-44 (HT2) - ody ground	Always	10 kΩ or higher

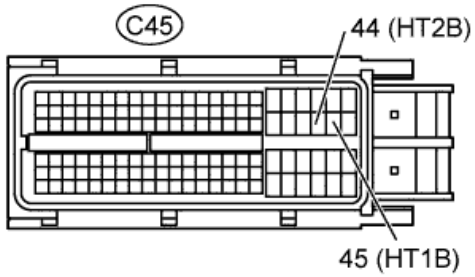
Front view of wire harness connector:
(to HO2 Sensor for Bank 1)



Front view of wire harness connector:
(to HO2 Sensor for Bank 2)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on ( ).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Allow the engine to idle for 2 minutes or more.

g. nter the following menus: Powertrain ngine and CT DTC.

h. Read DTCs.

Result

Result	Proceed to
o DTC is output	A
P0037 P0038 P0057 and or P0058 are output	

B

REPLACE ECM (Click here)

A

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0504 Brake Switch "A" / "B" Correlation

for Preparation Click here

DESCRIPTION

The stop light switch is a duplex system that transmits two signals: STP and ST1-. These two signals are used by the ECM to monitor whether or not the brake system is working properly. If the signals, which indicate the brake pedal is being depressed and released, are detected simultaneously, the ECM interprets this as a malfunction in the stop light switch and stores the DTC.

HINT:

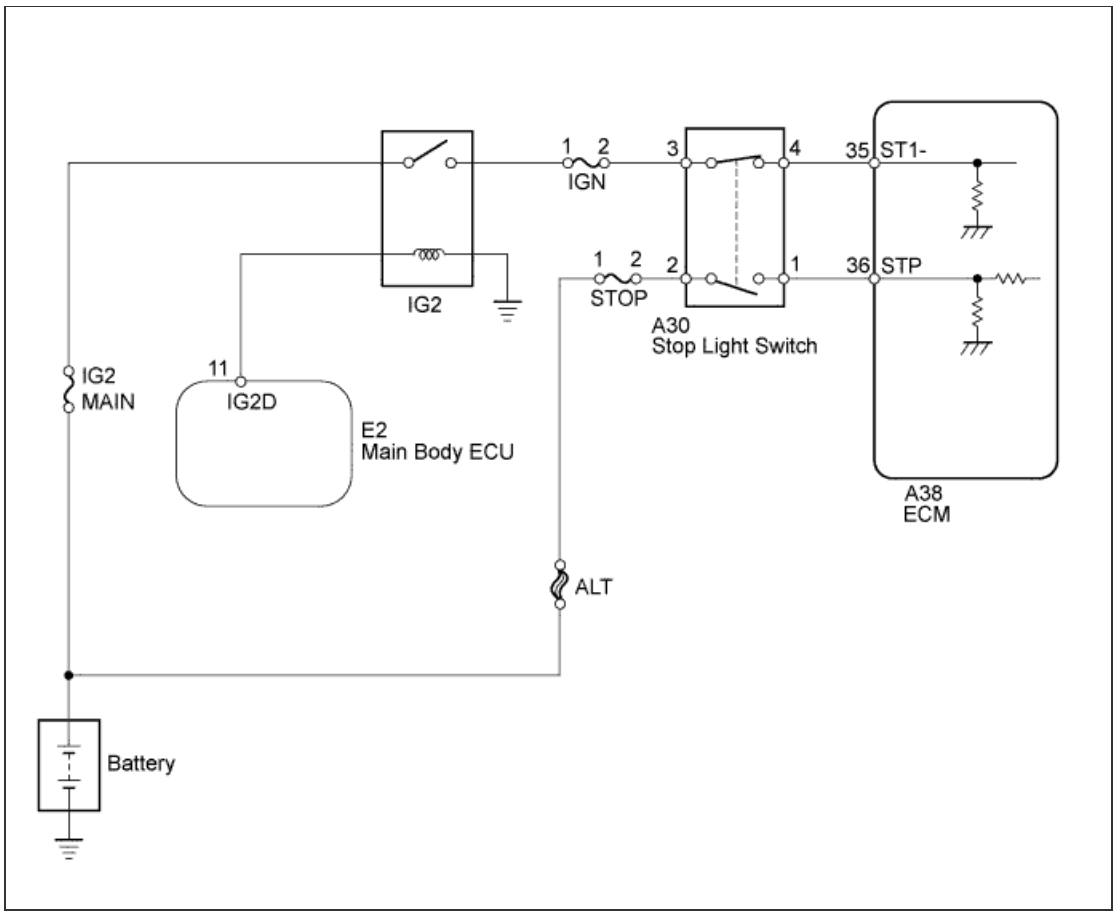
The normal signal conditions are as shown in the table below.

Signal (ECM Terminal)	Brake Pedal Released	In Transition	Brake Pedal Depressed
STP	OFF	ON	ON
ST1-	ON	ON	OFF

- **[OFF] denotes ground potential.**
- **[ON] denotes battery potential (+B).**
- **On the intelligent tester, both the Data List items Stop Light Switch and ST1 are ON when the brake pedal is depressed because the ST1 indication characteristic is opposite to the Stop Light Switch indication.**

DTC Code	DTC Detection Condition	Trouble Area
P0	Conditions (a), (b) and (c) continue for 0. seconds or more (1 trip detection logic): (a) The engine switch is on (IG). (b) The brake pedal is released. (c) The STP signal is OFF when the ST1- signal is OFF.	• Short in stop light switch signal circuit • STOP fuse • IGN fuse • Stop light switch • ECM

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **STP signal conditions can be checked using the intelligent tester.**
  1. **Connect the tester to the DLC3.**
  2. **Turn the engine switch on (IG).**
  3. **Turn the tester on.**
  4. **Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Stop Light Switch and ST1.**
  5. **Check the Data List indication when the brake pedal is depressed and released.**

Brake Pedal Operation	Stop ght Switch	ST1
Depressed	ON	ON
Released	OFF	OFF

1.CHECK STOP LIGHT SWITCH ASSEMBLY (B+ VOLTAGE)

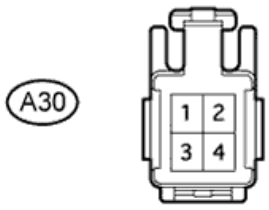
a. Disconnect the A stop light switch connector.

b. Measure the oltage according to the alue(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A -2 - Body ground	Always	11 to 14
- - Body ground	Engine switch on (IG)	11 to 14

Front view of wire Harness connector:
(to Stop Light Switch)



NG → Go to step 4

OK

2.INSPECT STOP LIGHT SWITCH ASSEMBLY

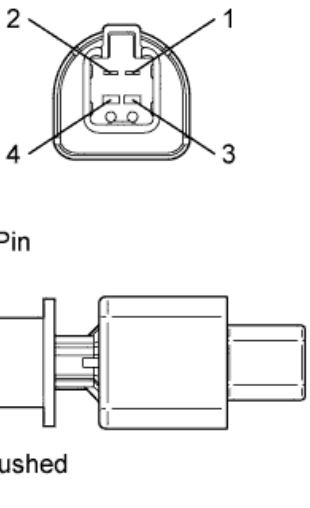
a. Remo e the stop light switch.

b. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

Tester Connection	Switch Condition	Specified Condition
1 - 2	Pin not pushed	Below 1 Ω
	Pin pushed	10 kΩ or higher
- 4	Pin not pushed	10 kΩ or higher
	Pin pushed	Below 1 Ω

Component without harness connected:
(Stop Light Switch)



NG → REPLACE STOP LIGHT SWITCH ASSEMBLY (Click here)

OK

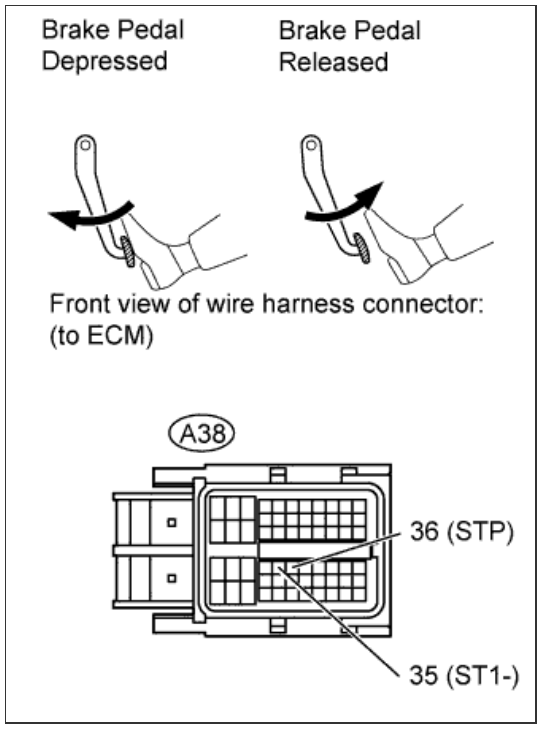
3.CHECK ECM (STP AND ST1 - VOLTAGE)

a. Disconnect the A or A ECM connector.

b. Measure the oltage according to the alue(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
A - (ST1-) - Body ground	Brake pedal released	11 to 14
	Brake pedal depressed	0 to
- (STP) - Body ground	Brake pedal released	0 to
	Brake pedal depressed	11 to 14



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

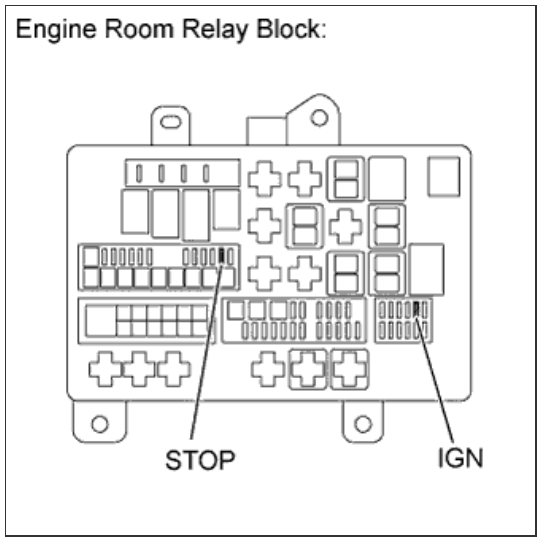
4.INSPECT FUSE (STOP AND IGN)

a. Remo e the STOP and IGN fuses from the engine room relay block.

b. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
STOP fuse	Always	Below 1 Ω
IGN fuse	Always	Below 1 Ω



NG → CHECK FOR SHORTS IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - STOP LIGHT SWITCH)

DTC P0037 Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)

DTC P0038 Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)

DTC P0057 Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)

DTC P0058 Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)

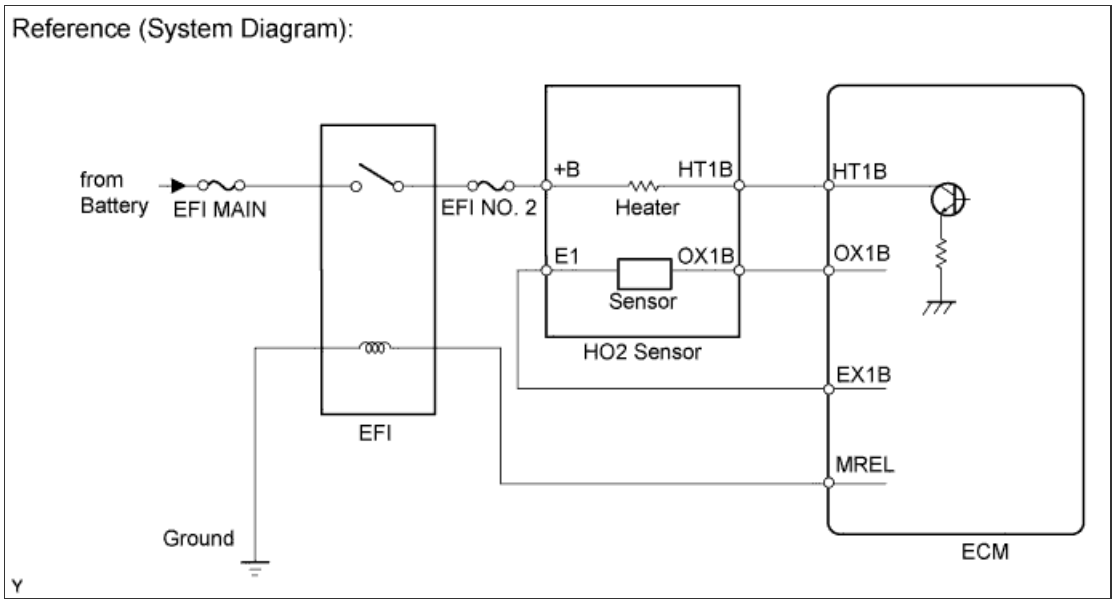
for Preparation Click here

DESCRIPTION

Refer to DTC P0136 (Click here).

HINT:

- **When any of these DTCs is stored, the ECM enters fail-safe mode. The ECM turns off the Heated Oxygen (HO2) Sensor heater in fail-safe mode. Fail-safe mode continues until the engine switch is turned off.**
- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The HO2 sensor heater circuit uses a relay on the +B side of the circuit.**



DTC Code	DTC Detection Condition	Trouble Area
P0037 P0057	The Heated Oxygen (HO2) sensor heater current is below 0.3 A (1 trip detection logic).	• Open in Heated Oxygen (HO2) sensor heater circuit • HO2 sensor heater (for Sensor 2) • ntegration relay • CM
P0038 P0058	The Heated Oxygen (HO2) sensor heater current is higher than 2 A (1 trip detection logic).	• Short in HO2 sensor heater circuit • HO2 sensor heater (for Sensor 2) • ntegration relay • CM

MONITOR DESCRIPTION

The sensing portion of the Heated Oxygen (HO2) sensor has a zirconia element which is used to detect the oxygen concentration in the exhaust gas. f the zirconia element is at the appropriate temperature and the difference between the oxygen concentrations surrounding the inside and outside surfaces of the sensor is large the zirconia element generates oltage signals. n order to increase the oxygen concentration detecting capacity of the zirconia element the CM supplements the heat from the exhaust with heat from a heating element inside the sensor.

Heated oxygen sensor heater range check (P0037 P0038 P0057 and P0058):

The CM monitors the current applied to the O2 sensor heater to check the heater for malfunctions. f the current is below the threshold alue the CM determines that there is an open circuit in the heater. f the current is higher than the threshold alue the CM determines that there is a short circuit in the heater.

The CM constantly monitors the current applied to the heater. f the CM detects an open or short circuit the CM turns the M on and stores a DTC.

f a malfunction is detected the CM cuts off the current applied to the heater.
 xample:
The CM stores DTC P0038 or P0058 when the current in the HO2 sensor heater is higher than 2 A. Con esely when the heater current is below 0.3 A DTC P0037 or P0057 is stored.

WIRING DIAGRAM

Refer to DTC P0136 (Click here).

CONFIRMATION DRIVING PATTERN

These DTCs are stored when the engine idles for 110 seconds or more.

INSPECTION PROCEDURE

HINT:

- **Sensor 2 refers to the sensor mounted behind the Three-Way Catalytic Converter (TWC) and located far from the engine assembly.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

1.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

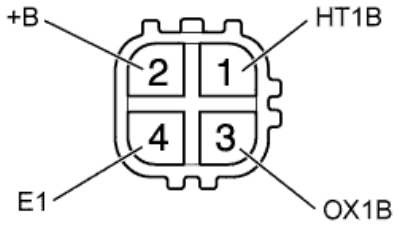
a. Disconnect the C20 or C56 heated oxygen (HO2) sensor connector.

b. Measure the resistance according to the alue(s) in the table below.

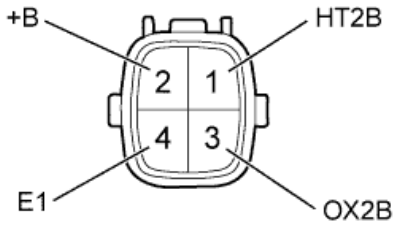
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1) - 2 (+)	20 C (68)	11 to 16 Ω
1 (HT1) - 4 (1)	Always	10 kΩ or higher
1 (HT2) - 2 (+)	20 C (68)	11 to 16 Ω
1 (HT2) - 4 (1)	Always	10 kΩ or higher

Component without harness connected
(HO2 Sensor for Bank 1)



Component without harness connected
(HO2 Sensor for Bank 2)



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF HO2 SENSOR)

a. Disconnect the C20 or C56 HO2 sensor connector.

b. Measure the oltage according to the alue(s) in the table below.

Standard Voltage:

		Specified

Tester Connection	Switch Condition	Condition
C20-2 (+) - ody ground	ngine switch on ( )	11 to 14 V
C56-2 (+) - ody ground	ngine switch on ( )	11 to 14 V

Result

Result	Proceed to
	A
OK	

Front view of wire harness connector:
(to HO2 Sensor for Bank 1)



Front view of wire harness connector:
(to HO2 Sensor for Bank 2)



B → Go to step 5

A

3.INSPECT INTEGRATION NO.1 RELAY (EFI)

a. Re o e the integration relay from the engine room relay block.

b. nspect the MA fuse.

i. Remo e the MA fuse from the integration relay.

ii. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
MA fuse	Always	e low 1 Ω

iii. Reinstall the MA fuse.

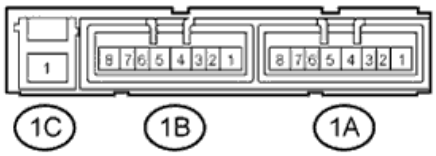
c. nspect the relay.

i. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1	o battery oltage applied to terminals 1 2 and 1 3	10 kΩ or higher
	attery oltage applied to terminals 1 2 and 1 3	e low 1 Ω

Component without harness connected:
(Integration Relay)



NG → REPLACE INTEGRATION NO.1 RELAY (EFI)

OK

4.CHECK HARNESS AND CONNECTOR (HO2 SENSOR - INTEGRATION RELAY)

a. Check the O. 2 fuse.

i. Remo the O. 2 fuse from the engine room relay block.

ii. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
O. 2 fuse	Always	dw 1 Ω

iii. Reinstall the O. 2 fuse.

b. Disconnect the C20 or C56 HO2 sensor connector.

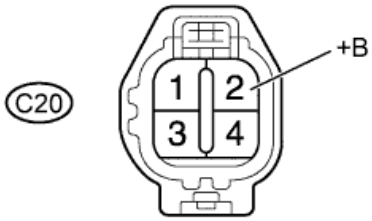
c. Remo the integration relay from the engine room relay block.

d. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C20-2 (+) - 1	Always	dw 1 Ω
C56-2 (+) - 1	Always	dw 1 Ω
C20-2 (+) or 1 ody ground	Always	10 kΩ or higher
C56-2 (+) or 1 ody ground	Always	10 kΩ or higher

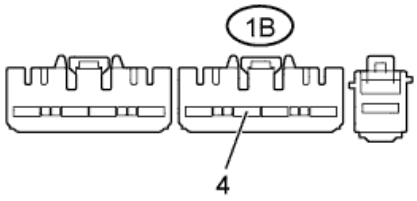
Front view of wire harness connector:
(to HO2 Sensor for Bank 1)



Front view of wire harness connector:
(to HO2 Sensor for Bank 2)



Front view of wire harness connector:
(to Integration Relay)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

5.CHECK HARNESS AND CONNECTOR (HO2 SENSOR - ECM)

a. Disconnect the C20 or C56 HO2 sensor connector.

b. Disconnect the C45 CM connector.

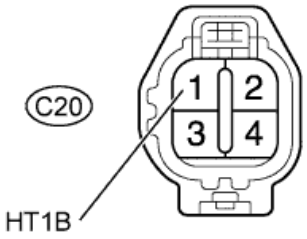
c. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

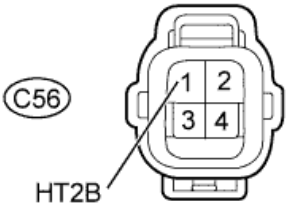
Tester Connection	Condition	Specified Condition
C20-1 (HT1) - C45-45 (HT1)	Always	dw 1 Ω
C56-1 (HT2) - C45-44 (HT2)	Always	dw 1 Ω

C20-1 (HT1) or C45-45 (HT1) - ody ground	Always	10 kΩ or higher
C56-1 (HT2) or C45-44 (HT2) - ody ground	Always	10 kΩ or higher

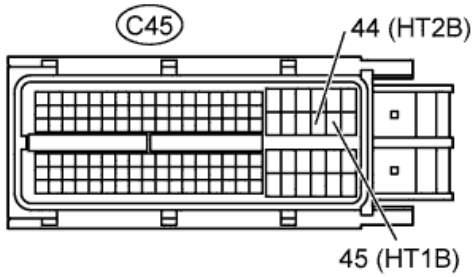
Front view of wire harness connector:
(to HO2 Sensor for Bank 1)



Front view of wire harness connector:
(to HO2 Sensor for Bank 2)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on ( ).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Allow the engine to idle for 2 minutes or more.

g. nter the following menus: Powertrain ngine and CT DTC.

h. Read DTCs.

Result

Result	Proceed to
o DTC is output	A
P0037 P0038 P0057 and or P0058 are output	

B

REPLACE ECM (Click here)

A

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0550 Power Steering Pressure Sensor Circuit Malfunction

DTC P0552 Power Steering Pressure Sensor Circuit Low Input

DTC P0553 Power Steering Pressure Sensor Circuit High Input

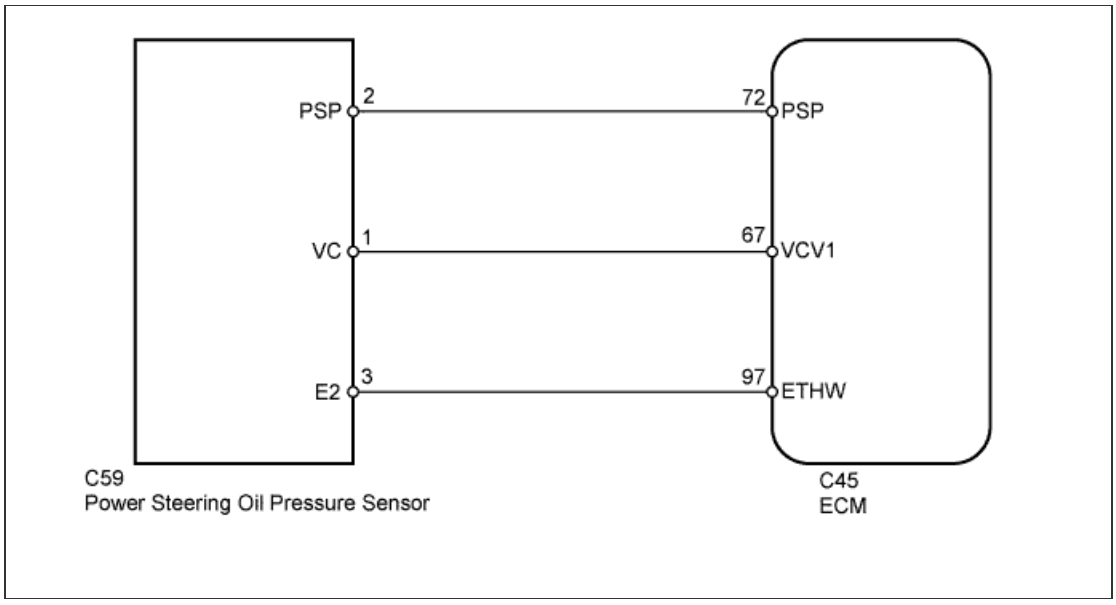
for Preparation Click here

DESCRIPTION

The power steering oil pressure sensor is turned on when a power steering wheel load occurs by turning the steering wheel. The ECM regulates the engine idling RPM according to the voltage output of the sensor.

DTC Code	DTC Detection Condition	Trouble Area
P0550	Power steering oil pressure sensor voltage less than 0.28 V, or more than 4.9 V for 0.5 seconds while engine running. (1 trip detection logic)	• Open or short in power steering oil pressure sensor circuit • Power steering oil pressure sensor • ECM
P0552	Power steering oil pressure sensor voltage less than 0.28 V for 0.5 seconds while engine running. (1 trip detection logic)	• Open or short in power steering oil pressure sensor circuit • Power steering oil pressure sensor • ECM
P0553	Power steering oil pressure sensor voltage more than 4.9 V for 0.5 seconds while engine running. (1 trip detection logic)	• Open or short in power steering oil pressure sensor circuit • Power steering oil pressure sensor • ECM

WIRING DIAGRAM



MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to regulate the engine idling speed. When the sensor output voltage deviates from the normal operating range, the ECM determines that there is a malfunction in the power steering oil pressure sensor and stores DTC(s).

INSPECTION PROCEDURE

HINT:

- **If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK HARNESS AND CONNECTOR (ECM - POWER STEERING OIL PRESSURE SENSOR)

a. Disconnect the C45 ECM connector.

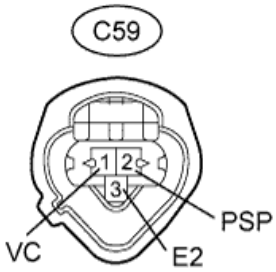
b. Disconnect the C59 power steering oil pressure sensor connector.

c. Measure the resistance according to the value(s) in the table below.

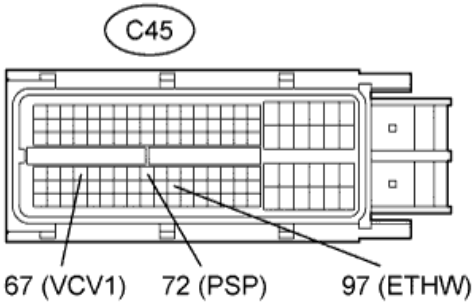
Standard Resistance:

Tester Connection	Condition	Specified Condition
C59-2 (PSP) - C45-72 (PSP)	Always	Below 1 Ω
C59-1 (VC) - C45-67 (VCV1)	Always	Below 1 Ω
C59-3 (E2) - C45-97 (ETHW)	Always	Below 1 Ω
C59-2 (PSP) or C45-72 (PSP) - Body ground	Always	10 kΩ or higher
C59-1 (VC) or C45-67 (VCV1) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Power Steering Oil Pressure Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE POWER STEERING OIL PRESSURE SENSOR

a. Replace the power steering oil pressure sensor (Click here).

NEXT

3.CONFIRM WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P0550, P0552 and/or P0553 are output	A
No DTC is output	B

B → END

A

REPLACE ECM (Click here)

DTC P0102 Mass or Volume Air Flow Circuit Low Input

DTC P0103 Mass or Volume Air Flow Circuit High Input

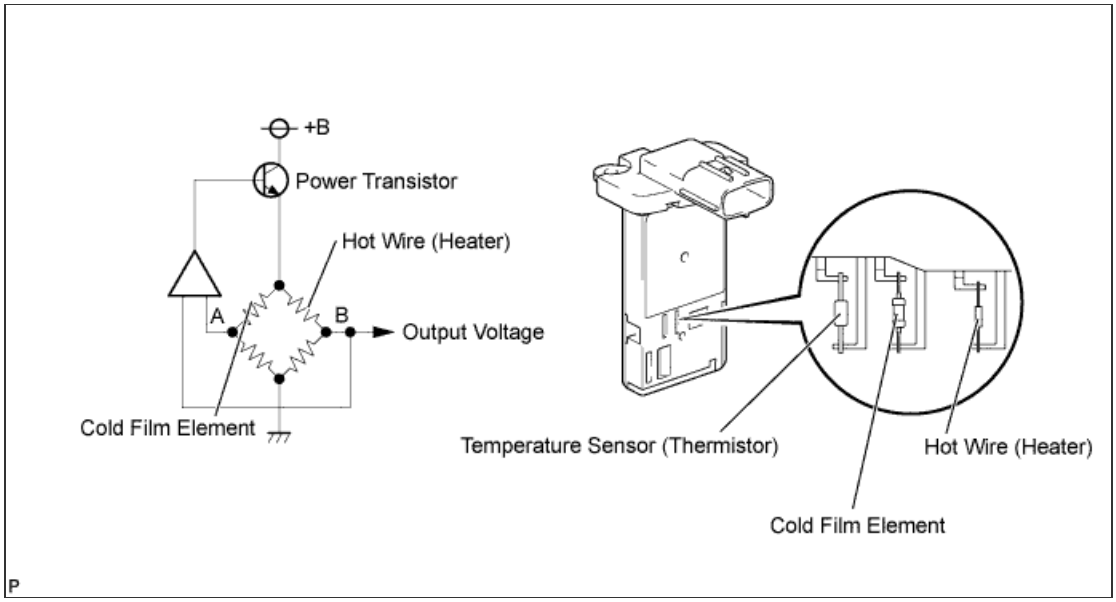
for Preparation Click here

DESCRIPTION

The Mass Air Flow (MAF) meter is a sensor that measures the amount of air flowing through the throttle valve.
The ECM uses this information to determine the fuel injection time and to provide the appropriate air-fuel ratio.
Inside the MAF meter, there is a heated platinum wire which is exposed to the flow of intake air.
By applying a specific electrical current to the wire, the ECM heats it to a given temperature. The flow of incoming air cools both the wire and an internal thermistor, affecting their resistance. To maintain a constant current value, the ECM varies the voltage applied to these components in the MAF meter.
The voltage level is proportional to the airflow through the sensor, and the ECM uses it to calculate the intake air volume.
The circuit is constructed so that the platinum hot wire and the cold film element create a bridge circuit, and the power transistor is controlled so that the potentials of A and B remain equal to maintain the predetermined temperature.

HINT:

When any of these DTCs are stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is calculated by the ECM, according to the engine speed and throttle valve position. Fail-safe mode continues until a pass condition is detected.



DTC Code	DTC Detection Condition	Trouble Area
P0102	The Mass Air Flow (MAF) meter voltage is below 0.2 V for 3 seconds (1 trip detection logic).	• Open or short in Mass Air Flow (MAF) meter circuit • MAF meter • ECM
P0103	The MAF meter voltage is higher than 4.9 V for 3 seconds (1 trip detection logic).	• Open or short in MAF meter circuit • MAF meter • ECM

HINT:

When any of these DTCs is output, check the air-flow rate by entering the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF.

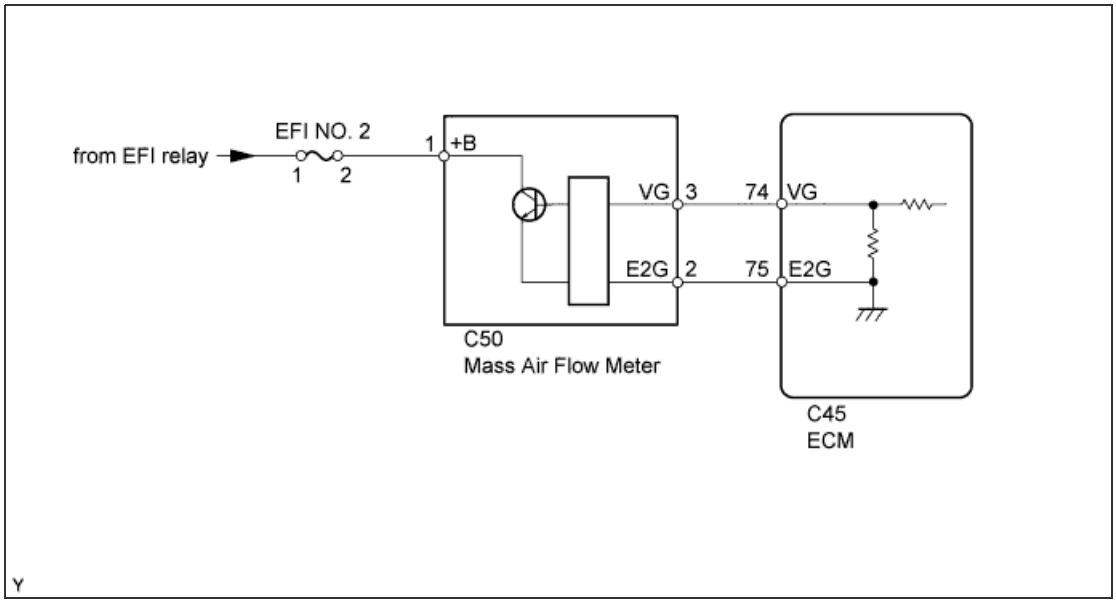
Mass Air Flow Rate (gm/s)	Malfunction
Approximately 0.0	• **Open in Mass Air Flow (MAF) meter power source circuit** • **Open or short in VG circuit**
271.0 or more	Open in E2G circuit

MONITOR DESCRIPTION

If there is a defect in the MAF meter or an open or short circuit, the voltage level deviates from the normal operating range. The ECM interprets this

deviation as a malfunction in the MAF meter and stores DTC(s).
Example:
When the sensor output voltage remains at below 0.2 V, or higher than 4.9 V for more than 3 seconds, the ECM stores DTC(s).
If the malfunction is not repaired successfully, a DTC is stored 3 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (MASS AIR FLOW RATE)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF.

e. Read the values displayed on the tester.

Result

Mass Air Flow Rate (gm/s)	Proceed to
0.0	A
271.0 or more	B
Between 1.0 and 270.0*	C

HINT:

*: The value must change when the throttle valve is open or closed with the engine running.

B	Go to step 6
C	CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

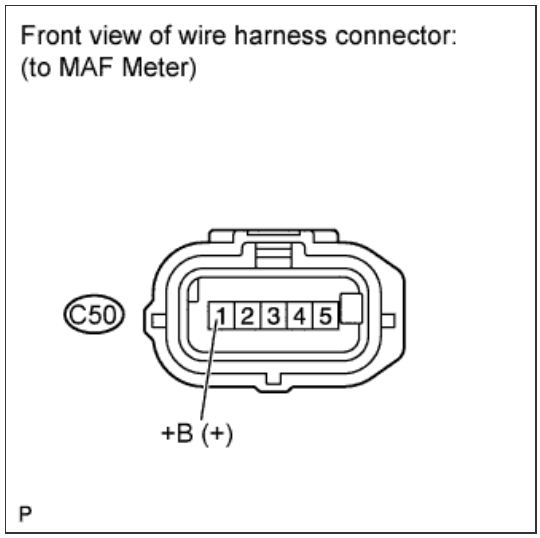
2.INSPECT MASS AIR FLOW METER (POWER SOURCE VOLTAGE)

a. Disconnect the C50 Mass Air Flow (MAF) meter connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C50-1 (+B) - Body ground	Engine switch on (IG)	11 to 14 V



NG → Go to step 5

OK

3.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter assembly (Click here)

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

4.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the C50 MAF meter connector.

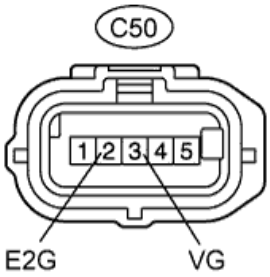
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

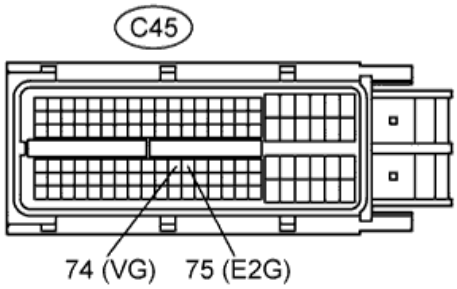
Standard Resistance:

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C45-74 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C45-75 (E2G)	Always	Below 1 Ω
C50-3 (VG) or C45-74 (VG) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Mass Air Flow Meter)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

5.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - INTEGRATION RELAY)

a. Check the EFI NO. 2 fuse.

i. Remove the EFI NO. 2 fuse from the engine room relay block.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse	Always	Below 1 Ω

iii. Reinstall the EFI NO. 2 fuse.

b. Disconnect the C50 MAF meter connector.

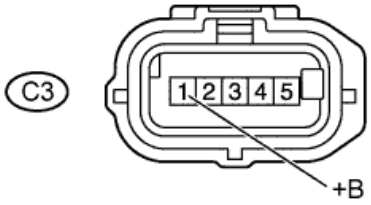
c. Remove the integration relay from the engine room relay block.

d. Measure the resistance according to the value(s) in the table below.

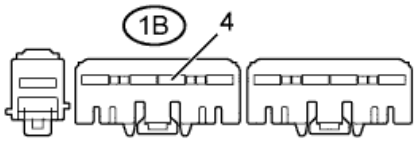
Standard Resistance:

Tester Connection	Condition	Specified Condition
C50-1 (+B) - 1B-4	Always	Below 1 Ω
C50-1 (+B) or 1B-4 - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to MAF Meter)



Front view of wire harness connector:
(to Integration Relay)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

6.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the C50 MAF meter connector.

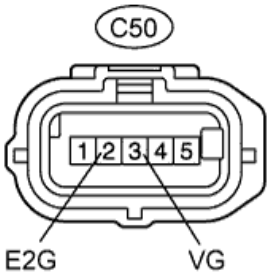
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

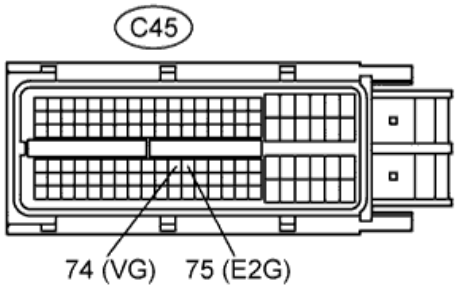
Standard Resistance:

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C45-74 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C45-75 (E2G)	Always	Below 1 Ω
C50-3 (VG) or C45-74 (VG) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Mass Air Flow Meter)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

7.CHECK HARNESS AND CONNECTOR (SENSOR GROUND)

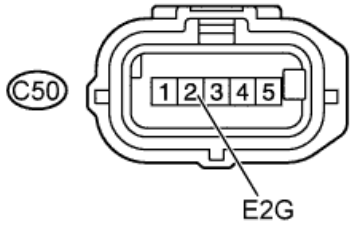
a. Disconnect the C50 MAF meter connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C50-2 (E2G) - Body ground	Always	Below 1 Ω

Front view of wire harness connector:
(to MAF Meter)



P

NG → REPLACE ECM (Click here)

OK

REPLACE MASS AIR FLOW METER (Click here)

DTC P0550 Power Steering Pressure Sensor Circuit Malfunction

DTC P0552 Power Steering Pressure Sensor Circuit Low Input

DTC P0553 Power Steering Pressure Sensor Circuit High Input

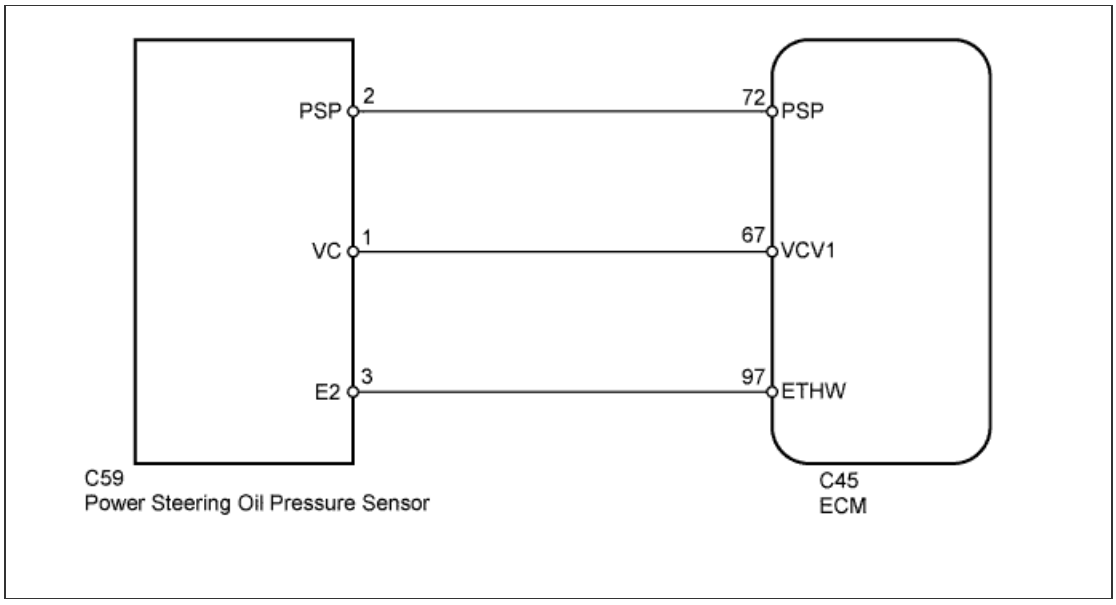
for Preparation Click here

DESCRIPTION

The power steering oil pressure sensor is turned on when a power steering wheel load occurs by turning the steering wheel. The ECM regulates the engine idling RPM according to the voltage output of the sensor.

DTC Code	DTC Detection Condition	Trouble Area
P0550	Power steering oil pressure sensor voltage less than 0.28 V, or more than 4.9 V for 0.5 seconds while engine running. (1 trip detection logic)	• Open or short in power steering oil pressure sensor circuit • Power steering oil pressure sensor • ECM
P0552	Power steering oil pressure sensor voltage less than 0.28 V for 0.5 seconds while engine running. (1 trip detection logic)	• Open or short in power steering oil pressure sensor circuit • Power steering oil pressure sensor • ECM
P0553	Power steering oil pressure sensor voltage more than 4.9 V for 0.5 seconds while engine running. (1 trip detection logic)	• Open or short in power steering oil pressure sensor circuit • Power steering oil pressure sensor • ECM

WIRING DIAGRAM



MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to regulate the engine idling speed. When the sensor output voltage deviates from the normal operating range, the ECM determines that there is a malfunction in the power steering oil pressure sensor and stores DTC(s).

INSPECTION PROCEDURE

HINT:

- **If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK HARNESS AND CONNECTOR (ECM - POWER STEERING OIL PRESSURE SENSOR)

a. Disconnect the C45 ECM connector.

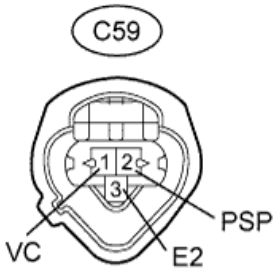
b. Disconnect the C59 power steering oil pressure sensor connector.

c. Measure the resistance according to the value(s) in the table below.

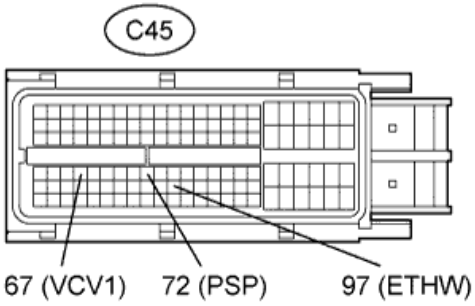
Standard Resistance:

Tester Connection	Condition	Specified Condition
C59-2 (PSP) - C45-72 (PSP)	Always	Below 1 Ω
C59-1 (VC) - C45-67 (VCV1)	Always	Below 1 Ω
C59-3 (E2) - C45-97 (ETHW)	Always	Below 1 Ω
C59-2 (PSP) or C45-72 (PSP) - Body ground	Always	10 kΩ or higher
C59-1 (VC) or C45-67 (VCV1) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Power Steering Oil Pressure Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE POWER STEERING OIL PRESSURE SENSOR

a. Replace the power steering oil pressure sensor (Click here).

NEXT

3.CONFIRM WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P0550, P0552 and/or P0553 are output	A
No DTC is output	B

B → END

A

REPLACE ECM (Click here)

DTC P0102 Mass or Volume Air Flow Circuit Low Input

DTC P0103 Mass or Volume Air Flow Circuit High Input

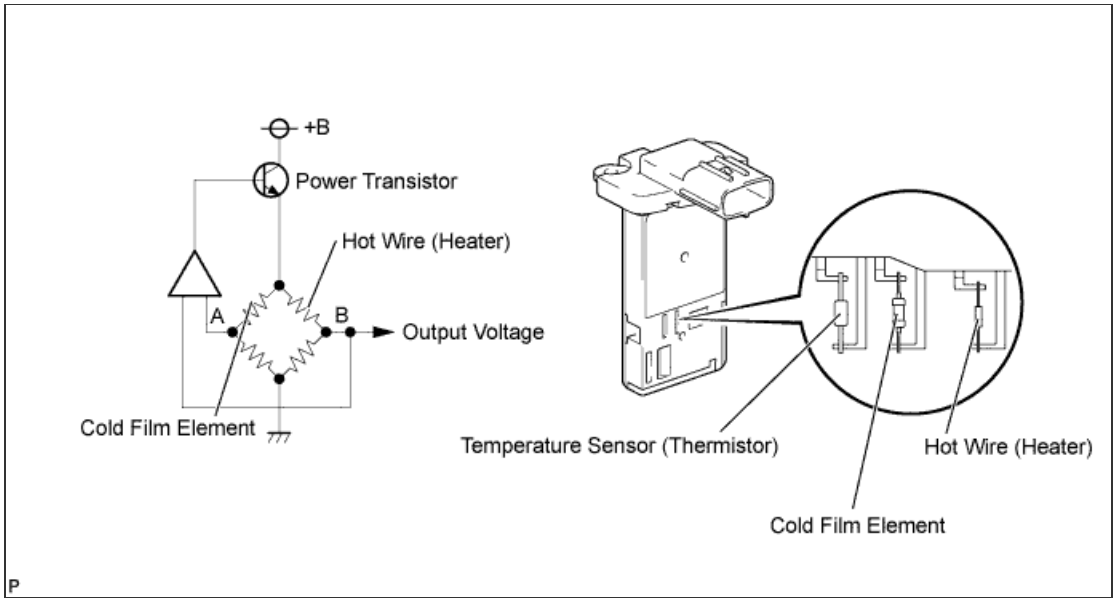
for Preparation Click here

DESCRIPTION

The Mass Air Flow (MAF) meter is a sensor that measures the amount of air flowing through the throttle valve.
The ECM uses this information to determine the fuel injection time and to provide the appropriate air-fuel ratio.
Inside the MAF meter, there is a heated platinum wire which is exposed to the flow of intake air.
By applying a specific electrical current to the wire, the ECM heats it to a given temperature. The flow of incoming air cools both the wire and an internal thermistor, affecting their resistance. To maintain a constant current value, the ECM varies the voltage applied to these components in the MAF meter.
The voltage level is proportional to the airflow through the sensor, and the ECM uses it to calculate the intake air volume.
The circuit is constructed so that the platinum hot wire and the cold film element create a bridge circuit, and the power transistor is controlled so that the potentials of A and B remain equal to maintain the predetermined temperature.

HINT:

When any of these DTCs are stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is calculated by the ECM, according to the engine speed and throttle valve position. Fail-safe mode continues until a pass condition is detected.



DTC Code	DTC Detection Condition	Trouble Area
P0102	The Mass Air Flow (MAF) meter voltage is below 0.2 V for 3 seconds (1 trip detection logic).	• Open or short in Mass Air Flow (MAF) meter circuit • MAF meter • ECM
P0103	The MAF meter voltage is higher than 4.9 V for 3 seconds (1 trip detection logic).	• Open or short in MAF meter circuit • MAF meter • ECM

HINT:

When any of these DTCs is output, check the air-flow rate by entering the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF.

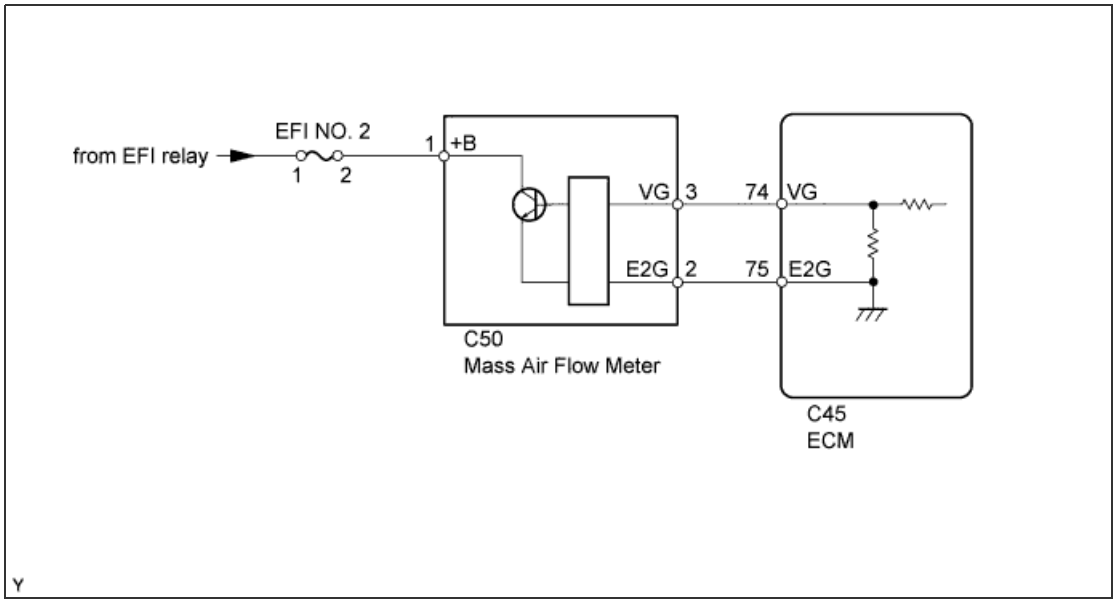
Mass Air Flow Rate (gm/s)	Malfunction
Approximately 0.0	• **Open in Mass Air Flow (MAF) meter power source circuit** • **Open or short in VG circuit**
271.0 or more	Open in E2G circuit

MONITOR DESCRIPTION

If there is a defect in the MAF meter or an open or short circuit, the voltage level deviates from the normal operating range. The ECM interprets this

deviation as a malfunction in the MAF meter and stores DTC(s).
Example:
When the sensor output voltage remains at below 0.2 V, or higher than 4.9 V for more than 3 seconds, the ECM stores DTC(s).
If the malfunction is not repaired successfully, a DTC is stored 3 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (MASS AIR FLOW RATE)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF.

e. Read the values displayed on the tester.

Result

Mass Air Flow Rate (gm/s)	Proceed to
0.0	A
271.0 or more	B
Between 1.0 and 270.0*	C

HINT:

*: The value must change when the throttle valve is open or closed with the engine running.

B	Go to step 6
C	CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

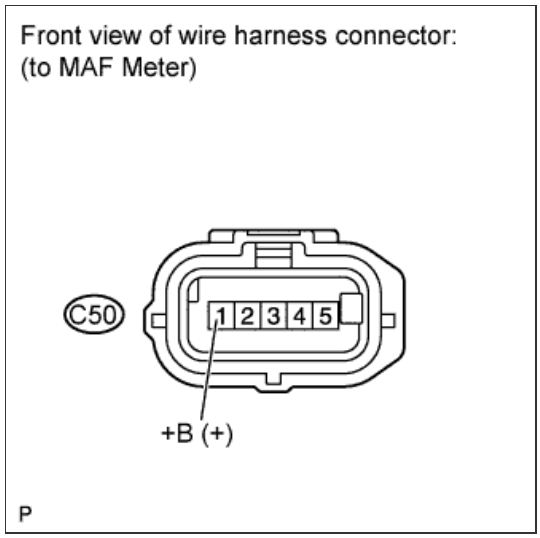
2.INSPECT MASS AIR FLOW METER (POWER SOURCE VOLTAGE)

a. Disconnect the C50 Mass Air Flow (MAF) meter connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C50-1 (+B) - Body ground	Engine switch on (IG)	11 to 14 V



NG → Go to step 5

OK

3.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter assembly (Click here)

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

4.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the C50 MAF meter connector.

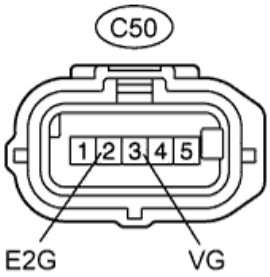
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

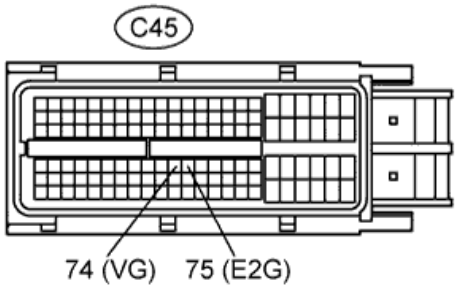
Standard Resistance:

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C45-74 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C45-75 (E2G)	Always	Below 1 Ω
C50-3 (VG) or C45-74 (VG) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Mass Air Flow Meter)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

5.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - INTEGRATION RELAY)

a. Check the EFI NO. 2 fuse.

i. Remove the EFI NO. 2 fuse from the engine room relay block.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse	Always	Below 1 Ω

iii. Reinstall the EFI NO. 2 fuse.

b. Disconnect the C50 MAF meter connector.

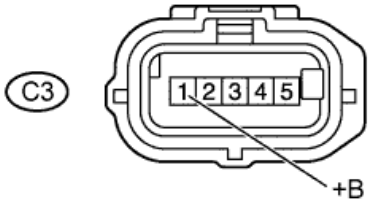
c. Remove the integration relay from the engine room relay block.

d. Measure the resistance according to the value(s) in the table below.

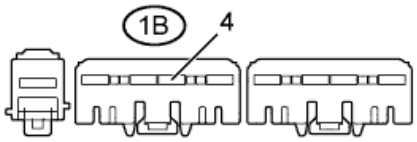
Standard Resistance:

Tester Connection	Condition	Specified Condition
C50-1 (+B) - 1B-4	Always	Below 1 Ω
C50-1 (+B) or 1B-4 - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to MAF Meter)



Front view of wire harness connector:
(to Integration Relay)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

6.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the C50 MAF meter connector.

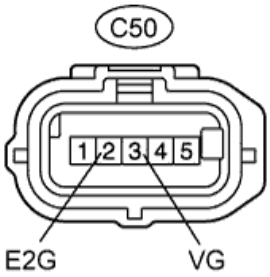
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

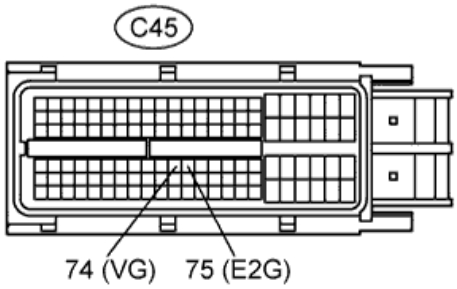
Standard Resistance:

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C45-74 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C45-75 (E2G)	Always	Below 1 Ω
C50-3 (VG) or C45-74 (VG) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Mass Air Flow Meter)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

7.CHECK HARNESS AND CONNECTOR (SENSOR GROUND)

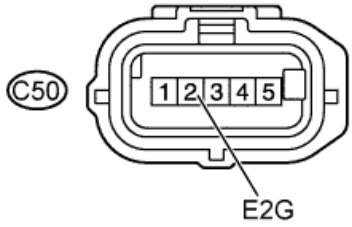
a. Disconnect the C50 MAF meter connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C50-2 (E2G) - Body ground	Always	Below 1 Ω

Front view of wire harness connector:
(to MAF Meter)



P

NG → REPLACE ECM (Click here)

OK

REPLACE MASS AIR FLOW METER (Click here)

DTC P0550 Power Steering Pressure Sensor Circuit Malfunction

DTC P0552 Power Steering Pressure Sensor Circuit Low Input

DTC P0553 Power Steering Pressure Sensor Circuit High Input

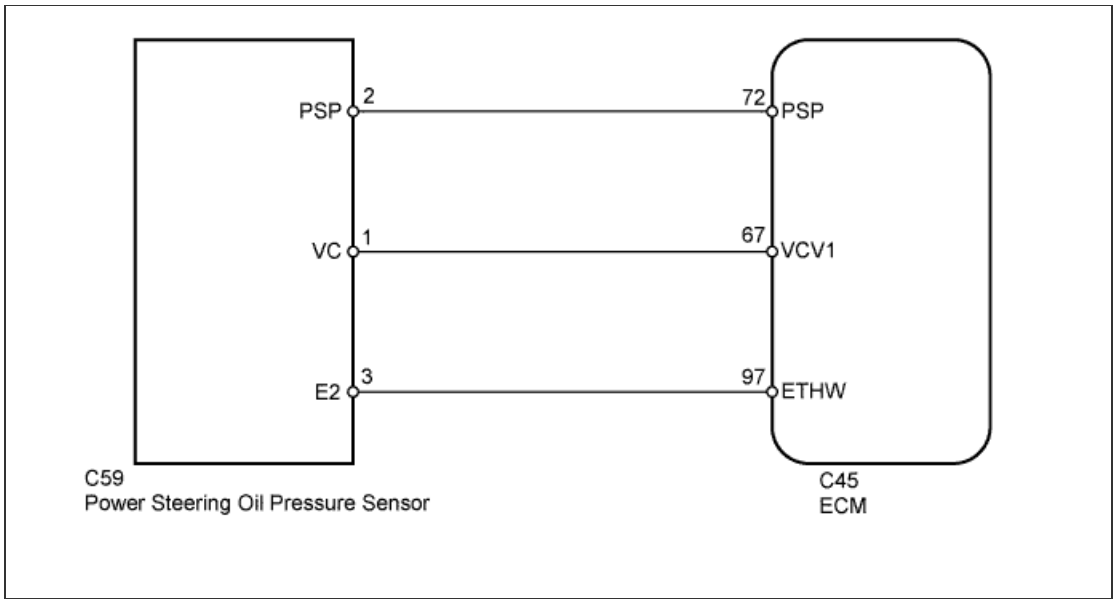
for Preparation Click here

DESCRIPTION

The power steering oil pressure sensor is turned on when a power steering wheel load occurs by turning the steering wheel. The ECM regulates the engine idling RPM according to the voltage output of the sensor.

DTC Code	DTC Detection Condition	Trouble Area
P0550	Power steering oil pressure sensor voltage less than 0.28 V, or more than 4.9 V for 0.5 seconds while engine running. (1 trip detection logic)	• Open or short in power steering oil pressure sensor circuit • Power steering oil pressure sensor • ECM
P0552	Power steering oil pressure sensor voltage less than 0.28 V for 0.5 seconds while engine running. (1 trip detection logic)	• Open or short in power steering oil pressure sensor circuit • Power steering oil pressure sensor • ECM
P0553	Power steering oil pressure sensor voltage more than 4.9 V for 0.5 seconds while engine running. (1 trip detection logic)	• Open or short in power steering oil pressure sensor circuit • Power steering oil pressure sensor • ECM

WIRING DIAGRAM



MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to regulate the engine idling speed. When the sensor output voltage deviates from the normal operating range, the ECM determines that there is a malfunction in the power steering oil pressure sensor and stores DTC(s).

INSPECTION PROCEDURE

HINT:

- **If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK HARNESS AND CONNECTOR (ECM - POWER STEERING OIL PRESSURE SENSOR)

a. Disconnect the C45 ECM connector.

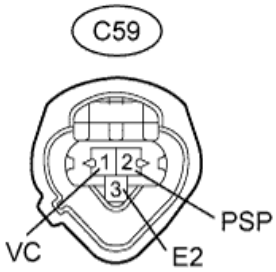
b. Disconnect the C59 power steering oil pressure sensor connector.

c. Measure the resistance according to the value(s) in the table below.

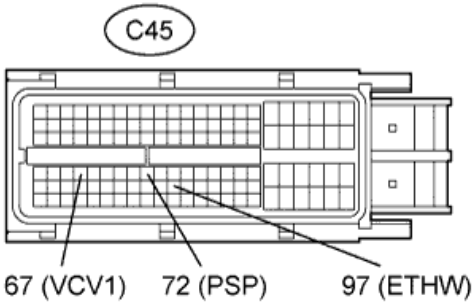
Standard Resistance:

Tester Connection	Condition	Specified Condition
C59-2 (PSP) - C45-72 (PSP)	Always	Below 1 Ω
C59-1 (VC) - C45-67 (VCV1)	Always	Below 1 Ω
C59-3 (E2) - C45-97 (ETHW)	Always	Below 1 Ω
C59-2 (PSP) or C45-72 (PSP) - Body ground	Always	10 kΩ or higher
C59-1 (VC) or C45-67 (VCV1) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Power Steering Oil Pressure Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE POWER STEERING OIL PRESSURE SENSOR

a. Replace the power steering oil pressure sensor (Click here).

NEXT

3.CONFIRM WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P0550, P0552 and/or P0553 are output	A
No DTC is output	B

B → END

A

REPLACE ECM (Click here)

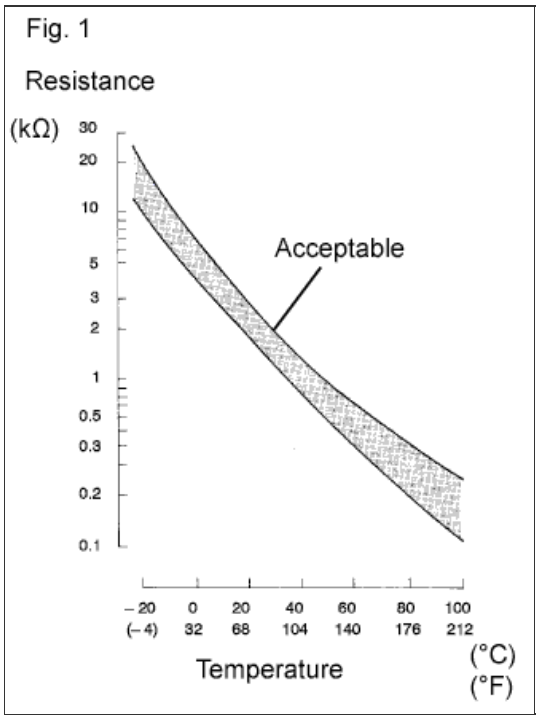
DTC P0110 Intake Air Temperature Circuit Malfunction

DTC P0112 Intake Air Temperature Circuit Low Input

DTC P0113 Intake Air Temperature Circuit High Input

for Preparation Click here

DESCRIPTION



The Intake Air Temperature (IAT) sensor, mounted on the Mass Air Flow (MAF) meter, monitors the IAT. The IAT sensor has a built-in thermistor with a resistance that varies according to the temperature of the intake air. When the IAT is low, the resistance of the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are transmitted to the ECM as voltage changes (See Fig. 1).
The IAT sensor is powered by a 5 V supply from the THA terminal of the ECM, via resistor R.
Resistor R and the IAT sensor are connected in series. When the resistance value of the IAT sensor changes, according to changes in the IAT, the voltage at terminal THA also varies. Based on this signal, the ECM increases the fuel injection volume when the engine is cold to improve driveability.

HINT:

When any of DTCs P0110, P0112 and P0113 is stored, the ECM enters fail-safe mode. During fail-safe mode, the IAT is estimated to be 20°C (68°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC Code	DTC Detection Condition	Trouble Area
P0110	An open or short in the Intake Air Temperature (IAT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in Intake Air Temperature (IAT) sensor circuit • IAT sensor (built into Mass Air Flow [MAF] meter) • ECM
P0112	A short in the IAT sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM
P0113	An open in the IAT sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM

HINT:

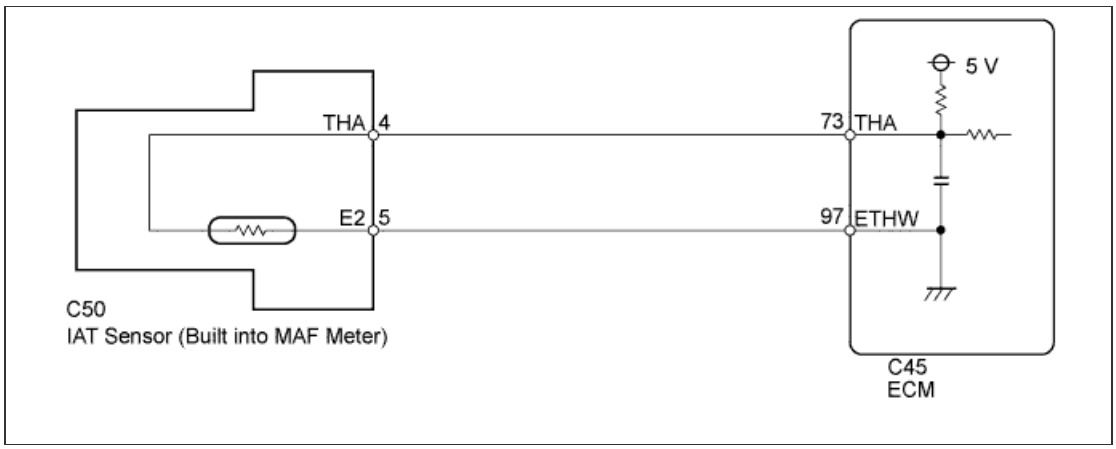
When any of these DTCs are output, check the IAT by entering the following menus: Powertrain / Engine and ECT / All Data / Intake Air.

Temperature Displayed	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to calculate the IAT. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a malfunction in the IAT sensor and stores a DTC.
Example:
If the sensor output voltage is higher than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the IAT sensor circuit, and stores DTC P0113. Conversely, if the output voltage is below 0.18 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and stores DTC P0112.
If the malfunction is not repaired successfully, a DTC is stored 0.5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (INTAKE AIR TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / All Data / Intake Air.

e. Read the value displayed on the tester.

Standard:
Same as actual Intake Air Temperature (IAT).

Result

Temperature Displayed	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
Same as actual IAT	C

HINT:

- **If there is an open circuit, the tester indicates -40°C (-40°F).**
- **If there is a short circuit, the tester indicates 140°C (284°F) or higher.**

B	Go to step 4
C	CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the C50 Mass Air Flow (MAF) meter connector.

b. Connect terminals 4 (THA) and 5 (E2) of the MAF meter wire harness side connector.

c. Connect the intelligent tester to the DLC3.

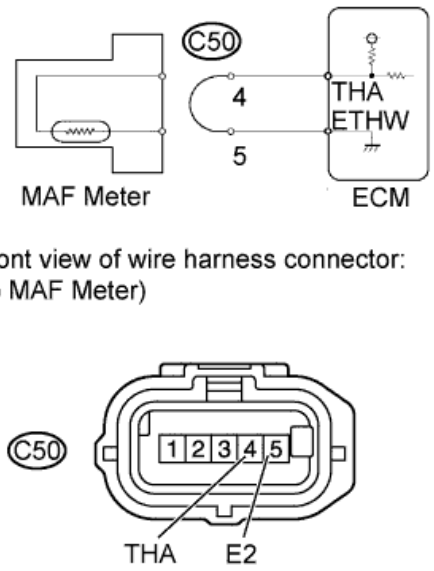
d. Turn the engine switch on (IG).

e. Turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / All Data / Intake Air.

g. Read the value displayed on the tester.

Standard value:
140°C (284°F) or higher



NG → Go to step 3

OK

CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE MASS AIR FLOW METER (Click here)

3.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the C50 MAF meter connector.

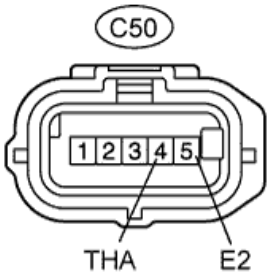
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

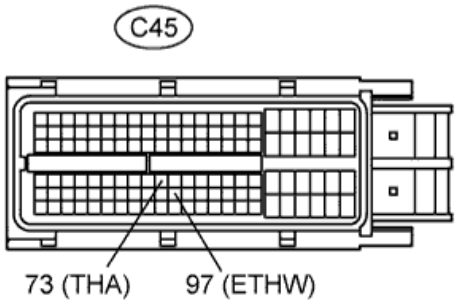
Standard Resistance:

Tester Connection	Condition	Specified Condition
C50-4 (THA) - C45-73 (THA)	Always	Below 1 Ω
C50-5 (E2) - C45-97 (ETHW)	Always	Below 1 Ω

Front view of wire harness connector:
(to Mass Air Flow Meter)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM (Click here)

4.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the C50 MAF meter connector.

b. Connect the intelligent tester to the DLC3.

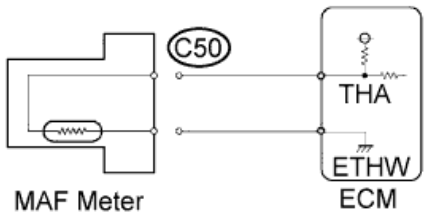
c. Turn the engine switch on (IG).

d. Turn the tester on.

e. Enter the following menus: Powertrain / Engine and ECT / All Data / Intake Air.

f. Read the value displayed on the tester.

Standard value:
-40°C (-40°F)



NG → Go to step 5

OK

REPLACE MASS AIR FLOW METER (Click here)

5.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the C50 MAF meter connector.

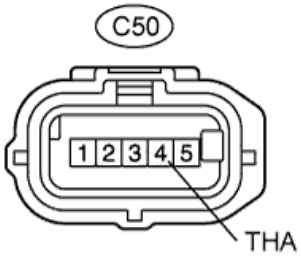
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

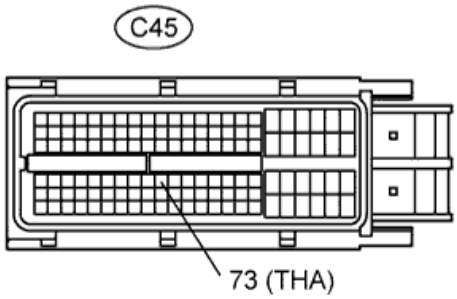
Standard Resistance:

Tester Connection	Condition	Specified Condition
C50-4 (THA) or C45-73 (THA) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to MAF Meter)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P0560 System Voltage

for Preparation Click here

DESCRIPTION

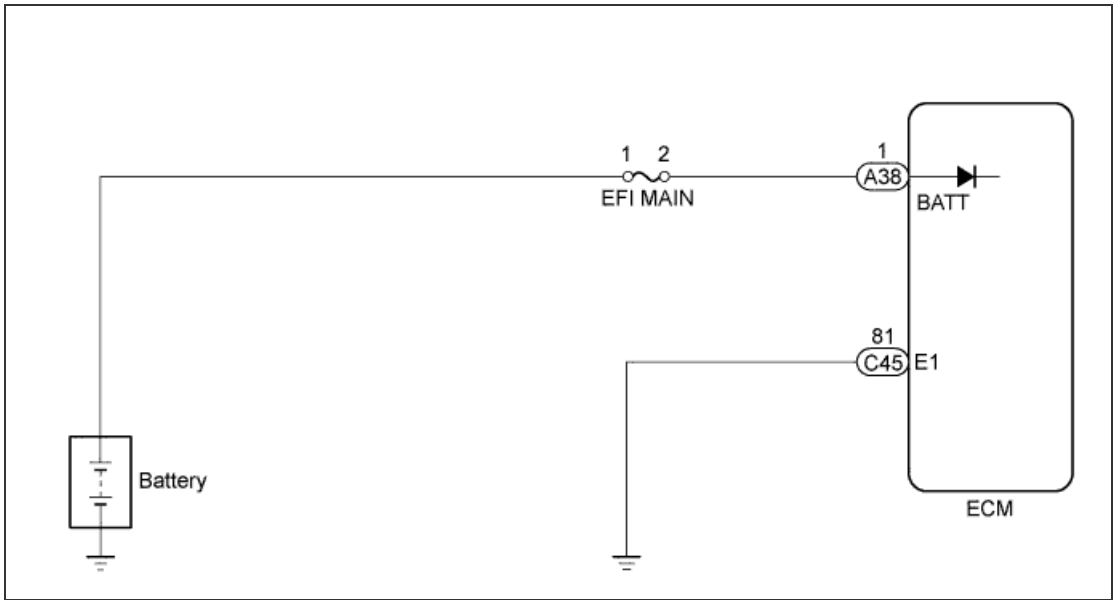
The battery supplies electricity to the ECM even when the engine switch is off. This power allows the ECM to store data such as DTC history, freeze frame data and fuel trim values. If the battery voltage falls below a minimum level, the memory is cleared and the ECM determines that there is a malfunction in the power supply circuit. When the engine is next started, the ECM illuminates the MIL and stores the DTC.

DTC Code	DTC Detection Condition	Trouble Area
P0560	An open in the ECM back up power source circuit (1 trip detection logic).	• Open in back up power source circuit • Battery • Battery terminals • EFI MAIN fuse • ECM

HINT:

If DTC P0560 is stored, the ECM does not store other DTCs or the data stored in the ECM is partly cleared.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT FUSE (EFI MAIN)

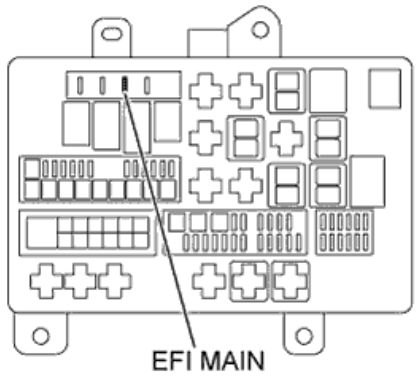
a. Remove the EFI MAIN fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAIN fuse	Always	Below 1 Ω

Engine Room Relay Block:



NG → CHECK FOR SHORTS IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

OK

2.CHECK HARNESS AND CONNECTOR (EFI NO. 1 FUSE - ECM, BATTERY)

a. Check the harness and the connector between the EFI MAIN fuse and ECM.

i. Remove the EFI MAIN fuse from the engine room relay block.

ii. Disconnect the A38 ECM connector.

iii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAIN fuse terminal 2 - A38-1 (BATT)	Always	Below 1 Ω
EFI MAIN fuse terminal 2 or A38-1 (BATT) - Body ground	Always	10 kΩ or higher

b. Check the harness and the connector between the EFI MAIN fuse and battery.

i. Remove the EFI MAIN fuse from the engine room relay block.

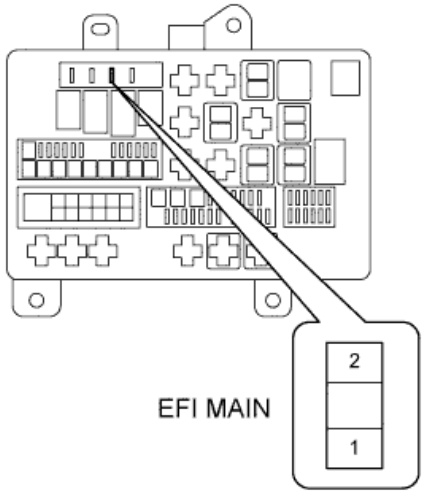
ii. Disconnect the positive battery terminal.

iii. Measure the resistance according to the value(s) in the table below.

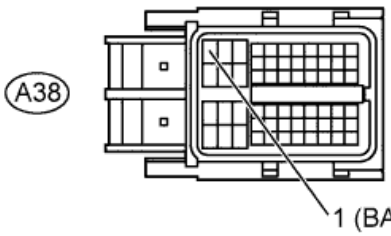
Standard Resistance:

Tester Connection	Condition	Specified Condition
Battery positive (+) terminal - EFI MAIN fuse terminal 1	Always	Below 1 Ω
Battery positive (+) terminal or EFI MAIN fuse terminal 1- Body ground	Always	10 kΩ or higher

Engine Room Relay Block:



Front view of wire harness connector: (to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT BATTERY

a. Check that the battery is not depleted (Click here).

OK:
Battery is not depleted.

NG → REPLACE BATTERY

OK ↓

4.CHECK BATTERY TERMINAL

a. Check that the battery terminals are not loose or corroded.

OK:
Battery terminals are not loose or corroded.

NG → REPAIR BATTERY TERMINAL

OK ↓

5.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Turn the engine switch off and turn the tester off.

e. Start the engine and turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
P0560 is output	A
No DTC is output	B

B → CHECK FOR INTERMITTENT PROBLEMS (**Click here**)

A ↓

REPLACE ECM (**Click here**)

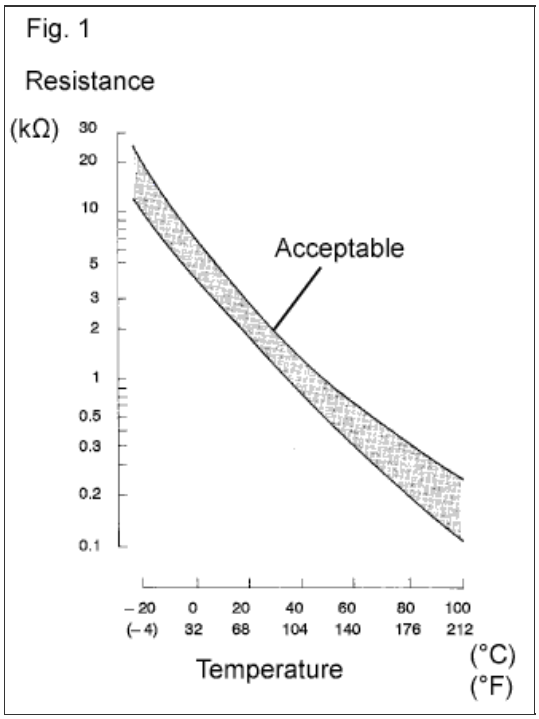
DTC P0110 Intake Air Temperature Circuit Malfunction

DTC P0112 Intake Air Temperature Circuit Low Input

DTC P0113 Intake Air Temperature Circuit High Input

for Preparation Click here

DESCRIPTION



The Intake Air Temperature (IAT) sensor, mounted on the Mass Air Flow (MAF) meter, monitors the IAT. The IAT sensor has a built-in thermistor with a resistance that varies according to the temperature of the intake air. When the IAT is low, the resistance of the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are transmitted to the ECM as voltage changes (See Fig. 1).
The IAT sensor is powered by a 5 V supply from the THA terminal of the ECM, via resistor R.
Resistor R and the IAT sensor are connected in series. When the resistance value of the IAT sensor changes, according to changes in the IAT, the voltage at terminal THA also varies. Based on this signal, the ECM increases the fuel injection volume when the engine is cold to improve driveability.

HINT:

When any of DTCs P0110, P0112 and P0113 is stored, the ECM enters fail-safe mode. During fail-safe mode, the IAT is estimated to be 20°C (68°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC Code	DTC Detection Condition	Trouble Area
P0110	An open or short in the Intake Air Temperature (IAT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in Intake Air Temperature (IAT) sensor circuit • IAT sensor (built into Mass Air Flow [MAF] meter) • ECM
P0112	A short in the IAT sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM
P0113	An open in the IAT sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM

HINT:

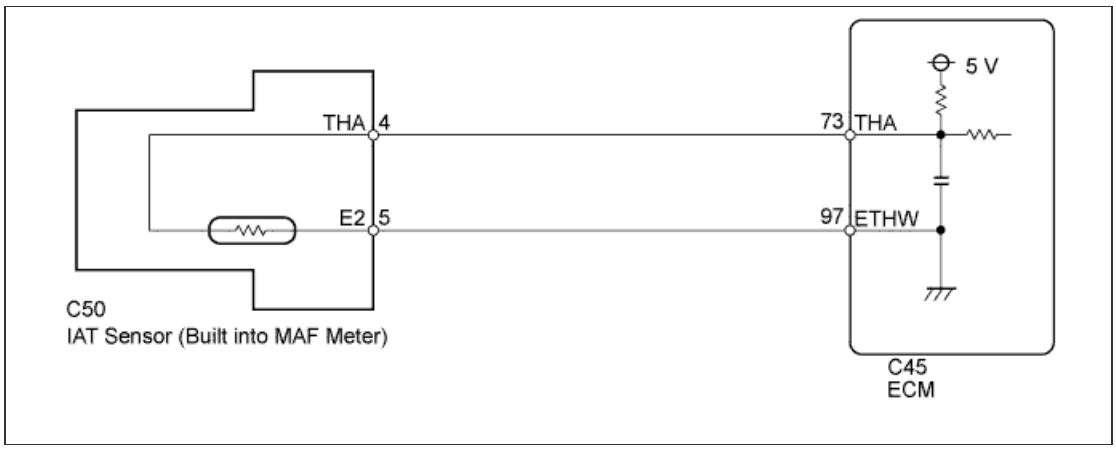
When any of these DTCs are output, check the IAT by entering the following menus: Powertrain / Engine and ECT / All Data / Intake Air.

Temperature Displayed	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to calculate the IAT. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a malfunction in the IAT sensor and stores a DTC.
Example:
If the sensor output voltage is higher than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the IAT sensor circuit, and stores DTC P0113. Conversely, if the output voltage is below 0.18 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and stores DTC P0112.
If the malfunction is not repaired successfully, a DTC is stored 0.5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (INTAKE AIR TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / All Data / Intake Air.

e. Read the value displayed on the tester.

Standard:
Same as actual Intake Air Temperature (IAT).

Result

Temperature Displayed	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
Same as actual IAT	C

HINT:

- **If there is an open circuit, the tester indicates -40°C (-40°F).**
- **If there is a short circuit, the tester indicates 140°C (284°F) or higher.**

B	Go to step 4
C	CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the C50 Mass Air Flow (MAF) meter connector.

b. Connect terminals 4 (THA) and 5 (E2) of the MAF meter wire harness side connector.

c. Connect the intelligent tester to the DLC3.

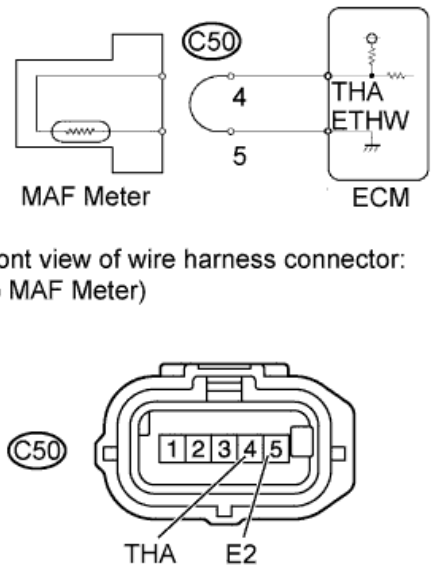
d. Turn the engine switch on (IG).

e. Turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / All Data / Intake Air.

g. Read the value displayed on the tester.

Standard value:
140°C (284°F) or higher



NG → Go to step 3

OK

CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE MASS AIR FLOW METER (Click here)

3.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the C50 MAF meter connector.

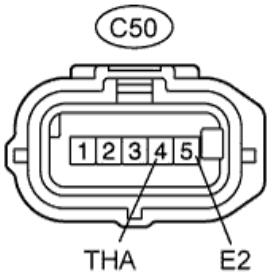
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

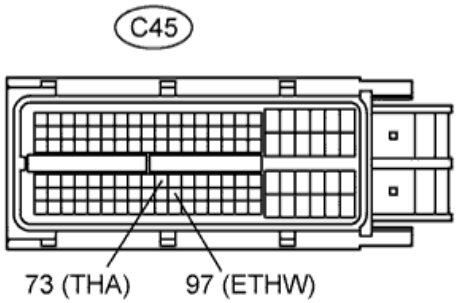
Standard Resistance:

Tester Connection	Condition	Specified Condition
C50-4 (THA) - C45-73 (THA)	Always	Below 1 Ω
C50-5 (E2) - C45-97 (ETHW)	Always	Below 1 Ω

Front view of wire harness connector:
(to Mass Air Flow Meter)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM (Click here)

4.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the C50 MAF meter connector.

b. Connect the intelligent tester to the DLC3.

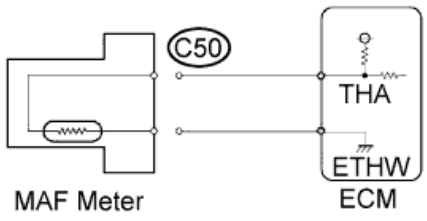
c. Turn the engine switch on (IG).

d. Turn the tester on.

e. Enter the following menus: Powertrain / Engine and ECT / All Data / Intake Air.

f. Read the value displayed on the tester.

Standard value:
-40°C (-40°F)



NG → Go to step 5

OK

REPLACE MASS AIR FLOW METER (Click here)

5.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the C50 MAF meter connector.

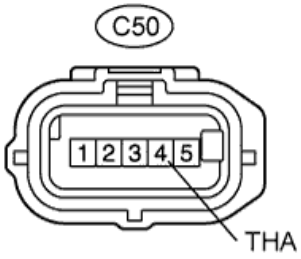
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

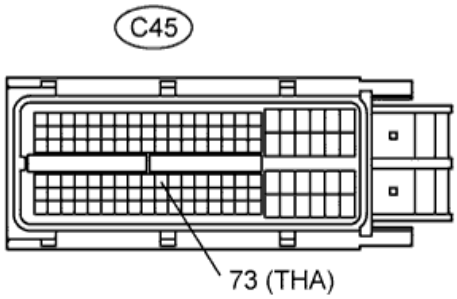
Standard Resistance:

Tester Connection	Condition	Specified Condition
C50-4 (THA) or C45-73 (THA) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to MAF Meter)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P0604 Random Access Memory (RAM)

for Preparation Click here

DESCRIPTION

The ECM continuously monitors its internal memory status. This self-check ensures that the ECM is functioning properly. This is diagnosed by internal "mirroring" of the main CPU and sub CPU to detect Random Access Memory (RAM) errors. If outputs from these CPUs are different and deviate from the standard, the ECM will illuminate the MIL and store DTC(s) immediately.

DTC Code	DTC Detection Condition	Trouble Area
P0604	ECM RAM errors.	ECM

INSPECTION PROCEDURE

1.CHECK DTC

a. Clear DTC (Click here).

b. Turn the engine switch off.

c. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

d. Connect the cable to the negative (-) battery terminal.

e. Turn the engine switch on (I .

f. Check DTC.

OK:
P0604 is not output.

NG → **REPLACE ECM (Click here)**

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

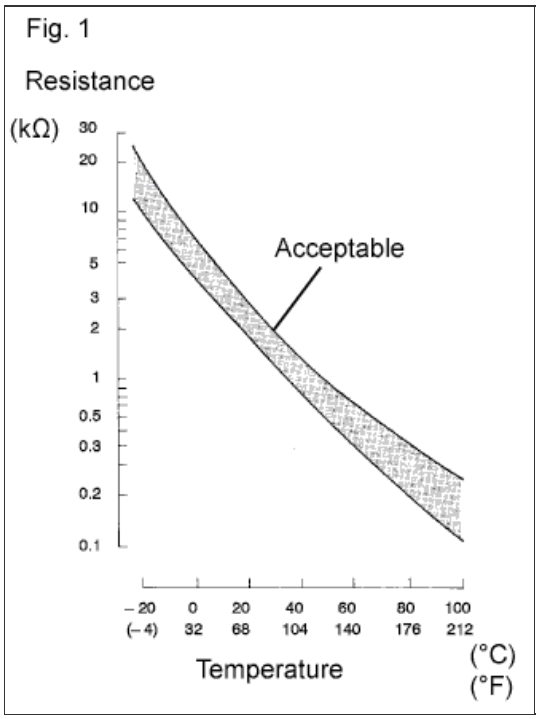
DTC P0110 Intake Air Temperature Circuit Malfunction

DTC P0112 Intake Air Temperature Circuit Low Input

DTC P0113 Intake Air Temperature Circuit High Input

for Preparation Click here

DESCRIPTION



The Intake Air Temperature (IAT) sensor, mounted on the Mass Air Flow (MAF) meter, monitors the IAT. The IAT sensor has a built-in thermistor with a resistance that varies according to the temperature of the intake air. When the IAT is low, the resistance of the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are transmitted to the ECM as voltage changes (See Fig. 1).
The IAT sensor is powered by a 5 V supply from the THA terminal of the ECM, via resistor R.
Resistor R and the IAT sensor are connected in series. When the resistance value of the IAT sensor changes, according to changes in the IAT, the voltage at terminal THA also varies. Based on this signal, the ECM increases the fuel injection volume when the engine is cold to improve driveability.

HINT:

When any of DTCs P0110, P0112 and P0113 is stored, the ECM enters fail-safe mode. During fail-safe mode, the IAT is estimated to be 20°C (68°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC Code	DTC Detection Condition	Trouble Area
P0110	An open or short in the Intake Air Temperature (IAT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in Intake Air Temperature (IAT) sensor circuit • IAT sensor (built into Mass Air Flow [MAF] meter) • ECM
P0112	A short in the IAT sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM
P0113	An open in the IAT sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM

HINT:

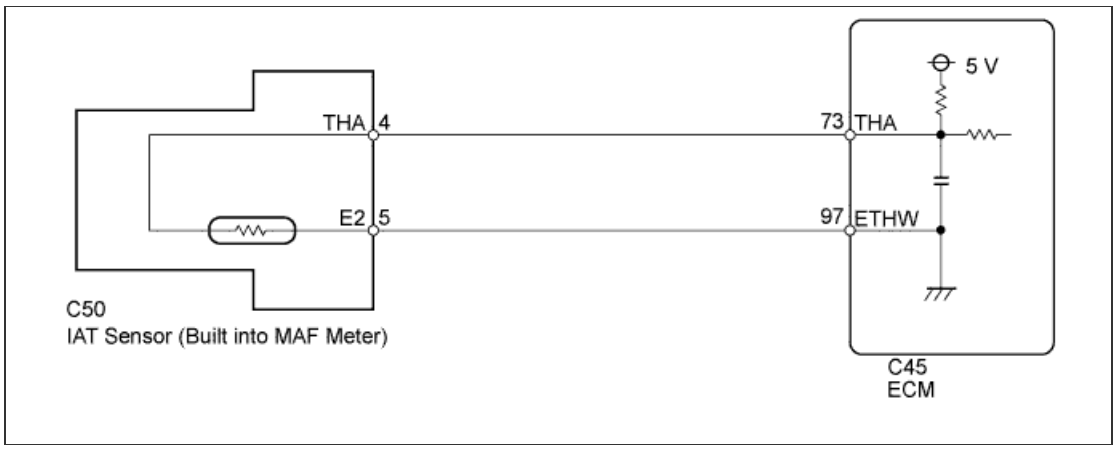
When any of these DTCs are output, check the IAT by entering the following menus: Powertrain / Engine and ECT / All Data / Intake Air.

Temperature Displayed	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to calculate the IAT. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a malfunction in the IAT sensor and stores a DTC.
Example:
If the sensor output voltage is higher than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the IAT sensor circuit, and stores DTC P0113. Conversely, if the output voltage is below 0.18 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and stores DTC P0112.
If the malfunction is not repaired successfully, a DTC is stored 0.5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (INTAKE AIR TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / All Data / Intake Air.

e. Read the value displayed on the tester.

Standard:
Same as actual Intake Air Temperature (IAT).

Result

Temperature Displayed	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
Same as actual IAT	C

HINT:

- **If there is an open circuit, the tester indicates -40°C (-40°F).**
- **If there is a short circuit, the tester indicates 140°C (284°F) or higher.**

B	Go to step 4
C	CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the C50 Mass Air Flow (MAF) meter connector.

b. Connect terminals 4 (THA) and 5 (E2) of the MAF meter wire harness side connector.

c. Connect the intelligent tester to the DLC3.

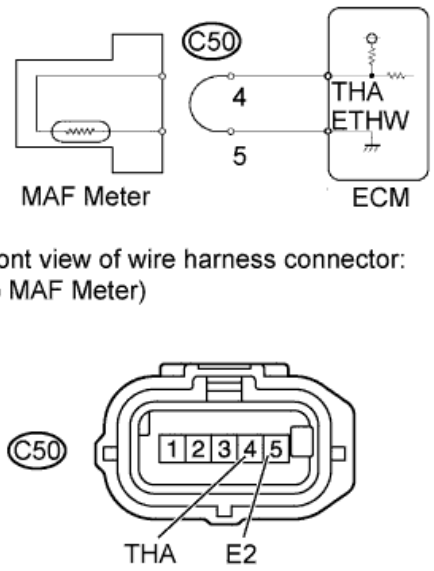
d. Turn the engine switch on (IG).

e. Turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / All Data / Intake Air.

g. Read the value displayed on the tester.

Standard value:
140°C (284°F) or higher



NG → Go to step 3

OK

CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE MASS AIR FLOW METER (Click here)

3.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the C50 MAF meter connector.

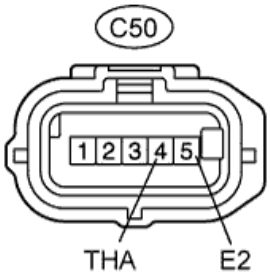
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

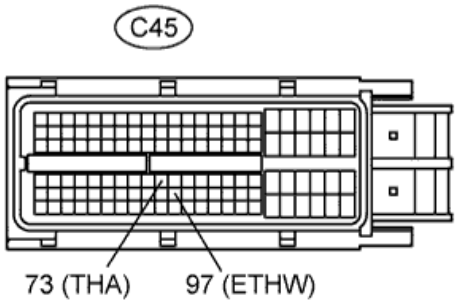
Standard Resistance:

Tester Connection	Condition	Specified Condition
C50-4 (THA) - C45-73 (THA)	Always	Below 1 Ω
C50-5 (E2) - C45-97 (ETHW)	Always	Below 1 Ω

Front view of wire harness connector:
(to Mass Air Flow Meter)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM (Click here)

4.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the C50 MAF meter connector.

b. Connect the intelligent tester to the DLC3.

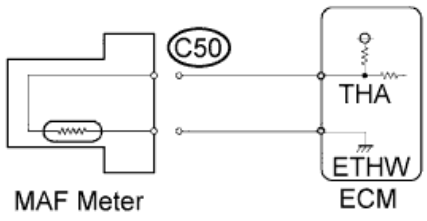
c. Turn the engine switch on (IG).

d. Turn the tester on.

e. Enter the following menus: Powertrain / Engine and ECT / All Data / Intake Air.

f. Read the value displayed on the tester.

Standard value:
-40°C (-40°F)



NG → Go to step 5

OK

REPLACE MASS AIR FLOW METER (Click here)

5.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the C50 MAF meter connector.

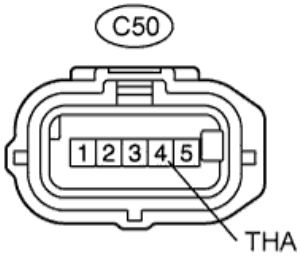
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

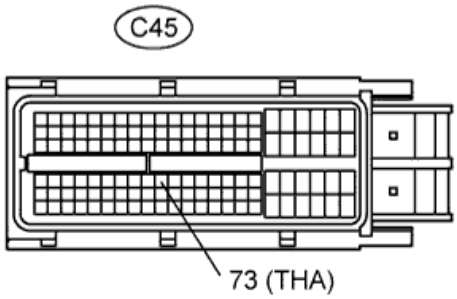
Standard Resistance:

Tester Connection	Condition	Specified Condition
C50-4 (THA) or C45-73 (THA) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to MAF Meter)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P0606 ECM / PCM Processor

for Preparation Click here

DESCRIPTION

The ECM continuously monitors its main and sub CPUs. This self-check ensures that the ECM is functioning properly. If outputs from the CPUs are different and deviate from the standard, the ECM will illuminate the MIL and store DTC(s) immediately.

DTC Code	DTC Detection Condition	Trouble Area
P0	hen either condition below is met: • An ECM main CPU error. • An ECM sub CPU error.	ECM

INSPECTION PROCEDURE

1.CHECK DTC

a. Clear DTC (Click here).

b. Turn the engine switch off.

c. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

d. Connect the cable to the negative (-) battery terminal.

e. Turn the engine switch on (IG).

f. Check DTC.

OK:
P0606 is not output.

NG → **REPLACE ECM (Click here)**

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0115 Engine Coolant Temperature Circuit Malfunction

DTC P0117 Engine Coolant Temperature Circuit Low Input

DTC P0118 Engine Coolant Temperature Circuit High Input

for Preparation Click here

DESCRIPTION

A thermistor, whose resistance value varies according to the ECT, is built into the Engine Coolant Temperature (ECT) sensor.
The structure of the sensor and its connection to the ECM are the same as those of the Intake Air Temperature (IAT) sensor.

HINT:

When any of DTCs P0115, P0117 and P0118 is stored, the ECM enters fail-safe mode. During fail-safe mode, the ECT is estimated to be 80°C (176°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC Code	DTC Detection Condition	Trouble Area
P0115	An open or short in the Engine Coolant Temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in Engine Coolant Temperature (ECT) sensor circuit • ECT sensor • ECM
P0117	A short in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in ECT sensor • ECT sensor • ECM
P0118	An open in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in ECT sensor circuit • ECT sensor • ECM

HINT:

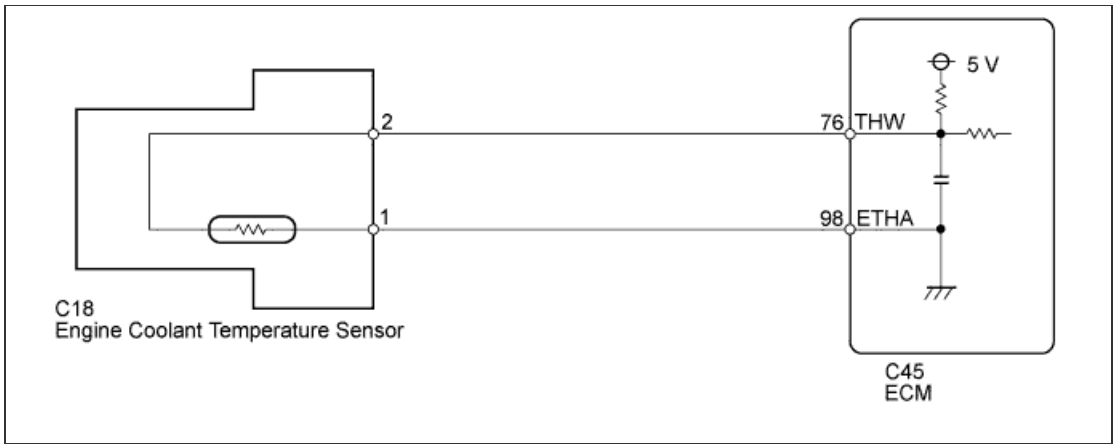
When any of these DTCs is output, check the ECT by entering the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

Temperature Displayed	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

MONITOR DESCRIPTION

The Engine Coolant Temperature (ECT) sensor is used to monitor the ECT. The ECT sensor has a thermistor with a resistance that varies according to the temperature of the engine coolant. When the coolant temperature is low, the resistance in the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are reflected in the output voltage from the sensor. The ECM monitors the sensor voltage and uses this value to calculate the ECT. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a fault in the ECT sensor and stores DTC(s).
Example:
If the sensor output voltage is higher than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the ECT sensor circuit, and stores DTC P0118. Conversely, if the voltage output is below 0.14 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and stores DTC P0117.
If the malfunction is not repaired successfully, a DTC is stored 0.5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (ENGINE COOLANT TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

e. Read the value displayed on the tester.

Standard value:
Between 75 and 100°C (167 and 212°F) with warm engine.

Result

Temperature Displayed	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
Between 75 and 100°C (176 and 212°F)	C

HINT:

- **If there is an open circuit, the tester indicates -40°C (-40°F).**
- **If there is a short circuit, the tester indicates 140°C (284°F) or higher.**

B	Go to step 4
C	CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the C18 Engine Coolant Temperature (ECT) sensor connector.

b. Connect terminals 1 and 2 of the ECT sensor connector on the wire harness side.

c. Connect the intelligent tester to the DLC3.

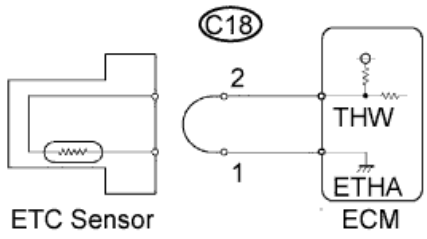
d. Turn the engine switch on (IG).

e. Turn the tester on.

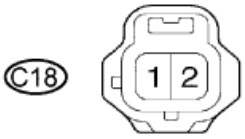
f. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

g. Read the value displayed on the tester.

Standard value:
140°C (284°F) or higher



Front view of wire harness connector:
(to ECT Sensor)



NG	Go to step 3

OK

GOOD CONNECTION TO ECM. IF OK, REPLACE ECM (Click here)

3.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the C18 ECT sensor connector.

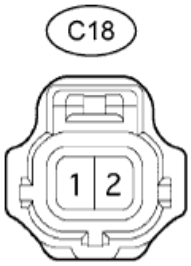
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

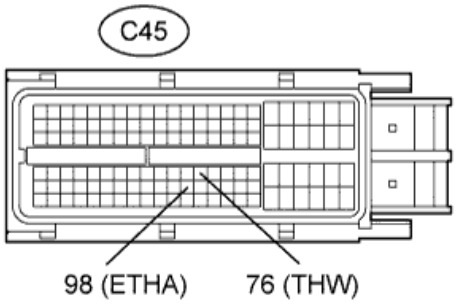
Standard Resistance:

Tester Connection	Condition	Specified Condition
C18-2 - C45-76 (THW)	Always	Below 1 Ω
C18-1 - C45-98 (ETHA)	Always	Below 1 Ω

Front view of wire harness connector:
(to ECT Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

4.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the C18 ECT sensor connector.

b. Connect the intelligent tester to the DLC3.

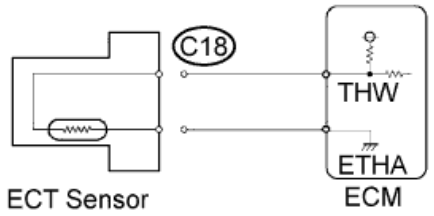
c. Turn the engine switch on (IG).

d. Turn the tester on.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

f. Read the value displayed on the tester.

Standard value:
-40°C (-40°F)



NG → Go to step 5

OK

REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

5.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the C18 ECT sensor connector.

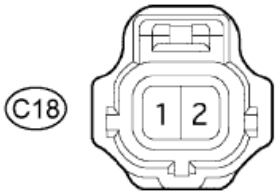
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

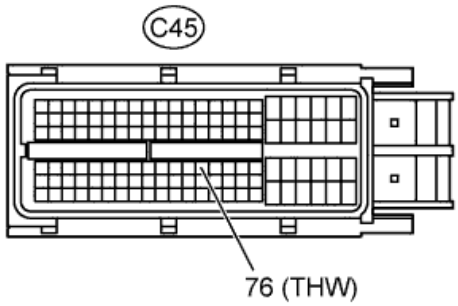
Standard Resistance:

Tester Connection	Condition	Specified Condition
C18-2 or C45-76 (THW) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector: (to ECT Sensor)



Front view of wire harness connector: (to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P060A Internal Control Module Monitoring Processor Performance

for Preparation Click here

DESCRIPTION

The main CPU and sub CPU of the ECM perform data communication between each other. The main CPU monitors the communications and C pulses from the sub CPU. hen the signal malfunctions below are detected, a DTC is stored.

DTC Code	DTC Detection Condition	Trouble Area
P060A	hen one of the following conditons is met: • An ECM main CPU error. • An ECM sub CPU error. • An electronic throttle monitoring CPU error.	ECM

INSPECTION PROCEDURE

1.CHECK DTC

a. Clear DTC (Click here).

b. Turn the engine switch off.

c. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

d. Connect the cable to the negative (-) battery terminal.

e. Turn the engine switch on (

f. Check DTC.

OK:
P060A is not output.

NG → **REPLACE ECM (Click here)**

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0115 Engine Coolant Temperature Circuit Malfunction

DTC P0117 Engine Coolant Temperature Circuit Low Input

DTC P0118 Engine Coolant Temperature Circuit High Input

for Preparation Click here

DESCRIPTION

A thermistor, whose resistance value varies according to the ECT, is built into the Engine Coolant Temperature (ECT) sensor.
The structure of the sensor and its connection to the ECM are the same as those of the Intake Air Temperature (IAT) sensor.

HINT:

When any of DTCs P0115, P0117 and P0118 is stored, the ECM enters fail-safe mode. During fail-safe mode, the ECT is estimated to be 80°C (176°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC Code	DTC Detection Condition	Trouble Area
P0115	An open or short in the Engine Coolant Temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in Engine Coolant Temperature (ECT) sensor circuit • ECT sensor • ECM
P0117	A short in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in ECT sensor • ECT sensor • ECM
P0118	An open in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in ECT sensor circuit • ECT sensor • ECM

HINT:

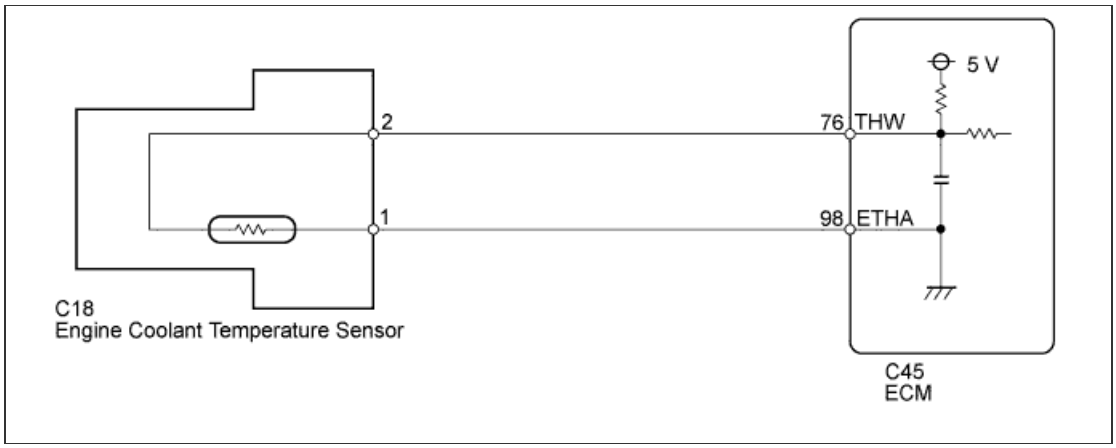
When any of these DTCs is output, check the ECT by entering the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

Temperature Displayed	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

MONITOR DESCRIPTION

The Engine Coolant Temperature (ECT) sensor is used to monitor the ECT. The ECT sensor has a thermistor with a resistance that varies according to the temperature of the engine coolant. When the coolant temperature is low, the resistance in the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are reflected in the output voltage from the sensor. The ECM monitors the sensor voltage and uses this value to calculate the ECT. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a fault in the ECT sensor and stores DTC(s).
Example:
If the sensor output voltage is higher than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the ECT sensor circuit, and stores DTC P0118. Conversely, if the voltage output is below 0.14 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and stores DTC P0117.
If the malfunction is not repaired successfully, a DTC is stored 0.5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (ENGINE COOLANT TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

e. Read the value displayed on the tester.

Standard value:
Between 75 and 100°C (167 and 212°F) with warm engine.

Result

Temperature Displayed	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
Between 75 and 100°C (176 and 212°F)	C

HINT:

- **If there is an open circuit, the tester indicates -40°C (-40°F).**
- **If there is a short circuit, the tester indicates 140°C (284°F) or higher.**

B	Go to step 4
C	CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the C18 Engine Coolant Temperature (ECT) sensor connector.

b. Connect terminals 1 and 2 of the ECT sensor connector on the wire harness side.

c. Connect the intelligent tester to the DLC3.

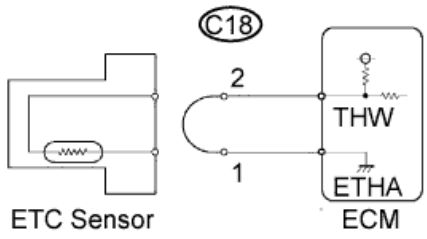
d. Turn the engine switch on (IG).

e. Turn the tester on.

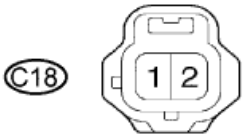
f. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

g. Read the value displayed on the tester.

Standard value:
140°C (284°F) or higher



Front view of wire harness connector:
(to ECT Sensor)



NG	Go to step 3

OK

GOOD CONNECTION TO ECM. IF OK, REPLACE ECM (Click here)

3.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the C18 ECT sensor connector.

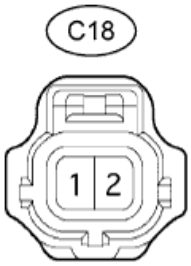
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

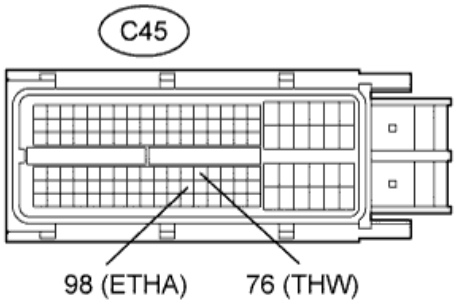
Standard Resistance:

Tester Connection	Condition	Specified Condition
C18-2 - C45-76 (THW)	Always	Below 1 Ω
C18-1 - C45-98 (ETHA)	Always	Below 1 Ω

Front view of wire harness connector:
(to ECT Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

4.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the C18 ECT sensor connector.

b. Connect the intelligent tester to the DLC3.

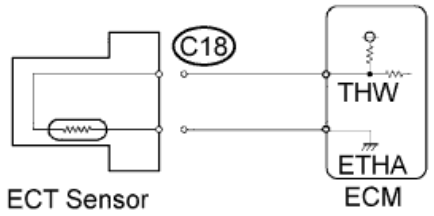
c. Turn the engine switch on (IG).

d. Turn the tester on.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

f. Read the value displayed on the tester.

Standard value:
-40°C (-40°F)



NG → Go to step 5

OK

REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

5.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the C18 ECT sensor connector.

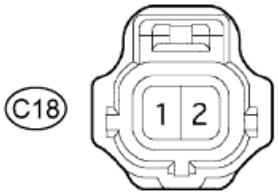
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

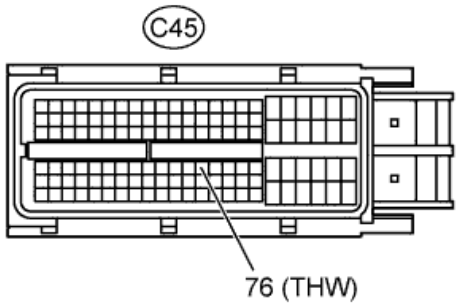
Standard Resistance:

Tester Connection	Condition	Specified Condition
C18-2 or C45-76 (THW) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector: (to ECT Sensor)



Front view of wire harness connector: (to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P060B Internal Control Module A/D Processing Performance

for Preparation Click here

DESCRIPTION

This DTC is stored when a communication error occurs in the ECM.

DTC Code	DTC Detection Condition	Trouble Area
P060B	An ECM main CPU communication error.	ECM

INSPECTION PROCEDURE

1.CHECK DTC

a. Clear DTC (Click here).

b. Turn the engine switch off.

c. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

d. Connect the cable to the negative (-) battery terminal.

e. Turn the engine switch on (IG).

f. Check DTC.

OK:
P060B is not output.

NG → **REPLACE ECM (Click here)**

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0115 Engine Coolant Temperature Circuit Malfunction

DTC P0117 Engine Coolant Temperature Circuit Low Input

DTC P0118 Engine Coolant Temperature Circuit High Input

for Preparation Click here

DESCRIPTION

A thermistor, whose resistance value varies according to the ECT, is built into the Engine Coolant Temperature (ECT) sensor.
The structure of the sensor and its connection to the ECM are the same as those of the Intake Air Temperature (IAT) sensor.

HINT:

When any of DTCs P0115, P0117 and P0118 is stored, the ECM enters fail-safe mode. During fail-safe mode, the ECT is estimated to be 80°C (176°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC Code	DTC Detection Condition	Trouble Area
P0115	An open or short in the Engine Coolant Temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in Engine Coolant Temperature (ECT) sensor circuit • ECT sensor • ECM
P0117	A short in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in ECT sensor • ECT sensor • ECM
P0118	An open in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in ECT sensor circuit • ECT sensor • ECM

HINT:

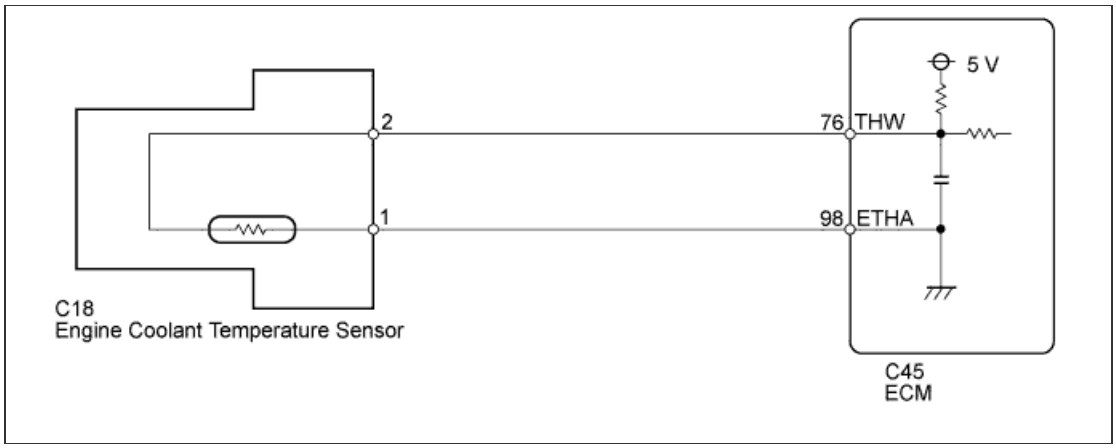
When any of these DTCs is output, check the ECT by entering the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

Temperature Displayed	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

MONITOR DESCRIPTION

The Engine Coolant Temperature (ECT) sensor is used to monitor the ECT. The ECT sensor has a thermistor with a resistance that varies according to the temperature of the engine coolant. When the coolant temperature is low, the resistance in the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are reflected in the output voltage from the sensor. The ECM monitors the sensor voltage and uses this value to calculate the ECT. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a fault in the ECT sensor and stores DTC(s).
Example:
If the sensor output voltage is higher than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the ECT sensor circuit, and stores DTC P0118. Conversely, if the voltage output is below 0.14 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and stores DTC P0117.
If the malfunction is not repaired successfully, a DTC is stored 0.5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (ENGINE COOLANT TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

e. Read the value displayed on the tester.

Standard value:
Between 75 and 100°C (167 and 212°F) with warm engine.

Result

Temperature Displayed	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
Between 75 and 100°C (176 and 212°F)	C

HINT:

- **If there is an open circuit, the tester indicates -40°C (-40°F).**
- **If there is a short circuit, the tester indicates 140°C (284°F) or higher.**

B	Go to step 4
C	CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the C18 Engine Coolant Temperature (ECT) sensor connector.

b. Connect terminals 1 and 2 of the ECT sensor connector on the wire harness side.

c. Connect the intelligent tester to the DLC3.

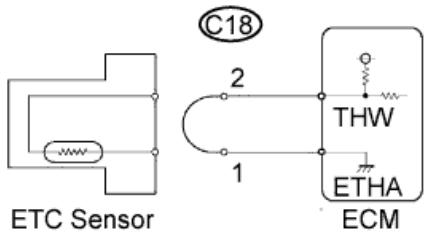
d. Turn the engine switch on (IG).

e. Turn the tester on.

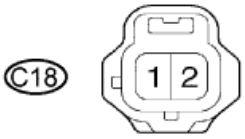
f. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

g. Read the value displayed on the tester.

Standard value:
140°C (284°F) or higher



Front view of wire harness connector:
(to ECT Sensor)



NG	Go to step 3

OK

GOOD CONNECTION TO ECM. IF OK, REPLACE ECM (Click here)

3.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the C18 ECT sensor connector.

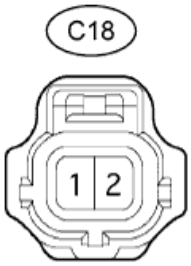
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

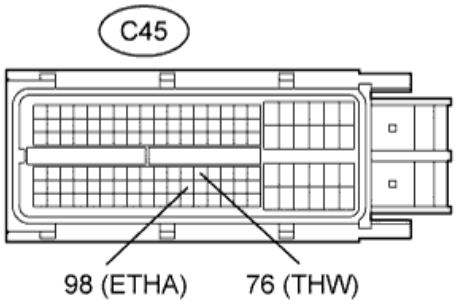
Standard Resistance:

Tester Connection	Condition	Specified Condition
C18-2 - C45-76 (THW)	Always	Below 1 Ω
C18-1 - C45-98 (ETHA)	Always	Below 1 Ω

Front view of wire harness connector:
(to ECT Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

4.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the C18 ECT sensor connector.

b. Connect the intelligent tester to the DLC3.

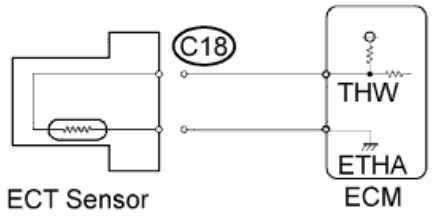
c. Turn the engine switch on (IG).

d. Turn the tester on.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

f. Read the value displayed on the tester.

Standard value:
-40°C (-40°F)



NG → Go to step 5

OK

REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

5.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the C18 ECT sensor connector.

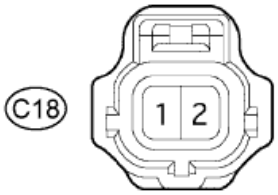
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

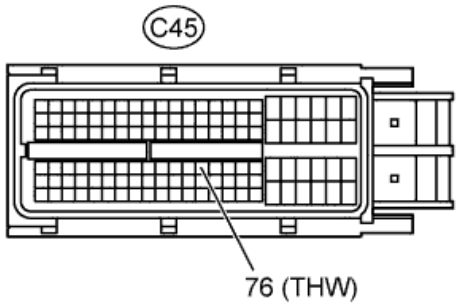
Standard Resistance:

Tester Connection	Condition	Specified Condition
C18-2 or C45-76 (THW) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector: (to ECT Sensor)



Front view of wire harness connector: (to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P060D Internal Control Module Accelerator Pedal Position Performance

for Preparation Click here

DESCRIPTION

The ECM monitors the input signals of the A elerator Pedal Position (APP) sensor o. 1. When the input signals and ontrol signals are deviated, a DTC is stored.

DTC Code	DTC Dete tion Condition	Trouble Area
P060D	When either ondition below is met: • An ECM main CPU error. • An ECM sub CPU error.	ECM

INSPECTION PROCEDURE

1.CHECK DTC

a. Clear DTC (Cli here).

b. Turn the engine swit h off.

c. Dis onne t the able from the negative (-) battery terminal and wait for 1 minute.

d. Conne t the able to the negative (-) battery terminal.

e. Turn the engine swit h on (IG).

f. Che DTC.

OK:
P060D is not output.

NG → **REPLACE ECM (Click here)**

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0116 Engine Coolant Temperature Circuit Range / Performance Problem

for Preparation Click here

DESCRIPTION

Refer to DTC P0115 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P0116	The Engine Coolant Temperature (ECT) is between 35°C and 60°C (95°F and 140°F) when the engine is started, and conditions (a) and (b) are met (2 trip detection logic): (a) The vehicle is driven at varying speeds (accelerated and decelerated). (b) The ECT remains within 3°C (5.4°F) of the initial ECT.	• Water inlet sub-assembly with thermostat • ECT sensor

MONITOR DESCRIPTION

The ECT sensor is used to monitor the ECT. The ECT sensor has a built-in thermistor with a resistance that varies according to the temperature of the engine coolant. When the ECT is low, the resistance of the thermistor increases. When the temperature is high, the resistance drops. These variations in the resistance are reflected in the output voltage from the ECT sensor.
The ECM monitors the sensor voltage and uses this value to calculate the ECT. If the sensor output voltage deviates from the normal operating range, the ECM interprets this deviation as a malfunction in the ECT sensor and stores the DTC.
Example:
Upon starting the engine, the ECT is between 35°C and 60°C (95°F and 140°F). If after driving for 250 seconds, the ECT remains within 3°C (5.4°F) of the starting temperature, the DTC is stored (2 trip detection logic).

INSPECTION PROCEDURE

HINT:

- **If any of DTCs P0115, P0117, P0118 or P0125 is output simultaneously with DTC P0116, the ECT sensor may have an open or a short circuit. Troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0116)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read the DTC.

Result

Result	Proceed to
P0116 is output	A
P0116 and other DTCs are output	B

B → GO TO DTC CHART (Click here)

A

2.INSPECT WATER INLET SUB-ASSEMBLY WITH THERMOSTAT

a. Remove the water inlet sub-assembly with thermostat (Click here).

b. Measure the valve opening temperature of the water inlet sub-assembly with thermostat.

Standard opening temperature:
80 to 84°C (176 to 183°F)

HINT:

In addition to the above check, confirm that the valve is completely closed when the temperature is below the standard.

c. Reinstall the water inlet sub-assembly with thermostat (Click here).

NG → REPLACE WATER INLET SUB-ASSEMBLY WITH THERMOSTAT (**Click here**)

OK → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (**Click here**)

DTC P060E Internal Control Module Throttle Position Performance

for Preparation Click here

DESCRIPTION

The ECM monitors the input signals of the Throttle Position (TP) sensor No. 1 and stop light switch. As the ECM monitors the input signals of the TP sensor No. 1 and the STP signals of the stop light switch, if the input signals and control signals are deviated, a DTC is stored.

DTC Code	DTC Detection Condition	Trouble Area
P060E	When either condition below is met: • An ECM main CPU error. • An ECM sub CPU error.	ECM

INSPECTION PROCEDURE

1.CHECK DTC

a. Clear DTC (Clic here).

b. Turn the engine switch off.

c. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

d. Connect the cable to the negative (-) battery terminal.

e. Turn the engine switch on (I

f. Chec DTC.

OK:
P060E is not output.

NG → **REPLACE ECM (Click here)**

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0120 Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0220 Throttle / Pedal Position Sensor / Switch "B" Circuit

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

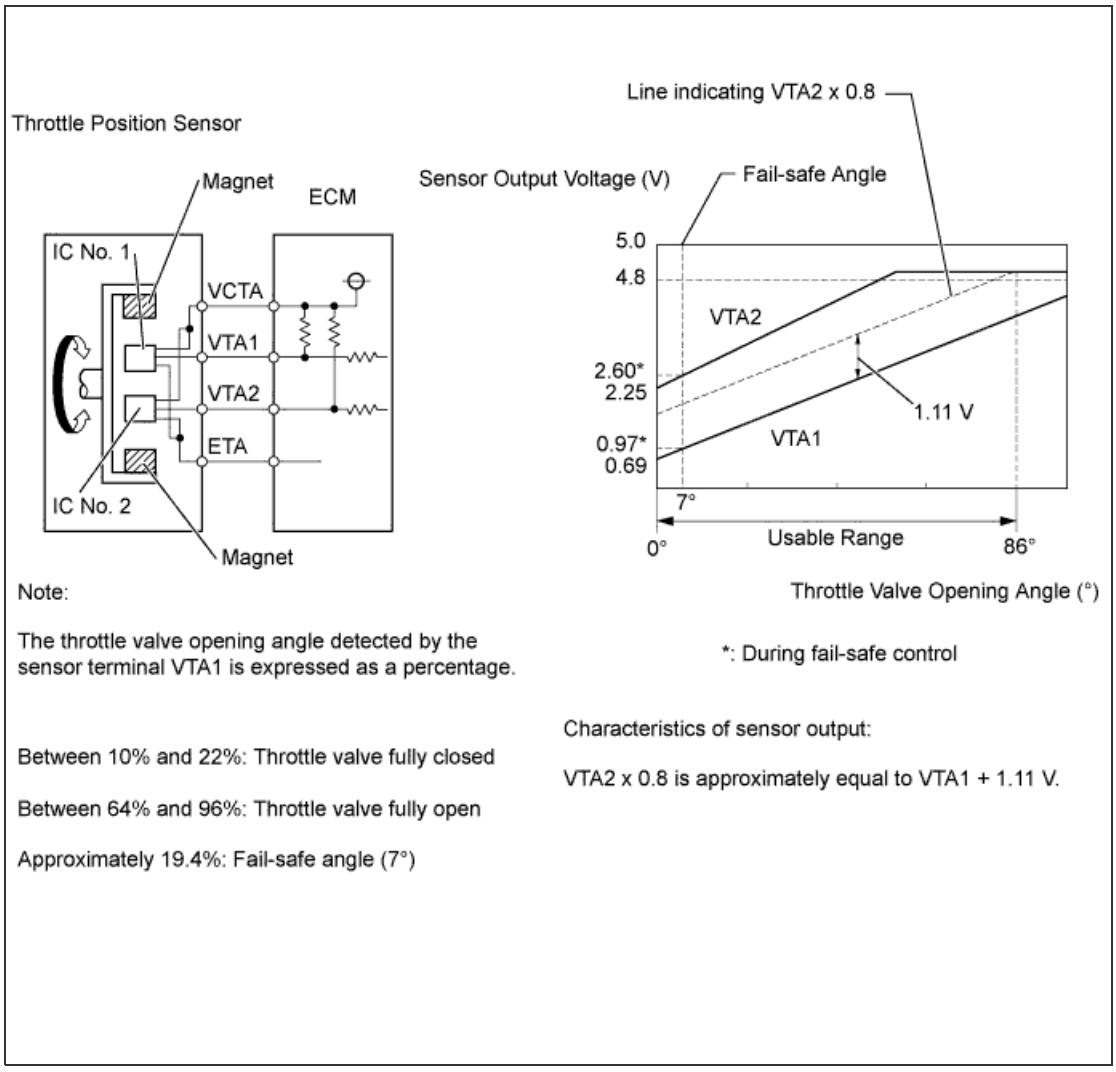
DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

DTC P2135 Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

for Preparation Click here

DESCRIPTION

The TP sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.
The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air-fuel ratio correction, power increase correction and fuel cut control.



DTC Code	DTC Detection Condition	Trouble Area
P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• Throttle Position (TP) sensor (built into throttle body) • ECM

P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.535 V or higher for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher, and VTA1 is between 0.2 V and 2.02 V for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) is met (1 trip detection logic): (a) The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:

- **When any of these DTCs is output, check the throttle valve opening angle by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.**
- **Throttle Position No.1 is the VTA1 signal, and Throttle Position No.2 is the VTA2 signal.**

Reference (Normal Condition):

Display Item	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No.1	0.5 to 1.1 V	3.2 to 4.8 V
Throttle Position No.2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

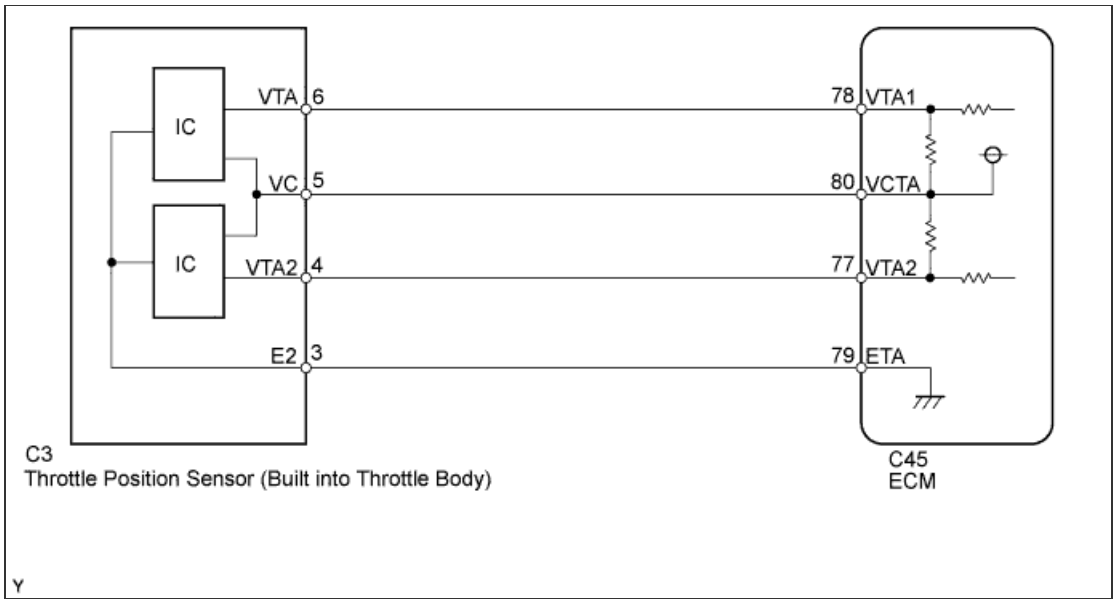
- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor, and stores DTC(s).
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and stores DTC(s).
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and stores DTC(s).

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain Engine and ECT Data List ETCS Throttle Position No.1 and Throttle Position No.2.

d. Check the values displayed on the tester.

Result

TP#1 (VTA1) When Accelerator Pedal Released	TP#2 (VTA2) When Accelerator Pedal Released	TP#1 (VTA1) When Accelerator Pedal Depressed	TP#2 (VTA2) When Accelerator Pedal Depressed	Trouble Area	Proceed to
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	A
0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	VTA1 circuit open or ground short	A
0.6 to 1.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.6 to 1.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	A
0.5 to 1.1 V	2.1 to 3.1 V	3.2 to 4.8 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

TP#1 stands for Throttle Position No. 1, and TP#2 stands for Throttle Position No. 2.

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the C3 throttle body connector.

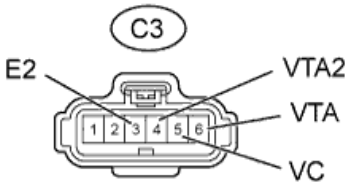
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

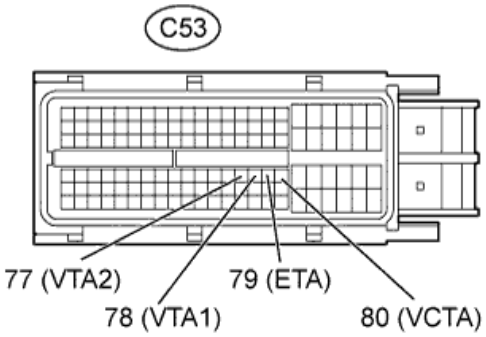
Standard Resistance:

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C45-80 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C45-78 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C45-77 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C45-7 (ETA)	Always	Below 1 Ω
C3-5 (VC) or C45-80 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C45-78 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C45-77 (VTA2) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Throttle Position Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT ECM (VC VOLTAGE)

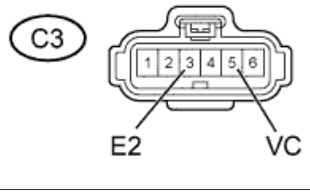
a. Disconnect the C3 throttle body connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C3-5 (VC) - C3-3 (E2)	Engine switch on (I)	4.5 to 5.5 V

Front view of wire harness connector:
(to Throttle Body)



Y

NG → REPLACE ECM (Click here)

OK

4.REPLACE THROTTLE BODY ASSEMBLY

a. Replace the throttle body assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds or more.

f. Enter the following menus: Powertrain Engine and ECT DTC.

g. Read DTCs.

Result

Result	Proceed to
P0120, P0122, P0123, P0220, P0222, P0223 and or P2135 are output	A
No DTC is output	B

B → **SYSTEM OK**

A → **REPLACE ECM (Click here)**

DTC P0617 Starter Relay Circuit High

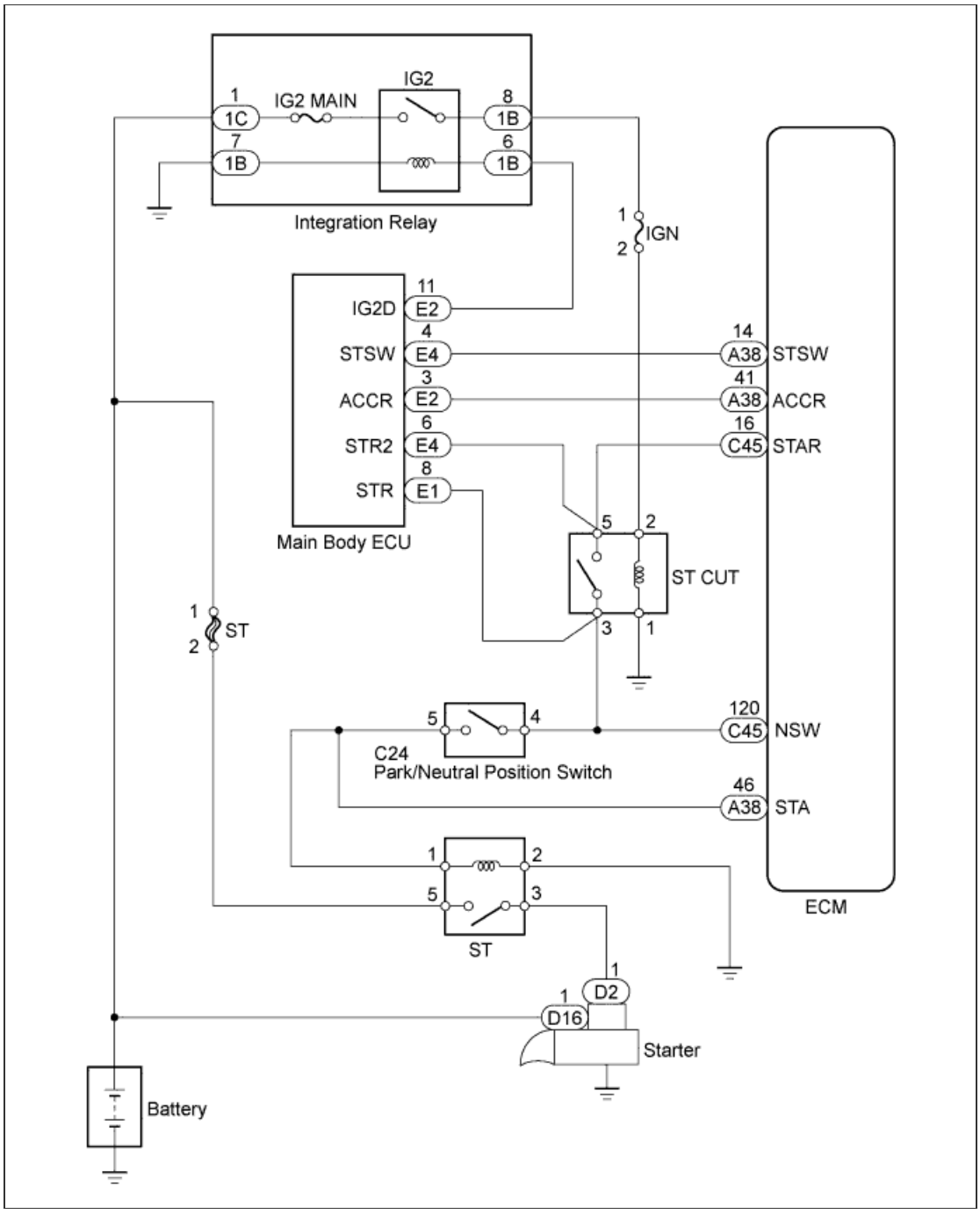
for Preparation Click here

DESCRIPTION

While the engine is being cranked, the positive battery voltage is applied to terminal STA of the ECM. If the ECM detects the Starter Control (STA) signal while the vehicle is being driven, it determines that there is a malfunction in the STA circuit. The ECM then illuminates the MIL and stores the DTC.
This monitor runs when the vehicle is driven at 20 km/h (12.4 mph) for over 20 seconds.

DTC Code	DTC Detection Condition	Trouble Area
P0617	When conditions (a), (b) and (c) are met, and a positive (+B) battery voltage of 10.5 V or higher is applied to the ECM for 20 seconds (1 trip detection logic). (a) The vehicle speed is 20 km/h (12.4 mph) or more. (b) The engine speed is 1000 rpm or more. (c) The STA signal is ON.	• Park/Neutral Position (PNP) switch • Starter relay circuit • Engine switch • ECM

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **The following troubleshooting flowchart is based on the premise that the engine is cranked normally.**
  If the engine will not crank, proceed to the Problem Symptoms Table (Click here).
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air uel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ ALUE USING INTELLIGENT TESTER (STARTER SIGNAL)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Starter Signal.

d. Check the value displayed on the tester when the engine switch is turned to the START positions.

O :

Engine Switch Position	Starter Signal
On (IG)	OFF
START	ON

NG → **Go to step**

O

CHEC OR INTERMITTENT PRO EMS (Click here)

INSPECT PAR NEUTRAL POSITION SWITCH ASSEM

a. Inspect the park/neutral position switch (Click here).

NG → **REPLACE PAR NEUTRAL POSITION SWITCH ASSEM (Click here)**

O

.CHEC HARNESS AND CONNECTOR (PNP SWITCH ECM)

a. Disconnect the C24 PNP switch connector.

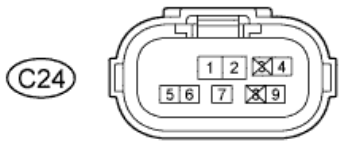
b. Disconnect the A38 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

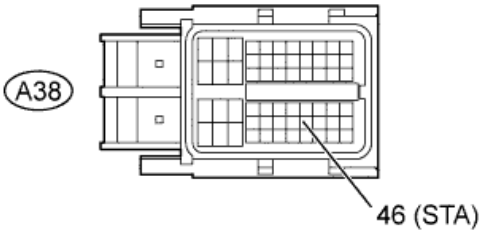
Standard Resistance:

Tester Connection	Condition	Specified Condition
C24-5 - A38-46 (STA)	Always	Below 1 Ω
C24-5 or A38-46 (STA) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Park/Neutral Position Switch)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

O

GO TO CRAN ING HOLDING FUNCTION CIRCUIT (Click here)

DTC P0120 Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0220 Throttle / Pedal Position Sensor / Switch "B" Circuit

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

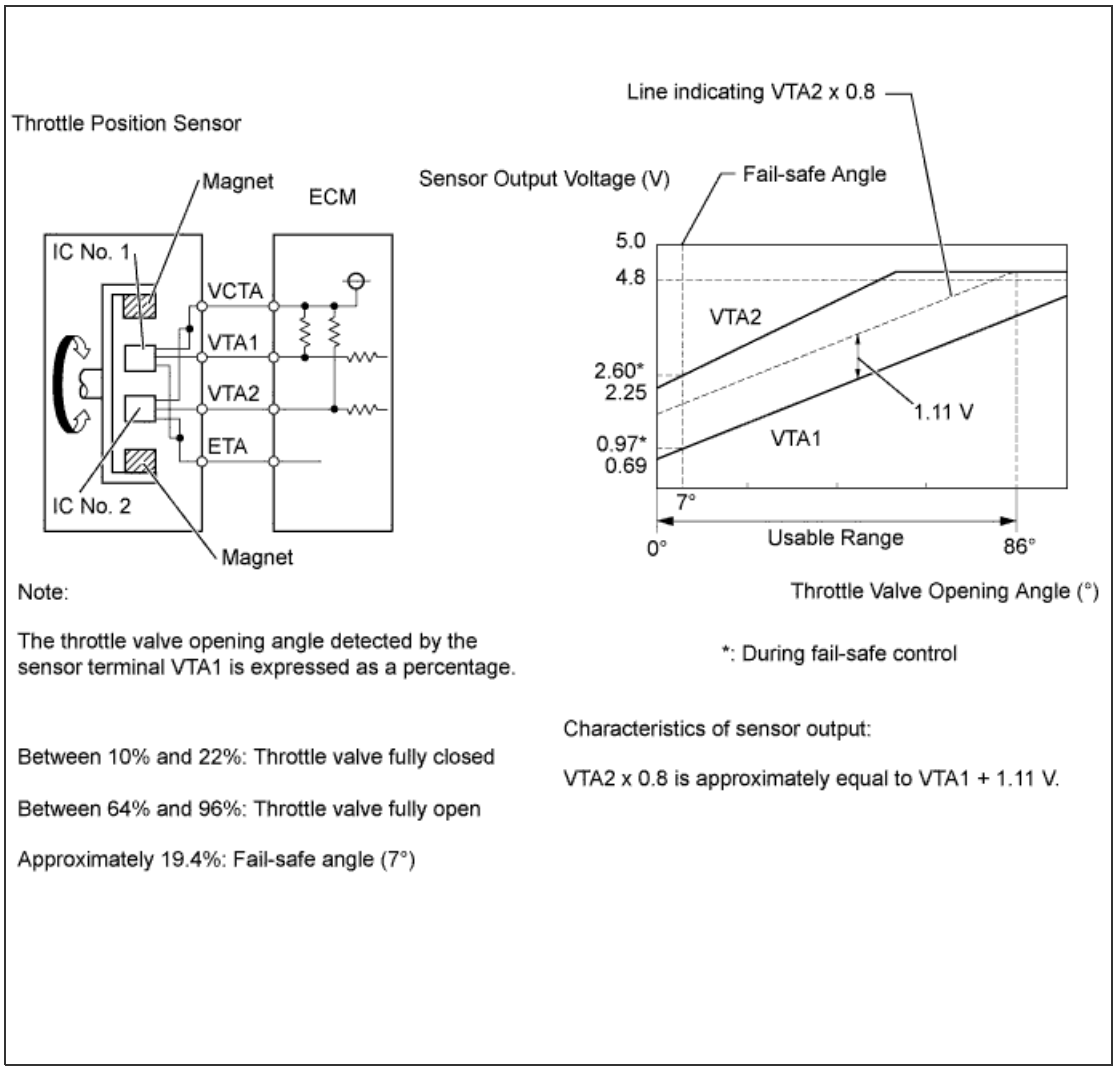
DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

DTC P2135 Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

for Preparation Click here

DESCRIPTION

The TP sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.
The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air-fuel ratio correction, power increase correction and fuel cut control.



DTC Code	DTC Detection Condition	Trouble Area
P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• Throttle Position (TP) sensor (built into throttle body) • ECM

P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.535 V or higher for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher, and VTA1 is between 0.2 V and 2.02 V for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) is met (1 trip detection logic): (a) The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:

- **When any of these DTCs is output, check the throttle valve opening angle by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.**
- **Throttle Position No.1 is the VTA1 signal, and Throttle Position No.2 is the VTA2 signal.**

Reference (Normal Condition):

Display Item	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No.1	0.5 to 1.1 V	3.2 to 4.8 V
Throttle Position No.2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

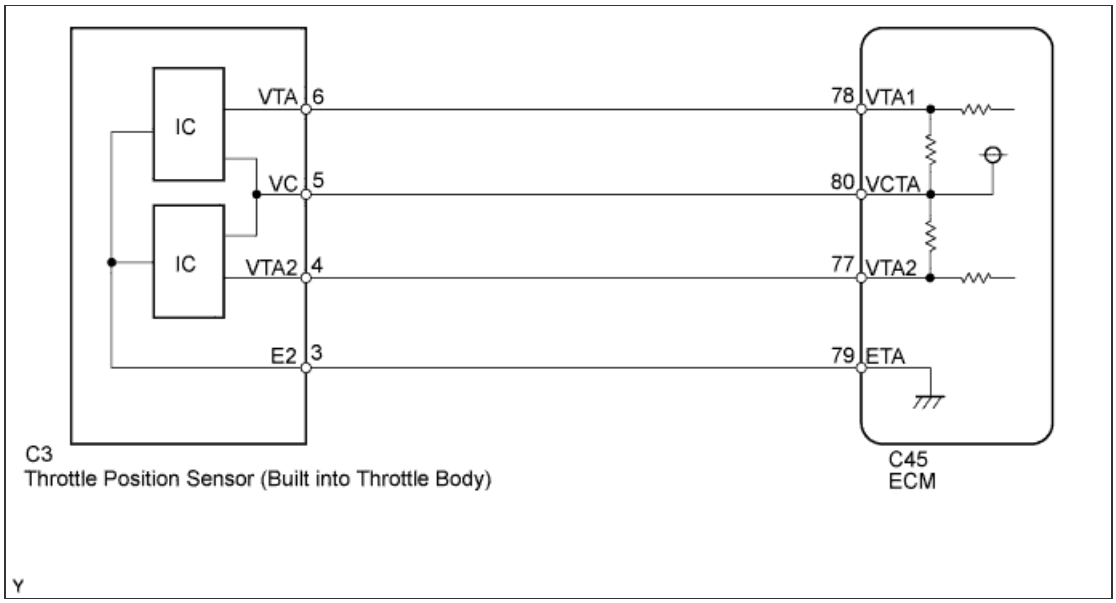
- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor, and stores DTC(s).
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and stores DTC(s).
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and stores DTC(s).

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain Engine and ECT Data List ETCS Throttle Position No.1 and Throttle Position No.2.

d. Check the values displayed on the tester.

Result

TP#1 (VTA1) When Accelerator Pedal Released	TP#2 (VTA2) When Accelerator Pedal Released	TP#1 (VTA1) When Accelerator Pedal Depressed	TP#2 (VTA2) When Accelerator Pedal Depressed	Trouble Area	Proceed to
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	A
0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	VTA1 circuit open or ground short	A
0.6 to 1.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.6 to 1.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	A
0.5 to 1.1 V	2.1 to 3.1 V	3.2 to 4.8 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

TP#1 stands for Throttle Position No. 1, and TP#2 stands for Throttle Position No. 2.

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the C3 throttle body connector.

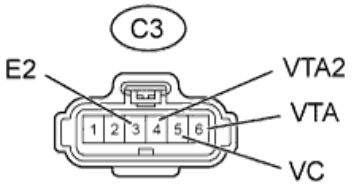
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

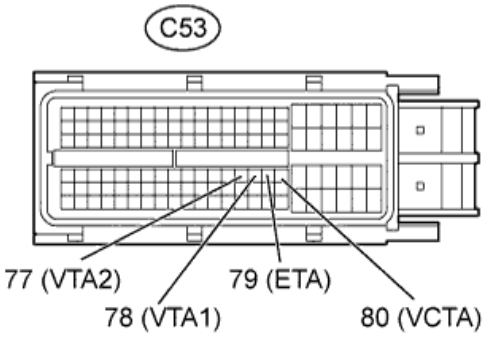
Standard Resistance:

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C45-80 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C45-78 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C45-77 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C45-7 (ETA)	Always	Below 1 Ω
C3-5 (VC) or C45-80 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C45-78 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C45-77 (VTA2) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Throttle Position Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT ECM (VC VOLTAGE)

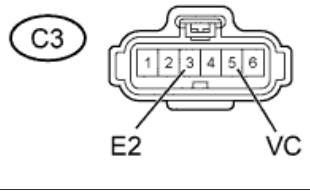
a. Disconnect the C3 throttle body connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C3-5 (VC) - C3-3 (E2)	Engine switch on (I)	4.5 to 5.5 V

Front view of wire harness connector:
(to Throttle Body)



Y

NG → REPLACE ECM (Click here)

OK

4.REPLACE THROTTLE BODY ASSEMBLY

a. Replace the throttle body assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds or more.

f. Enter the following menus: Powertrain Engine and ECT DTC.

g. Read DTCs.

Result

Result	Proceed to
P0120, P0122, P0123, P0220, P0222, P0223 and or P2135 are output	A
No DTC is output	B

B → **SYSTEM OK**

A → **REPLACE ECM (Click here)**

DTC P0657 Actuator Supply Voltage Circuit / Open

for Preparation Click here

DESCRIPTION

The ECM monitors the output voltage to the throttle actuator. This self-check ensures that the ECM is functioning properly. The output voltage usually is 0 V when the engine switch is turned off. If the output voltage is higher than 7 V when the engine switch is turned off, the ECM will illuminate the MIL and store DTC(s) when the engine switch is turned on (IG).

DTC Code	DTC Detection Condition	Trouble Area
P0657	A throttle actuator power supply error.	ECM

INSPECTION PROCEDURE

1.CHECK DTC

a. Clear DTC (Click here).

b. Turn the engine switch off.

c. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

d. Connect the cable to the negative (-) battery terminal.

e. Turn the engine switch on (IG) for 10 seconds.

f. Turn the engine switch off.

g. Turn the engine switch on (IG).

h. Check DTC.

OK:
P0657 is not output.

NG → **REPLACE EC (Click here)**

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0120 Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0220 Throttle / Pedal Position Sensor / Switch "B" Circuit

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

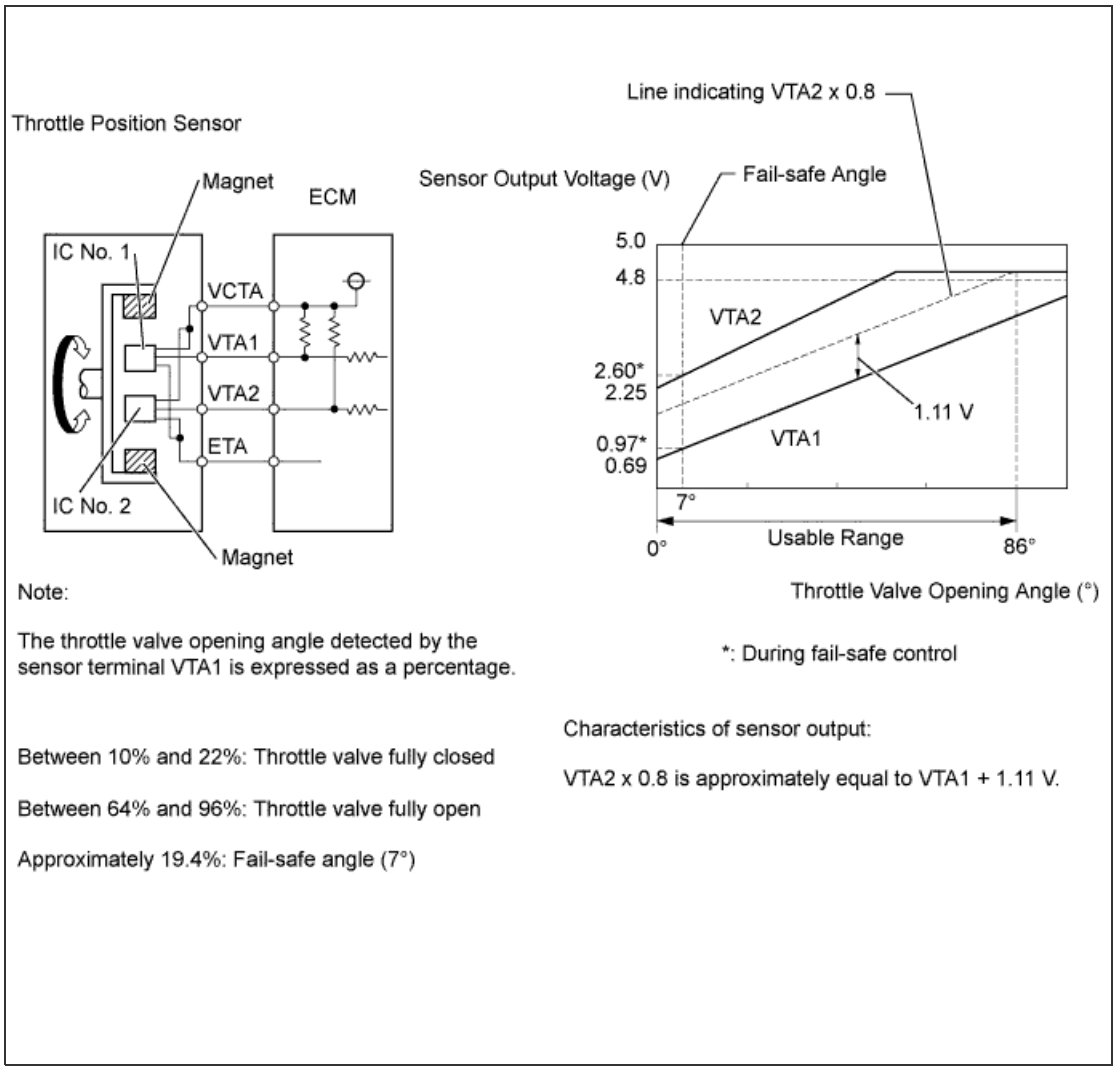
DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

DTC P2135 Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

for Preparation Click here

DESCRIPTION

The TP sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.
The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air-fuel ratio correction, power increase correction and fuel cut control.



DTC Code	DTC Detection Condition	Trouble Area
P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• Throttle Position (TP) sensor (built into throttle body) • ECM

P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.535 V or higher for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher, and VTA1 is between 0.2 V and 2.02 V for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) is met (1 trip detection logic): (a) The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:

- **When any of these DTCs is output, check the throttle valve opening angle by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.**
- **Throttle Position No.1 is the VTA1 signal, and Throttle Position No.2 is the VTA2 signal.**

Reference (Normal Condition):

Display Item	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No.1	0.5 to 1.1 V	3.2 to 4.8 V
Throttle Position No.2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

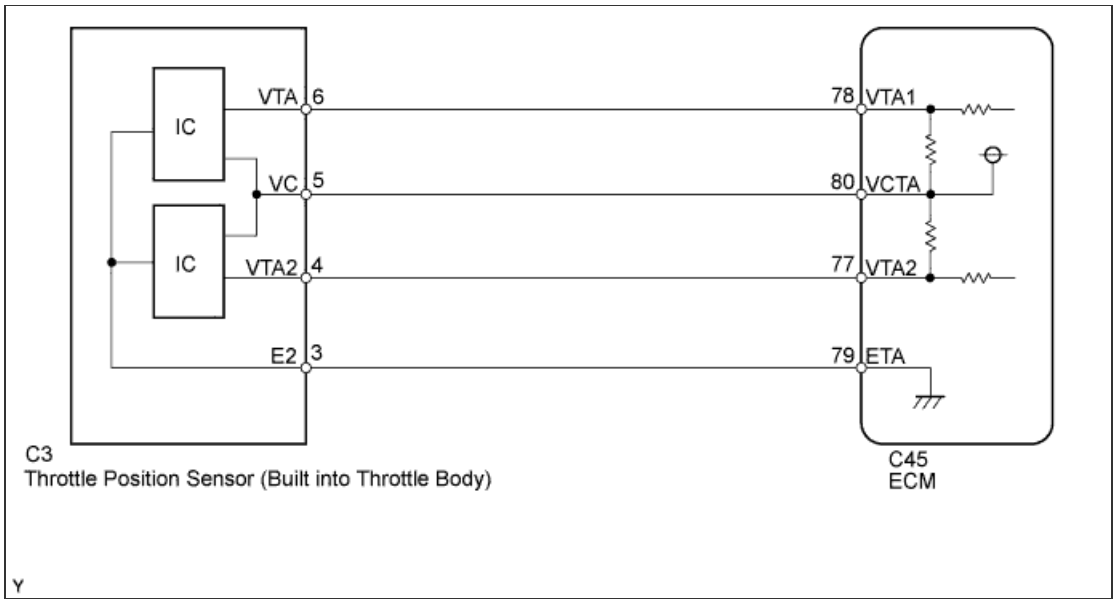
- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor, and stores DTC(s).
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and stores DTC(s).
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and stores DTC(s).

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain Engine and ECT Data List ETCS Throttle Position No.1 and Throttle Position No.2.

d. Check the values displayed on the tester.

Result

TP#1 (VTA1) When Accelerator Pedal Released	TP#2 (VTA2) When Accelerator Pedal Released	TP#1 (VTA1) When Accelerator Pedal Depressed	TP#2 (VTA2) When Accelerator Pedal Depressed	Trouble Area	Proceed to
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	A
0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	VTA1 circuit open or ground short	A
0.6 to 1.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.6 to 1.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	A
0.5 to 1.1 V	2.1 to 3.1 V	3.2 to 4.8 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

TP#1 stands for Throttle Position No. 1, and TP#2 stands for Throttle Position No. 2.

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the C3 throttle body connector.

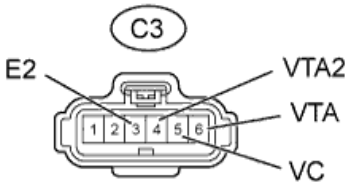
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

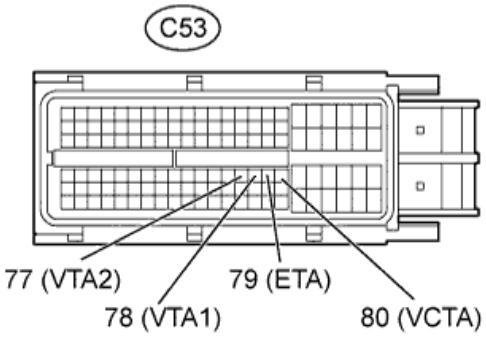
Standard Resistance:

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C45-80 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C45-78 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C45-77 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C45-7 (ETA)	Always	Below 1 Ω
C3-5 (VC) or C45-80 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C45-78 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C45-77 (VTA2) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Throttle Position Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT ECM (VC VOLTAGE)

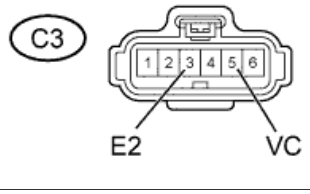
a. Disconnect the C3 throttle body connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C3-5 (VC) - C3-3 (E2)	Engine switch on (I)	4.5 to 5.5 V

Front view of wire harness connector:
(to Throttle Body)



Y

NG → REPLACE ECM (Click here)

OK

4.REPLACE THROTTLE BODY ASSEMBLY

a. Replace the throttle body assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds or more.

f. Enter the following menus: Powertrain Engine and ECT DTC.

g. Read DTCs.

Result

Result	Proceed to
P0120, P0122, P0123, P0220, P0222, P0223 and or P2135 are output	A
No DTC is output	B

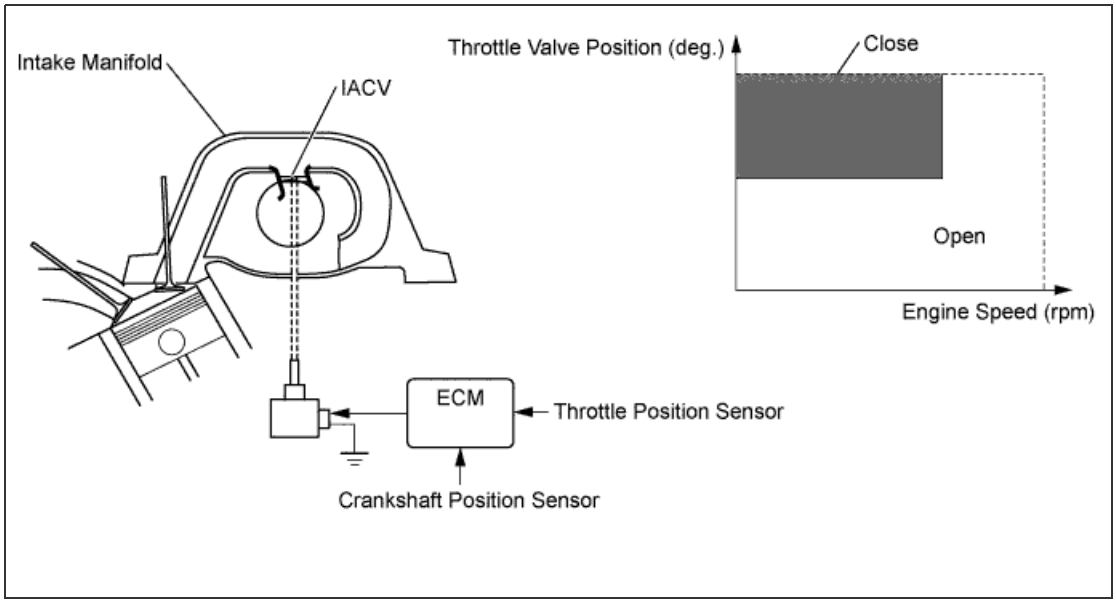
B → **SYSTEM OK**

A → **REPLACE ECM (Click here)**

for Preparation Click here

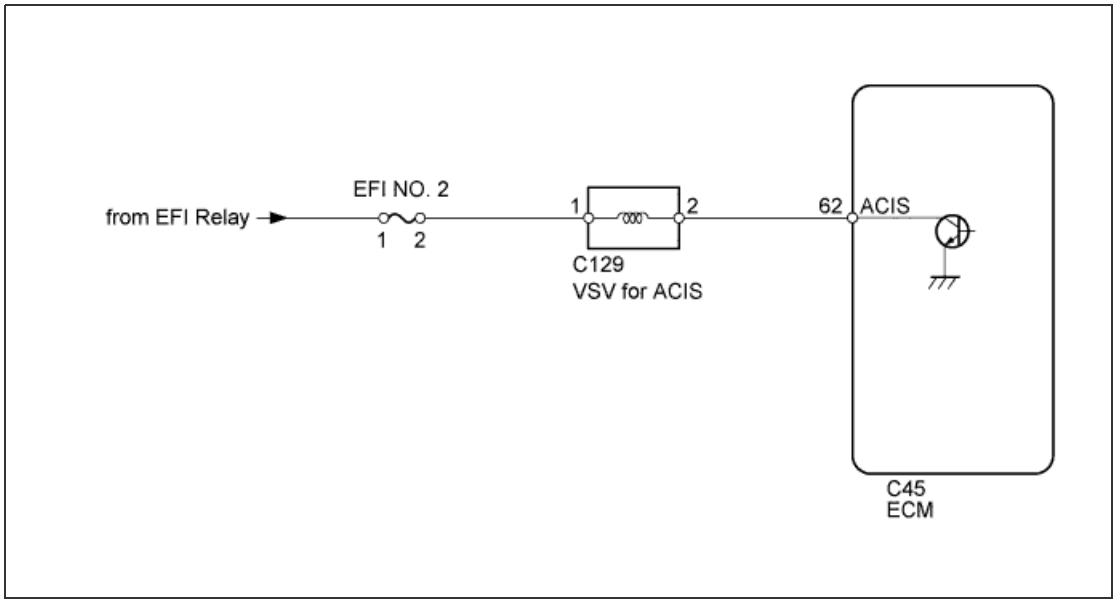
DESCRIPTION

This circuit opens and closes the Intake Air Control Valve (IACV) in response to the engine load in order to increase the intake efficiency (ACIS: Acoustic Control Induction System).



DTC Code	DTC Detection Condition	Trouble Area
P0660	Conditions (a) and (b) are met for 0.5 sec. or more (2 trip detection logic): (a) The voltage of terminal ACIS of the ECM is low when the VSV is OFF. (b) The engine has started.	• Open or short in VSV for ACIS circuit • VSV for ACIS • ECM

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE VSV FOR ACIS)

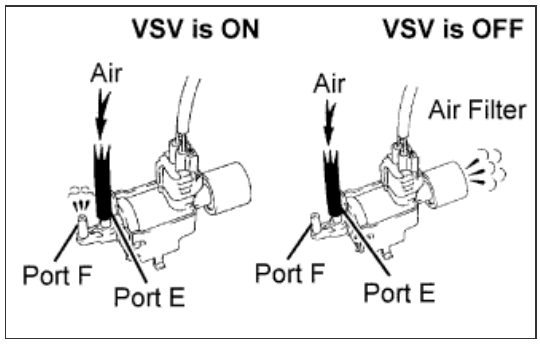
a. Disconnect the vacuum hose.

b. Connect the intelligent tester to the DLC3.

c. Turn the engine switch on (IG) and turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Active the VSV for Intake Control. Operate the VSV for ACIS.

e. Check the VSV operation when it is operated using the tester.



Standard:

Tester Operation	Specified Condition
VSV ON	Air from port E flows out through port F
VSV OFF	Air from port E flows out through air filter

NG → Go to step 4

OK ↓

2.CHECK VACUUM HOSE

a. Check that the vacuum hose is connected correctly, and that there are no cracks, holes, damage, or looseness.

OK:

Vacuu hose is nor al.

NG → REPAIR OR REPLACE VACUUM HOSE

OK ↓

3.INSPECT INTAKE MANIFOLD (INTAKE AIR CONTROL VALVE)

a. Inspect the intake air control valve (Click here).

NG → REPLACE INTAKE MANIFOLD (INTAKE AIR CONTROL VALVE) (Click here)

OK ↓

PROCEED TO NE T 0RCUIT INSPECTION SHOWN IN PROBLEM SYMPTOMS TABLE (Click here)

4.INSPECT VSV FOR ACIS (OPERATION)

a. Inspect the VSV for ACIS (Click here).

NG → REPLACE VSV FOR ACIS (Click here)

OK ↓

5.CHECK HARNESS AND CONNECTOR (VSV FOR ACIS - ECM VSV FOR ACIS - EFI NO. 2 FUSE)

a. Check the wire harness and connectors between the VSV for ACIS and ECM.

i. Disconnect the VSV for ACIS connector.

ii. Disconnect the ECM connector.

iii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition

C129-2 - C45-62 (ACIS)	Always	Below 1 Ω
C129-2 or C45-62 (ACIS) - Body ground	Always	10 kΩ or higher

b. Check the wire harness between the VSV for ACIS and EFI NO. 2 fuse.

i. Disconnect the VSV for ACIS connector.

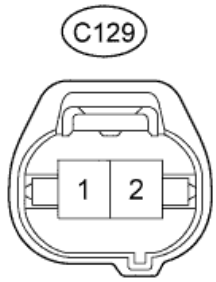
ii. Remove the EFI NO. 2 fuse from the engine room relay block.

iii. Measure the resistance according to the value(s) in the table below.

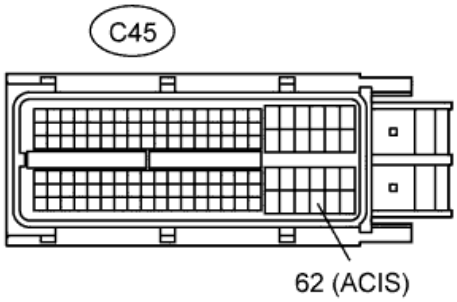
Standard Resistance:

Tester Connection	Condition	Specified Condition
C129-1 - EFI NO. 2 fuse	Always	Below 1 Ω

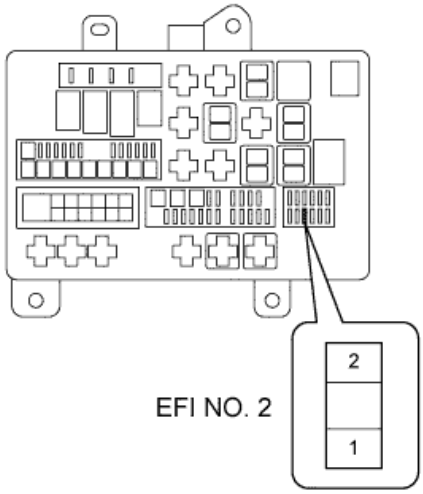
Front view of wire harness connector:
(to VSV for ACIS)



Front view of wire harness connector:
(to ECM)



Front view of wire harness connector:
(to Engine Room Relay Block)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P0120 Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0220 Throttle / Pedal Position Sensor / Switch "B" Circuit

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

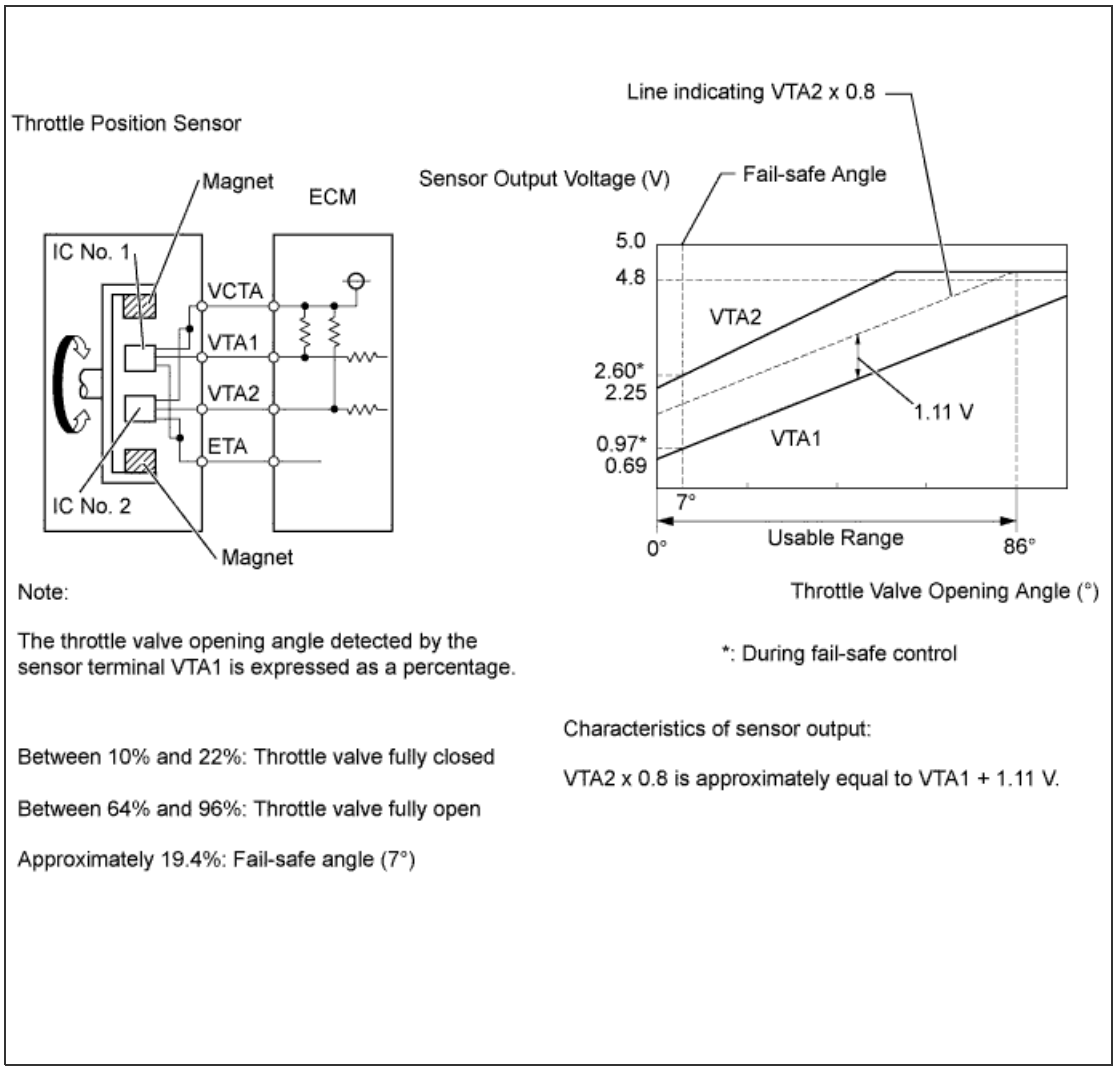
DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

DTC P2135 Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

for Preparation Click here

DESCRIPTION

The TP sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.
The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air-fuel ratio correction, power increase correction and fuel cut control.



DTC Code	DTC Detection Condition	Trouble Area
P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• Throttle Position (TP) sensor (built into throttle body) • ECM

P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.535 V or higher for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher, and VTA1 is between 0.2 V and 2.02 V for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) is met (1 trip detection logic): (a) The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:

- **When any of these DTCs is output, check the throttle valve opening angle by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.**
- **Throttle Position No.1 is the VTA1 signal, and Throttle Position No.2 is the VTA2 signal.**

Reference (Normal Condition):

Display Item	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No.1	0.5 to 1.1 V	3.2 to 4.8 V
Throttle Position No.2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

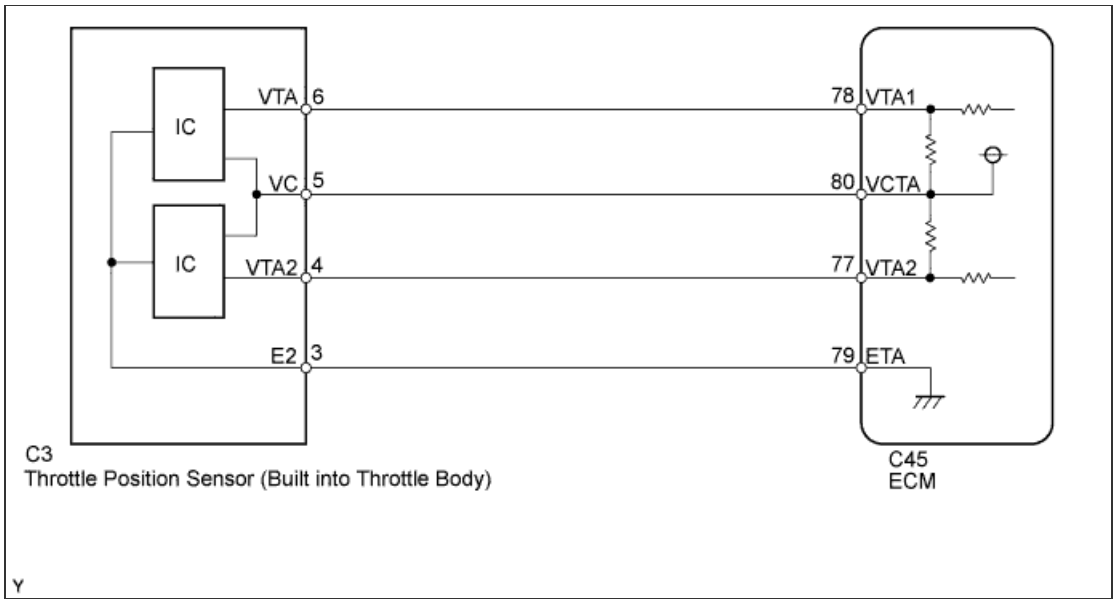
- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor, and stores DTC(s).
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and stores DTC(s).
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and stores DTC(s).

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain Engine and ECT Data List ETCS Throttle Position No.1 and Throttle Position No.2.

d. Check the values displayed on the tester.

Result

TP#1 (VTA1) When Accelerator Pedal Released	TP#2 (VTA2) When Accelerator Pedal Released	TP#1 (VTA1) When Accelerator Pedal Depressed	TP#2 (VTA2) When Accelerator Pedal Depressed	Trouble Area	Proceed to
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	A
0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	VTA1 circuit open or ground short	A
0.6 to 1.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.6 to 1.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	A
0.5 to 1.1 V	2.1 to 3.1 V	3.2 to 4.8 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

TP#1 stands for Throttle Position No. 1, and TP#2 stands for Throttle Position No. 2.

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the C3 throttle body connector.

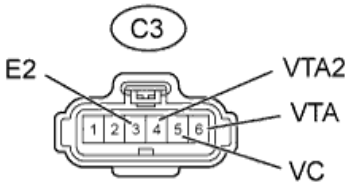
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

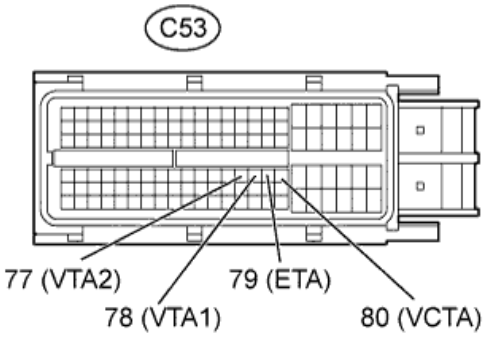
Standard Resistance:

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C45-80 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C45-78 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C45-77 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C45-7 (ETA)	Always	Below 1 Ω
C3-5 (VC) or C45-80 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C45-78 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C45-77 (VTA2) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Throttle Position Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT ECM (VC VOLTAGE)

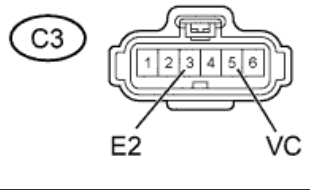
a. Disconnect the C3 throttle body connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C3-5 (VC) - C3-3 (E2)	Engine switch on (I)	4.5 to 5.5 V

Front view of wire harness connector:
(to Throttle Body)



Y

NG → REPLACE ECM (Click here)

OK

4.REPLACE THROTTLE BODY ASSEMBLY

a. Replace the throttle body assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds or more.

f. Enter the following menus: Powertrain Engine and ECT DTC.

g. Read DTCs.

Result

Result	Proceed to
P0120, P0122, P0123, P0220, P0222, P0223 and or P2135 are output	A
No DTC is output	B

B → **SYSTEM OK**

A → **REPLACE ECM (Click here)**

DTC P0724 Brake Switch "B" Circuit High

for Preparation Click here

DESCRIPTION

The purpose of this circuit is to prevent the engine from stalling while driving in the lock-up condition when the brakes are suddenly applied.
When the brake pedal is depressed, this switch sends a signal to the ECM. Then the ECM cancels the operation of the lock-up clutch while braking is in progress.

DTC No.	DTC Detection Condition	Trouble Area
P0724	Stop light switch remains ON even when vehicle is driven in GO (30 km/h (18.63 mph) or more) and STOP (less than 3 km/h (1.86 mph)) pattern 5 times (2 trip detection logic)	• Short in stop light switch signal circuit • Stop light switch • ECM

MONITOR DESCRIPTION

This DTC indicates that the stop light switch remains ON. When the stop light switch remains ON during GO and STOP driving, the ECM interprets this as a fault in the stop light switch. Then the MIL illuminates and the ECM stores the DTC. The vehicle must GO (30 km/h (18.63 mph) or more) and STOP (less than 3 km/h (1.86 mph)) 5 times for 2 driving cycles in order for the DTC to be output.

WIRING DIAGRAM

Refer to DTC P0504 (Click here).

INSPECTION PROCEDURE

HINT:

Using the intelligent tester to read the Data List allows switch, sensor, actuator and other item values to be read without removing any parts. Reading the Data List early in troubleshooting is one way to save time.

NOTICE:

In the table below, the values listed under "Normal Condition" are reference values. Do not depend solely on these reference values when deciding whether a part is faulty or not.

1. Warm up the engine.
2. Turn the ignition switch off.
3. Connect the intelligent tester to the DLC3.
4. Turn the ignition switch to ON.
5. Turn the intelligent tester on.
6. Enter the following menus: Powertrain / Engine and ECT / Data List.
7. Follow the instructions on the intelligent tester and read the Data List.

Item	Measurement Item/ Range (Display)	Normal Condition	Diagnostic Note
STOP LIGHT SW (Stop Light Switch)	Stop light switch status/ ON or OFF	• Brake pedal is depressed: ON • Brake pedal is released: OFF	-

1.INSPECT STOP LIGHT SWITCH

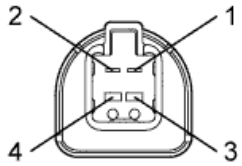
a. Remove the stop light switch.

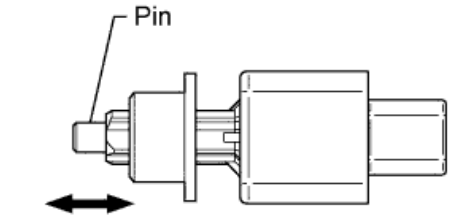
b. Measure the resistance according to the value(s) in the table below.

Standard Re i tance:

Tester Connection	Switch Condition	Specified Condition
1 - 2	Pin not pushed	Below 1 Ω
	Pin pushed	10 kΩ or higher
3 - 4	Pin not pushed	10 kΩ or higher
	Pin pushed	Below 1 Ω

Component without harness connected:
(Stop Light Switch)





NG → REPLACE STOP LIGHT SWITCH (Click here)

OK

2.CHECK HARNESS AND CONNECTOR (ECM - BATTERY)

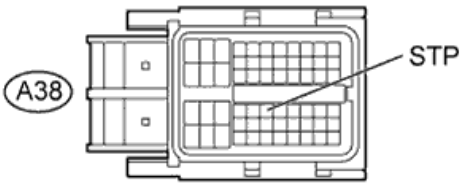
a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
A38-36 (STP) - Body ground	Brake pedal is depressed	11 to 14 V
A38-36 (STP) - Body ground	Brake pedal is released	Below 1 V

Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P0120 Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0220 Throttle / Pedal Position Sensor / Switch "B" Circuit

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

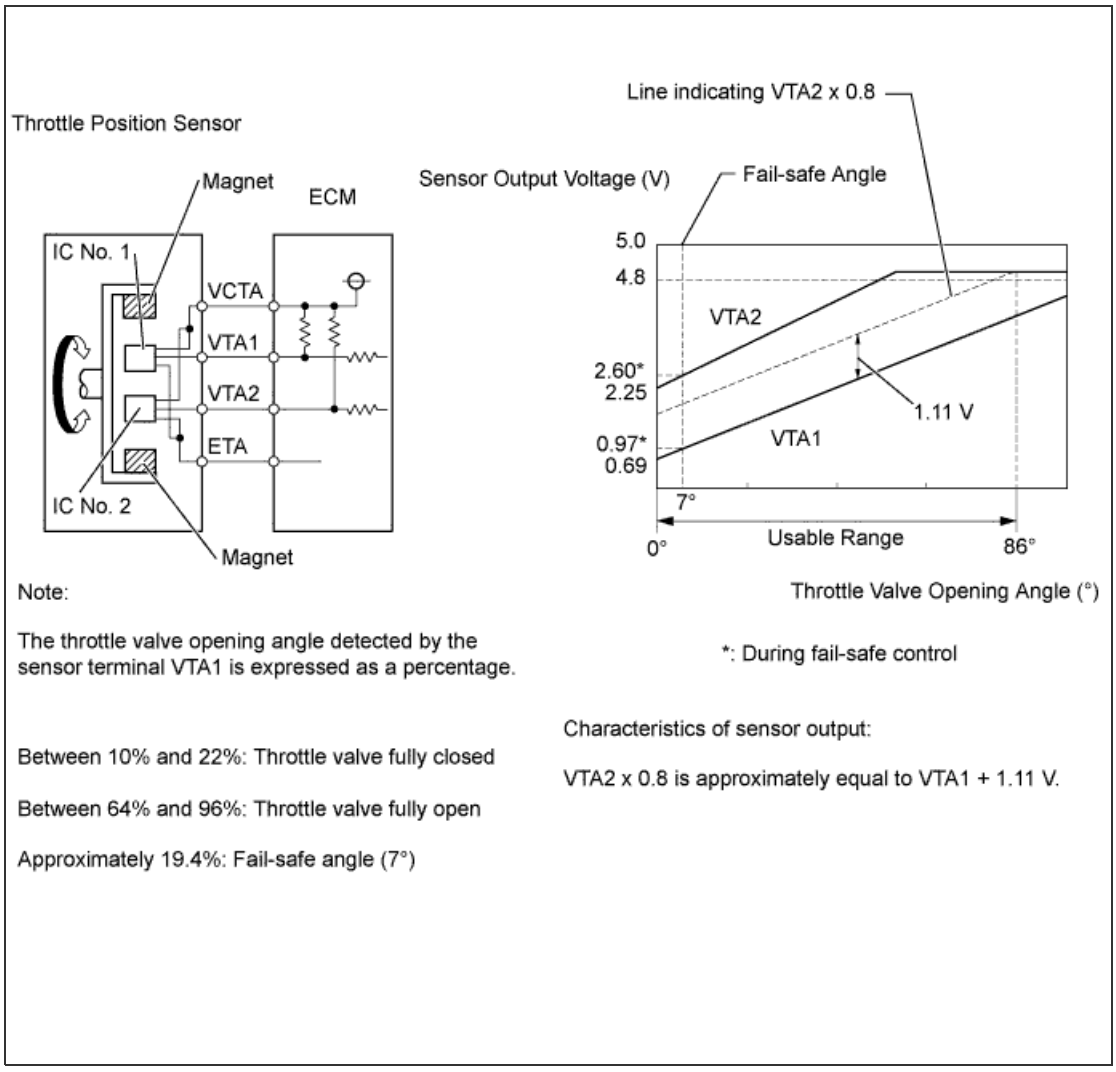
DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

DTC P2135 Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

for Preparation Click here

DESCRIPTION

The TP sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.
The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air-fuel ratio correction, power increase correction and fuel cut control.



DTC Code	DTC Detection Condition	Trouble Area
P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• Throttle Position (TP) sensor (built into throttle body) • ECM

P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.535 V or higher for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher, and VTA1 is between 0.2 V and 2.02 V for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) is met (1 trip detection logic): (a) The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:

- **When any of these DTCs is output, check the throttle valve opening angle by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.**
- **Throttle Position No.1 is the VTA1 signal, and Throttle Position No.2 is the VTA2 signal.**

Reference (Normal Condition):

Display Item	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No.1	0.5 to 1.1 V	3.2 to 4.8 V
Throttle Position No.2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

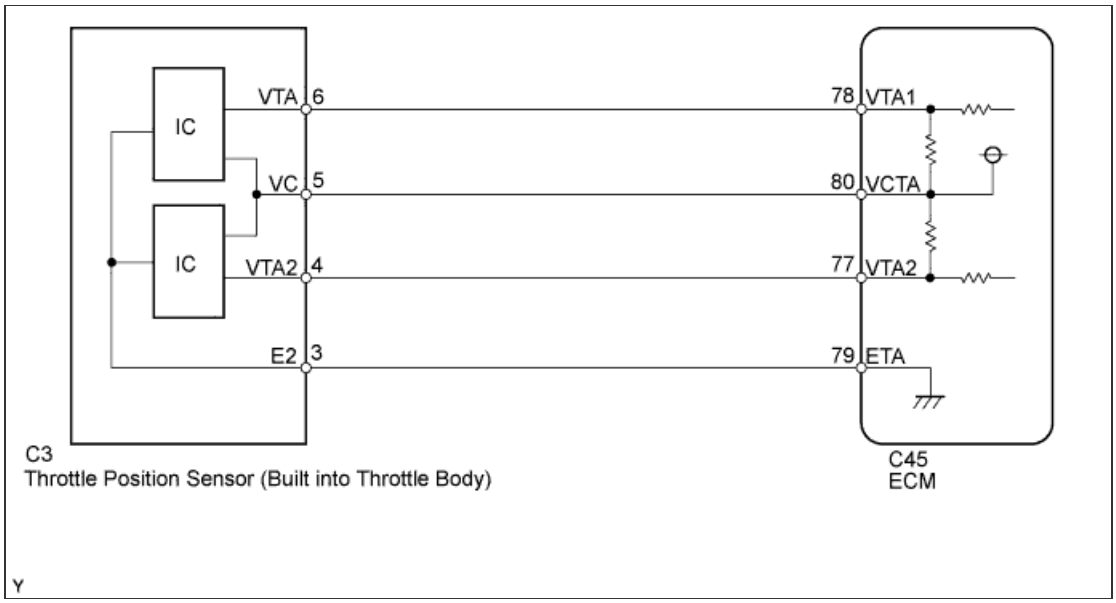
- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor, and stores DTC(s).
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and stores DTC(s).
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and stores DTC(s).

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain Engine and ECT Data List ETCS Throttle Position No.1 and Throttle Position No.2.

d. Check the values displayed on the tester.

Result

TP#1 (VTA1) When Accelerator Pedal Released	TP#2 (VTA2) When Accelerator Pedal Released	TP#1 (VTA1) When Accelerator Pedal Depressed	TP#2 (VTA2) When Accelerator Pedal Depressed	Trouble Area	Proceed to
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	A
0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	VTA1 circuit open or ground short	A
0.6 to 1.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.6 to 1.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	A
0.5 to 1.1 V	2.1 to 3.1 V	3.2 to 4.8 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

TP#1 stands for Throttle Position No. 1, and TP#2 stands for Throttle Position No. 2.

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the C3 throttle body connector.

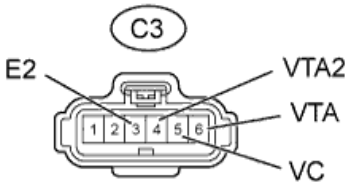
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

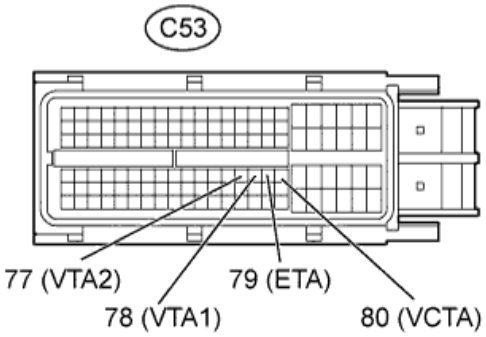
Standard Resistance:

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C45-80 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C45-78 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C45-77 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C45-7 (ETA)	Always	Below 1 Ω
C3-5 (VC) or C45-80 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C45-78 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C45-77 (VTA2) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Throttle Position Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT ECM (VC VOLTAGE)

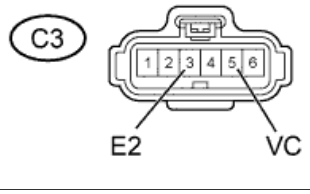
a. Disconnect the C3 throttle body connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C3-5 (VC) - C3-3 (E2)	Engine switch on (I)	4.5 to 5.5 V

Front view of wire harness connector:
(to Throttle Body)



Y

NG → REPLACE ECM (Click here)

OK

4.REPLACE THROTTLE BODY ASSEMBLY

a. Replace the throttle body assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds or more.

f. Enter the following menus: Powertrain Engine and ECT DTC.

g. Read DTCs.

Result

Result	Proceed to
P0120, P0122, P0123, P0220, P0222, P0223 and or P2135 are output	A
No DTC is output	B

B → **SYSTEM OK**

A → **REPLACE ECM (Click here)**

DTC P1340 Camshaft Position Sensor "A" (Bank 1 Sensor 2)

DTC P1342 Camshaft Position Sensor "A" Low Input (MRE)

DTC P1343 Camshaft Position Sensor "A" High Input (MRE)

for Preparation Click here

DESCRIPTION

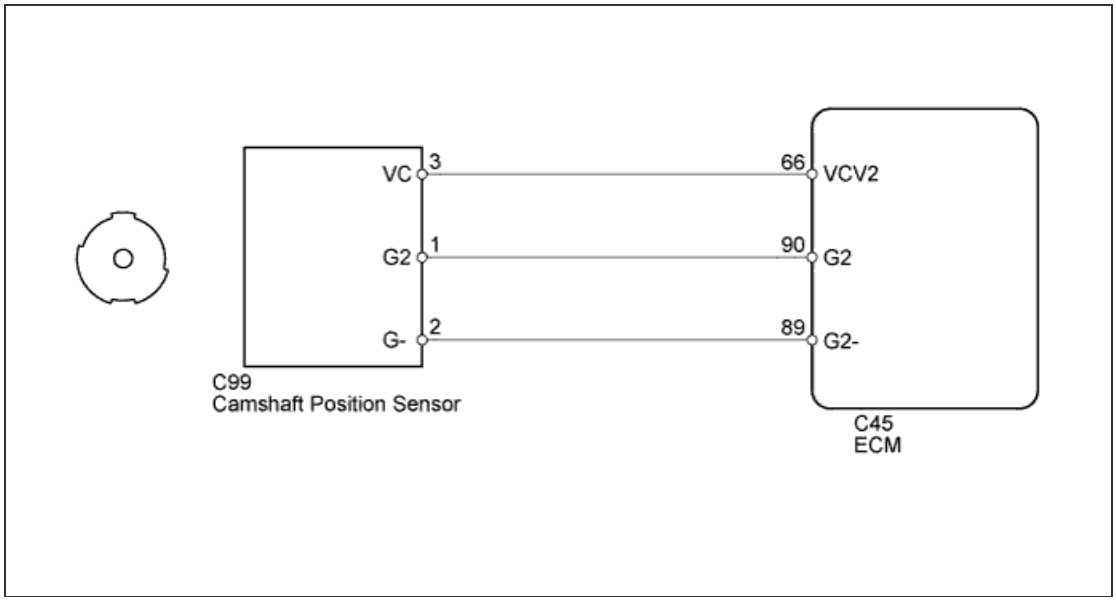
The camshaft position sensor (G signal) consists of a magnet and MRE (Magnetic Resistance Element).
The camshaft drive gear (LH) has 3 teeth on its inner circumference. When the camshaft gear rotates, air gap changes between the protrusion on the teeth and the MRE. The change affects the magnetic field and results in changes in the resistance of the MRE.
The crankshaft position sensor plate has 34 teeth and is installed to the rear end of the crankshaft. The crankshaft position sensor generates 34 signals with every revolution. The ECM detects the standard crankshaft angle based on the G signal, and the actual crankshaft angle and engine speed by the NE signal.

DTC Code	DTC Detection Condition	Trouble Area
P1340	No camshaft position sensor signal is sent to the ECM during cranking (2 trip detection logic).	• Open or short in camshaft position sensor circuit • Camshaft position sensor • Camshaft timing plate LH • ECM
	No camshaft position sensor signal is sent to the ECM with an engine speed of 600 rpm or more.	
P1342	The output voltage of the camshaft position sensor is below 0.3 V for 4 seconds (1 trip detection logic).	
P1343	The output voltage of the camshaft position sensor is higher than 4.7 V for 4 seconds (1 trip detection logic).	

MONITOR DESCRIPTION

The camshaft position sensor (G signal) consists of a magnet and MRE.
The camshaft drive gear has 3 teeth on its inner circumference. When the camshaft gear rotates, air gap changes between the protrusion on the gear and the MRE. The change affects the magnetic field and results in changes in the resistance of the MRE. The crankshaft position sensor plate has 34 teeth and outputs 34 signals with every revolution. The ECM detects the standard crankshaft angle based on the G signal, and the actual crankshaft angle and engine speed by the NE signal.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

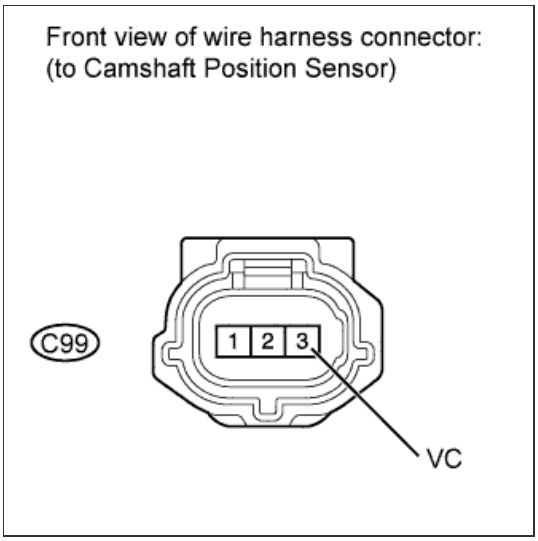
1.INSPECT CAMSHAFT POSITION SENSOR (SENSOR POWER SOURCE)

a. Disconnect the C99 camshaft position sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C99-3 (VC) - Body ground	Engine switch on (IG)	4.5 to 5.0 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (ECM - CAMSHAFT POSITION SENSOR)

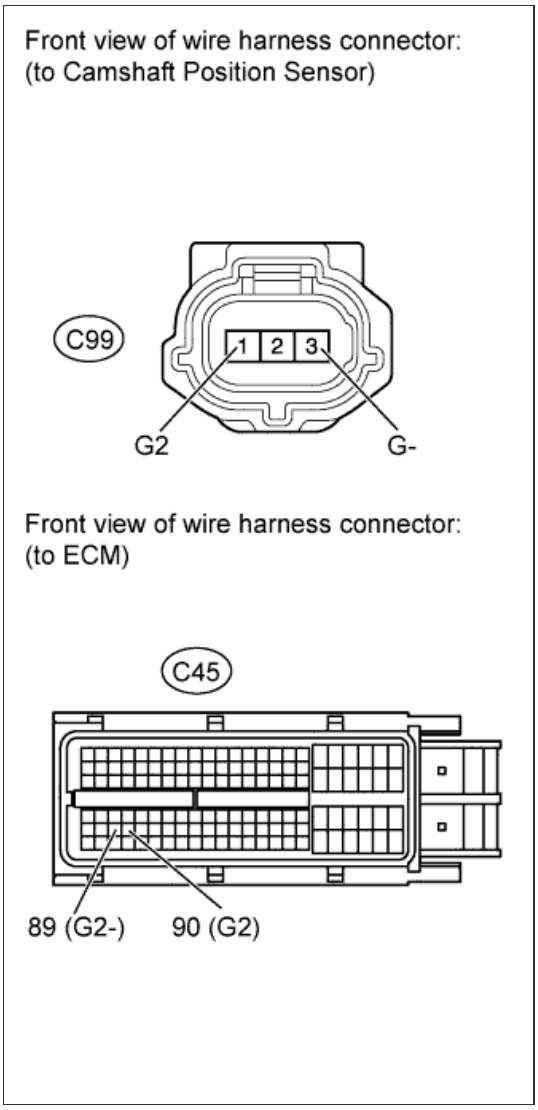
a. Disconnect the C99 camshaft position sensor connector.

b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C99-1 (G2) - C45-90 (G2)	Always	Below 1 Ω
C99-2 (G-) - C45-89 (G2-)	Always	Below 1 Ω
C99-1 (G2) or C45-90 (G2) - Body ground	Always	10 kΩ or higher
C99-2 (G-) or C45-89 (G2-) - Body ground	Always	10 kΩ or higher



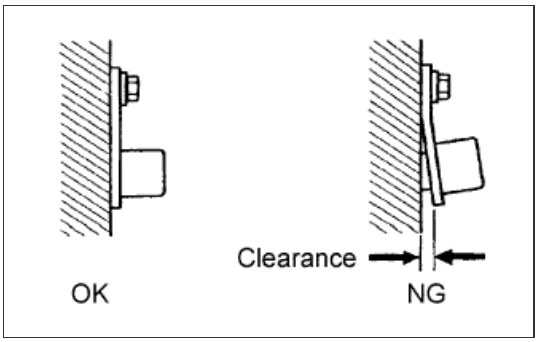
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT SENSOR INSTALLATION

a. Check the camshaft position sensor installation.

OK:
The camshaft position sensor is installed properly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

4.INSPECT CAMSHAFT TIMING PLATE (SIGNAL PLATE TOOTH)

a. Check the teeth of the signal plate.

OK:
Sensor plate teeth do not have any cracks or deformation.

NG → REPLACE CAMSHAFT TIMING PLATE (Click here)

OK

5.REPLACE CAMSHAFT POSITION SENSOR

a. Replace the camshaft position sensor (Click here).

NEXT

6.CONFIRM WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P1340, P1342 and/or P1343 are output	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

DTC P0120 Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0220 Throttle / Pedal Position Sensor / Switch "B" Circuit

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

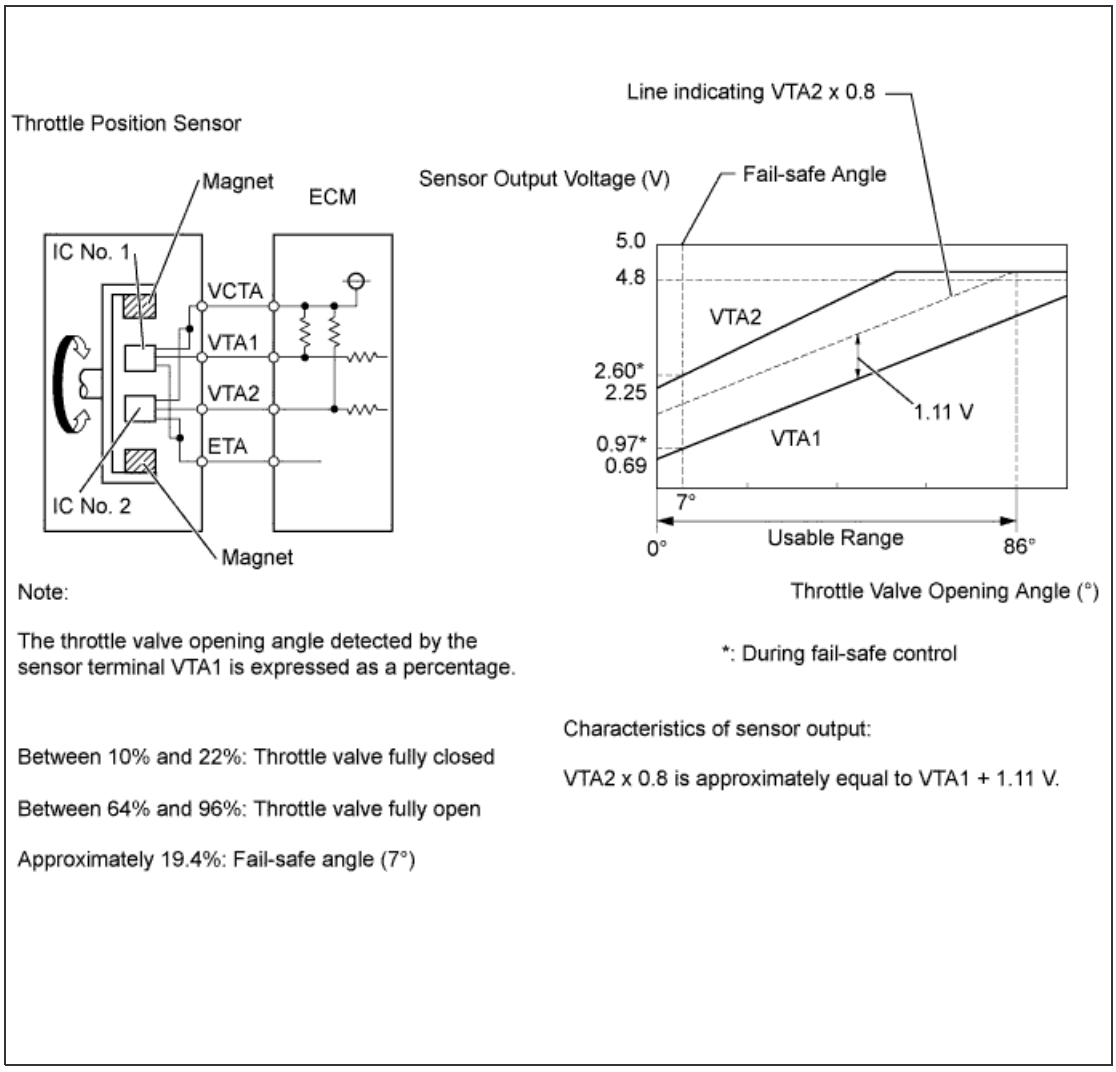
DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

DTC P2135 Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

for Preparation Click here

DESCRIPTION

The TP sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.
The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air-fuel ratio correction, power increase correction and fuel cut control.



DTC Code	DTC Detection Condition	Trouble Area
P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• Throttle Position (TP) sensor (built into throttle body) • ECM

P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.535 V or higher for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher, and VTA1 is between 0.2 V and 2.02 V for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) is met (1 trip detection logic): (a) The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:

- **When any of these DTCs is output, check the throttle valve opening angle by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.**
- **Throttle Position No.1 is the VTA1 signal, and Throttle Position No.2 is the VTA2 signal.**

Reference (Normal Condition):

Display Item	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No.1	0.5 to 1.1 V	3.2 to 4.8 V
Throttle Position No.2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

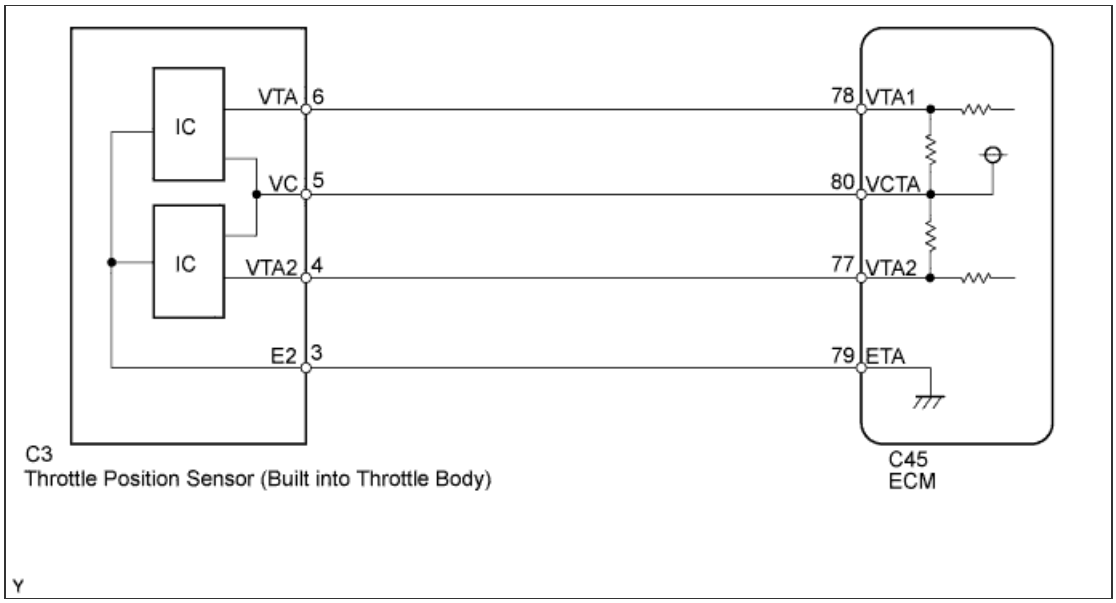
- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor, and stores DTC(s).
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and stores DTC(s).
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and stores DTC(s).

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain Engine and ECT Data List ETCS Throttle Position No.1 and Throttle Position No.2.

d. Check the values displayed on the tester.

Result

TP#1 (VTA1) When Accelerator Pedal Released	TP#2 (VTA2) When Accelerator Pedal Released	TP#1 (VTA1) When Accelerator Pedal Depressed	TP#2 (VTA2) When Accelerator Pedal Depressed	Trouble Area	Proceed to
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	A
0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	VTA1 circuit open or ground short	A
0.6 to 1.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.6 to 1.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	A
0.5 to 1.1 V	2.1 to 3.1 V	3.2 to 4.8 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

TP#1 stands for Throttle Position No. 1, and TP#2 stands for Throttle Position No. 2.

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the C3 throttle body connector.

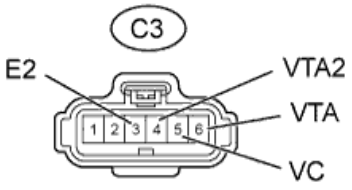
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

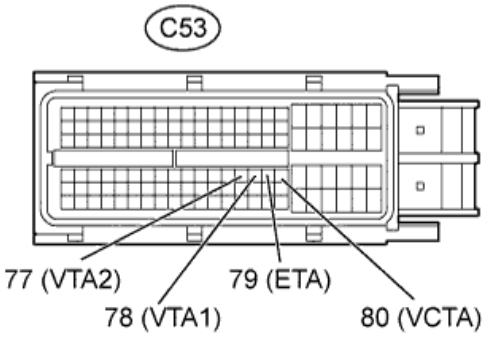
Standard Resistance:

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C45-80 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C45-78 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C45-77 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C45-7 (ETA)	Always	Below 1 Ω
C3-5 (VC) or C45-80 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C45-78 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C45-77 (VTA2) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Throttle Position Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT ECM (VC VOLTAGE)

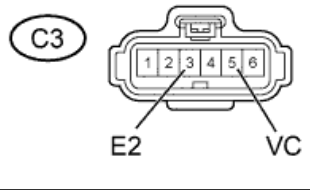
a. Disconnect the C3 throttle body connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C3-5 (VC) - C3-3 (E2)	Engine switch on (I)	4.5 to 5.5 V

Front view of wire harness connector:
(to Throttle Body)



Y

NG → REPLACE ECM (Click here)

OK

4.REPLACE THROTTLE BODY ASSEMBLY

a. Replace the throttle body assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds or more.

f. Enter the following menus: Powertrain Engine and ECT DTC.

g. Read DTCs.

Result

Result	Proceed to
P0120, P0122, P0123, P0220, P0222, P0223 and or P2135 are output	A
No DTC is output	B

B → SYSTEM OK

A → REPLACE ECM (**Click here**)

DTC P1340 Camshaft Position Sensor "A" (Bank 1 Sensor 2)

DTC P1342 Camshaft Position Sensor "A" Low Input (MRE)

DTC P1343 Camshaft Position Sensor "A" High Input (MRE)

for Preparation Click here

DESCRIPTION

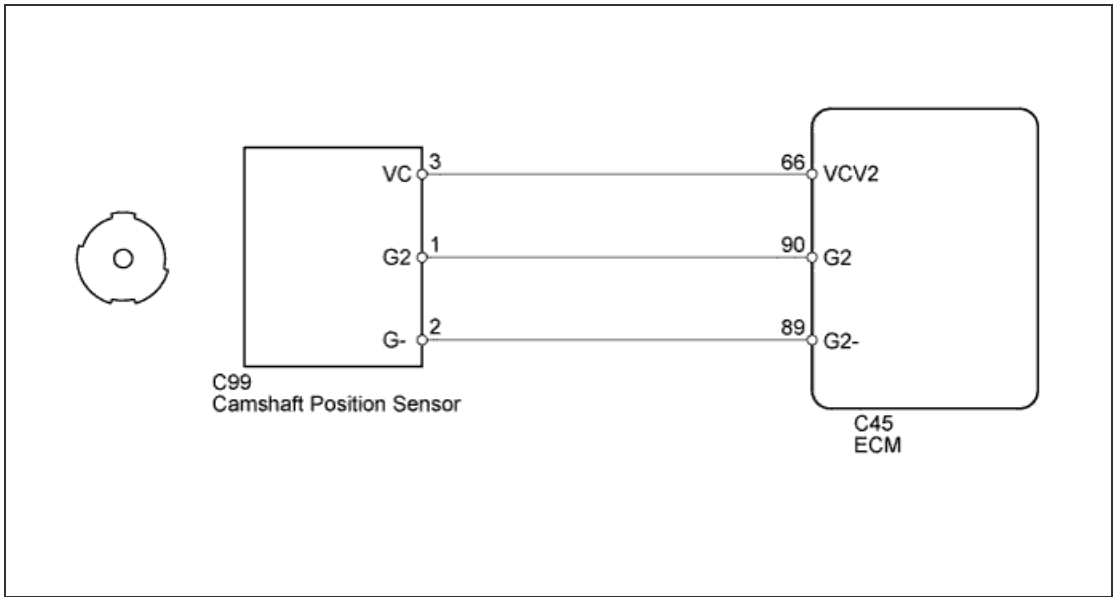
The camshaft position sensor (G signal) consists of a magnet and MRE (Magnetic Resistance Element).
The camshaft drive gear (LH) has 3 teeth on its inner circumference. When the camshaft gear rotates, air gap changes between the protrusion on the teeth and the MRE. The change affects the magnetic field and results in changes in the resistance of the MRE.
The crankshaft position sensor plate has 34 teeth and is installed to the rear end of the crankshaft. The crankshaft position sensor generates 34 signals with every revolution. The ECM detects the standard crankshaft angle based on the G signal, and the actual crankshaft angle and engine speed by the NE signal.

DTC Code	DTC Detection Condition	Trouble Area
P1340	No camshaft position sensor signal is sent to the ECM during cranking (2 trip detection logic).	• Open or short in camshaft position sensor circuit • Camshaft position sensor • Camshaft timing plate LH • ECM
	No camshaft position sensor signal is sent to the ECM with an engine speed of 600 rpm or more.	
P1342	The output voltage of the camshaft position sensor is below 0.3 V for 4 seconds (1 trip detection logic).	
P1343	The output voltage of the camshaft position sensor is higher than 4.7 V for 4 seconds (1 trip detection logic).	

MONITOR DESCRIPTION

The camshaft position sensor (G signal) consists of a magnet and MRE.
The camshaft drive gear has 3 teeth on its inner circumference. When the camshaft gear rotates, air gap changes between the protrusion on the gear and the MRE. The change affects the magnetic field and results in changes in the resistance of the MRE. The crankshaft position sensor plate has 34 teeth and outputs 34 signals with every revolution. The ECM detects the standard crankshaft angle based on the G signal, and the actual crankshaft angle and engine speed by the NE signal.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

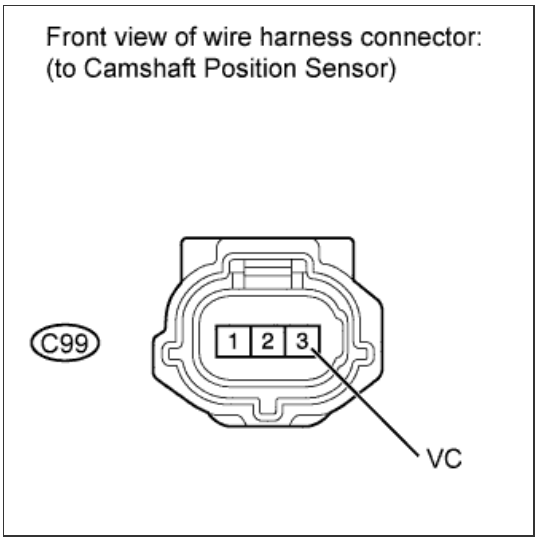
1.INSPECT CAMSHAFT POSITION SENSOR (SENSOR POWER SOURCE)

a. Disconnect the C99 camshaft position sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C99-3 (VC) - Body ground	Engine switch on (IG)	4.5 to 5.0 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (ECM - CAMSHAFT POSITION SENSOR)

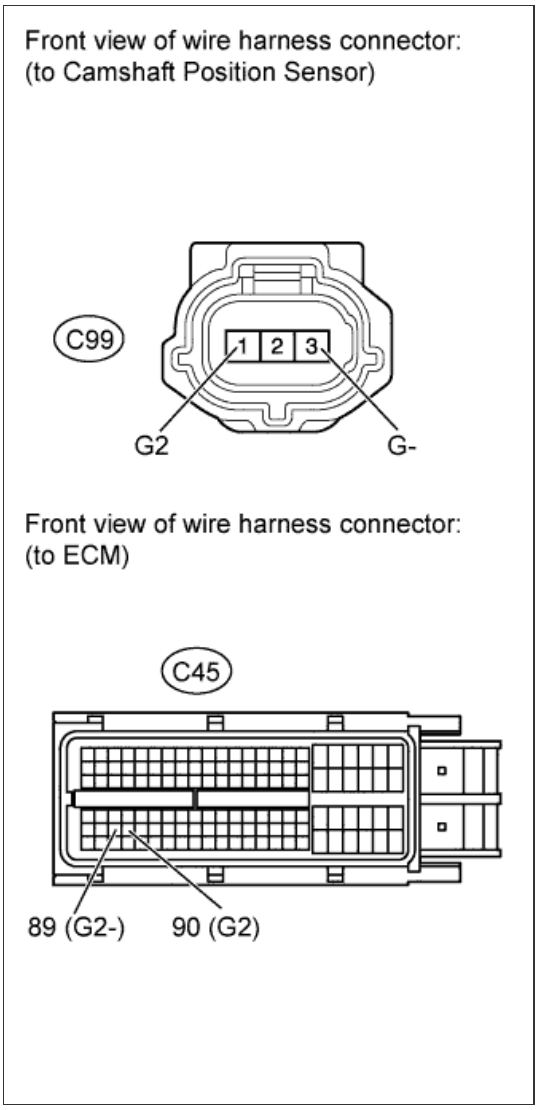
a. Disconnect the C99 camshaft position sensor connector.

b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C99-1 (G2) - C45-90 (G2)	Always	Below 1 Ω
C99-2 (G-) - C45-89 (G2-)	Always	Below 1 Ω
C99-1 (G2) or C45-90 (G2) - Body ground	Always	10 kΩ or higher
C99-2 (G-) or C45-89 (G2-) - Body ground	Always	10 kΩ or higher



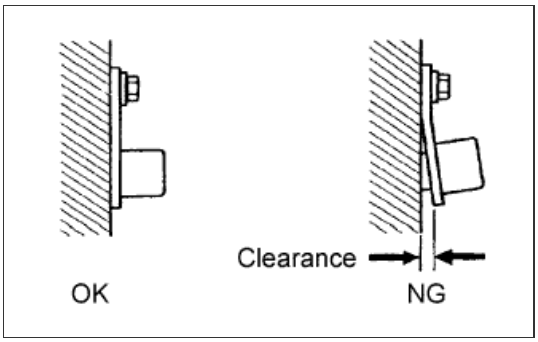
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT SENSOR INSTALLATION

a. Check the camshaft position sensor installation.

OK:
The camshaft position sensor is installed properly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

4.INSPECT CAMSHAFT TIMING PLATE (SIGNAL PLATE TOOTH)

a. Check the teeth of the signal plate.

OK:
Sensor plate teeth do not have any cracks or deformation.

NG → REPLACE CAMSHAFT TIMING PLATE (Click here)

OK

5.REPLACE CAMSHAFT POSITION SENSOR

a. Replace the camshaft position sensor (Click here).

NEXT

6.CONFIRM WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P1340, P1342 and/or P1343 are output	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

DTC P0120 Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0220 Throttle / Pedal Position Sensor / Switch "B" Circuit

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

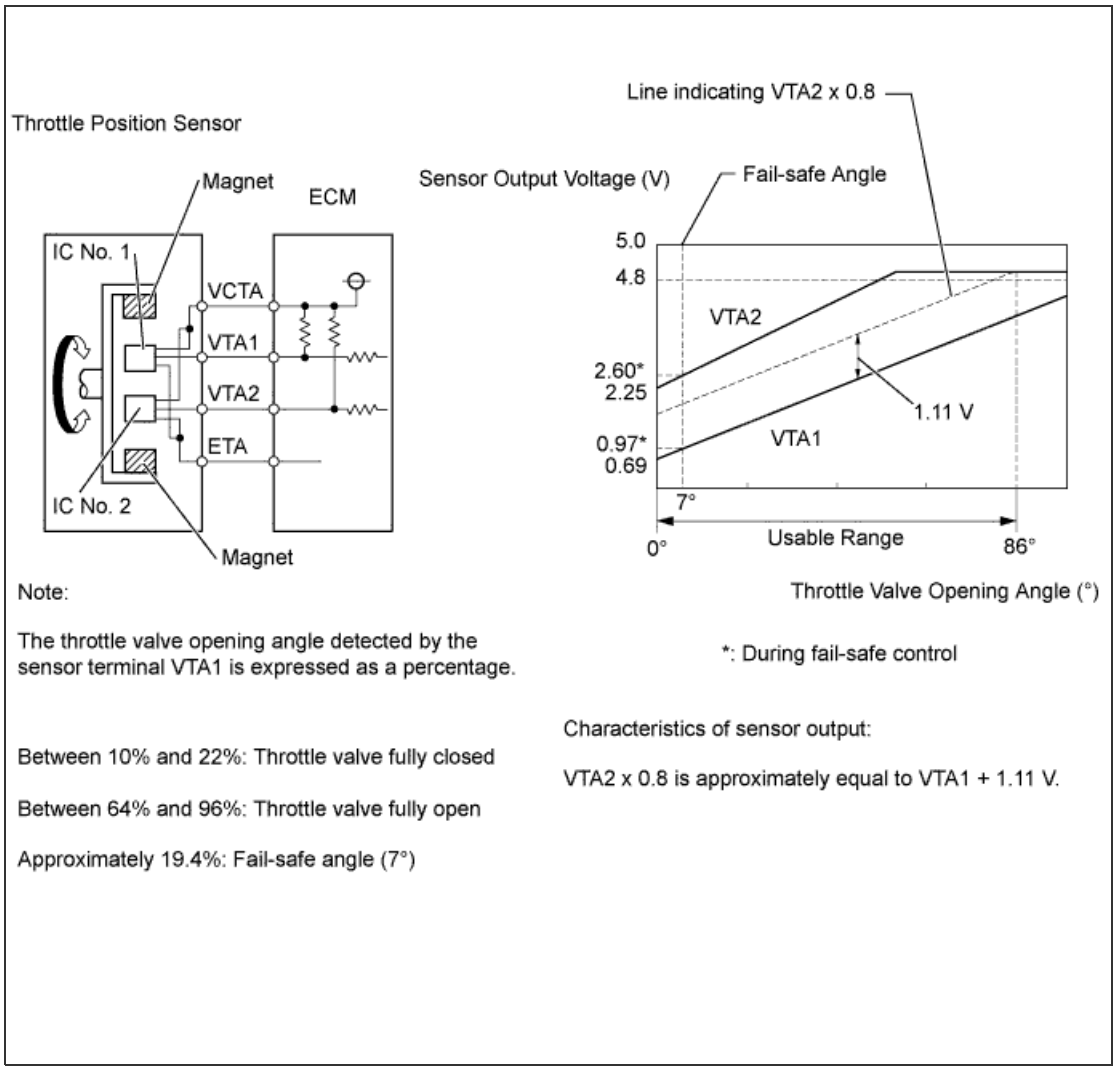
DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

DTC P2135 Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

for Preparation Click here

DESCRIPTION

The TP sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.
The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air-fuel ratio correction, power increase correction and fuel cut control.



DTC Code	DTC Detection Condition	Trouble Area
P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• Throttle Position (TP) sensor (built into throttle body) • ECM

P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.535 V or higher for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher, and VTA1 is between 0.2 V and 2.02 V for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) is met (1 trip detection logic): (a) The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:

- **When any of these DTCs is output, check the throttle valve opening angle by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.**
- **Throttle Position No.1 is the VTA1 signal, and Throttle Position No.2 is the VTA2 signal.**

Reference (Normal Condition):

Display Item	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No.1	0.5 to 1.1 V	3.2 to 4.8 V
Throttle Position No.2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

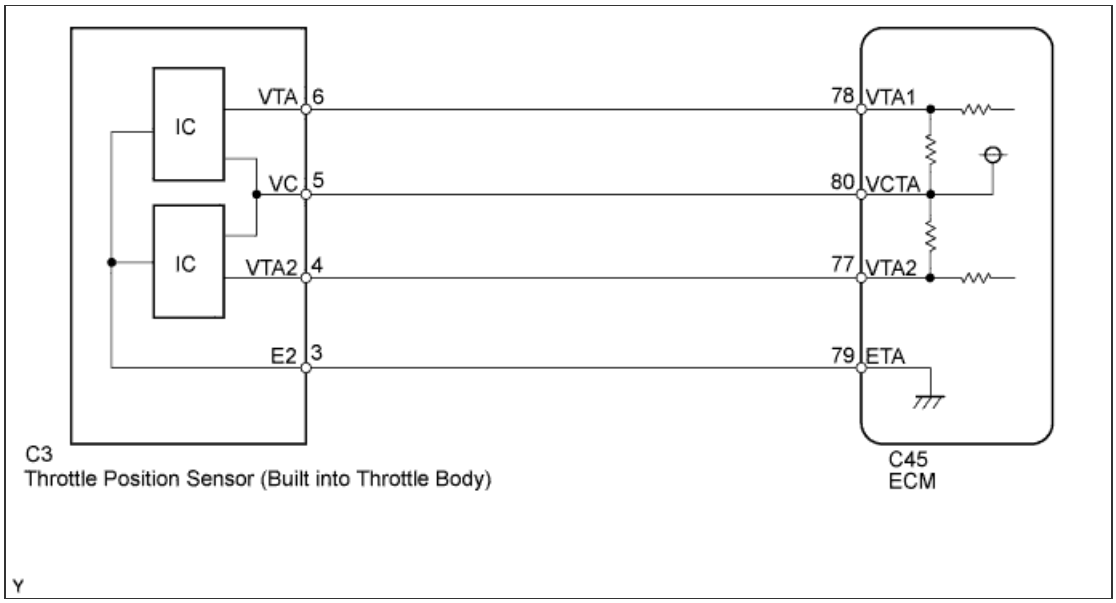
- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor, and stores DTC(s).
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and stores DTC(s).
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and stores DTC(s).

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain Engine and ECT Data List ETCS Throttle Position No.1 and Throttle Position No.2.

d. Check the values displayed on the tester.

Result

TP#1 (VTA1) When Accelerator Pedal Released	TP#2 (VTA2) When Accelerator Pedal Released	TP#1 (VTA1) When Accelerator Pedal Depressed	TP#2 (VTA2) When Accelerator Pedal Depressed	Trouble Area	Proceed to
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	A
0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.1 to 3.1 V (Fail-safe)	VTA1 circuit open or ground short	A
0.6 to 1.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.6 to 1.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	A
0.5 to 1.1 V	2.1 to 3.1 V	3.2 to 4.8 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

TP#1 stands for Throttle Position No. 1, and TP#2 stands for Throttle Position No. 2.

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the C3 throttle body connector.

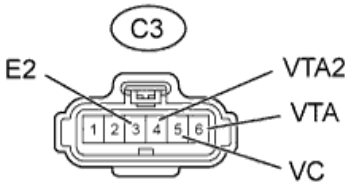
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

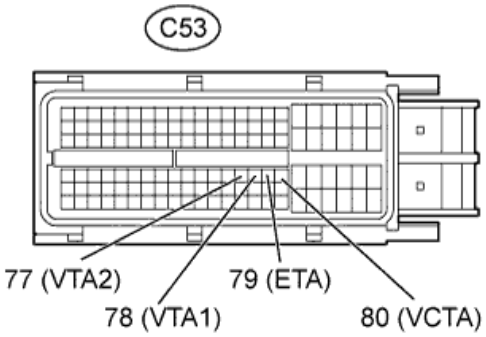
Standard Resistance:

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C45-80 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C45-78 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C45-77 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C45-7 (ETA)	Always	Below 1 Ω
C3-5 (VC) or C45-80 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C45-78 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C45-77 (VTA2) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Throttle Position Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT ECM (VC VOLTAGE)

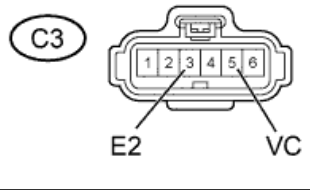
a. Disconnect the C3 throttle body connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C3-5 (VC) - C3-3 (E2)	Engine switch on (I)	4.5 to 5.5 V

Front view of wire harness connector:
(to Throttle Body)



Y

NG → REPLACE ECM (Click here)

OK

4.REPLACE THROTTLE BODY ASSEMBLY

a. Replace the throttle body assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds or more.

f. Enter the following menus: Powertrain Engine and ECT DTC.

g. Read DTCs.

Result

Result	Proceed to
P0120, P0122, P0123, P0220, P0222, P0223 and or P2135 are output	A
No DTC is output	B

B → SYSTEM OK

A → REPLACE ECM (**Click here**)

DTC P1340 Camshaft Position Sensor "A" (Bank 1 Sensor 2)

DTC P1342 Camshaft Position Sensor "A" Low Input (MRE)

DTC P1343 Camshaft Position Sensor "A" High Input (MRE)

for Preparation Click here

DESCRIPTION

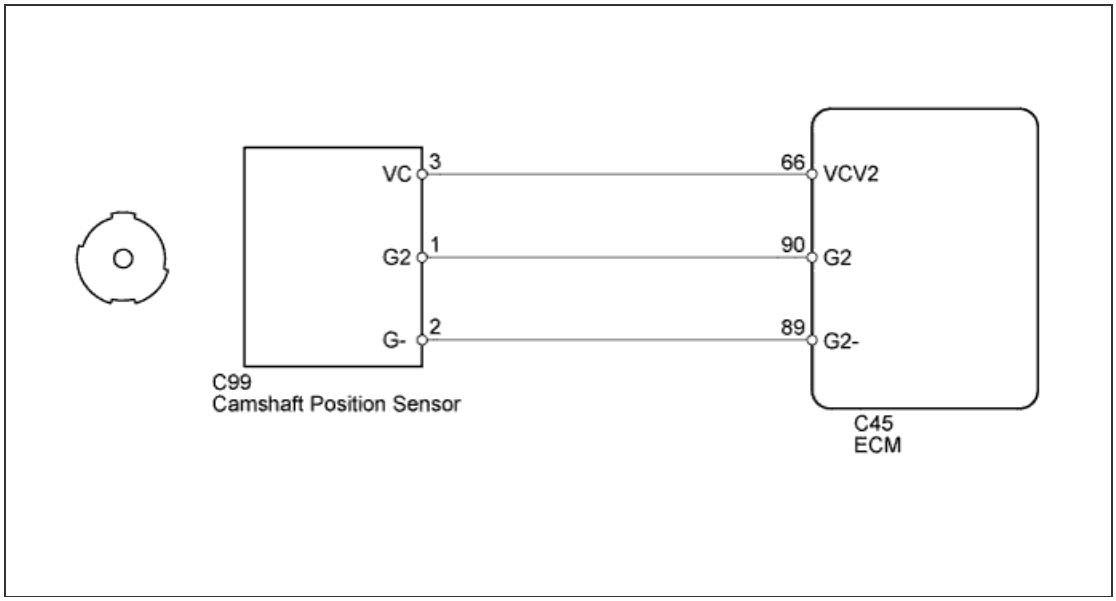
The camshaft position sensor (G signal) consists of a magnet and MRE (Magnetic Resistance Element).
The camshaft drive gear (LH) has 3 teeth on its inner circumference. When the camshaft gear rotates, air gap changes between the protrusion on the teeth and the MRE. The change affects the magnetic field and results in changes in the resistance of the MRE.
The crankshaft position sensor plate has 34 teeth and is installed to the rear end of the crankshaft. The crankshaft position sensor generates 34 signals with every revolution. The ECM detects the standard crankshaft angle based on the G signal, and the actual crankshaft angle and engine speed by the NE signal.

DTC Code	DTC Detection Condition	Trouble Area
P1340	No camshaft position sensor signal is sent to the ECM during cranking (2 trip detection logic).	• Open or short in camshaft position sensor circuit • Camshaft position sensor • Camshaft timing plate LH • ECM
	No camshaft position sensor signal is sent to the ECM with an engine speed of 600 rpm or more.	
P1342	The output voltage of the camshaft position sensor is below 0.3 V for 4 seconds (1 trip detection logic).	
P1343	The output voltage of the camshaft position sensor is higher than 4.7 V for 4 seconds (1 trip detection logic).	

MONITOR DESCRIPTION

The camshaft position sensor (G signal) consists of a magnet and MRE.
The camshaft drive gear has 3 teeth on its inner circumference. When the camshaft gear rotates, air gap changes between the protrusion on the gear and the MRE. The change affects the magnetic field and results in changes in the resistance of the MRE. The crankshaft position sensor plate has 34 teeth and outputs 34 signals with every revolution. The ECM detects the standard crankshaft angle based on the G signal, and the actual crankshaft angle and engine speed by the NE signal.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

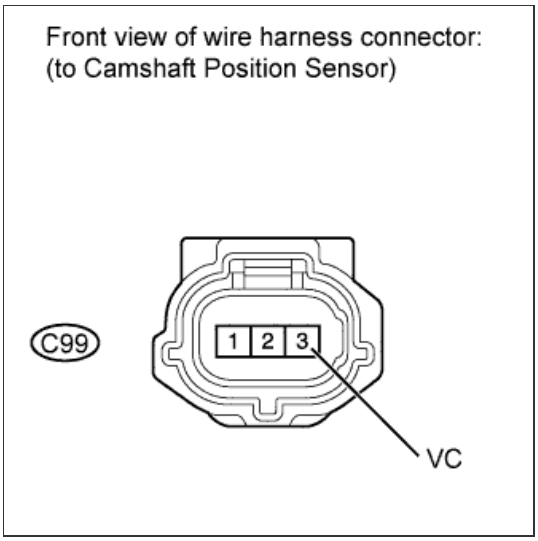
1.INSPECT CAMSHAFT POSITION SENSOR (SENSOR POWER SOURCE)

a. Disconnect the C99 camshaft position sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C99-3 (VC) - Body ground	Engine switch on (IG)	4.5 to 5.0 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (ECM - CAMSHAFT POSITION SENSOR)

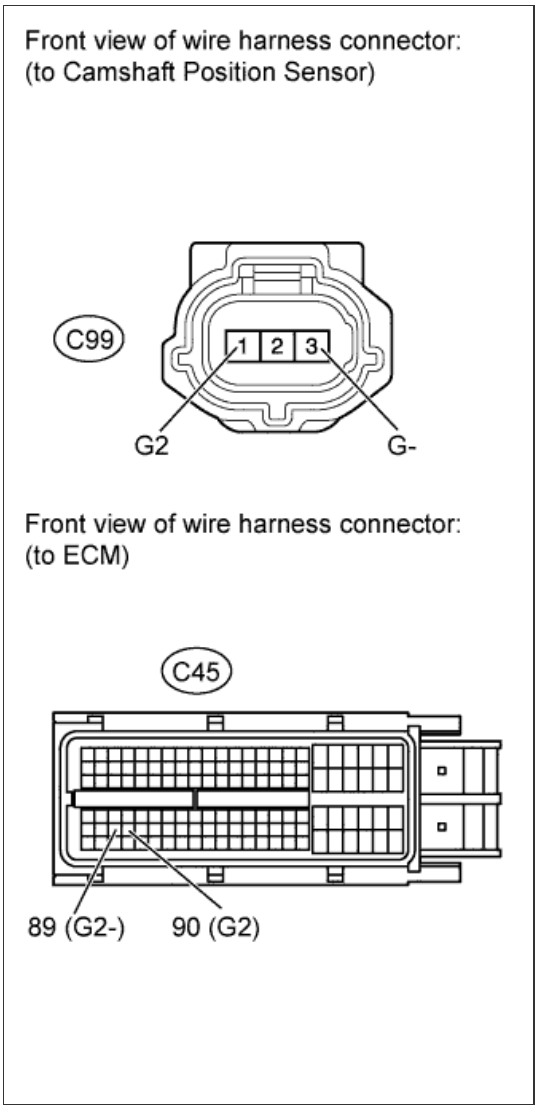
a. Disconnect the C99 camshaft position sensor connector.

b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C99-1 (G2) - C45-90 (G2)	Always	Below 1 Ω
C99-2 (G-) - C45-89 (G2-)	Always	Below 1 Ω
C99-1 (G2) or C45-90 (G2) - Body ground	Always	10 kΩ or higher
C99-2 (G-) or C45-89 (G2-) - Body ground	Always	10 kΩ or higher



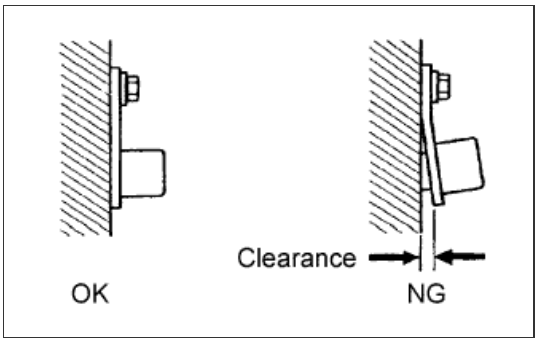
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT SENSOR INSTALLATION

a. Check the camshaft position sensor installation.

OK:
The camshaft position sensor is installed properly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

4.INSPECT CAMSHAFT TIMING PLATE (SIGNAL PLATE TOOTH)

a. Check the teeth of the signal plate.

OK:
Sensor plate teeth do not have any cracks or deformation.

NG → REPLACE CAMSHAFT TIMING PLATE (Click here)

OK

5.REPLACE CAMSHAFT POSITION SENSOR

a. Replace the camshaft position sensor (Click here).

NEXT

6.CONFIRM WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P1340, P1342 and/or P1343 are output	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

DTC P0121 Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem

for Preparation Click here

DESCRIPTION

Refer to DTC P0120 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P0121	The difference between the VTA1 and VTA2 voltages is below 0.8 V, or higher than 1.6 V for 2 seconds (1 trip detection logic).	Throttle Position (TP) sensor (built into throttle body)

MONITOR DESCRIPTION

The ECM uses the TP sensor to monitor the throttle valve opening angle.
This sensor transmits two signals: VTA1 and VTA2. VTA1 is used to detect the throttle opening angle and VTA2 is used to detect malfunctions in VTA1.
The ECM performs several checks to confirm the proper operation of the TP sensor and VTA1.
For each throttle opening angle, a specific voltage difference is expected between the outputs of VTA1 and VTA2. If the output voltage difference between the two signals deviates from the normal operating range, the ECM interprets this as a malfunction of the TP sensor. The ECM illuminates the MIL and stores the DTC.
If the malfunction is not repaired successfully, the DTC is stored 2 seconds after the engine is next started.

FAIL-SAFE

When this DTC, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

INSPECTION PROCEDURE

HINT:

- **This DTC relates to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0121)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0121 is output	A
P0121 and other DTCs are output	B

B → GO TO DTC CHART (Click here)

A → REPLACE THROTTLE BODY ASSEMBLY (Click here)

DTC P1607 Cruise Control Input Processor

for Preparation Click here

DESCRIPTION

The ECM continuously monitors its main and sub CPUs. This self-check ensures that the ECM is functioning properly. If outputs from the CPUs are different and deviate from the standard, the ECM will illuminate the MIL and store DTC(s) immediately.

DTC Code	DTC Detection Condition	Trouble Area
P1	heTECM CPUs malfunction.	ECM

INSPECTION PROCEDURE

1.CHECK DTC

a. Clear DTC (Click here).

b. Turn the engine switch off.

c. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

d. Connect the cable to the negative (-) battery terminal.

e. Turn the engine switch on (I

f. Check DTC.

OK:
P1607 is not output.

NG → **REPLACE ECM (Click here)**

OK ↓

CHECK FOR INTERMITTENT PROBLEMS (Click here)

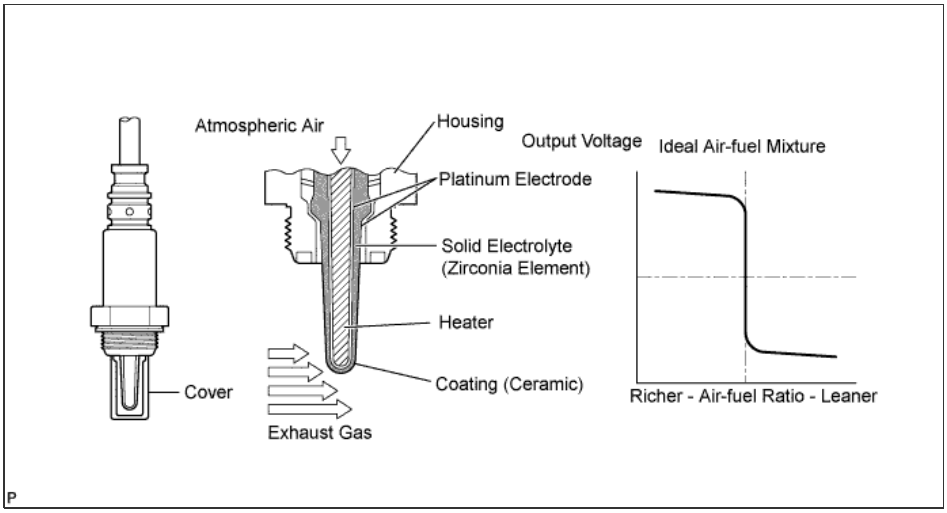
DTC P0137 Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)

DTC P0157 Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)

for Preparation Click here

DESCRIPTION

In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric air-fuel ratio. For the purpose of helping the ECM to deliver accurate air-fuel ratio control, a Heated Oxygen (HO2) sensor is used.
The HO2 sensor is located behind the TWC, and detects the oxygen concentration in the exhaust gas. Since the sensor is integrated with the heater that heats the sensing portion, it is possible to detect the oxygen concentration even when the intake air volume is low (the exhaust gas temperature is low).
When the air-fuel ratio becomes lean, the oxygen concentration in the exhaust gas is rich. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is lean (low voltage, i.e. below 0.45 V).
Conversely, when the air-fuel ratio is richer than the stoichiometric air-fuel ratio, the oxygen concentration in the exhaust gas becomes lean. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is rich (high voltage, i.e. higher than 0.45 V). The HO2 sensor has the property of changing its output voltage drastically when the air-fuel ratio is close to the stoichiometric level.
The ECM uses the supplementary information from the HO2 sensor to determine whether the air-fuel ratio after the TWC is rich or lean, and adjusts the fuel injection time accordingly. Thus, if the HO2 sensor is working improperly due to internal malfunctions, the ECM is unable to compensate for deviations in the primary air-fuel ratio control.



DTC Code	DTC Detection Condition	Trouble Area
P0137 P0157	Low voltage (open): During active air-fuel ratio control, the following conditions (a) and (b) are met for a certain period of time (2 trip detection logic): 1. The HO2 sensor voltage output is below 0.21 V. 2. The target air-fuel ratio is rich.	• Open in HO2 sensor (for Bank 1, 2) circuit • HO2 sensor (for Bank 1, 2) • HO2 sensor heater (for Bank 1, 2) • Integration relay • Gas leakage from exhaust system

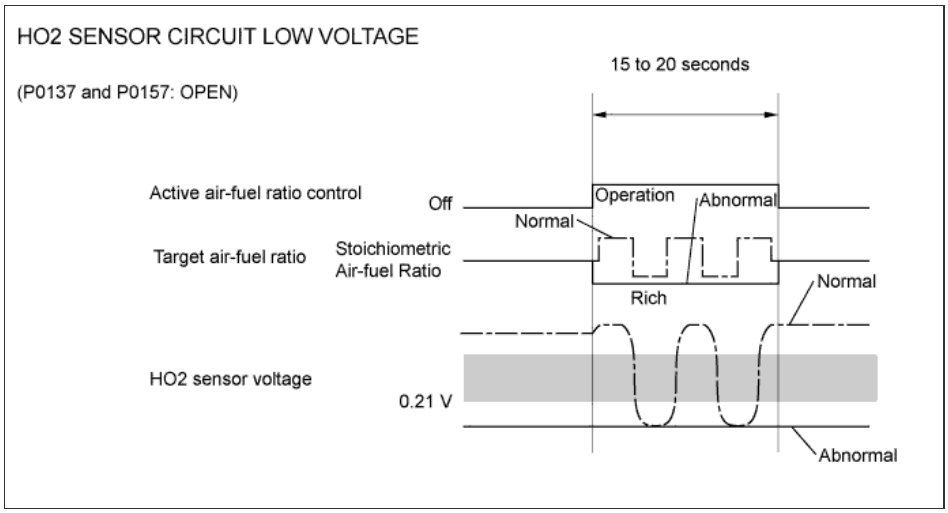
MONITOR DESCRIPTION

Active Air-Fuel Ratio Control

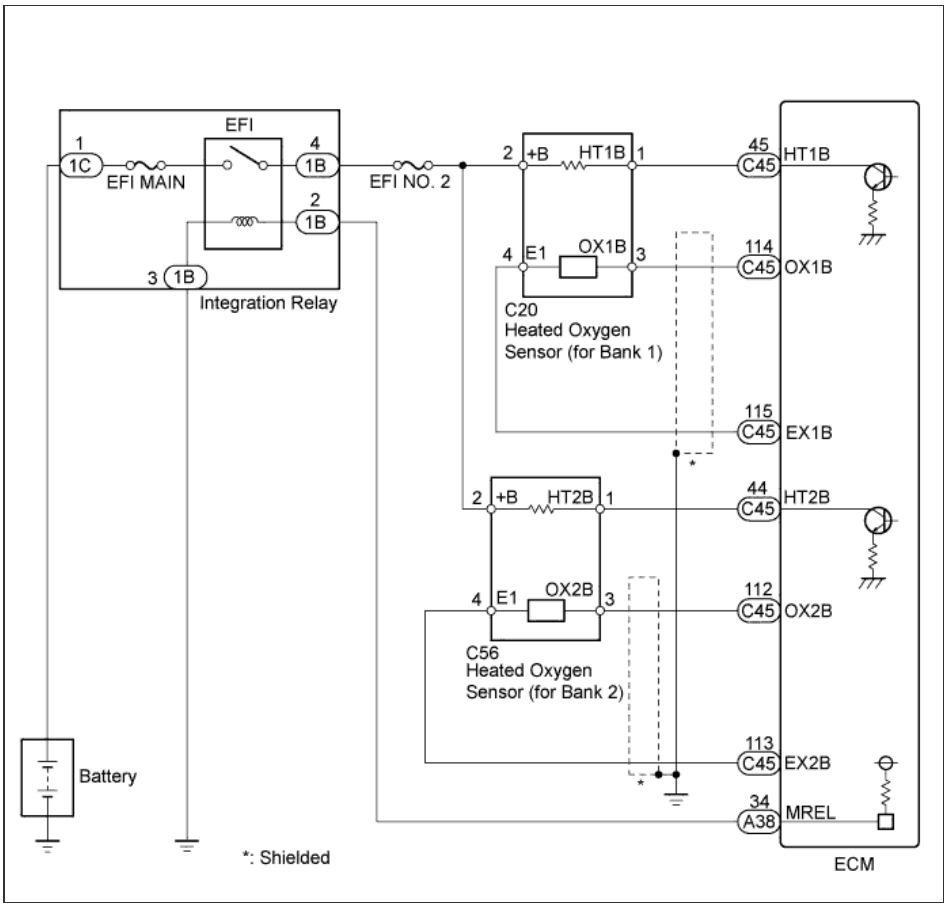
The ECM usually performs air-fuel ratio feedback control so that the Air Fuel ratio (A/F) sensor output indicates a near stoichiometric air-fuel ratio. This vehicle includes active air-fuel ratio control in addition to regular air-fuel ratio control. The ECM performs active air-fuel ratio control to detect any deterioration in the Three-Way Catalytic Converter (TWC) and Heated Oxygen (HO2) sensor malfunctions (refer to the diagram below).
Active air-fuel ratio control is performed for approximately 15 to 20 seconds while driving with a warm engine. During active air-fuel ratio control, the air-fuel ratio is forcibly regulated to become lean or rich by the ECM. If the ECM detects a malfunction, a DTC is stored.

Open or Short in Heated Oxygen (HO2) Sensor Circuit (DTC P0137 and P0157)

During active air-fuel ratio control, the ECM calculates the Oxygen Storage Capacity (OSC)* of the Three-Way Catalytic Converter (TWC) by forcibly regulating the air-fuel ratio to become rich or lean. If the HO2 sensor has an open or short, or the voltage output of the sensor decreases significantly, the OSC indicates an extraordinarily high value. Even if the ECM attempts to continue regulating the air-fuel ratio to become rich or lean, the HO2 sensor output does not change.
While performing active air-fuel ratio control, when the target air-fuel ratio is rich and the HO2 sensor voltage output is 0.21 V or less (lean), the ECM interprets this as an abnormally low sensor output voltage and stores DTC P0137 or P0157.
*: The TWC has the capability to store oxygen. The OSC and the emission purification capacity of the TWC are mutually related. The ECM determines whether the catalyst has deteriorated based on the calculated OSC value.



WIRING DIAGRAM



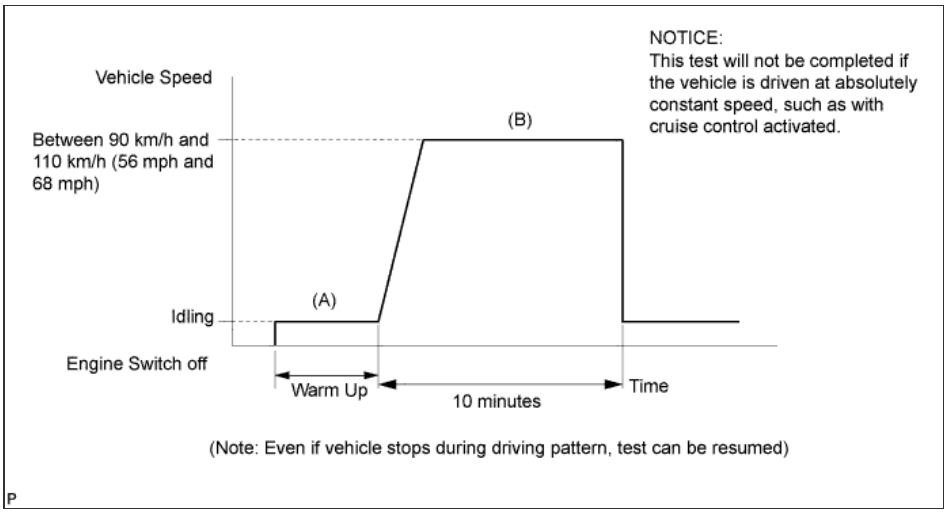
CONFIRMATION DRIVING PATTERN

HINT:

- **This confirmation driving pattern is used in the "Perform Confirmation Driving Pattern" procedure of the following diagnostic troubleshooting procedure.**
- **Performing this confirmation driving pattern will activate the Heated Oxygen (HO2) sensor monitor (the catalyst monitor is performed simultaneously). This is very useful for verifying the completion of a repair.**

NOTICE:

This test will not be completed if the vehicle is driven under absolutely constant speed conditions such as with cruise control activated.



1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Turn the tester on.
4. Enter the following menus: Powertrain / Engine and ECT / DTC / Clear.
5. Clear DTCs.
6. Switch the ECM from normal mode to check mode
7. Enter the following menus: Powertrain / Engine and ECT / Data List / O2S (A/FS) Monitor.
8. Check that the item O2S (A/FS) Monitor displays Incmpl (Incomplete).
9. Start the engine and warm it up. (Proceed to "A")
10. Drive the vehicle at between 90 km/h and 110 km/h (56 mph and 68 mph) for at least 10 minutes. (Proceed to "B")
11. Note the state of the Data List items. Those items will change to Compl (Complete) as the O2 Sensor monitor operates.
12. On the tester, enter the following menus: Powertrain / Engine and ECT / DTC / Pending and check if any DTCs (any pending DTCs) are output.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the tester to the DLC3.**
2. **Start the engine and turn the tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.**

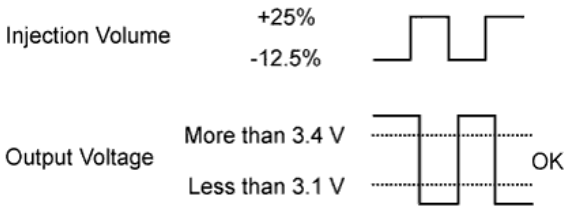
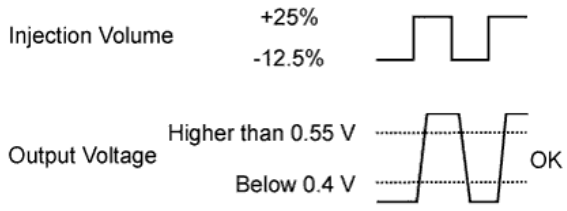
HINT:

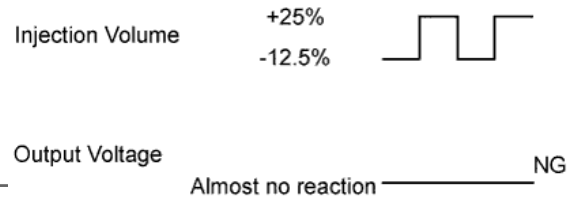
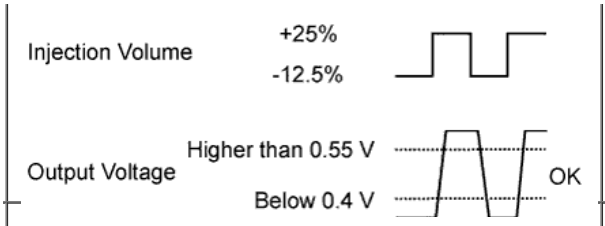
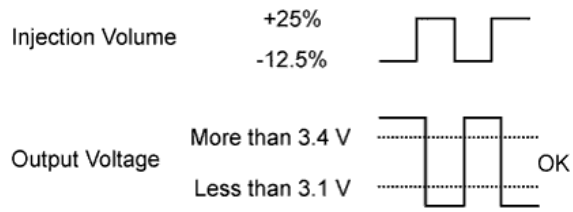
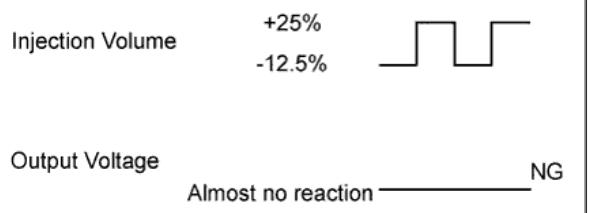
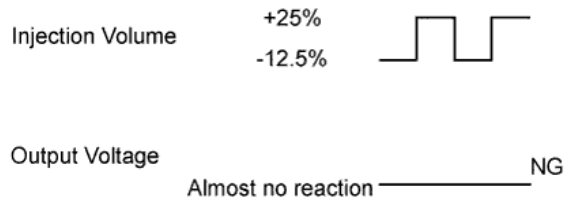
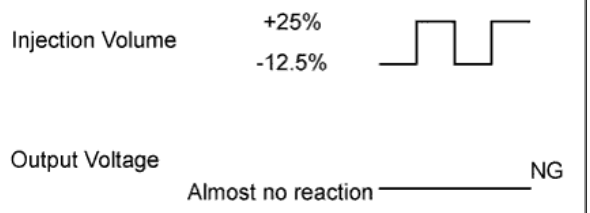
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Display Item (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 or AFS B2 S1 (A/F)	+25%	Rich	Below 3.1 V
AFS B1 S1 or AFS B2 S1 (A/F)	-12.5%	Lean	Higher than 3.4 V
O2S B1 S2 or O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55 V
O2S B1 S2 or O2S B2 S2 (HO2)	-12.5%	Lean	Below 0.4 V

NOTICE:

The Air Fuel ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
			• A/F

2			sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume / All Data / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

1.READ OUTPUT DTC

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0137 or P0157 is output	A
P0137 or P0157 and other DTCs are output	B

B → GO TO DTC CHART (Click here)

A

2.CHECK FOR EXHAUST GAS LEAKAGE

OK:

No gas leakage.

NG → REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT

OK

3.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

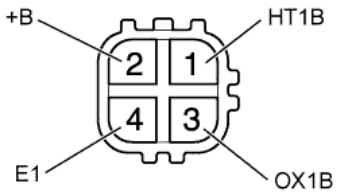
a. Disconnect the C20 or C56 heated oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

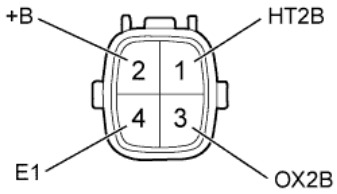
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT1B) - 4 (E1)	Always	10 kΩ or higher
1 (HT2B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT2B) - 4 (E1)	Always	10 kΩ or higher

Component without harness connected
(HO2 Sensor for Bank 1)



Component without harness connected
(HO2 Sensor for Bank 2)



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

4.INSPECT INTEGRATION NO.1 RELAY (EFI RELAY)

a. Remove the integration relay from the engine room relay block.

b. Inspect the EFI MAIN fuse.

i. Remove the EFI MAIN fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAIN fuse	Always	Below 1 Ω

iii. Reinstall the EFI MAIN fuse.

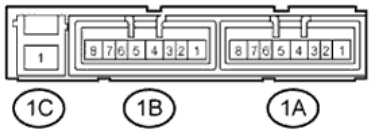
c. Inspect the EFI relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1B-4	No battery voltage applied to terminals 1B-2 and 1B-3	10 kΩ or higher
	Battery voltage applied to terminals 1B-2 and 1B-3	Below 1 Ω

Component without harness connected:
(Integration Relay)



NG → REPLACE INTEGRATION NO.1 RELAY

OK

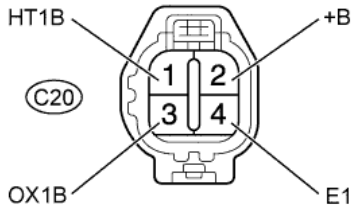
5.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)

a. Disconnect the C20 or C56 HO2 sensor connector.

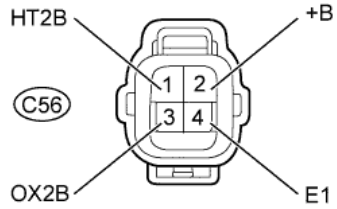
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

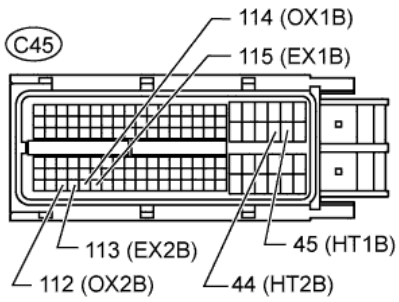
Front view of wire harness connector:
(to HO2 Sensor for Bank 1)



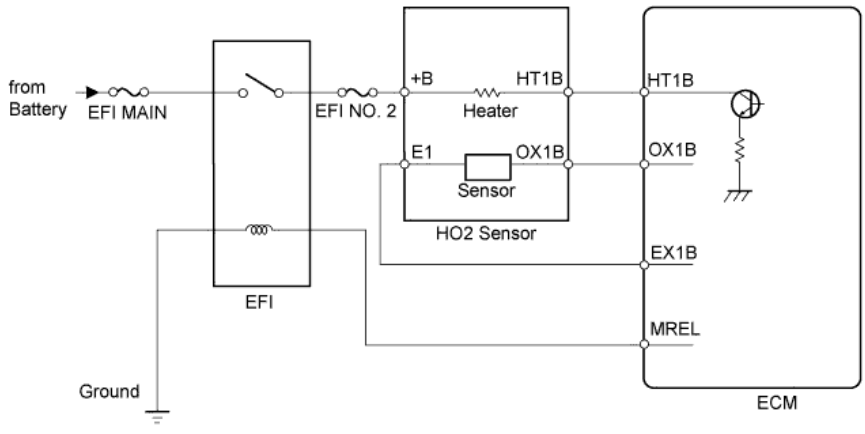
Front view of wire harness connector:
(to HO2 Sensor for Bank 2)



Front view of wire harness connector:
(to ECM)



Reference (System Diagram):



Y

Tester Connection	Switch Condition	Specified Condition
C20-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C56-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the C45 ECM connector.

e. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C45-45 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C45-114 (OX1B)	Always	Below 1 Ω
C20-4 (E1) - C45-115 (EX1B)	Always	Below 1 Ω
C56-1 (HT2B) - C45-44 (HT2B)	Always	Below 1 Ω
C56-3 (OX2B) - C45-112 (OX2B)	Always	Below 1 Ω
C56-4 (E1) - C45-113 (EX2B)	Always	Below 1 Ω
C20-1 (HT1B) or C45-45 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C45-114 (OX1B) - Body ground	Always	10 kΩ or higher
C56-1 (HT2B) or C45-44 (HT2B) - Body ground	Always	10 kΩ or higher
C56-3 (OX2B) or C45-112 (OX2B) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

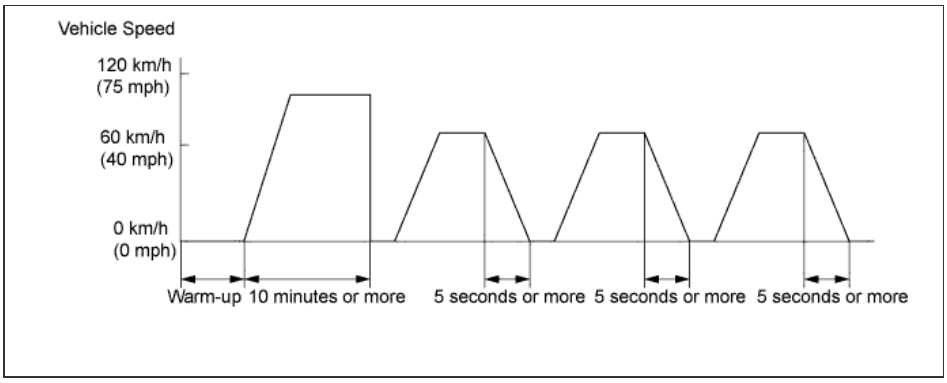
OK

6.REPLACE HEATED OXYGEN SENSOR

a. Replace the heated oxygen sensor (Click here).

NEXT

7.PERFORM CONFIRMATION DRIVING PATTERN



a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher.

d. Drive the vehicle at 60 to 120 km/h (40 to 75 mph) for at least 10 minutes.

e. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more. Perform this 3 times.

f. Turn the tester on.

g. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

h. Input DTCs: P0137 and P0157.

i. Check that DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern adding the vehicle speed and using the second gear to decelerate the vehicle.

OK:
No DTC is output.

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK → REPAIR COMPLETE

DTC P2102 Throttle Actuator Control Motor Circuit Low

DTC P2103 Throttle Actuator Control Motor Circuit High

for Preparation Click here

DESCRIPTION

The throttle actuator is operated by the ECM and opens and closes the throttle valve using gears.
The opening angle of the throttle valve is detected by the Throttle Position (TP) sensor, which is mounted on the throttle body. The TP sensor provides feedback to the ECM. This feedback allows the ECM to appropriately control the throttle actuator and monitor the throttle opening angle as the ECM responds to driver inputs.

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

DTC Code	DTC Detection Condition	Trouble Area
P2102	Conditions (a) and (b) continue for 2.0 seconds (1 trip detection logic): (a) The throttle actuator duty ratio is 80% or more. (b) The throttle actuator current is below 0.5 A.	• **Open in throttle actuator circuit** • **Throttle actuator** • **ECM**
P2103	Either of the following conditions is met (1 trip detection logic): • **A hybrid IC diagnosis signal failure.** • **A hybrid IC current limiter port failure.**	• **Short in throttle actuator circuit** • **Throttle actuator** • **Throttle valve** • **Throttle body assembly** • **ECM**

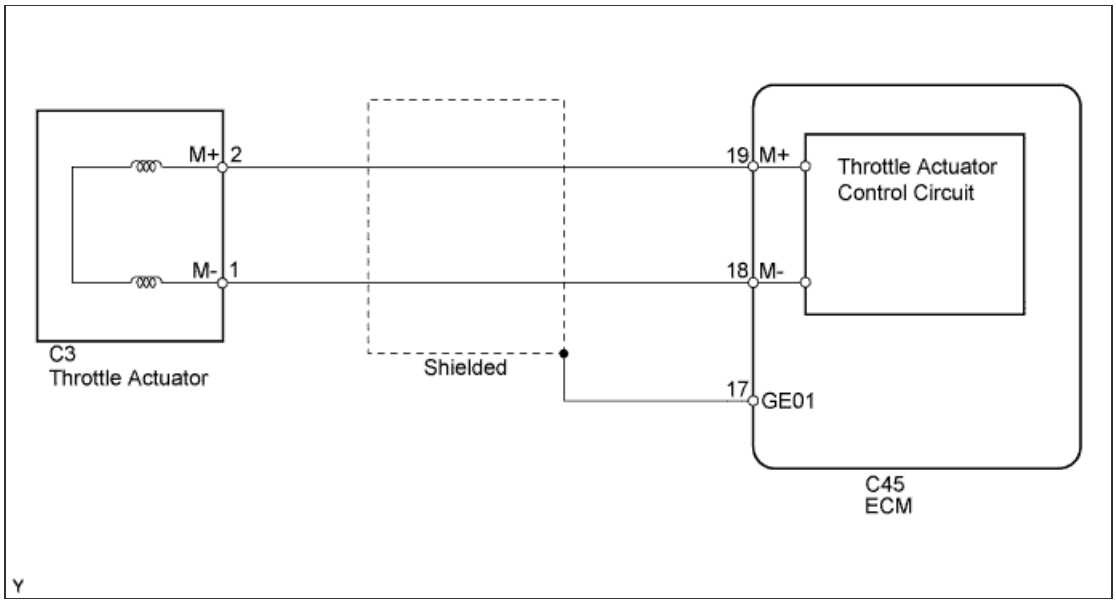
MONITOR DESCRIPTION

The ECM monitors the electrical current through the electronic actuator, and detects malfunctions and open circuits in the throttle actuator based on this value. If the current is outside the standard range, the ECM determines that there is a malfunction in the throttle actuator. In addition, if the throttle valve does not function properly (for example, stuck on), the ECM determines that there is a malfunction. The ECM then illuminates the MIL and stores DTC(s).
Example:
When the electrical current is below 0.5 A and the throttle actuator duty ratio exceeds 80%, the ECM interprets this as the current being outside the standard range, illuminates the MIL and stores DTC(s).
If the malfunction is not repaired successfully, a DTC is stored when the engine is quickly revved to a high rpm several times after the engine is started and has idled for 5 seconds.

FAIL-SAFE

When either of these DTCs, or other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **The throttle actuator current (Throttle Motor Current) and the throttle actuator duty ratio (Throttle Motor Open Duty / Throttle Motor Close Duty) can be read using the intelligent tester. However, the ECM shuts off the throttle actuator current when the ETCS malfunctions.**

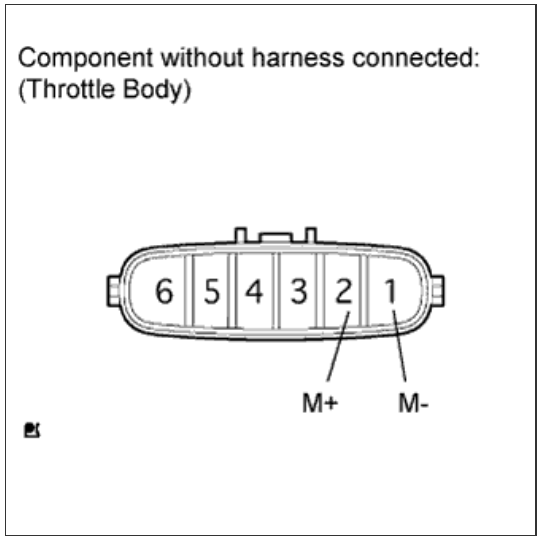
1.INSPECT THROTTLE BODY ASSEMBLY (RESISTANCE OF THROTTLE ACTUATOR)

a. Disconnect the C3 throttle body connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
2 (M+) - 1 (M-)	20°C (68°F)	0.3 to 100 Ω



NG → REPLACE THROTTLE BODY ASSEMBLY (Click here)

OK

2.CHECK HARNESS AND CONNECTOR (THROTTLE ACTUATOR - ECM)

a. Disconnect the C3 throttle body connector.

b. Disconnect the C45 ECM connector.

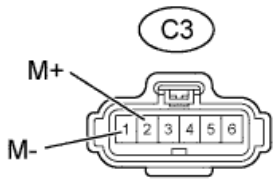
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

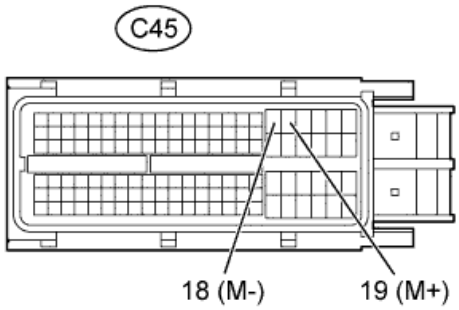
Tester Connection	Condition	Specified Condition
C3-2 (M+) - C45-19 (M+)	Always	Below 1 Ω

C3-1 (M-) - C45-18 (M-)	Always	Below 1 Ω
C3-2 (M+) or C45-19 (M+) - Body ground	Always	10 kΩ or higher
C3-1 (M-) or C45-18 (M-) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Throttle Body)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT THROTTLE BODY ASSEMBLY

a. Check for foreign objects between the throttle valve and the housing.

OK:
No foreign objects between throttle valve and housing.

NG → REMOVE FOREIGN OBJECT AND CLEAN THROTTLE BODY

OK

4.INSPECT THROTTLE VALVE

a. Check if the throttle valve opens and closes smoothly.

OK:
Throttle valve opens and closes smoothly.

NG → REPLACE THROTTLE BODY ASSEMBLY (Click here)

OK

REPLACE ECM (Click here)

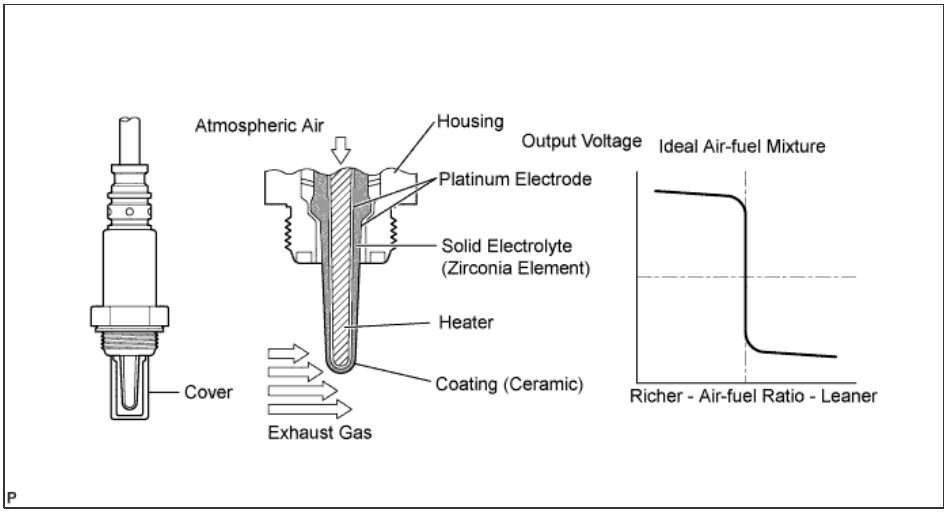
DTC P0137 Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)

DTC P0157 Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)

for Preparation Click here

DESCRIPTION

In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric air-fuel ratio. For the purpose of helping the ECM to deliver accurate air-fuel ratio control, a Heated Oxygen (HO2) sensor is used.
The HO2 sensor is located behind the TWC, and detects the oxygen concentration in the exhaust gas. Since the sensor is integrated with the heater that heats the sensing portion, it is possible to detect the oxygen concentration even when the intake air volume is low (the exhaust gas temperature is low).
When the air-fuel ratio becomes lean, the oxygen concentration in the exhaust gas is rich. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is lean (low voltage, i.e. below 0.45 V).
Conversely, when the air-fuel ratio is richer than the stoichiometric air-fuel ratio, the oxygen concentration in the exhaust gas becomes lean. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is rich (high voltage, i.e. higher than 0.45 V). The HO2 sensor has the property of changing its output voltage drastically when the air-fuel ratio is close to the stoichiometric level.
The ECM uses the supplementary information from the HO2 sensor to determine whether the air-fuel ratio after the TWC is rich or lean, and adjusts the fuel injection time accordingly. Thus, if the HO2 sensor is working improperly due to internal malfunctions, the ECM is unable to compensate for deviations in the primary air-fuel ratio control.



DTC Code	DTC Detection Condition	Trouble Area
P0137 P0157	Low voltage (open): During active air-fuel ratio control, the following conditions (a) and (b) are met for a certain period of time (2 trip detection logic): 1. The HO2 sensor voltage output is below 0.21 V. 2. The target air-fuel ratio is rich.	• Open in HO2 sensor (for Bank 1, 2) circuit • HO2 sensor (for Bank 1, 2) • HO2 sensor heater (for Bank 1, 2) • Integration relay • Gas leakage from exhaust system

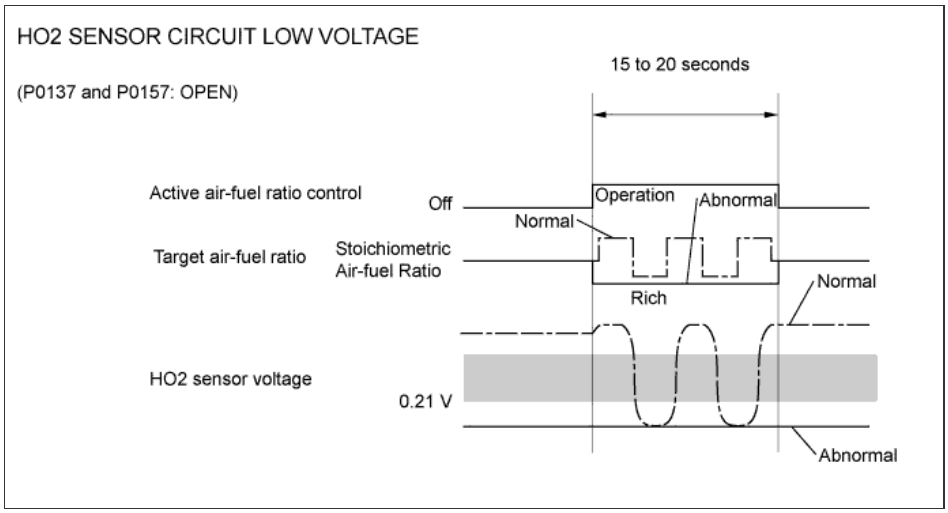
MONITOR DESCRIPTION

Active Air-Fuel Ratio Control

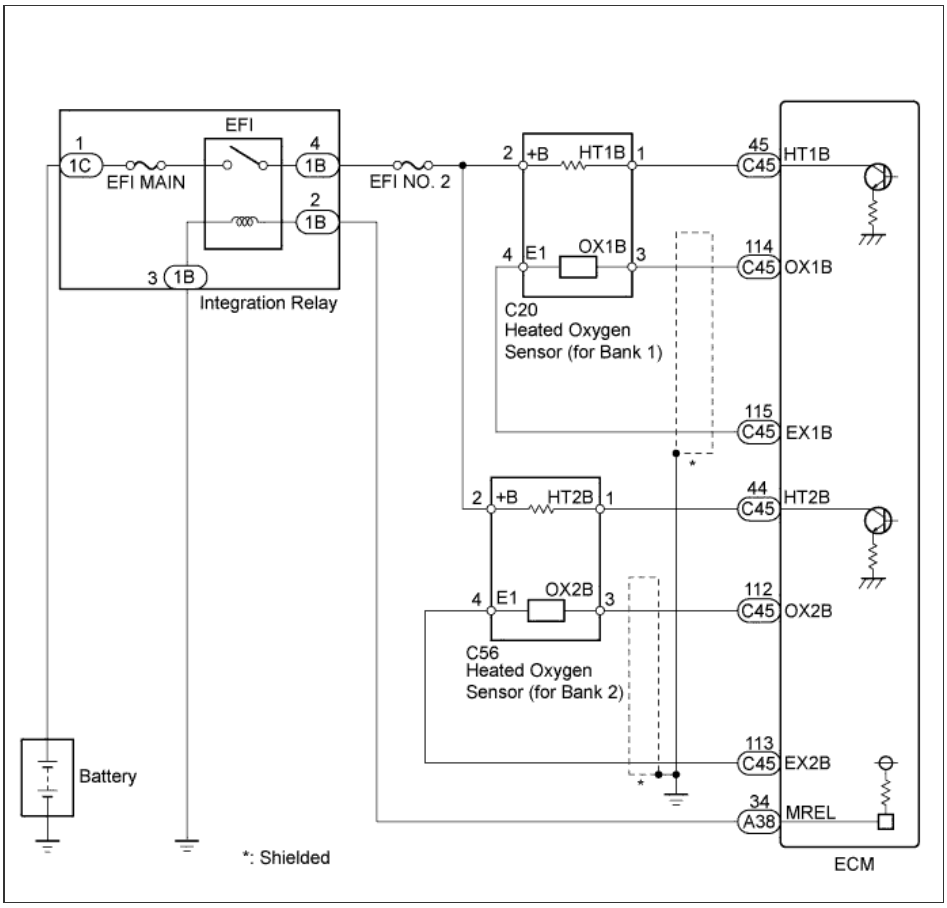
The ECM usually performs air-fuel ratio feedback control so that the Air Fuel ratio (A/F) sensor output indicates a near stoichiometric air-fuel ratio. This vehicle includes active air-fuel ratio control in addition to regular air-fuel ratio control. The ECM performs active air-fuel ratio control to detect any deterioration in the Three-Way Catalytic Converter (TWC) and Heated Oxygen (HO2) sensor malfunctions (refer to the diagram below).
Active air-fuel ratio control is performed for approximately 15 to 20 seconds while driving with a warm engine. During active air-fuel ratio control, the air-fuel ratio is forcibly regulated to become lean or rich by the ECM. If the ECM detects a malfunction, a DTC is stored.

Open or Short in Heated Oxygen (HO2) Sensor Circuit (DTC P0137 and P0157)

During active air-fuel ratio control, the ECM calculates the Oxygen Storage Capacity (OSC)* of the Three-Way Catalytic Converter (TWC) by forcibly regulating the air-fuel ratio to become rich or lean. If the HO2 sensor has an open or short, or the voltage output of the sensor decreases significantly, the OSC indicates an extraordinarily high value. Even if the ECM attempts to continue regulating the air-fuel ratio to become rich or lean, the HO2 sensor output does not change.
While performing active air-fuel ratio control, when the target air-fuel ratio is rich and the HO2 sensor voltage output is 0.21 V or less (lean), the ECM interprets this as an abnormally low sensor output voltage and stores DTC P0137 or P0157.
*: The TWC has the capability to store oxygen. The OSC and the emission purification capacity of the TWC are mutually related. The ECM determines whether the catalyst has deteriorated based on the calculated OSC value.



WIRING DIAGRAM



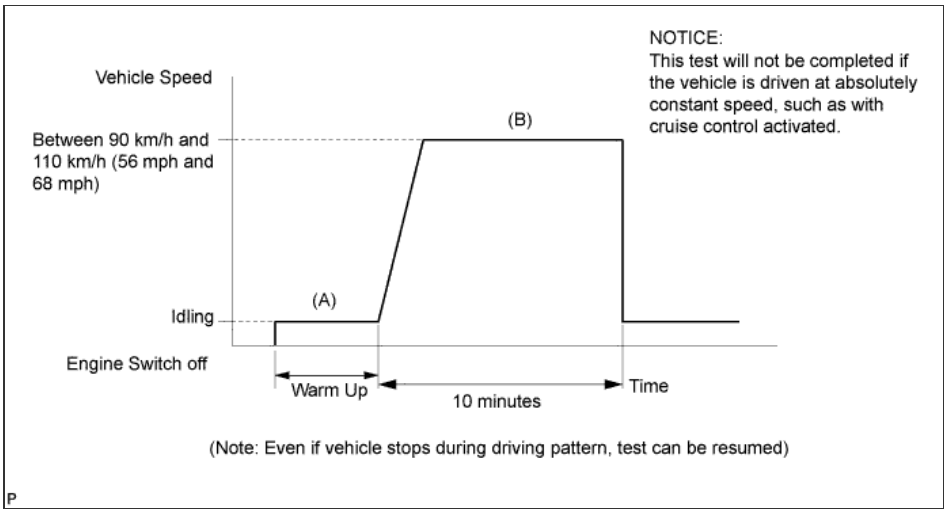
CONFIRMATION DRIVING PATTERN

HINT:

- **This confirmation driving pattern is used in the "Perform Confirmation Driving Pattern" procedure of the following diagnostic troubleshooting procedure.**
- **Performing this confirmation driving pattern will activate the Heated Oxygen (HO2) sensor monitor (the catalyst monitor is performed simultaneously). This is very useful for verifying the completion of a repair.**

NOTICE:

This test will not be completed if the vehicle is driven under absolutely constant speed conditions such as with cruise control activated.



1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Turn the tester on.
4. Enter the following menus: Powertrain / Engine and ECT / DTC / Clear.
5. Clear DTCs.
6. Switch the ECM from normal mode to check mode
7. Enter the following menus: Powertrain / Engine and ECT / Data List / O2S (A/FS) Monitor.
8. Check that the item O2S (A/FS) Monitor displays Incmpl (Incomplete).
9. Start the engine and warm it up. (Proceed to "A")
10. Drive the vehicle at between 90 km/h and 110 km/h (56 mph and 68 mph) for at least 10 minutes. (Proceed to "B")
11. Note the state of the Data List items. Those items will change to Compl (Complete) as the O2 Sensor monitor operates.
12. On the tester, enter the following menus: Powertrain / Engine and ECT / DTC / Pending and check if any DTCs (any pending DTCs) are output.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the tester to the DLC3.**
2. **Start the engine and turn the tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.**

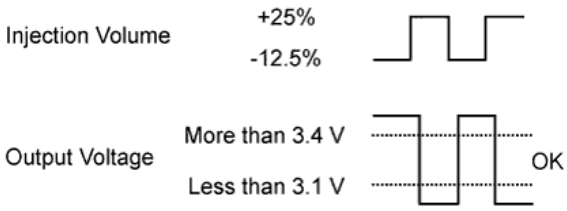
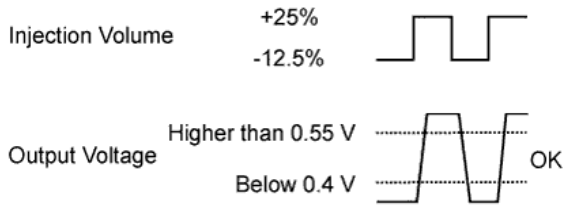
HINT:

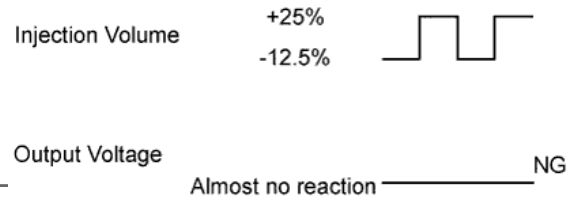
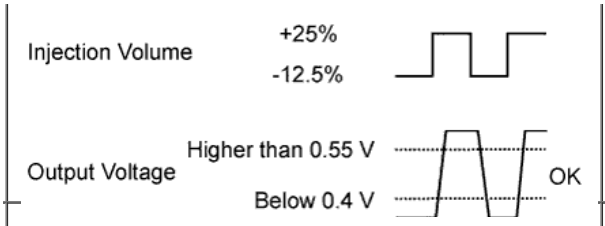
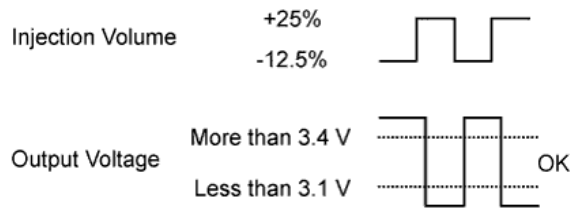
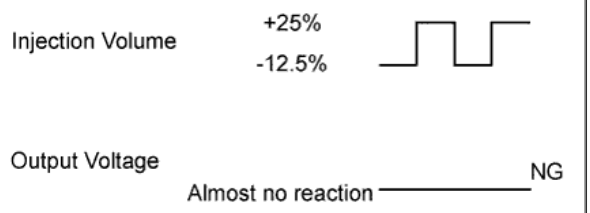
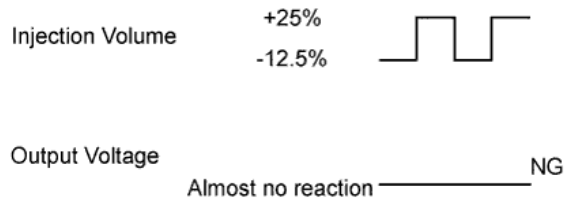
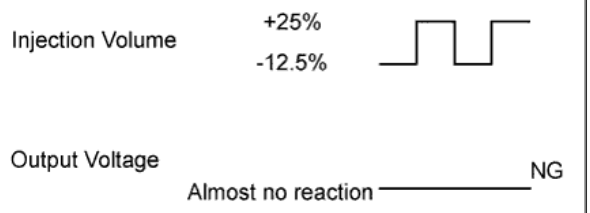
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Display Item (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 or AFS B2 S1 (A/F)	+25%	Rich	Below 3.1 V
AFS B1 S1 or AFS B2 S1 (A/F)	-12.5%	Lean	Higher than 3.4 V
O2S B1 S2 or O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55 V
O2S B1 S2 or O2S B2 S2 (HO2)	-12.5%	Lean	Below 0.4 V

NOTICE:

The Air Fuel ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
			• A/F

2			sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume / All Data / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

1.READ OUTPUT DTC

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0137 or P0157 is output	A
P0137 or P0157 and other DTCs are output	B

B → GO TO DTC CHART (Click here)

A

2.CHECK FOR EXHAUST GAS LEAKAGE

OK:

No gas leakage.

NG → REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT

OK

3.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

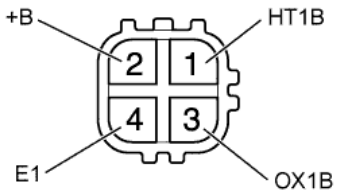
a. Disconnect the C20 or C56 heated oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

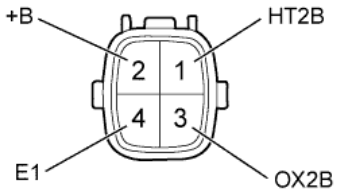
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT1B) - 4 (E1)	Always	10 kΩ or higher
1 (HT2B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT2B) - 4 (E1)	Always	10 kΩ or higher

Component without harness connected
(HO2 Sensor for Bank 1)



Component without harness connected
(HO2 Sensor for Bank 2)



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

4.INSPECT INTEGRATION NO.1 RELAY (EFI RELAY)

a. Remove the integration relay from the engine room relay block.

b. Inspect the EFI MAIN fuse.

i. Remove the EFI MAIN fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAIN fuse	Always	Below 1 Ω

iii. Reinstall the EFI MAIN fuse.

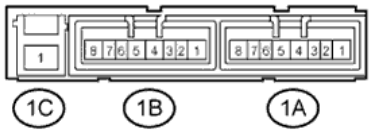
c. Inspect the EFI relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1B-4	No battery voltage applied to terminals 1B-2 and 1B-3	10 kΩ or higher
	Battery voltage applied to terminals 1B-2 and 1B-3	Below 1 Ω

Component without harness connected:
(Integration Relay)



NG → REPLACE INTEGRATION NO.1 RELAY

OK

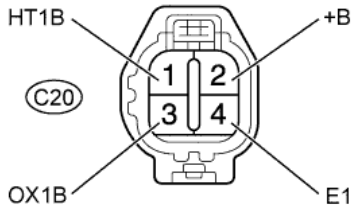
5.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)

a. Disconnect the C20 or C56 HO2 sensor connector.

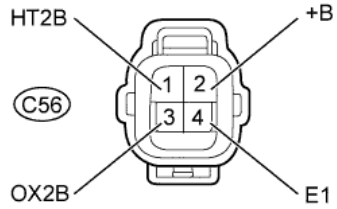
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

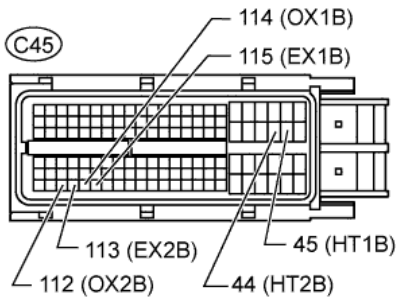
Front view of wire harness connector:
(to HO2 Sensor for Bank 1)



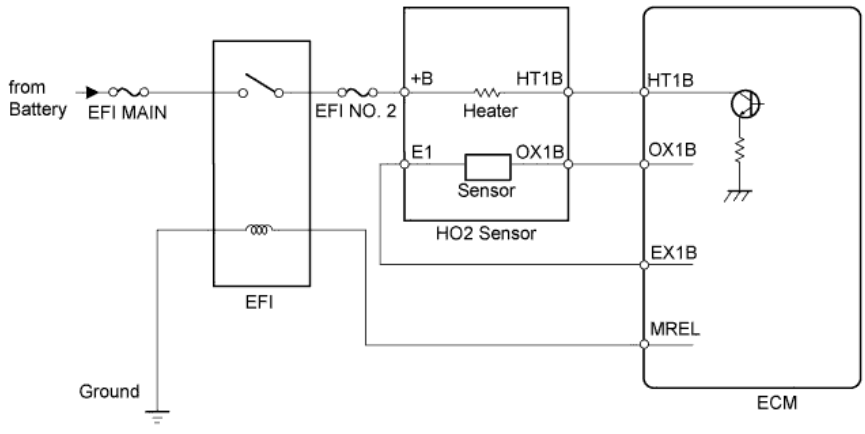
Front view of wire harness connector:
(to HO2 Sensor for Bank 2)



Front view of wire harness connector:
(to ECM)



Reference (System Diagram):



Y

Tester Connection	Switch Condition	Specified Condition
C20-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C56-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the C45 ECM connector.

e. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C45-45 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C45-114 (OX1B)	Always	Below 1 Ω
C20-4 (E1) - C45-115 (EX1B)	Always	Below 1 Ω
C56-1 (HT2B) - C45-44 (HT2B)	Always	Below 1 Ω
C56-3 (OX2B) - C45-112 (OX2B)	Always	Below 1 Ω
C56-4 (E1) - C45-113 (EX2B)	Always	Below 1 Ω
C20-1 (HT1B) or C45-45 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C45-114 (OX1B) - Body ground	Always	10 kΩ or higher
C56-1 (HT2B) or C45-44 (HT2B) - Body ground	Always	10 kΩ or higher
C56-3 (OX2B) or C45-112 (OX2B) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

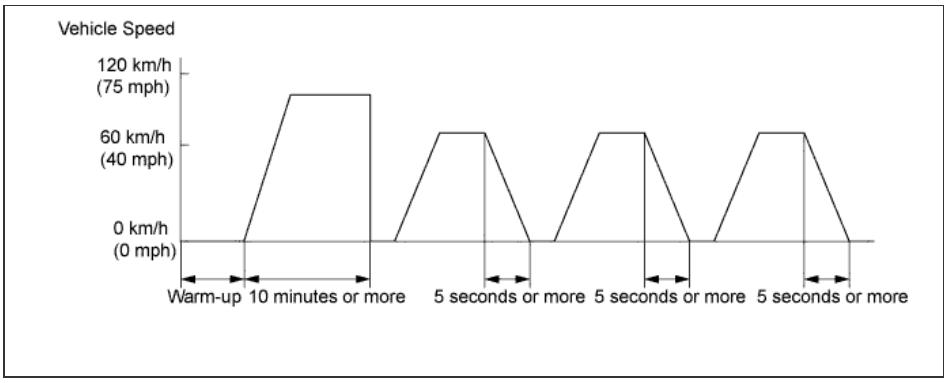
OK

6.REPLACE HEATED OXYGEN SENSOR

a. Replace the heated oxygen sensor (Click here).

NEXT

7.PERFORM CONFIRMATION DRIVING PATTERN



a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher.

d. Drive the vehicle at 60 to 120 km/h (40 to 75 mph) for at least 10 minutes.

e. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more. Perform this 3 times.

f. Turn the tester on.

g. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

h. Input DTCs: P0137 and P0157.

i. Check that DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern adding the vehicle speed and using the second gear to decelerate the vehicle.

OK:
No DTC is output.

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK → REPAIR COMPLETE

DTC P2102 Throttle Actuator Control Motor Circuit Low

DTC P2103 Throttle Actuator Control Motor Circuit High

for Preparation Click here

DESCRIPTION

The throttle actuator is operated by the ECM and opens and closes the throttle valve using gears.
The opening angle of the throttle valve is detected by the Throttle Position (TP) sensor, which is mounted on the throttle body. The TP sensor provides feedback to the ECM. This feedback allows the ECM to appropriately control the throttle actuator and monitor the throttle opening angle as the ECM responds to driver inputs.

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

DTC Code	DTC Detection Condition	Trouble Area
P2102	Conditions (a) and (b) continue for 2.0 seconds (1 trip detection logic): (a) The throttle actuator duty ratio is 80% or more. (b) The throttle actuator current is below 0.5 A.	• **Open in throttle actuator circuit** • **Throttle actuator** • **ECM**
P2103	Either of the following conditions is met (1 trip detection logic): • **A hybrid IC diagnosis signal failure.** • **A hybrid IC current limiter port failure.**	• **Short in throttle actuator circuit** • **Throttle actuator** • **Throttle valve** • **Throttle body assembly** • **ECM**

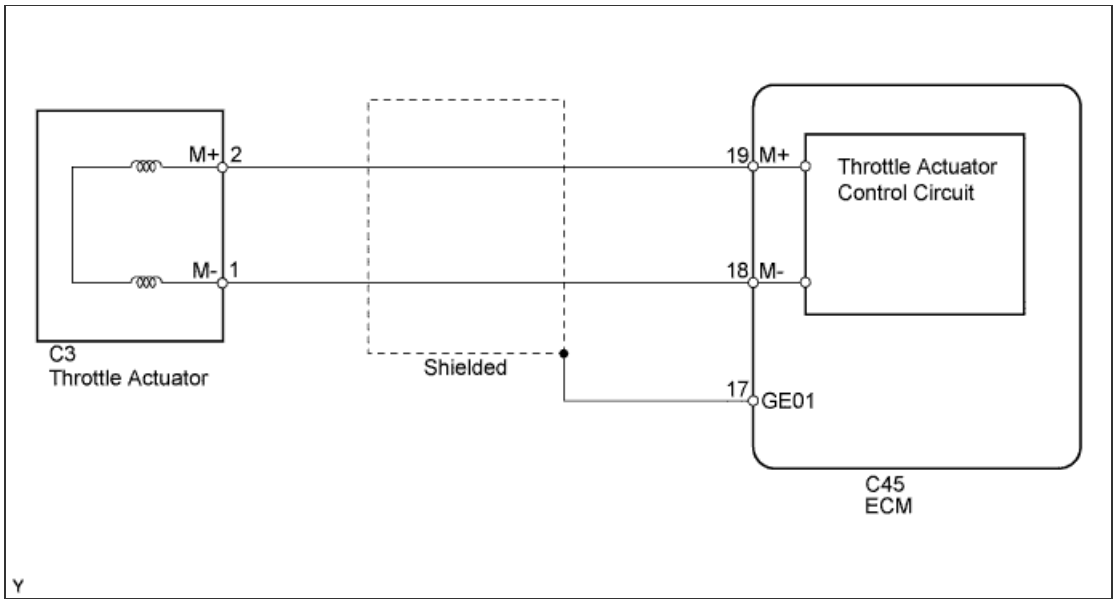
MONITOR DESCRIPTION

The ECM monitors the electrical current through the electronic actuator, and detects malfunctions and open circuits in the throttle actuator based on this value. If the current is outside the standard range, the ECM determines that there is a malfunction in the throttle actuator. In addition, if the throttle valve does not function properly (for example, stuck on), the ECM determines that there is a malfunction. The ECM then illuminates the MIL and stores DTC(s).
Example:
When the electrical current is below 0.5 A and the throttle actuator duty ratio exceeds 80%, the ECM interprets this as the current being outside the standard range, illuminates the MIL and stores DTC(s).
If the malfunction is not repaired successfully, a DTC is stored when the engine is quickly revved to a high rpm several times after the engine is started and has idled for 5 seconds.

FAIL-SAFE

When either of these DTCs, or other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **The throttle actuator current (Throttle Motor Current) and the throttle actuator duty ratio (Throttle Motor Open Duty / Throttle Motor Close Duty) can be read using the intelligent tester. However, the ECM shuts off the throttle actuator current when the ETCS malfunctions.**

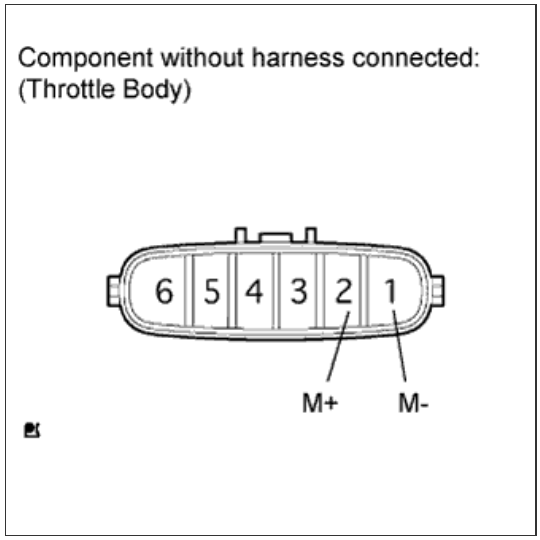
1.INSPECT THROTTLE BODY ASSEMBLY (RESISTANCE OF THROTTLE ACTUATOR)

a. Disconnect the C3 throttle body connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
2 (M+) - 1 (M-)	20°C (68°F)	0.3 to 100 Ω



NG → REPLACE THROTTLE BODY ASSEMBLY (Click here)

OK

2.CHECK HARNESS AND CONNECTOR (THROTTLE ACTUATOR - ECM)

a. Disconnect the C3 throttle body connector.

b. Disconnect the C45 ECM connector.

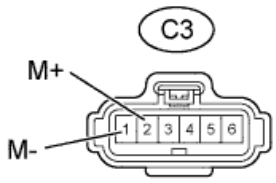
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

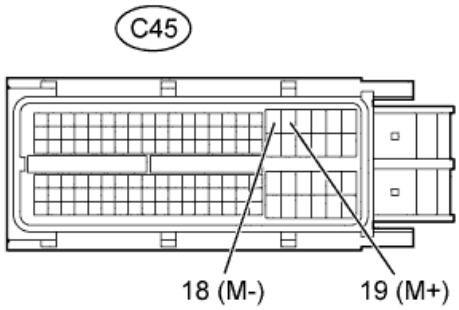
Tester Connection	Condition	Specified Condition
C3-2 (M+) - C45-19 (M+)	Always	Below 1 Ω

C3-1 (M-) - C45-18 (M-)	Always	Below 1 Ω
C3-2 (M+) or C45-19 (M+) - Body ground	Always	10 kΩ or higher
C3-1 (M-) or C45-18 (M-) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Throttle Body)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT THROTTLE BODY ASSEMBLY

a. Check for foreign objects between the throttle valve and the housing.

OK:
No foreign objects between throttle valve and housing.

NG → REMOVE FOREIGN OBJECT AND CLEAN THROTTLE BODY

OK

4.INSPECT THROTTLE VALVE

a. Check if the throttle valve opens and closes smoothly.

OK:
Throttle valve opens and closes smoothly.

NG → REPLACE THROTTLE BODY ASSEMBLY (Click here)

OK

REPLACE ECM (Click here)

DTC P0230 Fuel Pump Primary Circuit

for Preparation Click here

DESCRIPTION

When a malfunction in the fuel pump circuit is detected, DTC P0230 is stored.
The fuel pump circuit consists of the ECM, fuel pump and fuel pump ECU (which operates the fuel pump). Based on the engine output, the ECM determines the fuel pump speed. The speed is then converted to a duty signal and sent to the fuel pump ECU. Based on the signal sent from the ECM, the fuel pump ECU adjusts the fuel pump operation speed between 3 settings. The fuel pump ECU also has a self-diagnosis function. Based on the fuel pump circuit condition, the fuel pump ECU outputs a diagnostic signal (DI) to the ECM, and the ECM determines if there is a malfunction in the fuel pump circuit.

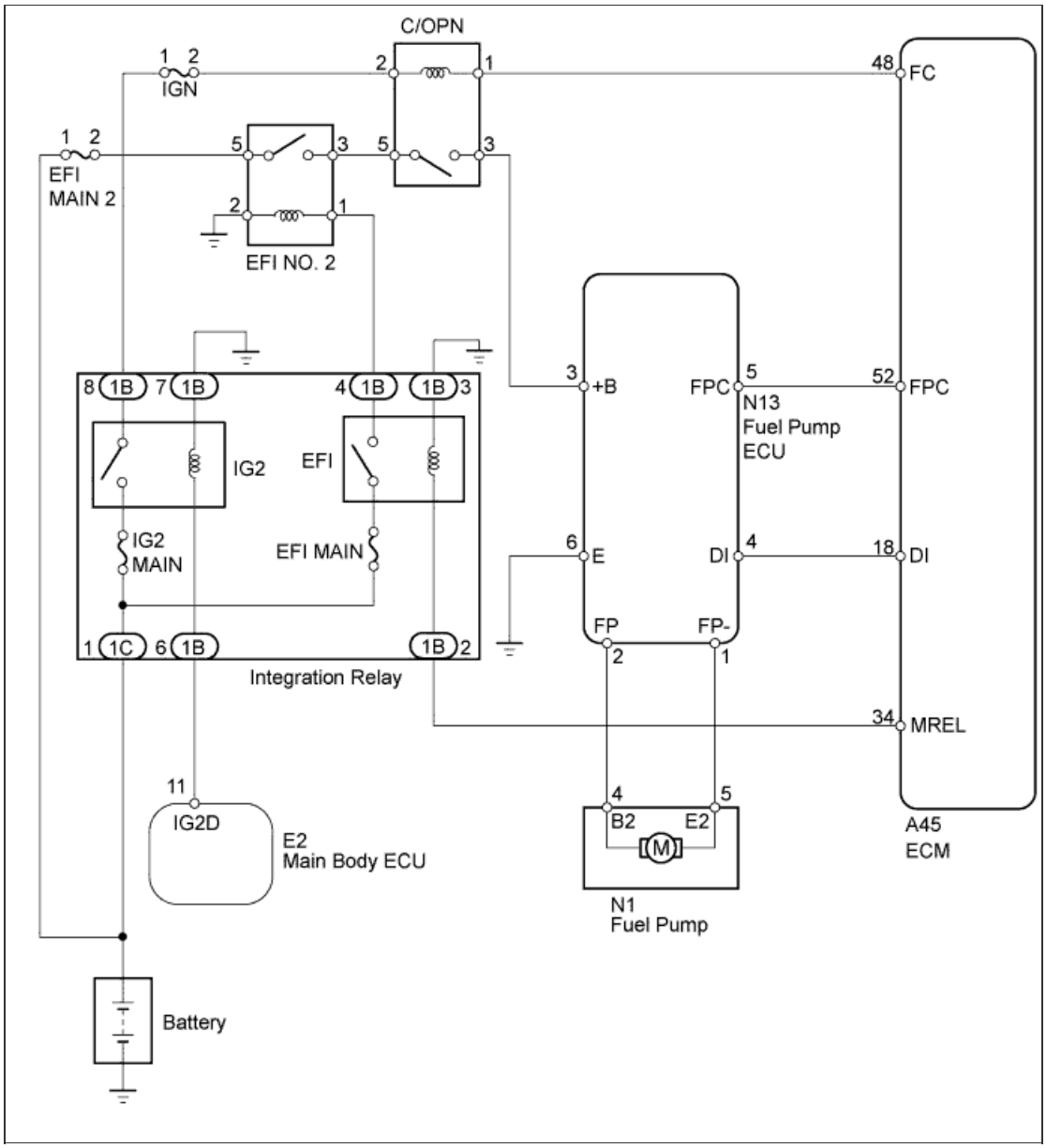
DTC Code	DTC Detection Condition	Trouble Area

P0230	When either condition below is met (1 trip detection logic):
	• When the fuel pump is operating:
	  ◦ The remaining fuel is 17 liters or more.
	  ◦ The DI terminal output is low.
	• When the fuel pump is not operating:
	  ◦ The DI terminal output is high.
		• Open or short in fuel pump circuit
		• Fuel pump
		• Fuel pump ECU
		• ECM

MONITOR DESCRIPTION

To monitor the fuel pump circuit, the ECM checks the fuel pump control signal (FPC) and diagnostic signal (DI). The FPC voltage varies between approximately 0 V to approximately 12 V (duty signal). Based on the condition of the fuel pump ECU malfunction, the DI voltage varies between approximately 0 V and approximately 12 V. The ECM then compares the variance of the FPC voltage and DI voltage, and determines if the fuel pump circuit is malfunctioning. When the ECM determines that the fuel pump circuit is malfunctioning, a DTC is stored immediately.

WIRING DIAGRAM



INSPECTION PROCEDURE

This troubleshooting procedure is based on the premise that the engine is started. If the engine is not started, proceed to the Problem Symptoms Table (Click here).

1.CHECK FOR DTC (B1500)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Body Electrical / Combination Meter / DTC.

e. Read the DTC.

Result

Result	Proceed to
DTC B1500 is not output	A
DTC B1500 is output	B

B → GO TO DTC B1500 (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (FUEL PUMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Fuel Pump / Speed.

d. Check whether operating sounds can be heard while operating the fuel pump using the tester.

OK:
Operating sounds can be heard from fuel pump.

NG → Go to step 6

OK

3.CHECK HARNESS AND CONNECTOR (FUEL PUMP ECU - ECM, BODY GROUND)

a. Disconnect the N3 fuel pump ECU connector.

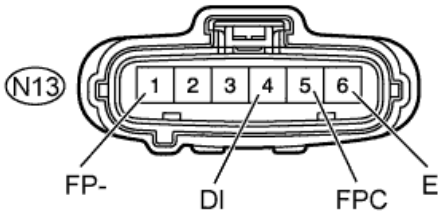
b. Disconnect the A38 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

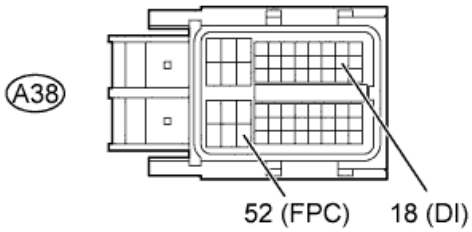
Standard Resistance:

Tester Connection	Condition	Specified Condition
N13-5 (FPC) - A38-52 (FPC)	Always	Below 1 Ω
N13-4 (DI) - A38-18 (DI)	Always	Below 1 Ω
N13-6 (E) - Body ground	Always	Below 1 Ω
N13-1 (FP-) - Body ground	Always	10 kΩ or higher
N13-5 (FPC) or A38-52 (FPC) - Body ground	Always	10 kΩ or higher
N13-4 (DI) or A38-18 (DI) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector: (to Fuel Pump ECU)



Front view of wire harness connector: (to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.REPLACE FUEL PUMP ECU

a. Replace the fuel pump ECU (Click here).

NEXT

5.CONFIRM WHETHER DTC OUTPUT RECURS

a. Check that there are 17 liters or more of fuel remaining.

b. Connect the intelligent tester to the DLC3.

c. Turn the engine switch on (IG).

d. Turn the tester on.

e. Clear DTCs (Click here).

f. Crank the engine for 15 seconds.

g. Idle the engine for 1 minute.

h. Enter the following menus: Powertrain / Engine and ECT / DTC.

i. Read the DTCs.

Result

Result	Proceed to
DTC is not output	A
DTC P0230 is output	B

B → REPLACE ECM (Click here)

A →

END

6.INSPECT CIRCUIT OPENING RELAY (C/OPN)

a. Inspect the circuit opening relay (C/OPN) (Click here).

NG → REPLACE CIRCUIT OPENING RELAY (C/OPN)

OK →

7.INSPECT CIRCUIT OPENING RELAY (POWER SOURCE VOLTAGE)

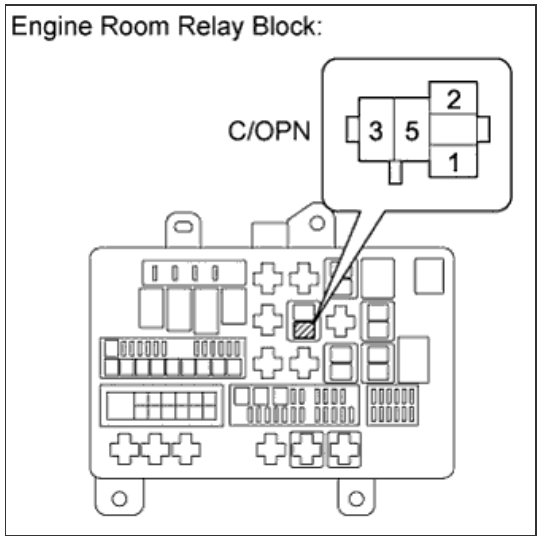
a. Remove the circuit opening relay (C/OPN) from the engine room relay block.

b. Turn the engine switch on (IG).

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C/OPN relay (2) - Body ground	Engine switch on (IG)	11 to 14 V
C/OPN relay (5) - Body ground	Engine switch on (IG)	11 to 14 V



NG → Go to step 14

OK →

8.CHECK HARNESS AND CONNECTOR (CIRCUIT OPENING RELAY (C/OPN) - ECM, FUEL PUMP ECU)

a. Remove the circuit opening relay (C/OPN) from the engine room relay block.

b. Disconnect the A38 ECM connector.

c. Disconnect the N13 fuel pump ECU connector.

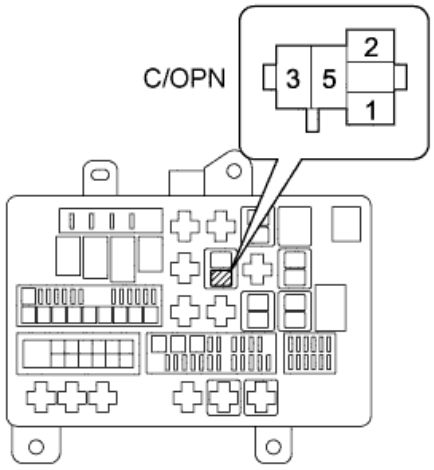
d. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

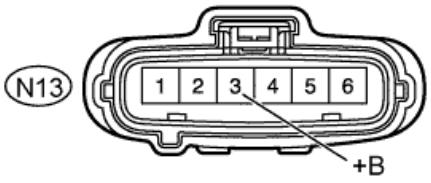
Tester Connection	Condition	Specified Condition
C/OPN relay (1) - A38-48 (FC)	Always	Below 1 Ω
C/OPN relay (3) -		

N13-3 (+B)	Always	Below 1 Ω
C/OPN relay (1) or A38-48 (FC) - Body ground	Always	10 kΩ or higher
C/OPN relay (3) or N13-3 (+B) - Body ground	Always	10 kΩ or higher

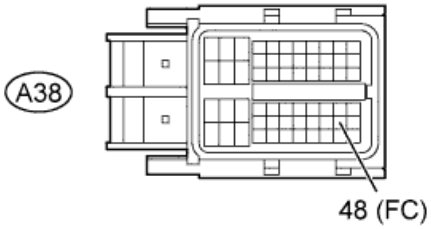
Engine Room Relay Block:



Front view of wire harness connector:
(to Fuel Pump ECU)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.CHECK HARNESS AND CONNECTOR (FUEL PUMP - FUEL PUMP ECU)

a. Disconnect the N1 fuel pump connector.

b. Disconnect the N13 fuel pump ECU connector.

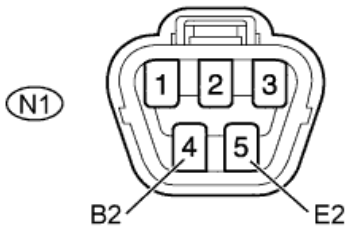
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

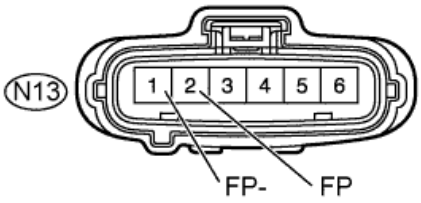
Tester Connection	Condition	Specified Condition
N1-4 (B2) - N13-2 (FP)	Always	Below 1 Ω
N1-5 (E2) - N13-1 (FP-)	Always	Below 1 Ω

N1-4 (B2) or N13-2 (FP) - Body ground	Always	10 kΩ or higher
N1-5 (E2) or N13-1 (FP-) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Fuel Pump)



Front view of wire harness connector:
(to Fuel Pump ECU)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

10.INSPECT FUEL PUMP

a. Inspect the fuel pump (Click here).

NG → REPLACE FUEL PUMP (**Click here**)

OK

11.CHECK HARNESS AND CONNECTOR (FUEL PUMP ECU - ECM, BODY GROUND)

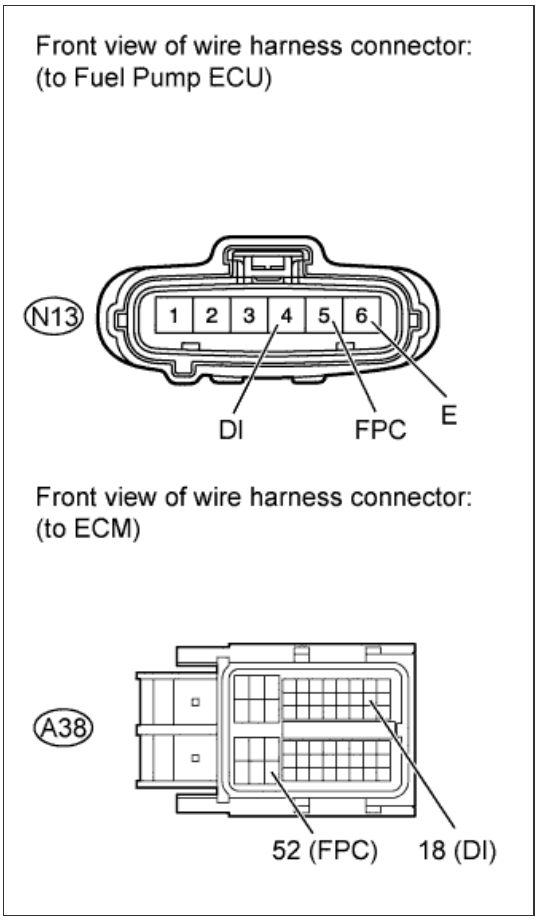
a. Disconnect the N13 fuel pump ECU connector.

b. Disconnect the A38 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
N13-5 (FPC) - A38-52 (FPC)	Always	Below 1 Ω
N13-4 (DI) - A38-18 (DI)	Always	Below 1 Ω
N13-6 (E) - Body ground	Always	Below 1 Ω
N13-5 (FPC) or A38-52 (FPC) - Body ground	Always	10 kΩ or higher
N13-4 (DI) or A38-18 (DI) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

12.REPLACE FUEL PUMP ECU

a. Replace the fuel pump ECU (Click here).

NEXT

13.CONFIRM WHETHER DTC OUTPUT RECURS

a. Check that there is 17 liters or more of fuel remaining.

b. Connect the intelligent tester to the DLC3.

c. Turn the engine switch on (IG).

d. Turn the tester on.

e. Clear DTCs (Click here).

f. Crank the engine for 15 seconds.

g. Idle the engine for 1 minute.

h. Enter the following menus: Powertrain / Engine and ECT / DTC.

i. Read the DTCs.

Result

Result	Proceed to
DTC is not output	A
DTC P0230 is output	B

B → REPLACE ECM (Click here)

A

END

14.CHECK HARNESS AND CONNECTOR (C/OPN RELAY - EFI NO. 2 RELAY, IGN FUSE)

a. Remove the circuit opening relay (C/OPN) from the engine room relay block.

b. Remove the EFI NO. 2 relay (EFI NO. 2) from the engine room relay block.

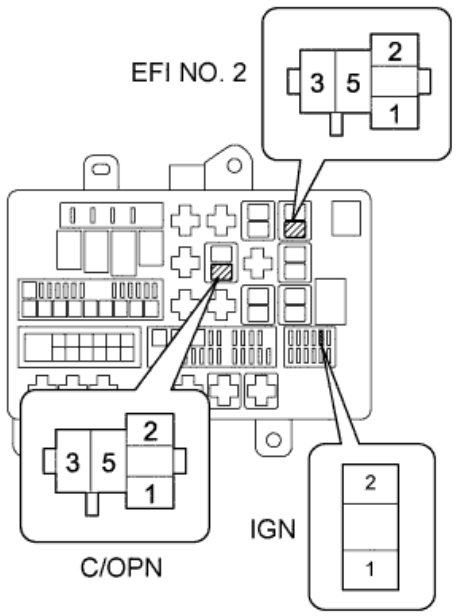
c. Remove the IGN fuse from the engine room relay block.

d. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C/OPN relay (2) - IGN fuse (2)	Always	Below 1 Ω
C/OPN relay (5) - EFI NO. 2 relay (3)	Always	Below 1 Ω
C/OPN relay (2) or IGN fuse (2) - Body ground	Always	10 kΩ or higher
C/OPN relay (5) or EFI NO. 2 relay (3) - Body ground	Always	10 kΩ or higher

Engine Room Relay Block:



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

15.INSPECT EFI NO. 2 RELAY (EFI NO. 2)

a. Inspect the EFI NO. 2 relay (EFI NO. 2) (Click here).

NG → REPLACE EFI NO. 2 RELAY (EFI NO. 2)

OK

16.CHECK HARNESS AND CONNECTOR (EFI NO. 2 RELAY - INTEGRATION RELAY, BATTERY, BODY GROUND)

a. Remove the EFI MAIN 2 fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAIN 2 fuse	Always	Below 1 Ω

c. Reinstall the EFI MAIN 2 fuse.

d. Remove the EFI NO. 2 relay (EFI NO. 2) from the engine room relay block.

e. Remove the integration relay from the engine room relay block.

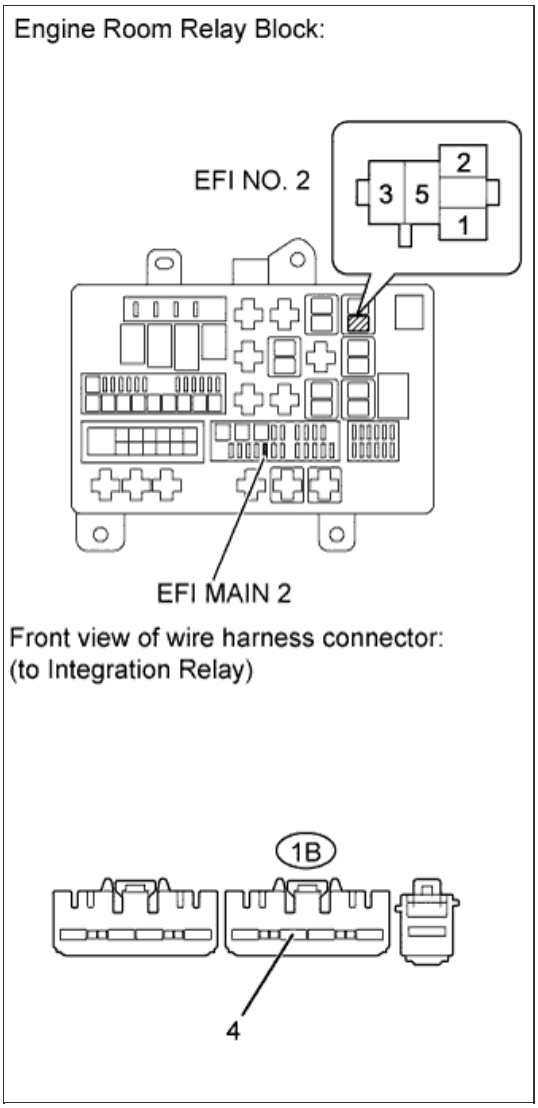
f. Disconnect the 1B integration relay connector.

g. Disconnect the cable from the battery positive (+) terminal.

h. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI NO. 2 relay (1) - 1B-4	Always	Below 1 Ω
EFI NO. 2 relay (5) - Positive (+) battery cable	Always	Below 1 Ω
EFI NO. 2 relay (2) - Body ground	Always	Below 1 Ω
EFI NO. 2 relay (1) or 1B-4 - Body ground	Always	10 kΩ or higher
EFI NO. 2 relay (5) or Positive (+) battery cable - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

GO TO ECM POWER SOURCE CIRCUIT (Click here)

DTC P2111 Throttle Actuator Control System - Stuck Open

DTC P2112 Throttle Actuator Control System - Stuck Closed

for Preparation Click here

DESCRIPTION

The throttle actuator is operated by the ECM, and opens and closes the throttle valve using gears. The opening angle of the throttle valve is detected by the Throttle Position (TP) sensor, which is mounted on the throttle body. The TP sensor provides feedback to the ECM so that it can control the throttle actuator (throttle valve) appropriately in response to driver inputs.

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

DTC Code	DTC Detection Condition	Trouble Area
P2111	The throttle actuator does not close when signaled by the ECM (1 trip detection logic).	• **Throttle actuator** • **Throttle body assembly** • **Throttle valve**
P2112	The throttle actuator does not open when signaled by the ECM (1 trip detection logic).	• **Throttle actuator** • **Throttle body assembly** • **Throttle valve**

MONITOR DESCRIPTION

The ECM determines that there is a malfunction in the ETCS when the throttle valve remains at a fixed angle despite a high drive current from the ECM. The ECM illuminates the MIL and stores DTC(s).
If the malfunction is not repaired successfully, a DTC is stored when the accelerator pedal is fully depressed and released quickly (to fully open and close the throttle valve) after the engine is next started.

FAIL-SAFE

When either of these DTCs, or other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM

Refer to DTC P2102 (Click here).

INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Refer to Data List Active Test Throttle Position Command, Throttle Position No. 1, Throttle Motor Current, Throttle Motor Duty (Open Throttle Motor Duty (Close Click here .**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2111 OR P2112

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P2111 or P2112 is output	A
P2111 or P2112 and other DTCs are output	B

HINT:

If any DTCs other than P2111 or P2112 are output, troubleshoot those DTCs first.

GO TO DTC CHART (Click here

A

2.INSPECT THROTTLE ODY ASSEM LY (VISUALLY CHECK THROTTLE VALVE

a. Check for contamination between the throttle valve and the housing. If necessary, clean the throttle body. And check that the throttle valve moves smoothly.

OK:
Throttle valve is not contaminated with foreign objects and moves smoothly.

NG → Go to step 4

OK

.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Turn the engine switch off and wait for at least 30 seconds.

f. Turn the engine switch on (IG).

g. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Throttle Position No. 1, Throttle Position No. 2 and Throttle Position Command.

h. Check the values displayed on the tester while wiggling the ECM wire harness.

i. Enter the following menus: Powertrain / Engine and ECT / DTC.

j. Check for DTCs.

Result

Result	Proceed to
Value in Data List changes when wire harness is wiggled, or DTC is output*	A
ther than above	B

*: As the DTC was stored due to a change in the contact resistance of the connector, repair or replace the wire harness or connector (Click here).

Go to step

A

REPAIR OR REPLACE HARNESS OR CONNECTOR

4.REPLACE THROTTLE ODY ASSEM LY

a. Replace the throttle body assembly (Click here).

NEXT

.CHECK WHETHER DTC OUTPUT RECURS (DTC P2111 OR P2112

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine, and fully depress and release the accelerator pedal quickly (to fully open and close the throttle valve).

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P2111 or P2112 is output	B

REPLACE ECM (Click here

A

END

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

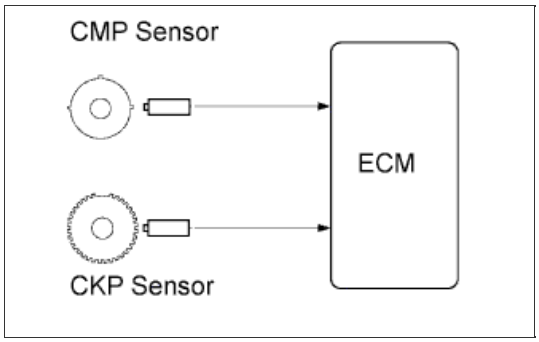
DTC P0306 Cylinder 6 Misfire Detected

DTC P0307 Cylinder 7 Misfire Detected

DTC P0308 Cylinder 8 Misfire Detected

for Preparation Click here

DESCRIPTION



When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause increases in exhaust emission levels. High concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent these increases in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the TWC reaches the point of thermal degradation, the MIL blinks. To monitor misfires, the ECM uses both the Camshaft Position (CMP) sensor and the Crankshaft Position (CKP) sensor. The CMP sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted as when the crankshaft rotation speed variations exceed predetermined thresholds.
If the misfire rate exceeds the threshold level, the ECM stores DTC(s).

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC). • An emission deterioration misfire occurs.	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Fuel injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306 P0307 P0308	Misfiring of a specific cylinder occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC). • An emission deterioration misfire occurs.	

HINT:

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

MONITOR DESCRIPTION

The ECM stores a DTC when either one of the following conditions, which could cause emission deterioration, is detected (2 trip detection logic).

- Within the first 1000 crankshaft revolutions of the engine starting, an excessive misfiring rate (approximately 30 to 110 misfires per 1000

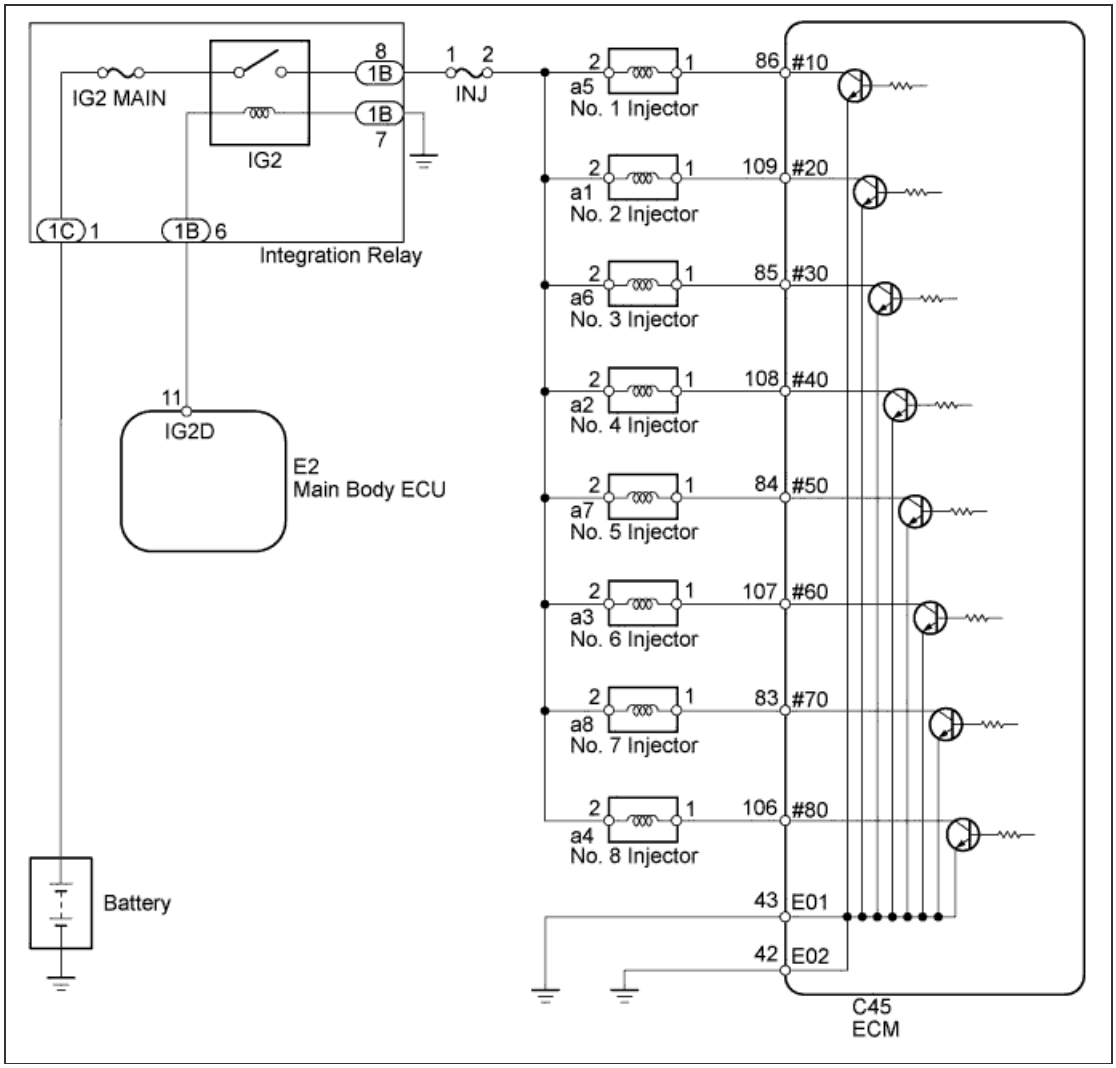
crankshaft revolutions) occurs once.

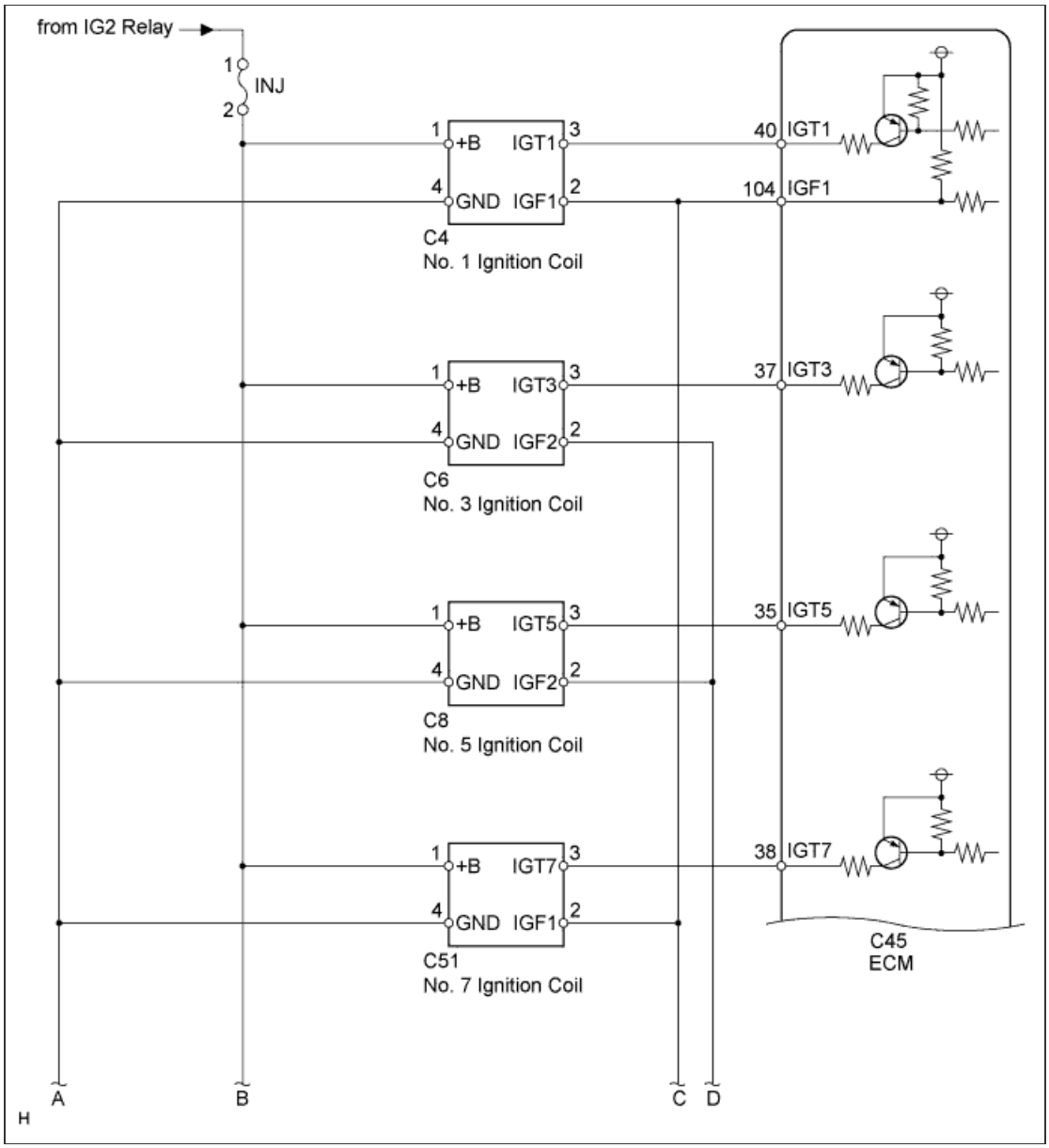
- An excessive misfiring rate (approximately 30 to 110 misfires per 1000 crankshaft revolutions) occurs a total of 4 times.

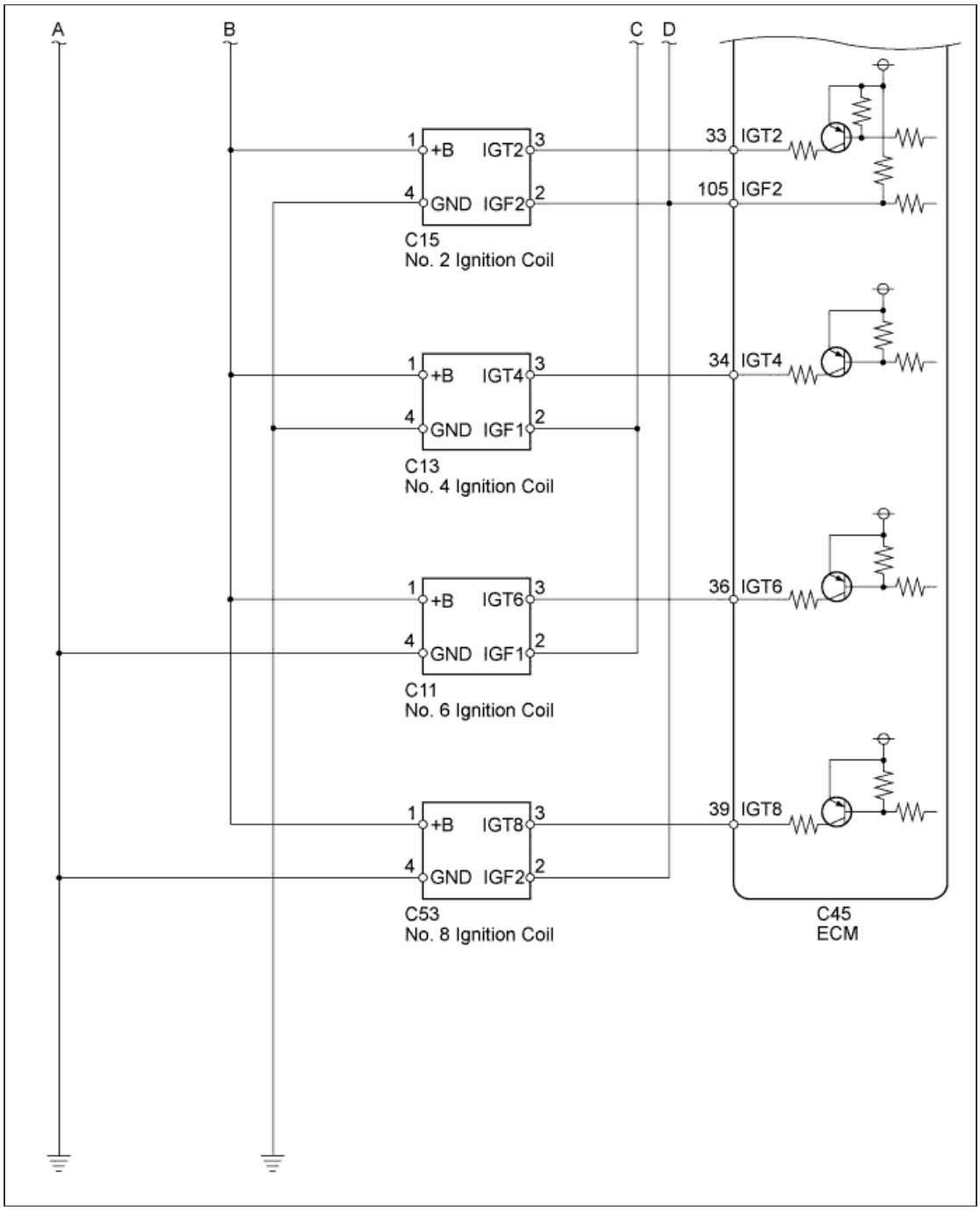
The ECM stores DTC(s) when either one of the following conditions, which could cause the Three-Way Catalytic Converter (TWC) damage, is detected (2 trip detection logic).

- At a high engine speed, a catalyst damage misfire, which monitored every 200 crankshaft revolutions, occurs once.
- At a normal engine speed, a catalyst damage misfire, which monitored every 200 crankshaft revolutions, occurs 3 times.

WIRING DIAGRAM




from IG2 Relay
1
INJ
2
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
38
IGT7
C45
ECM
A
B
C
D
H



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Turn the tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire counts of each cylinder (cylinder No. 1 to No. 8) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
7. Drive the vehicle several times with the conditions, such as engine speed and engine load, shown in Misfire RPM and Misfire Load in the Data List.

HINT:

In order to store misfire DTCs, it is necessary to operate the vehicle for the period of time shown in the table below, with the Misfire RPM and Misfire Load in the Data List.

Engine Speed	Duration
Idling	7 minutes or more
1000	4 minutes or more
2000	2 minutes or more
3000	1.5 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

   HINT:

   Do not turn the engine switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data will be cleared.

9. Record the DTC(s), freeze frame data and misfire counts.
10. Turn the engine switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **DTC P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are for Euro-OBD only.**
- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the freeze frame data have been duplicated, one of the following factors is considered to be a possible cause of the problem:**
  1. **The fuel level is low.**
  2. **Improper fuel is used.**
  3. **The spark plugs are dirty.**
- **After finishing repairs, check that no misfires occur in each cylinder (cylinder No. 1, No. 2, No. 3, No. 4, No. 5, No. 6, No. 7 and No. 8).**
- **Be sure to confirm that no misfiring cylinder DTCs are output again by conducting the confirmation driving pattern after the repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speed. If misfires only occur during high engine speed driving, only DTC P0300 is stored.**
  In the event of DTC P0300 being present, perform the following operations:
  1. **Clear the DTC (Click here).**
  2. **Start the engine and conduct the confirmation driving pattern.**
  3. **Read the misfiring rates of each cylinder or DTC(s) using the intelligent tester.**
  4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
  5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not output.**
- **When either Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air-fuel ratio may be rich (-20% or less) or lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is below 75°C (167°F), the misfires occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel which causes body vibration may cause misfire DTCs to be detected.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 are output	A
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 and other DTCs are output	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is connected correctly and is not damaged.

NG → **REPAIR OR REPLACE PCV HOSE (Click here)**

OK

3.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

4.READ VALUE USING INTELLIGENT TESTER (MISFIRE COUNT)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5, #6, #7 and #8.

f. Allow the engine to idle.

g. Read each value for Cylinder #1 Misfire Count to #8 displayed on the tester. If no misfire counts occur in any cylinders, perform the following procedures:

i. Move the shift lever to D.

ii. Check the Cylinder #1 Misfire Count to #8.

iii. If misfire counts are still not displayed, perform procedure A and and then check the misfire counts again.

h. Drive the vehicle with the Misfire RPM and Misfire Load noted in the ad Value Using tester (Misfire RPM and Misfire Load) procedures above (Procedure A).

i. Read the Cylinder #1 Misfire Count to #8 or DTCs displayed on the tester (Procedure).

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have e ual misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data record of the Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → **Go to step 16**

A

5.INSPECT SPARK PLUG

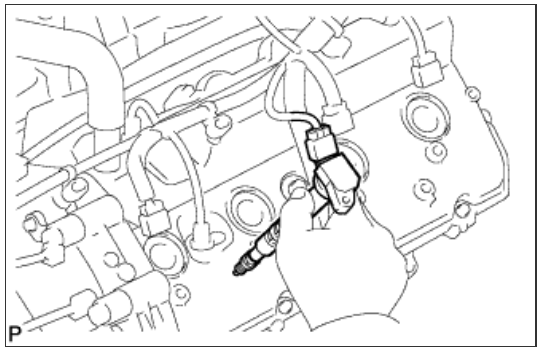
a. Inspect the spark plug of the misfiring cylinder (Click here).

NG → REPLACE SPARK PLUG (**Click here**)

OK

6.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.



CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → **Go to step 32**

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → GO TO FUEL INJECTOR CIRCUIT (**Click here**)

OK

9.CHECK HARNESS AND CONNECTOR

a. Disconnect the fuel injector connector.

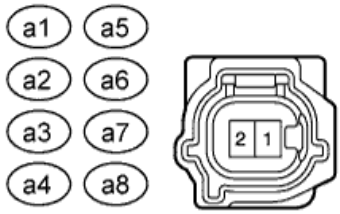
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

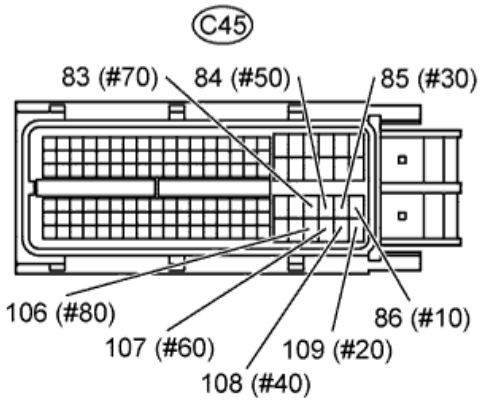
Standard Resistance:

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	a5-1 - Body ground	Always	10 kΩ or higher
	a5-1 - C45-86 (#10)	Always	Below 1 Ω
No. 2	a1-1 - Body ground	Always	10 kΩ or higher
	a1-1 - C45-109 (#20)	Always	Below 1 Ω
No. 3	a6-1 - Body ground	Always	10 kΩ or higher
	a6-1 - C45-85 (#30)	Always	Below 1 Ω
No. 4	a2-1 - Body ground	Always	10 kΩ or higher
	a2-1 - C45-108 (#40)	Always	Below 1 Ω
No. 5	a7-1 - Body ground	Always	10 kΩ or higher
	a7-1 - C45-84 (#50)	Always	Below 1 Ω
No. 6	a3-1 - Body ground	Always	10 kΩ or higher
	a3-1 - C45-107 (#60)	Always	Below 1 Ω
No. 7	a8-1 - Body ground	Always	10 kΩ or higher
	a8-1 - C45-83 (#70)	Always	Below 1 Ω
No. 8	a4-1 - Body ground	Always	10 kΩ or higher
	a4-1 - C45-106 (#80)	Always	Below 1 Ω

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (Click here)

OK

11.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

12.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → Go to step 34

OK

13.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

e. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine:
Same as ambient air temperature.
With warm engine:
Between 75°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

14.INSPECT MASS AIR FLOW METER

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF and Coolant Temp.

e. Allow the engine to idle until Coolant Temp reaches 75 C (167 F) or higher.

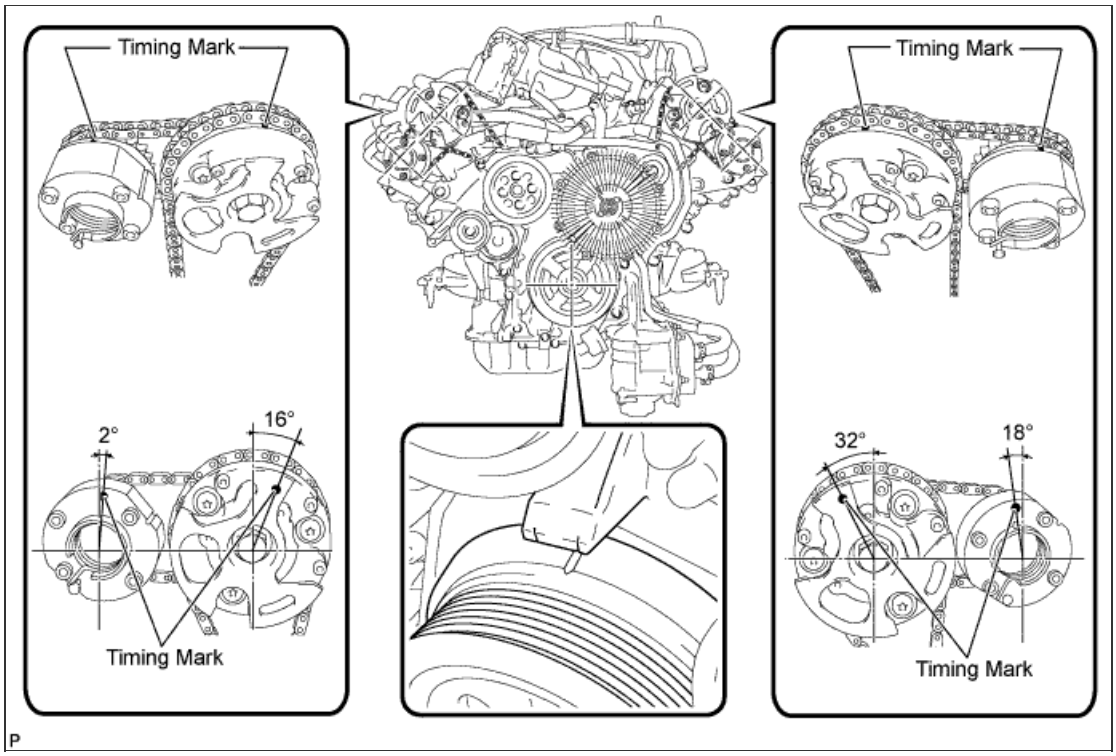
f. Read MAF with the engine speed at 3000 rpm.

Standard:
Between 25.2 gm/s and 35.2 gm/s (shift lever: N; A/C: Off).

NG → Go to step 27

OK

15.CHECK VALVE TIMING



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark 0 of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.

OK	Go to step 27
NG	ADJUST VALVE TIMING (Click here)

16.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG	REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

17.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG	Go to step 34

OK

18.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine:
Same as ambient air temperature.
With warm engine:
Between 75°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

19.INSPECT MASS AIR FLOW METER

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF and Coolant Temp.

e. Allow the engine to idle until Coolant Temp reaches 75 C (167 F) or higher.

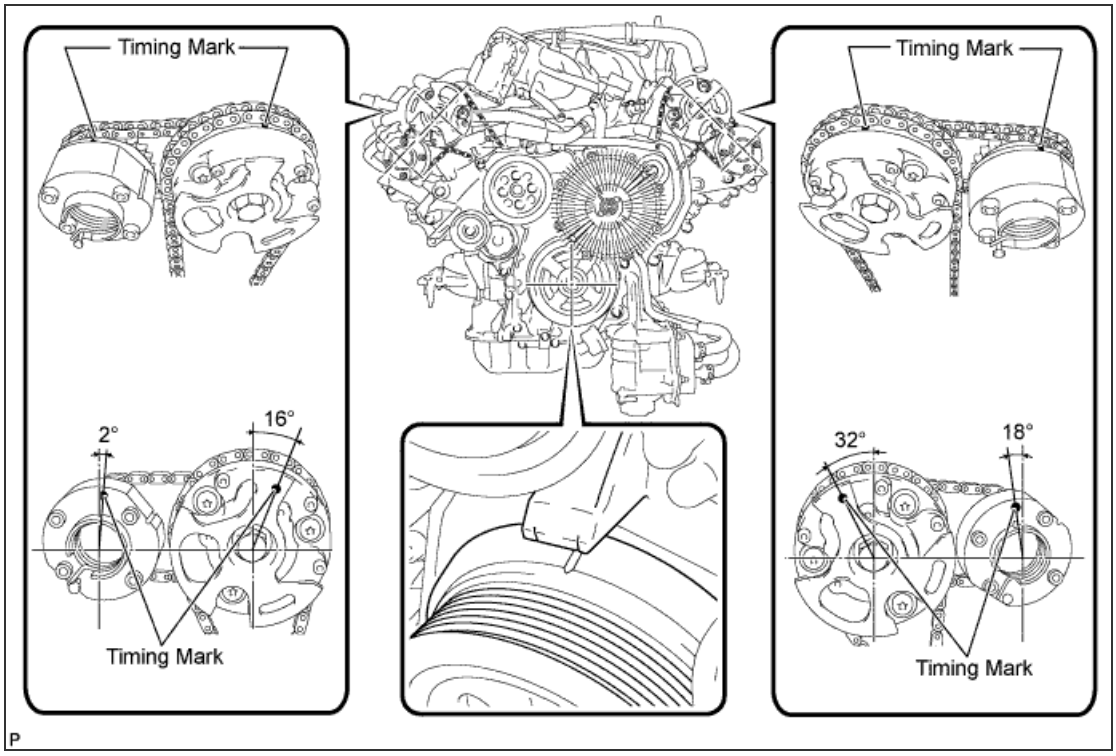
f. Read MAF with the engine speed at 3000 rpm.

Standard:
Between 25.2 gm/s and 35.2 gm/s (shift lever: N; A/C: Off).

NG → Go to step 27

OK

20.CHECK VALVE TIMING



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark 0 of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:

Timing marks on camshaft timing gears are aligned as shown in the illustration.

NG → ADJUST VALVE TIMING (Click here)

OK ↓

21.INSPECT SPARK PLUG

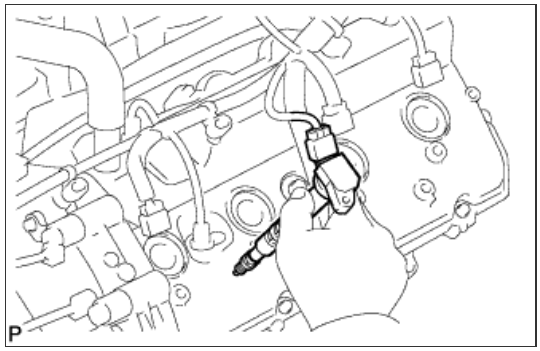
a. Inspect the spark plug of the misfiring cylinder (Click here).

NG → REPLACE SPARK PLUG (Click here)

OK ↓

22.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.



CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 32

OK ↓

23.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK ↓

24.CHECK FUEL INJECTOR ASSEMBLY (POWER SOURCE)

a. Disconnect the fuel injector connector.

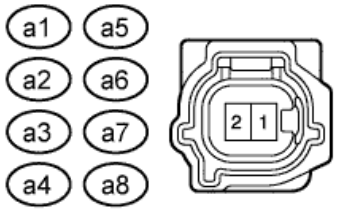
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	a5-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	a1-2 - Ground	Engine switch	11 to 14 V

		on (IG)	
No. 3	a6-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	a2-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	a7-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	a3-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	a8-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	a4-2 - Ground	Engine switch on (IG)	11 to 14 V

Front view of wire harness connector:
(to Injector)



NG → GO TO FUEL INJECTOR CIRCUIT (Click here)

OK

25.CHECK HARNESS AND CONNECTOR (FUEL INJECTOR - ECM)

a. Disconnect the fuel injector connector.

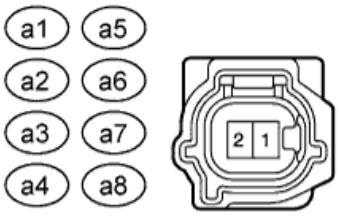
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

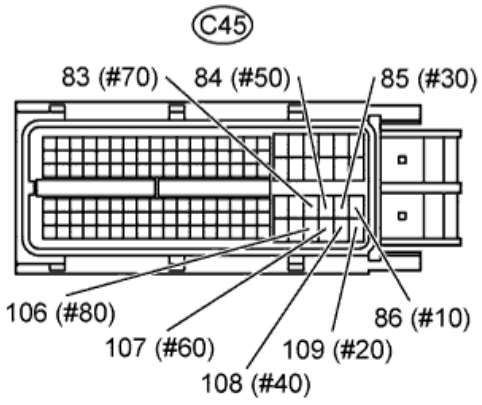
Standard Resistance:

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	a5-1 - Body ground	Always	10 kΩ or higher
	a5-1 - C45-86 (#10)	Always	Below 1 Ω
No. 2	a1-1 - Body ground	Always	10 kΩ or higher
	a1-1 - C45-109 (#20)	Always	Below 1 Ω
No. 3	a6-1 - Body ground	Always	10 kΩ or higher
	a6-1 - C45-85 (#30)	Always	Below 1 Ω
No. 4	a2-1 - Body ground	Always	10 kΩ or higher
	a2-1 - C45-108 (#40)	Always	Below 1 Ω
No. 5	a7-1 - Body ground	Always	10 kΩ or higher
	a7-1 - C45-84 (#50)	Always	Below 1 Ω
No. 6	a3-1 - Body ground	Always	10 kΩ or higher
	a3-1 - C45-107 (#60)	Always	Below 1 Ω
No. 7	a8-1 - Body ground	Always	10 kΩ or higher
	a8-1 - C45-83 (#70)	Always	Below 1 Ω
No. 8	a4-1 - Body ground	Always	10 kΩ or higher
	a4-1 - C45-106 (#80)	Always	Below 1 Ω

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.CHECK FUEL INJECTOR ASSEMBLY OF MISFIRING CYLINDER

Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (**Click here**)

OK

27.CHECK HARNESS AND CONNECTOR

a. Check the connection and terminal contact pressure of connectors and wire harnesses between the mass air flow meter and ECM (Click here).

HINT:

Repair any problems.

NEXT

28.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Turn the engine switch off.

f. Turn the engine switch on (IG) and turn the tester on.

g. Start the engine and warm it up.

h. Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input the DTC: P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308.

k. Check the DTC judgment result.

Result

Display (DTC Output)	Proceed to
ABNORMAL (P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308 output)	A
NORMAL (No DTC output)	B

B → END

A

29.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the mass air flow meter connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

		Specified

Tester Connection	Condition	Condition
C50-3 (VG) - C45-74 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C45-75 (E2G)	Always	Below 1 Ω
C50-3 (VG) or C45-74 (VG) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

30.REPLACE MASS AIR FLOW METER

Replace the mass air flow meter assembly (Click here).

HINT:

If the results of the inspections performed in steps 14 and 21 indicated no problem, proceed to the next step without replacing the mass air flow meter assembly.

NEXT

31.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Turn the engine switch off.

f. Turn the engine switch on (IG) and turn the tester on.

g. Start the engine and warm it up.

h. Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input the DTC: P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308.

k. Check the DTC judgment result.

Result

Display (DTC Output)	Proceed to
NORMAL (No DTC output)	A
ABNORMAL (P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308 output)	B

B → REPLACE ECM (**Click here**)

A

END

32.CHANGE TO CHANGE TO NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

a. Change the installed spark plug to a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → Go to step 33

OK ↓

REPLACE SPARK PLUG (Click here)

33.CHANGE TO NORMAL IGNITION COIL AND CHECK SPARK OF MISFIRING CYLINDER

a. Change the ignition coil to an ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK ↓

REPLACE IGNITION COIL (Click here)

34.CHECK FUEL LINE

a. Check the fuel lines for leaks or blockage.

NG → REPAIR OR REPLACE FUEL LINE

OK ↓

REPLACE FUEL PUMP ASSEMBLY (Click here)

DTC P2111 Throttle Actuator Control System - Stuck Open

DTC P2112 Throttle Actuator Control System - Stuck Closed

for Preparation Click here

DESCRIPTION

The throttle actuator is operated by the ECM, and opens and closes the throttle valve using gears. The opening angle of the throttle valve is detected by the Throttle Position (TP) sensor, which is mounted on the throttle body. The TP sensor provides feedback to the ECM so that it can control the throttle actuator (throttle valve) appropriately in response to driver inputs.

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

DTC Code	DTC Detection Condition	Trouble Area
P2111	The throttle actuator does not close when signaled by the ECM (1 trip detection logic).	• **Throttle actuator** • **Throttle body assembly** • **Throttle valve**
P2112	The throttle actuator does not open when signaled by the ECM (1 trip detection logic).	• **Throttle actuator** • **Throttle body assembly** • **Throttle valve**

MONITOR DESCRIPTION

The ECM determines that there is a malfunction in the ETCS when the throttle valve remains at a fixed angle despite a high drive current from the ECM. The ECM illuminates the MIL and stores DTC(s).
If the malfunction is not repaired successfully, a DTC is stored when the accelerator pedal is fully depressed and released quickly (to fully open and close the throttle valve) after the engine is next started.

FAIL-SAFE

When either of these DTCs, or other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM

Refer to DTC P2102 (Click here).

INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Refer to Data List Active Test Throttle Position Command, Throttle Position No. 1, Throttle Motor Current, Throttle Motor Duty (Open Throttle Motor Duty (Close Click here .**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2111 OR P2112

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P2111 or P2112 is output	A
P2111 or P2112 and other DTCs are output	B

HINT:

If any DTCs other than P2111 or P2112 are output, troubleshoot those DTCs first.

GO TO DTC CHART (Click here

A

2.INSPECT THROTTLE ODY ASSEM LY (VISUALLY CHECK THROTTLE VALVE

a. Check for contamination between the throttle valve and the housing. If necessary, clean the throttle body. And check that the throttle valve moves smoothly.

OK:
Throttle valve is not contaminated with foreign objects and moves smoothly.

NG → Go to step 4

OK

.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Turn the engine switch off and wait for at least 30 seconds.

f. Turn the engine switch on (IG).

g. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Throttle Position No. 1, Throttle Position No. 2 and Throttle Position Command.

h. Check the values displayed on the tester while wiggling the ECM wire harness.

i. Enter the following menus: Powertrain / Engine and ECT / DTC.

j. Check for DTCs.

Result

Result	Proceed to
Value in Data List changes when wire harness is wiggled, or DTC is output*	A
ther than above	B

*: As the DTC was stored due to a change in the contact resistance of the connector, repair or replace the wire harness or connector (Click here).

Go to step

A

REPAIR OR REPLACE HARNESS OR CONNECTOR

4.REPLACE THROTTLE ODY ASSEM LY

a. Replace the throttle body assembly (Click here).

NEXT

.CHECK WHETHER DTC OUTPUT RECURS (DTC P2111 OR P2112

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine, and fully depress and release the accelerator pedal quickly (to fully open and close the throttle valve).

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P2111 or P2112 is output	B

REPLACE ECM (Click here

A

END

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

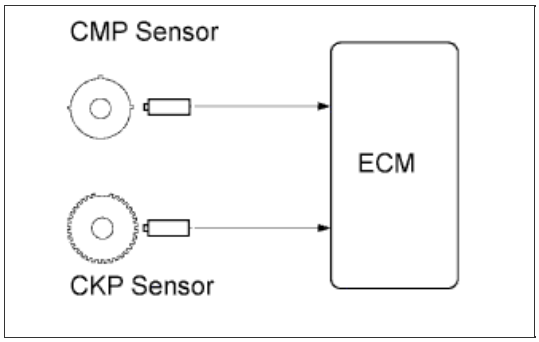
DTC P0306 Cylinder 6 Misfire Detected

DTC P0307 Cylinder 7 Misfire Detected

DTC P0308 Cylinder 8 Misfire Detected

for Preparation Click here

DESCRIPTION



When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause increases in exhaust emission levels. High concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent these increases in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the TWC reaches the point of thermal degradation, the MIL blinks. To monitor misfires, the ECM uses both the Camshaft Position (CMP) sensor and the Crankshaft Position (CKP) sensor. The CMP sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted as when the crankshaft rotation speed variations exceed predetermined thresholds.
If the misfire rate exceeds the threshold level, the ECM stores DTC(s).

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC). • An emission deterioration misfire occurs.	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Fuel injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306 P0307 P0308	Misfiring of a specific cylinder occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC). • An emission deterioration misfire occurs.	

HINT:

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

MONITOR DESCRIPTION

The ECM stores a DTC when either one of the following conditions, which could cause emission deterioration, is detected (2 trip detection logic).

- Within the first 1000 crankshaft revolutions of the engine starting, an excessive misfiring rate (approximately 30 to 110 misfires per 1000

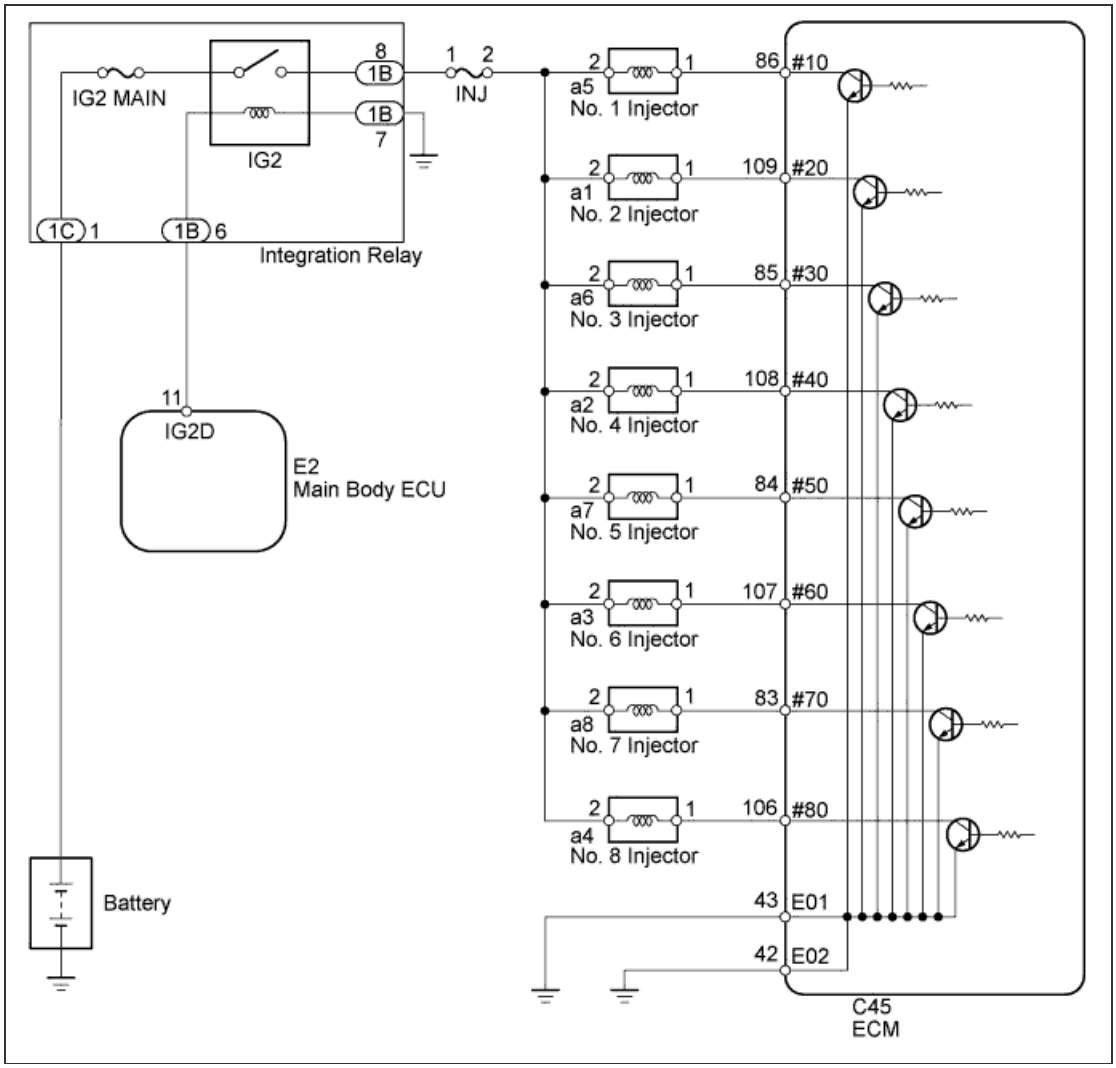
crankshaft revolutions) occurs once.

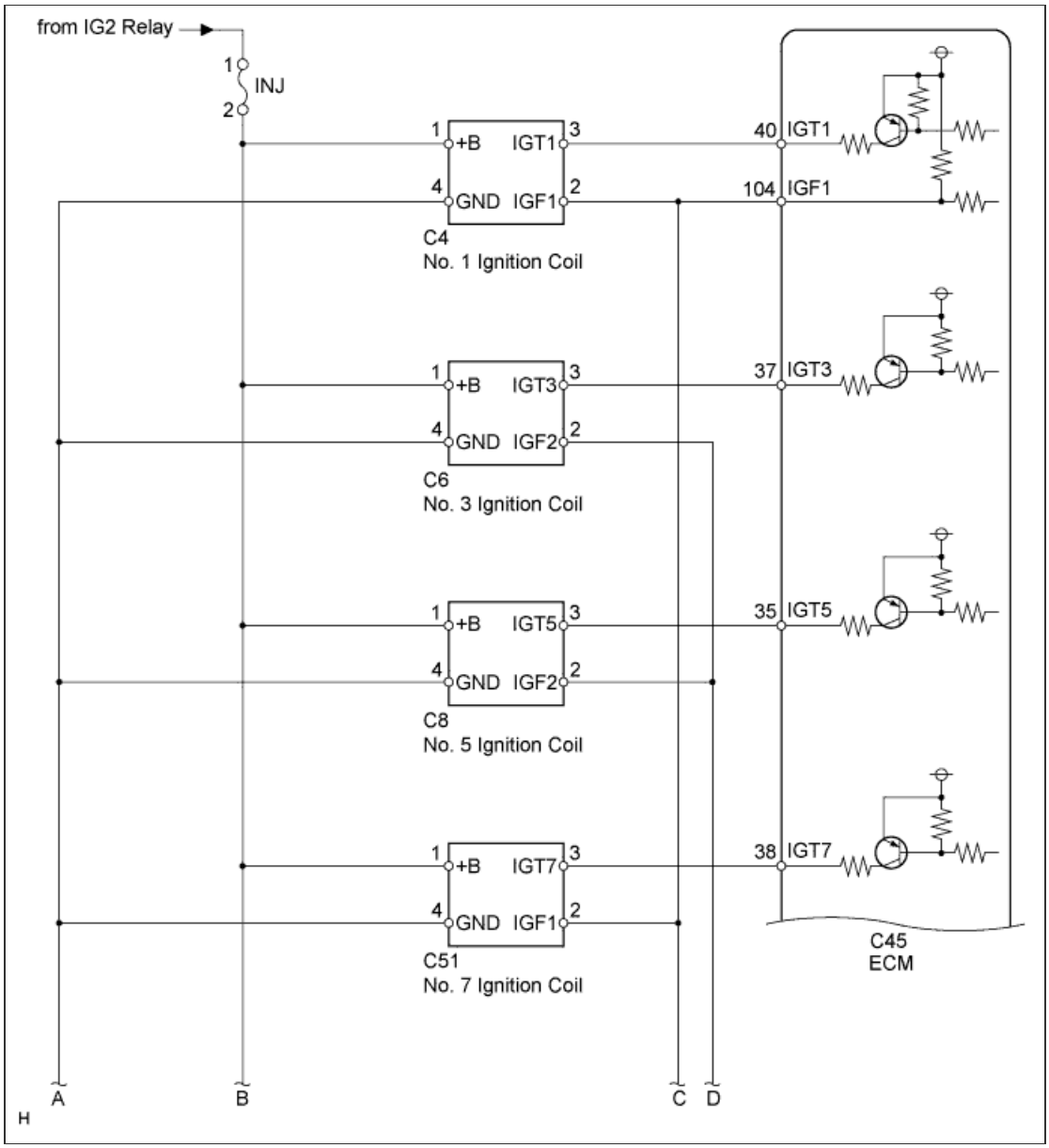
- An excessive misfiring rate (approximately 30 to 110 misfires per 1000 crankshaft revolutions) occurs a total of 4 times.

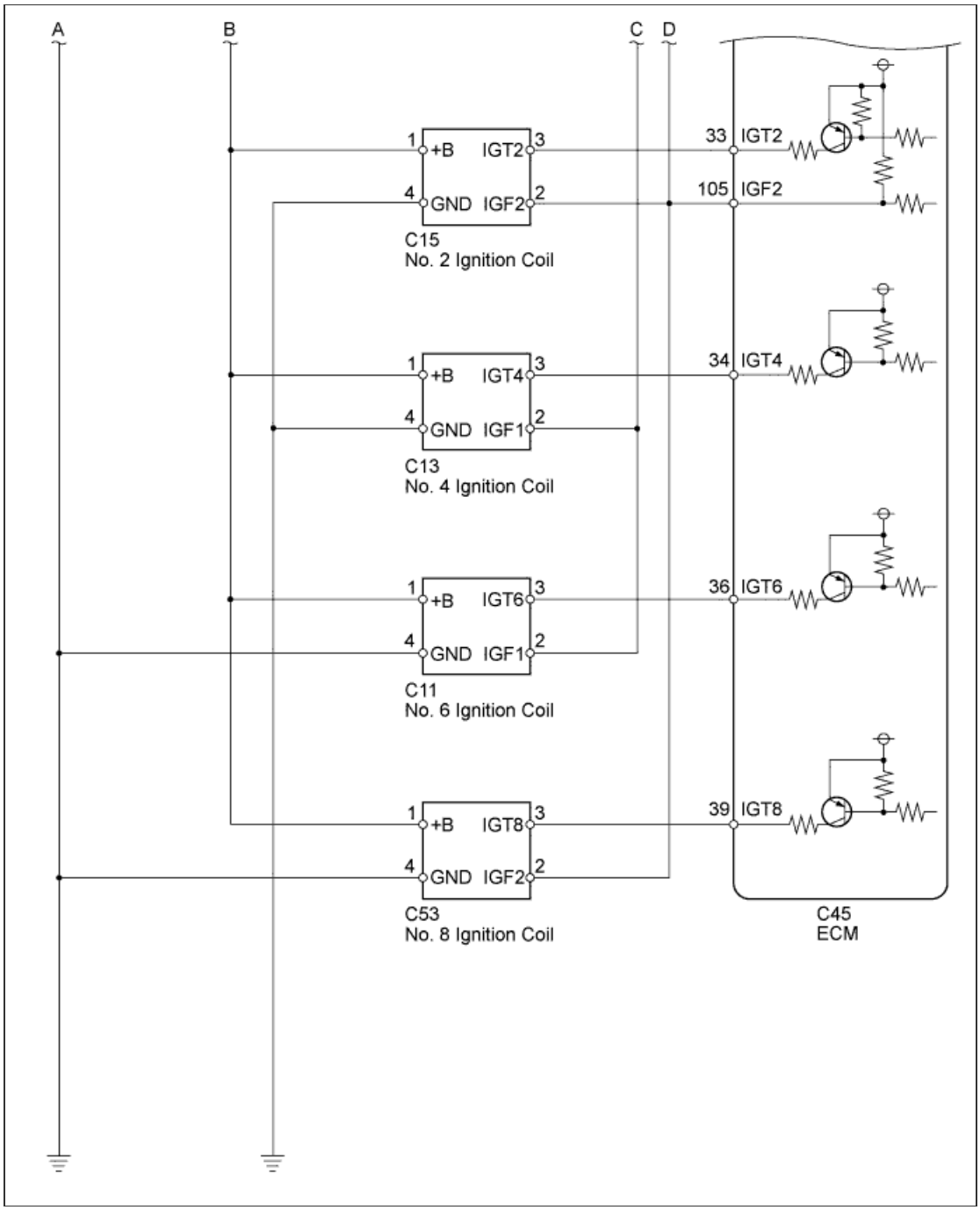
The ECM stores DTC(s) when either one of the following conditions, which could cause the Three-Way Catalytic Converter (TWC) damage, is detected (2 trip detection logic).

- At a high engine speed, a catalyst damage misfire, which monitored every 200 crankshaft revolutions, occurs once.
- At a normal engine speed, a catalyst damage misfire, which monitored every 200 crankshaft revolutions, occurs 3 times.

WIRING DIAGRAM




from IG2 Relay
1
INJ
2
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
38
IGT7
C45
ECM
A
B
C
D
H



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Turn the tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire counts of each cylinder (cylinder No. 1 to No. 8) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
7. Drive the vehicle several times with the conditions, such as engine speed and engine load, shown in Misfire RPM and Misfire Load in the Data List.

HINT:

In order to store misfire DTCs, it is necessary to operate the vehicle for the period of time shown in the table below, with the Misfire RPM and Misfire Load in the Data List.

Engine Speed	Duration
Idling	7 minutes or more
1000	4 minutes or more
2000	2 minutes or more
3000	1.5 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

   HINT:

   Do not turn the engine switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data will be cleared.

9. Record the DTC(s), freeze frame data and misfire counts.
10. Turn the engine switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **DTC P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are for Euro-OBD only.**
- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the freeze frame data have been duplicated, one of the following factors is considered to be a possible cause of the problem:**
  1. **The fuel level is low.**
  2. **Improper fuel is used.**
  3. **The spark plugs are dirty.**
- **After finishing repairs, check that no misfires occur in each cylinder (cylinder No. 1, No. 2, No. 3, No. 4, No. 5, No. 6, No. 7 and No. 8).**
- **Be sure to confirm that no misfiring cylinder DTCs are output again by conducting the confirmation driving pattern after the repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speed. If misfires only occur during high engine speed driving, only DTC P0300 is stored.**
  In the event of DTC P0300 being present, perform the following operations:
  1. **Clear the DTC (Click here).**
  2. **Start the engine and conduct the confirmation driving pattern.**
  3. **Read the misfiring rates of each cylinder or DTC(s) using the intelligent tester.**
  4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
  5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not output.**
- **When either Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air-fuel ratio may be rich (-20% or less) or lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is below 75°C (167°F), the misfires occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel which causes body vibration may cause misfire DTCs to be detected.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 are output	A
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 and other DTCs are output	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is connected correctly and is not damaged.

NG → **REPAIR OR REPLACE PCV HOSE (Click here)**

OK

3.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

4.READ VALUE USING INTELLIGENT TESTER (MISFIRE COUNT)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5, #6, #7 and #8.

f. Allow the engine to idle.

g. Read each value for Cylinder #1 Misfire Count to #8 displayed on the tester. If no misfire counts occur in any cylinders, perform the following procedures:

i. Move the shift lever to D.

ii. Check the Cylinder #1 Misfire Count to #8.

iii. If misfire counts are still not displayed, perform procedure A and and then check the misfire counts again.

h. Drive the vehicle with the Misfire RPM and Misfire Load noted in the ad Value Using tester (Misfire RPM and Misfire Load) procedures above (Procedure A).

i. Read the Cylinder #1 Misfire Count to #8 or DTCs displayed on the tester (Procedure).

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have e ual misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data record of the Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → **Go to step 16**

A

5.INSPECT SPARK PLUG

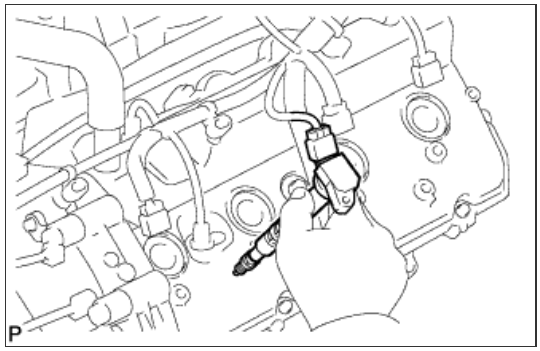
a. Inspect the spark plug of the misfiring cylinder (Click here).

NG → REPLACE SPARK PLUG (**Click here**)

OK

6.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.



CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → **Go to step 32**

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → GO TO FUEL INJECTOR CIRCUIT (**Click here**)

OK

9.CHECK HARNESS AND CONNECTOR

a. Disconnect the fuel injector connector.

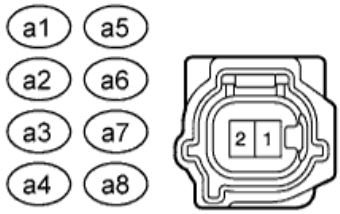
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

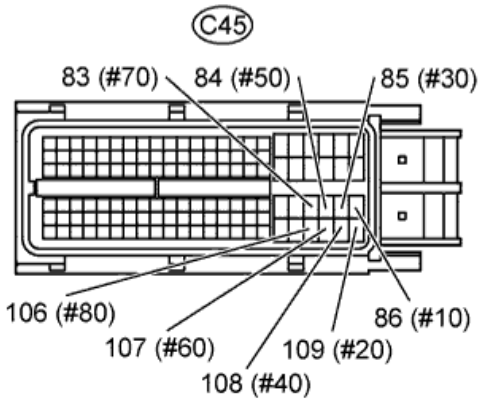
Standard Resistance:

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	a5-1 - Body ground	Always	10 kΩ or higher
	a5-1 - C45-86 (#10)	Always	Below 1 Ω
No. 2	a1-1 - Body ground	Always	10 kΩ or higher
	a1-1 - C45-109 (#20)	Always	Below 1 Ω
No. 3	a6-1 - Body ground	Always	10 kΩ or higher
	a6-1 - C45-85 (#30)	Always	Below 1 Ω
No. 4	a2-1 - Body ground	Always	10 kΩ or higher
	a2-1 - C45-108 (#40)	Always	Below 1 Ω
No. 5	a7-1 - Body ground	Always	10 kΩ or higher
	a7-1 - C45-84 (#50)	Always	Below 1 Ω
No. 6	a3-1 - Body ground	Always	10 kΩ or higher
	a3-1 - C45-107 (#60)	Always	Below 1 Ω
No. 7	a8-1 - Body ground	Always	10 kΩ or higher
	a8-1 - C45-83 (#70)	Always	Below 1 Ω
No. 8	a4-1 - Body ground	Always	10 kΩ or higher
	a4-1 - C45-106 (#80)	Always	Below 1 Ω

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (Click here)

OK

11.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

12.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → Go to step 34

OK

13.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

e. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine:
Same as ambient air temperature.
With warm engine:
Between 75°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

14.INSPECT MASS AIR FLOW METER

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF and Coolant Temp.

e. Allow the engine to idle until Coolant Temp reaches 75 C (167 F) or higher.

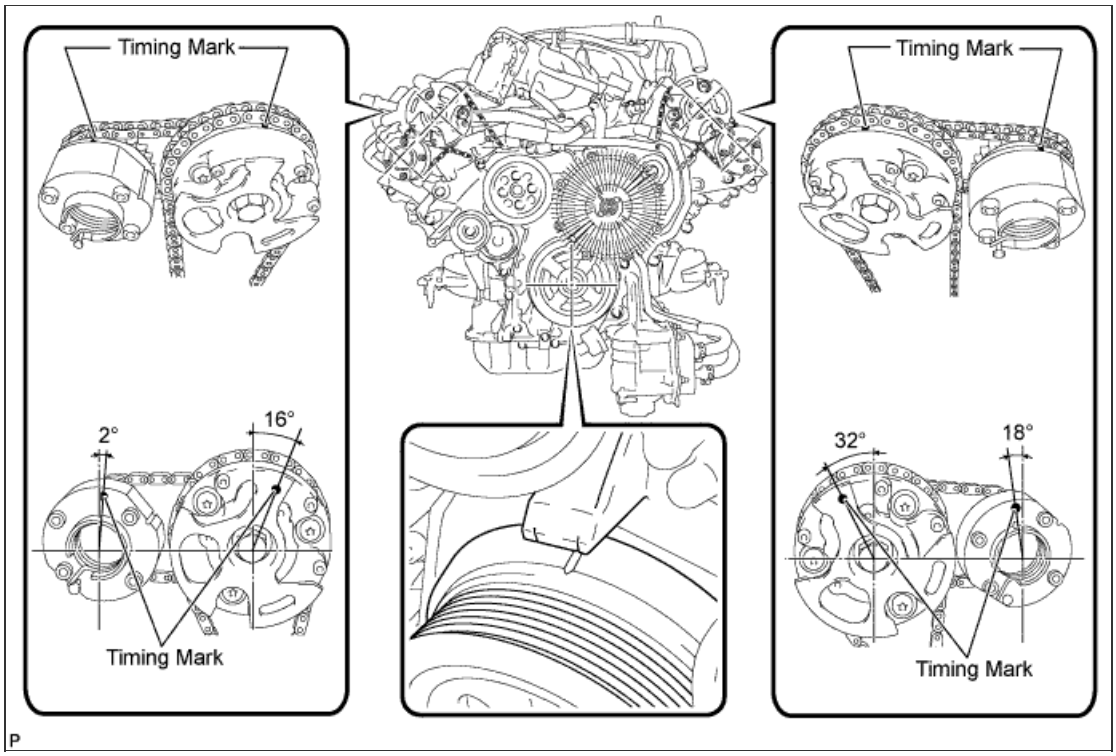
f. Read MAF with the engine speed at 3000 rpm.

Standard:
Between 25.2 gm/s and 35.2 gm/s (shift lever: N; A/C: Off).

NG → Go to step 27

OK

15.CHECK VALVE TIMING



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark 0 of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.

OK	Go to step 27
NG	ADJUST VALVE TIMING (Click here)

16.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG	REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

17.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG	Go to step 34

OK

18.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine:
Same as ambient air temperature.
With warm engine:
Between 75°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

19.INSPECT MASS AIR FLOW METER

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF and Coolant Temp.

e. Allow the engine to idle until Coolant Temp reaches 75 C (167 F) or higher.

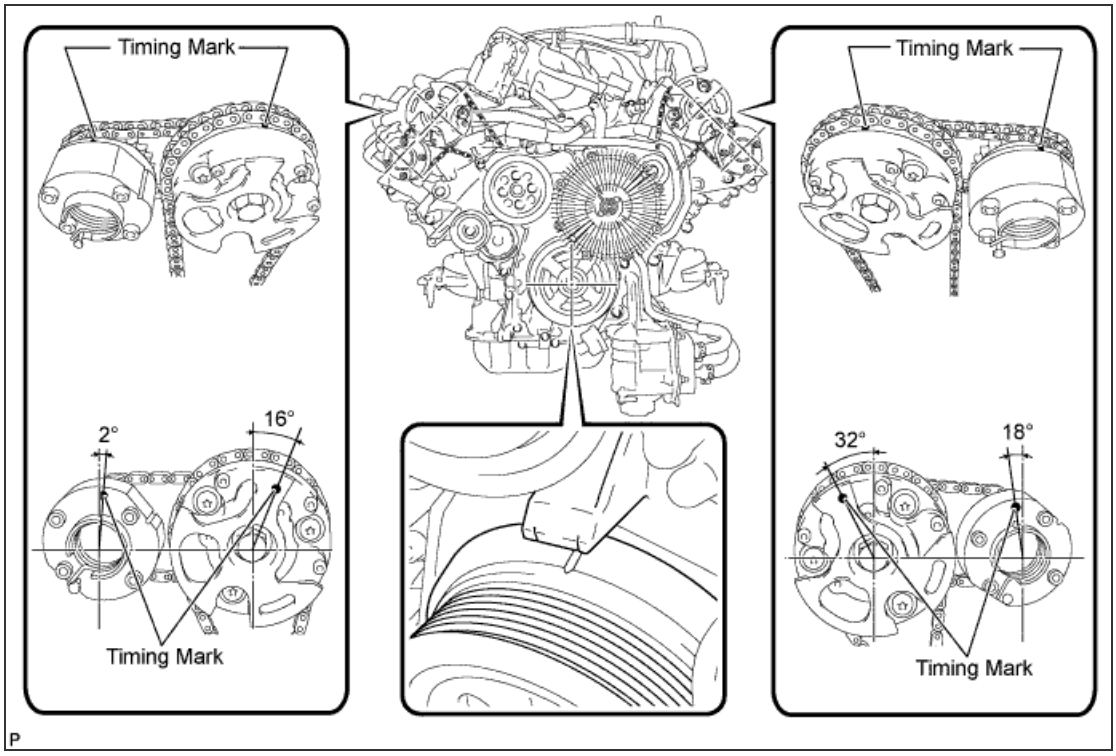
f. Read MAF with the engine speed at 3000 rpm.

Standard:
Between 25.2 gm/s and 35.2 gm/s (shift lever: N; A/C: Off).

NG → Go to step 27

OK

20.CHECK VALVE TIMING



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark 0 of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:

Timing marks on camshaft timing gears are aligned as shown in the illustration.

NG → ADJUST VALVE TIMING (Click here)

OK ↓

21.INSPECT SPARK PLUG

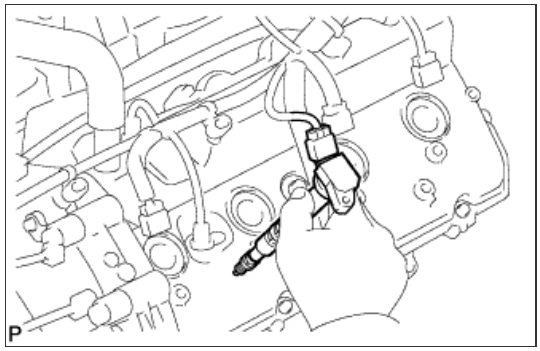
a. Inspect the spark plug of the misfiring cylinder (Click here).

NG → REPLACE SPARK PLUG (Click here)

OK ↓

22.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.



CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 32

OK ↓

23.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK ↓

24.CHECK FUEL INJECTOR ASSEMBLY (POWER SOURCE)

a. Disconnect the fuel injector connector.

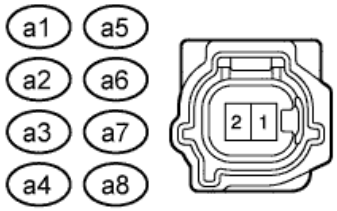
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	a5-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	a1-2 - Ground	Engine switch	11 to 14 V

		on (IG)	
No. 3	a6-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	a2-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	a7-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	a3-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	a8-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	a4-2 - Ground	Engine switch on (IG)	11 to 14 V

Front view of wire harness connector:
(to Injector)



NG → GO TO FUEL INJECTOR CIRCUIT (Click here)

OK

25.CHECK HARNESS AND CONNECTOR (FUEL INJECTOR - ECM)

a. Disconnect the fuel injector connector.

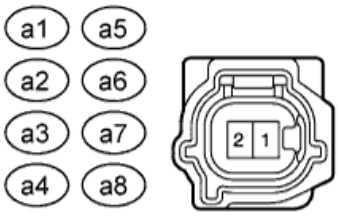
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

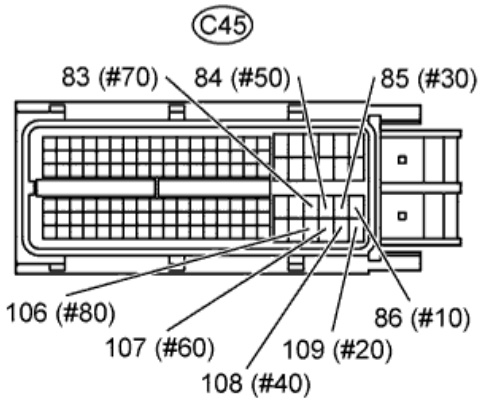
Standard Resistance:

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	a5-1 - Body ground	Always	10 kΩ or higher
	a5-1 - C45-86 (#10)	Always	Below 1 Ω
No. 2	a1-1 - Body ground	Always	10 kΩ or higher
	a1-1 - C45-109 (#20)	Always	Below 1 Ω
No. 3	a6-1 - Body ground	Always	10 kΩ or higher
	a6-1 - C45-85 (#30)	Always	Below 1 Ω
No. 4	a2-1 - Body ground	Always	10 kΩ or higher
	a2-1 - C45-108 (#40)	Always	Below 1 Ω
No. 5	a7-1 - Body ground	Always	10 kΩ or higher
	a7-1 - C45-84 (#50)	Always	Below 1 Ω
No. 6	a3-1 - Body ground	Always	10 kΩ or higher
	a3-1 - C45-107 (#60)	Always	Below 1 Ω
No. 7	a8-1 - Body ground	Always	10 kΩ or higher
	a8-1 - C45-83 (#70)	Always	Below 1 Ω
No. 8	a4-1 - Body ground	Always	10 kΩ or higher
	a4-1 - C45-106 (#80)	Always	Below 1 Ω

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.CHECK FUEL INJECTOR ASSEMBLY OF MISFIRING CYLINDER

Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (**Click here**)

OK

27.CHECK HARNESS AND CONNECTOR

a. Check the connection and terminal contact pressure of connectors and wire harnesses between the mass air flow meter and ECM (Click here).

HINT:

Repair any problems.

NEXT

28.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Turn the engine switch off.

f. Turn the engine switch on (IG) and turn the tester on.

g. Start the engine and warm it up.

h. Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input the DTC: P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308.

k. Check the DTC judgment result.

Result

Display (DTC Output)	Proceed to
ABNORMAL (P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308 output)	A
NORMAL (No DTC output)	B

B → END

A

29.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the mass air flow meter connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

		Specified

Tester Connection	Condition	Condition
C50-3 (VG) - C45-74 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C45-75 (E2G)	Always	Below 1 Ω
C50-3 (VG) or C45-74 (VG) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

30.REPLACE MASS AIR FLOW METER

Replace the mass air flow meter assembly (Click here).

HINT:

If the results of the inspections performed in steps 14 and 21 indicated no problem, proceed to the next step without replacing the mass air flow meter assembly.

NEXT

31.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Turn the engine switch off.

f. Turn the engine switch on (IG) and turn the tester on.

g. Start the engine and warm it up.

h. Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input the DTC: P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308.

k. Check the DTC judgment result.

Result

Display (DTC Output)	Proceed to
NORMAL (No DTC output)	A
ABNORMAL (P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308 output)	B

B → REPLACE ECM (**Click here**)

A

END

32.CHANGE TO CHANGE TO NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

a. Change the installed spark plug to a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → Go to step 33

OK ↓

REPLACE SPARK PLUG (Click here)

33.CHANGE TO NORMAL IGNITION COIL AND CHECK SPARK OF MISFIRING CYLINDER

a. Change the ignition coil to an ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK ↓

REPLACE IGNITION COIL (Click here)

34.CHECK FUEL LINE

a. Check the fuel lines for leaks or blockage.

NG → REPAIR OR REPLACE FUEL LINE

OK ↓

REPLACE FUEL PUMP ASSEMBLY (Click here)

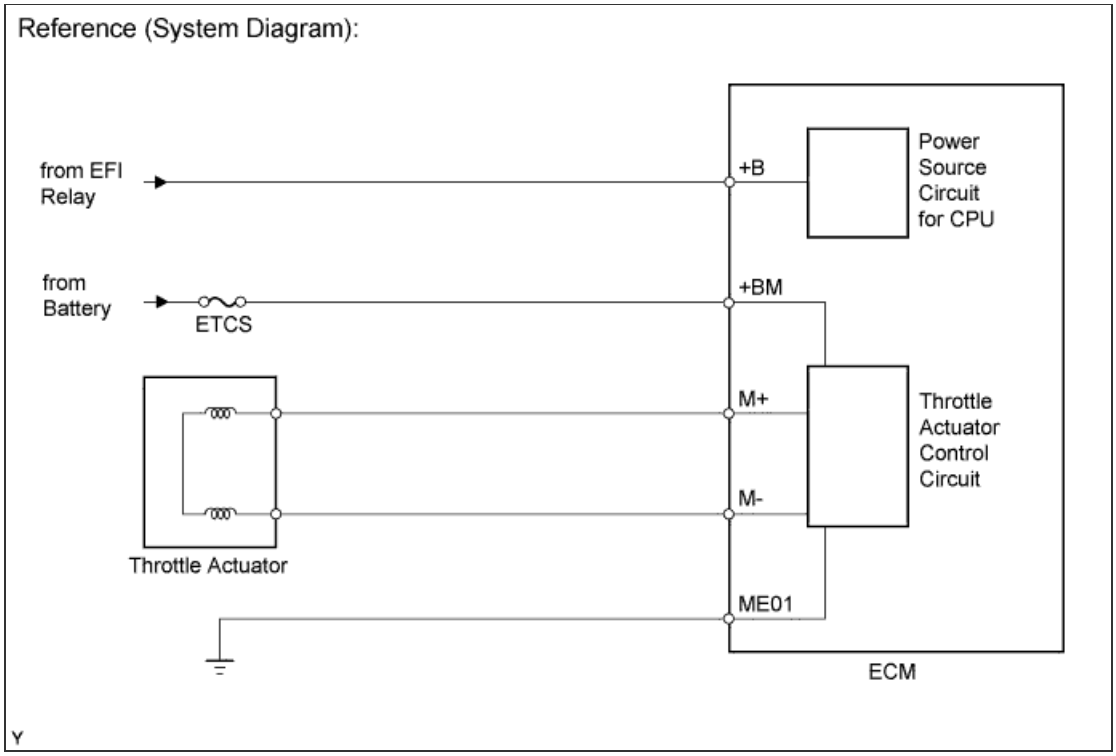
for Preparation Click here

DESCRIPTION

The ETCS (Electronic Throttle Control System) has a dedicated power supply circuit. The voltage (+BM) is monitored and when it is low (below 4 V), the ECM determines that there is a malfunction in the ETCS and cuts off the current to the throttle actuator.
When the voltage becomes unstable, the ETCS itself becomes unstable. For this reason, when the voltage is low, the current to the throttle actuator is cut. If repairs are made and the system returns to normal, turn the engine switch off. The ECM then allows the current to flow to the throttle actuator so that it can be restarted.

HINT:

The ETCS does not use a throttle cable.



DTC Code	DTC Detection Condition	Trouble Area
P2118	An open in the ETCS power source (+BM) circuit (1 trip detection logic).	• Open in ETCS power source circuit • ETCS fuse • ECM

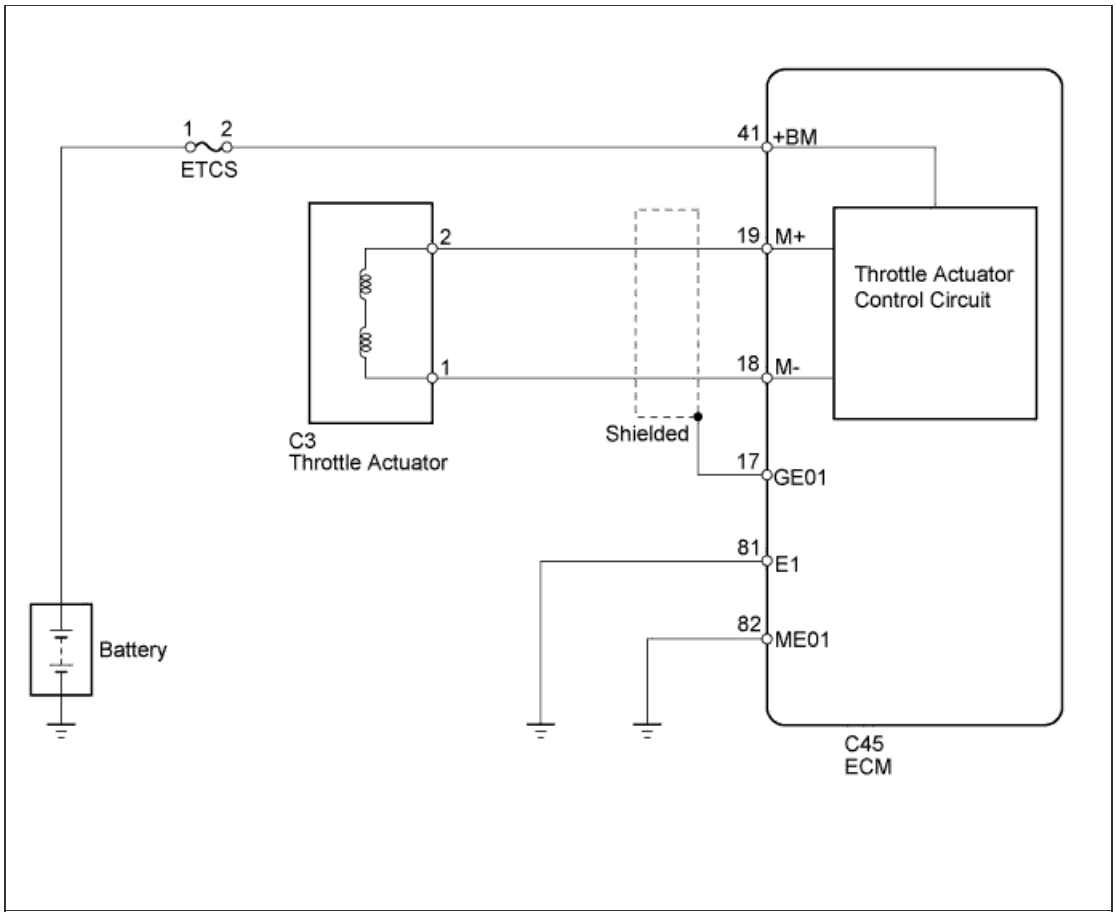
MONITOR DESCRIPTION

The ECM monitors the battery supply voltage applied to the throttle actuator.
When the power supply voltage (+BM) drops below 4 V for 0.8 seconds or more, the ECM interprets this as an open in the power supply circuit (+BM). The ECM illuminates the MIL and stores the DTC.
If the malfunction is not repaired successfully, the DTC is stored 5 seconds after the engine is next started.

FAIL-SAFE

When this DTC, or other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT FUSE (ETCS)

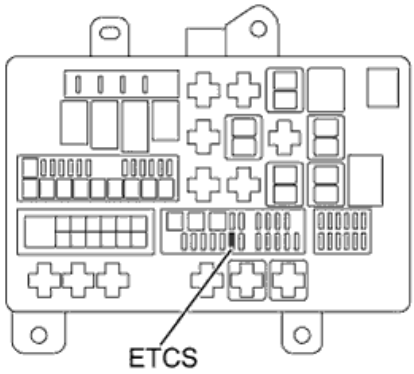
a. Remove the ETCS fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
ETCS fuse	Always	Below 1 Ω

Engine Room Relay Block:



NG → CHECK FOR SHORTS IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

OK

2.CHECK HARNESS AND CONNECTOR (ECM - ETCS FUSE, ETCS FUSE - BATTERY)

a. Check the harness and connector between the ETCS fuse and ECM.

i. Remove the ETCS fuse from the engine room relay block.

ii. Disconnect the C45 ECM connector.

iii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
ETCS fuse terminal 2 - C45-41 (+BM)	Always	Below 1 Ω
ETCS fuse terminal 2 or C45-41 (+BM) - Body ground	Always	10 kΩ or higher

b. Check the harness and connector between the ETCS fuse and positive battery cable.

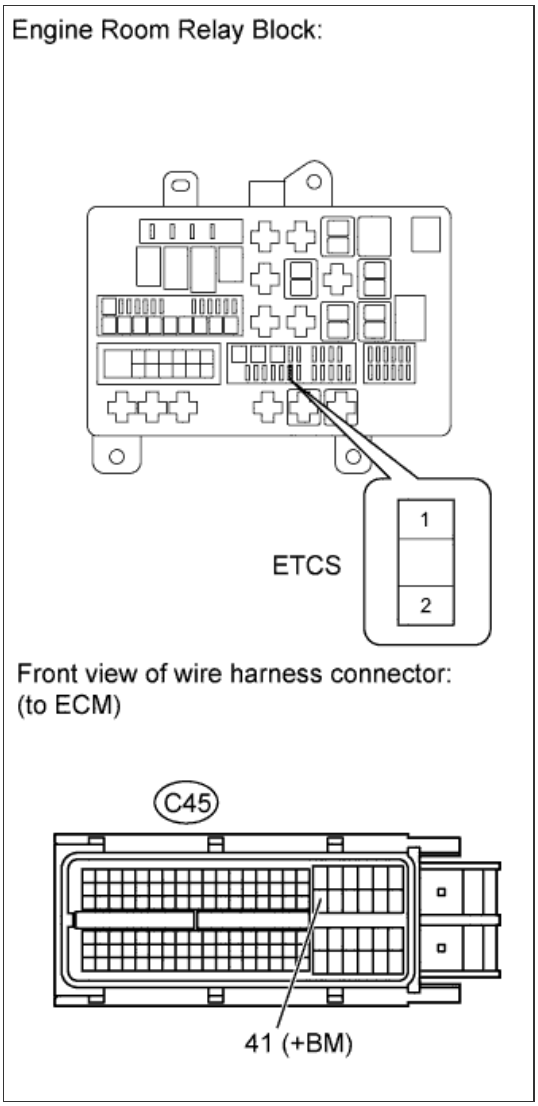
i. Remove the ETCS fuse from the engine room relay block.

ii. Disconnect the cable from the positive (+) battery terminal.

iii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Positive battery cable - ETCS fuse terminal 1	Always	Below 1 Ω
Positive battery cable or ETCS fuse terminal 1 - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

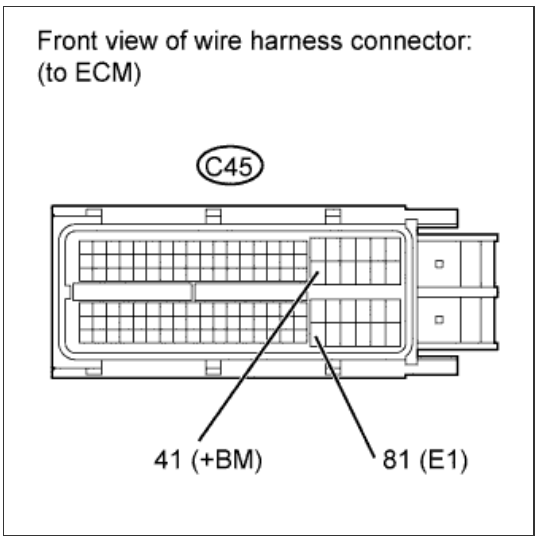
3.INSPECT ECM (+BM VOLTAGE)

a. Disconnect the C45 ECM connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
C45-41 (+BM) - C45-81 (E1)	Always	11 to 14 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (TERMINAL E1 - BODY GROUND)

OK

REPLACE ECM (Click here)

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

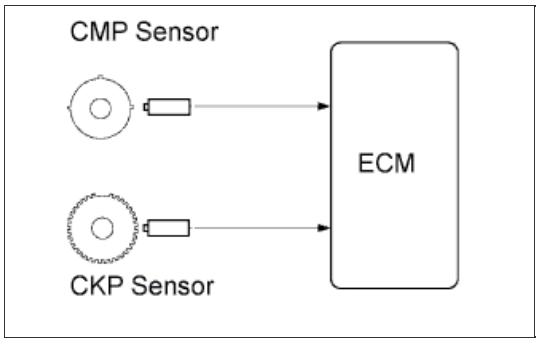
DTC P0306 Cylinder 6 Misfire Detected

DTC P0307 Cylinder 7 Misfire Detected

DTC P0308 Cylinder 8 Misfire Detected

for Preparation Click here

DESCRIPTION



When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause increases in exhaust emission levels. High concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent these increases in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the TWC reaches the point of thermal degradation, the MIL blinks. To monitor misfires, the ECM uses both the Camshaft Position (CMP) sensor and the Crankshaft Position (CKP) sensor. The CMP sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted as when the crankshaft rotation speed variations exceed predetermined thresholds.
If the misfire rate exceeds the threshold level, the ECM stores DTC(s).

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC). • An emission deterioration misfire occurs.	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Fuel injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306 P0307 P0308	Misfiring of a specific cylinder occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC). • An emission deterioration misfire occurs.	

HINT:

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

MONITOR DESCRIPTION

The ECM stores a DTC when either one of the following conditions, which could cause emission deterioration, is detected (2 trip detection logic).

- Within the first 1000 crankshaft revolutions of the engine starting, an excessive misfiring rate (approximately 30 to 110 misfires per 1000

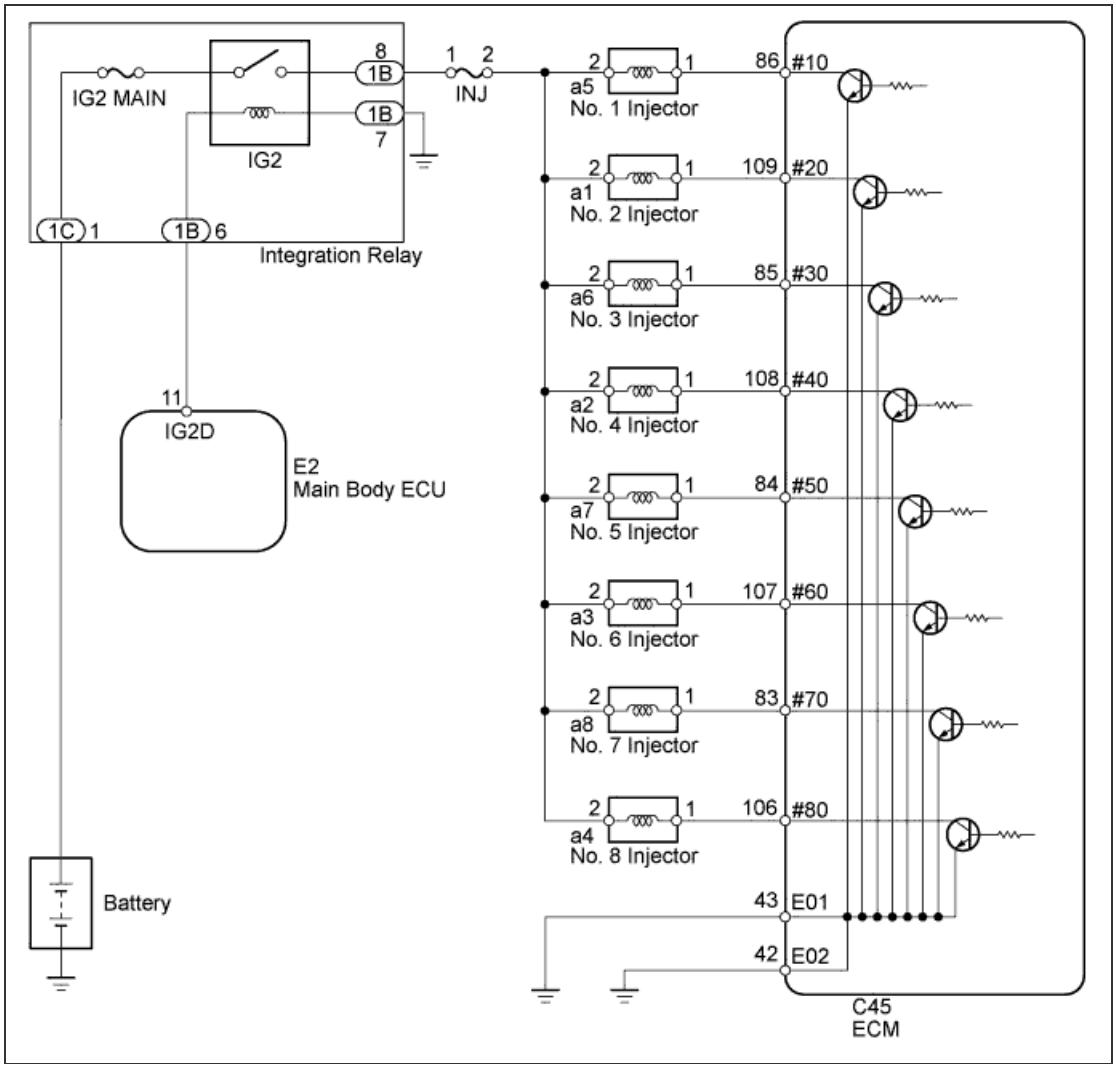
crankshaft revolutions) occurs once.

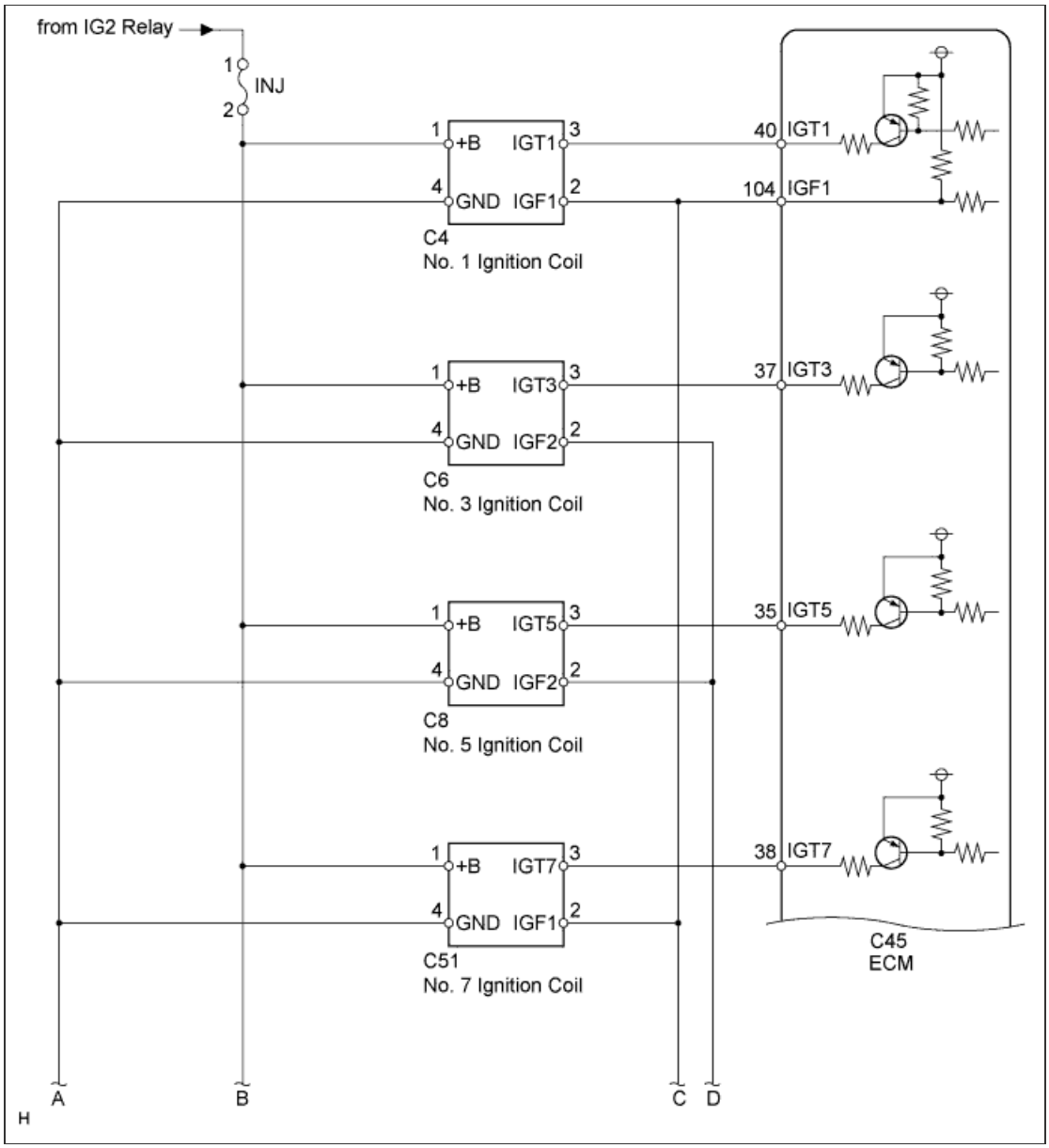
- An excessive misfiring rate (approximately 30 to 110 misfires per 1000 crankshaft revolutions) occurs a total of 4 times.

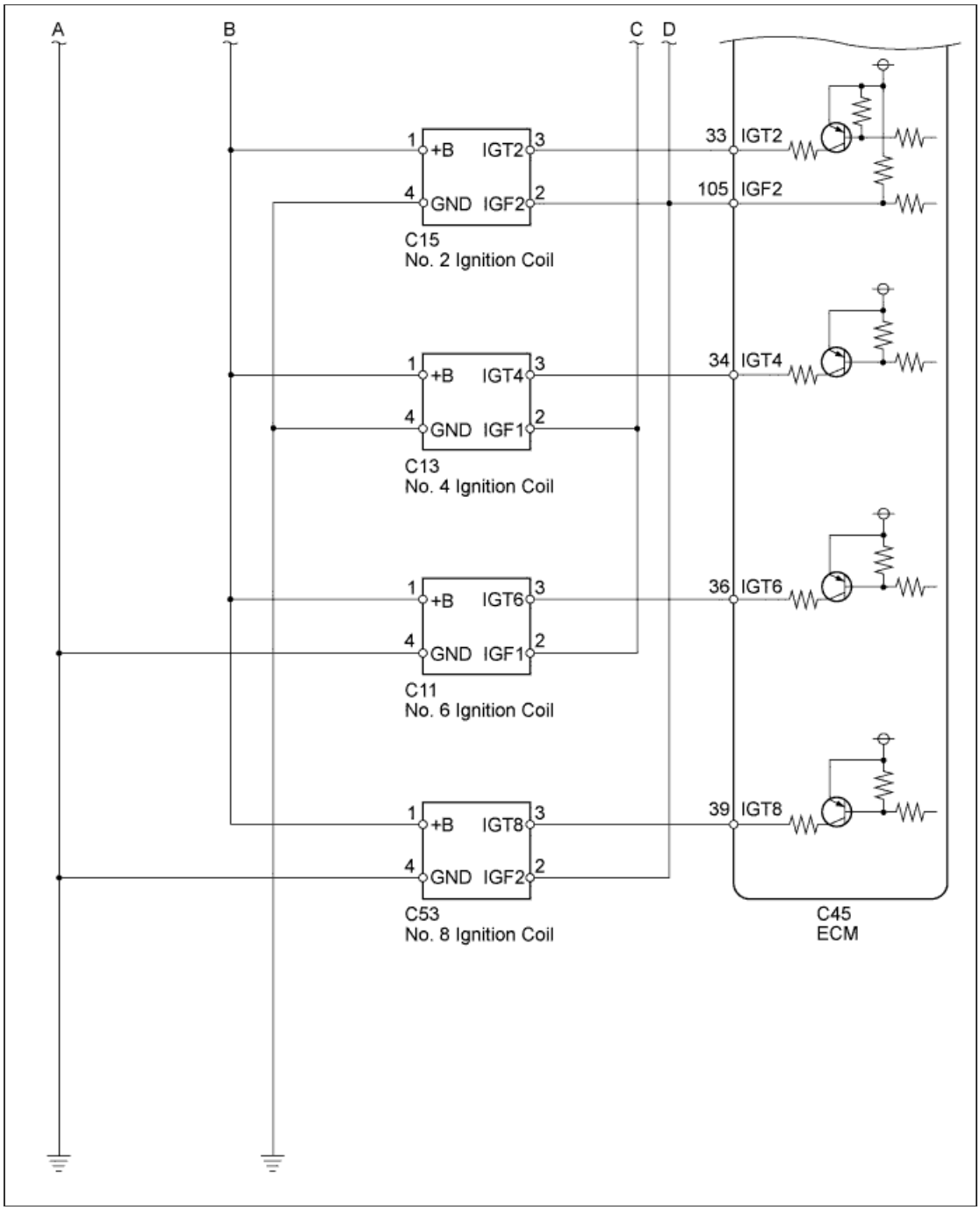
The ECM stores DTC(s) when either one of the following conditions, which could cause the Three-Way Catalytic Converter (TWC) damage, is detected (2 trip detection logic).

- At a high engine speed, a catalyst damage misfire, which monitored every 200 crankshaft revolutions, occurs once.
- At a normal engine speed, a catalyst damage misfire, which monitored every 200 crankshaft revolutions, occurs 3 times.

WIRING DIAGRAM




from IG2 Relay
1
INJ
2
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
38
IGT7
C45
ECM
A
B
C
D
H



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Turn the tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire counts of each cylinder (cylinder No. 1 to No. 8) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
7. Drive the vehicle several times with the conditions, such as engine speed and engine load, shown in Misfire RPM and Misfire Load in the Data List.

HINT:

In order to store misfire DTCs, it is necessary to operate the vehicle for the period of time shown in the table below, with the Misfire RPM and Misfire Load in the Data List.

Engine Speed	Duration
Idling	7 minutes or more
1000	4 minutes or more
2000	2 minutes or more
3000	1.5 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

   HINT:

   Do not turn the engine switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data will be cleared.

9. Record the DTC(s), freeze frame data and misfire counts.
10. Turn the engine switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **DTC P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are for Euro-OBD only.**
- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the freeze frame data have been duplicated, one of the following factors is considered to be a possible cause of the problem:**
  1. **The fuel level is low.**
  2. **Improper fuel is used.**
  3. **The spark plugs are dirty.**
- **After finishing repairs, check that no misfires occur in each cylinder (cylinder No. 1, No. 2, No. 3, No. 4, No. 5, No. 6, No. 7 and No. 8).**
- **Be sure to confirm that no misfiring cylinder DTCs are output again by conducting the confirmation driving pattern after the repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speed. If misfires only occur during high engine speed driving, only DTC P0300 is stored.**
  In the event of DTC P0300 being present, perform the following operations:
  1. **Clear the DTC (Click here).**
  2. **Start the engine and conduct the confirmation driving pattern.**
  3. **Read the misfiring rates of each cylinder or DTC(s) using the intelligent tester.**
  4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
  5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not output.**
- **When either Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air-fuel ratio may be rich (-20% or less) or lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is below 75°C (167°F), the misfires occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel which causes body vibration may cause misfire DTCs to be detected.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 are output	A
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 and other DTCs are output	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is connected correctly and is not damaged.

NG → **REPAIR OR REPLACE PCV HOSE (Click here)**

OK

3.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

4.READ VALUE USING INTELLIGENT TESTER (MISFIRE COUNT)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5, #6, #7 and #8.

f. Allow the engine to idle.

g. Read each value for Cylinder #1 Misfire Count to #8 displayed on the tester. If no misfire counts occur in any cylinders, perform the following procedures:

i. Move the shift lever to D.

ii. Check the Cylinder #1 Misfire Count to #8.

iii. If misfire counts are still not displayed, perform procedure A and and then check the misfire counts again.

h. Drive the vehicle with the Misfire RPM and Misfire Load noted in the ad Value Using tester (Misfire RPM and Misfire Load) procedures above (Procedure A).

i. Read the Cylinder #1 Misfire Count to #8 or DTCs displayed on the tester (Procedure).

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have e ual misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data record of the Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → **Go to step 16**

A

5.INSPECT SPARK PLUG

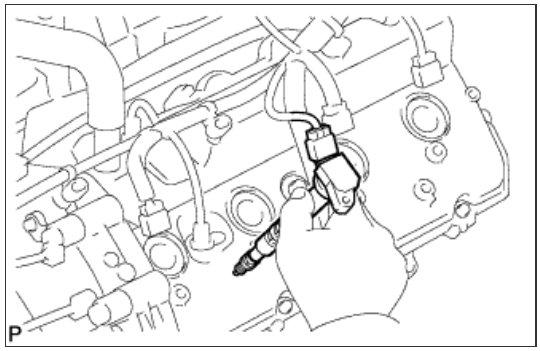
a. Inspect the spark plug of the misfiring cylinder (Click here).

NG → REPLACE SPARK PLUG (**Click here**)

OK

6.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.



CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → **Go to step 32**

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → GO TO FUEL INJECTOR CIRCUIT (**Click here**)

OK

9.CHECK HARNESS AND CONNECTOR

a. Disconnect the fuel injector connector.

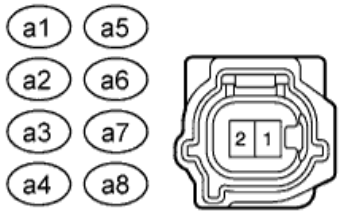
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

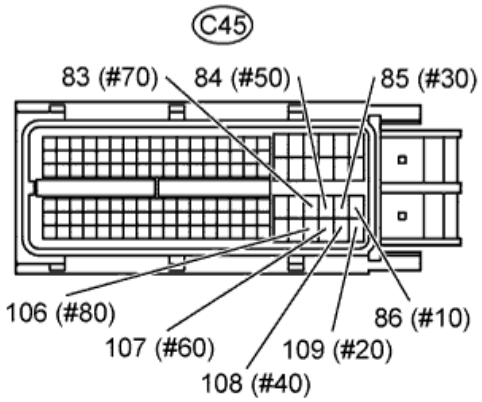
Standard Resistance:

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	a5-1 - Body ground	Always	10 kΩ or higher
	a5-1 - C45-86 (#10)	Always	Below 1 Ω
No. 2	a1-1 - Body ground	Always	10 kΩ or higher
	a1-1 - C45-109 (#20)	Always	Below 1 Ω
No. 3	a6-1 - Body ground	Always	10 kΩ or higher
	a6-1 - C45-85 (#30)	Always	Below 1 Ω
No. 4	a2-1 - Body ground	Always	10 kΩ or higher
	a2-1 - C45-108 (#40)	Always	Below 1 Ω
No. 5	a7-1 - Body ground	Always	10 kΩ or higher
	a7-1 - C45-84 (#50)	Always	Below 1 Ω
No. 6	a3-1 - Body ground	Always	10 kΩ or higher
	a3-1 - C45-107 (#60)	Always	Below 1 Ω
No. 7	a8-1 - Body ground	Always	10 kΩ or higher
	a8-1 - C45-83 (#70)	Always	Below 1 Ω
No. 8	a4-1 - Body ground	Always	10 kΩ or higher
	a4-1 - C45-106 (#80)	Always	Below 1 Ω

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (Click here)

OK

11.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

12.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → Go to step 34

OK

13.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

e. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine:
Same as ambient air temperature.
With warm engine:
Between 75°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

14.INSPECT MASS AIR FLOW METER

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF and Coolant Temp.

e. Allow the engine to idle until Coolant Temp reaches 75 C (167 F) or higher.

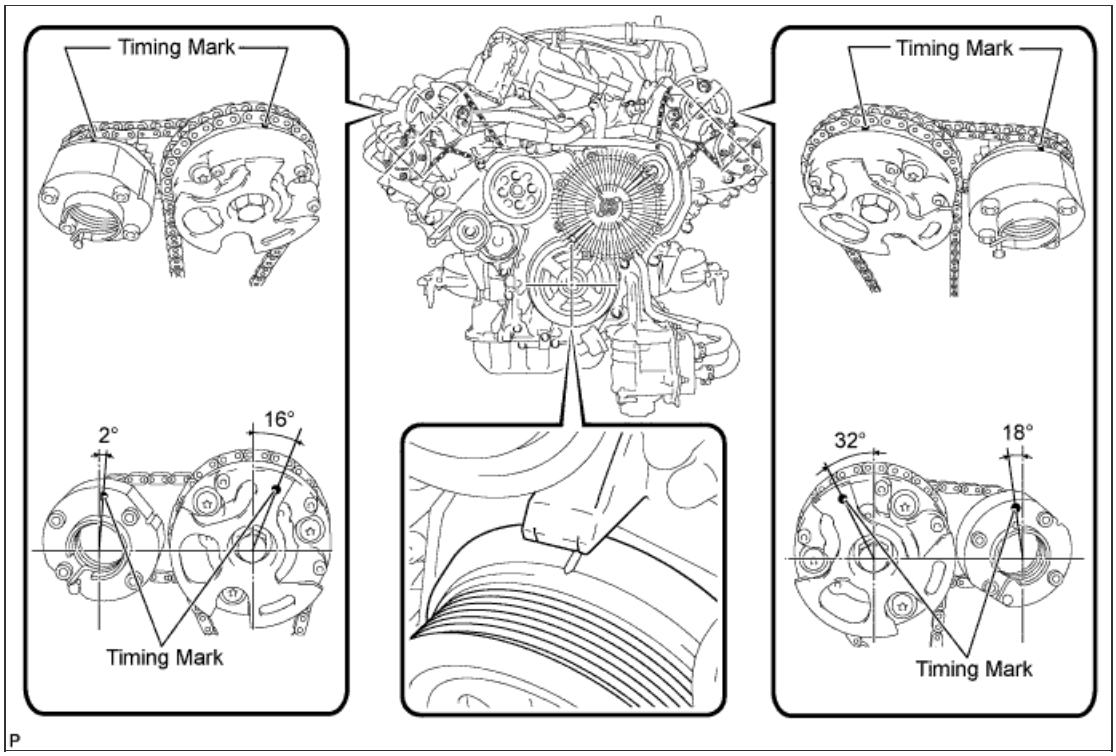
f. Read MAF with the engine speed at 3000 rpm.

Standard:
Between 25.2 gm/s and 35.2 gm/s (shift lever: N; A/C: Off).

NG → Go to step 27

OK

15.CHECK VALVE TIMING



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark 0 of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.

OK	Go to step 27
NG	ADJUST VALVE TIMING (Click here)

16.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG	REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

17.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG	Go to step 34

OK

18.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine:
Same as ambient air temperature.
With warm engine:
Between 75°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

19.INSPECT MASS AIR FLOW METER

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF and Coolant Temp.

e. Allow the engine to idle until Coolant Temp reaches 75 C (167 F) or higher.

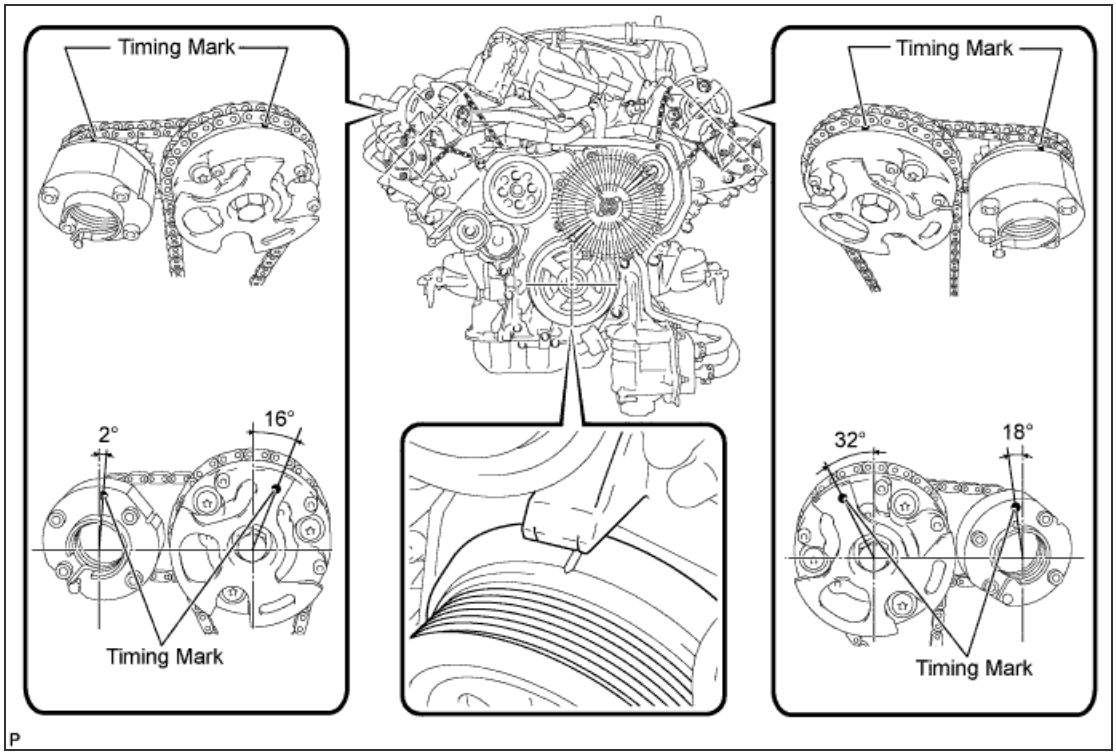
f. Read MAF with the engine speed at 3000 rpm.

Standard:
Between 25.2 gm/s and 35.2 gm/s (shift lever: N; A/C: Off).

NG → Go to step 27

OK

20.CHECK VALVE TIMING



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark 0 of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:

Timing marks on camshaft timing gears are aligned as shown in the illustration.

NG → ADJUST VALVE TIMING (Click here)

OK ↓

21.INSPECT SPARK PLUG

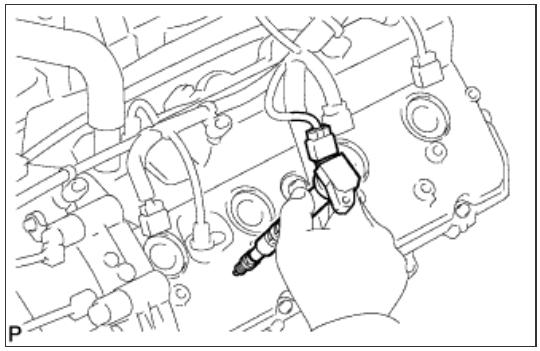
a. Inspect the spark plug of the misfiring cylinder (Click here).

NG → REPLACE SPARK PLUG (Click here)

OK ↓

22.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.



CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 32

OK ↓

23.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK ↓

24.CHECK FUEL INJECTOR ASSEMBLY (POWER SOURCE)

a. Disconnect the fuel injector connector.

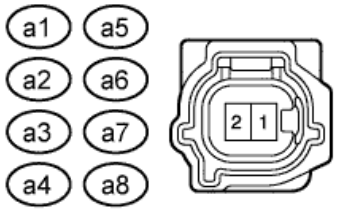
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	a5-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	a1-2 - Ground	Engine switch	11 to 14 V

		on (IG)	
No. 3	a6-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	a2-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	a7-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	a3-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	a8-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	a4-2 - Ground	Engine switch on (IG)	11 to 14 V

Front view of wire harness connector:
(to Injector)



NG → GO TO FUEL INJECTOR CIRCUIT (Click here)

OK

25.CHECK HARNESS AND CONNECTOR (FUEL INJECTOR - ECM)

a. Disconnect the fuel injector connector.

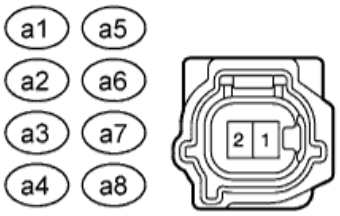
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

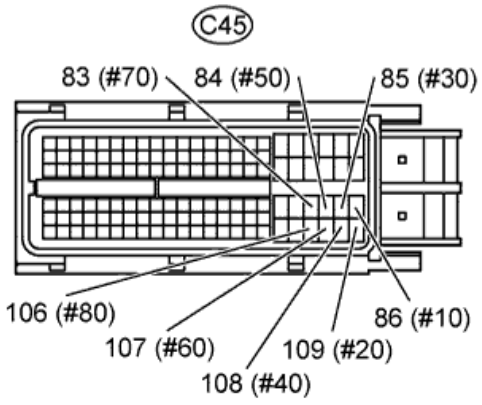
Standard Resistance:

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	a5-1 - Body ground	Always	10 kΩ or higher
	a5-1 - C45-86 (#10)	Always	Below 1 Ω
No. 2	a1-1 - Body ground	Always	10 kΩ or higher
	a1-1 - C45-109 (#20)	Always	Below 1 Ω
No. 3	a6-1 - Body ground	Always	10 kΩ or higher
	a6-1 - C45-85 (#30)	Always	Below 1 Ω
No. 4	a2-1 - Body ground	Always	10 kΩ or higher
	a2-1 - C45-108 (#40)	Always	Below 1 Ω
No. 5	a7-1 - Body ground	Always	10 kΩ or higher
	a7-1 - C45-84 (#50)	Always	Below 1 Ω
No. 6	a3-1 - Body ground	Always	10 kΩ or higher
	a3-1 - C45-107 (#60)	Always	Below 1 Ω
No. 7	a8-1 - Body ground	Always	10 kΩ or higher
	a8-1 - C45-83 (#70)	Always	Below 1 Ω
No. 8	a4-1 - Body ground	Always	10 kΩ or higher
	a4-1 - C45-106 (#80)	Always	Below 1 Ω

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.CHECK FUEL INJECTOR ASSEMBLY OF MISFIRING CYLINDER

Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (**Click here**)

OK

27.CHECK HARNESS AND CONNECTOR

a. Check the connection and terminal contact pressure of connectors and wire harnesses between the mass air flow meter and ECM (Click here).

HINT:

Repair any problems.

NEXT

28.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Turn the engine switch off.

f. Turn the engine switch on (IG) and turn the tester on.

g. Start the engine and warm it up.

h. Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input the DTC: P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308.

k. Check the DTC judgment result.

Result

Display (DTC Output)	Proceed to
ABNORMAL (P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308 output)	A
NORMAL (No DTC output)	B

B → END

A

29.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the mass air flow meter connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

		Specified

Tester Connection	Condition	Condition
C50-3 (VG) - C45-74 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C45-75 (E2G)	Always	Below 1 Ω
C50-3 (VG) or C45-74 (VG) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

30.REPLACE MASS AIR FLOW METER

Replace the mass air flow meter assembly (Click here).

HINT:

If the results of the inspections performed in steps 14 and 21 indicated no problem, proceed to the next step without replacing the mass air flow meter assembly.

NEXT

31.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Turn the engine switch off.

f. Turn the engine switch on (IG) and turn the tester on.

g. Start the engine and warm it up.

h. Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input the DTC: P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308.

k. Check the DTC judgment result.

Result

Display (DTC Output)	Proceed to
NORMAL (No DTC output)	A
ABNORMAL (P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308 output)	B

B → REPLACE ECM (**Click here**)

A

END

32.CHANGE TO CHANGE TO NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

a. Change the installed spark plug to a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → Go to step 33

OK ↓

REPLACE SPARK PLUG (Click here)

33.CHANGE TO NORMAL IGNITION COIL AND CHECK SPARK OF MISFIRING CYLINDER

a. Change the ignition coil to an ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK ↓

REPLACE IGNITION COIL (Click here)

34.CHECK FUEL LINE

a. Check the fuel lines for leaks or blockage.

NG → REPAIR OR REPLACE FUEL LINE

OK ↓

REPLACE FUEL PUMP ASSEMBLY (Click here)

DTC P2119 Throttle Actuator Control Throttle Body Range / Performance

for Preparation Click here

DESCRIPTION

The Electronic Throttle Control System (ETCS) is composed of the throttle actuator, Throttle Position (TP) sensor, Accelerator Pedal Position (APP) sensor, and ECM. The ECM operates the throttle actuator to regulate the throttle valve in response to driver inputs. The TP sensor detects the opening angle of the throttle valve, and provides the ECM with feedback so that the throttle valve can be appropriately controlled by the ECM.

DTC Code	DTC Detection Condition	Trouble Area
P2119	The throttle valve opening angle continues to vary greatly from the target opening angle (1 trip detection logic).	• ETCS • ECM

MONITOR DESCRIPTION

The ECM determines the actual opening angle of the throttle valve from the TP sensor signal. The actual opening angle is compared to the target opening angle commanded by the ECM. If the difference between these two values is outside the standard range, the ECM interprets this as a malfunction in the ETCS. The ECM then illuminates the MIL and stores the DTC.
If the malfunction is not repaired successfully, the DTC is stored when the accelerator pedal is quickly released (to close the throttle valve) after the engine speed reaches 5000 rpm by the accelerator pedal being fully depressed (fully open the throttle valve).

FAIL-SAFE

When this DTC, or other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly. Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM

Refer to DTC P2102 (Click here).

INSPECTION PROCEDURE

HINT:

- **Refer to "Data List / Active Test" [Throttle Position Commanded, Throttle Position No. 1, Throttle Motor Current, Throttle Motor Duty (Open) and Throttle Motor Duty (Close)] (Click here).**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2119)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P2119 is output	A
P2119 and other DTCs are output	B

HINT:

If any DTCs other than P2119 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION)

a. Connect the intelligent tester to the DLC3.

. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Turn the engine switch off and wait for at least 30 seconds.

f. Turn the engine switch on (IG).

g. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Throttle Position No. 1 and Throttle Position Command.

h. Check the values displayed on the tester while fully depressing and releasing the accelerator pedal quickly.

Result

Result	Proceed to
Throttle Position No. 1 does not change	A
Throttle Position No. 1 changes even a little	B

HINT:

When a DTC is output, the system changes to fail-safe mode. Therefore, only use the data up until the time the DTC is stored for confirmation.

B → Go to step 4

A

3.INSPECT THROTTLE BODY ASSEMBLY (RESISTANCE OF THROTTLE ACTUATOR)

a. Inspect the throttle body assembly (Click here).

NG → Go to step 6

OK

4.INSPECT THROTTLE BODY ASSEMBLY (VISUALLY CHECK THROTTLE VALVE)

a. Check for contamination between the throttle valve and housing. If necessary, clean the throttle body. Also, check that the throttle valve moves smoothly.

OK:

Throttle valve is not contaminated with foreign objects and moves smoothly.

NG → Go to step 6

OK

5.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Turn the engine switch off and wait for at least 30 seconds.

f. Turn the engine switch on (IG).

g. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Throttle Position No. 1, Throttle Position No. 2 and Throttle Position Command.

h. Check the values displayed on the tester while wiggling the ECM wire harness.

i. Enter the following menus: Powertrain / Engine and ECT / DTC.

j. Check for DTCs.

Result

Result	Proceed to
Value in Data List changes when wire harness is wiggled, or DTC is output	A
ther than above	B

: As the DTC was stored due to a change in the contact resistance of the connector, repair or replace the wire harness or connector (Click here).

B → Go to step 7

A

REPAIR OR REPLACE HARNESS OR CONNECTOR

6.REPLACE THROTTLE BODY ASSEMBLY

a. Replace the throttle body assembly (Click here).

NEXT

7.CHECK WHETHER DTC OUTPUT RECURS (DTC P2119)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Allow the engine to idle for 15 seconds.

g. Fully depress and release the accelerator pedal several times quickly.

h. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

i. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P2119 is output	B

B → REPLACE ECM

A

END

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

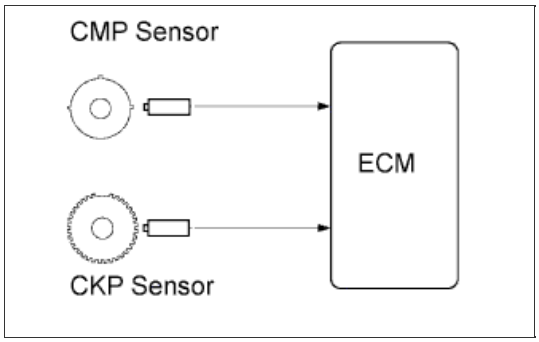
DTC P0306 Cylinder 6 Misfire Detected

DTC P0307 Cylinder 7 Misfire Detected

DTC P0308 Cylinder 8 Misfire Detected

for Preparation Click here

DESCRIPTION



When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause increases in exhaust emission levels. High concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent these increases in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the TWC reaches the point of thermal degradation, the MIL blinks. To monitor misfires, the ECM uses both the Camshaft Position (CMP) sensor and the Crankshaft Position (CKP) sensor. The CMP sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted as when the crankshaft rotation speed variations exceed predetermined thresholds.
If the misfire rate exceeds the threshold level, the ECM stores DTC(s).

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC). • An emission deterioration misfire occurs.	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Fuel injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306 P0307 P0308	Misfiring of a specific cylinder occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC). • An emission deterioration misfire occurs.	

HINT:

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

MONITOR DESCRIPTION

The ECM stores a DTC when either one of the following conditions, which could cause emission deterioration, is detected (2 trip detection logic).

- Within the first 1000 crankshaft revolutions of the engine starting, an excessive misfiring rate (approximately 30 to 110 misfires per 1000

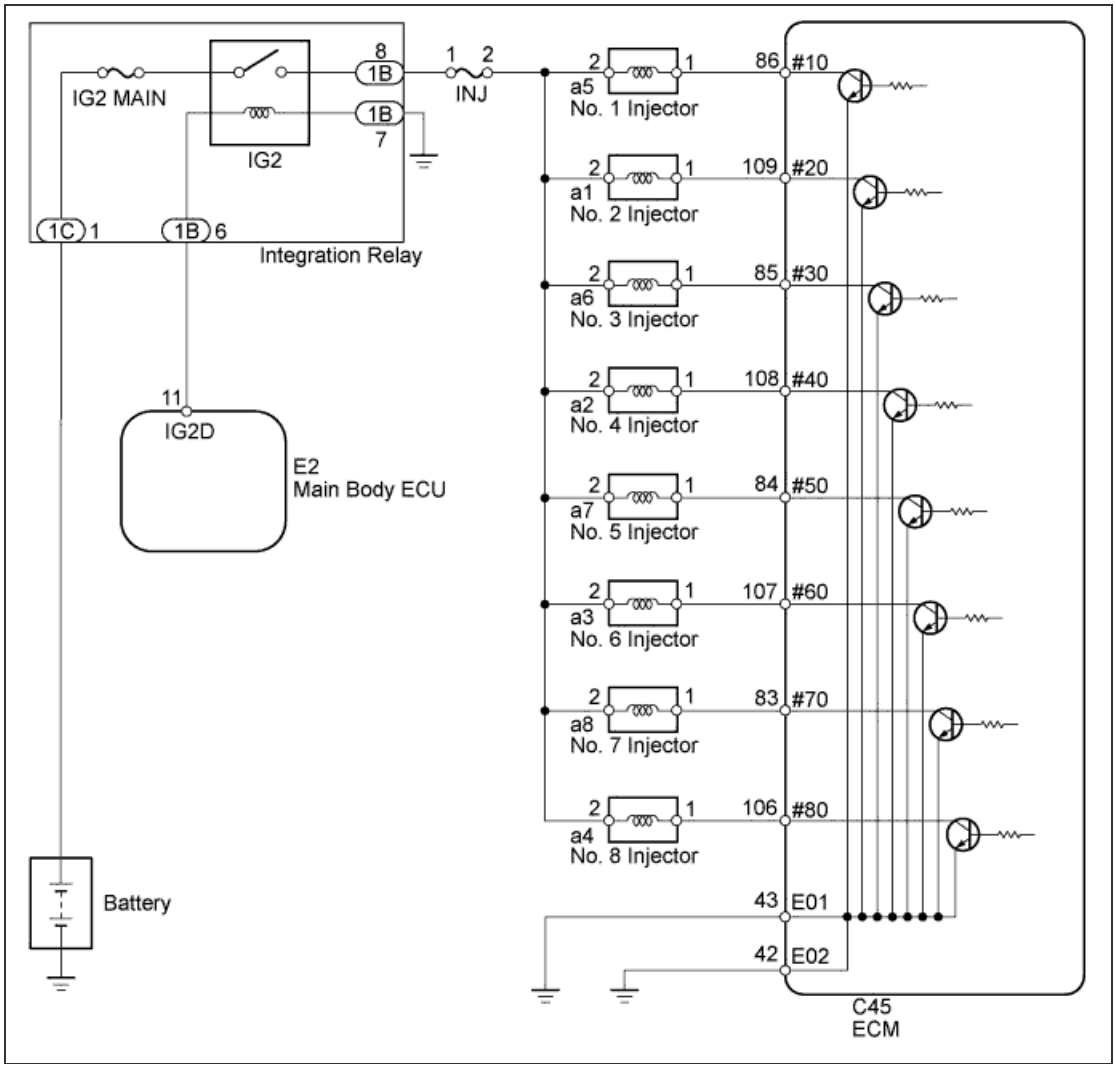
crankshaft revolutions) occurs once.

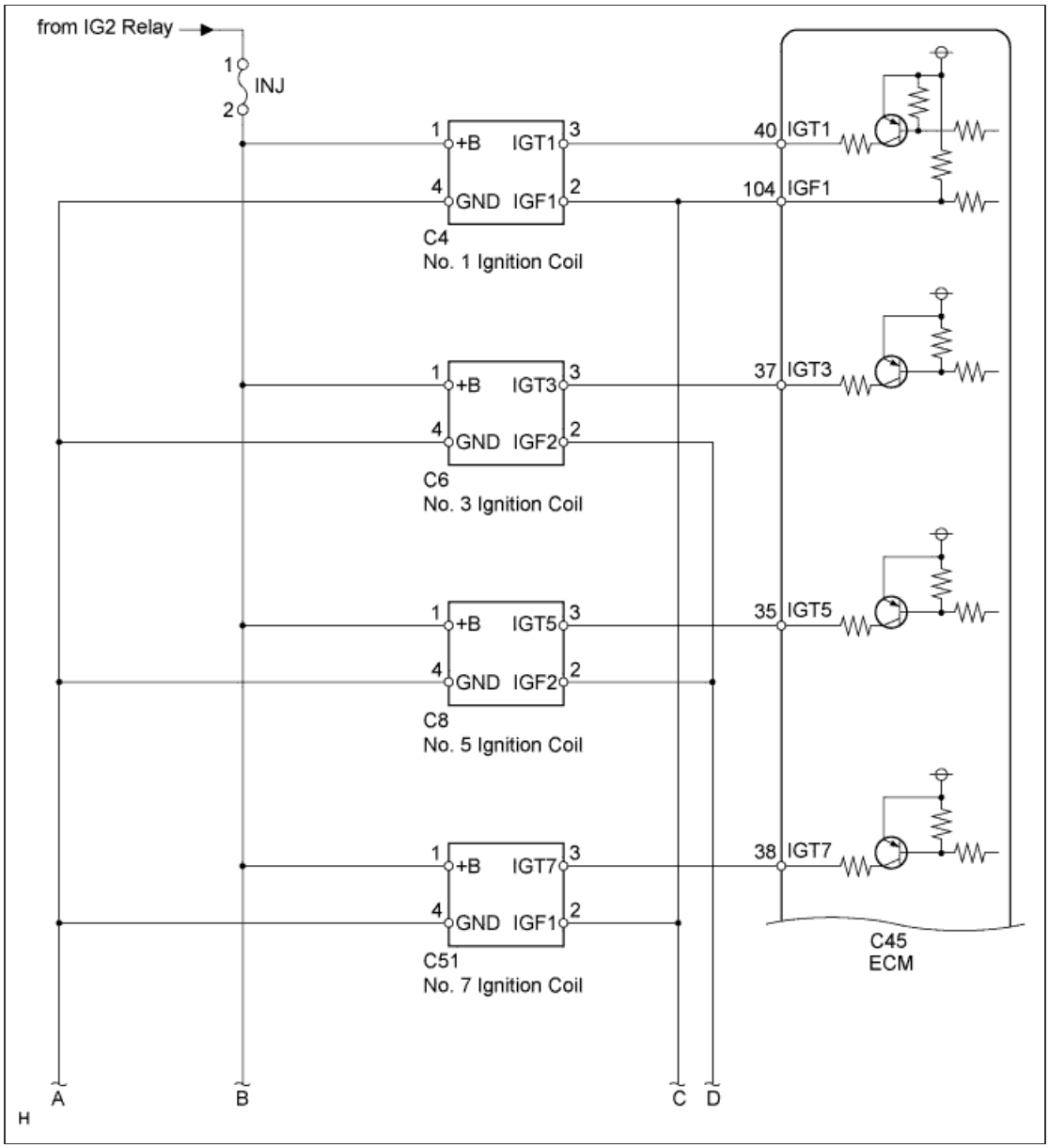
- An excessive misfiring rate (approximately 30 to 110 misfires per 1000 crankshaft revolutions) occurs a total of 4 times.

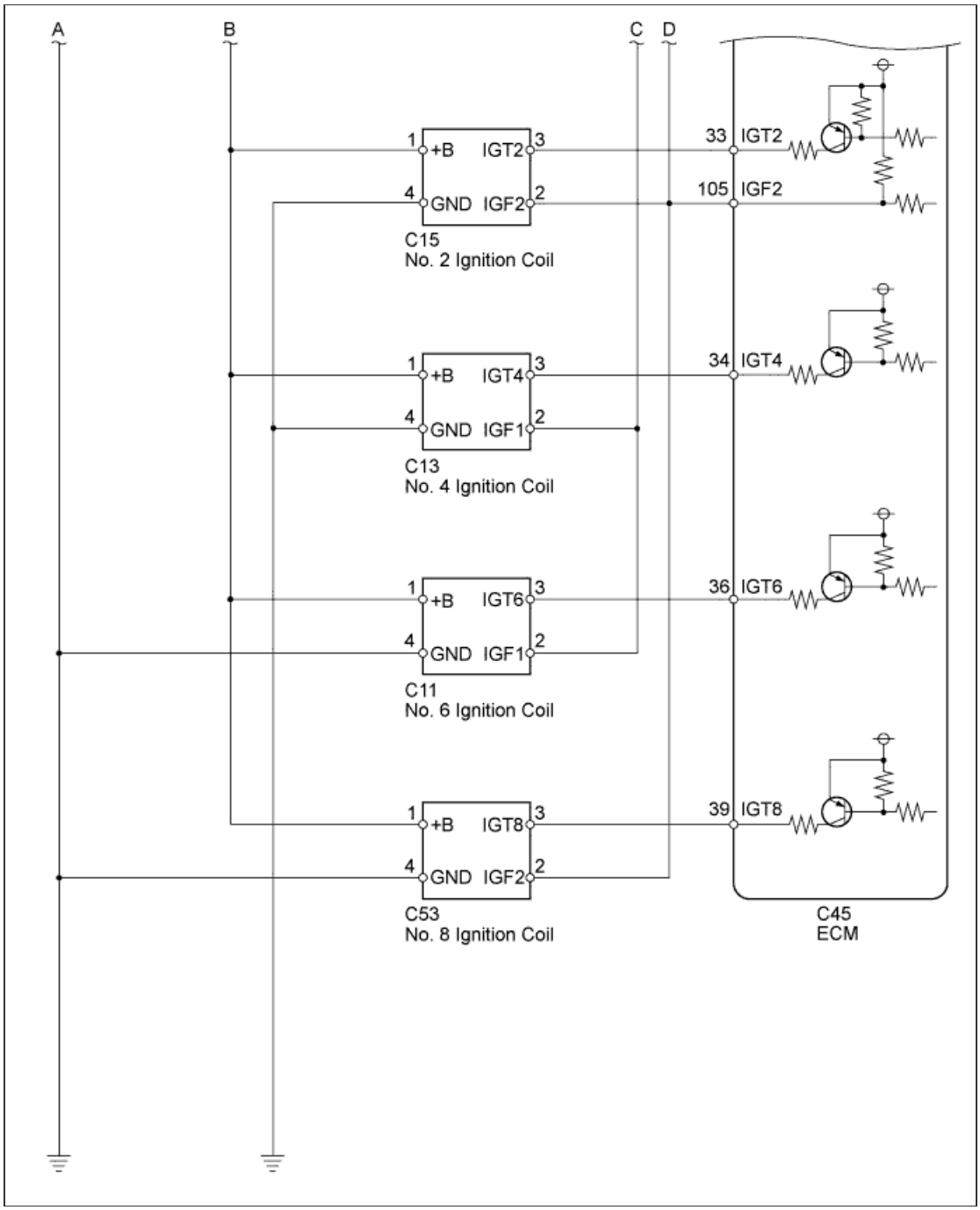
The ECM stores DTC(s) when either one of the following conditions, which could cause the Three-Way Catalytic Converter (TWC) damage, is detected (2 trip detection logic).

- At a high engine speed, a catalyst damage misfire, which monitored every 200 crankshaft revolutions, occurs once.
- At a normal engine speed, a catalyst damage misfire, which monitored every 200 crankshaft revolutions, occurs 3 times.

WIRING DIAGRAM




from IG2 Relay
1
INJ
2
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
38
IGT7
C45
ECM
A
B
C
D
H



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Turn the tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire counts of each cylinder (cylinder No. 1 to No. 8) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
7. Drive the vehicle several times with the conditions, such as engine speed and engine load, shown in Misfire RPM and Misfire Load in the Data List.

HINT:

In order to store misfire DTCs, it is necessary to operate the vehicle for the period of time shown in the table below, with the Misfire RPM and Misfire Load in the Data List.

Engine Speed	Duration
Idling	7 minutes or more
1000	4 minutes or more
2000	2 minutes or more
3000	1.5 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

   HINT:

   Do not turn the engine switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data will be cleared.

9. Record the DTC(s), freeze frame data and misfire counts.
10. Turn the engine switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **DTC P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are for Euro-OBD only.**
- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the freeze frame data have been duplicated, one of the following factors is considered to be a possible cause of the problem:**
  1. **The fuel level is low.**
  2. **Improper fuel is used.**
  3. **The spark plugs are dirty.**
- **After finishing repairs, check that no misfires occur in each cylinder (cylinder No. 1, No. 2, No. 3, No. 4, No. 5, No. 6, No. 7 and No. 8).**
- **Be sure to confirm that no misfiring cylinder DTCs are output again by conducting the confirmation driving pattern after the repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speed. If misfires only occur during high engine speed driving, only DTC P0300 is stored.**
  In the event of DTC P0300 being present, perform the following operations:
  1. **Clear the DTC (Click here).**
  2. **Start the engine and conduct the confirmation driving pattern.**
  3. **Read the misfiring rates of each cylinder or DTC(s) using the intelligent tester.**
  4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
  5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not output.**
- **When either Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air-fuel ratio may be rich (-20% or less) or lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is below 75°C (167°F), the misfires occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel which causes body vibration may cause misfire DTCs to be detected.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 are output	A
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 and other DTCs are output	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is connected correctly and is not damaged.

NG → **REPAIR OR REPLACE PCV HOSE (Click here)**

OK

3.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

4.READ VALUE USING INTELLIGENT TESTER (MISFIRE COUNT)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5, #6, #7 and #8.

f. Allow the engine to idle.

g. Read each value for Cylinder #1 Misfire Count to #8 displayed on the tester. If no misfire counts occur in any cylinders, perform the following procedures:

i. Move the shift lever to D.

ii. Check the Cylinder #1 Misfire Count to #8.

iii. If misfire counts are still not displayed, perform procedure A and and then check the misfire counts again.

h. Drive the vehicle with the Misfire RPM and Misfire Load noted in the ad Value Using tester (Misfire RPM and Misfire Load) procedures above (Procedure A).

i. Read the Cylinder #1 Misfire Count to #8 or DTCs displayed on the tester (Procedure).

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have e ual misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data record of the Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → **Go to step 16**

A

5.INSPECT SPARK PLUG

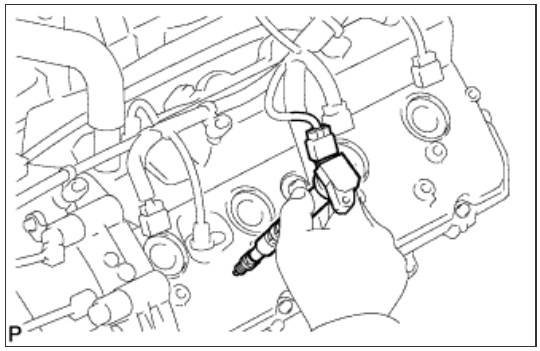
a. Inspect the spark plug of the misfiring cylinder (Click here).

NG → REPLACE SPARK PLUG (**Click here**)

OK

6.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.



CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → **Go to step 32**

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → GO TO FUEL INJECTOR CIRCUIT (**Click here**)

OK

9.CHECK HARNESS AND CONNECTOR

a. Disconnect the fuel injector connector.

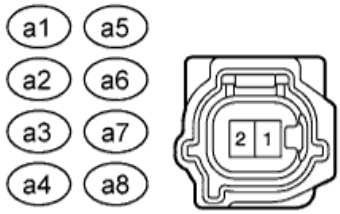
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

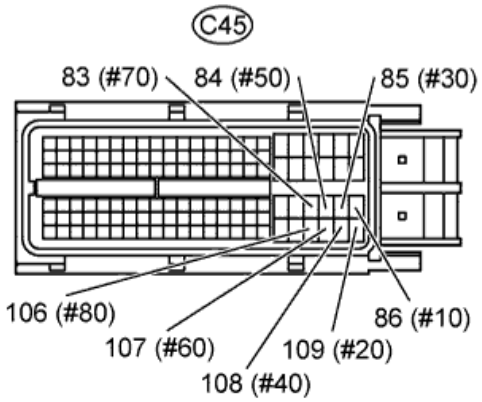
Standard Resistance:

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	a5-1 - Body ground	Always	10 kΩ or higher
	a5-1 - C45-86 (#10)	Always	Below 1 Ω
No. 2	a1-1 - Body ground	Always	10 kΩ or higher
	a1-1 - C45-109 (#20)	Always	Below 1 Ω
No. 3	a6-1 - Body ground	Always	10 kΩ or higher
	a6-1 - C45-85 (#30)	Always	Below 1 Ω
No. 4	a2-1 - Body ground	Always	10 kΩ or higher
	a2-1 - C45-108 (#40)	Always	Below 1 Ω
No. 5	a7-1 - Body ground	Always	10 kΩ or higher
	a7-1 - C45-84 (#50)	Always	Below 1 Ω
No. 6	a3-1 - Body ground	Always	10 kΩ or higher
	a3-1 - C45-107 (#60)	Always	Below 1 Ω
No. 7	a8-1 - Body ground	Always	10 kΩ or higher
	a8-1 - C45-83 (#70)	Always	Below 1 Ω
No. 8	a4-1 - Body ground	Always	10 kΩ or higher
	a4-1 - C45-106 (#80)	Always	Below 1 Ω

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (Click here)

OK

11.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

12.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → Go to step 34

OK

13.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

e. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine:
Same as ambient air temperature.
With warm engine:
Between 75°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

14.INSPECT MASS AIR FLOW METER

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF and Coolant Temp.

e. Allow the engine to idle until Coolant Temp reaches 75 C (167 F) or higher.

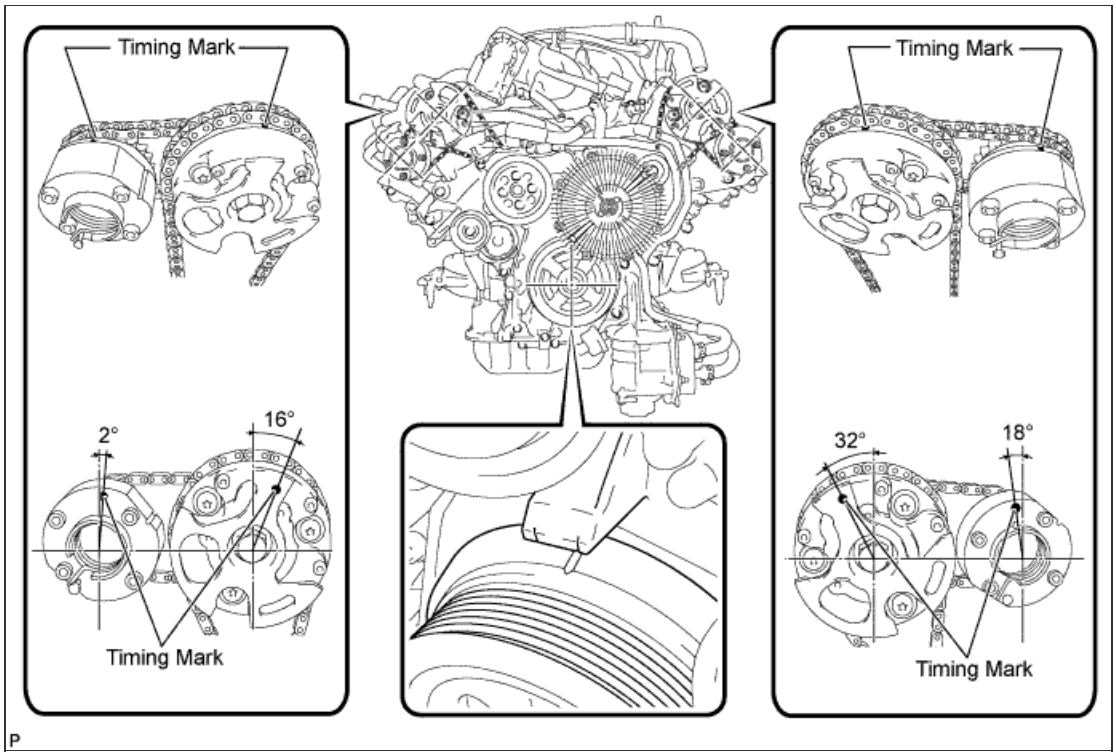
f. Read MAF with the engine speed at 3000 rpm.

Standard:
Between 25.2 gm/s and 35.2 gm/s (shift lever: N; A/C: Off).

NG → Go to step 27

OK

15.CHECK VALVE TIMING



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark 0 of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.

OK	Go to step 27
NG	ADJUST VALVE TIMING (Click here)

16.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG	REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

17.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG	Go to step 34

OK

18.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine:
Same as ambient air temperature.
With warm engine:
Between 75°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

19.INSPECT MASS AIR FLOW METER

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF and Coolant Temp.

e. Allow the engine to idle until Coolant Temp reaches 75 C (167 F) or higher.

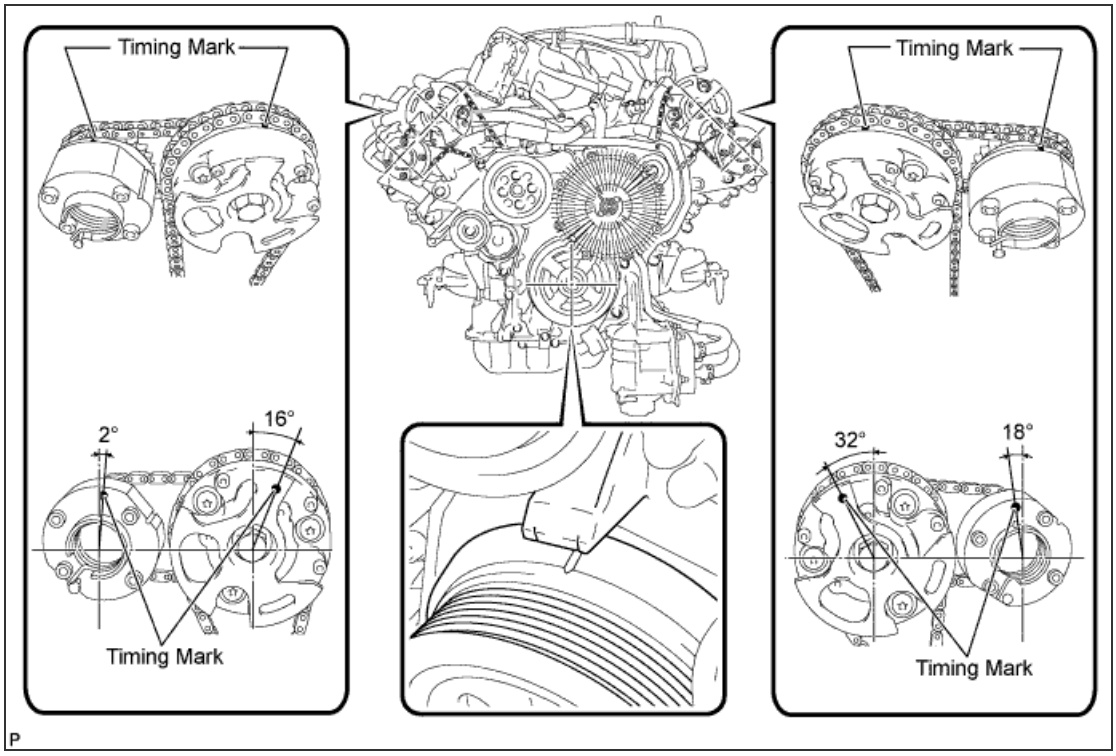
f. Read MAF with the engine speed at 3000 rpm.

Standard:
Between 25.2 gm/s and 35.2 gm/s (shift lever: N; A/C: Off).

NG → Go to step 27

OK

20.CHECK VALVE TIMING



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark 0 of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:

Timing marks on camshaft timing gears are aligned as shown in the illustration.

NG → ADJUST VALVE TIMING (Click here)

OK ↓

21.INSPECT SPARK PLUG

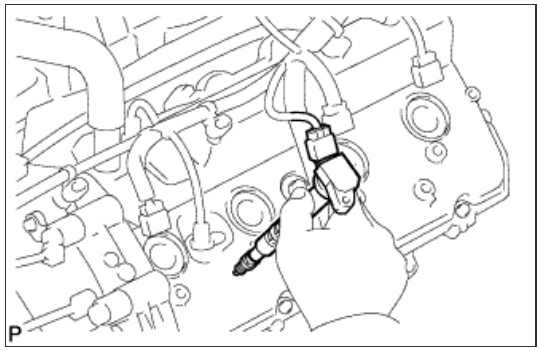
a. Inspect the spark plug of the misfiring cylinder (Click here).

NG → REPLACE SPARK PLUG (Click here)

OK ↓

22.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.



CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 32

OK ↓

23.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK ↓

24.CHECK FUEL INJECTOR ASSEMBLY (POWER SOURCE)

a. Disconnect the fuel injector connector.

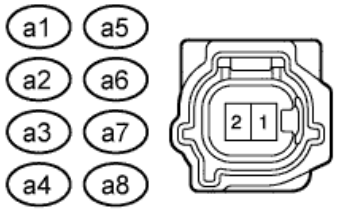
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	a5-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	a1-2 - Ground	Engine switch	11 to 14 V

		on (IG)	
No. 3	a6-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	a2-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	a7-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	a3-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	a8-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	a4-2 - Ground	Engine switch on (IG)	11 to 14 V

Front view of wire harness connector:
(to Injector)



NG → GO TO FUEL INJECTOR CIRCUIT (Click here)

OK

25.CHECK HARNESS AND CONNECTOR (FUEL INJECTOR - ECM)

a. Disconnect the fuel injector connector.

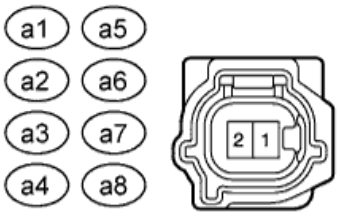
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

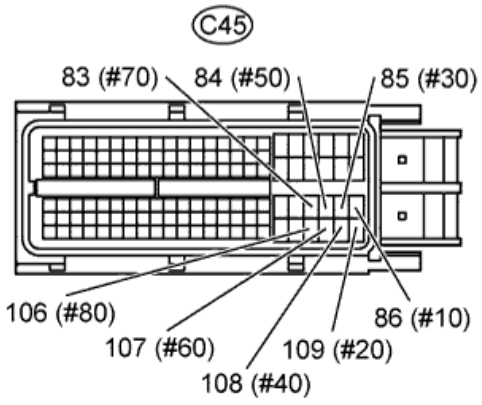
Standard Resistance:

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	a5-1 - Body ground	Always	10 kΩ or higher
	a5-1 - C45-86 (#10)	Always	Below 1 Ω
No. 2	a1-1 - Body ground	Always	10 kΩ or higher
	a1-1 - C45-109 (#20)	Always	Below 1 Ω
No. 3	a6-1 - Body ground	Always	10 kΩ or higher
	a6-1 - C45-85 (#30)	Always	Below 1 Ω
No. 4	a2-1 - Body ground	Always	10 kΩ or higher
	a2-1 - C45-108 (#40)	Always	Below 1 Ω
No. 5	a7-1 - Body ground	Always	10 kΩ or higher
	a7-1 - C45-84 (#50)	Always	Below 1 Ω
No. 6	a3-1 - Body ground	Always	10 kΩ or higher
	a3-1 - C45-107 (#60)	Always	Below 1 Ω
No. 7	a8-1 - Body ground	Always	10 kΩ or higher
	a8-1 - C45-83 (#70)	Always	Below 1 Ω
No. 8	a4-1 - Body ground	Always	10 kΩ or higher
	a4-1 - C45-106 (#80)	Always	Below 1 Ω

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.CHECK FUEL INJECTOR ASSEMBLY OF MISFIRING CYLINDER

Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (**Click here**)

OK

27.CHECK HARNESS AND CONNECTOR

a. Check the connection and terminal contact pressure of connectors and wire harnesses between the mass air flow meter and ECM (Click here).

HINT:

Repair any problems.

NEXT

28.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Turn the engine switch off.

f. Turn the engine switch on (IG) and turn the tester on.

g. Start the engine and warm it up.

h. Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input the DTC: P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308.

k. Check the DTC judgment result.

Result

Display (DTC Output)	Proceed to
ABNORMAL (P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308 output)	A
NORMAL (No DTC output)	B

B → END

A

29.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the mass air flow meter connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

		Specified

Tester Connection	Condition	Condition
C50-3 (VG) - C45-74 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C45-75 (E2G)	Always	Below 1 Ω
C50-3 (VG) or C45-74 (VG) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

30.REPLACE MASS AIR FLOW METER

Replace the mass air flow meter assembly (Click here).

HINT:

If the results of the inspections performed in steps 14 and 21 indicated no problem, proceed to the next step without replacing the mass air flow meter assembly.

NEXT

31.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Turn the engine switch off.

f. Turn the engine switch on (IG) and turn the tester on.

g. Start the engine and warm it up.

h. Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input the DTC: P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308.

k. Check the DTC judgment result.

Result

Display (DTC Output)	Proceed to
NORMAL (No DTC output)	A
ABNORMAL (P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308 output)	B

B → REPLACE ECM (**Click here**)

A

END

32.CHANGE TO CHANGE TO NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

a. Change the installed spark plug to a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → Go to step 33

OK ↓

REPLACE SPARK PLUG (Click here)

33.CHANGE TO NORMAL IGNITION COIL AND CHECK SPARK OF MISFIRING CYLINDER

a. Change the ignition coil to an ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK ↓

REPLACE IGNITION COIL (Click here)

34.CHECK FUEL LINE

a. Check the fuel lines for leaks or blockage.

NG → REPAIR OR REPLACE FUEL LINE

OK ↓

REPLACE FUEL PUMP ASSEMBLY (Click here)

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

for Preparation Click here

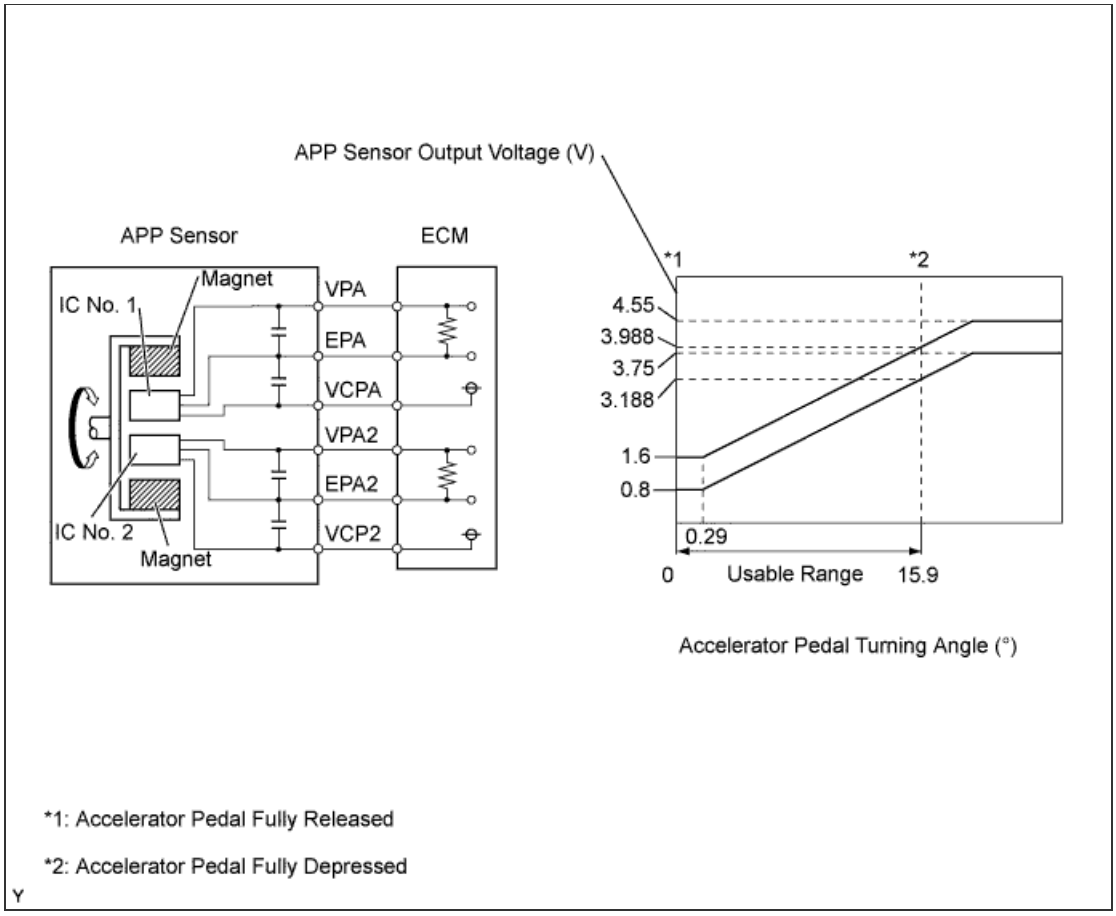
DESCRIPTION

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

The APP sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC Code	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM

P2122	VPA is 0.4 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP1 circuit • Open or ground short in VPA circuit • ECM
P2123	VPA is 4.8 V or higher for 2.0 seconds or more (1 trip detection logic).	• APP sensor • Open in EPA circuit • ECM
P2125	VPA2 fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or higher. (b) VPA is between 0.4 V and 3.45 V.	• APP sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): (a) The difference between VPA and VPA2 is 0.02 V or less. (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less.	• Short between VPA and VPA2 circuits • APP sensor • ECM

HINT:

When any of these DTCs is output, check the APP sensor voltage by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

Trouble Area	Accelerator Position No. 1 When AP Released	Accelerator Position No. 2 When AP Released	Accelerator Position No. 1 When AP Depressed	Accelerator Position No. 2 When AP Depressed
VCP circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.0 V
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 5.0 V

HINT:

- **Accelerator pedal positions are expressed as voltages.**
- **AP stands for Accelerator Pedal.**

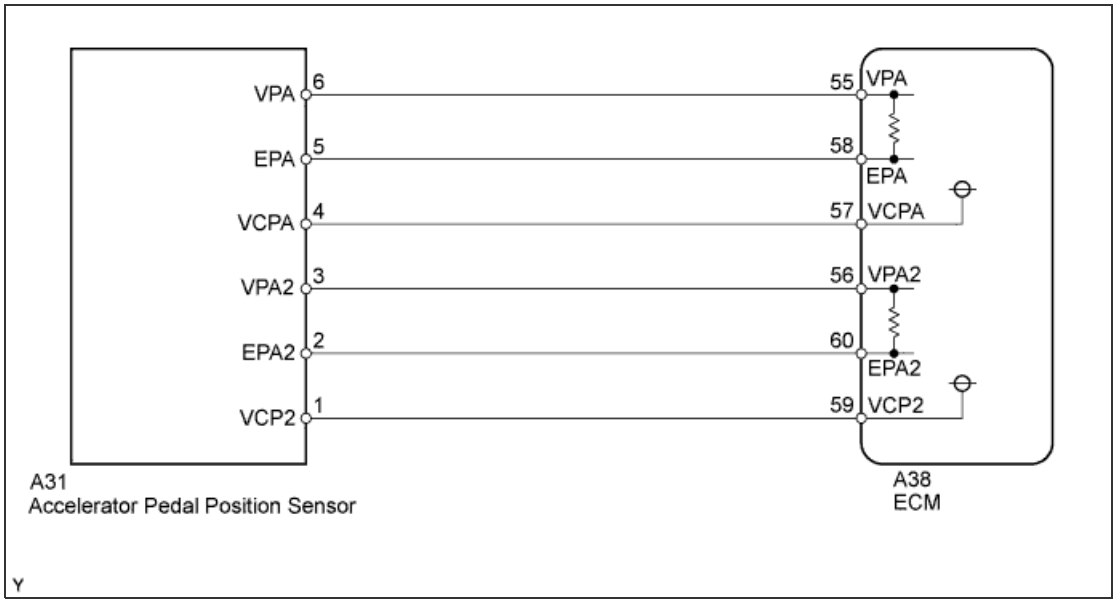
MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is less than the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and stores DTC(s).
Example:
When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is stored.
If the malfunction is not repaired successfully, a DTC is stored 2 seconds after the engine is next started.

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 is stored, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue driving. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.
Fail-safe mode continues until a pass condition is detected, and the engine switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Accelerator Pedal Position (APP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

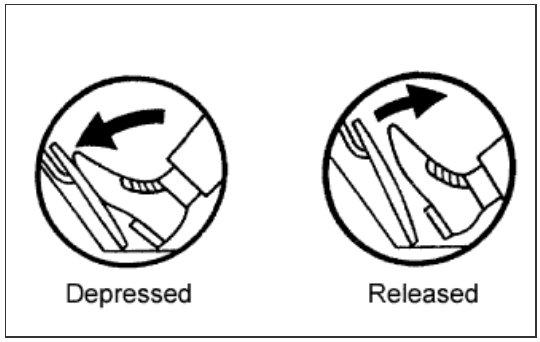
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

d. Read the value displayed on the tester.



Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released → Depressed → Released	0.5 to 4.5 V	1.2 to 5.0 V
	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V

Result

Result	Proceed to
N	A
OK	B

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

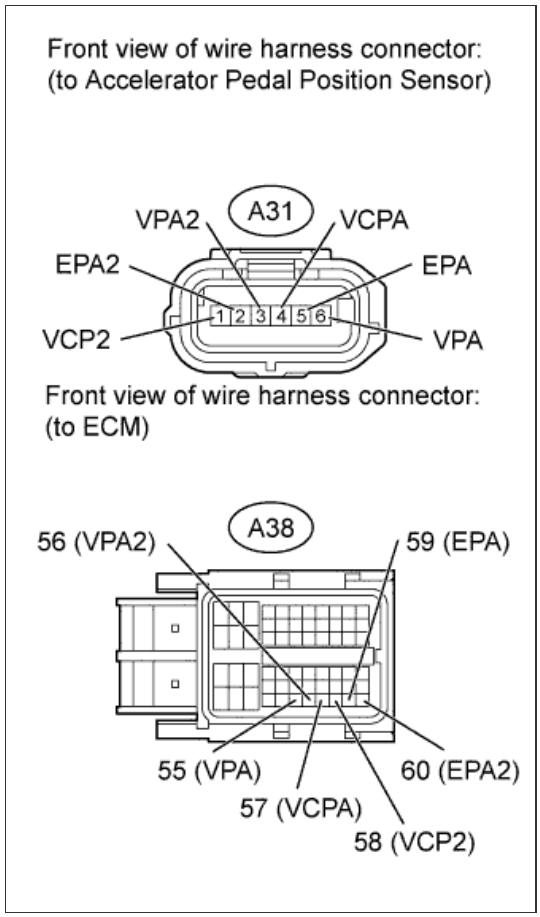
a. Disconnect the A31 accelerator pedal position (APP) sensor connector.

b. Disconnect the A38 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A38-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-58 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A38-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A38-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A38-59 (VCP2)	Always	Below 1 Ω
A31-6 (VPA) or A38-55 (VPA) - body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-58 (EPA) - body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-57 (VCPA) - body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-56 (VPA2) - body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A38-60 (EPA2) - body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A38-59 (VCP2) - body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

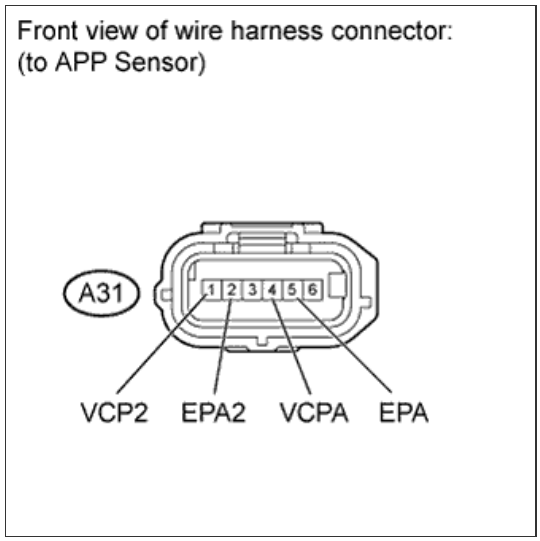
3.CHECK ECM (VCPA AND VCP2 VOLTAGE)

a. Disconnect the A31 APP sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Engine switch on (I)	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Engine switch on (I)	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

4.REPLACE ACCELERATOR PEDAL ASSEMBLY

a. Replace the accelerator pedal assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138 are output	A
No DTC is output	B

B → SYSTEM OK

A

REPLACE ECM (**Click here**)

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

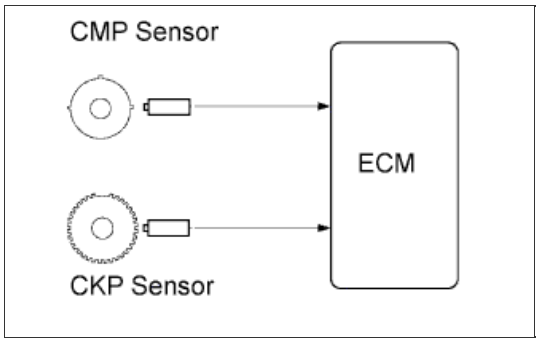
DTC P0306 Cylinder 6 Misfire Detected

DTC P0307 Cylinder 7 Misfire Detected

DTC P0308 Cylinder 8 Misfire Detected

for Preparation Click here

DESCRIPTION



When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause increases in exhaust emission levels. High concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent these increases in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the TWC reaches the point of thermal degradation, the MIL blinks. To monitor misfires, the ECM uses both the Camshaft Position (CMP) sensor and the Crankshaft Position (CKP) sensor. The CMP sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted as when the crankshaft rotation speed variations exceed predetermined thresholds.
If the misfire rate exceeds the threshold level, the ECM stores DTC(s).

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC). • An emission deterioration misfire occurs.	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Fuel injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306 P0307 P0308	Misfiring of a specific cylinder occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC). • An emission deterioration misfire occurs.	

HINT:

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

MONITOR DESCRIPTION

The ECM stores a DTC when either one of the following conditions, which could cause emission deterioration, is detected (2 trip detection logic).

- Within the first 1000 crankshaft revolutions of the engine starting, an excessive misfiring rate (approximately 30 to 110 misfires per 1000

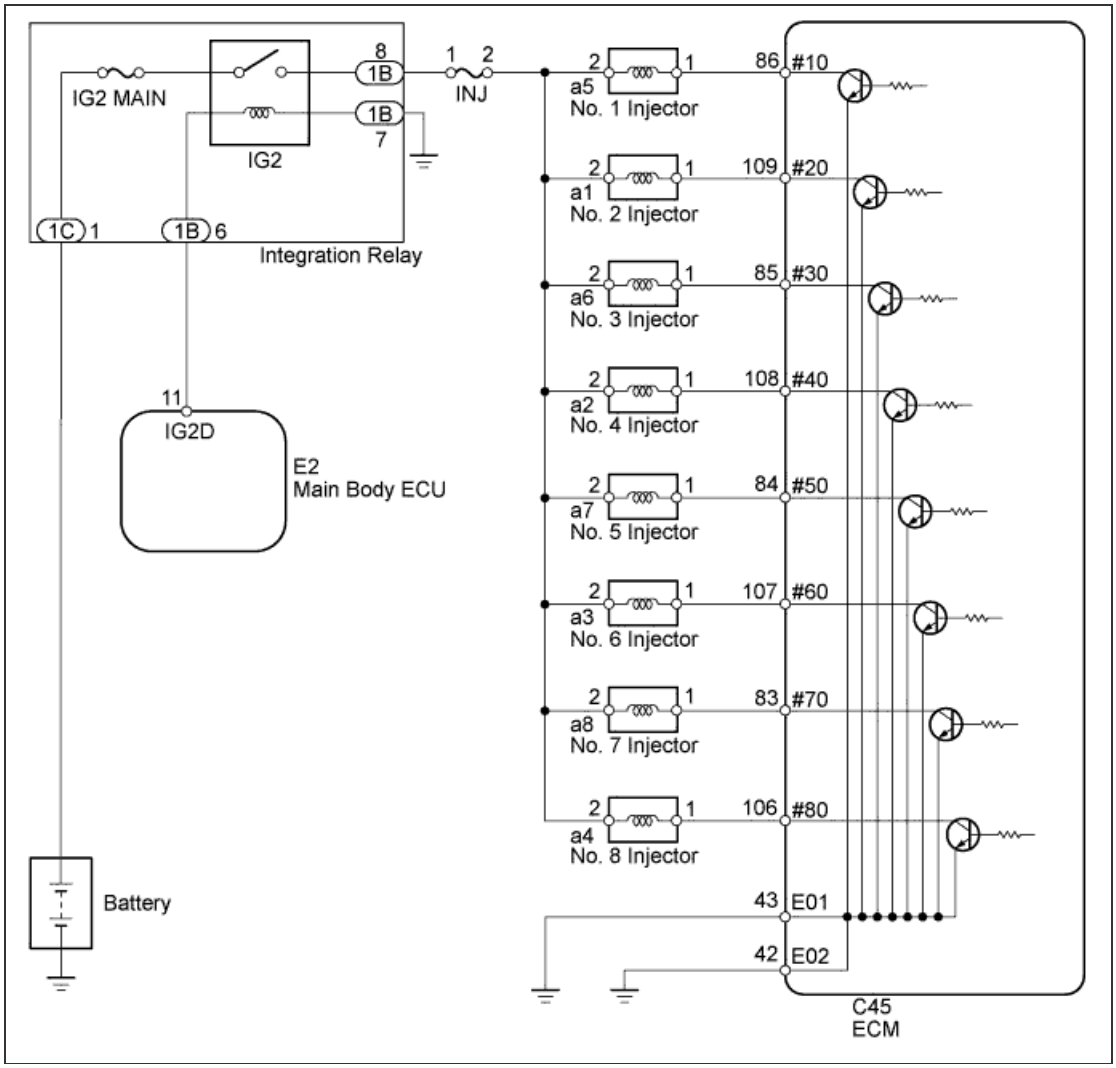
crankshaft revolutions) occurs once.

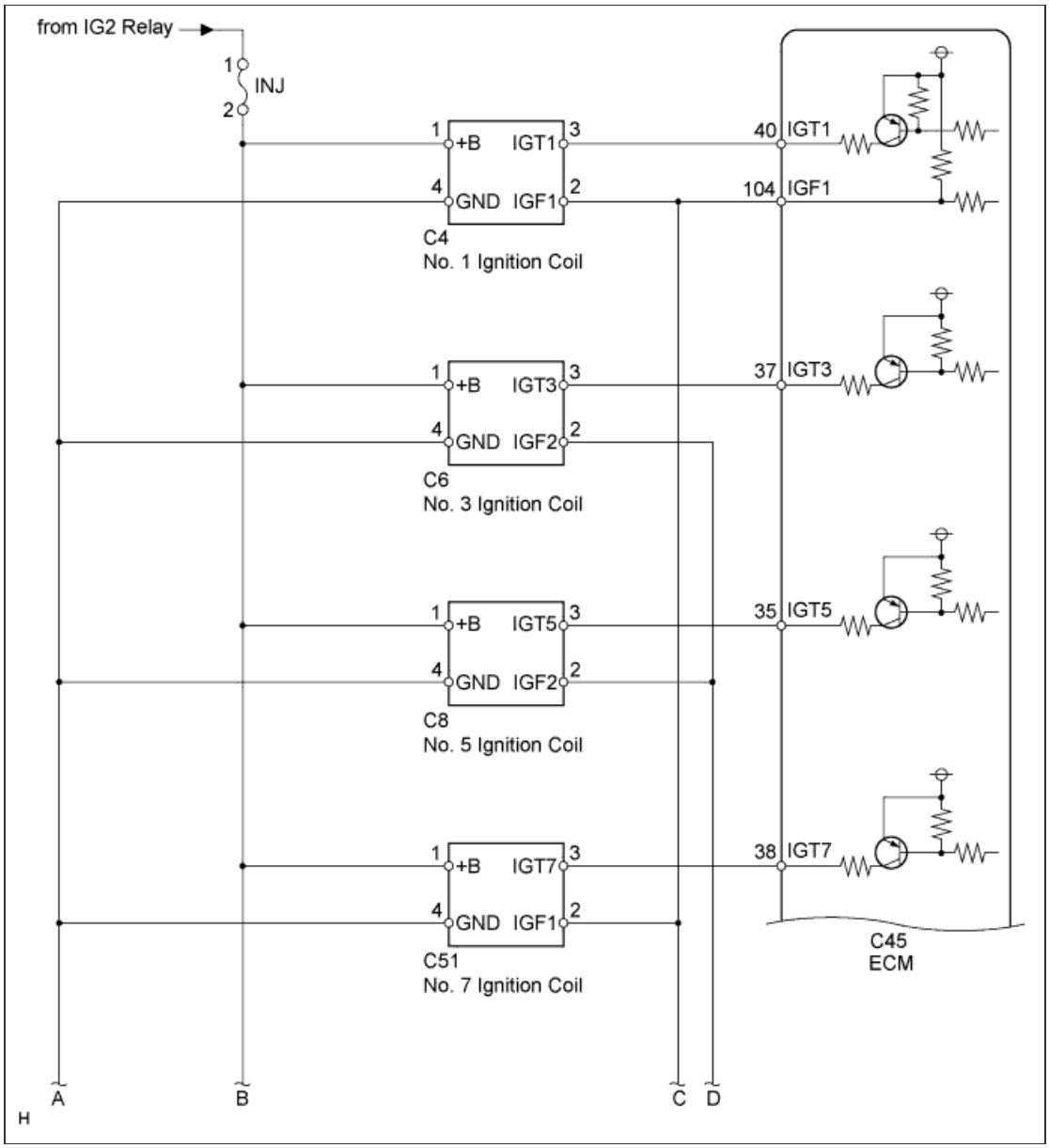
- An excessive misfiring rate (approximately 30 to 110 misfires per 1000 crankshaft revolutions) occurs a total of 4 times.

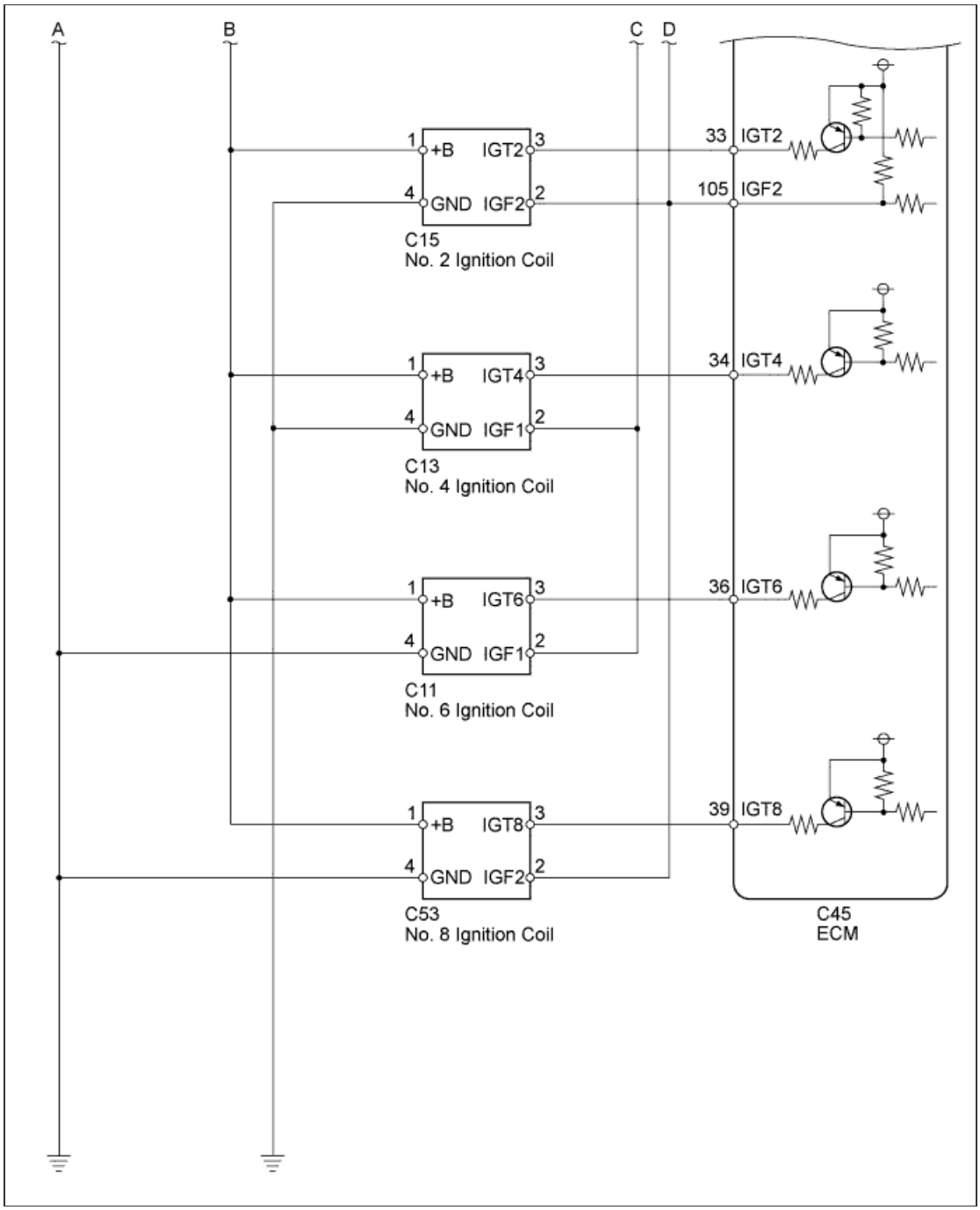
The ECM stores DTC(s) when either one of the following conditions, which could cause the Three-Way Catalytic Converter (TWC) damage, is detected (2 trip detection logic).

- At a high engine speed, a catalyst damage misfire, which monitored every 200 crankshaft revolutions, occurs once.
- At a normal engine speed, a catalyst damage misfire, which monitored every 200 crankshaft revolutions, occurs 3 times.

WIRING DIAGRAM




from IG2 Relay
1
INJ
2
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
38
IGT7
C45
ECM
A
B
C
D
H



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Turn the tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire counts of each cylinder (cylinder No. 1 to No. 8) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
7. Drive the vehicle several times with the conditions, such as engine speed and engine load, shown in Misfire RPM and Misfire Load in the Data List.

HINT:

In order to store misfire DTCs, it is necessary to operate the vehicle for the period of time shown in the table below, with the Misfire RPM and Misfire Load in the Data List.

Engine Speed	Duration
Idling	7 minutes or more
1000	4 minutes or more
2000	2 minutes or more
3000	1.5 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

   HINT:

   Do not turn the engine switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data will be cleared.

9. Record the DTC(s), freeze frame data and misfire counts.
10. Turn the engine switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **DTC P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are for Euro-OBD only.**
- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the freeze frame data have been duplicated, one of the following factors is considered to be a possible cause of the problem:**
  1. **The fuel level is low.**
  2. **Improper fuel is used.**
  3. **The spark plugs are dirty.**
- **After finishing repairs, check that no misfires occur in each cylinder (cylinder No. 1, No. 2, No. 3, No. 4, No. 5, No. 6, No. 7 and No. 8).**
- **Be sure to confirm that no misfiring cylinder DTCs are output again by conducting the confirmation driving pattern after the repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speed. If misfires only occur during high engine speed driving, only DTC P0300 is stored.**
  In the event of DTC P0300 being present, perform the following operations:
  1. **Clear the DTC (Click here).**
  2. **Start the engine and conduct the confirmation driving pattern.**
  3. **Read the misfiring rates of each cylinder or DTC(s) using the intelligent tester.**
  4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
  5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not output.**
- **When either Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air-fuel ratio may be rich (-20% or less) or lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is below 75°C (167°F), the misfires occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel which causes body vibration may cause misfire DTCs to be detected.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 are output	A
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 and other DTCs are output	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is connected correctly and is not damaged.

NG → **REPAIR OR REPLACE PCV HOSE (Click here)**

OK

3.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

4.READ VALUE USING INTELLIGENT TESTER (MISFIRE COUNT)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5, #6, #7 and #8.

f. Allow the engine to idle.

g. Read each value for Cylinder #1 Misfire Count to #8 displayed on the tester. If no misfire counts occur in any cylinders, perform the following procedures:

i. Move the shift lever to D.

ii. Check the Cylinder #1 Misfire Count to #8.

iii. If misfire counts are still not displayed, perform procedure A and and then check the misfire counts again.

h. Drive the vehicle with the Misfire RPM and Misfire Load noted in the ad Value Using tester (Misfire RPM and Misfire Load) procedures above (Procedure A).

i. Read the Cylinder #1 Misfire Count to #8 or DTCs displayed on the tester (Procedure).

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have e ual misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data record of the Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → **Go to step 16**

A

5.INSPECT SPARK PLUG

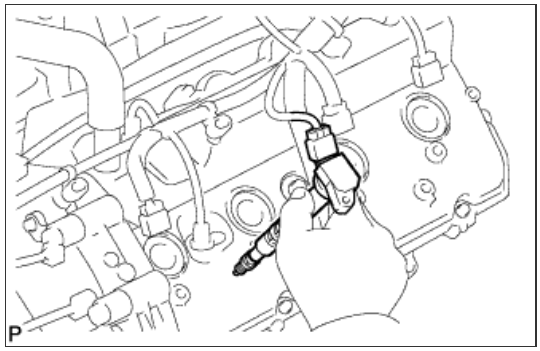
a. Inspect the spark plug of the misfiring cylinder (Click here).

NG → REPLACE SPARK PLUG (**Click here**)

OK

6.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.



CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → **Go to step 32**

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → GO TO FUEL INJECTOR CIRCUIT (**Click here**)

OK

9.CHECK HARNESS AND CONNECTOR

a. Disconnect the fuel injector connector.

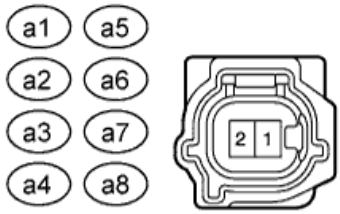
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

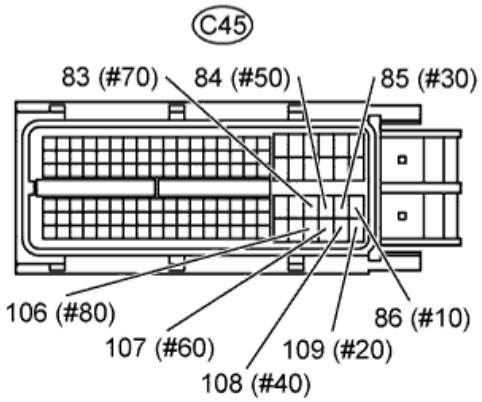
Standard Resistance:

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	a5-1 - Body ground	Always	10 kΩ or higher
	a5-1 - C45-86 (#10)	Always	Below 1 Ω
No. 2	a1-1 - Body ground	Always	10 kΩ or higher
	a1-1 - C45-109 (#20)	Always	Below 1 Ω
No. 3	a6-1 - Body ground	Always	10 kΩ or higher
	a6-1 - C45-85 (#30)	Always	Below 1 Ω
No. 4	a2-1 - Body ground	Always	10 kΩ or higher
	a2-1 - C45-108 (#40)	Always	Below 1 Ω
No. 5	a7-1 - Body ground	Always	10 kΩ or higher
	a7-1 - C45-84 (#50)	Always	Below 1 Ω
No. 6	a3-1 - Body ground	Always	10 kΩ or higher
	a3-1 - C45-107 (#60)	Always	Below 1 Ω
No. 7	a8-1 - Body ground	Always	10 kΩ or higher
	a8-1 - C45-83 (#70)	Always	Below 1 Ω
No. 8	a4-1 - Body ground	Always	10 kΩ or higher
	a4-1 - C45-106 (#80)	Always	Below 1 Ω

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (Click here)

OK

11.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

12.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → Go to step 34

OK

13.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

e. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine:
Same as ambient air temperature.
With warm engine:
Between 75°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

14.INSPECT MASS AIR FLOW METER

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF and Coolant Temp.

e. Allow the engine to idle until Coolant Temp reaches 75 C (167 F) or higher.

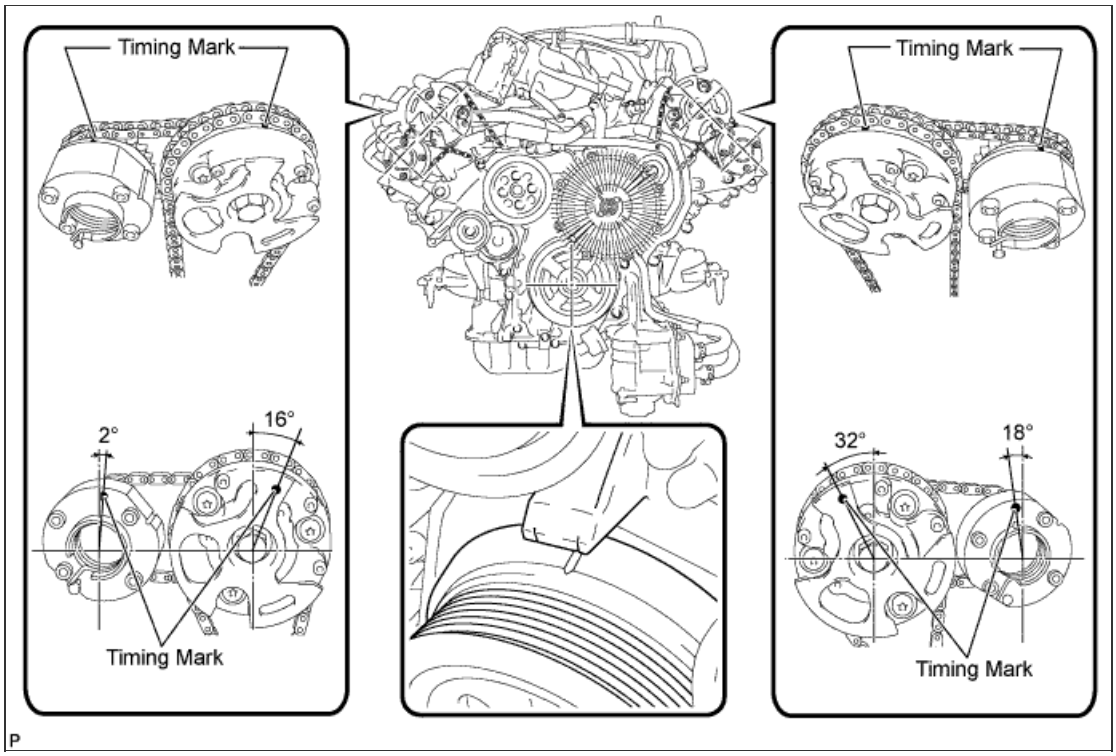
f. Read MAF with the engine speed at 3000 rpm.

Standard:
Between 25.2 gm/s and 35.2 gm/s (shift lever: N; A/C: Off).

NG → Go to step 27

OK

15.CHECK VALVE TIMING



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark 0 of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.

OK	Go to step 27
NG	ADJUST VALVE TIMING (Click here)

16.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG	REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

17.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG	Go to step 34

OK

18.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine:
Same as ambient air temperature.
With warm engine:
Between 75°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

19.INSPECT MASS AIR FLOW METER

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF and Coolant Temp.

e. Allow the engine to idle until Coolant Temp reaches 75 C (167 F) or higher.

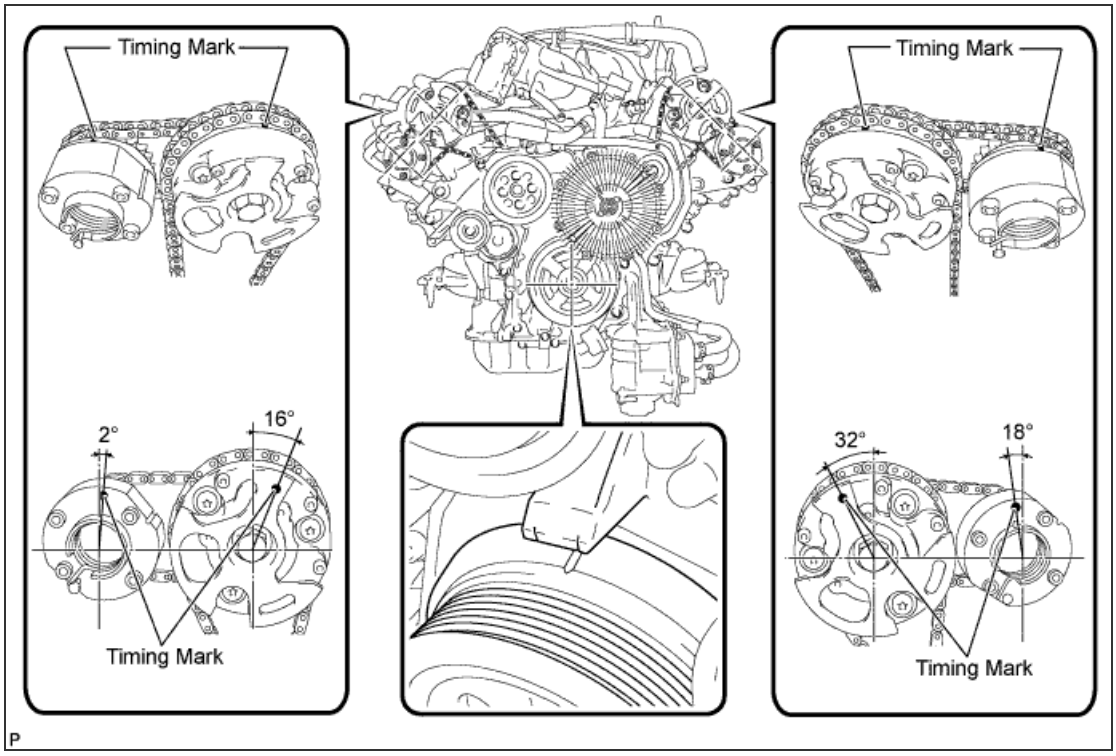
f. Read MAF with the engine speed at 3000 rpm.

Standard:
Between 25.2 gm/s and 35.2 gm/s (shift lever: N; A/C: Off).

NG → Go to step 27

OK

20.CHECK VALVE TIMING



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark 0 of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:

Timing marks on camshaft timing gears are aligned as shown in the illustration.

NG → ADJUST VALVE TIMING (Click here)

OK ↓

21.INSPECT SPARK PLUG

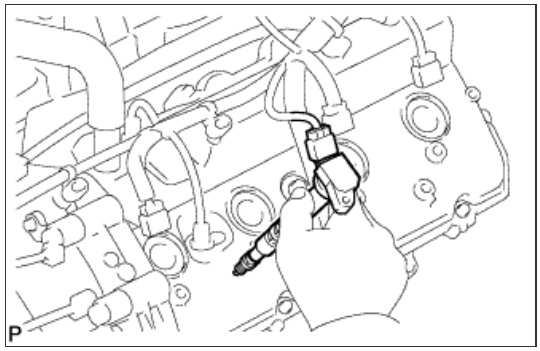
a. Inspect the spark plug of the misfiring cylinder (Click here).

NG → REPLACE SPARK PLUG (Click here)

OK ↓

22.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.



CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 32

OK ↓

23.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK ↓

24.CHECK FUEL INJECTOR ASSEMBLY (POWER SOURCE)

a. Disconnect the fuel injector connector.

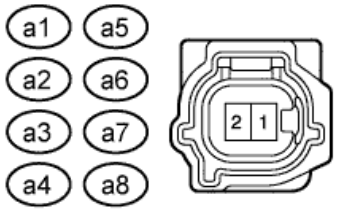
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	a5-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	a1-2 - Ground	Engine switch	11 to 14 V

		on (IG)	
No. 3	a6-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	a2-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	a7-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	a3-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	a8-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	a4-2 - Ground	Engine switch on (IG)	11 to 14 V

Front view of wire harness connector:
(to Injector)



NG → GO TO FUEL INJECTOR CIRCUIT (Click here)

OK

25.CHECK HARNESS AND CONNECTOR (FUEL INJECTOR - ECM)

a. Disconnect the fuel injector connector.

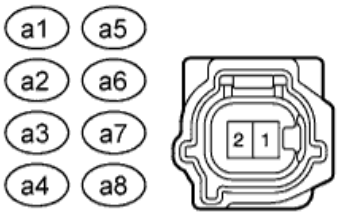
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

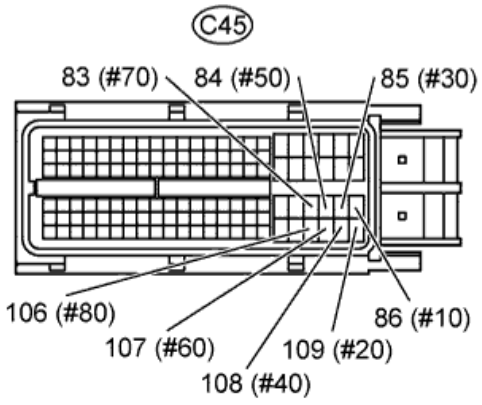
Standard Resistance:

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	a5-1 - Body ground	Always	10 kΩ or higher
	a5-1 - C45-86 (#10)	Always	Below 1 Ω
No. 2	a1-1 - Body ground	Always	10 kΩ or higher
	a1-1 - C45-109 (#20)	Always	Below 1 Ω
No. 3	a6-1 - Body ground	Always	10 kΩ or higher
	a6-1 - C45-85 (#30)	Always	Below 1 Ω
No. 4	a2-1 - Body ground	Always	10 kΩ or higher
	a2-1 - C45-108 (#40)	Always	Below 1 Ω
No. 5	a7-1 - Body ground	Always	10 kΩ or higher
	a7-1 - C45-84 (#50)	Always	Below 1 Ω
No. 6	a3-1 - Body ground	Always	10 kΩ or higher
	a3-1 - C45-107 (#60)	Always	Below 1 Ω
No. 7	a8-1 - Body ground	Always	10 kΩ or higher
	a8-1 - C45-83 (#70)	Always	Below 1 Ω
No. 8	a4-1 - Body ground	Always	10 kΩ or higher
	a4-1 - C45-106 (#80)	Always	Below 1 Ω

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.CHECK FUEL INJECTOR ASSEMBLY OF MISFIRING CYLINDER

Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (**Click here**)

OK

27.CHECK HARNESS AND CONNECTOR

a. Check the connection and terminal contact pressure of connectors and wire harnesses between the mass air flow meter and ECM (Click here).

HINT:

Repair any problems.

NEXT

28.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Turn the engine switch off.

f. Turn the engine switch on (IG) and turn the tester on.

g. Start the engine and warm it up.

h. Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input the DTC: P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308.

k. Check the DTC judgment result.

Result

Display (DTC Output)	Proceed to
ABNORMAL (P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308 output)	A
NORMAL (No DTC output)	B

B → END

A

29.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the mass air flow meter connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

		Specified

Tester Connection	Condition	Condition
C50-3 (VG) - C45-74 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C45-75 (E2G)	Always	Below 1 Ω
C50-3 (VG) or C45-74 (VG) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

30.REPLACE MASS AIR FLOW METER

Replace the mass air flow meter assembly (Click here).

HINT:

If the results of the inspections performed in steps 14 and 21 indicated no problem, proceed to the next step without replacing the mass air flow meter assembly.

NEXT

31.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Turn the engine switch off.

f. Turn the engine switch on (IG) and turn the tester on.

g. Start the engine and warm it up.

h. Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input the DTC: P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308.

k. Check the DTC judgment result.

Result

Display (DTC Output)	Proceed to
NORMAL (No DTC output)	A
ABNORMAL (P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308 output)	B

B → REPLACE ECM (**Click here**)

A

END

32.CHANGE TO CHANGE TO NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

a. Change the installed spark plug to a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → Go to step 33

OK ↓

REPLACE SPARK PLUG (Click here)

33.CHANGE TO NORMAL IGNITION COIL AND CHECK SPARK OF MISFIRING CYLINDER

a. Change the ignition coil to an ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK ↓

REPLACE IGNITION COIL (Click here)

34.CHECK FUEL LINE

a. Check the fuel lines for leaks or blockage.

NG → REPAIR OR REPLACE FUEL LINE

OK ↓

REPLACE FUEL PUMP ASSEMBLY (Click here)

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

for Preparation Click here

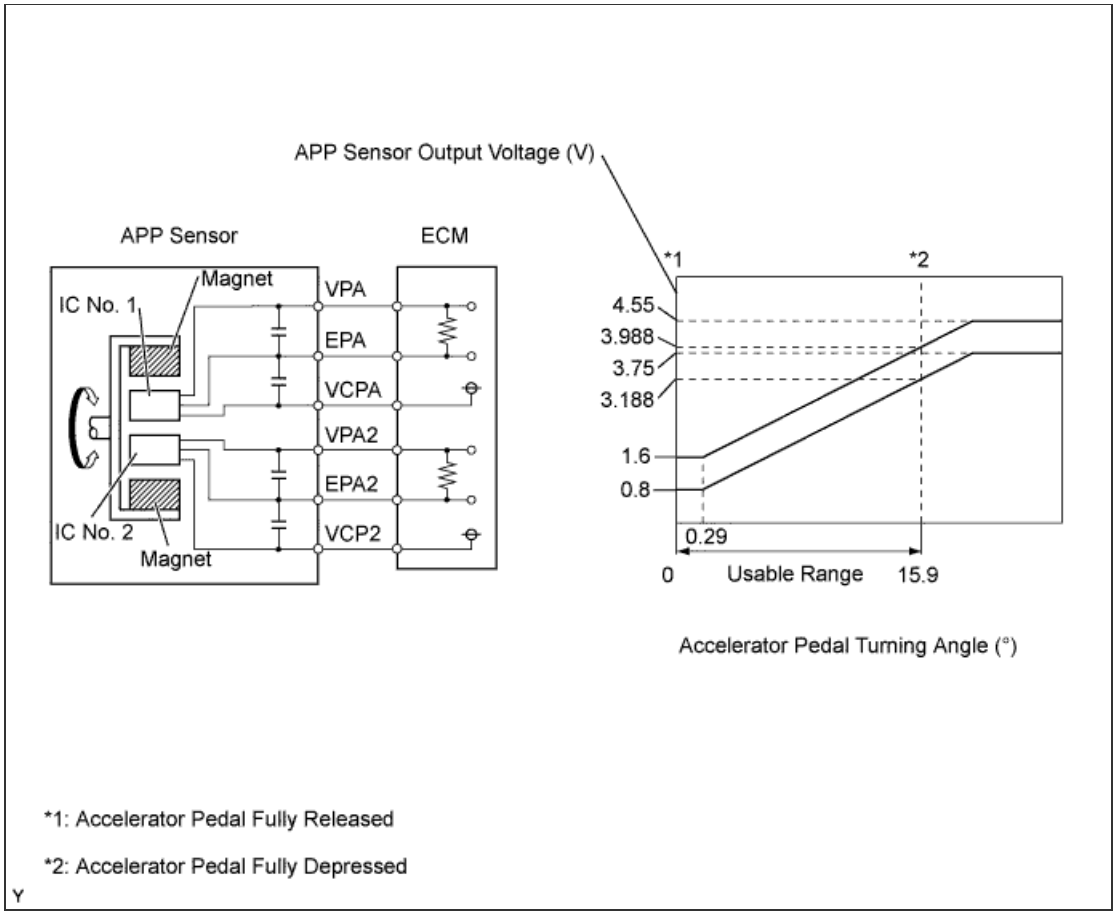
DESCRIPTION

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

The APP sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC Code	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM

P2122	VPA is 0.4 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP1 circuit • Open or ground short in VPA circuit • ECM
P2123	VPA is 4.8 V or higher for 2.0 seconds or more (1 trip detection logic).	• APP sensor • Open in EPA circuit • ECM
P2125	VPA2 fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or higher. (b) VPA is between 0.4 V and 3.45 V.	• APP sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): (a) The difference between VPA and VPA2 is 0.02 V or less. (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less.	• Short between VPA and VPA2 circuits • APP sensor • ECM

HINT:

When any of these DTCs is output, check the APP sensor voltage by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

Trouble Area	Accelerator Position No. 1 When AP Released	Accelerator Position No. 2 When AP Released	Accelerator Position No. 1 When AP Depressed	Accelerator Position No. 2 When AP Depressed
VCP circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.0 V
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 5.0 V

HINT:

- **Accelerator pedal positions are expressed as voltages.**
- **AP stands for Accelerator Pedal.**

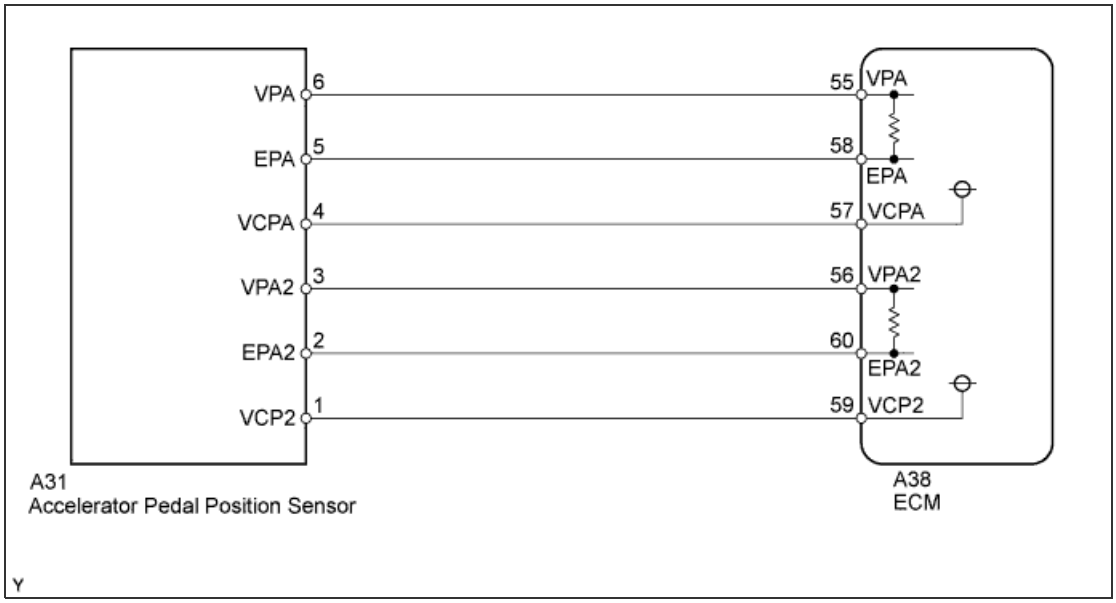
MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is less than the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and stores DTC(s).
Example:
When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is stored.
If the malfunction is not repaired successfully, a DTC is stored 2 seconds after the engine is next started.

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 is stored, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue driving. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.
Fail-safe mode continues until a pass condition is detected, and the engine switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Accelerator Pedal Position (APP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

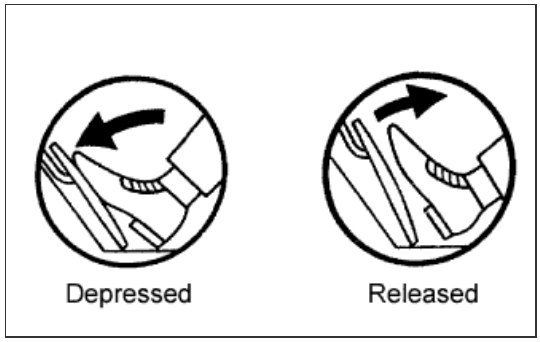
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

d. Read the value displayed on the tester.



Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released → Depressed → Released	0.5 to 4.5 V	1.2 to 5.0 V
	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V

Result

Result	Proceed to
N	A
OK	B

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

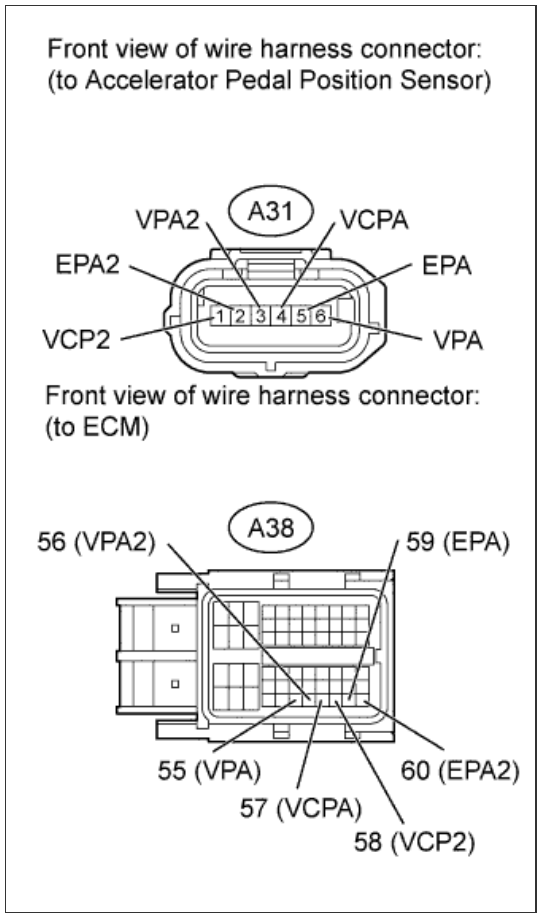
a. Disconnect the A31 accelerator pedal position (APP) sensor connector.

b. Disconnect the A38 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A38-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-58 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A38-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A38-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A38-59 (VCP2)	Always	Below 1 Ω
A31-6 (VPA) or A38-55 (VPA) - body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-58 (EPA) - body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-57 (VCPA) - body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-56 (VPA2) - body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A38-60 (EPA2) - body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A38-59 (VCP2) - body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

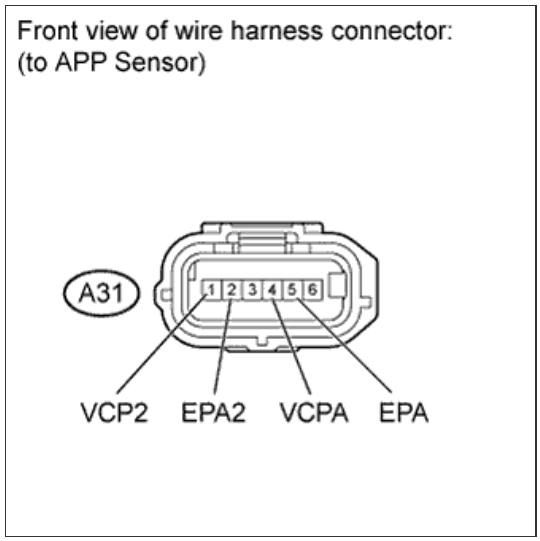
3.CHECK ECM (VCPA AND VCP2 VOLTAGE)

a. Disconnect the A31 APP sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Engine switch on (I)	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Engine switch on (I)	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

4.REPLACE ACCELERATOR PEDAL ASSEMBLY

a. Replace the accelerator pedal assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138 are output	A
No DTC is output	B

B → SYSTEM OK

A

REPLACE ECM (**Click here**)

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

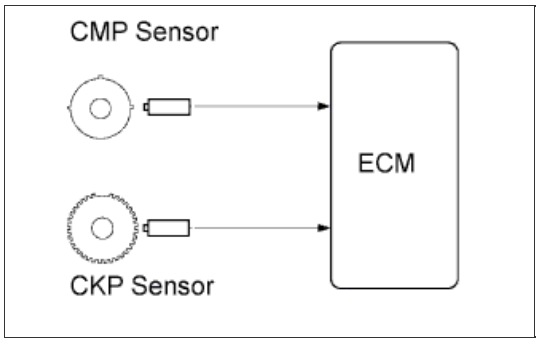
DTC P0306 Cylinder 6 Misfire Detected

DTC P0307 Cylinder 7 Misfire Detected

DTC P0308 Cylinder 8 Misfire Detected

for Preparation Click here

DESCRIPTION



When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause increases in exhaust emission levels. High concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent these increases in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the TWC reaches the point of thermal degradation, the MIL blinks. To monitor misfires, the ECM uses both the Camshaft Position (CMP) sensor and the Crankshaft Position (CKP) sensor. The CMP sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted as when the crankshaft rotation speed variations exceed predetermined thresholds.
If the misfire rate exceeds the threshold level, the ECM stores DTC(s).

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC). • An emission deterioration misfire occurs.	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Fuel injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306 P0307 P0308	Misfiring of a specific cylinder occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC). • An emission deterioration misfire occurs.	

HINT:

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

MONITOR DESCRIPTION

The ECM stores a DTC when either one of the following conditions, which could cause emission deterioration, is detected (2 trip detection logic).

- Within the first 1000 crankshaft revolutions of the engine starting, an excessive misfiring rate (approximately 30 to 110 misfires per 1000

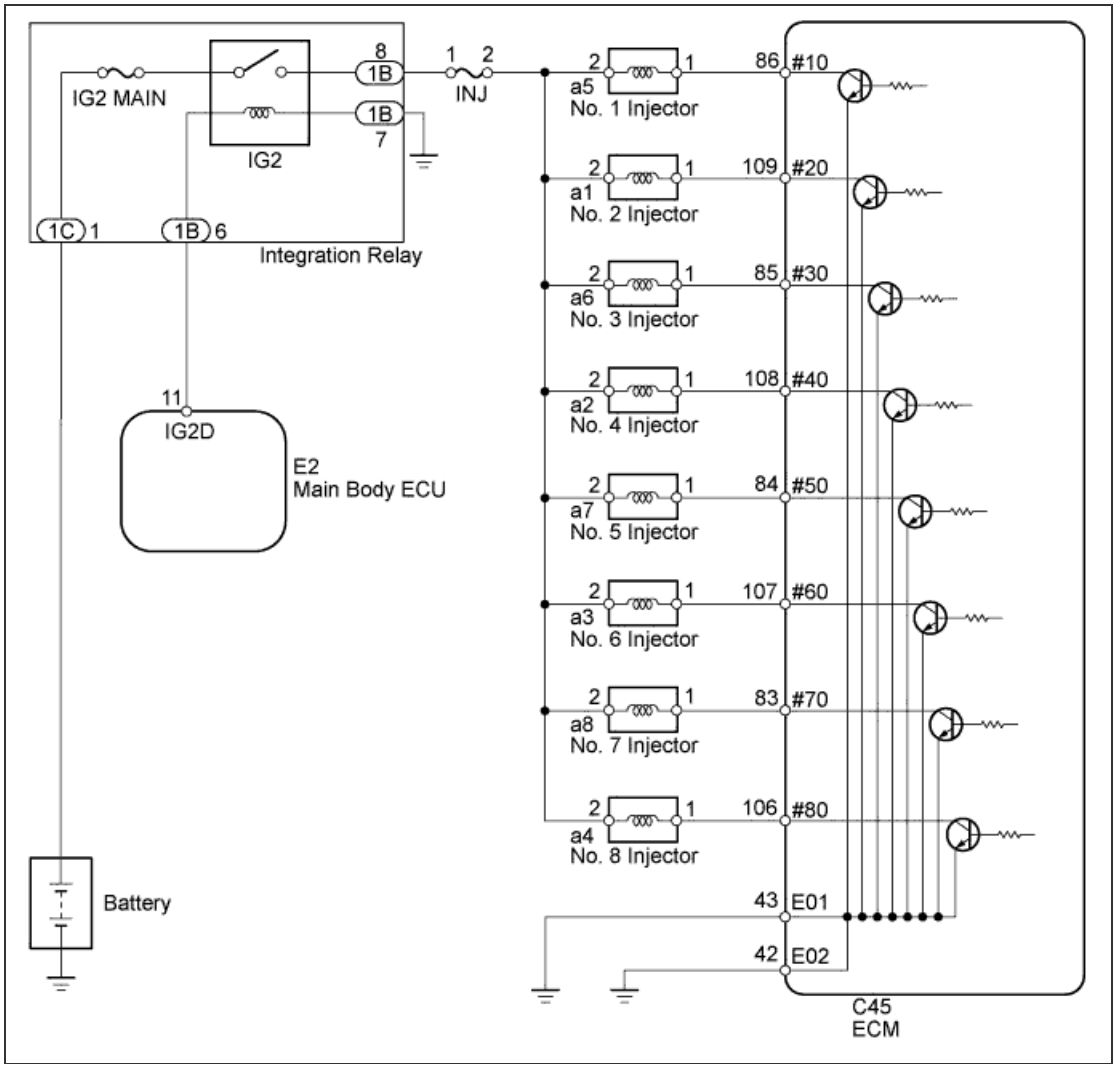
crankshaft revolutions) occurs once.

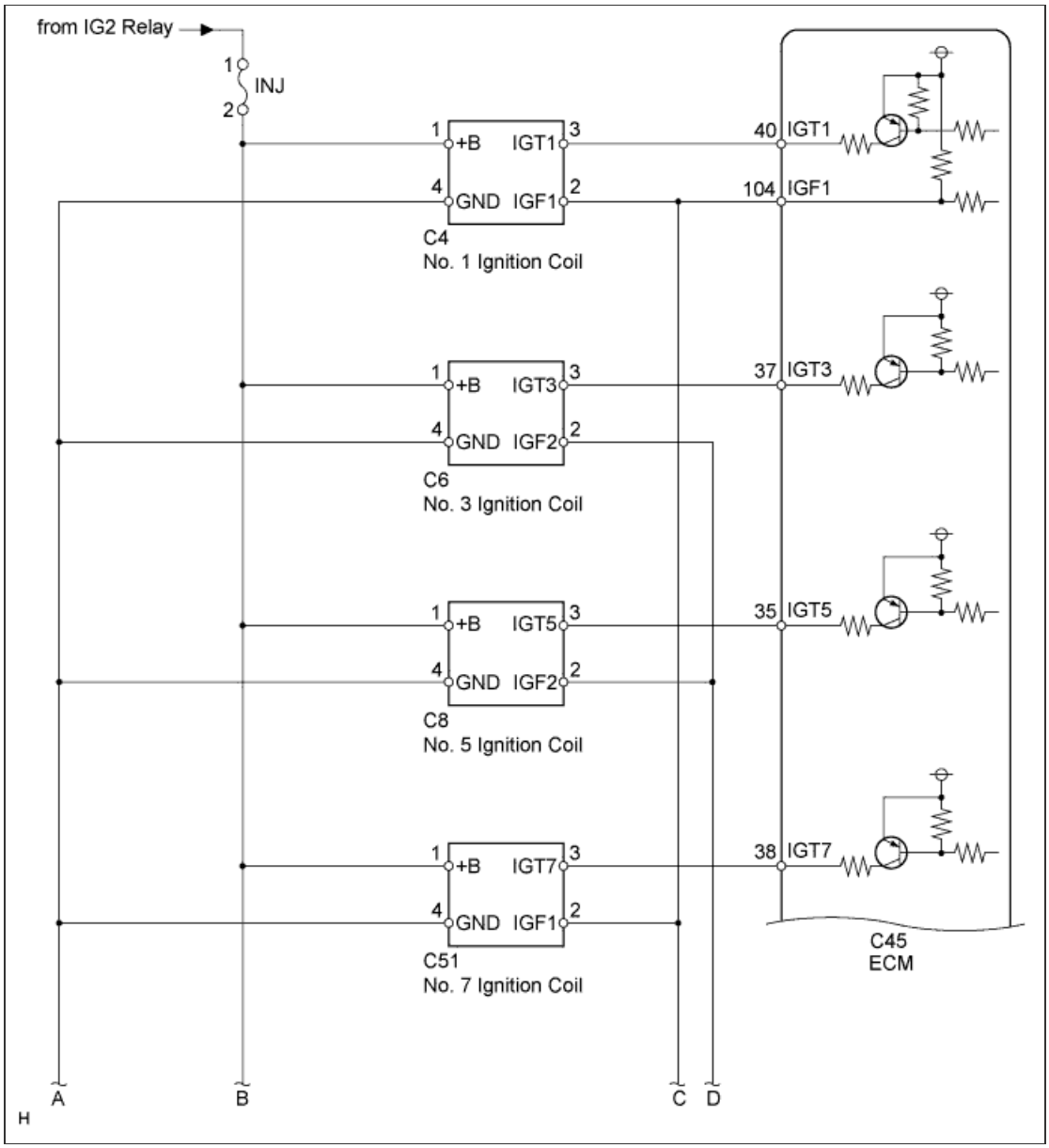
- An excessive misfiring rate (approximately 30 to 110 misfires per 1000 crankshaft revolutions) occurs a total of 4 times.

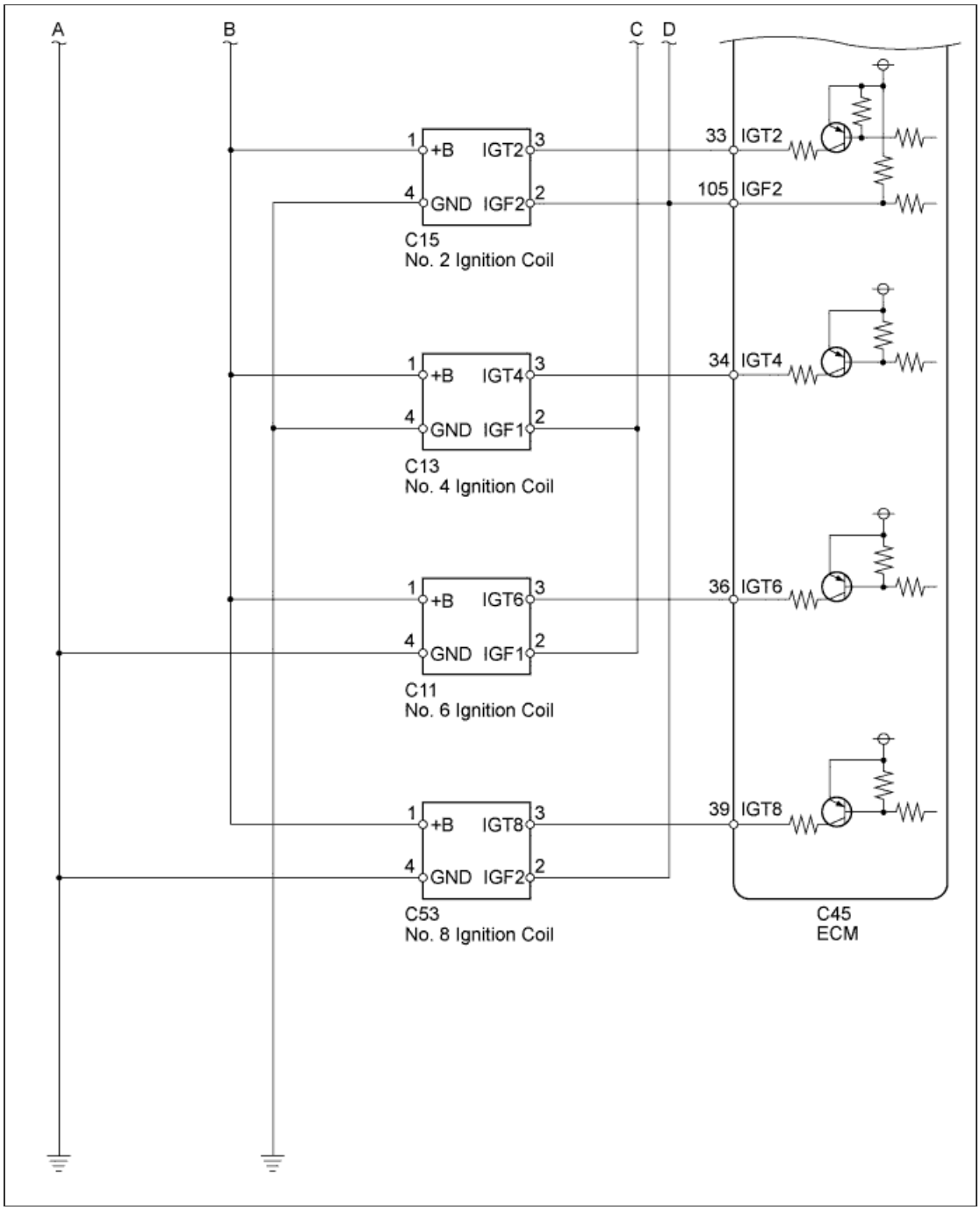
The ECM stores DTC(s) when either one of the following conditions, which could cause the Three-Way Catalytic Converter (TWC) damage, is detected (2 trip detection logic).

- At a high engine speed, a catalyst damage misfire, which monitored every 200 crankshaft revolutions, occurs once.
- At a normal engine speed, a catalyst damage misfire, which monitored every 200 crankshaft revolutions, occurs 3 times.

WIRING DIAGRAM




from IG2 Relay
1
INJ
2
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
38
IGT7
C45
ECM
A
B
C
D
H



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Turn the tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire counts of each cylinder (cylinder No. 1 to No. 8) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
7. Drive the vehicle several times with the conditions, such as engine speed and engine load, shown in Misfire RPM and Misfire Load in the Data List.

HINT:

In order to store misfire DTCs, it is necessary to operate the vehicle for the period of time shown in the table below, with the Misfire RPM and Misfire Load in the Data List.

Engine Speed	Duration
Idling	7 minutes or more
1000	4 minutes or more
2000	2 minutes or more
3000	1.5 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

   HINT:

   Do not turn the engine switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data will be cleared.

9. Record the DTC(s), freeze frame data and misfire counts.
10. Turn the engine switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **DTC P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are for Euro-OBD only.**
- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the freeze frame data have been duplicated, one of the following factors is considered to be a possible cause of the problem:**
  1. **The fuel level is low.**
  2. **Improper fuel is used.**
  3. **The spark plugs are dirty.**
- **After finishing repairs, check that no misfires occur in each cylinder (cylinder No. 1, No. 2, No. 3, No. 4, No. 5, No. 6, No. 7 and No. 8).**
- **Be sure to confirm that no misfiring cylinder DTCs are output again by conducting the confirmation driving pattern after the repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speed. If misfires only occur during high engine speed driving, only DTC P0300 is stored.**
  In the event of DTC P0300 being present, perform the following operations:
  1. **Clear the DTC (Click here).**
  2. **Start the engine and conduct the confirmation driving pattern.**
  3. **Read the misfiring rates of each cylinder or DTC(s) using the intelligent tester.**
  4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
  5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not output.**
- **When either Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air-fuel ratio may be rich (-20% or less) or lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is below 75°C (167°F), the misfires occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel which causes body vibration may cause misfire DTCs to be detected.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 are output	A
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 and other DTCs are output	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is connected correctly and is not damaged.

NG → **REPAIR OR REPLACE PCV HOSE (Click here)**

OK

3.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

4.READ VALUE USING INTELLIGENT TESTER (MISFIRE COUNT)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5, #6, #7 and #8.

f. Allow the engine to idle.

g. Read each value for Cylinder #1 Misfire Count to #8 displayed on the tester. If no misfire counts occur in any cylinders, perform the following procedures:

i. Move the shift lever to D.

ii. Check the Cylinder #1 Misfire Count to #8.

iii. If misfire counts are still not displayed, perform procedure A and and then check the misfire counts again.

h. Drive the vehicle with the Misfire RPM and Misfire Load noted in the ad Value Using tester (Misfire RPM and Misfire Load) procedures above (Procedure A).

i. Read the Cylinder #1 Misfire Count to #8 or DTCs displayed on the tester (Procedure).

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have e ual misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data record of the Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → **Go to step 16**

A

5.INSPECT SPARK PLUG

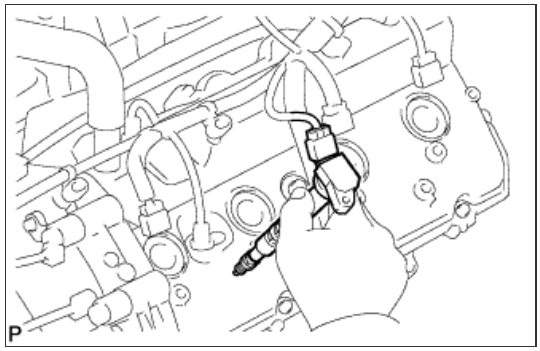
a. Inspect the spark plug of the misfiring cylinder (Click here).

NG → REPLACE SPARK PLUG (**Click here**)

OK

6.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.



CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → **Go to step 32**

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → GO TO FUEL INJECTOR CIRCUIT (**Click here**)

OK

9.CHECK HARNESS AND CONNECTOR

a. Disconnect the fuel injector connector.

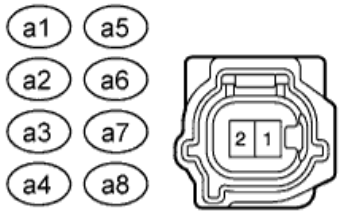
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

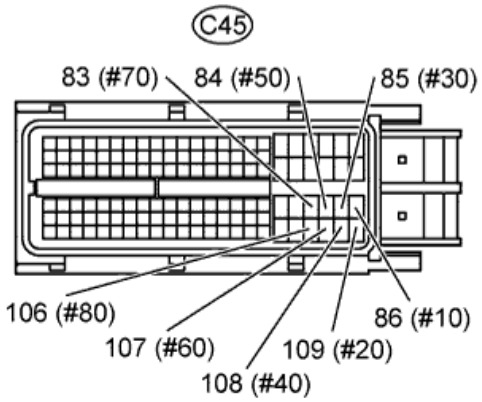
Standard Resistance:

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	a5-1 - Body ground	Always	10 kΩ or higher
	a5-1 - C45-86 (#10)	Always	Below 1 Ω
No. 2	a1-1 - Body ground	Always	10 kΩ or higher
	a1-1 - C45-109 (#20)	Always	Below 1 Ω
No. 3	a6-1 - Body ground	Always	10 kΩ or higher
	a6-1 - C45-85 (#30)	Always	Below 1 Ω
No. 4	a2-1 - Body ground	Always	10 kΩ or higher
	a2-1 - C45-108 (#40)	Always	Below 1 Ω
No. 5	a7-1 - Body ground	Always	10 kΩ or higher
	a7-1 - C45-84 (#50)	Always	Below 1 Ω
No. 6	a3-1 - Body ground	Always	10 kΩ or higher
	a3-1 - C45-107 (#60)	Always	Below 1 Ω
No. 7	a8-1 - Body ground	Always	10 kΩ or higher
	a8-1 - C45-83 (#70)	Always	Below 1 Ω
No. 8	a4-1 - Body ground	Always	10 kΩ or higher
	a4-1 - C45-106 (#80)	Always	Below 1 Ω

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (Click here)

OK

11.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

12.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → Go to step 34

OK

13.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

e. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine:
Same as ambient air temperature.
With warm engine:
Between 75°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

14.INSPECT MASS AIR FLOW METER

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF and Coolant Temp.

e. Allow the engine to idle until Coolant Temp reaches 75 C (167 F) or higher.

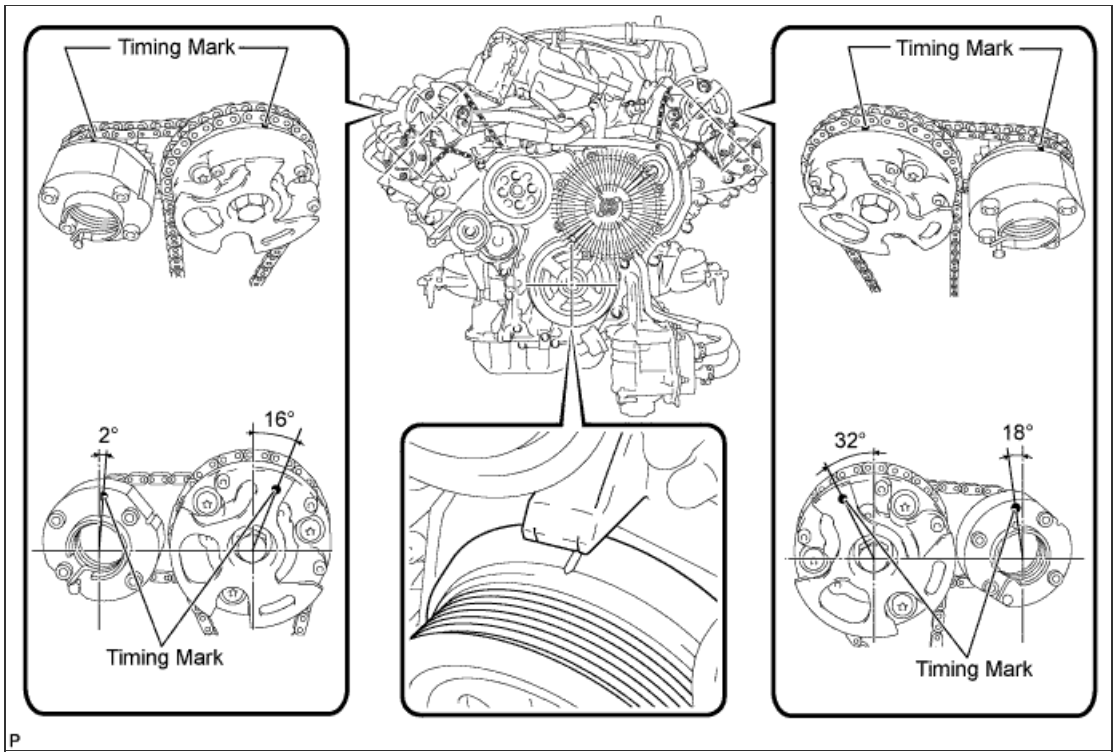
f. Read MAF with the engine speed at 3000 rpm.

Standard:
Between 25.2 gm/s and 35.2 gm/s (shift lever: N; A/C: Off).

NG → Go to step 27

OK

15.CHECK VALVE TIMING



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark 0 of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.

OK	Go to step 27
NG	ADJUST VALVE TIMING (Click here)

16.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG	REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

17.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG	Go to step 34

OK

18.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine:
Same as ambient air temperature.
With warm engine:
Between 75°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

19.INSPECT MASS AIR FLOW METER

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF and Coolant Temp.

e. Allow the engine to idle until Coolant Temp reaches 75 C (167 F) or higher.

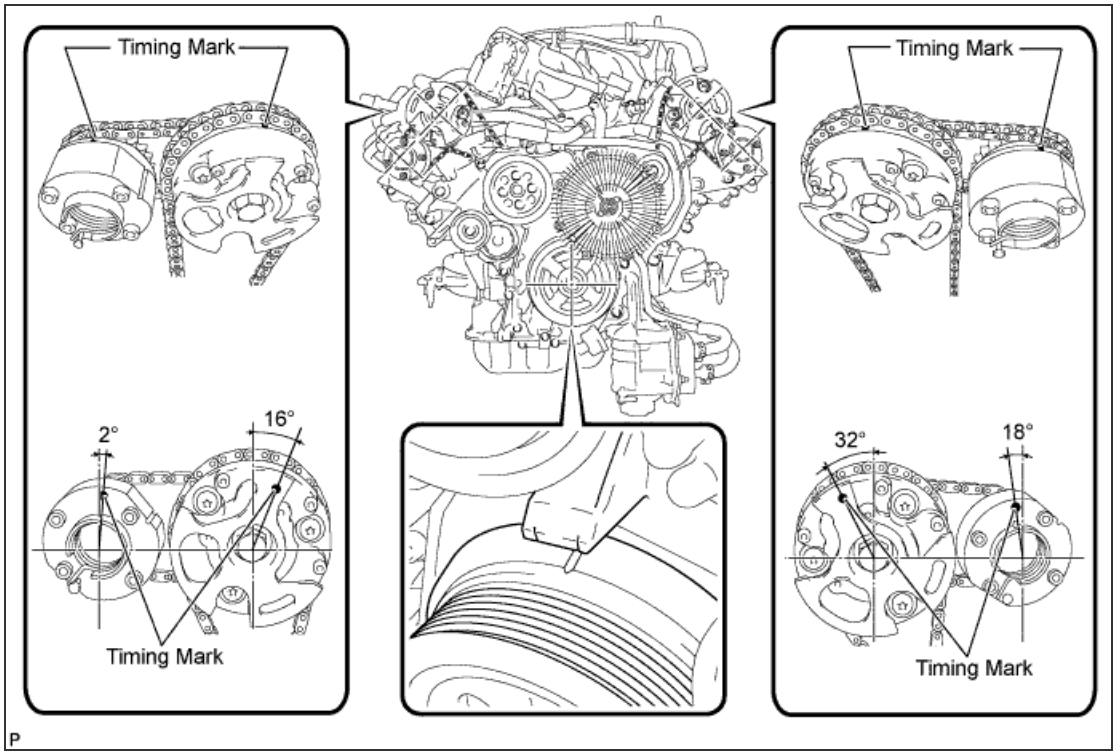
f. Read MAF with the engine speed at 3000 rpm.

Standard:
Between 25.2 gm/s and 35.2 gm/s (shift lever: N; A/C: Off).

NG → Go to step 27

OK

20.CHECK VALVE TIMING



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark 0 of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:

Timing marks on camshaft timing gears are aligned as shown in the illustration.

NG → ADJUST VALVE TIMING (Click here)

OK ↓

21.INSPECT SPARK PLUG

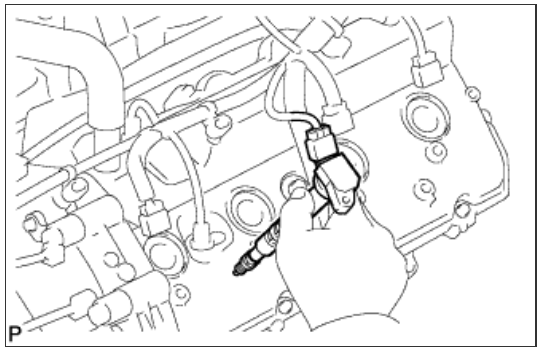
a. Inspect the spark plug of the misfiring cylinder (Click here).

NG → REPLACE SPARK PLUG (Click here)

OK ↓

22.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.



CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 32

OK ↓

23.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK ↓

24.CHECK FUEL INJECTOR ASSEMBLY (POWER SOURCE)

a. Disconnect the fuel injector connector.

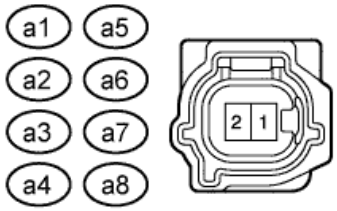
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	a5-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	a1-2 - Ground	Engine switch	11 to 14 V

		on (IG)	
No. 3	a6-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	a2-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	a7-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	a3-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	a8-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	a4-2 - Ground	Engine switch on (IG)	11 to 14 V

Front view of wire harness connector:
(to Injector)



NG → GO TO FUEL INJECTOR CIRCUIT (Click here)

OK

25.CHECK HARNESS AND CONNECTOR (FUEL INJECTOR - ECM)

a. Disconnect the fuel injector connector.

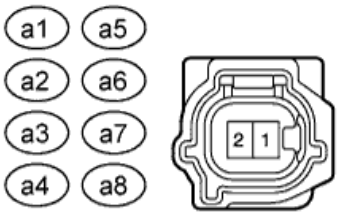
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

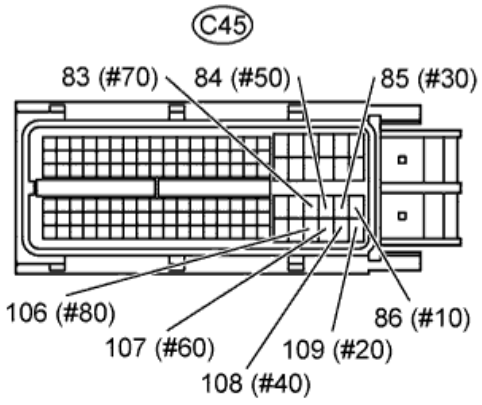
Standard Resistance:

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	a5-1 - Body ground	Always	10 kΩ or higher
	a5-1 - C45-86 (#10)	Always	Below 1 Ω
No. 2	a1-1 - Body ground	Always	10 kΩ or higher
	a1-1 - C45-109 (#20)	Always	Below 1 Ω
No. 3	a6-1 - Body ground	Always	10 kΩ or higher
	a6-1 - C45-85 (#30)	Always	Below 1 Ω
No. 4	a2-1 - Body ground	Always	10 kΩ or higher
	a2-1 - C45-108 (#40)	Always	Below 1 Ω
No. 5	a7-1 - Body ground	Always	10 kΩ or higher
	a7-1 - C45-84 (#50)	Always	Below 1 Ω
No. 6	a3-1 - Body ground	Always	10 kΩ or higher
	a3-1 - C45-107 (#60)	Always	Below 1 Ω
No. 7	a8-1 - Body ground	Always	10 kΩ or higher
	a8-1 - C45-83 (#70)	Always	Below 1 Ω
No. 8	a4-1 - Body ground	Always	10 kΩ or higher
	a4-1 - C45-106 (#80)	Always	Below 1 Ω

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.CHECK FUEL INJECTOR ASSEMBLY OF MISFIRING CYLINDER

Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (**Click here**)

OK

27.CHECK HARNESS AND CONNECTOR

a. Check the connection and terminal contact pressure of connectors and wire harnesses between the mass air flow meter and ECM (Click here).

HINT:

Repair any problems.

NEXT

28.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Turn the engine switch off.

f. Turn the engine switch on (IG) and turn the tester on.

g. Start the engine and warm it up.

h. Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input the DTC: P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308.

k. Check the DTC judgment result.

Result

Display (DTC Output)	Proceed to
ABNORMAL (P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308 output)	A
NORMAL (No DTC output)	B

B → END

A

29.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the mass air flow meter connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

		Specified

Tester Connection	Condition	Condition
C50-3 (VG) - C45-74 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C45-75 (E2G)	Always	Below 1 Ω
C50-3 (VG) or C45-74 (VG) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

30.REPLACE MASS AIR FLOW METER

Replace the mass air flow meter assembly (Click here).

HINT:

If the results of the inspections performed in steps 14 and 21 indicated no problem, proceed to the next step without replacing the mass air flow meter assembly.

NEXT

31.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Turn the engine switch off.

f. Turn the engine switch on (IG) and turn the tester on.

g. Start the engine and warm it up.

h. Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input the DTC: P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308.

k. Check the DTC judgment result.

Result

Display (DTC Output)	Proceed to
NORMAL (No DTC output)	A
ABNORMAL (P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308 output)	B

B → REPLACE ECM (**Click here**)

A

END

32.CHANGE TO CHANGE TO NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

a. Change the installed spark plug to a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → Go to step 33

OK ↓

REPLACE SPARK PLUG (Click here)

33.CHANGE TO NORMAL IGNITION COIL AND CHECK SPARK OF MISFIRING CYLINDER

a. Change the ignition coil to an ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK ↓

REPLACE IGNITION COIL (Click here)

34.CHECK FUEL LINE

a. Check the fuel lines for leaks or blockage.

NG → REPAIR OR REPLACE FUEL LINE

OK ↓

REPLACE FUEL PUMP ASSEMBLY (Click here)

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

for Preparation Click here

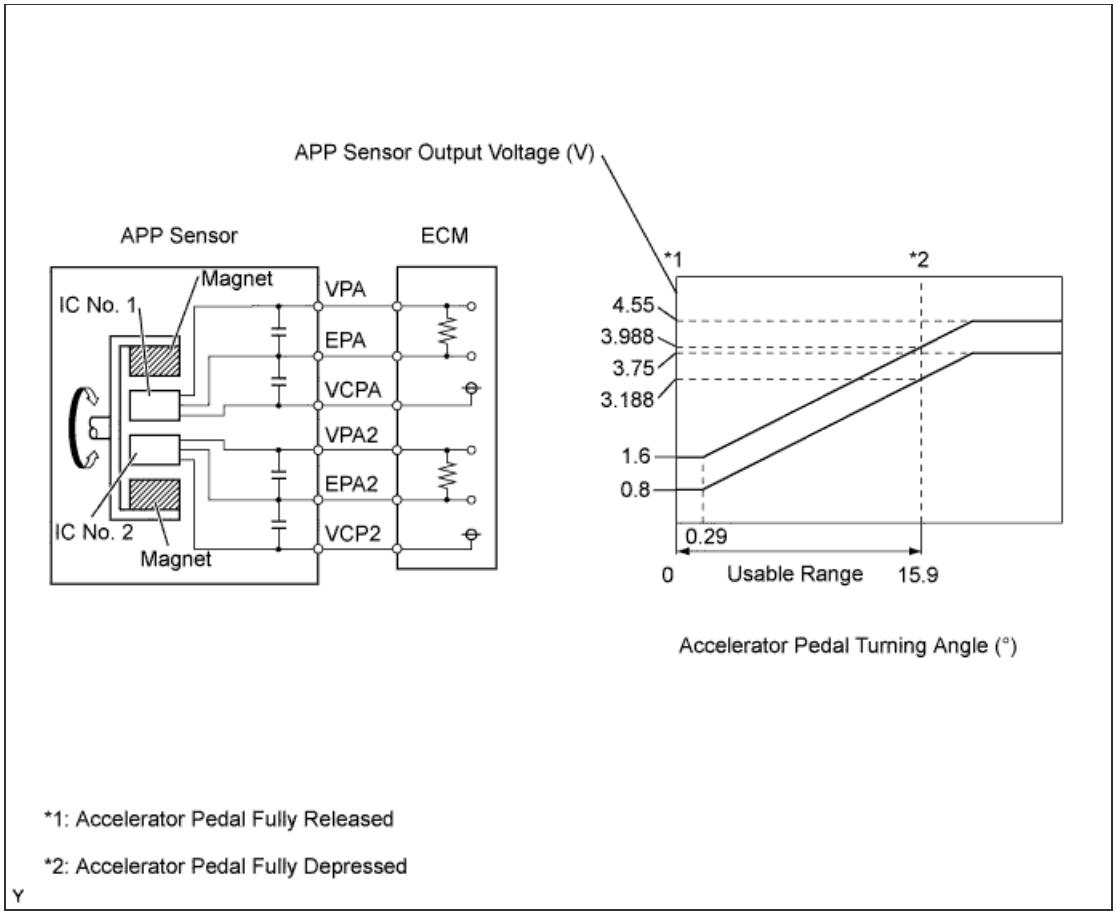
DESCRIPTION

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

The APP sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC Code	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM

P2122	VPA is 0.4 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP1 circuit • Open or ground short in VPA circuit • ECM
P2123	VPA is 4.8 V or higher for 2.0 seconds or more (1 trip detection logic).	• APP sensor • Open in EPA circuit • ECM
P2125	VPA2 fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or higher. (b) VPA is between 0.4 V and 3.45 V.	• APP sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): (a) The difference between VPA and VPA2 is 0.02 V or less. (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less.	• Short between VPA and VPA2 circuits • APP sensor • ECM

HINT:

When any of these DTCs is output, check the APP sensor voltage by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

Trouble Area	Accelerator Position No. 1 When AP Released	Accelerator Position No. 2 When AP Released	Accelerator Position No. 1 When AP Depressed	Accelerator Position No. 2 When AP Depressed
VCP circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.0 V
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 5.0 V

HINT:

- **Accelerator pedal positions are expressed as voltages.**
- **AP stands for Accelerator Pedal.**

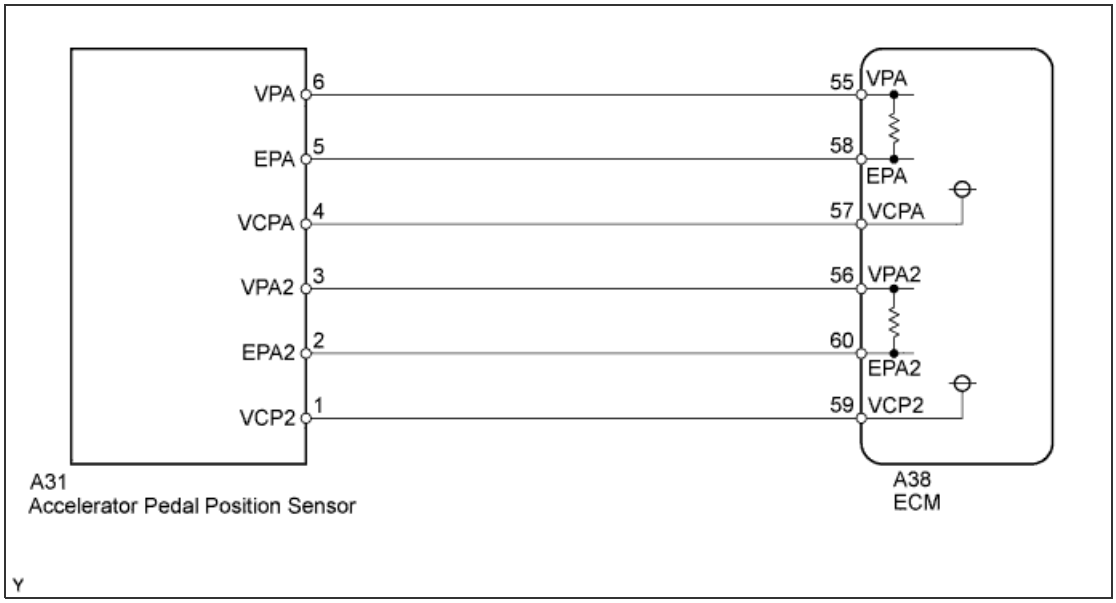
MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is less than the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and stores DTC(s).
Example:
When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is stored.
If the malfunction is not repaired successfully, a DTC is stored 2 seconds after the engine is next started.

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 is stored, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue driving. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.
Fail-safe mode continues until a pass condition is detected, and the engine switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Accelerator Pedal Position (APP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

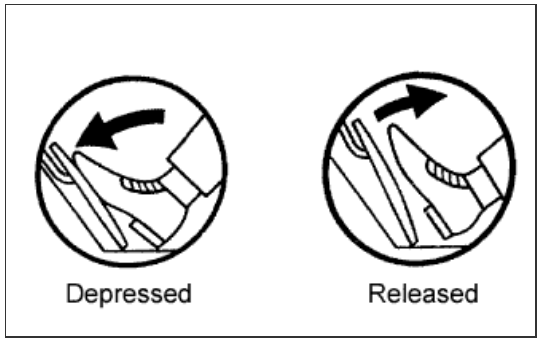
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

d. Read the value displayed on the tester.



Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released → Depressed → Released	0.5 to 4.5 V	1.2 to 5.0 V
	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V

Result

Result	Proceed to
N	A
OK	B

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

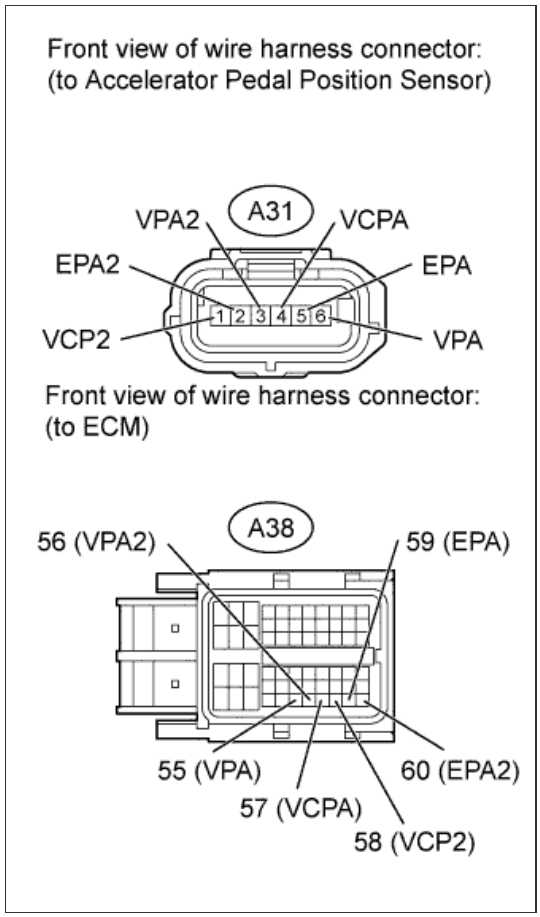
a. Disconnect the A31 accelerator pedal position (APP) sensor connector.

b. Disconnect the A38 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A38-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-58 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A38-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A38-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A38-59 (VCP2)	Always	Below 1 Ω
A31-6 (VPA) or A38-55 (VPA) - body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-58 (EPA) - body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-57 (VCPA) - body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-56 (VPA2) - body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A38-60 (EPA2) - body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A38-59 (VCP2) - body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

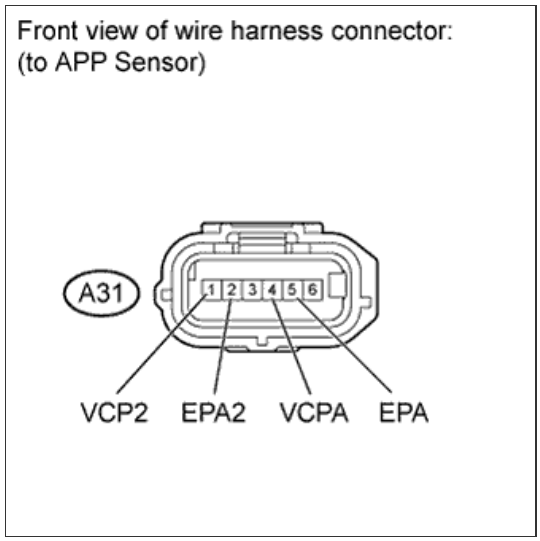
3.CHECK ECM (VCPA AND VCP2 VOLTAGE)

a. Disconnect the A31 APP sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Engine switch on (I)	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Engine switch on (I)	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

4.REPLACE ACCELERATOR PEDAL ASSEMBLY

a. Replace the accelerator pedal assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138 are output	A
No DTC is output	B

B → SYSTEM OK

A

REPLACE ECM (**Click here**)

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

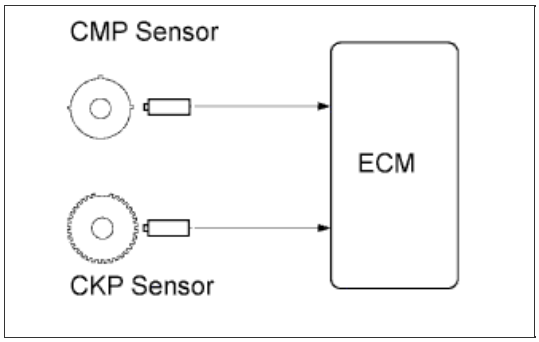
DTC P0306 Cylinder 6 Misfire Detected

DTC P0307 Cylinder 7 Misfire Detected

DTC P0308 Cylinder 8 Misfire Detected

for Preparation Click here

DESCRIPTION



When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause increases in exhaust emission levels. High concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent these increases in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the TWC reaches the point of thermal degradation, the MIL blinks. To monitor misfires, the ECM uses both the Camshaft Position (CMP) sensor and the Crankshaft Position (CKP) sensor. The CMP sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted as when the crankshaft rotation speed variations exceed predetermined thresholds.
If the misfire rate exceeds the threshold level, the ECM stores DTC(s).

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC). • An emission deterioration misfire occurs.	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Fuel injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306 P0307 P0308	Misfiring of a specific cylinder occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC). • An emission deterioration misfire occurs.	

HINT:

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

MONITOR DESCRIPTION

The ECM stores a DTC when either one of the following conditions, which could cause emission deterioration, is detected (2 trip detection logic).

- Within the first 1000 crankshaft revolutions of the engine starting, an excessive misfiring rate (approximately 30 to 110 misfires per 1000

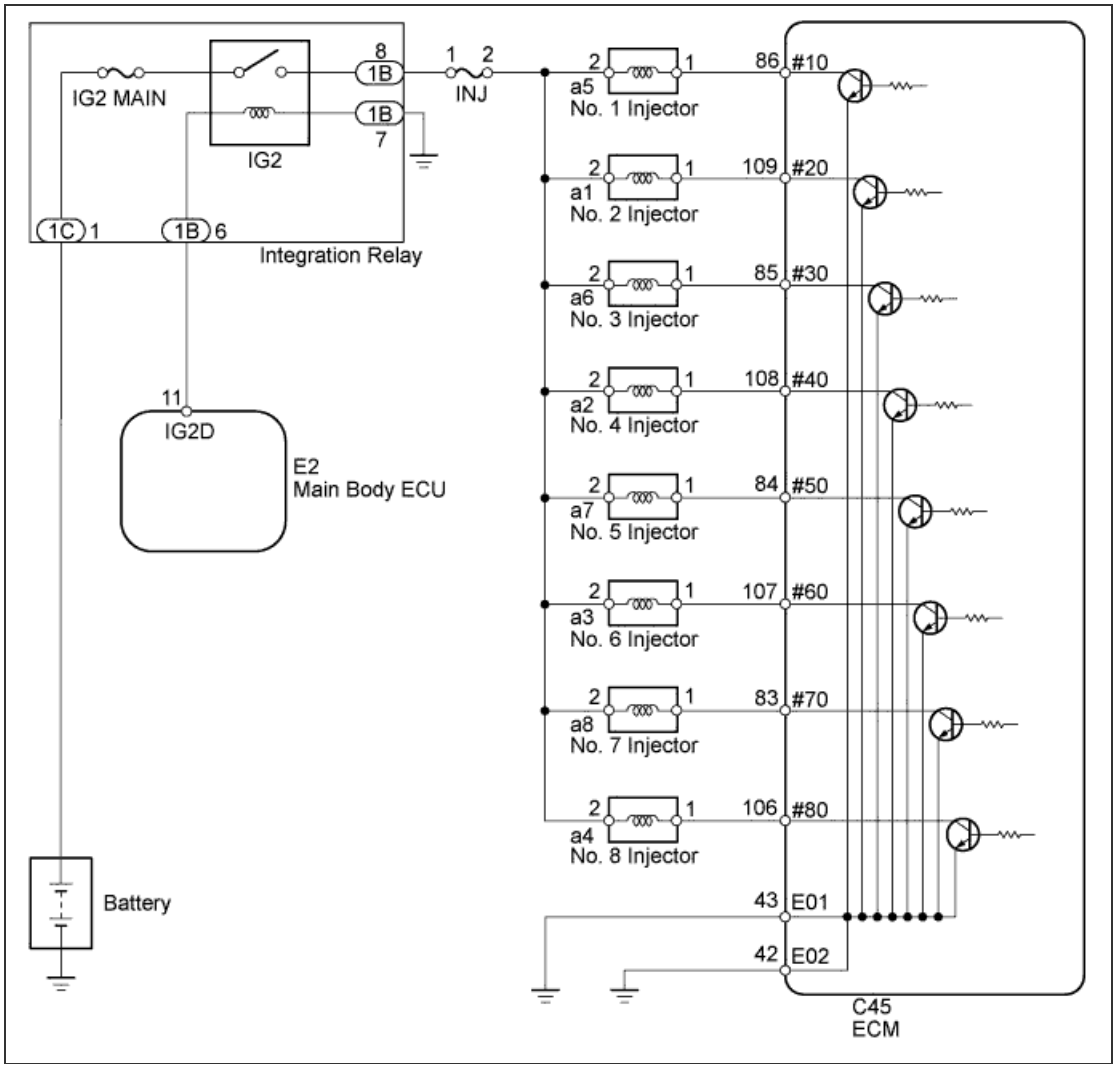
crankshaft revolutions) occurs once.

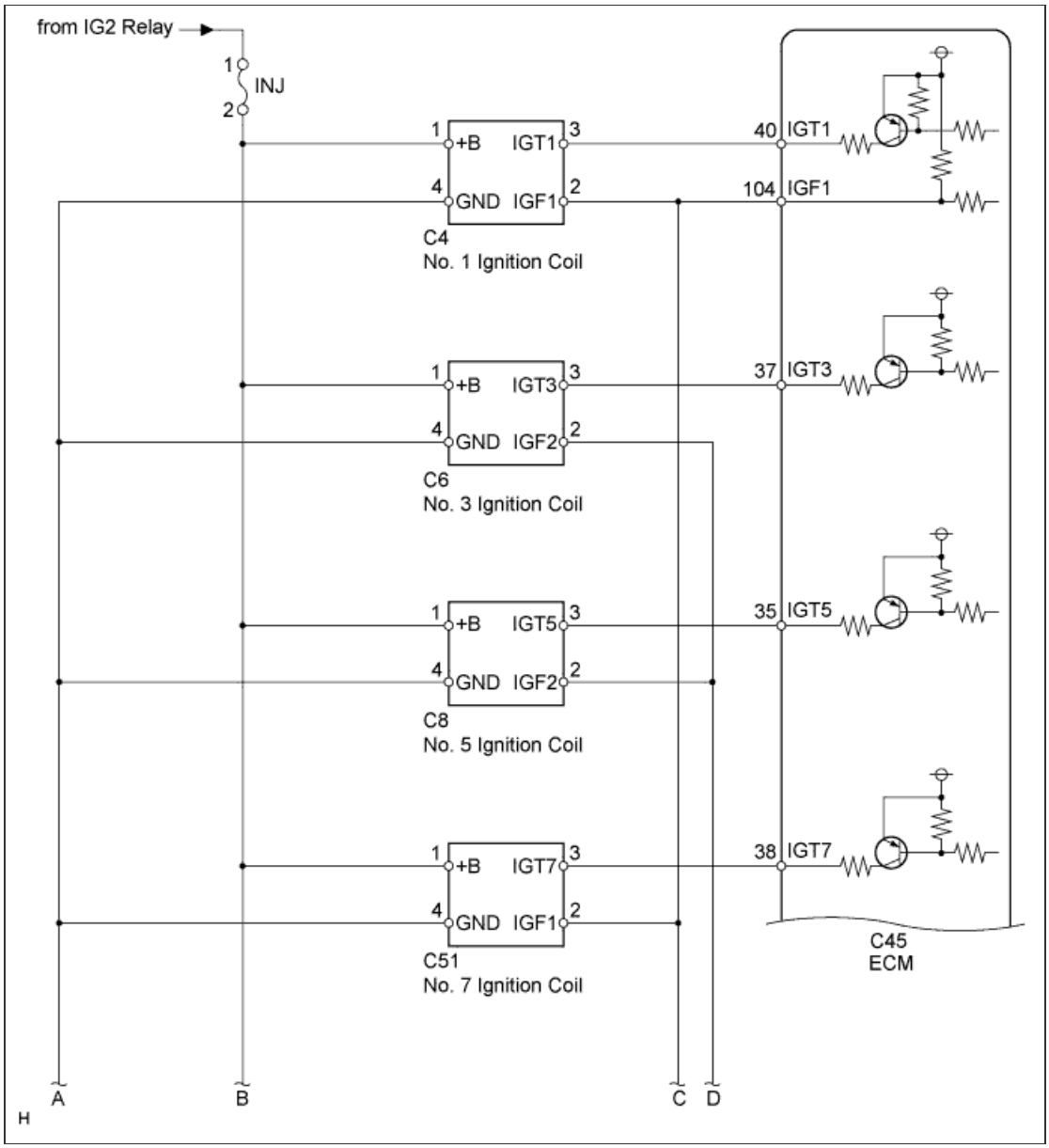
- An excessive misfiring rate (approximately 30 to 110 misfires per 1000 crankshaft revolutions) occurs a total of 4 times.

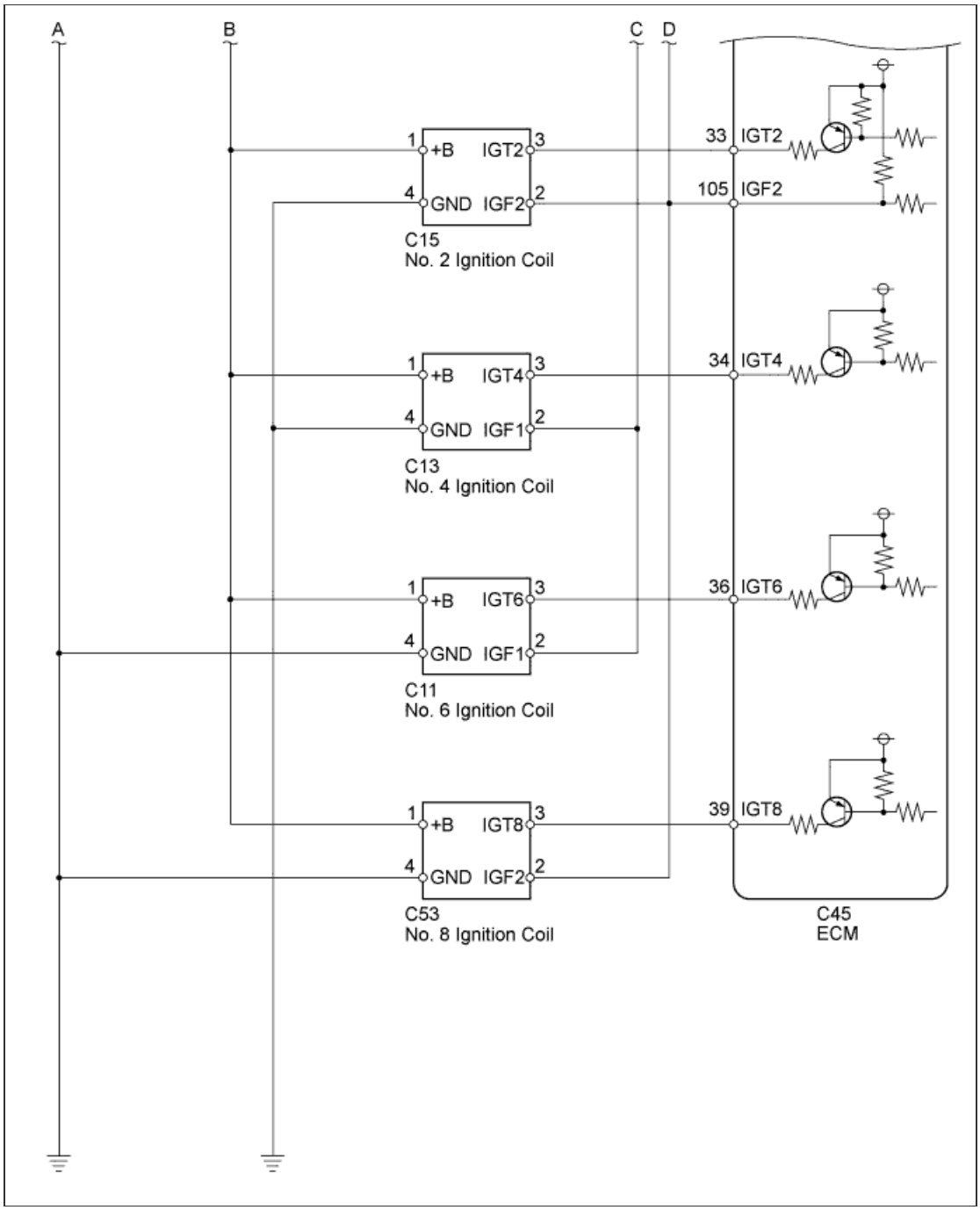
The ECM stores DTC(s) when either one of the following conditions, which could cause the Three-Way Catalytic Converter (TWC) damage, is detected (2 trip detection logic).

- At a high engine speed, a catalyst damage misfire, which monitored every 200 crankshaft revolutions, occurs once.
- At a normal engine speed, a catalyst damage misfire, which monitored every 200 crankshaft revolutions, occurs 3 times.

WIRING DIAGRAM




from IG2 Relay
1
INJ
2
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
38
IGT7
C45
ECM
A
B
C
D
H



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Turn the tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire counts of each cylinder (cylinder No. 1 to No. 8) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
7. Drive the vehicle several times with the conditions, such as engine speed and engine load, shown in Misfire RPM and Misfire Load in the Data List.

HINT:

In order to store misfire DTCs, it is necessary to operate the vehicle for the period of time shown in the table below, with the Misfire RPM and Misfire Load in the Data List.

Engine Speed	Duration
Idling	7 minutes or more
1000	4 minutes or more
2000	2 minutes or more
3000	1.5 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

   HINT:

   Do not turn the engine switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data will be cleared.

9. Record the DTC(s), freeze frame data and misfire counts.
10. Turn the engine switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **DTC P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are for Euro-OBD only.**
- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the freeze frame data have been duplicated, one of the following factors is considered to be a possible cause of the problem:**
  1. **The fuel level is low.**
  2. **Improper fuel is used.**
  3. **The spark plugs are dirty.**
- **After finishing repairs, check that no misfires occur in each cylinder (cylinder No. 1, No. 2, No. 3, No. 4, No. 5, No. 6, No. 7 and No. 8).**
- **Be sure to confirm that no misfiring cylinder DTCs are output again by conducting the confirmation driving pattern after the repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speed. If misfires only occur during high engine speed driving, only DTC P0300 is stored.**
  In the event of DTC P0300 being present, perform the following operations:
  1. **Clear the DTC (Click here).**
  2. **Start the engine and conduct the confirmation driving pattern.**
  3. **Read the misfiring rates of each cylinder or DTC(s) using the intelligent tester.**
  4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
  5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not output.**
- **When either Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air-fuel ratio may be rich (-20% or less) or lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is below 75°C (167°F), the misfires occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel which causes body vibration may cause misfire DTCs to be detected.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 are output	A
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 and other DTCs are output	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is connected correctly and is not damaged.

NG → **REPAIR OR REPLACE PCV HOSE (Click here)**

OK

3.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

4.READ VALUE USING INTELLIGENT TESTER (MISFIRE COUNT)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5, #6, #7 and #8.

f. Allow the engine to idle.

g. Read each value for Cylinder #1 Misfire Count to #8 displayed on the tester. If no misfire counts occur in any cylinders, perform the following procedures:

i. Move the shift lever to D.

ii. Check the Cylinder #1 Misfire Count to #8.

iii. If misfire counts are still not displayed, perform procedure A and and then check the misfire counts again.

h. Drive the vehicle with the Misfire RPM and Misfire Load noted in the ad Value Using tester (Misfire RPM and Misfire Load) procedures above (Procedure A).

i. Read the Cylinder #1 Misfire Count to #8 or DTCs displayed on the tester (Procedure).

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have e ual misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data record of the Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → **Go to step 16**

A

5.INSPECT SPARK PLUG

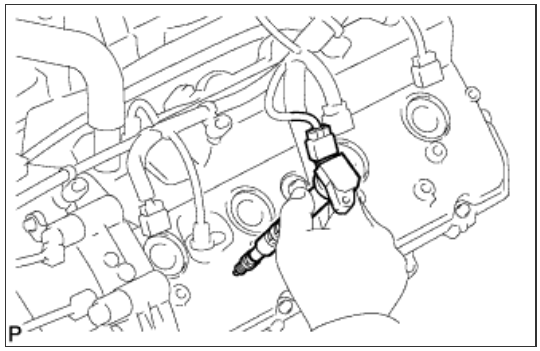
a. Inspect the spark plug of the misfiring cylinder (Click here).

NG → REPLACE SPARK PLUG (**Click here**)

OK

6.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.



CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → **Go to step 32**

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → GO TO FUEL INJECTOR CIRCUIT (**Click here**)

OK

9.CHECK HARNESS AND CONNECTOR

a. Disconnect the fuel injector connector.

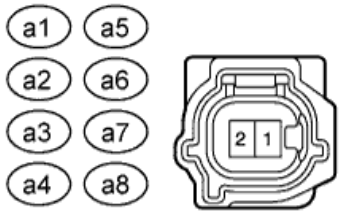
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

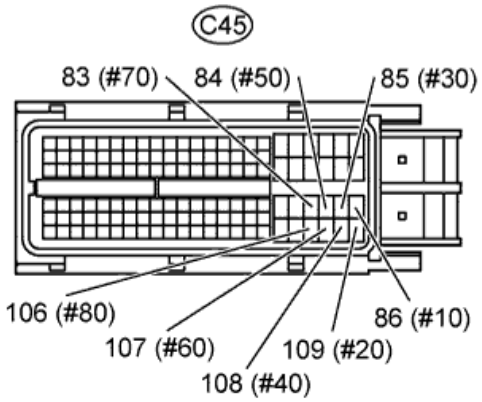
Standard Resistance:

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	a5-1 - Body ground	Always	10 kΩ or higher
	a5-1 - C45-86 (#10)	Always	Below 1 Ω
No. 2	a1-1 - Body ground	Always	10 kΩ or higher
	a1-1 - C45-109 (#20)	Always	Below 1 Ω
No. 3	a6-1 - Body ground	Always	10 kΩ or higher
	a6-1 - C45-85 (#30)	Always	Below 1 Ω
No. 4	a2-1 - Body ground	Always	10 kΩ or higher
	a2-1 - C45-108 (#40)	Always	Below 1 Ω
No. 5	a7-1 - Body ground	Always	10 kΩ or higher
	a7-1 - C45-84 (#50)	Always	Below 1 Ω
No. 6	a3-1 - Body ground	Always	10 kΩ or higher
	a3-1 - C45-107 (#60)	Always	Below 1 Ω
No. 7	a8-1 - Body ground	Always	10 kΩ or higher
	a8-1 - C45-83 (#70)	Always	Below 1 Ω
No. 8	a4-1 - Body ground	Always	10 kΩ or higher
	a4-1 - C45-106 (#80)	Always	Below 1 Ω

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (Click here)

OK

11.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

12.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → Go to step 34

OK

13.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

e. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine:
Same as ambient air temperature.
With warm engine:
Between 75°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

14.INSPECT MASS AIR FLOW METER

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF and Coolant Temp.

e. Allow the engine to idle until Coolant Temp reaches 75 C (167 F) or higher.

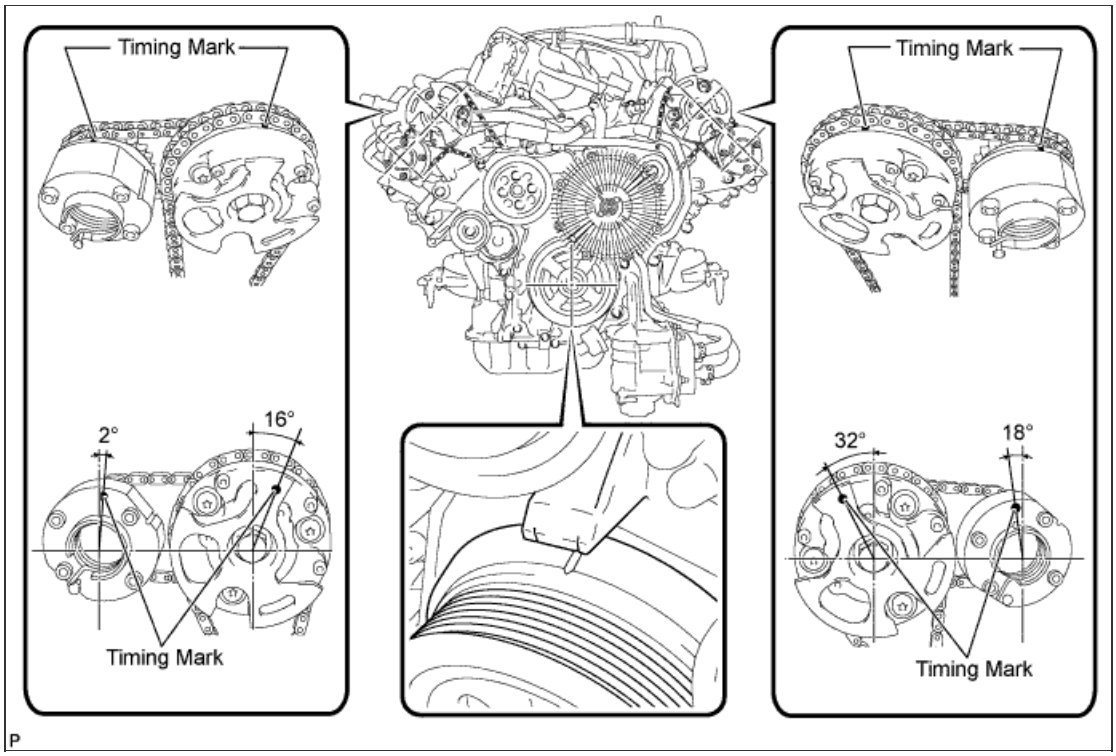
f. Read MAF with the engine speed at 3000 rpm.

Standard:
Between 25.2 gm/s and 35.2 gm/s (shift lever: N; A/C: Off).

NG → Go to step 27

OK

15.CHECK VALVE TIMING



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark 0 of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.

OK	Go to step 27
NG	ADJUST VALVE TIMING (Click here)

16.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG	REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

17.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG	Go to step 34

OK

18.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine:
Same as ambient air temperature.
With warm engine:
Between 75°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

19.INSPECT MASS AIR FLOW METER

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF and Coolant Temp.

e. Allow the engine to idle until Coolant Temp reaches 75 C (167 F) or higher.

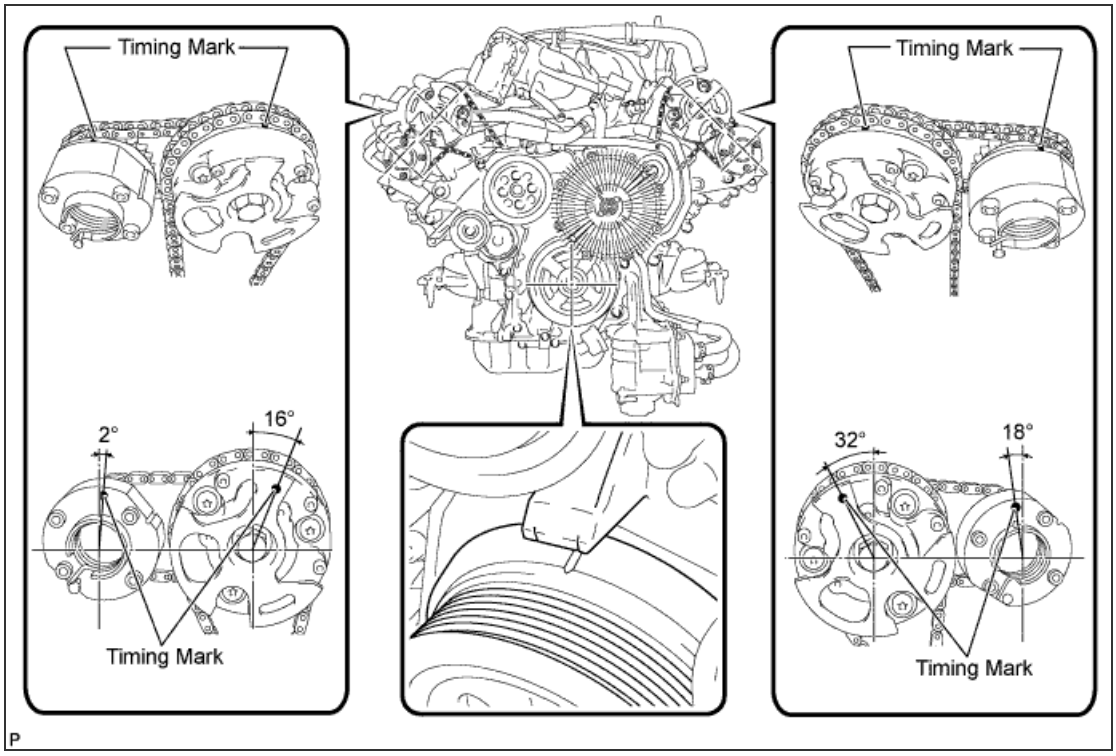
f. Read MAF with the engine speed at 3000 rpm.

Standard:
Between 25.2 gm/s and 35.2 gm/s (shift lever: N; A/C: Off).

NG → Go to step 27

OK

20.CHECK VALVE TIMING



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark 0 of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:

Timing marks on camshaft timing gears are aligned as shown in the illustration.

NG → ADJUST VALVE TIMING (Click here)

OK ↓

21.INSPECT SPARK PLUG

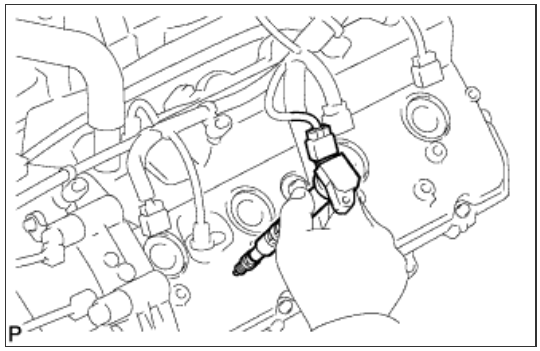
a. Inspect the spark plug of the misfiring cylinder (Click here).

NG → REPLACE SPARK PLUG (Click here)

OK ↓

22.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.



CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 32

OK ↓

23.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK ↓

24.CHECK FUEL INJECTOR ASSEMBLY (POWER SOURCE)

a. Disconnect the fuel injector connector.

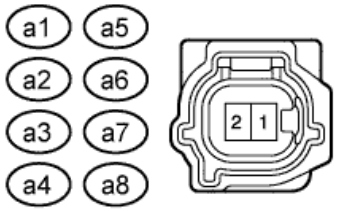
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	a5-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	a1-2 - Ground	Engine switch	11 to 14 V

		on (IG)	
No. 3	a6-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	a2-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	a7-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	a3-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	a8-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	a4-2 - Ground	Engine switch on (IG)	11 to 14 V

Front view of wire harness connector:
(to Injector)



NG → GO TO FUEL INJECTOR CIRCUIT (Click here)

OK

25.CHECK HARNESS AND CONNECTOR (FUEL INJECTOR - ECM)

a. Disconnect the fuel injector connector.

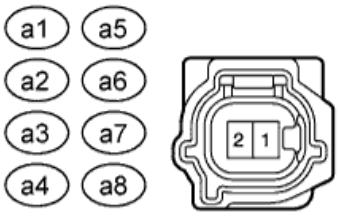
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

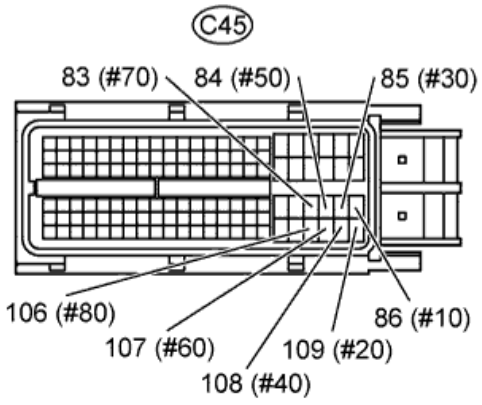
Standard Resistance:

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	a5-1 - Body ground	Always	10 kΩ or higher
	a5-1 - C45-86 (#10)	Always	Below 1 Ω
No. 2	a1-1 - Body ground	Always	10 kΩ or higher
	a1-1 - C45-109 (#20)	Always	Below 1 Ω
No. 3	a6-1 - Body ground	Always	10 kΩ or higher
	a6-1 - C45-85 (#30)	Always	Below 1 Ω
No. 4	a2-1 - Body ground	Always	10 kΩ or higher
	a2-1 - C45-108 (#40)	Always	Below 1 Ω
No. 5	a7-1 - Body ground	Always	10 kΩ or higher
	a7-1 - C45-84 (#50)	Always	Below 1 Ω
No. 6	a3-1 - Body ground	Always	10 kΩ or higher
	a3-1 - C45-107 (#60)	Always	Below 1 Ω
No. 7	a8-1 - Body ground	Always	10 kΩ or higher
	a8-1 - C45-83 (#70)	Always	Below 1 Ω
No. 8	a4-1 - Body ground	Always	10 kΩ or higher
	a4-1 - C45-106 (#80)	Always	Below 1 Ω

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.CHECK FUEL INJECTOR ASSEMBLY OF MISFIRING CYLINDER

Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (**Click here**)

OK

27.CHECK HARNESS AND CONNECTOR

a. Check the connection and terminal contact pressure of connectors and wire harnesses between the mass air flow meter and ECM (Click here).

HINT:

Repair any problems.

NEXT

28.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Turn the engine switch off.

f. Turn the engine switch on (IG) and turn the tester on.

g. Start the engine and warm it up.

h. Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input the DTC: P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308.

k. Check the DTC judgment result.

Result

Display (DTC Output)	Proceed to
ABNORMAL (P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308 output)	A
NORMAL (No DTC output)	B

B → END

A

29.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the mass air flow meter connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

		Specified

Tester Connection	Condition	Condition
C50-3 (VG) - C45-74 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C45-75 (E2G)	Always	Below 1 Ω
C50-3 (VG) or C45-74 (VG) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

30.REPLACE MASS AIR FLOW METER

Replace the mass air flow meter assembly (Click here).

HINT:

If the results of the inspections performed in steps 14 and 21 indicated no problem, proceed to the next step without replacing the mass air flow meter assembly.

NEXT

31.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Turn the engine switch off.

f. Turn the engine switch on (IG) and turn the tester on.

g. Start the engine and warm it up.

h. Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input the DTC: P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308.

k. Check the DTC judgment result.

Result

Display (DTC Output)	Proceed to
NORMAL (No DTC output)	A
ABNORMAL (P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308 output)	B

B → REPLACE ECM (**Click here**)

A

END

32.CHANGE TO CHANGE TO NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

a. Change the installed spark plug to a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → Go to step 33

OK ↓

REPLACE SPARK PLUG (Click here)

33.CHANGE TO NORMAL IGNITION COIL AND CHECK SPARK OF MISFIRING CYLINDER

a. Change the ignition coil to an ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK ↓

REPLACE IGNITION COIL (Click here)

34.CHECK FUEL LINE

a. Check the fuel lines for leaks or blockage.

NG → REPAIR OR REPLACE FUEL LINE

OK ↓

REPLACE FUEL PUMP ASSEMBLY (Click here)

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

for Preparation Click here

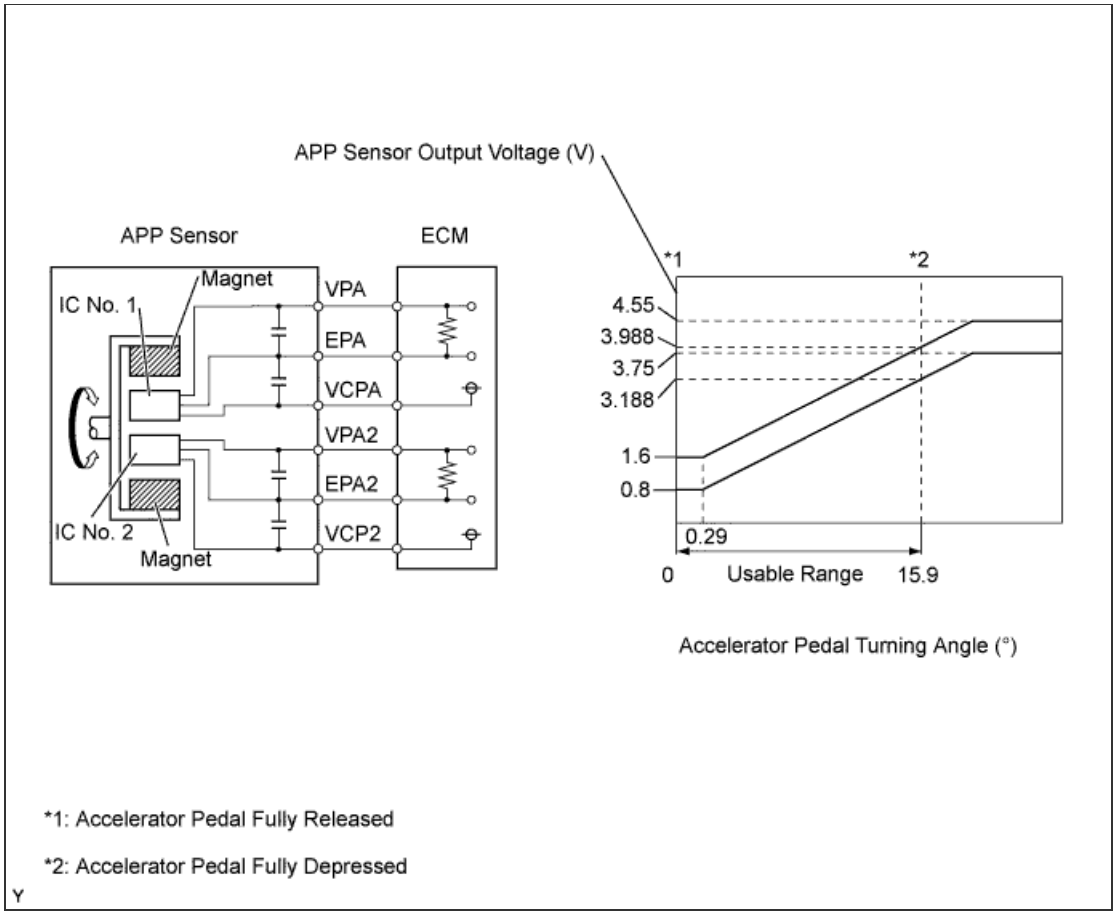
DESCRIPTION

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

The APP sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC Code	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM

P2122	VPA is 0.4 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP1 circuit • Open or ground short in VPA circuit • ECM
P2123	VPA is 4.8 V or higher for 2.0 seconds or more (1 trip detection logic).	• APP sensor • Open in EPA circuit • ECM
P2125	VPA2 fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or higher. (b) VPA is between 0.4 V and 3.45 V.	• APP sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): (a) The difference between VPA and VPA2 is 0.02 V or less. (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less.	• Short between VPA and VPA2 circuits • APP sensor • ECM

HINT:

When any of these DTCs is output, check the APP sensor voltage by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

Trouble Area	Accelerator Position No. 1 When AP Released	Accelerator Position No. 2 When AP Released	Accelerator Position No. 1 When AP Depressed	Accelerator Position No. 2 When AP Depressed
VCP circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.0 V
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 5.0 V

HINT:

- **Accelerator pedal positions are expressed as voltages.**
- **AP stands for Accelerator Pedal.**

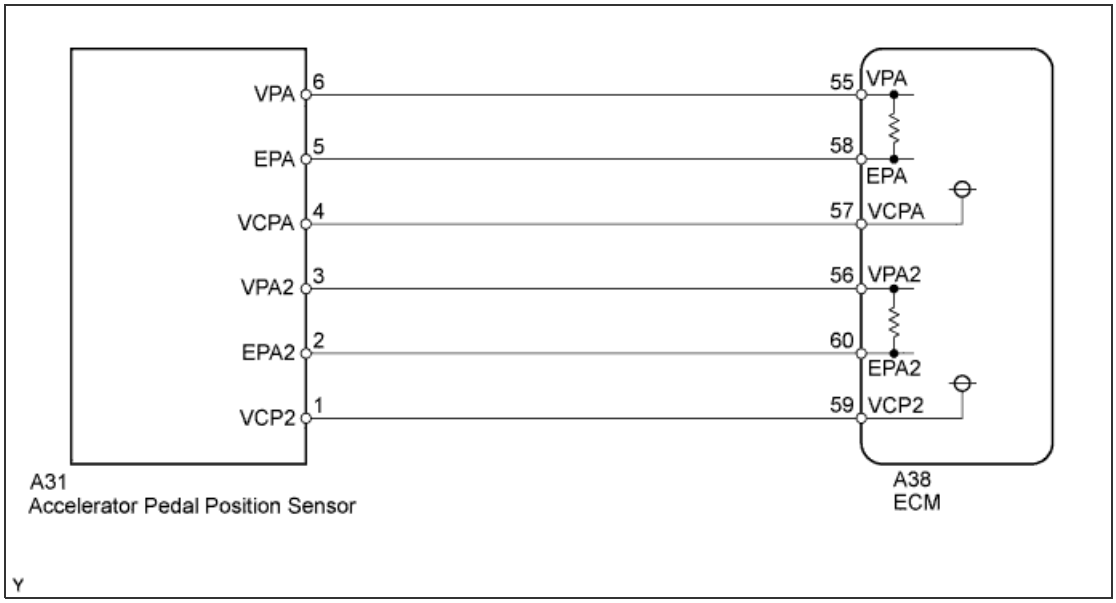
MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is less than the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and stores DTC(s).
Example:
When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is stored.
If the malfunction is not repaired successfully, a DTC is stored 2 seconds after the engine is next started.

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 is stored, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue driving. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.
Fail-safe mode continues until a pass condition is detected, and the engine switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Accelerator Pedal Position (APP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

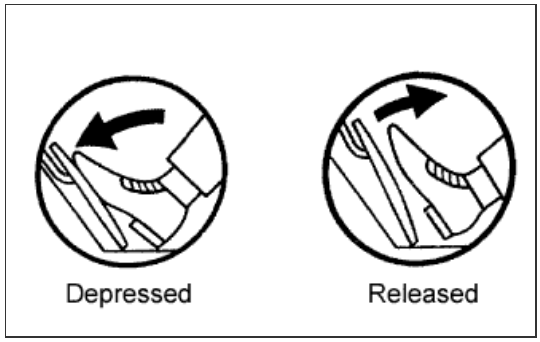
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

d. Read the value displayed on the tester.



Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released → Depressed → Released	0.5 to 4.5 V	1.2 to 5.0 V
	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V

Result

Result	Proceed to
N	A
OK	B

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

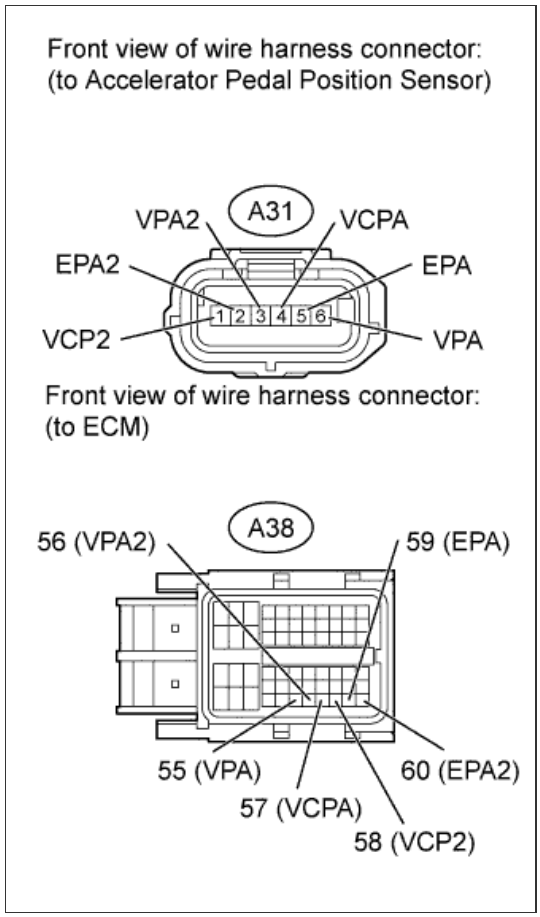
a. Disconnect the A31 accelerator pedal position (APP) sensor connector.

b. Disconnect the A38 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A38-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-58 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A38-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A38-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A38-59 (VCP2)	Always	Below 1 Ω
A31-6 (VPA) or A38-55 (VPA) - body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-58 (EPA) - body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-57 (VCPA) - body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-56 (VPA2) - body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A38-60 (EPA2) - body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A38-59 (VCP2) - body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

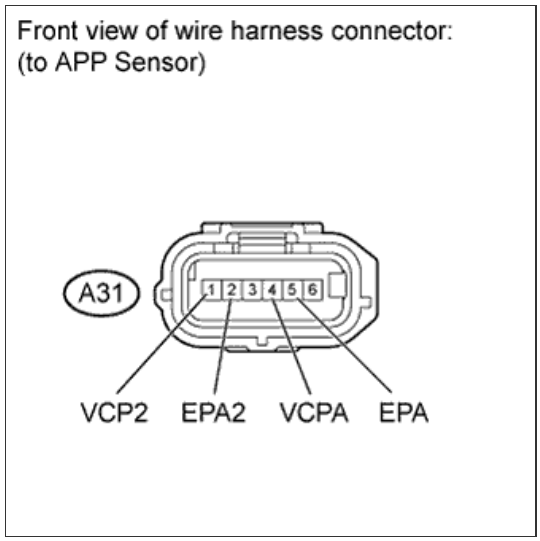
3.CHECK ECM (VCPA AND VCP2 VOLTAGE)

a. Disconnect the A31 APP sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Engine switch on (I)	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Engine switch on (I)	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

4.REPLACE ACCELERATOR PEDAL ASSEMBLY

a. Replace the accelerator pedal assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138 are output	A
No DTC is output	B

B → SYSTEM OK

A

REPLACE ECM (**Click here**)

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

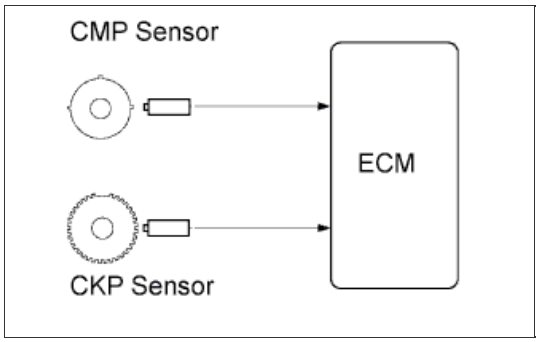
DTC P0306 Cylinder 6 Misfire Detected

DTC P0307 Cylinder 7 Misfire Detected

DTC P0308 Cylinder 8 Misfire Detected

for Preparation Click here

DESCRIPTION



When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause increases in exhaust emission levels. High concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent these increases in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the TWC reaches the point of thermal degradation, the MIL blinks. To monitor misfires, the ECM uses both the Camshaft Position (CMP) sensor and the Crankshaft Position (CKP) sensor. The CMP sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted as when the crankshaft rotation speed variations exceed predetermined thresholds.
If the misfire rate exceeds the threshold level, the ECM stores DTC(s).

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC). • An emission deterioration misfire occurs.	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Fuel injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306 P0307 P0308	Misfiring of a specific cylinder occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC). • An emission deterioration misfire occurs.	

HINT:

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

MONITOR DESCRIPTION

The ECM stores a DTC when either one of the following conditions, which could cause emission deterioration, is detected (2 trip detection logic).

- Within the first 1000 crankshaft revolutions of the engine starting, an excessive misfiring rate (approximately 30 to 110 misfires per 1000

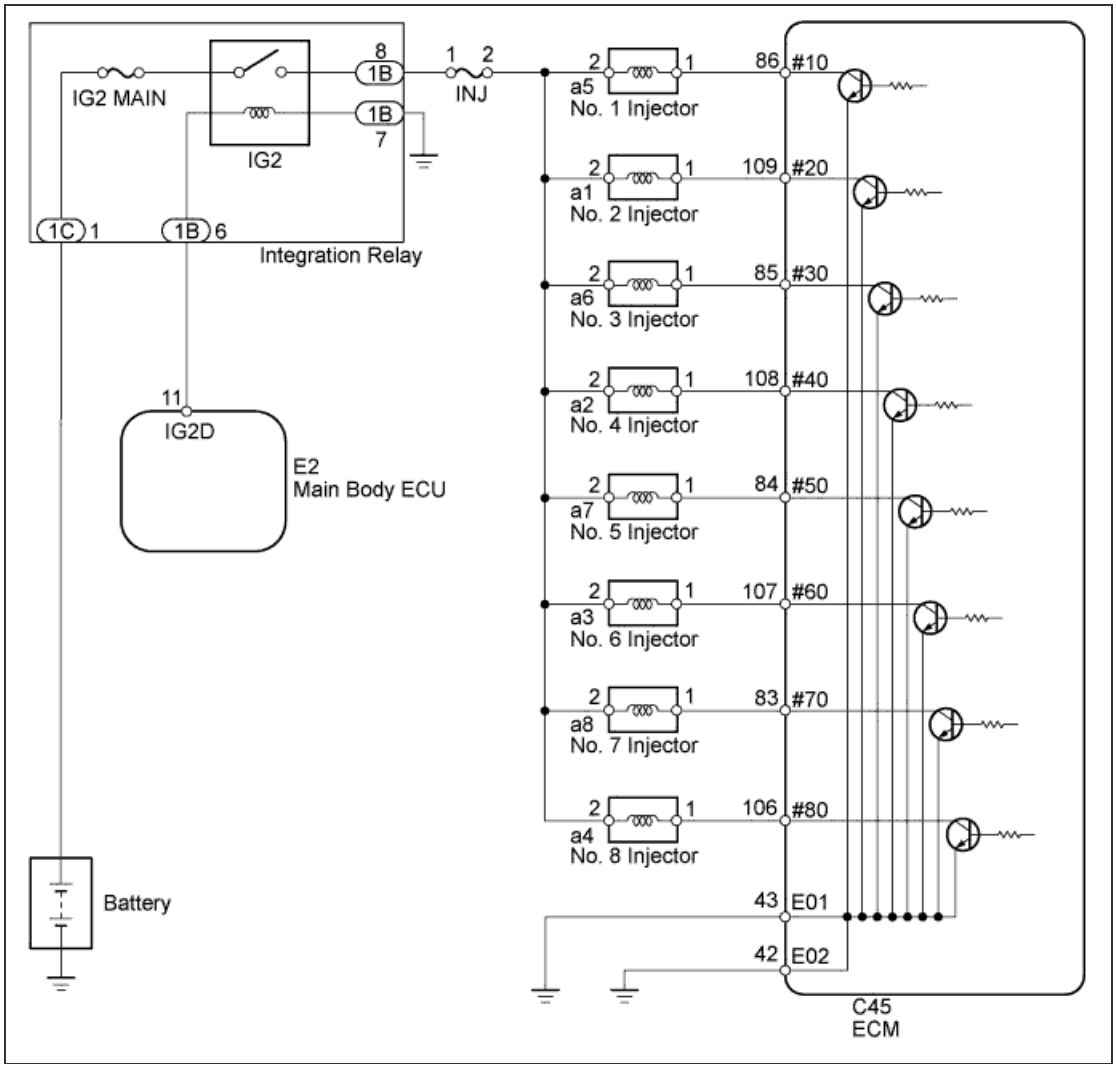
crankshaft revolutions) occurs once.

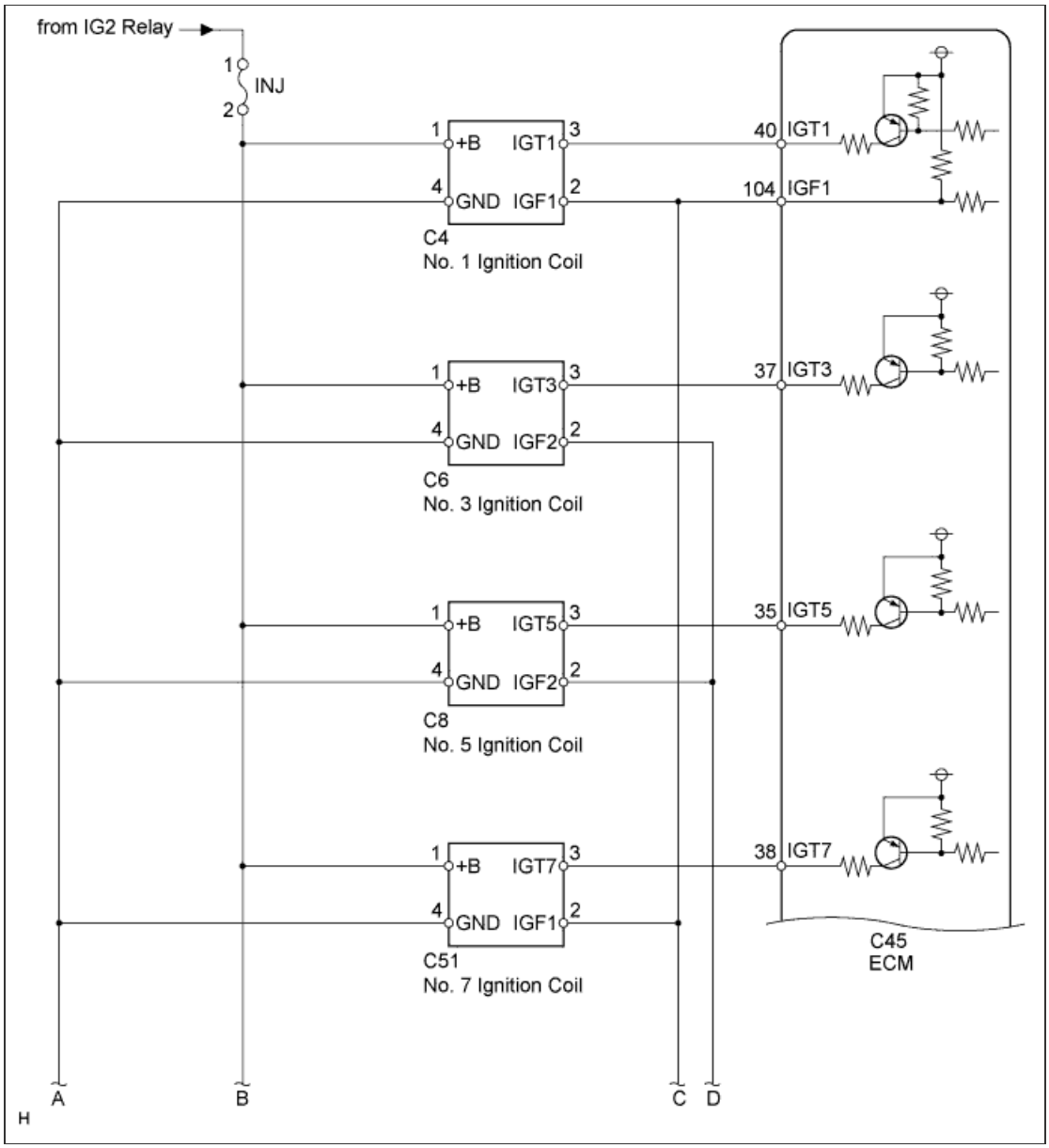
- An excessive misfiring rate (approximately 30 to 110 misfires per 1000 crankshaft revolutions) occurs a total of 4 times.

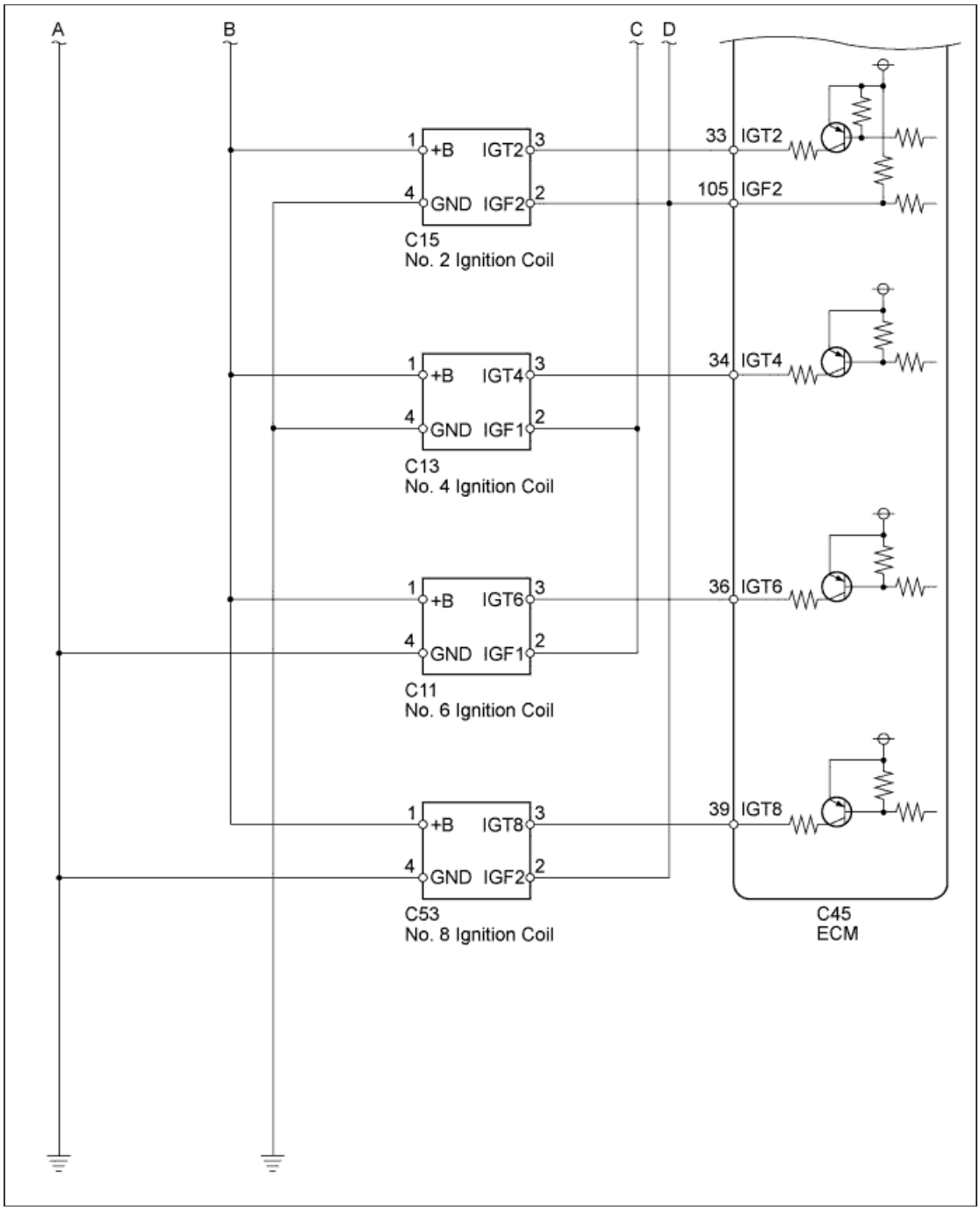
The ECM stores DTC(s) when either one of the following conditions, which could cause the Three-Way Catalytic Converter (TWC) damage, is detected (2 trip detection logic).

- At a high engine speed, a catalyst damage misfire, which monitored every 200 crankshaft revolutions, occurs once.
- At a normal engine speed, a catalyst damage misfire, which monitored every 200 crankshaft revolutions, occurs 3 times.

WIRING DIAGRAM




from IG2 Relay
1
INJ
2
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
38
IGT7
C45
ECM
A
B
C
D
H



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Turn the tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire counts of each cylinder (cylinder No. 1 to No. 8) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
7. Drive the vehicle several times with the conditions, such as engine speed and engine load, shown in Misfire RPM and Misfire Load in the Data List.

HINT:

In order to store misfire DTCs, it is necessary to operate the vehicle for the period of time shown in the table below, with the Misfire RPM and Misfire Load in the Data List.

Engine Speed	Duration
Idling	7 minutes or more
1000	4 minutes or more
2000	2 minutes or more
3000	1.5 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

   HINT:

   Do not turn the engine switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data will be cleared.

9. Record the DTC(s), freeze frame data and misfire counts.
10. Turn the engine switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **DTC P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are for Euro-OBD only.**
- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the freeze frame data have been duplicated, one of the following factors is considered to be a possible cause of the problem:**
  1. **The fuel level is low.**
  2. **Improper fuel is used.**
  3. **The spark plugs are dirty.**
- **After finishing repairs, check that no misfires occur in each cylinder (cylinder No. 1, No. 2, No. 3, No. 4, No. 5, No. 6, No. 7 and No. 8).**
- **Be sure to confirm that no misfiring cylinder DTCs are output again by conducting the confirmation driving pattern after the repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speed. If misfires only occur during high engine speed driving, only DTC P0300 is stored.**
  In the event of DTC P0300 being present, perform the following operations:
  1. **Clear the DTC (Click here).**
  2. **Start the engine and conduct the confirmation driving pattern.**
  3. **Read the misfiring rates of each cylinder or DTC(s) using the intelligent tester.**
  4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
  5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not output.**
- **When either Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air-fuel ratio may be rich (-20% or less) or lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is below 75°C (167°F), the misfires occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel which causes body vibration may cause misfire DTCs to be detected.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 are output	A
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 and other DTCs are output	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is connected correctly and is not damaged.

NG → **REPAIR OR REPLACE PCV HOSE (Click here)**

OK

3.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

4.READ VALUE USING INTELLIGENT TESTER (MISFIRE COUNT)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5, #6, #7 and #8.

f. Allow the engine to idle.

g. Read each value for Cylinder #1 Misfire Count to #8 displayed on the tester. If no misfire counts occur in any cylinders, perform the following procedures:

i. Move the shift lever to D.

ii. Check the Cylinder #1 Misfire Count to #8.

iii. If misfire counts are still not displayed, perform procedure A and and then check the misfire counts again.

h. Drive the vehicle with the Misfire RPM and Misfire Load noted in the ad Value Using tester (Misfire RPM and Misfire Load) procedures above (Procedure A).

i. Read the Cylinder #1 Misfire Count to #8 or DTCs displayed on the tester (Procedure).

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have e ual misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data record of the Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → **Go to step 16**

A

5.INSPECT SPARK PLUG

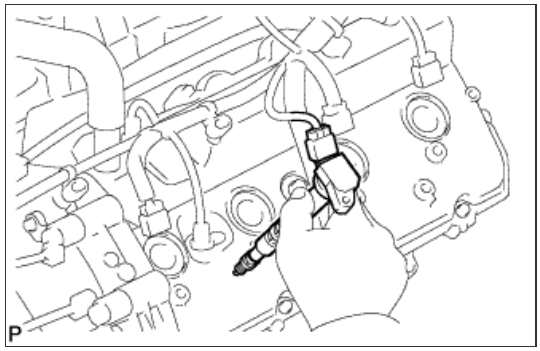
a. Inspect the spark plug of the misfiring cylinder (Click here).

NG → REPLACE SPARK PLUG (**Click here**)

OK

6.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.



CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → **Go to step 32**

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → GO TO FUEL INJECTOR CIRCUIT (**Click here**)

OK

9.CHECK HARNESS AND CONNECTOR

a. Disconnect the fuel injector connector.

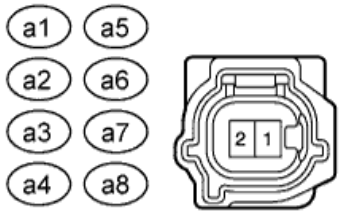
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

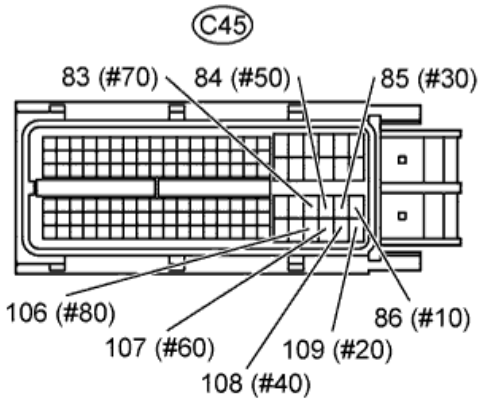
Standard Resistance:

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	a5-1 - Body ground	Always	10 kΩ or higher
	a5-1 - C45-86 (#10)	Always	Below 1 Ω
No. 2	a1-1 - Body ground	Always	10 kΩ or higher
	a1-1 - C45-109 (#20)	Always	Below 1 Ω
No. 3	a6-1 - Body ground	Always	10 kΩ or higher
	a6-1 - C45-85 (#30)	Always	Below 1 Ω
No. 4	a2-1 - Body ground	Always	10 kΩ or higher
	a2-1 - C45-108 (#40)	Always	Below 1 Ω
No. 5	a7-1 - Body ground	Always	10 kΩ or higher
	a7-1 - C45-84 (#50)	Always	Below 1 Ω
No. 6	a3-1 - Body ground	Always	10 kΩ or higher
	a3-1 - C45-107 (#60)	Always	Below 1 Ω
No. 7	a8-1 - Body ground	Always	10 kΩ or higher
	a8-1 - C45-83 (#70)	Always	Below 1 Ω
No. 8	a4-1 - Body ground	Always	10 kΩ or higher
	a4-1 - C45-106 (#80)	Always	Below 1 Ω

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (Click here)

OK

11.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

12.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → Go to step 34

OK

13.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

e. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine:
Same as ambient air temperature.
With warm engine:
Between 75°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

14.INSPECT MASS AIR FLOW METER

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF and Coolant Temp.

e. Allow the engine to idle until Coolant Temp reaches 75 C (167 F) or higher.

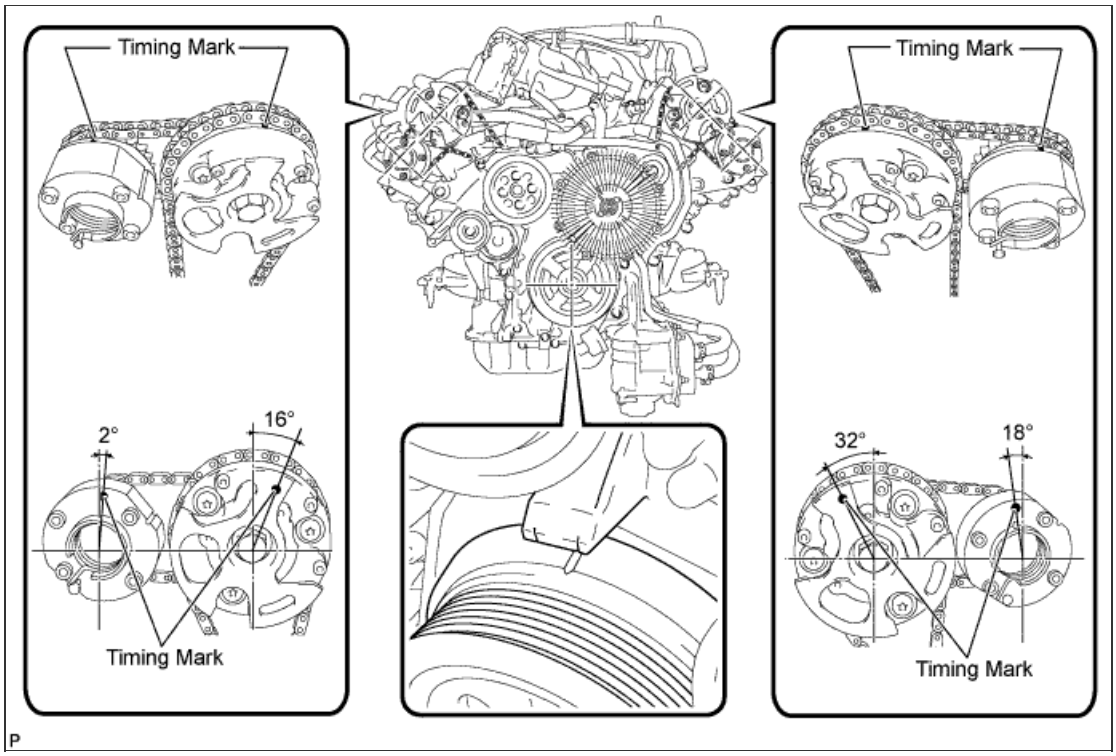
f. Read MAF with the engine speed at 3000 rpm.

Standard:
Between 25.2 gm/s and 35.2 gm/s (shift lever: N; A/C: Off).

NG → Go to step 27

OK

15.CHECK VALVE TIMING



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark 0 of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.

OK	Go to step 27
NG	ADJUST VALVE TIMING (Click here)

16.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG	REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

17.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG	Go to step 34

OK

18.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine:
Same as ambient air temperature.
With warm engine:
Between 75°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

19.INSPECT MASS AIR FLOW METER

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF and Coolant Temp.

e. Allow the engine to idle until Coolant Temp reaches 75 C (167 F) or higher.

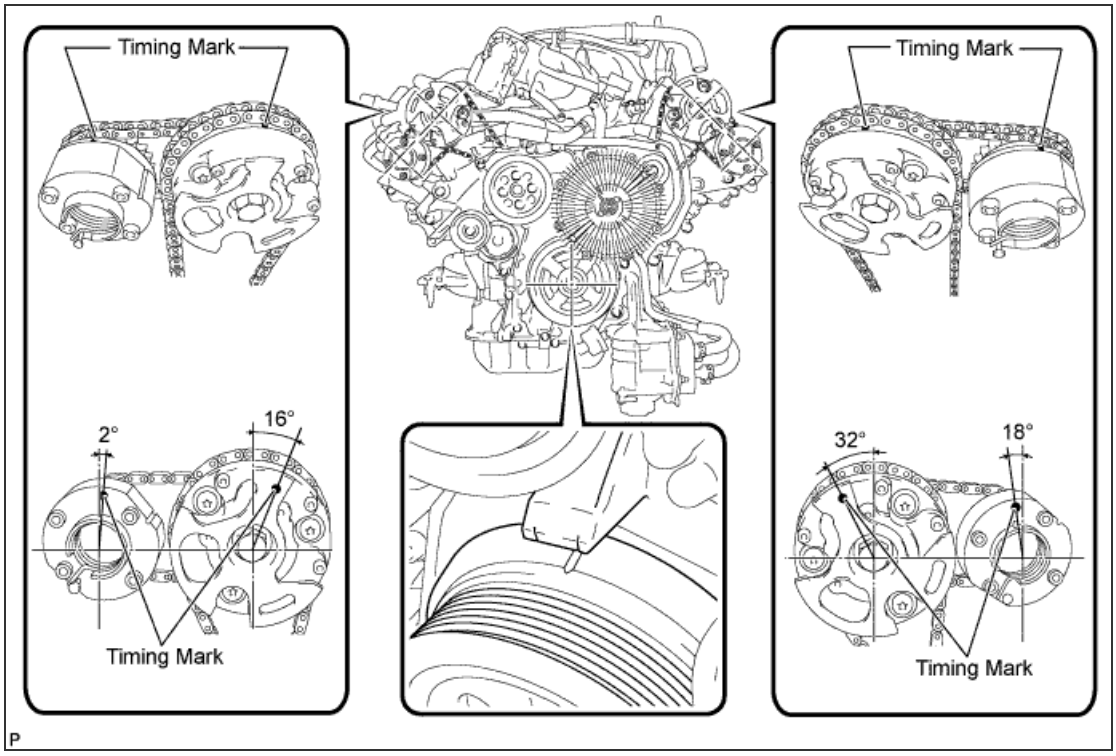
f. Read MAF with the engine speed at 3000 rpm.

Standard:
Between 25.2 gm/s and 35.2 gm/s (shift lever: N; A/C: Off).

NG → Go to step 27

OK

20.CHECK VALVE TIMING



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark 0 of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:

Timing marks on camshaft timing gears are aligned as shown in the illustration.

NG → ADJUST VALVE TIMING (Click here)

OK ↓

21.INSPECT SPARK PLUG

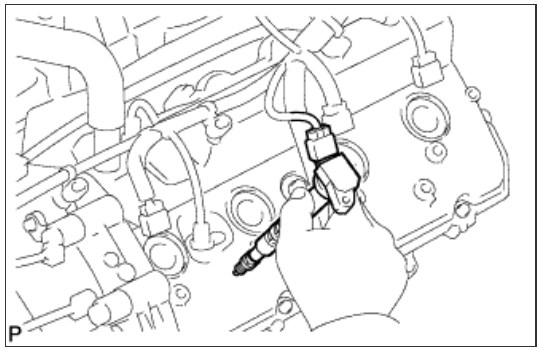
a. Inspect the spark plug of the misfiring cylinder (Click here).

NG → REPLACE SPARK PLUG (Click here)

OK ↓

22.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.



CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 32

OK ↓

23.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK ↓

24.CHECK FUEL INJECTOR ASSEMBLY (POWER SOURCE)

a. Disconnect the fuel injector connector.

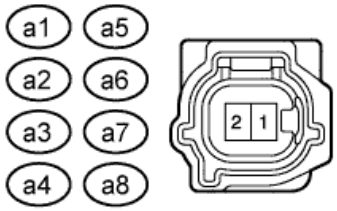
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	a5-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	a1-2 - Ground	Engine switch	11 to 14 V

		on (IG)	
No. 3	a6-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	a2-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	a7-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	a3-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	a8-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	a4-2 - Ground	Engine switch on (IG)	11 to 14 V

Front view of wire harness connector:
(to Injector)



NG → GO TO FUEL INJECTOR CIRCUIT (Click here)

OK

25.CHECK HARNESS AND CONNECTOR (FUEL INJECTOR - ECM)

a. Disconnect the fuel injector connector.

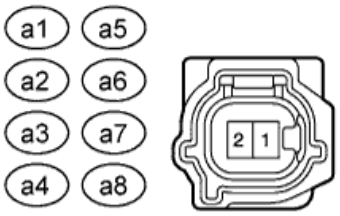
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

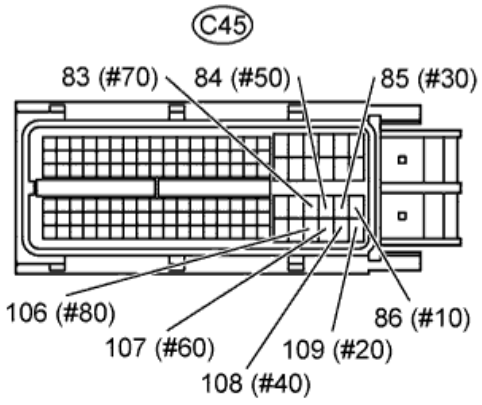
Standard Resistance:

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	a5-1 - Body ground	Always	10 kΩ or higher
	a5-1 - C45-86 (#10)	Always	Below 1 Ω
No. 2	a1-1 - Body ground	Always	10 kΩ or higher
	a1-1 - C45-109 (#20)	Always	Below 1 Ω
No. 3	a6-1 - Body ground	Always	10 kΩ or higher
	a6-1 - C45-85 (#30)	Always	Below 1 Ω
No. 4	a2-1 - Body ground	Always	10 kΩ or higher
	a2-1 - C45-108 (#40)	Always	Below 1 Ω
No. 5	a7-1 - Body ground	Always	10 kΩ or higher
	a7-1 - C45-84 (#50)	Always	Below 1 Ω
No. 6	a3-1 - Body ground	Always	10 kΩ or higher
	a3-1 - C45-107 (#60)	Always	Below 1 Ω
No. 7	a8-1 - Body ground	Always	10 kΩ or higher
	a8-1 - C45-83 (#70)	Always	Below 1 Ω
No. 8	a4-1 - Body ground	Always	10 kΩ or higher
	a4-1 - C45-106 (#80)	Always	Below 1 Ω

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.CHECK FUEL INJECTOR ASSEMBLY OF MISFIRING CYLINDER

Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (**Click here**)

OK

27.CHECK HARNESS AND CONNECTOR

a. Check the connection and terminal contact pressure of connectors and wire harnesses between the mass air flow meter and ECM (Click here).

HINT:

Repair any problems.

NEXT

28.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Turn the engine switch off.

f. Turn the engine switch on (IG) and turn the tester on.

g. Start the engine and warm it up.

h. Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input the DTC: P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308.

k. Check the DTC judgment result.

Result

Display (DTC Output)	Proceed to
ABNORMAL (P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308 output)	A
NORMAL (No DTC output)	B

B → END

A

29.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the mass air flow meter connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

		Specified

Tester Connection	Condition	Condition
C50-3 (VG) - C45-74 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C45-75 (E2G)	Always	Below 1 Ω
C50-3 (VG) or C45-74 (VG) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

30.REPLACE MASS AIR FLOW METER

Replace the mass air flow meter assembly (Click here).

HINT:

If the results of the inspections performed in steps 14 and 21 indicated no problem, proceed to the next step without replacing the mass air flow meter assembly.

NEXT

31.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Turn the engine switch off.

f. Turn the engine switch on (IG) and turn the tester on.

g. Start the engine and warm it up.

h. Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input the DTC: P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308.

k. Check the DTC judgment result.

Result

Display (DTC Output)	Proceed to
NORMAL (No DTC output)	A
ABNORMAL (P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308 output)	B

B → REPLACE ECM (**Click here**)

A

END

32.CHANGE TO CHANGE TO NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

a. Change the installed spark plug to a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → Go to step 33

OK ↓

REPLACE SPARK PLUG (Click here)

33.CHANGE TO NORMAL IGNITION COIL AND CHECK SPARK OF MISFIRING CYLINDER

a. Change the ignition coil to an ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK ↓

REPLACE IGNITION COIL (Click here)

34.CHECK FUEL LINE

a. Check the fuel lines for leaks or blockage.

NG → REPAIR OR REPLACE FUEL LINE

OK ↓

REPLACE FUEL PUMP ASSEMBLY (Click here)

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

for Preparation Click here

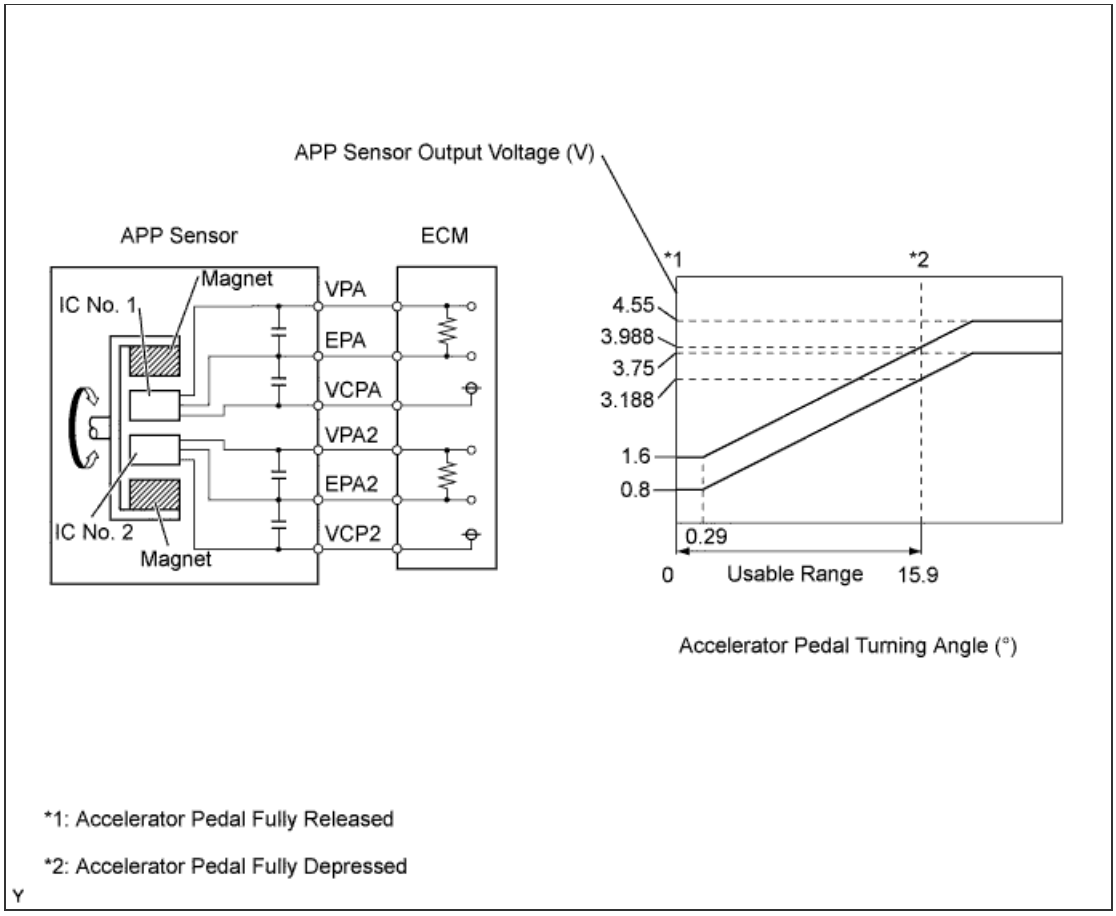
DESCRIPTION

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

The APP sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC Code	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM

P2122	VPA is 0.4 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP1 circuit • Open or ground short in VPA circuit • ECM
P2123	VPA is 4.8 V or higher for 2.0 seconds or more (1 trip detection logic).	• APP sensor • Open in EPA circuit • ECM
P2125	VPA2 fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or higher. (b) VPA is between 0.4 V and 3.45 V.	• APP sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): (a) The difference between VPA and VPA2 is 0.02 V or less. (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less.	• Short between VPA and VPA2 circuits • APP sensor • ECM

HINT:

When any of these DTCs is output, check the APP sensor voltage by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

Trouble Area	Accelerator Position No. 1 When AP Released	Accelerator Position No. 2 When AP Released	Accelerator Position No. 1 When AP Depressed	Accelerator Position No. 2 When AP Depressed
VCP circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.0 V
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 5.0 V

HINT:

- **Accelerator pedal positions are expressed as voltages.**
- **AP stands for Accelerator Pedal.**

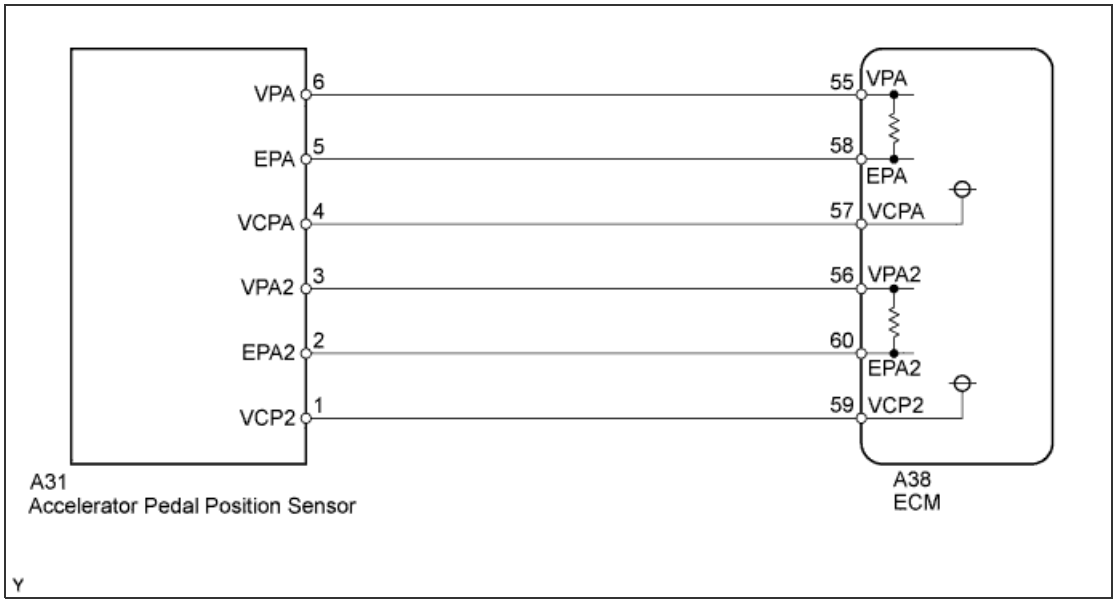
MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is less than the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and stores DTC(s).
Example:
When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is stored.
If the malfunction is not repaired successfully, a DTC is stored 2 seconds after the engine is next started.

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 is stored, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue driving. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.
Fail-safe mode continues until a pass condition is detected, and the engine switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Accelerator Pedal Position (APP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

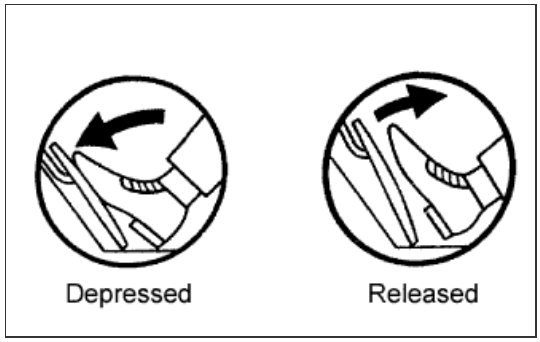
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

d. Read the value displayed on the tester.



Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released → Depressed → Released	0.5 to 4.5 V	1.2 to 5.0 V
	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V

Result

Result	Proceed to
N	A
OK	B

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

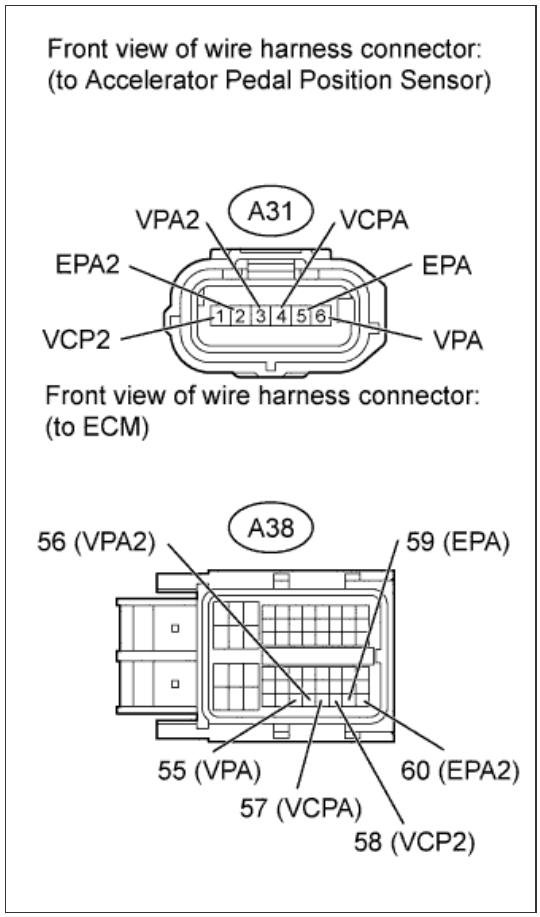
a. Disconnect the A31 accelerator pedal position (APP) sensor connector.

b. Disconnect the A38 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A38-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-58 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A38-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A38-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A38-59 (VCP2)	Always	Below 1 Ω
A31-6 (VPA) or A38-55 (VPA) - body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-58 (EPA) - body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-57 (VCPA) - body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-56 (VPA2) - body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A38-60 (EPA2) - body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A38-59 (VCP2) - body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

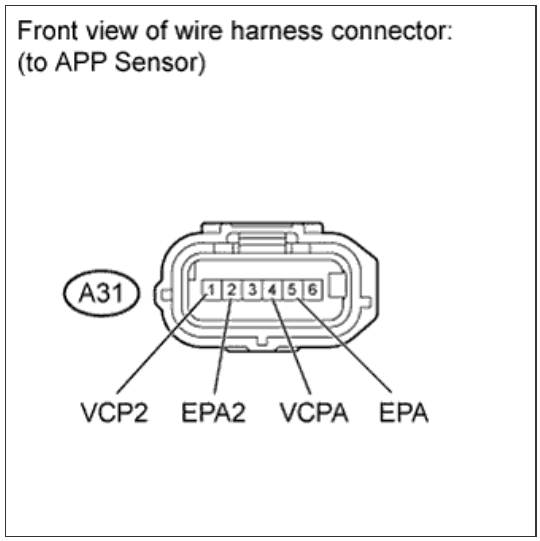
3.CHECK ECM (VCPA AND VCP2 VOLTAGE)

a. Disconnect the A31 APP sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Engine switch on (I)	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Engine switch on (I)	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

4.REPLACE ACCELERATOR PEDAL ASSEMBLY

a. Replace the accelerator pedal assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138 are output	A
No DTC is output	B

B → SYSTEM OK

A

REPLACE ECM (**Click here**)

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

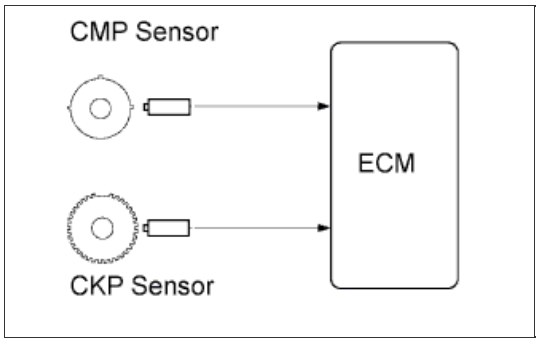
DTC P0306 Cylinder 6 Misfire Detected

DTC P0307 Cylinder 7 Misfire Detected

DTC P0308 Cylinder 8 Misfire Detected

for Preparation Click here

DESCRIPTION



When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause increases in exhaust emission levels. High concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent these increases in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the TWC reaches the point of thermal degradation, the MIL blinks. To monitor misfires, the ECM uses both the Camshaft Position (CMP) sensor and the Crankshaft Position (CKP) sensor. The CMP sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted as when the crankshaft rotation speed variations exceed predetermined thresholds.
If the misfire rate exceeds the threshold level, the ECM stores DTC(s).

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC). • An emission deterioration misfire occurs.	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Fuel injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306 P0307 P0308	Misfiring of a specific cylinder occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC). • An emission deterioration misfire occurs.	

HINT:

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

MONITOR DESCRIPTION

The ECM stores a DTC when either one of the following conditions, which could cause emission deterioration, is detected (2 trip detection logic).

- Within the first 1000 crankshaft revolutions of the engine starting, an excessive misfiring rate (approximately 30 to 110 misfires per 1000

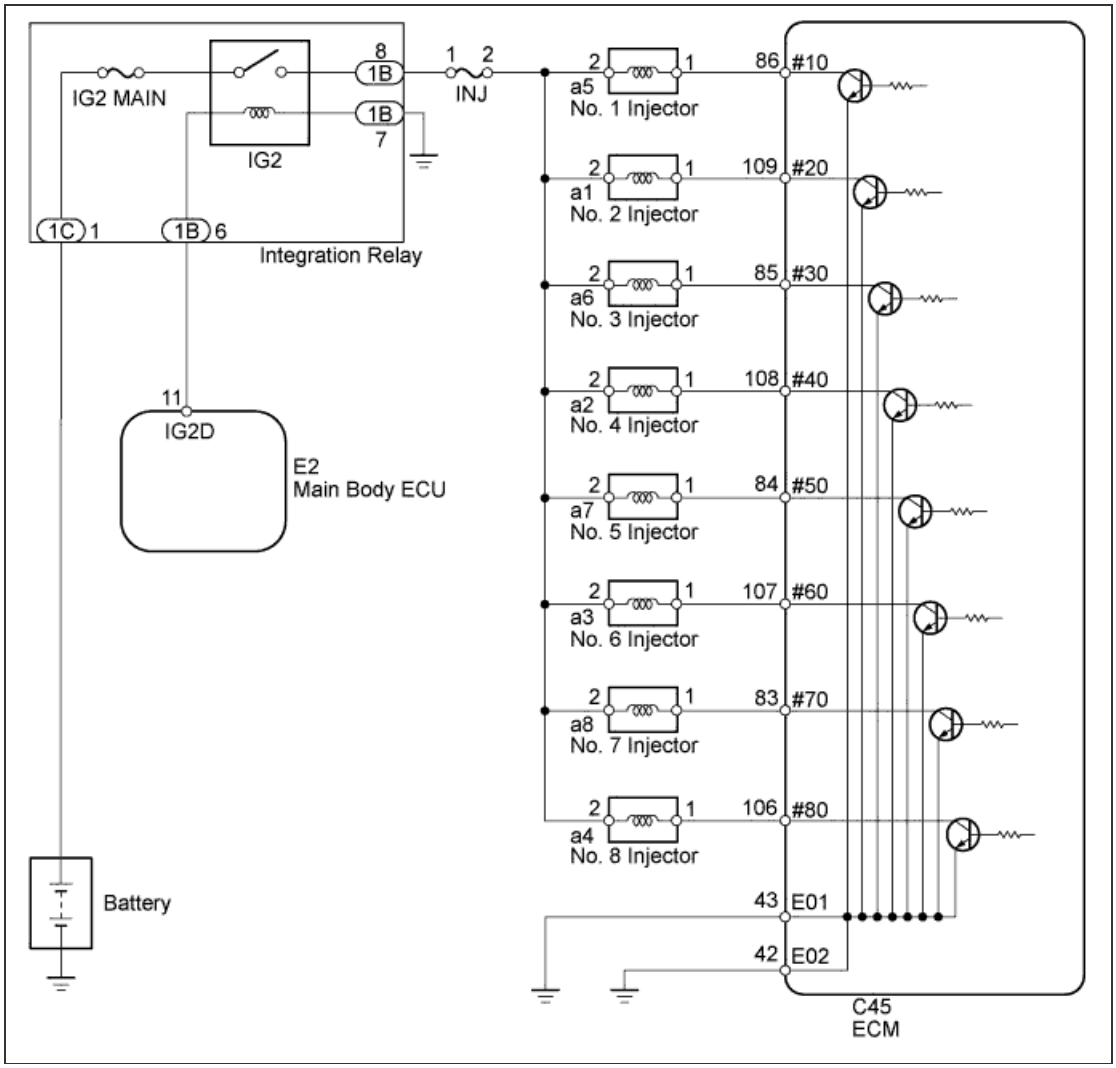
crankshaft revolutions) occurs once.

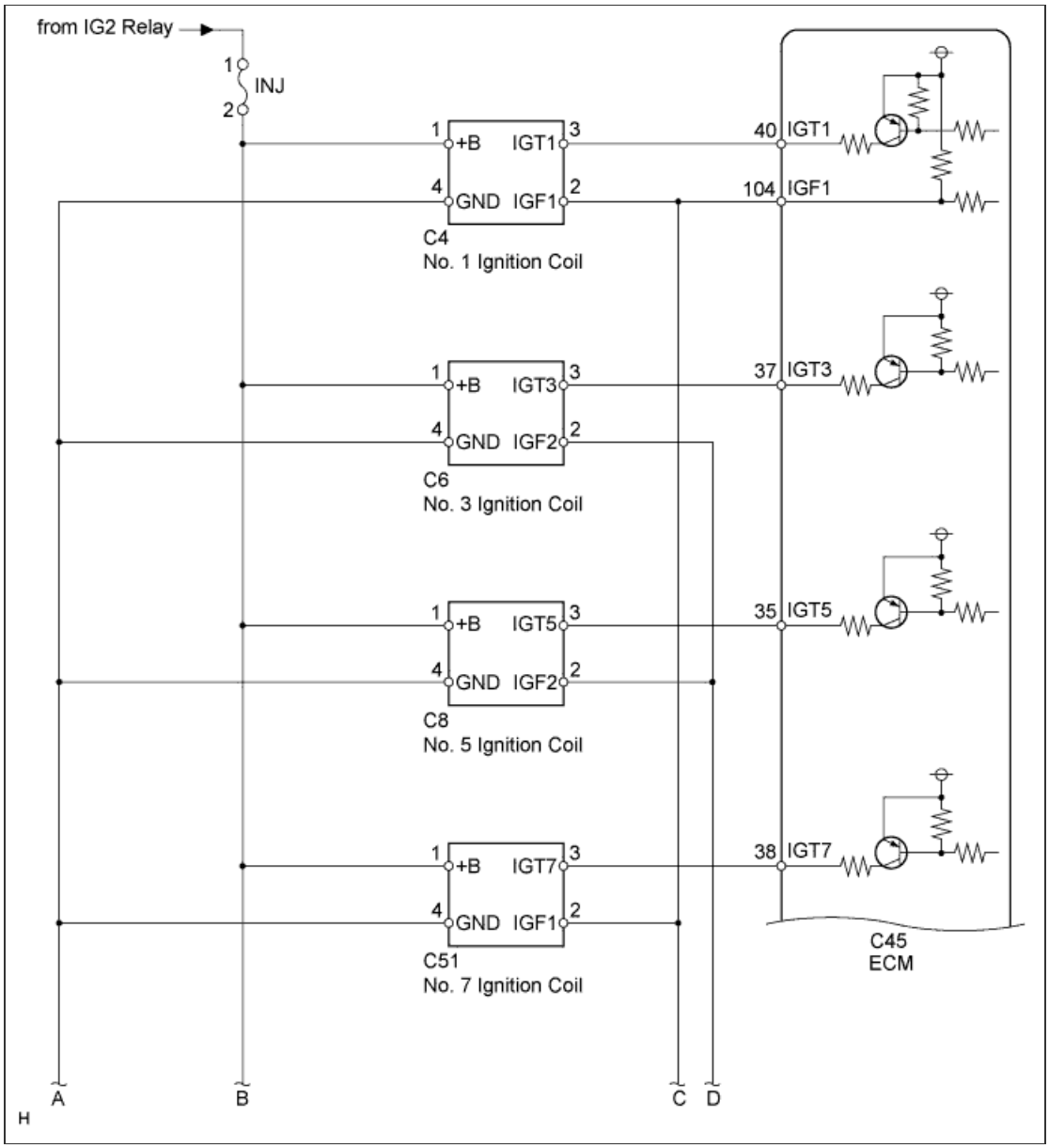
- An excessive misfiring rate (approximately 30 to 110 misfires per 1000 crankshaft revolutions) occurs a total of 4 times.

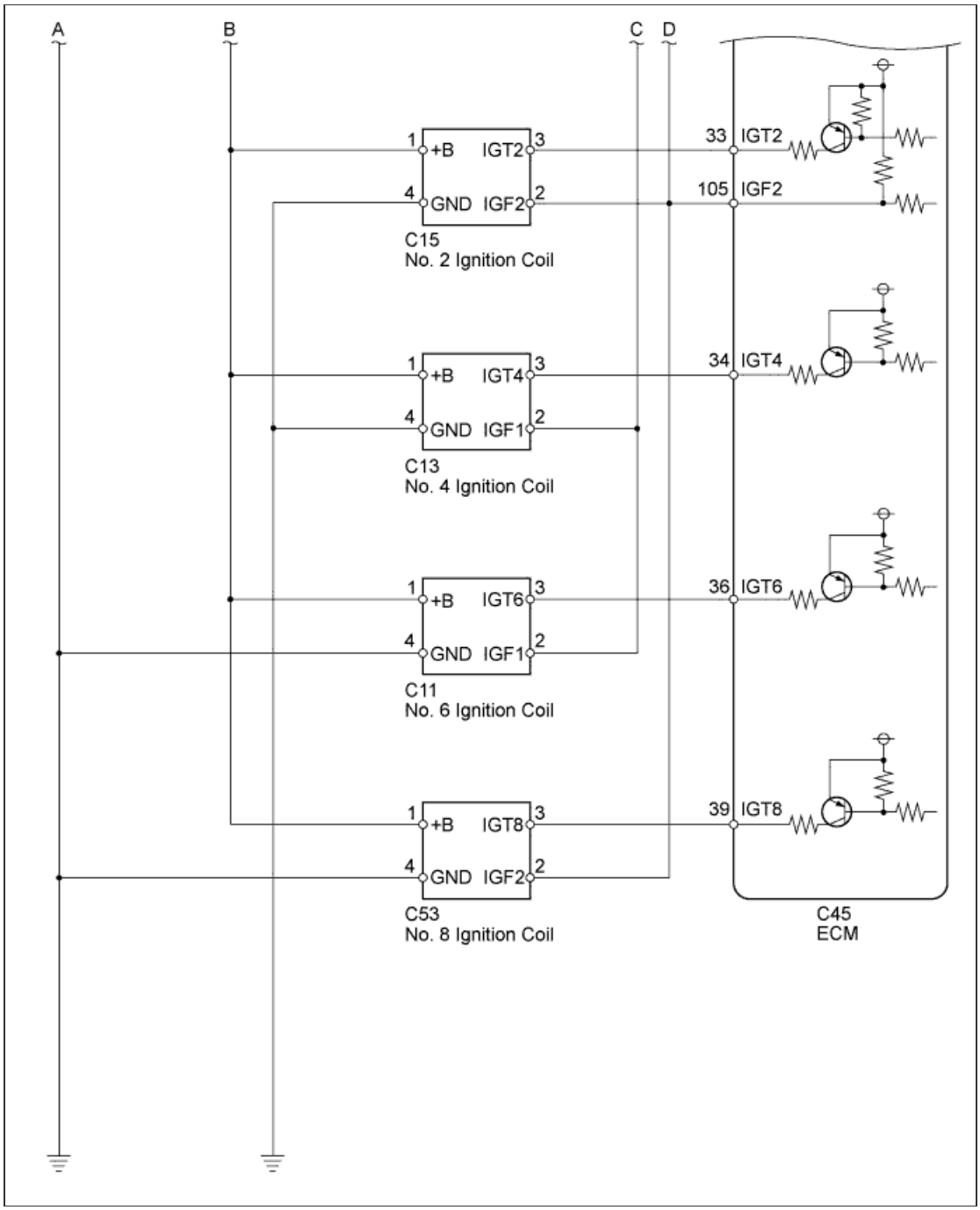
The ECM stores DTC(s) when either one of the following conditions, which could cause the Three-Way Catalytic Converter (TWC) damage, is detected (2 trip detection logic).

- At a high engine speed, a catalyst damage misfire, which monitored every 200 crankshaft revolutions, occurs once.
- At a normal engine speed, a catalyst damage misfire, which monitored every 200 crankshaft revolutions, occurs 3 times.

WIRING DIAGRAM




from IG2 Relay
1
INJ
2
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
38
IGT7
C45
ECM
A
B
C
D
H



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Turn the tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire counts of each cylinder (cylinder No. 1 to No. 8) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
7. Drive the vehicle several times with the conditions, such as engine speed and engine load, shown in Misfire RPM and Misfire Load in the Data List.

HINT:

In order to store misfire DTCs, it is necessary to operate the vehicle for the period of time shown in the table below, with the Misfire RPM and Misfire Load in the Data List.

Engine Speed	Duration
Idling	7 minutes or more
1000	4 minutes or more
2000	2 minutes or more
3000	1.5 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

   HINT:

   Do not turn the engine switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data will be cleared.

9. Record the DTC(s), freeze frame data and misfire counts.
10. Turn the engine switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **DTC P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are for Euro-OBD only.**
- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the freeze frame data have been duplicated, one of the following factors is considered to be a possible cause of the problem:**
  1. **The fuel level is low.**
  2. **Improper fuel is used.**
  3. **The spark plugs are dirty.**
- **After finishing repairs, check that no misfires occur in each cylinder (cylinder No. 1, No. 2, No. 3, No. 4, No. 5, No. 6, No. 7 and No. 8).**
- **Be sure to confirm that no misfiring cylinder DTCs are output again by conducting the confirmation driving pattern after the repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speed. If misfires only occur during high engine speed driving, only DTC P0300 is stored.**
  In the event of DTC P0300 being present, perform the following operations:
  1. **Clear the DTC (Click here).**
  2. **Start the engine and conduct the confirmation driving pattern.**
  3. **Read the misfiring rates of each cylinder or DTC(s) using the intelligent tester.**
  4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
  5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not output.**
- **When either Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air-fuel ratio may be rich (-20% or less) or lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is below 75°C (167°F), the misfires occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel which causes body vibration may cause misfire DTCs to be detected.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 are output	A
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 and other DTCs are output	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is connected correctly and is not damaged.

NG → **REPAIR OR REPLACE PCV HOSE (Click here)**

OK

3.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

4.READ VALUE USING INTELLIGENT TESTER (MISFIRE COUNT)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5, #6, #7 and #8.

f. Allow the engine to idle.

g. Read each value for Cylinder #1 Misfire Count to #8 displayed on the tester. If no misfire counts occur in any cylinders, perform the following procedures:

i. Move the shift lever to D.

ii. Check the Cylinder #1 Misfire Count to #8.

iii. If misfire counts are still not displayed, perform procedure A and and then check the misfire counts again.

h. Drive the vehicle with the Misfire RPM and Misfire Load noted in the ad Value Using tester (Misfire RPM and Misfire Load) procedures above (Procedure A).

i. Read the Cylinder #1 Misfire Count to #8 or DTCs displayed on the tester (Procedure).

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have e ual misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data record of the Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → **Go to step 16**

A

5.INSPECT SPARK PLUG

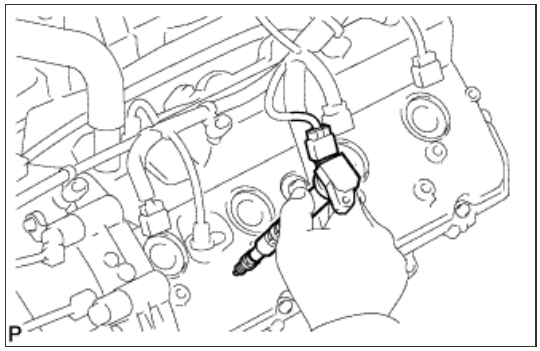
a. Inspect the spark plug of the misfiring cylinder (Click here).

NG → REPLACE SPARK PLUG (**Click here**)

OK

6.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.



CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → **Go to step 32**

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → GO TO FUEL INJECTOR CIRCUIT (**Click here**)

OK

9.CHECK HARNESS AND CONNECTOR

a. Disconnect the fuel injector connector.

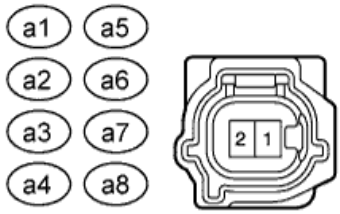
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

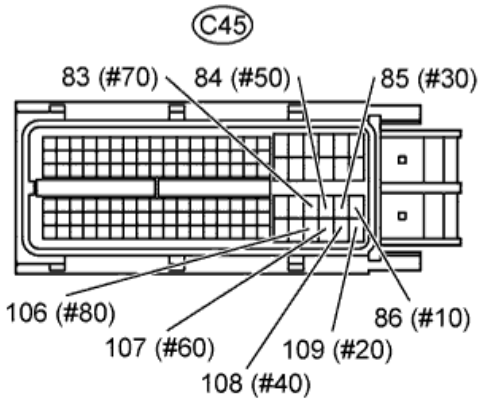
Standard Resistance:

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	a5-1 - Body ground	Always	10 kΩ or higher
	a5-1 - C45-86 (#10)	Always	Below 1 Ω
No. 2	a1-1 - Body ground	Always	10 kΩ or higher
	a1-1 - C45-109 (#20)	Always	Below 1 Ω
No. 3	a6-1 - Body ground	Always	10 kΩ or higher
	a6-1 - C45-85 (#30)	Always	Below 1 Ω
No. 4	a2-1 - Body ground	Always	10 kΩ or higher
	a2-1 - C45-108 (#40)	Always	Below 1 Ω
No. 5	a7-1 - Body ground	Always	10 kΩ or higher
	a7-1 - C45-84 (#50)	Always	Below 1 Ω
No. 6	a3-1 - Body ground	Always	10 kΩ or higher
	a3-1 - C45-107 (#60)	Always	Below 1 Ω
No. 7	a8-1 - Body ground	Always	10 kΩ or higher
	a8-1 - C45-83 (#70)	Always	Below 1 Ω
No. 8	a4-1 - Body ground	Always	10 kΩ or higher
	a4-1 - C45-106 (#80)	Always	Below 1 Ω

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (Click here)

OK

11.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

12.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → Go to step 34

OK

13.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

e. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine:
Same as ambient air temperature.
With warm engine:
Between 75°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

14.INSPECT MASS AIR FLOW METER

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF and Coolant Temp.

e. Allow the engine to idle until Coolant Temp reaches 75 C (167 F) or higher.

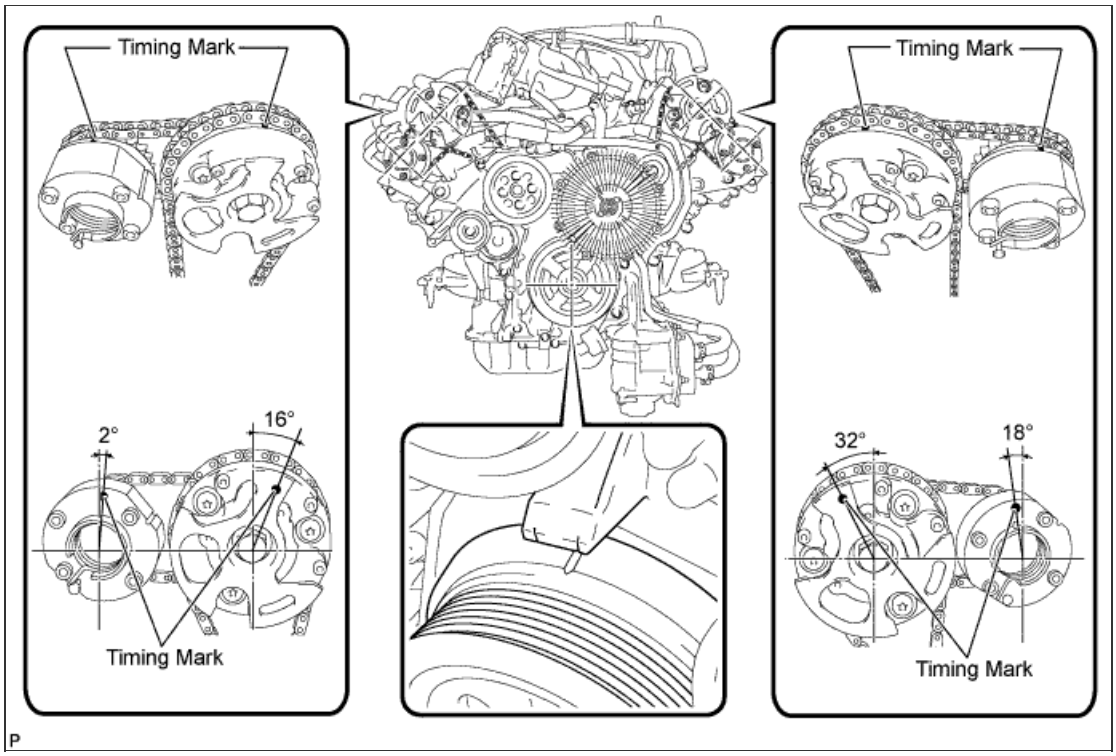
f. Read MAF with the engine speed at 3000 rpm.

Standard:
Between 25.2 gm/s and 35.2 gm/s (shift lever: N; A/C: Off).

NG → Go to step 27

OK

15.CHECK VALVE TIMING



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark 0 of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.

OK	Go to step 27
NG	ADJUST VALVE TIMING (Click here)

16.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG	REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

17.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG	Go to step 34

OK

18.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine:
Same as ambient air temperature.
With warm engine:
Between 75°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

19.INSPECT MASS AIR FLOW METER

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF and Coolant Temp.

e. Allow the engine to idle until Coolant Temp reaches 75 C (167 F) or higher.

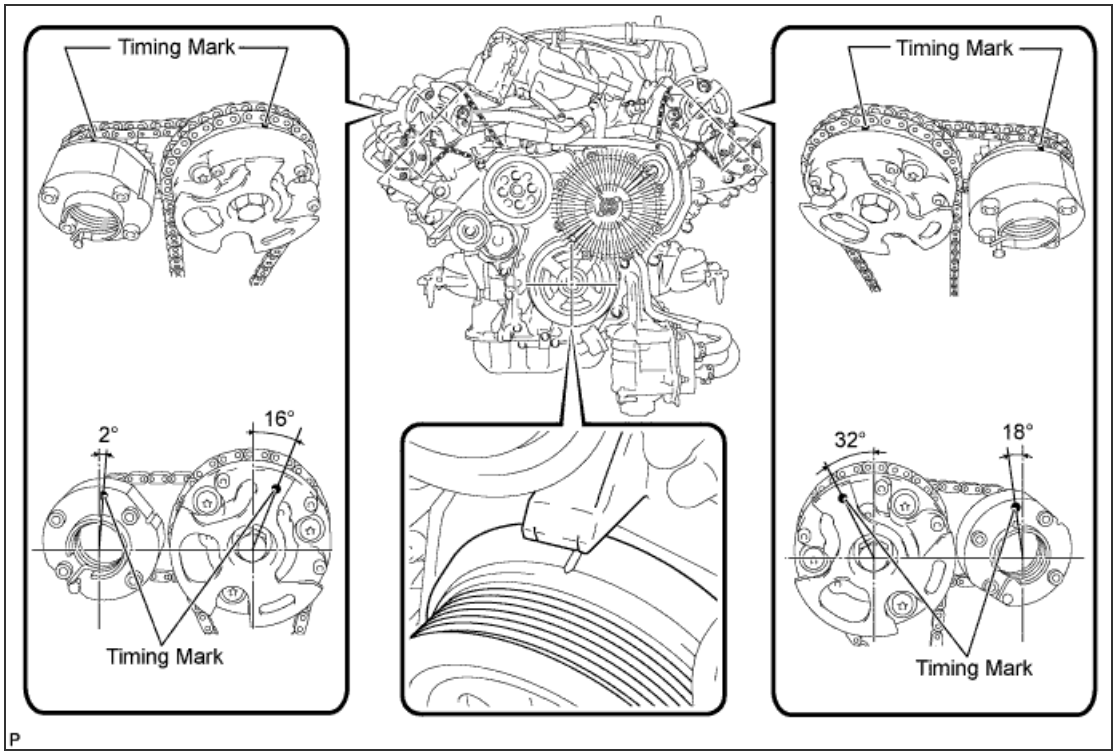
f. Read MAF with the engine speed at 3000 rpm.

Standard:
Between 25.2 gm/s and 35.2 gm/s (shift lever: N; A/C: Off).

NG → Go to step 27

OK

20.CHECK VALVE TIMING



a. Remove the cylinder head cover LH and RH.

b. Turn the crankshaft pulley, and align its groove with the timing mark 0 of the timing chain cover.

c. Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

OK:

Timing marks on camshaft timing gears are aligned as shown in the illustration.

NG → ADJUST VALVE TIMING (Click here)

OK ↓

21.INSPECT SPARK PLUG

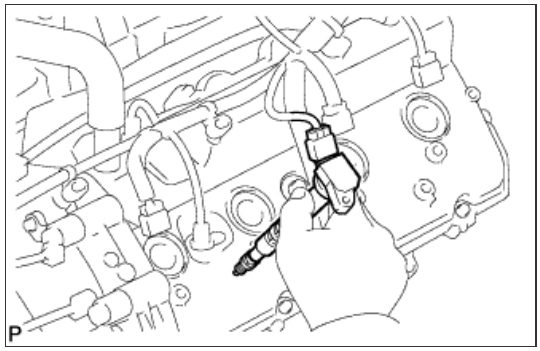
a. Inspect the spark plug of the misfiring cylinder (Click here).

NG → REPLACE SPARK PLUG (Click here)

OK ↓

22.CHECK FOR SPARKS AND IGNITION

a. Disconnect the injector connectors to prevent the engine from starting.



CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 32

OK ↓

23.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK ↓

24.CHECK FUEL INJECTOR ASSEMBLY (POWER SOURCE)

a. Disconnect the fuel injector connector.

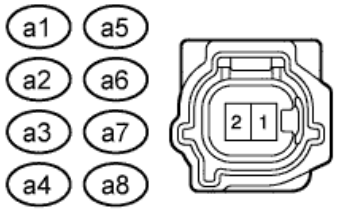
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	a5-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	a1-2 - Ground	Engine switch	11 to 14 V

		on (IG)	
No. 3	a6-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	a2-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	a7-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	a3-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	a8-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	a4-2 - Ground	Engine switch on (IG)	11 to 14 V

Front view of wire harness connector:
(to Injector)



NG → GO TO FUEL INJECTOR CIRCUIT (Click here)

OK

25.CHECK HARNESS AND CONNECTOR (FUEL INJECTOR - ECM)

a. Disconnect the fuel injector connector.

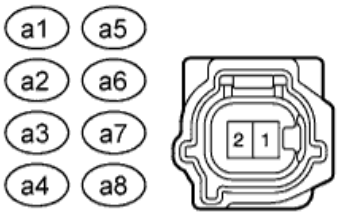
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

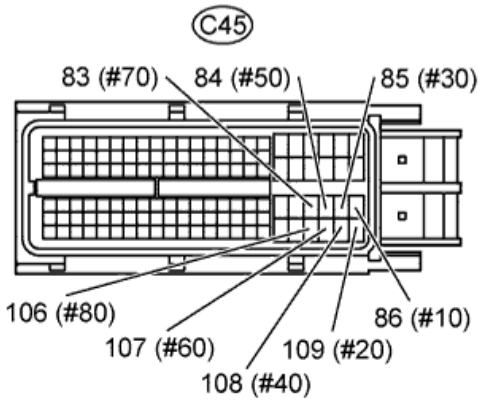
Standard Resistance:

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	a5-1 - Body ground	Always	10 kΩ or higher
	a5-1 - C45-86 (#10)	Always	Below 1 Ω
No. 2	a1-1 - Body ground	Always	10 kΩ or higher
	a1-1 - C45-109 (#20)	Always	Below 1 Ω
No. 3	a6-1 - Body ground	Always	10 kΩ or higher
	a6-1 - C45-85 (#30)	Always	Below 1 Ω
No. 4	a2-1 - Body ground	Always	10 kΩ or higher
	a2-1 - C45-108 (#40)	Always	Below 1 Ω
No. 5	a7-1 - Body ground	Always	10 kΩ or higher
	a7-1 - C45-84 (#50)	Always	Below 1 Ω
No. 6	a3-1 - Body ground	Always	10 kΩ or higher
	a3-1 - C45-107 (#60)	Always	Below 1 Ω
No. 7	a8-1 - Body ground	Always	10 kΩ or higher
	a8-1 - C45-83 (#70)	Always	Below 1 Ω
No. 8	a4-1 - Body ground	Always	10 kΩ or higher
	a4-1 - C45-106 (#80)	Always	Below 1 Ω

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.CHECK FUEL INJECTOR ASSEMBLY OF MISFIRING CYLINDER

Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (**Click here**)

OK

27.CHECK HARNESS AND CONNECTOR

a. Check the connection and terminal contact pressure of connectors and wire harnesses between the mass air flow meter and ECM (Click here).

HINT:

Repair any problems.

NEXT

28.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Turn the engine switch off.

f. Turn the engine switch on (IG) and turn the tester on.

g. Start the engine and warm it up.

h. Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input the DTC: P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308.

k. Check the DTC judgment result.

Result

Display (DTC Output)	Proceed to
ABNORMAL (P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308 output)	A
NORMAL (No DTC output)	B

B → END

A

29.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the mass air flow meter connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

		Specified

Tester Connection	Condition	Condition
C50-3 (VG) - C45-74 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C45-75 (E2G)	Always	Below 1 Ω
C50-3 (VG) or C45-74 (VG) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

30.REPLACE MASS AIR FLOW METER

Replace the mass air flow meter assembly (Click here).

HINT:

If the results of the inspections performed in steps 14 and 21 indicated no problem, proceed to the next step without replacing the mass air flow meter assembly.

NEXT

31.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Turn the engine switch off.

f. Turn the engine switch on (IG) and turn the tester on.

g. Start the engine and warm it up.

h. Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input the DTC: P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308.

k. Check the DTC judgment result.

Result

Display (DTC Output)	Proceed to
NORMAL (No DTC output)	A
ABNORMAL (P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308 output)	B

B → REPLACE ECM (**Click here**)

A

END

32.CHANGE TO CHANGE TO NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

a. Change the installed spark plug to a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → Go to step 33

OK ↓

REPLACE SPARK PLUG (Click here)

33.CHANGE TO NORMAL IGNITION COIL AND CHECK SPARK OF MISFIRING CYLINDER

a. Change the ignition coil to an ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK ↓

REPLACE IGNITION COIL (Click here)

34.CHECK FUEL LINE

a. Check the fuel lines for leaks or blockage.

NG → REPAIR OR REPLACE FUEL LINE

OK ↓

REPLACE FUEL PUMP ASSEMBLY (Click here)

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

for Preparation Click here

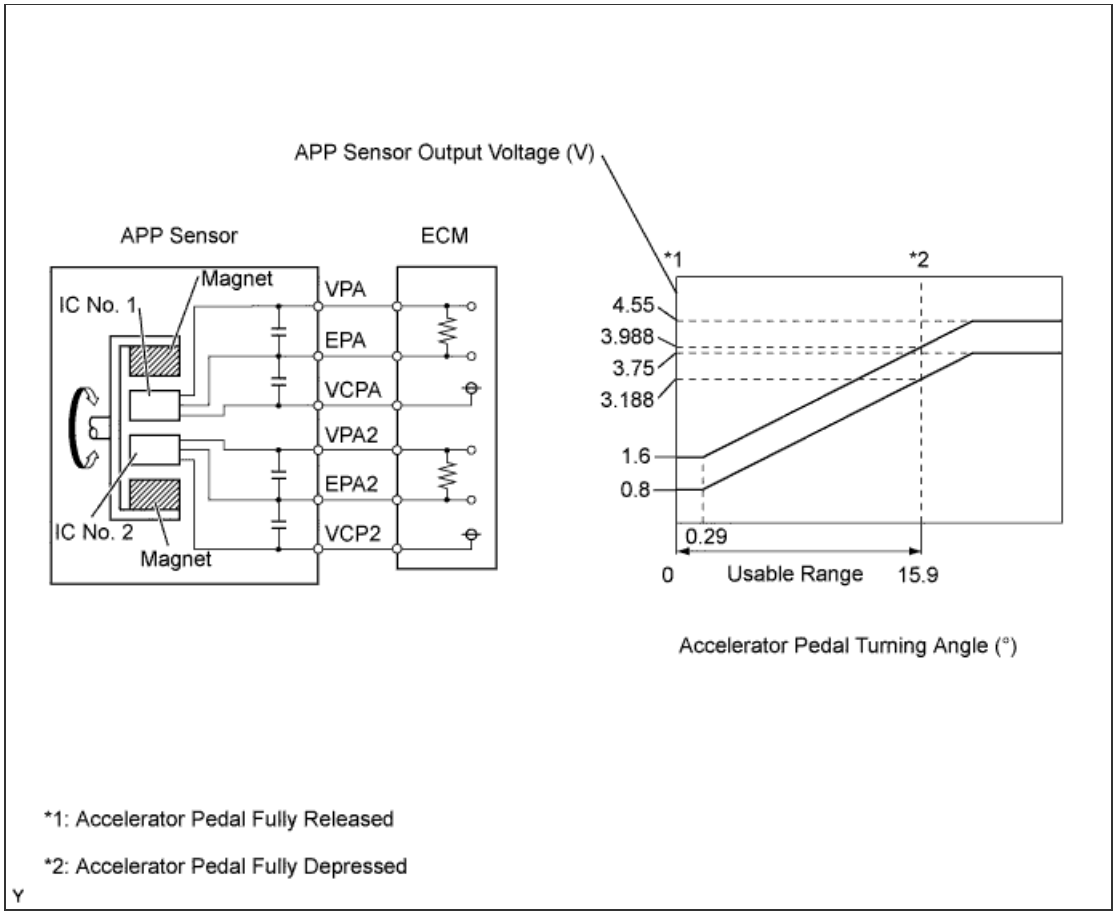
DESCRIPTION

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

The APP sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC Code	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM

P2122	VPA is 0.4 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP1 circuit • Open or ground short in VPA circuit • ECM
P2123	VPA is 4.8 V or higher for 2.0 seconds or more (1 trip detection logic).	• APP sensor • Open in EPA circuit • ECM
P2125	VPA2 fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or higher. (b) VPA is between 0.4 V and 3.45 V.	• APP sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): (a) The difference between VPA and VPA2 is 0.02 V or less. (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less.	• Short between VPA and VPA2 circuits • APP sensor • ECM

HINT:

When any of these DTCs is output, check the APP sensor voltage by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

Trouble Area	Accelerator Position No. 1 When AP Released	Accelerator Position No. 2 When AP Released	Accelerator Position No. 1 When AP Depressed	Accelerator Position No. 2 When AP Depressed
VCP circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.0 V
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 5.0 V

HINT:

- **Accelerator pedal positions are expressed as voltages.**
- **AP stands for Accelerator Pedal.**

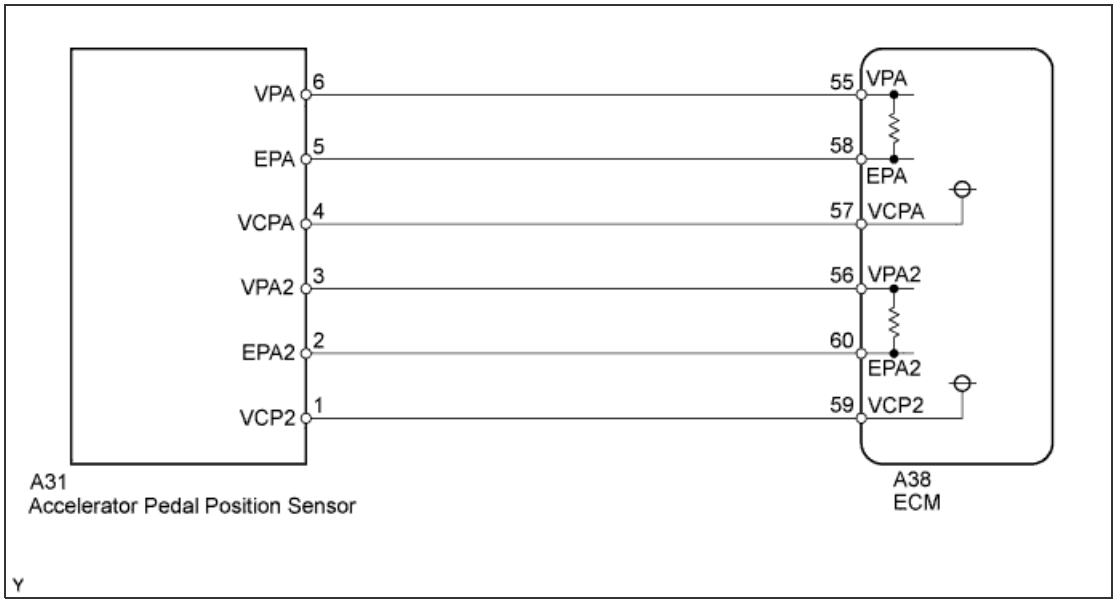
MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is less than the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and stores DTC(s).
Example:
When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is stored.
If the malfunction is not repaired successfully, a DTC is stored 2 seconds after the engine is next started.

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 is stored, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue driving. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.
Fail-safe mode continues until a pass condition is detected, and the engine switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Accelerator Pedal Position (APP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

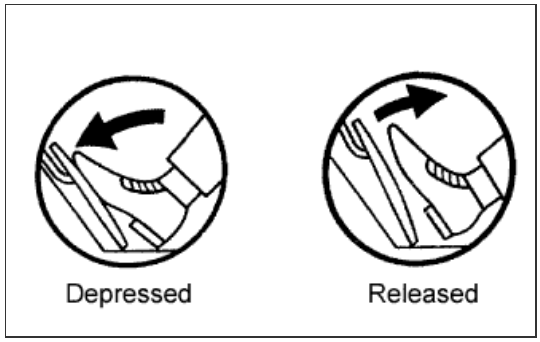
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

d. Read the value displayed on the tester.



Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released → Depressed → Released	0.5 to 4.5 V	1.2 to 5.0 V
	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V

Result

Result	Proceed to
N	A
OK	B

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

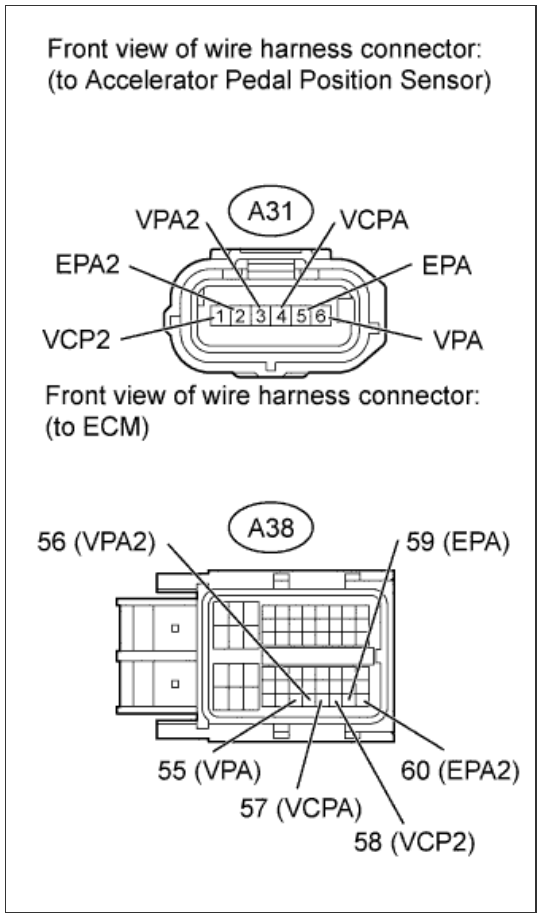
a. Disconnect the A31 accelerator pedal position (APP) sensor connector.

b. Disconnect the A38 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A38-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-58 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A38-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A38-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A38-59 (VCP2)	Always	Below 1 Ω
A31-6 (VPA) or A38-55 (VPA) - body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-58 (EPA) - body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-57 (VCPA) - body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-56 (VPA2) - body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A38-60 (EPA2) - body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A38-59 (VCP2) - body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

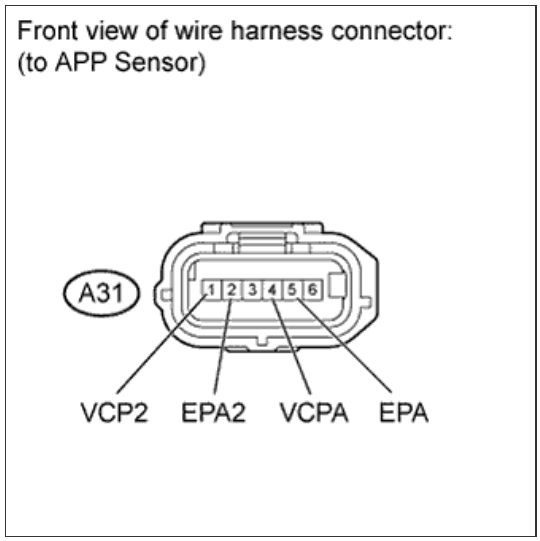
3.CHECK ECM (VCPA AND VCP2 VOLTAGE)

a. Disconnect the A31 APP sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Engine switch on (I)	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Engine switch on (I)	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

4.REPLACE ACCELERATOR PEDAL ASSEMBLY

a. Replace the accelerator pedal assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138 are output	A
No DTC is output	B

B → SYSTEM OK

A

REPLACE ECM (**Click here**)

DTC P0327 Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)

DTC P0328 Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)

DTC P032C Knock Sensor 3 Circuit Low

DTC P032D Knock Sensor 3 Circuit High

DTC P0332 Knock Sensor 2 Circuit Low Input (Bank 2)

DTC P0333 Knock Sensor 2 Circuit High Input (Bank 2)

DTC P033C Knock Sensor 4 Circuit Low Input

DTC P033D Knock Sensor 4 Circuit High Input

for Preparation Click here

DESCRIPTION

A flat type knock sensor (non-resonant type) has a structure that can detect vibrations between approximately 6 kHz and 15 kHz.
Knock sensors are fitted onto the engine block to detect engine knocking.
The knock sensor contains a piezoelectric element which generates a voltage when it becomes deformed.
The voltage is generated when the engine block vibrates due to knocking. Any occurrence of engine knocking can be suppressed by delaying the ignition timing.

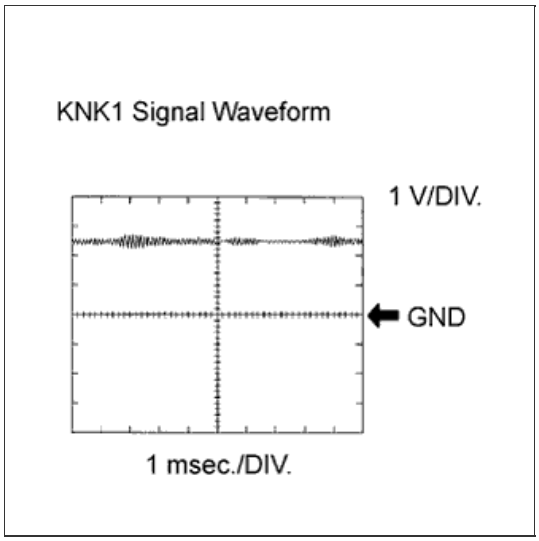
DTC Code	DTC Detection Condition	Trouble Area
P0327	The output voltage of the knock sensor (for Bank 1 Sensor 1) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 1 Sensor 1) circuit • Knock sensor (for Bank 1 Sensor 1) • ECM
P0328	The output voltage of the knock sensor (for Bank 1 Sensor 1) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 1 Sensor 1) circuit • Knock sensor (for Bank 1 Sensor 1) • ECM
P0332	The output voltage of the knock sensor (for Bank 2 Sensor 1) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 2 Sensor1) circuit • Knock sensor (for Bank 2 Sensor 1) • ECM
P0333	The output voltage of the knock sensor (for Bank 2 Sensor 1) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 2 Sensor1) circuit • Knock sensor (for Bank 2 Sensor 1) • ECM
P032C	The output voltage of the knock sensor (for Bank 1 Sensor 2) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 1 Sensor 2) circuit • Knock sensor (for Bank 1 Sensor 2) • ECM
P032D	The output voltage of the knock sensor (for Bank 1 Sensor 2) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 1 Sensor 2) circuit • Knock sensor (for Bank 1 Sensor 2) • ECM
P033C	The output voltage of the knock sensor (for Bank 2 Sensor 2) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 2 Sensor 2) circuit • Knock sensor (for Bank 2 Sensor 2)

		• ECM
P033D	The output voltage of the knock sensor (for Bank 2 Sensor 2) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 2 Sensor 2) circuit • Knock sensor (for Bank 2 Sensor 2) • ECM

HINT:

When any of DTCs P0327, P0328, P0332, P0333, P032C, P032D, P033C and P033D is stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is delayed to its maximum retardation. Fail-safe mode continues until the engine switch is turned off.

Reference: Inspection using an oscilloscope.



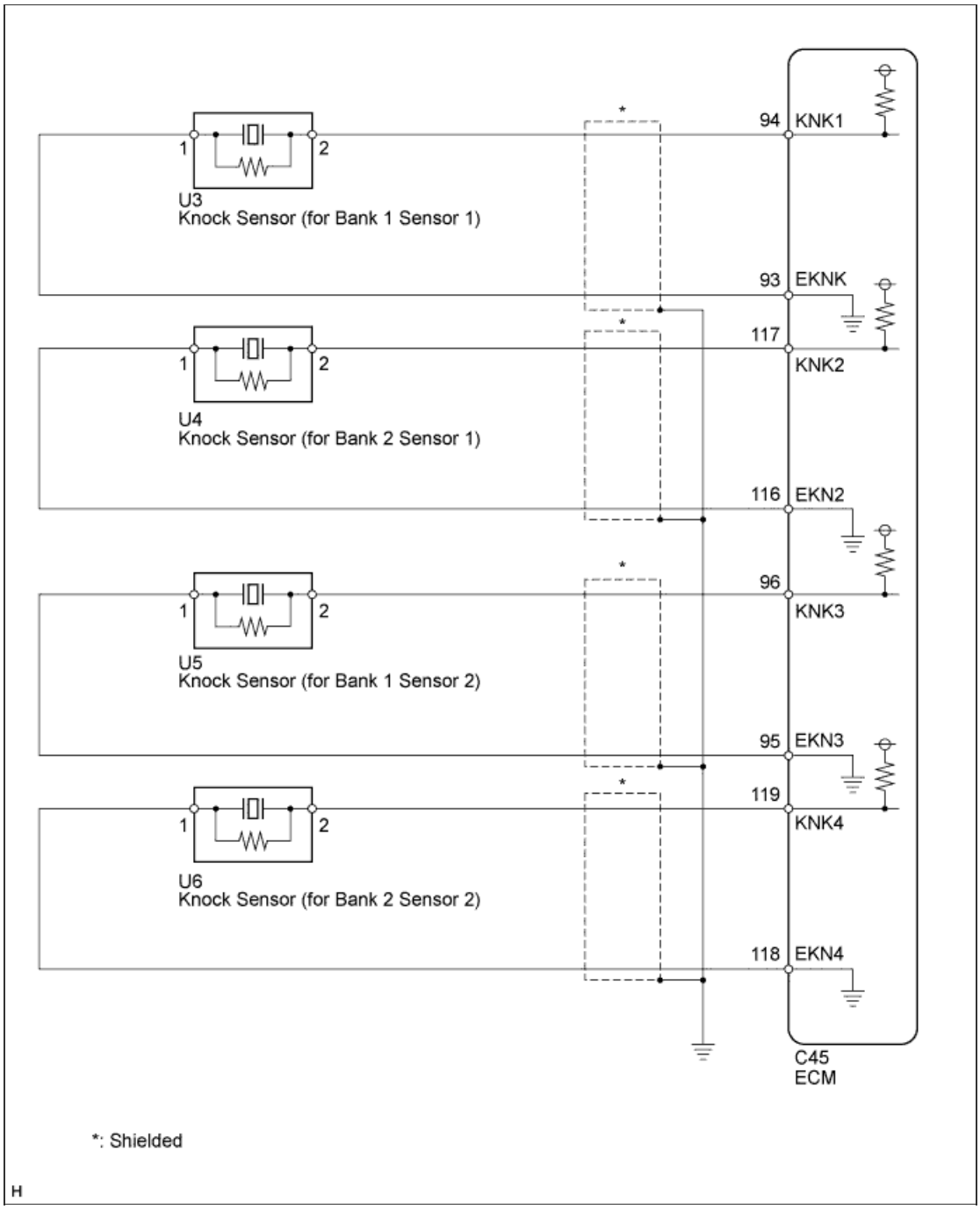
Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-94 (KNK1) - C45-93 (EKNK)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-117 (KNK2) - C45-116 (EKN2)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-96 (KNK3) - C45-95 (EKN3)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-119 (KNK4) - C45-118 (EKN4)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown

MONITOR DESCRIPTION

The knock sensor, located on the cylinder block, detects spark knock. When spark knock occurs, the piezoelectric element of the sensor vibrates. When the ECM detects a voltage in this frequency range, it retards the ignition timing to suppress the spark knock.
The ECM also senses background engine noise with the knock sensor and uses this noise to check for faults in the sensor. If the knock sensor signal level is too low for more than 10 seconds, or if the knock sensor output voltage is outside the normal range, the ECM interprets this as a fault in the knock sensor and stores DTC(s).

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **DTCs P0327 and P0328 are for the bank 1 sensor 1 knock sensor circuit.**
- **DTCs P032C and P032D are for the bank 1 sensor 2 knock sensor circuit.**
- **DTCs P0332 and P0333 are for the bank 2 sensor 1 knock sensor circuit.**
- **DTCs P033C and P033D are for the bank 2 sensor 2 knock sensor circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

1.INSPECT KNOCK SENSOR

a. Disconnect the C45 ECM connector.

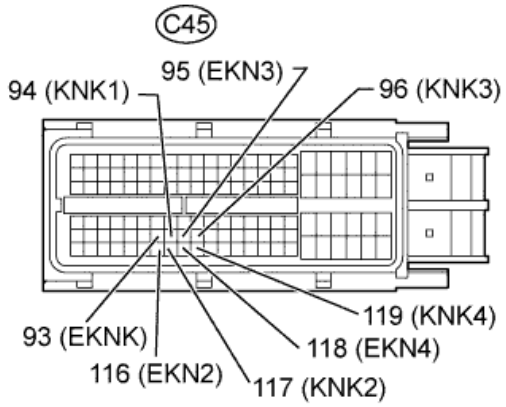
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition

C45-94 (KNK1) - C45-93 (EKNK)	20°C (68°F)	120 to 280 kΩ
C45-117 (KNK2) - C45-116 (EKN2)	20°C (68°F)	120 to 280 kΩ
C45-96 (KNK3) - C45-95 (EKN3)	20°C (68°F)	120 to 280 kΩ
C45-119 (KNK4) - C45-118 (EKN4)	20°C (68°F)	120 to 280 kΩ

Front view of wire harness connector:
(to ECM)



Result

Result	Proceed to
NG	A
OK	B

B → Go to step 3

A

2.CHECK HARNESS AND CONNECTOR (ECM - KNOCK SENSOR)

a. Disconnect the C45 ECM connector.

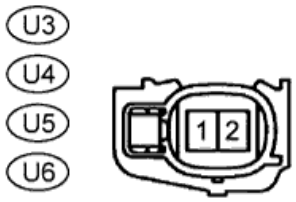
b. Disconnect the U3, U4, U5 or U6 knock sensor connector.

c. Measure the resistance according to the value(s) in the table below.

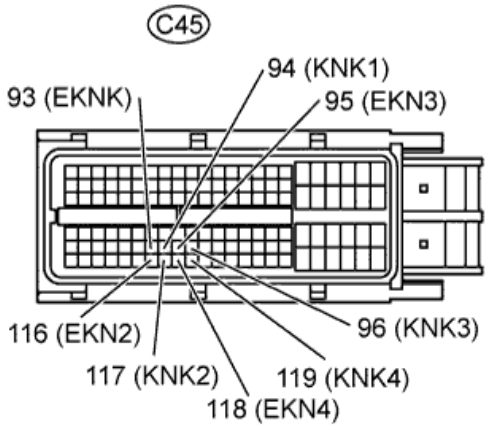
Standard Resistance:

Tester Connection	Condition	Specified Condition
U3-2 - C45-94 (KNK1)	Always	Below 1 Ω
U3-1 - C45-93 (EKNK)	Always	Below 1 Ω
U4-2 - C45-117 (KNK2)	Always	Below 1 Ω
U4-1 - C45-116 (EKN2)	Always	Below 1 Ω
U5-2 - C45-96 (KNK3)	Always	Below 1 Ω
U5-1 - C45-95 (EKN3)	Always	Below 1 Ω
U6-2 - C45-119 (KNK4)	Always	Below 1 Ω
U6-1 - C45-118 (EKN4)	Always	Below 1 Ω
U3-2 or C45-94 (KNK1) - Body ground	Always	10 kΩ or higher
U3-1 or C45-93 (EKNK) - Body ground	Always	10 kΩ or higher
U4-2 or C45-117 (KNK2) - Body ground	Always	10 kΩ or higher
U4-1 or C45-116 (EKN2) - Body ground	Always	10 kΩ or higher
U5-2 or C45-96		

Front view of wire harness connector:
(to Knock Sensor)



Front view of wire harness connector:
(to ECM)



(KNK3) - Body ground	Always	10 kΩ or higher
U5-1 or C45-95 (EKN3) - Body ground	Always	10 kΩ or higher
U6-2 or C45-119 (KNK4) - Body ground	Always	10 kΩ or higher
U6-1 or C45-118 (EKN4) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE KNOCK SENSOR (Click here)

3.INSPECT ECM

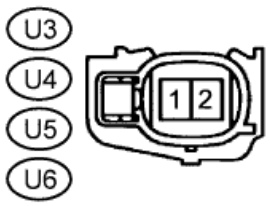
a. Disconnect the U3, U4, U5 or U6 knock sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
1 - 2	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to Knock Sensor)



NG → REPLACE ECM (Click here)

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

for Preparation Click here

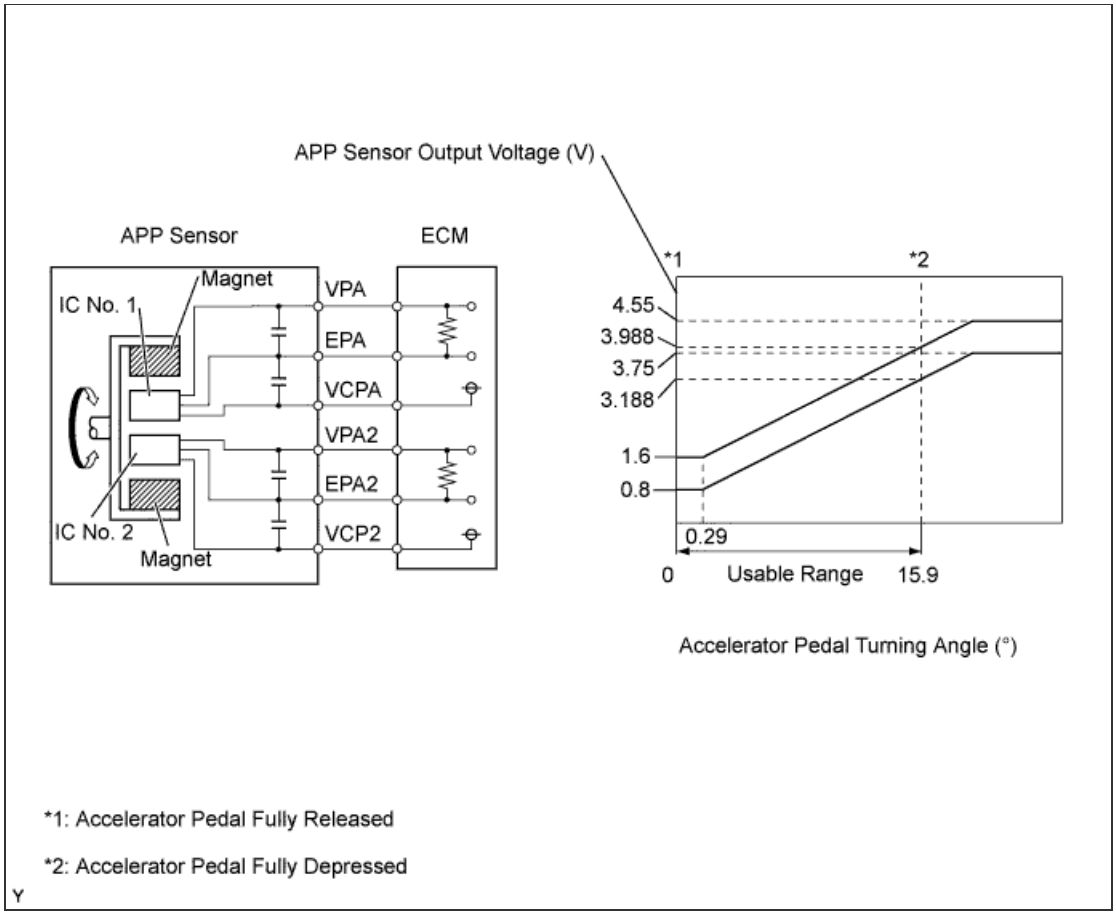
DESCRIPTION

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

The APP sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC Code	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM

P2122	VPA is 0.4 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP1 circuit • Open or ground short in VPA circuit • ECM
P2123	VPA is 4.8 V or higher for 2.0 seconds or more (1 trip detection logic).	• APP sensor • Open in EPA circuit • ECM
P2125	VPA2 fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or higher. (b) VPA is between 0.4 V and 3.45 V.	• APP sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): (a) The difference between VPA and VPA2 is 0.02 V or less. (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less.	• Short between VPA and VPA2 circuits • APP sensor • ECM

HINT:

When any of these DTCs is output, check the APP sensor voltage by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

Trouble Area	Accelerator Position No. 1 When AP Released	Accelerator Position No. 2 When AP Released	Accelerator Position No. 1 When AP Depressed	Accelerator Position No. 2 When AP Depressed
VCP circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.0 V
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 5.0 V

HINT:

- **Accelerator pedal positions are expressed as voltages.**
- **AP stands for Accelerator Pedal.**

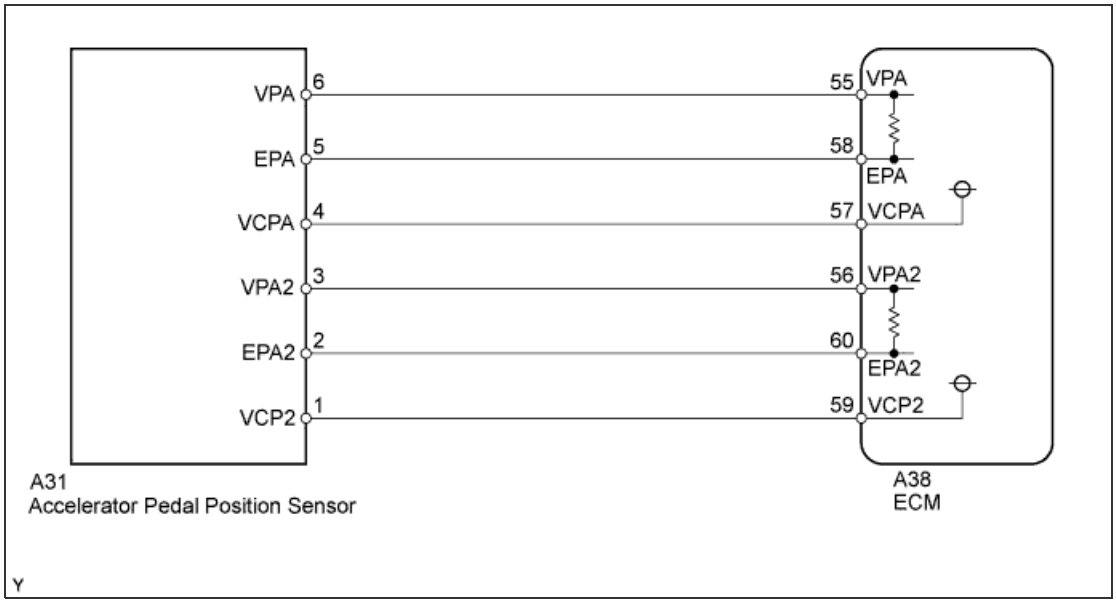
MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is less than the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and stores DTC(s).
Example:
When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is stored.
If the malfunction is not repaired successfully, a DTC is stored 2 seconds after the engine is next started.

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 is stored, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue driving. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.
Fail-safe mode continues until a pass condition is detected, and the engine switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Accelerator Pedal Position (APP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

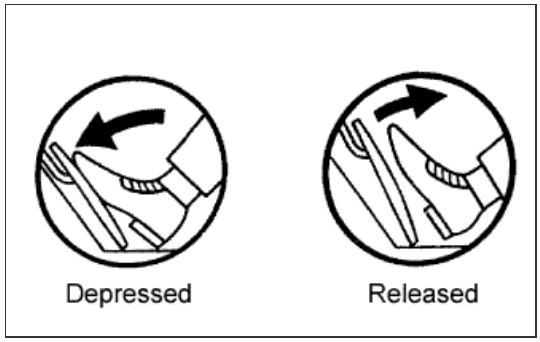
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

d. Read the value displayed on the tester.



Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released → Depressed → Released	0.5 to 4.5 V	1.2 to 5.0 V
	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V

Result

Result	Proceed to
N	A
OK	B

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

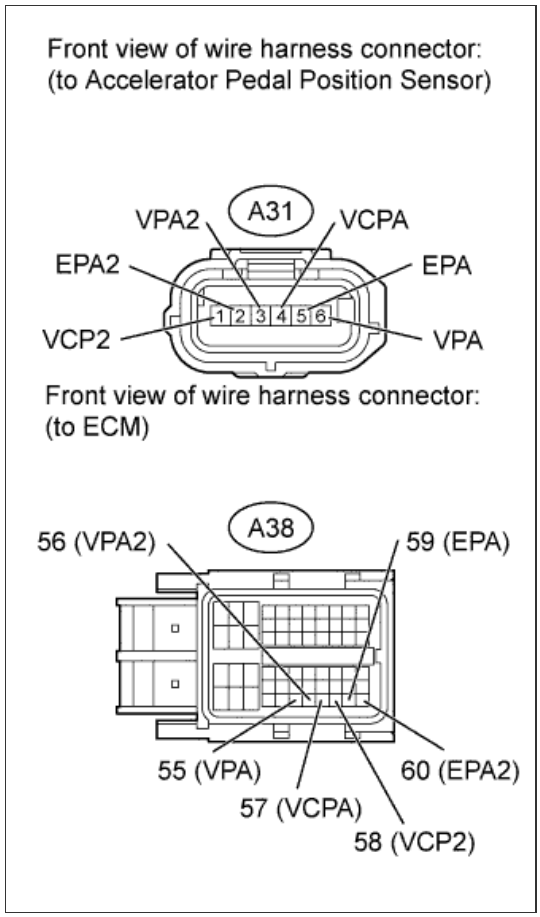
a. Disconnect the A31 accelerator pedal position (APP) sensor connector.

b. Disconnect the A38 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A38-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-58 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A38-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A38-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A38-59 (VCP2)	Always	Below 1 Ω
A31-6 (VPA) or A38-55 (VPA) - body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-58 (EPA) - body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-57 (VCPA) - body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-56 (VPA2) - body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A38-60 (EPA2) - body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A38-59 (VCP2) - body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

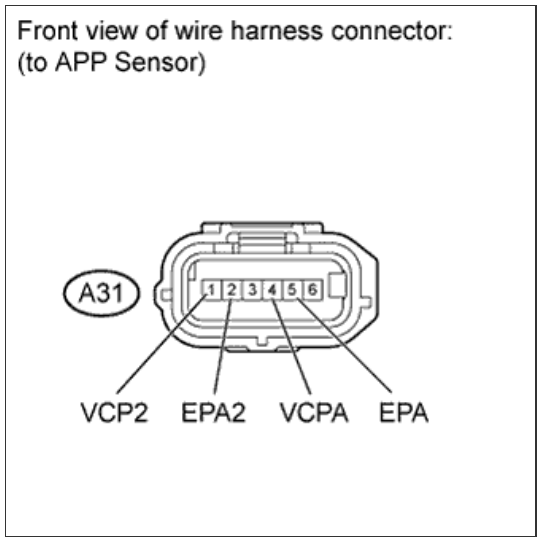
3.CHECK ECM (VCPA AND VCP2 VOLTAGE)

a. Disconnect the A31 APP sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Engine switch on (I)	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Engine switch on (I)	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

4.REPLACE ACCELERATOR PEDAL ASSEMBLY

a. Replace the accelerator pedal assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138 are output	A
No DTC is output	B

B → SYSTEM OK

A

REPLACE ECM (**Click here**)

DTC P0327 Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)

DTC P0328 Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)

DTC P032C Knock Sensor 3 Circuit Low

DTC P032D Knock Sensor 3 Circuit High

DTC P0332 Knock Sensor 2 Circuit Low Input (Bank 2)

DTC P0333 Knock Sensor 2 Circuit High Input (Bank 2)

DTC P033C Knock Sensor 4 Circuit Low Input

DTC P033D Knock Sensor 4 Circuit High Input

for Preparation Click here

DESCRIPTION

A flat type knock sensor (non-resonant type) has a structure that can detect vibrations between approximately 6 kHz and 15 kHz.
Knock sensors are fitted onto the engine block to detect engine knocking.
The knock sensor contains a piezoelectric element which generates a voltage when it becomes deformed.
The voltage is generated when the engine block vibrates due to knocking. Any occurrence of engine knocking can be suppressed by delaying the ignition timing.

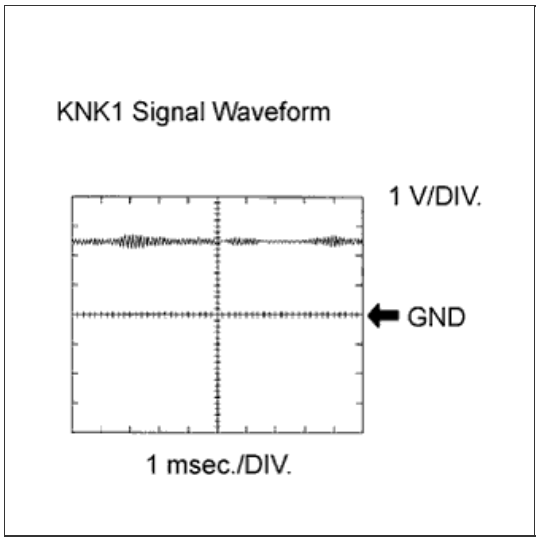
DTC Code	DTC Detection Condition	Trouble Area
P0327	The output voltage of the knock sensor (for Bank 1 Sensor 1) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 1 Sensor 1) circuit • Knock sensor (for Bank 1 Sensor 1) • ECM
P0328	The output voltage of the knock sensor (for Bank 1 Sensor 1) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 1 Sensor 1) circuit • Knock sensor (for Bank 1 Sensor 1) • ECM
P0332	The output voltage of the knock sensor (for Bank 2 Sensor 1) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 2 Sensor1) circuit • Knock sensor (for Bank 2 Sensor 1) • ECM
P0333	The output voltage of the knock sensor (for Bank 2 Sensor 1) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 2 Sensor1) circuit • Knock sensor (for Bank 2 Sensor 1) • ECM
P032C	The output voltage of the knock sensor (for Bank 1 Sensor 2) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 1 Sensor 2) circuit • Knock sensor (for Bank 1 Sensor 2) • ECM
P032D	The output voltage of the knock sensor (for Bank 1 Sensor 2) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 1 Sensor 2) circuit • Knock sensor (for Bank 1 Sensor 2) • ECM
P033C	The output voltage of the knock sensor (for Bank 2 Sensor 2) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 2 Sensor 2) circuit • Knock sensor (for Bank 2 Sensor 2)

		• ECM
P033D	The output voltage of the knock sensor (for Bank 2 Sensor 2) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 2 Sensor 2) circuit • Knock sensor (for Bank 2 Sensor 2) • ECM

HINT:

When any of DTCs P0327, P0328, P0332, P0333, P032C, P032D, P033C and P033D is stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is delayed to its maximum retardation. Fail-safe mode continues until the engine switch is turned off.

Reference: Inspection using an oscilloscope.



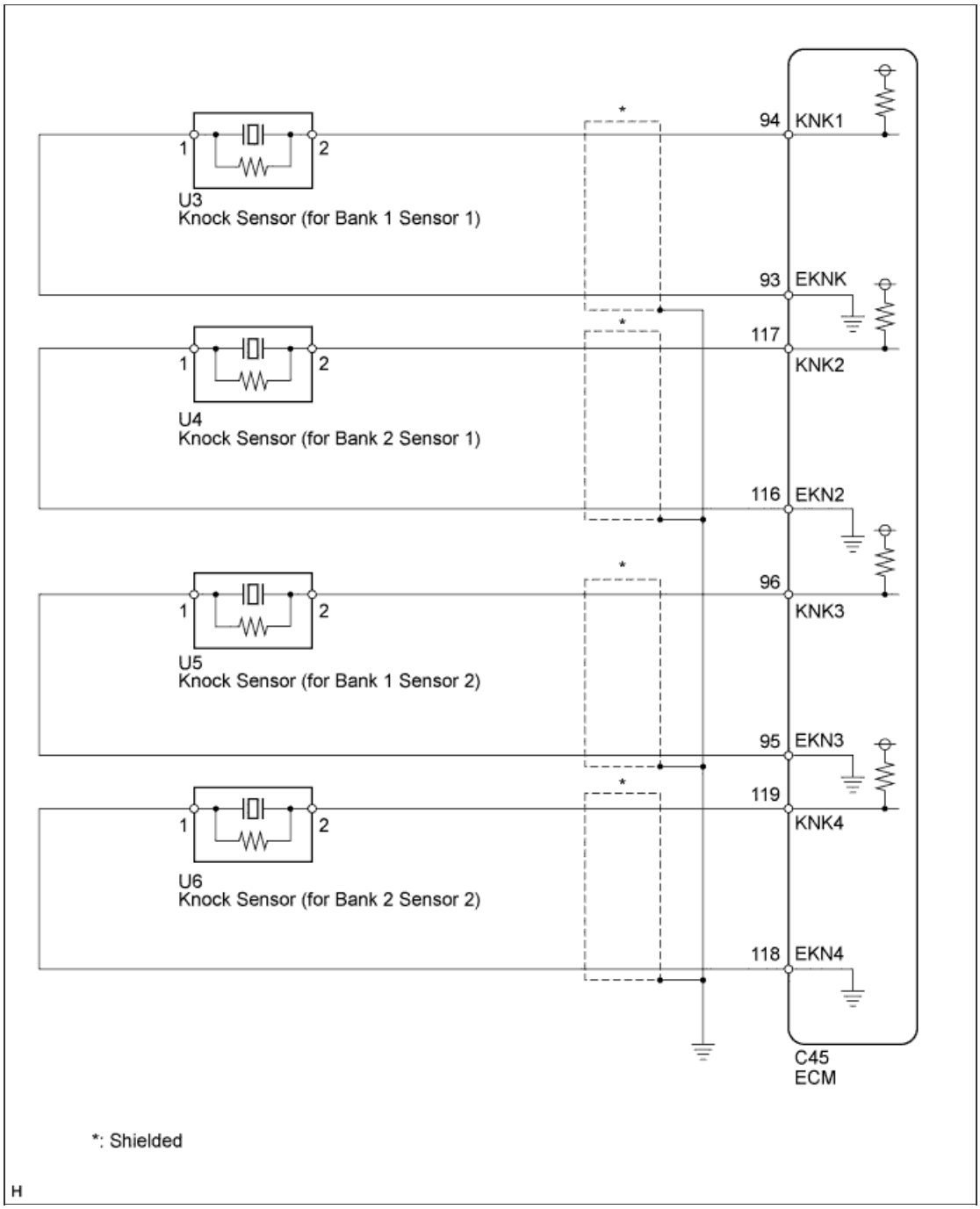
Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-94 (KNK1) - C45-93 (EKNK)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-117 (KNK2) - C45-116 (EKN2)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-96 (KNK3) - C45-95 (EKN3)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-119 (KNK4) - C45-118 (EKN4)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown

MONITOR DESCRIPTION

The knock sensor, located on the cylinder block, detects spark knock. When spark knock occurs, the piezoelectric element of the sensor vibrates. When the ECM detects a voltage in this frequency range, it retards the ignition timing to suppress the spark knock.
The ECM also senses background engine noise with the knock sensor and uses this noise to check for faults in the sensor. If the knock sensor signal level is too low for more than 10 seconds, or if the knock sensor output voltage is outside the normal range, the ECM interprets this as a fault in the knock sensor and stores DTC(s).

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **DTCs P0327 and P0328 are for the bank 1 sensor 1 knock sensor circuit.**
- **DTCs P032C and P032D are for the bank 1 sensor 2 knock sensor circuit.**
- **DTCs P0332 and P0333 are for the bank 2 sensor 1 knock sensor circuit.**
- **DTCs P033C and P033D are for the bank 2 sensor 2 knock sensor circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

1.INSPECT KNOCK SENSOR

a. Disconnect the C45 ECM connector.

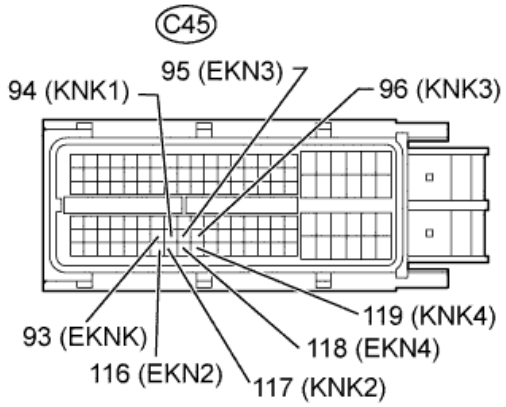
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition

C45-94 (KNK1) - C45-93 (EKNK)	20°C (68°F)	120 to 280 kΩ
C45-117 (KNK2) - C45-116 (EKN2)	20°C (68°F)	120 to 280 kΩ
C45-96 (KNK3) - C45-95 (EKN3)	20°C (68°F)	120 to 280 kΩ
C45-119 (KNK4) - C45-118 (EKN4)	20°C (68°F)	120 to 280 kΩ

Front view of wire harness connector:
(to ECM)



Result

Result	Proceed to
NG	A
OK	B

B → Go to step 3

A

2.CHECK HARNESS AND CONNECTOR (ECM - KNOCK SENSOR)

a. Disconnect the C45 ECM connector.

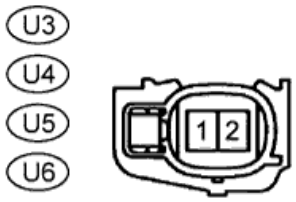
b. Disconnect the U3, U4, U5 or U6 knock sensor connector.

c. Measure the resistance according to the value(s) in the table below.

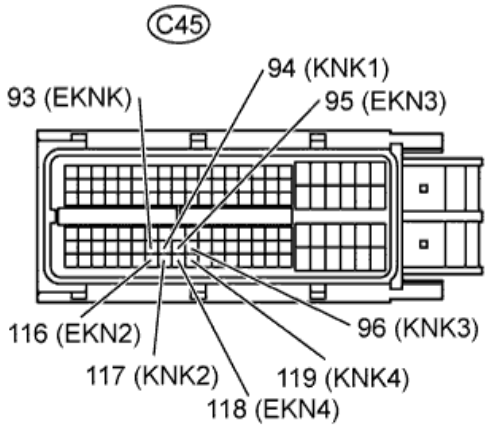
Standard Resistance:

Tester Connection	Condition	Specified Condition
U3-2 - C45-94 (KNK1)	Always	Below 1 Ω
U3-1 - C45-93 (EKNK)	Always	Below 1 Ω
U4-2 - C45-117 (KNK2)	Always	Below 1 Ω
U4-1 - C45-116 (EKN2)	Always	Below 1 Ω
U5-2 - C45-96 (KNK3)	Always	Below 1 Ω
U5-1 - C45-95 (EKN3)	Always	Below 1 Ω
U6-2 - C45-119 (KNK4)	Always	Below 1 Ω
U6-1 - C45-118 (EKN4)	Always	Below 1 Ω
U3-2 or C45-94 (KNK1) - Body ground	Always	10 kΩ or higher
U3-1 or C45-93 (EKNK) - Body ground	Always	10 kΩ or higher
U4-2 or C45-117 (KNK2) - Body ground	Always	10 kΩ or higher
U4-1 or C45-116 (EKN2) - Body ground	Always	10 kΩ or higher
U5-2 or C45-96		

Front view of wire harness connector:
(to Knock Sensor)



Front view of wire harness connector:
(to ECM)



(KNK3) - Body ground	Always	10 kΩ or higher
U5-1 or C45-95 (EKN3) - Body ground	Always	10 kΩ or higher
U6-2 or C45-119 (KNK4) - Body ground	Always	10 kΩ or higher
U6-1 or C45-118 (EKN4) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE KNOCK SENSOR (Click here)

3.INSPECT ECM

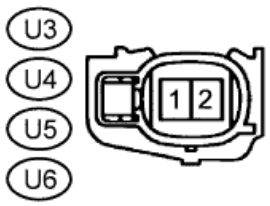
a. Disconnect the U3, U4, U5 or U6 knock sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
1 - 2	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to Knock Sensor)



NG → REPLACE ECM (Click here)

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P2121 Throttle / Pedal Position Sensor / Switch "D" Circuit Range / Performance

for Preparation Click here

DESCRIPTION

HINT:

Refer to DTC P2120 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2121	The difference between VPA and VPA2 is below 0.4 V, or higher than 1.2 V for 0.5 seconds (1 trip detection logic).	• **Accelerator Pedal Position (APP) sensor** • **ECM**

MONITOR DESCRIPTION

When the difference between the output voltages of VPA and VPA2 deviates from the standard, the ECM determines that the Accelerator Pedal Position (APP) sensor is malfunctioning. The ECM turns on the MIL and the DTC is stored.

FAIL-SAFE

The Accelerator Pedal Position (APP) sensor has two (main and sub) sensor circuits. If a malfunction occurs in either of the sensor circuits, the ECM detects the abnormal signal voltage difference between the two sensor circuits and switches to limp mode. In limp mode, the functioning circuit is used to calculate the accelerator pedal opening angle to allow the vehicle to continue driving. If both circuits malfunction, the ECM regards the opening angle of the accelerator pedal as being fully closed. In this case, the throttle valve remains closed as if the engine is idling.
If a pass condition is detected and then the engine switch is turned off, the fail-safe operation stops and the system returns to a normal condition.

WIRING DIAGRAM

Refer to DTC P2120 (Click here).

INSPECTION PROCEDURE

HINT:

- **This DTC relates to the Accelerator Pedal Position (APP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2121)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P2121 is output	A
P2121 and other DTCs are output	B

HINT:

If any DTCs other than P2121 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

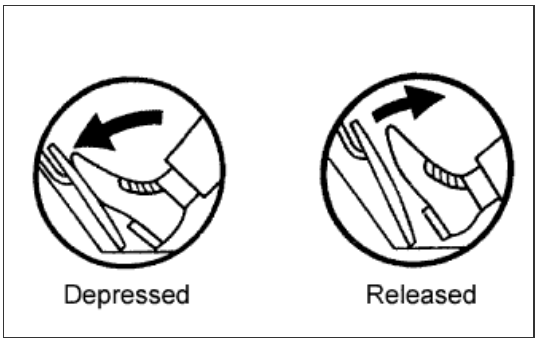
b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

d. Read the values displayed on the tester.

Standard Voltage:

Accelerator Pedal Operations	Accelerator Position No. 1	Accelerator Position No. 2
Released	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2.6 to 4.5 V	3.4 to 5.0 V



NG → Go to step

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

.REPLACE ACCELERATOR PEDAL

a. Replace the accelerator pedal assembly (Click here).

NEXT

.CHECK WHETHER DTC OUTPUT RECURS (DTC P2121)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
P2121 is output	A
No DTC is output	B

B → SYSTEM OK

A

REPLACE ECM (Click here)

DTC P0327 Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)

DTC P0328 Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)

DTC P032C Knock Sensor 3 Circuit Low

DTC P032D Knock Sensor 3 Circuit High

DTC P0332 Knock Sensor 2 Circuit Low Input (Bank 2)

DTC P0333 Knock Sensor 2 Circuit High Input (Bank 2)

DTC P033C Knock Sensor 4 Circuit Low Input

DTC P033D Knock Sensor 4 Circuit High Input

for Preparation Click here

DESCRIPTION

A flat type knock sensor (non-resonant type) has a structure that can detect vibrations between approximately 6 kHz and 15 kHz.
Knock sensors are fitted onto the engine block to detect engine knocking.
The knock sensor contains a piezoelectric element which generates a voltage when it becomes deformed.
The voltage is generated when the engine block vibrates due to knocking. Any occurrence of engine knocking can be suppressed by delaying the ignition timing.

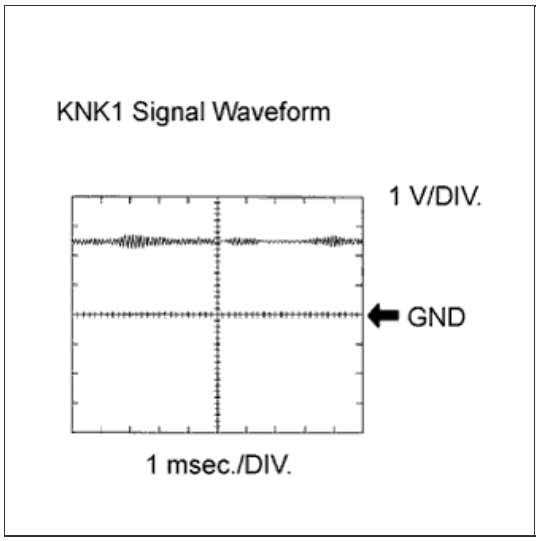
DTC Code	DTC Detection Condition	Trouble Area
P0327	The output voltage of the knock sensor (for Bank 1 Sensor 1) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 1 Sensor 1) circuit • Knock sensor (for Bank 1 Sensor 1) • ECM
P0328	The output voltage of the knock sensor (for Bank 1 Sensor 1) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 1 Sensor 1) circuit • Knock sensor (for Bank 1 Sensor 1) • ECM
P0332	The output voltage of the knock sensor (for Bank 2 Sensor 1) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 2 Sensor1) circuit • Knock sensor (for Bank 2 Sensor 1) • ECM
P0333	The output voltage of the knock sensor (for Bank 2 Sensor 1) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 2 Sensor1) circuit • Knock sensor (for Bank 2 Sensor 1) • ECM
P032C	The output voltage of the knock sensor (for Bank 1 Sensor 2) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 1 Sensor 2) circuit • Knock sensor (for Bank 1 Sensor 2) • ECM
P032D	The output voltage of the knock sensor (for Bank 1 Sensor 2) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 1 Sensor 2) circuit • Knock sensor (for Bank 1 Sensor 2) • ECM
P033C	The output voltage of the knock sensor (for Bank 2 Sensor 2) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 2 Sensor 2) circuit • Knock sensor (for Bank 2 Sensor 2)

		• ECM
P033D	The output voltage of the knock sensor (for Bank 2 Sensor 2) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 2 Sensor 2) circuit • Knock sensor (for Bank 2 Sensor 2) • ECM

HINT:

When any of DTCs P0327, P0328, P0332, P0333, P032C, P032D, P033C and P033D is stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is delayed to its maximum retardation. Fail-safe mode continues until the engine switch is turned off.

Reference: Inspection using an oscilloscope.



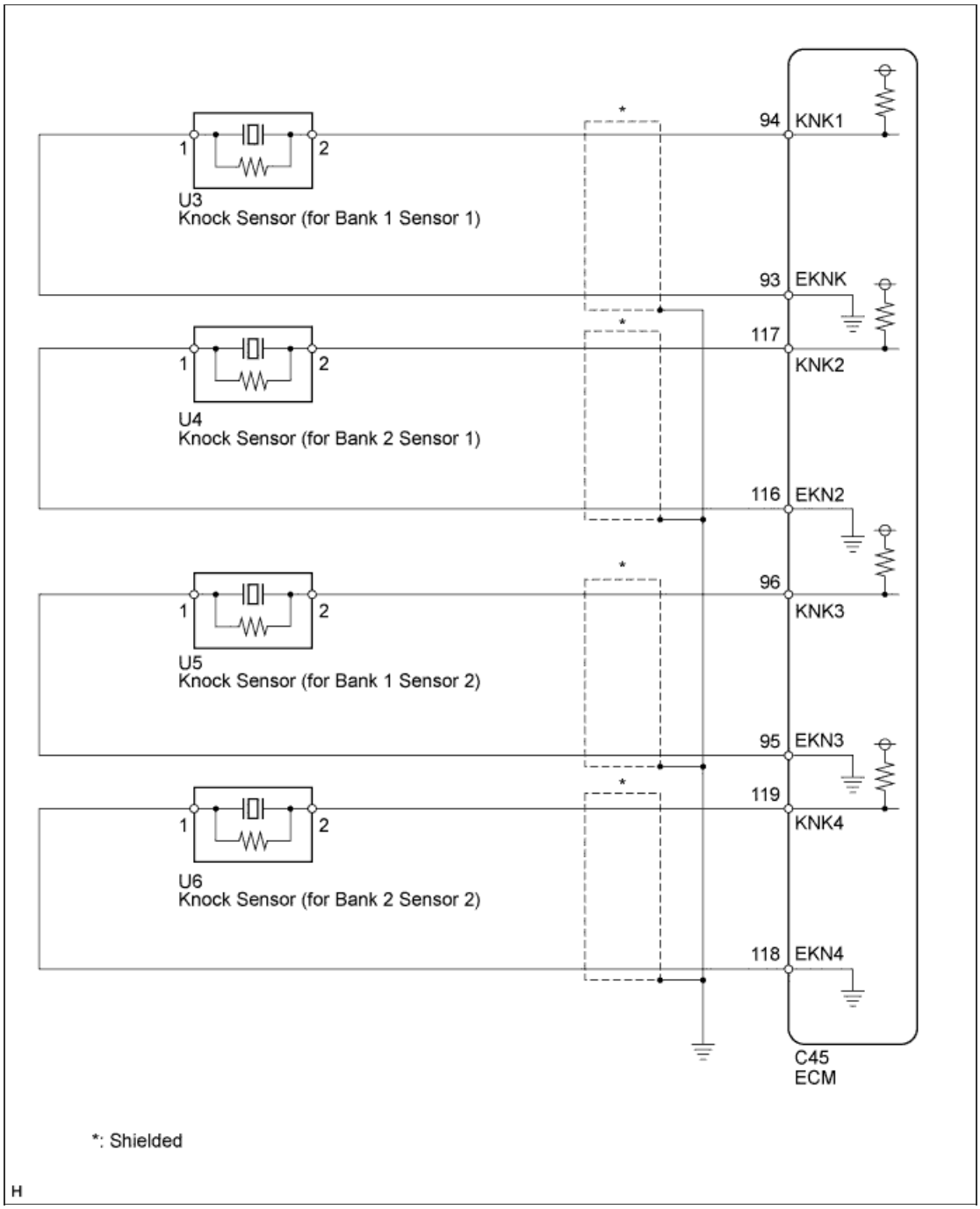
Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-94 (KNK1) - C45-93 (EKNK)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-117 (KNK2) - C45-116 (EKN2)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-96 (KNK3) - C45-95 (EKN3)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-119 (KNK4) - C45-118 (EKN4)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown

MONITOR DESCRIPTION

The knock sensor, located on the cylinder block, detects spark knock. When spark knock occurs, the piezoelectric element of the sensor vibrates. When the ECM detects a voltage in this frequency range, it retards the ignition timing to suppress the spark knock.
The ECM also senses background engine noise with the knock sensor and uses this noise to check for faults in the sensor. If the knock sensor signal level is too low for more than 10 seconds, or if the knock sensor output voltage is outside the normal range, the ECM interprets this as a fault in the knock sensor and stores DTC(s).

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **DTCs P0327 and P0328 are for the bank 1 sensor 1 knock sensor circuit.**
- **DTCs P032C and P032D are for the bank 1 sensor 2 knock sensor circuit.**
- **DTCs P0332 and P0333 are for the bank 2 sensor 1 knock sensor circuit.**
- **DTCs P033C and P033D are for the bank 2 sensor 2 knock sensor circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

1.INSPECT KNOCK SENSOR

a. Disconnect the C45 ECM connector.

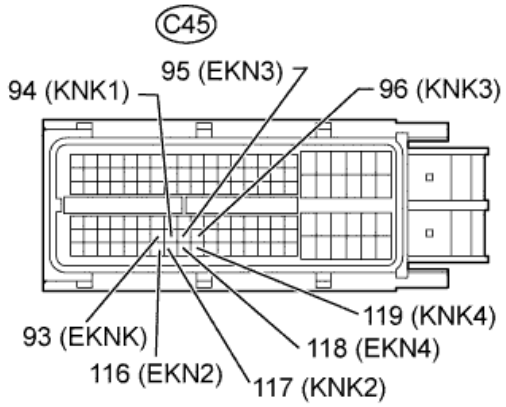
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition

C45-94 (KNK1) - C45-93 (EKNK)	20°C (68°F)	120 to 280 kΩ
C45-117 (KNK2) - C45-116 (EKN2)	20°C (68°F)	120 to 280 kΩ
C45-96 (KNK3) - C45-95 (EKN3)	20°C (68°F)	120 to 280 kΩ
C45-119 (KNK4) - C45-118 (EKN4)	20°C (68°F)	120 to 280 kΩ

Front view of wire harness connector:
(to ECM)



Result

Result	Proceed to
NG	A
OK	B

B → Go to step 3

A

2.CHECK HARNESS AND CONNECTOR (ECM - KNOCK SENSOR)

a. Disconnect the C45 ECM connector.

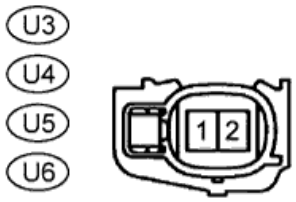
b. Disconnect the U3, U4, U5 or U6 knock sensor connector.

c. Measure the resistance according to the value(s) in the table below.

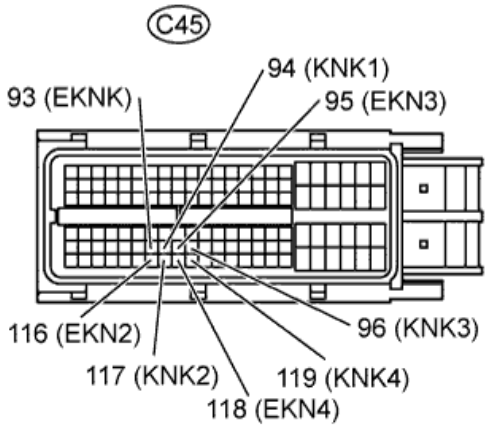
Standard Resistance:

Tester Connection	Condition	Specified Condition
U3-2 - C45-94 (KNK1)	Always	Below 1 Ω
U3-1 - C45-93 (EKNK)	Always	Below 1 Ω
U4-2 - C45-117 (KNK2)	Always	Below 1 Ω
U4-1 - C45-116 (EKN2)	Always	Below 1 Ω
U5-2 - C45-96 (KNK3)	Always	Below 1 Ω
U5-1 - C45-95 (EKN3)	Always	Below 1 Ω
U6-2 - C45-119 (KNK4)	Always	Below 1 Ω
U6-1 - C45-118 (EKN4)	Always	Below 1 Ω
U3-2 or C45-94 (KNK1) - Body ground	Always	10 kΩ or higher
U3-1 or C45-93 (EKNK) - Body ground	Always	10 kΩ or higher
U4-2 or C45-117 (KNK2) - Body ground	Always	10 kΩ or higher
U4-1 or C45-116 (EKN2) - Body ground	Always	10 kΩ or higher
U5-2 or C45-96		

Front view of wire harness connector:
(to Knock Sensor)



Front view of wire harness connector:
(to ECM)



(KNK3) - Body ground	Always	10 kΩ or higher
U5-1 or C45-95 (EKN3) - Body ground	Always	10 kΩ or higher
U6-2 or C45-119 (KNK4) - Body ground	Always	10 kΩ or higher
U6-1 or C45-118 (EKN4) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE KNOCK SENSOR (Click here)

3.INSPECT ECM

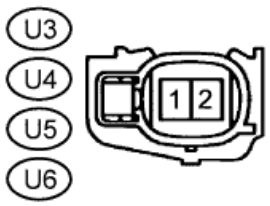
a. Disconnect the U3, U4, U5 or U6 knock sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
1 - 2	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to Knock Sensor)



NG → REPLACE ECM (Click here)

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

for Preparation Click here

DESCRIPTION

Refer to DTC P0031 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals A1A+ and A1A-/A2A+ and A2A- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in Air Fuel ratio (A/F) sensor (for Bank 1, 2 Sensor 1) circuit • Air Fuel ratio (A/F) sensor (for Bank 1, 2 Sensor 1) • ECM
P2238 P2241	• Case 1: Condition (a) or (b) continues for 5.0 seconds or more (1 trip detection logic): (a) The A1A+/A2A+ voltage is 0.5 V or less. (b) (A1A+/A2A+) - (A1A-/A2A-) = 0.1 V or less. • Case 2: The A/F sensor admittance is below 0.022 1/Ω (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2239 P2242	The A1A+/A2A+ voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2252 P2255	The A1A-/A2A- voltage is 0.5 V or less for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2253 P2256	The A1A-/A2A- voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM

HINT:

- **DTCs P2237, P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2240, P2241, P2242, P2255 and P2256 indicate malfunctions related to the bank 2 A/F sensor circuit.**

MONITOR DESCRIPTION

These DTCs are stored when there is an open or short in the A/F sensor circuit, or if A/F sensor output drops.
To detect these problems, the voltage of the A/F sensor is monitored when turning the engine switch on (IG), and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is outside of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in the next driving cycle, the MIL is illuminated and a DTC is stored.
The Air Fuel ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. If the A/F sensor impedance (alternating current resistance) or output voltage deviates greatly from the standard range, the ECM determines that there is an open or short in the A/F sensor circuit.

WIRING DIAGRAM

Refer to DTC P0031 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

(a) Connect the tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.
(e) Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.

HINT:

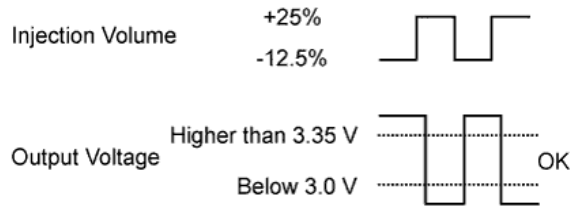
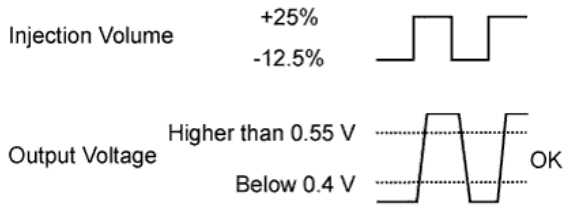
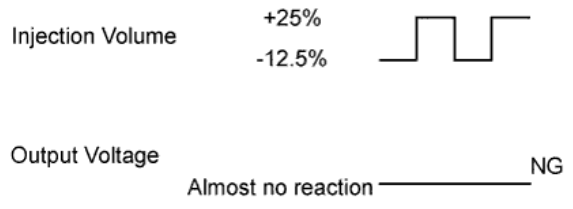
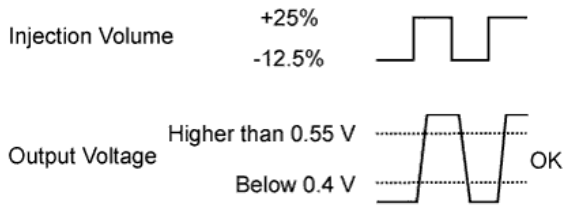
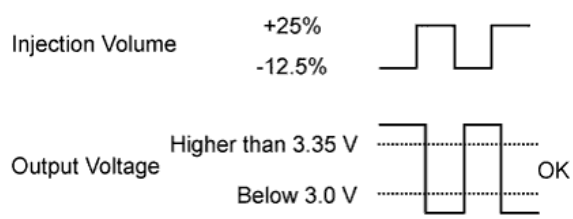
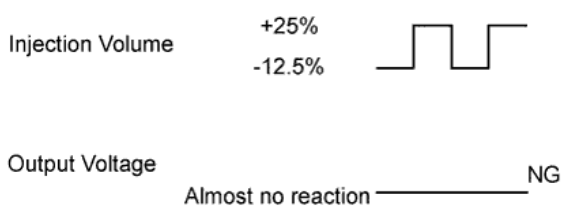
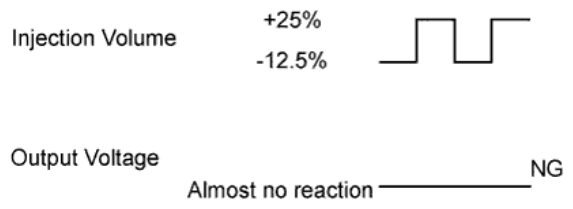
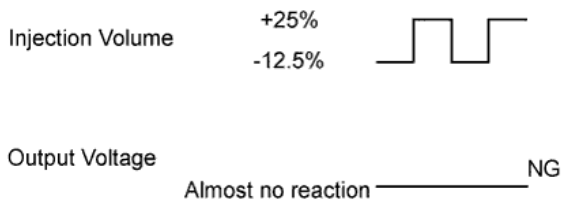
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Display Item (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.

To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the C22 or C23 Air Fuel ratio (A/F) sensor connector.

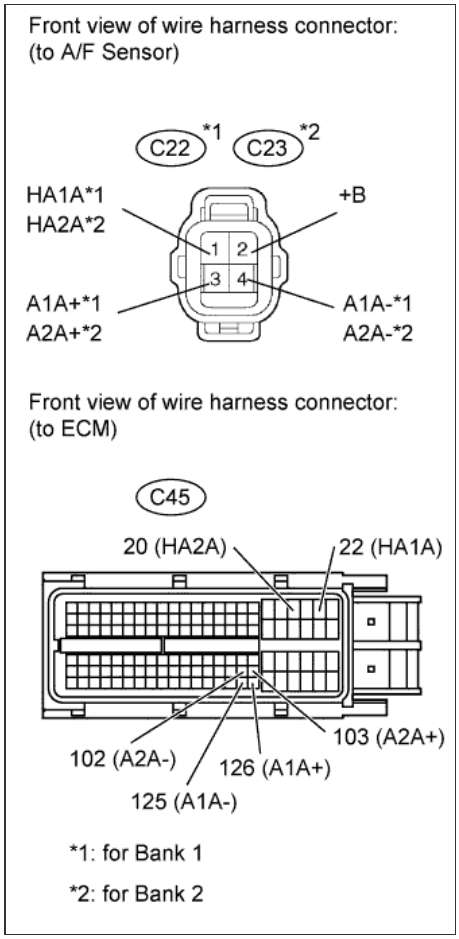
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the C45 ECM connector.



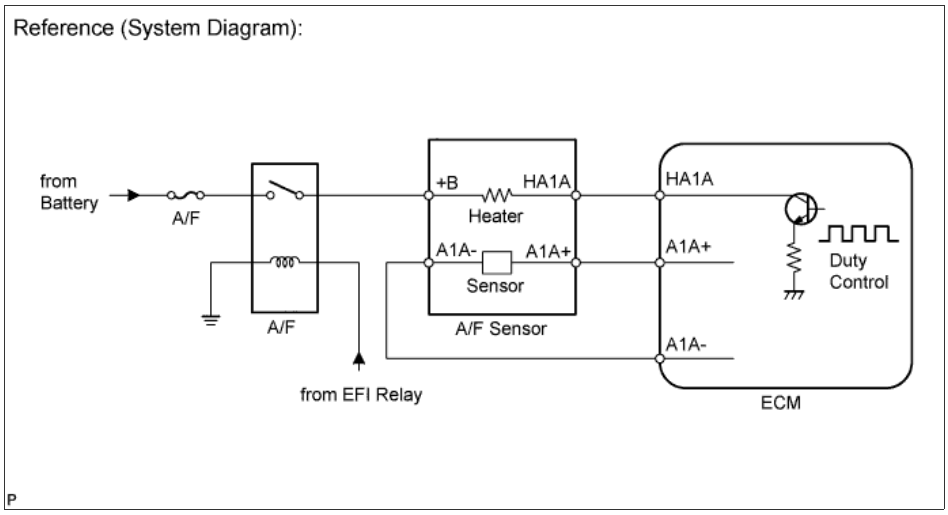
e. Measure the resistance according to the value(s) in the table below.

Standard Resistance

Tester Connection	Condition	Specified Condition

C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45- 126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45- 103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2237, P2238, P2239, P2240, P2241, P2242, P2252, P2253, P2255 or P2256 is output	B

B → REPLACE ECM (**Click here**)

A

END

DTC P0327 Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)

DTC P0328 Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)

DTC P032C Knock Sensor 3 Circuit Low

DTC P032D Knock Sensor 3 Circuit High

DTC P0332 Knock Sensor 2 Circuit Low Input (Bank 2)

DTC P0333 Knock Sensor 2 Circuit High Input (Bank 2)

DTC P033C Knock Sensor 4 Circuit Low Input

DTC P033D Knock Sensor 4 Circuit High Input

for Preparation Click here

DESCRIPTION

A flat type knock sensor (non-resonant type) has a structure that can detect vibrations between approximately 6 kHz and 15 kHz.
Knock sensors are fitted onto the engine block to detect engine knocking.
The knock sensor contains a piezoelectric element which generates a voltage when it becomes deformed.
The voltage is generated when the engine block vibrates due to knocking. Any occurrence of engine knocking can be suppressed by delaying the ignition timing.

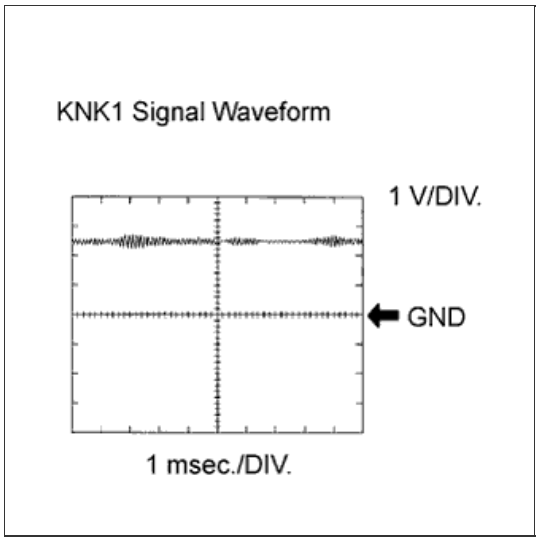
DTC Code	DTC Detection Condition	Trouble Area
P0327	The output voltage of the knock sensor (for Bank 1 Sensor 1) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 1 Sensor 1) circuit • Knock sensor (for Bank 1 Sensor 1) • ECM
P0328	The output voltage of the knock sensor (for Bank 1 Sensor 1) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 1 Sensor 1) circuit • Knock sensor (for Bank 1 Sensor 1) • ECM
P0332	The output voltage of the knock sensor (for Bank 2 Sensor 1) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 2 Sensor1) circuit • Knock sensor (for Bank 2 Sensor 1) • ECM
P0333	The output voltage of the knock sensor (for Bank 2 Sensor 1) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 2 Sensor1) circuit • Knock sensor (for Bank 2 Sensor 1) • ECM
P032C	The output voltage of the knock sensor (for Bank 1 Sensor 2) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 1 Sensor 2) circuit • Knock sensor (for Bank 1 Sensor 2) • ECM
P032D	The output voltage of the knock sensor (for Bank 1 Sensor 2) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 1 Sensor 2) circuit • Knock sensor (for Bank 1 Sensor 2) • ECM
P033C	The output voltage of the knock sensor (for Bank 2 Sensor 2) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 2 Sensor 2) circuit • Knock sensor (for Bank 2 Sensor 2)

		• ECM
P033D	The output voltage of the knock sensor (for Bank 2 Sensor 2) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 2 Sensor 2) circuit • Knock sensor (for Bank 2 Sensor 2) • ECM

HINT:

When any of DTCs P0327, P0328, P0332, P0333, P032C, P032D, P033C and P033D is stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is delayed to its maximum retardation. Fail-safe mode continues until the engine switch is turned off.

Reference: Inspection using an oscilloscope.



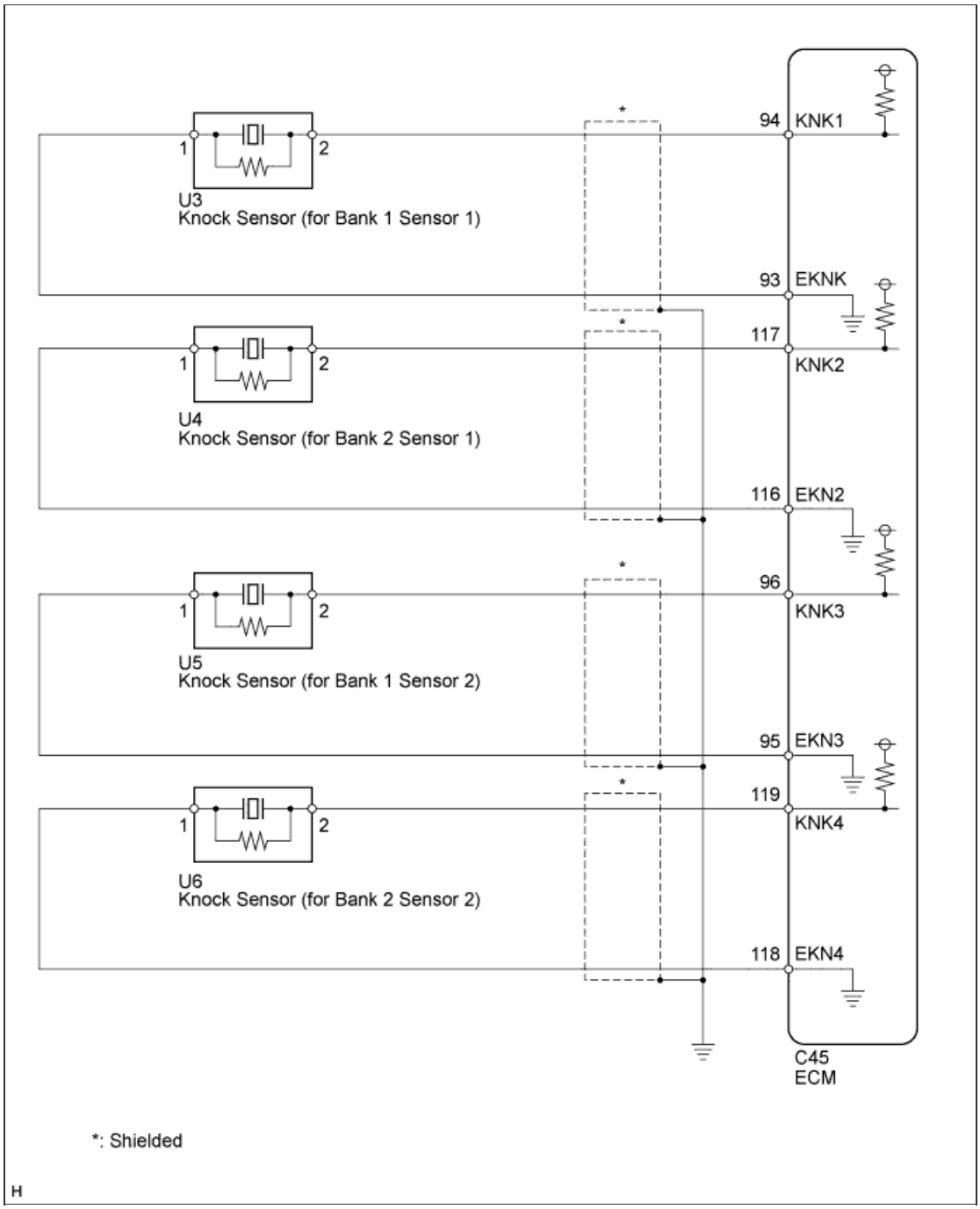
Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-94 (KNK1) - C45-93 (EKNK)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-117 (KNK2) - C45-116 (EKN2)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-96 (KNK3) - C45-95 (EKN3)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-119 (KNK4) - C45-118 (EKN4)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown

MONITOR DESCRIPTION

The knock sensor, located on the cylinder block, detects spark knock. When spark knock occurs, the piezoelectric element of the sensor vibrates. When the ECM detects a voltage in this frequency range, it retards the ignition timing to suppress the spark knock.
The ECM also senses background engine noise with the knock sensor and uses this noise to check for faults in the sensor. If the knock sensor signal level is too low for more than 10 seconds, or if the knock sensor output voltage is outside the normal range, the ECM interprets this as a fault in the knock sensor and stores DTC(s).

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **DTCs P0327 and P0328 are for the bank 1 sensor 1 knock sensor circuit.**
- **DTCs P032C and P032D are for the bank 1 sensor 2 knock sensor circuit.**
- **DTCs P0332 and P0333 are for the bank 2 sensor 1 knock sensor circuit.**
- **DTCs P033C and P033D are for the bank 2 sensor 2 knock sensor circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

1.INSPECT KNOCK SENSOR

a. Disconnect the C45 ECM connector.

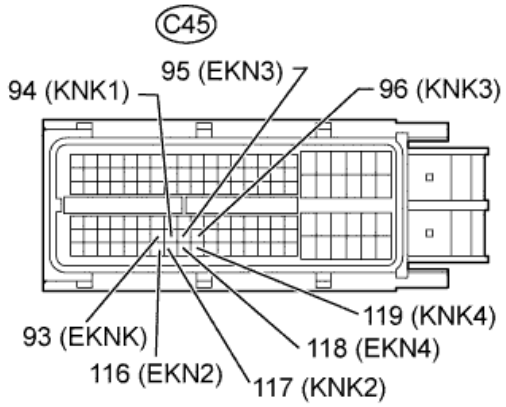
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition

C45-94 (KNK1) - C45-93 (EKNK)	20°C (68°F)	120 to 280 kΩ
C45-117 (KNK2) - C45-116 (EKN2)	20°C (68°F)	120 to 280 kΩ
C45-96 (KNK3) - C45-95 (EKN3)	20°C (68°F)	120 to 280 kΩ
C45-119 (KNK4) - C45-118 (EKN4)	20°C (68°F)	120 to 280 kΩ

Front view of wire harness connector:
(to ECM)



Result

Result	Proceed to
NG	A
OK	B

B → Go to step 3

A

2.CHECK HARNESS AND CONNECTOR (ECM - KNOCK SENSOR)

a. Disconnect the C45 ECM connector.

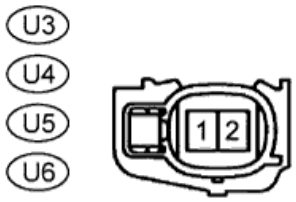
b. Disconnect the U3, U4, U5 or U6 knock sensor connector.

c. Measure the resistance according to the value(s) in the table below.

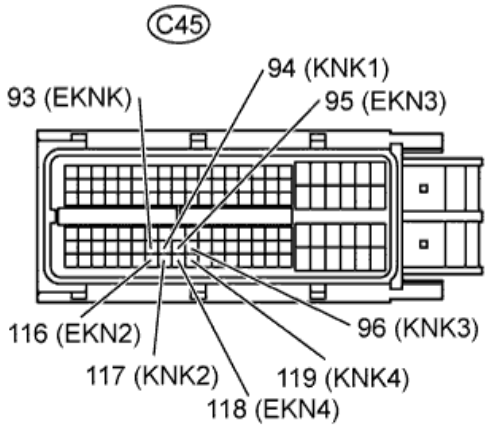
Standard Resistance:

Tester Connection	Condition	Specified Condition
U3-2 - C45-94 (KNK1)	Always	Below 1 Ω
U3-1 - C45-93 (EKNK)	Always	Below 1 Ω
U4-2 - C45-117 (KNK2)	Always	Below 1 Ω
U4-1 - C45-116 (EKN2)	Always	Below 1 Ω
U5-2 - C45-96 (KNK3)	Always	Below 1 Ω
U5-1 - C45-95 (EKN3)	Always	Below 1 Ω
U6-2 - C45-119 (KNK4)	Always	Below 1 Ω
U6-1 - C45-118 (EKN4)	Always	Below 1 Ω
U3-2 or C45-94 (KNK1) - Body ground	Always	10 kΩ or higher
U3-1 or C45-93 (EKNK) - Body ground	Always	10 kΩ or higher
U4-2 or C45-117 (KNK2) - Body ground	Always	10 kΩ or higher
U4-1 or C45-116 (EKN2) - Body ground	Always	10 kΩ or higher
U5-2 or C45-96		

Front view of wire harness connector:
(to Knock Sensor)



Front view of wire harness connector:
(to ECM)



(KNK3) - Body ground	Always	10 kΩ or higher
U5-1 or C45-95 (EKN3) - Body ground	Always	10 kΩ or higher
U6-2 or C45-119 (KNK4) - Body ground	Always	10 kΩ or higher
U6-1 or C45-118 (EKN4) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE KNOCK SENSOR (Click here)

3.INSPECT ECM

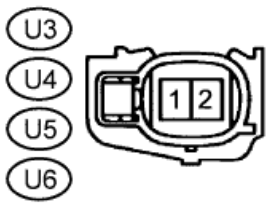
a. Disconnect the U3, U4, U5 or U6 knock sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
1 - 2	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to Knock Sensor)



NG → REPLACE ECM (Click here)

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

for Preparation Click here

DESCRIPTION

Refer to DTC P0031 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals A1A+ and A1A-/A2A+ and A2A- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in Air Fuel ratio (A/F) sensor (for Bank 1, 2 Sensor 1) circuit • Air Fuel ratio (A/F) sensor (for Bank 1, 2 Sensor 1) • ECM
P2238 P2241	• Case 1: Condition (a) or (b) continues for 5.0 seconds or more (1 trip detection logic): (a) The A1A+/A2A+ voltage is 0.5 V or less. (b) (A1A+/A2A+) - (A1A-/A2A-) = 0.1 V or less. • Case 2: The A/F sensor admittance is below 0.022 1/Ω (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2239 P2242	The A1A+/A2A+ voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2252 P2255	The A1A-/A2A- voltage is 0.5 V or less for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2253 P2256	The A1A-/A2A- voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM

HINT:

- **DTCs P2237, P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2240, P2241, P2242, P2255 and P2256 indicate malfunctions related to the bank 2 A/F sensor circuit.**

MONITOR DESCRIPTION

These DTCs are stored when there is an open or short in the A/F sensor circuit, or if A/F sensor output drops.
To detect these problems, the voltage of the A/F sensor is monitored when turning the engine switch on (IG), and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is outside of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in the next driving cycle, the MIL is illuminated and a DTC is stored.
The Air Fuel ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. If the A/F sensor impedance (alternating current resistance) or output voltage deviates greatly from the standard range, the ECM determines that there is an open or short in the A/F sensor circuit.

WIRING DIAGRAM

Refer to DTC P0031 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

(a) Connect the tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.
(e) Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.

HINT:

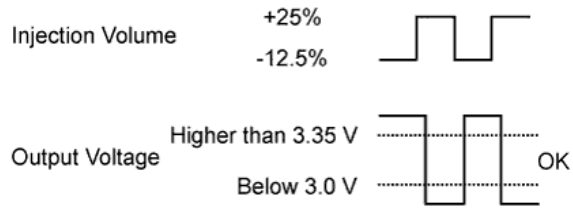
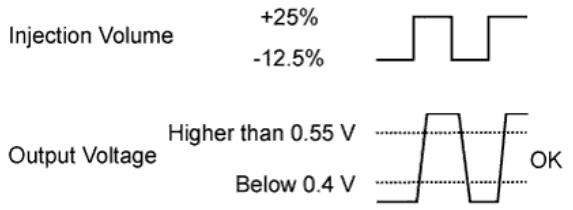
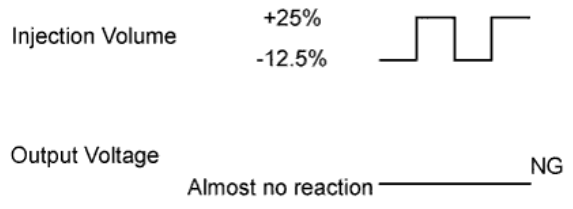
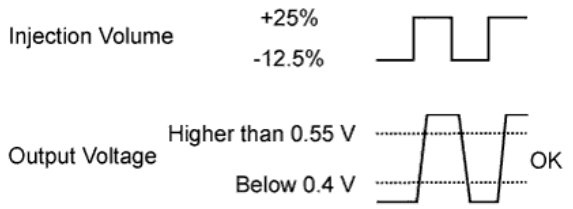
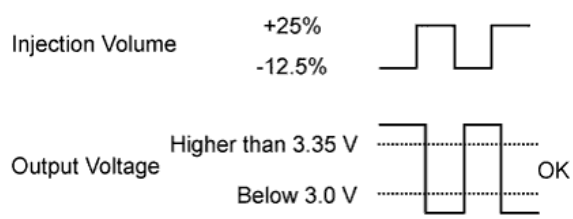
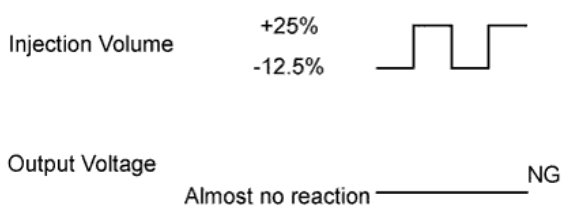
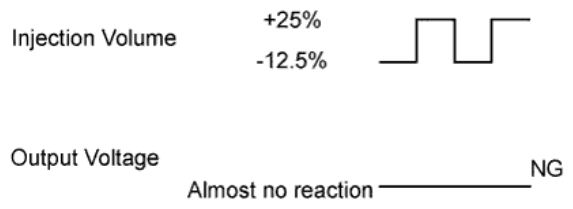
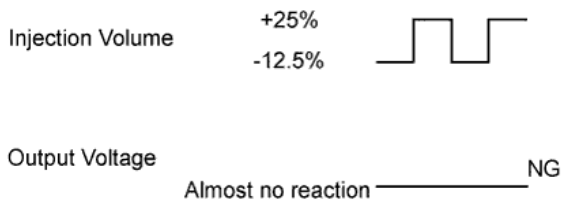
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Display Item (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.

To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the C22 or C23 Air Fuel ratio (A/F) sensor connector.

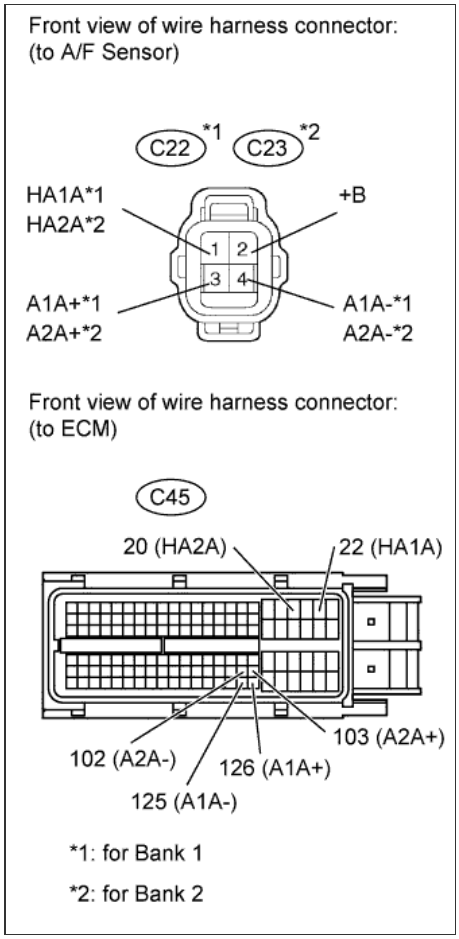
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the C45 ECM connector.



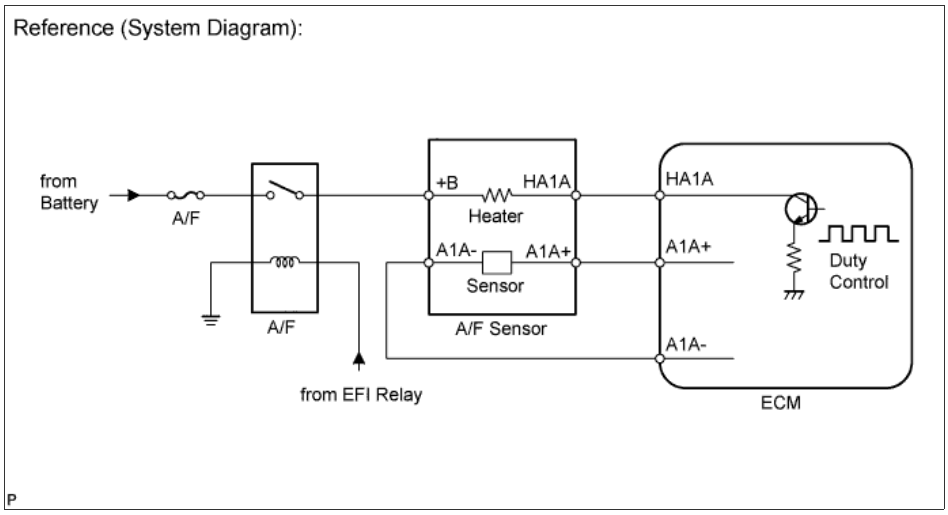
e. Measure the resistance according to the value(s) in the table below.

Standard Resistance

Tester Connection	Condition	Specified Condition

C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45- 126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45- 103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2237, P2238, P2239, P2240, P2241, P2242, P2252, P2253, P2255 or P2256 is output	B

B → REPLACE ECM (**Click here**)

A

END

DTC P0327 Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)

DTC P0328 Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)

DTC P032C Knock Sensor 3 Circuit Low

DTC P032D Knock Sensor 3 Circuit High

DTC P0332 Knock Sensor 2 Circuit Low Input (Bank 2)

DTC P0333 Knock Sensor 2 Circuit High Input (Bank 2)

DTC P033C Knock Sensor 4 Circuit Low Input

DTC P033D Knock Sensor 4 Circuit High Input

for Preparation Click here

DESCRIPTION

A flat type knock sensor (non-resonant type) has a structure that can detect vibrations between approximately 6 kHz and 15 kHz.
Knock sensors are fitted onto the engine block to detect engine knocking.
The knock sensor contains a piezoelectric element which generates a voltage when it becomes deformed.
The voltage is generated when the engine block vibrates due to knocking. Any occurrence of engine knocking can be suppressed by delaying the ignition timing.

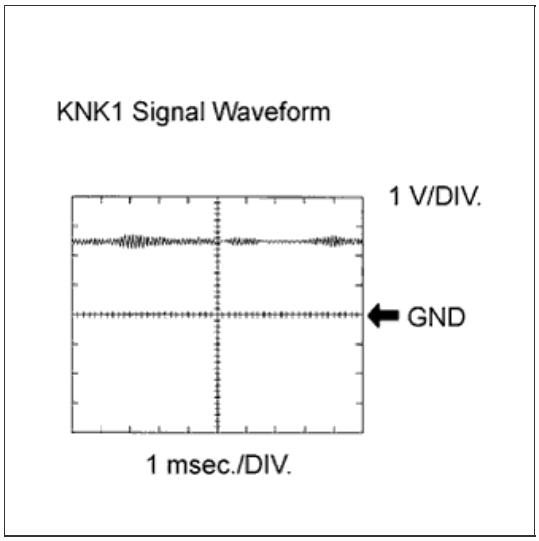
DTC Code	DTC Detection Condition	Trouble Area
P0327	The output voltage of the knock sensor (for Bank 1 Sensor 1) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 1 Sensor 1) circuit • Knock sensor (for Bank 1 Sensor 1) • ECM
P0328	The output voltage of the knock sensor (for Bank 1 Sensor 1) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 1 Sensor 1) circuit • Knock sensor (for Bank 1 Sensor 1) • ECM
P0332	The output voltage of the knock sensor (for Bank 2 Sensor 1) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 2 Sensor1) circuit • Knock sensor (for Bank 2 Sensor 1) • ECM
P0333	The output voltage of the knock sensor (for Bank 2 Sensor 1) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 2 Sensor1) circuit • Knock sensor (for Bank 2 Sensor 1) • ECM
P032C	The output voltage of the knock sensor (for Bank 1 Sensor 2) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 1 Sensor 2) circuit • Knock sensor (for Bank 1 Sensor 2) • ECM
P032D	The output voltage of the knock sensor (for Bank 1 Sensor 2) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 1 Sensor 2) circuit • Knock sensor (for Bank 1 Sensor 2) • ECM
P033C	The output voltage of the knock sensor (for Bank 2 Sensor 2) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 2 Sensor 2) circuit • Knock sensor (for Bank 2 Sensor 2)

		• ECM
P033D	The output voltage of the knock sensor (for Bank 2 Sensor 2) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 2 Sensor 2) circuit • Knock sensor (for Bank 2 Sensor 2) • ECM

HINT:

When any of DTCs P0327, P0328, P0332, P0333, P032C, P032D, P033C and P033D is stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is delayed to its maximum retardation. Fail-safe mode continues until the engine switch is turned off.

Reference: Inspection using an oscilloscope.



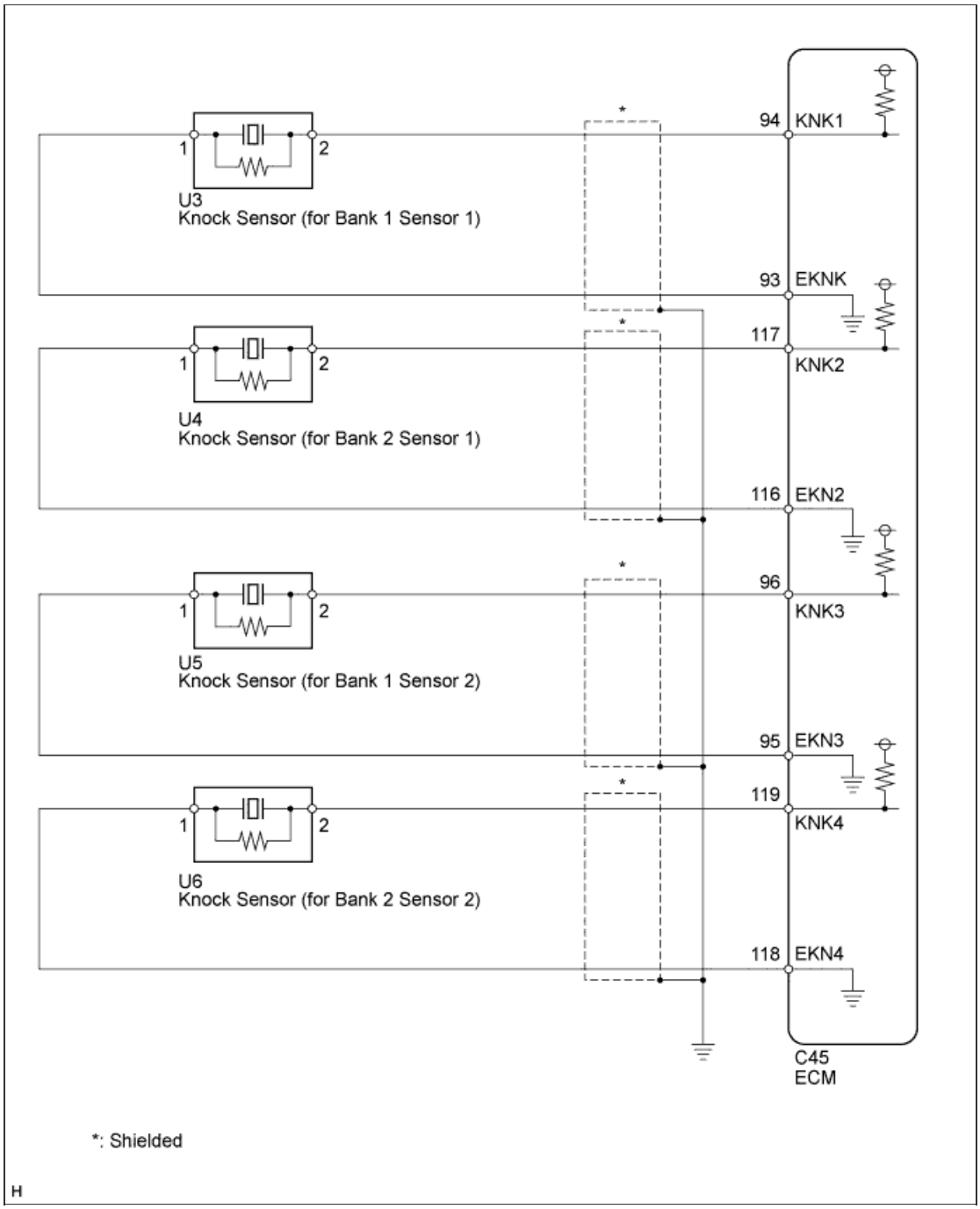
Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-94 (KNK1) - C45-93 (EKNK)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-117 (KNK2) - C45-116 (EKN2)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-96 (KNK3) - C45-95 (EKN3)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-119 (KNK4) - C45-118 (EKN4)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown

MONITOR DESCRIPTION

The knock sensor, located on the cylinder block, detects spark knock. When spark knock occurs, the piezoelectric element of the sensor vibrates. When the ECM detects a voltage in this frequency range, it retards the ignition timing to suppress the spark knock.
The ECM also senses background engine noise with the knock sensor and uses this noise to check for faults in the sensor. If the knock sensor signal level is too low for more than 10 seconds, or if the knock sensor output voltage is outside the normal range, the ECM interprets this as a fault in the knock sensor and stores DTC(s).

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **DTCs P0327 and P0328 are for the bank 1 sensor 1 knock sensor circuit.**
- **DTCs P032C and P032D are for the bank 1 sensor 2 knock sensor circuit.**
- **DTCs P0332 and P0333 are for the bank 2 sensor 1 knock sensor circuit.**
- **DTCs P033C and P033D are for the bank 2 sensor 2 knock sensor circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

1.INSPECT KNOCK SENSOR

a. Disconnect the C45 ECM connector.

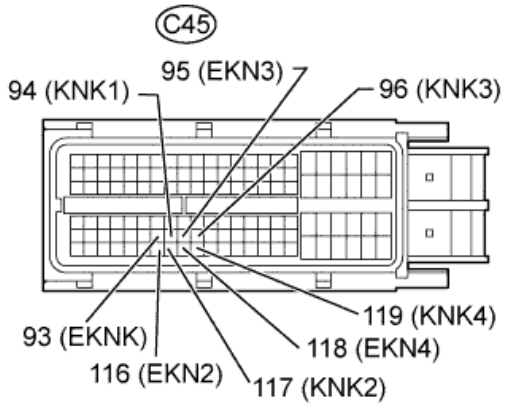
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition

C45-94 (KNK1) - C45-93 (EKNK)	20°C (68°F)	120 to 280 kΩ
C45-117 (KNK2) - C45-116 (EKN2)	20°C (68°F)	120 to 280 kΩ
C45-96 (KNK3) - C45-95 (EKN3)	20°C (68°F)	120 to 280 kΩ
C45-119 (KNK4) - C45-118 (EKN4)	20°C (68°F)	120 to 280 kΩ

Front view of wire harness connector:
(to ECM)



Result

Result	Proceed to
NG	A
OK	B

B → Go to step 3

A

2.CHECK HARNESS AND CONNECTOR (ECM - KNOCK SENSOR)

a. Disconnect the C45 ECM connector.

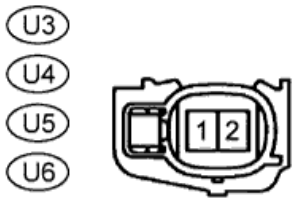
b. Disconnect the U3, U4, U5 or U6 knock sensor connector.

c. Measure the resistance according to the value(s) in the table below.

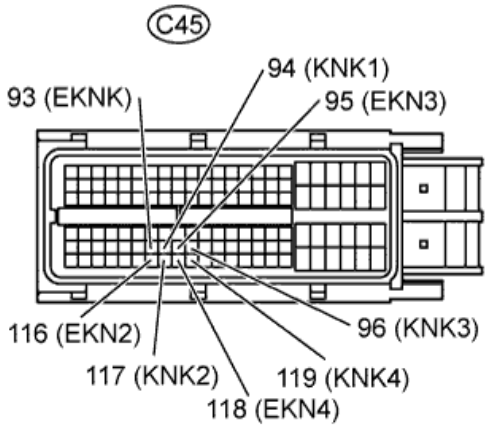
Standard Resistance:

Tester Connection	Condition	Specified Condition
U3-2 - C45-94 (KNK1)	Always	Below 1 Ω
U3-1 - C45-93 (EKNK)	Always	Below 1 Ω
U4-2 - C45-117 (KNK2)	Always	Below 1 Ω
U4-1 - C45-116 (EKN2)	Always	Below 1 Ω
U5-2 - C45-96 (KNK3)	Always	Below 1 Ω
U5-1 - C45-95 (EKN3)	Always	Below 1 Ω
U6-2 - C45-119 (KNK4)	Always	Below 1 Ω
U6-1 - C45-118 (EKN4)	Always	Below 1 Ω
U3-2 or C45-94 (KNK1) - Body ground	Always	10 kΩ or higher
U3-1 or C45-93 (EKNK) - Body ground	Always	10 kΩ or higher
U4-2 or C45-117 (KNK2) - Body ground	Always	10 kΩ or higher
U4-1 or C45-116 (EKN2) - Body ground	Always	10 kΩ or higher
U5-2 or C45-96		

Front view of wire harness connector:
(to Knock Sensor)



Front view of wire harness connector:
(to ECM)



(KNK3) - Body ground	Always	10 kΩ or higher
U5-1 or C45-95 (EKN3) - Body ground	Always	10 kΩ or higher
U6-2 or C45-119 (KNK4) - Body ground	Always	10 kΩ or higher
U6-1 or C45-118 (EKN4) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE KNOCK SENSOR (Click here)

3.INSPECT ECM

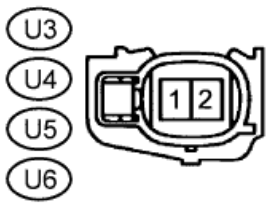
a. Disconnect the U3, U4, U5 or U6 knock sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
1 - 2	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to Knock Sensor)



NG → REPLACE ECM (Click here)

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

for Preparation Click here

DESCRIPTION

Refer to DTC P0031 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals A1A+ and A1A-/A2A+ and A2A- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in Air Fuel ratio (A/F) sensor (for Bank 1, 2 Sensor 1) circuit • Air Fuel ratio (A/F) sensor (for Bank 1, 2 Sensor 1) • ECM
P2238 P2241	• Case 1: Condition (a) or (b) continues for 5.0 seconds or more (1 trip detection logic): (a) The A1A+/A2A+ voltage is 0.5 V or less. (b) (A1A+/A2A+) - (A1A-/A2A-) = 0.1 V or less. • Case 2: The A/F sensor admittance is below 0.022 1/Ω (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2239 P2242	The A1A+/A2A+ voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2252 P2255	The A1A-/A2A- voltage is 0.5 V or less for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2253 P2256	The A1A-/A2A- voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM

HINT:

- **DTCs P2237, P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2240, P2241, P2242, P2255 and P2256 indicate malfunctions related to the bank 2 A/F sensor circuit.**

MONITOR DESCRIPTION

These DTCs are stored when there is an open or short in the A/F sensor circuit, or if A/F sensor output drops.
To detect these problems, the voltage of the A/F sensor is monitored when turning the engine switch on (IG), and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is outside of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in the next driving cycle, the MIL is illuminated and a DTC is stored.
The Air Fuel ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. If the A/F sensor impedance (alternating current resistance) or output voltage deviates greatly from the standard range, the ECM determines that there is an open or short in the A/F sensor circuit.

WIRING DIAGRAM

Refer to DTC P0031 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

(a) Connect the tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.
(e) Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.

HINT:

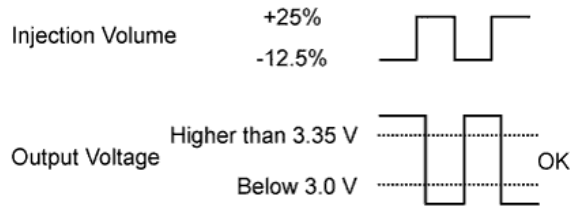
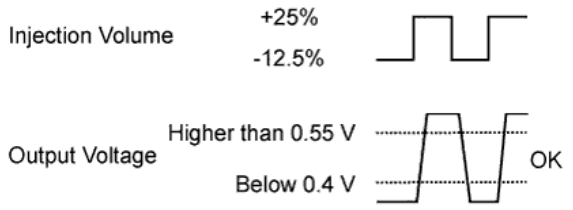
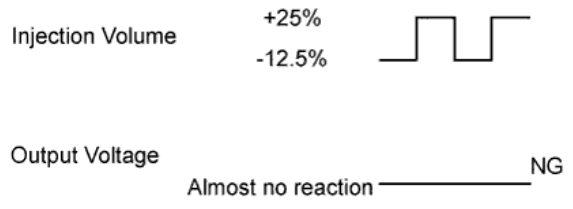
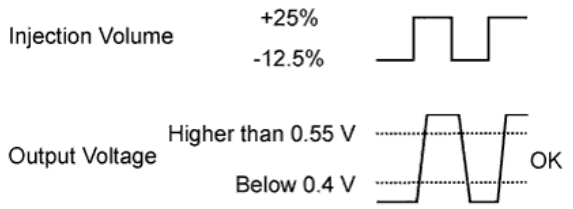
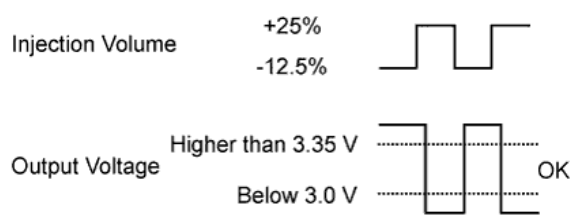
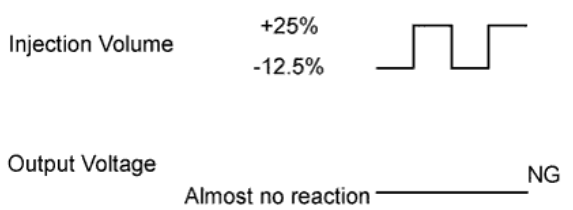
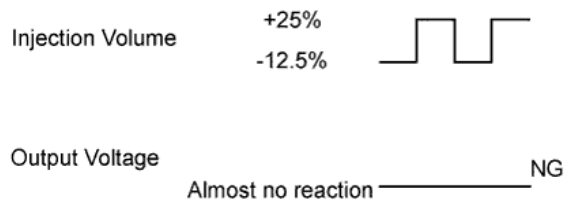
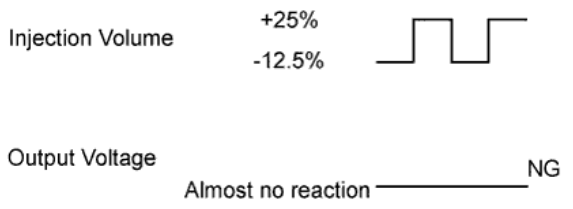
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Display Item (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.

To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the C22 or C23 Air Fuel ratio (A/F) sensor connector.

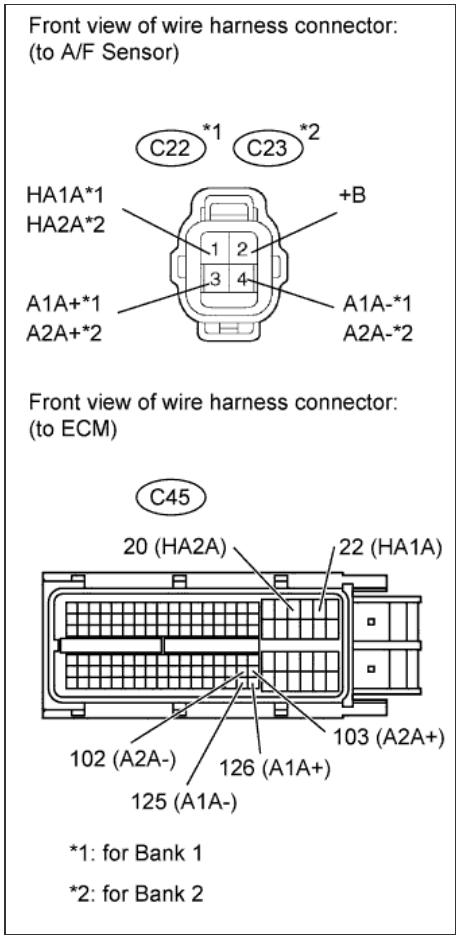
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the C45 ECM connector.



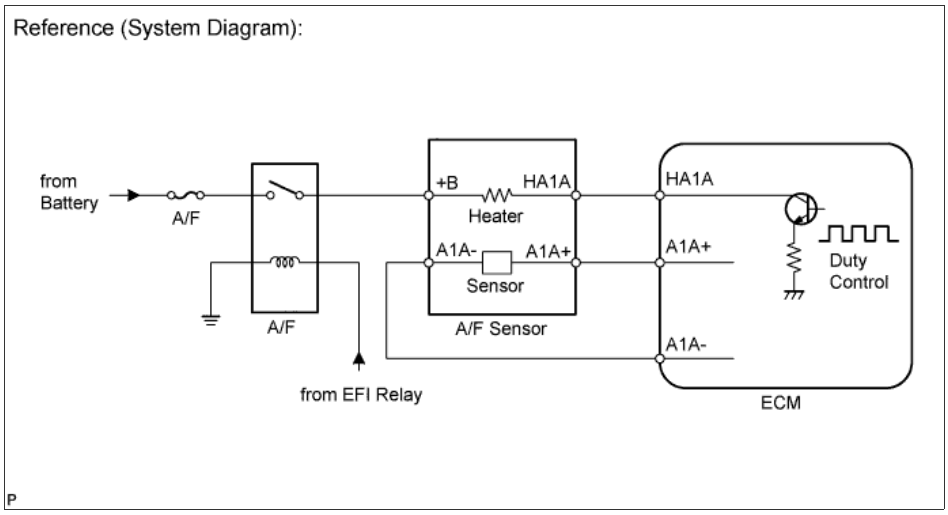
e. Measure the resistance according to the value(s) in the table below.

Standard Resistance

Tester Connection	Condition	Specified Condition

C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45- 126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45- 103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2237, P2238, P2239, P2240, P2241, P2242, P2252, P2253, P2255 or P2256 is output	B

B → REPLACE ECM (**Click here**)

A

END

DTC P0327 Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)

DTC P0328 Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)

DTC P032C Knock Sensor 3 Circuit Low

DTC P032D Knock Sensor 3 Circuit High

DTC P0332 Knock Sensor 2 Circuit Low Input (Bank 2)

DTC P0333 Knock Sensor 2 Circuit High Input (Bank 2)

DTC P033C Knock Sensor 4 Circuit Low Input

DTC P033D Knock Sensor 4 Circuit High Input

for Preparation Click here

DESCRIPTION

A flat type knock sensor (non-resonant type) has a structure that can detect vibrations between approximately 6 kHz and 15 kHz.
Knock sensors are fitted onto the engine block to detect engine knocking.
The knock sensor contains a piezoelectric element which generates a voltage when it becomes deformed.
The voltage is generated when the engine block vibrates due to knocking. Any occurrence of engine knocking can be suppressed by delaying the ignition timing.

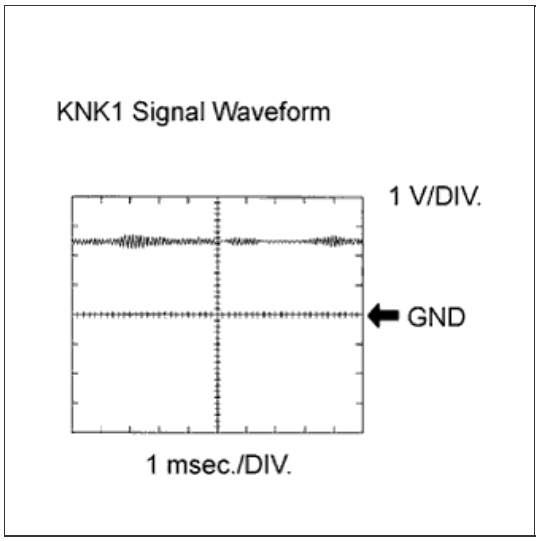
DTC Code	DTC Detection Condition	Trouble Area
P0327	The output voltage of the knock sensor (for Bank 1 Sensor 1) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 1 Sensor 1) circuit • Knock sensor (for Bank 1 Sensor 1) • ECM
P0328	The output voltage of the knock sensor (for Bank 1 Sensor 1) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 1 Sensor 1) circuit • Knock sensor (for Bank 1 Sensor 1) • ECM
P0332	The output voltage of the knock sensor (for Bank 2 Sensor 1) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 2 Sensor1) circuit • Knock sensor (for Bank 2 Sensor 1) • ECM
P0333	The output voltage of the knock sensor (for Bank 2 Sensor 1) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 2 Sensor1) circuit • Knock sensor (for Bank 2 Sensor 1) • ECM
P032C	The output voltage of the knock sensor (for Bank 1 Sensor 2) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 1 Sensor 2) circuit • Knock sensor (for Bank 1 Sensor 2) • ECM
P032D	The output voltage of the knock sensor (for Bank 1 Sensor 2) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 1 Sensor 2) circuit • Knock sensor (for Bank 1 Sensor 2) • ECM
P033C	The output voltage of the knock sensor (for Bank 2 Sensor 2) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 2 Sensor 2) circuit • Knock sensor (for Bank 2 Sensor 2)

		• ECM
P033D	The output voltage of the knock sensor (for Bank 2 Sensor 2) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 2 Sensor 2) circuit • Knock sensor (for Bank 2 Sensor 2) • ECM

HINT:

When any of DTCs P0327, P0328, P0332, P0333, P032C, P032D, P033C and P033D is stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is delayed to its maximum retardation. Fail-safe mode continues until the engine switch is turned off.

Reference: Inspection using an oscilloscope.



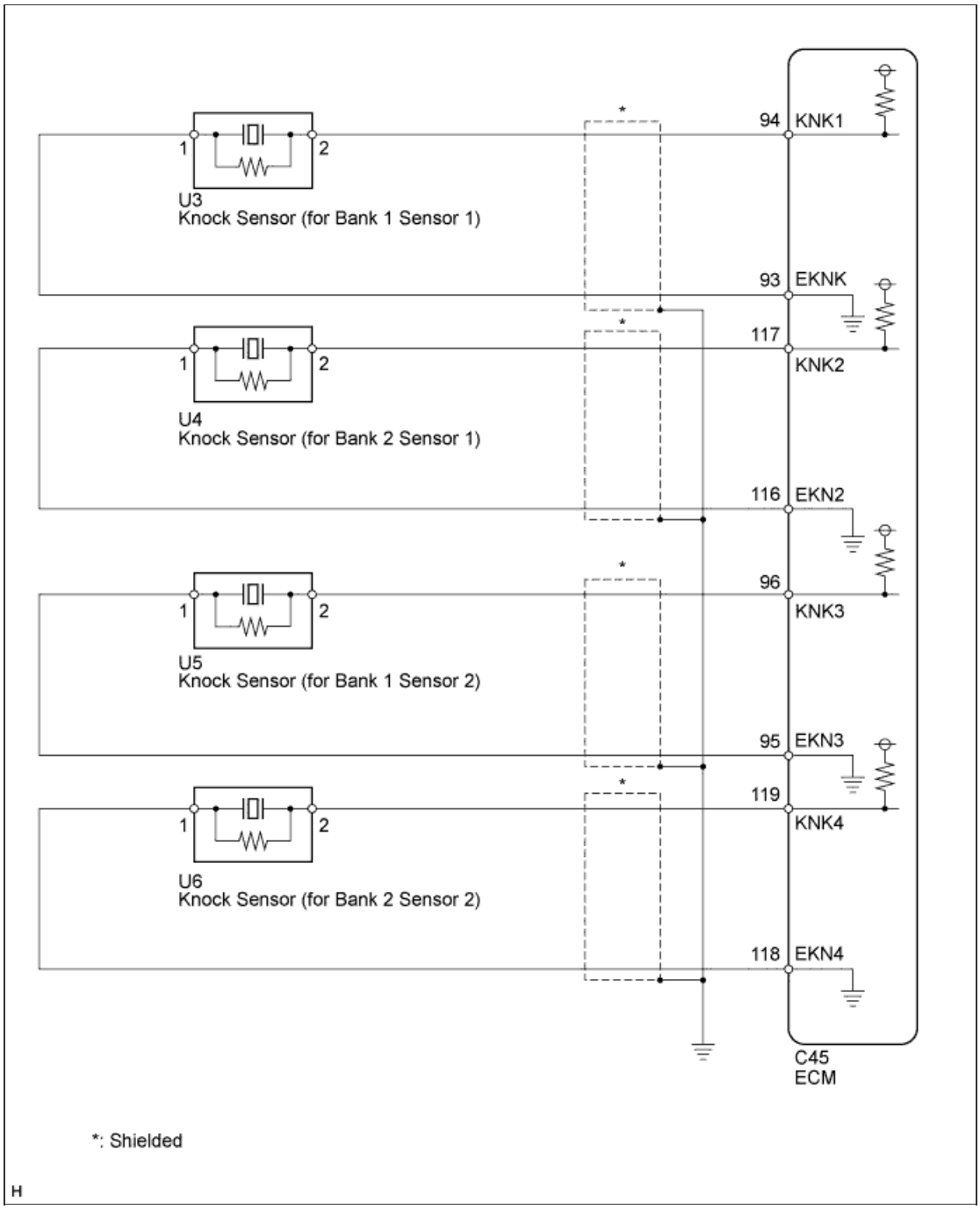
Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-94 (KNK1) - C45-93 (EKNK)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-117 (KNK2) - C45-116 (EKN2)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-96 (KNK3) - C45-95 (EKN3)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-119 (KNK4) - C45-118 (EKN4)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown

MONITOR DESCRIPTION

The knock sensor, located on the cylinder block, detects spark knock. When spark knock occurs, the piezoelectric element of the sensor vibrates. When the ECM detects a voltage in this frequency range, it retards the ignition timing to suppress the spark knock.
The ECM also senses background engine noise with the knock sensor and uses this noise to check for faults in the sensor. If the knock sensor signal level is too low for more than 10 seconds, or if the knock sensor output voltage is outside the normal range, the ECM interprets this as a fault in the knock sensor and stores DTC(s).

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **DTCs P0327 and P0328 are for the bank 1 sensor 1 knock sensor circuit.**
- **DTCs P032C and P032D are for the bank 1 sensor 2 knock sensor circuit.**
- **DTCs P0332 and P0333 are for the bank 2 sensor 1 knock sensor circuit.**
- **DTCs P033C and P033D are for the bank 2 sensor 2 knock sensor circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

1.INSPECT KNOCK SENSOR

a. Disconnect the C45 ECM connector.

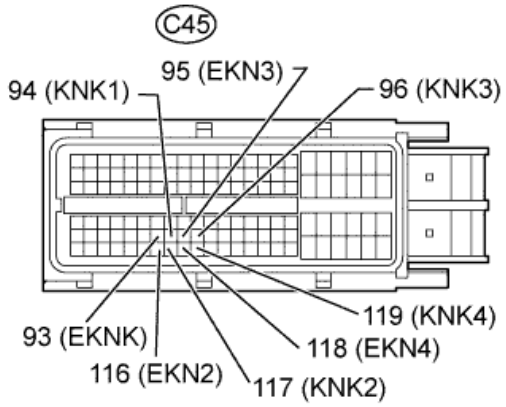
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition

C45-94 (KNK1) - C45-93 (EKNK)	20°C (68°F)	120 to 280 kΩ
C45-117 (KNK2) - C45-116 (EKN2)	20°C (68°F)	120 to 280 kΩ
C45-96 (KNK3) - C45-95 (EKN3)	20°C (68°F)	120 to 280 kΩ
C45-119 (KNK4) - C45-118 (EKN4)	20°C (68°F)	120 to 280 kΩ

Front view of wire harness connector:
(to ECM)



Result

Result	Proceed to
NG	A
OK	B

B → Go to step 3

A

2.CHECK HARNESS AND CONNECTOR (ECM - KNOCK SENSOR)

a. Disconnect the C45 ECM connector.

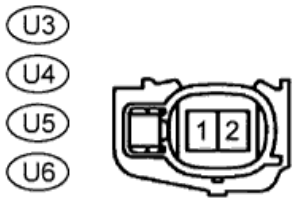
b. Disconnect the U3, U4, U5 or U6 knock sensor connector.

c. Measure the resistance according to the value(s) in the table below.

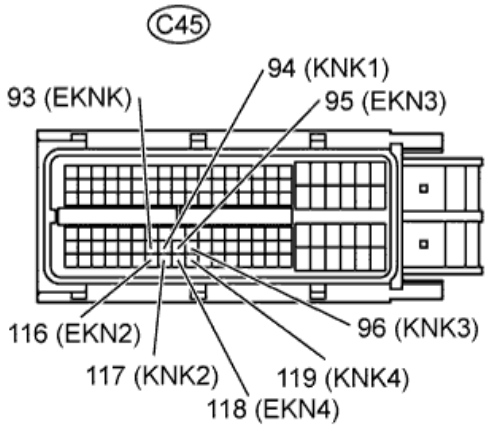
Standard Resistance:

Tester Connection	Condition	Specified Condition
U3-2 - C45-94 (KNK1)	Always	Below 1 Ω
U3-1 - C45-93 (EKNK)	Always	Below 1 Ω
U4-2 - C45-117 (KNK2)	Always	Below 1 Ω
U4-1 - C45-116 (EKN2)	Always	Below 1 Ω
U5-2 - C45-96 (KNK3)	Always	Below 1 Ω
U5-1 - C45-95 (EKN3)	Always	Below 1 Ω
U6-2 - C45-119 (KNK4)	Always	Below 1 Ω
U6-1 - C45-118 (EKN4)	Always	Below 1 Ω
U3-2 or C45-94 (KNK1) - Body ground	Always	10 kΩ or higher
U3-1 or C45-93 (EKNK) - Body ground	Always	10 kΩ or higher
U4-2 or C45-117 (KNK2) - Body ground	Always	10 kΩ or higher
U4-1 or C45-116 (EKN2) - Body ground	Always	10 kΩ or higher
U5-2 or C45-96		

Front view of wire harness connector:
(to Knock Sensor)



Front view of wire harness connector:
(to ECM)



(KNK3) - Body ground	Always	10 kΩ or higher
U5-1 or C45-95 (EKN3) - Body ground	Always	10 kΩ or higher
U6-2 or C45-119 (KNK4) - Body ground	Always	10 kΩ or higher
U6-1 or C45-118 (EKN4) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE KNOCK SENSOR (Click here)

3.INSPECT ECM

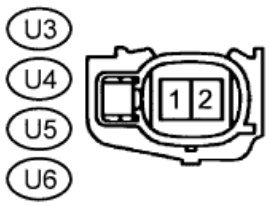
a. Disconnect the U3, U4, U5 or U6 knock sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
1 - 2	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to Knock Sensor)



NG → REPLACE ECM (Click here)

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

for Preparation Click here

DESCRIPTION

Refer to DTC P0031 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals A1A+ and A1A-/A2A+ and A2A- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in Air Fuel ratio (A/F) sensor (for Bank 1, 2 Sensor 1) circuit • Air Fuel ratio (A/F) sensor (for Bank 1, 2 Sensor 1) • ECM
P2238 P2241	• Case 1: Condition (a) or (b) continues for 5.0 seconds or more (1 trip detection logic): (a) The A1A+/A2A+ voltage is 0.5 V or less. (b) (A1A+/A2A+) - (A1A-/A2A-) = 0.1 V or less. • Case 2: The A/F sensor admittance is below 0.022 1/Ω (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2239 P2242	The A1A+/A2A+ voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2252 P2255	The A1A-/A2A- voltage is 0.5 V or less for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2253 P2256	The A1A-/A2A- voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM

HINT:

- **DTCs P2237, P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2240, P2241, P2242, P2255 and P2256 indicate malfunctions related to the bank 2 A/F sensor circuit.**

MONITOR DESCRIPTION

These DTCs are stored when there is an open or short in the A/F sensor circuit, or if A/F sensor output drops.
To detect these problems, the voltage of the A/F sensor is monitored when turning the engine switch on (IG), and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is outside of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in the next driving cycle, the MIL is illuminated and a DTC is stored.
The Air Fuel ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. If the A/F sensor impedance (alternating current resistance) or output voltage deviates greatly from the standard range, the ECM determines that there is an open or short in the A/F sensor circuit.

WIRING DIAGRAM

Refer to DTC P0031 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

(a) Connect the tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.
(e) Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.

HINT:

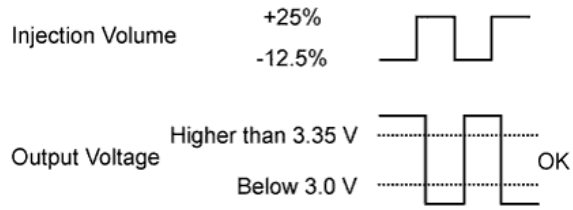
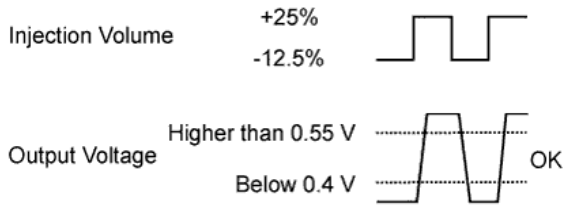
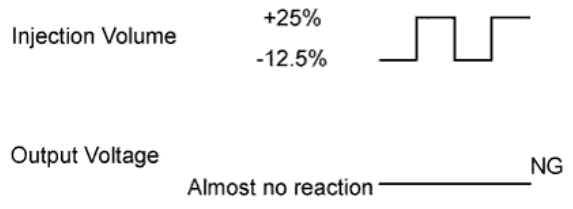
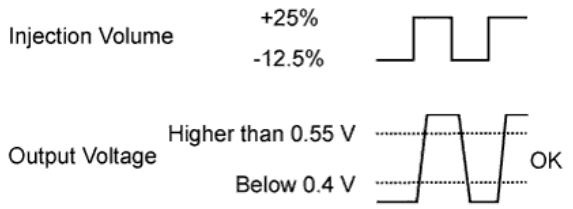
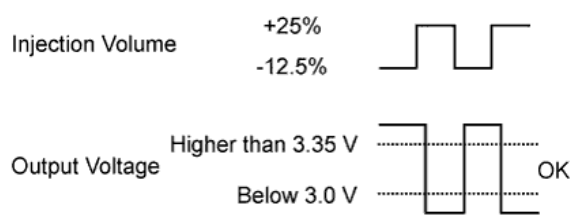
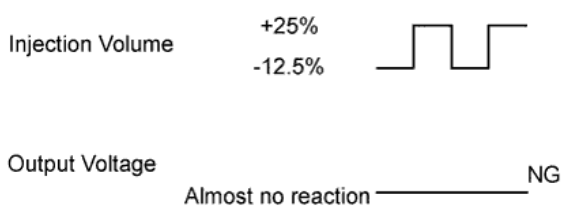
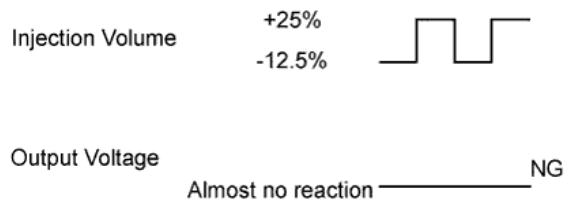
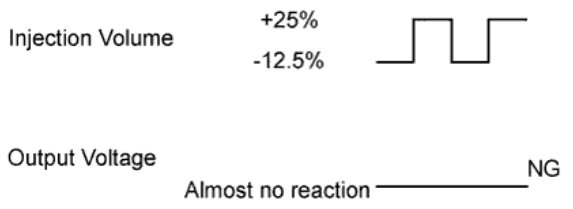
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Display Item (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.

To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the C22 or C23 Air Fuel ratio (A/F) sensor connector.

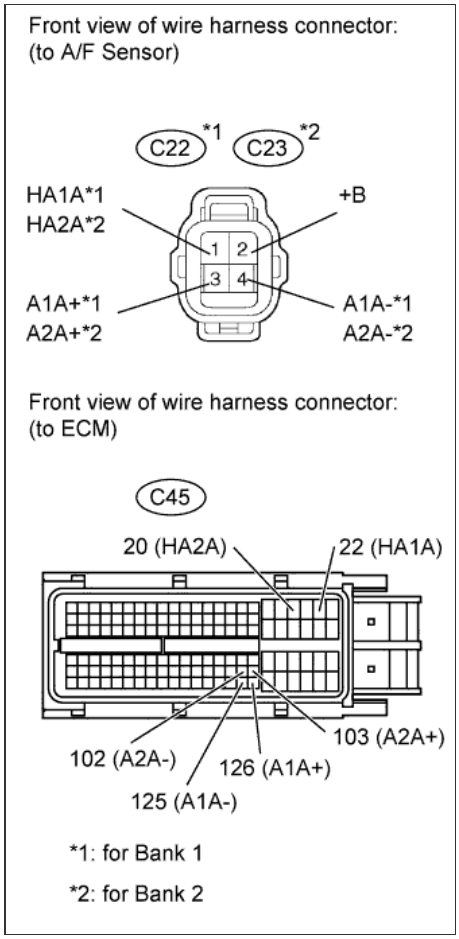
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the C45 ECM connector.



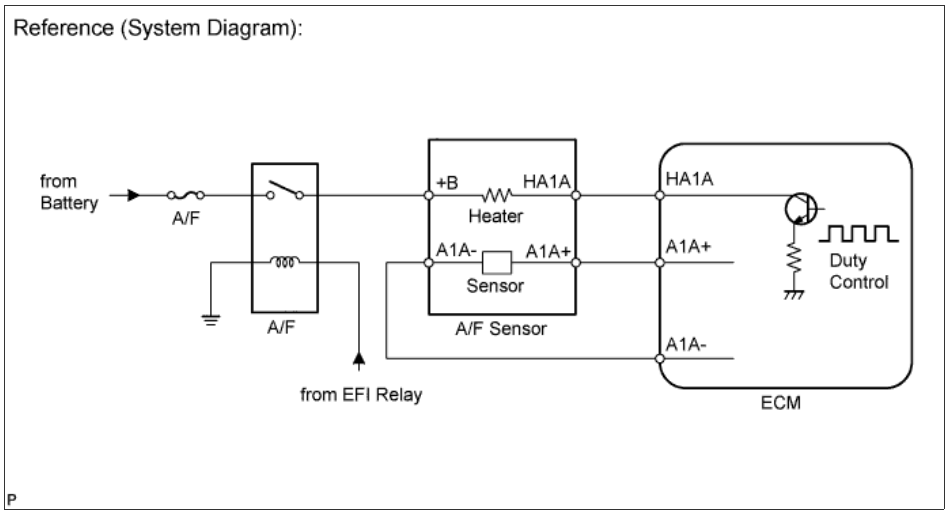
e. Measure the resistance according to the value(s) in the table below.

Standard Resistance

Tester Connection	Condition	Specified Condition

C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45- 126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45- 103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2237, P2238, P2239, P2240, P2241, P2242, P2252, P2253, P2255 or P2256 is output	B

B → REPLACE ECM (**Click here**)

A

END

DTC P0327 Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)

DTC P0328 Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)

DTC P032C Knock Sensor 3 Circuit Low

DTC P032D Knock Sensor 3 Circuit High

DTC P0332 Knock Sensor 2 Circuit Low Input (Bank 2)

DTC P0333 Knock Sensor 2 Circuit High Input (Bank 2)

DTC P033C Knock Sensor 4 Circuit Low Input

DTC P033D Knock Sensor 4 Circuit High Input

for Preparation Click here

DESCRIPTION

A flat type knock sensor (non-resonant type) has a structure that can detect vibrations between approximately 6 kHz and 15 kHz.
Knock sensors are fitted onto the engine block to detect engine knocking.
The knock sensor contains a piezoelectric element which generates a voltage when it becomes deformed.
The voltage is generated when the engine block vibrates due to knocking. Any occurrence of engine knocking can be suppressed by delaying the ignition timing.

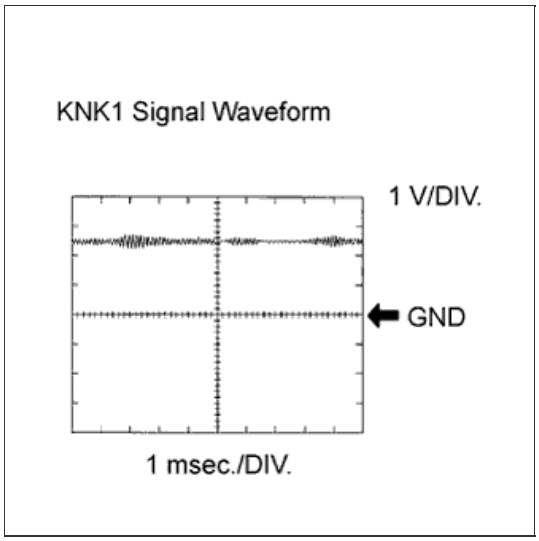
DTC Code	DTC Detection Condition	Trouble Area
P0327	The output voltage of the knock sensor (for Bank 1 Sensor 1) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 1 Sensor 1) circuit • Knock sensor (for Bank 1 Sensor 1) • ECM
P0328	The output voltage of the knock sensor (for Bank 1 Sensor 1) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 1 Sensor 1) circuit • Knock sensor (for Bank 1 Sensor 1) • ECM
P0332	The output voltage of the knock sensor (for Bank 2 Sensor 1) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 2 Sensor1) circuit • Knock sensor (for Bank 2 Sensor 1) • ECM
P0333	The output voltage of the knock sensor (for Bank 2 Sensor 1) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 2 Sensor1) circuit • Knock sensor (for Bank 2 Sensor 1) • ECM
P032C	The output voltage of the knock sensor (for Bank 1 Sensor 2) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 1 Sensor 2) circuit • Knock sensor (for Bank 1 Sensor 2) • ECM
P032D	The output voltage of the knock sensor (for Bank 1 Sensor 2) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 1 Sensor 2) circuit • Knock sensor (for Bank 1 Sensor 2) • ECM
P033C	The output voltage of the knock sensor (for Bank 2 Sensor 2) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 2 Sensor 2) circuit • Knock sensor (for Bank 2 Sensor 2)

		• ECM
P033D	The output voltage of the knock sensor (for Bank 2 Sensor 2) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 2 Sensor 2) circuit • Knock sensor (for Bank 2 Sensor 2) • ECM

HINT:

When any of DTCs P0327, P0328, P0332, P0333, P032C, P032D, P033C and P033D is stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is delayed to its maximum retardation. Fail-safe mode continues until the engine switch is turned off.

Reference: Inspection using an oscilloscope.



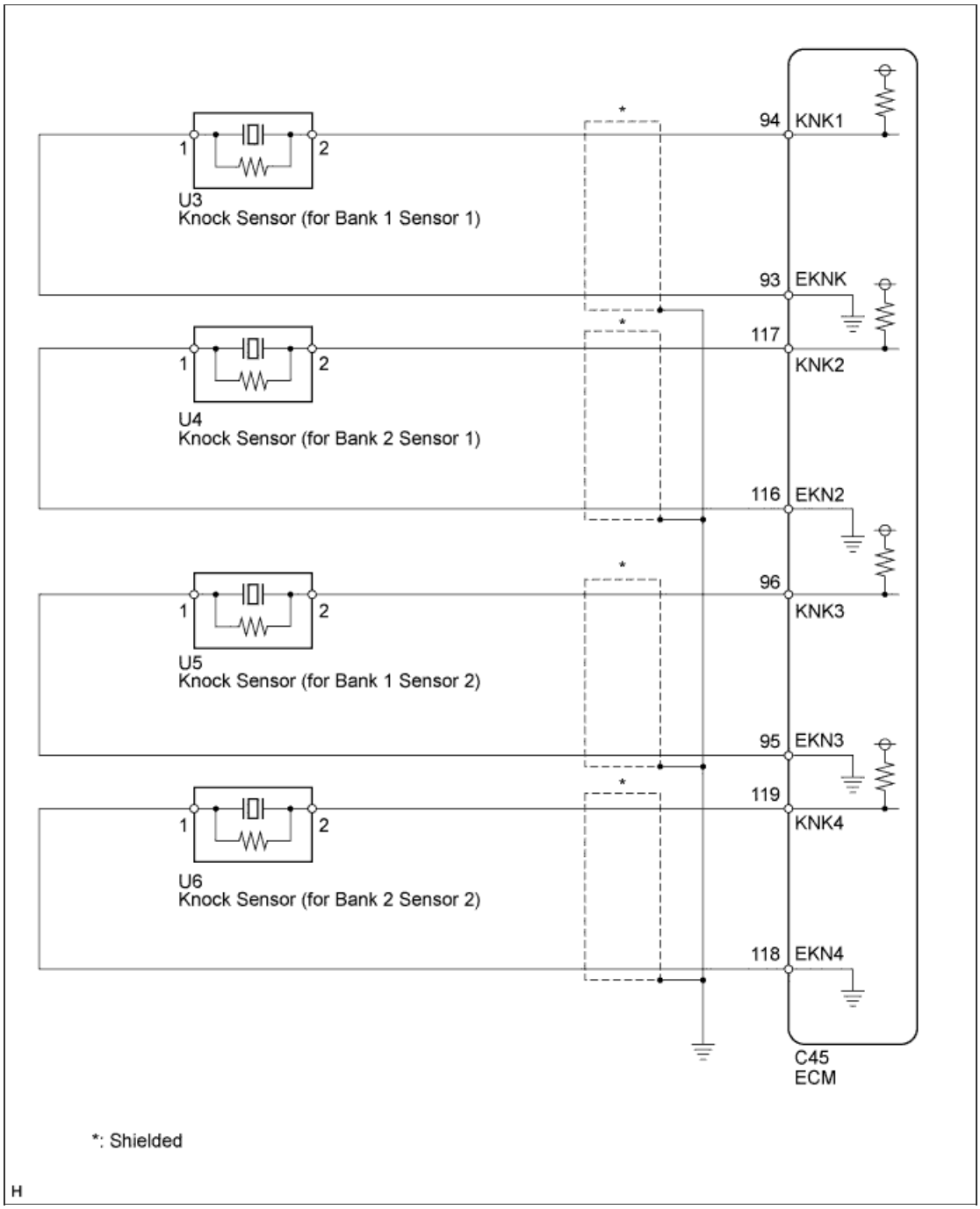
Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-94 (KNK1) - C45-93 (EKNK)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-117 (KNK2) - C45-116 (EKN2)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-96 (KNK3) - C45-95 (EKN3)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-119 (KNK4) - C45-118 (EKN4)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown

MONITOR DESCRIPTION

The knock sensor, located on the cylinder block, detects spark knock. When spark knock occurs, the piezoelectric element of the sensor vibrates. When the ECM detects a voltage in this frequency range, it retards the ignition timing to suppress the spark knock.
The ECM also senses background engine noise with the knock sensor and uses this noise to check for faults in the sensor. If the knock sensor signal level is too low for more than 10 seconds, or if the knock sensor output voltage is outside the normal range, the ECM interprets this as a fault in the knock sensor and stores DTC(s).

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **DTCs P0327 and P0328 are for the bank 1 sensor 1 knock sensor circuit.**
- **DTCs P032C and P032D are for the bank 1 sensor 2 knock sensor circuit.**
- **DTCs P0332 and P0333 are for the bank 2 sensor 1 knock sensor circuit.**
- **DTCs P033C and P033D are for the bank 2 sensor 2 knock sensor circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

1.INSPECT KNOCK SENSOR

a. Disconnect the C45 ECM connector.

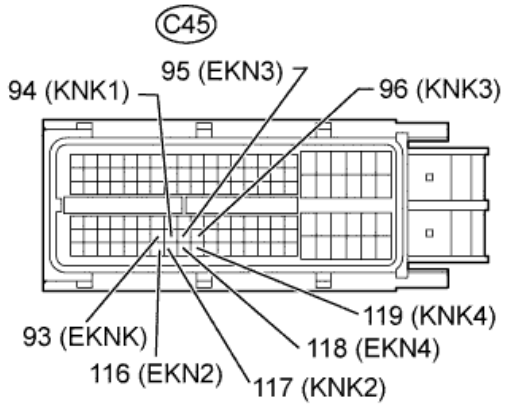
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition

C45-94 (KNK1) - C45-93 (EKNK)	20°C (68°F)	120 to 280 kΩ
C45-117 (KNK2) - C45-116 (EKN2)	20°C (68°F)	120 to 280 kΩ
C45-96 (KNK3) - C45-95 (EKN3)	20°C (68°F)	120 to 280 kΩ
C45-119 (KNK4) - C45-118 (EKN4)	20°C (68°F)	120 to 280 kΩ

Front view of wire harness connector:
(to ECM)



Result

Result	Proceed to
NG	A
OK	B

B → Go to step 3

A

2.CHECK HARNESS AND CONNECTOR (ECM - KNOCK SENSOR)

a. Disconnect the C45 ECM connector.

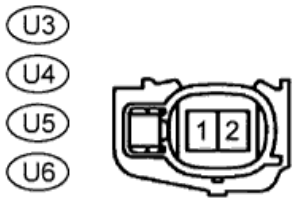
b. Disconnect the U3, U4, U5 or U6 knock sensor connector.

c. Measure the resistance according to the value(s) in the table below.

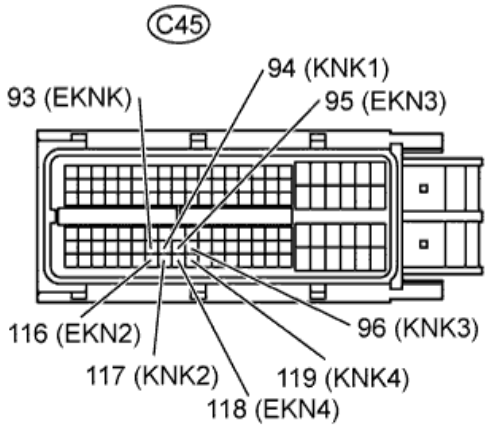
Standard Resistance:

Tester Connection	Condition	Specified Condition
U3-2 - C45-94 (KNK1)	Always	Below 1 Ω
U3-1 - C45-93 (EKNK)	Always	Below 1 Ω
U4-2 - C45-117 (KNK2)	Always	Below 1 Ω
U4-1 - C45-116 (EKN2)	Always	Below 1 Ω
U5-2 - C45-96 (KNK3)	Always	Below 1 Ω
U5-1 - C45-95 (EKN3)	Always	Below 1 Ω
U6-2 - C45-119 (KNK4)	Always	Below 1 Ω
U6-1 - C45-118 (EKN4)	Always	Below 1 Ω
U3-2 or C45-94 (KNK1) - Body ground	Always	10 kΩ or higher
U3-1 or C45-93 (EKNK) - Body ground	Always	10 kΩ or higher
U4-2 or C45-117 (KNK2) - Body ground	Always	10 kΩ or higher
U4-1 or C45-116 (EKN2) - Body ground	Always	10 kΩ or higher
U5-2 or C45-96		

Front view of wire harness connector:
(to Knock Sensor)



Front view of wire harness connector:
(to ECM)



(KNK3) - Body ground	Always	10 kΩ or higher
U5-1 or C45-95 (EKN3) - Body ground	Always	10 kΩ or higher
U6-2 or C45-119 (KNK4) - Body ground	Always	10 kΩ or higher
U6-1 or C45-118 (EKN4) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE KNOCK SENSOR (Click here)

3.INSPECT ECM

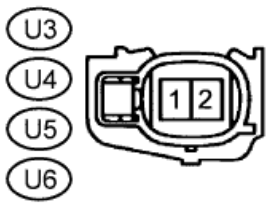
a. Disconnect the U3, U4, U5 or U6 knock sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
1 - 2	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to Knock Sensor)



NG → REPLACE ECM (Click here)

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

for Preparation Click here

DESCRIPTION

Refer to DTC P0031 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals A1A+ and A1A-/A2A+ and A2A- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in Air Fuel ratio (A/F) sensor (for Bank 1, 2 Sensor 1) circuit • Air Fuel ratio (A/F) sensor (for Bank 1, 2 Sensor 1) • ECM
P2238 P2241	• Case 1: Condition (a) or (b) continues for 5.0 seconds or more (1 trip detection logic): (a) The A1A+/A2A+ voltage is 0.5 V or less. (b) (A1A+/A2A+) - (A1A-/A2A-) = 0.1 V or less. • Case 2: The A/F sensor admittance is below 0.022 1/Ω (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2239 P2242	The A1A+/A2A+ voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2252 P2255	The A1A-/A2A- voltage is 0.5 V or less for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2253 P2256	The A1A-/A2A- voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM

HINT:

- **DTCs P2237, P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2240, P2241, P2242, P2255 and P2256 indicate malfunctions related to the bank 2 A/F sensor circuit.**

MONITOR DESCRIPTION

These DTCs are stored when there is an open or short in the A/F sensor circuit, or if A/F sensor output drops.
To detect these problems, the voltage of the A/F sensor is monitored when turning the engine switch on (IG), and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is outside of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in the next driving cycle, the MIL is illuminated and a DTC is stored.
The Air Fuel ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. If the A/F sensor impedance (alternating current resistance) or output voltage deviates greatly from the standard range, the ECM determines that there is an open or short in the A/F sensor circuit.

WIRING DIAGRAM

Refer to DTC P0031 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

(a) Connect the tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.
(e) Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.

HINT:

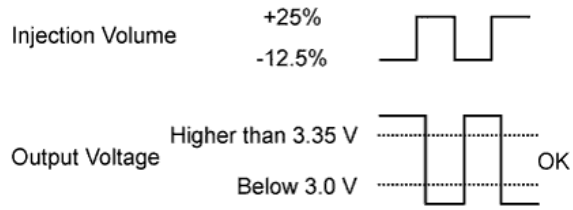
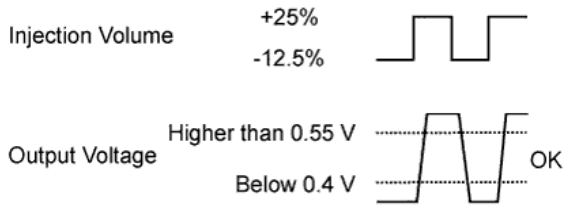
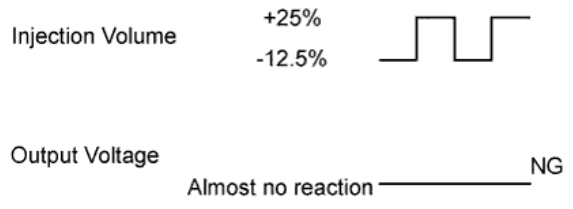
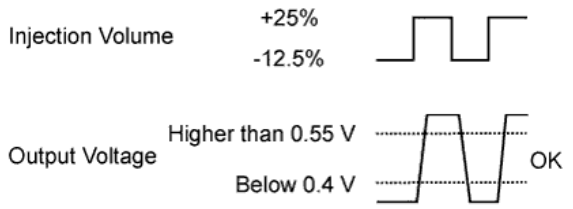
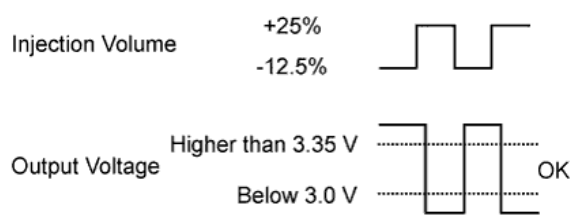
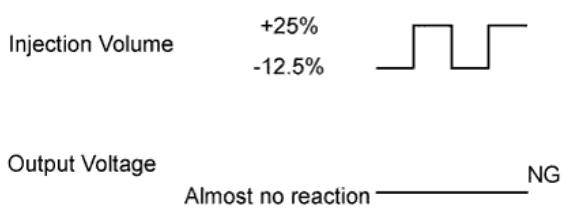
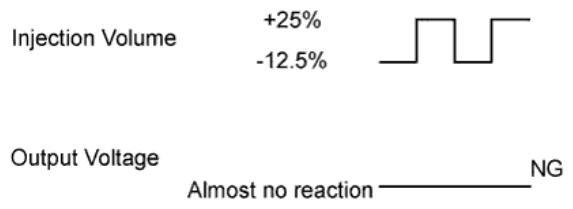
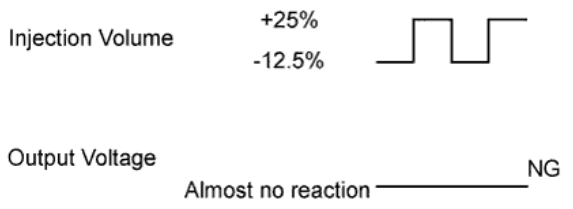
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Display Item (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.

To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the C22 or C23 Air Fuel ratio (A/F) sensor connector.

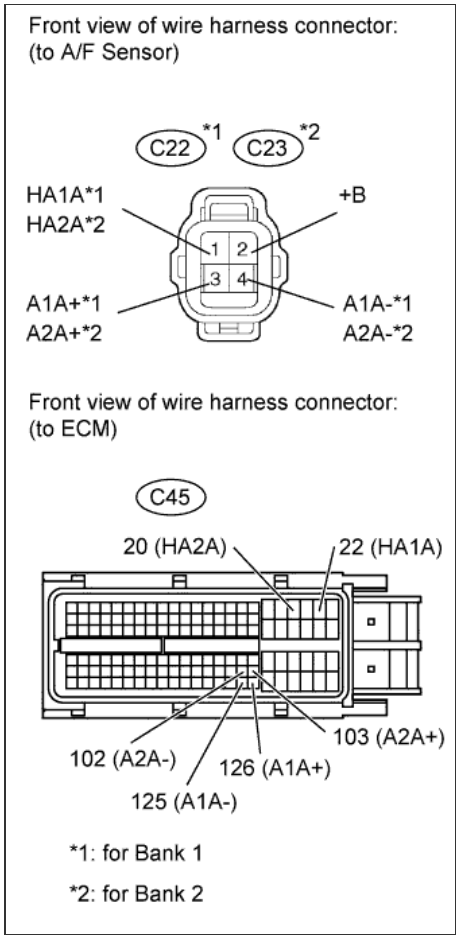
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the C45 ECM connector.



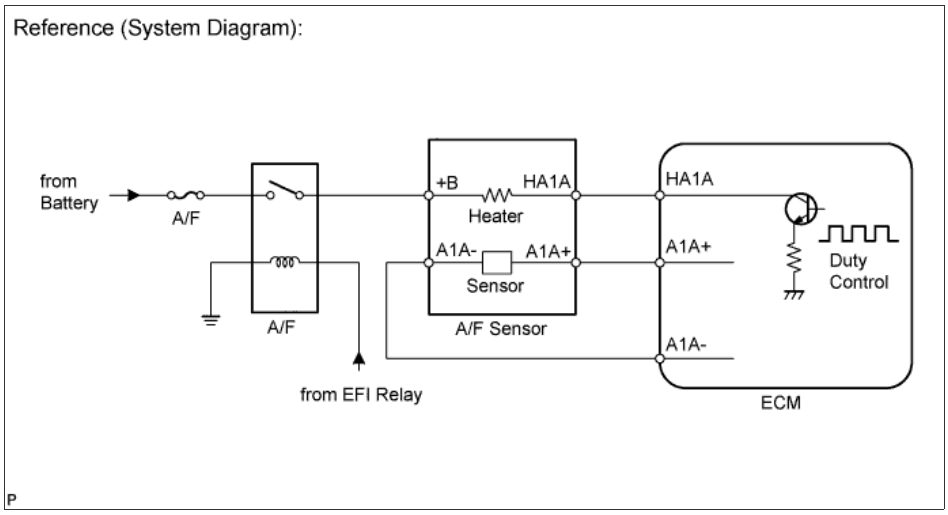
e. Measure the resistance according to the value(s) in the table below.

Standard Resistance

Tester Connection	Condition	Specified Condition

C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45- 126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45- 103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2237, P2238, P2239, P2240, P2241, P2242, P2252, P2253, P2255 or P2256 is output	B

B → REPLACE ECM (**Click here**)

A

END

DTC P0327 Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)

DTC P0328 Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)

DTC P032C Knock Sensor 3 Circuit Low

DTC P032D Knock Sensor 3 Circuit High

DTC P0332 Knock Sensor 2 Circuit Low Input (Bank 2)

DTC P0333 Knock Sensor 2 Circuit High Input (Bank 2)

DTC P033C Knock Sensor 4 Circuit Low Input

DTC P033D Knock Sensor 4 Circuit High Input

for Preparation Click here

DESCRIPTION

A flat type knock sensor (non-resonant type) has a structure that can detect vibrations between approximately 6 kHz and 15 kHz.
Knock sensors are fitted onto the engine block to detect engine knocking.
The knock sensor contains a piezoelectric element which generates a voltage when it becomes deformed.
The voltage is generated when the engine block vibrates due to knocking. Any occurrence of engine knocking can be suppressed by delaying the ignition timing.

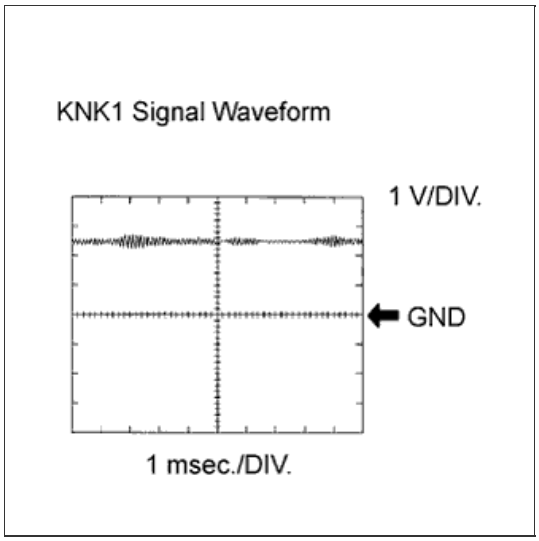
DTC Code	DTC Detection Condition	Trouble Area
P0327	The output voltage of the knock sensor (for Bank 1 Sensor 1) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 1 Sensor 1) circuit • Knock sensor (for Bank 1 Sensor 1) • ECM
P0328	The output voltage of the knock sensor (for Bank 1 Sensor 1) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 1 Sensor 1) circuit • Knock sensor (for Bank 1 Sensor 1) • ECM
P0332	The output voltage of the knock sensor (for Bank 2 Sensor 1) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 2 Sensor1) circuit • Knock sensor (for Bank 2 Sensor 1) • ECM
P0333	The output voltage of the knock sensor (for Bank 2 Sensor 1) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 2 Sensor1) circuit • Knock sensor (for Bank 2 Sensor 1) • ECM
P032C	The output voltage of the knock sensor (for Bank 1 Sensor 2) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 1 Sensor 2) circuit • Knock sensor (for Bank 1 Sensor 2) • ECM
P032D	The output voltage of the knock sensor (for Bank 1 Sensor 2) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 1 Sensor 2) circuit • Knock sensor (for Bank 1 Sensor 2) • ECM
P033C	The output voltage of the knock sensor (for Bank 2 Sensor 2) is 0.5 V or less (1 trip detection logic).	• Short in knock sensor (for Bank 2 Sensor 2) circuit • Knock sensor (for Bank 2 Sensor 2)

		• ECM
P033D	The output voltage of the knock sensor (for Bank 2 Sensor 2) is 4.5 V or higher (1 trip detection logic).	• Open in knock sensor (for Bank 2 Sensor 2) circuit • Knock sensor (for Bank 2 Sensor 2) • ECM

HINT:

When any of DTCs P0327, P0328, P0332, P0333, P032C, P032D, P033C and P033D is stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is delayed to its maximum retardation. Fail-safe mode continues until the engine switch is turned off.

Reference: Inspection using an oscilloscope.



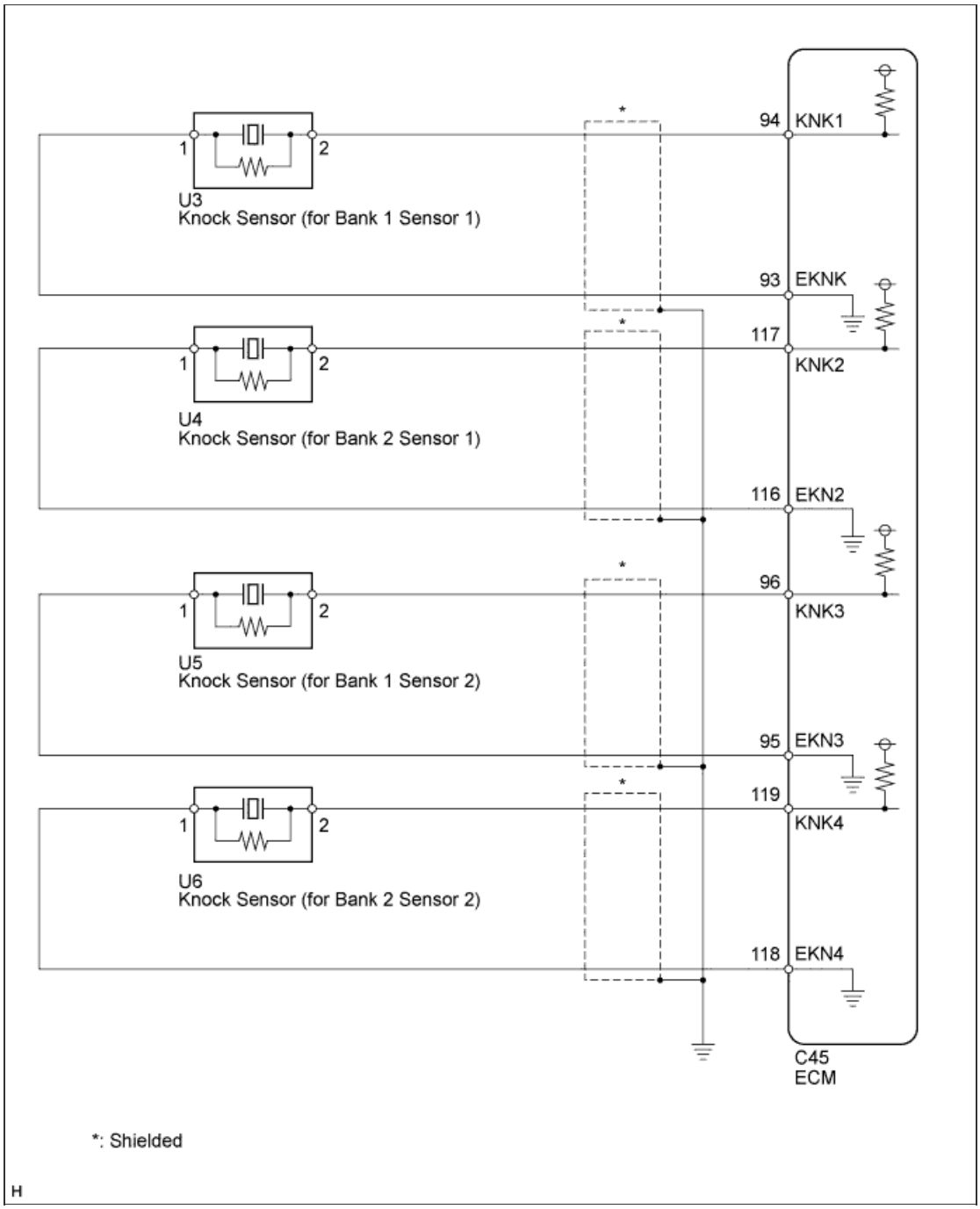
Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-94 (KNK1) - C45-93 (EKNK)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-117 (KNK2) - C45-116 (EKN2)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-96 (KNK3) - C45-95 (EKN3)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown
C45-119 (KNK4) - C45-118 (EKN4)	0.01 to 10 V/DIV. 0.01 to 10 msec./DIV.	Keep engine speed at 4000 rpm with warm engine	The correct waveform is as shown

MONITOR DESCRIPTION

The knock sensor, located on the cylinder block, detects spark knock. When spark knock occurs, the piezoelectric element of the sensor vibrates. When the ECM detects a voltage in this frequency range, it retards the ignition timing to suppress the spark knock.
The ECM also senses background engine noise with the knock sensor and uses this noise to check for faults in the sensor. If the knock sensor signal level is too low for more than 10 seconds, or if the knock sensor output voltage is outside the normal range, the ECM interprets this as a fault in the knock sensor and stores DTC(s).

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **DTCs P0327 and P0328 are for the bank 1 sensor 1 knock sensor circuit.**
- **DTCs P032C and P032D are for the bank 1 sensor 2 knock sensor circuit.**
- **DTCs P0332 and P0333 are for the bank 2 sensor 1 knock sensor circuit.**
- **DTCs P033C and P033D are for the bank 2 sensor 2 knock sensor circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**

1.INSPECT KNOCK SENSOR

a. Disconnect the C45 ECM connector.

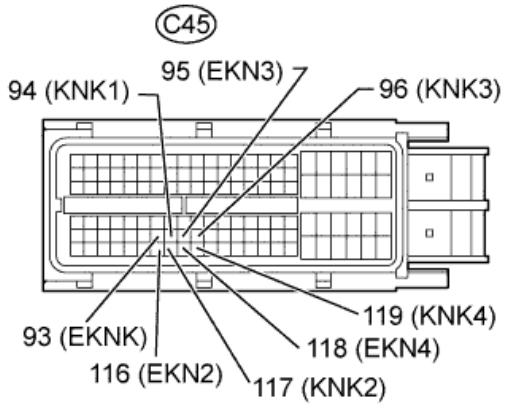
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition

C45-94 (KNK1) - C45-93 (EKNK)	20°C (68°F)	120 to 280 kΩ
C45-117 (KNK2) - C45-116 (EKN2)	20°C (68°F)	120 to 280 kΩ
C45-96 (KNK3) - C45-95 (EKN3)	20°C (68°F)	120 to 280 kΩ
C45-119 (KNK4) - C45-118 (EKN4)	20°C (68°F)	120 to 280 kΩ

Front view of wire harness connector:
(to ECM)



Result

Result	Proceed to
NG	A
OK	B

B → Go to step 3

A

2.CHECK HARNESS AND CONNECTOR (ECM - KNOCK SENSOR)

a. Disconnect the C45 ECM connector.

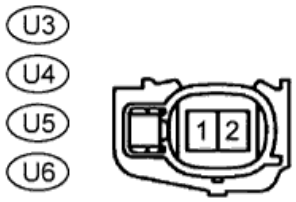
b. Disconnect the U3, U4, U5 or U6 knock sensor connector.

c. Measure the resistance according to the value(s) in the table below.

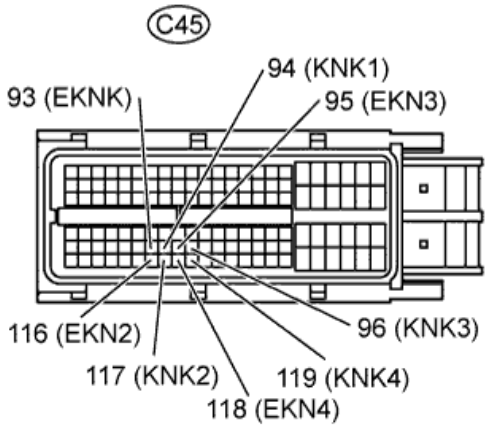
Standard Resistance:

Tester Connection	Condition	Specified Condition
U3-2 - C45-94 (KNK1)	Always	Below 1 Ω
U3-1 - C45-93 (EKNK)	Always	Below 1 Ω
U4-2 - C45-117 (KNK2)	Always	Below 1 Ω
U4-1 - C45-116 (EKN2)	Always	Below 1 Ω
U5-2 - C45-96 (KNK3)	Always	Below 1 Ω
U5-1 - C45-95 (EKN3)	Always	Below 1 Ω
U6-2 - C45-119 (KNK4)	Always	Below 1 Ω
U6-1 - C45-118 (EKN4)	Always	Below 1 Ω
U3-2 or C45-94 (KNK1) - Body ground	Always	10 kΩ or higher
U3-1 or C45-93 (EKNK) - Body ground	Always	10 kΩ or higher
U4-2 or C45-117 (KNK2) - Body ground	Always	10 kΩ or higher
U4-1 or C45-116 (EKN2) - Body ground	Always	10 kΩ or higher
U5-2 or C45-96		

Front view of wire harness connector:
(to Knock Sensor)



Front view of wire harness connector:
(to ECM)



(KNK3) - Body ground	Always	10 kΩ or higher
U5-1 or C45-95 (EKN3) - Body ground	Always	10 kΩ or higher
U6-2 or C45-119 (KNK4) - Body ground	Always	10 kΩ or higher
U6-1 or C45-118 (EKN4) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE KNOCK SENSOR (Click here)

3.INSPECT ECM

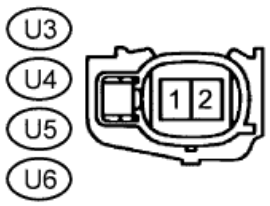
a. Disconnect the U3, U4, U5 or U6 knock sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
1 - 2	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to Knock Sensor)



NG → REPLACE ECM (Click here)

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

for Preparation Click here

DESCRIPTION

Refer to DTC P0031 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals A1A+ and A1A-/A2A+ and A2A- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in Air Fuel ratio (A/F) sensor (for Bank 1, 2 Sensor 1) circuit • Air Fuel ratio (A/F) sensor (for Bank 1, 2 Sensor 1) • ECM
P2238 P2241	• Case 1: Condition (a) or (b) continues for 5.0 seconds or more (1 trip detection logic): (a) The A1A+/A2A+ voltage is 0.5 V or less. (b) (A1A+/A2A+) - (A1A-/A2A-) = 0.1 V or less. • Case 2: The A/F sensor admittance is below 0.022 1/Ω (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2239 P2242	The A1A+/A2A+ voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2252 P2255	The A1A-/A2A- voltage is 0.5 V or less for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2253 P2256	The A1A-/A2A- voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM

HINT:

- **DTCs P2237, P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2240, P2241, P2242, P2255 and P2256 indicate malfunctions related to the bank 2 A/F sensor circuit.**

MONITOR DESCRIPTION

These DTCs are stored when there is an open or short in the A/F sensor circuit, or if A/F sensor output drops.
To detect these problems, the voltage of the A/F sensor is monitored when turning the engine switch on (IG), and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is outside of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in the next driving cycle, the MIL is illuminated and a DTC is stored.
The Air Fuel ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. If the A/F sensor impedance (alternating current resistance) or output voltage deviates greatly from the standard range, the ECM determines that there is an open or short in the A/F sensor circuit.

WIRING DIAGRAM

Refer to DTC P0031 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

(a) Connect the tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.
(e) Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.

HINT:

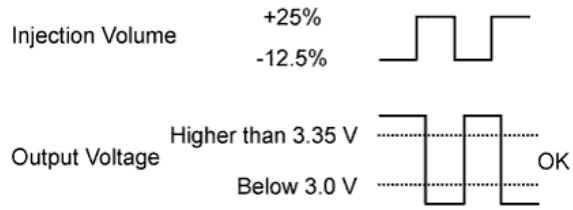
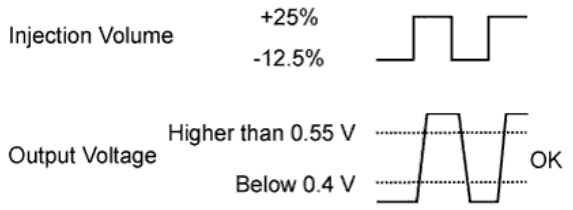
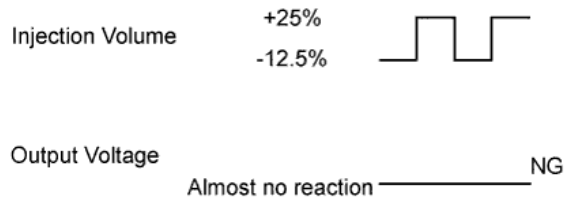
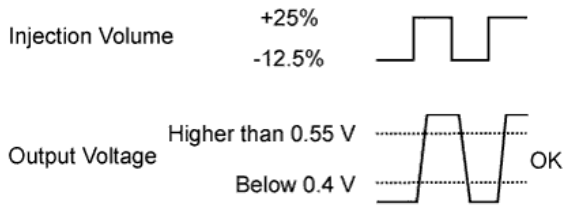
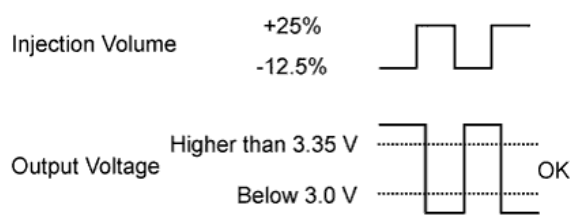
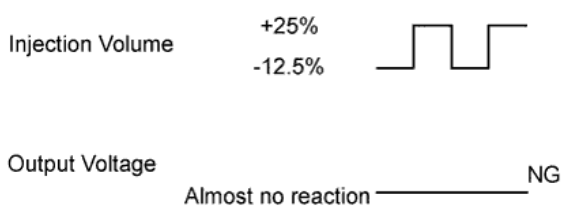
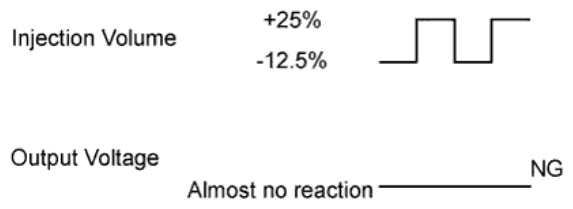
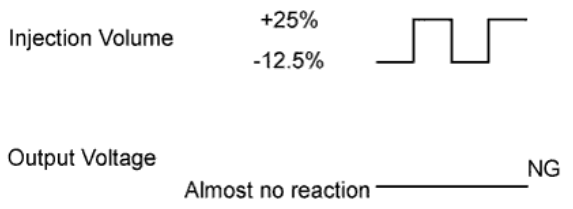
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Display Item (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.

To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the C22 or C23 Air Fuel ratio (A/F) sensor connector.

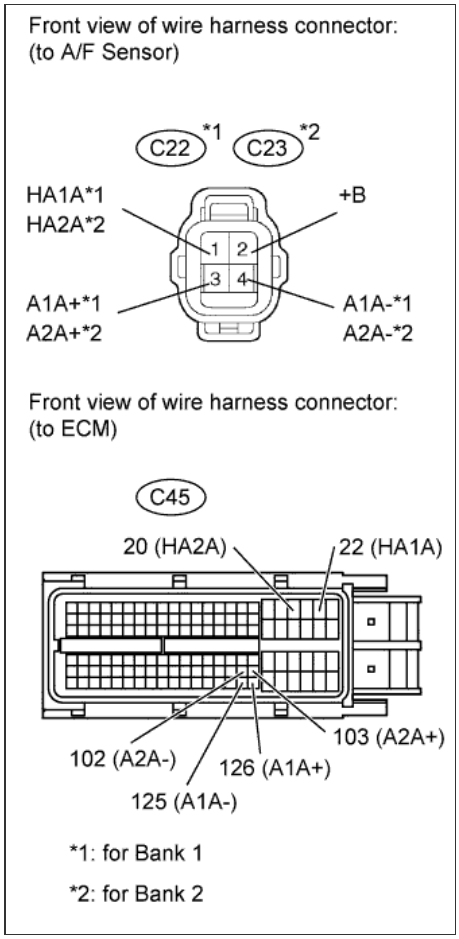
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the C45 ECM connector.



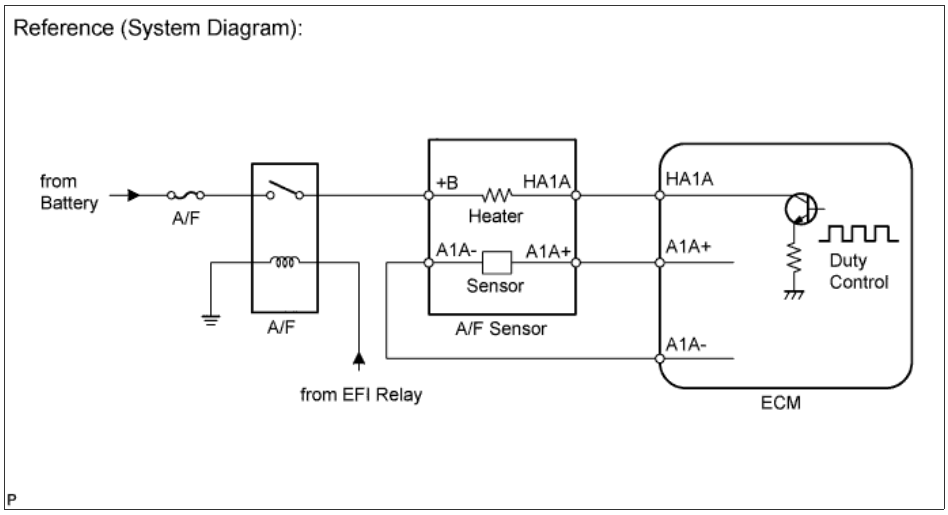
e. Measure the resistance according to the value(s) in the table below.

Standard Resistance

Tester Connection	Condition	Specified Condition

C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45- 126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45- 103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2237, P2238, P2239, P2240, P2241, P2242, P2252, P2253, P2255 or P2256 is output	B

B → REPLACE ECM (**Click here**)

A

END

DTC P0335 Crankshaft Position Sensor "A" Circuit

DTC P0337 Crankshaft Position Sensor "A" Circuit Low Input

DTC P0338 Crankshaft Position Sensor "A" Circuit High Input

DTC P0339 Crankshaft Position Sensor "A" Circuit Intermittent

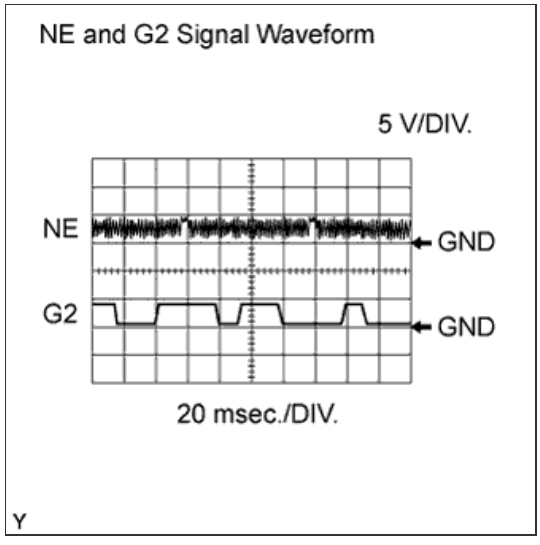
for Preparation Click here

DESCRIPTION

The Crankshaft Position (CKP) sensor system consists of a crankshaft position sensor plate and Magnetic Resistance Element (MRE) type sensor. The crankshaft position sensor plate has 34 teeth at 10° intervals (2 teeth are missing for detecting top dead center), and is installed to the rear end of the crankshaft. The crankshaft position sensor outputs 34 rotation signals per crankshaft revolution. The ECM uses the G2 signal to distinguish between the cylinders, and uses the NE signal to detect the crankshaft position and engine speed.

DTC Code	DTC Detection Condition	Trouble Area
P0335	• No Crankshaft Position (CKP) sensor signal is sent to the ECM while cranking (1 trip detection logic). • No CKP sensor signal is sent to the ECM at an engine speed of 600 rpm or more (1 trip detection logic).	• Open or short in Crankshaft Position (CKP) sensor circuit • CKP sensor • CKP sensor plate • ECM
P0337	The output voltage of the CKP sensor is 0.3 V or less for 4 seconds (1 trip detection logic).	• Open or short in CKP sensor circuit • CKP sensor • CKP sensor plate • ECM
P0338	The output voltage of the CKP sensor is 4.7 V or higher for 4 seconds (1 trip detection logic).	• Open or short in CKP sensor circuit • CKP sensor • CKP sensor plate • ECM
P0339	Under conditions (a), (b) and (c), no CKP sensor signal is sent to the ECM for 0.05 seconds or more (1 trip detection logic): (a) The engine speed is 1000 rpm or more. (b) The starter signal is OFF. (c) 3 seconds or more have elapsed since the starter signal was switched from ON to OFF.	• Open or short in CKP sensor circuit • CKP sensor • CKP sensor plate • ECM

Reference: Inspection using an oscilloscope.



Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-110 (NE+) - C45-111 (NE-)	5 V/DIV., 20 msec./DIV.	Cranking or idling	The correct waveform is as shown

C45-90 (G2) - C45-89 (G2-)	5 V/DIV., 20 msec./DIV.	Cranking or idling	The correct waveform is as shown

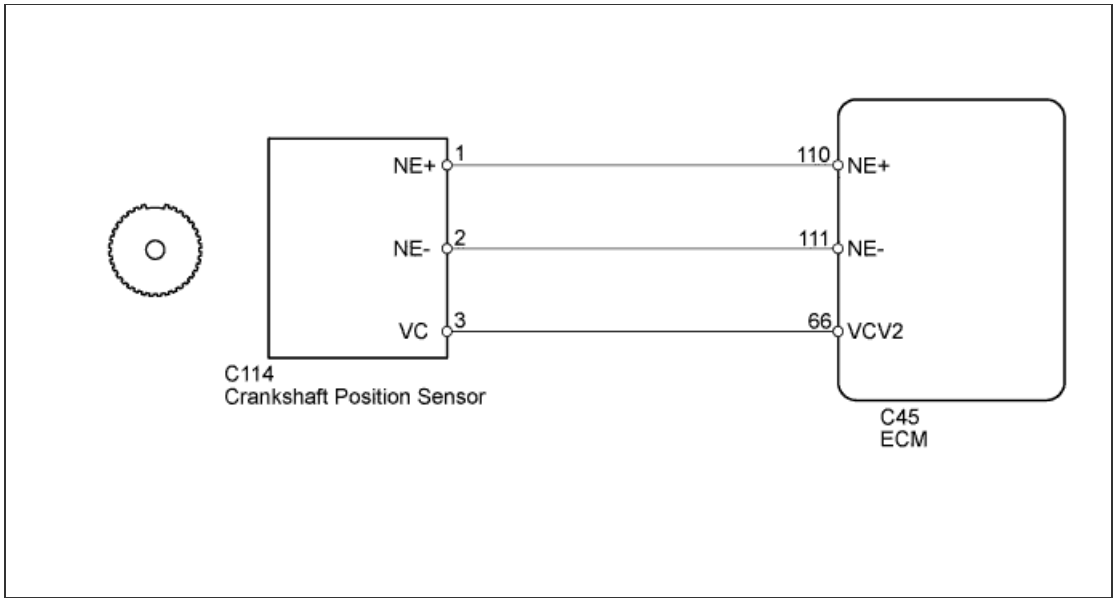
HINT:

G2 stands for the camshaft position sensor signal, and NE stands for the crankshaft position sensor signal.

MONITOR DESCRIPTION

If there is no signal from the crankshaft position sensor despite the engine revolving, the ECM interprets this as a malfunction of the sensor. When the sensor output voltage remains at below 0.3 V, or higher than 4.7 V for more than 4 seconds, the ECM stores DTC(s).

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **If no problem is found by this diagnostic troubleshooting procedure, check for problems by referring to the engine mechanical section.**
- **The engine speed can be checked by using the intelligent tester. To check, follow the procedures below:**
  1. **Connect the tester to the DLC3.**
  2. **Start the engine.**
  3. **Turn the tester on.**
  4. **Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Engine Speed.**
     The engine speed may be indicated as zero despite the engine revolving normally. This is caused by a lack of NE signals from the Crankshaft Position (CKP) sensor. Alternatively, the engine speed may be indicated as less than the actual engine speed, if the CKP sensor output voltage is insufficient.
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (ENGINE SPEED)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Engine Speed.

d. Start the engine.

e. Read the values displayed on the tester while the engine is running.

Standard:
Correct values are displayed.

HINT:

- **To check the engine speed change, display the graph on the intelligent tester.**
- **If the engine does not start, check the engine speed while cranking.**
- **If the engine speed indicated on the intelligent tester remains zero (0), there may be an open or short in the Crankshaft Position (CKP) sensor circuit.**

NG → Go to step 2

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

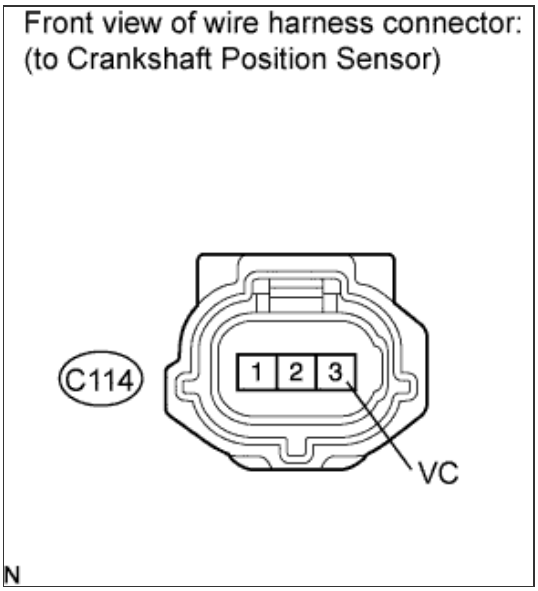
2.INSPECT CRANKSHAFT POSITION SENSOR (SENSOR POWER SOURCE)

a. Disconnect the C114 crankshaft position sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C114-3 (VC) - Body ground	Engine switch on (IG)	4.5 to 5.0 V



NG → Go to step 8

OK

3.CHECK HARNESS AND CONNECTOR (CRANKSHAFT POSITION SENSOR - ECM)

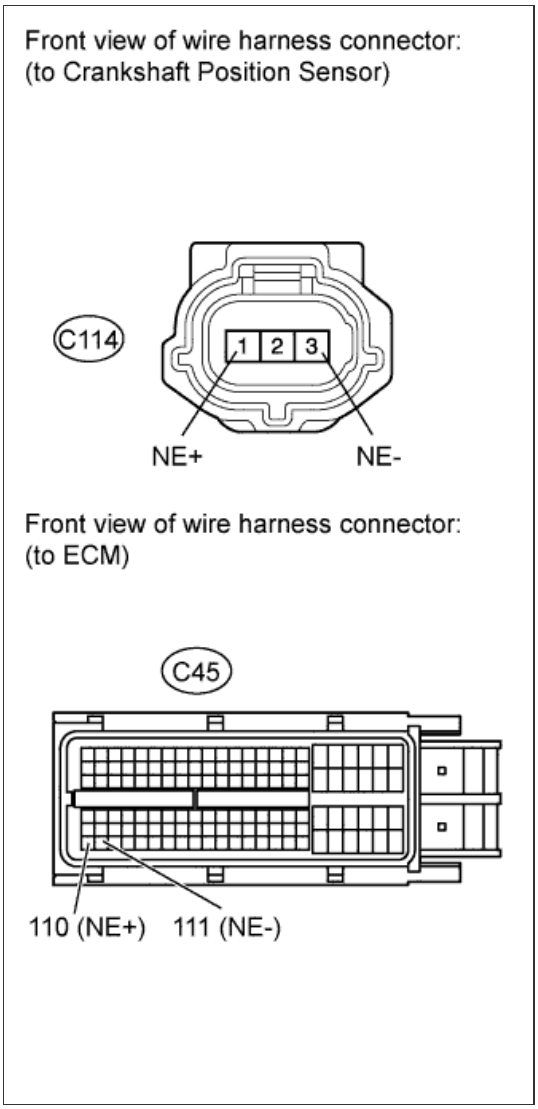
a. Disconnect the C114 crankshaft position sensor connector.

b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C114-1 (NE+) - C45-110 (NE+)	Always	Below 1 Ω
C114-2 (NE-) - C45-111 (NE-)	Always	Below 1 Ω
C114-1 (NE+) or C45-110 (NE+) - Body ground	Always	10 kΩ or higher
C114-2 (NE-) or C45-111 (NE-) - Body ground	Always	10 kΩ or higher



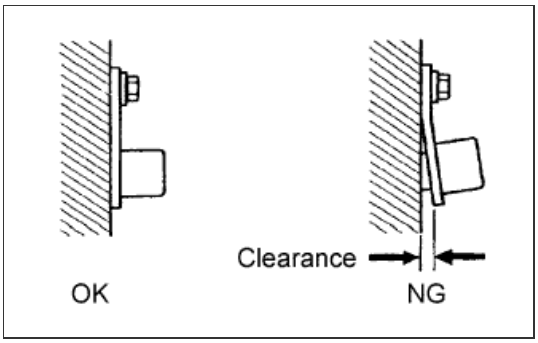
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.CHECK SENSOR INSTALLATION (CRANKSHAFT POSITION SENSOR)

a. Check the crankshaft position sensor installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

5.CHECK CRANKSHAFT POSITION SENSOR PLATE (TEETH OF SENSOR PLATE)

a. Check the teeth of the sensor plate.

OK:
Sensor plate does not have any cracks or deformation.

NG → REPLACE CRANKSHAFT POSITION SENSOR PLATE (Click here)

OK

6.REPLACE CRANKSHAFT POSITION SENSOR

a. Replace the crankshaft position sensor (Click here).

NEXT

7.CHECK WHETHER DTC OUTPUT RECURS (DTC P0335, P0337, P0338 AND/OR P0339)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No output	A
P0335, P0337, P0338 and/or P0339	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

8.CHECK HARNESS AND CONNECTOR (CRANKSHAFT POSITION SENSOR - ECM)

a. Disconnect the C114 crankshaft position sensor connector.

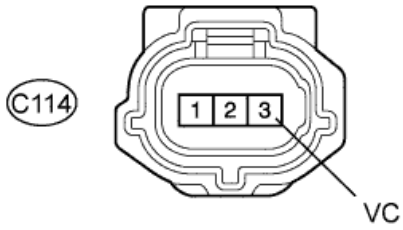
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

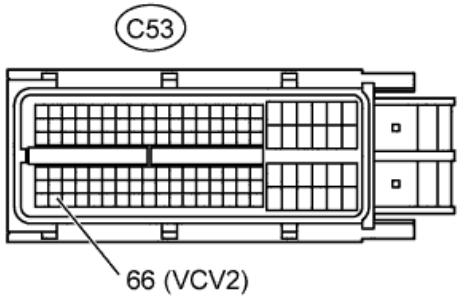
Standard Resistance:

Tester Connection	Condition	Specified Condition
C114-3 (VC) - C45-66 (VCV2)	Always	Below 1 Ω
C114-3 (VC) or C45-66 (VCV2) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Crankshaft Position Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

for Preparation Click here

DESCRIPTION

Refer to DTC P0031 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals A1A+ and A1A-/A2A+ and A2A- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in Air Fuel ratio (A/F) sensor (for Bank 1, 2 Sensor 1) circuit • Air Fuel ratio (A/F) sensor (for Bank 1, 2 Sensor 1) • ECM
P2238 P2241	• Case 1: Condition (a) or (b) continues for 5.0 seconds or more (1 trip detection logic): (a) The A1A+/A2A+ voltage is 0.5 V or less. (b) (A1A+/A2A+) - (A1A-/A2A-) = 0.1 V or less. • Case 2: The A/F sensor admittance is below 0.022 1/Ω (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2239 P2242	The A1A+/A2A+ voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2252 P2255	The A1A-/A2A- voltage is 0.5 V or less for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2253 P2256	The A1A-/A2A- voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM

HINT:

- **DTCs P2237, P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2240, P2241, P2242, P2255 and P2256 indicate malfunctions related to the bank 2 A/F sensor circuit.**

MONITOR DESCRIPTION

These DTCs are stored when there is an open or short in the A/F sensor circuit, or if A/F sensor output drops.
To detect these problems, the voltage of the A/F sensor is monitored when turning the engine switch on (IG), and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is outside of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in the next driving cycle, the MIL is illuminated and a DTC is stored.
The Air Fuel ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. If the A/F sensor impedance (alternating current resistance) or output voltage deviates greatly from the standard range, the ECM determines that there is an open or short in the A/F sensor circuit.

WIRING DIAGRAM

Refer to DTC P0031 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

(a) Connect the tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.
(e) Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.

HINT:

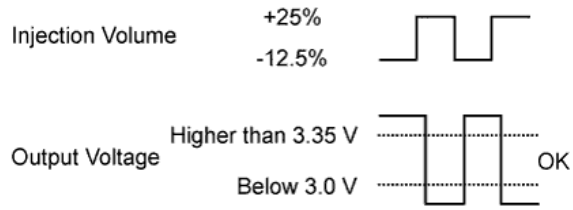
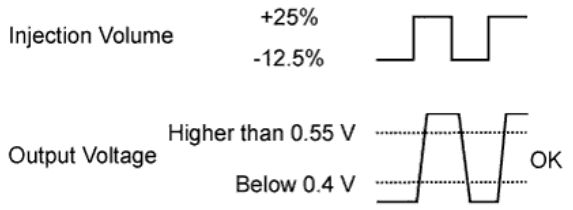
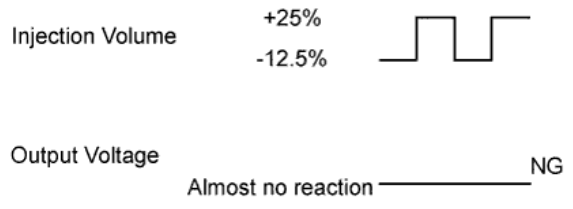
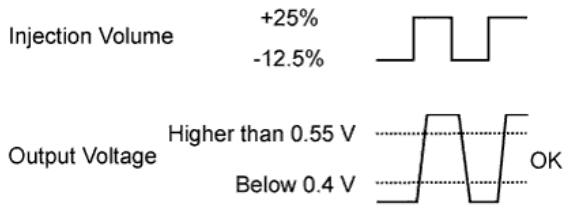
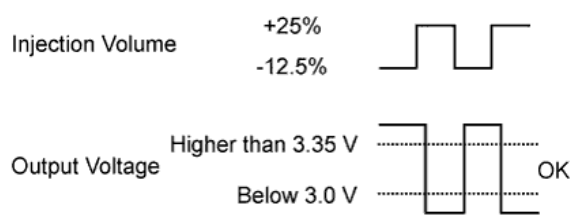
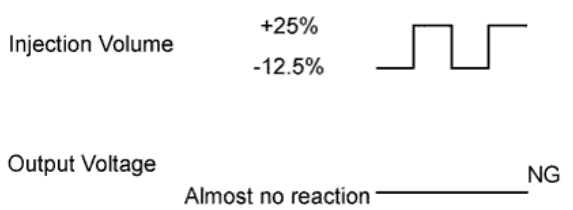
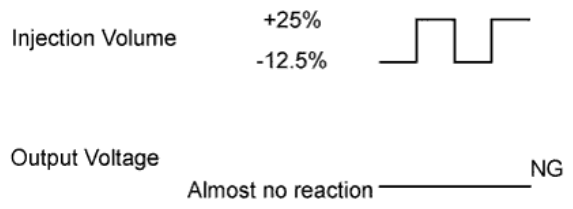
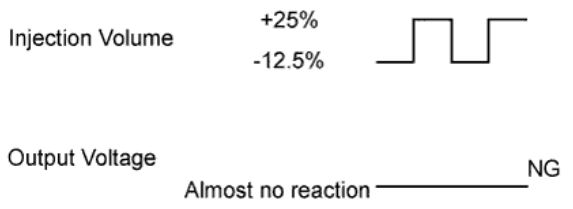
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Display Item (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.

To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the C22 or C23 Air Fuel ratio (A/F) sensor connector.

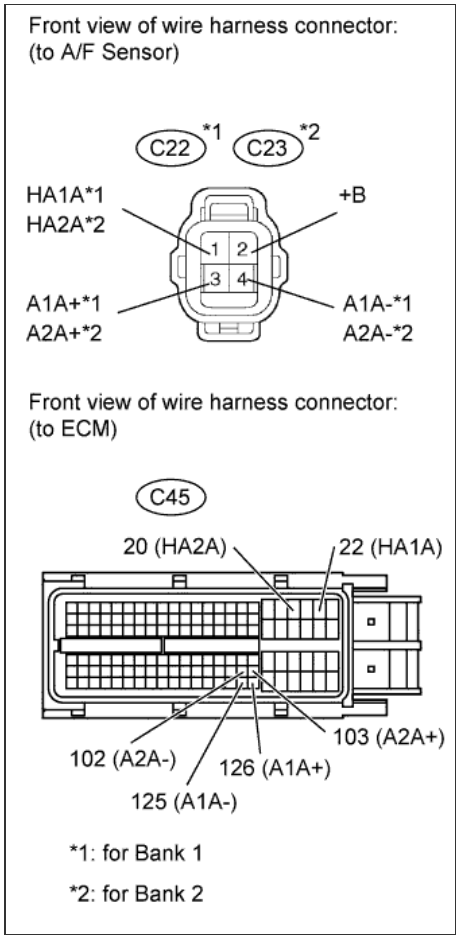
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the C45 ECM connector.



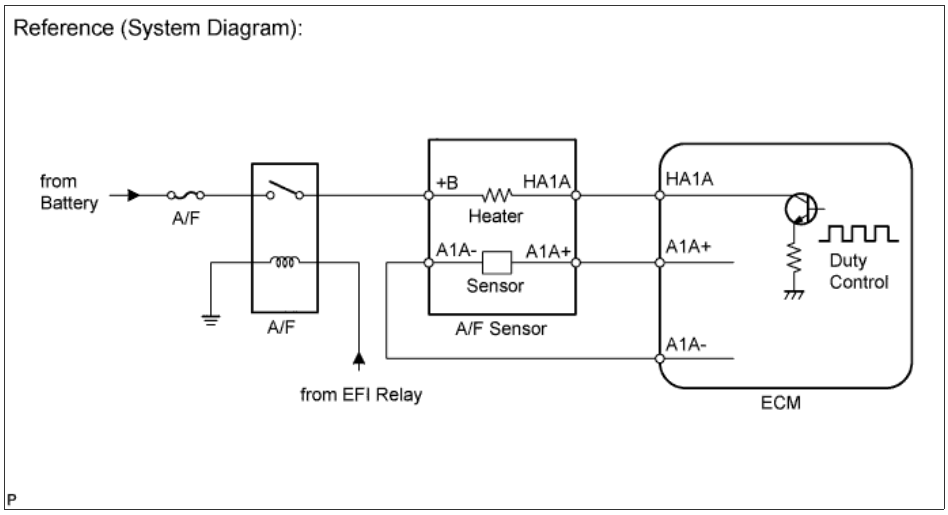
e. Measure the resistance according to the value(s) in the table below.

Standard Resistance

Tester Connection	Condition	Specified Condition

C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45- 126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45- 103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2237, P2238, P2239, P2240, P2241, P2242, P2252, P2253, P2255 or P2256 is output	B

B → REPLACE ECM (**Click here**)

A

END

DTC P0335 Crankshaft Position Sensor "A" Circuit

DTC P0337 Crankshaft Position Sensor "A" Circuit Low Input

DTC P0338 Crankshaft Position Sensor "A" Circuit High Input

DTC P0339 Crankshaft Position Sensor "A" Circuit Intermittent

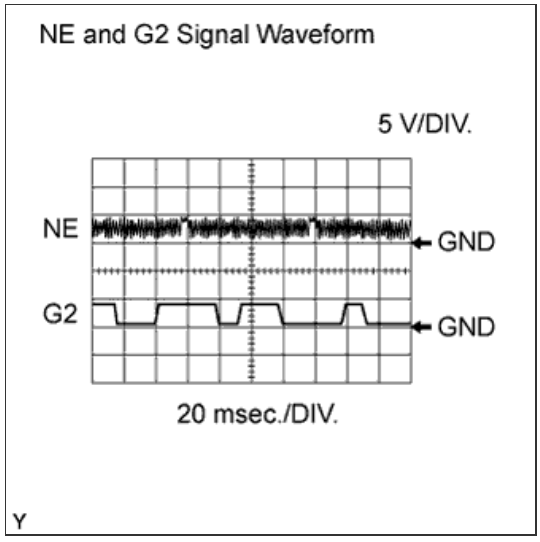
for Preparation Click here

DESCRIPTION

The Crankshaft Position (CKP) sensor system consists of a crankshaft position sensor plate and Magnetic Resistance Element (MRE) type sensor. The crankshaft position sensor plate has 34 teeth at 10° intervals (2 teeth are missing for detecting top dead center), and is installed to the rear end of the crankshaft. The crankshaft position sensor outputs 34 rotation signals per crankshaft revolution. The ECM uses the G2 signal to distinguish between the cylinders, and uses the NE signal to detect the crankshaft position and engine speed.

DTC Code	DTC Detection Condition	Trouble Area
P0335	• No Crankshaft Position (CKP) sensor signal is sent to the ECM while cranking (1 trip detection logic). • No CKP sensor signal is sent to the ECM at an engine speed of 600 rpm or more (1 trip detection logic).	• Open or short in Crankshaft Position (CKP) sensor circuit • CKP sensor • CKP sensor plate • ECM
P0337	The output voltage of the CKP sensor is 0.3 V or less for 4 seconds (1 trip detection logic).	• Open or short in CKP sensor circuit • CKP sensor • CKP sensor plate • ECM
P0338	The output voltage of the CKP sensor is 4.7 V or higher for 4 seconds (1 trip detection logic).	• Open or short in CKP sensor circuit • CKP sensor • CKP sensor plate • ECM
P0339	Under conditions (a), (b) and (c), no CKP sensor signal is sent to the ECM for 0.05 seconds or more (1 trip detection logic): (a) The engine speed is 1000 rpm or more. (b) The starter signal is OFF. (c) 3 seconds or more have elapsed since the starter signal was switched from ON to OFF.	• Open or short in CKP sensor circuit • CKP sensor • CKP sensor plate • ECM

Reference: Inspection using an oscilloscope.



Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-110 (NE+) - C45-111 (NE-)	5 V/DIV., 20 msec./DIV.	Cranking or idling	The correct waveform is as shown

C45-90 (G2) - C45-89 (G2-)	5 V/DIV., 20 msec./DIV.	Cranking or idling	The correct waveform is as shown

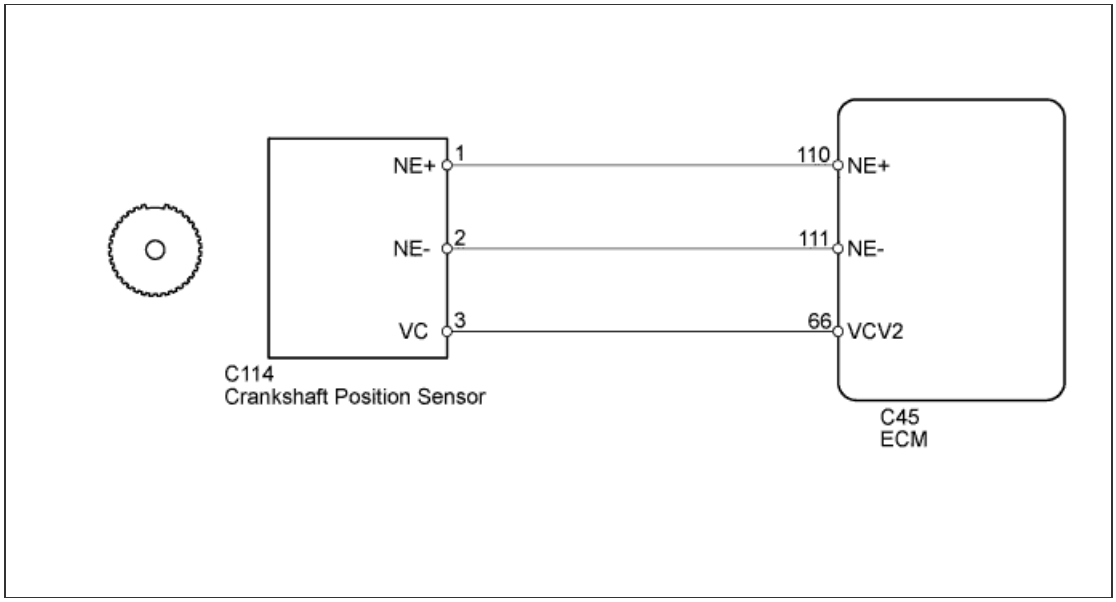
HINT:

G2 stands for the camshaft position sensor signal, and NE stands for the crankshaft position sensor signal.

MONITOR DESCRIPTION

If there is no signal from the crankshaft position sensor despite the engine revolving, the ECM interprets this as a malfunction of the sensor. When the sensor output voltage remains at below 0.3 V, or higher than 4.7 V for more than 4 seconds, the ECM stores DTC(s).

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **If no problem is found by this diagnostic troubleshooting procedure, check for problems by referring to the engine mechanical section.**
- **The engine speed can be checked by using the intelligent tester. To check, follow the procedures below:**
  1. **Connect the tester to the DLC3.**
  2. **Start the engine.**
  3. **Turn the tester on.**
  4. **Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Engine Speed.**
     The engine speed may be indicated as zero despite the engine revolving normally. This is caused by a lack of NE signals from the Crankshaft Position (CKP) sensor. Alternatively, the engine speed may be indicated as less than the actual engine speed, if the CKP sensor output voltage is insufficient.
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (ENGINE SPEED)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Engine Speed.

d. Start the engine.

e. Read the values displayed on the tester while the engine is running.

Standard:
Correct values are displayed.

HINT:

- **To check the engine speed change, display the graph on the intelligent tester.**
- **If the engine does not start, check the engine speed while cranking.**
- **If the engine speed indicated on the intelligent tester remains zero (0), there may be an open or short in the Crankshaft Position (CKP) sensor circuit.**

NG → Go to step 2

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

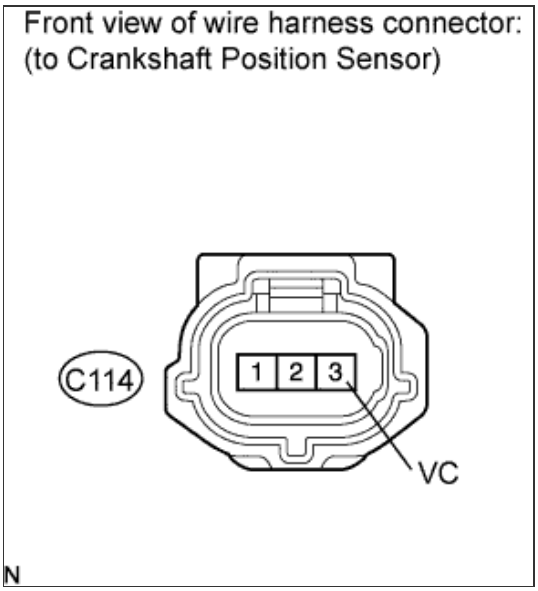
2.INSPECT CRANKSHAFT POSITION SENSOR (SENSOR POWER SOURCE)

a. Disconnect the C114 crankshaft position sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C114-3 (VC) - Body ground	Engine switch on (IG)	4.5 to 5.0 V



NG → Go to step 8

OK

3.CHECK HARNESS AND CONNECTOR (CRANKSHAFT POSITION SENSOR - ECM)

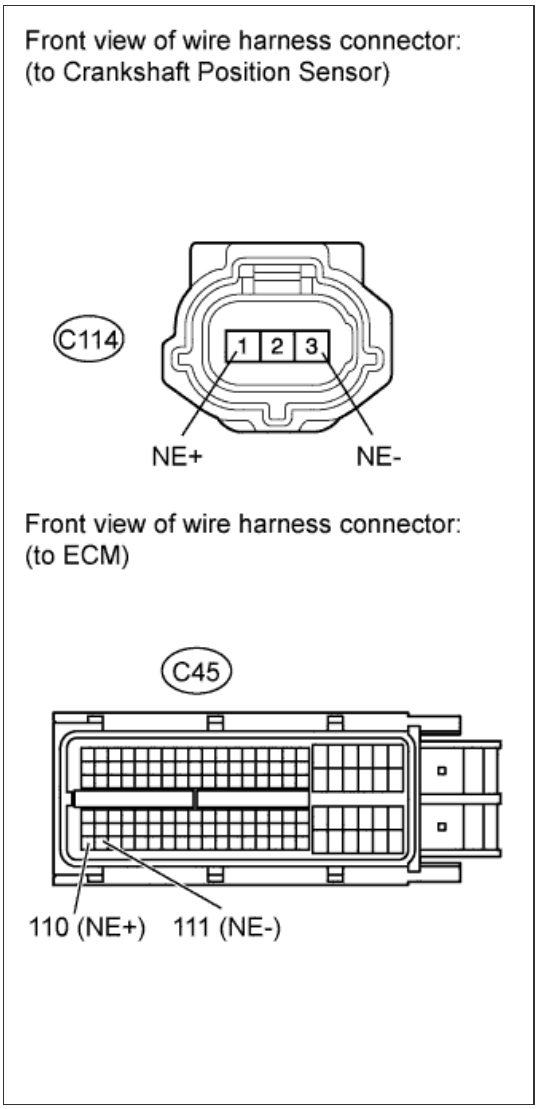
a. Disconnect the C114 crankshaft position sensor connector.

b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C114-1 (NE+) - C45-110 (NE+)	Always	Below 1 Ω
C114-2 (NE-) - C45-111 (NE-)	Always	Below 1 Ω
C114-1 (NE+) or C45-110 (NE+) - Body ground	Always	10 kΩ or higher
C114-2 (NE-) or C45-111 (NE-) - Body ground	Always	10 kΩ or higher



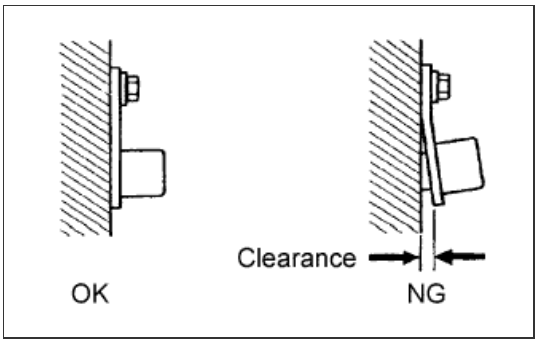
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.CHECK SENSOR INSTALLATION (CRANKSHAFT POSITION SENSOR)

a. Check the crankshaft position sensor installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

5.CHECK CRANKSHAFT POSITION SENSOR PLATE (TEETH OF SENSOR PLATE)

a. Check the teeth of the sensor plate.

OK:
Sensor plate does not have any cracks or deformation.

NG → REPLACE CRANKSHAFT POSITION SENSOR PLATE (Click here)

OK

6.REPLACE CRANKSHAFT POSITION SENSOR

a. Replace the crankshaft position sensor (Click here).

NEXT

7.CHECK WHETHER DTC OUTPUT RECURS (DTC P0335, P0337, P0338 AND/OR P0339)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No output	A
P0335, P0337, P0338 and/or P0339	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

8.CHECK HARNESS AND CONNECTOR (CRANKSHAFT POSITION SENSOR - ECM)

a. Disconnect the C114 crankshaft position sensor connector.

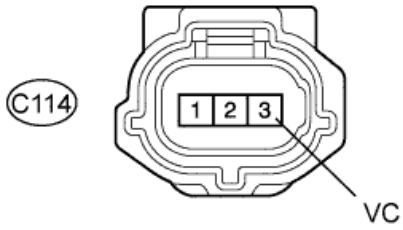
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

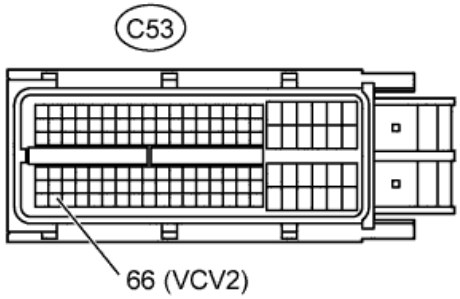
Standard Resistance:

Tester Connection	Condition	Specified Condition
C114-3 (VC) - C45-66 (VCV2)	Always	Below 1 Ω
C114-3 (VC) or C45-66 (VCV2) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Crankshaft Position Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

for Preparation Click here

DESCRIPTION

Refer to DTC P0031 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals A1A+ and A1A-/A2A+ and A2A- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in Air Fuel ratio (A/F) sensor (for Bank 1, 2 Sensor 1) circuit • Air Fuel ratio (A/F) sensor (for Bank 1, 2 Sensor 1) • ECM
P2238 P2241	• Case 1: Condition (a) or (b) continues for 5.0 seconds or more (1 trip detection logic): (a) The A1A+/A2A+ voltage is 0.5 V or less. (b) (A1A+/A2A+) - (A1A-/A2A-) = 0.1 V or less. • Case 2: The A/F sensor admittance is below 0.022 1/Ω (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2239 P2242	The A1A+/A2A+ voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2252 P2255	The A1A-/A2A- voltage is 0.5 V or less for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2253 P2256	The A1A-/A2A- voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM

HINT:

- **DTCs P2237, P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2240, P2241, P2242, P2255 and P2256 indicate malfunctions related to the bank 2 A/F sensor circuit.**

MONITOR DESCRIPTION

These DTCs are stored when there is an open or short in the A/F sensor circuit, or if A/F sensor output drops.
To detect these problems, the voltage of the A/F sensor is monitored when turning the engine switch on (IG), and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is outside of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in the next driving cycle, the MIL is illuminated and a DTC is stored.
The Air Fuel ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. If the A/F sensor impedance (alternating current resistance) or output voltage deviates greatly from the standard range, the ECM determines that there is an open or short in the A/F sensor circuit.

WIRING DIAGRAM

Refer to DTC P0031 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

(a) Connect the tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.
(e) Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.

HINT:

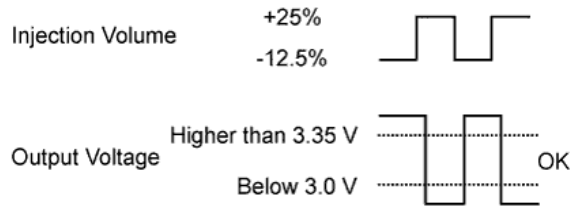
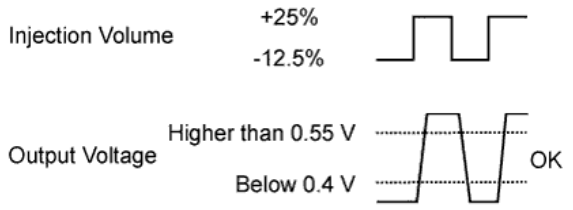
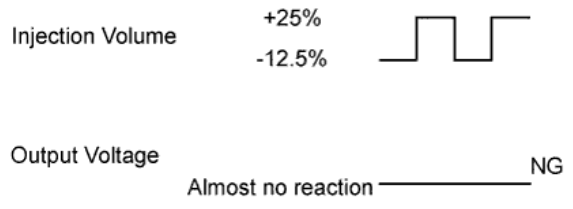
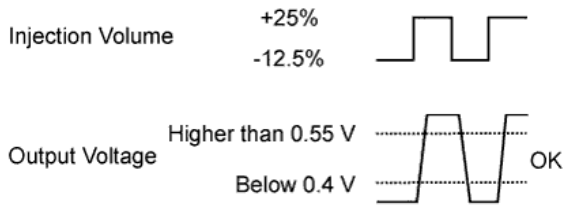
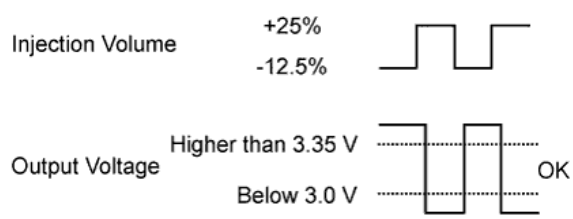
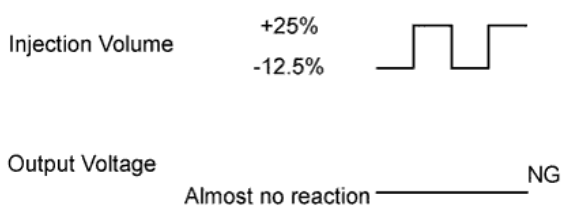
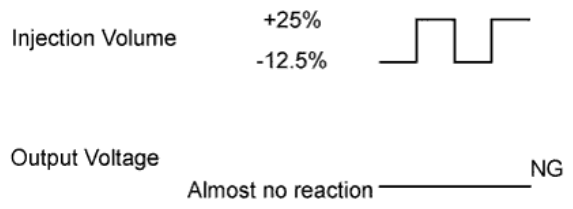
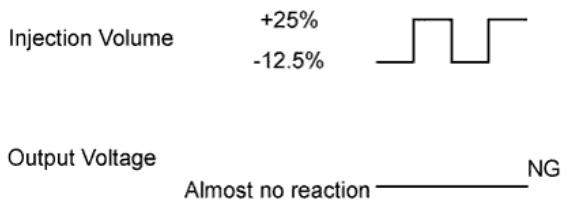
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Display Item (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.

To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the C22 or C23 Air Fuel ratio (A/F) sensor connector.

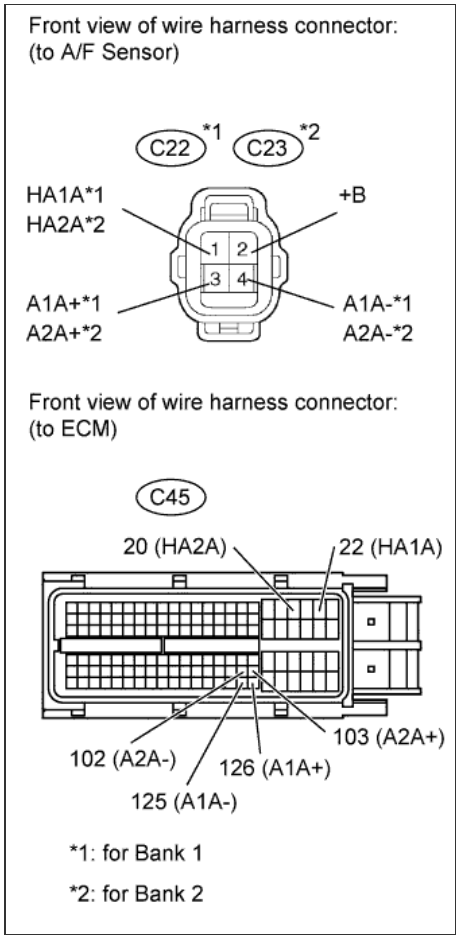
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the C45 ECM connector.



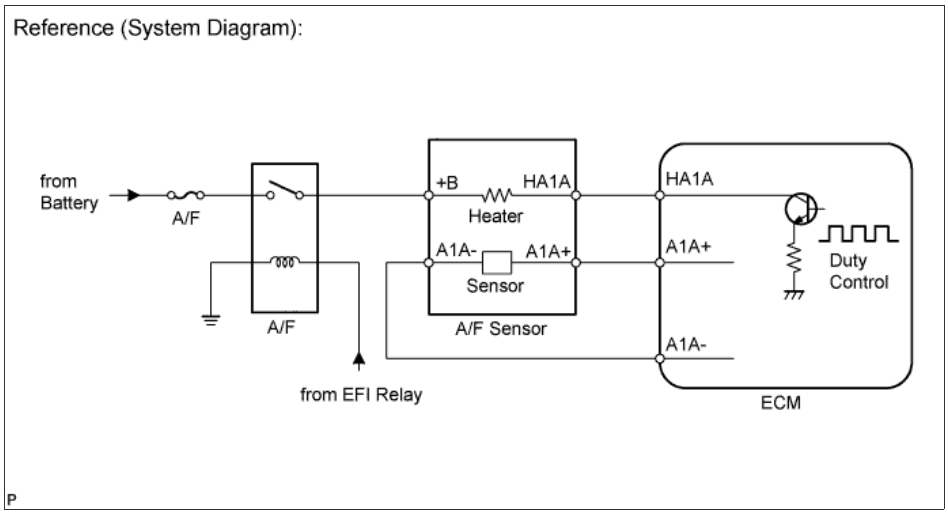
e. Measure the resistance according to the value(s) in the table below.

Standard Resistance

Tester Connection	Condition	Specified Condition

C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45- 126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45- 103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2237, P2238, P2239, P2240, P2241, P2242, P2252, P2253, P2255 or P2256 is output	B

B → REPLACE ECM (**Click here**)

A

END

DTC P0335 Crankshaft Position Sensor "A" Circuit

DTC P0337 Crankshaft Position Sensor "A" Circuit Low Input

DTC P0338 Crankshaft Position Sensor "A" Circuit High Input

DTC P0339 Crankshaft Position Sensor "A" Circuit Intermittent

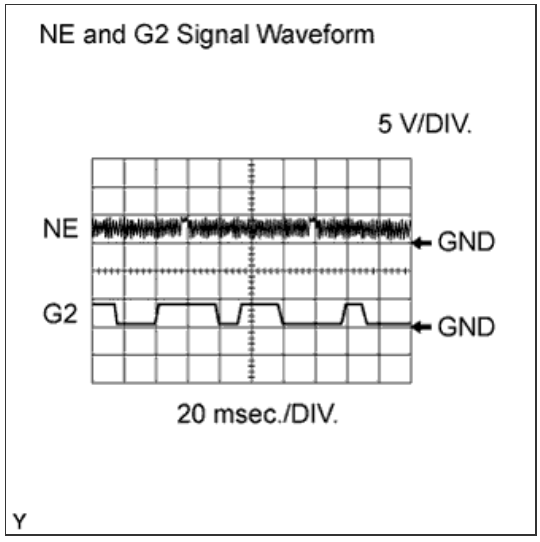
for Preparation Click here

DESCRIPTION

The Crankshaft Position (CKP) sensor system consists of a crankshaft position sensor plate and Magnetic Resistance Element (MRE) type sensor. The crankshaft position sensor plate has 34 teeth at 10° intervals (2 teeth are missing for detecting top dead center), and is installed to the rear end of the crankshaft. The crankshaft position sensor outputs 34 rotation signals per crankshaft revolution. The ECM uses the G2 signal to distinguish between the cylinders, and uses the NE signal to detect the crankshaft position and engine speed.

DTC Code	DTC Detection Condition	Trouble Area
P0335	• No Crankshaft Position (CKP) sensor signal is sent to the ECM while cranking (1 trip detection logic). • No CKP sensor signal is sent to the ECM at an engine speed of 600 rpm or more (1 trip detection logic).	• Open or short in Crankshaft Position (CKP) sensor circuit • CKP sensor • CKP sensor plate • ECM
P0337	The output voltage of the CKP sensor is 0.3 V or less for 4 seconds (1 trip detection logic).	• Open or short in CKP sensor circuit • CKP sensor • CKP sensor plate • ECM
P0338	The output voltage of the CKP sensor is 4.7 V or higher for 4 seconds (1 trip detection logic).	• Open or short in CKP sensor circuit • CKP sensor • CKP sensor plate • ECM
P0339	Under conditions (a), (b) and (c), no CKP sensor signal is sent to the ECM for 0.05 seconds or more (1 trip detection logic): (a) The engine speed is 1000 rpm or more. (b) The starter signal is OFF. (c) 3 seconds or more have elapsed since the starter signal was switched from ON to OFF.	• Open or short in CKP sensor circuit • CKP sensor • CKP sensor plate • ECM

Reference: Inspection using an oscilloscope.



Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-110 (NE+) - C45-111 (NE-)	5 V/DIV., 20 msec./DIV.	Cranking or idling	The correct waveform is as shown

C45-90 (G2) - C45-89 (G2-)	5 V/DIV., 20 msec./DIV.	Cranking or idling	The correct waveform is as shown

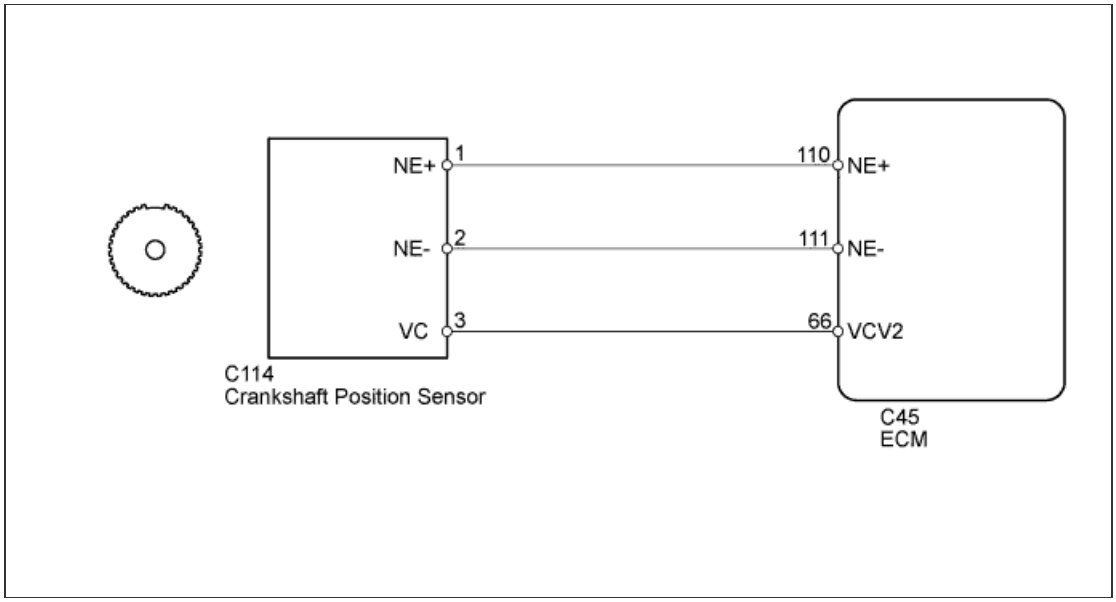
HINT:

G2 stands for the camshaft position sensor signal, and NE stands for the crankshaft position sensor signal.

MONITOR DESCRIPTION

If there is no signal from the crankshaft position sensor despite the engine revolving, the ECM interprets this as a malfunction of the sensor. When the sensor output voltage remains at below 0.3 V, or higher than 4.7 V for more than 4 seconds, the ECM stores DTC(s).

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **If no problem is found by this diagnostic troubleshooting procedure, check for problems by referring to the engine mechanical section.**
- **The engine speed can be checked by using the intelligent tester. To check, follow the procedures below:**
  1. **Connect the tester to the DLC3.**
  2. **Start the engine.**
  3. **Turn the tester on.**
  4. **Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Engine Speed.**
     The engine speed may be indicated as zero despite the engine revolving normally. This is caused by a lack of NE signals from the Crankshaft Position (CKP) sensor. Alternatively, the engine speed may be indicated as less than the actual engine speed, if the CKP sensor output voltage is insufficient.
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (ENGINE SPEED)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Engine Speed.

d. Start the engine.

e. Read the values displayed on the tester while the engine is running.

Standard:
Correct values are displayed.

HINT:

- **To check the engine speed change, display the graph on the intelligent tester.**
- **If the engine does not start, check the engine speed while cranking.**
- **If the engine speed indicated on the intelligent tester remains zero (0), there may be an open or short in the Crankshaft Position (CKP) sensor circuit.**

NG → Go to step 2

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

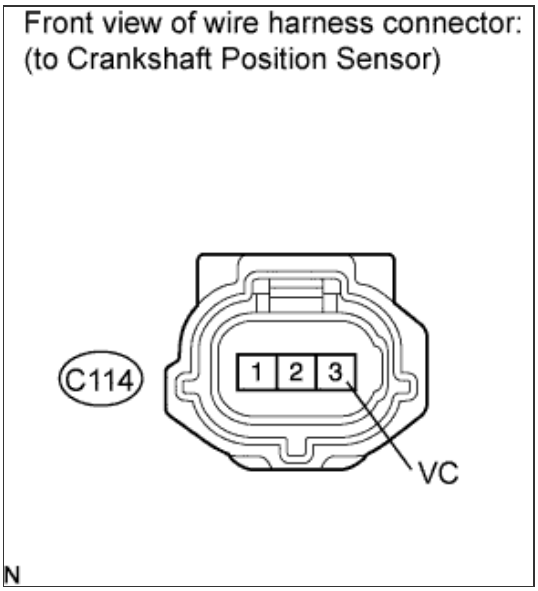
2.INSPECT CRANKSHAFT POSITION SENSOR (SENSOR POWER SOURCE)

a. Disconnect the C114 crankshaft position sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C114-3 (VC) - Body ground	Engine switch on (IG)	4.5 to 5.0 V



NG → Go to step 8

OK

3.CHECK HARNESS AND CONNECTOR (CRANKSHAFT POSITION SENSOR - ECM)

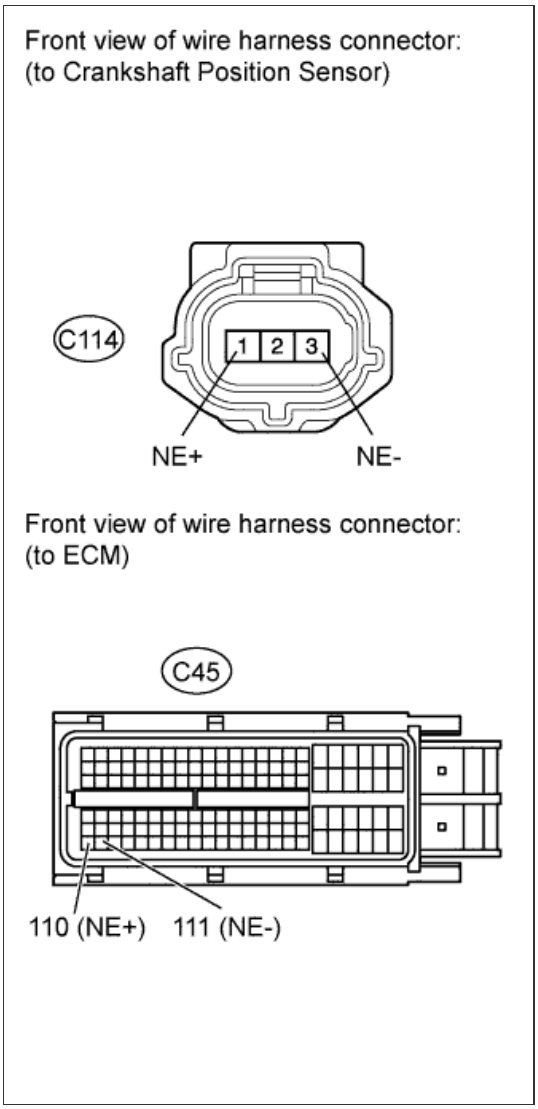
a. Disconnect the C114 crankshaft position sensor connector.

b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C114-1 (NE+) - C45-110 (NE+)	Always	Below 1 Ω
C114-2 (NE-) - C45-111 (NE-)	Always	Below 1 Ω
C114-1 (NE+) or C45-110 (NE+) - Body ground	Always	10 kΩ or higher
C114-2 (NE-) or C45-111 (NE-) - Body ground	Always	10 kΩ or higher



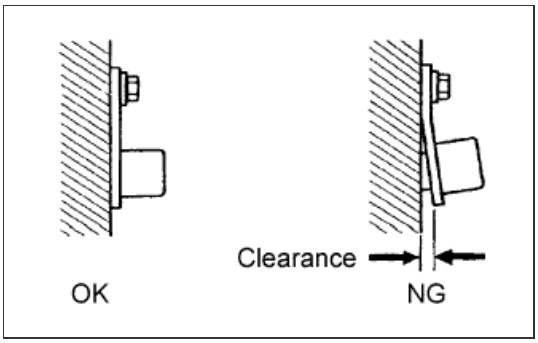
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.CHECK SENSOR INSTALLATION (CRANKSHAFT POSITION SENSOR)

a. Check the crankshaft position sensor installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

5.CHECK CRANKSHAFT POSITION SENSOR PLATE (TEETH OF SENSOR PLATE)

a. Check the teeth of the sensor plate.

OK:
Sensor plate does not have any cracks or deformation.

NG → REPLACE CRANKSHAFT POSITION SENSOR PLATE (Click here)

OK

6.REPLACE CRANKSHAFT POSITION SENSOR

a. Replace the crankshaft position sensor (Click here).

NEXT

7.CHECK WHETHER DTC OUTPUT RECURS (DTC P0335, P0337, P0338 AND/OR P0339)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No output	A
P0335, P0337, P0338 and/or P0339	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

8.CHECK HARNESS AND CONNECTOR (CRANKSHAFT POSITION SENSOR - ECM)

a. Disconnect the C114 crankshaft position sensor connector.

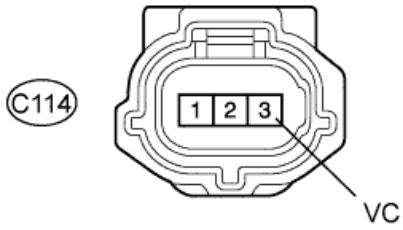
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

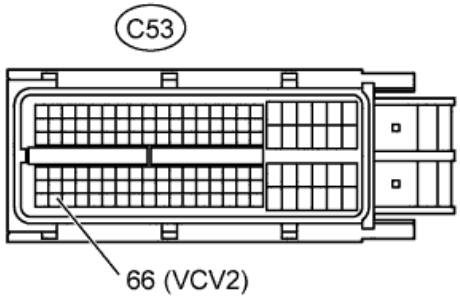
Standard Resistance:

Tester Connection	Condition	Specified Condition
C114-3 (VC) - C45-66 (VCV2)	Always	Below 1 Ω
C114-3 (VC) or C45-66 (VCV2) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Crankshaft Position Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

for Preparation Click here

DESCRIPTION

Refer to DTC P0031 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals A1A+ and A1A-/A2A+ and A2A- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in Air Fuel ratio (A/F) sensor (for Bank 1, 2 Sensor 1) circuit • Air Fuel ratio (A/F) sensor (for Bank 1, 2 Sensor 1) • ECM
P2238 P2241	• Case 1: Condition (a) or (b) continues for 5.0 seconds or more (1 trip detection logic): (a) The A1A+/A2A+ voltage is 0.5 V or less. (b) (A1A+/A2A+) - (A1A-/A2A-) = 0.1 V or less. • Case 2: The A/F sensor admittance is below 0.022 1/Ω (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2239 P2242	The A1A+/A2A+ voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2252 P2255	The A1A-/A2A- voltage is 0.5 V or less for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2253 P2256	The A1A-/A2A- voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM

HINT:

- **DTCs P2237, P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2240, P2241, P2242, P2255 and P2256 indicate malfunctions related to the bank 2 A/F sensor circuit.**

MONITOR DESCRIPTION

These DTCs are stored when there is an open or short in the A/F sensor circuit, or if A/F sensor output drops.
To detect these problems, the voltage of the A/F sensor is monitored when turning the engine switch on (IG), and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is outside of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in the next driving cycle, the MIL is illuminated and a DTC is stored.
The Air Fuel ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. If the A/F sensor impedance (alternating current resistance) or output voltage deviates greatly from the standard range, the ECM determines that there is an open or short in the A/F sensor circuit.

WIRING DIAGRAM

Refer to DTC P0031 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

(a) Connect the tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.
(e) Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.

HINT:

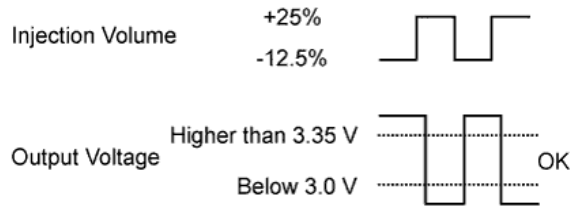
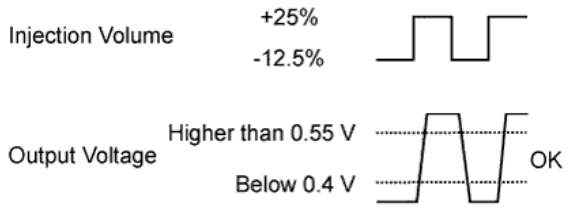
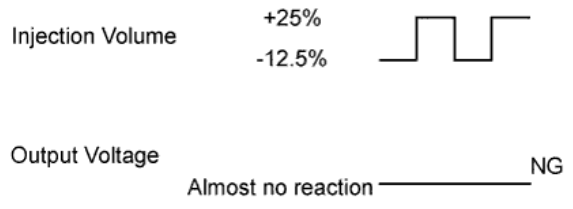
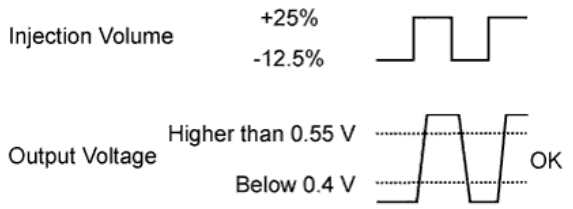
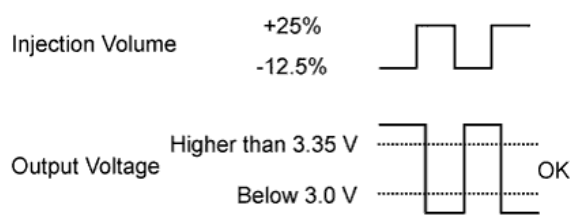
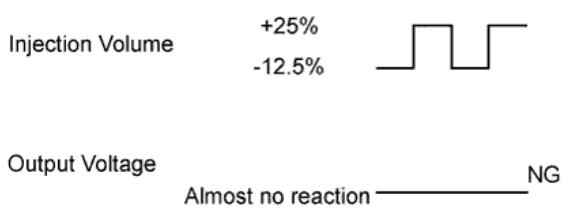
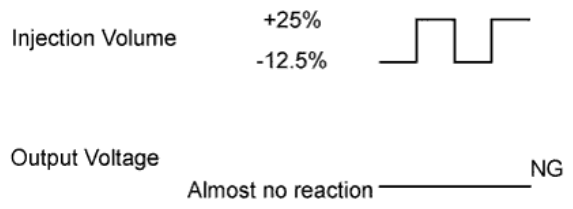
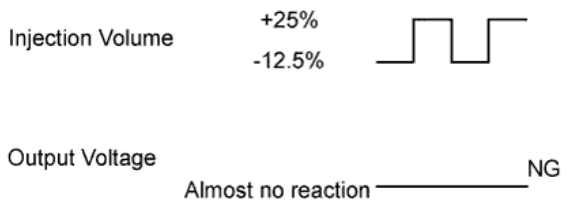
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Display Item (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.

To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the C22 or C23 Air Fuel ratio (A/F) sensor connector.

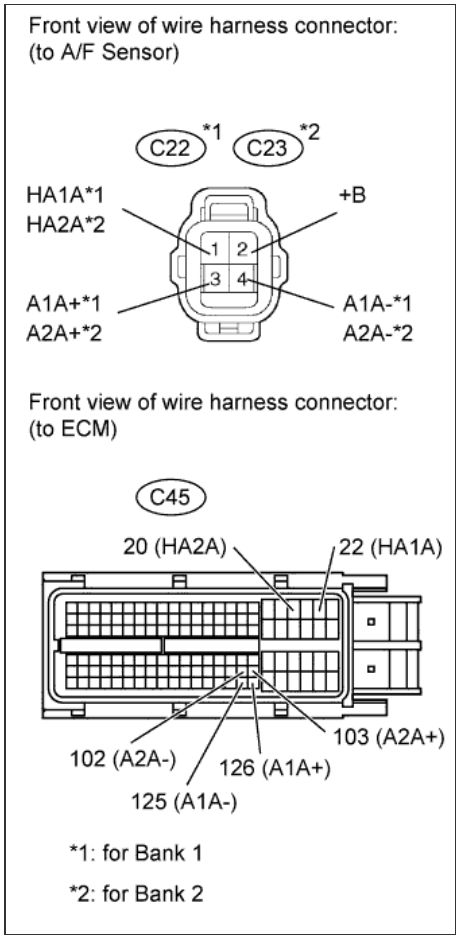
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the C45 ECM connector.



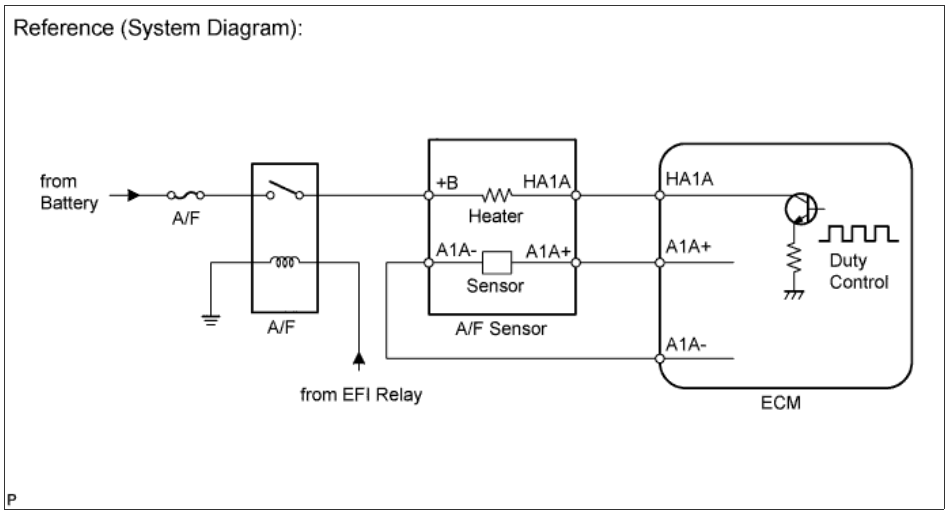
e. Measure the resistance according to the value(s) in the table below.

Standard Resistance

Tester Connection	Condition	Specified Condition

C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45- 126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45- 103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2237, P2238, P2239, P2240, P2241, P2242, P2252, P2253, P2255 or P2256 is output	B

B → REPLACE ECM (**Click here**)

A

END

DTC P0335 Crankshaft Position Sensor "A" Circuit

DTC P0337 Crankshaft Position Sensor "A" Circuit Low Input

DTC P0338 Crankshaft Position Sensor "A" Circuit High Input

DTC P0339 Crankshaft Position Sensor "A" Circuit Intermittent

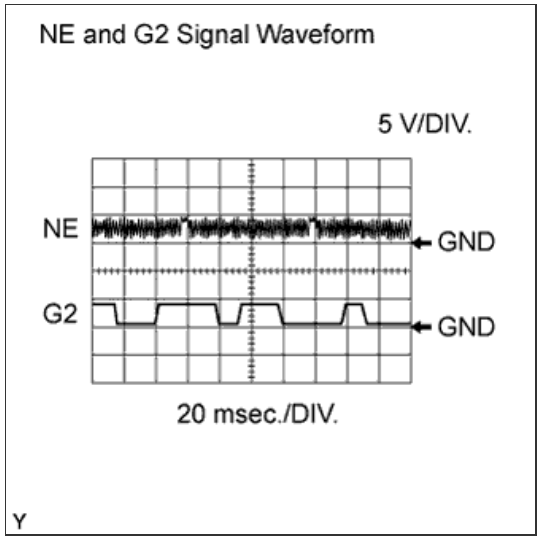
for Preparation Click here

DESCRIPTION

The Crankshaft Position (CKP) sensor system consists of a crankshaft position sensor plate and Magnetic Resistance Element (MRE) type sensor. The crankshaft position sensor plate has 34 teeth at 10° intervals (2 teeth are missing for detecting top dead center), and is installed to the rear end of the crankshaft. The crankshaft position sensor outputs 34 rotation signals per crankshaft revolution. The ECM uses the G2 signal to distinguish between the cylinders, and uses the NE signal to detect the crankshaft position and engine speed.

DTC Code	DTC Detection Condition	Trouble Area
P0335	• No Crankshaft Position (CKP) sensor signal is sent to the ECM while cranking (1 trip detection logic). • No CKP sensor signal is sent to the ECM at an engine speed of 600 rpm or more (1 trip detection logic).	• Open or short in Crankshaft Position (CKP) sensor circuit • CKP sensor • CKP sensor plate • ECM
P0337	The output voltage of the CKP sensor is 0.3 V or less for 4 seconds (1 trip detection logic).	• Open or short in CKP sensor circuit • CKP sensor • CKP sensor plate • ECM
P0338	The output voltage of the CKP sensor is 4.7 V or higher for 4 seconds (1 trip detection logic).	• Open or short in CKP sensor circuit • CKP sensor • CKP sensor plate • ECM
P0339	Under conditions (a), (b) and (c), no CKP sensor signal is sent to the ECM for 0.05 seconds or more (1 trip detection logic): (a) The engine speed is 1000 rpm or more. (b) The starter signal is OFF. (c) 3 seconds or more have elapsed since the starter signal was switched from ON to OFF.	• Open or short in CKP sensor circuit • CKP sensor • CKP sensor plate • ECM

Reference: Inspection using an oscilloscope.



Standard:

Tester Connection	Tool Setting	Condition	Specified Condition
C45-110 (NE+) - C45-111 (NE-)	5 V/DIV., 20 msec./DIV.	Cranking or idling	The correct waveform is as shown

C45-90 (G2) - C45-89 (G2-)	5 V/DIV., 20 msec./DIV.	Cranking or idling	The correct waveform is as shown

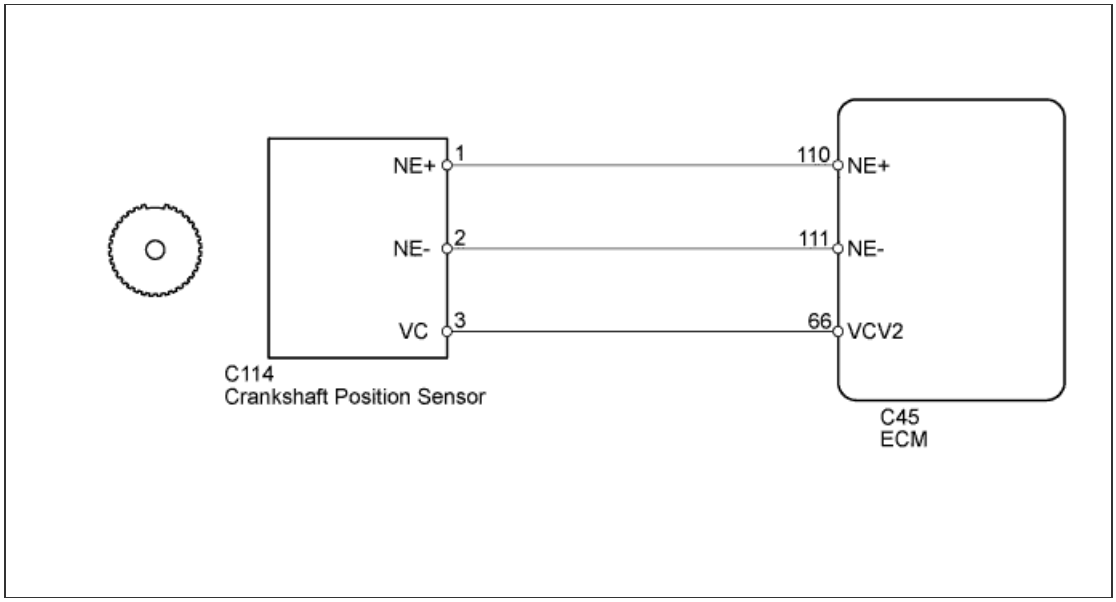
HINT:

G2 stands for the camshaft position sensor signal, and NE stands for the crankshaft position sensor signal.

MONITOR DESCRIPTION

If there is no signal from the crankshaft position sensor despite the engine revolving, the ECM interprets this as a malfunction of the sensor. When the sensor output voltage remains at below 0.3 V, or higher than 4.7 V for more than 4 seconds, the ECM stores DTC(s).

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **If no problem is found by this diagnostic troubleshooting procedure, check for problems by referring to the engine mechanical section.**
- **The engine speed can be checked by using the intelligent tester. To check, follow the procedures below:**
  1. **Connect the tester to the DLC3.**
  2. **Start the engine.**
  3. **Turn the tester on.**
  4. **Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Engine Speed.**
     The engine speed may be indicated as zero despite the engine revolving normally. This is caused by a lack of NE signals from the Crankshaft Position (CKP) sensor. Alternatively, the engine speed may be indicated as less than the actual engine speed, if the CKP sensor output voltage is insufficient.
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (ENGINE SPEED)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Engine Speed.

d. Start the engine.

e. Read the values displayed on the tester while the engine is running.

Standard:
Correct values are displayed.

HINT:

- **To check the engine speed change, display the graph on the intelligent tester.**
- **If the engine does not start, check the engine speed while cranking.**
- **If the engine speed indicated on the intelligent tester remains zero (0), there may be an open or short in the Crankshaft Position (CKP) sensor circuit.**

NG → Go to step 2

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

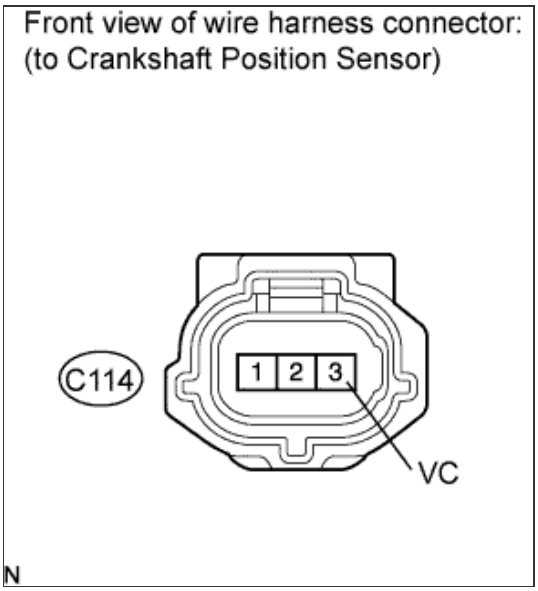
2.INSPECT CRANKSHAFT POSITION SENSOR (SENSOR POWER SOURCE)

a. Disconnect the C114 crankshaft position sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C114-3 (VC) - Body ground	Engine switch on (IG)	4.5 to 5.0 V



NG → Go to step 8

OK

3.CHECK HARNESS AND CONNECTOR (CRANKSHAFT POSITION SENSOR - ECM)

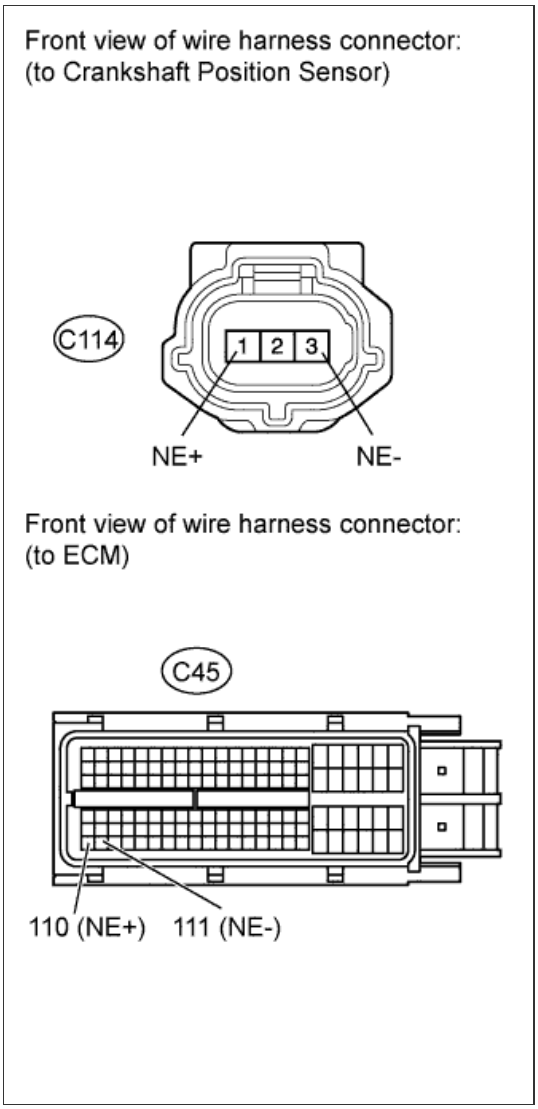
a. Disconnect the C114 crankshaft position sensor connector.

b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C114-1 (NE+) - C45-110 (NE+)	Always	Below 1 Ω
C114-2 (NE-) - C45-111 (NE-)	Always	Below 1 Ω
C114-1 (NE+) or C45-110 (NE+) - Body ground	Always	10 kΩ or higher
C114-2 (NE-) or C45-111 (NE-) - Body ground	Always	10 kΩ or higher



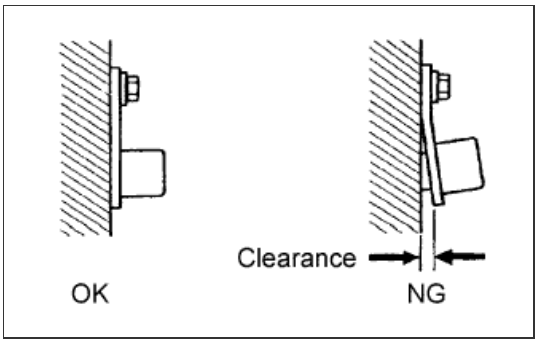
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.CHECK SENSOR INSTALLATION (CRANKSHAFT POSITION SENSOR)

a. Check the crankshaft position sensor installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

5.CHECK CRANKSHAFT POSITION SENSOR PLATE (TEETH OF SENSOR PLATE)

a. Check the teeth of the sensor plate.

OK:
Sensor plate does not have any cracks or deformation.

NG → REPLACE CRANKSHAFT POSITION SENSOR PLATE (Click here)

OK

6.REPLACE CRANKSHAFT POSITION SENSOR

a. Replace the crankshaft position sensor (Click here).

NEXT

7.CHECK WHETHER DTC OUTPUT RECURS (DTC P0335, P0337, P0338 AND/OR P0339)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No output	A
P0335, P0337, P0338 and/or P0339	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

8.CHECK HARNESS AND CONNECTOR (CRANKSHAFT POSITION SENSOR - ECM)

a. Disconnect the C114 crankshaft position sensor connector.

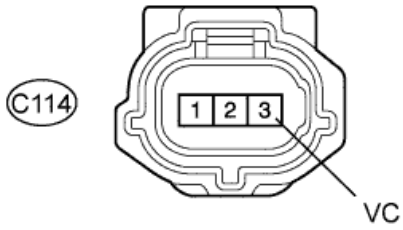
b. Disconnect the C45 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

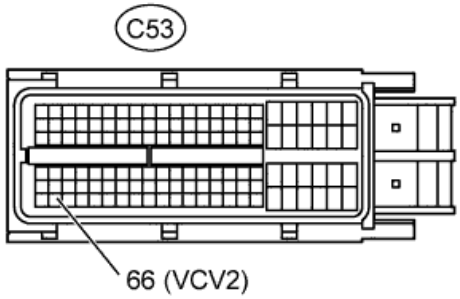
Standard Resistance:

Tester Connection	Condition	Specified Condition
C114-3 (VC) - C45-66 (VCV2)	Always	Below 1 Ω
C114-3 (VC) or C45-66 (VCV2) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Crankshaft Position Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

for Preparation Click here

DESCRIPTION

Refer to DTC P0031 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals A1A+ and A1A-/A2A+ and A2A- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in Air Fuel ratio (A/F) sensor (for Bank 1, 2 Sensor 1) circuit • Air Fuel ratio (A/F) sensor (for Bank 1, 2 Sensor 1) • ECM
P2238 P2241	• Case 1: Condition (a) or (b) continues for 5.0 seconds or more (1 trip detection logic): (a) The A1A+/A2A+ voltage is 0.5 V or less. (b) (A1A+/A2A+) - (A1A-/A2A-) = 0.1 V or less. • Case 2: The A/F sensor admittance is below 0.022 1/Ω (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2239 P2242	The A1A+/A2A+ voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2252 P2255	The A1A-/A2A- voltage is 0.5 V or less for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM
P2253 P2256	The A1A-/A2A- voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for Bank 1, 2 Sensor 1) circuit • A/F sensor (for Bank 1, 2 Sensor 1) • ECM

HINT:

- **DTCs P2237, P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2240, P2241, P2242, P2255 and P2256 indicate malfunctions related to the bank 2 A/F sensor circuit.**

MONITOR DESCRIPTION

These DTCs are stored when there is an open or short in the A/F sensor circuit, or if A/F sensor output drops.
To detect these problems, the voltage of the A/F sensor is monitored when turning the engine switch on (IG), and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is outside of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in the next driving cycle, the MIL is illuminated and a DTC is stored.
The Air Fuel ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. If the A/F sensor impedance (alternating current resistance) or output voltage deviates greatly from the standard range, the ECM determines that there is an open or short in the A/F sensor circuit.

WIRING DIAGRAM

Refer to DTC P0031 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

(a) Connect the tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.
(e) Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.

HINT:

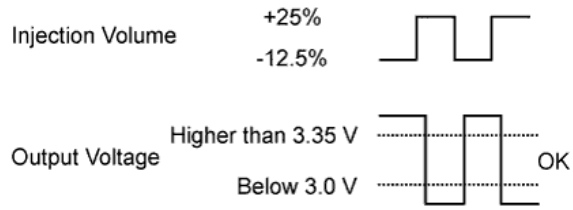
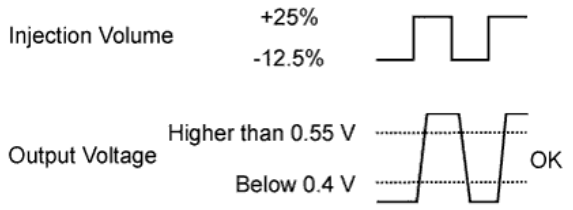
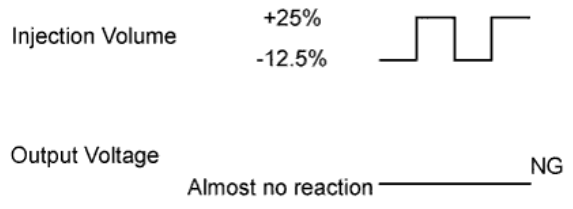
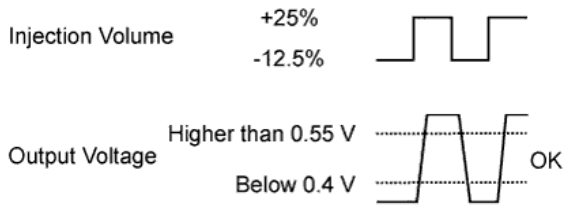
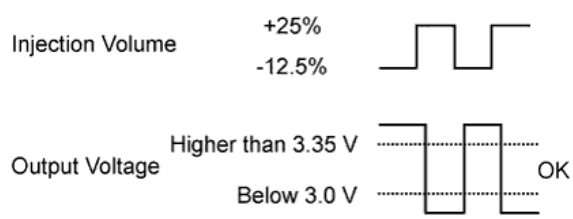
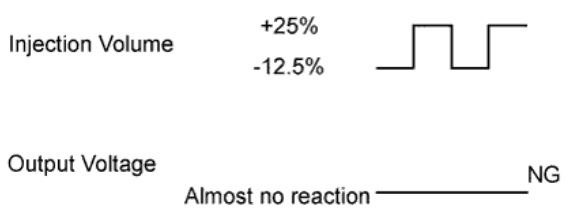
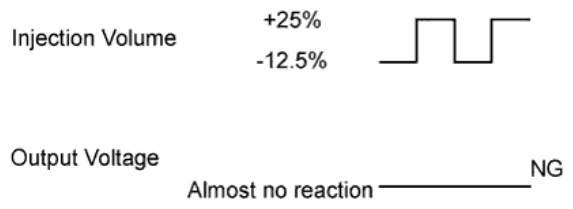
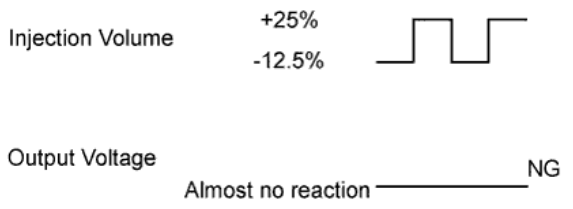
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Display Item (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.

To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2.

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder*.**
  ***: The No. 1 cylinder is the cylinder which is farthest from the transmission.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the C22 or C23 Air Fuel ratio (A/F) sensor connector.

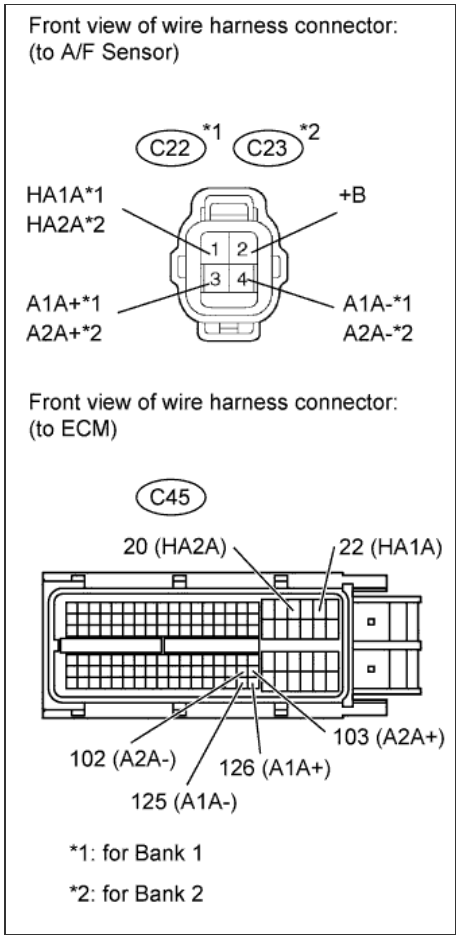
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the C45 ECM connector.



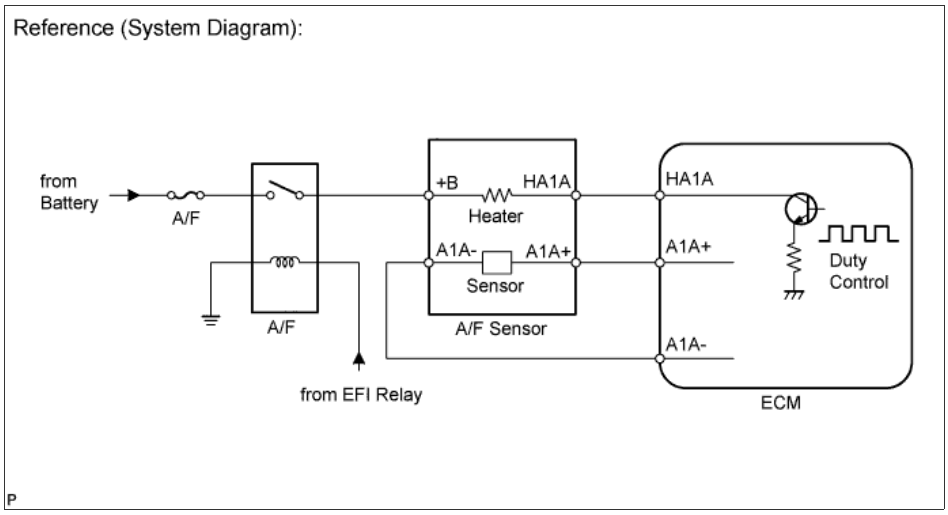
e. Measure the resistance according to the value(s) in the table below.

Standard Resistance

Tester Connection	Condition	Specified Condition

C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45- 126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45- 103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2237, P2238, P2239, P2240, P2241, P2242, P2252, P2253, P2255 or P2256 is output	B

B → REPLACE ECM (**Click here**)

A

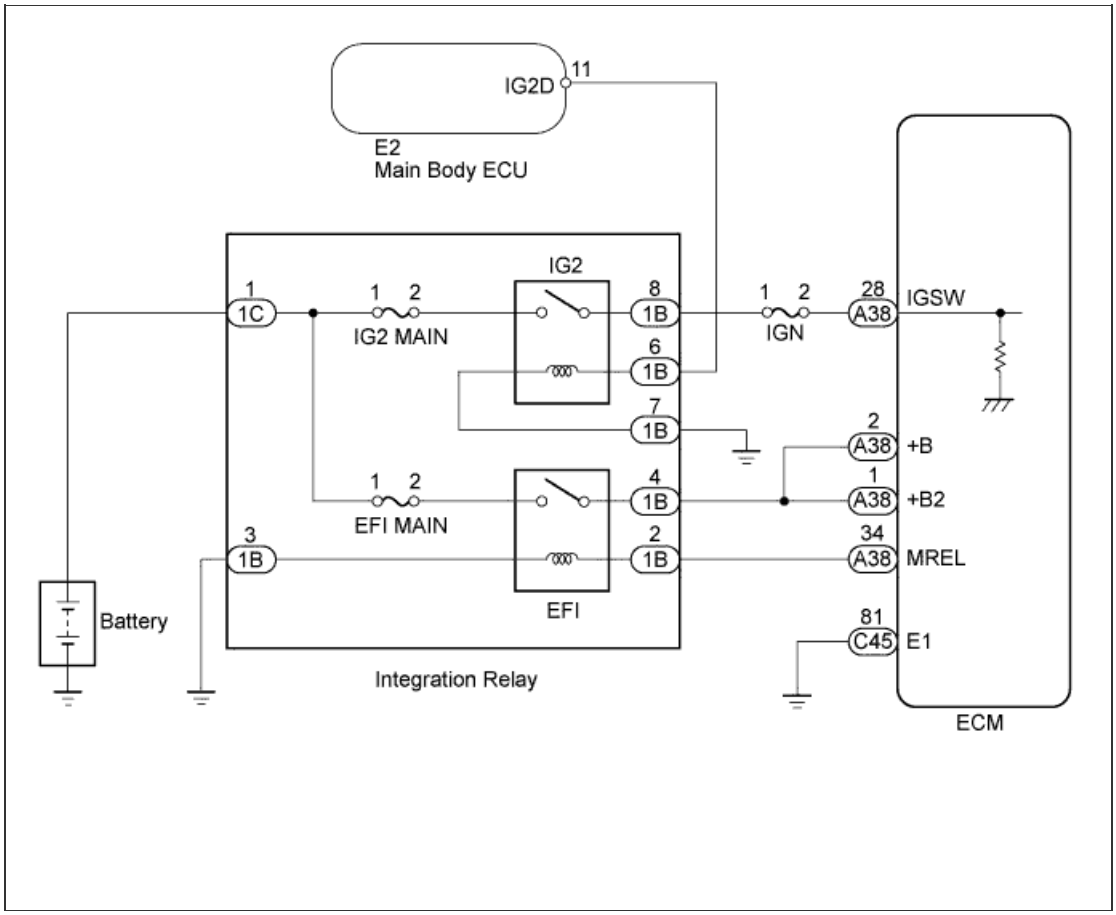
END

for Preparation Click here

DESCRIPTION

When the engine switch is turned on (IG), battery voltage is applied to the IGSW of the ECM. The output signal from the MREL terminal of the ECM causes a current to flow to the coil, closing the contacts of the integration relay (EFI relay) and supplying power to either terminal +B or +B2 of the ECM.

WIRING DIAGRAM



INSPECTION PROCEDURE

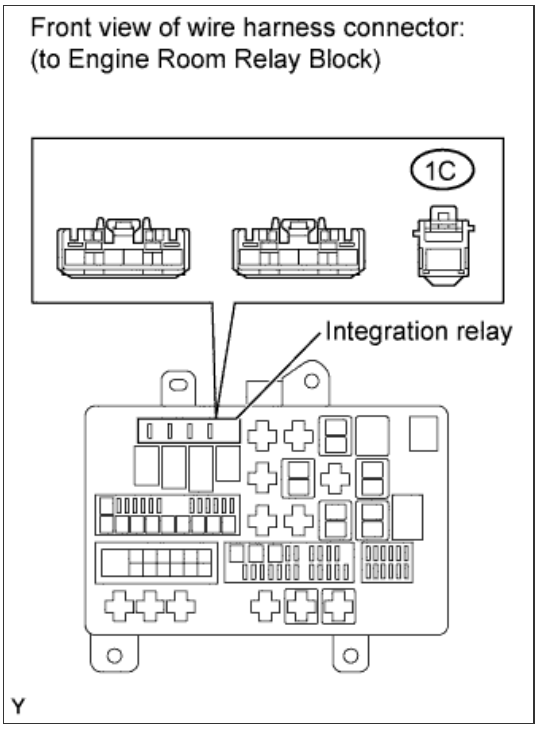
1.INSPECT INTEGRATION NO.1 RELAY (INTEGRATION RELAY - BODY GROUND)

a. Remove the integration relay from the engine room relay block.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
1C-1 - Body ground	Always	11 to 14 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.INSPECT INTEGRATION NO.1 RELAY (EFI AND IG2 RELAY)

a. Remove the integration relay from the engine room relay block.

b. Inspect the EFI MAIN fuse and the IG2 MAIN fuse.

i. Remove the EFI MAIN fuse and IG2 MAIN fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

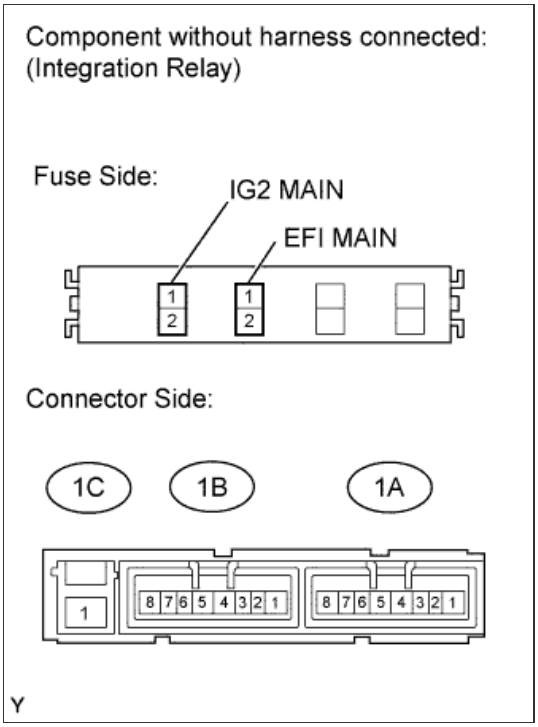
Tester Connection	Condition	Specified Condition
EFI MAIN fuse	Always	Below 1 Ω
IG2 MAIN fuse	Always	Below 1 Ω

c. Inspect the EFI relay and the IG2 relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1B-4	Battery voltage is not applied to terminals 1B-2 and 1B-3	10 kΩ or higher
	Battery voltage is applied to terminals 1B-2 and 1B-3	Below 1 Ω
1C-1 - 1B-8	Battery voltage is not applied to terminals 1B-7 and 1B-6	10 kΩ or higher
	Battery voltage is applied to terminals 1B-7 and 1B-6	Below 1 Ω



NG → REPLACE INTEGRATION NO.1 RELAY

OK

3.CHECK HARNESS AND CONNECTOR (+B, +B2 AND MREL CIRCUIT)

a. Check the harness and the connectors between the integration relay and the ECM.

i. Remove the integration relay from the engine room relay block.

ii. Disconnect the ECM connector.

iii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

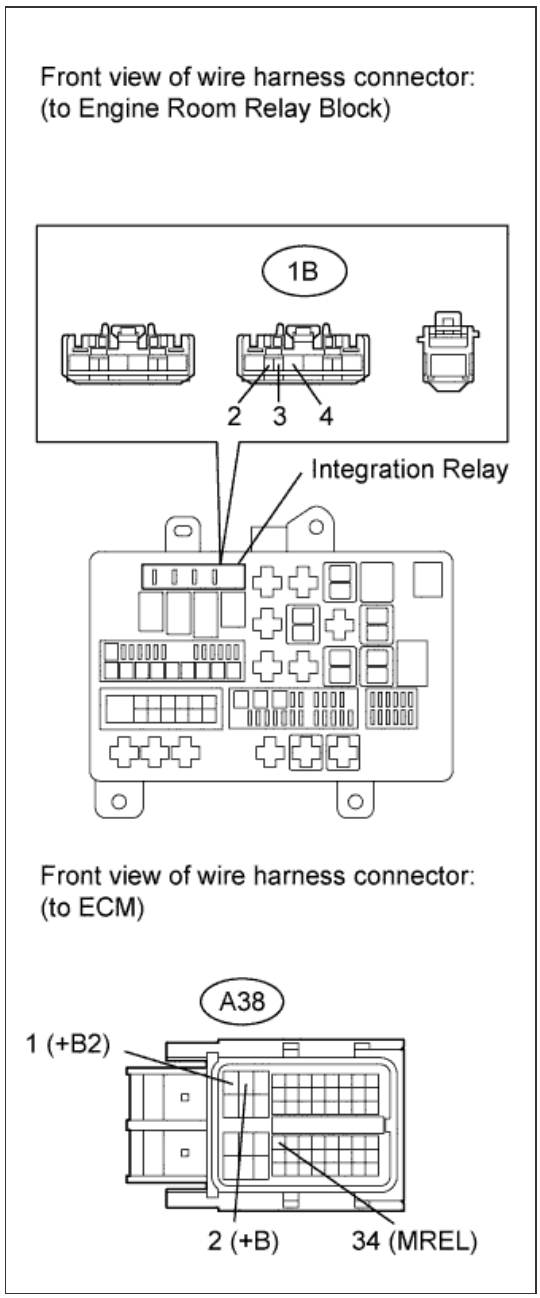
Tester Connection	Condition	Specified Condition
A38-34 (MREL) - 1B-2	Always	Below 1 Ω
A38-2 (+B) - 1B-4	Always	Below 1 Ω
A38-1 (+B2) - 1B-4	Always	Below 1 Ω
A38-34 (MREL) or 1B-2 - Body ground	Always	10 kΩ or higher
A38-2 (+B) or 1B-4 - Body ground	Always	10 kΩ or higher
A38-1 (+B2) or 1B-4 - Body ground	Always	10 kΩ or higher

b. Check the harness and connectors between the integration relay and body ground.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1B-3 - Body ground	Always	Below 1 Ω



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

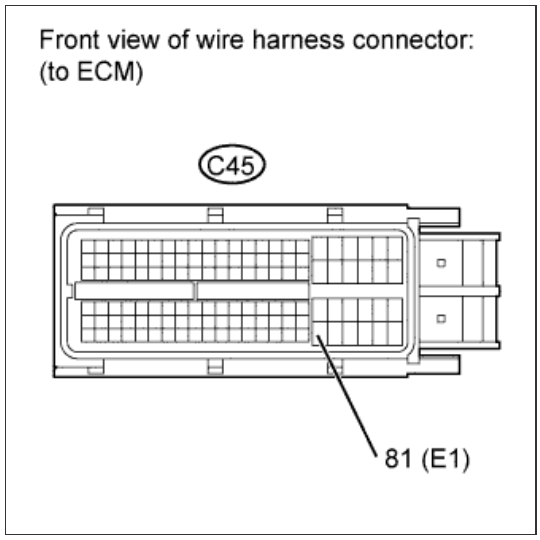
4.CHECK HARNESS AND CONNECTOR (ECM - BODY GROUND)

a. Disconnect the ECM connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C45-81 (E1) - Body ground	Always	Below 1 Ω



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

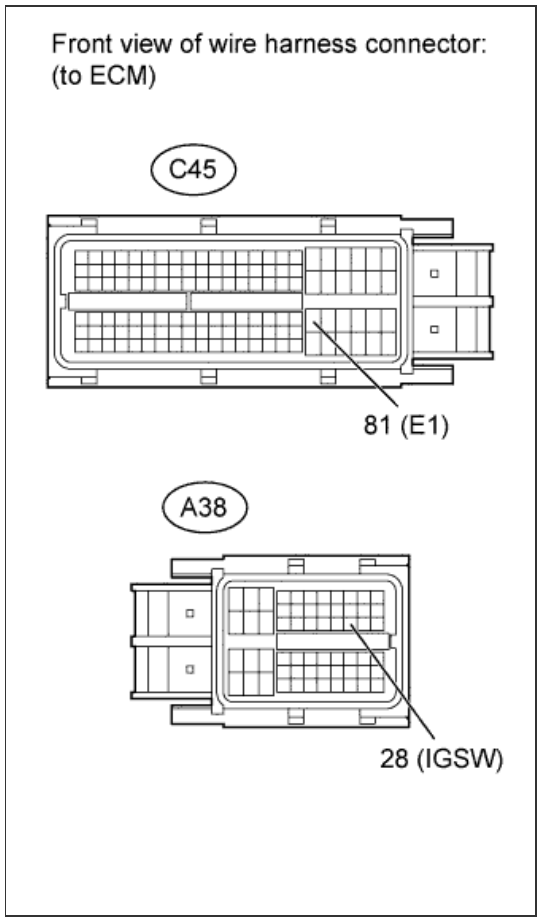
5.INSPECT ECM (IGSW VOLTAGE)

a. Disconnect the ECM connectors.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A38-28 (IGSW) - C45-81 (E1)	Engine switch on (IG)	11 to 14 V



NG → Go to step 6

OK

REPLACE ECM (Click here)

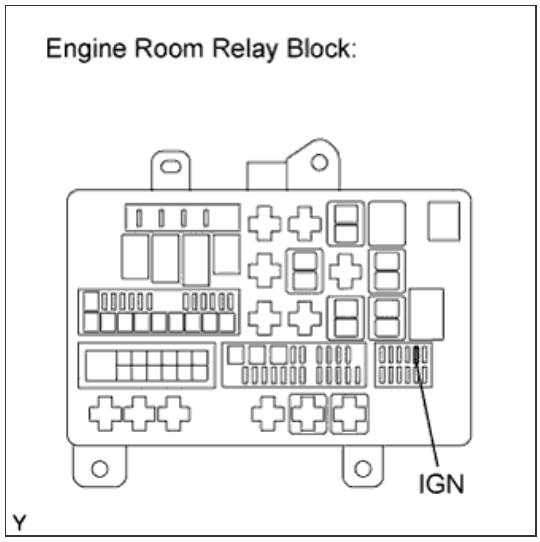
6.INSPECT FUSE (IGN)

a. Remove the IGN fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
IGN fuse	Always	Below 1 Ω



NG → CHECK FOR SHORT IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

OK

7.CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - ECM, INTEGRATION RELAY - BODY GROUND)

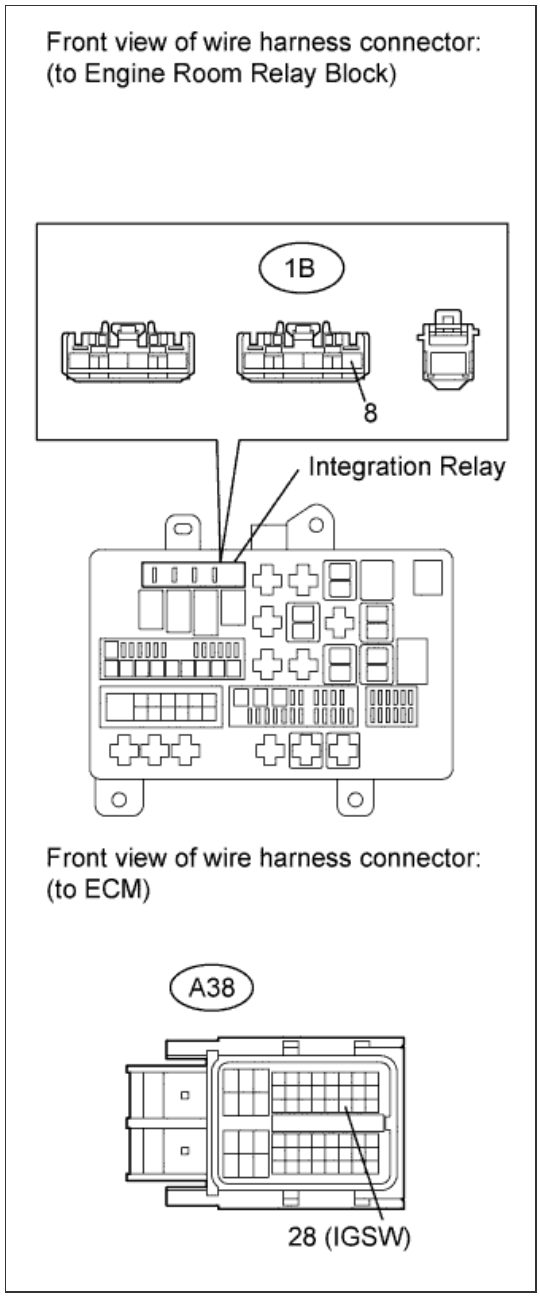
a. Remove the integration relay from the engine room relay block.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1B-8 - A38-28 (IGSW)	Always	Below 1 Ω
1B-8 or A38-28 (IGSW) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

8.CHECK HARNESS AND CONNECTOR (MAIN BODY ECU - ENGINE ROOM RELAY BLOCK)

a. Remove the integration relay from the engine room relay block.

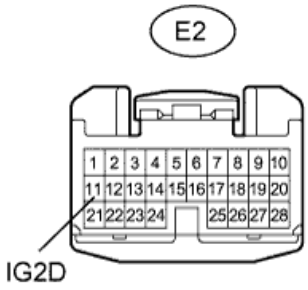
b. Disconnect the E2 main body ECU connector.

c. Measure the resistance according to the value(s) in the table below.

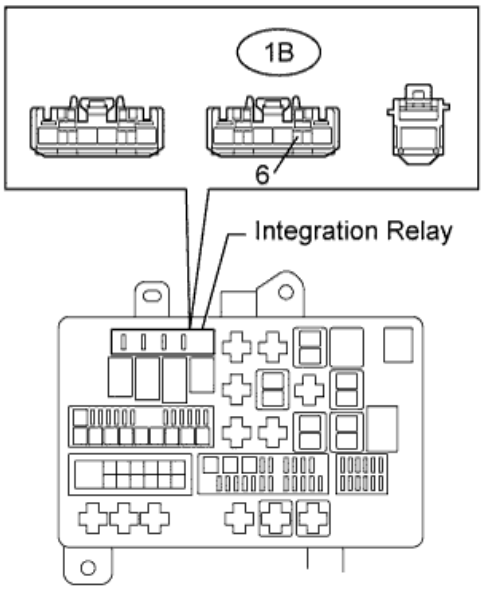
Standard Resistance:

Tester Connection	Condition	Specified Condition
E2-11 (IG2D) - 1B-6	Always	Below 1 Ω
E2-11 (IG2D) or 1B-6 - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Main Body ECU)



Front view of wire harness connector:
(to Engine Room Relay Block)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.CHECK ENTRY AND START SYSTEM (POWER SOURCE MODE DOES NOT CHANGE)

a. Check the entry and start system (Click here).

NG → REPAIR ENTRY AND START SYSTEM

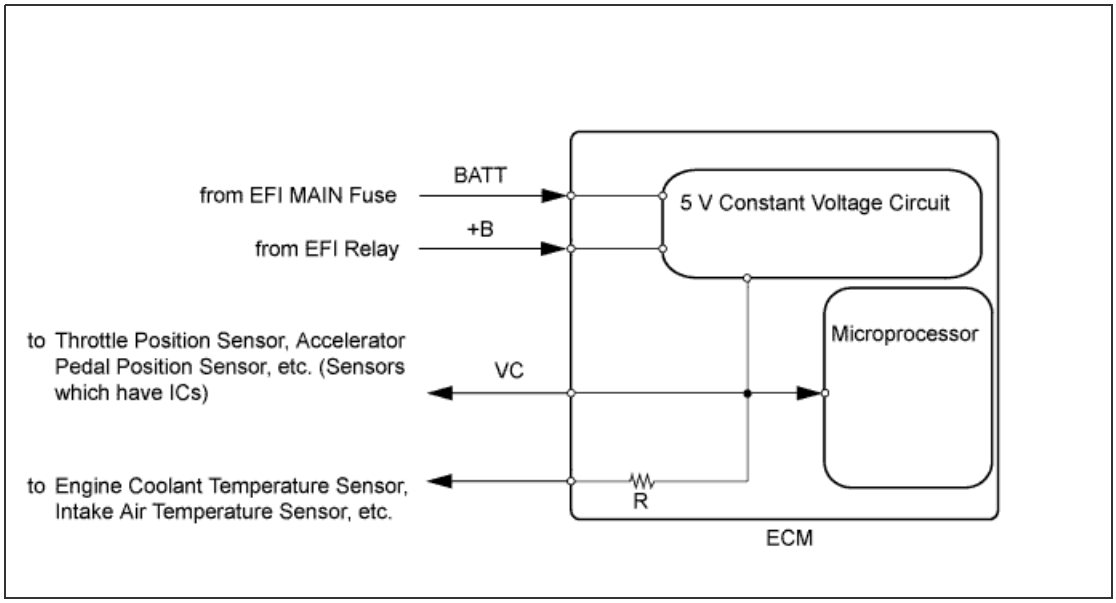
OK

REPLACE ECM (**Click here**)

for Preparation Click here

DESCRIPTION

The ECM constantly generates 5 V power from the battery voltages supplied to the +B (BATT) terminal to operate the microprocessor. The ECM also provides this power to the sensors through the VC output circuit.

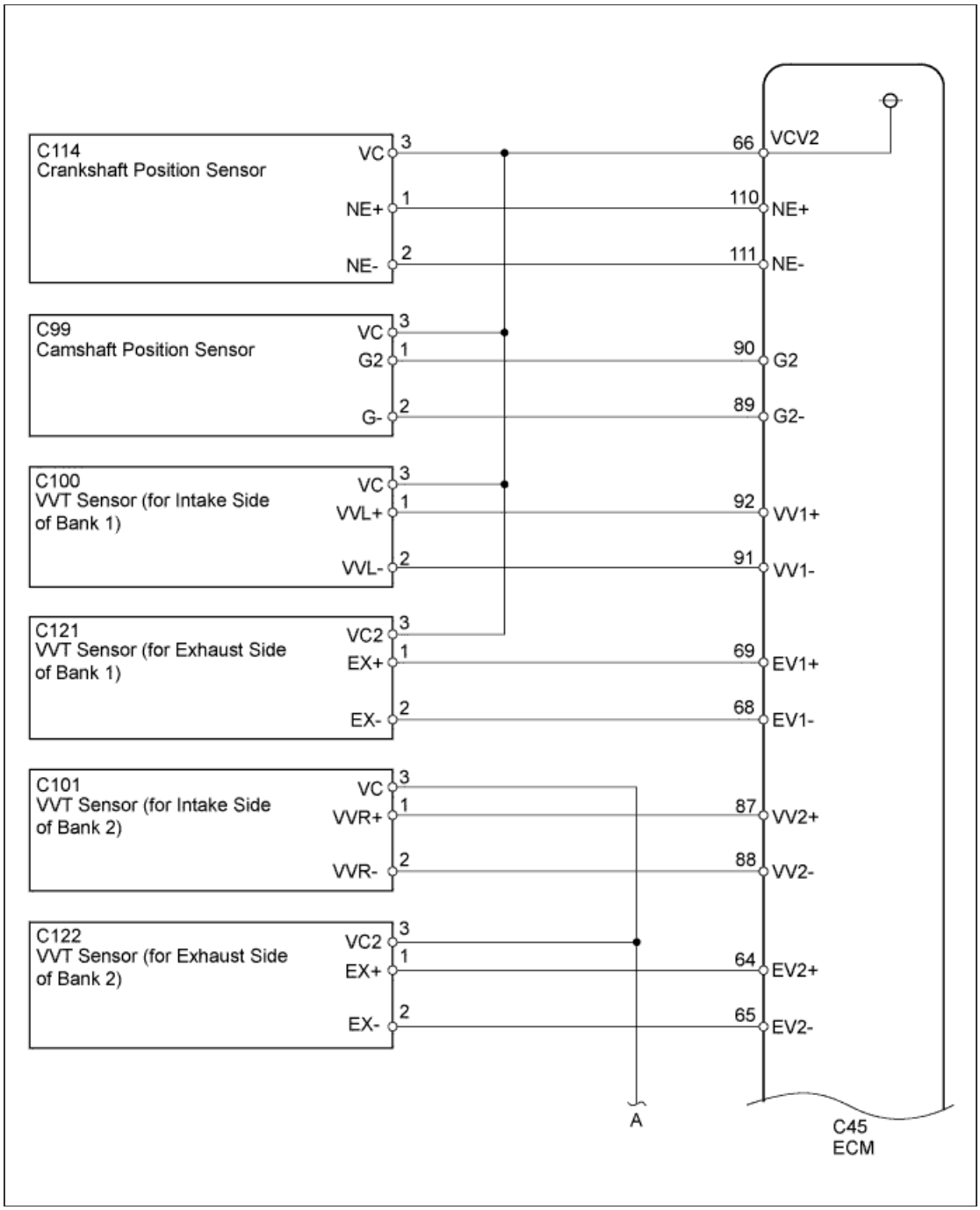


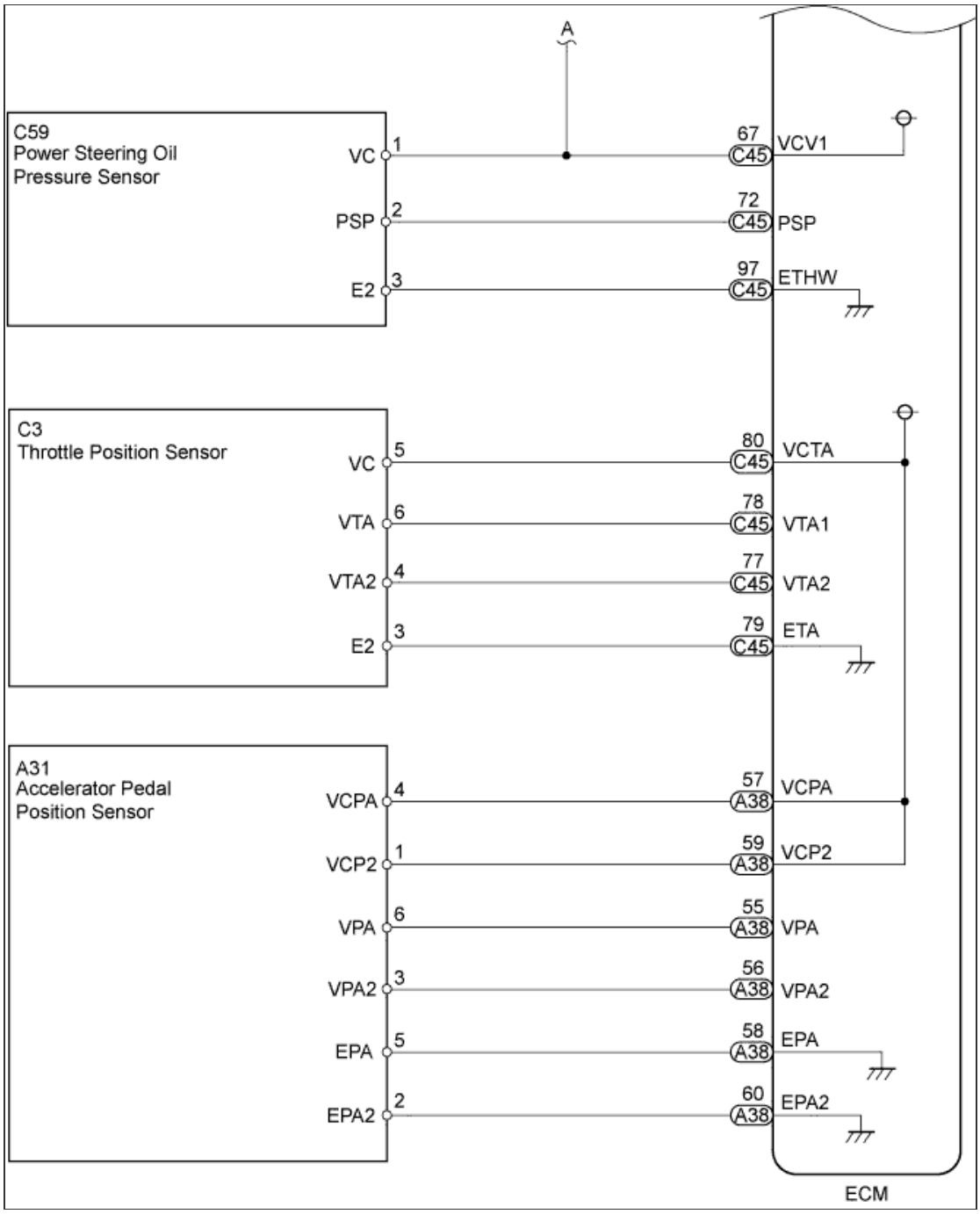
When the VC circuit is short-circuited, the microprocessor in the ECM and sensors that are supplied with power through the VC circuit are inactivated because the power is not supplied from the VC circuit. Under this condition, the system does not start up and the MIL does not illuminate even if the system malfunctions.

HINT:

Under normal conditions, the MIL is illuminated for several seconds when the engine switch is first turned on (IG). The MIL goes off when the engine is started.

WIRING DIAGRAM


C114
Crankshaft Position Sensor
VC
3
NE+
1
NE-
2
C99
Camshaft Position Sensor
VC
3
G2
1
G-
2
C100
VVT Sensor (for Intake Side of Bank 1)
VC
3
VVL+
1
VVL-
2
C121
VVT Sensor (for Exhaust Side of Bank 1)
VC2
3
EX+
1
EX-
2
C101
VVT Sensor (for Intake Side of Bank 2)
VC
3
VVR+
1
VVR-
2
C122
VVT Sensor (for Exhaust Side of Bank 2)
VC2
3
EX+
1
EX-
2
66
VCV2
110
NE+
111
NE-
90
G2
89
G2-
92
VV1+
91
VV1-
69
EV1+
68
EV1-
87
VV2+
88
VV2-
64
EV2+
65
EV2-
A
C45
ECM



INSPECTION PROCEDURE

1.CHECK MIL

a. Check that the Malfunction Indicator Lamp (MIL) lights up when turning the engine switch on (IG).

OK:
MIL lights up

NG → Go to step 2

OK

SYSTEM OK

2.CHECK COMMUNICATION BETWEEN INTELLIGENT TESTER AND ECM

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and tester on.

c. Check the communication between the tester and ECM.

Result

Result	Proceed to
Communication is possible	A
Communication is not possible	B

A → GO TO MIL CIRCUIT (Click here)

B

3.CHECK MIL (THROTTLE POSITION SENSOR)

a. Disconnect the C3 throttle body connector.

b. Turn the engine switch on (IG).

c. Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

A → REPLACE THROTTLE BODY ASSEMBLY (Click here)

B

4.CHECK MIL (ACCELERATOR PEDAL POSITION SENSOR)

a. Disconnect the A31 accelerator pedal position sensor connector.

b. Turn the engine switch on (IG).

c. Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

A → REPLACE ACCELERATOR PEDAL POSITION SENSOR (Click here)

B

5.CHECK MIL (POWER STEERING OIL PRESSURE SENSOR)

a. Disconnect the C59 power steering oil pressure sensor connector.

b. Turn the engine switch on (IG).

c. Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

A → REPLACE POWER STEERING OIL PRESSURE SENSOR (Click here)

B

6.CHECK MIL (CAMSHAFT POSITION SENSOR)

a. Disconnect the C99 camshaft position sensor connector.

b. Turn the engine switch on (IG).

c. Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

A → REPLACE CAMSHAFT POSITION SENSOR (Click here)

B

7.CHECK MIL (CRANKSHAFT POSITION SENSOR)

a. Disconnect the C114 crankshaft position sensor connector.

b. Turn the engine switch on (IG).

c. Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

A → REPLACE CRANKSHAFT POSITION SENSOR (Click here)

B

8.CHECK MIL (VVT SENSOR for Intake Side of Bank 1)

a. Disconnect the C100 VVT sensor (for Intake Side of Bank 1) connector.

b. Turn the engine switch on (IG).

c. Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

A → REPLACE VVT SENSOR (for Intake Side of Bank 1) (Click here)

B

9.CHECK MIL (VVT SENSOR for Exhaust Side of Bank 1)

a. Disconnect the C121T sensor (for Exhaust Side of Bank 1) connector.

b. Turn the engine switch on (IG).

c. Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

A → REPLACE VVT SENSOR (for Exhaust Side of Bank 1) (Click here)

B

10.CHECK MIL (VVT SENSOR for Intake Side of Bank 2)

a. Disconnect the C101 VVT sensor (for Intake Side of Bank 2) connector.

b. Turn the engine switch on (IG).

c. Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

A → REPLACE VVT SENSOR (for Intake Side of Bank 2) (Click here)

B

11.CHECK MIL (VVT SENSOR for Exhaust Side of Bank 2)

a. Disconnect the C122T sensor (for Exhaust Side of Bank 2) connector.

b. Turn the engine switch on (IG).

c. Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

A → REPLACE VVT SENSOR (for Exhaust Side of Bank 2) (Click here)

B

12.CHECK HARNESS AND CONNECTOR

a. Disconnect the C3throttle body connector.

b. Disconnect the A31 accelerator pedal position sensor connector.

c. Disconnect the C59 power steering oil pressure sensor connector.

d. Disconnect the C99 camshaft position sensor connector.

e. Disconnect the C114 crankshaft position sensor connector.

f. Disconnect the C100 VVT sensor (for Intake Side of Bank 1) connector.

g. Disconnect the C121 VVT sensor (for Exhaust Side of Bank 1) connector.

h. Disconnect the C101 VVT sensor (for Intake Side of Bank 2) connector.

i. Disconnect the C122 VVT sensor (for Exhaust Side of Bank 2) connector.

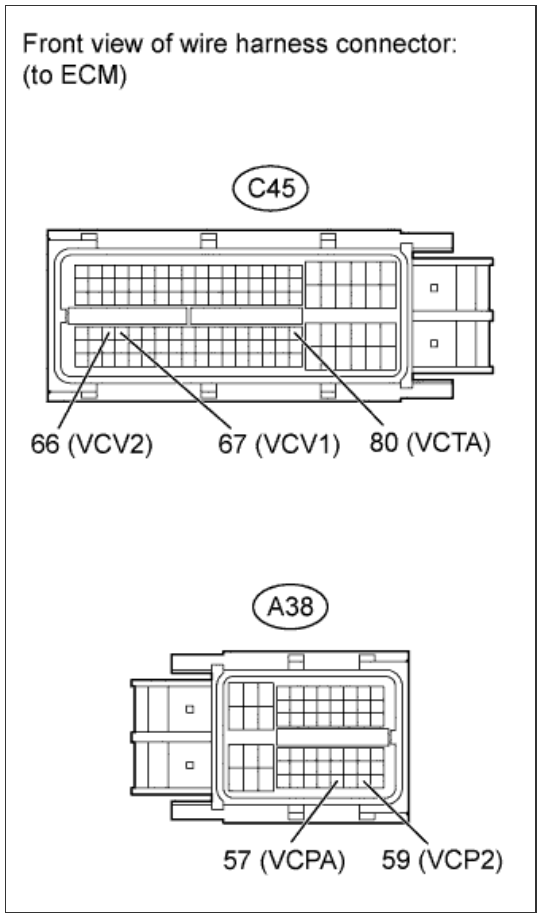
j. Disconnect the ECM connectors.

k. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C45-80 (VCTA) - Body ground	Always	10 kΩ or higher

A38-57 (VCPA) - Body ground	Always	10 kΩ or higher
A38-59 (VCP2) - Body ground	Always	10 kΩ or higher
C45-66 (VCV2) - Body ground	Always	10 kΩ or higher
C45-67 (VCV1) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

for Preparation Click here

DESCRIPTION

The fuel pump circuit consists of the ECM, fuel pump and fuel pump ECU (which operates the fuel pump). Based on the engine output, the ECM determines the fuel pump speed. The speed is then converted to a duty signal and sent to the fuel pump ECU. Based on the signal sent from the ECM, the fuel pump ECU adjusts the fuel pump operation speed between 3 settings.

WIRING DIAGRAM

Refer to DTC P0230 (Click here).

INSPECTION PROCEDURE

This troubleshooting procedure is based on the premise that the engine is started. If the engine is not started, proceed to the Problem Symptoms Table (Click here).

1.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (FUEL PUMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Fuel Pump / Speed.

d. Check whether operating sounds can be heard while operating the fuel pump using the tester.

OK:

Operating sounds can be heard from fuel pump.

NG → Go to step 5

OK ↓

2.CHECK HARNESS AND CONNECTOR (FUEL PUMP ECU - ECM, BODY GROUND)

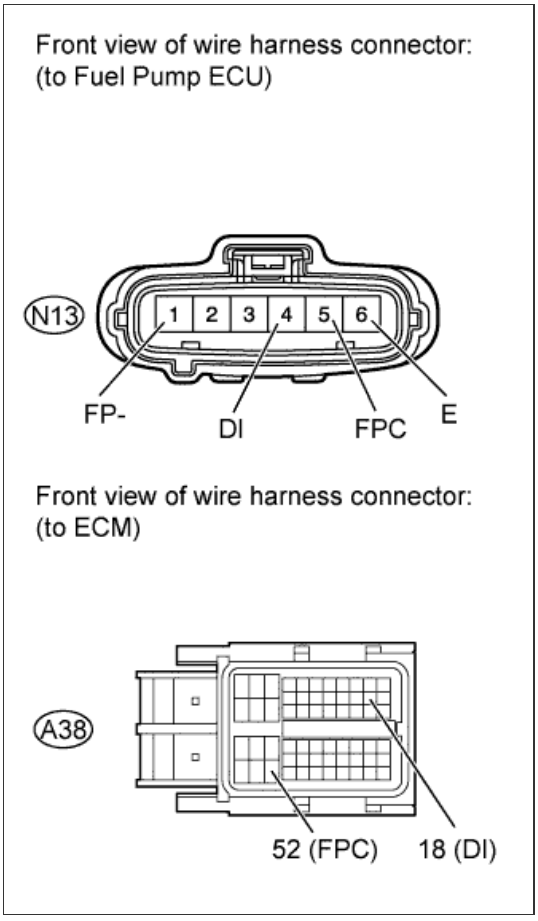
a. Disconnect the N3 fuel pump ECU connector.

b. Disconnect the A38 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
N13-5 (FPC) - A38-52 (FPC)	Always	Below 1 Ω
N13-4 (DI) - A38-18 (DI)	Always	Below 1 Ω
N13-6 (E) - Body ground	Always	Below 1 Ω
N13-1 (FP-) - Body ground	Always	10 kΩ or higher
N13-5 (FPC) or A38-52 (FPC) - Body ground	Always	10 kΩ or higher
N13-4 (DI) or A38-18 (DI) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.REPLACE FUEL PUMP ECU

a. Replace the fuel pump ECU (Click here).

NEXT

4.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Check the fuel pump operation.

OK:
Malfunction has been repaired successfully.

NG → REPLACE ECM (Click here)

OK

END

5.INSPECT CIRCUIT OPENING RELAY (C/OPN)

a. Inspect the circuit opening relay (C/OPN) (Click here).

NG → REPLACE CIRCUIT OPENING RELAY (C/OPN)

OK

6.INSPECT CIRCUIT OPENING RELAY (POWER SOURCE VOLTAGE)

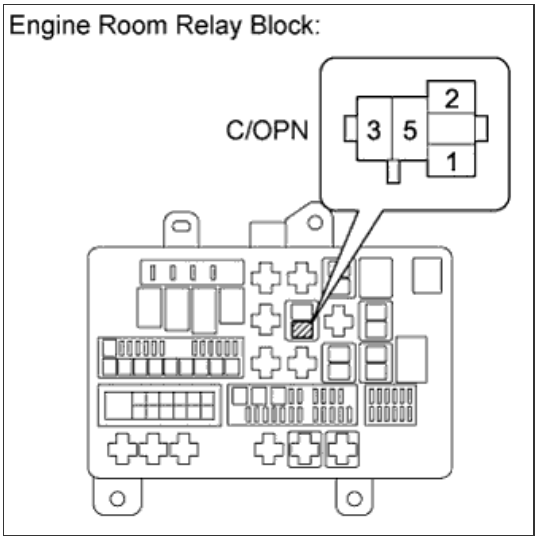
a. Remove the circuit opening relay (C/OPN) from the engine room relay block.

b. Turn the engine switch on (IG).

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C/OPN relay (2) - Body ground	Engine switch on (IG)	11 to 14 V
C/OPN relay (5) - Body ground	Engine switch on (IG)	11 to 14 V



NG → Go to step 13

OK

7.CHECK HARNESS AND CONNECTOR (CIRCUIT OPENING RELAY - ECU, FUEL PUMP ECU)

a. Remove the circuit opening relay (C/OPN) from the engine room relay block.

b. Disconnect the A38 ECM connector.

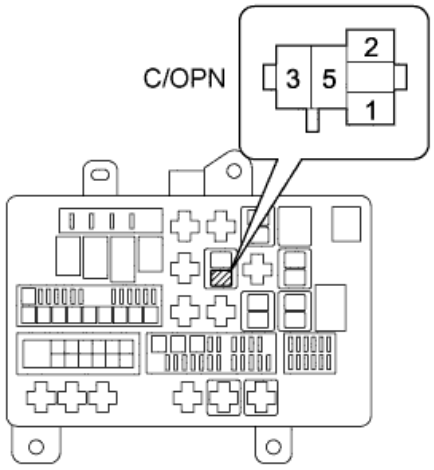
c. Disconnect the N13 fuel pump ECU connector.

d. Measure the resistance according to the value(s) in the table below.

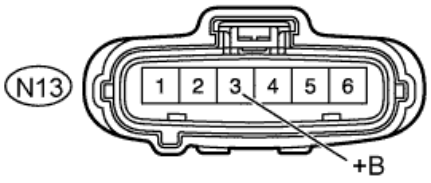
Standard Resistance:

Tester Connection	Condition	Specified Condition
C/OPN relay (1) - A38-48 (FC)	Always	Below 1 Ω
C/OPN relay (3) - N13-3 (+B)	Always	Below 1 Ω
C/OPN relay (1) or A38-48 (FC) - Body ground	Always	10 kΩ or higher
C/OPN relay (3) or N13-3 (+B) - Body ground	Always	10 kΩ or higher

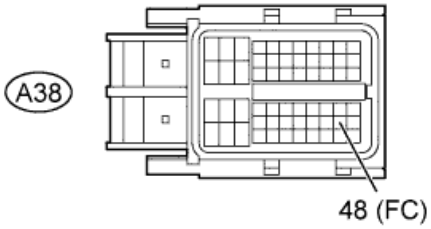
Engine Room Relay Block:



Front view of wire harness connector:
(to Fuel Pump ECU)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

.CHECK HARNESS AND CONNECTOR (FUEL PUMP - FUEL PUMP ECU)

a. Disconnect the N1 fuel pump connector.

b. Disconnect the N13 fuel pump ECU connector.

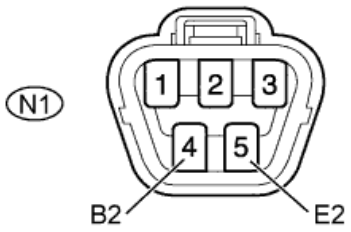
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

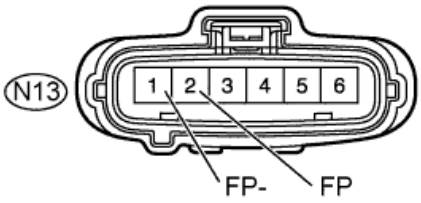
Tester Connection	Condition	Specified Condition
N1-4 (B2) - N13-2 (FP)	Always	Below 1 Ω
N1-5 (E2) - N13-1 (FP-)	Always	Below 1 Ω

N1-4 (B2) or N13-2 (FP) - Body ground	Always	10 kΩ or higher
N1-5 (E2) or N13-1 (FP-) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Fuel Pump)



Front view of wire harness connector:
(to Fuel Pump ECU)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

.INSPECT FUEL PUMP

a. Inspect the fuel pump (Click here).

NG → REPLACE FUEL PUMP (Click here)

OK

1 .CHECK HARNESS AND CONNECTOR (FUEL PUMP ECU - ECM, BODY GROUND)

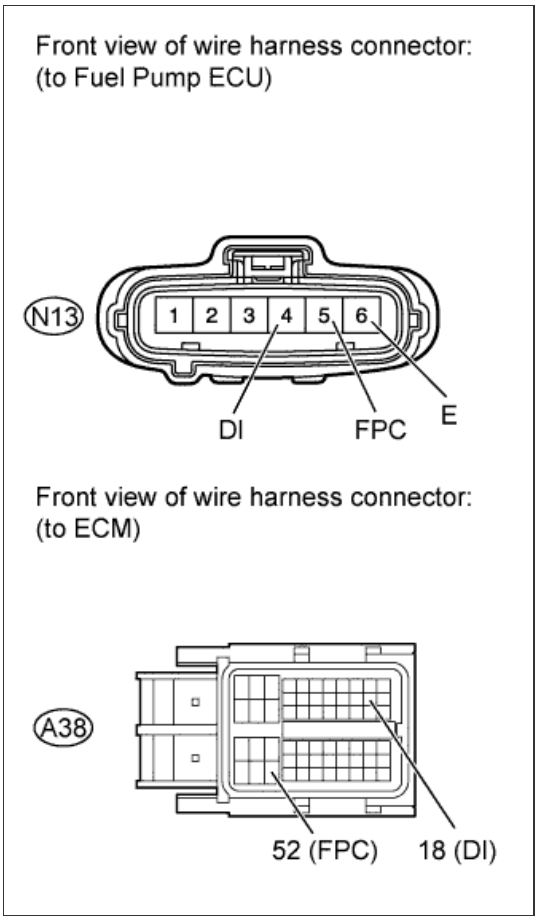
a. Disconnect the N13 fuel pump ECU connector.

b. Disconnect the A38 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
N13-5 (FPC) - A38-52 (FPC)	Always	Below 1 Ω
N13-4 (DI) - A38-18 (DI)	Always	Below 1 Ω
N13-6 (E) - Body ground	Always	Below 1 Ω
N13-5 (FPC) or A38-52 (FPC) - Body ground	Always	10 kΩ or higher
N13-4 (DI) or A38-18 (DI) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

11.REPLACE FUEL PUMP ECU

a. Replace the fuel pump ECU (Click here).

NEXT

12.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Check the fuel pump operation.

OK:
Malfunction has been repaired successfully.

NG → REPLACE ECM (**Click here**)

OK

END

13.CHECK HARNESS AND CONNECTOR (CIRCUIT OPENING RELAY - EFI NO. 2 RELAY, IGN FUSE)

a. Remove the circuit opening relay (C/OPN) from the engine room relay block.

b. Remove the EFI NO. 2 relay (EFI NO. 2) from the engine room relay block.

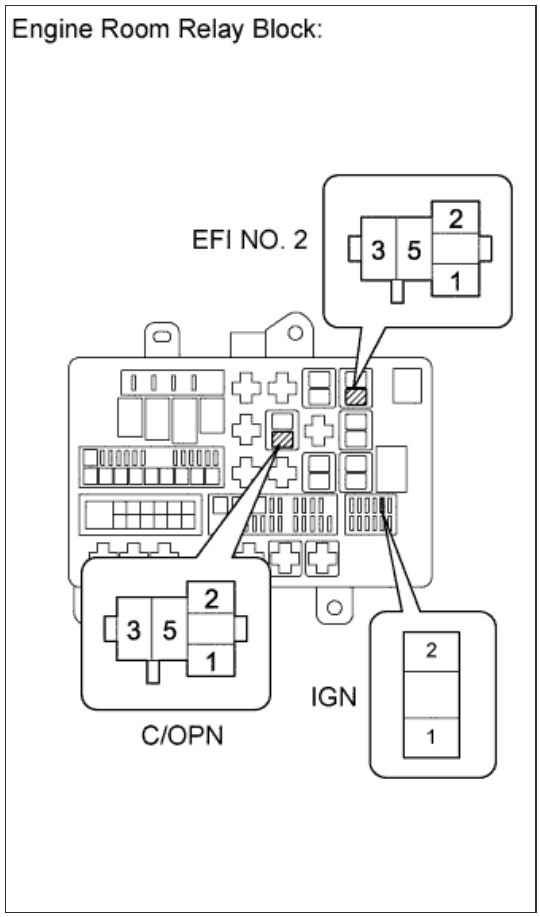
c. Remove the IGN fuse from the engine room relay block.

d. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition

C/OPN relay (2) - IGN fuse (2)	Always	Below 1 Ω
C/OPN relay (5) - EFI NO. 2 relay (3)	Always	Below 1 Ω
C/OPN relay (2) or IGN fuse (2) - Body ground	Always	10 kΩ or higher
C/OPN relay (5) or EFI NO. 2 relay (3) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

14.INSPECT EFI NO. 2 RELAY (EFI NO. 2)

a. Inspect the EFI NO. 2 relay (EFI NO. 2) (Click here).

NG → REPLACE EFI NO. 2 RELAY (EFI NO. 2)

OK

15.CHECK HARNESS AND CONNECTOR (EFI NO. 2 RELAY - INTEGRATION RELAY, BATTERY AND BODY GROUND)

a. Remove the EFI MAIN 2 fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAIN 2 fuse	Always	Below 1 Ω

c. Reinstall the EFI MAIN 2 fuse.

d. Remove the EFI NO. 2 relay (EFI NO. 2) from the engine room relay block.

e. Remove the integration relay from the engine room relay block.

f. Disconnect the 1B integration relay connector.

g. Disconnect the cable from the battery positive (+) terminal.

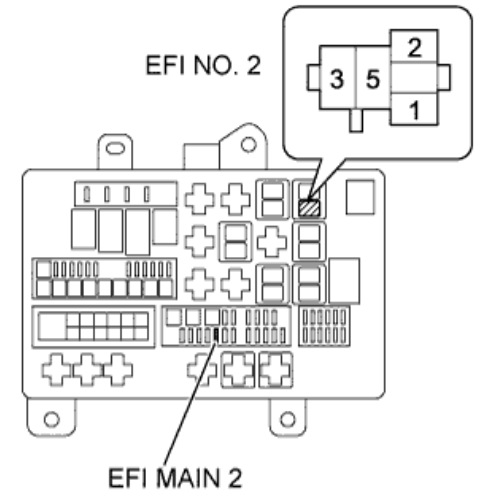
h. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

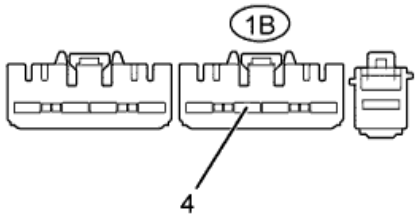
Tester Connection	Condition	Specified Condition

EFI NO. 2 relay (1) - 1B-4	Always	Below 1 Ω
EFI NO. 2 relay (5) - Positive (+) battery cable	Always	Below 1 Ω
EFI NO. 2 relay (2) - Body ground	Always	Below 1 Ω
EFI NO. 2 relay (1) or 1B-4 - Body ground	Always	10 kΩ or higher
EFI NO. 2 relay (5) or Positive (+) battery cable - Body ground	Always	10 kΩ or higher

Engine Room Relay Block:



Front view of wire harness connector:
(to Integration Relay)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

GO TO ECM POWER SOURCE CIRCUIT (Click here)

for Preparation Click here

DESCRIPTION

The fuel injectors are located on the intake manifold. They inject fuel into the cylinders based on the signals from the ECM.

WIRING DIAGRAM

Refer to DTC P0300 (Click here).

INSPECTION PROCEDURE

1.CHECK INJECTOR ASSEMBLY (POWER SOURCE)

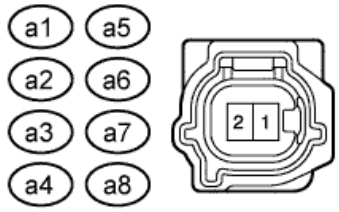
a. Disconnect the fuel injector connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	a5-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	a1-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 3	a6-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	a2-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	a7-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	a3-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	a8-2 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	a4-2 - Ground	Engine switch on (IG)	11 to 14 V

Front view of wire harness connector:
(to Injector)



NG → Go to step 4

OK

2.INSPECT FUEL INJECTOR ASSEMBLY

a. Inspect the fuel injector (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (Click here)

OK

3.CHECK HARNESS AND CONNECTOR (FUEL INJECTOR ASSEMBLY - ECM)

a. Disconnect the fuel injector connector.

b. Disconnect the C45 ECM connector.

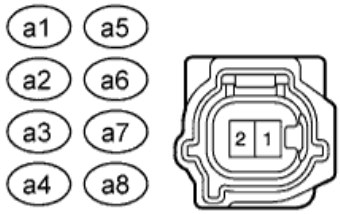
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

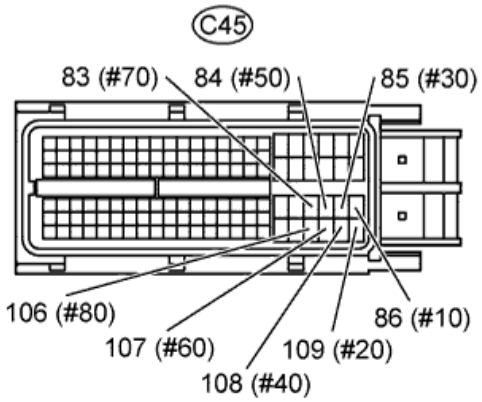
Cylinder	Tester Connection	Condition	Specified Condition
No. 1	a5-1 - Body ground	Always	10 kΩ or higher
	a5-1 - C45-86	Always	Below 1 Ω

	(#10)		
No. 2	a1-1 - Body ground	Always	10 kΩ or higher
	a1-1 - C45-109 (#20)	Always	Below 1 Ω
No. 3	a6-1 - Body ground	Always	10 kΩ or higher
	a6-1 - C45-85 (#30)	Always	Below 1 Ω
No. 4	a2-1 - Body ground	Always	10 kΩ or higher
	a2-1 - C45-108 (#40)	Always	Below 1 Ω
No. 5	a7-1 - Body ground	Always	10 kΩ or higher
	a7-1 - C45-84 (#50)	Always	Below 1 Ω
No. 6	a3-1 - Body ground	Always	10 kΩ or higher
	a3-1 - C45-107 (#60)	Always	Below 1 Ω
No. 7	a8-1 - Body ground	Always	10 kΩ or higher
	a8-1 - C45-83 (#70)	Always	Below 1 Ω
No. 8	a4-1 - Body ground	Always	10 kΩ or higher
	a4-1 - C45-106 (#80)	Always	Below 1 Ω

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

4.INSPECT FUSE (INJ, IG2 MAIN)

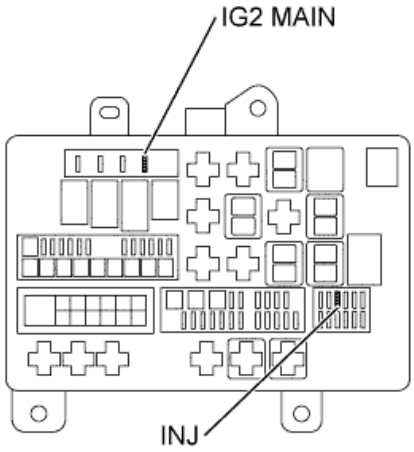
a. Remove the INJ fuse and IG2 MAIN fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
INJ fuse	Always	Below 1 Ω
IG2 MAIN fuse	Always	Below 1 Ω

Engine Room Relay Block:



NG → CHECK FOR SHORT IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

OK

5.INSPECT INTEGRATION NO.1 RELAY (IG2)

a. Inspect the integration relay (IG2) (Click here).

NG → REPLACE INTEGRATION NO.1 RELAY

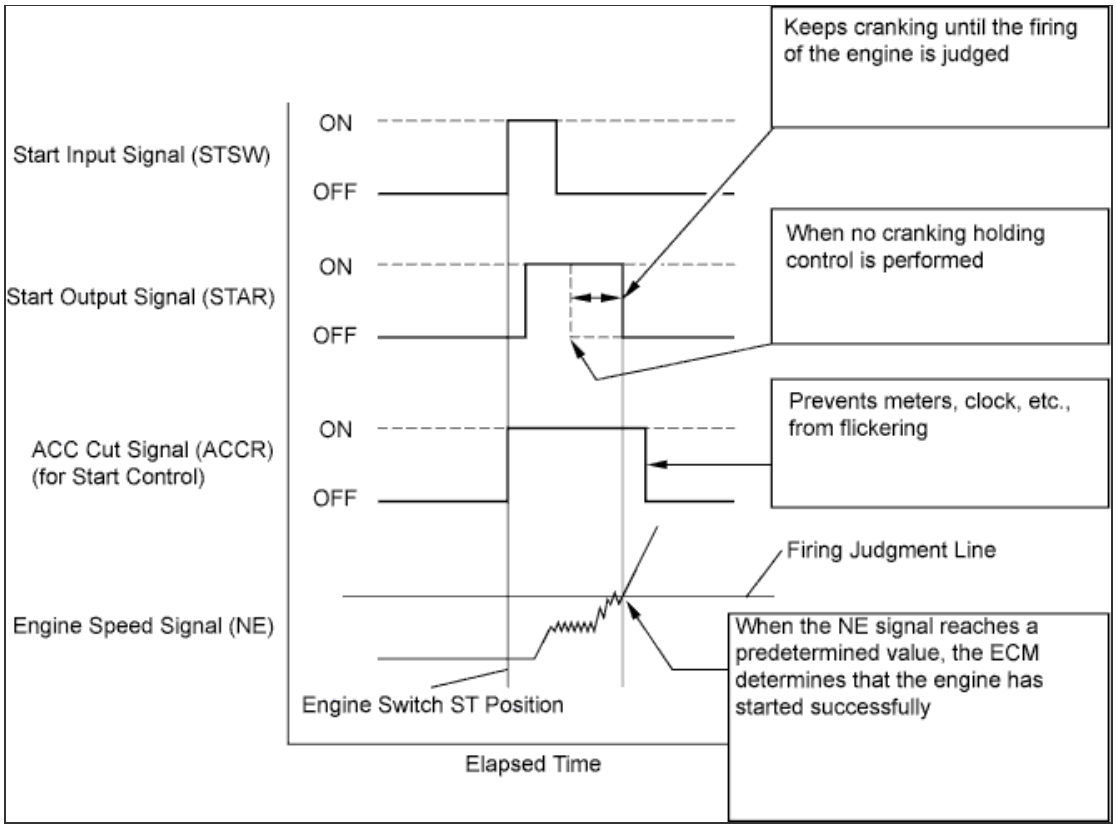
OK

REPAIR OR REPLACE HARNESS OR CONNECTOR (INTEGRATION RELAY - FUEL INJECTOR ASSEMBLY)

for Preparation Click here

DESCRIPTION

The cranking holding control system provides current to the starter when the ECM detects the engine switch start signal (STSW). When the ECM performs a firing judgment, the system cuts current to the starter. When an ECM receives the STSW signal, it turns on the ACC cut, which prevents flickering of the combination meter, clock, audio system, etc. Also, the ECM sends a signal to the ECM STAR terminal. Then the STAR output signal travels through the Park/Neutral Position (PNP) switch to the starter relay, causing the starter to activate.
When the engine is cranking, the starter operation signal is sent to the ECM STA terminal.



WIRING DIAGRAM

Refer to DTC P0617 (Click here).

INSPECTION PROCEDURE

1.CHECK CRANKING

a. Check the cranking of the engine.

Result

Result	Proceed to
Cranking possible and holding control operates	A
Does not crank	B
Cranking possible but holding control does not operate	C

B → Go to step 2

C → Go to step 11

A

PROCEED TO NEXT CIRCUIT INSPECTION SHOWN IN PROBLEM SYMPTOMS TABLE (Click here)

2.READ VALUE USING INTELLIGENT TESTER (STARTER SIGNAL)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / Starter Signal.

e. Check the value displayed on the tester when the engine switch is turned to the START.

Standard:

Engine Switch Position	Display (Starter Signal)
On (IG)	OFF
START	ON

NG → Go to step 7

OK ↓

3.INSPECT STARTER RELAY (ST)

a. Inspect the starter relay (ST) (Click here).

NG → REPLACE STARTER RELAY

OK ↓

4.CHECK HARNESS AND CONNECTOR (STARTER RELAY - PNP SWITCH)

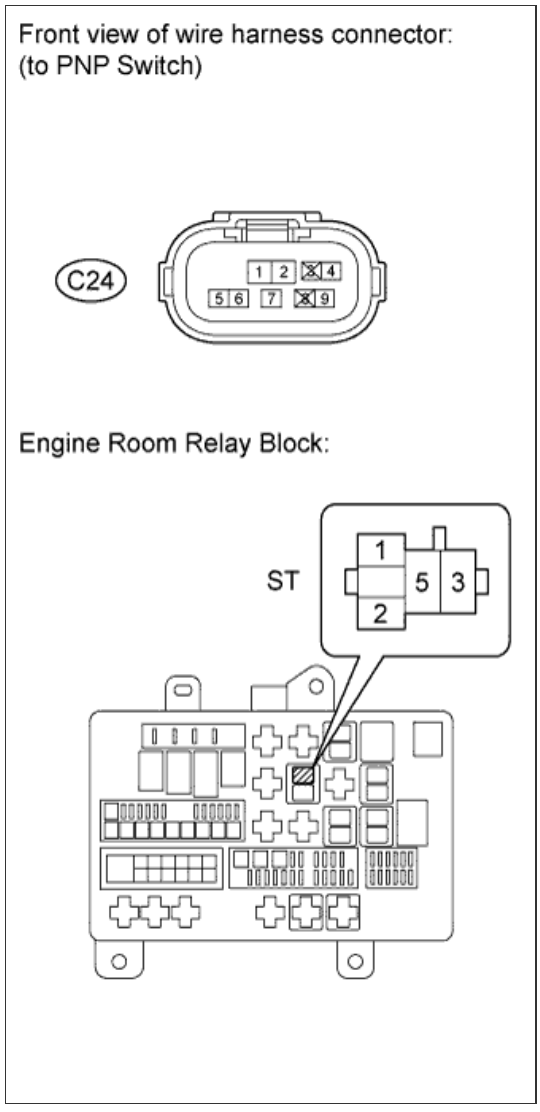
a. Remove the starter relay (ST) from the engine room relay block.

b. Disconnect the C24 PNP switch.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
ST relay (1) - C24-5	Always	Below 1 Ω
ST relay (1) or C24-5 - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

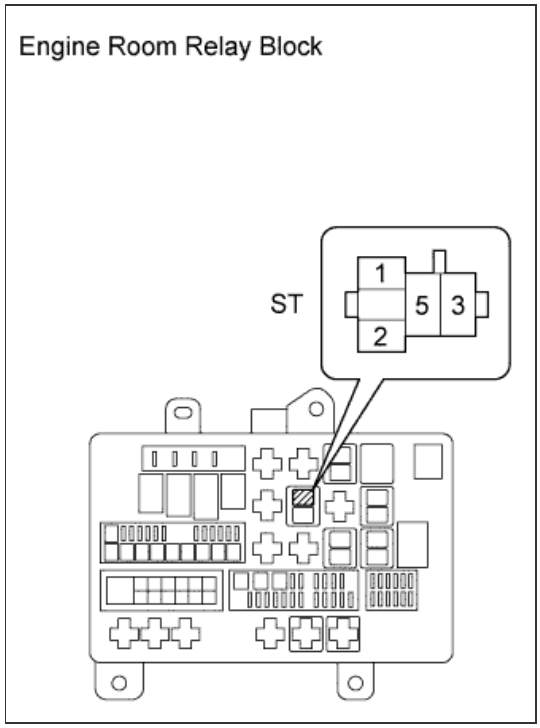
5.CHECK STARTER RELAY (POWER SOURCE)

a. Remove the ST relay from the engine room relay block.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
ST relay (2) - ST relay (5)	Always	11 to 14 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (STARTER RELAY (ST) - BATTERY, BODY GROUND)

OK

6.INSPECT STARTER

a. Inspect the starter (Click here).

NG → REPAIR OR REPLACE STARTER (Click here)

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR (STARTER - STARTER RELAY (ST), BATTERY)

7.INSPECT STARTER CUT RELAY (ST CUT)

a. Inspect the starter cut relay (ST CUT) (Click here).

NG → REPLACE STARTER CUT RELAY

OK

8.CHECK HARNESS AND CONNECTOR (ST CUT RELAY - PNP SWITCH, ECM)

a. Remove the starter cut relay (ST CUT) from the engine room relay block.

b. Disconnect the C24 PNP switch connector.

c. Disconnect the C45 ECM connector.

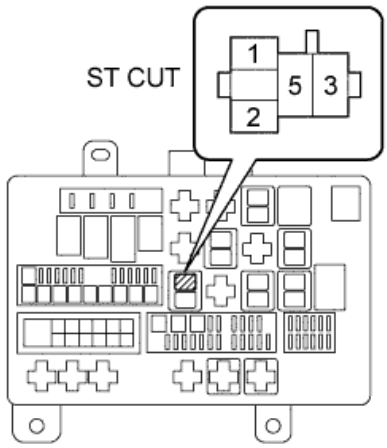
d. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

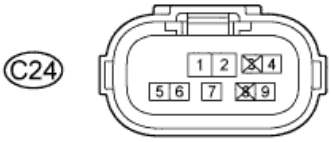
Tester Connection	Condition	Specified

		Condition
ST CUT relay (5) - C45-16 (STAR)	Always	Below 1 Ω
ST CUT relay (3) - C24-4	Always	Below 1 Ω
ST CUT relay (5) or C45-16 (STAR) - Body ground	Always	10 kΩ or higher
ST CUT relay (3) or C24-4 - Body ground	Always	10 kΩ or higher

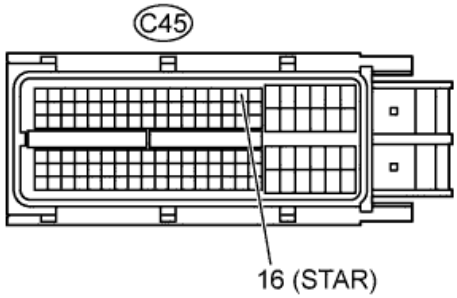
Engine Room Relay Block



Front view of wire harness connector:
(to PNP Switch)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.INSPECT PARK/NEUTRAL POSITION SWITCH

a. Inspect the park/neutral position switch (Click here).

NG → REPLACE PARK/NEUTRAL POSITION SWITCH (Click here)

OK

10.CHECK HARNESS AND CONNECTOR (PNP SWITCH - ECM)

a. Disconnect the C24 PNP switch connector.

b. Disconnect the A38 ECM connector.

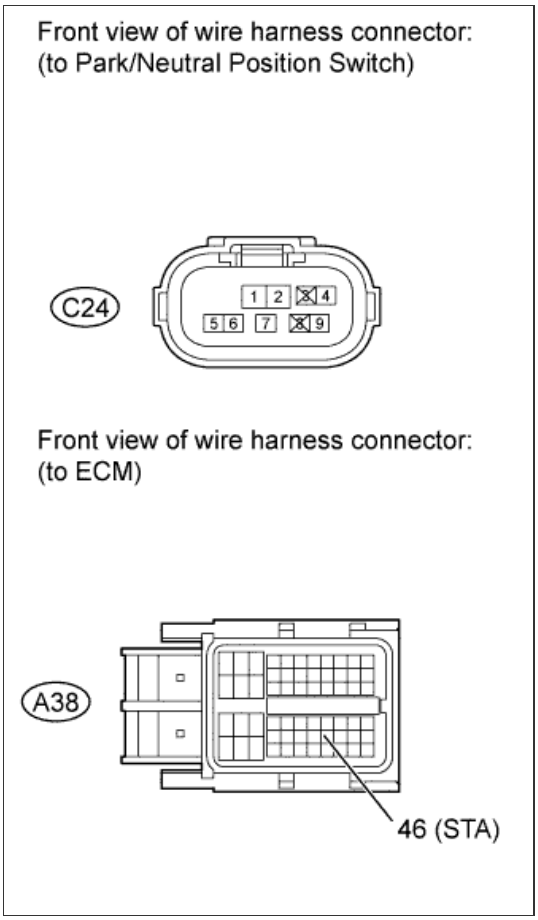
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C24-5 - A38-46 (STA)	Always	Below 1 Ω
C24-5 or A38-46 (STA) - Body ground	Always	10 kΩ or higher

Result

Result	Proceed to
NG	A
OK	B

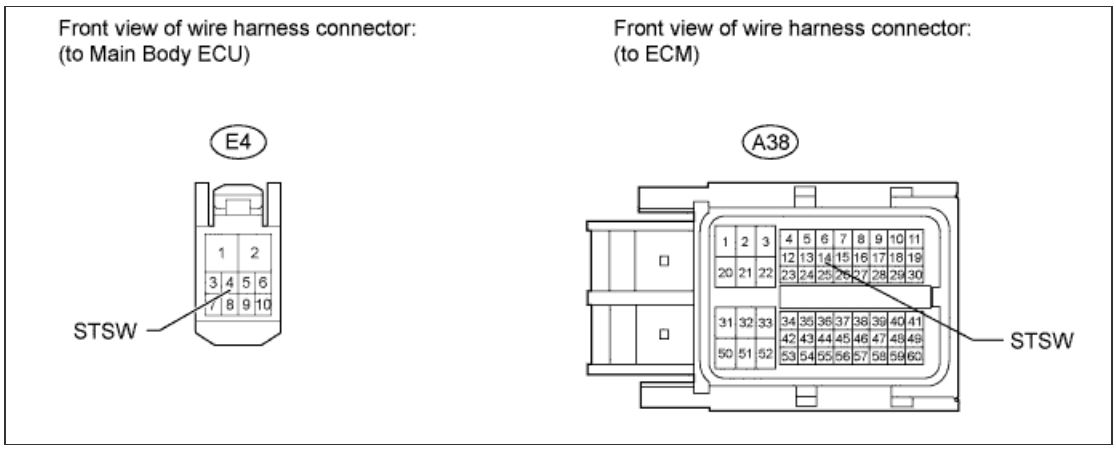


B → Go to step 13

A

REPAIR OR REPLACE HARNESS OR CONNECTOR

11.CHECK HARNESS AND CONNECTOR (MAIN BODY ECU - ECM)



a. Disconnect the E4 main body ECU connector.

b. Disconnect the A38 ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
E4-4 (STSW) - A38-14 (STSW)	Always	Below 1 Ω
E4-4 (STSW) or A38-14 (STSW) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

12.CHECK HARNESS AND CONNECTOR (STARTER CUT RELAY - PNP SWITCH, ECM)

a. Remove the starter cut relay (ST CUT) from the engine room relay block.

b. Disconnect the C24 PNP switch connector.

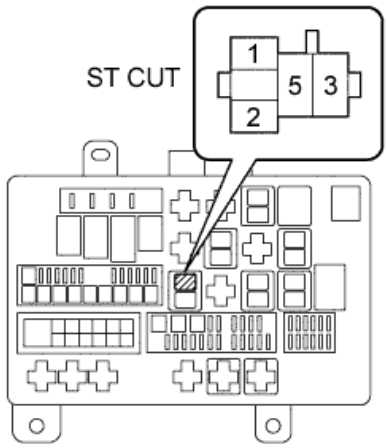
c. Disconnect the C45 ECM connector.

d. Measure the resistance according to the value(s) in the table below.

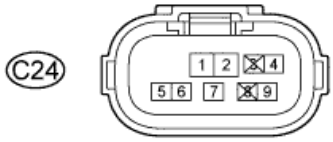
Standard Resistance:

Tester Connection	Condition	Specified Condition
ST CUT relay (5) - C45-16 (STAR)	Always	Below 1 Ω
ST CUT relay (3) - C24-4	Always	Below 1 Ω
ST CUT relay (5) or C45-16 (STAR) - Body ground	Always	10 kΩ or higher
ST CUT relay (3) or C24-4 - Body ground	Always	10 kΩ or higher

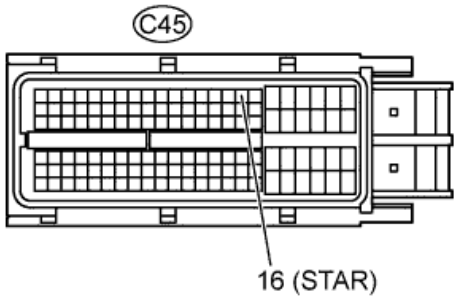
Engine Room Relay Block



Front view of wire harness connector: (to PNP Switch)



Front view of wire harness connector: (to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (**Click here**)

13.REPLACE ECM

a. Replace the ECM (Click here).

NEXT

14.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Check the starter operation.

OK:

Malfunction has been repaired successfully.

NG → GO TO ENTRY AND START SYSTEM (ENGINE DOES NOT START) (Click here)

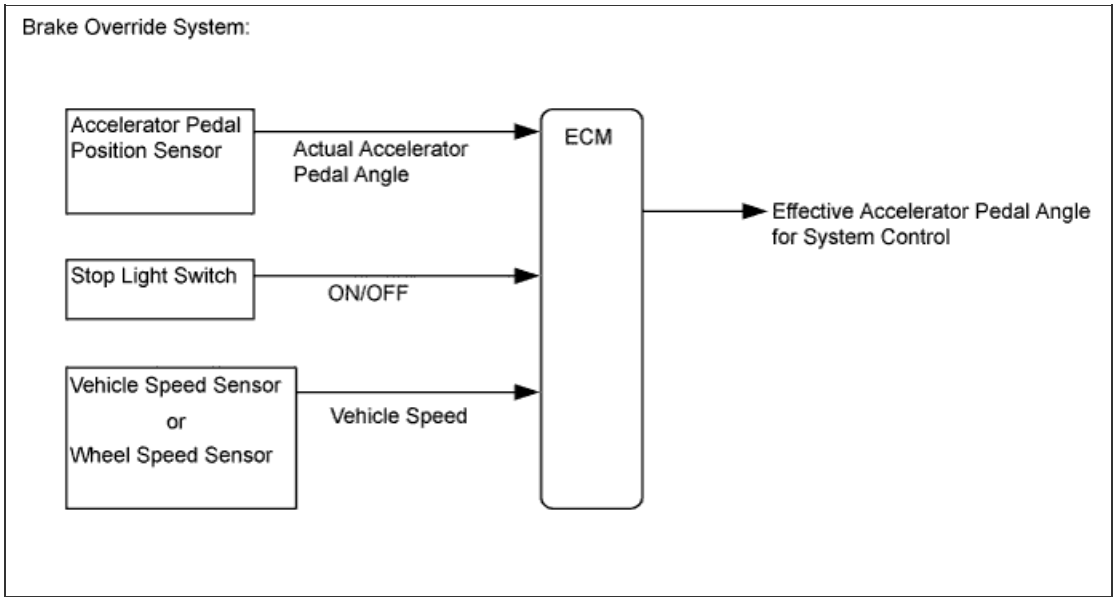
OK

END

for Preparation Click here

DESCRIPTION

When the vehicle is being driven with the accelerator pedal depressed, depressing the brake pedal without releasing the accelerator pedal will activate the brake override system to restrict driving torque. The conditions for activating the brake override system as well as the items that are controlled are explained below.



Activation Conditions:

- Vehicle is running at or above the specified speed.
- The accelerator pedal is depressed beyond a specified level, and then the brake pedal is depressed.

NOTICE:

The vehicle may not enter the brake override system control due to the relation of the accelerator pedal angle and the vehicle's speed.

Items Controlled:

- Driving torque is restricted.

HINT:

During brake override system control, the value for the accelerator pedal angle (which is used for engine control) is forcibly reduced to a specified value. For this reason, the Data List value for Accelerator Position (applied to electronic throttle control) will be replaced with a specified value regardless of the actual accelerator pedal angle (Accel Sens. No. 1 Volt %, Accel Sens. No. 2 Volt %)

Deactivation Conditions:

- When the Stop Light Switch turns OFF or the actual accelerator pedal angle increases or decreases beyond the specified range.

INSPECTION PROCEDURE

Inspection Method

Drive at 10 km/h (6.25 mph), depress the accelerator pedal by 1/2 to 3/4 and keep it in that position. Under these conditions, if the engine speed decreases to 1000 rpm when the brake pedal is depressed, then the brake override system has been activated.

CAUTION:

When carrying out the inspection, use a place where you are able to carry it out safely and also pay close attention to your surroundings.

Also, when driving make absolutely sure that all road traffic laws, such as speed limits, are observed.

HINT:

- **Under normal conditions, the Accelerator Position value changes in response to the Accel Sens. No. 1 Volt % value. For more information on the numerical values, refer to the Data List (Click here).**
- **If the Data List values of Accelerator Position and Accel Sens. No. 1 Volt % do not match, and the value of Accelerator Position changes but the value of Accel Sens. No. 1 Volt % is constant, this confirms that the brake override system has activated. (Data can be captured relatively easily by using the snapshot function in the Data List. Confirm the data after performing the driving test.)**

NOTICE:

The brake override system restricts driving torque if the brake pedal is depressed when driving with the accelerator pedal depressed. If a customer reports experiencing loss of torque after the accelerator and brake pedals have both been intentionally depressed, explain to the customer that this is not a malfunction, and that the customer should avoid depressing both the accelerator and brake pedals at the same time.

Example: While operating the accelerator pedal, the customer uses their left foot to operate the brake pedal.

1.CHECK DTC OUTPUT

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: System Select / Health Check.

d. Check DTCs.

Result

Result	Proceed to
No DTC output	A
DTC output	B

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (STOP LIGHT SWITCH AND ST1)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Stop Light Switch and ST1.

d. Check the Data List indication when the brake pedal is depressed and released.

OK:

intelligent tester Display	Condition	Specified Condition
Stop Light Switch	Brake pedal released	OFF
	Brake pedal depressed	ON
ST1	Brake pedal released	OFF
	Brake pedal depressed	ON

NG → INSPECT STOP LIGHT SWITCH ASSEMBLY (Click here)

OK

3.INSPECT BRAKE PEDAL

a. Inspect and adjust the brake pedal (Click here).

HINT:

If the stop light switch turns ON too late, the start of brake override system control may be delayed; if it turns ON too soon, brake override system control may begin too early, so conduct inspection of the brake pedal and stop light switch assembly.

NG → REPAIR OR REPLACE BRAKE PEDAL (Click here)

OK

4.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR PEDAL POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Accel Sens. No. 1 Volt % and Accel Sens. No. 2 Volt %.

d. Read the value displayed on the intelligent tester.

OK:

intelligent tester Display	Condition	Specified Condition
Accel Sens. No. 1 Volt %	Accelerator Pedal Released → Depressed → Released	Values smoothly change following accelerator pedal operation
Accel Sens. No. 2 Volt %		

HINT:

For numerical values of Accel Sens. No. 1 Volt % and Accel Sens. No. 2 Volt %, refer to the Data List (Click here).

NG → REPLACE ACCELERATOR PEDAL SENSOR ASSEMBLY (Click here)

OK

5.READ VALUE USING INTELLIGENT TESTER (VEHICLE SPEED)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Start the engine.

d. Enter the following menus: Powertrain / Engine / Data List / Vehicle Speed.

e. Read the value displayed on the intelligent tester.

Standard:

intelligent tester Display	Condition	Specified Condition
Vehicle Speed	Vehicle stopped, engine running	0 km/h (0 mph)
	Vehicle running at constant speed between 16.1 to 64.4 km/h (10 to 40 mph)	No large fluctuations when driving at a constant speed

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

Data can be captured relatively easily by using the snapshot function in the Data List. Confirm the data after performing the drive test.

NG → GO TO METER / GAUGE SYSTEM (SPEED SIGNAL CIRCUIT) (Click here)

OK

6.READ VALUE USING INTELLIGENT TESTER (FR, FL, RR, RL WHEEL SPEED)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Start the engine.

d. Enter the following menus: Chassis / ABS/VSC/TRAC / Data List / FR Wheel Speed, FL Wheel Speed, RR Wheel Speed and RL Wheel Speed.

e. Read the value displayed on the intelligent tester.

Standard:

intelligent tester Display	Condition	Specified Condition

FR Wheel Speed FL Wheel Speed RR Wheel Speed RL Wheel Speed	Vehicle stopped, engine running	0 km/h (0 mph)
	Vehicle running at constant speed between 16.1 to 64.4 km/h (10 to 40 mph)	No large fluctuations when driving at a constant speed

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

Data can be captured relatively easily by using the snapshot function in the Data List. Confirm the data after performing the drive test.

NG → INSPECT FRONT OR REAR SPEED SENSOR

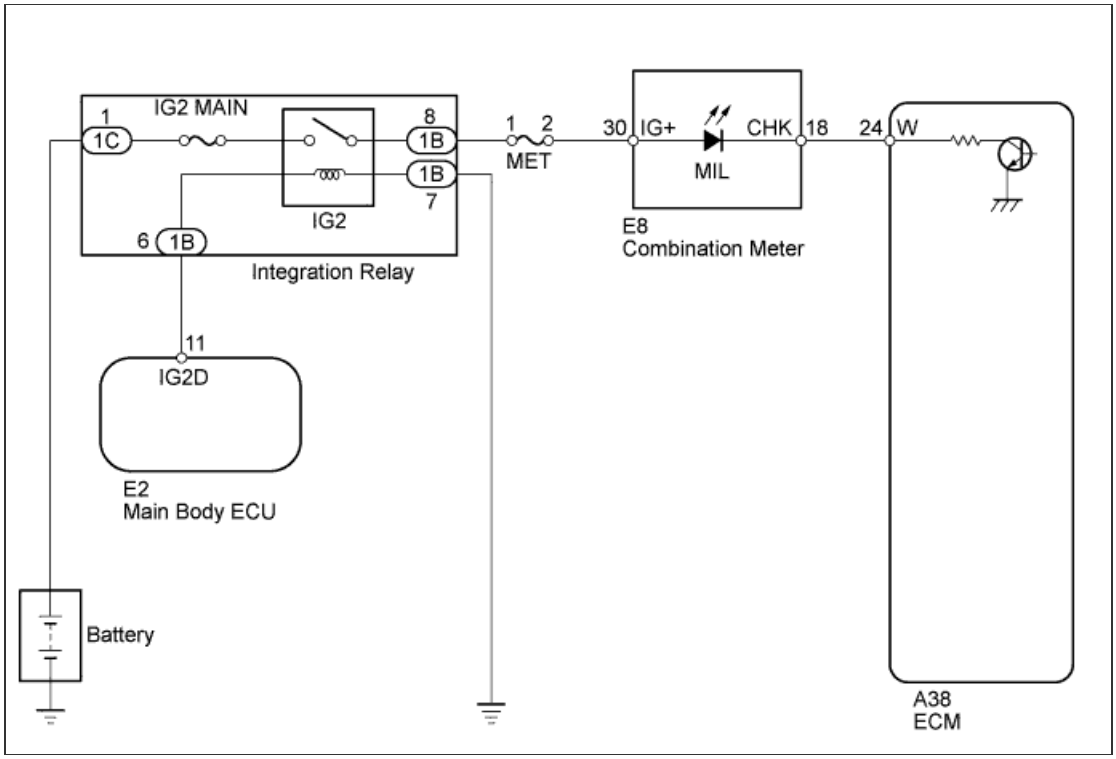
OK → END

for Preparation Click here

DESCRIPTION

The MIL (Malfunction Indicator Lamp) is used to indicate vehicle malfunction detections by the ECM. When the engine switch is turned on (IG), power is supplied to the MIL circuit, and the ECM provides the circuit ground which illuminates the MIL.
The MIL operation can be checked visually: When the engine switch is first turned on (IG), the MIL should be illuminated and should then turn off when the engine is started. If the MIL remains illuminated or is not illuminated, conduct the following troubleshooting procedure using the intelligent tester.

WIRING DIAGRAM



INSPECTION PROCEDURE

1.CHECK THAT MIL IS ILLUMINATED

a. Perform troubleshooting in accordance with the table below.

Result

Result	Proceed to
MIL remains ON	A
MIL does not illuminate	B

B → Go to step 5

A

2.CHECK WHETHER MIL TURNS OFF

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Check if any DTCs are output. Note down any DTCs.

e. Clear DTCs (Click here).

f. Check if the MIL goes off.

Standard:
MIL goes off

NG → Go to step 3

OK

REPAIR CIRCUITS INDICATED BY OUTPUT DTCS (Click here)

3.CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT IN WIRE HARNESS)

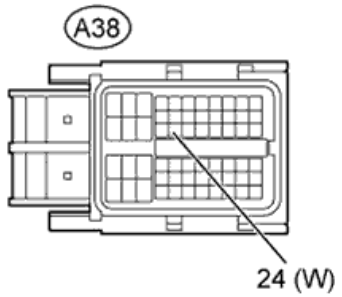
a. Disconnect the A38 ECM connector.

b. Turn the engine switch on (IG).

c. Check that the MIL is not illuminated.

OK:
MIL is not illuminated.

Front view of wire harness connector:
(to ECM)



NG → Go to step 4

OK

REPLACE ECM (Click here)

4.CHECK HARNESS AND CONNECTOR (COMBINATION METER ECM)

a. Disconnect the A38 ECM connector.

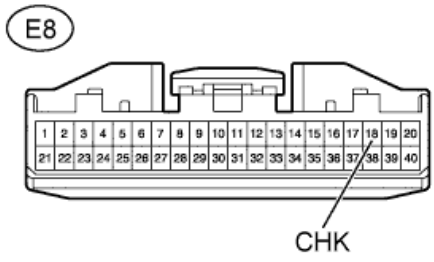
b. Disconnect the E8 combination meter connector.

c. Measure the resistance according to the value(s) in the table below.

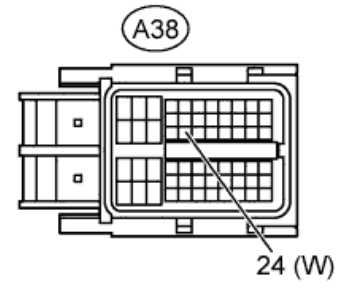
Standard Resistance:

Tester Connection	Condition	Specified Condition
A38-24 (W) or E8-18 (CHK) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Combination Meter)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE COMBINATION METER ASSEMBLY (Click here)

5.CHECK THAT MIL IS ILLUMINATED

a. Check if the MIL is illuminated when the engine switch is turned on (IG).

OK:
MIL is illuminated.

NG → Go to step 6

OK

SYSTEM OK

6.CHECK THAT ENGINE STARTS

a. Turn the engine switch on (IG).

b. Start the engine.

Result

Result	Proceed to
Engine starts	A
Engine does not start*	B

HINT:

*: The intelligent tester cannot communicate with the ECM.

B → GO TO VC OUTPUT CIRCUIT (Click here)

A

7.CHECK HARNESS AND CONNECTOR (COMBINATION METER ECM)

a. Disconnect the A38 ECM connector.

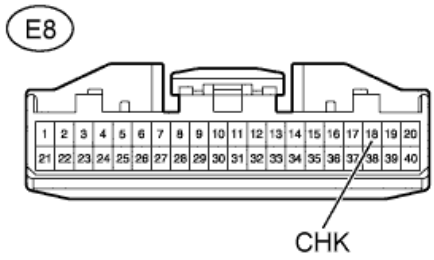
b. Disconnect the E8 combination meter connector.

c. Measure the resistance according to the value(s) in the table below.

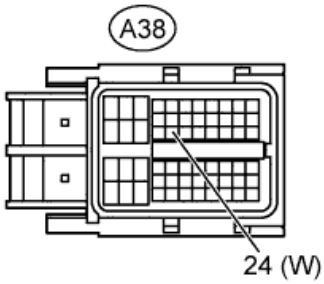
Standard Resistance:

Tester Connection	Condition	Specified Condition
A38-24 (W) - E8-18 (CHK)	Always	Below 1 Ω

Front view of wire harness connector:
(to Combination Meter)



Front view of wire harness connector:
(to ECM)

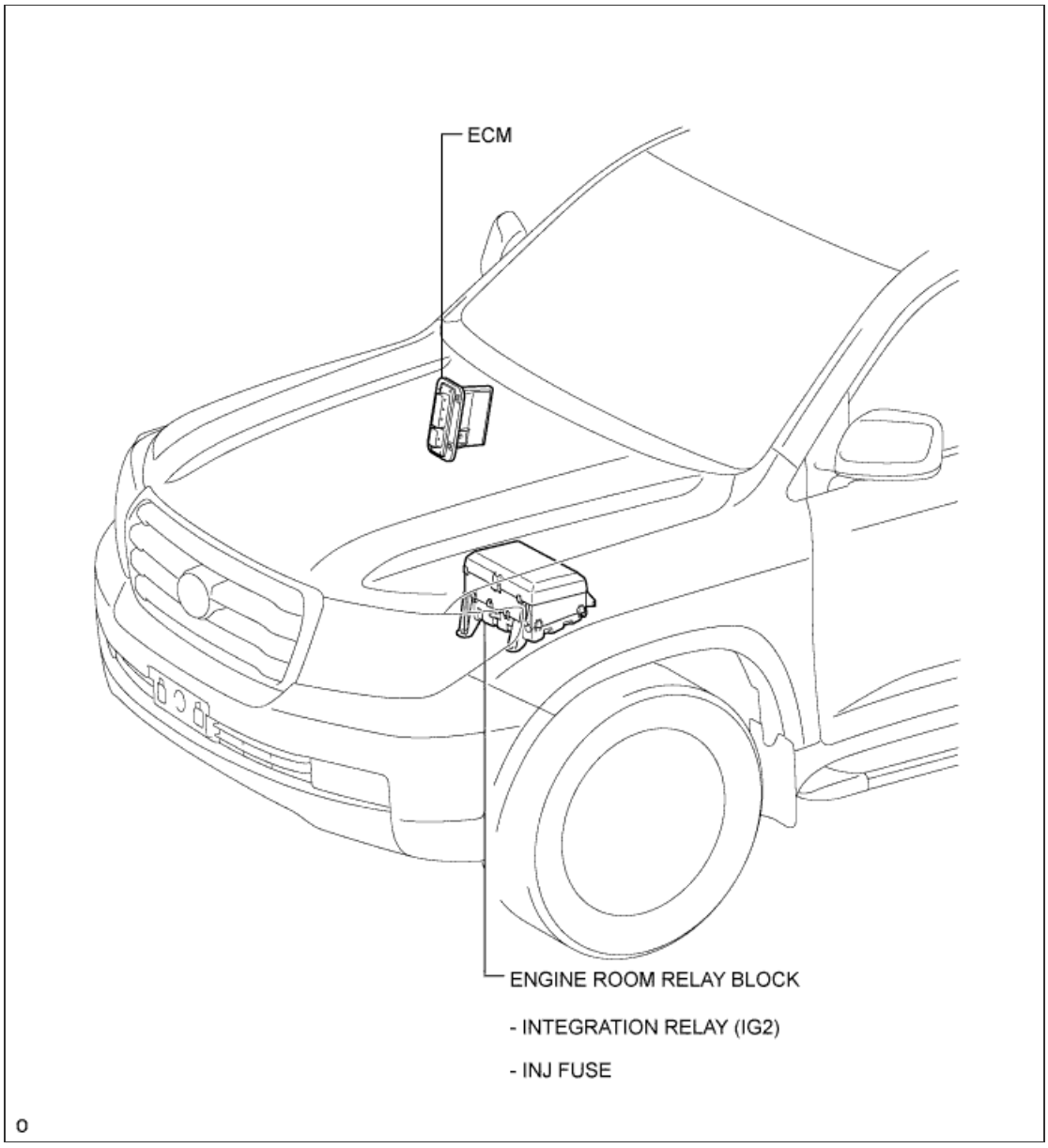


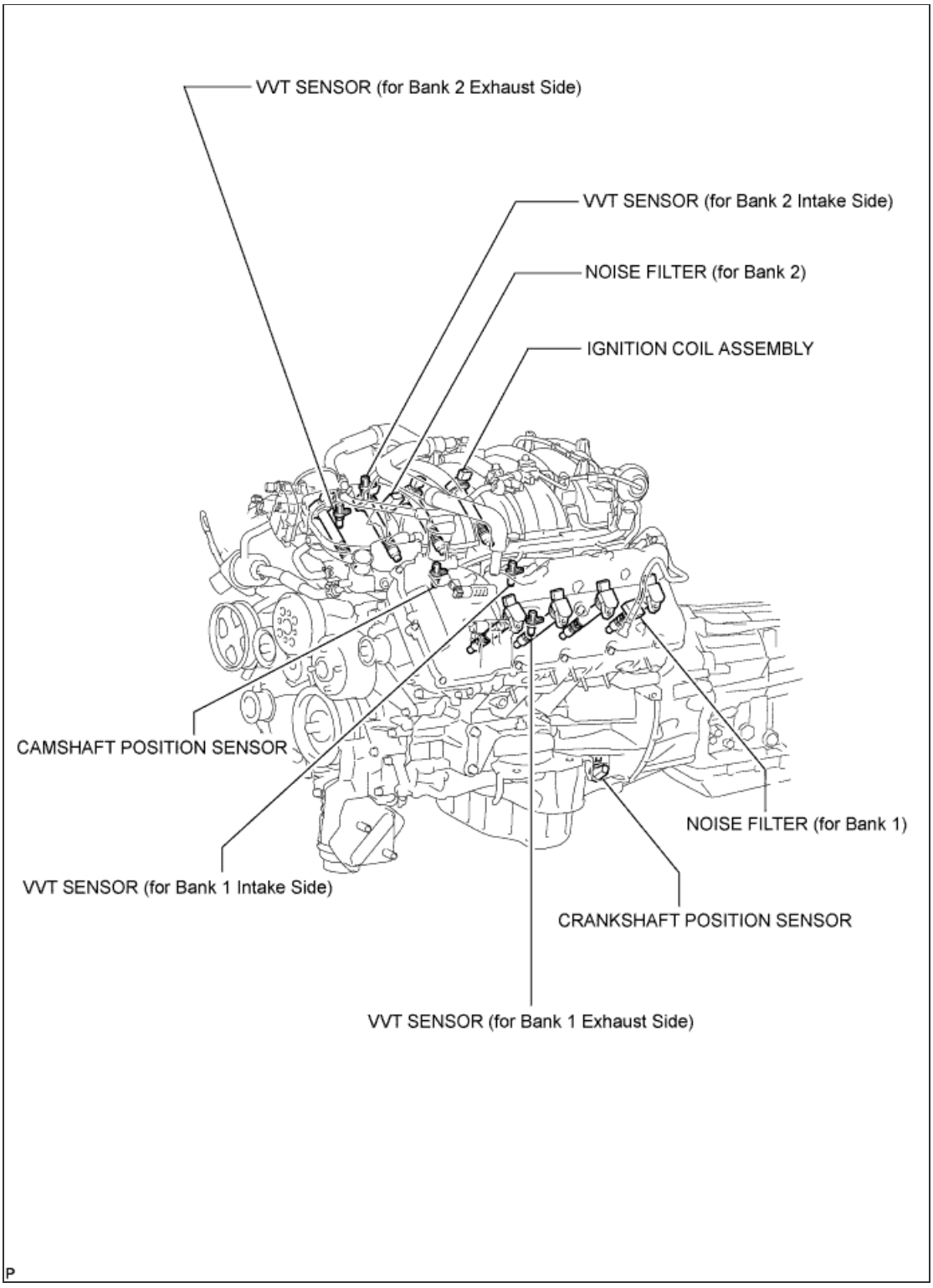
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

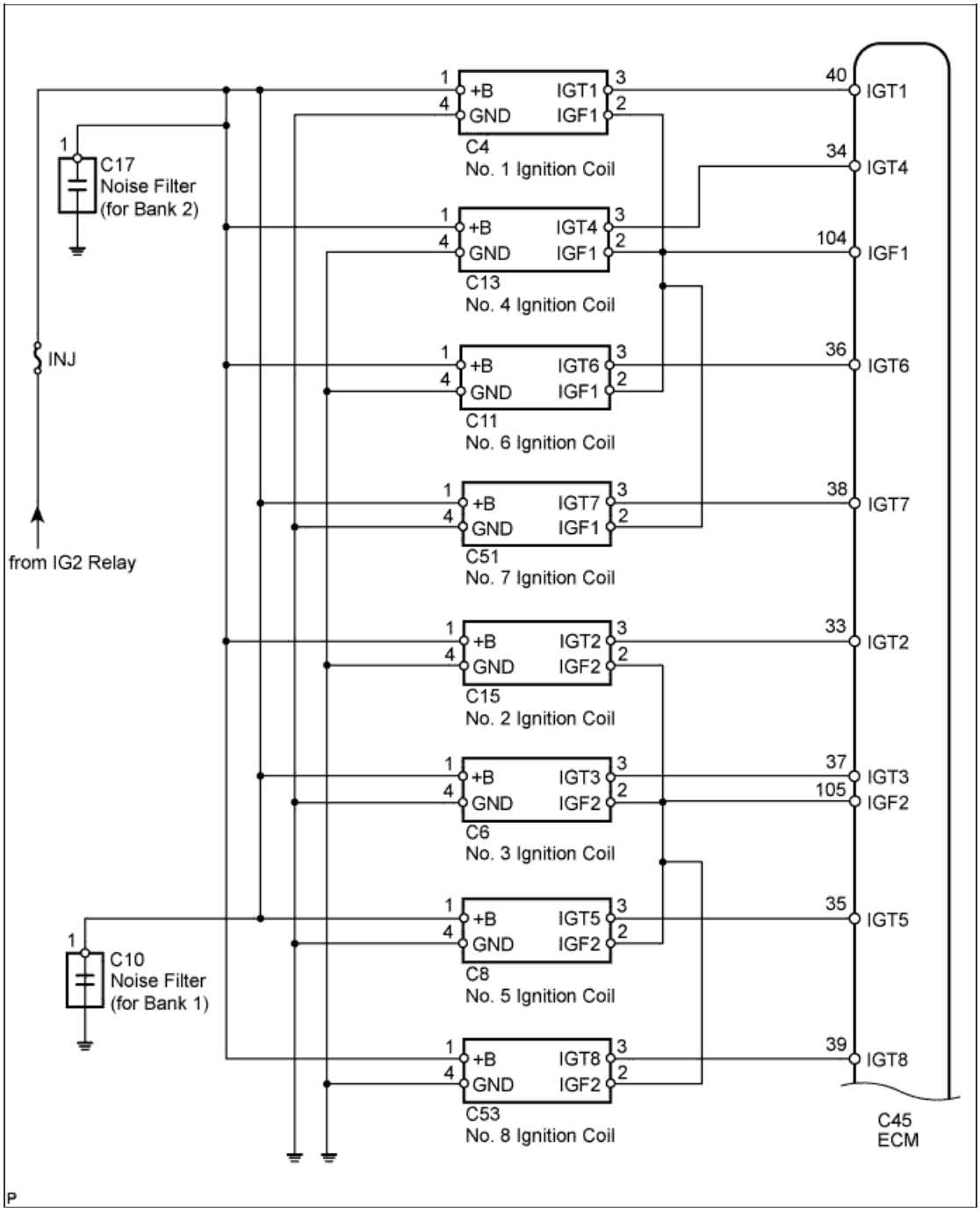
REPLACE COMBINATION METER ASSEMBLY (Click here)

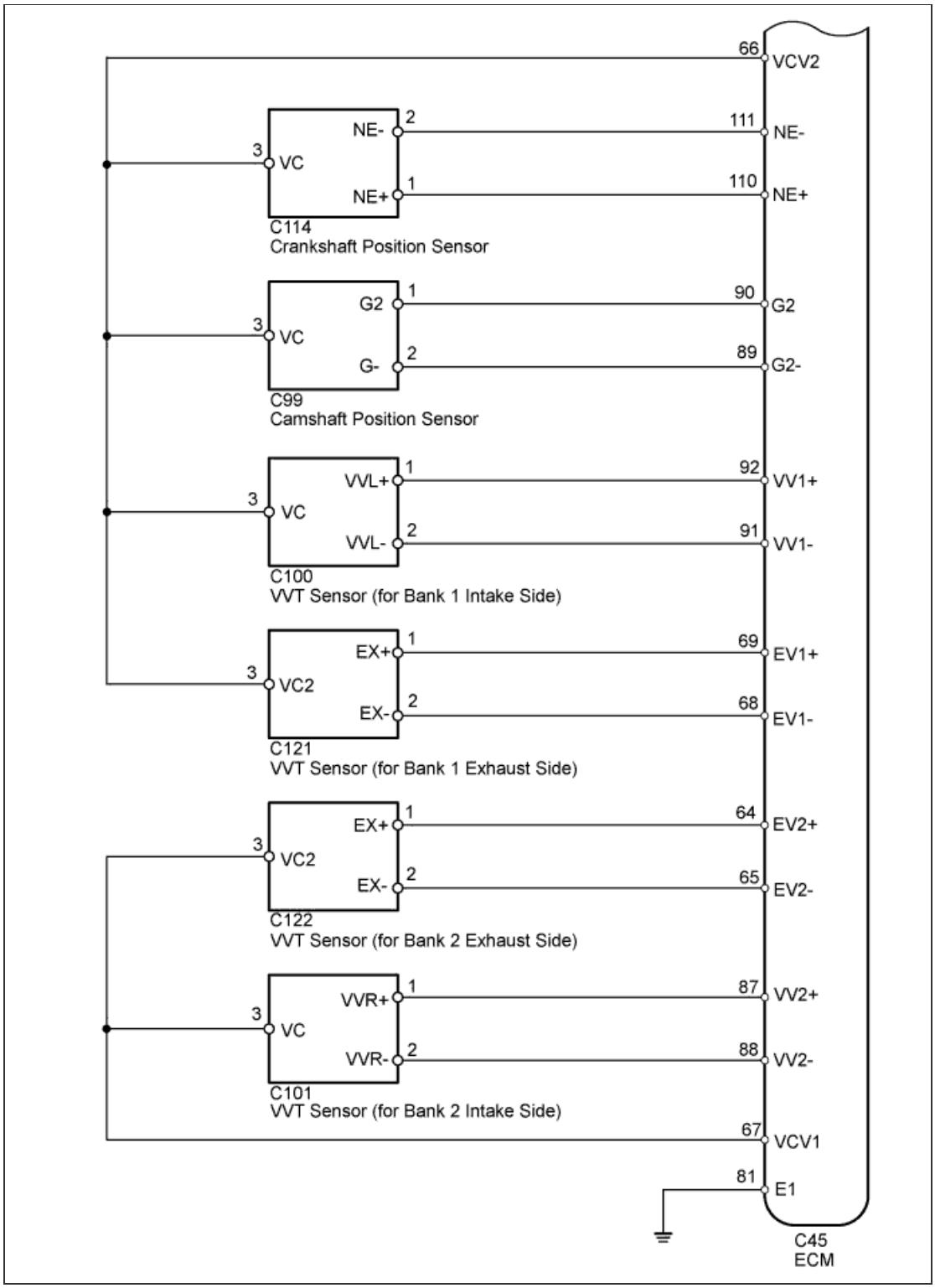
for Preparation Click here




VVT SENSOR (for Bank 2 Exhaust Side)
VVT SENSOR (for Bank 2 Intake Side)
NOISE FILTER (for Bank 2)
IGNITION COIL ASSEMBLY
CAMSHAFT POSITION SENSOR
NOISE FILTER (for Bank 1)
VVT SENSOR (for Bank 1 Intake Side)
CRANKSHAFT POSITION SENSOR
VVT SENSOR (for Bank 1 Exhaust Side)
P

for Preparation Click here




66
VCV2
NE-
2
111
NE-
3
VC
NE+
1
110
NE+
C114
Crankshaft Position Sensor
G2
1
90
G2
3
VC
G-
2
89
G2-
C99
Camshaft Position Sensor
VVL+
1
92
VV1+
3
VC
VVL-
2
91
VV1-
C100
VVT Sensor (for Bank 1 Intake Side)
EX+
1
69
EV1+
3
VC2
EX-
2
68
EV1-
C121
VVT Sensor (for Bank 1 Exhaust Side)
EX+
1
64
EV2+
3
VC2
EX-
2
65
EV2-
C122
VVT Sensor (for Bank 2 Exhaust Side)
VVR+
1
87
VV2+
3
VC
VVR-
2
88
VV2-
C101
VVT Sensor (for Bank 2 Intake Side)
67
VCV1
81
E1
C45
ECM

for Preparation Click here

1. PERFORM SPARK TEST

a. Check for DTCs (Click here).

NOTICE:

If any DTC is output, perform troubleshooting procedures for that DTC.

b. Check if sparks occur.

i. Remove the ignition coils and spark plugs (Click here).

ii. Install the spark plug to the ignition coil and connect the ignition coil connector.

iii. Disconnect the 8 injector connectors.

iv. Ground the spark plug.

v. Visually check that sparks occur while the engine is being cranked.

NOTICE:

- **Be sure to ground the spark plug when checking.**
- **If the ignition coil has been struck or dropped, replace it.**
- **Do not crank the engine for more than 2 seconds.**

c. Check that the wire harness side connector of the ignition coil with igniter is securely connected.

Result

Result	Proceed to
NG	Connect securely
OK	Go to next step

d. Perform a spark test on each ignition coil with igniter.

i. If there is a cylinder where sparks do not occur, replace its ignition coil with the ignition coil of a cylinder where sparks occur normally.

ii. Crank the engine and visually check that sparks occur at the cylinder with the normally operating ignition coil.

Result

Result	Proceed to
OK	Replace ignition coil with igniter
NG	Go to next step

e. Check spark plug.

Result

Result	Proceed to
NG	Replace spark plug
OK	Go to next step

f. Check the power supply to the ignition coil with igniter.

i. Turn the engine switch on (IG).

ii. Check that there is battery voltage at the ignition coil positive (+) terminal.

Result

Result	Proceed to
NG	Check wiring between engine switch and ignition coil with igniter
OK	Go to next step

g. Check the VVT sensor for intake side (Click here).

h. Check the VVT sensor for exhaust side (Click here).

i. Check the camshaft position sensor (Click here).

j. Check the crankshaft position sensor (Click here).

k. Check the IGT signal circuit (Click here).

l. Connect the 8 injector connectors.

m. Install the ignition coils and spark plugs (Click here).

2. INSPECT SPARK PLUG

NOTICE:

- **Do not use a wire brush for cleaning.**
- **Do not attempt to adjust the electrode gap of a used spark plug.**

a. Check the electrode.

i. Using a megohmmeter, measure the insulation resistance.

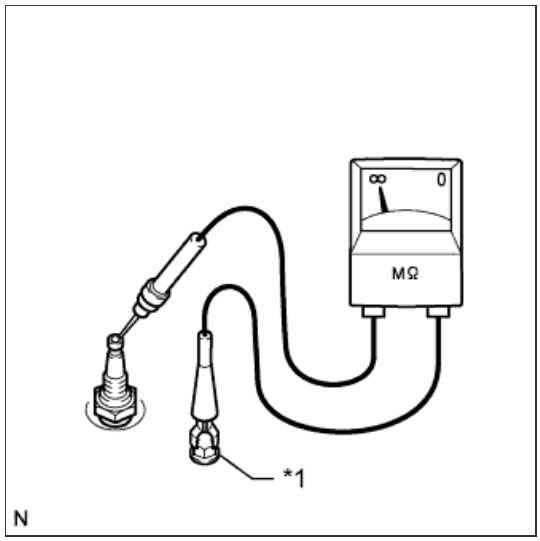
Standard Insulation Resistance:

Tester Connection	Condition	Specified Condition
Spark plug (terminal part) - Body ground	Always	10 MΩ or higher

Text in Illustration

*1	Ground

If the insulation resistance is below the specified range, replace the spark plug.



HINT:

If a megohmmeter is not available, perform the following simple inspection instead.

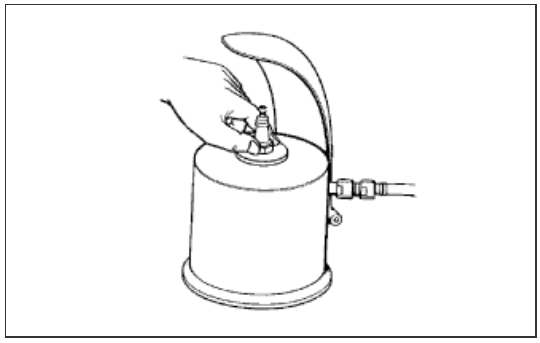
b. Alternative inspection method:

i. Quickly accelerate the engine to 4000 rpm 5 times.

ii. Remove the spark plug.

iii. Visually check the spark plug.
If the electrode is dry, the spark plug is functioning properly. If the electrode is damp, proceed to the next step.

c. Check the spark plug for any damage to its threads and insulator.
If there is any damage, replace the spark plug.



Recommended Spark Plug:

Manufacturer	Type
DENSO made	SK20HR11

HINT:

Maximum electrode gap for a used spark plug: 1.3 mm (0.0512 in.).

If the gap is more than the maximum, replace the spark plug.

Electrode gap for a new spark plug: 1.0 to 1.1 mm (0.0394 to 0.0433 in.).

NOTICE:

If adjusting the gap of a new spark plug, bend only the base of the ground electrode. Do not touch the tip. Never attempt to adjust the gap

of a used plug.

If the electrode has traces of wet carbon, allow it to dry and then clean it with a spark plug cleaner.

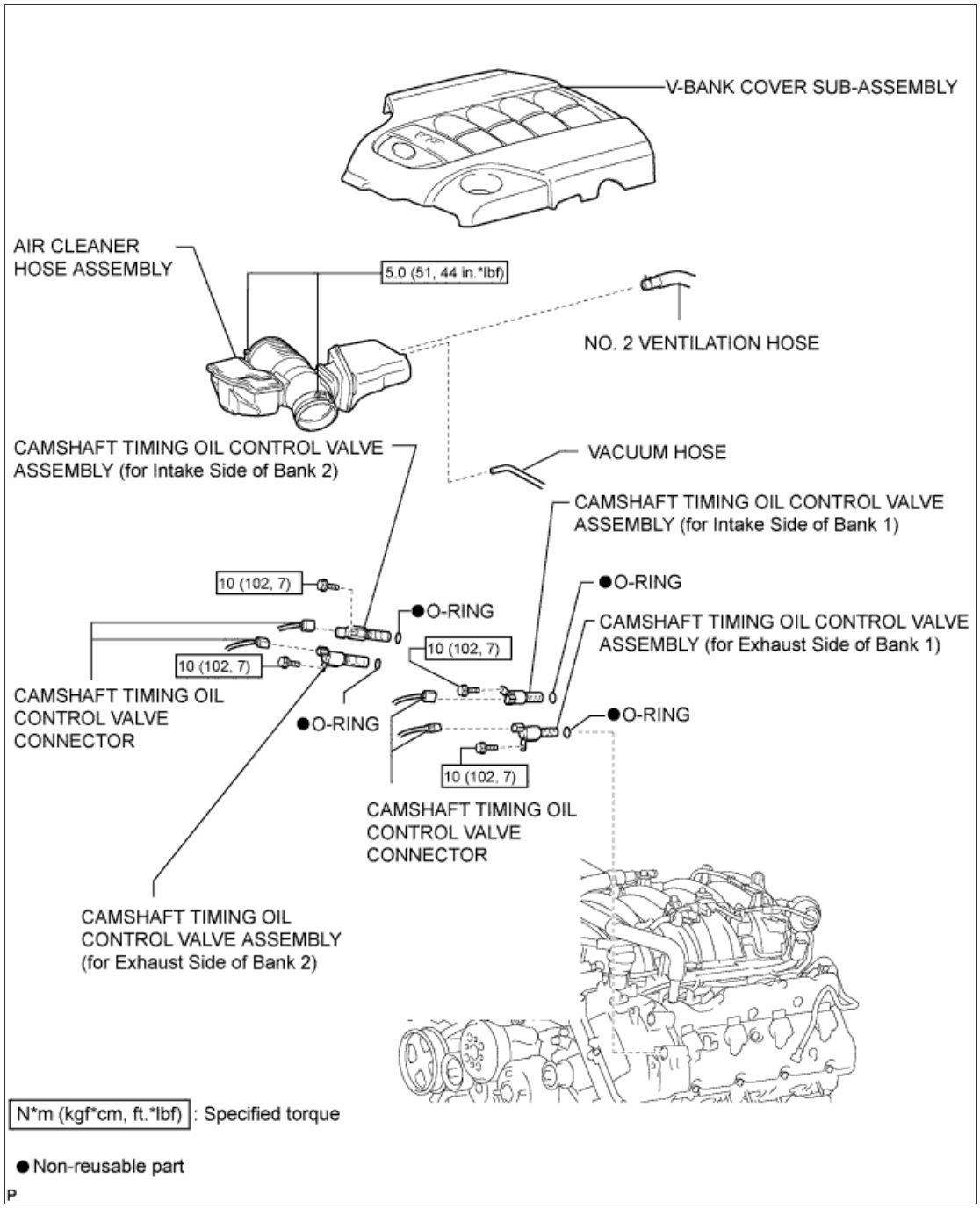
Standard air pressure:
588 kPa (6.0 kgf/cm^2, 85 psi)

Standard duration:
20 seconds or less

HINT:

Only use the spark plug cleaner when the electrode is free of oil. If the electrode has traces of oil, use gasoline to clean off the oil before using the spark plug cleaner.

for Preparation Click here



for Preparation Click here

1. INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the intelligent tester on.

c. Warm up the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT Linear (Bank 1) or Control the VVT Linear (Bank 2) or Control the VVT System (Bank 1) or Control the VVT System (Bank 2) or Control the VVT Exhaust Linear (Bank 1) or Control the VVT Exhaust Linear (Bank 2).

e. Check the engine speed while operating the Oil Control Valve (OCV) using the intelligent tester.

OK:

Tester Operation	Specified Condition
OCV OFF	Normal engine speed
OCV ON	Soon after OCV switched from OFF to ON, engine idles roughly or stalls

If the result is not as specified, check the oil control valve, wiring and camshaft timing gear.

HINT:

- **Control the VVT Linear (Bank 1): Command to activate exhaust and intake side oil control valves of bank 1 (Control range: Between -128 to 127%).**
- **Control the VVT Linear (Bank 2): Command to activate exhaust and intake side oil control valves of bank 2 (Control range: Between -128 to 127%).**
- **Control VVT System (Bank 1): Command to activate oil control valve of bank 1 (Control range: ON/OFF).**
- **Control VVT System (Bank 2): Command to activate oil control valve of bank 2 (Control range: ON/OFF).**
- **Control the VVT Exhaust Linear (Bank 1): Command to activate exhaust side oil control valve of bank 1 (Control range: Between -128 to 127%).**
- **Control the VVT Exhaust Linear (Bank 2): Command to activate exhaust side oil control valve of bank 2 (Control range: Between -128 to 127%).**

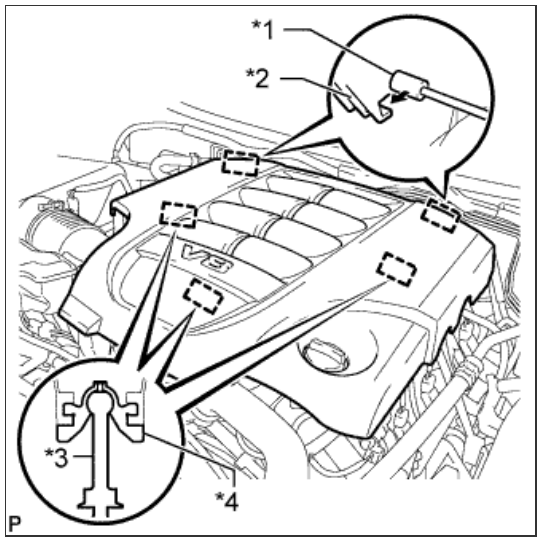
for Preparation Click here

1. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Raise the front of the V-bank cover to detach the 3 pins. Then remove the 2 V-bank cover hooks from the bracket, and remove the V-bank cover.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet

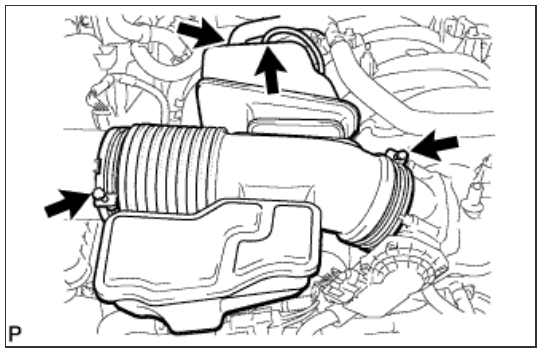


2. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum hose and No. 2 ventilation hose.

b. Loosen the 2 hose clamps.

c. Remove the air cleaner hose.

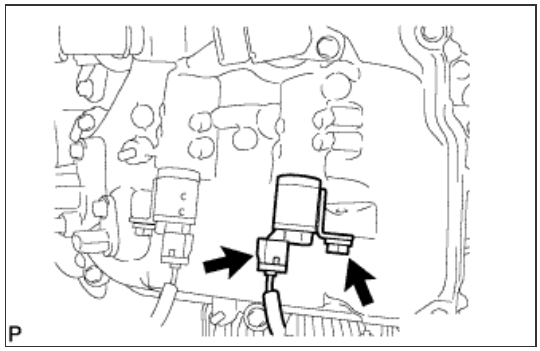


3. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Exhaust Side of Bank 1)

a. Disconnect the oil control valve connector.

b. Remove the bolt and oil control valve.

c. Remove the O-ring from the oil control valve.

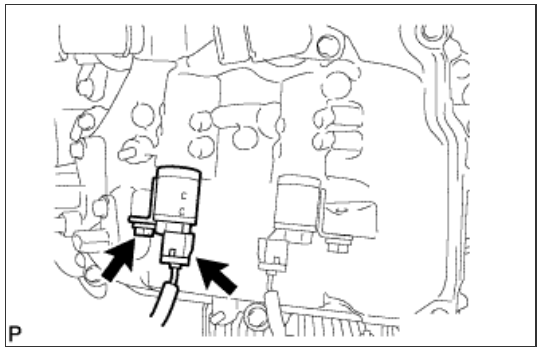


4. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Intake Side of Bank 1)

a. Disconnect the oil control valve connector.

b. Remove the bolt and oil control valve.

c. Remove the O-ring from the oil control valve.

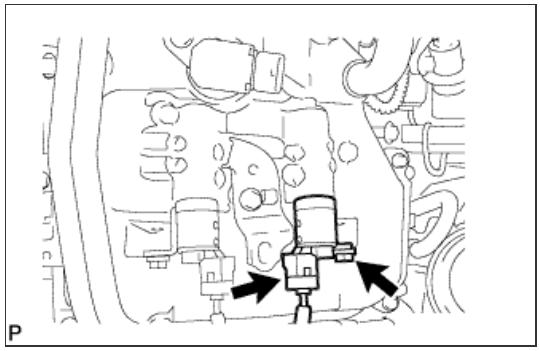


5. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Intake Side of Bank 2)

a. Disconnect the oil control valve connector.

b. Remove the bolt and oil control valve.

c. Remove the O-ring from the oil control valve.

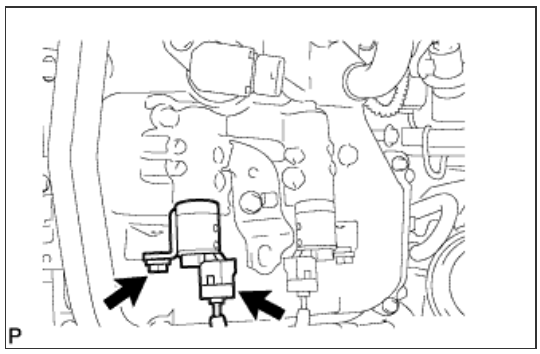


6. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Exhaust Side of Bank 2)

a. Disconnect the oil control valve connector.

b. Remove the bolt and oil control valve.

c. Remove the O-ring from the oil control valve.



for Preparation Click here

1. INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

If the result is not as specified, replace the oil control valve assembly.

b. Connect the battery positive (+) lead to terminal 1 and the negative (-) lead to terminal 2, and check the movement of the valve.

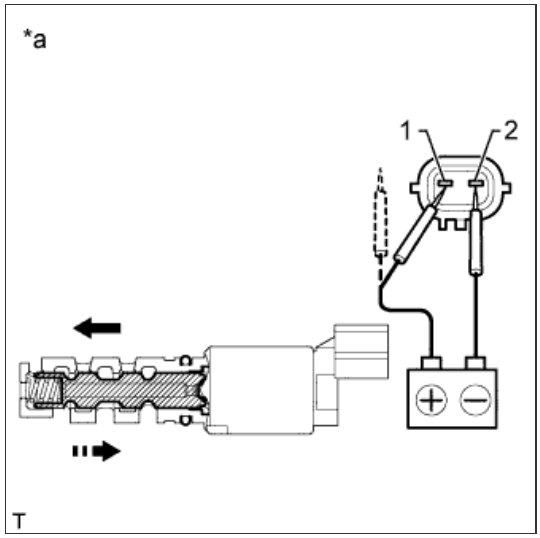
OK:

Condition	Specified Condition
Battery positive (+) voltage is applied	Valve moves in left arrow direction shown in the illustration
Battery positive (+) voltage is cut off	Valve moves in right arrow direction shown in the illustration

Te t in lll stcani

*a	Component without harness connected (Oil Control Valve)

If the result is not as specified, replace the oil control valve assembly. If the valve cannot return properly because of foreign matter, a small pressure leak in the advanced direction may occur and a DTC may be output.



for Preparation Click here

1. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Exhaust Side of Bank 1)

a. Install a new O-ring to the oil control valve.

b. Apply a light coat of engine oil to the O-ring.

c. Install the oil control valve with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

NOTICE:

- **Do not allow foreign matter to contact the oil seal face of the oil control valve (connecting surface with cylinder head cover).**
- **Be careful that the O-ring is not cracked or moved out of place when installing the oil control valve.**

d. Connect the oil control valve connector.

2. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Intake Side of Bank 1)

a. Install a new O-ring to the oil control valve.

b. Apply a light coat of engine oil to the O-ring.

c. Install the oil control valve with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

NOTICE:

- **Do not allow foreign matter to contact the oil seal face of the oil control valve (connecting surface with cylinder head cover).**
- **Be careful that the O-ring is not cracked or moved out of place when installing the oil control valve.**

d. Connect the oil control valve connector.

3. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Intake Side of Bank 2)

a. Install a new O-ring to the oil control valve.

b. Apply a light coat of engine oil to the O-ring.

c. Install the oil control valve with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

NOTICE:

- **Do not allow foreign matter to contact the oil seal face of the oil control valve (connecting surface with cylinder head cover).**
- **Be careful that the O-ring is not cracked or moved out of place when installing the oil control valve.**

d. Connect the oil control valve connector.

4. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Exhaust Side of Bank 2)

a. Install a new O-ring to the oil control valve.

b. Apply a light coat of engine oil to the O-ring.

c. Install the oil control valve with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

NOTICE:

- **Do not allow foreign matter to contact the oil seal face of the oil control valve (connecting surface with cylinder head cover).**
- **Be careful that the O-ring is not cracked or moved out of place when installing the oil control valve.**

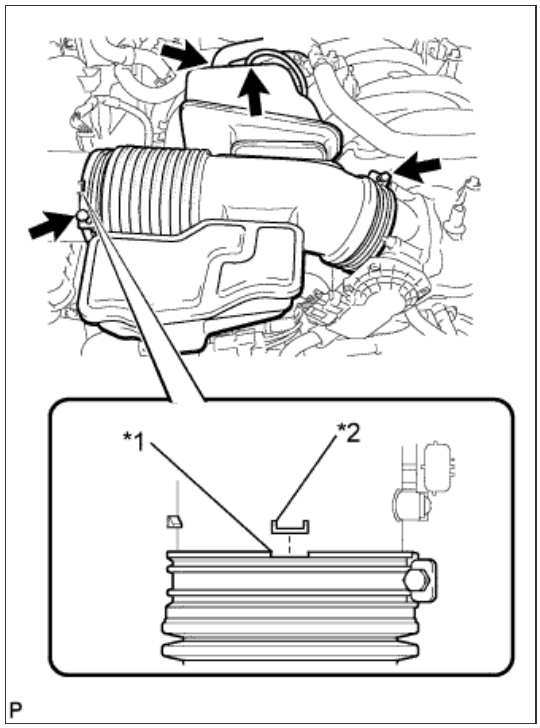
d. Connect the oil control valve connector.

5. INSTALL AIR CLEANER HOSE ASSEMBLY

a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

Text in Illustration

*1	Groove
*2	Protrusion



b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum hose.

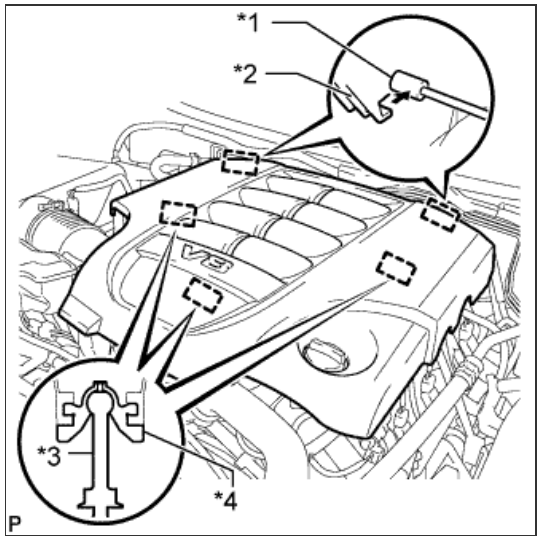
d. Connect the No. 2 ventilation hose.

6. INSTALL V-BANK COVER SUB-ASSEMBLY

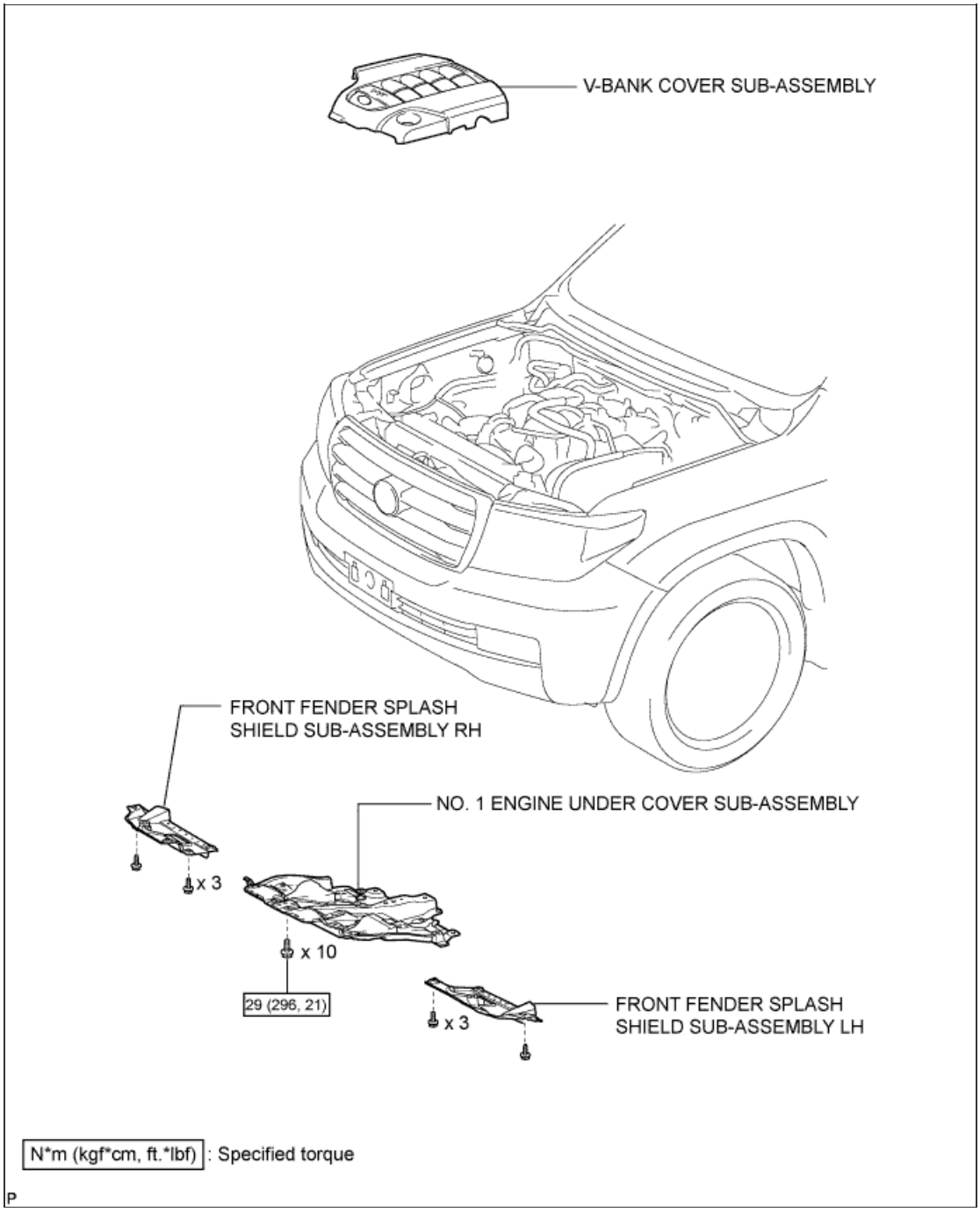
a. Attach the 2 V-bank cover hooks to the bracket. Then align the 3 V-bank cover grommets with the 3 pins, and press down on the V-bank cover to attach the pins.

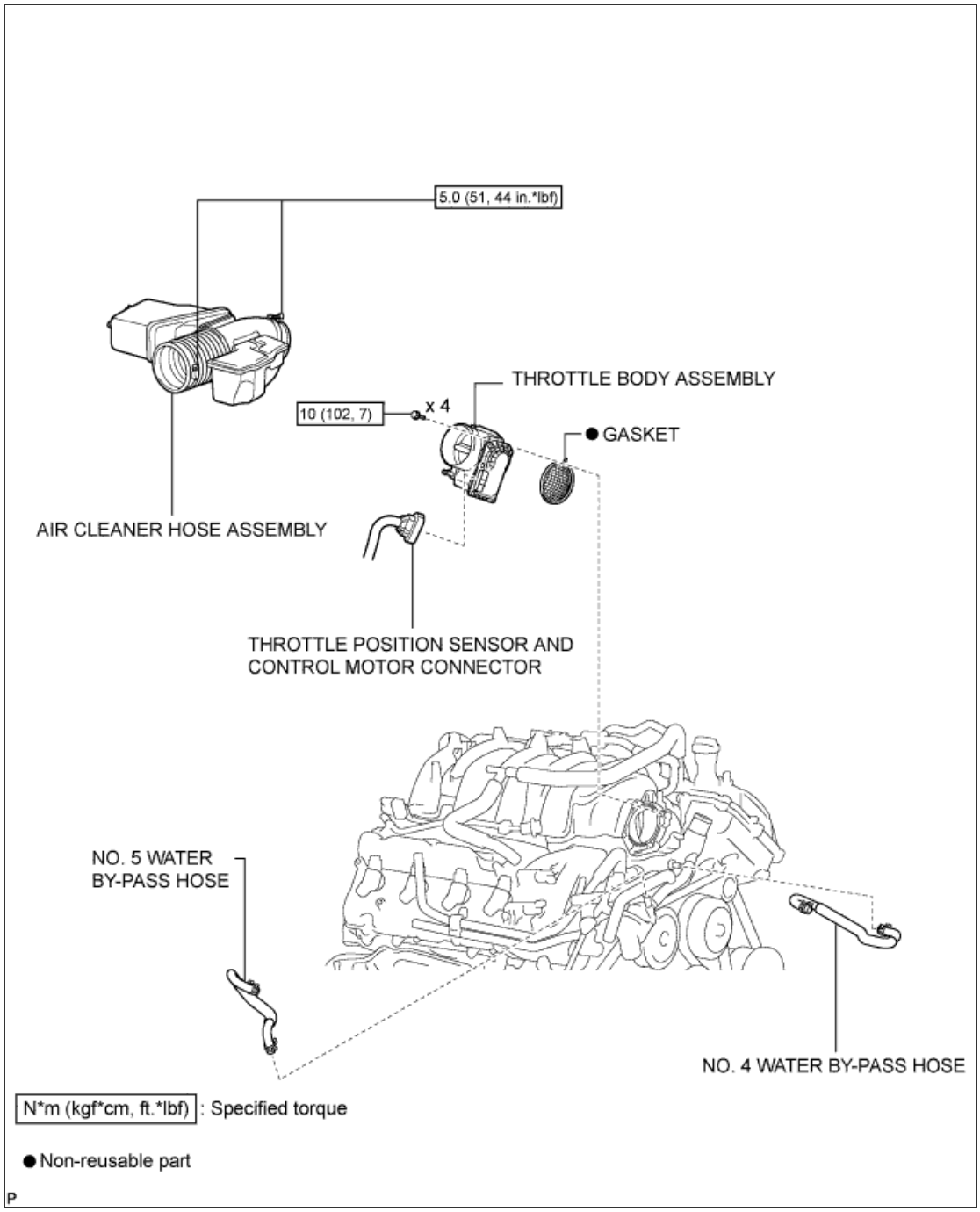
Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet



for Preparation Click here




5.0 (51, 44 in.*lbf)
THROTTLE BODY ASSEMBLY
10 (102, 7)
x 4
● GASKET
AIR CLEANER HOSE ASSEMBLY
THROTTLE POSITION SENSOR AND
CONTROL MOTOR CONNECTOR
NO. 5 WATER
BY-PASS HOSE
NO. 4 WATER BY-PASS HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
P

for Preparation Click here

1. CHECK THROTTLE BODY ASSEMBLY

a. Check the throttle control motor operating sounds.

i. Turn the engine switch on (IG).

ii. When depressing the accelerator pedal, check the operating sound of the running motor. Make sure that no friction noises are emitted from the motor. If friction noise exists, replace the throttle body.

b. Check the throttle position sensor.

i. Connect the intelligent tester to the DLC3.

ii. Turn the engine switch on (IG).

iii. Turn the intelligent tester main switch on.

iv. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Throttle Sensor Volt %.

v. Depress the accelerator pedal. When the throttle valve is fully opened, check that the value of "Throttle Sensor Volt %" is within the specification.

Standard throttle valve opening percentage:
60% or more

HINT:

When checking the standard throttle valve opening percentage, the shift lever should be in N.

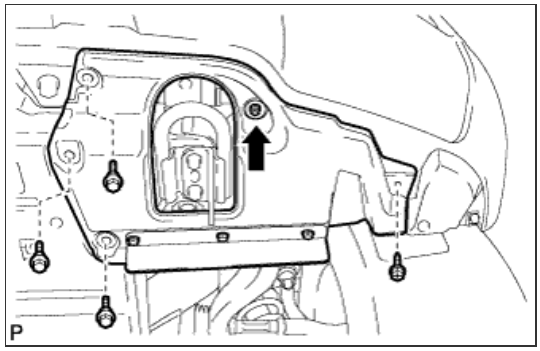
If the percentage is less than 60%, replace the throttle body.

for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



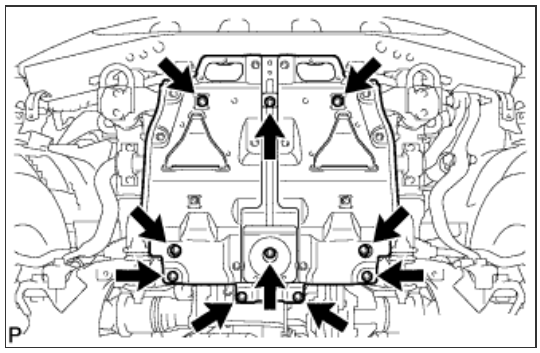
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and No. 1 engine under cover.



4. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

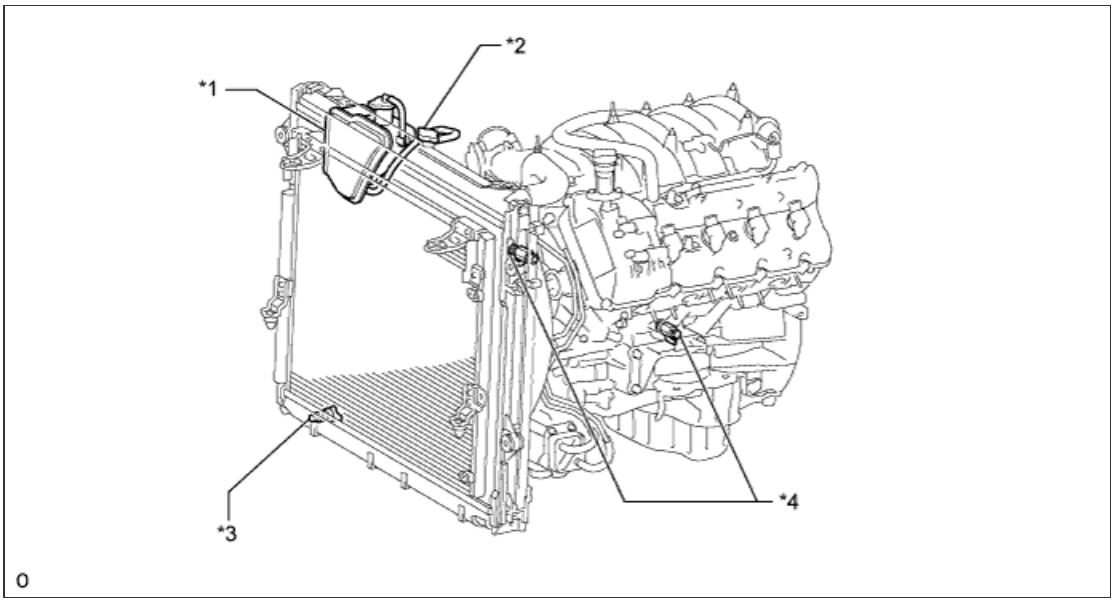
b. Remove the radiator cap. Then drain the coolant from the radiator.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

d. Tighten the 2 cylinder block drain cock plugs.

Torque:

13 N 33 kgf cm , 1 ft. lbf }



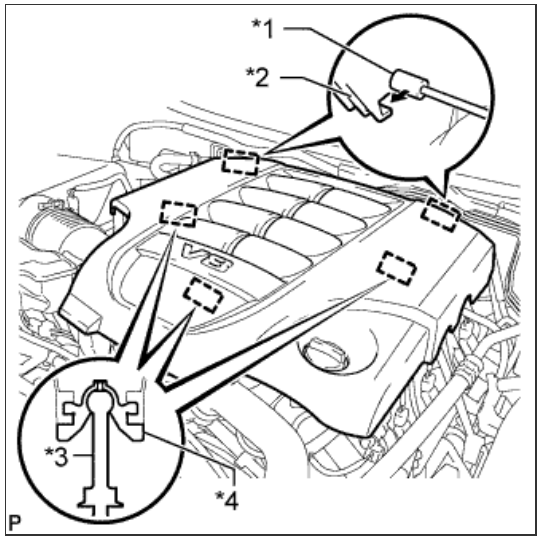
Text in Illustration

*1	Radiator Reservoir	*2	Radiator Cap
*3	Radiator Drain Cock Plug	*4	Cylinder Block Drain Cock Plug

e. Tighten the radiator drain cock plug by hand.

5. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Raise the front of the V bank cover to detach the 3 pins. Then remove the 2 V bank cover hooks from the bracket, and remove the V bank cover.



Text in Illustration

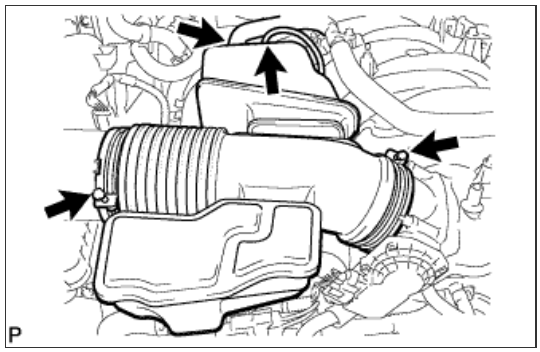
*1	Bracket
*2	Hook
*3	Pin
*4	Grommet

6. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum hose and No. 2 ventilation hose.

b. Loosen the 2 hose clamps.

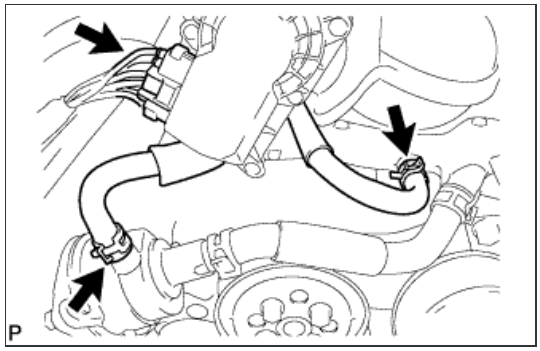
c. Remove the air cleaner hose.



7. REMOVE THROTTLE BODY ASSEMBLY

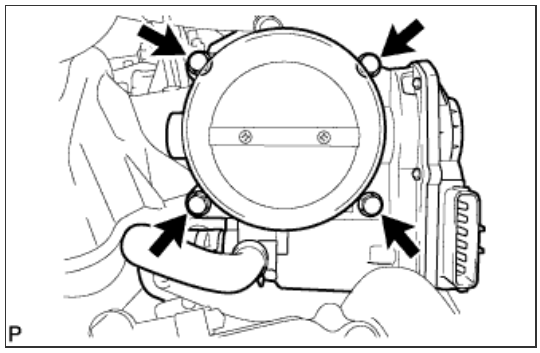
a. Disconnect the 2 water by pass hoses.

b. Disconnect the throttle position sensor and control motor connector.



c. Remove the 4 bolts, throttle body and gasket.

d. Remove the 2 water by pass hoses from the throttle body.



for Preparation Click here

1. INSPECT THROTTLE BODY ASSEMBLY

a. Check the throttle valve.

i. Check that the throttle valve opens and closes smoothly.

ii. Check that there is no sludge accumulating around the throttle body.

. Check the throttle control motor.

i. Measure the resistance according to the value(s) in the table below.

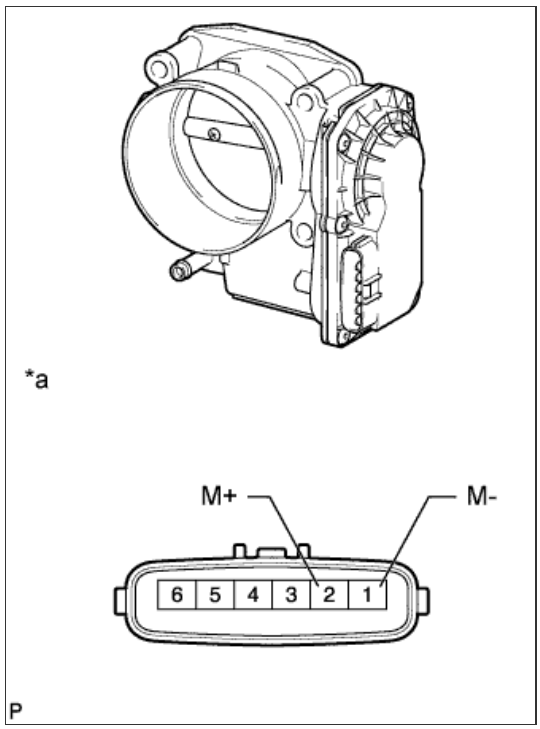
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (M-) - 2 (M+)	20°C (68°F)	0.3 to 100 Ω

Text in Illustration

*a	Component without harness connected (Throttle Body)

If the result is not as specified, replace the throttle body.



for Preparation Click here

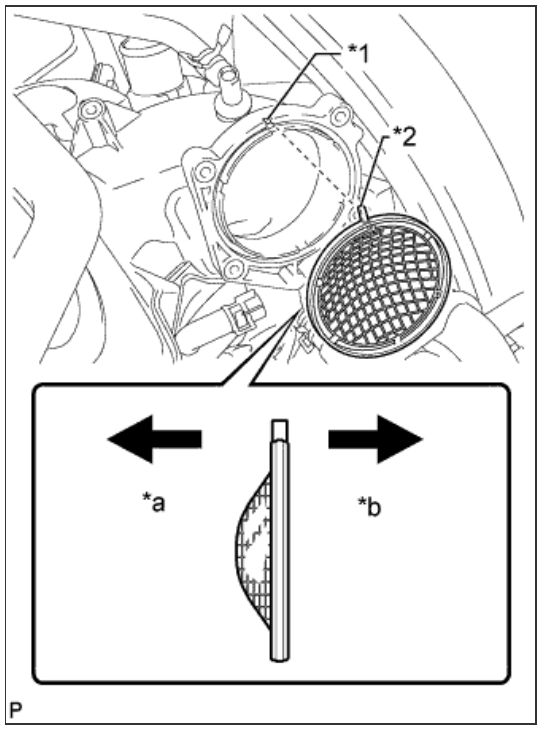
1. INSTALL THROTTLE BODY ASSEMBLY

a. Install the 2 water by-pass hoses to the throttle body.

b. Install a new gasket to the intake air surge tank.

Text in Illustration

*1	Groove
*2	Protrusion
*a	Surge Tank Side
*b	Throttle Body Side



HINT:

Align the protrusion of the gasket with the groove of the intake air surge tank.

c. Install the throttle body with the 4 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

d. Connect the throttle position sensor and control motor connector.

e. Connect the 2 water by-pass hoses.

2. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item	Specified Condition
with rear heater	16.2 liters (17.1 US qts, 14.3 Imp. qts)
without rear heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the radiator inlet hose by hand, and checking when the engine coolant starts

to flow inside the hose.

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

h. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the fan.**

i. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

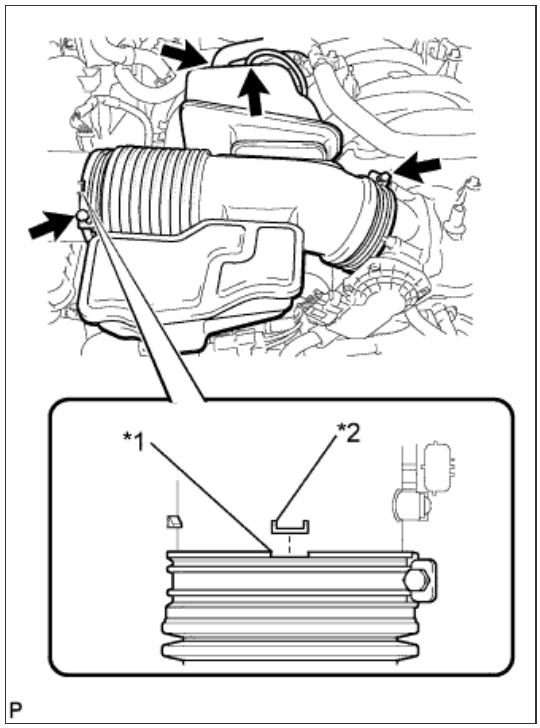
j. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.

3. INSTALL AIR CLEANER HOSE ASSEMBLY

a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

Text in Illustration

*1	Groove
*2	Protrusion



b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum hose.

d. Connect the No. 2 ventilation hose.

4. INSPECT FOR COOLANT LEAK

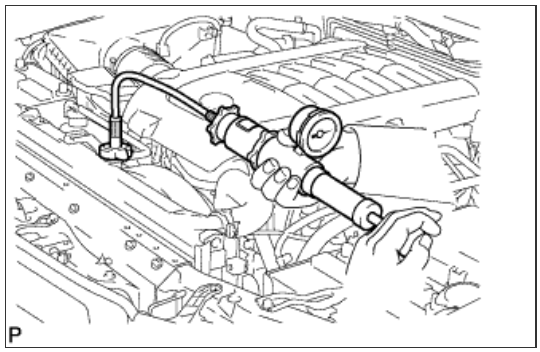
CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. ill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



5. CHECK THROTTLE BODY ASSEMBLY

a. Check the throttle control motor operating sounds.

i. Turn the engine switch on (IG).

ii. When depressing the accelerator pedal, check the operating sound of the running motor. Make sure that no friction noises are emitted from the motor. If friction noise exists, replace the throttle body.

b. Check the throttle position sensor.

i. Connect the intelligent tester to the DLC3.

ii. Turn the engine switch on (IG).

iii. Turn the intelligent tester main switch on.

iv. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Throttle Sensor Volt %.

v. Depress the accelerator pedal. When the throttle valve is fully opened, check that the value of "Throttle Sensor Volt %" is within the specification.

Standard throttle valve opening percentage:
60% or more

HINT:

When checking the standard throttle valve opening percentage, the shift lever should be in N.

If the percentage is less than 60%, replace the throttle body.

6. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

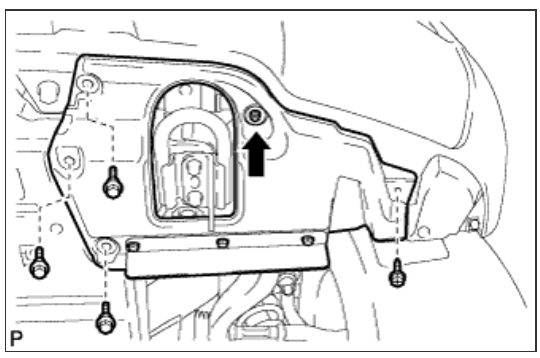
a. Install the No. 1 engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

7. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



8. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

9. PERFORM INITIALIZATION

NOTICE:

Perform the following procedure after replacing the ECM, throttle body assembly or any throttle body components. The following procedure should also be performed if the throttle body is cleaned.

a. Disconnect the cable from the negative (-) battery terminal. Wait at least 60 seconds and reconnect the cable.

b. Turn the engine switch on (IG) without operating the accelerator pedal.

NOTICE:

If the accelerator pedal is operated, perform the above steps again.

c. Connect the intelligent tester to the DLC3 and clear the DTCs (Click here).

d. Start the engine and check that the MIL is not illuminated and that the idle speed is within the specified range when the A/C is switched off after the engine is warmed up.

Standard:

Condition	Engine Idle Speed
A/C switched off	650 to 750 rpm

NOTICE:

- **Be sure to perform this step with all accessories off.**
- **Make sure that the shift lever is in N or P.**

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Throttle Sensor Volt %. Fully depress the accelerator pedal and check that the value is 60% or more.

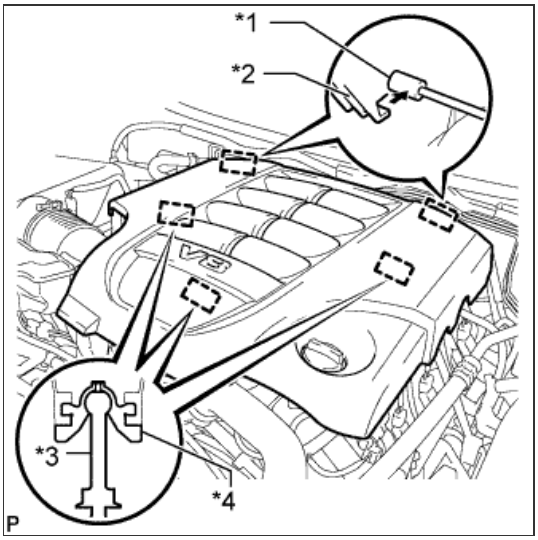
f. Perform a road test and confirm that there are no abnormalities.

10. INSTALL V-BANK COVER SUB-ASSEMBLY

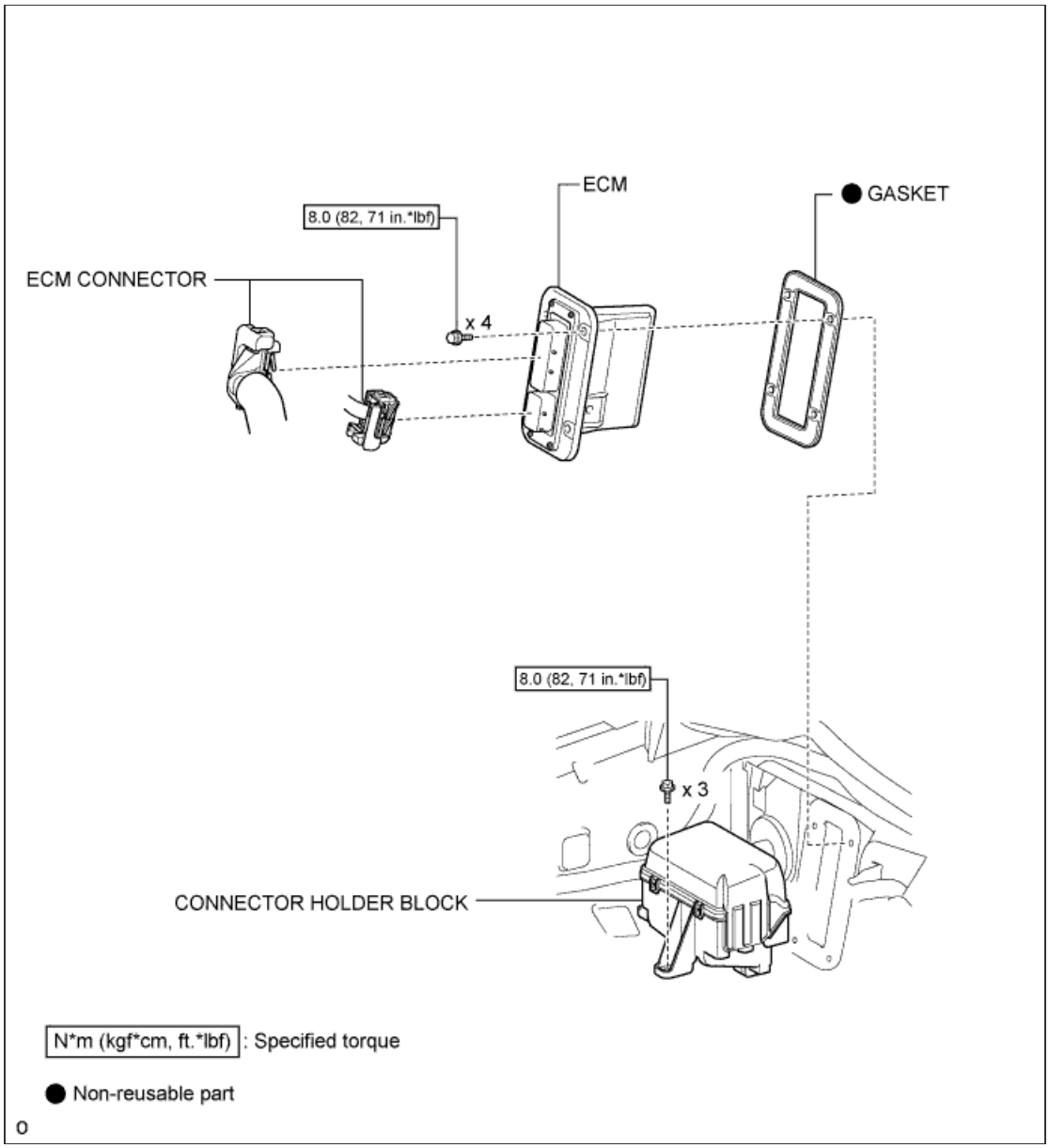
a. Attach the 2 V-bank cover hooks to the bracket. Then align the 3 V-bank cover grommets with the 3 pins, and press down on the V-bank cover to attach the pins.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet



for Preparation [Click here]



for Preparation Click here

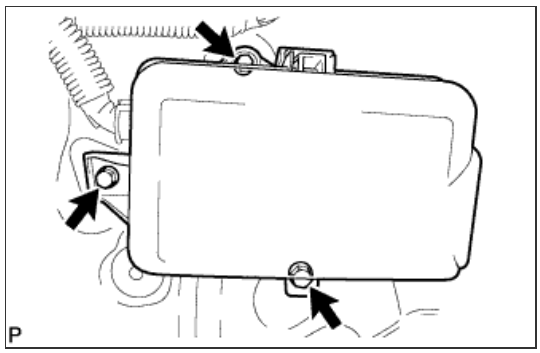
1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

2. DISCONNECT CONNECTOR HOLDER BLOCK

a. Remove the 3 bolts and move the connector holder block so that the ECM can be removed in the next step.



3. REMOVE ECM

a. Raise the 2 levers while pushing the locks on the 2 levers.

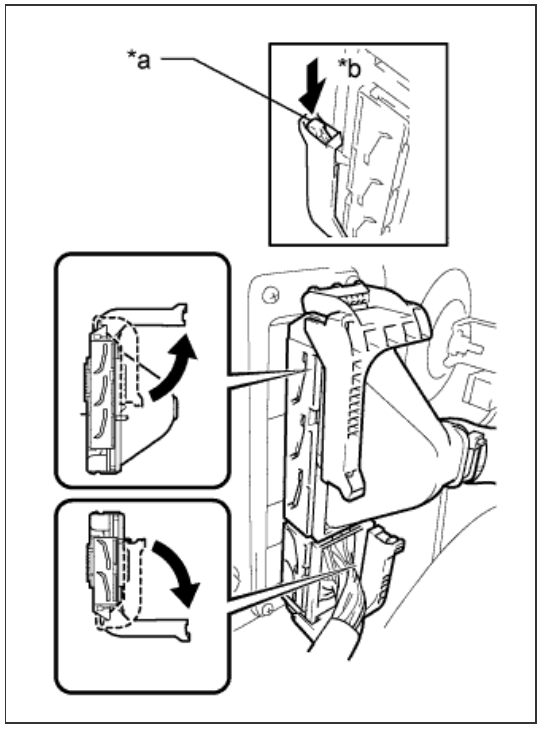
Text in Illustration

*a	Lock
*b	Push

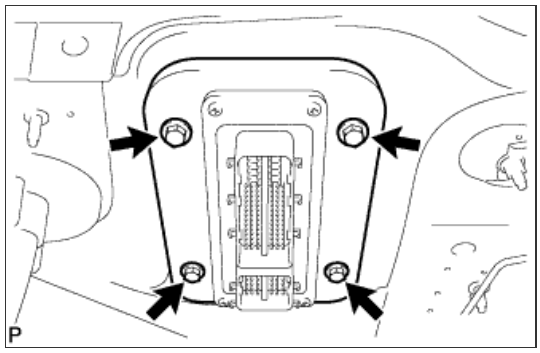
NOTICE:

Make sure that the lock levers are raised 90° as shown in the illustration before disconnecting the connectors. Failure to do this may cause the connectors to break.

b. Disconnect the 2 connectors.

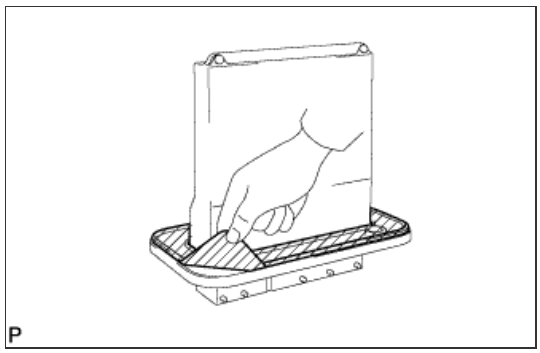


c. Remove the 4 bolts and ECM.



4. REMOVE GASKET

a. Peel off the gasket.



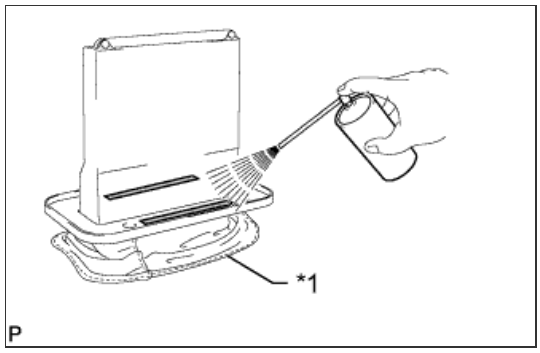
b. Spray gasket remover or e uivalent on the remaining tape of the gasket.

NOTICE:

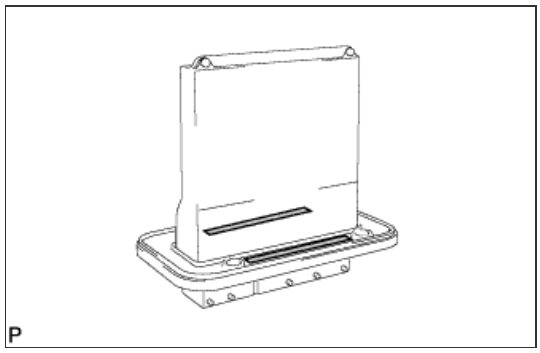
When using gasket remover or e uivalent, cover the ECM connectors with a cloth.

Text in Illustration

*	Cloth



c. Remove the tape of the gasket without using bladed ob ects.



for Preparation Click here

1. INSTALL GASKET

a. Clean the ECM seal surface with non-residue solvent.

b. Attach a new gasket to the ECM.

2. INSTALL ECM

a. Install the ECM with the 4 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

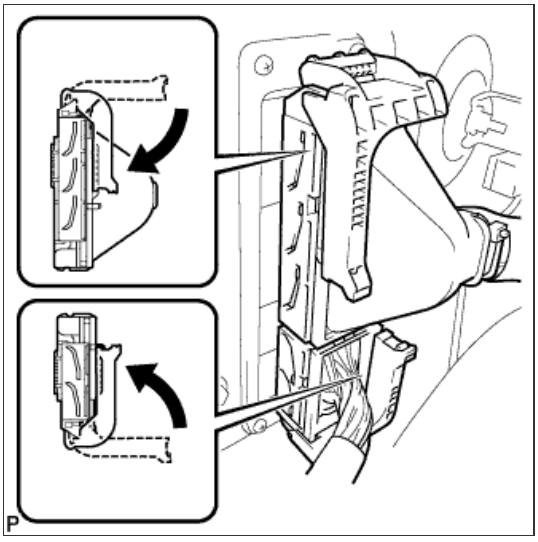
NOTICE:

- **Make sure the gasket is not folded or caught on any area of the surrounding part.**
- **Make sure there is no foreign matter caught between the gasket and surrounding part.**
- **Do not damage the gasket.**

b. Connect the 2 ECM connectors and push each lock lever down to lock the ECM connectors.

NOTICE:

- **Be careful not to allow dirt, water, or other foreign matter to adhere to the connecting parts when connecting the connectors.**
- **Do not twist the wire harness when connecting the ECM connectors.**
- **Make sure that the lock levers are raised 90° before connecting the ECM connectors. Failure to do this may cause the lock lever and terminals to break.**
- **Make sure that the levers are securely locked.**



3. INSTALL CONNECTOR HOLDER BLOCK

a. Install the connector holder block with the 3 bolts.

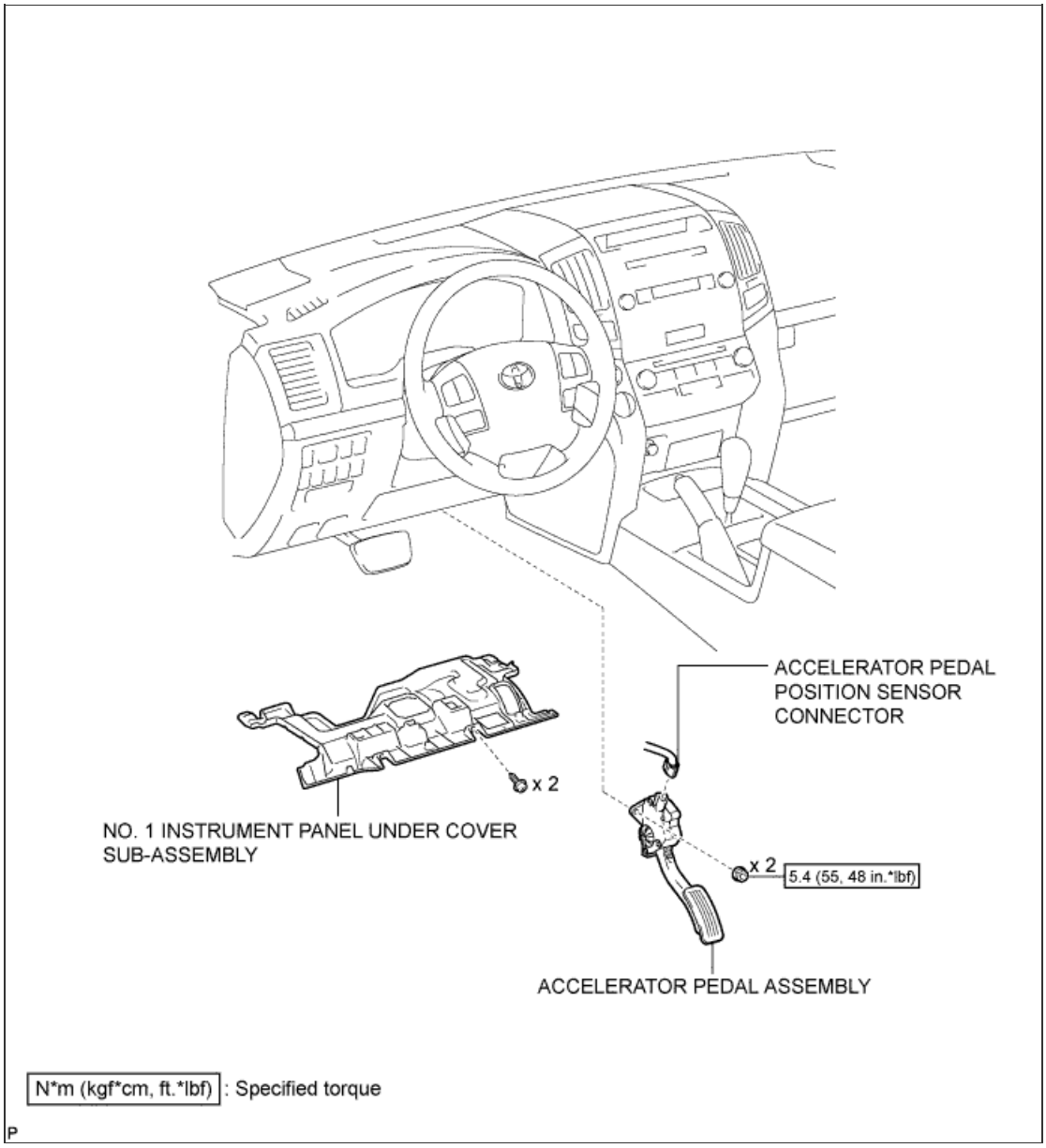
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

4. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

for Preparation Click here



for Preparation Click here

1. INSPECT ACCELERATOR PEDAL ASSEMBLY

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the intelligent tester main switch on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accel Sensor Out No. 1 and Accel Sensor Out No. 2.

e. Read the lue displayed on the intelligent tester.

Standard Voltage:

Accelerator Pedal Operations	Accel Sensor Out No. 1	Accel Sensor Out No. 2
Released	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2.6 to 4.5 V	3.4 to 5.0 V

If the result is not as specified chec the accelerator pedal wire harness and EC .

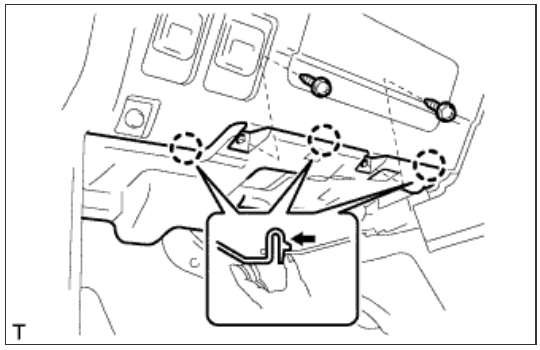
for Preparation Click here

1. REMOVE NO. 1 INSTRUMENT PANEL UNDER COVER SUB ASSEMBLY

a. Remove the 2 screws.

b. Detach the 3 claws.

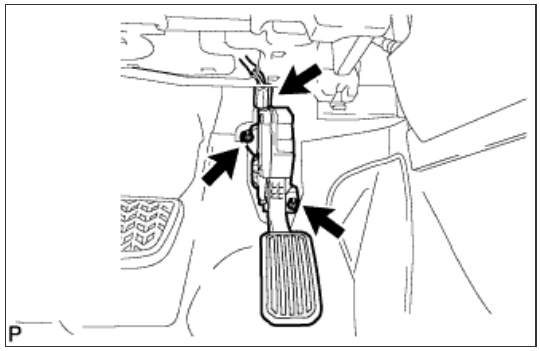
c. Disconnect the connectors and remove the No. 1 instrument panel under cover.



2. REMOVE ACCELERATOR PEDAL ASSEMBLY

a. Disconnect the accelerator pedal position sensor connector.

b. Remove the 2 nuts and accelerator pedal.



for Preparation Click here

1. INSTALL ACCELERATOR PEDAL ASSEMBLY

NOTICE:

- **Avoid physical shocks to the accelerator pedal.**
- **Do not disassemble the accelerator pedal.**

a. Install the accelerator pedal with the 2 nuts.

Torque:
5.4 N*m{ 55 kgf*cm , 48 in.*lbf }

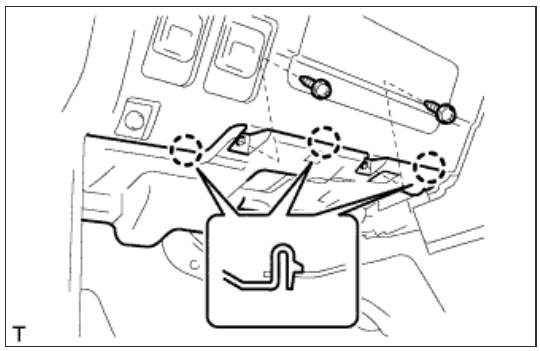
b. Connect the accelerator pedal position sensor connector.

2. INSTALL NO. 1 INSTRUMENT PANEL UNDER CO B SUB-ASSEMBLY

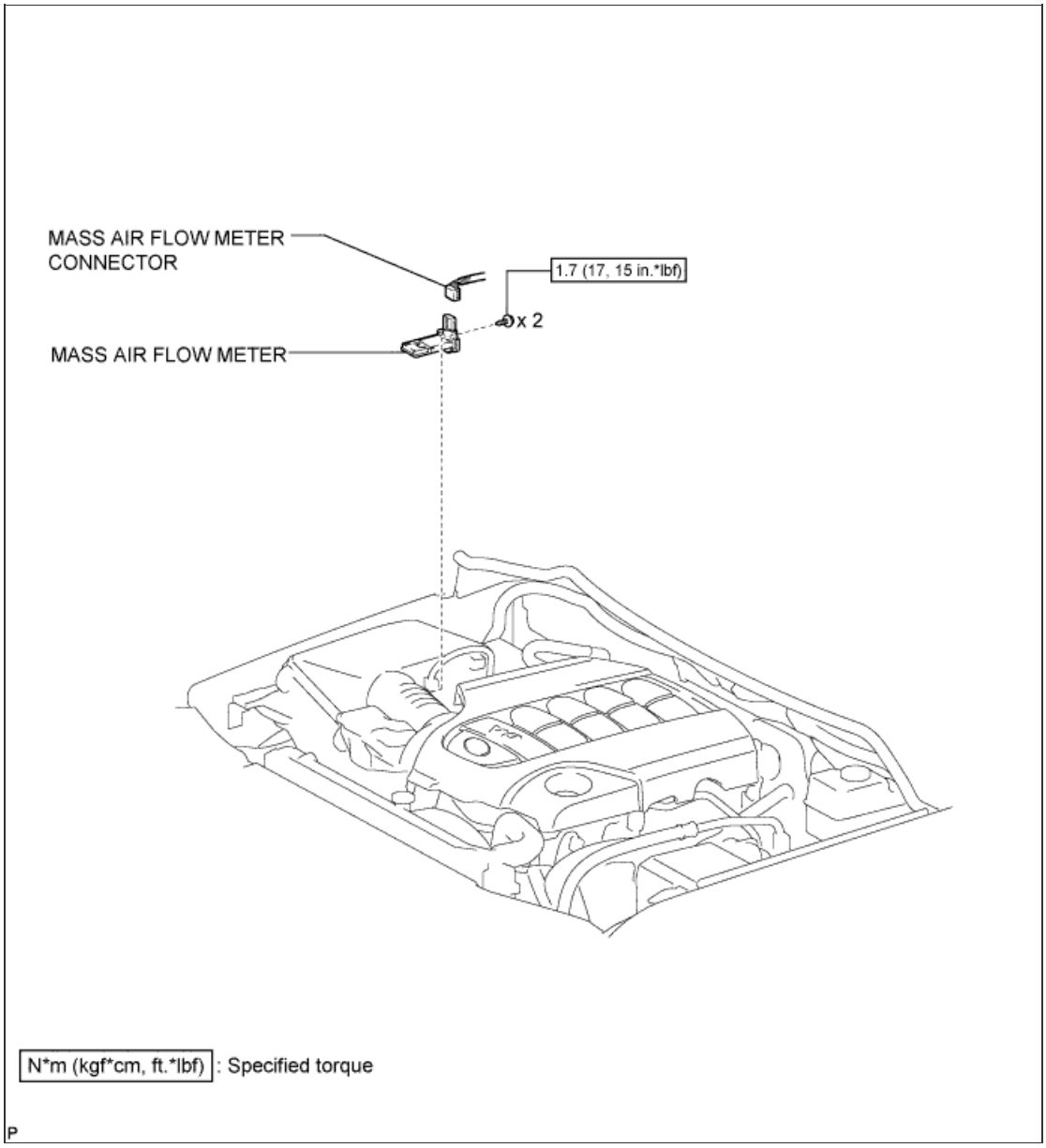
a. Connect the connectors.

b. Attach the 3 claws to install the o. instrument panel under cover.

c. Install the 2 screws.



for Preparation Click here



for Preparation Click here

1. CHECK MASS AIR FLOW METER

a. Check the mass air flow value.

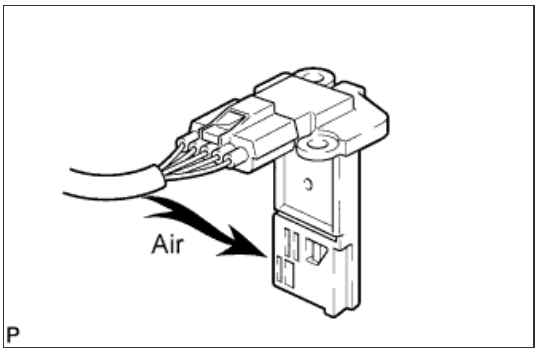
i. Connect the intelligent tester to the DLC3.

ii. Turn the engine switch on (IG).

iii. Turn the intelligent tester main switch on.

i Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / mass air flow meter.

Blow air into the mass air flow meter, and check that the mass air flow meter value fluctuates.
If the result is not as specified, check the mass air flow meter (Click here), or wiring and ECM (Click here).

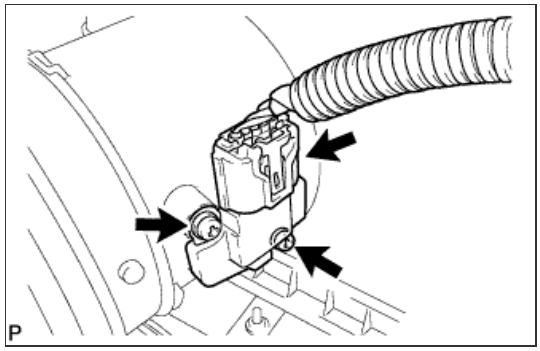


for Preparation Click here

1. REMOVE MASS AIR FLOW METER

a. Disconnect the mass air flow meter connector.

b. Remove the 2 screws and mass air flow meter.

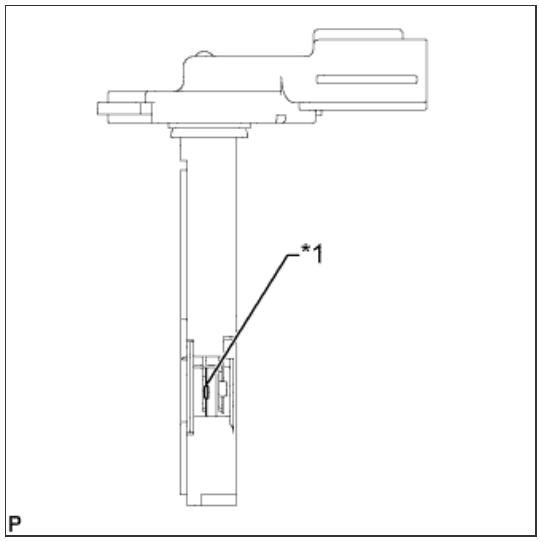


for Preparation Click here

1. INSPECT MASS AIR FLOW METER

a. Perform a visual check for any foreign matter on the platinum hot wire (heater) of the mass air flow meter shown in the illustration.

OK:
There is no foreign matter.

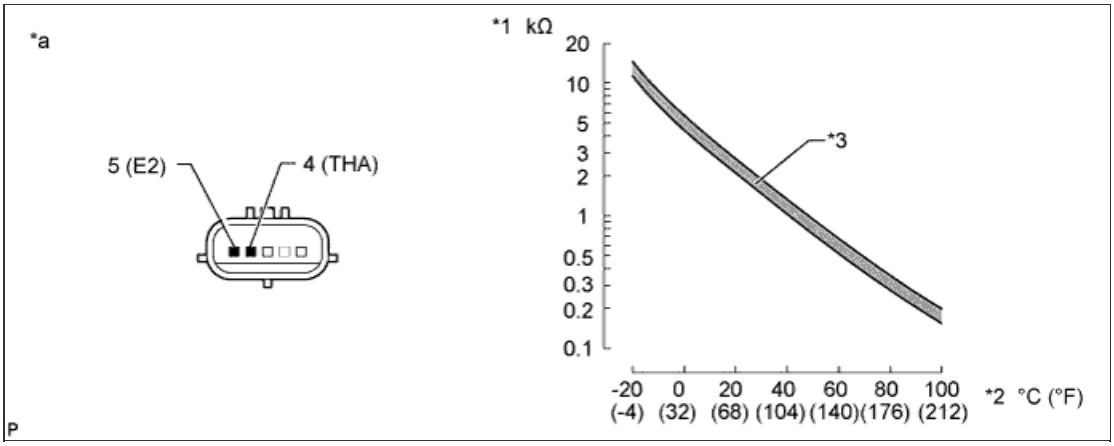


Text in Illustration

*1	Platinum Hot Wire (Heater)

If the result is not as specified, replace the mass air flow meter.

b. Check the intake air temperature sensor.



Text in Illustration

*1	Resistance kΩ	*2	Temperature °C (°F)
*3	Acceptable Range	-	-
*a	Component without harness connected (Mass air flow meter)	-	-

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
4 (THA) - 5 (E2)	-20°C (-4°F)	12.5 to 16.9 kΩ
	20°C (68°F)	2.19 to 2.67 kΩ
	60°C (140°F)	0.50 to 0.68 kΩ

If the result is not as specified, replace the mass air flow meter.

for Preparation Click here

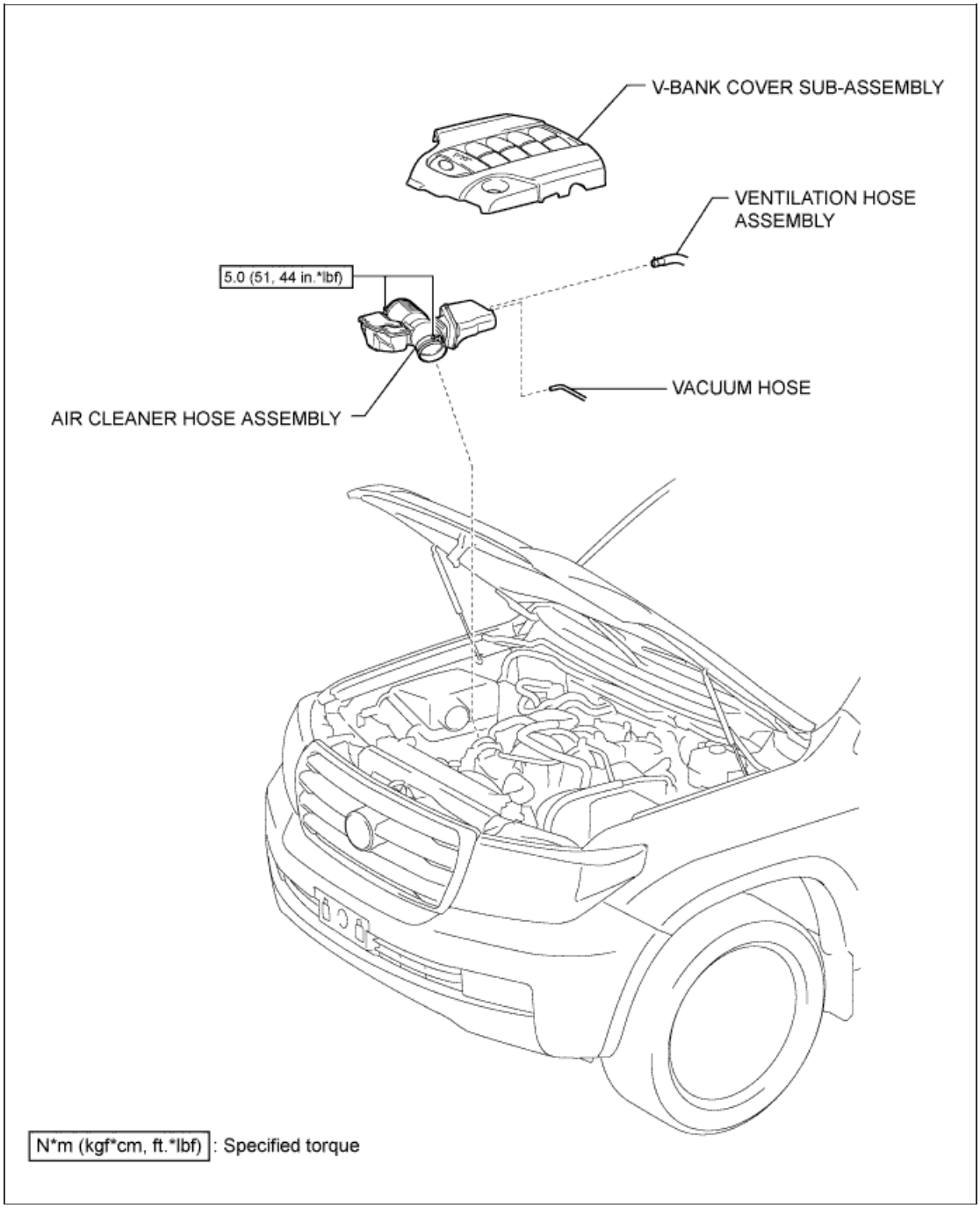
1. INSTALL MASS AIR FLOW METER

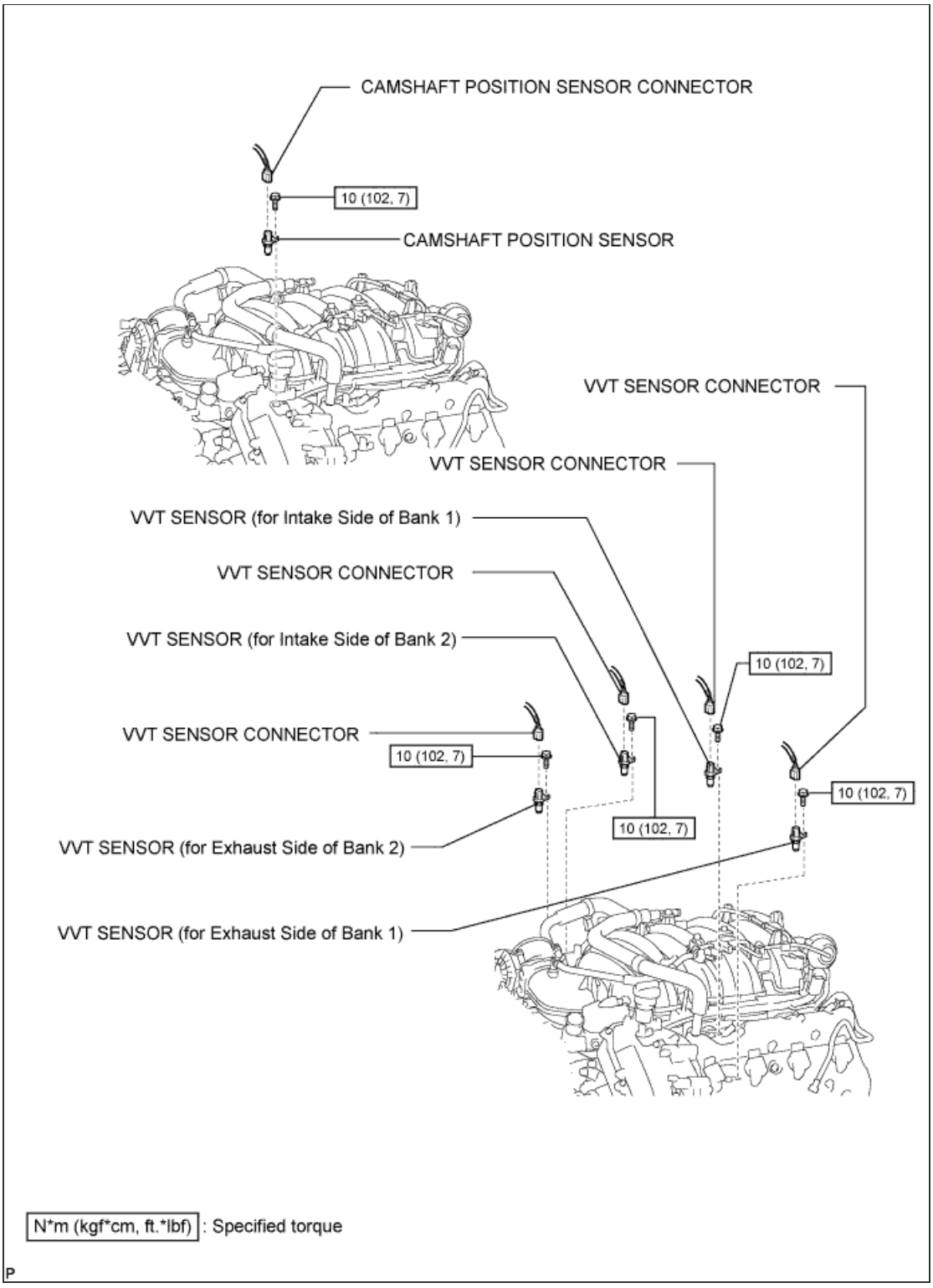
a. Install the mass air flow meter with the 2 screws.

Torque:
1.7 N*m{ 17 kgf*cm , 15 in.*lbf }

b. Connect the mass air flow meter connector.

for Preparation Click here




CAMSHAFT POSITION SENSOR CONNECTOR
10 (102, 7)
CAMSHAFT POSITION SENSOR
VVT SENSOR CONNECTOR
VVT SENSOR CONNECTOR
VVT SENSOR (for Intake Side of Bank 1)
VVT SENSOR CONNECTOR
VVT SENSOR (for Intake Side of Bank 2)
10 (102, 7)
VVT SENSOR CONNECTOR
10 (102, 7)
10 (102, 7)
10 (102, 7)
VVT SENSOR (for Exhaust Side of Bank 2)
VVT SENSOR (for Exhaust Side of Bank 1)
N*m (kgf*cm, ft.*lbf) : Specified torque

P

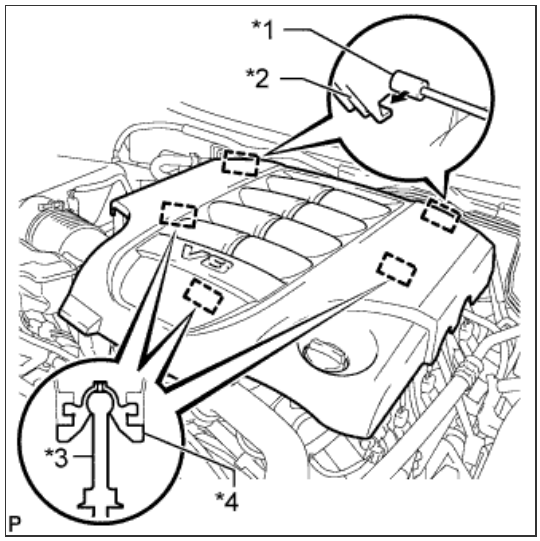
for Preparation Click here

1. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Raise the front of the V-bank cover to detach the 3 pins. Then remove the 2 V-bank cover hooks from the bracket, and remove the V-bank cover.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet

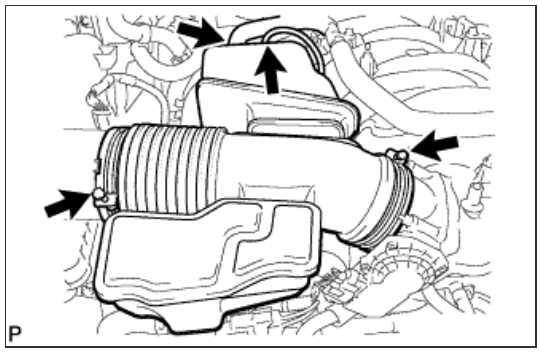


2. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum hose and No. 2 ventilation hose.

b. Loosen the 2 hose clamps.

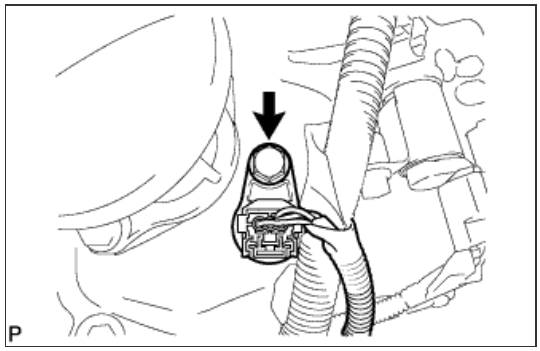
c. Remove the air cleaner hose.



3. REMOVE CAMSHAFT POSITION SENSOR

a. Disconnect the sensor connector.

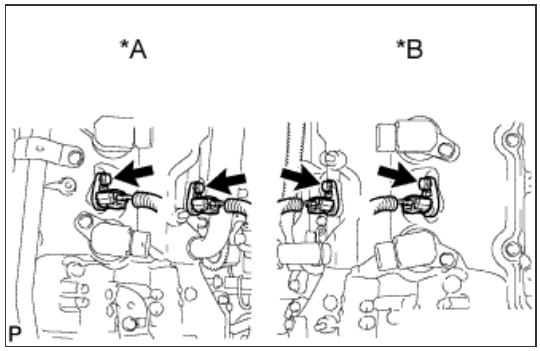
b. Remove the bolt and sensor.



4. REMOVE VVT SENSOR

a. Disconnect the 4 sensor connectors.

b. Remove the 4 bolts and 4 sensors.



Text in Illustration

*A	for Bank 2
*B	for Bank 1

for Preparation Click here

1. INSTALL VVT SENSOR

a. Apply a light coat of engine oil to the O-ring of the VVT sensor.

NOTICE:

- **When reusing the sensor, inspect the O-ring.**
- **If the O-ring has scratches or cuts, replace the sensor.**

b. Install the 4 sensors with the 4 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

c. Connect the 4 sensor connectors.

2. INSTALL CAMSHAFT POSITION SENSOR

a. Install the sensor with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

NOTICE:

- **When reusing the sensor, inspect the O-ring.**
- **If the O-ring has scratches or cuts, replace the sensor.**

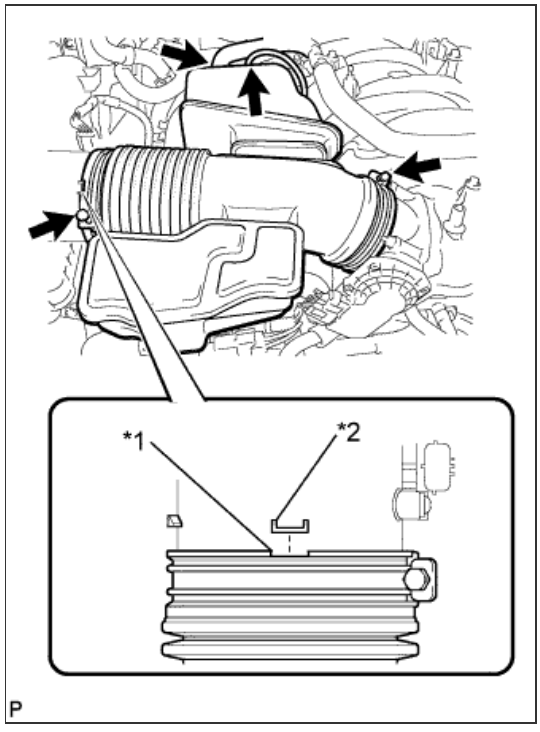
b. Connect the sensor connector.

3. INSTALL AIR CLEANER HOSE ASSEMBLY

a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

Text in Illustration

*1	Groove
*2	Protrusion



b. Tighten the 2 clamps.

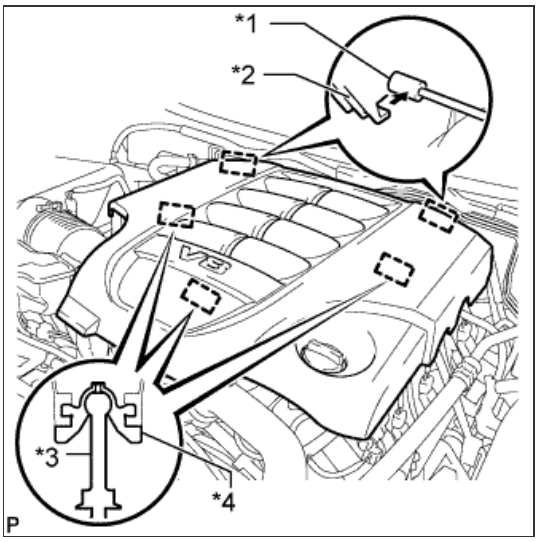
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum hose.

d. Connect the No. 2 ventilation hose.

4. INSTALL V-BANK COVER SUB-ASSEMBLY

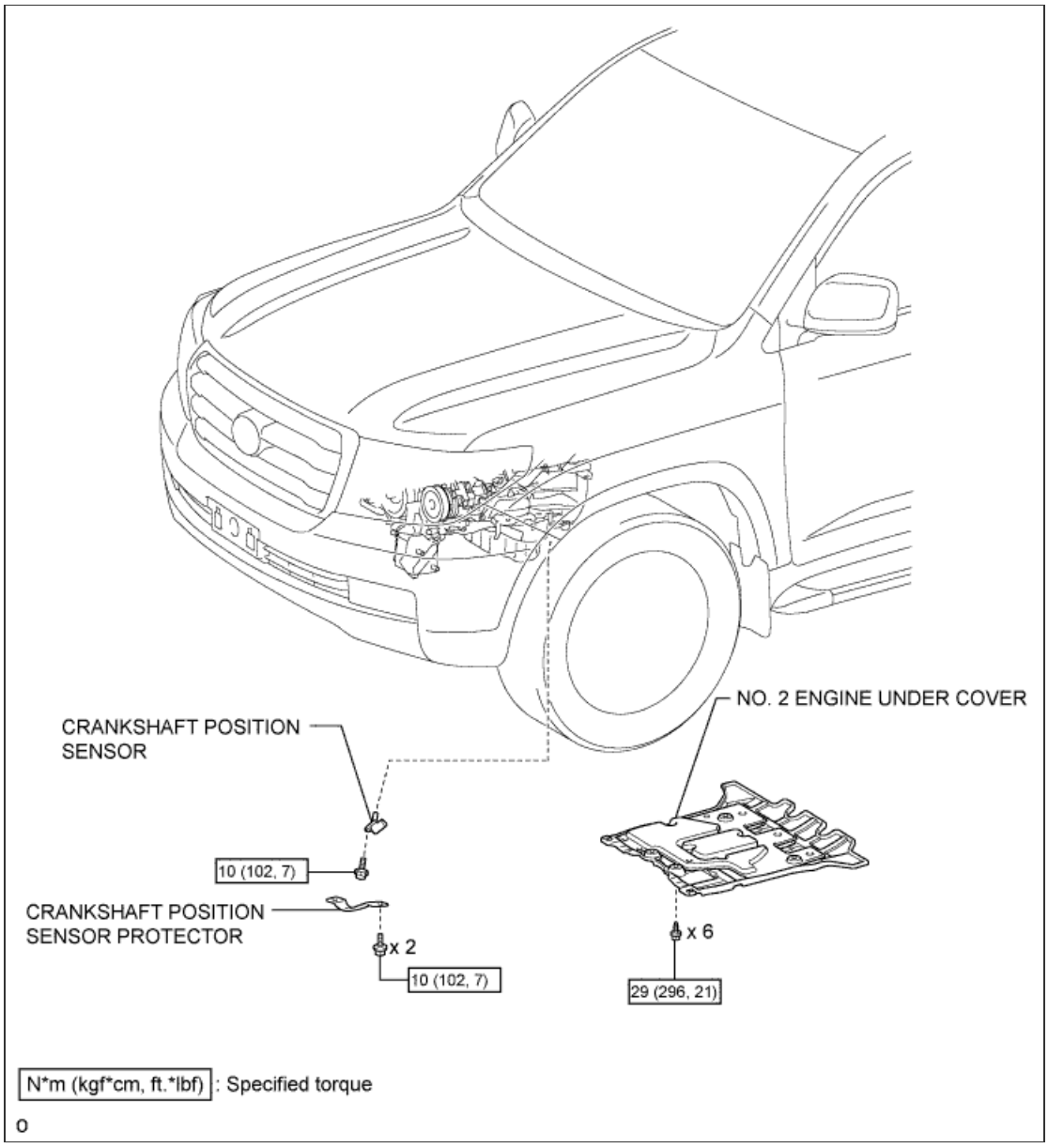
a. Attach the 2 V-bank cover hooks to the bracket. Then align the 3 V-bank cover grommets with the 3 pins, and press down on the V-bank cover to attach the pins.



Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet

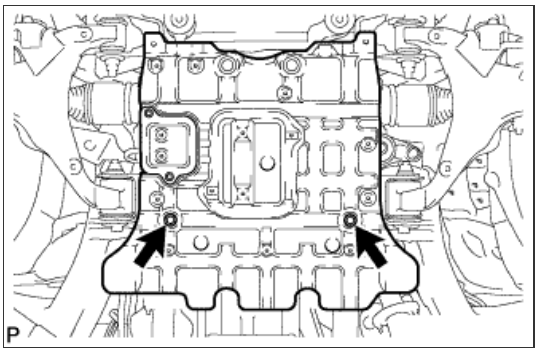
for Preparation Click here



for Preparation Click here

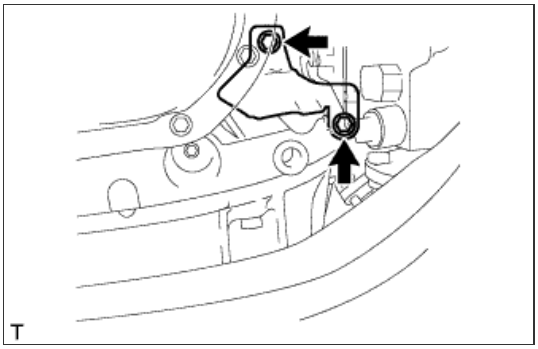
1. REMOVE NO. 2 ENGINE UN ER COVER

a. Remove the 2 bolts and No. 2 engine under over.



2. REMOVE CRANKSHAFT POSITION SENSOR PROTECTOR

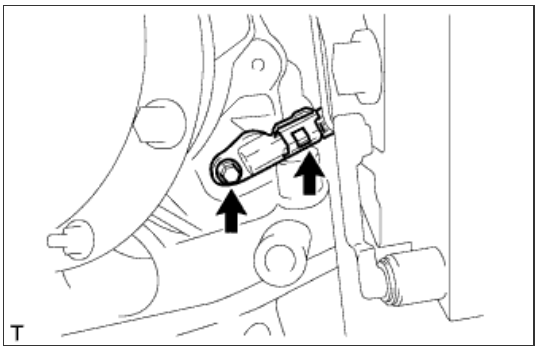
a. Remove the 2 bolts and sensor prote tor.



. REMOVE CRANKSHAFT POSITION SENSOR

a. Dis onne t the sensor onne tor.

b. Remove the bolt and sensor.



for Preparation Click here

1. INSTALL CRANKSHAFT POSITION SENSOR

a. Apply a light coat of engine oil to the O-ring of the crank haft po ition en or.

NOTICE:

- **When reusing the sensor, inspect the O-ring.**
- **If the O-ring has scratches or cuts, replace the sensor.**

b. n tall the en or ith the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

c. Connect the en or connector.

2. INSTALL CRANKSHAFT POSITION SENSOR PROTECTOR

a. n tall the en or protector ith the bolt

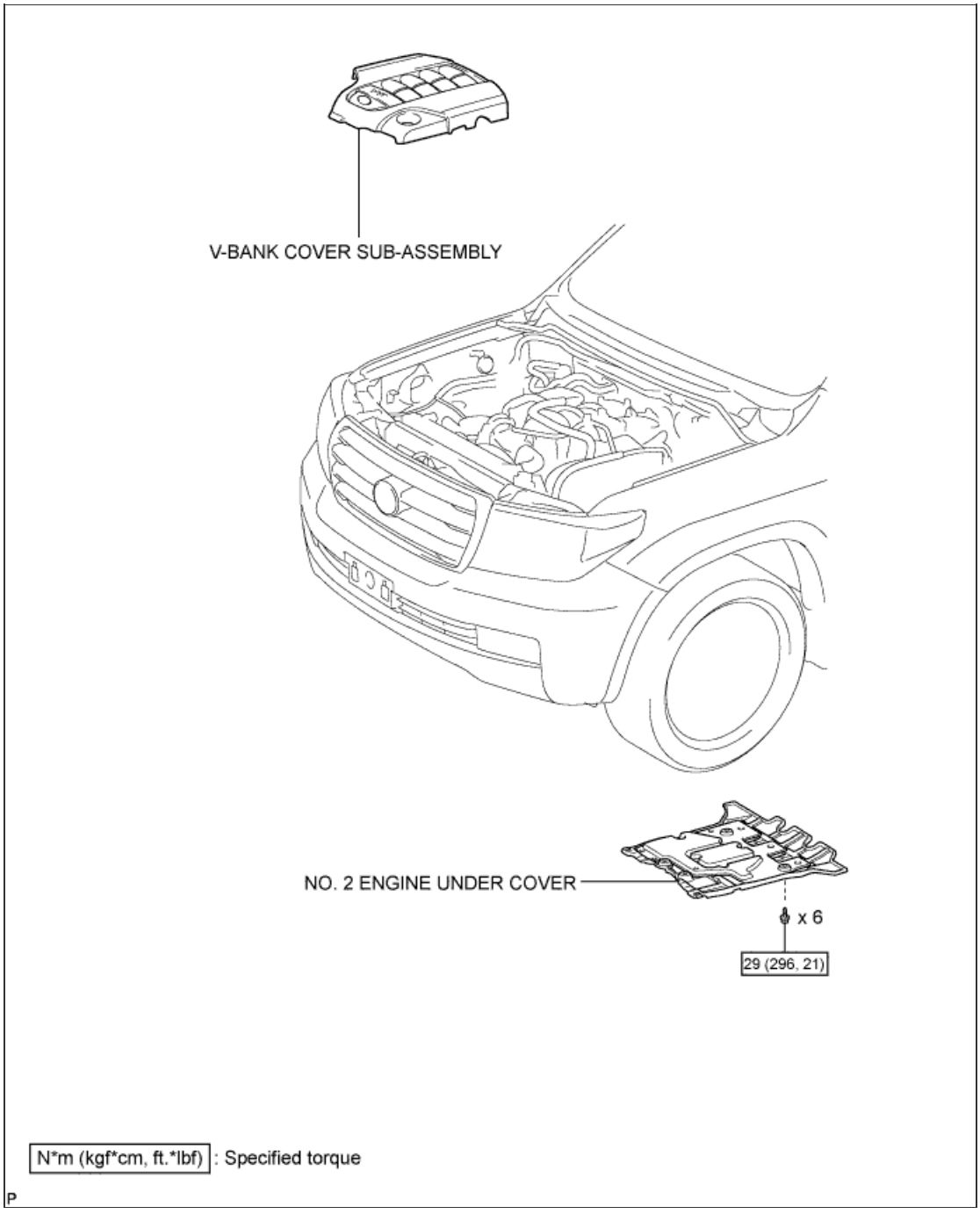
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

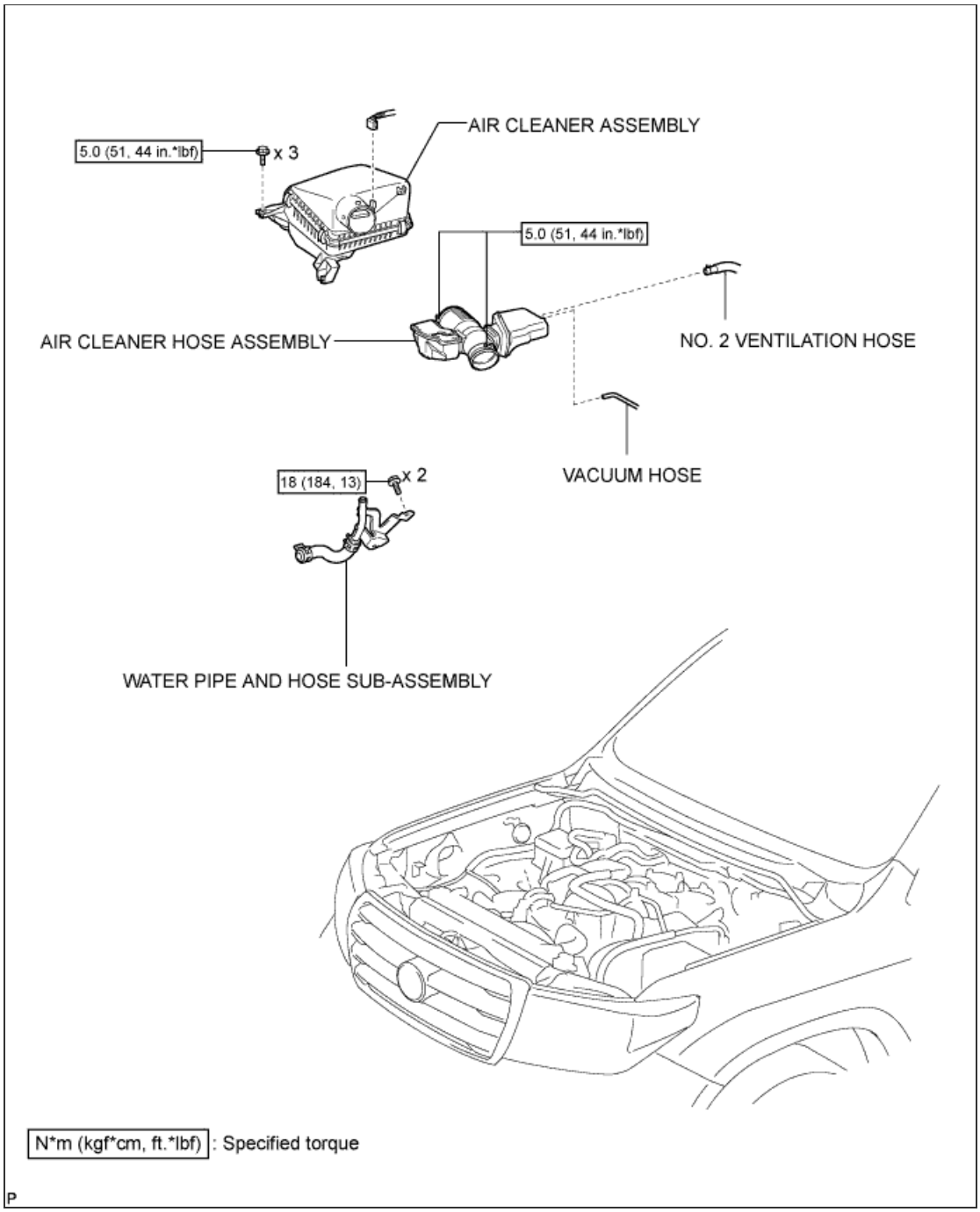
3. INSTALL NO. 2 ENGINE UNDER COVER

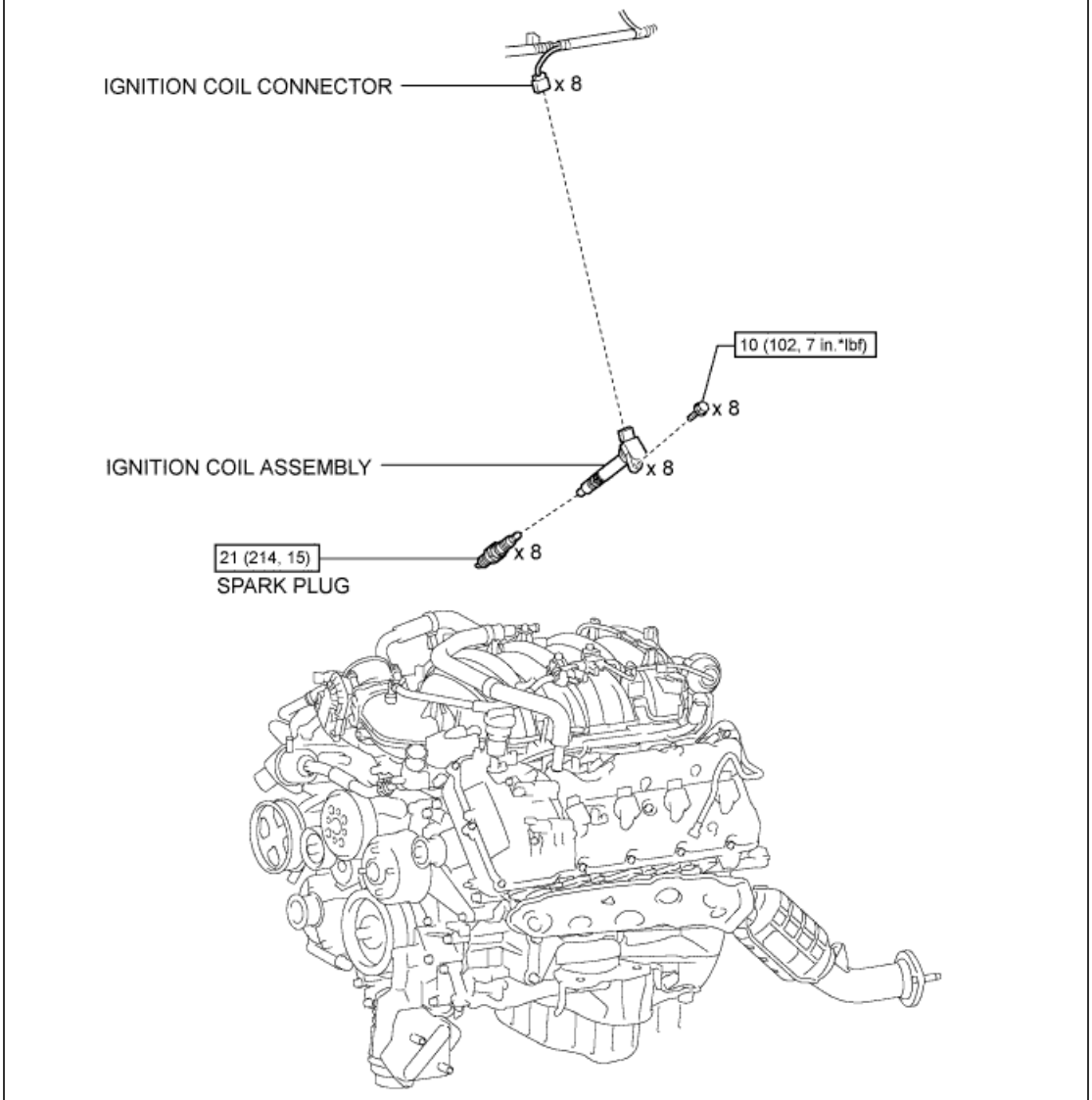
a. n tall the No. engine under cover ith the bolt

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

for Preparation Click here




5.0 (51, 44 in.*lbf)
x 3
AIR CLEANER ASSEMBLY
5.0 (51, 44 in.*lbf)
AIR CLEANER HOSE ASSEMBLY
NO. 2 VENTILATION HOSE
VACUUM HOSE
18 (184, 13)
x 2
WATER PIPE AND HOSE SUB-ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
P



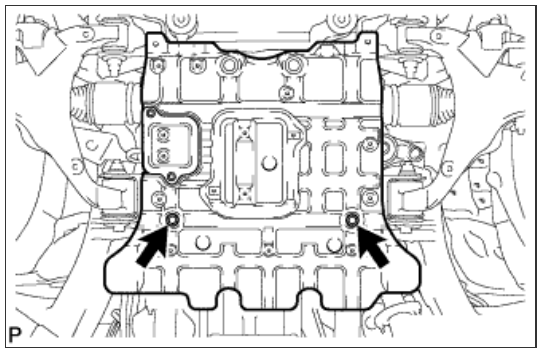
N*m (kgf*cm, ft.*lbf) : Specified torque

P

for Preparation Click here

1. REMOVE NO. 2 ENGINE UNDER COVER

a. Remove the 2 bolts and No. 2 engine under cover.

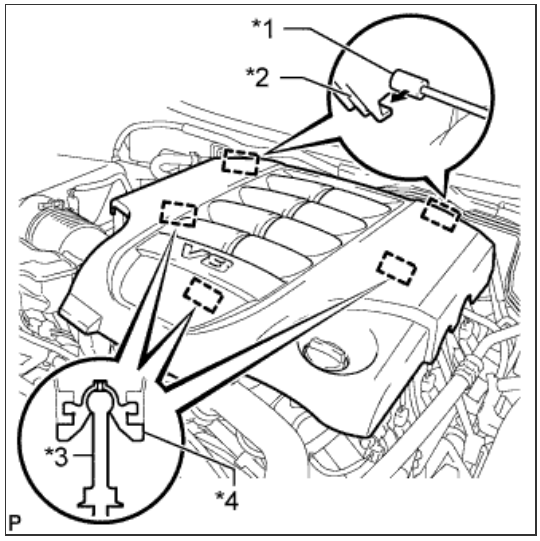


2. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Raise the front of the V-bank cover to detach the 3 pins. Then remove the 2 V-bank cover hooks from the bracket, and remove the V-bank cover.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet

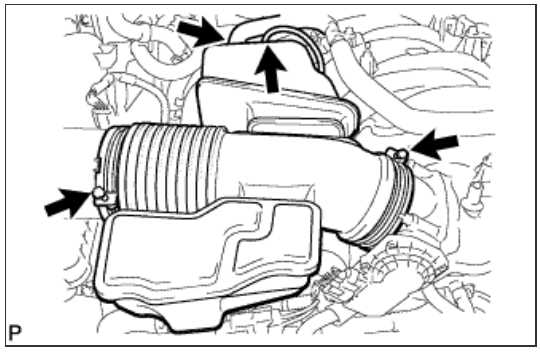


3. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum hose and No. 2 ventilation hose.

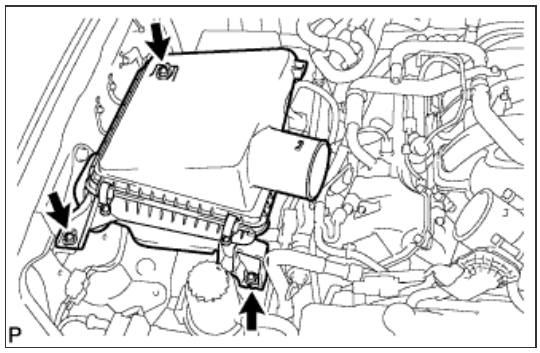
b. Loosen the 2 hose clamps.

c. Remove the air cleaner hose.



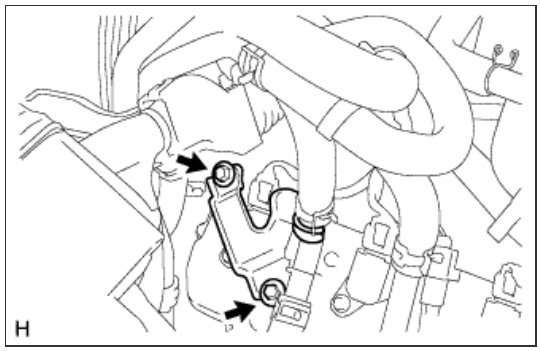
4. REMOVE AIR CLEANER ASSEMBLY

a. Remove the 3 bolts and air cleaner.



5. DISCONNECT WATER PIPE AND HOSE SUB-ASSEMBLY

a. Remove the 2 bolt and disconnect the water pipe and hose.



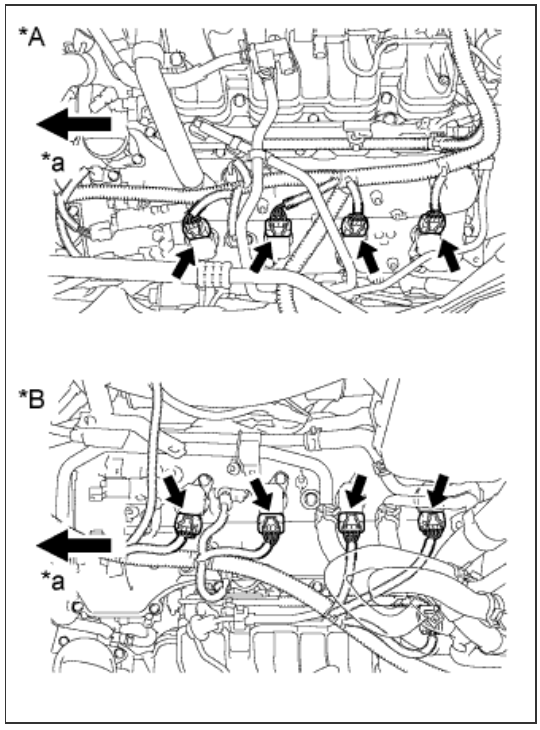
6. REMOVE IGNITION COIL ASSEMBLY

a. Disconnect the 8 ignition coil connectors.

b. Remove the 8 bolts and 8 ignition coils.

Text in Illustration

*A	for Bank 1
*B	for Bank 2
*a	Engine Front



7. REMOVE SPARK PLUG

a. Remove the 8 spark plugs.

for Preparation Click here

1. INSTALL SPARK PLUG

a. Install the 8 spark plugs.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

2. INSTALL IGNITION COIL ASSEMBLY

a. Install the 8 ignition coils with the 8 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 in.*lbf }

b. Connect the 8 ignition coil connectors.

3. CONNECT WATER PIPE AND HOSE SUB-ASSEMBLY

a. Connect the water pipe and hose and install the 2 bolts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

4. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner with the 3 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

5. INSTALL AIR CLEANER HOSE ASSEMBLY

a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

Text in Illustration

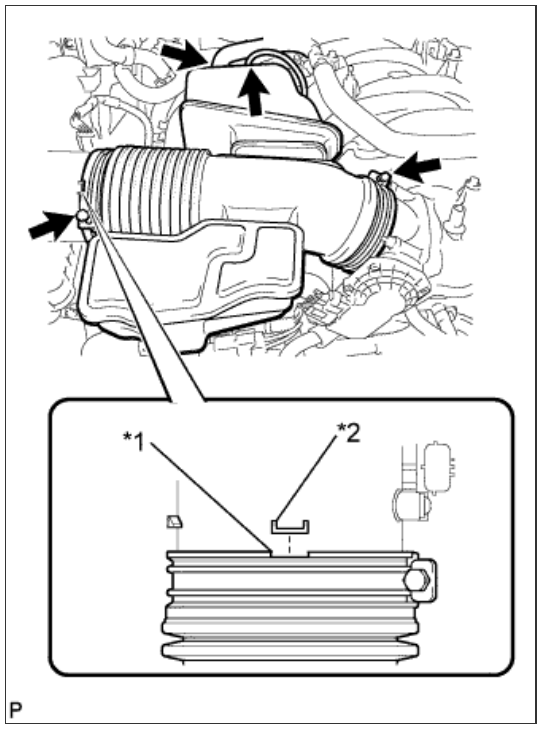
*1	Groove
*2	Protrusion

b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

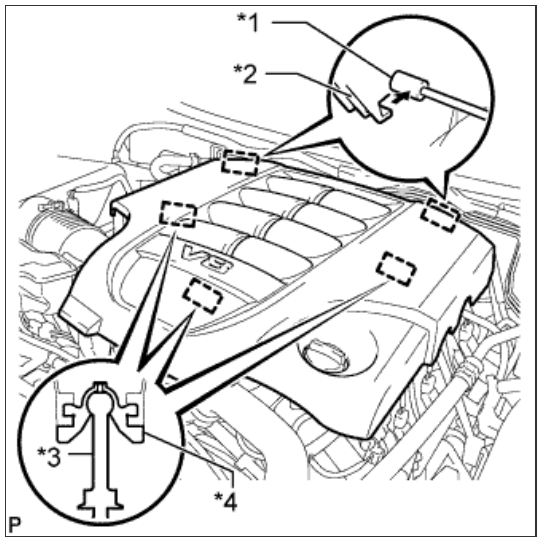
c. Connect the vacuum hose.

d. Connect the No. 2 ventilation hose.



6. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket. Then align the 3 V-bank cover grommets with the 3 pins, and press down on the V-bank cover to attach the pins.



Text in Illustration

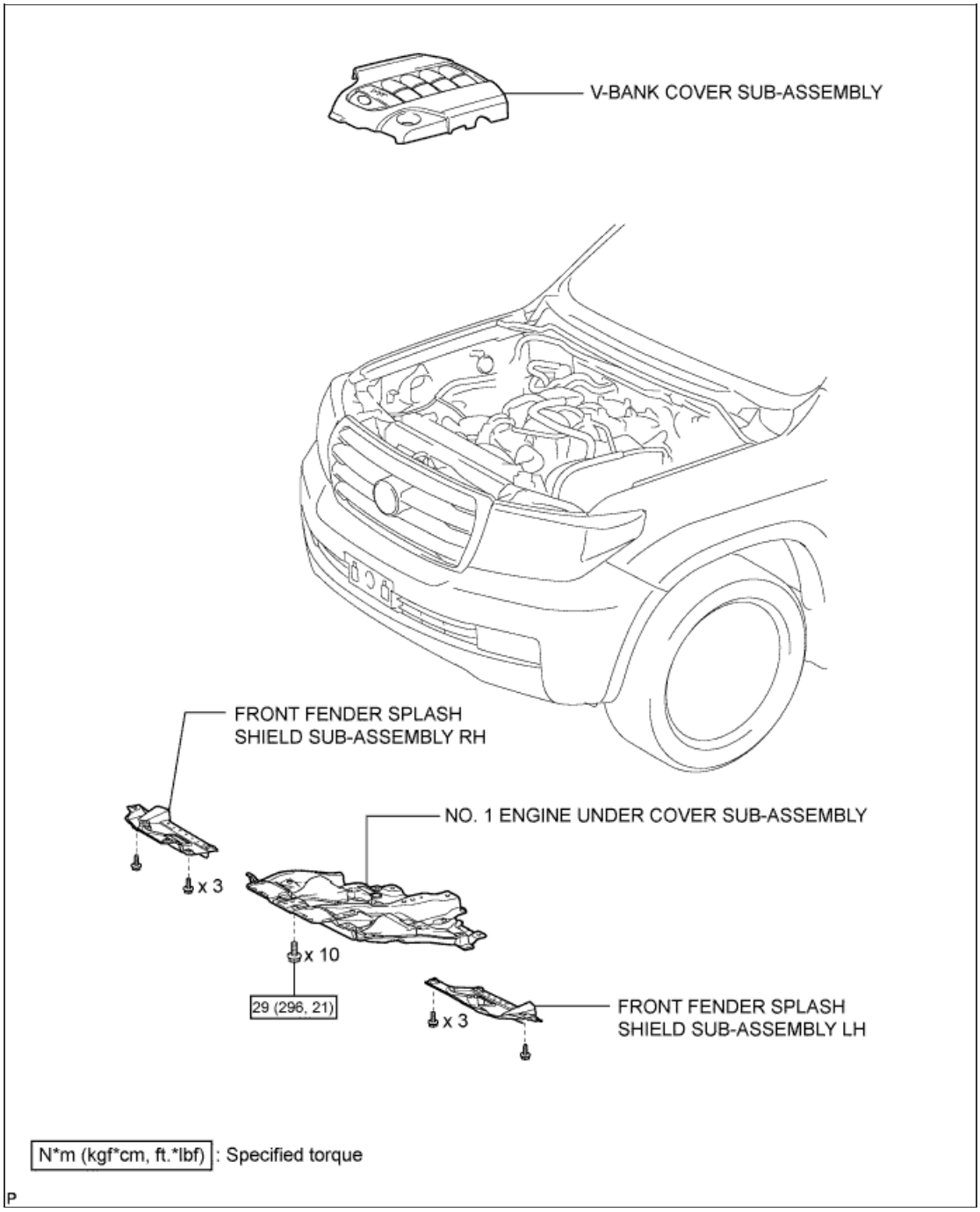
*1	Bracket
*2	Hook
*3	Pin
*4	Grommet

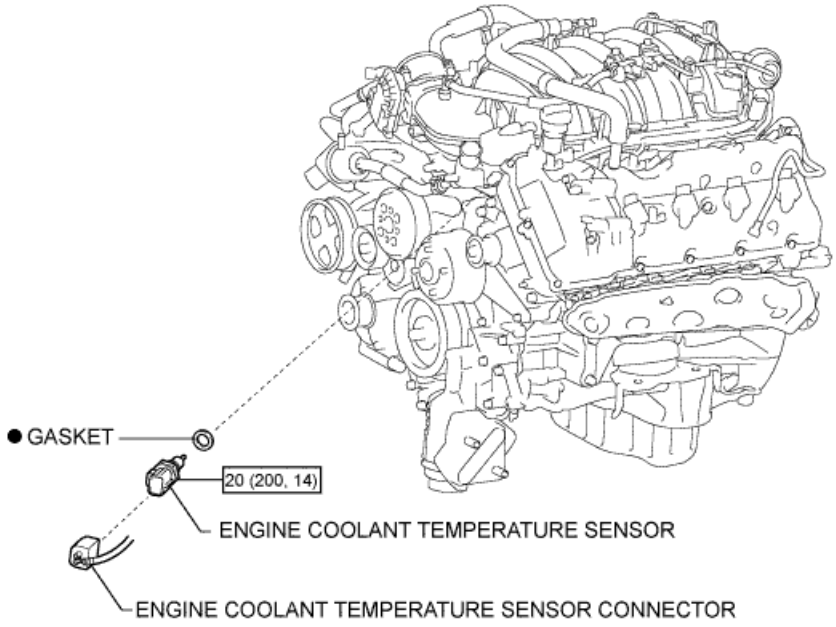
7. INSTALL NO. 2 ENGINE UNDER COVER

a. Install the No. 2 engine under cover with the 2 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

for Preparation Click here





N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P

for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

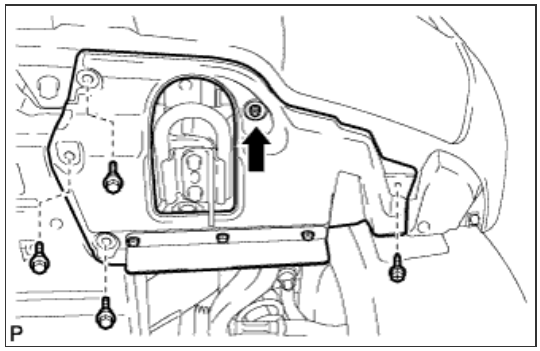
HINT:

Use the same procedures described for the LH side.

2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

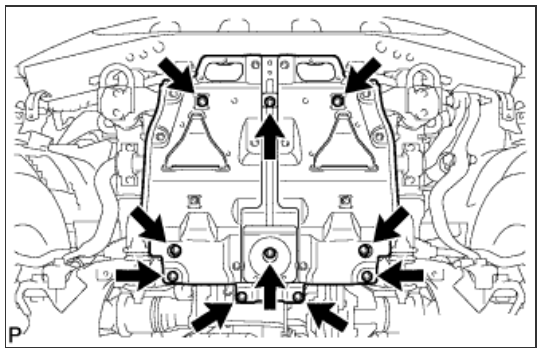
a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and No. 1 engine under cover.



4. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

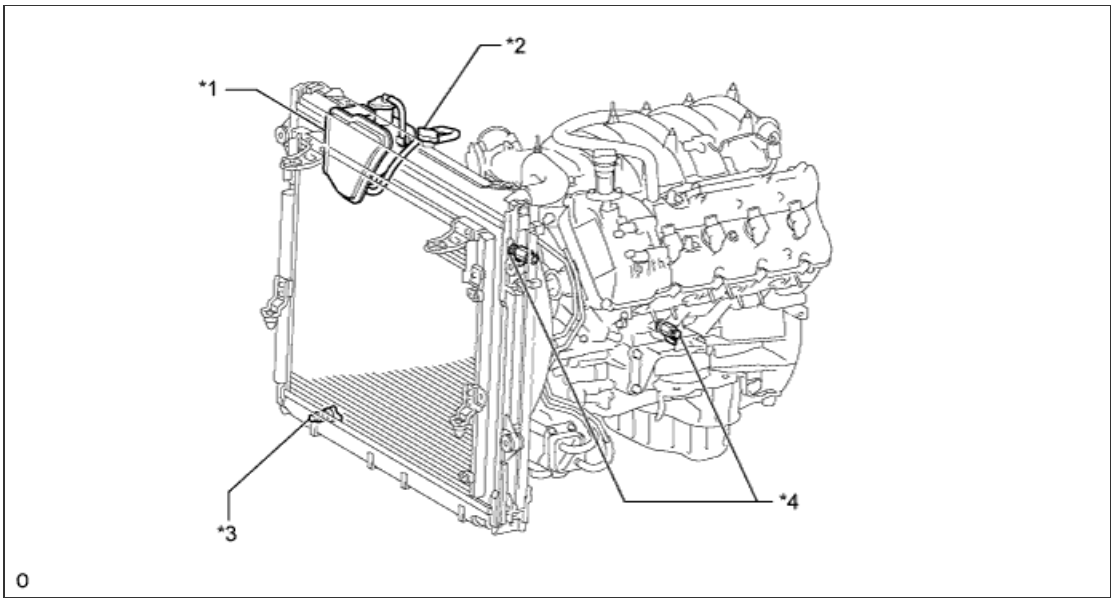
b. Remove the radiator cap. Then drain the coolant from the radiator.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

d. Tighten the 2 cylinder block drain cock plugs.

Torque:

13 N*m{ 133 kgf*cm , 10 ft.*lbf }



Text in Illustration

*1	Radiator Reservoir	*2	Radiator Cap
*3	Radiator Drain Cock Plug	*4	Cylinder Block Drain Cock Plug

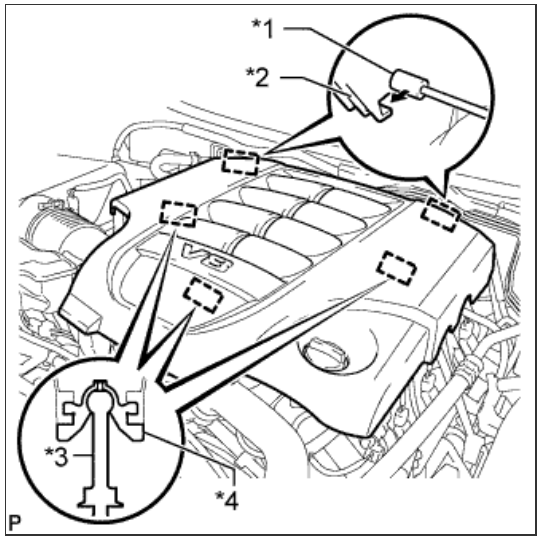
e. Tighten the radiator drain cock plug by hand.

5. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Raise the front of the V-bank cover to detach the 3 pins. Then remove the 2 V-bank cover hooks from the bracket, and remove the V-bank cover.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet

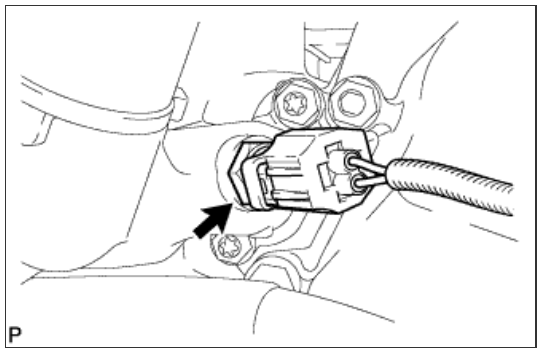


6. REMOVE ENGINE COOLANT TEMPERATURE SENSOR

a. Disconnect the sensor connector.

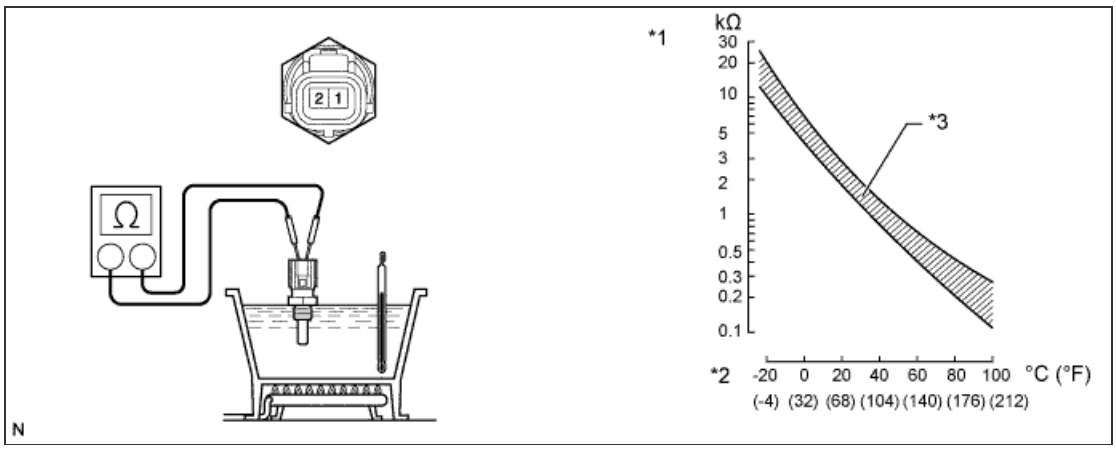
b. Using a 19 mm deep socket wrench, remove the sensor.

c. Remove the gasket from the sensor.


P

for Preparation Click here

1. INSPECT ENGINE COOLANT TEMPERATURE SENSOR



Text in Illustration

*1	Resistance kΩ	*2	Temperature °C (°F)
*3	Acceptable Range	-	-

a. Partially immerse the sensor in water and warm up the water.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	Approximately 20°C (68°F)	2.32 to 2.59 kΩ
1 - 2	Approximately 80°C (176°F)	0.310 to 0.326 kΩ

NOTICE:

When checking the sensor in water, keep the terminals dry. After the check, wipe the sensor dry.

If the result is not as specified, replace the sensor.

for Preparation Click here

1. INSTALL ENGINE COOLANT TEMPERATURE SENSOR

a. Install a new gasket to the sensor.

b. Using a 19 mm deep socked wrench, install the sensor.

Torque:
20 N*m{ 200 kgf*cm , 14 ft.*lbf }

c. Connect the sensor connector.

2. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item	Specified Condition
with rear heater	16.2 liters (17.1 US qts, 14.3 Imp. qts)
without rear heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the radiator inlet hose by hand, and checking when the engine coolant starts to flow inside the hose.

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

h. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the fan.**

i. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

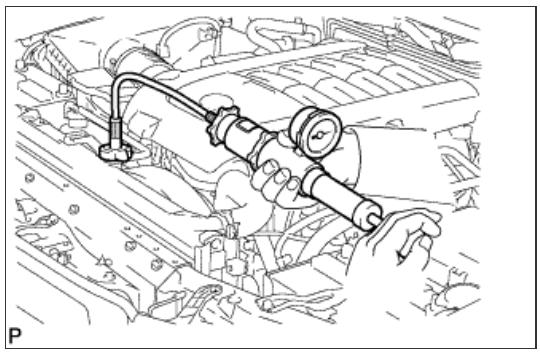
Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

j. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.

3. INSPECT FOR COOLANT LEAK

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.



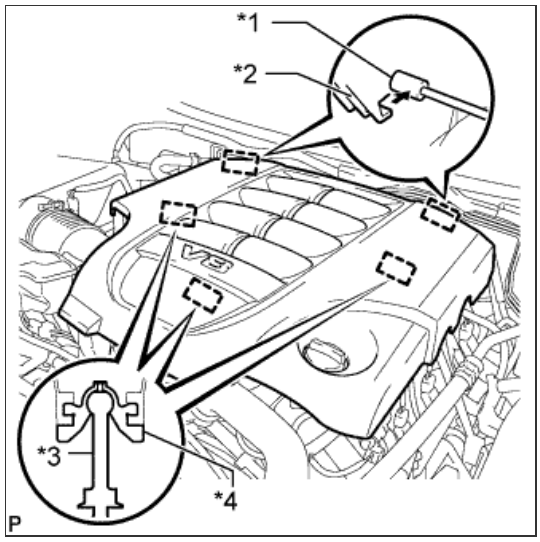
a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.

4. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket. Then align the 3 V-bank cover grommets with the 3 pins, and press down on the V-bank cover to attach the pins.



Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet

5. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

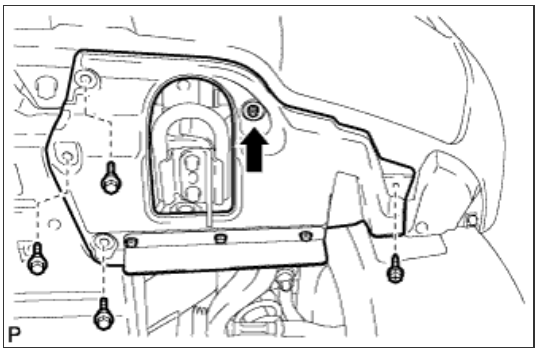
a. Install the No. 1 engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

6. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.

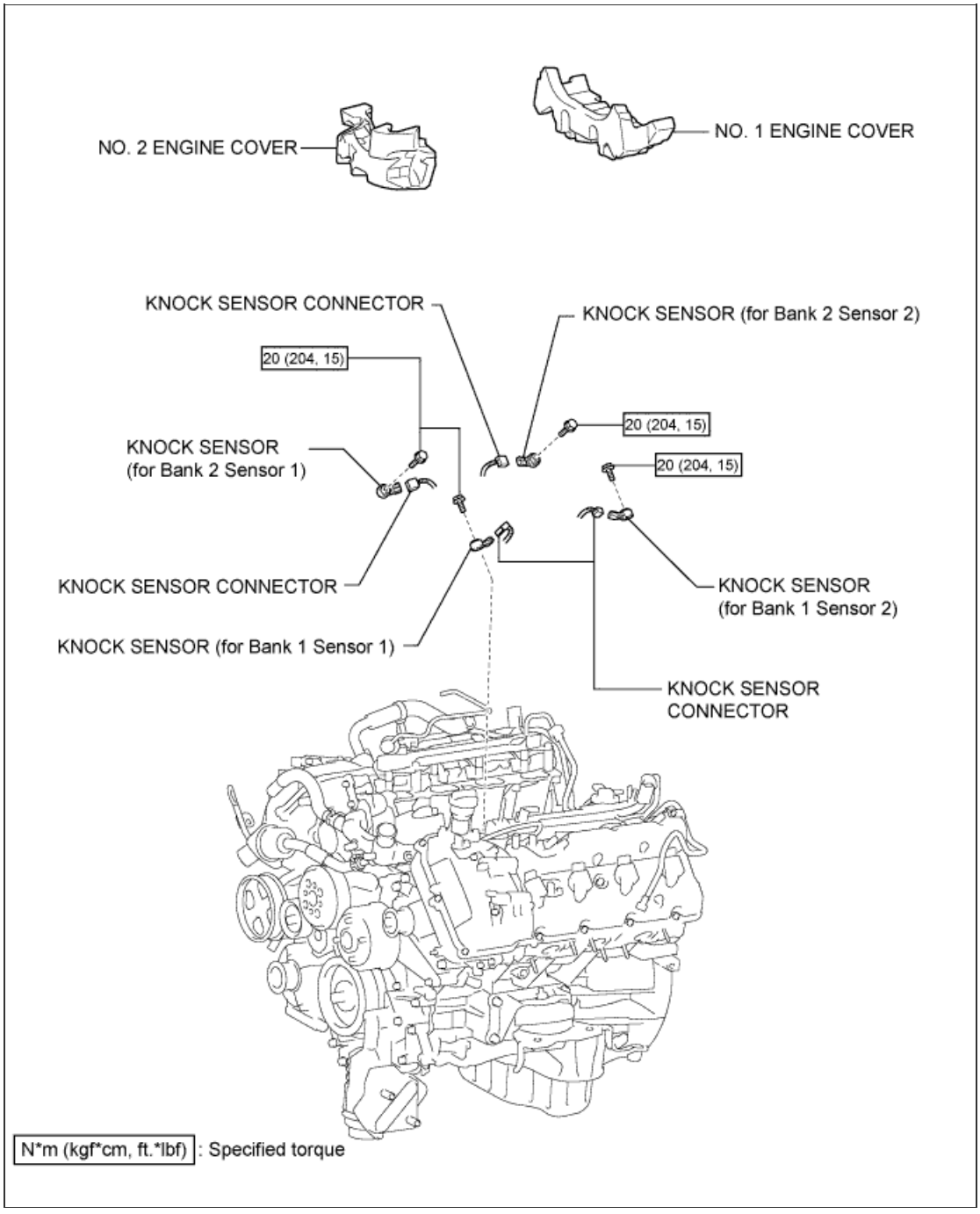


. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

for Preparation Click here

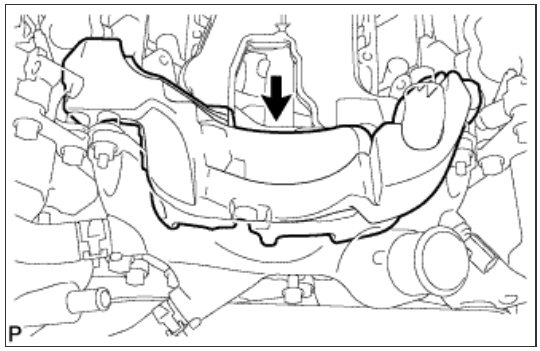


for Preparation Click here

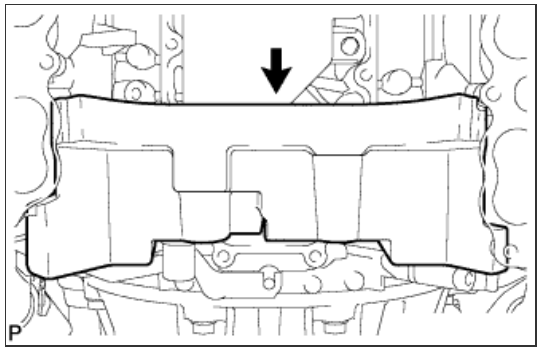
1. REMOVE INTAKE MANIFOLD

(Click here)

2. REMOVE NO. 2 ENGINE COVER



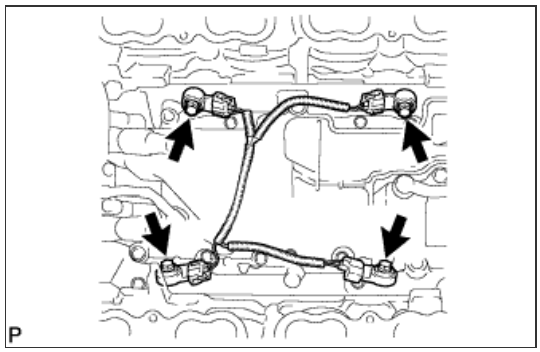
3. REMOVE NO. 1 ENGINE COVER



4. REMOVE KNOCK SENSOR

a. Disconnect the 4 knock sensor connectors.

b. Remove the 4 bolts and 4 knock sensors.



for Preparation Click here

1. INSPECT KNOCK SENSOR

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	120 to 280 kΩ

If the result is not as specified, replace the sensor.

for Preparation Click here

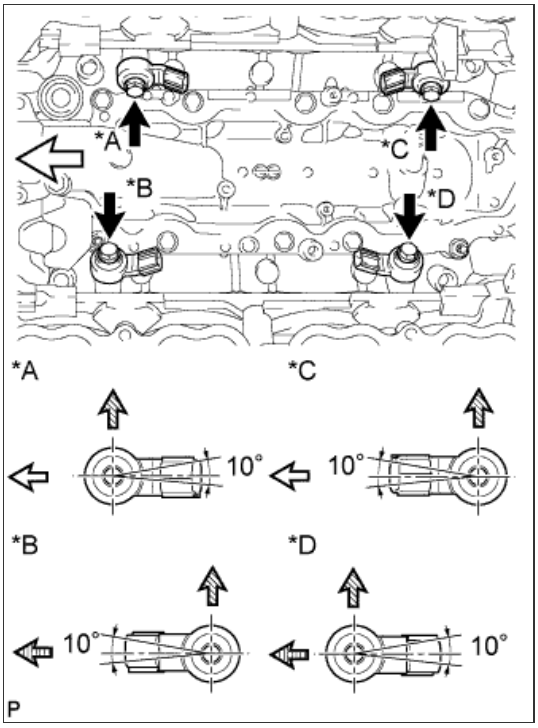
1. INSTALL KNOCK SENSOR

a. Install the 4 sensors with the 4 bolts so that the sensors are angled as shown in the illustration.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

NOTICE:

The acceptable installation angle of the sensor is between 10° upward and downward from the horizontal position.



Text in Illu tration

*A	for Bank 2 Sensor 1
*B	for Bank 1 Sensor 1
*C	for Bank 2 Sensor 2
*D	for Bank 1 Sensor 2
⇨	Front
⇧	Upper Side
⇦	Rear

b. Connect the 4 sensor connectors.

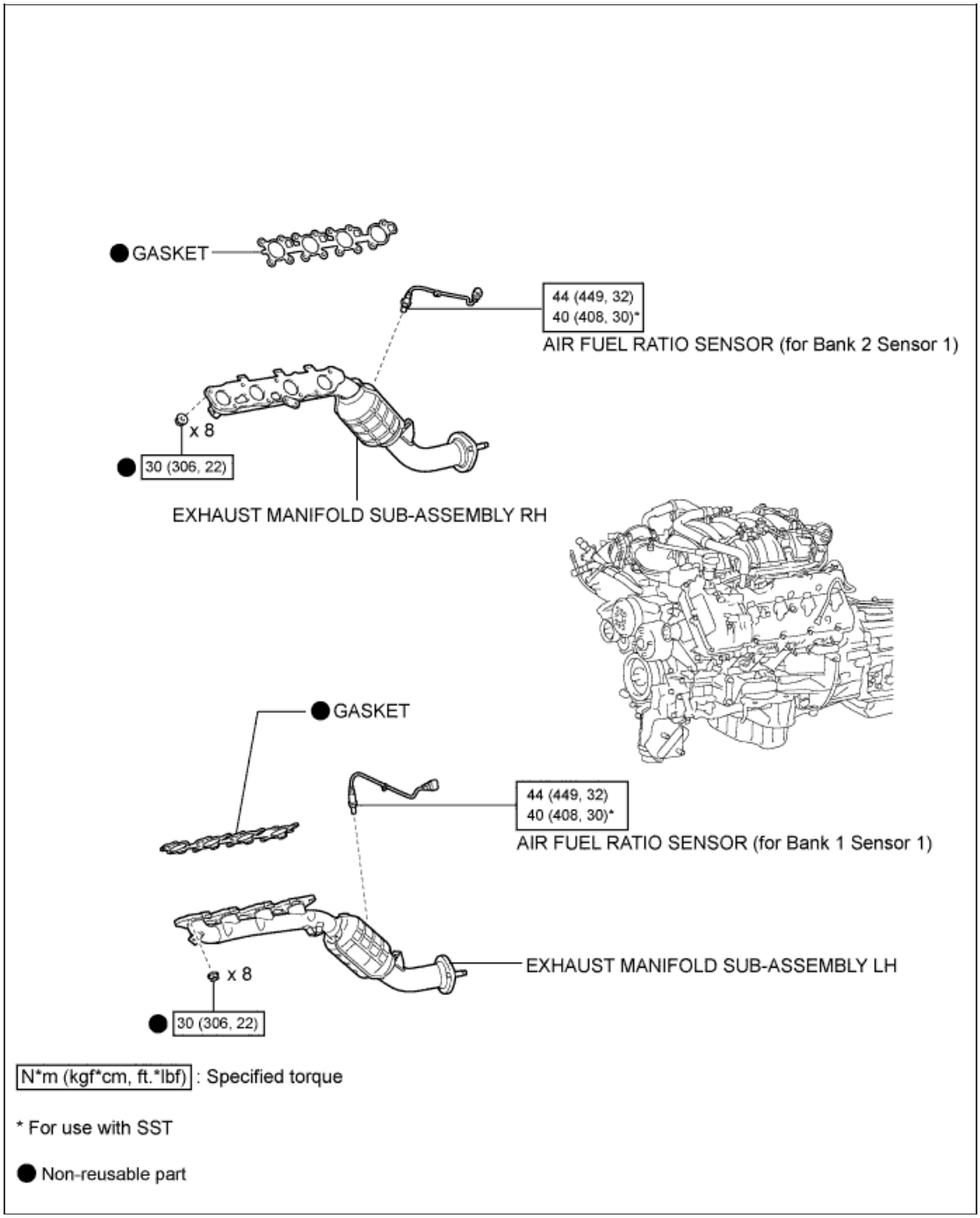
2. INSTALL NO. 1 EN INE CO ER

3. INSTALL NO. 2 EN INE CO ER

4. INSTALL INTAKE MANIFOLD

(Click here)

for Preparation Click here



for Preparation Click here

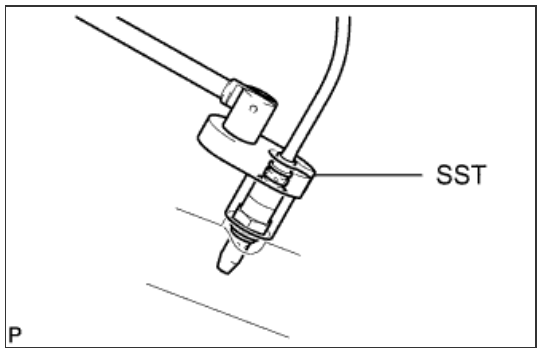
1. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY

(Click here)

2. REMOVE AIR FUEL RATIO SENSOR (for Bank 1 Sensor 1)

a. Using SST, remove he sensor.

SST
09224-00010



3. REMOVE AIR FUEL RATIO SENSOR (for Bank 2 Sensor 1)

a. Using SST, remove he sensor.

SST
09224-00010

for Preparation Click here

1. INSPECT AIR FUEL RATIO SENSOR

a. Measure the resistance according to the value(s) in the table below.

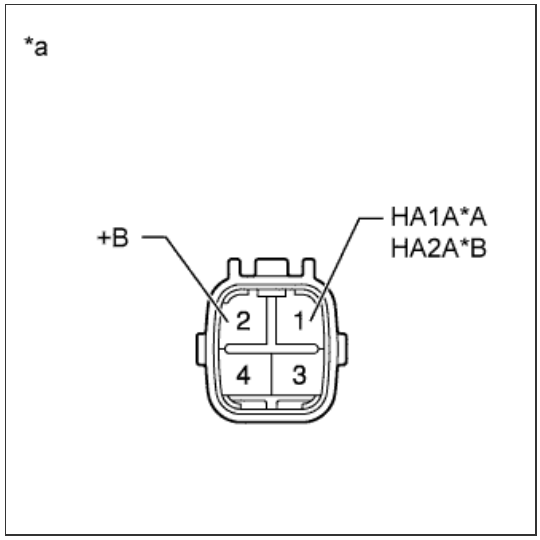
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B) (for Bank 1)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 2 (+B) (for Bank 2)		

Te t in Illustration

A	foBank 1
B	for Bank 2
a	Component without harness connected (Air Fuel Ratio Sensor)

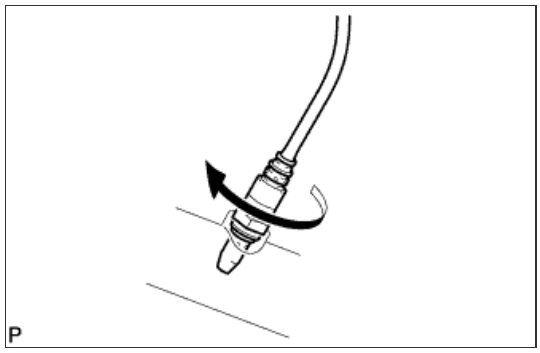
If the result is not as specified, replace the sensor.



for Preparation Click here

1. INSTALL AIR FUEL RATIO SENSOR (for Bank 2 Sensor 1)

a. Temporarily install the sensor to the exhaust pipe by hand.



b. Using SST, tighten the sensor.

SST
09224-00010

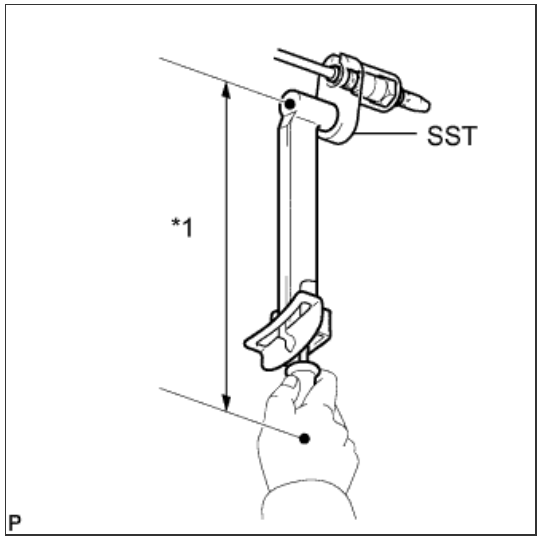
Torque:
without SST:
44 N*m{ 449 kgf*cm , 32 ft.*lbf }
with SST:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

Text in Illustration

	ulcrum Length

HINT:

- **Use a torque wrench with a fulcrum length of 300 mm (11.8 in.). If using a torque wrench with a length that is not 300 mm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the without SST torque specification (Click here).**
- **ake sure SST and the wrench are connected in a straight line.**



2. INSTALL AIR FUEL RATIO SENSOR (for Bank 1 Sensor 1)

a. Temporarily install the sensor to the exhaust pipe by hand.

b. Using SST, tighten the sensor.

SST
09224-00010

Torque:
without SST:
44 N*m{ 449 kgf*cm , 32 ft.*lbf }
with SST:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

Text in Illustration

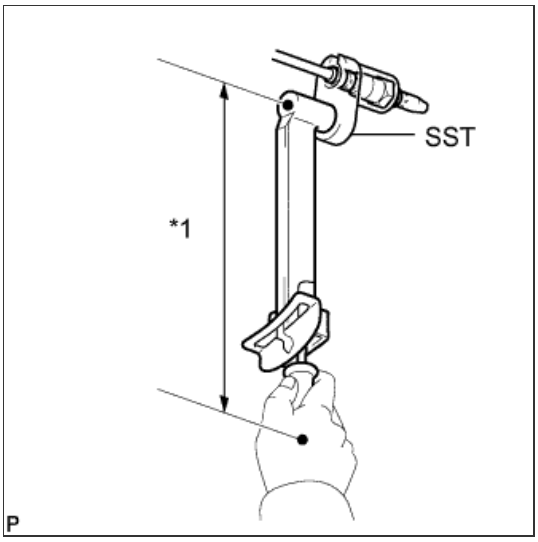
	ulcrum Length

HINT:

- **Use a torque wrench with a fulcrum length of 300 mm (11.8 in.).**

If using a torque wrench with a length that is not 300 mm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the without SST torque specification (Click here).

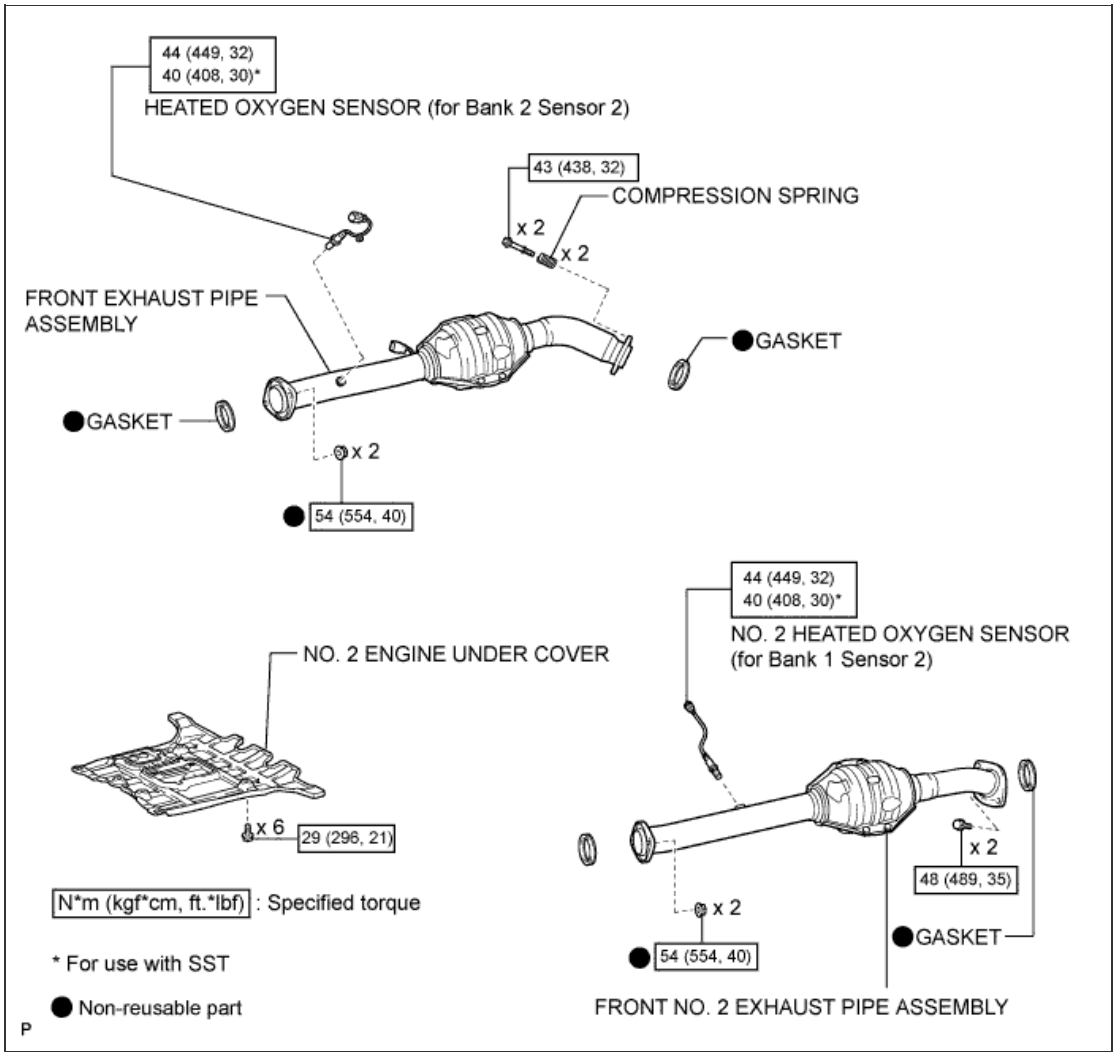
- ake sure SST and the wrench are connected in a straight line.



3. INSTALL E AUST ANIFOL SUB-ASSE BLY

(Click here)

for Preparation Click here



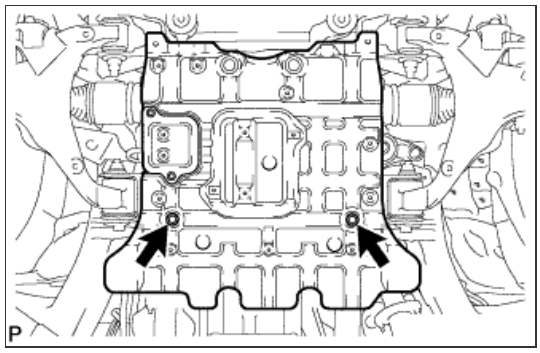
for Preparation Click here

CAUTION:

- **The procedures should be performed by at least 2 people.**
- **Wear protective gloves when removing the exhaust pipe.**
- **The exhaust pipe is extremely hot immediately after the engine has stopped.**
- **Confirm that the exhaust pipe has cooled down before removing it.**

1. REMOVE NO. 2 ENGINE UNDER COVER

a. Remove the 2 bolts and No. 2 engine under cover.



2. REMOVE FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Disconnect the heated o gen sensor connector.

b. Remove the bolt and disconnect the wire harness clamp brac et of the o gen sensor from the transmission.

c. Remove the 2 nuts, front No. 2 e haust pipe and gas et from the e haust manifold LH.

3. REMOVE FRONT EXHAUST PIPE ASSEMBLY

a. Disconnect the heated o gen sensor connector.

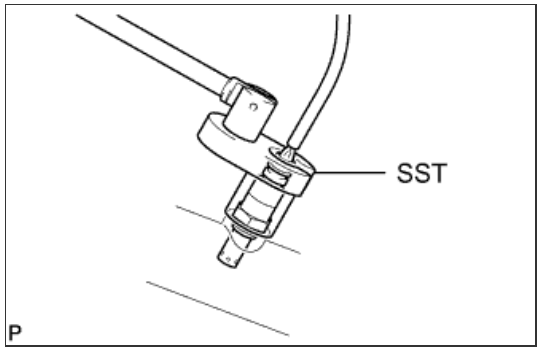
b. Remove the bolt and disconnect the wire harness clamp brac et of the o gen sensor from the transmission.

c. Remove the 2 nuts, front e haust pipe and gas et from the e haust manifold RH.

4. REMOVE HEATED OXYGEN SENSOR (for Bank 2 Sensor 2)

a. sing remove the sensor.

SST
09224-00010



. REMOVE NO. 2 HEATED OXYGEN SENSOR (for Bank Sensor 2)

a. sing remove the sensor.

SST
224-

for Preparation Click here

1. INSPECT HEATED OXYGEN SENSOR

a. Measure the heater resistance according to the value(s) in the table below.

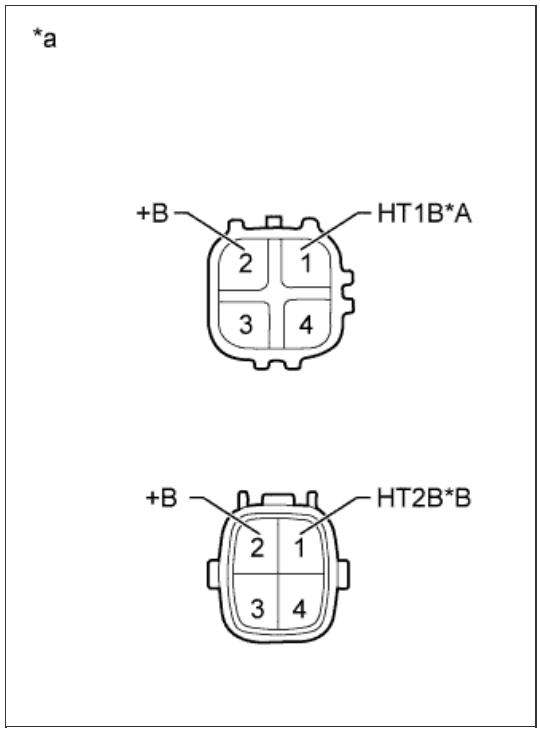
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B) (for Bank 1)	20°C (68°F)	11 to 16 Ω
1 (HT2B) - 2 (+B) (for Bank 2)		

Te t in Ill stration

*A	for Bank 1
*B	for Bank 2
*a	Co ponent without harness connected (Heated Oxygen Sensor)

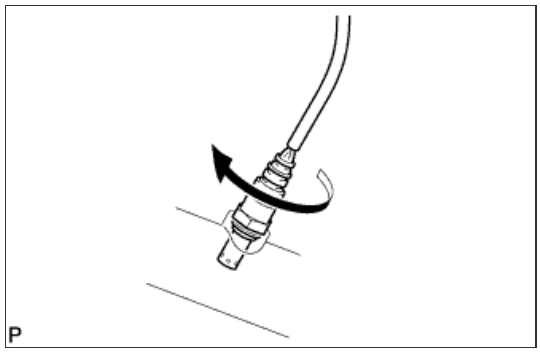
If the result is not as specified, replace the sensor.



for Preparation Click here

1. INSTALL NO. 2 HEATED OXYGEN SENSOR (for Bank 1 Sensor 2)

a. Temporarily install the sensor to the exhaust pipe by hand.



b. Using SST, tighten the sensor.

SST
09224-00010

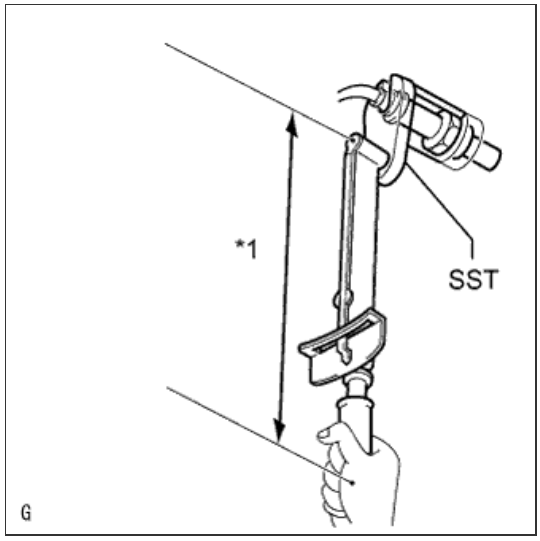
Torque:
without SST:
44 N*m{ 449 kgf*cm , 32 ft.*lbf }
with SST:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

Text in Illustration

	ulcrum Length

HINT:

- **Use a torque wrench with a fulcrum length of 300 mm (11.8 in.). If using a torque wrench with a length that is not 300 mm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the "without SST" torque specification (Click here).**
- **Make sure SST and the wrench are connected in a straight line.**



2. INSTALL HEATED OXYGEN SENSOR (for Bank 2 Sensor 2)

a. Temporarily install the sensor to the exhaust pipe by hand.

b. Using SST, tighten the sensor.

SST
09224-00010

Torque:
without SST:
44 N*m{ 449 kgf*cm , 32 ft.*lbf }
with SST:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

Text in Illustration

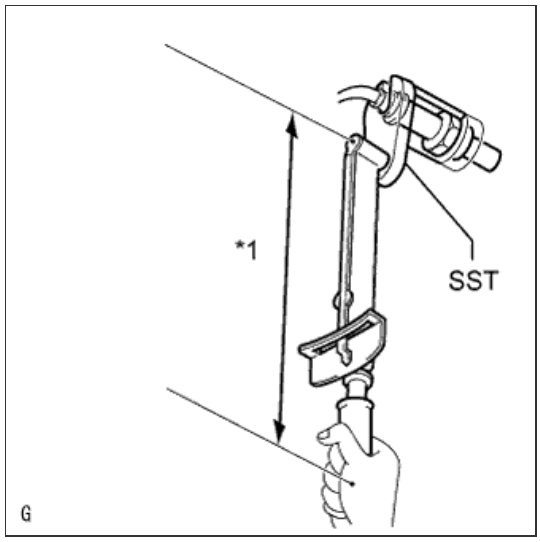
	ulcrum Length

HINT:

- **Use a torque wrench with a fulcrum length of 300 mm (11.8 in.).**

If using a torque wrench with a length that is not 300 mm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the "without SST" torque specification (Click here).

- **Make sure SST and the wrench are connected in a straight line.**



3. INSTALL FRONT EXHAUST PIPE ASSEMBLY

a. Install a new gasket and the front exhaust pipe to the exhaust manifold RH with 2 new nuts.

Torque:
54 N*m{ 551 kgf*cm , 40 ft.*lbf }

b. Install the wire harness clamp bracket of the oxygen sensor to the transmission with the bolt.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

c. Connect the heated oxygen sensor connector.

4. INSTALL FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Install a new gasket and the front No. 2 exhaust pipe to the exhaust manifold LH with 2 new nuts.

Torque:
54 N*m{ 551 kgf*cm , 40 ft.*lbf }

b. Install the wire harness clamp bracket of the oxygen sensor to the transmission with the bolt.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

c. Connect the heated oxygen sensor connector.

5. INSPECT FOR EXHAUST GAS LEAK

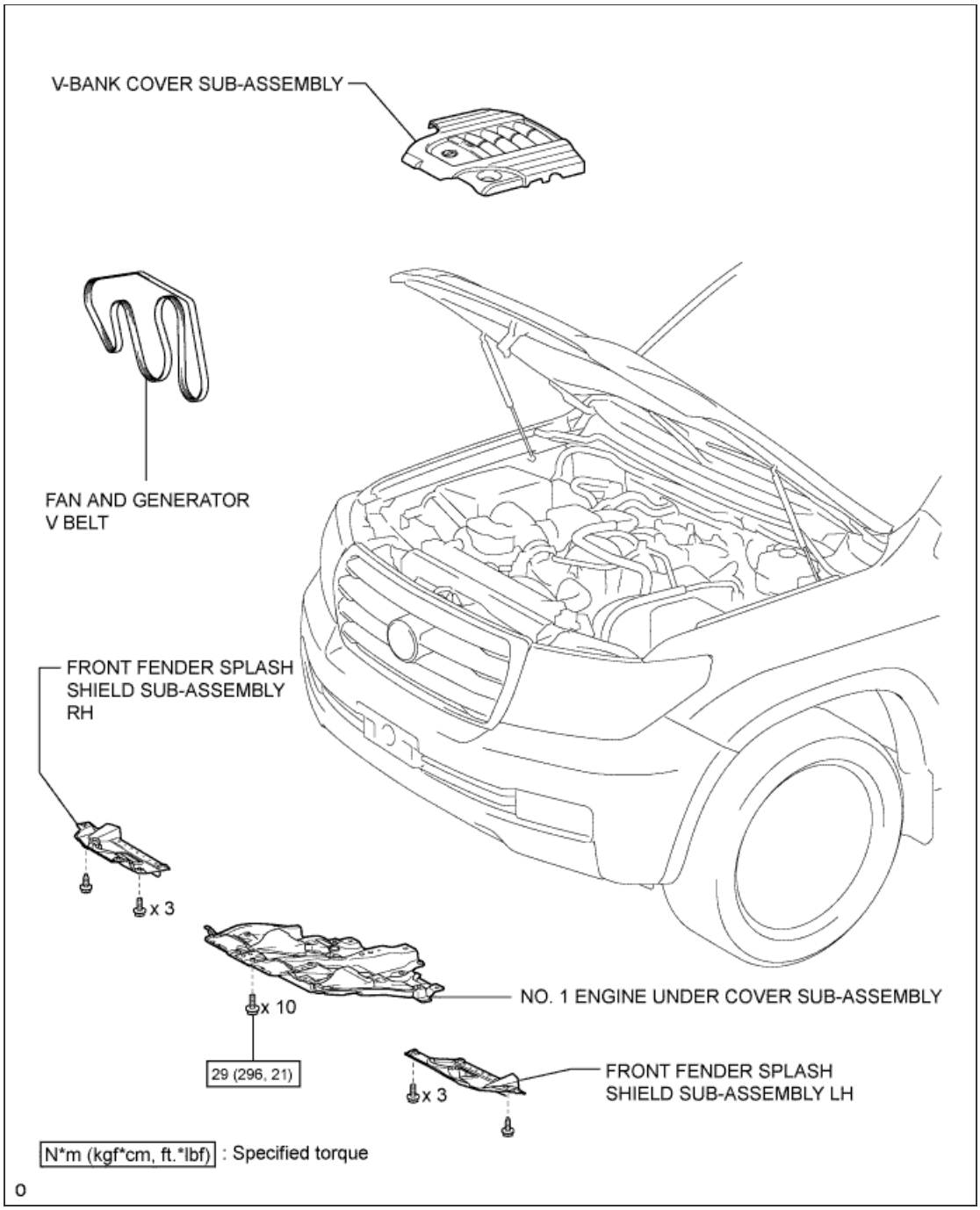
If gas is leaking, tighten the areas necessary to stop the leak. Replace damaged parts as necessary.

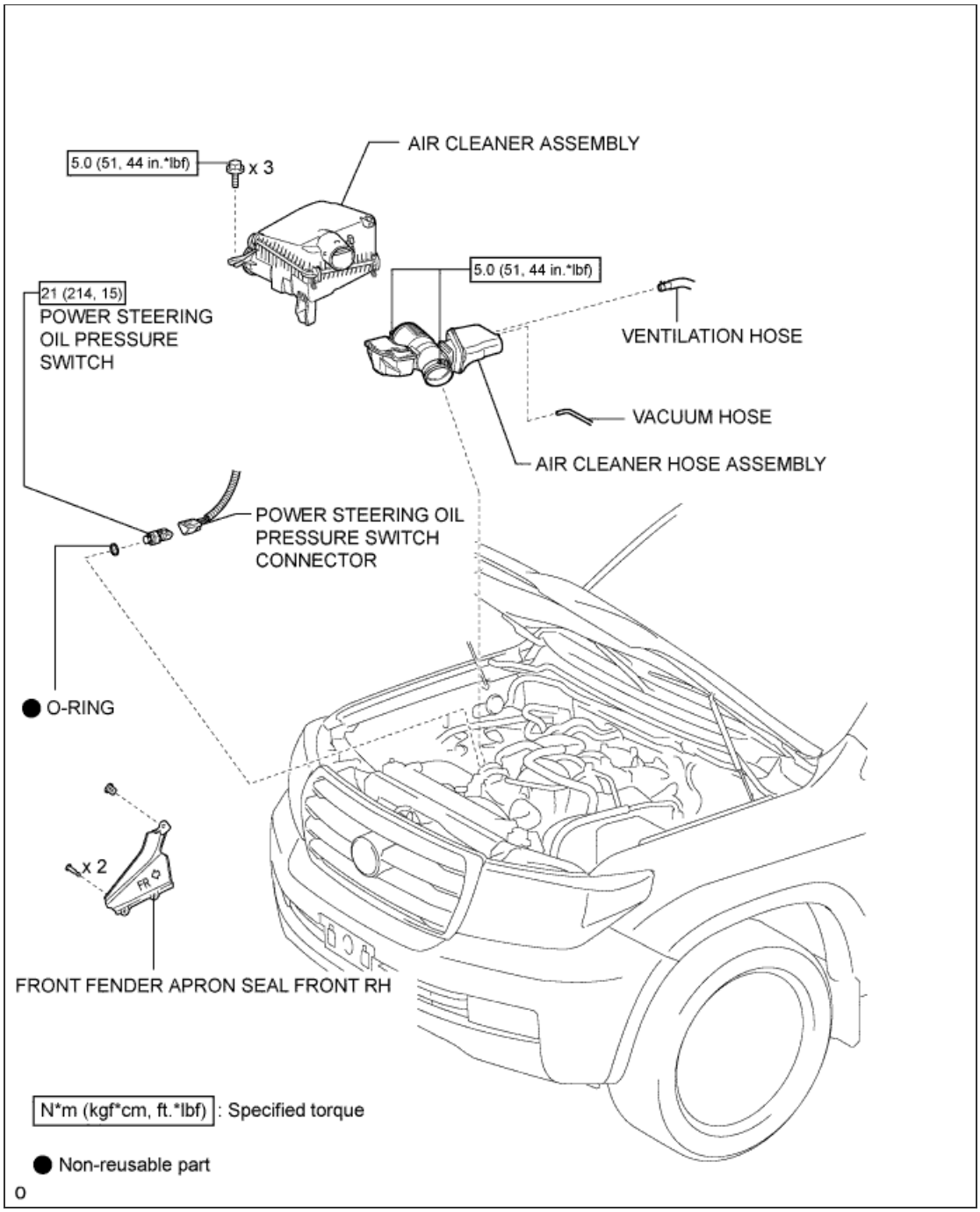
6. INSTALL NO. 2 ENGINE UNDER COVER

a. Install the No. 2 engine under co er with the 2 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

for Preparation Click here




5.0 (51, 44 in.*lbf)
x 3
AIR CLEANER ASSEMBLY
21 (214, 15)
POWER STEERING
OIL PRESSURE
SWITCH
5.0 (51, 44 in.*lbf)
VENTILATION HOSE
VACUUM HOSE
AIR CLEANER HOSE ASSEMBLY
POWER STEERING OIL
PRESSURE SWITCH
CONNECTOR
● O-RING
x 2
FR
FRONT FENDER APRON SEAL FRONT RH
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part

for Preparation Click here

1. INSPECT POWER STEERING OIL PRESSURE SWITCH

a. Check the oil pressure switch.

i. Connect the intelligent tester to the DLC3.

ii. Turn the engine switch on (IG).

iii. Turn the intelligent tester main switch on.

iv. Enter the following menus Powertrain / Engine and ECT / Data List / All Data / Power Steering pressure.

v. Start the engine.

vi. ead the value displa ed on the intelligent tester.

OK:

Condition	Specified Condition
Power steering operating	ON
Power steering not operating	OFF

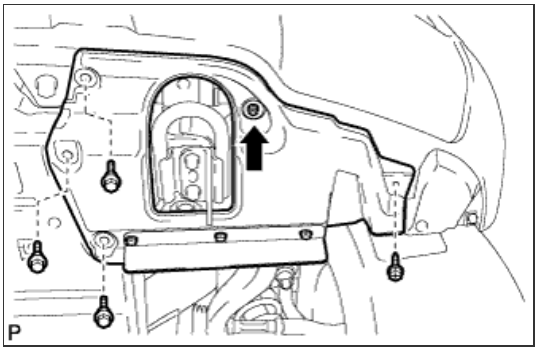
If the result is not as specified, check the wire harness and connector. If the wire harness and connector are normal, replace the power steering oil pressure switch.

for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



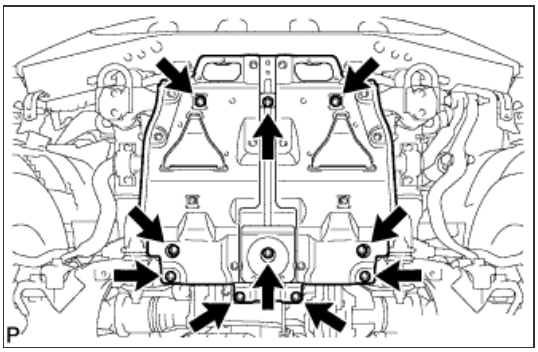
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and No. 1 engine under cover.

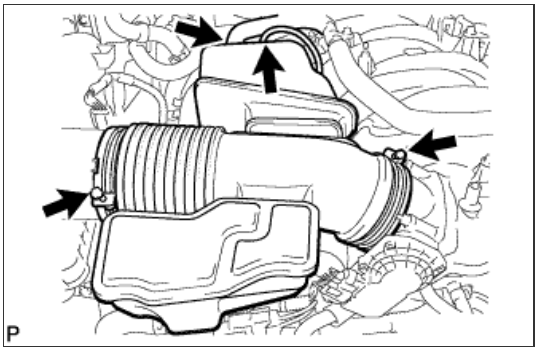


4. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum hose and No. 2 ventilation hose.

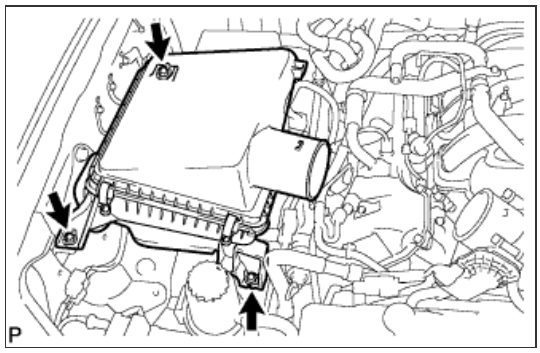
b. Loosen the 2 hose clamps.

c. Remove the air cleaner hose.



5. REMOVE AIR CLEANER ASSEMBLY

a. Remove the 3 bolts and air cleaner.

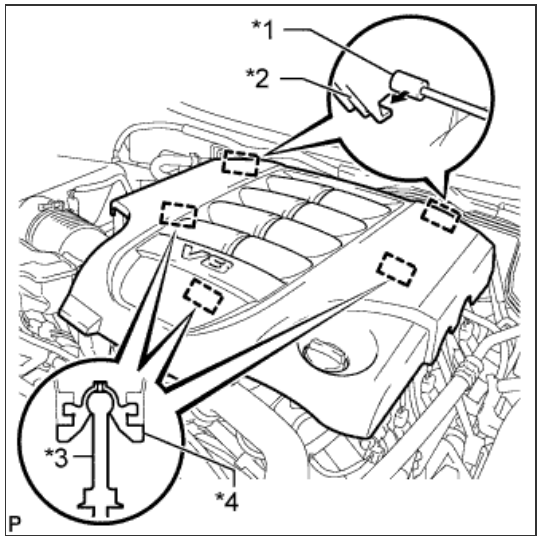


6. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Raise the front of the V-bank cover to detach the 3 pins. Then remove the 2 V-bank cover hooks from the bracket, and remove the V-bank cover.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet



7. REMOVE FAN AND GENERATOR V BELT

a. hile turning the belt tensioner counterclockwise, align the service hole for the belt tensioner and the belt tensioner fixing position, and then insert a bar of 5 mm 0.1 in.) into the service hole to fix the belt tensioner in place.

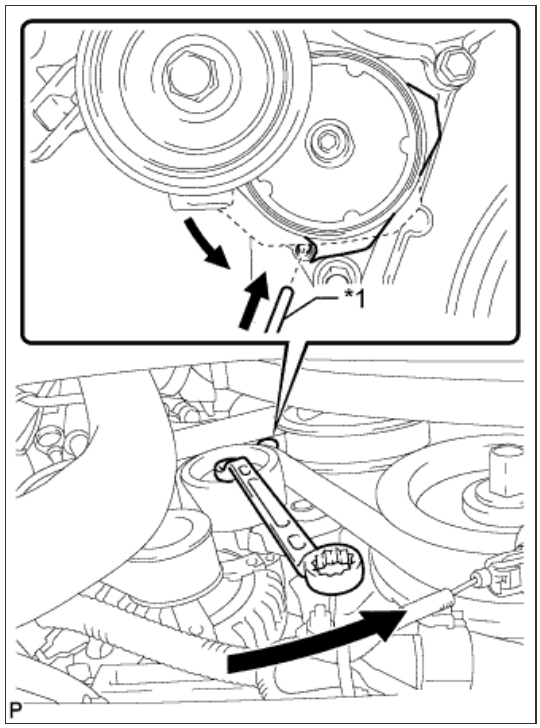
Text in Illustration

*1	Bar

HINT:

The pulley bolt for the belt tensioner has a left-hand thread.

b. Remove the V belt.

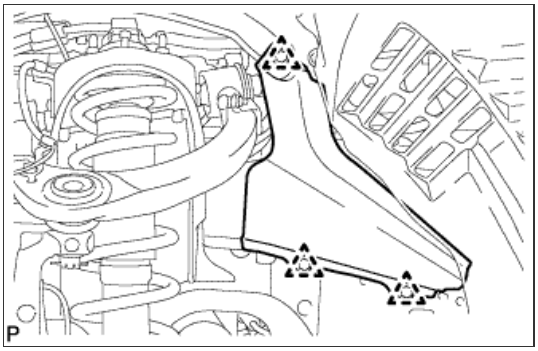


8. DRAIN POWER STEERING FLUID

9. REMOVE FRONT WHEEL

1 . REMOVE FRONT FENDER APRON SEAL FRONT RH

a. Using a clip remover, remove the 3 clips and fender apron seal.

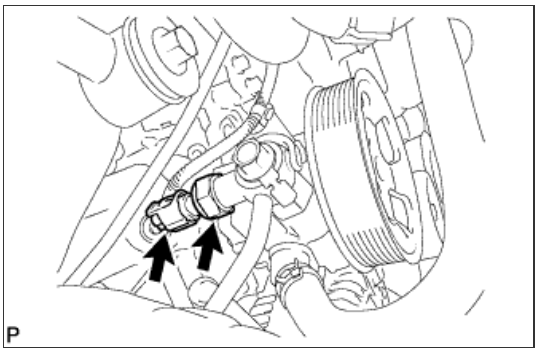


11. REMOVE POWER STEERING OIL PRESSURE SWITCH

a. Disconnect the switch connector.

b. Using a 24 mm deep socket wrench, remove the oil pressure switch.

c. Remove the O-ring.



for Preparation Click here

1. INSTALL POWER STEERING OIL PRESSURE SWITCH

a. Install a new O-ring to the oil pressure switch.

b. Apply a light coat of engine oil to the O-ring of the oil pressure switch.

NOTICE:

- **When reusing the oil pressure switch, inspect the O-ring.**
- **If the O-ring has scratches or cuts, replace the new O-ring.**

c. Using a 24 mm deep socket wrench, install the oil pressure switch.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

d. Connect the oil pressure switch connector.

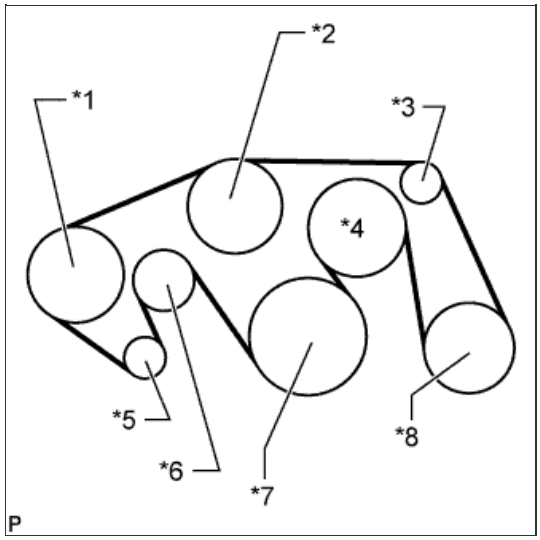
2. INSTALL FAN AND GENERATOR V BELT

a. Set the V belt onto every part.

b. While turning the belt tensioner counterclockwise, remove the bar.

Text in Illustration

*1	Vane Pump
*2	Water Pump
*3	No. 1 Idler
*4	Fan
*5	Generator
*6	Belt Tensioner
*7	Crankshaft
*8	Cooler Compressor



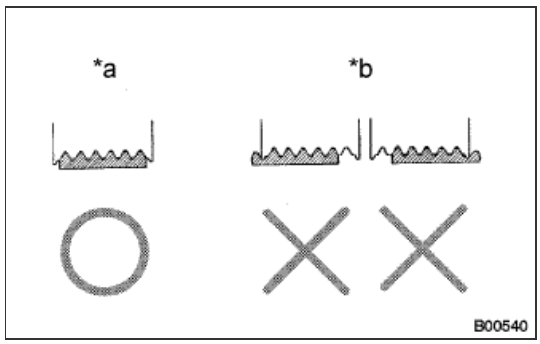
NOTICE:

Make sure that the V belt is properly set to each pulley.

c. After installing the belt, check that it fits properly in the ribbed grooves.

Text in Illustration

*a	CORRECT
*b	INCORRECT



HINT:

Make sure to check by hand that the belt has not slipped out of the grooves on the bottom of the pulley.

3. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner with the 3 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

4. INSTALL AIR CLEANER HOSE ASSEMBLY

a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

Text in Illustration

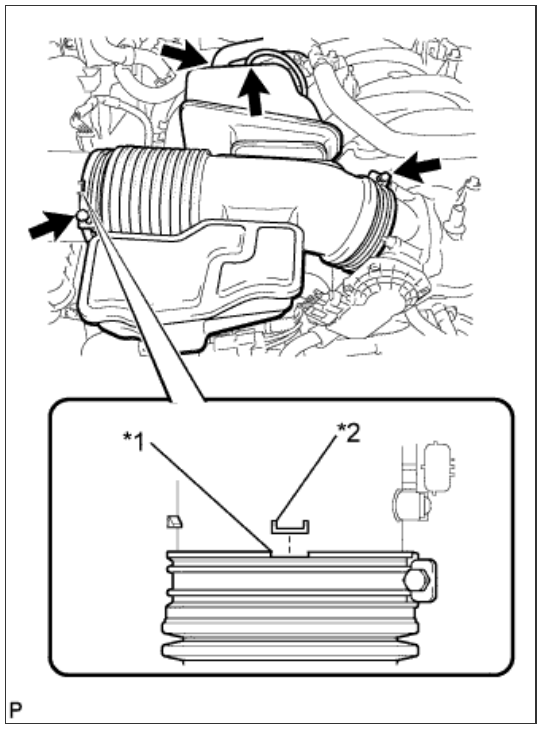
*1	Groove
*2	Protrusion

b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum hose.

d. Connect the No. 2 ventilation hose.



5. ADD POWER STEERING FLUID

6. BLEED POWER STEERING FLUID

a. Check the fluid level.

b. Jack up the front of the vehicle and support it with stands.

c. Turn the steering wheel.

i. With the engine stopped, turn the wheel slowly from lock to lock several times.

d. Lower the vehicle.

e. Start the engine.

f. Idle the engine for a few minutes.

g. Turn the steering wheel.

i. With the engine idling, turn the wheel left or right to the full lock position and keep it there for 2 to 3 seconds, then turn the wheel to the opposite full lock position and keep it there for 2 to 3 seconds. *1

ii. Repeat *1 several times.

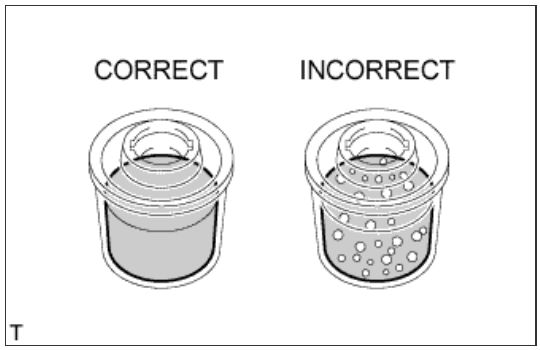
NOTICE:

For vehicles with VGRS, if the steering wheel is turned from lock to lock repeatedly, the system may stop operating and the amount of rotation before the steering wheel locks may increase due to operation of the overheating prevention function. When the system temperature drops, the system operation automatically returns to normal.

h. Stop the engine.

i. Check for foaming or emulsification.
If the system has to be bled twice because of foaming or emulsification, check for fluid leaks in the system.

j. Check the fluid level.



7. INSPECT FOR POWER STEERING FLUID LEAK

8. INSTALL FRONT FENDER APRON SEAL FRONT RH

a. Install the fender apron seal with the 3 clips.

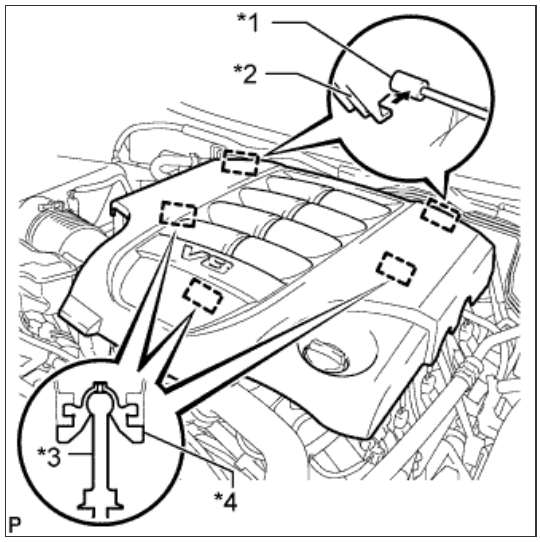
9. INSTALL FRONT WHEEL

10. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket. Then align the 3 V-bank cover grommets with the 3 pins, and press down on the V-bank cover to attach the pins.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet



11. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

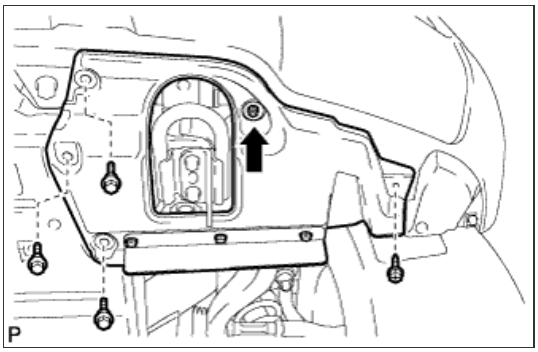
a. Install the No. 1 engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

12. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



13. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

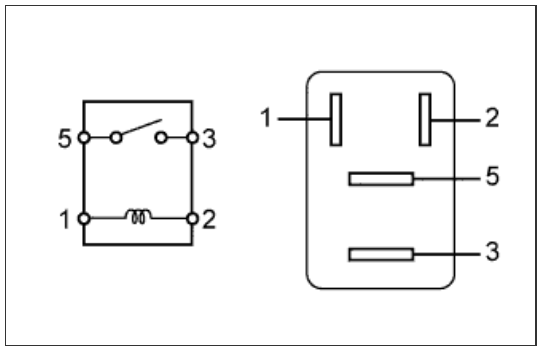
HINT:

Use the same procedures described for the LH side.

for Preparation Click here

1. INSPECT CIRCUIT OPENING RELAY (C/OPN)

a. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage is not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage is applied to terminals 1 and 2	Below 1 Ω

If the result is not as specified, replace the relay.

2. INSPECT INTEGRATION RELAY (IG2)

a. Measure the resistance of the IG2 MAIN fuse.

i. Remove the IG2 MAIN fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

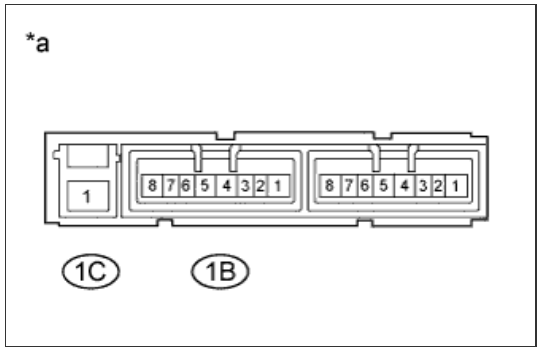
Standard Resistance:

Tester Connection	Condition	Specified Condition
IG2 MAIN fuse	Always	Below 1 Ω

If the result is not as specified, replace the IG2 MAIN fuse.

iii. Install the IG2 MAIN fuse to the integration relay.

b. Measure the resistance of the ignition relay No. 2 (IG2) circuit.



i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1B-6	Battery voltage is not applied to terminals 1B-6 and 1B-7	10 kΩ or higher
	Battery voltage is applied to terminals 1B-6 and 1B-7	Below 1 Ω

Text in Illustration

a	Component without harness connected (Integration Relay)

If the result is not as specified, replace the integration relay.

3. INSPECT INTEGRATION RELAY (EFI)

a. Measure the resistance of the EFI MAIN fuse.

i. Remove the EFI MAIN fuse from the integration relay

ii. Measure the resistance according to the value(s) in the table below.

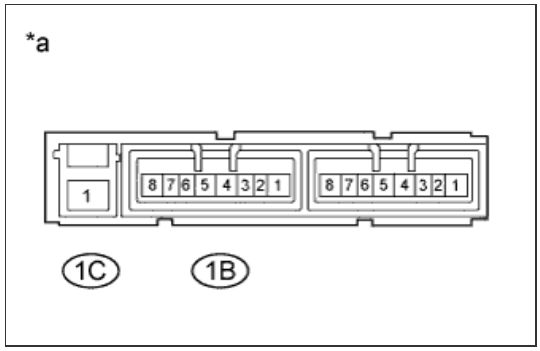
Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAIN fuse	Always	Below 1 Ω

If the result is not as specified, replace the EFI MAIN fuse.

iii. Install the EFI MAIN fuse to the integration relay.

b. Measure the resistance of the EFI relay circuit.



i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1B-4	Battery voltage is not applied to terminals 1B-2 and 1B-3	10 kΩ or higher
	Battery voltage is applied to terminals 1B-2 and 1B-3	Below 1 Ω

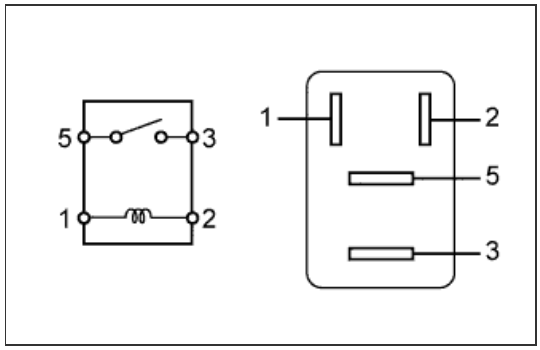
Text in Illustration

a	Component without harness connected (Integration Relay)

If the result is not as specified, replace the integration relay.

4. INSPECT EFI NO. 2 RELAY

a. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage is not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage is applied to terminals 1 and 2	Below 1 Ω

If the result is not as specified, replace the relay.

5. INSPECT INTEGRATION RELAY (A/F)

a. Measure the resistance of the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

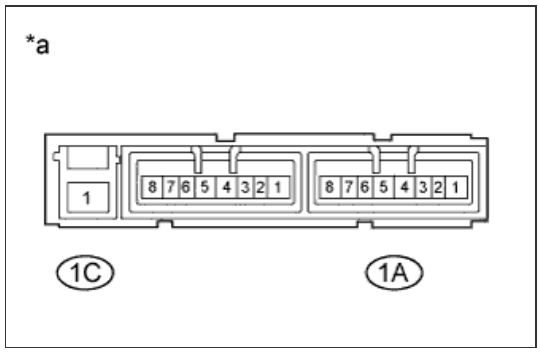
Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

If the result is not as specified, replace the A/F fuse.

iii. Install the A/F fuse to the integration relay.

b. Measure the resistance of the A/F sensor heater relay circuit.



i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1A-4	Battery voltage is not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage is applied to terminals 1 A-2 and 1A-3	Below 1 Ω

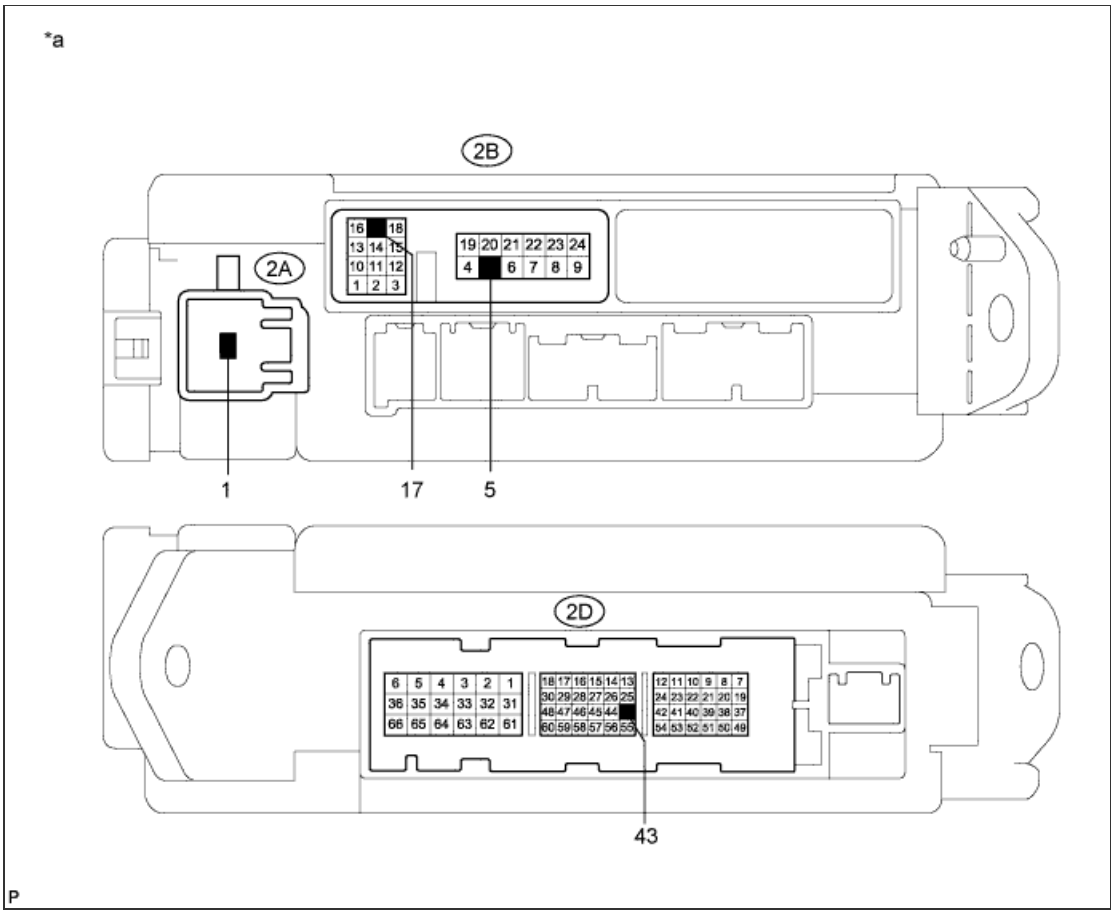
Text in Illustration

a	Component without harness connected (Integration Relay)

If the result is not as specified, replace the integration relay.

6. INSPECT MAIN BODY ECU (IG1 NO. 1)

a. Measure the resistance according to the value(s) in the table below.



Text in Illustration

a	Component without harness connected (Main Body EC)	-	-

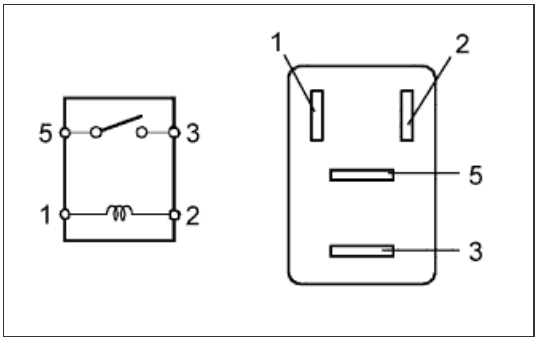
Standard Resistance:

Tester Connection	Condition	Specified Condition
2A-1 - 2B-17	Battery voltage is not applied to terminals 2B-5 and 2D-43	10 kΩ or higher
	Battery voltage is applied to terminals 2B-5 and 2D-43	Below 1 Ω

If the result is not as specified, replace the main body EC .

7. INSPECT STARTER RELAY (ST)

a. Measure the resistance according to the value(s) in the table below.



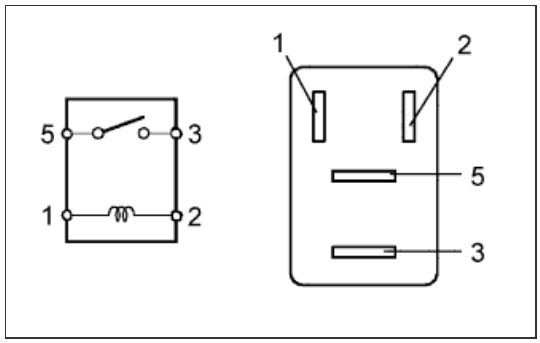
Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage applied to terminals 1 and 2	Below 1 Ω

If the result is not as specified, replace the starter relay.

8. INSPECT STARTER CUT RELAY (ST CUT)

a. Measure the resistance according to the value(s) in the table below.

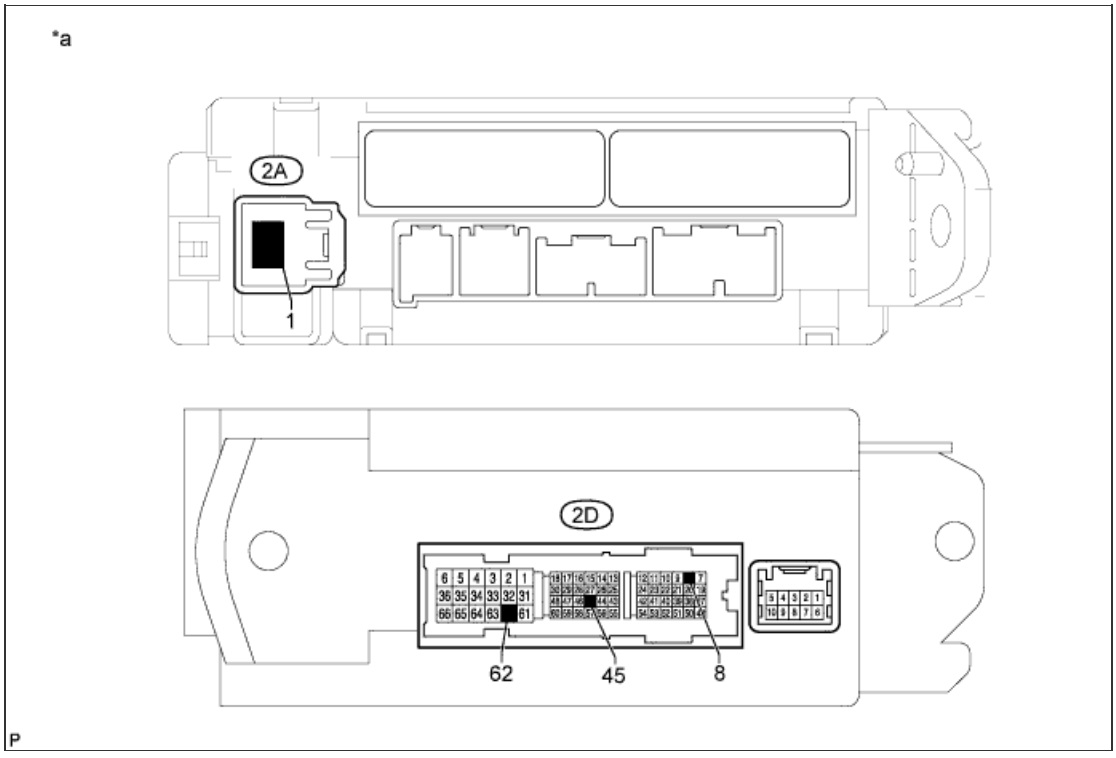


Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage applied to terminals 1 and 2	Below 1 Ω

If the result is not as specified, replace the starter relay.

9. INSPECT MAIN BODY ECU (ACC RELAY)



Text in Illustration

a	Component without harness connected (Main Body EC)	-	-

a. Measure the resistance of the ACC relay circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
	Battery voltage not applied between 2D-45 and 2D-62	10 kΩ or higher

2A-1 - 2D-	Battery voltage applied between 2D-45 and 2D-62	Below 1 Ω

If the result is not as specified, replace the main body EC .

for Preparation Click here

CAUTION:

When using the intelligent tester, observe the following items for safety reasons:

- **Read its instruction books before using the tester.**
- **Prevent the tester cable from being caught on the pedals, shift lever and steering wheel when driving with the tester connected to the vehicle.**
- **When driving the vehicle for testing purposes using the tester, 2 persons are required. One person drives the vehicle, and the other operates the tester.**

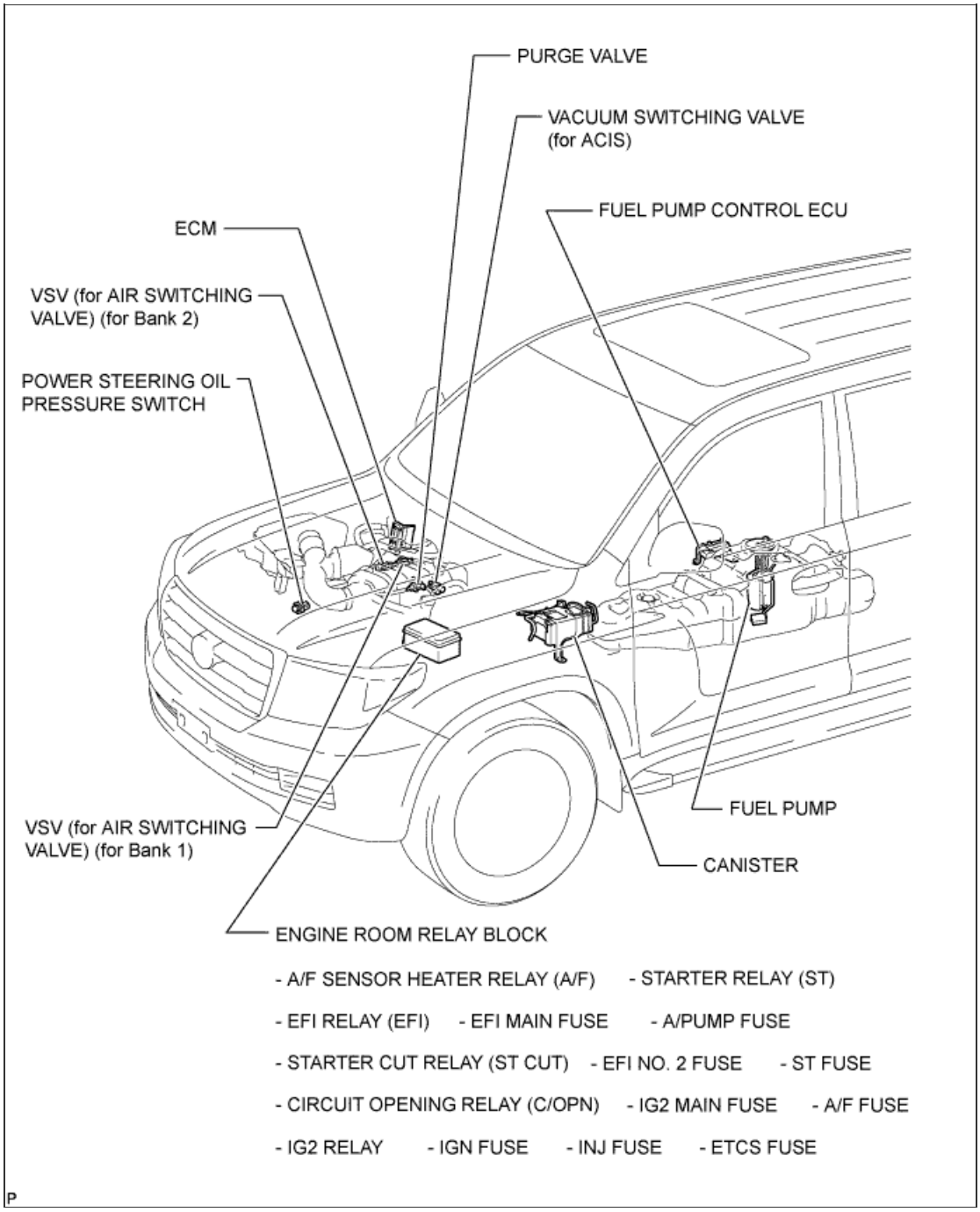
NOTICE:

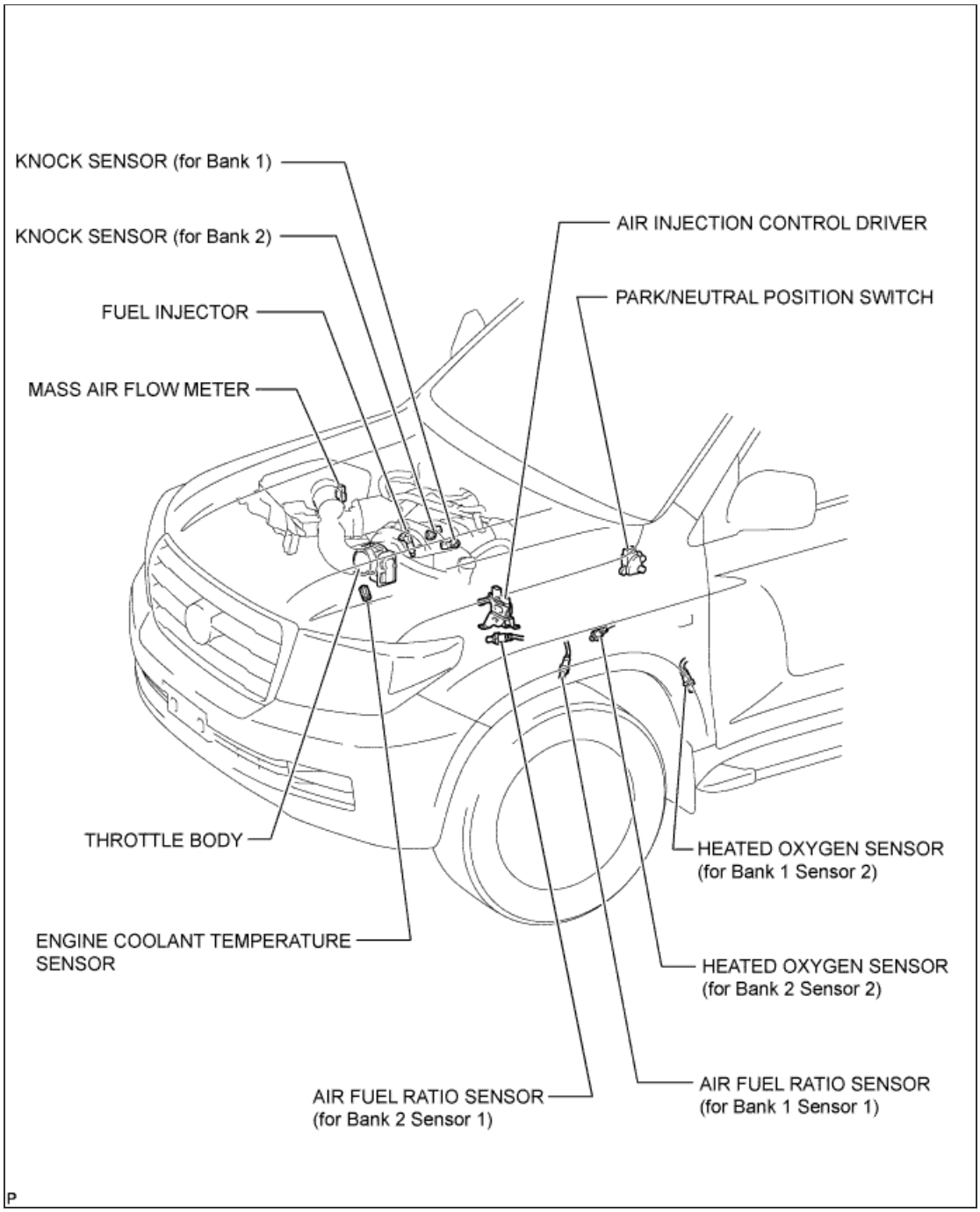
Perform eset emory (AT initialization) for 4WD when repla ing the automati transmission assembly, engine assembly or EC (Cli here).

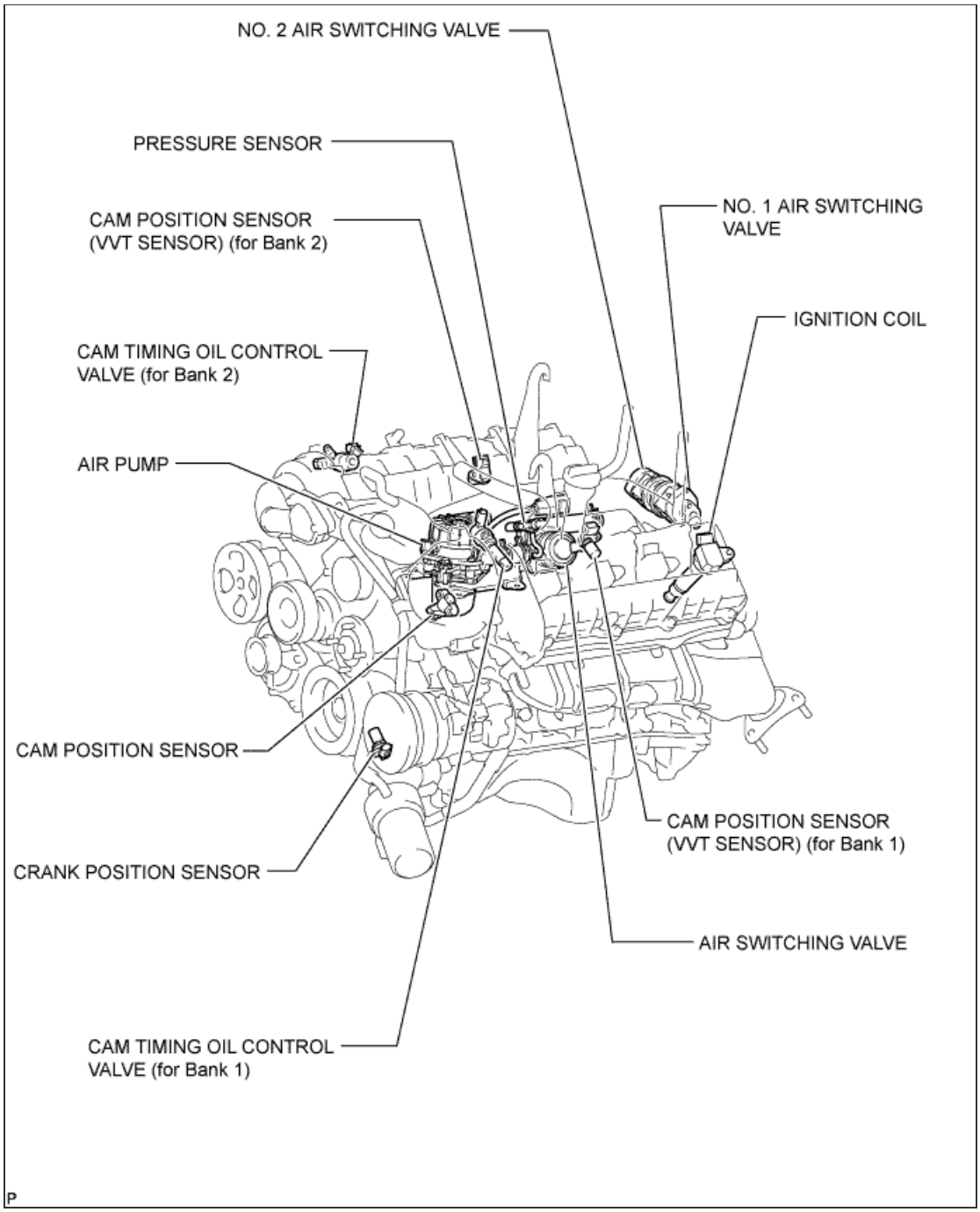
HINT:

eset emory annot be mpleted only by dis one ting the able from the negative (-) battery terminal.

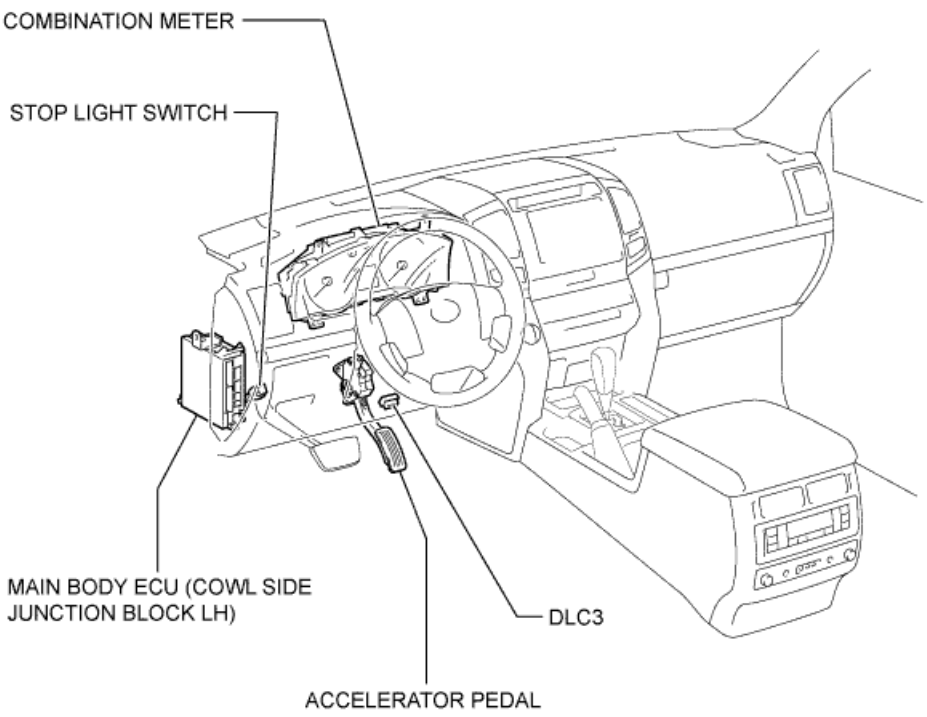
for Preparation Click here




KNOCK SENSOR (for Bank 1)
KNOCK SENSOR (for Bank 2)
FUEL INJECTOR
MASS AIR FLOW METER
AIR INJECTION CONTROL DRIVER
PARK/NEUTRAL POSITION SWITCH
THROTTLE BODY
ENGINE COOLANT TEMPERATURE SENSOR
HEATED OXYGEN SENSOR (for Bank 1 Sensor 2)
HEATED OXYGEN SENSOR (for Bank 2 Sensor 2)
AIR FUEL RATIO SENSOR (for Bank 2 Sensor 1)
AIR FUEL RATIO SENSOR (for Bank 1 Sensor 1)
P

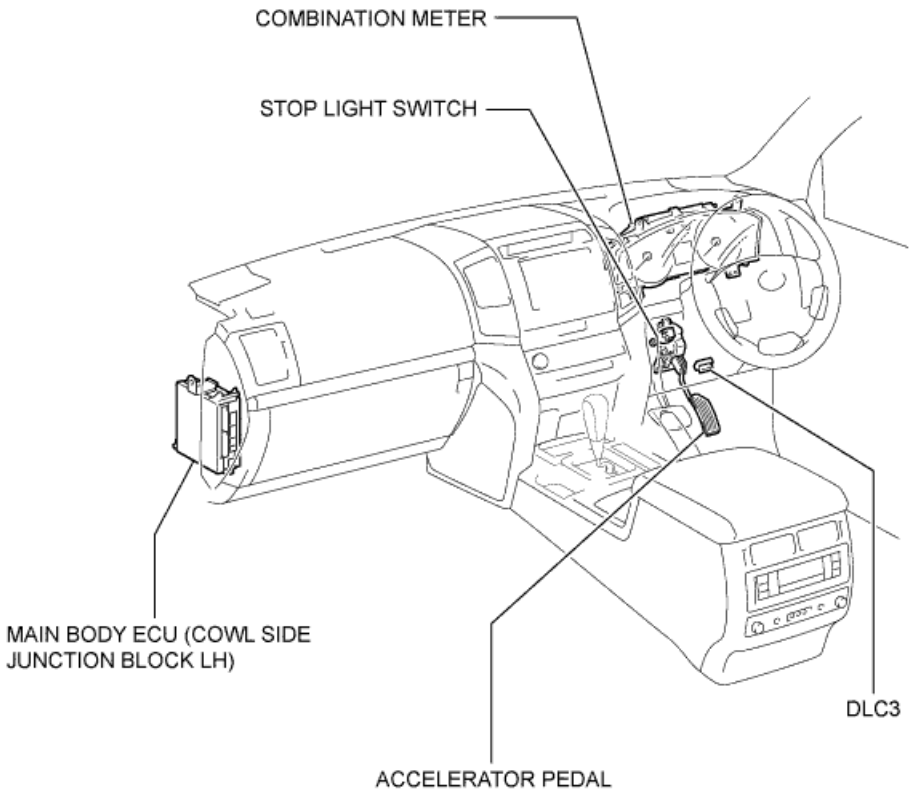

NO. 2 AIR SWITCHING VALVE
PRESSURE SENSOR
CAM POSITION SENSOR
(VVT SENSOR) (for Bank 2)
NO. 1 AIR SWITCHING
VALVE
IGNITION COIL
CAM TIMING OIL CONTROL
VALVE (for Bank 2)
AIR PUMP
CAM POSITION SENSOR
CAM POSITION SENSOR
(VVT SENSOR) (for Bank 1)
CRANK POSITION SENSOR
AIR SWITCHING VALVE
CAM TIMING OIL CONTROL
VALVE (for Bank 1)
P

for LHD:


COMBINATION METER
STOP LIGHT SWITCH
MAIN BODY ECU (COWL SIDE JUNCTION BLOCK LH)
DLC3
ACCELERATOR PEDAL

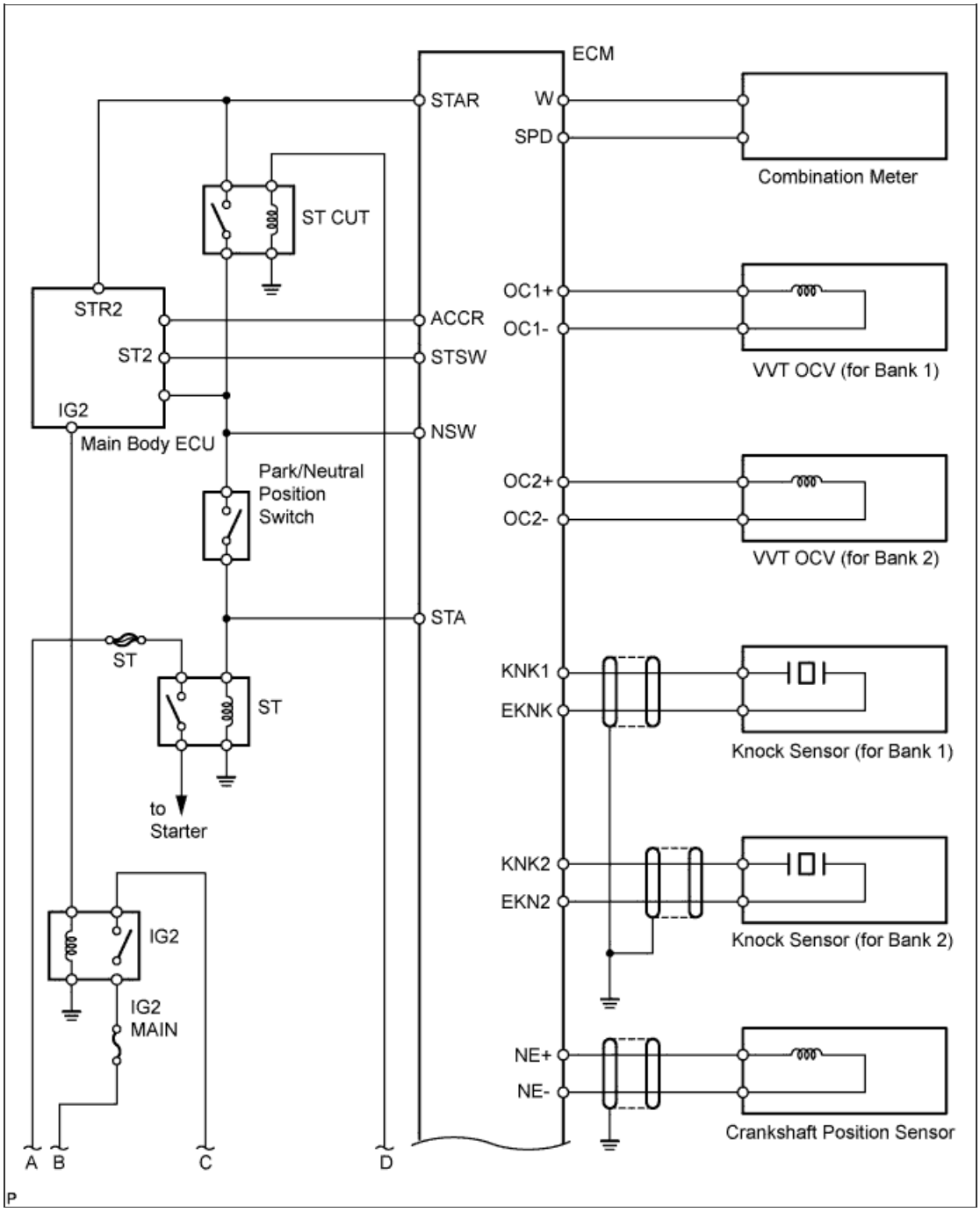
P

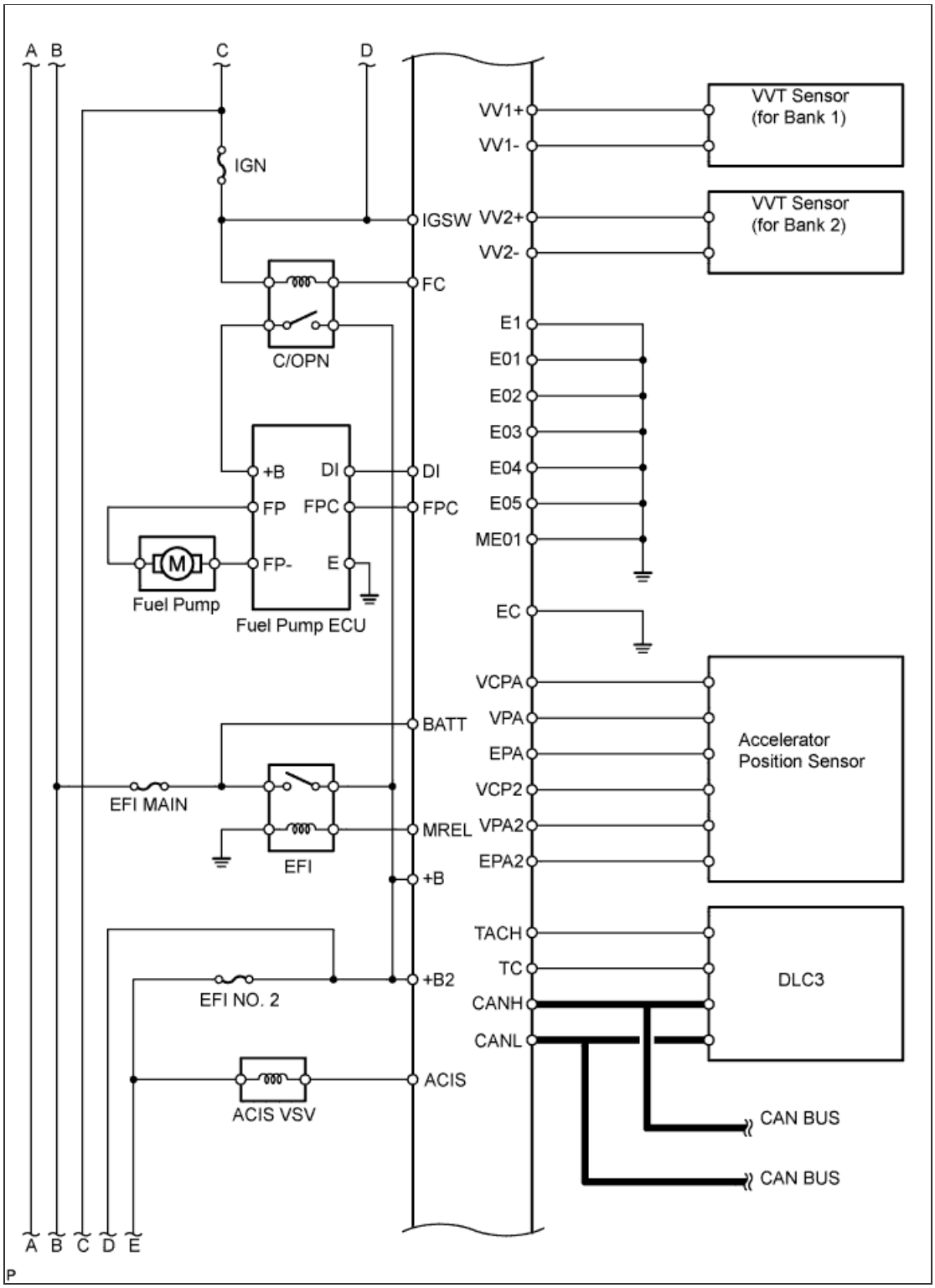
for RHD:

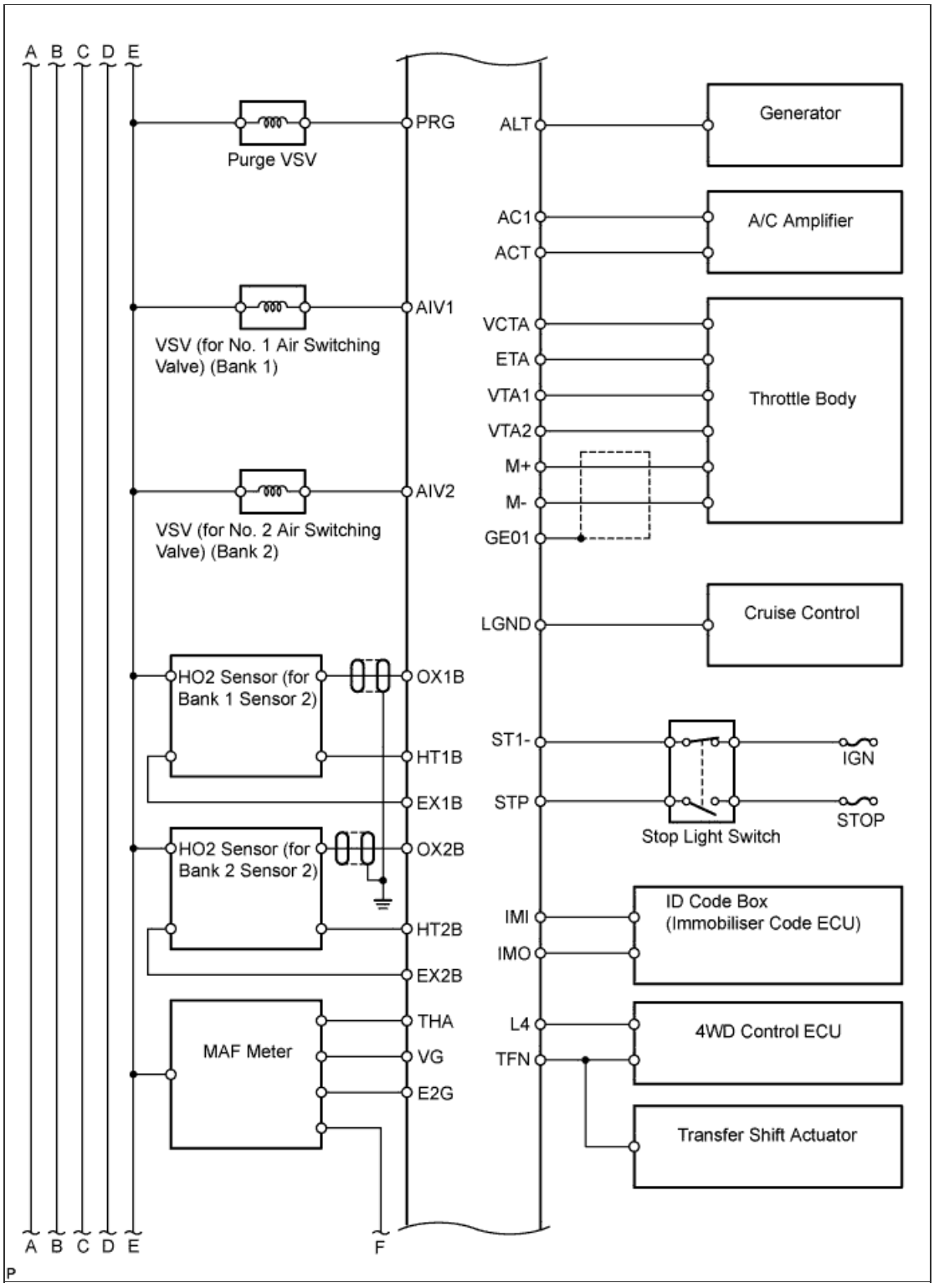

COMBINATION METER
STOP LIGHT SWITCH
MAIN BODY ECU (COWL SIDE JUNCTION BLOCK LH)
DLC3
ACCELERATOR PEDAL

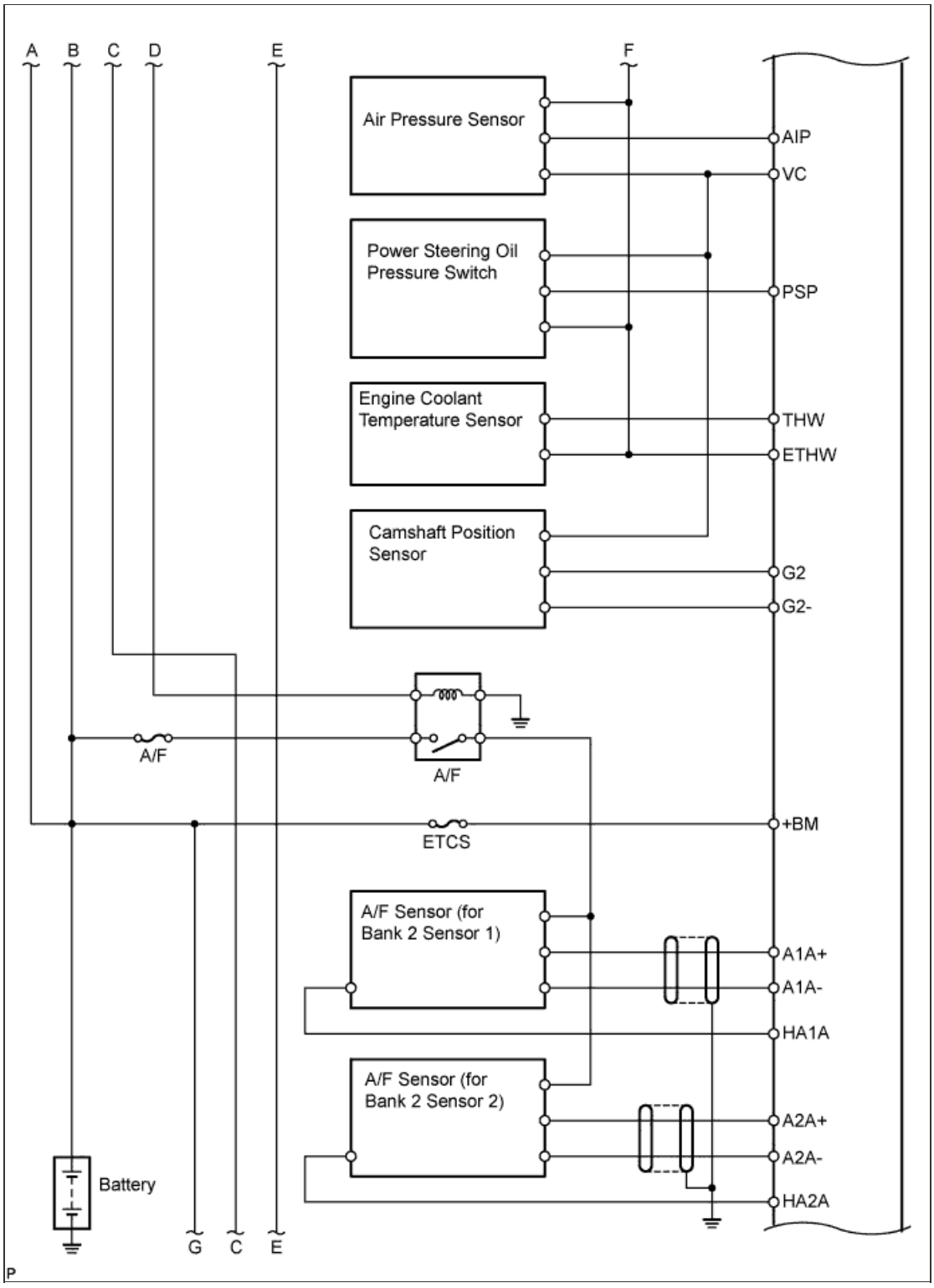
P

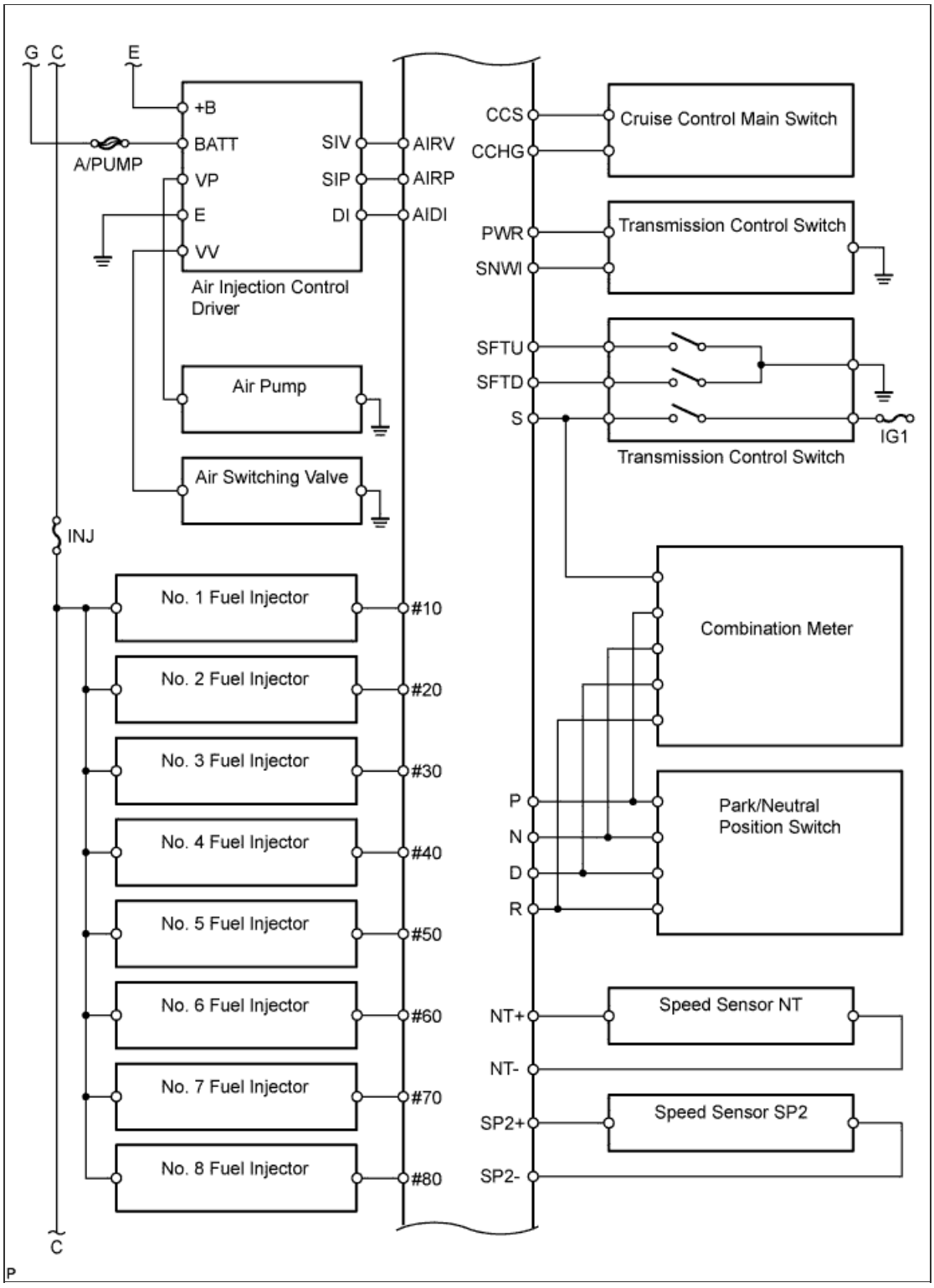
for Preparation Click here

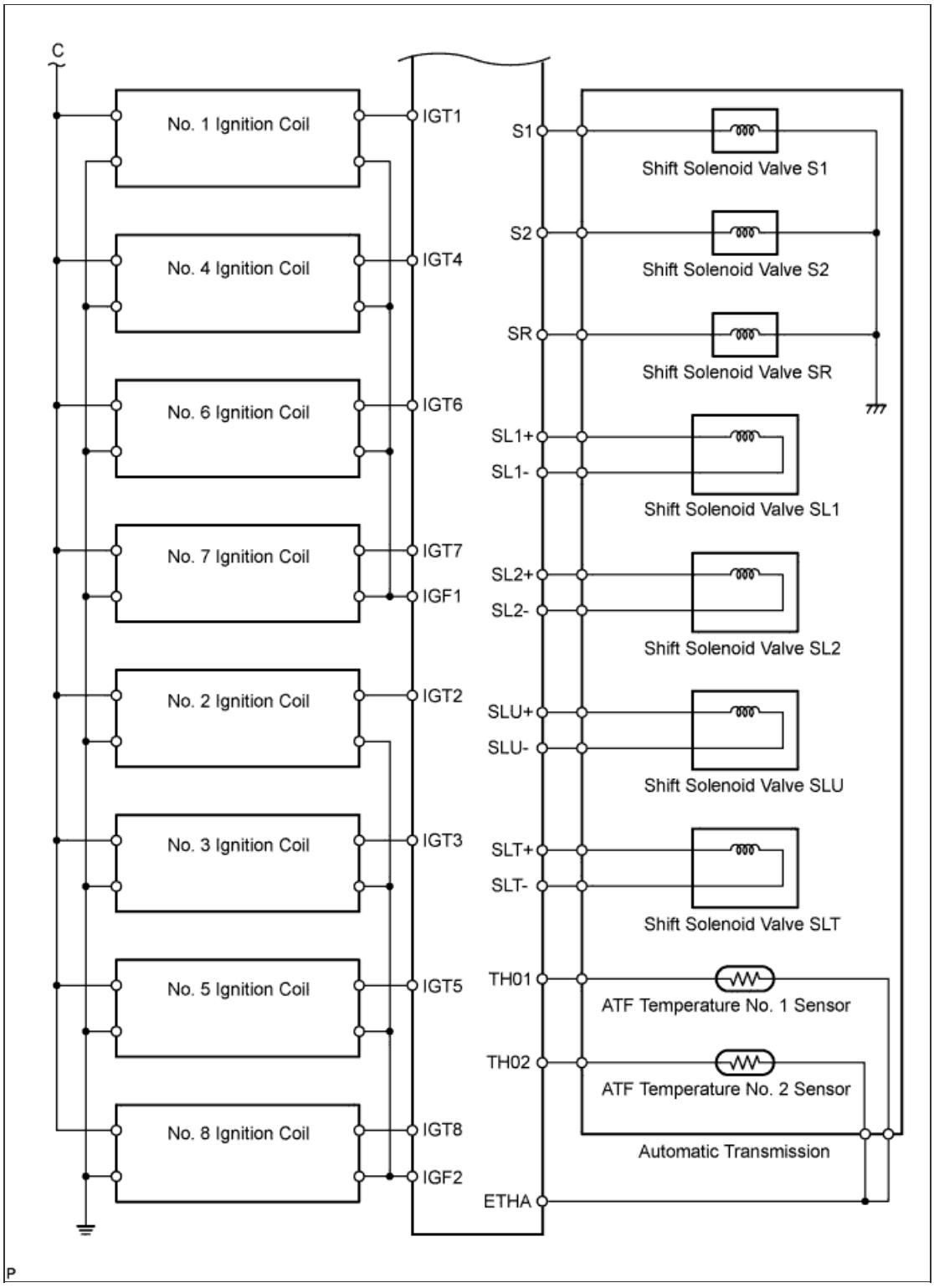



A B C D
IGN
IGSW
FC
C/OPN
+B DI
FP FPC
FP- E
M
Fuel Pump
Fuel Pump ECU
EFI MAIN
EFI
BATT
MREL
+B
EFI NO. 2
+B2
ACIS VSV
ACIS
VV1+
VV1-
VV2+
VV2-
VVT Sensor (for Bank 1)
VVT Sensor (for Bank 2)
E1
E01
E02
E03
E04
E05
ME01
EC
VCPA
VPA
EPA
VCP2
VPA2
EPA2
Accelerator Position Sensor
TACH
TC
CANH
CANL
DLC3
CAN BUS
CAN BUS
A B C D E


A B C D E
Purge VSV
PRG
VSV (for No. 1 Air Switching Valve) (Bank 1)
AIV1
VSV (for No. 2 Air Switching Valve) (Bank 2)
AIV2
HO2 Sensor (for Bank 1 Sensor 2)
OX1B
HT1B
EX1B
HO2 Sensor (for Bank 2 Sensor 2)
OX2B
HT2B
EX2B
MAF Meter
THA
VG
E2G
F
ALT
Generator
AC1
ACT
A/C Amplifier
VCTA
ETA
VTA1
VTA2
M+
M-
GE01
Throttle Body
LGND
Cruise Control
ST1-
STP
IGN
STOP
Stop Light Switch
IMI
IMO
ID Code Box (Immobiliser Code ECU)
L4
TFN
4WD Control ECU
Transfer Shift Actuator
A B C D E
P


A
B
C
D
E
F
Air Pressure Sensor
AIP
VC
Power Steering Oil Pressure Switch
PSP
Engine Coolant Temperature Sensor
THW
ETHW
Camshaft Position Sensor
G2
G2-
A/F
A/F
+BM
ETCS
A/F Sensor (for Bank 2 Sensor 1)
A1A+
A1A-
HA1A
A/F Sensor (for Bank 2 Sensor 2)
A2A+
A2A-
HA2A
Battery
G
C
E
P


G
C
E
+B
BATT
VP
E
VV
A/PUMP
SIV
SIP
DI
AIRV
AIRP
AIDI
Air Injection Control Driver
Air Pump
Air Switching Valve
INJ
No. 1 Fuel Injector
No. 2 Fuel Injector
No. 3 Fuel Injector
No. 4 Fuel Injector
No. 5 Fuel Injector
No. 6 Fuel Injector
No. 7 Fuel Injector
No. 8 Fuel Injector
#10
#20
#30
#40
#50
#60
#70
#80
C
CCS
CCHG
Cruise Control Main Switch
PWR
SNWI
Transmission Control Switch
SFTU
SFTD
S
IG1
Transmission Control Switch
Combination Meter
P
N
D
R
Park/Neutral Position Switch
NT+
NT-
Speed Sensor NT
SP2+
SP2-
Speed Sensor SP2
P


C
No. 1 Ignition Coil
No. 4 Ignition Coil
No. 6 Ignition Coil
No. 7 Ignition Coil
No. 2 Ignition Coil
No. 3 Ignition Coil
No. 5 Ignition Coil
No. 8 Ignition Coil
IGT1
IGT4
IGT6
IGT7
IGF1
IGT2
IGT3
IGT5
IGT8
IGF2
S1
S2
SR
SL1+
SL1-
SL2+
SL2-
SLU+
SLU-
SLT+
SLT-
TH01
TH02
ETHA
Shift Solenoid Valve S1
Shift Solenoid Valve S2
Shift Solenoid Valve SR
Shift Solenoid Valve SL1
Shift Solenoid Valve SL2
Shift Solenoid Valve SLU
Shift Solenoid Valve SLT
ATF Temperature No. 1 Sensor
ATF Temperature No. 2 Sensor
Automatic Transmission
P

for Preparation Click here

HINT:

*: Use the intelligent tester.

1.VEHICLE BROUGHT TO WORKSHOP

NEXT

2.CUSTOMER PROBLEM ANALYSIS

NEXT

3.CONNECT INTELLIGENT TESTER TO DLC3

HINT:

If the display indicates a communication fault in the tester, inspect the DLC3.

NEXT

4.CHECK DTC AND FREEZE FRAME DATA*

HINT:

Record or print DTCs and freeze frame data, if necessary.

NEXT

5.CLEAR DTC AND FREEZE FRAME DATA*

NEXT

6.CONDUCT VISUAL INSPECTION

NEXT

7.SET CHECK MODE DIAGNOSIS*

NEXT

8.CONFIRM PROBLEM SYMPTOMS

HINT:

If the engine does not start, first perform the "Check DTC" procedures and "Conduct Basic Inspection" procedures below.

Result

Result	Proceed to
Malfunction does not occur	A
Malfunction occurs	B

B. GO TO STEP 10

A

9.SIMULATE SYMPTOMS

NEXT

10.CHECK DTC*

Result

Result	Proceed to
Trouble code output	A
No code output	B

B. GO TO STEP 12

A

11.REFER TO DTC CHART

NEXT

GO TO STEP 14

12.CONDUCT BASIC INSPECTION

Result

Result	Proceed to
Malfunctioning parts not confirmed	A
Malfunctioning parts confirmed	B

B. GO TO STEP 17

A

13.REFER TO PROBLEM SYMPTOMS TABLE

Result

Result	Proceed to
Malfunctioning circuit confirmed	A
Malfunctioning parts confirmed	B

B. GO TO STEP 17

A

14.CHECK ECM POWER SOURCE CIRCUIT

NEXT

15.CONDUCT CIRCUIT INSPECTION

Result

Result	Proceed to
Malfunction not confirmed	A
Malfunction confirmed	B

B. GO TO STEP 18

A

16.CHECK FOR INTERMITTENT PROBLEMS

NEXT

GO TO STEP 18

17.CONDUCT PARTS INSPECTION

NEXT

18.IDENTIFY PROBLEM

NEXT

19.ADJUST AND/OR REPAIR

NEXT

20.CONDUCT CONFIRMATION TEST

NEXT

END

for Preparation Click here

HINT:

Inspect the vehicle ECM using check mode. Intermittent problems are easier to detect with the intelligent tester when the ECM is in check mode. In check mode, the ECM uses 1 trip detection logic, which is more sensitive to malfunctions than normal mode (default), which uses 2 trip detection logic.

1. **Clear the DTCs (Click here).**
2. **Switch the ECM from normal mode to check mode using the intelligent tester (Click here).**
3. **Perform a simulation test.**
4. **Check and wiggle the harness(es), connector(s) and terminal(s).**

for Preparation Click here

When a malfunction is not confirmed by the DTC check, troubleshooting should be carried out in all circuits considered to be possible causes of the problem. In many cases, by carrying out the basic engine check shown in the following flowchart, the location of the problem can be found quickly and efficiently. Therefore, using this check is essential when performing engine troubleshooting.

1.CHECK BATTERY VOLTAGE

NOTICE:

Conduct this check with the engine stopped and engine switch off.

Result

Result	Proceed to
11 V or higher	OK
Below 11 V	NG

NG. → CHARGE OR REPLACE BATTERY

OK ↓

2.CHECK WHETHER ENGINE WILL CRANK

NG. → PROCEED TO PROBLEM SYMPTOMS TABLE

OK ↓

3.CHECK WHETHER ENGINE STARTS

NG. → GO TO STEP 6

OK ↓

4.CHECK AIR FILTER

a. Visually check that the air filter is not excessively contaminated with dirt or oil.

NG. → REPLACE AIR FILTER

OK ↓

5.CHECK IDLING SPEED

NG. → TROUBLESHOOT IDLING SPEED AND PROCEED TO NEXT STEP

OK ↓

6.CHECK FUEL PRESSURE

NG. → TROUBLESHOOT FUEL PRESSURE AND PROCEED TO NEXT STEP

OK

7.CHECK FOR SPARK

NG. → TROUBLESHOOT SPARK AND PROCEED TO NEXT STEP

OK

PROCEED TO PROBLEM SYMPTOMS TABLE

for Preparation Click here

HINT:

Use the table below to help determine the cause of the problem symptom. The potential causes of the symptoms are listed in order of probability in the "Suspected Area" column of the table. Check each symptom by checking the suspected areas in the order they are listed. Replace parts as necessary.

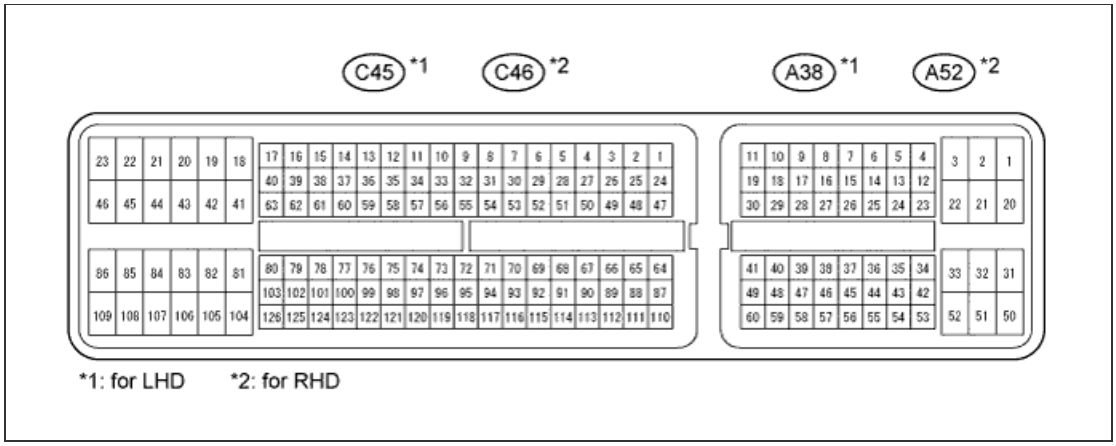
SFI System

Symptom	Suspected Area	See page
Engine does not crank (Does not start)	Battery	Click here
	Starter (for 1.4 kW Type)	Click here
	Starter (for 2.0 kW Type)	Click here
	Starter relay	Click here
	Park/neutral position switch	Click here
	Immobiliser system	Click here
No initial combustion (Does not start)	ECM power source circuit	Click here
	Crankshaft position sensor	Click here
	Camshaft position sensor	Click here
	Ignition system	Click here
	Fuel pump control circuit	Click here
	ECM	Click here
	VC output circuit	Click here
Engine cranks normally but difficult to start	Fuel pump control circuit	Click here
	Compression	Click here
Difficult to start with cold engine	Ignition system	Click here
	Spark plug	Click here
	Fuel pump control circuit	Click here
	Injector circuit	Click here
	Cranking holding function circuit	Click here
Difficult to start with warm engine	Fuel Injector circuit	Click here
	Ignition system	Click here
	Spark plug	Click here
	Fuel pump control circuit	Click here
	Cranking holding function circuit	Click here
High engine idle speed	Electronic throttle control system	Click here
	A/C signal circuit	Click here
	ECM power source circuit	Click here
	Acoustic Control Induction System (ACIS)	Click here
Low engine idle speed (Poor idling)	Electronic throttle control system	Click here
	A/C signal circuit	Click here
	Fuel pump control circuit	Click here
	Air induction system	Click here
	Acoustic Control Induction System (ACIS)	Click here
	PCV hose	Click here
Rough idling	Compression	Click here
	Spark plug	Click here
	Fuel Injector circuit	Click here
	Ignition system	Click here
	Fuel pump control circuit	Click here
	Electronic throttle control system	Click here
	Air induction system	Click here
	Acoustic Control Induction System (ACIS)	Click here
	PCV hose	Click here

	Mass air flow meter	Click here
Idle hunting	Electronic throttle control system	Click here
	Air induction system	Click here
	ECM power source circuit	Click here
	Acoustic Control Induction System (ACIS)	Click here
Hesitation/Poor acceleration	Fuel pump control circuit	Click here
	Spark plug	Click here
	Ignition system	Click here
	Fuel Injector circuit	Click here
	Mass air flow meter	Click here
	Electronic throttle control system	Click here
	Air induction system	Click here
	Compression	Click here
	Brake override system	Click here
Surging (Poor driveability)	Spark plug	Click here
	Fuel pump control circuit	Click here
	Ignition system	Click here
	Fuel Injector circuit	Click here
	Mass air flow meter	Click here
	Variable valve timing system	Click here
	Compression	Click here
Engine stalls soon after starting	Fuel pump control circuit	Click here
	Spark plug	Click here
	Ignition system	Click here
	Fuel Injector circuit	Click here
	Variable valve timing system	Click here
	Electronic throttle control system	Click here
	Air induction system	Click here
	PCV hose	Click here
	Compression	Click here
Engine stalls only during A/C operation	A/C signal circuit	Click here
	ECM	Click here
Unable/difficult to refuel	Refueling valve (canister)	Click here

for Preparation Click here

CHECK ECM



a. Measure the voltage according to the value(s) in the table below.

HINT:

The standard normal voltage between each pair of ECM terminals is shown in the table below. The appropriate conditions for checking each pair of terminals are also indicated. The result of checks should be compared with the standard normal voltage for that pair of terminals, displayed in the Specified Condition column. The illustration above can be used as a reference to identify the ECM terminal locations.

Terminal No. (Symbol)	Wiring Color	Terminal Description	Condition	Specified Condition
A38-1 (BATT) - C45-81 (E1) A52-1 (BATT) - C46-81 (E1)		atter (for measuring battery voltage and for ECM memory)	Always	11 to 14 V
C45-41 (M) C45-81 (E1) C46-41 (M) C46-81 (E1)		ower source of throttle actuator	Always	11 to 14 V
A38-28 (IGSW) - C45-81 (E1) A52-28 (IGSW) - C46-81 (E1)		Engine switch	Engine switch on (IG)	11 to 14 V
A38-3 ( ) C45-81 (E1) A52-3 ( ) C46-81 (E1)		ower source of ECM	Engine switch on (IG)	11 to 14 V
A38-2 (O) 45-81 (E1) A52-2 (O) 46-81 (E1)		ower source of ECM	Engine switch on (IG)	11 to 14 V
C45-58 (C1) C45-57 (C1-) C46-58 (C1) C46-57 (C1-)		Cam Timing oil control valve (CV) (for Bank 1)	Engine switch on (IG)	se generation (see waveform 1)
C45-52 (C2) C45-51 (C2-) C46-52 (C2) C46-51 (C2-)		Cam Timing oil control valve (CV) (for Bank 2)	Engine switch on (IG)	se generation (see waveform 1)
A38-34 (MREL) - C45-81 (E1) A52-34 (MREL) - C46-81 (E1)		EFI relay	Engine switch on (IG)	11 to 14 V
C45-74 (VG) - C45-75 (E2G) C46-74 (VG) - C46-75	L- W	Mass air flow meter	Idling, shift lever in or N, A/C switch off	. o 8.

(E2G)				
C45-73 (THA) - C45-97 (ETHW) C46-73 (THA) - C46-97 (ETHW)		ntake air temperature sensor	Idling, intake air temperature 2 C (68°F)	. o 8.4 V
C45-76 (THW) - C45-97 (ETHW) C46-76 (THW) - C46-97 (ETHW)		Engine coolant temperature sensor	Idling, engine coolant temperature 8 C (176°F)	. o 1.
C45-8 (CTA) - C45-79 (ETA) C46-8 (CTA) - C46-79 (ETA)		ower source of throttle position sensor (specific voltage)	Engine switch on (IG)	4.5 to 5.5 V
C45-78 (VTA1) - C45-79 (ETA) C46-78 (VTA1) - C46-79 (ETA)		Throttle position sensor (for engine control)	Engine switch on (IG), throttle valve fully closed	. o 1.2 V
			Engine switch on (IG), throttle valve fully open	3.2 to 4.8 V
C45-77 (VTA2) - C45-79 (ETA) C46-77 (VTA2) - C46-79 (ETA)		Throttle position sensor (for sensor malfunction detection)	Engine switch on (IG), throttle valve fully closed	2.1 to 3.1 V
			Engine switch on (IG), throttle valve fully open	4.5 to 5.5 V
A38-55 (V A) - A38-58 (E A) A52-55 (V A) - A52-58 (E A)	W-L	Accelerator pedal position sensor (for engine control)	Engine switch on (IG), accelerator pedal released	. o 1.1 V
			Engine switch on (IG), accelerator pedal fully depressed	2.6 to 4.5 V
A38-56 (V A2) - A38-6 (E A2) A52-56 (V A2) - A52-6 (E A2)		Accelerator pedal position sensor (for sensor malfunctioning detection)	Engine switch on (IG), accelerator pedal released	1.2 to 2.
			Engine switch on (IG), accelerator pedal fully depressed	3.4 to 5.3 V
A38-57 (VC A) - A38-58 (E A) A52-57 (VC A) - A52-58 (E A)	W - W-L	ower source of accelerator pedal position sensor (for V A)	Engine switch on (IG)	4.5 to 5.5 V
A38-59 (VC)A38-6 (E A2) A52-59 (VC)A52-6 (E A2)		ower source of accelerator pedal position sensor (for V A2)	Engine switch on (IG)	4.5 to 5.5 V
C45-22 (HA1A) - C45-23 (E) C46-22 (HA1A) - C46-23 (E)	W-B	A/F sensor heater	Idling	Below 3.
			Engine switch on (IG)	11 to 14 V
C45-2 (A2A) - C45-21 (E) C46-2 (A2A) - C46-21 (E)	W-B	A/F sensor heater	Idling	Below 3.
			Engine switch on (IG)	11 to 14 V
C45-126 (A1A) C45-81 (E1) C46-126 (A1A) C46-81 (E1)		A/F sensor	Engine switch on (IG)	3.3 V
C45-125 (A1A-) - C45-81 (E1) C46-125 (A1A-) - C46-81 (E1)		A/F sensor	Engine switch on (IG)	2.9 V
C45-1 3 (A2A) C45-81 (E1) C46-1 3 (A2A) C46-81 (E1)		A/F sensor	Engine switch on (IG)	3.3 V
C45-1 A2A-) - C45-81 (E1) C46-1 A2A-) - C46-81 (E1)		A/F sensor	Engine switch on (IG)	2.9 V
C45-45 (HT1B) - C45-46 (E 3) C46-45 (HT1B) - C46-46 (E 3)	W-B	Heated oxygen sensor heater	Idling	Below 3.
			Engine switch on (IG)	11 to 14 V
C45-44 (HT2B) - C45-46 (E 3)		eated oxygen	Idling	Below 3.

C46-44 (HT2B) - C46-46 (E 3)	W-B	sensor heater	Engine switch on (IG)	11 to 14 V
C45-114 (C45-115 (EX1B) C46-114 (C46-115 (EX1B)	W - BR	Heated oxygen sensor	Engine speed maintained at 25 pm for 2 minutes after warming up sensor	se generation (see waveform 2)
C45-112 (C45-113 (EX2B) C46-112 (C46-113 (EX2B)				
C45-86 (#1) C45-43 (E) C46-86 (#1) C46-43 (E)	W-B	Fuel Injector	Engine switch on (IG)	11 to 14 V
C45-1 (C45-43 (E) C46-1 (C46-43 (E)	W-B			
C45-85 (#3) C45-43 (E) C46-85 (#3) C46-43 (E)	W-B			
C45-1 8 (#4) C45-43 (E) C46-1 8 (#4) C46-43 (E)	W-B			
C45-84 (#5) C45-43 (E) C46-84 (#5) C46-43 (E)	W-B		Idling	se generation (see waveform 3)
C45-1 (C45-43 (E) C46-1 (C46-43 (E)	W-B			
C45-83 (#7) C45-43 (E) C46-83 (#7) C46-43 (E)	W - W-B			
C45-1 8 ( ) C45-43 (E) C46-1 8 ( ) C46-43 (E)	W-B			
C45-94 (KNK1) - C45-93 (EKNK) C46-94 (KNK1) - C46-93 (EKNK)		nock sensor	Engine speed maintained at 4 pmrafter warming up engine	se generation (see waveform 4)
C45-117 (KNK2) - C45-116 (EKN2) C46-117 (KNK2) - C46-116 (EKN2)	W - B			
C45-92 (VV1) C45-91 (VV1-) C46-92 (VV1) C46-91 (VV1-)		aable valve timing (VVT) sensor (for intake side of bank 1)	Idling	se generation (see waveform 5)
C45-87 (VV2) C45-88 (VV2-) C46-87 (VV2) C46-88 (VV2-)	W	Variable valve timing (VVT) sensor (for intake side of bank 2)	Idling	se generation (see waveform 5)
C45-11 (E) C45-111 (NE-) C46-11 (E) C46-111 (NE-)		Crank position sensor	Idling	se generation (see waveform 5)
C45-4 (T1) - C45-81 (E1) C46-4 (T1) - C46-81 (E1)				
C45-33 (IGT2) - C45-81 (E1) C46-33 (IGT2) - C46-81 (E1)				

C45-37 (IGT3) - C45-81 (E1) C46-37 (IGT3) - C46-81 (E1)		gnition coil (ignition signal)	Idling	Use generation (see waveform 6)
C45-38 (IGT4) - C45-81 (E1) C46-38 (IGT4) - C46-81 (E1)				
C45-35 (IGT5) - C45-81 (E1) C46-35 (IGT5) - C46-81 (E1)				
C45-36 (IGT6) - C45-81 (E1) C46-36 (IGT6) - C46-81 (E1)				
C45-34 (IGT7) - C45-81 (E1) C46-34 (IGT7) - C46-81 (E1)	W - BR			
C45-39 (IGT8) - C45-81 (E1) C46-39 (IGT8) - C46-81 (E1)				
C45-1 (C45-31 (E1) C46-1 (C46-31 (E1)		gnition coil (ignition confirmation signal)	Engine switch on (IG)	4.5 to 5.5 V
			Idling	Use generation (see waveform 6)
C45-1 (C45-31 (E1) C46-1 (C46-31 (E1)		gnition coil (ignition confirmation signal)	Engine switch on (IG)	4.5 to 5.5 V
			Idling	Use generation (see waveform 6)
C45-63 (O45-81 (E1) C46-63 (O46-81 (E1)		ge VSV ur	Engine switch on (IG)	11 to 14 V
			Idling	Use generation (see waveform 7)
A38-13 (S D) - C45-81 (E1) A52-13 (S D) - C46-81 (E1)		Speed signal from combination meter	Driving at 2 km/h (12 mph)	Use generation (see waveform 8)
A38-46 (STA) - C45-81 (E1) A52-46 (STA) - C46-81 (E1)		Starter signal	Cranking	5.5 V or higher
C45-12 (NSW) - C45-81 (E1) C46-12 (NSW) - C46-81 (E1)		ak/neutral position switch	Engine switch on (IG), shift lever not in or N	11 to 14 V
			Engine switch on (IG), shift lever in or N	Below 3.
A38-36 (ST) C45-81 (E1) A52-36 (ST) C46-81 (E1)		Stop light switch	Brake pedal depressed	7.5 to 14 V
			Brake pedal released	Below 1.5 V
A38-35 (ST1-) - C45-81 (E1) A52-35 (ST1-) - C46-81 (E1)	W - BR	Stop light switch (opposite to ST terminal)	Engine switch on (IG), brake pedal depressed	Below 1.5 V
			Engine switch on (IG), brake pedal released	7.5 to 14 V
C45-19 (M) C45-82 (ME) C46-19 (M) C46-82 (ME)	W-B	Throttle actuator	Idling with warm engine	Use generation (see waveform 9)
C45-18 (M-) - C45-82 (ME) C46-18 (M-) - C46-82 (ME)	W-B	Throttle actuator	Idling with warm engine	Use generation (see waveform 1)
A38-48 (FC) - C45-81 (E1) A52-48 (FC) - C46-81 (E1)		l pump ue control	Engine switch on (IG)	11 to 14 V
A38-52 (F C) - C45-81 (E1)				

A52-52 (F C) - C46-81 (E1)	W - BR	Fuel pump control	Engine switch on (IG)	Below 1.5 V
A38-24 (W) - C45-81 (E1) A52-24 (W) - C46-81 (E1)		M	Engine switch on (IG)	Below 3.
			dling	11 to 14 V
A38-16 (TC) - C45-81 (E1) A52-16 (TC) - C46-81 (E1)	W - BR	Terminal TC of DLC3	Engine switch on (IG)	11 to 14 V
A38-15 (TACH) - C45-81 (E1) A52-15 (TACH) - C46-81 (E1)	W-G - BR	Engine speed	Idling	se generation (see waveform 11)
C45-66 (VC) - C45-97 (ETHW) C46-66 (VC) - C46-97 (ETHW)		ower source for sensor (specific voltage)	Engine switch on (IG)	4.5 to 5.5 V
C45-32 (ALT) - C45-81 (E1) C46-32 (ALT) - C46-81 (E1)		nerator	Engine switch on (IG)	11 to 14 V
A38-1 (CANH) - C45-81 (E1) A52-1 (CANH) - C46-81 (E1)		CAN communication line	Engine switch on (IG)	se generation (see waveform 12)
A38-11 (CANL) - C45-81 (E1) A52-11 (CANL) - C46-81 (E1)		CAN communication line	Engine switch on (IG)	se generation (see waveform 13)
C45-62 (ACIS) - C45-81 (E1) C46-62 (ACIS) - C46-81 (E1)	W - BR	VSV for ACIS (Acoustic Control Induction System) operation signal	Engine switch on (IG)	11 to 14 V
C45-28 (AIRV) - C45-81 (E1) C46-28 (AIRV) - C46-81 (E1)		Air switching valve for secondary air injection system	Engine switch on (IG)	11 to 14 V
C45-54 (AIR) C45-81 (E1) C46-54 (AIR) C46-81 (E1)		Air pump control	Engine switch on (IG)	11 to 14 V
C45-3 (AIDI) - C45-81 (E1) C46-3 (AIDI) - C46-81 (E1)		Diagnostic information signal for air injection system	Air injection system operates	se generation (see waveform 15)
A38-54 (AI) C45-98 (ETHA) A52-54 (AI) C46-98 (ETHA)		Secondary air injection system pressure signal	Engine switch on (IG)	3. d 3.6 V
C45-9 (C)45- 89 (G2-) C46-9 (C)46- 89 (G2-)		Cam position sensor	Idling	se generation (see waveform 14)
A38-18 (DI) - C45-81 (E1) A52-18 (DI) - C46-81 (E1)		l pump control	Engine switch on (IG)	d 3.
A38-14 (STSW) - C45-81 (E1) A52-14 (STSW) - C46-81 (E1)		Starter switch	Shift lever in or N, cranking	6. or higher
A38-41 (ACCR) - C45-81 (E1) A52-41 (ACCR) - C46-81 (E1)		ACC relay control signal	Engine switch on (IG) → Cranking	11 to 14 V → Below 1 V
C45-16 (STAR) - C45-81 (E1) C46-16 (STAR) - C46-81 (E1)		Starter relay control	Engine switch on (IG)	Below 1.5 V
			Cranking	5.5 V or higher

C45-72 (S) C45-81 (E1) C46-72 (S) C46-81 (E1)		ower steering oil pressure sensor	Engine switch on (IG)	. o 4.5 V

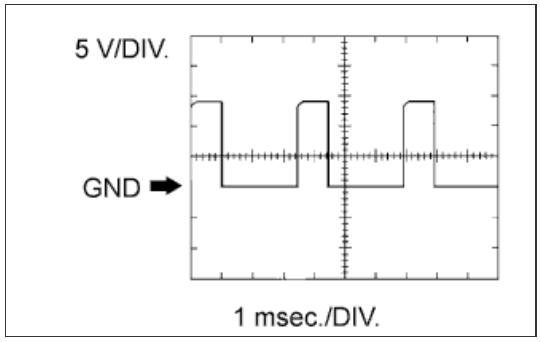
HINT:

- ***1: for LHD**
- ***2: for RHD**

b. WAVEF M

Cam Timing Oil Control Valve (OCV)

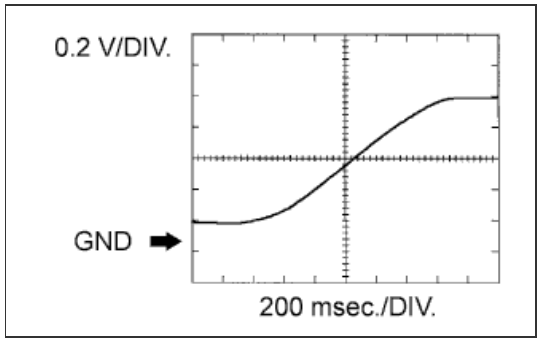
ten	Content
Terminal No. (Symbol)	Between C1 ad C1- Between C2 ad C2-
Tool Setting	5 V/DIV., 1 msec./DIV.
Condition	Idling



c. WAVEF M

Heated Oxygen Sensor

ten	Content
Terminal No. (Symbol)	Between nd EX1B Between nd EX2B
Tool Setting	. DIV., 2 msec./DIV.
Condition	Engine speed maintained at 25 pm for 2 minutes after warming up sensor



HINT:

In Data List, item S B1 S2 or S B2 S2 shows the ECM input values from the heated oxygen sensor.

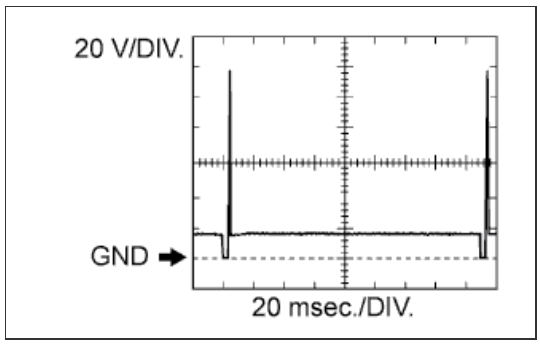
d. WAVEF M

Fuel Injector No. 1 (to No. 8) Injection Signal

Item	Content
Terminal No. (Symbol)	Between #1 (t #8) ad E
Tool Setting	2 DIV., 2 msec./DIV.
Condition	Idling

HINT:

The wavelength becomes shorter as the engine speed increases.

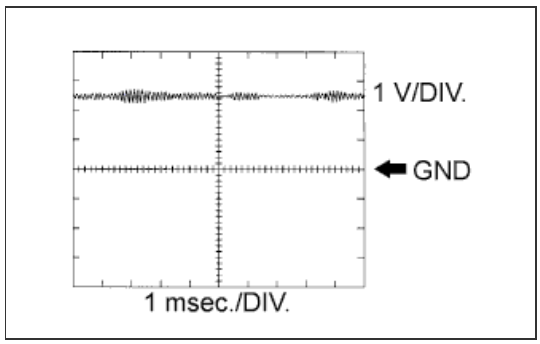


e. WAVEF M

Knock Sensor

ten	Content
Terminal No. (Symbol)	Between KNK1 and EKNK Between KNK2 and EKN2
Tool Setting	1 V/DIV., 1 msec./DIV.
Condition	Engine speed maintained at 4 pmrafter warming up engine

HINT:



- **The wavelength becomes shorter as the engine speed increases.**
- **The waveforms and amplitudes displayed differ slightly depending on the vehicle.**

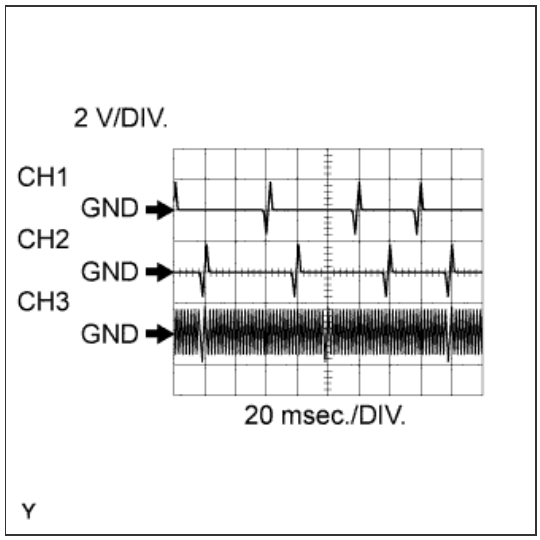
f. WAVEF M

Variable Valve Timing (VVT) Sensor (for Bank 1, 2) and Crankshaft Position Sensor

tem	Content
Terminal No. (Symbol)	CH1: Between VV1 ad VV1- CH2: Between VV2 ad VV2- CH3: Between NE ad NE-
Tool Setting	2 V/DIV., 2 msec./DIV.
Condition	Idling after engine warmed up

HINT:

The wavelength becomes shorter as engine speed increases.



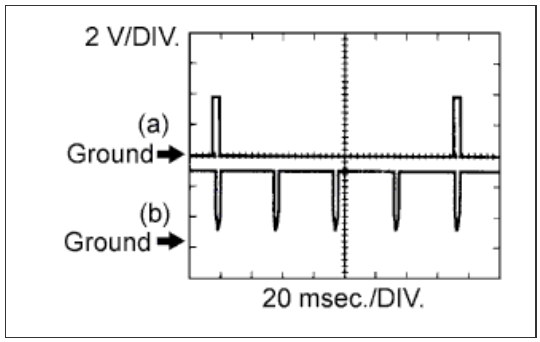
g. WAVEF M

Igniter IGT Signal (from ECM to Igniter) and Igniter IGF Signal (from Igniter to ECM)

tem	Content
Terminal No. (Symbol)	(a) Between IGT1 (to IGT8) and E1 (b) Between IGF1 (IGF2) and E1
Tool Setting	2 V/DIV., 2 msec./DIV.
Condition	Idling

HINT:

The wavelength becomes shorter as engine speed increases.



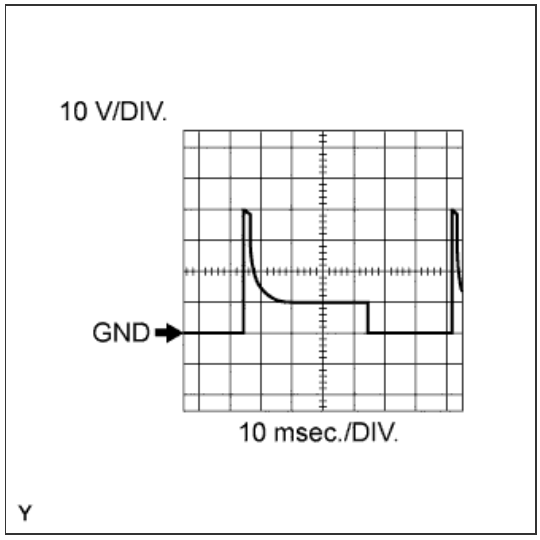
h. WAVEF M

Purge VSV

tem	Content
Terminal No. (Symbol)	Between ndÆ1
Tool Setting	1 DIV., 1 d 1 msec./DIV.
Condition	Idling

HINT:

If the waveform is not similar to the illustration, check the waveform again after idling for 1 minutes or more.



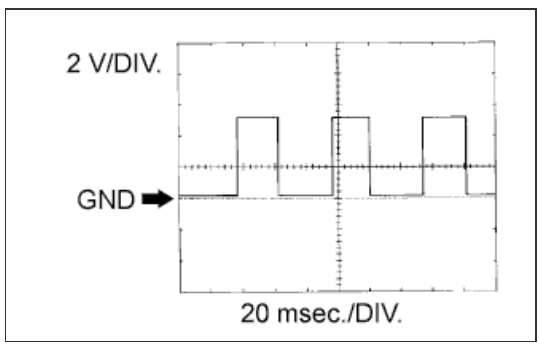
i. WAVEF M

Vehicle Speed Signal

Item	Content
Terminal No. (Symbol)	Between S D and E1
Tool Setting	2 V/DIV., 2 msec./DIV.
Condition	Driving at 2 km/h (12 mph)

HINT:

The wavelength becomes shorter as the vehicle speed increases.



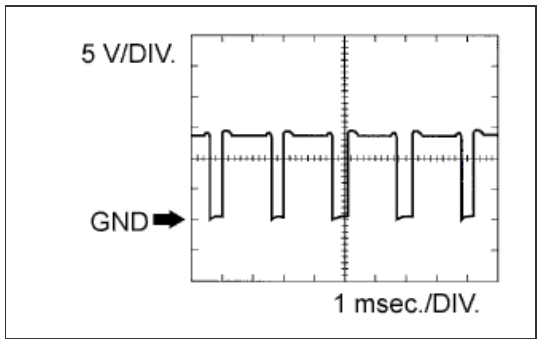
j. WAVEF M

Throttle Act ator Positive Terminal

ten	Content
Terminal No. (Symbol)	Between M ad ME
Tool Setting	5 V/DIV., 1 msec./DIV.
Condition	Idling with warm engine

HINT:

The duty ratio varies depending on the throttle actuator operation.



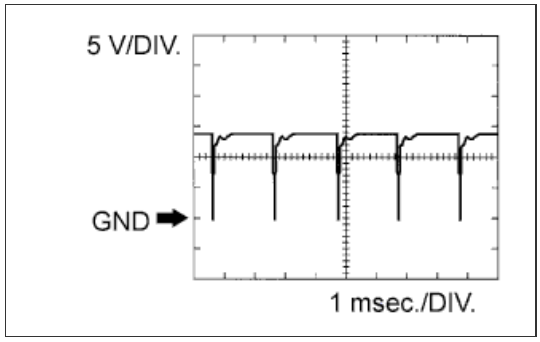
k. WAVEF M

Throttle Actuator Negative Terminal

ten	Content
Terminal No. (Symbol)	Between M- and ME
Tool Setting	5 V/DIV., 1 msec./DIV.
Condition	Idling with warm engine

HINT:

The duty ratio varies depending on the throttle actuator operation.



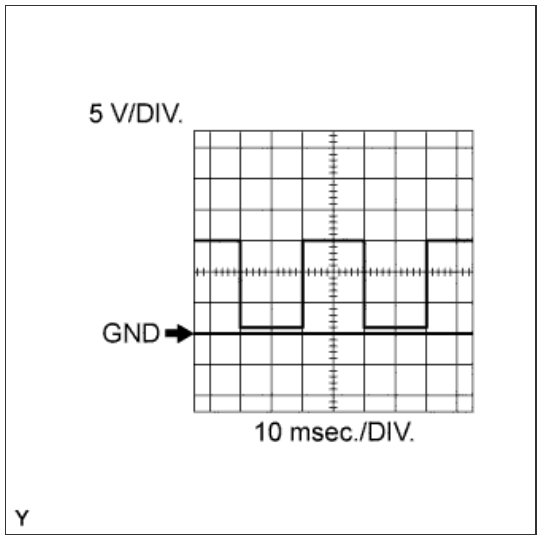
l. WAVEF M

Engine Speed Signal

ten	Content
Terminal No. (Symbol)	Between TACH and E1
Tool Setting	5 V/DIV., 1 msec./DIV.
Condition	Idling

HINT:

The wavelength becomes shorter as the engine speed increases.



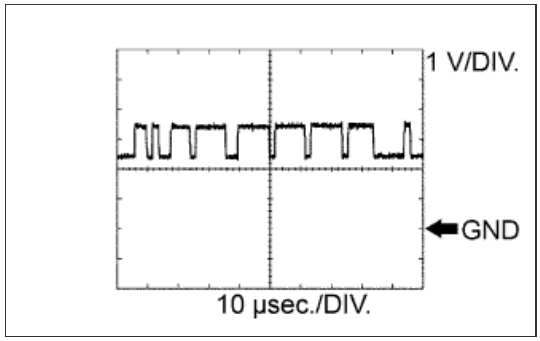
m. WAVEF M

CAN Communication Signal

ten	Content
Terminal No. (Symbol)	Between CANH and E1
Tool Setting	1 V/DIV., 1 sec/DIV.
Condition	Engine stopped and engine switch on (IG)

HINT:

The waveform varies depending on the CAN communication signal.

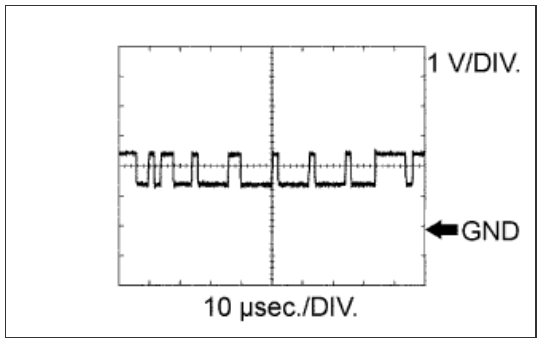


n. WAVEF M:

CAN Communication Signal

Item	Content

Terminal No. (Symbol)	Between CANL and E1
Tool Setting	1 V/DIV., 1 sec./DIV.
Condition	Engine stopped and engine switch on (IG)



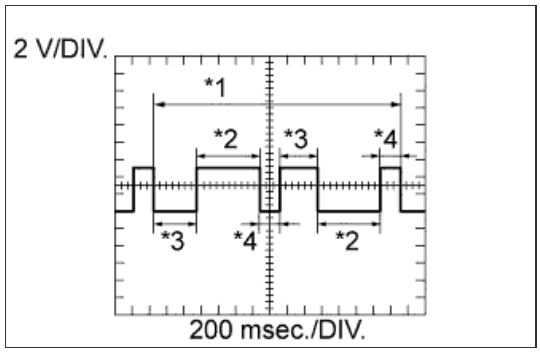
HINT:

The waveform varies depending on the CAN communication signal.

o. WAVEF M

Cam Position Sensor

tem	Content
Terminal No. (Symbol)	Between G2 and G2-
Tool Setting	2 V/DIV., 2 msec./DIV.
Condition	Idling after engine warmed up



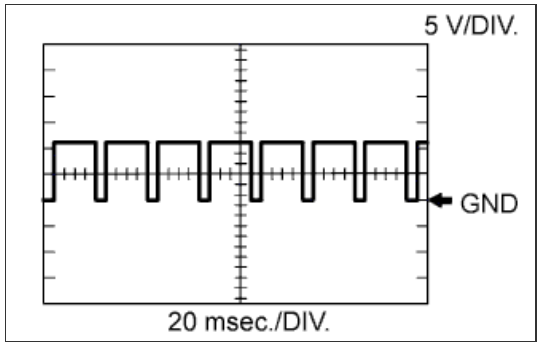
HINT:

- **The wavelength becomes shorter as engine speed increases.**
- ***1: 720°**
- ***2: 180°**
- ***3: 120°**
- ***4: 60°**

p. WAVEF M

Terminal DI of Air Injection Control Driver

tem	Content
Terminal No. (Symbol)	Between AIDI and E1
Tool Setting	5 V/DIV., 2 to 4 msec./DIV.
Condition	forming system check using intelligent tester (air injection check)



HINT:

The wavelength changes when the air injection control driver detects malfunctions in the air injection system.

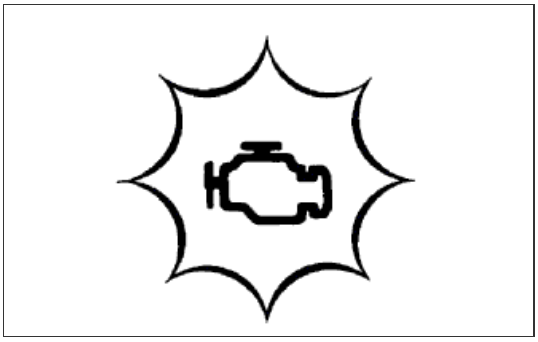
for Preparation Click here

EURO-OBD (EUROPE)

When troubleshooting Europe On-Board Diagnostic (Euro-OBD) vehicles, the vehicle must be connected to an OBD scan tool (complying with ISO 15765-4). Various data output from the vehicle ECM can then be read.

Euro-OBD regulations require that the on-board computer of the vehicle illuminate the Malfunction Indicator Lamp (MIL) on the instrument panel when the computer detects a malfunction in:

1. The emission control system components
2. The powertrain control components (which affect vehicle emissions)
3. The computer itself



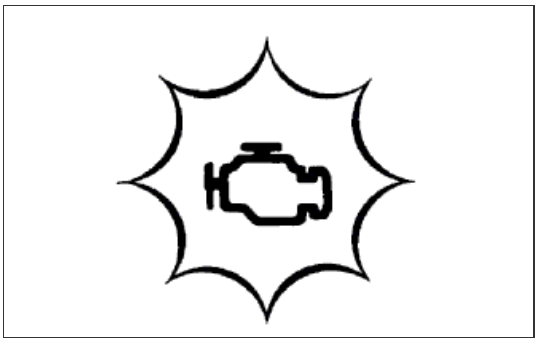
In addition, the applicable Diagnostic Trouble Codes (DTCs) prescribed by ISO 15765-4 are stored in the ECM memory. If the malfunction does not reoccur in 3 consecutive trips, the MIL turns off automatically but the DTCs remain stored in the ECM memory.

To check the DTCs, connect the intelligent tester to the Data Link Connector 3 (DLC3) of the vehicle. The scan tool displays DTCs, the freeze frame data and a variety of the engine data. The DTCs and freeze frame data can be cleared with the scan tool.

M-OBD (EXCEPT EUROPEAN SPEC.)

When troubleshooting Multiplex On-Board Diagnostic (M-OBD) vehicle, the vehicle must be connected to the intelligent tester. Various data output from the ECM can then be read.
OBD regulations require that the on-board computer of the vehicle illuminate the MIL on the instrument panel when the computer detects a malfunction in:

1. The emission control system components
2. The powertrain control components (which affect vehicle emissions)
3. The computer



In addition, the applicable DTCs are stored in the ECM memory. If the malfunction does not recur in 3 consecutive trips, the MIL turns off automatically but the DTCs remain stored in the ECM memory.

NORMAL MODE AND CHECK MODE

The diagnosis system operates in normal mode during normal vehicle use. In normal mode, 2 trip detection logic is used to ensure accurate detection of malfunctions. Check mode is also available as an option for technicians. In check mode, 1 trip detection logic is used for simulating malfunction symptoms and increasing the ability of the system to detect malfunctions, including intermittent problems (intelligent tester only).

2 TRIP DETECTION LOGIC

When a malfunction is first detected, the malfunction is temporarily stored in the ECM memory (1st trip). If the same malfunction is detected during the next subsequent driving cycle, the MIL is illuminated (2nd trip).

FREEZE FRAME DATA

The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.

BATTERY VOLTAGE

Standard voltage:
11 to 14 V

If voltage is below 11 V, replace or recharge the battery before proceeding.

MIL (Malfunction Indicator Lamp)

a. The MIL is illuminated when the engine switch is first turned on (IG) (the engine is not running).

b. The MIL should turn off when the engine is started. If the MIL remains illuminated, the diagnosis system has detected a malfunction or abnormality in the system.

HINT:

If the MIL is not illuminated when the engine switch is first turned on (IG), check the MIL circuit (Click here).

ALL READINESS

HINT:

- **With "All Readiness" it is possible to check whether or not the DTC judgment has been completed by using the intelligent tester.**
- **Check "All Readiness" after simulating malfunction symptoms or for validation after finishing repairs.**

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Perform the DTC judgment driving pattern to run the DTC judgment.

f. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

g. Input the DTCs to be confirmed.

h. Check the DTC judgment result.

Result

Tester Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

for Preparation Click here

NOTICE:

When the diagnosis system is changed from the normal mode to check mode or vice versa, all DTCs and freeze frame data stored in normal mode are cleared. Before changing modes, always check and make a note of DTCs and freeze frame data.

HINT:

- **DTCs which are stored in the ECM can be output to the intelligent tester. The intelligent tester can display the current and pending DTCs.**
- **Some DTCs are not stored if the ECM does not detect the same malfunction again during a second consecutive driving cycle. However, such malfunctions, detected on only one occasion, are stored as pending DTCs.**

CHECK DTC

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Check the DTC(s) and freeze frame data, and then write them down.

f. Check the details of the DTC(s) (Click here).

CLEAR DTC

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Clear the DTCs.

CLEAR DTC (Without using the intelligent tester)

a. Perform either of the following operations:

i. Disconnect the cable from the negative (-) battery terminal for more than 1 minute.

ii. Remove the EFI MAIN fuse from the engine room relay block located inside the engine compartment for more than 1 minute.

for Preparation Click here

DESCRIPTION

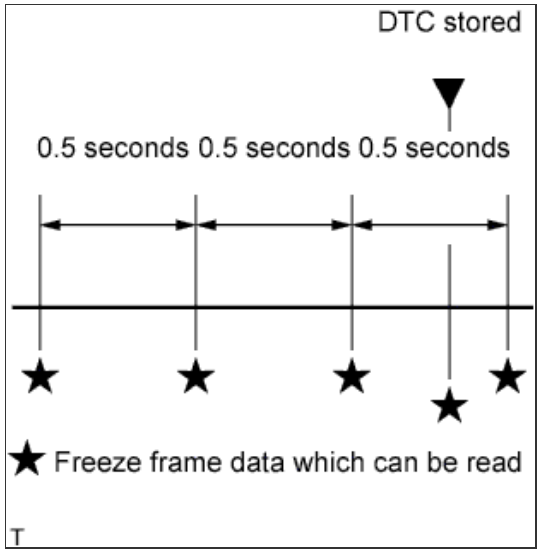
Freeze frame data records the engine conditions (fuel system, calculated load, engine coolant temperature, fuel trim, engine speed, vehicle speed, etc.) when a malfunction is detected. When troubleshooting, it can help determine if the vehicle was running or stopped, the engine was warmed up or not, the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

HINT:

If it is impossible to duplicate the problem even though a DTC is stored, confirm the freeze frame data.

The ECM records engine conditions in the form of freeze frame data every 0.5 seconds. Using the intelligent tester, 5 separate sets of freeze frame data can be checked.

- 3 data sets before the DTC was stored.
- 1 data set when the DTC was stored.
- 1 data set after the DTC was stored.
  These data sets can be used to simulate the condition of the vehicle around the time of the occurrence of the malfunction. The data may assist in identifying the cause of the malfunction, and in judging whether it was temporary or not.



LIST OF FREEZE FRAME DATA

L EL (Tester Display)	Measurement Item	Diagnostic Note
Trouble Code	Trouble code	-
Injector (port)	Injection period of No. 1 cylinder	-
IGN dvance	Ignition advance	-
Calculate Load	Calculated load	The load calculated by the ECM.
Vehicle Load	Vehicle load	-
M F	Mass air flow volume	If the value is approximately 0.0 g/sec.: • The mass air flow meter power source circuit is open or shorted. • The VG circuit is open or shorted. If the value is 160.0 g/sec. or more: • The E circuit is open.
Engine peed	Engine speed	-
Vehicle peed	Vehicle speed	The speed indicated on the speedometer.
Coolant Temp	Engine coolant temperature	If the value is -40°C (-40°F), the sensor circuit is open. If the value is 140°C (F) or higher, the sensor circuit is shorted.
Intake ir	Intake air temperature	If the value is -40°C (-40°F), the sensor circuit is open. If the value is 140°C (F) or higher, the sensor circuit is shorted.
nd ir ystem tatus	econd air system status	-
ir-Fuel atio	atio compared to stoichiometric level	-
urge Density Learn Value	Learning value of purge density	-

Evap urge Flow	atio of evaporative purge flow to intake air volume	-
EV (urge) V	EV purge V duty ratio	-
Knock Correct Learn Value	Correction learning value of knocking	-
Knock Feedback Value	Feedback value of knocking	-
ccelerator osition No.1	bsolute ccelerator edal osition ( ) No. 1	-
ccelerator osition No.	bsolute No.	-
Throttle osition	Throttle position	-
Throttle ensor osition	Throttle sensor positioning	-
Throttle ensor osition #	Throttle sensor positioning #	-
Throttle Motor	Throttle motor	-
B1 B	eated oxygen sensor output	erforming the Control the Injection Volume or Control the Injection Volume for F ensor function of the ctive Test enables the technician to check the output voltage of the sensor.
F B1 F B	F sensor output	erforming the Control the Injection Volume or Control the Injection Volume for F ensor function of the ctive Test enables the technician to check the output voltage of the sensor.
F B	F sensor current	-
Total FT #1 Total FT #	Total fuel trim	-
hort FT #1	hort-term fuel trim	hort-term fuel compensation is used to maintain the air-fuel ratio at the stoichiometric air-fuel ratio.
Long FT #1	Long-term fuel trim	verall fuel compensation is carried out in the long-term to compensate for a continual deviation of the short-term fuel trim from the central value.
hort FT #	hort-term fuel trim	hort-term fuel compensation is used to maintain the air-fuel ratio at the stoichiometric air-fuel ratio.
Long FT #	ong-term fuel trim	verall fuel compensation is carried out in the long-term to compensate for a continual deviation of the short-term fuel trim from the central value.
Fuel ystem tatus (Bank1)	Fuel system status (for Bank 1)	• (pen Loop): as not yet satisfied the conditions to go to closed loop. • CL (Closed Loop): Using the heated oxygen sensor as feedback for fuel control. • Drive: pen loop due to driving conditions (fuel enrichment). • Fault: pen loop due to a detected system fault. • CLFault: Closed loop but the heated oxygen sensor, which is used for fuel control, is malfunctioning.
Fuel ystem tatus (Bank)	Fuel system status (for Bank)	• (pen Loop): as not yet satisfied the conditions to go to closed loop. • CL (Closed Loop): Using the heated oxygen sensor as feedback for fuel control. • Drive: pen loop due to driving conditions (fuel enrichment). • Fault: pen loop due to a detected system fault. • CLFault: Closed loop but the heated oxygen sensor, which is used for fuel control, is malfunctioning.
FT B1 FT B	Fuel trim at heated oxygen sensor	-
F FT B1	Fuel trim at F sensor	-

F B1	F sensor current	-
F FT B	Fuel trim at F sensor	-
Catalyst Temp (B1) Catalyst Temp (B)	Estimated catalyst temperature (for ensor 1)	-
Catalyst Temp (B1) Catalyst Temp (B)	Estimated catalyst temperature (for ensor)	-
Initial Engine Coolant Temp	Engine coolant temperature at engine start	-
Initial Intake ir Temp	Intake air temperature at engine start	-
Injection Volum (Cylinder1)	Injection volume	-
ir pump pressure (absolute)	ir pump pressure	-
ir ump ulsation ressure	ir pump pulsation pressure	-
ower teering ressure	ower steering pressure sensor	-
CC elay	CC relay status	-
tarter elay	tarter relay status	-
tarter ignal	tarter switch (T W) signal	-
tarter Control	tarter switch status	-
ower teering witch	ower steering switch status	-
ower teering ignal	ower steering signal status	-
Closed Throttle osition W	Closed throttle position switch	-
C ignal	C signal	-
Neutral osition W ignal	ark/Neutral osition ( ) switch signal	-
Electrical Load ignal	Electrical load signal	-
top Light witch	top light switch	-
Immobiliser Communication	Immobiliser communication	-
Fuel Cut Condition	Fuel cut condition	-
Battery Voltage	Battery voltage	-
tmosphere ressure	tmospheric pressure	-
econdary ir Control V	econdary air injection system status	-
CI V	for coustic Control Induction ystem (CI)	-
CT V	C cut status for ctive Test	-
VVT Control tatus (Bank)	VVT control status	-
EV urge V	EV purge V	-
Fuel ump/ peed tatus	Fuel pump/speed status	-
VVT Control tatus (Bank1)	VVT control status	-
TC and TE1	TC and CG (TE1) terminals of DLC3	-
I Test	I test status	-
Engine peed of Cyl #1	Engine speed during No. 1 cylinder fuel cut	-
Engine peed of Cyl #	Engine speed during No. cylinder fuel cut	-
Engine peed of Cyl #3	Engine speed during No. 3 cylinder fuel cut	-
Engine peed of Cyl #4	Engine speed during No. 4 cylinder fuel cut	-
Engine peed of Cyl #5	Engine speed during No. 5 cylinder fuel cut	-
Engine peed of Cyl #6	Engine speed during No. 6 cylinder fuel cut	-
Engine peed of Cyl #	Engine speed during No. cylinder fuel cut	-
Engine peed of Cyl #8	Engine speed during No. 8 cylinder fuel cut	-
VVT im ngle (Bank1)	VVT aim angle	-
VVT Change ngle (Bank1)	VVT change angle	-
VVT CV Duty (Bank1)	VVT CV operation duty	-
VVT im ngle (Bank)	VVT aim angle	-
VVT Change ngle (Bank)	VVT change angle	-
VVT CV Duty (Bank)	VVT CV operation duty	-
Idle Fuel Cut	Fuel cut idle	when the throttle valve is fully closed and the engine speed is more than 3500 rpm.
FC T	Fuel cut during very light load	Fuel cut is being performed under a very light load to prevent the engine combustion from becoming incomplete.
Ignition	Ignition counter	-
Cylinder #1 Misfire Count	Cylinder #1 misfire	nly displayed during idling.

Cylinder # Misfire Count	Cylinder # misfire	nly displayed during idling.
Cylinder #3 Misfire Count	Cylinder #3 misfire	nly displayed during idling.
Cylinder #4 Misfire Count	Cylinder #4 misfire	nly displayed during idling.
Cylinder #5 Misfire Count	Cylinder #5 misfire	nly displayed during idling.
Cylinder #6 Misfire Count	Cylinder #6 misfire	nly displayed during idling.
Cylinder # Misfire Count	Cylinder # misfire	nly displayed during idling.
Cylinder #8 Misfire Count	Cylinder #8 misfire	nly displayed during idling.
lCylinders Misfire Count	ll cylinders misfire	ly displayed during idling.
Multi Cylinders Misfire Count	Multiple cylinder misfire	-
Misfire M	Engine speed when misfire occurred	-
Misfire Load	Engine load when misfire occurred	-
Misfire Margin	Margin to detect engine misfire	-
Engine un Time	cumulated engine running time	-
Time after DTC Cleared	Cumulative time after DTC cleared	-
Distance from DTC Cleared	cumulated distance from DTC cleared	-
Warmup Cycle Cleared DTC	Warm-up cycle after DTC cleared	-

for Preparation Click here

HINT:

Intelligent tester:

Compared to the normal mode, check mode is more sensitive to malfunctions. Therefore, check mode can detect the malfunctions that cannot be detected in normal mode.

NOTICE:

All the stored DTCs and freeze frame data are cleared if: 1) the ECM is changed from normal mode to check mode or vice versa; or 2) the engine switch is turned from on (IG) to on (ACC) or off while in check mode. Before changing modes, always check and note any DTCs and freeze frame data.

CHECK MODE PROCEDURE

a. Check and ensure the following conditions:

   i. Battery positive voltage 11 V or more.

   ii. Throttle valve fully closed.

   iii. Transmission in the P or N position.

   iv. A/C switch off.

b. Turn the engine switch off.

c. Connect the intelligent tester to the DLC3.

d. Turn the engine switch on (IG).

e. Turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / Utility / Check Mode.

g. Switch the ECM from normal mode to check mode.

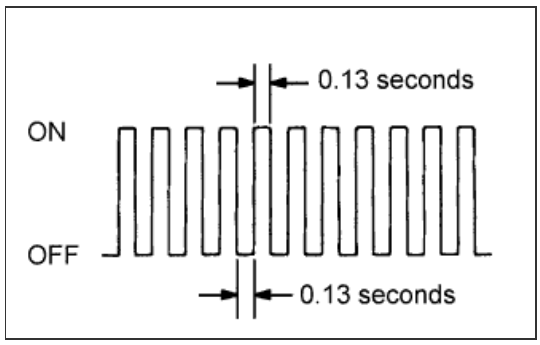
h. Make sure the MIL flashes as shown in the illustration.

i. Start the engine.

j. Make sure the MIL turns off.

k. Simulate the conditions of the malfunction described by the customer.

l. Check the DTCs and freeze frame data using the tester.



for Preparation Click here

If any of the following DTCs are stored, the ECM enters fail-safe mode to allow the vehicle to be driven temporarily.

DTC	Component	Fail-Safe Operation	Fail-Safe Deactivation Condition
P0031, P0032, P0051 and P0052	Air-Fuel Ratio (A/F) Sensor Heater	The ECM turns off the A/F sensor heater.	Engine switch off
P0037, P0038, P0057 and P0058	Heated Oxygen (HO2) Sensor Heater	The ECM turns off the HO2 sensor heater.	Engine switch off
P0102 and P0103	Mass Air Flow (MAF) Meter	The ECM calculates the ignition timing according to the engine speed and throttle valve position.	Pass condition detected
P0110, P0112 and P0113	Intake Air Temperature (IAT) Sensor	The ECM estimates the IAT to be 20°C (68°F).	Pass condition detected
P0115, P0117 and P0118	Engine Coolant Temperature (ECT) Sensor	The ECM estimates the ECT to be 80°C (176°F).	Pass condition detected
P0120, P0121, P0122, P0123, P0220, P0222, P0223, P060 , P0606, P060A, P060D, P060E, P0657, P2102, P2103, P2111, P2112, P2118, P2119 and P2135	Electronic Throttle Control System (ETCS)	The ECM cuts off the throttle actuator current and the throttle valve is returned to 7° throttle position by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing in accordance with the accelerator pedal opening angle to allow the vehicle to continue at minimal speed.*	Pass condition detected and then engine switch turned off
P0327, P0328, P0332 and P0333	Knock Sensor	The ECM sets the ignition timing to maximum retard.	Engine switch off
P0351 to P0358	Igniter	The ECM cuts fuel.	Pass condition detected
P050	Stop ight Switch	The accelerator pedal angle is fixed.	Pass condition detected and then engine switch turned off
P2 0 and P1 1 and/or P1	Secondary Air Injection system	The throttle is restricted (ex. 70 km/h or less).	Pass condition detected
P1 1 and P1	Secondary Air Injection system	The throttle is restricted (ex. 100 km/h or less).	Pass condition detected
P1 1 or P1	Secondary Air Injection system	The throttle is restricted (no problem under normal driving).	Pass condition detected
P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138	Accelerator Pedal Position (APP) Sensor	The APP sensor has 2 sensor circuits: Main and Sub. If either circuit malfunctions, the ECM controls the engine using the other circuit. If both circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.	Pass condition detected and then engine switch turned off
P2 31	Secondary Air Injection System	The throttle is restricted (ex. 100 km/h or less).	Pass condition detected

HINT:

*: The vehicle can be driven slowly when the accelerator pedal is depressed firmly and slowly. If the accelerator pedal is depressed quickly, the vehicle may speed up and slow down erratically.

for Preparation Click here

DATA LIST

HINT:

Using the intelligent tester to read the Data List allows the values or states of switches, sensors, actuators and other items to be read without removing any parts. This non-intrusive inspection can be very useful because intermittent conditions or signals may be discovered before parts or wiring is disturbed. Reading the Data List information early in troubleshooting is one way to save diagnostic time.

NOTICE:

In the table below, the values listed under "Normal Condition" are reference values. Do not depend solely on these reference values when deciding whether a part is faulty or not.

a. Warm up the engine.

b. Turn the engine switch off.

c. Connect the intelligent tester to the DLC3.

d. Turn the engine switch on (IG).

e. Turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data.

g. According to the display on the tester, read the Data List.

Engine and ECT

Tester Display	Measurement Item/Range	Normal Condition	Diagnostic Note
Injector (port)	Injection period of the No. 1 cylinder/ Min.: 0 ms, Max.: 32.64 ms	2.0 to 4.0 ms: idling	-
IGN Advance	Ignition timing advance for No. 1 cylinder/ Min.: -64 deg., Max.: 63.5 deg.	BTDC 5 to 15°: Idling	-
Calculate Load	Calculated load by ECM/ Min.: 0%, Max.: 100%	• 11 to 25%: Idling • 12 to 26%: Running without load (2500 rpm)	-
Vehicle Load	Vehicle load/ Min.: 0%, Max.: 25700%	Actual vehicle load	-
MAF	Air flow rate from Mass Air Flow (MAF) meter/ Min.: 0 g/sec., Max.: 655 g/sec.	4.0 to 8.0 g/sec.: Idling	If the value is approximately 0.0 g/sec.: • The mass air flow meter power source circuit is open or shorted. • The VG circuit is open or shorted. If the value is 160.0 g/sec. or more: • The E2G circuit is open.
Engine Speed	Engine speed/ Min.: 0 rpm, Max.: 16383 rpm	650 to 750 rpm: Idling	-
Vehicle Speed	Vehicle speed/ Min.: 0 km/h, Max.: 255 km/h	Actual vehicle speed	The speed indicated on the speedometer.
Coolant Temp	Engine coolant temperature/ Min.: -40°C, Max.: 140°C	80 to 100°C (176 to 212°F): After warming up	If the value is -40°C (-40°F), the sensor circuit is open. If the value is 140°C (284°F), the sensor circuit is shorted.
Intake Air	Intake air temperature/ Min.: -40°C, Max.:	Equivalent to ambient air temperature	If the value is -40°C (-40°F), the sensor circuit is open. If the value is 140°C (284°F), the sensor circuit is shorted.

	140°C		
2nd Air System Status	Secondary air system status/ ON or OFF	ON: Secondary air system operation	-
Air-Fuel Ratio	Air fuel ratio: Min.: 0, Max.: 1.999	0.8 to 1.2: During idling	-
Purge Density Learn Value	Learning value of purge density/ Min.: -50, Max.: 350	Idling: -40 to 0%	Service data.
Evap Purge Flow	Purge flow/ Min.: 0%, Max.: 102.4%	0 to 100%: Idling	-
EVAP (Purge) VSV	Purge VSV control duty/ Min.: 0%, Max.: 100%	0 to 100%: During idling	The order signal from the ECM.
Knock Correct Learn Value	Correction learning value of knocking/ Min.: -64 CA, Max.: 1984 CA	0 to 22° CA: Driving, 70 km/h (44 mph)	Service data.
Knock Feedback Value	Feedback value of knocking/ Min.: -64 CA, Max.: 1984 CA	-22 to 0° CA: Driving, 70 km/h (44 mph)	Service data.
Clutch Current	Clutch current/ Min.: 0 A, Max.: 2.49 A	-	-
Accelerator Position No.1	Absolute Accelerator Pedal Position (APP) No. 1/ Min.: 0%, Max.: 100%	10 to 22%: accelerator pedal is released 54 to 86%: accelerator pedal is fully depressed	-
Accelerator Position No.2	Absolute APP No. 2/ Min.: 0%, Max.: 100%	12 to 42%: accelerator pedal is released 66 to 98%: accelerator pedal is fully depressed	-
Accelerator Position No.1	APP sensor No. 1 voltage/ Min.: 0 V, Max.: 4.98 V	-	The ETCS freeze data.
Accelerator Position No.2	APP sensor No. 2 voltage/ Min.: 0 V, Max.: 4.98 V	-	The ETCS freeze data.
Accelerator Position No.1	APP sensor No. 1 voltage/ Min.: 0 V, Max.: 5 V	0.5 to 1.1 V: accelerator pedal is released 2.6 to 4.5 V: accelerator pedal is fully depressed	-
Accelerator Position No.2	APP sensor No. 2 voltage/ Min.: 0 V, Max.: 5 V	1.2 to 2.0 V: accelerator pedal is released 3.4 to 5.3 V: accelerator pedal is fully depressed	-
Accelerator Idle Position	Whether or not accelerator pedal position sensor detecting idle/ ON or OFF	ON: Idling	-
Throttle Fully Close Learn	Throttle valve fully closed (learned value)	0.4 to 0.8 V	-
Accel Fully Close #1 (AD)	Accelerator fully closed value No. 1 (AD)/ Min.: 0, Max.: 4.98 V	-	The ETCS service data.
Accel Fully Close Learn #1	Accelerator fully closed learning value No. 1/ Min.: 0, Max.: 124.512	-	The ETCS service data.
	Accelerator fully		

Accel Fully Close Learn #2	closed learning value No. 2/ Min.: 0, Max.: 124.512	-	The ETCS service data.
Fail Safe Drive	Whether or not fail-safe function executed/ ON or OFF	ON: ETCS has failed	-
Fail Safe Drive (Main CPU)	Whether or not fail-safe function executed/ ON or OFF	ON: ETCS has failed	-
ST1	Starter signal/ ON or OFF	ON: Cranking	-
System Guard	System guard/ ON or OFF	-	The ETCS service data.
Open Side Malfunction	Open side malfunction/ ON or OFF	-	The ETCS service data.
Throttle Position	Absolute throttle position sensor/ Min.: 0%, Max.: 100%	• 10 to 24%: Throttle fully closed • 64 to 96%: Throttle fully open	-
Throttle Idle Position	Whether or not throttle position sensor detecting idle/ ON or OFF	ON: Idling	-
Throttle Require Position	Throttle requirement position/ Min.: 0 V, Max.: 5 V	0.5 to 1.0 V: Idling	-
Throttle Sensor Position	Throttle sensor positioning/ Min.: 0%, Max.: 100%	10 to 18%: Idling	The calculated value based on VTA1.
Throttle Sensor Position #2	Throttle sensor positioning #2/ Min.: 0%, Max.: 100%	-	The calculated value based on VTA2.
Throttle Position No.1	Throttle position sensor No. 1 output voltage/ Min.: 0 V, Max.: 4.9 V	-	The ETCS freeze data.
Throttle Position No.2	Throttle position sensor No. 2 output voltage/ Min.: 0 V, Max.: 4.9 V	-	The ETCS freeze data.
Throttle Position No.1	Throttle position No. 1/ Min.: 0 V, Max.: 5 V	• 0.5 to 1.2 V: Throttle fully closed • 3.2 to 4.8 V: Throttle fully open	-
Throttle Position No.2	Throttle position No. 2/ Min.: 0 V, Max.: 5 V	• 2.0 to 2.9 V: Throttle fully closed • 4.6 to 5.5 V: Throttle fully open	-
Throttle Position Command	Throttle position command value/ Min.: 0 V, Max.: 4.98 V	0.5 to 4.8 V	The ETCS service data.
Throttle Sens Open Pos #1	Throttle sensor opener position No. 1/ Min.: 0 V, Max.: 4.98 V	0.6 to 0.9 V	The ETCS service data.

Throttle Sens Open Pos #2	Throttle sensor opener position No. 2/ Min.: 0 V, Max.: 4.98 V	2.2 to 2.6 V	The ETCS service data.
Throttle Sens Open #1(AD)	Throttle sensor opener position No. 1 (AD)/ Min.: 0 V, Max.: 4.98 V	0.6 to 0.9 V	The ETCS service data.
Throttle Motor	Whether or not throttle actuator control permitted/ ON or OFF	ON: Idling	Read the value with the engine switch on (IG) (do not the start engine).
Throttle Motor Current	Throttle actuator current/ Min.: 0 A, Max.: 80 A	0 to 3.0 A: Idling	-
Throttle Motor	Throttle actuator/ Min.: 0%, Max.: 100%	0.5 to 40%: Idling	-
Throttle Motor Current	Throttle actuator current/ Min.: 0 A, Max.: 19.92 A	0 to 3.0 A: Idling	-
Throttle Motor Open Duty	Throttle actuator opening duty ratio/ Min.: 0%, Max.: 100%	0 to 40%: During idling	When the accelerator pedal is depressed, the duty ratio increases.
Throttle Motor Close Duty	Throttle actuator closed duty ratio/ Min.: 0%, Max.: 100%	0 to 40%: During idling	When the accelerator pedal is released quickly, the duty ratio increases.
Throttle Motor Duty (Open)	Throttle actuator duty ratio (open)/ Min.: 0%, Max.: 100%	-	The ETCS service data.
Throttle Motor Duty (Close)	Throttle actuator duty ratio (close)/ Min.: 0%, Max.: 100%	-	The ETCS service data.
O2S B1 S2	Heated oxygen sensor output voltage for bank 1 sensor 2/ Min.: 0 V, Max.: 1.275 V	0.1 to 0.9 V: Driving, 70 km/h (44 mph)	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the voltage output of the sensor.
O2S B2 S2	Heated oxygen sensor output voltage for bank 2 sensor 2/ Min.: 0 V, Max.: 1.275 V	0.1 to 0.9 V: Driving, 70 km/h (44 mph)	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the voltage output of the sensor.
AFS B1 S1	Air fuel ratio sensor output voltage for bank 1 sensor 1/ Min.: 0 V, Max.: 7.999 V	2.8 to 3.8 V: Idling	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the voltage output of the sensor.
AFS B2 S1	Air fuel ratio sensor output voltage for bank 2 sensor 1/ Min.: 0 V, Max.: 7.999 V	2.8 to 3.8 V: Idling	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the voltage output of the sensor.
AFS B2 S1	Air fuel ratio sensor current for bank 2 sensor 1/ Min.: 128 mA, Max.: 127.99 mA	-0.5 to 0.5 mA: Idling	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the output current of the sensor.
	Total fuel trim of bank 1 Average value for		

Total FT #1	fuel trim system of bank 1/ Min.: -0.5 V, Max.: 1496 V	-0.2 to 0.2 V: Idling	-
Total FT #2	Total fuel trim of bank 2 Average value for fuel trim system of bank 2/ Min.: -0.5 V, Max.: 1496 V	-0.2 to 0.2 V: Idling	-
Short FT #1	Short-term fuel trim of bank 1/ Min.: -100%, Max.: 99.2%	-20 to +20%	This item refers to the short-term fuel compensation used to maintain the air-fuel ratio at the stoichiometric air-fuel ratio.
Long FT #1	Long-term fuel trim of bank 1/ Min.: -100%, Max.: 99.2%	-20 to +20%	This item refers to the overall fuel compensation carried out in long-term to compensate a continual deviation of the short-term fuel trim from the central value.
Short FT #2	Short-term fuel trim of bank 2/ Min.: -100%, Max.: 99.2%	-20 to +20%	This item refers to the short-term fuel compensation used to maintain the air-fuel ratio at the stoichiometric air-fuel ratio.
Long FT #2	Long-term fuel trim of bank 2/ Min.: -100%, Max.: 99.2%	-20 to +20%	This item refers to the overall fuel compensation carried out in long-term to compensate a continual deviation of the short-term fuel trim from the central value.
Fuel System Status (Bank1)	Fuel system status (bank 1)/ OL, CL, OL Drive, OL Fault or CL Fault	CL: Idling after warming up	• OL (Open Loop): Has not yet satisfied the conditions to go to closed loop. • CL (Closed Loop): Using the heated oxygen sensor as feedback for fuel control. • OLDrive: Open loop due to driving conditions (fuel enrichment). • OLFault: Open loop due to a detected system fault. • CLFault: Closed loop but the heated oxygen sensor, which is used for fuel control, is malfunctioning.
Fuel System Status (Bank2)	Fuel system status (bank 2)/ OL, CL, OL Drive, OL Fault or CL Fault	CL: Idling after warming up	• OL (Open Loop): Has not yet satisfied the conditions to go to closed loop. • CL (Closed Loop): Using the heated oxygen sensor as feedback for fuel control. • OLDrive: Open loop due to driving conditions (fuel enrichment). • OLFault: Open loop due to a detected system fault. • CLFault: Closed loop but the heated oxygen sensor, which is used for fuel control, is malfunctioning.
O2 FT B1 S2	Short-term fuel trim associated with the bank 1 sensor 2/ Min.: -100%, Max.: 99.2%	-20 to +20%	The same as Short FT #1.
O2 FT B2 S2	Short-term fuel trim associated with the bank 2 sensor 2/ Min.: -100%, Max.: 99.2%	-20 to +20%	The same as Short FT #1.
AF FT B1 S1	Short-term fuel trim associated with the bank 1 sensor 1/ Min.: 0, Max.: 1.999	• Value less than 1 (0.000 to 0.999) = Rich • Value equal to 1 = Stoichiometric air-fuel ratio • Value more than 1 (1.001 to 1.999) = Lean	-
AFS B1 S1	Air fuel ratio sensor current bank 1 sensor 1/ Min.: 128 mA, Max.:	-0.5 to 0.5 mA: Idling	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the output current of the sensor.

AF FT B2 S1	127.99 mA Short-term fuel trim associated with the bank 2 sensor 1/ Min.: 0, Max.: 1.999	• Value less than 1 (0.000 to 0.999) = Rich • Value equal to 1 = Stoichiometric air-fuel ratio • Value more than 1 (1.001 to 1.999) = Lean	-
Catalyst Temp (B1 S1)	Catalyst temperature (bank 1, sensor 1)/ Min.: -40°C, Max.: 6513.5°C	-	-
Catalyst Temp (B2 S1)	Catalyst temperature (bank 2, sensor 1)/ Min.: -40°C, Max.: 6513.5°C	-	-
Catalyst Temp (B1 S2)	Catalyst temperature (bank 1, sensor 2)/ Min.: -40°C, Max.: 6513.5°C	-	-
Catalyst Temp (B2 S2)	Catalyst temperature (bank 2, sensor 2)/ Min.: -40°C, Max.: 6513.5°C	-	-
Initial Engine Coolant Temp	Initial engine coolant temperature/ Min.: -40°C, Max.: 140°C	Close to ambient air temperature	Service data.
Initial Intake Air Temp	Initial intake air temperature/ Min.: -40°C, Max.: 140°C	Close to ambient air temperature	Service data.
Injection Volum (Cylinder1)	Injection volume (cylinder 1)/ Min.: 0 ml, Max.: 2.048 ml	0 to 0.5 ml	The quantity of fuel injection volume for 10 times.
Air pump pressure (absolute)	Air pump pressure (absolute)/ Min.: 0 kPa, Max.: 320 kPa	Atmospheric pressure +1 kPa or more: Air pump on, air switching valve open Close to atmospheric pressure: Air pump off, air switching valve close	Refer to DTC P2431 (Click here).
Air Pump Pulsation Pressure	Air pump pulsation pressure/ Min.: 0 kPa, Max.: 639.9 kPa	-	The cumulative pulsation pressure calculated by the ECM.
Power Steering Pressure	Power steering oil pressure/ Min.: -1.897 MPa, Max.: 12.799 MPa	-	-
ACC Relay	Acc relay status/ ON or OFF	ON: Cranking	-
Starter Relay	Starter relay status/ ON or OFF	ON: Cranking	-
Starter Signal	Starter signal/ ON or OFF	ON: Cranking	-
Starter Control	Starter switch status/ ON or OFF	ON: Cranking	-
Power Steering Switch	Power steering switch status/ ON or OFF	ON: Power steering operation	-
Power Steering Signal	Power steering signal (history)/ ON or OFF	ON: When steering wheel first turned after battery terminals connected	This signal status is usually ON until the cables are disconnected from the battery terminals.
		• ON: Throttle	

Closed Throttle Position SW	Closed throttle position switch/ ON or OFF	fully closed • OFF: Throttle open	-
A/C Signal	A/C switch status/ ON or OFF	ON: A/C ON	-
Neutral Position SW Signal	PNP switch status/ ON or OFF	ON: P or N position	-
Electrical Load Signal	Electrical load signal/ ON or OFF	ON: Headlights or defogger turned on	-
Stop Light Switch	Stop light switch/ ON or OFF	ON: Brake pedal depressed	-
Immobiliser Communication	Immobiliser communication/ ON or OFF	ON: Normal	-
Fuel Cut Condition	Fuel cut condition/ ON or OFF	ON: Fuel cut operating	-
ETCS Actuator Power	Whether or not electric throttle control system power inputted/ ON or OFF	ON: Idling	-
+BM Voltage	+BM voltage/ Min.: 0, Max.: 19.92	10 to 15 V: Idling	The ETCS service data.
Battery Voltage	Battery voltage/ Min.: 0 V, Max.: 65535 V	11 to 14 V: Idling	-
Actuator Power Supply	Actuator power supply/ ON or OFF	ON: Idling	The ETCS service data.
Atmosphere Pressure	Atmospheric pressure/ Min.: 0 kPa, Max.: 150 kPa	Equivalent to atmospheric pressure (absolute pressure)	-
Secondary Air Control VSV	Secondary air injection system status	ON: Secondary air injection system operation	-
ACIS VSV	VSV status for ACIS control/ ON or OFF	-	The Active Test support data.
ACT VSV	A/C cut status for Active Test/ ON or OFF	-	The Active Test support data.
VVT Control Status (Bank2)	VVT control status (bank 2)/ ON or OFF	-	The Active Test support data.
EVAP Purge VSV	VSV status for EVAP control/ ON or OFF	-	The Active Test support data.
Fuel Pump/Speed Status	Fuel pump/speed status/ ON or OFF	-	The Active Test support data.
VVT Control Status (Bank1)	Variable valve timing (VVT) control status (bank 1)/ ON or OFF	-	The Active Test support data.
TC and TE1	TC and TE1 terminal of DLC3/ ON or OFF	-	The Active Test support data.
AI Test	AI Test status/ READY or NOT RDY	-	The Active Test support data.
Engine Speed of Cyl #1	Engine speed during No. 1 cylinder fuel cut/ Min.: 0 rpm, Max.: 25600 rpm	-	Output only when Cylinder #1 injector fuel cut is performed using Active Test
Engine Speed	Engine speed during No. 2 cylinder fuel cut/	-	Output only when Control the Cylinder #2 fuel cut is performed

of Cyl #2	Min.: 0 rpm, Max.: 25600 rpm		using Active Test
Engine Speed of Cyl #3	Engine speed during No. 3 cylinder fuel cut/ Min.: 0 rpm, Max.: 25600 rpm	-	Output only when Control the Cylinder #3 fuel cut is performed using Active Test
Engine Speed of Cyl #4	Engine speed during No. 4 cylinder fuel cut/ Min.: 0 rpm, Max.: 25600 rpm	-	Output only when Control the Cylinder #4 fuel cut is performed using Active Test
Engine Speed of Cyl #5	Engine speed during No. 5 cylinder fuel cut/ Min.: 0 rpm, Max.: 25600 rpm	-	Output only when Control the Cylinder #5 fuel cut is performed using Active Test
Engine Speed of Cyl #6	Engine speed during No. 6 cylinder fuel cut/ Min.: 0 rpm, Max.: 25600 rpm	-	Output only when Control the Cylinder #6 fuel cut is performed using Active Test
Engine Speed of Cyl #7	Engine speed during No. 7 cylinder fuel cut/ Min.: 0 rpm, Max.: 25600 rpm	-	Output only when Control the Cylinder #7 fuel cut is performed using Active Test
Engine Speed of Cyl #8	Engine speed during No. 8 cylinder fuel cut/ Min.: 0 rpm, Max.: 25600 rpm	-	Output only when Control the Cylinder #8 fuel cut is performed using Active Test
VVT Aim Angle (Bank1)*1	VVT aim angle (bank 1)/ Min.: 0%, Max.: 100%	0%: Idling	The VVT duty signal value during the intrusive operation.
VVT Change Angle (Bank1)*1	VVT change angle (bank 1)/ Min.: 0° FR, Max.: 60° FR	0 to 5° FR: Idling	The displacement angle during the intrusive operation.
VVT OCV Duty (Bank1)*1	VVT OCV operation duty (bank 1)/ Min.: 0%, Max.: 100%	0%: Idling	The requested duty value for the intrusive operation.
VVT Aim Angle (Bank2)*1	VVT aim angle (bank 2)/ Min.: 0%, Max.: 100%	0%: Idling	The VVT duty signal value during the intrusive operation.
VVT Change Angle (Bank2)*1	VVT change angle (bank 2)/ Min.: 0° FR, Max.: 60° FR	0 to 5° FR: Idling	The displacement angle during the intrusive operation.
VVT OCV Duty (Bank2)*1	VVT OCV operation duty (bank 2)/ Min.: 0%, Max.: 100%	0%: Idling	The requested duty value for the intrusive operation.
Idle Fuel Cut	Fuel cut idle/ ON or OFF	ON: Fuel cut operation	Idle Fuel Cut is "ON" when the throttle valve is fully closed and the engine speed is more than 2800 rpm.
FC TAU	Fuel cut TAU: Fuel cut during very light load/ ON or OFF	ON: Fuel cut operation	The fuel cut being performed under a very light load to prevent the engine combustion from becoming incomplete.
Ignition	Ignition counter/ Min.: 0, Max.: 800	0 to 800	-
Cylinder #1 Misfire Count to Cylinder #8 Misfire Count	Misfire count of the cylinder 1 to 8/ Min.: 0, Max.: 255	0%	This item is displayed only when idling the engine.
All Cylinders	All cylinders misfire		

Misfire Count	count/ Min.: 0, Max.: 255	0 to 35	-
Multi Cylinders Misfire Count	Multiple cylinder misfire count/ Min.: 0 Max.:65535	0 to 65535	-
Misfire RPM	Engine speed for first misfire range/ Min.: 0 rpm, Max.: 6375 rpm	0 rpm: Misfire 0	-
Misfire Load	Engine load for first misfire range/ Min.: 0 g/rev, Max.: 3.98 g/rev	0 g/rev: Misfire 0	-
Misfire Margin	Misfire monitoring/ Min.: -100%, Max.: 99.22%	-100 to 99.2%	The misfire detecting margin.
# Codes	Number of codes/ Min.: 0, Max.: 255	-	The number of stored DTCs.
Check Mode	Check mode/ ON or OFF	ON: Check mode ON	Refer to the Check Mode Procedure (Click here).
AS Test	Check mode result for secondary air injection system/ 0: Compl, 1: Incmpl	-	-
Misfire Test	Check mode result for misfire monitor/ 0: Compl, 1: Incmpl	-	-
OXS2 Test	Check mode result for heated oxygen sensor (bank 2)/ 0: Compl, 1: Incmpl	-	-
OXS1 Test	Check mode result for heated oxygen sensor (bank 1)/ 0: Compl, 1: Incmpl	-	-
A/F Test Results (Bank2)	Check mode result for air fuel ratio sensor (bank 2)/ 0: Compl, 1: Incmpl	-	-
A/F Test Results (Bank1)	Check mode result for air fuel ratio sensor (bank 1)/ 0: Compl, 1: Incmpl	-	-
MIL	MIL status/ ON or OFF	ON: MIL on	-
MIL ON Run Distance	MIL ON run distance/ Min.: 0 km, Max.: 65535 km	Distance after DTC stored	-
Running Time from MIL ON	Running time from MIL on/ Min.: 0 minute, Max.: 65535 minutes	Equivalent to running time after MIL is on	-
Engine Run Time	Engine run time/ Min.: 0 seconds, Max.: 65535 seconds	Time after engine start	Service data.
Time after DTC Cleared	Time after DTC cleared/ Min.: 0 minutes, Max.: 65535 minutes	Equivalent to time after DTCs are cleared	-
Distance from DTC Cleared	Distance after DTC cleared/ Min.: 0 km, Max.: 65535 km	Equivalent to drive distance after DTCs are cleared	-
Warmup Cycle Cleard DTC	Warm-up cycle after DTC cleared/ Min.: 0, Max.: 255	-	The number of warm-up cycles after the DTC is cleared.
OBD Requirements	OBD requirement	OBD2	-

Number of Emission DTC	Emission related DTCs	-	The number of emission related DTCs.
Complete Parts Monitor	Comprehensive component monitor/ Not Avl or Avail	-	-
Fuel System Monitor	Fuel system monitor/ Not Avl or Avail	-	-
Misfire Monitor	Misfire monitor/ Not Avl or Avail	-	-
EGR Monitor	EGR monitor/ Not Avl or Avail	-	-
EGR Monitor	EGR monitor/ Compl or Incmpl	-	-
O2S(A/FS) Heater Monitor	O2S (A/FS) heater monitor/ Not Avl or Avail	-	-
O2S(A/FS) Heater Monitor	O2S (A/FS) heater monitor/ Compl or Incmpl	-	-
O2S(A/FS) Monitor	O2S (A/FS) monitor/ Not Avl or Avail	-	-
O2S(A/FS) Monitor	O2S (A/FS) monitor/ Compl or Incmpl	-	-
2nd Air Monitor	2nd air monitor/ Not Avl or Avail	-	-
2nd AIR MON	2nd air monitor/ Compl or Incmpl	-	-
EVAP Monitor	EVAP monitor/ Not Avl or Avail	-	-
EVAP Monitor	EVAP monitor/ Compl or Incmpl	-	-
Catalyst Monitor	Catalyst monitor/ Not Avl or Avail	-	-
Catalyst Monitor	Catalyst monitor/ Compl or Incmpl	-	-
Model Code	Model code	-	Identifying the model code: UZJ2##
Engine Type	Engine type	-	Identifying the engine type: 2UZFE
Cylinder Number	Cylinder number/ Min.: 0, Max.: 255	-	Identifying the cylinder number: 8
Transmission Type	Transmission type	-	Identifying the transmission type: ECT (5AT)
Destination	Destination	-	Identifying the destination: W
Model Year	Model year/ Min.: 0, Max.: 255	-	Identifying the model year: 200#
System Identification	System identification	-	Identifying the engine system: Gasoline (gasoline engine)

HINT:

- **Normal Condition: If no conditions are specifically stated for "idling", the shift lever is in N or P, and the A/C switch is off and all accessory switches are off.**
- ***1: Data List values are only displayed when performing the following Active Tests: Control the VVT Linear ank , Control the VVT Linear ank 2 . For other Active Tests, the Data List value will be .**

ACTIVE TEST

HINT:

Using the intelligent tester to perform Active Tests allows relays, VSVs, actuators and other items to be operated without removing any parts. This non-intrusive functional inspection can be very useful because intermittent operation may be discovered before parts or wiring is disturbed. Performing Active Tests early in troubleshooting is one way to save diagnostic time. Data List information can be displayed while performing Active Tests.

a. Warm up the engine.

b. Turn the engine switch off.

c. Connect the intelligent tester to the DLC3.

d. Turn the engine switch on (IG).

e. Turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / Active Test.

g. According to the display on the tester, perform the Active Test.

Engine and ECT

Tester Display	Test Part	Control Range	Diagnostic Note
Control the Injection Volume	Change injection volume	Between -12% and 25%	• All the injectors are tested at the same time. • Perform the test at less than 3000 rpm. • The injection volume can be changed in 1% graduations within the control range.
Control the Injection Volume for A/F Sensor	Change injection volume	Lower by -12.5% or increase 25%	• Perform the test at less than 3000 rpm. • Control the Injection Volume for A/F Sensor enables the checking and graphing of the A/F (Air-Fuel ratio) sensor voltage outputs. • To conduct the test, enter the following menus: Active Test / Control the Injection Volume for A/F Sensor / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S.
Activate the VSV for Secondary Air Control	Activate the secondary air system	ON/OFF	• Do not perform the test for 5 seconds or more. • After the test, do not perform the test again for 30 seconds.
Activate the VSV for Intake Control	Activate VSV for intake control	ON/OFF	-
Activate the VSV for Evap Control	Activate purge VSV control	ON/OFF	-
Control the A/C Cut Signal	Control A/C cut signal	ON/OFF	-
Control the Fuel Pump / Speed	Activate fuel pump	ON/OFF	-
Connect the TC and TE1	Turn on and off TC and TE1 connection	ON/OFF	• ON: TC and TE1 are connected. • OFF: TC and TE1 are disconnected.
Control the Idle Fuel Cut Prohibit	Prohibit idling fuel cut control	ON/OFF	-
Activate the Starter Relay	Activate the starter relay	ON/OFF	The engine is stopped.
Activate the ACC Cut Relay	Activate the ACC CUT relay	ON/OFF	The engine is stopped.
Control the ETCS Open/Close Slow Speed	Throttle actuator	ON: throttle valve opens slowly	This test is possible when the following conditions are met: • The engine switch is on (IG). • The engine does not start. • The accelerator pedal is fully depressed (APP: 58 degrees or more).
Control the ETCS Open/Close Fast Speed	Throttle actuator	ON: throttle valve opens fast	The same as above.
Control the VVT Linear (Bank1)	Control Variable Valve Timing (VVT) [bank 1]	-128 to 127%: This value added to present OCV control duty 100%: Maximum advance -100%: Maximum retard	• The engine stalls or idles roughly when the VVT actuator is operated by 100%. • The test is possible during idle.
Control the VVT System (Bank1)	Turn on and off Camshaft Oil Control Valve (OCV)	ON/OFF	• The engine stalls or idles roughly when the OCV is turned on. • The engine runs or idles normally when the OCV is off.
Control the VVT	Control Variable Valve Timing	-128 to 127%: This value added to present OCV control duty 100%: Maximum	• The engine stalls or idles roughly when the VVT actuator is operated by 100%.

Linear (Bank2)	(VVT) [bank 2]	advance -100%: Maximum retard	• The test is possible during idle.
Control the VVT System (Bank2)	Turn on and off Camshaft Oil Control Valve (OCV)	ON/OFF	• The engine stalls or idles roughly when the OCV is turned on. • The engine runs or idles normally when the OCV is off.
Control the Cylinder#1 Fuel Cut	Cylinder #1 injector fuel cut	ON/OFF	The test is possible while the vehicle is stopped and the engine is idling.*
Control the Cylinder#2 Fuel Cut	Cylinder #2 injector fuel cut	ON/OFF	The test is possible while the vehicle is stopped and the engine is idling.*
Control the Cylinder#3 Fuel Cut	Cylinder #3 injector fuel cut	ON/OFF	The test is possible while the vehicle is stopped and the engine is idling.*
Control the Cylinder#4 Fuel Cut	Cylinder #4 injector fuel cut	ON/OFF	The test is possible while the vehicle is stopped and the engine is idling.*
Control the Cylinder#5 Fuel Cut	Cylinder #5 injector fuel cut	ON/OFF	The test is possible while the vehicle is stopped and the engine is idling.*
Control the Cylinder#6 Fuel Cut	Cylinder #6 injector fuel cut	ON/OFF	The test is possible while the vehicle is stopped and the engine is idling.*
Control the Cylinder#7 Fuel Cut	Cylinder #7 injector fuel cut	ON/OFF	The test is possible while the vehicle is stopped and the engine is idling.*
Control the Cylinder#8 Fuel Cut	Cylinder #8 injector fuel cut	ON/OFF	The test is possible while the vehicle is stopped and the engine is idling.*
Control the All Cylinders Fuel Cut	All cylinder fuel cut	ON/OFF	The test is possible while the vehicle is stopped and the engine is idling.*
Check the Cylinder Compression*1	Check the cylinder compression pressure	ON/OFF	The fuel injection and ignition stop in all cylinders.

NOTICE:

*1: If the display of the Prohibit the Catalyst OT Misfire prevent F/C item of the Data List is Not Avl, perform this Active Test with the vehicle stopped and the engine idling. If the display of the Prohibit the Catalyst OT Misfire prevent F/C item of the Data List is Avail, perform this Active Test as described below.

1. **Stop the engine and turn the engine switch on I to turn Control the Cylinder Fuel Cut to Control the Cylinder Fuel Cut ON.**
2. **Start the engine.**

HINT:

*: When cranking the engine, the Active Test measures the speed of each cylinder.

In this Active Test, the fuel of all cylinders is cut, and cranking occurs for approximately 10 seconds. At this time, the speed of each cylinder is measured. If the speed of one cylinder is higher than the other cylinders, the compression pressure of that cylinder is determined to be lower than the other cylinders.

1. **Warm up the engine.**
2. **Turn the engine switch off.**
3. **Connect the intelligent tester to the DLC .**
4. **Turn the engine switch on I and turn the intelligent tester on.**
5. **Enter the following menus: Powertrain / Engine and ECT / Active Test / Check the Cylinder Compression.**

HINT:

To display the entire Data List, press the pull down menu button next to Primary. Then select Compression.

.While the engine is not running, press the RI HT or LEFT button to change the Check the Cylinder Compression to ON.

HINT:

After performing the above procedure, the Active Test Check the Cylinder Compression will start. Fuel injection for all cylinders is prohibited, and each cylinder engine speed measurement will enter standby.

. Bly open the throttle.

8. **Crank the engine for about seconds.**

. **Monitor the engine speed Engine Speed of Cyl to displayed on the intelligent tester.**

HINT:

At first, the intelligent tester display will show each cylinder engine speed measurement to be extremely high. After approximately 10 seconds of engine cranking, each cylinder engine speed measurement will change to the actual engine speed.

NOTICE:

- **When the Check the Cylinder Compression test is OFF and the engine is cranked, the engine will start.**
- **If the Check the Cylinder Compression test needs to be performed after it is turned on and performed once, press E it to return to the Active Test menu screen. Then perform the Check the Cylinder Compression test again.**
- **se a lly charged battery.**

SYSTEM CHEC

HINT:

Performing a System Check enables the system, which consists of multiple actuators, to be operated without removing any parts. In addition, it can show whether or not any DTCs are stored, and can detect potential malfunctions in the system. The System Check can be performed with the intelligent tester.

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Utility.

e. Perform the System Check by referring to the table below.

Tester Display	Test Part	Control Range	Diagnostic Notes
Secondary Air Injection Check (Automatic Mode)	Perform secondary air injection system operation automatically	With warm engine, engine switch turned off once	• If no DTCs in Pending after performing this test, system functioning normally • Refer to inspection procedure for secondary air injection system DTCs • When performing Air Injection Check operation after battery cable has been reconnected, wait for 7 minutes with engine switch turned on (IG) or engine running • Turn engine switch off when System Check finished
Secondary Air Injection Check (Manual Mode)	Perform 8 operations in order to operate air injection system monitor manually	With warm engine, engine switch turned off once	• Used to detect malfunctioning parts • Refer to inspection procedure for secondary air injection system DTCs • When performing Air Injection Check operation after battery cable has been reconnected, wait for 7 minutes with engine switch turned on (IG) or engine running • Turn engine switch off when System

			Check finishes

for Preparation Click here

HINT:

Parameters listed in the chart may be different than your readings depending on the type of instrument and other factors.

If any DTCs are output during a check mode DTC check, check the trouble area for the DTCs listed in the table below. For details of each DTC, refer to the "See page" below.

SFI SYSTEM

DTC Code	Detection Item	Trouble Areas	MIL	Memory	See page
P0010	Camshaft Position "A" Actuator Circuit (Bank 1)	- Open or short in Camshaft Oil Control Valve (OCV) (for intake side of bank 1) circuit - OCV (for intake side of bank 1) - ECM	Comes on	DTC stored	Click here
P0011	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)	- Valve timing - Camshaft oil control valve (OCV) for intake side - OCV filter - Intake camshaft timing tube (for Bank 1) - ECM	Comes on (Euro-OBD) Does not come on (M-OBD)	DTC stored	Click here
P0012	Camshaft Position "A" - Timing Over-Retarded (Bank 1)	- Valve timing - Camshaft oil control valve (OCV) for intake side - OCV filter - Intake camshaft timing tube (for Bank 1) - ECM	Comes on (Euro-OBD) Does not come on (M-OBD)	DTC stored	Click here
P0016	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)	- Mechanical system (Timing belt has umped tooth or belt stretched) - Oil control valve - Camshaft timing tube - ECM	Comes on (Euro-OBD) Does not come on (M-OBD)	DTC stored	Click here
P0018	Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor A)	(Timing belt has umped tooth or belt stretched) - Oil control valve - Camshaft timing tube - ECM	Comes on (Euro-OBD) Does not come on (M-OBD)	DTC stored	Click here
P0020	Camshaft Position "A" Actuator Circuit (Bank 2)	- Open or short in Camshaft Oil Control Valve (OCV) (for intake side of bank 2) circuit - OCV (for intake side of bank 2) - ECM	Comes on	DTC stored	Click here
P0021	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)	- Valve timing - Camshaft oil control valve (OCV) for intake side - OCV filter - Intake camshaft timing tube (for Bank 2) - ECM	Comes on (Euro-OBD) Does not come on (M-OBD)	DTC stored	Click here
P0022	Camshaft Position "A" - Timing Over-Retarded (Bank 2)	- Valve timing - Camshaft oil control valve (OCV) for intake side - OCV filter - Intake camshaft timing tube (for Bank 2) - ECM	Comes on (Euro-OBD) Does not come on (M-OBD)	DTC stored	Click here
P0031	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)	- Open in Air-Fuel Ratio (A/F) sensor heater circuit - A/F sensor heater (for sensor 1) - Integration relay - ECM	Comes on	DTC stored	Click here
P0032	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)	- Short in A/F sensor heater circuit - A/F sensor heater (for sensor 1) - Integration relay - ECM	Comes on	DTC stored	Click here
P0037	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)	- Open in HO2 sensor heater circuit - HO2 sensor heater (for sensor 2) - Integration relay (EFI) - ECM	Comes on	DTC stored	Click here
P0038	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)	- Short in HO2 sensor heater circuit - HO2 sensor heater (for sensor 2) - Integration relay (EFI) - ECM	Comes on	DTC stored	Click here

P0051	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)	- Open in Air-Fuel Ratio (A/F) sensor heater circuit - A/F sensor heater (for sensor 1) - Integration relay - ECM	Comes on	DTC stored	Click here
P0052	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)	- Short in A/F sensor heater circuit - A/F sensor heater (for sensor 1) - Integration relay - ECM	Comes on	DTC stored	Click here
P0057	Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)	- Open in HO2 sensor heater circuit - HO2 sensor heater (for sensor 2) - Integration relay (EFI) - ECM	Comes on	DTC stored	Click here
P0058	Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)	- Short in HO2 sensor heater circuit - HO2 sensor heater (for sensor 2) - Integration relay (EFI) - ECM	Comes on	DTC stored	Click here
P0102	Mass or Volume Air Flow Circuit Low Input	- Open or short in Mass Air Flow (MAF) meter circuit - MAF meter - ECM	Comes on	DTC stored	Click here
P0103	Mass or Volume Air Flow Circuit High Input	- Open or short in Mass Air Flow (MAF) meter circuit - MAF meter - ECM	Comes on	DTC stored	Click here
P0110	Intake Air Temperature Circuit Malfunction	- Open or short in Intake Air Temperature (IAT) sensor circuit - IAT sensor (built into MAF meter) - ECM	Comes on	DTC stored	Click here
P0112	Intake Air Temperature Circuit Low Input	- Short in Intake Air Temperature (IAT) sensor circuit - IAT sensor (built into MAF meter) - ECM	Comes on	DTC stored	Click here
P0113	Intake Air Temperature Circuit High Input	- Open in Intake Air Temperature (IAT) sensor circuit - IAT sensor (built into MAF meter) - ECM	Comes on	DTC stored	Click here
P0115	Engine Coolant Temperature Circuit Malfunction	- Open or short in Engine Coolant Temperature (ECT) sensor circuit - ECT sensor - ECM	Comes on	DTC stored	Click here
P0116	Engine Coolant Temperature Circuit Range / Performance Problem	- Thermostat - ECT sensor	Comes on	DTC stored	Click here
P0117	Engine Coolant Temperature Circuit Low Input	- Short in Engine Coolant Temperature (ECT) sensor circuit - ECT sensor - ECM	Comes on	DTC stored	Click here
P0118	Engine Coolant Temperature Circuit High Input	- Open in Engine Coolant Temperature (ECT) sensor circuit - ECT sensor - ECM	Comes on	DTC stored	Click here
P0120	Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction	- Throttle Position (TP) sensor (built into throttle body) - ECM	Comes on	DTC stored	Click here
P0121	Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem	TP sensor (built into throttle body)	Comes on	DTC stored	Click here
P0122	Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input	- TP sensor (built into throttle body) - Short in VTA1 circuit - Open in VC circui - ECM	Comes on	DTC stored	Click here
P0123	Throttle / Pedal Position Sensor / Switch "A" Circuit High Input	- TP sensor (built into throttle body) - Open in VTA1 circuit - Open in E2 circuit - Short between VC and VTA1 circuits - ECM	Comes on	DTC stored	Click here
P0136	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)	- Open or short in HO2 sensor (for bank 1) circuit - HO2 sensor (for bank 1) - HO2 sensor heater (for bank 1) - Air-fuel Ratio (A/F) sensor (for bank 1) - Integration relay - as leakage from exhaust system	Comes on	DTC stored	Click here

P0137	Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)	- Open in HO2 sensor (for bank 1) circuit - HO2 sensor (for bank 1) - HO2 sensor heater (for bank 1) - Integration relay - as leakage from exhaust system	Comes on	DTC stored	Click here
P0138	Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)	- Short in HO2 sensor (for bank 1) circuit - HO2 sensor (for bank 1) - ECM internal circuit malfunction - Air-Fuel ratio (A/F) sensor (for bank 1)	Comes on	DTC stored	Click here
P0156	Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)	- Open or short in HO2 sensor (for bank 2) circuit - HO2 sensor (for bank 2) - HO2 sensor heater (for bank 2) - Air-fuel Ratio (A/F) sensor (for bank 2) - Integration relay - as leakage from exhaust system	Comes on	DTC stored	Click here
P0157	Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)	- Open in HO2 sensor (for bank 2) circuit - HO2 sensor (for bank 2) - HO2 sensor heater (for bank 2) - Integration relay - as leakage from exhaust system	Comes on	DTC stored	Click here
P0158	Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)	- Short in HO2 sensor (for bank 2) circuit - HO2 sensor (for bank 2) - ECM internal circuit malfunction - Air-Fuel ratio (A/F) sensor (for bank 2)	Comes on	DTC stored	Click here
P0171	System Too Lean (Bank 1)	- Air induction system - In ector blockage - Mass Air Flow (MAF) meter - Engine Coolant Temperature (ECT) sensor - Fuel pressure - as leakage from exhaust system - Open or short in Air-Fuel Ratio (A/F) sensor (for sensor 1) circuit - A/F sensor (for sensor 1) - A/F sensor heater (for sensor 1) - Integration relay - A/F sensor heater and integration relay circuits - PCV valve and hose - PCV hose connections - ECM	Comes on	DTC stored	Click here
P0172	System Too Rich (Bank 1)	- In ector leakage or blockage - MAF meter - ECT sensor - Ignition system - Fuel pressure - as leakage from exhaust system - Open or short in A/F sensor (for sensor 1) circuit - A/F sensor (for sensor 1) - A/F sensor heater (for sensor 1) - Integration relay - A/F sensor heater and integration relay circuits - ECM	Comes on	DTC stored	Click here
P0174	System Too Lean (Bank 2)	- Air induction system - In ector blockage - Mass Air Flow (MAF) meter - Engine Coolant Temperature (ECT) sensor - Fuel pressure - as leakage from exhaust system - Open or short in Air-Fuel Ratio (A/F) sensor (for sensor 1) circuit - A/F sensor (for sensor 1) - A/F sensor heater (for sensor 1) - Integration relay - A/F sensor heater and integration relay circuits - PCV valve and hose - PCV hose connections - ECM	Comes on	DTC stored	Click here
P0175	System Too Rich (Bank 2)	- In ector leakage or blockage - MAF meter - ECT sensor - Ignition system - Fuel pressure - as leakage from exhaust system - Open or short in A/F sensor (for sensor 1) circuit - A/F sensor (for sensor 1)	Comes on	DTC stored	Click here

		- A/F sensor heater (for sensor 1) - Integration relay - A/F sensor heater and integration relay circuits - ECM			
P0220	Throttle / Pedal Position Sensor / Switch "B" Circuit	- TP sensor (built into throttle body) - ECM	Comes on	DTC stored	Click here
P0222	Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input	- TP sensor (built into throttle body) - Short in VTA2 circuit - Open in VC circuit - ECM	Comes on	DTC stored	Click here
P0223	Throttle / Pedal Position Sensor / Switch "B" Circuit High Input	- TP sensor (built into throttle body) - Open in VTA2 circuit - Open in E2 circuit - Short between VC and VTA2 circuits - ECM	Comes on	DTC stored	Click here
P0230	Fuel Pump Primary Circuit	- Open or short in fuel pump circuit - Fuel pump - Fuel pump EC - ECM	-	DTC stored	Click here
P0300	Random / Multiple Cylinder Misfire Detected	- Open or short in engine wire harness - Connector connection - Vacuum hose connections - Ignition system - Fuel in ector - Fuel pressure - Mass Air Flow (MAF) meter - Engine Coolant Temperature (ECT) sensor - Compression pressure - Valve clearance - Valve timing - PCV valve and hose - PCV hose connections - Air induction system - ECM	Comes on/Blinks*	DTC stored	Click here
P0301	Cylinder 1 Misfire Detected	- Open or short in engine wire harness - Connector connection - Vacuum hose connections - Ignition system - Fuel in ector - Fuel pressure - Mass Air Flow (MAF) meter - Engine Coolant Temperature (ECT) sensor - Compression pressure - Valve clearance - Valve timing - PCV valve and hose - PCV hose connections - Air induction system - ECM	Comes on/Blinks*	DTC stored	Click here
P0302	Cylinder 2 Misfire Detected	- Open or short in engine wire harness - Connector connection - Vacuum hose connections - Ignition system - Fuel in ector - Fuel pressure - Mass Air Flow (MAF) meter - Engine Coolant Temperature (ECT) sensor - Compression pressure - Valve clearance - Valve timing - PCV valve and hose - PCV hose connections - Air induction system - ECM	Comes on/Blinks*	DTC stored	Click here
P0303	Cylinder 3 Misfire Detected	- Open or short in engine wire harness - Connector connection - Vacuum hose connections - Ignition system - Fuel in ector - Fuel pressure - Mass Air Flow (MAF) meter - Engine Coolant Temperature (ECT) sensor - Compression pressure	Comes on/Blinks*	DTC stored	Click here

		- Valve clearance - Valve timing - PCV valve and hose - PCV hose connections - Air induction system - ECM			
P0304	Cylinder 4 Misfire Detected	- Open or short in engine wire harness - Connector connection - Vacuum hose connections - Ignition system - Fuel in ector - Fuel pressure - Mass Air Flow (MAF) meter - Engine Coolant Temperature (ECT) sensor - Compression pressure - Valve clearance - Valve timing - PCV valve and hose - PCV hose connections - Air induction system - ECM	Comes on/Blinks*	DTC stored	Click here
P0305	Cylinder 5 Misfire Detected	- Open or short in engine wire harness - Connector connection - Vacuum hose connections - Ignition system - Fuel in ector - Fuel pressure - Mass Air Flow (MAF) meter - Engine Coolant Temperature (ECT) sensor - Compression pressure - Valve clearance - Valve timing - PCV valve and hose - PCV hose connections - Air induction system - ECM	Comes on/Blinks*	DTC stored	Click here
P0306	Cylinder 6 Misfire Detected	- Open or short in engine wire harness - Connector connection - Vacuum hose connections - Ignition system - Fuel in ector - Fuel pressure - Mass Air Flow (MAF) meter - Engine Coolant Temperature (ECT) sensor - Compression pressure - Valve clearance - Valve timing - PCV valve and hose - PCV hose connections - Air induction system - ECM	Comes on/Blinks*	DTC stored	Click here
P0307	Cylinder 7 Misfire Detected	- Open or short in engine wire harness - Connector connection - Vacuum hose connections - Ignition system - Fuel in ector - Fuel pressure - Mass Air Flow (MAF) meter - Engine Coolant Temperature (ECT) sensor - Compression pressure - Valve clearance - Valve timing - PCV valve and hose - PCV hose connections - Air induction system - ECM	Comes on/Blinks*	DTC stored	Click here
P0308	Cylinder 8 Misfire Detected	- Open or short in engine wire harness - Connector connection - Vacuum hose connections - Ignition system - Fuel in ector - Fuel pressure - Mass Air Flow (MAF) meter - Engine Coolant Temperature (ECT) sensor - Compression pressure	Comes on/Blinks*	DTC stored	Click here

		- Valve clearance - Valve timing - PCV valve and hose - PCV hose connections - Air induction system - ECM			
P0327	Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)	- Short in knock sensor circuit - Knock sensor - ECM	Comes on	DTC stored	Click here
P0328	Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)	- Open in knock sensor circuit - Knock sensor - ECM	Comes on	DTC stored	Click here
P0332	Knock Sensor 2 Circuit Low Input (Bank 2)	- Short in knock sensor circuit - Knock sensor - ECM	Comes on	DTC stored	Click here
P0333	Knock Sensor 2 Circuit High Input (Bank 2)	- Short in knock sensor circuit - Knock sensor - ECM	Comes on	DTC stored	Click here
P0335	Crankshaft Position Sensor "A" Circuit	- Open or short in CKP sensor circuit - CKP sensor - CKP sensor plate - ECM	Comes on	DTC stored	Click here
P0339	Crankshaft Position Sensor "A" Circuit Intermittent	- Open or short in CKP sensor circuit - CKP sensor - CKP sensor plate - ECM	-	DTC stored	Click here
P0340	Camshaft Position Sensor Circuit Malfunction	- Open or short in VVT sensor circuit - VVT sensor - Intake camshaft - Timing belt has a umped tooth - ECM	Comes on	DTC stored	Click here
P0345	Camshaft Position Sensor "A" Circuit (Bank 2)	- Open or short in VVT sensor circuit - VVT sensor - Intake camshaft - Timing belt has a umped tooth - ECM	Comes on	DTC stored	Click here
P0351	Ignition Coil "A" Primary / Secondary Circuit	- Ignition system - Open or short in I F1 or I T 1 circuit between ignition coil and ECM - No. 1 ignition coils - ECM	Comes on	DTC stored	Click here
P0352	Ignition Coil "B" Primary / Secondary Circuit	- Ignition system - Open or short in I F2 or I T 2 circuit between ignition coil and ECM - No. 2 ignition coils - ECM	Comes on	DTC stored	Click here
P0353	Ignition Coil "C" Primary / Secondary Circuit	- Ignition system - Open or short in I F2 or I T 3 circuit between ignition coil and ECM - No. 3 ignition coils - ECM	Comes on	DTC stored	Click here
P0354	Ignition Coil "D" Primary / Secondary Circuit	- Ignition system - Open or short in I F1 or I T 4 circuit between ignition coil and ECM - No. 4 ignition coils - ECM	Comes on	DTC stored	Click here
P0355	Ignition Coil "E" Primary / Secondary Circuit	- Ignition system - Open or short in I F2 or I T 5 circuit between ignition coil and ECM - No. 5 ignition coils - ECM	Comes on	DTC stored	Click here
P0356	Ignition Coil "F" Primary / Secondary Circuit	- Ignition system - Open or short in I F1 or I T 6 circuit between ignition coil and ECM - No. 6 ignition coils - ECM	Comes on	DTC stored	Click here
P0357	Ignition Coil " " Primary / Secondary Circuit	- Ignition system - Open or short in I F1 or I T 7 circuit between ignition coil and ECM - No. 7 ignition coils - ECM	Comes on	DTC stored	Click here

P0358	Ignition Coil "H" Primary / Secondary Circuit	- Ignition system - Open or short in I F2 or I T 8 circuit between ignition coil and ECM - No. 8 ignition coils - ECM	Comes on	DTC stored	Click here
P0412	Secondary Air In ection System Switching Valve "A" Circuit	- ASV circuit - Air in ection control driver - Air switching valve	Comes on	DTC stored	Click here
P0418	Secondary Air In ection System Control "A" Circuit	- Air pump circuit - Air pump - Air in ection control driver	Comes on	DTC stored	Click here
P0420	Catalyst System Efficiency Below Threshold (Bank 1)	- Front exhaust pipe (with TWC) - as leakage from exhaust system - Air-Fuel Ratio (A/F) sensor (for bank 1 sensor 1) - Heated Oxygen (HO2) sensor (for bank 1 sensor 2)	Comes on	DTC stored	Click here
P0430	Catalyst System Efficiency Below Threshold (Bank 2)	- Front No. 2 exhaust pipe (with TWC) - as leakage from exhaust system - Air-Fuel Ratio (A/F) sensor (for bank 2 sensor 1) - Heated Oxygen (HO2) sensor (for bank 2 sensor 2)	Comes on	DTC stored	Click here
P0443	Evaporative Emission Control System Purge Control Valve Circuit	- Open or short in purge VSV circuit - Purge VSV - ECM	Comes on	DTC stored	Click here
P0500	Vehicle Speed Sensor "A"	- Open or short in speed signal circuit - Wheel speed sensor - Combination meter - ECM - Skid control EC	Comes on	DTC stored	Click here
P0504	Brake Switch "A" / "B" Correlation	- Short in stop light switch signal circuit - STOP fuse - I fuse - Stop light switch - ECM	-	DTC stored	Click here
P0505	Idle Control System Malfunction	- ETCS - Air induction system - PCV hose connections - ECM	Comes on	DTC stored	Click here
P0550	Power Steering Pressure Sensor Circuit Malfunction	- Open or short in power steering oil pressure switch circuit - Power steering oil pressure switch - ECM	Comes on	DTC stored	Click here
P0552	Power Steering Pressure Sensor Circuit Low Input	- Open or short in power steering oil pressure switch circuit - Power steering oil pressure switch - ECM	Comes on	DTC stored	Click here
P0553	Power Steering Pressure Sensor Circuit High Input	- Open or short in power steering oil pressure switch circuit - Power steering oil pressure switch - ECM	Comes on	DTC stored	Click here
P0560	System Voltage	- Open in back up power source circuit - Battery - Battery terminals - EFI MAIN fuse - ECM	Comes on	DTC stored	Click here
P0604	Random Access Memory (RAM)	ECM	Comes on	DTC stored	Click here
P0606	ECM / PCM Processor	ECM	Comes on	DTC stored	Click here
P060A	Internal Control Module Monitoring Processor Performance	ECM	Comes on	DTC stored	Click here
P060B	Internal Control Module A/D Processing Performance	ECM	Comes on	DTC stored	Click here
P060D	Internal Control Module Accelerator Pedal Position Performance	ECM	Comes on	DTC stored	Click here
P060E	Internal Control Module Throttle Position Performance	ECM	Comes on	DTC stored	Click here
P0617	Starter Relay Circuit High	- Park/neutral Position (PNP) switch - Starter relay circuit - Engine switch	Comes on	DTC stored	Click here

		- ECM			
P0657	Actuator Supply Voltage Circuit / Open	ECM	Comes on	DTC stored	Click here
P0660	Intake Manifold Tuning Valve Control Circuit / Open (Bank 1)	- Open or short in intake manifold tuning valve control circuit - Surge tank (intake air control valve) - ECM	Comes on	DTC stored	Click here
P0724	Brake Switch "B" Circuit High	- Short in stop light switch signal circuit - Stop light switch - ECM	Comes on	DTC stored	Click here
P1340	Camshaft Position Sensor "A" (Bank 1 Sensor 2)	- Open or short in camshaft position sensor circuit - Camshaft position sensor - Camshaft timing pulley LH - ECM	Comes on	DTC stored	Click here
P1342	Camshaft Position Sensor "A" Low Input (MRE)	- Open or short in camshaft position sensor circuit - Camshaft position sensor - Camshaft timing pulley LH - ECM	Comes on	DTC stored	Click here
P1343	Camshaft Position Sensor "A" High Input (MRE)	- Open or short in camshaft position sensor circuit - Camshaft position sensor - Camshaft timing pulley LH - ECM	Comes on	DTC stored	Click here
P1440	Secondary Air In ection Vacuum Switching Valve Circuit Malfunction Bank 1	- VSV circuit (bank 1) - VSV (bank 1) - ECM	Comes on	DTC stored	Click here
P1441	Stuck Open in Secondary Air In ection Vacuum Switching Valve Bank 1	- ASV (bank 1) - VSV (bank 1)	Comes on	DTC stored	Click here
P1442	Stuck Close in Secondary Air In ection Vacuum Switching Valve Bank 1	- ASV (bank 1) - VSV (bank 1) - Vacuum hose (Intake manifold - VSV) - Vacuum hose (ASV - VSV) - Air in ection pipe	Comes on	DTC stored	Click here
P1443	Secondary Air In ection Vacuum Switching Valve Circuit Malfunction Bank 2	- VSV circuit (bank 2) - VSV (bank 2) - ECM	Comes on	DTC stored	Click here
P1444	Stuck Open in Secondary Air In ection Vacuum Switching Valve Bank 2	- ASV (bank 2) - VSV (bank 2)	Comes on	DTC stored	Click here
P1445	Stuck Close in Secondary Air In ection Vacuum Switching Valve Bank 2	- ASV (bank 2) - VSV (bank 2) - Vacuum hose (Intake manifold - VSV) - Vacuum hose (ASV - VSV) - Air in ection pipe	Comes on	DTC stored	Click here
P1607	Cruise Control Input Processor	ECM	Comes on	DTC stored	Click here
P1613	Secondary Air In ection Driver Malfunction	- Air in ection control driver - ECM - Diagnostic signal circuit (Driver - ECM)	Comes on	DTC stored	Click here
P2102	Throttle Actuator Control Motor Circuit Low	- Open in throttle actuator circuit - Throttle actuator - ECM	Comes on	DTC stored	Click here
P2103	Throttle Actuator Control Motor Circuit High	- Short in throttle actuator circuit - Throttle actuator - Throttle valve - Throttle body assembly - ECM	Comes on	DTC stored	Click here
P2111	Throttle Actuator Control System - Stuck Open	- Throttle actuator - Throttle body assembly - Throttle valve	Comes on	DTC stored	Click here
P2112	Throttle Actuator Control System - Stuck Closed	- Throttle actuator - Throttle body assembly - Throttle valve	Comes on	DTC stored	Click here
P2118	Throttle Actuator Control Motor Current Range / Performance	- Open in ETCS power source circuit - Battery - Battery terminals - ETCS fuse - ECM	Comes on	DTC stored	Click here
P2119	Throttle Actuator Control Throttle Body Range / Performance	- ETCS - ECM	Comes on	DTC stored	Click here
P2120	Throttle / Pedal Position Sensor / Switch "D" Circuit	- APP sensor	Comes on	DTC	Click

		- ECM		stored	here
P2121	Throttle / Pedal Position Sensor / Switch "D" Circuit Range / Performance	- Accelerator Pedal Position (APP) sensor - ECM	Comes on	DTC stored	Click here
P2122	Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input	- APP sensor - Open in VCP1 circuit - Open or ground short in VPA circuit - ECM	Comes on	DTC stored	Click here
P2123	Throttle / Pedal Position Sensor / Switch "D" Circuit High Input	- APP sensor - Open in EPA circuit - ECM	Comes on	DTC stored	Click here
P2125	Throttle / Pedal Position Sensor / Switch "E" Circuit	- APP sensor - ECM	Comes on	DTC stored	Click here
P2127	Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input	- APP sensor - Open in VCP2 circuit - Open or ground short in VPA2 circuit - ECM	Comes on	DTC stored	Click here
P2128	Throttle / Pedal Position Sensor / Switch "E" Circuit High Input	- APP sensor - Open in EPA2 circuit - ECM	Comes on	DTC stored	Click here
P2135	Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation	- Short between VTA1 and VTA2 circuits - TP sensor (built into throttle body) - ECM	Comes on	DTC stored	Click here
P2138	Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation	- Short between VPA and VPA2 circuits - APP sensor - ECM	Comes on	DTC stored	Click here
P2195	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)	- Open or short in A/F sensor (for sensor 1) circuit - A/F sensor (for sensor 1) - A/F sensor heater (for sensor 1) - Integration relay - A/F sensor heater and integration relay circuits - Air induction system - Fuel pressure - In ector - ECM	Comes on	DTC stored	Click here
P2196	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)	- Open or short in A/F sensor (for sensor 1) circuit - A/F sensor (for sensor 1) - A/F sensor heater (for sensor 1) - Integration relay - A/F sensor heater and integration relay circuits - Air induction system - Fuel pressure - In ector - ECM	Comes on	DTC stored	Click here
P2197	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 2 Sensor 1)	- Open or short in A/F sensor (for sensor 1) circuit - A/F sensor (for sensor 1) - A/F sensor heater (for sensor 1) - Integration relay - A/F sensor heater and integration relay circuits - Air induction system - Fuel pressure - In ector - ECM	Comes on	DTC stored	Click here
P2198	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 2 Sensor 1)	- Open or short in A/F sensor (for sensor 1) circuit - A/F sensor (for sensor 1) - A/F sensor heater (for sensor 1) - Integration relay - A/F sensor heater and integration relay circuits - Air induction system - Fuel pressure - In ector - ECM	Comes on	DTC stored	Click here
P2237	Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)	- Open in Air Fuel Ratio (A/F) sensor (for sensor 1) circuit - Air Fuel Ratio (A/F) sensor (for sensor 1) - ECM	Comes on	DTC stored	Click here
P2238	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)	- Open or short in A/F sensor (for sensor 1) circuit - A/F sensor (for sensor 1) - ECM	Comes on	DTC stored	Click here
P2239	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)	- Open or short in A/F sensor (for sensor 1) circuit - A/F sensor (for sensor 1) - ECM	Comes on	DTC stored	Click here

P2240	Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)	- Open in Air Fuel Ratio (A/F) sensor (for sensor 1) circuit - Air Fuel Ratio (A/F) sensor (for sensor 1) - ECM	Comes on	DTC stored	Click here
P2241	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)	- Open or short in A/F sensor (for sensor 1) circuit - A/F sensor (for sensor 1) - ECM	Comes on	DTC stored	Click here
P2242	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)	- Open or short in A/F sensor (for sensor 1) circuit - A/F sensor (for sensor 1) - ECM	Comes on	DTC stored	Click here
P2252	Oxygen (A/F) Sensor Reference round Circuit Low (Bank 1 Sensor 1)	- Open or short in A/F sensor (for sensor 1) circuit - A/F sensor (for sensor 1) - ECM	Comes on	DTC stored	Click here
P2253	Oxygen (A/F) Sensor Reference round Circuit High (Bank 1 Sensor 1)	- Open or short in A/F sensor (for sensor 1) circuit - A/F sensor (for sensor 1) - ECM	Comes on	DTC stored	Click here
P2255	Oxygen (A/F) Sensor Reference round Circuit Low (Bank 2 Sensor 1)	- Open or short in A/F sensor (for sensor 1) circuit - A/F sensor (for sensor 1) - ECM	Comes on	DTC stored	Click here
P2256	Oxygen (A/F) Sensor Reference round Circuit High (Bank 2 Sensor 1)	- Open or short in A/F sensor (for sensor 1) circuit - A/F sensor (for sensor 1) - ECM	Comes on	DTC stored	Click here
P2431	Secondary Air In ection System Air Flow / Pressure Sensor Circuit Range / Performance Bank1	- Pressure sensor circuit - Pressure sensor - ECM	Comes on	DTC stored	Click here
P2432	Secondary Air In ection System Air Flow / Pressure Sensor Circuit Low Bank1	- Pressure sensor circuit - Pressure sensor - ECM	Comes on	DTC stored	Click here
P2433	Secondary Air In ection System Air Flow / Pressure Sensor Circuit High Bank1	- Pressure sensor circuit - Pressure sensor - ECM	Comes on	DTC stored	Click here
P2440	Secondary Air In ection System Switching Valve Stuck Open Bank1	- E-ASV - ASV (bank 1 and/or bank 2) - VSV (bank 1 and/or bank 2)	Comes on	DTC stored	Click here
P2441	Secondary Air In ection System Switching Valve Stuck Close Bank1	- E-ASV - ASV (bank 1 and/or bank 2) - VSV (bank 1 and/or bank 2) - Vacuum hose (Intake manifold - VSV) - Vacuum hose (ASV - VSV) - Air in ection pipe	Comes on	DTC stored	Click here
P2444	Secondary Air In ection System Pump Stuck On Bank1	- Air pump - Pressure sensor	Comes on	DTC stored	Click here
P2445	Secondary Air In ection System Pump Stuck Off Bank1	- Air pump - Pressure sensor - Air in ection system piping - Pressure sensor	Comes on	DTC stored	Click here
P2A00	A/F Sensor Circuit Slow Response (Bank 1 Sensor 1)	- Open or short in A/F sensor circuit (for bank 1) - A/F sensor (for bank 1) - ECM	Comes on	DTC stored	Click here
P2A03	A/F Sensor Circuit Slow Response (Bank 2 Sensor 1)	- Open or short in A/F sensor circuit (for bank 2) - A/F sensor (for bank 2) - ECM	Comes on	DTC stored	Click here
0101	Lost Communication with TCM	- Open or short in TCM and ECM circuit - TCM - ECM	Comes on	DTC stored	Click here

HINT:

* The MIL flashes when a catalyst damaged misfire is detected.

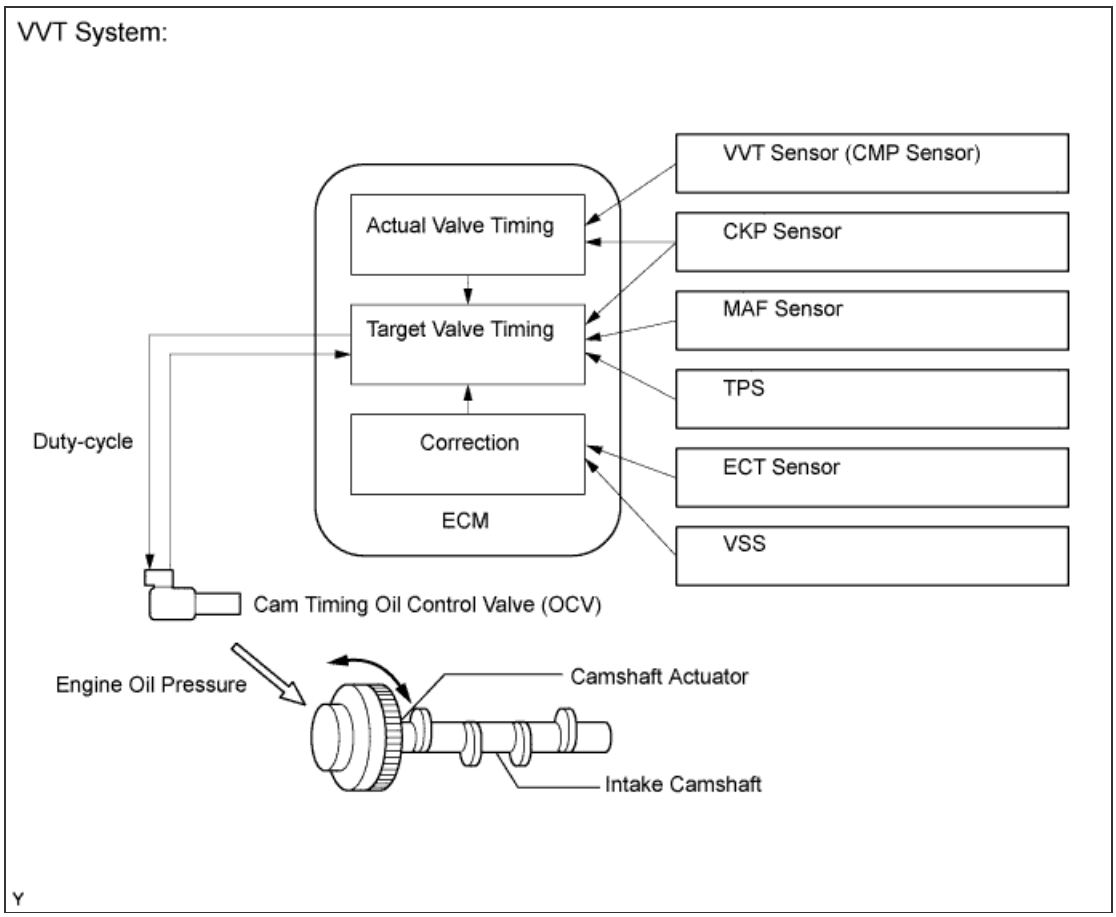
DTC P0010 Camshaft Position "A" Actuator Circuit (Bank 1)

DTC P0020 Camshaft Position "A" Actuator Circuit (Bank 2)

for Preparation Click here

DESCRIPTION

- This DTC is designed to detect opens or shorts in the cam timing oil control valve (OCV) circuit. If the duty-cycle of the OCV is excessively high or low while the engine is running, the ECM will illuminate the MIL and store the DTC.
- The VVT (variable valve timing) system adjusts the intake valve timing to improve the driveability. The engine oil pressure turns the camshaft actuator to adjust the valve timing. The OCV is a solenoid valve and switches the engine oil line. The valve moves when the ECM applies 12 V to the solenoid. The ECM changes the energizing time to the solenoid (duty-cycle) in accordance with the camshaft position, crankshaft position, throttle position, etc.



DTC Code	DTC Detection Condition	Trouble Area
P0010	An open or short in the Cam Timing Oil Control Valve (OCV) (for intake side of bank 1) circuit (1 trip detection logic).	• Open or short in Cam Timing Oil Control Valve (OCV) (for intake side of bank 1) circuit • OCV (for intake side of bank 1) • ECM
P0020	An open or short in the Cam Timing Oil Control Valve (OCV) (for intake side of bank 2) circuit (1 trip detection logic).	• Open or short in OCV (for intake side of bank 2) circuit • OCV (for intake side of bank 2) • ECM

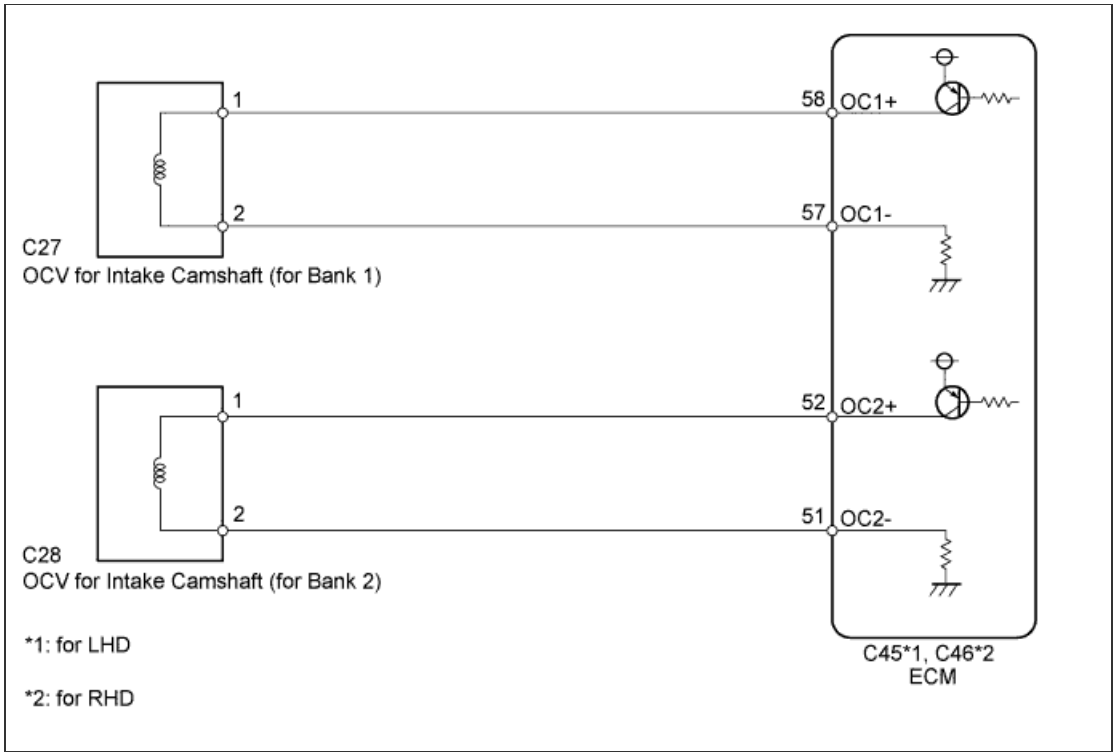
HINT:

This DTC relates to the Oil Control Valve (OCV).

MONITOR DESCRIPTION

This DTC is designed to detect opens or shorts in the cam Timing oil control valve (OCV) circuit. If the duty-cycle of the OCV is excessively high or low while the engine is running, the ECM will illuminate the MIL and store the DTC.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK DTC

a. Clear DTC after recording the freeze frame data and DTC (Click here).

b. Turn the engine switch off.

c. Allow the engine to idle and check for DTC.

d. Check that P0010 or P0020 is not output.

OK:
P0010 or P0020 is not output.

NG → Go to step 2

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

2.INSPECT CAM TIMING OIL CONTROL VALVE ASSEMBLY

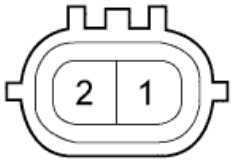
a. Disconnect the OCV connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

Component without harness connected:
(Oil Control Valve)



NG → REPLACE CAM TIMING OIL CONTROL VALVE ASSEMBLY (Click here)

OK

3.CHECK HARNESS AND CONNECTOR (CAM TIMING OIL CONTROL VALVE ECM)

a. Disconnect the OCV connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

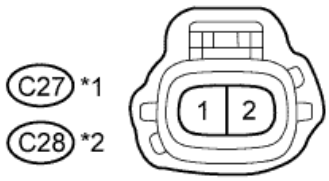
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C27-1 - C45-58 (OC1+)	Always	Below 1 Ω
C28-1 - C45-52 (OC2+)	Always	Below 1 Ω
C27-2 - C45-57 (OC1-)	Always	Below 1 Ω
C28-2 - C45-51 (OC2-)	Always	Below 1 Ω
C27-1 or C45-58 (OC1+) - Body ground	Always	10 kΩ or higher
C28-1 or C45-52 (OC2+) - Body ground	Always	10 kΩ or higher
C27-2 or C45-57 (OC1-) - Body ground	Always	10 kΩ or higher
C28-2 or C45-51 (OC2-) - Body ground	Always	10 kΩ or higher

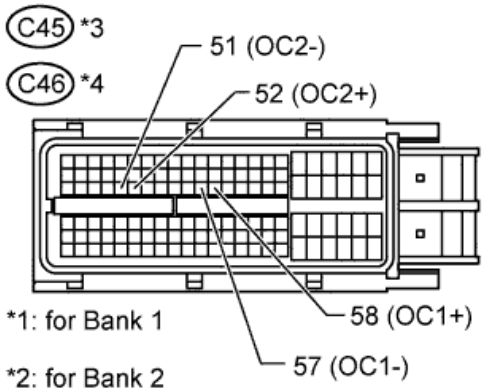
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C27-1 - C46-58 (OC1+)	Always	Below 1 Ω
C28-1 - C46-52 (OC2+)	Always	Below 1 Ω
C27-2 - C46-57 (OC1-)	Always	Below 1 Ω
C28-2 - C46-51		

Front view of wire harness connector:
(to Oil Control Valve)



Front view of wire harness connector:
(to ECM)



*1: for Bank 1

*2: for Bank 2

*3: for LHD

*4: for RHD

(OC2-)	Always	Below 1 Ω
C27-1 or C46-58 (OC1+) - Body ground	Always	10 kΩ or higher
C28-1 or C46-52 (OC2+) - Body ground	Always	10 kΩ or higher
C27-2 or C46-57 (OC1-) - Body ground	Always	10 kΩ or higher
C28-2 or C46-51 (OC2-) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

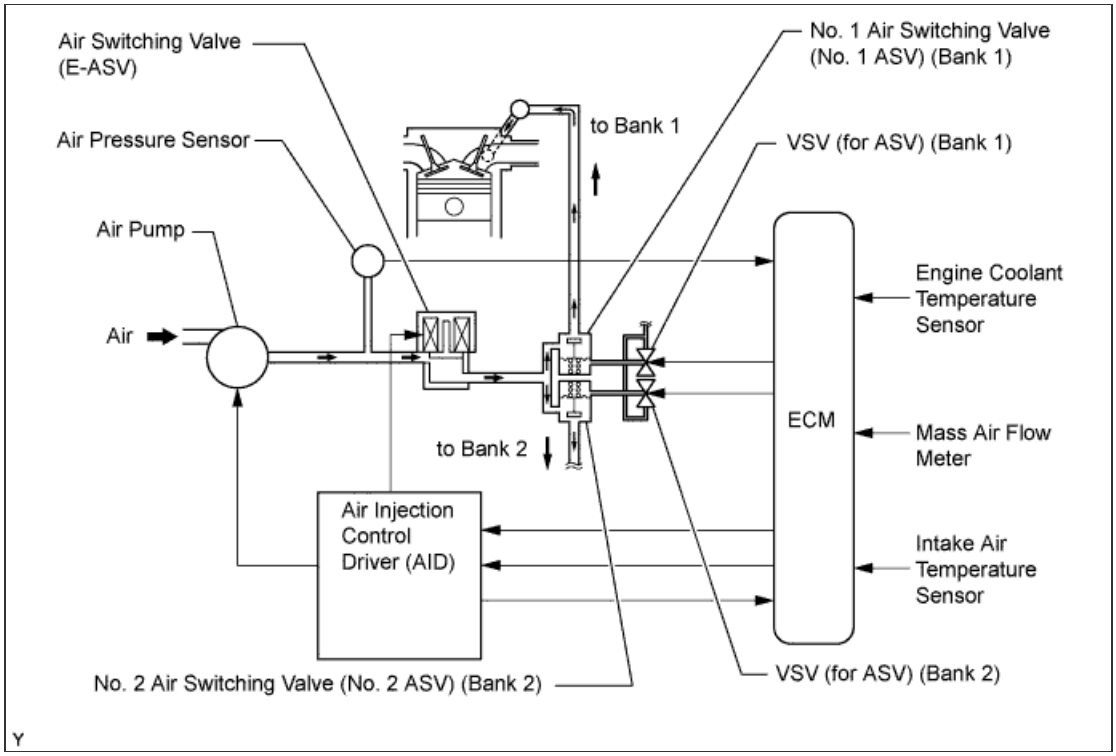
REPLACE ECM (Click here)

DTC P0418 Secondary Air Injection System Control "A" Circuit

for Preparation Click here

DESCRIPTION

The diagnostic trouble code (DTC) indicates an open or short in the air pump circuit of the secondary air injection (AIR) system. The air injection control driver diagnoses the air pump circuit, E-ASV circuit and itself, and sends the diagnosis signal to the engine control module (ECM). If the ECM receives a malfunction signal from the air injection control driver, the ECM illuminates the malfunction indicator lamp (MIL), and stores a DTC.
The secondary air injection (AIR) system introduces fresh air into the exhaust manifold in order to reduce carbon monoxide (CO) and hydrocarbon (HC) in the exhaust emission. This system is activated just after the engine start, and is stopped when the catalyst converter is warmed-up. This system consists of the following components: 1) the air pump which sends fresh air to the exhaust manifold, 2) the electric air switching valve (E-ASV) which switches the fresh air flow, 3) the air switching valve (ASV) which switches the air passage to the exhaust manifold of each bank, 4) the vacuum switching valve (VSV) which switches the vacuum (intake manifold pressure) to operate the ASV, 5) the pressure sensor which detects the fresh air pressure and exhaust pulse, 6) the air injection control driver which controls the power sources of the air pump and E-ASV, 7) the engine control module (ECM) which controls and monitors this system.



DTC Code	DTC Detection Condition	Trouble Area
P0418	The ECM receives a diagnostic signal from the driver (20% duty-cycle) (1 trip detection logic).	• Air pump circuit • Air pump • Air injection control driver

WIRING DIAGRAM

Refer to DTC P0412 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air -fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (AIR INJECTION CONTROL DRIVER - BODY GROUND)

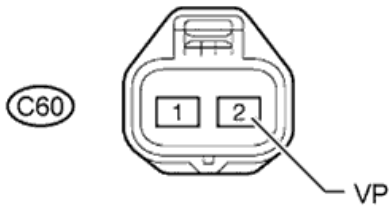
a. Disconnect the air injection control driver connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C60-2 (VP) - Body ground	Always	0.4 to 1.0 Ω

Front view of wire harness connector:
(to Air Injection Control Driver)



NG → Go to step 2

OK

REPLACE AIR INJECTION CONTROL DRIVER (Click here)

2.INSPECT AIR PUMP

a. Remove the intake manifold (Click here).

b. Disconnect the air pump connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	Always	0.4 to 1.0 Ω

Component without harness connected:
(Air Pump)



NG → REPLACE AIR PUMP (Click here)

OK

3.CHECK HARNESS AND CONNECTOR (AIR PUMP - BODY GROUND)

a. Remove the intake manifold (Click here).

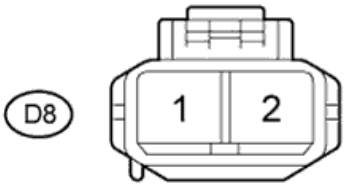
b. Disconnect the air pump connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
D8-1 - Body ground	Always	Below 1 Ω

Front view of wire harness connector:
(to Air Pump)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.CHECK HARNESS AND CONNECTOR (AIR INJECTION CONTROL DRIVER - AIR PUMP)

a. Remove the intake manifold (Click here).

b. Disconnect the air injection control driver connector.

c. Disconnect the air pump connector.

d. Measure the resistance according to the value(s) in the table below.

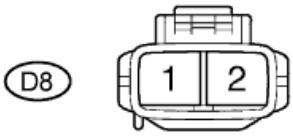
Standard Resistance:

Tester Connection	Condition	Specified Condition
C60-2 (VP) - D8-2	Always	Below 1 Ω
C60-2 (VP) or D8-2 - Body ground	Always	10 kΩ higher

Front view of wire harness connector:
(to Air Injection Control Driver)



Front view of wire harness connector:
(to Air Pump)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

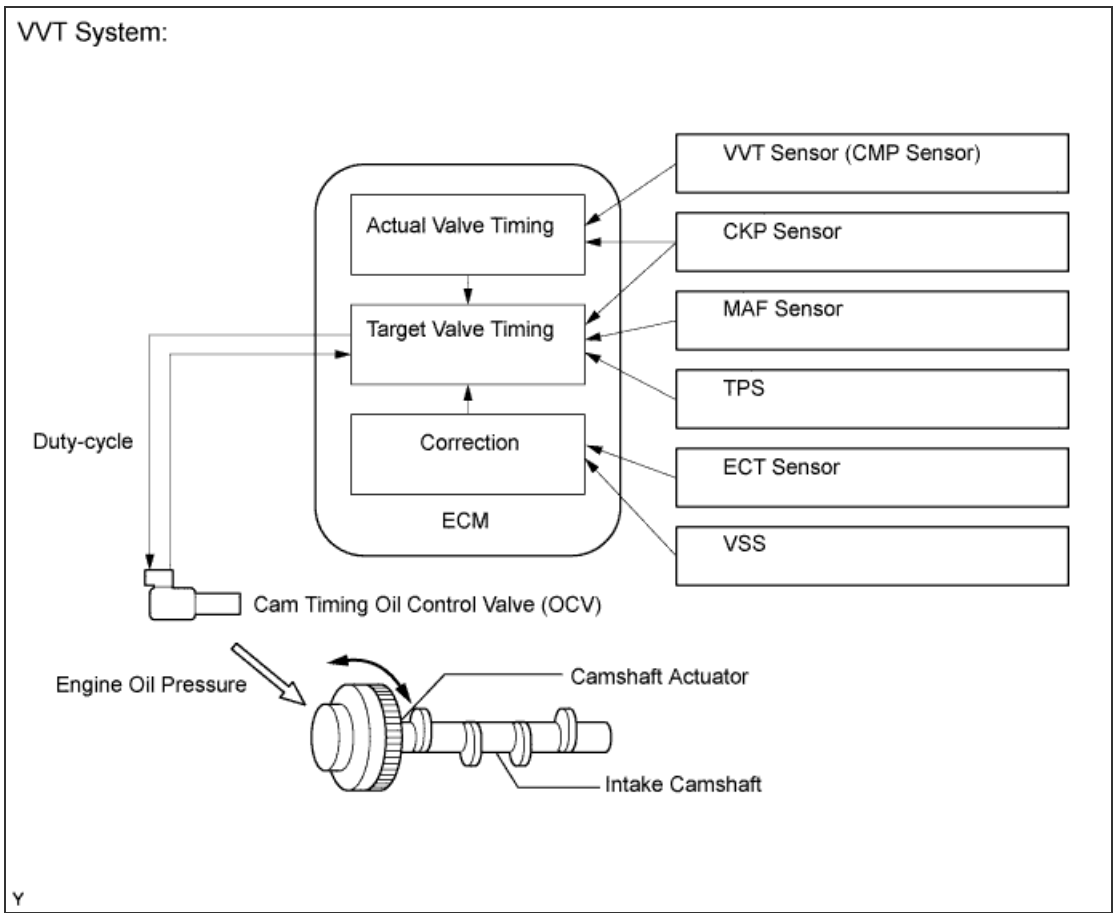
DTC P0010 Camshaft Position "A" Actuator Circuit (Bank 1)

DTC P0020 Camshaft Position "A" Actuator Circuit (Bank 2)

for Preparation Click here

DESCRIPTION

- This DTC is designed to detect opens or shorts in the cam timing oil control valve (OCV) circuit. If the duty-cycle of the OCV is excessively high or low while the engine is running, the ECM will illuminate the MIL and store the DTC.
- The VVT (variable valve timing) system adjusts the intake valve timing to improve the driveability. The engine oil pressure turns the camshaft actuator to adjust the valve timing. The OCV is a solenoid valve and switches the engine oil line. The valve moves when the ECM applies 12 V to the solenoid. The ECM changes the energizing time to the solenoid (duty-cycle) in accordance with the camshaft position, crankshaft position, throttle position, etc.



DTC Code	DTC Detection Condition	Trouble Area
P0010	An open or short in the Cam Timing Oil Control Valve (OCV) (for intake side of bank 1) circuit (1 trip detection logic).	• Open or short in Cam Timing Oil Control Valve (OCV) (for intake side of bank 1) circuit • OCV (for intake side of bank 1) • ECM
P0020	An open or short in the Cam Timing Oil Control Valve (OCV) (for intake side of bank 2) circuit (1 trip detection logic).	• Open or short in OCV (for intake side of bank 2) circuit • OCV (for intake side of bank 2) • ECM

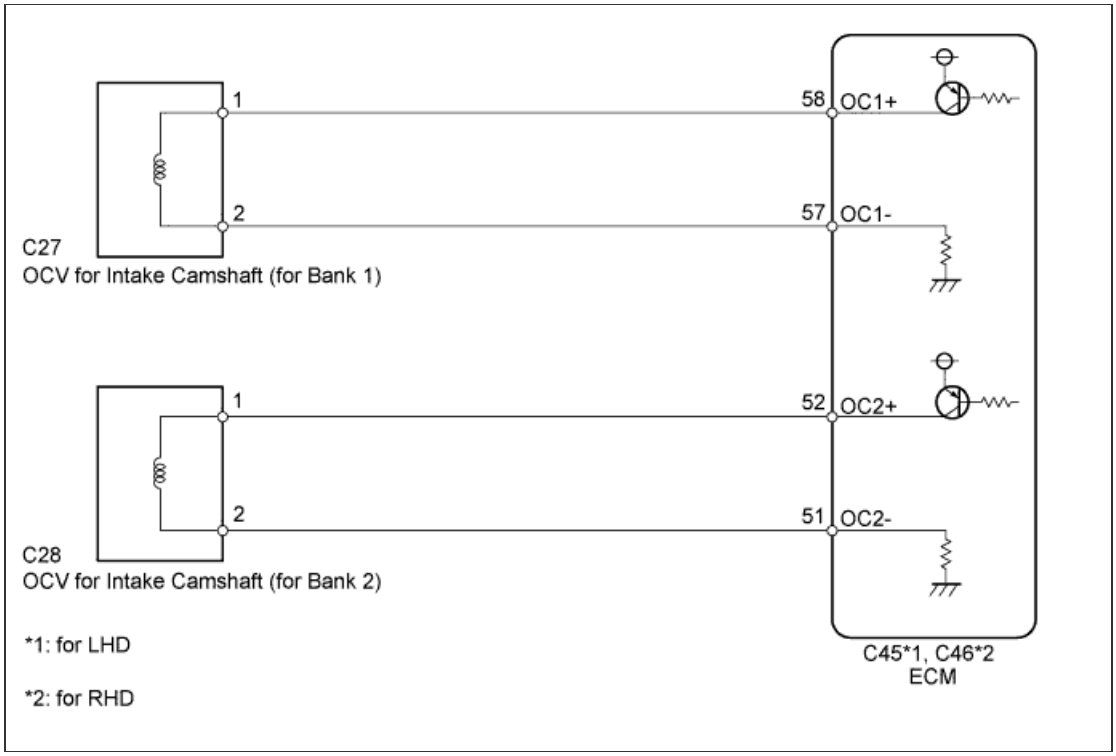
HINT:

This DTC relates to the Oil Control Valve (OCV).

MONITOR DESCRIPTION

This DTC is designed to detect opens or shorts in the cam Timing oil control valve (OCV) circuit. If the duty-cycle of the OCV is excessively high or low while the engine is running, the ECM will illuminate the MIL and store the DTC.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK DTC

a. Clear DTC after recording the freeze frame data and DTC (Click here).

b. Turn the engine switch off.

c. Allow the engine to idle and check for DTC.

d. Check that P0010 or P0020 is not output.

OK:
P0010 or P0020 is not output.

NG → Go to step 2

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

2.INSPECT CAM TIMING OIL CONTROL VALVE ASSEMBLY

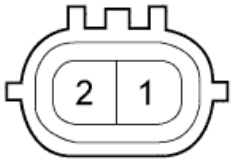
a. Disconnect the OCV connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

Component without harness connected:
(Oil Control Valve)



NG → REPLACE CAM TIMING OIL CONTROL VALVE ASSEMBLY (Click here)

OK

3.CHECK HARNESS AND CONNECTOR (CAM TIMING OIL CONTROL VALVE ECM)

a. Disconnect the OCV connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

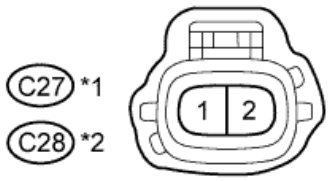
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C27-1 - C45-58 (OC1+)	Always	Below 1 Ω
C28-1 - C45-52 (OC2+)	Always	Below 1 Ω
C27-2 - C45-57 (OC1-)	Always	Below 1 Ω
C28-2 - C45-51 (OC2-)	Always	Below 1 Ω
C27-1 or C45-58 (OC1+) - Body ground	Always	10 kΩ or higher
C28-1 or C45-52 (OC2+) - Body ground	Always	10 kΩ or higher
C27-2 or C45-57 (OC1-) - Body ground	Always	10 kΩ or higher
C28-2 or C45-51 (OC2-) - Body ground	Always	10 kΩ or higher

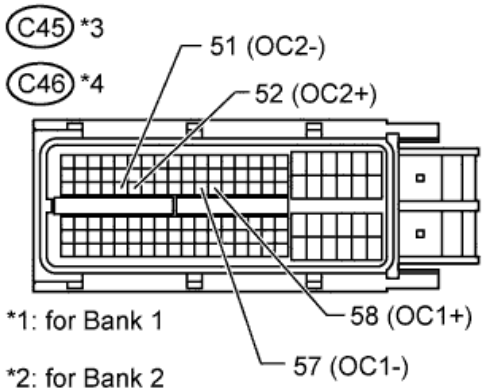
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C27-1 - C46-58 (OC1+)	Always	Below 1 Ω
C28-1 - C46-52 (OC2+)	Always	Below 1 Ω
C27-2 - C46-57 (OC1-)	Always	Below 1 Ω
C28-2 - C46-51		

Front view of wire harness connector:
(to Oil Control Valve)



Front view of wire harness connector:
(to ECM)



*1: for Bank 1

*2: for Bank 2

*3: for LHD

*4: for RHD

(OC2-)	Always	Below 1 Ω
C27-1 or C46-58 (OC1+) - Body ground	Always	10 kΩ or higher
C28-1 or C46-52 (OC2+) - Body ground	Always	10 kΩ or higher
C27-2 or C46-57 (OC1-) - Body ground	Always	10 kΩ or higher
C28-2 or C46-51 (OC2-) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P0420 Catalyst System Efficiency Below Threshold (Bank 1)

DTC P0430 Catalyst System Efficiency Below Threshold (Bank 2)

for Preparation Click here

MONITOR DESCRIPTION

The ECM uses sensors mounted in front of and behind the Three-Way Catalytic Converter (TWC) to monitor its efficiency.
The first sensor, the Air-Fuel Ratio (A/F) sensor, sends pre-catalyst information to the ECM. The second sensor, the Heated Oxygen (HO2) sensor, sends post-catalyst information to the ECM. In order to detect any deterioration in the TWC, the ECM calculates the Oxygen Storage Capacity (OSC) of the TWC. This calculation is based on the voltage output of the HO2 sensor while performing active air-fuel ratio control.
The OSC value is an indication of the oxygen storage capacity of the TWC. When the vehicle is being driven with a warm engine, active air-fuel ratio control is performed for approximately 15 to 20 seconds. When it is performed, the ECM deliberately sets the air-fuel ratio to lean or rich levels. If the rich-lean cycle of the HO2 sensor is long, the OSC becomes greater. There is a direct correlation between the OSCs of the HO2 sensor and the TWC.
The ECM uses the OSC value to determine the state of the TWC. If any deterioration has occurred, it illuminates the MIL and stores the DTC.

DTC Code	DTC Detection Condition	Trouble Area
P0420	The OSC value is less than the standard value under active air-fuel ratio control (2 trip detection logic).	• Front exhaust pipe (with TWC) • Gas leakage from exhaust system • Air-Fuel Ratio (A/F) sensor (for bank 1 sensor 1) • Heated Oxygen (HO2) sensor (for bank 1 sensor 2)
P0430	The OSC value is less than the standard value under active air-fuel ratio control (2 trip detection logic).	• Front No. 2 exhaust pipe (with TWC) • Gas leakage from exhaust system • Air-Fuel Ratio (A/F) sensor (for bank 2 sensor 1) • Heated Oxygen (HO2) sensor (for bank 2 sensor 2)

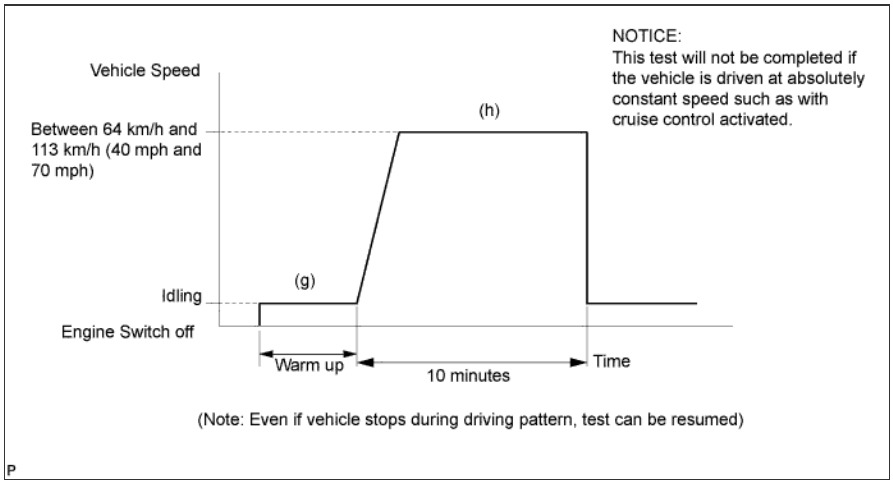
HINT:

- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

CONFIRMATION DRIVING PATTERN

HINT:

Performing this confirmation pattern will activate the catalyst monitor. This is very useful for verifying the completion of a repair.



(a) Connect the intelligent tester to the DLC3.
(b) Turn the engine switch on (IG).
(c) Turn the tester on.
(d) Clear DTCs (if output) (Click here).
(e) Enter the following menus: Powertrain / Engine and ECT / Utility / Monitor Status.
(f) Check that Catalyst is Incomplete.
(g) Start the engine and warm it up.
(h) Drive the vehicle at between 64 km/h and 113 km/h (40 mph and mph) for at least 10 minutes.
(i) Note the state of the Readiness Tests items. Those items will change to Complete as the Catalyst Monitor CMPL monitor operates.
(j) Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.
(k) Check if any DTCs (any pending DTCs) are output.

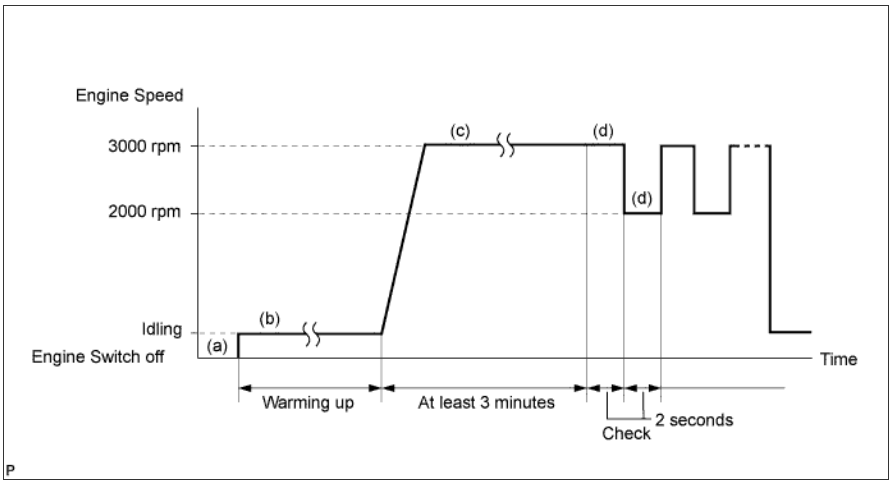
HINT:

If Catalyst Monitor CMPL does not change to Complete, and any pending DTCs fail to store, extend the driving time.

CONDITIONING FOR SENSOR TESTING

HINT:

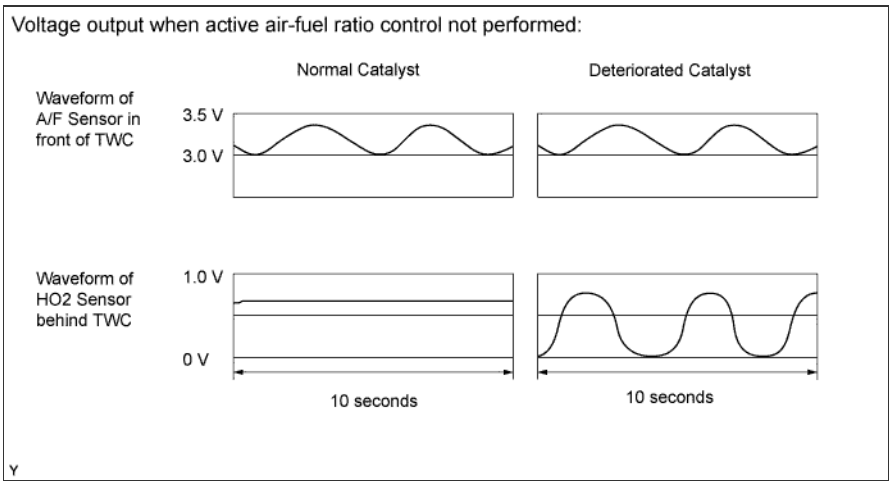
Perform the operation with the engine speeds and time durations described below prior to checking the waveforms of the A/F and HO2 sensors. This is in order to activate the sensors sufficiently to obtain the appropriate inspection results.



(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and warm it up with all the accessories switched off until the engine coolant temperature stabilizes.
(c) Run the engine at an engine speed of between 2500 rpm and 3000 rpm for at least 3 minutes.
(d) While running the engine at 3000 rpm and 2000 rpm at 2 second intervals, check the waveforms of the A/F and HO2 sensors using the tester.

HINT:

- **If either voltage output of the A/F or Heated Oxygen (HO2) sensor does not fluctuate, or there is noise in the waveform of either sensor, the sensor may be malfunctioning.**
- **If the voltage outputs of both the sensors remain lean or rich, the air-fuel ratio may be extremely lean or rich. In such cases, perform the following Control the Injection Volume for A/F Sensor using the intelligent tester.**
- **If the Three-Way Catalytic Converter (TWC) has deteriorated, the HO2 sensor (located behind the TWC) voltage output fluctuates up and down frequently, even under normal driving conditions (active air-fuel ratio control is not performed).**



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0420 OR P0430)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0420 or P0430 is output	A
P0420 or P0430 and other DTCs are output	B

HINT:

If any DTCs other than P0420 or P0430 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (A/F CONTROL)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor.

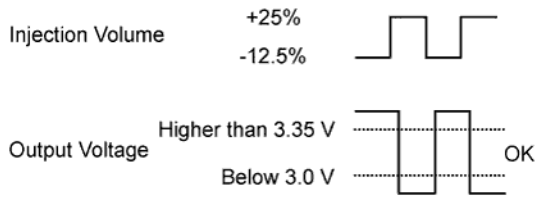
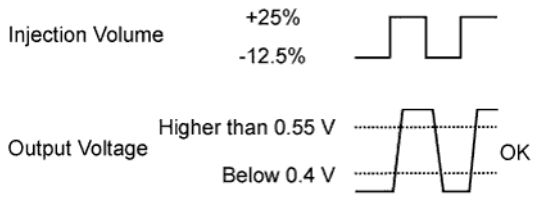
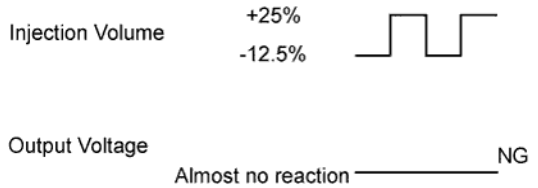
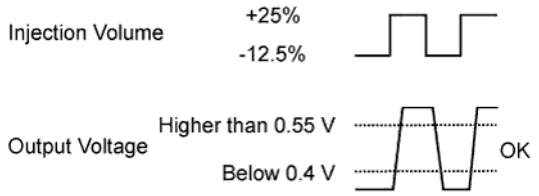
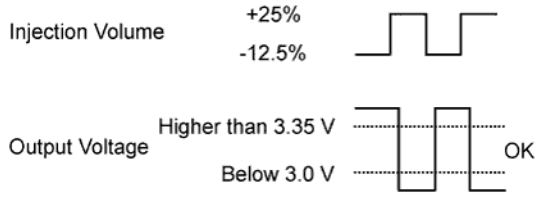
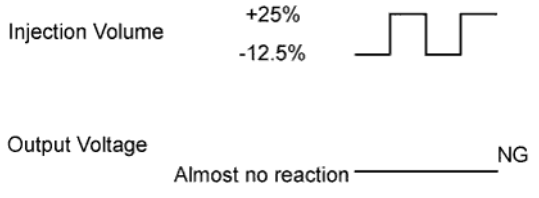
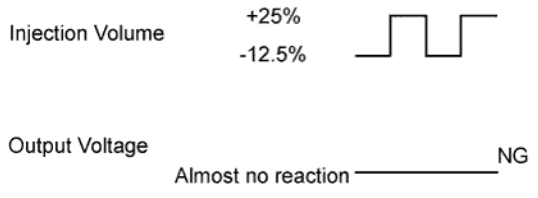
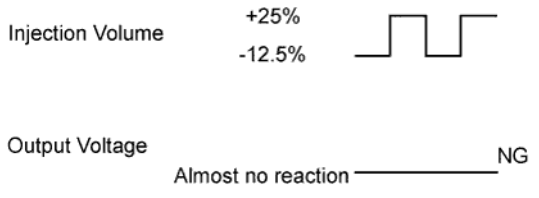
e. Perform the Control the Injection Volume for A/F Sensor operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).

f. Monitor the voltage outputs of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

Result:
A/F sensor reacts in accordance with increases and decreases in fuel injection volume:
+25% = Rich output:
Below 3.0 V
-12.5% = Lean output:
Higher than 3.35 V

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors. To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

Result

Result	Proceed to
Case 1	A
Case 2	B
Case 3	C
Case 4	D

B → REPLACE AIR FUEL RATIO SENSOR (Click here)

C → Go to step 5

D → CHECK CAUSE OF EXTREMELY RICH OR LEAN ACTUAL AIR-FUEL RATIO, REPLACE FAULTY AREA AND GO TO NEXT STEP

A

3.INSPECT FOR EXHAUST GAS LEAK

a. Check for exhaust gas leakage.

OK:
No gas leakage.

NG → REPAIR OR REPLACE EXHAUST GAS LEAK POINT

OK

4.CHECK DTC OUTPUT (DTC P0420 AND/OR P0430)

a. According to the DTCs output in the first step (Check Any Other DTCs Output), proceed to the next step by referring to the table below.

Result

Result	Proceed to
P0420 is output	A
P0430 is output	B
P0420 and P0430 is output	A and B

B → REPLACE FRONT NO. 2 EXHAUST PIPE ASSEMBLY (Click here)

A

REPLACE FRONT EXHAUST PIPE ASSEMBLY (Click here)

5.INSPECT FOR EXHAUST GAS LEAK

a. Check for exhaust gas leakage.

OK:
No gas leakage.

NG → REPAIR OR REPLACE EXHAUST GAS LEAK POINT

OK

REPLACE HEATED OXYGEN SENSOR (Click here)

DTC P0011 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)

DTC P0012 Camshaft Position "A" - Timing Over-Retarded (Bank 1)

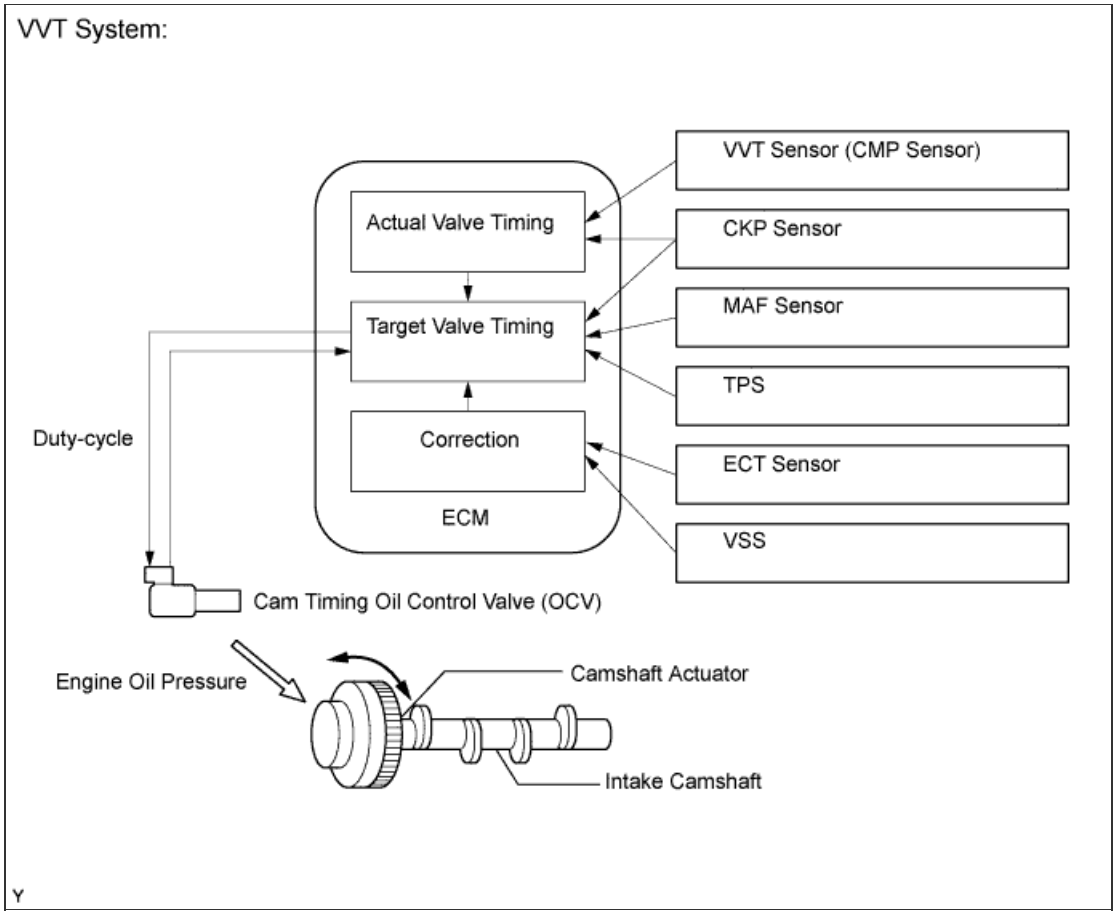
DTC P0021 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)

DTC P0022 Camshaft Position "A" - Timing Over-Retarded (Bank 2)

for Preparation Click here

DESCRIPTION

The VVT system includes the ECM, Cam Timing Oil Control Valve (OCV) and VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. Camshaft timing control is performed according to engine operating conditions such as the intake air volume, throttle valve position and engine coolant temperature. The ECM controls the OCV, based on the signals transmitted by several sensors. The VVT controller regulates the intake camshaft angle using oil pressure through the OCV. As a result, the relative positions of the camshaft and crankshaft are optimized, the engine torque and fuel economy improve, and the exhaust emissions decrease under overall driving conditions. The ECM detects the actual intake valve timing using signals from the camshaft and crankshaft position sensors, and performs feedback control. This is how the target intake valve timing is verified by the ECM.



DTC Code	DTC Detection Condition	Trouble Area
P0011 P0021	The valve timing is not adjusted in the valve timing advance range (1 trip detection logic).	• Valve timing • Cam Timing Oil Control Valve (OCV) for intake side • OCV filter • Intake camshaft timing tube (for Bank 1, 2) • ECM
P0012 P0022	The valve timing is not adjusted in the valve timing retard range (2 trip detection logic).	• Valve timing • OCV for intake side • OCV filter • Intake camshaft timing tube (for Bank 1, 2) • ECM

MONITOR DESCRIPTION

The ECM optimizes the intake valve timing using the VVT (Variable Valve Timing) system to control the intake camshaft. The VVT system

includes the ECM, the Cam Timing Oil Control Valve (OCV) and the VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake camshaft.
If the difference between the target and actual intake valve timings is large, and changes in the actual intake valve timing are small, the ECM interprets this as the VVT controller stuck malfunction and stores a DTC.

Example:
A DTC is stored when the following conditions 1, 2 and 3 are met:

1. The difference between the target and actual intake valve timing is more than 5°CA (Crankshaft Angle) and the condition continues for more than 4.5 seconds.
2. It takes 5 seconds or more to change the valve timing by 5°CA.
3. After above conditions 1 and 2 are met, the OCV is forcibly activated 63 times or more.

DTC P0011 and P0021 (Advanced Cam Timing) are subject to 1 trip detection logic.
DTC P0012 and P0022 (Retarded Cam Timing) are subject to 2 trip detection logic.
These DTCs indicate that the VVT controller cannot operate properly due to OCV malfunctions or the presence of foreign objects in the OCV.
The monitor will run if all of the following conditions are met:

- The engine is warm (the engine coolant temperature is 75°C or higher).
- The vehicle has been driven at more than 64 km/h (40 mph) for 3 minutes.
- The engine has idled for 3 minutes.

WIRING DIAGRAM

Refer to DTC P0010 (Click here).

INSPECTION PROCEDURE

HINT:

DTC P0011, P0012, P0021 or P0022 may be stored when foreign objects in the engine oil are caught in some parts of the system. The DTC will remain stored even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

HINT:

Abnormal Bank	Advanced Timing Over (Valve Timing is Out of Specified Range)	Retarded Timing Over (Valve Timing is Out of Specified Range)
Bank 1	P0011	P0012
Bank 2	P0021	P0022

- **If DTC P0011 or P0012 is output, check the left bank VVT system for intake side circuit (for bank 1).**
- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **If DTC P0021 or P0022 is output, check the right bank VVT system for intake side circuit (for bank 2).**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHEC ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0011, P0012, P0021 or P0022 is output	A
P0011, P0012, P0021 or P0022 and other DTCs are output	B

HINT:

If any DTCs other than P0011, P0012, P0021 or P0022 are output, troubleshoot those DTCs first.

B → **GO TO DTC CHART (Click here)**

A

2.PERFORM ACTIVE TEST USING INTE IGENT TESTER (OPERATE OCV)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1) or Control the VVT System (Bank 2).

e. Check the engine speed while operating the Camshaft Oil Control Valve (OCV) using the tester.

O

Tester Operation	Specified Condition
OCV OFF	Normal engine speed
OCV ON	Engine idles roughly or stalls (soon after OCV switched from OFF to ON)

NG → Go to step 4

O

CHEC WHETHER DTC OUTPUT RECURS (DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester.

f. Drive the vehicle for more than 10 minutes.

g. Read DTCs using the tester.

O :
No DTC output.

NG → Go to step 4

O

CHEC OR INTERMITTENT PROB EMS (**Click here**)

4.CHEC A E TIMING (CHEC OR OOSE AND UMPED TOOTH OF TIMING BE T)

a. Remove the drive belt (Click here).

b. Remove the timing belt cover L and R (Click here).

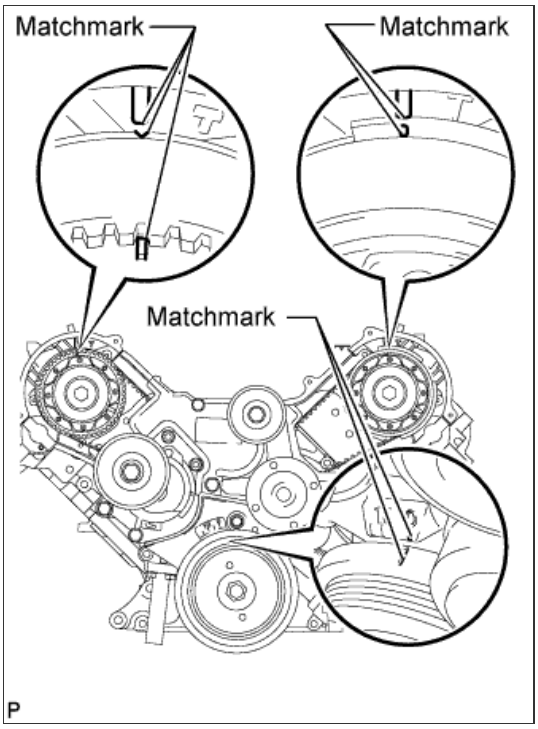
c. Turn the crankshaft to align the matchmarks of the crankshaft.

d. Align the notch of the crankshaft pulley with the "0" position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360°. Confirm again if the matchmarks are facing each other.

O :
The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NG → AD UST VA E TIMING (Click here)

O

INSPECT CAM TIMING OI CONTRO A E ASSEMB (OCV)

a. Remove the OCV.

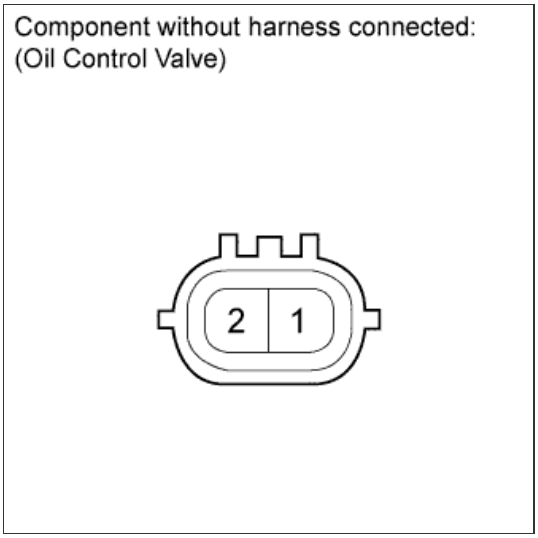
b. Measure the resistance according to the value(s) in the table below.

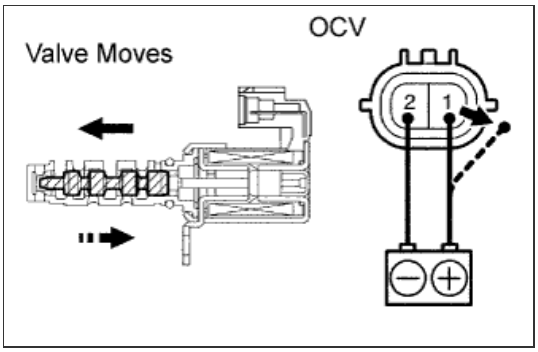
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (6 °F)	6. to 7. Ω

c. Apply positive battery voltage to terminal 1 and negative battery voltage to terminal 2. Check the valve operation.

O :
Valve moves quickly.





NG → REP ACE CAM TIMING OI CONTRO A E ASSEMB (Click here)

O

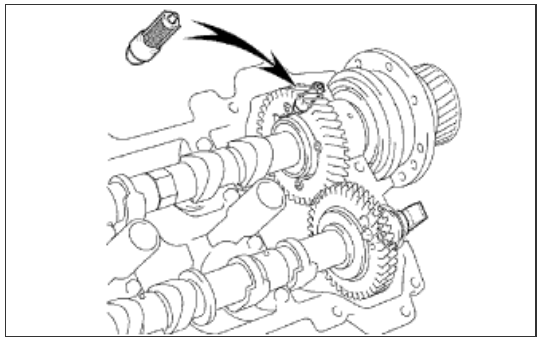
INSPECT OI CONTRO A E FI TER

a. Remove the cylinder head cover (Click here).

b. Remove the camshaft bearing cap and OCV filter.

c. Check that the filter is not clogged.

O :
Filter is not clogged.



NG → **CLEAN OIL CONTROL VALVE FILTER**

O

REPLACE CAMSHAFT TIMING TUBE ASSEMB

a. Replace the camshaft timing tube assembly.

HINT:

- **If P0011 or P0012 is output, replace the camshaft timing tube assembly for bank 1 (Click here).**
- **If P0021 or P0022 is output, replace the camshaft timing tube assembly for bank 2 (Click here).**

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester.

f. Drive the vehicle for more than 10 minutes.

g. Read output DTCs using the tester.

O :
No DTC is output.

HINT:

DTC P0011, P0012, P0021 or P0022 is output when foreign objects in the engine oil are caught in some parts of the system. These codes will stay stored even if the system returns to normal after a short time. These foreign objects are then captured by the oil filter, thus eliminating the source of the problem.

NG → **REPLACE ECM (Click here)**

O

SYSTEM O

DTC P0420 Catalyst System Efficiency Below Threshold (Bank 1)

DTC P0430 Catalyst System Efficiency Below Threshold (Bank 2)

for Preparation Click here

MONITOR DESCRIPTION

The ECM uses sensors mounted in front of and behind the Three-Way Catalytic Converter (TWC) to monitor its efficiency.
The first sensor, the Air-Fuel Ratio (A/F) sensor, sends pre-catalyst information to the ECM. The second sensor, the Heated Oxygen (HO2) sensor, sends post-catalyst information to the ECM. In order to detect any deterioration in the TWC, the ECM calculates the Oxygen Storage Capacity (OSC) of the TWC. This calculation is based on the voltage output of the HO2 sensor while performing active air-fuel ratio control.
The OSC value is an indication of the oxygen storage capacity of the TWC. When the vehicle is being driven with a warm engine, active air-fuel ratio control is performed for approximately 15 to 20 seconds. When it is performed, the ECM deliberately sets the air-fuel ratio to lean or rich levels. If the rich-lean cycle of the HO2 sensor is long, the OSC becomes greater. There is a direct correlation between the OSCs of the HO2 sensor and the TWC.
The ECM uses the OSC value to determine the state of the TWC. If any deterioration has occurred, it illuminates the MIL and stores the DTC.

DTC Code	DTC Detection Condition	Trouble Area
P0420	The OSC value is less than the standard value under active air-fuel ratio control (2 trip detection logic).	• Front exhaust pipe (with TWC) • Gas leakage from exhaust system • Air-Fuel Ratio (A/F) sensor (for bank 1 sensor 1) • Heated Oxygen (HO2) sensor (for bank 1 sensor 2)
P0430	The OSC value is less than the standard value under active air-fuel ratio control (2 trip detection logic).	• Front No. 2 exhaust pipe (with TWC) • Gas leakage from exhaust system • Air-Fuel Ratio (A/F) sensor (for bank 2 sensor 1) • Heated Oxygen (HO2) sensor (for bank 2 sensor 2)

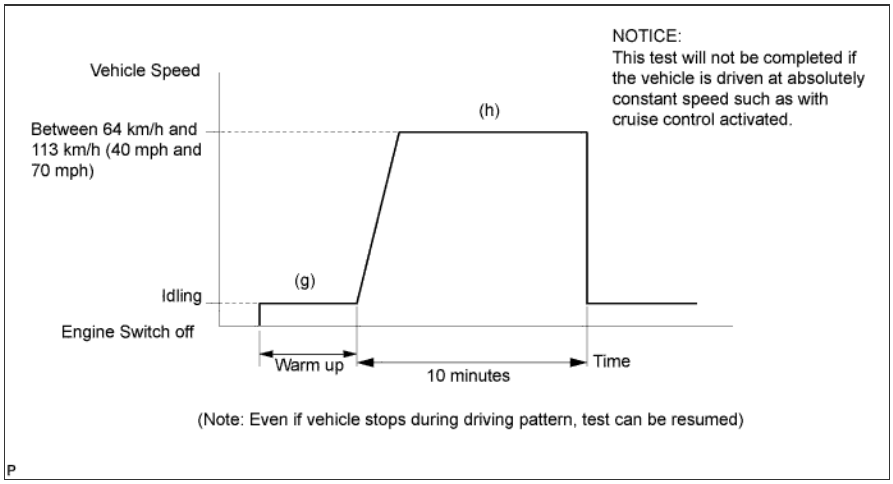
HINT:

- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

CONFIRMATION DRIVING PATTERN

HINT:

Performing this confirmation pattern will activate the catalyst monitor. This is very useful for verifying the completion of a repair.



(a) Connect the intelligent tester to the DLC3.
(b) Turn the engine switch on (IG).
(c) Turn the tester on.
(d) Clear DTCs (if output) (Click here).
(e) Enter the following menus: Powertrain / Engine and ECT / Utility / Monitor Status.
(f) Check that Catalyst is Incomplete.
(g) Start the engine and warm it up.
(h) Drive the vehicle at between 64 km/h and 113 km/h (40 mph and mph) for at least 10 minutes.
(i) Note the state of the Readiness Tests items. Those items will change to Complete as the Catalyst Monitor CMPL monitor operates.
(j) Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.
(k) Check if any DTCs (any pending DTCs) are output.

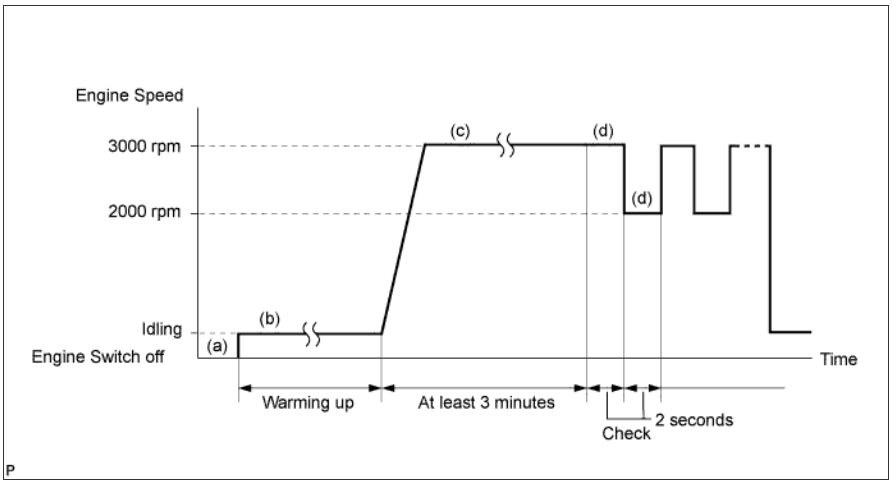
HINT:

If Catalyst Monitor CMPL does not change to Complete, and any pending DTCs fail to store, extend the driving time.

CONDITIONING FOR SENSOR TESTING

HINT:

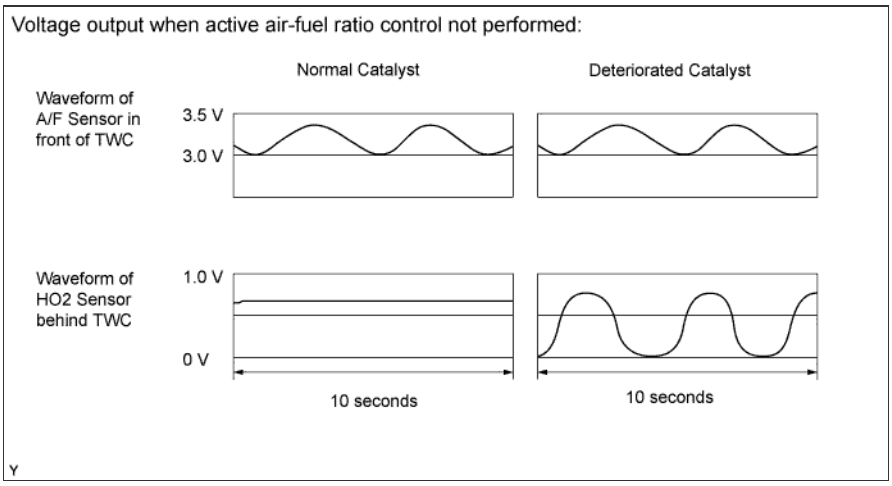
Perform the operation with the engine speeds and time durations described below prior to checking the waveforms of the A/F and HO2 sensors. This is in order to activate the sensors sufficiently to obtain the appropriate inspection results.



(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and warm it up with all the accessories switched off until the engine coolant temperature stabilizes.
(c) Run the engine at an engine speed of between 2500 rpm and 3000 rpm for at least 3 minutes.
(d) While running the engine at 3000 rpm and 2000 rpm at 2 second intervals, check the waveforms of the A/F and HO2 sensors using the tester.

HINT:

- **If either voltage output of the A/F or Heated Oxygen (HO2) sensor does not fluctuate, or there is noise in the waveform of either sensor, the sensor may be malfunctioning.**
- **If the voltage outputs of both the sensors remain lean or rich, the air-fuel ratio may be extremely lean or rich. In such cases, perform the following Control the Injection Volume for A/F Sensor using the intelligent tester.**
- **If the Three-Way Catalytic Converter (TWC) has deteriorated, the HO2 sensor (located behind the TWC) voltage output fluctuates up and down frequently, even under normal driving conditions (active air-fuel ratio control is not performed).**



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0420 OR P0430)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0420 or P0430 is output	A
P0420 or P0430 and other DTCs are output	B

HINT:

If any DTCs other than P0420 or P0430 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (A/F CONTROL)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor.

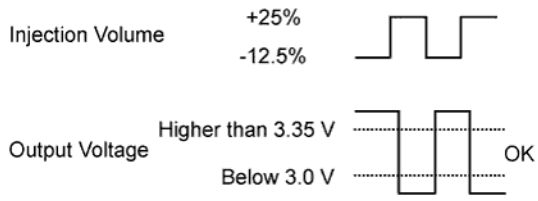
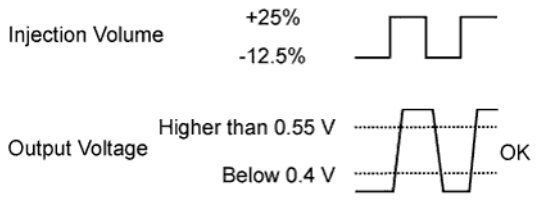
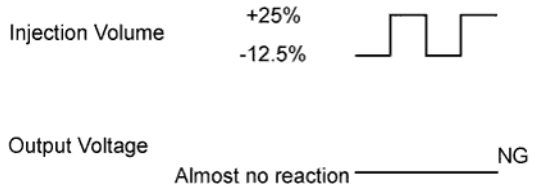
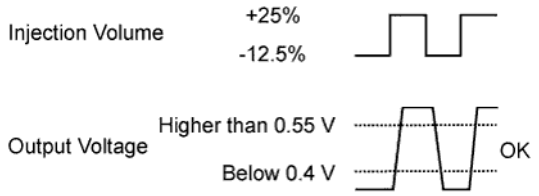
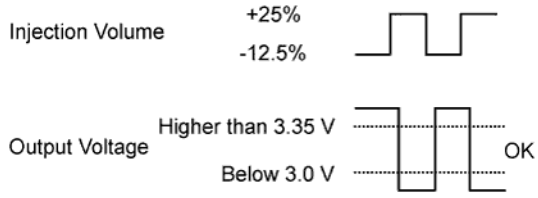
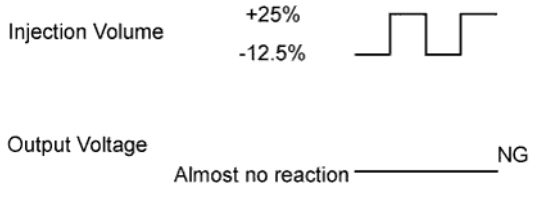
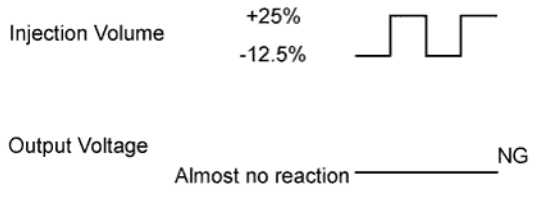
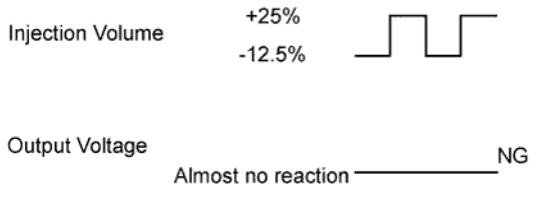
e. Perform the Control the Injection Volume for A/F Sensor operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).

f. Monitor the voltage outputs of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

Result:
A/F sensor reacts in accordance with increases and decreases in fuel injection volume:
+25% = Rich output:
Below 3.0 V
-12.5% = Lean output:
Higher than 3.35 V

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors. To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

Result

Result	Proceed to
Case 1	A
Case 2	B
Case 3	C
Case 4	D

B → REPLACE AIR FUEL RATIO SENSOR (Click here)

C → Go to step 5

D → CHECK CAUSE OF EXTREMELY RICH OR LEAN ACTUAL AIR-FUEL RATIO, REPLACE FAULTY AREA AND GO TO NEXT STEP

A

3.INSPECT FOR EXHAUST GAS LEAK

a. Check for exhaust gas leakage.

OK:
No gas leakage.

NG → REPAIR OR REPLACE EXHAUST GAS LEAK POINT

OK

4.CHECK DTC OUTPUT (DTC P0420 AND/OR P0430)

a. According to the DTCs output in the first step (Check Any Other DTCs Output), proceed to the next step by referring to the table below.

Result

Result	Proceed to
P0420 is output	A
P0430 is output	B
P0420 and P0430 is output	A and B

B → REPLACE FRONT NO. 2 EXHAUST PIPE ASSEMBLY (Click here)

A

REPLACE FRONT EXHAUST PIPE ASSEMBLY (Click here)

5.INSPECT FOR EXHAUST GAS LEAK

a. Check for exhaust gas leakage.

OK:
No gas leakage.

NG → REPAIR OR REPLACE EXHAUST GAS LEAK POINT

OK

REPLACE HEATED OXYGEN SENSOR (Click here)

DTC P0011 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)

DTC P0012 Camshaft Position "A" - Timing Over-Retarded (Bank 1)

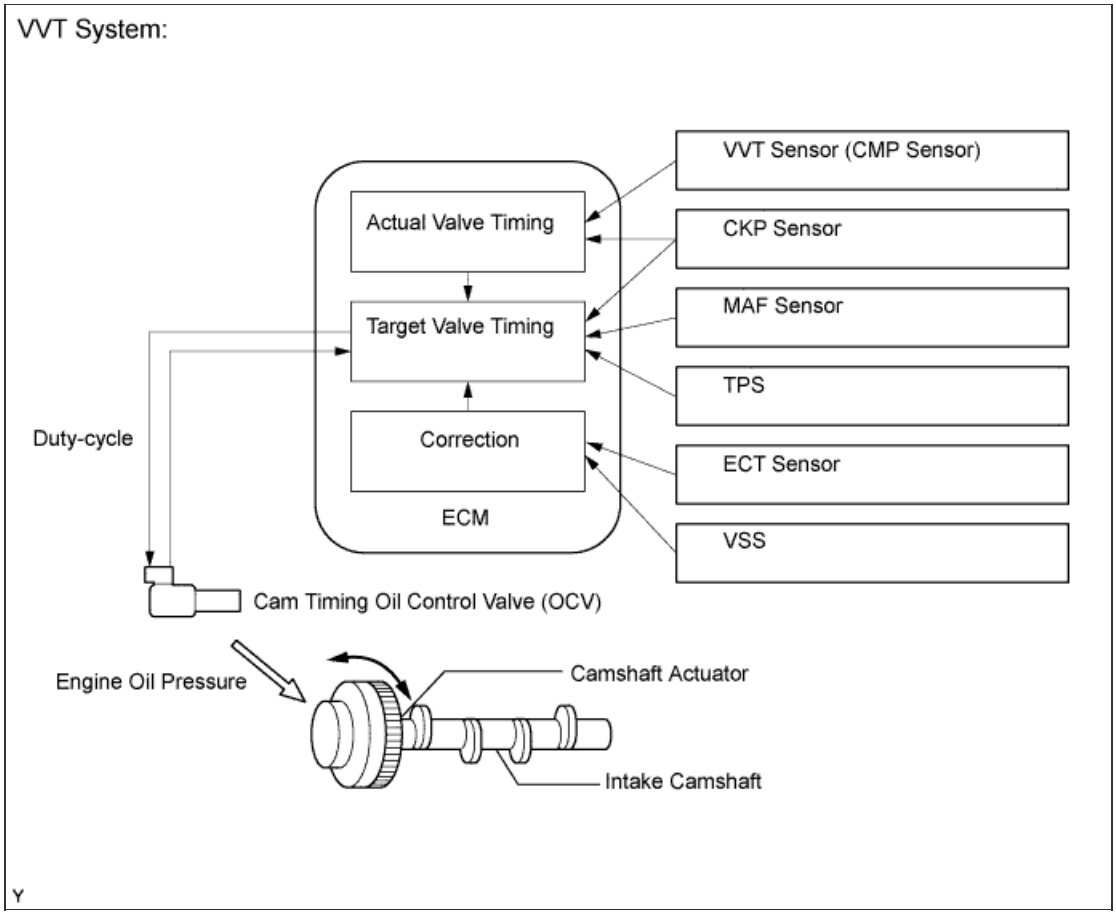
DTC P0021 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)

DTC P0022 Camshaft Position "A" - Timing Over-Retarded (Bank 2)

for Preparation Click here

DESCRIPTION

The VVT system includes the ECM, Cam Timing Oil Control Valve (OCV) and VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. Camshaft timing control is performed according to engine operating conditions such as the intake air volume, throttle valve position and engine coolant temperature. The ECM controls the OCV, based on the signals transmitted by several sensors. The VVT controller regulates the intake camshaft angle using oil pressure through the OCV. As a result, the relative positions of the camshaft and crankshaft are optimized, the engine torque and fuel economy improve, and the exhaust emissions decrease under overall driving conditions. The ECM detects the actual intake valve timing using signals from the camshaft and crankshaft position sensors, and performs feedback control. This is how the target intake valve timing is verified by the ECM.



DTC Code	DTC Detection Condition	Trouble Area
P0011 P0021	The valve timing is not adjusted in the valve timing advance range (1 trip detection logic).	• Valve timing • Cam Timing Oil Control Valve (OCV) for intake side • OCV filter • Intake camshaft timing tube (for Bank 1, 2) • ECM
P0012 P0022	The valve timing is not adjusted in the valve timing retard range (2 trip detection logic).	• Valve timing • OCV for intake side • OCV filter • Intake camshaft timing tube (for Bank 1, 2) • ECM

MONITOR DESCRIPTION

The ECM optimizes the intake valve timing using the VVT (Variable Valve Timing) system to control the intake camshaft. The VVT system

includes the ECM, the Cam Timing Oil Control Valve (OCV) and the VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake camshaft.
If the difference between the target and actual intake valve timings is large, and changes in the actual intake valve timing are small, the ECM interprets this as the VVT controller stuck malfunction and stores a DTC.

Example:
A DTC is stored when the following conditions 1, 2 and 3 are met:

1. The difference between the target and actual intake valve timing is more than 5°CA (Crankshaft Angle) and the condition continues for more than 4.5 seconds.
2. It takes 5 seconds or more to change the valve timing by 5°CA.
3. After above conditions 1 and 2 are met, the OCV is forcibly activated 63 times or more.

DTC P0011 and P0021 (Advanced Cam Timing) are subject to 1 trip detection logic.
DTC P0012 and P0022 (Retarded Cam Timing) are subject to 2 trip detection logic.
These DTCs indicate that the VVT controller cannot operate properly due to OCV malfunctions or the presence of foreign objects in the OCV.
The monitor will run if all of the following conditions are met:

- The engine is warm (the engine coolant temperature is 75°C or higher).
- The vehicle has been driven at more than 64 km/h (40 mph) for 3 minutes.
- The engine has idled for 3 minutes.

WIRING DIAGRAM

Refer to DTC P0010 (Click here).

INSPECTION PROCEDURE

HINT:

DTC P0011, P0012, P0021 or P0022 may be stored when foreign objects in the engine oil are caught in some parts of the system. The DTC will remain stored even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

HINT:

Abnormal Bank	Advanced Timing Over (Valve Timing is Out of Specified Range)	Retarded Timing Over (Valve Timing is Out of Specified Range)
Bank 1	P0011	P0012
Bank 2	P0021	P0022

- **If DTC P0011 or P0012 is output, check the left bank VVT system for intake side circuit (for bank 1).**
- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **If DTC P0021 or P0022 is output, check the right bank VVT system for intake side circuit (for bank 2).**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHEC ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0011, P0012, P0021 or P0022 is output	A
P0011, P0012, P0021 or P0022 and other DTCs are output	B

HINT:

If any DTCs other than P0011, P0012, P0021 or P0022 are output, troubleshoot those DTCs first.

B → **GO TO DTC CHART (Click here)**

A

2.PERFORM ACTIVE TEST USING INTE IGENT TESTER (OPERATE OCV)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1) or Control the VVT System (Bank 2).

e. Check the engine speed while operating the Camshaft Oil Control Valve (OCV) using the tester.

O

Tester Operation	Specified Condition
OCV OFF	Normal engine speed
OCV ON	Engine idles roughly or stalls (soon after OCV switched from OFF to ON)

NG → Go to step 4

O

CHEC WHETHER DTC OUTPUT RECURS (DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester.

f. Drive the vehicle for more than 10 minutes.

g. Read DTCs using the tester.

O :
No DTC output.

NG → Go to step 4

O

CHEC OR INTERMITTENT PROB EMS (**Click here**)

4.CHEC A E TIMING (CHEC OR OOSE AND UMPED TOOTH OF TIMING BE T)

a. Remove the drive belt (Click here).

b. Remove the timing belt cover L and R (Click here).

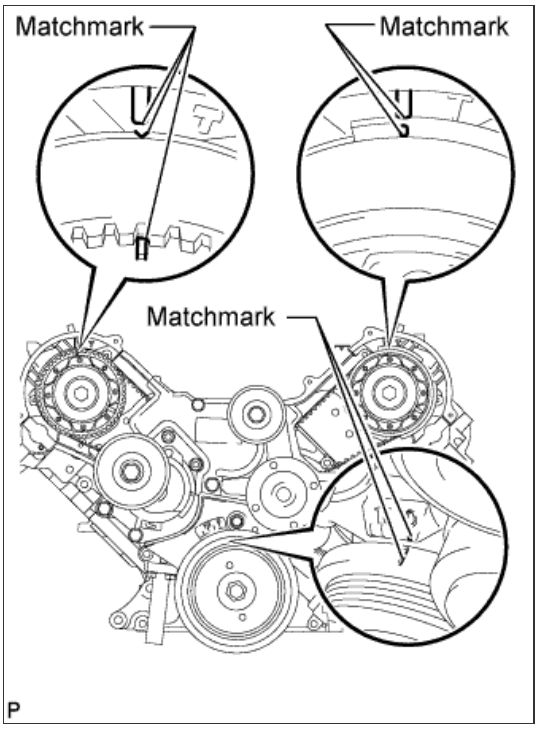
c. Turn the crankshaft to align the matchmarks of the crankshaft.

d. Align the notch of the crankshaft pulley with the "0" position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360°. Confirm again if the matchmarks are facing each other.

O :
The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NG → AD UST VA E TIMING (Click here)

O

INSPECT CAM TIMING OI CONTRO A E ASSEMB (OCV)

a. Remove the OCV.

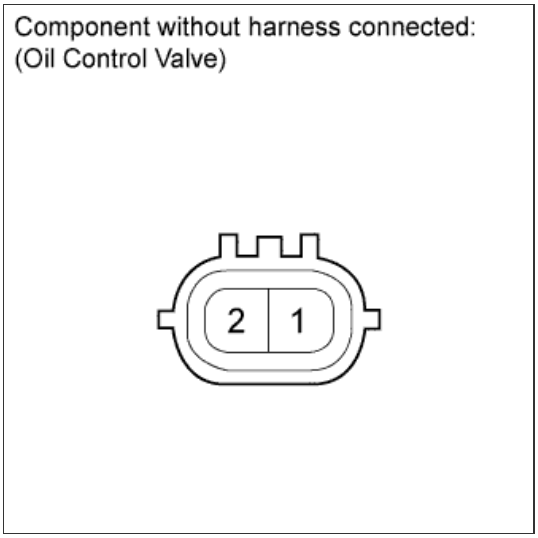
b. Measure the resistance according to the value(s) in the table below.

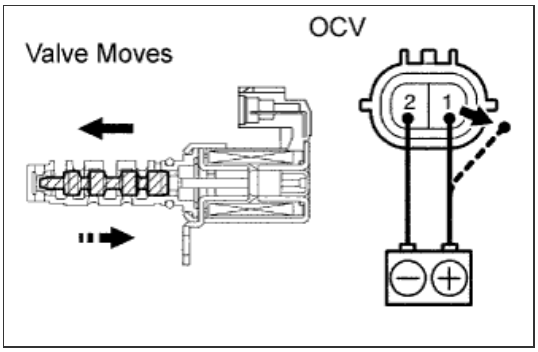
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (6 °F)	6. to 7. Ω

c. Apply positive battery voltage to terminal 1 and negative battery voltage to terminal 2. Check the valve operation.

O :
Valve moves quickly.





NG → REP ACE CAM TIMING OI CONTRO A E ASSEMB (Click here)

O

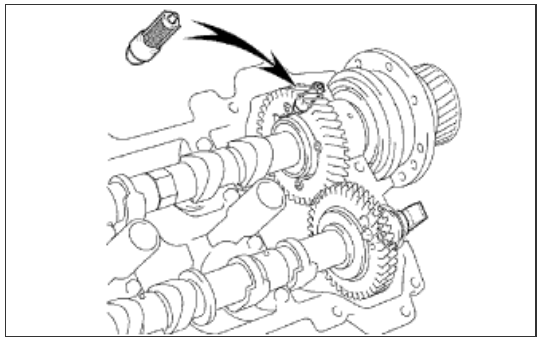
INSPECT OI CONTRO A E FI TER

a. Remove the cylinder head cover (Click here).

b. Remove the camshaft bearing cap and OCV filter.

c. Check that the filter is not clogged.

O :
Filter is not clogged.



NG → **CLEAN OIL CONTROL VALVE FILTER**

O

REPLACE CAMSHAFT TIMING TUBE ASSEMB

a. Replace the camshaft timing tube assembly.

HINT:

- **If P0011 or P0012 is output, replace the camshaft timing tube assembly for bank 1 (Click here).**
- **If P0021 or P0022 is output, replace the camshaft timing tube assembly for bank 2 (Click here).**

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester.

f. Drive the vehicle for more than 10 minutes.

g. Read output DTCs using the tester.

O :
No DTC is output.

HINT:

DTC P0011, P0012, P0021 or P0022 is output when foreign objects in the engine oil are caught in some parts of the system. These codes will stay stored even if the system returns to normal after a short time. These foreign objects are then captured by the oil filter, thus eliminating the source of the problem.

NG → **REPLACE ECM (Click here)**

O

SYSTEM O

DTC P0443 Evaporative Emission Control System Purge Control Valve Circuit

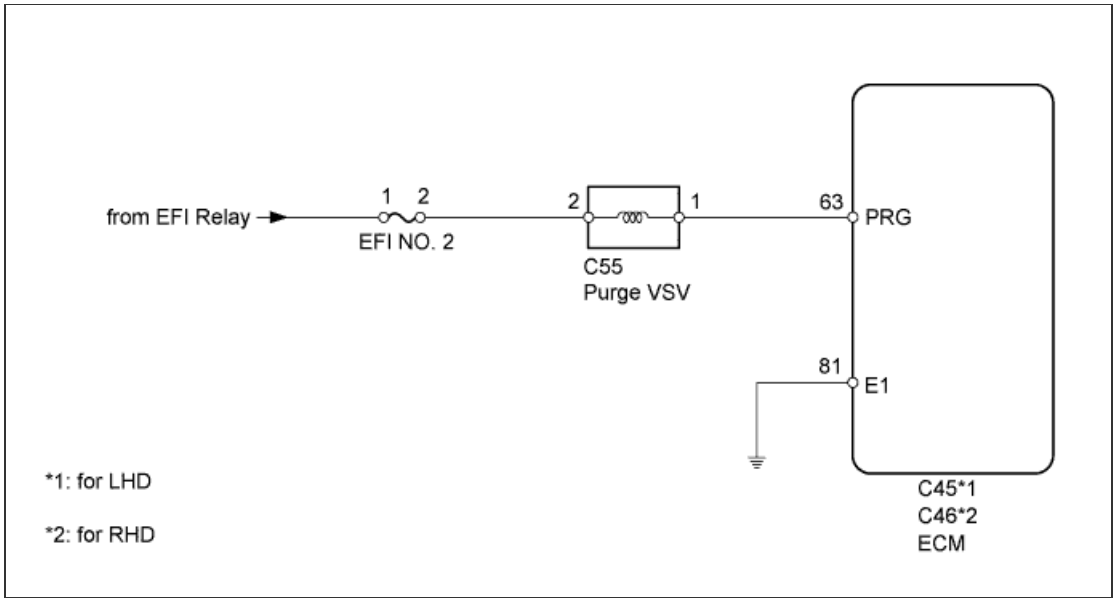
for Preparation Click here

DESCRIPTION

To reduce HC emissions, evaporated fuel from the fuel tank is routed through the canister to the intake manifold for combustion in the cylinders. The ECM changes the duty signal to the purge VSV so that the intake quantity of HC emissions is appropriate for the driving conditions (engine load, engine speed, vehicle speed, etc.) after the engine is warmed up.

DTC Code	DTC Detection Condition	Trouble Area
P0443	The proper response to the ECM command does not occur (1 trip detection logic).	• Open or short in purge VSV circuit • Purge VSV • ECM

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (PURGE VSV)

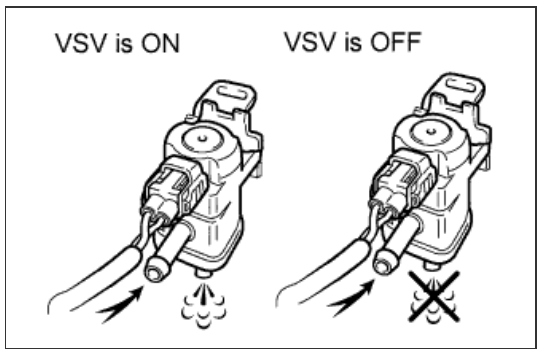
a. Disconnect the vacuum hose from the purge VSV.

b. Connect the intelligent tester to the DLC3.

c. Start the engine and turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the VSV for Evap Control.

e. Check if air is sucked into the port when operating the purge VSV using the intelligent tester.



OK:

Tester Operation	Specified Condition
VSV is ON	Suction of air
VSV is OFF	No suction of air

NG	Go to step 2

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

2.INSPECT PURGE VSV

a. Inspect the purge VSV (Click here).

NG → REPLACE PURGE VSV (Click here)

OK

3.INSPECT PURGE VSV (POWER SOURCE VOLTAGE)

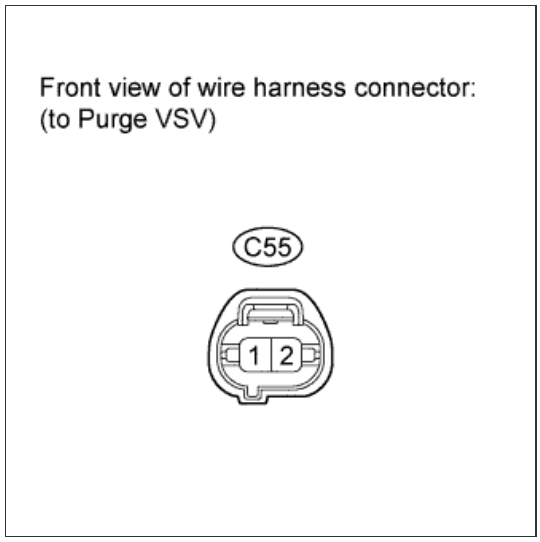
a. Disconnect the purge VSV connector.

b. Turn the engine switch on (IG).

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
C55-2 - Body ground	Always	11 to 14 V



NG → Go to step 5

OK

4.CHECK HARNESS AND CONNECTOR (PURGE VSV - ECM)

a. Disconnect the purge VSV connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

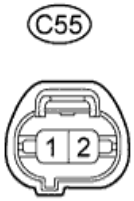
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C55-1 - C45-63 (PRG)	Always	Below 1 Ω
C55-1 or C45-63 (PRG) - Body ground	Always	10 kΩ or higher

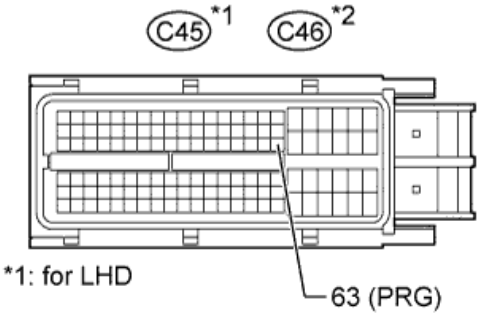
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C55-1 - C46-63 (PRG)	Always	Below 1 Ω
C55-1 or C46-63 (PRG) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Purge VSV)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

5.CHECK HARNESS AND CONNECTOR (PURGE VSV - EFI NO. 2 FUSE)

a. Disconnect the purge VSV connector.

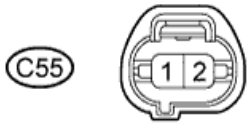
b. Remove the EFI No. 2 fuse from the engine room relay block.

c. Measure the resistance according to the value(s) in the table below.

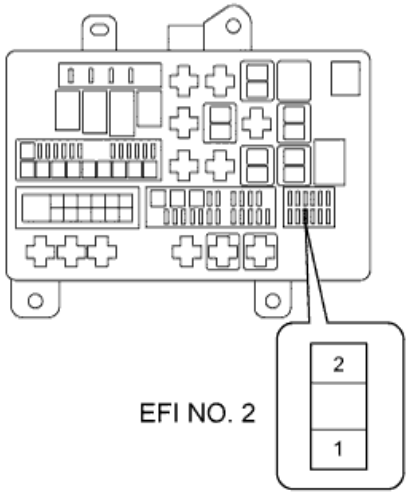
Standard Resistance:

Tester Connection	Condition	Specified Condition
C55-2 - EFI No. 2 fuse terminal 2	Always	Below 1 Ω
C55-2 or EFI No. 2 fuse terminal 2 - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Purge VSV)



Engine Room Relay Block:



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

DTC P0011 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)

DTC P0012 Camshaft Position "A" - Timing Over-Retarded (Bank 1)

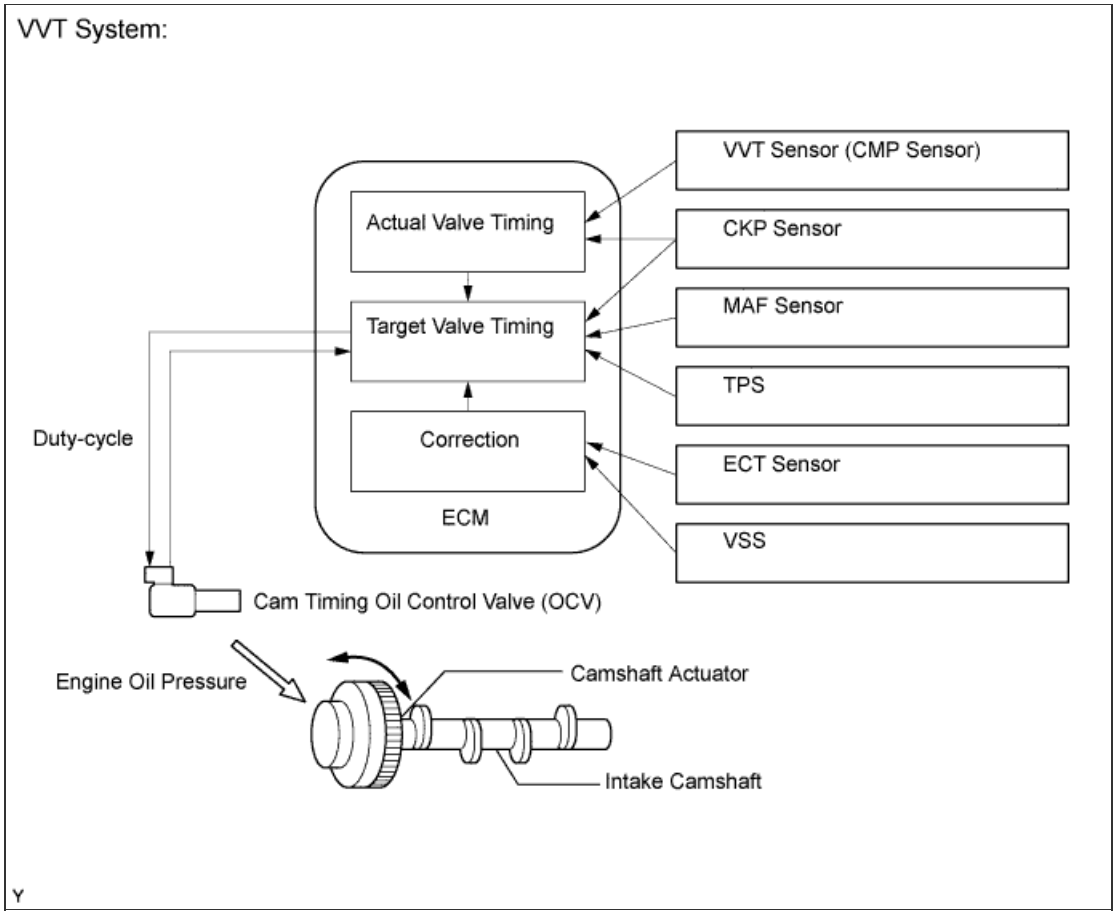
DTC P0021 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)

DTC P0022 Camshaft Position "A" - Timing Over-Retarded (Bank 2)

for Preparation Click here

DESCRIPTION

The VVT system includes the ECM, Cam Timing Oil Control Valve (OCV) and VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. Camshaft timing control is performed according to engine operating conditions such as the intake air volume, throttle valve position and engine coolant temperature. The ECM controls the OCV, based on the signals transmitted by several sensors. The VVT controller regulates the intake camshaft angle using oil pressure through the OCV. As a result, the relative positions of the camshaft and crankshaft are optimized, the engine torque and fuel economy improve, and the exhaust emissions decrease under overall driving conditions. The ECM detects the actual intake valve timing using signals from the camshaft and crankshaft position sensors, and performs feedback control. This is how the target intake valve timing is verified by the ECM.



DTC Code	DTC Detection Condition	Trouble Area
P0011 P0021	The valve timing is not adjusted in the valve timing advance range (1 trip detection logic).	• Valve timing • Cam Timing Oil Control Valve (OCV) for intake side • OCV filter • Intake camshaft timing tube (for Bank 1, 2) • ECM
P0012 P0022	The valve timing is not adjusted in the valve timing retard range (2 trip detection logic).	• Valve timing • OCV for intake side • OCV filter • Intake camshaft timing tube (for Bank 1, 2) • ECM

MONITOR DESCRIPTION

The ECM optimizes the intake valve timing using the VVT (Variable Valve Timing) system to control the intake camshaft. The VVT system

includes the ECM, the Cam Timing Oil Control Valve (OCV) and the VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake camshaft.
If the difference between the target and actual intake valve timings is large, and changes in the actual intake valve timing are small, the ECM interprets this as the VVT controller stuck malfunction and stores a DTC.

Example:
A DTC is stored when the following conditions 1, 2 and 3 are met:

1. The difference between the target and actual intake valve timing is more than 5°CA (Crankshaft Angle) and the condition continues for more than 4.5 seconds.
2. It takes 5 seconds or more to change the valve timing by 5°CA.
3. After above conditions 1 and 2 are met, the OCV is forcibly activated 63 times or more.

DTC P0011 and P0021 (Advanced Cam Timing) are subject to 1 trip detection logic.
DTC P0012 and P0022 (Retarded Cam Timing) are subject to 2 trip detection logic.
These DTCs indicate that the VVT controller cannot operate properly due to OCV malfunctions or the presence of foreign objects in the OCV.
The monitor will run if all of the following conditions are met:

- The engine is warm (the engine coolant temperature is 75°C or higher).
- The vehicle has been driven at more than 64 km/h (40 mph) for 3 minutes.
- The engine has idled for 3 minutes.

WIRING DIAGRAM

Refer to DTC P0010 (Click here).

INSPECTION PROCEDURE

HINT:

DTC P0011, P0012, P0021 or P0022 may be stored when foreign objects in the engine oil are caught in some parts of the system. The DTC will remain stored even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

HINT:

Abnormal Bank	Advanced Timing Over (Valve Timing is Out of Specified Range)	Retarded Timing Over (Valve Timing is Out of Specified Range)
Bank 1	P0011	P0012
Bank 2	P0021	P0022

- **If DTC P0011 or P0012 is output, check the left bank VVT system for intake side circuit (for bank 1).**
- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **If DTC P0021 or P0022 is output, check the right bank VVT system for intake side circuit (for bank 2).**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHEC ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0011, P0012, P0021 or P0022 is output	A
P0011, P0012, P0021 or P0022 and other DTCs are output	B

HINT:

If any DTCs other than P0011, P0012, P0021 or P0022 are output, troubleshoot those DTCs first.

B → **GO TO DTC CHART (Click here)**

A

2.PERFORM ACTIVE TEST USING INTE IGENT TESTER (OPERATE OCV)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1) or Control the VVT System (Bank 2).

e. Check the engine speed while operating the Camshaft Oil Control Valve (OCV) using the tester.

O

Tester Operation	Specified Condition
OCV OFF	Normal engine speed
OCV ON	Engine idles roughly or stalls (soon after OCV switched from OFF to ON)

NG → Go to step 4

O

CHEC WHETHER DTC OUTPUT RECURS (DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester.

f. Drive the vehicle for more than 10 minutes.

g. Read DTCs using the tester.

O :
No DTC output.

NG → Go to step 4

O

CHEC OR INTERMITTENT PROB EMS (**Click here**)

4.CHEC A E TIMING (CHEC OR OOSE AND UMPED TOOTH OF TIMING BE T)

a. Remove the drive belt (Click here).

b. Remove the timing belt cover L and R (Click here).

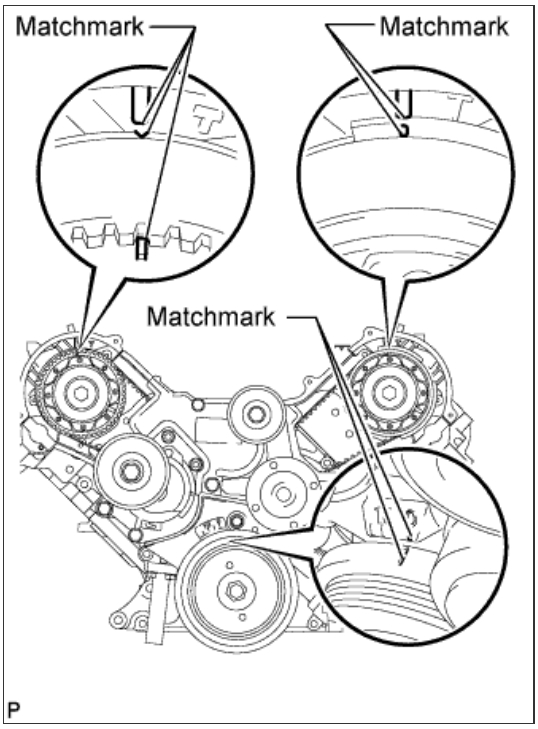
c. Turn the crankshaft to align the matchmarks of the crankshaft.

d. Align the notch of the crankshaft pulley with the "0" position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360°. Confirm again if the matchmarks are facing each other.

O :
The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NG → AD UST VA E TIMING (Click here)

O

INSPECT CAM TIMING OI CONTRO A E ASSEMB (OCV)

a. Remove the OCV.

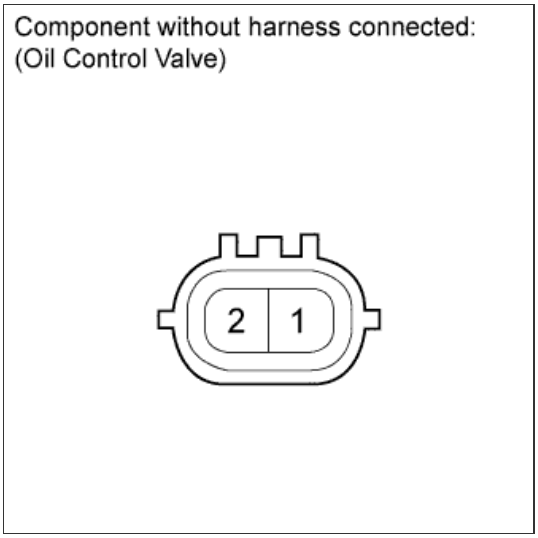
b. Measure the resistance according to the value(s) in the table below.

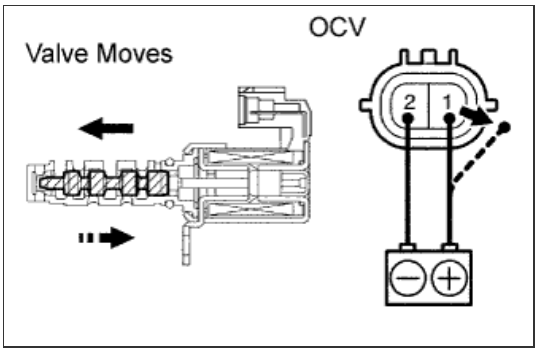
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (6 °F)	6. to 7. Ω

c. Apply positive battery voltage to terminal 1 and negative battery voltage to terminal 2. Check the valve operation.

O :
Valve moves quickly.





NG → REP ACE CAM TIMING OI CONTRO A E ASSEMB (Click here)

O

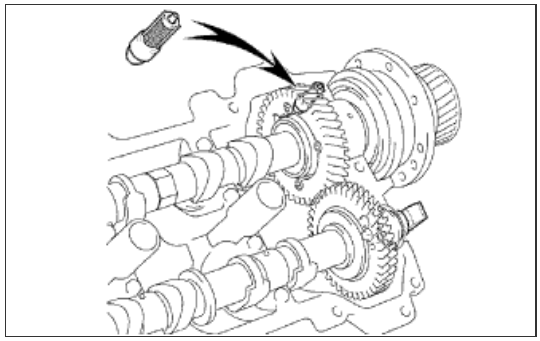
INSPECT OI CONTRO A E FI TER

a. Remove the cylinder head cover (Click here).

b. Remove the camshaft bearing cap and OCV filter.

c. Check that the filter is not clogged.

O :
Filter is not clogged.



NG → **CLEAN OIL CONTROL VALVE FILTER**

O

REPLACE CAMSHAFT TIMING TUBE ASSEMB

a. Replace the camshaft timing tube assembly.

HINT:

- **If P0011 or P0012 is output, replace the camshaft timing tube assembly for bank 1 (Click here).**
- **If P0021 or P0022 is output, replace the camshaft timing tube assembly for bank 2 (Click here).**

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester.

f. Drive the vehicle for more than 10 minutes.

g. Read output DTCs using the tester.

O :
No DTC is output.

HINT:

DTC P0011, P0012, P0021 or P0022 is output when foreign objects in the engine oil are caught in some parts of the system. These codes will stay stored even if the system returns to normal after a short time. These foreign objects are then captured by the oil filter, thus eliminating the source of the problem.

NG → **REPLACE ECM (Click here)**

O

SYSTEM O

DTC P0500 Vehicle Speed Sensor "A"

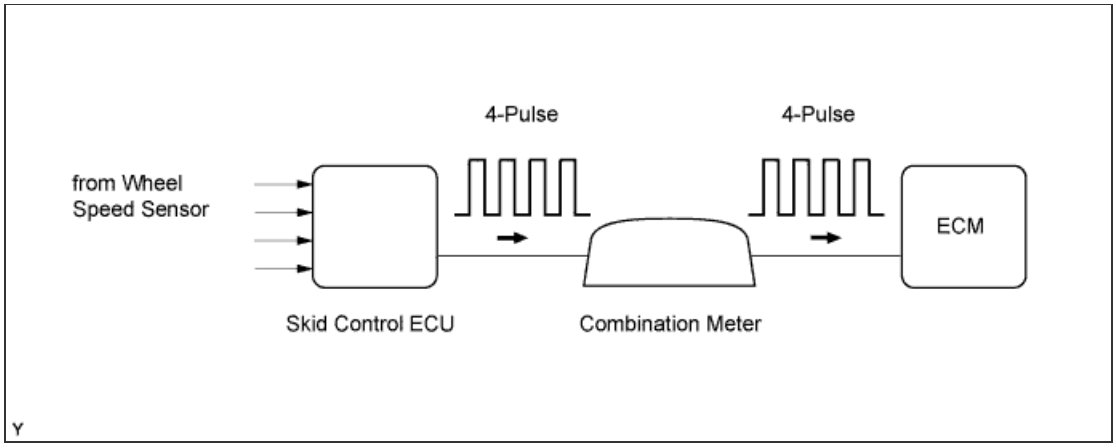
for Preparation Click here

DESCRIPTION

The speed sensor detects the wheel speed and sends the appropriate signals to the skid control ECU. The skid control ECU converts these wheel speed signals into a 4-pulse signal and outputs it to the ECM via the combination meter. The ECM determines the vehicle speed based on the frequency of these pulse signals.

HINT:

- **A voltage of 12 V or 5 V is output from each ECU and then input to the combination meter. The signal is changed to a pulse signal at the transistor in the combination meter. Each ECU controls the respective system based on the pulse signal.**
- **If a short occurs in any of the ECUs or in the wire harness connected to an ECU, all systems in the diagram below will not operate normally.**

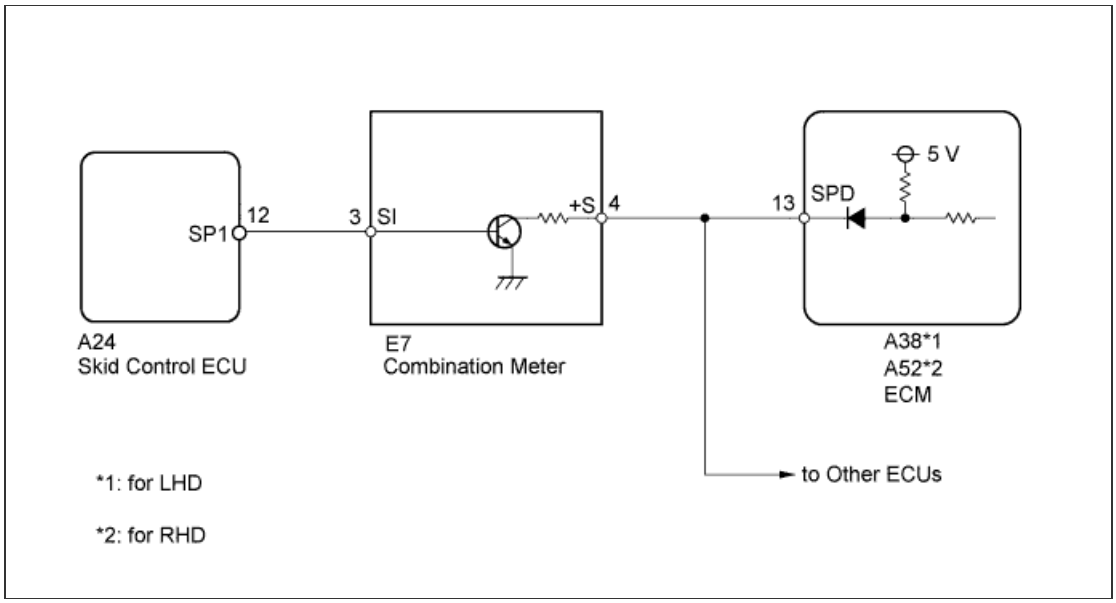


DTC Code	DTC Detection Condition	Trouble Area
P0500	While the vehicle is being driven, no vehicle speed sensor signal is transmitted to the ECM (2 trip detection logic).	• Open or short in speed signal circuit • Combination meter • ECM • Skid control ECU

MONITOR DESCRIPTION

The ECM assumes that the vehicle is being driven when the indicated vehicle speed is more than km/h (5.6 mph). If there is no speed signal from the combination meter despite these conditions being met, the ECM interprets this as a malfunction in the speed signal circuit. The ECM then illuminates the MIL and stores the DTC.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK OPERATION OF SPEEDOMETER

a. Drive the vehicle and check whether the operation of the speedometer in the combination meter is normal.

OK:
Speedometer operation is normal.

HINT:

- **The vehicle speed sensor is operating normally if the speedometer reading is normal.**
- **If the speedometer does not operate, check it by following the procedure described in Speedometer Malfunction (Click here).**

NG → GO TO MALFUNCTION IN SPEEDOMETER (Click here)

OK

2.READ VALUE USING INTELLIGENT TESTER (VEHICLE SPD)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / Vehicle Speed.

e. Drive the vehicle.

f. Read the value displayed on the tester.

OK:
Vehicle speeds displayed on tester and speedometer display are equal.

NG → Go to step 3

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

3.CHECK HARNESS AND CONNECTOR (COMBINATION METER ASSEMBLY - ECM)

a. Disconnect the combination meter connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
E -4 (+S) - A38- 3 (SPD)	Always	Below Ω
E -4 (+S) or A38- 3 (SPD) - Body ground	Always	0 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
E -4 (+S) - A52- 3 (SPD)	Always	Below Ω
E -4 (+S) or A52- 3 (SPD) - Body ground	Always	0 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

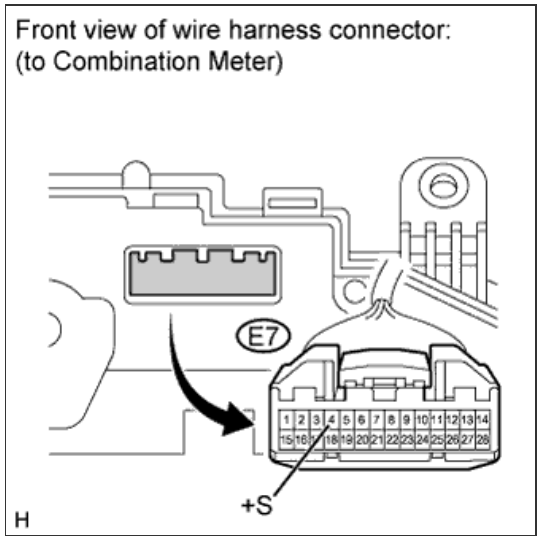
4.CHECK COMBINATION METER ASSEMBLY (+S VOLTAGE)

a. Disconnect the combination meter connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
E -4 (+S) - Body ground	Engine switch on (IG)	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

5.CHECK COMBINATION METER ASSEMBLY (SPD SIGNAL WAVEFORM)

a. Move the shift lever to N.

b. ack up the vehicle.

c. Measure the voltage according to the value(s) in the table below.

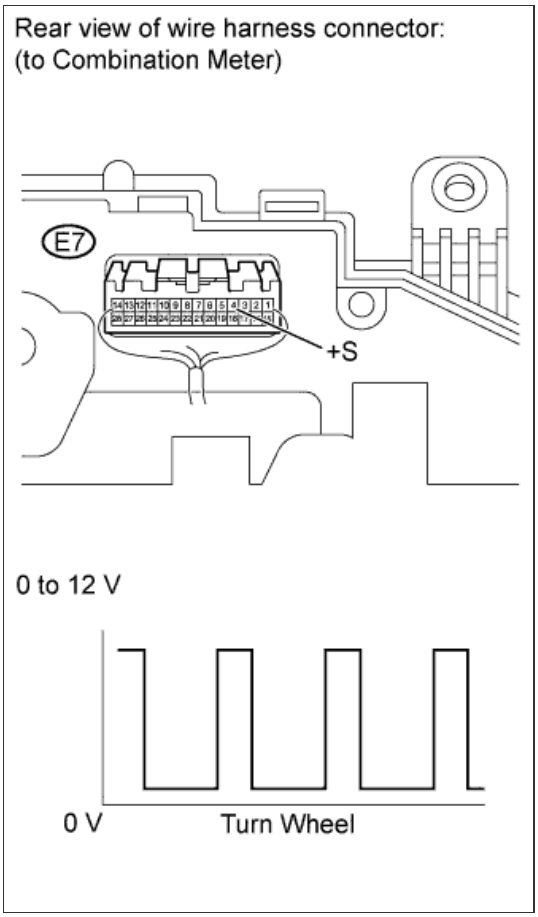
Standard Voltage:

Tester Connection	Condition	Specified Condition
E -4 (+S) - Body ground	• Engine switch on (IG) • Wheel is	Voltage generated intermittently

	turned slowly	

HINT:

The output voltage should fluctuate up and down, similarly to the diagram, when the wheel is turned slowly.



NG → Go to step 6

OK

REPLACE ECM (Click here)

6.CHECK COMBINATION METER ASSEMBLY (SPD SIGNAL WAVEFORM)

a. Move the shift lever to N.

b. ack up the vehicle.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

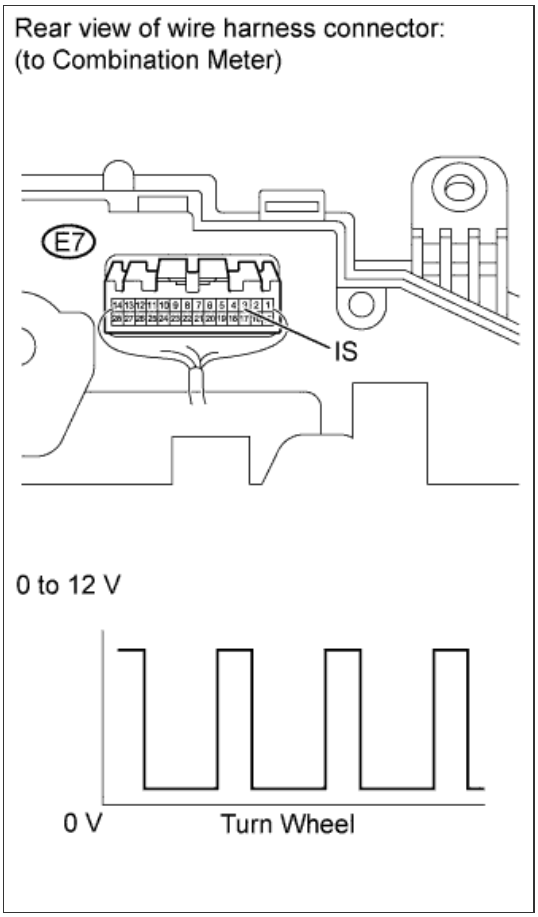
Tester Connection	Condition	Specified Condition
E -3 (IS) - Body ground	• Engine switch on (IG) • Wheel is turned slowly	Voltage generated intermittently

Result

Result	Proceed to
NG	A
O (w/ Multi-information Display)	B
O (w/o Multi-information Display)	C

HINT:

The output voltage should fluctuate up and down, similarly to the diagram, when the wheel is turned slowly.



B	REPLACE COMBINATION METER ASSEMBLY (Click here)
C	REPLACE COMBINATION METER ASSEMBLY (Click here)

A

7.CHECK HARNESS AND CONNECTOR (COMBINATION METER ASSEMBLY - SKID CONTROL ECU)

a. Disconnect the combination meter connector.

b. Disconnect the skid control ECU connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
E -3 (IS) - A24- 2 (SPD)	Always	Below Ω
E -3 (IS) or A24- 2 (SPD) - Body ground	Always	0 kΩ or higher

Result

Result	Proceed to
NG	A
O (for LHD)	B
O (for RHD)	C

B	REPLACE MASTER CYLINDER SOLENOID (Click here)
C	REPLACE MASTER CYLINDER SOLENOID (Click here)

A

REPAIR OR REPLACE HARNESS OR CONNECTOR

DTC P0011 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)

DTC P0012 Camshaft Position "A" - Timing Over-Retarded (Bank 1)

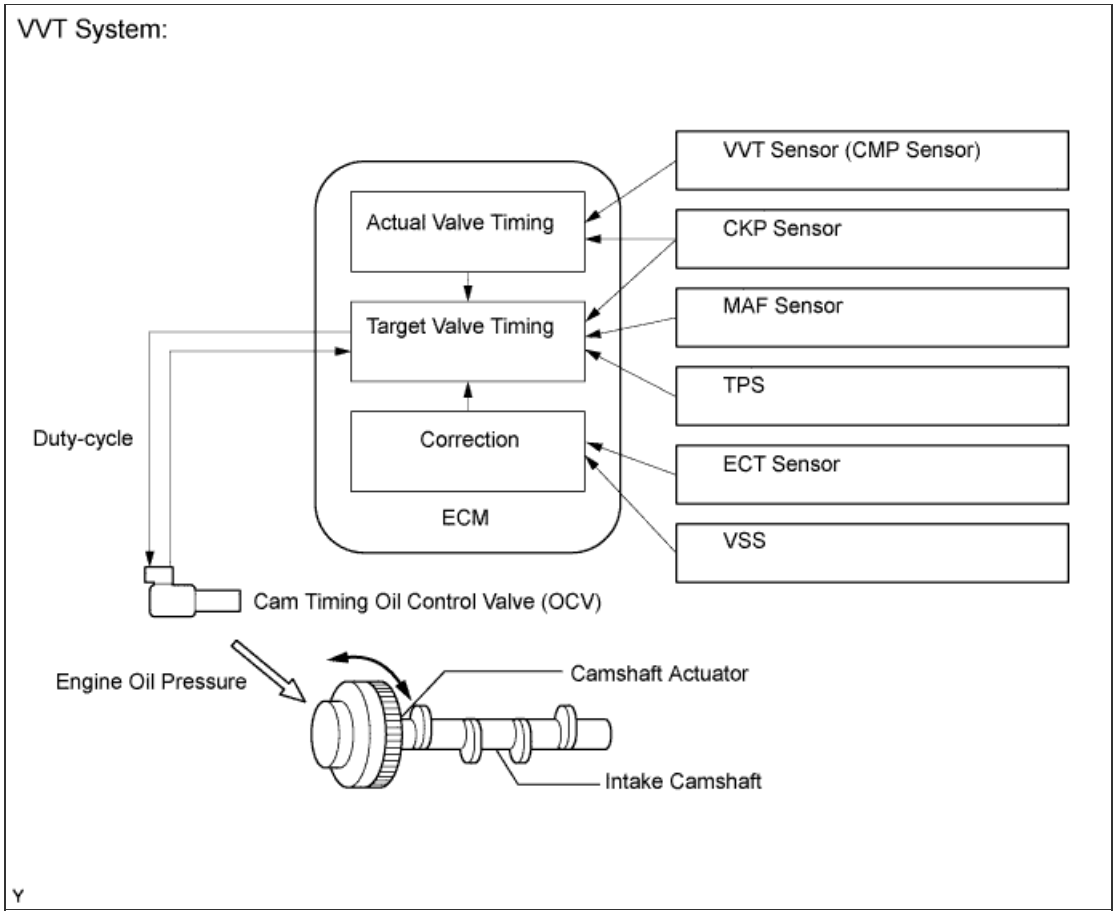
DTC P0021 Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)

DTC P0022 Camshaft Position "A" - Timing Over-Retarded (Bank 2)

for Preparation Click here

DESCRIPTION

The VVT system includes the ECM, Cam Timing Oil Control Valve (OCV) and VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. Camshaft timing control is performed according to engine operating conditions such as the intake air volume, throttle valve position and engine coolant temperature. The ECM controls the OCV, based on the signals transmitted by several sensors. The VVT controller regulates the intake camshaft angle using oil pressure through the OCV. As a result, the relative positions of the camshaft and crankshaft are optimized, the engine torque and fuel economy improve, and the exhaust emissions decrease under overall driving conditions. The ECM detects the actual intake valve timing using signals from the camshaft and crankshaft position sensors, and performs feedback control. This is how the target intake valve timing is verified by the ECM.



DTC Code	DTC Detection Condition	Trouble Area
P0011 P0021	The valve timing is not adjusted in the valve timing advance range (1 trip detection logic).	• Valve timing • Cam Timing Oil Control Valve (OCV) for intake side • OCV filter • Intake camshaft timing tube (for Bank 1, 2) • ECM
P0012 P0022	The valve timing is not adjusted in the valve timing retard range (2 trip detection logic).	• Valve timing • OCV for intake side • OCV filter • Intake camshaft timing tube (for Bank 1, 2) • ECM

MONITOR DESCRIPTION

The ECM optimizes the intake valve timing using the VVT (Variable Valve Timing) system to control the intake camshaft. The VVT system

includes the ECM, the Cam Timing Oil Control Valve (OCV) and the VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake camshaft.
If the difference between the target and actual intake valve timings is large, and changes in the actual intake valve timing are small, the ECM interprets this as the VVT controller stuck malfunction and stores a DTC.

Example:
A DTC is stored when the following conditions 1, 2 and 3 are met:

1. The difference between the target and actual intake valve timing is more than 5°CA (Crankshaft Angle) and the condition continues for more than 4.5 seconds.
2. It takes 5 seconds or more to change the valve timing by 5°CA.
3. After above conditions 1 and 2 are met, the OCV is forcibly activated 63 times or more.

DTC P0011 and P0021 (Advanced Cam Timing) are subject to 1 trip detection logic.
DTC P0012 and P0022 (Retarded Cam Timing) are subject to 2 trip detection logic.
These DTCs indicate that the VVT controller cannot operate properly due to OCV malfunctions or the presence of foreign objects in the OCV.
The monitor will run if all of the following conditions are met:

- The engine is warm (the engine coolant temperature is 75°C or higher).
- The vehicle has been driven at more than 64 km/h (40 mph) for 3 minutes.
- The engine has idled for 3 minutes.

WIRING DIAGRAM

Refer to DTC P0010 (Click here).

INSPECTION PROCEDURE

HINT:

DTC P0011, P0012, P0021 or P0022 may be stored when foreign objects in the engine oil are caught in some parts of the system. The DTC will remain stored even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

HINT:

Abnormal Bank	Advanced Timing Over (Valve Timing is Out of Specified Range)	Retarded Timing Over (Valve Timing is Out of Specified Range)
Bank 1	P0011	P0012
Bank 2	P0021	P0022

- **If DTC P0011 or P0012 is output, check the left bank VVT system for intake side circuit (for bank 1).**
- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **If DTC P0021 or P0022 is output, check the right bank VVT system for intake side circuit (for bank 2).**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHEC ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0011, P0012, P0021 or P0022 is output	A
P0011, P0012, P0021 or P0022 and other DTCs are output	B

HINT:

If any DTCs other than P0011, P0012, P0021 or P0022 are output, troubleshoot those DTCs first.

B → **GO TO DTC CHART (Click here)**

A

2.PERFORM ACTIVE TEST USING INTE IGENT TESTER (OPERATE OCV)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1) or Control the VVT System (Bank 2).

e. Check the engine speed while operating the Camshaft Oil Control Valve (OCV) using the tester.

O

Tester Operation	Specified Condition
OCV OFF	Normal engine speed
OCV ON	Engine idles roughly or stalls (soon after OCV switched from OFF to ON)

NG → Go to step 4

O

CHEC WHETHER DTC OUTPUT RECURS (DTC P0011, P0012, P0021 OR P0022)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester.

f. Drive the vehicle for more than 10 minutes.

g. Read DTCs using the tester.

O :
No DTC output.

NG → Go to step 4

O

CHEC OR INTERMITTENT PROB EMS (**Click here**)

4.CHEC A E TIMING (CHEC OR OOSE AND UMPED TOOTH OF TIMING BE T)

a. Remove the drive belt (Click here).

b. Remove the timing belt cover L and R (Click here).

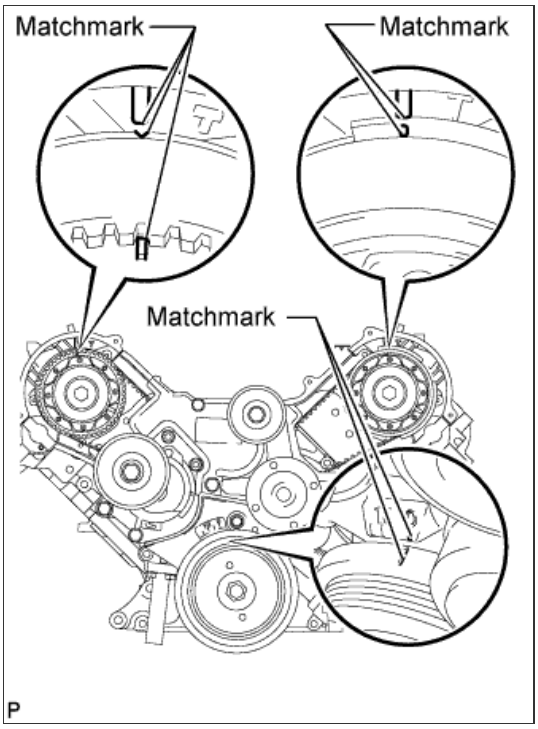
c. Turn the crankshaft to align the matchmarks of the crankshaft.

d. Align the notch of the crankshaft pulley with the "0" position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360°. Confirm again if the matchmarks are facing each other.

O :
The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NG → AD UST VA E TIMING (Click here)

O

INSPECT CAM TIMING OI CONTRO A E ASSEMB (OCV)

a. Remove the OCV.

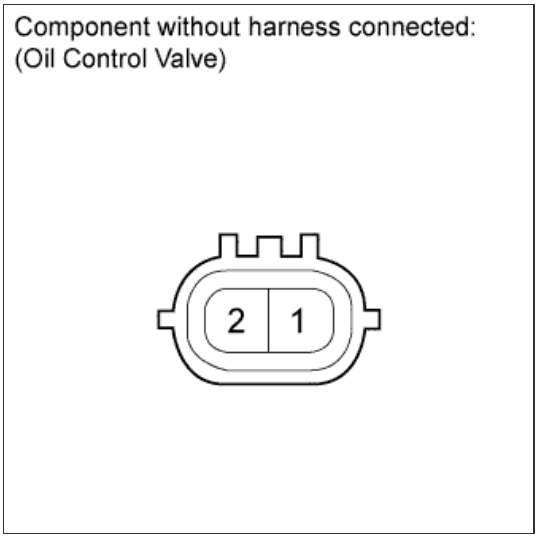
b. Measure the resistance according to the value(s) in the table below.

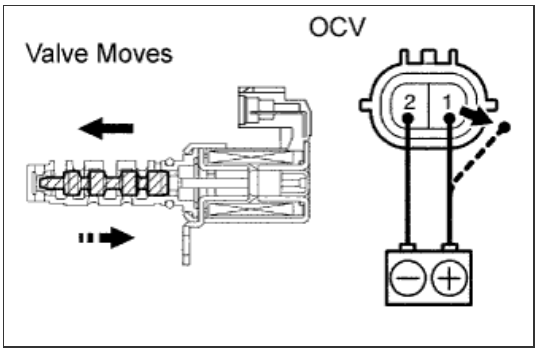
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (6 °F)	6. to 7. Ω

c. Apply positive battery voltage to terminal 1 and negative battery voltage to terminal 2. Check the valve operation.

O :
Valve moves quickly.





NG → REP ACE CAM TIMING OI CONTRO A E ASSEMB (Click here)

O

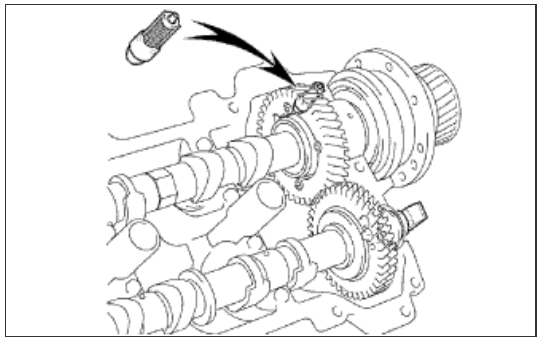
INSPECT OI CONTRO A E FI TER

a. Remove the cylinder head cover (Click here).

b. Remove the camshaft bearing cap and OCV filter.

c. Check that the filter is not clogged.

O :
Filter is not clogged.



NG → **CLEAN OIL CONTROL VALVE FILTER**

O

REPLACE CAMSHAFT TIMING TUBE ASSEMB

a. Replace the camshaft timing tube assembly.

HINT:

- **If P0011 or P0012 is output, replace the camshaft timing tube assembly for bank 1 (Click here).**
- **If P0021 or P0022 is output, replace the camshaft timing tube assembly for bank 2 (Click here).**

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester.

f. Drive the vehicle for more than 10 minutes.

g. Read output DTCs using the tester.

O :
No DTC is output.

HINT:

DTC P0011, P0012, P0021 or P0022 is output when foreign objects in the engine oil are caught in some parts of the system. These codes will stay stored even if the system returns to normal after a short time. These foreign objects are then captured by the oil filter, thus eliminating the source of the problem.

NG → **REPLACE ECM (Click here)**

O

SYSTEM O

DTC P0504 Brake Switch "A" / "B" Correlation

for Preparation Click here

DESCRIPTION

The stop light switch is a duplex system that transmits two signals: STP and ST1-. These two signals are used by the ECM to monitor whether or not the brake system is working properly. If the signals, which indicate the brake pedal is being depressed and released, are detected simultaneously, the ECM interprets this as a malfunction in the stop light switch and stores the DTC.

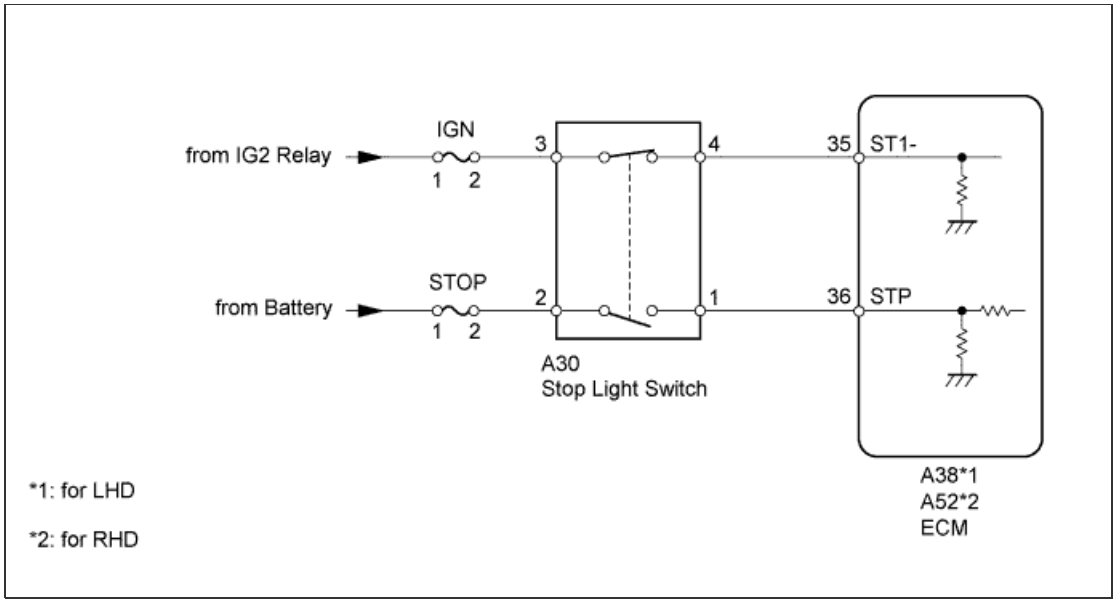
HINT:

The normal conditions are as shown in the table below. The signals can be read using the intelligent tester.

Signal	Brake Pedal Released	In Transition	Brake Pedal Depressed
STP	OFF	ON	ON
ST1-	ON	ON	OFF

DTC Code	DTC Detection Condition	Trouble Area
P0504	Conditions (a), (b) and (c) continue for 0.5 seconds or more (1 trip detection logic): (a) The engine switch is on (IG). (b) The brake pedal is released. (c) The STP signal is OFF when the ST1- signal is OFF.	• Short in stop light switch signal circuit • STOP fuse • IGN fuse • Stop light switch • ECM

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **STP signal conditions can be checked using the intelligent tester.**
  - **. Connect the intelligent tester to the DLC3.**
  - **. Turn the engine switch on (IG .**
  3. **Turn the tester on.**
  4. **Enter the following menus: Powertrain / Engine and ECT / All Data / Stop Light Switch.**
  5. **Check the STP signal when the brake pedal is depressed and released.**

Brake Pedal Operation	Specified Condition

Depressed	STP signal ON
Released	STP signal OFF

.CHECK STOP LIGHT SWITCH ASSEMBLY (B+ VOLTAGE

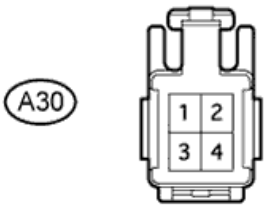
a. Disconnect the stop light switch connector.

b. Measure the oltage according to the alue(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
A30-2 - Body ground	Always	11 to 14 V
A30-3 - Body ground	Engine switch on (IG)	11 to 14 V

Front view of wire Harness connector:
(to Stop Light Switch)



NG → Go to step 4

OK

.INSPECT STOP LIGHT SWITCH ASSEMBLY

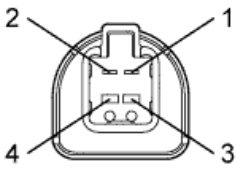
a. Remo e the stop light switch.

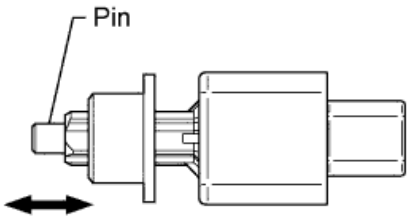
b. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

Tester Connection	Switch Condition	Specified Condition
1 - 2	Switch pin not pushed	Below 1 Ω
	Switch pin pushed	10 kΩ or higher
3 - 4	Switch pin not pushed	10 kΩ or higher
	Switch pin pushed	Below 1 Ω

Component without harness connected:
(Stop Light Switch)





NG → REPLACE STOP LIGHT SWITCH ASSEMBLY (Click here

OK

3.CHECK ECM (STP AND ST - VOLTAGE

a. Disconnect the ECM connector.

b. Turn the engine switch on (IG).

c. Measure the oltage according to the alue(s) in the table below.

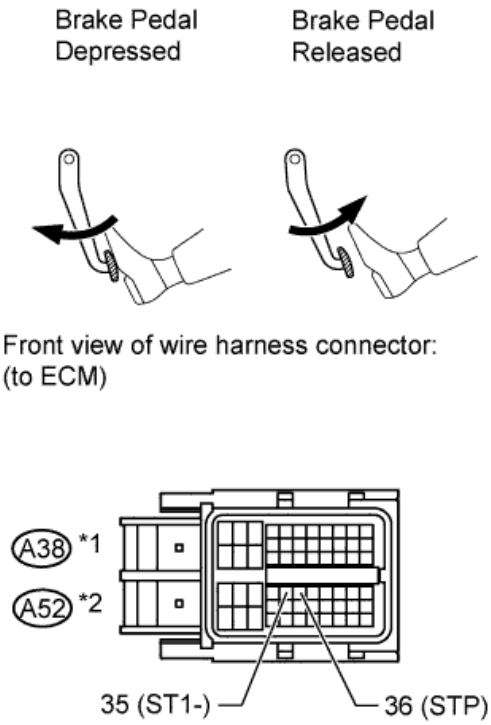
Standard Voltage (for LHD :

Tester Connection	Condition	Specified Condition

A38-35 (ST1-) - Body ground	Brake pedal released	11 to 14 V
	Brake pedal depressed	0 to 3 V
A38-36 (STP) - Body ground	Brake pedal released	0 to 3 V
	Brake pedal depressed	11 to 14 V

Standard Voltage (for RHD :

Tester Connection	Condition	Specified Condition
A52-35 (ST1-) - Body ground	Brake pedal released	11 to 14 V
	Brake pedal depressed	0 to 3 V
A52-36 (STP) - Body ground	Brake pedal released	0 to 3 V
	Brake pedal depressed	11 to 14 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK →

REPLACE ECM (Click here

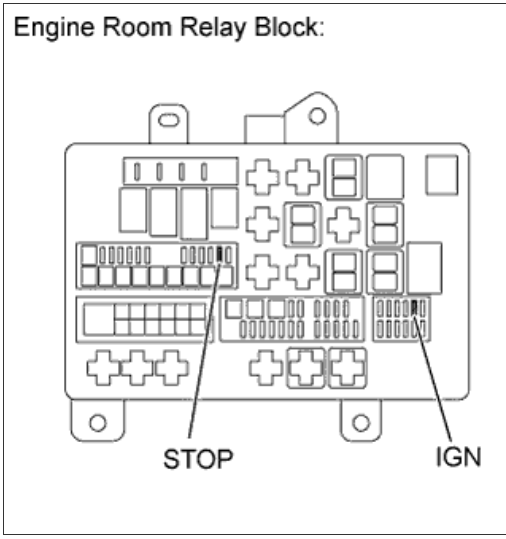
4.INSPECT FUSE (STOP AND IGN

a. Remo e the STOP and IGN fuses from the engine room relay block.

b. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
STOP fuse	Always	Below 1 Ω
IGN fuse	Always	Below 1 Ω



NG → CHECK FOR SHORTS IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

OK →

REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - STOP LIGHT SWITCH

DTC P0016 Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)

DTC P0018 Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor A)

for Preparation Click here

DESCRIPTION

In the VVT (Variable Valve Timing) system, the appropriate intake valve open and close timing is controlled by the ECM. The ECM performs intake valve control by performing the following: 1) controlling the camshaft and camshaft oil control valve, and operating the camshaft timing gear; and 2) changing the relative positions of the gaps between the camshaft and crankshaft.

DTC Code	DTC Detection Condition	Trouble Area
P0016	Deviation in the crankshaft position sensor signal and VVT sensor 1 (for intake side of bank 1) signal (2 trip detection logic).	• Mechanical system (Timing belt has jumped tooth or belt stretched) • Oil control valve • Camshaft timing tube • ECM
P0018	Deviation in the crankshaft position sensor signal and VVT sensor 2 (for intake side of bank 2) signal (2 trip detection logic).	• Mechanical system (Timing belt has jumped tooth or belt stretched) • Oil control valve • Camshaft timing tube • ECM

MONITOR DESCRIPTION

To monitor the correlation of the intake camshaft position and crankshaft position, the ECM checks the VVT learning value while the engine is idling. The VVT learning value is calibrated based on the camshaft position and crankshaft position. The intake valve timing is set to the most retarded angle while the engine is idling. If the VVT learning value is out of the specified range in consecutive driving cycles, the ECM illuminates the MIL and stores DTC P0016 (for bank 1) or P0018 (for bank 2).

WIRING DIAGRAM

Refer to DTC P0335 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0016 OR P0018)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0016 or P0018 is output	A
P0016 or P0018 and other DTCs are output	B

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTE IGENT TESTER (OPERATE OCV)

HINT:

If the VVT system can be operated through the Active Test, it can be assumed that the VVT system is operating normally.

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1) or Control the VVT System (Bank 2) / All Data / VVT Change Angle (Bank 1) or VVT Change Angle (Bank 2).

e. Perform the Active Test. Check that the displacement angle varies.

OK:
Varies.

NG → Go to step 4

OK

3.CHECK VA E TIMING

a. Remove the drive belt (Click here).

b. Remove the timing belt cover LH and RH (Click here).

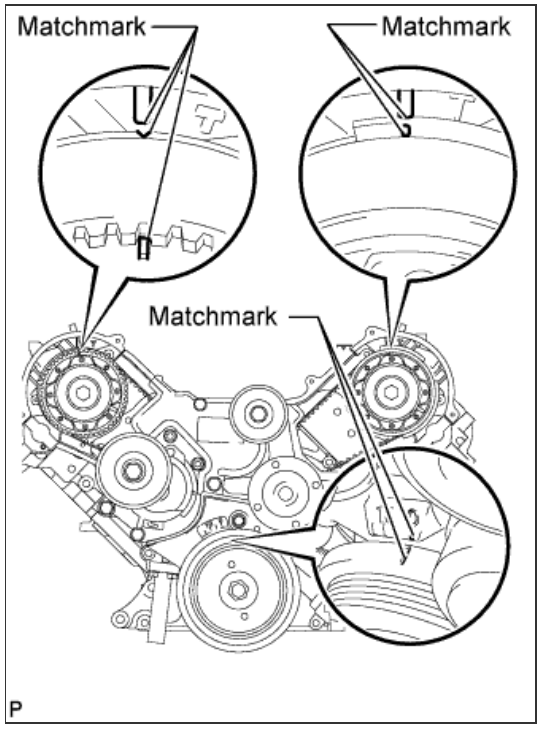
c. Turn the crankshaft to align the matchmarks of the crankshaft.

d. Align the notch of the crankshaft pulley with the "0" position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360°. Confirm again if the matchmarks are facing each other.

OK:
The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NE T → Go to step 6

4.INSPECT CAMSHAFT OI CONTRO A E

a. Remove the OCV.

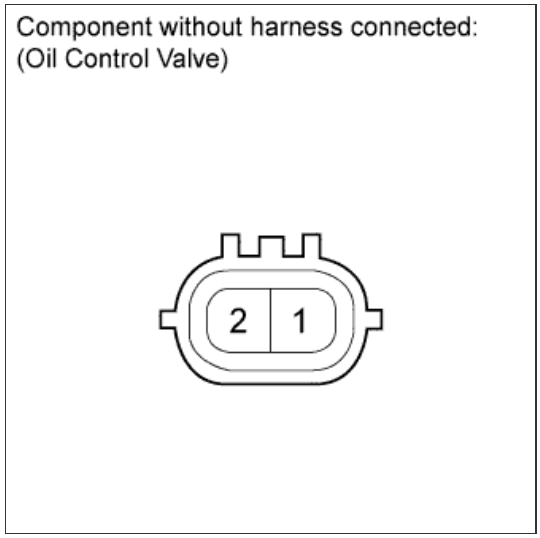
b. Measure the resistance according to the value(s) in the table below.

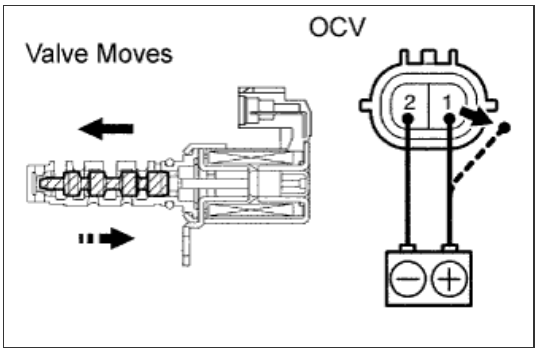
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

c. Apply positive battery voltage to terminal 1 and negative battery voltage to terminal 2. Check the valve operation.

OK:
Valve moves uickly.





NG → REP ACE CAMSHAFT OI CONTRO A E (Click here)

OK

5.REP ACE CAMSHAFT TIMING TUBE ASSEMB Y

a. Replace the camshaft timing tube assembly.

HINT:

- **P0016 is output, replace the camshaft timing tube assembly for bank 1 (Click here).**
- **P0018 is output, replace the camshaft timing tube assembly for bank 2 (Click here).**

NE T

6.CONFIRM WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear the DTC (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. Drive the vehicle in an urban area for approximately 10 minutes.

g. Read DTCs using the tester.

OK:
No DTC is output.

NG → GO TO DTC CHART (Click here)

OK

END

DTC P0505 Idle Control System Malfunction

for Preparation Click here

DESCRIPTION

The idling speed is controlled by the ETCS (Electronic Throttle Control System). The ETCS is comprised of: 1) the one valve type throttle body; 2) the throttle actuator, which operates the throttle valve; 3) the Throttle Position (TP) sensor, which detects the opening angle of the throttle valve; 4) the Accelerator Pedal Position (APP) sensor, which detects the accelerator pedal position; and 5) the ECM, which controls the ETCS. Based on the target idling speed, the ECM controls the throttle actuator to provide the proper throttle valve opening angle.

DTC Code	DTC Detection Condition	Trouble Area
P0505	The idling speed continues to vary greatly from the target idling speed (2 trip detection logic).	• ETCS • Air induction system • PCV hose connections • ECM

MONITOR DESCRIPTION

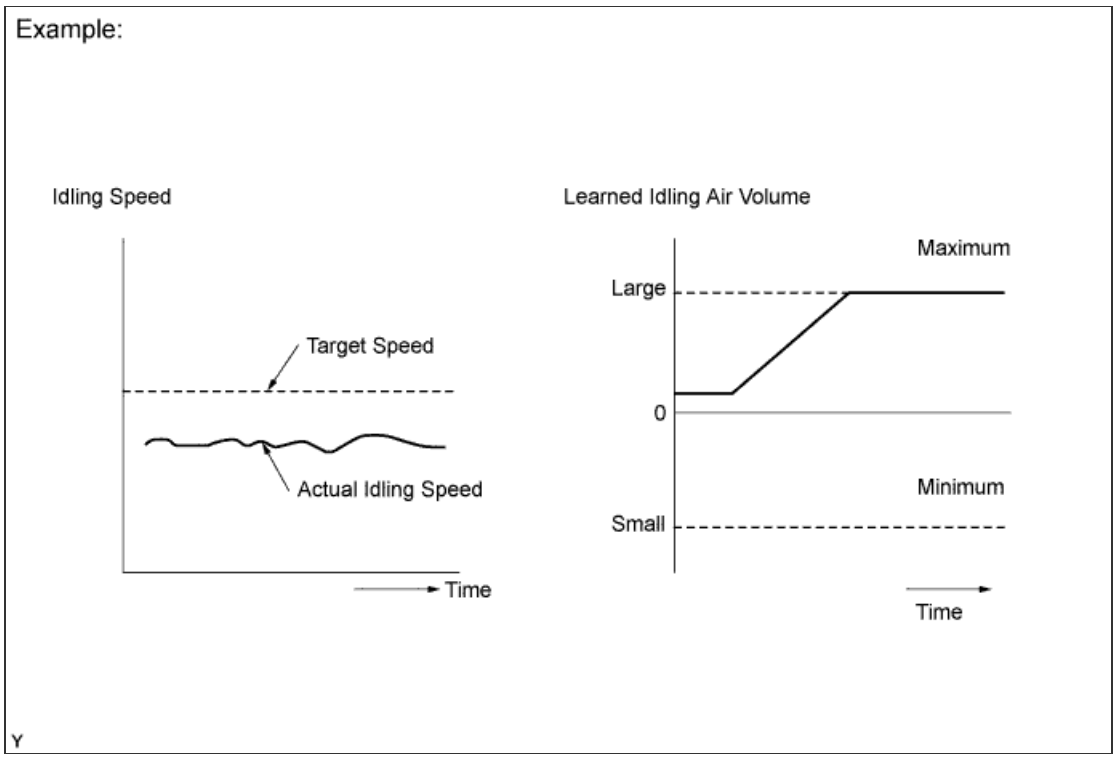
The ECM monitors the idling speed and idling air flow volume to conduct Idle Speed Control (ISC). The ECM determines that the ISC system is malfunctioning if the following conditions apply:

- The learned idling air flow volume remains at the maximum or minimum volume for 5 seconds during a drive cycle.
- After driving at 10 km/h (6.25 mph) or more, the actual engine idling speed varies from the target idling speed by between 100 rpm and 150 rpm, 5 times or more during a drive cycle.

Example:
If the actual idling speed varies from the target idling speed by more than 150 rpm* 5 times during a drive cycle, the ECM illuminates the MIL and stores the DTC.

HINT:

*: Threshold idling speed varies with engine load.



INSPECTION PROCEDURE

HINT:

- **The following conditions may also cause DTC P0505 to be stored:**
  1. **The floor carpet overlapping slightly onto the accelerator pedal, causing the accelerator pedal to be slightly depressed and therefore the throttle valve position to be slightly open.**
  2. **The accelerator pedal being not fully released.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are**

detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK AN OTHER DTCS OUTPUT (IN ADDITION TO DTC P0505)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0505 is output	A
P0505 and other DTCs are output	B

HINT:

If any DTCs other than P0505 are output, troubleshoot those DTCs first.

B → **O TO DTC CHART (Click here)**

A

2.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is connected correctly and is not damaged.

N → **REPAIR OR REP ACE PCV HOSE**

OK

.CHECK AIR INDUCTION S STEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

N → **REPAIR OR REP ACE AIR INDUCTION S STEM**

OK

4.CHECK THROTT E VA E

a. Check the throttle valve condition.

OK:
Throttle valve is not contaminated with foreign objects and moves smoothly.

N → **REP ACE THROTT E BOD SSEMB Click here)**

OK

REP ACE ECM (Click here)

DTC P0016 Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)

DTC P0018 Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor A)

for Preparation Click here

DESCRIPTION

In the VVT (Variable Valve Timing) system, the appropriate intake valve open and close timing is controlled by the ECM. The ECM performs intake valve control by performing the following: 1) controlling the camshaft and camshaft oil control valve, and operating the camshaft timing gear; and 2) changing the relative positions of the gaps between the camshaft and crankshaft.

DTC Code	DTC Detection Condition	Trouble Area
P0016	Deviation in the crankshaft position sensor signal and VVT sensor 1 (for intake side of bank 1) signal (2 trip detection logic).	• Mechanical system (Timing belt has jumped tooth or belt stretched) • Oil control valve • Camshaft timing tube • ECM
P0018	Deviation in the crankshaft position sensor signal and VVT sensor 2 (for intake side of bank 2) signal (2 trip detection logic).	• Mechanical system (Timing belt has jumped tooth or belt stretched) • Oil control valve • Camshaft timing tube • ECM

MONITOR DESCRIPTION

To monitor the correlation of the intake camshaft position and crankshaft position, the ECM checks the VVT learning value while the engine is idling. The VVT learning value is calibrated based on the camshaft position and crankshaft position. The intake valve timing is set to the most retarded angle while the engine is idling. If the VVT learning value is out of the specified range in consecutive driving cycles, the ECM illuminates the MIL and stores DTC P0016 (for bank 1) or P0018 (for bank 2).

WIRING DIAGRAM

Refer to DTC P0335 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0016 OR P0018)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0016 or P0018 is output	A
P0016 or P0018 and other DTCs are output	B

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTE IGENT TESTER (OPERATE OCV)

HINT:

If the VVT system can be operated through the Active Test, it can be assumed that the VVT system is operating normally.

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1) or Control the VVT System (Bank 2) / All Data / VVT Change Angle (Bank 1) or VVT Change Angle (Bank 2).

e. Perform the Active Test. Check that the displacement angle varies.

OK:
Varies.

NG → Go to step 4

OK

3.CHECK VA E TIMING

a. Remove the drive belt (Click here).

b. Remove the timing belt cover LH and RH (Click here).

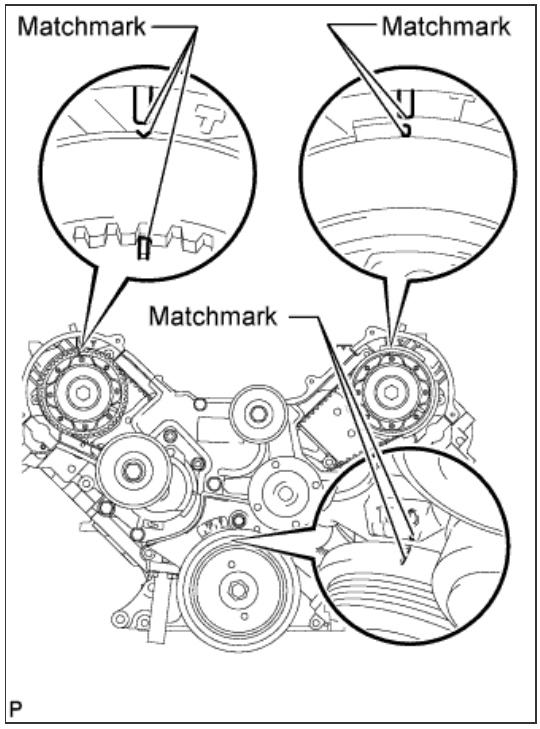
c. Turn the crankshaft to align the matchmarks of the crankshaft.

d. Align the notch of the crankshaft pulley with the "0" position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360°. Confirm again if the matchmarks are facing each other.

OK:
The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NE T → Go to step 6

4.INSPECT CAMSHAFT OI CONTRO A E

a. Remove the OCV.

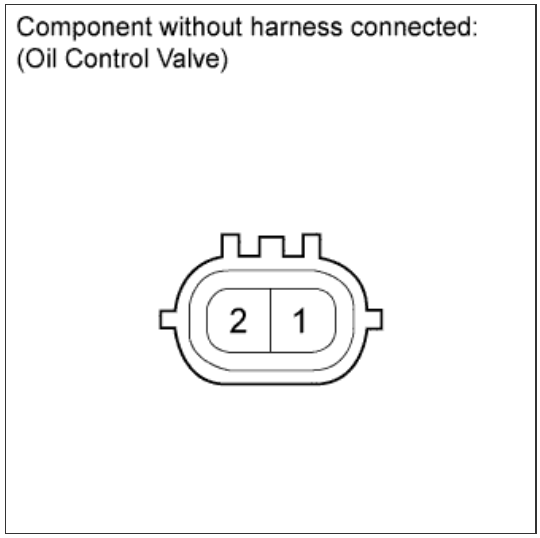
b. Measure the resistance according to the value(s) in the table below.

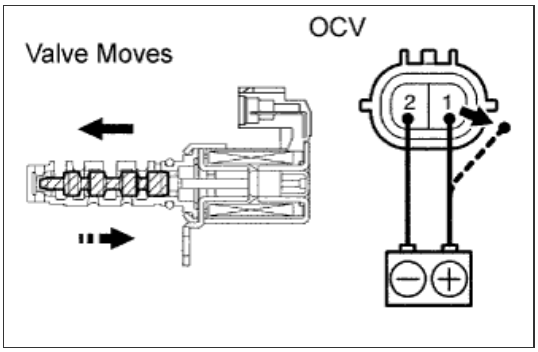
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

c. Apply positive battery voltage to terminal 1 and negative battery voltage to terminal 2. Check the valve operation.

OK:
Valve moves uickly.





NG → REP ACE CAMSHAFT OI CONTRO A E (Click here)

OK

5.REP ACE CAMSHAFT TIMING TUBE ASSEMB Y

a. Replace the camshaft timing tube assembly.

HINT:

- **P0016 is output, replace the camshaft timing tube assembly for bank 1 (Click here).**
- **P0018 is output, replace the camshaft timing tube assembly for bank 2 (Click here).**

NE T

6.CONFIRM WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear the DTC (Click here).

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. Drive the vehicle in an urban area for approximately 10 minutes.

g. Read DTCs using the tester.

OK:
No DTC is output.

NG → GO TO DTC CHART (Click here)

OK

END

DTC P0550 Power Steering Pressure Sensor Circuit Malfunction

DTC P0552 Power Steering Pressure Sensor Circuit Low Input

DTC P0553 Power Steering Pressure Sensor Circuit High Input

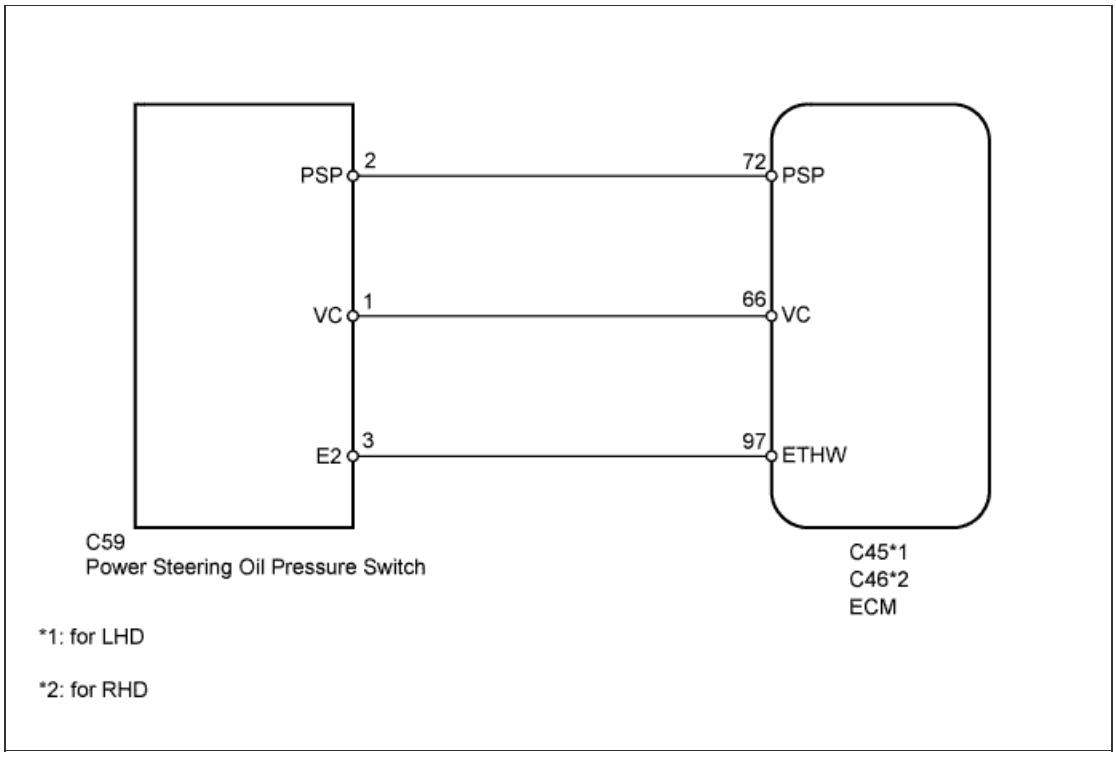
for Preparation Click here

DESCRIPTION

The power steering oil pressure sensor is turned on when a power steering wheel load occurs by turning the steering wheel. The ECM regulates the engine idling speed according to the voltage output of the sensor.

DTC Code	DTC Detection Condition	Trouble Area
P0550	Power steering oil pressure sensor voltage less than 0.28 V, or more than 4.9 V for 0.5 seconds while engine running. (1 trip detection logic)	• Open or short in power steering oil pressure sensor circuit • Power steering oil pressure sensor • ECM
P0552	Power steering oil pressure sensor voltage less than 0.28 V for 0.5 seconds while engine running. (1 trip detection logic)	• Open or short in power steering oil pressure sensor circuit • Power steering oil pressure sensor • ECM
P0553	Power steering oil pressure sensor voltage more than 4.9 V for 0.5 seconds while engine running. (1 trip detection logic)	• Open or short in power steering oil pressure sensor circuit • Power steering oil pressure sensor • ECM

WIRING DIAGRAM



MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to regulate the engine idling speed. When the sensor output voltage deviates from the normal operating range, the ECM determines that there is a malfunction in the power steering oil pressure sensor and stores a DTC.

INSPECTION PROCEDURE

HINT:

- **If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.**

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK HARNESS AND CONNECTOR (ECM - POWER STEERING OIL PRESSURE SWITCH)

a. Disconnect the ECM connector.

b. Disconnect the power steering oil pressure switch connector.

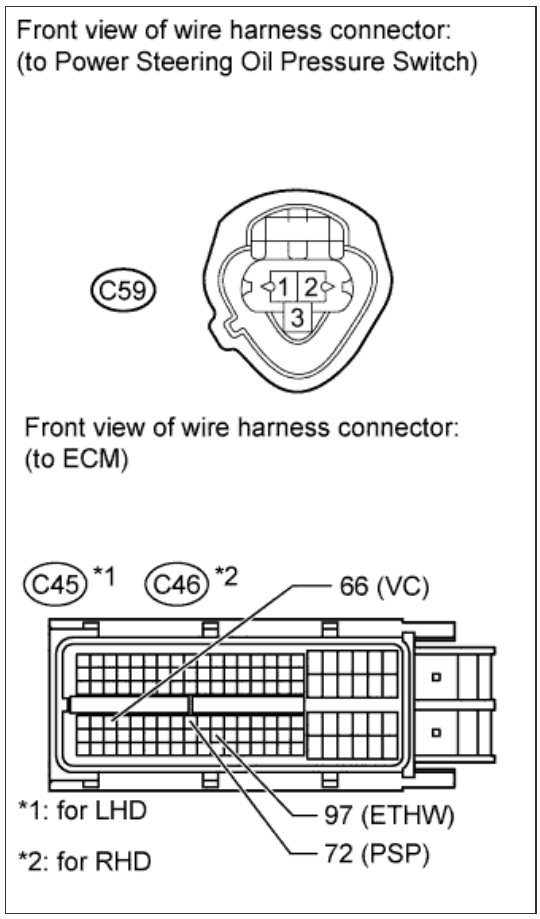
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C59-2 (PSP) - C45-72 (PSP)	Always	Below 1 Ω
C59-1 (VC) - C45-66 (VC)	Always	Below 1 Ω
C59-3 (E2) - C45-97 (ETHW)	Always	Below 1 Ω
C59-2 (PSP) or C45-72 (PSP) - Body ground	Always	10 kΩ or higher
C59-1 (VC) or C45-66 (VC) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C59-2 (PSP) - C46-72 (PSP)	Always	Below 1 Ω
C59-1 (VC) - C46-66 (VC)	Always	Below 1 Ω
C59-3 (E2) - C46-97 (ETHW)	Always	Below 1 Ω
C59-2 (PSP) or C46-72 (PSP) - Body ground	Always	10 kΩ or higher
C59-1 (VC) or C46-66 (VC) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE POWER STEERING OIL PRESSURE SWITCH

a. Replace the power steering oil pressure switch (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P0550, P0552 and/or P0553 is output	A

No DTC is output	B

B → END

A

REPLACE ECM (Click here)

DTC P0031 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)

DTC P0032 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)

DTC P0051 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)

DTC P0052 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)

for Preparation Click here

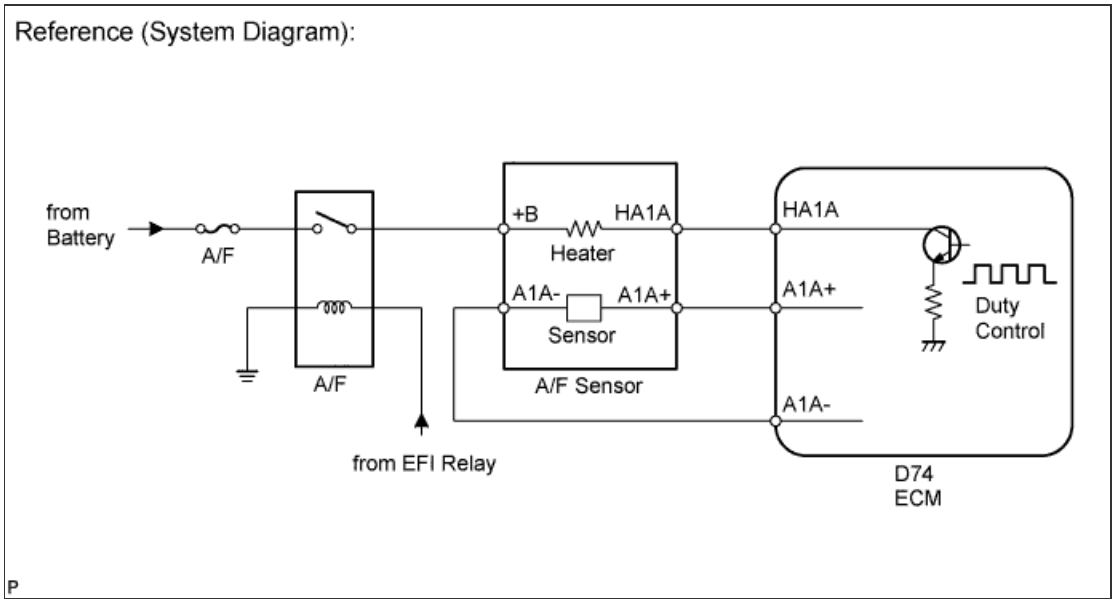
DESCRIPTION

Refer to DTC P2195 (Click here).

HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air-Fuel Ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**
- **When one of these DTCs is stored, the ECM enters fail-safe mode. The ECM turns off the A/F sensor heater in fail-safe mode. Fail-safe mode continues until the engine switch is turned off.**

- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The A/F sensor heater circuit uses a relay on the +B side of the circuit.**



DTC Code	DTC Detection Condition	Trouble Area
P0031 P0051	The Air-Fuel Ratio (A/F) sensor heater current is below 0.8 A (1 trip detection logic).	• Open in Air-Fuel Ratio (A/F) sensor heater circuit • A/F sensor heater (for sensor 1) • Integration relay • ECM
P0032 P0052	An Air-Fuel Ratio (A/F) sensor heater current failure (1 trip detection logic).	• Short in A/F sensor heater circuit • A/F sensor heater (for sensor 1) • Integration relay • ECM

HINT:

- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

MONITOR DESCRIPTION

The ECM uses information from the Air-Fuel Ratio (A/F) sensor to regulate the air-fuel ratio and keep it close to the stoichiometric level. This maximizes the ability of the Three-Way Catalytic Converter (TWC) to purify the exhaust gases.

The A/F sensor detects oxygen levels in the exhaust gas and transmits the information to the ECM. The inner surface of the sensor element is exposed to the outside air. The outer surface of the sensor element is exposed to the exhaust gas. The sensor element is made of platinum coated zirconia and includes an integrated heating element.
The zirconia element generates a small voltage when there is a large difference in the oxygen concentrations between the exhaust gas and outside air. The platinum coating amplifies this voltage generation.
The A/F sensor is more efficient when heated. When the exhaust gas temperature is low, the sensor cannot generate useful voltage signals without supplementary heating. The ECM regulates the supplementary heating using a duty-cycle approach to adjust the average current in the sensor heater element. If the heater current is outside the normal range, the signal transmitted by the A/F sensor becomes inaccurate. As a result, the ECM is unable to regulate air-fuel ratio properly.
When the current in the A/F sensor heater is outside the normal operating range, the ECM interprets this as a malfunction in the sensor heater and stores a DTC.
Example:
The ECM stores DTC P0032 or P0052 when the current in the A/F sensor heater is higher than 10 A. Conversely, when the heater current is below 0.8 A, DTC P0031 or P0051 is stored.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

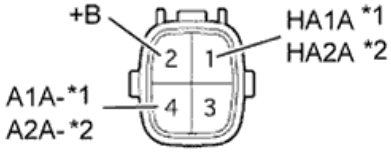
a. Disconnect the Air-Fuel Ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF A/F SENSOR)

a. Disconnect the A/F sensor connector.

b. Measure the voltage according to the value(s) in the table below.

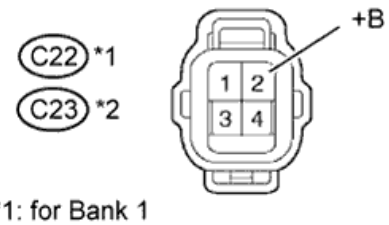
Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

Result

Result	Proceed to
NG	A
OK	B

Front view of wire harness connector:
(to A/F Sensor)



*1: for Bank 1

*2: for Bank 2

B → Go to step 5

A

3.INSPECT INTEGRATION RELAY (A/F)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

iii. Reinstall the A/F fuse.

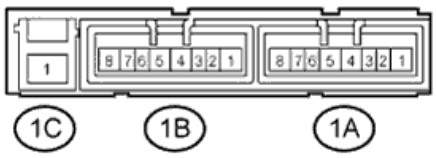
c. Inspect the integration relay (A/F).

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1A-4	Battery voltage not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω

Component without harness connected:
(Integration Relay)



NG → REPLACE INTEGRATION RELAY (A/F)

OK

4.CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - A/F SENSOR AND BODY GROUND)

a. Disconnect the A/F sensor connector.

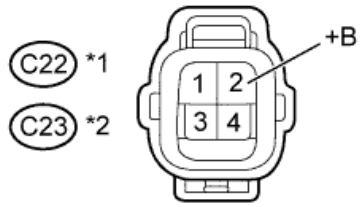
b. Remove the integration relay from the engine room relay block.

c. Measure the resistance according to the value(s) in the table below.

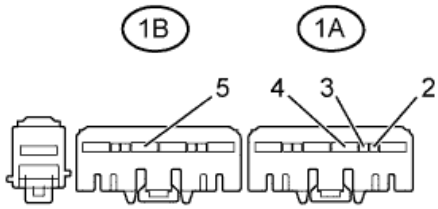
Standard Resistance:

Tester Connection	Condition	Specified Condition
C22-2 (+B) - 1A-4	Always	Below 1 Ω
C23-2 (+B) - 1A-4	Always	Below 1 Ω
1A-2 - 1B-5	Always	Below 1 Ω
1A-3 - Body ground	Always	Below 1 Ω
C22-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher
C23-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher
1A-2 or 1B-5 - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to A/F Sensor)



Front view of wire harness connector:
(to Integration Relay)



*1: for Bank 1

*2: for Bank 2

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

5.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

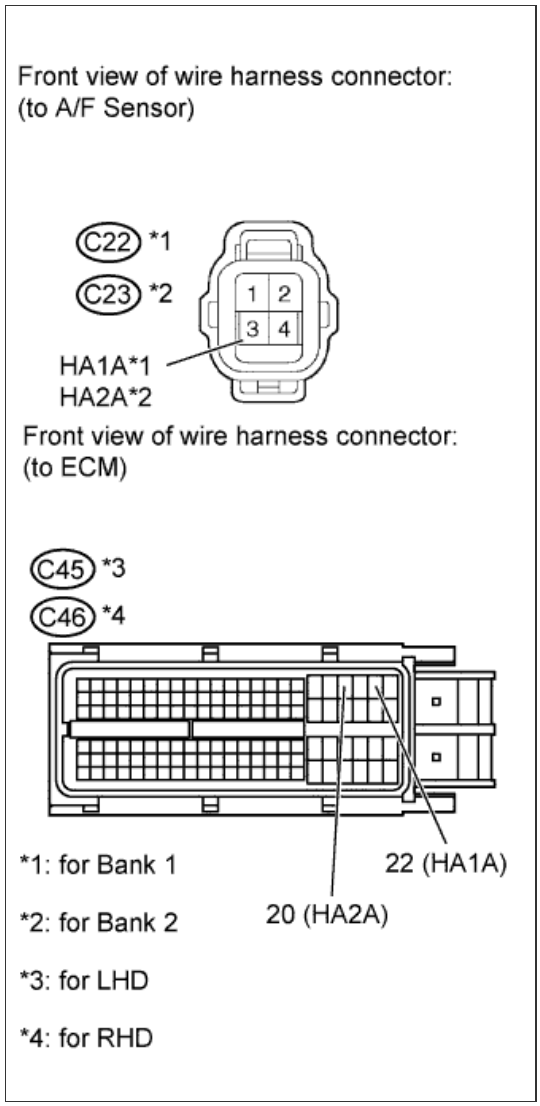
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher

C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Allow the engine to idle for 1 minute or more.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P0031, P0032, P0051 or P0052 is output	B

B → REPLACE ECM (Click here)

A

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0550 Power Steering Pressure Sensor Circuit Malfunction

DTC P0552 Power Steering Pressure Sensor Circuit Low Input

DTC P0553 Power Steering Pressure Sensor Circuit High Input

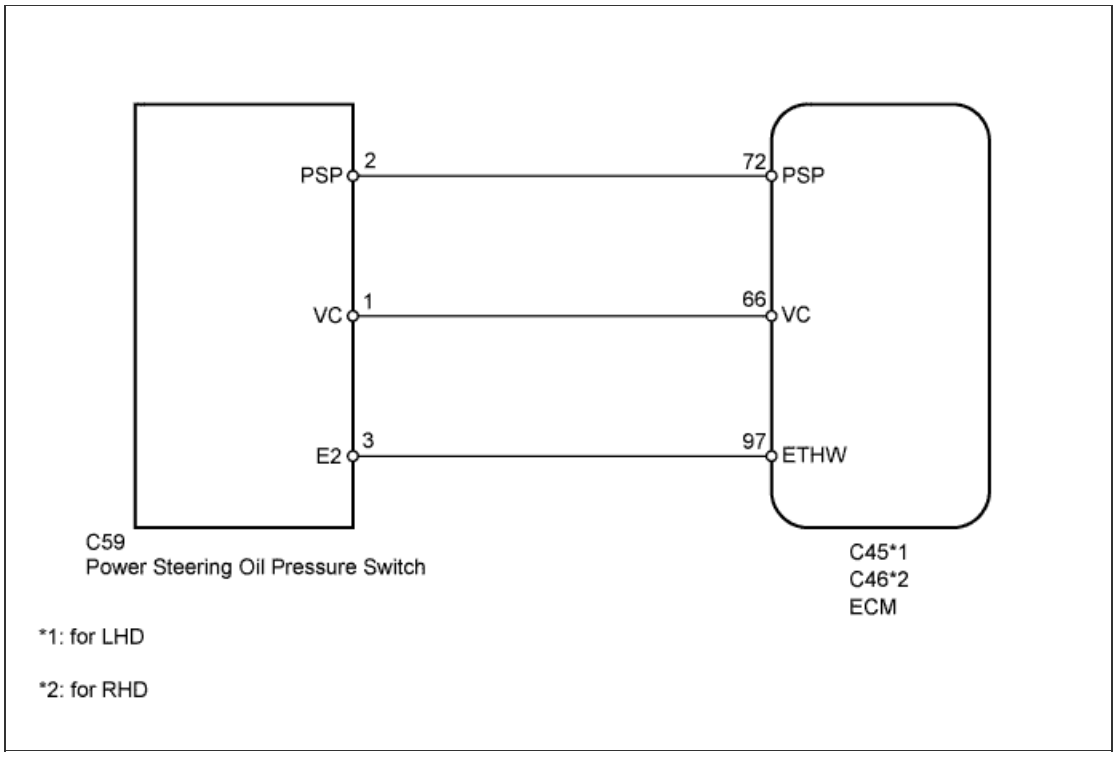
for Preparation Click here

DESCRIPTION

The power steering oil pressure sensor is turned on when a power steering wheel load occurs by turning the steering wheel. The ECM regulates the engine idling speed according to the voltage output of the sensor.

DTC Code	DTC Detection Condition	Trouble Area
P0550	Power steering oil pressure sensor voltage less than 0.28 V, or more than 4.9 V for 0.5 seconds while engine running. (1 trip detection logic)	• Open or short in power steering oil pressure sensor circuit • Power steering oil pressure sensor • ECM
P0552	Power steering oil pressure sensor voltage less than 0.28 V for 0.5 seconds while engine running. (1 trip detection logic)	• Open or short in power steering oil pressure sensor circuit • Power steering oil pressure sensor • ECM
P0553	Power steering oil pressure sensor voltage more than 4.9 V for 0.5 seconds while engine running. (1 trip detection logic)	• Open or short in power steering oil pressure sensor circuit • Power steering oil pressure sensor • ECM

WIRING DIAGRAM



MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to regulate the engine idling speed. When the sensor output voltage deviates from the normal operating range, the ECM determines that there is a malfunction in the power steering oil pressure sensor and stores a DTC.

INSPECTION PROCEDURE

HINT:

- **If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.**

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK HARNESS AND CONNECTOR (ECM - POWER STEERING OIL PRESSURE SWITCH)

a. Disconnect the ECM connector.

b. Disconnect the power steering oil pressure switch connector.

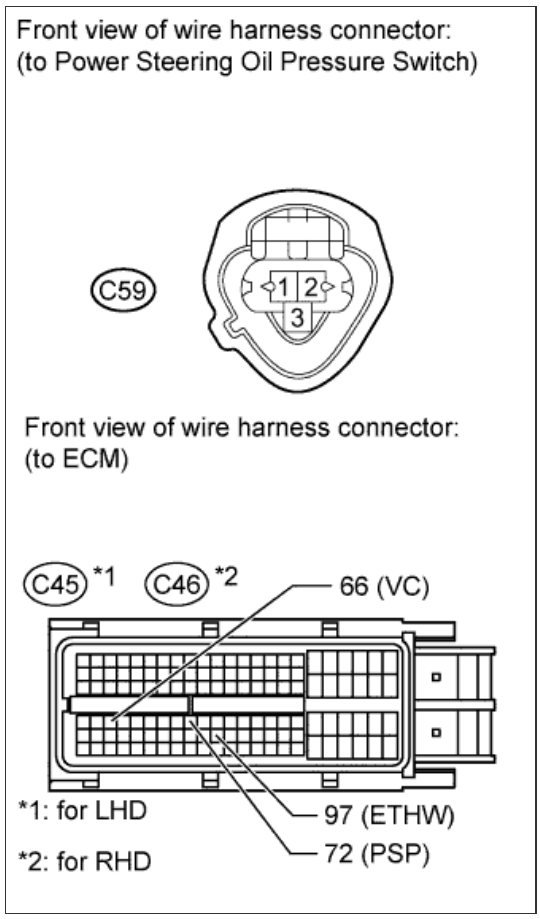
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C59-2 (PSP) - C45-72 (PSP)	Always	Below 1 Ω
C59-1 (VC) - C45-66 (VC)	Always	Below 1 Ω
C59-3 (E2) - C45-97 (ETHW)	Always	Below 1 Ω
C59-2 (PSP) or C45-72 (PSP) - Body ground	Always	10 kΩ or higher
C59-1 (VC) or C45-66 (VC) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C59-2 (PSP) - C46-72 (PSP)	Always	Below 1 Ω
C59-1 (VC) - C46-66 (VC)	Always	Below 1 Ω
C59-3 (E2) - C46-97 (ETHW)	Always	Below 1 Ω
C59-2 (PSP) or C46-72 (PSP) - Body ground	Always	10 kΩ or higher
C59-1 (VC) or C46-66 (VC) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE POWER STEERING OIL PRESSURE SWITCH

a. Replace the power steering oil pressure switch (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P0550, P0552 and/or P0553 is output	A

No DTC is output	B

B → END

A

REPLACE ECM (Click here)

DTC P0031 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)

DTC P0032 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)

DTC P0051 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)

DTC P0052 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)

for Preparation Click here

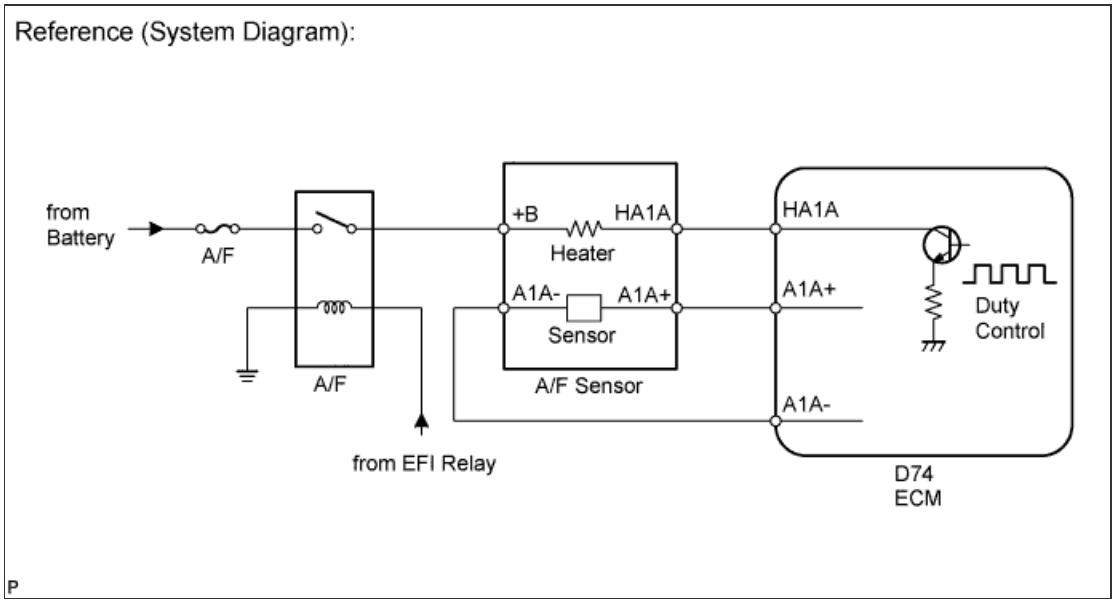
DESCRIPTION

Refer to DTC P2195 (Click here).

HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air-Fuel Ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**
- **When one of these DTCs is stored, the ECM enters fail-safe mode. The ECM turns off the A/F sensor heater in fail-safe mode. Fail-safe mode continues until the engine switch is turned off.**

- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The A/F sensor heater circuit uses a relay on the +B side of the circuit.**



DTC Code	DTC Detection Condition	Trouble Area
P0031 P0051	The Air-Fuel Ratio (A/F) sensor heater current is below 0.8 A (1 trip detection logic).	• Open in Air-Fuel Ratio (A/F) sensor heater circuit • A/F sensor heater (for sensor 1) • Integration relay • ECM
P0032 P0052	An Air-Fuel Ratio (A/F) sensor heater current failure (1 trip detection logic).	• Short in A/F sensor heater circuit • A/F sensor heater (for sensor 1) • Integration relay • ECM

HINT:

- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

MONITOR DESCRIPTION

The ECM uses information from the Air-Fuel Ratio (A/F) sensor to regulate the air-fuel ratio and keep it close to the stoichiometric level. This maximizes the ability of the Three-Way Catalytic Converter (TWC) to purify the exhaust gases.

The A/F sensor detects oxygen levels in the exhaust gas and transmits the information to the ECM. The inner surface of the sensor element is exposed to the outside air. The outer surface of the sensor element is exposed to the exhaust gas. The sensor element is made of platinum coated zirconia and includes an integrated heating element.
The zirconia element generates a small voltage when there is a large difference in the oxygen concentrations between the exhaust gas and outside air. The platinum coating amplifies this voltage generation.
The A/F sensor is more efficient when heated. When the exhaust gas temperature is low, the sensor cannot generate useful voltage signals without supplementary heating. The ECM regulates the supplementary heating using a duty-cycle approach to adjust the average current in the sensor heater element. If the heater current is outside the normal range, the signal transmitted by the A/F sensor becomes inaccurate. As a result, the ECM is unable to regulate air-fuel ratio properly.
When the current in the A/F sensor heater is outside the normal operating range, the ECM interprets this as a malfunction in the sensor heater and stores a DTC.
Example:
The ECM stores DTC P0032 or P0052 when the current in the A/F sensor heater is higher than 10 A. Conversely, when the heater current is below 0.8 A, DTC P0031 or P0051 is stored.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

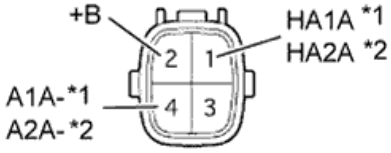
a. Disconnect the Air-Fuel Ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF A/F SENSOR)

a. Disconnect the A/F sensor connector.

b. Measure the voltage according to the value(s) in the table below.

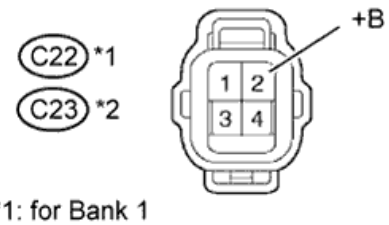
Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

Result

Result	Proceed to
NG	A
OK	B

Front view of wire harness connector:
(to A/F Sensor)



*1: for Bank 1

*2: for Bank 2

B → Go to step 5

A

3.INSPECT INTEGRATION RELAY (A/F)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

iii. Reinstall the A/F fuse.

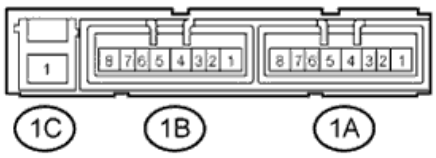
c. Inspect the integration relay (A/F).

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1A-4	Battery voltage not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω

Component without harness connected:
(Integration Relay)



NG → REPLACE INTEGRATION RELAY (A/F)

OK

4.CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - A/F SENSOR AND BODY GROUND)

a. Disconnect the A/F sensor connector.

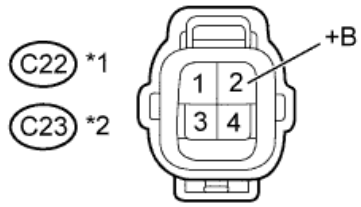
b. Remove the integration relay from the engine room relay block.

c. Measure the resistance according to the value(s) in the table below.

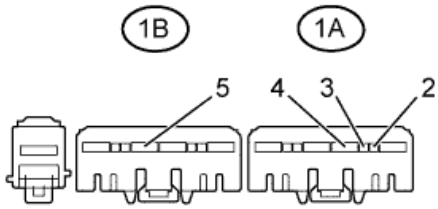
Standard Resistance:

Tester Connection	Condition	Specified Condition
C22-2 (+B) - 1A-4	Always	Below 1 Ω
C23-2 (+B) - 1A-4	Always	Below 1 Ω
1A-2 - 1B-5	Always	Below 1 Ω
1A-3 - Body ground	Always	Below 1 Ω
C22-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher
C23-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher
1A-2 or 1B-5 - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to A/F Sensor)



Front view of wire harness connector:
(to Integration Relay)



*1: for Bank 1

*2: for Bank 2

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

5.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

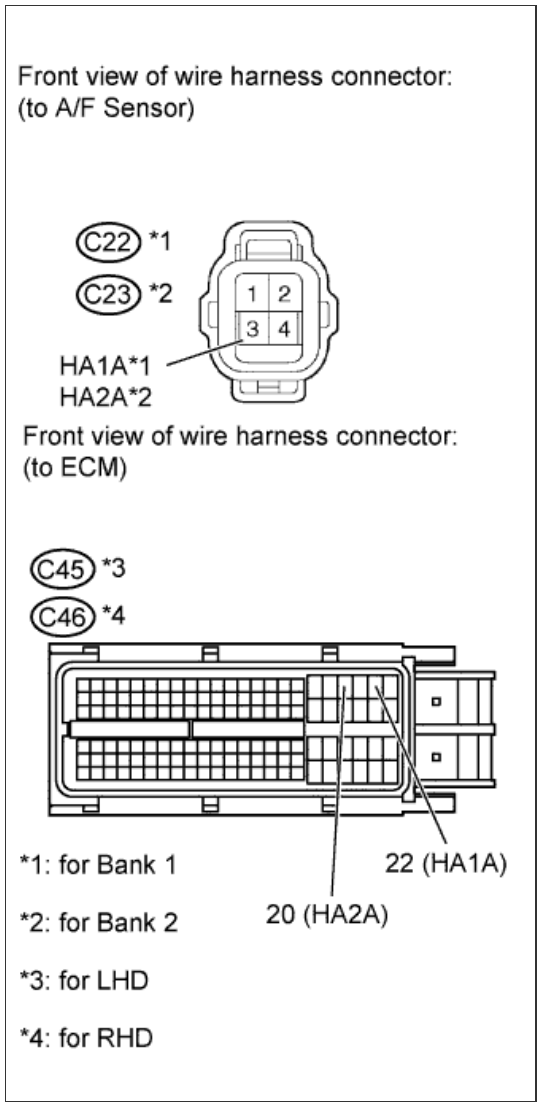
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher

C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Allow the engine to idle for 1 minute or more.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P0031, P0032, P0051 or P0052 is output	B

B → REPLACE ECM (Click here)

A

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0550 Power Steering Pressure Sensor Circuit Malfunction

DTC P0552 Power Steering Pressure Sensor Circuit Low Input

DTC P0553 Power Steering Pressure Sensor Circuit High Input

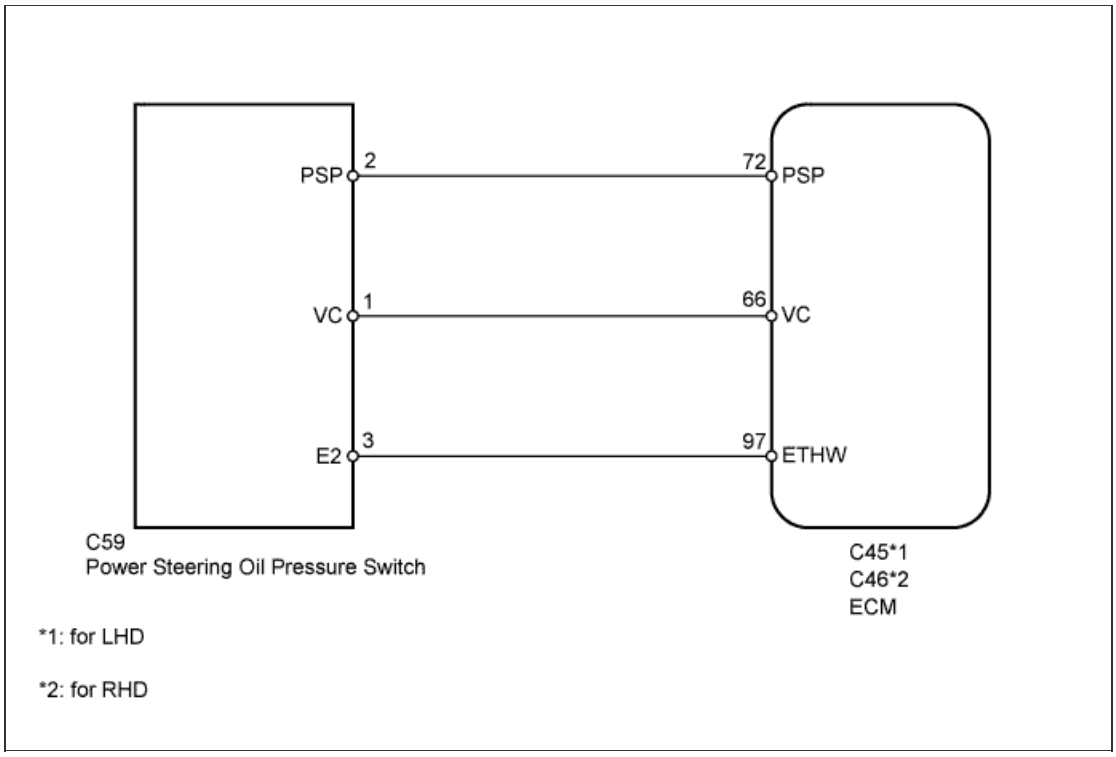
for Preparation Click here

DESCRIPTION

The power steering oil pressure sensor is turned on when a power steering wheel load occurs by turning the steering wheel. The ECM regulates the engine idling speed according to the voltage output of the sensor.

DTC Code	DTC Detection Condition	Trouble Area
P0550	Power steering oil pressure sensor voltage less than 0.28 V, or more than 4.9 V for 0.5 seconds while engine running. (1 trip detection logic)	• Open or short in power steering oil pressure sensor circuit • Power steering oil pressure sensor • ECM
P0552	Power steering oil pressure sensor voltage less than 0.28 V for 0.5 seconds while engine running. (1 trip detection logic)	• Open or short in power steering oil pressure sensor circuit • Power steering oil pressure sensor • ECM
P0553	Power steering oil pressure sensor voltage more than 4.9 V for 0.5 seconds while engine running. (1 trip detection logic)	• Open or short in power steering oil pressure sensor circuit • Power steering oil pressure sensor • ECM

WIRING DIAGRAM



MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to regulate the engine idling speed. When the sensor output voltage deviates from the normal operating range, the ECM determines that there is a malfunction in the power steering oil pressure sensor and stores a DTC.

INSPECTION PROCEDURE

HINT:

- **If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.**

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK HARNESS AND CONNECTOR (ECM - POWER STEERING OIL PRESSURE SWITCH)

a. Disconnect the ECM connector.

b. Disconnect the power steering oil pressure switch connector.

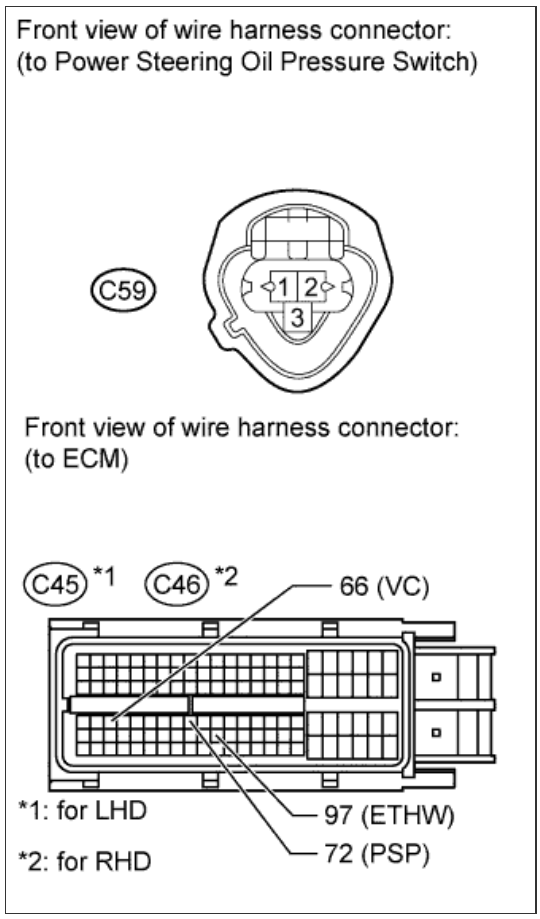
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C59-2 (PSP) - C45-72 (PSP)	Always	Below 1 Ω
C59-1 (VC) - C45-66 (VC)	Always	Below 1 Ω
C59-3 (E2) - C45-97 (ETHW)	Always	Below 1 Ω
C59-2 (PSP) or C45-72 (PSP) - Body ground	Always	10 kΩ or higher
C59-1 (VC) or C45-66 (VC) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C59-2 (PSP) - C46-72 (PSP)	Always	Below 1 Ω
C59-1 (VC) - C46-66 (VC)	Always	Below 1 Ω
C59-3 (E2) - C46-97 (ETHW)	Always	Below 1 Ω
C59-2 (PSP) or C46-72 (PSP) - Body ground	Always	10 kΩ or higher
C59-1 (VC) or C46-66 (VC) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE POWER STEERING OIL PRESSURE SWITCH

a. Replace the power steering oil pressure switch (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P0550, P0552 and/or P0553 is output	A

No DTC is output	B

B → END

A

REPLACE ECM (Click here)

DTC P0031 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)

DTC P0032 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)

DTC P0051 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)

DTC P0052 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)

for Preparation Click here

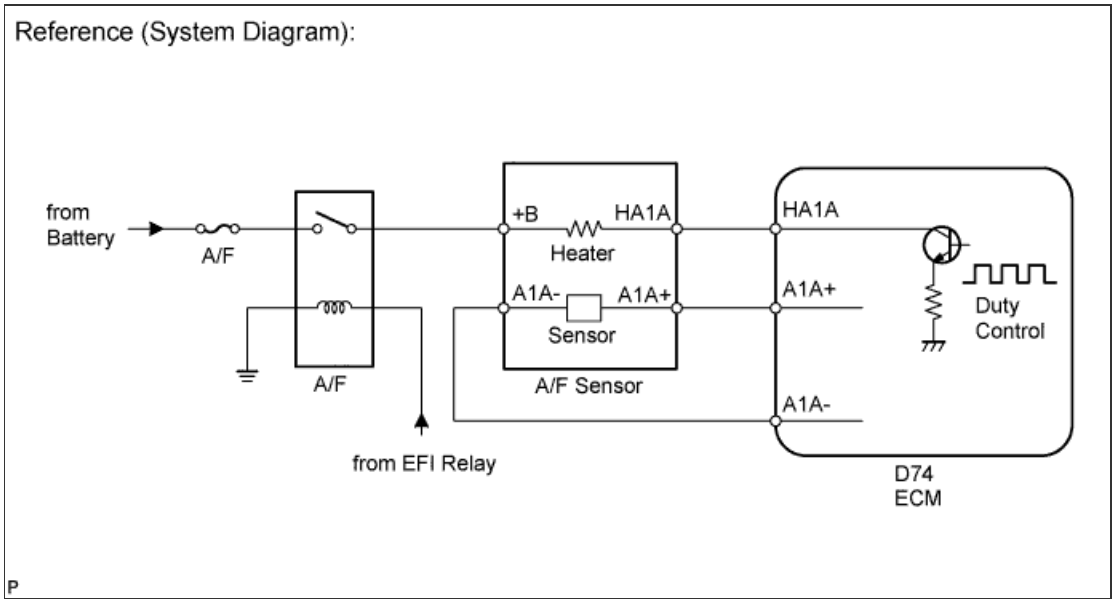
DESCRIPTION

Refer to DTC P2195 (Click here).

HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air-Fuel Ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**
- **When one of these DTCs is stored, the ECM enters fail-safe mode. The ECM turns off the A/F sensor heater in fail-safe mode. Fail-safe mode continues until the engine switch is turned off.**

- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The A/F sensor heater circuit uses a relay on the +B side of the circuit.**



DTC Code	DTC Detection Condition	Trouble Area
P0031 P0051	The Air-Fuel Ratio (A/F) sensor heater current is below 0.8 A (1 trip detection logic).	• Open in Air-Fuel Ratio (A/F) sensor heater circuit • A/F sensor heater (for sensor 1) • Integration relay • ECM
P0032 P0052	An Air-Fuel Ratio (A/F) sensor heater current failure (1 trip detection logic).	• Short in A/F sensor heater circuit • A/F sensor heater (for sensor 1) • Integration relay • ECM

HINT:

- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

MONITOR DESCRIPTION

The ECM uses information from the Air-Fuel Ratio (A/F) sensor to regulate the air-fuel ratio and keep it close to the stoichiometric level. This maximizes the ability of the Three-Way Catalytic Converter (TWC) to purify the exhaust gases.

The A/F sensor detects oxygen levels in the exhaust gas and transmits the information to the ECM. The inner surface of the sensor element is exposed to the outside air. The outer surface of the sensor element is exposed to the exhaust gas. The sensor element is made of platinum coated zirconia and includes an integrated heating element.
The zirconia element generates a small voltage when there is a large difference in the oxygen concentrations between the exhaust gas and outside air. The platinum coating amplifies this voltage generation.
The A/F sensor is more efficient when heated. When the exhaust gas temperature is low, the sensor cannot generate useful voltage signals without supplementary heating. The ECM regulates the supplementary heating using a duty-cycle approach to adjust the average current in the sensor heater element. If the heater current is outside the normal range, the signal transmitted by the A/F sensor becomes inaccurate. As a result, the ECM is unable to regulate air-fuel ratio properly.
When the current in the A/F sensor heater is outside the normal operating range, the ECM interprets this as a malfunction in the sensor heater and stores a DTC.
Example:
The ECM stores DTC P0032 or P0052 when the current in the A/F sensor heater is higher than 10 A. Conversely, when the heater current is below 0.8 A, DTC P0031 or P0051 is stored.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

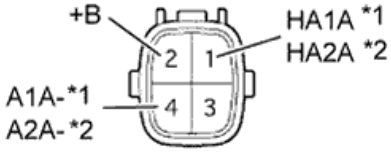
a. Disconnect the Air-Fuel Ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF A/F SENSOR)

a. Disconnect the A/F sensor connector.

b. Measure the voltage according to the value(s) in the table below.

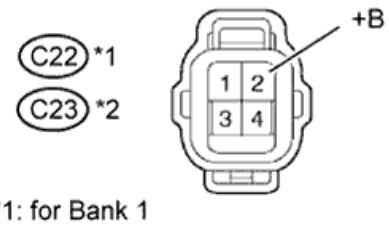
Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

Result

Result	Proceed to
NG	A
OK	B

Front view of wire harness connector:
(to A/F Sensor)



*1: for Bank 1

*2: for Bank 2

B → Go to step 5

A

3.INSPECT INTEGRATION RELAY (A/F)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

iii. Reinstall the A/F fuse.

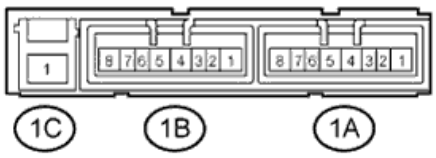
c. Inspect the integration relay (A/F).

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1A-4	Battery voltage not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω

Component without harness connected:
(Integration Relay)



NG → REPLACE INTEGRATION RELAY (A/F)

OK

4.CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - A/F SENSOR AND BODY GROUND)

a. Disconnect the A/F sensor connector.

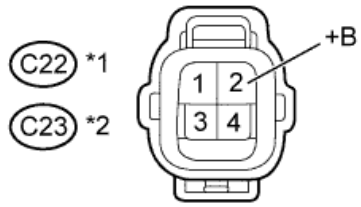
b. Remove the integration relay from the engine room relay block.

c. Measure the resistance according to the value(s) in the table below.

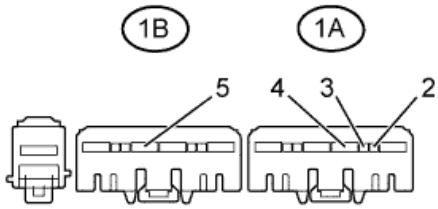
Standard Resistance:

Tester Connection	Condition	Specified Condition
C22-2 (+B) - 1A-4	Always	Below 1 Ω
C23-2 (+B) - 1A-4	Always	Below 1 Ω
1A-2 - 1B-5	Always	Below 1 Ω
1A-3 - Body ground	Always	Below 1 Ω
C22-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher
C23-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher
1A-2 or 1B-5 - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to A/F Sensor)



Front view of wire harness connector:
(to Integration Relay)



*1: for Bank 1

*2: for Bank 2

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

5.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

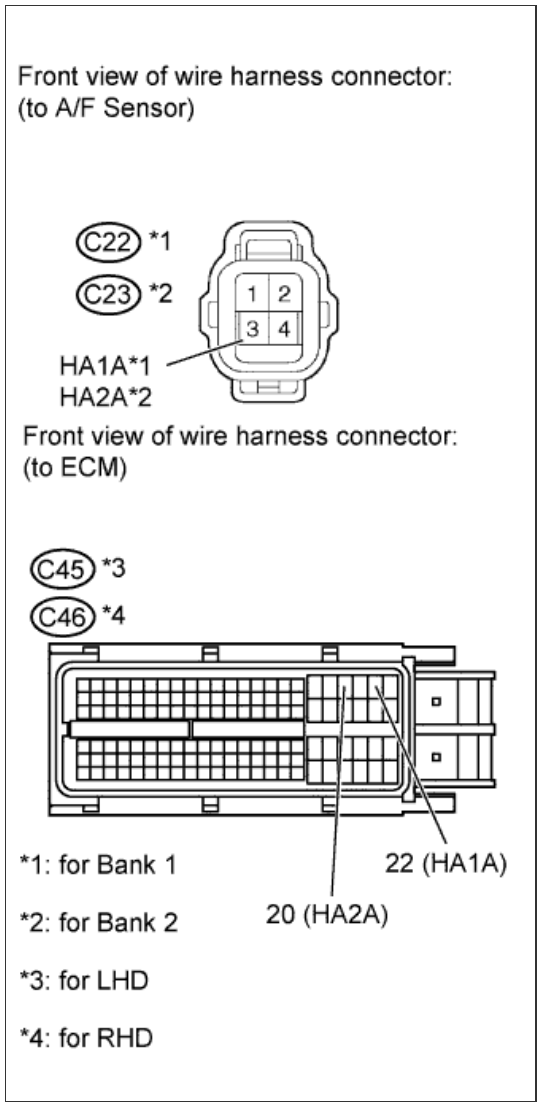
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher

C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Allow the engine to idle for 1 minute or more.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P0031, P0032, P0051 or P0052 is output	B

B → REPLACE ECM (Click here)

A

CHECK FOR INTERMITTENT PROBLEMS (Click here)

for Preparation Click here

DESCRIPTION

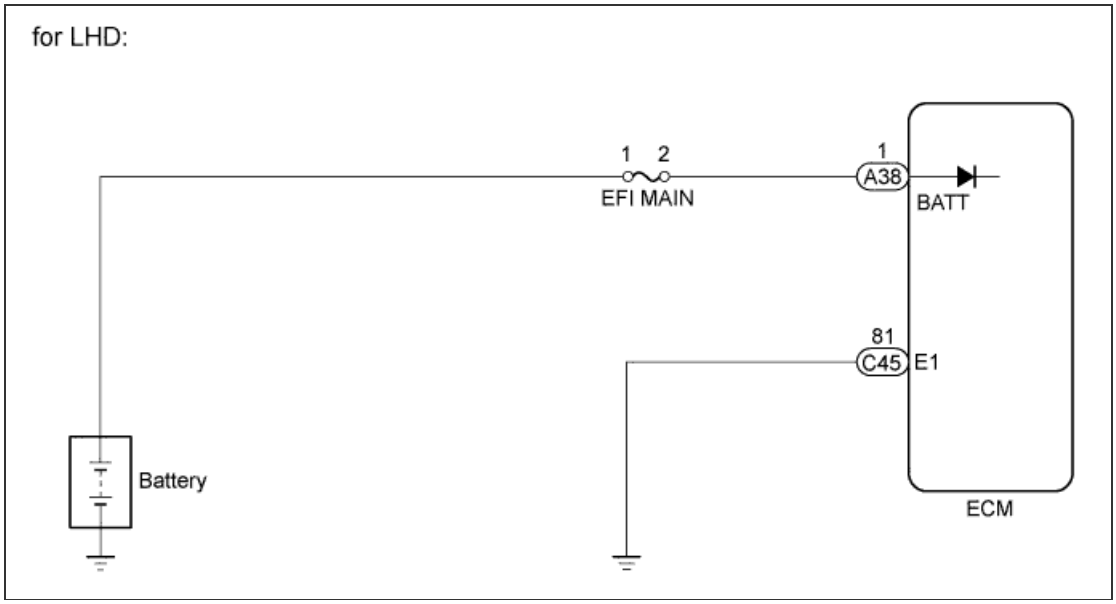
The battery supplies electricity to the ECM even when the engine switch is off. This power allows the ECM to store data such as DTC history, freeze frame data and fuel trim values. If the battery voltage falls below a minimum level, the memory is cleared and the ECM determines that there is a malfunction in the power supply circuit. When the engine is next started, the ECM illuminates the MIL and stores the DTC.

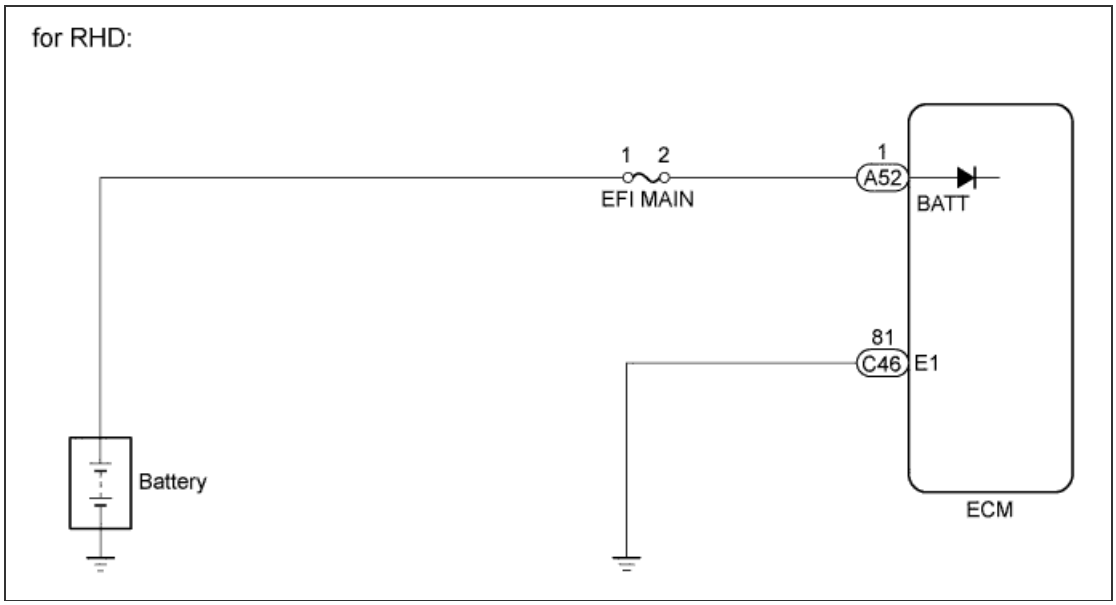
DTC Code	DTC Detection Condition	Trouble Area
P0560	An open in the ECM back up power source circuit (1 trip detection logic).	• Open in back up power source circuit • Battery • Battery terminals • EFI MAIN fuse • ECM

HINT:

If DTC P0560 is stored, the ECM does not store other DTCs or the data stored in the ECM is partly cleared.

WIRING DIAGRAM





INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT FUSE (EFI MAIN)

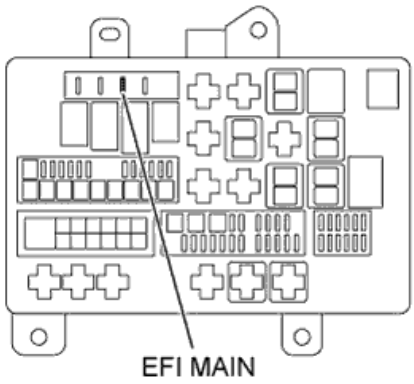
a. Remove the EFI MAIN fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAIN fuse	Always	Below 1 Ω

Engine Room Relay Block:



NG → CHECK FOR SHORTS IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

OK

2.CHECK HARNESS AND CONNECTOR (EFI MAIN FUSE - ECM, BATTERY)

a. Check the harness and the connector between the EFI MAIN fuse and ECM.

i. Remove the EFI MAIN fuse from the engine room relay block.

ii. Disconnect the ECM connector.

iii. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
EFI MAIN fuse terminal 2 - A38-1 (BATT)	Always	Below 1 Ω
EFI MAIN fuse terminal 2 or A38-1 (BATT) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
EFI MAIN fuse terminal 2 - A52-1 (BATT)	Always	Below 1 Ω
EFI MAIN fuse terminal 2 or A52-1 (BATT) - Body ground	Always	10 kΩ or higher

b. Check the harness and the connector between the EFI MAIN fuse and battery.

i. Remove the EFI MAIN fuse from the engine room relay block.

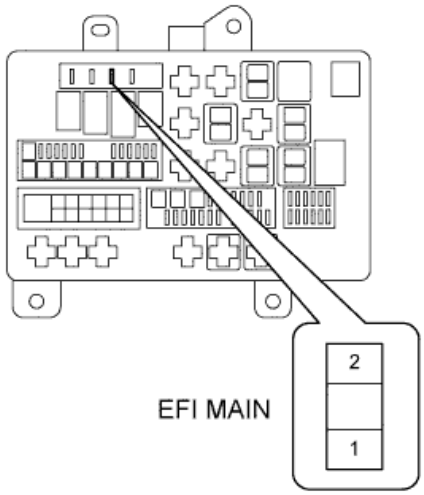
ii. Disconnect the positive battery terminal.

iii. Measure the resistance according to the value(s) in the table below.

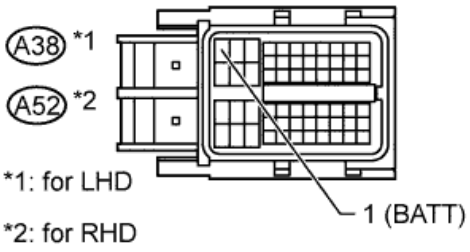
Standard Resistance:

Tester Connection	Condition	Specified Condition
Battery positive (+) terminal - EFI MAIN fuse terminal 1	Always	Below 1 Ω
Battery positive (+) terminal or EFI MAIN fuse terminal 1 - Body ground	Always	10 kΩ or higher

Engine Room Relay Block:



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT BATTERY

a. Check that the battery is not depleted (Click here).

OK:
Battery is not depleted

NG → REPLACE BATTERY

OK

4.CHECK BATTERY TERMINAL

a. Check that the battery terminals are not loose or corroded.

OK:
Battery terminals are not loose or corroded

NG → REPAIR OR REPLACE BATTERY TERMINAL

OK

5.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Turn the engine switch off and turn the tester off.

e. Start the engine and turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
P0560 is output	A
No DTC is output	B

B → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A → REPLACE ECM (Click here)

DTC P0031 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)

DTC P0032 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)

DTC P0051 Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)

DTC P0052 Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)

for Preparation Click here

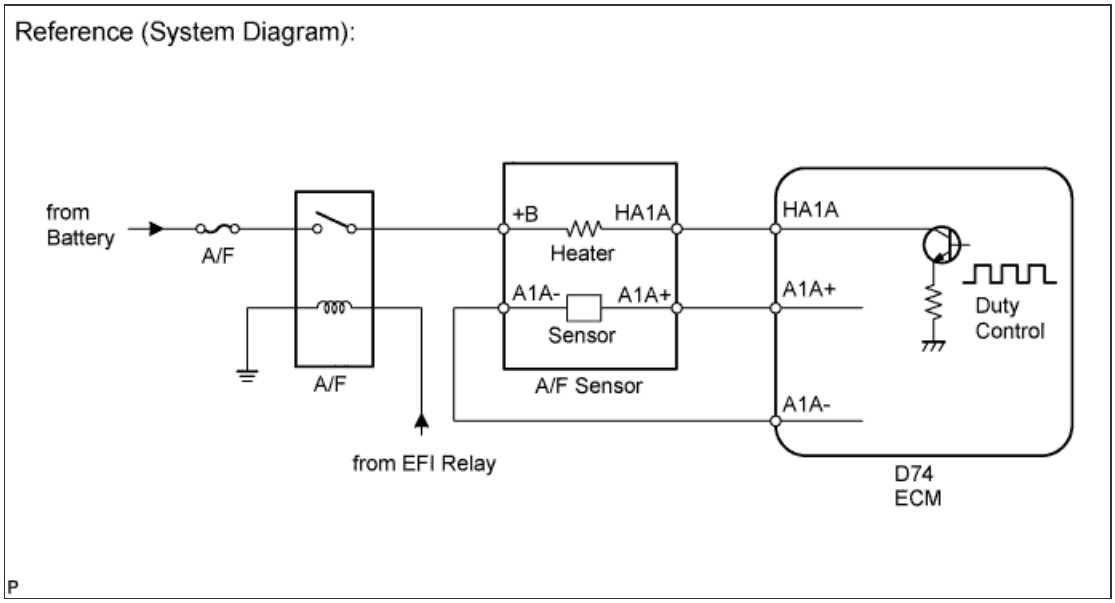
DESCRIPTION

Refer to DTC P2195 (Click here).

HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air-Fuel Ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**
- **When one of these DTCs is stored, the ECM enters fail-safe mode. The ECM turns off the A/F sensor heater in fail-safe mode. Fail-safe mode continues until the engine switch is turned off.**

- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The A/F sensor heater circuit uses a relay on the +B side of the circuit.**



DTC Code	DTC Detection Condition	Trouble Area
P0031 P0051	The Air-Fuel Ratio (A/F) sensor heater current is below 0.8 A (1 trip detection logic).	• Open in Air-Fuel Ratio (A/F) sensor heater circuit • A/F sensor heater (for sensor 1) • Integration relay • ECM
P0032 P0052	An Air-Fuel Ratio (A/F) sensor heater current failure (1 trip detection logic).	• Short in A/F sensor heater circuit • A/F sensor heater (for sensor 1) • Integration relay • ECM

HINT:

- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that does not include the No. 1 cylinder.**
- **Sensor 1 refers to the sensor closest to the engine assembly.**
- **Sensor 2 refers to the sensor farthest away from the engine assembly.**

MONITOR DESCRIPTION

The ECM uses information from the Air-Fuel Ratio (A/F) sensor to regulate the air-fuel ratio and keep it close to the stoichiometric level. This maximizes the ability of the Three-Way Catalytic Converter (TWC) to purify the exhaust gases.

The A/F sensor detects oxygen levels in the exhaust gas and transmits the information to the ECM. The inner surface of the sensor element is exposed to the outside air. The outer surface of the sensor element is exposed to the exhaust gas. The sensor element is made of platinum coated zirconia and includes an integrated heating element.
The zirconia element generates a small voltage when there is a large difference in the oxygen concentrations between the exhaust gas and outside air. The platinum coating amplifies this voltage generation.
The A/F sensor is more efficient when heated. When the exhaust gas temperature is low, the sensor cannot generate useful voltage signals without supplementary heating. The ECM regulates the supplementary heating using a duty-cycle approach to adjust the average current in the sensor heater element. If the heater current is outside the normal range, the signal transmitted by the A/F sensor becomes inaccurate. As a result, the ECM is unable to regulate air-fuel ratio properly.
When the current in the A/F sensor heater is outside the normal operating range, the ECM interprets this as a malfunction in the sensor heater and stores a DTC.
Example:
The ECM stores DTC P0032 or P0052 when the current in the A/F sensor heater is higher than 10 A. Conversely, when the heater current is below 0.8 A, DTC P0031 or P0051 is stored.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

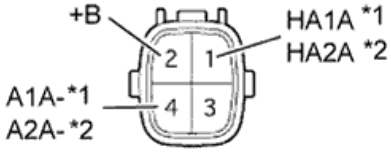
a. Disconnect the Air-Fuel Ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF A/F SENSOR)

a. Disconnect the A/F sensor connector.

b. Measure the voltage according to the value(s) in the table below.

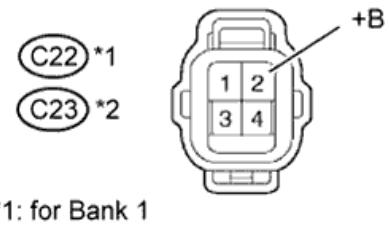
Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

Result

Result	Proceed to
NG	A
OK	B

Front view of wire harness connector:
(to A/F Sensor)



*1: for Bank 1

*2: for Bank 2

B → Go to step 5

A

3.INSPECT INTEGRATION RELAY (A/F)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

iii. Reinstall the A/F fuse.

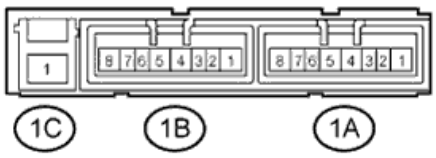
c. Inspect the integration relay (A/F).

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1A-4	Battery voltage not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω

Component without harness connected:
(Integration Relay)



NG → REPLACE INTEGRATION RELAY (A/F)

OK

4.CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - A/F SENSOR AND BODY GROUND)

a. Disconnect the A/F sensor connector.

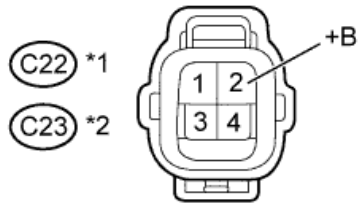
b. Remove the integration relay from the engine room relay block.

c. Measure the resistance according to the value(s) in the table below.

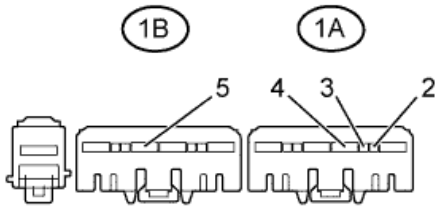
Standard Resistance:

Tester Connection	Condition	Specified Condition
C22-2 (+B) - 1A-4	Always	Below 1 Ω
C23-2 (+B) - 1A-4	Always	Below 1 Ω
1A-2 - 1B-5	Always	Below 1 Ω
1A-3 - Body ground	Always	Below 1 Ω
C22-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher
C23-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher
1A-2 or 1B-5 - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to A/F Sensor)



Front view of wire harness connector:
(to Integration Relay)



*1: for Bank 1

*2: for Bank 2

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

5.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

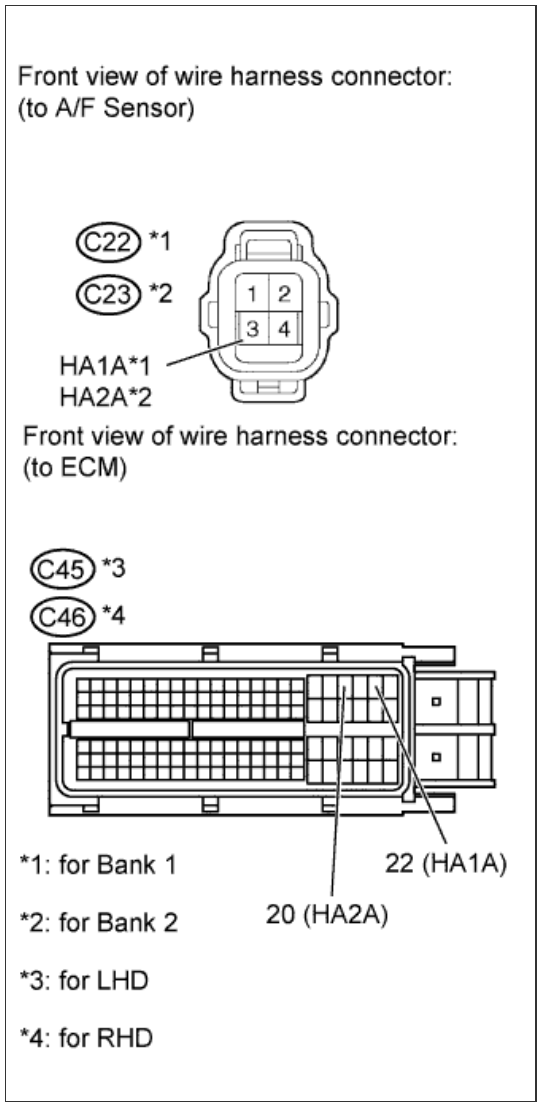
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher

C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Allow the engine to idle for 1 minute or more.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P0031, P0032, P0051 or P0052 is output	B

B → REPLACE ECM (Click here)

A

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0604 Random Access Memory (RAM)

for Preparation Click here

DESCRIPTION

The ECM continuously monitors its internal memory status. This self-check ensures that the ECM is functioning properly. This is diagnosed by internal "mirroring" of the main CPU and sub CPU to detect Random Access Memory (RAM) errors. If outputs from these CPUs are different and deviate from the standard, the ECM will illuminate the MIL and store a DTC immediately.

DTC Code	DTC Detection Condition	Trouble Area
P0604	ECM RAM errors.	ECM

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK DTC

a. Clear DTC (Click here).

b. Turn the engine switch off.

c. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

d. Connect the cable to the negative (-) battery terminal.

e. Turn the engine switch on (IG).

f. Check for DTC.

OK:
P0604 is not output.

NG → **REPLACE ECM (Click here)**

OK ↓

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0037 Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)

DTC P0038 Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)

DTC P0057 Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)

DTC P0058 Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)

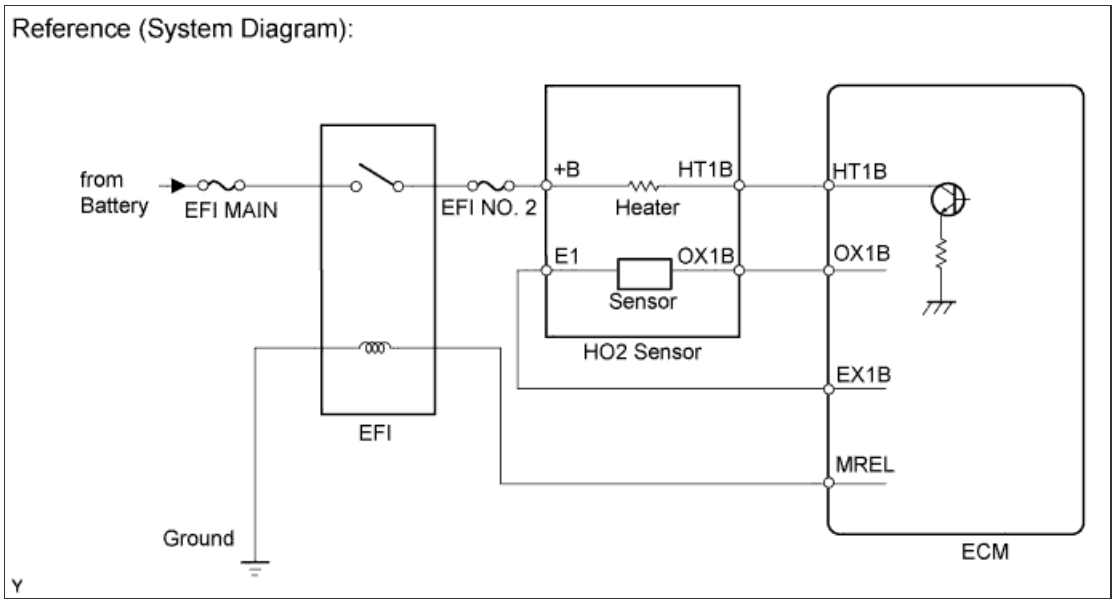
for Preparation Click here

DESCRIPTION

Refer to DTC P0136 (Click here).

HINT:

- **When any of these DTCs are stored, the ECM enters fail-safe mode. The ECM turns off the Heated Oxygen (HO2) sensor heater in fail-safe mode. Fail-safe mode continues until the engine switch is turned off.**
- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The HO2 sensor heater circuit uses a relay on the +B side of the circuit.**



DTC Code	DTC Detection Condition	Trouble Area
P0037 P0057	The Heated Oxygen (HO2) sensor heater current is below 0.3 A (1 trip detection logic).	• Open in HO2 sensor heater circuit • HO2 sensor heater (for sensor 2) • Integration relay (EFI) • ECM
P0038 P0058	The Heated Oxygen (HO2) sensor heater current is higher than 2 A (1 trip detection logic).	• Short in HO2 sensor heater circuit • HO2 sensor heater (for sensor 2) • Integration relay (EFI) • ECM

MONITOR DESCRIPTION

The sensing portion of the Heated Oxygen (HO2) sensor has a zirconia ele ent which is used to detect the oxygen concentration in the exhaust gas. If the zirconia ele ent is at the appropriate te perature, and the difference between the oxygen concentrations surrounding the inside and outside surfaces of the sensor is large, the zirconia ele ent generates voltage signals. In order to increase the oxygen concentration detecting capacity of the zirconia ele ent, the ECM supple ents the heat fro the exhaust with heat fro a heating ele ent inside the sensor.

Heated oxygen sensor heater range check (P0037, P0038, P0057 and P0058):

The ECM onitors the current applied to the HO2 sensor heater to check the heater for alfunctions. If the current is below the threshold value, the ECM deter ines that there is an open circuit in the heater. If the current is above the threshold value, the ECM deter ines that there is a short circuit in the heater.

The ECM constantly onitors the current applied to the heater. If the ECM detects an open or short circuit, the ECM turns the MIL on and stores a DTC.

If a alfunction is detected, the ECM cuts off the current applied to the heater.
Exa ple:
The ECM stores DTC P0038 or P0058 when the current in the HO2 sensor heater is higher than 2 A. Conversely, when the heater current is below 0.3 A, DTC P0037 or P0057 is stored.

WIRING DIAGRAM

Refer to DTC P0136 (Click here).

CONFIRMATION DRIVING PATTERN

These DTCs are stored when the engine idles for 110 seconds or ore.

INSPECTION PROCEDURE

HINT:

- **Sensor 2 refers to the sensor mounted behind the Three-Way Catalytic Converter (TWC) and located far from the engine assembly.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

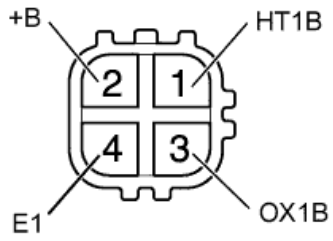
a. Disconnect the Heated Oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

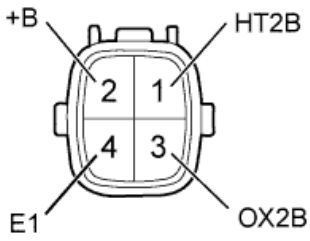
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1) - 2 (+)	20°C (68°F)	11 to 16 Ω
1 (HT1) - 4 (E1)	Always	10 kΩ or higher
1 (HT2) - 2 (+)	20°C (68°F)	11 to 16 Ω
1 (HT2) - 4 (E1)	Always	10 kΩ or higher

Component without harness connected:
(HO2 Sensor for Bank 1)



Component without harness connected:
(HO2 Sensor for Bank 2)



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF HO2 SENSOR)

a. Disconnect the HO2 sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

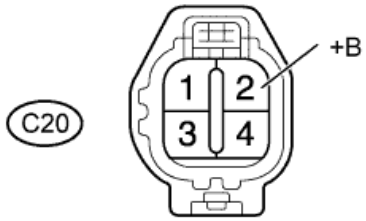
Tester Connection	Switch Condition	Specified Condition
C20-2 (+) - ody ground	Engine switch on (I)	11 to 14 V

C56-2 (+) - ody ground	Engine switch on (I)	11 to 14 V

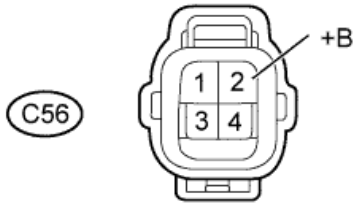
Result

Result	Proceed to
	A
OK	

Front view of wire harness connector:
(to HO2 Sensor for Bank 1)



Front view of wire harness connector:
(to HO2 Sensor for Bank 2)

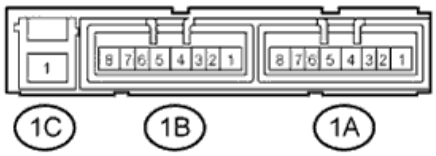


B → Go to step 5

A

3.INSPECT INTEGRATION RELAY (EFI MAIN)

Component without harness connected:
(Integration Relay)



a. Re ove the integration relay fro the engine roo relay block.

b. Inspect the EFI MAI fuse.

i. Re ove the EFI MAI fuse fro the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAI fuse	Always	elow 1 Ω

iii. Reinstall the EFI MAI fuse.

c. Inspect the EFI relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1	hen no battery voltage applied to ter inals 1 2 and 1 3	10 kΩ or higher
	When battery voltage applied to ter inals 1 2 and 1 3	elow 1 Ω

NG → REPLACE INTEGRATION RELAY (EFI MAIN)

OK

.CHECK HARNESS AND CONNECTOR (HO2 SENSOR - INTEGRATION RELAY)

a. Check the EFI O. 2 fuse.

i. Re ove the EFI O. 2 fuse fro the engine roo relay block.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI O. 2 fuse	Always	elow 1 Ω

iii. Reinstall the EFI O. 2 fuse.

b. Disconnect the HO2 sensor connector.

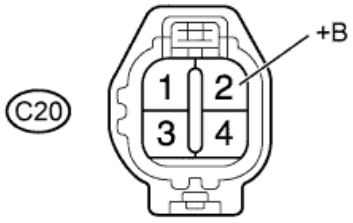
c. Re ove the integration relay fro the engine roo relay block.

d. Measure the resistance according to the value(s) in the table below.

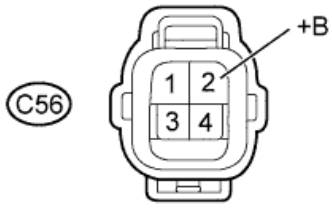
Standard Resistance:

Tester Connection	Condition	Specified Condition
C20-2 (+) - 1	Always	elow 1 Ω
C56-2 (+) - 1	Always	elow 1 Ω
C20-2 (+) or 1 ody ground	Always	10 kΩ or higher
C56-2 (+) or 1 ody ground	Always	10 kΩ or higher

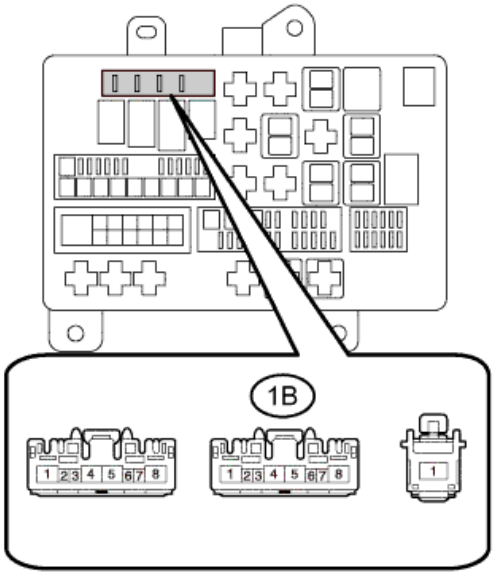
Front view of wire harness connector:
(to HO2 Sensor for Bank 1)



Front view of wire harness connector:
(to HO2 Sensor for Bank 2)



Front view of wire harness connector:
(to Integration Relay)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

5.CHECK HARNESS AND CONNECTOR (HO2 SENSOR - ECM)

a. Disconnect the HO2 sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

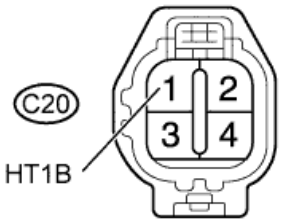
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C20-1 (HT1) - C45-45 (HT1)	Always	elow 1 Ω
C56-1 (HT2) - C45-44 (HT2)	Always	elow 1 Ω
C20-1 (HT1) or C45-45 (HT1) - ody ground	Always	10 kΩ or higher
C56-1 (HT2) or C45-44 (HT2) - ody ground	Always	10 kΩ or higher

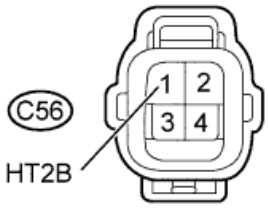
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C20-1 (HT1) - C46-45 (HT1)	Always	elow 1 Ω
C56-1 (HT2) - C46-44 (HT2)	Always	elow 1 Ω
C20-1 (HT1) or C46-45 (HT1) - ody ground	Always	10 kΩ or higher
C56-1 (HT2) or C46-44 (HT2) - ody ground	Always	10 kΩ or higher

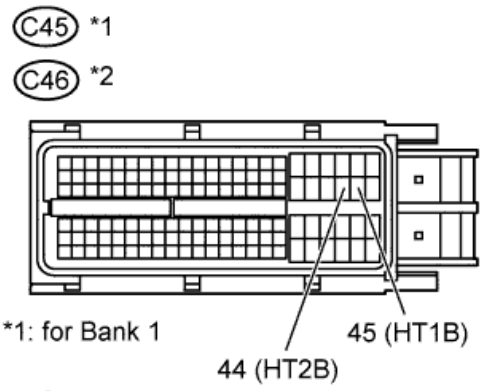
Front view of wire harness connector:
(to HO2 Sensor)



Front view of wire harness connector:
(to HO2 Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Allow the engine to idle for 2 inutes or ore.

g. Enter the following enus: Powertrain / Engine and ECT / DTC.

h. Read DTCs.

Result

Result	Proceed to
o DTC is output	A
P0037, P0038, P0057 and/or P0058 is output	

B → REPLACE ECM (Click here)

A

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0606 ECM / PCM Processor

for Preparation Click here

DESCRIPTION

The ECM continuously monitors its main and sub CPUs. This self-check ensures that the ECM is functioning properly. If outputs from the CPUs are different and deviate from the standard, the ECM will illuminate the MIL and store a DTC immediately.

DTC Code	DTC Detection Condition	Trouble Area
P0606	When either condition below is met: • An ECM main CPU error. • An ECM sub CPU error.	ECM

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK DTC

a. Clear DTC (Click here).

b. Turn the engine switch off.

c. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

d. Connect the cable to the negative (-) battery terminal.

e. Turn the engine switch on (I .

f. Check for DTC.

OK:
P0606 is not output.

NG → **REPLACE ECM (Click here)**

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0037 Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)

DTC P0038 Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)

DTC P0057 Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)

DTC P0058 Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)

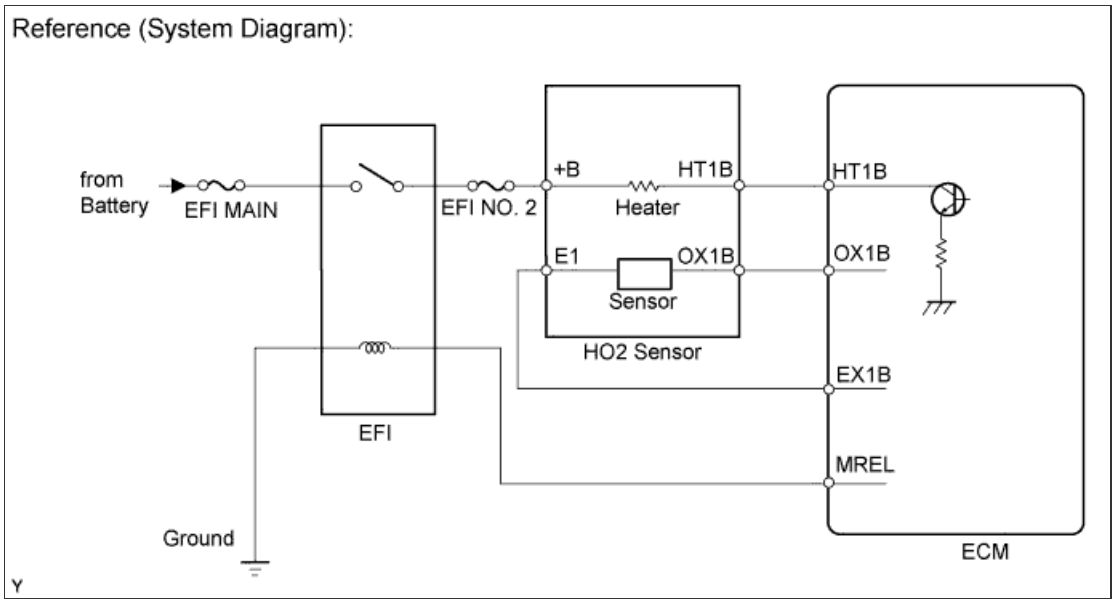
for Preparation Click here

DESCRIPTION

Refer to DTC P0136 (Click here).

HINT:

- **When any of these DTCs are stored, the ECM enters fail-safe mode. The ECM turns off the Heated Oxygen (HO2) sensor heater in fail-safe mode. Fail-safe mode continues until the engine switch is turned off.**
- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The HO2 sensor heater circuit uses a relay on the +B side of the circuit.**



DTC Code	DTC Detection Condition	Trouble Area
P0037 P0057	The Heated Oxygen (HO2) sensor heater current is below 0.3 A (1 trip detection logic).	• Open in HO2 sensor heater circuit • HO2 sensor heater (for sensor 2) • Integration relay (EFI) • ECM
P0038 P0058	The Heated Oxygen (HO2) sensor heater current is higher than 2 A (1 trip detection logic).	• Short in HO2 sensor heater circuit • HO2 sensor heater (for sensor 2) • Integration relay (EFI) • ECM

MONITOR DESCRIPTION

The sensing portion of the Heated Oxygen (HO2) sensor has a zirconia ele ent which is used to detect the oxygen concentration in the exhaust gas. If the zirconia ele ent is at the appropriate te perature, and the difference between the oxygen concentrations surrounding the inside and outside surfaces of the sensor is large, the zirconia ele ent generates voltage signals. In order to increase the oxygen concentration detecting capacity of the zirconia ele ent, the ECM supple ents the heat fro the exhaust with heat fro a heating ele ent inside the sensor.

Heated oxygen sensor heater range check (P0037, P0038, P0057 and P0058):

The ECM onitors the current applied to the HO2 sensor heater to check the heater for alfunctions. If the current is below the threshold value, the ECM deter ines that there is an open circuit in the heater. If the current is above the threshold value, the ECM deter ines that there is a short circuit in the heater.

The ECM constantly onitors the current applied to the heater. If the ECM detects an open or short circuit, the ECM turns the MIL on and stores a DTC.

If a alfunction is detected, the ECM cuts off the current applied to the heater.
Exa ple:
The ECM stores DTC P0038 or P0058 when the current in the HO2 sensor heater is higher than 2 A. Conversely, when the heater current is below 0.3 A, DTC P0037 or P0057 is stored.

WIRING DIAGRAM

Refer to DTC P0136 (Click here).

CONFIRMATION DRIVING PATTERN

These DTCs are stored when the engine idles for 110 seconds or ore.

INSPECTION PROCEDURE

HINT:

- **Sensor 2 refers to the sensor mounted behind the Three-Way Catalytic Converter (TWC) and located far from the engine assembly.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

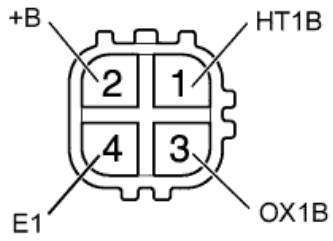
a. Disconnect the Heated Oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

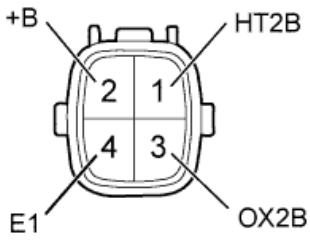
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1) - 2 (+)	20°C (68°F)	11 to 16 Ω
1 (HT1) - 4 (E1)	Always	10 kΩ or higher
1 (HT2) - 2 (+)	20°C (68°F)	11 to 16 Ω
1 (HT2) - 4 (E1)	Always	10 kΩ or higher

Component without harness connected:
(HO2 Sensor for Bank 1)



Component without harness connected:
(HO2 Sensor for Bank 2)



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF HO2 SENSOR)

a. Disconnect the HO2 sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

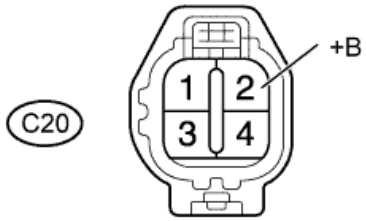
Tester Connection	Switch Condition	Specified Condition
C20-2 (+) - ody ground	Engine switch on (I)	11 to 14 V

C56-2 (+) - ody ground	Engine switch on (I)	11 to 14 V

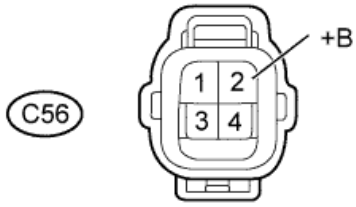
Result

Result	Proceed to
	A
OK	

Front view of wire harness connector:
(to HO2 Sensor for Bank 1)



Front view of wire harness connector:
(to HO2 Sensor for Bank 2)

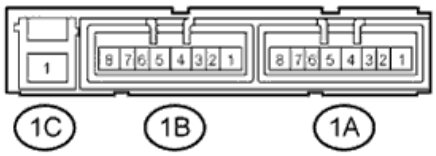


B → Go to step 5

A

3.INSPECT INTEGRATION RELAY (EFI MAIN)

Component without harness connected:
(Integration Relay)



a. Re ove the integration relay fro the engine roo relay block.

b. Inspect the EFI MAI fuse.

i. Re ove the EFI MAI fuse fro the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAI fuse	Always	elow 1 Ω

iii. Reinstall the EFI MAI fuse.

c. Inspect the EFI relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1	hen no battery voltage applied to ter inals 1 2 and 1 3	10 kΩ or higher
	When battery voltage applied to ter inals 1 2 and 1 3	elow 1 Ω

NG → REPLACE INTEGRATION RELAY (EFI MAIN)

OK

.CHECK HARNESS AND CONNECTOR (HO2 SENSOR - INTEGRATION RELAY)

a. Check the EFI O. 2 fuse.

i. Re ove the EFI O. 2 fuse fro the engine roo relay block.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI O. 2 fuse	Always	elow 1 Ω

iii. Reinstall the EFI O. 2 fuse.

b. Disconnect the HO2 sensor connector.

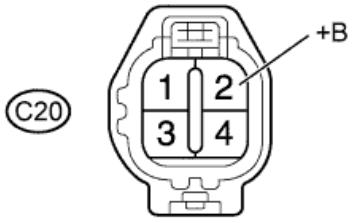
c. Re ove the integration relay fro the engine roo relay block.

d. Measure the resistance according to the value(s) in the table below.

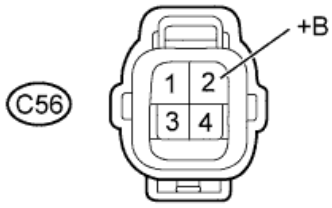
Standard Resistance:

Tester Connection	Condition	Specified Condition
C20-2 (+) - 1	Always	elow 1 Ω
C56-2 (+) - 1	Always	elow 1 Ω
C20-2 (+) or 1 ody ground	Always	10 kΩ or higher
C56-2 (+) or 1 ody ground	Always	10 kΩ or higher

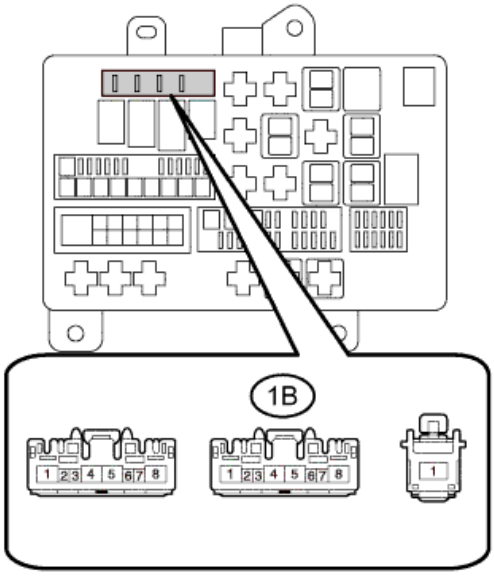
Front view of wire harness connector:
(to HO2 Sensor for Bank 1)



Front view of wire harness connector:
(to HO2 Sensor for Bank 2)



Front view of wire harness connector:
(to Integration Relay)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

5.CHECK HARNESS AND CONNECTOR (HO2 SENSOR - ECM)

a. Disconnect the HO2 sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

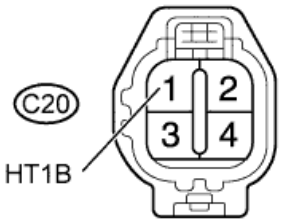
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C20-1 (HT1) - C45-45 (HT1)	Always	elow 1 Ω
C56-1 (HT2) - C45-44 (HT2)	Always	elow 1 Ω
C20-1 (HT1) or C45-45 (HT1) - ody ground	Always	10 kΩ or higher
C56-1 (HT2) or C45-44 (HT2) - ody ground	Always	10 kΩ or higher

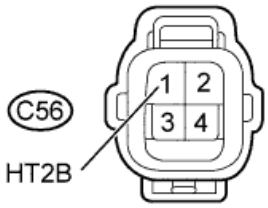
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C20-1 (HT1) - C46-45 (HT1)	Always	elow 1 Ω
C56-1 (HT2) - C46-44 (HT2)	Always	elow 1 Ω
C20-1 (HT1) or C46-45 (HT1) - ody ground	Always	10 kΩ or higher
C56-1 (HT2) or C46-44 (HT2) - ody ground	Always	10 kΩ or higher

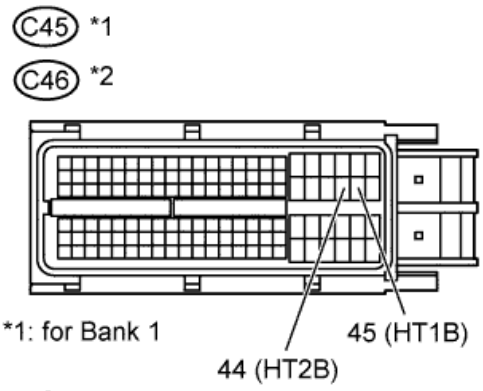
Front view of wire harness connector:
(to HO2 Sensor)



Front view of wire harness connector:
(to HO2 Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Allow the engine to idle for 2 inutes or ore.

g. Enter the following enus: Powertrain / Engine and ECT / DTC.

h. Read DTCs.

Result

Result	Proceed to
o DTC is output	A
P0037, P0038, P0057 and/or P0058 is output	

B → REPLACE ECM (Click here)

A

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P060A Internal Control Module Monitoring Processor Performance

for Preparation Click here

DESCRIPTION

The main CPU and sub CPU of the ECM perform data communication between each other. The main CPU monitors the communications and C pu es from the sub CPU. hen the signa ma functions be ow are detected, a DTC is stored.

DTC Code	DTC Detection Condition	Troub e Area
P060A	hen a condition be ow is met • n ECM main CPU error. • An ECM sub CPU error. • An e ectronic throtte monitoring CPU error.	ECM

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the inte igent tester. Freeze frame data records the engine condition when ma functions are detected. hen troub eshooting, freeze frame data can he p determine if the vehic e was moving or stationar if the engine was warmed up or not, if the air-fue ratio was ean or rich, and other data from the time the ma function occurred.

1.CHECK DTC

a. C ear DTC (C ick here).

b. Turn the engine switch off.

c. Disconnect the cab e from the negative (-) batter termina and wait for 1 minute.

d. Connect the cab e to the negative (-) batter termina

e. Turn the engine switch on (IG).

f. Check for DTC.

OK:
P060A is not output.

NG → **REPLACE ECM (Click here)**

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0037 Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)

DTC P0038 Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)

DTC P0057 Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)

DTC P0058 Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)

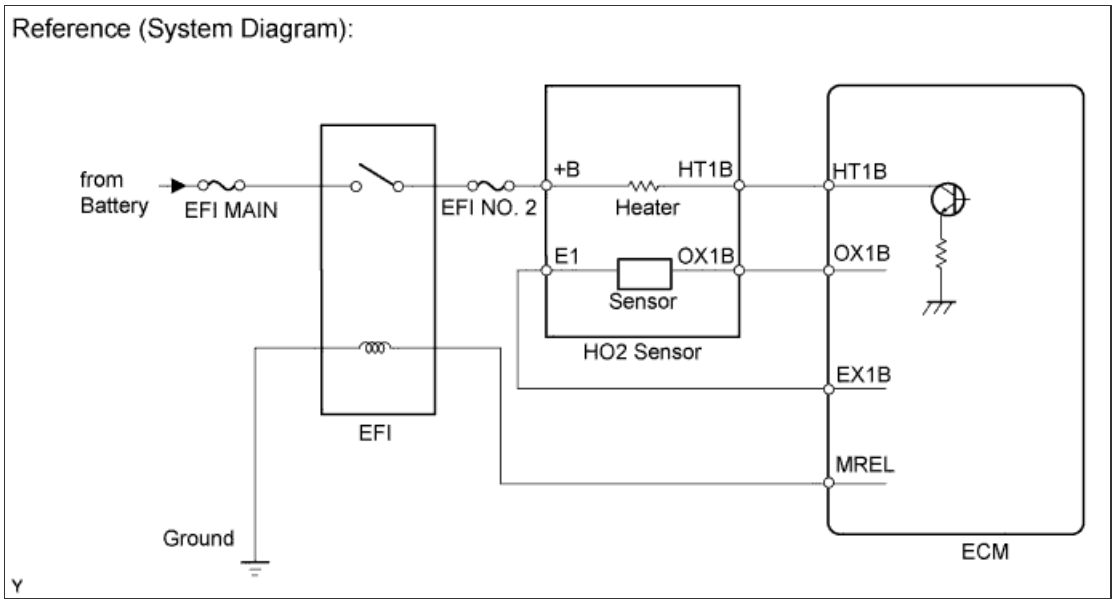
for Preparation Click here

DESCRIPTION

Refer to DTC P0136 (Click here).

HINT:

- **When any of these DTCs are stored, the ECM enters fail-safe mode. The ECM turns off the Heated Oxygen (HO2) sensor heater in fail-safe mode. Fail-safe mode continues until the engine switch is turned off.**
- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The HO2 sensor heater circuit uses a relay on the +B side of the circuit.**



DTC Code	DTC Detection Condition	Trouble Area
P0037 P0057	The Heated Oxygen (HO2) sensor heater current is below 0.3 A (1 trip detection logic).	• Open in HO2 sensor heater circuit • HO2 sensor heater (for sensor 2) • Integration relay (EFI) • ECM
P0038 P0058	The Heated Oxygen (HO2) sensor heater current is higher than 2 A (1 trip detection logic).	• Short in HO2 sensor heater circuit • HO2 sensor heater (for sensor 2) • Integration relay (EFI) • ECM

MONITOR DESCRIPTION

The sensing portion of the Heated Oxygen (HO2) sensor has a zirconia ele ent which is used to detect the oxygen concentration in the exhaust gas. If the zirconia ele ent is at the appropriate te perature, and the difference between the oxygen concentrations surrounding the inside and outside surfaces of the sensor is large, the zirconia ele ent generates voltage signals. In order to increase the oxygen concentration detecting capacity of the zirconia ele ent, the ECM supple ents the heat fro the exhaust with heat fro a heating ele ent inside the sensor.

Heated oxygen sensor heater range check (P0037, P0038, P0057 and P0058):

The ECM onitors the current applied to the HO2 sensor heater to check the heater for alfunctions. If the current is below the threshold value, the ECM deter ines that there is an open circuit in the heater. If the current is above the threshold value, the ECM deter ines that there is a short circuit in the heater.

The ECM constantly onitors the current applied to the heater. If the ECM detects an open or short circuit, the ECM turns the MIL on and stores a DTC.

If a alfunction is detected, the ECM cuts off the current applied to the heater.
Exa ple:
The ECM stores DTC P0038 or P0058 when the current in the HO2 sensor heater is higher than 2 A. Conversely, when the heater current is below 0.3 A, DTC P0037 or P0057 is stored.

WIRING DIAGRAM

Refer to DTC P0136 (Click here).

CONFIRMATION DRIVING PATTERN

These DTCs are stored when the engine idles for 110 seconds or ore.

INSPECTION PROCEDURE

HINT:

- **Sensor 2 refers to the sensor mounted behind the Three-Way Catalytic Converter (TWC) and located far from the engine assembly.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

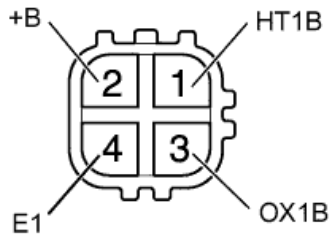
a. Disconnect the Heated Oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

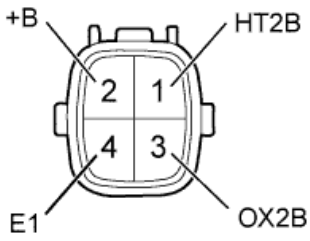
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1) - 2 (+)	20°C (68°F)	11 to 16 Ω
1 (HT1) - 4 (E1)	Always	10 kΩ or higher
1 (HT2) - 2 (+)	20°C (68°F)	11 to 16 Ω
1 (HT2) - 4 (E1)	Always	10 kΩ or higher

Component without harness connected:
(HO2 Sensor for Bank 1)



Component without harness connected:
(HO2 Sensor for Bank 2)



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF HO2 SENSOR)

a. Disconnect the HO2 sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

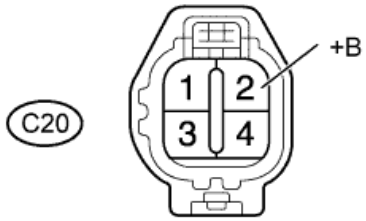
Tester Connection	Switch Condition	Specified Condition
C20-2 (+) - ody ground	Engine switch on (I)	11 to 14 V

C56-2 (+) - ody ground	Engine switch on (I)	11 to 14 V

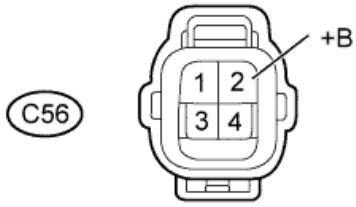
Result

Result	Proceed to
	A
OK	

Front view of wire harness connector:
(to HO2 Sensor for Bank 1)



Front view of wire harness connector:
(to HO2 Sensor for Bank 2)

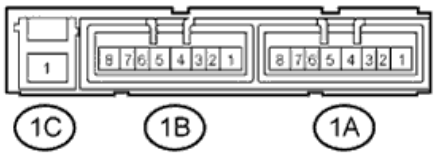


B → Go to step 5

A

3.INSPECT INTEGRATION RELAY (EFI MAIN)

Component without harness connected:
(Integration Relay)



a. Re ove the integration relay fro the engine roo relay block.

b. Inspect the EFI MAI fuse.

i. Re ove the EFI MAI fuse fro the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAI fuse	Always	elow 1 Ω

iii. Reinstall the EFI MAI fuse.

c. Inspect the EFI relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1	hen no battery voltage applied to ter inals 1 2 and 1 3	10 kΩ or higher
	When battery voltage applied to ter inals 1 2 and 1 3	elow 1 Ω

NG → REPLACE INTEGRATION RELAY (EFI MAIN)

OK

.CHECK HARNESS AND CONNECTOR (HO2 SENSOR - INTEGRATION RELAY)

a. Check the EFI O. 2 fuse.

i. Re ove the EFI O. 2 fuse fro the engine roo relay block.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI O. 2 fuse	Always	elow 1 Ω

iii. Reinstall the EFI O. 2 fuse.

b. Disconnect the HO2 sensor connector.

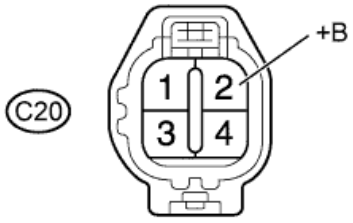
c. Re ove the integration relay fro the engine roo relay block.

d. Measure the resistance according to the value(s) in the table below.

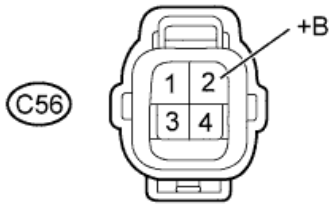
Standard Resistance:

Tester Connection	Condition	Specified Condition
C20-2 (+) - 1	Always	elow 1 Ω
C56-2 (+) - 1	Always	elow 1 Ω
C20-2 (+) or 1 ody ground	Always	10 kΩ or higher
C56-2 (+) or 1 ody ground	Always	10 kΩ or higher

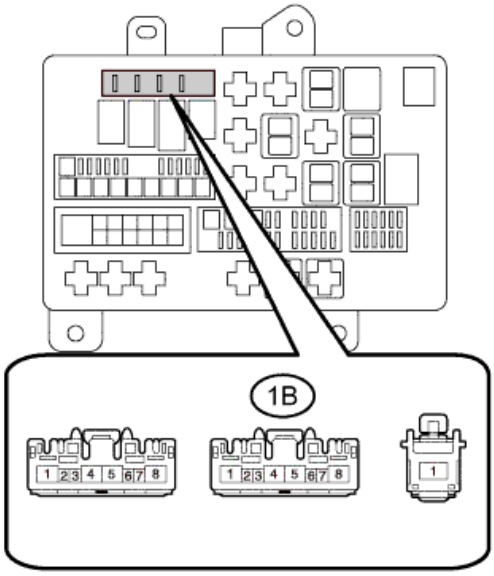
Front view of wire harness connector:
(to HO2 Sensor for Bank 1)



Front view of wire harness connector:
(to HO2 Sensor for Bank 2)



Front view of wire harness connector:
(to Integration Relay)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

5.CHECK HARNESS AND CONNECTOR (HO2 SENSOR - ECM)

a. Disconnect the HO2 sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

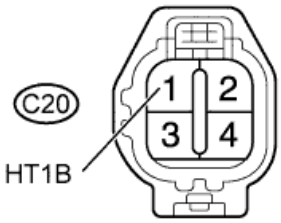
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C20-1 (HT1) - C45-45 (HT1)	Always	elow 1 Ω
C56-1 (HT2) - C45-44 (HT2)	Always	elow 1 Ω
C20-1 (HT1) or C45-45 (HT1) - ody ground	Always	10 kΩ or higher
C56-1 (HT2) or C45-44 (HT2) - ody ground	Always	10 kΩ or higher

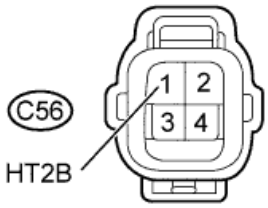
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C20-1 (HT1) - C46-45 (HT1)	Always	elow 1 Ω
C56-1 (HT2) - C46-44 (HT2)	Always	elow 1 Ω
C20-1 (HT1) or C46-45 (HT1) - ody ground	Always	10 kΩ or higher
C56-1 (HT2) or C46-44 (HT2) - ody ground	Always	10 kΩ or higher

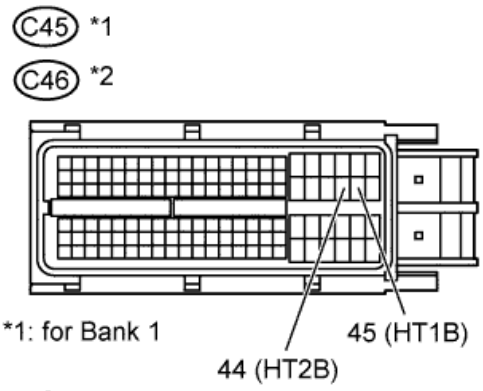
Front view of wire harness connector:
(to HO2 Sensor)



Front view of wire harness connector:
(to HO2 Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Allow the engine to idle for 2 inutes or ore.

g. Enter the following enus: Powertrain / Engine and ECT / DTC.

h. Read DTCs.

Result

Result	Proceed to
o DTC is output	A
P0037, P0038, P0057 and/or P0058 is output	

B → REPLACE ECM (Click here)

A

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P060B Internal Control Module A/D Processing Performance

for Preparation Click here

DESCRIPTION

This DTC is stored when a communication error occurs in the ECM.

DTC Code	DTC Detection Condition	Trouble Area
P060B	An ECM main CPU communication error.	ECM

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK DTC

a. Clear DTC (Click here).

b. Turn the engine switch off.

c. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

d. Connect the cable to the negative (-) battery terminal.

e. Turn the engine switch on (IG).

f. Check for DTC.

OK:
P060B is not output.

NG → REPLACE ECM (Click here)

OK ↓

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0037 Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)

DTC P0038 Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)

DTC P0057 Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)

DTC P0058 Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)

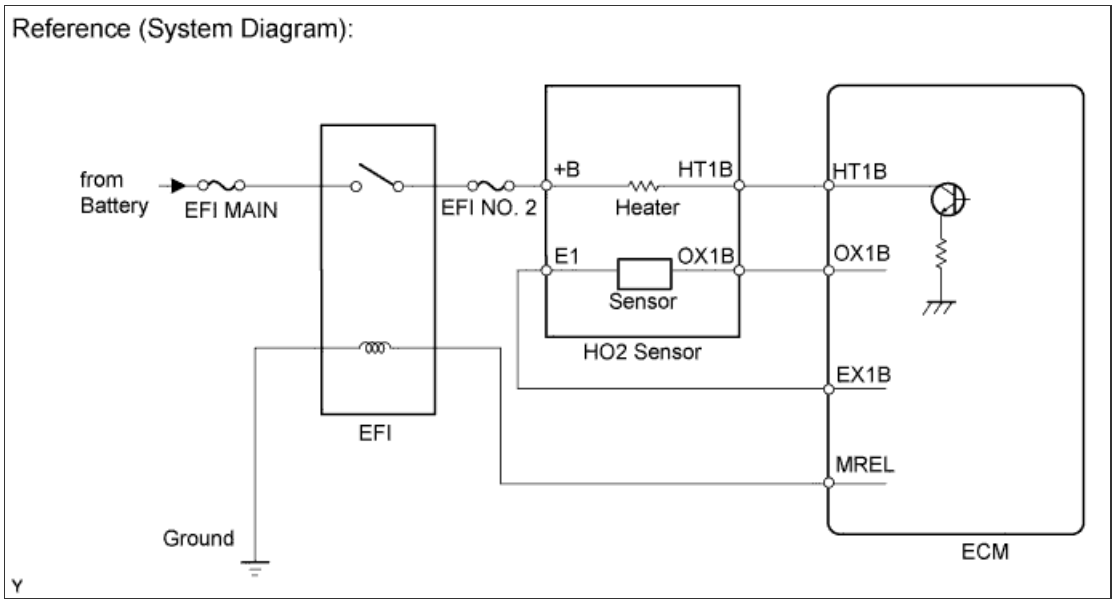
for Preparation Click here

DESCRIPTION

Refer to DTC P0136 (Click here).

HINT:

- **When any of these DTCs are stored, the ECM enters fail-safe mode. The ECM turns off the Heated Oxygen (HO2) sensor heater in fail-safe mode. Fail-safe mode continues until the engine switch is turned off.**
- **The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The HO2 sensor heater circuit uses a relay on the +B side of the circuit.**



DTC Code	DTC Detection Condition	Trouble Area
P0037 P0057	The Heated Oxygen (HO2) sensor heater current is below 0.3 A (1 trip detection logic).	• Open in HO2 sensor heater circuit • HO2 sensor heater (for sensor 2) • Integration relay (EFI) • ECM
P0038 P0058	The Heated Oxygen (HO2) sensor heater current is higher than 2 A (1 trip detection logic).	• Short in HO2 sensor heater circuit • HO2 sensor heater (for sensor 2) • Integration relay (EFI) • ECM

MONITOR DESCRIPTION

The sensing portion of the Heated Oxygen (HO2) sensor has a irconia ele ent which is used to detect the oxygen concentration in the exhaust gas. If the irconia ele ent is at the appropriate te perature and the difference between the oxygen concentrations surrounding the inside and outside surfaces of the sensor is large the irconia ele ent generates voltage signals. In order to increase the oxygen concentration detecting capacity of the irconia ele ent the ECM supple ents the heat fro the exhaust with heat fro a heating ele ent inside the sensor.

Heated oxygen sensor heater range check (P0037 P0038 P0057 and P0058)

The ECM onitors the current applied to the HO2 sensor heater to check the heater for alunctions. If the current is below the threshold value the ECM deter ines that there is an open circuit in the heater. If the current is above the threshold value the ECM deter ines that there is a short circuit in the heater.

The ECM constantly onitors the current applied to the heater. If the ECM detects an open or short circuit the ECM turns the MIL on and stores a DTC.

If a lfunction is detected the ECM cuts off the current applied to the heater.
Exa ple
The ECM stores DTC P0038 or P0058 when the current in the HO2 sensor heater is higher than 2 A. Conversely when the heater current is below 0.3 A DTC P0037 or P0057 is stored.

WIRING DIAGRAM

Refer to DTC P0136 (Click here).

CONFIRMATION DRIVING PATTERN

These DTCs are stored when the engine idles for 110 seconds or ore.

INSPECTION PROCEDURE

HINT:

- **Sensor 2 refers to the sensor mounted behind the Three-Way Catalytic Converter (TWC) and located far from the engine assembly.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

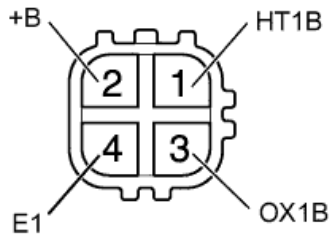
a. Disconnect the Heated Oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

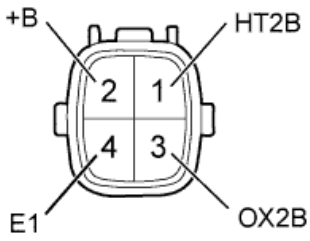
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1) 2 ( )	20 C (68 F)	11 to 16 Ω
1 (HT1) (E1)	Always	10 kΩ or higher
1 (HT2) 2 ( )	20 C (68 F)	11 to 16 Ω
1 (HT2) (E1)	Always	10 kΩ or higher

Component without harness connected:
(HO2 Sensor for Bank 1)



Component without harness connected:
(HO2 Sensor for Bank 2)



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

2.CHECK TERMINAL VOLTAGE (+B OF HO2 SENSOR)

a. Disconnect the HO2 sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

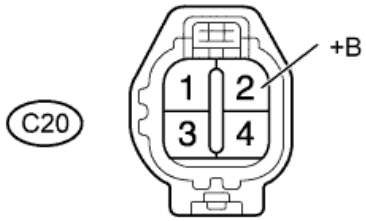
Tester Connection	Switch Condition	Specified Condition
C20 2 ( ) ody ground	Engine switch on (I)	11 to 14

C56 2 ( ) ody ground	Engine switch on (I)	11 to 14

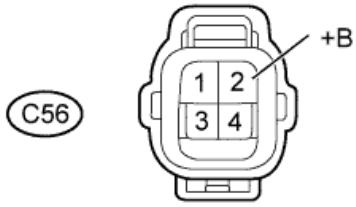
Result

Result	Proceed to
	A
OK	

Front view of wire harness connector:
(to HO2 Sensor for Bank 1)



Front view of wire harness connector:
(to HO2 Sensor for Bank 2)



B → Go to step 5

A

3.INSPECT INTEGRATION RELAY (EFI MAIN)

a. Re ove the integration relay fro the engine roo relay block.

b. Inspect the EFI MAI fuse.

i. Re ove the EFI MAI fuse fro the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAI fuse	Always	elow 1 Ω

iii. Reinstall the EFI MAI fuse.

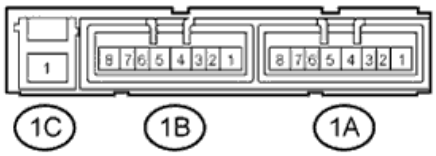
c. Inspect the EFI relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C 1 1	hen no battery oltage applied to ter inals 1 2 and 1 3	10 kΩ or higher
	When battery oltage applied to ter inals 1 2 and 1 3	elow 1 Ω

Component without harness connected:
(Integration Relay)



NG → REPLACE INTEGRATION RELAY (EFI MAIN)

OK

.CHECK HARNESS AND CONNECTOR (HO2 SENSOR - INTEGRATION RELAY)

a. Check the EFI O. 2 fuse.

i. Re ove the EFI O. 2 fuse fro the engine roo relay block.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI O. 2 fuse	Always	elow 1 Ω

iii. Reinstall the EFI O. 2 fuse.

b. Disconnect the HO2 sensor connector.

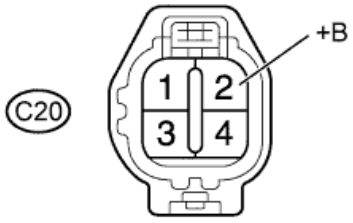
c. Re ove the integration relay fro the engine roo relay block.

d. Measure the resistance according to the value(s) in the table below.

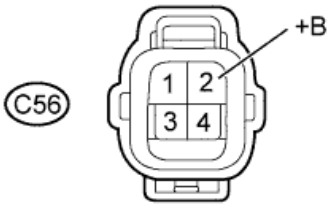
Standard Resistance:

Tester Connection	Condition	Specified Condition
C20 2 ( ) 1	lwAys	elow 1 Ω
C56 2 ( ) 1	lwAys	elow 1 Ω
C20 2 ( ) or 1 ody ground	Always	10 kΩ or higher
C56 2 ( ) or 1 ody ground	Always	10 kΩ or higher

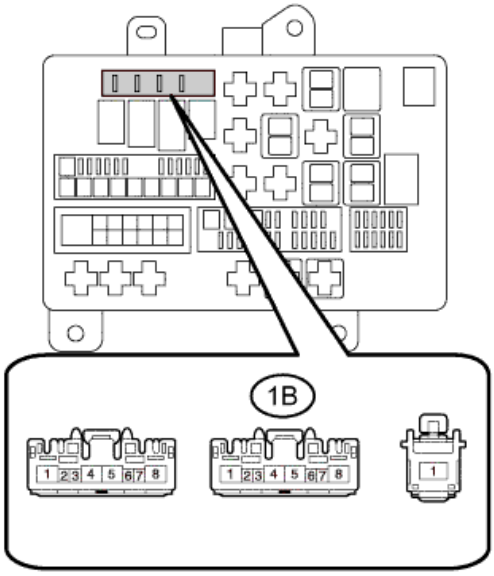
Front view of wire harness connector:
(to HO2 Sensor for Bank 1)



Front view of wire harness connector:
(to HO2 Sensor for Bank 2)



Front view of wire harness connector:
(to Integration Relay)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

5.CHECK HARNESS AND CONNECTOR (HO2 SENSOR - ECM)

a. Disconnect the HO2 sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

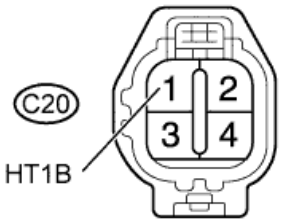
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C20 1 (HT1) C45 5 (HT1)	Always	elow 1 Ω
C56 1 (HT2) C45 (HT2)	Always	elow 1 Ω
C20 1 (HT1) or C45 5 (HT1) ody ground	Always	10 kΩ or higher
C56 1 (HT2) or C45 (HT2) ody ground	Always	10 kΩ or higher

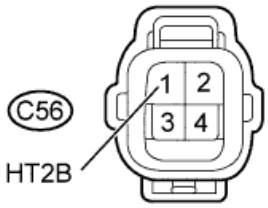
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C20 1 (HT1) C46 5 (HT1)	Always	elow 1 Ω
C56 1 (HT2) C46 (HT2)	Always	elow 1 Ω
C20 1 (HT1) or C46 5 (HT1) ody ground	Always	10 kΩ or higher
C56 1 (HT2) or C46 (HT2) ody ground	Always	10 kΩ or higher

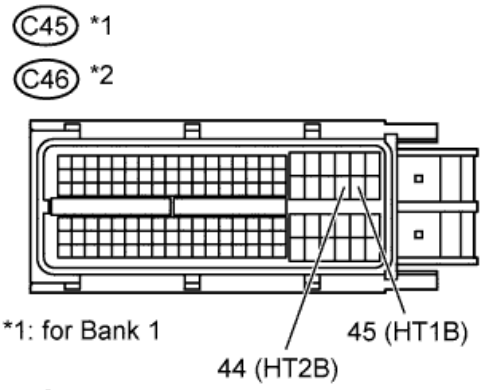
Front view of wire harness connector:
(to HO2 Sensor)



Front view of wire harness connector:
(to HO2 Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Allow the engine to idle for 2 inutes or ore.

g. Enter the following enus Powertrain Engine and ECT DTC.

h. Read DTCs.

Result

Result	Proceed to
o DTC is output	A
P0037 P0038 P0057 and or P0058 is output	

B → REPLACE ECM (Click here)

A

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P060D Internal Control Module Accelerator Pedal Position Performance

for Preparation Click here

DESCRIPTION

The ECM monitors the input signals of the Accelerator Pedal Position (APP) sensor No. 1. When the input signals and control signals are deviated, a DTC is stored.

DTC Code	DTC Detection Condition	Trouble Area
P060D	When either condition below is met: • An ECM main CPU error. • An ECM sub CPU error.	ECM

INSPECTION PROCEDURE

HINT:

Read free e frame data using the intelligent tester. Free e frame data records the engine condition when malfunctions are detected. When troubleshooting, free e frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK DTC

a. Clear DTC (Click here).

b. Turn the engine switch off.

c. Disconnect the cable from the negative (battery terminal and wait for 1 minute.

d. Connect the cable to the negative (battery terminal.

e. Turn the engine switch on (I).

f. Check for DTC.

OK:
P060D is not output.

NG → **REPLACE ECM (Click here)**

OK → **CHECK FOR INTERMITTENT PROBLEMS (Click here)**

DTC P0102 Mass or Volume Air Flow Circuit Low Input

DTC P0103 Mass or Volume Air Flow Circuit High Input

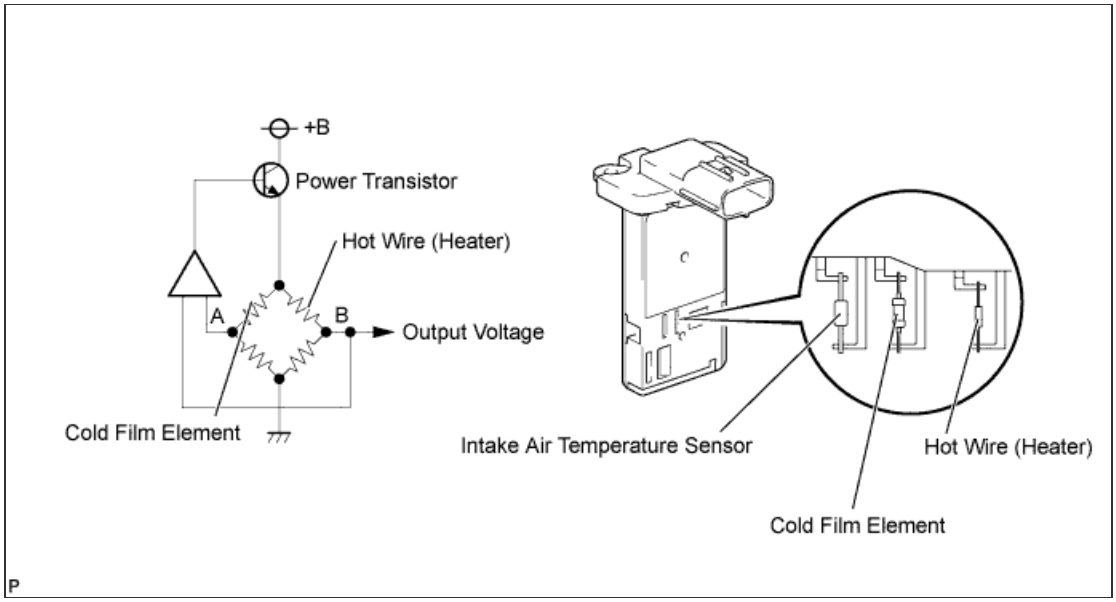
for Preparation Click here

DESCRIPTION

The Mass Air Flow (MAF) meter is a sensor that measures the amount of air flowing through the throttle valve.
The ECM uses this information to determine the fuel injection time and to provide the appropriate air-fuel ratio.
Inside the MAF meter, there is a heated platinum wire which is exposed to the flow of intake air.
By applying a specific electrical current to the wire, the ECM heats it to a given temperature. The flow of incoming air cools both the wire and an internal thermistor, affecting their resistance. To maintain a constant current value, the ECM varies the voltage applied to these components in the MAF meter.
The voltage level is proportional to the airflow through the sensor, and the ECM uses it to calculate the intake air volume.
The circuit is constructed so that the platinum hot wire and the temperature sensor create a bridge circuit, and the power transistor is controlled so that the potentials of A and B remain equal to maintain the predetermined temperature.

HINT:

When any of these DTCs are stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is calculated by the ECM, according to the engine speed and throttle valve position. Fail-safe mode continues until a pass condition is detected.



DTC Code	DTC Detection Condition	Trouble Area
P0102	The Mass Air Flow (MAF) meter voltage is below 0.2 V for 3 seconds (1 trip detection logic).	• Open or short in Mass Air Flow (MAF) meter circuit • MAF meter • ECM
P0103	The MAF meter voltage is higher than 4.9 V for 3 seconds (1 trip detection logic).	• Open or short in MAF meter circuit • MAF meter • ECM

HINT:

When any of these DTCs are output, check the air-flow rate by entering the following menus: Powertrain / Engine and ECT / Data List / MAF.

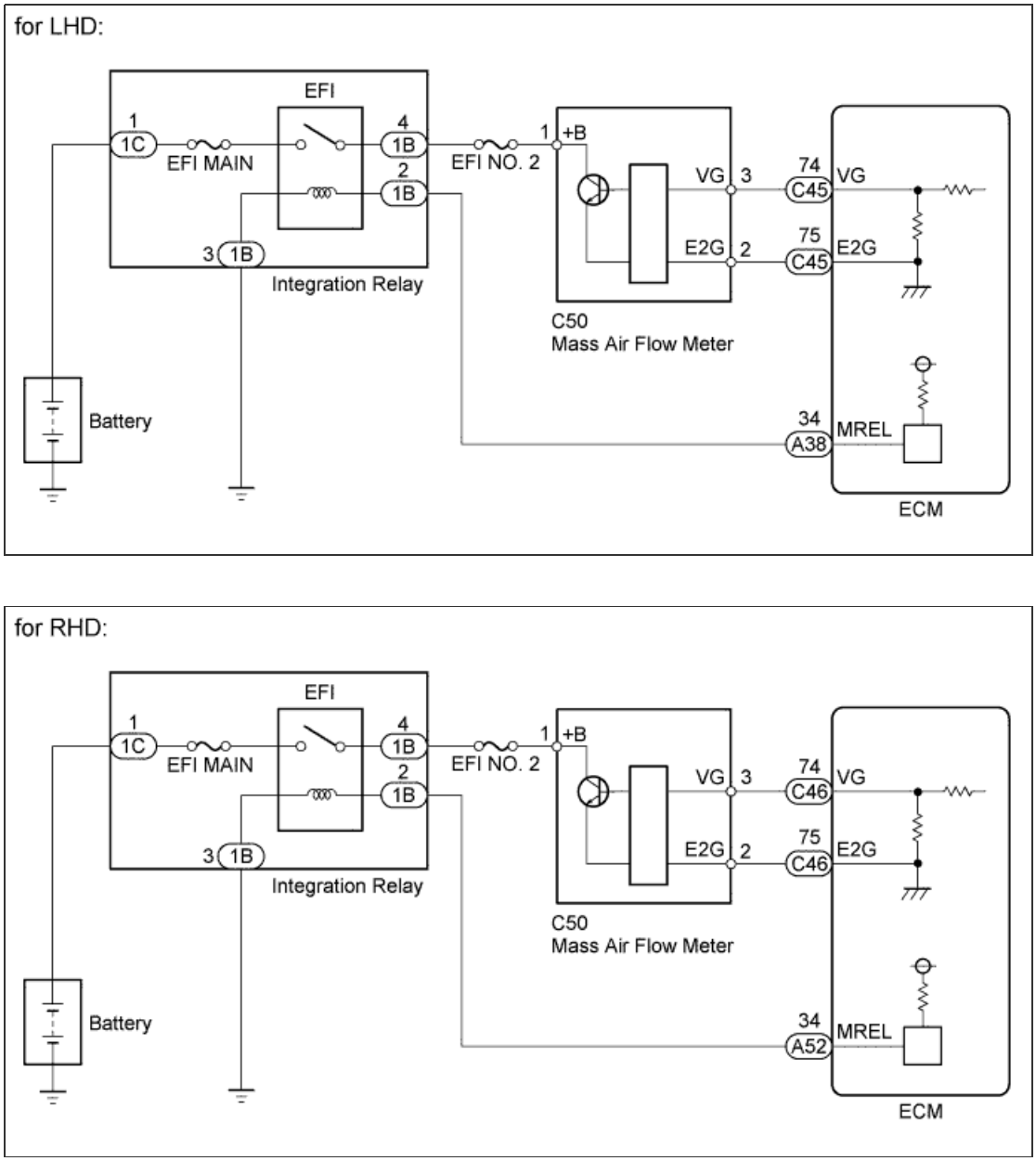
Mass Air Flow Rate (g/sec.)	Malfunction
Approximately 0.0	• **Open in Mass Air Flow (MAF) meter power source circuit** • **Open or short in VG circuit**
271.0 or more	Open in E2G circuit

MONITOR DESCRIPTION

If there is a defect in the MAF meter or an open or short circuit, the voltage level deviates from the normal operating range. The ECM interprets this

deviation as a malfunction in the MAF meter and stores a DTC.
Example:
When the sensor output voltage remains below 0.2 V, or higher than 4.9 V, for more than 3 seconds, the ECM stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored 3 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (MASS AIR FLOW RATE)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / MAF.

e. Read the values displayed on the tester.

Result

Result	Proceed to

0.0	A
271.0 or more	B
Between 1.0 and 270.0*	C

HINT:

*: The value must change when the throttle valve is open or closed with the engine running.

B	Go to step 6
C	CHEC FOR INTERMITTENT PROBLEMS (Click here)

A

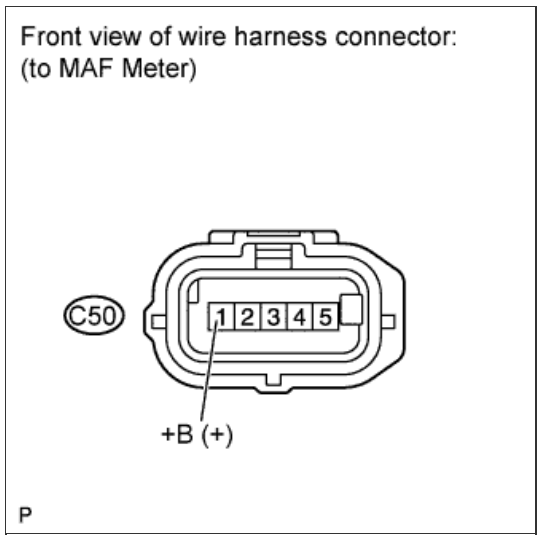
2.INSPECT MASS AIR FLOW METER (POWER SOURCE VOLTAGE)

a. Disconnect the Mass Air Flow (MAF) meter connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C50-1 (+B) - Body ground	Engine switch on (IG)	11 to 14 V



NG	Go to step 5

OK

3.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG	REPLACE MASS AIR FLOW METER (Click here)

OK

4.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the MAF meter connector.

b. Disconnect the ECM connector.

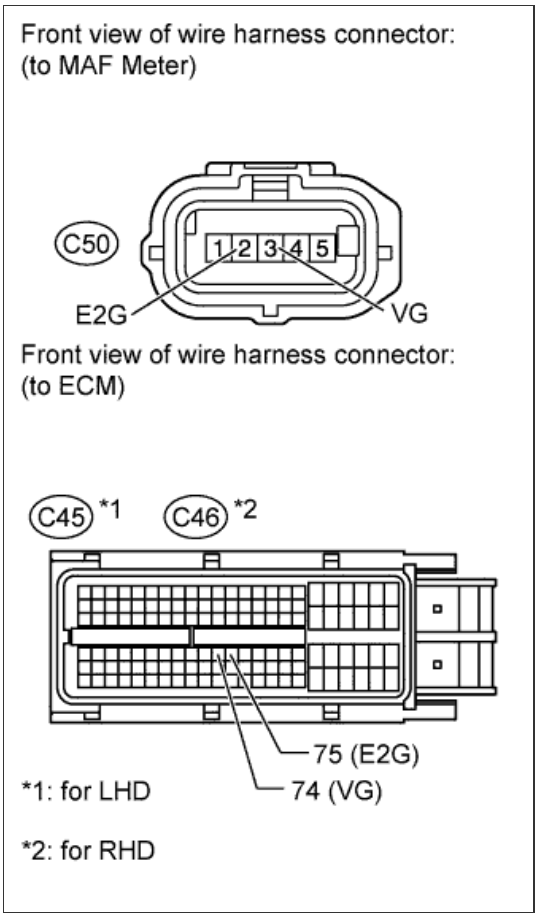
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C45-74 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C45-75 (E2G)	Always	Below 1 Ω
C50-3 (VG) or C45-74 (VG) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C4 -74 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C4 -75 (E2G)	Always	Below 1 Ω
C50-3 (VG) or C4 -74 (VG) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK → REPLACE ECM (Click here)

5.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - INTEGRATION RELAY)

a. Check the EFI N . 2 fuse.

i. Remove the EFI N . 2 fuse from the engine room relay block.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI N . 2 fuse	Always	Below 1 Ω

iii. Reinstall the EFI N . 2 fuse.

b. Disconnect the MAF meter connector.

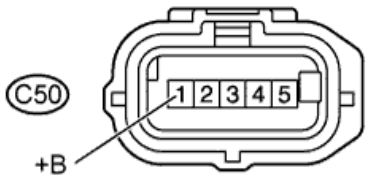
c. Remove the integration relay from the engine room relay block.

d. Measure the resistance according to the value(s) in the table below.

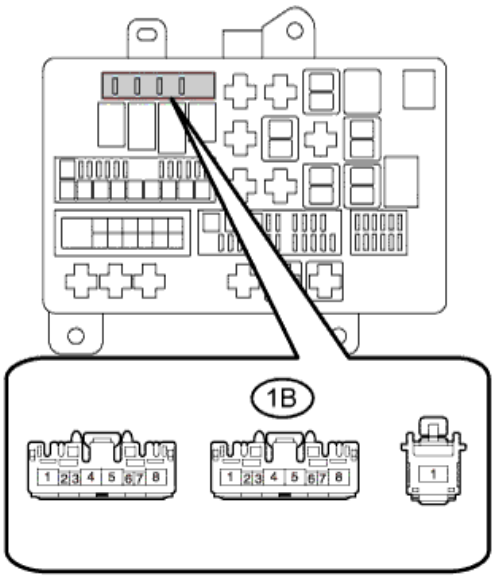
Standard Resistance:

Tester Connection	Condition	Specified Condition
C50-1 (+B) - 1B-4	Always	Below 1 Ω
C50-1 (+B) or 1B-4 - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to MAF Meter)



Front view of wire harness connector:
(to Integration Relay)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

6.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the MAF meter connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

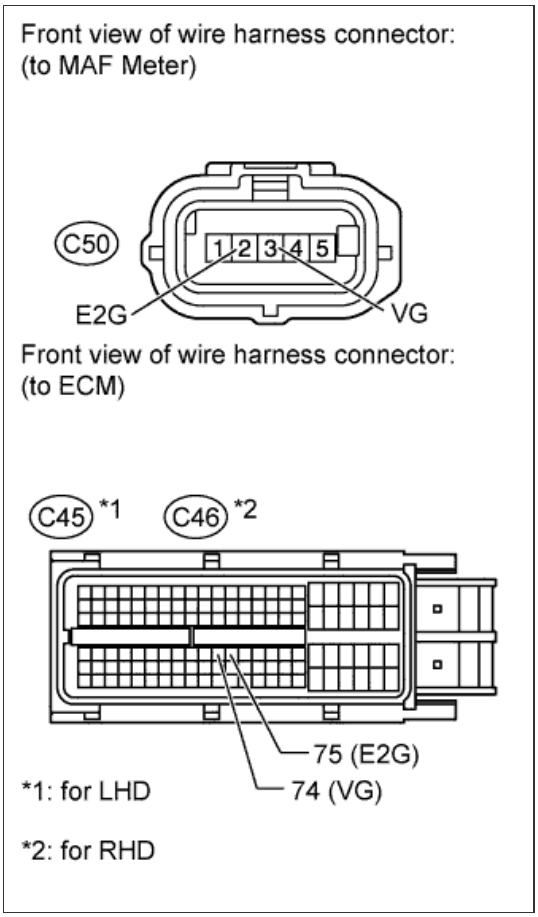
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C45-74 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C45-75 (E2G)	Always	Below 1 Ω
C50-3 (VG) or C45-74 (VG) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C4 -74 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C4 -75 (E2G)	Always	Below 1 Ω

C 0-3 (VG) or C4 -74 (VG) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

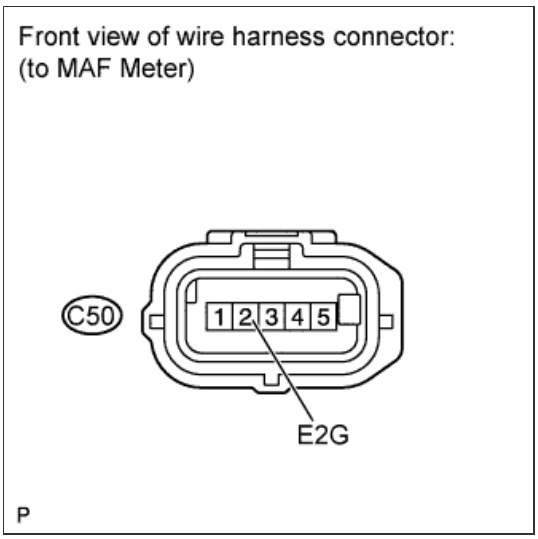
.CHEC HARNESS AND CONNECTOR (SENSOR GROUND)

a. Disconnect the MAF meter connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C50-2 (E2G) - Body ground	Always	Below 1 Ω



NG → REPLACE ECM (Click here)

OK

REPLACE MASS AIR FLOW METER (Click here)

DTC P060E Internal Control Module Throttle Position Performance

for Preparation Click here

DESCRIPTION

The ECM monitors the input signals of the Throttle Position (TP) sensor No. 1 and stop light switch. As the ECM monitors the input signals of the TP sensor No. 1 and the STP signals of the stop light switch, if the input signals and control signals are deviated, a DTC is stored.

DTC Code	DTC Detection Condition	Trouble Area
P060E	When either condition below is met: • An ECM main CPU error. • An ECM sub CPU error. • HO2S transistors malfunction	ECM

INSPECTION PROCEDURE

1.CHECK DTC

a. Clear DTC (Click here).

b. Turn the engine switch off.

c. Disconnect the cable from the negative (-) batter terminal and wait for 1 minute.

d. Connect the cable to the negative (-) batter terminal.

e. Start the engine.

f. Check DTC.

OK:
P060E is not output.

NG → **REPLACE ECM (Click here)**

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0102 Mass or Volume Air Flow Circuit Low Input

DTC P0103 Mass or Volume Air Flow Circuit High Input

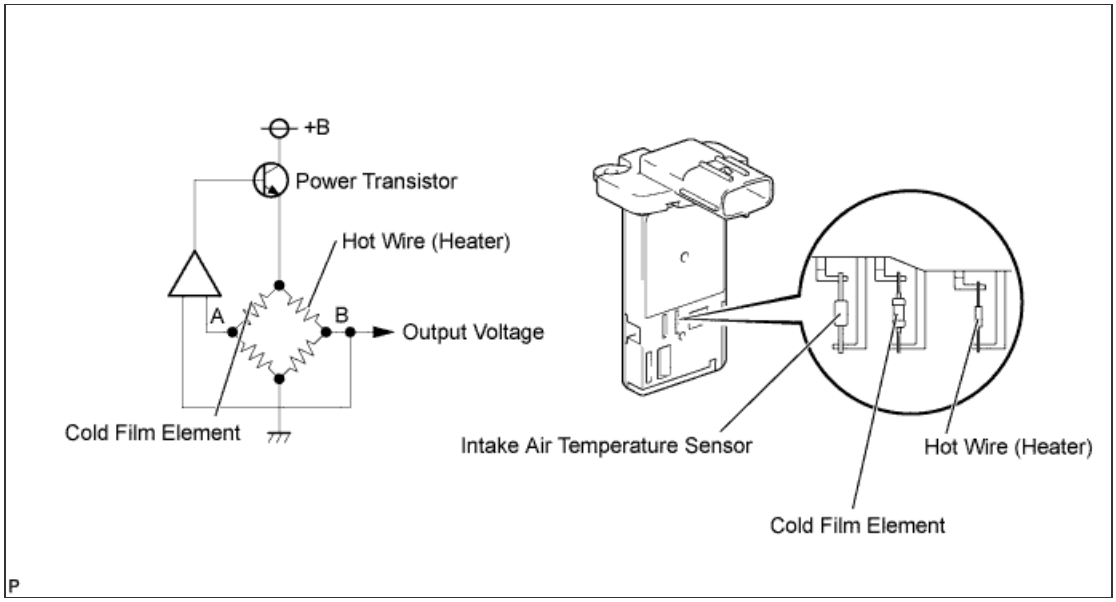
for Preparation Click here

DESCRIPTION

The Mass Air Flow (MAF) meter is a sensor that measures the amount of air flowing through the throttle valve.
The ECM uses this information to determine the fuel injection time and to provide the appropriate air-fuel ratio.
Inside the MAF meter, there is a heated platinum wire which is exposed to the flow of intake air.
By applying a specific electrical current to the wire, the ECM heats it to a given temperature. The flow of incoming air cools both the wire and an internal thermistor, affecting their resistance. To maintain a constant current value, the ECM varies the voltage applied to these components in the MAF meter.
The voltage level is proportional to the airflow through the sensor, and the ECM uses it to calculate the intake air volume.
The circuit is constructed so that the platinum hot wire and the temperature sensor create a bridge circuit, and the power transistor is controlled so that the potentials of A and B remain equal to maintain the predetermined temperature.

HINT:

When any of these DTCs are stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is calculated by the ECM, according to the engine speed and throttle valve position. Fail-safe mode continues until a pass condition is detected.



DTC Code	DTC Detection Condition	Trouble Area
P0102	The Mass Air Flow (MAF) meter voltage is below 0.2 V for 3 seconds (1 trip detection logic).	• Open or short in Mass Air Flow (MAF) meter circuit • MAF meter • ECM
P0103	The MAF meter voltage is higher than 4.9 V for 3 seconds (1 trip detection logic).	• Open or short in MAF meter circuit • MAF meter • ECM

HINT:

When any of these DTCs are output, check the air-flow rate by entering the following menus: Powertrain / Engine and ECT / Data List / MAF.

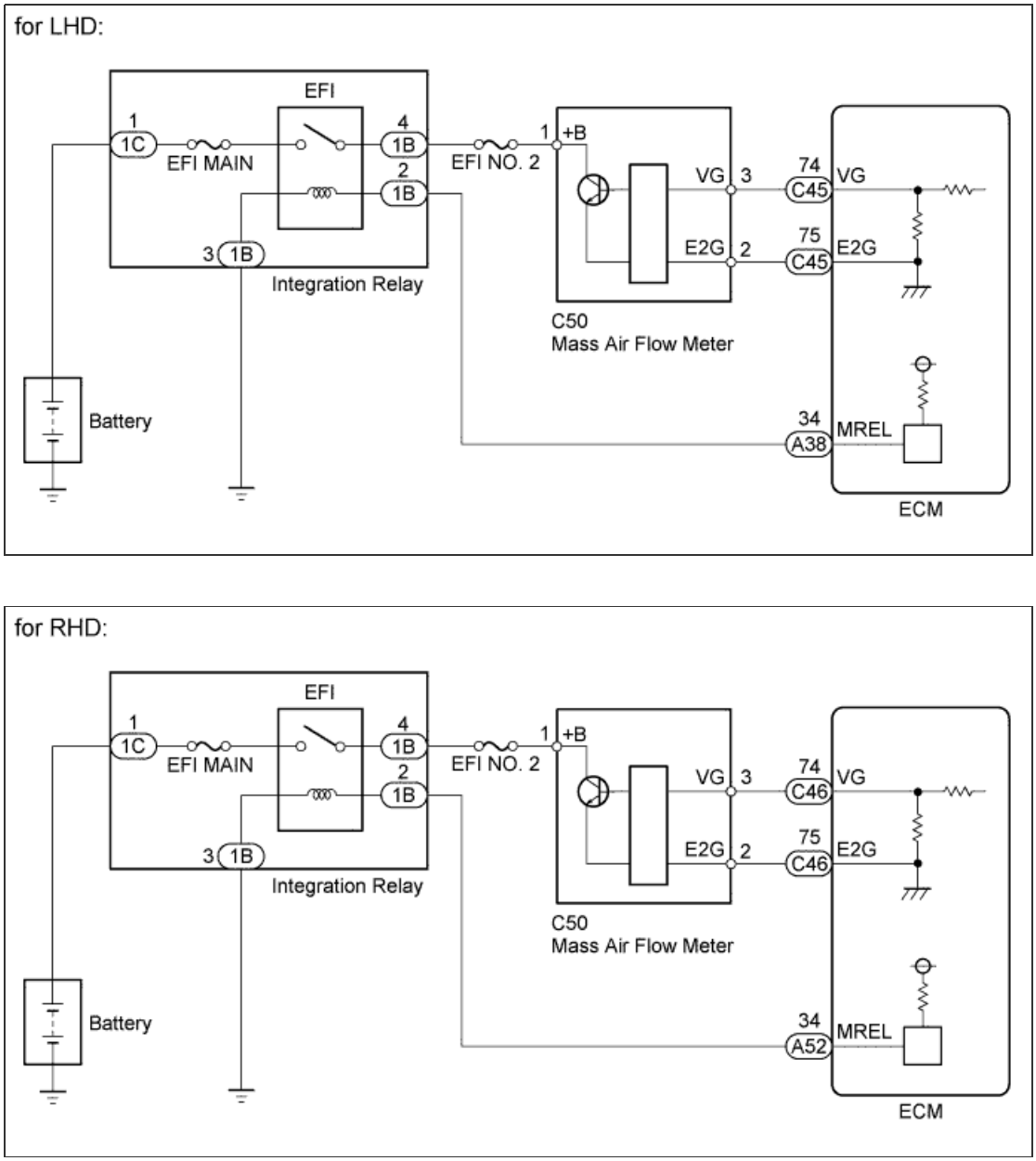
Mass Air Flow Rate (g/sec.)	Malfunction
Approximately 0.0	• **Open in Mass Air Flow (MAF) meter power source circuit** • **Open or short in VG circuit**
271.0 or more	Open in E2G circuit

MONITOR DESCRIPTION

If there is a defect in the MAF meter or an open or short circuit, the voltage level deviates from the normal operating range. The ECM interprets this

deviation as a malfunction in the MAF meter and stores a DTC.
Example:
When the sensor output voltage remains below 0.2 V, or higher than 4.9 V, for more than 3 seconds, the ECM stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored 3 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (MASS AIR FLOW RATE)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / MAF.

e. Read the values displayed on the tester.

Result

Result	Proceed to

0.0	A
271.0 or more	B
Between 1.0 and 270.0*	C

HINT:

*: The value must change when the throttle valve is open or closed with the engine running.

B	Go to step 6
C	CHEC FOR INTERMITTENT PROBLEMS (Click here)

A

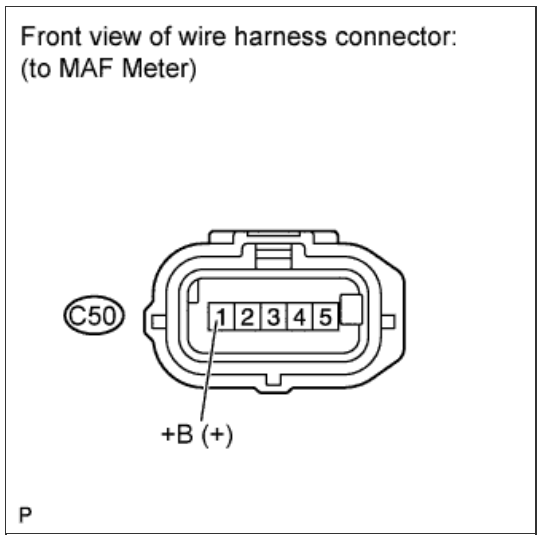
2.INSPECT MASS AIR FLOW METER (POWER SOURCE VOLTAGE)

a. Disconnect the Mass Air Flow (MAF) meter connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C50-1 (+B) - Body ground	Engine switch on (IG)	11 to 14 V



NG	Go to step 5

OK

3.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG	REPLACE MASS AIR FLOW METER (Click here)

OK

4.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the MAF meter connector.

b. Disconnect the ECM connector.

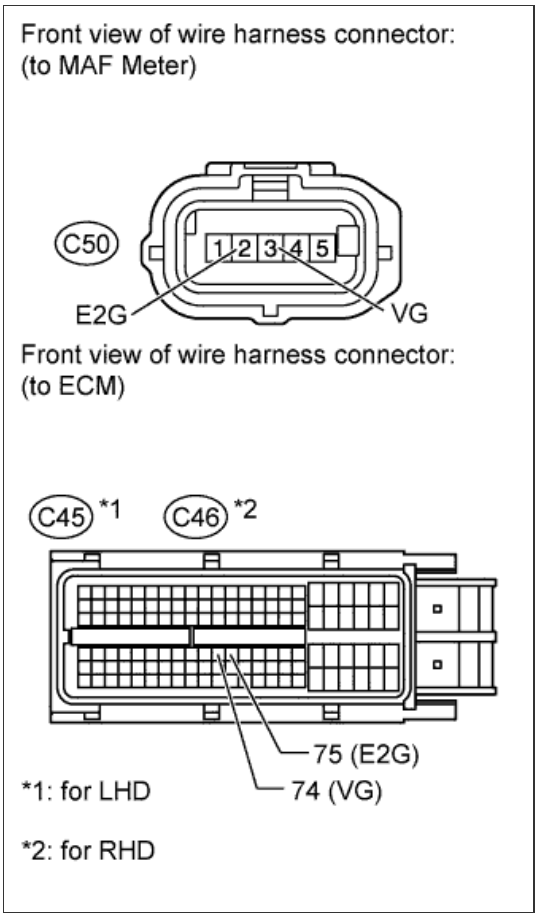
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C45-74 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C45-75 (E2G)	Always	Below 1 Ω
C50-3 (VG) or C45-74 (VG) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C4 -74 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C4 -75 (E2G)	Always	Below 1 Ω
C50-3 (VG) or C4 -74 (VG) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK → REPLACE ECM (Click here)

5.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - INTEGRATION RELAY)

a. Check the EFI N . 2 fuse.

i. Remove the EFI N . 2 fuse from the engine room relay block.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI N . 2 fuse	Always	Below 1 Ω

iii. Reinstall the EFI N . 2 fuse.

b. Disconnect the MAF meter connector.

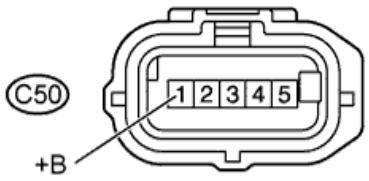
c. Remove the integration relay from the engine room relay block.

d. Measure the resistance according to the value(s) in the table below.

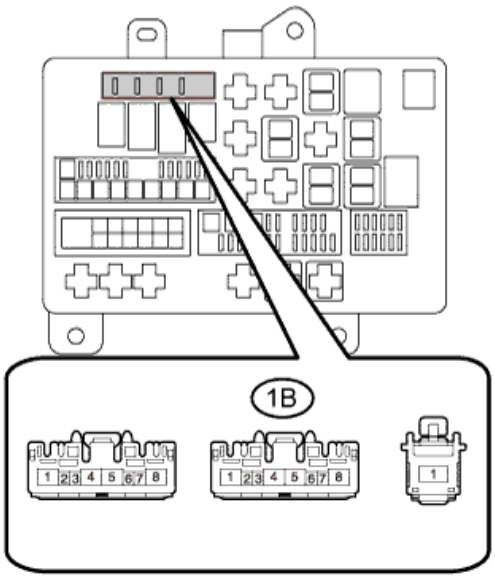
Standard Resistance:

Tester Connection	Condition	Specified Condition
C50-1 (+B) - 1B-4	Always	Below 1 Ω
C50-1 (+B) or 1B-4 - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to MAF Meter)



Front view of wire harness connector:
(to Integration Relay)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

6.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the MAF meter connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

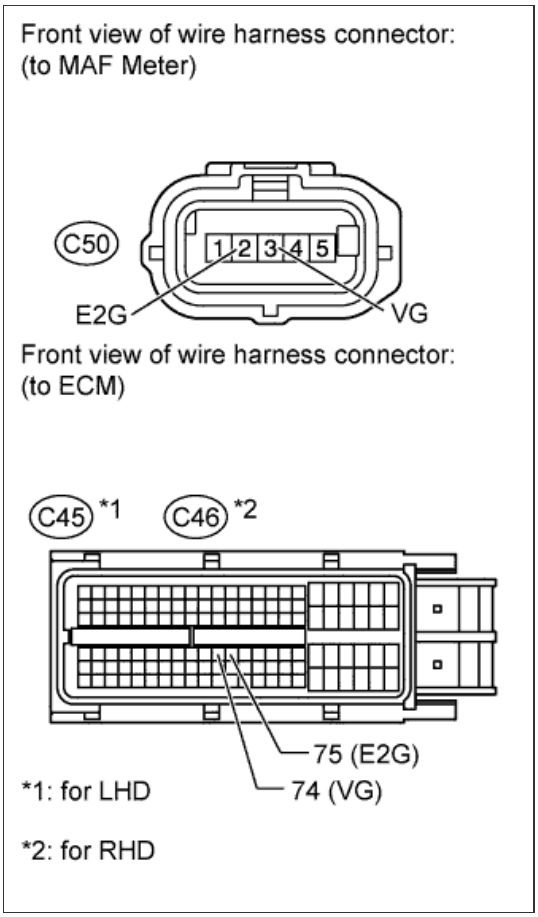
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C45-74 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C45-75 (E2G)	Always	Below 1 Ω
C50-3 (VG) or C45-74 (VG) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C4 -74 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C4 -75 (E2G)	Always	Below 1 Ω

C 0-3 (VG) or C4 -74 (VG) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

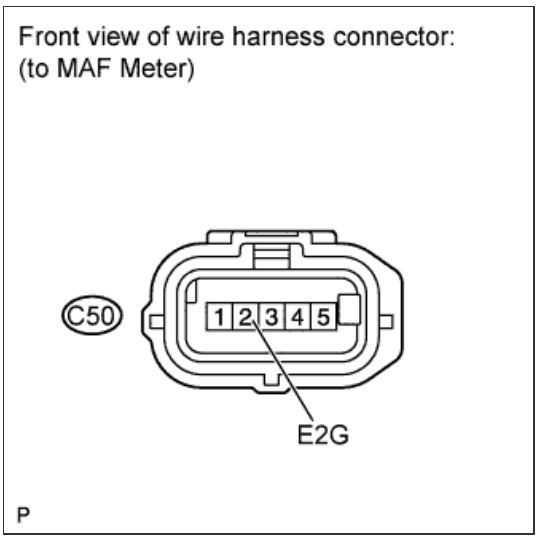
.CHEC HARNESS AND CONNECTOR (SENSOR GROUND)

a. Disconnect the MAF meter connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C50-2 (E2G) - Body ground	Always	Below 1 Ω



NG → REPLACE ECM (Click here)

OK

REPLACE MASS AIR FLOW METER (Click here)

DTC P0617 Starter Relay Circuit High

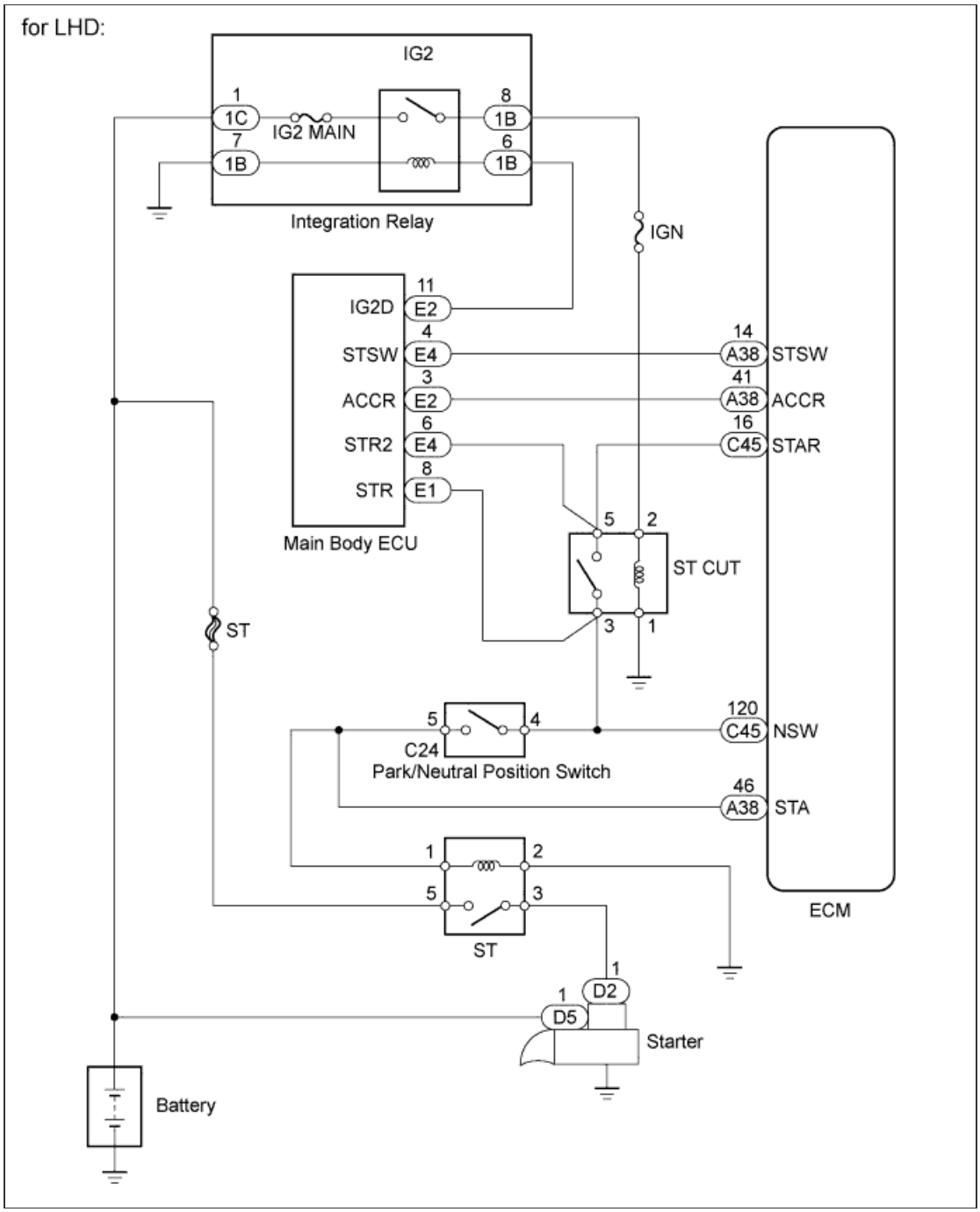
for Preparation Click here

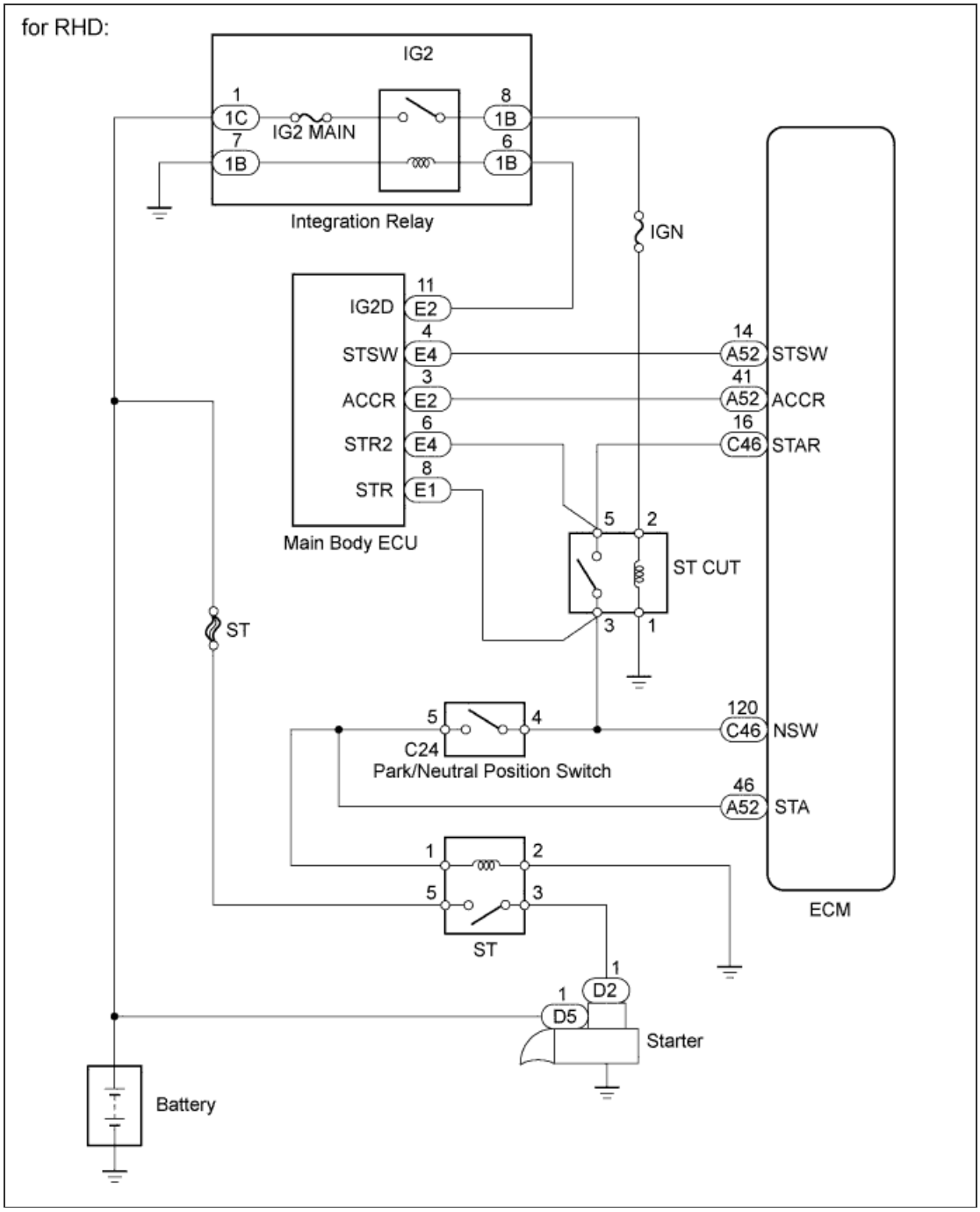
DESCRIPTION

While the engine is being cranked, positive battery voltage is applied to terminal STA of the ECM. If the ECM detects the starter control (STA) signal while the vehicle is being driven, it determines that there is a malfunction in the STA circuit. The ECM then illuminates the MIL and stores the DTC. This monitor runs when the vehicle is driven at 20 km/h (12.4 mph) for over 20 seconds.

DTC Code	DTC Detection Condition	Trouble Area
P0617	When conditions (a), (b) and (c) are met, a positive (+B) battery voltage of 10.5 V or higher is applied to the ECM for 20 seconds (1 trip detection logic). (a) The vehicle speed is 20 km/h (12.4 mph) or more. (b) The engine speed is 1000 rpm or more. (c) The STA signal is .	• Park/Neutral Position (PNP) switch • Starter relay circuit • Engine switch • ECM

WIRING DIAGRAM





INSPECTION PROCEDURE

HINT:

- **The following troubleshooting flowchart is based on the premise that the engine is cranked normally.**
  If the engine will not crank, proceed to the Problem Symptoms Table (Click here).
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (STARTER SIGNAL)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Activate Test / Activate the Starter Relay.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Starter Signal.

e. Check the Starter Signal on the intelligent tester.

O :

Activate Test	Starter Signal
ON	ON
OFF	OFF

NG → Go to step

O

CHEC FOR INTERMITTENT PROBLEMS (Click here)

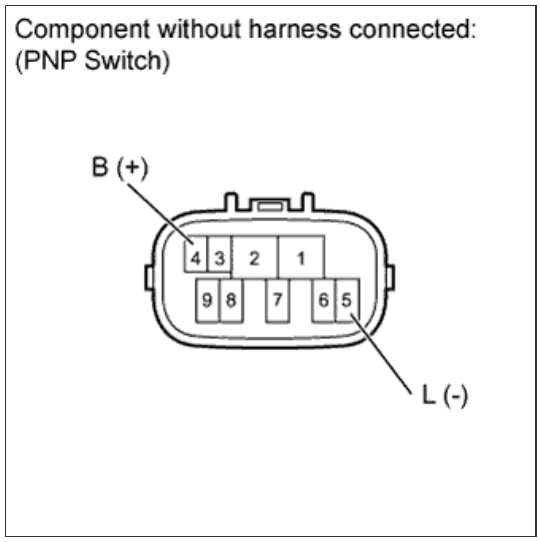
.INSPECT PAR NEUTRAL POSITION SWITCH ASSEMBLY

a. Disconnect the PNP switch connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
4 (B) - 5 (L)	Shift lever in P or N	Below 1 Ω
4 (B) - 5 (L)	Shift lever not in P or N	10 kΩ or higher



NG → REPLACE PAR NEUTRAL POSITION SWITCH ASSEMBLY (Click here)

O

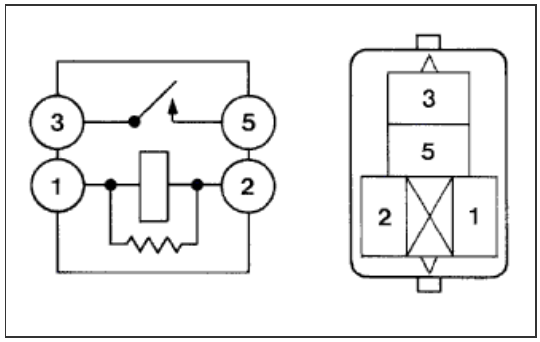
.INSPECT STARTER CUT RELAY (ST CUT)

a. Remove the circuit opening relay (ST CUT) from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied to terminals 1 and 2	10 kΩ or higher
3 - 5	Battery voltage applied to terminals 1 and 2	Below 1 Ω



NG → REPLACE STARTER CUT RELAY

O

.CHEC HARNESS AND CONNECTOR (ECM - ST CUT RELAY)

a. Move the shift lever to P or N.

b. Disconnect the ECM connector.

c. Remove the ST CUT relay from the engine room relay block.

d. Measure the resistance according to the value(s) in the table below.

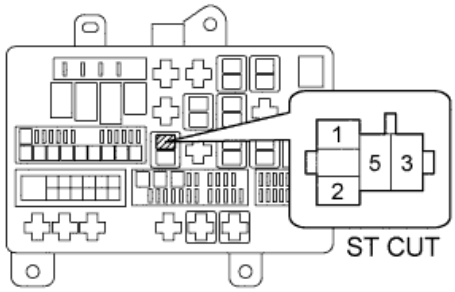
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
A38-46 (STA) or ST CUT relay terminal 3 - Body ground	Always	10 kΩ or more

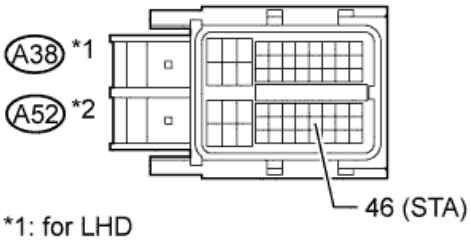
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
A52-46 (STA) or ST CUT relay terminal 3 - Body ground	Always	10 kΩ or more

Engine Room Relay Block:



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

O

.CHEC HARNESS AND CONNECTOR (MAIN BODY ECU - ECM)

a. Disconnect the ECM connector.

b. Disconnect the main body ECU connector.

c. Measure the resistance according to the value(s) in the table below.

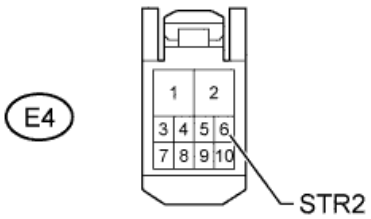
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
E4-6 (STR2) or C45-16 (STR2) - Body ground	Always	10 kΩ or more

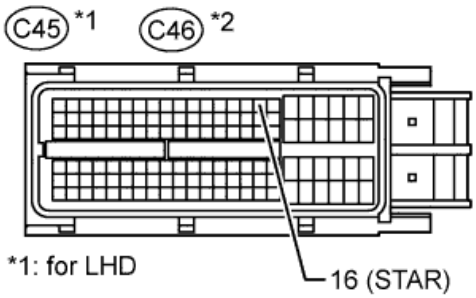
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
E4-6 (STR2) or C46-16 (STR2) - Body ground	Always	10 kΩ or more

Front view of wire harness connector:
(to Main Body ECU)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

O

6.CHEC HARNESS AND CONNECTOR (ECM - ST CUT RELAY)

a. Disconnect the ECM connector.

b. Remove the ST CUT relay from the engine room relay block.

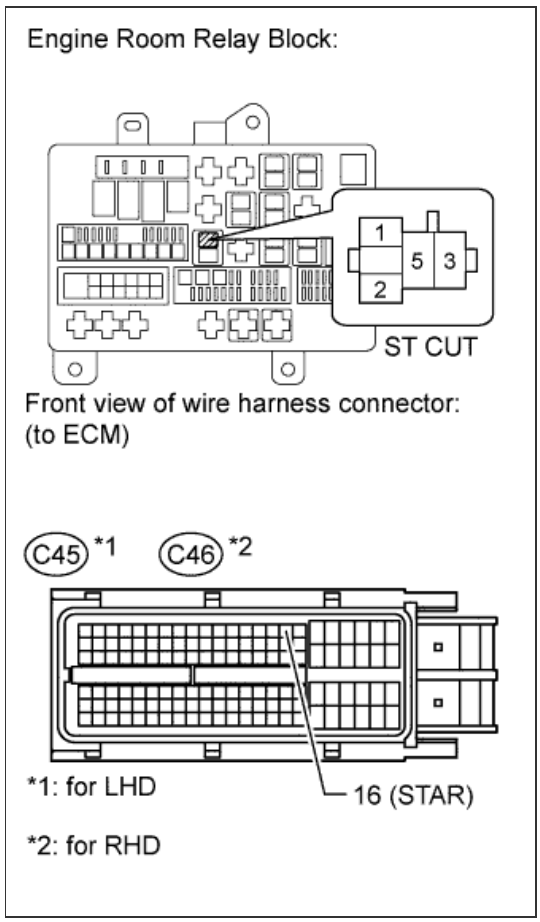
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C45-16 (STAR) or ST CUT relay terminal 5 - Body ground	Always	10 kΩ or more

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C46-16 (STAR) or ST CUT relay terminal 5 - Body ground	Always	10 kΩ or more



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

O

7.CHEC HARNESS AND CONNECTOR (ST CUT RELAY - INTEGRATION RELAY)

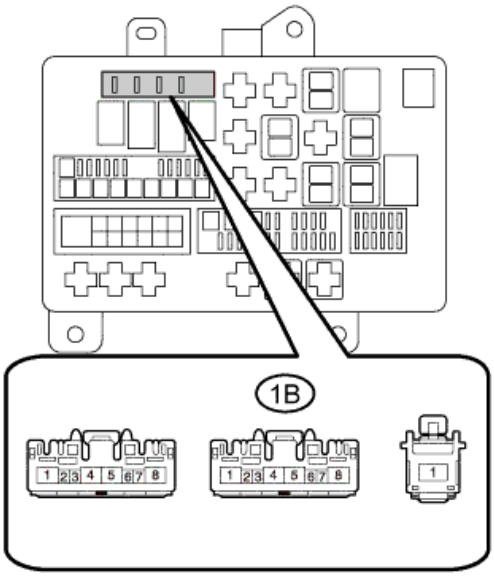
a. Remove the ST CUT relay and integration relay from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

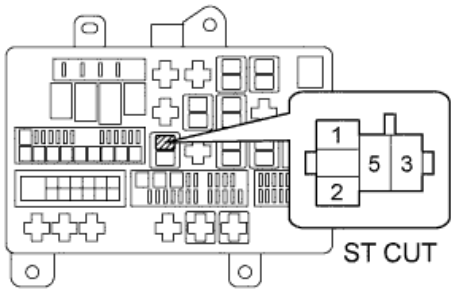
Standard Resistance:

Tester Connection	Condition	Specified Condition
1B-8 or ST CUT relay terminal 2 - Body ground	Always	10 kΩ or more

Front view of wire harness connector:
(to Integration Relay)



Engine Room Relay Block:



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

O

REPLACE ECM (Click here)

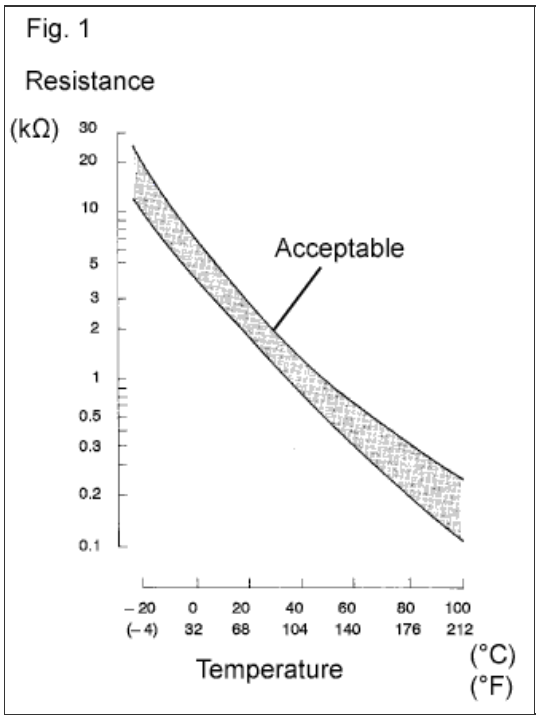
DTC P0110 Intake Air Temperature Circuit Malfunction

DTC P0112 Intake Air Temperature Circuit Low Input

DTC P0113 Intake Air Temperature Circuit High Input

for Preparation Click here

DESCRIPTION



The Intake Air Temperature (IAT) sensor, mounted on the Mass Air Flow (MAF) meter, monitors the IAT. The IAT sensor has a built-in thermistor with a resistance that varies according to the temperature of the intake air. When the IAT is low, the resistance of the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are transmitted to the ECM as voltage changes (see Fig. 1).
The IAT sensor is powered by a 5 V power supply from the THA terminal of the ECM, via resistor R.
Resistor R and the IAT sensor are connected in series. When the resistance value of the IAT sensor changes, according to changes in the IAT, the voltage at terminal THA also varies. Based on this signal, the ECM increases the fuel injection volume when the engine is cold to improve driveability.

HINT:

When any of DTCs P0110, P0112 and P0113 are stored, the ECM enters fail-safe mode. During fail-safe mode, the IAT is estimated to be 20°C (68°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC Code	DTC Detection Condition	Trouble Area
P0110	An open or short in the Intake Air Temperature (IAT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in Intake Air Temperature (IAT) sensor circuit • IAT sensor (built into MAF meter) • ECM
P0112	A short in the IAT sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM
P0113	An open in the IAT sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM

HINT:

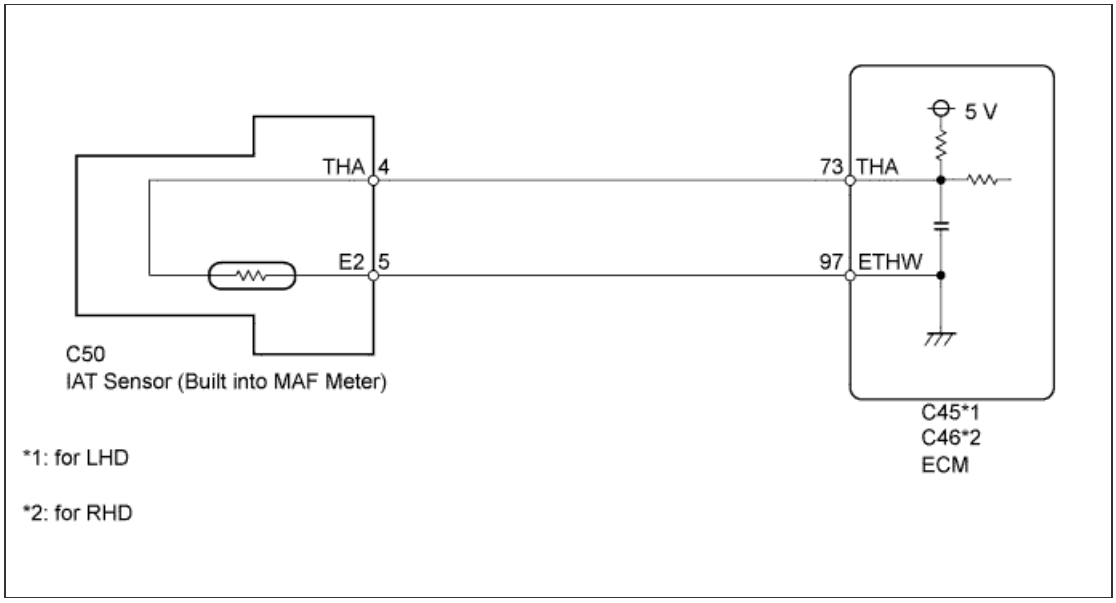
When any of these DTCs are output, check the IAT by entering the following menus: Powertrain / Engine and ECT / Intake Air.

Temperature Displayed	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to calculate the IAT. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a malfunction in the IAT sensor and stores a DTC.
Example:
If the sensor output voltage is higher than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the IAT sensor circuit, and stores DTC P0113. Conversely, if the output voltage is below 0.18 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and stores DTC P0112.
If the malfunction is not repaired successfully, a DTC is stored 0.5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ OUTPUT DTC

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0110 is output	A
P0112 is output	B
P0113 is output	C

B → Go to step 5

C → Go to step 3

A

2.READ VALUE USING INTELLIGENT TESTER (INTAKE AIR TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Intake Air.

e. Read the value displayed on the tester.

Result

Result	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
Same as actual IAT	C

HINT:

- **If there is an open circuit, the intelligent tester indicates -40°C (-40°F).**
- **If there is a short circuit, the intelligent tester indicates 140°C (284°F) or higher.**

B → Go to step 5

C → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

3.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the Mass Air Flow (MAF) meter connector.

b. Connect terminals 4 (THA) and 5 (E2) of the MAF meter wire harness side connector.

c. Connect the intelligent tester to the DLC3.

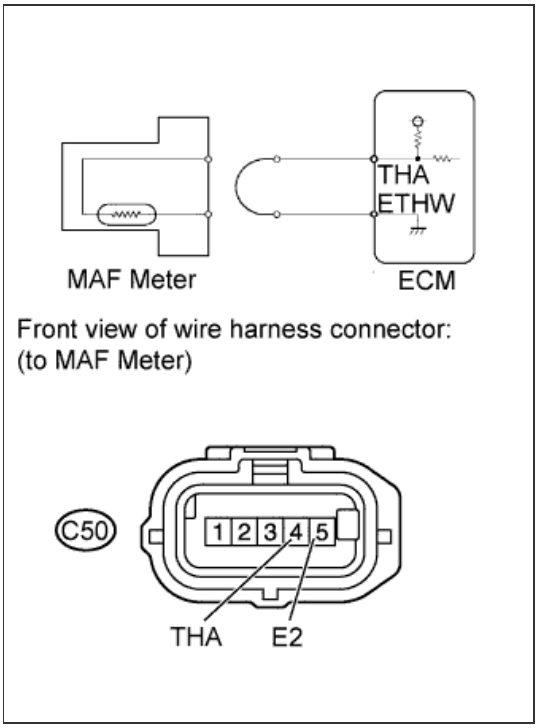
d. Turn the engine switch on (IG).

e. Turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / Intake Air.

g. Read the value displayed on the tester.

Standard value:
140°C (284°F) or higher



NG → Go to step 4

OK

CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE MASS AIR FLOW METER (Click here)

4.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the MAF meter connector.

b. Disconnect the ECM connector.

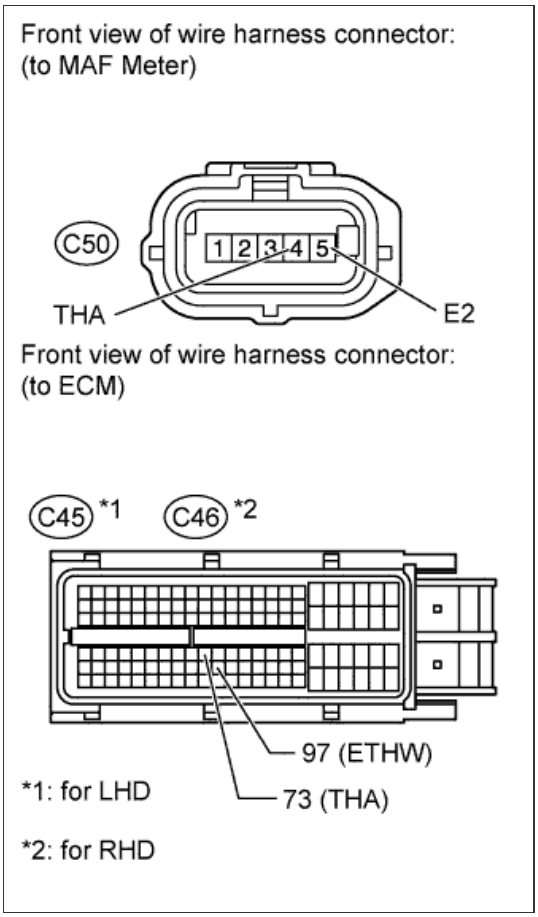
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C50-4 (THA) - C45-73 (THA)	Always	Below 1 Ω
C50-5 (E2) - C45-97 (ETHW)	Always	Below 1 Ω

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C50-4 (THA) - C46-73 (THA)	Always	Below 1 Ω
C50-5 (E2) - C46-97 (ETHW)	Always	Below 1 Ω



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK →

CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM (Click here)

5.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the MAF meter connector.

b. Connect the intelligent tester to the DLC3.

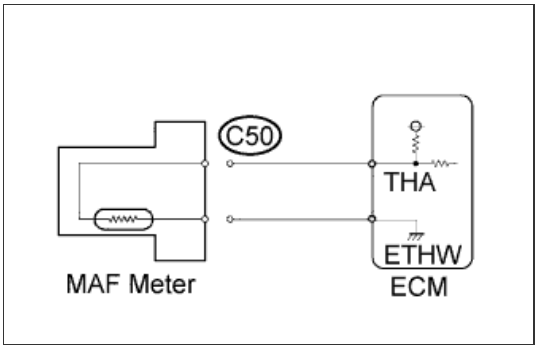
c. Turn the engine switch on (IG).

d. Turn the tester on.

e. Enter the following menus: Powertrain / Engine and ECT / Intake Air.

f. Read the value displayed on the tester.

Standard value:
-40°C (-40°F)



NG → Go to step 6

OK →

REPLACE MASS AIR FLOW METER (Click here)

6.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the MAF meter connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

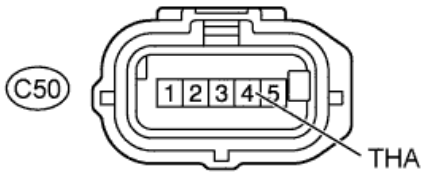
Tester Connection	Condition	Specified Condition

C50-4 (THA) or C45-73 (THA) - Body ground	Always	10 kΩ or higher

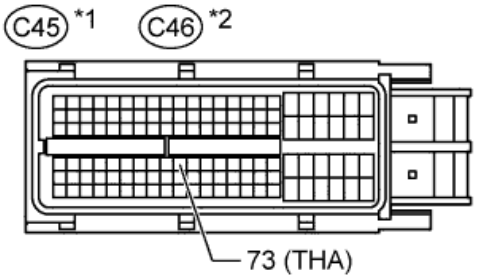
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C50-4 (THA) or C46-73 (THA) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to MAF Meter)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P0657 Actuator Supply Voltage Circuit / Open

for Preparation Click here

DESCRIPTION

The ECM monitors the output voltage to the throttle actuator. This self-check ensures that the ECM is functioning properly. The output voltage usually is 0 V when the engine switch is turned off. If the output voltage is higher than 7 V when the engine switch is turned off, the ECM will illuminate the MIL and store a DTC when the engine switch is turned on (IG).

DTC Code	DTC Detection Condition	Trouble Area
P	throttle actuator power supply error.	ECM

INSPECTION PROCEDURE

1.CHECK DTC

a. Clear DTC (Click here).

b. Turn the engine switch off.

c. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

d. Connect the cable to the negative (-) battery terminal.

e. Turn the engine switch on (IG) for 1 seconds.

f. Turn the engine switch off.

g. Turn the engine switch on (IG).

h. Check for DTC.

OK:
P0657 is not output.

NG → **REPLACE ECM (Click here)**

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

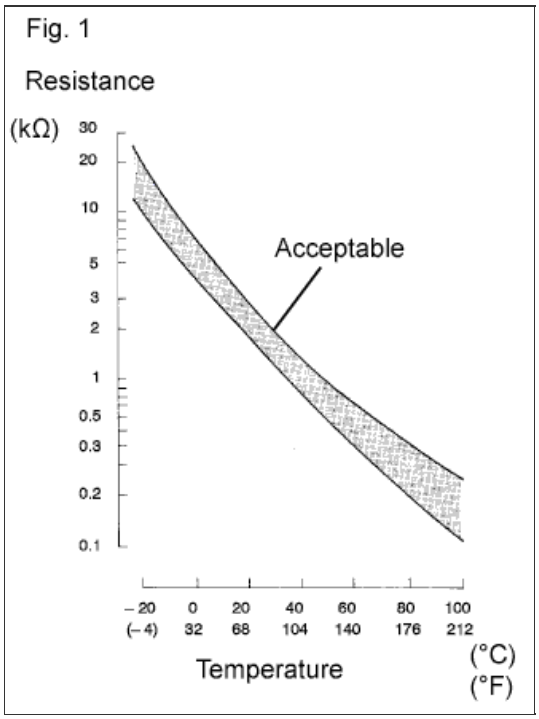
DTC P0110 Intake Air Temperature Circuit Malfunction

DTC P0112 Intake Air Temperature Circuit Low Input

DTC P0113 Intake Air Temperature Circuit High Input

for Preparation Click here

DESCRIPTION



The Intake Air Temperature (IAT) sensor, mounted on the Mass Air Flow (MAF) meter, monitors the IAT. The IAT sensor has a built-in thermistor with a resistance that varies according to the temperature of the intake air. When the IAT is low, the resistance of the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are transmitted to the ECM as voltage changes (see Fig. 1).
The IAT sensor is powered by a 5 V power supply from the THA terminal of the ECM, via resistor R.
Resistor R and the IAT sensor are connected in series. When the resistance value of the IAT sensor changes, according to changes in the IAT, the voltage at terminal THA also varies. Based on this signal, the ECM increases the fuel injection volume when the engine is cold to improve driveability.

HINT:

When any of DTCs P0110, P0112 and P0113 are stored, the ECM enters fail-safe mode. During fail-safe mode, the IAT is estimated to be 20°C (68°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC Code	DTC Detection Condition	Trouble Area
P0110	An open or short in the Intake Air Temperature (IAT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in Intake Air Temperature (IAT) sensor circuit • IAT sensor (built into MAF meter) • ECM
P0112	A short in the IAT sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM
P0113	An open in the IAT sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM

HINT:

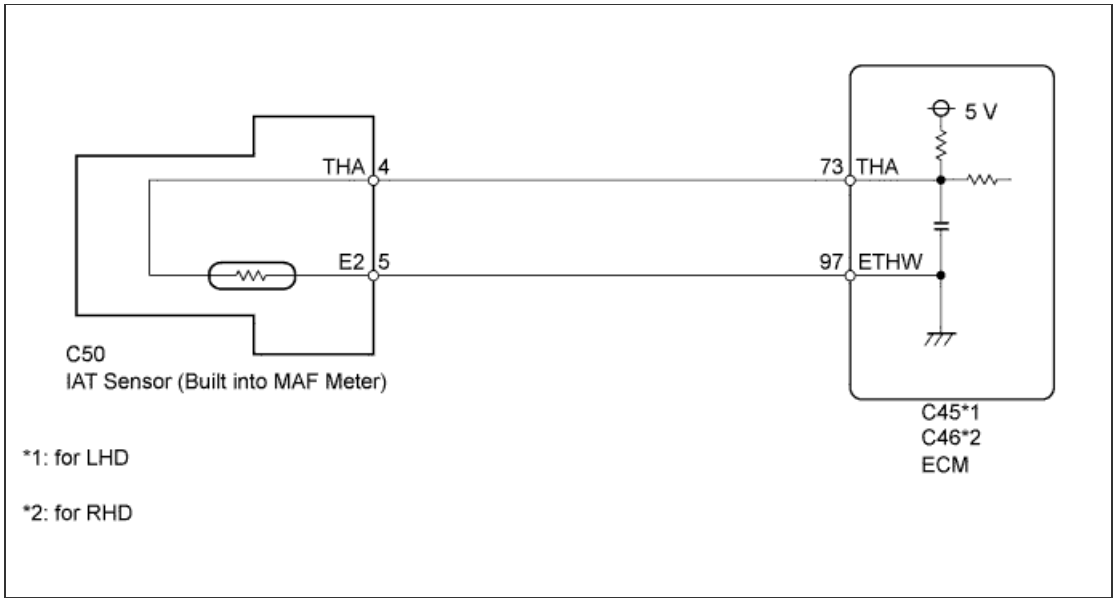
When any of these DTCs are output, check the IAT by entering the following menus: Powertrain / Engine and ECT / Intake Air.

Temperature Displayed	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to calculate the IAT. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a malfunction in the IAT sensor and stores a DTC.
Example:
If the sensor output voltage is higher than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the IAT sensor circuit, and stores DTC P0113. Conversely, if the output voltage is below 0.18 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and stores DTC P0112.
If the malfunction is not repaired successfully, a DTC is stored 0.5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ OUTPUT DTC

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0110 is output	A
P0112 is output	B
P0113 is output	C

B → Go to step 5

C → Go to step 3

A

2.READ VALUE USING INTELLIGENT TESTER (INTAKE AIR TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Intake Air.

e. Read the value displayed on the tester.

Result

Result	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
Same as actual IAT	C

HINT:

- **If there is an open circuit, the intelligent tester indicates -40°C (-40°F).**
- **If there is a short circuit, the intelligent tester indicates 140°C (284°F) or higher.**

B → Go to step 5

C → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

3.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the Mass Air Flow (MAF) meter connector.

b. Connect terminals 4 (THA) and 5 (E2) of the MAF meter wire harness side connector.

c. Connect the intelligent tester to the DLC3.

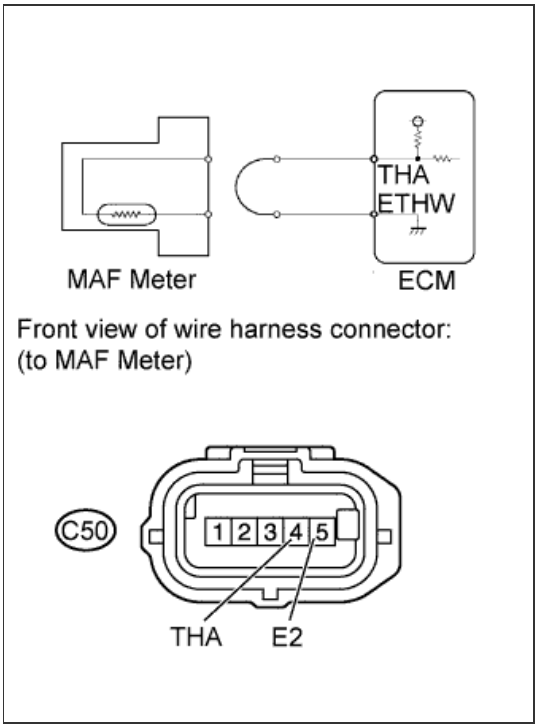
d. Turn the engine switch on (IG).

e. Turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / Intake Air.

g. Read the value displayed on the tester.

Standard value:
140°C (284°F) or higher



NG → Go to step 4

OK

CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE MASS AIR FLOW METER (Click here)

4.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the MAF meter connector.

b. Disconnect the ECM connector.

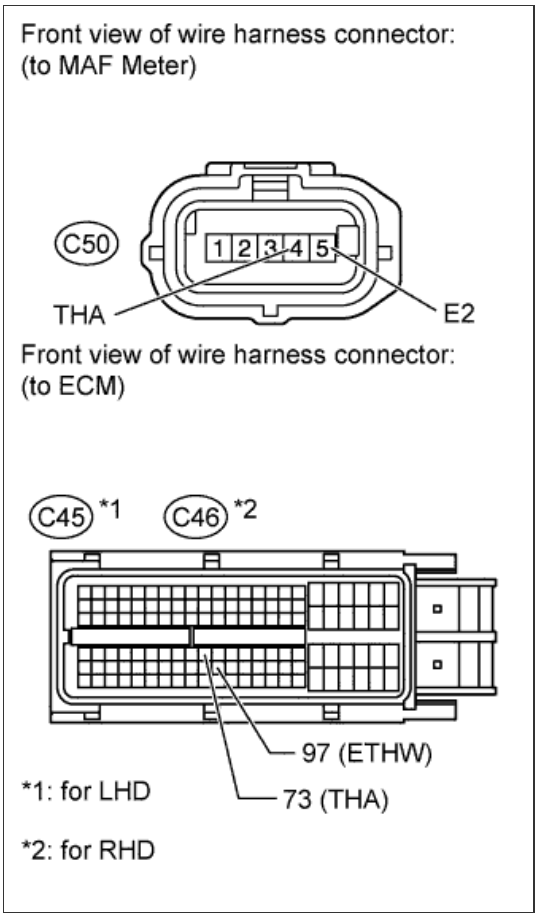
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C50-4 (THA) - C45-73 (THA)	Always	Below 1 Ω
C50-5 (E2) - C45-97 (ETHW)	Always	Below 1 Ω

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C50-4 (THA) - C46-73 (THA)	Always	Below 1 Ω
C50-5 (E2) - C46-97 (ETHW)	Always	Below 1 Ω



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK →

CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM (Click here)

5.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the MAF meter connector.

b. Connect the intelligent tester to the DLC3.

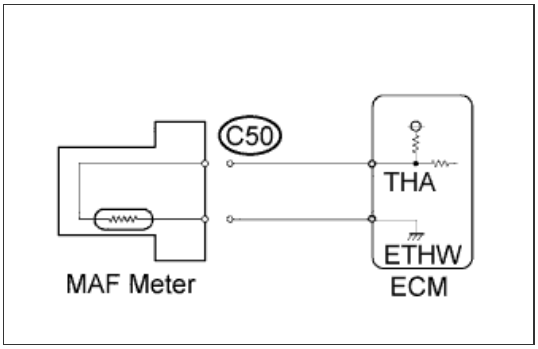
c. Turn the engine switch on (IG).

d. Turn the tester on.

e. Enter the following menus: Powertrain / Engine and ECT / Intake Air.

f. Read the value displayed on the tester.

Standard value:
-40°C (-40°F)



NG → Go to step 6

OK →

REPLACE MASS AIR FLOW METER (Click here)

6.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the MAF meter connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

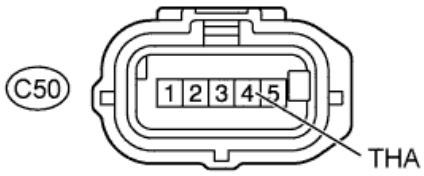
Tester Connection	Condition	Specified Condition

C50-4 (THA) or C45-73 (THA) - Body ground	Always	10 kΩ or higher

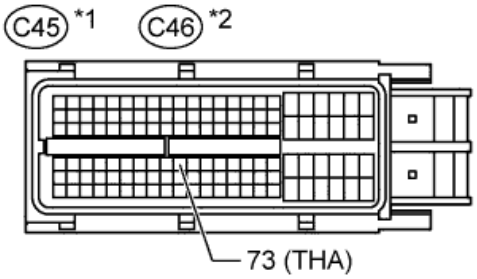
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C50-4 (THA) or C46-73 (THA) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to MAF Meter)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

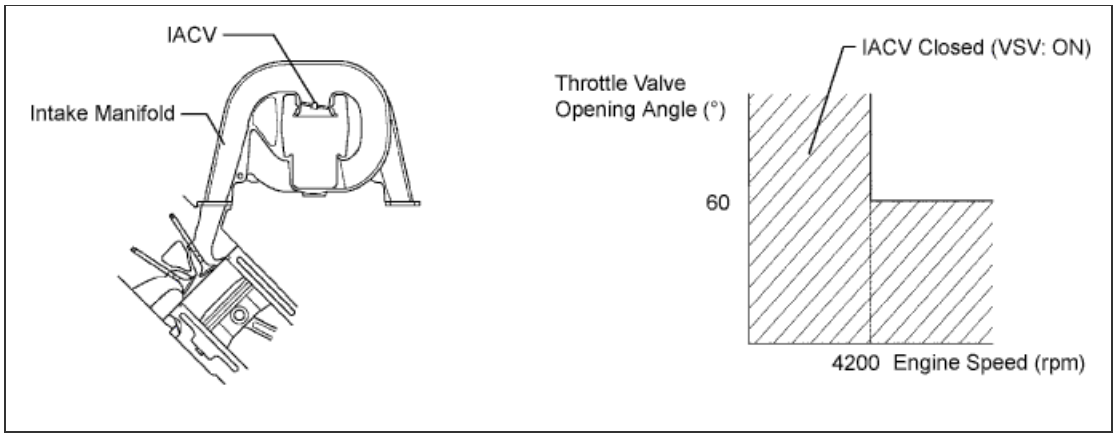
REPLACE ECM (Click here)

DTC P0660 Intake Manifold Tuning Valve Control Circuit / Open (Bank 1)

for Preparation Click here

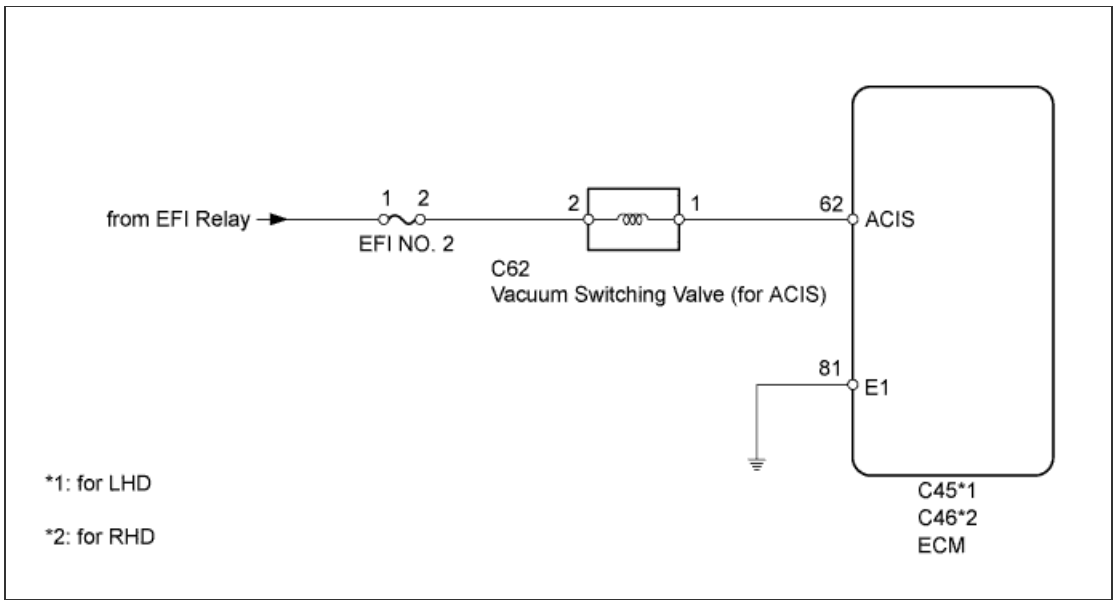
DESCRIPTION

This circuit opens and closes the Intake Air Control Valve (IACV) in response to changes in the engine load in order to increase the intake efficiency (ACIS: Acoustic Control Induction System).
When the engine speed is between 0 and 4200 rpm and the throttle valve opening angle is 60° or more, the ECM supplies current to the VSV (ON status), to close the IACV. Under other conditions, the VSV is usually OFF and the IACV is open.



DTC Code	DTC Detection Condition	Trouble Area
P0660	The following conditions are met simultaneously for 0.5 seconds or more (2 trip detection logic): 1. The voltage of terminal ACIS of the ECM is low when the VSV is off. 2. The engine has been started.	• Open or short in intake manifold tuning valve control circuit • Surge tank (intake air control valve) • ECM

WIRING DIAGRAM



INSPECTION PROCEDURE

1.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (VSV (for ACIS))

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Active Test / Active the VSV for Intake Control.

d. Check if operating noise can be heard when operating the air intake control valve using the intelligent tester.

OK:
Operating noise can be heard.

NG → Go to step 2

OK ↓

C ECK FOR INTERMITTENT PROBLEMS (Click here)

2.INSPECT VACUUM SWITC ING VALVE ASSEMBLY (for ACIS)

a. Inspect the vacuum switching valve assembly (Click here).

NG → REPLACE VACUUM SWITC ING VALVE ASSEMBLY (Click here)

OK ↓

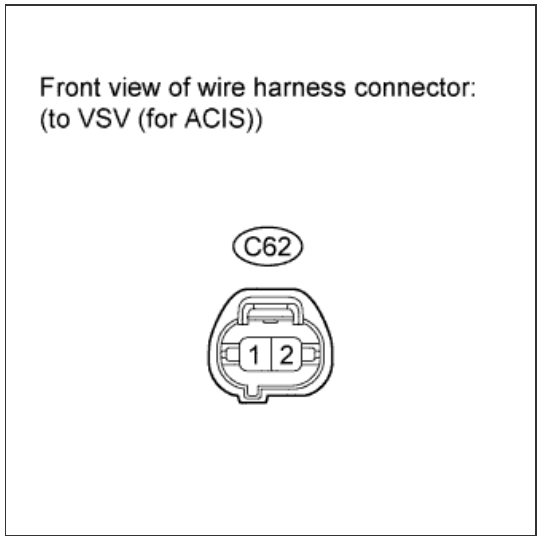
3.C ECK VACUUM SWITC ING VALVE ASSEMBLY (for ACIS) (POWER SOURCE VOLTAGE)

a. Disconnect the VSV connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
C62-2 - Body ground	Engine switch on (IG)	11 to 14 V



NG → Go to step 5

OK ↓

4.C ECK ARNESS AND CONNECTOR (VSV (for ACIS) - ECM)

a. Disconnect the VSV connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for L D):

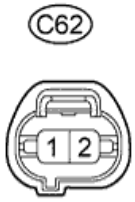
Tester Connection	Condition	Specified Condition
C62-1 - C45-62 (ACIS)	Always	Below 1 Ω
C62-1 or C45-62 (ACIS) - Body ground	Always	10 kΩ or higher

Standard Resistance (for R D):

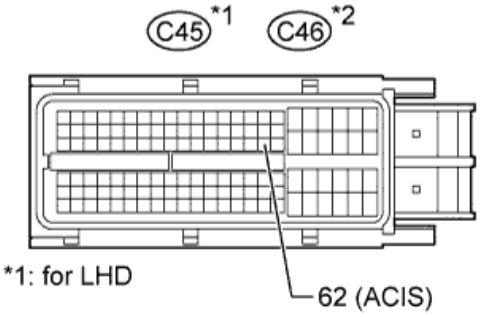
Tester Connection	Condition	Specified Condition
C62-1 - C46-62	Always	Below 1 Ω

(ACIS)		
C62-1 or C46-62 (ACIS) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to VSV (for ACIS))



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

NG → REPAIR OR REPLACE ARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

5.C ECK ARNESS AND CONNECTOR (VSV (for ACIS) - EFI NO. 2 FUSE)

a. Disconnect the VSV connector.

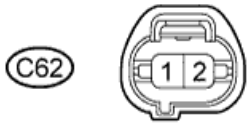
b. Remove the EFI No. 2 fuse from the engine room relay block.

c. Measure the resistance according to the value(s) in the table below.

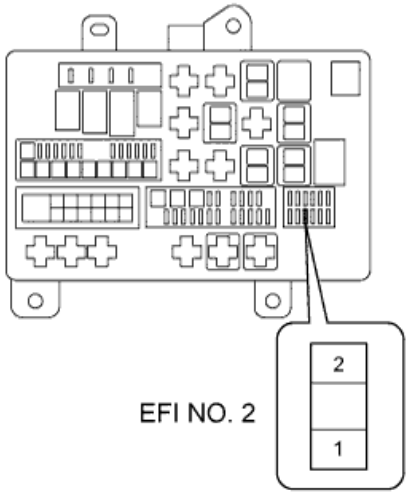
Standard Resistance:

Tester Connection	Condition	Specified Condition
C62-2 - EFI No. 2 fuse terminal 2	Always	Below 1 Ω
C62-2 or EFI No. 2 fuse terminal 2 - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to VSV (for ACIS))



Engine Room Relay Block:



NG → REPAIR OR REPLACE ARNESS OR CONNECTOR

OK

C ECK ECM POWER SOURCE CIRCUIT (Click here)

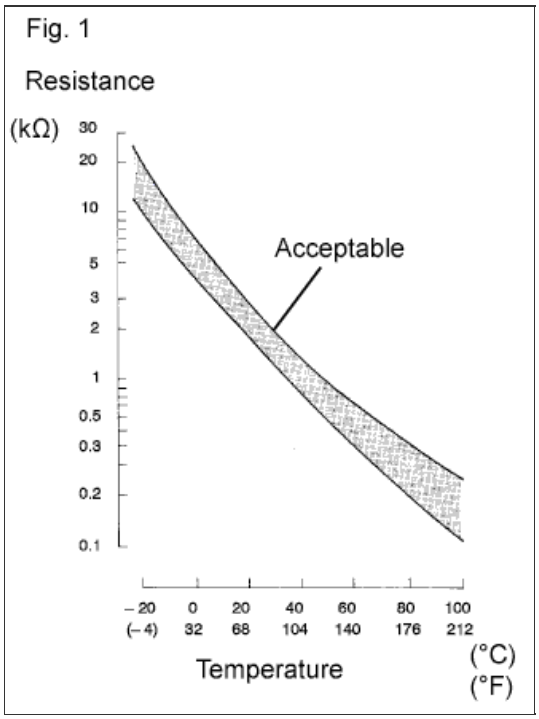
DTC P0110 Intake Air Temperature Circuit Malfunction

DTC P0112 Intake Air Temperature Circuit Low Input

DTC P0113 Intake Air Temperature Circuit High Input

for Preparation Click here

DESCRIPTION



The Intake Air Temperature (IAT) sensor, mounted on the Mass Air Flow (MAF) meter, monitors the IAT. The IAT sensor has a built-in thermistor with a resistance that varies according to the temperature of the intake air. When the IAT is low, the resistance of the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are transmitted to the ECM as voltage changes (see Fig. 1).
The IAT sensor is powered by a 5 V power supply from the THA terminal of the ECM, via resistor R.
Resistor R and the IAT sensor are connected in series. When the resistance value of the IAT sensor changes, according to changes in the IAT, the voltage at terminal THA also varies. Based on this signal, the ECM increases the fuel injection volume when the engine is cold to improve driveability.

HINT:

When any of DTCs P0110, P0112 and P0113 are stored, the ECM enters fail-safe mode. During fail-safe mode, the IAT is estimated to be 20°C (68°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC Code	DTC Detection Condition	Trouble Area
P0110	An open or short in the Intake Air Temperature (IAT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in Intake Air Temperature (IAT) sensor circuit • IAT sensor (built into MAF meter) • ECM
P0112	A short in the IAT sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM
P0113	An open in the IAT sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM

HINT:

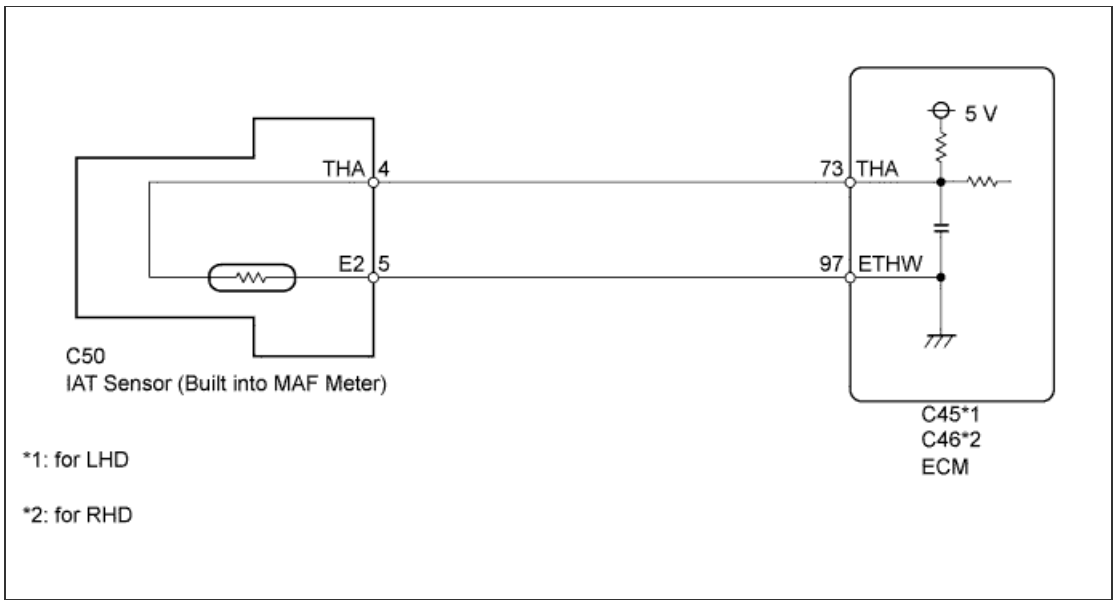
When any of these DTCs are output, check the IAT by entering the following menus: Powertrain / Engine and ECT / Intake Air.

Temperature Displayed	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to calculate the IAT. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a malfunction in the IAT sensor and stores a DTC.
Example:
If the sensor output voltage is higher than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the IAT sensor circuit, and stores DTC P0113. Conversely, if the output voltage is below 0.18 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and stores DTC P0112.
If the malfunction is not repaired successfully, a DTC is stored 0.5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ OUTPUT DTC

a. Connect the intelligent tester to the D C3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0110 is output	A
P0112 is output	B
P0113 is output	C

B → Go to step 5

C → Go to step 3

A

2.READ VALUE USING INTELLIGENT TESTER (INTAKE AIR TEMPERATURE)

a. Connect the intelligent tester to the D C3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Intake Air.

e. Read the value displayed on the tester.

Result

Result	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
Same as actual IAT	C

HINT:

- **If there is an open circuit, the intelligent tester indicates -40°C (-40°F).**
- **If there is a short circuit, the intelligent tester indicates 140°C (284°F) or higher.**

B → Go to step 5

C → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

3.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the Mass Air Flow (MAF) meter connector.

b. Connect terminals 4 (THA) and 5 (E2) of the MAF meter wire harness side connector.

c. Connect the intelligent tester to the D C3.

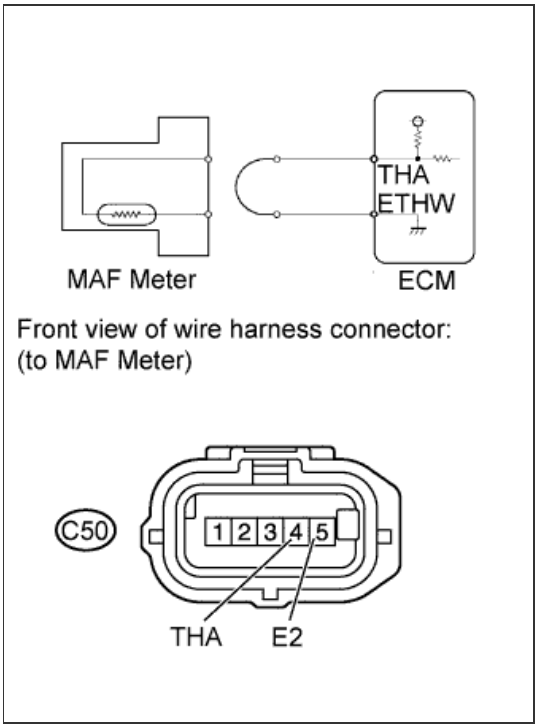
d. Turn the engine switch on (IG).

e. Turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / Intake Air.

g. Read the value displayed on the tester.

Standard value:
140°C (284°F) or higher



NG → Go to step 4

OK

CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE MASS AIR FLOW METER (Click here)

4.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the MAF meter connector.

b. Disconnect the ECM connector.

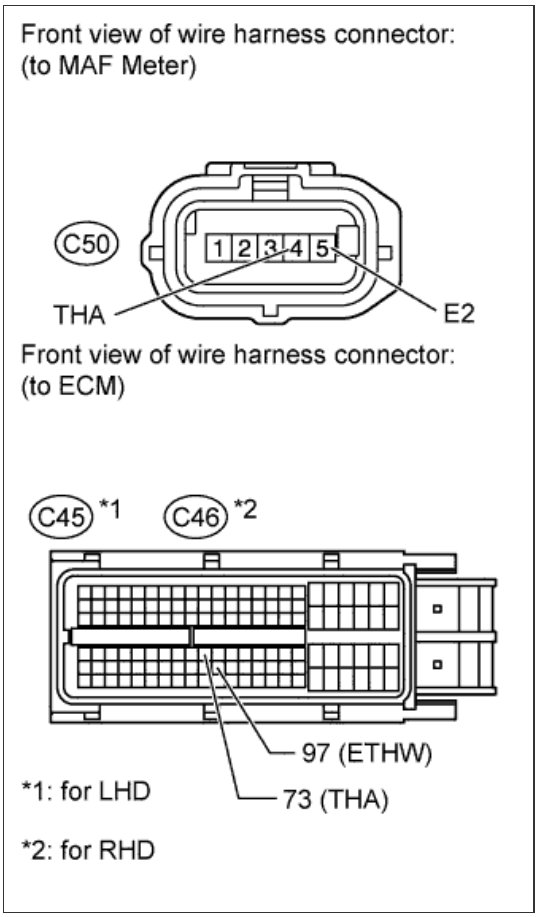
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C50-4 (THA) - C45-73 (THA)	Always	Below 1 Ω
C50-5 (E2) - C45-97 (ETHW)	Always	Below 1 Ω

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C50-4 (THA) - C46-73 (THA)	Always	Below 1 Ω
C50-5 (E2) - C46-97 (ETHW)	Always	Below 1 Ω



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK →

CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM (Click here)

5.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the MAF meter connector.

b. Connect the intelligent tester to the D C3.

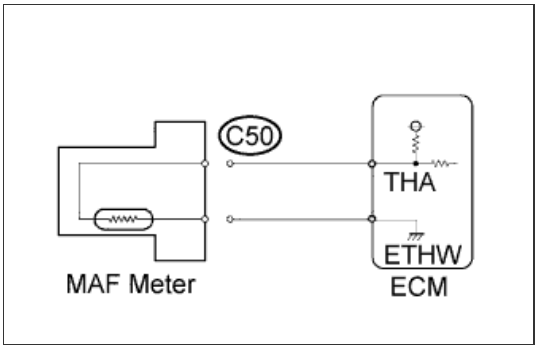
c. Turn the engine switch on (IG).

d. Turn the tester on.

e. Enter the following menus: Powertrain / Engine and ECT / Intake Air.

f. Read the value displayed on the tester.

Standard value:
-40°C (-40°F)



NG → Go to step 6

OK →

REPLACE MASS AIR FLOW METER (Click here)

6.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the MAF meter connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

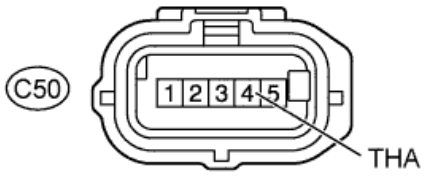
Tester Connection	Condition	Specified Condition

C50-4 (THA) or C45-73 (THA) - Body ground	Always	10 kΩ or higher

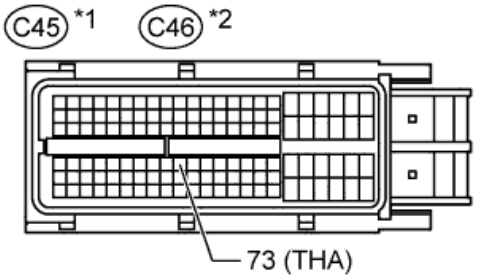
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C50-4 (THA) or C46-73 (THA) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to MAF Meter)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P0724 Brake Switch "B" Circuit High

for Preparation Click here

DESCRIPTION

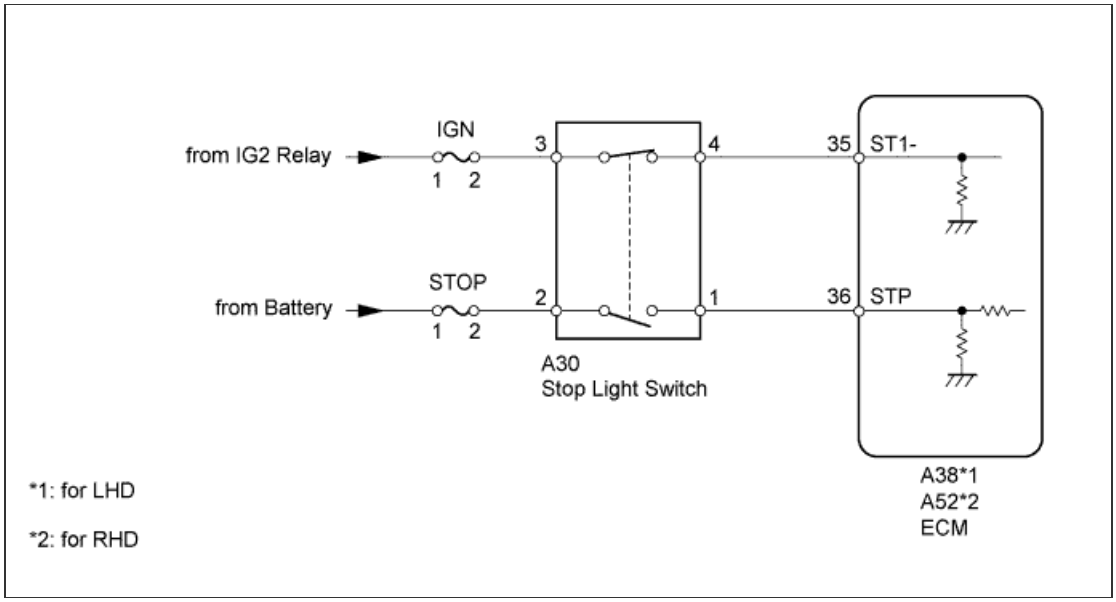
The purpose of this circuit is to prevent the engine from stalling while driving in the lock-up condition when the brakes are suddenly applied.
When the brake pedal is depressed, this switch sends a signal to the ECM. Then the ECM cancels the operation of the lock-up clutch while braking is in progress.

DTC Code	DTC Detection Condition	Trouble Area
P0724	The stop light switch remains on even when the vehicle is driven in a GO (30 km/h (18.63 mph) or more) and STOP (less than 3 km/h (1.86 mph)) pattern 5 times (2 trip detection logic).	• Short in stop light switch signal circuit • Stop light switch • ECM

MONITOR DESCRIPTION

This DTC indicates that the stop light switch remains on. When the stop light switch remains on during GO and STOP driving, the ECM interprets this as a fault in the stop light switch. Then the MIL illuminates and the ECM stores the DTC. The vehicle must GO (30 km/h (18.63 mph) or more) and STOP (less than 3 km/h (1.86 mph)) 5 times for 2 driving cycles in order for the DTC to be stored.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Using the intelligent tester to read the Data List allows switch, sensor, actuator and other item values to be read without removing any parts. Reading the Data List early in troubleshooting is one way to save time.

NOTICE:

In the table below, the values listed under "Normal Condition" are reference values. Do not depend solely on these reference values when deciding whether a part is faulty or not.

1. Warm up the engine.
2. Turn the engine switch off.
3. Connect the intelligent tester to the DLC3.
4. Turn the engine switch on (IG).
5. Turn the tester on.
6. Enter the following menus: Powertrain / Engine and ECT / Data List /
7. Follow the instructions on the tester and read the Data List.

Item	Measurement Item/ Range (Display)	Normal Condition	Diagnostic Note
	Stop light switch status/	• Brake pedal depressed: ON	

Stop Light Switch	ON or OFF	• Brake pedal released: OFF	-

1.INSPECT STOP LIGHT SWITCH

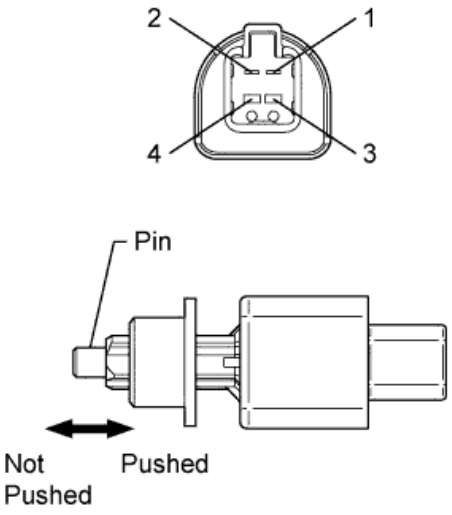
a. Remove the stop light switch.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Switch Condition	Specified Condition
1 - 2	Switch pin not pushed	Below 1 Ω
	Switch pin pushed	10 kΩ or higher
3 - 4	Switch pin not pushed	10 kΩ or higher
	Switch pin pushed	Below 1 Ω

Component without harness connected:
(Stop Light Switch)



NG → REPLACE STOP LIGHT SWITCH (Click here)

OK ↓

2.CHECK HARNESS AND CONNECTOR (ECM - BATTERY)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.

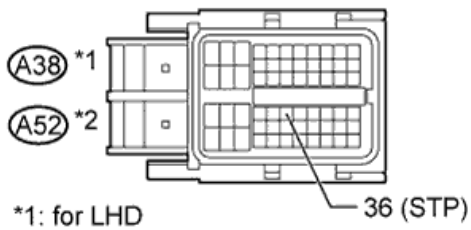
Standard Voltage (for LHD):

Tester Connection	Condition	Specified Condition
A38-36 (STP) - Body ground	Brake pedal is depressed	11 to 14 V
A38-36 (STP) - Body ground	Brake pedal is released	Below 1 V

Standard Voltage (for RHD):

Tester Connection	Condition	Specified Condition
A52-36 (STP) - Body ground	Brake pedal is depressed	11 to 14 V
A52-36 (STP) - Body ground	Brake pedal is released	Below 1 V

Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK ↓

REPLACE ECM (Click here)

DTC P0115 Engine Coolant Temperature Circuit Malfunction

DTC P0117 Engine Coolant Temperature Circuit Low Input

DTC P0118 Engine Coolant Temperature Circuit High Input

for Preparation Click here

DESCRIPTION

A thermistor, whose resistance value varies according to the ECT, is built into the Engine Coolant Temperature (ECT) sensor.
The structure of the sensor and its connection to the ECM are the same as those of the Intake Air Temperature (IAT) sensor.

HINT:

When any of DTCs P0115, P0117 and P0118 are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECT is estimated to be 80°C (176°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC Code	DTC Detection Condition	Trouble Area
P0115	An open or short in the Engine Coolant Temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in Engine Coolant Temperature (ECT) sensor circuit • ECT sensor • ECM
P0117	A short in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in ECT sensor • ECT sensor • ECM
P0118	An open in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in ECT sensor circuit • ECT sensor • ECM

HINT:

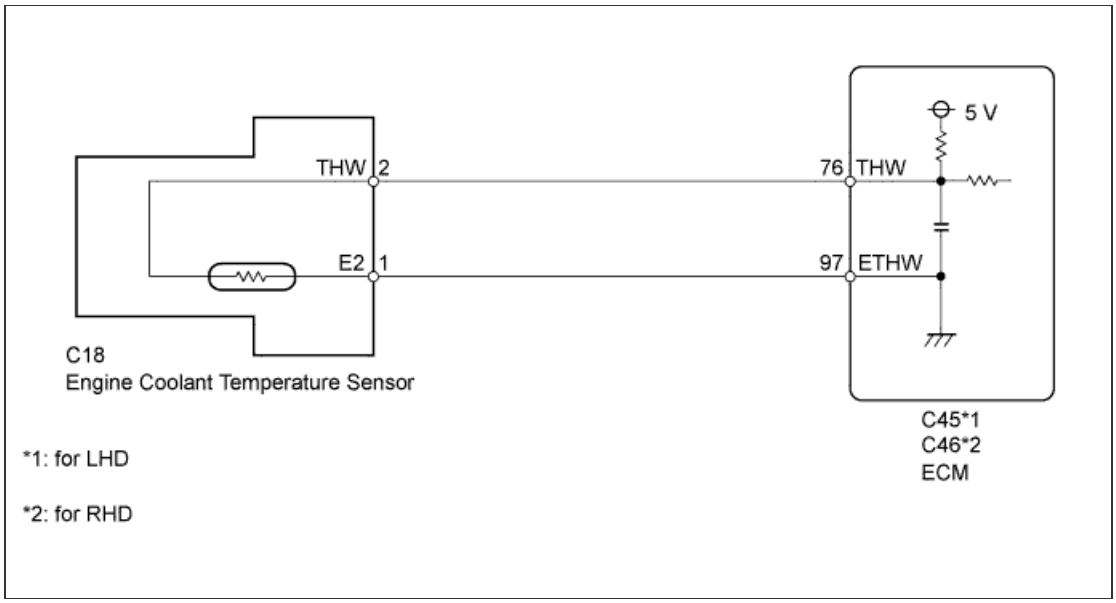
When any of these DTCs are output, check the ECT by entering the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

Temperature Displayed	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

MONITOR DESCRIPTION

The Engine Coolant Temperature (ECT) sensor is used to monitor the ECT. The ECT sensor has a thermistor with a resistance that varies according to the temperature of the engine coolant. When the coolant temperature is low, the resistance in the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are reflected in the output voltage from the sensor. The ECM monitors the sensor voltage and uses this value to calculate the ECT. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a fault in the ECT sensor and stores a DTC.
Example:
If the sensor output voltage is higher than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the ECT sensor circuit, and stores DTC P0118. Conversely, if the voltage output is below 0.14 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and stores DTC P0117.
If the malfunction is not repaired successfully, a DTC is stored 0.5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ OUTPUT DTC

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0115 is output	A
P0117 is output	B
P0118 is output	C

B → Go to step 5

C → Go to step

A

2.READ VALUE USING INTELLIGENT TESTER (ENGINE COOLANT TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

e. Read the value displayed on the tester.

Result

Result	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
Between 80 and 100°C (176 and 212°F) with warm engine	C

HINT:

- **If there is an open circuit, the intelligent tester indicates -40 C (-40 .**
- **If there is a short circuit, the intelligent tester indicates 140 C (284 r higher.**

B	Go to step 5
C	CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the Engine Coolant Temperature (ECT) sensor connector.

b. Connect terminals 1 and 2 of the ECT sensor connector on the wire harness side.

c. Connect the intelligent tester to the DLC3.

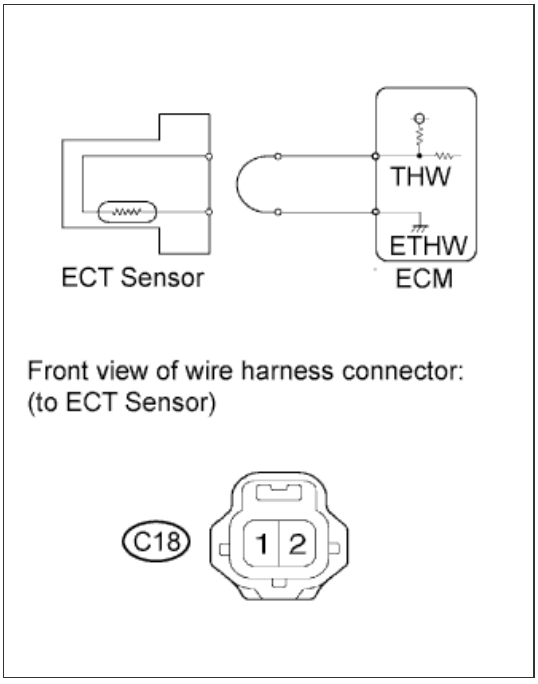
d. Turn the engine switch on (IG).

e. Turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

g. Read the value displayed on the tester.

Standard value:
140 C (284 r higher.



NG	Go to step 4

OK

CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

4.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the ECT sensor connector.

b. Disconnect the ECM connector.

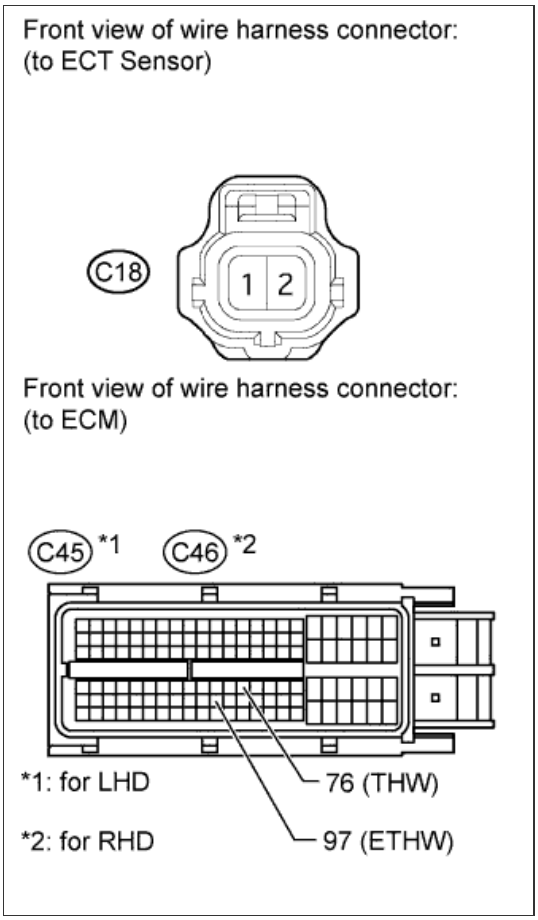
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C18-2 - C45-76 (THW)	Always	Below 1 Ω
C18-1 - C45-97 (ETHW)	Always	Below 1 Ω

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C18-2 - C46-76 (THW)	Always	Below 1 Ω
C18-1 - C46-97 (ETHW)	Always	Below 1 Ω

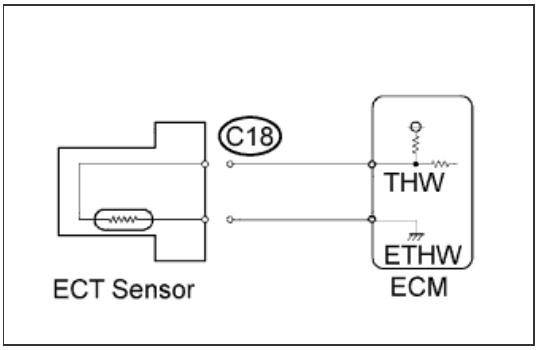


NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK →

CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM (Click here)

5.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)



a. Disconnect the ECT sensor connector.

b. Connect the intelligent tester to the DLC3.

c. Turn the engine switch on (IG).

d. Turn the tester on.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

f. Read the value displayed on the tester.

Standard value:
-40 C (-40

NG → Go to step 6

OK →

REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

6.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the ECT sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

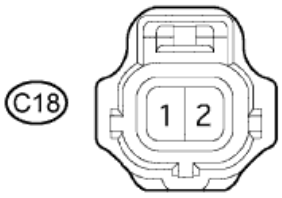
Tester Connection	Condition	Specified

		Condition
C18-2 or C45-76 (THW) - Body ground	Always	10 kΩ or higher

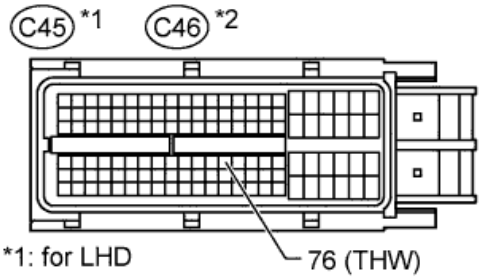
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C18-2 or C46-76 (THW) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to ECT Sensor)



Front view of wire harness connector:
(to ECM)



*2: for RHD

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK → REPLACE ECM (Click here)

DTC P1340 Camshaft Position Sensor "A" (Bank 1 Sensor 2)

DTC P1342 Camshaft Position Sensor "A" Low Input (MRE)

DTC P1343 Camshaft Position Sensor "A" High Input (MRE)

for Preparation Click here

DESCRIPTION

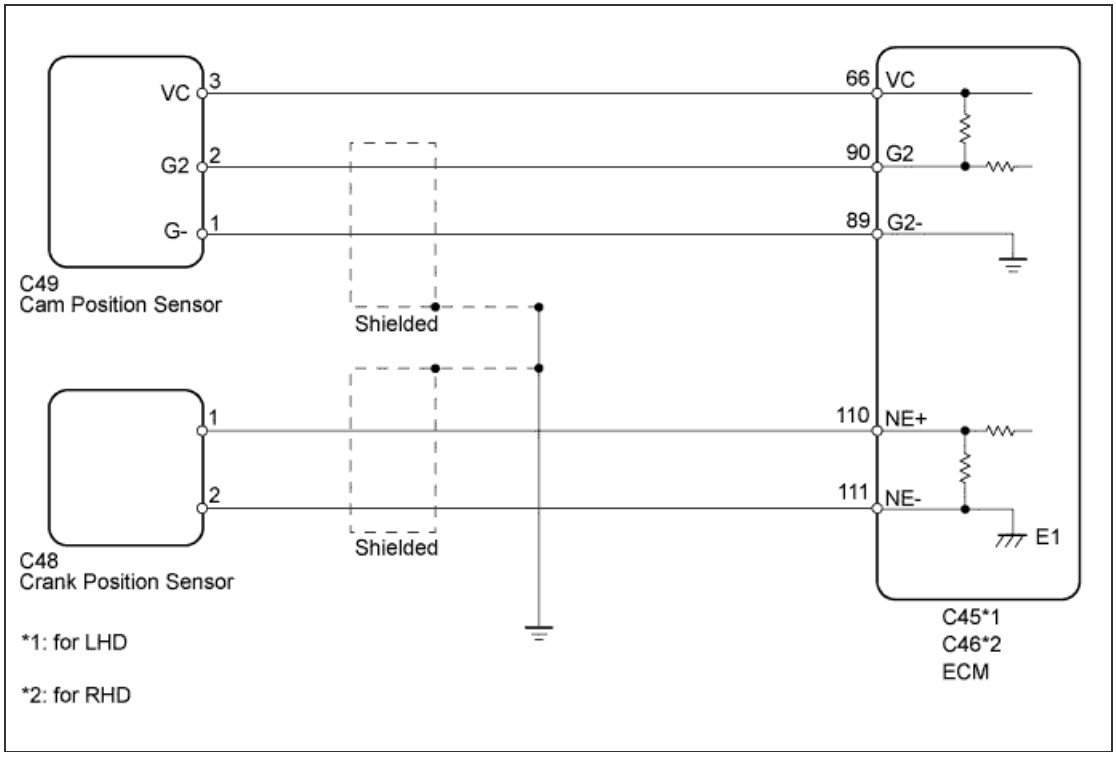
The cam position sensor (G signal) consists of a magnet, iron core and pickup coil.
The camshaft drive gear (LH) has 3 teeth on its inner circumference. When the camshaft gear rotates, the air gap changes between the protrusion on the gear and the pickup coil. The change affects the magnetic field and results in changes in the resistance of the MRE element.
The crankshaft signal plate has 34 teeth and is mounted on the crankshaft. The crank position sensor generates 34 signals at every revolution. The ECM detects the standard crankshaft angle based on the G signal, and the actual crankshaft angle and engine speed by the NE signal.

DTC Code	DTC Detection Condition	Trouble Area
P1340	No cam position sensor signal is sent to the ECM during cranking (2 trip detection logic).	• Open or short in cam position sensor circuit • Camshaft position sensor • Camshaft timing pulley LH • ECM
	No cam position sensor signal is sent to the ECM with an engine speed of 600 rpm or more.	
P1342	The output voltage of the camshaft position sensor is below 0.3 V for 4 seconds (1 trip detection logic).	
P1343	The output voltage of the camshaft position sensor is higher than 4.7 V for 4 seconds (1 trip detection logic).	

MONITOR DESCRIPTION

The cam position sensor (G signal) consists of a magnet and MRE element.
The camshaft drive gear has 3 teeth on its inner circumference. When the camshaft gear rotates, the air gap changes between the protrusion on the gear and the pickup coil. The change affects the magnetic field and results in changes in the resistance of the MRE element. The crankshaft angle sensor plate has 34 teeth and outputs 34 signals at every revolution. The ECM detects the standard crankshaft angle based on the G signal, and the actual crankshaft angle and engine speed by the NE signal.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio

was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT CAM POSITION SENSOR ASSEMBLY (SENSOR POWER SOURCE)

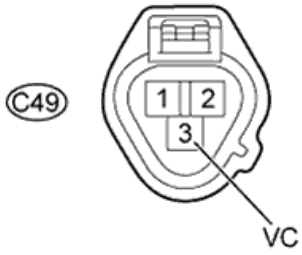
a. Disconnect the cam position sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C49-3 (VC) - Body ground	Engine switch on (IG)	4.5 to 5.0 V

Front view of wire harness connector:
(to Cam Position Sensor)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (ECM - CAM POSITION SENSOR)

a. Disconnect the cam position sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

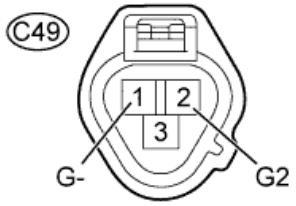
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C49-2 (G2) - C45-90 (G2)	Always	Below 1 Ω
C49-1 (G-) - C45-89 (G2-)	Always	Below 1 Ω
C49-2 (G2) or C45-90 (G2) - Body ground	Always	10 kΩ or higher
C49-1 (G-) or C45-89 (G2-) - Body ground	Always	10 kΩ or higher

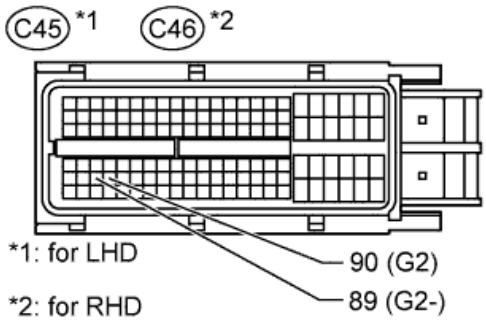
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C49-2 (G2) - C46-90 (G2)	Always	Below 1 Ω
C49-1 (G-) - C46-89 (G2-)	Always	Below 1 Ω
C49-2 (G2) or C46-90 (G2) - Body ground	Always	10 kΩ or higher
C49-1 (G-) or C46-89 (G2-) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Cam Position Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

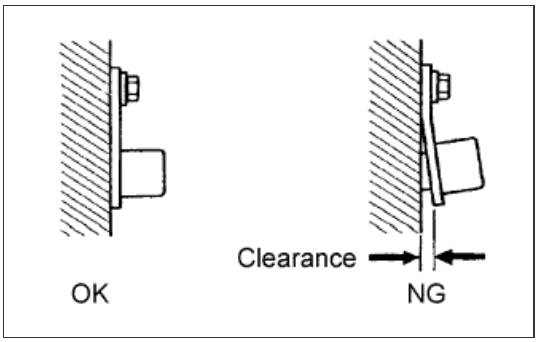
OK

3.INSPECT SENSOR INSTALLATION

a. Check the cam position sensor installation.

OK:

The cam position sensor is installed properly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

4.INSPECT CAMSHAFT TIMING PULLEY LH (SIGNAL PLATE TOOTH)

a. Check the teeth of the signal plate.

OK:

Sensor plate teeth do not have any cracks or deformation.

NG → REPLACE CAMSHAFT TIMING PULLEY LH (Click here)

OK

5.REPLACE CAM POSITION SENSOR ASSEMBLY

a. Replace the cam position sensor (Click here).

NEXT

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P1340, P1342 and/or P1343 is output	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

DTC P0115 Engine Coolant Temperature Circuit Malfunction

DTC P0117 Engine Coolant Temperature Circuit Low Input

DTC P0118 Engine Coolant Temperature Circuit High Input

for Preparation Click here

DESCRIPTION

A thermistor, whose resistance value varies according to the ECT, is built into the Engine Coolant Temperature (ECT) sensor.
The structure of the sensor and its connection to the ECM are the same as those of the Intake Air Temperature (IAT) sensor.

HINT:

When any of DTCs P0115, P0117 and P0118 are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECT is estimated to be 80°C (176°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC Code	DTC Detection Condition	Trouble Area
P0115	An open or short in the Engine Coolant Temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in Engine Coolant Temperature (ECT) sensor circuit • ECT sensor • ECM
P0117	A short in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in ECT sensor • ECT sensor • ECM
P0118	An open in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in ECT sensor circuit • ECT sensor • ECM

HINT:

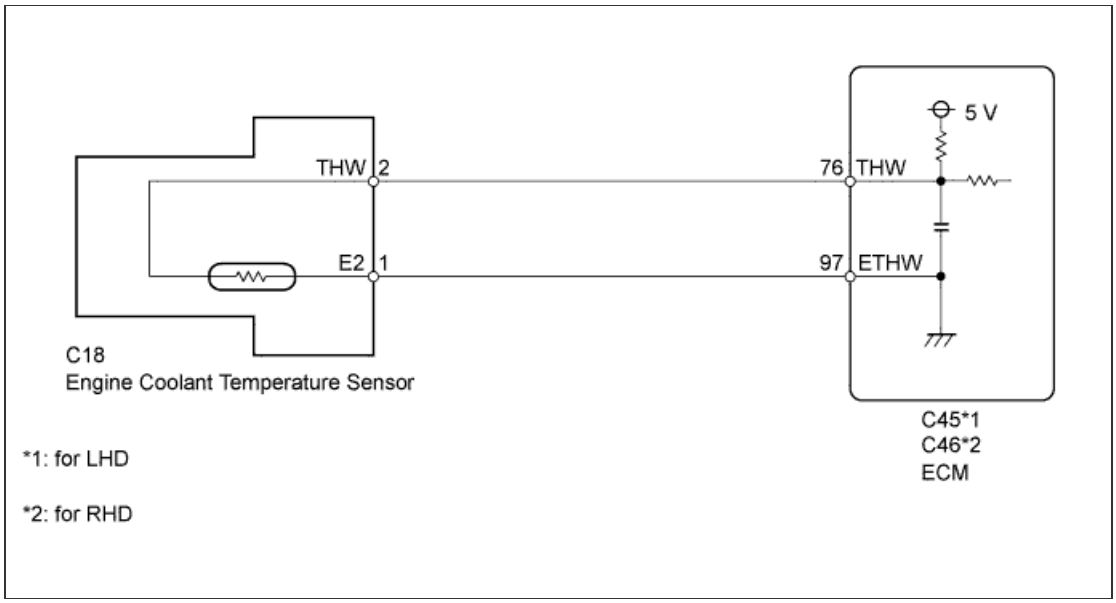
When any of these DTCs are output, check the ECT by entering the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

Temperature Displayed	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

MONITOR DESCRIPTION

The Engine Coolant Temperature (ECT) sensor is used to monitor the ECT. The ECT sensor has a thermistor with a resistance that varies according to the temperature of the engine coolant. When the coolant temperature is low, the resistance in the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are reflected in the output voltage from the sensor. The ECM monitors the sensor voltage and uses this value to calculate the ECT. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a fault in the ECT sensor and stores a DTC.
Example:
If the sensor output voltage is higher than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the ECT sensor circuit, and stores DTC P0118. Conversely, if the voltage output is below 0.14 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and stores DTC P0117.
If the malfunction is not repaired successfully, a DTC is stored 0.5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ OUTPUT DTC

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0115 is output	A
P0117 is output	B
P0118 is output	C

B → Go to step 5

C → Go to step

A

2.READ VALUE USING INTELLIGENT TESTER (ENGINE COOLANT TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

e. Read the value displayed on the tester.

Result

Result	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
Between 80 and 100°C (176 and 212°F) with warm engine	C

HINT:

- **If there is an open circuit, the intelligent tester indicates -40 C (-40 .**
- **If there is a short circuit, the intelligent tester indicates 140 C (284 r higher.**

B	Go to step 5
C	CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the Engine Coolant Temperature (ECT) sensor connector.

b. Connect terminals 1 and 2 of the ECT sensor connector on the wire harness side.

c. Connect the intelligent tester to the DLC3.

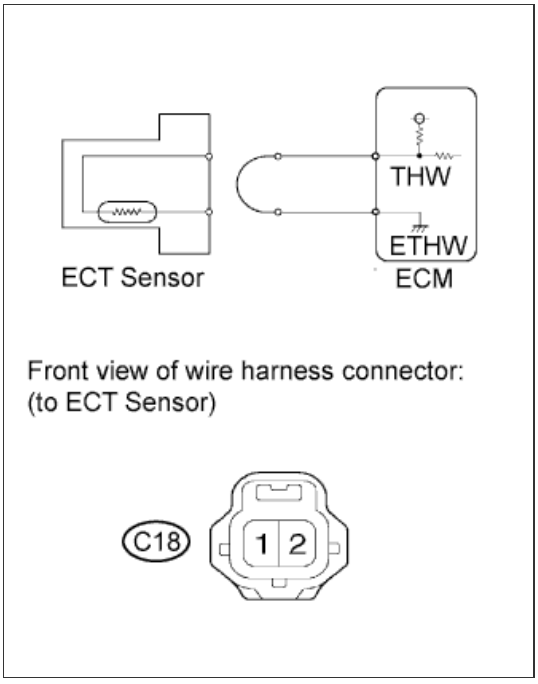
d. Turn the engine switch on (IG).

e. Turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

g. Read the value displayed on the tester.

Standard value:
140 C (284 r higher.



NG	Go to step 4

OK

CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

4.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the ECT sensor connector.

b. Disconnect the ECM connector.

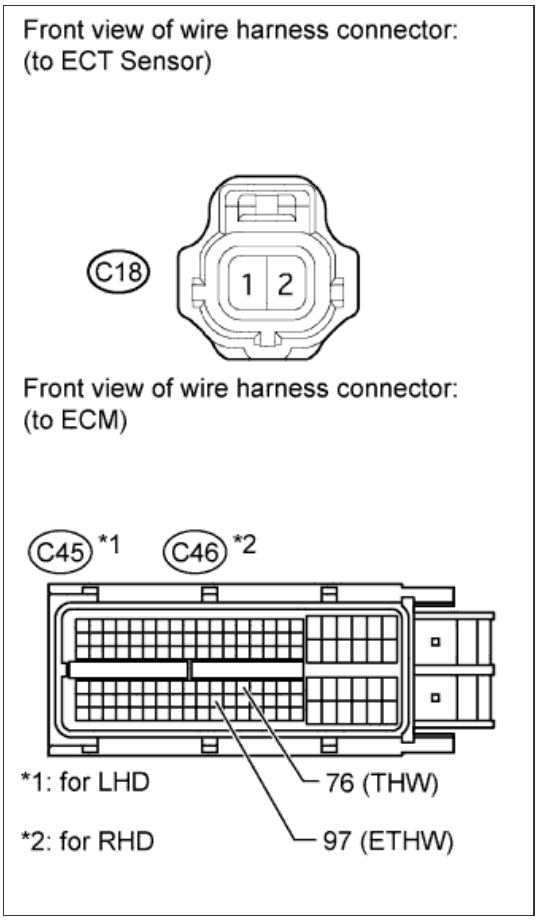
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C18-2 - C45-76 (THW)	Always	Below 1 Ω
C18-1 - C45-97 (ETHW)	Always	Below 1 Ω

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C18-2 - C46-76 (THW)	Always	Below 1 Ω
C18-1 - C46-97 (ETHW)	Always	Below 1 Ω

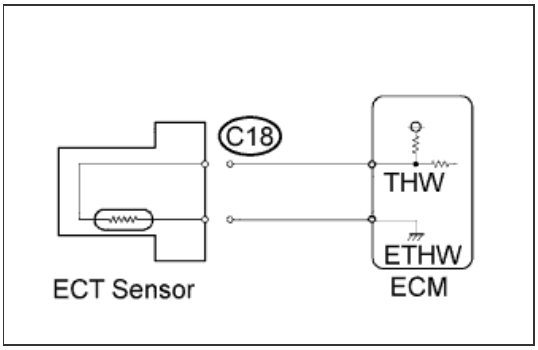


NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK →

CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM (Click here)

5.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)



a. Disconnect the ECT sensor connector.

b. Connect the intelligent tester to the DLC3.

c. Turn the engine switch on (IG).

d. Turn the tester on.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

f. Read the value displayed on the tester.

Standard value:
-40 C (-40

NG → Go to step 6

OK →

REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

6.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the ECT sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

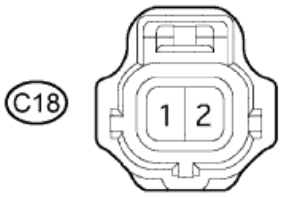
Tester Connection	Condition	Specified

		Condition
C18-2 or C45-76 (THW) - Body ground	Always	10 kΩ or higher

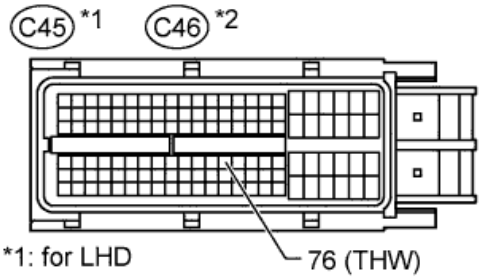
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C18-2 or C46-76 (THW) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to ECT Sensor)



Front view of wire harness connector:
(to ECM)



*2: for RHD

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK → REPLACE ECM (Click here)

DTC P1340 Camshaft Position Sensor "A" (Bank 1 Sensor 2)

DTC P1342 Camshaft Position Sensor "A" Low Input (MRE)

DTC P1343 Camshaft Position Sensor "A" High Input (MRE)

for Preparation Click here

DESCRIPTION

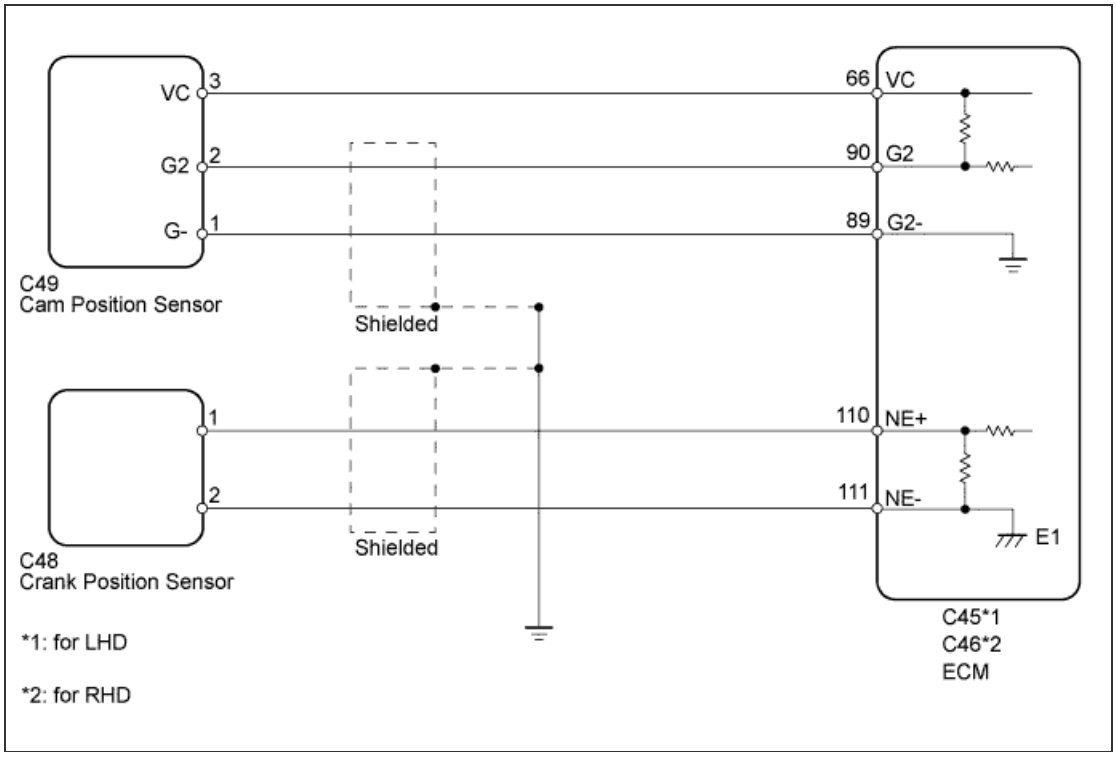
The cam position sensor (G signal) consists of a magnet, iron core and pickup coil.
The camshaft drive gear (LH) has 3 teeth on its inner circumference. When the camshaft gear rotates, the air gap changes between the protrusion on the gear and the pickup coil. The change affects the magnetic field and results in changes in the resistance of the MRE element.
The crankshaft signal plate has 34 teeth and is mounted on the crankshaft. The crank position sensor generates 34 signals at every revolution. The ECM detects the standard crankshaft angle based on the G signal, and the actual crankshaft angle and engine speed by the NE signal.

DTC Code	DTC Detection Condition	Trouble Area
P1340	No cam position sensor signal is sent to the ECM during cranking (2 trip detection logic).	• Open or short in cam position sensor circuit • Camshaft position sensor • Camshaft timing pulley LH • ECM
	No cam position sensor signal is sent to the ECM with an engine speed of 600 rpm or more.	
P1342	The output voltage of the camshaft position sensor is below 0.3 V for 4 seconds (1 trip detection logic).	
P1343	The output voltage of the camshaft position sensor is higher than 4.7 V for 4 seconds (1 trip detection logic).	

MONITOR DESCRIPTION

The cam position sensor (G signal) consists of a magnet and MRE element.
The camshaft drive gear has 3 teeth on its inner circumference. When the camshaft gear rotates, the air gap changes between the protrusion on the gear and the pickup coil. The change affects the magnetic field and results in changes in the resistance of the MRE element. The crankshaft angle sensor plate has 34 teeth and outputs 34 signals at every revolution. The ECM detects the standard crankshaft angle based on the G signal, and the actual crankshaft angle and engine speed by the NE signal.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio

was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT CAM POSITION SENSOR ASSEMBLY (SENSOR POWER SOURCE)

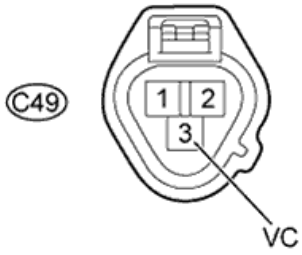
a. Disconnect the cam position sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C49-3 (VC) - Body ground	Engine switch on (IG)	4.5 to 5.0 V

Front view of wire harness connector:
(to Cam Position Sensor)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (ECM - CAM POSITION SENSOR)

a. Disconnect the cam position sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

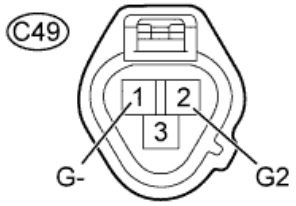
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C49-2 (G2) - C45-90 (G2)	Always	Below 1 Ω
C49-1 (G-) - C45-89 (G2-)	Always	Below 1 Ω
C49-2 (G2) or C45-90 (G2) - Body ground	Always	10 kΩ or higher
C49-1 (G-) or C45-89 (G2-) - Body ground	Always	10 kΩ or higher

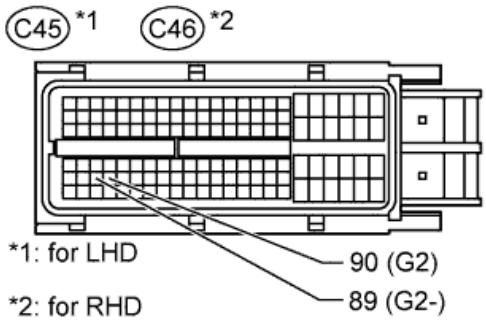
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C49-2 (G2) - C46-90 (G2)	Always	Below 1 Ω
C49-1 (G-) - C46-89 (G2-)	Always	Below 1 Ω
C49-2 (G2) or C46-90 (G2) - Body ground	Always	10 kΩ or higher
C49-1 (G-) or C46-89 (G2-) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Cam Position Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

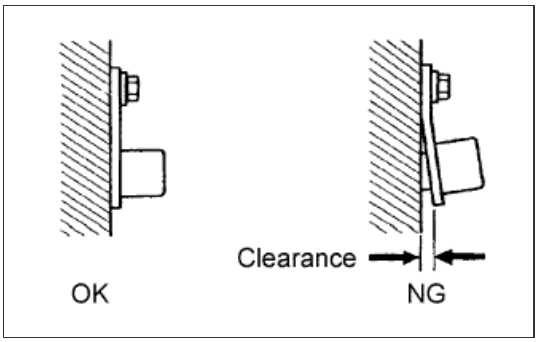
OK

3.INSPECT SENSOR INSTALLATION

a. Check the cam position sensor installation.

OK:

The cam position sensor is installed properly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

4.INSPECT CAMSHAFT TIMING PULLEY LH (SIGNAL PLATE TOOTH)

a. Check the teeth of the signal plate.

OK:

Sensor plate teeth do not have any cracks or deformation.

NG → REPLACE CAMSHAFT TIMING PULLEY LH (Click here)

OK

5.REPLACE CAM POSITION SENSOR ASSEMBLY

a. Replace the cam position sensor (Click here).

NEXT

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P1340, P1342 and/or P1343 is output	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

DTC P0115 Engine Coolant Temperature Circuit Malfunction

DTC P0117 Engine Coolant Temperature Circuit Low Input

DTC P0118 Engine Coolant Temperature Circuit High Input

for Preparation Click here

DESCRIPTION

A thermistor, whose resistance value varies according to the ECT, is built into the Engine Coolant Temperature (ECT) sensor.
The structure of the sensor and its connection to the ECM are the same as those of the Intake Air Temperature (IAT) sensor.

HINT:

When any of DTCs P0115, P0117 and P0118 are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECT is estimated to be 80°C (176°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC Code	DTC Detection Condition	Trouble Area
P0115	An open or short in the Engine Coolant Temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in Engine Coolant Temperature (ECT) sensor circuit • ECT sensor • ECM
P0117	A short in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in ECT sensor • ECT sensor • ECM
P0118	An open in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in ECT sensor circuit • ECT sensor • ECM

HINT:

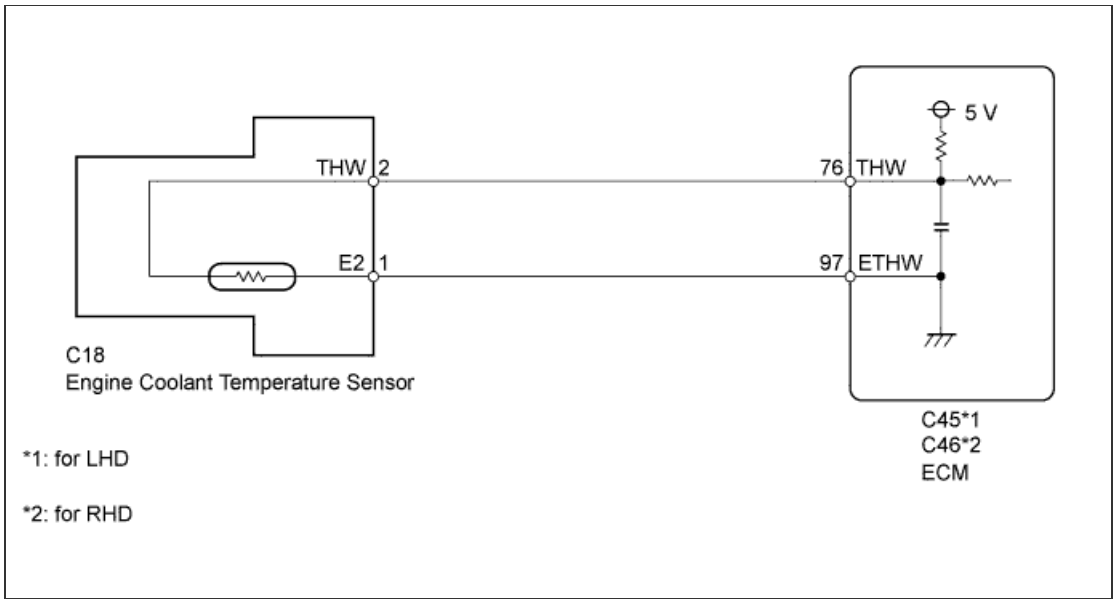
When any of these DTCs are output, check the ECT by entering the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

Temperature Displayed	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

MONITOR DESCRIPTION

The Engine Coolant Temperature (ECT) sensor is used to monitor the ECT. The ECT sensor has a thermistor with a resistance that varies according to the temperature of the engine coolant. When the coolant temperature is low, the resistance in the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are reflected in the output voltage from the sensor. The ECM monitors the sensor voltage and uses this value to calculate the ECT. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a fault in the ECT sensor and stores a DTC.
Example:
If the sensor output voltage is higher than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the ECT sensor circuit, and stores DTC P0118. Conversely, if the voltage output is below 0.14 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and stores DTC P0117.
If the malfunction is not repaired successfully, a DTC is stored 0.5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ OUTPUT DTC

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0115 is output	A
P0117 is output	B
P0118 is output	C

B → Go to step 5

C → Go to step

A

2.READ VALUE USING INTELLIGENT TESTER (ENGINE COOLANT TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

e. Read the value displayed on the tester.

Result

Result	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
Between 80 and 100°C (176 and 212°F) with warm engine	C

HINT:

- **If there is an open circuit, the intelligent tester indicates -40 C (-40 .**
- **If there is a short circuit, the intelligent tester indicates 140 C (284 r higher.**

B	Go to step 5
C	CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the Engine Coolant Temperature (ECT) sensor connector.

b. Connect terminals 1 and 2 of the ECT sensor connector on the wire harness side.

c. Connect the intelligent tester to the DLC3.

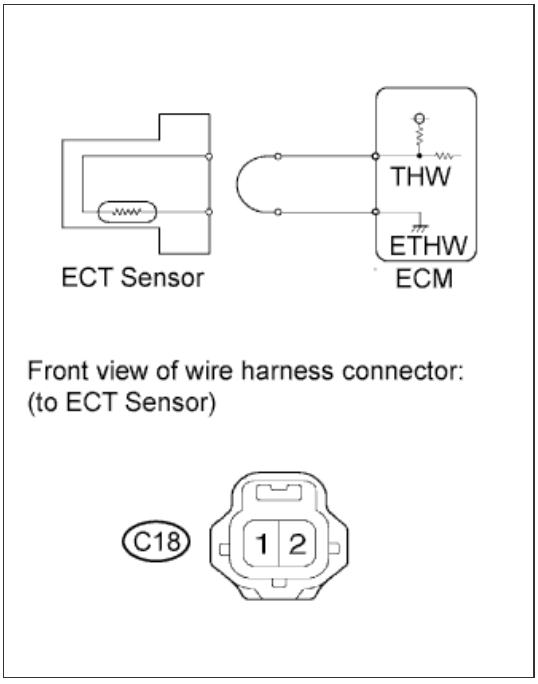
d. Turn the engine switch on (IG).

e. Turn the tester on.

f. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

g. Read the value displayed on the tester.

Standard value:
140 C (284 r higher.



NG	Go to step 4

OK

CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

4.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the ECT sensor connector.

b. Disconnect the ECM connector.

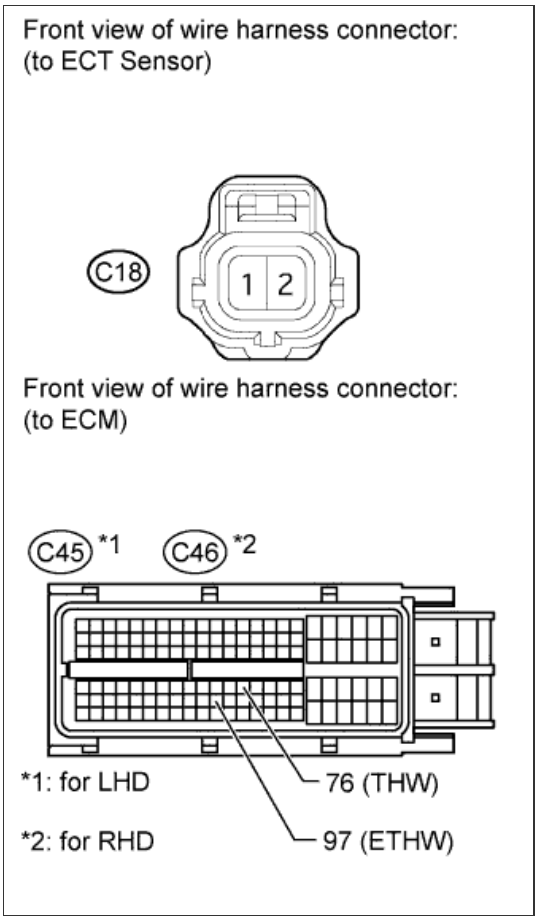
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C18-2 - C45-76 (THW)	Always	Below 1 Ω
C18-1 - C45-97 (ETHW)	Always	Below 1 Ω

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C18-2 - C46-76 (THW)	Always	Below 1 Ω
C18-1 - C46-97 (ETHW)	Always	Below 1 Ω

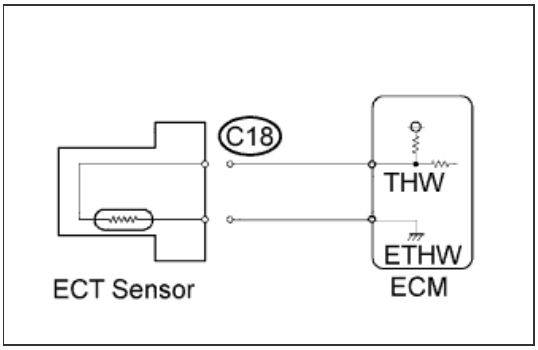


NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK →

CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM (Click here)

5.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)



a. Disconnect the ECT sensor connector.

b. Connect the intelligent tester to the DLC3.

c. Turn the engine switch on (IG).

d. Turn the tester on.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

f. Read the value displayed on the tester.

Standard value:
-40 C (-40

NG → Go to step 6

OK →

REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

6.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the ECT sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

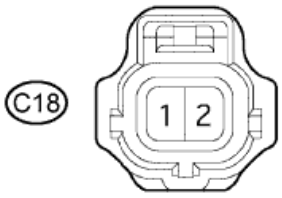
Tester Connection	Condition	Specified

		Condition
C18-2 or C45-76 (THW) - Body ground	Always	10 kΩ or higher

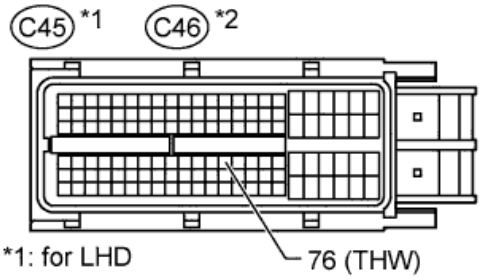
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C18-2 or C46-76 (THW) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to ECT Sensor)



Front view of wire harness connector:
(to ECM)



*2: for RHD

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK → REPLACE ECM (Click here)

DTC P1340 Camshaft Position Sensor "A" (Bank 1 Sensor 2)

DTC P1342 Camshaft Position Sensor "A" Low Input (MRE)

DTC P1343 Camshaft Position Sensor "A" High Input (MRE)

for Preparation Click here

DESCRIPTION

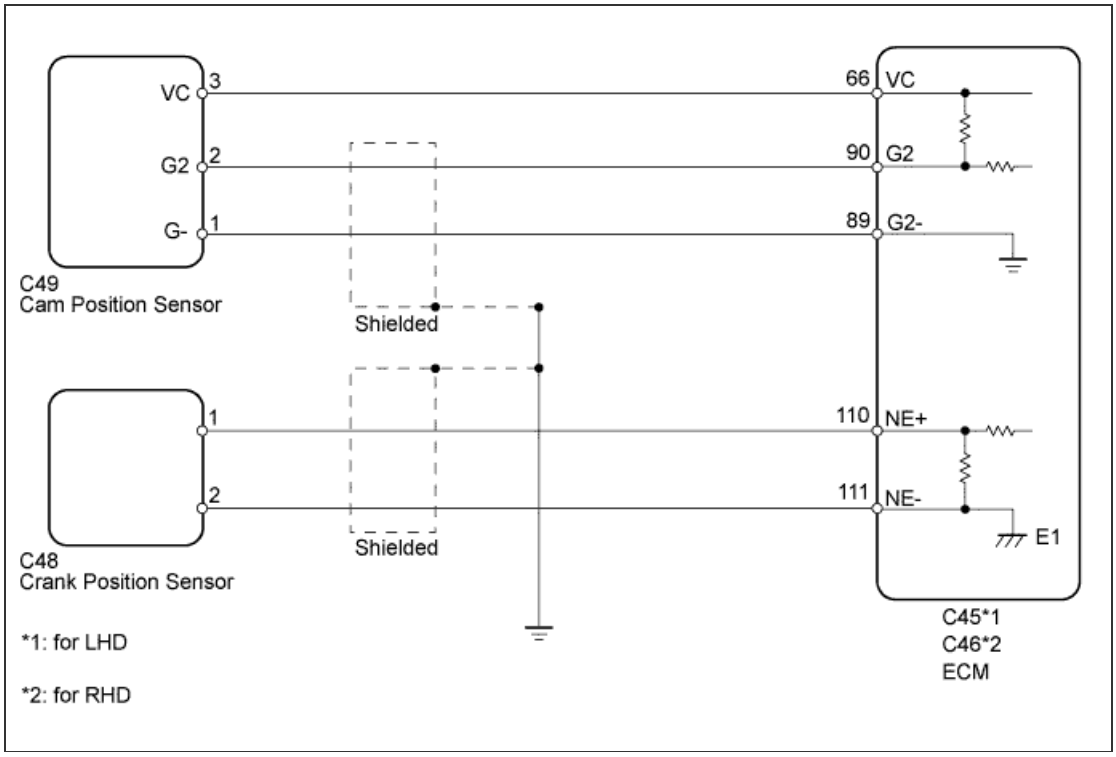
The cam position sensor (G signal) consists of a magnet, iron core and pickup coil.
The camshaft drive gear (LH) has 3 teeth on its inner circumference. When the camshaft gear rotates, the air gap changes between the protrusion on the gear and the pickup coil. The change affects the magnetic field and results in changes in the resistance of the MRE element.
The crankshaft signal plate has 34 teeth and is mounted on the crankshaft. The crank position sensor generates 34 signals at every revolution. The ECM detects the standard crankshaft angle based on the G signal, and the actual crankshaft angle and engine speed by the NE signal.

DTC Code	DTC Detection Condition	Trouble Area
P1340	No cam position sensor signal is sent to the ECM during cranking (2 trip detection logic).	• Open or short in cam position sensor circuit • Camshaft position sensor • Camshaft timing pulley LH • ECM
	No cam position sensor signal is sent to the ECM with an engine speed of 600 rpm or more.	
P1342	The output voltage of the camshaft position sensor is below 0.3 V for 4 seconds (1 trip detection logic).	
P1343	The output voltage of the camshaft position sensor is higher than 4.7 V for 4 seconds (1 trip detection logic).	

MONITOR DESCRIPTION

The cam position sensor (G signal) consists of a magnet and MRE element.
The camshaft drive gear has 3 teeth on its inner circumference. When the camshaft gear rotates, the air gap changes between the protrusion on the gear and the pickup coil. The change affects the magnetic field and results in changes in the resistance of the MRE element. The crankshaft angle sensor plate has 34 teeth and outputs 34 signals at every revolution. The ECM detects the standard crankshaft angle based on the G signal, and the actual crankshaft angle and engine speed by the NE signal.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio

was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT CAM POSITION SENSOR ASSEMBLY (SENSOR POWER SOURCE)

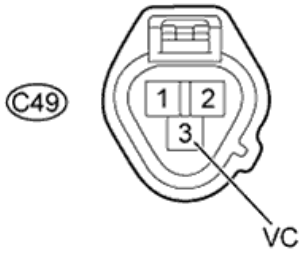
a. Disconnect the cam position sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C49-3 (VC) - Body ground	Engine switch on (IG)	4.5 to 5.0 V

Front view of wire harness connector:
(to Cam Position Sensor)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (ECM - CAM POSITION SENSOR)

a. Disconnect the cam position sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

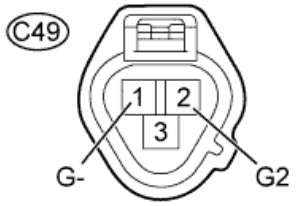
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C49-2 (G2) - C45-90 (G2)	Always	Below 1 Ω
C49-1 (G-) - C45-89 (G2-)	Always	Below 1 Ω
C49-2 (G2) or C45-90 (G2) - Body ground	Always	10 kΩ or higher
C49-1 (G-) or C45-89 (G2-) - Body ground	Always	10 kΩ or higher

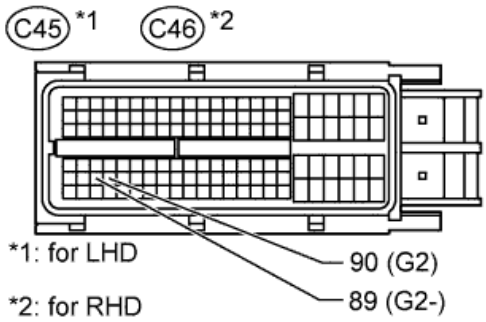
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C49-2 (G2) - C46-90 (G2)	Always	Below 1 Ω
C49-1 (G-) - C46-89 (G2-)	Always	Below 1 Ω
C49-2 (G2) or C46-90 (G2) - Body ground	Always	10 kΩ or higher
C49-1 (G-) or C46-89 (G2-) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Cam Position Sensor)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

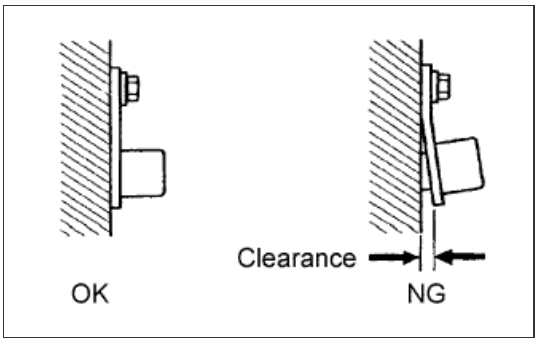
OK

3.INSPECT SENSOR INSTALLATION

a. Check the cam position sensor installation.

OK:

The cam position sensor is installed properly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

4.INSPECT CAMSHAFT TIMING PULLEY LH (SIGNAL PLATE TOOTH)

a. Check the teeth of the signal plate.

OK:

Sensor plate teeth do not have any cracks or deformation.

NG → REPLACE CAMSHAFT TIMING PULLEY LH (Click here)

OK

5.REPLACE CAM POSITION SENSOR ASSEMBLY

a. Replace the cam position sensor (Click here).

NEXT

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P1340, P1342 and/or P1343 is output	B

HINT:

If the engine does not start, replace the ECM.

B → REPLACE ECM (Click here)

A

END

DTC P0116 Engine Coolant Temperature Circuit Range / Performance Problem

for Preparation Click here

DESCRIPTION

Refer to DTC P0115 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P0116	The Engine Coolant Temperature (ECT) is between -40°C (-40°F) and 60°C (140°F) when the engine is started, and conditions (a) and (b) are met (2 trip detection logic): (a) The vehicle is driven at varying speeds (accelerated and decelerated). (b) The ECT remains within 3°C (5.4°F) of the initial ECT.	• Thermostat • ECT sensor

MONITOR DESCRIPTION

The ECT sensor is used to monitor the ECT. The ECT sensor has a built-in thermistor with a resistance that varies according to the temperature of the engine coolant. When the ECT is low, the resistance of the thermistor increases. When the temperature is high, the resistance drops. These variations in the resistance are reflected in the output voltage from the ECT sensor.
The ECM monitors the sensor voltage and uses this value to calculate the ECT. If the sensor output voltage deviates from the normal operating range, the ECM interprets this deviation as a malfunction in the ECT sensor and stores the DTC.
Examples:
Upon starting the engine, the ECT is between -40°C (-40°F) and 60°C (140°F). If, after driving for 250 seconds, the ECT remains within 3°C (5.4°F) of the starting temperature, the DTC is stored (2 trip detection logic).

INSPECTION PROCEDURE

HINT:

- **If any of DTCs P0115, P0117, P0118 or P0125 are output simultaneously with DTC P0116, the ECT sensor may have an open or a short circuit. Troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0116)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read the DTC.

Result

Result	Proceed to
P0116 is output	A
P0116 and other DTCs are output	B

B → GO TO DTC CHART (Click here)

A

2.INSPECT THERMOSTAT

a. Remove the thermostat (Click here).

b. Measure the valve opening temperature of the thermostat.

Standard opening temperature:
80 to 8 (176 to 183 F)

HINT:

In addition to the above check, confirm that the valve is completely closed when the temperature is below the standard.

c. Reinstall the thermostat (Click here).

NG → REP ACE THERMOSTAT (Click here)

OK → REP ACE ENGINE COO ANT TEMPERATURE SENSOR (Click here)

DTC P1440 Secondary Air Injection Vacuum Switching Valve Circuit Malfunction Bank 1

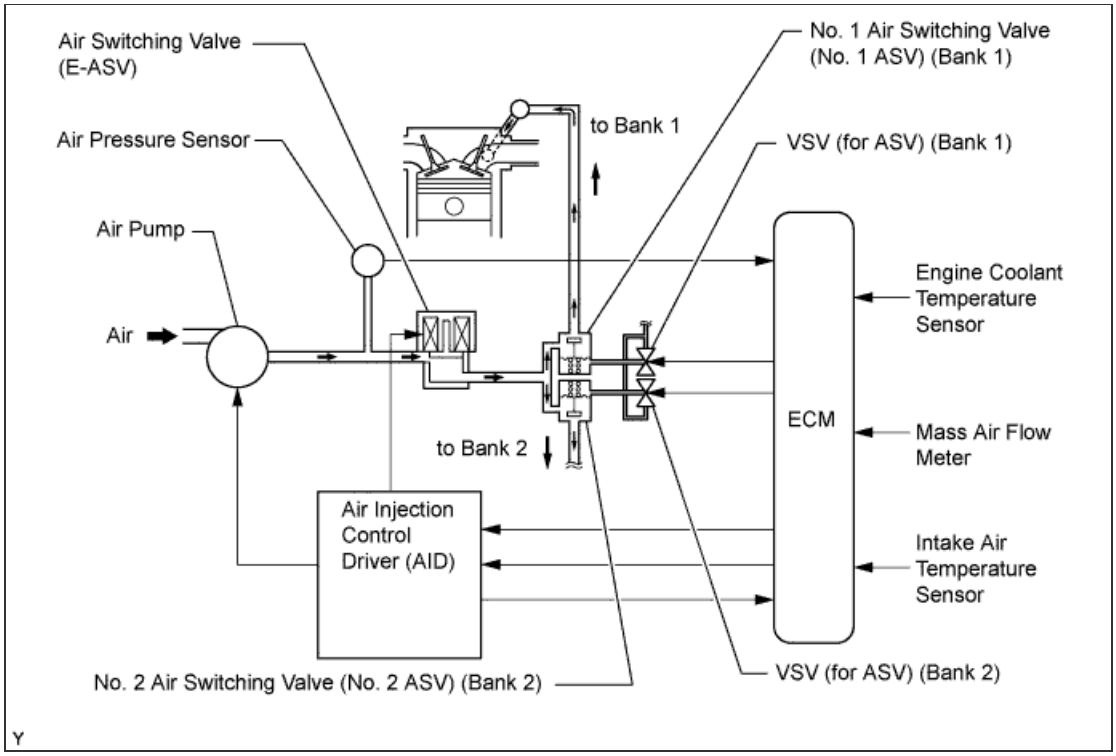
DTC P1443 Secondary Air Injection Vacuum Switching Valve Circuit Malfunction Bank 2

for Preparation Click here

DESCRIPTION

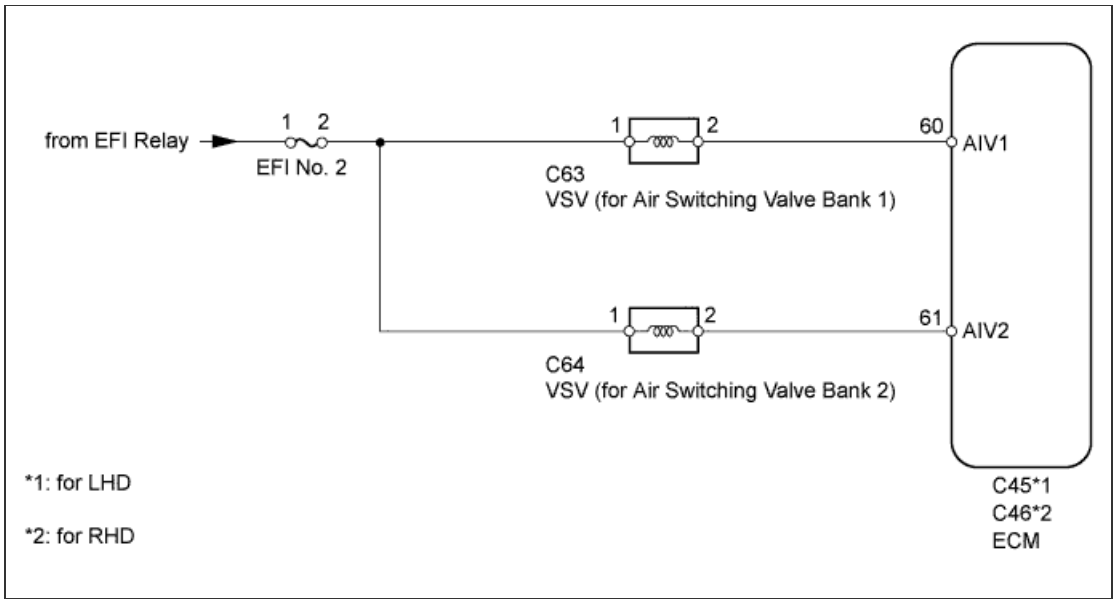
The diagnostic trouble code (DTC) indicates an open in the vacuum switching valve (VSV) circuit of the secondary air injection (AIR) system. The engine control module (ECM) monitors the VSV voltage to detect the malfunction. If the VSV voltage is below half of the battery voltage, the ECM illuminates the malfunction indicator lamp (MIL), and stores a DTC.

The secondary air injection (AIR) system introduces fresh air into the exhaust manifold in order to reduce carbon monoxide (CO) and hydrocarbon (HC) in the exhaust emission. This system is activated just after the engine start, and is stopped when the catalyst converter is warmed-up. This system consists of the following components: 1) the air pump which sends fresh air to the exhaust manifold, 2) the electric air switching valve (E-ASV) which switches the fresh air flow, 3) the air switching valve (ASV) which switches the air passage to the exhaust manifold of each bank, 4) the vacuum switching valve (VSV) which switches the vacuum (intake manifold pressure) to operate the ASV, 5) the pressure sensor which detects the fresh air pressure and exhaust pulse, 6) the air injection control driver which controls the power sources of the air pump and E-ASV, 7) the engine control module (ECM) which controls and monitors this system.



DTC Code	DTC Detection Condition	Trouble Area
P1440	The VSV bank 1 voltage is below half of the battery voltage (1 trip detection logic).	• VSV circuit (bank 1) • VSV (bank 1) • ECM
P1443	The VSV bank 2 voltage is below half of the battery voltage (1 trip detection logic).	• VSV circuit (bank 2) • VSV (bank 2) • ECM

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (AIR INJECTION SYSTEM POWER SOURCE)

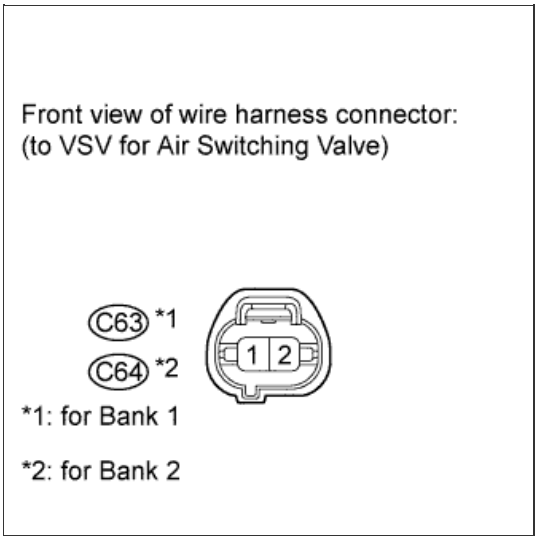
a. Disconnect the VSV for air switching valve connector.

b. Turn the engine switch on (IG).

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C63-1 - Body ground	Engine switch on (IG)	11 to 14 V
C64-1 - Body ground	Engine switch on (IG)	11 to 14 V



NG → Go to step 4

OK

2.CHECK HARNESS AND CONNECTOR (ECM - VSV)

a. Disconnect the ECM connector.

b. Disconnect the VSV for air switching valve connector.

c. Measure the resistance according to the value(s) in the table below.

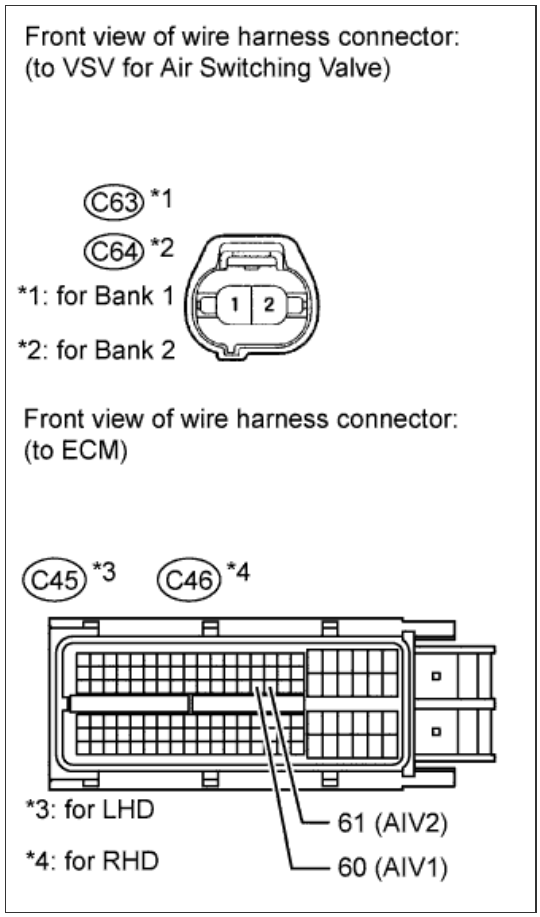
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C63-2 - C45-60 (AIV1)	Always	Below 1 Ω
C64-2 - C45-61 (AIV2)	Always	Below 1 Ω
C63-2 or C45-60		

(AIV1) - Body ground	Always	10 kΩ or higher
C64-2 or C45-61 (AIV2) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C63-2 - C46-60 (AIV1)	Always	Below 1 Ω
C64-2 - C46-61 (AIV2)	Always	Below 1 Ω
C63-2 or C46-60 (AIV1) - Body ground	Always	10 kΩ or higher
C64-2 or C46-61 (AIV2) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK VSV (RESISTANCE)

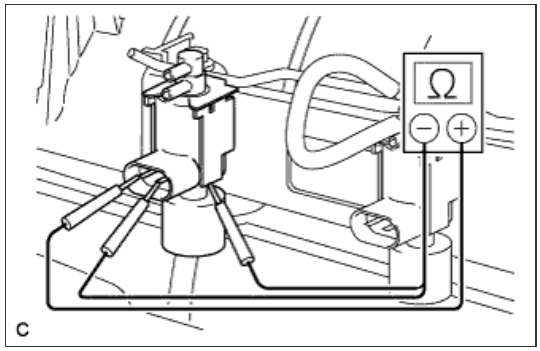
a. Disconnect the VSV for air switching valve connector.

b. Disconnect the 2 vacuum hoses from the VSV.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	Always	33 to 39 Ω at 20°C (68°F)
1 - Body ground	Always	10 kΩ or higher
2 - Body ground	Always	10 kΩ or higher



NG → REPLACE VSV (Click here)

OK

REPLACE ECM (Click here)

4.CHECK HARNESS AND CONNECTOR (VSV - EFI NO. 2 FUSE)

a. Disconnect the VSV connector.

b. Remove the EFI No. 2 fuse from the engine room relay block.

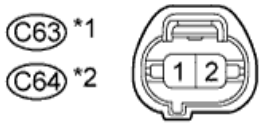
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

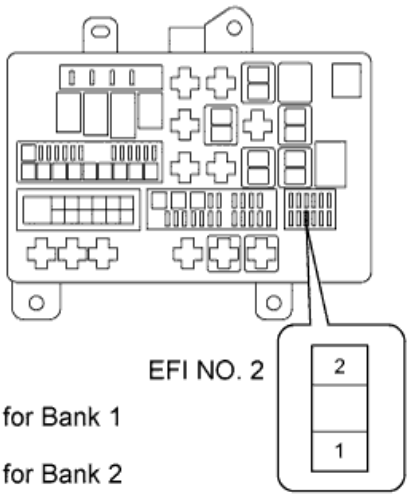
Tester Connection	Condition	Specified Condition

C63-1 - EFI No. 2 fuse terminal 2	Always	Below 1 Ω
C64-1 - EFI No. 2 fuse terminal 2	Always	Below 1 Ω
C63-1 or EFI No. 2 fuse terminal 2 - Body ground	Always	10 kΩ or higher
C64-1 or EFI No. 2 fuse terminal 2 - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to VSV for Air Switching Valve)



Engine Room Relay Block:



*1: for Bank 1

*2: for Bank 2

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

DTC P0120 Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0220 Throttle / Pedal Position Sensor / Switch "B" Circuit

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

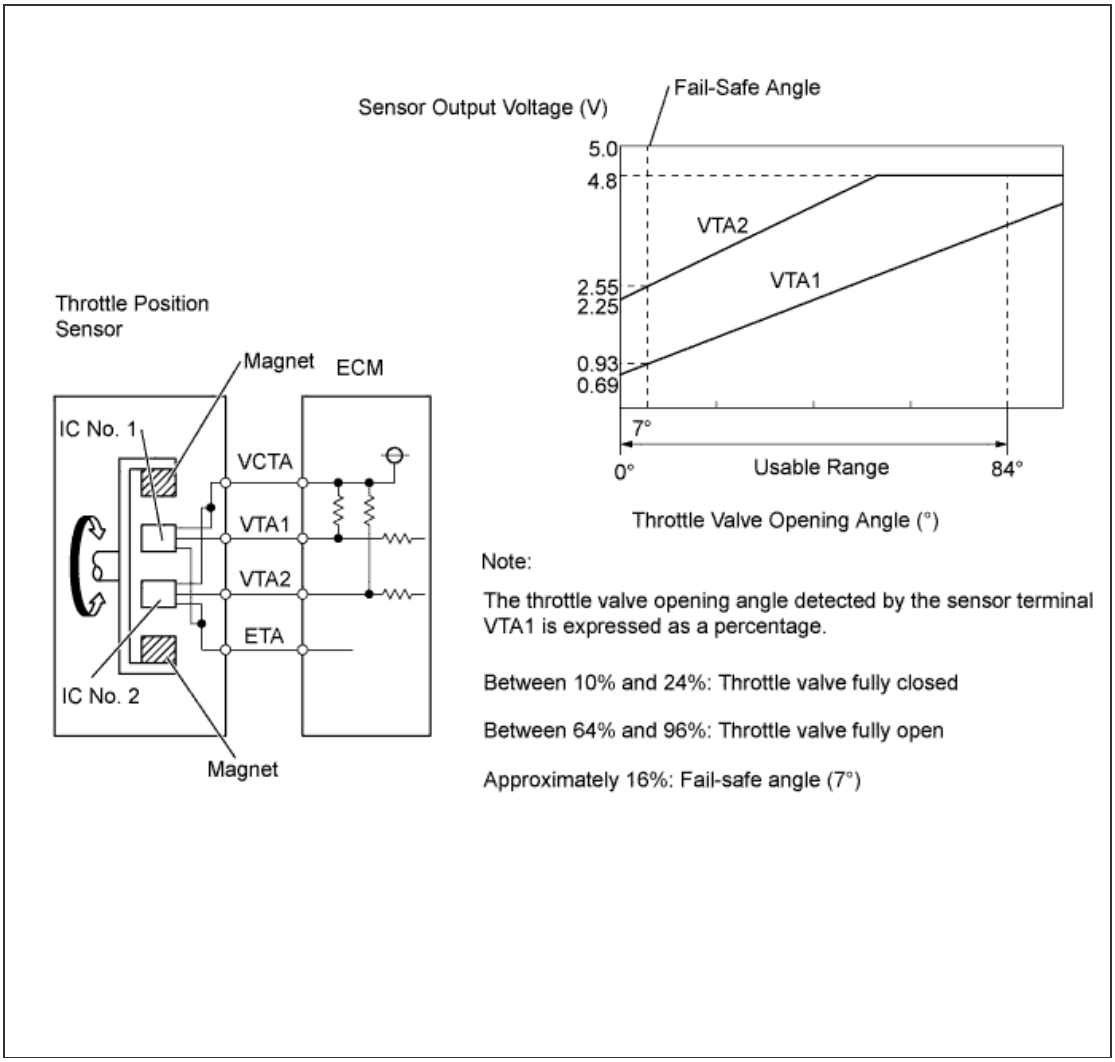
DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

DTC P2135 Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

for Preparation Click here

DESCRIPTION

The TP sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.
The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air-fuel ratio correction, power increase correction and fuel-cut control.



DTC Code	DTC Detection Condition	Trouble Area
P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• Throttle Position (TP) sensor (built into throttle body) • ECM

P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.535 V or higher for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher, and VTA1 is between 0.2 V and 2.02 V for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) is met (1 trip detection logic): (a) The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:

- **When any of these DTCs are output, check the throttle valve opening angle by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No. 1 and Throttle Position No. 2.**
- **Throttle Position No. 1 is the VTA1 signal, and Throttle Position No. 2 is the VTA2 signal.**

Reference (Normal Condition):

Tester Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No. 1	0.5 to 1.1 V	3.3 to 4.9 V
Throttle Position No. 2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

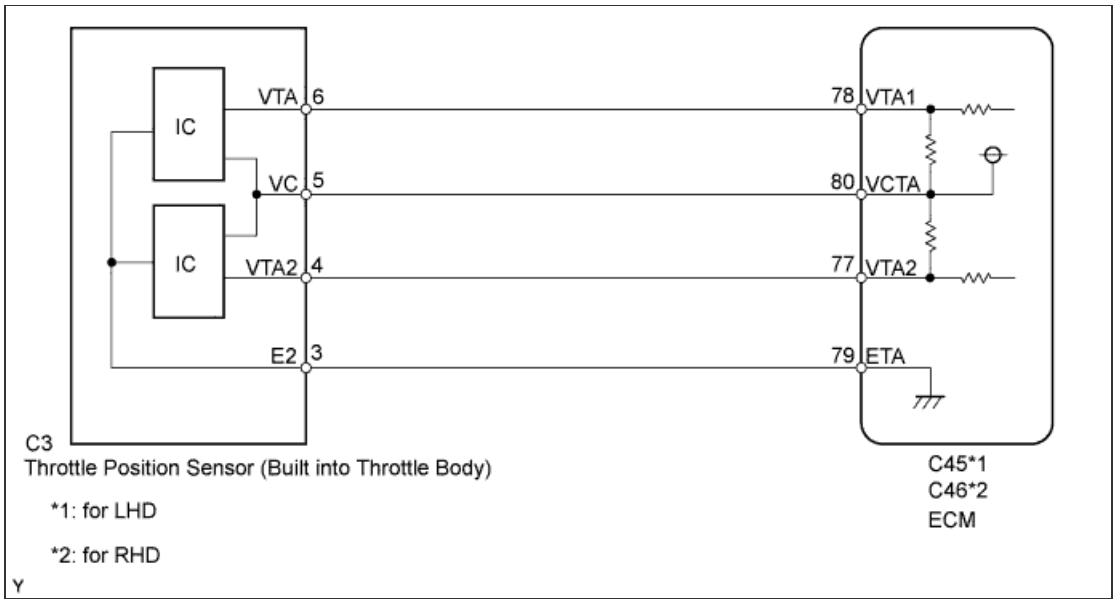
- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then ad usts the engine output by controlling the fuel in ection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION)

a. Connect the intelligent tester to the D C3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain Engine and ECT Data ist ETCS Throttle Position No.1 and Throttle Position No.2.

d. Check the values displayed on the tester.

Result

TP 1 (VTA1) When Accelerator Pedal Released	TP 2 (VTA2) When Accelerator Pedal Released	TP 1 (VTA1) When Accelerator Pedal Depressed	TP 2 (VTA2) When Accelerator Pedal Depressed	Trouble Area	Proceed to
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	A
0 to 0.2 V, or 4.5 to 5.0 V	2.4 to 3.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.4 to 3.4 V (Fail-safe)	VTA1 circuit open or ground short	A
0.7 to 1.3 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.7 to 1.3 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	A
0.5 to 1.1 V	2.1 to 3.1 V	3.3 to 4.9 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

TP 1 stands for Throttle Position No. 1, and TP 2 stands for Throttle Position No. 2.

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the throttle body connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

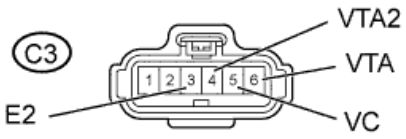
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C45-80 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C45-78 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C45-77 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C45-79 (ETA)	Always	Below 1 Ω
C3-5 (VC) or C45-80 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C45-78 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C45-77 (VTA2) - Body ground	Always	10 kΩ or higher

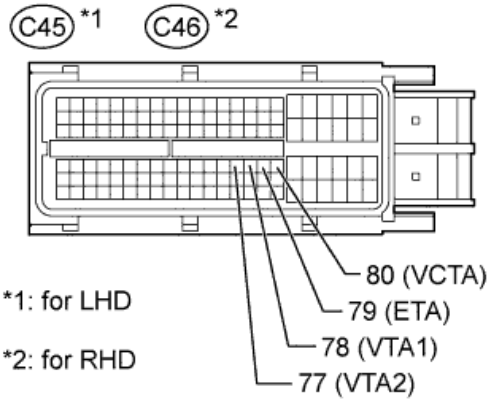
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C46-80 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C46-78 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C46-77 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C46-79 (ETA)	Always	Below 1 Ω
C3-5 (VC) or C46-80 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C46-78 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C46-77 (VTA2) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Throttle Body)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT ECM (VC VOLTAGE)

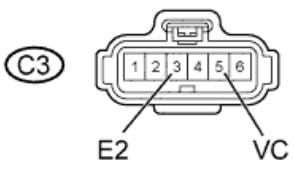
a. Disconnect the throttle body connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C3-5 (VC) - C3-3 (E2)	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to Throttle Body)



Y

NG → REPLACE ECM (Click here)

OK

4.REPLACE THROTTLE BODY ASSEMBLY

a. Replace the throttle body assembly (Click here).

NE T

5.CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

a. Connect the intelligent tester to the D C3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds or more.

f. Enter the following menus: Powertrain Engine and ECT DTC.

g. Read DTCs.

Result

Result	Proceed to
P0120, P0122, P0123, P0220, P0222, P0223 and or P2135 is output	A
No DTC is output	B

B → SYSTEM OK

A

REPLACE ECM (**Click here**)

DTC P1440 Secondary Air Injection Vacuum Switching Valve Circuit Malfunction Bank 1

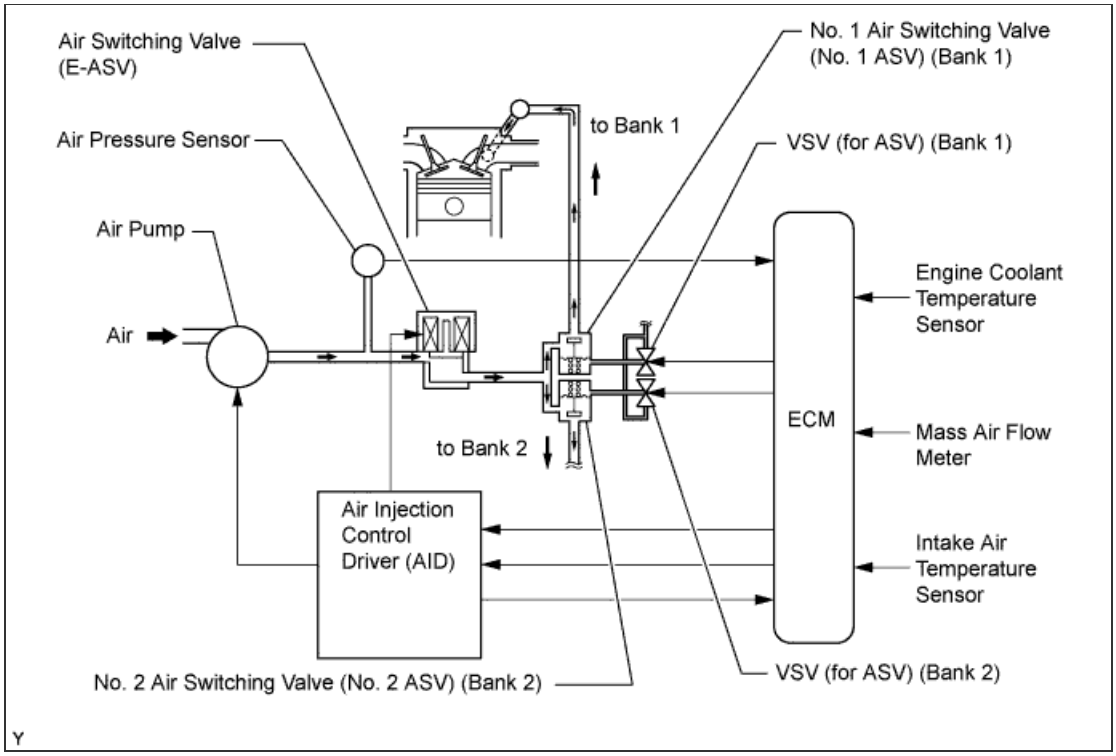
DTC P1443 Secondary Air Injection Vacuum Switching Valve Circuit Malfunction Bank 2

for Preparation Click here

DESCRIPTION

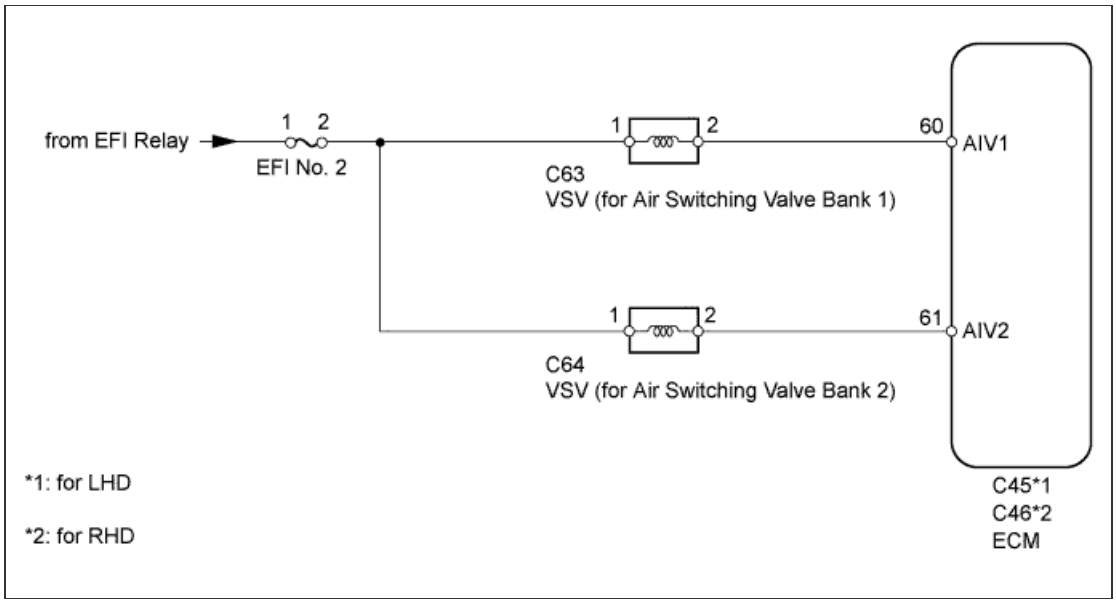
The diagnostic trouble code (DTC) indicates an open in the vacuum switching valve (VSV) circuit of the secondary air injection (AIR) system. The engine control module (ECM) monitors the VSV voltage to detect the malfunction. If the VSV voltage is below half of the battery voltage, the ECM illuminates the malfunction indicator lamp (MIL), and stores a DTC.

The secondary air injection (AIR) system introduces fresh air into the exhaust manifold in order to reduce carbon monoxide (CO) and hydrocarbon (HC) in the exhaust emission. This system is activated just after the engine start, and is stopped when the catalyst converter is warmed-up. This system consists of the following components: 1) the air pump which sends fresh air to the exhaust manifold, 2) the electric air switching valve (E-ASV) which switches the fresh air flow, 3) the air switching valve (ASV) which switches the air passage to the exhaust manifold of each bank, 4) the vacuum switching valve (VSV) which switches the vacuum (intake manifold pressure) to operate the ASV, 5) the pressure sensor which detects the fresh air pressure and exhaust pulse, 6) the air injection control driver which controls the power sources of the air pump and E-ASV, 7) the engine control module (ECM) which controls and monitors this system.



DTC Code	DTC Detection Condition	Trouble Area
P1440	The VSV bank 1 voltage is below half of the battery voltage (1 trip detection logic).	• VSV circuit (bank 1) • VSV (bank 1) • ECM
P1443	The VSV bank 2 voltage is below half of the battery voltage (1 trip detection logic).	• VSV circuit (bank 2) • VSV (bank 2) • ECM

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (AIR INJECTION SYSTEM POWER SOURCE)

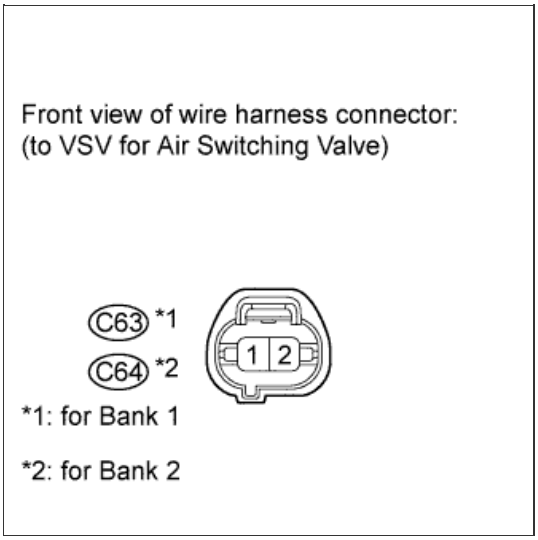
a. Disconnect the VSV for air switching valve connector.

b. Turn the engine switch on (IG).

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C63-1 - Body ground	Engine switch on (IG)	11 to 14 V
C64-1 - Body ground	Engine switch on (IG)	11 to 14 V



NG → Go to step 4

OK

2.CHECK HARNESS AND CONNECTOR (ECM - VSV)

a. Disconnect the ECM connector.

b. Disconnect the VSV for air switching valve connector.

c. Measure the resistance according to the value(s) in the table below.

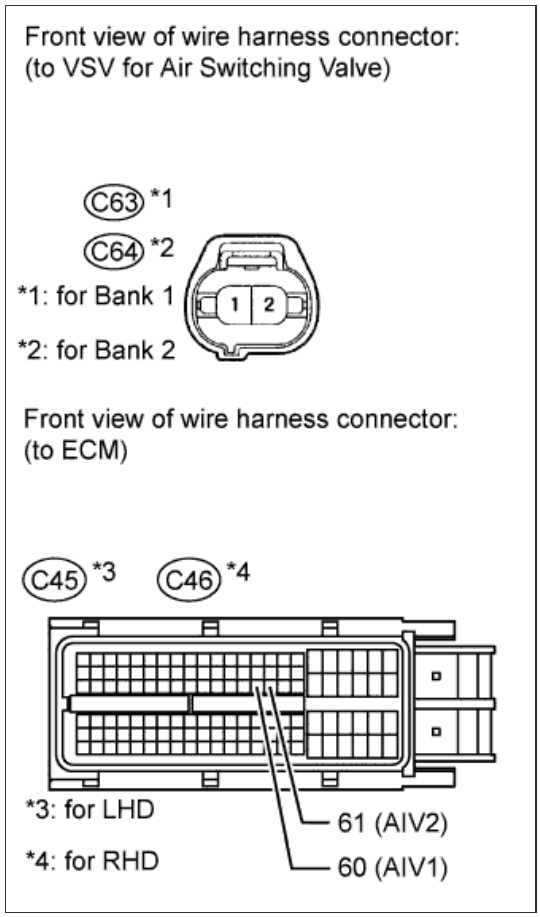
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C63-2 - C45-60 (AIV1)	Always	Below 1 Ω
C64-2 - C45-61 (AIV2)	Always	Below 1 Ω
C63-2 or C45-60		

(AIV1) - Body ground	Always	10 kΩ or higher
C64-2 or C45-61 (AIV2) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C63-2 - C46-60 (AIV1)	Always	Below 1 Ω
C64-2 - C46-61 (AIV2)	Always	Below 1 Ω
C63-2 or C46-60 (AIV1) - Body ground	Always	10 kΩ or higher
C64-2 or C46-61 (AIV2) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK VSV (RESISTANCE)

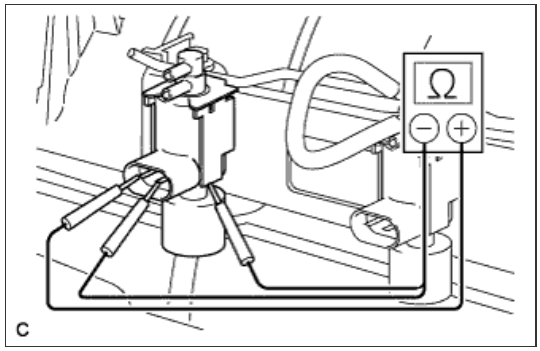
a. Disconnect the VSV for air switching valve connector.

b. Disconnect the 2 vacuum hoses from the VSV.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	Always	33 to 39 Ω at 20°C (68°F)
1 - Body ground	Always	10 kΩ or higher
2 - Body ground	Always	10 kΩ or higher



NG → REPLACE VSV (Click here)

OK

REPLACE ECM (Click here)

4.CHECK HARNESS AND CONNECTOR (VSV - EFI NO. 2 FUSE)

a. Disconnect the VSV connector.

b. Remove the EFI No. 2 fuse from the engine room relay block.

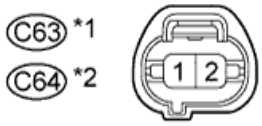
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

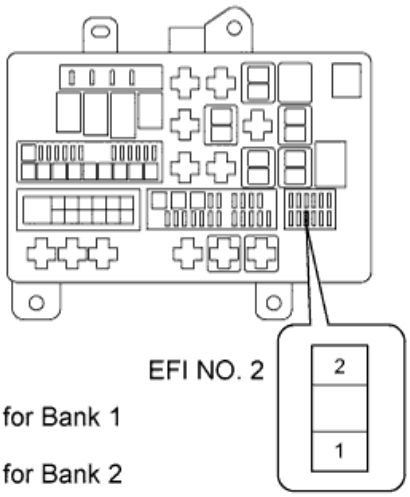
Tester Connection	Condition	Specified Condition

C63-1 - EFI No. 2 fuse terminal 2	Always	Below 1 Ω
C64-1 - EFI No. 2 fuse terminal 2	Always	Below 1 Ω
C63-1 or EFI No. 2 fuse terminal 2 - Body ground	Always	10 kΩ or higher
C64-1 or EFI No. 2 fuse terminal 2 - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to VSV for Air Switching Valve)



Engine Room Relay Block:



*1: for Bank 1

*2: for Bank 2

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

DTC P0120 Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0220 Throttle / Pedal Position Sensor / Switch "B" Circuit

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

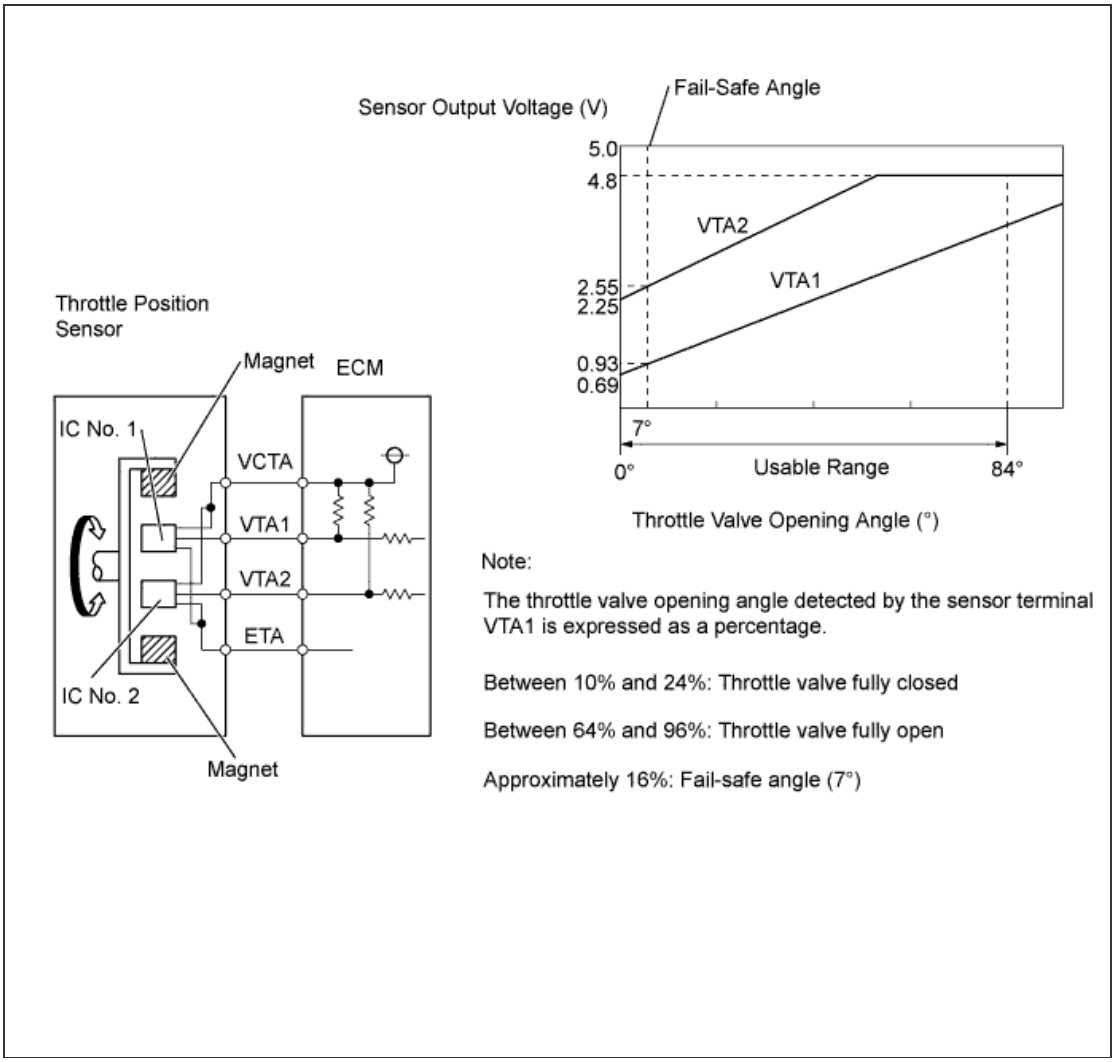
DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

DTC P2135 Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

for Preparation Click here

DESCRIPTION

The TP sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.
The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air-fuel ratio correction, power increase correction and fuel-cut control.



DTC Code	DTC Detection Condition	Trouble Area
P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• Throttle Position (TP) sensor (built into throttle body) • ECM

P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.535 V or higher for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher, and VTA1 is between 0.2 V and 2.02 V for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) is met (1 trip detection logic): (a) The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:

- **When any of these DTCs are output, check the throttle valve opening angle by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No. 1 and Throttle Position No. 2.**
- **Throttle Position No. 1 is the VTA1 signal, and Throttle Position No. 2 is the VTA2 signal.**

Reference (Normal Condition):

Tester Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No. 1	0.5 to 1.1 V	3.3 to 4.9 V
Throttle Position No. 2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

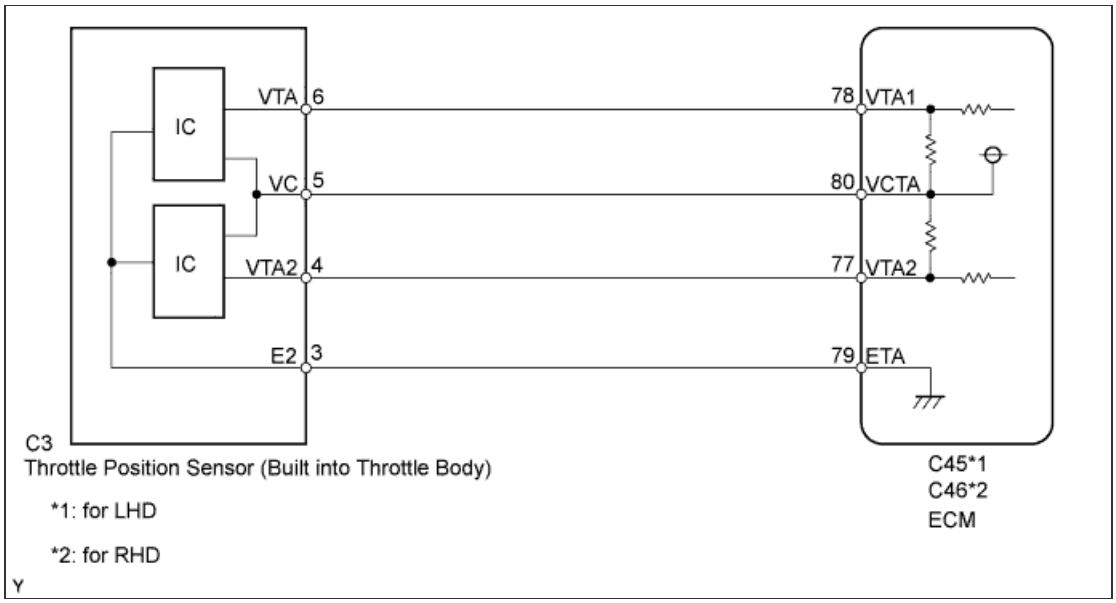
- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then ad usts the engine output by controlling the fuel in ection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION)

a. Connect the intelligent tester to the D C3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain Engine and ECT Data ist ETCS Throttle Position No.1 and Throttle Position No.2.

d. Check the values displayed on the tester.

Result

TP 1 (VTA1) When Accelerator Pedal Released	TP 2 (VTA2) When Accelerator Pedal Released	TP 1 (VTA1) When Accelerator Pedal Depressed	TP 2 (VTA2) When Accelerator Pedal Depressed	Trouble Area	Proceed to
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	A
0 to 0.2 V, or 4.5 to 5.0 V	2.4 to 3.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.4 to 3.4 V (Fail-safe)	VTA1 circuit open or ground short	A
0.7 to 1.3 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.7 to 1.3 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	A
0.5 to 1.1 V	2.1 to 3.1 V	3.3 to 4.9 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

TP 1 stands for Throttle Position No. 1, and TP 2 stands for Throttle Position No. 2.

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the throttle body connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

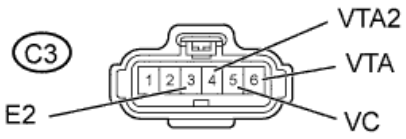
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C45-80 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C45-78 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C45-77 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C45-79 (ETA)	Always	Below 1 Ω
C3-5 (VC) or C45-80 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C45-78 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C45-77 (VTA2) - Body ground	Always	10 kΩ or higher

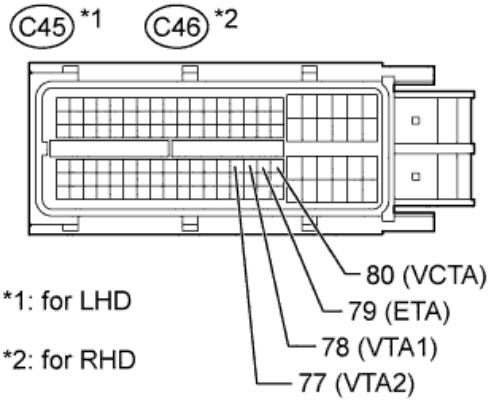
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C46-80 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C46-78 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C46-77 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C46-79 (ETA)	Always	Below 1 Ω
C3-5 (VC) or C46-80 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C46-78 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C46-77 (VTA2) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Throttle Body)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT ECM (VC VOLTAGE)

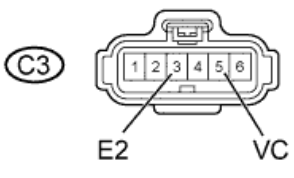
a. Disconnect the throttle body connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C3-5 (VC) - C3-3 (E2)	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to Throttle Body)



Y

NG → REPLACE ECM (Click here)

OK

4.REPLACE THROTTLE BODY ASSEMBLY

a. Replace the throttle body assembly (Click here).

NE T

5.CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

a. Connect the intelligent tester to the D C3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds or more.

f. Enter the following menus: Powertrain Engine and ECT DTC.

g. Read DTCs.

Result

Result	Proceed to
P0120, P0122, P0123, P0220, P0222, P0223 and or P2135 is output	A
No DTC is output	B

B → SYSTEM OK

A

REPLACE ECM (**Click here**)

DTC P1441 Stuck Open in Secondary Air Injection Vacuum Switching Valve Bank 1

DTC P1444 Stuck Open in Secondary Air Injection Vacuum Switching Valve Bank 2

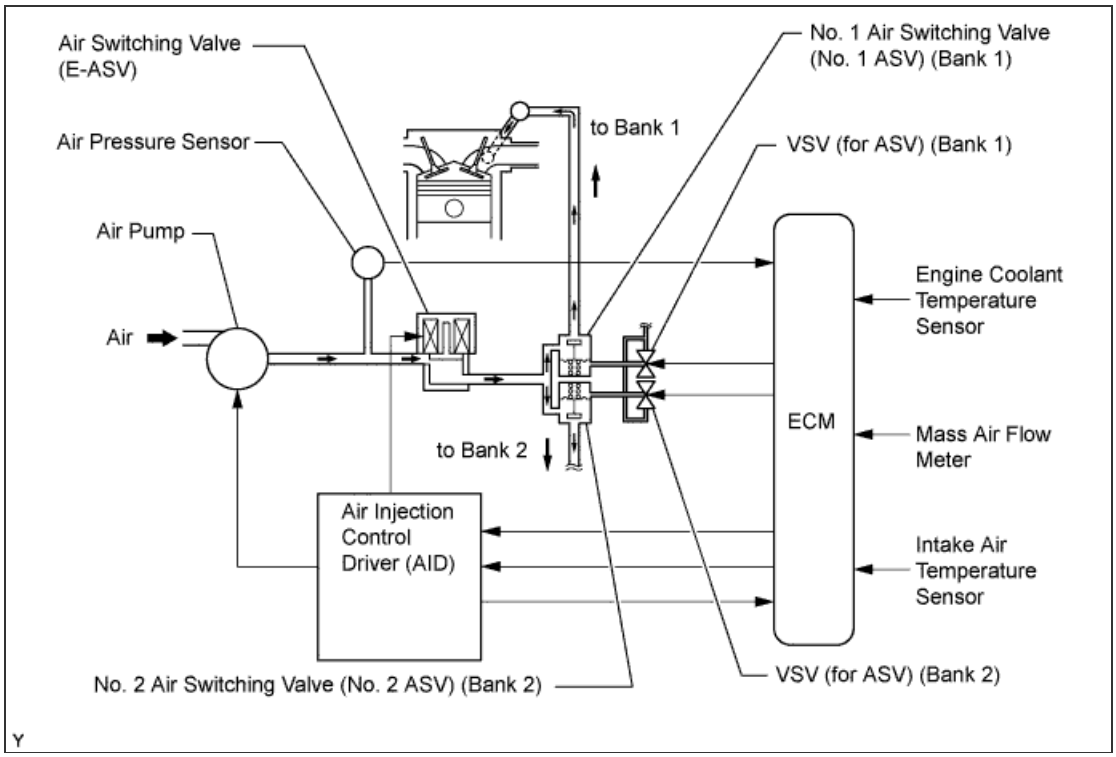
DTC P2440 Secondary Air Injection System Switching Valve Stuck Open Bank1

for Preparation Click here

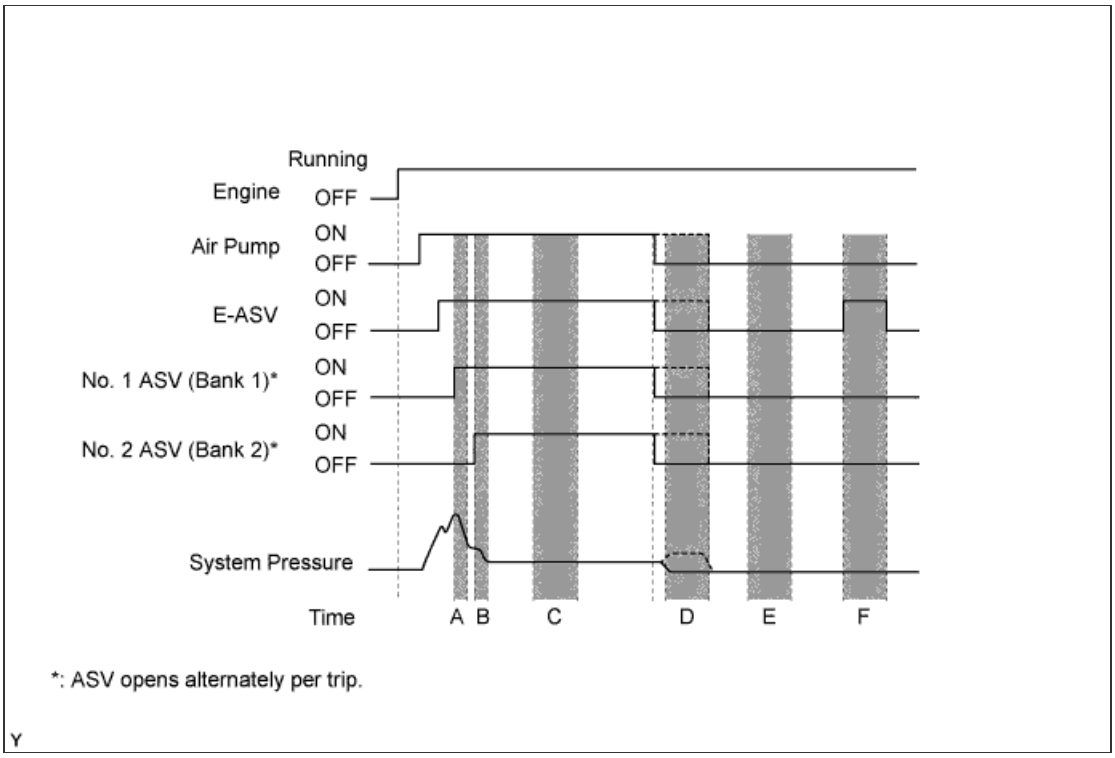
DESCRIPTION

The diagnostic trouble code (DTC) indicates that the electric air switching valve (E-ASV) and air switching valves (ASVs) of the secondary air injection (AIR) system are stuck open. The engine control module (ECM) operates entire components of this system in a sequence, and monitors the system pressure and exhaust pulse (AIR monitor). This monitor will run just after a cold engine start. If abnormal pressure and exhaust pulse are detected, the ECM interprets this as a malfunction. When the malfunction is detected in consecutive driving cycles, the ECM illuminates the malfunction indicator lamp (MIL), and stores a DTC.

The secondary air injection (AIR) system introduces fresh air into the exhaust manifold in order to reduce carbon monoxide (CO) and hydrocarbon (HC) in the exhaust emission. This system is activated just after engine start, and is stopped when the catalyst converter is warmed-up. This system consists of the following components: 1) the air pump which sends fresh air to the exhaust manifold, 2) the electric air switching valve (E-ASV) which switches the fresh air flow, 3) the air switching valve (ASV) which switches the air passage to the exhaust manifold of each bank, 4) the vacuum switching valve (VSV) which switches the vacuum (intake manifold pressure) to operate the ASV, 5) the pressure sensor which detects the fresh air pressure and exhaust pulse, 6) the air injection control driver which controls the power sources of the air pump and E-ASV, 7) the engine control module (ECM) which controls and monitors this system.



Reference 1: Operation of each component during AIR monitor



Y

Reference 2: DTC Storing Conditions

Time A [Pressure Change]	Time B [Pressure Change]	Time C [See Chart Below]	Time D [Exhaust Pulse]	Time E [Exhaust Pulse]	Time F [See Chart Below]	DTC
Yes	Yes	Pattern 1	-	No	Pattern 4	Normal
Yes	No	Pattern 1	Yes	No	Pattern 4	
Yes	Yes	Pattern 1	-	No	Pattern 1	P1441 P1444 P2444
No	Yes	Pattern 1	-	No	Pattern 1	
Yes	No	Pattern 1	Yes	No	Pattern 1	
No	No	Pattern 1	Yes	No	Pattern 1	
Yes	Yes	Pattern 1	-	No	Pattern 2	P1441 P1444
No	Yes	Pattern 1	-	No	Pattern 2	
Yes	No	Pattern 1	Yes	No	Pattern 2	
No	No	Pattern 1	Yes	No	Pattern 2	
-	-	-	-	Yes	-	P1441 P1444 P2444

Reference 3: System Pressure and Exhaust Pulse

Pattern	System Pressure	Exhaust Pulse
1	High	Yes
2	Low	Yes
3	High	No
4	Low	No

DTC Code

DTC Code	DTC Detection Condition	Trouble Area
P1441	The ASV (bank 1) is stuck open (2 trip detection logic).	• ASV (bank 1) • VSV (bank 1)
P1444	The ASV (bank 2) is stuck open (2 trip detection logic).	• ASV (bank 2) • VSV (bank 2)
P2440	The E-ASV is stuck open (2 trip detection logic).	• E-ASV • ASV (bank 1 and/or bank 2) • VSV (bank 1 and/or bank 2)

WIRING DIAGRAM

Refer to DTC P0412 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.PERFORM SECONDARY AIR INJECTION SYSTEM CHECK (AUTOMATIC MODE)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Record the DTCs and freeze frame data.

d. Clear the DTCs (Click here).

e. Warm-up the engine.

f. Enter the following menus: Powertrain / Engine and ECT / Utility / Secondary Air Injection Check (Automatic Mode).

g. Perform the Active Test and check the pending DTC.

Result

Result	Proceed to
P1441 and/or P1444 is output	A
P2440, P1441 and/or P1444 is output	B
DTCs other than P1441, P1444 and P2440 are output	C
No DTC is output	D

HINT:

If any DTCs other than P1441, P1444 or P2440 are output, troubleshoot those DTCs first.

B → Go to step 3

C → GO TO DTC CHART (Click here)

D → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

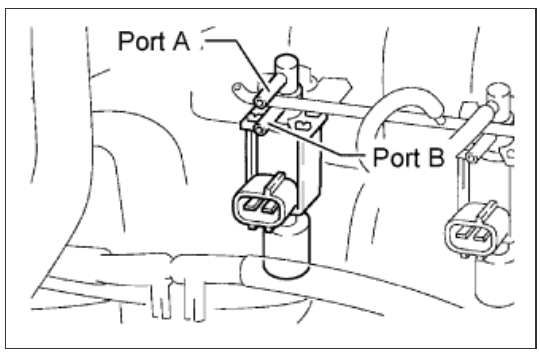
2.CHECK VACUUM SWITCHING VALVE

a. Disconnect the vacuum hoses connected to the Vacuum Switching Valve (VSV).

b. Connect the vacuum pump to port A shown in the illustration.

c. Operate the pump and check that there is no vacuum from the other port.

OK:
No vacuum.



NG → REPLACE VACUUM SWITCHING VALVE (Click here)

OK

REPLACE AIR SWITCHING VALVE (NO. 1 or NO. 2) (Click here)

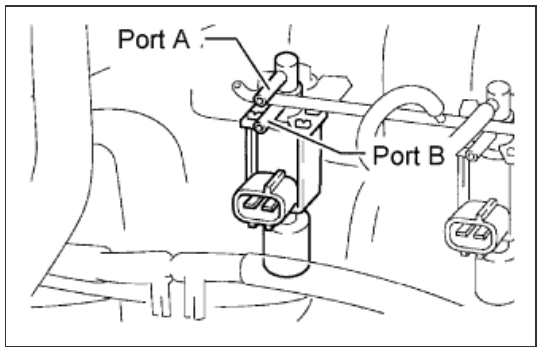
3.CHECK VACUUM SWITCHING VALVE

a. Disconnect the vacuum hoses connected to the Vacuum Switching Valve (VSV).

b. Connect the vacuum pump to port A shown in the illustration.

c. Operate the pump and check that there is no vacuum from the other port.

OK:
No vacuum.



NG → REPLACE VACUUM SWITCHING VALVE (Click here)

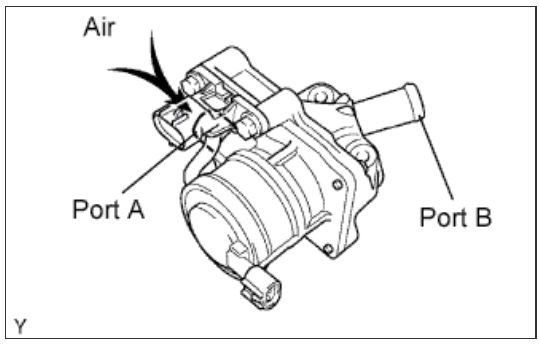
OK

4.CHECK AIR SWITCHING VALVE (OPERATION)

a. Remove the intake manifold (Click here).

b. Remove the Air Switching Valve (ASV).

c. Blow air into port A and check that air is not discharged from port B.

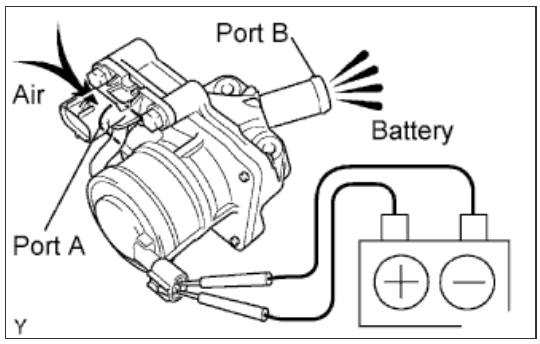


d. Apply battery positive voltage across the terminals.

e. Blow air into port A and check that air is discharged from port B.

OK:

Tester Connection	Condition	Specified Condition
port A - port B	Always	Not discharged
port A - port B	Battery positive voltage applied	Discharged



NG → REPLACE AIR SWITCHING VALVE ASSEMBLY (Click here)

OK

REPLACE AIR SWITCHING VALVE (NO. 1 or NO. 2) (Click here)

DTC P0120 Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0220 Throttle / Pedal Position Sensor / Switch "B" Circuit

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

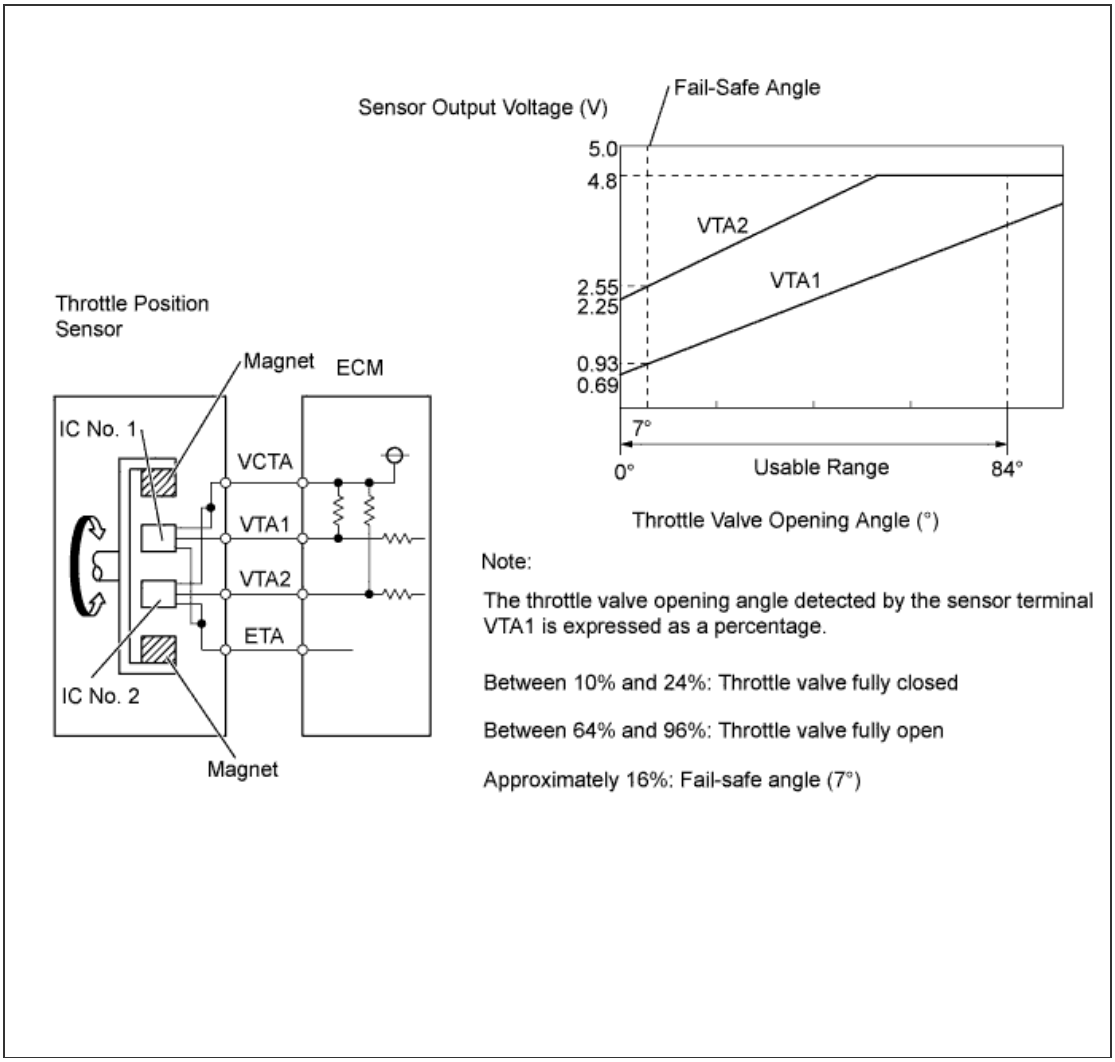
DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

DTC P2135 Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

for Preparation Click here

DESCRIPTION

The TP sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.
The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air-fuel ratio correction, power increase correction and fuel-cut control.



DTC Code	DTC Detection Condition	Trouble Area
P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• Throttle Position (TP) sensor (built into throttle body) • ECM

P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.535 V or higher for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher, and VTA1 is between 0.2 V and 2.02 V for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) is met (1 trip detection logic): (a) The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:

- **When any of these DTCs are output, check the throttle valve opening angle by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No. 1 and Throttle Position No. 2.**
- **Throttle Position No. 1 is the VTA1 signal, and Throttle Position No. 2 is the VTA2 signal.**

Reference (Normal Condition):

Tester Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No. 1	0.5 to 1.1 V	3.3 to 4.9 V
Throttle Position No. 2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

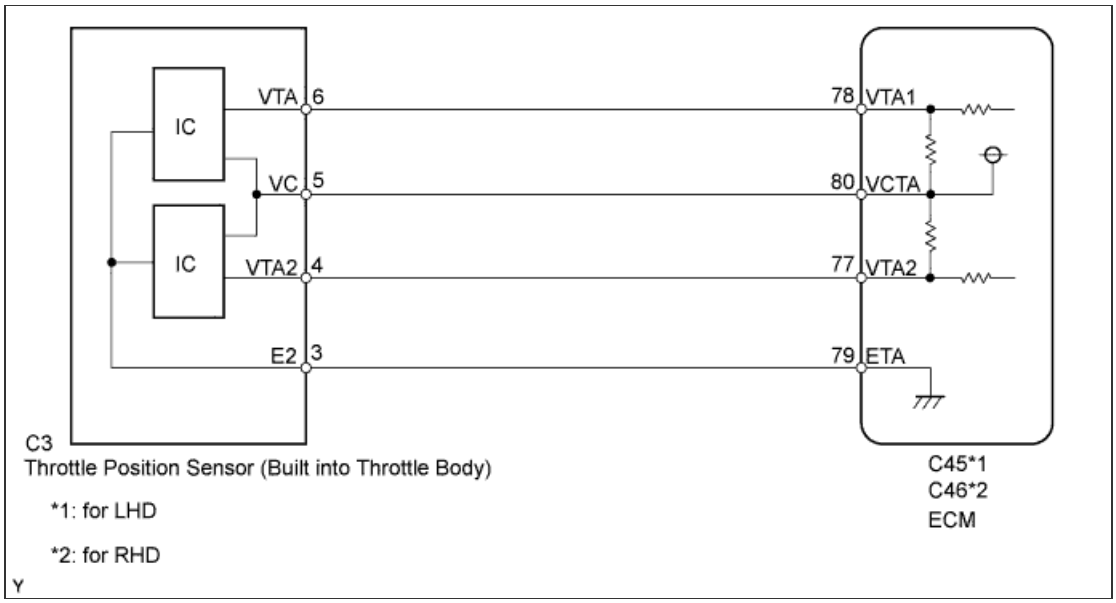
- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then ad usts the engine output by controlling the fuel in ection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION)

a. Connect the intelligent tester to the D C3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data ist / ETCS / Throttle Position No.1 and Throttle Position No.2.

d. Check the values displayed on the tester.

Result

TP 1 (VTA1) When Accelerator Pedal Released	TP 2 (VTA2) When Accelerator Pedal Released	TP 1 (VTA1) When Accelerator Pedal Depressed	TP 2 (VTA2) When Accelerator Pedal Depressed	Trouble Area	Proceed to
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	A
0 to 0.2 V, or 4.5 to 5.0 V	2.4 to 3.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.4 to 3.4 V (Fail-safe)	VTA1 circuit open or ground short	A
0.7 to 1.3 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.7 to 1.3 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	A
0.5 to 1.1 V	2.1 to 3.1 V	3.3 to 4.9 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

TP 1 stands for Throttle Position No. 1, and TP 2 stands for Throttle Position No. 2.

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the throttle body connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

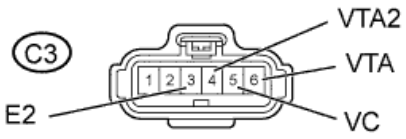
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C45-80 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C45-78 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C45-77 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C45-79 (ETA)	Always	Below 1 Ω
C3-5 (VC) or C45-80 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C45-78 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C45-77 (VTA2) - Body ground	Always	10 kΩ or higher

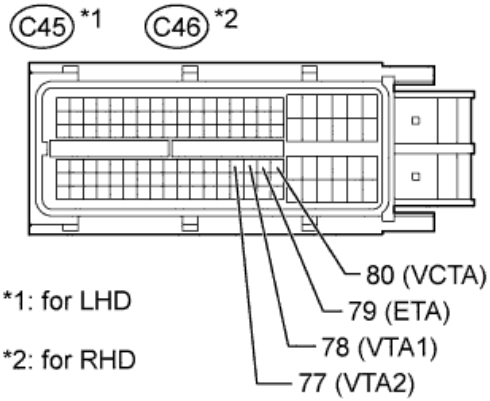
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C46-80 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C46-78 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C46-77 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C46-79 (ETA)	Always	Below 1 Ω
C3-5 (VC) or C46-80 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C46-78 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C46-77 (VTA2) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Throttle Body)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT ECM (VC VOLTAGE)

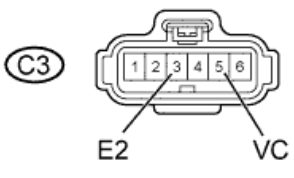
a. Disconnect the throttle body connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C3-5 (VC) - C3-3 (E2)	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to Throttle Body)



Y

NG → REPLACE ECM (Click here)

OK

4.REPLACE THROTTLE BODY ASSEMBLY

a. Replace the throttle body assembly (Click here).

NE T

5.CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

a. Connect the intelligent tester to the D C3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
P0120, P0122, P0123, P0220, P0222, P0223 and/or P2135 is output	A
No DTC is output	B

B → SYSTEM OK

A → REPLACE ECM (**Click here**)

DTC P1441 Stuck Open in Secondary Air Injection Vacuum Switching Valve Bank 1

DTC P1444 Stuck Open in Secondary Air Injection Vacuum Switching Valve Bank 2

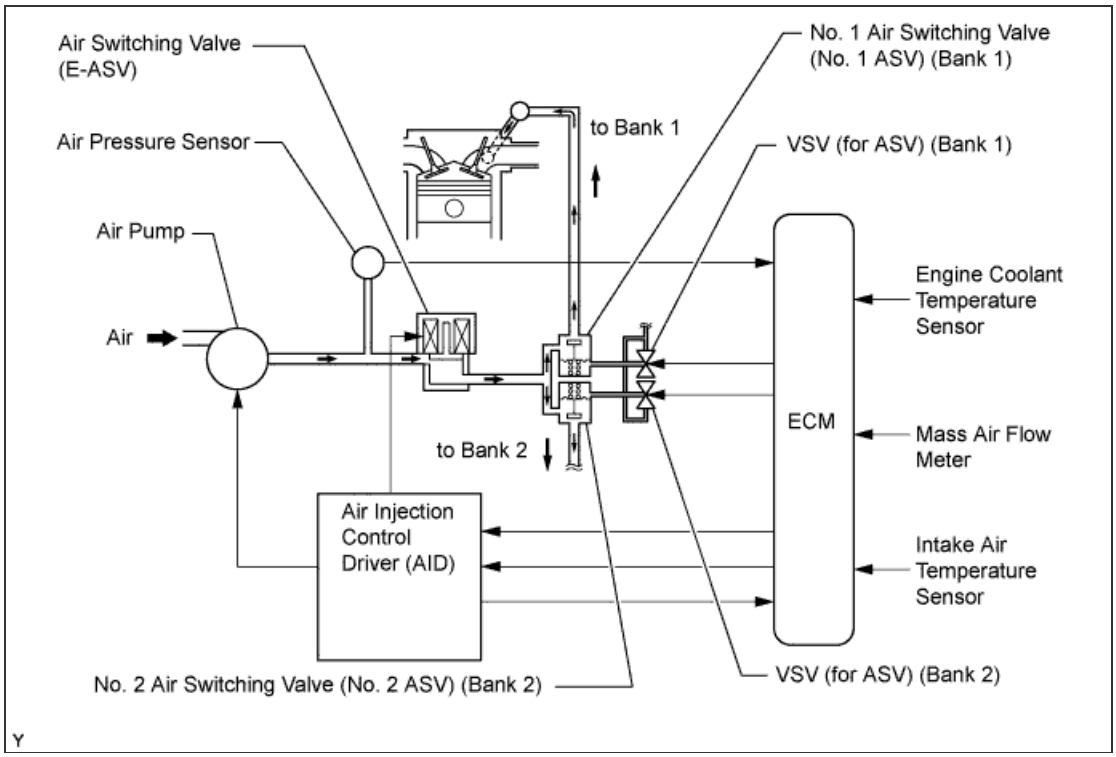
DTC P2440 Secondary Air Injection System Switching Valve Stuck Open Bank1

for Preparation Click here

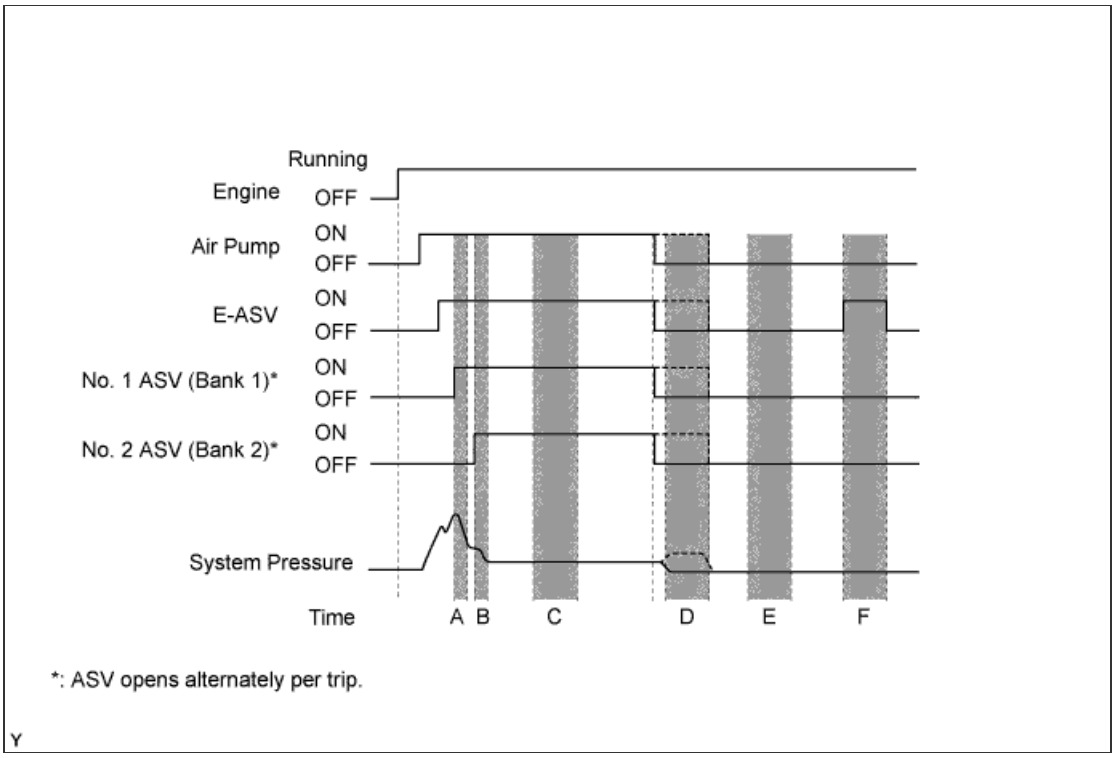
DESCRIPTION

The diagnostic trouble code (DTC) indicates that the electric air switching valve (E-ASV) and air switching valves (ASVs) of the secondary air injection (AIR) system are stuck open. The engine control module (ECM) operates entire components of this system in a sequence, and monitors the system pressure and exhaust pulse (AIR monitor). This monitor will run just after a cold engine start. If abnormal pressure and exhaust pulse are detected, the ECM interprets this as a malfunction. When the malfunction is detected in consecutive driving cycles, the ECM illuminates the malfunction indicator lamp (MIL), and stores a DTC.

The secondary air injection (AIR) system introduces fresh air into the exhaust manifold in order to reduce carbon monoxide (CO) and hydrocarbon (HC) in the exhaust emission. This system is activated just after engine start, and is stopped when the catalyst converter is warmed-up. This system consists of the following components: 1) the air pump which sends fresh air to the exhaust manifold, 2) the electric air switching valve (E-ASV) which switches the fresh air flow, 3) the air switching valve (ASV) which switches the air passage to the exhaust manifold of each bank, 4) the vacuum switching valve (VSV) which switches the vacuum (intake manifold pressure) to operate the ASV, 5) the pressure sensor which detects the fresh air pressure and exhaust pulse, 6) the air injection control driver which controls the power sources of the air pump and E-ASV, 7) the engine control module (ECM) which controls and monitors this system.



Reference 1: Operation of each component during AIR monitor



Y

Reference 2: DTC Storing Conditions

Time A [Pressure Change]	Time B [Pressure Change]	Time C [See Chart Below]	Time D [Exhaust Pulse]	Time E [Exhaust Pulse]	Time F [See Chart Below]	DTC
Yes	Yes	Pattern 1	-	No	Pattern 4	Normal
Yes	No	Pattern 1	Yes	No	Pattern 4	
Yes	Yes	Pattern 1	-	No	Pattern 1	P1441 P1444 P2444
No	Yes	Pattern 1	-	No	Pattern 1	
Yes	No	Pattern 1	Yes	No	Pattern 1	
No	No	Pattern 1	Yes	No	Pattern 1	
Yes	Yes	Pattern 1	-	No	Pattern 2	P1441 P1444
No	Yes	Pattern 1	-	No	Pattern 2	
Yes	No	Pattern 1	Yes	No	Pattern 2	
No	No	Pattern 1	Yes	No	Pattern 2	
-	-	-	-	Yes	-	P1441 P1444 P2444

Reference 3: System Pressure and Exhaust Pulse

Pattern	System Pressure	Exhaust Pulse
1	High	Yes
2	Low	Yes
3	High	No
4	Low	No

DTC Code

DTC Code	DTC Detection Condition	Trouble Area
P1441	The ASV (bank 1) is stuck open (2 trip detection logic).	• ASV (bank 1) • VSV (bank 1)
P1444	The ASV (bank 2) is stuck open (2 trip detection logic).	• ASV (bank 2) • VSV (bank 2)
P2440	The E-ASV is stuck open (2 trip detection logic).	• E-ASV • ASV (bank 1 and/or bank 2) • VSV (bank 1 and/or bank 2)

WIRING DIAGRAM

Refer to DTC P0412 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.PERFORM SECONDARY AIR INJECTION SYSTEM CHECK (AUTOMATIC MODE)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Record the DTCs and freeze frame data.

d. Clear the DTCs (Click here).

e. Warm-up the engine.

f. Enter the following menus: Powertrain / Engine and ECT / Utility / Secondary Air Injection Check (Automatic Mode).

g. Perform the Active Test and check the pending DTC.

Result

Result	Proceed to
P1441 and/or P1444 is output	A
P2440, P1441 and/or P1444 is output	B
DTCs other than P1441, P1444 and P2440 are output	C
No DTC is output	D

HINT:

If any DTCs other than P1441, P1444 or P2440 are output, troubleshoot those DTCs first.

B → Go to step 3

C → GO TO DTC CHART (Click here)

D → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

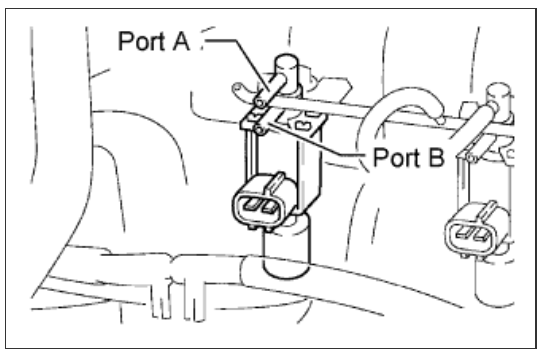
2.CHECK VACUUM SWITCHING VALVE

a. Disconnect the vacuum hoses connected to the Vacuum Switching Valve (VSV).

b. Connect the vacuum pump to port A shown in the illustration.

c. Operate the pump and check that there is no vacuum from the other port.

OK:
No vacuum.



NG → REPLACE VACUUM SWITCHING VALVE (Click here)

OK

REPLACE AIR SWITCHING VALVE (NO. 1 or NO. 2) (Click here)

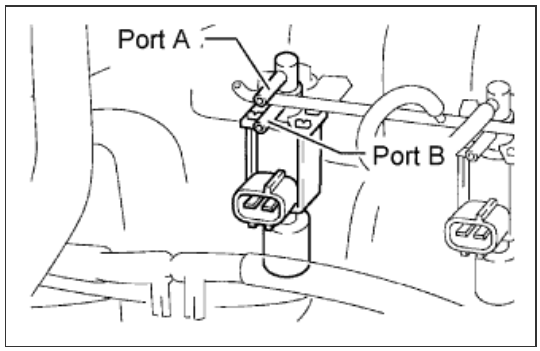
3.CHECK VACUUM SWITCHING VALVE

a. Disconnect the vacuum hoses connected to the Vacuum Switching Valve (VSV).

b. Connect the vacuum pump to port A shown in the illustration.

c. Operate the pump and check that there is no vacuum from the other port.

OK:
No vacuum.



NG → REPLACE VACUUM SWITCHING VALVE (Click here)

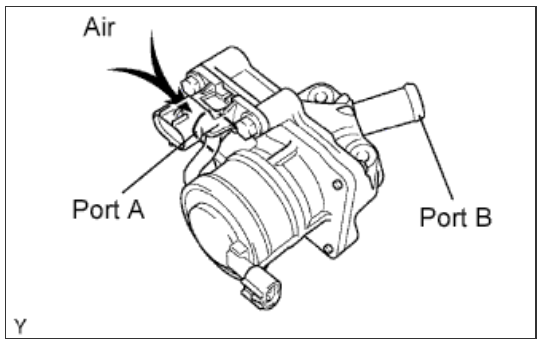
OK

4.CHECK AIR SWITCHING VALVE (OPERATION)

a. Remove the intake manifold (Click here).

b. Remove the Air Switching Valve (ASV).

c. Blow air into port A and check that air is not discharged from port B.

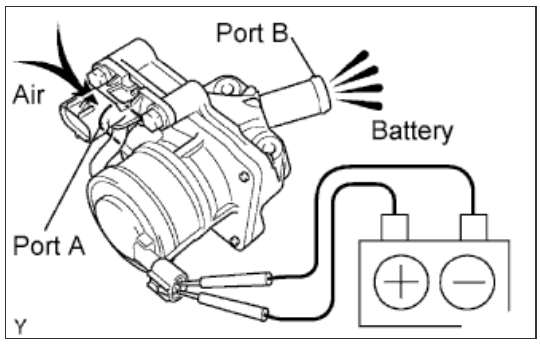


d. Apply battery positive voltage across the terminals.

e. Blow air into port A and check that air is discharged from port B.

OK:

Tester Connection	Condition	Specified Condition
port A - port B	Always	Not discharged
port A - port B	Battery positive voltage applied	Discharged



NG → REPLACE AIR SWITCHING VALVE ASSEMBLY (Click here)

OK

REPLACE AIR SWITCHING VALVE (NO. 1 or NO. 2) (Click here)

DTC P0120 Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0220 Throttle / Pedal Position Sensor / Switch "B" Circuit

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

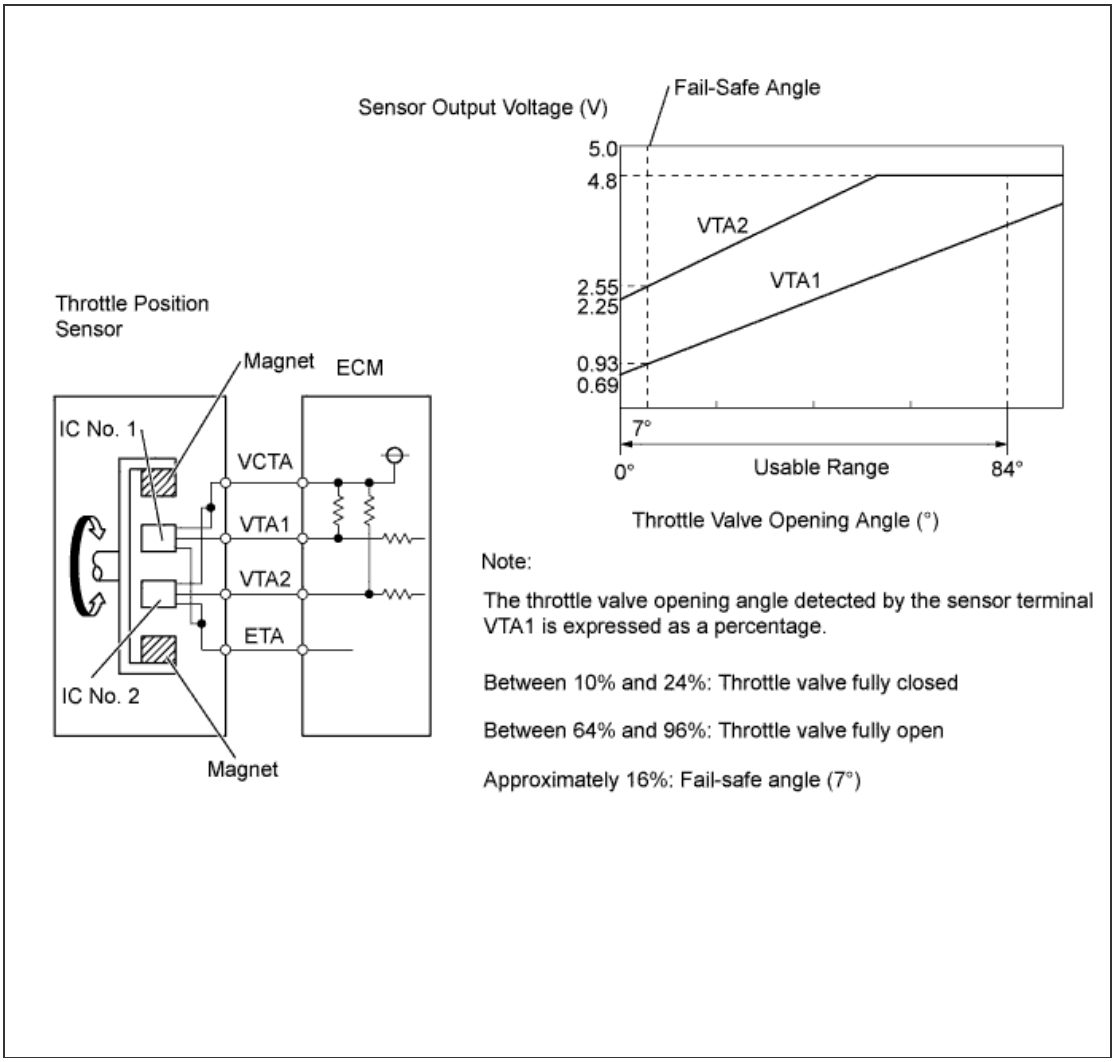
DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

DTC P2135 Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

for Preparation Click here

DESCRIPTION

The TP sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.
The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air-fuel ratio correction, power increase correction and fuel-cut control.



DTC Code	DTC Detection Condition	Trouble Area
P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• Throttle Position (TP) sensor (built into throttle body) • ECM

P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.535 V or higher for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher, and VTA1 is between 0.2 V and 2.02 V for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) is met (1 trip detection logic): (a) The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:

- **When any of these DTCs are output, check the throttle valve opening angle by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No. 1 and Throttle Position No. 2.**
- **Throttle Position No. 1 is the VTA1 signal, and Throttle Position No. 2 is the VTA2 signal.**

Reference (Normal Condition):

Tester Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No. 1	0.5 to 1.1 V	3.3 to 4.9 V
Throttle Position No. 2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

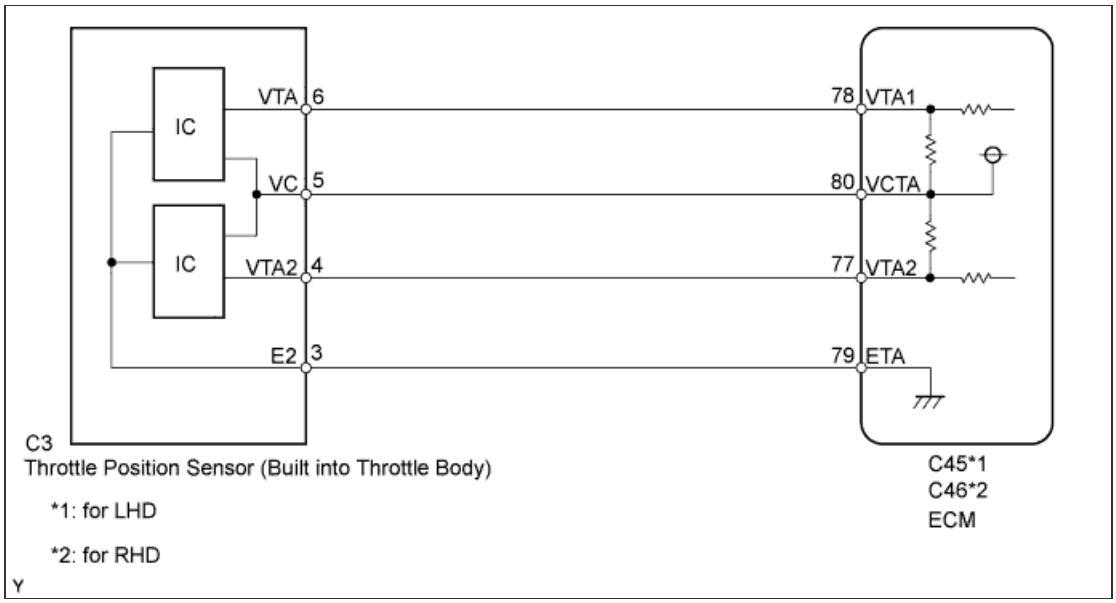
- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then ad usts the engine output by controlling the fuel in ection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION)

a. Connect the intelligent tester to the D C3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data ist / ETCS / Throttle Position No.1 and Throttle Position No.2.

d. Check the values displayed on the tester.

Result

TP 1 (VTA1) When Accelerator Pedal Released	TP 2 (VTA2) When Accelerator Pedal Released	TP 1 (VTA1) When Accelerator Pedal Depressed	TP 2 (VTA2) When Accelerator Pedal Depressed	Trouble Area	Proceed to
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	A
0 to 0.2 V, or 4.5 to 5.0 V	2.4 to 3.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.4 to 3.4 V (Fail-safe)	VTA1 circuit open or ground short	A
0.7 to 1.3 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.7 to 1.3 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	A
0.5 to 1.1 V	2.1 to 3.1 V	3.3 to 4.9 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

TP 1 stands for Throttle Position No. 1, and TP 2 stands for Throttle Position No. 2.

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the throttle body connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

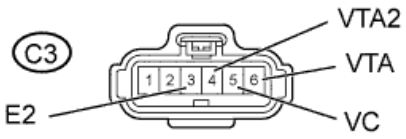
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C45-80 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C45-78 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C45-77 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C45-79 (ETA)	Always	Below 1 Ω
C3-5 (VC) or C45-80 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C45-78 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C45-77 (VTA2) - Body ground	Always	10 kΩ or higher

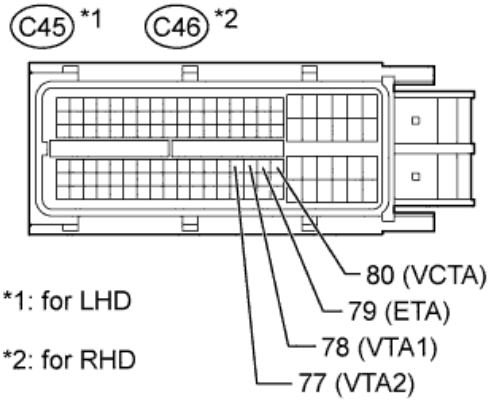
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C46-80 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C46-78 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C46-77 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C46-79 (ETA)	Always	Below 1 Ω
C3-5 (VC) or C46-80 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C46-78 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C46-77 (VTA2) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Throttle Body)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT ECM (VC VOLTAGE)

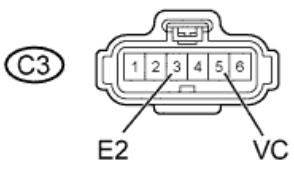
a. Disconnect the throttle body connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C3-5 (VC) - C3-3 (E2)	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to Throttle Body)



Y

NG → REPLACE ECM (Click here)

OK

4.REPLACE THROTTLE BODY ASSEMBLY

a. Replace the throttle body assembly (Click here).

NE T

5.CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

a. Connect the intelligent tester to the D C3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
P0120, P0122, P0123, P0220, P0222, P0223 and/or P2135 is output	A
No DTC is output	B

B → SYSTEM OK

A → REPLACE ECM (**Click here**)

DTC P1441 Stuck Open in Secondary Air Injection Vacuum Switching Valve Bank 1

DTC P1444 Stuck Open in Secondary Air Injection Vacuum Switching Valve Bank 2

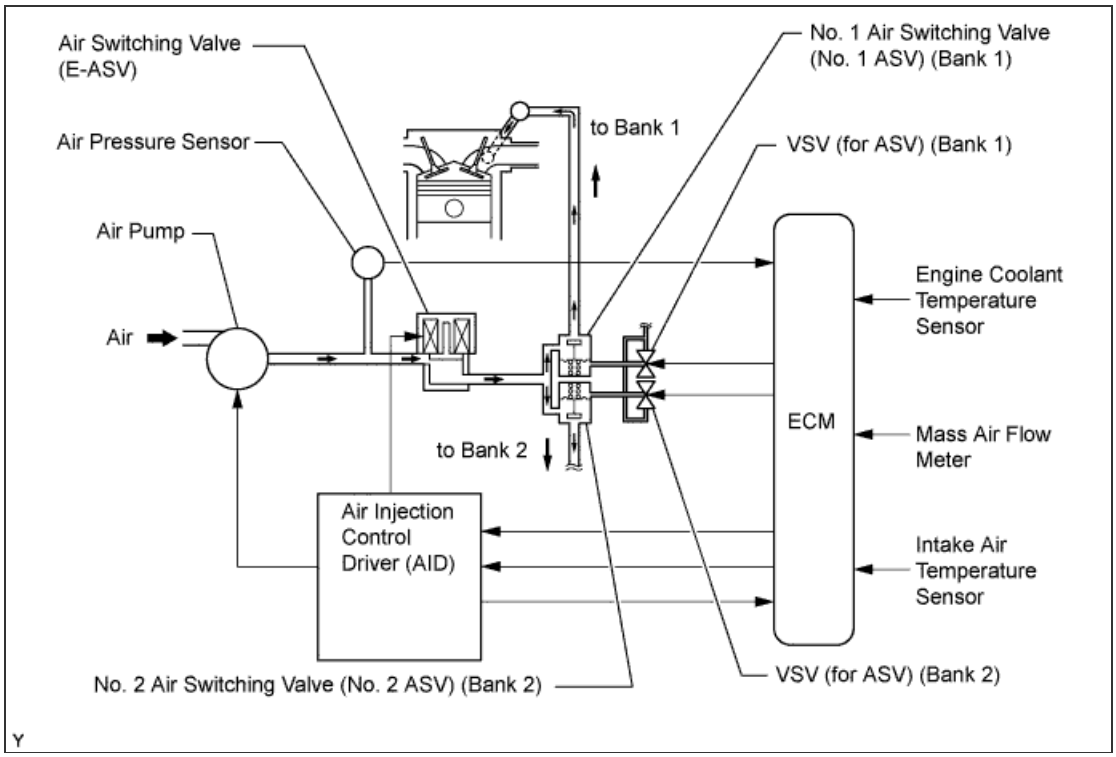
DTC P2440 Secondary Air Injection System Switching Valve Stuck Open Bank1

for Preparation Click here

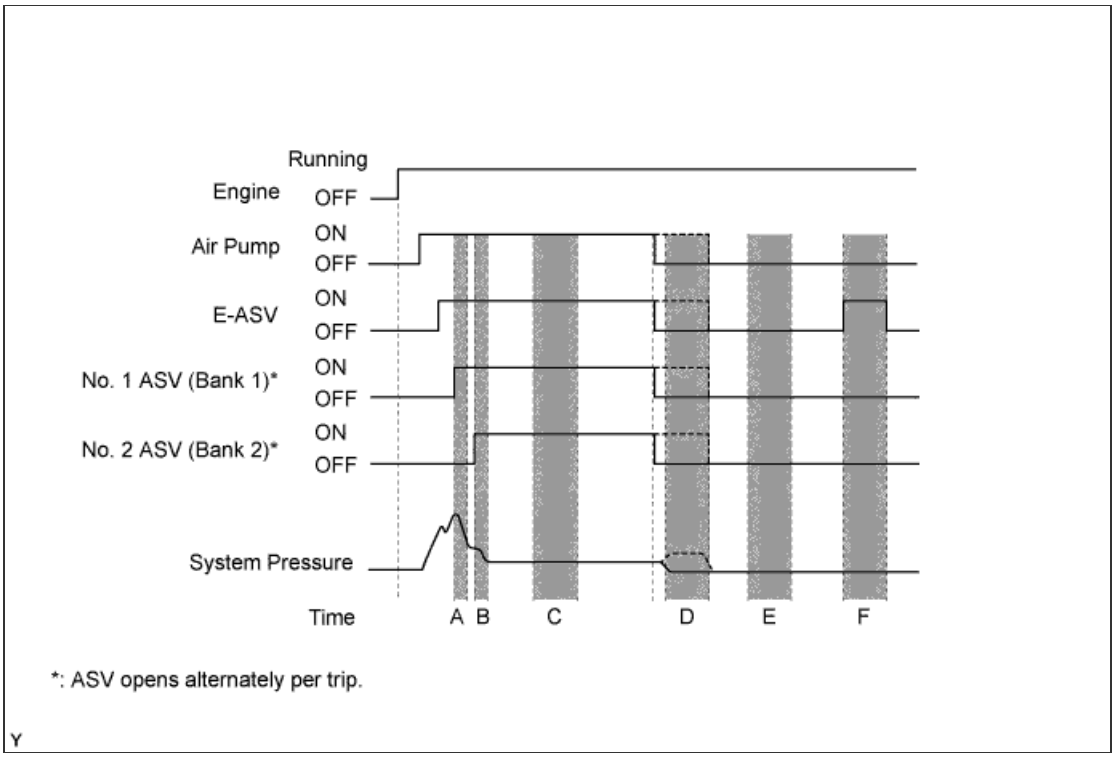
DESCRIPTION

The diagnostic trouble code (DTC) indicates that the electric air switching valve (E-ASV) and air switching valves (ASVs) of the secondary air injection (AIR) system are stuck open. The engine control module (ECM) operates entire components of this system in a sequence, and monitors the system pressure and exhaust pulse (AIR monitor). This monitor will run just after a cold engine start. If abnormal pressure and exhaust pulse are detected, the ECM interprets this as a malfunction. When the malfunction is detected in consecutive driving cycles, the ECM illuminates the malfunction indicator lamp (MIL), and stores a DTC.

The secondary air injection (AIR) system introduces fresh air into the exhaust manifold in order to reduce carbon monoxide (CO) and hydrocarbon (HC) in the exhaust emission. This system is activated just after engine start, and is stopped when the catalyst converter is warmed-up. This system consists of the following components: 1) the air pump which sends fresh air to the exhaust manifold, 2) the electric air switching valve (E-ASV) which switches the fresh air flow, 3) the air switching valve (ASV) which switches the air passage to the exhaust manifold of each bank, 4) the vacuum switching valve (VSV) which switches the vacuum (intake manifold pressure) to operate the ASV, 5) the pressure sensor which detects the fresh air pressure and exhaust pulse, 6) the air injection control driver which controls the power sources of the air pump and E-ASV, 7) the engine control module (ECM) which controls and monitors this system.



Reference 1: Operation of each component during AIR monitor



Y

Reference 2: DTC Storing Conditions

Time A [Pressure Change]	Time B [Pressure Change]	Time C [See Chart Below]	Time D [Exhaust Pulse]	Time E [Exhaust Pulse]	Time F [See Chart Below]	DTC
Yes	Yes	Pattern 1	-	No	Pattern 4	Normal
Yes	No	Pattern 1	Yes	No	Pattern 4	
Yes	Yes	Pattern 1	-	No	Pattern 1	P1441 P1444 P2444
No	Yes	Pattern 1	-	No	Pattern 1	
Yes	No	Pattern 1	Yes	No	Pattern 1	
No	No	Pattern 1	Yes	No	Pattern 1	
Yes	Yes	Pattern 1	-	No	Pattern 2	P1441 P1444
No	Yes	Pattern 1	-	No	Pattern 2	
Yes	No	Pattern 1	Yes	No	Pattern 2	
No	No	Pattern 1	Yes	No	Pattern 2	
-	-	-	-	Yes	-	P1441 P1444 P2444

Reference 3: System Pressure and Exhaust Pulse

Pattern	System Pressure	Exhaust Pulse
1	High	Yes
2	Low	Yes
3	High	No
4	Low	No

DTC Code

DTC Code	DTC Detection Condition	Trouble Area
P1441	The ASV (bank 1) is stuck open (2 trip detection logic).	• ASV (bank 1) • VSV (bank 1)
P1444	The ASV (bank 2) is stuck open (2 trip detection logic).	• ASV (bank 2) • VSV (bank 2)
P2440	The E-ASV is stuck open (2 trip detection logic).	• E-ASV • ASV (bank 1 and/or bank 2) • VSV (bank 1 and/or bank 2)

WIRING DIAGRAM

Refer to DTC P0412 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.PERFORM SECONDARY AIR INJECTION SYSTEM CHECK (AUTOMATIC MODE)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Record the DTCs and freeze frame data.

d. Clear the DTCs (Click here).

e. Warm-up the engine.

f. Enter the following menus: Powertrain / Engine and ECT / Utility / Secondary Air Injection Check (Automatic Mode).

g. Perform the Active Test and check the pending DTC.

Result

Result	Proceed to
P1441 and/or P1444 is output	A
P2440, P1441 and/or P1444 is output	B
DTCs other than P1441, P1444 and P2440 are output	C
No DTC is output	D

HINT:

If any DTCs other than P1441, P1444 or P2440 are output, troubleshoot those DTCs first.

B → Go to step 3

C → GO TO DTC CHART (Click here)

D → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

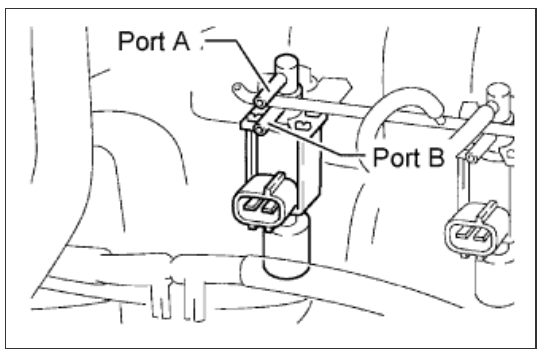
2.CHECK VACUUM SWITCHING VALVE

a. Disconnect the vacuum hoses connected to the Vacuum Switching Valve (VSV).

b. Connect the vacuum pump to port A shown in the illustration.

c. Operate the pump and check that there is no vacuum from the other port.

OK:
No vacuum.



NG → REPLACE VACUUM SWITCHING VALVE (Click here)

OK

REPLACE AIR SWITCHING VALVE (NO. 1 or NO. 2) (Click here)

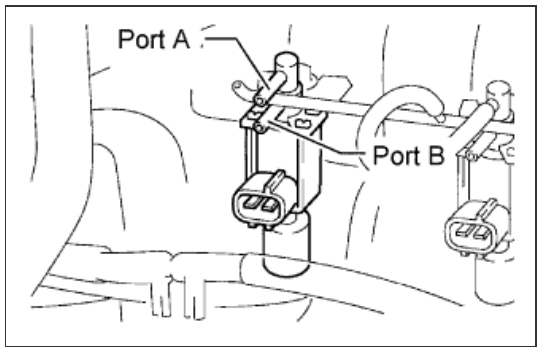
3.CHECK VACUUM SWITCHING VALVE

a. Disconnect the vacuum hoses connected to the Vacuum Switching Valve (VSV).

b. Connect the vacuum pump to port A shown in the illustration.

c. Operate the pump and check that there is no vacuum from the other port.

OK:
No vacuum.



NG → REPLACE VACUUM SWITCHING VALVE (Click here)

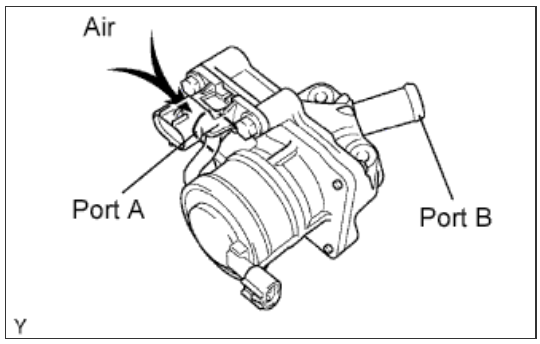
OK

4.CHECK AIR SWITCHING VALVE (OPERATION)

a. Remove the intake manifold (Click here).

b. Remove the Air Switching Valve (ASV).

c. Blow air into port A and check that air is not discharged from port B.

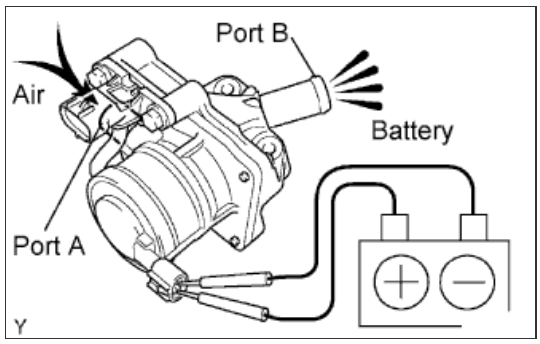


d. Apply battery positive voltage across the terminals.

e. Blow air into port A and check that air is discharged from port B.

OK:

Tester Connection	Condition	Specified Condition
port A - port B	Always	Not discharged
port A - port B	Battery positive voltage applied	Discharged



NG → REPLACE AIR SWITCHING VALVE ASSEMBLY (Click here)

OK

REPLACE AIR SWITCHING VALVE (NO. 1 or NO. 2) (Click here)

DTC P0120 Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0220 Throttle / Pedal Position Sensor / Switch "B" Circuit

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

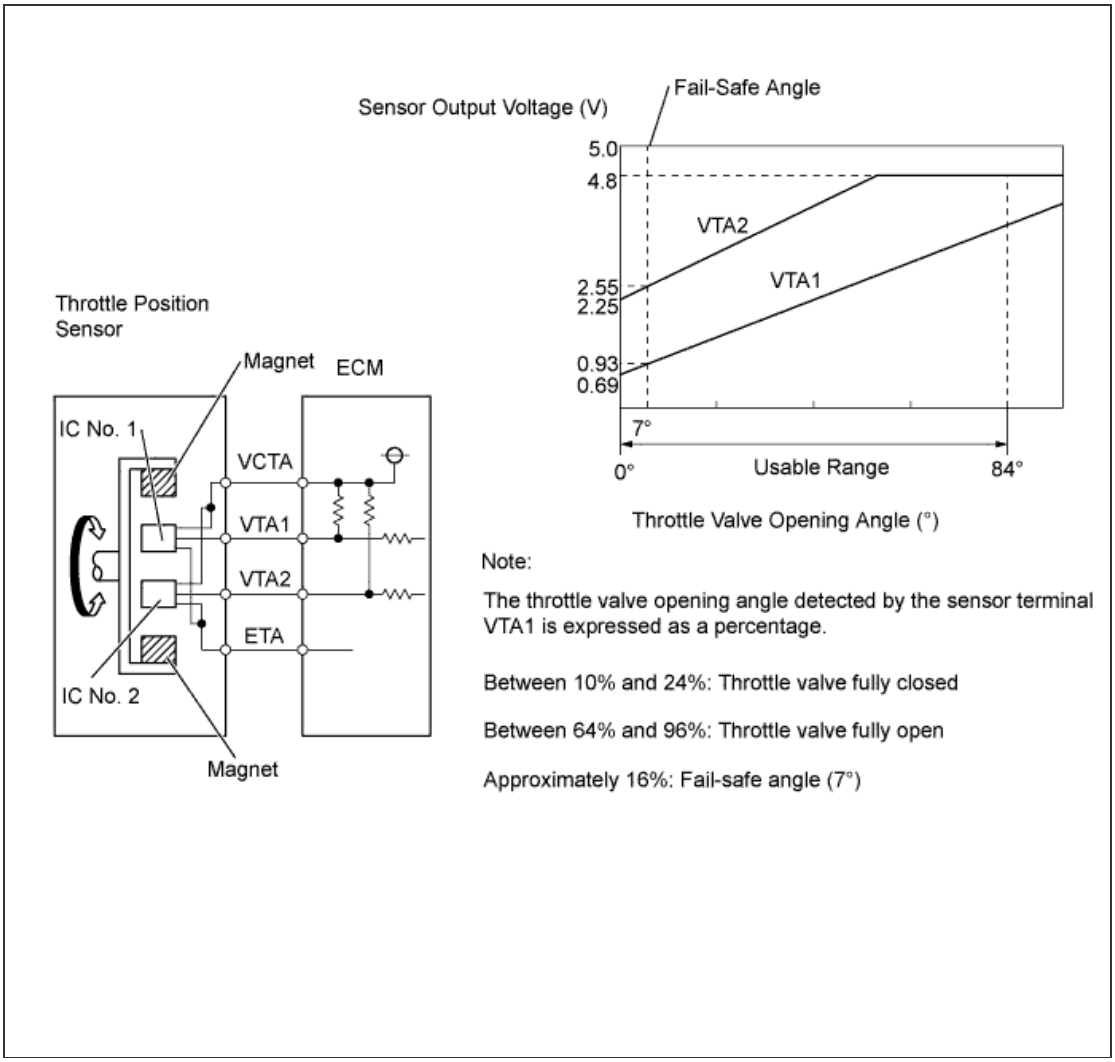
DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

DTC P2135 Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

for Preparation Click here

DESCRIPTION

The TP sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.
The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air-fuel ratio correction, power increase correction and fuel-cut control.



DTC Code	DTC Detection Condition	Trouble Area
P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• Throttle Position (TP) sensor (built into throttle body) • ECM

P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.535 V or higher for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher, and VTA1 is between 0.2 V and 2.02 V for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) is met (1 trip detection logic): (a) The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:

- **When any of these DTCs are output, check the throttle valve opening angle by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No. 1 and Throttle Position No. 2.**
- **Throttle Position No. 1 is the VTA1 signal, and Throttle Position No. 2 is the VTA2 signal.**

Reference (Normal Condition):

Tester Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No. 1	0.5 to 1.1 V	3.3 to 4.9 V
Throttle Position No. 2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

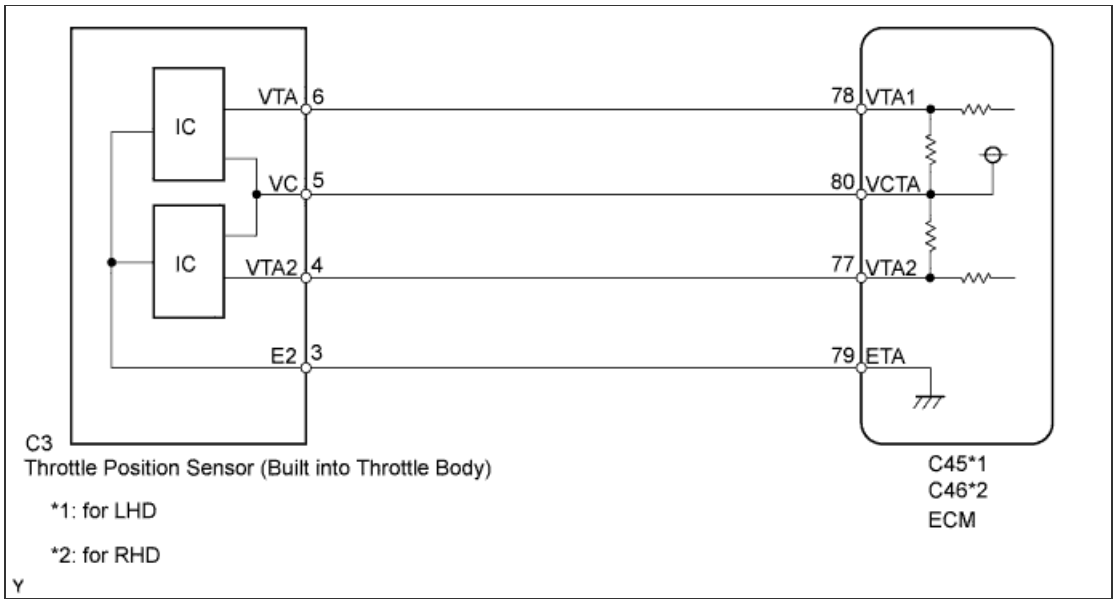
- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then ad usts the engine output by controlling the fuel in ection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION)

a. Connect the intelligent tester to the D C3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data ist / ETCS / Throttle Position No.1 and Throttle Position No.2.

d. Check the values displayed on the tester.

Result

TP 1 (VTA1) When Accelerator Pedal Released	TP 2 (VTA2) When Accelerator Pedal Released	TP 1 (VTA1) When Accelerator Pedal Depressed	TP 2 (VTA2) When Accelerator Pedal Depressed	Trouble Area	Proceed to
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	A
0 to 0.2 V, or 4.5 to 5.0 V	2.4 to 3.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.4 to 3.4 V (Fail-safe)	VTA1 circuit open or ground short	A
0.7 to 1.3 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.7 to 1.3 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	A
0.5 to 1.1 V	2.1 to 3.1 V	3.3 to 4.9 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

TP 1 stands for Throttle Position No. 1, and TP 2 stands for Throttle Position No. 2.

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the throttle body connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

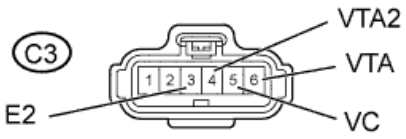
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C45-80 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C45-78 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C45-77 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C45-79 (ETA)	Always	Below 1 Ω
C3-5 (VC) or C45-80 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C45-78 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C45-77 (VTA2) - Body ground	Always	10 kΩ or higher

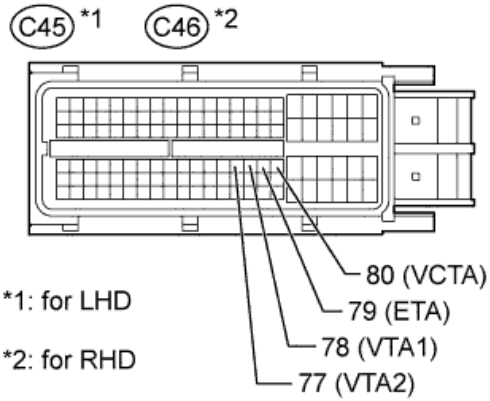
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C46-80 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C46-78 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C46-77 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C46-79 (ETA)	Always	Below 1 Ω
C3-5 (VC) or C46-80 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C46-78 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C46-77 (VTA2) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Throttle Body)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT ECM (VC VOLTAGE)

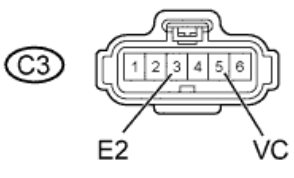
a. Disconnect the throttle body connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C3-5 (VC) - C3-3 (E2)	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to Throttle Body)



Y

NG → REPLACE ECM (Click here)

OK

4.REPLACE THROTTLE BODY ASSEMBLY

a. Replace the throttle body assembly (Click here).

NE T

5.CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

a. Connect the intelligent tester to the D C3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
P0120, P0122, P0123, P0220, P0222, P0223 and/or P2135 is output	A
No DTC is output	B

B → SYSTEM OK

A → REPLACE ECM (**Click here**)

DTC P1442 Stuck Close in Secondary Air Injection Vacuum Switching Valve Bank 1

DTC P1445 Stuck Close in Secondary Air Injection Vacuum Switching Valve Bank 2

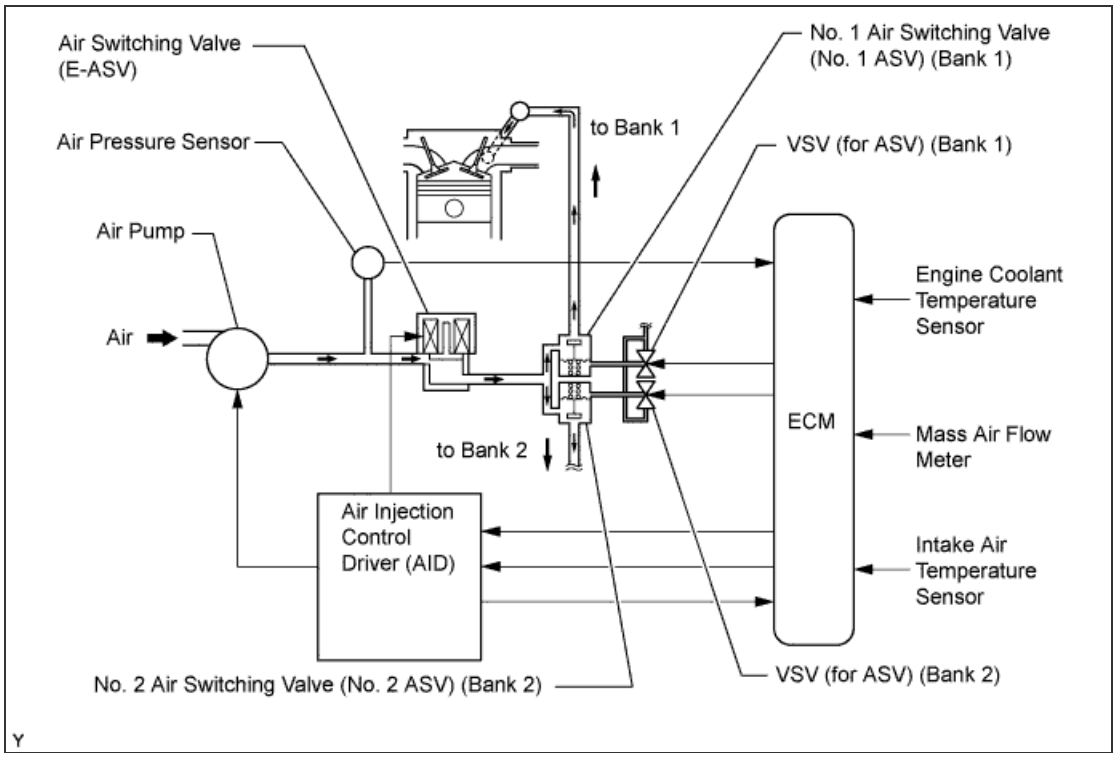
DTC P2441 Secondary Air Injection System Switching Valve Stuck Close Bank1

for Preparation Click here

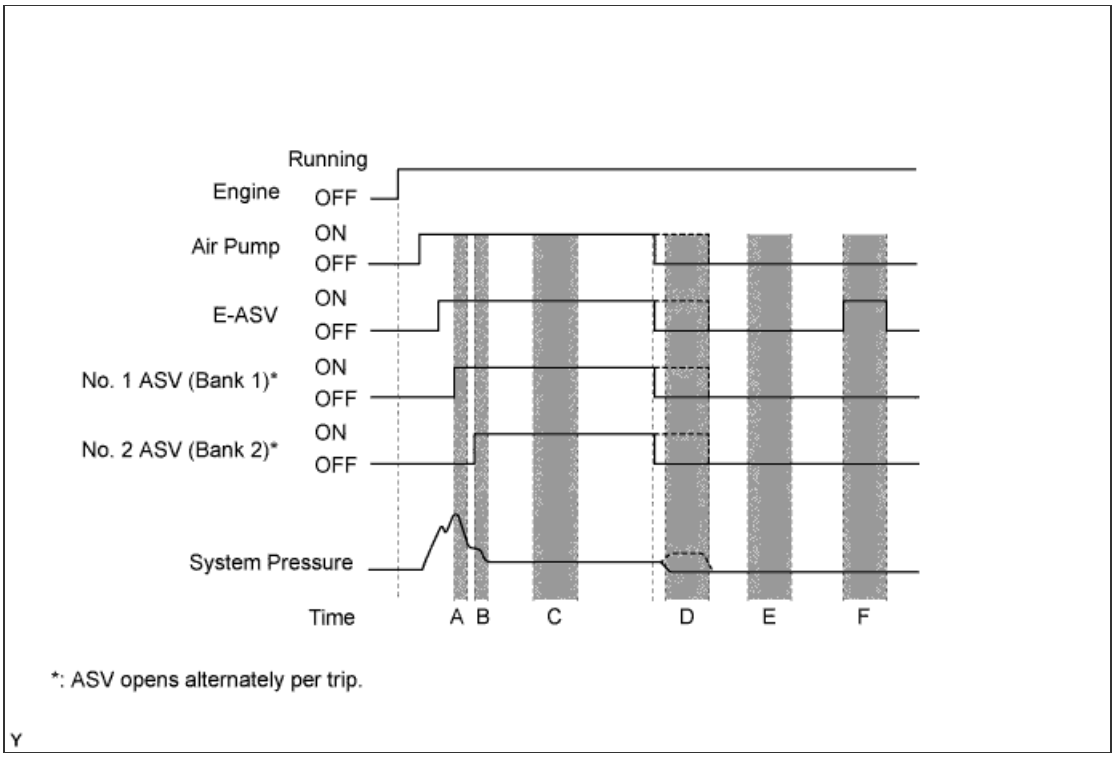
DESCRIPTION

The diagnostic trouble code (DTC) indicates that the electric air switching valve (E-ASV) and air switching valves (ASVs) of the secondary air injection (AIR) system are stuck closed. The engine control module (ECM) operates entire components of this system in a sequence, and monitors the system pressure and exhaust pulse (AIR monitor). This monitor will run just after a cold engine start. If abnormal pressure and exhaust pulse are detected, the ECM interprets this as a malfunction. When the malfunction is detected in consecutive driving cycles, the ECM illuminates the malfunction indicator lamp (MIL), and stores a DTC.

The secondary air injection (AIR) system introduces fresh air into the exhaust manifold in order to reduce carbon monoxide (CO) and hydrocarbon (HC) in the exhaust emission. This system is activated just after engine start, and is stopped when the catalyst converter is warmed-up. This system consists of the following components: 1) the air pump which sends fresh air to the exhaust manifold, 2) the electric air switching valve (E-ASV) which switches the fresh air flow, 3) the air switching valve (ASV) which switches the air passage to the exhaust manifold of each bank, 4) the vacuum switching valve (VSV) which switches the vacuum (intake manifold pressure) to operate the ASV, 5) the pressure sensor which detects the fresh air pressure and exhaust pulse, 6) the air injection control driver which controls the power sources of the air pump and E-ASV, 7) the engine control module (ECM) which controls and monitors this system.



Reference 1: Operation of each component during AIR monitor



Y

Reference 2: DTC Storing Conditions

Time A [Pressure Change]	Time B [Pressure Change]	Time C [See Chart Below]	Time D [Exhaust Pulse]	Time E [Exhaust Pulse]	Time F [See Chart Below]	DTC
Yes	Yes	Pattern 1	-	No	Pattern 4	Normal
Yes	No	Pattern 1	Yes	No	Pattern 4	
No	Yes	Pattern 1	-	No	Pattern 3	P1442 P1445 P2444
Yes	No	Pattern 1	No	No	Pattern 3	
Yes	No	Pattern 1	No	No	Pattern 4	P1442 P1445
No	Yes	Pattern 1	-	No	Pattern 4	
No	No	Pattern 1	Yes	No	Pattern 4	
No	No	Pattern 1	No	No	Pattern 4	
No	No	Pattern 3	No	No	Pattern 3	P1442 P1445 P2441 P2444
No	No	Pattern 3	No	No	Pattern 4	P1442 P1445 P2441

Reference 3: System Pressure and Exhaust Pulse

Pattern	System Pressure	Exhaust Pulse
1	High	Yes
2	Low	Yes
3	High	No
4	Low	No

DTC Code

DTC Code	DTC Detection Condition	Trouble Area
P1442	The ASV (bank 1) is stuck closed (2 trip detection logic).	• ASV (bank 1) • VSV (bank 1) • Vacuum hose (Intake manifold - VSV) • Vacuum hose (ASV - VSV) • Air injection pipe
P1445	The ASV (bank 2) is stuck closed (2 trip detection logic).	• ASV (bank 2) • VSV (bank 2) • Vacuum hose (Intake manifold - VSV) • Vacuum hose (ASV - VSV) • Air injection pipe

P2441	The E-ASV is stuck closed (2 trip detection logic).	• E-ASV • ASV (bank 1 and obank 2) • VSV (bank 1 and obank 2) • Vacuum hose (Intake manifold - VSV) • Vacuum hose (ASV - VSV) • Air injection pipe

WIRING DIAGRAM

Refer to DTC P 412 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.PERFORM SECONDARY AIR INJECTION SYSTEM CHECK (AUTOMATIC MODE)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Record the DTCs and freeze frame data.

d. Clear the DTCs.

e. Warm-up the engine.

f. Enter the following menus: Powertrain Engine and ECT Utility Secondary Air Injection Check (Automatic Mode).

g. Perform the Active Test and check the pending DTC.

Result

Result	Proceed to
P1442, P1445 and oP2441 is output	A
DTC other than P1442, P1445 and oP2441 are output	B
No DTC is output	C

B → GO TO DTC CHART (Click here)

C → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

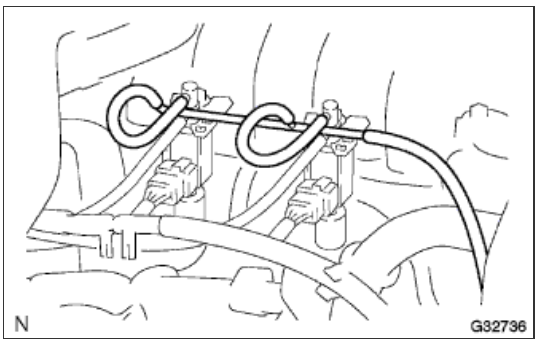
2.CHECK VACUUM HOSES (VSV)

a. Check that the vacuum hoses between the throttle body and VSV for the secondary air injection system are securely connected.

OK:
The vacuum hoses are securely connected.

b. Inspect the vacuum hoses for blockages or damage.

OK:
The vacuum hoses have no blockages or damage.



NG → REPAIR OR REPLACE VACUUM HOSES

OK

3.CHECK VACUUM SWITCHING VALVE (VSV)

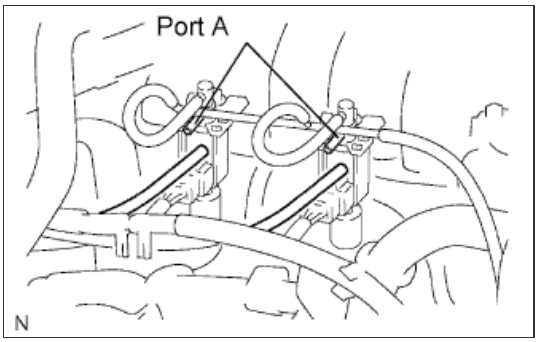
a. Turn the engine switch off.

b. Disconnect the vacuum hoses from the VSV for the secondary air injection system.

c. Connect the intelligent tester to the DLC3.

d. Start the engine and turn the tester on.

e. Perform the Active Test to operate the secondary air injection system, and check that there is negative pressure from ports A. Enter the following menus: Powertrain Engine and ECT Utility Secondary Air Injection Check (Manual Mode) Operation 5 or 6.



OK:

Negative pressure from ports A.

NOTICE:

- **This test only allows technicians to operate the AIR system for 5 seconds. Furthermore, the test can be performed 4 times a trip. If the test is repeated, intervals of at least 30 seconds are required between tests.**
  While the AIR system operation using the intelligent tester is prohibited, the tester displays the prohibition (WAIT or ERROR). If ERROR (AI Status NG) is displayed on the tester, stop the engine for 10 minutes and then try again.
- **When performing the Secondary Air Injection Check operation after the battery cable has been reconnected, wait for 7 minutes with the engine switch turned on (IG) or the engine running.**
- **Turn the engine switch off when the Secondary Air Injection Check operation finishes.**

NG → REPLACE VACUUM SWITCHING VALVE (Click here)

OK

4.CHECK VACUUM HOSES (AIR SWITCHING VALVE)

a. Check that the vacuum hoses between the air switching valve(s) and VSV for the secondary air injection system are securely connected.

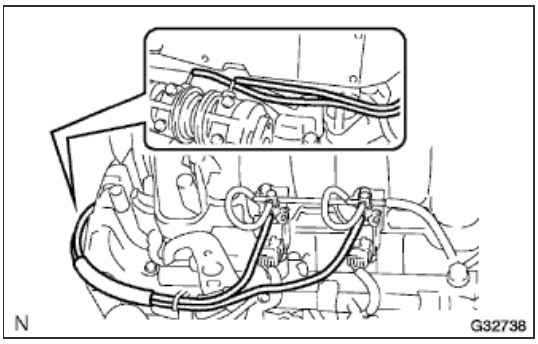
OK:

The vacuum hose(s) are securely connected.

b. Check the vacuum hoses for blockages and damage.

OK:

The vacuum hoses have no blockages or damage.



NG → REPAIR OR REPLACE VACUUM HOSES

OK

5.CHECK PIPES AND HOSES

a. Remove the intake manifold (Click here).

b. Check all pipes and hoses of the secondary air injection system.

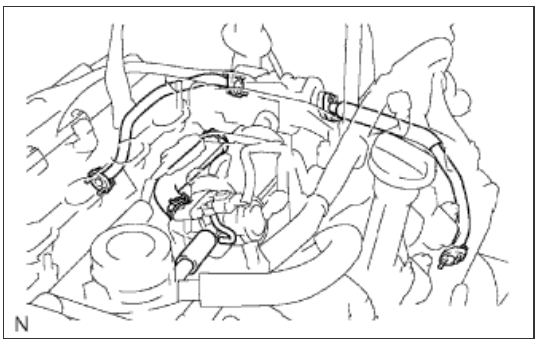
OK:

All air injection pipes and hoses are securely connected.

c. Check all pipes and hoses for blockage or damage.

OK:

All air injection pipes and hoses have no blockages or damage.



NG → REPAIR OR REPLACE PIPE AND HOSES

OK

6.CHECK AIR SWITCHING VALVE (OPERATION)

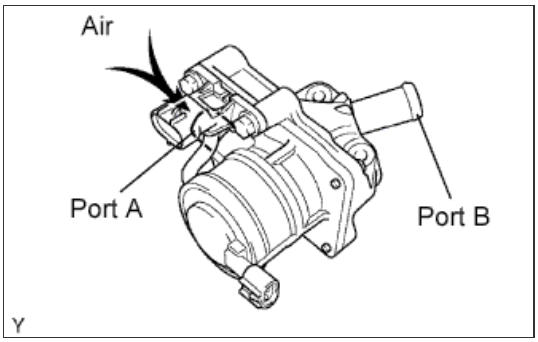
a. Remove the intake manifold (Click here).

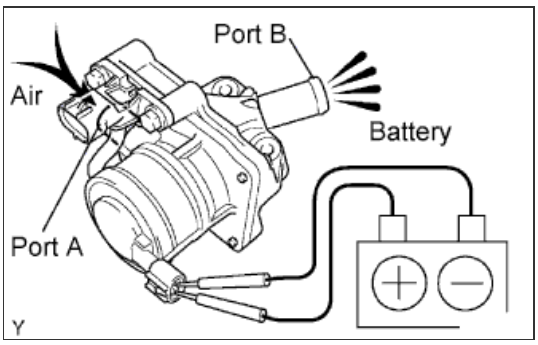
b. Remove the Air Switching Valve (ASV).

c. Blow air into port A and check that air is not discharged from port B.

d. Apply battery positive voltage across the terminals.

e. Blow air into port A and check that air is discharged from port B.





OK:

Tester Connection	Condition	Specified Condition
port A - port B	Always	Not discharged
port A - port B	Battery positive voltage applied	Discharged

NG → REPLACE AIR SWITCHING VALVE (Click here)

OK

REPLACE AIR SWITCHING VALVE ASSEMBLY (NO. 1 or NO. 2) (Click here)

DTC P0120 Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0220 Throttle / Pedal Position Sensor / Switch "B" Circuit

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

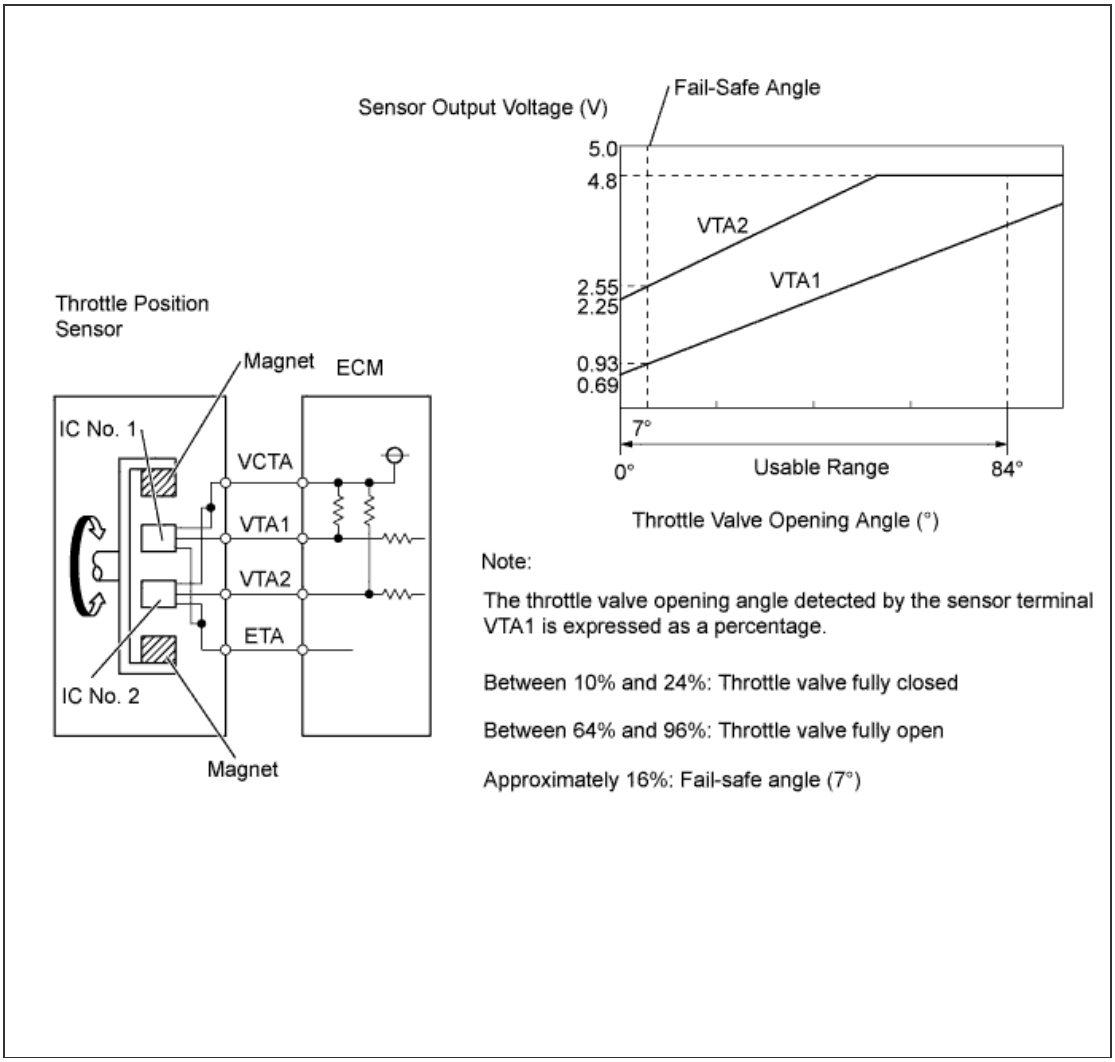
DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

DTC P2135 Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

for Preparation Click here

DESCRIPTION

The TP sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.
The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air-fuel ratio correction, power increase correction and fuel-cut control.



DTC Code	DTC Detection Condition	Trouble Area
P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• Throttle Position (TP) sensor (built into throttle body) • ECM

P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.535 V or higher for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher, and VTA1 is between 0.2 V and 2.02 V for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) is met (1 trip detection logic): (a) The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:

- **When any of these DTCs are output, check the throttle valve opening angle by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No. 1 and Throttle Position No. 2.**
- **Throttle Position No. 1 is the VTA1 signal, and Throttle Position No. 2 is the VTA2 signal.**

Reference (Normal Condition):

Tester Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No. 1	0.5 to 1.1 V	3.3 to 4.9 V
Throttle Position No. 2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

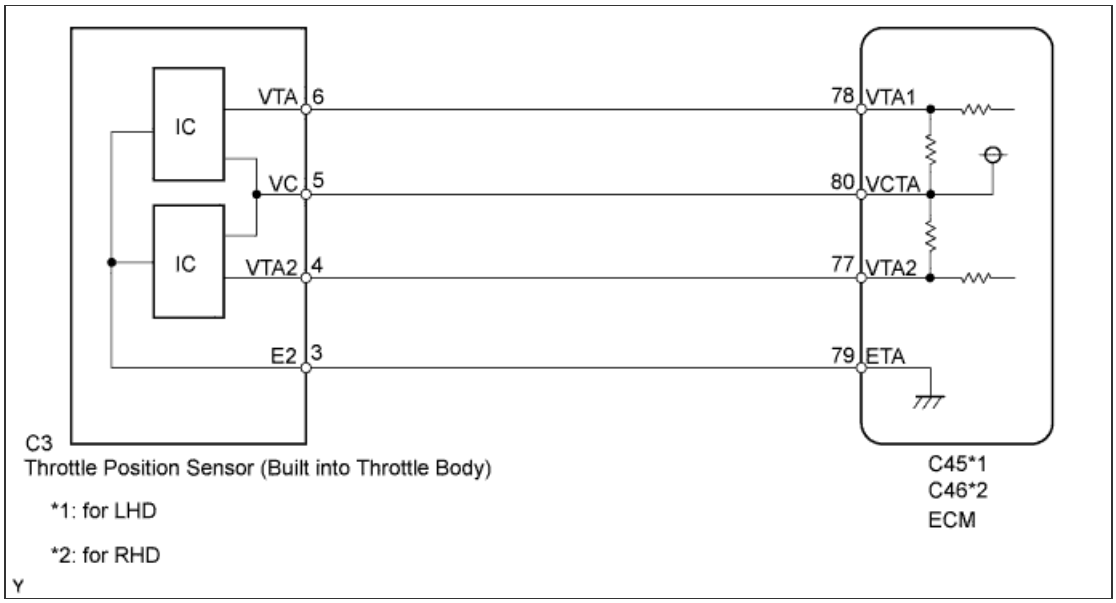
- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then ad usts the engine output by controlling the fuel in ection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION)

a. Connect the intelligent tester to the D C3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data ist / ETCS / Throttle Position No.1 and Throttle Position No.2.

d. Check the values displayed on the tester.

Result

TP 1 (VTA1) When Accelerator Pedal Released	TP 2 (VTA2) When Accelerator Pedal Released	TP 1 (VTA1) When Accelerator Pedal Depressed	TP 2 (VTA2) When Accelerator Pedal Depressed	Trouble Area	Proceed to
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	A
0 to 0.2 V, or 4.5 to 5.0 V	2.4 to 3.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.4 to 3.4 V (Fail-safe)	VTA1 circuit open or ground short	A
0.7 to 1.3 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.7 to 1.3 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	A
0.5 to 1.1 V	2.1 to 3.1 V	3.3 to 4.9 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

TP 1 stands for Throttle Position No. 1, and TP 2 stands for Throttle Position No. 2.

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the throttle body connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

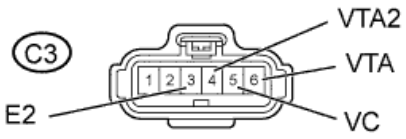
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C45-80 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C45-78 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C45-77 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C45-79 (ETA)	Always	Below 1 Ω
C3-5 (VC) or C45-80 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C45-78 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C45-77 (VTA2) - Body ground	Always	10 kΩ or higher

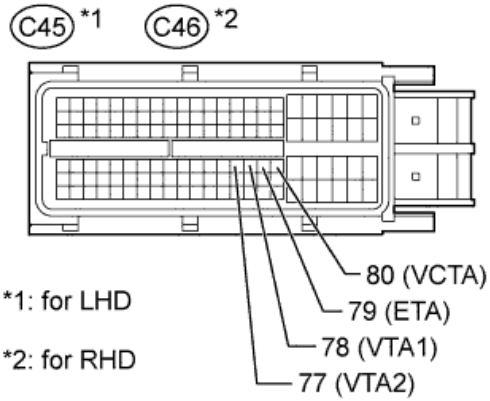
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C46-80 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C46-78 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C46-77 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C46-79 (ETA)	Always	Below 1 Ω
C3-5 (VC) or C46-80 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C46-78 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C46-77 (VTA2) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Throttle Body)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT ECM (VC VOLTAGE)

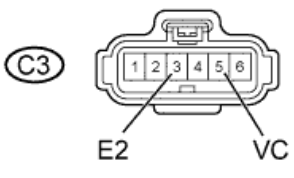
a. Disconnect the throttle body connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C3-5 (VC) - C3-3 (E2)	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to Throttle Body)



Y

NG → REPLACE ECM (Click here)

OK

4.REPLACE THROTTLE BODY ASSEMBLY

a. Replace the throttle body assembly (Click here).

NE T

5.CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

a. Connect the intelligent tester to the D C3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
P0120, P0122, P0123, P0220, P0222, P0223 and/or P2135 is output	A
No DTC is output	B

B → SYSTEM OK

A → REPLACE ECM (**Click here**)

DTC P1442 Stuck Close in Secondary Air Injection Vacuum Switching Valve Bank 1

DTC P1445 Stuck Close in Secondary Air Injection Vacuum Switching Valve Bank 2

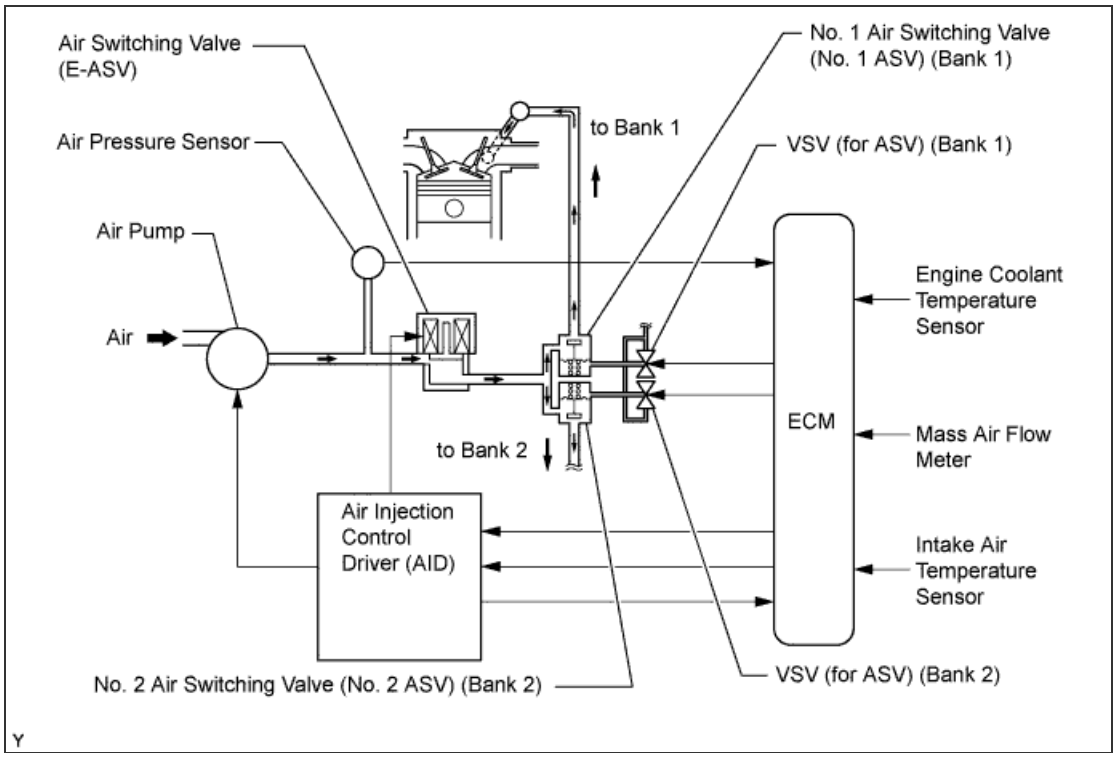
DTC P2441 Secondary Air Injection System Switching Valve Stuck Close Bank1

for Preparation Click here

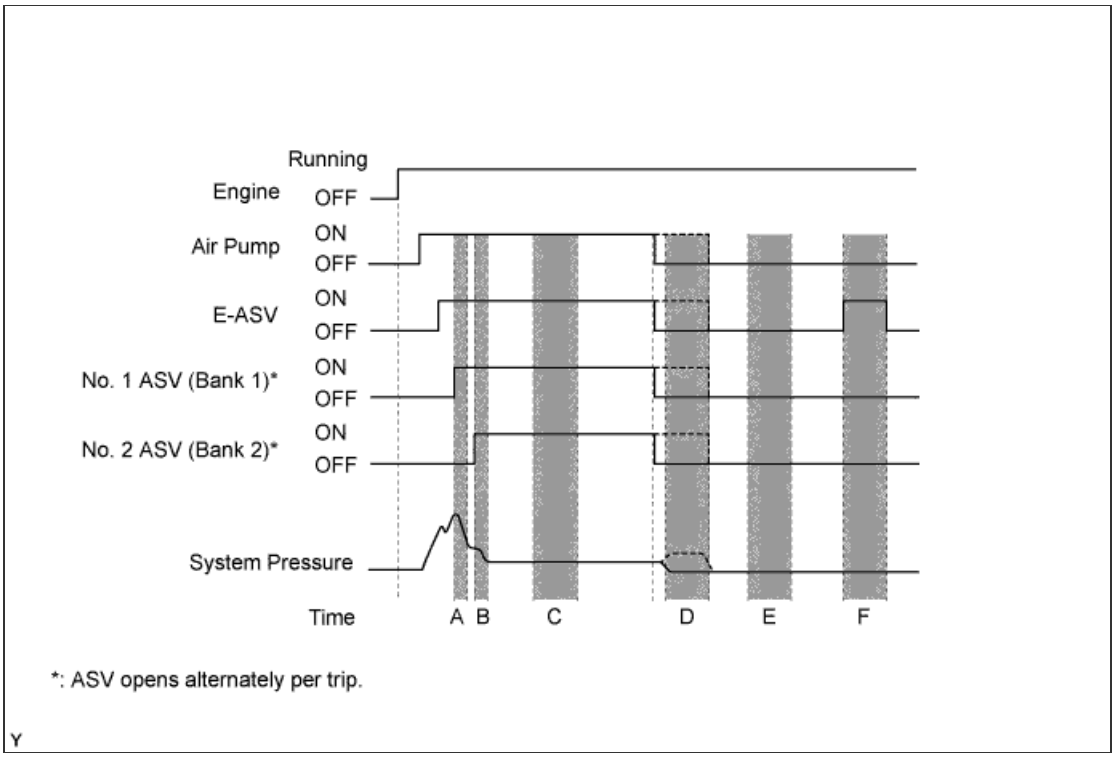
DESCRIPTION

The diagnostic trouble code (DTC) indicates that the electric air switching valve (E-ASV) and air switching valves (ASVs) of the secondary air injection (AIR) system are stuck closed. The engine control module (ECM) operates entire components of this system in a sequence, and monitors the system pressure and exhaust pulse (AIR monitor). This monitor will run just after a cold engine start. If abnormal pressure and exhaust pulse are detected, the ECM interprets this as a malfunction. When the malfunction is detected in consecutive driving cycles, the ECM illuminates the malfunction indicator lamp (MIL), and stores a DTC.

The secondary air injection (AIR) system introduces fresh air into the exhaust manifold in order to reduce carbon monoxide (CO) and hydrocarbon (HC) in the exhaust emission. This system is activated just after engine start, and is stopped when the catalyst converter is warmed-up. This system consists of the following components: 1) the air pump which sends fresh air to the exhaust manifold, 2) the electric air switching valve (E-ASV) which switches the fresh air flow, 3) the air switching valve (ASV) which switches the air passage to the exhaust manifold of each bank, 4) the vacuum switching valve (VSV) which switches the vacuum (intake manifold pressure) to operate the ASV, 5) the pressure sensor which detects the fresh air pressure and exhaust pulse, 6) the air injection control driver which controls the power sources of the air pump and E-ASV, 7) the engine control module (ECM) which controls and monitors this system.



Reference 1: Operation of each component during AIR monitor



Y

Reference 2: DTC Storing Conditions

Time A [Pressure Change]	Time B [Pressure Change]	Time C [See Chart Below]	Time D [Exhaust Pulse]	Time E [Exhaust Pulse]	Time F [See Chart Below]	DTC
Yes	Yes	Pattern 1	-	No	Pattern 4	Normal
Yes	No	Pattern 1	Yes	No	Pattern 4	
No	Yes	Pattern 1	-	No	Pattern 3	P1442 P1445 P2444
Yes	No	Pattern 1	No	No	Pattern 3	
Yes	No	Pattern 1	No	No	Pattern 4	P1442 P1445
No	Yes	Pattern 1	-	No	Pattern 4	
No	No	Pattern 1	Yes	No	Pattern 4	
No	No	Pattern 1	No	No	Pattern 4	
No	No	Pattern 3	No	No	Pattern 3	P1442 P1445 P2441 P2444
No	No	Pattern 3	No	No	Pattern 4	P1442 P1445 P2441

Reference 3: System Pressure and Exhaust Pulse

Pattern	System Pressure	Exhaust Pulse
1	High	Yes
2	Low	Yes
3	High	No
4	Low	No

DTC Code

DTC Code	DTC Detection Condition	Trouble Area
P1442	The ASV (bank 1) is stuck closed (2 trip detection logic).	• ASV (bank 1) • VSV (bank 1) • Vacuum hose (Intake manifold - VSV) • Vacuum hose (ASV - VSV) • Air injection pipe
P1445	The ASV (bank 2) is stuck closed (2 trip detection logic).	• ASV (bank 2) • VSV (bank 2) • Vacuum hose (Intake manifold - VSV) • Vacuum hose (ASV - VSV) • Air injection pipe

P2441	The E-ASV is stuck closed (2 trip detection logic).	• E-ASV • ASV (bank 1 and obank 2) • VSV (bank 1 and obank 2) • Vacuum hose (Intake manifold - VSV) • Vacuum hose (ASV - VSV) • Air injection pipe

WIRING DIAGRAM

Refer to DTC P 412 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.PERFORM SECONDARY AIR INJECTION SYSTEM CHECK (AUTOMATIC MODE)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Record the DTCs and freeze frame data.

d. Clear the DTCs.

e. Warm-up the engine.

f. Enter the following menus: Powertrain Engine and ECT Utility Secondary Air Injection Check (Automatic Mode).

g. Perform the Active Test and check the pending DTC.

Result

Result	Proceed to
P1442, P1445 and oP2441 is output	A
DTC other than P1442, P1445 and oP2441 are output	B
No DTC is output	C

B → GO TO DTC CHART (Click here)

C → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

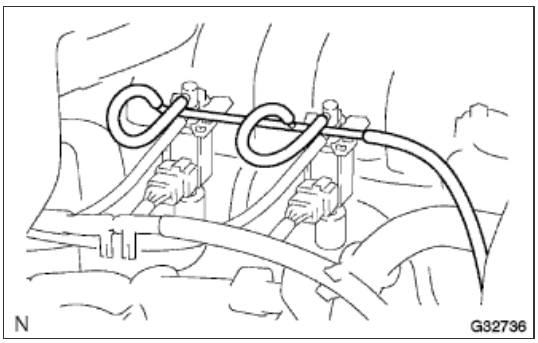
2.CHECK VACUUM HOSES (VSV)

a. Check that the vacuum hoses between the throttle body and VSV for the secondary air injection system are securely connected.

OK:
The vacuum hoses are securely connected.

b. Inspect the vacuum hoses for blockages or damage.

OK:
The vacuum hoses have no blockages or damage.



NG → REPAIR OR REPLACE VACUUM HOSES

OK

3.CHECK VACUUM SWITCHING VALVE (VSV)

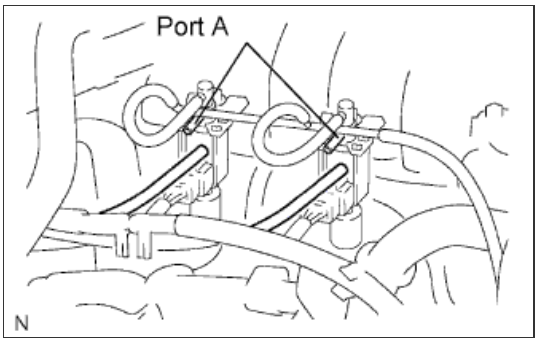
a. Turn the engine switch off.

b. Disconnect the vacuum hoses from the VSV for the secondary air injection system.

c. Connect the intelligent tester to the DLC3.

d. Start the engine and turn the tester on.

e. Perform the Active Test to operate the secondary air injection system, and check that there is negative pressure from ports A. Enter the following menus: Powertrain Engine and ECT Utility Secondary Air Injection Check (Manual Mode) Operation 5 or 6.



OK:

Negative pressure from ports A.

NOTICE:

- **This test only allows technicians to operate the AIR system for 5 seconds. Furthermore, the test can be performed 4 times a trip. If the test is repeated, intervals of at least 30 seconds are required between tests.**
  While the AIR system operation using the intelligent tester is prohibited, the tester displays the prohibition (WAIT or ERROR). If ERROR (AI Status NG) is displayed on the tester, stop the engine for 10 minutes and then try again.
- **When performing the Secondary Air Injection Check operation after the battery cable has been reconnected, wait for 7 minutes with the engine switch turned on (IG) or the engine running.**
- **Turn the engine switch off when the Secondary Air Injection Check operation finishes.**

NG → REPLACE VACUUM SWITCHING VALVE (Click here)

OK

4.CHECK VACUUM HOSES (AIR SWITCHING VALVE)

a. Check that the vacuum hoses between the air switching valve(s) and VSV for the secondary air injection system are securely connected.

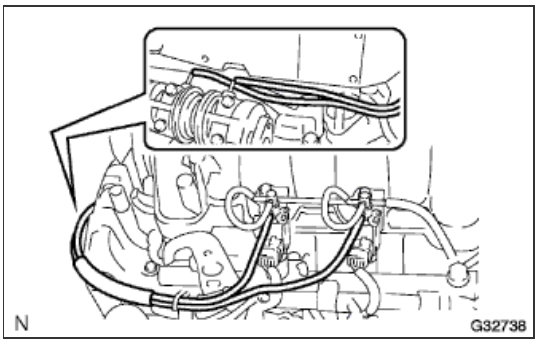
OK:

The vacuum hose(s) are securely connected.

b. Check the vacuum hoses for blockages and damage.

OK:

The vacuum hoses have no blockages or damage.



NG → REPAIR OR REPLACE VACUUM HOSES

OK

5.CHECK PIPES AND HOSES

a. Remove the intake manifold (Click here).

b. Check all pipes and hoses of the secondary air injection system.

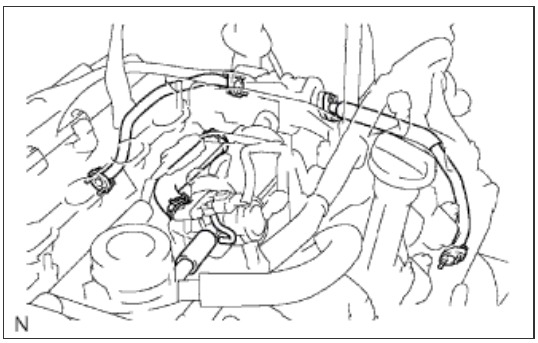
OK:

All air injection pipes and hoses are securely connected.

c. Check all pipes and hoses for blockage or damage.

OK:

All air injection pipes and hoses have no blockages or damage.



NG → REPAIR OR REPLACE PIPE AND HOSES

OK

6.CHECK AIR SWITCHING VALVE (OPERATION)

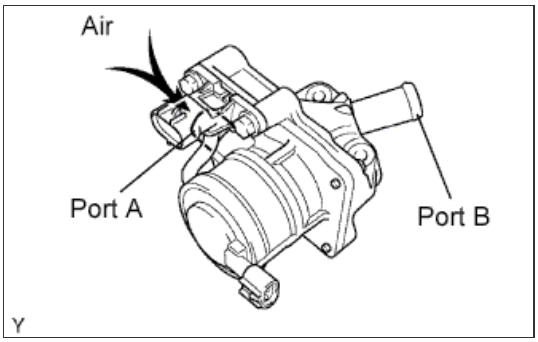
a. Remove the intake manifold (Click here).

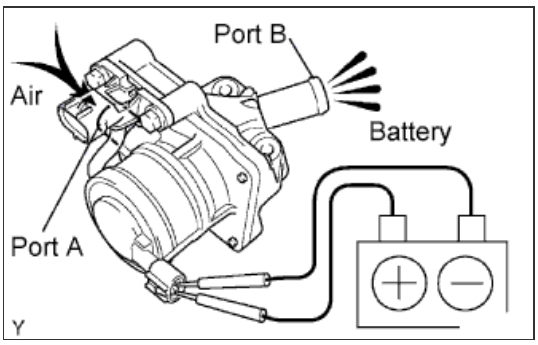
b. Remove the Air Switching Valve (ASV).

c. Blow air into port A and check that air is not discharged from port B.

d. Apply battery positive voltage across the terminals.

e. Blow air into port A and check that air is discharged from port B.





OK:

Tester Connection	Condition	Specified Condition
port A - port B	Always	Not discharged
port A - port B	Battery positive voltage applied	Discharged

NG → REPLACE AIR SWITCHING VALVE (Click here)

OK

REPLACE AIR SWITCHING VALVE ASSEMBLY (NO. 1 or NO. 2) (Click here)

DTC P0120 Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0220 Throttle / Pedal Position Sensor / Switch "B" Circuit

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

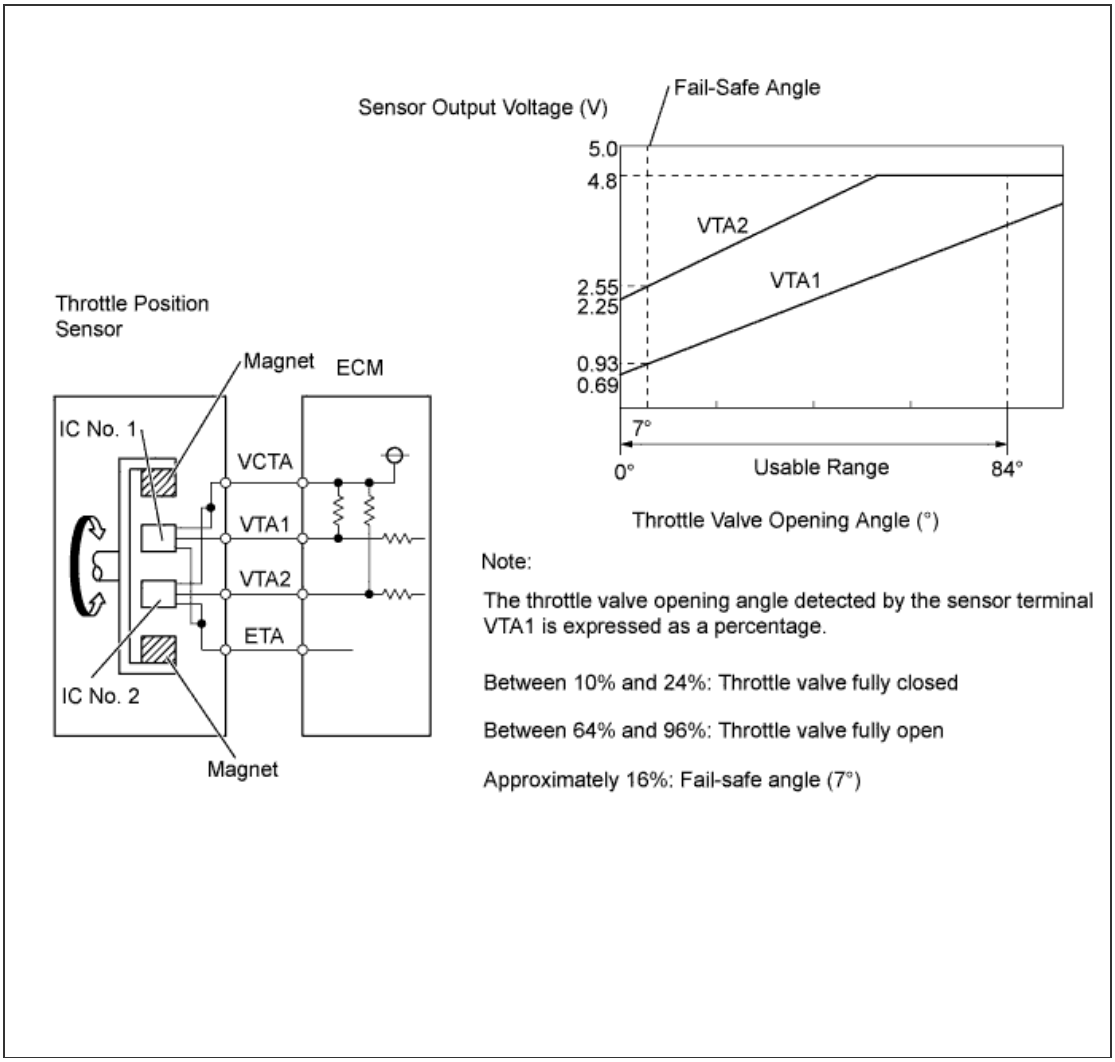
DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

DTC P2135 Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

for Preparation Click here

DESCRIPTION

The TP sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.
The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air-fuel ratio correction, power increase correction and fuel-cut control.



DTC Code	DTC Detection Condition	Trouble Area
P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• Throttle Position (TP) sensor (built into throttle body) • ECM

P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.535 V or higher for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher, and VTA1 is between 0.2 V and 2.02 V for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) is met (1 trip detection logic): (a) The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:

- **When any of these DTCs are output, check the throttle valve opening angle by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No. 1 and Throttle Position No. 2.**
- **Throttle Position No. 1 is the VTA1 signal, and Throttle Position No. 2 is the VTA2 signal.**

Reference (Normal Condition):

Tester Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No. 1	0.5 to 1.1 V	3.3 to 4.9 V
Throttle Position No. 2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

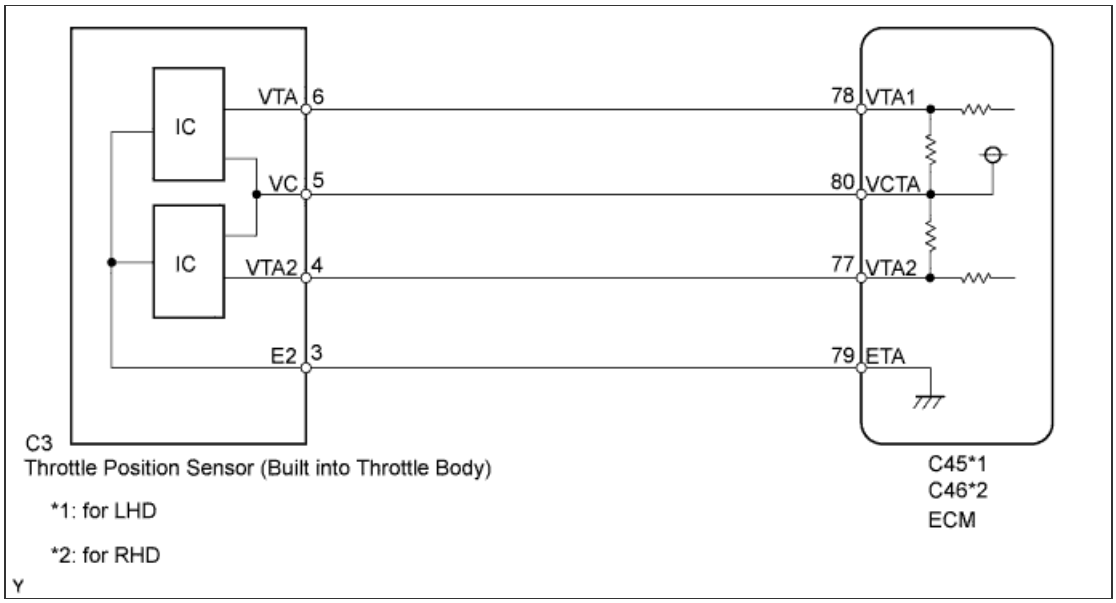
- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and stores a DTC.
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then ad usts the engine output by controlling the fuel in ection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (THROTTLE POSITION)

a. Connect the intelligent tester to the D C3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data ist / ETCS / Throttle Position No.1 and Throttle Position No.2.

d. Check the values displayed on the tester.

Result

TP 1 (VTA1) When Accelerator Pedal Released	TP 2 (VTA2) When Accelerator Pedal Released	TP 1 (VTA1) When Accelerator Pedal Depressed	TP 2 (VTA2) When Accelerator Pedal Depressed	Trouble Area	Proceed to
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	A
0 to 0.2 V, or 4.5 to 5.0 V	2.4 to 3.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.4 to 3.4 V (Fail-safe)	VTA1 circuit open or ground short	A
0.7 to 1.3 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.7 to 1.3 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	A
0.5 to 1.1 V	2.1 to 3.1 V	3.3 to 4.9 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

TP 1 stands for Throttle Position No. 1, and TP 2 stands for Throttle Position No. 2.

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the throttle body connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

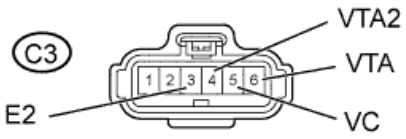
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C45-80 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C45-78 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C45-77 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C45-79 (ETA)	Always	Below 1 Ω
C3-5 (VC) or C45-80 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C45-78 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C45-77 (VTA2) - Body ground	Always	10 kΩ or higher

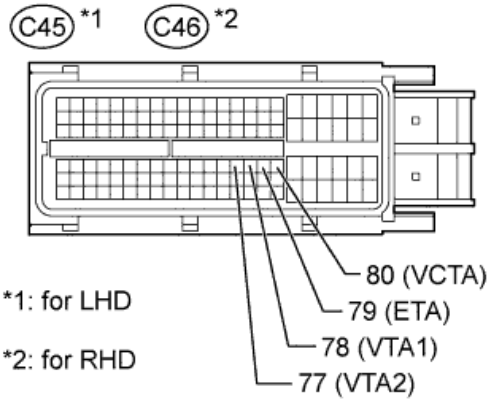
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C3-5 (VC) - C46-80 (VCTA)	Always	Below 1 Ω
C3-6 (VTA) - C46-78 (VTA1)	Always	Below 1 Ω
C3-4 (VTA2) - C46-77 (VTA2)	Always	Below 1 Ω
C3-3 (E2) - C46-79 (ETA)	Always	Below 1 Ω
C3-5 (VC) or C46-80 (VCTA) - Body ground	Always	10 kΩ or higher
C3-6 (VTA) or C46-78 (VTA1) - Body ground	Always	10 kΩ or higher
C3-4 (VTA2) or C46-77 (VTA2) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Throttle Body)



Front view of wire harness connector:
(to ECM)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT ECM (VC VOLTAGE)

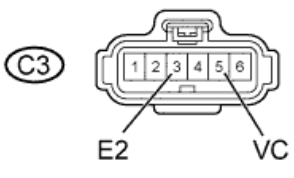
a. Disconnect the throttle body connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C3-5 (VC) - C3-3 (E2)	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to Throttle Body)



Y

NG → REPLACE ECM (Click here)

OK

4.REPLACE THROTTLE BODY ASSEMBLY

a. Replace the throttle body assembly (Click here).

NE T

5.CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

a. Connect the intelligent tester to the D C3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
P0120, P0122, P0123, P0220, P0222, P0223 and/or P2135 is output	A
No DTC is output	B

B → SYSTEM OK

A → REPLACE ECM (**Click here**)

DTC P1442 Stuck Close in Secondary Air Injection Vacuum Switching Valve Bank 1

DTC P1445 Stuck Close in Secondary Air Injection Vacuum Switching Valve Bank 2

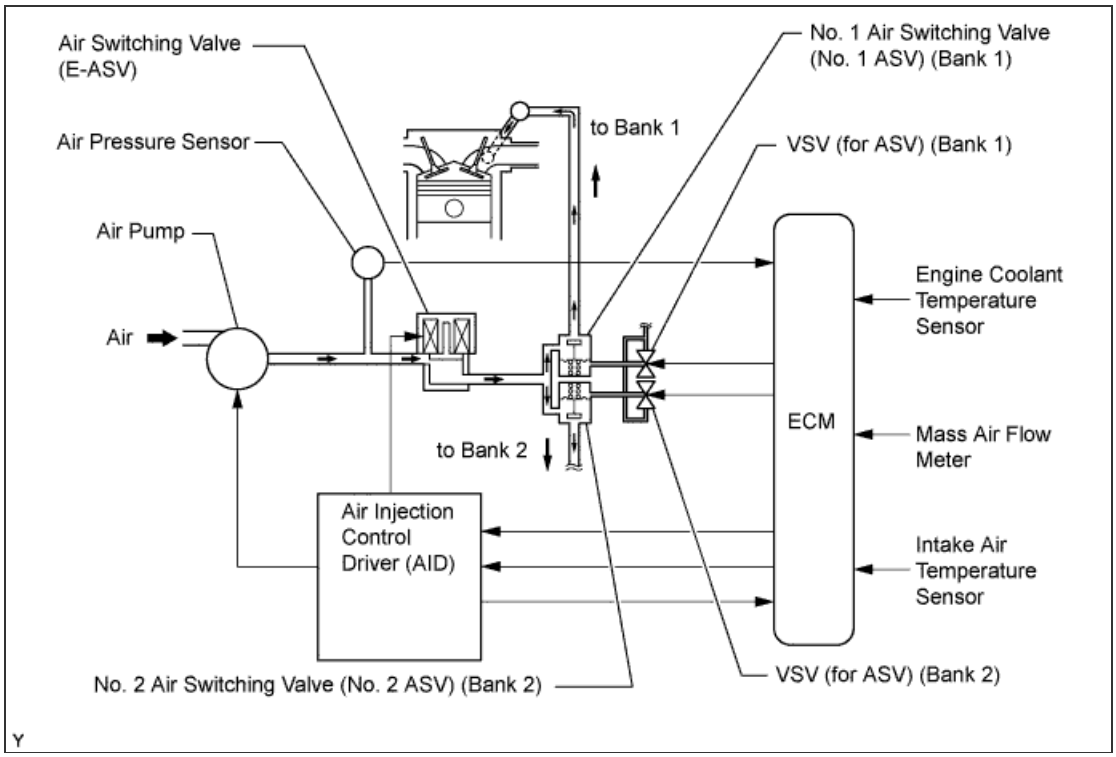
DTC P2441 Secondary Air Injection System Switching Valve Stuck Close Bank1

for Preparation Click here

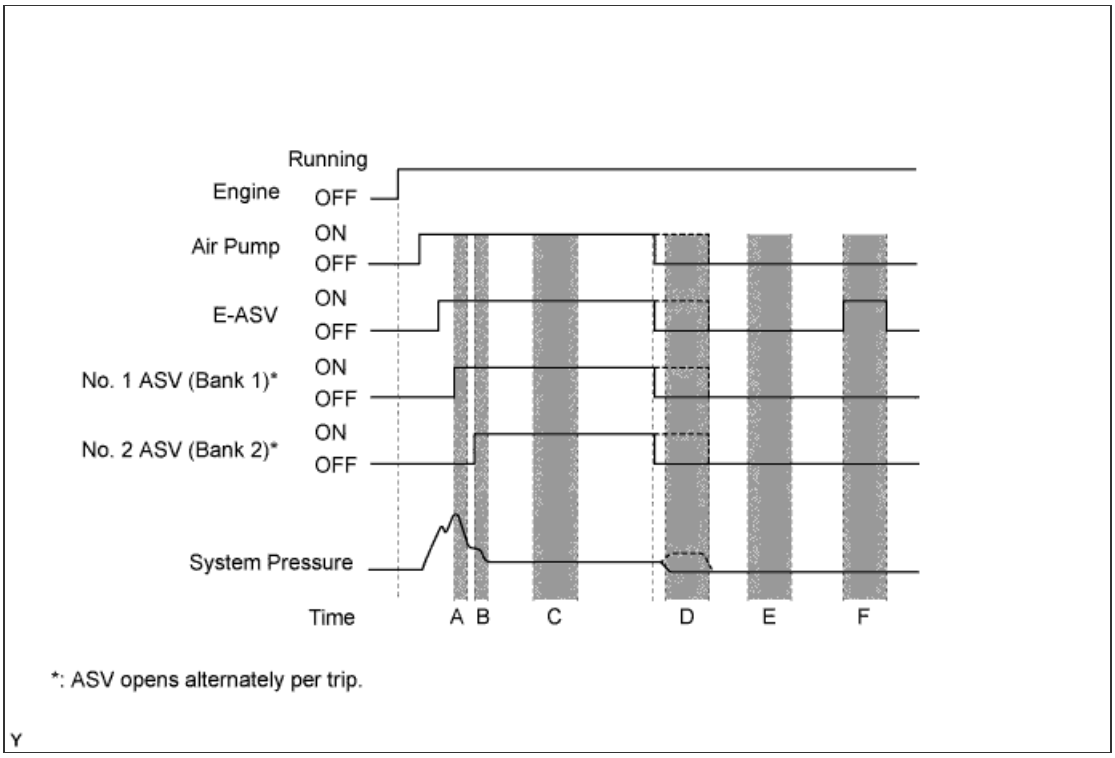
DESCRIPTION

The diagnostic trouble code (DTC) indicates that the electric air switching valve (E-ASV) and air switching valves (ASVs) of the secondary air injection (AIR) system are stuck closed. The engine control module (ECM) operates entire components of this system in a sequence, and monitors the system pressure and exhaust pulse (AIR monitor). This monitor will run just after a cold engine start. If abnormal pressure and exhaust pulse are detected, the ECM interprets this as a malfunction. When the malfunction is detected in consecutive driving cycles, the ECM illuminates the malfunction indicator lamp (MIL), and stores a DTC.

The secondary air injection (AIR) system introduces fresh air into the exhaust manifold in order to reduce carbon monoxide (CO) and hydrocarbon (HC) in the exhaust emission. This system is activated just after engine start, and is stopped when the catalyst converter is warmed-up. This system consists of the following components: 1) the air pump which sends fresh air to the exhaust manifold, 2) the electric air switching valve (E-ASV) which switches the fresh air flow, 3) the air switching valve (ASV) which switches the air passage to the exhaust manifold of each bank, 4) the vacuum switching valve (VSV) which switches the vacuum (intake manifold pressure) to operate the ASV, 5) the pressure sensor which detects the fresh air pressure and exhaust pulse, 6) the air injection control driver which controls the power sources of the air pump and E-ASV, 7) the engine control module (ECM) which controls and monitors this system.



Reference 1: Operation of each component during AIR monitor



Y

Reference 2: DTC Storing Conditions

Time A [Pressure Change]	Time B [Pressure Change]	Time C [See Chart Below]	Time D [Exhaust Pulse]	Time E [Exhaust Pulse]	Time F [See Chart Below]	DTC
Yes	Yes	Pattern 1	-	No	Pattern 4	Normal
Yes	No	Pattern 1	Yes	No	Pattern 4	
No	Yes	Pattern 1	-	No	Pattern 3	P1442 P1445 P2444
Yes	No	Pattern 1	No	No	Pattern 3	
Yes	No	Pattern 1	No	No	Pattern 4	P1442 P1445
No	Yes	Pattern 1	-	No	Pattern 4	
No	No	Pattern 1	Yes	No	Pattern 4	
No	No	Pattern 1	No	No	Pattern 4	
No	No	Pattern 3	No	No	Pattern 3	P1442 P1445 P2441 P2444
No	No	Pattern 3	No	No	Pattern 4	P1442 P1445 P2441

Reference 3: System Pressure and Exhaust Pulse

Pattern	System Pressure	Exhaust Pulse
1	High	Yes
2	Low	Yes
3	High	No
4	Low	No

DTC Code

DTC Code	DTC Detection Condition	Trouble Area
P1442	The ASV (bank 1) is stuck closed (2 trip detection logic).	• ASV (bank 1) • VSV (bank 1) • Vacuum hose (Intake manifold - VSV) • Vacuum hose (ASV - VSV) • Air injection pipe
P1445	The ASV (bank 2) is stuck closed (2 trip detection logic).	• ASV (bank 2) • VSV (bank 2) • Vacuum hose (Intake manifold - VSV) • Vacuum hose (ASV - VSV) • Air injection pipe

P2441	The E-ASV is stuck closed (2 trip detection logic).	• E-ASV • ASV (bank 1 and obank 2) • VSV (bank 1 and obank 2) • Vacuum hose (Intake manifold - VSV) • Vacuum hose (ASV - VSV) • Air injection pipe

WIRING DIAGRAM

Refer to DTC P 412 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.PERFORM SECONDARY AIR INJECTION SYSTEM CHECK (AUTOMATIC MODE)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Record the DTCs and freeze frame data.

d. Clear the DTCs.

e. Warm-up the engine.

f. Enter the following menus: Powertrain Engine and ECT Utility Secondary Air Injection Check (Automatic Mode).

g. Perform the Active Test and check the pending DTC.

Result

Result	Proceed to
P1442, P1445 and oP2441 is output	A
DTC other than P1442, P1445 and oP2441 are output	B
No DTC is output	C

B → GO TO DTC CHART (Click here)

C → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

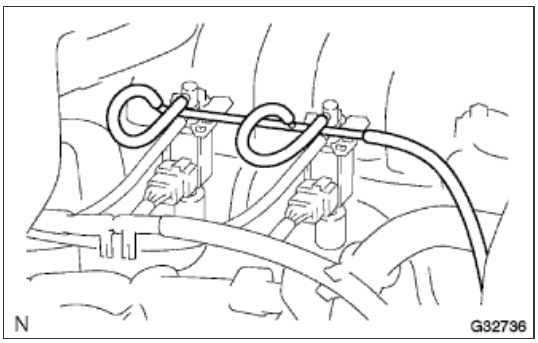
2.CHECK VACUUM HOSES (VSV)

a. Check that the vacuum hoses between the throttle body and VSV for the secondary air injection system are securely connected.

OK:
The vacuum hoses are securely connected.

b. Inspect the vacuum hoses for blockages or damage.

OK:
The vacuum hoses have no blockages or damage.



NG → REPAIR OR REPLACE VACUUM HOSES

OK

3.CHECK VACUUM SWITCHING VALVE (VSV)

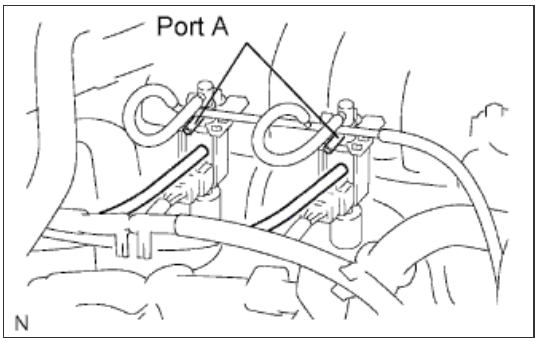
a. Turn the engine switch off.

b. Disconnect the vacuum hoses from the VSV for the secondary air injection system.

c. Connect the intelligent tester to the DLC3.

d. Start the engine and turn the tester on.

e. Perform the Active Test to operate the secondary air injection system, and check that there is negative pressure from ports A. Enter the following menus: Powertrain Engine and ECT Utility Secondary Air Injection Check (Manual Mode) Operation 5 or 6.



OK:

Negative pressure from ports A.

NOTICE:

- **This test only allows technicians to operate the AIR system for 5 seconds. Furthermore, the test can be performed 4 times a trip. If the test is repeated, intervals of at least 30 seconds are required between tests.**
  While the AIR system operation using the intelligent tester is prohibited, the tester displays the prohibition (WAIT or ERROR). If ERROR (AI Status NG) is displayed on the tester, stop the engine for 10 minutes and then try again.
- **When performing the Secondary Air Injection Check operation after the battery cable has been reconnected, wait for 7 minutes with the engine switch turned on (IG) or the engine running.**
- **Turn the engine switch off when the Secondary Air Injection Check operation finishes.**

NG → REPLACE VACUUM SWITCHING VALVE (Click here)

OK

4.CHECK VACUUM HOSES (AIR SWITCHING VALVE)

a. Check that the vacuum hoses between the air switching valve(s) and VSV for the secondary air injection system are securely connected.

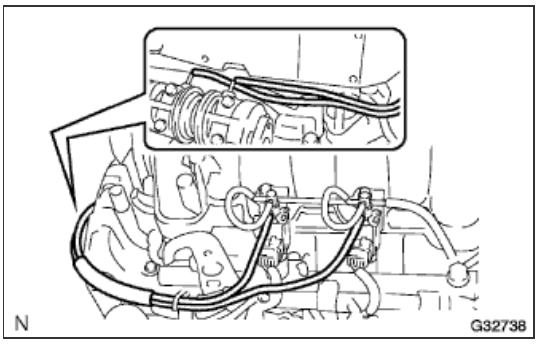
OK:

The vacuum hose(s) are securely connected.

b. Check the vacuum hoses for blockages and damage.

OK:

The vacuum hoses have no blockages or damage.



NG → REPAIR OR REPLACE VACUUM HOSES

OK

5.CHECK PIPES AND HOSES

a. Remove the intake manifold (Click here).

b. Check all pipes and hoses of the secondary air injection system.

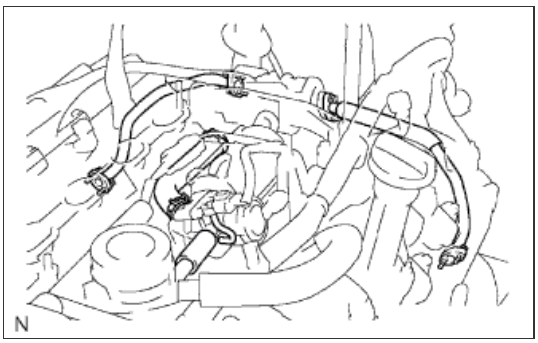
OK:

All air injection pipes and hoses are securely connected.

c. Check all pipes and hoses for blockage or damage.

OK:

All air injection pipes and hoses have no blockages or damage.



NG → REPAIR OR REPLACE PIPE AND HOSES

OK

6.CHECK AIR SWITCHING VALVE (OPERATION)

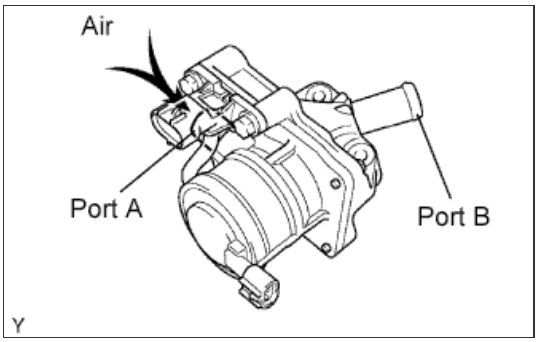
a. Remove the intake manifold (Click here).

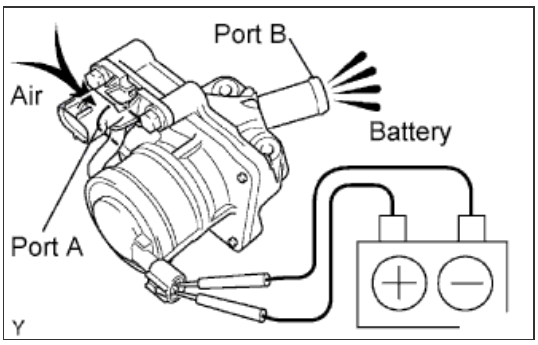
b. Remove the Air Switching Valve (ASV).

c. Blow air into port A and check that air is not discharged from port B.

d. Apply battery positive voltage across the terminals.

e. Blow air into port A and check that air is discharged from port B.





OK:

Tester Connection	Condition	Specified Condition
port A - port B	Always	Not discharged
port A - port B	Battery positive voltage applied	Discharged

NG → REPLACE AIR SWITCHING VALVE (Click here)

OK

REPLACE AIR SWITCHING VALVE ASSEMBLY (NO. 1 or NO. 2) (Click here)

DTC P0121 Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem

for Preparation Click here

DESCRIPTION

Refer to DTC P0120 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P0121	The difference between the VTA1 and VTA2 voltages is below 0.8 V, or higher than 1.6 V for 2 seconds (1 trip detection logic).	TP sensor (built into throttle body)

MONITOR DESCRIPTION

The ECM uses the TP sensor to monitor the throttle valve opening angle.
This sensor transmits two signals: VTA1 and VTA2. VTA1 is used to detect the throttle opening angle and VTA2 is used to detect malfunctions in VTA1.
The ECM performs several checks to confirm the proper operation of the TP sensor and VTA1.
For each throttle opening angle, a specific voltage difference is expected between the outputs of VTA1 and VTA2. If the output voltage difference between the two signals deviates from the normal operating range, the ECM interprets this as a malfunction of the TP sensor. The ECM illuminates the MIL and stores the DTC.
If the malfunction is not repaired successfully, the DTC is stored 2 seconds after the engine is next started.

FAIL-SAFE

When this DTC, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

INSPECTION PROCEDURE

HINT:

- **This DTC relates to the Throttle Position (TP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0121)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0121 is output	A
P0121 and other DTCs are output	B

B → GO TO DTC CHART (Click here)

A → REPLACE THROTTLE BODY ASSEMBLY (Click here)

DTC P1607 Cruise Control Input Processor

for Preparation Click here

DESCRIPTION

The ECM continuously monitors its main and sub CPUs. This self-check ensures that the ECM is functioning properly. If outputs from the CPUs are different and deviate from the standard, the ECM will illuminate the MIL and store a DTC immediately.

DTC Code	DTC Detection Condition	Trouble Area
P1607	The ECM CPUs malfunction.	ECM

INSPECTION PROCEDURE

1.CHECK DTC

a. Clear DTC (Click here).

b. Turn the engine switch off.

c. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

d. Connect the cable to the negative (-) battery terminal.

e. Turn the engine switch on (IG).

f. Check for DTC.

OK:
P1607 is not output.

NG → **REPLACE ECM (Click here)**

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0136 Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)

DTC P0137 Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)

DTC P0138 Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)

DTC P0156 Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)

DTC P0157 Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)

DTC P0158 Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)

for Preparation Click here

DESCRIPTION

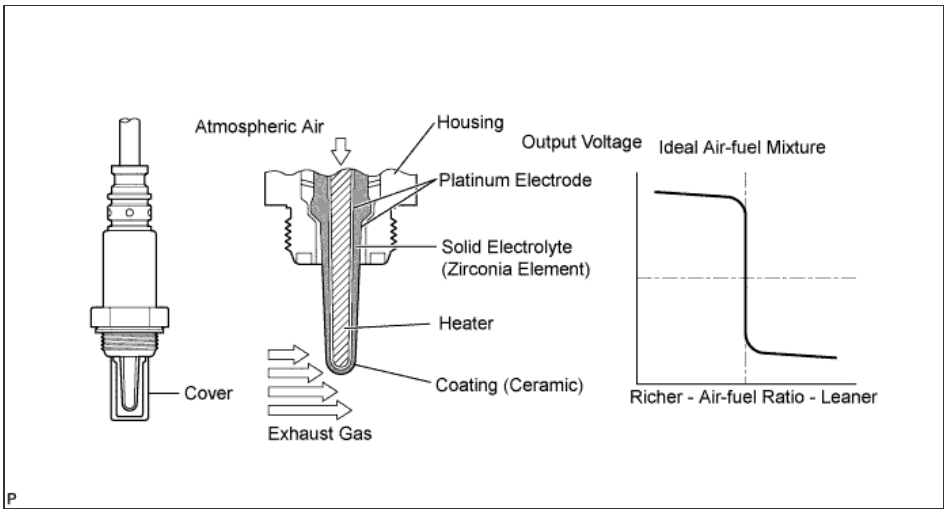
In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric air-fuel level. For the purpose of helping the ECM to deliver accurate air-fuel ratio control, a Heated Oxygen (HO2) sensor is used.

The HO2 sensor is located behind the TWC, and detects the oxygen concentration in the exhaust gas. Since the sensor is integrated with a heater that heats the sensing portion, it is possible to detect the oxygen concentration even when the intake air volume is low (the exhaust gas temperature is low).

When the air-fuel ratio becomes lean, the oxygen concentration in the exhaust gas is rich. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is lean (low voltage, i.e. below 0.45 V).

Conversely, when the air-fuel ratio is richer than the stoichiometric air-fuel level, the oxygen concentration in the exhaust gas becomes lean. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is rich (high voltage, i.e. higher than 0.45 V). The HO2 sensor has the property of changing its output voltage drastically when the air-fuel ratio is close to the stoichiometric level.

The ECM uses the supplementary information from the HO2 sensor to determine whether the air-fuel ratio after the TWC is rich or lean, and adjusts the fuel injection time accordingly. Thus, if the HO2 sensor is working improperly due to internal malfunctions, the ECM is unable to compensate for deviations in the primary air-fuel ratio control.



DTC Code	DTC Detection Condition	Trouble Area
P0136 P0156	• Abnormal voltage output: During active air-fuel ratio control, conditions (a) and (b) are met for a certain period of time (2 trip detection logic): (a) The Heated Oxygen (HO2) sensor voltage does not decrease to below 0.21 V. (b) The HO2 sensor voltage does not increase to higher than 0.59 V.	• Open or short in HO2 sensor (for bank 1, 2) circuit • HO2 sensor (for bank 1, 2) • HO2 sensor heater (for bank 1, 2) • Air-Fuel Ratio (A/F) sensor (for bank 1, 2) • Integration relay • Gas leakage from exhaust system
P0137 P0157	• Low voltage (open): During active air-fuel ratio control, conditions (a) and (b) are met for a certain period of time (2 trip detection logic): (a) The HO2 sensor voltage output is below 0.21 V. (b) The target air-fuel ratio is rich.	• Open in HO2 sensor (for bank 1, 2) circuit • HO2 sensor (for bank 1, 2) • HO2 sensor heater (for bank 1, 2) • Integration relay • Gas leakage from exhaust system
P0138 P0158	• High voltage (short): During active air-fuel ratio control, conditions (a) and (b) are met for a certain period of time (2 trip detection logic): (a) The HO2 sensor voltage output is higher than 0.59 V. (b) The target air-fuel ratio is lean.	• Short in HO2 sensor (for bank 1, 2) circuit • HO2 sensor (for bank 1, 2) • ECM internal circuit malfunction • Air-Fuel Ratio (A/F) sensor (for bank 1, 2)

MONITOR DESCRIPTION

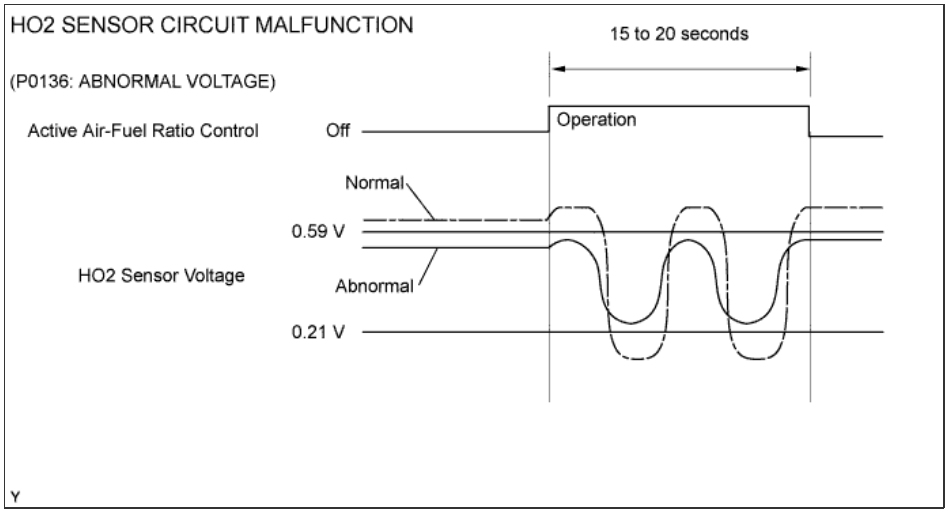
Active Air-Fuel Ratio Control

The ECM usually performs air-fuel ratio feedback control so that the Air-Fuel Ratio (A/F) sensor output indicates a near stoichiometric air-fuel level. This vehicle includes active air-fuel ratio control in addition to regular air-fuel ratio control. The ECM performs active air-fuel ratio control to detect any deterioration in the Three-Way Catalytic Converter (TWC) and Heated Oxygen (HO2) sensor malfunctions (refer to the diagram below).

Active air-fuel ratio control is performed for approximately 15 to 20 seconds while driving with a warm engine. During active air-fuel ratio control, the air-fuel ratio is forcibly regulated to become lean or rich by the ECM. If the ECM detects a malfunction, a DTC is stored.

Abnormal Voltage Output of HO2 Sensor (DTC P0136 and P0156)

While the ECM is performing active air-fuel ratio control, the air-fuel ratio is forcibly regulated to become rich or lean. If the sensor is not functioning properly, the voltage output variation is small. For example, when the HO2 sensor voltage does not decrease to below 0.21 V and does not increase to higher than 0.59 V during active air-fuel ratio control, the ECM determines that the sensor voltage output is abnormal and stores DTC P0136 or P0156.



Open or Short in Heated Oxygen (HO2) Sensor Circuit (DTC P0137 and P0157 or P0138 and P0158)

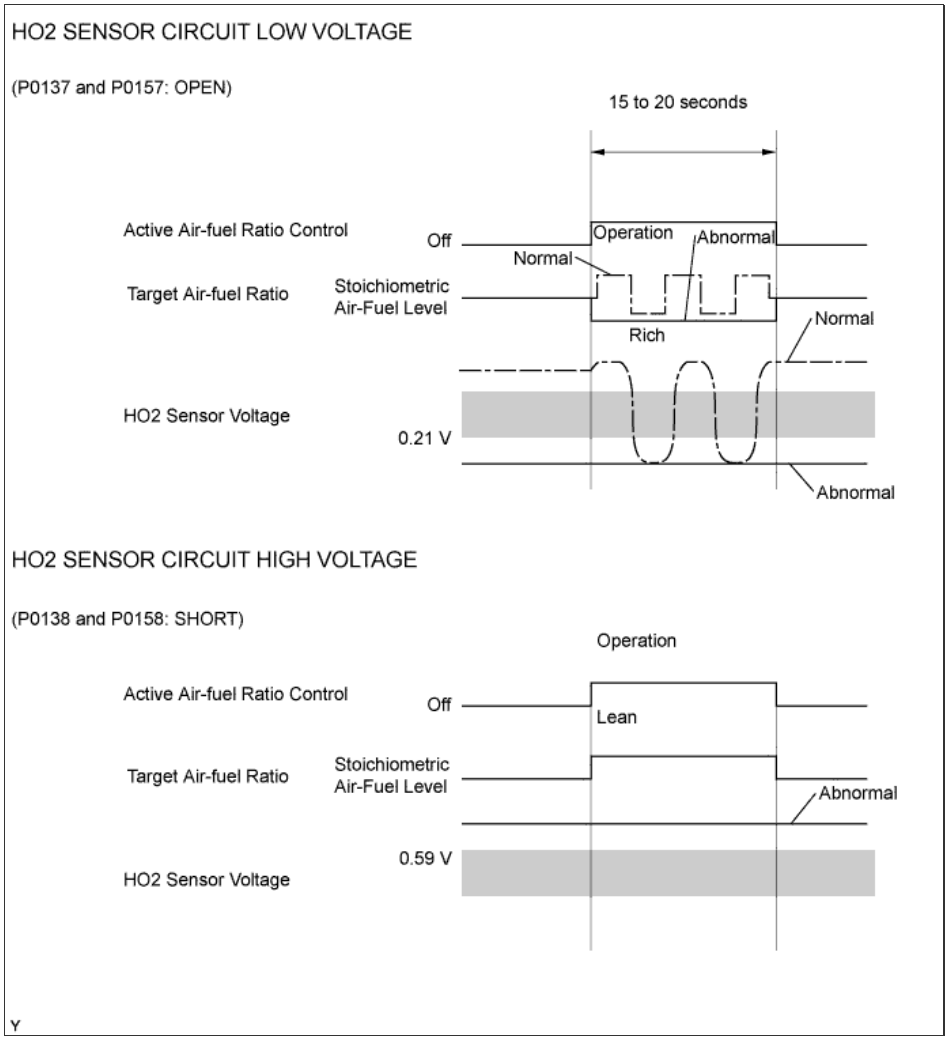
During active air-fuel ratio control, the ECM calculates the Oxygen Storage Capacity (OSC)* of the Three-Way Catalytic Converter (TWC) by forcibly regulating the air-fuel ratio to become rich or lean. If the HO2 sensor has an open or short, or the voltage output of the sensor decreases significantly, the OSC indicates an extraordinarily high value. Even if the ECM attempts to continue regulating the air-fuel ratio to become rich or lean, the HO2 sensor output does not change.

While performing active air-fuel ratio control, when the target air-fuel ratio is rich and the HO2 sensor voltage output is 0.21 V or less (lean), the ECM interprets this as an abnormally low sensor output voltage and stores DTC P0137 or P0157. When the target air-fuel ratio is lean and the voltage output is 0.59 V or higher (rich) during active air-fuel ratio control, the ECM determines that the sensor voltage output is abnormally high, and stores DTC P0138 or P0158.

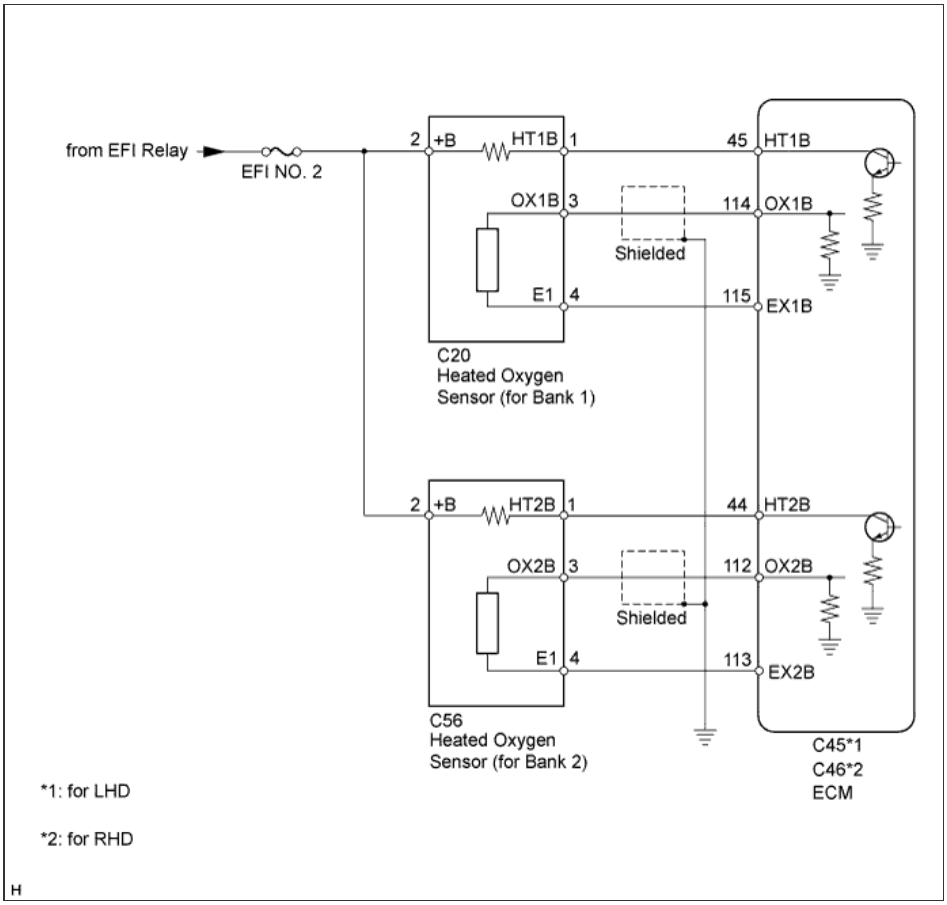
HINT:

DTC P0138 or P0158 is also stored if the HO2 sensor voltage output is higher than 1.2 V for 10 seconds or more.

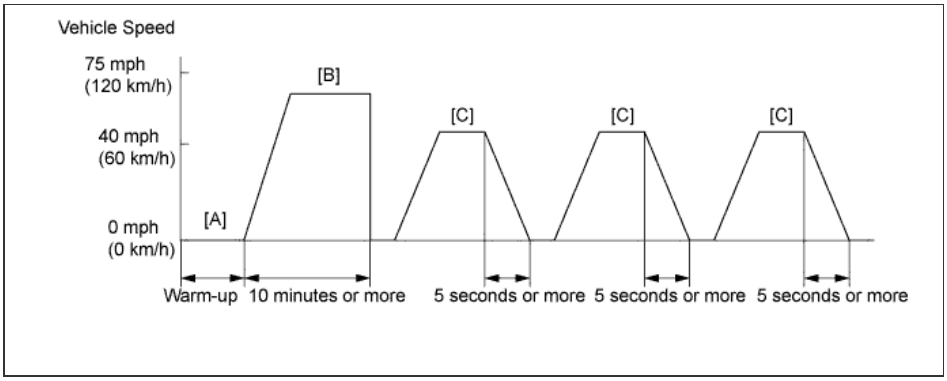
*: The TWC has the capability to store oxygen. The OSC and the emission purification capacity of the TWC are mutually related. The ECM determines whether the catalyst has deteriorated based on the calculated OSC value (Click here).



WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN



1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher [A].
4. Drive the vehicle at 60 to 120 km/h (40 to 75 mph) for 10 minutes or more [B].
5. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more. Perform this 3 times [C].
6. Turn the tester on.
7. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
8. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.
9. Check that DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern by accelerating and decelerating the vehicle.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.**

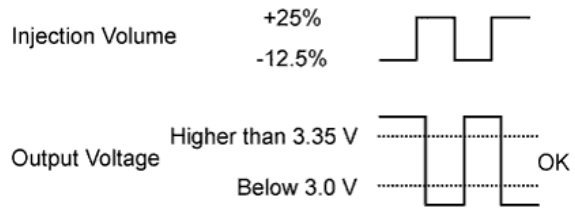
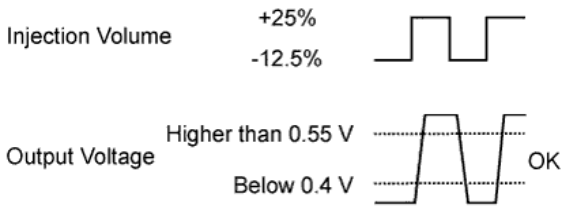
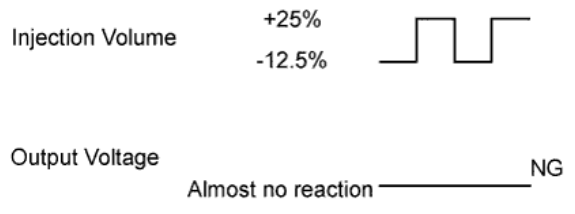
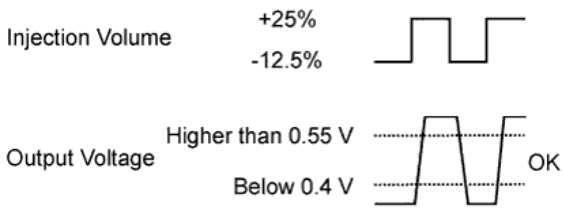
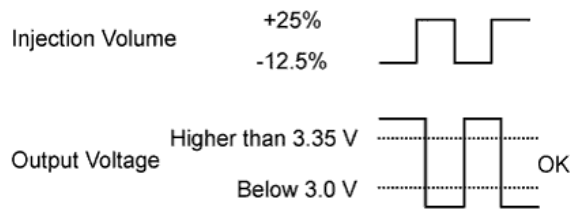
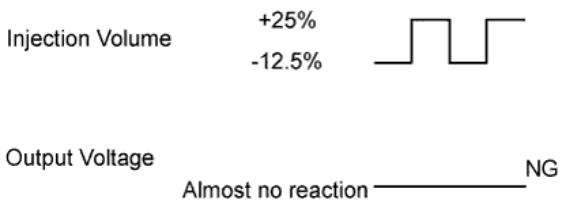
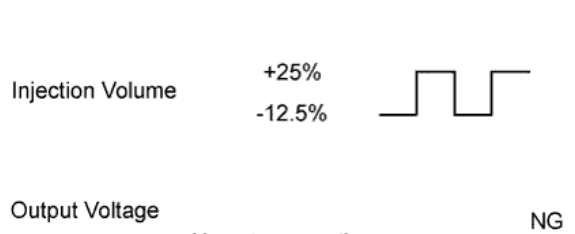
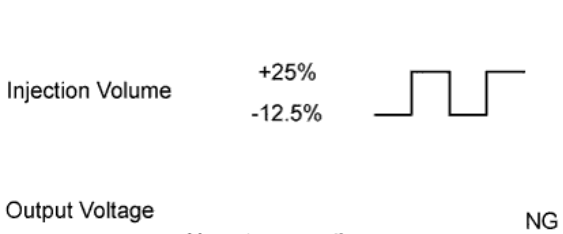
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 or AFS B2 S1 (A/F)	+25%	Rich	Below 3.0 V
AFS B1 S1 or AFS B2 S1 (A/F)	-12.5%	Lean	Higher than 3.35 V
O2S B1 S2 or O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55 V
O2S B1 S2 or O2S B2 S2 (HO2)	-12.5%	Lean	Below 0.4 V

NOTICE:

The Air-Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

HINT:

- **If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously terminal E2 may have an open circuit.**
- **Read free e frame data using the intelligent tester. Free e frame data records the engine condition when malfunctions are detected. When troubleshooting free e frame data can help determine if the vehicle was moving or stationary if the engine was warmed up or not if the air fuel ratio was lean or rich and other data from the time the malfunction occurred.**
- **If the OX1B wire from the ECM connector is short circuited to the B wire DTC P0136 will be stored.**
- **If the OX2B wire from the ECM connector is short circuited to the B wire DTC P0156 will be stored.**

1.READ OUTPUT DTC

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0138 or P0158 is output	A
P0137 or P0157 is output	B
P0136 or P0156 is output	C

B → Go to step 8

C → Go to step 6

A

2.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1 S2 or O2S B2 S2.

d. Allow the engine to idle.

e. Read the Heated Oxygen (HO2) sensor output voltage while idling.

Result

Result	Proceed to
Higher than 1.2 V	A
Below 1.0 V	B

O → o to step 5

NG → Go to step 3

3.INSPECT HEATED OXYGEN SENSOR (CHEC OR SHORT)

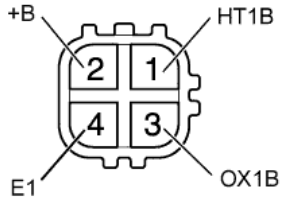
a. Disconnect the Heated Oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

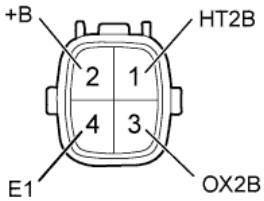
Standard Resistance:

Tester Connection	Condition	Specified Condition
2 (+B) - 3 (OX1B)	Always	10 kΩ or higher
2 (+B) - 4 (E1)	Always	10 kΩ or higher
2 (+B) - 3 (OX2B)	Always	10 kΩ or higher
2 (+B) - 4 (E1)	Always	10 kΩ or higher

Component without harness connected:
(HO2 Sensor for Bank 1)



Component without harness connected:
(HO2 Sensor for Bank 2)



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

O

CHEC HARNESS AND CONNECTOR (CHEC OR SHORT)

a. Turn the engine switch off and wait for 5 minutes.

b. Disconnect the ECM connector.

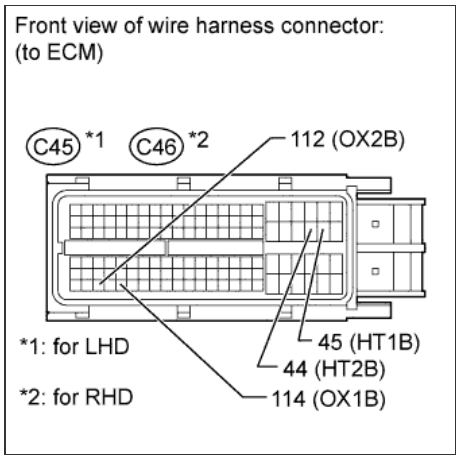
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C45-45 (HT1B) - C45-114 (OX1B)	Always	10 kΩ or higher
C45-44 (HT2B) - C45-112 (OX2B)	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C46-45 (HT1B) - C46-114 (OX1B)	Always	10 kΩ or higher
C46-44 (HT2B) - C46-112 (OX2B)	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

O

REPLACE ECM (Click here)

5.CHEC IR FUEL RATIO SENSOR CURRENT

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS B1 S1 or AFS B2 S1.

d. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher.

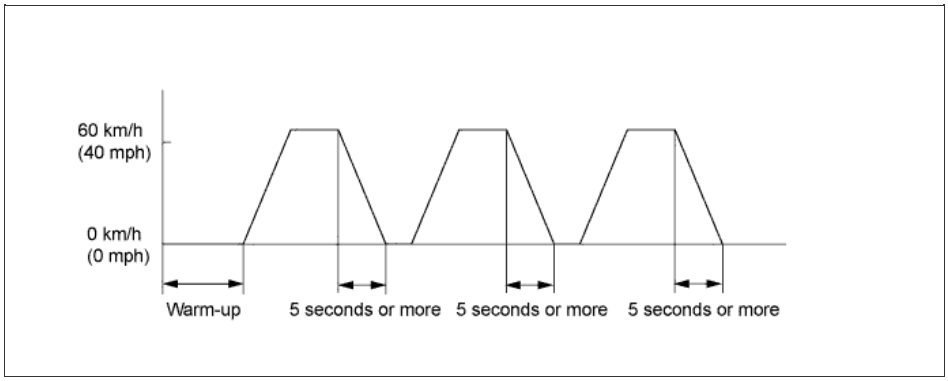
e. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more.
Perform this 3 times.

HINT:

If the tester shows Utility / Monitor Status / O2 Sensor / Incomplete again, increase the vehicle speed and use second gear to decelerate the vehicle.

f. Read the value.

Standard current:
Below 3.0 mA



O → o to step 12

NG → Go to step 14

6.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Start the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1 S2 or O2S B2 S2.

e. After warming up the engine, run the engine at an engine speed of 2500 rpm for 3 minutes.

f. Read the output voltage of the HO2 sensor when the engine speed is suddenly increased.

HINT:

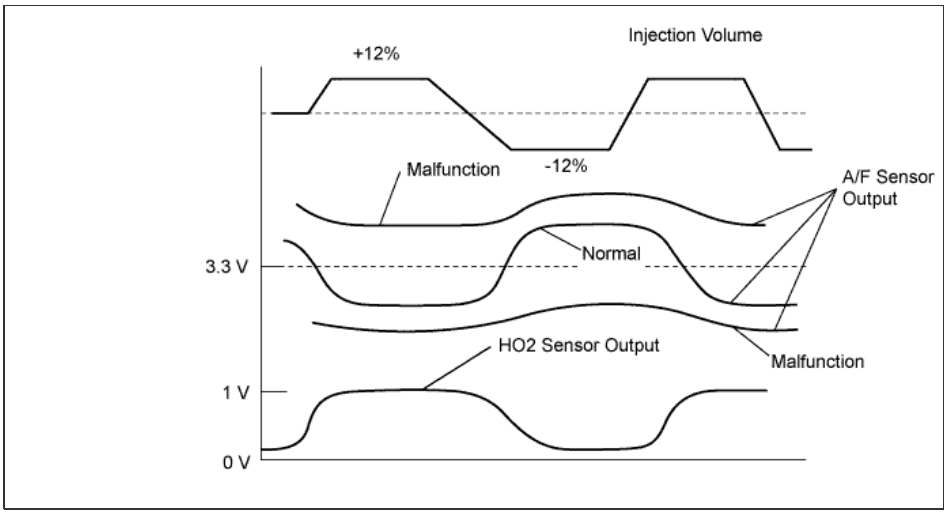
Quickly accelerate the engine to 4000 rpm 3 times using the accelerator pedal.

Standard voltage:
Fluctuates between 0.4 V or less and 0.5 V or higher.

NG	Go to step 8

O

7.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (IN ECTION VOLUME)



a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume.

e. Change the fuel injection volume using the tester, and monitor the voltage output of Air-Fuel Ratio (A/F) and HO2 sensors displayed on the tester.

HINT:

- **Change the fuel injection volume within the range of 12% and 12%. The injection volume can be changed in 1% graduations within the range.**
- **The A/F sensor is displayed as AFS B1 S1 or AFS B2 S1 and the HO2 sensor is displayed as O2S B1 S2 or O2S B2 S2 on the intelligent tester.**

Result:

Tester Display (Sensor)	Voltage Variation	Proceed to
AFS B1 S1 (A/F) AFS B2 S1 (A/F)	Alternates between higher than and below 3.3 V	OK
	Remains at higher than 3.3 V	NG
	Remains at below 3.3 V	NG

HINT:

A normal HO2 sensor voltage (O2S B1 S2 or O2S B2 S2) reacts in accordance with increases and decreases in fuel injection volumes. When the A/F sensor voltage remains at either below or higher than 3.3 V despite the HO2 sensor indicating a normal reaction, the A/F sensor is malfunctioning.

NG	Go to step 14

O

CHEC EXTREMELY RICH OR LEAN ACTUAL AIR EL RATIO AND REPAIR CAUSE (IN ECTOR EL PRESSURE LEAKAGE FROM EXHAUST SYSTEM, ETC.)

8.CHECK FOR EXHAUST GAS LEAK

a. Check for exhaust gas leakage from the exhaust manifold and pipe.

OK:
No exhaust gas leakage.

NG	REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT

OK

9.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

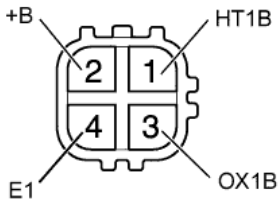
a. Disconnect the Heated Oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

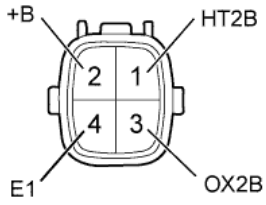
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT1B) - 4 (E1)	Always	10 kΩ or higher
1 (HT2B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT2B) - 4 (E1)	Always	10 kΩ or higher

Component without harness connected:
(HO2 Sensor for Bank 1)



Component without harness connected:
(HO2 Sensor for Bank 2)



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

10.INSPECT INTEGRATION RELAY (EFI RELAY)

a. Remove the integration relay from the engine room relay block.

b. Inspect the EFI MAIN fuse.

i. Remove the EFI MAIN fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAIN fuse	Always	Below 1 Ω

iii. Reinstall the EFI MAIN fuse.

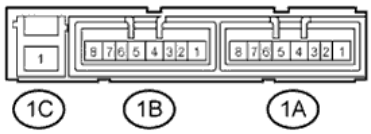
c. Inspect the EFI relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1B-4	When no battery voltage applied to terminals 1B-2 and 1B-3	10 kΩ or higher
	When battery voltage applied to terminals 1B-2 and 1B-3	Below 1 Ω

Component without harness connected:
(Integration Relay)



NG → REPLACE INTEGRATION RELAY

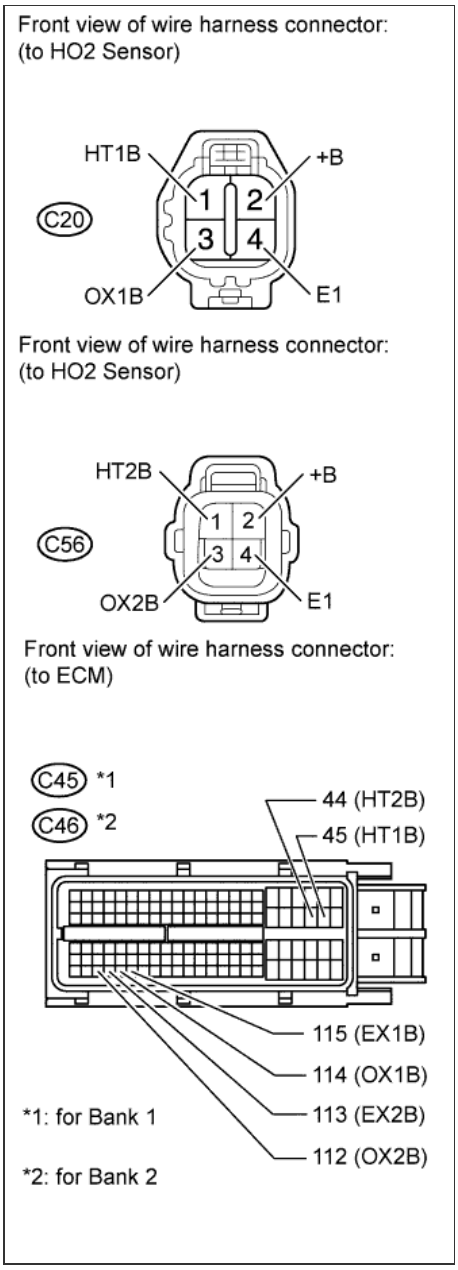
OK

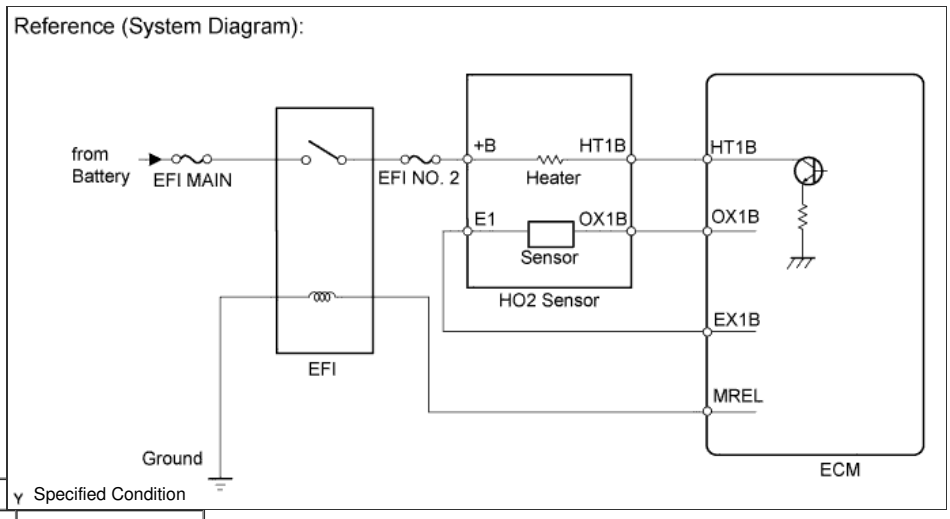
11.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)

a. Disconnect the HO2 sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:





Tester Connection	Switch Condition	Specified Condition
C20-2 (+B) - Body ground	Engine switch on (IG)	9 to 14 V
C56-2 (+B) - Body ground	Engine switch on (IG)	9 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.

e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C45-45 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C45-114 (OX1B)	Always	Below 1 Ω
C20-4 (E1) - C45-115 (EX1B)	Always	Below 1 Ω
C56-1 (HT2B) - C45-44 (HT2B)	Always	Below 1 Ω
C56-3 (OX2B) - C45-112 (OX2B)	Always	Below 1 Ω
C56-4 (E1) - C45-113 (EX2B)	Always	Below 1 Ω
C20-1 (HT1B) or C45-45 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C45-114 (OX1B) - Body ground	Always	10 kΩ or higher
C56-1 (HT2B) or C45-44 (HT2B) - Body ground	Always	10 kΩ or higher
C56-3 (OX2B) or C45-112 (OX2B) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C46-45 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C46-114 (OX1B)	Always	Below 1 Ω
C20-4 (E1) - C46-115 (EX1B)	Always	Below 1 Ω
C56-1 (HT2B) - C46-44 (HT2B)	Always	Below 1 Ω
C56-3 (OX2B) - C46-112 (OX2B)	Always	Below 1 Ω
C56-4 (E1) - C46-113 (EX2B)	Always	Below 1 Ω
C20-1 (HT1B) or C46-45 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C46-114 (OX1B) - Body ground	Always	10 kΩ or higher
C56-1 (HT2B) or C46-44 (HT2B) - Body ground	Always	10 kΩ or higher
C56-3 (OX2B) or C46-112 (OX2B) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE HEATED OXYGEN SENSOR (Click here)

12.REPLACE HEATED OXYGEN SENSOR

a. Replace the heated oxygen sensor (Click here).

NEXT

13.PERFORM CONFIRMATION DRIVING PATTERN

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher.

d. Drive the vehicle at 60 to 120 km/h (40 to 75 mph) for 10 minutes.

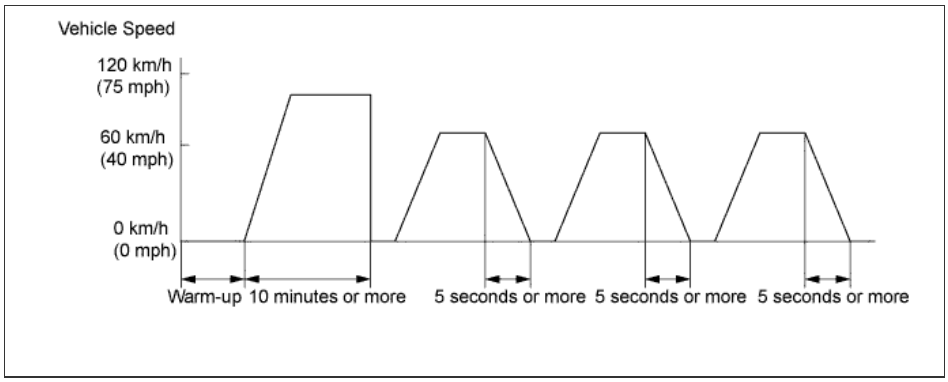
e. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more. Perform this 3 times.

f. Turn the tester on.

g. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

h. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

i. Check that DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern increasing the vehicle speed and using second gear to decelerate the vehicle.



NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK → END

14.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

15.PERFORM CONFIRMATION DRIVING PATTERN

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Clear the DTCs.

d. Switch the ECM from normal mode to check mode using the tester.

e. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher.

f. Drive the vehicle at 60 to 120 km/h (40 to 75 mph) for 10 minutes.

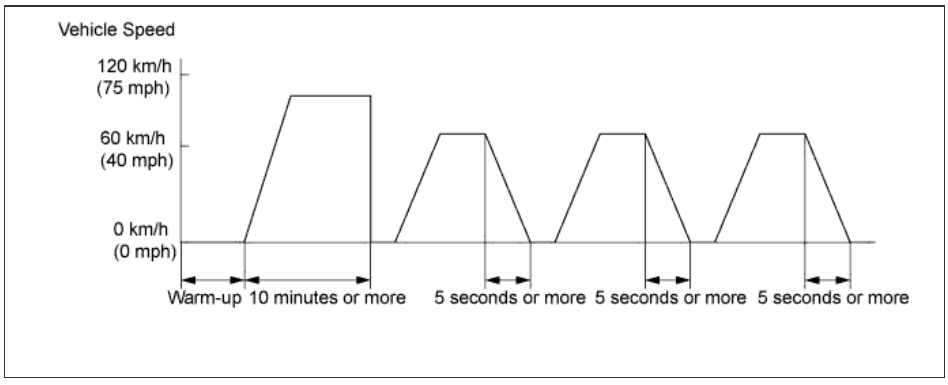
g. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more. Perform this 3 times.

h. Turn the tester on.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

k. Check that DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern increasing the vehicle speed and using second gear to decelerate the vehicle.



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

END

DTC P1613 Secondary Air Injection Driver Malfunction

for Preparation Click here

DESCRIPTION

The diagnostic trouble code (DTC) indicates an open or short in the air injection control driver circuit of the secondary air injection (AIR) system. The air injection control driver diagnoses the air pump circuit, E-ASV circuit and itself, and sends the diagnosis signal to the engine control module (ECM). If the ECM receives a malfunction signal from the air injection control driver, the ECM illuminates the malfunction indicator lamp (MIL), and stores a DTC.
The secondary air injection (AIR) system introduces fresh air into the exhaust manifold in order to reduce carbon monoxide (CO) and hydrocarbon (HC) in the exhaust emission. This system is activated just after engine start, and is stopped when the catalyst converter is warmed-up. This system consists of the following components: 1) the air pump which sends fresh air to the exhaust manifold, 2) the electric air switching valve (E-ASV) which switches the fresh air flow, 3) the air switching valve (ASV) which switches the air passage to the exhaust manifold of each bank, 4) the vacuum switching valve (VSV) which switches the vacuum (intake manifold pressure) to operate the ASV, 5) the pressure sensor which detects the fresh air pressure and exhaust pulse, 6) the air injection control driver which controls the power sources of the air pump and E-ASV, 7) the engine control module (ECM) which controls and monitors this system.

DTC Code	DTC Detection Condition	Trouble Area
P1613	The ECM receives a diagnostic signal from the driver (duty-cycle: 0%, 100% or other than 0, 20, 40, 60, 80, or 100%).	• Air injection control driver • ECM • Diagnostic signal circuit (Driver - ECM)

WIRING DIAGRAM

Refer to DTC P0412 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK AIR INJECTION CONTROL DRIVER

a. Inspection 1.

i. Disconnect the air injection control driver connector.

ii. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C61-5 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

b. Inspection 2.

i. Disconnect the air injection control driver connector.

ii. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C60-1 (BATT) - Body ground	Engine switch on (IG)	11 to 14 V

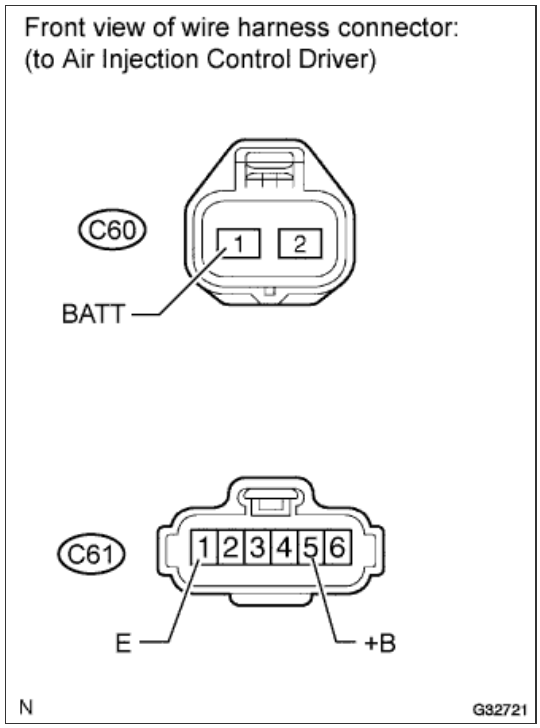
c. Inspection 3.

i. Disconnect the air injection control driver connector.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C61-1 (E) - Body ground	Always	Below 1 Ω



Result

Result	Proceed to
OK	A
Inspection 1 NG	B
Inspection 2 NG	C
Inspection 3 NG	D

B → Go to step 4

C → Go to step 5

D → REPAIR OR REPLACE HARNESS OR CONNECTOR

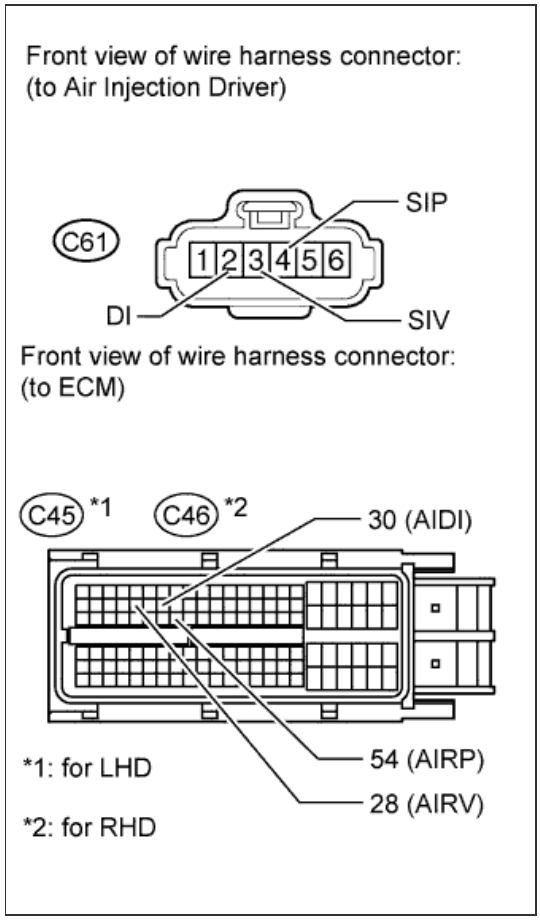
A

2.CHECK HARNESS AND CONNECTOR (AIR INJECTION CONTROL DRIVER - ECM)

a. Disconnect the ECM connector.

b. Disconnect the air injection control driver connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C61-3 (SIV) - C45-28 (AIRV)	Always	Below 1 Ω
C61-4 (SIP) - C45-54 (AIRP)	Always	Below 1 Ω
C61-2 (DI) - C45-30 (AIDI)	Always	Below 1 Ω
C61-3 (SIV) or C45-28 (AIRV) - Body ground	Always	10 kΩ or higher
C61-4 (SIP) or C45-54 (AIRP) - Body ground	Always	10 kΩ or higher
C61-2 (DI) or C45-30 (AIDI) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C61-3 (SIV) - C46-28 (AIRV)	Always	Below 1 Ω
C61-4 (SIP) - C46-54 (AIRP)	Always	Below 1 Ω
C61-2 (DI) - C46-30 (AIDI)	Always	Below 1 Ω
C61-3 (SIV) or C46-28 (AIRV) - Body ground	Always	10 kΩ or higher
C61-4 (SIP) or C46-54 (AIRP) - Body ground	Always	10 kΩ or higher
C61-2 (DI) or C46-30 (AIDI) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK ECM (AIDI VOLTAGE)

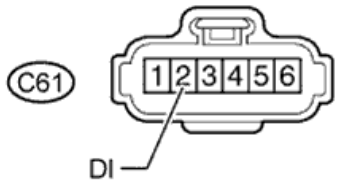
a. Disconnect the air injection control driver connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C61-2 (DI) - Body ground	Engine switch on (IG)	11 to 14 V

Front view of wire harness connector:
(to Air Injection Control Driver)



OK → Go to step 6

NG → REPLACE ECM (Click here)

4.CHECK HARNESS AND CONNECTOR (AIR INJECTION CONTROL DRIVER - EFI NO. 2 FUSE)

a. Disconnect the air injection control driver connector.

b. Remove the EFI NO. 2 fuse from the engine room relay block.

c. Measure the resistance according to the value(s) in the table below.

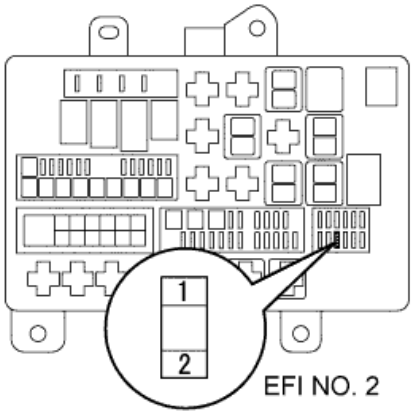
Standard Resistance:

Tester Connection	Condition	Specified Condition
C61-5 (+B) - EFI NO. 2 fuse (2)	Always	Below 1 Ω
C61-5 (+B) or EFI NO. 2 fuse (2) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Air Injection Control Driver)



Engine Room Relay Block:



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ECU POWER SOURCE CIRCUIT (Click here)

5.CHECK HARNESS OR CONNECTOR (BATTERY - A/PUMP FUSE)

a. Remove the A/PUMP fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/PUMP Fuse	Always	Below 1 Ω

NG → CHECK FOR SHORTS IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - A/PUMP FUSE)

6.REPLACE AIR INJECTION CONTROL DRIVER

a. Replace the air injection control driver (Click here).

NEXT

7.CHECK WHETHER DTC OUTPUT RECURS (DTC P1613)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine.

e. Perform the Active Test to operate the air injection system.
Enter the following menus: Powertrain / Engine and ECT / Utility / Secondary Air Injection Check (Automatic Mode).

f. After operating the secondary air injection system, confirm the pending codes of the secondary air injection system by entering the following menus: Powertrain / Engine and ECT / DTC / Pending codes.

Result

Result	Proceed to
No DTC is output	A
P1613 is output	B

NOTICE:

- **When performing the Secondary Air Injection Check operation after the battery cable has been reconnected, wait for 7 minutes with the engine switch turned on (IG) or the engine running.**
- **Turn the engine switch off when the Secondary Air Injection Check operation finishes.**

B → REPLACE ECM (Click here)

A

END

DTC P0136 Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)

DTC P0137 Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)

DTC P0138 Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)

DTC P0156 Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)

DTC P0157 Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)

DTC P0158 Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)

for Preparation Click here

DESCRIPTION

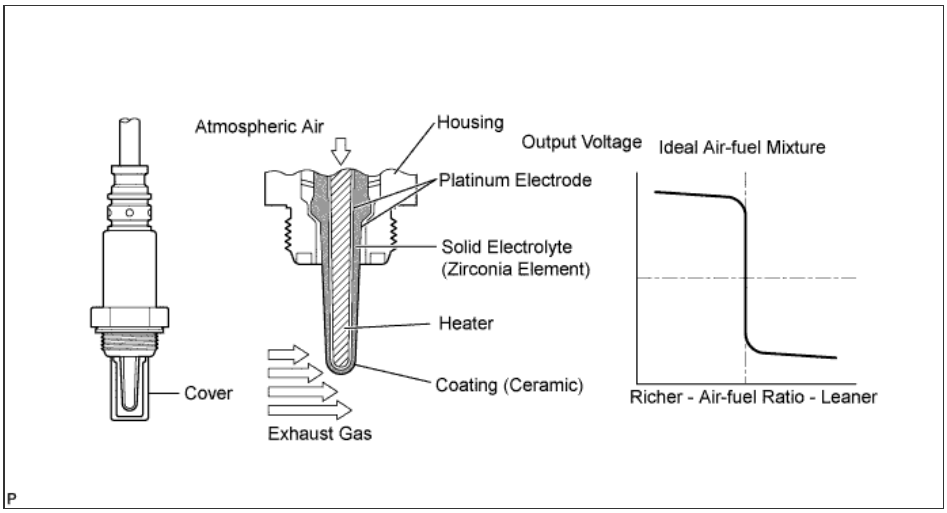
In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric air-fuel level. For the purpose of helping the ECM to deliver accurate air-fuel ratio control, a Heated Oxygen (HO2) sensor is used.

The HO2 sensor is located behind the TWC, and detects the oxygen concentration in the exhaust gas. Since the sensor is integrated with a heater that heats the sensing portion, it is possible to detect the oxygen concentration even when the intake air volume is low (the exhaust gas temperature is low).

When the air-fuel ratio becomes lean, the oxygen concentration in the exhaust gas is rich. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is lean (low voltage, i.e. below 0.45 V).

Conversely, when the air-fuel ratio is richer than the stoichiometric air-fuel level, the oxygen concentration in the exhaust gas becomes lean. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is rich (high voltage, i.e. higher than 0.45 V). The HO2 sensor has the property of changing its output voltage drastically when the air-fuel ratio is close to the stoichiometric level.

The ECM uses the supplementary information from the HO2 sensor to determine whether the air-fuel ratio after the TWC is rich or lean, and adjusts the fuel injection time accordingly. Thus, if the HO2 sensor is working improperly due to internal malfunctions, the ECM is unable to compensate for deviations in the primary air-fuel ratio control.



DTC Code	DTC Detection Condition	Trouble Area
P0136 P0156	• Abnormal voltage output: During active air-fuel ratio control, conditions (a) and (b) are met for a certain period of time (2 trip detection logic): (a) The Heated Oxygen (HO2) sensor voltage does not decrease to below 0.21 V. (b) The HO2 sensor voltage does not increase to higher than 0.59 V.	• Open or short in HO2 sensor (for bank 1, 2) circuit • HO2 sensor (for bank 1, 2) • HO2 sensor heater (for bank 1, 2) • Air-Fuel Ratio (A/F) sensor (for bank 1, 2) • Integration relay • Gas leakage from exhaust system
P0137 P0157	• Low voltage (open): During active air-fuel ratio control, conditions (a) and (b) are met for a certain period of time (2 trip detection logic): (a) The HO2 sensor voltage output is below 0.21 V. (b) The target air-fuel ratio is rich.	• Open in HO2 sensor (for bank 1, 2) circuit • HO2 sensor (for bank 1, 2) • HO2 sensor heater (for bank 1, 2) • Integration relay • Gas leakage from exhaust system
P0138 P0158	• High voltage (short): During active air-fuel ratio control, conditions (a) and (b) are met for a certain period of time (2 trip detection logic): (a) The HO2 sensor voltage output is higher than 0.59 V. (b) The target air-fuel ratio is lean.	• Short in HO2 sensor (for bank 1, 2) circuit • HO2 sensor (for bank 1, 2) • ECM internal circuit malfunction • Air-Fuel Ratio (A/F) sensor (for bank 1, 2)

MONITOR DESCRIPTION

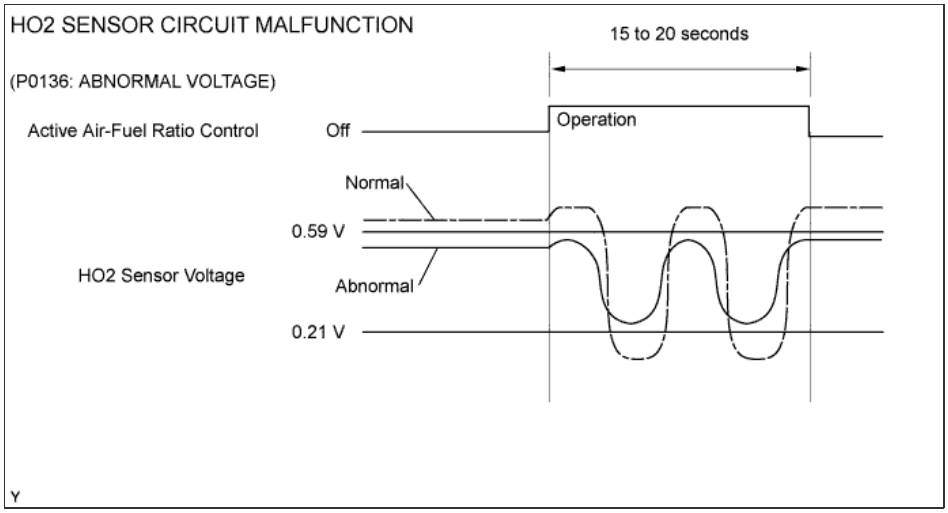
Active Air-Fuel Ratio Control

The ECM usually performs air-fuel ratio feedback control so that the Air-Fuel Ratio (A/F) sensor output indicates a near stoichiometric air-fuel level. This vehicle includes active air-fuel ratio control in addition to regular air-fuel ratio control. The ECM performs active air-fuel ratio control to detect any deterioration in the Three-Way Catalytic Converter (TWC) and Heated Oxygen (HO2) sensor malfunctions (refer to the diagram below).

Active air-fuel ratio control is performed for approximately 15 to 20 seconds while driving with a warm engine. During active air-fuel ratio control, the air-fuel ratio is forcibly regulated to become lean or rich by the ECM. If the ECM detects a malfunction, a DTC is stored.

Abnormal Voltage Output of HO2 Sensor (DTC P0136 and P0156)

While the ECM is performing active air-fuel ratio control, the air-fuel ratio is forcibly regulated to become rich or lean. If the sensor is not functioning properly, the voltage output variation is small. For example, when the HO2 sensor voltage does not decrease to below 0.21 V and does not increase to higher than 0.59 V during active air-fuel ratio control, the ECM determines that the sensor voltage output is abnormal and stores DTC P0136 or P0156.



Open or Short in Heated Oxygen (HO2) Sensor Circuit (DTC P0137 and P0157 or P0138 and P0158)

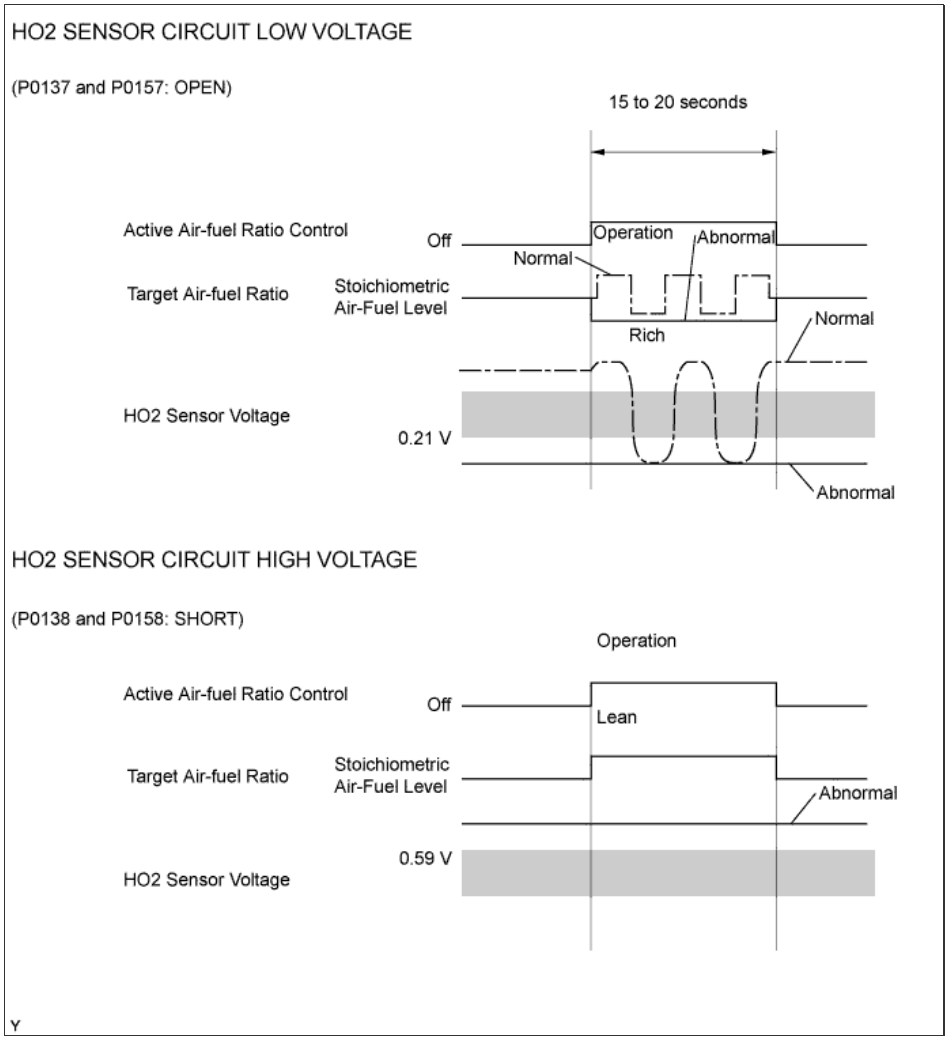
During active air-fuel ratio control, the ECM calculates the Oxygen Storage Capacity (OSC)* of the Three-Way Catalytic Converter (TWC) by forcibly regulating the air-fuel ratio to become rich or lean. If the HO2 sensor has an open or short, or the voltage output of the sensor decreases significantly, the OSC indicates an extraordinarily high value. Even if the ECM attempts to continue regulating the air-fuel ratio to become rich or lean, the HO2 sensor output does not change.

While performing active air-fuel ratio control, when the target air-fuel ratio is rich and the HO2 sensor voltage output is 0.21 V or less (lean), the ECM interprets this as an abnormally low sensor output voltage and stores DTC P0137 or P0157. When the target air-fuel ratio is lean and the voltage output is 0.59 V or higher (rich) during active air-fuel ratio control, the ECM determines that the sensor voltage output is abnormally high, and stores DTC P0138 or P0158.

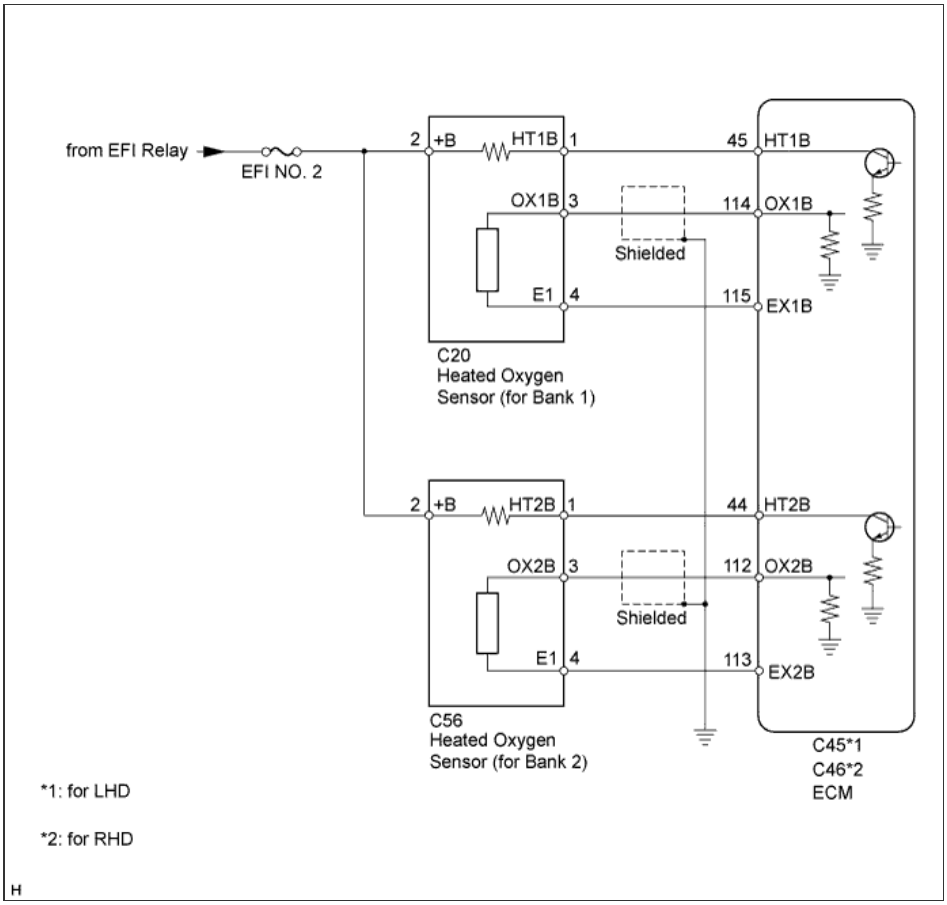
HINT:

DTC P0138 or P0158 is also stored if the HO2 sensor voltage output is higher than 1.2 V for 10 seconds or more.

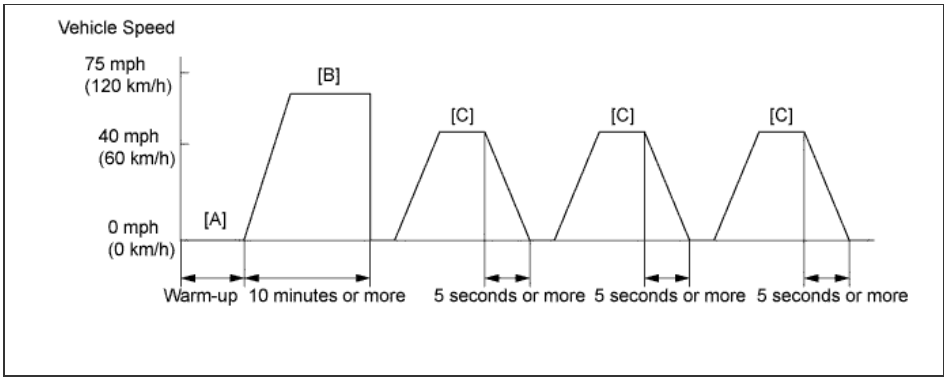
*: The TWC has the capability to store oxygen. The OSC and the emission purification capacity of the TWC are mutually related. The ECM determines whether the catalyst has deteriorated based on the calculated OSC value (Click here).



WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN



1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher [A].
4. Drive the vehicle at 60 to 120 km/h (40 to 75 mph) for 10 minutes or more [B].
5. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more. Perform this 3 times [C].
6. Turn the tester on.
7. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
8. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.
9. Check that DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern by accelerating and decelerating the vehicle.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.**

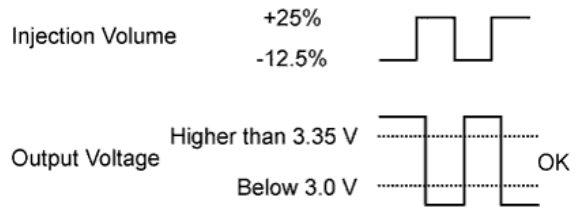
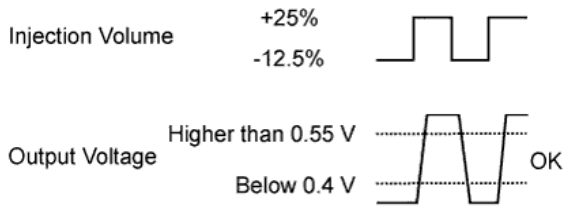
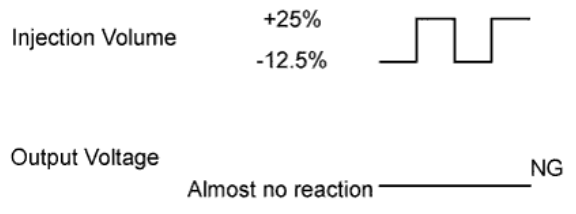
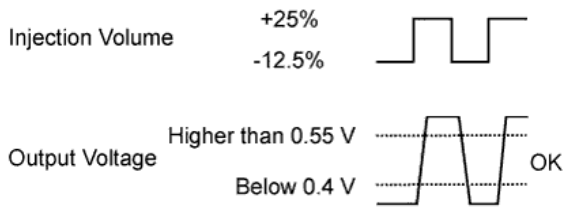
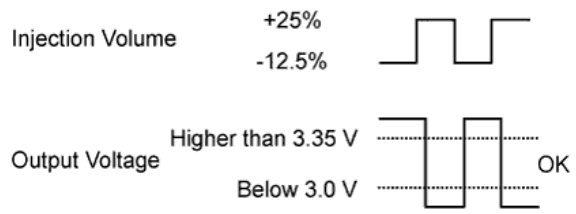
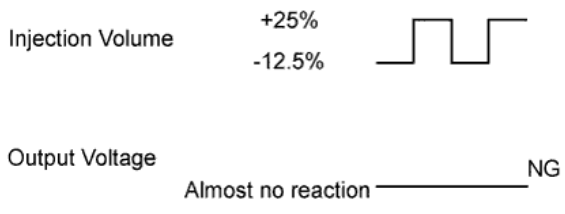
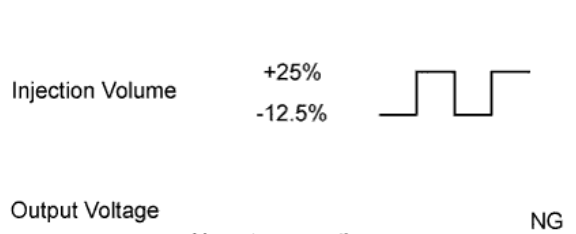
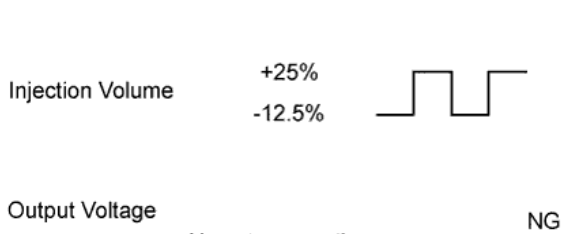
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 or AFS B2 S1 (A/F)	+25%	Rich	Below 3.0 V
AFS B1 S1 or AFS B2 S1 (A/F)	-12.5%	Lean	Higher than 3.35 V
O2S B1 S2 or O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55 V
O2S B1 S2 or O2S B2 S2 (HO2)	-12.5%	Lean	Below 0.4 V

NOTICE:

The Air-Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

HINT:

- **If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the OX1B wire from the ECM connector is short-circuited to the +B wire, DTC P0136 will be stored.**
- **If the OX2B wire from the ECM connector is short-circuited to the +B wire, DTC P0156 will be stored.**

1.READ OUTPUT DTC

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0138 or P0158 is output	A
P0137 or P0157 is output	B
P0136 or P0156 is output	C

B → Go to step 8

C → Go to step 6

A

2.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1 S2 or O2S B2 S2.

d. Allow the engine to idle.

e. Read the Heated Oxygen (HO2) sensor output voltage while idling.

Result

Result	Proceed to
Higher than 1.2 V	A
Below 1.0 V	B

OK → Go to step 5

NG → Go to step 3

3.INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)

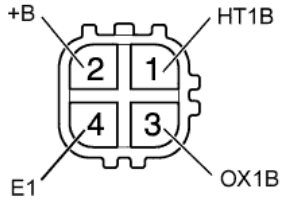
a. Disconnect the Heated Oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

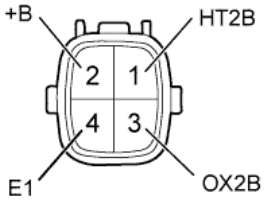
Standard Resistance:

Tester Connection	Condition	Specified Condition
2 (+B) - 3 (OX1B)	Always	10 kΩ or higher
2 (+B) - 4 (E1)	Always	10 kΩ or higher
2 (+B) - 3 (OX2B)	Always	10 kΩ or higher
2 (+B) - 4 (E1)	Always	10 kΩ or higher

Component without harness connected:
(HO2 Sensor for Bank 1)



Component without harness connected:
(HO2 Sensor for Bank 2)



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

4.CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT)

a. Turn the engine switch off and wait for 5 minutes.

b. Disconnect the ECM connector.

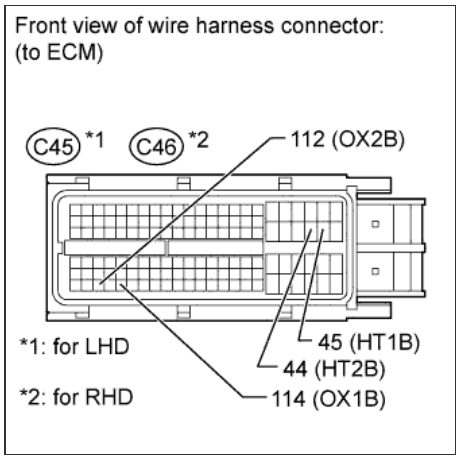
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C45-45 (HT1B) - C45-114 (OX1B)	Always	10 kΩ or higher
C45-44 (HT2B) - C45-112 (OX2B)	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C46-45 (HT1B) - C46-114 (OX1B)	Always	10 kΩ or higher
C46-44 (HT2B) - C46-112 (OX2B)	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

5.CHECK AIR FUEL RATIO SENSOR CURRENT

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS B1 S1 or AFS B2 S1.

d. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher.

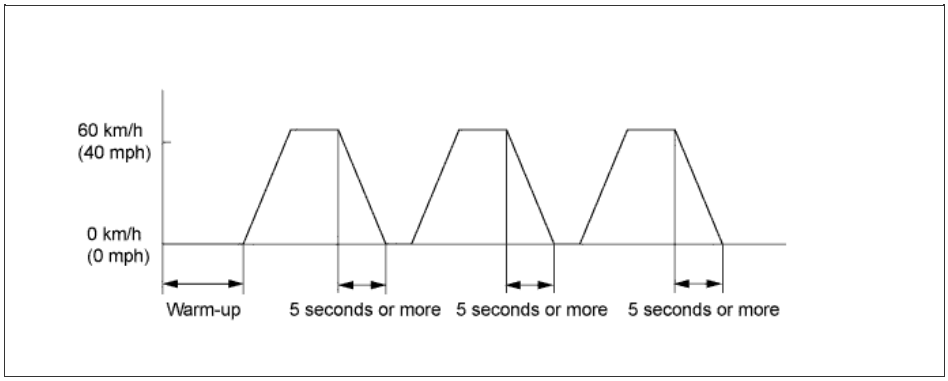
e. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more.
Perform this 3 times.

HINT:

If the tester shows Utility / Monitor Status / O2 Sensor / Incomplete again, increase the vehicle speed and use second gear to decelerate the vehicle.

f. Read the value.

Standard current:
Below 3.0 mA



OK → Go to step 12

NG → Go to step 14

6.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Start the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1 S2 or O2S B2 S2.

e. After warming up the engine, run the engine at an engine speed of 2500 rpm for 3 minutes.

f. Read the output voltage of the HO2 sensor when the engine speed is suddenly increased.

HINT:

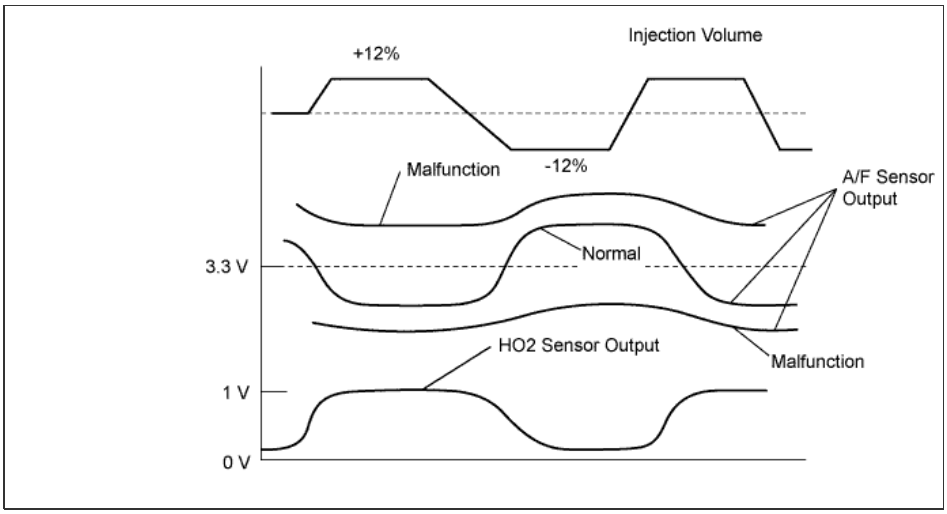
Quickly accelerate the engine to 4000 rpm 3 times using the accelerator pedal.

Standard voltage:
Fluctuates between 0.4 V or less and 0.5 V or higher.

NG	Go to step 8

OK

7.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (INJECTION VOLUME)



a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume.

e. Change the fuel injection volume using the tester, and monitor the voltage output of Air-Fuel Ratio (A/F) and HO2 sensors displayed on the tester.

HINT:

- **Change the fuel injection volume within the range of -12% and +12%. The injection volume can be changed in 1% graduations within the range.**
- **The A/F sensor is displayed as AFS B1 S1 or AFS B2 S1, and the HO2 sensor is displayed as O2S B1 S2 or O2S B2 S2, on the intelligent tester.**

Result:

Tester Display (Sensor)	Voltage Variation	Proceed to
AFS B1 S1 (A/F) AFS B2 S1 (A/F)	Alternates between higher than and below 3.3 V	OK
	Remains at higher than 3.3 V	NG
	Remains at below 3.3 V	NG

HINT:

A normal HO2 sensor voltage (O2S B1 S2 or O2S B2 S2) reacts in accordance with increases and decreases in fuel injection volumes. When the A/F sensor voltage remains at either below or higher than 3.3 V despite the HO2 sensor indicating a normal reaction, the A/F sensor is malfunctioning.

NG	Go to step 14

OK

CHECK EXTREMELY RICH OR LEAN ACTUAL AIR-FUEL RATIO AND REPAIR CAUSE (INJECTOR, FUEL PRESSURE, GAS LEAKAGE FROM EXHAUST SYSTEM, ETC.)

8.CHECK FOR EXHAUST GAS LEAK

a. Check for exhaust gas leakage from the exhaust manifold and pipe.

OK:
No exhaust gas leakage.

NG	REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT

OK

9.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

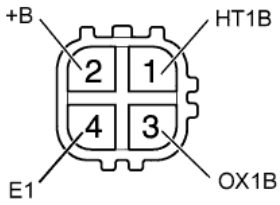
a. Disconnect the Heated Oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

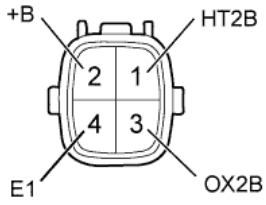
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT1B) - 4 (E1)	Always	10 kΩ or higher
1 (HT2B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT2B) - 4 (E1)	Always	10 kΩ or higher

Component without harness connected:
(HO2 Sensor for Bank 1)



Component without harness connected:
(HO2 Sensor for Bank 2)



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

10.INSPECT INTEGRATION RELAY (EFI RELAY)

a. Remove the integration relay from the engine room relay block.

b. Inspect the EFI MAIN fuse.

i. Remove the EFI MAIN fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAIN fuse	Always	Below 1 Ω

iii. Reinstall the EFI MAIN fuse.

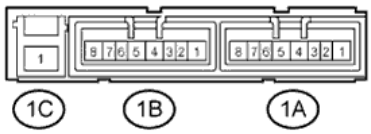
c. Inspect the EFI relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1B-4	When no battery voltage applied to terminals 1B-2 and 1B-3	10 kΩ or higher
	When battery voltage applied to terminals 1B-2 and 1B-3	Below 1 Ω

Component without harness connected:
(Integration Relay)



NG → REPLACE INTEGRATION RELAY

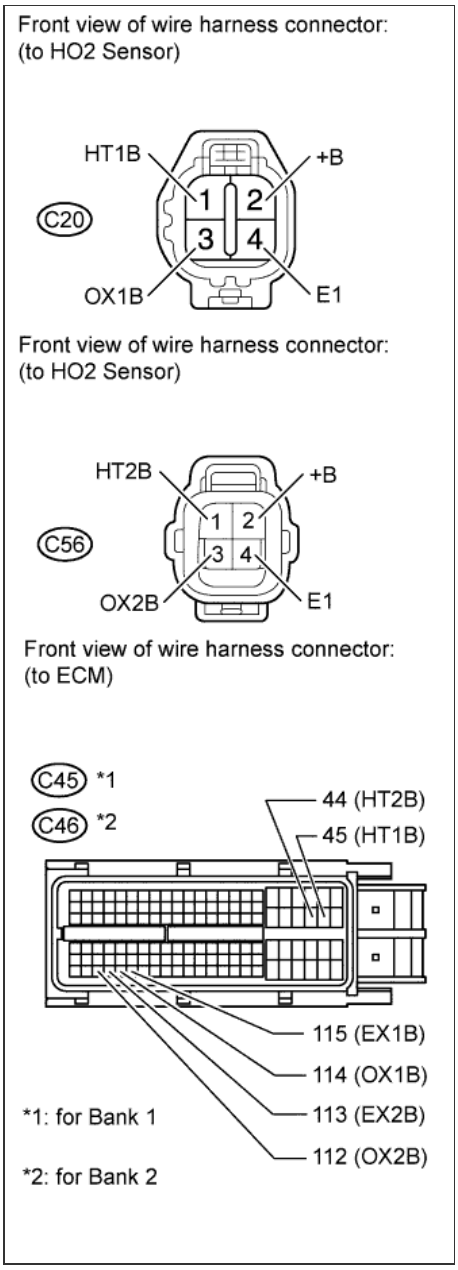
OK

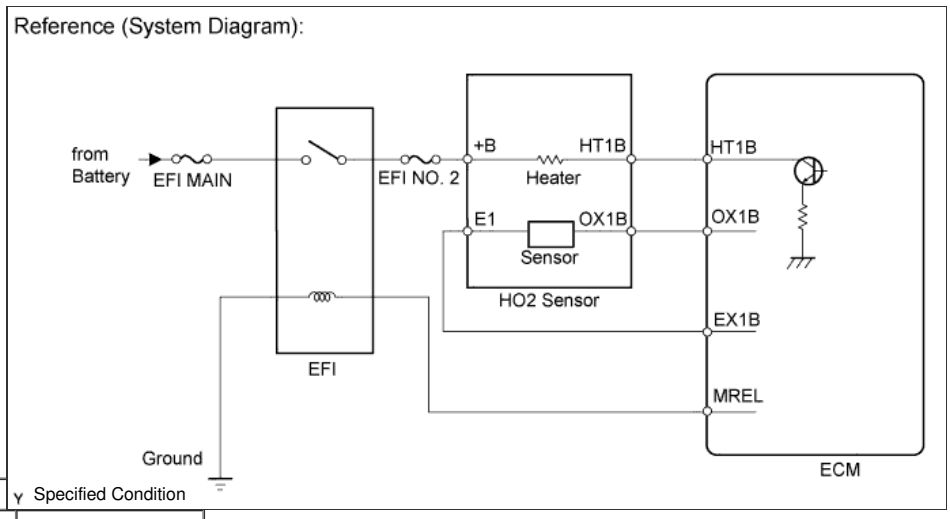
11.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)

a. Disconnect the HO2 sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:





Tester Connection	Switch Condition	Specified Condition
C20-2 (+B) - Body ground	Engine switch on (IG)	9 to 14 V
C56-2 (+B) - Body ground	Engine switch on (IG)	9 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.

e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C45-45 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C45-114 (OX1B)	Always	Below 1 Ω
C20-4 (E1) - C45-115 (EX1B)	Always	Below 1 Ω
C56-1 (HT2B) - C45-44 (HT2B)	Always	Below 1 Ω
C56-3 (OX2B) - C45-112 (OX2B)	Always	Below 1 Ω
C56-4 (E1) - C45-113 (EX2B)	Always	Below 1 Ω
C20-1 (HT1B) or C45-45 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C45-114 (OX1B) - Body ground	Always	10 kΩ or higher
C56-1 (HT2B) or C45-44 (HT2B) - Body ground	Always	10 kΩ or higher
C56-3 (OX2B) or C45-112 (OX2B) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C46-45 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C46-114 (OX1B)	Always	Below 1 Ω
C20-4 (E1) - C46-115 (EX1B)	Always	Below 1 Ω
C56-1 (HT2B) - C46-44 (HT2B)	Always	Below 1 Ω
C56-3 (OX2B) - C46-112 (OX2B)	Always	Below 1 Ω
C56-4 (E1) - C46-113 (EX2B)	Always	Below 1 Ω
C20-1 (HT1B) or C46-45 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C46-114 (OX1B) - Body ground	Always	10 kΩ or higher
C56-1 (HT2B) or C46-44 (HT2B) - Body ground	Always	10 kΩ or higher
C56-3 (OX2B) or C46-112 (OX2B) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE HEATED OXYGEN SENSOR (Click here)

12.REPLACE HEATED OXYGEN SENSOR

a. Replace the heated oxygen sensor (Click here).

NEXT

13.PERFORM CONFIRMATION DRIVING PATTERN

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher.

d. Drive the vehicle at 60 to 120 km/h (40 to 75 mph) for 10 minutes.

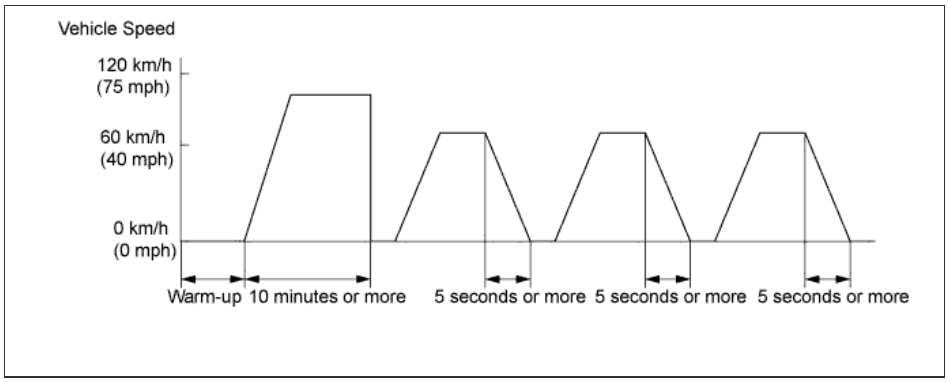
e. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more. Perform this 3 times.

f. Turn the tester on.

g. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

h. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

i. Check that DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern increasing the vehicle speed and using second gear to decelerate the vehicle.



NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK → END

14.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

15.PERFORM CONFIRMATION DRIVING PATTERN

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Clear the DTCs.

d. Switch the ECM from normal mode to check mode using the tester.

e. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher.

f. Drive the vehicle at 60 to 120 km/h (40 to 75 mph) for 10 minutes.

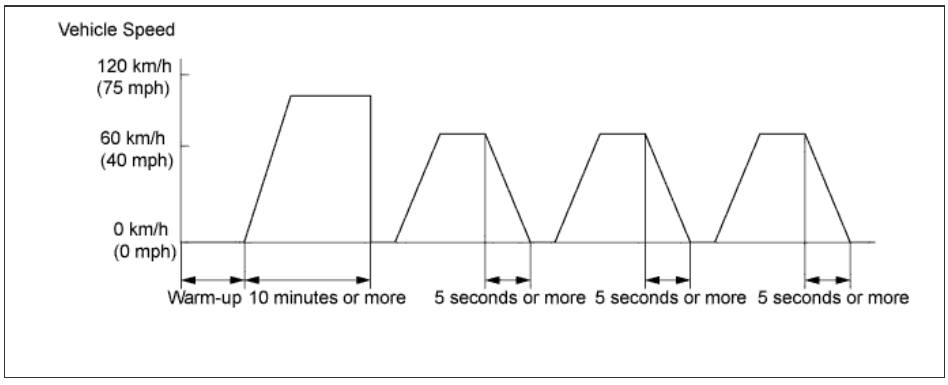
g. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more. Perform this 3 times.

h. Turn the tester on.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

k. Check that DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern increasing the vehicle speed and using second gear to decelerate the vehicle.



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

END

DTC P2102 Throttle Actuator Control Motor Circuit Low

DTC P2103 Throttle Actuator Control Motor Circuit High

for Preparation Click here

DESCRIPTION

The throttle actuator is operated by the ECM and opens and closes the throttle valve using gears.
The opening angle of the throttle valve is detected by the Throttle Position (TP) sensor, which is mounted on the throttle body. The TP sensor provides feedback to the ECM. This feedback allows the ECM to appropriately control the throttle actuator and monitor the throttle opening angle as the ECM responds to driver inputs.

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

DTC Code	DTC Detection Condition	Trouble Area
P2102	Conditions (a) and (b) continue for 2.0 seconds (1 trip detection logic): (a) The throttle actuator duty ratio is 80% or more. (b) The throttle actuator current is below 0.5 A.	• **Open in throttle actuator circuit** • **Throttle actuator** • **ECM**
P2103	Either of the following conditions are met (1 trip detection logic): • **A hybrid IC diagnosis signal failure.** • **A hybrid IC current limiter port failure.**	• **Short in throttle actuator circuit** • **Throttle actuator** • **Throttle valve** • **Throttle body assembly** • **ECM**

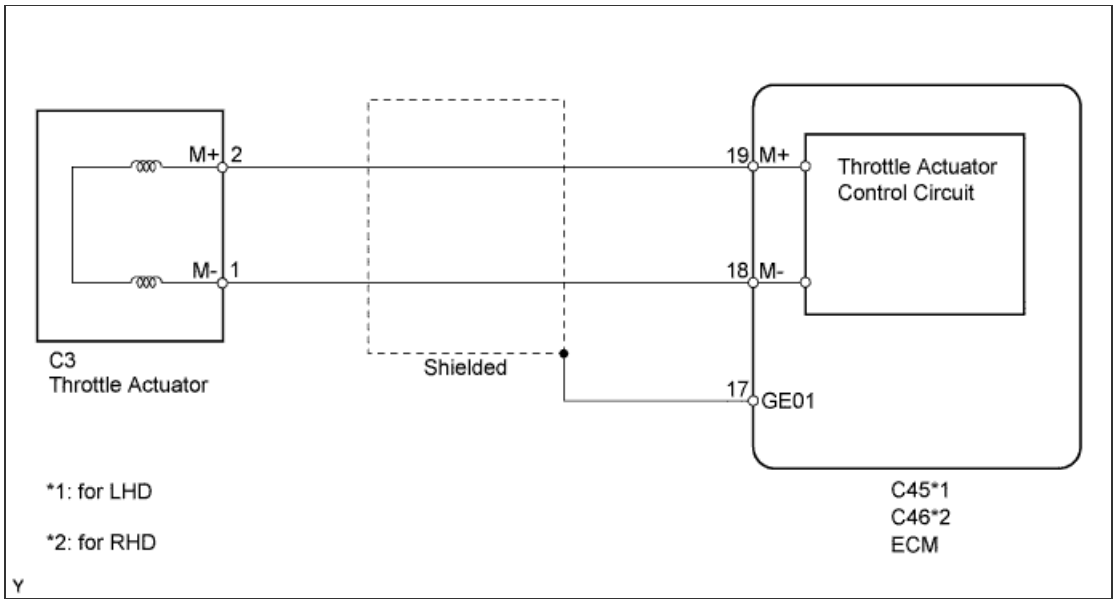
MONITOR DESCRIPTION

The ECM monitors the electrical current through the electronic actuator, and detects malfunctions and open circuits in the throttle actuator based on this value. If the current is outside the standard range, the ECM determines that there is a malfunction in the throttle actuator. In addition, if the throttle valve does not function properly (for example, stuck on), the ECM determines that there is a malfunction. The ECM then illuminates the MIL and stores a DTC.
Example:
When the electrical current is below 0.5 A and the throttle actuator duty ratio is 80% or more, the ECM interprets this as the current being outside the standard range, and illuminates the MIL and stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored when the engine is quickly revved to a high rpm several times after the engine is started and has idled for 5 seconds.

FAIL-SAFE

When either of these DTCs, or other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **The throttle actuator current (Throttle Motor Current) and the throttle actuator duty ratio (Throttle Motor Open Duty / Throttle Motor Close Duty) can be read using the tester. However, the ECM shuts off the throttle actuator current when the ETCS malfunctions.**

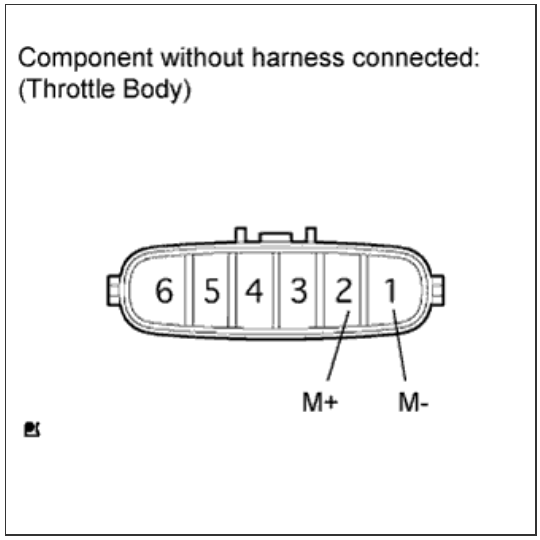
1.INSPECT THROTTLE BODY ASSEMBLY (RESISTANCE OF THROTTLE ACTUATOR)

a. Disconnect the throttle body connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
2 (M+) - 1 (M-)	20°C (68°F)	0.3 to 100 Ω



NG → REPLACE THROTTLE BODY ASSEMBLY (Click here)

OK

2.CHECK HARNESS AND CONNECTOR (THROTTLE ACTUATOR - ECM)

a. Disconnect the throttle body connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

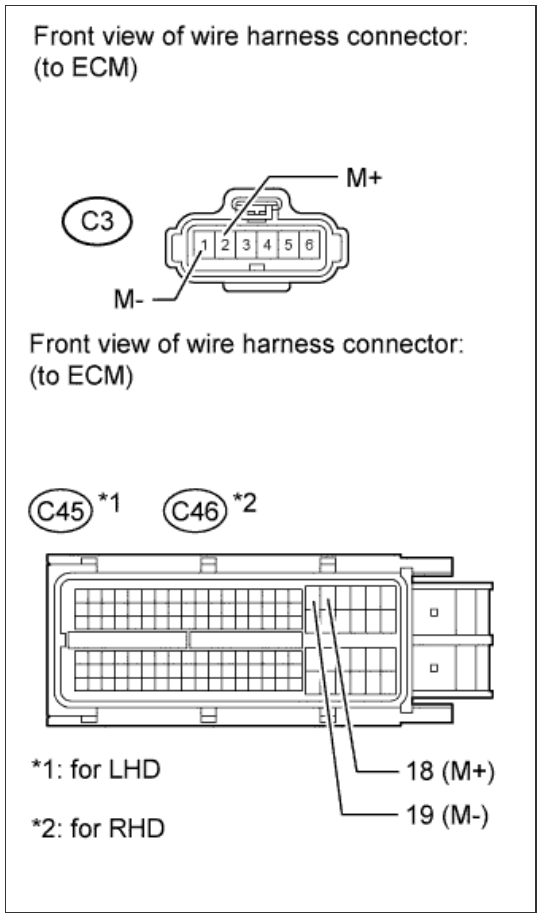
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C3-2 (M+) - C45-19 (M+)	Always	Below 1 Ω
C3-1 (M-) - C45-18	Always	Below 1 Ω

(M-)		
C3-2 (M+) or C45-19 (M+) - Body ground	Always	10 kΩ or higher
C3-1 (M-) or C45-18 (M-) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C3-2 (M+) - C46-19 (M+)	Always	Below 1 Ω
C3-1 (M-) - C46-18 (M-)	Always	Below 1 Ω
C3-2 (M+) or C46-19 (M+) - Body ground	Always	10 kΩ or higher
C3-1 (M-) or C46-18 (M-) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT THROTTLE BODY ASSEMBLY

a. Check for foreign objects between the throttle valve and the housing.

OK:
No foreign objects between throttle valve and housing.

NG → REMOVE FOREIGN OBJECT AND CLEAN THROTTLE BODY

OK

4.INSPECT THROTTLE VALVE

a. Check if the throttle valve opens and closes smoothly.

OK:
Throttle valve opens and closes smoothly.

NG → REPLACE THROTTLE BODY ASSEMBLY (Click here)

OK

REPLACE ECM (Click here)

DTC P0136 Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)

DTC P0137 Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)

DTC P0138 Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)

DTC P0156 Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)

DTC P0157 Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)

DTC P0158 Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)

for Preparation Click here

DESCRIPTION

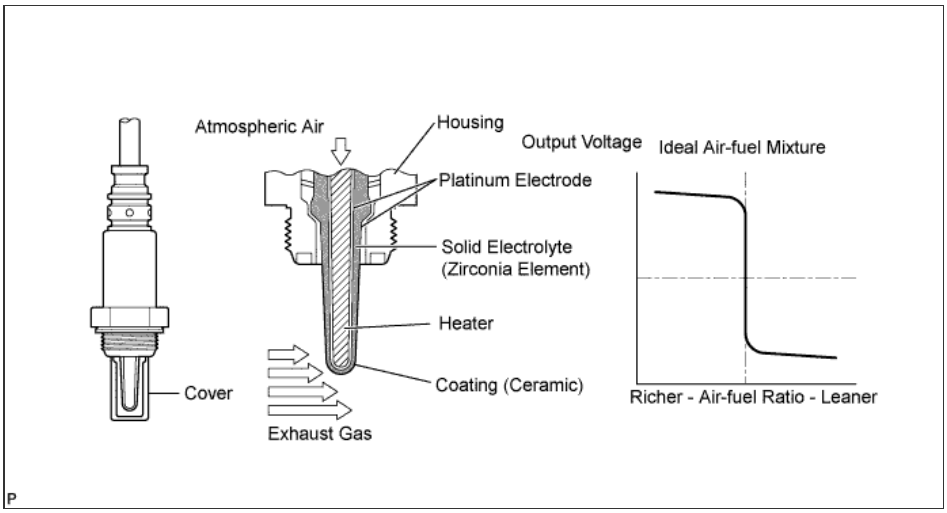
In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric air-fuel level. For the purpose of helping the ECM to deliver accurate air-fuel ratio control, a Heated Oxygen (HO2) sensor is used.

The HO2 sensor is located behind the TWC, and detects the oxygen concentration in the exhaust gas. Since the sensor is integrated with a heater that heats the sensing portion, it is possible to detect the oxygen concentration even when the intake air volume is low (the exhaust gas temperature is low).

When the air-fuel ratio becomes lean, the oxygen concentration in the exhaust gas is rich. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is lean (low voltage, i.e. below 0.45 V).

Conversely, when the air-fuel ratio is richer than the stoichiometric air-fuel level, the oxygen concentration in the exhaust gas becomes lean. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is rich (high voltage, i.e. higher than 0.45 V). The HO2 sensor has the property of changing its output voltage drastically when the air-fuel ratio is close to the stoichiometric level.

The ECM uses the supplementary information from the HO2 sensor to determine whether the air-fuel ratio after the TWC is rich or lean, and adjusts the fuel injection time accordingly. Thus, if the HO2 sensor is working improperly due to internal malfunctions, the ECM is unable to compensate for deviations in the primary air-fuel ratio control.



DTC Code	DTC Detection Condition	Trouble Area
P0136 P0156	• Abnormal voltage output: During active air-fuel ratio control, conditions (a) and (b) are met for a certain period of time (2 trip detection logic): (a) The Heated Oxygen (HO2) sensor voltage does not decrease to below 0.21 V. (b) The HO2 sensor voltage does not increase to higher than 0.59 V.	• Open or short in HO2 sensor (for bank 1, 2) circuit • HO2 sensor (for bank 1, 2) • HO2 sensor heater (for bank 1, 2) • Air-Fuel Ratio (A/F) sensor (for bank 1, 2) • Integration relay • Gas leakage from exhaust system
P0137 P0157	• Low voltage (open): During active air-fuel ratio control, conditions (a) and (b) are met for a certain period of time (2 trip detection logic): (a) The HO2 sensor voltage output is below 0.21 V. (b) The target air-fuel ratio is rich.	• Open in HO2 sensor (for bank 1, 2) circuit • HO2 sensor (for bank 1, 2) • HO2 sensor heater (for bank 1, 2) • Integration relay • Gas leakage from exhaust system
P0138 P0158	• High voltage (short): During active air-fuel ratio control, conditions (a) and (b) are met for a certain period of time (2 trip detection logic): (a) The HO2 sensor voltage output is higher than 0.59 V. (b) The target air-fuel ratio is lean.	• Short in HO2 sensor (for bank 1, 2) circuit • HO2 sensor (for bank 1, 2) • ECM internal circuit malfunction • Air-Fuel Ratio (A/F) sensor (for bank 1, 2)

MONITOR DESCRIPTION

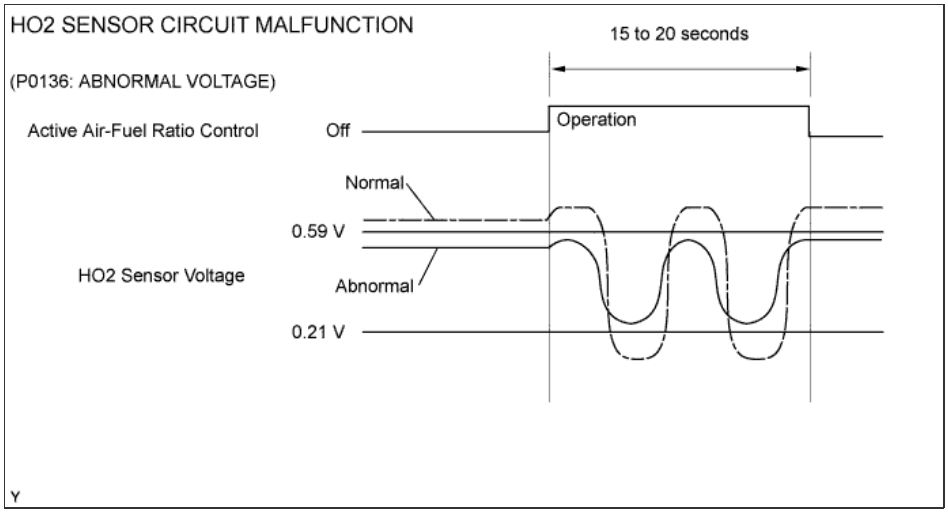
Active Air-Fuel Ratio Control

The ECM usually performs air-fuel ratio feedback control so that the Air-Fuel Ratio (A/F) sensor output indicates a near stoichiometric air-fuel level. This vehicle includes active air-fuel ratio control in addition to regular air-fuel ratio control. The ECM performs active air-fuel ratio control to detect any deterioration in the Three-Way Catalytic Converter (TWC) and Heated Oxygen (HO2) sensor malfunctions (refer to the diagram below).

Active air-fuel ratio control is performed for approximately 15 to 20 seconds while driving with a warm engine. During active air-fuel ratio control, the air-fuel ratio is forcibly regulated to become lean or rich by the ECM. If the ECM detects a malfunction, a DTC is stored.

Abnormal Voltage Output of HO2 Sensor (DTC P0136 and P0156)

While the ECM is performing active air-fuel ratio control, the air-fuel ratio is forcibly regulated to become rich or lean. If the sensor is not functioning properly, the voltage output variation is small. For example, when the HO2 sensor voltage does not decrease to below 0.21 V and does not increase to higher than 0.59 V during active air-fuel ratio control, the ECM determines that the sensor voltage output is abnormal and stores DTC P0136 or P0156.



Open or Short in Heated Oxygen (HO2) Sensor Circuit (DTC P0137 and P0157 or P0138 and P0158)

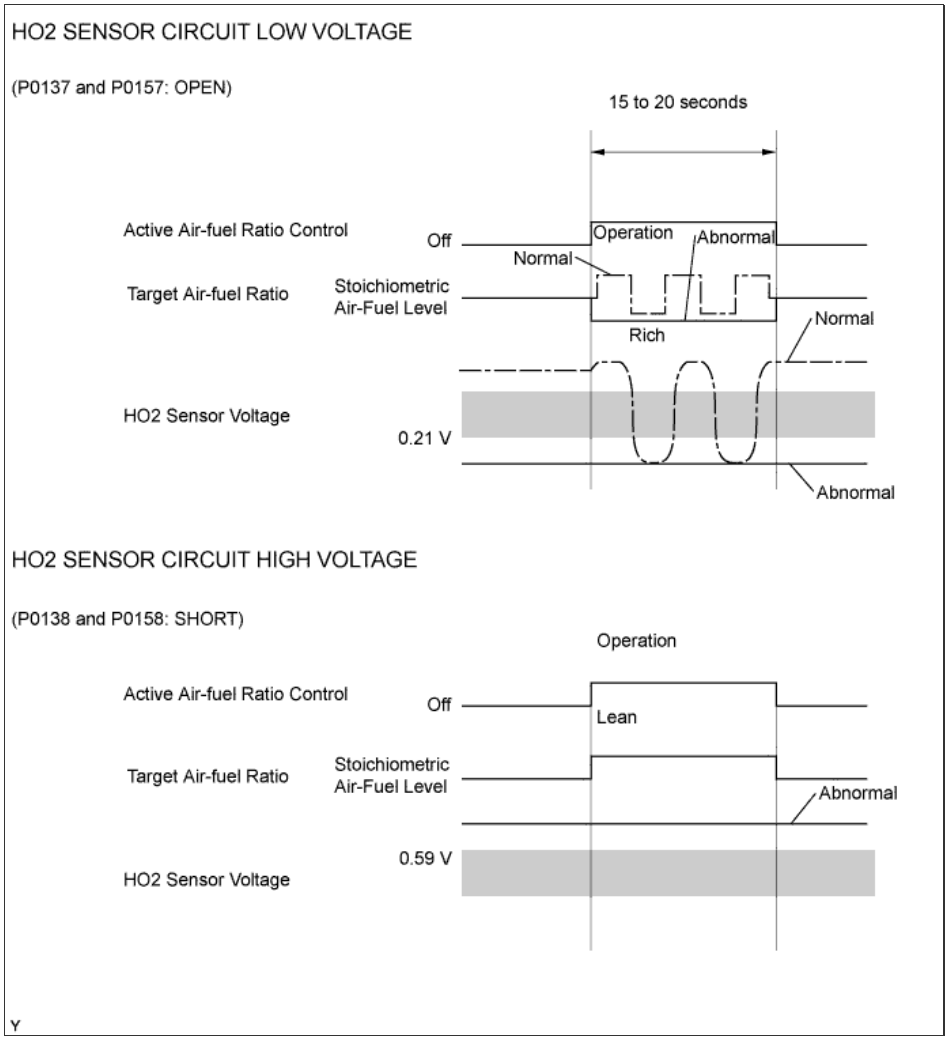
During active air-fuel ratio control, the ECM calculates the Oxygen Storage Capacity (OSC)* of the Three-Way Catalytic Converter (TWC) by forcibly regulating the air-fuel ratio to become rich or lean. If the HO2 sensor has an open or short, or the voltage output of the sensor decreases significantly, the OSC indicates an extraordinarily high value. Even if the ECM attempts to continue regulating the air-fuel ratio to become rich or lean, the HO2 sensor output does not change.

While performing active air-fuel ratio control, when the target air-fuel ratio is rich and the HO2 sensor voltage output is 0.21 V or less (lean), the ECM interprets this as an abnormally low sensor output voltage and stores DTC P0137 or P0157. When the target air-fuel ratio is lean and the voltage output is 0.59 V or higher (rich) during active air-fuel ratio control, the ECM determines that the sensor voltage output is abnormally high, and stores DTC P0138 or P0158.

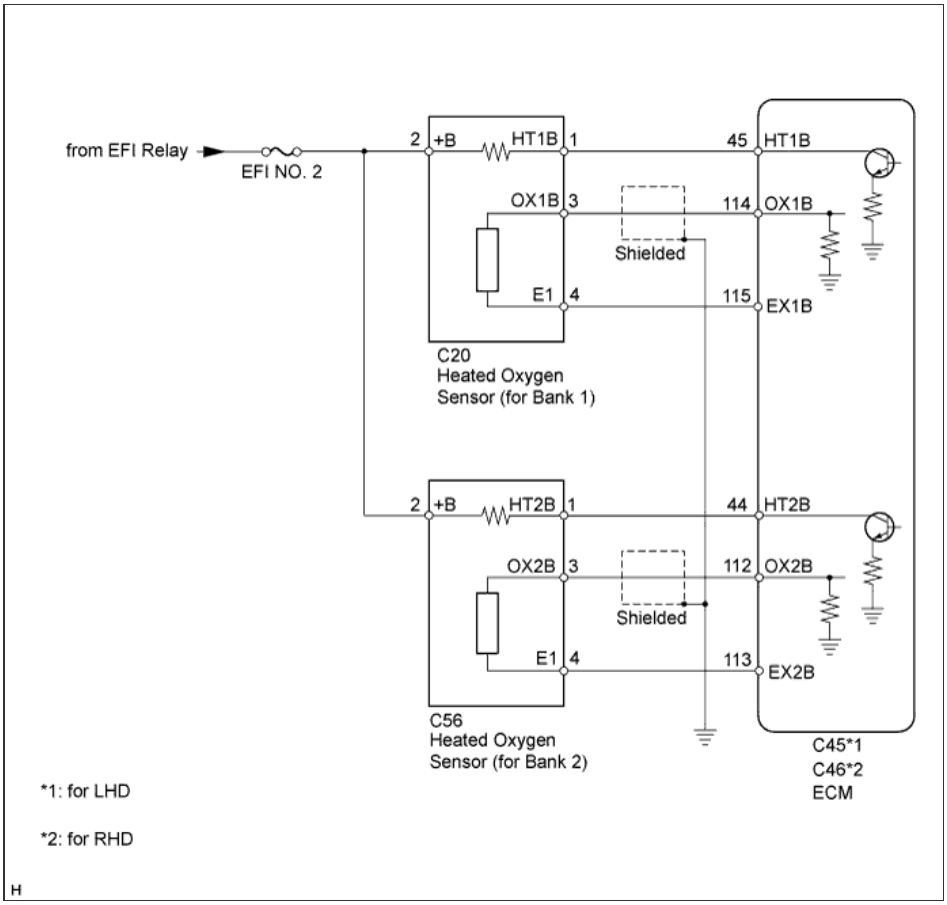
HINT:

DTC P0138 or P0158 is also stored if the HO2 sensor voltage output is higher than 1.2 V for 10 seconds or more.

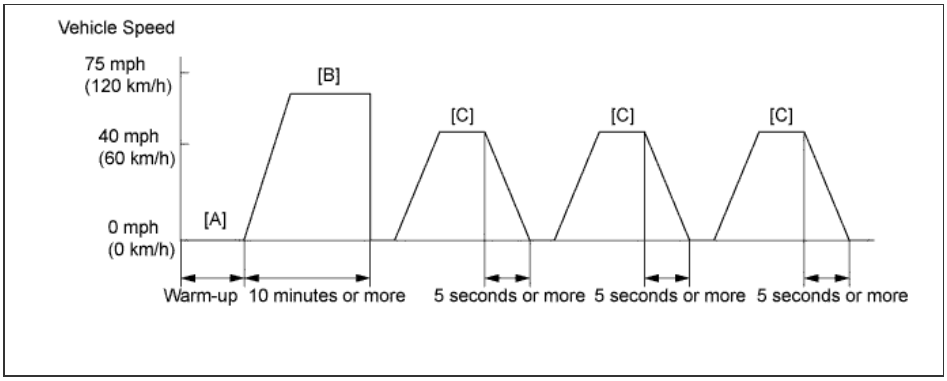
*: The TWC has the capability to store oxygen. The OSC and the emission purification capacity of the TWC are mutually related. The ECM determines whether the catalyst has deteriorated based on the calculated OSC value (Click here).



WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN



1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher [A].
4. Drive the vehicle at 60 to 120 km/h (40 to 75 mph) for 10 minutes or more [B].
5. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more. Perform this 3 times [C].
6. Turn the tester on.
7. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
8. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.
9. Check that DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern by accelerating and decelerating the vehicle.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.**

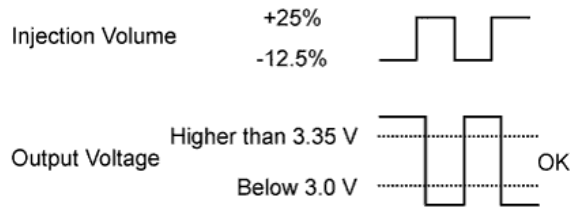
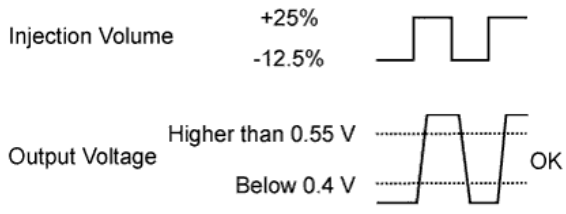
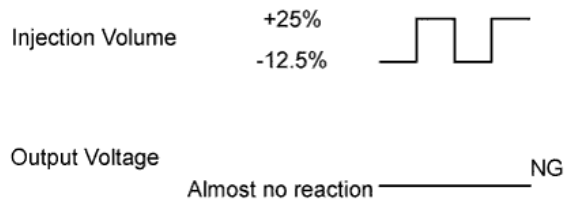
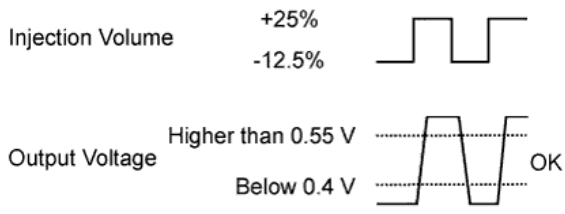
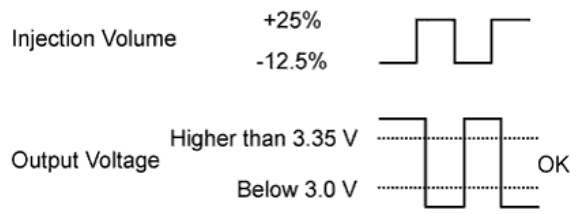
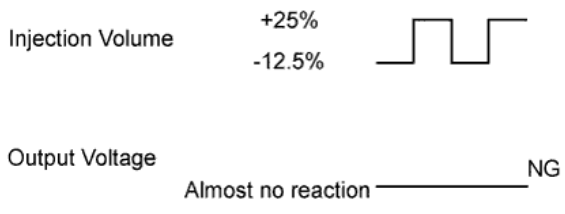
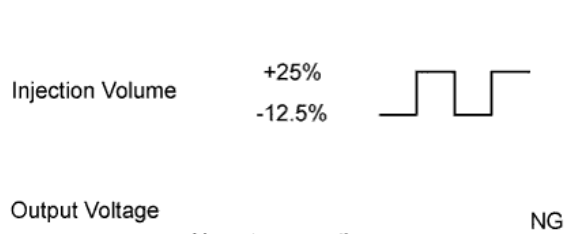
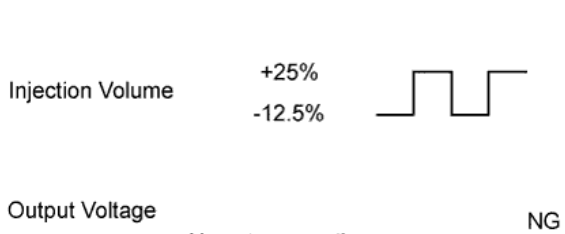
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 or AFS B2 S1 (A/F)	+25%	Rich	Below 3.0 V
AFS B1 S1 or AFS B2 S1 (A/F)	-12.5%	Lean	Higher than 3.35 V
O2S B1 S2 or O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55 V
O2S B1 S2 or O2S B2 S2 (HO2)	-12.5%	Lean	Below 0.4 V

NOTICE:

The Air-Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

HINT:

- **If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the OX1B wire from the ECM connector is short-circuited to the +B wire, DTC P0136 will be stored.**
- **If the OX2B wire from the ECM connector is short-circuited to the +B wire, DTC P0156 will be stored.**

1.READ OUTPUT DTC

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0138 or P0158 is output	A
P0137 or P0157 is output	B
P0136 or P0156 is output	C

B → Go to step 8

C → Go to step 6

A

2.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1 S2 or O2S B2 S2.

d. Allow the engine to idle.

e. Read the Heated Oxygen (HO2) sensor output voltage while idling.

Result

Result	Proceed to
Higher than 1.2 V	A
Below 1.0 V	B

OK → Go to step 5

NG → Go to step 3

3.INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)

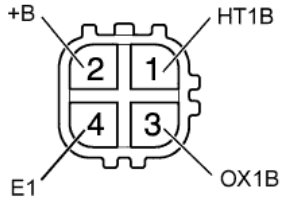
a. Disconnect the Heated Oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

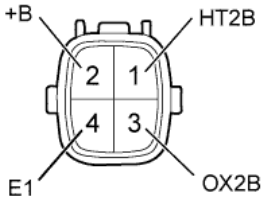
Standard Resistance:

Tester Connection	Condition	Specified Condition
2 (+B) - 3 (OX1B)	Always	10 kΩ or higher
2 (+B) - 4 (E1)	Always	10 kΩ or higher
2 (+B) - 3 (OX2B)	Always	10 kΩ or higher
2 (+B) - 4 (E1)	Always	10 kΩ or higher

Component without harness connected:
(HO2 Sensor for Bank 1)



Component without harness connected:
(HO2 Sensor for Bank 2)



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

4.CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT)

a. Turn the engine switch off and wait for 5 minutes.

b. Disconnect the ECM connector.

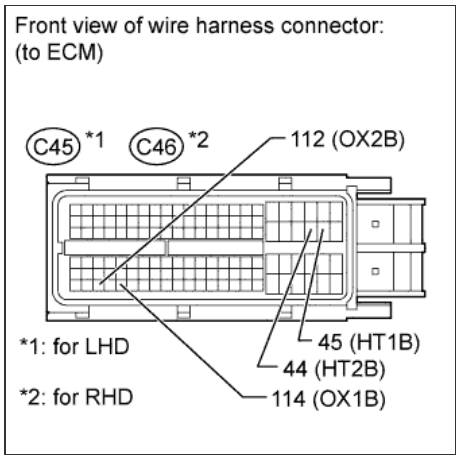
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C45-45 (HT1B) - C45-114 (OX1B)	Always	10 kΩ or higher
C45-44 (HT2B) - C45-112 (OX2B)	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C46-45 (HT1B) - C46-114 (OX1B)	Always	10 kΩ or higher
C46-44 (HT2B) - C46-112 (OX2B)	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

5.CHECK AIR FUEL RATIO SENSOR CURRENT

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS B1 S1 or AFS B2 S1.

d. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher.

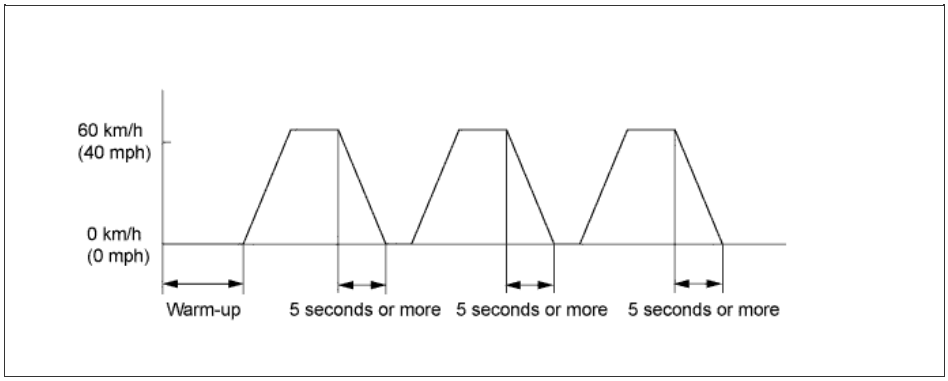
e. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more.
Perform this 3 times.

HINT:

If the tester shows Utility / Monitor Status / O2 Sensor / Incomplete again, increase the vehicle speed and use second gear to decelerate the vehicle.

f. Read the value.

Standard current:
Below 3.0 mA



OK → Go to step 12

NG → Go to step 14

6.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Start the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1 S2 or O2S B2 S2.

e. After warming up the engine, run the engine at an engine speed of 2500 rpm for 3 minutes.

f. Read the output voltage of the HO2 sensor when the engine speed is suddenly increased.

HINT:

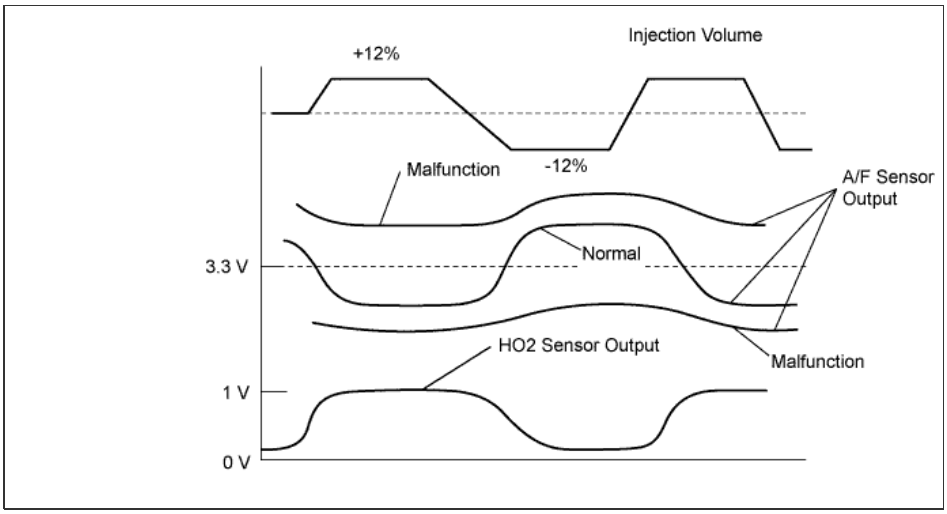
Quickly accelerate the engine to 4000 rpm 3 times using the accelerator pedal.

Standard voltage:
Fluctuates between 0.4 V or less and 0.5 V or higher.

NG	Go to step 8

OK

7.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (INJECTION VOLUME)



a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume.

e. Change the fuel injection volume using the tester, and monitor the voltage output of Air-Fuel Ratio (A/F) and HO2 sensors displayed on the tester.

HINT:

- **Change the fuel injection volume within the range of -12% and +12%. The injection volume can be changed in 1% graduations within the range.**
- **The A/F sensor is displayed as AFS B1 S1 or AFS B2 S1, and the HO2 sensor is displayed as O2S B1 S2 or O2S B2 S2, on the intelligent tester.**

Result:

Tester Display (Sensor)	Voltage Variation	Proceed to
AFS B1 S1 (A/F) AFS B2 S1 (A/F)	Alternates between higher than and below 3.3 V	OK
	Remains at higher than 3.3 V	NG
	Remains at below 3.3 V	NG

HINT:

A normal HO2 sensor voltage (O2S B1 S2 or O2S B2 S2) reacts in accordance with increases and decreases in fuel injection volumes. When the A/F sensor voltage remains at either below or higher than 3.3 V despite the HO2 sensor indicating a normal reaction, the A/F sensor is malfunctioning.

NG	Go to step 14

OK

CHECK EXTREMELY RICH OR LEAN ACTUAL AIR-FUEL RATIO AND REPAIR CAUSE (INJECTOR, FUEL PRESSURE, GAS LEAKAGE FROM EXHAUST SYSTEM, ETC.)

8.CHECK FOR EXHAUST GAS LEAK

a. Check for exhaust gas leakage from the exhaust manifold and pipe.

OK:
No exhaust gas leakage.

NG	REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT

OK

9.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

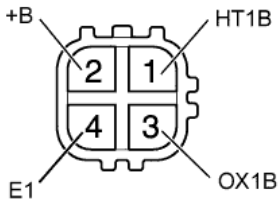
a. Disconnect the Heated Oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

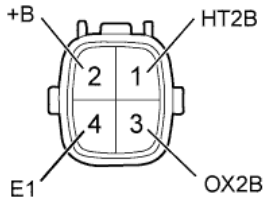
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT1B) - 4 (E1)	Always	10 kΩ or higher
1 (HT2B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT2B) - 4 (E1)	Always	10 kΩ or higher

Component without harness connected:
(HO2 Sensor for Bank 1)



Component without harness connected:
(HO2 Sensor for Bank 2)



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

10.INSPECT INTEGRATION RELAY (EFI RELAY)

a. Remove the integration relay from the engine room relay block.

b. Inspect the EFI MAIN fuse.

i. Remove the EFI MAIN fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAIN fuse	Always	Below 1 Ω

iii. Reinstall the EFI MAIN fuse.

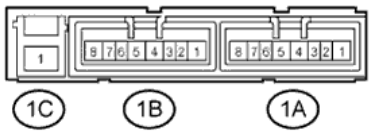
c. Inspect the EFI relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1B-4	When no battery voltage applied to terminals 1B-2 and 1B-3	10 kΩ or higher
	When battery voltage applied to terminals 1B-2 and 1B-3	Below 1 Ω

Component without harness connected:
(Integration Relay)



NG → REPLACE INTEGRATION RELAY

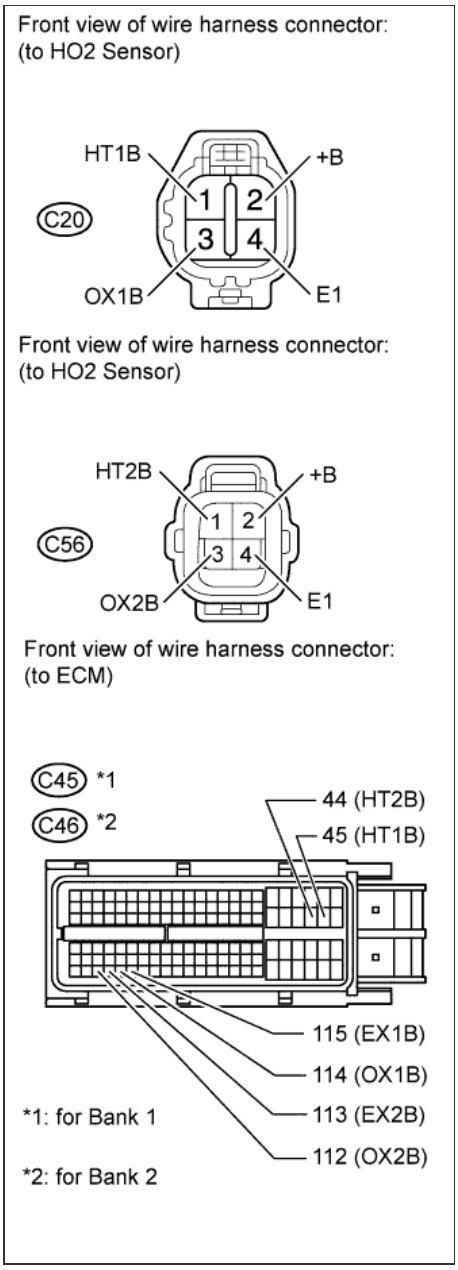
OK

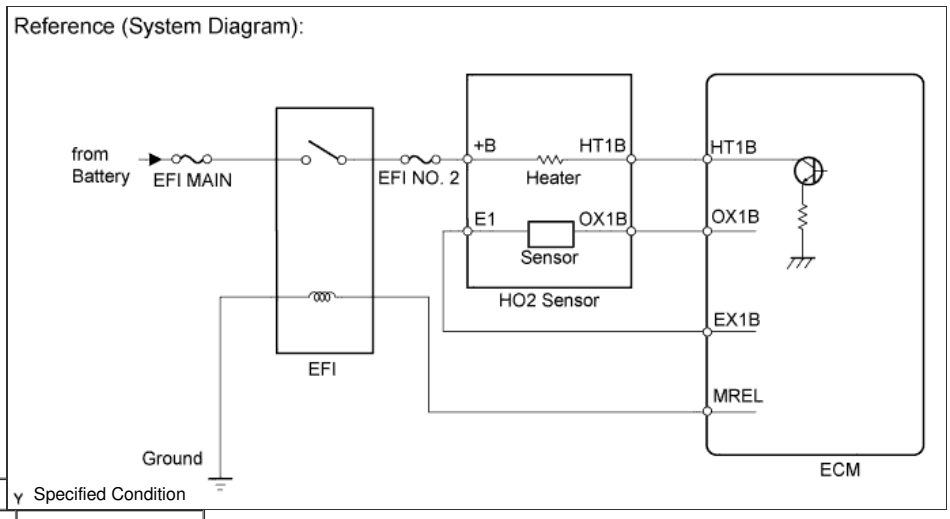
11.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)

a. Disconnect the HO2 sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:





Tester Connection	Switch Condition	Specified Condition
C20-2 (+B) - Body ground	Engine switch on (IG)	9 to 14 V
C56-2 (+B) - Body ground	Engine switch on (IG)	9 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.

e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C45-45 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C45-114 (OX1B)	Always	Below 1 Ω
C20-4 (E1) - C45-115 (EX1B)	Always	Below 1 Ω
C56-1 (HT2B) - C45-44 (HT2B)	Always	Below 1 Ω
C56-3 (OX2B) - C45-112 (OX2B)	Always	Below 1 Ω
C56-4 (E1) - C45-113 (EX2B)	Always	Below 1 Ω
C20-1 (HT1B) or C45-45 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C45-114 (OX1B) - Body ground	Always	10 kΩ or higher
C56-1 (HT2B) or C45-44 (HT2B) - Body ground	Always	10 kΩ or higher
C56-3 (OX2B) or C45-112 (OX2B) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C46-45 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C46-114 (OX1B)	Always	Below 1 Ω
C20-4 (E1) - C46-115 (EX1B)	Always	Below 1 Ω
C56-1 (HT2B) - C46-44 (HT2B)	Always	Below 1 Ω
C56-3 (OX2B) - C46-112 (OX2B)	Always	Below 1 Ω
C56-4 (E1) - C46-113 (EX2B)	Always	Below 1 Ω
C20-1 (HT1B) or C46-45 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C46-114 (OX1B) - Body ground	Always	10 kΩ or higher
C56-1 (HT2B) or C46-44 (HT2B) - Body ground	Always	10 kΩ or higher
C56-3 (OX2B) or C46-112 (OX2B) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE HEATED OXYGEN SENSOR (Click here)

12.REPLACE HEATED OXYGEN SENSOR

a. Replace the heated oxygen sensor (Click here).

NEXT

13.PERFORM CONFIRMATION DRIVING PATTERN

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher.

d. Drive the vehicle at 60 to 120 km/h (40 to 75 mph) for 10 minutes.

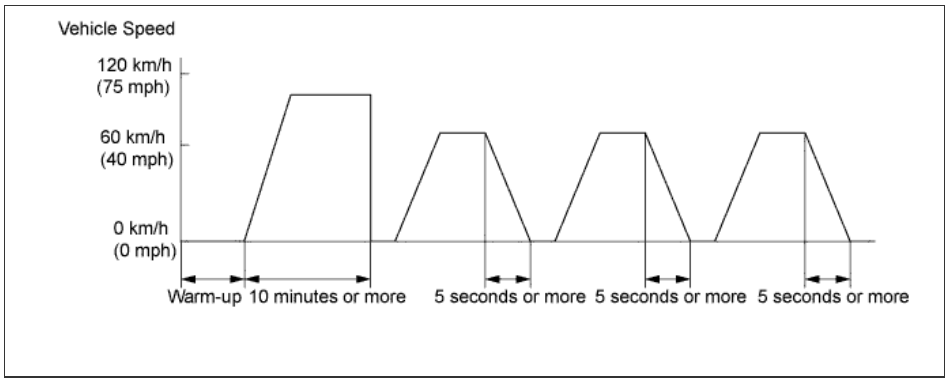
e. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more. Perform this 3 times.

f. Turn the tester on.

g. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

h. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

i. Check that DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern increasing the vehicle speed and using second gear to decelerate the vehicle.



NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK → END

14.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

15.PERFORM CONFIRMATION DRIVING PATTERN

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Clear the DTCs.

d. Switch the ECM from normal mode to check mode using the tester.

e. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher.

f. Drive the vehicle at 60 to 120 km/h (40 to 75 mph) for 10 minutes.

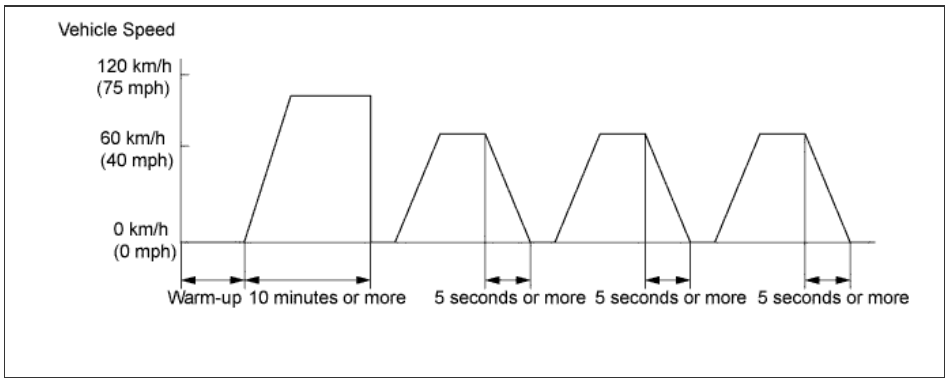
g. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more. Perform this 3 times.

h. Turn the tester on.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

k. Check that DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern increasing the vehicle speed and using second gear to decelerate the vehicle.



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

END

DTC P2102 Throttle Actuator Control Motor Circuit Low

DTC P2103 Throttle Actuator Control Motor Circuit High

for Preparation Click here

DESCRIPTION

The throttle actuator is operated by the ECM and opens and closes the throttle valve using gears.
The opening angle of the throttle valve is detected by the Throttle Position (TP) sensor, which is mounted on the throttle body. The TP sensor provides feedback to the ECM. This feedback allows the ECM to appropriately control the throttle actuator and monitor the throttle opening angle as the ECM responds to driver inputs.

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

DTC Code	DTC Detection Condition	Trouble Area
P2102	Conditions (a) and (b) continue for 2.0 seconds (1 trip detection logic): (a) The throttle actuator duty ratio is 80% or more. (b) The throttle actuator current is below 0.5 A.	• **Open in throttle actuator circuit** • **Throttle actuator** • **ECM**
P2103	Either of the following conditions are met (1 trip detection logic): • **A hybrid IC diagnosis signal failure.** • **A hybrid IC current limiter port failure.**	• **Short in throttle actuator circuit** • **Throttle actuator** • **Throttle valve** • **Throttle body assembly** • **ECM**

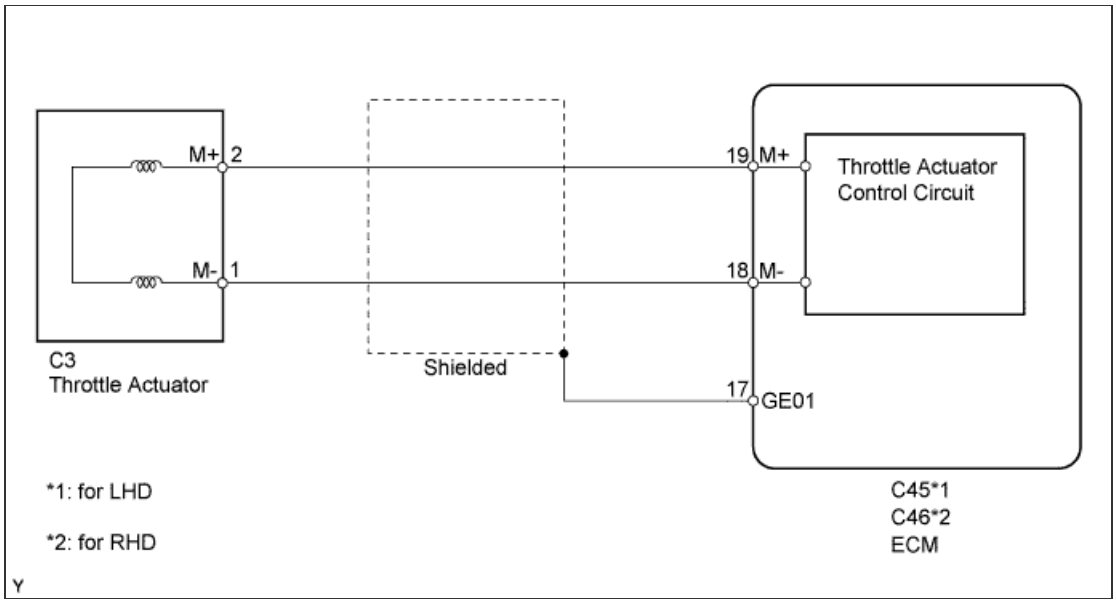
MONITOR DESCRIPTION

The ECM monitors the electrical current through the electronic actuator, and detects malfunctions and open circuits in the throttle actuator based on this value. If the current is outside the standard range, the ECM determines that there is a malfunction in the throttle actuator. In addition, if the throttle valve does not function properly (for example, stuck on), the ECM determines that there is a malfunction. The ECM then illuminates the MIL and stores a DTC.
Example:
When the electrical current is below 0.5 A and the throttle actuator duty ratio is 80% or more, the ECM interprets this as the current being outside the standard range, and illuminates the MIL and stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored when the engine is quickly revved to a high rpm several times after the engine is started and has idled for 5 seconds.

FAIL-SAFE

When either of these DTCs, or other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **The throttle actuator current (Throttle Motor Current) and the throttle actuator duty ratio (Throttle Motor Open Duty / Throttle Motor Close Duty) can be read using the tester. However, the ECM shuts off the throttle actuator current when the ETCS malfunctions.**

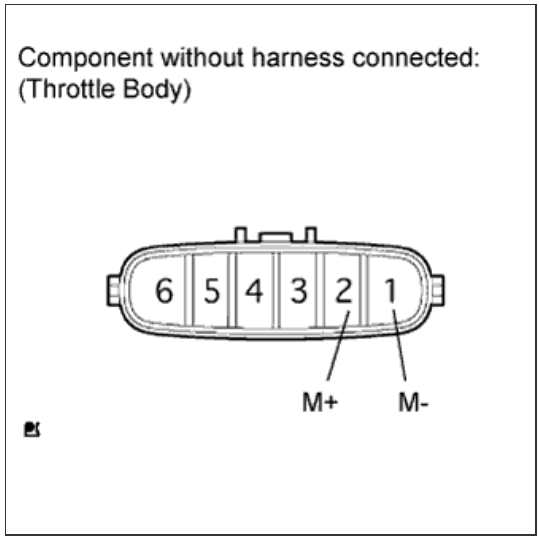
1.INSPECT THROTTLE BODY ASSEMBLY (RESISTANCE OF THROTTLE ACTUATOR)

a. Disconnect the throttle body connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
2 (M+) - 1 (M-)	20°C (68°F)	0.3 to 100 Ω



NG → REPLACE THROTTLE BODY ASSEMBLY (Click here)

OK

2.CHECK HARNESS AND CONNECTOR (THROTTLE ACTUATOR - ECM)

a. Disconnect the throttle body connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

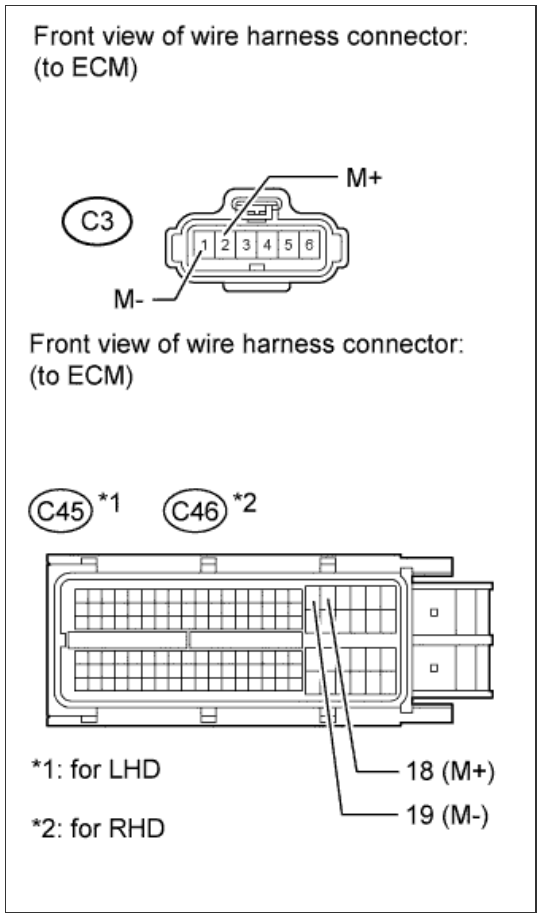
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C3-2 (M+) - C45-19 (M+)	Always	Below 1 Ω
C3-1 (M-) - C45-18	Always	Below 1 Ω

(M-)		
C3-2 (M+) or C45-19 (M+) - Body ground	Always	10 kΩ or higher
C3-1 (M-) or C45-18 (M-) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C3-2 (M+) - C46-19 (M+)	Always	Below 1 Ω
C3-1 (M-) - C46-18 (M-)	Always	Below 1 Ω
C3-2 (M+) or C46-19 (M+) - Body ground	Always	10 kΩ or higher
C3-1 (M-) or C46-18 (M-) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT THROTTLE BODY ASSEMBLY

a. Check for foreign objects between the throttle valve and the housing.

OK:
No foreign objects between throttle valve and housing.

NG → REMOVE FOREIGN OBJECT AND CLEAN THROTTLE BODY

OK

4.INSPECT THROTTLE VALVE

a. Check if the throttle valve opens and closes smoothly.

OK:
Throttle valve opens and closes smoothly.

NG → REPLACE THROTTLE BODY ASSEMBLY (Click here)

OK

REPLACE ECM (Click here)

DTC P0136 Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)

DTC P0137 Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)

DTC P0138 Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)

DTC P0156 Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)

DTC P0157 Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)

DTC P0158 Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)

for Preparation Click here

DESCRIPTION

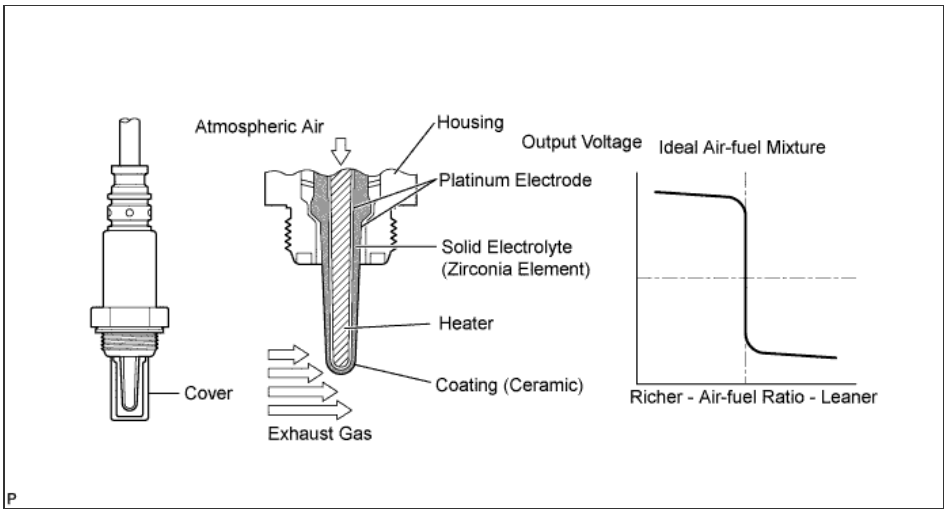
In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric air-fuel level. For the purpose of helping the ECM to deliver accurate air-fuel ratio control, a Heated Oxygen (HO2) sensor is used.

The HO2 sensor is located behind the TWC, and detects the oxygen concentration in the exhaust gas. Since the sensor is integrated with a heater that heats the sensing portion, it is possible to detect the oxygen concentration even when the intake air volume is low (the exhaust gas temperature is low).

When the air-fuel ratio becomes lean, the oxygen concentration in the exhaust gas is rich. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is lean (low voltage, i.e. below 0.45 V).

Conversely, when the air-fuel ratio is richer than the stoichiometric air-fuel level, the oxygen concentration in the exhaust gas becomes lean. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is rich (high voltage, i.e. higher than 0.45 V). The HO2 sensor has the property of changing its output voltage drastically when the air-fuel ratio is close to the stoichiometric level.

The ECM uses the supplementary information from the HO2 sensor to determine whether the air-fuel ratio after the TWC is rich or lean, and adjusts the fuel injection time accordingly. Thus, if the HO2 sensor is working improperly due to internal malfunctions, the ECM is unable to compensate for deviations in the primary air-fuel ratio control.



DTC Code	DTC Detection Condition	Trouble Area
P0136 P0156	• Abnormal voltage output: During active air-fuel ratio control, conditions (a) and (b) are met for a certain period of time (2 trip detection logic): (a) The Heated Oxygen (HO2) sensor voltage does not decrease to below 0.21 V. (b) The HO2 sensor voltage does not increase to higher than 0.59 V.	• Open or short in HO2 sensor (for bank 1, 2) circuit • HO2 sensor (for bank 1, 2) • HO2 sensor heater (for bank 1, 2) • Air-Fuel Ratio (A/F) sensor (for bank 1, 2) • Integration relay • Gas leakage from exhaust system
P0137 P0157	• Low voltage (open): During active air-fuel ratio control, conditions (a) and (b) are met for a certain period of time (2 trip detection logic): (a) The HO2 sensor voltage output is below 0.21 V. (b) The target air-fuel ratio is rich.	• Open in HO2 sensor (for bank 1, 2) circuit • HO2 sensor (for bank 1, 2) • HO2 sensor heater (for bank 1, 2) • Integration relay • Gas leakage from exhaust system
P0138 P0158	• High voltage (short): During active air-fuel ratio control, conditions (a) and (b) are met for a certain period of time (2 trip detection logic): (a) The HO2 sensor voltage output is higher than 0.59 V. (b) The target air-fuel ratio is lean.	• Short in HO2 sensor (for bank 1, 2) circuit • HO2 sensor (for bank 1, 2) • ECM internal circuit malfunction • Air-Fuel Ratio (A/F) sensor (for bank 1, 2)

MONITOR DESCRIPTION

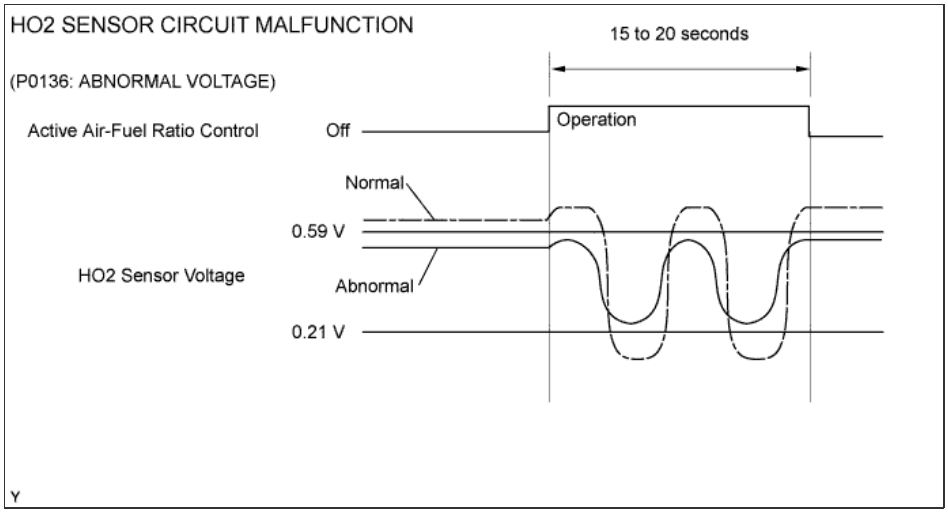
Active Air-Fuel Ratio Control

The ECM usually performs air-fuel ratio feedback control so that the Air-Fuel Ratio (A/F) sensor output indicates a near stoichiometric air-fuel level. This vehicle includes active air-fuel ratio control in addition to regular air-fuel ratio control. The ECM performs active air-fuel ratio control to detect any deterioration in the Three-Way Catalytic Converter (TWC) and Heated Oxygen (HO2) sensor malfunctions (refer to the diagram below).

Active air-fuel ratio control is performed for approximately 15 to 20 seconds while driving with a warm engine. During active air-fuel ratio control, the air-fuel ratio is forcibly regulated to become lean or rich by the ECM. If the ECM detects a malfunction, a DTC is stored.

Abnormal Voltage Output of HO2 Sensor (DTC P0136 and P0156)

While the ECM is performing active air-fuel ratio control, the air-fuel ratio is forcibly regulated to become rich or lean. If the sensor is not functioning properly, the voltage output variation is small. For example, when the HO2 sensor voltage does not decrease to below 0.21 V and does not increase to higher than 0.59 V during active air-fuel ratio control, the ECM determines that the sensor voltage output is abnormal and stores DTC P0136 or P0156.



Open or Short in Heated Oxygen (HO2) Sensor Circuit (DTC P0137 and P0157 or P0138 and P0158)

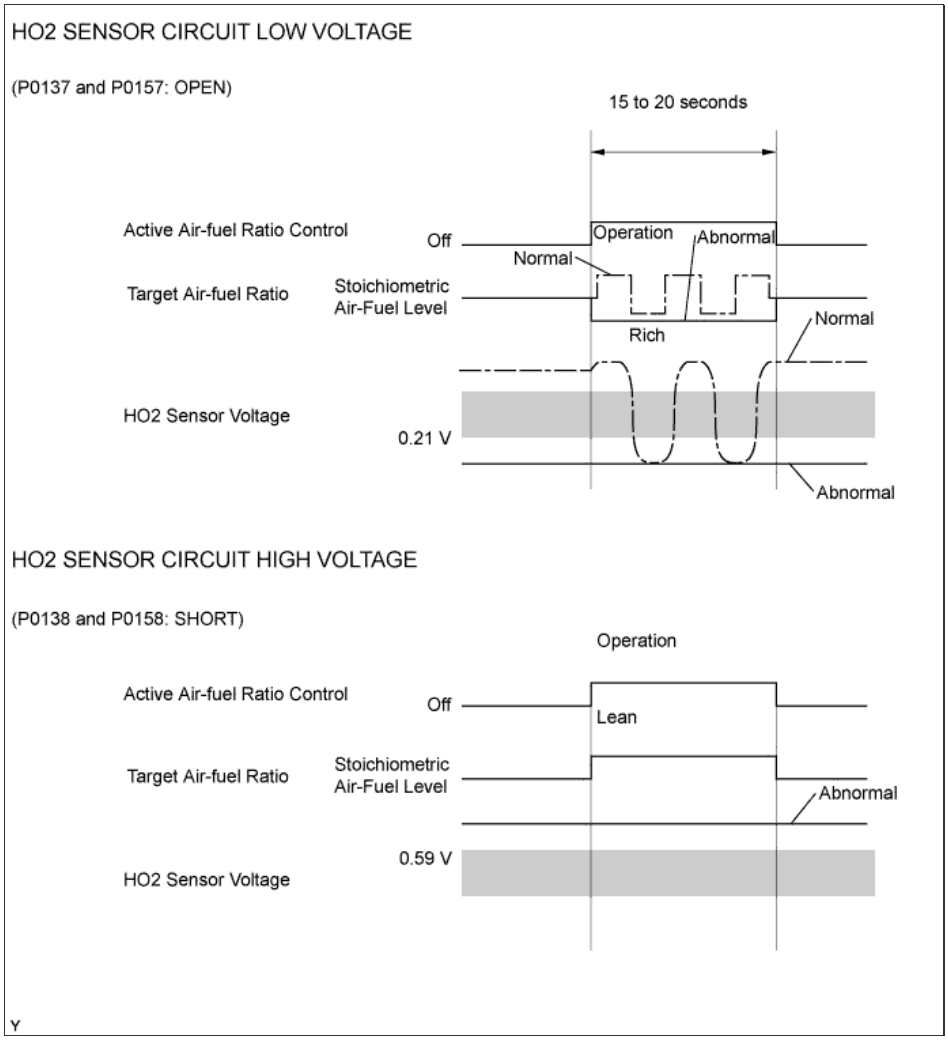
During active air-fuel ratio control, the ECM calculates the Oxygen Storage Capacity (OSC)* of the Three-Way Catalytic Converter (TWC) by forcibly regulating the air-fuel ratio to become rich or lean. If the HO2 sensor has an open or short, or the voltage output of the sensor decreases significantly, the OSC indicates an extraordinarily high value. Even if the ECM attempts to continue regulating the air-fuel ratio to become rich or lean, the HO2 sensor output does not change.

While performing active air-fuel ratio control, when the target air-fuel ratio is rich and the HO2 sensor voltage output is 0.21 V or less (lean), the ECM interprets this as an abnormally low sensor output voltage and stores DTC P0137 or P0157. When the target air-fuel ratio is lean and the voltage output is 0.59 V or higher (rich) during active air-fuel ratio control, the ECM determines that the sensor voltage output is abnormally high, and stores DTC P0138 or P0158.

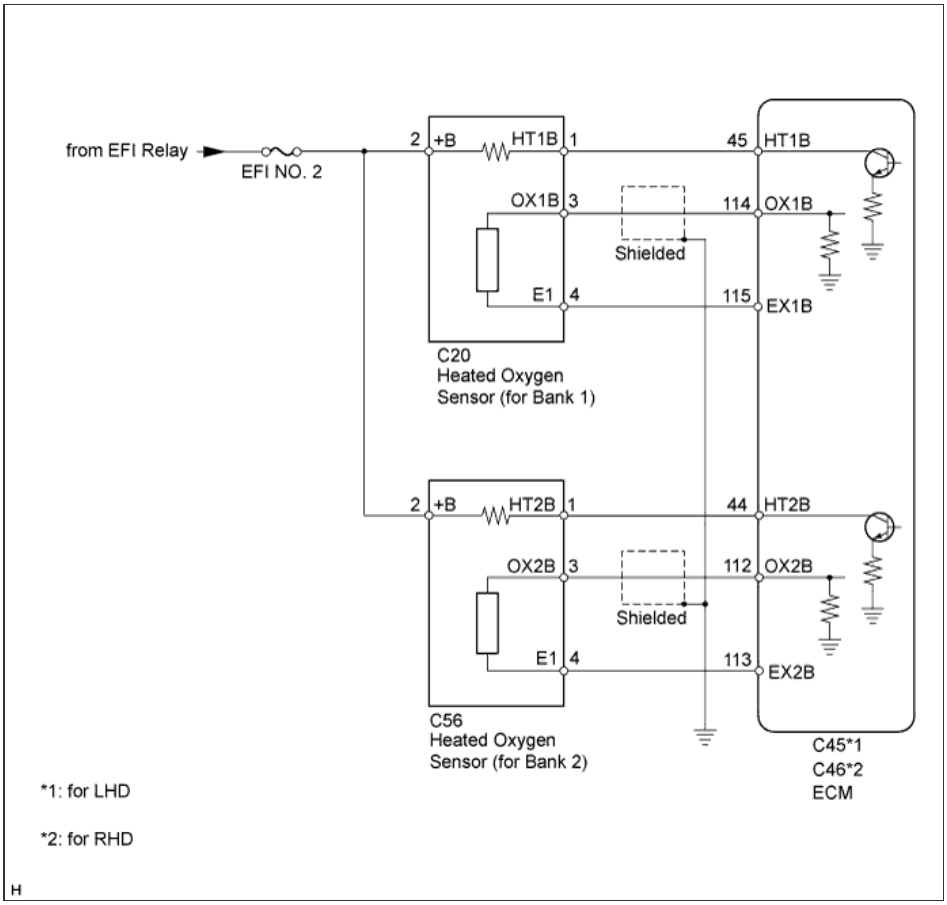
HINT:

DTC P0138 or P0158 is also stored if the HO2 sensor voltage output is higher than 1.2 V for 10 seconds or more.

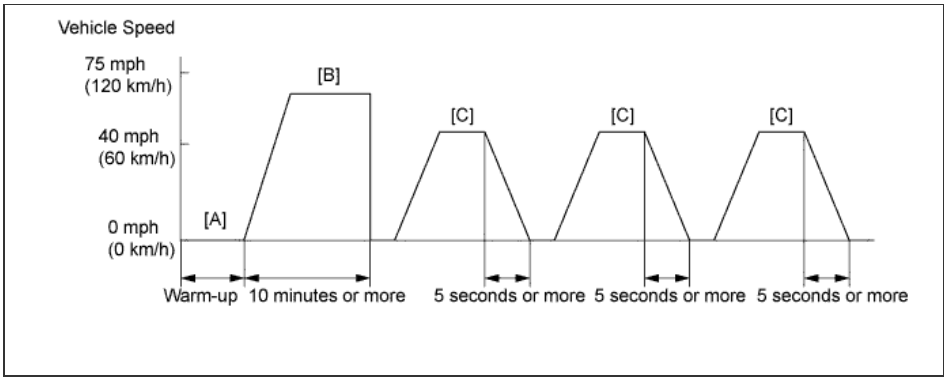
*: The TWC has the capability to store oxygen. The OSC and the emission purification capacity of the TWC are mutually related. The ECM determines whether the catalyst has deteriorated based on the calculated OSC value (Click here).



WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN



1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher [A].
4. Drive the vehicle at 60 to 120 km/h (40 to 75 mph) for 10 minutes or more [B].
5. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more. Perform this 3 times [C].
6. Turn the tester on.
7. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
8. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.
9. Check that DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern by accelerating and decelerating the vehicle.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.**

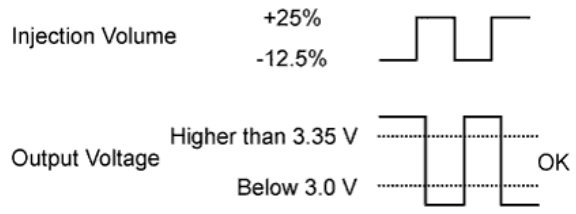
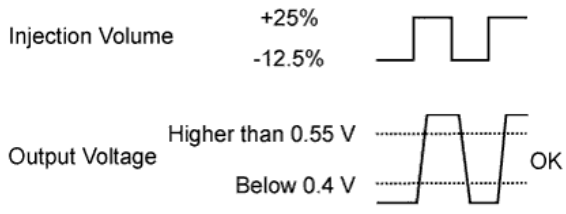
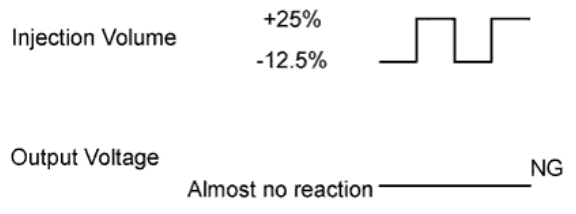
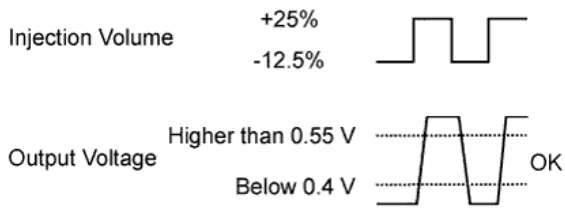
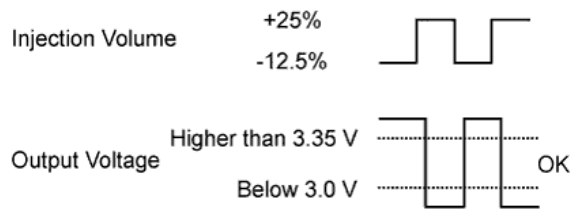
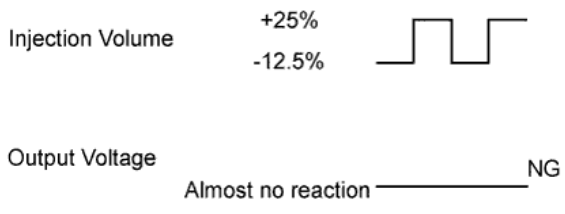
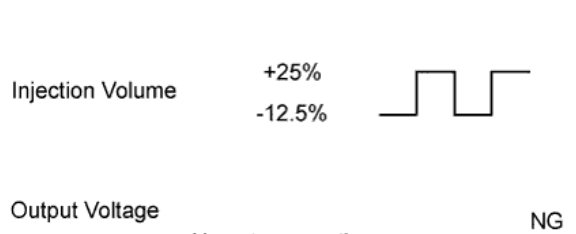
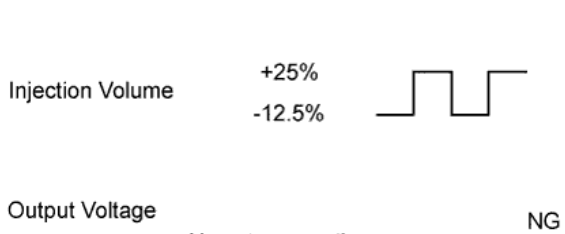
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 or AFS B2 S1 (A/F)	+25%	Rich	Below 3.0 V
AFS B1 S1 or AFS B2 S1 (A/F)	-12.5%	Lean	Higher than 3.35 V
O2S B1 S2 or O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55 V
O2S B1 S2 or O2S B2 S2 (HO2)	-12.5%	Lean	Below 0.4 V

NOTICE:

The Air-Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

HINT:

- **If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the OX1B wire from the ECM connector is short-circuited to the +B wire, DTC P0136 will be stored.**
- **If the OX2B wire from the ECM connector is short-circuited to the +B wire, DTC P0156 will be stored.**

1.READ OUTPUT DTC

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0138 or P0158 is output	A
P0137 or P0157 is output	B
P0136 or P0156 is output	C

B → Go to step 8

C → Go to step 6

A

2.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1 S2 or O2S B2 S2.

d. Allow the engine to idle.

e. Read the Heated Oxygen (HO2) sensor output voltage while idling.

Result

Result	Proceed to
Higher than 1.2 V	A
Below 1.0 V	B

OK → Go to step 5

NG → Go to step 3

3.INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)

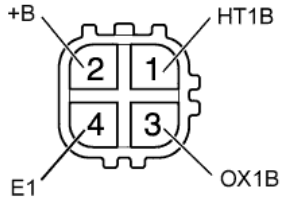
a. Disconnect the Heated Oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

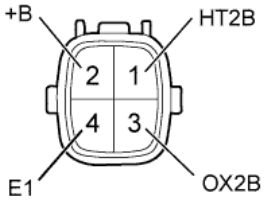
Standard Resistance:

Tester Connection	Condition	Specified Condition
2 (+B) - 3 (OX1B)	Always	10 kΩ or higher
2 (+B) - 4 (E1)	Always	10 kΩ or higher
2 (+B) - 3 (OX2B)	Always	10 kΩ or higher
2 (+B) - 4 (E1)	Always	10 kΩ or higher

Component without harness connected:
(HO2 Sensor for Bank 1)



Component without harness connected:
(HO2 Sensor for Bank 2)



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

4.CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT)

a. Turn the engine switch off and wait for 5 minutes.

b. Disconnect the ECM connector.

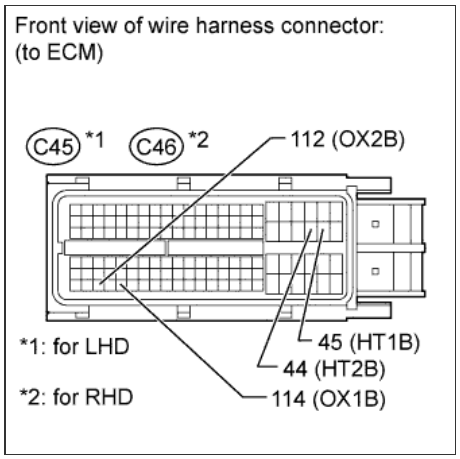
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C45-45 (HT1B) - C45-114 (OX1B)	Always	10 kΩ or higher
C45-44 (HT2B) - C45-112 (OX2B)	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C46-45 (HT1B) - C46-114 (OX1B)	Always	10 kΩ or higher
C46-44 (HT2B) - C46-112 (OX2B)	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

5.CHECK AIR FUEL RATIO SENSOR CURRENT

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS B1 S1 or AFS B2 S1.

d. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher.

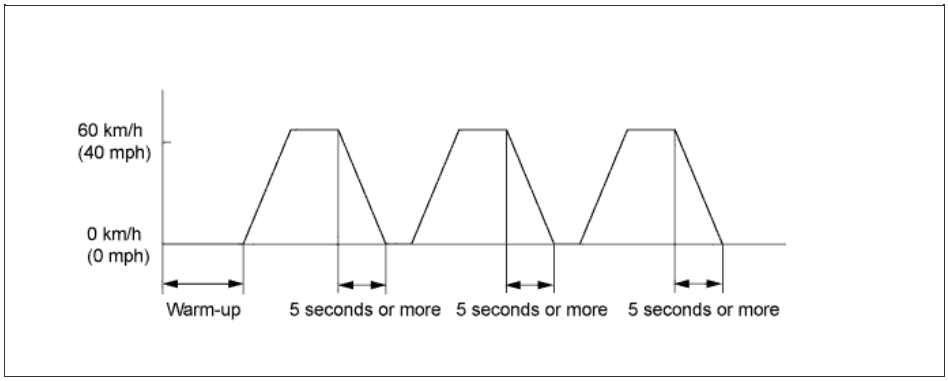
e. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more.
Perform this 3 times.

HINT:

If the tester shows Utility / Monitor Status / O2 Sensor / Incomplete again, increase the vehicle speed and use second gear to decelerate the vehicle.

f. Read the value.

Standard current:
Below 3.0 mA



OK → Go to step 12

NG → Go to step 14

6.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Start the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1 S2 or O2S B2 S2.

e. After warming up the engine, run the engine at an engine speed of 2500 rpm for 3 minutes.

f. Read the output voltage of the HO2 sensor when the engine speed is suddenly increased.

HINT:

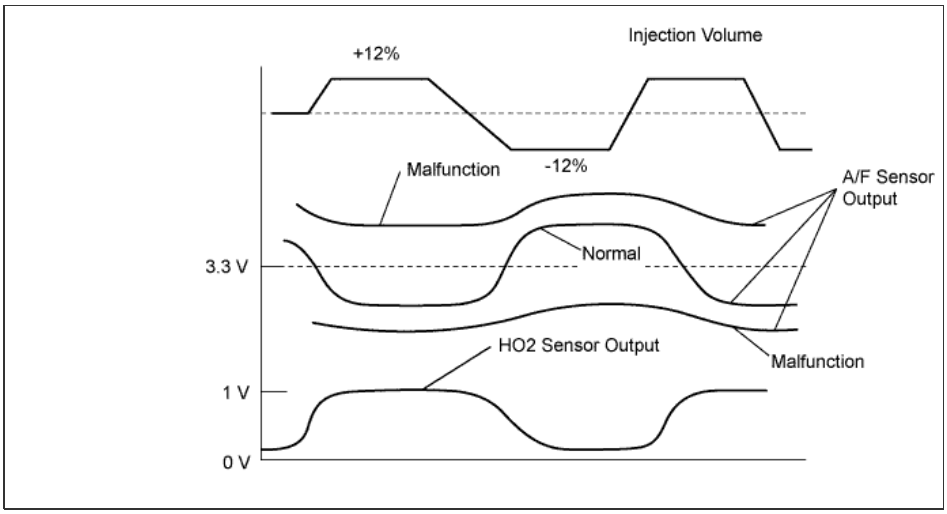
Quickly accelerate the engine to 4000 rpm 3 times using the accelerator pedal.

Standard voltage:
Fluctuates between 0.4 V or less and 0.5 V or higher.

NG	Go to step 8

OK

7.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (INJECTION VOLUME)



a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume.

e. Change the fuel injection volume using the tester, and monitor the voltage output of Air-Fuel Ratio (A/F) and HO2 sensors displayed on the tester.

HINT:

- **Change the fuel injection volume within the range of -12% and +12%. The injection volume can be changed in 1% graduations within the range.**
- **The A/F sensor is displayed as AFS B1 S1 or AFS B2 S1, and the HO2 sensor is displayed as O2S B1 S2 or O2S B2 S2, on the intelligent tester.**

Result:

Tester Display (Sensor)	Voltage Variation	Proceed to
AFS B1 S1 (A/F) AFS B2 S1 (A/F)	Alternates between higher than and below 3.3 V	OK
	Remains at higher than 3.3 V	NG
	Remains at below 3.3 V	NG

HINT:

A normal HO2 sensor voltage (O2S B1 S2 or O2S B2 S2) reacts in accordance with increases and decreases in fuel injection volumes. When the A/F sensor voltage remains at either below or higher than 3.3 V despite the HO2 sensor indicating a normal reaction, the A/F sensor is malfunctioning.

NG	Go to step 14

OK

CHECK EXTREMELY RICH OR LEAN ACTUAL AIR-FUEL RATIO AND REPAIR CAUSE (INJECTOR, FUEL PRESSURE, GAS LEAKAGE FROM EXHAUST SYSTEM, ETC.)

8.CHECK FOR EXHAUST GAS LEAK

a. Check for exhaust gas leakage from the exhaust manifold and pipe.

OK:
No exhaust gas leakage.

NG	REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT

OK

9.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

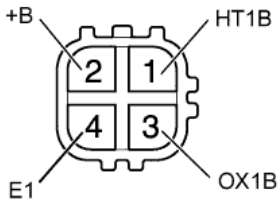
a. Disconnect the Heated Oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

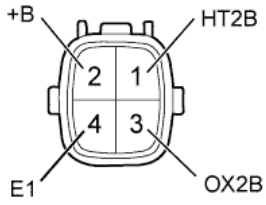
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT1B) - 4 (E1)	Always	10 kΩ or higher
1 (HT2B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT2B) - 4 (E1)	Always	10 kΩ or higher

Component without harness connected:
(HO2 Sensor for Bank 1)



Component without harness connected:
(HO2 Sensor for Bank 2)



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

10.INSPECT INTEGRATION RELAY (EFI RELAY)

a. Remove the integration relay from the engine room relay block.

b. Inspect the EFI MAIN fuse.

i. Remove the EFI MAIN fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAIN fuse	Always	Below 1 Ω

iii. Reinstall the EFI MAIN fuse.

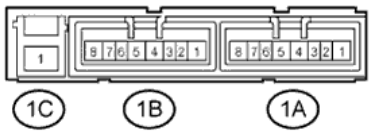
c. Inspect the EFI relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1B-4	When no battery voltage applied to terminals 1B-2 and 1B-3	10 kΩ or higher
	When battery voltage applied to terminals 1B-2 and 1B-3	Below 1 Ω

Component without harness connected:
(Integration Relay)



NG → REPLACE INTEGRATION RELAY

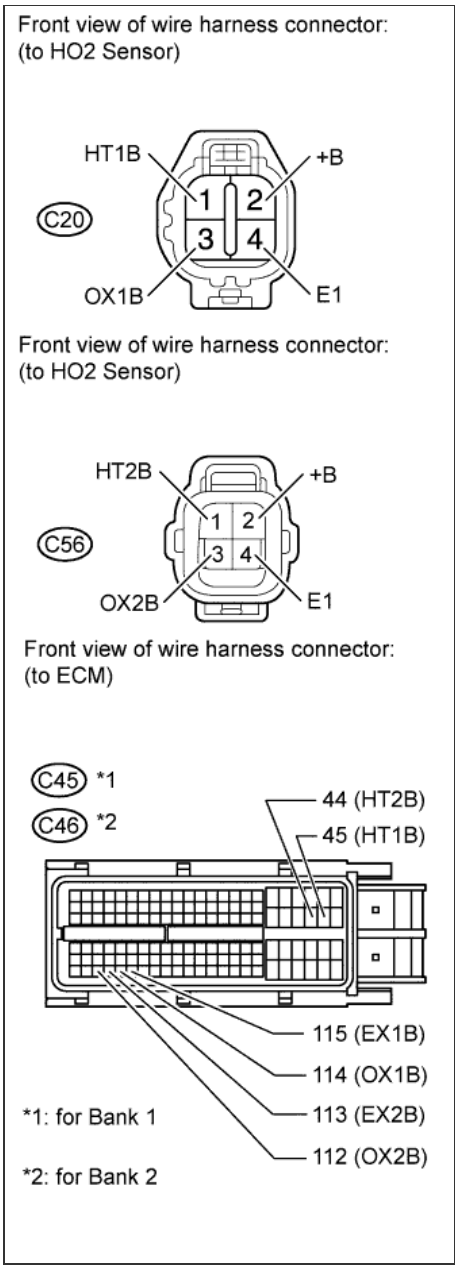
OK

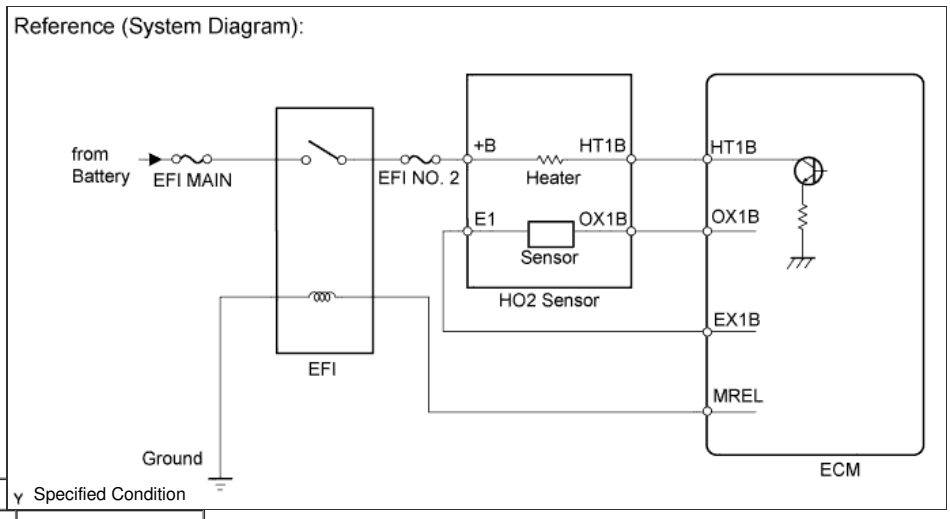
11.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)

a. Disconnect the HO2 sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:





Tester Connection	Switch Condition	Specified Condition
C20-2 (+B) - Body ground	Engine switch on (IG)	9 to 14 V
C56-2 (+B) - Body ground	Engine switch on (IG)	9 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.

e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C45-45 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C45-114 (OX1B)	Always	Below 1 Ω
C20-4 (E1) - C45-115 (EX1B)	Always	Below 1 Ω
C56-1 (HT2B) - C45-44 (HT2B)	Always	Below 1 Ω
C56-3 (OX2B) - C45-112 (OX2B)	Always	Below 1 Ω
C56-4 (E1) - C45-113 (EX2B)	Always	Below 1 Ω
C20-1 (HT1B) or C45-45 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C45-114 (OX1B) - Body ground	Always	10 kΩ or higher
C56-1 (HT2B) or C45-44 (HT2B) - Body ground	Always	10 kΩ or higher
C56-3 (OX2B) or C45-112 (OX2B) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C46-45 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C46-114 (OX1B)	Always	Below 1 Ω
C20-4 (E1) - C46-115 (EX1B)	Always	Below 1 Ω
C56-1 (HT2B) - C46-44 (HT2B)	Always	Below 1 Ω
C56-3 (OX2B) - C46-112 (OX2B)	Always	Below 1 Ω
C56-4 (E1) - C46-113 (EX2B)	Always	Below 1 Ω
C20-1 (HT1B) or C46-45 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C46-114 (OX1B) - Body ground	Always	10 kΩ or higher
C56-1 (HT2B) or C46-44 (HT2B) - Body ground	Always	10 kΩ or higher
C56-3 (OX2B) or C46-112 (OX2B) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE HEATED OXYGEN SENSOR (Click here)

12.REPLACE HEATED OXYGEN SENSOR

a. Replace the heated oxygen sensor (Click here).

NEXT

13.PERFORM CONFIRMATION DRIVING PATTERN

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher.

d. Drive the vehicle at 60 to 120 km/h (40 to 75 mph) for 10 minutes.

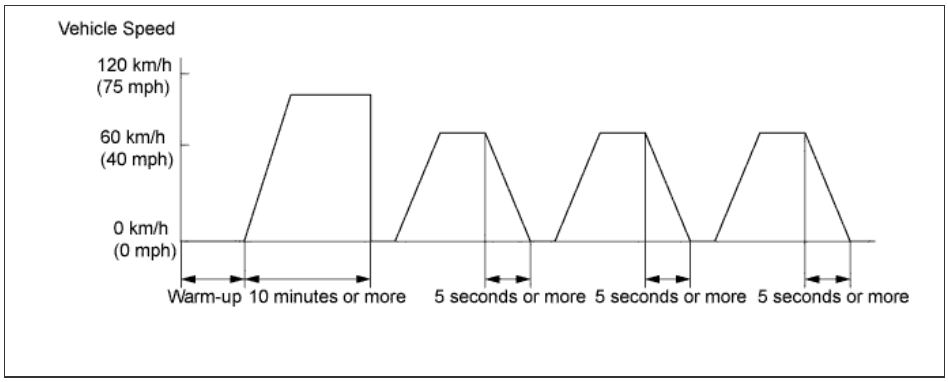
e. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more. Perform this 3 times.

f. Turn the tester on.

g. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

h. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

i. Check that DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern increasing the vehicle speed and using second gear to decelerate the vehicle.



NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK → END

14.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

15.PERFORM CONFIRMATION DRIVING PATTERN

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Clear the DTCs.

d. Switch the ECM from normal mode to check mode using the tester.

e. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher.

f. Drive the vehicle at 60 to 120 km/h (40 to 75 mph) for 10 minutes.

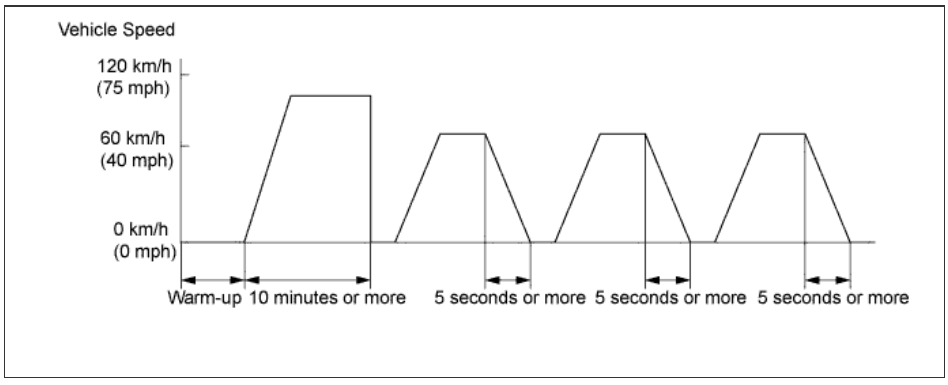
g. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more. Perform this 3 times.

h. Turn the tester on.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

k. Check that DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern increasing the vehicle speed and using second gear to decelerate the vehicle.



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

END

DTC P2111 Throttle Actuator Control System - Stuck Open

DTC P2112 Throttle Actuator Control System - Stuck Closed

for Preparation Click here

DESCRIPTION

The throttle actuator is operated by the ECM, and opens and closes the throttle valve using gears. The opening angle of the throttle valve is detected by the Throttle Position (TP) sensor, which is mounted on the throttle body. The TP sensor provides feedback to the ECM so that it can control the throttle actuator (throttle valve) appropriately in response to driver inputs.

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

DTC Code	DTC Detection Condition	Trouble Area
P2111	The throttle actuator does not close when signaled by the ECM (1 trip detection logic).	• **Throttle actuator** • **Throttle body assembly** • **Throttle valve**
P2112	The throttle actuator does not open when signaled by the ECM (1 trip detection logic).	• **Throttle actuator** • **Throttle body assembly** • **Throttle valve**

MONITOR DESCRIPTION

The ECM determines that there is a malfunction in the ETCS when the throttle valve remains at a fixed angle despite a high drive current from the ECM. The ECM illuminates the MIL and stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored when the accelerator pedal is fully depressed and released quickly (to fully open and close the throttle valve) after the engine is next started.

FAIL-SAFE

When either of these DTCs, or other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM

Refer to DTC P2102 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2111 OR P2112)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P2111 or P2112 is output	A
P2111 or P2112 and other DTCs are output	B

HINT:

If any DTCs other than P2111 or P2112 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.INSPECT THROTTLE BODY ASSEMBLY (VISUALLY CHECK THROTTLE VALVE)

a. Check for contamination between the throttle valve and the housing. If necessary, clean the throttle body. And check that the throttle valve moves smoothly.

OK:
Throttle valve is not contaminated with foreign objects and moves smoothly.

NG → REPLACE THROTTLE BODY ASSEMBLY (Click here)

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P2111 OR P2112)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine, and fully depress and release the accelerator pedal quickly (to fully open and close the throttle valve).

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P2111 or P2112 is output	B

B → REPLACE ECM (Click here)

A

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0136 Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)

DTC P0137 Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)

DTC P0138 Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)

DTC P0156 Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)

DTC P0157 Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)

DTC P0158 Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)

for Preparation Click here

DESCRIPTION

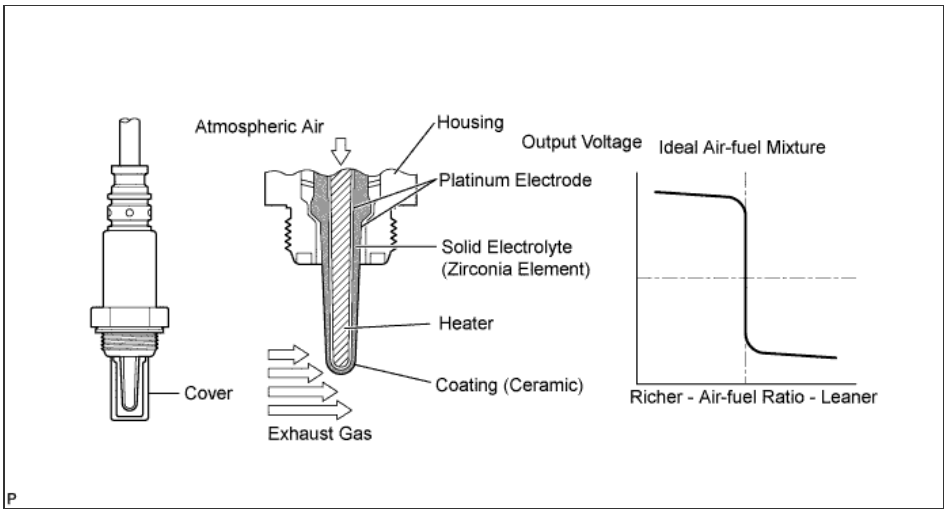
In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric air-fuel level. For the purpose of helping the ECM to deliver accurate air-fuel ratio control, a Heated Oxygen (HO2) sensor is used.

The HO2 sensor is located behind the TWC, and detects the oxygen concentration in the exhaust gas. Since the sensor is integrated with a heater that heats the sensing portion, it is possible to detect the oxygen concentration even when the intake air volume is low (the exhaust gas temperature is low).

When the air-fuel ratio becomes lean, the oxygen concentration in the exhaust gas is rich. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is lean (low voltage, i.e. below 0.45 V).

Conversely, when the air-fuel ratio is richer than the stoichiometric air-fuel level, the oxygen concentration in the exhaust gas becomes lean. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is rich (high voltage, i.e. higher than 0.45 V). The HO2 sensor has the property of changing its output voltage drastically when the air-fuel ratio is close to the stoichiometric level.

The ECM uses the supplementary information from the HO2 sensor to determine whether the air-fuel ratio after the TWC is rich or lean, and adjusts the fuel injection time accordingly. Thus, if the HO2 sensor is working improperly due to internal malfunctions, the ECM is unable to compensate for deviations in the primary air-fuel ratio control.



DTC Code	DTC Detection Condition	Trouble Area
P0136 P0156	• Abnormal voltage output: During active air-fuel ratio control, conditions (a) and (b) are met for a certain period of time (2 trip detection logic): (a) The Heated Oxygen (HO2) sensor voltage does not decrease to below 0.21 V. (b) The HO2 sensor voltage does not increase to higher than 0.59 V.	• Open or short in HO2 sensor (for bank 1, 2) circuit • HO2 sensor (for bank 1, 2) • HO2 sensor heater (for bank 1, 2) • Air-Fuel Ratio (A/F) sensor (for bank 1, 2) • Integration relay • Gas leakage from exhaust system
P0137 P0157	• Low voltage (open): During active air-fuel ratio control, conditions (a) and (b) are met for a certain period of time (2 trip detection logic): (a) The HO2 sensor voltage output is below 0.21 V. (b) The target air-fuel ratio is rich.	• Open in HO2 sensor (for bank 1, 2) circuit • HO2 sensor (for bank 1, 2) • HO2 sensor heater (for bank 1, 2) • Integration relay • Gas leakage from exhaust system
P0138 P0158	• High voltage (short): During active air-fuel ratio control, conditions (a) and (b) are met for a certain period of time (2 trip detection logic): (a) The HO2 sensor voltage output is higher than 0.59 V. (b) The target air-fuel ratio is lean.	• Short in HO2 sensor (for bank 1, 2) circuit • HO2 sensor (for bank 1, 2) • ECM internal circuit malfunction • Air-Fuel Ratio (A/F) sensor (for bank 1, 2)

MONITOR DESCRIPTION

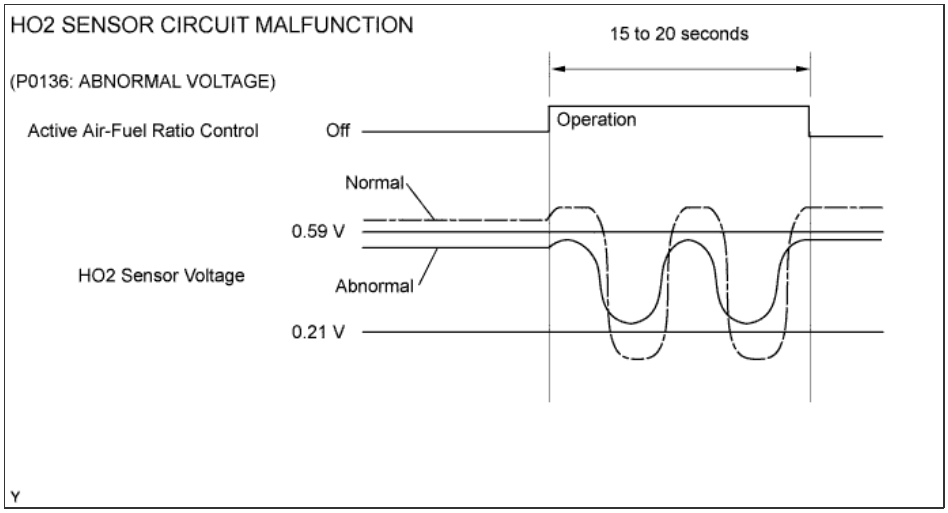
Active Air-Fuel Ratio Control

The ECM usually performs air-fuel ratio feedback control so that the Air-Fuel Ratio (A/F) sensor output indicates a near stoichiometric air-fuel level. This vehicle includes active air-fuel ratio control in addition to regular air-fuel ratio control. The ECM performs active air-fuel ratio control to detect any deterioration in the Three-Way Catalytic Converter (TWC) and Heated Oxygen (HO2) sensor malfunctions (refer to the diagram below).

Active air-fuel ratio control is performed for approximately 15 to 20 seconds while driving with a warm engine. During active air-fuel ratio control, the air-fuel ratio is forcibly regulated to become lean or rich by the ECM. If the ECM detects a malfunction, a DTC is stored.

Abnormal Voltage Output of HO2 Sensor (DTC P0136 and P0156)

While the ECM is performing active air-fuel ratio control, the air-fuel ratio is forcibly regulated to become rich or lean. If the sensor is not functioning properly, the voltage output variation is small. For example, when the HO2 sensor voltage does not decrease to below 0.21 V and does not increase to higher than 0.59 V during active air-fuel ratio control, the ECM determines that the sensor voltage output is abnormal and stores DTC P0136 or P0156.



Open or Short in Heated Oxygen (HO2) Sensor Circuit (DTC P0137 and P0157 or P0138 and P0158)

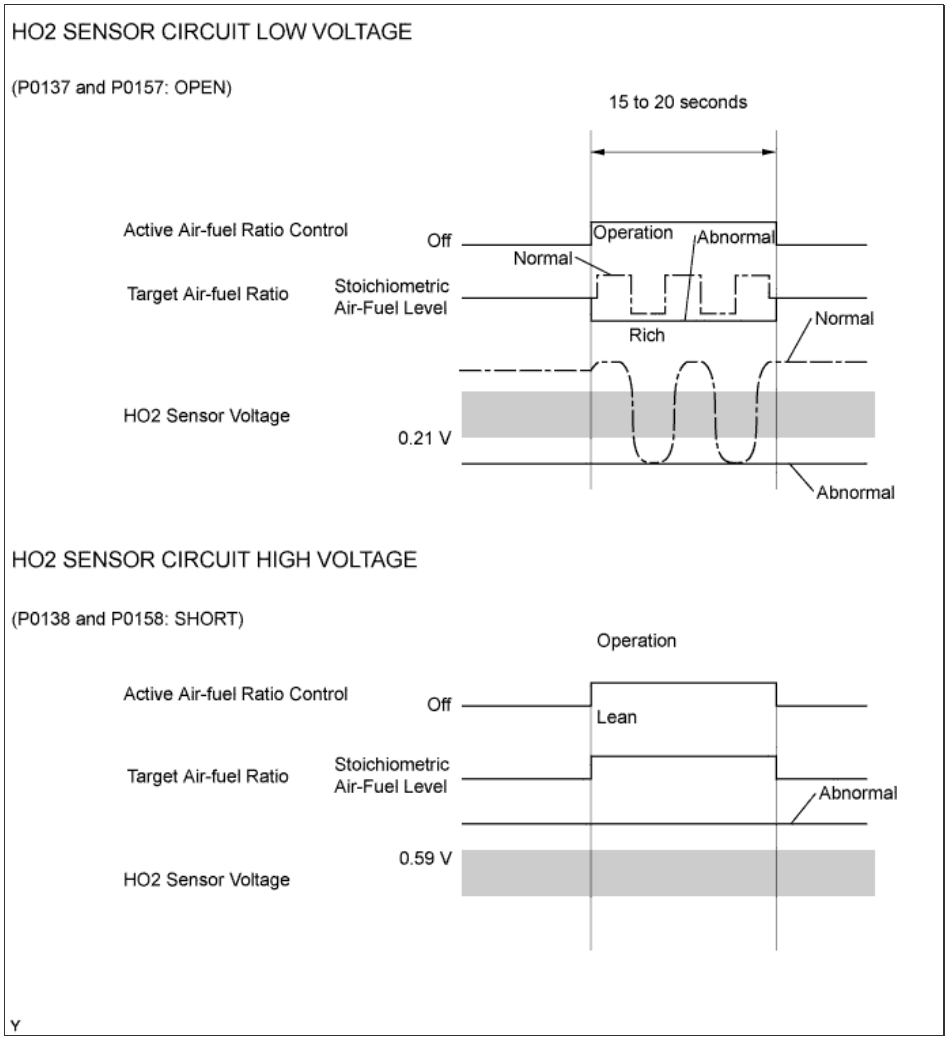
During active air-fuel ratio control, the ECM calculates the Oxygen Storage Capacity (OSC)* of the Three-Way Catalytic Converter (TWC) by forcibly regulating the air-fuel ratio to become rich or lean. If the HO2 sensor has an open or short, or the voltage output of the sensor decreases significantly, the OSC indicates an extraordinarily high value. Even if the ECM attempts to continue regulating the air-fuel ratio to become rich or lean, the HO2 sensor output does not change.

While performing active air-fuel ratio control, when the target air-fuel ratio is rich and the HO2 sensor voltage output is 0.21 V or less (lean), the ECM interprets this as an abnormally low sensor output voltage and stores DTC P0137 or P0157. When the target air-fuel ratio is lean and the voltage output is 0.59 V or higher (rich) during active air-fuel ratio control, the ECM determines that the sensor voltage output is abnormally high, and stores DTC P0138 or P0158.

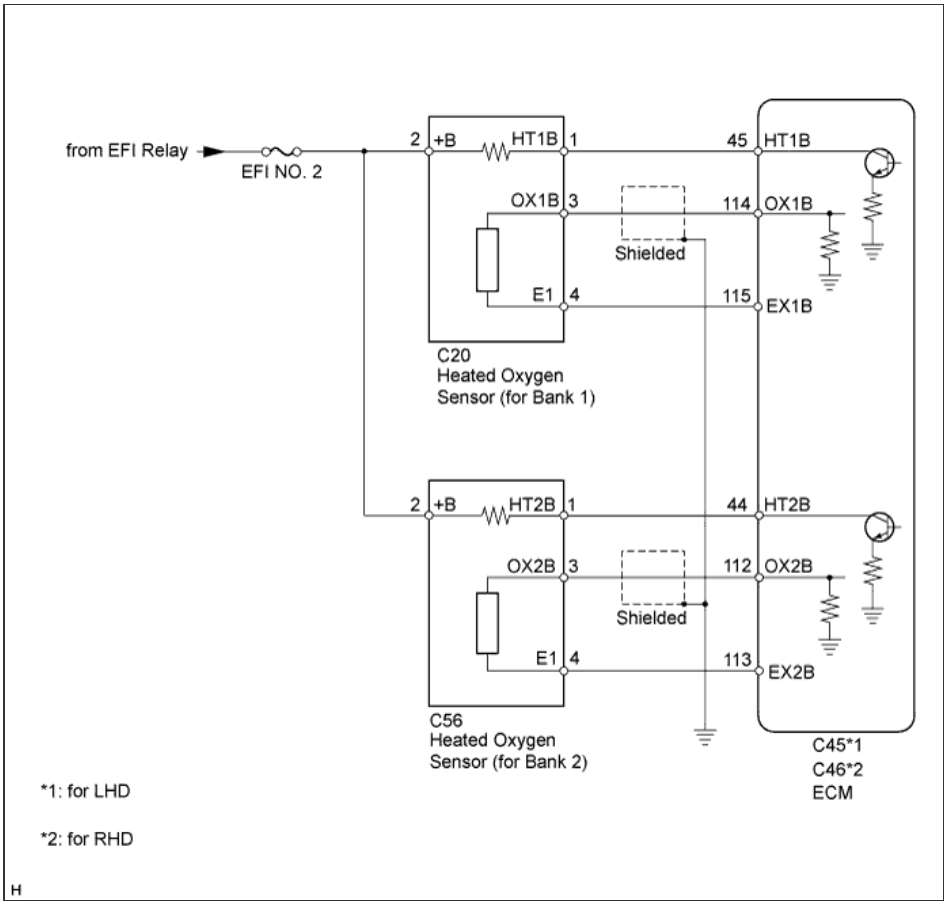
HINT:

DTC P0138 or P0158 is also stored if the HO2 sensor voltage output is higher than 1.2 V for 10 seconds or more.

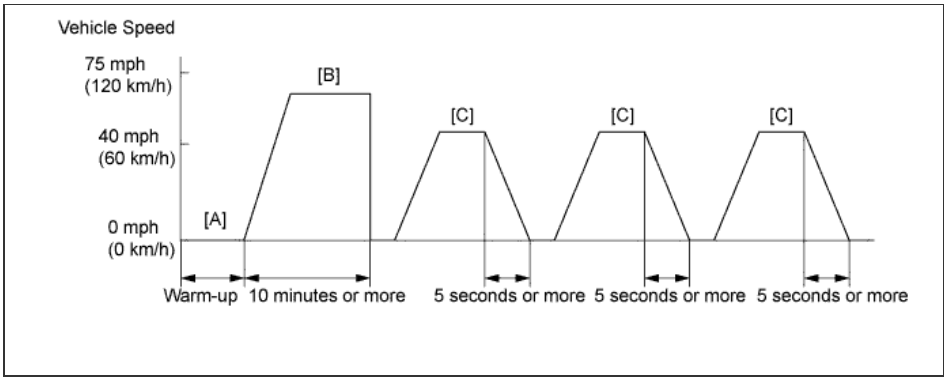
*: The TWC has the capability to store oxygen. The OSC and the emission purification capacity of the TWC are mutually related. The ECM determines whether the catalyst has deteriorated based on the calculated OSC value (Click here).



WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN



1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher [A].
4. Drive the vehicle at 60 to 120 km/h (40 to 75 mph) for 10 minutes or more [B].
5. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more. Perform this 3 times [C].
6. Turn the tester on.
7. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
8. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.
9. Check that DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern by accelerating and decelerating the vehicle.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.**

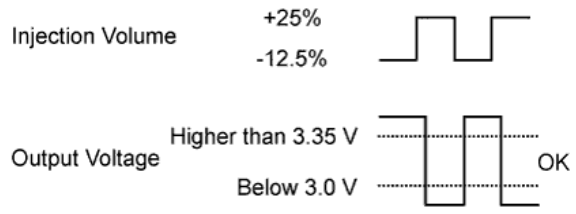
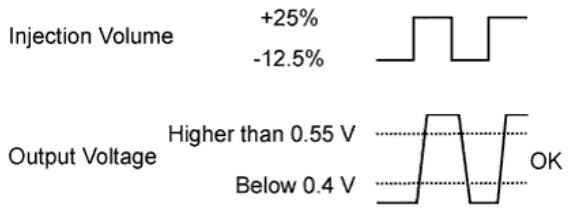
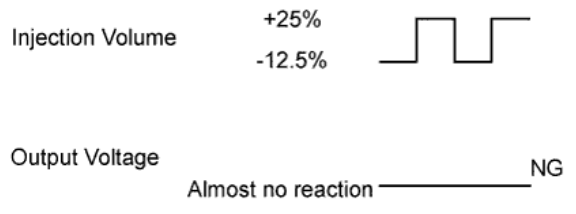
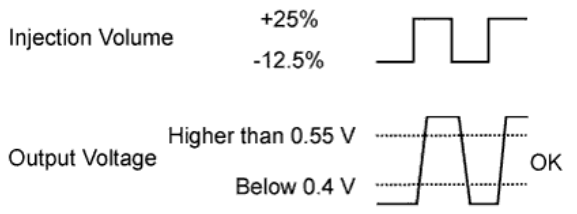
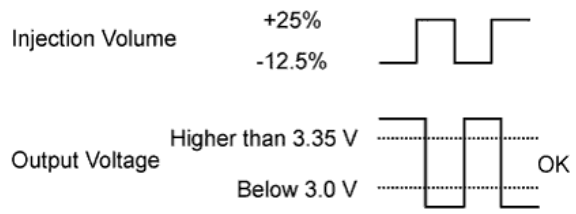
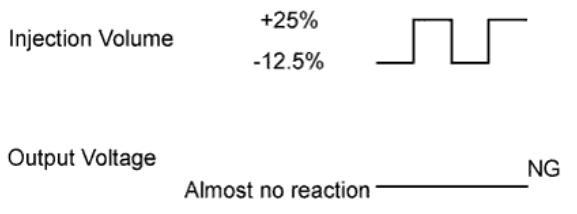
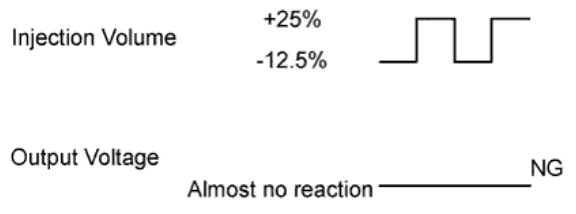
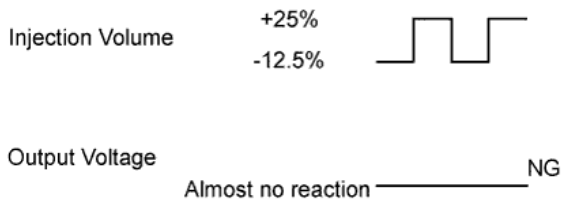
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 or AFS B2 S1 (A/F)	+25%	Rich	Below 3.0 V
AFS B1 S1 or AFS B2 S1 (A/F)	-12.5%	Lean	Higher than 3.35 V
O2S B1 S2 or O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55 V
O2S B1 S2 or O2S B2 S2 (HO2)	-12.5%	Lean	Below 0.4 V

NOTICE:

The Air-Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

HINT:

- **If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the OX1B wire from the ECM connector is short-circuited to the +B wire, DTC P0136 will be stored.**
- **If the OX2B wire from the ECM connector is short-circuited to the +B wire, DTC P0156 will be stored.**

1.READ OUTPUT DTC

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0138 or P0158 is output	A
P0137 or P0157 is output	B
P0136 or P0156 is output	C

B → Go to step 8

C → Go to step 6

A

2.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1 S2 or O2S B2 S2.

d. Allow the engine to idle.

e. Read the Heated Oxygen (HO2) sensor output voltage while idling.

Result

Result	Proceed to
Higher than 1.2 V	A
Below 1.0 V	B

OK → Go to step 5

NG → Go to step 3

3.INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)

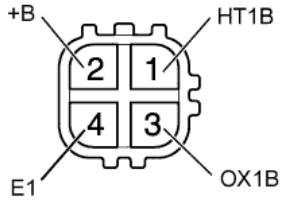
a. Disconnect the Heated Oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

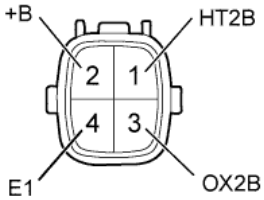
Standard Resistance:

Tester Connection	Condition	Specified Condition
2 (+B) - 3 (OX1B)	Always	10 kΩ or higher
2 (+B) - 4 (E1)	Always	10 kΩ or higher
2 (+B) - 3 (OX2B)	Always	10 kΩ or higher
2 (+B) - 4 (E1)	Always	10 kΩ or higher

Component without harness connected:
(HO2 Sensor for Bank 1)



Component without harness connected:
(HO2 Sensor for Bank 2)



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

4.CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT)

a. Turn the engine switch off and wait for 5 minutes.

b. Disconnect the ECM connector.

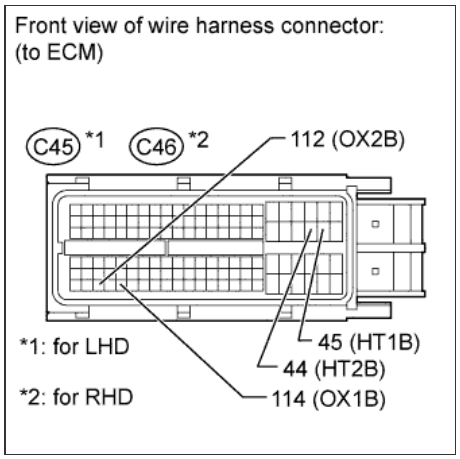
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C45-45 (HT1B) - C45-114 (OX1B)	Always	10 kΩ or higher
C45-44 (HT2B) - C45-112 (OX2B)	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C46-45 (HT1B) - C46-114 (OX1B)	Always	10 kΩ or higher
C46-44 (HT2B) - C46-112 (OX2B)	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

5.CHECK AIR FUEL RATIO SENSOR CURRENT

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS B1 S1 or AFS B2 S1.

d. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher.

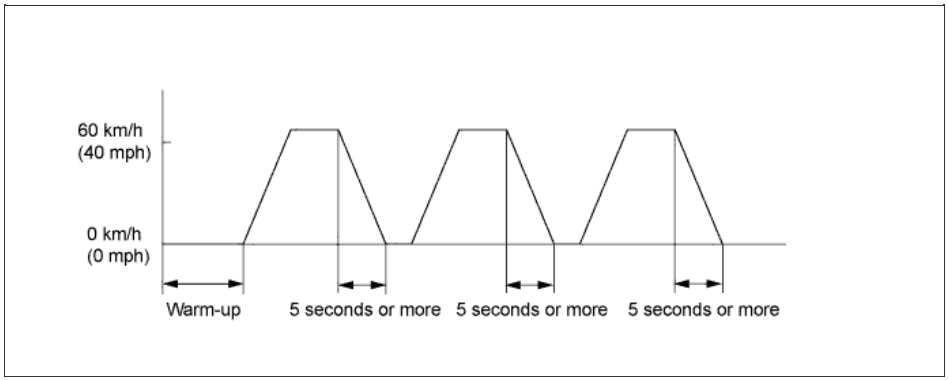
e. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more.
Perform this 3 times.

HINT:

If the tester shows Utility / Monitor Status / O2 Sensor / Incomplete again, increase the vehicle speed and use second gear to decelerate the vehicle.

f. Read the value.

Standard current:
Below 3.0 mA



OK → Go to step 12

NG → Go to step 14

6.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Start the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1 S2 or O2S B2 S2.

e. After warming up the engine, run the engine at an engine speed of 2500 rpm for 3 minutes.

f. Read the output voltage of the HO2 sensor when the engine speed is suddenly increased.

HINT:

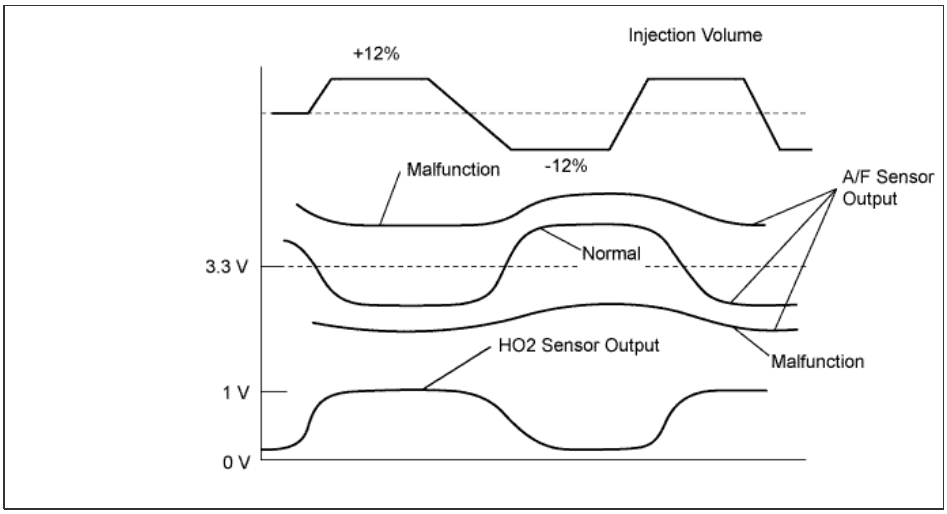
Quickly accelerate the engine to 4000 rpm 3 times using the accelerator pedal.

Standard voltage:
Fluctuates between 0.4 V or less and 0.5 V or higher.

NG	Go to step 8

OK

7.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (INJECTION VOLUME)



a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume.

e. Change the fuel injection volume using the tester, and monitor the voltage output of Air-Fuel Ratio (A/F) and HO2 sensors displayed on the tester.

HINT:

- **Change the fuel injection volume within the range of -12% and +12%. The injection volume can be changed in 1% graduations within the range.**
- **The A/F sensor is displayed as AFS B1 S1 or AFS B2 S1, and the HO2 sensor is displayed as O2S B1 S2 or O2S B2 S2, on the intelligent tester.**

Result:

Tester Display (Sensor)	Voltage Variation	Proceed to
AFS B1 S1 (A/F) AFS B2 S1 (A/F)	Alternates between higher than and below 3.3 V	OK
	Remains at higher than 3.3 V	NG
	Remains at below 3.3 V	NG

HINT:

A normal HO2 sensor voltage (O2S B1 S2 or O2S B2 S2) reacts in accordance with increases and decreases in fuel injection volumes. When the A/F sensor voltage remains at either below or higher than 3.3 V despite the HO2 sensor indicating a normal reaction, the A/F sensor is malfunctioning.

NG	Go to step 14

OK

CHECK EXTREMELY RICH OR LEAN ACTUAL AIR-FUEL RATIO AND REPAIR CAUSE (INJECTOR, FUEL PRESSURE, GAS LEAKAGE FROM EXHAUST SYSTEM, ETC.)

8.CHECK FOR EXHAUST GAS LEAK

a. Check for exhaust gas leakage from the exhaust manifold and pipe.

OK:
No exhaust gas leakage.

NG	REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT

OK

9.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

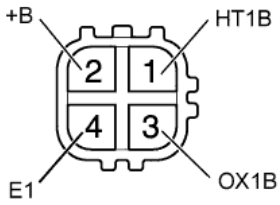
a. Disconnect the Heated Oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

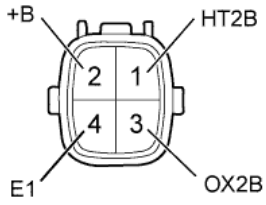
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT1B) - 4 (E1)	Always	10 kΩ or higher
1 (HT2B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT2B) - 4 (E1)	Always	10 kΩ or higher

Component without harness connected:
(HO2 Sensor for Bank 1)



Component without harness connected:
(HO2 Sensor for Bank 2)



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

10.INSPECT INTEGRATION RELAY (EFI RELAY)

a. Remove the integration relay from the engine room relay block.

b. Inspect the EFI MAIN fuse.

i. Remove the EFI MAIN fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAIN fuse	Always	Below 1 Ω

iii. Reinstall the EFI MAIN fuse.

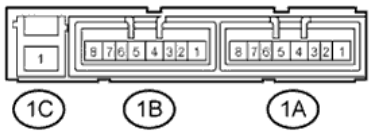
c. Inspect the EFI relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1B-4	When no battery voltage applied to terminals 1B-2 and 1B-3	10 kΩ or higher
	When battery voltage applied to terminals 1B-2 and 1B-3	Below 1 Ω

Component without harness connected:
(Integration Relay)



NG → REPLACE INTEGRATION RELAY

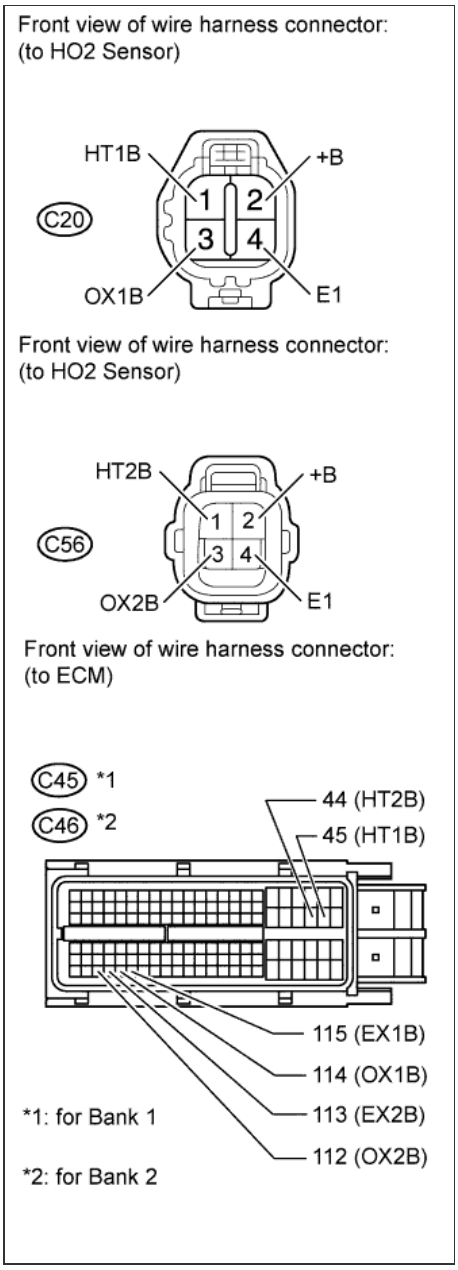
OK

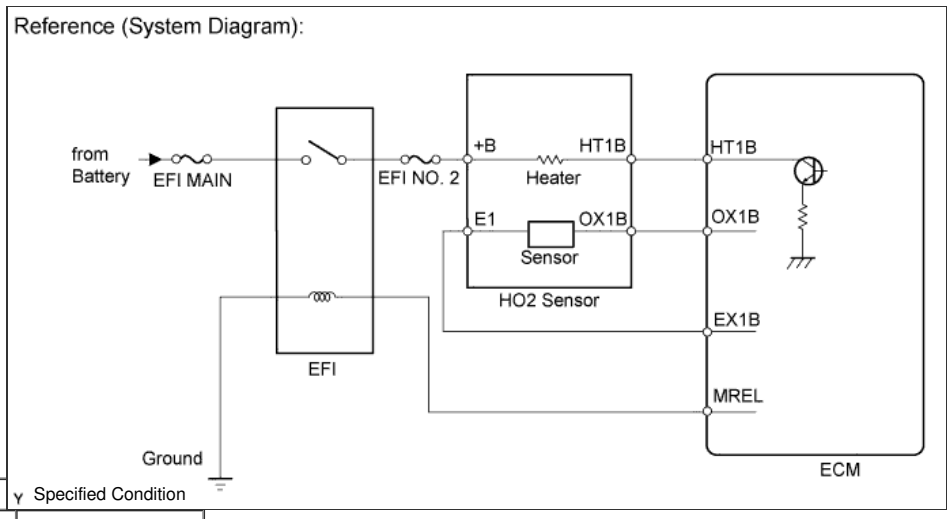
11.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)

a. Disconnect the HO2 sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:





Tester Connection	Switch Condition	Specified Condition
C20-2 (+B) - Body ground	Engine switch on (IG)	9 to 14 V
C56-2 (+B) - Body ground	Engine switch on (IG)	9 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.

e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C45-45 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C45-114 (OX1B)	Always	Below 1 Ω
C20-4 (E1) - C45-115 (EX1B)	Always	Below 1 Ω
C56-1 (HT2B) - C45-44 (HT2B)	Always	Below 1 Ω
C56-3 (OX2B) - C45-112 (OX2B)	Always	Below 1 Ω
C56-4 (E1) - C45-113 (EX2B)	Always	Below 1 Ω
C20-1 (HT1B) or C45-45 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C45-114 (OX1B) - Body ground	Always	10 kΩ or higher
C56-1 (HT2B) or C45-44 (HT2B) - Body ground	Always	10 kΩ or higher
C56-3 (OX2B) or C45-112 (OX2B) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C46-45 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C46-114 (OX1B)	Always	Below 1 Ω
C20-4 (E1) - C46-115 (EX1B)	Always	Below 1 Ω
C56-1 (HT2B) - C46-44 (HT2B)	Always	Below 1 Ω
C56-3 (OX2B) - C46-112 (OX2B)	Always	Below 1 Ω
C56-4 (E1) - C46-113 (EX2B)	Always	Below 1 Ω
C20-1 (HT1B) or C46-45 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C46-114 (OX1B) - Body ground	Always	10 kΩ or higher
C56-1 (HT2B) or C46-44 (HT2B) - Body ground	Always	10 kΩ or higher
C56-3 (OX2B) or C46-112 (OX2B) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE HEATED OXYGEN SENSOR (Click here)

12.REPLACE HEATED OXYGEN SENSOR

a. Replace the heated oxygen sensor (Click here).

NEXT

13.PERFORM CONFIRMATION DRIVING PATTERN

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher.

d. Drive the vehicle at 60 to 120 km/h (40 to 75 mph) for 10 minutes.

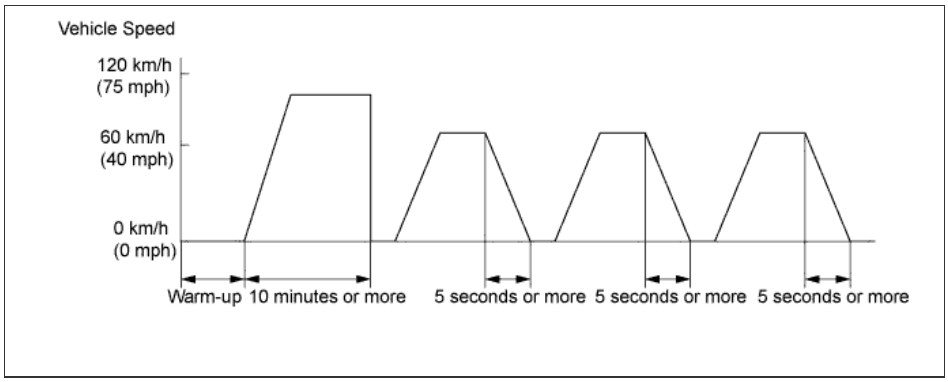
e. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more. Perform this 3 times.

f. Turn the tester on.

g. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

h. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

i. Check that DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern increasing the vehicle speed and using second gear to decelerate the vehicle.



NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK → END

14.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

15.PERFORM CONFIRMATION DRIVING PATTERN

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Clear the DTCs.

d. Switch the ECM from normal mode to check mode using the tester.

e. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher.

f. Drive the vehicle at 60 to 120 km/h (40 to 75 mph) for 10 minutes.

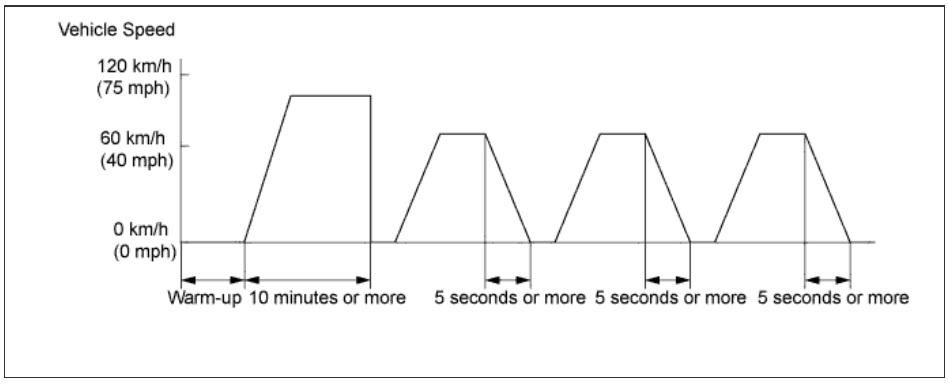
g. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more. Perform this 3 times.

h. Turn the tester on.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

k. Check that DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern increasing the vehicle speed and using second gear to decelerate the vehicle.



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

END

DTC P2111 Throttle Actuator Control System - Stuck Open

DTC P2112 Throttle Actuator Control System - Stuck Closed

for Preparation Click here

DESCRIPTION

The throttle actuator is operated by the ECM, and opens and closes the throttle valve using gears. The opening angle of the throttle valve is detected by the Throttle Position (TP) sensor, which is mounted on the throttle body. The TP sensor provides feedback to the ECM so that it can control the throttle actuator (throttle valve) appropriately in response to driver inputs.

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

DTC Code	DTC Detection Condition	Trouble Area
P2111	The throttle actuator does not close when signaled by the ECM (1 trip detection logic).	• **Throttle actuator** • **Throttle body assembly** • **Throttle valve**
P2112	The throttle actuator does not open when signaled by the ECM (1 trip detection logic).	• **Throttle actuator** • **Throttle body assembly** • **Throttle valve**

MONITOR DESCRIPTION

The ECM determines that there is a malfunction in the ETCS when the throttle valve remains at a fixed angle despite a high drive current from the ECM. The ECM illuminates the MIL and stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored when the accelerator pedal is fully depressed and released quickly (to fully open and close the throttle valve) after the engine is next started.

FAIL-SAFE

When either of these DTCs, or other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM

Refer to DTC P2102 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2111 OR P2112)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P2111 or P2112 is output	A
P2111 or P2112 and other DTCs are output	B

HINT:

If any DTCs other than P2111 or P2112 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.INSPECT THROTTLE BODY ASSEMBLY (VISUALLY CHECK THROTTLE VALVE)

a. Check for contamination between the throttle valve and the housing. If necessary, clean the throttle body. And check that the throttle valve moves smoothly.

OK:
Throttle valve is not contaminated with foreign objects and moves smoothly.

NG → REPLACE THROTTLE BODY ASSEMBLY (Click here)

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P2111 OR P2112)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine, and fully depress and release the accelerator pedal quickly (to fully open and close the throttle valve).

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P2111 or P2112 is output	B

B → REPLACE ECM (Click here)

A

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0136 Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)

DTC P0137 Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)

DTC P0138 Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)

DTC P0156 Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)

DTC P0157 Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)

DTC P0158 Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)

for Preparation Click here

DESCRIPTION

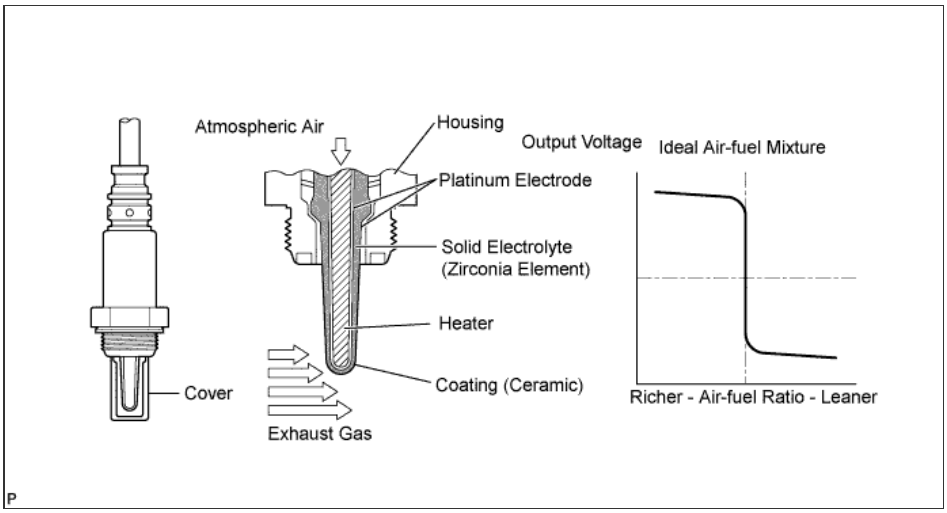
In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric air-fuel level. For the purpose of helping the ECM to deliver accurate air-fuel ratio control, a Heated Oxygen (HO2) sensor is used.

The HO2 sensor is located behind the TWC, and detects the oxygen concentration in the exhaust gas. Since the sensor is integrated with a heater that heats the sensing portion, it is possible to detect the oxygen concentration even when the intake air volume is low (the exhaust gas temperature is low).

When the air-fuel ratio becomes lean, the oxygen concentration in the exhaust gas is rich. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is lean (low voltage, i.e. below 0.45 V).

Conversely, when the air-fuel ratio is richer than the stoichiometric air-fuel level, the oxygen concentration in the exhaust gas becomes lean. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is rich (high voltage, i.e. higher than 0.45 V). The HO2 sensor has the property of changing its output voltage drastically when the air-fuel ratio is close to the stoichiometric level.

The ECM uses the supplementary information from the HO2 sensor to determine whether the air-fuel ratio after the TWC is rich or lean, and adjusts the fuel injection time accordingly. Thus, if the HO2 sensor is working improperly due to internal malfunctions, the ECM is unable to compensate for deviations in the primary air-fuel ratio control.



DTC Code	DTC Detection Condition	Trouble Area
P0136 P0156	• Abnormal voltage output: During active air-fuel ratio control, conditions (a) and (b) are met for a certain period of time (2 trip detection logic): (a) The Heated Oxygen (HO2) sensor voltage does not decrease to below 0.21 V. (b) The HO2 sensor voltage does not increase to higher than 0.59 V.	• Open or short in HO2 sensor (for bank 1, 2) circuit • HO2 sensor (for bank 1, 2) • HO2 sensor heater (for bank 1, 2) • Air-Fuel Ratio (A/F) sensor (for bank 1, 2) • Integration relay • Gas leakage from exhaust system
P0137 P0157	• Low voltage (open): During active air-fuel ratio control, conditions (a) and (b) are met for a certain period of time (2 trip detection logic): (a) The HO2 sensor voltage output is below 0.21 V. (b) The target air-fuel ratio is rich.	• Open in HO2 sensor (for bank 1, 2) circuit • HO2 sensor (for bank 1, 2) • HO2 sensor heater (for bank 1, 2) • Integration relay • Gas leakage from exhaust system
P0138 P0158	• High voltage (short): During active air-fuel ratio control, conditions (a) and (b) are met for a certain period of time (2 trip detection logic): (a) The HO2 sensor voltage output is higher than 0.59 V. (b) The target air-fuel ratio is lean.	• Short in HO2 sensor (for bank 1, 2) circuit • HO2 sensor (for bank 1, 2) • ECM internal circuit malfunction • Air-Fuel Ratio (A/F) sensor (for bank 1, 2)

MONITOR DESCRIPTION

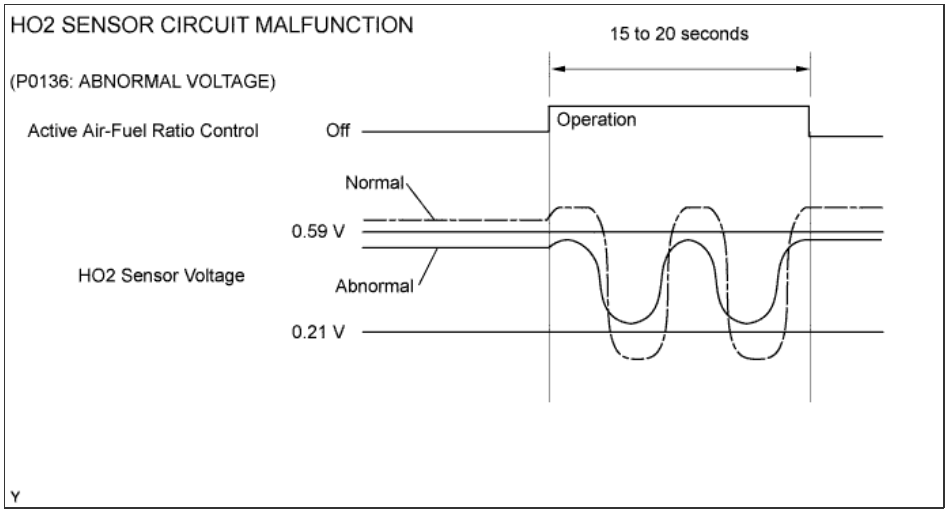
Active Air-Fuel Ratio Control

The ECM usually performs air-fuel ratio feedback control so that the Air-Fuel Ratio (A/F) sensor output indicates a near stoichiometric air-fuel level. This vehicle includes active air-fuel ratio control in addition to regular air-fuel ratio control. The ECM performs active air-fuel ratio control to detect any deterioration in the Three-Way Catalytic Converter (TWC) and Heated Oxygen (HO2) sensor malfunctions (refer to the diagram below).

Active air-fuel ratio control is performed for approximately 15 to 20 seconds while driving with a warm engine. During active air-fuel ratio control, the air-fuel ratio is forcibly regulated to become lean or rich by the ECM. If the ECM detects a malfunction, a DTC is stored.

Abnormal Voltage Output of HO2 Sensor (DTC P0136 and P0156)

While the ECM is performing active air-fuel ratio control, the air-fuel ratio is forcibly regulated to become rich or lean. If the sensor is not functioning properly, the voltage output variation is small. For example, when the HO2 sensor voltage does not decrease to below 0.21 V and does not increase to higher than 0.59 V during active air-fuel ratio control, the ECM determines that the sensor voltage output is abnormal and stores DTC P0136 or P0156.



Open or Short in Heated Oxygen (HO2) Sensor Circuit (DTC P0137 and P0157 or P0138 and P0158)

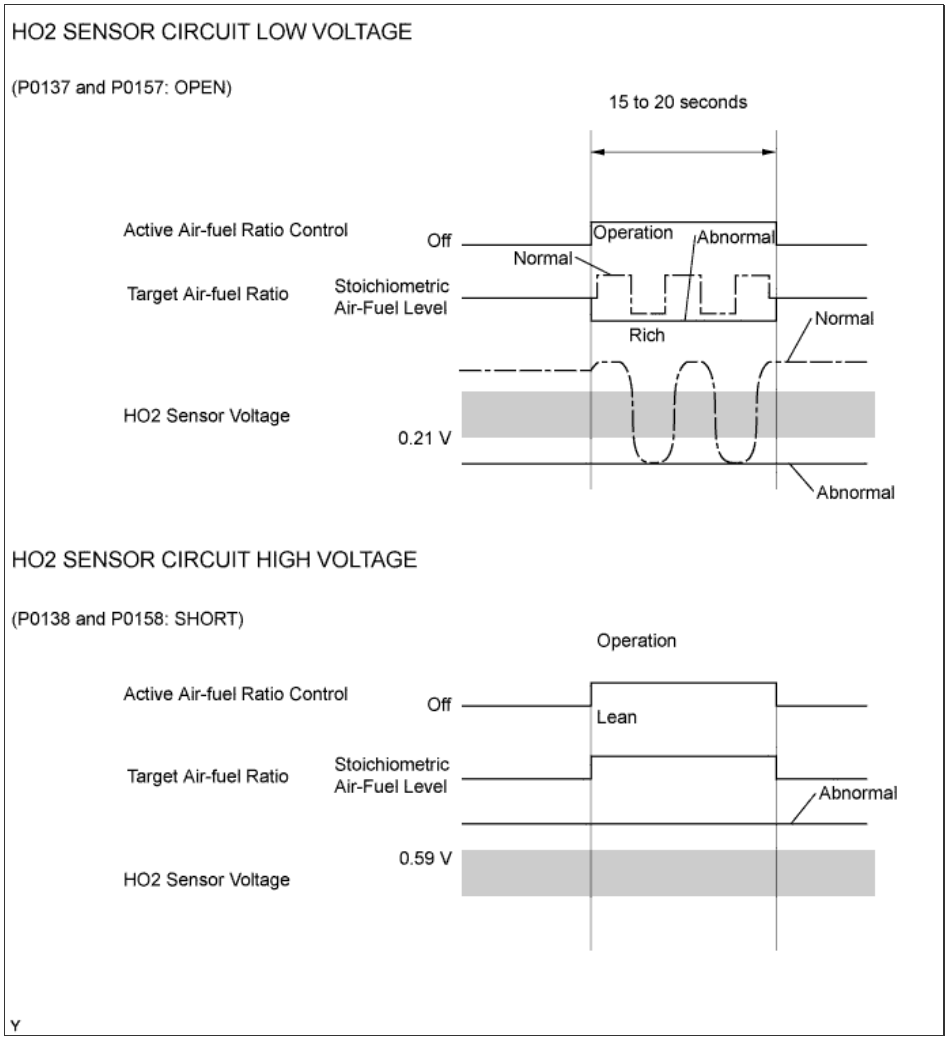
During active air-fuel ratio control, the ECM calculates the Oxygen Storage Capacity (OSC)* of the Three-Way Catalytic Converter (TWC) by forcibly regulating the air-fuel ratio to become rich or lean. If the HO2 sensor has an open or short, or the voltage output of the sensor decreases significantly, the OSC indicates an extraordinarily high value. Even if the ECM attempts to continue regulating the air-fuel ratio to become rich or lean, the HO2 sensor output does not change.

While performing active air-fuel ratio control, when the target air-fuel ratio is rich and the HO2 sensor voltage output is 0.21 V or less (lean), the ECM interprets this as an abnormally low sensor output voltage and stores DTC P0137 or P0157. When the target air-fuel ratio is lean and the voltage output is 0.59 V or higher (rich) during active air-fuel ratio control, the ECM determines that the sensor voltage output is abnormally high, and stores DTC P0138 or P0158.

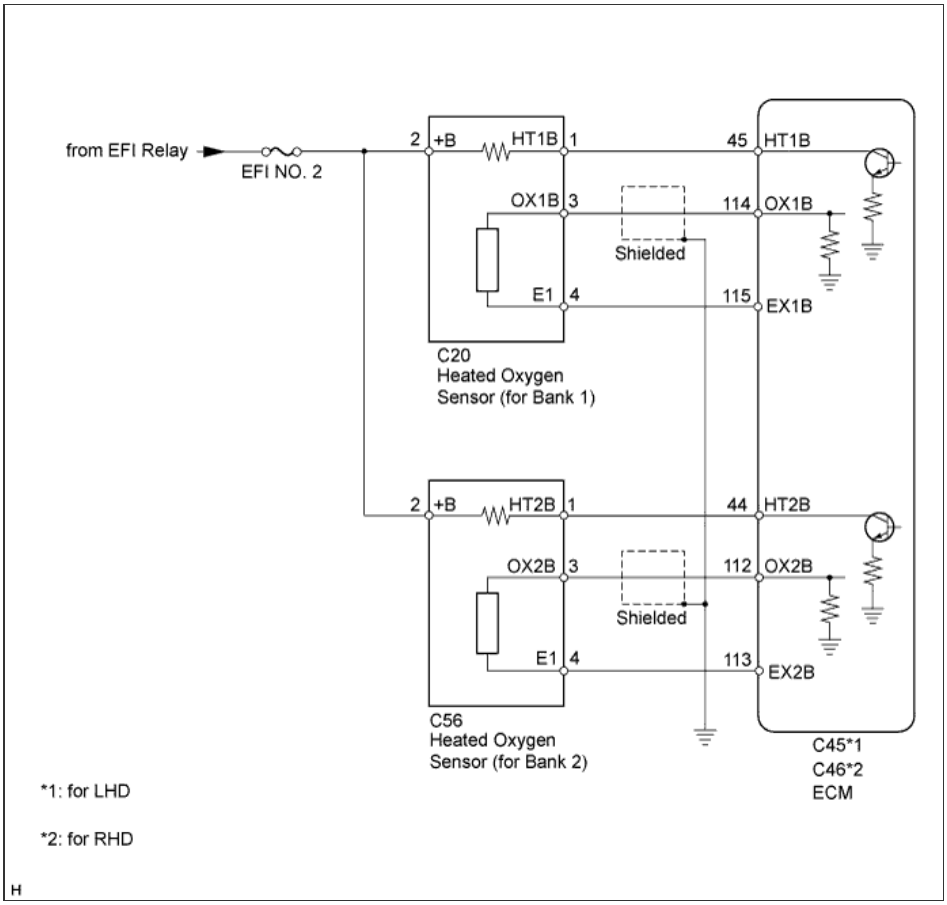
HINT:

DTC P0138 or P0158 is also stored if the HO2 sensor voltage output is higher than 1.2 V for 10 seconds or more.

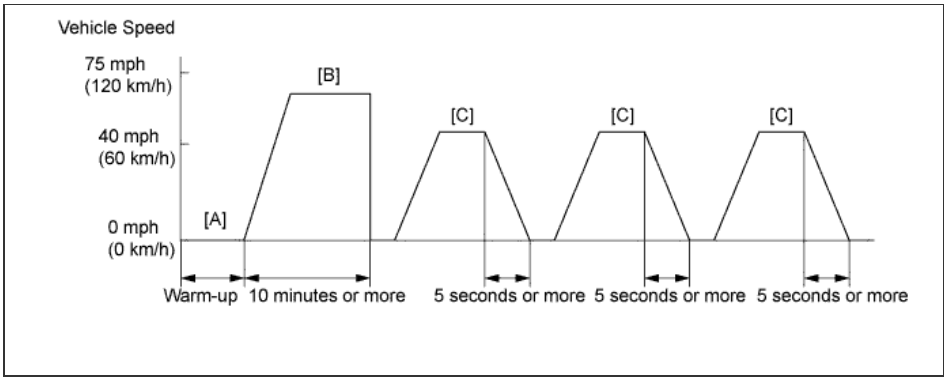
*: The TWC has the capability to store oxygen. The OSC and the emission purification capacity of the TWC are mutually related. The ECM determines whether the catalyst has deteriorated based on the calculated OSC value (Click here).



WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN



1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher [A].
4. Drive the vehicle at 60 to 120 km/h (40 to 75 mph) for 10 minutes or more [B].
5. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more. Perform this 3 times [C].
6. Turn the tester on.
7. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
8. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.
9. Check that DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern by accelerating and decelerating the vehicle.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

1. **Connect the intelligent tester to the DLC3.**
2. **Start the engine and turn the tester on.**
3. **Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.**
4. **Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.**
5. **Perform the Active Test operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).**
6. **Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.**

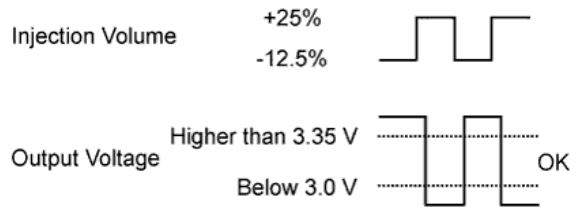
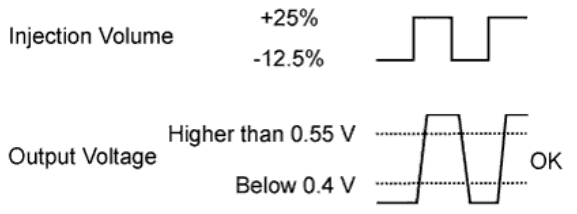
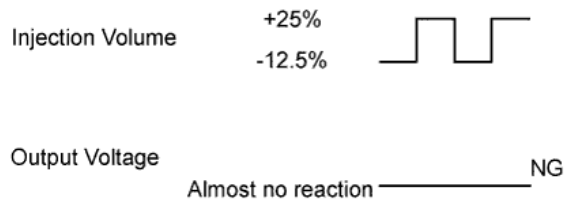
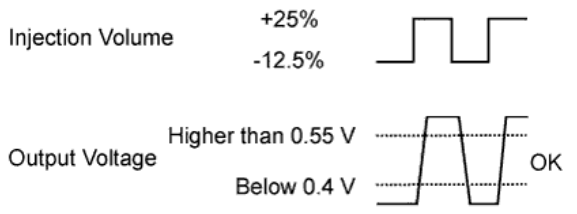
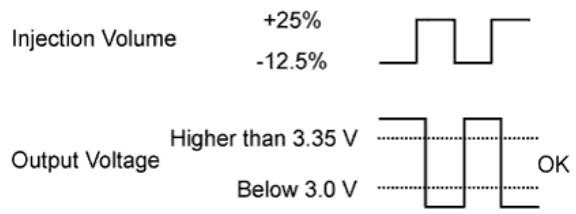
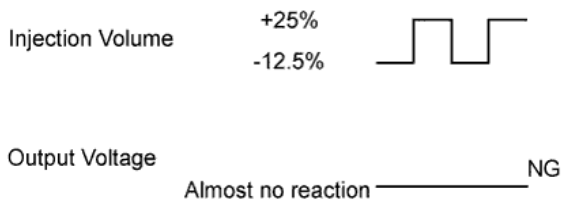
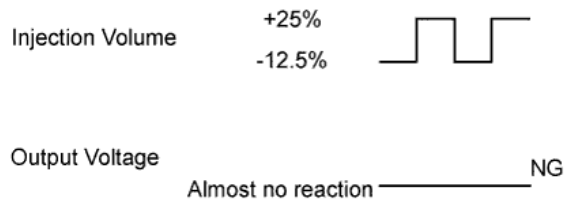
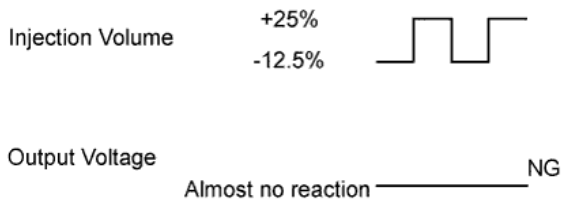
HINT:

- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 or AFS B2 S1 (A/F)	+25%	Rich	Below 3.0 V
AFS B1 S1 or AFS B2 S1 (A/F)	-12.5%	Lean	Higher than 3.35 V
O2S B1 S2 or O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55 V
O2S B1 S2 or O2S B2 S2 (HO2)	-12.5%	Lean	Below 0.4 V

NOTICE:

The Air-Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

HINT:

- **If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the OX1B wire from the ECM connector is short-circuited to the +B wire, DTC P0136 will be stored.**
- **If the OX2B wire from the ECM connector is short-circuited to the +B wire, DTC P0156 will be stored.**

1.READ OUTPUT DTC

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0138 or P0158 is output	A
P0137 or P0157 is output	B
P0136 or P0156 is output	C

B → Go to step 8

C → Go to step 6

A

2.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1 S2 or O2S B2 S2.

d. Allow the engine to idle.

e. Read the Heated Oxygen (HO2) sensor output voltage while idling.

Result

Result	Proceed to
Higher than 1.2 V	A
Below 1.0 V	B

OK → Go to step 5

NG → Go to step 3

3.INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)

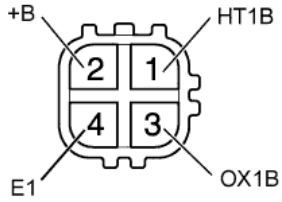
a. Disconnect the Heated Oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

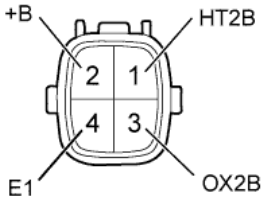
Standard Resistance:

Tester Connection	Condition	Specified Condition
2 (+B) - 3 (OX1B)	Always	10 kΩ or higher
2 (+B) - 4 (E1)	Always	10 kΩ or higher
2 (+B) - 3 (OX2B)	Always	10 kΩ or higher
2 (+B) - 4 (E1)	Always	10 kΩ or higher

Component without harness connected:
(HO2 Sensor for Bank 1)



Component without harness connected:
(HO2 Sensor for Bank 2)



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

4.CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT)

a. Turn the engine switch off and wait for 5 minutes.

b. Disconnect the ECM connector.

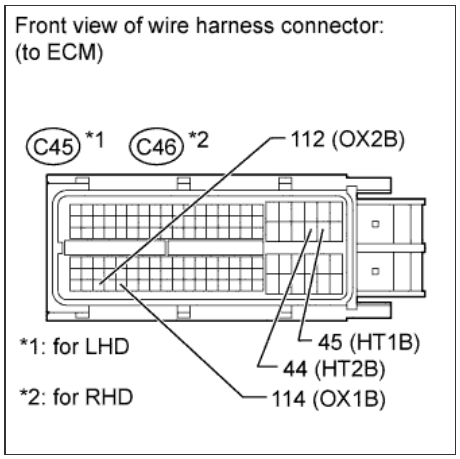
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C45-45 (HT1B) - C45-114 (OX1B)	Always	10 kΩ or higher
C45-44 (HT2B) - C45-112 (OX2B)	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C46-45 (HT1B) - C46-114 (OX1B)	Always	10 kΩ or higher
C46-44 (HT2B) - C46-112 (OX2B)	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

5.CHECK AIR FUEL RATIO SENSOR CURRENT

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS B1 S1 or AFS B2 S1.

d. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher.

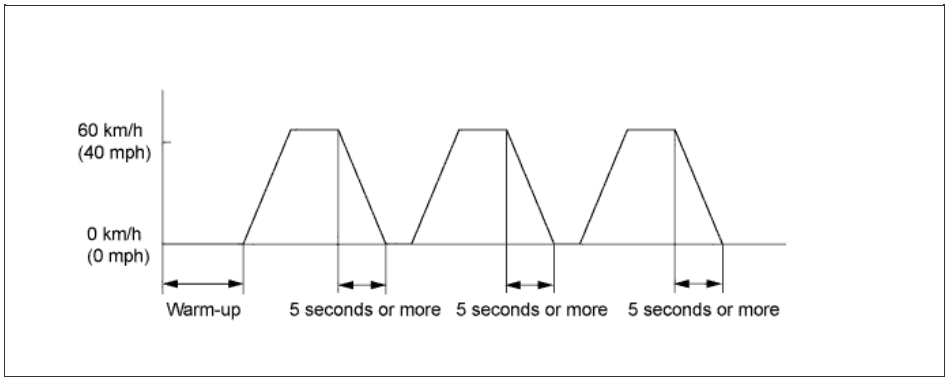
e. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more.
Perform this 3 times.

HINT:

If the tester shows Utility / Monitor Status / O2 Sensor / Incomplete again, increase the vehicle speed and use second gear to decelerate the vehicle.

f. Read the value.

Standard current:
Below 3.0 mA



OK → Go to step 12

NG → Go to step 14

6.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Start the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1 S2 or O2S B2 S2.

e. After warming up the engine, run the engine at an engine speed of 2500 rpm for 3 minutes.

f. Read the output voltage of the HO2 sensor when the engine speed is suddenly increased.

HINT:

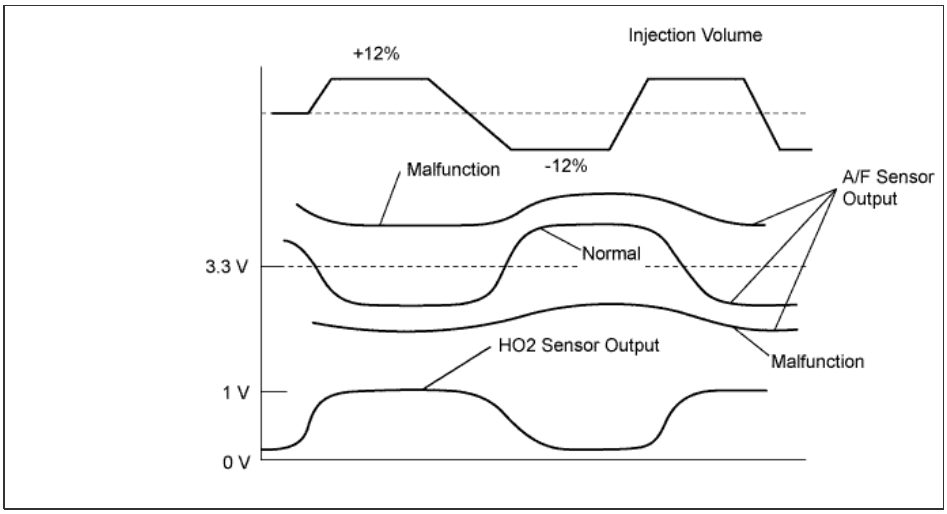
Quickly accelerate the engine to 4000 rpm 3 times using the accelerator pedal.

Standard voltage:
Fluctuates between 0.4 V or less and 0.5 V or higher.

NG	Go to step 8

OK

7.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (INJECTION VOLUME)



a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume.

e. Change the fuel injection volume using the tester, and monitor the voltage output of Air-Fuel Ratio (A/F) and HO2 sensors displayed on the tester.

HINT:

- **Change the fuel injection volume within the range of -12% and +12%. The injection volume can be changed in 1% graduations within the range.**
- **The A/F sensor is displayed as AFS B1 S1 or AFS B2 S1, and the HO2 sensor is displayed as O2S B1 S2 or O2S B2 S2, on the intelligent tester.**

Result:

Tester Display (Sensor)	Voltage Variation	Proceed to
AFS B1 S1 (A/F) AFS B2 S1 (A/F)	Alternates between higher than and below 3.3 V	OK
	Remains at higher than 3.3 V	NG
	Remains at below 3.3 V	NG

HINT:

A normal HO2 sensor voltage (O2S B1 S2 or O2S B2 S2) reacts in accordance with increases and decreases in fuel injection volumes. When the A/F sensor voltage remains at either below or higher than 3.3 V despite the HO2 sensor indicating a normal reaction, the A/F sensor is malfunctioning.

NG	Go to step 14

OK

CHECK EXTREMELY RICH OR LEAN ACTUAL AIR-FUEL RATIO AND REPAIR CAUSE (INJECTOR, FUEL PRESSURE, GAS LEAKAGE FROM EXHAUST SYSTEM, ETC.)

8.CHECK FOR EXHAUST GAS LEAK

a. Check for exhaust gas leakage from the exhaust manifold and pipe.

OK:
No exhaust gas leakage.

NG	REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT

OK

9.INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

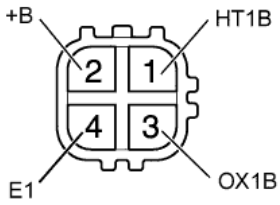
a. Disconnect the Heated Oxygen (HO2) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

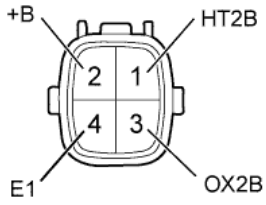
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT1B) - 4 (E1)	Always	10 kΩ or higher
1 (HT2B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT2B) - 4 (E1)	Always	10 kΩ or higher

Component without harness connected:
(HO2 Sensor for Bank 1)



Component without harness connected:
(HO2 Sensor for Bank 2)



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

10.INSPECT INTEGRATION RELAY (EFI RELAY)

a. Remove the integration relay from the engine room relay block.

b. Inspect the EFI MAIN fuse.

i. Remove the EFI MAIN fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAIN fuse	Always	Below 1 Ω

iii. Reinstall the EFI MAIN fuse.

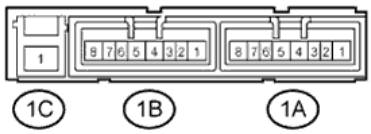
c. Inspect the EFI relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1B-4	When no battery voltage applied to terminals 1B-2 and 1B-3	10 kΩ or higher
	When battery voltage applied to terminals 1B-2 and 1B-3	Below 1 Ω

Component without harness connected:
(Integration Relay)



NG → REPLACE INTEGRATION RELAY

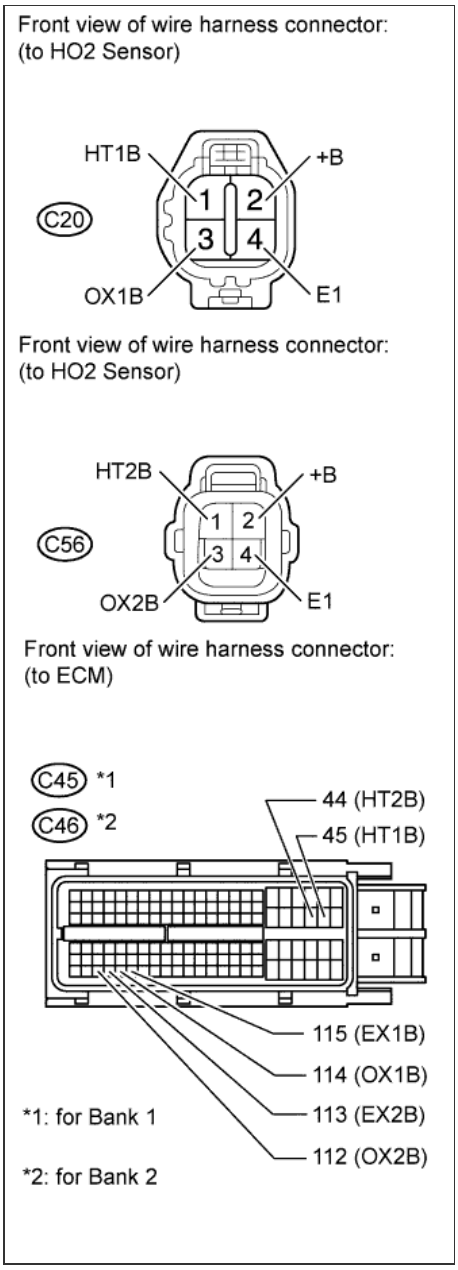
OK

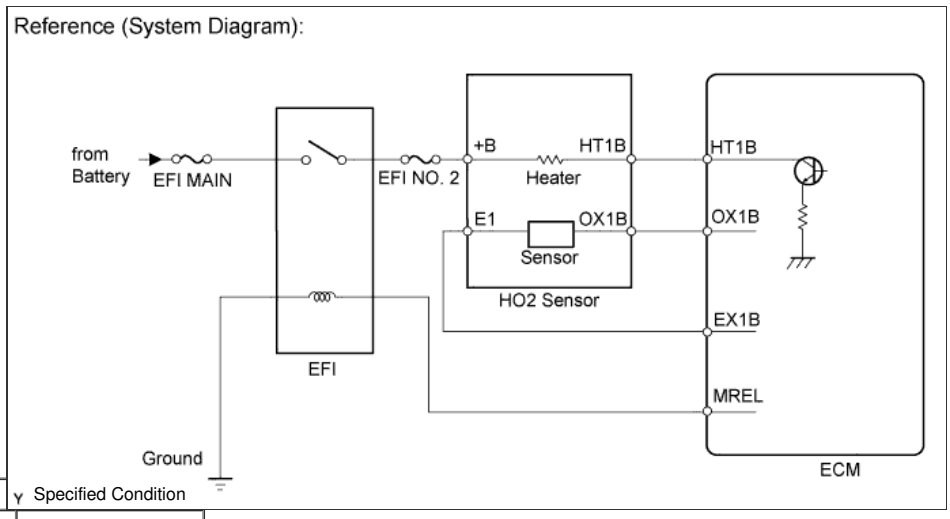
11.CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)

a. Disconnect the HO2 sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:





Tester Connection	Switch Condition	Specified Condition
C20-2 (+B) - Body ground	Engine switch on (IG)	9 to 14 V
C56-2 (+B) - Body ground	Engine switch on (IG)	9 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.

e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C45-45 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C45-114 (OX1B)	Always	Below 1 Ω
C20-4 (E1) - C45-115 (EX1B)	Always	Below 1 Ω
C56-1 (HT2B) - C45-44 (HT2B)	Always	Below 1 Ω
C56-3 (OX2B) - C45-112 (OX2B)	Always	Below 1 Ω
C56-4 (E1) - C45-113 (EX2B)	Always	Below 1 Ω
C20-1 (HT1B) or C45-45 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C45-114 (OX1B) - Body ground	Always	10 kΩ or higher
C56-1 (HT2B) or C45-44 (HT2B) - Body ground	Always	10 kΩ or higher
C56-3 (OX2B) or C45-112 (OX2B) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C20-1 (HT1B) - C46-45 (HT1B)	Always	Below 1 Ω
C20-3 (OX1B) - C46-114 (OX1B)	Always	Below 1 Ω
C20-4 (E1) - C46-115 (EX1B)	Always	Below 1 Ω
C56-1 (HT2B) - C46-44 (HT2B)	Always	Below 1 Ω
C56-3 (OX2B) - C46-112 (OX2B)	Always	Below 1 Ω
C56-4 (E1) - C46-113 (EX2B)	Always	Below 1 Ω
C20-1 (HT1B) or C46-45 (HT1B) - Body ground	Always	10 kΩ or higher
C20-3 (OX1B) or C46-114 (OX1B) - Body ground	Always	10 kΩ or higher
C56-1 (HT2B) or C46-44 (HT2B) - Body ground	Always	10 kΩ or higher
C56-3 (OX2B) or C46-112 (OX2B) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE HEATED OXYGEN SENSOR (Click here)

12.REPLACE HEATED OXYGEN SENSOR

a. Replace the heated oxygen sensor (Click here).

NEXT

13.PERFORM CONFIRMATION DRIVING PATTERN

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher.

d. Drive the vehicle at 60 to 120 km/h (40 to 75 mph) for 10 minutes.

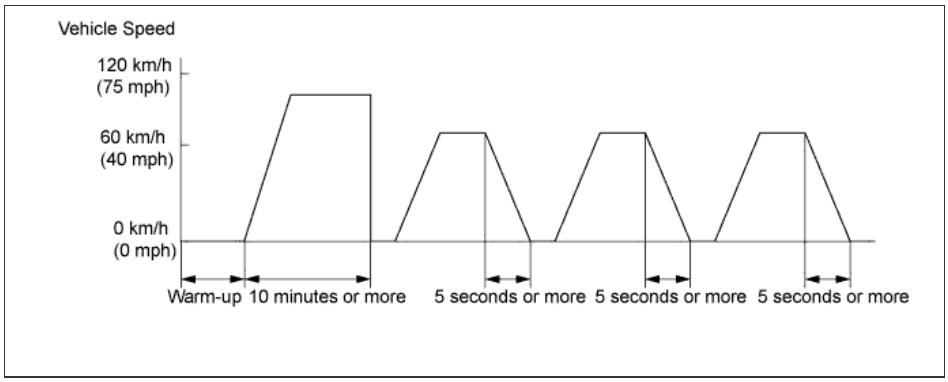
e. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more. Perform this 3 times.

f. Turn the tester on.

g. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

h. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

i. Check that DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern increasing the vehicle speed and using second gear to decelerate the vehicle.



NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK → END

14.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

15.PERFORM CONFIRMATION DRIVING PATTERN

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Clear the DTCs.

d. Switch the ECM from normal mode to check mode using the tester.

e. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher.

f. Drive the vehicle at 60 to 120 km/h (40 to 75 mph) for 10 minutes.

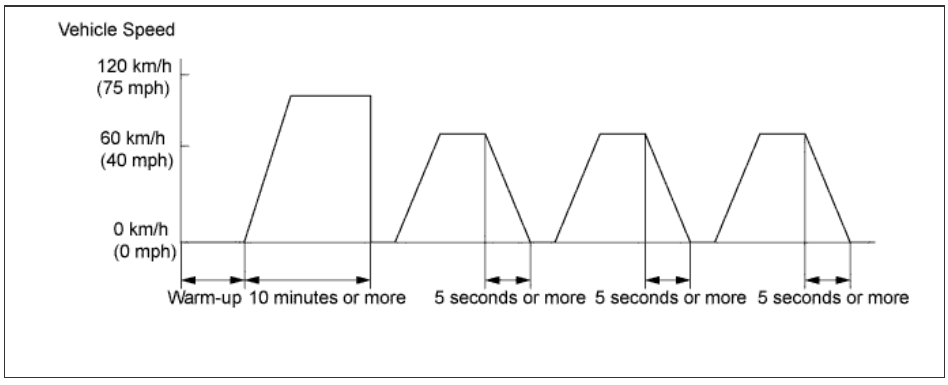
g. Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more. Perform this 3 times.

h. Turn the tester on.

i. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

j. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

k. Check that DTC monitor is NORMAL. If DTC monitor is INCOMPLETE, perform the drive pattern increasing the vehicle speed and using second gear to decelerate the vehicle.



NG → REPLACE HEATED OXYGEN SENSOR (Click here)

OK

END

DTC P2118 Throttle Actuator Control Motor Current Range / Performance

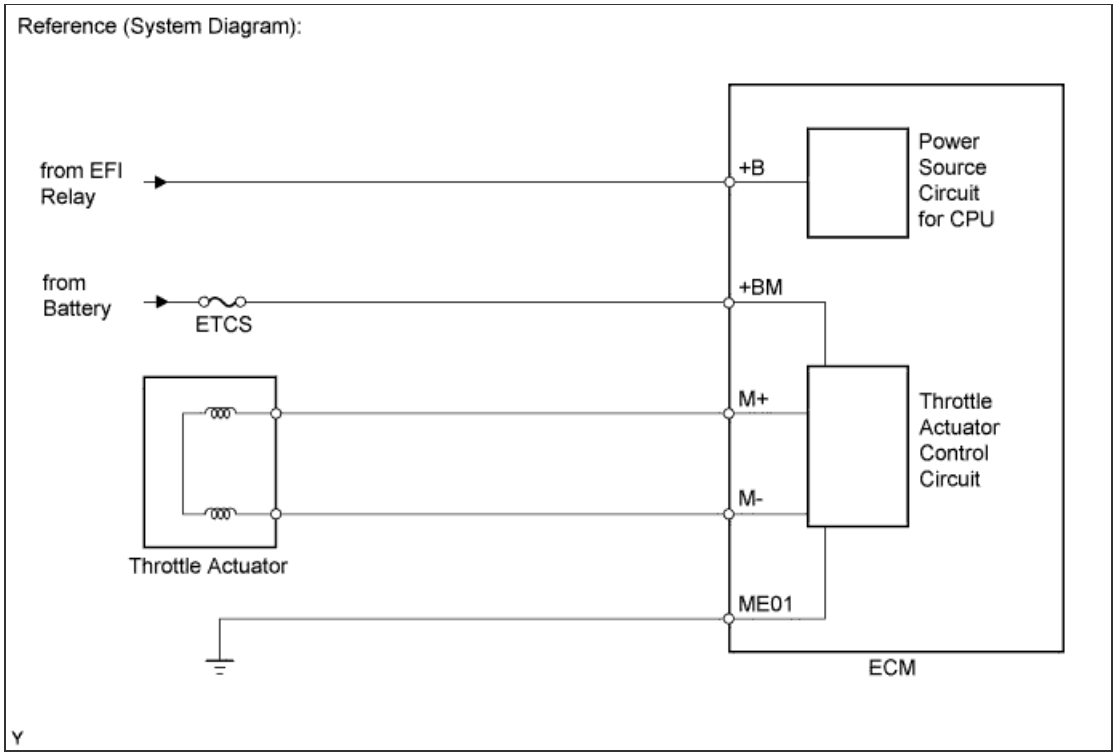
for Preparation Click here

DESCRIPTION

The ETCS (Electronic Throttle Control System) has a dedicated power supply circuit. The voltage (+BM) is monitored and when it is low (below 4 V), the ECM determines that there is a malfunction in the ETCS and cuts off the current to the throttle actuator.
When the voltage becomes unstable, the ETCS itself becomes unstable. For this reason, when the voltage is low, the current to the throttle actuator is cut. If repairs are made and the system returns to normal, turn the engine switch off. The ECM then allows the current to flow to the throttle actuator so that it can be restarted.

HINT:

The ETCS does not use a throttle cable.



DTC Code	DTC Detection Condition	Trouble Area
P2118	An open in the ETCS power source (+BM) circuit (1 trip detection logic).	• Open in ETCS power source circuit • Battery • Battery terminals • ETCS fuse • ECM

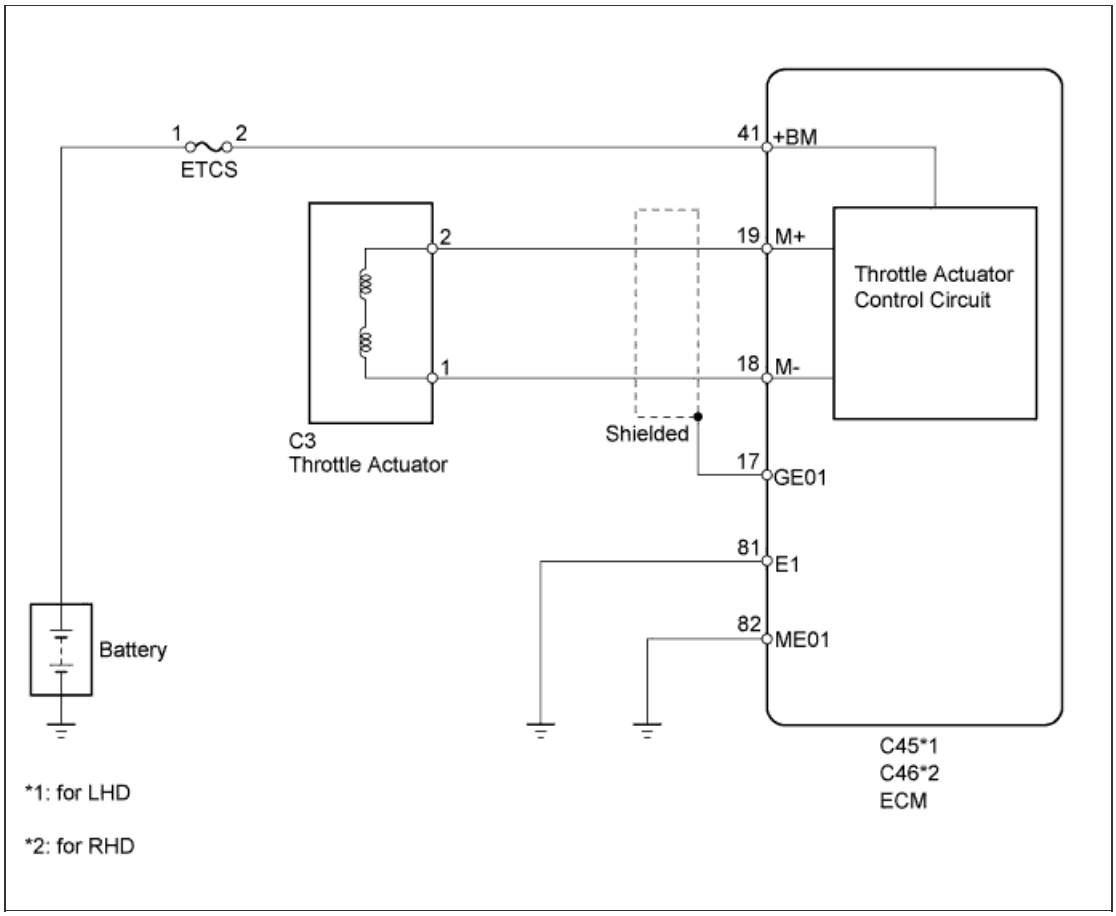
MONITOR DESCRIPTION

The ECM monitors the battery supply voltage applied to the throttle actuator.
When the power supply voltage (+BM) drops below 4 V for 0.8 seconds or more, the ECM interprets this as an open in the power supply circuit (+BM). The ECM illuminates the MIL and stores the DTC.
If the malfunction is not repaired successfully, the DTC is stored 5 seconds after the engine is next started.

FAIL-SAFE

When this DTC, or other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.
Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (+BM VOLTAGE)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / +BM Voltage.

e. Read the value displayed on the tester.

Result

Result	Proceed to
Below 11 V or higher than 14 V	A
11 to 14 V	B

B → Go to step 5

A

2.INSPECT FUSE (ETCS)

a. Remove the ETCS fuse from the engine room relay bloc .

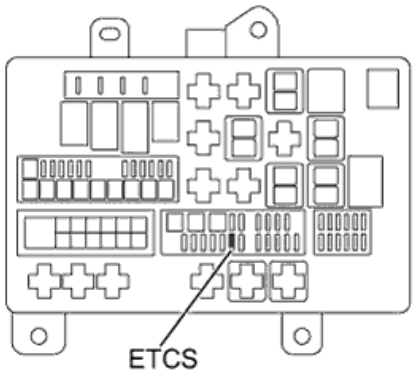
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition

ETCS fuse	Always	Below 1 Ω

Engine Room Relay Block:



NG

CHECK FOR SHORTS IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

OK

3.CHECK HARNESS AND CONNECTOR (ECM - ETCS FUSE, ETCS FUSE - BATTERY)

a. Chec the harness and connector between the ETCS fuse and ECM.

i. Remove the ETCS fuse from the engine room relay bloc .

ii. Disconnect the ECM connector.

iii. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
ETCS fuse terminal 2 - C45-41 (+BM)	Always	Below 1 Ω
ETCS fuse terminal 2 or C45-41 (+BM) - Body ground	Always	10 Ω or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
ETCS fuse terminal 2 - C4 -41 (+BM)	Always	Below 1 Ω
ETCS fuse terminal 2 or C4 -41 (+BM) - Body ground	Always	10 Ω or higher

b. Chec the harness and connector between the ETCS fuse and positive battery cable.

i. Remove the ETCS fuse from the engine room relay bloc .

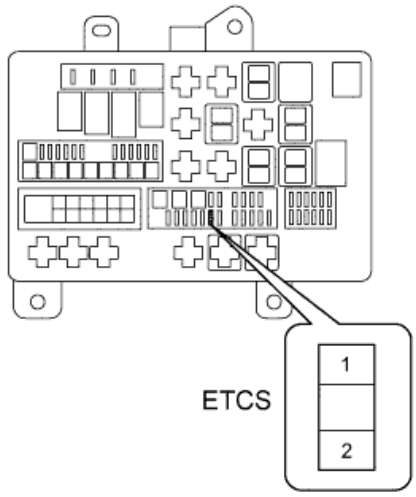
ii. Disconnect the cable from the positive (+) battery terminal.

iii. Measure the resistance according to the value(s) in the table below.

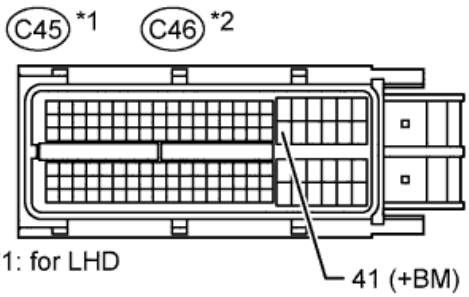
Standard Resistance:

Tester Connection	Condition	Specified Condition
Positive battery cable - ETCS fuse terminal 1	Always	Below 1 Ω
Positive battery		

Engine Room Relay Block:



Front view of wire harness connector: (to ECM)



*1: for LHD

*2: for RHD

cable or ETCS fuse terminal 1 - Body ground	Always	10 Ω or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.INSPECT ECM (+BM VOLTAGE)

a. Disconnect the ECM connector.

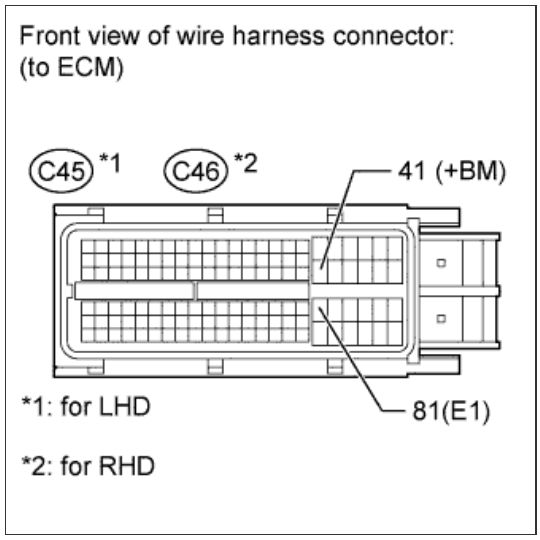
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage (for LHD):

Tester Connection	Condition	Specified Condition
C45-41 (+BM) - C45-81 (E1)	Always	11 to 14 V

Standard voltage (for RHD):

Tester Connection	Condition	Specified Condition
C4 -41 (+BM) - C4 -81 (E1)	Always	11 to 14 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

5.INSPECT BATTERY

a. Chec that the battery is not depleted (Clic here).

OK:

Battery is not depleted.

NG → REPLACE BATTERY

OK

6.CHECK BATTERY TERMINAL

a. Chec that the battery terminals and ECM ground are not loose or corroded.

OK:

Battery terminals and ECM ground are not loose or corroded.

NG → REPAIR OR REPLACE BATTERY TERMINAL

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0171 System Too Lean (Bank 1)

DTC P0172 System Too Rich (Bank 1)

DTC P0174 System Too Lean (Bank 2)

DTC P0175 System Too Rich (Bank 2)

for Preparation Click here

DESCRIPTION

The fuel trim is related to the feedback compensation value, not to the basic injection time. The fuel trim consists of both the short-term and the long-term fuel trims.
The short-term fuel trim is fuel compensation that is used to constantly maintain the air-fuel ratio at stoichiometric levels. The signal from the Air-Fuel Ratio (A/F) sensor indicates whether the air-fuel ratio is rich or lean compared to the stoichiometric ratio. This triggers a reduction in the fuel injection volume if the air-fuel ratio is rich and an increase in the fuel injection volume if it is lean.
Factors such as individual engine differences, wear over time and changes in operating environment cause short-term fuel trim to vary from the central value. The long-term fuel trim, which controls overall fuel compensation, compensates for long-term deviations in the fuel trim from the central value caused by the short-term fuel trim compensation.

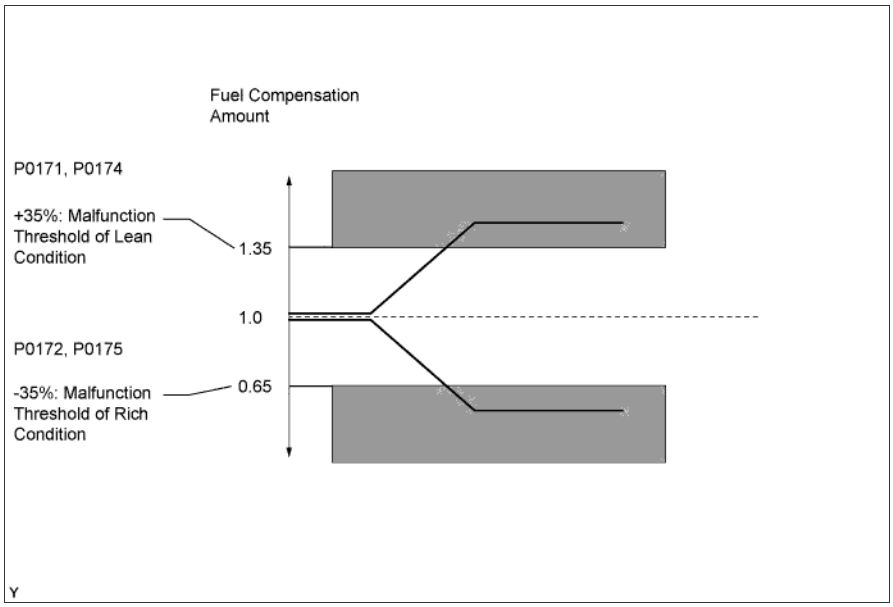
DTC Code	DTC Detection Condition	Trouble Area
P0171 P0174	With a warm engine and stable air-fuel ratio feedback, the fuel trim is considerably in error to the lean side (2 trip detection logic).	• Air induction system • Injector blockage • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Fuel pressure • Gas leakage from exhaust system • Open or short in Air-Fuel Ratio (A/F) sensor (for sensor 1) circuit • A/F sensor (for sensor 1) • A/F sensor heater (for sensor 1) • Integration relay • A/F sensor heater and integration relay circuits • PCV valve and hose • PCV hose connections • ECM
P0172 P0175	With a warm engine and stable air-fuel ratio feedback, the fuel trim is considerably in error to the rich side (2 trip detection logic).	• Injector leakage or blockage • MAF meter • ECT sensor • Ignition system • Fuel pressure • Gas leakage from exhaust system • Open or short in A/F sensor (for sensor 1) circuit • A/F sensor (for sensor 1) • A/F sensor heater (for sensor 1) • Integration relay • A/F sensor heater and integration relay circuits • ECM

HINT:

- **When DTC P0171 or P0174 is stored, the actual air-fuel ratio is on the lean side. When DTC P0172 or P0175 is stored, the actual air-fuel ratio is on the rich side.**
- **If the vehicle runs out of fuel, the air-fuel ratio is lean and DTC P0171 or P0174 may be stored. The MIL is then illuminated.**
- **When the total of the short-term and long-term fuel trim values is within the malfunction threshold (and the engine coolant temperature is higher than 75°C [167°F]), the system is functioning normally.**

MONITOR DESCRIPTION

Under closed-loop fuel control, fuel injection volumes that deviate from those estimated by the ECM cause changes in the long-term fuel trim compensation value. The long-term fuel trim is adjusted when there are persistent deviations in the short-term fuel trim values. Deviations from the fuel injection volumes estimated by the ECM also affect the average fuel trim learning value, which is a combination of the average short-term fuel trim (fuel feedback compensation value) and the average long-term fuel trim (learning value of the air-fuel ratio). If the average fuel trim learning value exceeds the malfunction threshold, the ECM interprets this as a fault in the fuel system and stores a DTC.
Example:
The average fuel trim learning value is +35% or more or -35% or less, the ECM interprets this as a fuel system malfunction.



WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.**
- **A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0171, P0172, P0174 OR P0175)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0171, P0172, P0174 or P0175 is output	A
P0171, P0172, P0174 or P0175 and other DTCs are output	B

HINT:

If any DTCs other than P0171, P0172, P0174 or P0175 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (A/F CONTROL)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor.

e. Perform the Control the Injection Volume for A/F Sensor operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).

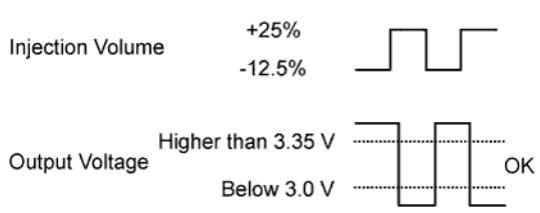
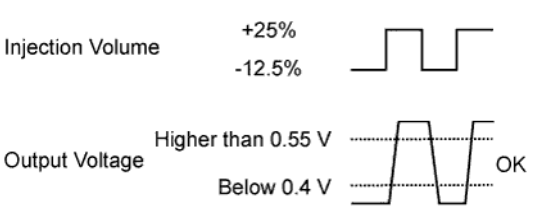
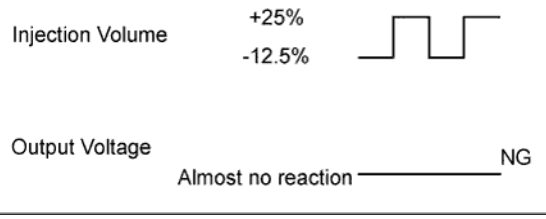
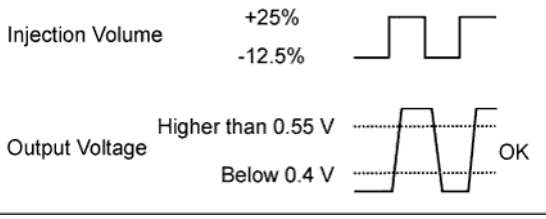
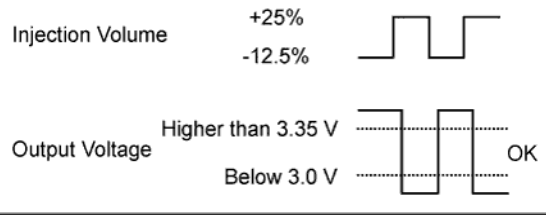
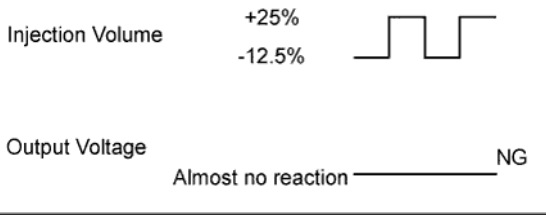
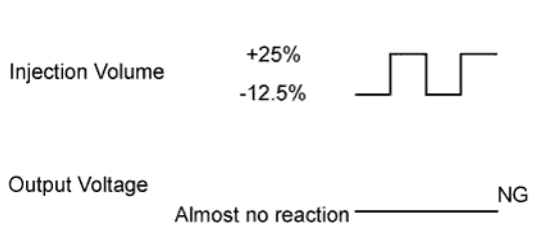
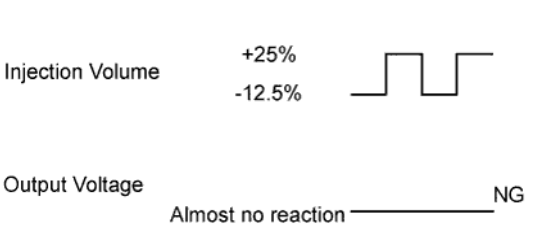
f. Monitor the output voltages of A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

Result:
The A/F sensor reacts in accordance with increases and decreases in the fuel injection volume:
+25% = Rich output:
Below 3.0 V
-12.5% = Lean output:
Higher than 3.35 V

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area

1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors. To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/ F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

Result

Result	Proceed to
Case 1	C
Case 2	B
Case 3	A

B → Go to step 11

C → Go to step 15

A

3.CHECK MASS AIR FLOW METER

a. Check the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

4.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: Between 80°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

5.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is connected correctly and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE

OK ↓

6.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK ↓

7.CHECK FOR SPARKS AND IGNITION

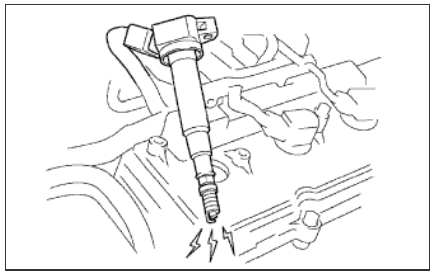
a. Disconnect the fuel injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.



b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → REPAIR OR REPLACE IGNITION SYSTEM

OK ↓

8.CHECK FOR EXHAUST GAS LEAK

a. Check for exhaust gas leakage.

OK:
No gas leakage.

NG → REPAIR OR REPLACE EXHAUST SYSTEM

OK ↓

9.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → REPAIR OR REPLACE FUEL SYSTEM

OK ↓

10.INSPECT FUEL INJECTOR (INJECTION AND VOLUME)

a. Check the injection volume (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK ↓

11.INSPECT AIR-FUEL RATIO SENSOR (HEATER RESISTANCE)

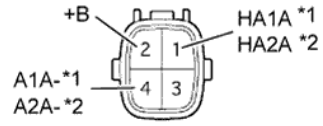
a. Disconnect the Air-Fuel Ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

12.INSPECT INTEGRATION RELAY (A/F RELAY)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

iii. Reinstall the A/F fuse.

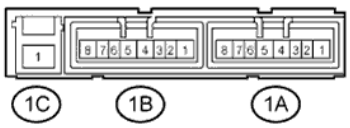
c. Inspect the integration relay (A/F).

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1A-4	Battery voltage not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω

Component without harness connected:
(Integration Relay)



NG → REPLACE INTEGRATION RELAY

OK

13.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

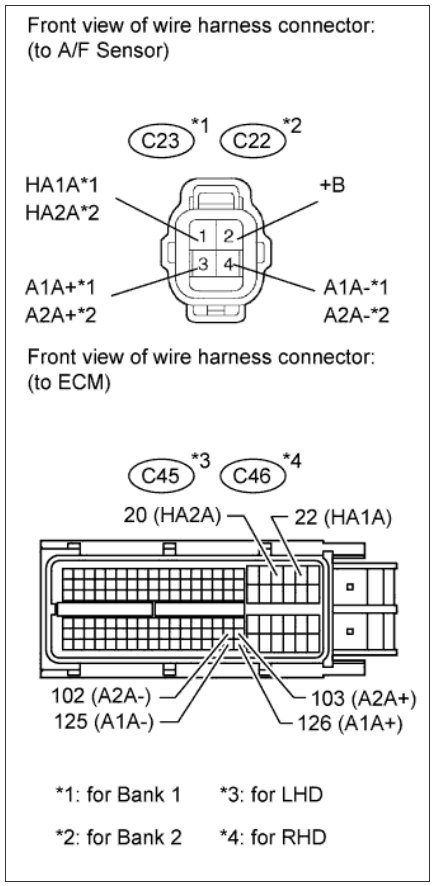
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.



e. Measure the resistance according to the value(s) in the table below.

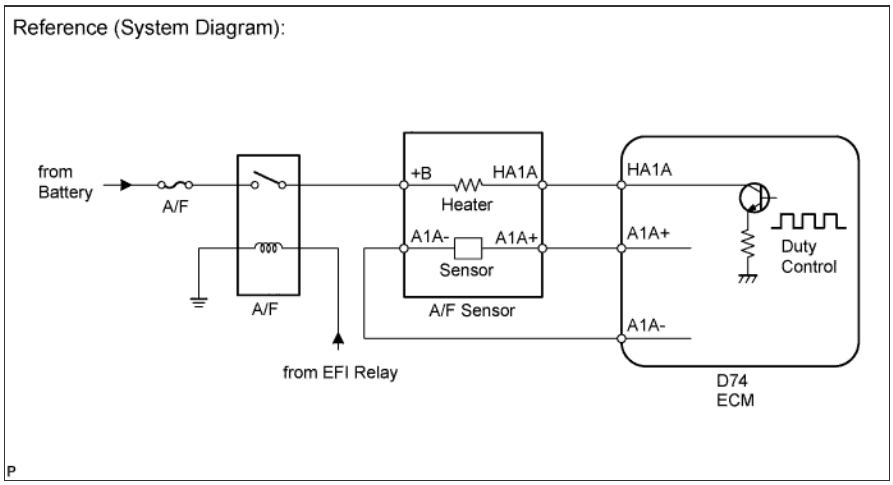
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C46-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-125 (A1A-) - Body ground	Always	10 kΩ or higher

C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-102 (A2A-) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

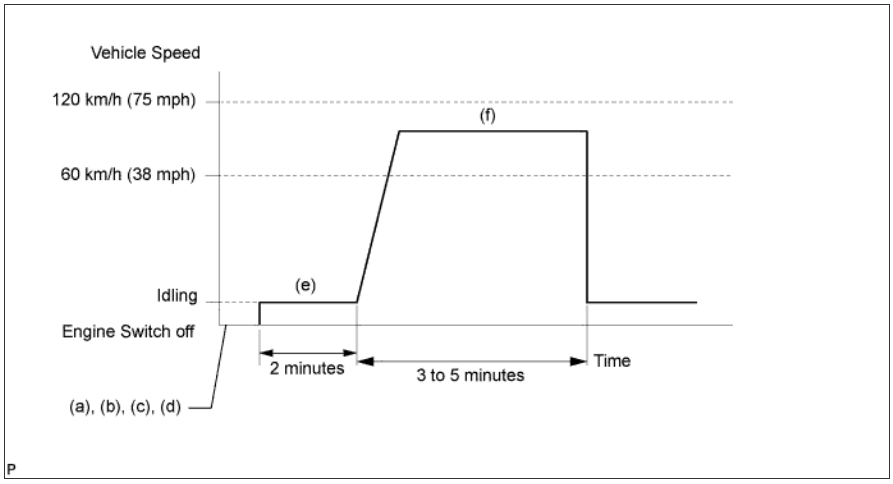
OK

14.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

15.PERFORM CONFIRMATION DRIVING PATTERN



(a) Connect the intelligent tester to the DLC3.
(b) Turn the engine switch on (IG) and turn the tester on.
(c) Clear DTCs (Click here).
(d) Switch the ECM from normal mode to check mode using the tester (Click here).
(e) Start the engine and warm it up with all the accessories switched off.
(f) Drive the vehicle at between 60 km/h and 120 km/h (38 mph and 75 mph) and at an engine speed of between 1400 rpm and 3200 rpm for 3 to 5 minutes.

HINT:

If the system is still malfunctioning, the MIL will be illuminated during step (f).

NOTICE:

If the conditions in this test are not strictly followed, no malfunction will be detected.

NEXT

16.CHECK WHETHER DTC OUTPUT RECURS (DTC P0171, P0172, P0174 OR P0175)

a. Enter the following menus: Powertrain / Engine and ECT / DTC.

b. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P0171, P0172, P0174 or P0175 is output	B

B → REPLACE ECM (Click here)

A → END

DTC P2119 Throttle Actuator Control Throttle Body Range / Performance

for Preparation Click here

DESCRIPTION

The Electronic Throttle Control System (ETCS) is composed of the throttle actuator, Throttle Position (TP) sensor, Accelerator Pedal Position (APP) sensor, and ECM. The ECM operates the throttle actuator to regulate the throttle valve in response to driver inputs. The TP sensor detects the opening angle of the throttle valve, and provides the ECM with feedback so that the throttle valve can be appropriately controlled by the ECM.

DTC Code	DTC Detection Condition	Trouble Area
P2119	The throttle valve opening angle continues to vary greatly from the target opening angle (1 trip detection logic).	• ETCS • ECM

MONITOR DESCRIPTION

The ECM determines the actual opening angle of the throttle valve from the TP sensor signal. The actual opening angle is compared to the target opening angle commanded by the ECM. If the difference between these two values is outside the standard range, the ECM interprets this as a malfunction in the ETCS. The ECM then illuminates the MIL and stores the DTC.
If the malfunction is not repaired successfully, the DTC is stored when the accelerator pedal is quickly released (to close the throttle valve) after the engine speed reaches 5000 rpm by the accelerator pedal being fully depressed (fully open the throttle valve).

FAIL-SAFE

When this DTC, or other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly. Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM

Refer to DTC P2102 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK AN OTHER DTCS OUTPUT (IN ADDITION TO DTC P2119)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P2119 is output	A
P2119 and other DTCs are output	B

HINT:

If any DTCs other than P2119 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.CHECK WHETHER DTC OUTPUT RECURS (DTC P2119)

a. Connect the intelligent tester to the DLC3.

b. Turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Fully depress and release the accelerator pedal several times quickly.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read the DTCs.

OK:

No DTC is output.

HINT:

The output voltage of the throttle position sensor can be checked using the intelligent tester. Variations in the output voltage indicate that the throttle actuator is in operation. To check the output voltage using the intelligent tester, enter the following menus: Powertrain / Engine and ECT / ETCS / Throttle Position o1.

NG → REPLACE THROTTLE BOD ASSEMBL (Click here)

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P0171 System Too Lean (Bank 1)

DTC P0172 System Too Rich (Bank 1)

DTC P0174 System Too Lean (Bank 2)

DTC P0175 System Too Rich (Bank 2)

for Preparation Click here

DESCRIPTION

The fuel trim is related to the feedback compensation value, not to the basic injection time. The fuel trim consists of both the short-term and the long-term fuel trims.
The short-term fuel trim is fuel compensation that is used to constantly maintain the air-fuel ratio at stoichiometric levels. The signal from the Air-Fuel Ratio (A/F) sensor indicates whether the air-fuel ratio is rich or lean compared to the stoichiometric ratio. This triggers a reduction in the fuel injection volume if the air-fuel ratio is rich and an increase in the fuel injection volume if it is lean.
Factors such as individual engine differences, wear over time and changes in operating environment cause short-term fuel trim to vary from the central value. The long-term fuel trim, which controls overall fuel compensation, compensates for long-term deviations in the fuel trim from the central value caused by the short-term fuel trim compensation.

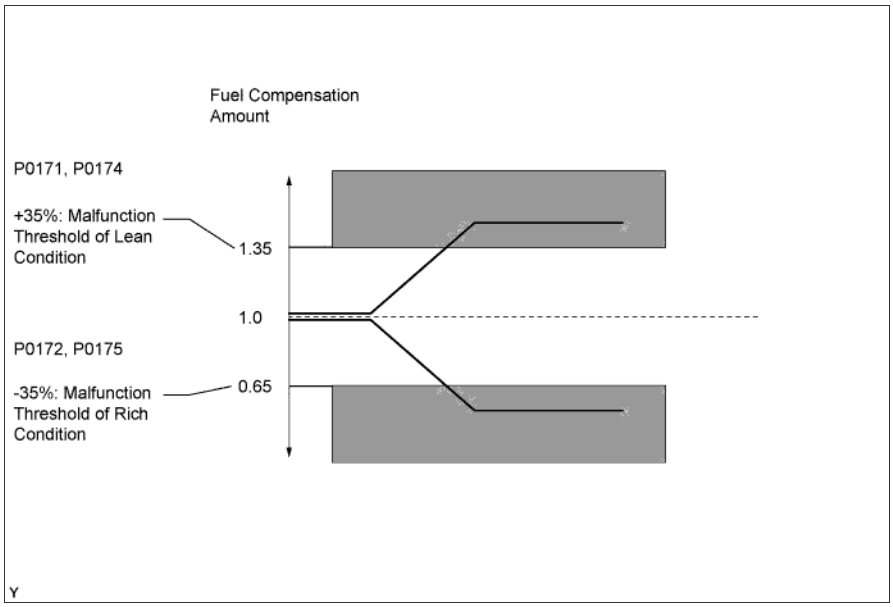
DTC Code	DTC Detection Condition	Trouble Area
P0171 P0174	With a warm engine and stable air-fuel ratio feedback, the fuel trim is considerably in error to the lean side (2 trip detection logic).	• Air induction system • Injector blockage • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Fuel pressure • Gas leakage from exhaust system • Open or short in Air-Fuel Ratio (A/F) sensor (for sensor 1) circuit • A/F sensor (for sensor 1) • A/F sensor heater (for sensor 1) • Integration relay • A/F sensor heater and integration relay circuits • PCV valve and hose • PCV hose connections • ECM
P0172 P0175	With a warm engine and stable air-fuel ratio feedback, the fuel trim is considerably in error to the rich side (2 trip detection logic).	• Injector leakage or blockage • MAF meter • ECT sensor • Ignition system • Fuel pressure • Gas leakage from exhaust system • Open or short in A/F sensor (for sensor 1) circuit • A/F sensor (for sensor 1) • A/F sensor heater (for sensor 1) • Integration relay • A/F sensor heater and integration relay circuits • ECM

HINT:

- **When DTC P0171 or P0174 is stored, the actual air-fuel ratio is on the lean side. When DTC P0172 or P0175 is stored, the actual air-fuel ratio is on the rich side.**
- **If the vehicle runs out of fuel, the air-fuel ratio is lean and DTC P0171 or P0174 may be stored. The MIL is then illuminated.**
- **When the total of the short-term and long-term fuel trim values is within the malfunction threshold (and the engine coolant temperature is higher than 75°C [167°F]), the system is functioning normally.**

MONITOR DESCRIPTION

Under closed-loop fuel control, fuel injection volumes that deviate from those estimated by the ECM cause changes in the long-term fuel trim compensation value. The long-term fuel trim is adjusted when there are persistent deviations in the short-term fuel trim values. Deviations from the fuel injection volumes estimated by the ECM also affect the average fuel trim learning value, which is a combination of the average short-term fuel trim (fuel feedback compensation value) and the average long-term fuel trim (learning value of the air-fuel ratio). If the average fuel trim learning value exceeds the malfunction threshold, the ECM interprets this as a fault in the fuel system and stores a DTC.
Example:
The average fuel trim learning value is +35% or more or -35% or less, the ECM interprets this as a fuel system malfunction.



WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.**
- **A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0171, P0172, P0174 OR P0175)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0171, P0172, P0174 or P0175 is output	A
P0171, P0172, P0174 or P0175 and other DTCs are output	B

HINT:

If any DTCs other than P0171, P0172, P0174 or P0175 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (A/F CONTROL)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor.

e. Perform the Control the Injection Volume for A/F Sensor operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).

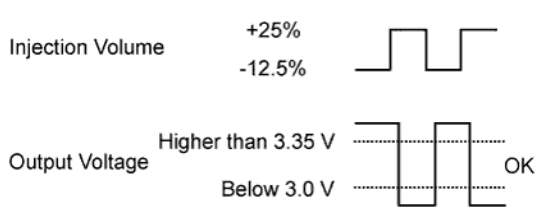
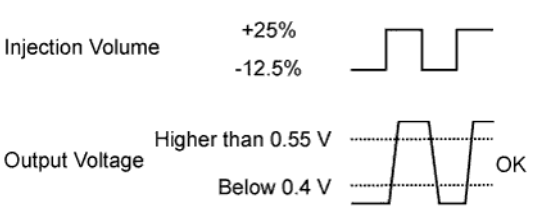
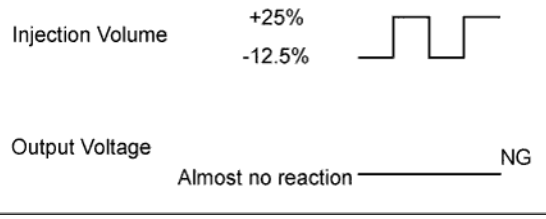
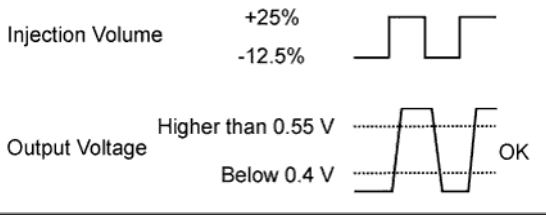
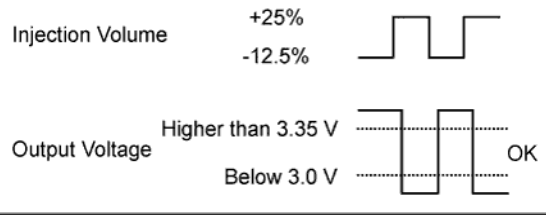
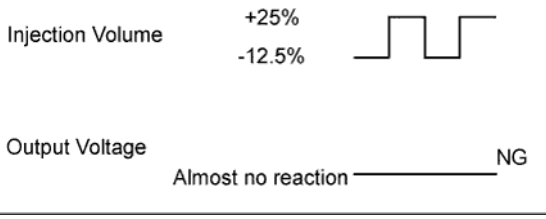
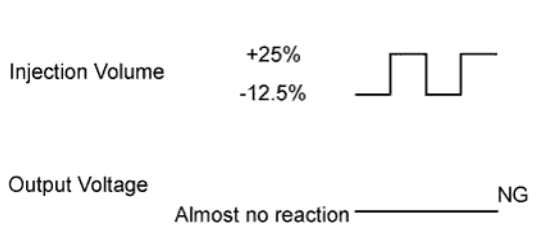
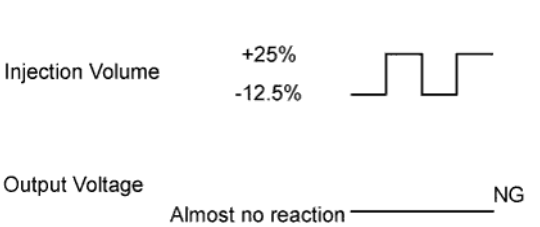
f. Monitor the output voltages of A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

Result:
The A/F sensor reacts in accordance with increases and decreases in the fuel injection volume:
+25% = Rich output:
Below 3.0 V
-12.5% = Lean output:
Higher than 3.35 V

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area

1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors. To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/ F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

Result

Result	Proceed to
Case 1	C
Case 2	B
Case 3	A

B → Go to step 11

C → Go to step 15

A

3.CHECK MASS AIR FLOW METER

a. Check the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

4.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: Between 80°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

5.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is connected correctly and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE

OK ↓

6.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK ↓

7.CHECK FOR SPARKS AND IGNITION

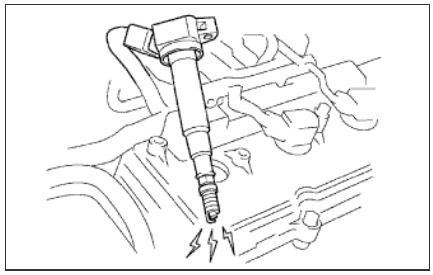
a. Disconnect the fuel injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.



b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → REPAIR OR REPLACE IGNITION SYSTEM

OK ↓

8.CHECK FOR EXHAUST GAS LEAK

a. Check for exhaust gas leakage.

OK:
No gas leakage.

NG → REPAIR OR REPLACE EXHAUST SYSTEM

OK ↓

9.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → REPAIR OR REPLACE FUEL SYSTEM

OK ↓

10.INSPECT FUEL INJECTOR (INJECTION AND VOLUME)

a. Check the injection volume (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK ↓

11.INSPECT AIR-FUEL RATIO SENSOR (HEATER RESISTANCE)

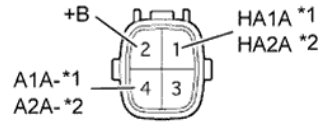
a. Disconnect the Air-Fuel Ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

12.INSPECT INTEGRATION RELAY (A/F RELAY)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

iii. Reinstall the A/F fuse.

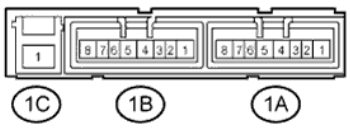
c. Inspect the integration relay (A/F).

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1A-4	Battery voltage not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω

Component without harness connected:
(Integration Relay)



NG → REPLACE INTEGRATION RELAY

OK

13.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

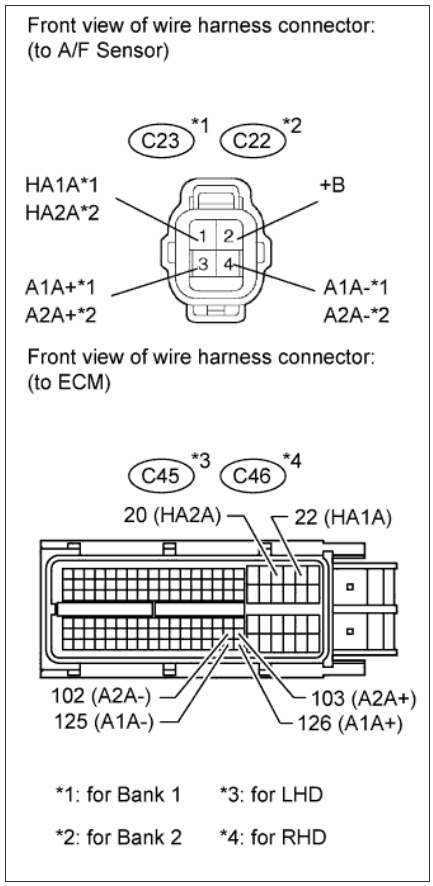
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.



e. Measure the resistance according to the value(s) in the table below.

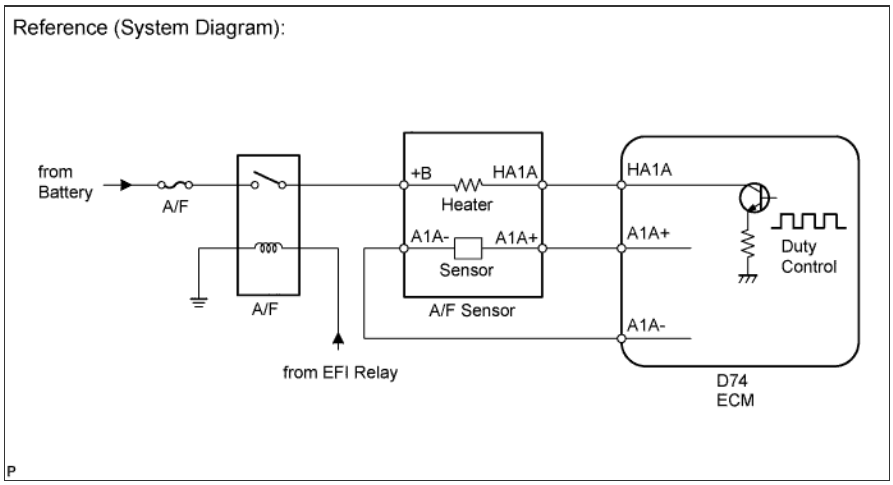
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C46-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-125 (A1A-) - Body ground	Always	10 kΩ or higher

C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-102 (A2A-) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

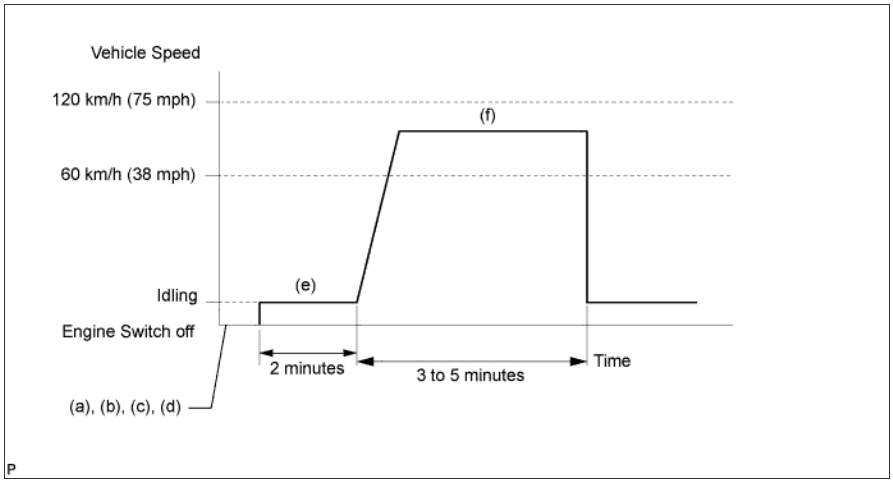
OK

14.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

15.PERFORM CONFIRMATION DRIVING PATTERN



(a) Connect the intelligent tester to the DLC3.
(b) Turn the engine switch on (IG) and turn the tester on.
(c) Clear DTCs (Click here).
(d) Switch the ECM from normal mode to check mode using the tester (Click here).
(e) Start the engine and warm it up with all the accessories switched off.
(f) Drive the vehicle at between 60 km/h and 120 km/h (38 mph and 75 mph) and at an engine speed of between 1400 rpm and 3200 rpm for 3 to 5 minutes.

HINT:

If the system is still malfunctioning, the MIL will be illuminated during step (f).

NOTICE:

If the conditions in this test are not strictly followed, no malfunction will be detected.

NEXT

16.CHECK WHETHER DTC OUTPUT RECURS (DTC P0171, P0172, P0174 OR P0175)

a. Enter the following menus: Powertrain / Engine and ECT / DTC.

b. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P0171, P0172, P0174 or P0175 is output	B

B → REPLACE ECM (Click here)

A → END

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

for Preparation Click here

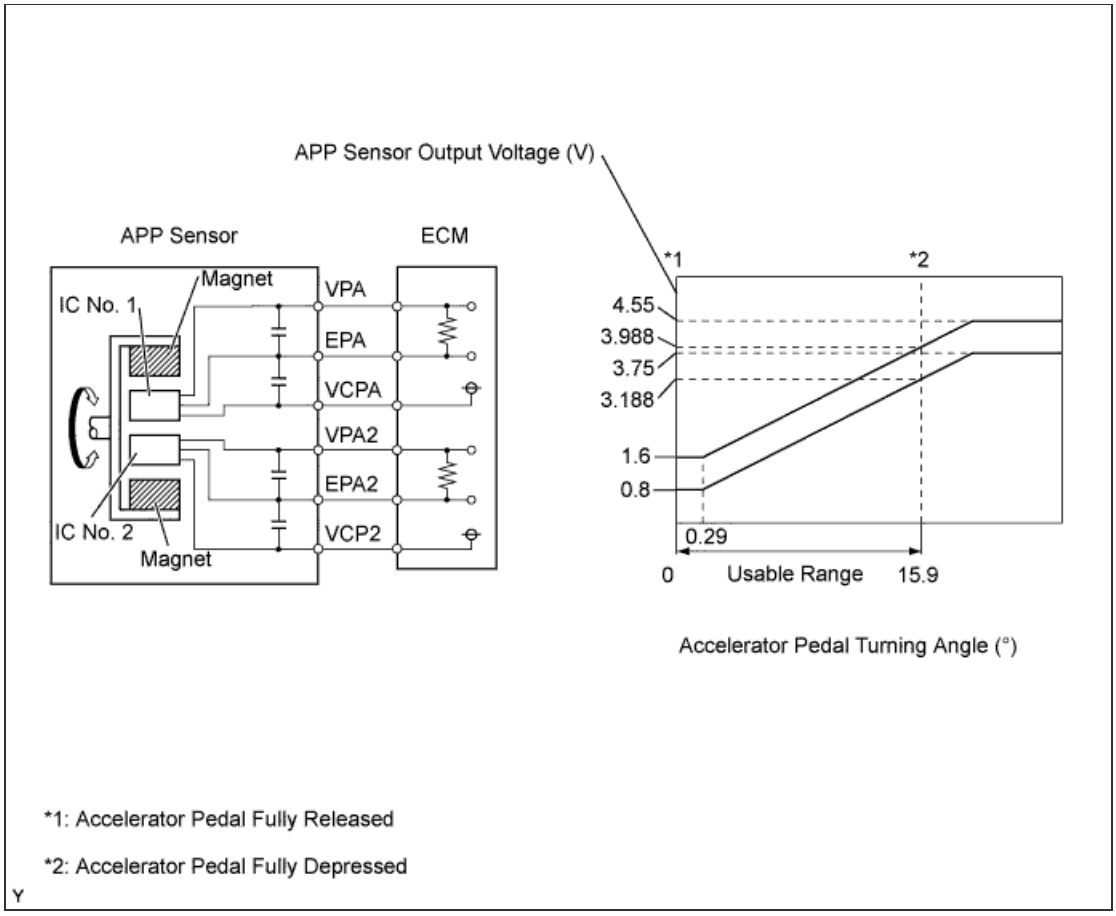
DESCRIPTION

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

The APP sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC Code	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
		• APP sensor

P2122	VPA is 0.4 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• Open in VCP1 circuit • Open or ground short in VPA circuit • ECM
P2123	VPA is 4.8 V or higher for 2.0 seconds or more (1 trip detection logic).	• APP sensor • Open in EPA circuit • ECM
P2125	VPA2 fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or higher. (b) VPA is between 0.4 V and 3.45 V.	• APP sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): (a) The difference between VPA and VPA2 is 0.02 V or less. (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less.	• Short between VPA and VPA2 circuits • APP sensor • ECM

HINT:

When any of these DTCs are output, check the APP sensor voltage by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

Trouble Area	Accelerator Position No. 1 When AP Released	Accelerator Position No. 2 When AP Released	Accelerator Position No. 1 When AP Depressed	Accelerator Position No. 2 When AP Depressed
VCP circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 4.7 V
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 4.7 V

HINT:

- **Accelerator pedal positions are expressed as voltages.**
- **AP stands for Accelerator Pedal.**

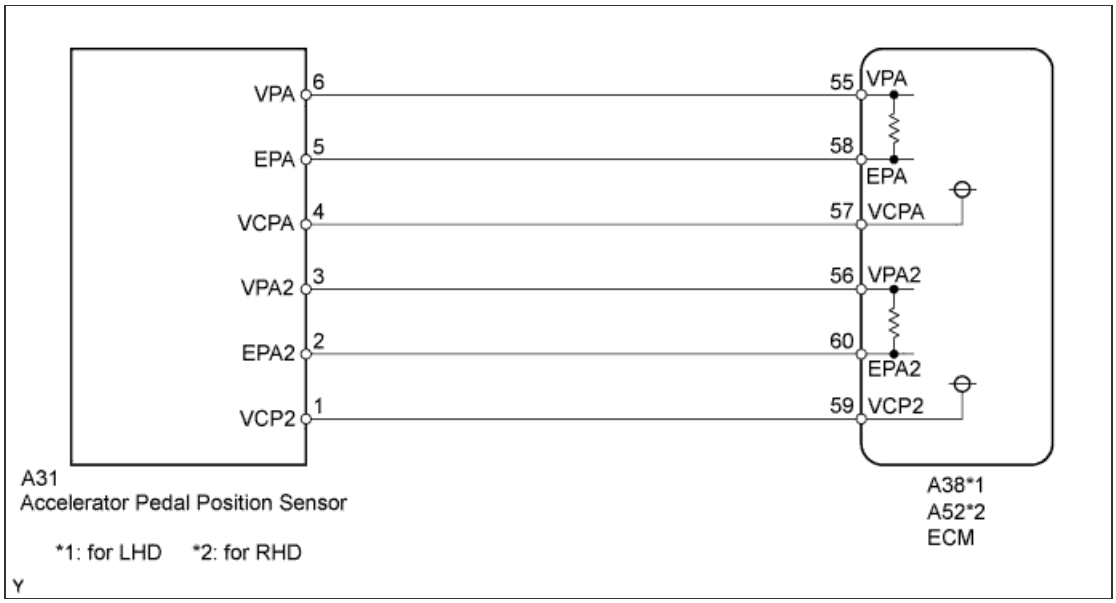
MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is less than the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and stores a DTC.
Example:
When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is stored.
If the malfunction is not repaired successfully, a DTC is stored 2 seconds after the engine is next started.

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 are stored, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue driving. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.
Fail-safe mode continues until a pass condition is detected, and the engine switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Accelerator Pedal Position (APP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

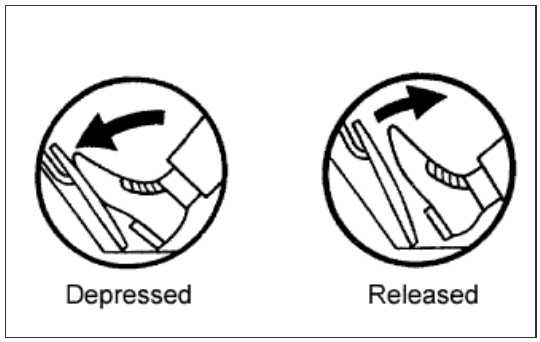
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

d. Read the value displayed on the tester.



Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released → Depressed → Released	0.5 to 4.5 V	1.2 to 4.7 V
	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V

Result

Result	Proceed to
N	A
O	

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the APP sensor connector.

b. Disconnect the ECM connector.

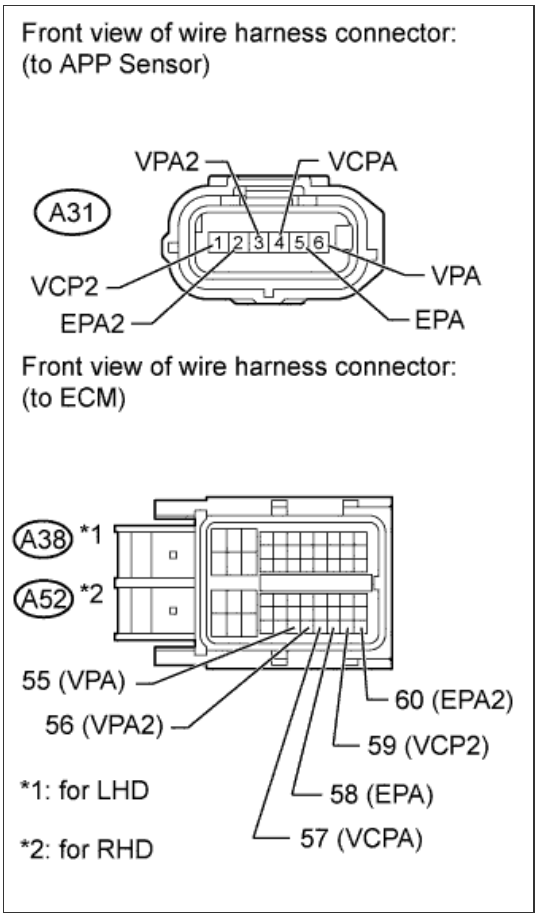
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A38-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-58 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A38-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A38-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A38-59 (VCP2)	Always	Below 1 Ω
A31-6 (VPA) or A38-55 (VPA) - body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-58 (EPA) - body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-57 (VCPA) - body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-56 (VPA2) - body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A38-60 (EPA2) - body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A38-59 (VCP2) - body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A52-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-58 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A52-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A52-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A52-59 (VCP2)	Always	Below 1 Ω
A31-6 (VPA) or A52-55 (VPA) - body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-58 (EPA) - body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-57 (VCPA) - body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-56 (VPA2) - body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-60 (EPA2) - body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A52-59 (VCP2) - body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK ECM (VCPA AND VCP2 VOLTAGE)

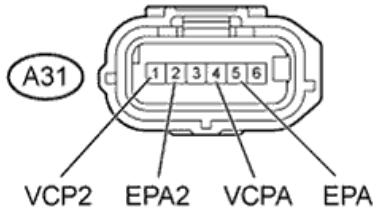
a. Disconnect the APP sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Engine switch on (I)	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Engine switch on (I)	4.5 to 5.5 V

Front view of wire harness connector:
(to APP Sensor)



NG → REPLACE ECM (Click here)

OK

4.REPLACE ACCELERATOR PEDAL SENSOR ASSEMBLY

a. Replace the accelerator pedal assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138 is output	A
No DTC is output	B

B → SYSTEM OK

A

REPLACE ECM (Click here)

DTC P0171 System Too Lean (Bank 1)

DTC P0172 System Too Rich (Bank 1)

DTC P0174 System Too Lean (Bank 2)

DTC P0175 System Too Rich (Bank 2)

for Preparation Click here

DESCRIPTION

The fuel trim is related to the feedback compensation value, not to the basic injection time. The fuel trim consists of both the short-term and the long-term fuel trims.
The short-term fuel trim is fuel compensation that is used to constantly maintain the air-fuel ratio at stoichiometric levels. The signal from the Air-Fuel Ratio (A/F) sensor indicates whether the air-fuel ratio is rich or lean compared to the stoichiometric ratio. This triggers a reduction in the fuel injection volume if the air-fuel ratio is rich and an increase in the fuel injection volume if it is lean.
Factors such as individual engine differences, wear over time and changes in operating environment cause short-term fuel trim to vary from the central value. The long-term fuel trim, which controls overall fuel compensation, compensates for long-term deviations in the fuel trim from the central value caused by the short-term fuel trim compensation.

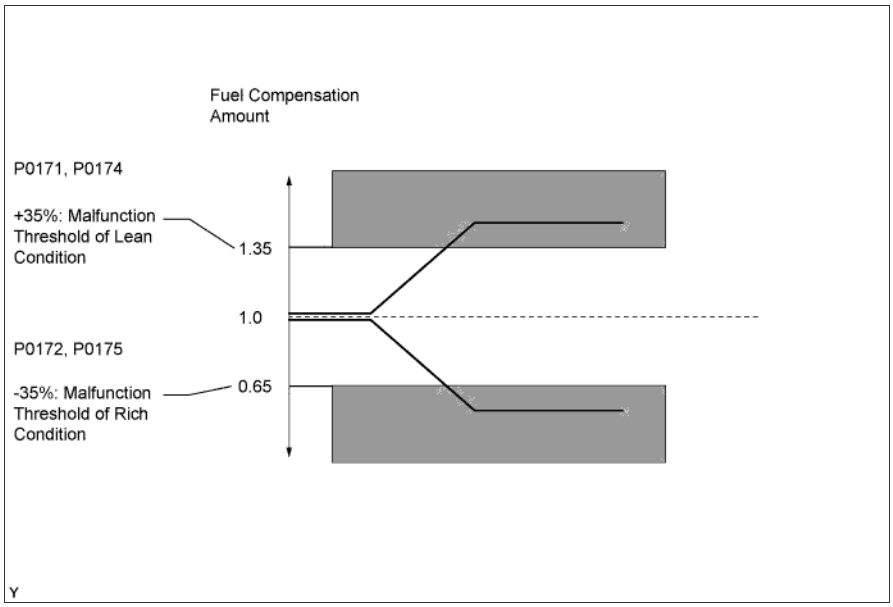
DTC Code	DTC Detection Condition	Trouble Area
P0171 P0174	With a warm engine and stable air-fuel ratio feedback, the fuel trim is considerably in error to the lean side (2 trip detection logic).	• Air induction system • Injector blockage • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Fuel pressure • Gas leakage from exhaust system • Open or short in Air-Fuel Ratio (A/F) sensor (for sensor 1) circuit • A/F sensor (for sensor 1) • A/F sensor heater (for sensor 1) • Integration relay • A/F sensor heater and integration relay circuits • PCV valve and hose • PCV hose connections • ECM
P0172 P0175	With a warm engine and stable air-fuel ratio feedback, the fuel trim is considerably in error to the rich side (2 trip detection logic).	• Injector leakage or blockage • MAF meter • ECT sensor • Ignition system • Fuel pressure • Gas leakage from exhaust system • Open or short in A/F sensor (for sensor 1) circuit • A/F sensor (for sensor 1) • A/F sensor heater (for sensor 1) • Integration relay • A/F sensor heater and integration relay circuits • ECM

HINT:

- **When DTC P0171 or P0174 is stored, the actual air-fuel ratio is on the lean side. When DTC P0172 or P0175 is stored, the actual air-fuel ratio is on the rich side.**
- **If the vehicle runs out of fuel, the air-fuel ratio is lean and DTC P0171 or P0174 may be stored. The MIL is then illuminated.**
- **When the total of the short-term and long-term fuel trim values is within the malfunction threshold (and the engine coolant temperature is higher than 75°C [167°F]), the system is functioning normally.**

MONITOR DESCRIPTION

Under closed-loop fuel control, fuel injection volumes that deviate from those estimated by the ECM cause changes in the long-term fuel trim compensation value. The long-term fuel trim is adjusted when there are persistent deviations in the short-term fuel trim values. Deviations from the fuel injection volumes estimated by the ECM also affect the average fuel trim learning value, which is a combination of the average short-term fuel trim (fuel feedback compensation value) and the average long-term fuel trim (learning value of the air-fuel ratio). If the average fuel trim learning value exceeds the malfunction threshold, the ECM interprets this as a fault in the fuel system and stores a DTC.
Example:
The average fuel trim learning value is +35% or more or -35% or less, the ECM interprets this as a fuel system malfunction.



WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.**
- **A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0171, P0172, P0174 OR P0175)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0171, P0172, P0174 or P0175 is output	A
P0171, P0172, P0174 or P0175 and other DTCs are output	B

HINT:

If any DTCs other than P0171, P0172, P0174 or P0175 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (A/F CONTROL)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor.

e. Perform the Control the Injection Volume for A/F Sensor operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).

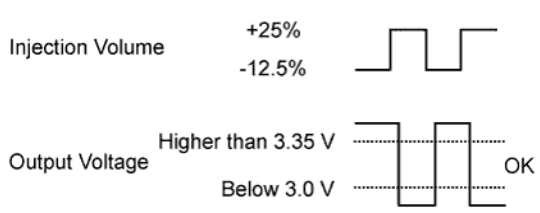
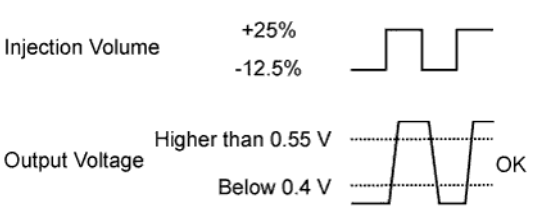
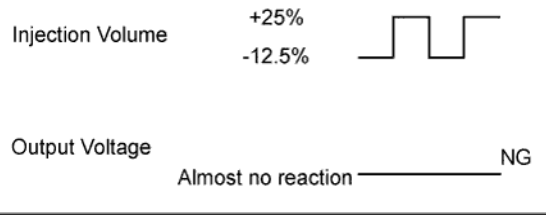
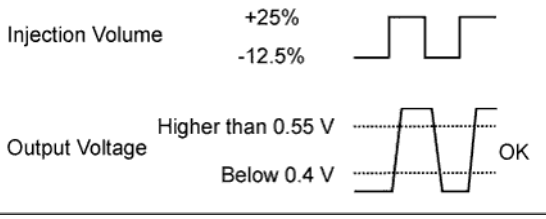
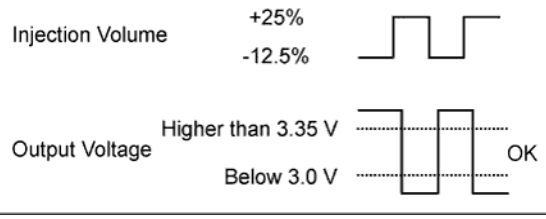
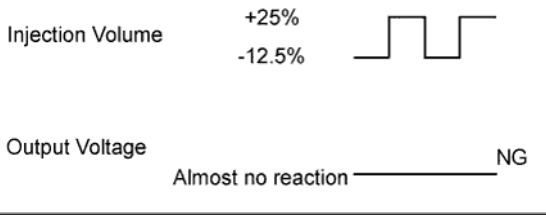
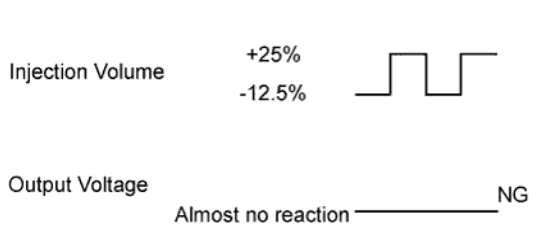
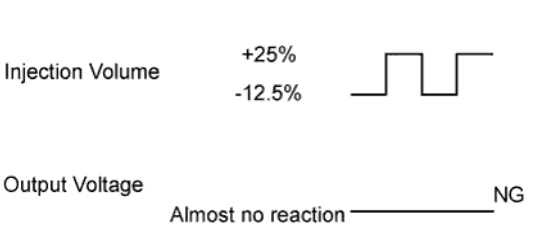
f. Monitor the output voltages of A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

Result:
The A/F sensor reacts in accordance with increases and decreases in the fuel injection volume:
+25% = Rich output:
Below 3.0 V
-12.5% = Lean output:
Higher than 3.35 V

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area

1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors. To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/ F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

Result

Result	Proceed to
Case 1	C
Case 2	B
Case 3	A

B → Go to step 11

C → Go to step 15

A

3.CHECK MASS AIR FLOW METER

a. Check the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

4.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: Between 80°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

5.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is connected correctly and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE

OK ↓

6.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK ↓

7.CHECK FOR SPARKS AND IGNITION

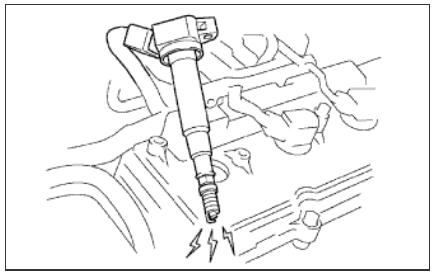
a. Disconnect the fuel injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.



b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → REPAIR OR REPLACE IGNITION SYSTEM

OK ↓

8.CHECK FOR EXHAUST GAS LEAK

a. Check for exhaust gas leakage.

OK:
No gas leakage.

NG → REPAIR OR REPLACE EXHAUST SYSTEM

OK ↓

9.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → REPAIR OR REPLACE FUEL SYSTEM

OK ↓

10.INSPECT FUEL INJECTOR (INJECTION AND VOLUME)

a. Check the injection volume (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK ↓

11.INSPECT AIR-FUEL RATIO SENSOR (HEATER RESISTANCE)

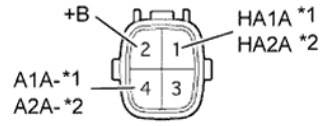
a. Disconnect the Air-Fuel Ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

12.INSPECT INTEGRATION RELAY (A/F RELAY)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

iii. Reinstall the A/F fuse.

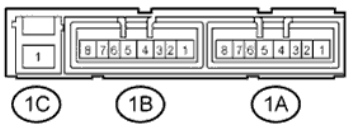
c. Inspect the integration relay (A/F).

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1A-4	Battery voltage not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω

Component without harness connected:
(Integration Relay)



NG → REPLACE INTEGRATION RELAY

OK

13.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

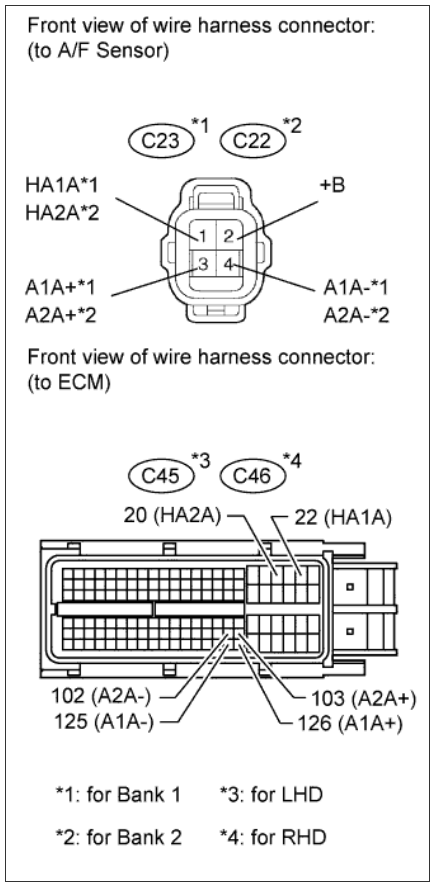
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.



e. Measure the resistance according to the value(s) in the table below.

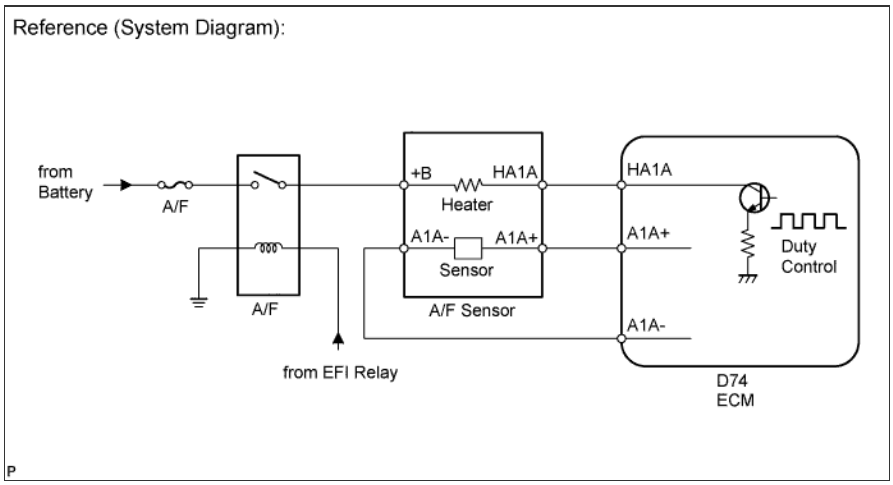
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C46-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-125 (A1A-) - Body ground	Always	10 kΩ or higher

C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-102 (A2A-) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

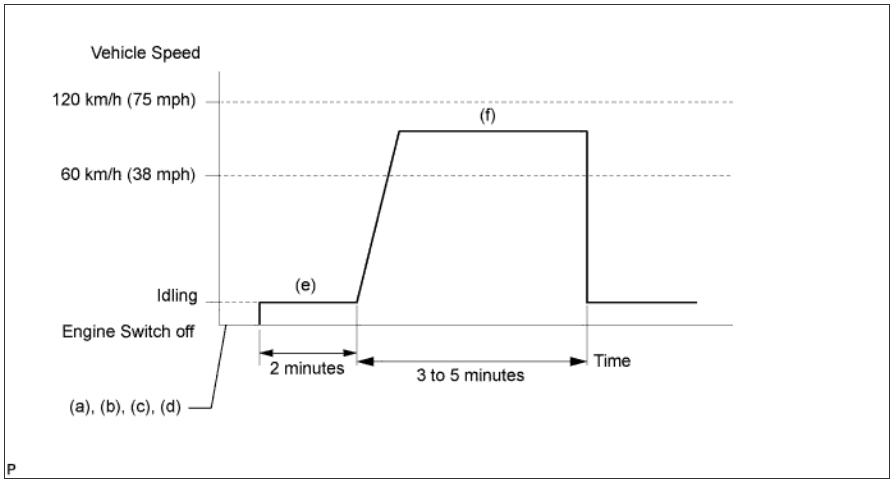
OK

14.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

15.PERFORM CONFIRMATION DRIVING PATTERN



(a) Connect the intelligent tester to the DLC3.
(b) Turn the engine switch on (IG) and turn the tester on.
(c) Clear DTCs (Click here).
(d) Switch the ECM from normal mode to check mode using the tester (Click here).
(e) Start the engine and warm it up with all the accessories switched off.
(f) Drive the vehicle at between 60 km/h and 120 km/h (38 mph and 75 mph) and at an engine speed of between 1400 rpm and 3200 rpm for 3 to 5 minutes.

HINT:

If the system is still malfunctioning, the MIL will be illuminated during step (f).

NOTICE:

If the conditions in this test are not strictly followed, no malfunction will be detected.

NEXT

16.CHECK WHETHER DTC OUTPUT RECURS (DTC P0171, P0172, P0174 OR P0175)

a. Enter the following menus: Powertrain / Engine and ECT / DTC.

b. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P0171, P0172, P0174 or P0175 is output	B

B → REPLACE ECM (Click here)

A → END

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

for Preparation Click here

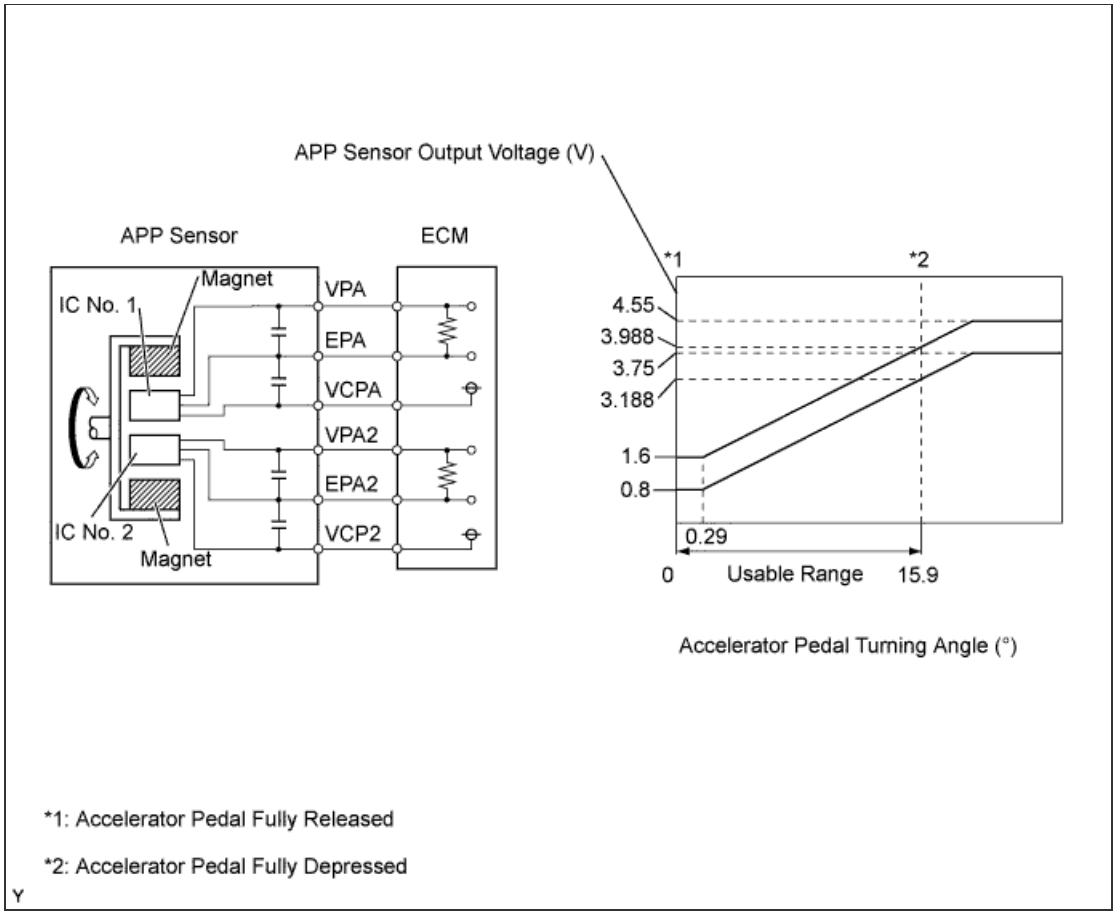
DESCRIPTION

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

The APP sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC Code	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
		• APP sensor

P2122	VPA is 0.4 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• Open in VCP1 circuit • Open or ground short in VPA circuit • ECM
P2123	VPA is 4.8 V or higher for 2.0 seconds or more (1 trip detection logic).	• APP sensor • Open in EPA circuit • ECM
P2125	VPA2 fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or higher. (b) VPA is between 0.4 V and 3.45 V.	• APP sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): (a) The difference between VPA and VPA2 is 0.02 V or less. (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less.	• Short between VPA and VPA2 circuits • APP sensor • ECM

HINT:

When any of these DTCs are output, check the APP sensor voltage by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

Trouble Area	Accelerator Position No. 1 When AP Released	Accelerator Position No. 2 When AP Released	Accelerator Position No. 1 When AP Depressed	Accelerator Position No. 2 When AP Depressed
VCP circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 4.7 V
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 4.7 V

HINT:

- **Accelerator pedal positions are expressed as voltages.**
- **AP stands for Accelerator Pedal.**

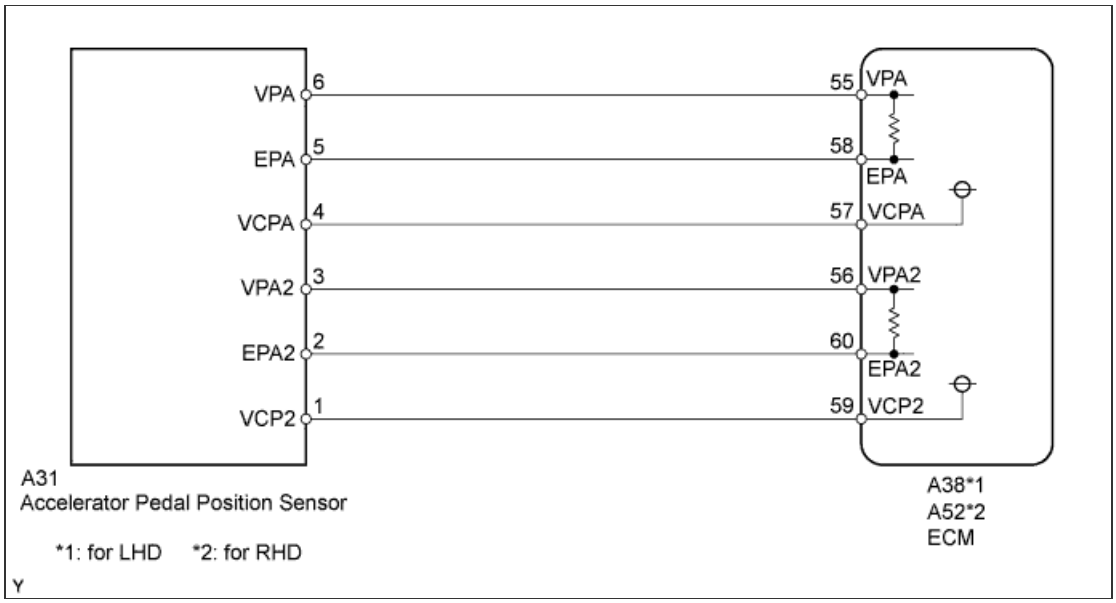
MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is less than the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and stores a DTC.
Example:
When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is stored.
If the malfunction is not repaired successfully, a DTC is stored 2 seconds after the engine is next started.

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 are stored, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue driving. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.
Fail-safe mode continues until a pass condition is detected, and the engine switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Accelerator Pedal Position (APP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

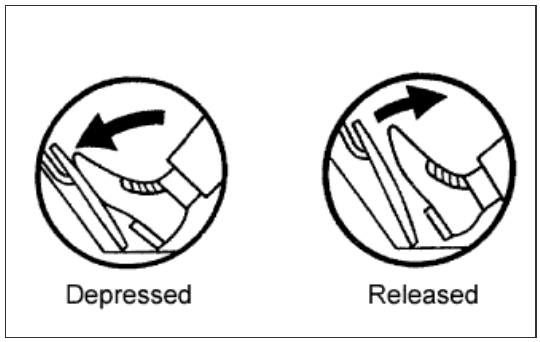
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

d. Read the value displayed on the tester.



Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released → Depressed → Released	0.5 to 4.5 V	1.2 to 4.7 V
	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V

Result

Result	Proceed to
N	A
O	

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the APP sensor connector.

b. Disconnect the ECM connector.

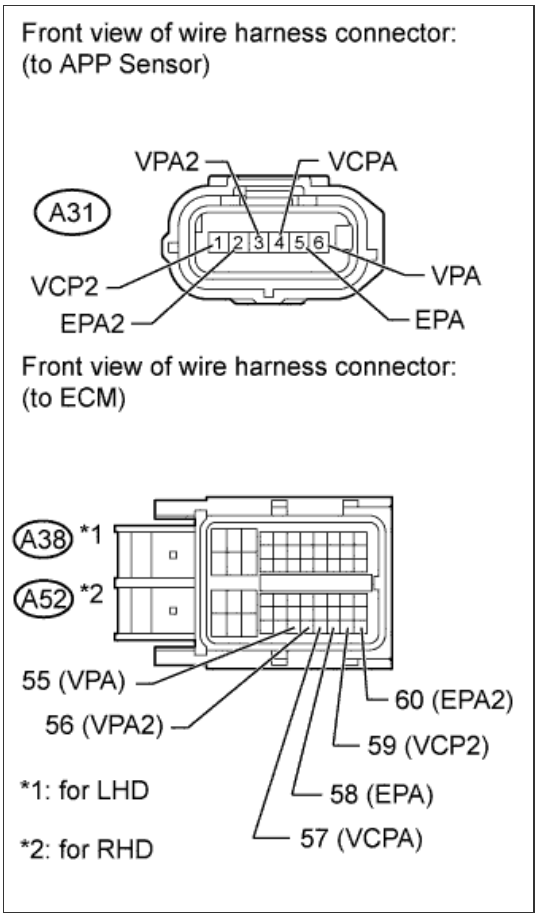
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A38-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-58 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A38-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A38-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A38-59 (VCP2)	Always	Below 1 Ω
A31-6 (VPA) or A38-55 (VPA) - body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-58 (EPA) - body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-57 (VCPA) - body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-56 (VPA2) - body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A38-60 (EPA2) - body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A38-59 (VCP2) - body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A52-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-58 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A52-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A52-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A52-59 (VCP2)	Always	Below 1 Ω
A31-6 (VPA) or A52-55 (VPA) - body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-58 (EPA) - body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-57 (VCPA) - body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-56 (VPA2) - body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-60 (EPA2) - body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A52-59 (VCP2) - body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK ECM (VCPA AND VCP2 VOLTAGE)

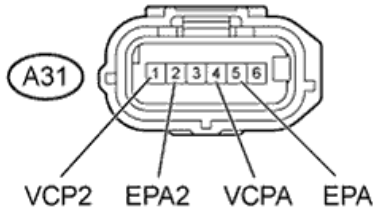
a. Disconnect the APP sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Engine switch on (I)	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Engine switch on (I)	4.5 to 5.5 V

Front view of wire harness connector:
(to APP Sensor)



NG → REPLACE ECM (Click here)

OK

4.REPLACE ACCELERATOR PEDAL SENSOR ASSEMBLY

a. Replace the accelerator pedal assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138 is output	A
No DTC is output	B

B → SYSTEM OK

A

REPLACE ECM (Click here)

DTC P0171 System Too Lean (Bank 1)

DTC P0172 System Too Rich (Bank 1)

DTC P0174 System Too Lean (Bank 2)

DTC P0175 System Too Rich (Bank 2)

for Preparation Click here

DESCRIPTION

The fuel trim is related to the feedback compensation value, not to the basic injection time. The fuel trim consists of both the short-term and the long-term fuel trims.
The short-term fuel trim is fuel compensation that is used to constantly maintain the air-fuel ratio at stoichiometric levels. The signal from the Air-Fuel Ratio (A/F) sensor indicates whether the air-fuel ratio is rich or lean compared to the stoichiometric ratio. This triggers a reduction in the fuel injection volume if the air-fuel ratio is rich and an increase in the fuel injection volume if it is lean.
Factors such as individual engine differences, wear over time and changes in operating environment cause short-term fuel trim to vary from the central value. The long-term fuel trim, which controls overall fuel compensation, compensates for long-term deviations in the fuel trim from the central value caused by the short-term fuel trim compensation.

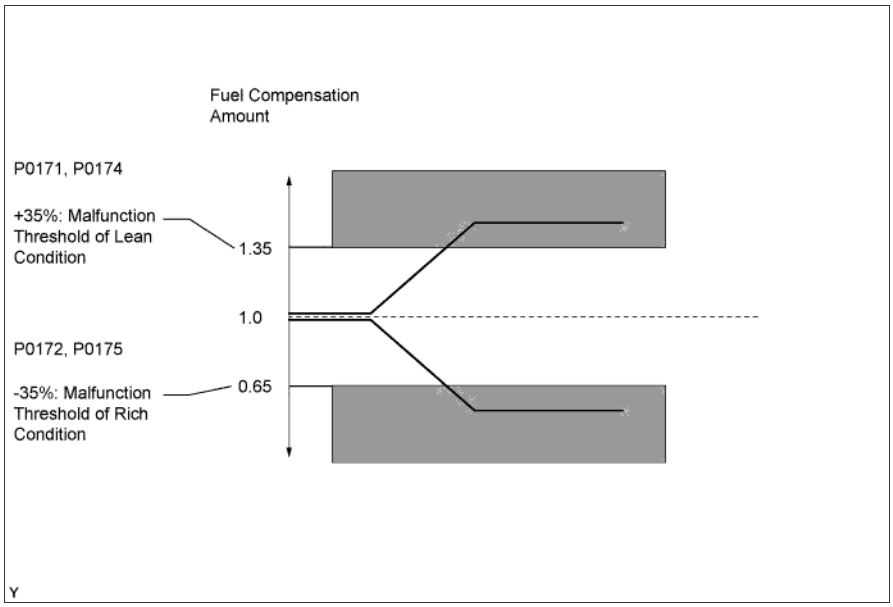
DTC Code	DTC Detection Condition	Trouble Area
P0171 P0174	With a warm engine and stable air-fuel ratio feedback, the fuel trim is considerably in error to the lean side (2 trip detection logic).	• Air induction system • Injector blockage • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Fuel pressure • Gas leakage from exhaust system • Open or short in Air-Fuel Ratio (A/F) sensor (for sensor 1) circuit • A/F sensor (for sensor 1) • A/F sensor heater (for sensor 1) • Integration relay • A/F sensor heater and integration relay circuits • PCV valve and hose • PCV hose connections • ECM
P0172 P0175	With a warm engine and stable air-fuel ratio feedback, the fuel trim is considerably in error to the rich side (2 trip detection logic).	• Injector leakage or blockage • MAF meter • ECT sensor • Ignition system • Fuel pressure • Gas leakage from exhaust system • Open or short in A/F sensor (for sensor 1) circuit • A/F sensor (for sensor 1) • A/F sensor heater (for sensor 1) • Integration relay • A/F sensor heater and integration relay circuits • ECM

HINT:

- **When DTC P0171 or P0174 is stored, the actual air-fuel ratio is on the lean side. When DTC P0172 or P0175 is stored, the actual air-fuel ratio is on the rich side.**
- **If the vehicle runs out of fuel, the air-fuel ratio is lean and DTC P0171 or P0174 may be stored. The MIL is then illuminated.**
- **When the total of the short-term and long-term fuel trim values is within the malfunction threshold (and the engine coolant temperature is higher than 75°C [167°F]), the system is functioning normally.**

MONITOR DESCRIPTION

Under closed-loop fuel control, fuel injection volumes that deviate from those estimated by the ECM cause changes in the long-term fuel trim compensation value. The long-term fuel trim is adjusted when there are persistent deviations in the short-term fuel trim values. Deviations from the fuel injection volumes estimated by the ECM also affect the average fuel trim learning value, which is a combination of the average short-term fuel trim (fuel feedback compensation value) and the average long-term fuel trim (learning value of the air-fuel ratio). If the average fuel trim learning value exceeds the malfunction threshold, the ECM interprets this as a fault in the fuel system and stores a DTC.
Example:
The average fuel trim learning value is +35% or more or -35% or less, the ECM interprets this as a fuel system malfunction.



WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.**
- **A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0171, P0172, P0174 OR P0175)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read DTCs.

Result

Result	Proceed to
P0171, P0172, P0174 or P0175 is output	A
P0171, P0172, P0174 or P0175 and other DTCs are output	B

HINT:

If any DTCs other than P0171, P0172, P0174 or P0175 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (A/F CONTROL)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor.

e. Perform the Control the Injection Volume for A/F Sensor operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).

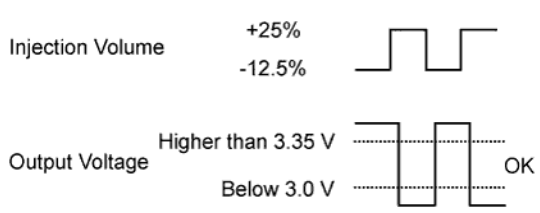
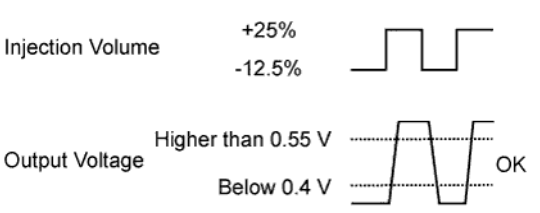
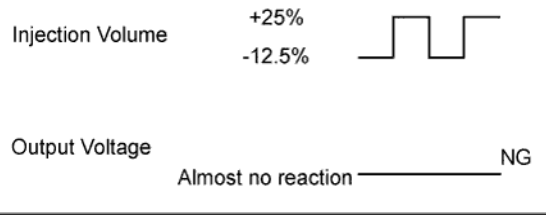
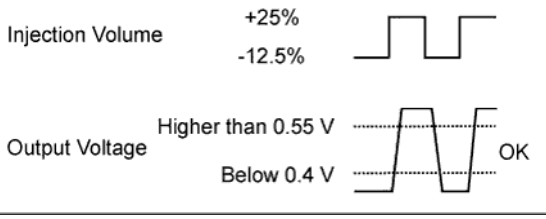
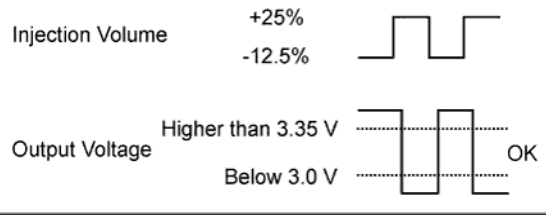
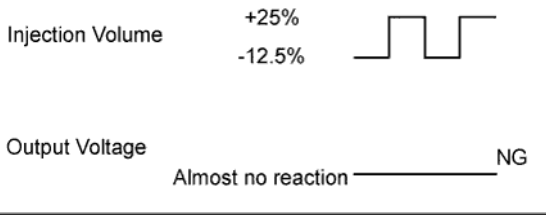
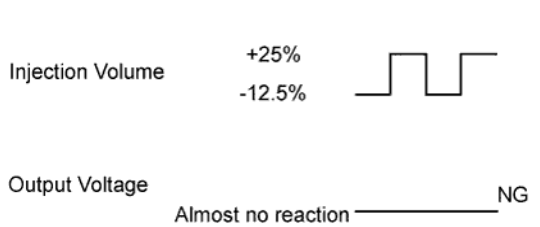
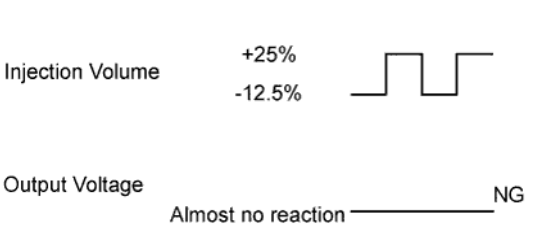
f. Monitor the output voltages of A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

Result:
The A/F sensor reacts in accordance with increases and decreases in the fuel injection volume:
+25% = Rich output:
Below 3.0 V
-12.5% = Lean output:
Higher than 3.35 V

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area

1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors. To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/ F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

Result

Result	Proceed to
Case 1	C
Case 2	B
Case 3	A

B → Go to step 11

C → Go to step 15

A

3.CHECK MASS AIR FLOW METER

a. Check the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK

4.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: Between 80°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

5.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is connected correctly and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE

OK ↓

6.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK ↓

7.CHECK FOR SPARKS AND IGNITION

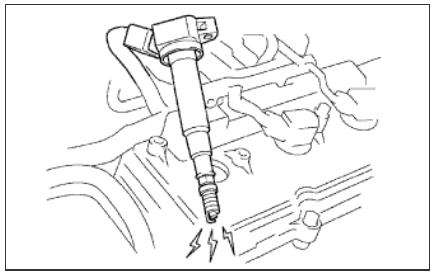
a. Disconnect the fuel injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.



b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → REPAIR OR REPLACE IGNITION SYSTEM

OK ↓

8.CHECK FOR EXHAUST GAS LEAK

a. Check for exhaust gas leakage.

OK:
No gas leakage.

NG → REPAIR OR REPLACE EXHAUST SYSTEM

OK ↓

9.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → REPAIR OR REPLACE FUEL SYSTEM

OK ↓

10.INSPECT FUEL INJECTOR (INJECTION AND VOLUME)

a. Check the injection volume (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK ↓

11.INSPECT AIR-FUEL RATIO SENSOR (HEATER RESISTANCE)

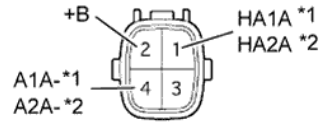
a. Disconnect the Air-Fuel Ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

12.INSPECT INTEGRATION RELAY (A/F RELAY)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

iii. Reinstall the A/F fuse.

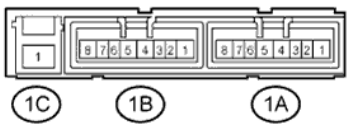
c. Inspect the integration relay (A/F).

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1A-4	Battery voltage not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω

Component without harness connected:
(Integration Relay)



NG → REPLACE INTEGRATION RELAY

OK

13.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

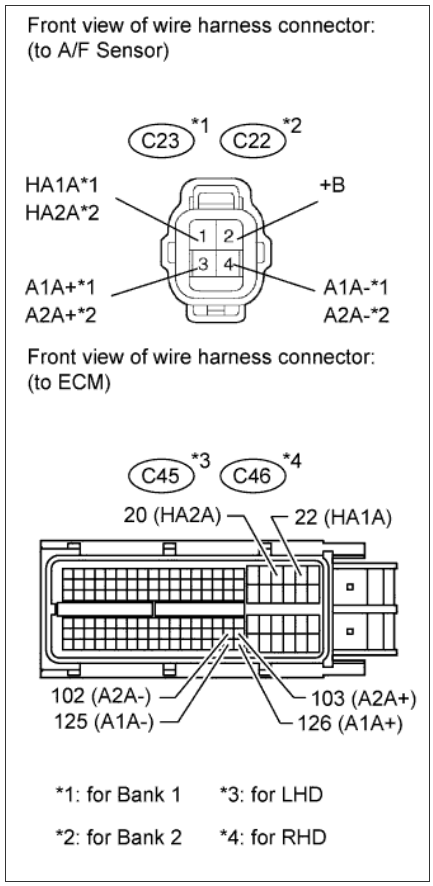
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.



e. Measure the resistance according to the value(s) in the table below.

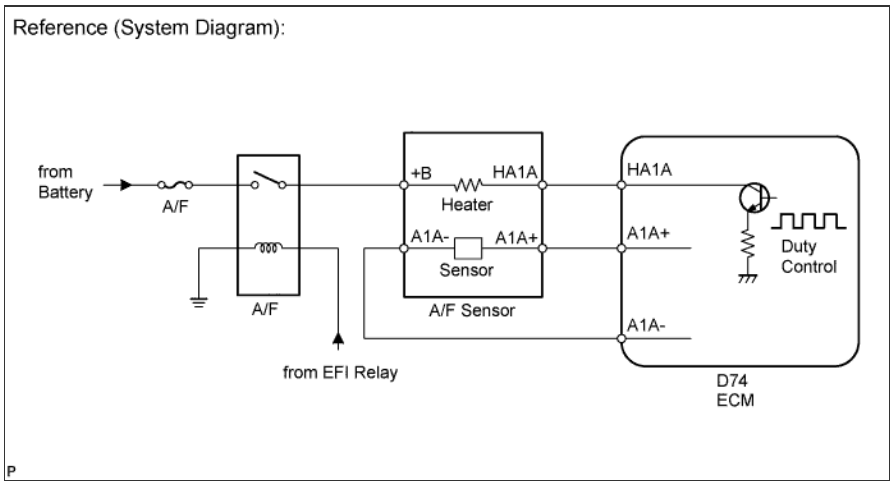
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C46-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-125 (A1A-) - Body ground	Always	10 kΩ or higher

C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-102 (A2A-) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

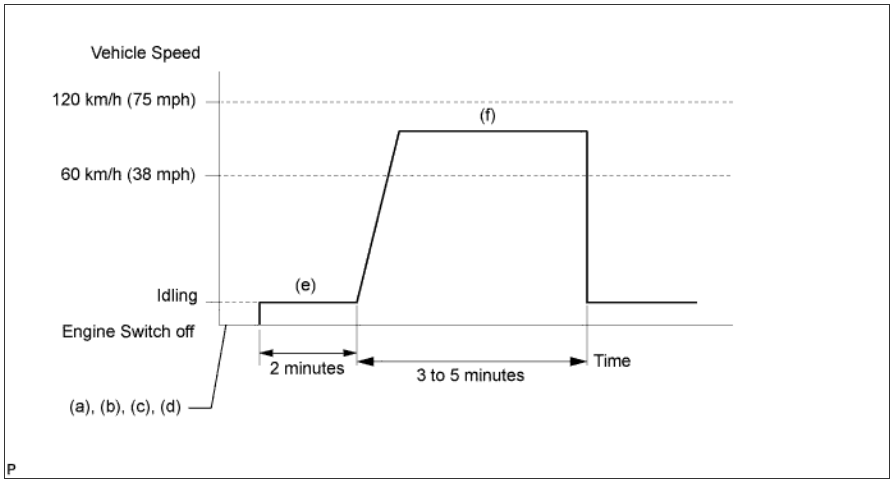
OK

14.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

15.PERFORM CONFIRMATION DRIVING PATTERN



(a) Connect the intelligent tester to the DLC3.
(b) Turn the engine switch on (IG) and turn the tester on.
(c) Clear DTCs (Click here).
(d) Switch the ECM from normal mode to check mode using the tester (Click here).
(e) Start the engine and warm it up with all the accessories switched off.
(f) Drive the vehicle at between 60 km/h and 120 km/h (38 mph and 75 mph) and at an engine speed of between 1400 rpm and 3200 rpm for 3 to 5 minutes.

HINT:

If the system is still malfunctioning, the MIL will be illuminated during step (f).

NOTICE:

If the conditions in this test are not strictly followed, no malfunction will be detected.

NEXT

16.CHECK WHETHER DTC OUTPUT RECURS (DTC P0171, P0172, P0174 OR P0175)

a. Enter the following menus: Powertrain / Engine and ECT / DTC.

b. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P0171, P0172, P0174 or P0175 is output	B

B → REPLACE ECM (Click here)

A → END

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

for Preparation Click here

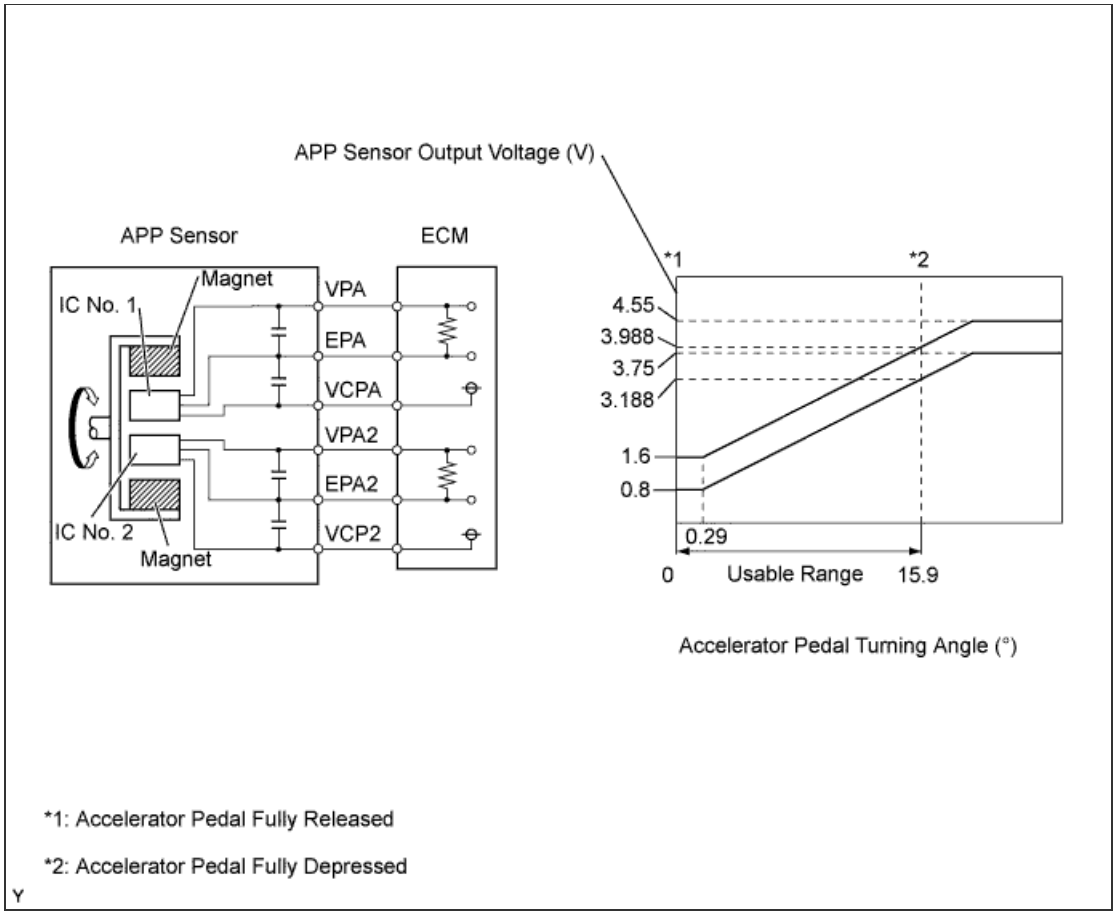
DESCRIPTION

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

The APP sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC Code	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
		• APP sensor

P2122	VPA is 0.4 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• Open in VCP1 circuit • Open or ground short in VPA circuit • ECM
P2123	VPA is 4.8 V or higher for 2.0 seconds or more (1 trip detection logic).	• APP sensor • Open in EPA circuit • ECM
P2125	VPA2 fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or higher. (b) VPA is between 0.4 V and 3.45 V.	• APP sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): (a) The difference between VPA and VPA2 is 0.02 V or less. (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less.	• Short between VPA and VPA2 circuits • APP sensor • ECM

HINT:

When any of these DTCs are output, check the APP sensor voltage by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

Trouble Area	Accelerator Position No. 1 When AP Released	Accelerator Position No. 2 When AP Released	Accelerator Position No. 1 When AP Depressed	Accelerator Position No. 2 When AP Depressed
VCP circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 4.7 V
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 4.7 V

HINT:

- **Accelerator pedal positions are expressed as voltages.**
- **AP stands for Accelerator Pedal.**

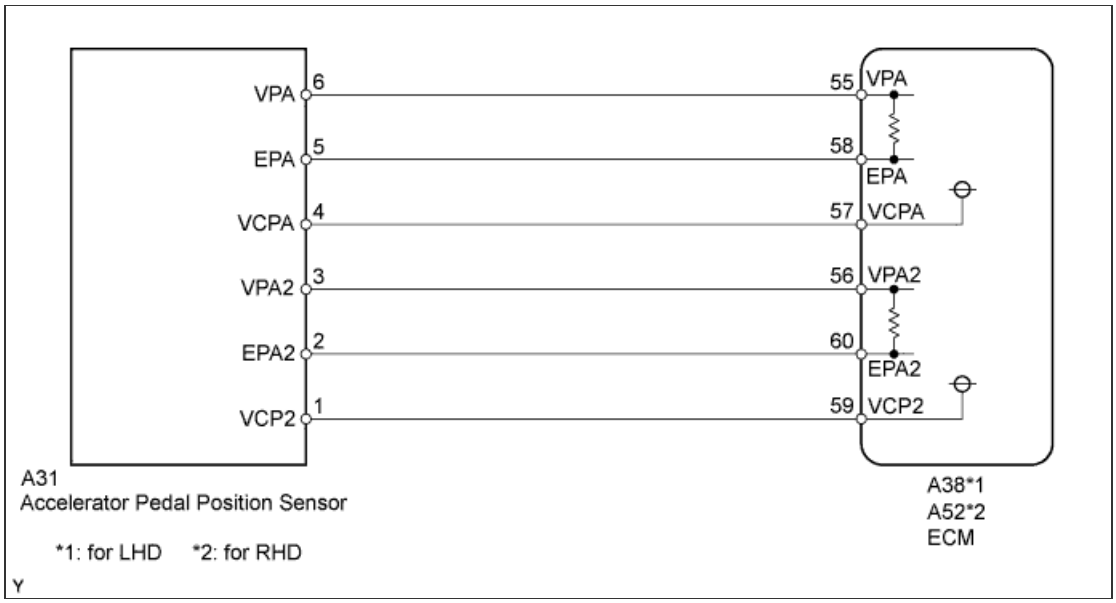
MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is less than the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and stores a DTC.
Example:
When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is stored.
If the malfunction is not repaired successfully, a DTC is stored 2 seconds after the engine is next started.

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 are stored, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue driving. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.
Fail-safe mode continues until a pass condition is detected, and the engine switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Accelerator Pedal Position (APP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

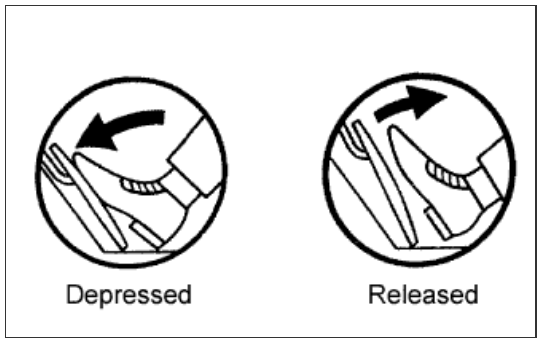
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

d. Read the value displayed on the tester.



Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released → Depressed → Released	0.5 to 4.5 V	1.2 to 4.7 V
	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V

Result

Result	Proceed to
N	A
O	

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the APP sensor connector.

b. Disconnect the ECM connector.

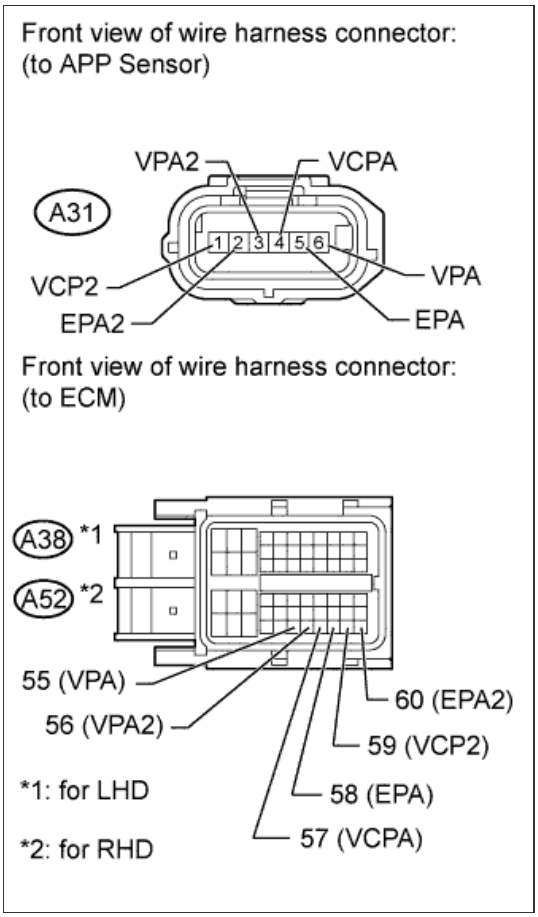
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A38-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-58 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A38-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A38-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A38-59 (VCP2)	Always	Below 1 Ω
A31-6 (VPA) or A38-55 (VPA) - body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-58 (EPA) - body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-57 (VCPA) - body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-56 (VPA2) - body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A38-60 (EPA2) - body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A38-59 (VCP2) - body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A52-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-58 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A52-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A52-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A52-59 (VCP2)	Always	Below 1 Ω
A31-6 (VPA) or A52-55 (VPA) - body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-58 (EPA) - body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-57 (VCPA) - body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-56 (VPA2) - body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-60 (EPA2) - body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A52-59 (VCP2) - body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK ECM (VCPA AND VCP2 VOLTAGE)

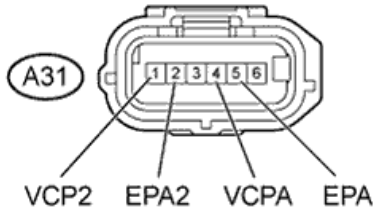
a. Disconnect the APP sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Engine switch on (I)	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Engine switch on (I)	4.5 to 5.5 V

Front view of wire harness connector:
(to APP Sensor)



NG → REPLACE ECM (Click here)

OK

4.REPLACE ACCELERATOR PEDAL SENSOR ASSEMBLY

a. Replace the accelerator pedal assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (I) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138 is output	A
No DTC is output	B

B → SYSTEM OK

A

REPLACE ECM (Click here)

DTC P0230 Fuel Pump Primary Circuit

for Preparation Click here

DESCRIPTION

When a malfunction in the fuel pump circuit is detected, DTC P0230 is stored.
The fuel pump circuit consists of the ECM, fuel pump and fuel pump ECU (which operates the fuel pump). Based on the engine output, the ECM determines the fuel pump speed. The speed is then converted to a duty signal and sent to the fuel pump ECU. Based on the signal sent from the ECM, the fuel pump ECU adjusts the fuel pump operation speed between 3 settings. The fuel pump ECU also has a self-diagnosis function. Based on the fuel pump circuit condition, the fuel pump ECU outputs a diagnostic signal (DI) to the ECM, and the ECM determines if there is a malfunction in the fuel pump circuit.

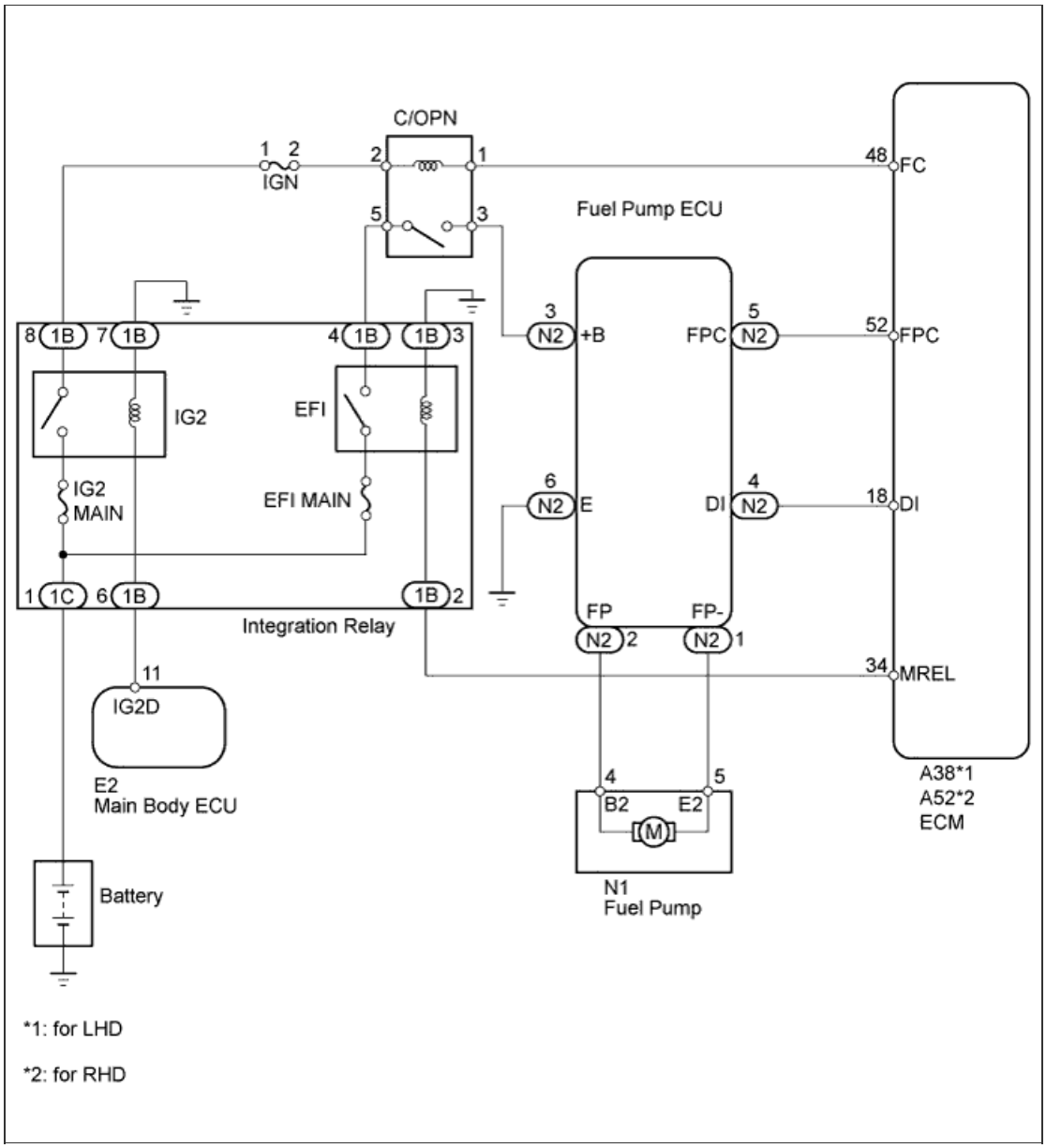
DTC Code	DTC Detection Condition	Trouble Area

P0230	When either condition below is met (1 trip detection logic):
	• When the fuel pump is operating:
	  • The remaining amount of fuel is 17 L or more.
	  • The DI terminal output is low.
	• When the fuel pump is not operating:
	  • The DI terminal output is high.
		• Open or short in fuel pump circuit
		• Fuel pump
		• Fuel pump ECU
		• ECM

MONITOR DESCRIPTION

To monitor the fuel pump circuit, the ECM checks the fuel pump control signal (FPC) and diagnostic signal (DI). The FPC voltage varies between approximately 0 V to approximately 12 V (duty signal). Based on the condition of the fuel pump ECU malfunction, the DI voltage varies between approximately 0 V and approximately 12 V. The ECM then compares the variance of the FPC voltage and DI voltage, and determines if the fuel pump circuit is malfunctioning. When the ECM determines that the fuel pump circuit is malfunctioning, a DTC is stored immediately.

WIRING DIAGRAM



INSPECTION PROCEDURE

This troubleshooting procedure is based on the premise that the engine is started. If the engine is not started, proceed to the Problem Symptoms Table (Click here).

1.CHECK FOR DTC (B1500)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Body / (desired system) / DTC.

e. Read the DTC.

Result

Result	Proceed to
DTC B1500 is not output	A
DTC B1500 is output	B

B → GO TO DTC B1500 (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (FUEL PUMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Fuel Pump / Speed.

d. Check whether operating sounds can be heard while operating the relay using the tester.

OK:

Operating sounds can be heard from fuel pump.

NG → Go to step 6

OK ↓

3.CHECK HARNESS AND CONNECTOR (FUEL PUMP ECU - ECM - FUEL PUMP)

a. Disconnect the fuel pump ECU connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

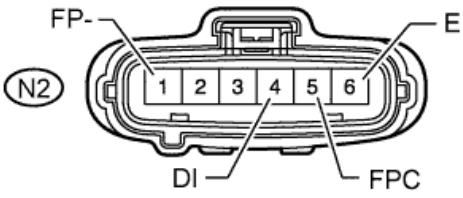
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
N2-5 (FPC) - A38-52 (FPC)	Always	Below 1 Ω
N2-4 (DI) - A38-18 (DI)	Always	Below 1 Ω
N2-6 (E) - Body ground	Always	Below 1 Ω
N2-5 (FPC) or A38-52 (FPC) - Body ground	Always	10 kΩ or more
N2-4 (DI) or A38-18 (DI) - Body ground	Always	10 kΩ or more
N2-1 (FP-) or N1-5 (E2) - Body ground	Always	10 kΩ or more

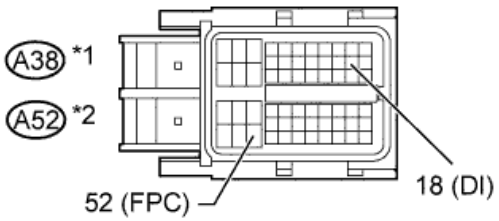
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
N2-5 (FPC) - A52-52 (FPC)	Always	Below 1 Ω
N2-4 (DI) - A52-18 (DI)	Always	Below 1 Ω
N2-6 (E) - Body ground	Always	Below 1 Ω
N2-5 (FPC) or A52-52 (FPC) - Body ground	Always	10 kΩ or more
N2-4 (DI) or A52-18 (DI) - Body ground	Always	10 kΩ or more
N2-1 (FP-) or N1-5 (E2) - Body ground	Always	10 kΩ or more

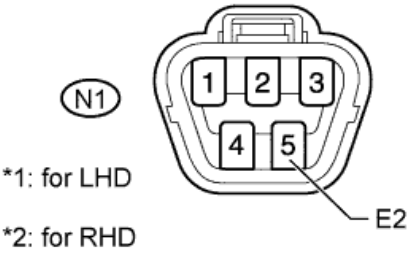
Front view of wire harness connector:
(to Fuel Pump ECU)



Front view of wire harness connector:
(to ECM)



Front view of wire harness connector:
(to Fuel Pump)



*1: for LHD

*2: for RHD

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK ↓

4.REPLACE FUEL PUMP CONTROL ECU

a. Replace the fuel pump control ECU.

HINT:

- w/ Active Height Control (Click here).
- w/o Active Height Control (Click here).

NE T

5.CONFIRM WHETHER DTC OUTPUT RECURS

a. Check that there is 17 L or more of fuel remaining.

b. Connect the intelligent tester to the DLC3.

c. Turn the engine switch on (IG).

d. Turn the tester on.

e. Clear DTCs (Click here).

f. Start the engine and idle it for 1 minute.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read the DTCs.

Result

Result	Proceed to
No DTC is output	A
P0230 is output	B

B → REPLACE ECM (Click here)

A

END

6.CHECK HARNESS AND CONNECTOR (FUEL PUMP POWER SOURCE VOLTAGE)

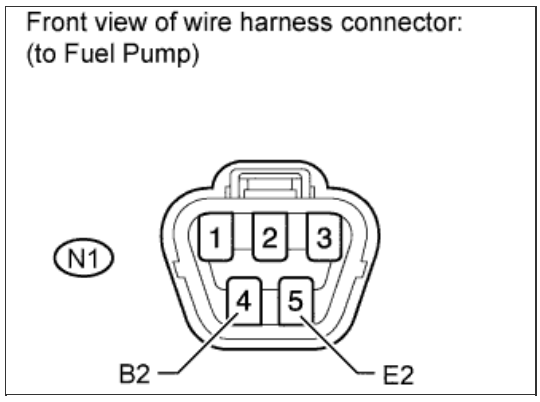
a. Disconnect the fuel pump connector.

b. Connect the intelligent tester to the DLC3.

c. Turn the engine switch on (IG) and turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Fuel Pump / Speed.

e. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

Tester Connection	Condition	Specified Condition
N1-4 - N1-5	Engine switch on (IG) Active Test on	11 to 14 V

Result

Result	Proceed to
NG	A
OK (for Single Tank Type)	B
OK (for Double Tank Type)	C

B → REPLACE FUEL PUMP (Click here)

C → REPLACE FUEL PUMP (Click here)

A

7.CHECK HARNESS AND CONNECTOR (ECM - FUEL PUMP CONTROL ECU - FUEL PUMP)

a. Disconnect the ECM connector.

b. Disconnect the fuel pump ECU connector.

c. Disconnect the fuel pump connector.

d. Measure the resistance according to the value(s) in the table below.

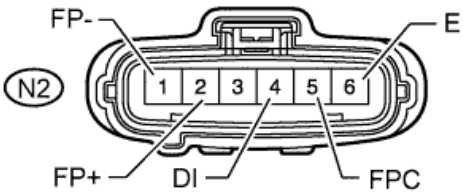
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
N2-5 (FPC) - A38-52 (FPC)	Always	Below 1 Ω
N2-4 (DI) - A38-18 (DI)	Always	Below 1 Ω
N2-6 (E) - Body ground	Always	Below 1 Ω
N2-2 (FP) - N1-4 (B2)	Always	Below 1 Ω
N2-1 (FP-) - N1-5 (E2)	Always	Below 1 Ω
N2-5 (FPC) or A38-52 (FPC) - Body ground	Always	10 kΩ or more
N2-4 (DI) or A38-18 (DI) - Body ground	Always	10 kΩ or more
N2-2 (FP) or N1-4 (B2) - Body ground	Always	10 kΩ or more
N2-1 (FP-) or N1-5 (E2) - Body ground	Always	10 kΩ or more

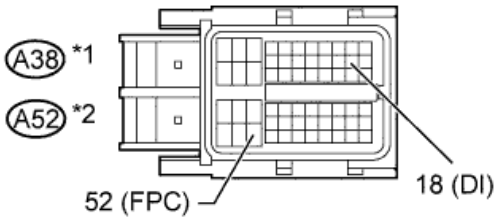
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
N2-5 (FPC) - A52-52 (FPC)	Always	Below 1 Ω
N2-4 (DI) - A52-18 (DI)	Always	Below 1 Ω
N2-6 (E) - Body ground	Always	Below 1 Ω
N2-2 (FP) - N1-4 (B2)	Always	Below 1 Ω
N2-1 (FP-) - N1-5 (E2)	Always	Below 1 Ω
N2-5 (FPC) or A52-52 (FPC) - Body ground	Always	10 kΩ or more
N2-4 (DI) or A52-18 (DI) - Body ground	Always	10 kΩ or more
N2-2 (FP) or N1-4 (B2) - Body ground	Always	10 kΩ or more
N2-1 (FP-) or N1-5 (E2) - Body ground	Always	10 kΩ or more

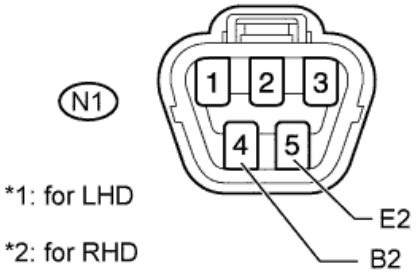
Front view of wire harness connector:
(to Fuel Pump ECU)



Front view of wire harness connector:
(to ECM)



Front view of wire harness connector:
(to Fuel Pump)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

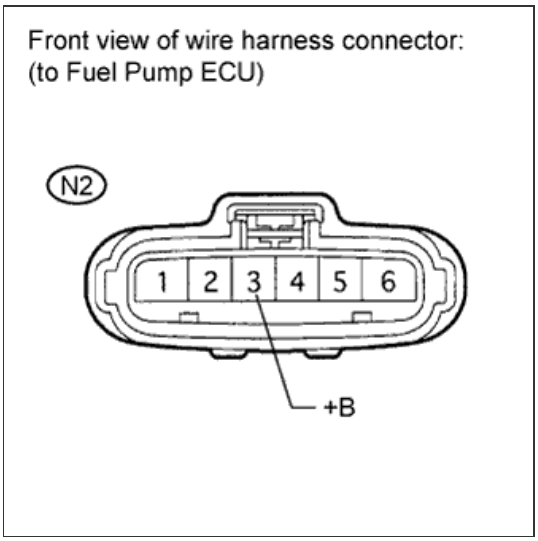
8.CHECK HARNESS AND CONNECTOR (FUEL PUMP CONTROL ECU POWER SOURCE VOLTAGE)

a. Disconnect the fuel pump ECU connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
N2-3 (B) - Body ground	Engine switch on (IG)	11 to 14 V



NG → Go to step 11

OK

9.REPLACE FUEL PUMP CONTROL ECU

a. Replace the fuel pump control ECU.

HINT:

- **w/ Active Height Control (Click here).**
- **w/o Active Height Control (Click here).**

NE T

10.CONFIRM WHETHER DTC OUTPUT RECURS

a. Check that there is 17 L or more of fuel remaining.

b. Connect the intelligent tester to the DLC3.

c. Turn the engine switch on (IG).

d. Turn the tester on.

e. Clear DTCs (Click here).

f. Start the engine and idle it for 1 minute.

g. Enter the following menus: Powertrain / Engine and ECT / DTC.

h. Read the DTCs.

Result

Result	Proceed to
No DTC is output	A
P0230 is output	B

B → REPLACE ECM (Click here)

A

END

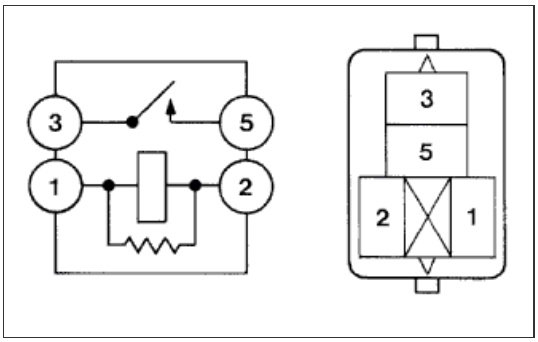
11.INSPECT CIRCUIT OPENING RELAY (C/OPN)

a. Remove the circuit opening relay (C/OPN) from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied to terminals 1 and 2	10 kΩ or higher
3 - 5	Battery voltage applied to terminals 1 and 2	Below 1 Ω



NG → REPLACE CIRCUIT OPENING RELAY (C/OPN)

OK

12.CHECK CIRCUIT OPENING RELAY

a. Check the operating sound of the relay when the engine switch is turned on (IG).

OK:

Tester Connection	Condition	Specified Condition
C/OPN relay	Engine switch on (IG)	Operating sound heard

NG → Go to step 13

OK

13.CHECK HARNESS AND CONNECTOR (FUEL PUMP ECU - CIRCUIT OPENING RELAY - INTEGRATION RELAY)

a. Remove the circuit opening relay (C/OPN) and integration relay from the engine room relay block.

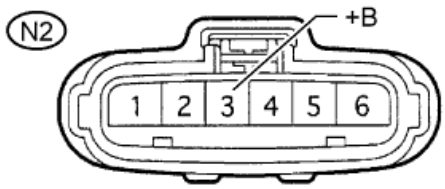
b. Disconnect the fuel pump ECU connector.

c. Measure the resistance according to the value(s) in the table below.

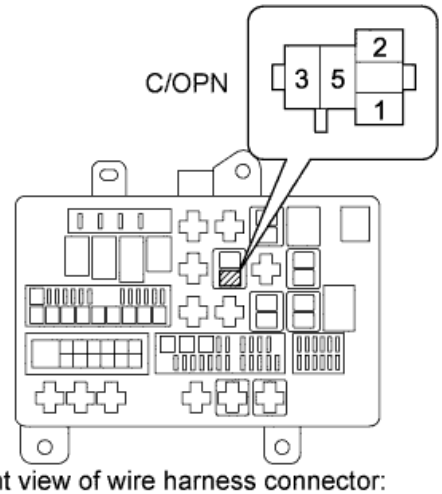
Standard Resistance:

Tester Connection	Condition	Specified Condition
N2-3 (B) - C/OPN relay terminal 3	Always	Below 1 Ω
1B-4 - C/OPN relay terminal 5	Always	Below 1 Ω
N2-3 (B) or C/OPN relay terminal 3 - Body ground	Always	10 kΩ or more
1B-4 or C/OPN relay terminal 5 - Body ground	Always	10 kΩ or more

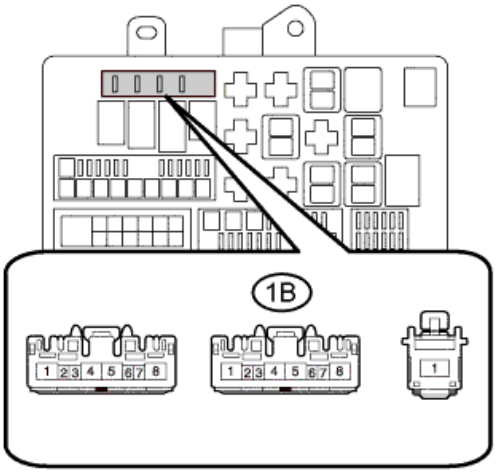
Front view of wire harness connector:
(to Fuel Pump ECU)



Engine Room Relay Block:



Front view of wire harness connector:
(to Integration Relay)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

GO TO ECM POWER SOURCE CIRCUIT (Click here)

14.CHECK FUSE (IGN)

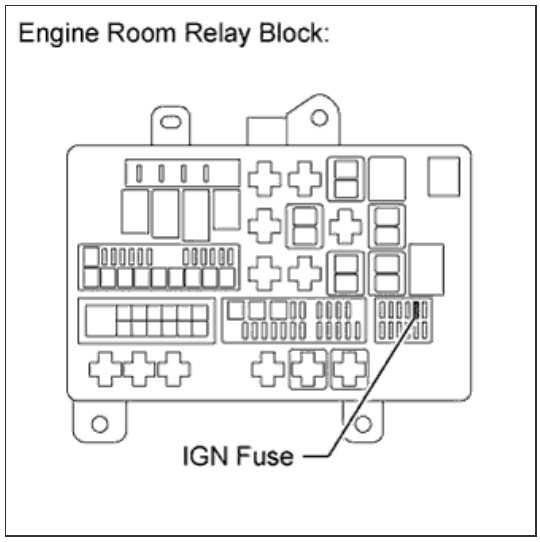
a. Remove the IGN fuse from the integration relay.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
IGN fuse	Always	Below 1 Ω

c. Reinstall the IGN fuse.



NG → CHECK FOR SHORTS IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

OK

15.CHECK HARNESS AND CONNECTOR (ECM - CIRCUIT OPENING RELAY - INTEGRATION RELAY)

a. Remove the circuit opening relay (C/OPN) and integration relay from the engine room relay block.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

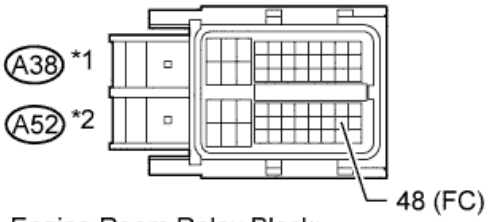
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
A38-48 (FC) - C/OPN relay terminal 1	Always	Below 1 Ω
1B-8 - C/OPN relay terminal 2	Always	Below 1 Ω
A38-48 (FC) - C/OPN relay terminal 1 or Body ground	Always	10 kΩ or more
1B-8 or C/OPN relay terminal 2 - Body ground	Always	10 kΩ or more

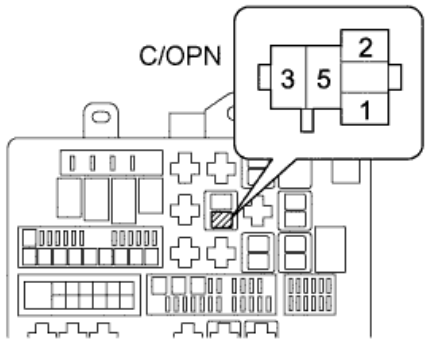
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
A52-48 (FC) - C/OPN relay terminal 1	Always	Below 1 Ω
1B-8 - C/OPN relay terminal 2	Always	Below 1 Ω
A52-48 (FC) - C/OPN relay terminal 1 or Body ground	Always	10 kΩ or more
1B-8 or C/OPN relay terminal 2 - Body ground	Always	10 kΩ or more

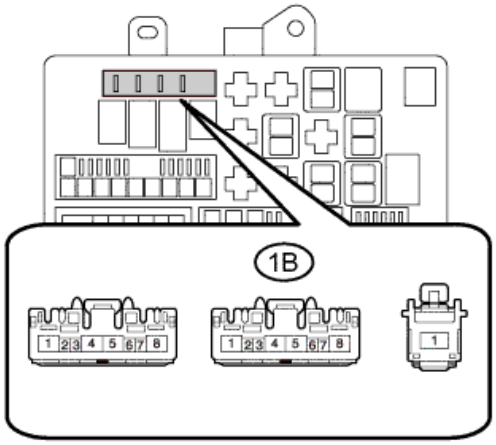
Front view of wire harness connector:
(to ECM)



Engine Room Relay Block:



Front view of wire harness connector:
(to Integration Relay)



*1: for LHD

*2: for RHD

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

for Preparation Click here

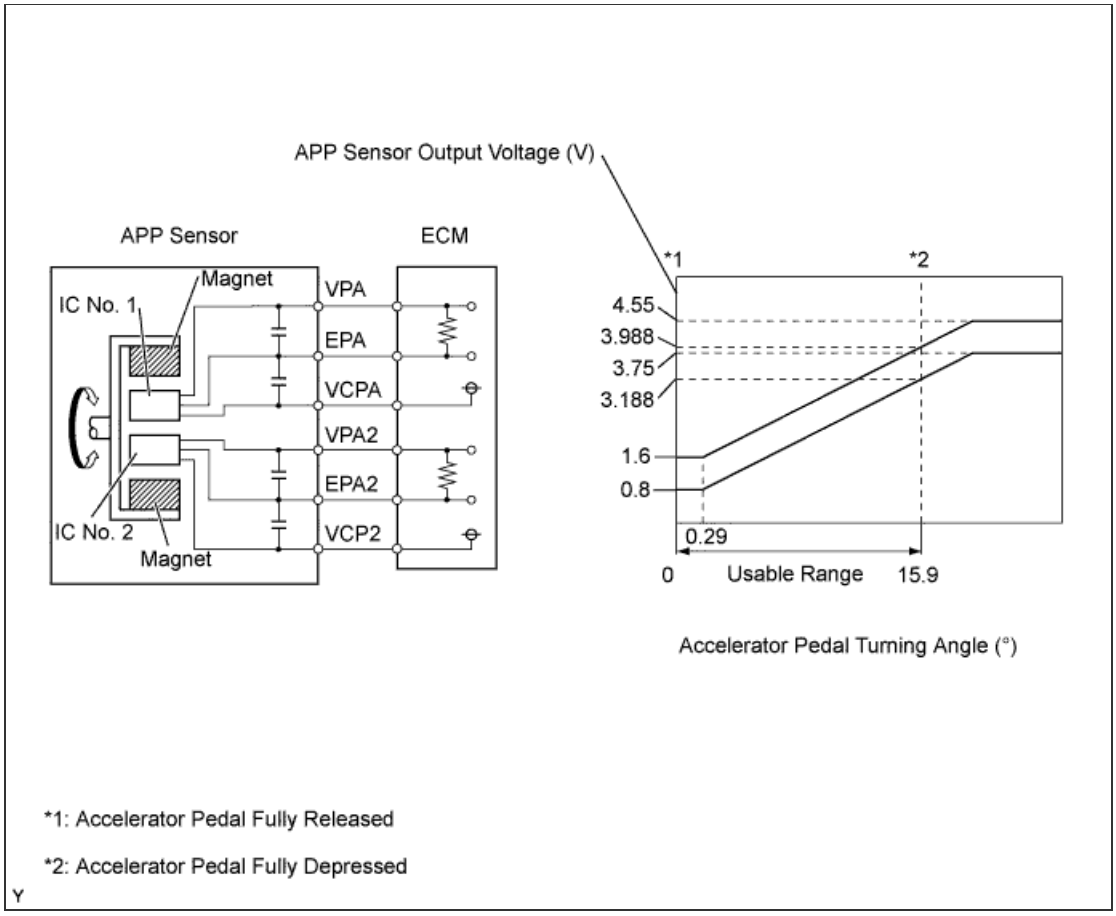
DESCRIPTION

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

The APP sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC Code	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
		• APP sensor

P2122	VPA is 0.4 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• Open in VCP1 circuit • Open or ground short in VPA circuit • ECM
P2123	VPA is 4.8 V or higher for 2.0 seconds or more (1 trip detection logic).	• APP sensor • Open in EPA circuit • ECM
P2125	VPA2 fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or higher. (b) VPA is between 0.4 V and 3.45 V.	• APP sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): (a) The difference between VPA and VPA2 is 0.02 V or less. (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less.	• Short between VPA and VPA2 circuits • APP sensor • ECM

HINT:

When any of these DTCs are output, check the APP sensor voltage by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

Trouble Area	Accelerator Position No. 1 When AP Released	Accelerator Position No. 2 When AP Released	Accelerator Position No. 1 When AP Depressed	Accelerator Position No. 2 When AP Depressed
VCP circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 4.7 V
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 4.7 V

HINT:

- **Accelerator pedal positions are expressed as voltages.**
- **AP stands for Accelerator Pedal.**

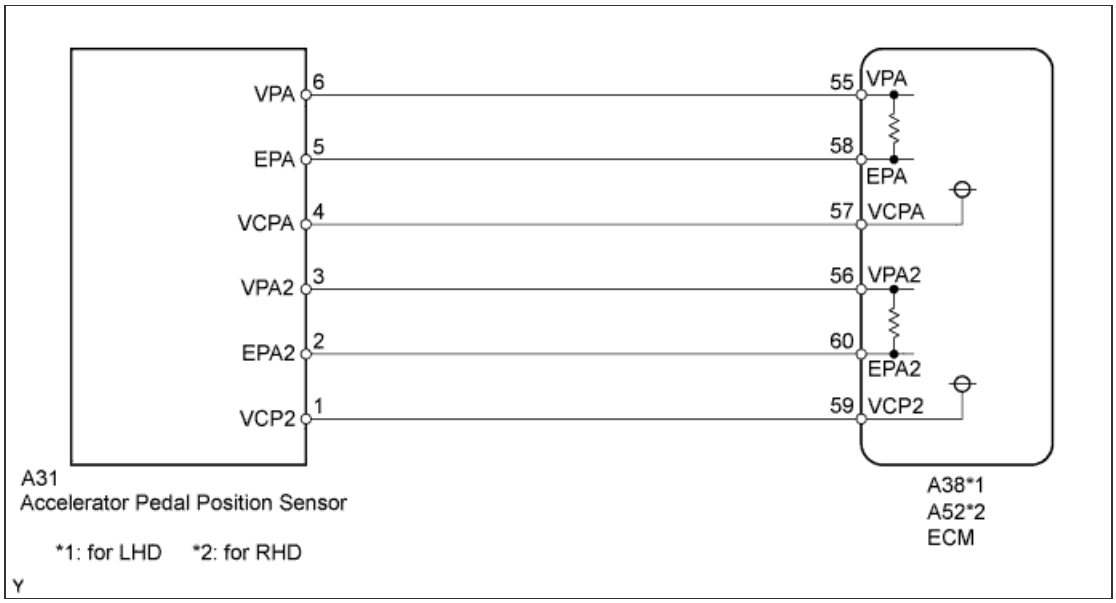
MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is less than the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and stores a DTC.
Example:
When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is stored.
If the malfunction is not repaired successfully, a DTC is stored 2 seconds after the engine is next started.

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 are stored, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue driving. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.
Fail-safe mode continues until a pass condition is detected, and the engine switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Accelerator Pedal Position (APP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

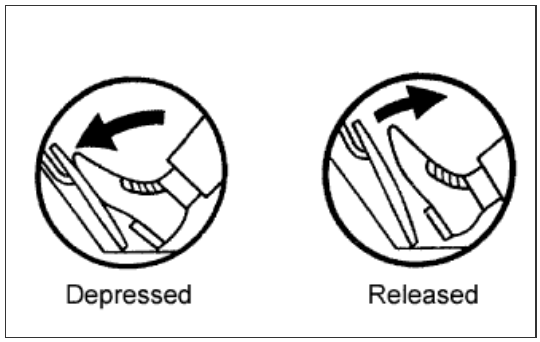
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

d. Read the value displayed on the tester.



Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released → Depressed → Released	0.5 to 4.5 V	1.2 to 4.7 V
	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V

Result

Result	Proceed to
NG	A
OK	B

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the APP sensor connector.

b. Disconnect the ECM connector.

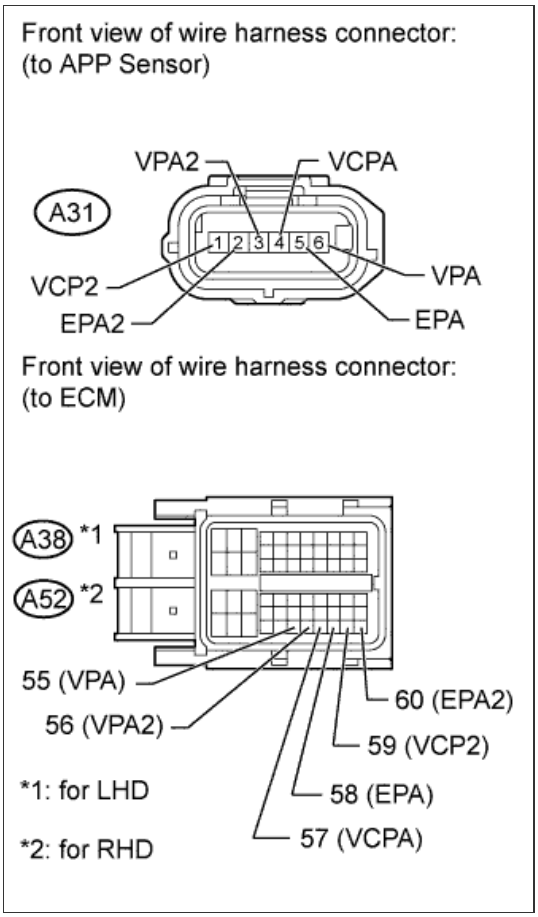
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A38-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-58 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A38-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A38-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A38-59 (VCP2)	Always	Below 1 Ω
A31-6 (VPA) or A38-55 (VPA) - body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-58 (EPA) - body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-57 (VCPA) - body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-56 (VPA2) - body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A38-60 (EPA2) - body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A38-59 (VCP2) - body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A52-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-58 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A52-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A52-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A52-59 (VCP2)	Always	Below 1 Ω
A31-6 (VPA) or A52-55 (VPA) - body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-58 (EPA) - body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-57 (VCPA) - body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-56 (VPA2) - body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-60 (EPA2) - body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A52-59 (VCP2) - body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK ECM (VCPA AND VCP2 VOLTAGE)

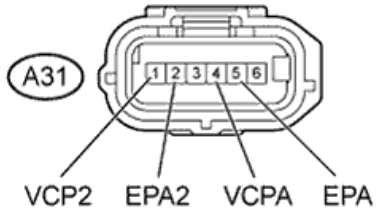
a. Disconnect the APP sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Engine switch on (IG)	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to APP Sensor)



NG → REPLACE ECM (Click here)

OK

4.REPLACE ACCELERATOR PEDAL SENSOR ASSEMBLY

a. Replace the accelerator pedal assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138 is output	A
No DTC is output	B

B → SYSTEM OK

A

REPLACE ECM (Click here)

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

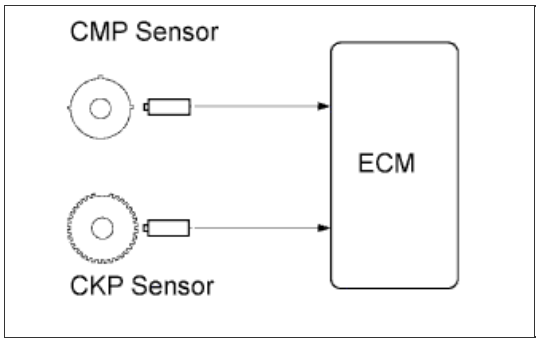
DTC P0306 Cylinder 6 Misfire Detected

DTC P0307 Cylinder 7 Misfire Detected

DTC P0308 Cylinder 8 Misfire Detected

for Preparation Click here

DESCRIPTION



When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause increases in exhaust emission levels. High concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent these increases in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the TWC reaches the point of thermal degradation, the ECM blinks the MIL. To monitor misfires, the ECM uses both the Camshaft Position (CMP) sensor and the Crankshaft Position (CKP) sensor. The CMP sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted as when the crankshaft rotation speed variations exceed predetermined thresholds.
If the misfire rate exceeds the threshold level, the ECM illuminates the MIL and stores a DTC.

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Fuel injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve clearance • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306 P0307 P0308	Misfiring of a specific cylinder occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

MONITOR DESCRIPTION

The ECM illuminates the MIL and stores a DTC when either one of the following conditions, which could cause emission deterioration, is detected (2 trip detection logic).

- Within the first 1000 crankshaft revolutions of the engine starting, an excessive misfiring rate (approximately 130 to 160 misfires per 1000 crankshaft revolutions) occurs once.
- An excessive misfiring rate (approximately 130 to 160 misfires per 1000 crankshaft revolutions) occurs a total of 4 times.

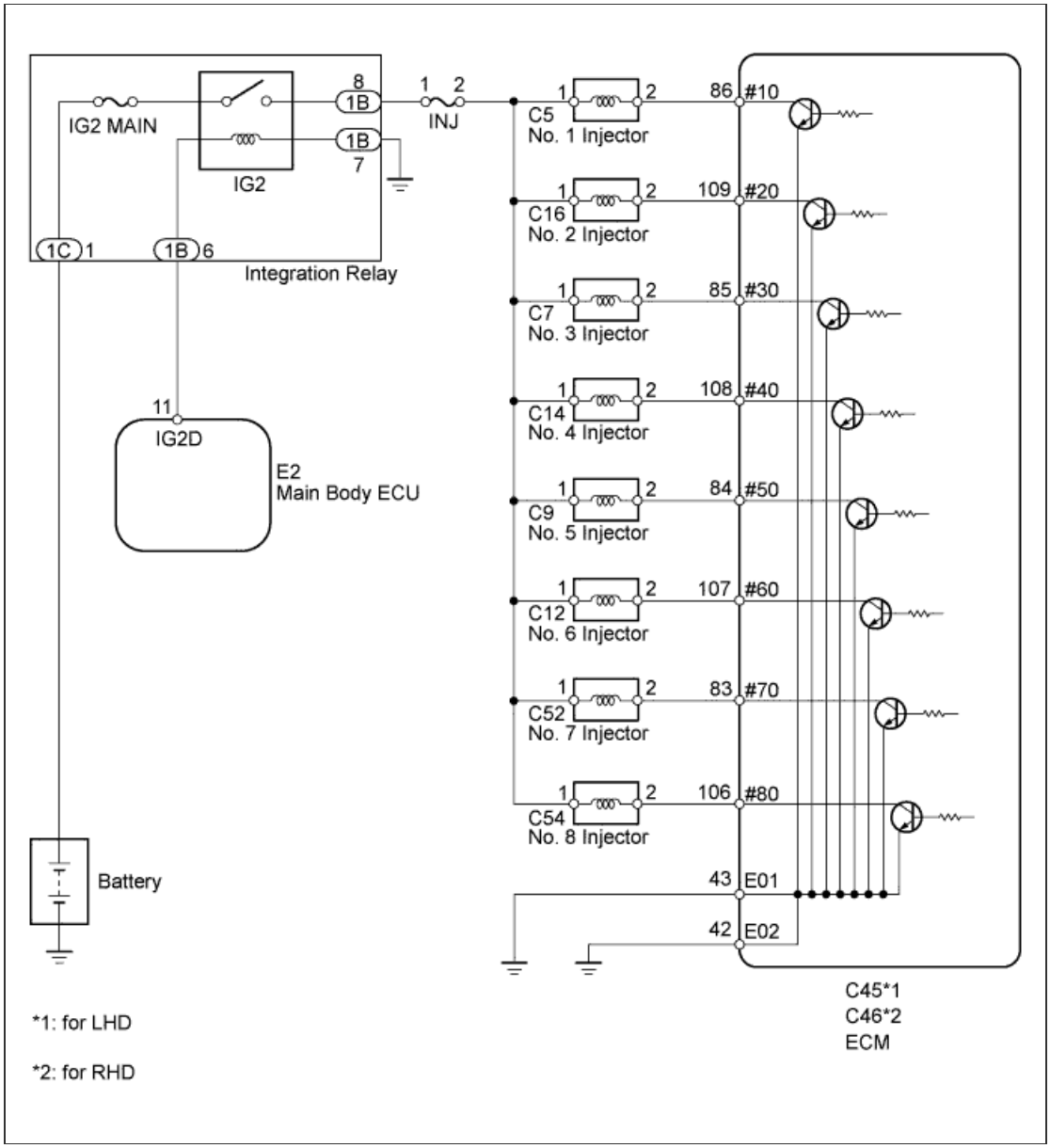
The ECM flashes the MIL and stores a DTC when either one of the following conditions, which could cause damage to the Three-Way Catalytic Converter (TWC), is detected (2 trip detection logic).

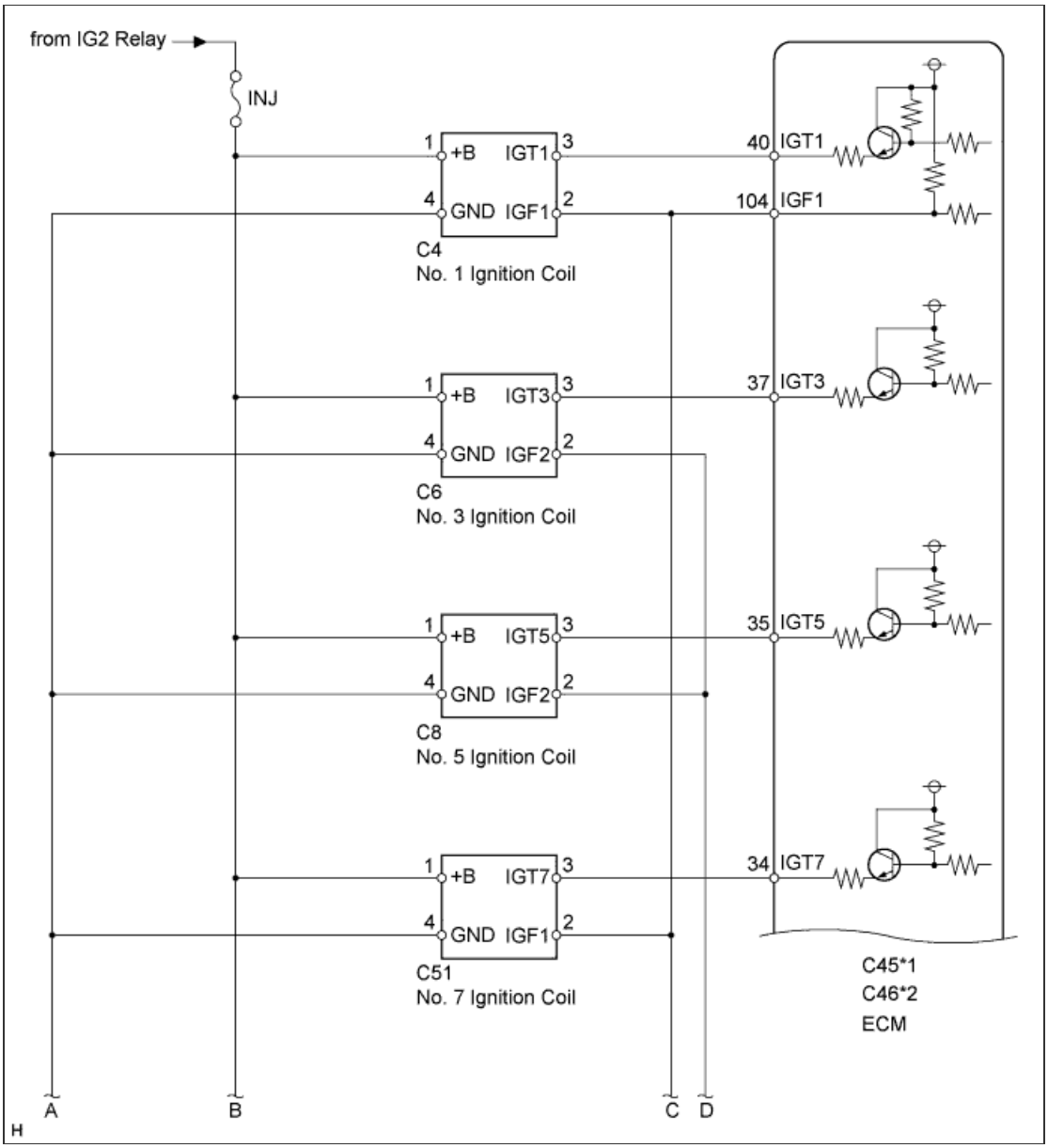
- At a high engine speed, a catalyst damage misfire, which is monitored every 200 crankshaft revolutions, occurs once.
- At a normal engine speed, a catalyst damage misfire, which is monitored every 200 crankshaft revolutions, occurs 3 times.

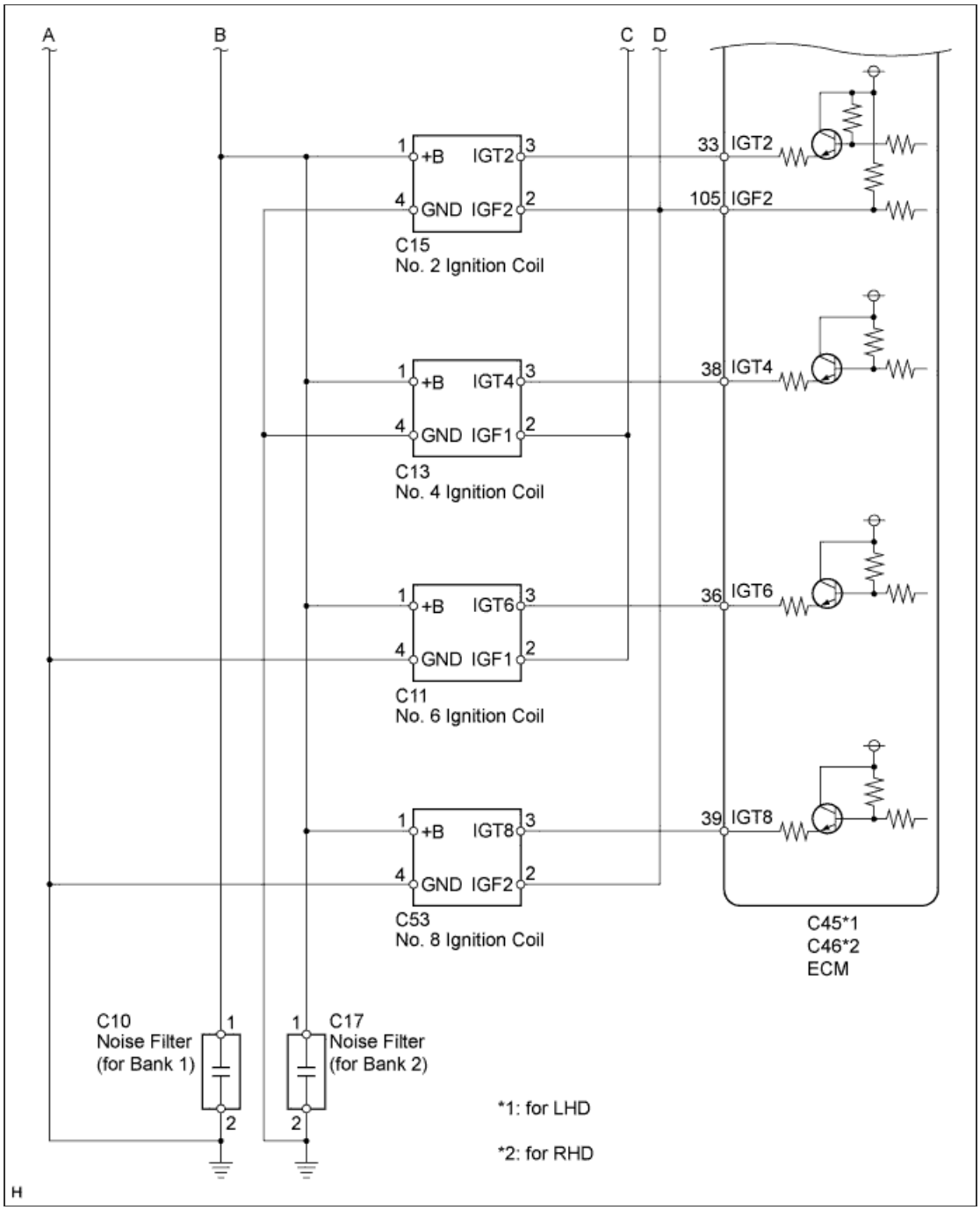
HINT:

If a catalyst damage misfire occurs, the ECM informs the driver by flashing the MIL.

WIRING DIAGRAM




from IG2 Relay
INJ
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
34
IGT7
C45*1
C46*2
ECM
A
B
C
D
H



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Turn the tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire counts of each cylinder (cylinder No. 1 to No. 8) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
7. Drive the vehicle several times with the conditions, such as engine speed and engine load, shown in Misfire RPM and Misfire Load in the Data List.

HINT:

In order to store misfire DTCs, it is necessary to operate the vehicle for the period of time shown in the table below, with the Misfire RPM and Misfire Load in the Data List.

Engine Speed	Duration
Idling	3.5 minutes or more
1000	3 minutes or more
2000	1.5 minutes or more
3000	1 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

   HINT:

   Do not turn the engine switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data will be cleared.

9. Record the DTC(s), freeze frame data and misfire counts.
10. Turn the engine switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the freeze frame data have been duplicated, one of the following factors is considered to be a possible cause of the problem:**
  1. **The fuel level is low.**
  2. **Improper fuel is used.**
  3. **The spark plugs are dirty.**
- **After finishing repairs, check that no misfires occur in each cylinder (cylinder No. 1, No. 2, No. 3, No. 4, No. 5, No. 6, No. 7 and No. 8).**
- **Be sure to confirm that no misfiring cylinder DTCs are output again by conducting the confirmation driving pattern, after the repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speed. If misfires only occur during high engine speed driving, only DTC P0300 is stored.**
  In the event of DTC P0300 being output, perform the following operations:
  1. **Clear the DTC (Click here).**
  2. **Start the engine and conduct the confirmation driving pattern.**
  3. **Read the misfiring rates of each cylinder or DTC(s) using the tester.**
  4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
  5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not output.**
- **When either Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air-fuel ratio may be rich (-20% or less) or lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is below 75°C (167°F), the misfires occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel can cause body vibration, which may cause misfire DTC(s) to be stored.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 is output	A
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 and other DTCs are output	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

3.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is connected correctly and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE (Click here)

OK

4.READ VALUE USING INTELLIGENT TESTER (MISFIRE COUNT)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5, #6, #7 and #8.

f. Allow the engine to idle.

g. Read each value for Cylinder #1 Misfire Count to #8 displayed on the tester. If no misfire counts occur in any cylinders, perform the following procedures:

i. Move the shift lever to D.

ii. Check the Cylinder #1 Misfire Count to #8.

iii. If misfire counts are still not displayed, perform procedure A and and then check the misfire counts again.

h. Drive the vehicle with the Misfire RPM and Misfire Load noted in the Read value using intelligent tester (Misfire RPM and Misfire Load) procedures above (procedure A).

i. Read the Cylinder #1 Misfire Count to #8 or DTCs displayed on the tester (procedure).

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have e ual misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data record of the Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → Go to step 17

A

5.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

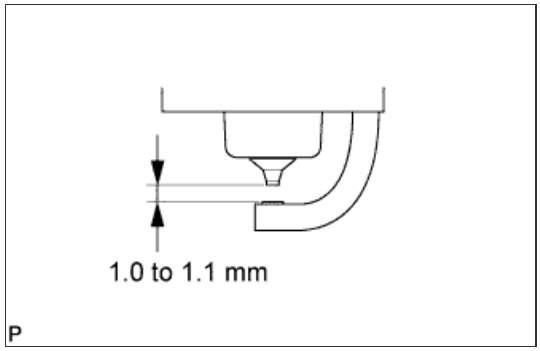
b. Measure the spark plug electrode gap.

Standard gap:
1.0 to 1.1 mm (0.039 to 0.043 in.)

c. Check the electrode for carbon deposits.

Recommended Spark Plug:

Manufacturer	Product
DENSO	SK20R11
NGK	IFR6A11



NOTICE:

If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.

NG → REPLACE SPARK PLUG (Click here)

OK

6.CHECK FOR SPARKS AND IGNITION

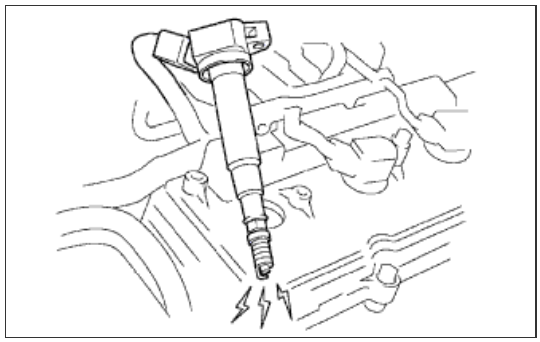
a. Disconnect the fuel injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.



b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → REPAIR ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK HARNESS AND CONNECTOR (ECM - FUEL INJECTOR)

a. Disconnect the fuel injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	C16-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 3	C7-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	C14-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	C9-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	C12-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	C52-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	C54-1 - Ground	Engine switch on (IG)	11 to 14 V

d. Turn the engine switch off.

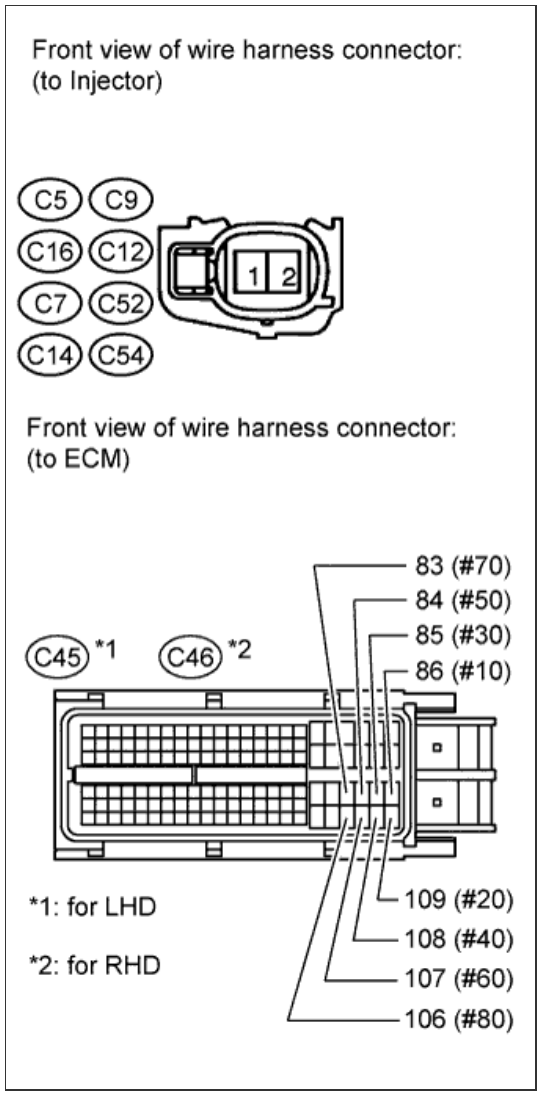
e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C45-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C45-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C45-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C45-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C45-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C45-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C45-106 (#80)	Always	Below 1 Ω

Standard Resistance (for RHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher



	C5-2 - C46-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C46-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C46-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C46-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C46-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C46-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C46-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C46-106 (#80)	Always	Below 1 Ω

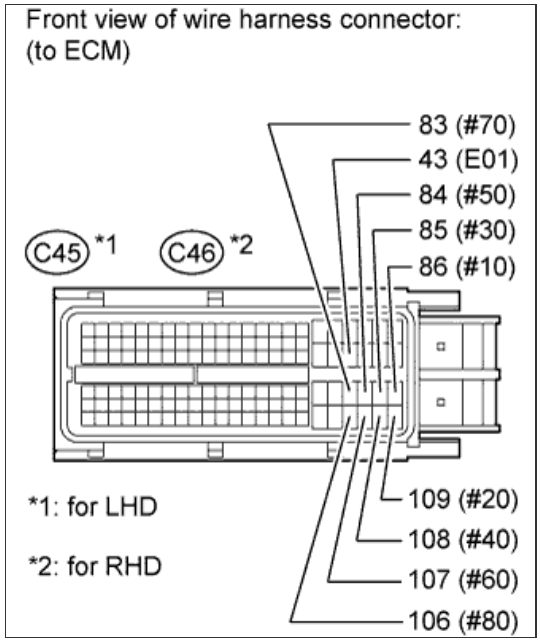
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50, #60, #70 AND/OR #80 VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage (for LHD):

Tester Connection	Switch Condition	Specified Condition
C45-86 (#10) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-109 (#20) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-85 (#30) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-108 (#40) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-84 (#50) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-107 (#60) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-83 (#70) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-106 (#80) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V

Standard Voltage (for RHD):

Tester Connection	Switch Condition	Specified Condition
C46-86 (#10) -	Engine switch on	

C46-43 (E01)	(IG)	11 to 14 V
C46-109 (#20) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-85 (#30) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-108 (#40) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-84 (#50) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-107 (#60) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-83 (#70) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-106 (#80) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK

11.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

12.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (**Click here**)

OK

13.CHECK VALVE TIMING

a. Remove the drive belt (Click here).

b. Remove the timing belt cover LH and RH (Click here).

c. Turn the crankshaft to align the matchmarks of the crankshaft.

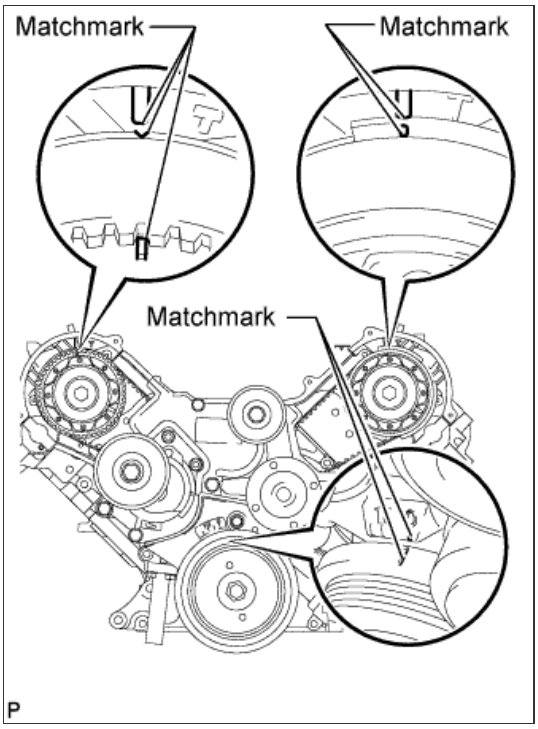
d. Align the notch of the crankshaft pulley with the 0 position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360 . Confirm again if the matchmarks are facing each other.

OK:

The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NG → ADJUST VALVE TIMING (Click here)

OK ↓

14.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK AND REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER

OK ↓

15.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:

With cold engine: Same as ambient air temperature.

With warm engine: Between 80°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK ↓

16.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK ↓

REPLACE ECM (Click here)

17.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

18.CHECK VALVE TIMING

a. Remove the drive belt (Click here).

b. Remove the timing belt cover LH and RH (Click here).

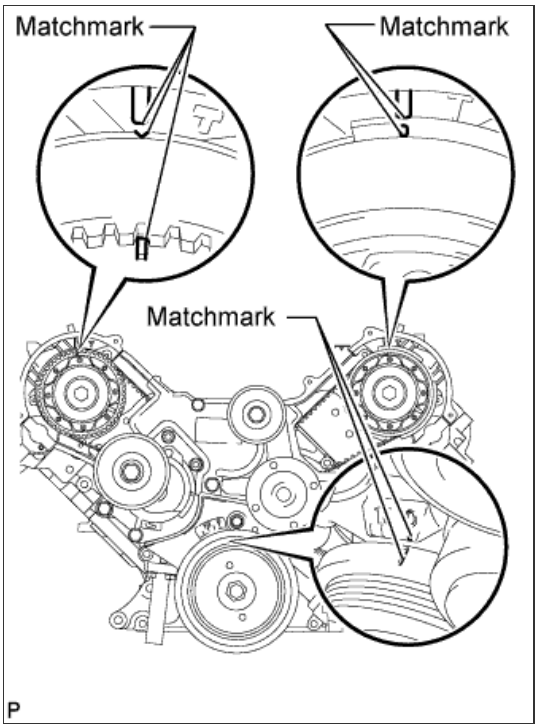
c. Turn the crankshaft to align the matchmarks of the crankshaft.

d. Align the notch of the crankshaft pulley with the 0 position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360 . Confirm again if the matchmarks are facing each other.

OK:
The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NG → ADJUST VALVE TIMING (Click here)

OK

19.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK AND REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER

OK

20.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: Between 80°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

21.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

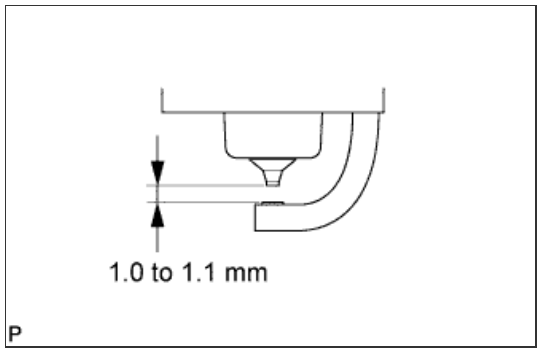
OK

22.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

b. Measure the spark plug electrode gap.

Standard gap:
1.0 to 1.1 mm (0.039 to 0.043 in.)



c. Check the electrode for carbon deposits.

Recommended Spark Plug:

Manufacturer	Product
DENSO	SK20R11
NGK	IFR6A11

NOTICE:

If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.

NG → REPLACE SPARK PLUG (Click here)

OK

23.CHECK FOR SPARKS AND IGNITION

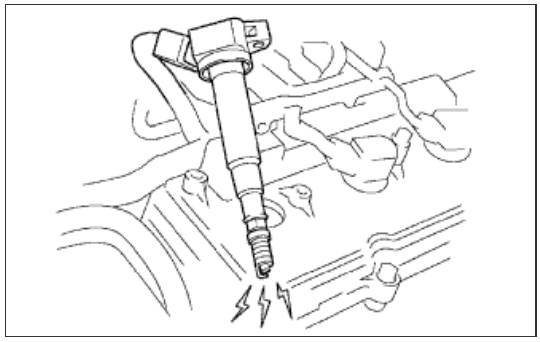
a. Disconnect the fuel injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.



b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

24.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → REPAIR ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

25.CHECK HARNESS AND CONNECTOR (ECM - FUEL INJECTOR)

a. Disconnect the fuel injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

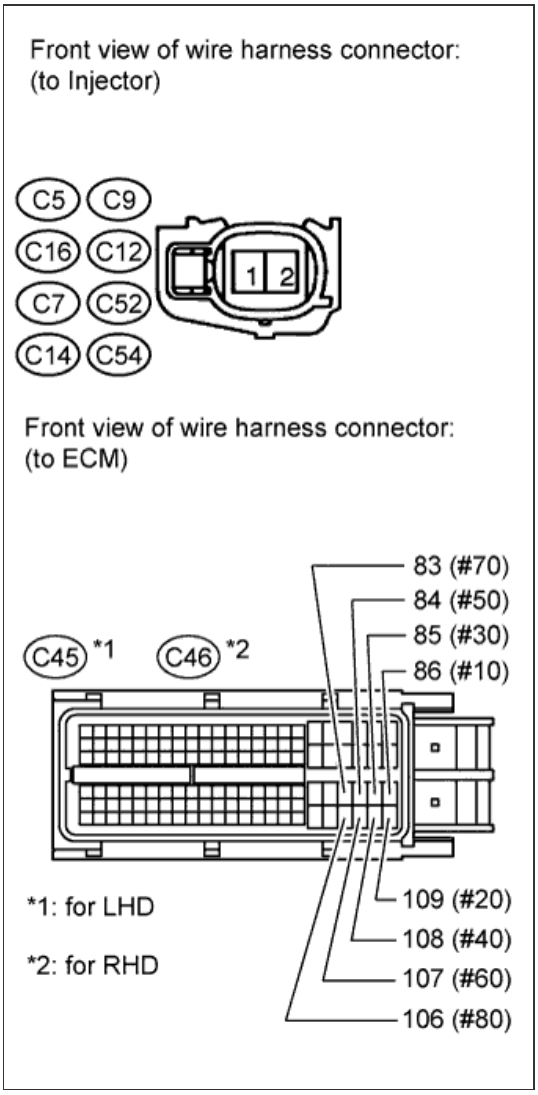
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	C16-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 3	C7-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	C14-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	C9-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	C12-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	C52-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	C54-1 - Ground	Engine switch on (IG)	11 to 14 V

d. Turn the engine switch off.

e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C45-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C45-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C45-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C45-84 (#50)	Always	Below 1 Ω
	C12-2 - Ground	Always	10 kΩ or higher



No. 6	C12-2 - C45-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C45-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C45-106 (#80)	Always	Below 1 Ω

Standard Resistance (for RHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C46-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C46-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C46-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C46-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C46-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C46-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C46-106 (#80)	Always	Below 1 Ω

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50, #60, #70 AND/OR #80 VOLTAGE)

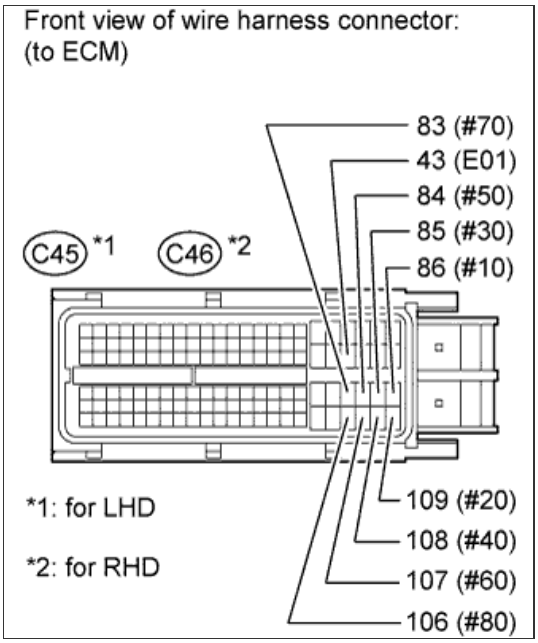
a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage (for LHD):

Tester Connection	Switch Condition	Specified Condition
C45-86 (#10) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-109 (#20) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-85 (#30) -	Engine switch on	11 to 14 V

C45-43 (E01)	(IG)	
C45-108 (#40) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-84 (#50) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-107 (#60) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-83 (#70) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-106 (#80) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V



Standard Voltage (for RHD):

Tester Connection	Switch Condition	Specified Condition
C46-86 (#10) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-109 (#20) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-85 (#30) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-108 (#40) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-84 (#50) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-107 (#60) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-83 (#70) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-106 (#80) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

27.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK

28.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

REPLACE ECM (**Click here**)

29.CHANGE TO NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the installed spark plug with a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → Go to step 30

OK

REPLACE SPARK PLUG (Click here)

30.CHANGE TO NORMAL IGNITION COIL AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the ignition coil with an ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK

REPLACE IGNITION COIL (Click here)

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

for Preparation Click here

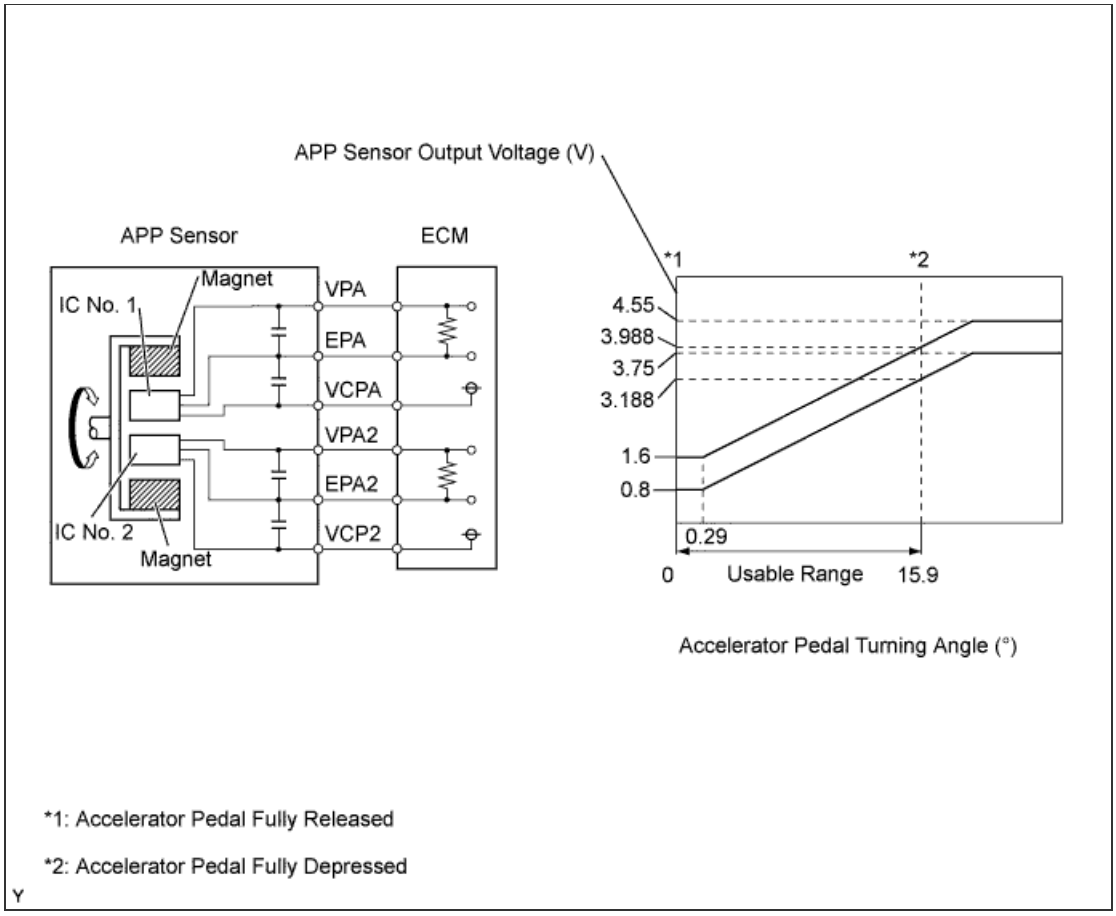
DESCRIPTION

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

The APP sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC Code	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
		• APP sensor

P2122	VPA is 0.4 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• Open in VCP1 circuit • Open or ground short in VPA circuit • ECM
P2123	VPA is 4.8 V or higher for 2.0 seconds or more (1 trip detection logic).	• APP sensor • Open in EPA circuit • ECM
P2125	VPA2 fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or higher. (b) VPA is between 0.4 V and 3.45 V.	• APP sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): (a) The difference between VPA and VPA2 is 0.02 V or less. (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less.	• Short between VPA and VPA2 circuits • APP sensor • ECM

HINT:

When any of these DTCs are output, check the APP sensor voltage by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

Trouble Area	Accelerator Position No. 1 When AP Released	Accelerator Position No. 2 When AP Released	Accelerator Position No. 1 When AP Depressed	Accelerator Position No. 2 When AP Depressed
VCP circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 4.7 V
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 4.7 V

HINT:

- **Accelerator pedal positions are expressed as voltages.**
- **AP stands for Accelerator Pedal.**

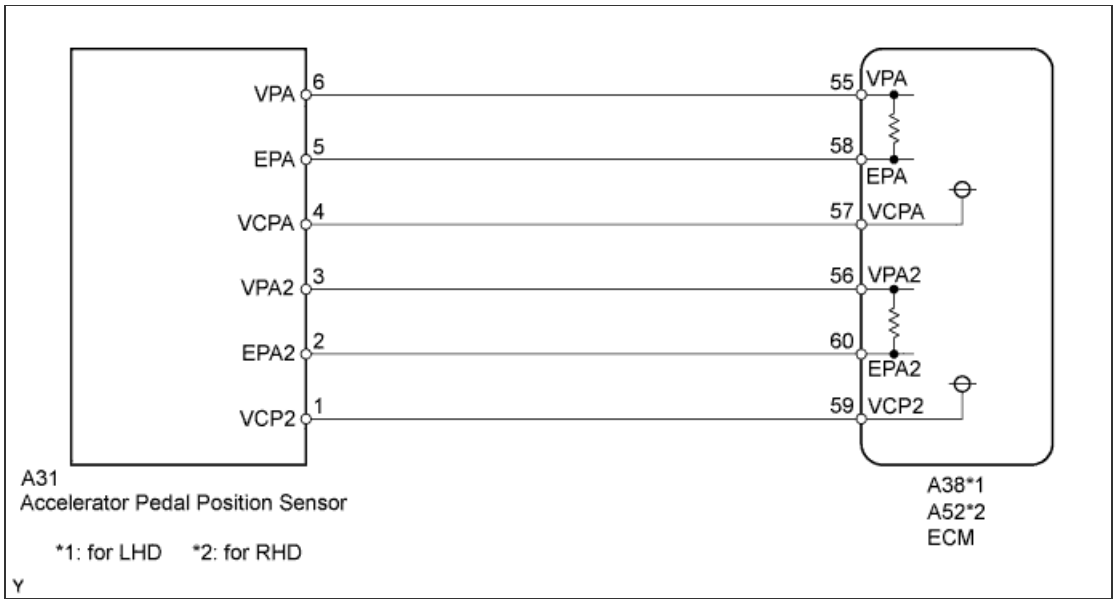
MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is less than the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and stores a DTC.
Example:
When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is stored.
If the malfunction is not repaired successfully, a DTC is stored 2 seconds after the engine is next started.

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 are stored, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue driving. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.
Fail-safe mode continues until a pass condition is detected, and the engine switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Accelerator Pedal Position (APP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

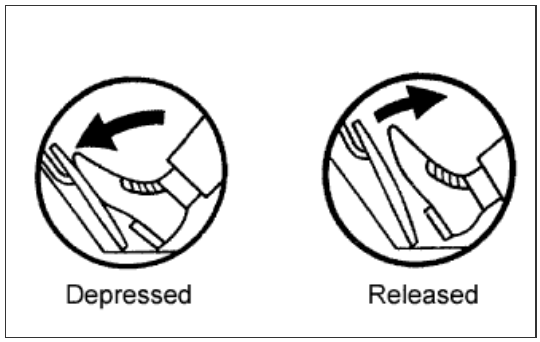
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

d. Read the value displayed on the tester.



Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released → Depressed → Released	0.5 to 4.5 V	1.2 to 4.7 V
	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V

Result

Result	Proceed to
NG	A
OK	B

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the APP sensor connector.

b. Disconnect the ECM connector.

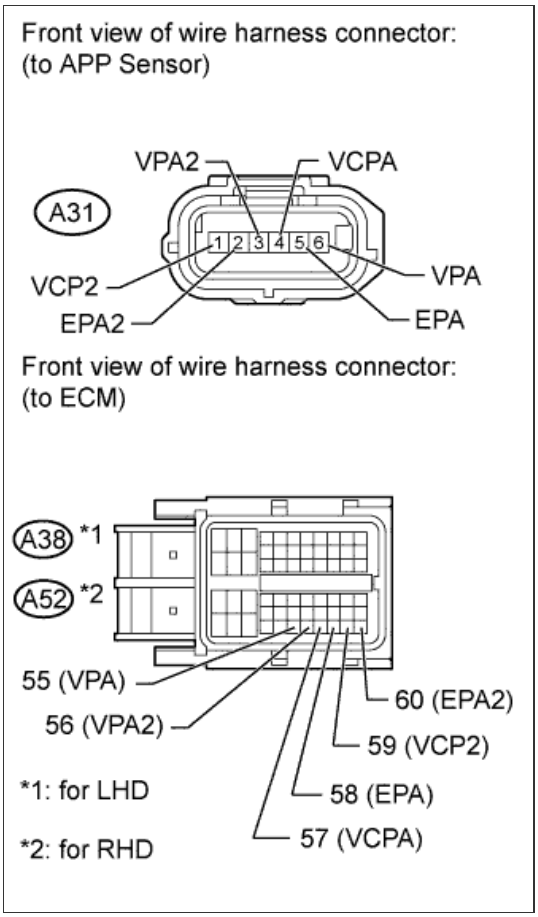
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A38-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-58 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A38-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A38-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A38-59 (VCP2)	Always	Below 1 Ω
A31-6 (VPA) or A38-55 (VPA) - body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-58 (EPA) - body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-57 (VCPA) - body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-56 (VPA2) - body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A38-60 (EPA2) - body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A38-59 (VCP2) - body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A52-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-58 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A52-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A52-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A52-59 (VCP2)	Always	Below 1 Ω
A31-6 (VPA) or A52-55 (VPA) - body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-58 (EPA) - body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-57 (VCPA) - body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-56 (VPA2) - body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-60 (EPA2) - body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A52-59 (VCP2) - body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK ECM (VCPA AND VCP2 VOLTAGE)

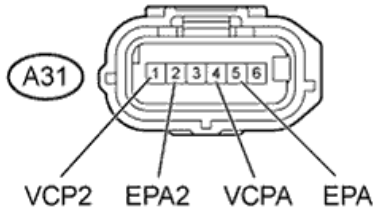
a. Disconnect the APP sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Engine switch on (IG)	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to APP Sensor)



NG → REPLACE ECM (Click here)

OK

4.REPLACE ACCELERATOR PEDAL SENSOR ASSEMBLY

a. Replace the accelerator pedal assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138 is output	A
No DTC is output	B

B → SYSTEM OK

A

REPLACE ECM (Click here)

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

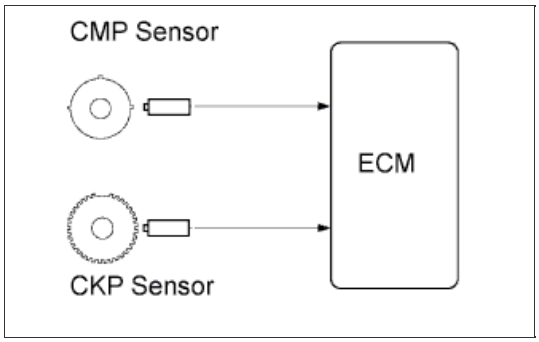
DTC P0306 Cylinder 6 Misfire Detected

DTC P0307 Cylinder 7 Misfire Detected

DTC P0308 Cylinder 8 Misfire Detected

for Preparation Click here

DESCRIPTION



When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause increases in exhaust emission levels. High concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent these increases in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the TWC reaches the point of thermal degradation, the ECM blinks the MIL. To monitor misfires, the ECM uses both the Camshaft Position (CMP) sensor and the Crankshaft Position (CKP) sensor. The CMP sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted as when the crankshaft rotation speed variations exceed predetermined thresholds.
If the misfire rate exceeds the threshold level, the ECM illuminates the MIL and stores a DTC.

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Fuel injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve clearance • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306 P0307 P0308	Misfiring of a specific cylinder occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

MONITOR DESCRIPTION

The ECM illuminates the MIL and stores a DTC when either one of the following conditions, which could cause emission deterioration, is detected (2 trip detection logic).

- Within the first 1000 crankshaft revolutions of the engine starting, an excessive misfiring rate (approximately 130 to 160 misfires per 1000 crankshaft revolutions) occurs once.
- An excessive misfiring rate (approximately 130 to 160 misfires per 1000 crankshaft revolutions) occurs a total of 4 times.

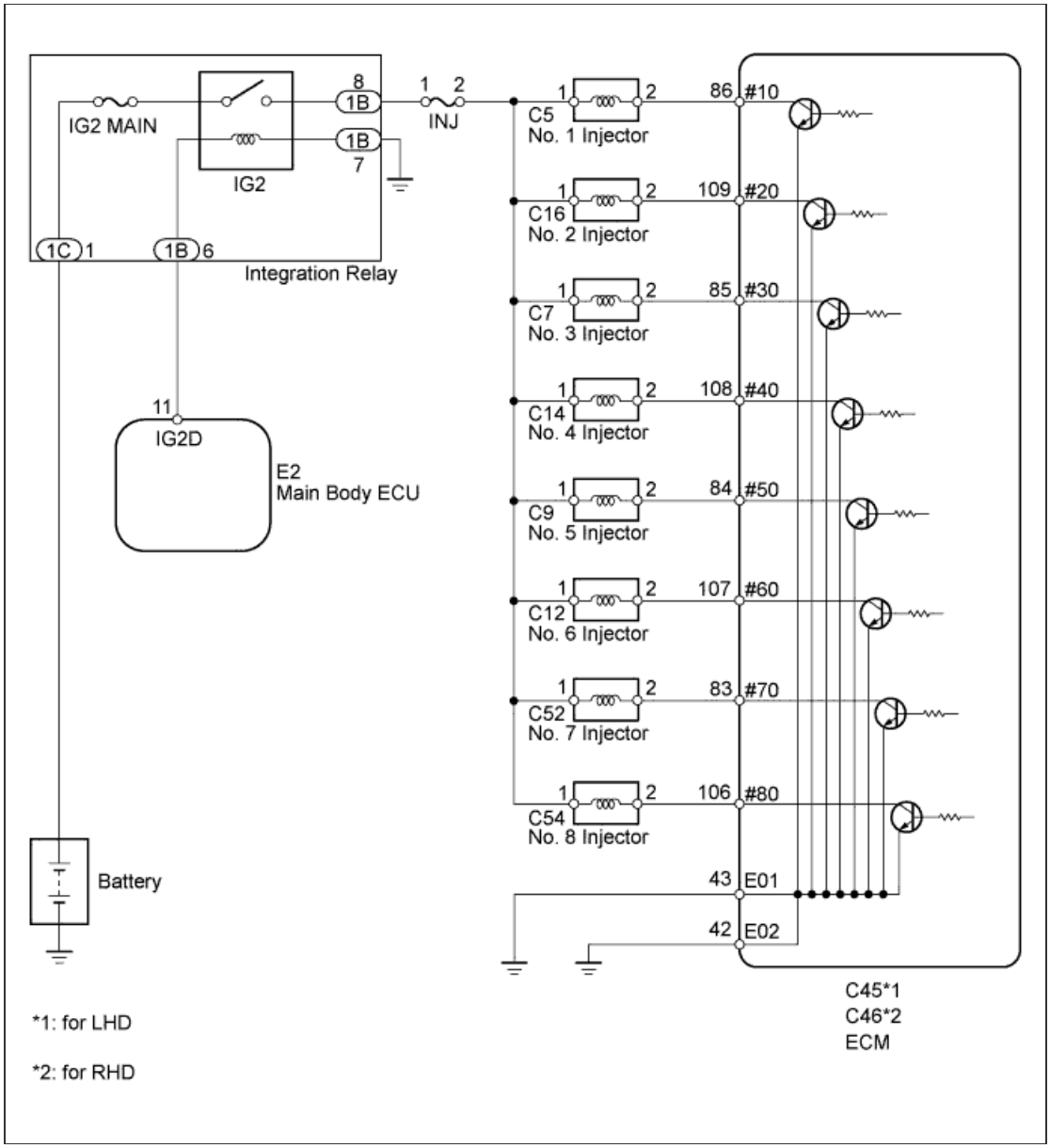
The ECM flashes the MIL and stores a DTC when either one of the following conditions, which could cause damage to the Three-Way Catalytic Converter (TWC), is detected (2 trip detection logic).

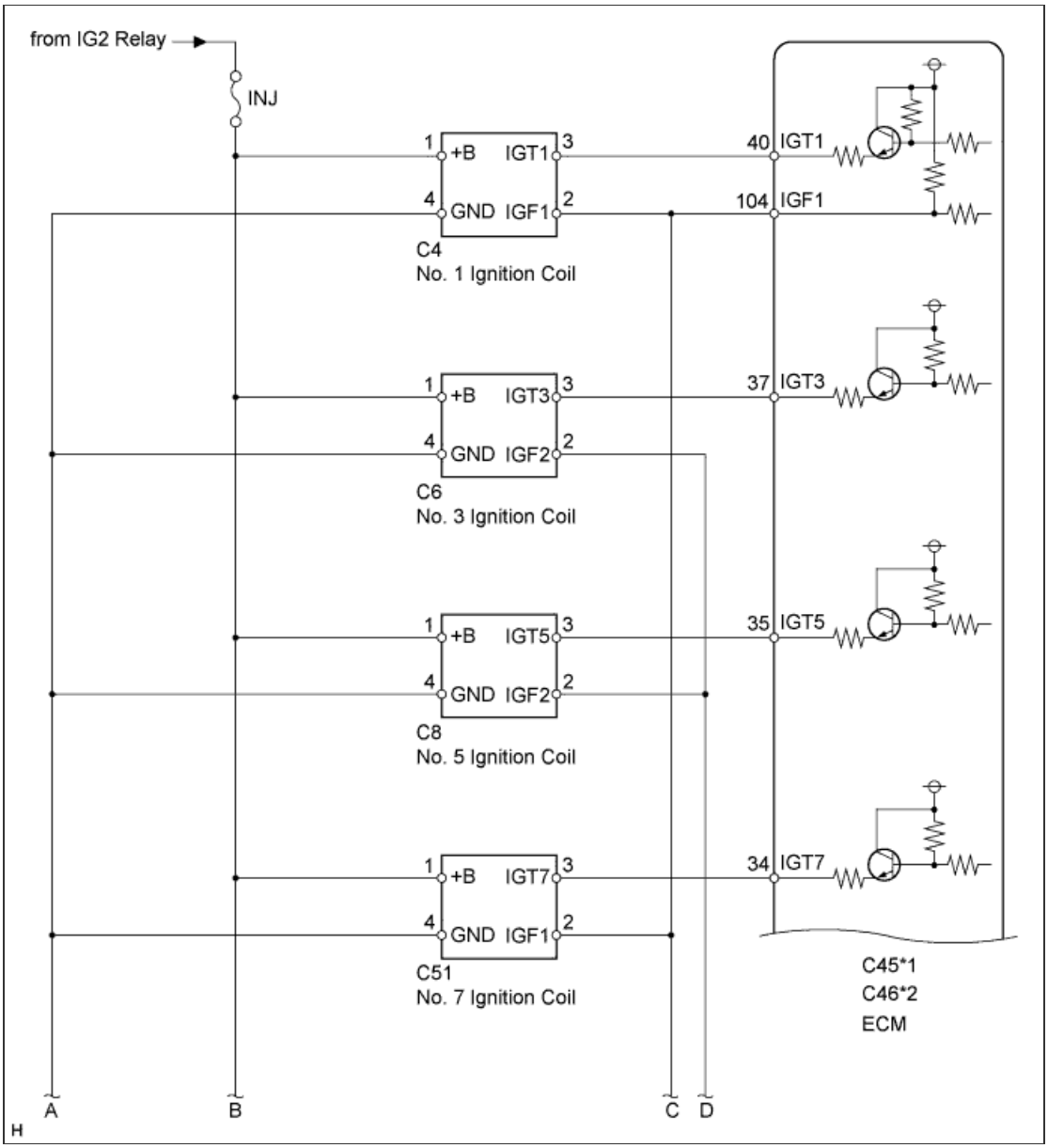
- At a high engine speed, a catalyst damage misfire, which is monitored every 200 crankshaft revolutions, occurs once.
- At a normal engine speed, a catalyst damage misfire, which is monitored every 200 crankshaft revolutions, occurs 3 times.

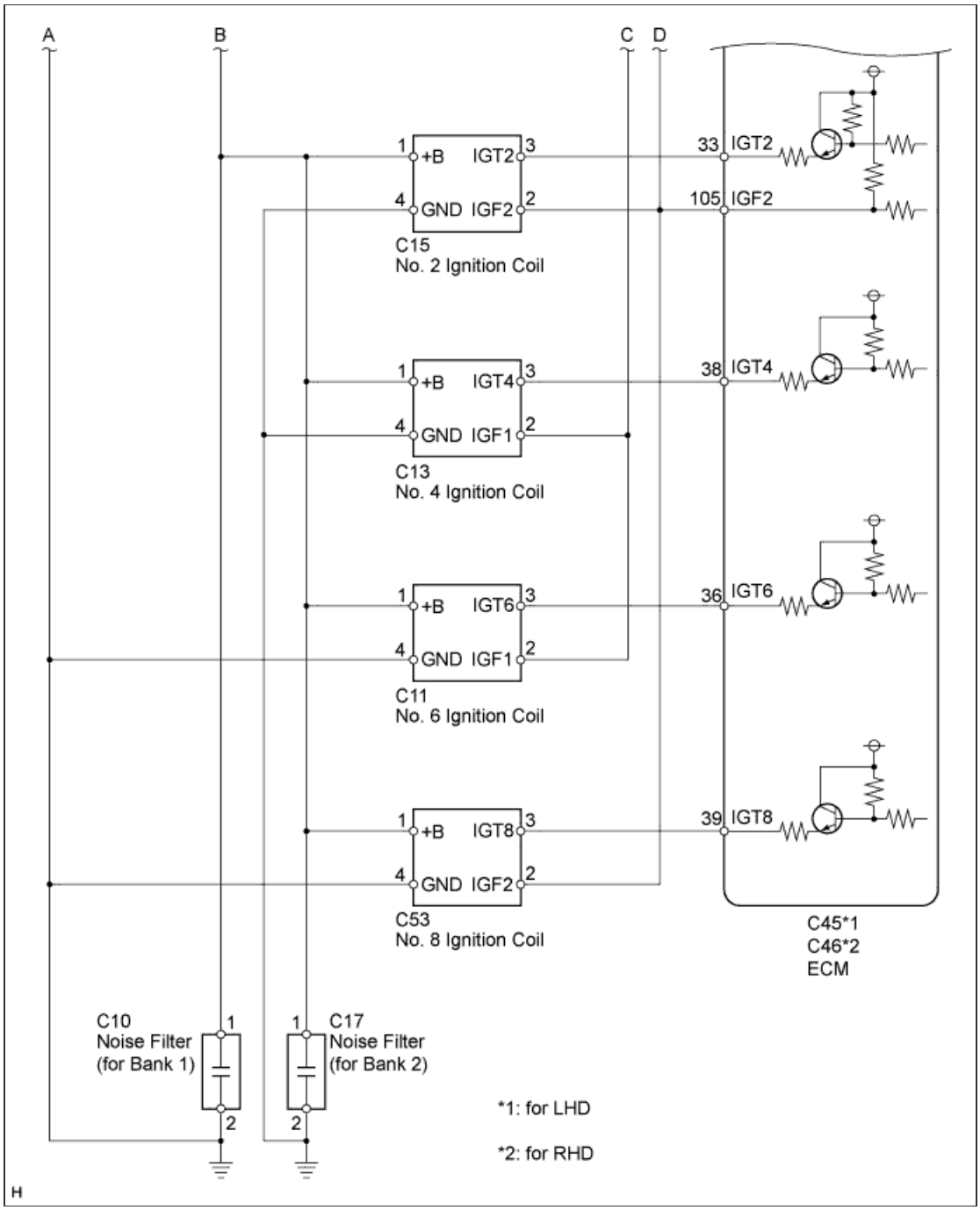
HINT:

If a catalyst damage misfire occurs, the ECM informs the driver by flashing the MIL.

WIRING DIAGRAM




from IG2 Relay
INJ
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
34
IGT7
C45*1
C46*2
ECM
A
B
C
D
H



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Turn the tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire counts of each cylinder (cylinder No. 1 to No. 8) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
7. Drive the vehicle several times with the conditions, such as engine speed and engine load, shown in Misfire RPM and Misfire Load in the Data List.

HINT:

In order to store misfire DTCs, it is necessary to operate the vehicle for the period of time shown in the table below, with the Misfire RPM and Misfire Load in the Data List.

Engine Speed	Duration
Idling	3.5 minutes or more
1000	3 minutes or more
2000	1.5 minutes or more
3000	1 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

   HINT:

   Do not turn the engine switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data will be cleared.

9. Record the DTC(s), freeze frame data and misfire counts.
10. Turn the engine switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the freeze frame data have been duplicated, one of the following factors is considered to be a possible cause of the problem:**
  1. **The fuel level is low.**
  2. **Improper fuel is used.**
  3. **The spark plugs are dirty.**
- **After finishing repairs, check that no misfires occur in each cylinder (cylinder No. 1, No. 2, No. 3, No. 4, No. 5, No. 6, No. 7 and No. 8).**
- **Be sure to confirm that no misfiring cylinder DTCs are output again by conducting the confirmation driving pattern, after the repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speed. If misfires only occur during high engine speed driving, only DTC P0300 is stored.**
  In the event of DTC P0300 being output, perform the following operations:
  1. **Clear the DTC (Click here).**
  2. **Start the engine and conduct the confirmation driving pattern.**
  3. **Read the misfiring rates of each cylinder or DTC(s) using the tester.**
  4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
  5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not output.**
- **When either Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air-fuel ratio may be rich (-20% or less) or lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is below 75°C (167°F), the misfires occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel can cause body vibration, which may cause misfire DTC(s) to be stored.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 is output	A
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 and other DTCs are output	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

3.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is connected correctly and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE (Click here)

OK

4.READ VALUE USING INTELLIGENT TESTER (MISFIRE COUNT)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5, #6, #7 and #8.

f. Allow the engine to idle.

g. Read each value for Cylinder #1 Misfire Count to #8 displayed on the tester. If no misfire counts occur in any cylinders, perform the following procedures:

i. Move the shift lever to D.

ii. Check the Cylinder #1 Misfire Count to #8.

iii. If misfire counts are still not displayed, perform procedure A and and then check the misfire counts again.

h. Drive the vehicle with the Misfire RPM and Misfire Load noted in the Read value using intelligent tester (Misfire RPM and Misfire Load) procedures above (procedure A).

i. Read the Cylinder #1 Misfire Count to #8 or DTCs displayed on the tester (procedure).

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have e ual misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data record of the Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → Go to step 17

A

5.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

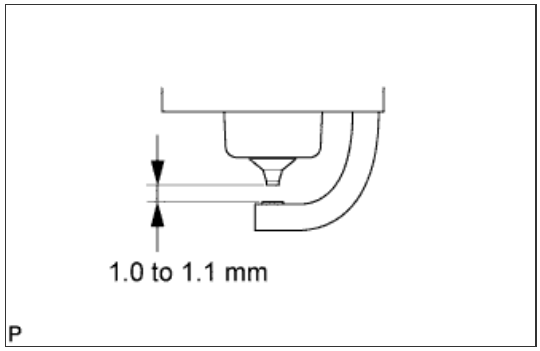
b. Measure the spark plug electrode gap.

Standard gap:
1.0 to 1.1 mm (0.039 to 0.043 in.)

c. Check the electrode for carbon deposits.

Recommended Spark Plug:

Manufacturer	Product
DENSO	SK20R11
NGK	IFR6A11



NOTICE:

If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.

NG → REPLACE SPARK PLUG (Click here)

OK

6.CHECK FOR SPARKS AND IGNITION

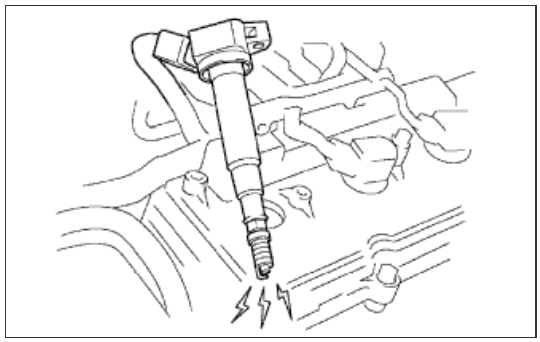
a. Disconnect the fuel injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.



b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → REPAIR ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK HARNESS AND CONNECTOR (ECM - FUEL INJECTOR)

a. Disconnect the fuel injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	C16-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 3	C7-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	C14-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	C9-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	C12-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	C52-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	C54-1 - Ground	Engine switch on (IG)	11 to 14 V

d. Turn the engine switch off.

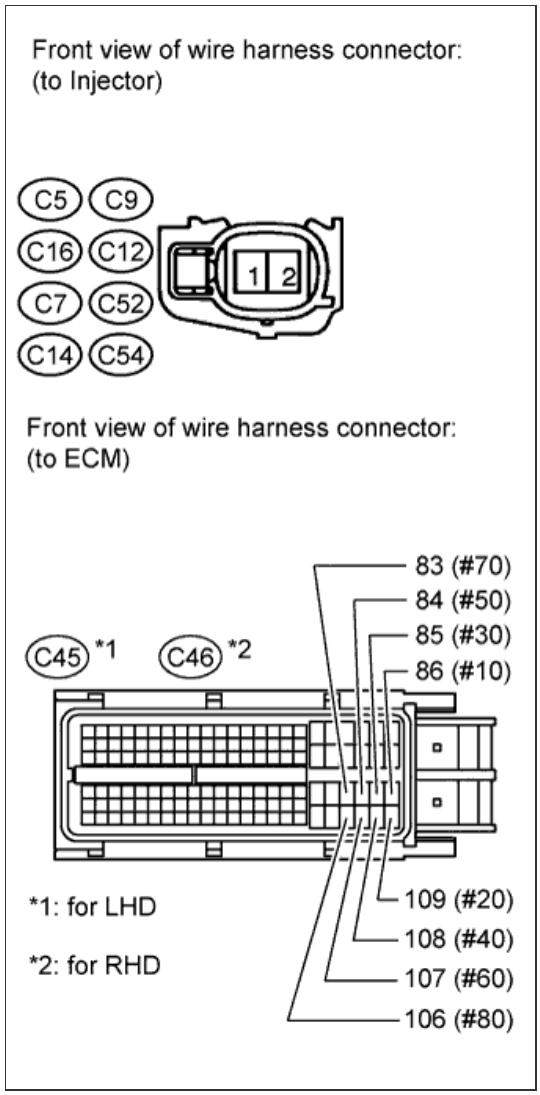
e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C45-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C45-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C45-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C45-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C45-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C45-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C45-106 (#80)	Always	Below 1 Ω

Standard Resistance (for RHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher



	C5-2 - C46-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C46-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C46-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C46-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C46-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C46-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C46-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C46-106 (#80)	Always	Below 1 Ω

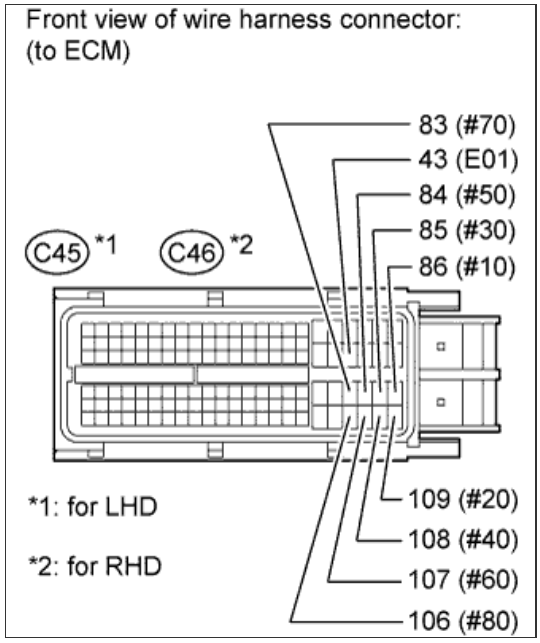
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50, #60, #70 AND/OR #80 VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage (for LHD):

Tester Connection	Switch Condition	Specified Condition
C45-86 (#10) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-109 (#20) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-85 (#30) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-108 (#40) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-84 (#50) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-107 (#60) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-83 (#70) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-106 (#80) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V

Standard Voltage (for RHD):

Tester Connection	Switch Condition	Specified Condition
C46-86 (#10) -	Engine switch on	

C46-43 (E01)	(IG)	11 to 14 V
C46-109 (#20) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-85 (#30) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-108 (#40) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-84 (#50) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-107 (#60) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-83 (#70) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-106 (#80) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK

11.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

12.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (**Click here**)

OK

13.CHECK VALVE TIMING

a. Remove the drive belt (Click here).

b. Remove the timing belt cover LH and RH (Click here).

c. Turn the crankshaft to align the matchmarks of the crankshaft.

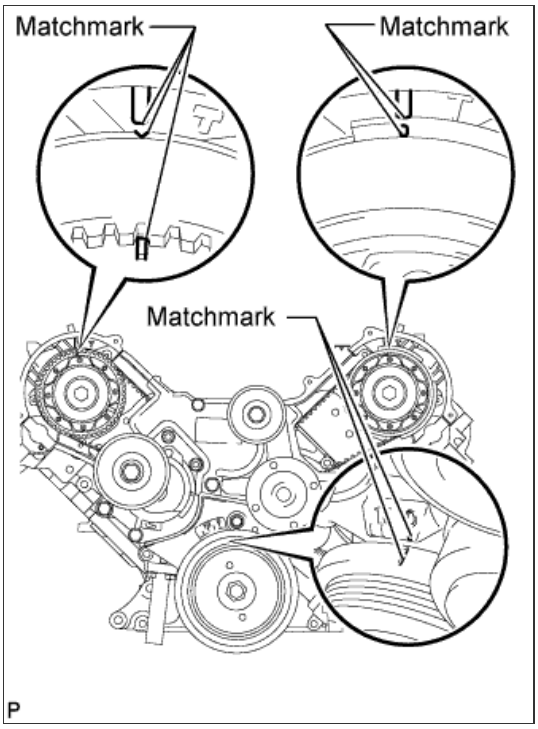
d. Align the notch of the crankshaft pulley with the 0 position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360 . Confirm again if the matchmarks are facing each other.

OK:

The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NG → ADJUST VALVE TIMING (Click here)

OK ↓

14.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK AND REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER

OK ↓

15.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:

With cold engine: Same as ambient air temperature.

With warm engine: Between 80°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK ↓

16.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK ↓

REPLACE ECM (Click here)

17.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

18.CHECK VALVE TIMING

a. Remove the drive belt (Click here).

b. Remove the timing belt cover LH and RH (Click here).

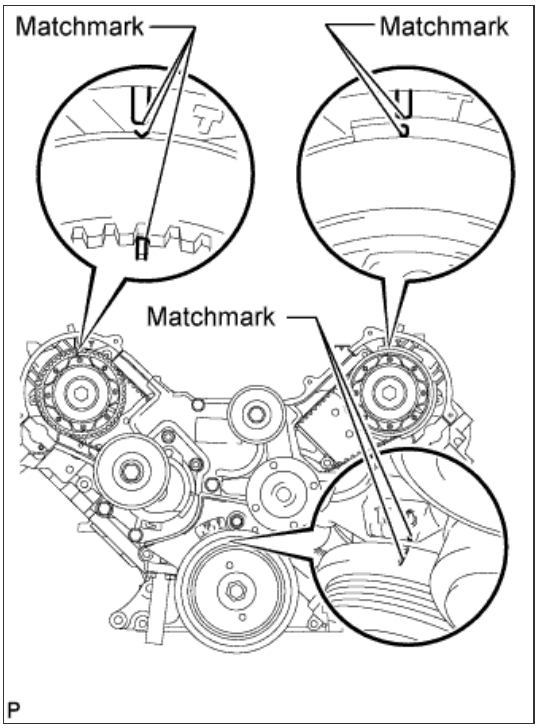
c. Turn the crankshaft to align the matchmarks of the crankshaft.

d. Align the notch of the crankshaft pulley with the 0 position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360 . Confirm again if the matchmarks are facing each other.

OK:
The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NG → ADJUST VALVE TIMING (Click here)

OK

19.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK AND REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER

OK

20.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: Between 80°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

21.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

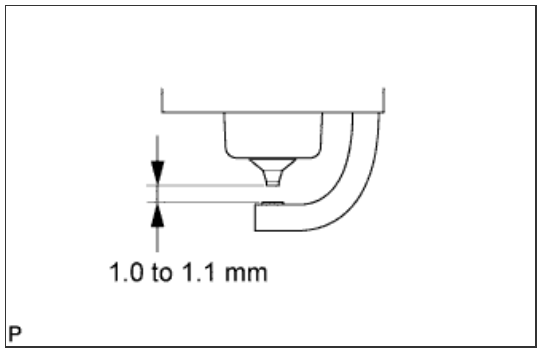
OK

22.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

b. Measure the spark plug electrode gap.

Standard gap:
1.0 to 1.1 mm (0.039 to 0.043 in.)



c. Check the electrode for carbon deposits.

Recommended Spark Plug:

Manufacturer	Product
DENSO	SK20R11
NGK	IFR6A11

NOTICE:

If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.

NG → REPLACE SPARK PLUG (Click here)

OK

23.CHECK FOR SPARKS AND IGNITION

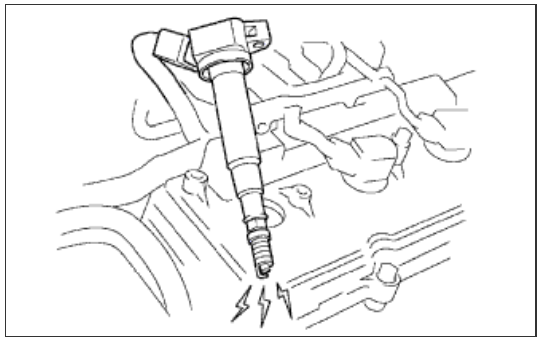
a. Disconnect the fuel injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.



b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

24.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → REPAIR ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

25.CHECK HARNESS AND CONNECTOR (ECM - FUEL INJECTOR)

a. Disconnect the fuel injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

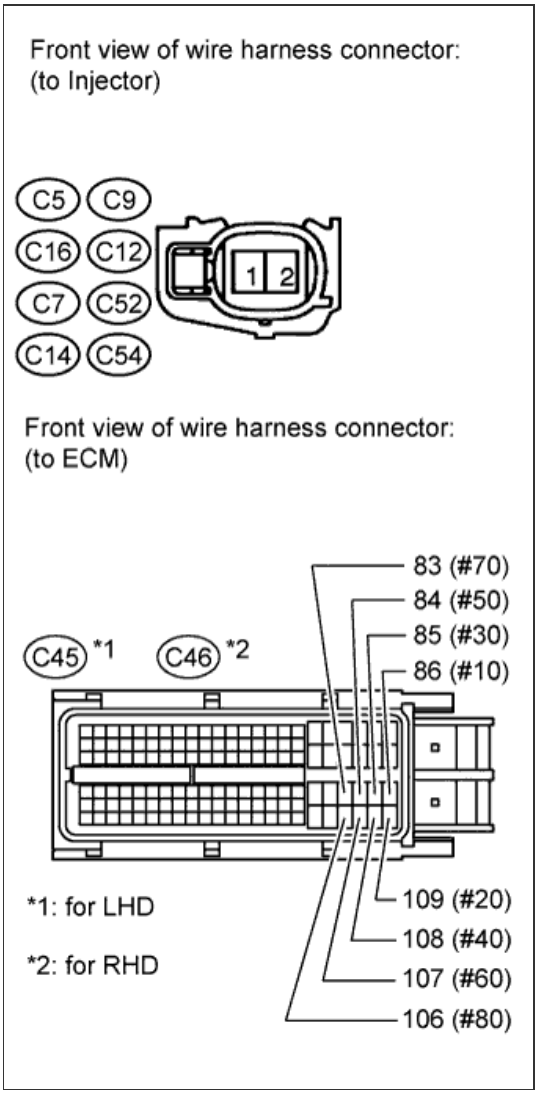
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	C16-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 3	C7-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	C14-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	C9-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	C12-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	C52-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	C54-1 - Ground	Engine switch on (IG)	11 to 14 V

d. Turn the engine switch off.

e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C45-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C45-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C45-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C45-84 (#50)	Always	Below 1 Ω
	C12-2 - Ground	Always	10 kΩ or higher



No. 6	C12-2 - C45-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C45-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C45-106 (#80)	Always	Below 1 Ω

Standard Resistance (for RHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C46-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C46-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C46-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C46-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C46-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C46-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C46-106 (#80)	Always	Below 1 Ω

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50, #60, #70 AND/OR #80 VOLTAGE)

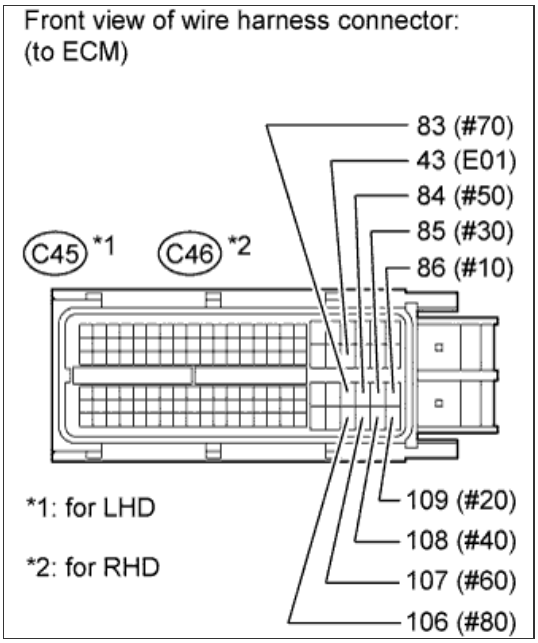
a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage (for LHD):

Tester Connection	Switch Condition	Specified Condition
C45-86 (#10) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-109 (#20) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-85 (#30) -	Engine switch on	11 to 14 V

C45-43 (E01)	(IG)	
C45-108 (#40) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-84 (#50) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-107 (#60) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-83 (#70) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-106 (#80) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V



Standard Voltage (for RHD):

Tester Connection	Switch Condition	Specified Condition
C46-86 (#10) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-109 (#20) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-85 (#30) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-108 (#40) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-84 (#50) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-107 (#60) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-83 (#70) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-106 (#80) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

27.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK

28.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

REPLACE ECM (**Click here**)

29.CHANGE TO NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the installed spark plug with a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → Go to step 30

OK

REPLACE SPARK PLUG (Click here)

30.CHANGE TO NORMAL IGNITION COIL AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the ignition coil with an ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK

REPLACE IGNITION COIL (Click here)

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

for Preparation Click here

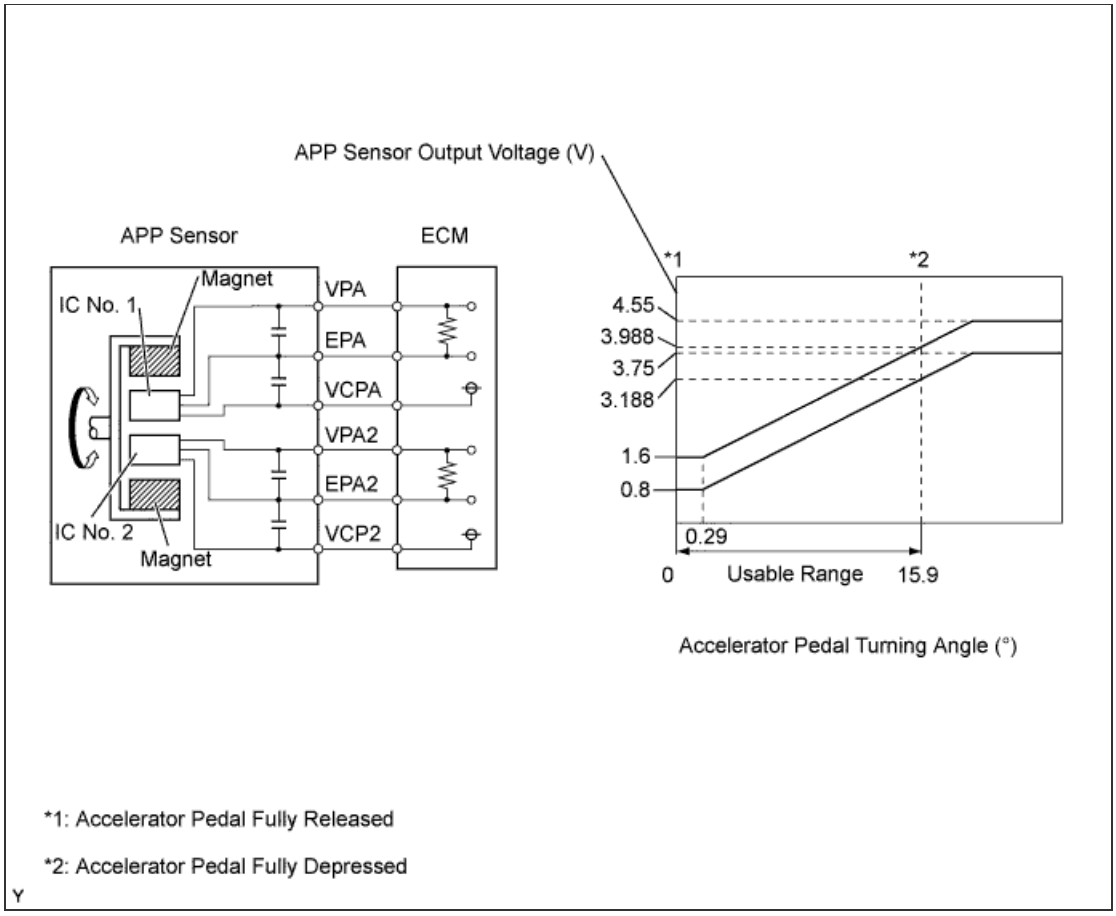
DESCRIPTION

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

The APP sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC Code	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
		• APP sensor

P2122	VPA is 0.4 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• Open in VCP1 circuit • Open or ground short in VPA circuit • ECM
P2123	VPA is 4.8 V or higher for 2.0 seconds or more (1 trip detection logic).	• APP sensor • Open in EPA circuit • ECM
P2125	VPA2 fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or higher. (b) VPA is between 0.4 V and 3.45 V.	• APP sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): (a) The difference between VPA and VPA2 is 0.02 V or less. (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less.	• Short between VPA and VPA2 circuits • APP sensor • ECM

HINT:

When any of these DTCs are output, check the APP sensor voltage by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

Trouble Area	Accelerator Position No. 1 When AP Released	Accelerator Position No. 2 When AP Released	Accelerator Position No. 1 When AP Depressed	Accelerator Position No. 2 When AP Depressed
VCP circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 4.7 V
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 4.7 V

HINT:

- **Accelerator pedal positions are expressed as voltages.**
- **AP stands for Accelerator Pedal.**

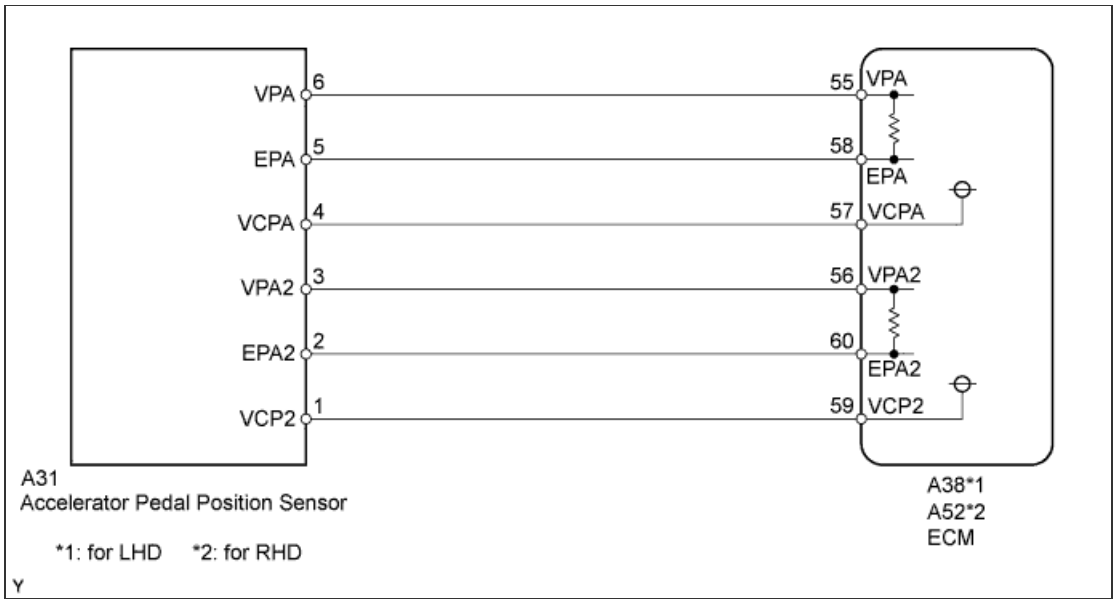
MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is less than the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and stores a DTC.
Example:
When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is stored.
If the malfunction is not repaired successfully, a DTC is stored 2 seconds after the engine is next started.

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 are stored, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue driving. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.
Fail-safe mode continues until a pass condition is detected, and the engine switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Accelerator Pedal Position (APP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

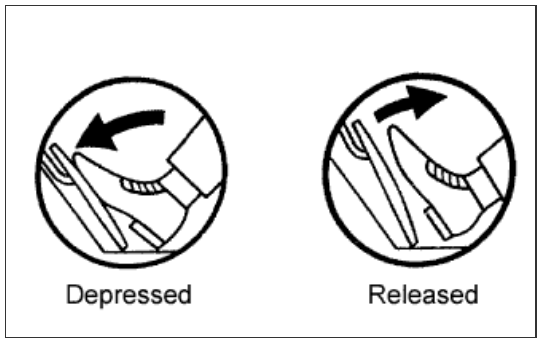
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

d. Read the value displayed on the tester.



Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released → Depressed → Released	0.5 to 4.5 V	1.2 to 4.7 V
	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V

Result

Result	Proceed to
NG	A
OK	B

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the APP sensor connector.

b. Disconnect the ECM connector.

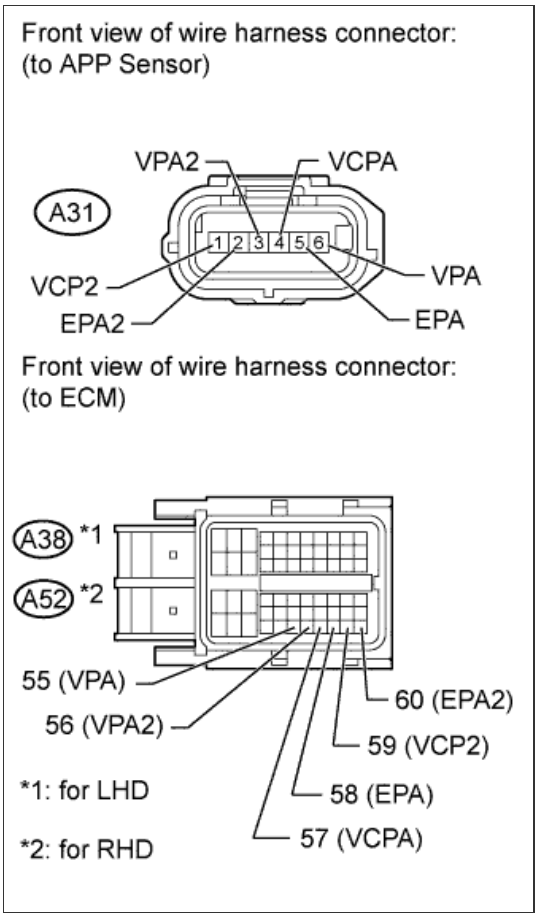
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A38-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-58 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A38-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A38-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A38-59 (VCP2)	Always	Below 1 Ω
A31-6 (VPA) or A38-55 (VPA) - body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-58 (EPA) - body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-57 (VCPA) - body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-56 (VPA2) - body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A38-60 (EPA2) - body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A38-59 (VCP2) - body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A52-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-58 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A52-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A52-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A52-59 (VCP2)	Always	Below 1 Ω
A31-6 (VPA) or A52-55 (VPA) - body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-58 (EPA) - body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-57 (VCPA) - body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-56 (VPA2) - body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-60 (EPA2) - body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A52-59 (VCP2) - body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK ECM (VCPA AND VCP2 VOLTAGE)

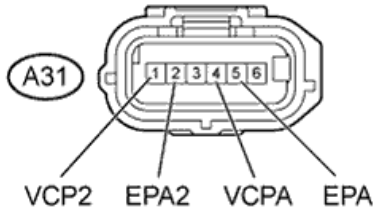
a. Disconnect the APP sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Engine switch on (IG)	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to APP Sensor)



NG → REPLACE ECM (Click here)

OK

4.REPLACE ACCELERATOR PEDAL SENSOR ASSEMBLY

a. Replace the accelerator pedal assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138 is output	A
No DTC is output	B

B → SYSTEM OK

A

REPLACE ECM (Click here)

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

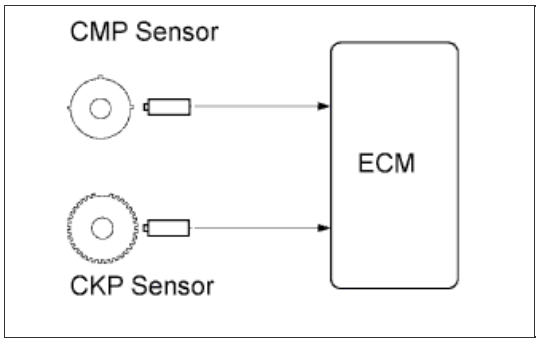
DTC P0306 Cylinder 6 Misfire Detected

DTC P0307 Cylinder 7 Misfire Detected

DTC P0308 Cylinder 8 Misfire Detected

for Preparation Click here

DESCRIPTION



When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause increases in exhaust emission levels. High concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent these increases in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the TWC reaches the point of thermal degradation, the ECM blinks the MIL. To monitor misfires, the ECM uses both the Camshaft Position (CMP) sensor and the Crankshaft Position (CKP) sensor. The CMP sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted as when the crankshaft rotation speed variations exceed predetermined thresholds.
If the misfire rate exceeds the threshold level, the ECM illuminates the MIL and stores a DTC.

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Fuel injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve clearance • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306 P0307 P0308	Misfiring of a specific cylinder occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

MONITOR DESCRIPTION

The ECM illuminates the MIL and stores a DTC when either one of the following conditions, which could cause emission deterioration, is detected (2 trip detection logic).

- Within the first 1000 crankshaft revolutions of the engine starting, an excessive misfiring rate (approximately 130 to 160 misfires per 1000 crankshaft revolutions) occurs once.
- An excessive misfiring rate (approximately 130 to 160 misfires per 1000 crankshaft revolutions) occurs a total of 4 times.

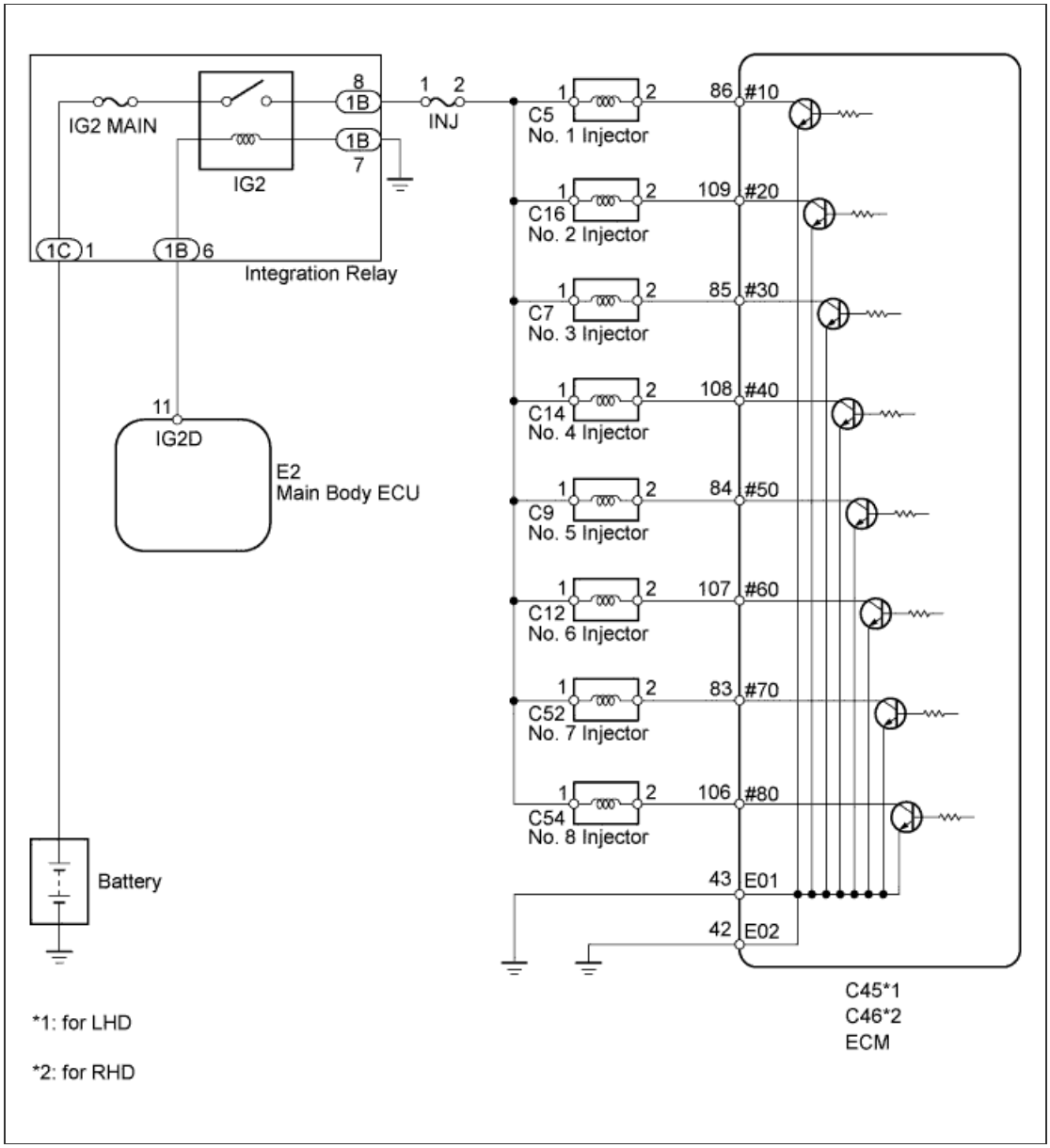
The ECM flashes the MIL and stores a DTC when either one of the following conditions, which could cause damage to the Three-Way Catalytic Converter (TWC), is detected (2 trip detection logic).

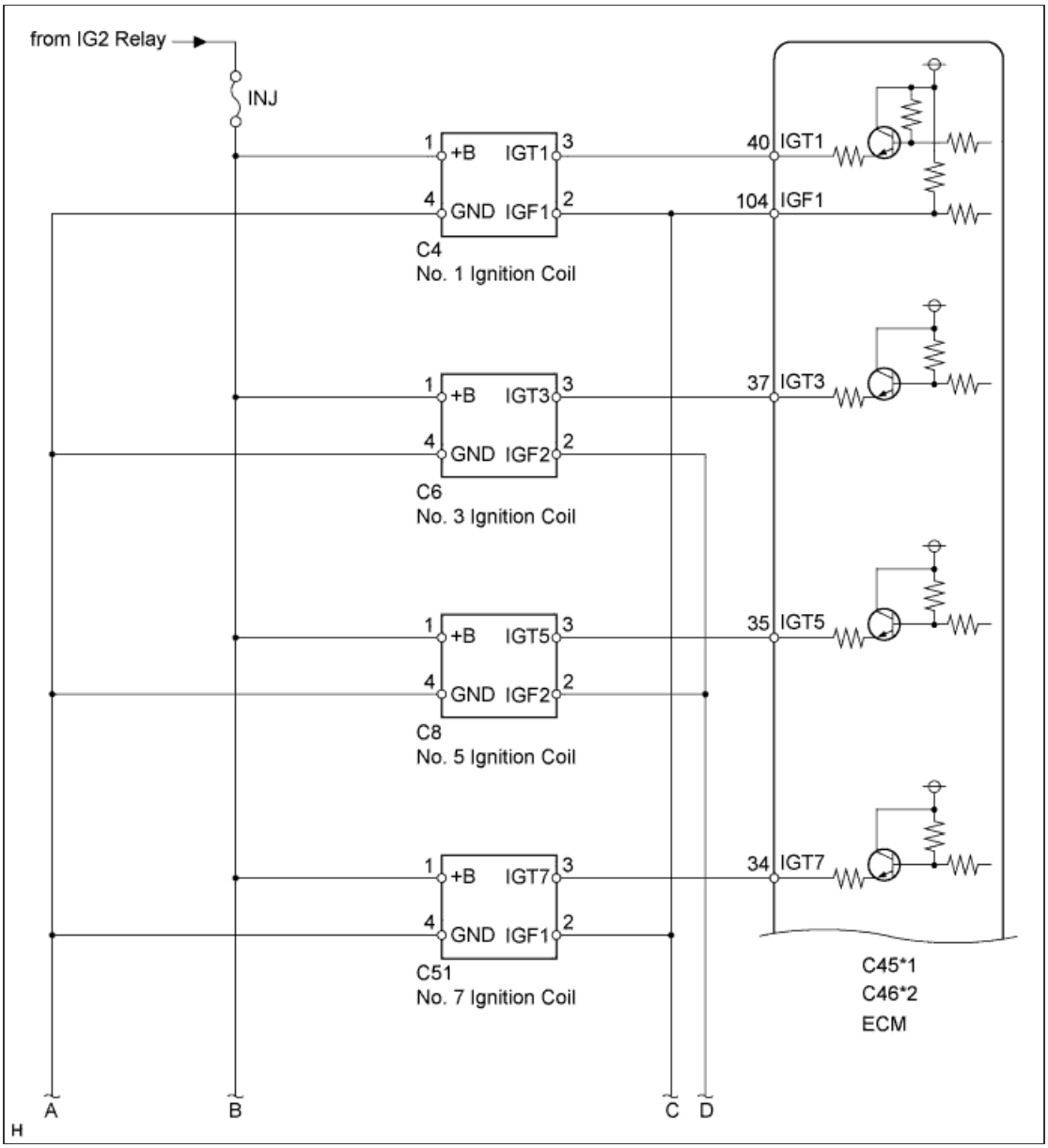
- At a high engine speed, a catalyst damage misfire, which is monitored every 200 crankshaft revolutions, occurs once.
- At a normal engine speed, a catalyst damage misfire, which is monitored every 200 crankshaft revolutions, occurs 3 times.

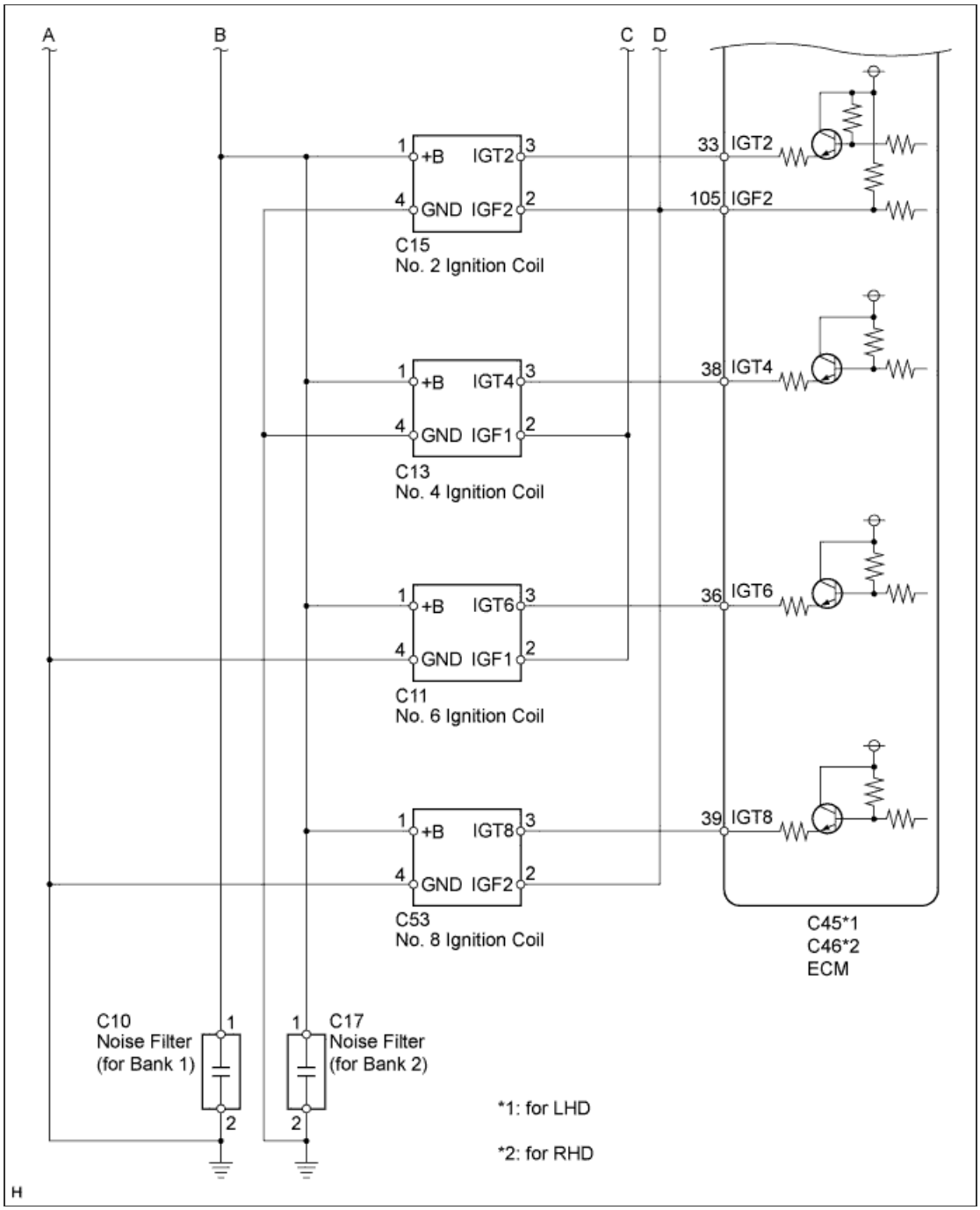
HINT:

If a catalyst damage misfire occurs, the ECM informs the driver by flashing the MIL.

WIRING DIAGRAM




from IG2 Relay
INJ
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
34
IGT7
C45*1
C46*2
ECM
A
B
C
D
H



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Turn the tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire counts of each cylinder (cylinder No. 1 to No. 8) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
7. Drive the vehicle several times with the conditions, such as engine speed and engine load, shown in Misfire RPM and Misfire Load in the Data List.

HINT:

In order to store misfire DTCs, it is necessary to operate the vehicle for the period of time shown in the table below, with the Misfire RPM and Misfire Load in the Data List.

Engine Speed	Duration
Idling	3.5 minutes or more
1000	3 minutes or more
2000	1.5 minutes or more
3000	1 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

   HINT:

   Do not turn the engine switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data will be cleared.

9. Record the DTC(s), freeze frame data and misfire counts.
10. Turn the engine switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the freeze frame data have been duplicated, one of the following factors is considered to be a possible cause of the problem:**
  1. **The fuel level is low.**
  2. **Improper fuel is used.**
  3. **The spark plugs are dirty.**
- **After finishing repairs, check that no misfires occur in each cylinder (cylinder No. 1, No. 2, No. 3, No. 4, No. 5, No. 6, No. 7 and No. 8).**
- **Be sure to confirm that no misfiring cylinder DTCs are output again by conducting the confirmation driving pattern, after the repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speed. If misfires only occur during high engine speed driving, only DTC P0300 is stored.**
  In the event of DTC P0300 being output, perform the following operations:
  1. **Clear the DTC (Click here).**
  2. **Start the engine and conduct the confirmation driving pattern.**
  3. **Read the misfiring rates of each cylinder or DTC(s) using the tester.**
  4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
  5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not output.**
- **When either Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air-fuel ratio may be rich (-20% or less) or lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is below 75°C (167°F), the misfires occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel can cause body vibration, which may cause misfire DTC(s) to be stored.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 is output	A
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 and other DTCs are output	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

3.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is connected correctly and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE (Click here)

OK

4.READ VALUE USING INTELLIGENT TESTER (MISFIRE COUNT)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5, #6, #7 and #8.

f. Allow the engine to idle.

g. Read each value for Cylinder #1 Misfire Count to #8 displayed on the tester. If no misfire counts occur in any cylinders, perform the following procedures:

i. Move the shift lever to D.

ii. Check the Cylinder #1 Misfire Count to #8.

iii. If misfire counts are still not displayed, perform procedure A and and then check the misfire counts again.

h. Drive the vehicle with the Misfire RPM and Misfire Load noted in the Read value using intelligent tester (Misfire RPM and Misfire Load) procedures above (procedure A).

i. Read the Cylinder #1 Misfire Count to #8 or DTCs displayed on the tester (procedure).

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have e ual misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data record of the Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → Go to step 17

A

5.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

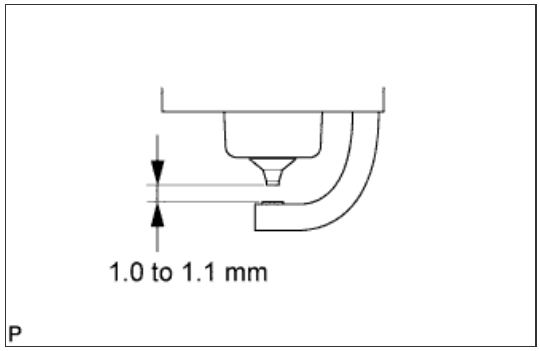
b. Measure the spark plug electrode gap.

Standard gap:
1.0 to 1.1 mm (0.039 to 0.043 in.)

c. Check the electrode for carbon deposits.

Recommended Spark Plug:

Manufacturer	Product
DENSO	SK20R11
NGK	IFR6A11



NOTICE:

If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.

NG → REPLACE SPARK PLUG (Click here)

OK

6.CHECK FOR SPARKS AND IGNITION

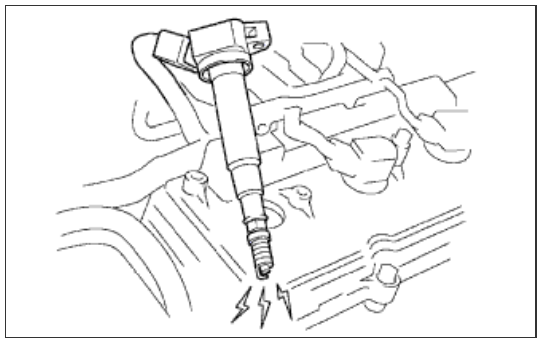
a. Disconnect the fuel injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.



b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → REPAIR ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK HARNESS AND CONNECTOR (ECM - FUEL INJECTOR)

a. Disconnect the fuel injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	C16-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 3	C7-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	C14-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	C9-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	C12-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	C52-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	C54-1 - Ground	Engine switch on (IG)	11 to 14 V

d. Turn the engine switch off.

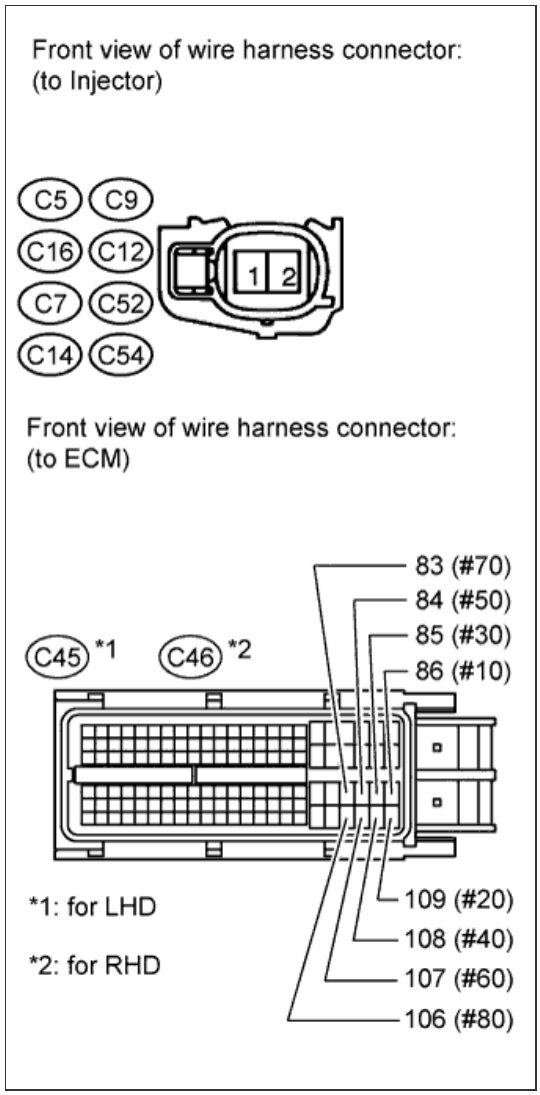
e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C45-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C45-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C45-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C45-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C45-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C45-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C45-106 (#80)	Always	Below 1 Ω

Standard Resistance (for RHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher



	C5-2 - C46-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C46-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C46-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C46-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C46-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C46-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C46-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C46-106 (#80)	Always	Below 1 Ω

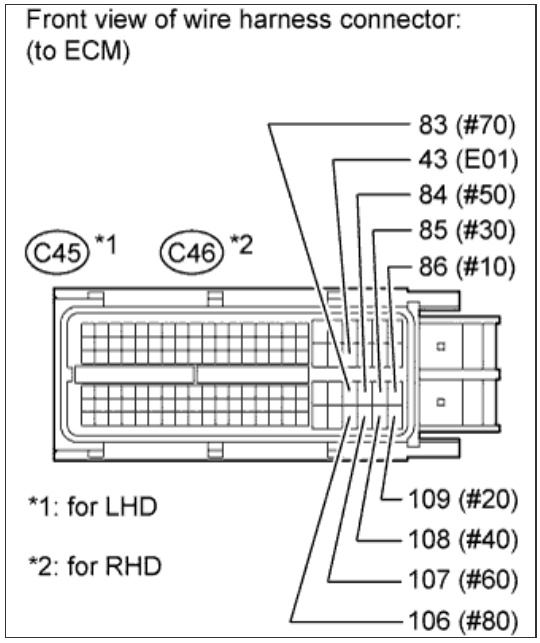
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50, #60, #70 AND/OR #80 VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage (for LHD):

Tester Connection	Switch Condition	Specified Condition
C45-86 (#10) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-109 (#20) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-85 (#30) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-108 (#40) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-84 (#50) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-107 (#60) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-83 (#70) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-106 (#80) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V

Standard Voltage (for RHD):

Tester Connection	Switch Condition	Specified Condition
C46-86 (#10) -	Engine switch on	

C46-43 (E01)	(IG)	11 to 14 V
C46-109 (#20) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-85 (#30) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-108 (#40) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-84 (#50) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-107 (#60) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-83 (#70) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-106 (#80) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK

11.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

12.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (**Click here**)

OK

13.CHECK VALVE TIMING

a. Remove the drive belt (Click here).

b. Remove the timing belt cover LH and RH (Click here).

c. Turn the crankshaft to align the matchmarks of the crankshaft.

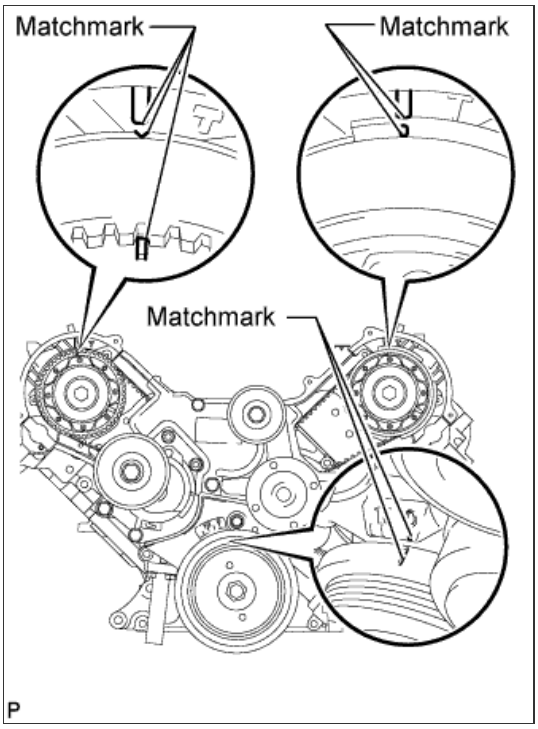
d. Align the notch of the crankshaft pulley with the 0 position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360 . Confirm again if the matchmarks are facing each other.

OK:

The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NG → ADJUST VALVE TIMING (Click here)

OK ↓

14.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK AND REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER

OK ↓

15.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:

With cold engine: Same as ambient air temperature.

With warm engine: Between 80°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK ↓

16.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK ↓

REPLACE ECM (Click here)

17.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

18.CHECK VALVE TIMING

a. Remove the drive belt (Click here).

b. Remove the timing belt cover LH and RH (Click here).

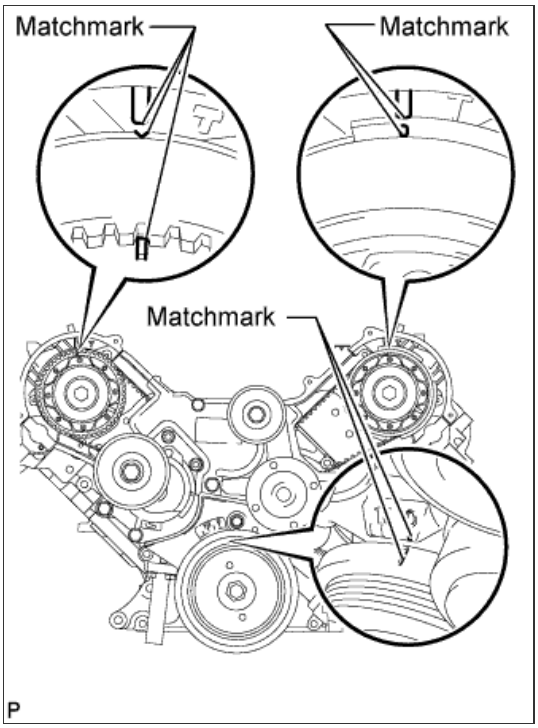
c. Turn the crankshaft to align the matchmarks of the crankshaft.

d. Align the notch of the crankshaft pulley with the 0 position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360 . Confirm again if the matchmarks are facing each other.

OK:
The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NG → ADJUST VALVE TIMING (Click here)

OK

19.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK AND REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER

OK

20.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: Between 80°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

21.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

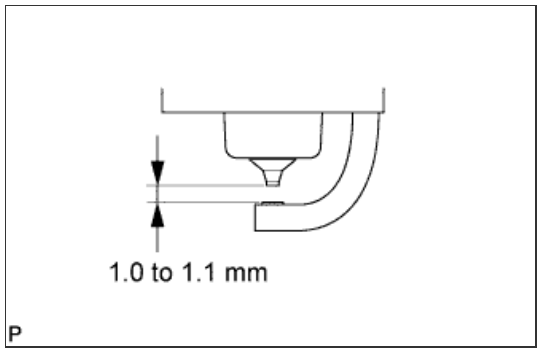
OK

22.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

b. Measure the spark plug electrode gap.

Standard gap:
1.0 to 1.1 mm (0.039 to 0.043 in.)



c. Check the electrode for carbon deposits.

Recommended Spark Plug:

Manufacturer	Product
DENSO	SK20R11
NGK	IFR6A11

NOTICE:

If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.

NG → REPLACE SPARK PLUG (Click here)

OK

23.CHECK FOR SPARKS AND IGNITION

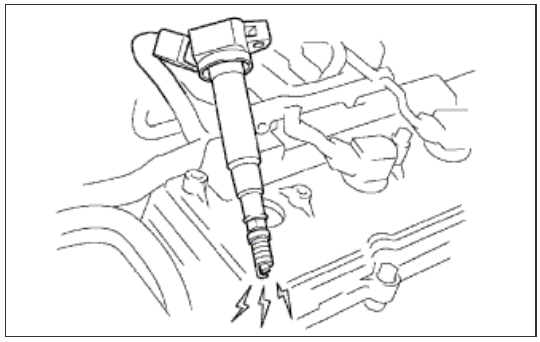
a. Disconnect the fuel injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.



b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

24.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → REPAIR ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

25.CHECK HARNESS AND CONNECTOR (ECM - FUEL INJECTOR)

a. Disconnect the fuel injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

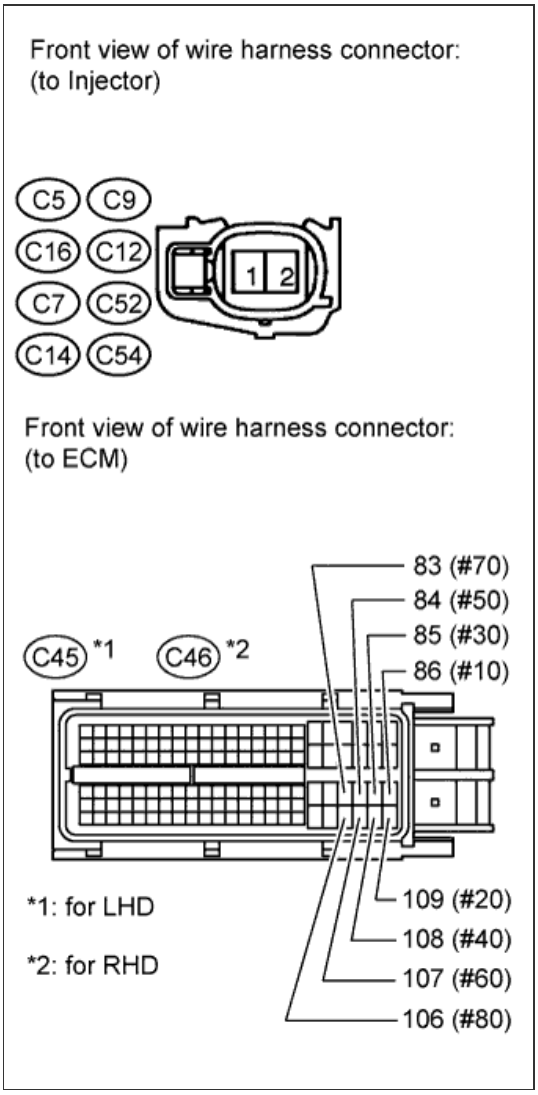
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	C16-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 3	C7-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	C14-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	C9-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	C12-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	C52-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	C54-1 - Ground	Engine switch on (IG)	11 to 14 V

d. Turn the engine switch off.

e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C45-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C45-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C45-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C45-84 (#50)	Always	Below 1 Ω
	C12-2 - Ground	Always	10 kΩ or higher



No. 6	C12-2 - C45-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C45-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C45-106 (#80)	Always	Below 1 Ω

Standard Resistance (for RHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C46-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C46-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C46-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C46-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C46-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C46-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C46-106 (#80)	Always	Below 1 Ω

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50, #60, #70 AND/OR #80 VOLTAGE)

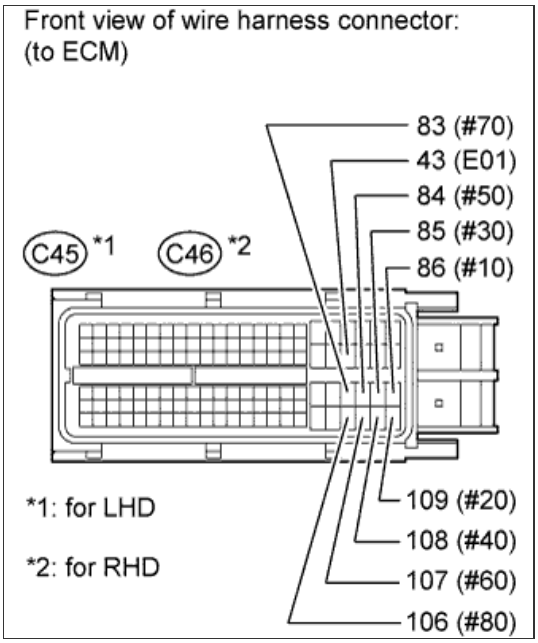
a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage (for LHD):

Tester Connection	Switch Condition	Specified Condition
C45-86 (#10) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-109 (#20) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-85 (#30) -	Engine switch on	11 to 14 V

C45-43 (E01)	(IG)	
C45-108 (#40) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-84 (#50) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-107 (#60) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-83 (#70) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-106 (#80) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V



Standard Voltage (for RHD):

Tester Connection	Switch Condition	Specified Condition
C46-86 (#10) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-109 (#20) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-85 (#30) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-108 (#40) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-84 (#50) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-107 (#60) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-83 (#70) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-106 (#80) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

27.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK

28.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

REPLACE ECM (**Click here**)

29.CHANGE TO NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the installed spark plug with a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → Go to step 30

OK

REPLACE SPARK PLUG (Click here)

30.CHANGE TO NORMAL IGNITION COIL AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the ignition coil with an ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK

REPLACE IGNITION COIL (Click here)

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

for Preparation Click here

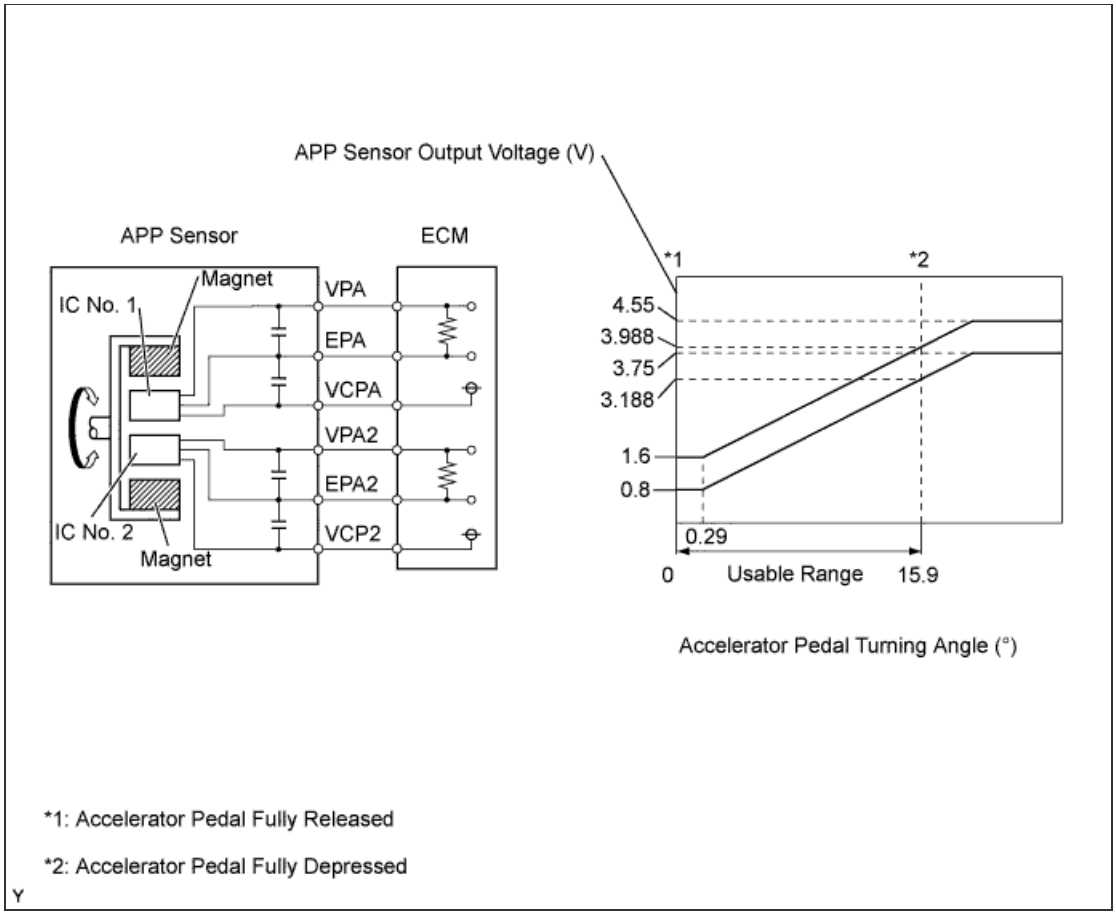
DESCRIPTION

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

The APP sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC Code	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
		• APP sensor

P2122	VPA is 0.4 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• Open in VCP1 circuit • Open or ground short in VPA circuit • ECM
P2123	VPA is 4.8 V or higher for 2.0 seconds or more (1 trip detection logic).	• APP sensor • Open in EPA circuit • ECM
P2125	VPA2 fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• APP sensor • ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when the accelerator pedal is fully released (1 trip detection logic).	• APP sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or higher. (b) VPA is between 0.4 V and 3.45 V.	• APP sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): (a) The difference between VPA and VPA2 is 0.02 V or less. (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less.	• Short between VPA and VPA2 circuits • APP sensor • ECM

HINT:

When any of these DTCs are output, check the APP sensor voltage by entering the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

Trouble Area	Accelerator Position No. 1 When AP Released	Accelerator Position No. 2 When AP Released	Accelerator Position No. 1 When AP Depressed	Accelerator Position No. 2 When AP Depressed
VCP circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 4.7 V
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 4.7 V

HINT:

- **Accelerator pedal positions are expressed as voltages.**
- **AP stands for Accelerator Pedal.**

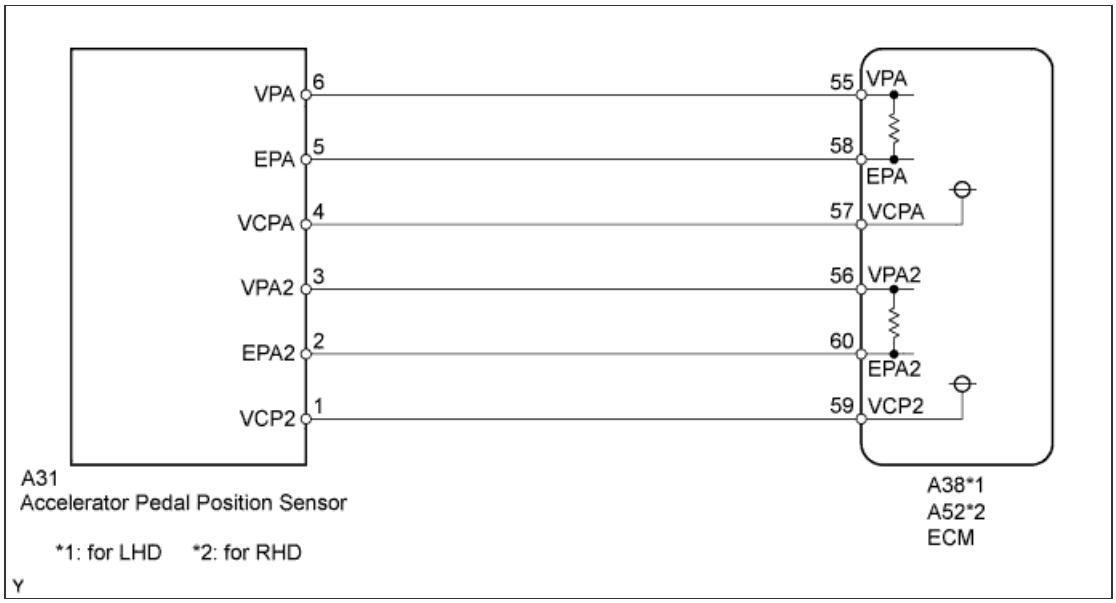
MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is less than the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and stores a DTC.
Example:
When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is stored.
If the malfunction is not repaired successfully, a DTC is stored 2 seconds after the engine is next started.

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 are stored, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue driving. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.
Fail-safe mode continues until a pass condition is detected, and the engine switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **These DTCs relate to the Accelerator Pedal Position (APP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

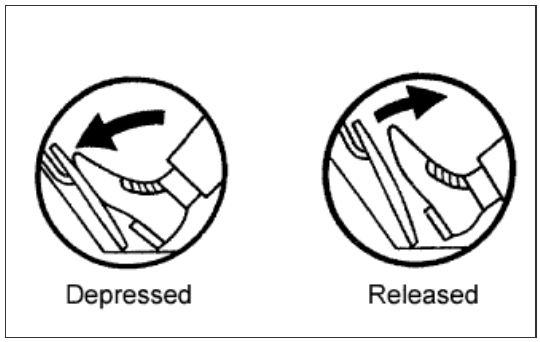
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

d. Read the value displayed on the tester.



Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released → Depressed → Released	0.5 to 4.5 V	1.2 to 4.7 V
	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V	Difference between Accelerator Position No. 1 and Accelerator Position No. 2 is higher than 0.02 V

Result

Result	Proceed to
NG	A
OK	B

B → Go to step 5

A

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the APP sensor connector.

b. Disconnect the ECM connector.

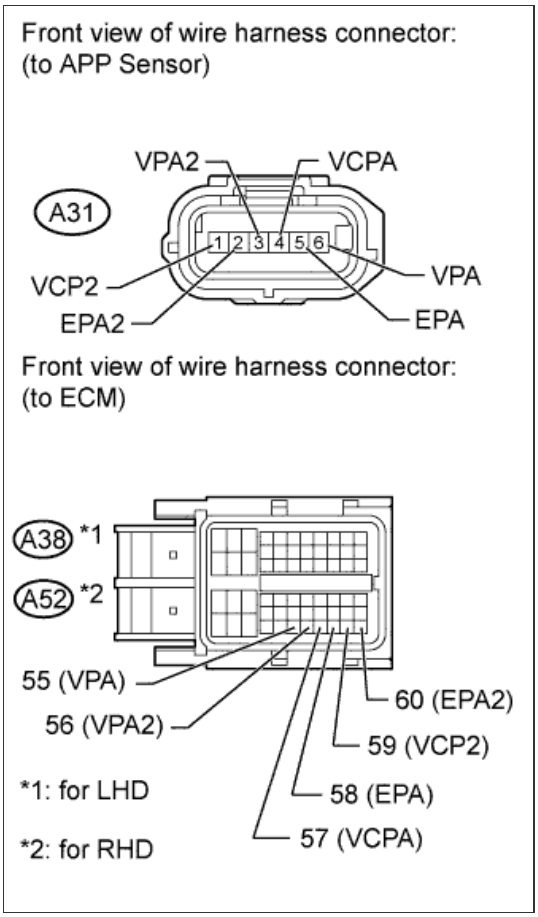
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A38-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-58 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A38-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A38-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A38-59 (VCP2)	Always	Below 1 Ω
A31-6 (VPA) or A38-55 (VPA) - body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-58 (EPA) - body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-57 (VCPA) - body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-56 (VPA2) - body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A38-60 (EPA2) - body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A38-59 (VCP2) - body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
A31-6 (VPA) - A52-55 (VPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-58 (EPA)	Always	Below 1 Ω
A31-4 (VCPA) - A52-57 (VCPA)	Always	Below 1 Ω
A31-3 (VPA2) - A52-56 (VPA2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-60 (EPA2)	Always	Below 1 Ω
A31-1 (VCP2) - A52-59 (VCP2)	Always	Below 1 Ω
A31-6 (VPA) or A52-55 (VPA) - body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-58 (EPA) - body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-57 (VCPA) - body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-56 (VPA2) - body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-60 (EPA2) - body ground	Always	10 kΩ or higher
A31-1 (VCP2) or A52-59 (VCP2) - body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK ECM (VCPA AND VCP2 VOLTAGE)

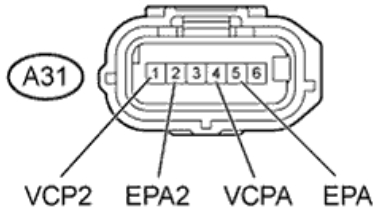
a. Disconnect the APP sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Engine switch on (IG)	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to APP Sensor)



NG → REPLACE ECM (Click here)

OK

4.REPLACE ACCELERATOR PEDAL SENSOR ASSEMBLY

a. Replace the accelerator pedal assembly (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138 is output	A
No DTC is output	B

B → SYSTEM OK

A

REPLACE ECM (Click here)

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

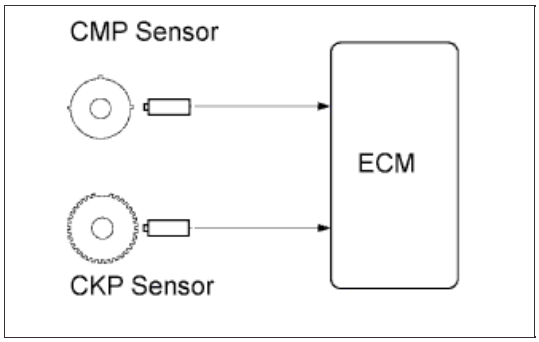
DTC P0306 Cylinder 6 Misfire Detected

DTC P0307 Cylinder 7 Misfire Detected

DTC P0308 Cylinder 8 Misfire Detected

for Preparation Click here

DESCRIPTION



When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause increases in exhaust emission levels. High concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent these increases in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the TWC reaches the point of thermal degradation, the ECM blinks the MIL. To monitor misfires, the ECM uses both the Camshaft Position (CMP) sensor and the Crankshaft Position (CKP) sensor. The CMP sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted as when the crankshaft rotation speed variations exceed predetermined thresholds.
If the misfire rate exceeds the threshold level, the ECM illuminates the MIL and stores a DTC.

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Fuel injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve clearance • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306 P0307 P0308	Misfiring of a specific cylinder occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

MONITOR DESCRIPTION

The ECM illuminates the MIL and stores a DTC when either one of the following conditions, which could cause emission deterioration, is detected (2 trip detection logic).

- Within the first 1000 crankshaft revolutions of the engine starting, an excessive misfiring rate (approximately 130 to 160 misfires per 1000 crankshaft revolutions) occurs once.
- An excessive misfiring rate (approximately 130 to 160 misfires per 1000 crankshaft revolutions) occurs a total of 4 times.

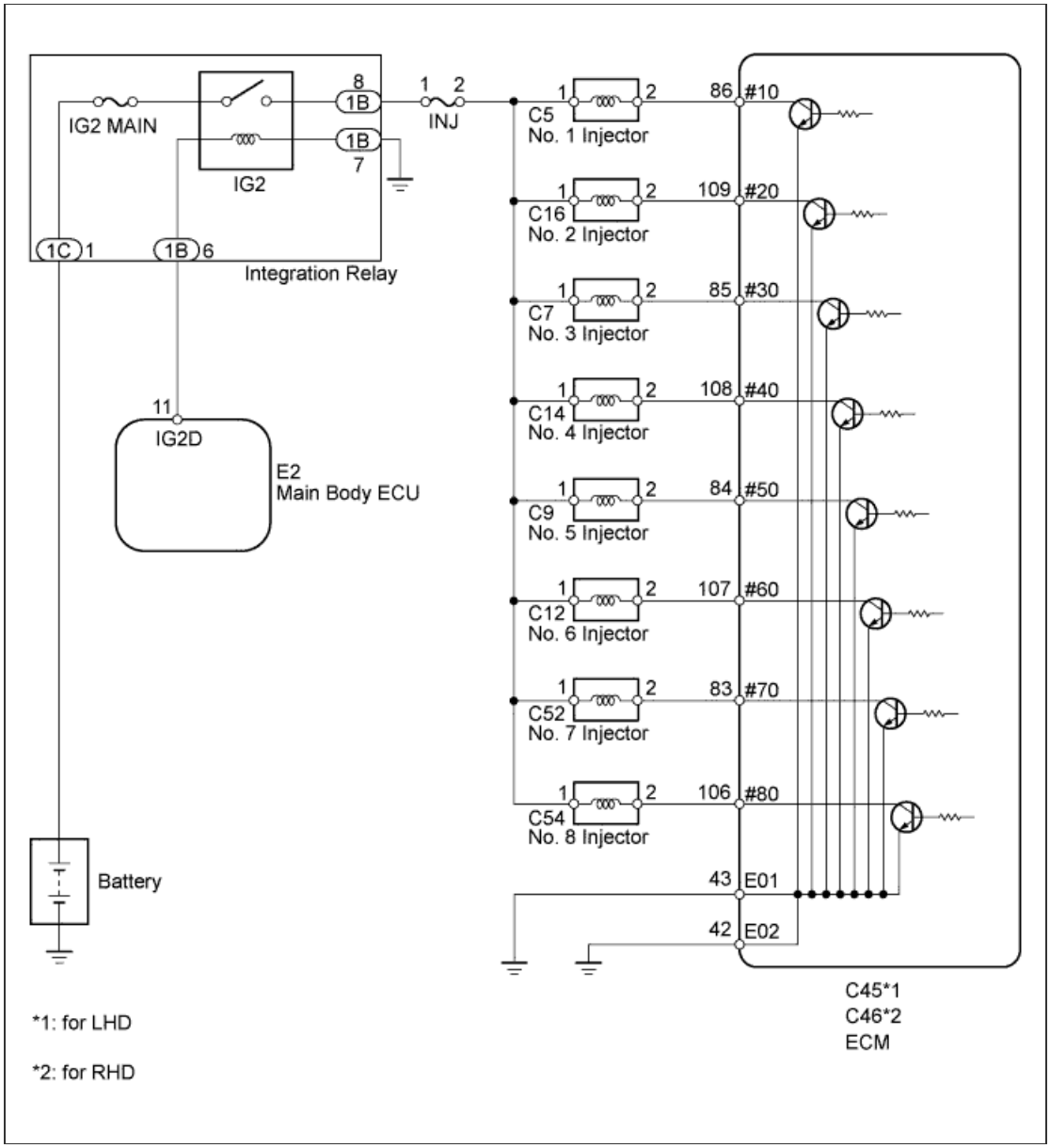
The ECM flashes the MIL and stores a DTC when either one of the following conditions, which could cause damage to the Three-Way Catalytic Converter (TWC), is detected (2 trip detection logic).

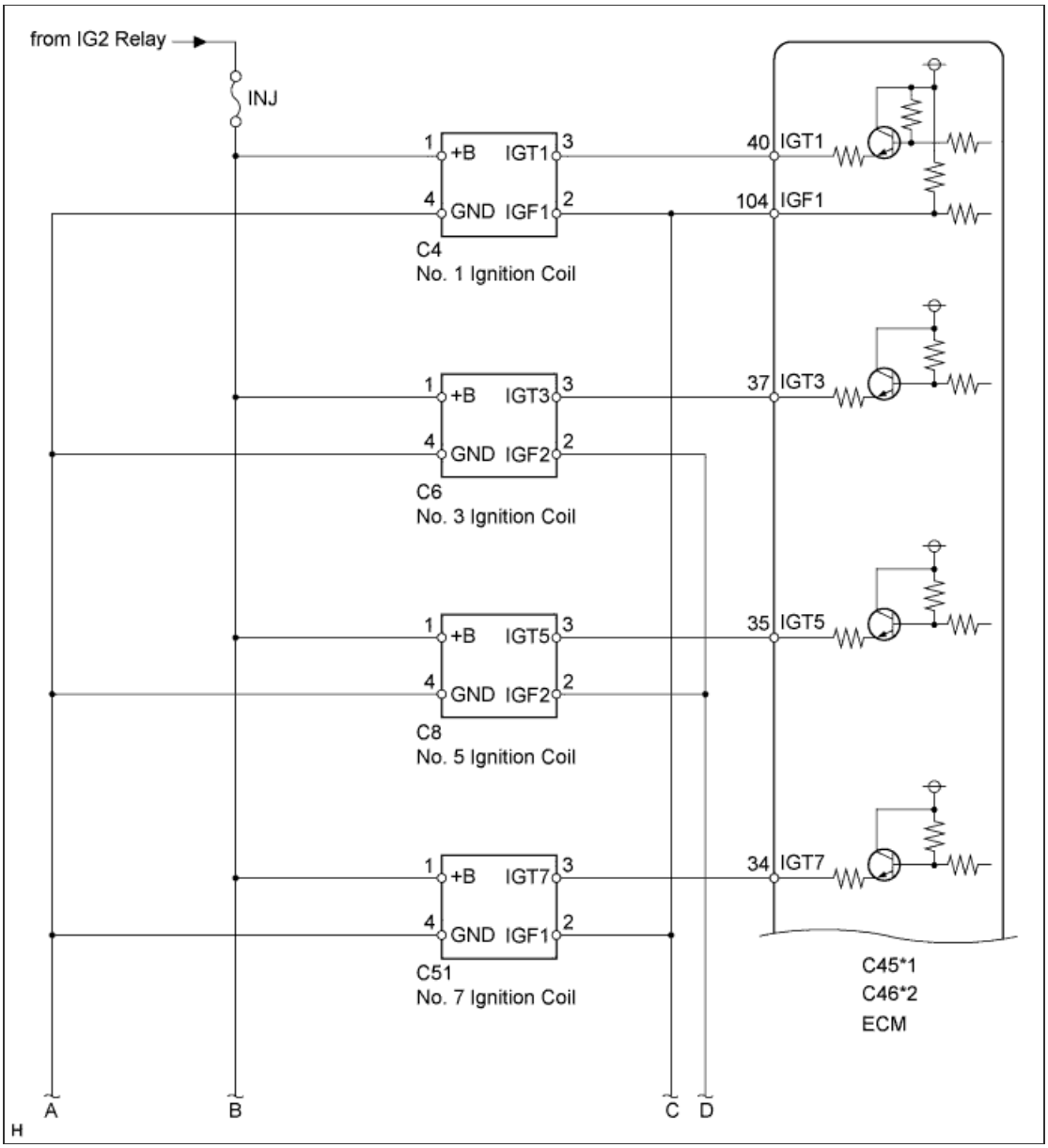
- At a high engine speed, a catalyst damage misfire, which is monitored every 200 crankshaft revolutions, occurs once.
- At a normal engine speed, a catalyst damage misfire, which is monitored every 200 crankshaft revolutions, occurs 3 times.

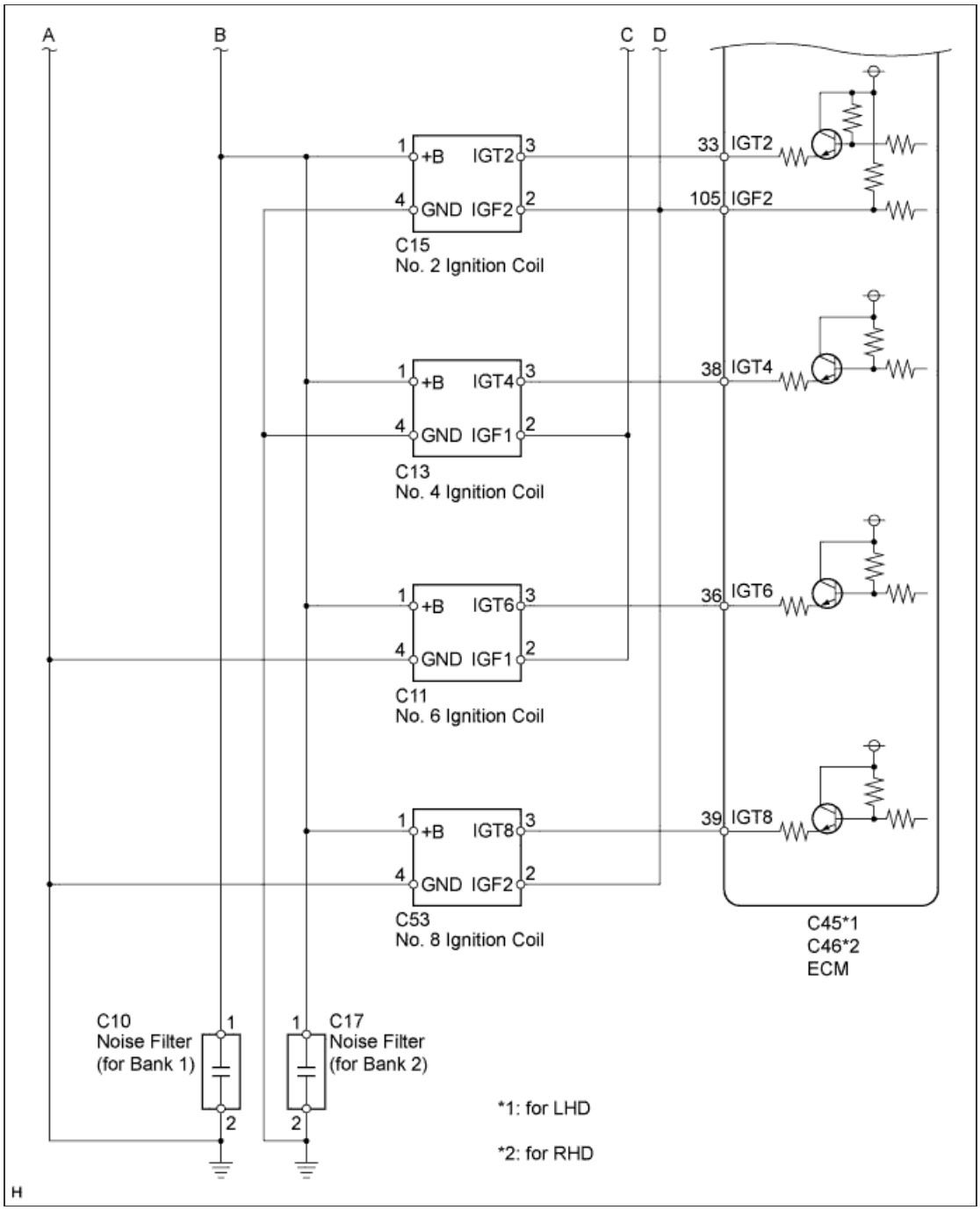
HINT:

If a catalyst damage misfire occurs, the ECM informs the driver by flashing the MIL.

WIRING DIAGRAM




from IG2 Relay
INJ
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
34
IGT7
C45*1
C46*2
ECM
A
B
C
D
H



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Turn the tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire counts of each cylinder (cylinder No. 1 to No. 8) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
7. Drive the vehicle several times with the conditions, such as engine speed and engine load, shown in Misfire RPM and Misfire Load in the Data List.

HINT:

In order to store misfire DTCs, it is necessary to operate the vehicle for the period of time shown in the table below, with the Misfire RPM and Misfire Load in the Data List.

Engine Speed	Duration
Idling	3.5 minutes or more
1000	3 minutes or more
2000	1.5 minutes or more
3000	1 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

   HINT:

   Do not turn the engine switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data will be cleared.

9. Record the DTC(s), freeze frame data and misfire counts.
10. Turn the engine switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the freeze frame data have been duplicated, one of the following factors is considered to be a possible cause of the problem:**
  1. **The fuel level is low.**
  2. **Improper fuel is used.**
  3. **The spark plugs are dirty.**
- **After finishing repairs, check that no misfires occur in each cylinder (cylinder No. 1, No. 2, No. 3, No. 4, No. 5, No. 6, No. 7 and No. 8).**
- **Be sure to confirm that no misfiring cylinder DTCs are output again by conducting the confirmation driving pattern, after the repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speed. If misfires only occur during high engine speed driving, only DTC P0300 is stored.**
  In the event of DTC P0300 being output, perform the following operations:
  1. **Clear the DTC (Click here).**
  2. **Start the engine and conduct the confirmation driving pattern.**
  3. **Read the misfiring rates of each cylinder or DTC(s) using the tester.**
  4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
  5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not output.**
- **When either Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air-fuel ratio may be rich (-20% or less) or lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is below 75°C (167°F), the misfires occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel can cause body vibration, which may cause misfire DTC(s) to be stored.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 is output	A
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 and other DTCs are output	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

3.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is connected correctly and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE (Click here)

OK

4.READ VALUE USING INTELLIGENT TESTER (MISFIRE COUNT)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5, #6, #7 and #8.

f. Allow the engine to idle.

g. Read each value for Cylinder #1 Misfire Count to #8 displayed on the tester. If no misfire counts occur in any cylinders, perform the following procedures:

i. Move the shift lever to D.

ii. Check the Cylinder #1 Misfire Count to #8.

iii. If misfire counts are still not displayed, perform procedure A and and then check the misfire counts again.

h. Drive the vehicle with the Misfire RPM and Misfire Load noted in the Read value using intelligent tester (Misfire RPM and Misfire Load) procedures above (procedure A).

i. Read the Cylinder #1 Misfire Count to #8 or DTCs displayed on the tester (procedure).

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have e ual misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data record of the Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → Go to step 17

A

5.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

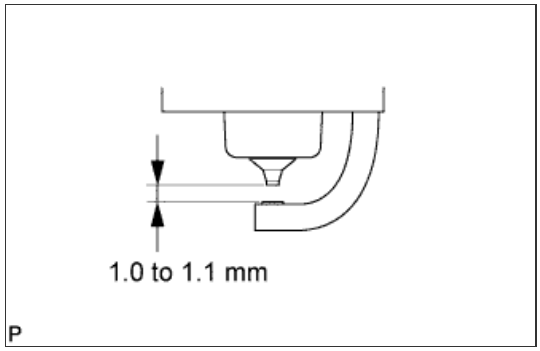
b. Measure the spark plug electrode gap.

Standard gap:
1.0 to 1.1 mm (0.039 to 0.043 in.)

c. Check the electrode for carbon deposits.

Recommended Spark Plug:

Manufacturer	Product
DENSO	SK20R11
NGK	IFR6A11



NOTICE:

If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.

NG → REPLACE SPARK PLUG (Click here)

OK

6.CHECK FOR SPARKS AND IGNITION

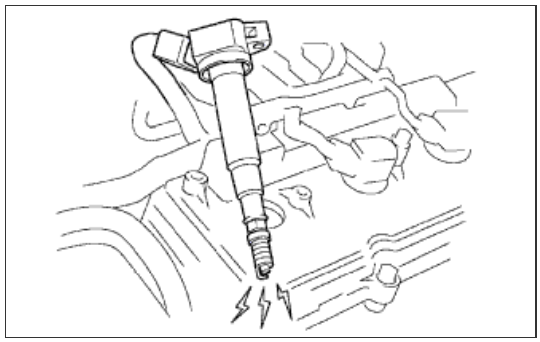
a. Disconnect the fuel injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.



b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → REPAIR ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK HARNESS AND CONNECTOR (ECM - FUEL INJECTOR)

a. Disconnect the fuel injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	C16-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 3	C7-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	C14-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	C9-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	C12-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	C52-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	C54-1 - Ground	Engine switch on (IG)	11 to 14 V

d. Turn the engine switch off.

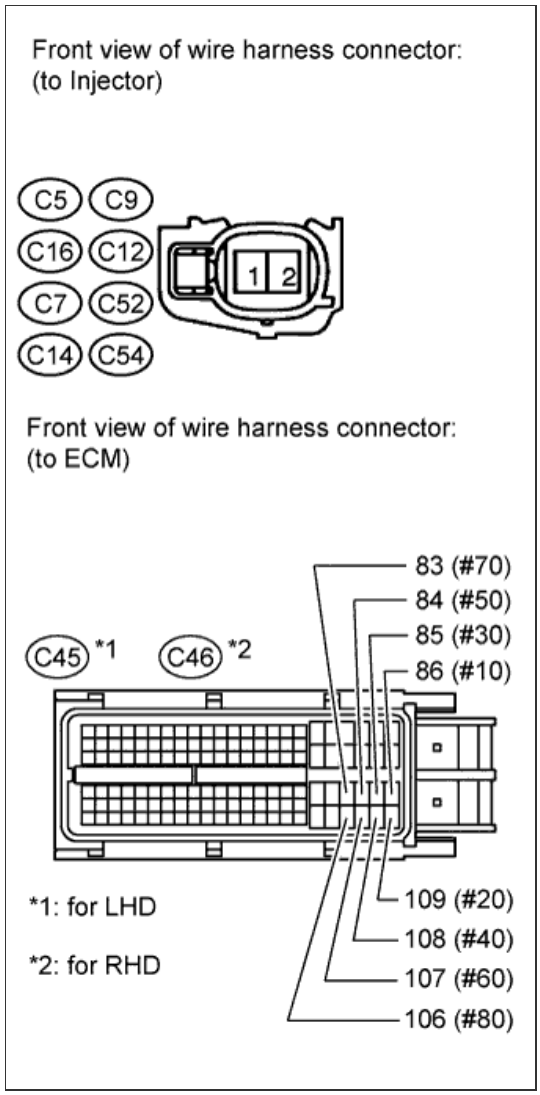
e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C45-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C45-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C45-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C45-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C45-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C45-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C45-106 (#80)	Always	Below 1 Ω

Standard Resistance (for RHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher



	C5-2 - C46-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C46-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C46-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C46-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C46-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C46-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C46-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C46-106 (#80)	Always	Below 1 Ω

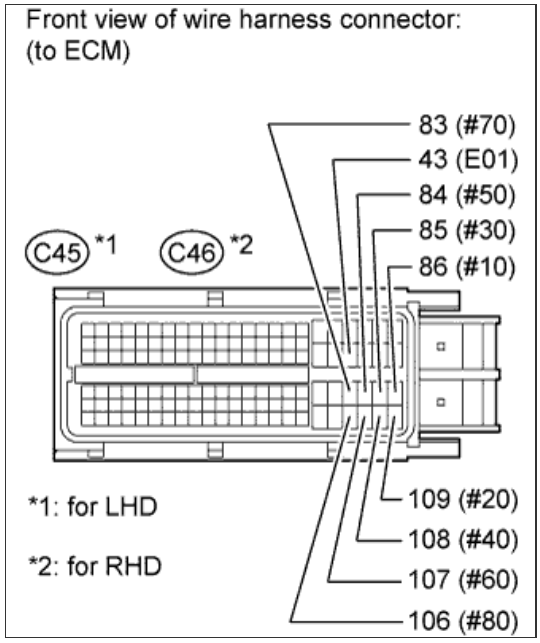
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50, #60, #70 AND/OR #80 VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage (for LHD):

Tester Connection	Switch Condition	Specified Condition
C45-86 (#10) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-109 (#20) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-85 (#30) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-108 (#40) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-84 (#50) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-107 (#60) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-83 (#70) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-106 (#80) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V

Standard Voltage (for RHD):

Tester Connection	Switch Condition	Specified Condition
C46-86 (#10) -	Engine switch on	

C46-43 (E01)	(IG)	11 to 14 V
C46-109 (#20) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-85 (#30) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-108 (#40) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-84 (#50) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-107 (#60) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-83 (#70) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-106 (#80) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK

11.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

12.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (**Click here**)

OK

13.CHECK VALVE TIMING

a. Remove the drive belt (Click here).

b. Remove the timing belt cover LH and RH (Click here).

c. Turn the crankshaft to align the matchmarks of the crankshaft.

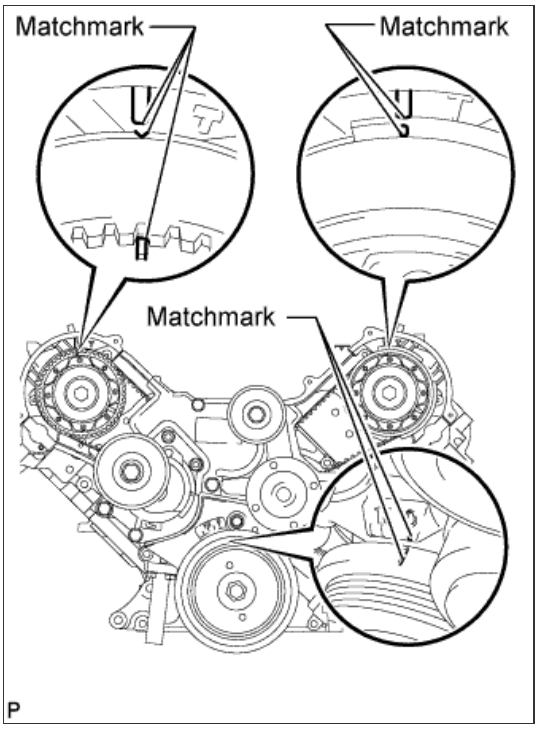
d. Align the notch of the crankshaft pulley with the 0 position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360 . Confirm again if the matchmarks are facing each other.

OK:

The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NG → ADJUST VALVE TIMING (Click here)

OK ↓

14.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK AND REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER

OK ↓

15.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:

With cold engine: Same as ambient air temperature.

With warm engine: Between 80°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK ↓

16.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK ↓

REPLACE ECM (Click here)

17.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

18.CHECK VALVE TIMING

a. Remove the drive belt (Click here).

b. Remove the timing belt cover LH and RH (Click here).

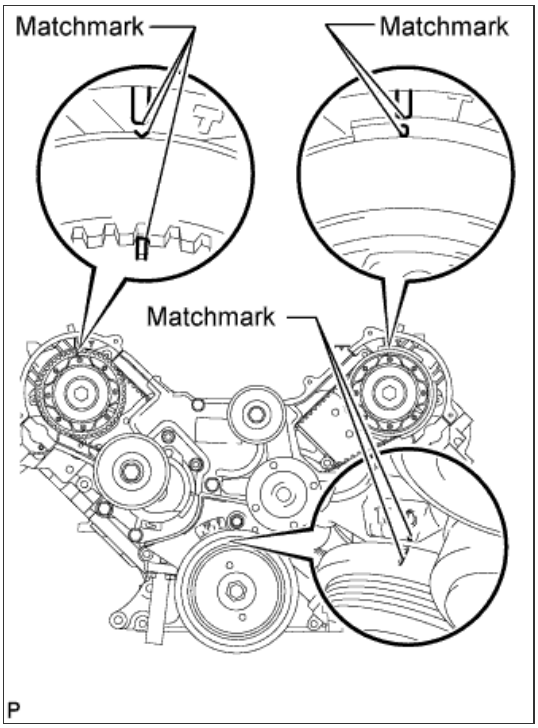
c. Turn the crankshaft to align the matchmarks of the crankshaft.

d. Align the notch of the crankshaft pulley with the 0 position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360 . Confirm again if the matchmarks are facing each other.

OK:
The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NG → ADJUST VALVE TIMING (Click here)

OK

19.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK AND REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER

OK

20.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: Between 80°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

21.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

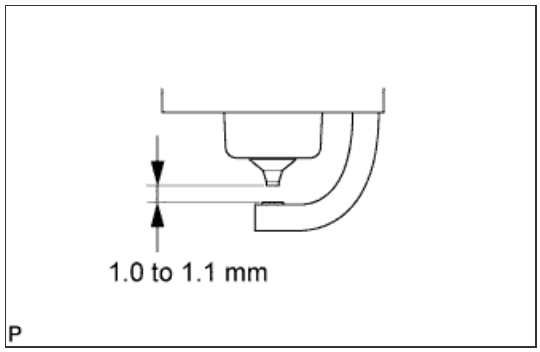
OK

22.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

b. Measure the spark plug electrode gap.

Standard gap:
1.0 to 1.1 mm (0.039 to 0.043 in.)



c. Check the electrode for carbon deposits.

Recommended Spark Plug:

Manufacturer	Product
DENSO	SK20R11
NGK	IFR6A11

NOTICE:

If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.

NG → REPLACE SPARK PLUG (Click here)

OK

23.CHECK FOR SPARKS AND IGNITION

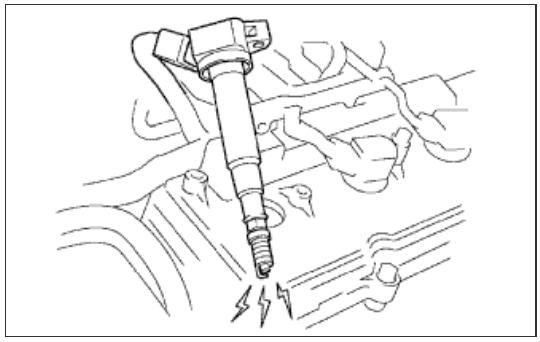
a. Disconnect the fuel injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.



b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

24.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → REPAIR ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

25.CHECK HARNESS AND CONNECTOR (ECM - FUEL INJECTOR)

a. Disconnect the fuel injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

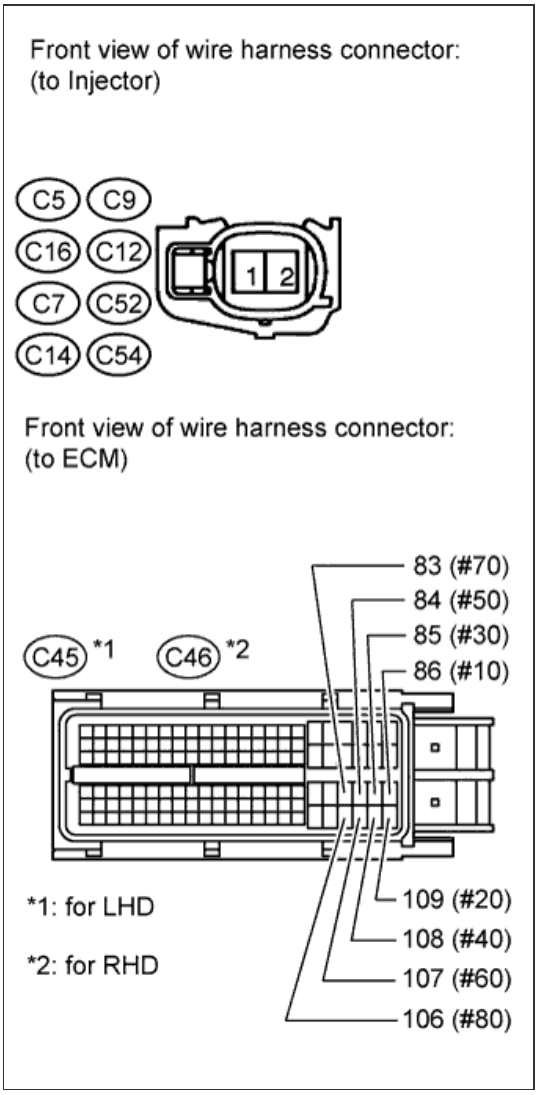
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	C16-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 3	C7-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	C14-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	C9-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	C12-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	C52-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	C54-1 - Ground	Engine switch on (IG)	11 to 14 V

d. Turn the engine switch off.

e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C45-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C45-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C45-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C45-84 (#50)	Always	Below 1 Ω
	C12-2 - Ground	Always	10 kΩ or higher



No. 6	C12-2 - C45-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C45-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C45-106 (#80)	Always	Below 1 Ω

Standard Resistance (for RHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C46-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C46-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C46-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C46-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C46-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C46-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C46-106 (#80)	Always	Below 1 Ω

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50, #60, #70 AND/OR #80 VOLTAGE)

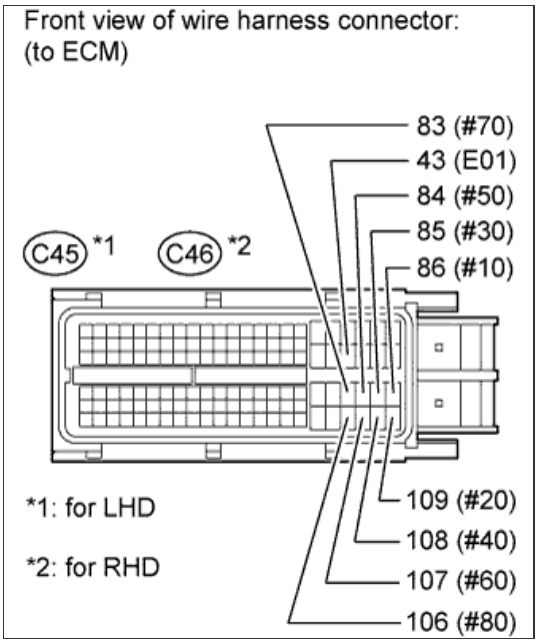
a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage (for LHD):

Tester Connection	Switch Condition	Specified Condition
C45-86 (#10) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-109 (#20) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-85 (#30) -	Engine switch on	11 to 14 V

C45-43 (E01)	(IG)	
C45-108 (#40) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-84 (#50) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-107 (#60) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-83 (#70) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-106 (#80) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V



Standard Voltage (for RHD):

Tester Connection	Switch Condition	Specified Condition
C46-86 (#10) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-109 (#20) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-85 (#30) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-108 (#40) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-84 (#50) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-107 (#60) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-83 (#70) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-106 (#80) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

27.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK

28.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

REPLACE ECM (**Click here**)

29.CHANGE TO NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the installed spark plug with a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → Go to step 30

OK

REPLACE SPARK PLUG (Click here)

30.CHANGE TO NORMAL IGNITION COIL AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the ignition coil with an ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK

REPLACE IGNITION COIL (Click here)

DTC P2121 Throttle / Pedal Position Sensor / Switch "D" Circuit Range / Performance

for Preparation Click here

DESCRIPTION

HINT:

Refer to DTC P2120 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2121	The difference between VPA and VPA2 is below 0.4 V, or higher than 1.2 V for 0.5 seconds (1 trip detection logic).	• **Accelerator Pedal Position (APP) sensor** • **ECM**

MONITOR DESCRIPTION

When the difference between the output voltages of VPA and VPA2 deviates from the standard, the ECM determines that the Accelerator Pedal Position (APP) sensor is malfunctioning. The ECM turns on the MIL and the DTC is stored.

FAIL-SAFE

The APP sensor has two (main and sub) sensor circuits. If a malfunction occurs in either of the sensor circuits, the ECM detects the abnormal signal voltage difference between the two sensor circuits and switches to limp mode. In limp mode, the functioning circuit is used to calculate the accelerator pedal opening angle to allow the vehicle to continue driving. If both circuits malfunction, the ECM regards the opening angle of the accelerator pedal as being fully closed. In this case, the throttle valve remains closed as if the engine is idling.
If a pass condition is detected and then the engine switch is turned off, the fail-safe operation stops and the system returns to a normal condition.

WIRING DIAGRAM

Refer to DTC P2120 (Click here).

INSPECTION PROCEDURE

HINT:

- **This DTC relates to the Accelerator Pedal Position (APP) sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2121)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P2121 is output	A
P2121 and other DTCs are output	B

HINT:

If any DTCs other than P2121 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

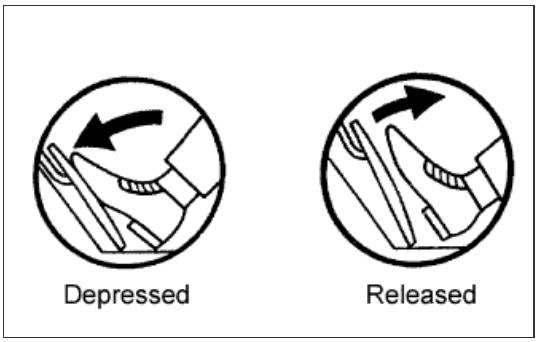
b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

d. Read the values displayed on the tester.

Standard Voltage:

Accelerator Pedal Operations	Accelerator Position No. 1	Accelerator Position No. 2
Released	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2.6 to 4.5 V	3.4 to 4.7 V



NG → Go to step

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

REPLACE ACCELERATOR PEDAL SENSOR ASSEMBLY

a. Replace the accelerator pedal assembly (Click here).

NEXT

4.CHECK WHETHER DTC OUTPUT RECURS (DTC P2121)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 15 seconds.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
P2121 is output	A
No DTC is output	B

B → SYSTEM OK

A

REPLACE ECM (Click here)

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

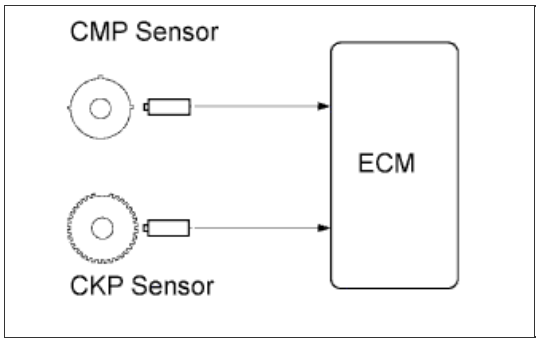
DTC P0306 Cylinder 6 Misfire Detected

DTC P0307 Cylinder 7 Misfire Detected

DTC P0308 Cylinder 8 Misfire Detected

for Preparation Click here

DESCRIPTION



When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause increases in exhaust emission levels. High concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent these increases in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the TWC reaches the point of thermal degradation, the ECM blinks the MIL. To monitor misfires, the ECM uses both the Camshaft Position (CMP) sensor and the Crankshaft Position (CKP) sensor. The CMP sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted as when the crankshaft rotation speed variations exceed predetermined thresholds.
If the misfire rate exceeds the threshold level, the ECM illuminates the MIL and stores a DTC.

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Fuel injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve clearance • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306 P0307 P0308	Misfiring of a specific cylinder occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

MONITOR DESCRIPTION

The ECM illuminates the MIL and stores a DTC when either one of the following conditions, which could cause emission deterioration, is detected (2 trip detection logic).

- Within the first 1000 crankshaft revolutions of the engine starting, an excessive misfiring rate (approximately 130 to 160 misfires per 1000 crankshaft revolutions) occurs once.
- An excessive misfiring rate (approximately 130 to 160 misfires per 1000 crankshaft revolutions) occurs a total of 4 times.

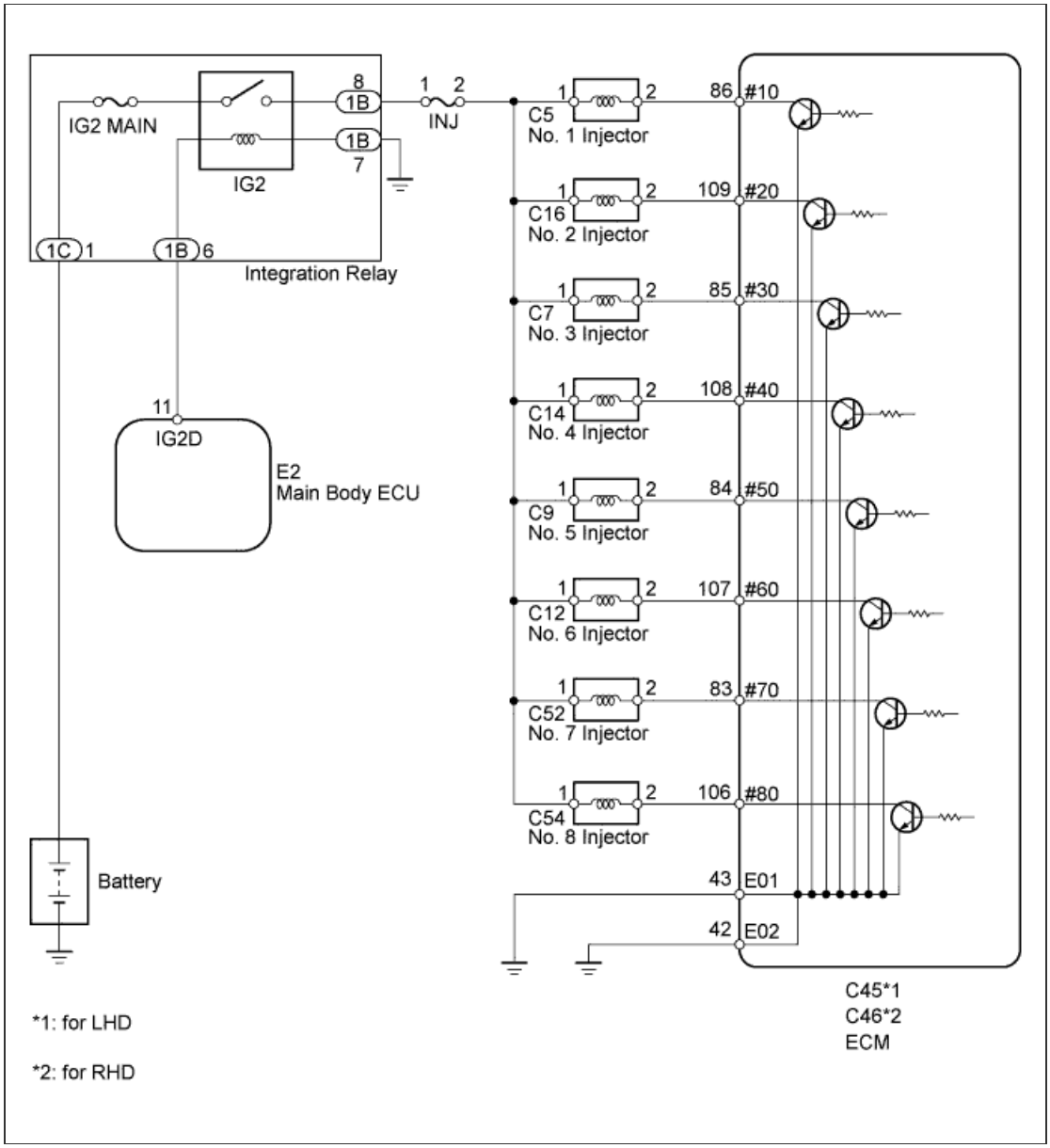
The ECM flashes the MIL and stores a DTC when either one of the following conditions, which could cause damage to the Three-Way Catalytic Converter (TWC), is detected (2 trip detection logic).

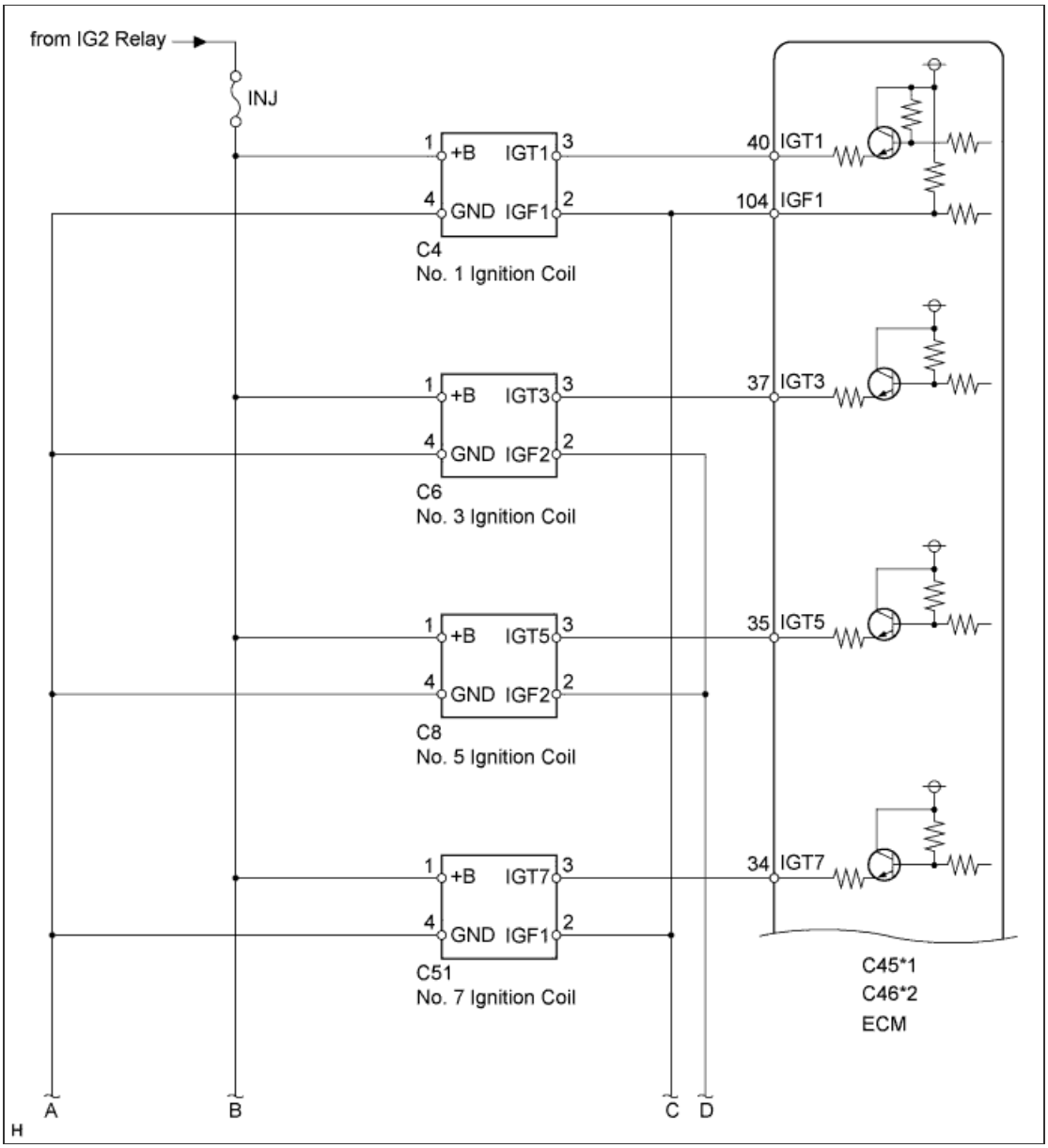
- At a high engine speed, a catalyst damage misfire, which is monitored every 200 crankshaft revolutions, occurs once.
- At a normal engine speed, a catalyst damage misfire, which is monitored every 200 crankshaft revolutions, occurs 3 times.

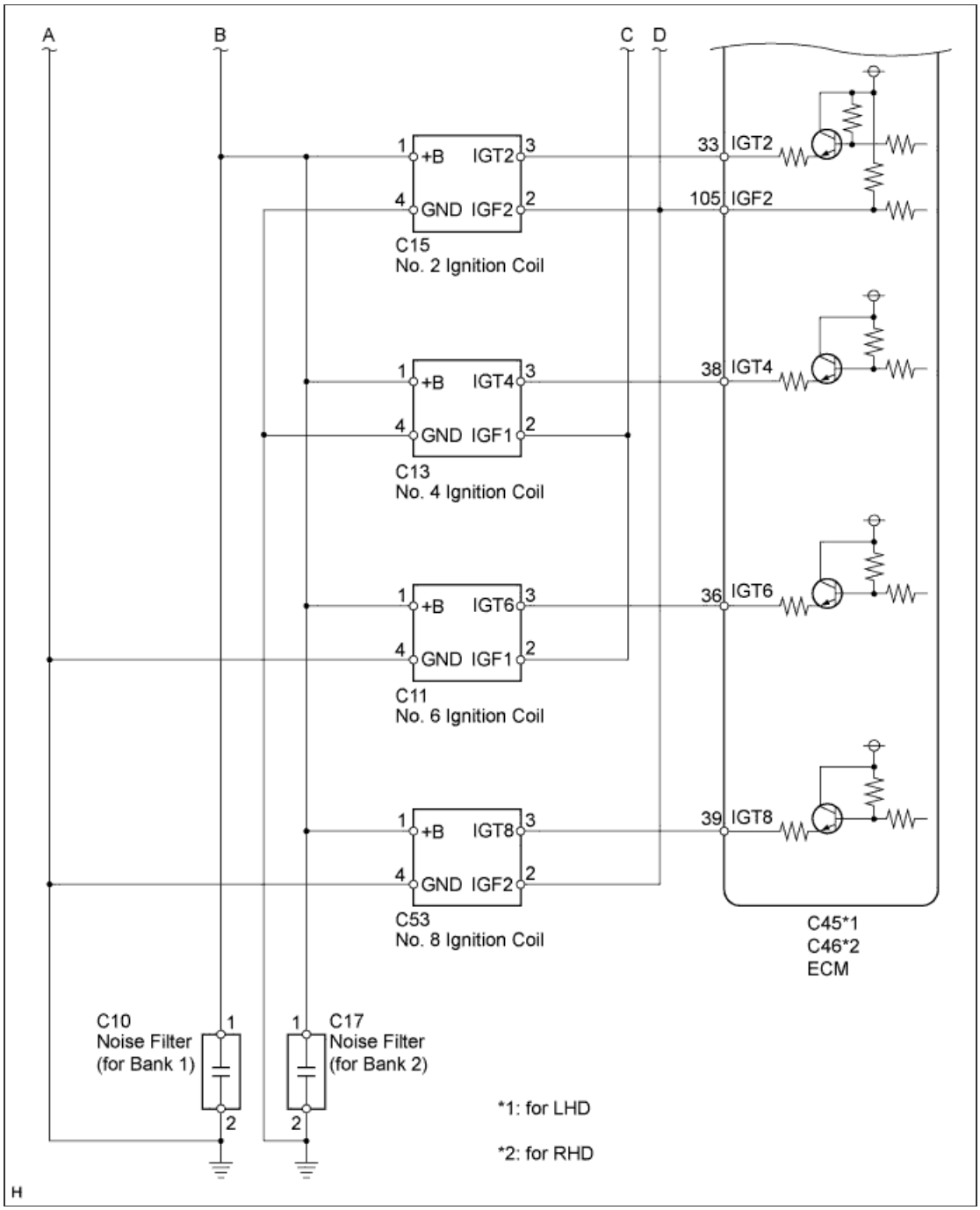
HINT:

If a catalyst damage misfire occurs, the ECM informs the driver by flashing the MIL.

WIRING DIAGRAM




from IG2 Relay
INJ
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
34
IGT7
C45*1
C46*2
ECM
A
B
C
D
H



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Turn the tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire counts of each cylinder (cylinder No. 1 to No. 8) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
7. Drive the vehicle several times with the conditions, such as engine speed and engine load, shown in Misfire RPM and Misfire Load in the Data List.

HINT:

In order to store misfire DTCs, it is necessary to operate the vehicle for the period of time shown in the table below, with the Misfire RPM and Misfire Load in the Data List.

Engine Speed	Duration
Idling	3.5 minutes or more
1000	3 minutes or more
2000	1.5 minutes or more
3000	1 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

   HINT:

   Do not turn the engine switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data will be cleared.

9. Record the DTC(s), freeze frame data and misfire counts.
10. Turn the engine switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the freeze frame data have been duplicated, one of the following factors is considered to be a possible cause of the problem:**
  1. **The fuel level is low.**
  2. **Improper fuel is used.**
  3. **The spark plugs are dirty.**
- **After finishing repairs, check that no misfires occur in each cylinder (cylinder No. 1, No. 2, No. 3, No. 4, No. 5, No. 6, No. 7 and No. 8).**
- **Be sure to confirm that no misfiring cylinder DTCs are output again by conducting the confirmation driving pattern, after the repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speed. If misfires only occur during high engine speed driving, only DTC P0300 is stored.**
  In the event of DTC P0300 being output, perform the following operations:
  1. **Clear the DTC (Click here).**
  2. **Start the engine and conduct the confirmation driving pattern.**
  3. **Read the misfiring rates of each cylinder or DTC(s) using the tester.**
  4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
  5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not output.**
- **When either Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air-fuel ratio may be rich (-20% or less) or lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is below 75°C (167°F), the misfires occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel can cause body vibration, which may cause misfire DTC(s) to be stored.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 is output	A
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 and other DTCs are output	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

3.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is connected correctly and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE (Click here)

OK

4.READ VALUE USING INTELLIGENT TESTER (MISFIRE COUNT)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5, #6, #7 and #8.

f. Allow the engine to idle.

g. Read each value for Cylinder #1 Misfire Count to #8 displayed on the tester. If no misfire counts occur in any cylinders, perform the following procedures:

i. Move the shift lever to D.

ii. Check the Cylinder #1 Misfire Count to #8.

iii. If misfire counts are still not displayed, perform procedure A and and then check the misfire counts again.

h. Drive the vehicle with the Misfire RPM and Misfire Load noted in the Read value using intelligent tester (Misfire RPM and Misfire Load) procedures above (procedure A).

i. Read the Cylinder #1 Misfire Count to #8 or DTCs displayed on the tester (procedure).

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have e ual misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data record of the Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → Go to step 17

A

5.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

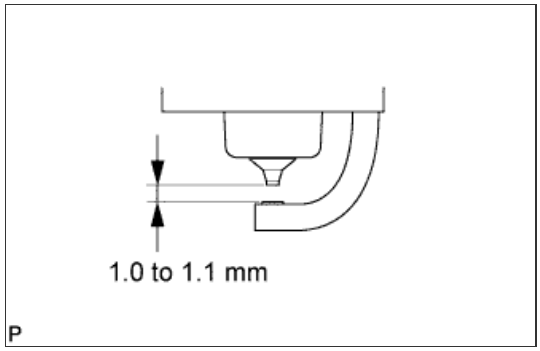
b. Measure the spark plug electrode gap.

Standard gap:
1.0 to 1.1 mm (0.039 to 0.043 in.)

c. Check the electrode for carbon deposits.

Recommended Spark Plug:

Manufacturer	Product
DENSO	SK20R11
NGK	IFR6A11



NOTICE:

If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.

NG → REPLACE SPARK PLUG (Click here)

OK

6.CHECK FOR SPARKS AND IGNITION

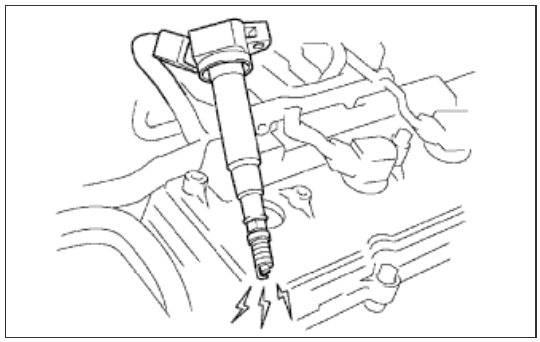
a. Disconnect the fuel injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.



b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → REPAIR ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK HARNESS AND CONNECTOR (ECM - FUEL INJECTOR)

a. Disconnect the fuel injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	C16-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 3	C7-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	C14-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	C9-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	C12-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	C52-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	C54-1 - Ground	Engine switch on (IG)	11 to 14 V

d. Turn the engine switch off.

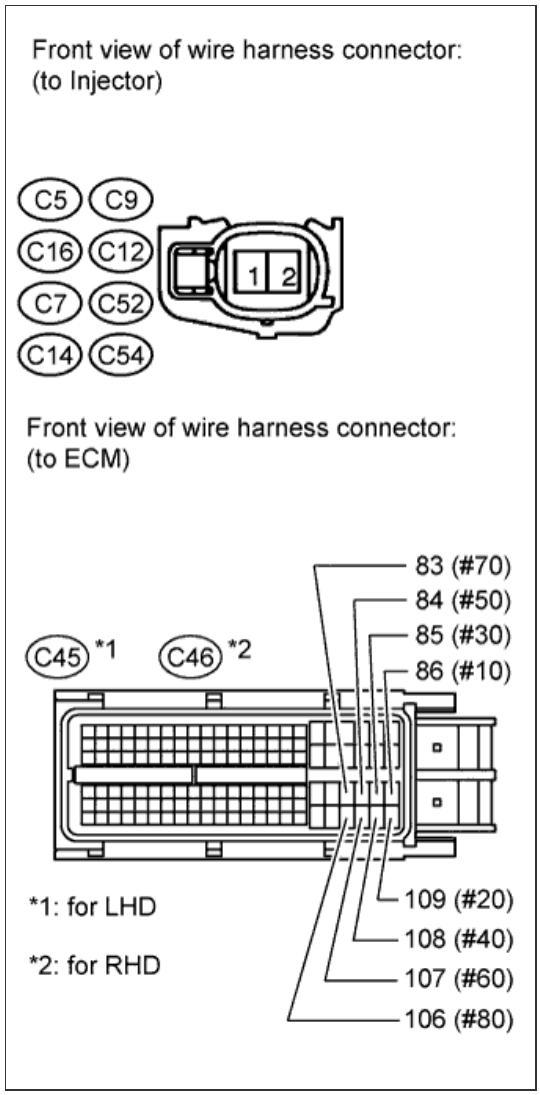
e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C45-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C45-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C45-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C45-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C45-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C45-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C45-106 (#80)	Always	Below 1 Ω

Standard Resistance (for RHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher



	C5-2 - C46-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C46-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C46-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C46-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C46-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C46-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C46-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C46-106 (#80)	Always	Below 1 Ω

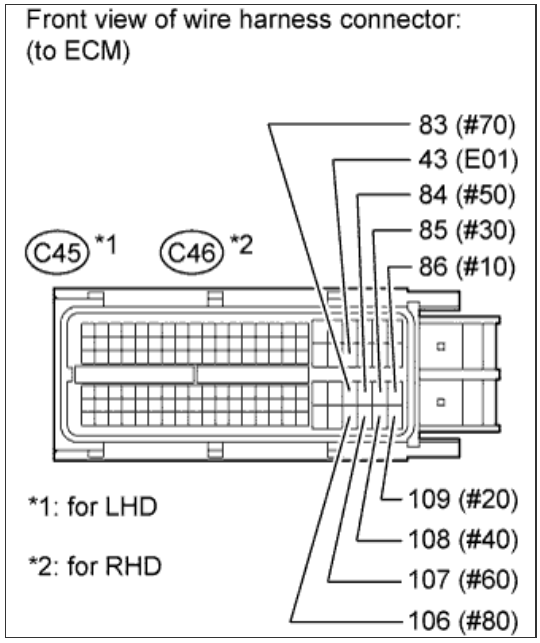
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50, #60, #70 AND/OR #80 VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage (for LHD):

Tester Connection	Switch Condition	Specified Condition
C45-86 (#10) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-109 (#20) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-85 (#30) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-108 (#40) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-84 (#50) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-107 (#60) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-83 (#70) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-106 (#80) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V

Standard Voltage (for RHD):

Tester Connection	Switch Condition	Specified Condition
C46-86 (#10) -	Engine switch on	

C46-43 (E01)	(IG)	11 to 14 V
C46-109 (#20) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-85 (#30) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-108 (#40) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-84 (#50) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-107 (#60) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-83 (#70) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-106 (#80) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK

11.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

12.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (**Click here**)

OK

13.CHECK VALVE TIMING

a. Remove the drive belt (Click here).

b. Remove the timing belt cover LH and RH (Click here).

c. Turn the crankshaft to align the matchmarks of the crankshaft.

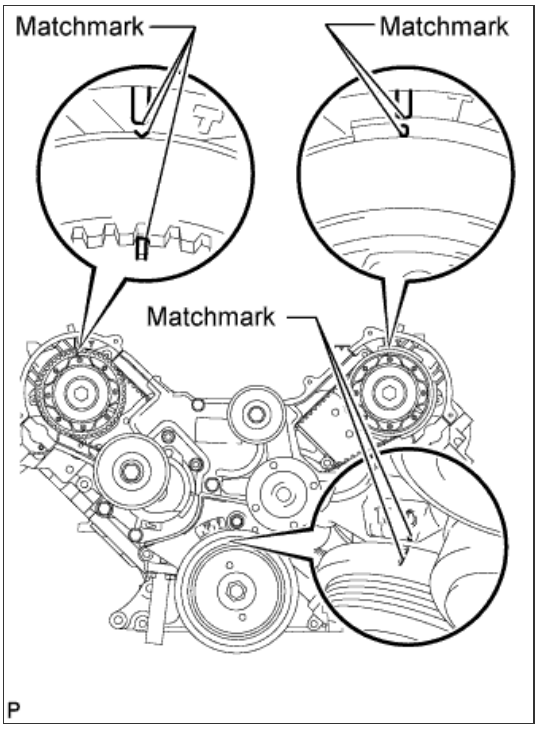
d. Align the notch of the crankshaft pulley with the 0 position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360 . Confirm again if the matchmarks are facing each other.

OK:

The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NG → ADJUST VALVE TIMING (Click here)

OK ↓

14.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK AND REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER

OK ↓

15.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:

With cold engine: Same as ambient air temperature.

With warm engine: Between 80°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK ↓

16.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK ↓

REPLACE ECM (Click here)

17.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

18.CHECK VALVE TIMING

a. Remove the drive belt (Click here).

b. Remove the timing belt cover LH and RH (Click here).

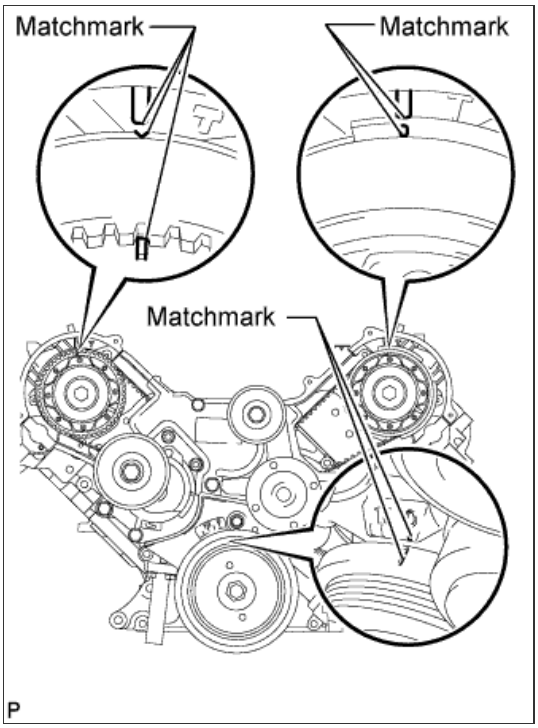
c. Turn the crankshaft to align the matchmarks of the crankshaft.

d. Align the notch of the crankshaft pulley with the 0 position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360 . Confirm again if the matchmarks are facing each other.

OK:
The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NG → ADJUST VALVE TIMING (Click here)

OK

19.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK AND REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER

OK

20.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: Between 80°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

21.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

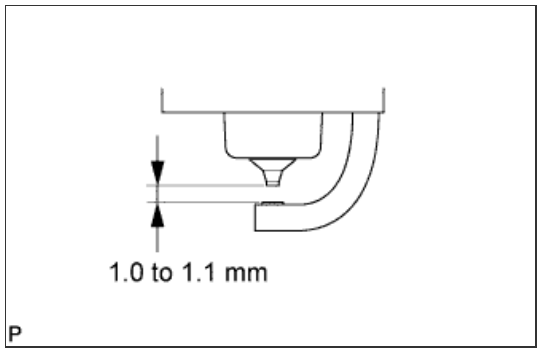
OK

22.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

b. Measure the spark plug electrode gap.

Standard gap:
1.0 to 1.1 mm (0.039 to 0.043 in.)



c. Check the electrode for carbon deposits.

Recommended Spark Plug:

Manufacturer	Product
DENSO	SK20R11
NGK	IFR6A11

NOTICE:

If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.

NG → REPLACE SPARK PLUG (Click here)

OK

23.CHECK FOR SPARKS AND IGNITION

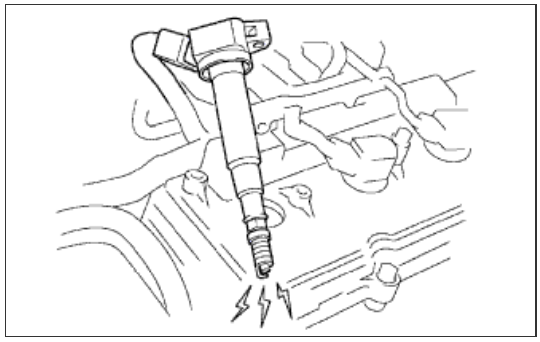
a. Disconnect the fuel injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.



b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

24.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → REPAIR ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

25.CHECK HARNESS AND CONNECTOR (ECM - FUEL INJECTOR)

a. Disconnect the fuel injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

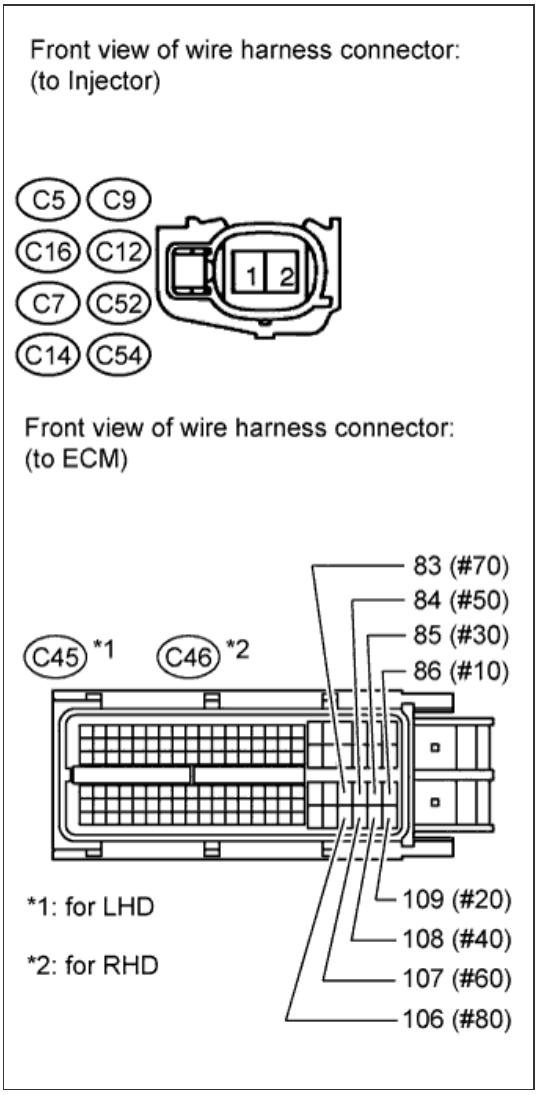
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	C16-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 3	C7-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	C14-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	C9-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	C12-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	C52-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	C54-1 - Ground	Engine switch on (IG)	11 to 14 V

d. Turn the engine switch off.

e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C45-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C45-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C45-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C45-84 (#50)	Always	Below 1 Ω
	C12-2 - Ground	Always	10 kΩ or higher



No. 6	C12-2 - C45-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C45-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C45-106 (#80)	Always	Below 1 Ω

Standard Resistance (for RHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C46-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C46-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C46-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C46-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C46-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C46-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C46-106 (#80)	Always	Below 1 Ω

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50, #60, #70 AND/OR #80 VOLTAGE)

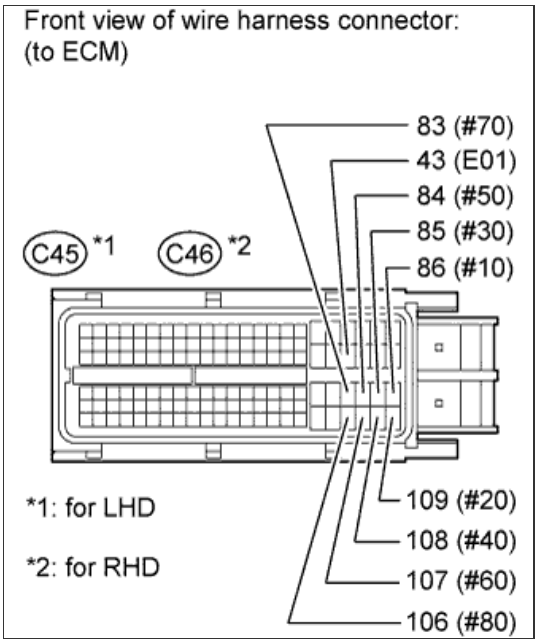
a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage (for LHD):

Tester Connection	Switch Condition	Specified Condition
C45-86 (#10) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-109 (#20) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-85 (#30) -	Engine switch on	11 to 14 V

C45-43 (E01)	(IG)	
C45-108 (#40) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-84 (#50) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-107 (#60) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-83 (#70) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-106 (#80) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V



Standard Voltage (for RHD):

Tester Connection	Switch Condition	Specified Condition
C46-86 (#10) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-109 (#20) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-85 (#30) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-108 (#40) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-84 (#50) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-107 (#60) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-83 (#70) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-106 (#80) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

27.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK

28.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

REPLACE ECM (**Click here**)

29.CHANGE TO NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the installed spark plug with a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → Go to step 30

OK

REPLACE SPARK PLUG (Click here)

30.CHANGE TO NORMAL IGNITION COIL AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the ignition coil with an ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK

REPLACE IGNITION COIL (Click here)

DTC P2195 Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)

DTC P2196 Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)

DTC P2197 Oxygen (A/F) Sensor Signal Stuck Lean (Bank 2 Sensor 1)

DTC P2198 Oxygen (A/F) Sensor Signal Stuck Rich (Bank 2 Sensor 1)

for Preparation Click here

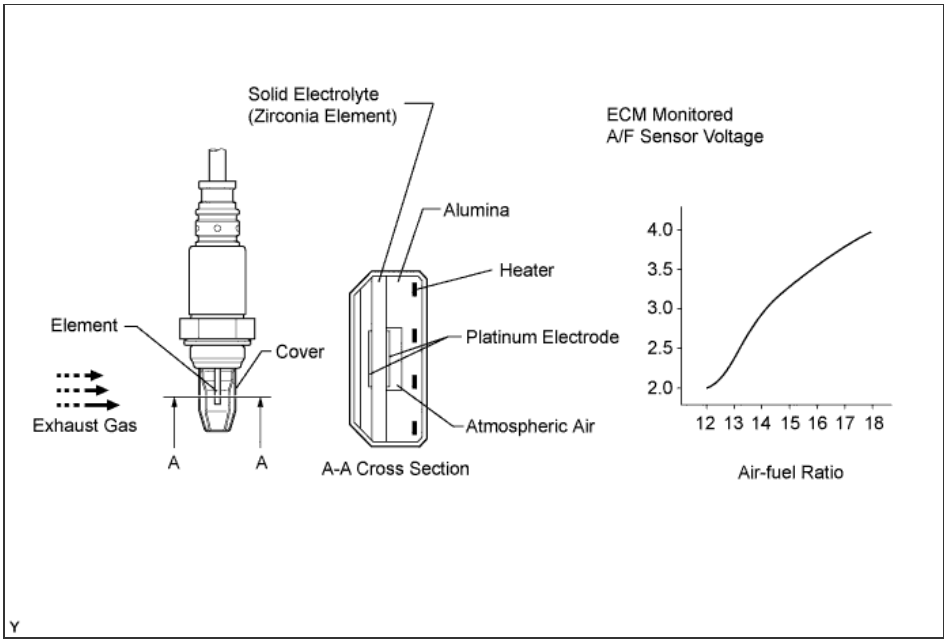
DESCRIPTION

The A/F sensor generates a voltage* that corresponds to the actual air-fuel ratio. This sensor voltage is used to provide the ECM with feedback so that it can control the air-fuel ratio. The ECM determines the deviation from the stoichiometric air-fuel ratio level, and regulates the fuel injection time. If the A/F sensor malfunctions, the ECM is unable to control the air-fuel ratio accurately.

The A/F sensor is the planar type and is integrated with the heater, which heats the solid electrolyte (zirconia element). This heater is controlled by the ECM. When the intake air volume is low (the exhaust gas temperature is low), a current flows into the heater to heat the sensor in order to facilitate accurate air-fuel ratio detection. In addition, the sensor and heater portions are the narrow type. The heat generated by the heater is conducted to the solid electrolyte through the alumina, therefore the sensor activation is accelerated.

In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric level.

*: The value changes inside the ECM. Since the A/F sensor is the current output element, a current is converted into a voltage inside the ECM. Any measurements taken at the A/F sensor or ECM connectors will show a constant voltage.



DTC Code	DTC Detection Condition	Trouble Area
P2195 P2197	Conditions (a) and (b) continue for 5 seconds or more (2 trip detection logic): (a) The A/F sensor voltage is higher than 3.8 V for 5 seconds. (b) The Heated Oxygen (HO2) sensor voltage is 0.21 V or higher.	• Open or short in A/F sensor (for sensor 1) circuit • A/F sensor (for sensor 1) • A/F sensor heater (for sensor 1) • Integration relay • A/F sensor heater and integration relay circuits • Air induction system • Fuel pressure • Injector • ECM
	While the fuel-cut operation is performed (during vehicle deceleration), the A/F sensor current is 3.6 mA or higher for 3 seconds (2 trip detection logic).	• A/F sensor • ECM
P2196 P2198	Conditions (a) and (b) continue for 5 seconds or more (2 trip detection logic): (a) The A/F sensor voltage is below 2.8 V for 5 seconds. (b) The HO2 sensor voltage is below 0.59 V.	• Open or short in A/F sensor (for sensor 1) circuit • A/F sensor (for sensor 1) • A/F sensor heater (for sensor 1) • Integration relay • A/F sensor heater and integration relay circuits • Air induction system • Fuel pressure • Injector • ECM
	While the fuel-cut operation is performed (during vehicle deceleration), the A/F sensor current is below 1.4 mA for 3 seconds (2 trip detection logic).	• A/F sensor • ECM

HINT:

- **DTCs P2195 and P2196 indicate malfunctions related to bank 1 A/F sensor circuit.**
- **DTCs P2197 and P2198 indicate malfunctions related to bank 2 A/F sensor circuit.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that includes the No. 2 cylinder.**

- **When either of these DTCs is output, check the A/F sensor output voltage by entering the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS B1 S1 or AFS B2 S1.**
- **Short-term fuel trim values can also be read using the intelligent tester.**
- **The ECM regulates the voltages at the A1A+ and A1A- or A2A+ and A2A- terminals of the ECM to a constant level. Therefore, the A/F sensor output voltage cannot be confirmed without using the intelligent tester.**
- **If the A/F sensor is malfunctioning, the ECM stores DTC P2195, P2196, P2197 or P2198.**

MONITOR DESCRIPTION

Sensor voltage detection monitor

Under the air-fuel ratio feedback control, if the A/F sensor output voltage indicates rich or lean for a certain period of time, the ECM determines that there is a malfunction in the A/F sensor. The ECM illuminates the MIL and stores a DTC.

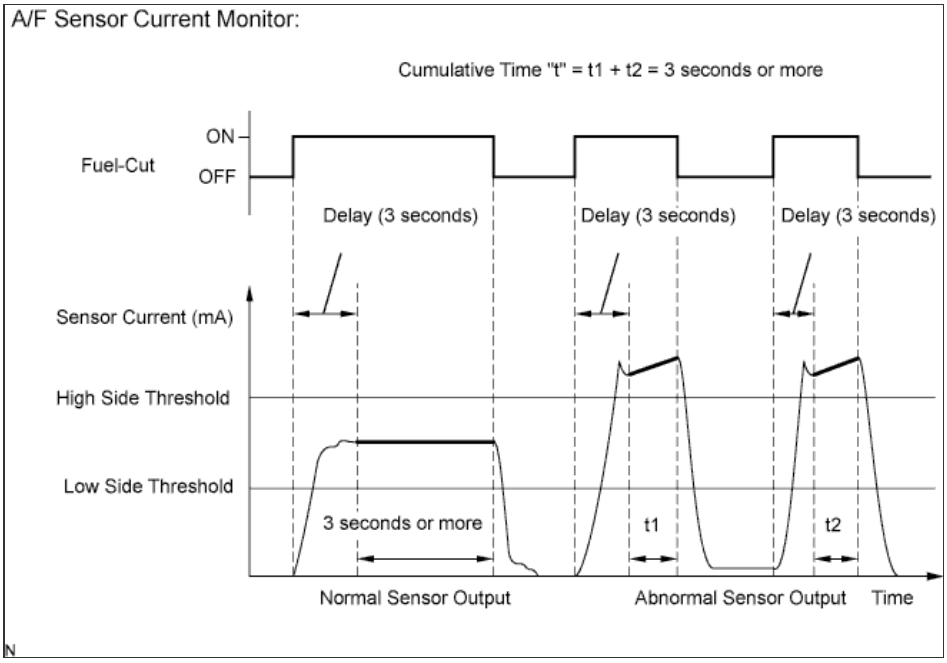
Example:

If the A/F sensor output voltage is below 2.8 V (very rich condition) for 5 seconds, despite the rear HO2 sensor output voltage being below 0.59 V, the ECM stores DTC P2196 or P2198. Alternatively, if the A/F sensor output voltage is higher than 3.8 V (very lean condition) for 5 seconds despite the rear HO2 sensor output voltage being 0.21 V or higher, DTC P2195 or P2197 is stored.

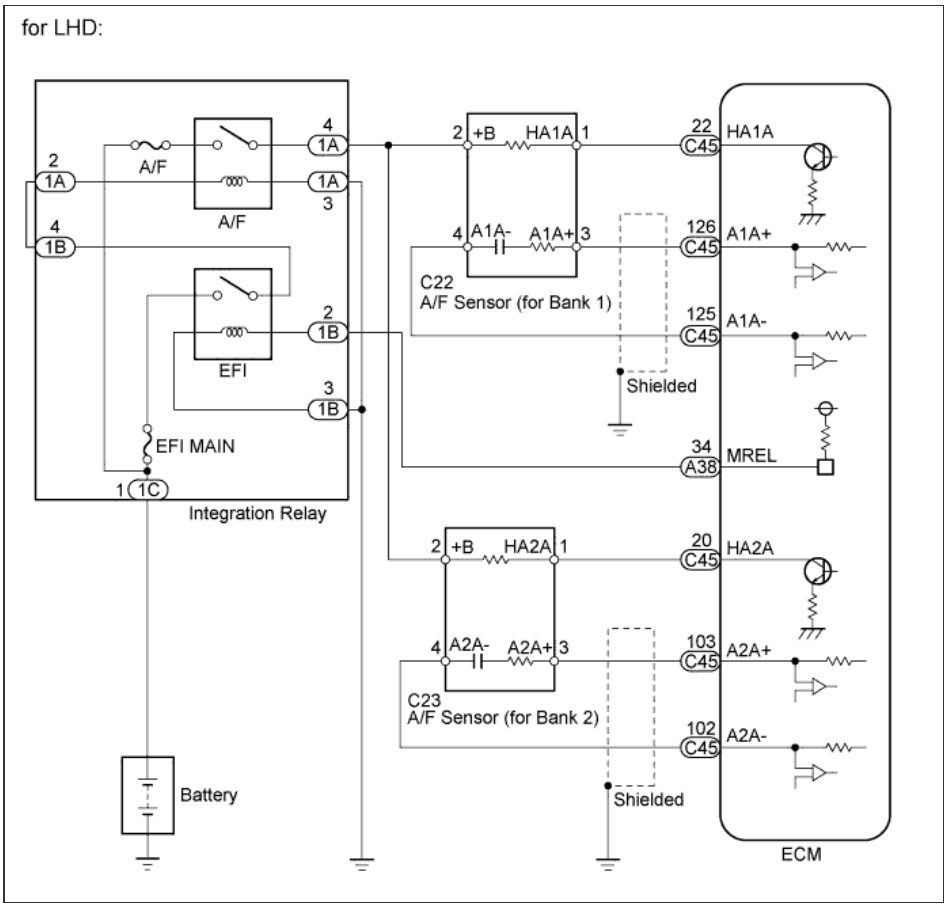
Sensor current detection monitor

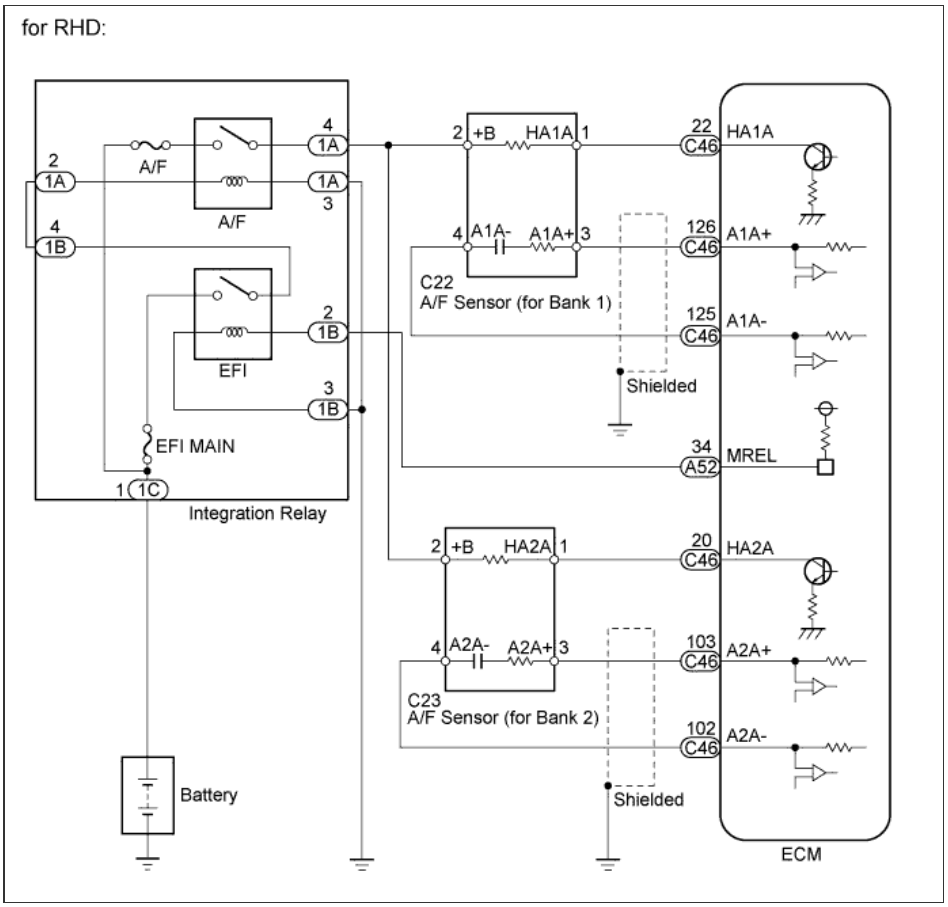
A rich air-fuel mixture causes a low A/F sensor current, and a lean air-fuel mixture causes a high A/F sensor current. Therefore, the sensor output becomes low during acceleration, and it becomes high during deceleration with the throttle valve fully closed. The ECM monitors the A/F sensor current during fuel-cut and detects any abnormal current values.

If the A/F sensor output is 3.6 mA or higher for more than 3 seconds of cumulative time, the ECM interprets this as a malfunction in the A/F sensor and stores DTC P2195 or P2197 (high-side stuck). If the A/F sensor output is below 1.4 mA for more than 3 seconds of cumulative time, the ECM stores DTC P2196 or P2198 (low-side stuck).



WIRING DIAGRAM



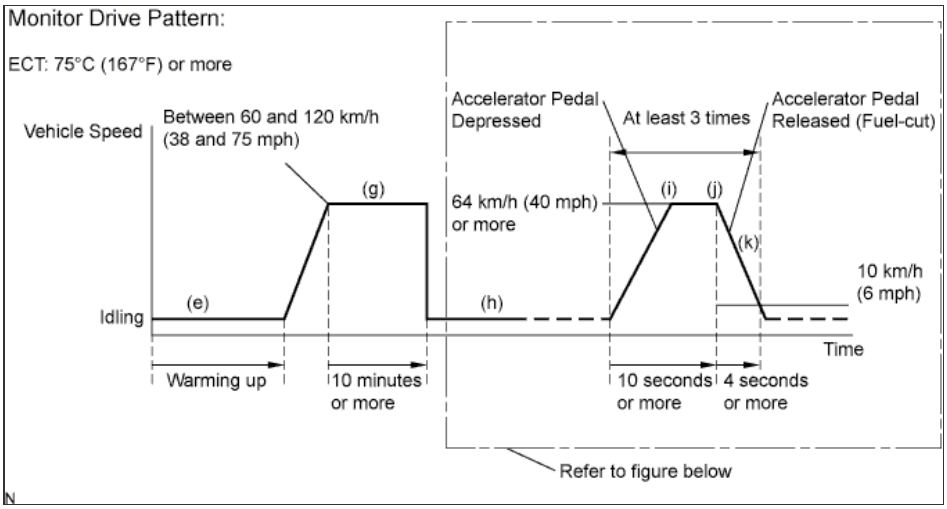


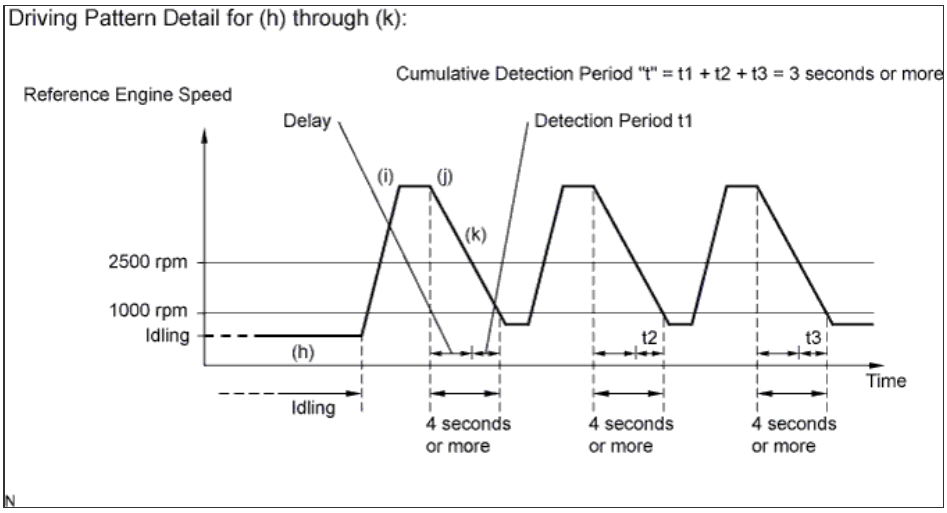
CONFIRMATION DRIVING PATTERN

CAUTION:

Strictly observe posted speed limits, traffic laws, and road conditions when performing these drive patterns.

This confirmation driving pattern is used in the "Perform Confirmation Driving Pattern" procedure of the following diagnostic troubleshooting procedure.





(a) Connect the intelligent tester to the DLC3.
(b) Turn the engine switch on (IG).
(c) Turn the tester on.
(d) Clear DTCs (Click here).
(e) Start the engine, and warm it up until the ECT reaches 75°C (167°F) or higher.
(f) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Idle Fuel Cut.
(g) Drive the vehicle at between 60 km/h (38 mph) and 120 km/h (75 mph) for at least 10 minutes.
(h) Change the transmission to 2nd gear.
(i) Drive the vehicle at the proper vehicle speed to perform fuel-cut operation.

HINT:

Fuel-cut is performed when the following conditions are met:

- **Accelerator pedal fully released.**
- **Engine speed is 2500 rpm or more (fuel injection returns at 1000 rpm).**

(j) Accelerate the vehicle to 64 km/h (40 mph) or more by depressing the accelerator pedal for at least 10 seconds.
(k) Soon after performing step (j) above, release the accelerator pedal for at least 4 seconds without depressing the brake pedal, in order to execute fuel-cut control.
(l) Allow the vehicle to decelerate until the vehicle speed decreases to less than 10 km/h (6 mph).
(m) Repeat steps (h) through (k) above at least 3 times in one driving cycle.

HINT:

Completion of all O2S (A/F) Monitor is required to change the value in the Data List.

INSPECTION PROCEDURE

HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air-Fuel Ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**
- **DTC P2A00 may be stored when the air-fuel ratio is stuck rich or lean.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.**
- **A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.**

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F Sensor function provided in the Active Test. The Control the Injection Volume for A/F Sensor function can help to determine whether the Air-fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F Sensor operation using the tester.

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor.
(e) Perform the Control the Injection Volume for A/F Sensor operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

HINT:

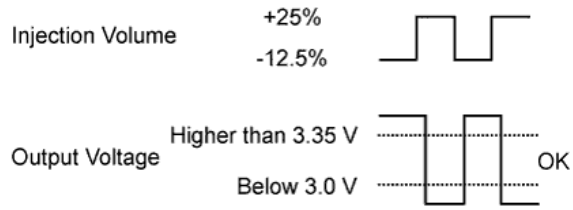
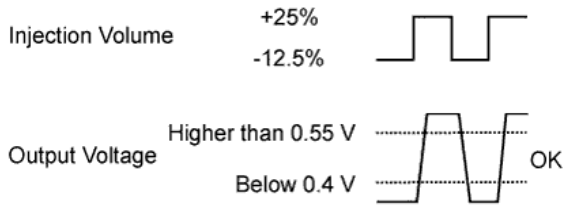
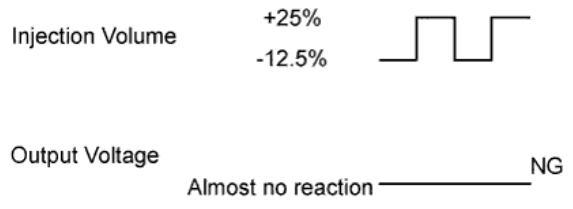
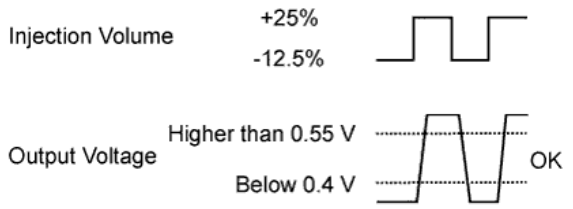
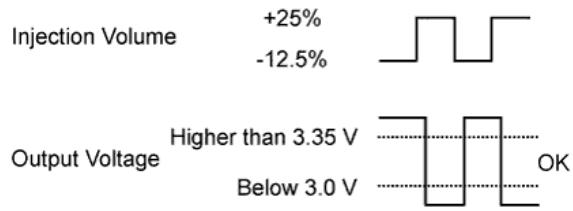
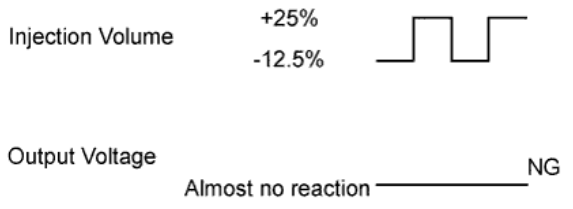
- **The Control the Injection Volume for A/F Sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **The sensors react in accordance with increases and decreases in the fuel injection volume.**

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor (for sensor 2) output has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors. To display the graph, enter the following menus on the tester: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/ F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P2195, P2196, P2197 or P2198 is output	A
P2195, P2196, P2197 or P2198 and other DTCs are output	B

HINT:

If any DTCs relating to the A/F sensor (DTCs for the A/F sensor heater or A/F sensor admittance) are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (TEST VALUE OF A/F SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the vehicle to drive in accordance with the drive pattern described in the Confirmation Driving Pattern.

f. Enter the following menus: Powertrain / Engine and ECT / Data List / Monitor Status.

g. Check that the status of O2S (A/FS) Monitor is Complete.
If the status is still Incomplete, drive the vehicle according to the driving pattern again.

HINT:

- **Complete indicates that the component is functioning normally.**
- **Incomplete indicates that the component is malfunctioning.**

h. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS B1 S1 or AFS B2 S1.

i. Check the test value of the A/F sensor output current during fuel-cut.

Result

Test Value	Proceed to
Within normal range (1.4 mA or higher, and below 3.6 mA)	A
Outside normal range (Below 1.4 mA, or 3.6 mA or higher)	B

B → Go to step 12

A

3.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF A/F SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Warm up the A/F sensor at an engine speed of 2500 rpm for 90 seconds.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / Snapshot / AFS B1 S1 or AFS B2 S1 and Engine Speed.

f. Check the A/F sensor voltage 3 times, when the engine is in each of the following conditions:

i. While idling (check for at least 30 seconds).

ii. At an engine speed of approximately 2500 rpm (without any sudden changes in engine speed).

iii. Raise the engine speed to 4000 rpm and then quickly release the accelerator pedal so that the throttle valve is fully closed.

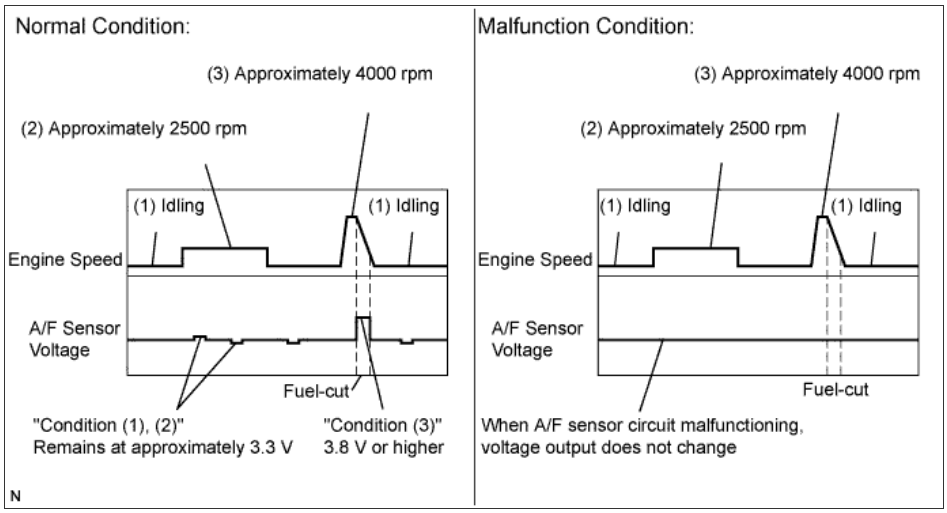
Standard Voltage:

Condition	A/F Sensor Voltage Variation	Reference
(1) and (2)	Remains at approximately 3.3 V	3.1 V to 3.5 V
		This occurs during

(3)	Increases to 3.8 V or higher	engine deceleration (when fuel-cut performed)

HINT:

- **For more information, see the diagrams below.**



- **If the output voltage of the A/F sensor remains at approximately 3.3 V (see Malfunction Condition diagram) under any conditions, including those above, the A/F sensor may have an open circuit (this will also happen if the A/F sensor heater has an open circuit).**
- **If the output voltage of the A/F sensor remains at either approximately 3.8 V or higher, or 2.8 V or less (see Malfunction Condition diagram) under any conditions, including those above, the A/F sensor may have a short circuit.**
- **The ECM stops fuel injection (fuel cut) during engine deceleration. This causes a lean condition and results in a momentary increase in the A/F sensor output voltage.**
- **The ECM must establish a closed throttle valve position learning value to perform fuel cut. If the battery terminal has been reconnected, the vehicle must be driven over 16 km/h (10 mph) to allow the ECM to learn the closed throttle valve position.**
- **When the vehicle is driven:**
  The output voltage of the A/F sensor may be below 2.8 V during fuel enrichment. For the vehicle, this translates to a sudden increase in speed with the accelerator pedal fully depressed when trying to overtake another vehicle. The A/F sensor is functioning normally.
- **The A/F sensor is a current output element; therefore, the current is converted into a voltage inside the ECM. Measuring the voltage at the connectors of the A/F sensor or ECM will show a constant voltage result.**

NG → **Go to step 9**

OK

4.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

b. Read pending DTCs.

Result

Result	Proceed to
P2195, P2196, P2197 or P2198 is output	A
No DTC is output	B

B → **END**

A

6.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

7.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

b. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2195, P2196, P2197 or P2198 is output	B

B → REPLACE ECM (Click here)

A

END

9.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

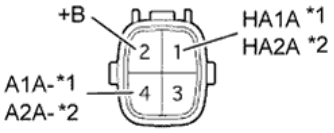
a. Disconnect the Air-Fuel Ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

Component without harness connected: (A/F Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

10.INSPECT INTEGRATION NO.1 RELAY (A/F)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

iii. Reinstall the A/F fuse.

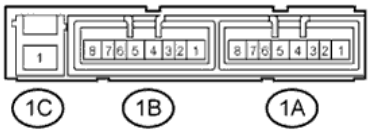
c. Inspect the integration relay (A/F).

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1A-4	Battery voltage not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω

Component without harness connected: (Integration Relay)



NG → REPLACE INTEGRATION NO.1 RELAY (A/F)

OK

11.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

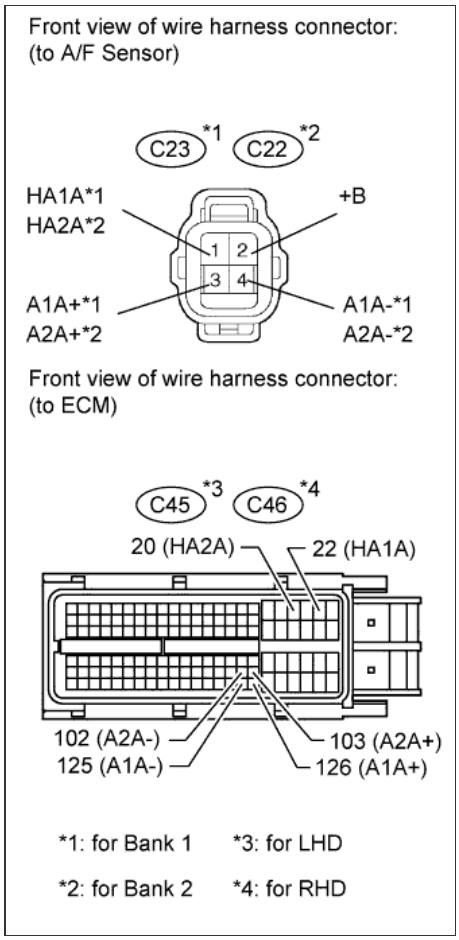
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.



e. Measure the resistance according to the value(s) in the table below.

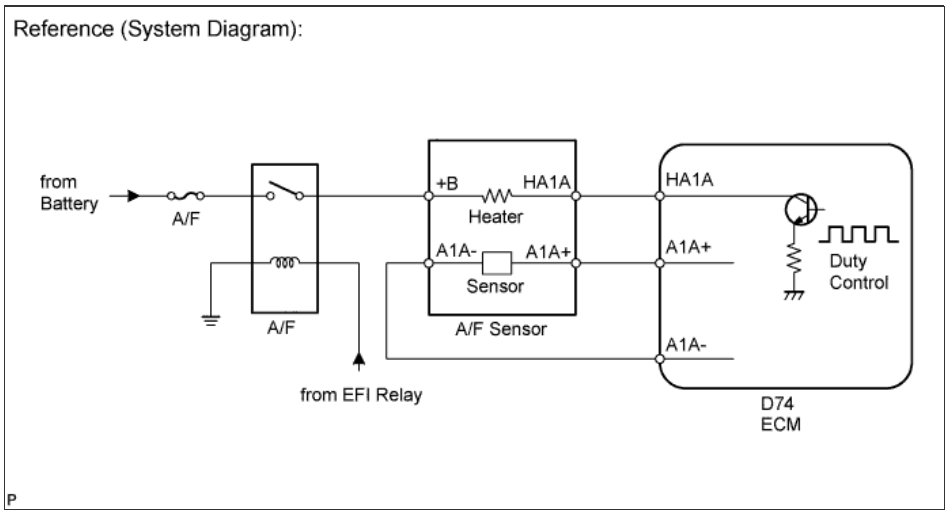
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C46-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



P

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

12.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

13.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

14.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

b. Read pending DTCs.

Result

Result	Proceed to

No DTC is output	A
P2195, P2196, P2197 or P2198 is output	B

B → REPLACE ECM (Click here)

A

END

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

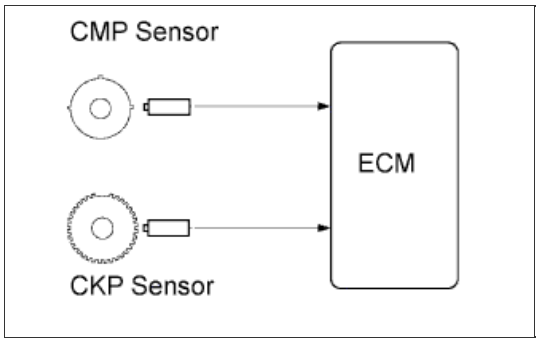
DTC P0306 Cylinder 6 Misfire Detected

DTC P0307 Cylinder 7 Misfire Detected

DTC P0308 Cylinder 8 Misfire Detected

for Preparation Click here

DESCRIPTION



When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause increases in exhaust emission levels. High concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent these increases in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the TWC reaches the point of thermal degradation, the ECM blinks the MIL. To monitor misfires, the ECM uses both the Camshaft Position (CMP) sensor and the Crankshaft Position (CKP) sensor. The CMP sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted as when the crankshaft rotation speed variations exceed predetermined thresholds.
If the misfire rate exceeds the threshold level, the ECM illuminates the MIL and stores a DTC.

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Fuel injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve clearance • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306 P0307 P0308	Misfiring of a specific cylinder occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

MONITOR DESCRIPTION

The ECM illuminates the MIL and stores a DTC when either one of the following conditions, which could cause emission deterioration, is detected (2 trip detection logic).

- Within the first 1000 crankshaft revolutions of the engine starting, an excessive misfiring rate (approximately 130 to 160 misfires per 1000 crankshaft revolutions) occurs once.
- An excessive misfiring rate (approximately 130 to 160 misfires per 1000 crankshaft revolutions) occurs a total of 4 times.

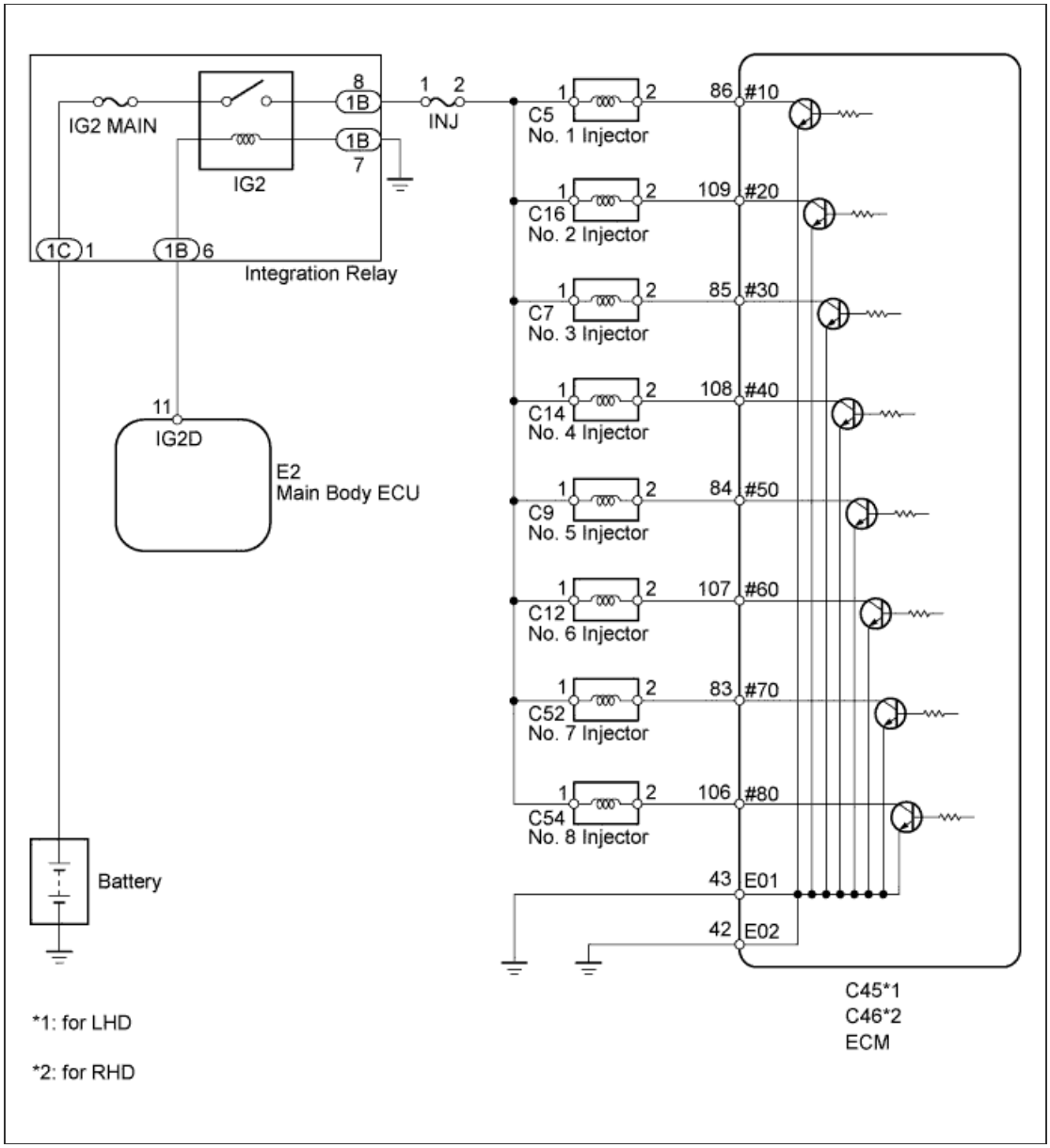
The ECM flashes the MIL and stores a DTC when either one of the following conditions, which could cause damage to the Three-Way Catalytic Converter (TWC), is detected (2 trip detection logic).

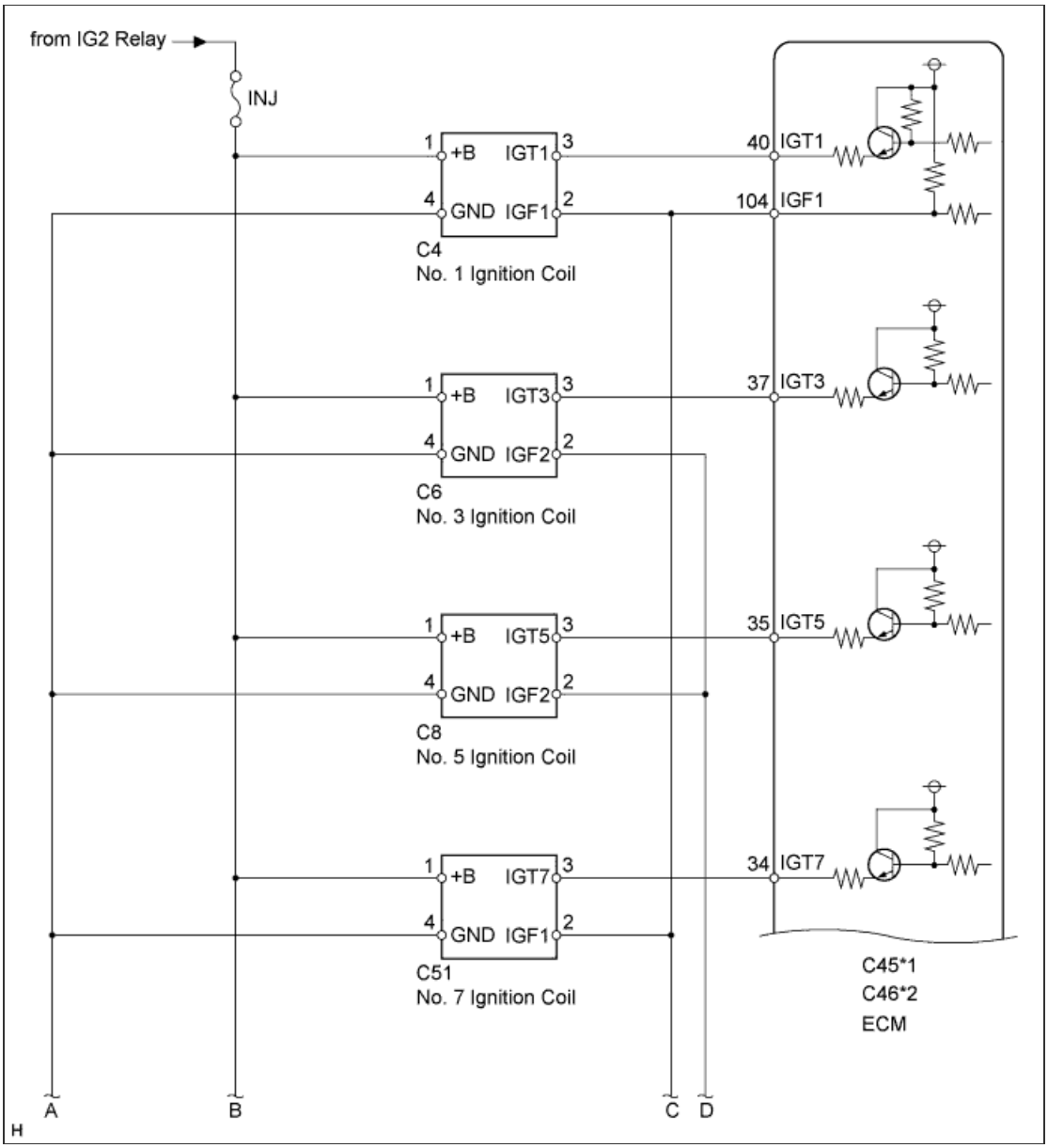
- At a high engine speed, a catalyst damage misfire, which is monitored every 200 crankshaft revolutions, occurs once.
- At a normal engine speed, a catalyst damage misfire, which is monitored every 200 crankshaft revolutions, occurs 3 times.

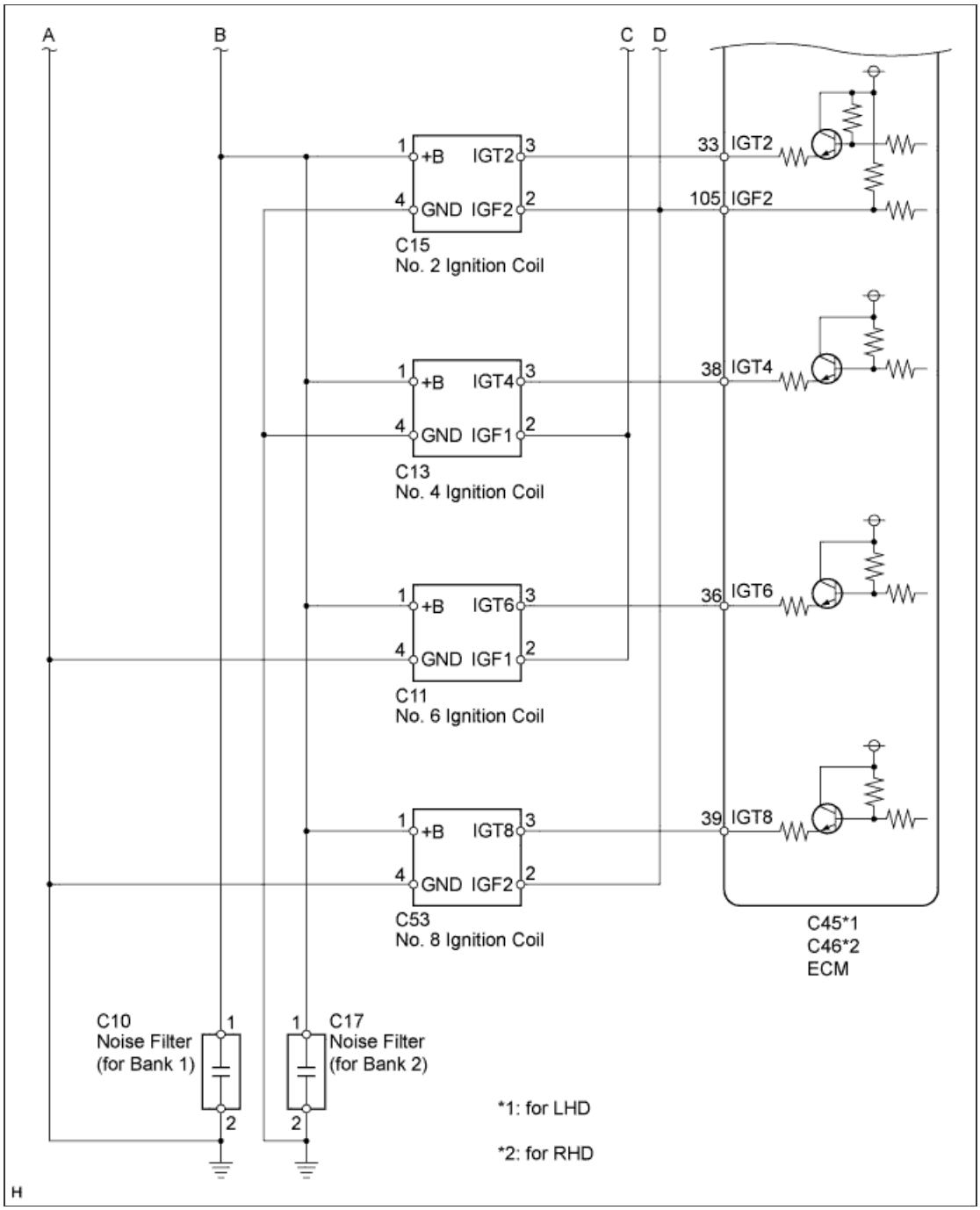
HINT:

If a catalyst damage misfire occurs, the ECM informs the driver by flashing the MIL.

WIRING DIAGRAM




from IG2 Relay
INJ
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
34
IGT7
C45*1
C46*2
ECM
A
B
C
D
H



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Turn the tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire counts of each cylinder (cylinder No. 1 to No. 8) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
7. Drive the vehicle several times with the conditions, such as engine speed and engine load, shown in Misfire RPM and Misfire Load in the Data List.

HINT:

In order to store misfire DTCs, it is necessary to operate the vehicle for the period of time shown in the table below, with the Misfire RPM and Misfire Load in the Data List.

Engine Speed	Duration
Idling	3.5 minutes or more
1000	3 minutes or more
2000	1.5 minutes or more
3000	1 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

   HINT:

   Do not turn the engine switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data will be cleared.

9. Record the DTC(s), freeze frame data and misfire counts.
10. Turn the engine switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the freeze frame data have been duplicated, one of the following factors is considered to be a possible cause of the problem:**
  1. **The fuel level is low.**
  2. **Improper fuel is used.**
  3. **The spark plugs are dirty.**
- **After finishing repairs, check that no misfires occur in each cylinder (cylinder No. 1, No. 2, No. 3, No. 4, No. 5, No. 6, No. 7 and No. 8).**
- **Be sure to confirm that no misfiring cylinder DTCs are output again by conducting the confirmation driving pattern, after the repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speed. If misfires only occur during high engine speed driving, only DTC P0300 is stored.**
  In the event of DTC P0300 being output, perform the following operations:
  1. **Clear the DTC (Click here).**
  2. **Start the engine and conduct the confirmation driving pattern.**
  3. **Read the misfiring rates of each cylinder or DTC(s) using the tester.**
  4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
  5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not output.**
- **When either Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air-fuel ratio may be rich (-20% or less) or lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is below 75°C (167°F), the misfires occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel can cause body vibration, which may cause misfire DTC(s) to be stored.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 is output	A
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 and other DTCs are output	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

3.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is connected correctly and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE (Click here)

OK

4.READ VALUE USING INTELLIGENT TESTER (MISFIRE COUNT)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5, #6, #7 and #8.

f. Allow the engine to idle.

g. Read each value for Cylinder #1 Misfire Count to #8 displayed on the tester. If no misfire counts occur in any cylinders, perform the following procedures:

i. Move the shift lever to D.

ii. Check the Cylinder #1 Misfire Count to #8.

iii. If misfire counts are still not displayed, perform procedure A and and then check the misfire counts again.

h. Drive the vehicle with the Misfire RPM and Misfire Load noted in the Read value using intelligent tester (Misfire RPM and Misfire Load) procedures above (procedure A).

i. Read the Cylinder #1 Misfire Count to #8 or DTCs displayed on the tester (procedure).

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have e ual misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data record of the Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → Go to step 17

A

5.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

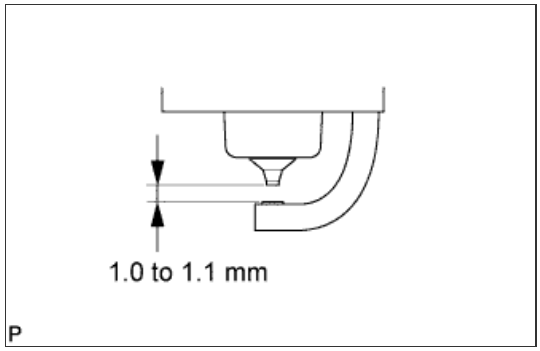
b. Measure the spark plug electrode gap.

Standard gap:
1.0 to 1.1 mm (0.039 to 0.043 in.)

c. Check the electrode for carbon deposits.

Recommended Spark Plug:

Manufacturer	Product
DENSO	SK20R11
NGK	IFR6A11



NOTICE:

If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.

NG → REPLACE SPARK PLUG (Click here)

OK

6.CHECK FOR SPARKS AND IGNITION

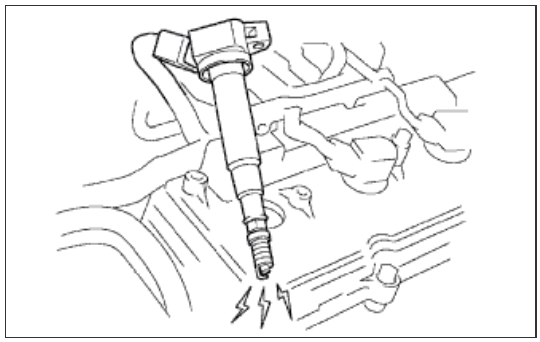
a. Disconnect the fuel injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.



b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → REPAIR ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK HARNESS AND CONNECTOR (ECM - FUEL INJECTOR)

a. Disconnect the fuel injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	C16-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 3	C7-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	C14-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	C9-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	C12-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	C52-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	C54-1 - Ground	Engine switch on (IG)	11 to 14 V

d. Turn the engine switch off.

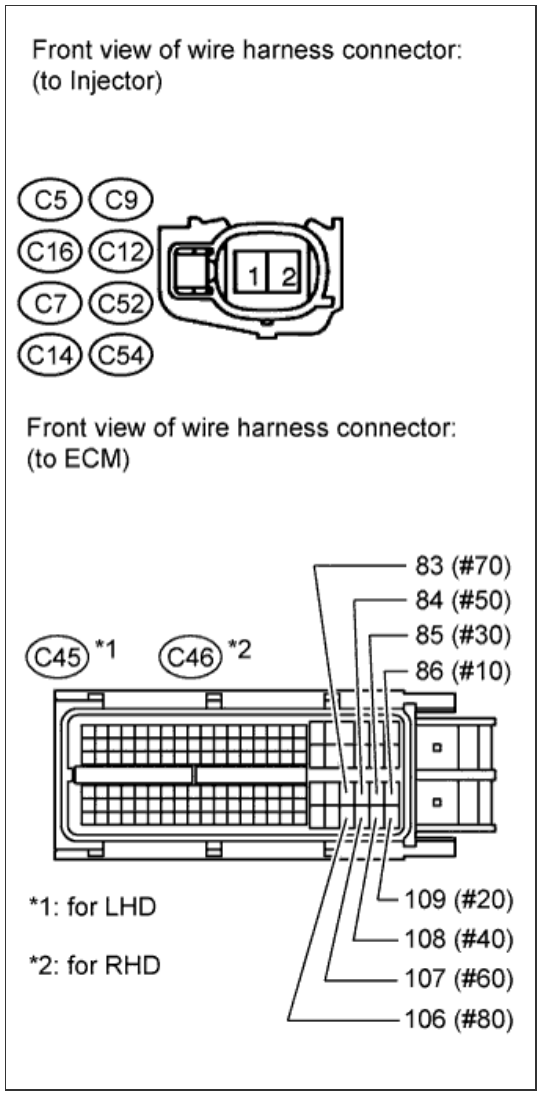
e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C45-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C45-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C45-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C45-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C45-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C45-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C45-106 (#80)	Always	Below 1 Ω

Standard Resistance (for RHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher



	C5-2 - C46-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C46-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C46-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C46-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C46-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C46-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C46-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C46-106 (#80)	Always	Below 1 Ω

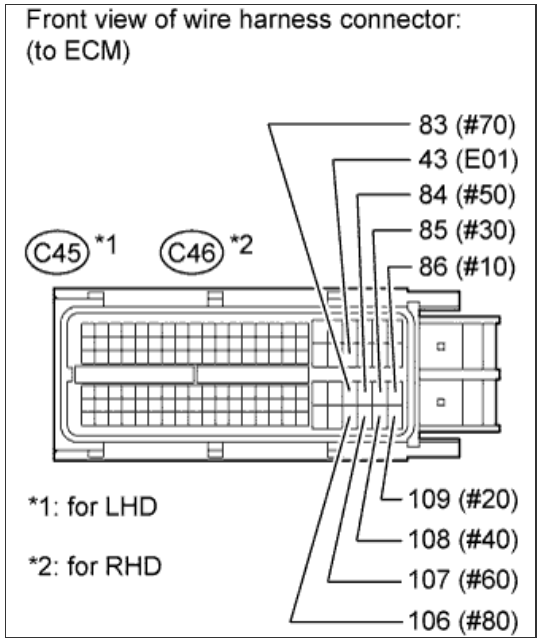
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50, #60, #70 AND/OR #80 VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage (for LHD):

Tester Connection	Switch Condition	Specified Condition
C45-86 (#10) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-109 (#20) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-85 (#30) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-108 (#40) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-84 (#50) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-107 (#60) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-83 (#70) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-106 (#80) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V

Standard Voltage (for RHD):

Tester Connection	Switch Condition	Specified Condition
C46-86 (#10) -	Engine switch on	

C46-43 (E01)	(IG)	11 to 14 V
C46-109 (#20) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-85 (#30) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-108 (#40) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-84 (#50) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-107 (#60) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-83 (#70) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-106 (#80) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK

11.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

12.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (**Click here**)

OK

13.CHECK VALVE TIMING

a. Remove the drive belt (Click here).

b. Remove the timing belt cover LH and RH (Click here).

c. Turn the crankshaft to align the matchmarks of the crankshaft.

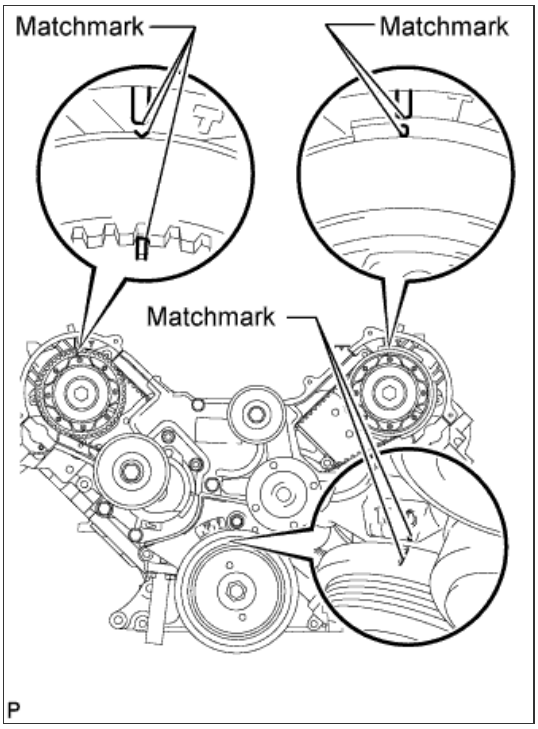
d. Align the notch of the crankshaft pulley with the 0 position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360 . Confirm again if the matchmarks are facing each other.

OK:

The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NG → ADJUST VALVE TIMING (Click here)

OK ↓

14.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK AND REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER

OK ↓

15.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:

With cold engine: Same as ambient air temperature.

With warm engine: Between 80°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK ↓

16.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK ↓

REPLACE ECM (Click here)

17.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

18.CHECK VALVE TIMING

a. Remove the drive belt (Click here).

b. Remove the timing belt cover LH and RH (Click here).

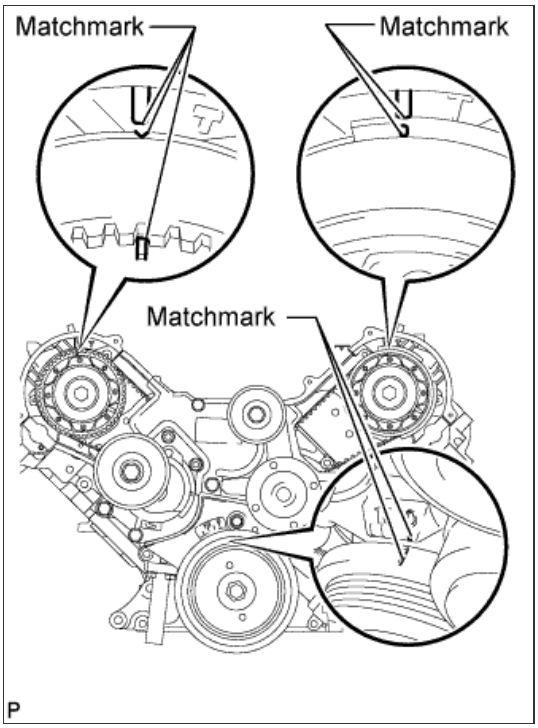
c. Turn the crankshaft to align the matchmarks of the crankshaft.

d. Align the notch of the crankshaft pulley with the 0 position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360 . Confirm again if the matchmarks are facing each other.

OK:
The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NG → ADJUST VALVE TIMING (Click here)

OK

19.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK AND REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER

OK

20.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: Between 80°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

21.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

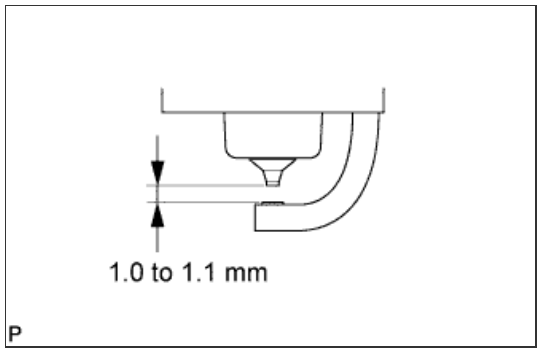
OK

22.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

b. Measure the spark plug electrode gap.

Standard gap:
1.0 to 1.1 mm (0.039 to 0.043 in.)



c. Check the electrode for carbon deposits.

Recommended Spark Plug:

Manufacturer	Product
DENSO	SK20R11
NGK	IFR6A11

NOTICE:

If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.

NG → REPLACE SPARK PLUG (Click here)

OK

23.CHECK FOR SPARKS AND IGNITION

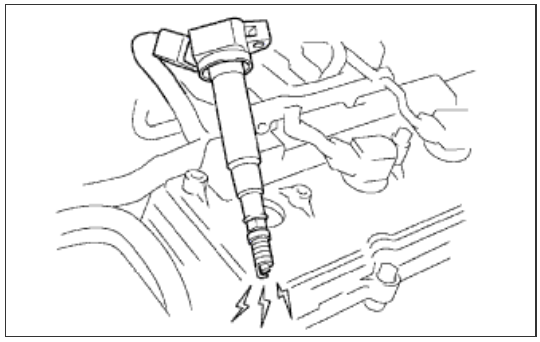
a. Disconnect the fuel injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.



b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

24.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → REPAIR ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

25.CHECK HARNESS AND CONNECTOR (ECM - FUEL INJECTOR)

a. Disconnect the fuel injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

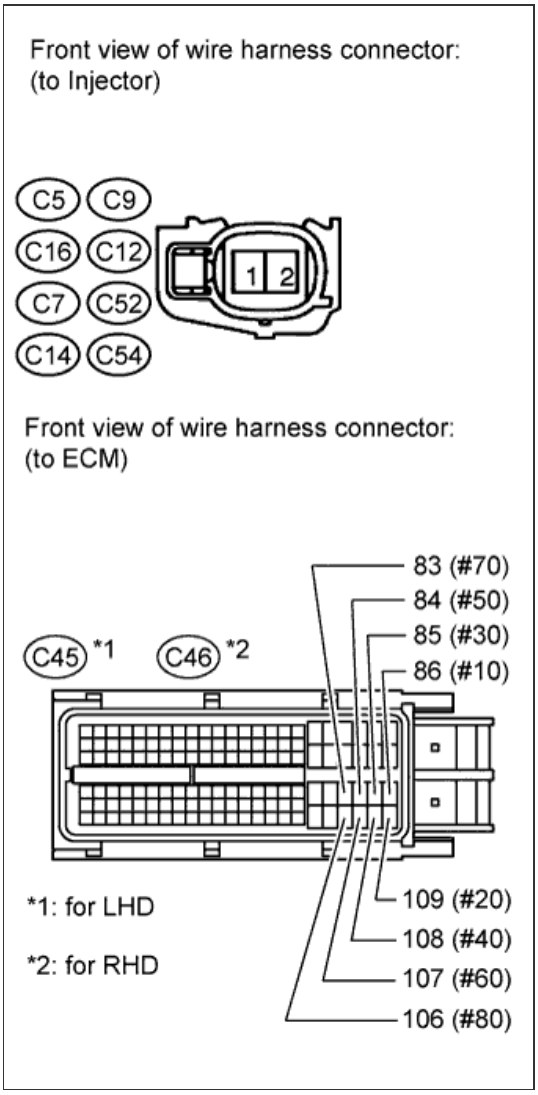
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	C16-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 3	C7-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	C14-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	C9-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	C12-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	C52-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	C54-1 - Ground	Engine switch on (IG)	11 to 14 V

d. Turn the engine switch off.

e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C45-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C45-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C45-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C45-84 (#50)	Always	Below 1 Ω
	C12-2 - Ground	Always	10 kΩ or higher



No. 6	C12-2 - C45-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C45-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C45-106 (#80)	Always	Below 1 Ω

Standard Resistance (for RHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C46-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C46-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C46-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C46-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C46-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C46-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C46-106 (#80)	Always	Below 1 Ω

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50, #60, #70 AND/OR #80 VOLTAGE)

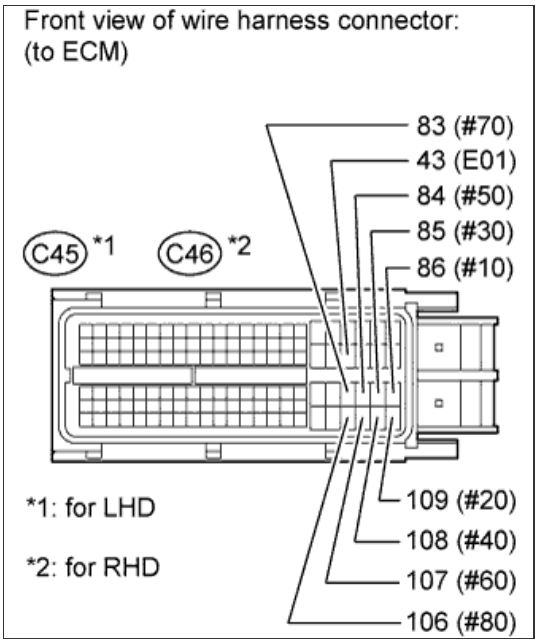
a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage (for LHD):

Tester Connection	Switch Condition	Specified Condition
C45-86 (#10) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-109 (#20) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-85 (#30) -	Engine switch on	11 to 14 V

C45-43 (E01)	(IG)	
C45-108 (#40) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-84 (#50) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-107 (#60) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-83 (#70) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-106 (#80) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V



Standard Voltage (for RHD):

Tester Connection	Switch Condition	Specified Condition
C46-86 (#10) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-109 (#20) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-85 (#30) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-108 (#40) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-84 (#50) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-107 (#60) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-83 (#70) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-106 (#80) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

27.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK

28.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

REPLACE ECM (**Click here**)

29.CHANGE TO NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the installed spark plug with a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → Go to step 30

OK

REPLACE SPARK PLUG (Click here)

30.CHANGE TO NORMAL IGNITION COIL AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the ignition coil with an ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK

REPLACE IGNITION COIL (Click here)

DTC P2195 Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)

DTC P2196 Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)

DTC P2197 Oxygen (A/F) Sensor Signal Stuck Lean (Bank 2 Sensor 1)

DTC P2198 Oxygen (A/F) Sensor Signal Stuck Rich (Bank 2 Sensor 1)

for Preparation Click here

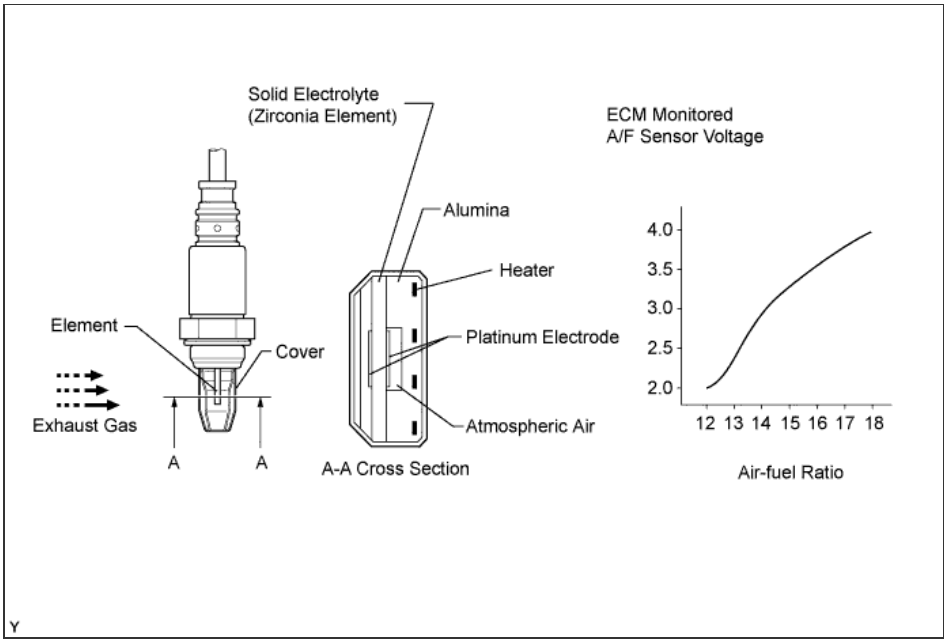
DESCRIPTION

The A/F sensor generates a voltage* that corresponds to the actual air-fuel ratio. This sensor voltage is used to provide the ECM with feedback so that it can control the air-fuel ratio. The ECM determines the deviation from the stoichiometric air-fuel ratio level, and regulates the fuel injection time. If the A/F sensor malfunctions, the ECM is unable to control the air-fuel ratio accurately.

The A/F sensor is the planar type and is integrated with the heater, which heats the solid electrolyte (zirconia element). This heater is controlled by the ECM. When the intake air volume is low (the exhaust gas temperature is low), a current flows into the heater to heat the sensor in order to facilitate accurate air-fuel ratio detection. In addition, the sensor and heater portions are the narrow type. The heat generated by the heater is conducted to the solid electrolyte through the alumina, therefore the sensor activation is accelerated.

In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric level.

*: The value changes inside the ECM. Since the A/F sensor is the current output element, a current is converted into a voltage inside the ECM. Any measurements taken at the A/F sensor or ECM connectors will show a constant voltage.



DTC Code	DTC Detection Condition	Trouble Area
P2195 P2197	Conditions (a) and (b) continue for 5 seconds or more (2 trip detection logic): (a) The A/F sensor voltage is higher than 3.8 V for 5 seconds. (b) The Heated Oxygen (HO2) sensor voltage is 0.21 V or higher.	• Open or short in A/F sensor (for sensor 1) circuit • A/F sensor (for sensor 1) • A/F sensor heater (for sensor 1) • Integration relay • A/F sensor heater and integration relay circuits • Air induction system • Fuel pressure • Injector • ECM
	While the fuel-cut operation is performed (during vehicle deceleration), the A/F sensor current is 3.6 mA or higher for 3 seconds (2 trip detection logic).	• A/F sensor • ECM
P2196 P2198	Conditions (a) and (b) continue for 5 seconds or more (2 trip detection logic): (a) The A/F sensor voltage is below 2.8 V for 5 seconds. (b) The HO2 sensor voltage is below 0.59 V.	• Open or short in A/F sensor (for sensor 1) circuit • A/F sensor (for sensor 1) • A/F sensor heater (for sensor 1) • Integration relay • A/F sensor heater and integration relay circuits • Air induction system • Fuel pressure • Injector • ECM
	While the fuel-cut operation is performed (during vehicle deceleration), the A/F sensor current is below 1.4 mA for 3 seconds (2 trip detection logic).	• A/F sensor • ECM

HINT:

- **DTCs P2195 and P2196 indicate malfunctions related to bank 1 A/F sensor circuit.**
- **DTCs P2197 and P2198 indicate malfunctions related to bank 2 A/F sensor circuit.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that includes the No. 2 cylinder.**

- **When either of these DTCs is output, check the A/F sensor output voltage by entering the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS B1 S1 or AFS B2 S1.**
- **Short-term fuel trim values can also be read using the intelligent tester.**
- **The ECM regulates the voltages at the A1A+ and A1A- or A2A+ and A2A- terminals of the ECM to a constant level. Therefore, the A/F sensor output voltage cannot be confirmed without using the intelligent tester.**
- **If the A/F sensor is malfunctioning, the ECM stores DTC P2195, P2196, P2197 or P2198.**

MONITOR DESCRIPTION

Sensor voltage detection monitor

Under the air-fuel ratio feedback control, if the A/F sensor output voltage indicates rich or lean for a certain period of time, the ECM determines that there is a malfunction in the A/F sensor. The ECM illuminates the MIL and stores a DTC.

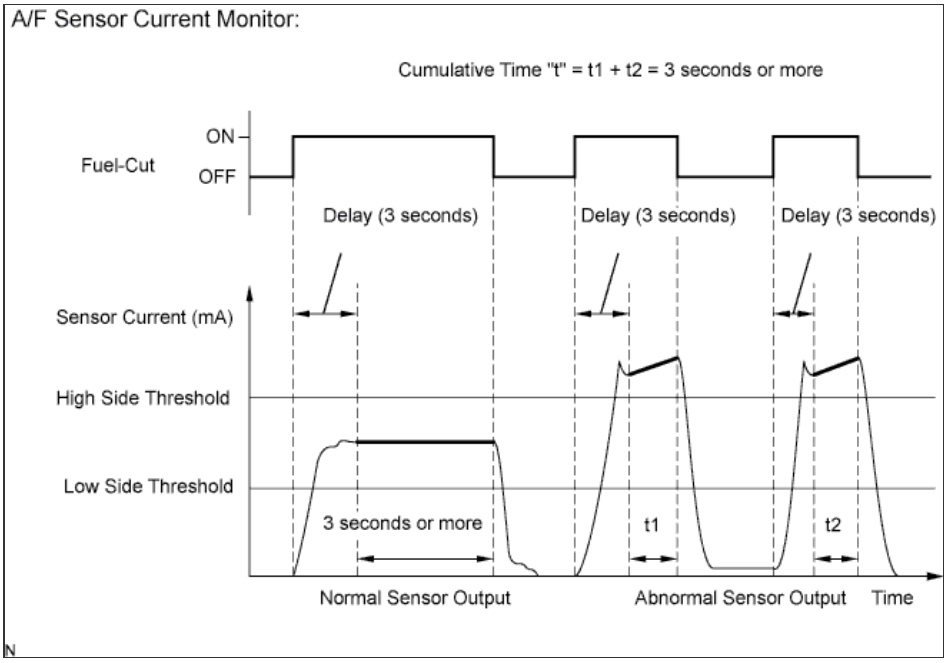
Example:

If the A/F sensor output voltage is below 2.8 V (very rich condition) for 5 seconds, despite the rear HO2 sensor output voltage being below 0.59 V, the ECM stores DTC P2196 or P2198. Alternatively, if the A/F sensor output voltage is higher than 3.8 V (very lean condition) for 5 seconds despite the rear HO2 sensor output voltage being 0.21 V or higher, DTC P2195 or P2197 is stored.

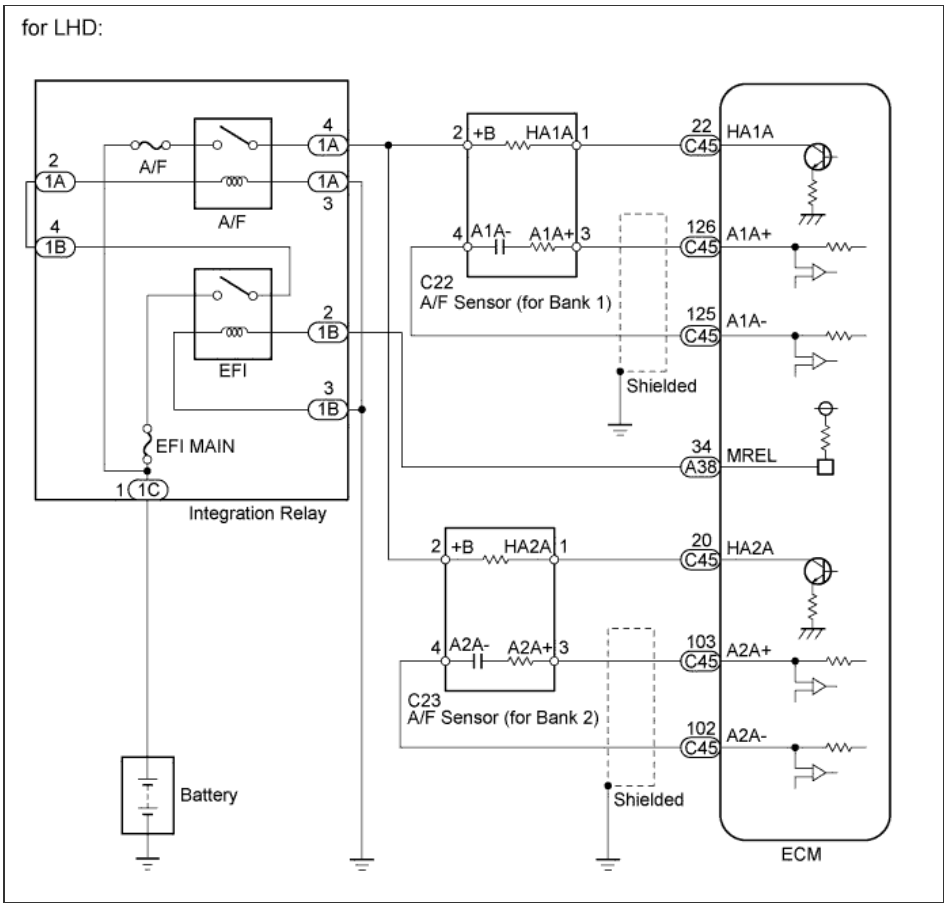
Sensor current detection monitor

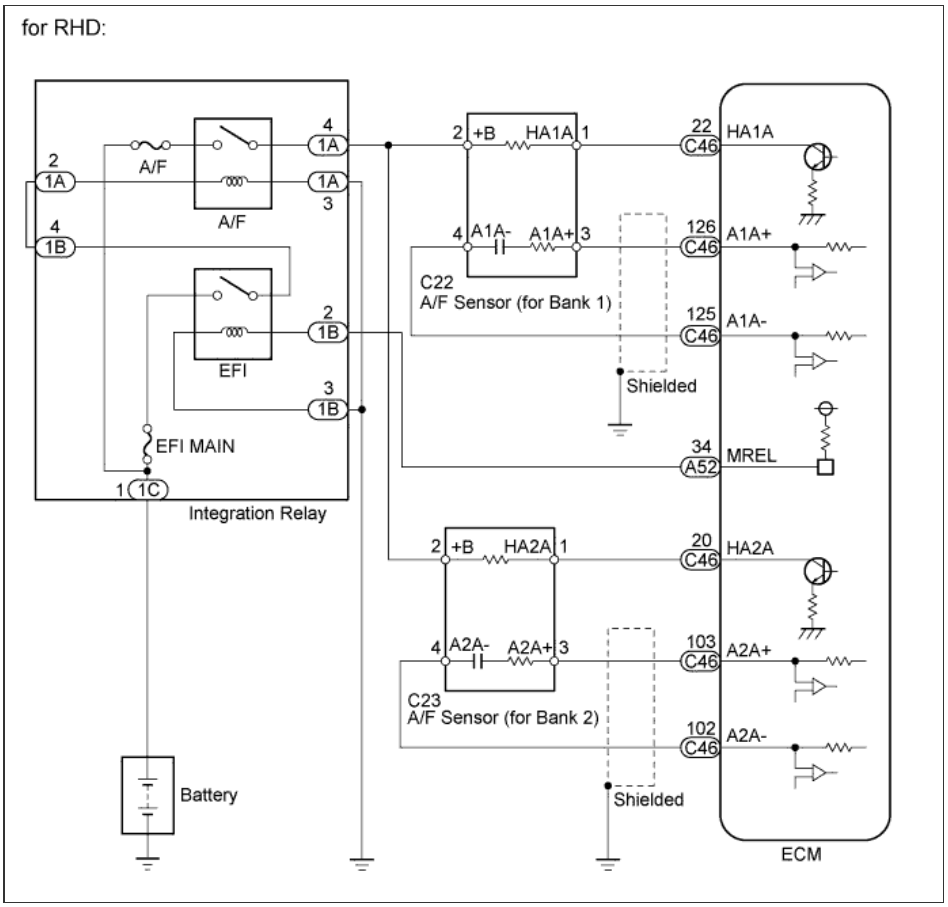
A rich air-fuel mixture causes a low A/F sensor current, and a lean air-fuel mixture causes a high A/F sensor current. Therefore, the sensor output becomes low during acceleration, and it becomes high during deceleration with the throttle valve fully closed. The ECM monitors the A/F sensor current during fuel-cut and detects any abnormal current values.

If the A/F sensor output is 3.6 mA or higher for more than 3 seconds of cumulative time, the ECM interprets this as a malfunction in the A/F sensor and stores DTC P2195 or P2197 (high-side stuck). If the A/F sensor output is below 1.4 mA for more than 3 seconds of cumulative time, the ECM stores DTC P2196 or P2198 (low-side stuck).



WIRING DIAGRAM



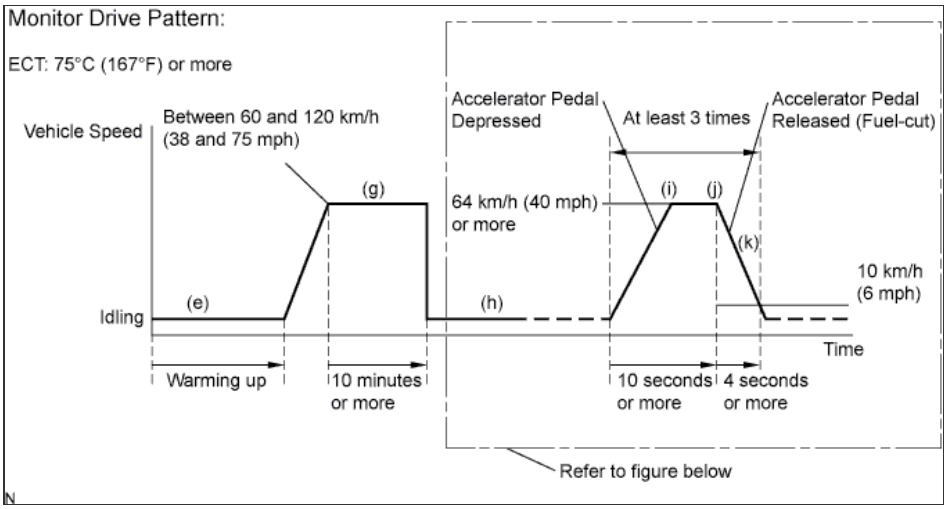


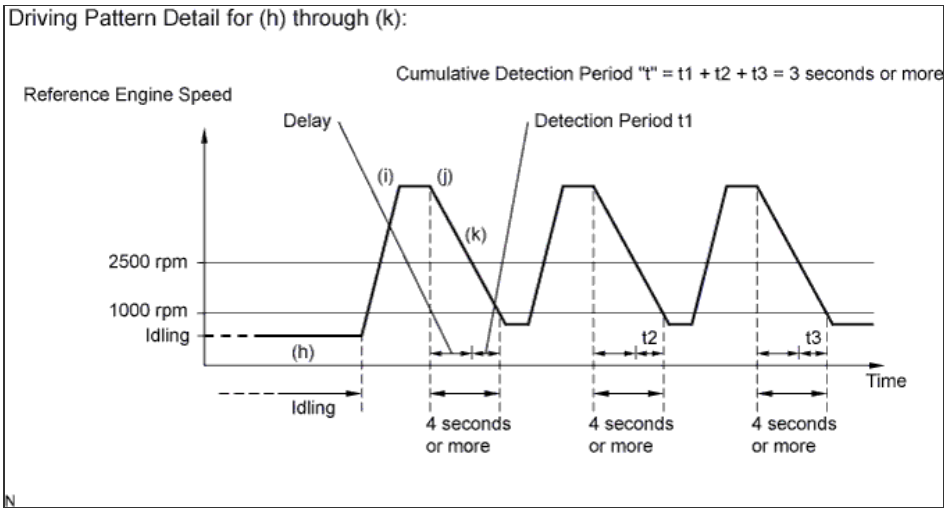
CONFIRMATION DRIVING PATTERN

CAUTION:

Strictly observe posted speed limits, traffic laws, and road conditions when performing these drive patterns.

This confirmation driving pattern is used in the "Perform Confirmation Driving Pattern" procedure of the following diagnostic troubleshooting procedure.





(a) Connect the intelligent tester to the DLC3.
(b) Turn the engine switch on (IG).
(c) Turn the tester on.
(d) Clear DTCs (Click here).
(e) Start the engine, and warm it up until the ECT reaches 75°C (167°F) or higher.
(f) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Idle Fuel Cut.
(g) Drive the vehicle at between 60 km/h (38 mph) and 120 km/h (75 mph) for at least 10 minutes.
(h) Change the transmission to 2nd gear.
(i) Drive the vehicle at the proper vehicle speed to perform fuel-cut operation.

HINT:

Fuel-cut is performed when the following conditions are met:

- **Accelerator pedal fully released.**
- **Engine speed is 2500 rpm or more (fuel injection returns at 1000 rpm).**

(j) Accelerate the vehicle to 64 km/h (40 mph) or more by depressing the accelerator pedal for at least 10 seconds.
(k) Soon after performing step (j) above, release the accelerator pedal for at least 4 seconds without depressing the brake pedal, in order to execute fuel-cut control.
(l) Allow the vehicle to decelerate until the vehicle speed decreases to less than 10 km/h (6 mph).
(m) Repeat steps (h) through (k) above at least 3 times in one driving cycle.

HINT:

Completion of all O2S (A/F) Monitor is required to change the value in the Data List.

INSPECTION PROCEDURE

HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air-Fuel Ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**
- **DTC P2A00 may be stored when the air-fuel ratio is stuck rich or lean.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.**
- **A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.**

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F Sensor function provided in the Active Test. The Control the Injection Volume for A/F Sensor function can help to determine whether the Air-fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F Sensor operation using the tester.

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor.
(e) Perform the Control the Injection Volume for A/F Sensor operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

HINT:

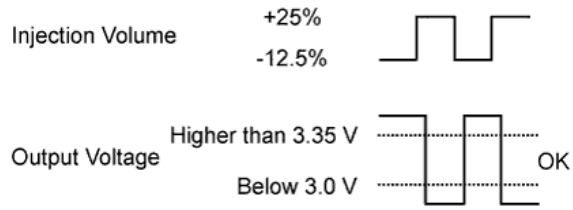
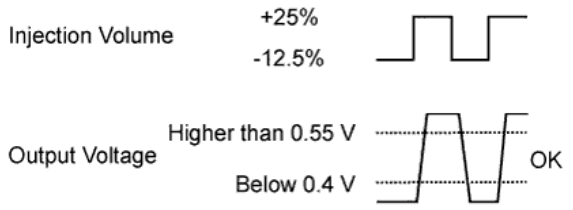
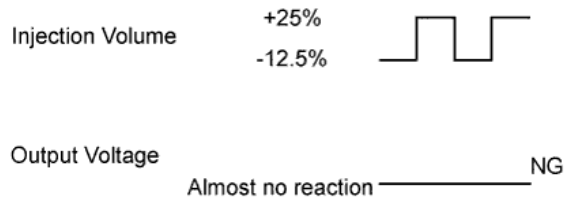
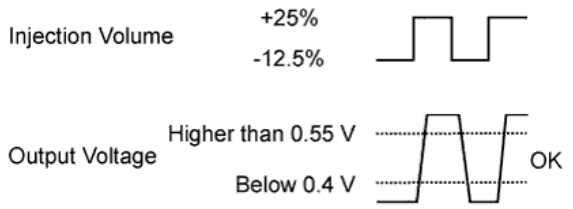
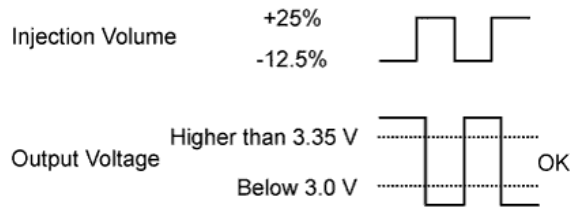
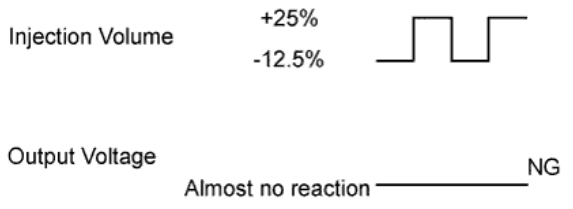
- **The Control the Injection Volume for A/F Sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **The sensors react in accordance with increases and decreases in the fuel injection volume.**

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor (for sensor 2) output has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors. To display the graph, enter the following menus on the tester: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/ F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P2195, P2196, P2197 or P2198 is output	A
P2195, P2196, P2197 or P2198 and other DTCs are output	B

HINT:

If any DTCs relating to the A/F sensor (DTCs for the A/F sensor heater or A/F sensor admittance) are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (TEST VALUE OF A/F SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the vehicle to drive in accordance with the drive pattern described in the Confirmation Driving Pattern.

f. Enter the following menus: Powertrain / Engine and ECT / Data List / Monitor Status.

g. Check that the status of O2S (A/FS) Monitor is Complete.
If the status is still Incomplete, drive the vehicle according to the driving pattern again.

HINT:

- **Complete indicates that the component is functioning normally.**
- **Incomplete indicates that the component is malfunctioning.**

h. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS B1 S1 or AFS B2 S1.

i. Check the test value of the A/F sensor output current during fuel-cut.

Result

Test Value	Proceed to
Within normal range (1.4 mA or higher, and below 3.6 mA)	A
Outside normal range (Below 1.4 mA, or 3.6 mA or higher)	B

B → Go to step 12

A

3.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF A/F SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Warm up the A/F sensor at an engine speed of 2500 rpm for 90 seconds.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / Snapshot / AFS B1 S1 or AFS B2 S1 and Engine Speed.

f. Check the A/F sensor voltage 3 times, when the engine is in each of the following conditions:

i. While idling (check for at least 30 seconds).

ii. At an engine speed of approximately 2500 rpm (without any sudden changes in engine speed).

iii. Raise the engine speed to 4000 rpm and then quickly release the accelerator pedal so that the throttle valve is fully closed.

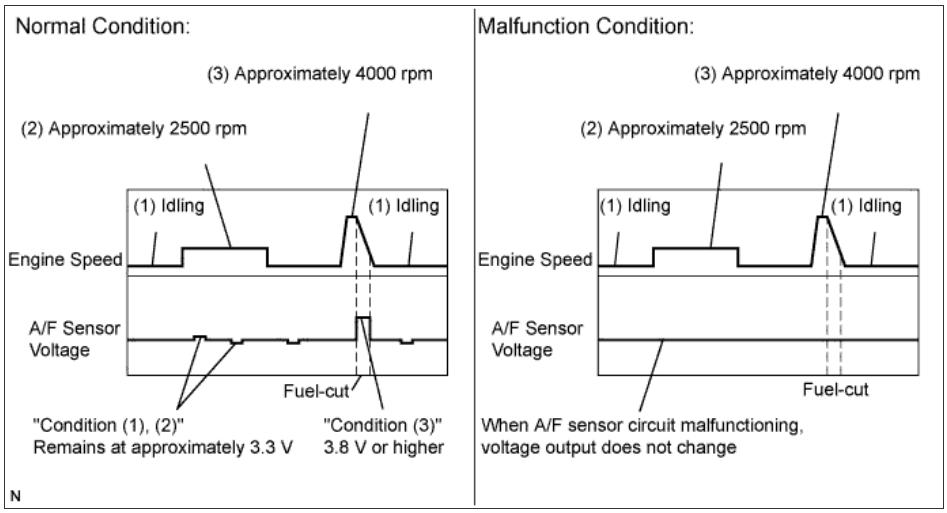
Standard Voltage:

Condition	A/F Sensor Voltage Variation	Reference
(1) and (2)	Remains at approximately 3.3 V	3.1 V to 3.5 V
		This occurs during

(3)	Increases to 3.8 V or higher	engine deceleration (when fuel-cut performed)

HINT:

- **For more information, see the diagrams below.**



- **If the output voltage of the A/F sensor remains at approximately 3.3 V (see Malfunction Condition diagram) under any conditions, including those above, the A/F sensor may have an open circuit (this will also happen if the A/F sensor heater has an open circuit).**
- **If the output voltage of the A/F sensor remains at either approximately 3.8 V or higher, or 2.8 V or less (see Malfunction Condition diagram) under any conditions, including those above, the A/F sensor may have a short circuit.**
- **The ECM stops fuel injection (fuel cut) during engine deceleration. This causes a lean condition and results in a momentary increase in the A/F sensor output voltage.**
- **The ECM must establish a closed throttle valve position learning value to perform fuel cut. If the battery terminal has been reconnected, the vehicle must be driven over 16 km/h (10 mph) to allow the ECM to learn the closed throttle valve position.**
- **When the vehicle is driven:**
  The output voltage of the A/F sensor may be below 2.8 V during fuel enrichment. For the vehicle, this translates to a sudden increase in speed with the accelerator pedal fully depressed when trying to overtake another vehicle. The A/F sensor is functioning normally.
- **The A/F sensor is a current output element; therefore, the current is converted into a voltage inside the ECM. Measuring the voltage at the connectors of the A/F sensor or ECM will show a constant voltage result.**

NG → **Go to step 9**

OK

4.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

b. Read pending DTCs.

Result

Result	Proceed to
P2195, P2196, P2197 or P2198 is output	A
No DTC is output	B

B → **END**

A

6.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

7.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

b. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2195, P2196, P2197 or P2198 is output	B

B → REPLACE ECM (Click here)

A

END

9.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

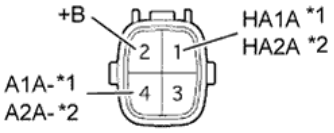
a. Disconnect the Air-Fuel Ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

Component without harness connected: (A/F Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

10.INSPECT INTEGRATION NO.1 RELAY (A/F)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

iii. Reinstall the A/F fuse.

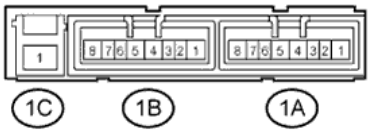
c. Inspect the integration relay (A/F).

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1A-4	Battery voltage not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω

Component without harness connected: (Integration Relay)



NG → REPLACE INTEGRATION NO.1 RELAY (A/F)

OK

11.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

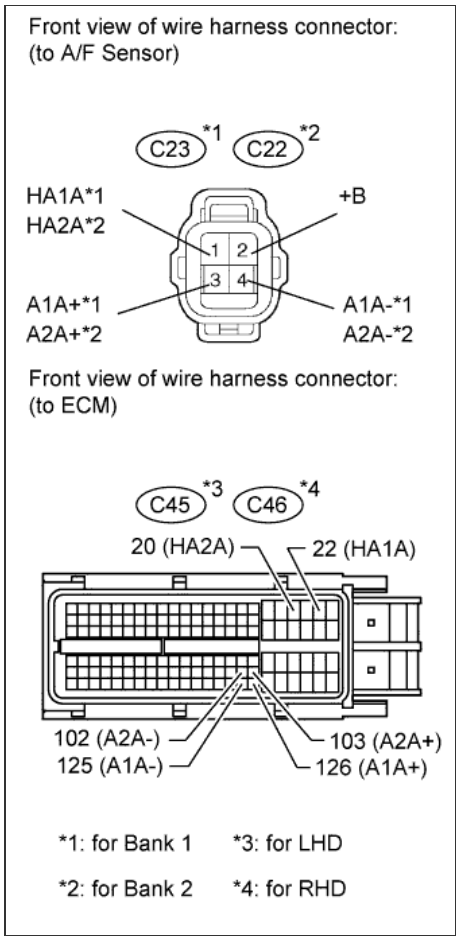
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.



e. Measure the resistance according to the value(s) in the table below.

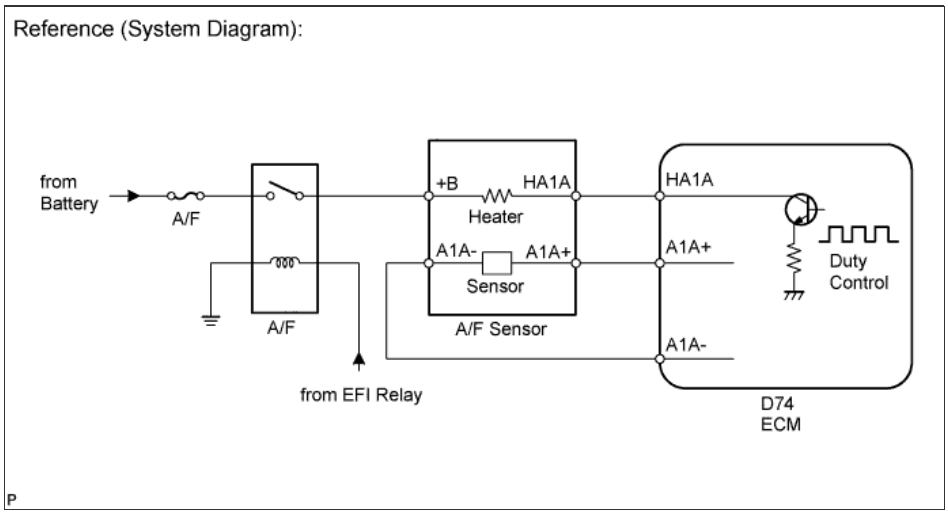
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C46-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



P

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

12.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

13.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

14.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

b. Read pending DTCs.

Result

Result	Proceed to

No DTC is output	A
P2195, P2196, P2197 or P2198 is output	B

B → REPLACE ECM (Click here)

A

END

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

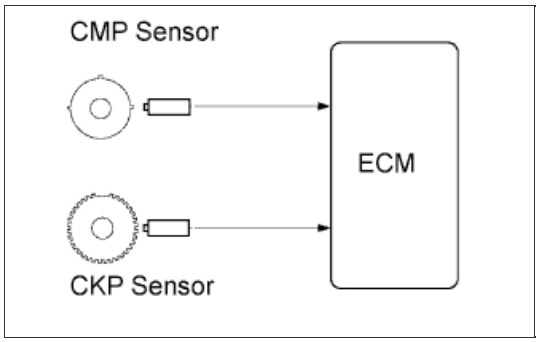
DTC P0306 Cylinder 6 Misfire Detected

DTC P0307 Cylinder 7 Misfire Detected

DTC P0308 Cylinder 8 Misfire Detected

for Preparation Click here

DESCRIPTION



When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause increases in exhaust emission levels. High concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent these increases in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the TWC reaches the point of thermal degradation, the ECM blinks the MIL. To monitor misfires, the ECM uses both the Camshaft Position (CMP) sensor and the Crankshaft Position (CKP) sensor. The CMP sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted as when the crankshaft rotation speed variations exceed predetermined thresholds.
If the misfire rate exceeds the threshold level, the ECM illuminates the MIL and stores a DTC.

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Fuel injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve clearance • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306 P0307 P0308	Misfiring of a specific cylinder occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

MONITOR DESCRIPTION

The ECM illuminates the MIL and stores a DTC when either one of the following conditions, which could cause emission deterioration, is detected (2 trip detection logic).

- Within the first 1000 crankshaft revolutions of the engine starting, an excessive misfiring rate (approximately 130 to 160 misfires per 1000 crankshaft revolutions) occurs once.
- An excessive misfiring rate (approximately 130 to 160 misfires per 1000 crankshaft revolutions) occurs a total of 4 times.

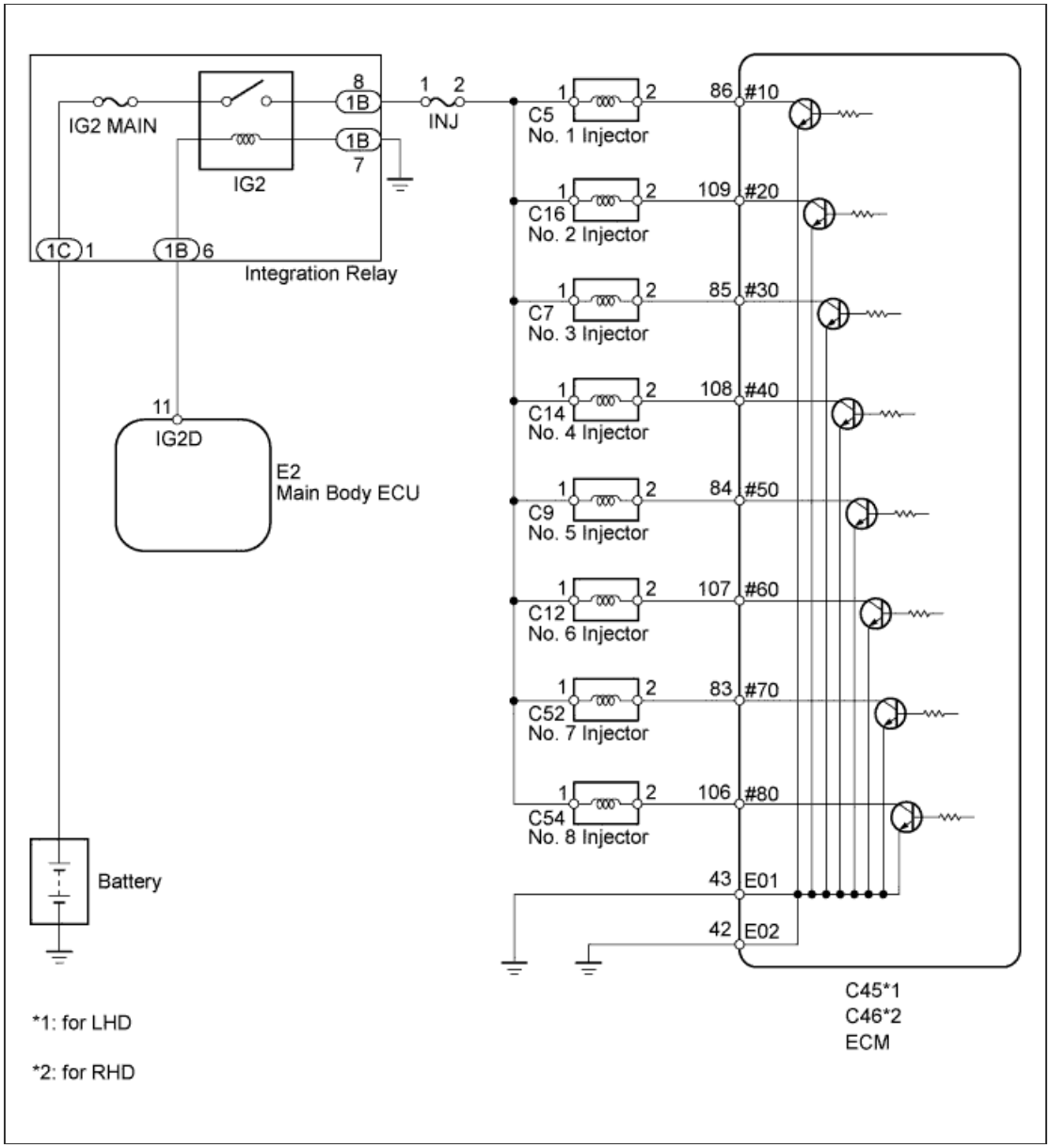
The ECM flashes the MIL and stores a DTC when either one of the following conditions, which could cause damage to the Three-Way Catalytic Converter (TWC), is detected (2 trip detection logic).

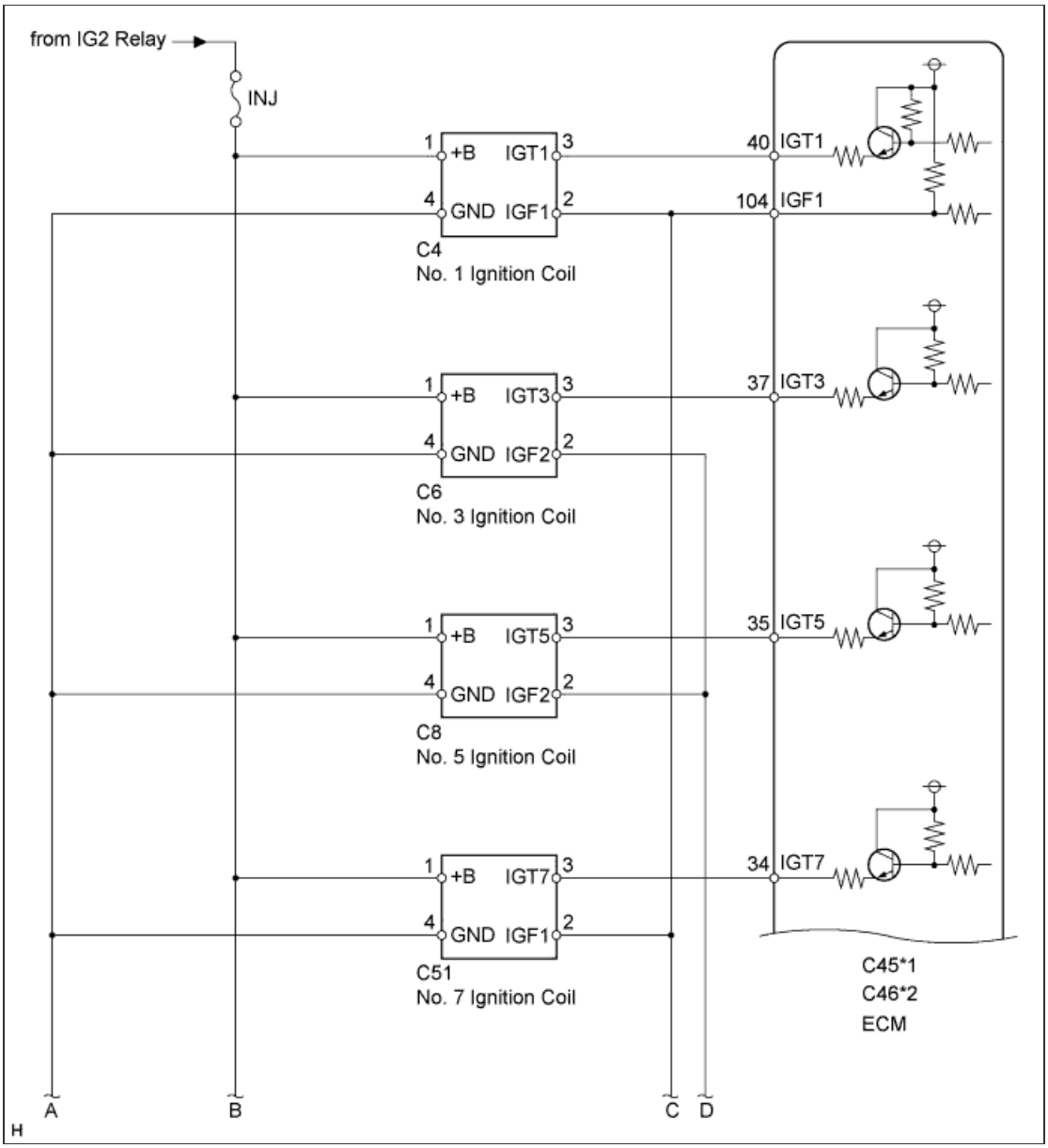
- At a high engine speed, a catalyst damage misfire, which is monitored every 200 crankshaft revolutions, occurs once.
- At a normal engine speed, a catalyst damage misfire, which is monitored every 200 crankshaft revolutions, occurs 3 times.

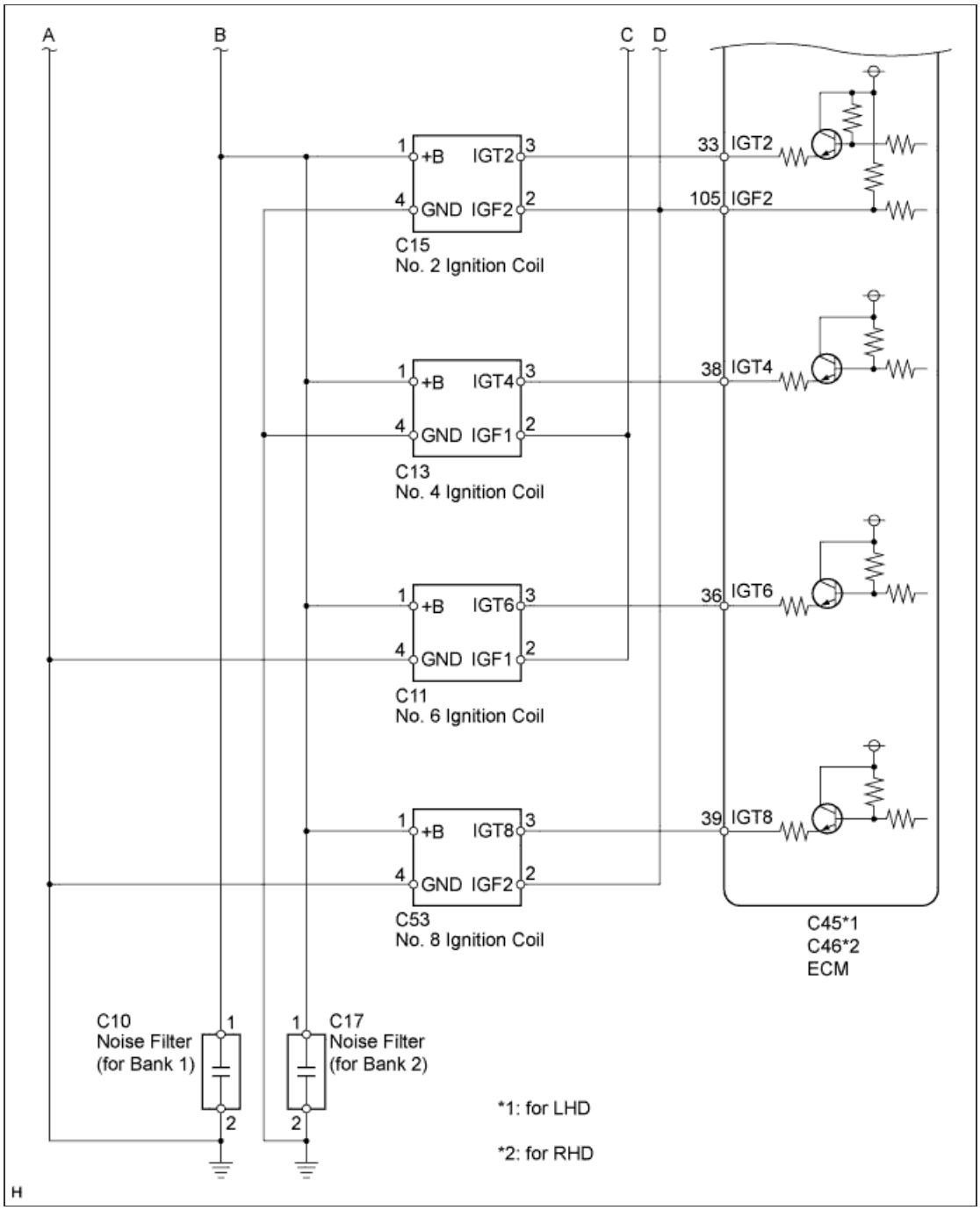
HINT:

If a catalyst damage misfire occurs, the ECM informs the driver by flashing the MIL.

WIRING DIAGRAM




from IG2 Relay
INJ
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
34
IGT7
C45*1
C46*2
ECM
A
B
C
D
H



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Turn the tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire counts of each cylinder (cylinder No. 1 to No. 8) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
7. Drive the vehicle several times with the conditions, such as engine speed and engine load, shown in Misfire RPM and Misfire Load in the Data List.

HINT:

In order to store misfire DTCs, it is necessary to operate the vehicle for the period of time shown in the table below, with the Misfire RPM and Misfire Load in the Data List.

Engine Speed	Duration
Idling	3.5 minutes or more
1000	3 minutes or more
2000	1.5 minutes or more
3000	1 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

   HINT:

   Do not turn the engine switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data will be cleared.

9. Record the DTC(s), freeze frame data and misfire counts.
10. Turn the engine switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the freeze frame data have been duplicated, one of the following factors is considered to be a possible cause of the problem:**
  1. **The fuel level is low.**
  2. **Improper fuel is used.**
  3. **The spark plugs are dirty.**
- **After finishing repairs, check that no misfires occur in each cylinder (cylinder No. 1, No. 2, No. 3, No. 4, No. 5, No. 6, No. 7 and No. 8).**
- **Be sure to confirm that no misfiring cylinder DTCs are output again by conducting the confirmation driving pattern, after the repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speed. If misfires only occur during high engine speed driving, only DTC P0300 is stored.**
  In the event of DTC P0300 being output, perform the following operations:
  1. **Clear the DTC (Click here).**
  2. **Start the engine and conduct the confirmation driving pattern.**
  3. **Read the misfiring rates of each cylinder or DTC(s) using the tester.**
  4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
  5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not output.**
- **When either Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air-fuel ratio may be rich (-20% or less) or lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is below 75°C (167°F), the misfires occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel can cause body vibration, which may cause misfire DTC(s) to be stored.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 is output	A
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 and other DTCs are output	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

3.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is connected correctly and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE (Click here)

OK

4.READ VALUE USING INTELLIGENT TESTER (MISFIRE COUNT)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5, #6, #7 and #8.

f. Allow the engine to idle.

g. Read each value for Cylinder #1 Misfire Count to #8 displayed on the tester. If no misfire counts occur in any cylinders, perform the following procedures:

i. Move the shift lever to D.

ii. Check the Cylinder #1 Misfire Count to #8.

iii. If misfire counts are still not displayed, perform procedure A and and then check the misfire counts again.

h. Drive the vehicle with the Misfire RPM and Misfire Load noted in the Read value using intelligent tester (Misfire RPM and Misfire Load) procedures above (procedure A).

i. Read the Cylinder #1 Misfire Count to #8 or DTCs displayed on the tester (procedure).

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have e ual misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data record of the Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → Go to step 17

A

5.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

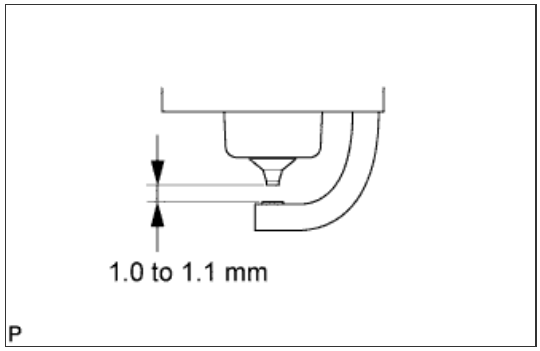
b. Measure the spark plug electrode gap.

Standard gap:
1.0 to 1.1 mm (0.039 to 0.043 in.)

c. Check the electrode for carbon deposits.

Recommended Spark Plug:

Manufacturer	Product
DENSO	SK20R11
NGK	IFR6A11



NOTICE:

If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.

NG → REPLACE SPARK PLUG (Click here)

OK

6.CHECK FOR SPARKS AND IGNITION

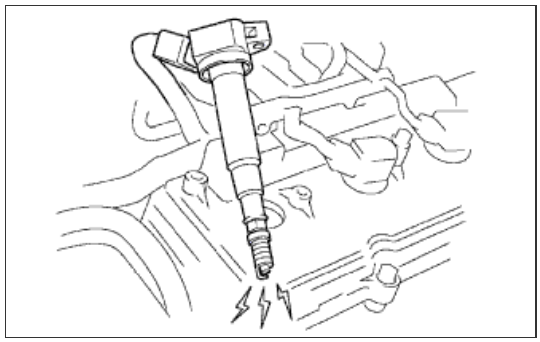
a. Disconnect the fuel injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.



b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → REPAIR ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK HARNESS AND CONNECTOR (ECM - FUEL INJECTOR)

a. Disconnect the fuel injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	C16-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 3	C7-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	C14-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	C9-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	C12-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	C52-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	C54-1 - Ground	Engine switch on (IG)	11 to 14 V

d. Turn the engine switch off.

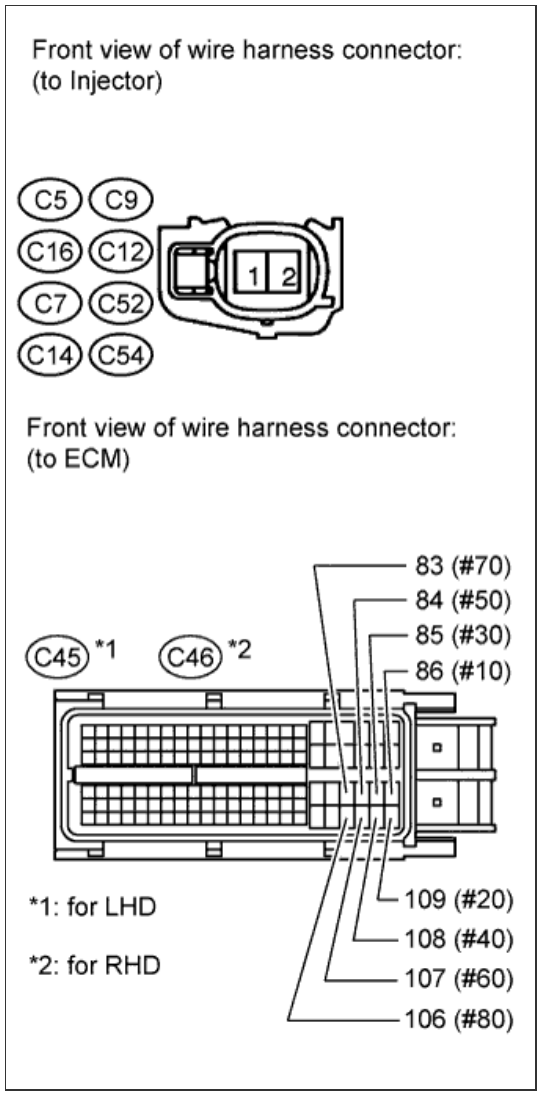
e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C45-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C45-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C45-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C45-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C45-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C45-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C45-106 (#80)	Always	Below 1 Ω

Standard Resistance (for RHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher



	C5-2 - C46-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C46-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C46-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C46-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C46-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C46-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C46-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C46-106 (#80)	Always	Below 1 Ω

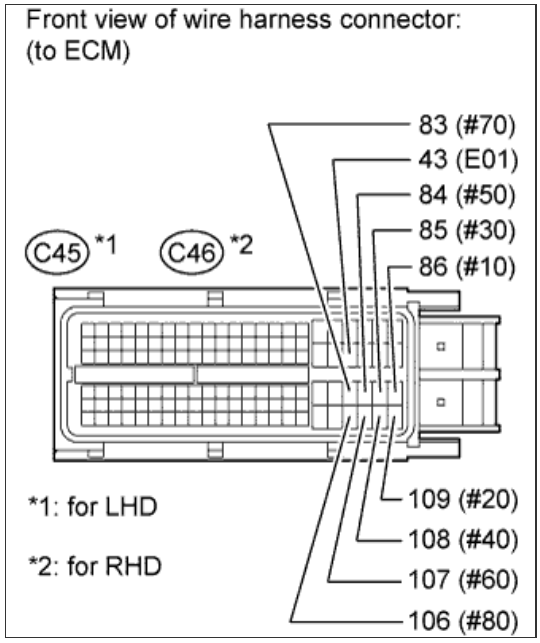
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50, #60, #70 AND/OR #80 VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage (for LHD):

Tester Connection	Switch Condition	Specified Condition
C45-86 (#10) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-109 (#20) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-85 (#30) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-108 (#40) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-84 (#50) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-107 (#60) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-83 (#70) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-106 (#80) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V

Standard Voltage (for RHD):

Tester Connection	Switch Condition	Specified Condition
C46-86 (#10) -	Engine switch on	

C46-43 (E01)	(IG)	11 to 14 V
C46-109 (#20) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-85 (#30) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-108 (#40) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-84 (#50) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-107 (#60) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-83 (#70) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-106 (#80) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK

11.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

12.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (**Click here**)

OK

13.CHECK VALVE TIMING

a. Remove the drive belt (Click here).

b. Remove the timing belt cover LH and RH (Click here).

c. Turn the crankshaft to align the matchmarks of the crankshaft.

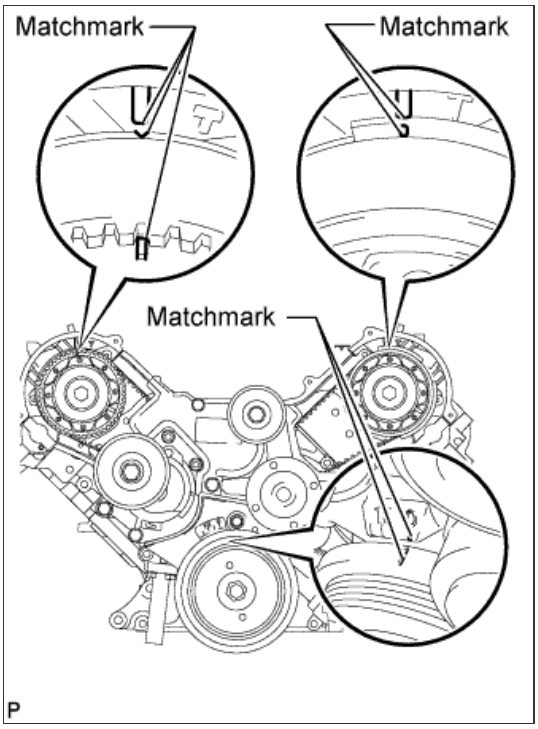
d. Align the notch of the crankshaft pulley with the 0 position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360 . Confirm again if the matchmarks are facing each other.

OK:

The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NG → ADJUST VALVE TIMING (Click here)

OK ↓

14.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK AND REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER

OK ↓

15.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:

With cold engine: Same as ambient air temperature.

With warm engine: Between 80°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK ↓

16.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK ↓

REPLACE ECM (Click here)

17.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

18.CHECK VALVE TIMING

a. Remove the drive belt (Click here).

b. Remove the timing belt cover LH and RH (Click here).

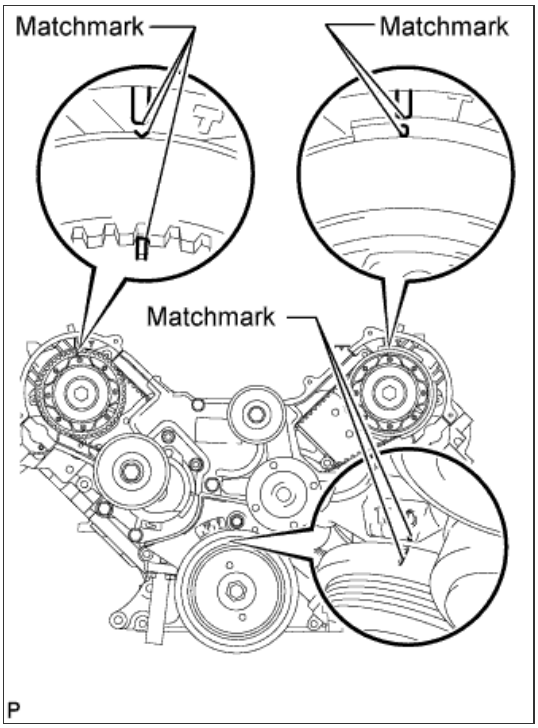
c. Turn the crankshaft to align the matchmarks of the crankshaft.

d. Align the notch of the crankshaft pulley with the 0 position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360 . Confirm again if the matchmarks are facing each other.

OK:
The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NG → ADJUST VALVE TIMING (Click here)

OK

19.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK AND REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER

OK

20.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: Between 80°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

21.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

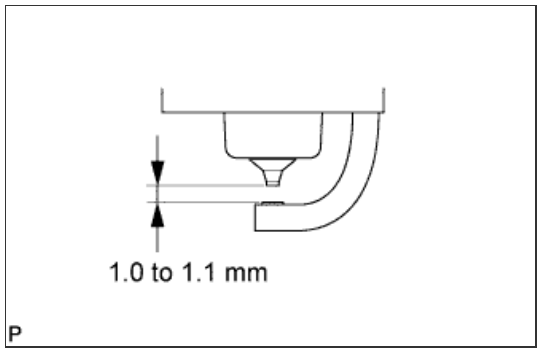
OK

22.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

b. Measure the spark plug electrode gap.

Standard gap:
1.0 to 1.1 mm (0.039 to 0.043 in.)



c. Check the electrode for carbon deposits.

Recommended Spark Plug:

Manufacturer	Product
DENSO	SK20R11
NGK	IFR6A11

NOTICE:

If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.

NG → REPLACE SPARK PLUG (Click here)

OK

23.CHECK FOR SPARKS AND IGNITION

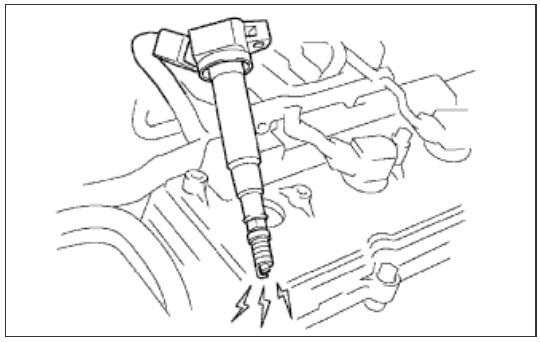
a. Disconnect the fuel injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.



b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

24.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → REPAIR ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

25.CHECK HARNESS AND CONNECTOR (ECM - FUEL INJECTOR)

a. Disconnect the fuel injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

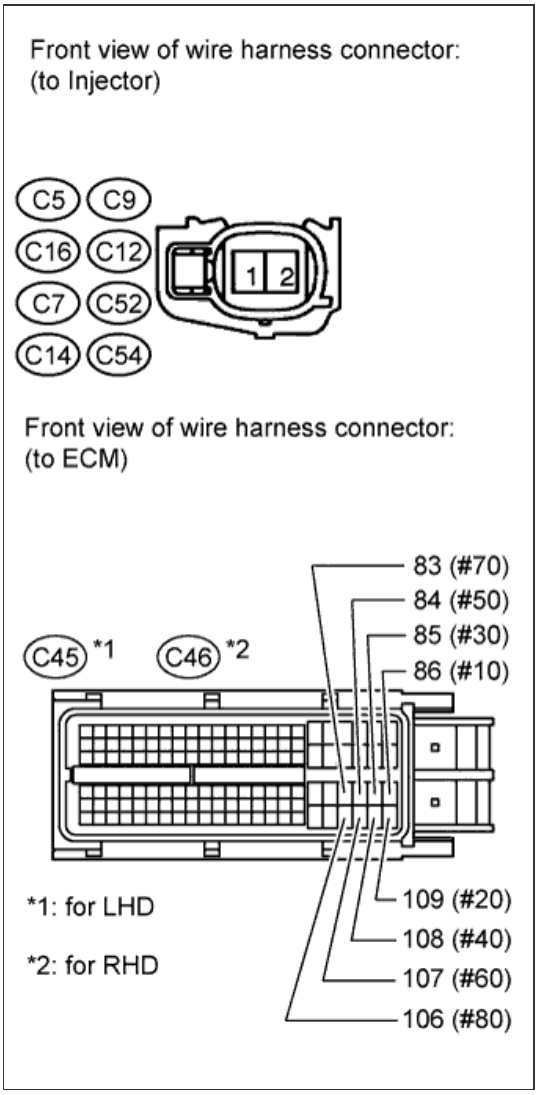
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	C16-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 3	C7-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	C14-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	C9-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	C12-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	C52-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	C54-1 - Ground	Engine switch on (IG)	11 to 14 V

d. Turn the engine switch off.

e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C45-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C45-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C45-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C45-84 (#50)	Always	Below 1 Ω
	C12-2 - Ground	Always	10 kΩ or higher



No. 6	C12-2 - C45-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C45-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C45-106 (#80)	Always	Below 1 Ω

Standard Resistance (for RHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C46-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C46-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C46-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C46-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C46-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C46-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C46-106 (#80)	Always	Below 1 Ω

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50, #60, #70 AND/OR #80 VOLTAGE)

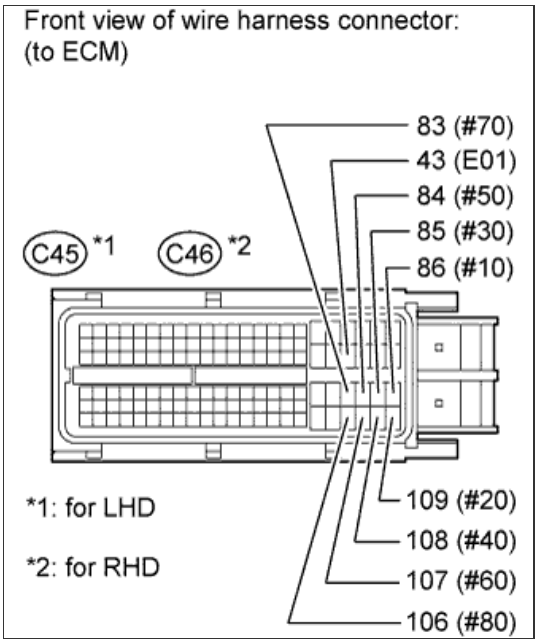
a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage (for LHD):

Tester Connection	Switch Condition	Specified Condition
C45-86 (#10) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-109 (#20) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-85 (#30) -	Engine switch on	11 to 14 V

C45-43 (E01)	(IG)	
C45-108 (#40) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-84 (#50) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-107 (#60) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-83 (#70) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-106 (#80) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V



Standard Voltage (for RHD):

Tester Connection	Switch Condition	Specified Condition
C46-86 (#10) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-109 (#20) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-85 (#30) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-108 (#40) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-84 (#50) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-107 (#60) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-83 (#70) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-106 (#80) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

27.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK

28.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

REPLACE ECM (**Click here**)

29.CHANGE TO NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the installed spark plug with a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → Go to step 30

OK

REPLACE SPARK PLUG (Click here)

30.CHANGE TO NORMAL IGNITION COIL AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the ignition coil with an ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK

REPLACE IGNITION COIL (Click here)

DTC P2195 Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)

DTC P2196 Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)

DTC P2197 Oxygen (A/F) Sensor Signal Stuck Lean (Bank 2 Sensor 1)

DTC P2198 Oxygen (A/F) Sensor Signal Stuck Rich (Bank 2 Sensor 1)

for Preparation Click here

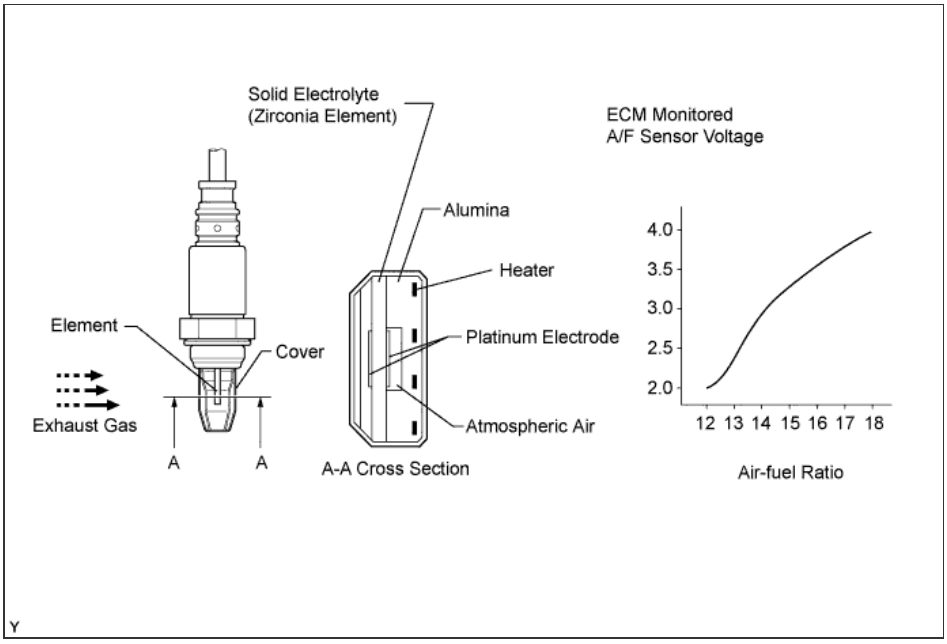
DESCRIPTION

The A/F sensor generates a voltage* that corresponds to the actual air-fuel ratio. This sensor voltage is used to provide the ECM with feedback so that it can control the air-fuel ratio. The ECM determines the deviation from the stoichiometric air-fuel ratio level, and regulates the fuel injection time. If the A/F sensor malfunctions, the ECM is unable to control the air-fuel ratio accurately.

The A/F sensor is the planar type and is integrated with the heater, which heats the solid electrolyte (zirconia element). This heater is controlled by the ECM. When the intake air volume is low (the exhaust gas temperature is low), a current flows into the heater to heat the sensor in order to facilitate accurate air-fuel ratio detection. In addition, the sensor and heater portions are the narrow type. The heat generated by the heater is conducted to the solid electrolyte through the alumina, therefore the sensor activation is accelerated.

In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric level.

*: The value changes inside the ECM. Since the A/F sensor is the current output element, a current is converted into a voltage inside the ECM. Any measurements taken at the A/F sensor or ECM connectors will show a constant voltage.



DTC Code	DTC Detection Condition	Trouble Area
P2195 P2197	Conditions (a) and (b) continue for 5 seconds or more (2 trip detection logic): (a) The A/F sensor voltage is higher than 3.8 V for 5 seconds. (b) The Heated Oxygen (HO2) sensor voltage is 0.21 V or higher.	• Open or short in A/F sensor (for sensor 1) circuit • A/F sensor (for sensor 1) • A/F sensor heater (for sensor 1) • Integration relay • A/F sensor heater and integration relay circuits • Air induction system • Fuel pressure • Injector • ECM
	While the fuel-cut operation is performed (during vehicle deceleration), the A/F sensor current is 3.6 mA or higher for 3 seconds (2 trip detection logic).	• A/F sensor • ECM
P2196 P2198	Conditions (a) and (b) continue for 5 seconds or more (2 trip detection logic): (a) The A/F sensor voltage is below 2.8 V for 5 seconds. (b) The HO2 sensor voltage is below 0.59 V.	• Open or short in A/F sensor (for sensor 1) circuit • A/F sensor (for sensor 1) • A/F sensor heater (for sensor 1) • Integration relay • A/F sensor heater and integration relay circuits • Air induction system • Fuel pressure • Injector • ECM
	While the fuel-cut operation is performed (during vehicle deceleration), the A/F sensor current is below 1.4 mA for 3 seconds (2 trip detection logic).	• A/F sensor • ECM

HINT:

- **DTCs P2195 and P2196 indicate malfunctions related to bank 1 A/F sensor circuit.**
- **DTCs P2197 and P2198 indicate malfunctions related to bank 2 A/F sensor circuit.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that includes the No. 2 cylinder.**

- **When either of these DTCs is output, check the A/F sensor output voltage by entering the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS B1 S1 or AFS B2 S1.**
- **Short-term fuel trim values can also be read using the intelligent tester.**
- **The ECM regulates the voltages at the A1A+ and A1A- or A2A+ and A2A- terminals of the ECM to a constant level. Therefore, the A/F sensor output voltage cannot be confirmed without using the intelligent tester.**
- **If the A/F sensor is malfunctioning, the ECM stores DTC P2195, P2196, P2197 or P2198.**

MONITOR DESCRIPTION

Sensor voltage detection monitor

Under the air-fuel ratio feedback control, if the A/F sensor output voltage indicates rich or lean for a certain period of time, the ECM determines that there is a malfunction in the A/F sensor. The ECM illuminates the MIL and stores a DTC.

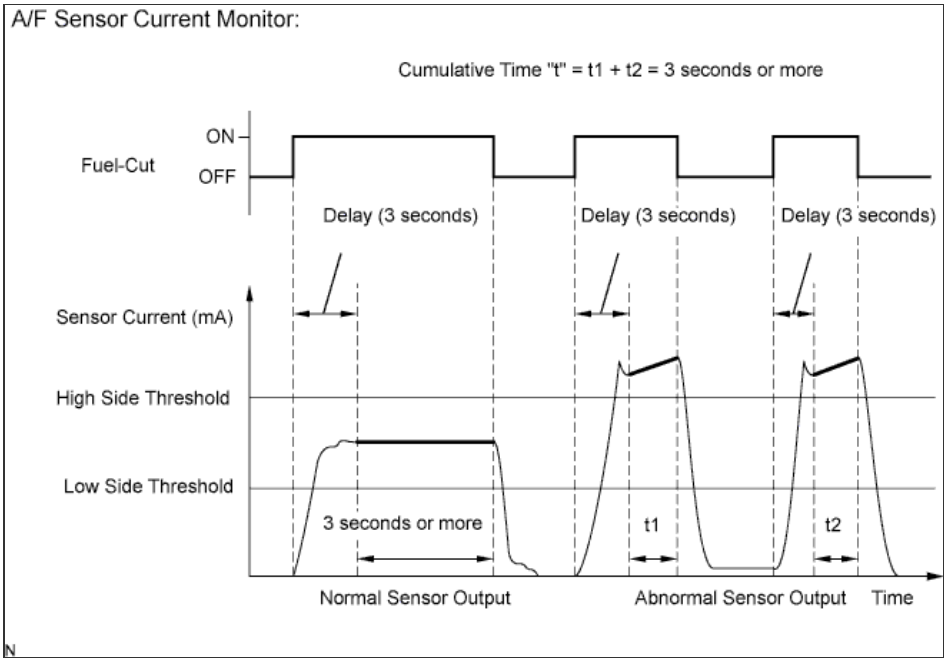
Example:

If the A/F sensor output voltage is below 2.8 V (very rich condition) for 5 seconds, despite the rear HO2 sensor output voltage being below 0.59 V, the ECM stores DTC P2196 or P2198. Alternatively, if the A/F sensor output voltage is higher than 3.8 V (very lean condition) for 5 seconds despite the rear HO2 sensor output voltage being 0.21 V or higher, DTC P2195 or P2197 is stored.

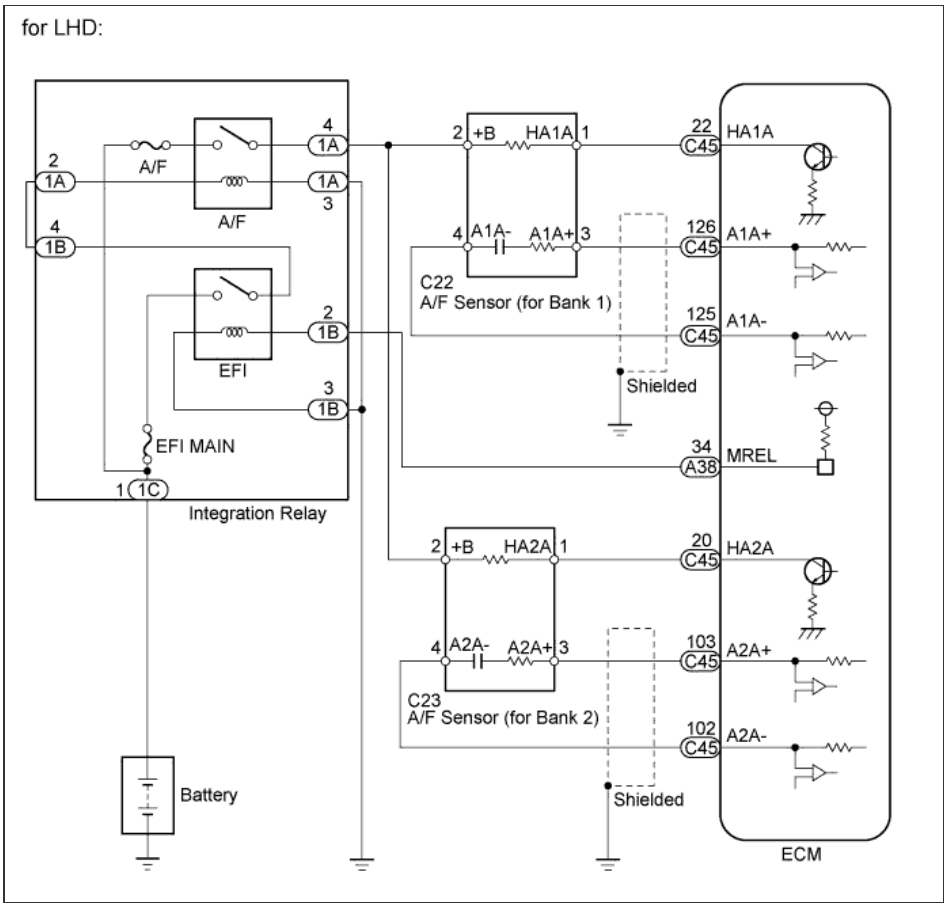
Sensor current detection monitor

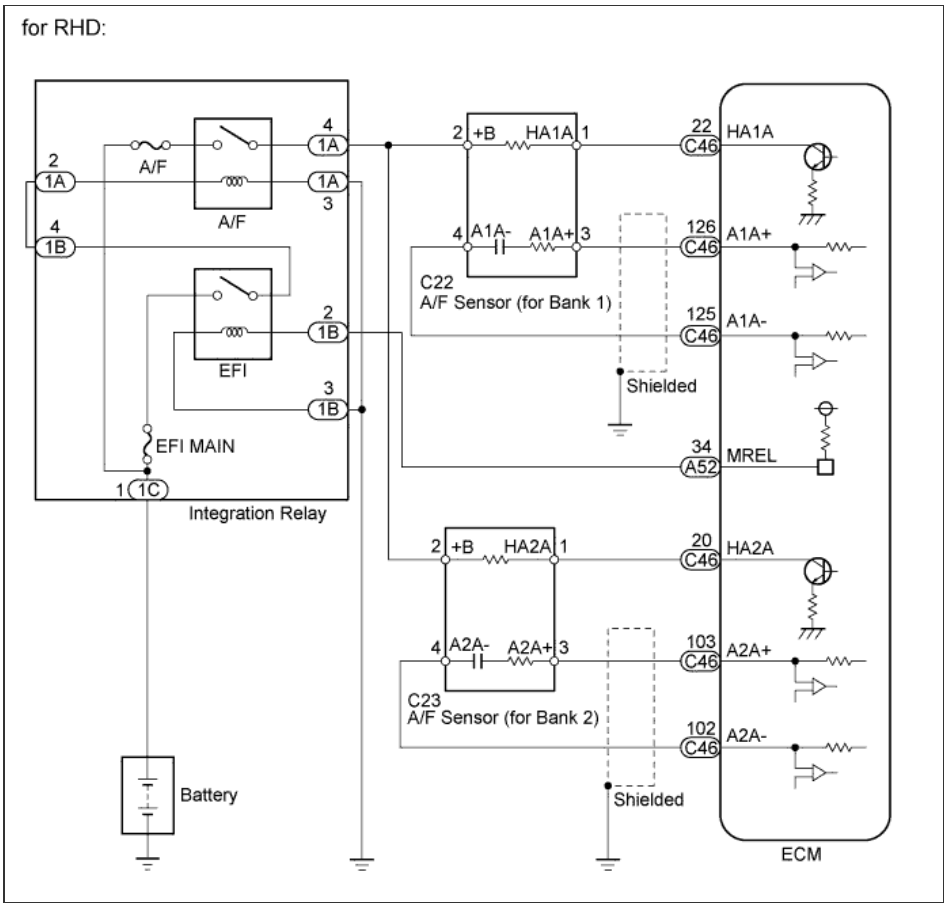
A rich air-fuel mixture causes a low A/F sensor current, and a lean air-fuel mixture causes a high A/F sensor current. Therefore, the sensor output becomes low during acceleration, and it becomes high during deceleration with the throttle valve fully closed. The ECM monitors the A/F sensor current during fuel-cut and detects any abnormal current values.

If the A/F sensor output is 3.6 mA or higher for more than 3 seconds of cumulative time, the ECM interprets this as a malfunction in the A/F sensor and stores DTC P2195 or P2197 (high-side stuck). If the A/F sensor output is below 1.4 mA for more than 3 seconds of cumulative time, the ECM stores DTC P2196 or P2198 (low-side stuck).



WIRING DIAGRAM



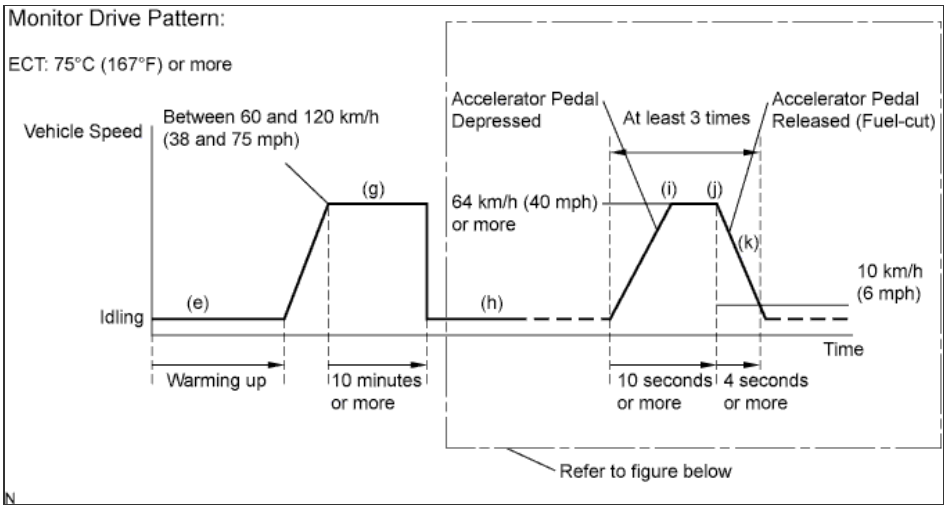


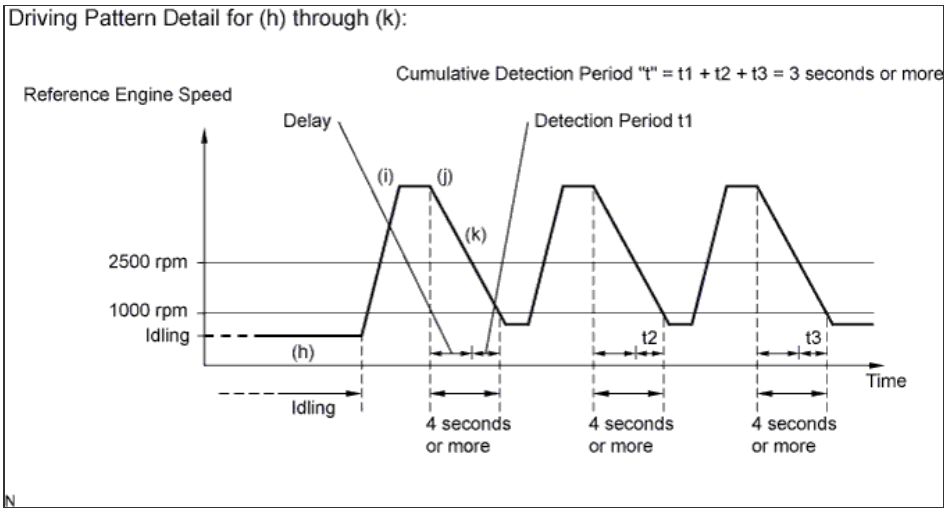
CONFIRMATION DRIVING PATTERN

CAUTION:

Strictly observe posted speed limits, traffic laws, and road conditions when performing these drive patterns.

This confirmation driving pattern is used in the "Perform Confirmation Driving Pattern" procedure of the following diagnostic troubleshooting procedure.





(a) Connect the intelligent tester to the DLC3.
(b) Turn the engine switch on (IG).
(c) Turn the tester on.
(d) Clear DTCs (Click here).
(e) Start the engine, and warm it up until the ECT reaches 75°C (167°F) or higher.
(f) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Idle Fuel Cut.
(g) Drive the vehicle at between 60 km/h (38 mph) and 120 km/h (75 mph) for at least 10 minutes.
(h) Change the transmission to 2nd gear.
(i) Drive the vehicle at the proper vehicle speed to perform fuel-cut operation.

HINT:

Fuel-cut is performed when the following conditions are met:

- **Accelerator pedal fully released.**
- **Engine speed is 2500 rpm or more (fuel injection returns at 1000 rpm).**

(j) Accelerate the vehicle to 64 km/h (40 mph) or more by depressing the accelerator pedal for at least 10 seconds.
(k) Soon after performing step (j) above, release the accelerator pedal for at least 4 seconds without depressing the brake pedal, in order to execute fuel-cut control.
(l) Allow the vehicle to decelerate until the vehicle speed decreases to less than 10 km/h (6 mph).
(m) Repeat steps (h) through (k) above at least 3 times in one driving cycle.

HINT:

Completion of all O2S (A/F) Monitor is required to change the value in the Data List.

INSPECTION PROCEDURE

HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air-Fuel Ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**
- **DTC P2A00 may be stored when the air-fuel ratio is stuck rich or lean.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.**
- **A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.**

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F Sensor function provided in the Active Test. The Control the Injection Volume for A/F Sensor function can help to determine whether the Air-fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F Sensor operation using the tester.

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor.
(e) Perform the Control the Injection Volume for A/F Sensor operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

HINT:

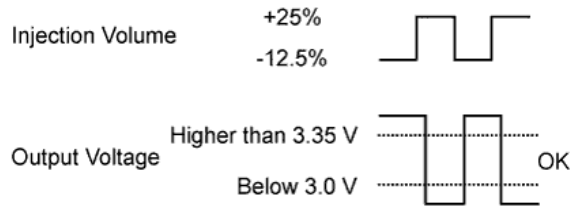
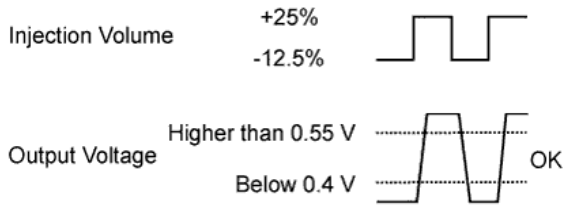
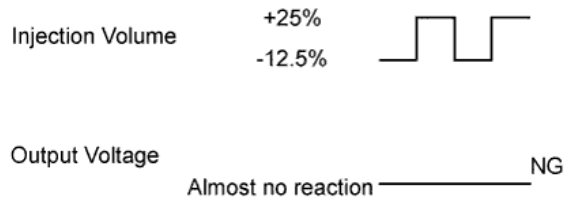
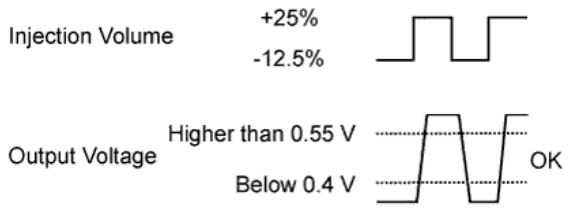
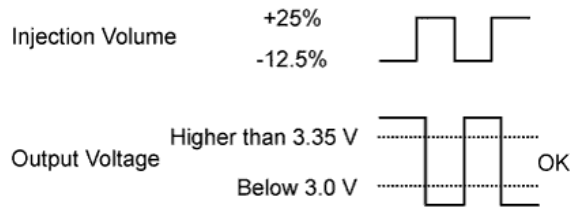
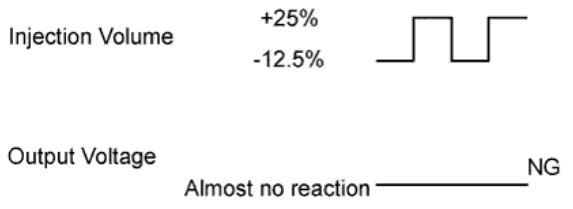
- **The Control the Injection Volume for A/F Sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **The sensors react in accordance with increases and decreases in the fuel injection volume.**

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor (for sensor 2) output has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors. To display the graph, enter the following menus on the tester: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/ F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P2195, P2196, P2197 or P2198 is output	A
P2195, P2196, P2197 or P2198 and other DTCs are output	B

HINT:

If any DTCs relating to the A/F sensor (DTCs for the A/F sensor heater or A/F sensor admittance) are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (TEST VALUE OF A/F SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the vehicle to drive in accordance with the drive pattern described in the Confirmation Driving Pattern.

f. Enter the following menus: Powertrain / Engine and ECT / Data List / Monitor Status.

g. Check that the status of O2S (A/FS) Monitor is Complete.
If the status is still Incomplete, drive the vehicle according to the driving pattern again.

HINT:

- **Complete indicates that the component is functioning normally.**
- **Incomplete indicates that the component is malfunctioning.**

h. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS B1 S1 or AFS B2 S1.

i. Check the test value of the A/F sensor output current during fuel-cut.

Result

Test Value	Proceed to
Within normal range (1.4 mA or higher, and below 3.6 mA)	A
Outside normal range (Below 1.4 mA, or 3.6 mA or higher)	B

B → Go to step 12

A

3.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF A/F SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Warm up the A/F sensor at an engine speed of 2500 rpm for 90 seconds.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / Snapshot / AFS B1 S1 or AFS B2 S1 and Engine Speed.

f. Check the A/F sensor voltage 3 times, when the engine is in each of the following conditions:

i. While idling (check for at least 30 seconds).

ii. At an engine speed of approximately 2500 rpm (without any sudden changes in engine speed).

iii. Raise the engine speed to 4000 rpm and then quickly release the accelerator pedal so that the throttle valve is fully closed.

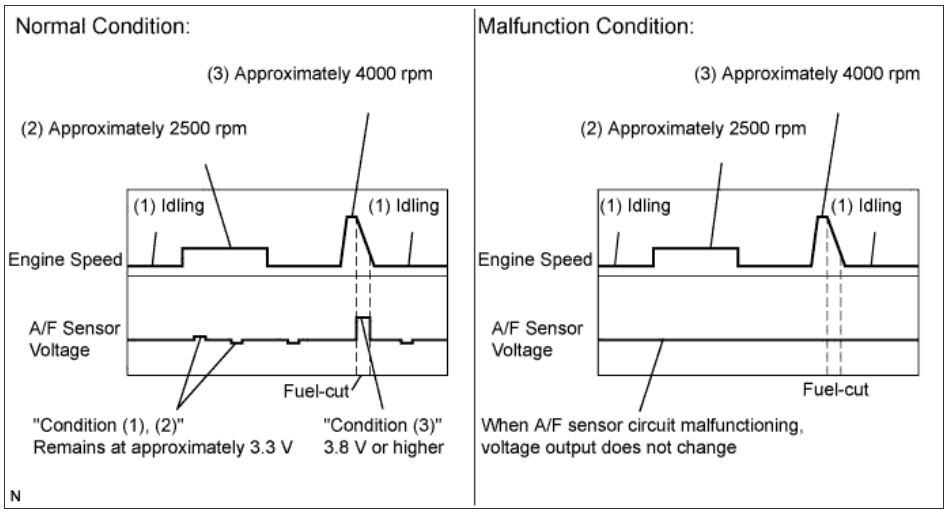
Standard Voltage:

Condition	A/F Sensor Voltage Variation	Reference
(1) and (2)	Remains at approximately 3.3 V	3.1 V to 3.5 V
		This occurs during

(3)	Increases to 3.8 V or higher	engine deceleration (when fuel-cut performed)

HINT:

- **For more information, see the diagrams below.**



- **If the output voltage of the A/F sensor remains at approximately 3.3 V (see Malfunction Condition diagram) under any conditions, including those above, the A/F sensor may have an open circuit (this will also happen if the A/F sensor heater has an open circuit).**
- **If the output voltage of the A/F sensor remains at either approximately 3.8 V or higher, or 2.8 V or less (see Malfunction Condition diagram) under any conditions, including those above, the A/F sensor may have a short circuit.**
- **The ECM stops fuel injection (fuel cut) during engine deceleration. This causes a lean condition and results in a momentary increase in the A/F sensor output voltage.**
- **The ECM must establish a closed throttle valve position learning value to perform fuel cut. If the battery terminal has been reconnected, the vehicle must be driven over 16 km/h (10 mph) to allow the ECM to learn the closed throttle valve position.**
- **When the vehicle is driven:**
  The output voltage of the A/F sensor may be below 2.8 V during fuel enrichment. For the vehicle, this translates to a sudden increase in speed with the accelerator pedal fully depressed when trying to overtake another vehicle. The A/F sensor is functioning normally.
- **The A/F sensor is a current output element; therefore, the current is converted into a voltage inside the ECM. Measuring the voltage at the connectors of the A/F sensor or ECM will show a constant voltage result.**

NG → **Go to step 9**

OK

4.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

b. Read pending DTCs.

Result

Result	Proceed to
P2195, P2196, P2197 or P2198 is output	A
No DTC is output	B

B → **END**

A

6.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

7.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

b. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2195, P2196, P2197 or P2198 is output	B

B → REPLACE ECM (Click here)

A

END

9.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

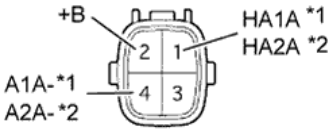
a. Disconnect the Air-Fuel Ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

Component without harness connected: (A/F Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

10.INSPECT INTEGRATION NO.1 RELAY (A/F)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

iii. Reinstall the A/F fuse.

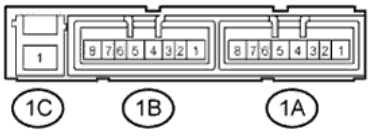
c. Inspect the integration relay (A/F).

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1A-4	Battery voltage not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω

Component without harness connected: (Integration Relay)



NG → REPLACE INTEGRATION NO.1 RELAY (A/F)

OK

11.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

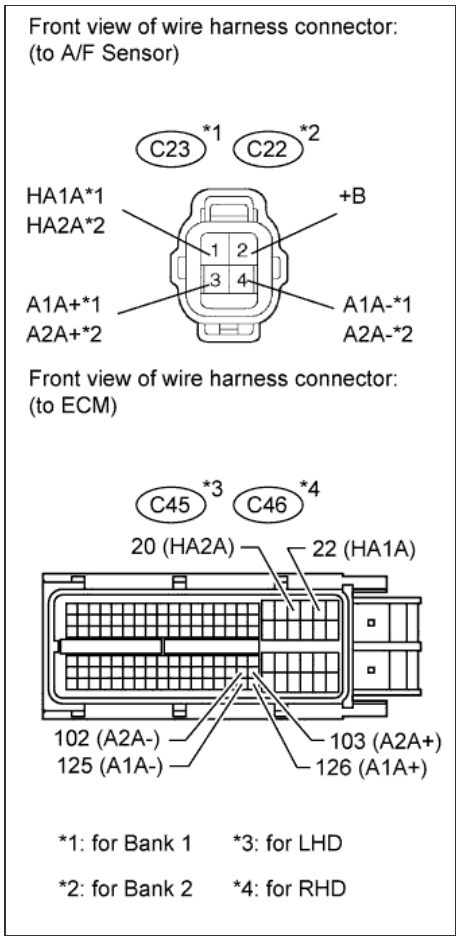
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.



e. Measure the resistance according to the value(s) in the table below.

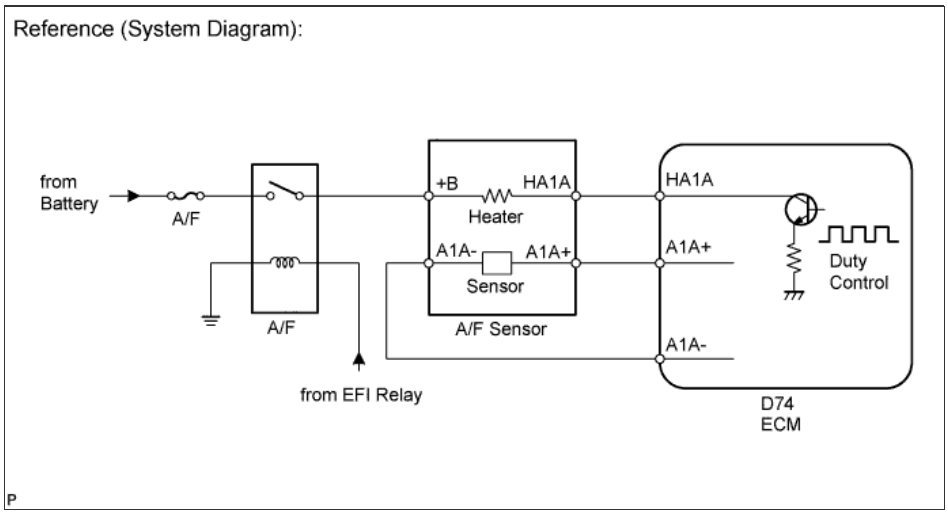
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C46-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



P

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

12.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

13.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

14.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

b. Read pending DTCs.

Result

Result	Proceed to

No DTC is output	A
P2195, P2196, P2197 or P2198 is output	B

B → REPLACE ECM (Click here)

A

END

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

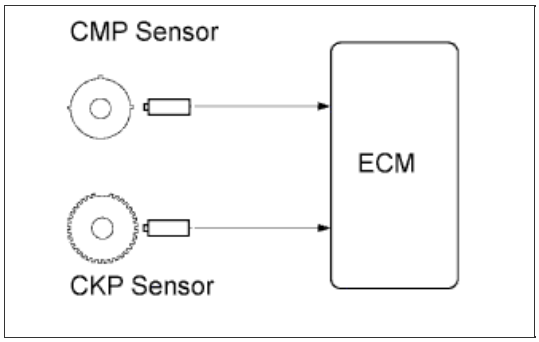
DTC P0306 Cylinder 6 Misfire Detected

DTC P0307 Cylinder 7 Misfire Detected

DTC P0308 Cylinder 8 Misfire Detected

for Preparation Click here

DESCRIPTION



When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause increases in exhaust emission levels. High concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent these increases in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the TWC reaches the point of thermal degradation, the ECM blinks the MIL. To monitor misfires, the ECM uses both the Camshaft Position (CMP) sensor and the Crankshaft Position (CKP) sensor. The CMP sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted as when the crankshaft rotation speed variations exceed predetermined thresholds.
If the misfire rate exceeds the threshold level, the ECM illuminates the MIL and stores a DTC.

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Fuel injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve clearance • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306 P0307 P0308	Misfiring of a specific cylinder occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

MONITOR DESCRIPTION

The ECM illuminates the MIL and stores a DTC when either one of the following conditions, which could cause emission deterioration, is detected (2 trip detection logic).

- Within the first 1000 crankshaft revolutions of the engine starting, an excessive misfiring rate (approximately 130 to 160 misfires per 1000 crankshaft revolutions) occurs once.
- An excessive misfiring rate (approximately 130 to 160 misfires per 1000 crankshaft revolutions) occurs a total of 4 times.

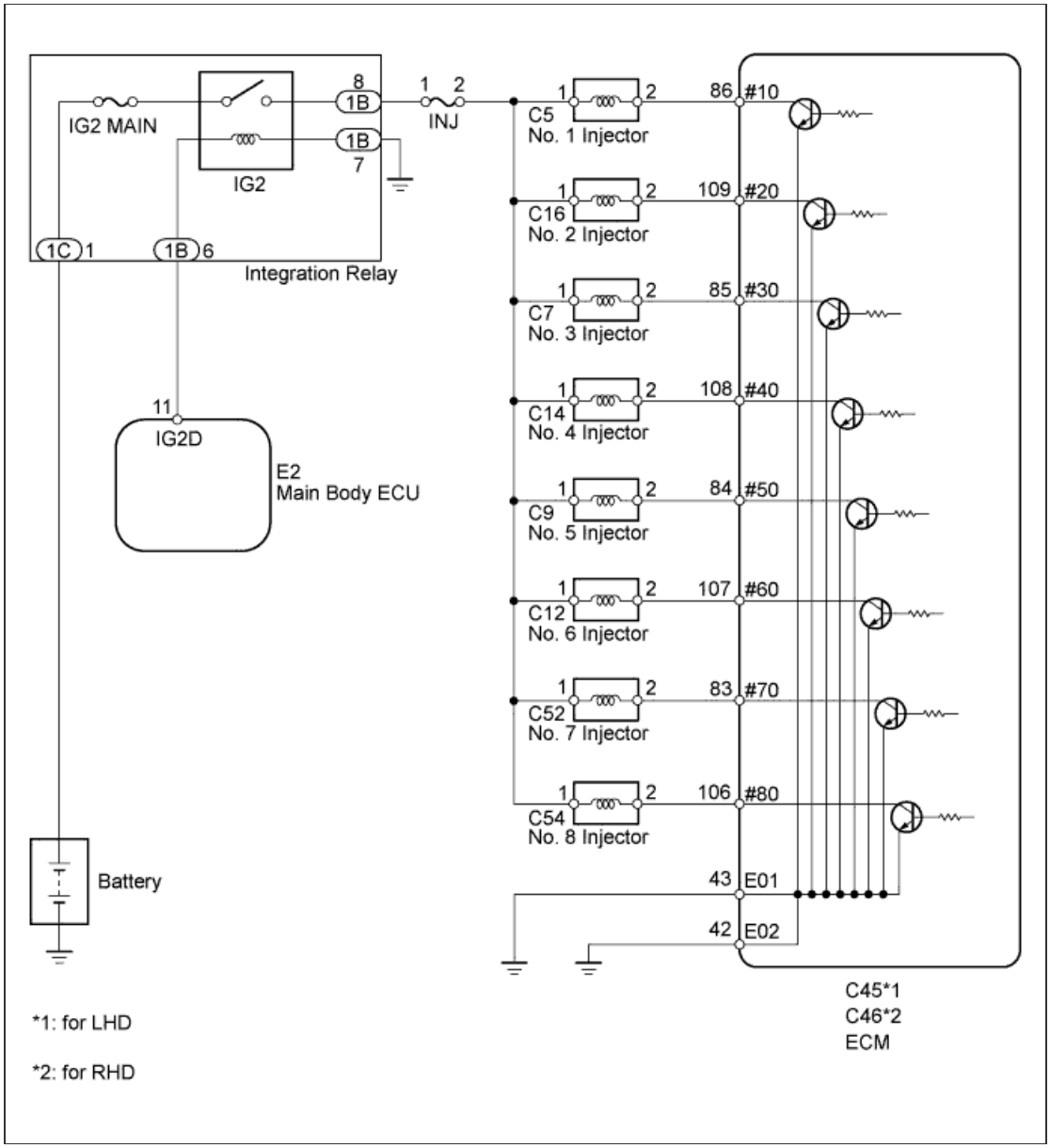
The ECM flashes the MIL and stores a DTC when either one of the following conditions, which could cause damage to the Three-Way Catalytic Converter (TWC), is detected (2 trip detection logic).

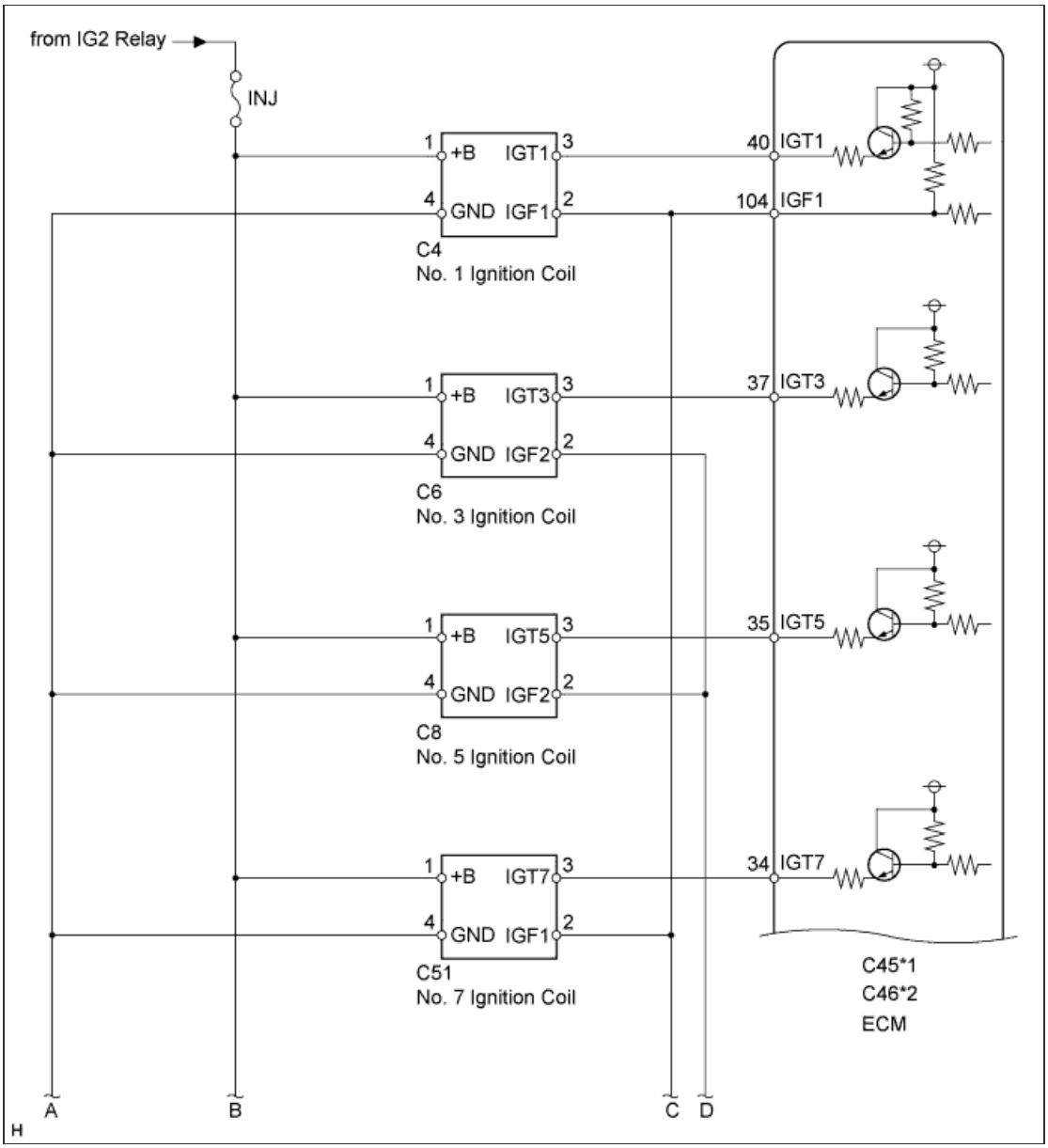
- At a high engine speed, a catalyst damage misfire, which is monitored every 200 crankshaft revolutions, occurs once.
- At a normal engine speed, a catalyst damage misfire, which is monitored every 200 crankshaft revolutions, occurs 3 times.

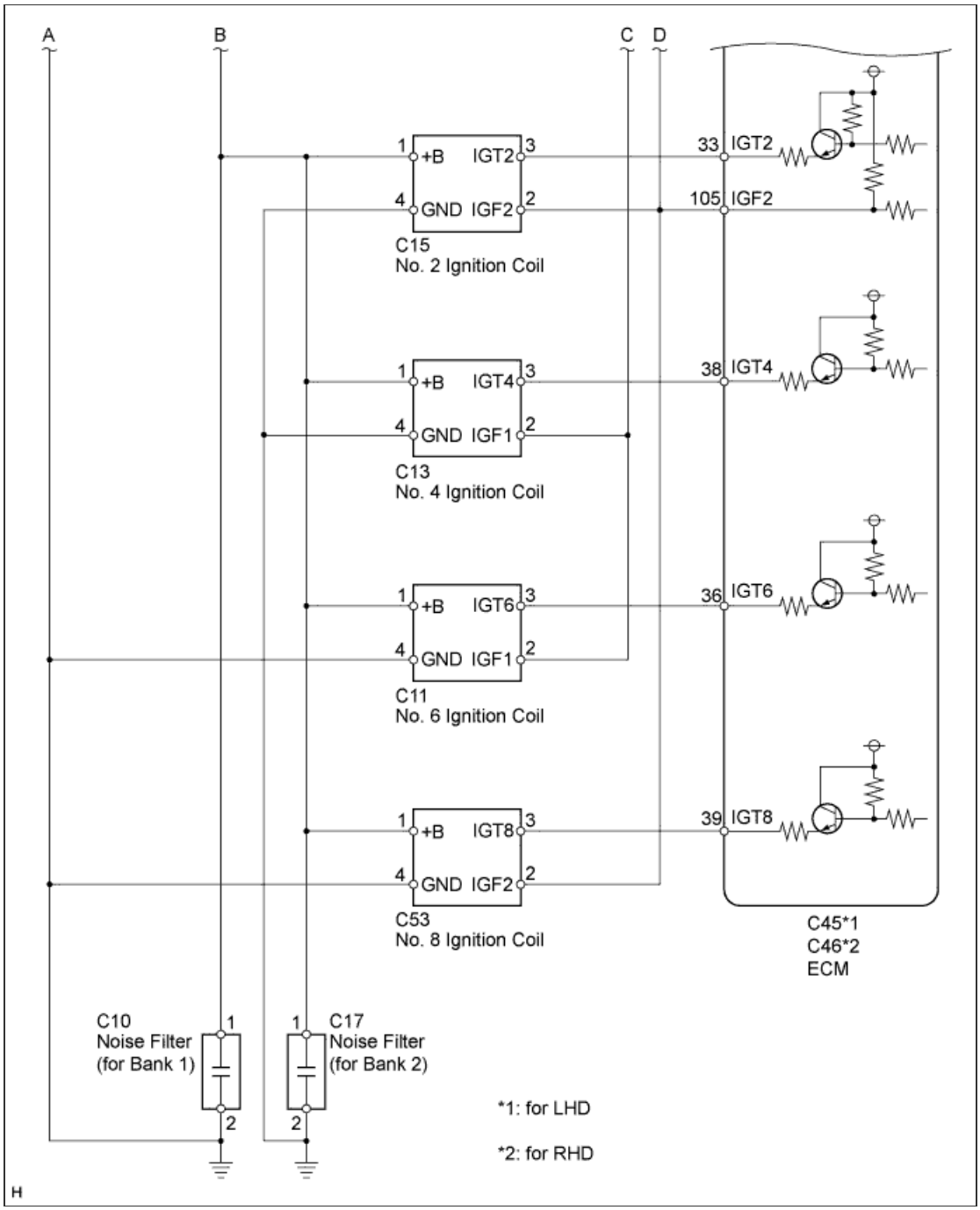
HINT:

If a catalyst damage misfire occurs, the ECM informs the driver by flashing the MIL.

WIRING DIAGRAM




from IG2 Relay
INJ
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
34
IGT7
C45*1
C46*2
ECM
A
B
C
D
H



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Turn the tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire counts of each cylinder (cylinder No. 1 to No. 8) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
7. Drive the vehicle several times with the conditions, such as engine speed and engine load, shown in Misfire RPM and Misfire Load in the Data List.

HINT:

In order to store misfire DTCs, it is necessary to operate the vehicle for the period of time shown in the table below, with the Misfire RPM and Misfire Load in the Data List.

Engine Speed	Duration
Idling	3.5 minutes or more
1000	3 minutes or more
2000	1.5 minutes or more
3000	1 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

   HINT:

   Do not turn the engine switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data will be cleared.

9. Record the DTC(s), freeze frame data and misfire counts.
10. Turn the engine switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the freeze frame data have been duplicated, one of the following factors is considered to be a possible cause of the problem:**
  1. **The fuel level is low.**
  2. **Improper fuel is used.**
  3. **The spark plugs are dirty.**
- **After finishing repairs, check that no misfires occur in each cylinder (cylinder No. 1, No. 2, No. 3, No. 4, No. 5, No. 6, No. 7 and No. 8).**
- **Be sure to confirm that no misfiring cylinder DTCs are output again by conducting the confirmation driving pattern, after the repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speed. If misfires only occur during high engine speed driving, only DTC P0300 is stored.**
  In the event of DTC P0300 being output, perform the following operations:
  1. **Clear the DTC (Click here).**
  2. **Start the engine and conduct the confirmation driving pattern.**
  3. **Read the misfiring rates of each cylinder or DTC(s) using the tester.**
  4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
  5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not output.**
- **When either Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air-fuel ratio may be rich (-20% or less) or lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is below 75°C (167°F), the misfires occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel can cause body vibration, which may cause misfire DTC(s) to be stored.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 is output	A
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 and other DTCs are output	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

3.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is connected correctly and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE (Click here)

OK

4.READ VALUE USING INTELLIGENT TESTER (MISFIRE COUNT)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5, #6, #7 and #8.

f. Allow the engine to idle.

g. Read each value for Cylinder #1 Misfire Count to #8 displayed on the tester. If no misfire counts occur in any cylinders, perform the following procedures:

i. Move the shift lever to D.

ii. Check the Cylinder #1 Misfire Count to #8.

iii. If misfire counts are still not displayed, perform procedure A and and then check the misfire counts again.

h. Drive the vehicle with the Misfire RPM and Misfire Load noted in the Read value using intelligent tester (Misfire RPM and Misfire Load) procedures above (procedure A).

i. Read the Cylinder #1 Misfire Count to #8 or DTCs displayed on the tester (procedure).

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have e ual misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data record of the Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → Go to step 17

A

5.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

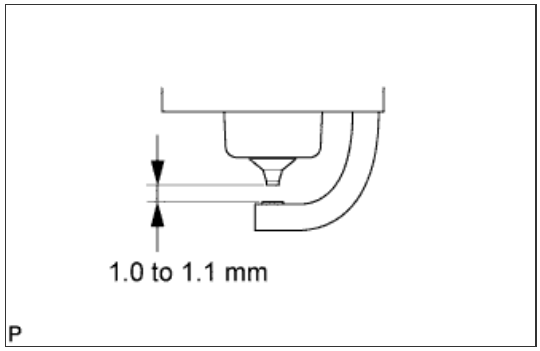
b. Measure the spark plug electrode gap.

Standard gap:
1.0 to 1.1 mm (0.039 to 0.043 in.)

c. Check the electrode for carbon deposits.

Recommended Spark Plug:

Manufacturer	Product
DENSO	SK20R11
NGK	IFR6A11



NOTICE:

If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.

NG → REPLACE SPARK PLUG (Click here)

OK

6.CHECK FOR SPARKS AND IGNITION

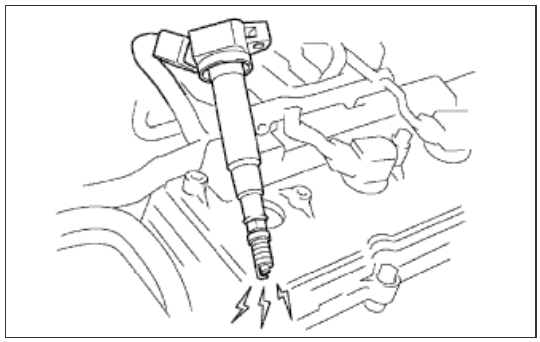
a. Disconnect the fuel injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.



b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → REPAIR ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK HARNESS AND CONNECTOR (ECM - FUEL INJECTOR)

a. Disconnect the fuel injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	C16-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 3	C7-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	C14-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	C9-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	C12-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	C52-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	C54-1 - Ground	Engine switch on (IG)	11 to 14 V

d. Turn the engine switch off.

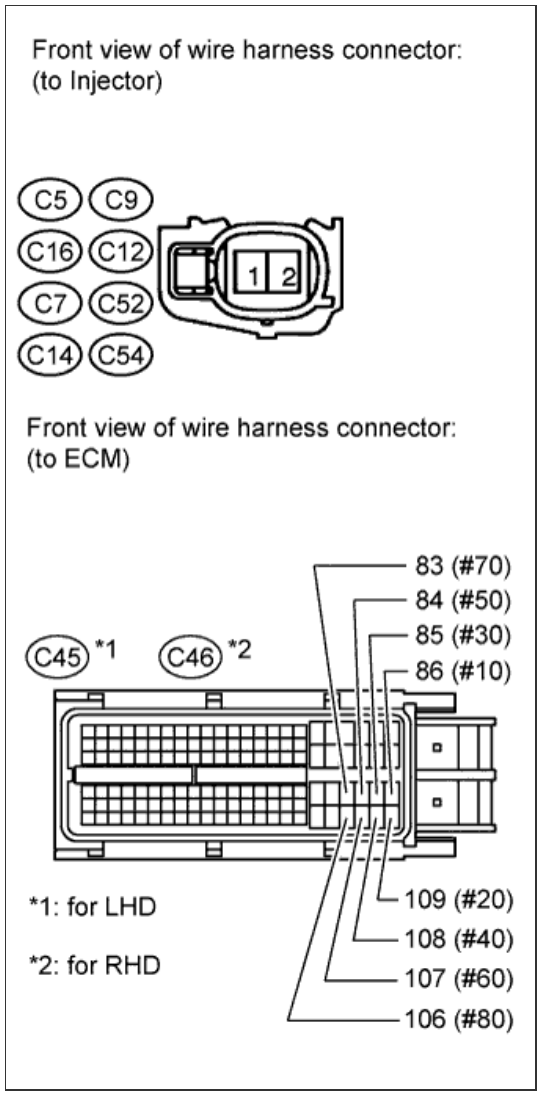
e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C45-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C45-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C45-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C45-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C45-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C45-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C45-106 (#80)	Always	Below 1 Ω

Standard Resistance (for RHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher



	C5-2 - C46-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C46-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C46-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C46-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C46-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C46-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C46-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C46-106 (#80)	Always	Below 1 Ω

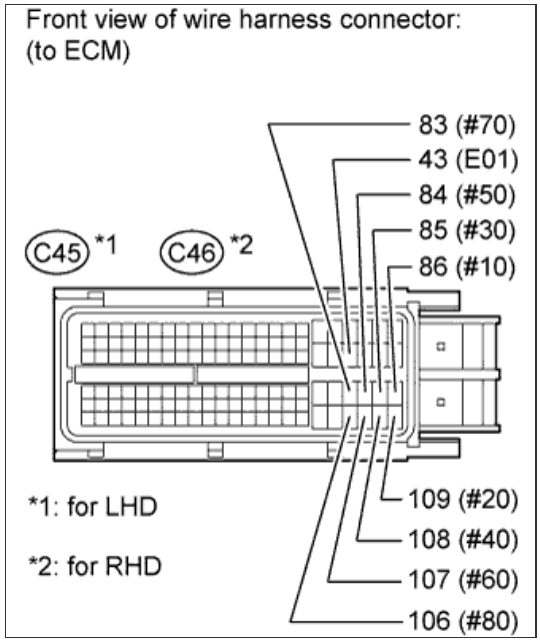
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50, #60, #70 AND/OR #80 VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage (for LHD):

Tester Connection	Switch Condition	Specified Condition
C45-86 (#10) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-109 (#20) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-85 (#30) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-108 (#40) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-84 (#50) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-107 (#60) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-83 (#70) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-106 (#80) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V

Standard Voltage (for RHD):

Tester Connection	Switch Condition	Specified Condition
C46-86 (#10) -	Engine switch on	

C46-43 (E01)	(IG)	11 to 14 V
C46-109 (#20) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-85 (#30) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-108 (#40) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-84 (#50) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-107 (#60) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-83 (#70) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-106 (#80) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK

11.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

12.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (**Click here**)

OK

13.CHECK VALVE TIMING

a. Remove the drive belt (Click here).

b. Remove the timing belt cover LH and RH (Click here).

c. Turn the crankshaft to align the matchmarks of the crankshaft.

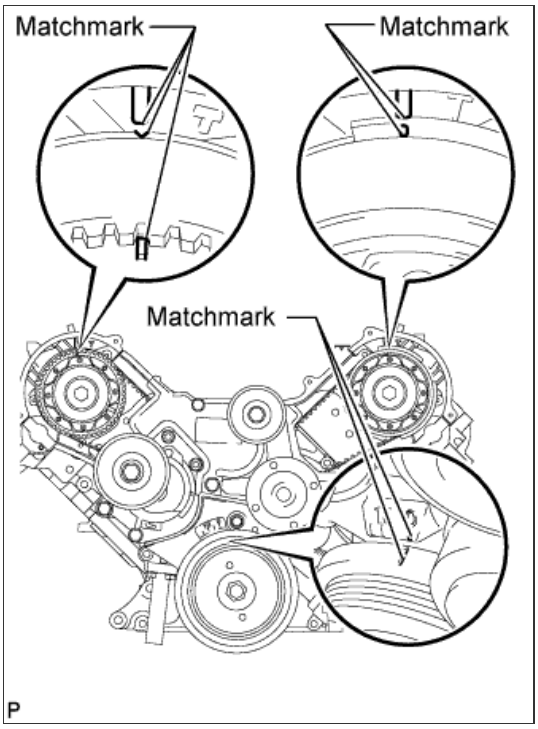
d. Align the notch of the crankshaft pulley with the 0 position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360 . Confirm again if the matchmarks are facing each other.

OK:

The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NG → ADJUST VALVE TIMING (Click here)

OK ↓

14.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK AND REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER

OK ↓

15.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:

With cold engine: Same as ambient air temperature.

With warm engine: Between 80°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK ↓

16.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK ↓

REPLACE ECM (Click here)

17.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

18.CHECK VALVE TIMING

a. Remove the drive belt (Click here).

b. Remove the timing belt cover LH and RH (Click here).

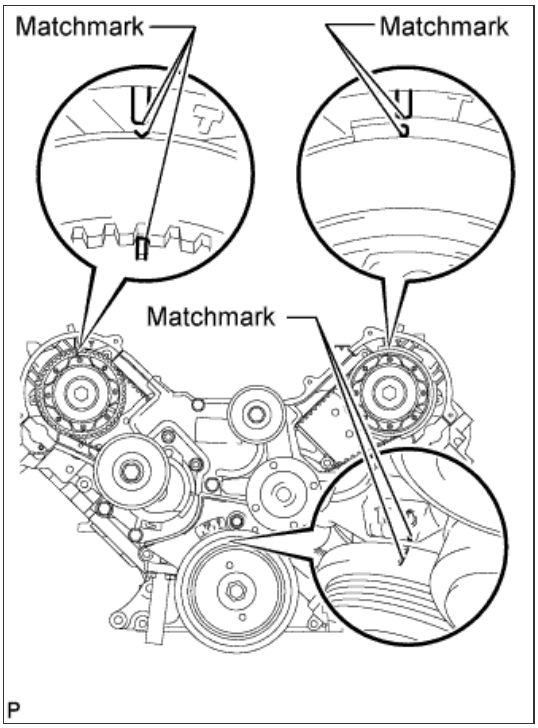
c. Turn the crankshaft to align the matchmarks of the crankshaft.

d. Align the notch of the crankshaft pulley with the 0 position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360 . Confirm again if the matchmarks are facing each other.

OK:
The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NG → ADJUST VALVE TIMING (Click here)

OK

19.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK AND REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER

OK

20.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: Between 80°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

21.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

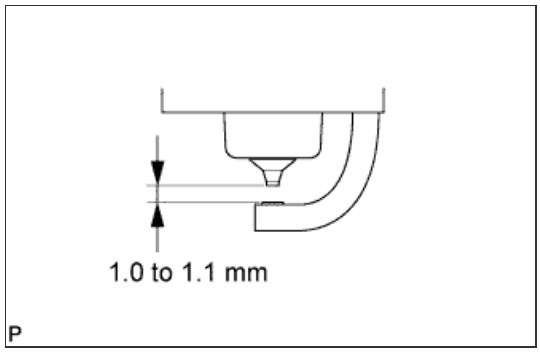
OK

22.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

b. Measure the spark plug electrode gap.

Standard gap:
1.0 to 1.1 mm (0.039 to 0.043 in.)



c. Check the electrode for carbon deposits.

Recommended Spark Plug:

Manufacturer	Product
DENSO	SK20R11
NGK	IFR6A11

NOTICE:

If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.

NG → REPLACE SPARK PLUG (Click here)

OK

23.CHECK FOR SPARKS AND IGNITION

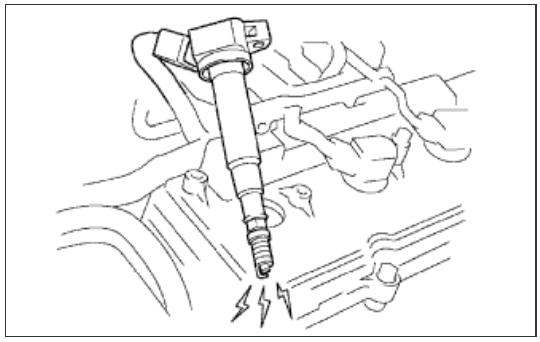
a. Disconnect the fuel injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.



b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

24.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → REPAIR ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

25.CHECK HARNESS AND CONNECTOR (ECM - FUEL INJECTOR)

a. Disconnect the fuel injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

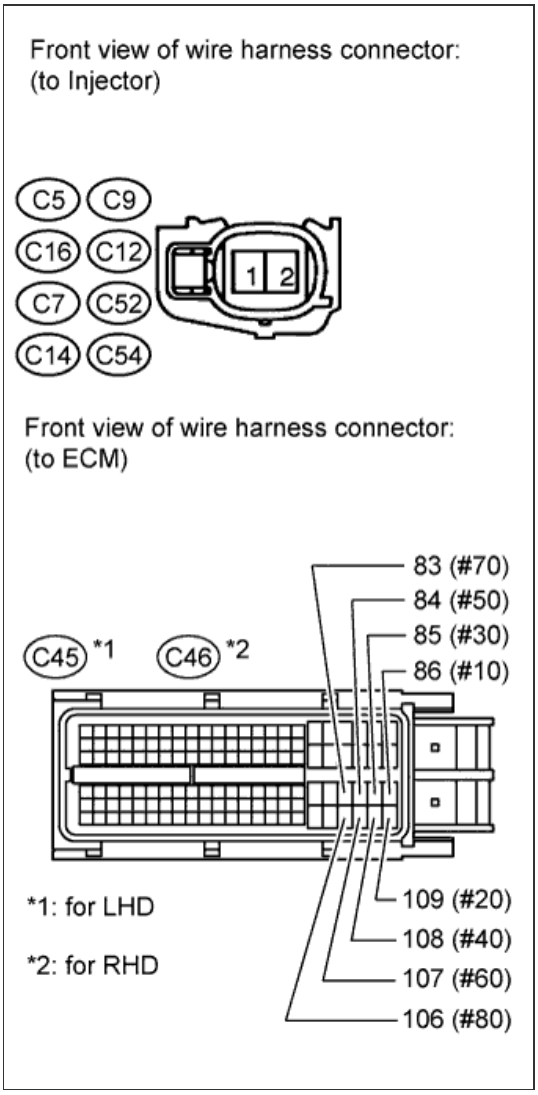
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	C16-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 3	C7-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	C14-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	C9-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	C12-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	C52-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	C54-1 - Ground	Engine switch on (IG)	11 to 14 V

d. Turn the engine switch off.

e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C45-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C45-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C45-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C45-84 (#50)	Always	Below 1 Ω
	C12-2 - Ground	Always	10 kΩ or higher



No. 6	C12-2 - C45-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C45-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C45-106 (#80)	Always	Below 1 Ω

Standard Resistance (for RHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C46-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C46-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C46-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C46-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C46-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C46-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C46-106 (#80)	Always	Below 1 Ω

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50, #60, #70 AND/OR #80 VOLTAGE)

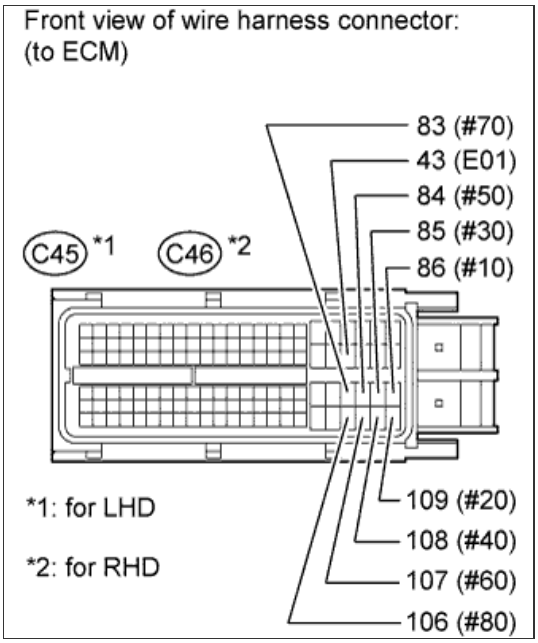
a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage (for LHD):

Tester Connection	Switch Condition	Specified Condition
C45-86 (#10) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-109 (#20) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-85 (#30) -	Engine switch on	11 to 14 V

C45-43 (E01)	(IG)	
C45-108 (#40) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-84 (#50) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-107 (#60) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-83 (#70) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-106 (#80) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V



Standard Voltage (for RHD):

Tester Connection	Switch Condition	Specified Condition
C46-86 (#10) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-109 (#20) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-85 (#30) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-108 (#40) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-84 (#50) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-107 (#60) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-83 (#70) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-106 (#80) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

27.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK

28.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

REPLACE ECM (**Click here**)

29.CHANGE TO NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the installed spark plug with a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → Go to step 30

OK

REPLACE SPARK PLUG (Click here)

30.CHANGE TO NORMAL IGNITION COIL AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the ignition coil with an ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK

REPLACE IGNITION COIL (Click here)

DTC P2195 Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)

DTC P2196 Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)

DTC P2197 Oxygen (A/F) Sensor Signal Stuck Lean (Bank 2 Sensor 1)

DTC P2198 Oxygen (A/F) Sensor Signal Stuck Rich (Bank 2 Sensor 1)

for Preparation Click here

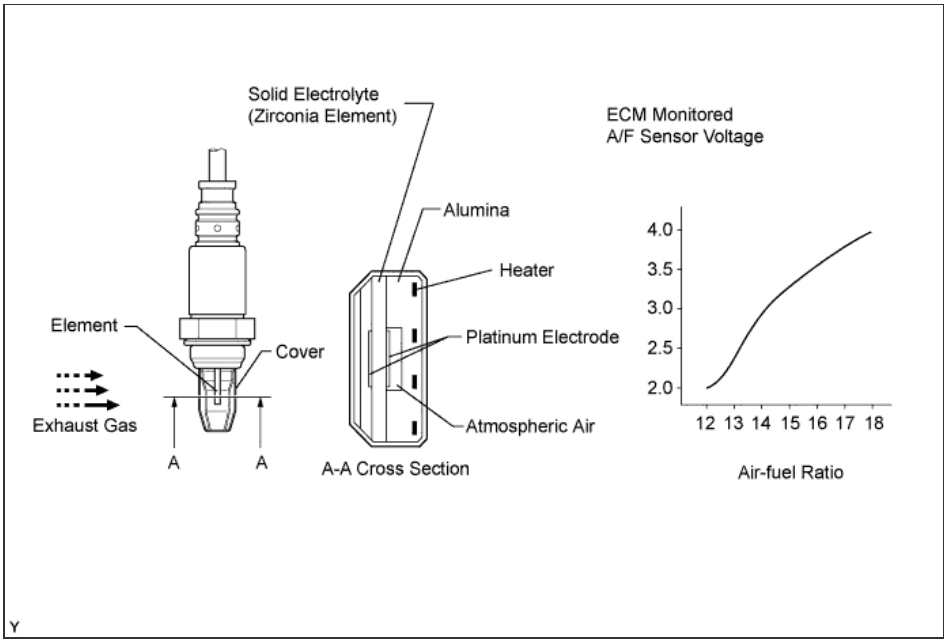
DESCRIPTION

The A/F sensor generates a voltage* that corresponds to the actual air-fuel ratio. This sensor voltage is used to provide the ECM with feedback so that it can control the air-fuel ratio. The ECM determines the deviation from the stoichiometric air-fuel ratio level, and regulates the fuel injection time. If the A/F sensor malfunctions, the ECM is unable to control the air-fuel ratio accurately.

The A/F sensor is the planar type and is integrated with the heater, which heats the solid electrolyte (zirconia element). This heater is controlled by the ECM. When the intake air volume is low (the exhaust gas temperature is low), a current flows into the heater to heat the sensor in order to facilitate accurate air-fuel ratio detection. In addition, the sensor and heater portions are the narrow type. The heat generated by the heater is conducted to the solid electrolyte through the alumina, therefore the sensor activation is accelerated.

In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric level.

*: The value changes inside the ECM. Since the A/F sensor is the current output element, a current is converted into a voltage inside the ECM. Any measurements taken at the A/F sensor or ECM connectors will show a constant voltage.



DTC Code	DTC Detection Condition	Trouble Area
P2195 P2197	Conditions (a) and (b) continue for 5 seconds or more (2 trip detection logic): (a) The A/F sensor voltage is higher than 3.8 V for 5 seconds. (b) The Heated Oxygen (HO2) sensor voltage is 0.21 V or higher.	• Open or short in A/F sensor (for sensor 1) circuit • A/F sensor (for sensor 1) • A/F sensor heater (for sensor 1) • Integration relay • A/F sensor heater and integration relay circuits • Air induction system • Fuel pressure • Injector • ECM
	While the fuel-cut operation is performed (during vehicle deceleration), the A/F sensor current is 3.6 mA or higher for 3 seconds (2 trip detection logic).	• A/F sensor • ECM
P2196 P2198	Conditions (a) and (b) continue for 5 seconds or more (2 trip detection logic): (a) The A/F sensor voltage is below 2.8 V for 5 seconds. (b) The HO2 sensor voltage is below 0.59 V.	• Open or short in A/F sensor (for sensor 1) circuit • A/F sensor (for sensor 1) • A/F sensor heater (for sensor 1) • Integration relay • A/F sensor heater and integration relay circuits • Air induction system • Fuel pressure • Injector • ECM
	While the fuel-cut operation is performed (during vehicle deceleration), the A/F sensor current is below 1.4 mA for 3 seconds (2 trip detection logic).	• A/F sensor • ECM

HINT:

- **DTCs P2195 and P2196 indicate malfunctions related to bank 1 A/F sensor circuit.**
- **DTCs P2197 and P2198 indicate malfunctions related to bank 2 A/F sensor circuit.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that includes the No. 2 cylinder.**

- **When either of these DTCs is output, check the A/F sensor output voltage by entering the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS B1 S1 or AFS B2 S1.**
- **Short-term fuel trim values can also be read using the intelligent tester.**
- **The ECM regulates the voltages at the A1A+ and A1A- or A2A+ and A2A- terminals of the ECM to a constant level. Therefore, the A/F sensor output voltage cannot be confirmed without using the intelligent tester.**
- **If the A/F sensor is malfunctioning, the ECM stores DTC P2195, P2196, P2197 or P2198.**

MONITOR DESCRIPTION

Sensor voltage detection monitor

Under the air-fuel ratio feedback control, if the A/F sensor output voltage indicates rich or lean for a certain period of time, the ECM determines that there is a malfunction in the A/F sensor. The ECM illuminates the MIL and stores a DTC.

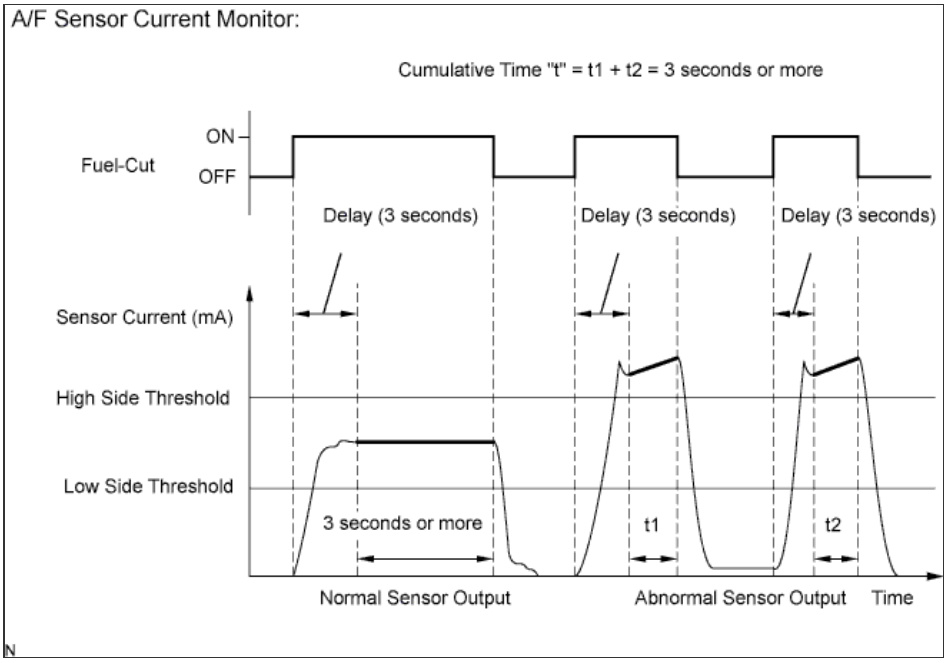
Example:

If the A/F sensor output voltage is below 2.8 V (very rich condition) for 5 seconds, despite the rear HO2 sensor output voltage being below 0.59 V, the ECM stores DTC P2196 or P2198. Alternatively, if the A/F sensor output voltage is higher than 3.8 V (very lean condition) for 5 seconds despite the rear HO2 sensor output voltage being 0.21 V or higher, DTC P2195 or P2197 is stored.

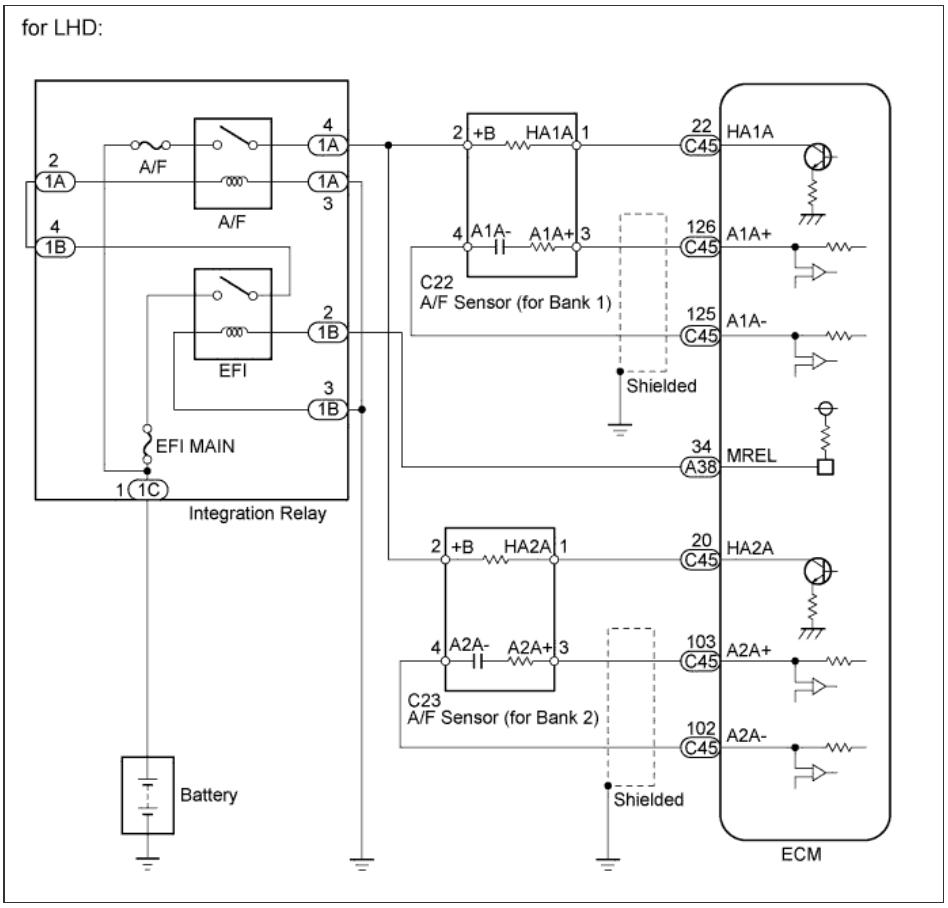
Sensor current detection monitor

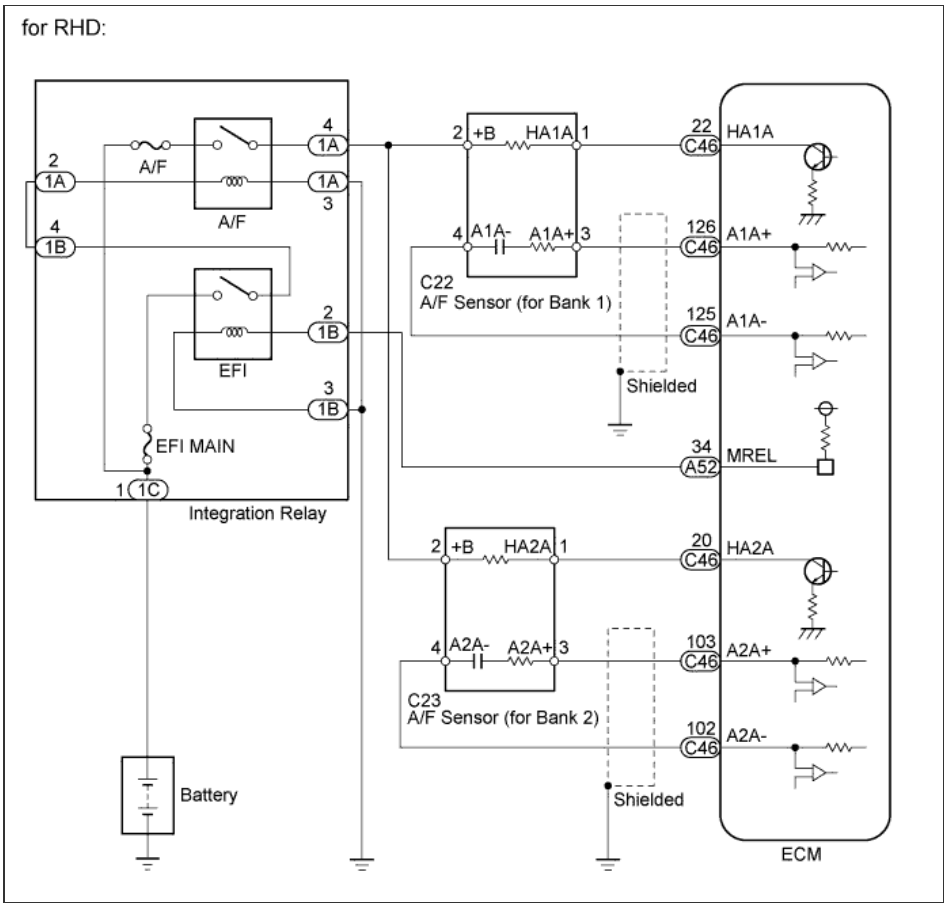
A rich air-fuel mixture causes a low A/F sensor current, and a lean air-fuel mixture causes a high A/F sensor current. Therefore, the sensor output becomes low during acceleration, and it becomes high during deceleration with the throttle valve fully closed. The ECM monitors the A/F sensor current during fuel-cut and detects any abnormal current values.

If the A/F sensor output is 3.6 mA or higher for more than 3 seconds of cumulative time, the ECM interprets this as a malfunction in the A/F sensor and stores DTC P2195 or P2197 (high-side stuck). If the A/F sensor output is below 1.4 mA for more than 3 seconds of cumulative time, the ECM stores DTC P2196 or P2198 (low-side stuck).



WIRING DIAGRAM



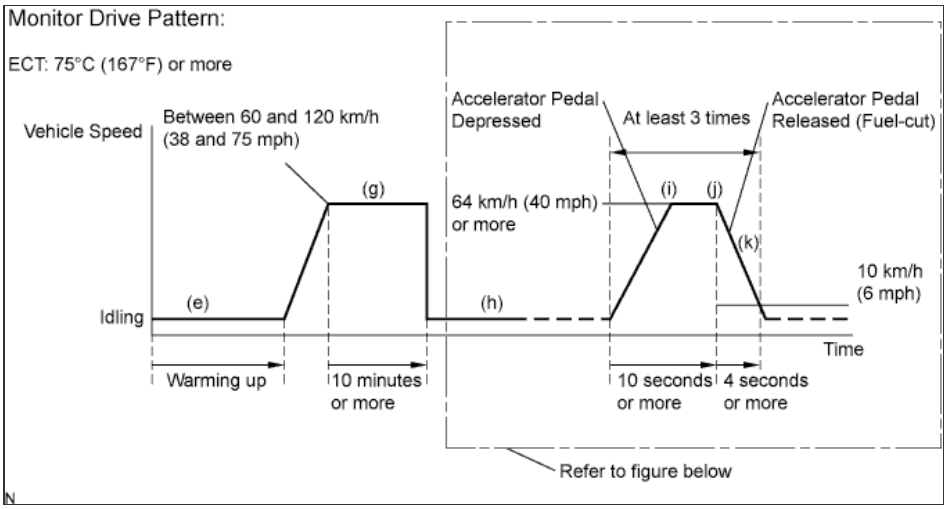


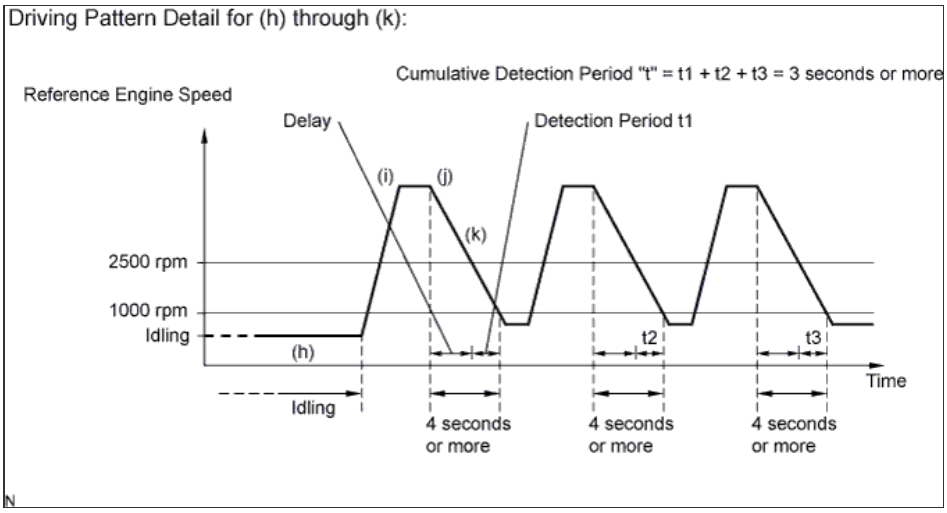
CONFIRMATION DRIVING PATTERN

CAUTION:

Strictly observe posted speed limits, traffic laws, and road conditions when performing these drive patterns.

This confirmation driving pattern is used in the "Perform Confirmation Driving Pattern" procedure of the following diagnostic troubleshooting procedure.





(a) Connect the intelligent tester to the DLC3.
(b) Turn the engine switch on (IG).
(c) Turn the tester on.
(d) Clear DTCs (Click here).
(e) Start the engine, and warm it up until the ECT reaches 75°C (167°F) or higher.
(f) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Idle Fuel Cut.
(g) Drive the vehicle at between 60 km/h (38 mph) and 120 km/h (75 mph) for at least 10 minutes.
(h) Change the transmission to 2nd gear.
(i) Drive the vehicle at the proper vehicle speed to perform fuel-cut operation.

HINT:

Fuel-cut is performed when the following conditions are met:

- **Accelerator pedal fully released.**
- **Engine speed is 2500 rpm or more (fuel injection returns at 1000 rpm).**

(j) Accelerate the vehicle to 64 km/h (40 mph) or more by depressing the accelerator pedal for at least 10 seconds.
(k) Soon after performing step (j) above, release the accelerator pedal for at least 4 seconds without depressing the brake pedal, in order to execute fuel-cut control.
(l) Allow the vehicle to decelerate until the vehicle speed decreases to less than 10 km/h (6 mph).
(m) Repeat steps (h) through (k) above at least 3 times in one driving cycle.

HINT:

Completion of all O2S (A/F) Monitor is required to change the value in the Data List.

INSPECTION PROCEDURE

HINT:

- **Although the DTC titles say oxygen sensor, these DTCs relate to the Air-Fuel Ratio (A/F) sensor.**
- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**
- **DTC P2A00 may be stored when the air-fuel ratio is stuck rich or lean.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.**
- **A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.**

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F Sensor function provided in the Active Test. The Control the Injection Volume for A/F Sensor function can help to determine whether the Air-fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F Sensor operation using the tester.

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor.
(e) Perform the Control the Injection Volume for A/F Sensor operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

HINT:

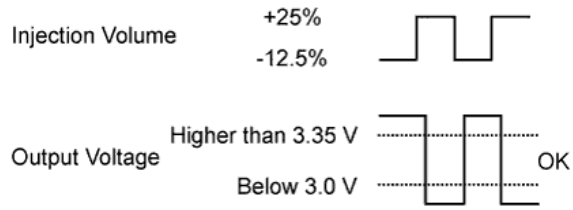
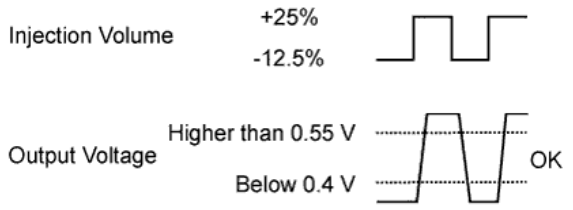
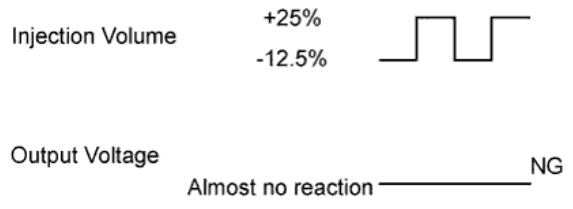
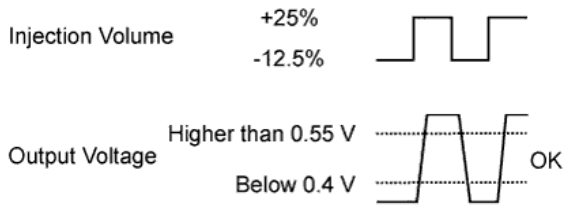
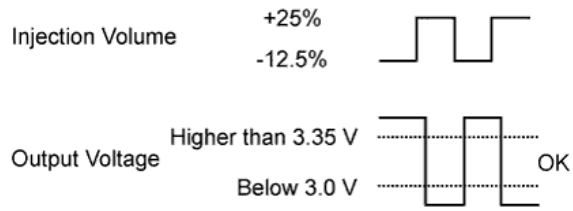
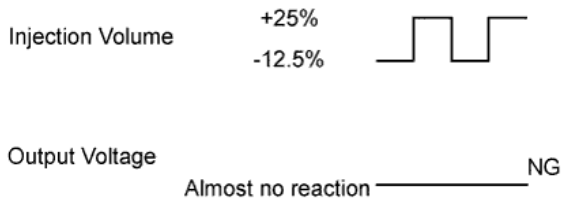
- **The Control the Injection Volume for A/F Sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **The sensors react in accordance with increases and decreases in the fuel injection volume.**

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor (for sensor 2) output has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors. To display the graph, enter the following menus on the tester: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/ F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO P2195, P2196, P2197 OR P2198)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P2195, P2196, P2197 or P2198 is output	A
P2195, P2196, P2197 or P2198 and other DTCs are output	B

HINT:

If any DTCs relating to the A/F sensor (DTCs for the A/F sensor heater or A/F sensor admittance) are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (TEST VALUE OF A/F SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the vehicle to drive in accordance with the drive pattern described in the Confirmation Driving Pattern.

f. Enter the following menus: Powertrain / Engine and ECT / Data List / Monitor Status.

g. Check that the status of O2S (A/FS) Monitor is Complete.
If the status is still Incomplete, drive the vehicle according to the driving pattern again.

HINT:

- **Complete indicates that the component is functioning normally.**
- **Incomplete indicates that the component is malfunctioning.**

h. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS B1 S1 or AFS B2 S1.

i. Check the test value of the A/F sensor output current during fuel-cut.

Result

Test Value	Proceed to
Within normal range (1.4 mA or higher, and below 3.6 mA)	A
Outside normal range (Below 1.4 mA, or 3.6 mA or higher)	B

B → Go to step 12

A

3.READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF A/F SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Warm up the A/F sensor at an engine speed of 2500 rpm for 90 seconds.

e. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / Snapshot / AFS B1 S1 or AFS B2 S1 and Engine Speed.

f. Check the A/F sensor voltage 3 times, when the engine is in each of the following conditions:

i. While idling (check for at least 30 seconds).

ii. At an engine speed of approximately 2500 rpm (without any sudden changes in engine speed).

iii. Raise the engine speed to 4000 rpm and then quickly release the accelerator pedal so that the throttle valve is fully closed.

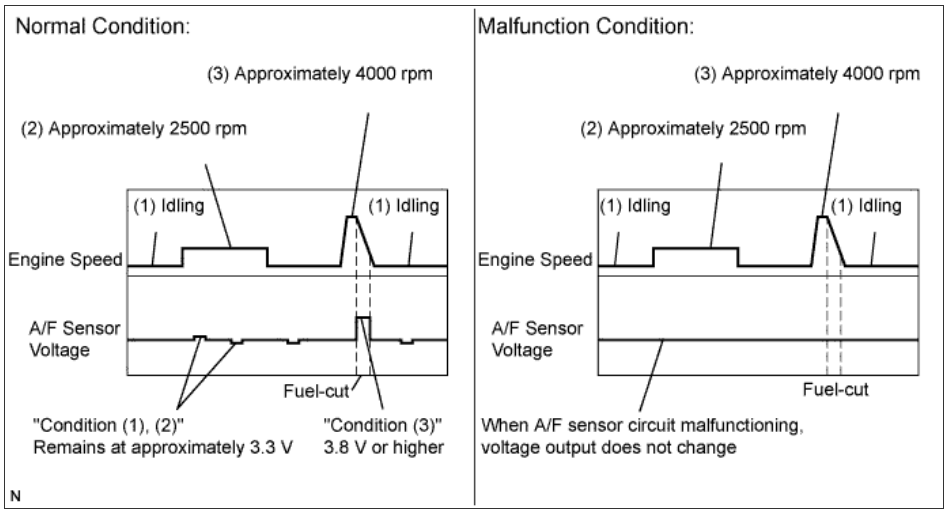
Standard Voltage:

Condition	A/F Sensor Voltage Variation	Reference
(1) and (2)	Remains at approximately 3.3 V	3.1 V to 3.5 V
		This occurs during

(3)	Increases to 3.8 V or higher	engine deceleration (when fuel-cut performed)

HINT:

- **For more information, see the diagrams below.**



- **If the output voltage of the A/F sensor remains at approximately 3.3 V (see Malfunction Condition diagram) under any conditions, including those above, the A/F sensor may have an open circuit (this will also happen if the A/F sensor heater has an open circuit).**
- **If the output voltage of the A/F sensor remains at either approximately 3.8 V or higher, or 2.8 V or less (see Malfunction Condition diagram) under any conditions, including those above, the A/F sensor may have a short circuit.**
- **The ECM stops fuel injection (fuel cut) during engine deceleration. This causes a lean condition and results in a momentary increase in the A/F sensor output voltage.**
- **The ECM must establish a closed throttle valve position learning value to perform fuel cut. If the battery terminal has been reconnected, the vehicle must be driven over 16 km/h (10 mph) to allow the ECM to learn the closed throttle valve position.**
- **When the vehicle is driven:**
  The output voltage of the A/F sensor may be below 2.8 V during fuel enrichment. For the vehicle, this translates to a sudden increase in speed with the accelerator pedal fully depressed when trying to overtake another vehicle. The A/F sensor is functioning normally.
- **The A/F sensor is a current output element; therefore, the current is converted into a voltage inside the ECM. Measuring the voltage at the connectors of the A/F sensor or ECM will show a constant voltage result.**

NG → **Go to step 9**

OK

4.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

b. Read pending DTCs.

Result

Result	Proceed to
P2195, P2196, P2197 or P2198 is output	A
No DTC is output	B

B → **END**

A

6.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

7.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

b. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2195, P2196, P2197 or P2198 is output	B

B → REPLACE ECM (Click here)

A

END

9.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

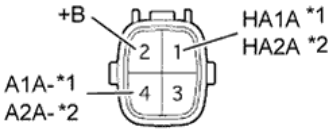
a. Disconnect the Air-Fuel Ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

Component without harness connected: (A/F Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

10.INSPECT INTEGRATION NO.1 RELAY (A/F)

a. Remove the integration relay from the engine room relay block.

b. Inspect the A/F fuse.

i. Remove the A/F fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

iii. Reinstall the A/F fuse.

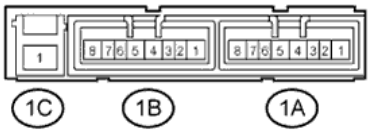
c. Inspect the integration relay (A/F).

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1A-4	Battery voltage not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage applied to terminals 1A-2 and 1A-3	Below 1 Ω

Component without harness connected: (Integration Relay)



NG → REPLACE INTEGRATION NO.1 RELAY (A/F)

OK

11.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

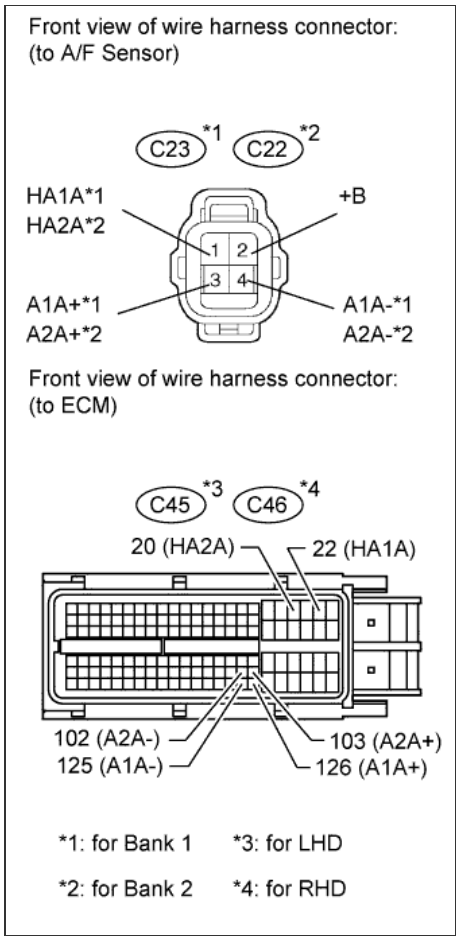
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.



e. Measure the resistance according to the value(s) in the table below.

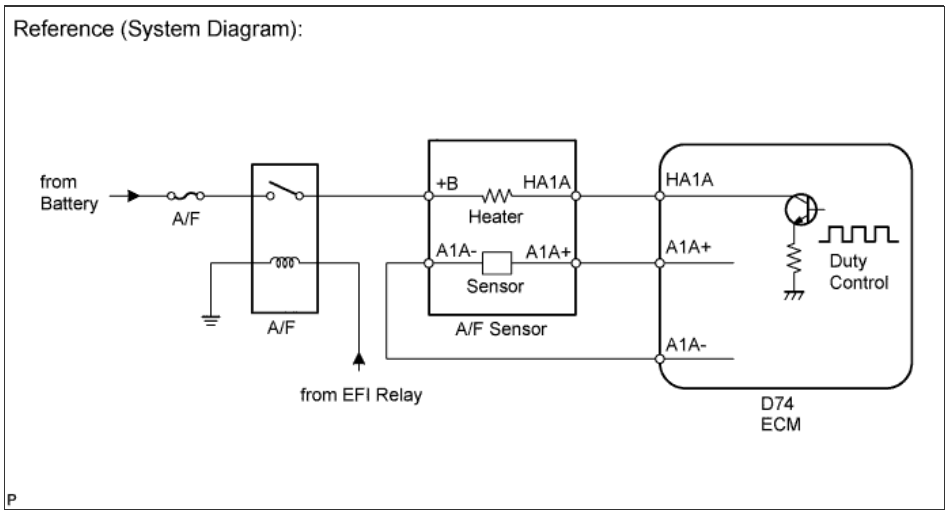
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C46-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



P

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

12.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

13.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

14.CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

a. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

b. Read pending DTCs.

Result

Result	Proceed to

No DTC is output	A
P2195, P2196, P2197 or P2198 is output	B

B → REPLACE ECM (Click here)

A

END

DTC P0300 Random / Multiple Cylinder Misfire Detected

DTC P0301 Cylinder 1 Misfire Detected

DTC P0302 Cylinder 2 Misfire Detected

DTC P0303 Cylinder 3 Misfire Detected

DTC P0304 Cylinder 4 Misfire Detected

DTC P0305 Cylinder 5 Misfire Detected

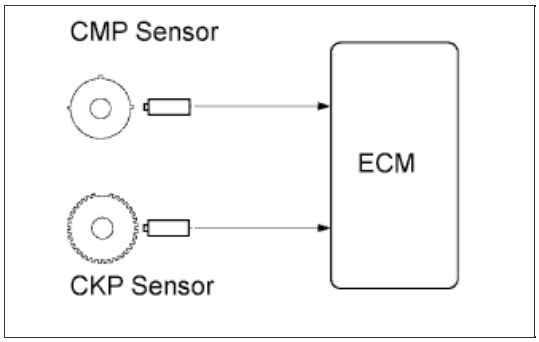
DTC P0306 Cylinder 6 Misfire Detected

DTC P0307 Cylinder 7 Misfire Detected

DTC P0308 Cylinder 8 Misfire Detected

for Preparation Click here

DESCRIPTION



When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause increases in exhaust emission levels. High concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent these increases in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the TWC reaches the point of thermal degradation, the ECM blinks the MIL. To monitor misfires, the ECM uses both the Camshaft Position (CMP) sensor and the Crankshaft Position (CKP) sensor. The CMP sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted as when the crankshaft rotation speed variations exceed predetermined thresholds.
If the misfire rate exceeds the threshold level, the ECM illuminates the MIL and stores a DTC.

DTC Code	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Fuel injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve clearance • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306 P0307 P0308	Misfiring of a specific cylinder occurs and one of the following conditions below is detected (2 trip detection logic): • A high temperature misfire occurs in the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates).	

When multiple DTCs for misfiring cylinders are stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

MONITOR DESCRIPTION

The ECM illuminates the MIL and stores a DTC when either one of the following conditions, which could cause emission deterioration, is detected (2 trip detection logic).

- Within the first 1000 crankshaft revolutions of the engine starting, an excessive misfiring rate (approximately 130 to 160 misfires per 1000 crankshaft revolutions) occurs once.
- An excessive misfiring rate (approximately 130 to 160 misfires per 1000 crankshaft revolutions) occurs a total of 4 times.

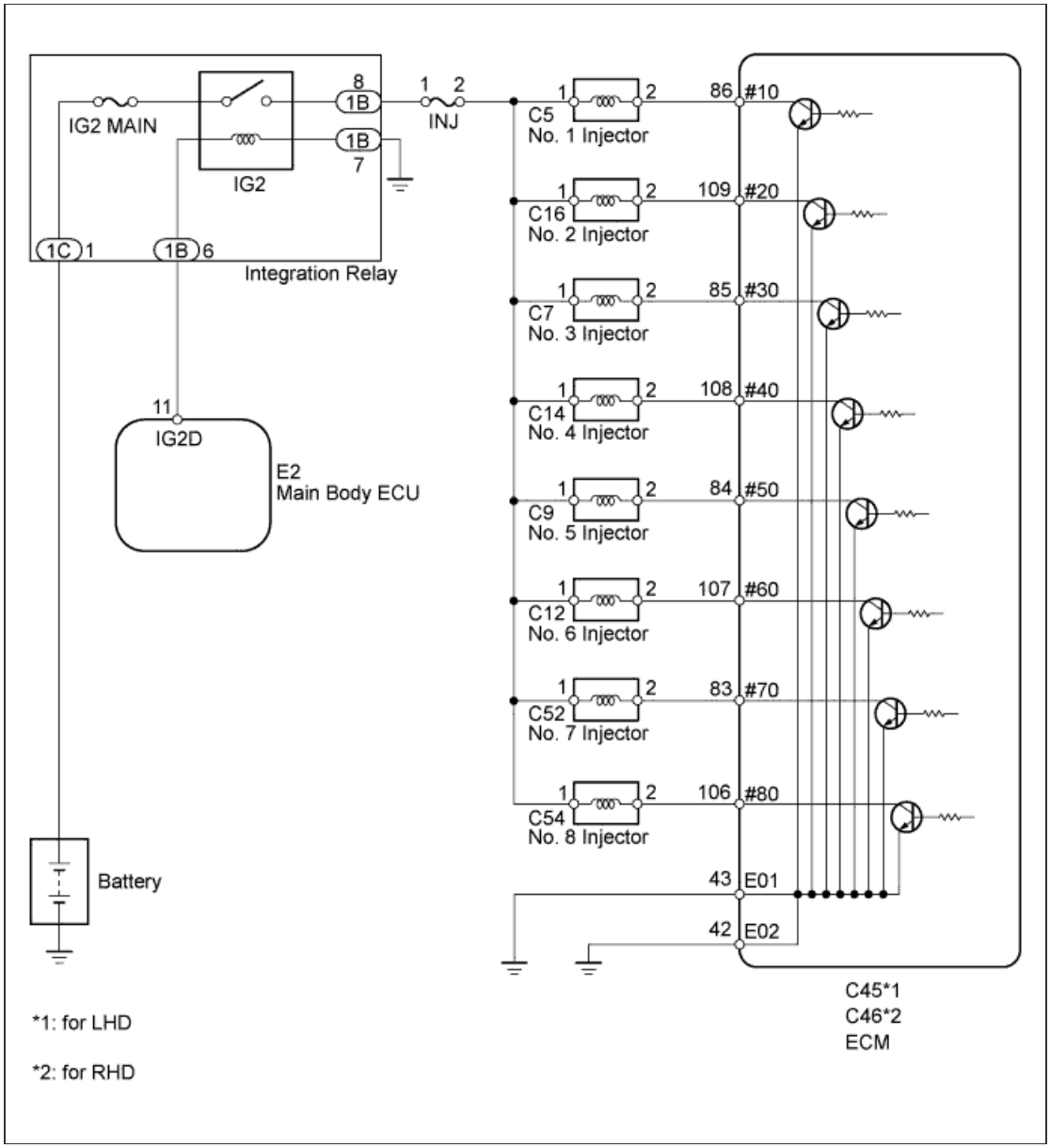
The ECM flashes the MIL and stores a DTC when either one of the following conditions, which could cause damage to the Three-Way Catalytic Converter (TWC), is detected (2 trip detection logic).

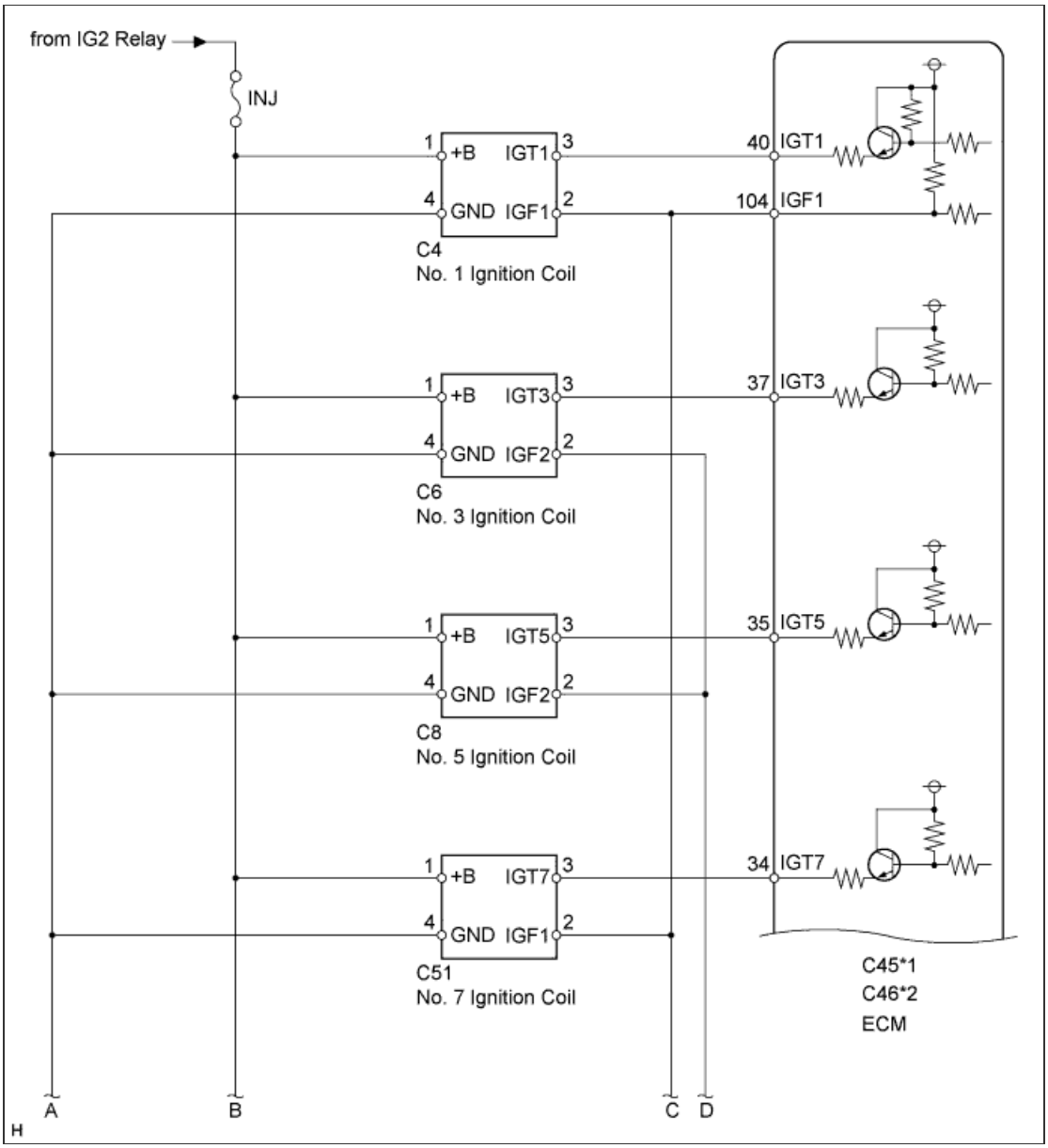
- At a high engine speed, a catalyst damage misfire, which is monitored every 200 crankshaft revolutions, occurs once.
- At a normal engine speed, a catalyst damage misfire, which is monitored every 200 crankshaft revolutions, occurs 3 times.

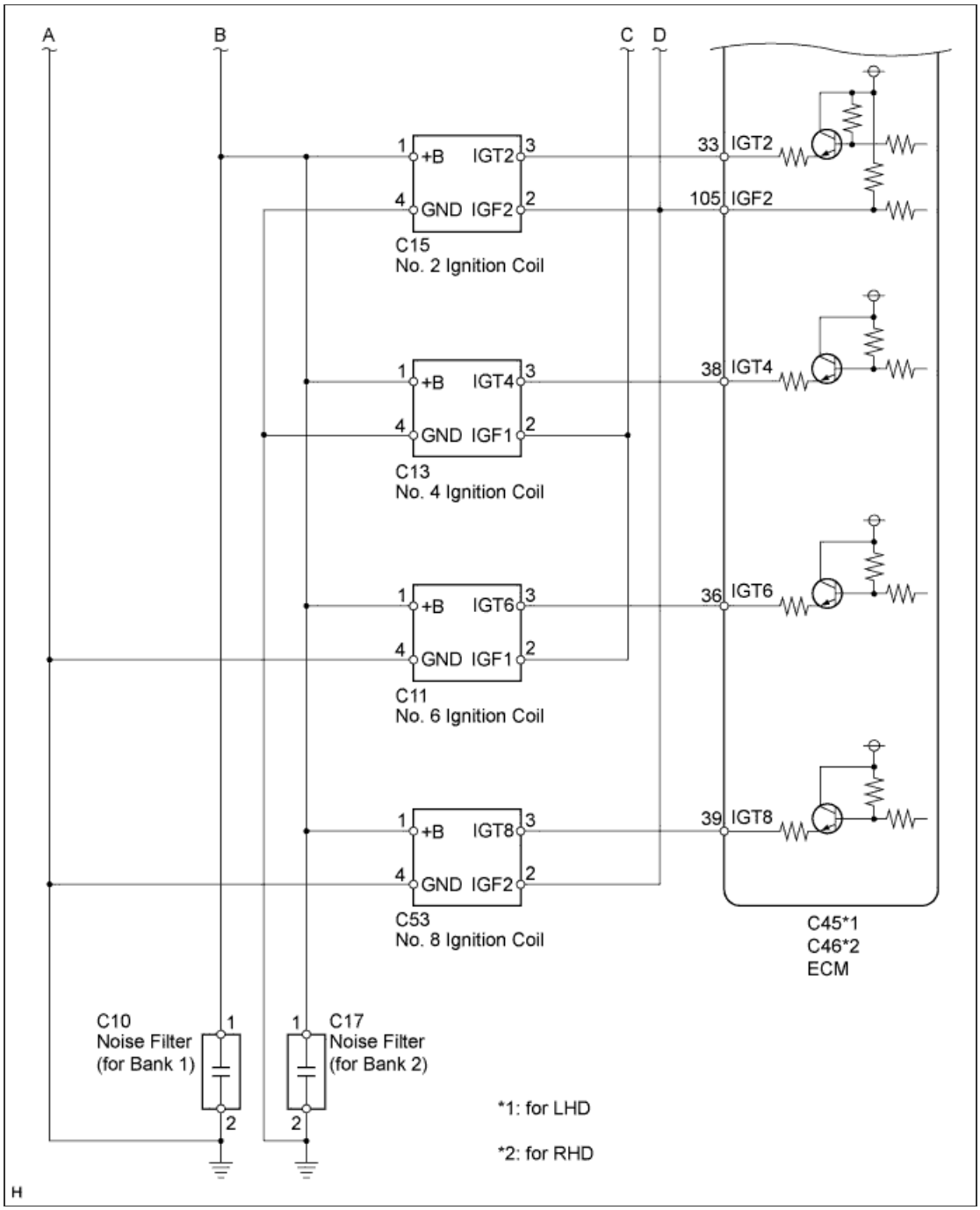
HINT:

If a catalyst damage misfire occurs, the ECM informs the driver by flashing the MIL.

WIRING DIAGRAM




from IG2 Relay
INJ
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
34
IGT7
C45*1
C46*2
ECM
A
B
C
D
H



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Turn the tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the tester, switch the ECM from normal mode to check mode (Click here).
6. Read the misfire counts of each cylinder (cylinder No. 1 to No. 8) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
7. Drive the vehicle several times with the conditions, such as engine speed and engine load, shown in Misfire RPM and Misfire Load in the Data List.

HINT:

In order to store misfire DTCs, it is necessary to operate the vehicle for the period of time shown in the table below, with the Misfire RPM and Misfire Load in the Data List.

Engine Speed	Duration
Idling	3.5 minutes or more
1000	3 minutes or more
2000	1.5 minutes or more
3000	1 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

   HINT:

   Do not turn the engine switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data will be cleared.

9. Record the DTC(s), freeze frame data and misfire counts.
10. Turn the engine switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- **If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the freeze frame data.**
- **If the misfire still cannot be reproduced even though the conditions stored in the freeze frame data have been duplicated, one of the following factors is considered to be a possible cause of the problem:**
  1. **The fuel level is low.**
  2. **Improper fuel is used.**
  3. **The spark plugs are dirty.**
- **After finishing repairs, check that no misfires occur in each cylinder (cylinder No. 1, No. 2, No. 3, No. 4, No. 5, No. 6, No. 7 and No. 8).**
- **Be sure to confirm that no misfiring cylinder DTCs are output again by conducting the confirmation driving pattern, after the repairs.**
- **For 6 and 8 cylinder engines, the ECM intentionally does not store the specific misfiring cylinder DTCs at high engine speed. If misfires only occur during high engine speed driving, only DTC P0300 is stored.**
  In the event of DTC P0300 being output, perform the following operations:
  1. **Clear the DTC (Click here).**
  2. **Start the engine and conduct the confirmation driving pattern.**
  3. **Read the misfiring rates of each cylinder or DTC(s) using the tester.**
  4. **Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.**
  5. **After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not output.**
- **When either Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air-fuel ratio may be rich (-20% or less) or lean (+20% or more).**
- **When the Coolant Temp in the freeze frame data is below 75°C (167°F), the misfires occurred only while warming up the engine.**
- **An extremely imbalanced drive wheel can cause body vibration, which may cause misfire DTC(s) to be stored.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE CODES)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 is output	A
P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308 and other DTCs are output	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

a. Connect the intelligent tester the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.

d. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

3.CHECK PCV HOSE CONNECTIONS

a. Check the PCV hose connections.

OK:
PCV hose is connected correctly and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE (Click here)

OK

4.READ VALUE USING INTELLIGENT TESTER (MISFIRE COUNT)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, #2, #3, #4, #5, #6, #7 and #8.

f. Allow the engine to idle.

g. Read each value for Cylinder #1 Misfire Count to #8 displayed on the tester. If no misfire counts occur in any cylinders, perform the following procedures:

i. Move the shift lever to D.

ii. Check the Cylinder #1 Misfire Count to #8.

iii. If misfire counts are still not displayed, perform procedure A and and then check the misfire counts again.

h. Drive the vehicle with the Misfire RPM and Misfire Load noted in the Read value using intelligent tester (Misfire RPM and Misfire Load) procedures above (procedure A).

i. Read the Cylinder #1 Misfire Count to #8 or DTCs displayed on the tester (procedure).

Result

Misfire Count	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have e ual misfire counts	B

HINT:

- **If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.**
- **If the freeze frame data record of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.**
- **If the freeze frame data record of the Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.**

B → Go to step 17

A

5.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

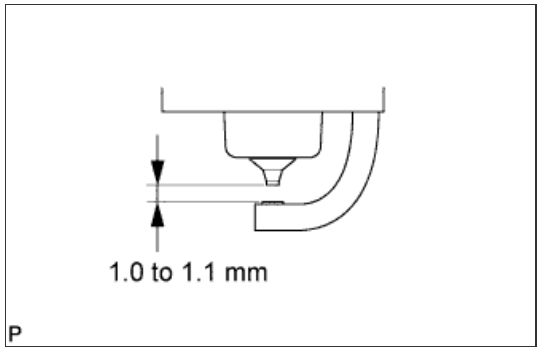
b. Measure the spark plug electrode gap.

Standard gap:
1.0 to 1.1 mm (0.039 to 0.043 in.)

c. Check the electrode for carbon deposits.

Recommended Spark Plug:

Manufacturer	Product
DENSO	SK20R11
NGK	IFR6A11



NOTICE:

If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.

NG → REPLACE SPARK PLUG (Click here)

OK

6.CHECK FOR SPARKS AND IGNITION

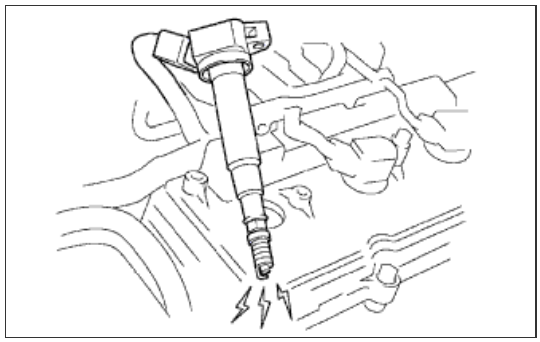
a. Disconnect the fuel injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.



b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

7.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → REPAIR ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

8.CHECK HARNESS AND CONNECTOR (ECM - FUEL INJECTOR)

a. Disconnect the fuel injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	C16-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 3	C7-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	C14-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	C9-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	C12-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	C52-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	C54-1 - Ground	Engine switch on (IG)	11 to 14 V

d. Turn the engine switch off.

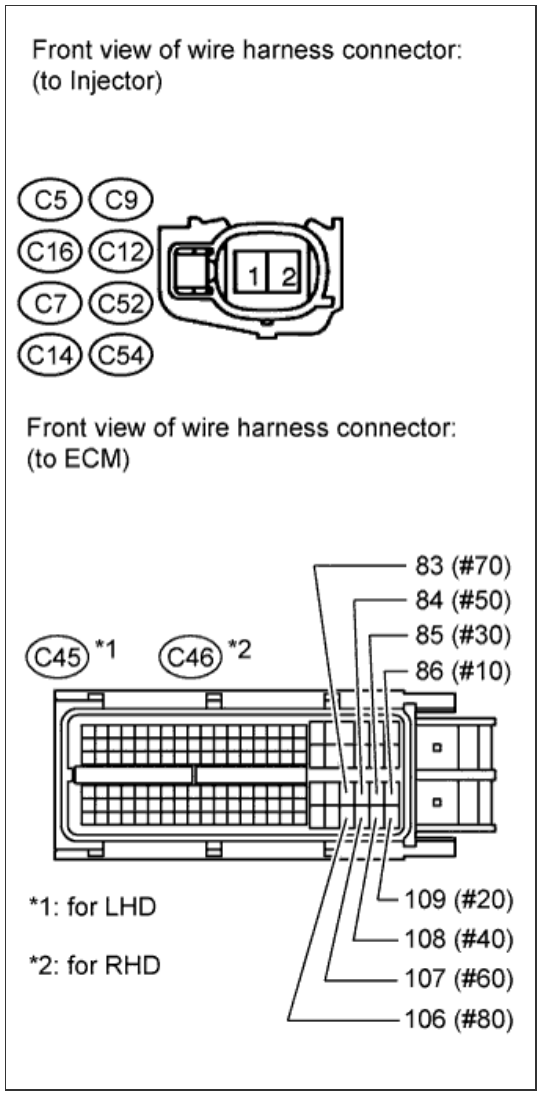
e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C45-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C45-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C45-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C45-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C45-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C45-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C45-106 (#80)	Always	Below 1 Ω

Standard Resistance (for RHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher



	C5-2 - C46-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C46-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C46-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C46-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C46-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C46-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C46-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C46-106 (#80)	Always	Below 1 Ω

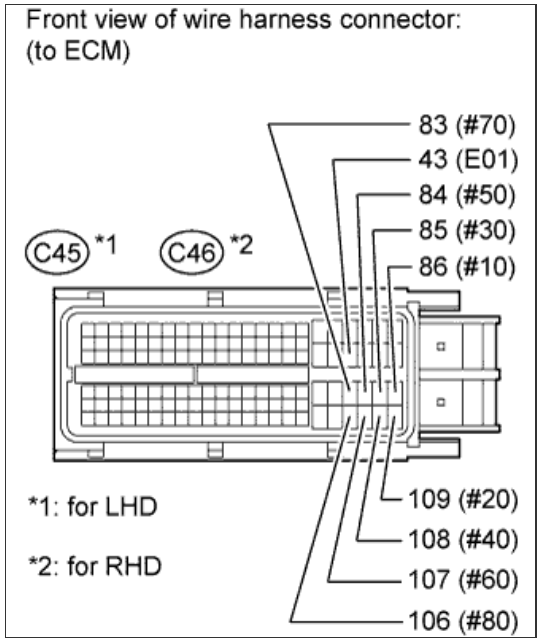
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50, #60, #70 AND/OR #80 VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage (for LHD):

Tester Connection	Switch Condition	Specified Condition
C45-86 (#10) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-109 (#20) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-85 (#30) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-108 (#40) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-84 (#50) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-107 (#60) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-83 (#70) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-106 (#80) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V

Standard Voltage (for RHD):

Tester Connection	Switch Condition	Specified Condition
C46-86 (#10) -	Engine switch on	

C46-43 (E01)	(IG)	11 to 14 V
C46-109 (#20) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-85 (#30) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-108 (#40) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-84 (#50) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-107 (#60) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-83 (#70) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-106 (#80) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

10.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK

11.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

12.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (**Click here**)

OK

13.CHECK VALVE TIMING

a. Remove the drive belt (Click here).

b. Remove the timing belt cover LH and RH (Click here).

c. Turn the crankshaft to align the matchmarks of the crankshaft.

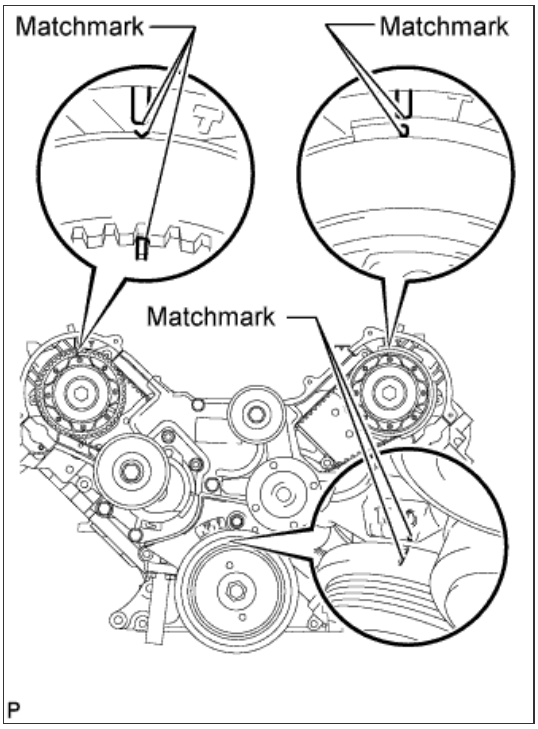
d. Align the notch of the crankshaft pulley with the 0 position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360 . Confirm again if the matchmarks are facing each other.

OK:

The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NG → ADJUST VALVE TIMING (Click here)

OK ↓

14.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK AND REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER

OK ↓

15.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:

With cold engine: Same as ambient air temperature.

With warm engine: Between 80°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK ↓

16.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK ↓

REPLACE ECM (Click here)

17.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM (Click here)

OK

18.CHECK VALVE TIMING

a. Remove the drive belt (Click here).

b. Remove the timing belt cover LH and RH (Click here).

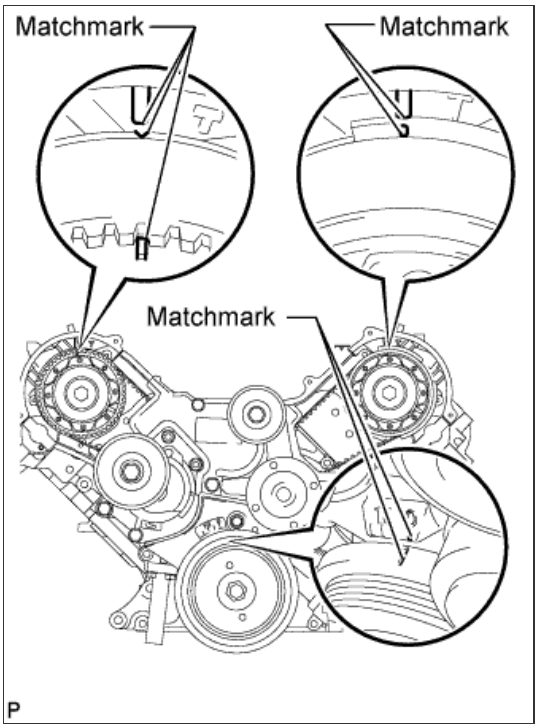
c. Turn the crankshaft to align the matchmarks of the crankshaft.

d. Align the notch of the crankshaft pulley with the 0 position.

e. Confirm whether the matchmarks of the camshaft pulley and cylinder head cover are facing each other.

f. If the matchmarks are not facing each other, turn the crankshaft clockwise by 360 . Confirm again if the matchmarks are facing each other.

OK:
The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.



NG → ADJUST VALVE TIMING (Click here)

OK

19.CHECK FUEL PRESSURE

a. Check the fuel pressure (Click here).

NG → CHECK AND REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER

OK

20.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

d. Read the Coolant Temp twice, when the engine is both cold and warmed up.

Standard:
With cold engine: Same as ambient air temperature.
With warm engine: Between 80°C and 100°C (167°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

21.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

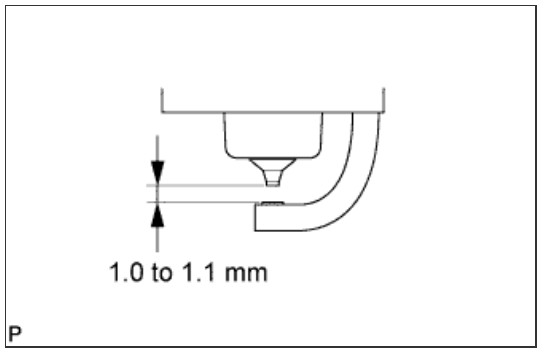
OK

22.CHECK SPARK PLUG

a. Remove the ignition coil and the spark plug of the misfiring cylinder (Click here).

b. Measure the spark plug electrode gap.

Standard gap:
1.0 to 1.1 mm (0.039 to 0.043 in.)



c. Check the electrode for carbon deposits.

Recommended Spark Plug:

Manufacturer	Product
DENSO	SK20R11
NGK	IFR6A11

NOTICE:

If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.

NG → REPLACE SPARK PLUG (Click here)

OK

23.CHECK FOR SPARKS AND IGNITION

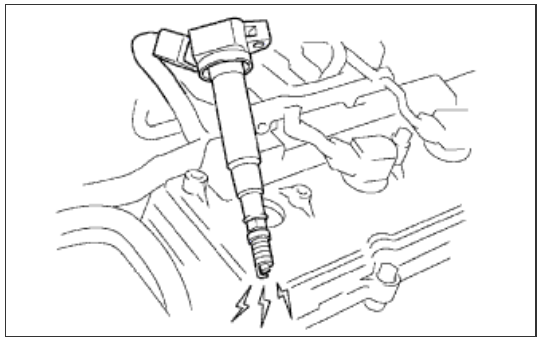
a. Disconnect the fuel injector connectors to prevent the engine from starting.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.



b. Remove the ignition coil from the cylinder head (Click here).

c. Install the spark plug onto the ignition coil.

d. Attach the spark plug assembly to the cylinder head.

e. Crank the engine for less than 2 seconds and check the spark.

OK:
Sparks jump across electrode gap.

f. Install the ignition coil.

g. Reconnect the injector connectors.

NG → Go to step 29

OK

24.CHECK CYLINDER COMPRESSION PRESSURE

a. Measure the cylinder compression pressure of the misfiring cylinder (Click here).

NG → REPAIR ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

25.CHECK HARNESS AND CONNECTOR (ECM - FUEL INJECTOR)

a. Disconnect the fuel injector connector (of the misfiring cylinder).

b. Disconnect the ECM connector.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

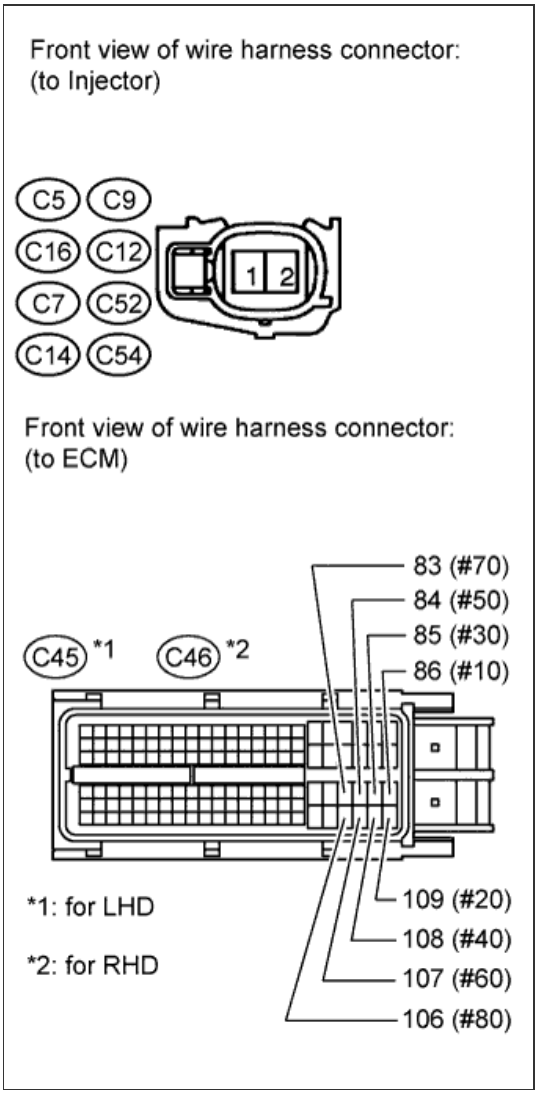
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	C16-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 3	C7-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 4	C14-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	C9-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	C12-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	C52-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	C54-1 - Ground	Engine switch on (IG)	11 to 14 V

d. Turn the engine switch off.

e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C45-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C45-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C45-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C45-84 (#50)	Always	Below 1 Ω
	C12-2 - Ground	Always	10 kΩ or higher



No. 6	C12-2 - C45-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C45-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C45-106 (#80)	Always	Below 1 Ω

Standard Resistance (for RHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Ground	Always	10 kΩ or higher
	C16-2 - C46-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Ground	Always	10 kΩ or higher
	C7-2 - C46-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Ground	Always	10 kΩ or higher
	C14-2 - C46-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Ground	Always	10 kΩ or higher
	C9-2 - C46-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Ground	Always	10 kΩ or higher
	C12-2 - C46-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Ground	Always	10 kΩ or higher
	C52-2 - C46-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Ground	Always	10 kΩ or higher
	C54-2 - C46-106 (#80)	Always	Below 1 Ω

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

26.INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50, #60, #70 AND/OR #80 VOLTAGE)

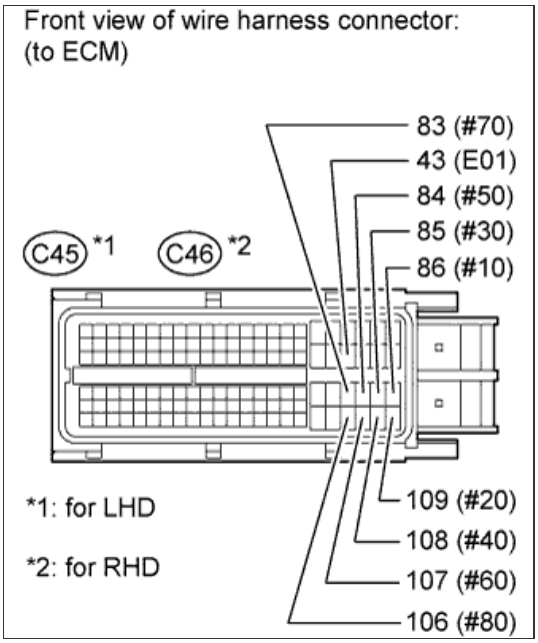
a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage (for LHD):

Tester Connection	Switch Condition	Specified Condition
C45-86 (#10) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-109 (#20) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-85 (#30) -	Engine switch on	11 to 14 V

C45-43 (E01)	(IG)	
C45-108 (#40) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-84 (#50) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-107 (#60) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-83 (#70) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V
C45-106 (#80) - C45-43 (E01)	Engine switch on (IG)	11 to 14 V



Standard Voltage (for RHD):

Tester Connection	Switch Condition	Specified Condition
C46-86 (#10) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-109 (#20) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-85 (#30) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-108 (#40) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-84 (#50) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-107 (#60) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-83 (#70) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V
C46-106 (#80) - C46-43 (E01)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - ECM)

OK

27.CHECK FUEL INJECTOR OF MISFIRING CYLINDER

a. Check the fuel injector injection whether fuel volume is high or low, and whether injection pattern is poor (Click here).

NG → REPLACE FUEL INJECTOR (**Click here**)

OK

28.CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

a. Check the valve clearance (Click here).

NG → ADJUST VALVE CLEARANCE (**Click here**)

OK

REPLACE ECM (**Click here**)

29.CHANGE TO NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the installed spark plug with a spark plug that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → Go to step 30

OK

REPLACE SPARK PLUG (Click here)

30.CHANGE TO NORMAL IGNITION COIL AND CHECK SPARK OF MISFIRING CYLINDER

a. Replace the ignition coil with an ignition coil that functions normally.

b. Perform a spark test.

CAUTION:

Always disconnect all injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

i. Install the spark plug to the ignition coil and connect the ignition coil connector.

ii. Disconnect the injector connector.

iii. Ground the spark plug.

iv. Check if sparks occur while the engine is being cranked.

OK:
Sparks jump across electrode gap.

NG → REPLACE ECM (Click here)

OK

REPLACE IGNITION COIL (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

for Preparation Click here

DESCRIPTION

Refer to DTC P2195 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals AF+ and AF- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in Air Fuel Ratio (A/F) sensor (for bank 1, 2 sensor 1) circuit • Air Fuel Ratio (A/F) sensor (for bank 1, 2 sensor 1) • ECM
P2238 P2241	• Case 1: Condition (a) or (b) continues for 5.0 seconds or more (1 trip detection logic): (a) The AF+ voltage is 0.5 V or less. (b) (AF+) - (AF-) = 0.1 V or less. • Case 2: The A/F sensor admittance is less than 0.022 1/Ω (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2239 P2242	The AF+ voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2252 P2255	The AF- voltage is 0.5 V or less for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2253 P2256	The AF- voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM

HINT:

- **DTCs P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2241, P2242, P2255 and P2256 indicate malfunctions related to the bank 2 A/F sensor circuit.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that includes the No. 2 cylinder.**

MONITOR DESCRIPTION

These DTCs are output when there is an open or short in the A/F sensor circuit, or if the A/F sensor output drops.
To detect these problems, the voltage of the A/F sensor is monitored when turning the engine switch on (IG), and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is outside of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in the next driving cycle, the MIL is illuminated and a DTC is stored.
The Air-Fuel Ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. If the A/F sensor impedance (alternating current resistance) or output voltage deviates greatly from the standard range, the ECM determines that there is an open or short in the A/F sensor circuit.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/ F sensor.
(e) Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

HINT:

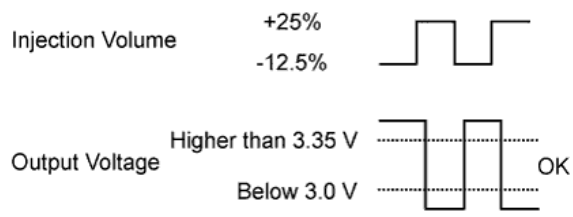
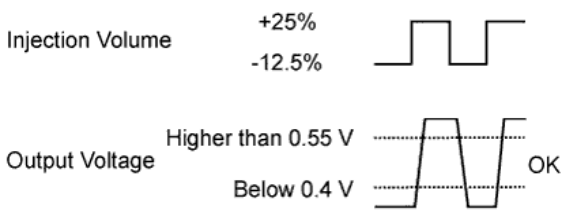
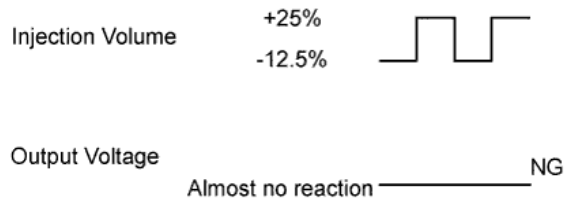
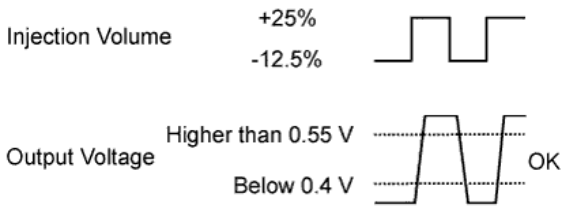
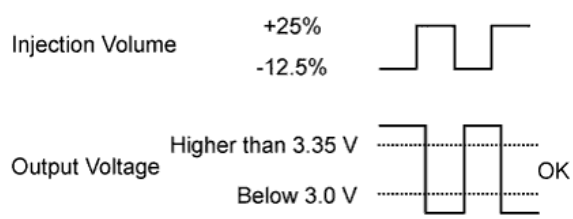
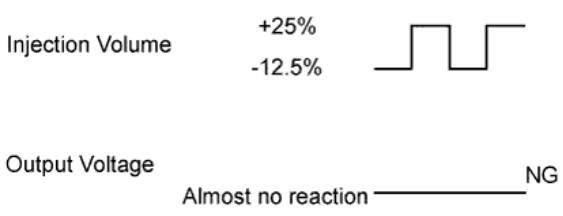
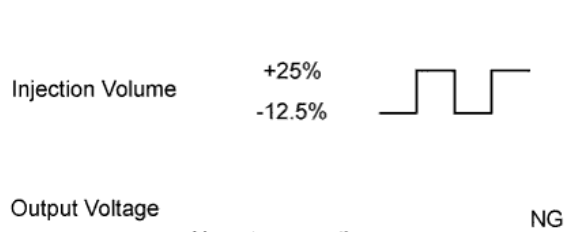
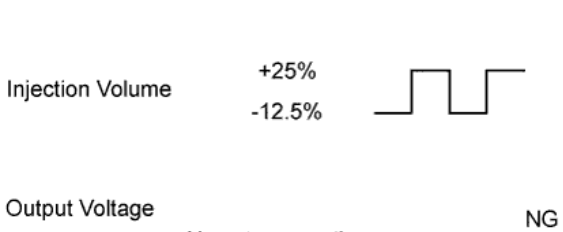
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.

To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

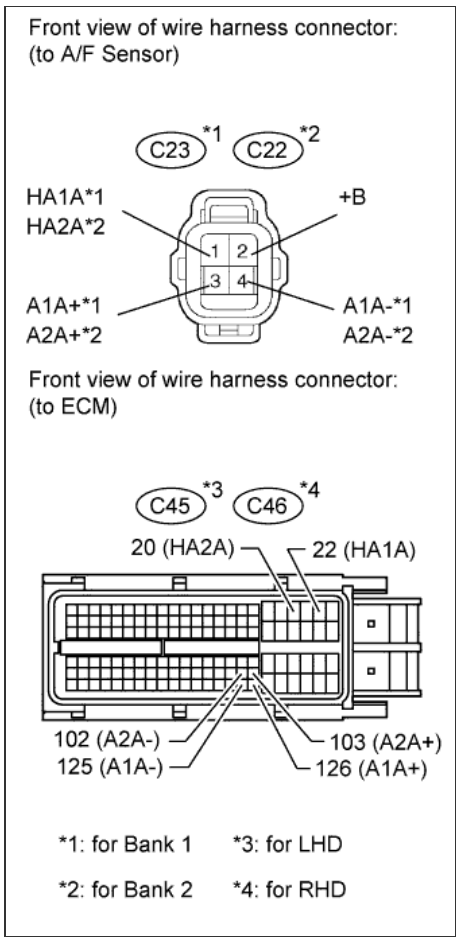
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.



e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

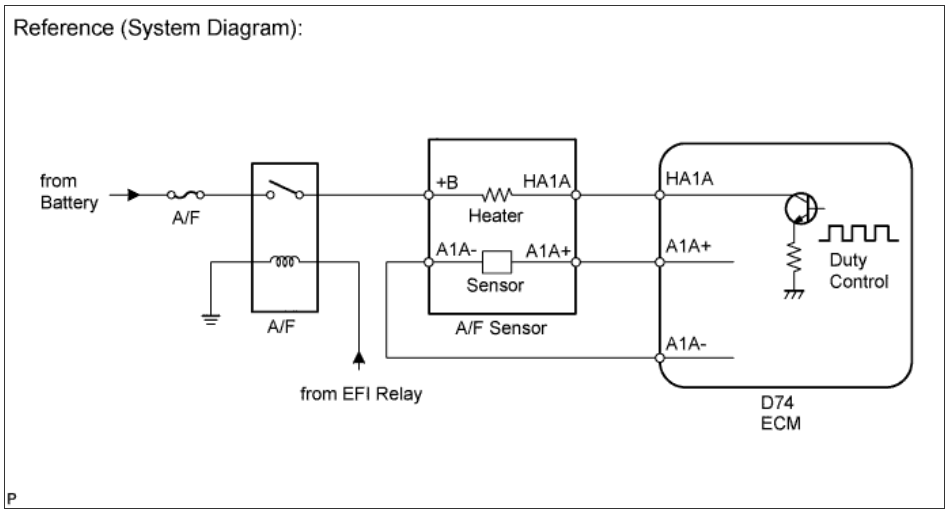
Tester Connection	Condition	Specified Condition

C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C46-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



P

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2237, P2238, P2239, P2240, P2241, P2242, P2252, P2253, P2255 or P2256 is output	B

B → REPLACE ECM (**Click here**)

A

END

DTC P0327 Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)

DTC P0328 Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)

DTC P0332 Knock Sensor 2 Circuit Low Input (Bank 2)

DTC P0333 Knock Sensor 2 Circuit High Input (Bank 2)

for Preparation Click here

DESCRIPTION

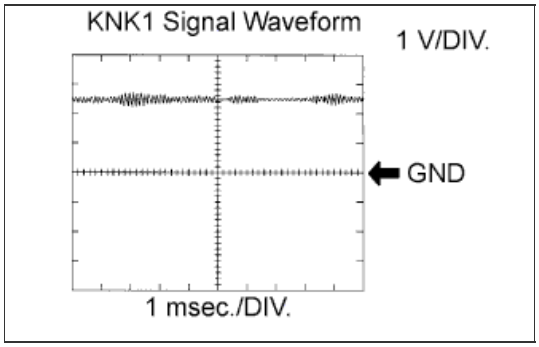
Flat type knock sensors (non-resonant type) have structures that can detect vibrations between approximately 6 kHz and 15 kHz.
A knock sensor is fitted onto the engine block to detect engine knocking.
The knock sensor contains a piezoelectric element which generates a voltage when it becomes deformed.
The voltage is generated when the engine block vibrates due to knocking. Any occurrence of engine knocking can be suppressed by delaying the ignition timing.

DTC Code	DTC Detection Condition	Trouble Area
P0327 P0332	The output voltage of the knock sensor is below 0.5 V (1 trip detection logic).	• Short in knock sensor circuit • Knock sensor • ECM
P0328 P0333	The output voltage of the knock sensor is higher than 4.5 V (1 trip detection logic).	• Open in knock sensor circuit • Knock sensor • ECM

HINT:

When any of DTCs P0327, P0328, P0332 and P0333 are stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is delayed to its maximum retardation. Fail-safe mode continues until the engine switch is turned off.

Reference: Inspection using an oscilloscope



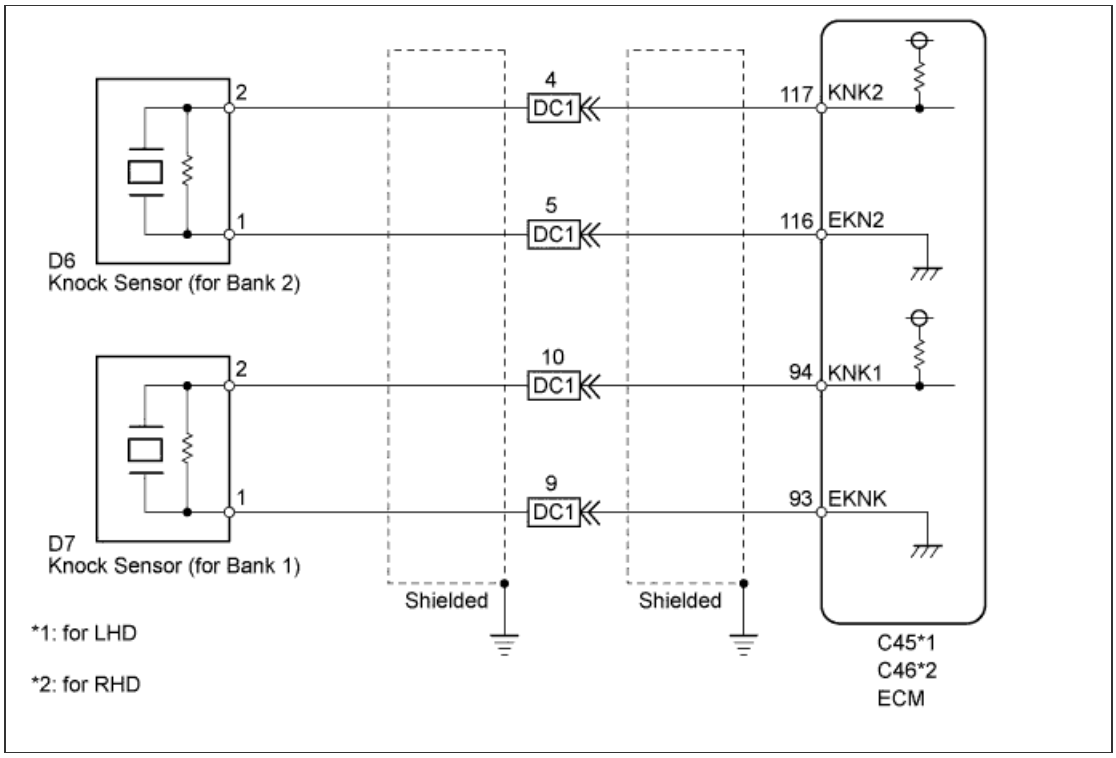
The correct waveform is as shown.

Item	Content
Terminal	KNK1 - EKNK KNK2 - EKN2
Equipment Setting	1 V/DIV. 1 msec./DIV.
Condition	Keep engine speed at 4000 rpm with warm engine

MONITOR DESCRIPTION

If the output voltage transmitted by the knock sensor remains low or high for more than 1 second, the ECM interprets this as a malfunction in the sensor circuit, and stores a DTC.
The monitor for DTCs P0327, P0328, P0332 and P0333 begins to run when 5 seconds have elapsed since the engine was started.
If the malfunction is not repaired successfully, DTC P0327, P0328, P0332 or P0333 is stored 5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

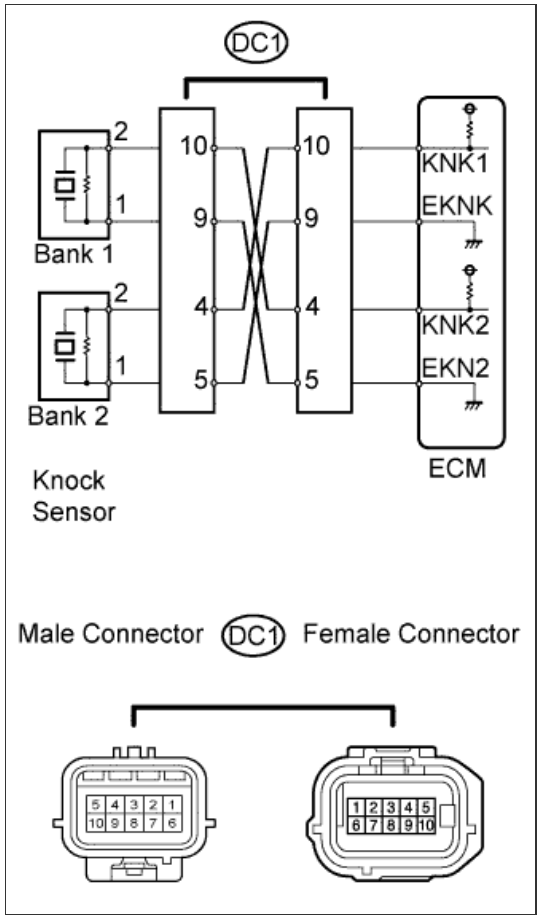
- **DTCs P0327 and P0328 are the bank 1 knock sensor circuit.**
- **DTCs P0332 and P0333 are the bank 2 knock sensor circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ DTC OUTPUT (CHECK KNOCK SENSOR CIRCUIT)

a. Disconnect the DC1 connector.

b. Using lead wires, connect the connectors as follows:

Male Connector - Female Connector
Terminal 10 - Terminal 4
Terminal 9 - Terminal 5
Terminal 4 - Terminal 10
Terminal 5 - Terminal 9



c. Connect the intelligent tester to the DLC3.

d. Turn the engine switch on (IG) and turn the tester on.

e. Clear DTCs (Click here).

f. Warm up the engine.

g. Run the engine at 3000 rpm for 10 seconds or more.

h. Enter the following menus: Powertrain / Engine and ECT / DTC.

i. Read the DTCs.

Result

Display	Proceed to
DTC is same as when vehicle brought in (for example, P0327 and P0328 are output again, or P0332 and P0333 are output again)	A
DTC is different from when vehicle brought in (for example, P0327 and P0328 are output at first, but then P0332 and P0333 are output, or vice versa)	B

HINT:

- If DTC P0327 or P0328 has changed to P0332 or P0333, check the knock sensor circuit on the left bank side.
- If DTC P0332 or P0333 has changed to P0327 or P0328, check the knock sensor circuit on the right bank side.

B	Go to step 4

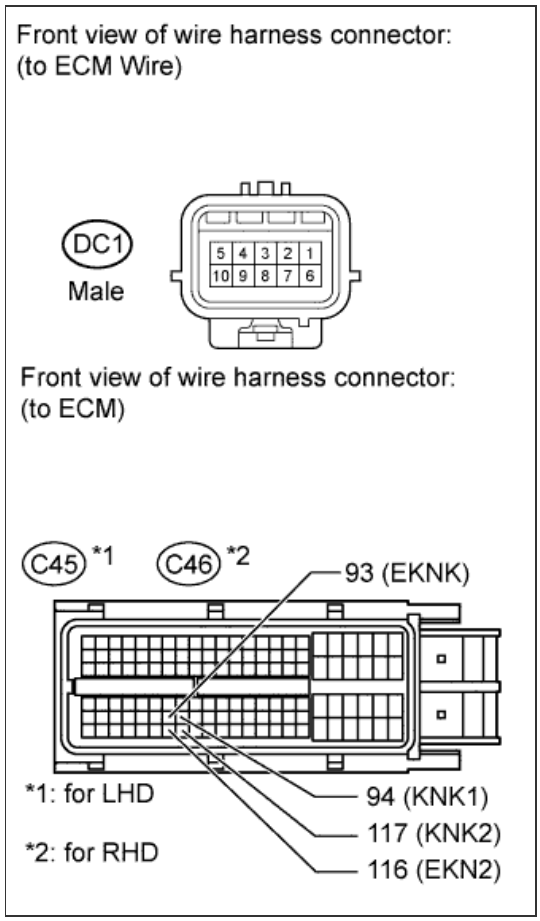
A

2.CHECK HARNESS AND CONNECTOR (CONNECTOR - ECM)

a. Disconnect the DC1 connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
DC1 male connector 10 - C45-94 (KNK1)	Always	Below 1 Ω
DC1 male connector 9 - C45-93 (EKNK)	Always	Below 1 Ω
DC1 male connector 4 - C45-117 (KNK2)	Always	Below 1 Ω
DC1 male connector 5 - C45-116 (EKN2)	Always	Below 1 Ω
DC1 male connector 10 or C45-94 (KNK1) - Body ground	Always	10 kΩ or higher
DC1 male connector 9 or C45-93 (EKNK) - Body ground	Always	10 kΩ or higher
DC1 male connector 4 or C45-117 (KNK2) - Body ground	Always	10 kΩ or higher
DC1 male connector 5 or C45-116 (EKN2) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
DC1 male connector 10 - C46-94 (KNK1)	Always	Below 1 Ω
DC1 male connector 9 - C46-93 (EKNK)	Always	Below 1 Ω
DC1 male connector 4 - C46-117 (KNK2)	Always	Below 1 Ω
DC1 male connector 5 - C46-116 (EKN2)	Always	Below 1 Ω
DC1 male connector 10 or C46-94 (KNK1) - Body ground	Always	10 kΩ or higher
DC1 male connector 9 or	Always	10 kΩ or higher

C46-93 (EKNK) - Body ground		
DC1 male connector 4 or C46-117 (KNK2) - Body ground	Always	10 kΩ or higher
DC1 male connector 5 or C46-116 (EKN2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT ECM (VOLTAGE)

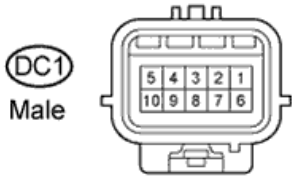
a. Disconnect the DC1 connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
DC1 male connector 10 - 9	Engine switch on (IG)	4.5 to 5.5 V
DC1 male connector 4 - 5	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to ECM Wire)



NG → REPLACE ECM (Click here)

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

4.INSPECT KNOCK CONTROL SENSOR

a. Disconnect the DC1 connector.

b. Measure the resistance according to the value(s) in the table below.

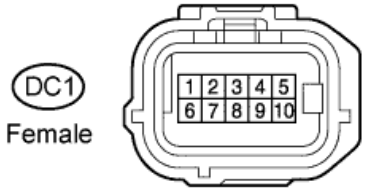
Standard Resistance:

Tester Connection	Condition	Specified Condition
DC1 female connector 10 - 9	20 C (68 F)	120 to 280 kΩ
DC1 female connector 4 - 5	20 C (68 F)	120 to 280 kΩ

Result

Result	Proceed to
NG	A
OK	B

Front view of wire harness connector:
(to Knock Sensor Wire)



B → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

5.CHECK HARNESS AND CONNECTOR (CONNECTOR - KNOCK SENSOR)

a. Disconnect the DC1 connector.

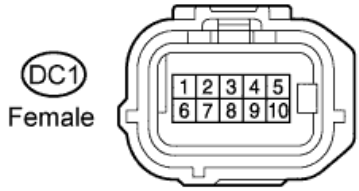
b. Disconnect the knock sensor connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
DC1 female connector 10 - D7-2	Always	Below 1 Ω
DC1 female connector 9 - D7-1	Always	Below 1 Ω
DC1 female connector 4 - D6-2	Always	Below 1 Ω
DC1 female connector 5 - D6-1	Always	Below 1 Ω
DC1 female connector 10 or D7-2 - Body ground	Always	10 kΩ or higher
DC1 female connector 9 or D7-1 - Body ground	Always	10 kΩ or higher
DC1 female connector 4 or D6-2 - Body ground	Always	10 kΩ or higher
DC1 female connector 5 or D6-1 - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Knock Sensor Wire)



Front view of wire harness connector:
(to Knock Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE KNOCK CONTROL SENSOR (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

for Preparation Click here

DESCRIPTION

Refer to DTC P2195 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals AF+ and AF- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in Air Fuel Ratio (A/F) sensor (for bank 1, 2 sensor 1) circuit • Air Fuel Ratio (A/F) sensor (for bank 1, 2 sensor 1) • ECM
P2238 P2241	• Case 1: Condition (a) or (b) continues for 5.0 seconds or more (1 trip detection logic): (a) The AF+ voltage is 0.5 V or less. (b) (AF+) - (AF-) = 0.1 V or less. • Case 2: The A/F sensor admittance is less than 0.022 1/Ω (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2239 P2242	The AF+ voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2252 P2255	The AF- voltage is 0.5 V or less for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2253 P2256	The AF- voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM

HINT:

- **DTCs P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2241, P2242, P2255 and P2256 indicate malfunctions related to the bank 2 A/F sensor circuit.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that includes the No. 2 cylinder.**

MONITOR DESCRIPTION

These DTCs are output when there is an open or short in the A/F sensor circuit, or if the A/F sensor output drops.
To detect these problems, the voltage of the A/F sensor is monitored when turning the engine switch on (IG), and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is outside of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in the next driving cycle, the MIL is illuminated and a DTC is stored.
The Air-Fuel Ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. If the A/F sensor impedance (alternating current resistance) or output voltage deviates greatly from the standard range, the ECM determines that there is an open or short in the A/F sensor circuit.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/ F sensor.
(e) Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

HINT:

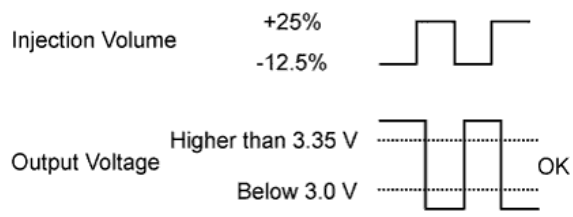
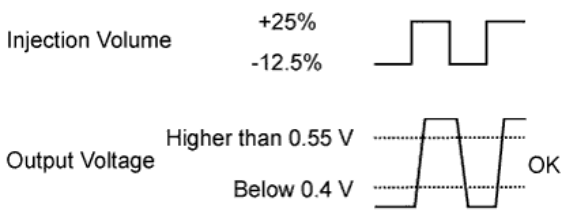
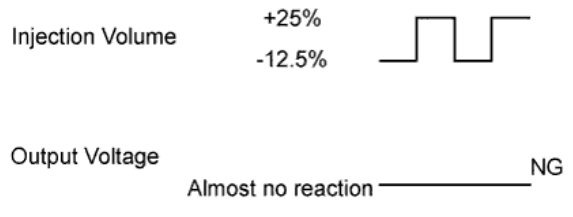
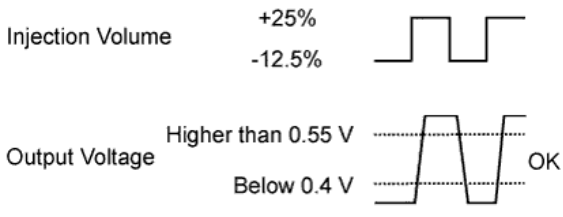
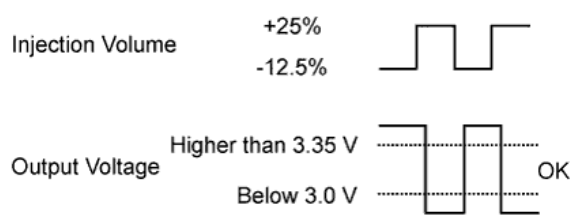
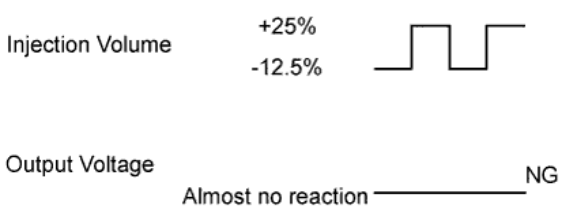
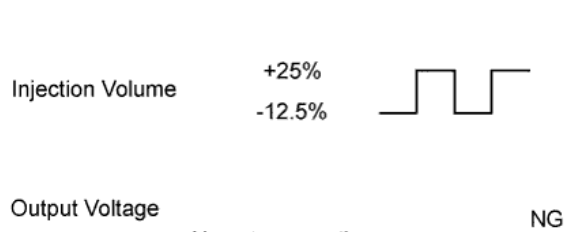
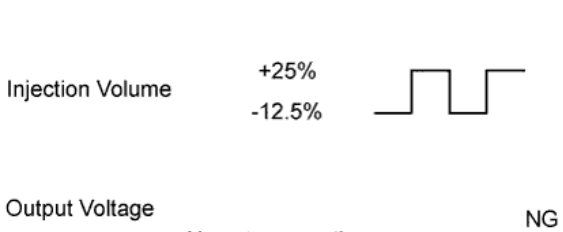
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.

To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

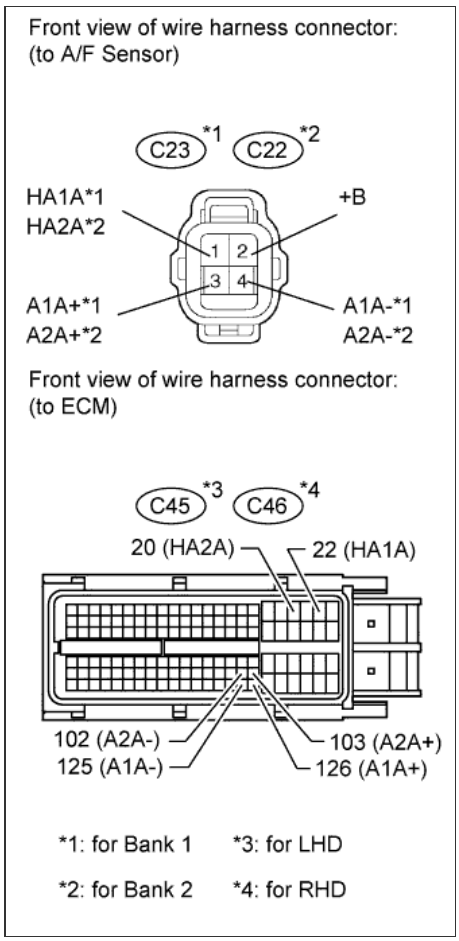
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.



e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

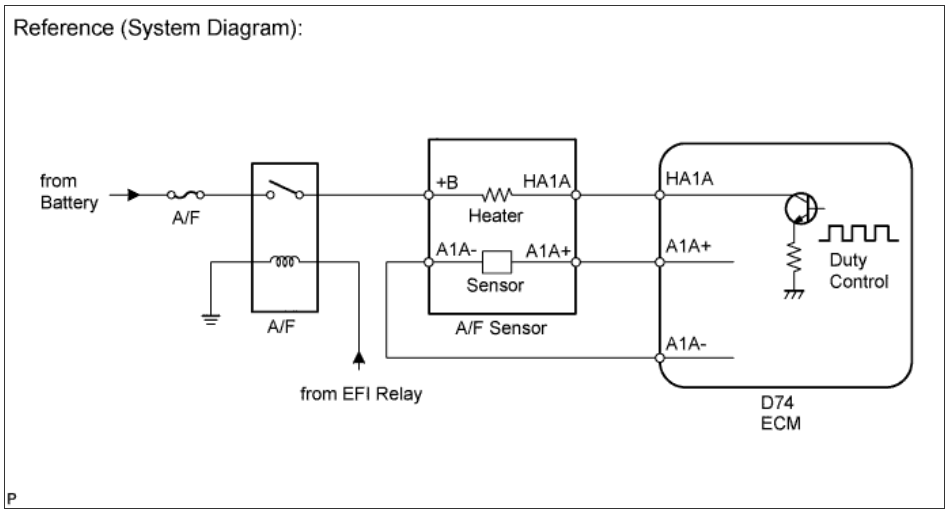
Tester Connection	Condition	Specified Condition

C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C46-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



P

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2237, P2238, P2239, P2240, P2241, P2242, P2252, P2253, P2255 or P2256 is output	B

B → REPLACE ECM (**Click here**)

A

END

DTC P0327 Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)

DTC P0328 Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)

DTC P0332 Knock Sensor 2 Circuit Low Input (Bank 2)

DTC P0333 Knock Sensor 2 Circuit High Input (Bank 2)

for Preparation Click here

DESCRIPTION

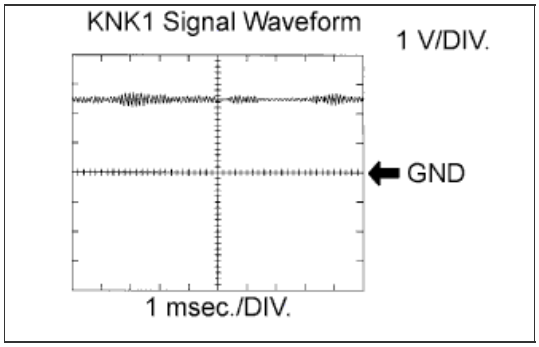
Flat type knock sensors (non-resonant type) have structures that can detect vibrations between approximately 6 kHz and 15 kHz.
A knock sensor is fitted onto the engine block to detect engine knocking.
The knock sensor contains a piezoelectric element which generates a voltage when it becomes deformed.
The voltage is generated when the engine block vibrates due to knocking. Any occurrence of engine knocking can be suppressed by delaying the ignition timing.

DTC Code	DTC Detection Condition	Trouble Area
P0327 P0332	The output voltage of the knock sensor is below 0.5 V (1 trip detection logic).	• Short in knock sensor circuit • Knock sensor • ECM
P0328 P0333	The output voltage of the knock sensor is higher than 4.5 V (1 trip detection logic).	• Open in knock sensor circuit • Knock sensor • ECM

HINT:

When any of DTCs P0327, P0328, P0332 and P0333 are stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is delayed to its maximum retardation. Fail-safe mode continues until the engine switch is turned off.

Reference: Inspection using an oscilloscope



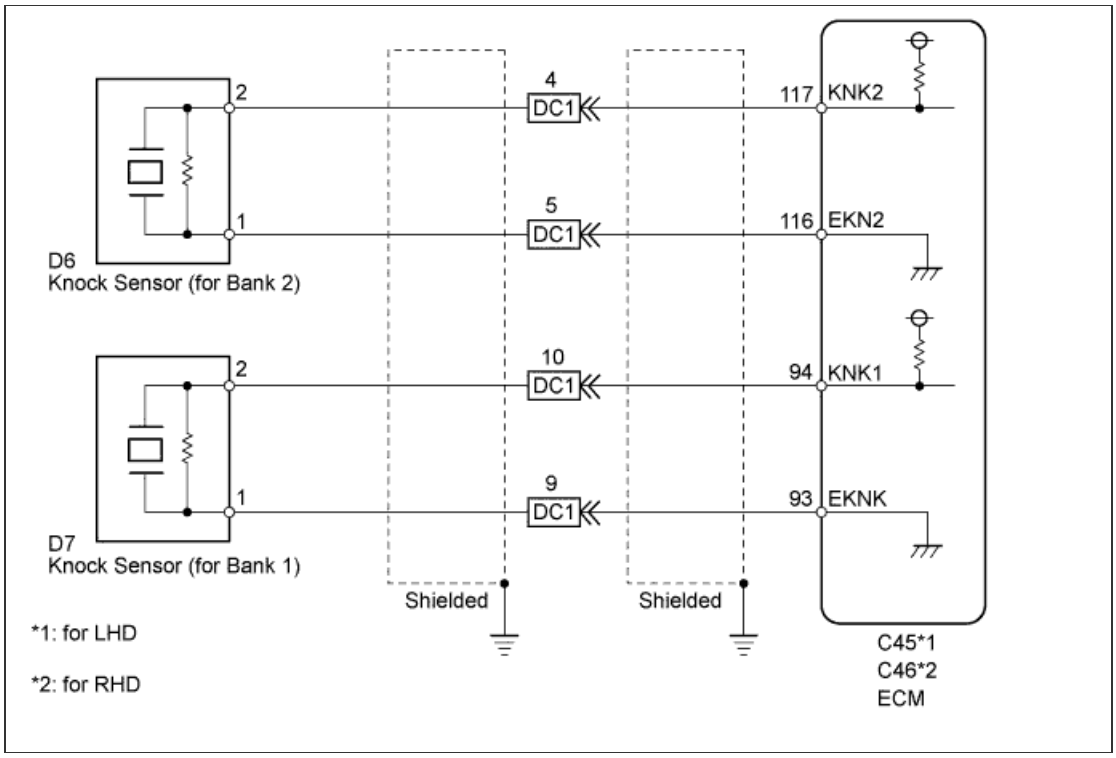
The correct waveform is as shown.

Item	Content
Terminal	KNK1 - EKNK KNK2 - EKN2
Equipment Setting	1 V/DIV. 1 msec./DIV.
Condition	Keep engine speed at 4000 rpm with warm engine

MONITOR DESCRIPTION

If the output voltage transmitted by the knock sensor remains low or high for more than 1 second, the ECM interprets this as a malfunction in the sensor circuit, and stores a DTC.
The monitor for DTCs P0327, P0328, P0332 and P0333 begins to run when 5 seconds have elapsed since the engine was started.
If the malfunction is not repaired successfully, DTC P0327, P0328, P0332 or P0333 is stored 5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

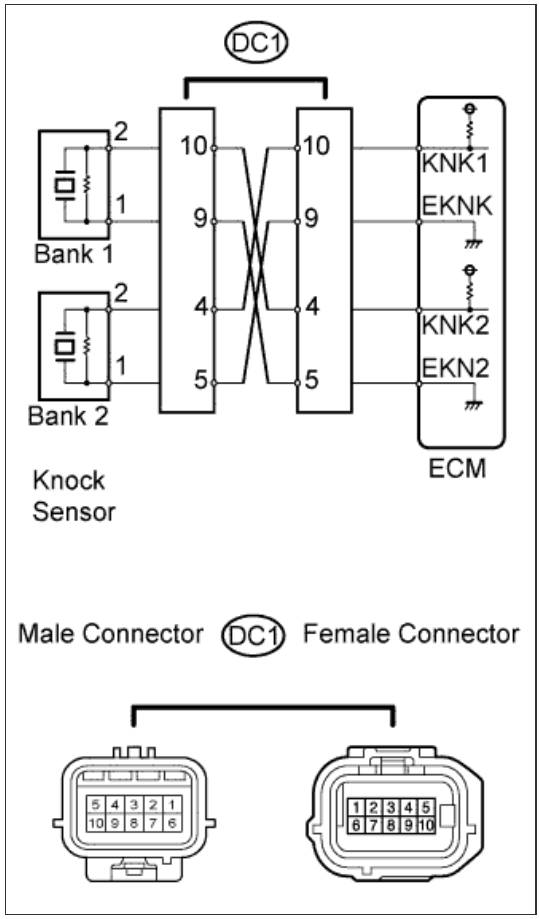
- **DTCs P0327 and P0328 are the bank 1 knock sensor circuit.**
- **DTCs P0332 and P0333 are the bank 2 knock sensor circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ DTC OUTPUT (CHECK KNOCK SENSOR CIRCUIT)

a. Disconnect the DC1 connector.

b. Using lead wires, connect the connectors as follows:

Male Connector - Female Connector
Terminal 10 - Terminal 4
Terminal 9 - Terminal 5
Terminal 4 - Terminal 10
Terminal 5 - Terminal 9



c. Connect the intelligent tester to the DLC3.

d. Turn the engine switch on (IG) and turn the tester on.

e. Clear DTCs (Click here).

f. Warm up the engine.

g. Run the engine at 3000 rpm for 10 seconds or more.

h. Enter the following menus: Powertrain / Engine and ECT / DTC.

i. Read the DTCs.

Result

Display	Proceed to
DTC is same as when vehicle brought in (for example, P0327 and P0328 are output again, or P0332 and P0333 are output again)	A
DTC is different from when vehicle brought in (for example, P0327 and P0328 are output at first, but then P0332 and P0333 are output, or vice versa)	B

HINT:

- If DTC P0327 or P0328 has changed to P0332 or P0333, check the knock sensor circuit on the left bank side.
- If DTC P0332 or P0333 has changed to P0327 or P0328, check the knock sensor circuit on the right bank side.

B	Go to step 4

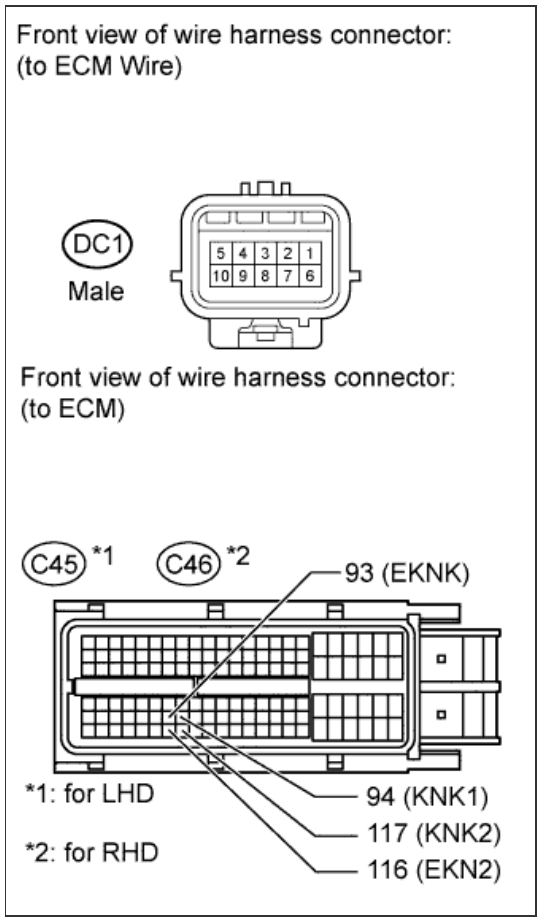
A

2.CHECK HARNESS AND CONNECTOR (CONNECTOR - ECM)

a. Disconnect the DC1 connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
DC1 male connector 10 - C45-94 (KNK1)	Always	Below 1 Ω
DC1 male connector 9 - C45-93 (EKNK)	Always	Below 1 Ω
DC1 male connector 4 - C45-117 (KNK2)	Always	Below 1 Ω
DC1 male connector 5 - C45-116 (EKN2)	Always	Below 1 Ω
DC1 male connector 10 or C45-94 (KNK1) - Body ground	Always	10 kΩ or higher
DC1 male connector 9 or C45-93 (EKNK) - Body ground	Always	10 kΩ or higher
DC1 male connector 4 or C45-117 (KNK2) - Body ground	Always	10 kΩ or higher
DC1 male connector 5 or C45-116 (EKN2) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
DC1 male connector 10 - C46-94 (KNK1)	Always	Below 1 Ω
DC1 male connector 9 - C46-93 (EKNK)	Always	Below 1 Ω
DC1 male connector 4 - C46-117 (KNK2)	Always	Below 1 Ω
DC1 male connector 5 - C46-116 (EKN2)	Always	Below 1 Ω
DC1 male connector 10 or C46-94 (KNK1) - Body ground	Always	10 kΩ or higher
DC1 male connector 9 or	Always	10 kΩ or higher

C46-93 (EKNK) - Body ground		
DC1 male connector 4 or C46-117 (KNK2) - Body ground	Always	10 kΩ or higher
DC1 male connector 5 or C46-116 (EKN2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT ECM (VOLTAGE)

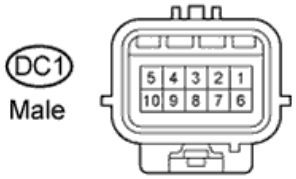
a. Disconnect the DC1 connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
DC1 male connector 10 - 9	Engine switch on (IG)	4.5 to 5.5 V
DC1 male connector 4 - 5	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to ECM Wire)



NG → REPLACE ECM (Click here)

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

4.INSPECT KNOCK CONTROL SENSOR

a. Disconnect the DC1 connector.

b. Measure the resistance according to the value(s) in the table below.

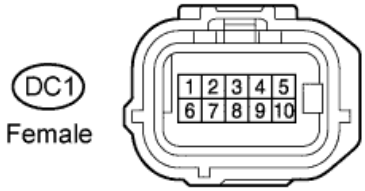
Standard Resistance:

Tester Connection	Condition	Specified Condition
DC1 female connector 10 - 9	20 C (68 F)	120 to 280 kΩ
DC1 female connector 4 - 5	20 C (68 F)	120 to 280 kΩ

Result

Result	Proceed to
NG	A
OK	B

Front view of wire harness connector:
(to Knock Sensor Wire)



B → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

5.CHECK HARNESS AND CONNECTOR (CONNECTOR - KNOCK SENSOR)

a. Disconnect the DC1 connector.

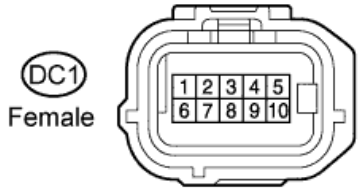
b. Disconnect the knock sensor connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
DC1 female connector 10 - D7-2	Always	Below 1 Ω
DC1 female connector 9 - D7-1	Always	Below 1 Ω
DC1 female connector 4 - D6-2	Always	Below 1 Ω
DC1 female connector 5 - D6-1	Always	Below 1 Ω
DC1 female connector 10 or D7-2 - Body ground	Always	10 kΩ or higher
DC1 female connector 9 or D7-1 - Body ground	Always	10 kΩ or higher
DC1 female connector 4 or D6-2 - Body ground	Always	10 kΩ or higher
DC1 female connector 5 or D6-1 - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Knock Sensor Wire)



Front view of wire harness connector:
(to Knock Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE KNOCK CONTROL SENSOR (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

for Preparation Click here

DESCRIPTION

Refer to DTC P2195 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals AF+ and AF- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in Air Fuel Ratio (A/F) sensor (for bank 1, 2 sensor 1) circuit • Air Fuel Ratio (A/F) sensor (for bank 1, 2 sensor 1) • ECM
P2238 P2241	• Case 1: Condition (a) or (b) continues for 5.0 seconds or more (1 trip detection logic): (a) The AF+ voltage is 0.5 V or less. (b) (AF+) - (AF-) = 0.1 V or less. • Case 2: The A/F sensor admittance is less than 0.022 1/Ω (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2239 P2242	The AF+ voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2252 P2255	The AF- voltage is 0.5 V or less for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2253 P2256	The AF- voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM

HINT:

- **DTCs P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2241, P2242, P2255 and P2256 indicate malfunctions related to the bank 2 A/F sensor circuit.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that includes the No. 2 cylinder.**

MONITOR DESCRIPTION

These DTCs are output when there is an open or short in the A/F sensor circuit, or if the A/F sensor output drops.
To detect these problems, the voltage of the A/F sensor is monitored when turning the engine switch on (IG), and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is outside of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in the next driving cycle, the MIL is illuminated and a DTC is stored.
The Air-Fuel Ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. If the A/F sensor impedance (alternating current resistance) or output voltage deviates greatly from the standard range, the ECM determines that there is an open or short in the A/F sensor circuit.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/ F sensor.
(e) Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

HINT:

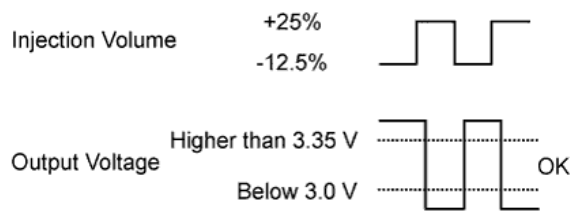
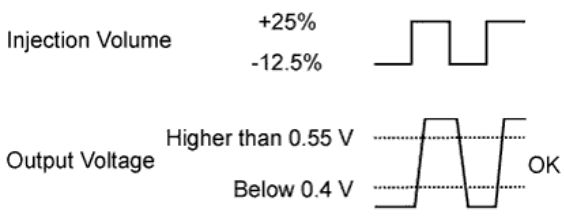
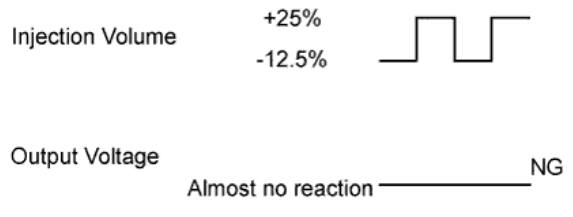
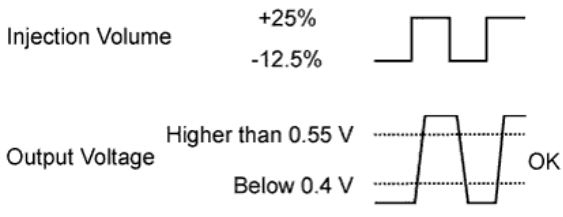
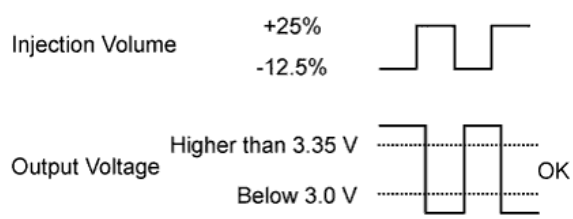
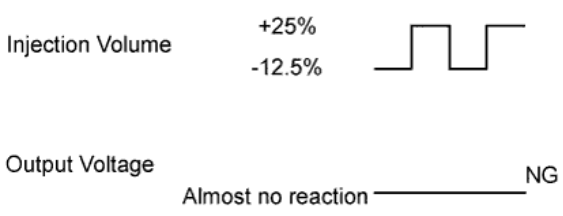
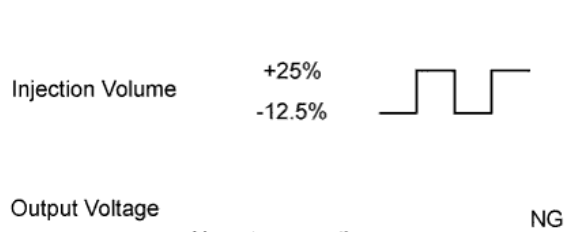
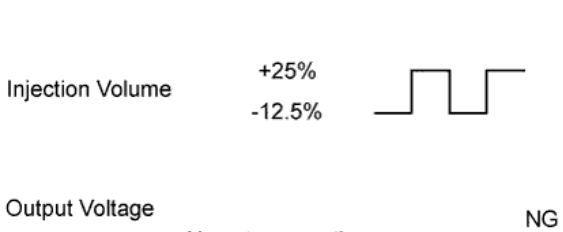
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.

To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

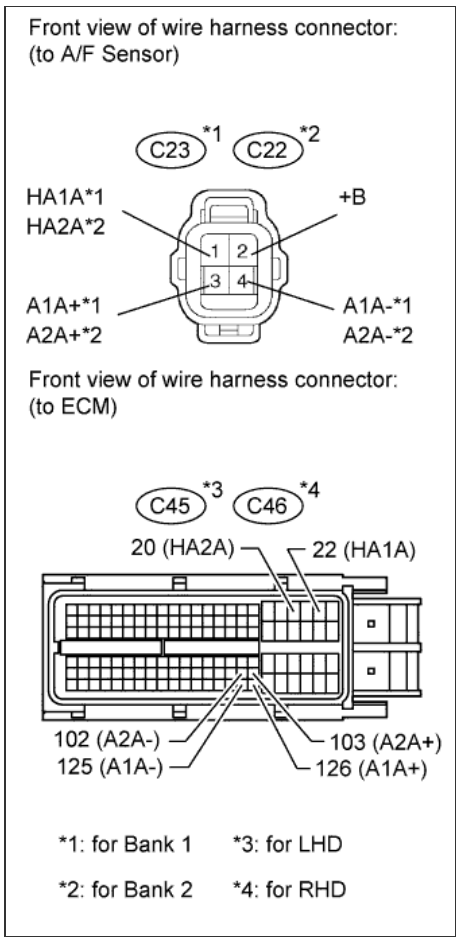
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.



e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

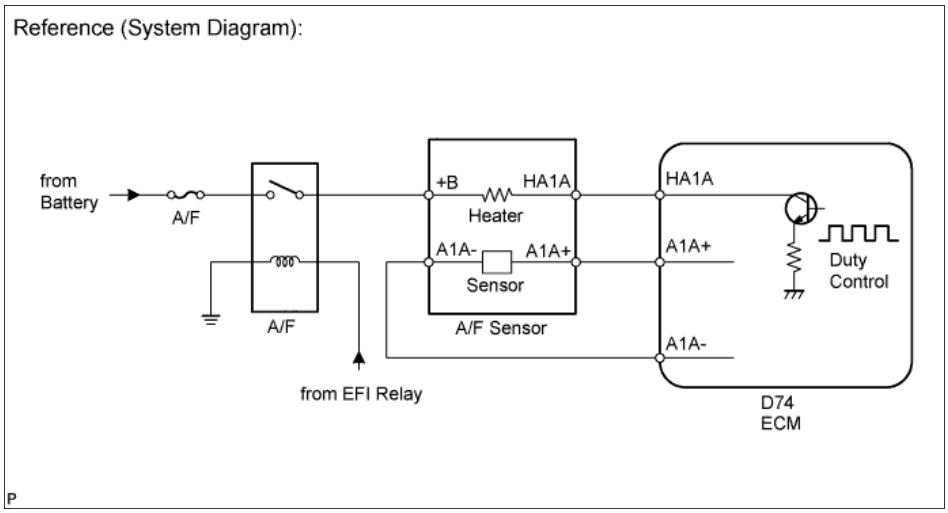
Tester Connection	Condition	Specified Condition

C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C46-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



P

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2237, P2238, P2239, P2240, P2241, P2242, P2252, P2253, P2255 or P2256 is output	B

B → REPLACE ECM (**Click here**)

A

END

DTC P0327 Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)

DTC P0328 Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)

DTC P0332 Knock Sensor 2 Circuit Low Input (Bank 2)

DTC P0333 Knock Sensor 2 Circuit High Input (Bank 2)

for Preparation Click here

DESCRIPTION

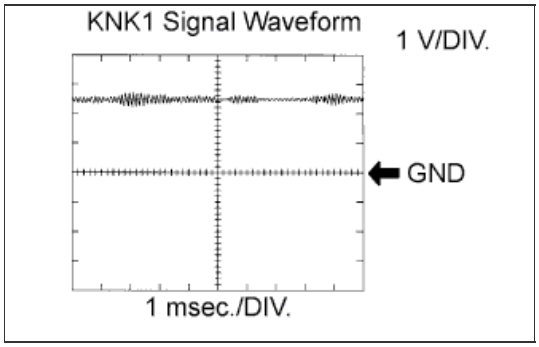
Flat type knock sensors (non-resonant type) have structures that can detect vibrations between approximately 6 kHz and 15 kHz.
A knock sensor is fitted onto the engine block to detect engine knocking.
The knock sensor contains a piezoelectric element which generates a voltage when it becomes deformed.
The voltage is generated when the engine block vibrates due to knocking. Any occurrence of engine knocking can be suppressed by delaying the ignition timing.

DTC Code	DTC Detection Condition	Trouble Area
P0327 P0332	The output voltage of the knock sensor is below 0.5 V (1 trip detection logic).	• Short in knock sensor circuit • Knock sensor • ECM
P0328 P0333	The output voltage of the knock sensor is higher than 4.5 V (1 trip detection logic).	• Open in knock sensor circuit • Knock sensor • ECM

HINT:

When any of DTCs P0327, P0328, P0332 and P0333 are stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is delayed to its maximum retardation. Fail-safe mode continues until the engine switch is turned off.

Reference: Inspection using an oscilloscope



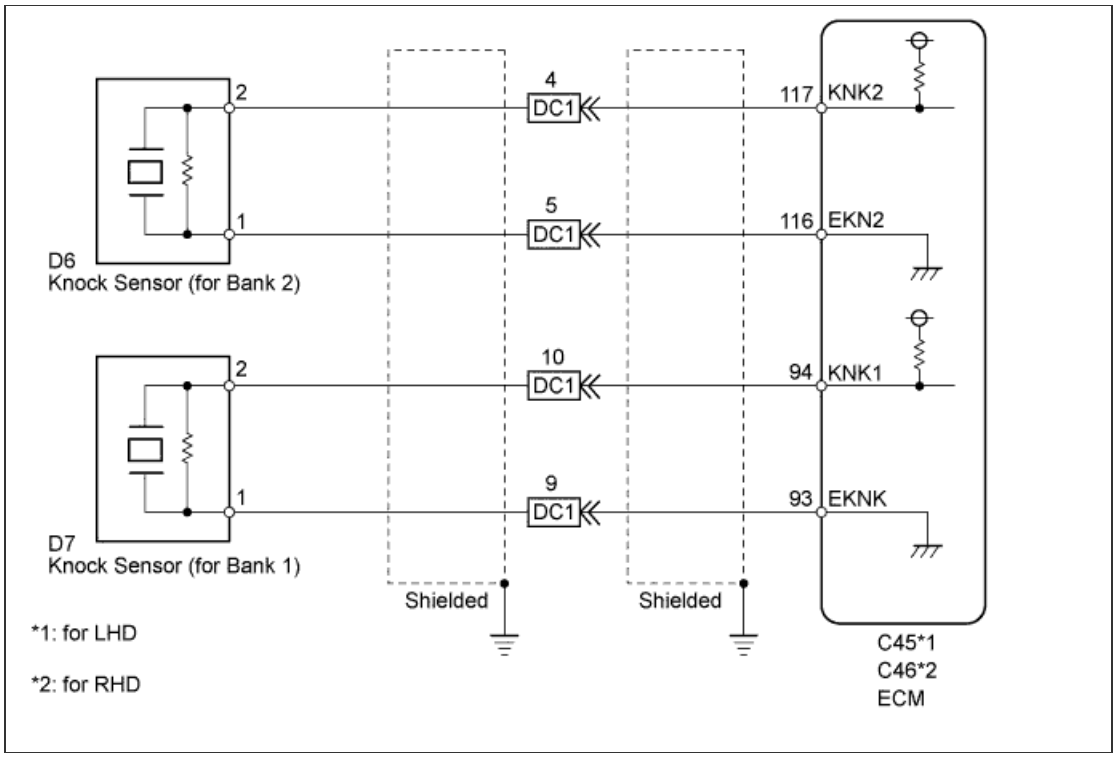
The correct waveform is as shown.

Item	Content
Terminal	KNK1 - EKNK KNK2 - EKN2
Equipment Setting	1 V/DIV. 1 msec./DIV.
Condition	Keep engine speed at 4000 rpm with warm engine

MONITOR DESCRIPTION

If the output voltage transmitted by the knock sensor remains low or high for more than 1 second, the ECM interprets this as a malfunction in the sensor circuit, and stores a DTC.
The monitor for DTCs P0327, P0328, P0332 and P0333 begins to run when 5 seconds have elapsed since the engine was started.
If the malfunction is not repaired successfully, DTC P0327, P0328, P0332 or P0333 is stored 5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

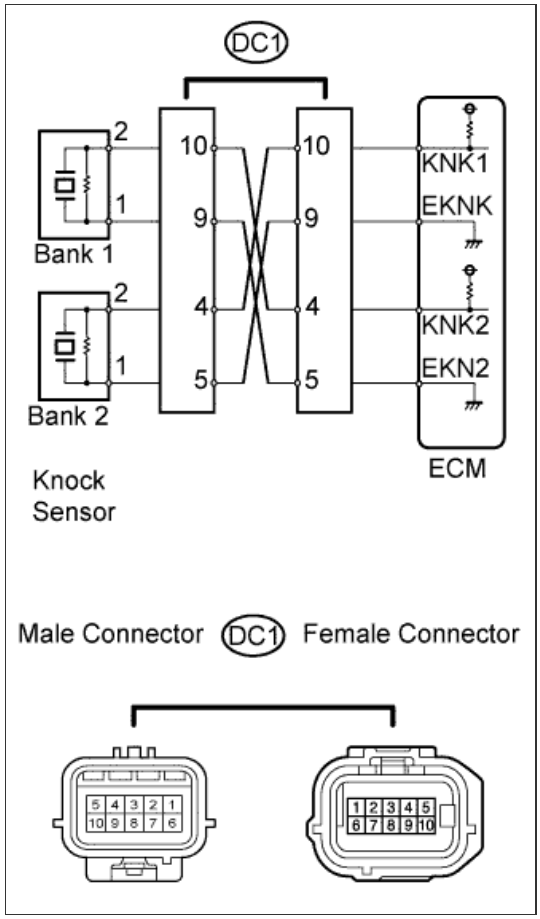
- **DTCs P0327 and P0328 are the bank 1 knock sensor circuit.**
- **DTCs P0332 and P0333 are the bank 2 knock sensor circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ DTC OUTPUT (CHECK KNOCK SENSOR CIRCUIT)

a. Disconnect the DC1 connector.

b. Using lead wires, connect the connectors as follows:

Male Connector - Female Connector
Terminal 10 - Terminal 4
Terminal 9 - Terminal 5
Terminal 4 - Terminal 10
Terminal 5 - Terminal 9



c. Connect the intelligent tester to the DLC3.

d. Turn the engine switch on (IG) and turn the tester on.

e. Clear DTCs (Click here).

f. Warm up the engine.

g. Run the engine at 3000 rpm for 10 seconds or more.

h. Enter the following menus: Powertrain / Engine and ECT / DTC.

i. Read the DTCs.

Result

Display	Proceed to
DTC is same as when vehicle brought in (for example, P0327 and P0328 are output again, or P0332 and P0333 are output again)	A
DTC is different from when vehicle brought in (for example, P0327 and P0328 are output at first, but then P0332 and P0333 are output, or vice versa)	B

HINT:

- If DTC P0327 or P0328 has changed to P0332 or P0333, check the knock sensor circuit on the left bank side.
- If DTC P0332 or P0333 has changed to P0327 or P0328, check the knock sensor circuit on the right bank side.

B	Go to step 4

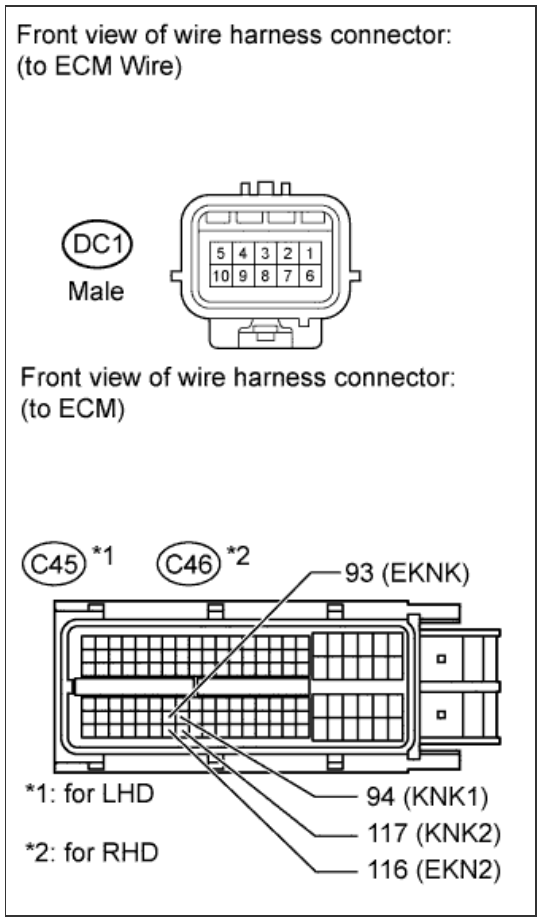
A

2.CHECK HARNESS AND CONNECTOR (CONNECTOR - ECM)

a. Disconnect the DC1 connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
DC1 male connector 10 - C45-94 (KNK1)	Always	Below 1 Ω
DC1 male connector 9 - C45-93 (EKNK)	Always	Below 1 Ω
DC1 male connector 4 - C45-117 (KNK2)	Always	Below 1 Ω
DC1 male connector 5 - C45-116 (EKN2)	Always	Below 1 Ω
DC1 male connector 10 or C45-94 (KNK1) - Body ground	Always	10 kΩ or higher
DC1 male connector 9 or C45-93 (EKNK) - Body ground	Always	10 kΩ or higher
DC1 male connector 4 or C45-117 (KNK2) - Body ground	Always	10 kΩ or higher
DC1 male connector 5 or C45-116 (EKN2) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
DC1 male connector 10 - C46-94 (KNK1)	Always	Below 1 Ω
DC1 male connector 9 - C46-93 (EKNK)	Always	Below 1 Ω
DC1 male connector 4 - C46-117 (KNK2)	Always	Below 1 Ω
DC1 male connector 5 - C46-116 (EKN2)	Always	Below 1 Ω
DC1 male connector 10 or C46-94 (KNK1) - Body ground	Always	10 kΩ or higher
DC1 male connector 9 or	Always	10 kΩ or higher

C46-93 (EKNK) - Body ground		
DC1 male connector 4 or C46-117 (KNK2) - Body ground	Always	10 kΩ or higher
DC1 male connector 5 or C46-116 (EKN2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT ECM (VOLTAGE)

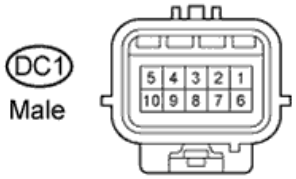
a. Disconnect the DC1 connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
DC1 male connector 10 - 9	Engine switch on (IG)	4.5 to 5.5 V
DC1 male connector 4 - 5	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to ECM Wire)



NG → REPLACE ECM (Click here)

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

4.INSPECT KNOCK CONTROL SENSOR

a. Disconnect the DC1 connector.

b. Measure the resistance according to the value(s) in the table below.

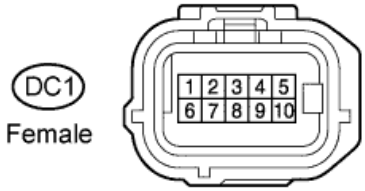
Standard Resistance:

Tester Connection	Condition	Specified Condition
DC1 female connector 10 - 9	20 C (68 F)	120 to 280 kΩ
DC1 female connector 4 - 5	20 C (68 F)	120 to 280 kΩ

Result

Result	Proceed to
NG	A
OK	B

Front view of wire harness connector:
(to Knock Sensor Wire)



B → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

5.CHECK HARNESS AND CONNECTOR (CONNECTOR - KNOCK SENSOR)

a. Disconnect the DC1 connector.

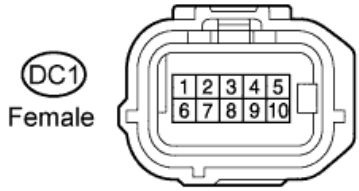
b. Disconnect the knock sensor connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
DC1 female connector 10 - D7-2	Always	Below 1 Ω
DC1 female connector 9 - D7-1	Always	Below 1 Ω
DC1 female connector 4 - D6-2	Always	Below 1 Ω
DC1 female connector 5 - D6-1	Always	Below 1 Ω
DC1 female connector 10 or D7-2 - Body ground	Always	10 kΩ or higher
DC1 female connector 9 or D7-1 - Body ground	Always	10 kΩ or higher
DC1 female connector 4 or D6-2 - Body ground	Always	10 kΩ or higher
DC1 female connector 5 or D6-1 - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Knock Sensor Wire)



Front view of wire harness connector:
(to Knock Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE KNOCK CONTROL SENSOR (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

for Preparation Click here

DESCRIPTION

Refer to DTC P2195 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals AF+ and AF- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in Air Fuel Ratio (A/F) sensor (for bank 1, 2 sensor 1) circuit • Air Fuel Ratio (A/F) sensor (for bank 1, 2 sensor 1) • ECM
P2238 P2241	• Case 1: Condition (a) or (b) continues for 5.0 seconds or more (1 trip detection logic): (a) The AF+ voltage is 0.5 V or less. (b) (AF+) - (AF-) = 0.1 V or less. • Case 2: The A/F sensor admittance is less than 0.022 1/Ω (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2239 P2242	The AF+ voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2252 P2255	The AF- voltage is 0.5 V or less for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2253 P2256	The AF- voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM

HINT:

- **DTCs P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2241, P2242, P2255 and P2256 indicate malfunctions related to the bank 2 A/F sensor circuit.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that includes the No. 2 cylinder.**

MONITOR DESCRIPTION

These DTCs are output when there is an open or short in the A/F sensor circuit, or if the A/F sensor output drops.
To detect these problems, the voltage of the A/F sensor is monitored when turning the engine switch on (IG), and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is outside of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in the next driving cycle, the MIL is illuminated and a DTC is stored.
The Air-Fuel Ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. If the A/F sensor impedance (alternating current resistance) or output voltage deviates greatly from the standard range, the ECM determines that there is an open or short in the A/F sensor circuit.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/ F sensor.
(e) Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

HINT:

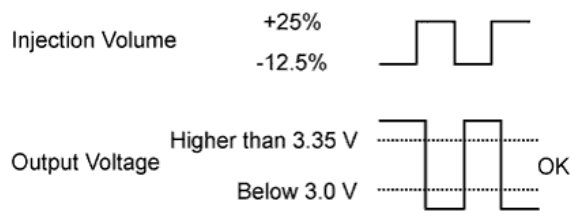
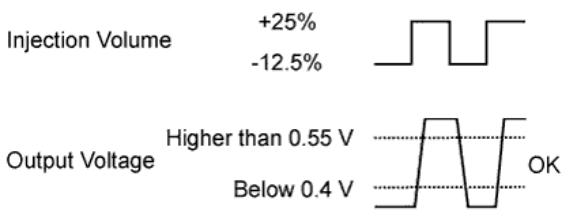
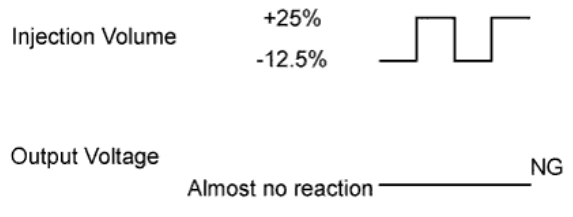
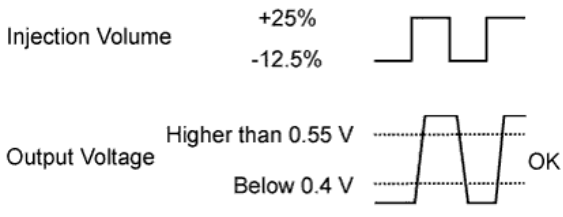
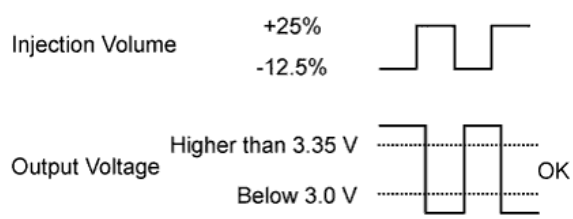
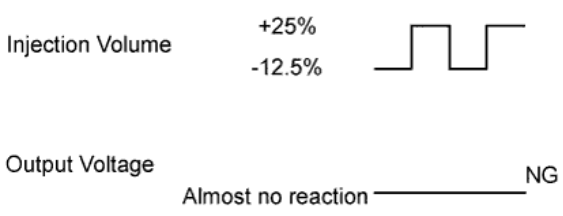
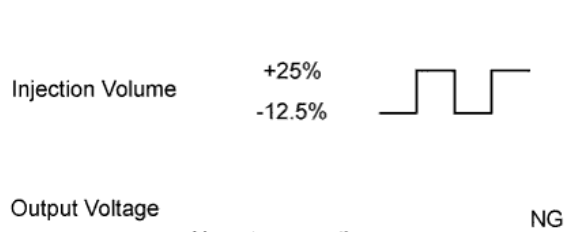
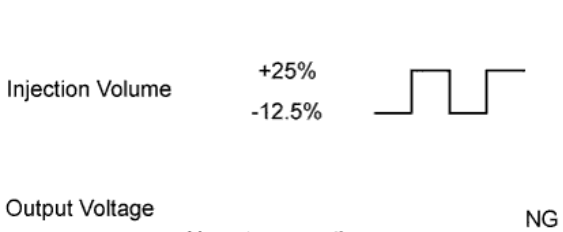
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.

To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

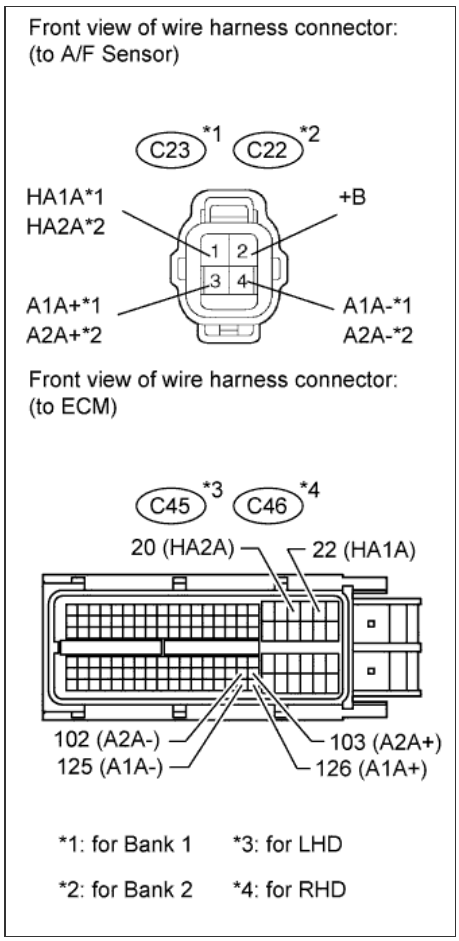
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.



e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

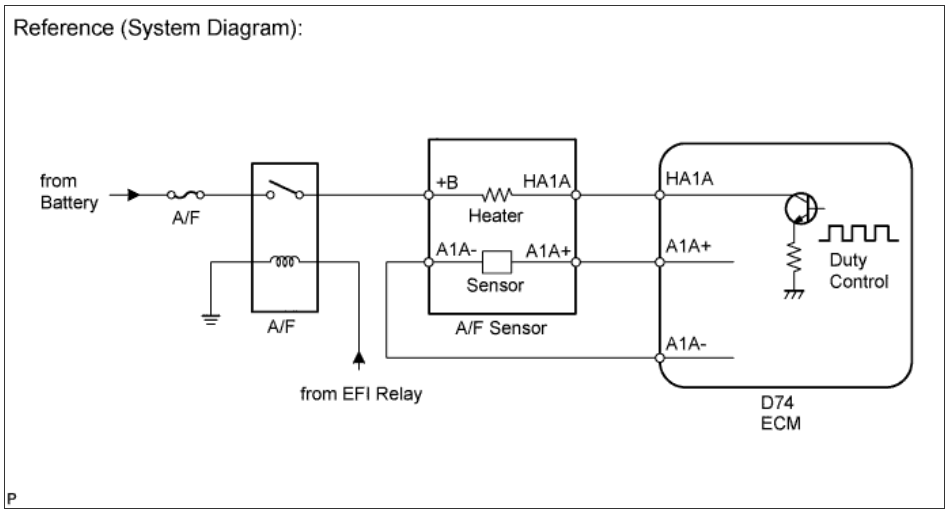
Tester Connection	Condition	Specified Condition

C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C46-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



P

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2237, P2238, P2239, P2240, P2241, P2242, P2252, P2253, P2255 or P2256 is output	B

B → REPLACE ECM (**Click here**)

A

END

DTC P0327 Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)

DTC P0328 Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)

DTC P0332 Knock Sensor 2 Circuit Low Input (Bank 2)

DTC P0333 Knock Sensor 2 Circuit High Input (Bank 2)

for Preparation Click here

DESCRIPTION

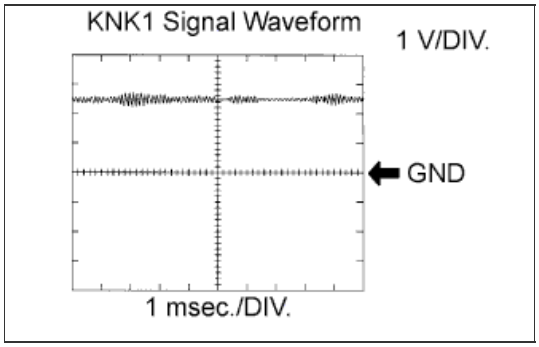
Flat type knock sensors (non-resonant type) have structures that can detect vibrations between approximately 6 kHz and 15 kHz.
A knock sensor is fitted onto the engine block to detect engine knocking.
The knock sensor contains a piezoelectric element which generates a voltage when it becomes deformed.
The voltage is generated when the engine block vibrates due to knocking. Any occurrence of engine knocking can be suppressed by delaying the ignition timing.

DTC Code	DTC Detection Condition	Trouble Area
P0327 P0332	The output voltage of the knock sensor is below 0.5 V (1 trip detection logic).	• Short in knock sensor circuit • Knock sensor • ECM
P0328 P0333	The output voltage of the knock sensor is higher than 4.5 V (1 trip detection logic).	• Open in knock sensor circuit • Knock sensor • ECM

HINT:

When any of DTCs P0327, P0328, P0332 and P0333 are stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is delayed to its maximum retardation. Fail-safe mode continues until the engine switch is turned off.

Reference: Inspection using an oscilloscope



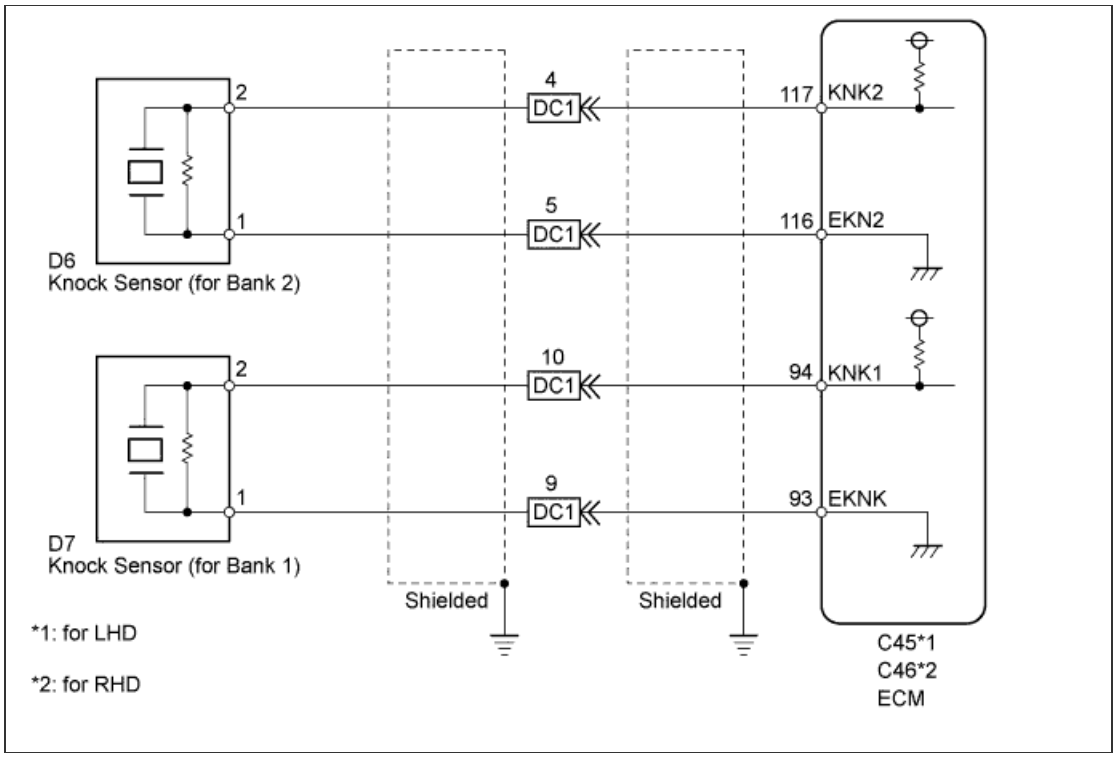
The correct waveform is as shown.

Item	Content
Terminal	KNK1 - EKNK KNK2 - EKN2
Equipment Setting	1 V/DIV. 1 msec./DIV.
Condition	Keep engine speed at 4000 rpm with warm engine

MONITOR DESCRIPTION

If the output voltage transmitted by the knock sensor remains low or high for more than 1 second, the ECM interprets this as a malfunction in the sensor circuit, and stores a DTC.
The monitor for DTCs P0327, P0328, P0332 and P0333 begins to run when 5 seconds have elapsed since the engine was started.
If the malfunction is not repaired successfully, DTC P0327, P0328, P0332 or P0333 is stored 5 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

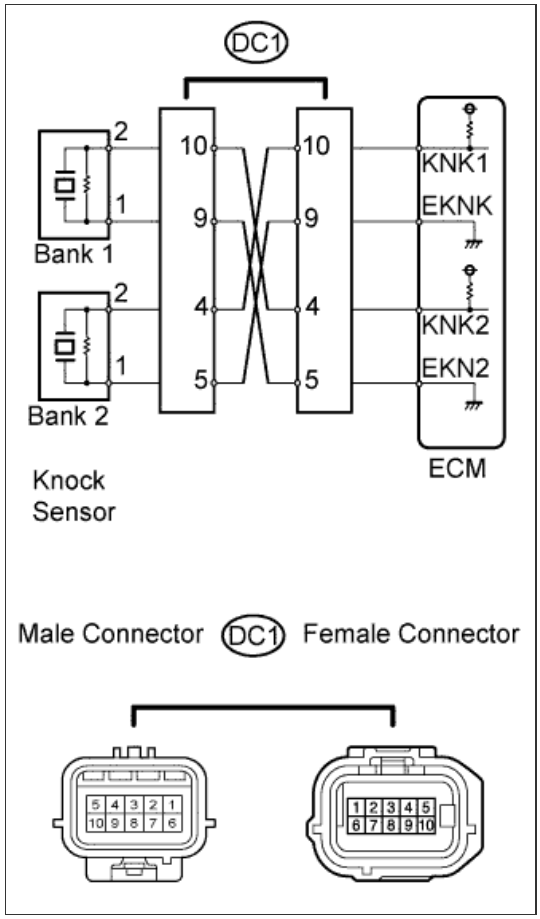
- **DTCs P0327 and P0328 are the bank 1 knock sensor circuit.**
- **DTCs P0332 and P0333 are the bank 2 knock sensor circuit.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ DTC OUTPUT (CHECK KNOCK SENSOR CIRCUIT)

a. Disconnect the DC1 connector.

b. Using lead wires, connect the connectors as follows:

Male Connector - Female Connector
Terminal 10 - Terminal 4
Terminal 9 - Terminal 5
Terminal 4 - Terminal 10
Terminal 5 - Terminal 9



c. Connect the intelligent tester to the DLC3.

d. Turn the engine switch on (IG) and turn the tester on.

e. Clear DTCs (Click here).

f. Warm up the engine.

g. Run the engine at 3000 rpm for 10 seconds or more.

h. Enter the following menus: Powertrain / Engine and ECT / DTC.

i. Read the DTCs.

Result

Display	Proceed to
DTC is same as when vehicle brought in (for example, P0327 and P0328 are output again, or P0332 and P0333 are output again)	A
DTC is different from when vehicle brought in (for example, P0327 and P0328 are output at first, but then P0332 and P0333 are output, or vice versa)	B

HINT:

- If DTC P0327 or P0328 has changed to P0332 or P0333, check the knock sensor circuit on the left bank side.
- If DTC P0332 or P0333 has changed to P0327 or P0328, check the knock sensor circuit on the right bank side.

B	Go to step 4

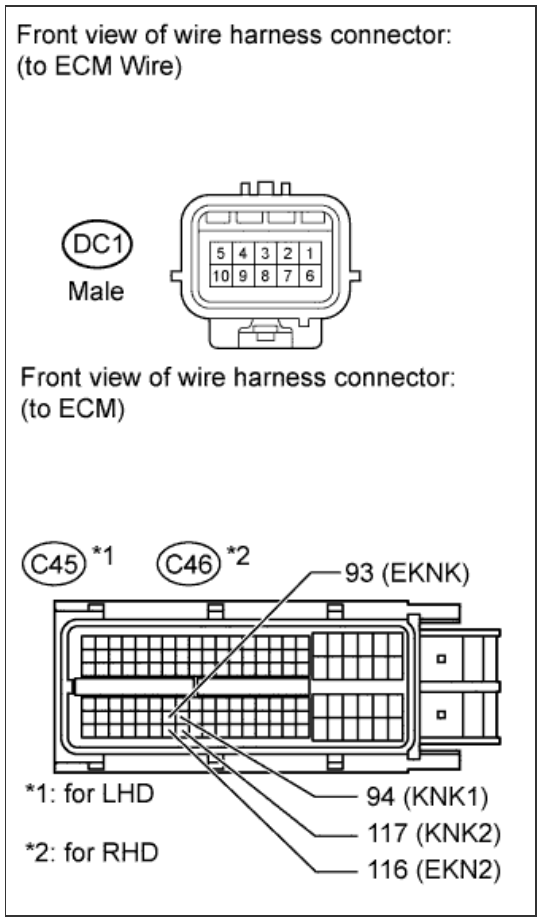
A

2.CHECK HARNESS AND CONNECTOR (CONNECTOR - ECM)

a. Disconnect the DC1 connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
DC1 male connector 10 - C45-94 (KNK1)	Always	Below 1 Ω
DC1 male connector 9 - C45-93 (EKNK)	Always	Below 1 Ω
DC1 male connector 4 - C45-117 (KNK2)	Always	Below 1 Ω
DC1 male connector 5 - C45-116 (EKN2)	Always	Below 1 Ω
DC1 male connector 10 or C45-94 (KNK1) - Body ground	Always	10 kΩ or higher
DC1 male connector 9 or C45-93 (EKNK) - Body ground	Always	10 kΩ or higher
DC1 male connector 4 or C45-117 (KNK2) - Body ground	Always	10 kΩ or higher
DC1 male connector 5 or C45-116 (EKN2) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
DC1 male connector 10 - C46-94 (KNK1)	Always	Below 1 Ω
DC1 male connector 9 - C46-93 (EKNK)	Always	Below 1 Ω
DC1 male connector 4 - C46-117 (KNK2)	Always	Below 1 Ω
DC1 male connector 5 - C46-116 (EKN2)	Always	Below 1 Ω
DC1 male connector 10 or C46-94 (KNK1) - Body ground	Always	10 kΩ or higher
DC1 male connector 9 or	Always	10 kΩ or higher

C46-93 (EKNK) - Body ground		
DC1 male connector 4 or C46-117 (KNK2) - Body ground	Always	10 kΩ or higher
DC1 male connector 5 or C46-116 (EKN2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.INSPECT ECM (VOLTAGE)

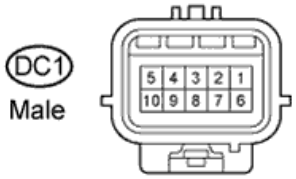
a. Disconnect the DC1 connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
DC1 male connector 10 - 9	Engine switch on (IG)	4.5 to 5.5 V
DC1 male connector 4 - 5	Engine switch on (IG)	4.5 to 5.5 V

Front view of wire harness connector:
(to ECM Wire)



NG → REPLACE ECM (Click here)

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

4.INSPECT KNOCK CONTROL SENSOR

a. Disconnect the DC1 connector.

b. Measure the resistance according to the value(s) in the table below.

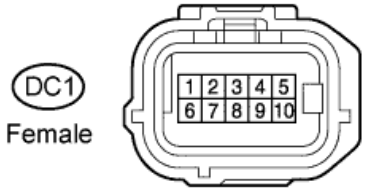
Standard Resistance:

Tester Connection	Condition	Specified Condition
DC1 female connector 10 - 9	20 C (68 F)	120 to 280 kΩ
DC1 female connector 4 - 5	20 C (68 F)	120 to 280 kΩ

Result

Result	Proceed to
NG	A
OK	B

Front view of wire harness connector:
(to Knock Sensor Wire)



B → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

5.CHECK HARNESS AND CONNECTOR (CONNECTOR - KNOCK SENSOR)

a. Disconnect the DC1 connector.

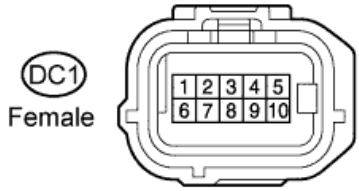
b. Disconnect the knock sensor connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
DC1 female connector 10 - D7-2	Always	Below 1 Ω
DC1 female connector 9 - D7-1	Always	Below 1 Ω
DC1 female connector 4 - D6-2	Always	Below 1 Ω
DC1 female connector 5 - D6-1	Always	Below 1 Ω
DC1 female connector 10 or D7-2 - Body ground	Always	10 kΩ or higher
DC1 female connector 9 or D7-1 - Body ground	Always	10 kΩ or higher
DC1 female connector 4 or D6-2 - Body ground	Always	10 kΩ or higher
DC1 female connector 5 or D6-1 - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Knock Sensor Wire)



Front view of wire harness connector:
(to Knock Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE KNOCK CONTROL SENSOR (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

for Preparation Click here

DESCRIPTION

Refer to DTC P2195 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals AF+ and AF- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in Air Fuel Ratio (A/F) sensor (for bank 1, 2 sensor 1) circuit • Air Fuel Ratio (A/F) sensor (for bank 1, 2 sensor 1) • ECM
P2238 P2241	• Case 1: Condition (a) or (b) continues for 5.0 seconds or more (1 trip detection logic): (a) The AF+ voltage is 0.5 V or less. (b) (AF+) - (AF-) = 0.1 V or less. • Case 2: The A/F sensor admittance is less than 0.022 1/Ω (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2239 P2242	The AF+ voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2252 P2255	The AF- voltage is 0.5 V or less for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2253 P2256	The AF- voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM

HINT:

- **DTCs P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2241, P2242, P2255 and P2256 indicate malfunctions related to the bank 2 A/F sensor circuit.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that includes the No. 2 cylinder.**

MONITOR DESCRIPTION

These DTCs are output when there is an open or short in the A/F sensor circuit, or if the A/F sensor output drops.
To detect these problems, the voltage of the A/F sensor is monitored when turning the engine switch on (IG), and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is outside of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in the next driving cycle, the MIL is illuminated and a DTC is stored.
The Air-Fuel Ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. If the A/F sensor impedance (alternating current resistance) or output voltage deviates greatly from the standard range, the ECM determines that there is an open or short in the A/F sensor circuit.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/ F sensor.
(e) Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

HINT:

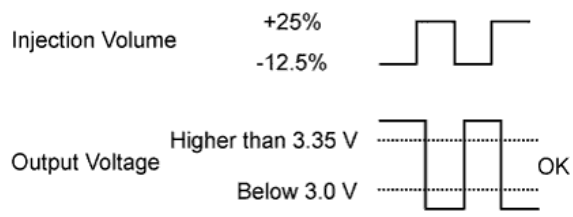
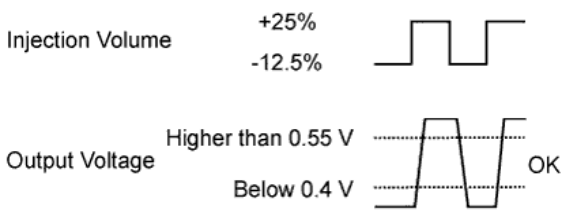
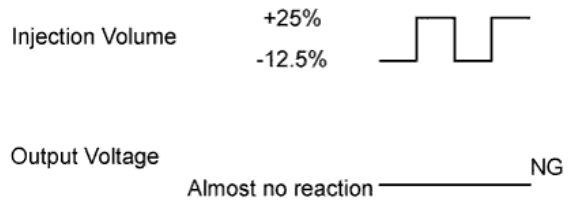
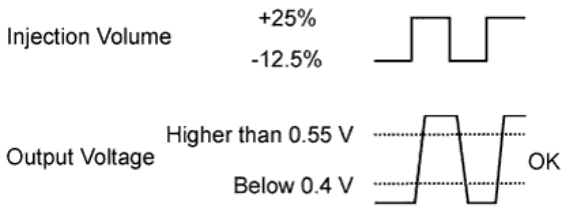
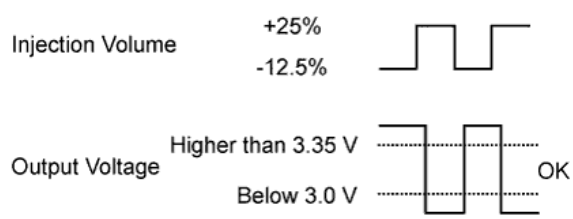
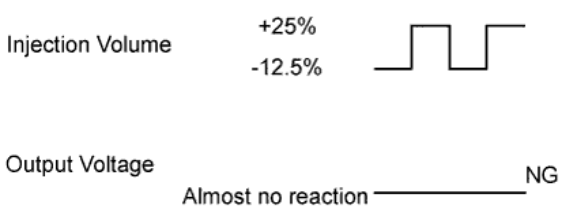
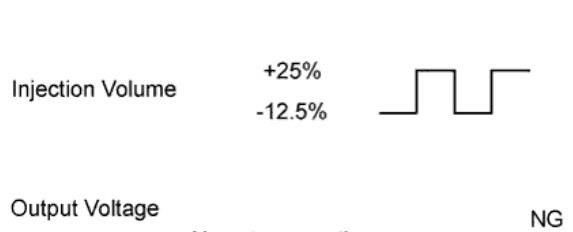
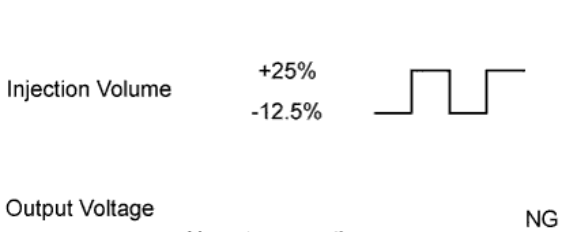
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.

To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

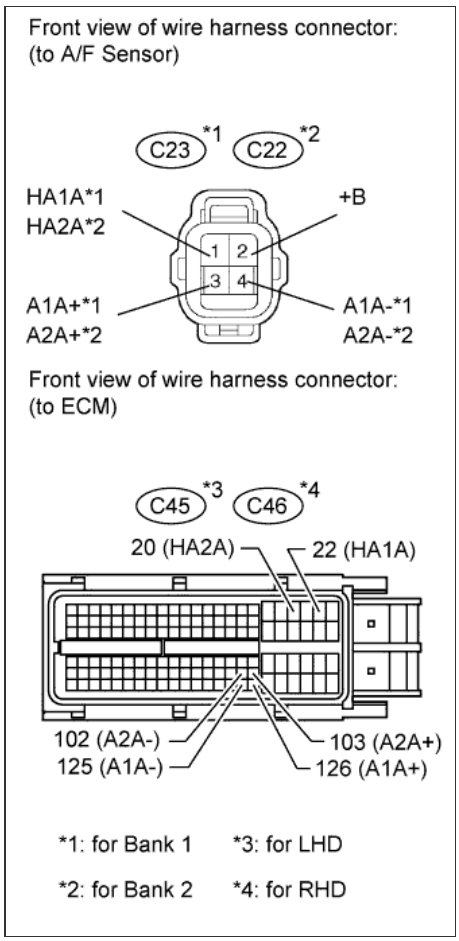
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.



e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

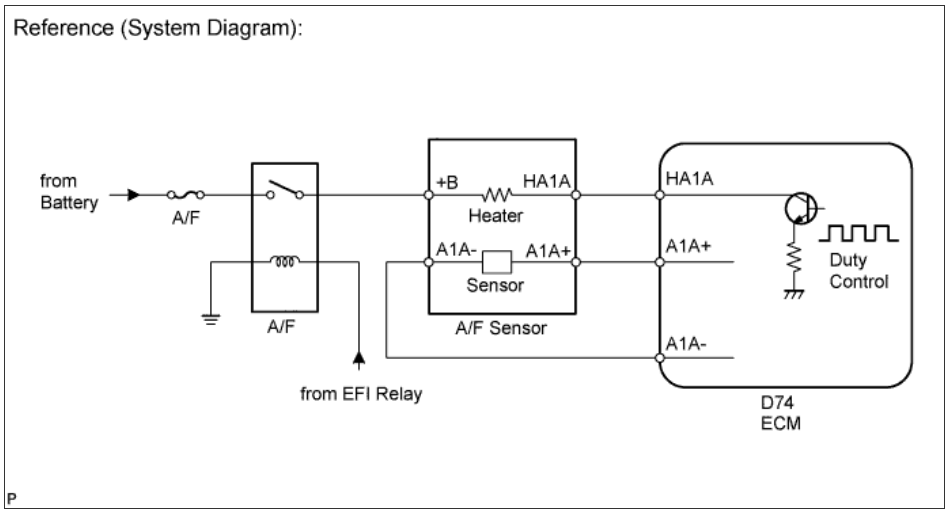
Tester Connection	Condition	Specified Condition

C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C46-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



P

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2237, P2238, P2239, P2240, P2241, P2242, P2252, P2253, P2255 or P2256 is output	B

B → REPLACE ECM (**Click here**)

A

END

DTC P0335 Crankshaft Position Sensor "A" Circuit

DTC P0339 Crankshaft Position Sensor "A" Circuit Intermittent

for Preparation Click here

DESCRIPTION

The Crank Position (CKP) sensor system consists of a CKP sensor plate and a pickup coil.
The sensor plate has 34 teeth and is installed on the crankshaft. The pickup coil is made of wound copper wire, an iron core and magnet. The sensor plate rotates and, as each tooth passes by the pickup coil, a pulse signal is created. The pickup coil generates 34 signals per revolution. Based on these signals, the ECM calculates the crankshaft position and engine speed. Using these calculations, the fuel injection time and ignition timing are controlled.

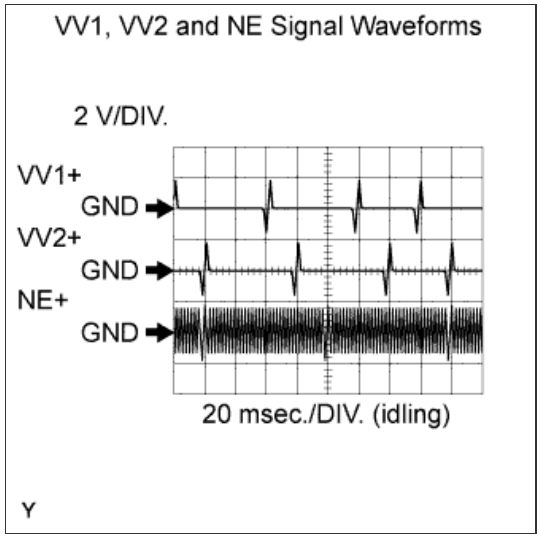
DTC Code	DTC Detection Condition	Trouble Area
P0335	When either condition below is met: • No CKP sensor signal is sent to the ECM while cranking (1 trip detection logic). • No CKP sensor signal is sent to the ECM at an engine speed of 450 rpm or more (1 trip detection logic).	• Open or short in CKP sensor circuit • CKP sensor • CKP sensor plate • ECM
P0339	Under conditions (a), (b) and (c), no CKP sensor signal is sent to the ECM for 0.05 seconds or more (1 trip detection logic): (a) An engine speed of 1000 rpm or more. (b) The starter signal is OFF. (c) 3 seconds or more have elapsed since the starter signal switched from ON to OFF.	• Open or short in CKP sensor circuit • CKP sensor • CKP sensor plate • ECM

Reference: Inspection using an oscilloscope.

HINT:

- **The correct waveform is as shown.**
- **VV1+ and VV2+ stand for the VVT sensor signal, and NE+ stands for the CKP sensor signal.**
- **Grounding failure of the shielded wire may cause noise in the waveforms.**

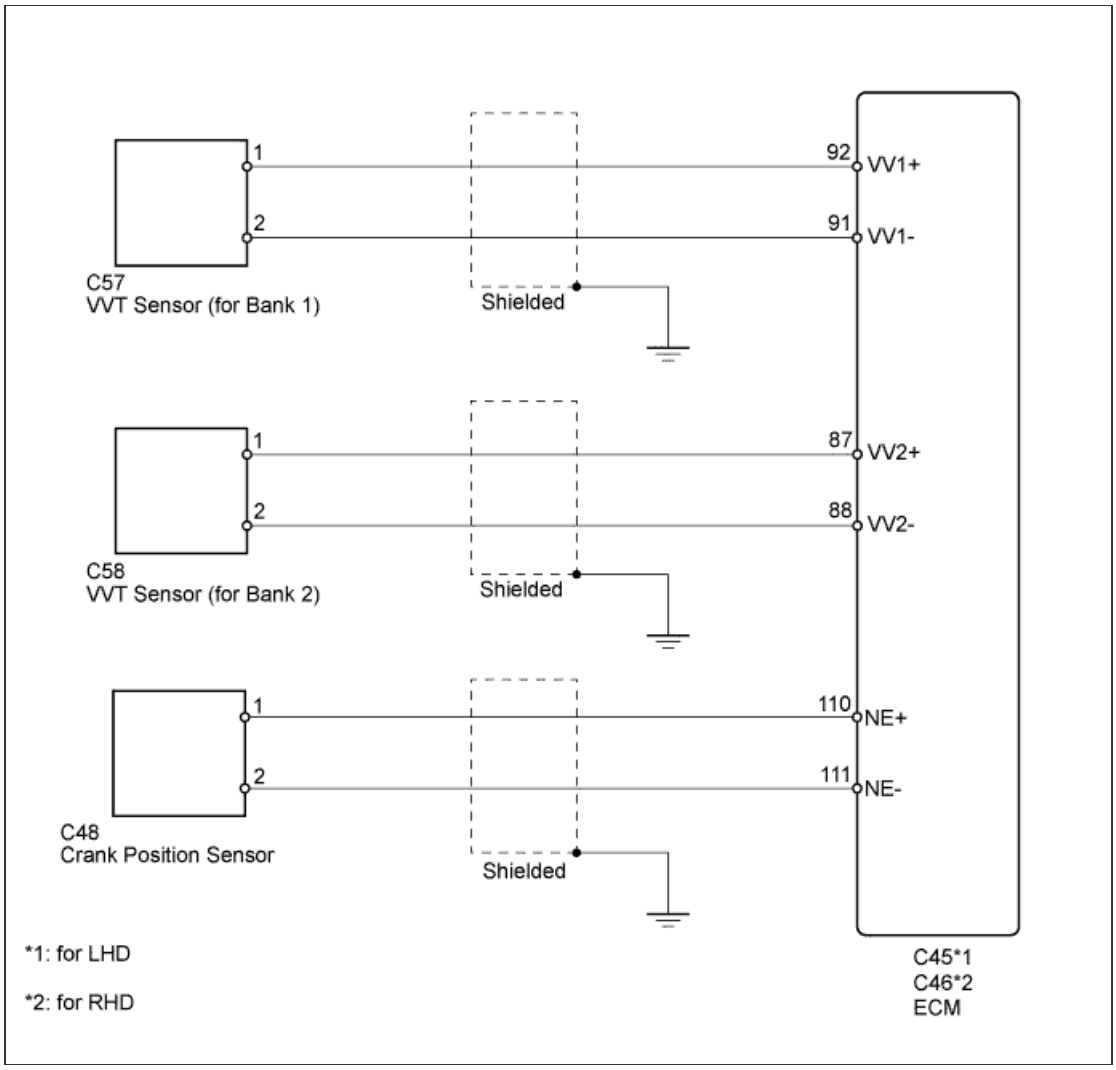
Item	Content
Terminal	VV1+ - VV1- VV2+ - VV2- NE+ - NE-
Equipment Setting	2 V/DIV., 20 msec./DIV.
Condition	Cranking or idling



MONITOR DESCRIPTION

If there is no signal from the CKP sensor despite the engine running, the ECM interprets this as a malfunction of the sensor.
If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **If no problem is found through this diagnostic troubleshooting procedure, troubleshoot the engine mechanical systems.**
- **Check the engine speed. The engine speed can be checked by using the intelligent tester. To check, follow the operation below:**
  1. **Connect the intelligent tester to the DLC3.**
  2. **Start the engine.**
  3. **Turn the tester on.**
  4. **Enter the following menus: Powertrain / Engine and ECT / Data List / Engine Speed.**
     The engine speed may be indicated as zero despite the engine running normally. This is caused by a lack of NE signals from the Crankshaft Position (CKP) sensor. Alternatively, the engine speed may be indicated as less than the actual engine speed if the CKP sensor output voltage is insufficient.
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (ENGINE SPD)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / Engine Speed.

e. Start the engine.

f. Read the values displayed on the tester while the engine is running.

Standard:
Correct values are displayed.

HINT:

- **To check the engine speed change, display the graph on the tester.**

- **If the engine does not start, check the engine speed while cranking.**
- **If the engine speed indicated on the tester remains at zero (0), there may be an open or short in the Crank Position (CKP) sensor circuit.**

NG → Go to step 2

OK

CHECK FOR INTERMITTENT PRO LEMS (Click here)

2.INSPECT CRANK POSITION SENSOR (RESISTANCE)

a. Disconnect the crank position (CKP) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	Cold	1630 to 2740 Ω
1 - 2	Hot	2065 to 3225 Ω

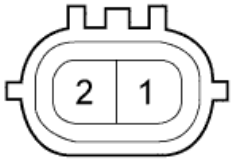
NOTICE:

In the above chart, the terms "cold" and "hot" refer to the temperature of the sensor.

"Cold" means approximately -10 to 50°C (14 to 122°F).

"Hot" means approximately 50 to 100°C (122 to 212°F).

Component without harness connected:
(Crank Position Sensor)



NG → REPLACE CRANK POSITION SENSOR (Click here)

OK

3.CHECK HARNESS AND CONNECTOR (CRANK POSITION SENSOR - ECM)

a. Disconnect the CKP sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

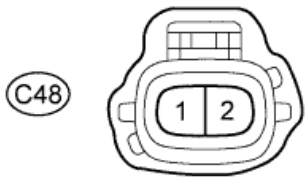
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C48-1 (NE+) - C45-110 (NE+)	Always	Below 1 Ω
C48-2 (NE-) - C45-111 (NE-)	Always	Below 1 Ω
C48-1 (NE+) or C45-110 (NE+) - Body ground	Always	10 kΩ or higher
C48-2 (NE-) or C45-111 (NE-) - Body ground	Always	10 kΩ or higher

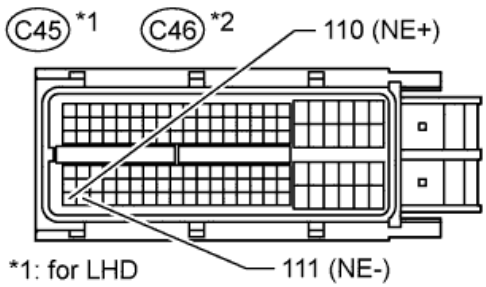
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C48-1 (NE+) - C46-110 (NE+)	Always	Below 1 Ω
C48-2 (NE-) - C46-111 (NE-)	Always	Below 1 Ω
C48-1 (NE+) or C46-110 (NE+) - Body ground	Always	10 kΩ or higher
C48-2 (NE-) or		

Front view of wire harness connector:
(to Crank Position Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

C46-111 (NE-) - Body ground	Always	10 kΩ or higher

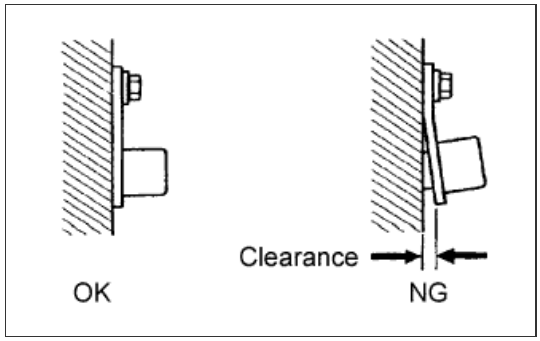
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.CHECK SENSOR INSTALLATION (CRANK POSITION SENSOR)

a. Check the CKP sensor installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

5.CHECK CRANKSHAFT POSITION SENSOR PLATE NO. 1 (TEETH OF SENSOR PLATE)

a. Check the teeth of the sensor plate.

OK:
Sensor plate does not have any cracks or deformation.

NG → REPLACE CRANKSHAFT POSITION SENSOR PLATE NO. 1

OK

6.REPLACE CRANKSHAFT POSITION SENSOR

a. Replace the crank position sensor (Click here).

NEXT

7.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P0335 or P0339 is output	B

HINT:

If the engine does not start, replace the ECM.

REPLACE ECM (Click here)

A

END

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

for Preparation Click here

DESCRIPTION

Refer to DTC P2195 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals AF+ and AF- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in Air Fuel Ratio (A/F) sensor (for bank 1, 2 sensor 1) circuit • Air Fuel Ratio (A/F) sensor (for bank 1, 2 sensor 1) • ECM
P2238 P2241	• Case 1: Condition (a) or (b) continues for 5.0 seconds or more (1 trip detection logic): (a) The AF+ voltage is 0.5 V or less. (b) (AF+) - (AF-) = 0.1 V or less. • Case 2: The A/F sensor admittance is less than 0.022 1/Ω (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2239 P2242	The AF+ voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2252 P2255	The AF- voltage is 0.5 V or less for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2253 P2256	The AF- voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM

HINT:

- **DTCs P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2241, P2242, P2255 and P2256 indicate malfunctions related to the bank 2 A/F sensor circuit.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that includes the No. 2 cylinder.**

MONITOR DESCRIPTION

These DTCs are output when there is an open or short in the A/F sensor circuit, or if the A/F sensor output drops.
To detect these problems, the voltage of the A/F sensor is monitored when turning the engine switch on (IG), and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is outside of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in the next driving cycle, the MIL is illuminated and a DTC is stored.
The Air-Fuel Ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. If the A/F sensor impedance (alternating current resistance) or output voltage deviates greatly from the standard range, the ECM determines that there is an open or short in the A/F sensor circuit.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/ F sensor.
(e) Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

HINT:

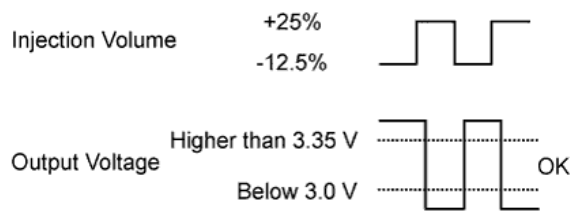
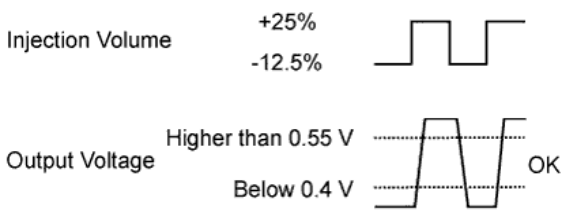
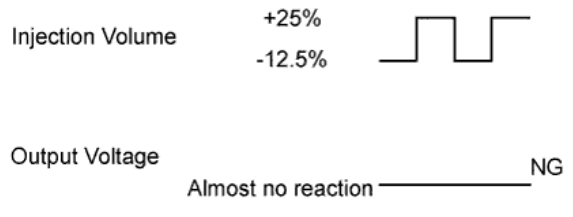
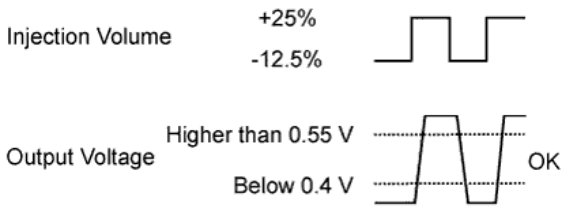
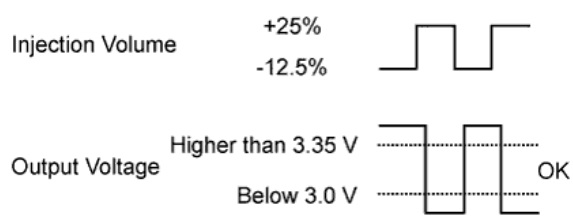
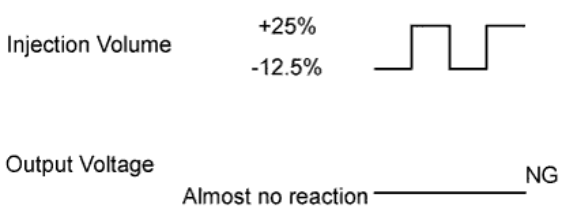
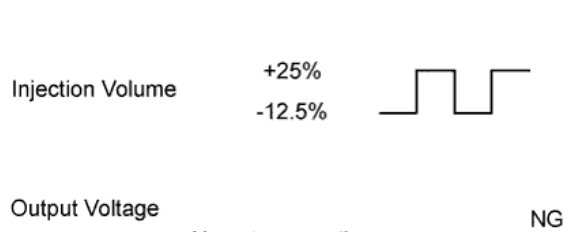
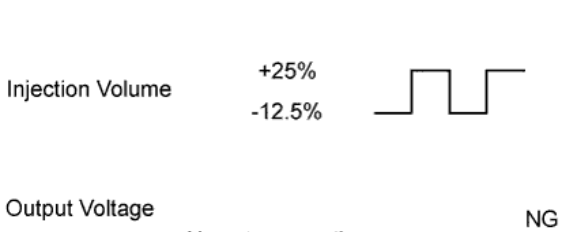
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.

To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

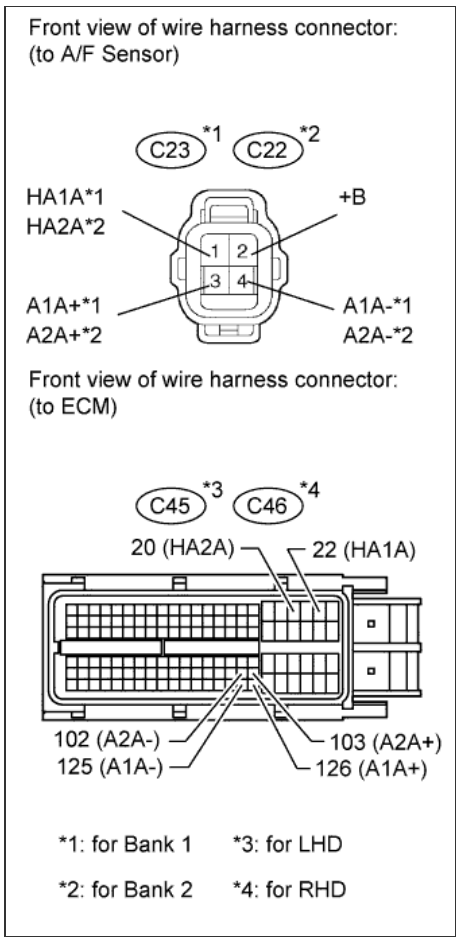
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.



e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

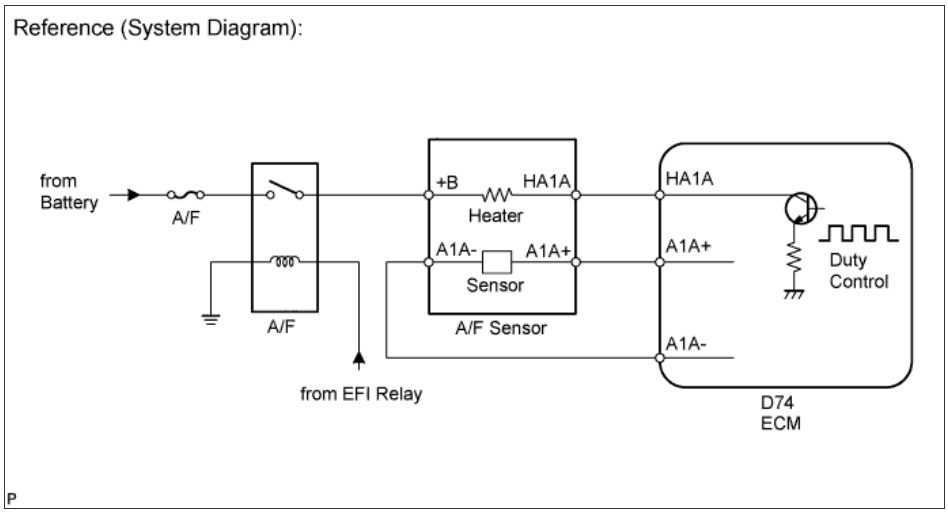
Tester Connection	Condition	Specified Condition

C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C46-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



P

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2237, P2238, P2239, P2240, P2241, P2242, P2252, P2253, P2255 or P2256 is output	B

B → REPLACE ECM (**Click here**)

A

END

DTC P0335 Crankshaft Position Sensor "A" Circuit

DTC P0339 Crankshaft Position Sensor "A" Circuit Intermittent

for Preparation Click here

DESCRIPTION

The Crank Position (CKP) sensor system consists of a CKP sensor plate and a pickup coil.
The sensor plate has 34 teeth and is installed on the crankshaft. The pickup coil is made of wound copper wire, an iron core and magnet. The sensor plate rotates and, as each tooth passes by the pickup coil, a pulse signal is created. The pickup coil generates 34 signals per revolution. Based on these signals, the ECM calculates the crankshaft position and engine speed. Using these calculations, the fuel injection time and ignition timing are controlled.

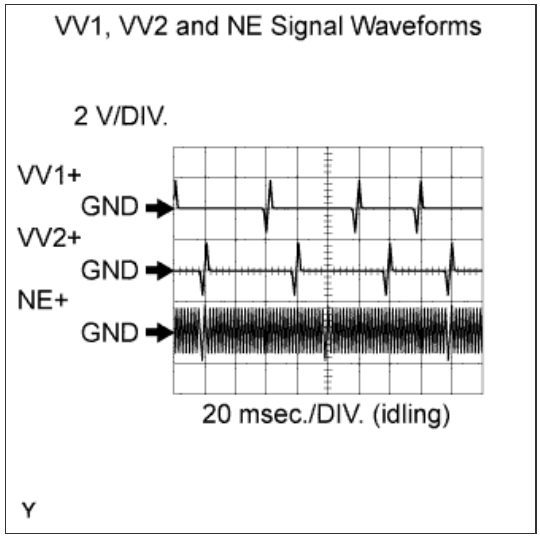
DTC Code	DTC Detection Condition	Trouble Area
P0335	When either condition below is met: • No CKP sensor signal is sent to the ECM while cranking (1 trip detection logic). • No CKP sensor signal is sent to the ECM at an engine speed of 450 rpm or more (1 trip detection logic).	• Open or short in CKP sensor circuit • CKP sensor • CKP sensor plate • ECM
P0339	Under conditions (a), (b) and (c), no CKP sensor signal is sent to the ECM for 0.05 seconds or more (1 trip detection logic): (a) An engine speed of 1000 rpm or more. (b) The starter signal is OFF. (c) 3 seconds or more have elapsed since the starter signal switched from ON to OFF.	• Open or short in CKP sensor circuit • CKP sensor • CKP sensor plate • ECM

Reference: Inspection using an oscilloscope.

HINT:

- **The correct waveform is as shown.**
- **VV1+ and VV2+ stand for the VVT sensor signal, and NE+ stands for the CKP sensor signal.**
- **Grounding failure of the shielded wire may cause noise in the waveforms.**

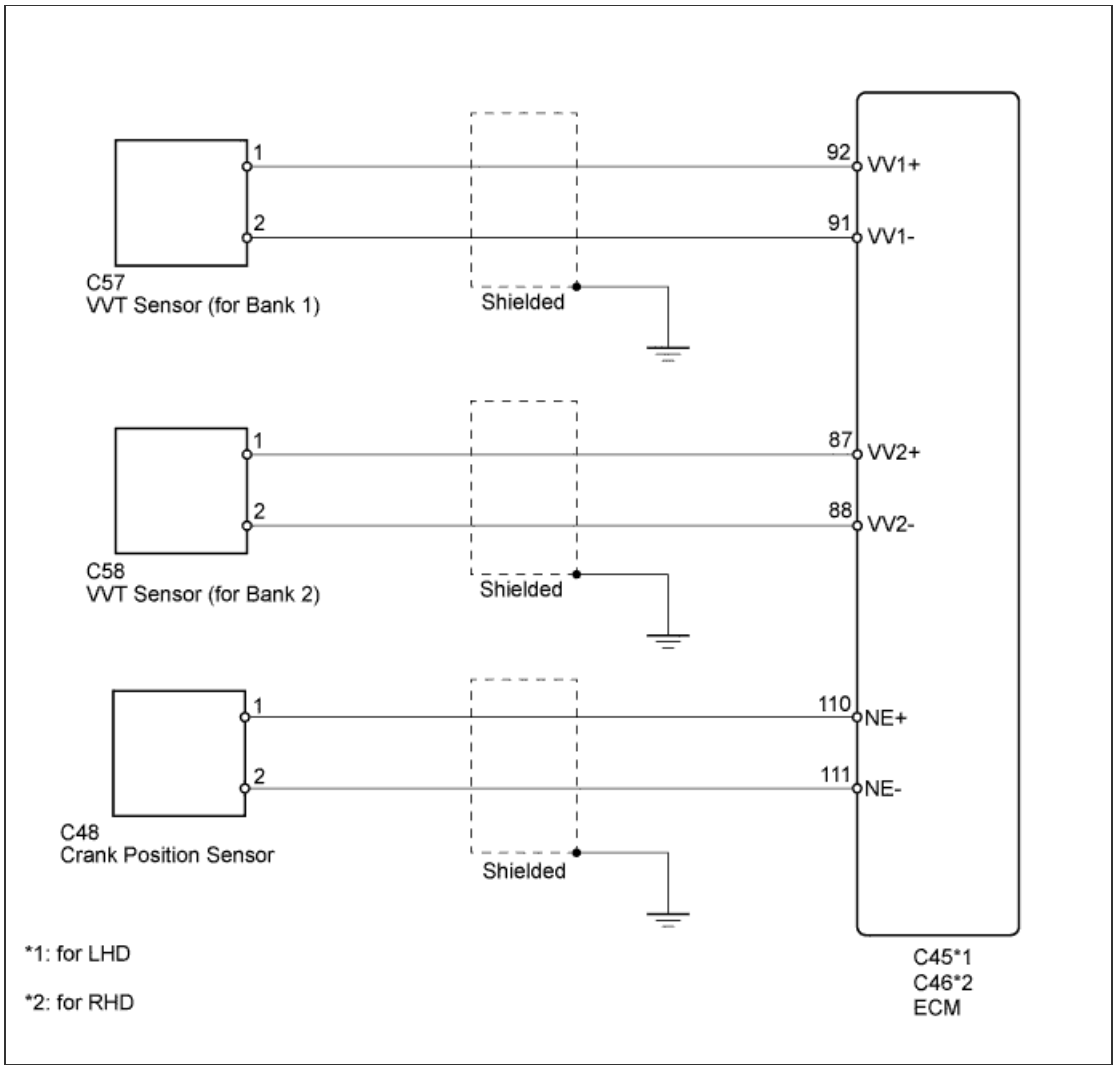
Item	Content
Terminal	VV1+ - VV1- VV2+ - VV2- NE+ - NE-
Equipment Setting	2 V/DIV., 20 msec./DIV.
Condition	Cranking or idling



MONITOR DESCRIPTION

If there is no signal from the CKP sensor despite the engine running, the ECM interprets this as a malfunction of the sensor.
If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **If no problem is found through this diagnostic troubleshooting procedure, troubleshoot the engine mechanical systems.**
- **Check the engine speed. The engine speed can be checked by using the intelligent tester. To check, follow the operation below:**
  1. **Connect the intelligent tester to the DLC3.**
  2. **Start the engine.**
  3. **Turn the tester on.**
  4. **Enter the following menus: Powertrain / Engine and ECT / Data List / Engine Speed.**
     The engine speed may be indicated as zero despite the engine running normally. This is caused by a lack of NE signals from the Crankshaft Position (CKP) sensor. Alternatively, the engine speed may be indicated as less than the actual engine speed if the CKP sensor output voltage is insufficient.
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (ENGINE SPD)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / Engine Speed.

e. Start the engine.

f. Read the values displayed on the tester while the engine is running.

Standard:
Correct values are displayed.

HINT:

- **To check the engine speed change, display the graph on the tester.**

- **If the engine does not start, check the engine speed while cranking.**
- **If the engine speed indicated on the tester remains at zero (0), there may be an open or short in the Crank Position (CKP) sensor circuit.**

NG → Go to step 2

OK

CHECK FOR INTERMITTENT PRO LEMS (Click here)

2.INSPECT CRANK POSITION SENSOR (RESISTANCE)

a. Disconnect the crank position (CKP) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	Cold	1630 to 2740 Ω
1 - 2	Hot	2065 to 3225 Ω

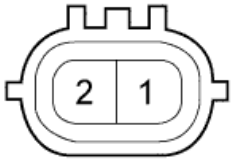
NOTICE:

In the above chart, the terms "cold" and "hot" refer to the temperature of the sensor.

"Cold" means approximately -10 to 50°C (14 to 122°F).

"Hot" means approximately 50 to 100°C (122 to 212°F).

Component without harness connected:
(Crank Position Sensor)



NG → REPLACE CRANK POSITION SENSOR (Click here)

OK

3.CHECK HARNESS AND CONNECTOR (CRANK POSITION SENSOR - ECM)

a. Disconnect the CKP sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

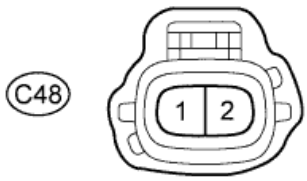
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C48-1 (NE+) - C45-110 (NE+)	Always	Below 1 Ω
C48-2 (NE-) - C45-111 (NE-)	Always	Below 1 Ω
C48-1 (NE+) or C45-110 (NE+) - Body ground	Always	10 kΩ or higher
C48-2 (NE-) or C45-111 (NE-) - Body ground	Always	10 kΩ or higher

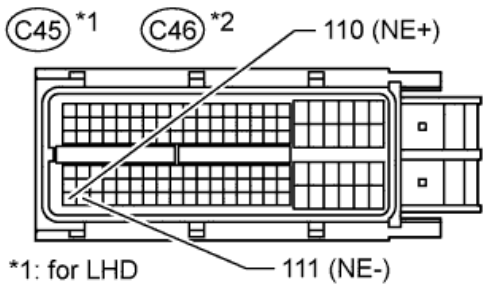
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C48-1 (NE+) - C46-110 (NE+)	Always	Below 1 Ω
C48-2 (NE-) - C46-111 (NE-)	Always	Below 1 Ω
C48-1 (NE+) or C46-110 (NE+) - Body ground	Always	10 kΩ or higher
C48-2 (NE-) or		

Front view of wire harness connector:
(to Crank Position Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

C46-111 (NE-) - Body ground	Always	10 kΩ or higher

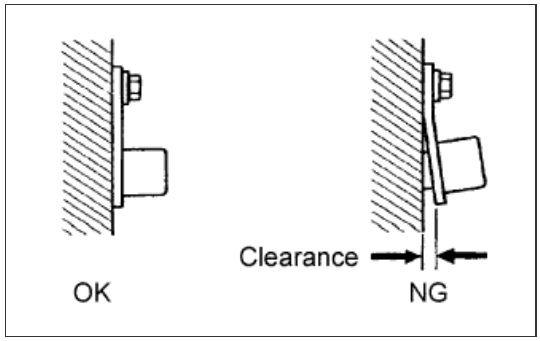
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.CHECK SENSOR INSTALLATION (CRANK POSITION SENSOR)

a. Check the CKP sensor installation.

OK:
Sensor is installed correctly.



NG → SECURELY REINSTALL SENSOR (Click here)

OK

5.CHECK CRANKSHAFT POSITION SENSOR PLATE NO. 1 (TEETH OF SENSOR PLATE)

a. Check the teeth of the sensor plate.

OK:
Sensor plate does not have any cracks or deformation.

NG → REPLACE CRANKSHAFT POSITION SENSOR PLATE NO. 1

OK

6.REPLACE CRANKSHAFT POSITION SENSOR

a. Replace the crank position sensor (Click here).

NEXT

7.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Clear DTCs (Click here).

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result

Result	Proceed to
No DTC is output	A
P0335 or P0339 is output	B

HINT:

If the engine does not start, replace the ECM.

REPLACE ECM (Click here)

A

END

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

for Preparation Click here

DESCRIPTION

Refer to DTC P2195 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals AF+ and AF- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in Air Fuel Ratio (A/F) sensor (for bank 1, 2 sensor 1) circuit • Air Fuel Ratio (A/F) sensor (for bank 1, 2 sensor 1) • ECM
P2238 P2241	• Case 1: Condition (a) or (b) continues for 5.0 seconds or more (1 trip detection logic): (a) The AF+ voltage is 0.5 V or less. (b) (AF+) - (AF-) = 0.1 V or less. • Case 2: The A/F sensor admittance is less than 0.022 1/Ω (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2239 P2242	The AF+ voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2252 P2255	The AF- voltage is 0.5 V or less for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2253 P2256	The AF- voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM

HINT:

- **DTCs P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2241, P2242, P2255 and P2256 indicate malfunctions related to the bank 2 A/F sensor circuit.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that includes the No. 2 cylinder.**

MONITOR DESCRIPTION

These DTCs are output when there is an open or short in the A/F sensor circuit, or if the A/F sensor output drops.
To detect these problems, the voltage of the A/F sensor is monitored when turning the engine switch on (IG), and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is outside of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in the next driving cycle, the MIL is illuminated and a DTC is stored.
The Air-Fuel Ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. If the A/F sensor impedance (alternating current resistance) or output voltage deviates greatly from the standard range, the ECM determines that there is an open or short in the A/F sensor circuit.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/ F sensor.
(e) Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

HINT:

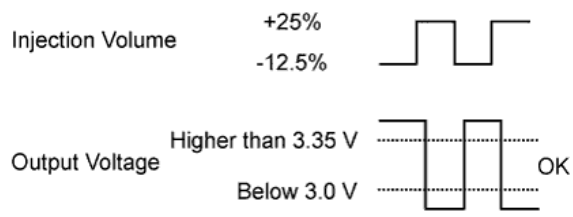
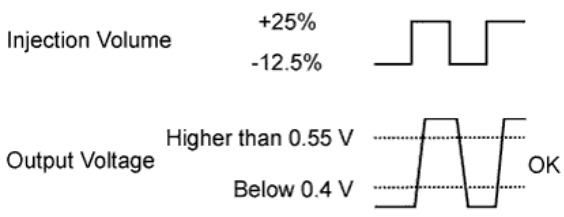
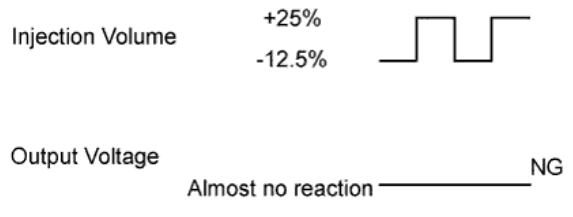
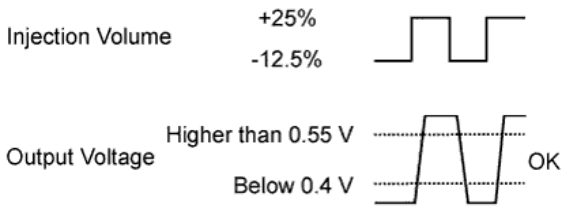
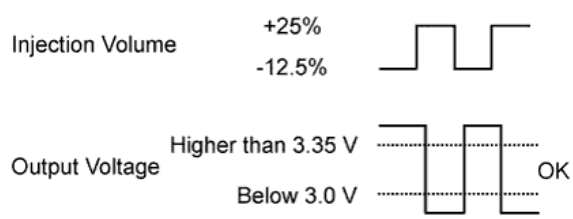
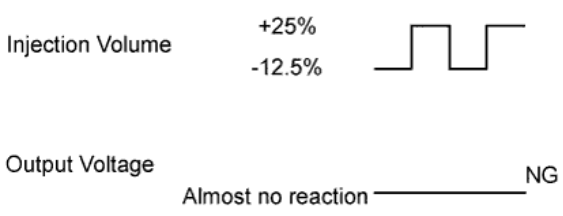
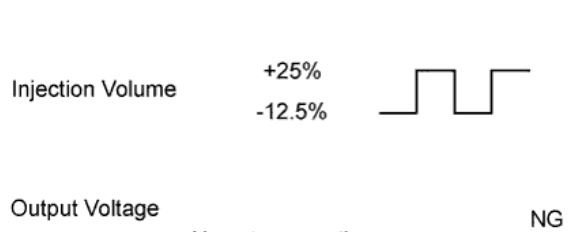
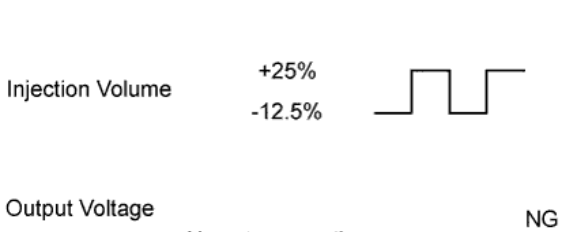
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.

To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

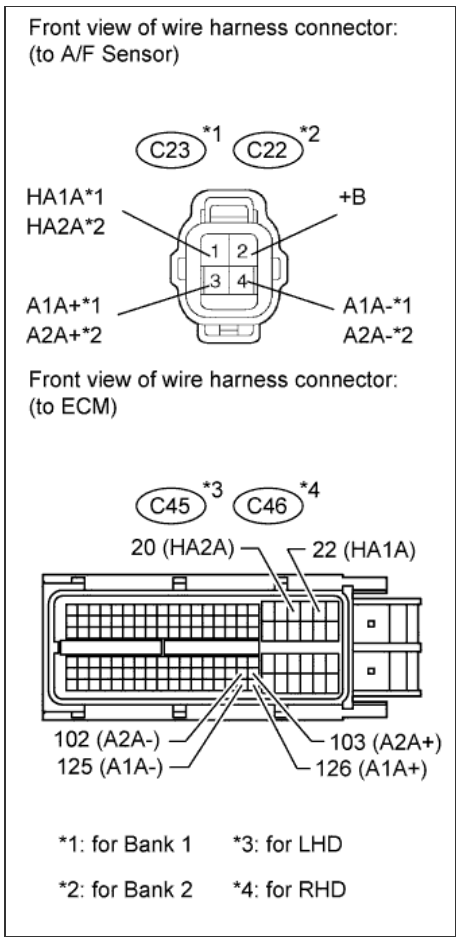
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.



e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

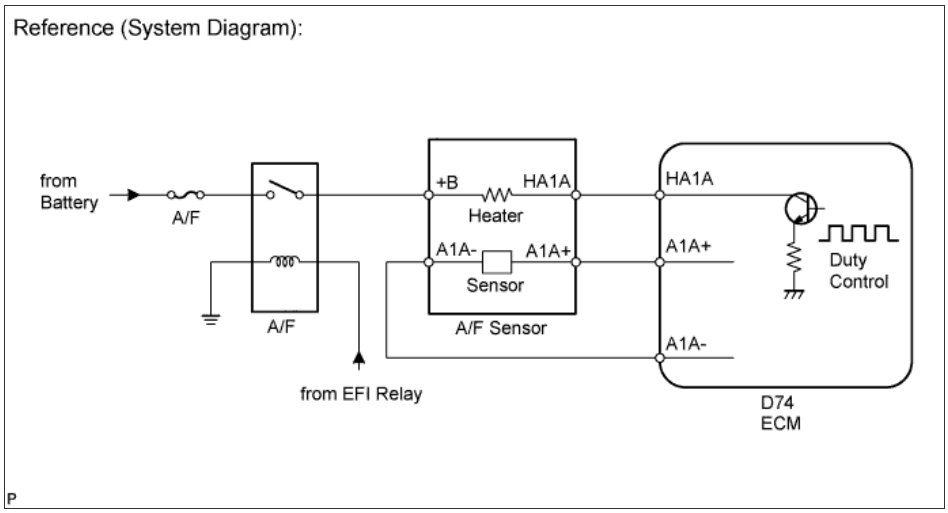
Tester Connection	Condition	Specified Condition

C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C46-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



P

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2237, P2238, P2239, P2240, P2241, P2242, P2252, P2253, P2255 or P2256 is output	B

B → REPLACE ECM (**Click here**)

A

END

DTC P0340 Camshaft Position Sensor Circuit Malfunction

DTC P0345 Camshaft Position Sensor "A" Circuit (Bank 2)

for Preparation Click here

DESCRIPTION

The Variable Valve Timing (VVT) sensor consists of a magnet, iron core and pickup coil. The VVT signal plate has 3 teeth on its outer circumference and is installed on the camshaft timing pulley. When the camshaft rotates, changes occur on the camshaft protrusions and the pickup coil air gaps. These changes cause fluctuations in the magnetic field and generate voltage in the pickup coil.
Each sensor monitors its timing rotor, which is located on the camshaft. The ECM uses the sensor to detect the camshaft angle. The camshaft rotation synchronizes with the crankshaft rotation, and this sensor communicates the rotation of the camshaft timing rotor as a pulse signal to the ECM. Based on the signal, the ECM controls the camshaft position.
The crankshaft angle sensor plate has 34 teeth. The pickup coil generates 34 signals for each revolution. Based on a combination of the VVT signal and NE signal, the ECM detects the crankshaft angle. Then the ECM uses this data to control fuel injection time and injection timing. Also, based on the NE signal, the ECM detects the engine speed.

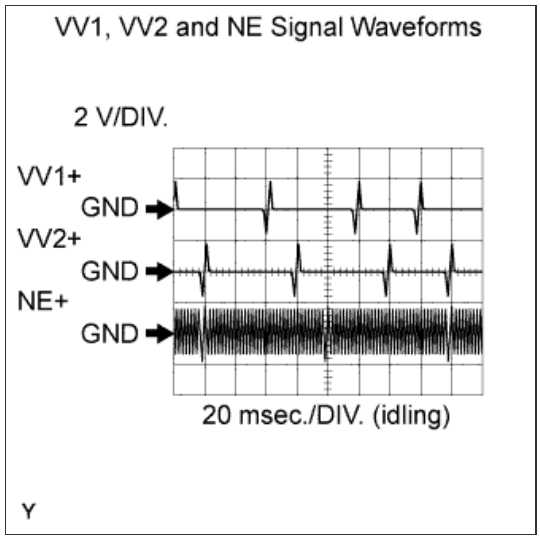
DTC Code	DTC Detection Condition	Trouble Area
P0340 P0345	When either condition below is met: • No VVT sensor signal is sent to the ECM during cranking (2 trip detection logic). • No VVT sensor signal is sent to the ECM with an engine speed of 600 rpm or more (1 trip detection logic).	• Open or short in VVT sensor circuit • VVT sensor • Intake camshaft • Timing belt has a jumped tooth • ECM

Reference: Inspection using an oscilloscope

HINT:

- **The correct waveform is as shown.**
- **VV1+ and VV2+ stand for the VVT sensor signal, and NE+ stands for the CKP sensor signal.**

Item	Content
Terminal	NE+ - NE- VV1+ - VV1- VV2+ - VV2-
Equipment Setting	2 V/DIV. 20 msec./DIV.
Condition	Cranking or idling



MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine running, the ECM interprets this as a malfunction of the sensor.

WIRING DIAGRAM

Refer to DTC P0335 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT VVT SENSOR (RESISTANCE)

a. Disconnect the VVT sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	Cold	835 to 1400 Ω
1 - 2	Hot	1060 to 1645 Ω

NOTICE:

In the above chart, the terms cold and hot refer to the temperature of the coils.

Cold means appro imately -10 to 50°C (14 to 122°F).

ot means appro imately 50 to 100 C (122 to 212°F).

Component without harness connected:
(VVT Sensor)



N → REP ACE VVT SENSOR (Click here)

OK

2.CHECK HARNESS AND CONNECTOR (VVT SENSOR - ECM)

a. Disconnect the VVT sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

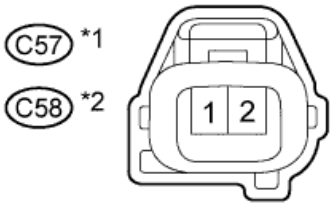
Standard Resistance (for HD):

Tester Connection	Condition	Specified Condition
C57-1 - C45- 2 (VV1+)	Always	Below 1 Ω
C57-2 - C45- 1 (VV1-)	Always	Below 1 Ω
C58-1 - C45-87 (VV2+)	Always	Below 1 Ω
C58-2 - C45-88 (VV2-)	Always	Below 1 Ω
C57-1 or C45- 2 (VV1+) - Body ground	Always	10 kΩ or higher
C57-2 or C45- 1 (VV1-) - Body ground	Always	10 kΩ or higher
C58-1 or C45-87 (VV2+) - Body ground	Always	10 kΩ or higher
C58-2 or C45-88 (VV2-) - Body ground	Always	10 kΩ or higher

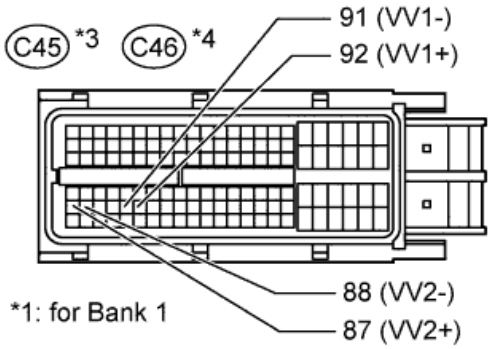
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C57-1 - C46- 2 (VV1+)	Always	Below 1 Ω
C57-2 - C46- 1 (VV1-)	Always	Below 1 Ω
C58-1 - C46-87 (VV2+)	Always	Below 1 Ω
C58-2 - C46-88 (VV2-)	Always	Below 1 Ω

Front view of wire harness connector:
(to VVT Sensor)



Front view of wire harness connector:
(to ECM)



*1: for Bank 1

*2: for Bank 2

*3: for LHD

*4: for RHD

C57-1 or C46- 2 (VV1+) - Body ground	Always	10 kΩ or higher
C57-2 or C46- 1 (VV1-) - Body ground	Always	10 kΩ or higher
C58-1 or C46-87 (VV2+) - Body ground	Always	10 kΩ or higher
C58-2 or C46-88 (VV2-) - Body ground	Always	10 kΩ or higher

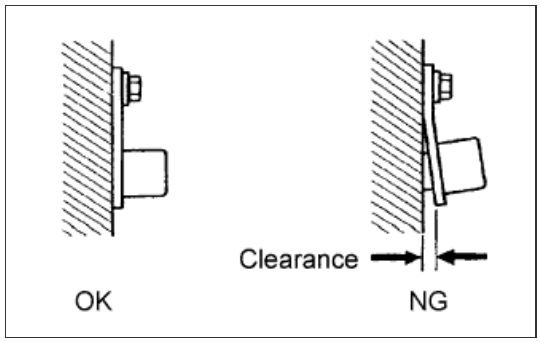
N → REPAIR OR REP ACE HARNESS OR CONNECTOR

OK

3.CHECK SENSOR INSTA ATION (VVT SENSOR)

a. Check the VVT sensor installation.

OK:
Sensor is installed correctly.



N → SEC RE REINSTA SENSOR (Click here)

OK

4.CHECK INTAKE CAMSHAFT (TEETH)

a. Remove the cylinder head cover (Click here).

b. Check the teeth of the intake camshaft.

OK:
The intake camshaft does not have any cracks or deformation.

N → REP ACE INTAKE CAMSHAFT (Click here)

OK

5.REPLACE VVT SENSOR

a. Replace the VVT sensor (Click here).

NEXT

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the D C3.

b. Turn the engine switch on (I).

c. Turn the tester on.

d. Clear DTCs.

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result:

Result	Proceed to
No DTC is output	A
P0340 or P0345 is output	B

HINT:

If the engine does not start, replace the ECM.

B → REP ACE ECM (Click here)

A → END

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

for Preparation Click here

DESCRIPTION

Refer to DTC P2195 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals AF+ and AF- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in Air Fuel Ratio (A/F) sensor (for bank 1, 2 sensor 1) circuit • Air Fuel Ratio (A/F) sensor (for bank 1, 2 sensor 1) • ECM
P2238 P2241	• Case 1: Condition (a) or (b) continues for 5.0 seconds or more (1 trip detection logic): (a) The AF+ voltage is 0.5 V or less. (b) (AF+) - (AF-) = 0.1 V or less. • Case 2: The A/F sensor admittance is less than 0.022 1/Ω (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2239 P2242	The AF+ voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2252 P2255	The AF- voltage is 0.5 V or less for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2253 P2256	The AF- voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM

HINT:

- **DTCs P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2241, P2242, P2255 and P2256 indicate malfunctions related to the bank 2 A/F sensor circuit.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that includes the No. 2 cylinder.**

MONITOR DESCRIPTION

These DTCs are output when there is an open or short in the A/F sensor circuit, or if the A/F sensor output drops.
To detect these problems, the voltage of the A/F sensor is monitored when turning the engine switch on (IG), and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is outside of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in the next driving cycle, the MIL is illuminated and a DTC is stored.
The Air-Fuel Ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. If the A/F sensor impedance (alternating current resistance) or output voltage deviates greatly from the standard range, the ECM determines that there is an open or short in the A/F sensor circuit.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/ F sensor.
(e) Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

HINT:

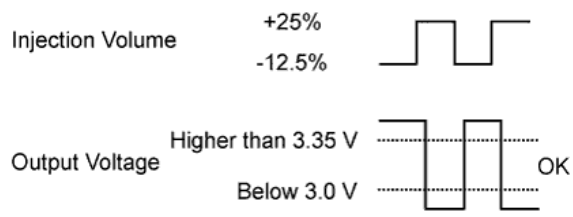
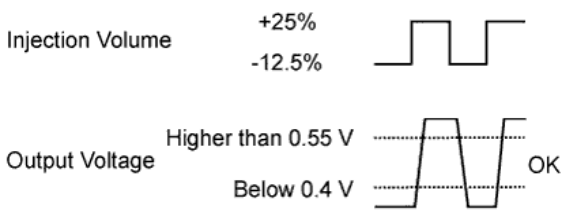
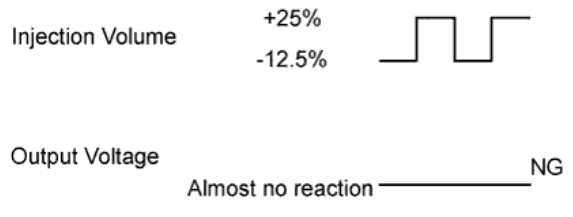
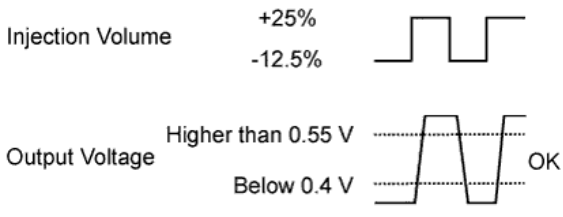
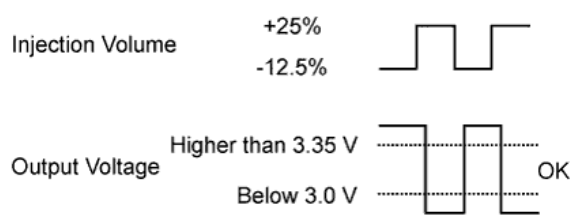
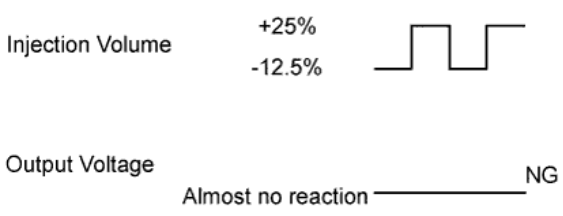
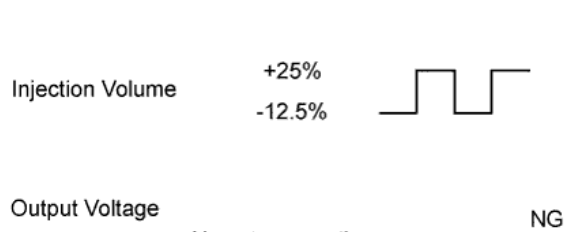
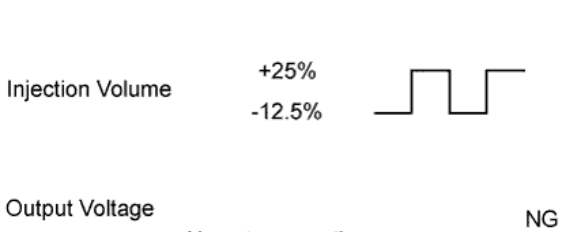
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.

To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

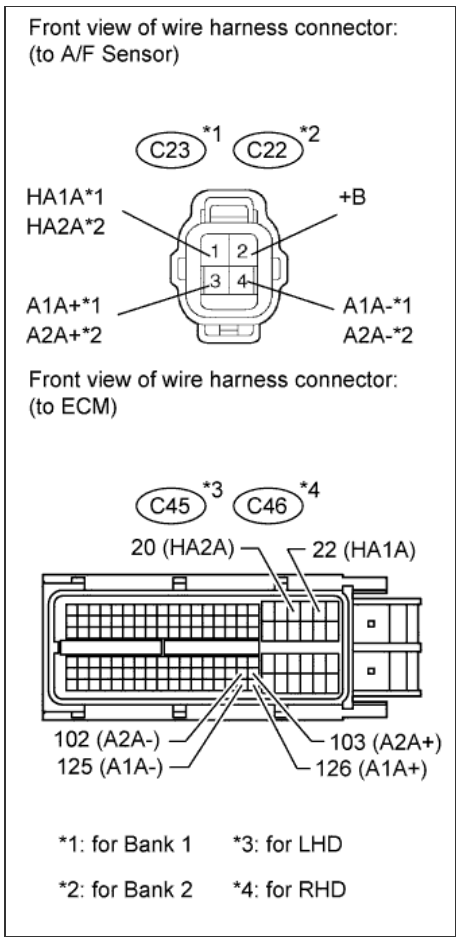
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.



e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

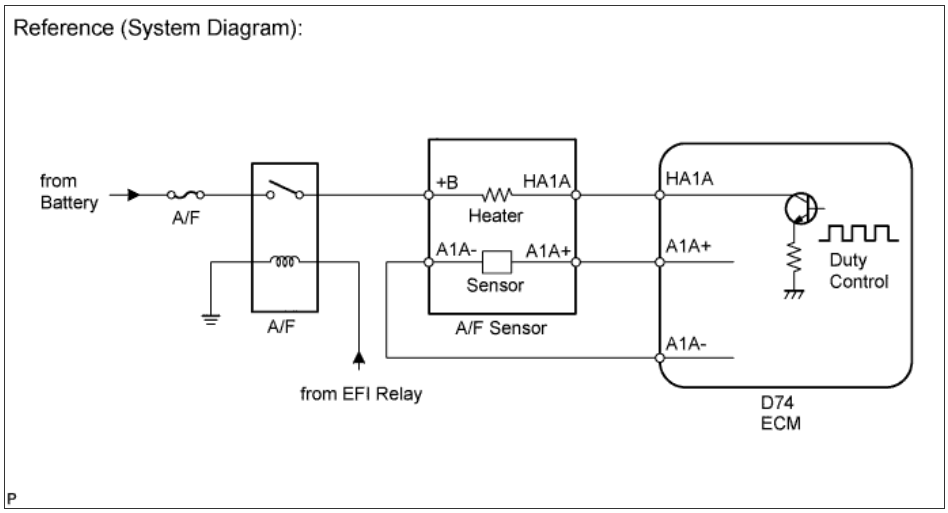
Tester Connection	Condition	Specified Condition

C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C46-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



P

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2237, P2238, P2239, P2240, P2241, P2242, P2252, P2253, P2255 or P2256 is output	B

B → REPLACE ECM (**Click here**)

A

END

DTC P0340 Camshaft Position Sensor Circuit Malfunction

DTC P0345 Camshaft Position Sensor "A" Circuit (Bank 2)

for Preparation Click here

DESCRIPTION

The Variable Valve Timing (VVT) sensor consists of a magnet, iron core and pickup coil. The VVT signal plate has 3 teeth on its outer circumference and is installed on the camshaft timing pulley. When the camshaft rotates, changes occur on the camshaft protrusions and the pickup coil air gaps. These changes cause fluctuations in the magnetic field and generate voltage in the pickup coil.
Each sensor monitors its timing rotor, which is located on the camshaft. The ECM uses the sensor to detect the camshaft angle. The camshaft rotation synchronizes with the crankshaft rotation, and this sensor communicates the rotation of the camshaft timing rotor as a pulse signal to the ECM. Based on the signal, the ECM controls the camshaft position.
The crankshaft angle sensor plate has 34 teeth. The pickup coil generates 34 signals for each revolution. Based on a combination of the VVT signal and NE signal, the ECM detects the crankshaft angle. Then the ECM uses this data to control fuel injection time and injection timing. Also, based on the NE signal, the ECM detects the engine speed.

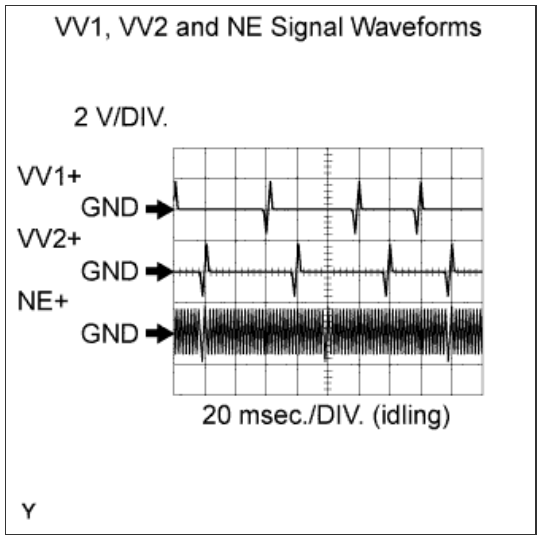
DTC Code	DTC Detection Condition	Trouble Area
P0340 P0345	When either condition below is met: • No VVT sensor signal is sent to the ECM during cranking (2 trip detection logic). • No VVT sensor signal is sent to the ECM with an engine speed of 600 rpm or more (1 trip detection logic).	• Open or short in VVT sensor circuit • VVT sensor • Intake camshaft • Timing belt has a jumped tooth • ECM

Reference: Inspection using an oscilloscope

HINT:

- **The correct waveform is as shown.**
- **VV1+ and VV2+ stand for the VVT sensor signal, and NE+ stands for the CKP sensor signal.**

Item	Content
Terminal	NE+ - NE- VV1+ - VV1- VV2+ - VV2-
Equipment Setting	2 V/DIV. 20 msec./DIV.
Condition	Cranking or idling



MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine running, the ECM interprets this as a malfunction of the sensor.

WIRING DIAGRAM

Refer to DTC P0335 (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT VVT SENSOR (RESISTANCE)

a. Disconnect the VVT sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	Cold	835 to 1400 Ω
1 - 2	Hot	1060 to 1645 Ω

NOTICE:

In the above chart, the terms cold and hot refer to the temperature of the coils.

Cold means appro imately -10 to 50°C (14 to 122°F).

ot means appro imately 50 to 100 C (122 to 212°F).

Component without harness connected:
(VVT Sensor)



N → REP ACE VVT SENSOR (Click here)

OK

2.CHECK HARNESS AND CONNECTOR (VVT SENSOR - ECM)

a. Disconnect the VVT sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

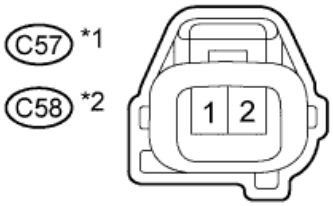
Standard Resistance (for HD):

Tester Connection	Condition	Specified Condition
C57-1 - C45- 2 (VV1+)	Always	Below 1 Ω
C57-2 - C45- 1 (VV1-)	Always	Below 1 Ω
C58-1 - C45-87 (VV2+)	Always	Below 1 Ω
C58-2 - C45-88 (VV2-)	Always	Below 1 Ω
C57-1 or C45- 2 (VV1+) - Body ground	Always	10 kΩ or higher
C57-2 or C45- 1 (VV1-) - Body ground	Always	10 kΩ or higher
C58-1 or C45-87 (VV2+) - Body ground	Always	10 kΩ or higher
C58-2 or C45-88 (VV2-) - Body ground	Always	10 kΩ or higher

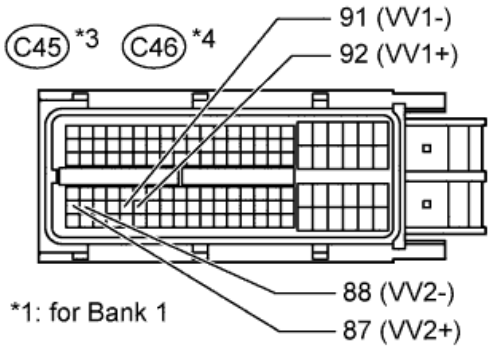
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C57-1 - C46- 2 (VV1+)	Always	Below 1 Ω
C57-2 - C46- 1 (VV1-)	Always	Below 1 Ω
C58-1 - C46-87 (VV2+)	Always	Below 1 Ω
C58-2 - C46-88 (VV2-)	Always	Below 1 Ω

Front view of wire harness connector:
(to VVT Sensor)



Front view of wire harness connector:
(to ECM)



*1: for Bank 1

*2: for Bank 2

*3: for LHD

*4: for RHD

C57-1 or C46- 2 (VV1+) - Body ground	Always	10 kΩ or higher
C57-2 or C46- 1 (VV1-) - Body ground	Always	10 kΩ or higher
C58-1 or C46-87 (VV2+) - Body ground	Always	10 kΩ or higher
C58-2 or C46-88 (VV2-) - Body ground	Always	10 kΩ or higher

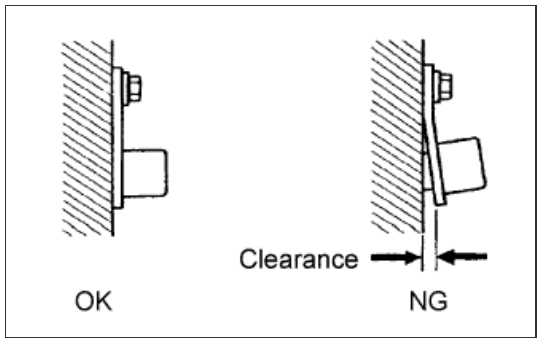
N → REPAIR OR REP ACE HARNESS OR CONNECTOR

OK

3.CHECK SENSOR INSTA ATION (VVT SENSOR)

a. Check the VVT sensor installation.

OK:
Sensor is installed correctly.



N → SEC RE REINSTA SENSOR (Click here)

OK

4.CHECK INTAKE CAMSHAFT (TEETH)

a. Remove the cylinder head cover (Click here).

b. Check the teeth of the intake camshaft.

OK:
The intake camshaft does not have any cracks or deformation.

N → REP ACE INTAKE CAMSHAFT (Click here)

OK

5.REPLACE VVT SENSOR

a. Replace the VVT sensor (Click here).

NEXT

6.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the D C3.

b. Turn the engine switch on (I).

c. Turn the tester on.

d. Clear DTCs.

e. Start the engine.

f. Enter the following menus: Powertrain / Engine and ECT / DTC.

g. Read DTCs.

Result:

Result	Proceed to
No DTC is output	A
P0340 or P0345 is output	B

HINT:

If the engine does not start, replace the ECM.

B → REP ACE ECM (Click here)

A → END

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

for Preparation Click here

DESCRIPTION

Refer to DTC P2195 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals AF+ and AF- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in Air Fuel Ratio (A/F) sensor (for bank 1, 2 sensor 1) circuit • Air Fuel Ratio (A/F) sensor (for bank 1, 2 sensor 1) • ECM
P2238 P2241	• Case 1: Condition (a) or (b) continues for 5.0 seconds or more (1 trip detection logic): (a) The AF+ voltage is 0.5 V or less. (b) (AF+) - (AF-) = 0.1 V or less. • Case 2: The A/F sensor admittance is less than 0.022 1/Ω (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2239 P2242	The AF+ voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2252 P2255	The AF- voltage is 0.5 V or less for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2253 P2256	The AF- voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM

HINT:

- **DTCs P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2241, P2242, P2255 and P2256 indicate malfunctions related to the bank 2 A/F sensor circuit.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that includes the No. 2 cylinder.**

MONITOR DESCRIPTION

These DTCs are output when there is an open or short in the A/F sensor circuit, or if the A/F sensor output drops.
To detect these problems, the voltage of the A/F sensor is monitored when turning the engine switch on (IG), and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is outside of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in the next driving cycle, the MIL is illuminated and a DTC is stored.
The Air-Fuel Ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. If the A/F sensor impedance (alternating current resistance) or output voltage deviates greatly from the standard range, the ECM determines that there is an open or short in the A/F sensor circuit.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/ F sensor.
(e) Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

HINT:

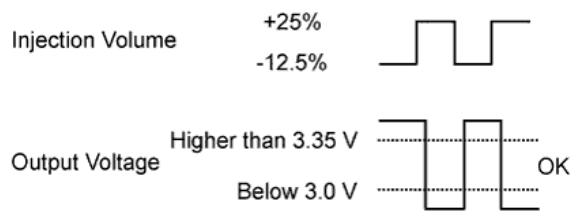
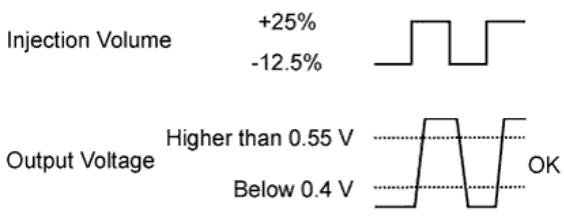
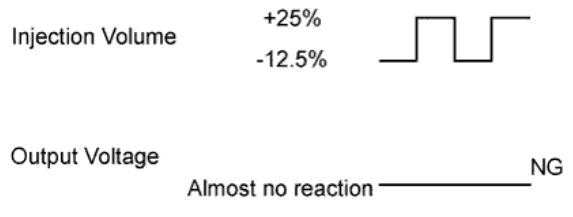
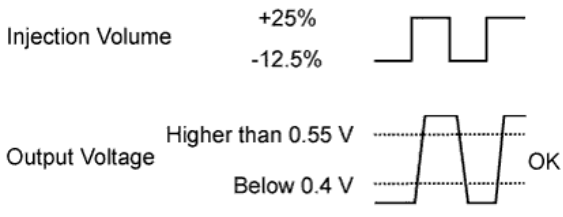
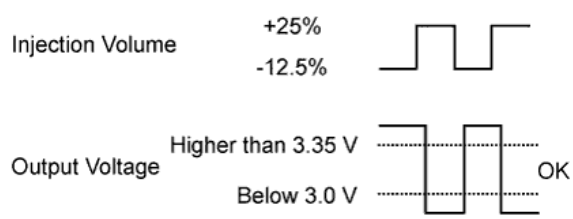
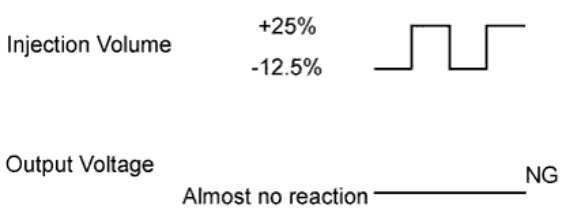
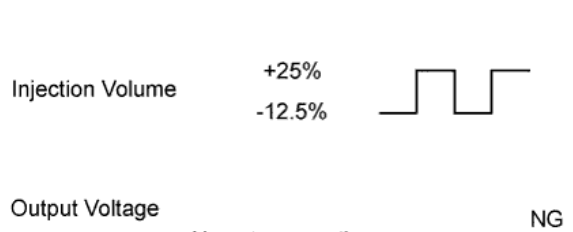
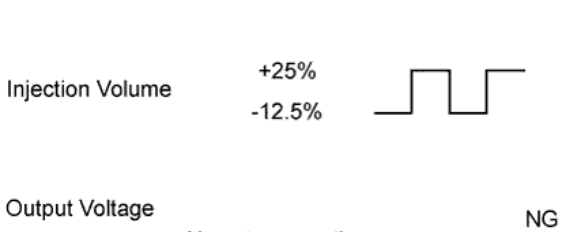
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.

To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

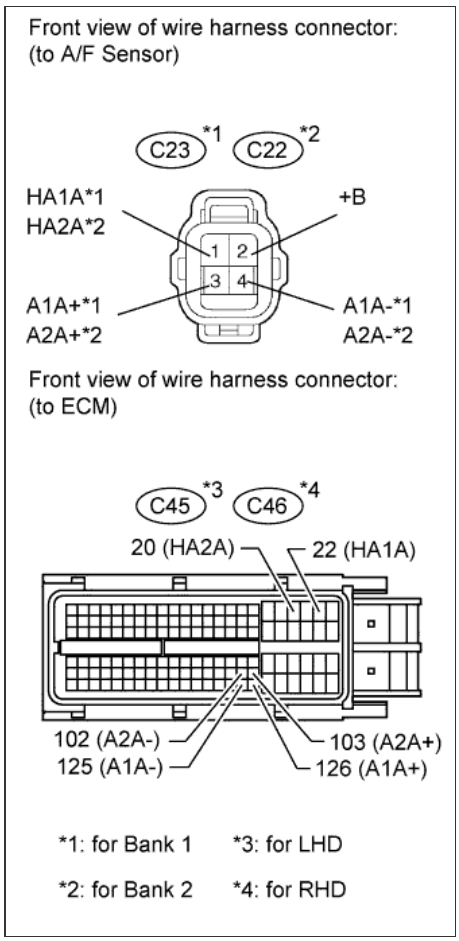
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.



e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

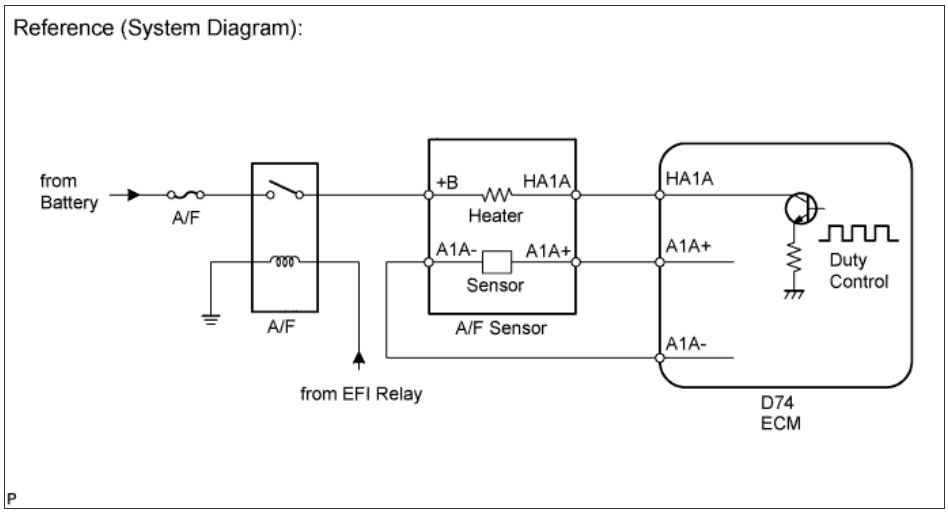
Tester Connection	Condition	Specified Condition

C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C46-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



P

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2237, P2238, P2239, P2240, P2241, P2242, P2252, P2253, P2255 or P2256 is output	B

B → REPLACE ECM (**Click here**)

A

END

DTC P0351 Ignition Coil "A" Primary / Secondary Circuit

DTC P0352 Ignition Coil "B" Primary / Secondary Circuit

DTC P0353 Ignition Coil "C" Primary / Secondary Circuit

DTC P0354 Ignition Coil "D" Primary / Secondary Circuit

DTC P0355 Ignition Coil "E" Primary / Secondary Circuit

DTC P0356 Ignition Coil "F" Primary / Secondary Circuit

DTC P0357 Ignition Coil "G" Primary / Secondary Circuit

DTC P0358 Ignition Coil "H" Primary / Secondary Circuit

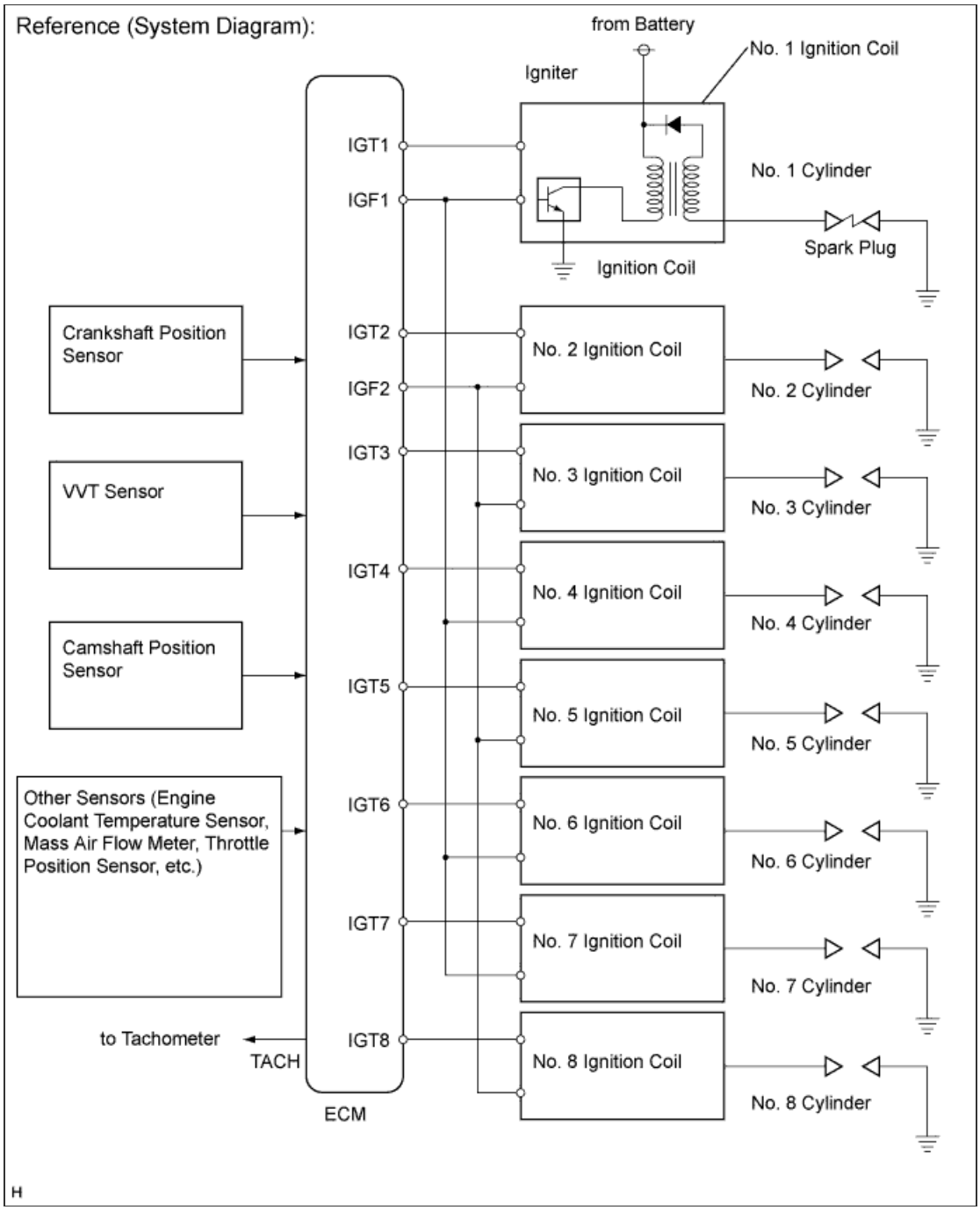
for Preparation Click here

DESCRIPTION

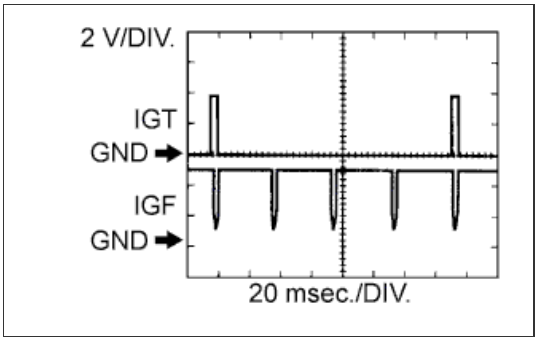
HINT:

- **These DTCs indicate malfunctions relating to the primary circuit.**
- **If DTC P0351 is output, check the No. 1 ignition coil circuit.**
- **If DTC P0352 is output, check the No. 2 ignition coil circuit.**
- **If DTC P0353 is output, check the No. 3 ignition coil circuit.**
- **If DTC P0354 is output, check the No. 4 ignition coil circuit.**
- **If DTC P0355 is output, check the No. 5 ignition coil circuit.**
- **If DTC P0356 is output, check the No. 6 ignition coil circuit.**
- **If DTC P0357 is output, check the No. 7 ignition coil circuit.**
- **If DTC P0358 is output, check the No. 8 ignition coil circuit.**

A Direct Ignition System (DIS) is used on this vehicle.
The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.
The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.



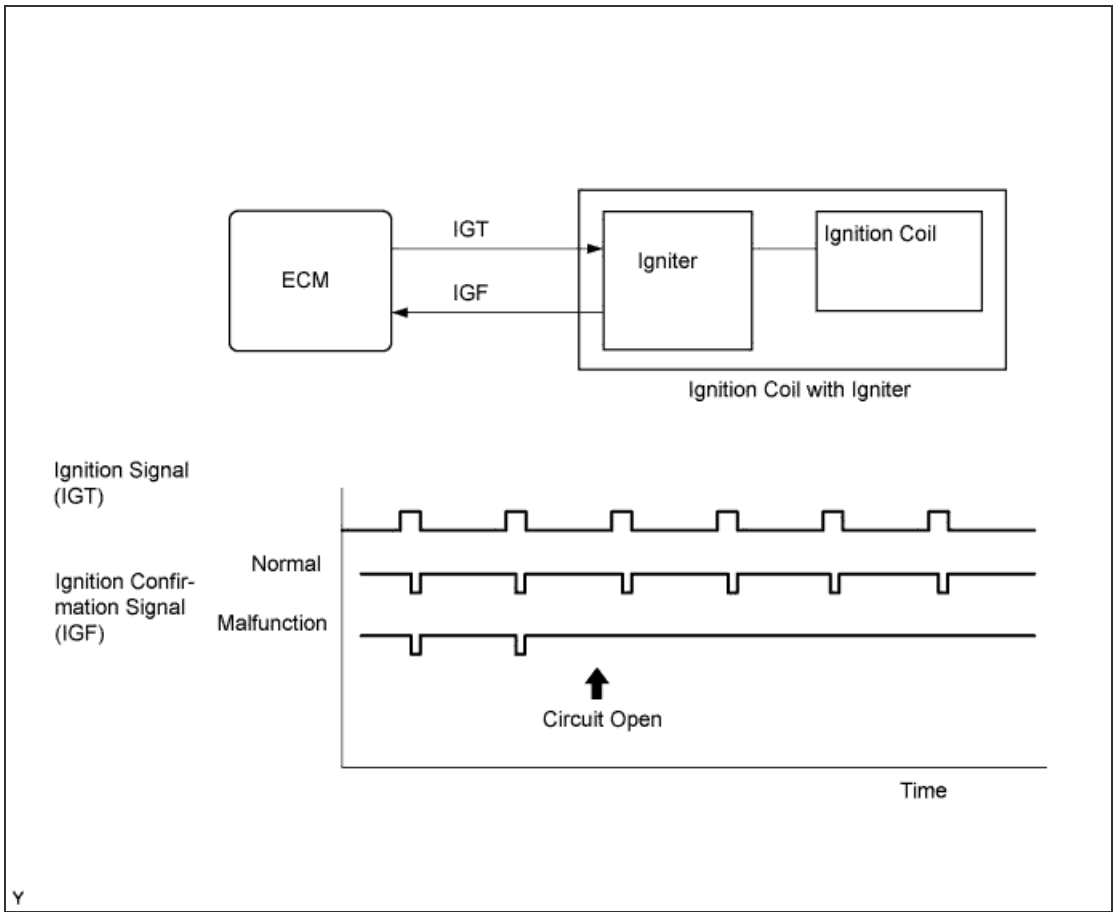
DTC Code	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356 P0357 P0358	No IGF signal is sent to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 8) between ignition coil and ECM • No. 1 to No. 8 ignition coils • ECM



Reference: Inspection using an oscilloscope.
While cranking or idling the engine, check the waveform between terminals IGT (1 to 8) and E1, and IGF1 or IGF2 and E1 of the ECM connector.

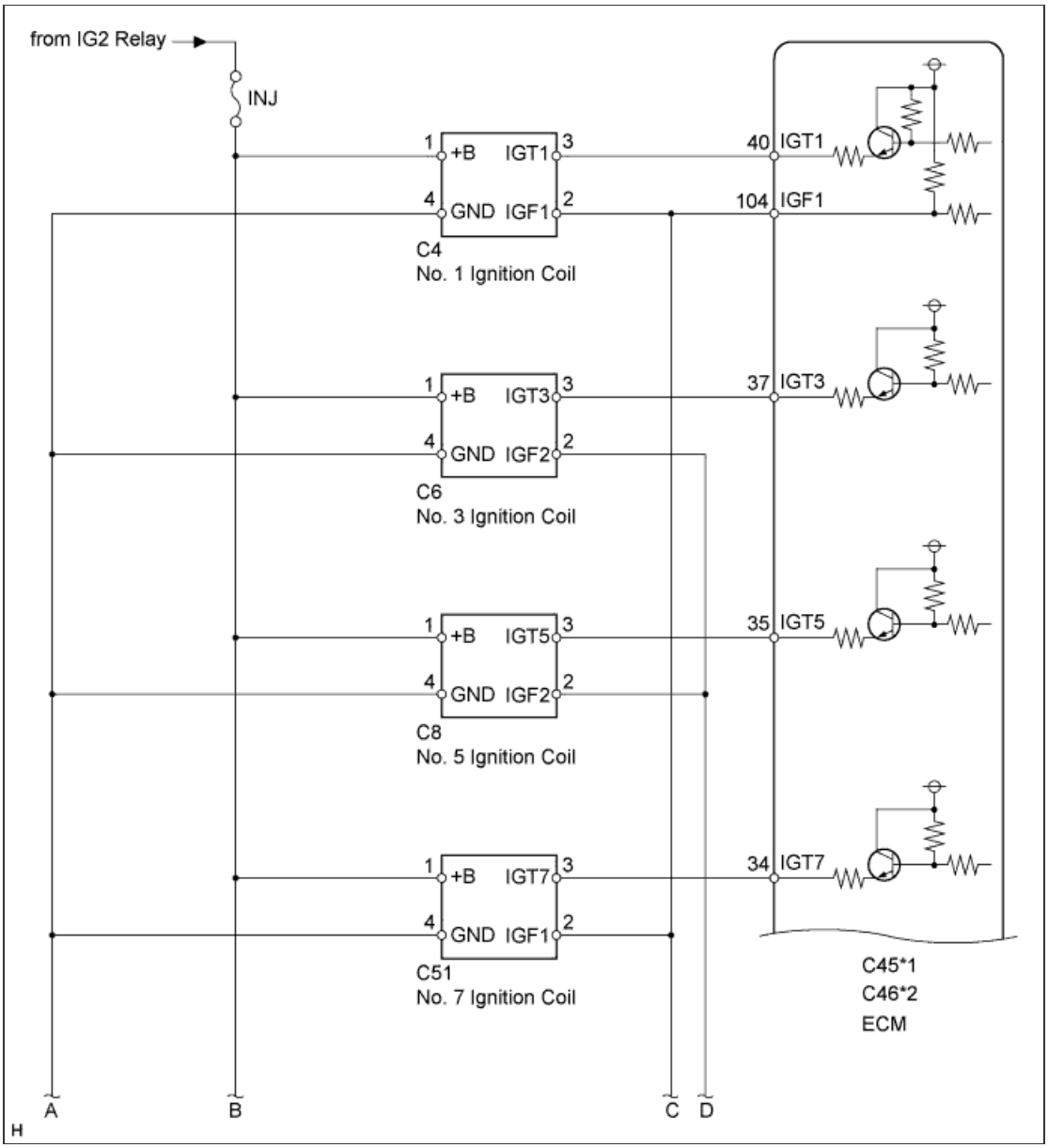
Item	Content
Terminal	CH1: IGT1, IGT2, IGT3, IGT4, IGT5, IGT6, IGT7, IGT8 - E1 CH2: IGF1, IGF2 - E1
Equipment Setting	2 V/DIV. 20 msec./DIV.
Condition	Cranking or idling

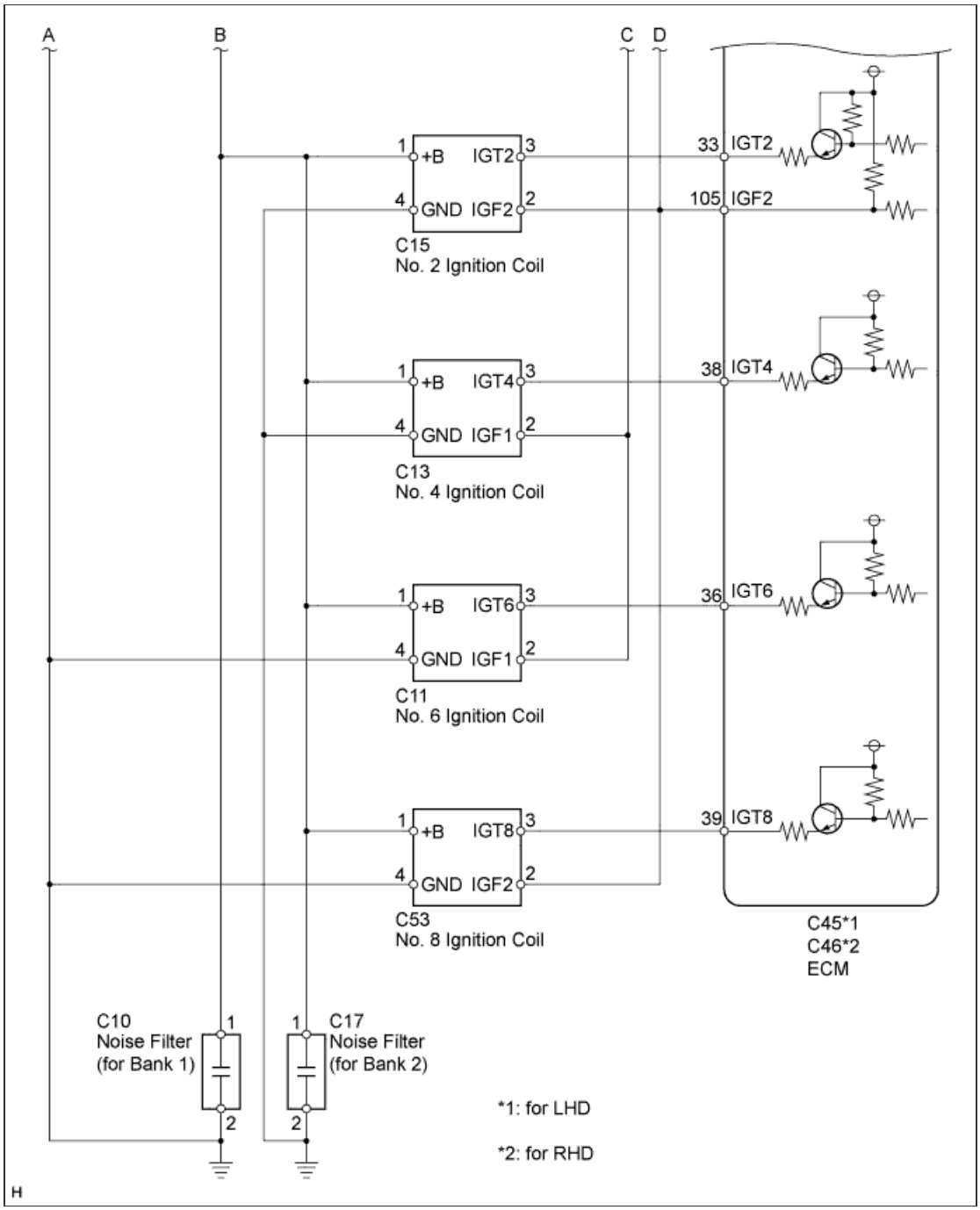
MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

WIRING DIAGRAM


from IG2 Relay
INJ
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
34
IGT7
C45*1
C46*2
ECM
A
B
C
D
H



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)

a. Disconnect the No. 1 to No. 8 ignition coil connectors.

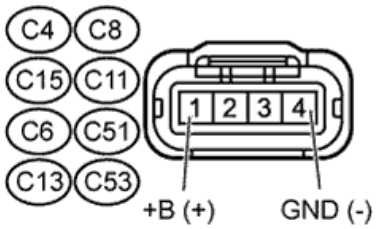
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C4-4 (GND) - Body ground	Always	Below 1 Ω
C15-4 (GND) - Body ground	Always	Below 1 Ω
C6-4 (GND) - Body ground	Always	Below 1 Ω

C13-4 (GND) - Body ground	Always	Below 1 Ω
C8-4 (GND) - Body ground	Always	Below 1 Ω
C11-4 (GND) - Body ground	Always	Below 1 Ω
C51-4 (GND) - Body ground	Always	Below 1 Ω
C53-4 (GND) - Body ground	Always	Below 1 Ω

Front view of wire harness connector:
(to Ignition Coil with Igniter)



c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C4-1 ( ) - C4-4 (GND)	Engine switch on (IG)	11 to 14 V
C15-1 ( ) - C15-4 (GND)	Engine switch on (IG)	11 to 14 V
C6-1 ( ) - C6-4 (GND)	Engine switch on (IG)	11 to 14 V
C13-1 ( ) - C13-4 (GND)	Engine switch on (IG)	11 to 14 V
C8-1 ( ) - C8-4 (GND)	Engine switch on (IG)	11 to 14 V
C11-1 ( ) - C11-4 (GND)	Engine switch on (IG)	11 to 14 V
C51-1 ( ) - C51-4 (GND)	Engine switch on (IG)	11 to 14 V
C53-1 ( ) - C53-4 (GND)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

a. Disconnect the No. 1 to No. 8 ignition coil connectors.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

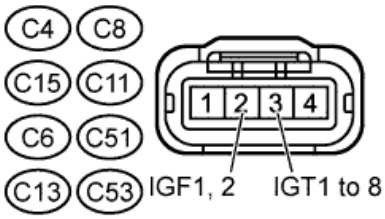
Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C15-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C45-40 (IGT1)	Always	Below 1 Ω

C15-3 (IGT2) - C45-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C45-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C45-38 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C45-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C45-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C45-34 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C45-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C45-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C45-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C45-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C45-38 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C45-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C45-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C45-34 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C45-39 (IGT8) - Body ground	Always	10 kΩ or higher

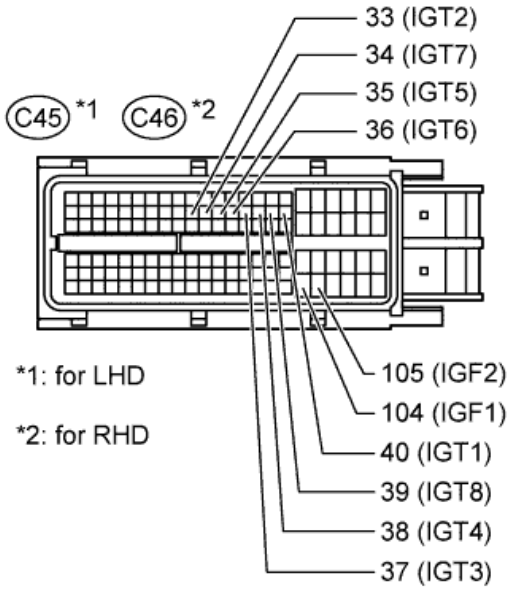
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω

Front view of wire harness connector:
(to Ignition Coil with Igniter)



Front view of wire harness connector:
(to ECM)



C15-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C46-40 (IGT1)	Always	Below 1 Ω
C15-3 (IGT2) - C46-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C46-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C46-38 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C46-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C46-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C46-34 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C46-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C46-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C46-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C46-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C46-38 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or		

C46-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C46-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C46-34 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C46-39 (IGT8) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353, P0354, P0355, P0356, P0357 OR P0358)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Shuffle arrangement of the ignition coils with igniters (among No. 1 to No. 8 cylinders).

NOTICE:

Do not shuffle the connectors.

e. Perform a simulation test.

f. Check the DTCs displayed on the tester.

Result

Result	Proceed to
Same DTC is output	A
Different ignition coil DTC is output	B

B → REPLACE IGNITION COIL ASSEMBLY (Click here)

A

REPLACE ECM (Click here)

DTC P2237 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)

DTC P2238 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC P2239 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC P2240 Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 2 Sensor 1)

DTC P2241 Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC P2242 Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)

DTC P2252 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC P2253 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DTC P2255 Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC P2256 Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

for Preparation Click here

DESCRIPTION

Refer to DTC P2195 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2237 P2240	An open in the circuit between terminals AF+ and AF- of the A/F sensor while the engine is running (2 trip detection logic).	• Open in Air Fuel Ratio (A/F) sensor (for bank 1, 2 sensor 1) circuit • Air Fuel Ratio (A/F) sensor (for bank 1, 2 sensor 1) • ECM
P2238 P2241	• Case 1: Condition (a) or (b) continues for 5.0 seconds or more (1 trip detection logic): (a) The AF+ voltage is 0.5 V or less. (b) (AF+) - (AF-) = 0.1 V or less. • Case 2: The A/F sensor admittance is less than 0.022 1/Ω (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2239 P2242	The AF+ voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2252 P2255	The AF- voltage is 0.5 V or less for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM
P2253 P2256	The AF- voltage is higher than 4.5 V for 5.0 seconds or more (2 trip detection logic).	• Open or short in A/F sensor (for bank 1, 2 sensor 1) circuit • A/F sensor (for bank 1, 2 sensor 1) • ECM

HINT:

- **DTCs P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 A/F sensor circuit.**
- **DTCs P2241, P2242, P2255 and P2256 indicate malfunctions related to the bank 2 A/F sensor circuit.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that includes the No. 2 cylinder.**

MONITOR DESCRIPTION

These DTCs are output when there is an open or short in the A/F sensor circuit, or if the A/F sensor output drops.
To detect these problems, the voltage of the A/F sensor is monitored when turning the engine switch on (IG), and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is outside of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in the next driving cycle, the MIL is illuminated and a DTC is stored.
The Air-Fuel Ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. If the A/F sensor impedance (alternating current resistance) or output voltage deviates greatly from the standard range, the ECM determines that there is an open or short in the A/F sensor circuit.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the intelligent tester.

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/ F sensor.
(e) Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

HINT:

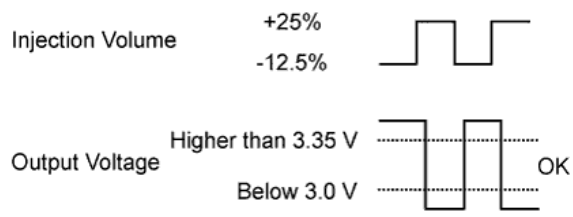
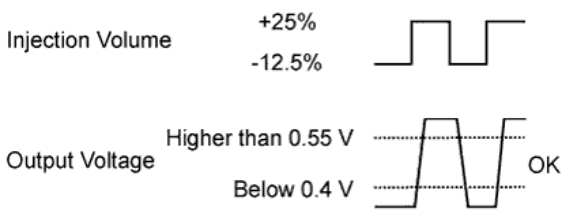
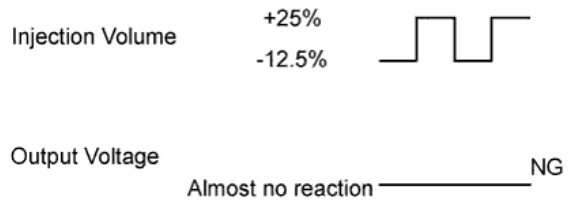
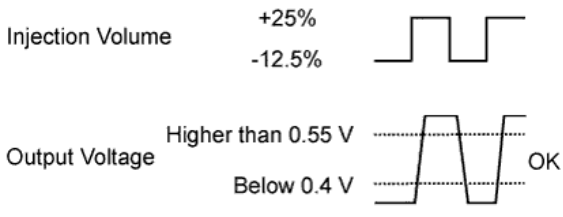
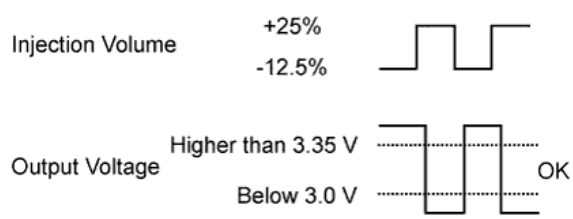
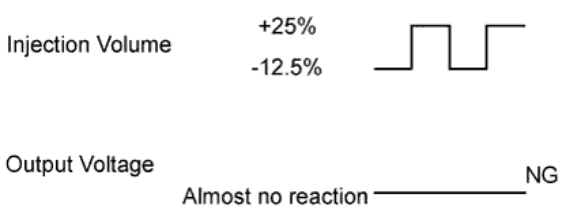
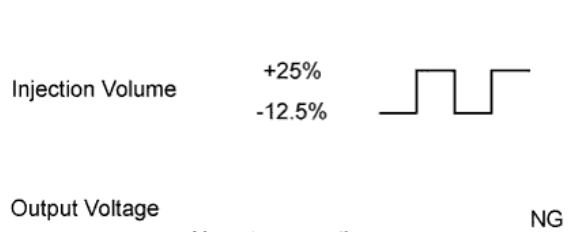
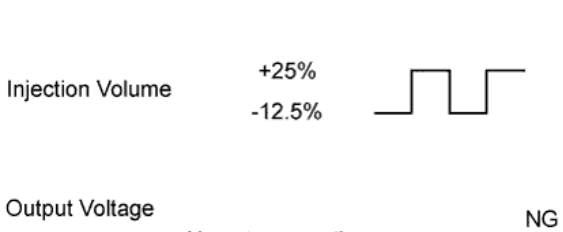
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.

To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

a. Disconnect the A/F sensor connector.

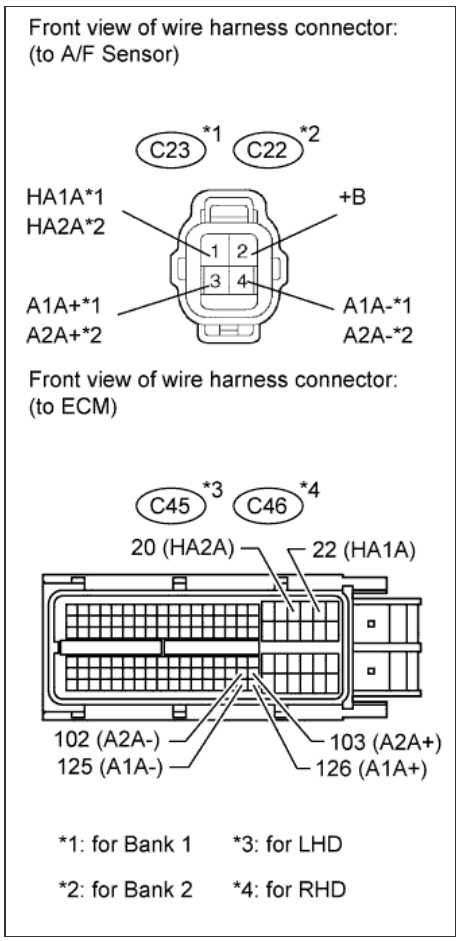
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.



e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

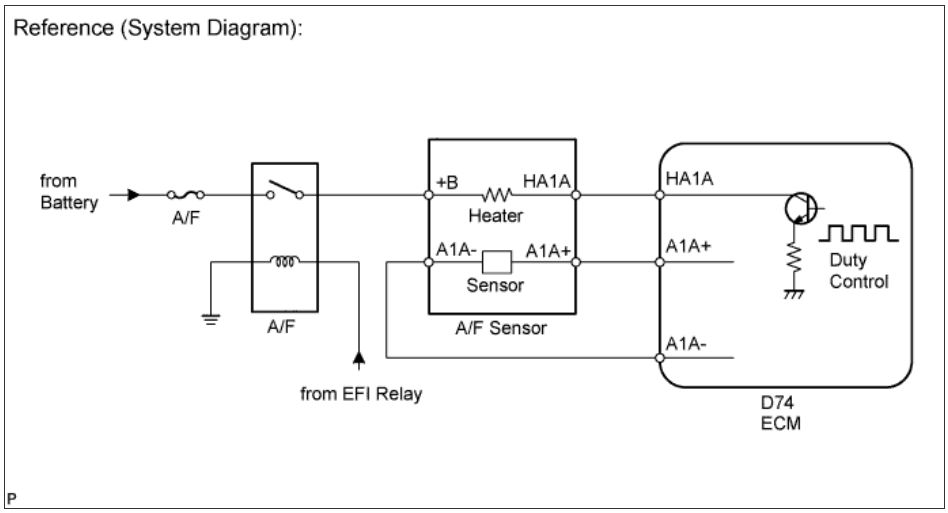
Tester Connection	Condition	Specified Condition

C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C46-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



P

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Start the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

g. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2237, P2238, P2239, P2240, P2241, P2242, P2252, P2253, P2255 or P2256 is output	B

B → REPLACE ECM (**Click here**)

A

END

DTC P0351 Ignition Coil "A" Primary / Secondary Circuit

DTC P0352 Ignition Coil "B" Primary / Secondary Circuit

DTC P0353 Ignition Coil "C" Primary / Secondary Circuit

DTC P0354 Ignition Coil "D" Primary / Secondary Circuit

DTC P0355 Ignition Coil "E" Primary / Secondary Circuit

DTC P0356 Ignition Coil "F" Primary / Secondary Circuit

DTC P0357 Ignition Coil "G" Primary / Secondary Circuit

DTC P0358 Ignition Coil "H" Primary / Secondary Circuit

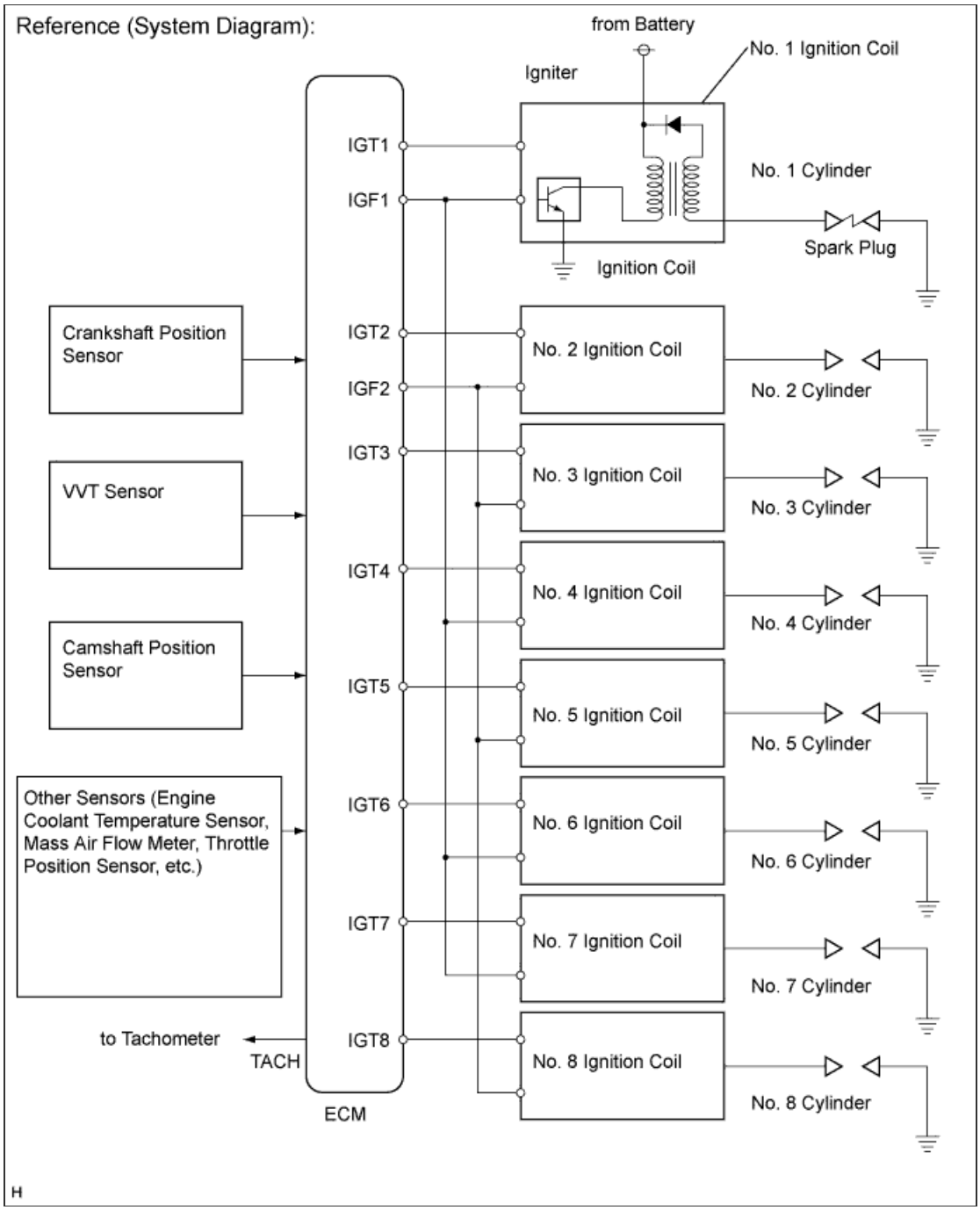
for Preparation Click here

DESCRIPTION

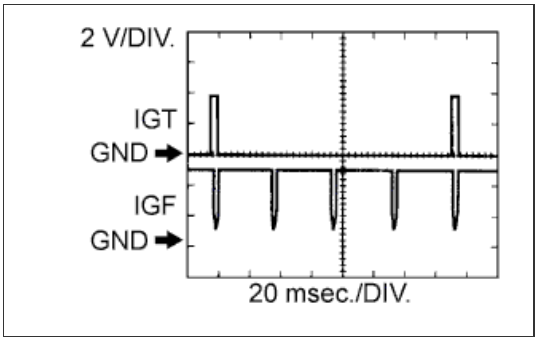
HINT:

- **These DTCs indicate malfunctions relating to the primary circuit.**
- **If DTC P0351 is output, check the No. 1 ignition coil circuit.**
- **If DTC P0352 is output, check the No. 2 ignition coil circuit.**
- **If DTC P0353 is output, check the No. 3 ignition coil circuit.**
- **If DTC P0354 is output, check the No. 4 ignition coil circuit.**
- **If DTC P0355 is output, check the No. 5 ignition coil circuit.**
- **If DTC P0356 is output, check the No. 6 ignition coil circuit.**
- **If DTC P0357 is output, check the No. 7 ignition coil circuit.**
- **If DTC P0358 is output, check the No. 8 ignition coil circuit.**

A Direct Ignition System (DIS) is used on this vehicle.
The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.
The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.



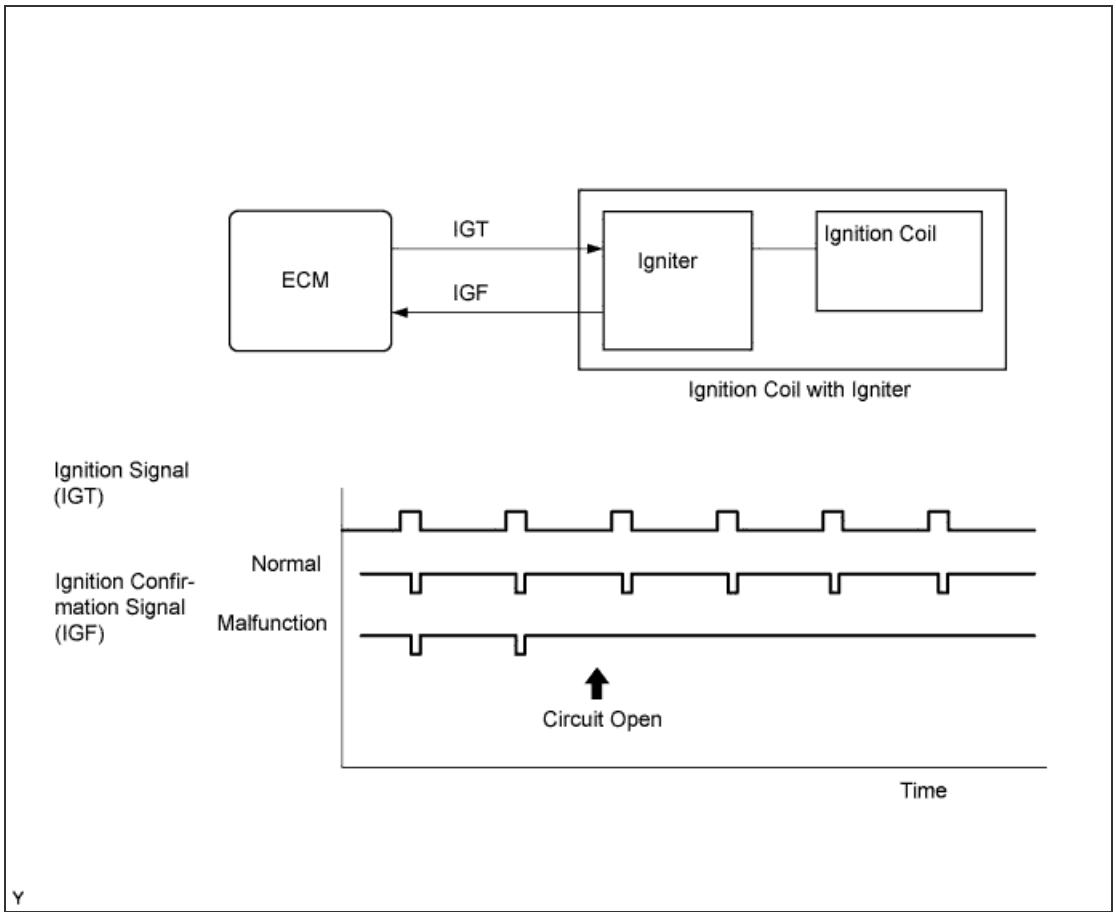
DTC Code	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356 P0357 P0358	No IGF signal is sent to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 8) between ignition coil and ECM • No. 1 to No. 8 ignition coils • ECM



Reference: Inspection using an oscilloscope.
While cranking or idling the engine, check the waveform between terminals IGT (1 to 8) and E1, and IGF1 or IGF2 and E1 of the ECM connector.

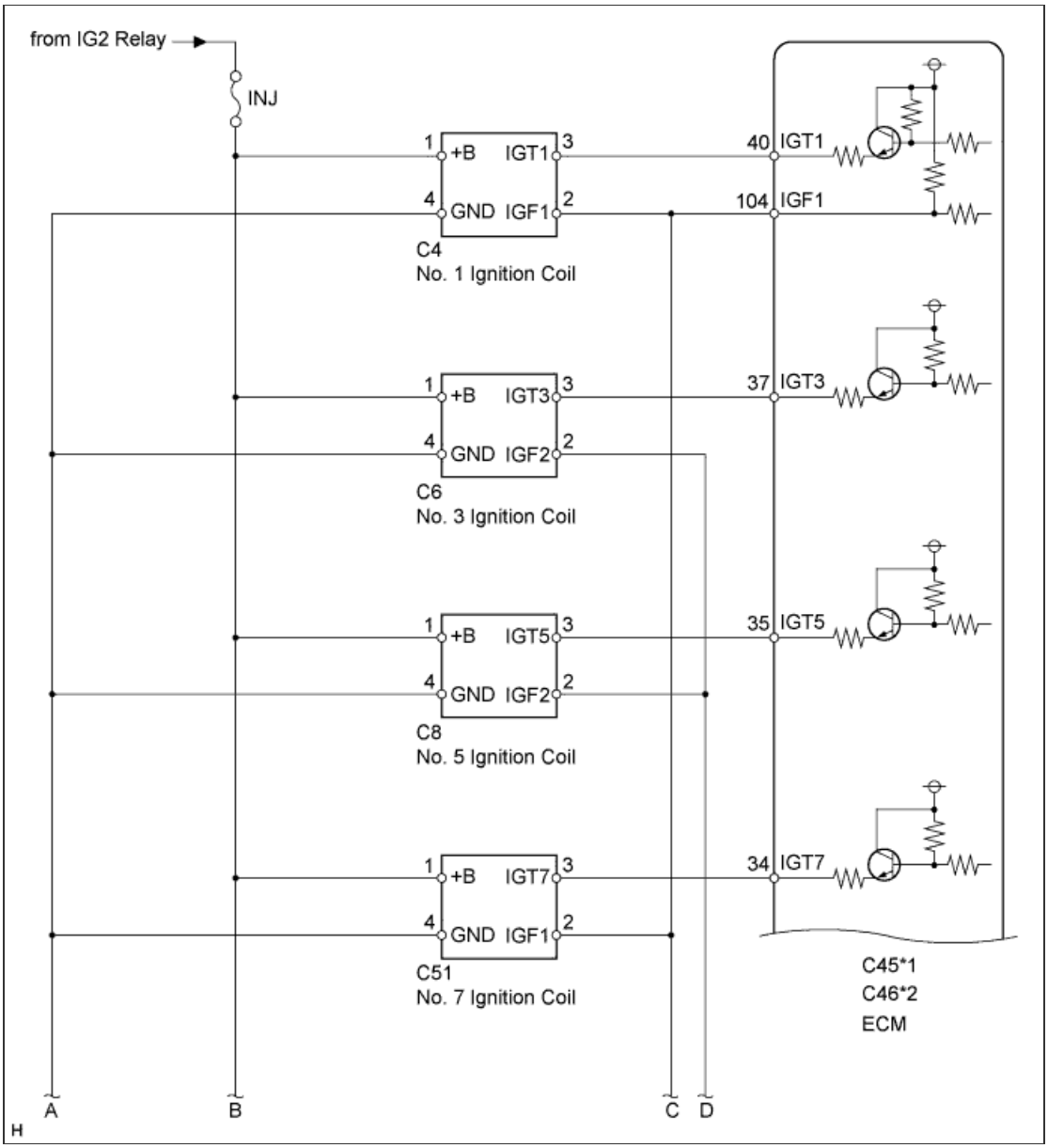
Item	Content
Terminal	CH1: IGT1, IGT2, IGT3, IGT4, IGT5, IGT6, IGT7, IGT8 - E1 CH2: IGF1, IGF2 - E1
Equipment Setting	2 V/DIV. 20 msec./DIV.
Condition	Cranking or idling

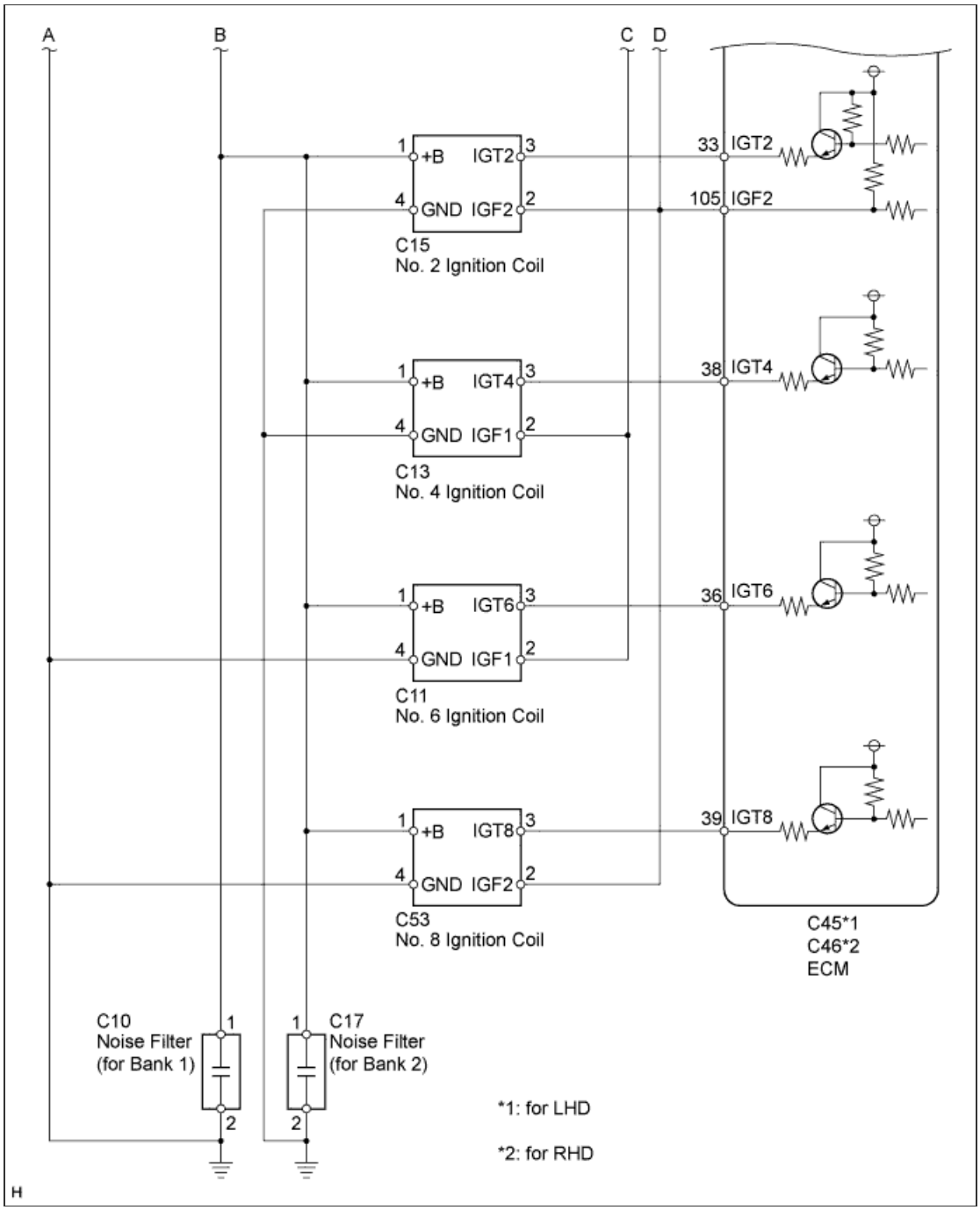
MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

WIRING DIAGRAM


from IG2 Relay
INJ
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
34
IGT7
C45*1
C46*2
ECM
A
B
C
D
H



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)

a. Disconnect the No. 1 to No. 8 ignition coil connectors.

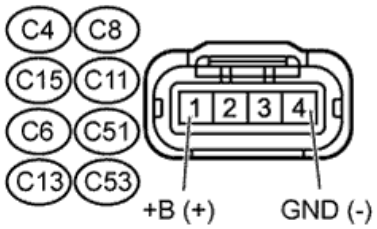
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C4-4 (GND) - Body ground	Always	Below 1 Ω
C15-4 (GND) - Body ground	Always	Below 1 Ω
C6-4 (GND) - Body ground	Always	Below 1 Ω

C13-4 (GND) - Body ground	Always	Below 1 Ω
C8-4 (GND) - Body ground	Always	Below 1 Ω
C11-4 (GND) - Body ground	Always	Below 1 Ω
C51-4 (GND) - Body ground	Always	Below 1 Ω
C53-4 (GND) - Body ground	Always	Below 1 Ω

Front view of wire harness connector:
(to Ignition Coil with Igniter)



c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C4-1 ( ) - C4-4 (GND)	Engine switch on (IG)	11 to 14 V
C15-1 ( ) - C15-4 (GND)	Engine switch on (IG)	11 to 14 V
C6-1 ( ) - C6-4 (GND)	Engine switch on (IG)	11 to 14 V
C13-1 ( ) - C13-4 (GND)	Engine switch on (IG)	11 to 14 V
C8-1 ( ) - C8-4 (GND)	Engine switch on (IG)	11 to 14 V
C11-1 ( ) - C11-4 (GND)	Engine switch on (IG)	11 to 14 V
C51-1 ( ) - C51-4 (GND)	Engine switch on (IG)	11 to 14 V
C53-1 ( ) - C53-4 (GND)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

a. Disconnect the No. 1 to No. 8 ignition coil connectors.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

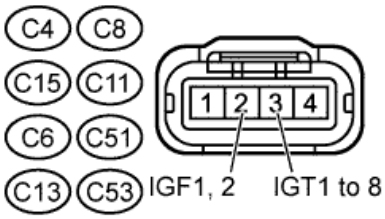
Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C15-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C45-40 (IGT1)	Always	Below 1 Ω

C15-3 (IGT2) - C45-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C45-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C45-38 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C45-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C45-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C45-34 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C45-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C45-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C45-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C45-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C45-38 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C45-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C45-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C45-34 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C45-39 (IGT8) - Body ground	Always	10 kΩ or higher

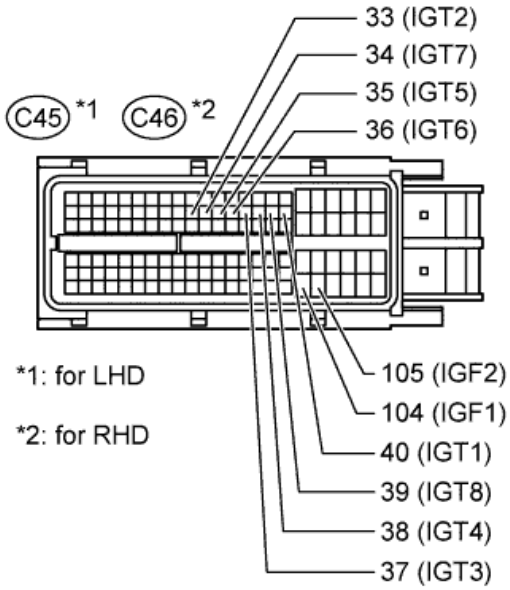
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω

Front view of wire harness connector:
(to Ignition Coil with Igniter)



Front view of wire harness connector:
(to ECM)



C15-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C46-40 (IGT1)	Always	Below 1 Ω
C15-3 (IGT2) - C46-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C46-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C46-38 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C46-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C46-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C46-34 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C46-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C46-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C46-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C46-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C46-38 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or		

C46-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C46-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C46-34 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C46-39 (IGT8) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353, P0354, P0355, P0356, P0357 OR P0358)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Shuffle arrangement of the ignition coils with igniters (among No. 1 to No. 8 cylinders).

NOTICE:

Do not shuffle the connectors.

e. Perform a simulation test.

f. Check the DTCs displayed on the tester.

Result

Result	Proceed to
Same DTC is output	A
Different ignition coil DTC is output	B

B → REPLACE IGNITION COIL ASSEMBLY (Click here)

A

REPLACE ECM (Click here)

DTC P2431 Secondary Air Injection System Air Flow / Pressure Sensor Circuit Range / Performance Bank1

DTC P2432 Secondary Air Injection System Air Flow / Pressure Sensor Circuit Low Bank1

DTC P2433 Secondary Air Injection System Air Flow / Pressure Sensor Circuit High Bank1

for Preparation Click here

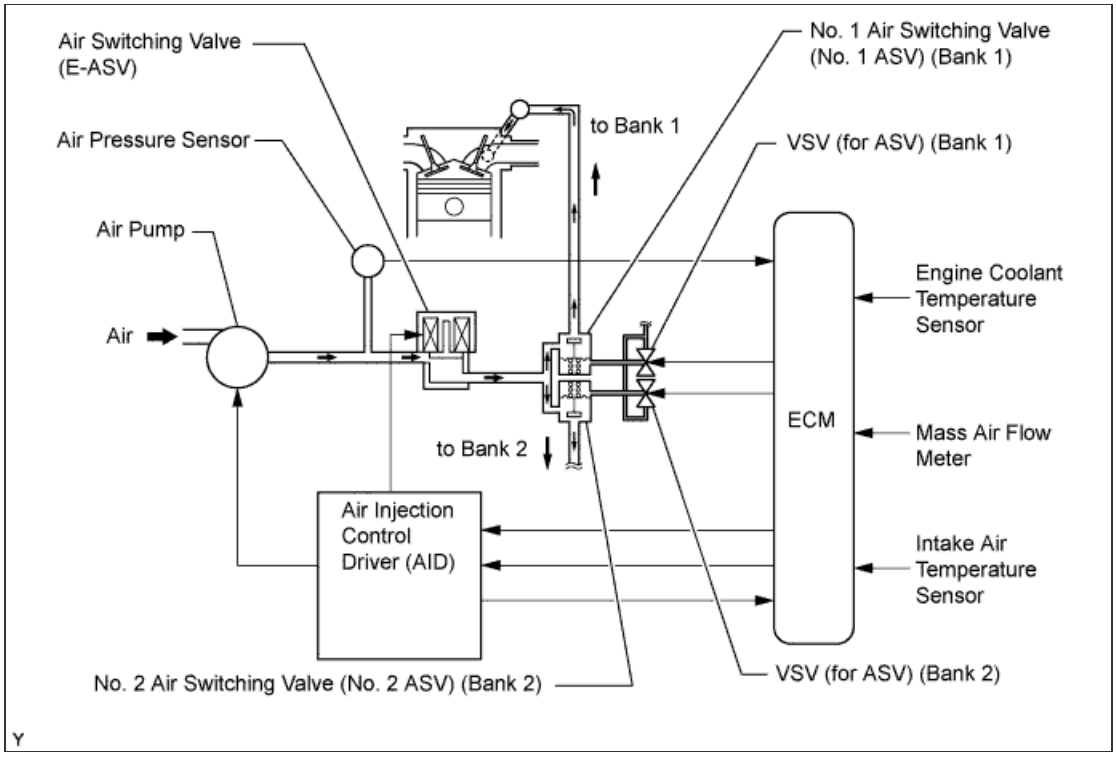
DESCRIPTION

The diagnostic trouble code (DTC) P2431 indicates that the pressure sensor of the secondary air injection (AIR) system malfunctions. The engine control module (ECM) monitors the sensor value to detect the malfunction. If the sensor value reaches the criteria (below 45 kPa or higher than 135 kPa), the ECM illuminates the malfunction indicator lamp (MIL), and stores a DTC.

The DTC P2432 and P2433 indicate an open or short circuit in the pressure sensor circuit. The ECM monitors the pressure sensor voltage to detect the open or short circuit. If the voltage reaches the criteria (below 0.1 V or higher than 4.8 V), the ECM illuminates the malfunction indicator lamp (MIL), and stores a DTC.

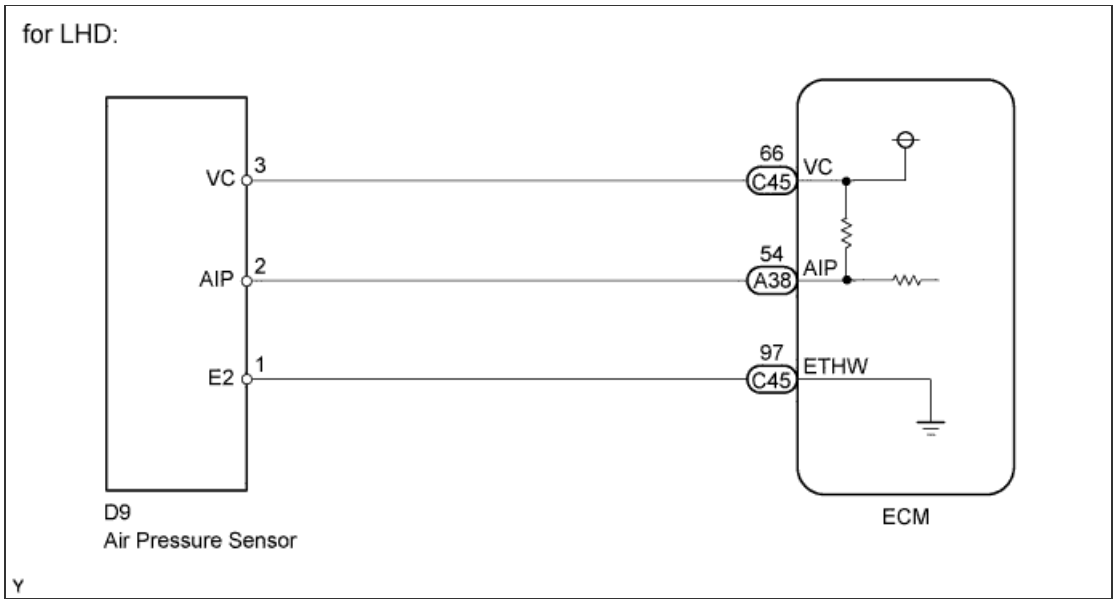
The pressure sensor detects the air pressure via a piezo element. The ECM applies 5 volts to the sensor, and it is varied with the air pressure. When the pressure is high, the voltage is high. When the pressure is low, the voltage is low.

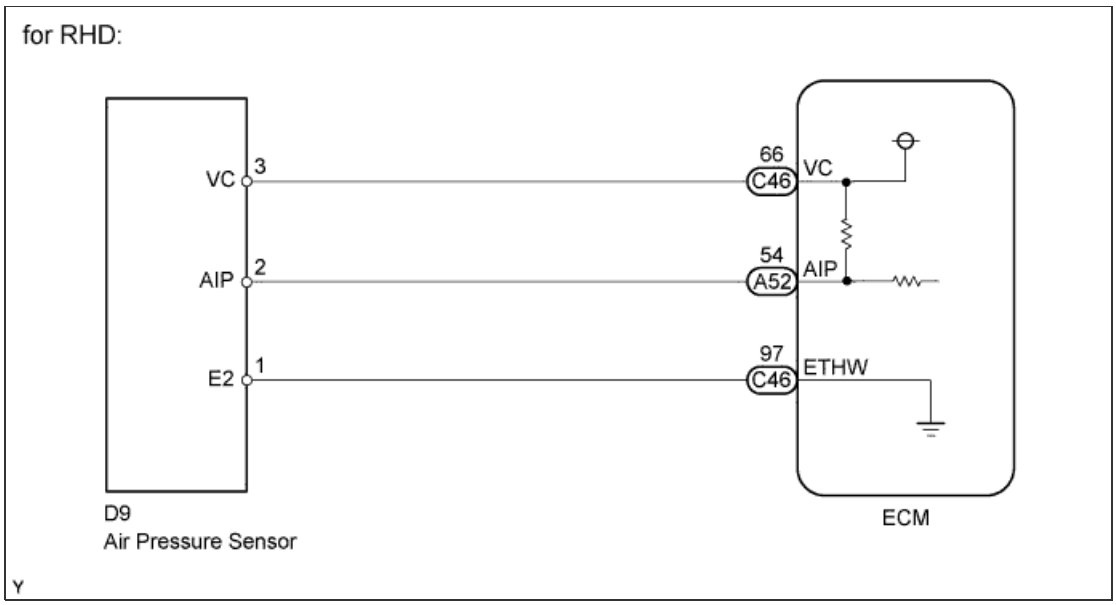
The secondary air injection (AIR) system introduces fresh air into the exhaust manifold in order to reduce carbon monoxide (CO) and hydrocarbon (HC) in the exhaust emission. This system is activated just after engine start, and is stopped when the catalyst converter is warmed-up. This system consists of the following components: 1) the air pump which sends fresh air to the exhaust manifold, 2) the electric air switching valve (E-ASV) which switches the fresh air flow, 3) the air switching valve (ASV) which switches the air passage to the exhaust manifold of each bank, 4) the vacuum switching valve (VSV) which switches the vacuum (intake manifold pressure) to operate the ASV, 5) the pressure sensor which detects the fresh air pressure and exhaust pulse, 6) the air injection control driver which controls the power sources of the air pump and E-ASV, 7) the engine control module (ECM) which controls and monitors this system.



DTC Code	DTC Detection Condition	Trouble Area
P2431	The pressure sensor indicates below 45 kPa (338 mmHg) or higher than 135 kPa (1013 mmHg) (2 trip detection logic).	• Pressure sensor circuit • Pressure sensor • ECM
P2432	The pressure sensor voltage is below 0.1 V (1 trip detection logic).	• Pressure sensor circuit • Pressure sensor • ECM
P2433	The pressure sensor voltage is higher than 4.8 V (1 trip detection logic).	• Pressure sensor circuit • Pressure sensor • ECM

WIRING DIAGRAM





INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.**

1.CHECK HARNESS AND CONNECTOR (AIR PRESSURE SENSOR - ECM)

a. Disconnect the air pressure sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

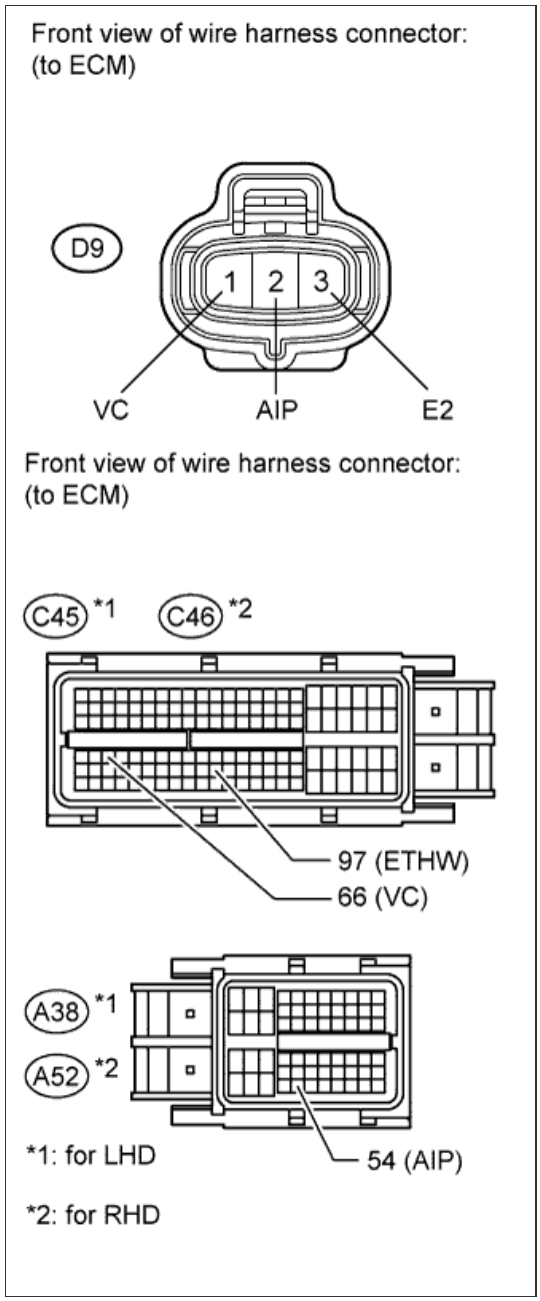
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C45-66 (VC) - D9-3 (VC)	Always	Below 1 Ω
A38-54 (AIP) - D9-2 (AIP)	Always	Below 1 Ω
C45-97 (ETHW) - D9-3 (ETHW)	Always	Below 1 Ω
C45-66 (VC) or		

D9-3 (VC) - body ground	Always	10 kΩ or higher
A38-54 (AIP) or D9-2 (AIP) (EPA) - body ground	Always	10 kΩ or higher
C45-97 (ETHW) or D9-3 (ETHW) - body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C46-66 (VC) - D9-3 (VC)	Always	Below 1 Ω
A52-54 (AIP) - D9-2 (AIP)	Always	Below 1 Ω
C46-97 (ETHW) - D9-3 (ETHW)	Always	Below 1 Ω
C46-66 (VC) or D9-3 (VC) - body ground	Always	10 kΩ or higher
A52-54 (AIP) or D9-2 (AIP) (EPA) - body ground	Always	10 kΩ or higher
C46-97 (ETHW) or D9-3 (ETHW) - body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (VC VOLTAGE)

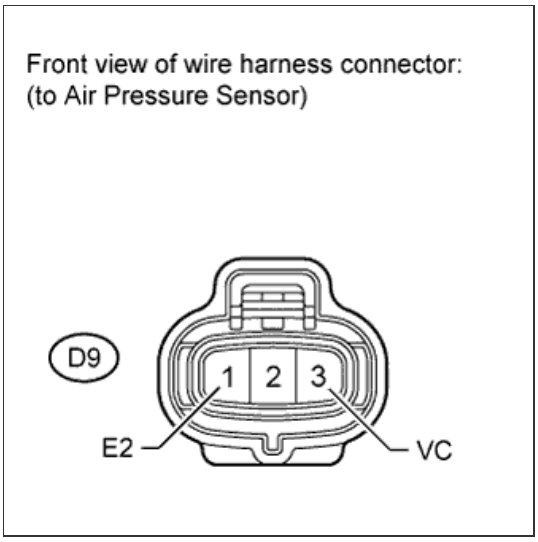
a. Remove the intake manifold (Click here).

b. Disconnect the air pressure sensor connector.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
D9-3 (VC) - D9-1 (VC)	Engine switch on (IG)	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

3.REPLACE AIR PRESSURE SENSOR

a. Replace the air pressure sensor (Click here).

NEXT

4.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Warm-up the engine.

e. Enter the following menus: Powertrain / Engine and ECT / Utility / Secondary Air Injection Check (Automatic Mode).

f. Perform the Active Test and check the pending DTC.

Result

Result	Proceed to
P2430, P2431, P2432, and/or P2433 is output	A
No DTC is output	B

NG → REPLACE ECM (Click here)

OK

END

DTC P0351 Ignition Coil "A" Primary / Secondary Circuit

DTC P0352 Ignition Coil "B" Primary / Secondary Circuit

DTC P0353 Ignition Coil "C" Primary / Secondary Circuit

DTC P0354 Ignition Coil "D" Primary / Secondary Circuit

DTC P0355 Ignition Coil "E" Primary / Secondary Circuit

DTC P0356 Ignition Coil "F" Primary / Secondary Circuit

DTC P0357 Ignition Coil "G" Primary / Secondary Circuit

DTC P0358 Ignition Coil "H" Primary / Secondary Circuit

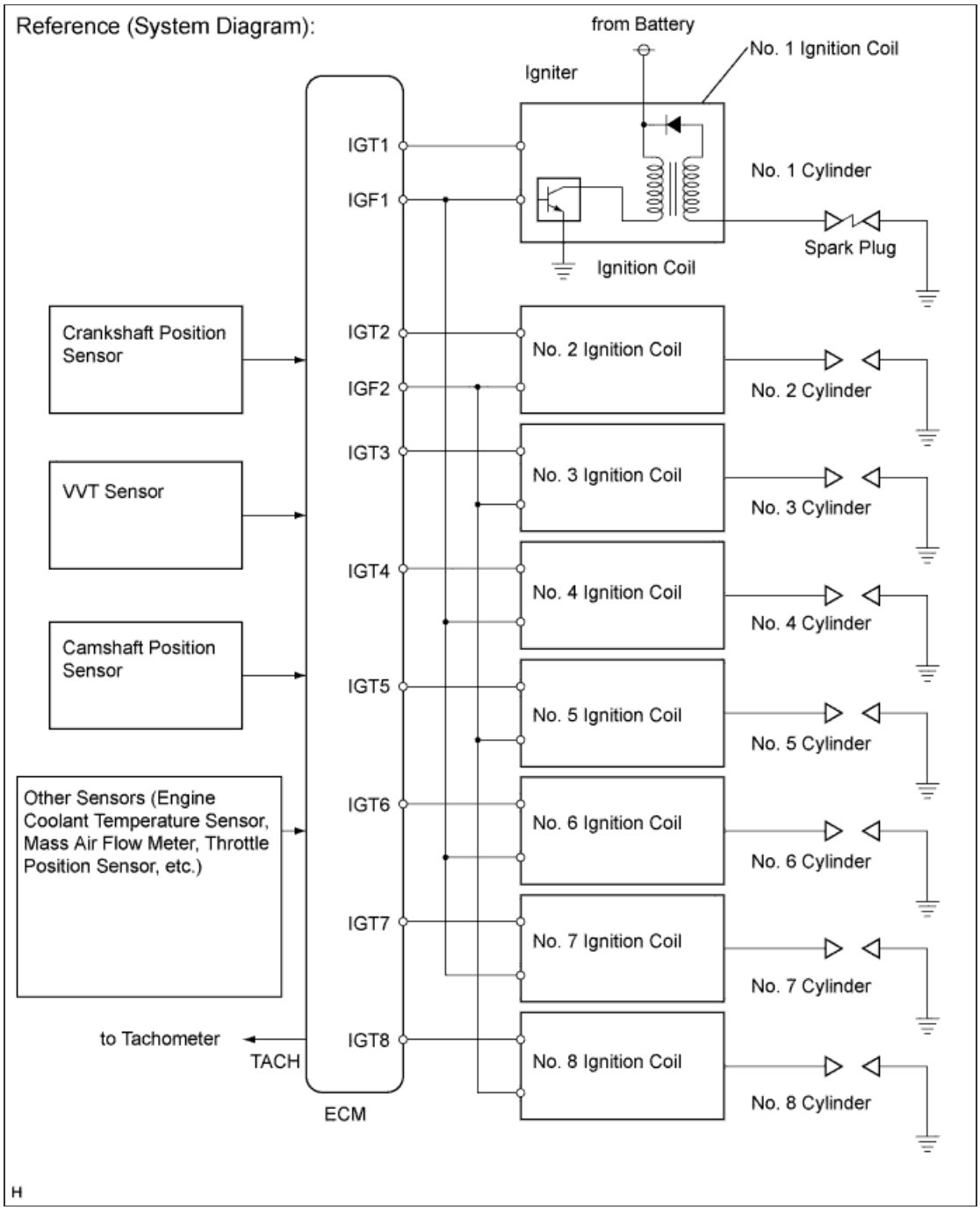
for Preparation Click here

DESCRIPTION

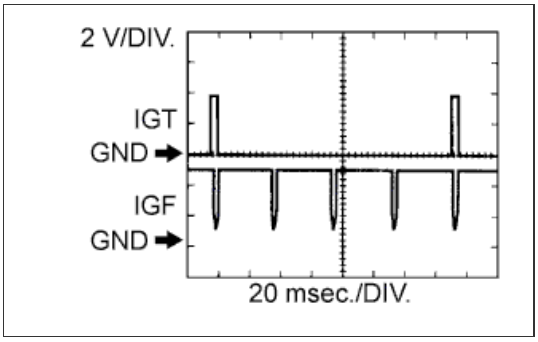
HINT:

- **These DTCs indicate malfunctions relating to the primary circuit.**
- **If DTC P0351 is output, check the No. 1 ignition coil circuit.**
- **If DTC P0352 is output, check the No. 2 ignition coil circuit.**
- **If DTC P0353 is output, check the No. 3 ignition coil circuit.**
- **If DTC P0354 is output, check the No. 4 ignition coil circuit.**
- **If DTC P0355 is output, check the No. 5 ignition coil circuit.**
- **If DTC P0356 is output, check the No. 6 ignition coil circuit.**
- **If DTC P0357 is output, check the No. 7 ignition coil circuit.**
- **If DTC P0358 is output, check the No. 8 ignition coil circuit.**

A Direct Ignition System (DIS) is used on this vehicle.
The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.
The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.



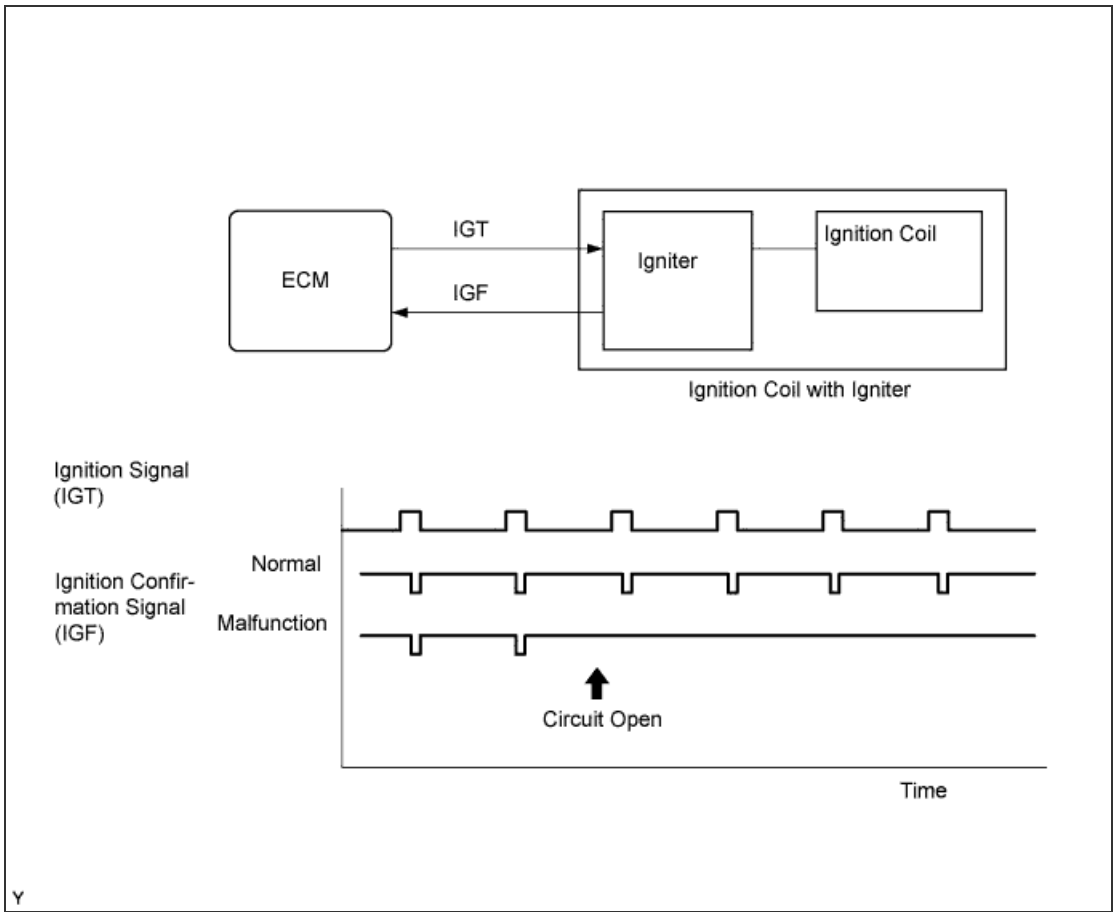
DTC Code	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356 P0357 P0358	No IGF signal is sent to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 8) between ignition coil and ECM • No. 1 to No. 8 ignition coils • ECM



Reference: Inspection using an oscilloscope.
While cranking or idling the engine, check the waveform between terminals IGT (1 to 8) and E1, and IGF1 or IGF2 and E1 of the ECM connector.

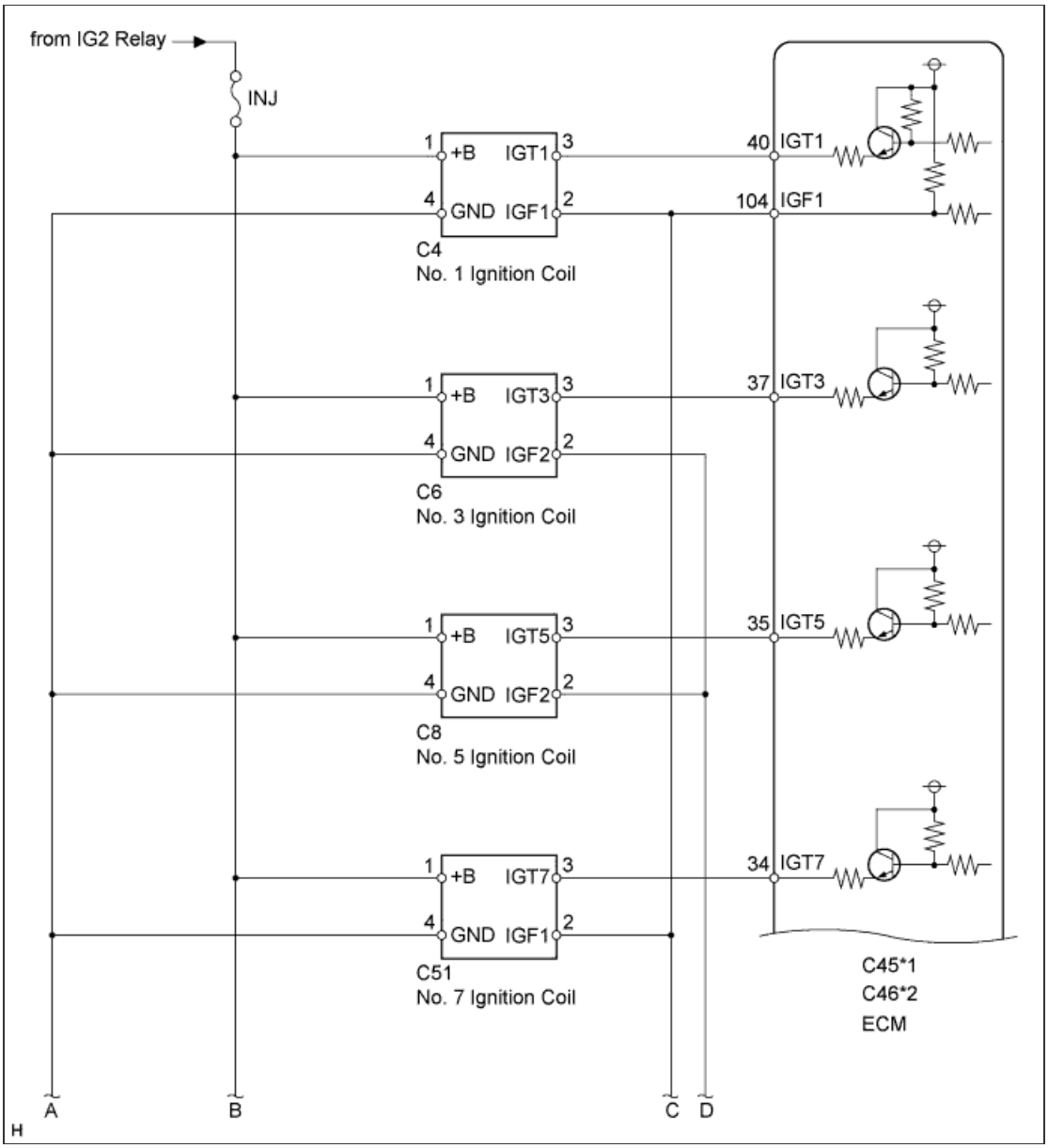
Item	Content
Terminal	CH1: IGT1, IGT2, IGT3, IGT4, IGT5, IGT6, IGT7, IGT8 - E1 CH2: IGF1, IGF2 - E1
Equipment Setting	2 V/DIV. 20 msec./DIV.
Condition	Cranking or idling

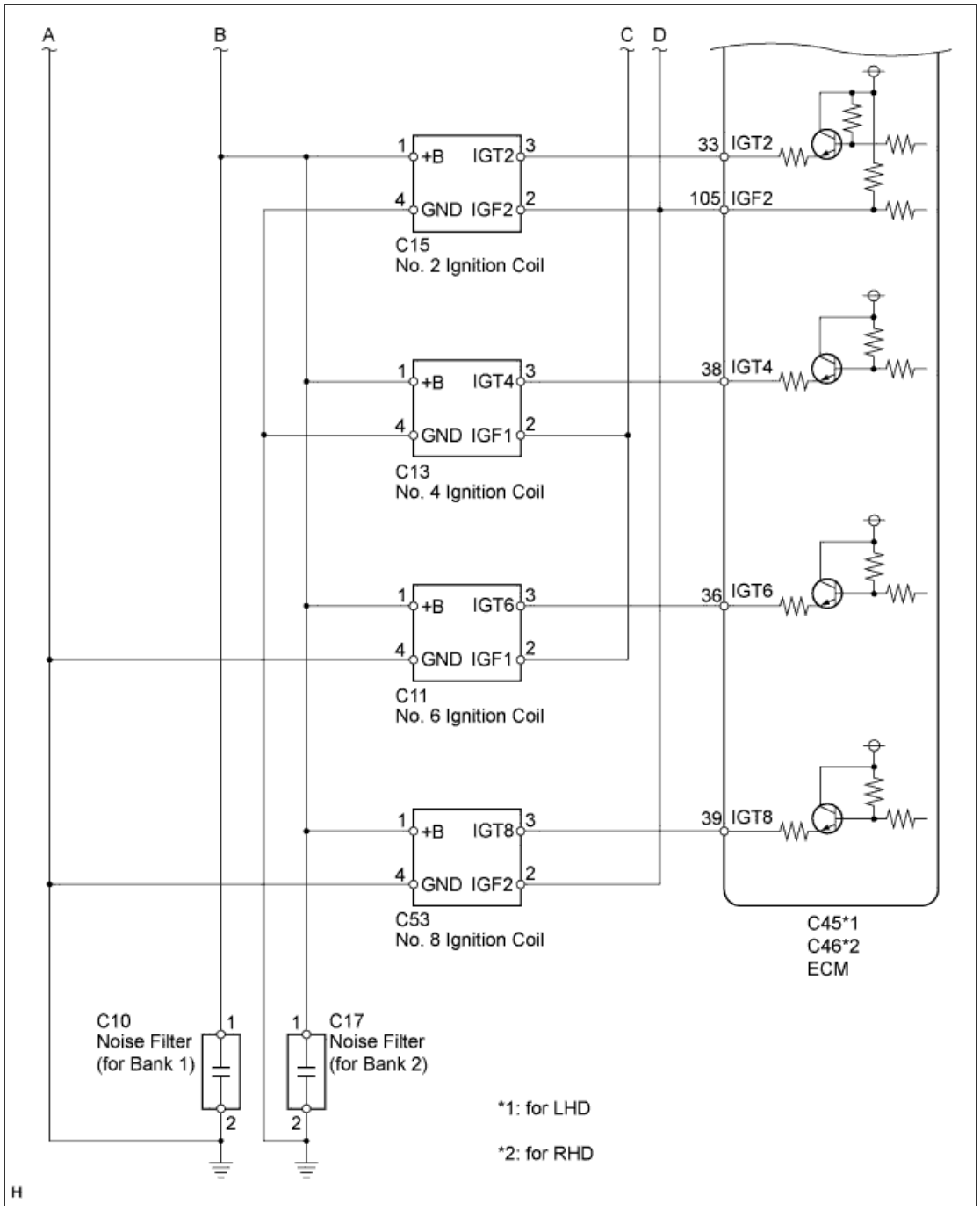
MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

WIRING DIAGRAM


from IG2 Relay
INJ
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
34
IGT7
C45*1
C46*2
ECM
A
B
C
D
H



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)

a. Disconnect the No. 1 to No. 8 ignition coil connectors.

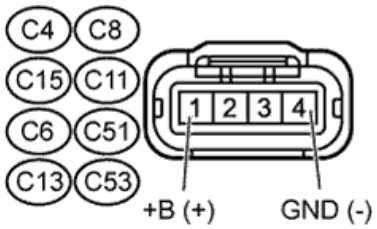
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C4-4 (GND) - Body ground	Always	Below 1 Ω
C15-4 (GND) - Body ground	Always	Below 1 Ω
C6-4 (GND) - Body ground	Always	Below 1 Ω

C13-4 (GND) - Body ground	Always	Below 1 Ω
C8-4 (GND) - Body ground	Always	Below 1 Ω
C11-4 (GND) - Body ground	Always	Below 1 Ω
C51-4 (GND) - Body ground	Always	Below 1 Ω
C53-4 (GND) - Body ground	Always	Below 1 Ω

Front view of wire harness connector:
(to Ignition Coil with Igniter)



c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C4-1 ( ) - C4-4 (GND)	Engine switch on (IG)	11 to 14 V
C15-1 ( ) - C15-4 (GND)	Engine switch on (IG)	11 to 14 V
C6-1 ( ) - C6-4 (GND)	Engine switch on (IG)	11 to 14 V
C13-1 ( ) - C13-4 (GND)	Engine switch on (IG)	11 to 14 V
C8-1 ( ) - C8-4 (GND)	Engine switch on (IG)	11 to 14 V
C11-1 ( ) - C11-4 (GND)	Engine switch on (IG)	11 to 14 V
C51-1 ( ) - C51-4 (GND)	Engine switch on (IG)	11 to 14 V
C53-1 ( ) - C53-4 (GND)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

a. Disconnect the No. 1 to No. 8 ignition coil connectors.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

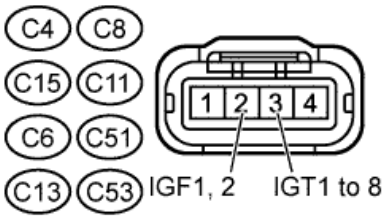
Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C15-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C45-40 (IGT1)	Always	Below 1 Ω

C15-3 (IGT2) - C45-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C45-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C45-38 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C45-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C45-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C45-34 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C45-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C45-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C45-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C45-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C45-38 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C45-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C45-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C45-34 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C45-39 (IGT8) - Body ground	Always	10 kΩ or higher

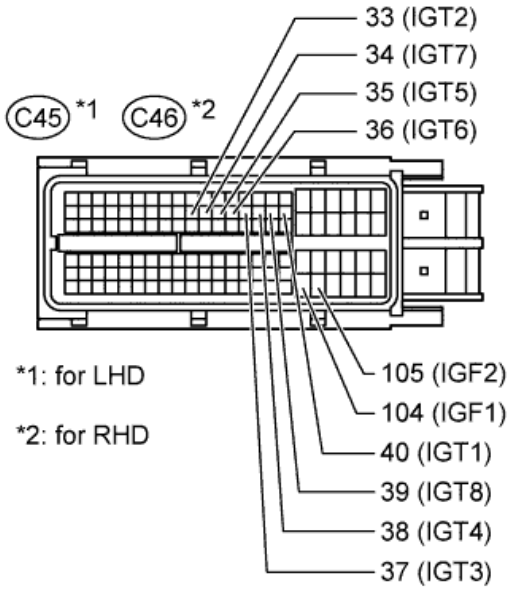
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω

Front view of wire harness connector:
(to Ignition Coil with Igniter)



Front view of wire harness connector:
(to ECM)



C15-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C46-40 (IGT1)	Always	Below 1 Ω
C15-3 (IGT2) - C46-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C46-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C46-38 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C46-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C46-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C46-34 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C46-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C46-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C46-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C46-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C46-38 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or		

C46-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C46-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C46-34 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C46-39 (IGT8) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353, P0354, P0355, P0356, P0357 OR P0358)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Shuffle arrangement of the ignition coils with igniters (among No. 1 to No. 8 cylinders).

NOTICE:

Do not shuffle the connectors.

e. Perform a simulation test.

f. Check the DTCs displayed on the tester.

Result

Result	Proceed to
Same DTC is output	A
Different ignition coil DTC is output	B

B → REPLACE IGNITION COIL ASSEMBLY (Click here)

A

REPLACE ECM (Click here)

DTC P2431 Secondary Air Injection System Air Flow / Pressure Sensor Circuit Range / Performance Bank1

DTC P2432 Secondary Air Injection System Air Flow / Pressure Sensor Circuit Low Bank1

DTC P2433 Secondary Air Injection System Air Flow / Pressure Sensor Circuit High Bank1

for Preparation Click here

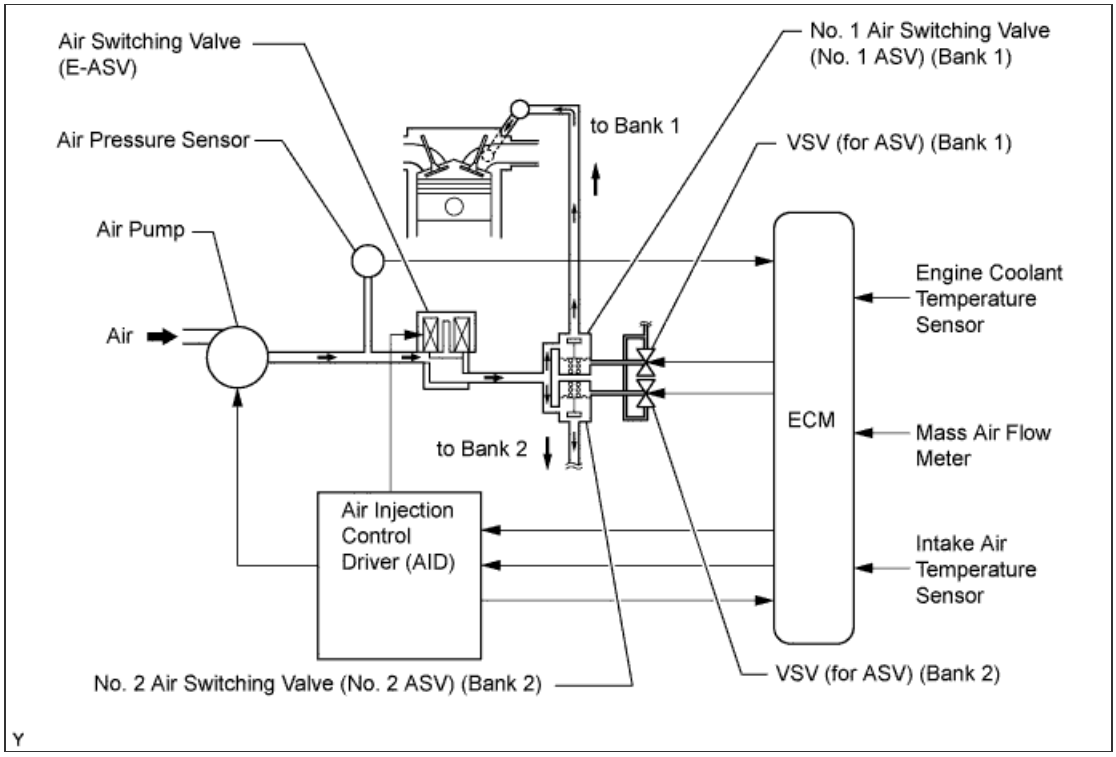
DESCRIPTION

The diagnostic trouble code (DTC) P2431 indicates that the pressure sensor of the secondary air injection (AIR) system malfunctions. The engine control module (ECM) monitors the sensor value to detect the malfunction. If the sensor value reaches the criteria (below 45 kPa or higher than 135 kPa), the ECM illuminates the malfunction indicator lamp (MIL), and stores a DTC.

The DTC P2432 and P2433 indicate an open or short circuit in the pressure sensor circuit. The ECM monitors the pressure sensor voltage to detect the open or short circuit. If the voltage reaches the criteria (below 0.1 V or higher than 4.8 V), the ECM illuminates the malfunction indicator lamp (MIL), and stores a DTC.

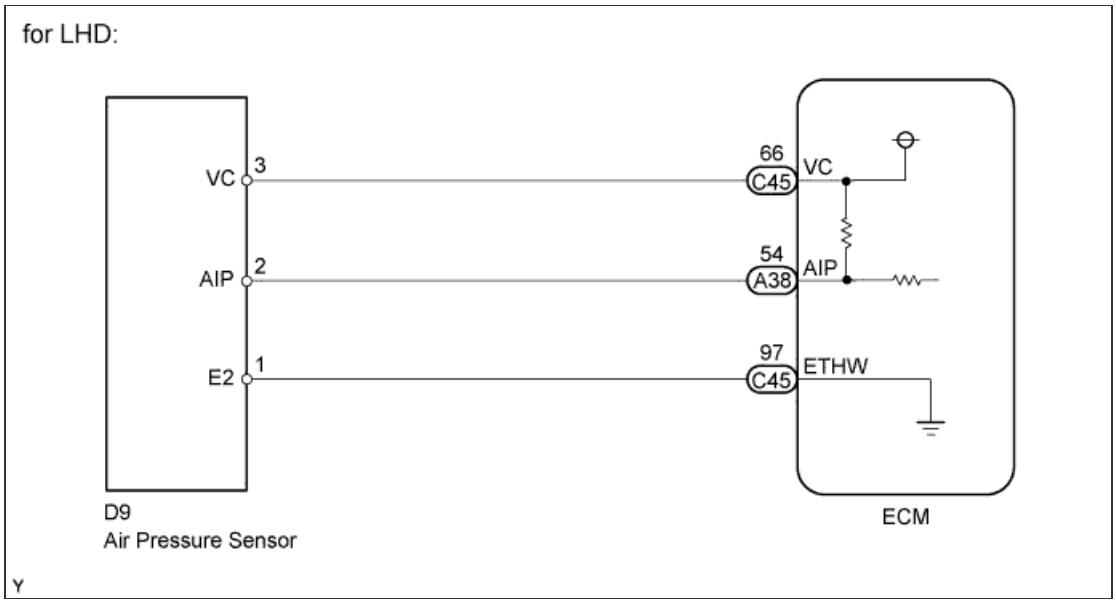
The pressure sensor detects the air pressure via a piezo element. The ECM applies 5 volts to the sensor, and it is varied with the air pressure. When the pressure is high, the voltage is high. When the pressure is low, the voltage is low.

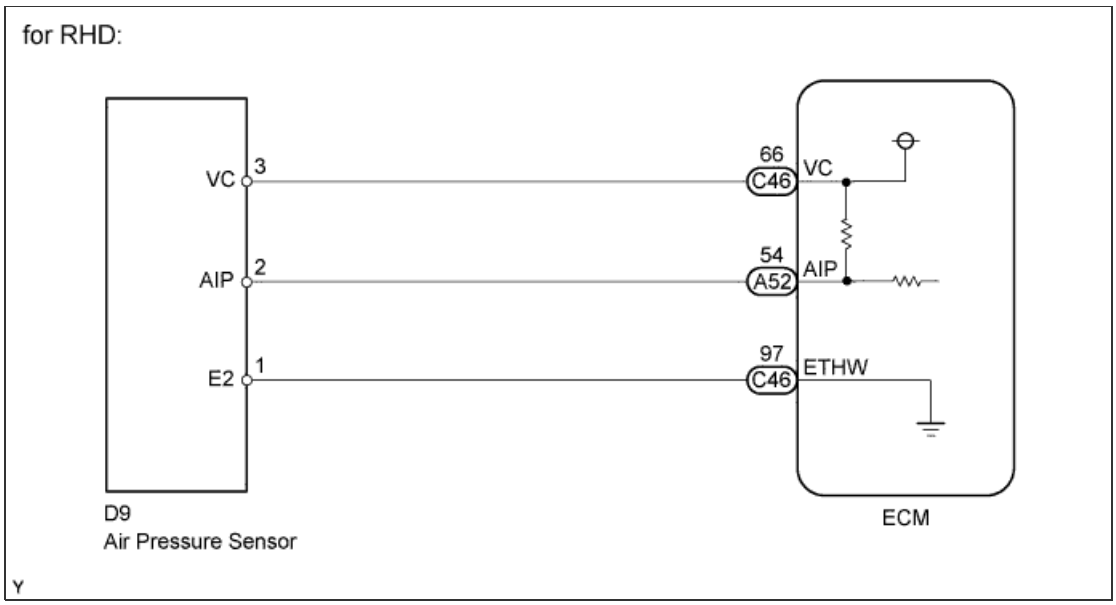
The secondary air injection (AIR) system introduces fresh air into the exhaust manifold in order to reduce carbon monoxide (CO) and hydrocarbon (HC) in the exhaust emission. This system is activated just after engine start, and is stopped when the catalyst converter is warmed-up. This system consists of the following components: 1) the air pump which sends fresh air to the exhaust manifold, 2) the electric air switching valve (E-ASV) which switches the fresh air flow, 3) the air switching valve (ASV) which switches the air passage to the exhaust manifold of each bank, 4) the vacuum switching valve (VSV) which switches the vacuum (intake manifold pressure) to operate the ASV, 5) the pressure sensor which detects the fresh air pressure and exhaust pulse, 6) the air injection control driver which controls the power sources of the air pump and E-ASV, 7) the engine control module (ECM) which controls and monitors this system.



DTC Code	DTC Detection Condition	Trouble Area
P2431	The pressure sensor indicates below 45 kPa (338 mmHg) or higher than 135 kPa (1013 mmHg) (2 trip detection logic).	• Pressure sensor circuit • Pressure sensor • ECM
P2432	The pressure sensor voltage is below 0.1 V (1 trip detection logic).	• Pressure sensor circuit • Pressure sensor • ECM
P2433	The pressure sensor voltage is higher than 4.8 V (1 trip detection logic).	• Pressure sensor circuit • Pressure sensor • ECM

WIRING DIAGRAM





INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.**

1.CHECK HARNESS AND CONNECTOR (AIR PRESSURE SENSOR - ECM)

a. Disconnect the air pressure sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

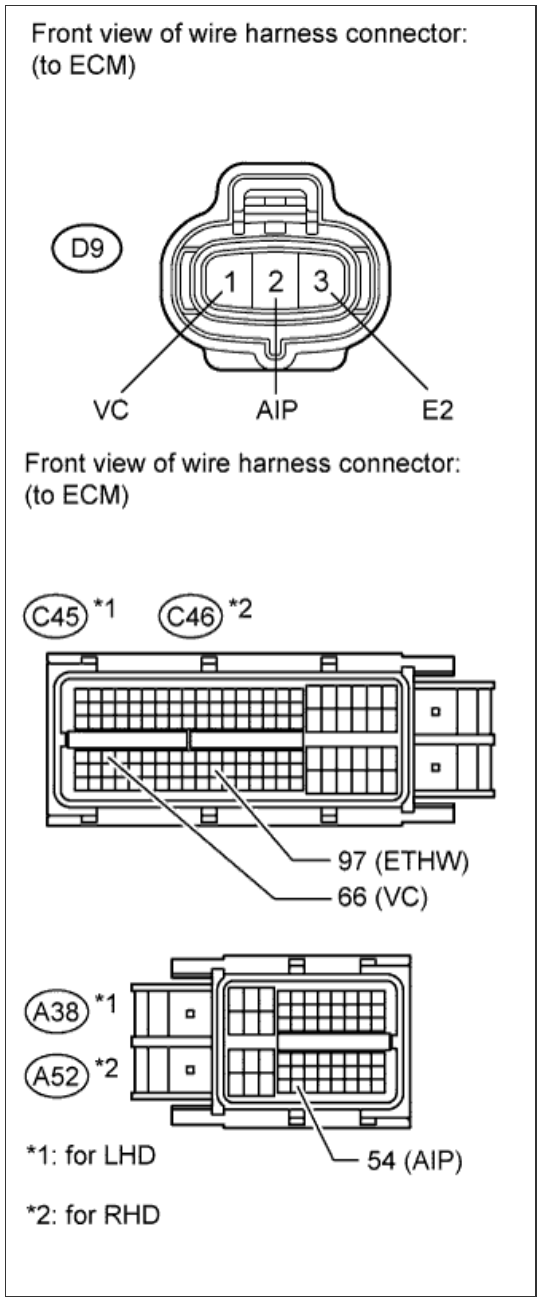
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C45-66 (VC) - D9-3 (VC)	Always	Below 1 Ω
A38-54 (AIP) - D9-2 (AIP)	Always	Below 1 Ω
C45-97 (ETHW) - D9-3 (ETHW)	Always	Below 1 Ω
C45-66 (VC) or		

D9-3 (VC) - body ground	Always	10 kΩ or higher
A38-54 (AIP) or D9-2 (AIP) (EPA) - body ground	Always	10 kΩ or higher
C45-97 (ETHW) or D9-3 (ETHW) - body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C46-66 (VC) - D9-3 (VC)	Always	Below 1 Ω
A52-54 (AIP) - D9-2 (AIP)	Always	Below 1 Ω
C46-97 (ETHW) - D9-3 (ETHW)	Always	Below 1 Ω
C46-66 (VC) or D9-3 (VC) - body ground	Always	10 kΩ or higher
A52-54 (AIP) or D9-2 (AIP) (EPA) - body ground	Always	10 kΩ or higher
C46-97 (ETHW) or D9-3 (ETHW) - body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (VC VOLTAGE)

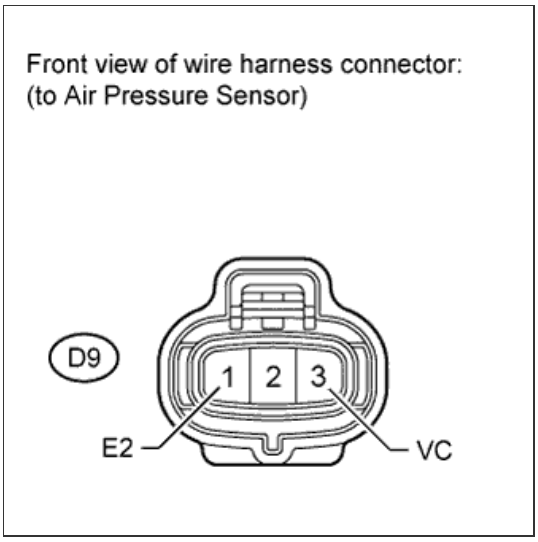
a. Remove the intake manifold (Click here).

b. Disconnect the air pressure sensor connector.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
D9-3 (VC) - D9-1 (VC)	Engine switch on (IG)	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

3.REPLACE AIR PRESSURE SENSOR

a. Replace the air pressure sensor (Click here).

NEXT

4.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Warm-up the engine.

e. Enter the following menus: Powertrain / Engine and ECT / Utility / Secondary Air Injection Check (Automatic Mode).

f. Perform the Active Test and check the pending DTC.

Result

Result	Proceed to
P2430, P2431, P2432, and/or P2433 is output	A
No DTC is output	B

NG → REPLACE ECM (Click here)

OK

END

DTC P0351 Ignition Coil "A" Primary / Secondary Circuit

DTC P0352 Ignition Coil "B" Primary / Secondary Circuit

DTC P0353 Ignition Coil "C" Primary / Secondary Circuit

DTC P0354 Ignition Coil "D" Primary / Secondary Circuit

DTC P0355 Ignition Coil "E" Primary / Secondary Circuit

DTC P0356 Ignition Coil "F" Primary / Secondary Circuit

DTC P0357 Ignition Coil "G" Primary / Secondary Circuit

DTC P0358 Ignition Coil "H" Primary / Secondary Circuit

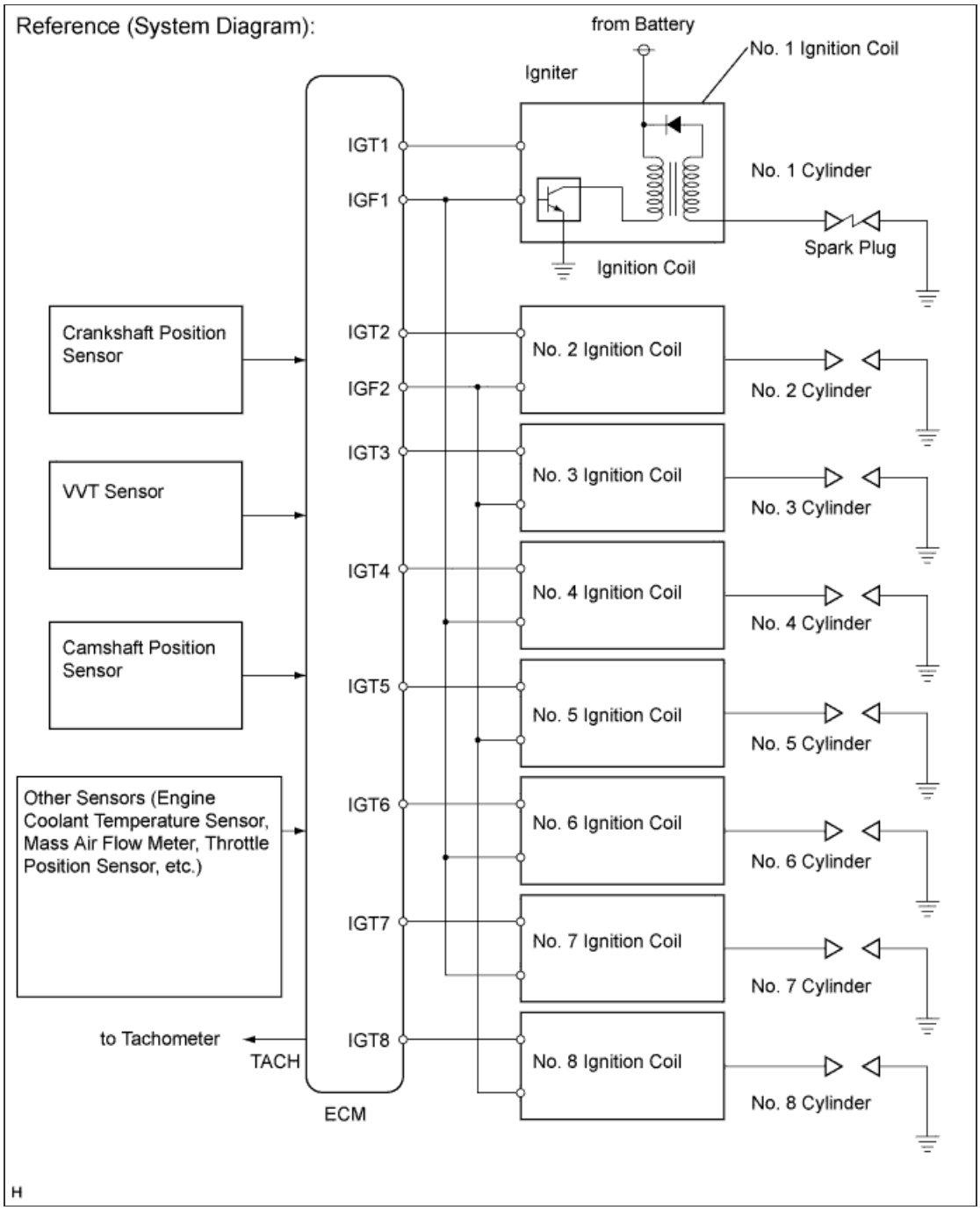
for Preparation Click here

DESCRIPTION

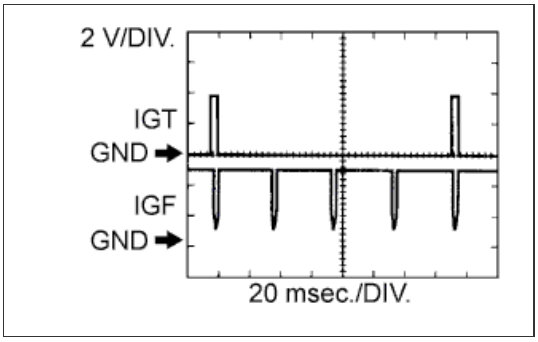
HINT:

- **These DTCs indicate malfunctions relating to the primary circuit.**
- **If DTC P0351 is output, check the No. 1 ignition coil circuit.**
- **If DTC P0352 is output, check the No. 2 ignition coil circuit.**
- **If DTC P0353 is output, check the No. 3 ignition coil circuit.**
- **If DTC P0354 is output, check the No. 4 ignition coil circuit.**
- **If DTC P0355 is output, check the No. 5 ignition coil circuit.**
- **If DTC P0356 is output, check the No. 6 ignition coil circuit.**
- **If DTC P0357 is output, check the No. 7 ignition coil circuit.**
- **If DTC P0358 is output, check the No. 8 ignition coil circuit.**

A Direct Ignition System (DIS) is used on this vehicle.
The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.
The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.



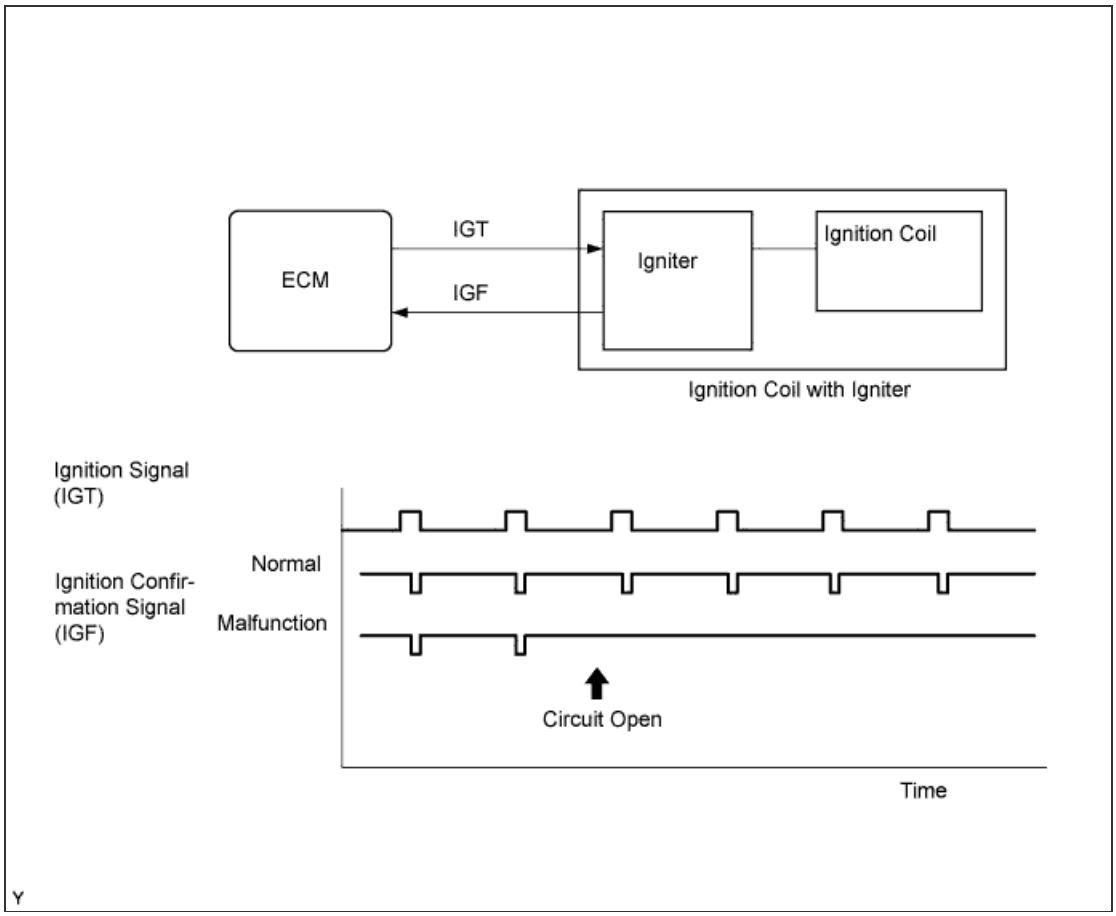
DTC Code	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356 P0357 P0358	No IGF signal is sent to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 8) between ignition coil and ECM • No. 1 to No. 8 ignition coils • ECM



Reference: Inspection using an oscilloscope.
While cranking or idling the engine, check the waveform between terminals IGT (1 to 8) and E1, and IGF1 or IGF2 and E1 of the ECM connector.

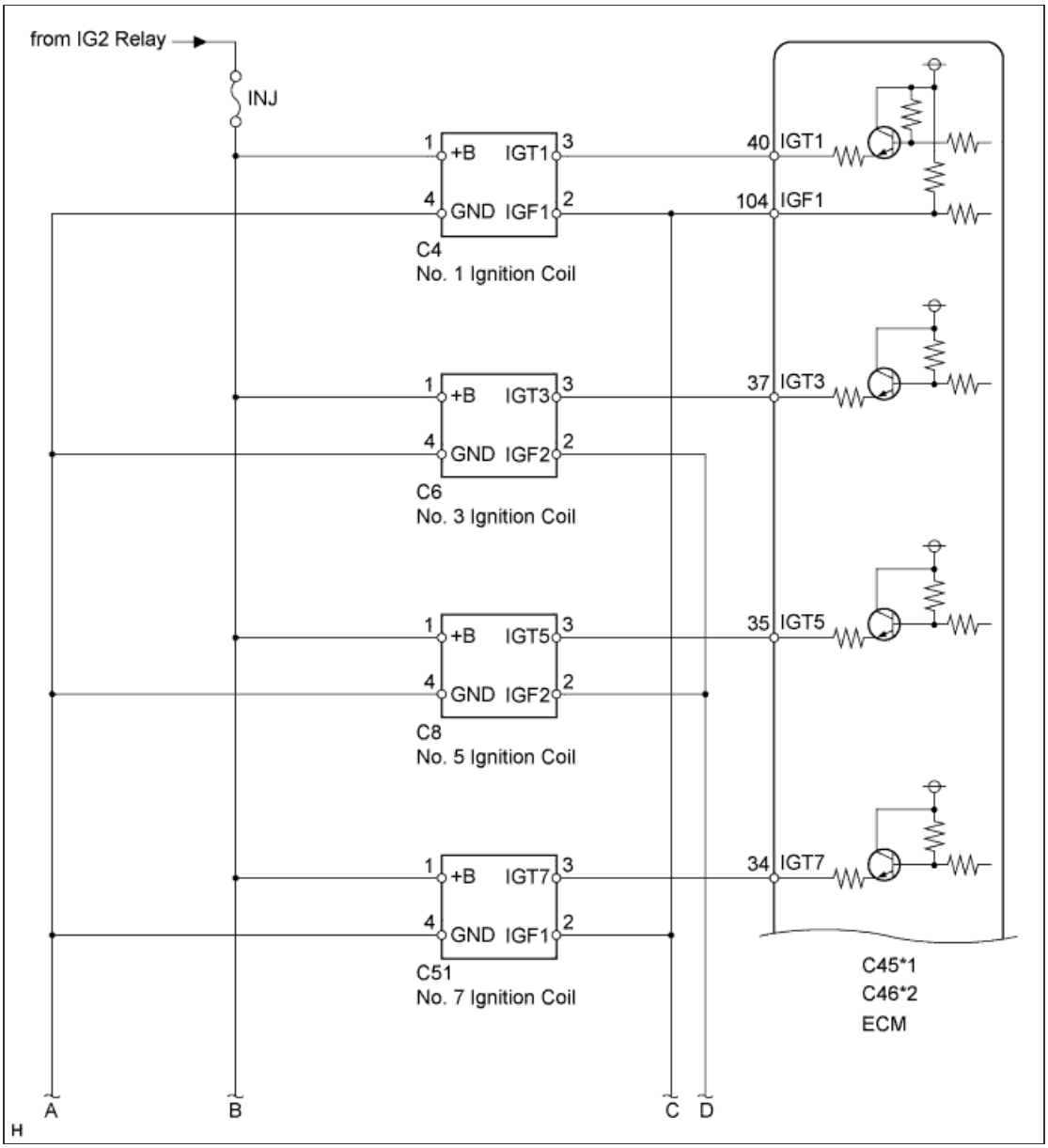
Item	Content
Terminal	CH1: IGT1, IGT2, IGT3, IGT4, IGT5, IGT6, IGT7, IGT8 - E1 CH2: IGF1, IGF2 - E1
Equipment Setting	2 V/DIV. 20 msec./DIV.
Condition	Cranking or idling

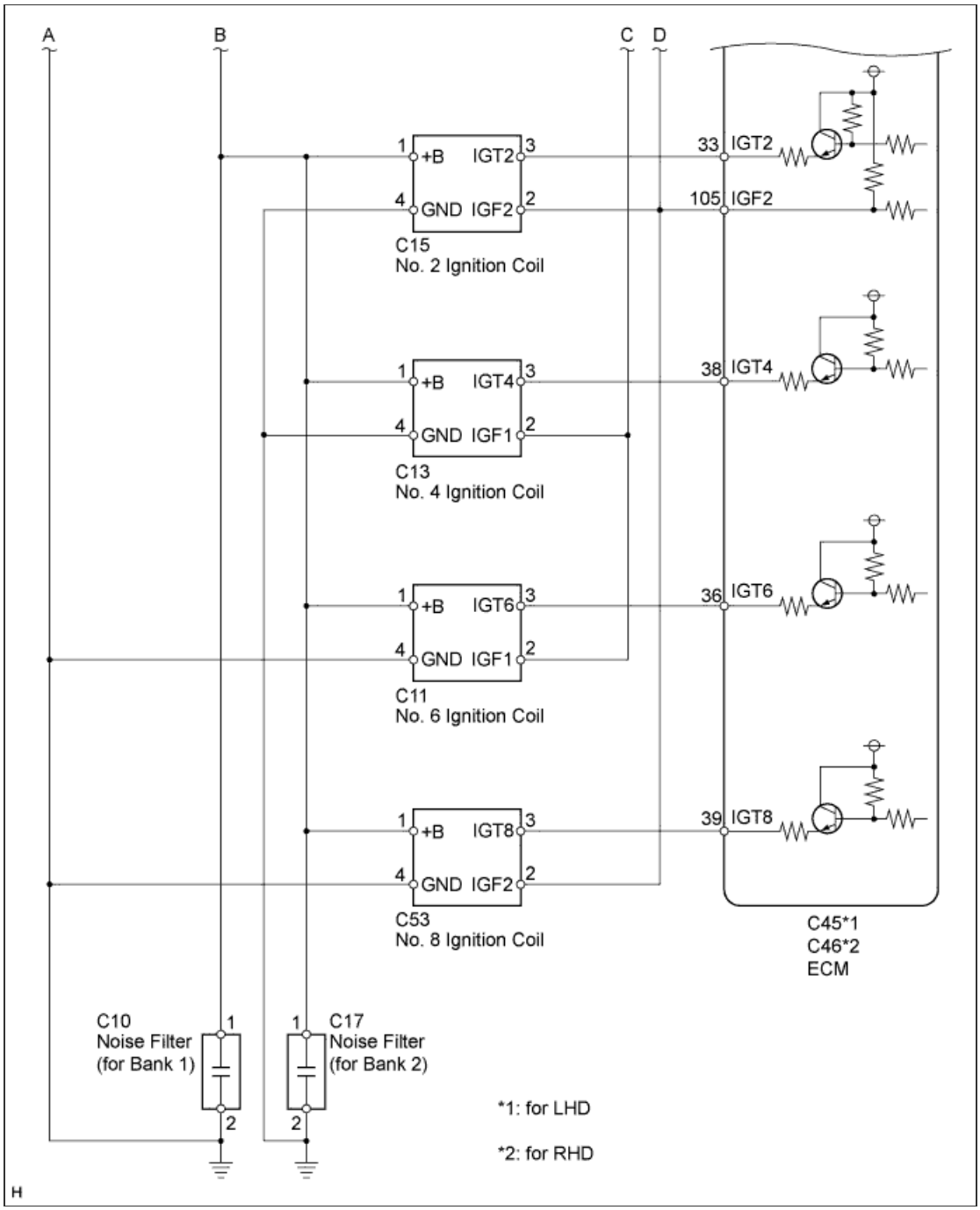
MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

WIRING DIAGRAM


from IG2 Relay
INJ
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
34
IGT7
C45*1
C46*2
ECM
A
B
C
D
H



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)

a. Disconnect the No. 1 to No. 8 ignition coil connectors.

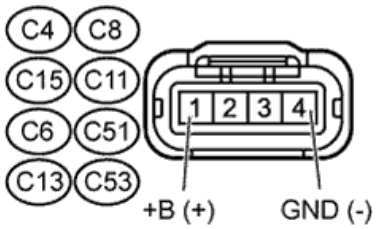
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C4-4 (GND) - Body ground	Always	Below 1 Ω
C15-4 (GND) - Body ground	Always	Below 1 Ω
C6-4 (GND) - Body ground	Always	Below 1 Ω

C13-4 (GND) - Body ground	Always	Below 1 Ω
C8-4 (GND) - Body ground	Always	Below 1 Ω
C11-4 (GND) - Body ground	Always	Below 1 Ω
C51-4 (GND) - Body ground	Always	Below 1 Ω
C53-4 (GND) - Body ground	Always	Below 1 Ω

Front view of wire harness connector:
(to Ignition Coil with Igniter)



c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C4-1 ( ) - C4-4 (GND)	Engine switch on (IG)	11 to 14 V
C15-1 ( ) - C15-4 (GND)	Engine switch on (IG)	11 to 14 V
C6-1 ( ) - C6-4 (GND)	Engine switch on (IG)	11 to 14 V
C13-1 ( ) - C13-4 (GND)	Engine switch on (IG)	11 to 14 V
C8-1 ( ) - C8-4 (GND)	Engine switch on (IG)	11 to 14 V
C11-1 ( ) - C11-4 (GND)	Engine switch on (IG)	11 to 14 V
C51-1 ( ) - C51-4 (GND)	Engine switch on (IG)	11 to 14 V
C53-1 ( ) - C53-4 (GND)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

a. Disconnect the No. 1 to No. 8 ignition coil connectors.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

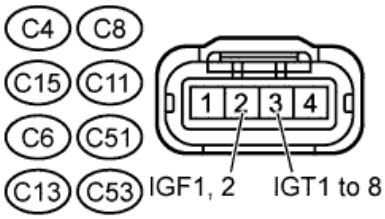
Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C15-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C45-40 (IGT1)	Always	Below 1 Ω

C15-3 (IGT2) - C45-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C45-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C45-38 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C45-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C45-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C45-34 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C45-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C45-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C45-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C45-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C45-38 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C45-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C45-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C45-34 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C45-39 (IGT8) - Body ground	Always	10 kΩ or higher

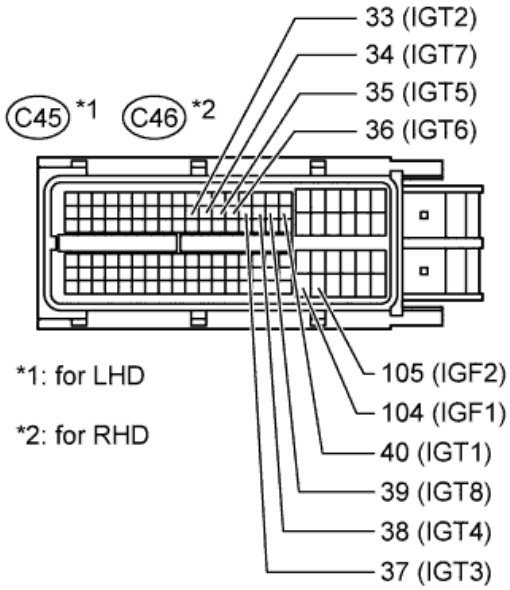
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω

Front view of wire harness connector:
(to Ignition Coil with Igniter)



Front view of wire harness connector:
(to ECM)



C15-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C46-40 (IGT1)	Always	Below 1 Ω
C15-3 (IGT2) - C46-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C46-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C46-38 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C46-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C46-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C46-34 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C46-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C46-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C46-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C46-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C46-38 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or		

C46-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C46-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C46-34 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C46-39 (IGT8) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353, P0354, P0355, P0356, P0357 OR P0358)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Shuffle arrangement of the ignition coils with igniters (among No. 1 to No. 8 cylinders).

NOTICE:

Do not shuffle the connectors.

e. Perform a simulation test.

f. Check the DTCs displayed on the tester.

Result

Result	Proceed to
Same DTC is output	A
Different ignition coil DTC is output	B

B → REPLACE IGNITION COIL ASSEMBLY (Click here)

A

REPLACE ECM (Click here)

DTC P2431 Secondary Air Injection System Air Flow / Pressure Sensor Circuit Range / Performance Bank1

DTC P2432 Secondary Air Injection System Air Flow / Pressure Sensor Circuit Low Bank1

DTC P2433 Secondary Air Injection System Air Flow / Pressure Sensor Circuit High Bank1

for Preparation Click here

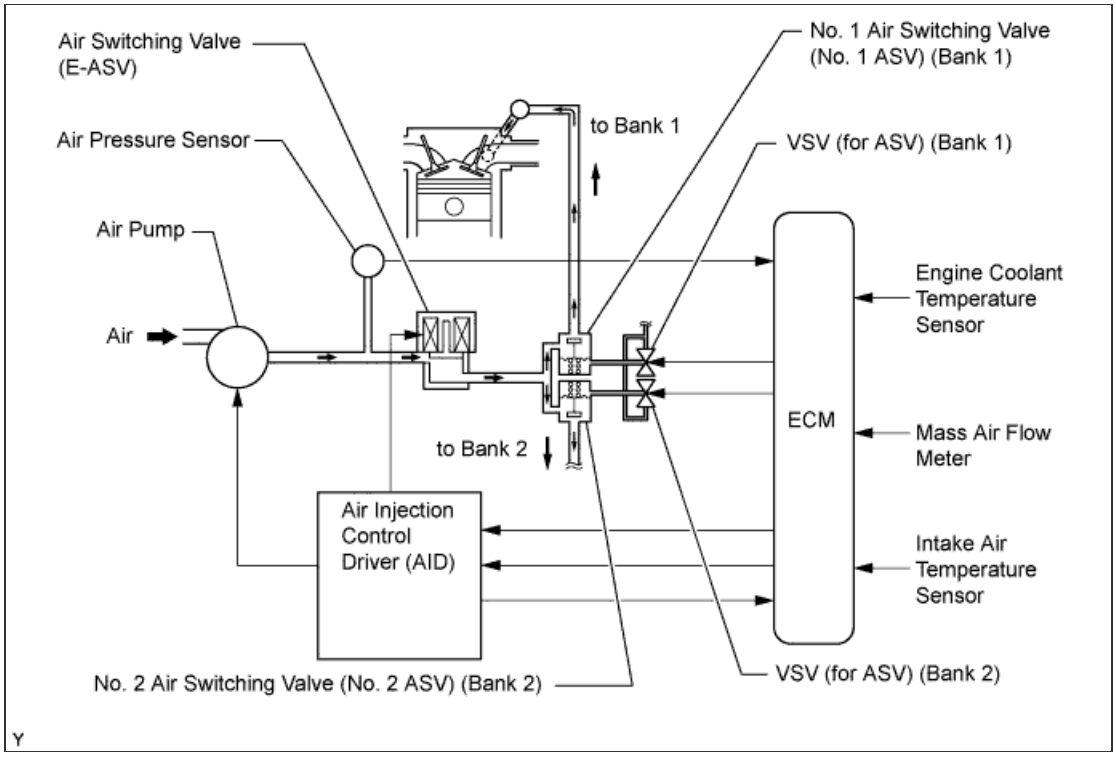
DESCRIPTION

The diagnostic trouble code (DTC) P2431 indicates that the pressure sensor of the secondary air injection (AIR) system malfunctions. The engine control module (ECM) monitors the sensor value to detect the malfunction. If the sensor value reaches the criteria (below 45 kPa or higher than 135 kPa), the ECM illuminates the malfunction indicator lamp (MIL), and stores a DTC.

The DTC P2432 and P2433 indicate an open or short circuit in the pressure sensor circuit. The ECM monitors the pressure sensor voltage to detect the open or short circuit. If the voltage reaches the criteria (below 0.1 V or higher than 4.8 V), the ECM illuminates the malfunction indicator lamp (MIL), and stores a DTC.

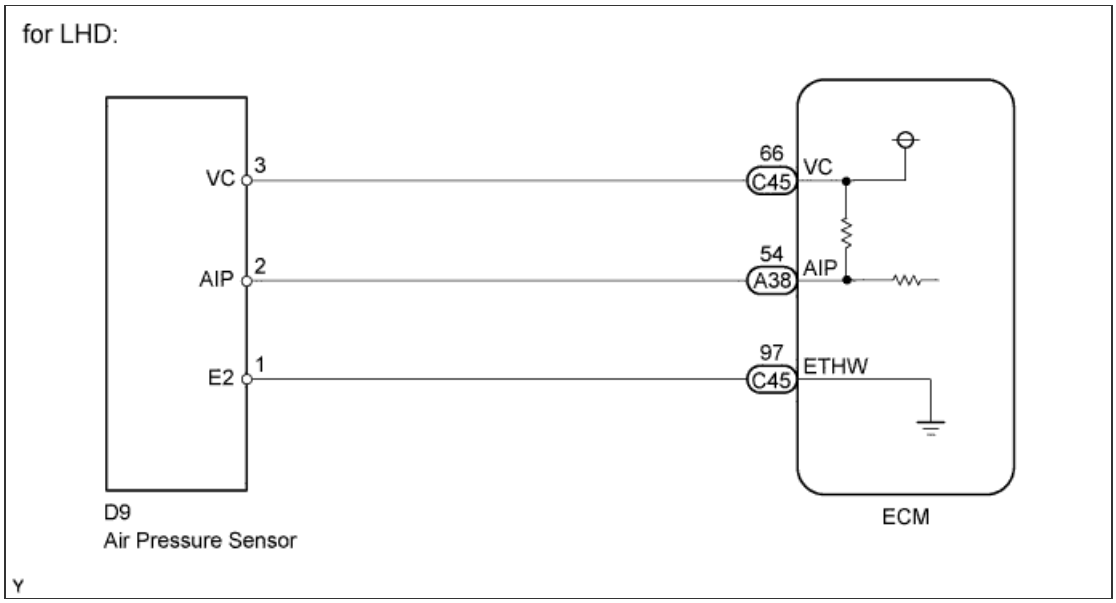
The pressure sensor detects the air pressure via a piezo element. The ECM applies 5 volts to the sensor, and it is varied with the air pressure. When the pressure is high, the voltage is high. When the pressure is low, the voltage is low.

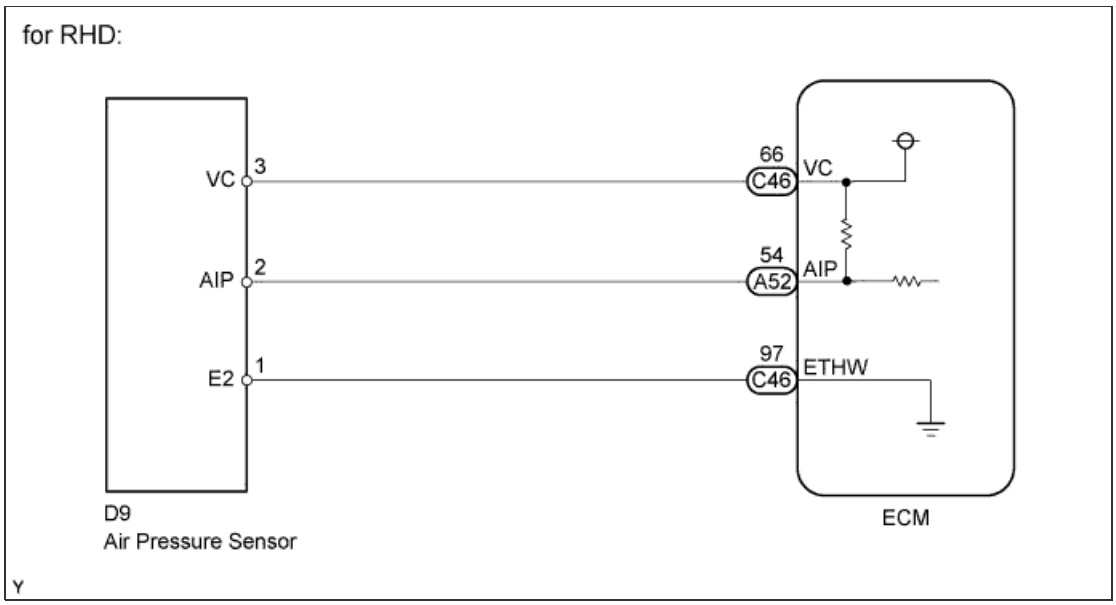
The secondary air injection (AIR) system introduces fresh air into the exhaust manifold in order to reduce carbon monoxide (CO) and hydrocarbon (HC) in the exhaust emission. This system is activated just after engine start, and is stopped when the catalyst converter is warmed-up. This system consists of the following components: 1) the air pump which sends fresh air to the exhaust manifold, 2) the electric air switching valve (E-ASV) which switches the fresh air flow, 3) the air switching valve (ASV) which switches the air passage to the exhaust manifold of each bank, 4) the vacuum switching valve (VSV) which switches the vacuum (intake manifold pressure) to operate the ASV, 5) the pressure sensor which detects the fresh air pressure and exhaust pulse, 6) the air injection control driver which controls the power sources of the air pump and E-ASV, 7) the engine control module (ECM) which controls and monitors this system.



DTC Code	DTC Detection Condition	Trouble Area
P2431	The pressure sensor indicates below 45 kPa (338 mmHg) or higher than 135 kPa (1013 mmHg) (2 trip detection logic).	• Pressure sensor circuit • Pressure sensor • ECM
P2432	The pressure sensor voltage is below 0.1 V (1 trip detection logic).	• Pressure sensor circuit • Pressure sensor • ECM
P2433	The pressure sensor voltage is higher than 4.8 V (1 trip detection logic).	• Pressure sensor circuit • Pressure sensor • ECM

WIRING DIAGRAM





INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.**

1.CHECK HARNESS AND CONNECTOR (AIR PRESSURE SENSOR - ECM)

a. Disconnect the air pressure sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

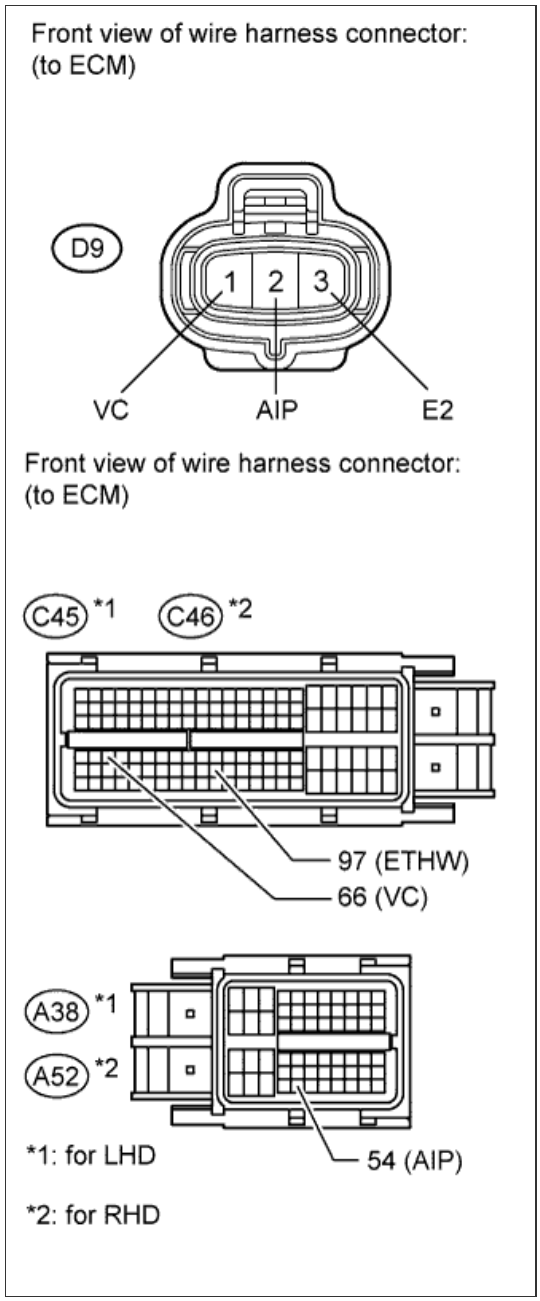
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C45-66 (VC) - D9-3 (VC)	Always	Below 1 Ω
A38-54 (AIP) - D9-2 (AIP)	Always	Below 1 Ω
C45-97 (ETHW) - D9-3 (ETHW)	Always	Below 1 Ω
C45-66 (VC) or		

D9-3 (VC) - body ground	Always	10 kΩ or higher
A38-54 (AIP) or D9-2 (AIP) (EPA) - body ground	Always	10 kΩ or higher
C45-97 (ETHW) or D9-3 (ETHW) - body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C46-66 (VC) - D9-3 (VC)	Always	Below 1 Ω
A52-54 (AIP) - D9-2 (AIP)	Always	Below 1 Ω
C46-97 (ETHW) - D9-3 (ETHW)	Always	Below 1 Ω
C46-66 (VC) or D9-3 (VC) - body ground	Always	10 kΩ or higher
A52-54 (AIP) or D9-2 (AIP) (EPA) - body ground	Always	10 kΩ or higher
C46-97 (ETHW) or D9-3 (ETHW) - body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (VC VOLTAGE)

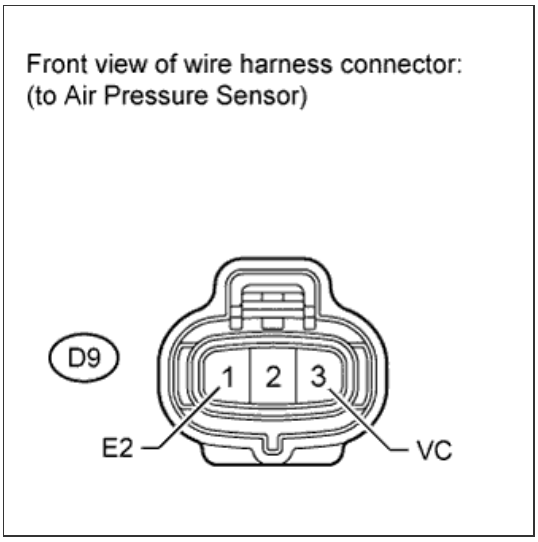
a. Remove the intake manifold (Click here).

b. Disconnect the air pressure sensor connector.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
D9-3 (VC) - D9-1 (VC)	Engine switch on (IG)	4.5 to 5.5 V



NG → REPLACE ECM (Click here)

OK

3.REPLACE AIR PRESSURE SENSOR

a. Replace the air pressure sensor (Click here).

NEXT

4.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Warm-up the engine.

e. Enter the following menus: Powertrain / Engine and ECT / Utility / Secondary Air Injection Check (Automatic Mode).

f. Perform the Active Test and check the pending DTC.

Result

Result	Proceed to
P2430, P2431, P2432, and/or P2433 is output	A
No DTC is output	B

NG → REPLACE ECM (Click here)

OK

END

DTC P0351 Ignition Coil "A" Primary / Secondary Circuit

DTC P0352 Ignition Coil "B" Primary / Secondary Circuit

DTC P0353 Ignition Coil "C" Primary / Secondary Circuit

DTC P0354 Ignition Coil "D" Primary / Secondary Circuit

DTC P0355 Ignition Coil "E" Primary / Secondary Circuit

DTC P0356 Ignition Coil "F" Primary / Secondary Circuit

DTC P0357 Ignition Coil "G" Primary / Secondary Circuit

DTC P0358 Ignition Coil "H" Primary / Secondary Circuit

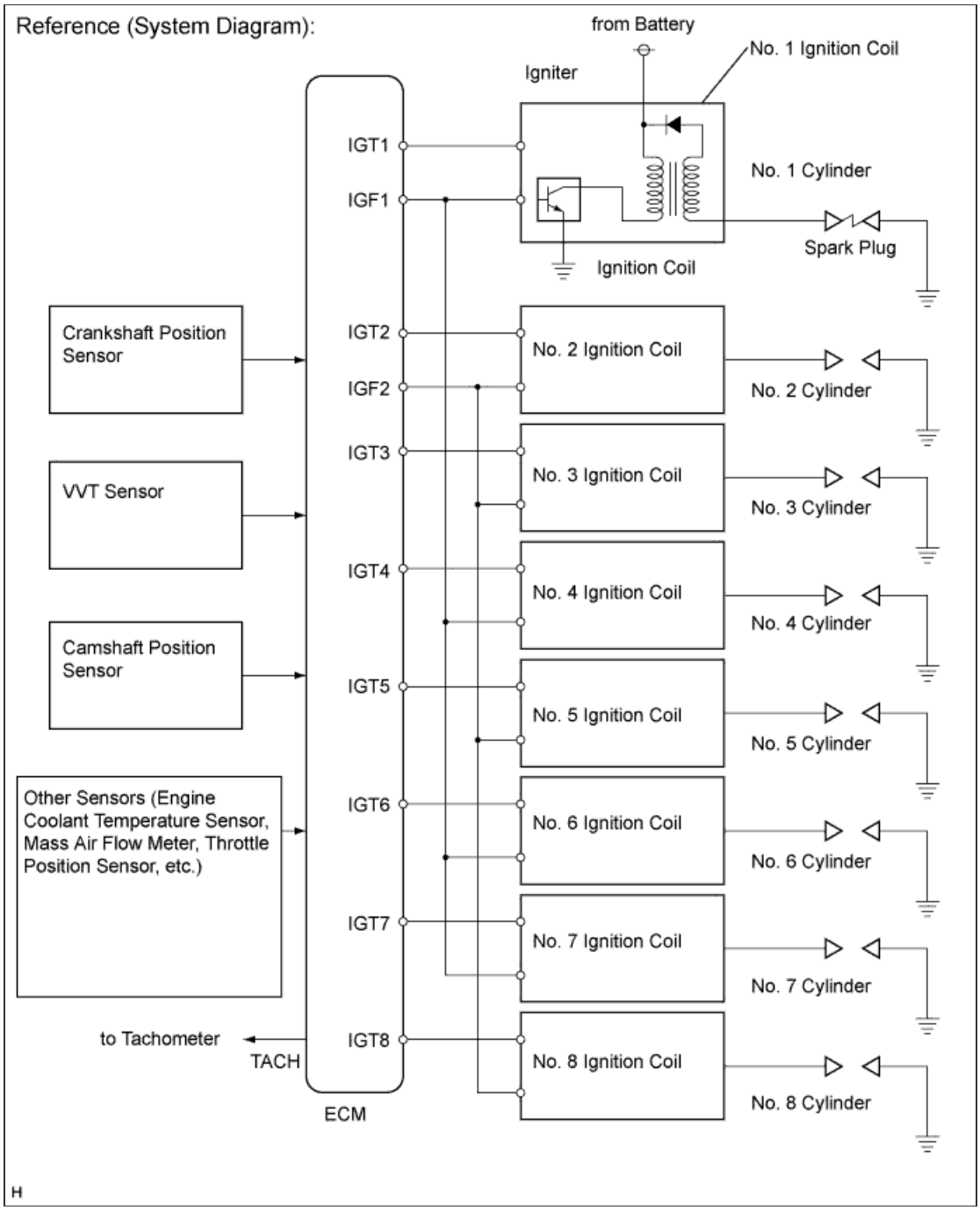
for Preparation Click here

DESCRIPTION

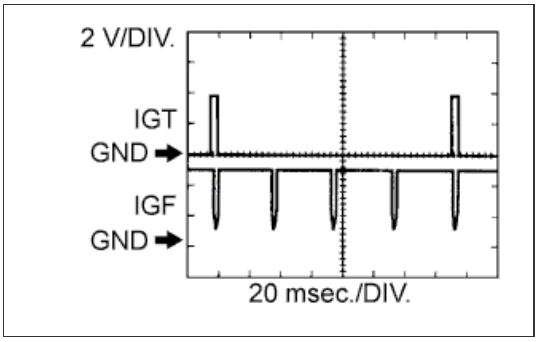
HINT:

- **These DTCs indicate malfunctions relating to the primary circuit.**
- **If DTC P0351 is output, check the No. 1 ignition coil circuit.**
- **If DTC P0352 is output, check the No. 2 ignition coil circuit.**
- **If DTC P0353 is output, check the No. 3 ignition coil circuit.**
- **If DTC P0354 is output, check the No. 4 ignition coil circuit.**
- **If DTC P0355 is output, check the No. 5 ignition coil circuit.**
- **If DTC P0356 is output, check the No. 6 ignition coil circuit.**
- **If DTC P0357 is output, check the No. 7 ignition coil circuit.**
- **If DTC P0358 is output, check the No. 8 ignition coil circuit.**

A Direct Ignition System (DIS) is used on this vehicle.
The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.
The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.



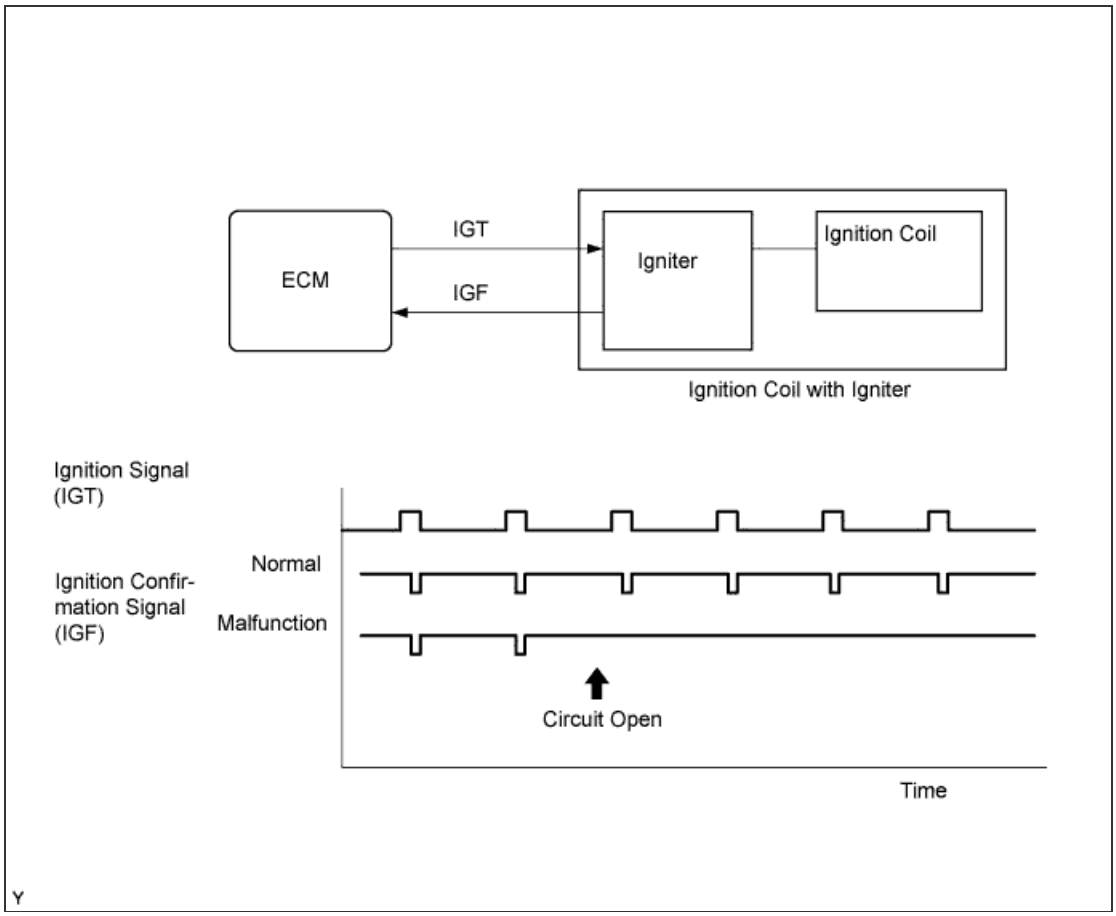
DTC Code	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356 P0357 P0358	No IGF signal is sent to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 8) between ignition coil and ECM • No. 1 to No. 8 ignition coils • ECM



Reference: Inspection using an oscilloscope.
While cranking or idling the engine, check the waveform between terminals IGT (1 to 8) and E1, and IGF1 or IGF2 and E1 of the ECM connector.

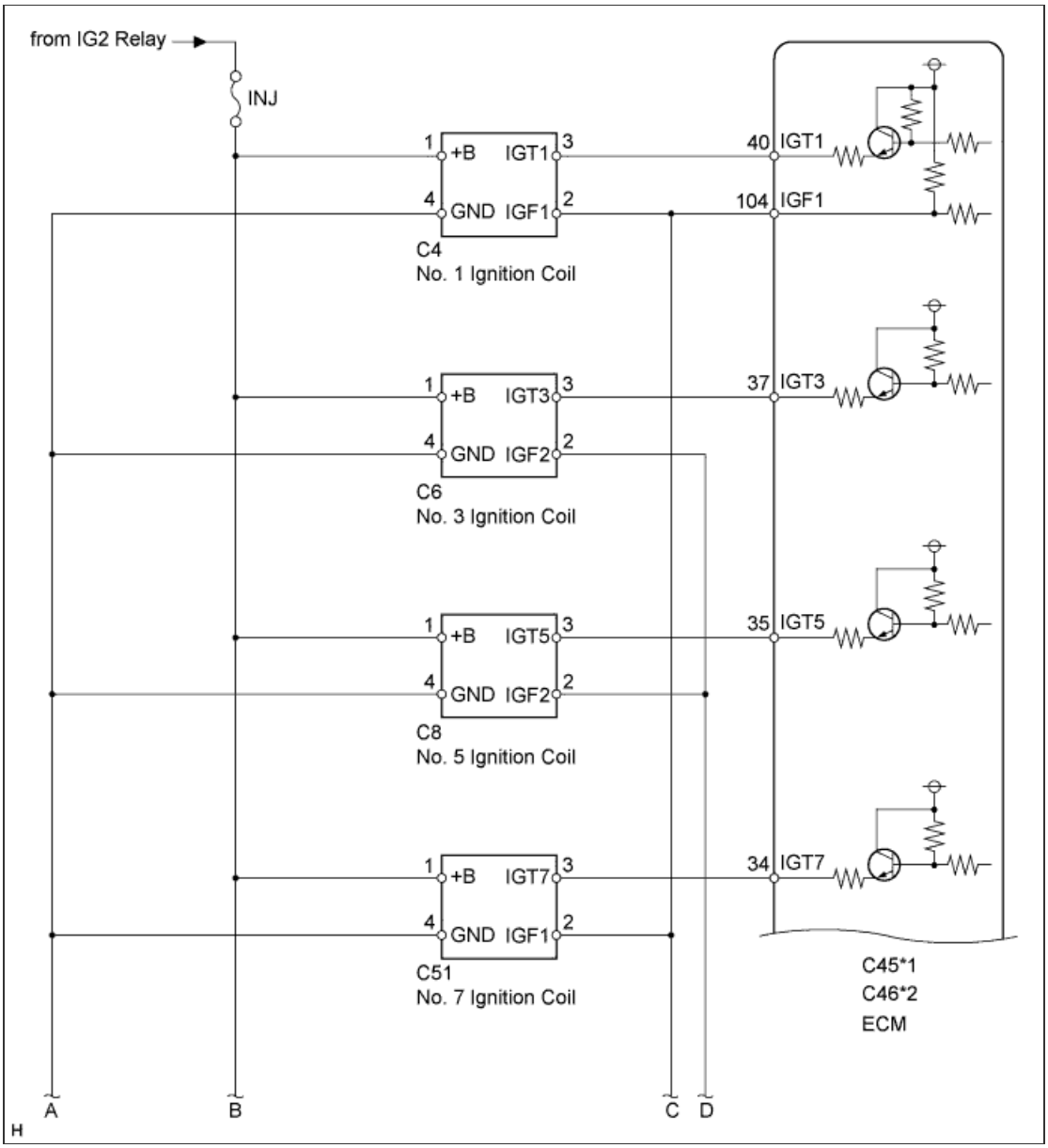
Item	Content
Terminal	CH1: IGT1, IGT2, IGT3, IGT4, IGT5, IGT6, IGT7, IGT8 - E1 CH2: IGF1, IGF2 - E1
Equipment Setting	2 V/DIV. 20 msec./DIV.
Condition	Cranking or idling

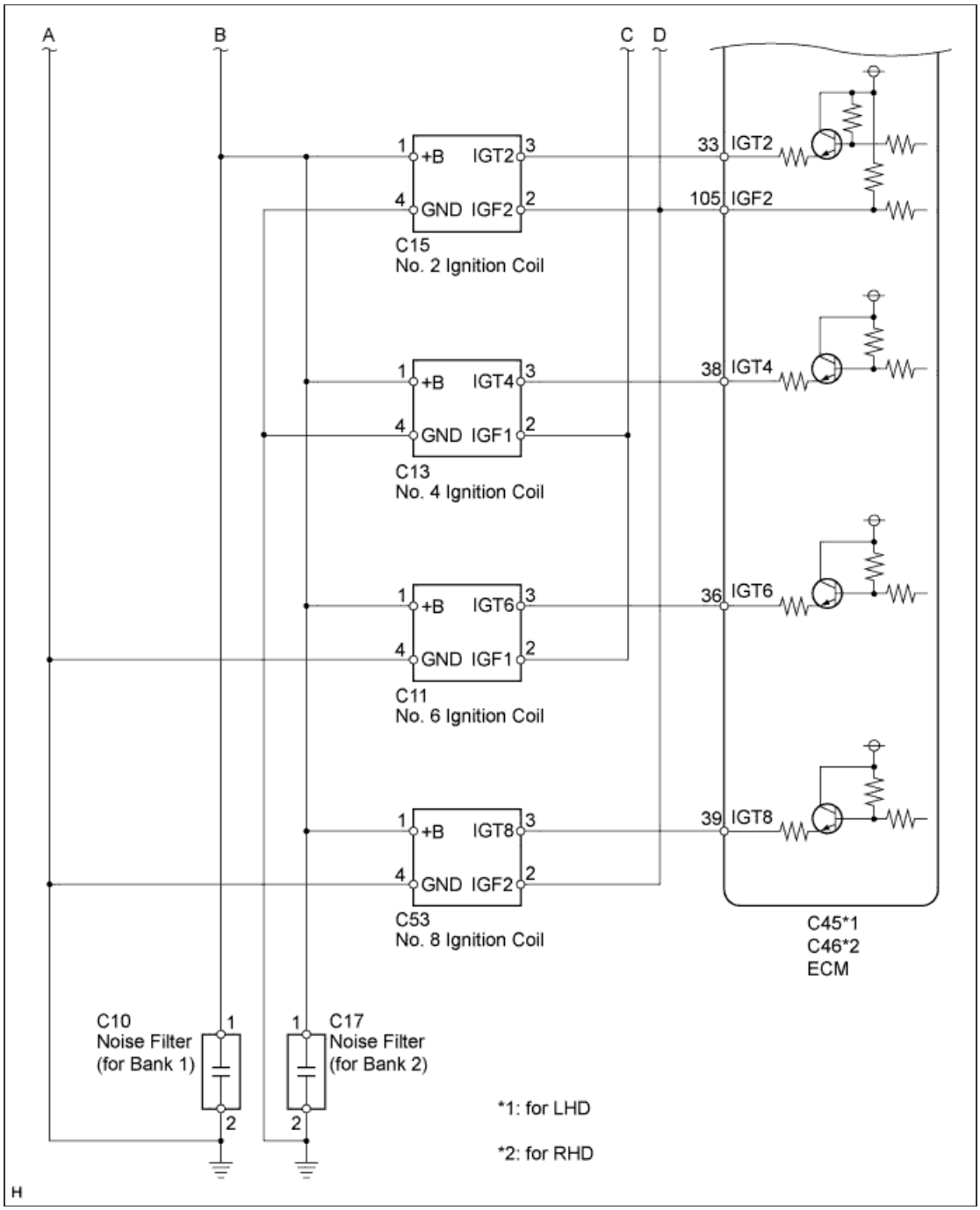
MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

WIRING DIAGRAM


from IG2 Relay
INJ
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
34
IGT7
C45*1
C46*2
ECM
A
B
C
D
H



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)

a. Disconnect the No. 1 to No. 8 ignition coil connectors.

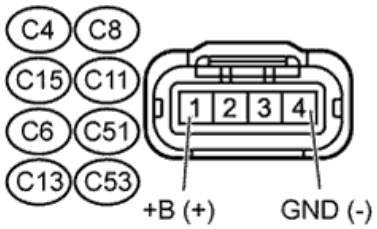
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C4-4 (GND) - Body ground	Always	Below 1 Ω
C15-4 (GND) - Body ground	Always	Below 1 Ω
C6-4 (GND) - Body ground	Always	Below 1 Ω

C13-4 (GND) - Body ground	Always	Below 1 Ω
C8-4 (GND) - Body ground	Always	Below 1 Ω
C11-4 (GND) - Body ground	Always	Below 1 Ω
C51-4 (GND) - Body ground	Always	Below 1 Ω
C53-4 (GND) - Body ground	Always	Below 1 Ω

Front view of wire harness connector:
(to Ignition Coil with Igniter)



c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C4-1 ( ) - C4-4 (GND)	Engine switch on (IG)	11 to 14 V
C15-1 ( ) - C15-4 (GND)	Engine switch on (IG)	11 to 14 V
C6-1 ( ) - C6-4 (GND)	Engine switch on (IG)	11 to 14 V
C13-1 ( ) - C13-4 (GND)	Engine switch on (IG)	11 to 14 V
C8-1 ( ) - C8-4 (GND)	Engine switch on (IG)	11 to 14 V
C11-1 ( ) - C11-4 (GND)	Engine switch on (IG)	11 to 14 V
C51-1 ( ) - C51-4 (GND)	Engine switch on (IG)	11 to 14 V
C53-1 ( ) - C53-4 (GND)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

a. Disconnect the No. 1 to No. 8 ignition coil connectors.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

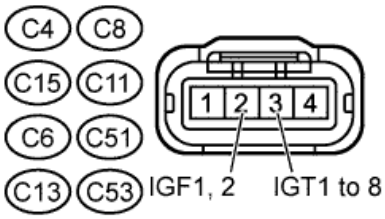
Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C15-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C45-40 (IGT1)	Always	Below 1 Ω

C15-3 (IGT2) - C45-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C45-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C45-38 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C45-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C45-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C45-34 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C45-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C45-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C45-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C45-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C45-38 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C45-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C45-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C45-34 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C45-39 (IGT8) - Body ground	Always	10 kΩ or higher

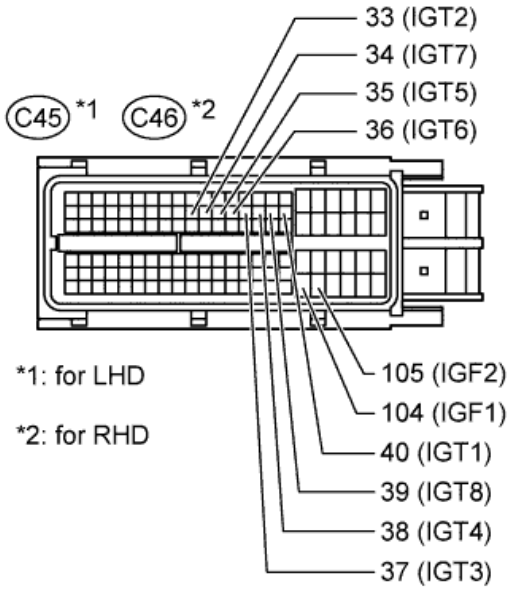
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω

Front view of wire harness connector:
(to Ignition Coil with Igniter)



Front view of wire harness connector:
(to ECM)



C15-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C46-40 (IGT1)	Always	Below 1 Ω
C15-3 (IGT2) - C46-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C46-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C46-38 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C46-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C46-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C46-34 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C46-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C46-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C46-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C46-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C46-38 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or		

C46-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C46-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C46-34 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C46-39 (IGT8) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353, P0354, P0355, P0356, P0357 OR P0358)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Shuffle arrangement of the ignition coils with igniters (among No. 1 to No. 8 cylinders).

NOTICE:

Do not shuffle the connectors.

e. Perform a simulation test.

f. Check the DTCs displayed on the tester.

Result

Result	Proceed to
Same DTC is output	A
Different ignition coil DTC is output	B

B → REPLACE IGNITION COIL ASSEMBLY (Click here)

A

REPLACE ECM (Click here)

DTC P2444 Secondary Air Injection System Pump Stuck On Bank1

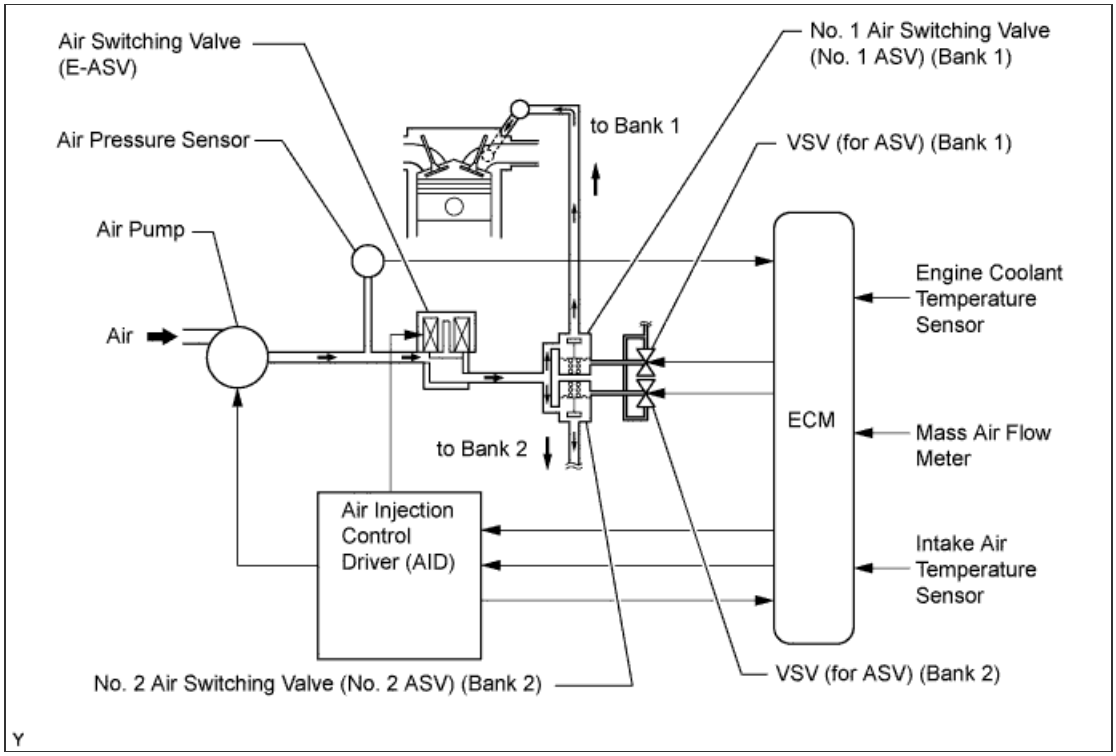
DTC P2445 Secondary Air Injection System Pump Stuck Off Bank1

for Preparation Click here

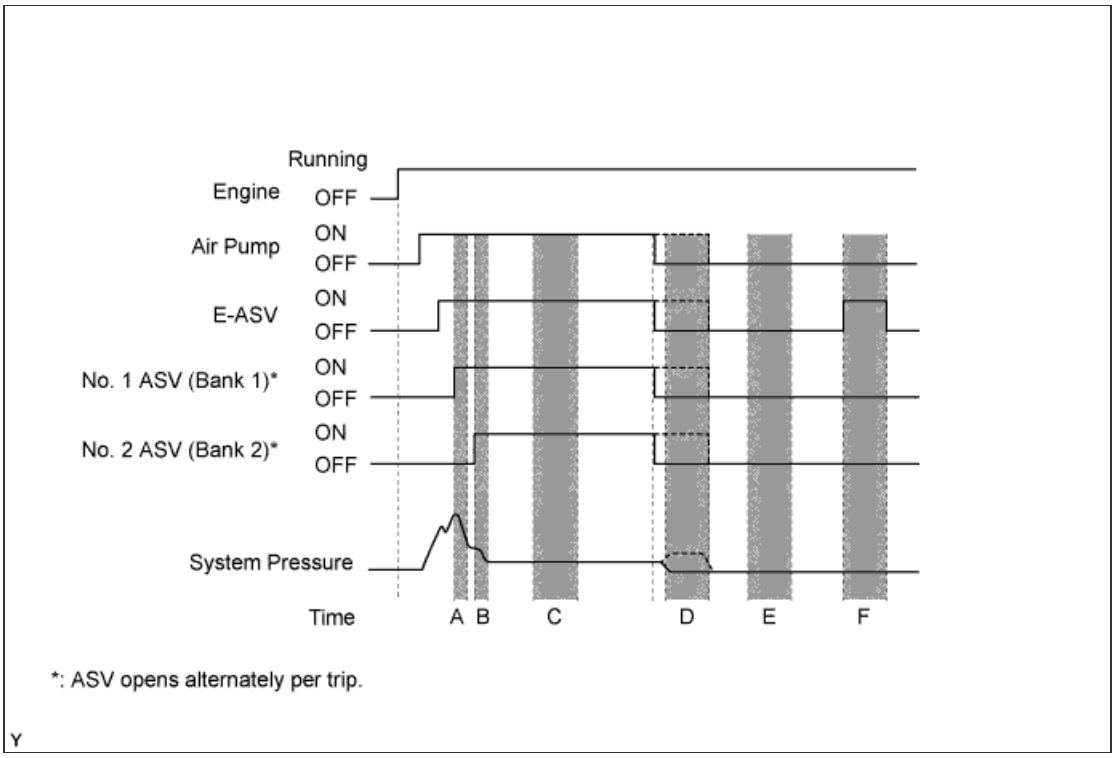
DESCRIPTION

The diagnostic trouble code (DTC) indicates that the air pump of the secondary air injection (AIR) system malfunctions. The engine control module (ECM) operates entire components of this system in a sequence, and monitors the system pressure and exhaust pulse (AIR monitor). This monitor will run just after a cold engine start. If abnormal pressure and exhaust pulse are detected, the ECM interprets this as a malfunction. When the malfunction is detected in consecutive driving cycle, the ECM illuminates the malfunction indicator lamp (MIL), and stores a DTC.

The secondary air injection (AIR) system introduces fresh air into the exhaust manifold in order to reduce carbon monoxide (CO) and hydrocarbon (HC) in the exhaust emission. This system is activated just after engine start, and is stopped when the catalyst converter is warmed-up. This system consists of the following components: 1) the air pump which sends fresh air to the exhaust manifold, 2) the electric air switching valve (E-ASV) which switches the fresh air flow, 3) the air switching valve (ASV) which switches the air passage to the exhaust manifold of each bank, 4) the vacuum switching valve (VSV) which switches the vacuum (intake manifold pressure) to operate the ASV, 5) the pressure sensor which detects the fresh air pressure and exhaust pulse, 6) the air injection control driver which controls the power sources of the air pump and E-ASV, 7) the engine control module (ECM) which controls and monitors this system.



Reference 1: Operation of each component during AIR monitor



Y

Reference 2: DTC Storing Conditions

Time A [Pressure Change]	Time B [Pressure Change]	Time C [See Chart Below]	Time D [Exhaust Pulse]	Time E [Exhaust Pulse]	Time F [See Chart Below]	DTC
Yes	Yes	Pattern 1	-	No	Pattern 4	Normal
Yes	No	Pattern 1	Yes	No	Pattern 4	
Yes	Yes	Pattern 1	-	No	Pattern 1	P1441 P1444 P2444
No	Yes	Pattern 1	-	No	Pattern 1	
Yes	No	Pattern 1	Yes	No	Pattern 1	
No	No	Pattern 1	Yes	No	Pattern 1	
Yes	Yes	Pattern 1	-	No	Pattern 3	P2444
No	Yes	Pattern 1	-	No	Pattern 3	P1442 P1445 P2444
Yes	No	Pattern 1	No	No	Pattern 3	
No	No	Pattern 1	No	No	Pattern 3	P1442 P1444 P2444
No	No	Pattern 2	-	-	-	P2445
No	No	Pattern 4	-	-	-	P1442 P1445 P2441 P2444
No	No	Pattern 3	No	No	Pattern 3	

Reference 3: System Pressure and Exhaust Pulse

Pattern	System Pressure	Exhaust Pulse
1	High	Yes
2	Low	Yes
3	High	No
4	Low	No

DTC Code

DTC Code	DTC Detection Condition	Trouble Area
P2444	The air pump is stuck on (2 trip detection logic).	• Air pump • Pressure sensor
P2445	- The air pump is stuck off (2 trip detection logic). - The air injection amount is insufficient (2 trip detection logic).	• Air pump • Pressure sensor • Air injection system piping • Pressure sensor

WIRING DIAGRAM

Refer to DTC P0412 (Click here).

INSPECTION PROCEDURE

HINT:

Read free e frame data using the intelligent tester. Free e frame data records the engine conditions when malfunctions are detected. When troubleshooting, free e frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.PERFORM SECONDARY AIR INJECTION SYSTEM CHECK (AUTOMATIC MODE)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Record the DTCs and free e frame data.

d. Clear the DTCs (Click here).

e. Warm-up the engine.

f. Enter the following menus: Powertrain / Engine and ECT / Utility / Secondary Air Injection Check (Automatic Mode).

g. Perform the Active Test and check the pending DTC.

Result

Result	Proceed to
P2444 and P2445 is output	A
DTCs other than P2444 and P2445 are output	B
No DTC is output	C

B → GO TO DTC CHART (Click here)

C → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

2.CHECK VACUUM HOSE

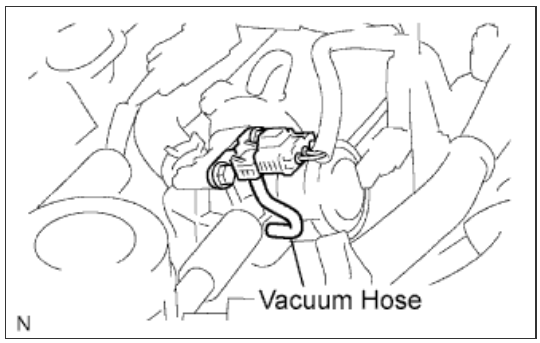
a. Remove the intake manifold (Click here).

b. Check the vacuum hose connection between the pressure sensor and air switching valve.

OK:
The vacuum hose is securely connected.

c. Inspect the vacuum hose for blockage and damage.

OK:
The vacuum hose has no blockage or damage.



NG → REPAIR OR REPLACE VACUUM HOSE

OK

3.READ VALUE USING INTELLIGENT TESTER (AIR VOLTAGE)

a. Remove the intake manifold (Click here).

b. Connect the pressure gauge to the pressure sensor as shown in the illustration.

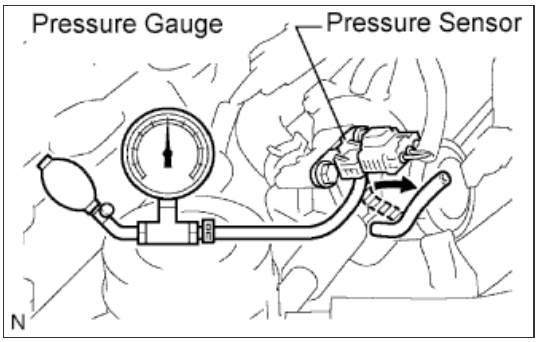
c. Connect the intelligent tester to the DLC3.

d. Turn the engine switch on (IG) and turn the tester on (do not start the engine).

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Air pump pressure.

f. When applying pressure by the hand pump, check that the air pump pressure is almost same as the pressure gauge indication.

OK:
Pressure fluctuates in response to the pressure applied with pressure gauge.



NG → REPLACE AIR PRESSURE SENSOR (Click here)

OK

4.CHECK HOSE AND PIPE

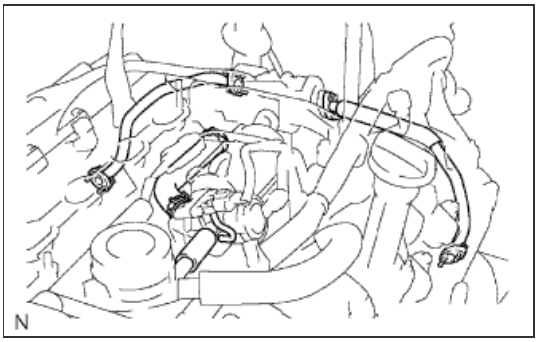
a. Remove the intake manifold (Click here).

b. Check that all the pipes and hoses between the air pump and air switching valve are securely connected.

OK:
All air injection pipes and hoses are securely connected.

c. Check all pipes and hoses for blockages and damage.

OK:
All air injection pipes and hoses have no blockages or damage.



NG → REPAIR OR REPLACE HOSES AND TUBES (Click here)

OK

REPLACE AIR PUMP ASSEMBLY (Click here)

DTC P0351 Ignition Coil "A" Primary / Secondary Circuit

DTC P0352 Ignition Coil "B" Primary / Secondary Circuit

DTC P0353 Ignition Coil "C" Primary / Secondary Circuit

DTC P0354 Ignition Coil "D" Primary / Secondary Circuit

DTC P0355 Ignition Coil "E" Primary / Secondary Circuit

DTC P0356 Ignition Coil "F" Primary / Secondary Circuit

DTC P0357 Ignition Coil "G" Primary / Secondary Circuit

DTC P0358 Ignition Coil "H" Primary / Secondary Circuit

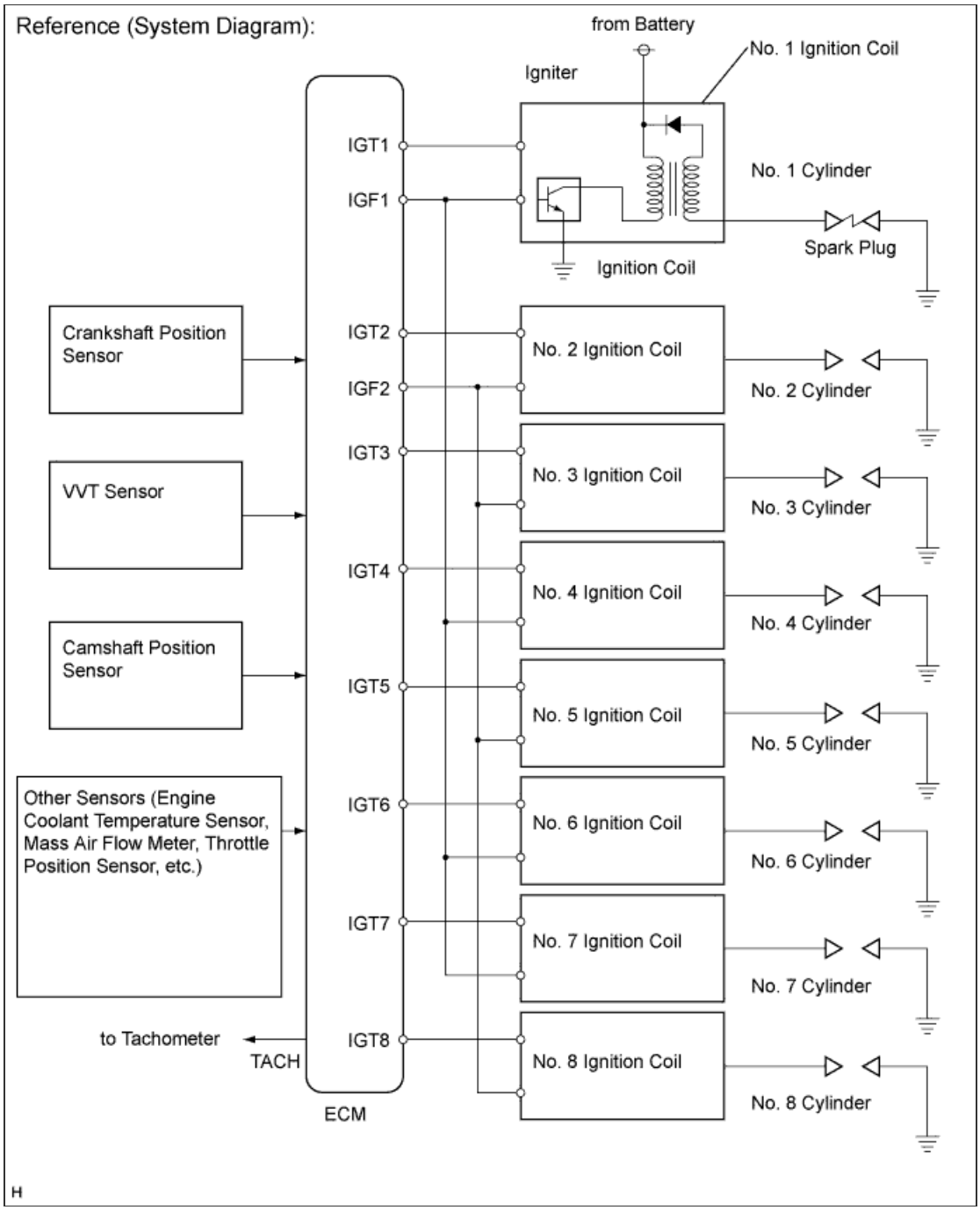
for Preparation Click here

DESCRIPTION

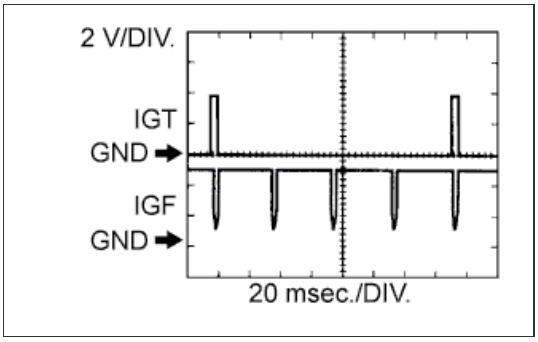
HINT:

- **These DTCs indicate malfunctions relating to the primary circuit.**
- **If DTC P0351 is output, check the No. 1 ignition coil circuit.**
- **If DTC P0352 is output, check the No. 2 ignition coil circuit.**
- **If DTC P0353 is output, check the No. 3 ignition coil circuit.**
- **If DTC P0354 is output, check the No. 4 ignition coil circuit.**
- **If DTC P0355 is output, check the No. 5 ignition coil circuit.**
- **If DTC P0356 is output, check the No. 6 ignition coil circuit.**
- **If DTC P0357 is output, check the No. 7 ignition coil circuit.**
- **If DTC P0358 is output, check the No. 8 ignition coil circuit.**

A Direct Ignition System (DIS) is used on this vehicle.
The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.
The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.



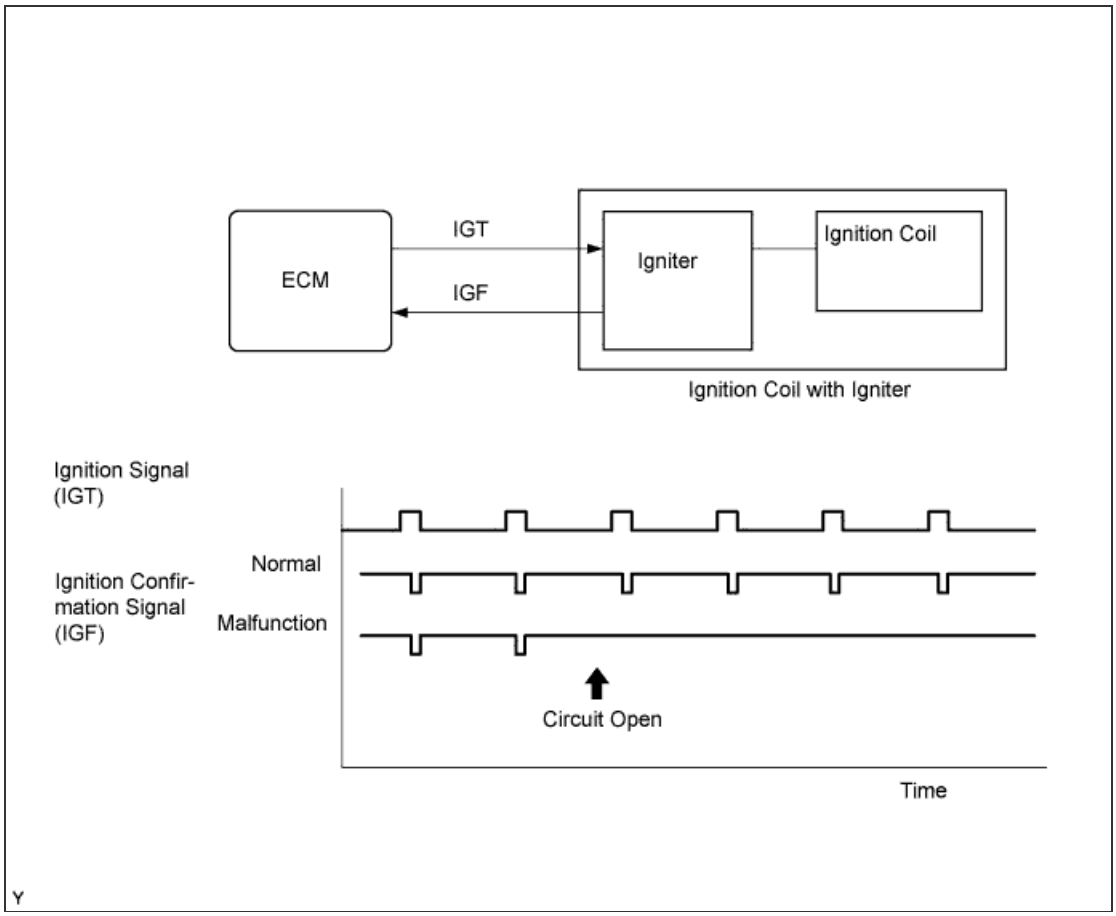
DTC Code	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356 P0357 P0358	No IGF signal is sent to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 8) between ignition coil and ECM • No. 1 to No. 8 ignition coils • ECM



Reference: Inspection using an oscilloscope.
While cranking or idling the engine, check the waveform between terminals IGT (1 to 8) and E1, and IGF1 or IGF2 and E1 of the ECM connector.

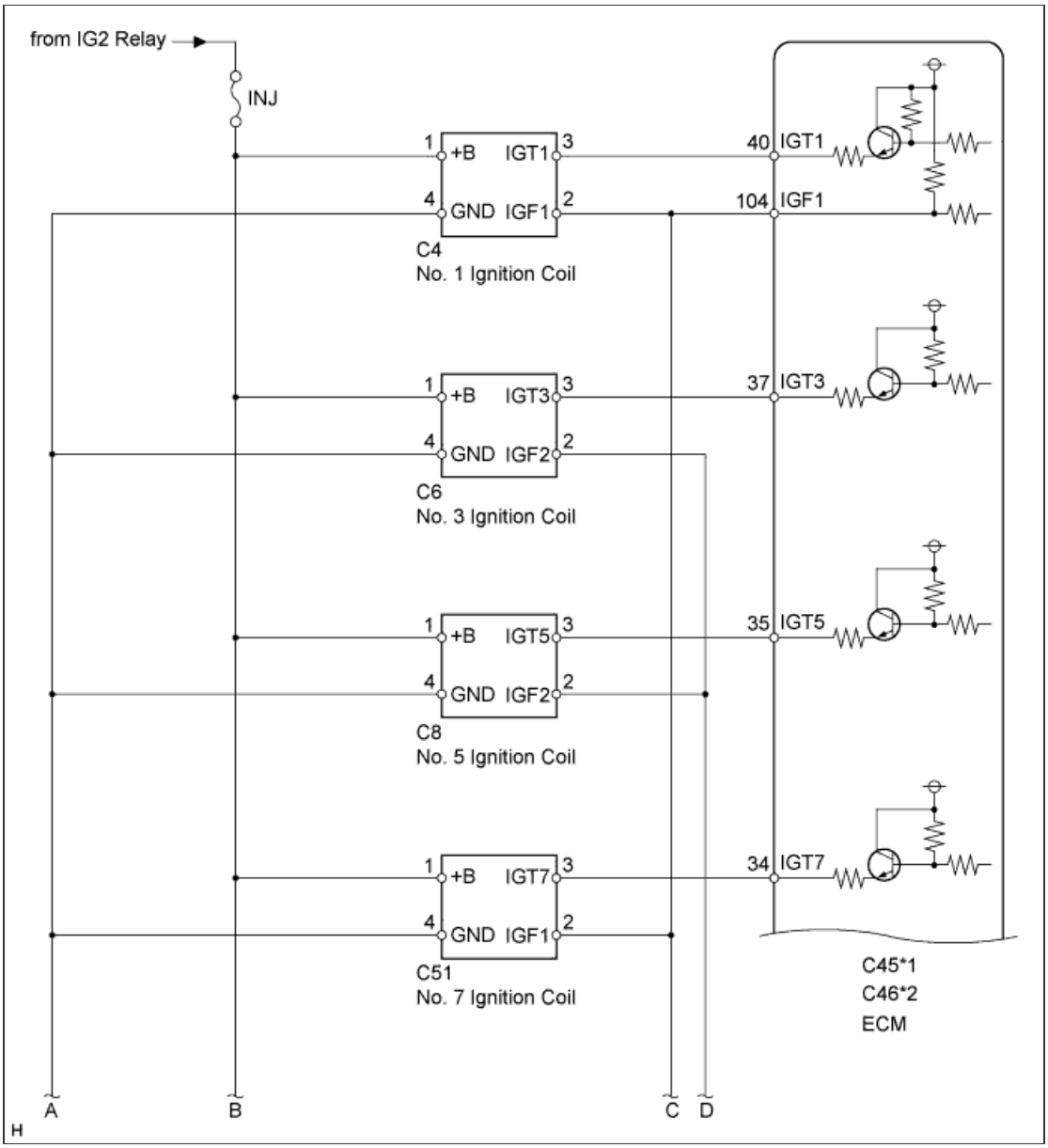
Item	Content
Terminal	CH1: IGT1, IGT2, IGT3, IGT4, IGT5, IGT6, IGT7, IGT8 - E1 CH2: IGF1, IGF2 - E1
Equipment Setting	2 V/DIV. 20 msec./DIV.
Condition	Cranking or idling

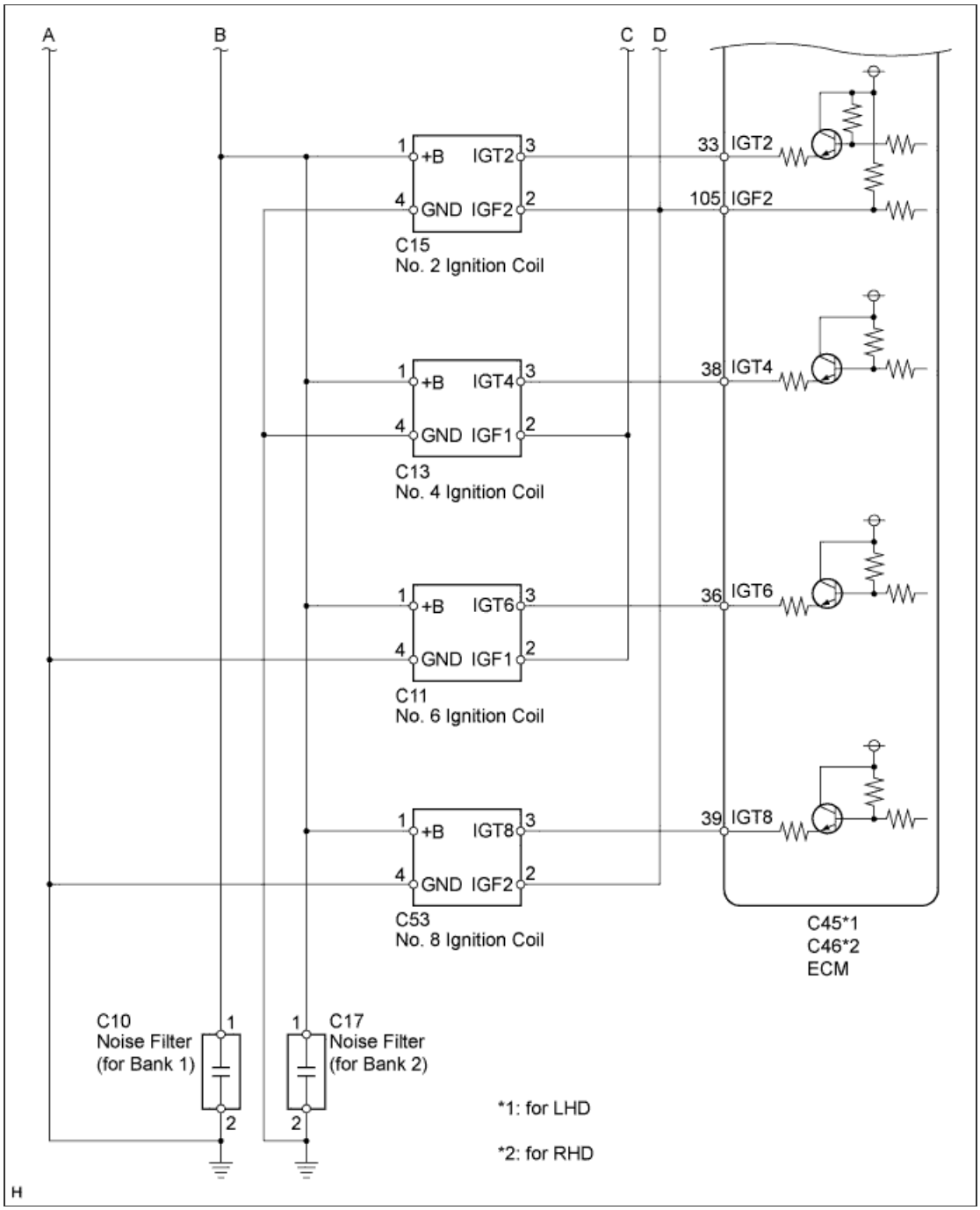
MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

WIRING DIAGRAM


from IG2 Relay
INJ
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
34
IGT7
C45*1
C46*2
ECM
A
B
C
D
H



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)

a. Disconnect the No. 1 to No. 8 ignition coil connectors.

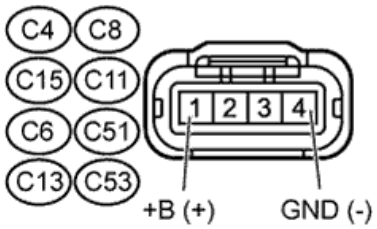
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C4-4 (GND) - Body ground	Always	Below 1 Ω
C15-4 (GND) - Body ground	Always	Below 1 Ω
C6-4 (GND) - Body ground	Always	Below 1 Ω

C13-4 (GND) - Body ground	Always	Below 1 Ω
C8-4 (GND) - Body ground	Always	Below 1 Ω
C11-4 (GND) - Body ground	Always	Below 1 Ω
C51-4 (GND) - Body ground	Always	Below 1 Ω
C53-4 (GND) - Body ground	Always	Below 1 Ω

Front view of wire harness connector:
(to Ignition Coil with Igniter)



c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C4-1 ( ) - C4-4 (GND)	Engine switch on (IG)	11 to 14 V
C15-1 ( ) - C15-4 (GND)	Engine switch on (IG)	11 to 14 V
C6-1 ( ) - C6-4 (GND)	Engine switch on (IG)	11 to 14 V
C13-1 ( ) - C13-4 (GND)	Engine switch on (IG)	11 to 14 V
C8-1 ( ) - C8-4 (GND)	Engine switch on (IG)	11 to 14 V
C11-1 ( ) - C11-4 (GND)	Engine switch on (IG)	11 to 14 V
C51-1 ( ) - C51-4 (GND)	Engine switch on (IG)	11 to 14 V
C53-1 ( ) - C53-4 (GND)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

a. Disconnect the No. 1 to No. 8 ignition coil connectors.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

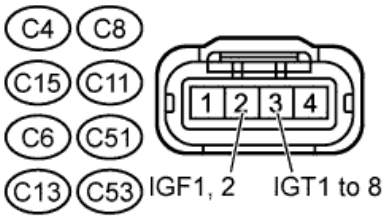
Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C15-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C45-40 (IGT1)	Always	Below 1 Ω

C15-3 (IGT2) - C45-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C45-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C45-38 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C45-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C45-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C45-34 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C45-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C45-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C45-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C45-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C45-38 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C45-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C45-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C45-34 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C45-39 (IGT8) - Body ground	Always	10 kΩ or higher

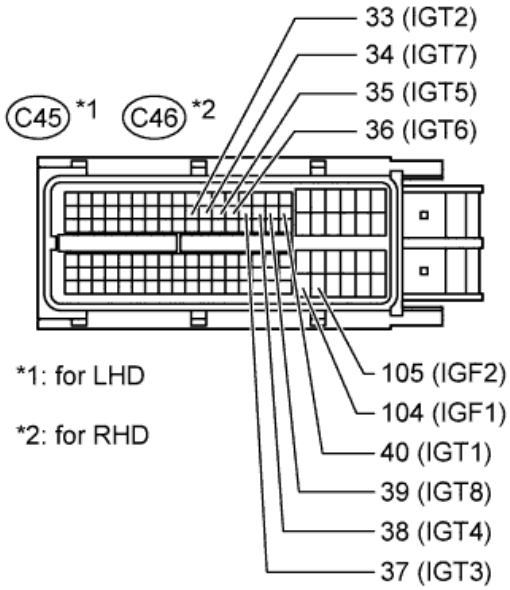
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω

Front view of wire harness connector:
(to Ignition Coil with Igniter)



Front view of wire harness connector:
(to ECM)



C15-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C46-40 (IGT1)	Always	Below 1 Ω
C15-3 (IGT2) - C46-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C46-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C46-38 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C46-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C46-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C46-34 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C46-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C46-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C46-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C46-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C46-38 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or		

C46-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C46-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C46-34 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C46-39 (IGT8) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353, P0354, P0355, P0356, P0357 OR P0358)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Shuffle arrangement of the ignition coils with igniters (among No. 1 to No. 8 cylinders).

NOTICE:

Do not shuffle the connectors.

e. Perform a simulation test.

f. Check the DTCs displayed on the tester.

Result

Result	Proceed to
Same DTC is output	A
Different ignition coil DTC is output	B

B → REPLACE IGNITION COIL ASSEMBLY (Click here)

A

REPLACE ECM (Click here)

DTC P2444 Secondary Air Injection System Pump Stuck On Bank1

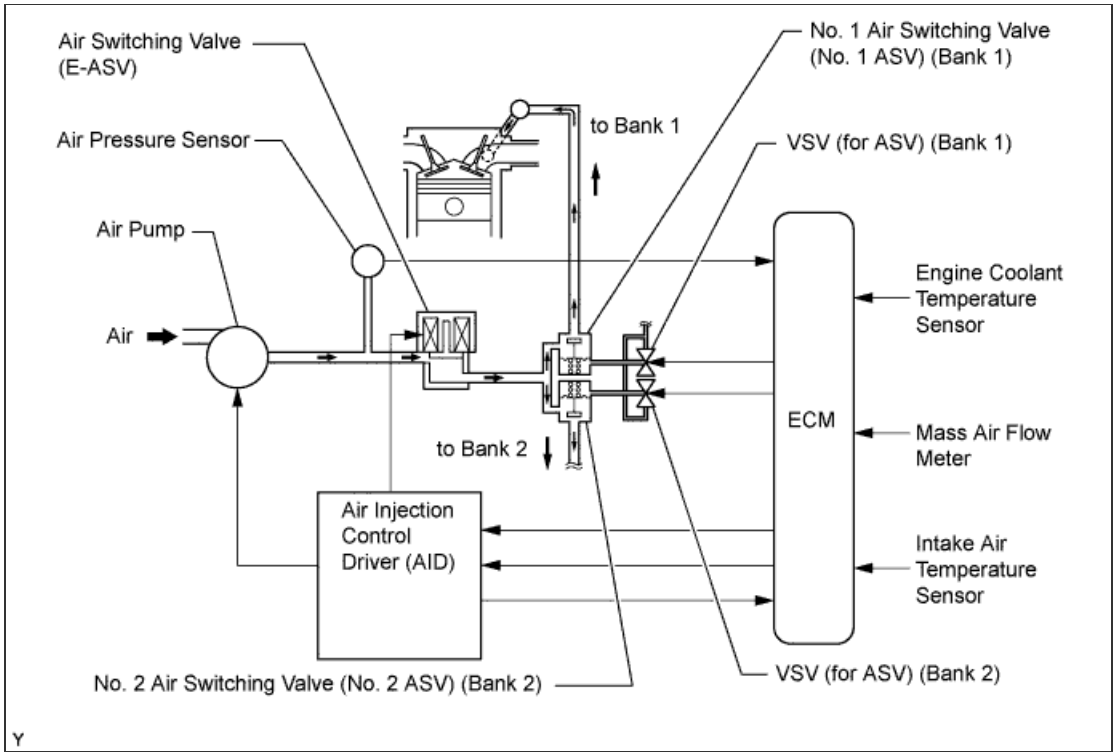
DTC P2445 Secondary Air Injection System Pump Stuck Off Bank1

for Preparation Click here

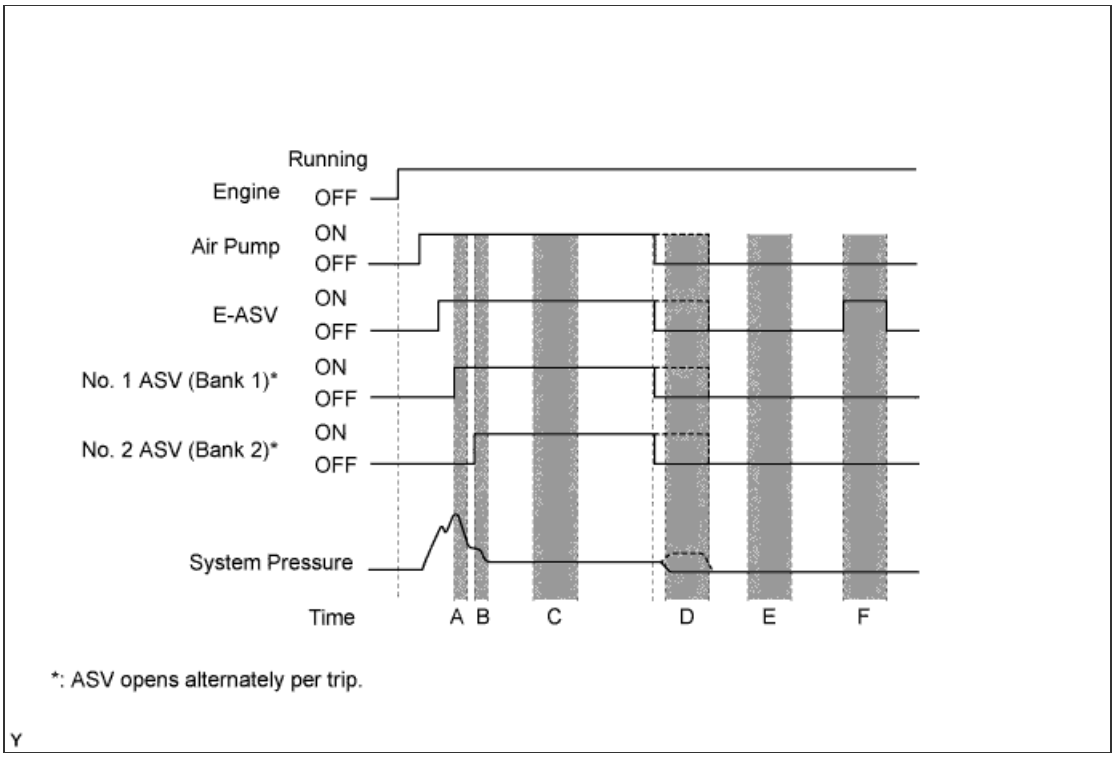
DESCRIPTION

The diagnostic trouble code (DTC) indicates that the air pump of the secondary air injection (AIR) system malfunctions. The engine control module (ECM) operates entire components of this system in a sequence, and monitors the system pressure and exhaust pulse (AIR monitor). This monitor will run just after a cold engine start. If abnormal pressure and exhaust pulse are detected, the ECM interprets this as a malfunction. When the malfunction is detected in consecutive driving cycle, the ECM illuminates the malfunction indicator lamp (MIL), and stores a DTC.

The secondary air injection (AIR) system introduces fresh air into the exhaust manifold in order to reduce carbon monoxide (CO) and hydrocarbon (HC) in the exhaust emission. This system is activated just after engine start, and is stopped when the catalyst converter is warmed-up. This system consists of the following components: 1) the air pump which sends fresh air to the exhaust manifold, 2) the electric air switching valve (E-ASV) which switches the fresh air flow, 3) the air switching valve (ASV) which switches the air passage to the exhaust manifold of each bank, 4) the vacuum switching valve (VSV) which switches the vacuum (intake manifold pressure) to operate the ASV, 5) the pressure sensor which detects the fresh air pressure and exhaust pulse, 6) the air injection control driver which controls the power sources of the air pump and E-ASV, 7) the engine control module (ECM) which controls and monitors this system.



Reference 1: Operation of each component during AIR monitor



Y

Reference 2: DTC Storing Conditions

Time A [Pressure Change]	Time B [Pressure Change]	Time C [See Chart Below]	Time D [Exhaust Pulse]	Time E [Exhaust Pulse]	Time F [See Chart Below]	DTC
Yes	Yes	Pattern 1	-	No	Pattern 4	Normal
Yes	No	Pattern 1	Yes	No	Pattern 4	
Yes	Yes	Pattern 1	-	No	Pattern 1	P1441 P1444 P2444
No	Yes	Pattern 1	-	No	Pattern 1	
Yes	No	Pattern 1	Yes	No	Pattern 1	
No	No	Pattern 1	Yes	No	Pattern 1	
Yes	Yes	Pattern 1	-	No	Pattern 3	P2444
No	Yes	Pattern 1	-	No	Pattern 3	P1442 P1445 P2444
Yes	No	Pattern 1	No	No	Pattern 3	
No	No	Pattern 1	No	No	Pattern 3	P1442 P1444 P2444
No	No	Pattern 2	-	-	-	P2445
No	No	Pattern 4	-	-	-	P1442 P1445 P2441 P2444
No	No	Pattern 3	No	No	Pattern 3	

Reference 3: System Pressure and Exhaust Pulse

Pattern	System Pressure	Exhaust Pulse
1	High	Yes
2	Low	Yes
3	High	No
4	Low	No

DTC Code

DTC Code	DTC Detection Condition	Trouble Area
P2444	The air pump is stuck on (2 trip detection logic).	• Air pump • Pressure sensor
P2445	- The air pump is stuck off (2 trip detection logic). - The air injection amount is insufficient (2 trip detection logic).	• Air pump • Pressure sensor • Air injection system piping • Pressure sensor

WIRING DIAGRAM

Refer to DTC P0412 (Click here).

INSPECTION PROCEDURE

HINT:

Read free e frame data using the intelligent tester. Free e frame data records the engine conditions when malfunctions are detected. When troubleshooting, free e frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.PERFORM SECONDARY AIR INJECTION SYSTEM CHECK (AUTOMATIC MODE)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Record the DTCs and free e frame data.

d. Clear the DTCs (Click here).

e. Warm-up the engine.

f. Enter the following menus: Powertrain / Engine and ECT / Utility / Secondary Air Injection Check (Automatic Mode).

g. Perform the Active Test and check the pending DTC.

Result

Result	Proceed to
P2444 and P2445 is output	A
DTCs other than P2444 and P2445 are output	B
No DTC is output	C

B → GO TO DTC CHART (Click here)

C → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

2.CHECK VACUUM HOSE

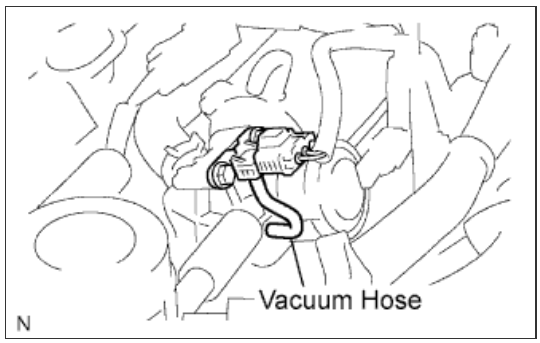
a. Remove the intake manifold (Click here).

b. Check the vacuum hose connection between the pressure sensor and air switching valve.

OK:
The vacuum hose is securely connected.

c. Inspect the vacuum hose for blockage and damage.

OK:
The vacuum hose has no blockage or damage.



NG → REPAIR OR REPLACE VACUUM HOSE

OK

3.READ VALUE USING INTELLIGENT TESTER (AIR VOLTAGE)

a. Remove the intake manifold (Click here).

b. Connect the pressure gauge to the pressure sensor as shown in the illustration.

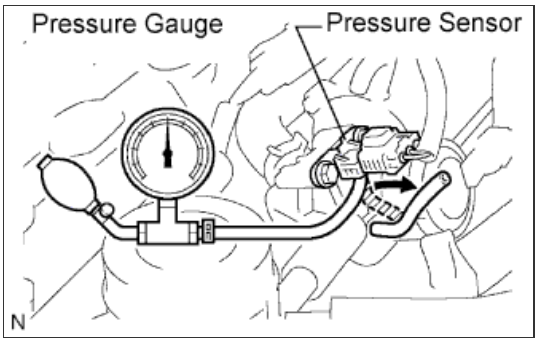
c. Connect the intelligent tester to the DLC3.

d. Turn the engine switch on (IG) and turn the tester on (do not start the engine).

e. Enter the following menus: Powertrain / Engine and ECT / Data List / Air pump pressure.

f. When applying pressure by the hand pump, check that the air pump pressure is almost same as the pressure gauge indication.

OK:
Pressure fluctuates in response to the pressure applied with pressure gauge.



NG → REPLACE AIR PRESSURE SENSOR (Click here)

OK

4.CHECK HOSE AND PIPE

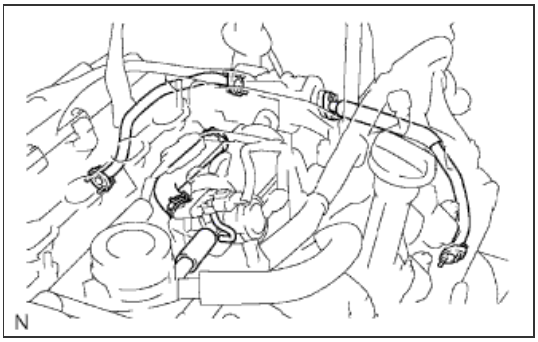
a. Remove the intake manifold (Click here).

b. Check that all the pipes and hoses between the air pump and air switching valve are securely connected.

OK:
All air injection pipes and hoses are securely connected.

c. Check all pipes and hoses for blockages and damage.

OK:
All air injection pipes and hoses have no blockages or damage.



NG → REPAIR OR REPLACE HOSES AND TUBES (Click here)

OK

REPLACE AIR PUMP ASSEMBLY (Click here)

DTC P0351 Ignition Coil "A" Primary / Secondary Circuit

DTC P0352 Ignition Coil "B" Primary / Secondary Circuit

DTC P0353 Ignition Coil "C" Primary / Secondary Circuit

DTC P0354 Ignition Coil "D" Primary / Secondary Circuit

DTC P0355 Ignition Coil "E" Primary / Secondary Circuit

DTC P0356 Ignition Coil "F" Primary / Secondary Circuit

DTC P0357 Ignition Coil "G" Primary / Secondary Circuit

DTC P0358 Ignition Coil "H" Primary / Secondary Circuit

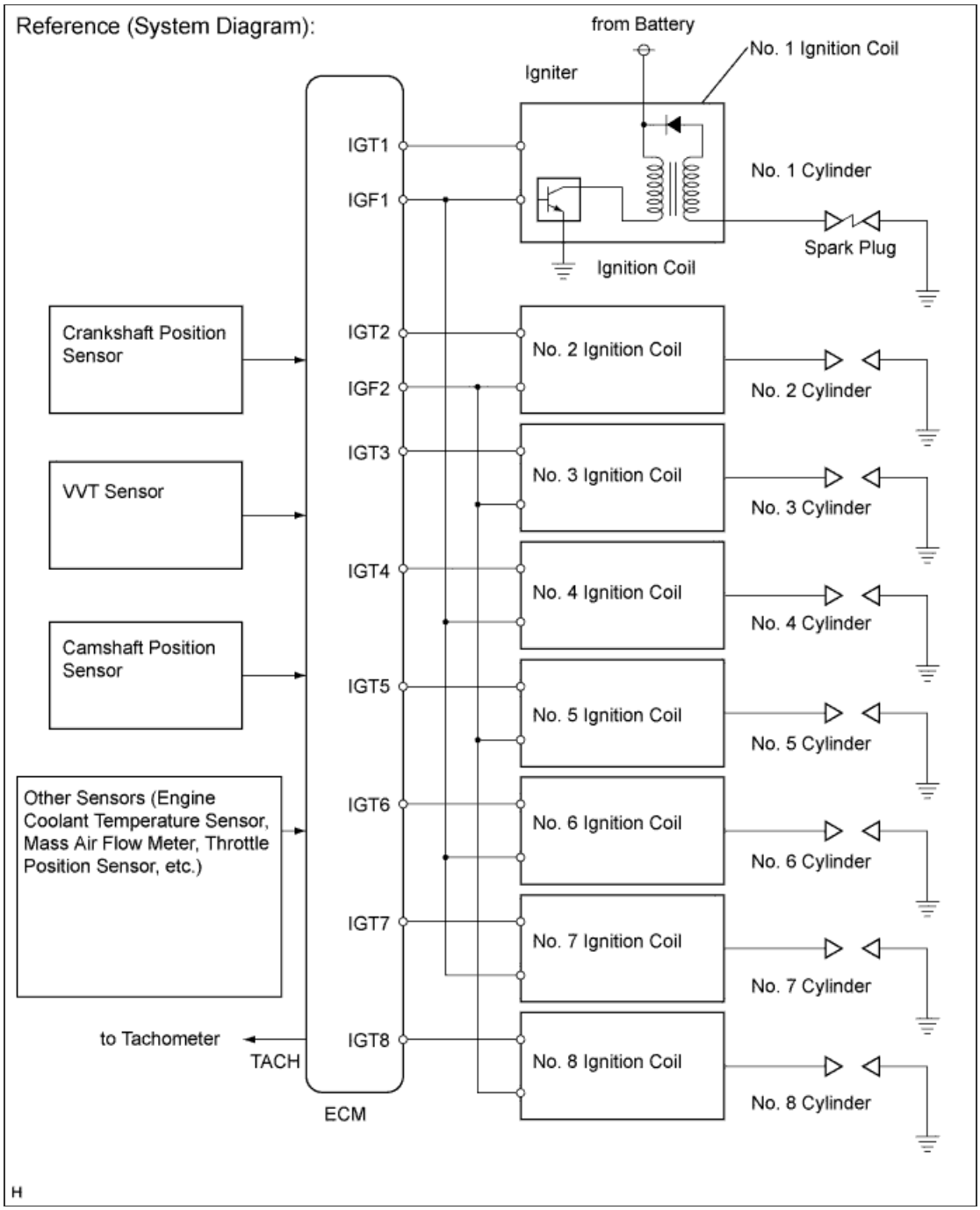
for Preparation Click here

DESCRIPTION

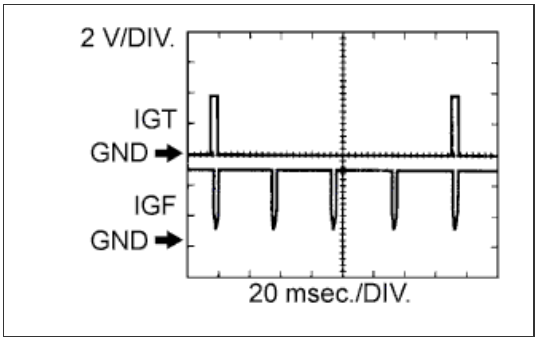
HINT:

- **These DTCs indicate malfunctions relating to the primary circuit.**
- **If DTC P0351 is output, check the No. 1 ignition coil circuit.**
- **If DTC P0352 is output, check the No. 2 ignition coil circuit.**
- **If DTC P0353 is output, check the No. 3 ignition coil circuit.**
- **If DTC P0354 is output, check the No. 4 ignition coil circuit.**
- **If DTC P0355 is output, check the No. 5 ignition coil circuit.**
- **If DTC P0356 is output, check the No. 6 ignition coil circuit.**
- **If DTC P0357 is output, check the No. 7 ignition coil circuit.**
- **If DTC P0358 is output, check the No. 8 ignition coil circuit.**

A Direct Ignition System (DIS) is used on this vehicle.
The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.
The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.



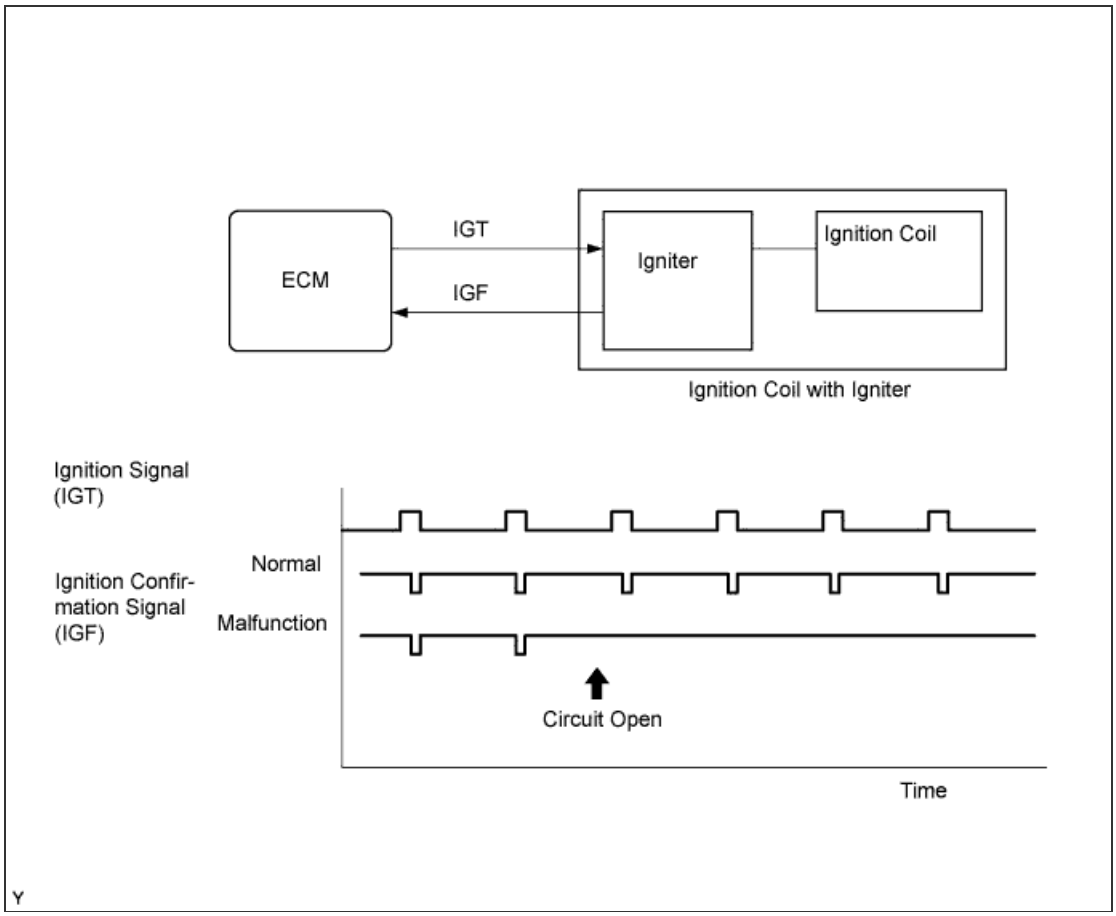
DTC Code	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356 P0357 P0358	No IGF signal is sent to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 8) between ignition coil and ECM • No. 1 to No. 8 ignition coils • ECM



Reference: Inspection using an oscilloscope.
While cranking or idling the engine, check the waveform between terminals IGT (1 to 8) and E1, and IGF1 or IGF2 and E1 of the ECM connector.

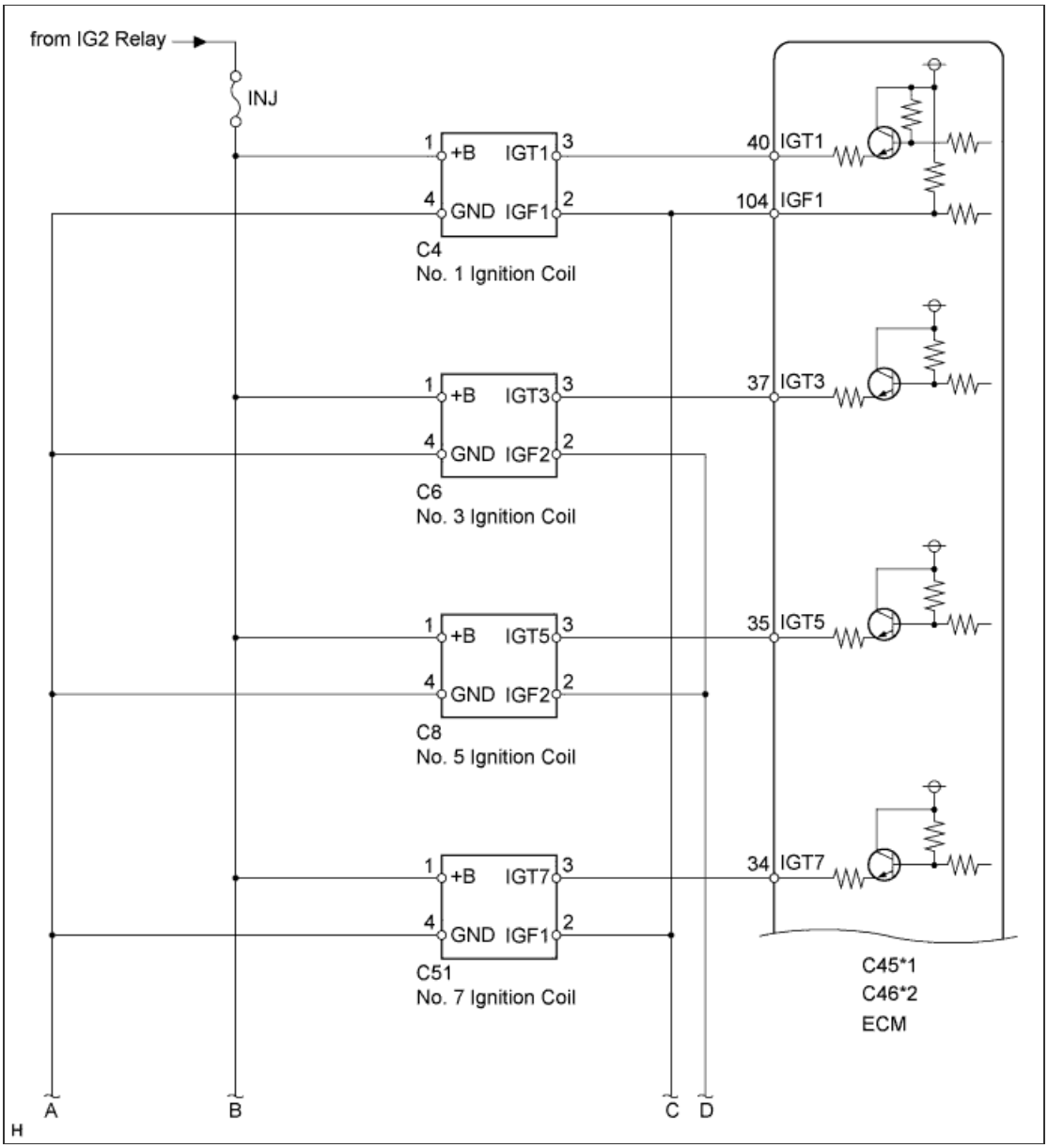
Item	Content
Terminal	CH1: IGT1, IGT2, IGT3, IGT4, IGT5, IGT6, IGT7, IGT8 - E1 CH2: IGF1, IGF2 - E1
Equipment Setting	2 V/DIV. 20 msec./DIV.
Condition	Cranking or idling

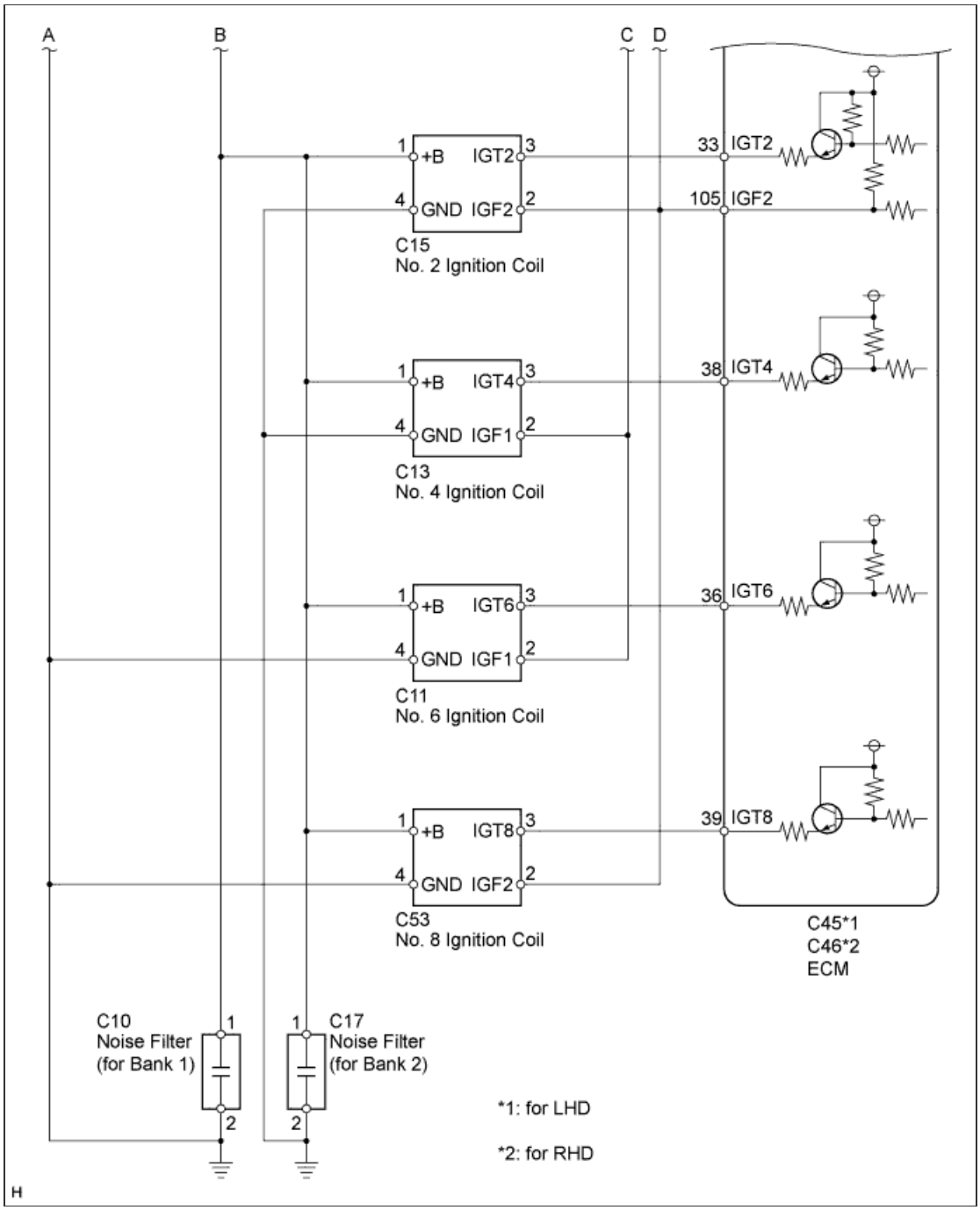
MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

WIRING DIAGRAM


from IG2 Relay
INJ
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
34
IGT7
C45*1
C46*2
ECM
A
B
C
D
H



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)

a. Disconnect the No. 1 to No. 8 ignition coil connectors.

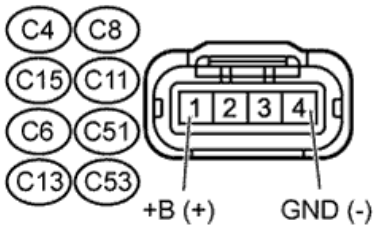
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C4-4 (GND) - Body ground	Always	Below 1 Ω
C15-4 (GND) - Body ground	Always	Below 1 Ω
C6-4 (GND) - Body ground	Always	Below 1 Ω

C13-4 (GND) - Body ground	Always	Below 1 Ω
C8-4 (GND) - Body ground	Always	Below 1 Ω
C11-4 (GND) - Body ground	Always	Below 1 Ω
C51-4 (GND) - Body ground	Always	Below 1 Ω
C53-4 (GND) - Body ground	Always	Below 1 Ω

Front view of wire harness connector:
(to Ignition Coil with Igniter)



c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C4-1 ( ) - C4-4 (GND)	Engine switch on (IG)	11 to 14 V
C15-1 ( ) - C15-4 (GND)	Engine switch on (IG)	11 to 14 V
C6-1 ( ) - C6-4 (GND)	Engine switch on (IG)	11 to 14 V
C13-1 ( ) - C13-4 (GND)	Engine switch on (IG)	11 to 14 V
C8-1 ( ) - C8-4 (GND)	Engine switch on (IG)	11 to 14 V
C11-1 ( ) - C11-4 (GND)	Engine switch on (IG)	11 to 14 V
C51-1 ( ) - C51-4 (GND)	Engine switch on (IG)	11 to 14 V
C53-1 ( ) - C53-4 (GND)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

a. Disconnect the No. 1 to No. 8 ignition coil connectors.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

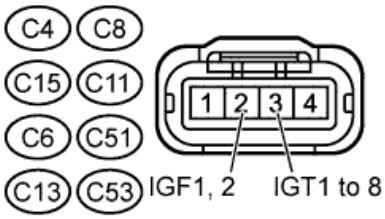
Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C15-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C45-40 (IGT1)	Always	Below 1 Ω

C15-3 (IGT2) - C45-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C45-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C45-38 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C45-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C45-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C45-34 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C45-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C45-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C45-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C45-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C45-38 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C45-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C45-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C45-34 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C45-39 (IGT8) - Body ground	Always	10 kΩ or higher

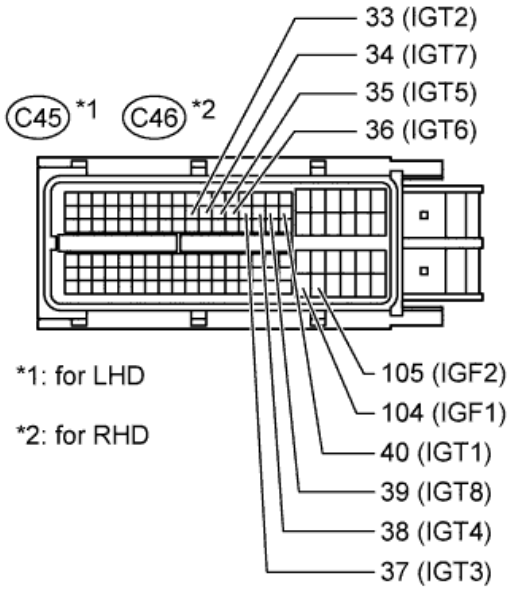
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω

Front view of wire harness connector:
(to Ignition Coil with Igniter)



Front view of wire harness connector:
(to ECM)



C15-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C46-40 (IGT1)	Always	Below 1 Ω
C15-3 (IGT2) - C46-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C46-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C46-38 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C46-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C46-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C46-34 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C46-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C46-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C46-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C46-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C46-38 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or		

C46-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C46-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C46-34 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C46-39 (IGT8) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353, P0354, P0355, P0356, P0357 OR P0358)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Shuffle arrangement of the ignition coils with igniters (among No. 1 to No. 8 cylinders).

NOTICE:

Do not shuffle the connectors.

e. Perform a simulation test.

f. Check the DTCs displayed on the tester.

Result

Result	Proceed to
Same DTC is output	A
Different ignition coil DTC is output	B

B → REPLACE IGNITION COIL ASSEMBLY (Click here)

A

REPLACE ECM (Click here)

DTC P2A00 A/F Sensor Circuit Slow Response (Bank 1 Sensor 1)

DTC P2A03 A/F Sensor Circuit Slow Response (Bank 2 Sensor 1)

for Preparation Click here

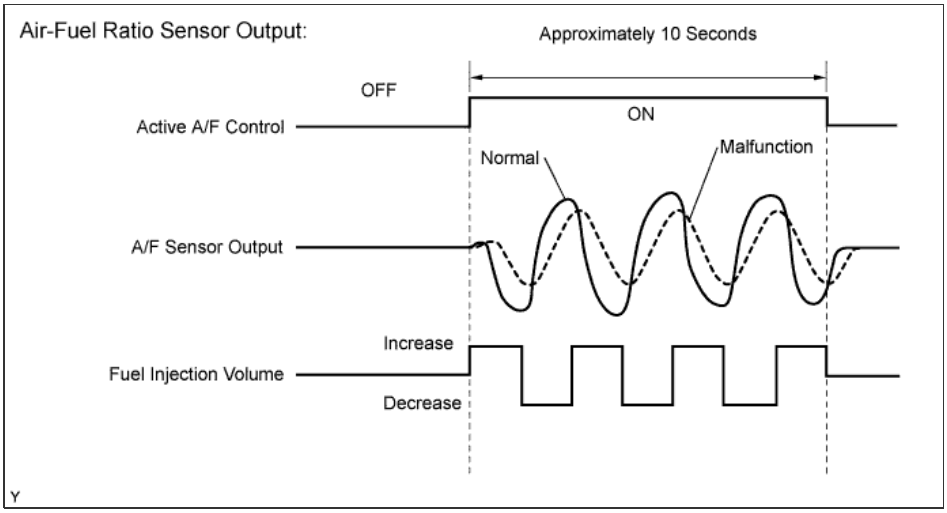
DESCRIPTION

Refer to DTC P2195 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2A00	The calculated value of the air-fuel ratio (A/F) sensor response rate deterioration level is less than the threshold (2 trip detection logic).	• Open or short in A/F sensor circuit (for bank 1) • A/F sensor (for bank 1) • ECM
P2A03	The calculated value of the air-fuel ratio (A/F) sensor response rate deterioration level is less than the threshold (2 trip detection logic).	• Open or short in A/F sensor circuit (for bank 2) • A/F sensor (for bank 2) • ECM

MONITOR DESCRIPTION

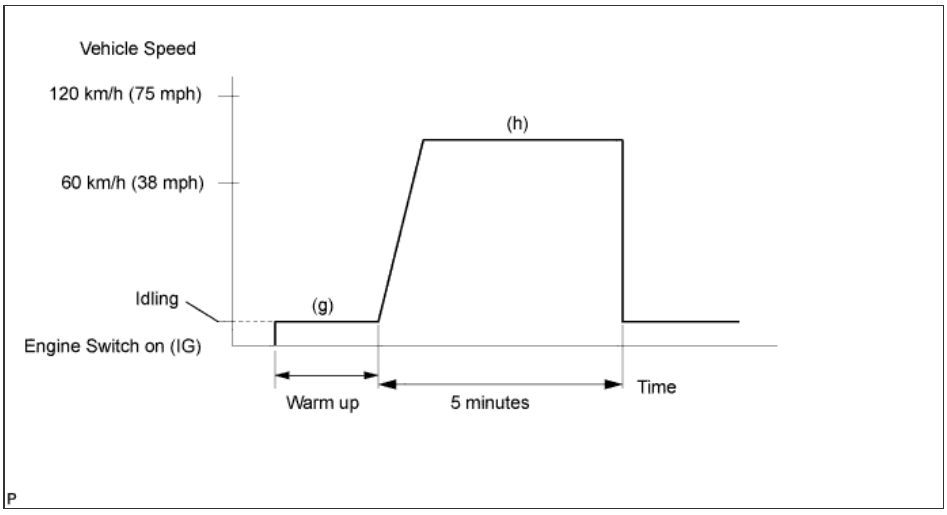
After the engine is warmed up, the ECM performs air-fuel ratio feedback control to maintain the air-fuel ratio at the stoichiometric level. In addition, active A/F control is performed for approximately 10 seconds after the preconditions are met in order to measure the A/F sensor response rate. During active A/F control, the ECM forcibly increases and decreases the injection volume a certain amount, based on the stoichiometric air-fuel ratio learned during normal air-fuel ratio control, and measures the A/F sensor response rate. The ECM receives a signal from the A/F sensor while performing active A/F control and uses it to calculate the A/F sensor response rate deterioration level.
If the A/F sensor response rate deterioration level is less than the threshold, the ECM interprets this as a malfunction and stores the DTC.



CONFIRMATION DRIVING PATTERN

HINT:

Performing this confirmation pattern will activate the A/F sensor response monitor.



(a) Connect the intelligent tester to the DLC3.
(b) Turn the engine switch on (IG).
(c) Turn the tester on.
(d) Clear the DTCs.
(e) Start the engine.

(f) Enter the following menus: Powertrain / Engine and ECT / Data List / Monitor Status.
(g) Check that O2S (A/FS) Monitor is Incmpl.
(h) Warm up the engine.
(i) Drive the vehicle at between 60 km/h and 120 km/h (38 mph and 75 mph) for 5 minutes. However, the vehicle should be driven at a constant speed.
(j) Check that O2S (A/FS) Monitor is Incmpl.
(k) Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.
(l) Check if any DTCs (any pending DTCs) are output.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/ F sensor operation using the intelligent tester.

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/ F sensor.
(e) Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

HINT:

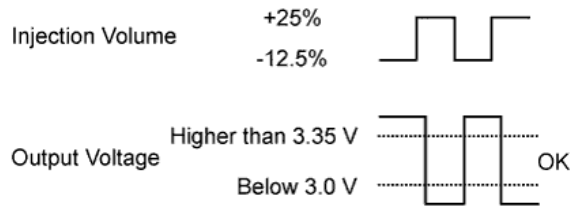
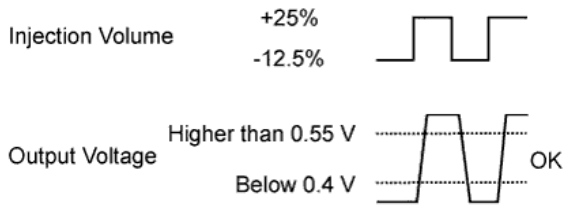
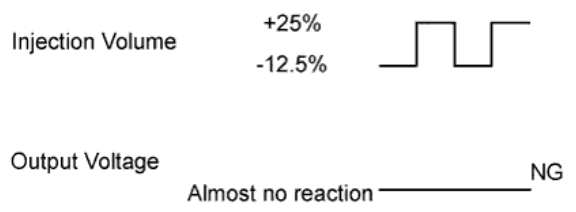
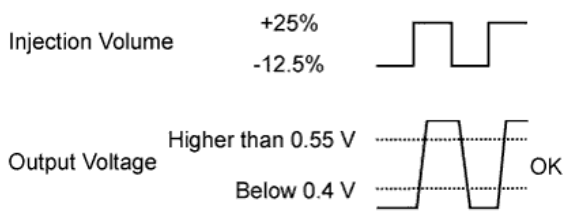
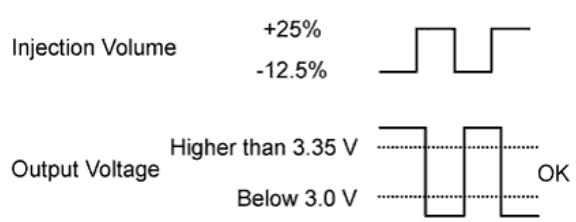
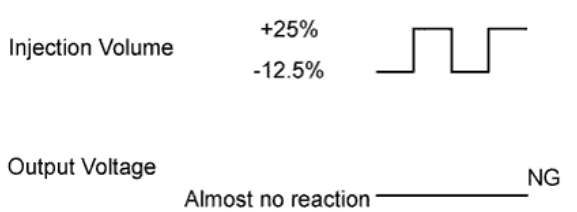
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
			• Injector

4	Injection Volume +25% -12.5%  Output Voltage Almost no reaction NG	Injection Volume +25% -12.5%  Output Voltage Almost no reaction NG	• Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors. To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/ F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

HINT:

- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**
- **DTC P2A00 indicates malfunctions related to the bank 1 A/F sensor.**
- **DTC P2A03 indicates malfunctions related to the bank 2 A/F sensor.**
- **For Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **For Bank 2 refers to the bank that includes the No. 2 cylinder.**
- **DTC P2A00 or P2A03 may be stored when the air-fuel ratio is stuck rich or lean.**
- **A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.**
- **A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2A00 AND/OR P2A03)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P2A00 and/or P2A03 is output	A
P2A00 and/or P2A03 and other DTCs are output	B

HINT:

If any DTCs relating to the A/F sensor (DTCs for the A/F sensor heater or A/F sensor admittance) are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

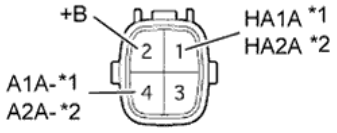
a. Disconnect the Air-Fuel Ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

3.CHECK HARNESS AND CONNECTOR (ECM - AIR-FUEL RATIO SENSOR)

a. Disconnect the A/F sensor connector.

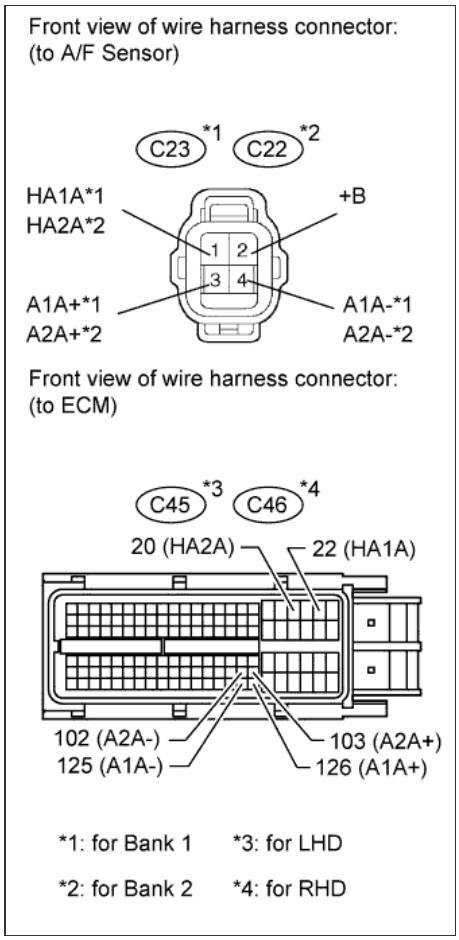
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.



e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

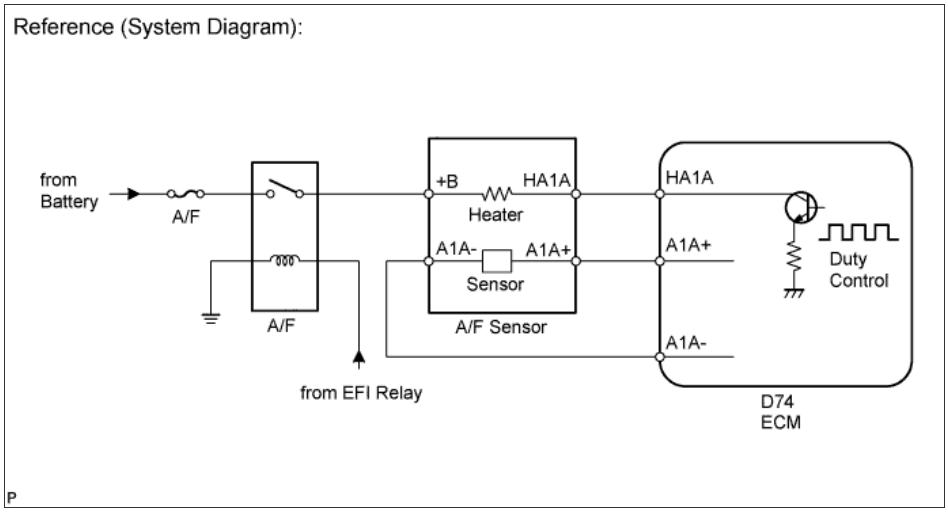
Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-		

103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C46-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (DTC P2A00 AND/OR P2A03)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

d. Read pending DTCs.

Result

Result	Proceed to
P2A00 and/or P2A03 is output	A
No DTC is output	B

B → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

6.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

7.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS (DTC P2A00 AND/OR P2A03)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

d. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2A00 and/or P2A03 is output	B

B → REPLACE ECM (Click here)

A

END

DTC P0351 Ignition Coil "A" Primary / Secondary Circuit

DTC P0352 Ignition Coil "B" Primary / Secondary Circuit

DTC P0353 Ignition Coil "C" Primary / Secondary Circuit

DTC P0354 Ignition Coil "D" Primary / Secondary Circuit

DTC P0355 Ignition Coil "E" Primary / Secondary Circuit

DTC P0356 Ignition Coil "F" Primary / Secondary Circuit

DTC P0357 Ignition Coil "G" Primary / Secondary Circuit

DTC P0358 Ignition Coil "H" Primary / Secondary Circuit

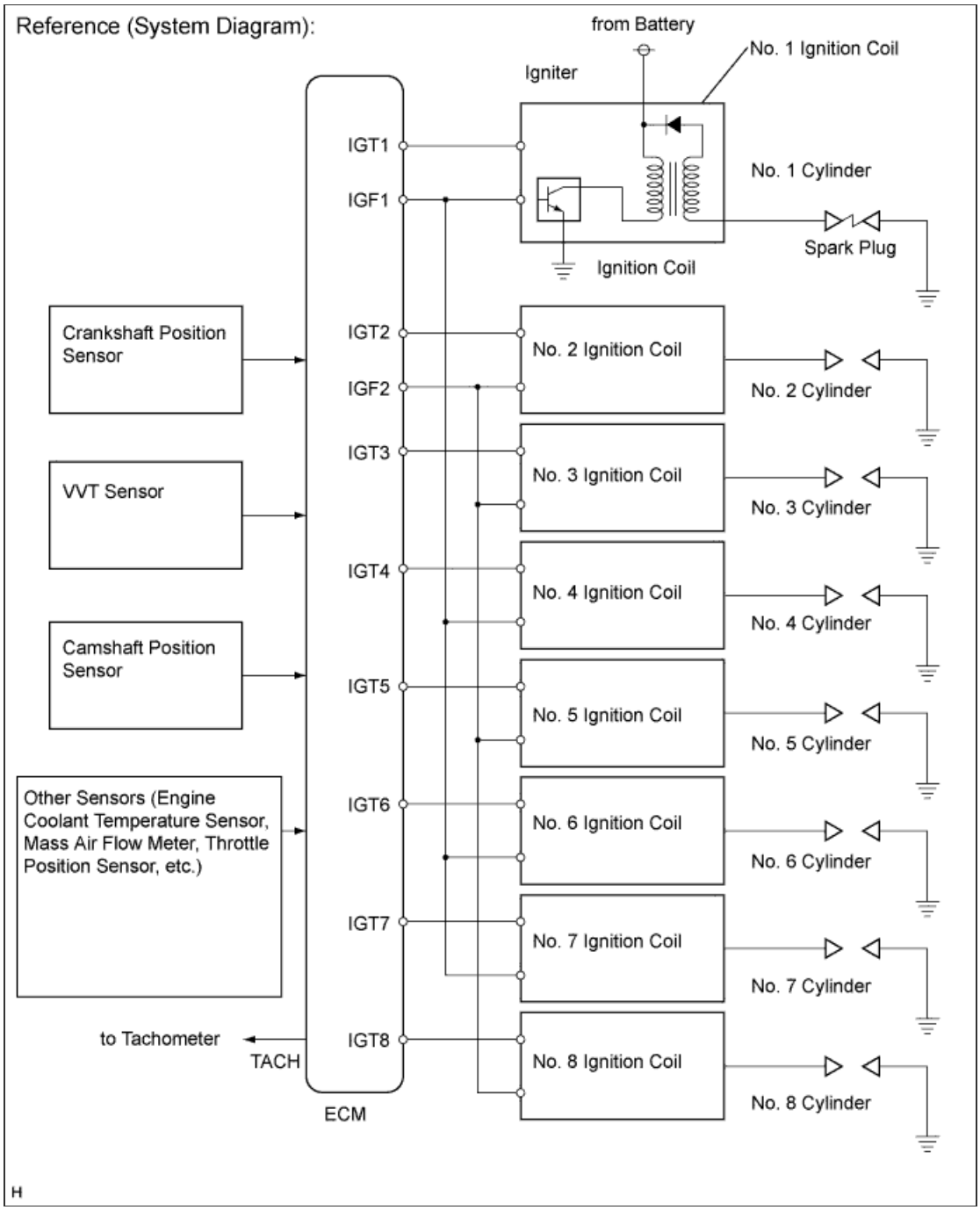
for Preparation Click here

DESCRIPTION

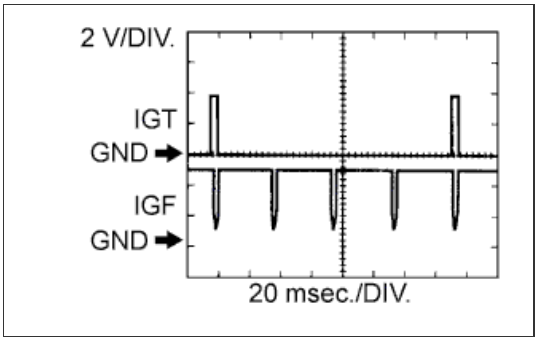
HINT:

- **These DTCs indicate malfunctions relating to the primary circuit.**
- **If DTC P0351 is output, check the No. 1 ignition coil circuit.**
- **If DTC P0352 is output, check the No. 2 ignition coil circuit.**
- **If DTC P0353 is output, check the No. 3 ignition coil circuit.**
- **If DTC P0354 is output, check the No. 4 ignition coil circuit.**
- **If DTC P0355 is output, check the No. 5 ignition coil circuit.**
- **If DTC P0356 is output, check the No. 6 ignition coil circuit.**
- **If DTC P0357 is output, check the No. 7 ignition coil circuit.**
- **If DTC P0358 is output, check the No. 8 ignition coil circuit.**

A Direct Ignition System (DIS) is used on this vehicle.
The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.
The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.



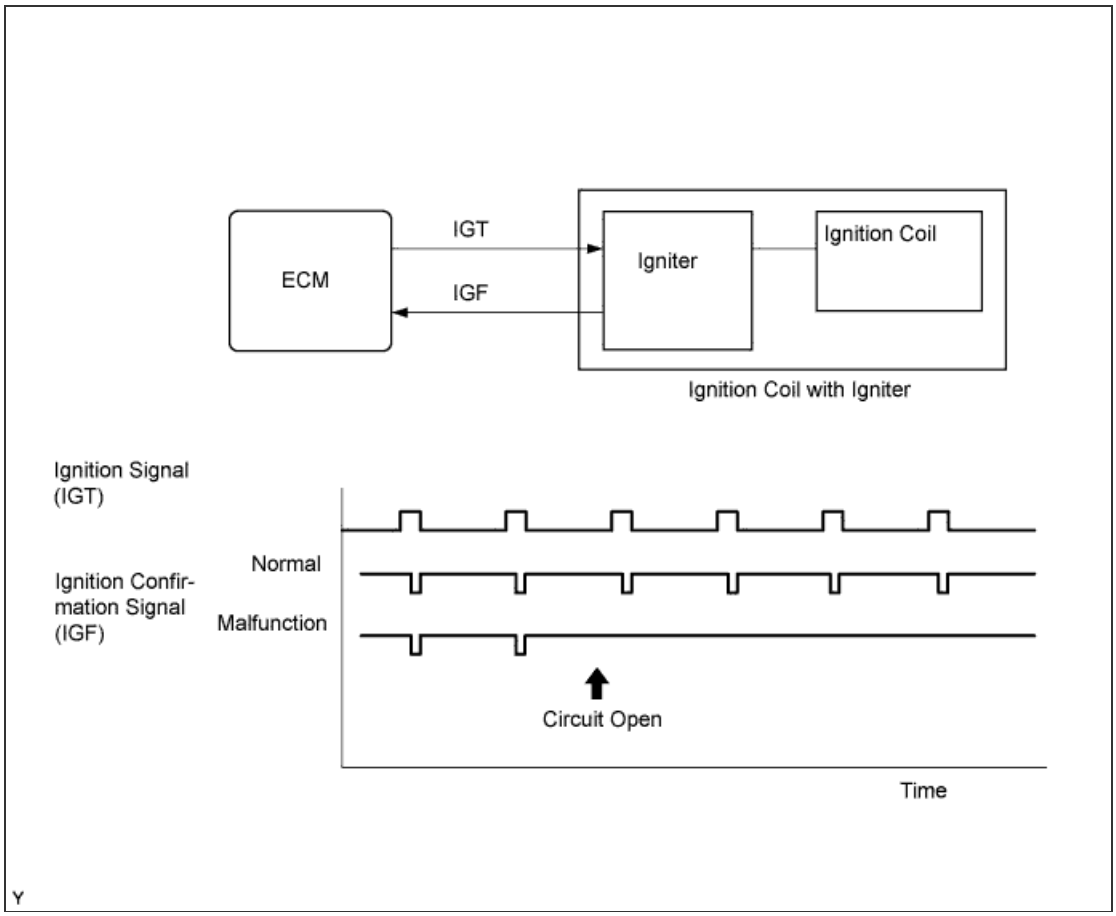
DTC Code	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356 P0357 P0358	No IGF signal is sent to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 8) between ignition coil and ECM • No. 1 to No. 8 ignition coils • ECM



Reference: Inspection using an oscilloscope.
While cranking or idling the engine, check the waveform between terminals IGT (1 to 8) and E1, and IGF1 or IGF2 and E1 of the ECM connector.

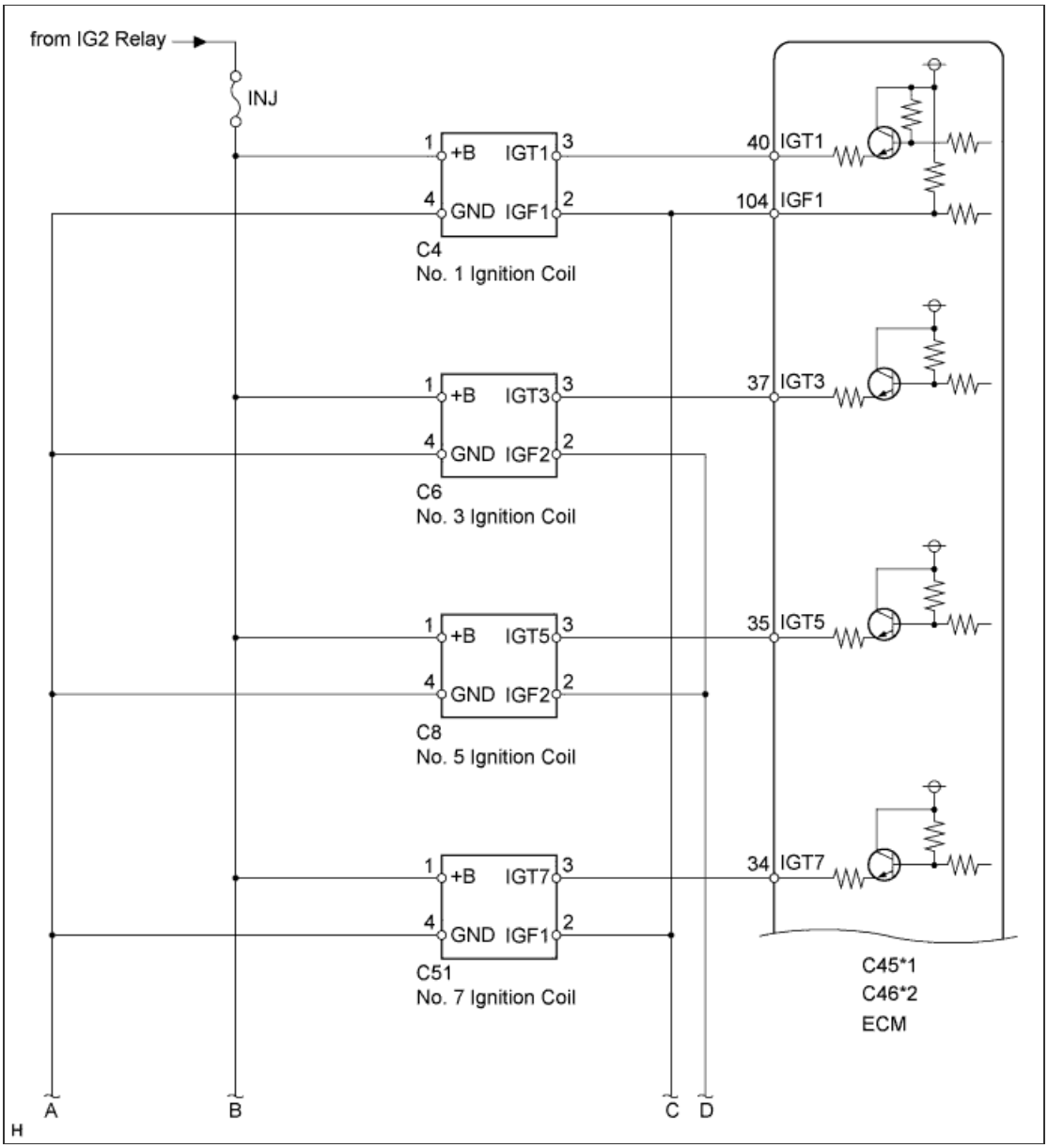
Item	Content
Terminal	CH1: IGT1, IGT2, IGT3, IGT4, IGT5, IGT6, IGT7, IGT8 - E1 CH2: IGF1, IGF2 - E1
Equipment Setting	2 V/DIV. 20 msec./DIV.
Condition	Cranking or idling

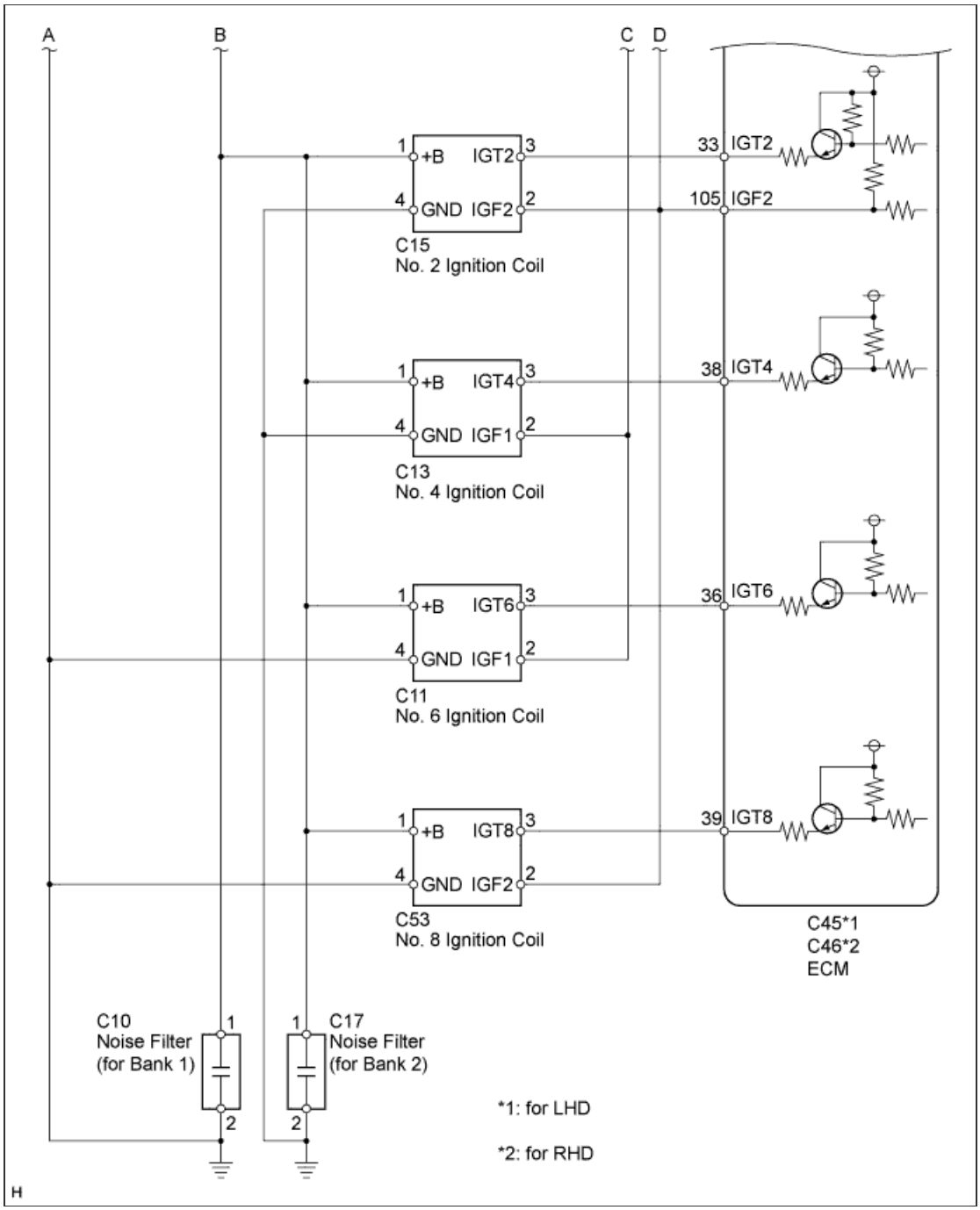
MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores a DTC.
If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

WIRING DIAGRAM


from IG2 Relay
INJ
1
+B
IGT1
3
4
GND
IGF1
2
C4
No. 1 Ignition Coil
40
IGT1
104
IGF1
1
+B
IGT3
3
4
GND
IGF2
2
C6
No. 3 Ignition Coil
37
IGT3
1
+B
IGT5
3
4
GND
IGF2
2
C8
No. 5 Ignition Coil
35
IGT5
1
+B
IGT7
3
4
GND
IGF1
2
C51
No. 7 Ignition Coil
34
IGT7
C45*1
C46*2
ECM
A
B
C
D
H



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1.INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)

a. Disconnect the No. 1 to No. 8 ignition coil connectors.

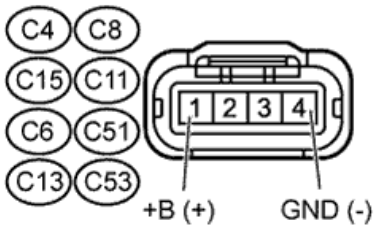
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C4-4 (GND) - Body ground	Always	Below 1 Ω
C15-4 (GND) - Body ground	Always	Below 1 Ω
C6-4 (GND) - Body ground	Always	Below 1 Ω

C13-4 (GND) - Body ground	Always	Below 1 Ω
C8-4 (GND) - Body ground	Always	Below 1 Ω
C11-4 (GND) - Body ground	Always	Below 1 Ω
C51-4 (GND) - Body ground	Always	Below 1 Ω
C53-4 (GND) - Body ground	Always	Below 1 Ω

Front view of wire harness connector:
(to Ignition Coil with Igniter)



c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C4-1 ( ) - C4-4 (GND)	Engine switch on (IG)	11 to 14 V
C15-1 ( ) - C15-4 (GND)	Engine switch on (IG)	11 to 14 V
C6-1 ( ) - C6-4 (GND)	Engine switch on (IG)	11 to 14 V
C13-1 ( ) - C13-4 (GND)	Engine switch on (IG)	11 to 14 V
C8-1 ( ) - C8-4 (GND)	Engine switch on (IG)	11 to 14 V
C11-1 ( ) - C11-4 (GND)	Engine switch on (IG)	11 to 14 V
C51-1 ( ) - C51-4 (GND)	Engine switch on (IG)	11 to 14 V
C53-1 ( ) - C53-4 (GND)	Engine switch on (IG)	11 to 14 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

a. Disconnect the No. 1 to No. 8 ignition coil connectors.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

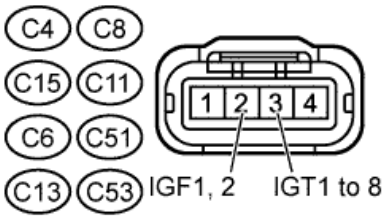
Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C15-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C45-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C45-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C45-40 (IGT1)	Always	Below 1 Ω

C15-3 (IGT2) - C45-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C45-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C45-38 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C45-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C45-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C45-34 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C45-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C45-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C45-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C45-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C45-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C45-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C45-38 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or C45-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C45-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C45-34 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C45-39 (IGT8) - Body ground	Always	10 kΩ or higher

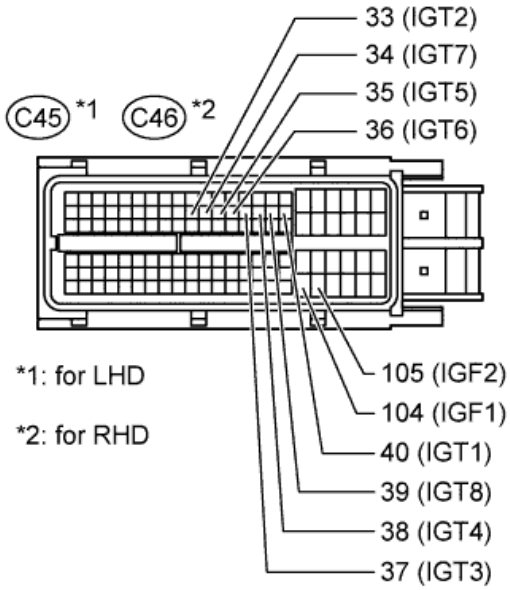
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C4-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω

Front view of wire harness connector:
(to Ignition Coil with Igniter)



Front view of wire harness connector:
(to ECM)



C15-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C6-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C13-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C8-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C11-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C51-2 (IGF1) - C46-104 (IGF1)	Always	Below 1 Ω
C53-2 (IGF2) - C46-105 (IGF2)	Always	Below 1 Ω
C4-3 (IGT1) - C46-40 (IGT1)	Always	Below 1 Ω
C15-3 (IGT2) - C46-33 (IGT2)	Always	Below 1 Ω
C6-3 (IGT3) - C46-37 (IGT3)	Always	Below 1 Ω
C13-3 (IGT4) - C46-38 (IGT4)	Always	Below 1 Ω
C8-3 (IGT5) - C46-35 (IGT5)	Always	Below 1 Ω
C11-3 (IGT6) - C46-36 (IGT6)	Always	Below 1 Ω
C51-3 (IGT7) - C46-34 (IGT7)	Always	Below 1 Ω
C53-3 (IGT8) - C46-39 (IGT8)	Always	Below 1 Ω
C4-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C15-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C6-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C13-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C8-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C11-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C51-2 (IGF1) or C46-104 (IGF1) - Body ground	Always	10 kΩ or higher
C53-2 (IGF2) or C46-105 (IGF2) - Body ground	Always	10 kΩ or higher
C4-3 (IGT1) or C46-40 (IGT1) - Body ground	Always	10 kΩ or higher
C15-3 (IGT2) or C46-33 (IGT2) - Body ground	Always	10 kΩ or higher
C6-3 (IGT3) or C46-37 (IGT3) - Body ground	Always	10 kΩ or higher
C13-3 (IGT4) or C46-38 (IGT4) - Body ground	Always	10 kΩ or higher
C8-3 (IGT5) or		

C46-35 (IGT5) - Body ground	Always	10 kΩ or higher
C11-3 (IGT6) or C46-36 (IGT6) - Body ground	Always	10 kΩ or higher
C51-3 (IGT7) or C46-34 (IGT7) - Body ground	Always	10 kΩ or higher
C53-3 (IGT8) or C46-39 (IGT8) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353, P0354, P0355, P0356, P0357 OR P0358)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Clear DTCs (Click here).

d. Shuffle arrangement of the ignition coils with igniters (among No. 1 to No. 8 cylinders).

NOTICE:

Do not shuffle the connectors.

e. Perform a simulation test.

f. Check the DTCs displayed on the tester.

Result

Result	Proceed to
Same DTC is output	A
Different ignition coil DTC is output	B

B → REPLACE IGNITION COIL ASSEMBLY (Click here)

A

REPLACE ECM (Click here)

DTC P2A00 A/F Sensor Circuit Slow Response (Bank 1 Sensor 1)

DTC P2A03 A/F Sensor Circuit Slow Response (Bank 2 Sensor 1)

for Preparation Click here

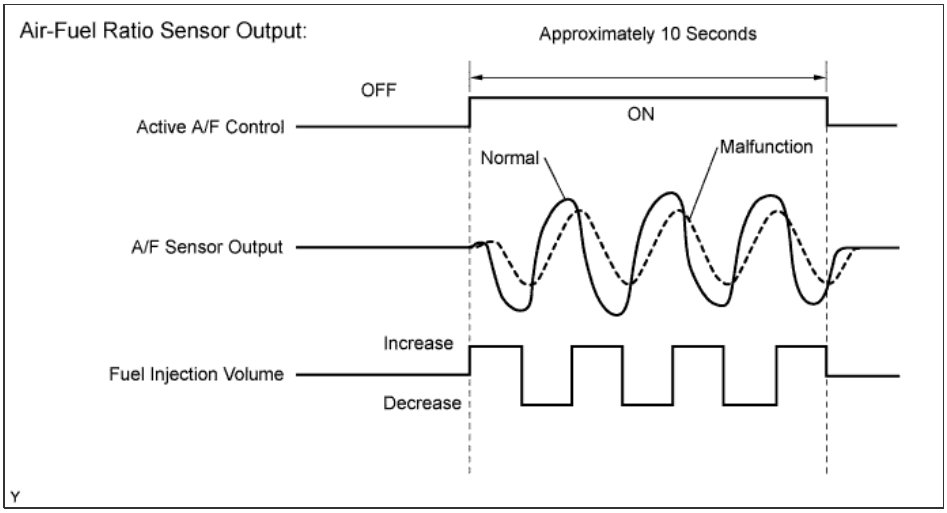
DESCRIPTION

Refer to DTC P2195 (Click here).

DTC Code	DTC Detection Condition	Trouble Area
P2A00	The calculated value of the air-fuel ratio (A/F) sensor response rate deterioration level is less than the threshold (2 trip detection logic).	• Open or short in A/F sensor circuit (for bank 1) • A/F sensor (for bank 1) • ECM
P2A03	The calculated value of the air-fuel ratio (A/F) sensor response rate deterioration level is less than the threshold (2 trip detection logic).	• Open or short in A/F sensor circuit (for bank 2) • A/F sensor (for bank 2) • ECM

MONITOR DESCRIPTION

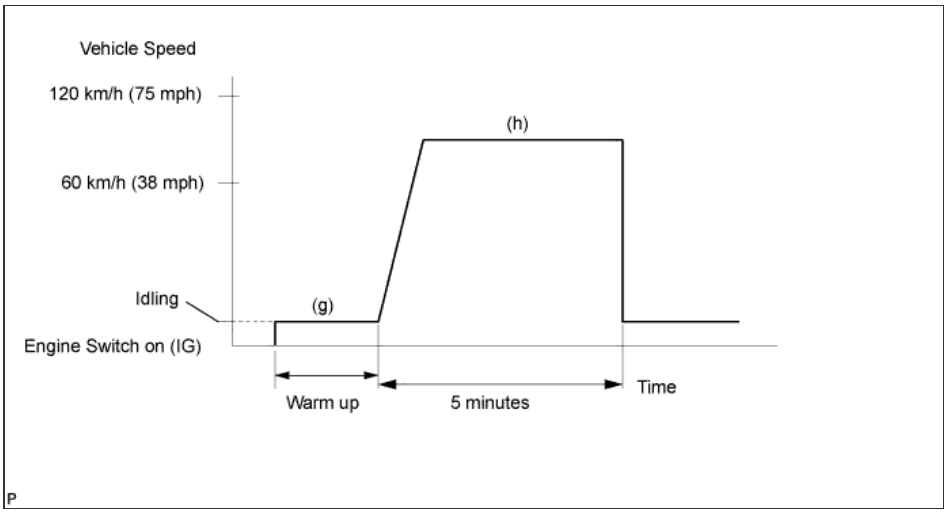
After the engine is warmed up, the ECM performs air-fuel ratio feedback control to maintain the air-fuel ratio at the stoichiometric level. In addition, active A/F control is performed for approximately 10 seconds after the preconditions are met in order to measure the A/F sensor response rate. During active A/F control, the ECM forcibly increases and decreases the injection volume a certain amount, based on the stoichiometric air-fuel ratio learned during normal air-fuel ratio control, and measures the A/F sensor response rate. The ECM receives a signal from the A/F sensor while performing active A/F control and uses it to calculate the A/F sensor response rate deterioration level.
If the A/F sensor response rate deterioration level is less than the threshold, the ECM interprets this as a malfunction and stores the DTC.



CONFIRMATION DRIVING PATTERN

HINT:

Performing this confirmation pattern will activate the A/F sensor response monitor.



(a) Connect the intelligent tester to the DLC3.
(b) Turn the engine switch on (IG).
(c) Turn the tester on.
(d) Clear the DTCs.
(e) Start the engine.

(f) Enter the following menus: Powertrain / Engine and ECT / Data List / Monitor Status.
(g) Check that O2S (A/FS) Monitor is Incmpl.
(h) Warm up the engine.
(i) Drive the vehicle at between 60 km/h and 120 km/h (38 mph and 75 mph) for 5 minutes. However, the vehicle should be driven at a constant speed.
(j) Check that O2S (A/FS) Monitor is Incmpl.
(k) Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.
(l) Check if any DTCs (any pending DTCs) are output.

WIRING DIAGRAM

Refer to DTC P2195 (Click here).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/ F sensor operation using the intelligent tester.

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/ F sensor.
(e) Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

HINT:

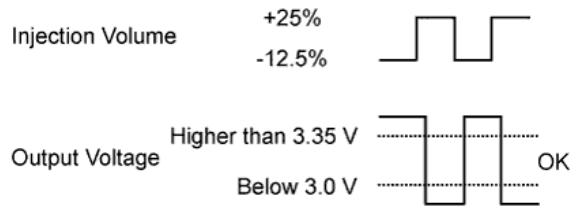
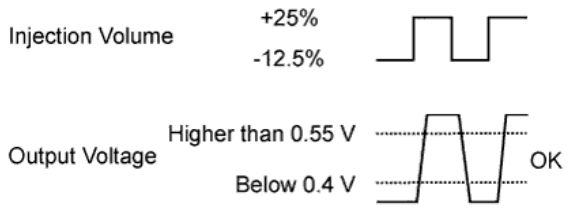
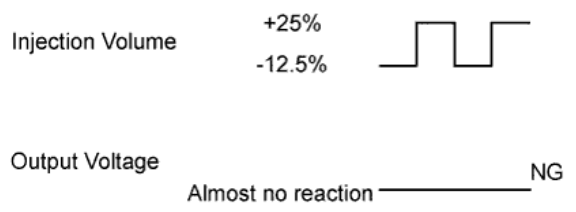
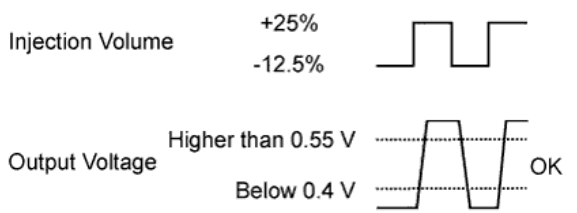
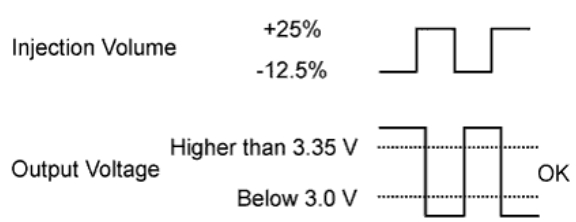
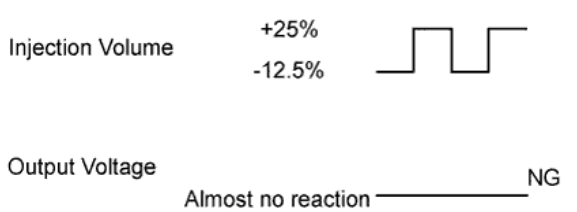
- **The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.**
- **Each sensor reacts in accordance with increases and decreases in the fuel injection volume.**

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4
AFS B2 S1 (A/F)	+25%	Rich	Below 3.0
	-12.5%	Lean	Higher than 3.35
O2S B2 S2 (HO2)	+25%	Rich	Higher than 0.55
	-12.5%	Lean	Below 0.4

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
			• Injector

4	Injection Volume +25% -12.5%  Output Voltage Almost no reaction NG	Injection Volume +25% -12.5%  Output Voltage Almost no reaction NG	• Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)

Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors. To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/ F Sensor / A/F Control System / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2.

HINT:

- **Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.**
- **DTC P2A00 indicates malfunctions related to the bank 1 A/F sensor.**
- **DTC P2A03 indicates malfunctions related to the bank 2 A/F sensor.**
- **For Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **For Bank 2 refers to the bank that includes the No. 2 cylinder.**
- **DTC P2A00 or P2A03 may be stored when the air-fuel ratio is stuck rich or lean.**
- **A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.**
- **A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2A00 AND/OR P2A03)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read DTCs.

Result

Result	Proceed to
P2A00 and/or P2A03 is output	A
P2A00 and/or P2A03 and other DTCs are output	B

HINT:

If any DTCs relating to the A/F sensor (DTCs for the A/F sensor heater or A/F sensor admittance) are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

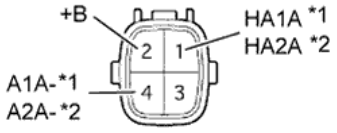
a. Disconnect the Air-Fuel Ratio (A/F) sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	Always	10 kΩ or higher

Component without harness connected:
(A/F Sensor)



*1: for Bank 1

*2: for Bank 2

NG → REPLACE AIR FUEL RATIO SENSOR (Click here)

OK

3.CHECK HARNESS AND CONNECTOR (ECM - AIR-FUEL RATIO SENSOR)

a. Disconnect the A/F sensor connector.

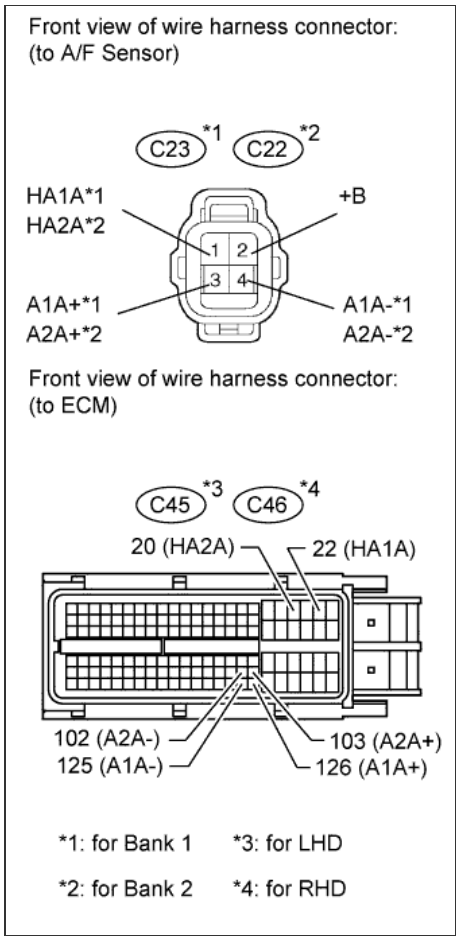
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C22-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C23-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

c. Turn the engine switch off.

d. Disconnect the ECM connector.



e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

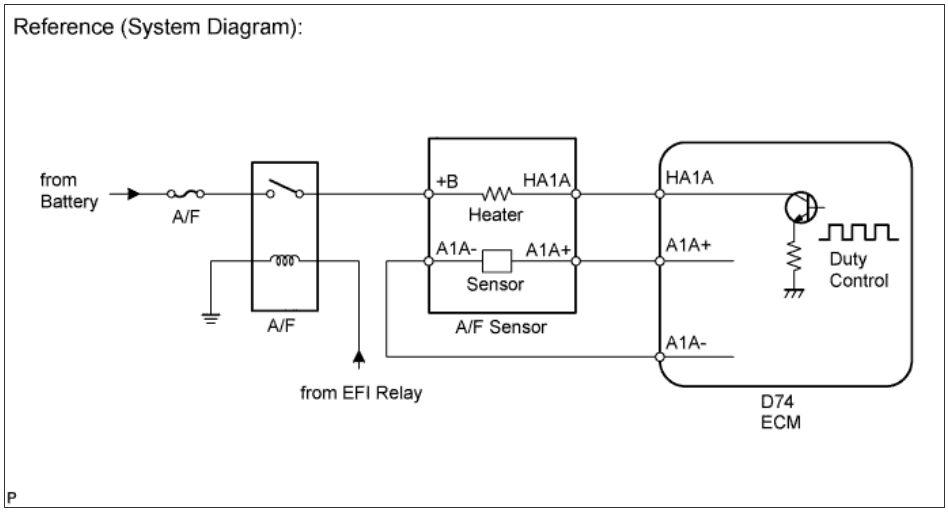
Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C45-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C45-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C45-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C45-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C45-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C45-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C45-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C45-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C45-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C45-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C45-		

103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C45-102 (A2A-) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C22-1 (HA1A) - C46-22 (HA1A)	Always	Below 1 Ω
C22-3 (A1A+) - C46-126 (A1A+)	Always	Below 1 Ω
C22-4 (A1A-) - C46-125 (A1A-)	Always	Below 1 Ω
C23-1 (HA2A) - C46-20 (HA2A)	Always	Below 1 Ω
C23-3 (A2A+) - C46-103 (A2A+)	Always	Below 1 Ω
C23-4 (A2A-) - C46-102 (A2A-)	Always	Below 1 Ω
C22-1 (HA1A) or C46-22 (HA1A) - Body ground	Always	10 kΩ or higher
C22-3 (A1A+) or C46-126 (A1A+) - Body ground	Always	10 kΩ or higher
C22-4 (A1A-) or C46-125 (A1A-) - Body ground	Always	10 kΩ or higher
C23-1 (HA2A) or C46-20 (HA2A) - Body ground	Always	10 kΩ or higher
C23-3 (A2A+) or C46-103 (A2A+) - Body ground	Always	10 kΩ or higher
C23-4 (A2A-) or C46-102 (A2A-) - Body ground	Always	10 kΩ or higher

Reference (System Diagram):



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (DTC P2A00 AND/OR P2A03)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

d. Read pending DTCs.

Result

Result	Proceed to
P2A00 and/or P2A03 is output	A
No DTC is output	B

B → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

6.REPLACE AIR FUEL RATIO SENSOR

a. Replace the air fuel ratio sensor (Click here).

NEXT

7.PERFORM CONFIRMATION DRIVING PATTERN

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS (DTC P2A00 AND/OR P2A03)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC / Pending.

d. Read pending DTCs.

Result

Result	Proceed to
No DTC is output	A
P2A00 and/or P2A03 is output	B

B → REPLACE ECM (Click here)

A

END

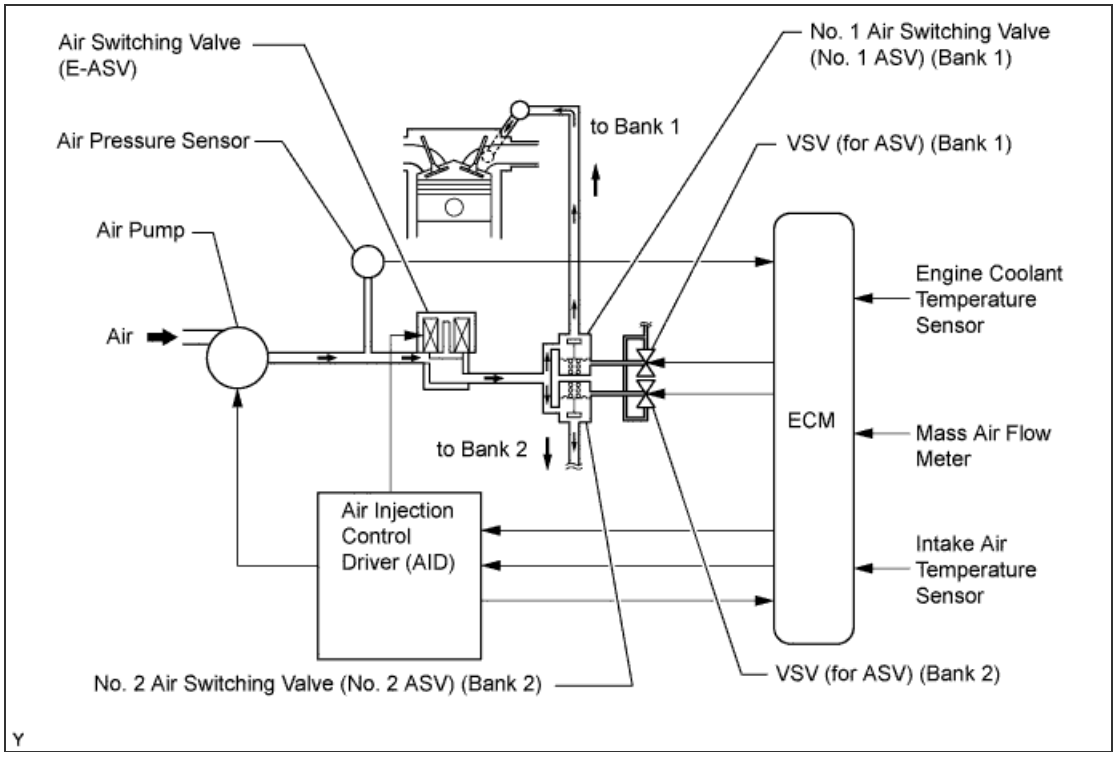
DTC P0412 Secondary Air Injection System Switching Valve "A" Circuit

for Preparation Click here

DESCRIPTION

The diagnostic trouble code (DTC) indicates an open or short in the electric air switching valve (E-ASV) circuit of the secondary air injection (AIR) system. The air injection control driver diagnoses the air pump circuit, E-ASV circuit and itself, and sends the diagnosis signal to the engine control module (ECM). If the ECM receives a malfunction signal from the air injection control driver, the ECM illuminates the malfunction indicator lamp (MIL), and stores a DTC.

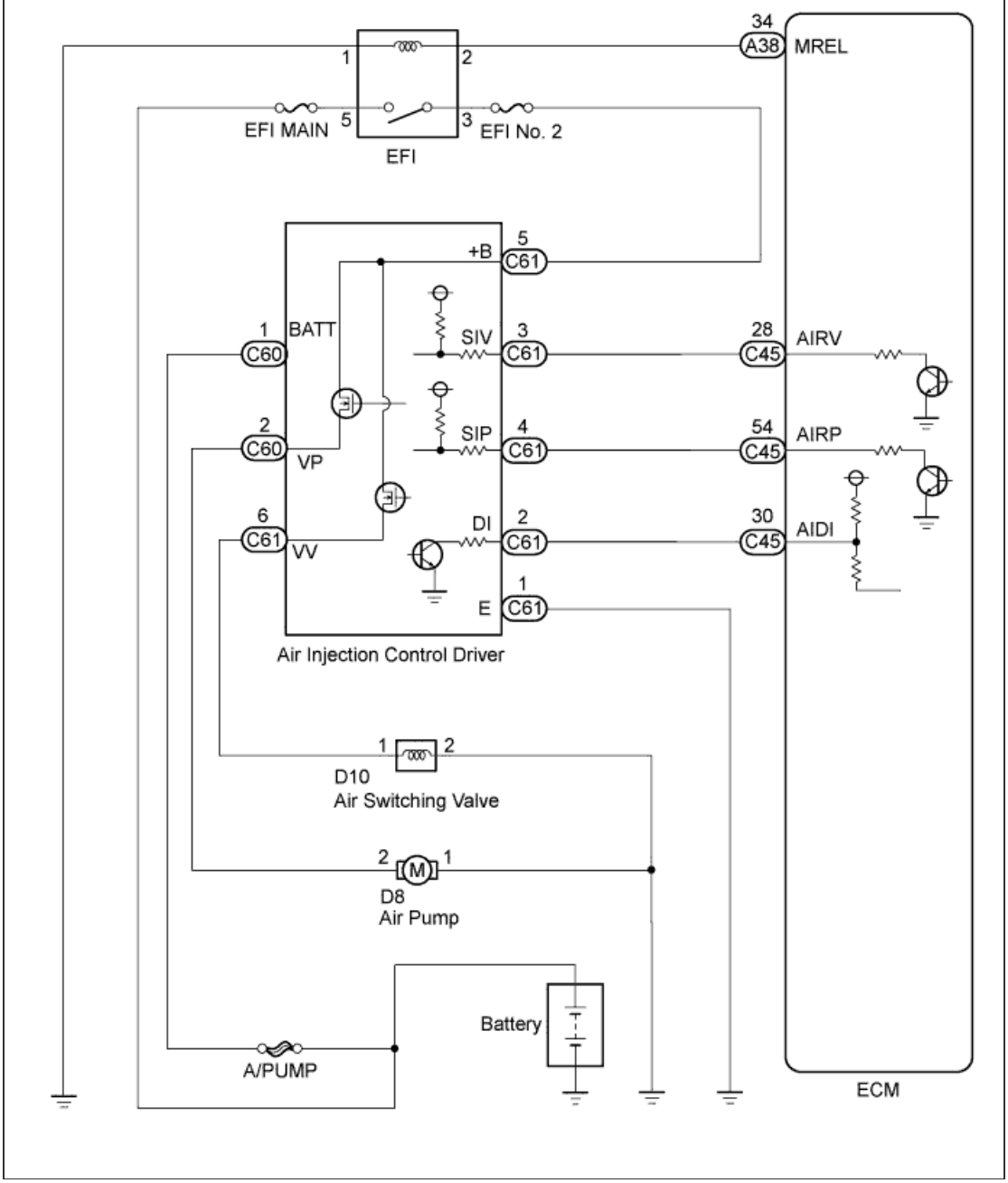
The secondary air injection (AIR) system introduces fresh air into the exhaust manifold in order to reduce carbon monoxide (CO) and hydrocarbon (HC) in the exhaust emission. This system is activated just after the engine start, and is stopped when the catalyst converter is warmed-up. This system consists of the following components: 1) the air pump which sends fresh air to the exhaust manifold, 2) the electric air switching valve (E-ASV) which switches the fresh air flow, 3) the air switching valve (ASV) which switches the air passage to the exhaust manifold of each bank, 4) the vacuum switching valve (VSV) which switches the vacuum (intake manifold pressure) to operate the ASV, 5) the pressure sensor which detects the fresh air pressure and exhaust pulse, 6) the air injection control driver which controls the power sources of the air pump and E-ASV, 7) the engine control module (ECM) which controls and monitors this system.

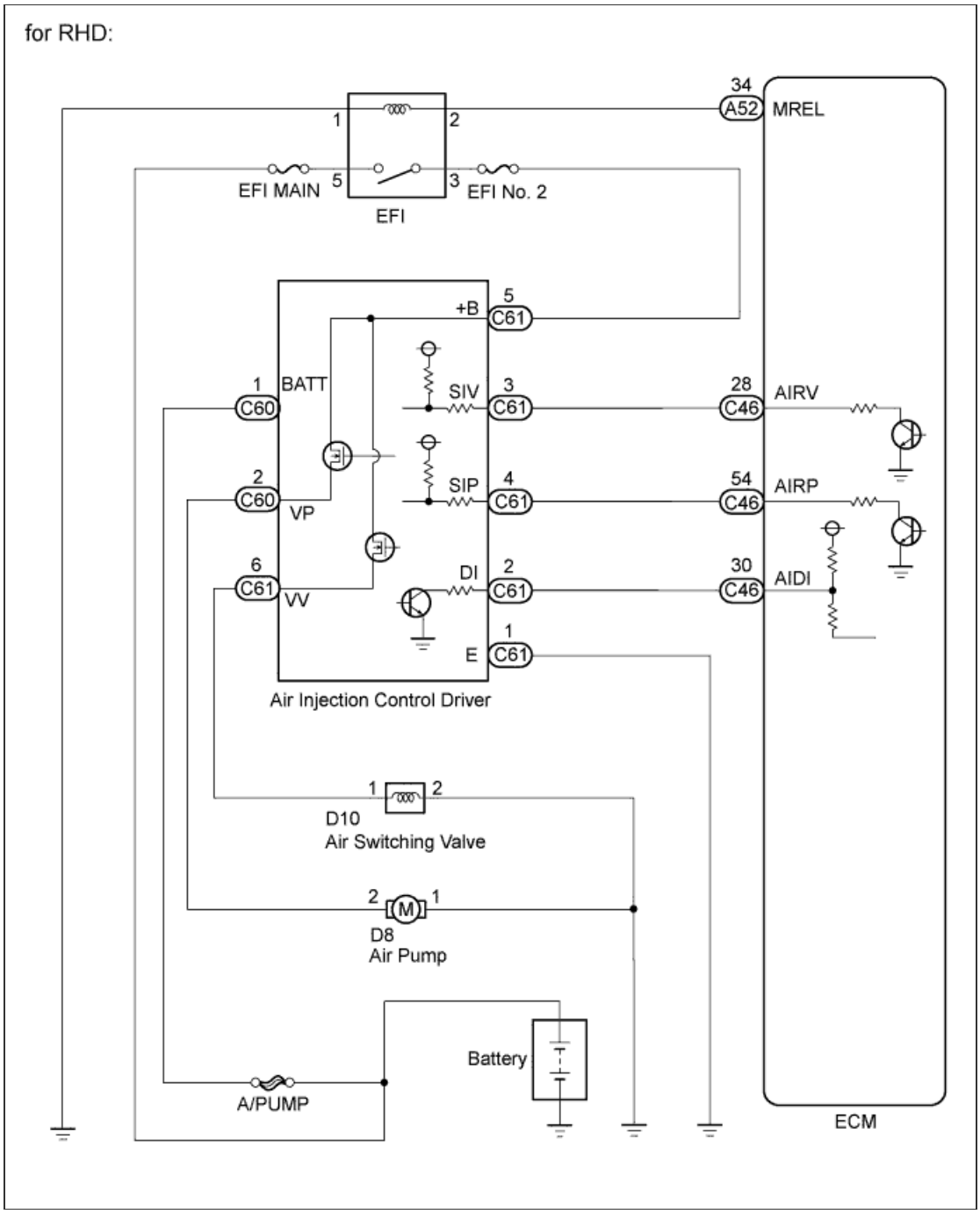


DTC Code	DTC Detection Condition	Trouble Area
P0412	The ECM receives a diagnostic signal from the driver (40% duty-cycle) (1 trip detection logic).	• ASV circuit • Air injection control driver • Air switching valve

WIRING DIAGRAM

for LHD:


34
A38
MREL
1
2
EFI MAIN
5
3
EFI No. 2
EFI
+B
5
C61
1
C60
BATT
SIV
3
C61
28
C45
AIRV
2
C60
VP
SIP
4
C61
54
C45
AIRP
6
C61
VV
DI
2
C61
30
C45
AIDI
E
1
C61
Air Injection Control Driver
D10
Air Switching Valve
D8
Air Pump
M
Battery
A/PUMP
ECM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

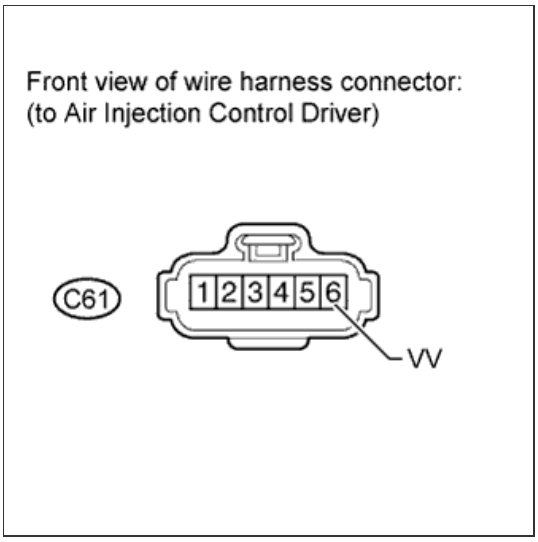
1.CHECK HARNESS AND CONNECTOR (AIR INJECTION CONTROL DRIVER - BODY GROUND)

a. Disconnect the air injection control driver connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C61-6 (VV) or - Body ground	20°C (68°F)	4.5 to 5.5 Ω



NG → Go to step 2

OK

REPLACE AIR INJECTION CONTROL DRIVER (Click here)

2.INSPECT AIR SWITCHING VALVE

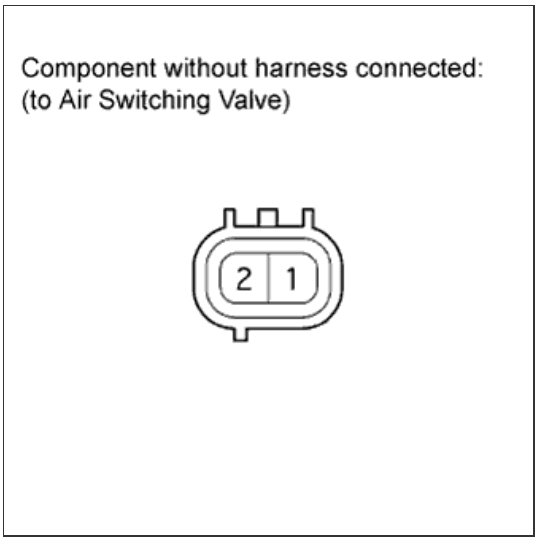
a. Remove the intake manifold (Click here).

b. Disconnect the Air Switching Valve (ASV) connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	4.5 to 5.5 Ω



NG → REPLACE AIR SWITCHING VALVE (Click here)

OK

3.CHECK HARNESS AND CONNECTOR (AIR SWITCHING VALVE - BODY GROUND)

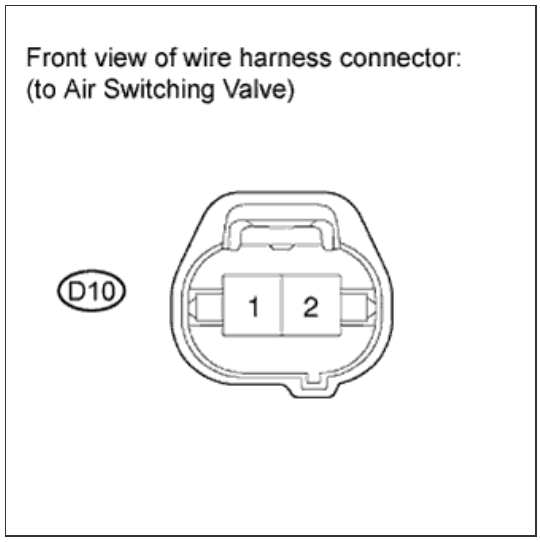
a. Remove the intake manifold (Click here).

b. Disconnect the Air Switching Valve (ASV) connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
D10-2 - Body ground	Always	Below 1 Ω



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.CHECK HARNESS AND CONNECTOR (AIR SWITCHING VALVE - AIR INJECTION CONTROL DRIVER)

a. Remove the intake manifold (Click here).

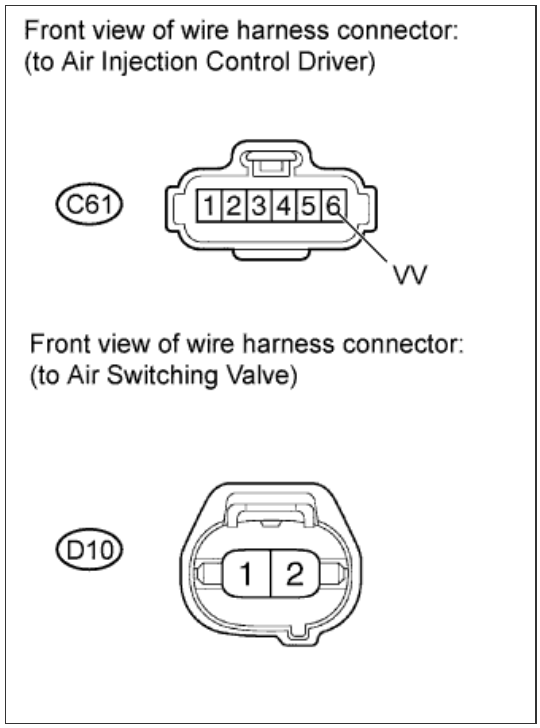
b. Disconnect the air injection control driver connector.

c. Disconnect the air switching valve connector.

d. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C61-6 (VV) - D10-1	Always	Below 1 Ω
C61-6 (VV) or D10-1 - Body ground	Always	10 kΩ higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC U0101 Lost Communication with TCM

for Preparation Click here

DESCRIPTION

The Transmission Control Module (TCM) and ECM perform 2-way communications with each other via the Controller Area Network (CAN). The TCM sends signals to the ECM concerning required engine speed, required engine torque, warning indicator speed, opening angles of the throttle valve, temperature of intake air, temperature of engine coolant, engine torque and other data. If the TCM cannot communicate with the ECM, the TCM will conclude that there is a malfunction in the CAN system, illuminate the MIL and store a DTC.

DTC Code	DTC Detection Condition	Trouble Area
U0101	No communication from the TCM continues.	• Open or short in TCM and ECM circuit • TCM • ECM

INSPECTION PROCEDURE

1.CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC U0101)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / DTC.

e. Read the DTCs.

Result

Result	Proceed to
U0101 is output	A
U0101 and other DTCs are output	B

B → GO TO DTC CHART (Click here)

A

2.REPLACE ECM

a. Replace the ECM (Click here).

NEXT

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Clear the DTC (Click here).

c. Start the engine.

d. Turn the tester on.

e. Enter the following menus: Powertrain / Engine and ECT / DTC.

f. Read the DTCs.

Result

Result	Proceed to
No DTC is output	A
Other DTCs are output	B

B → GO TO DTC CHART (Click here)

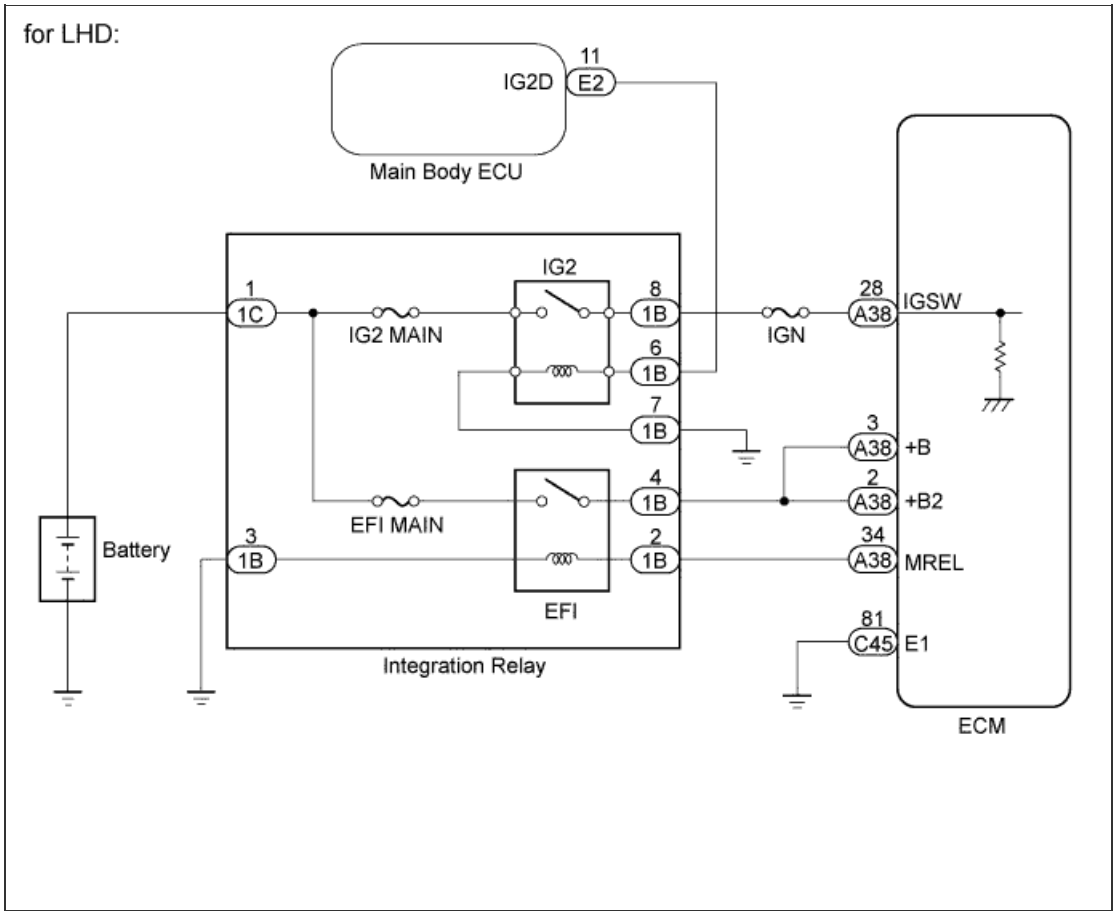

A
END

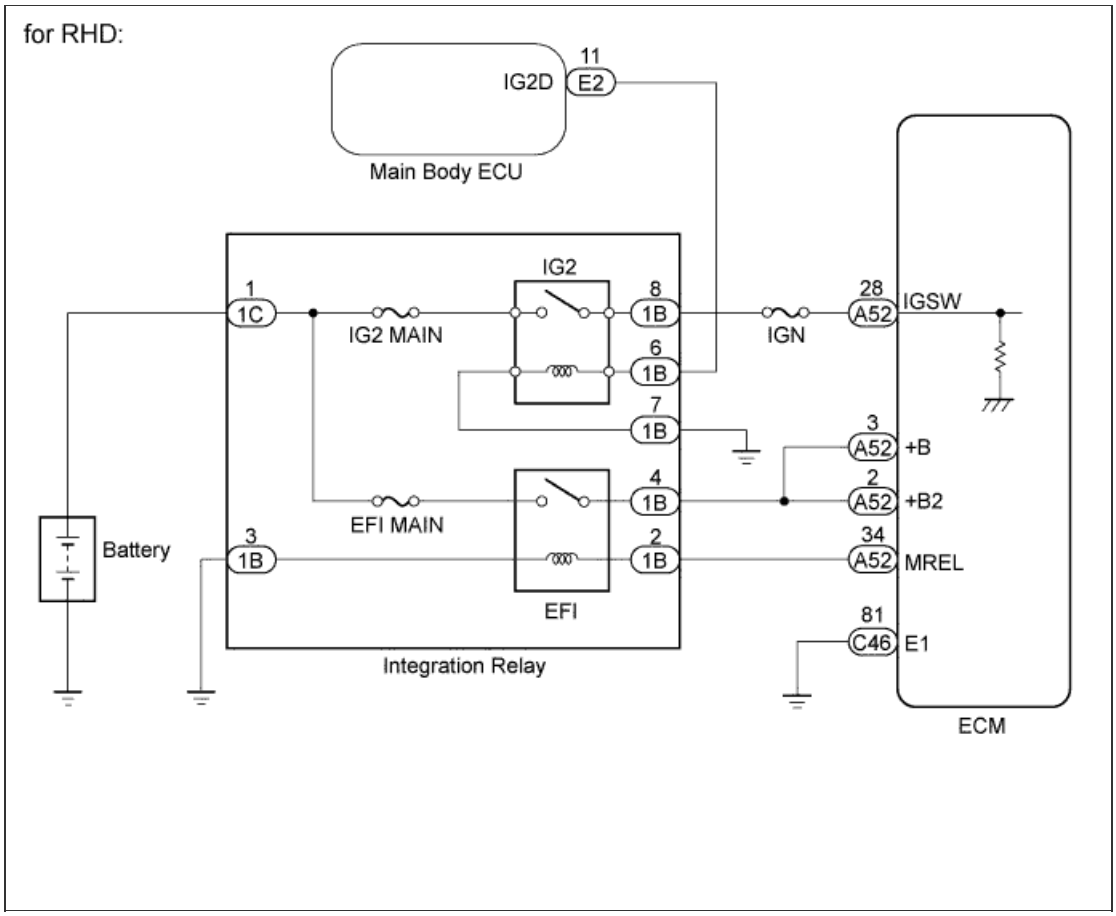
for Preparation Click here

DESCRIPTION

When the engine switch is turned on (IG), battery voltage is applied to terminal IGSW of the ECM. The output signal from the MREL terminal of the ECM causes a current to flow to the coil, closing the contacts of the integration relay (EFI relay) and supplying power to either terminal +B or +B2 of the ECM.

WIRING DIAGRAM





INSPECTION PROCEDURE

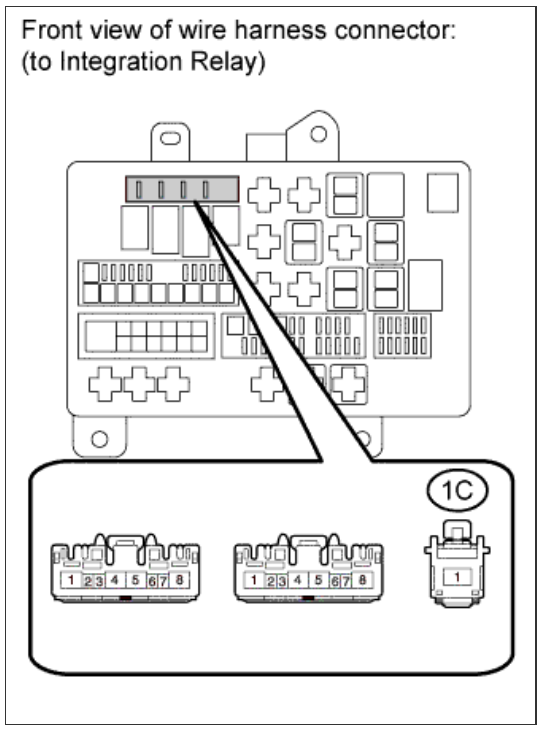
1.CHECK HARNESS AND CONNECTOR (BATTERY VOLTAGE)

a. Remove the integration relay from the engine room relay block.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
1C-1 - Body ground	Always	11 to 14 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - INTEGRATION RELAY)

OK

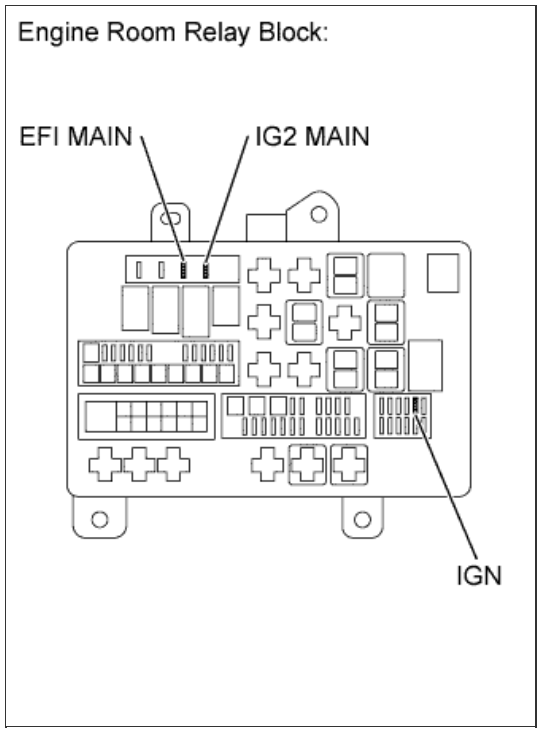
2.INSPECT FUSES (IG2 MAIN, EFI MAIN AND IGN)

a. Remove the IG2 MAIN fuse, EFI MAIN fuse and IGN fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
IG2 MAIN fuse	Always	Below 1 Ω
EFI MAIN fuse	Always	Below 1 Ω
IGN fuse	Always	Below 1 Ω



NG → CHECK FOR SHORT IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

OK

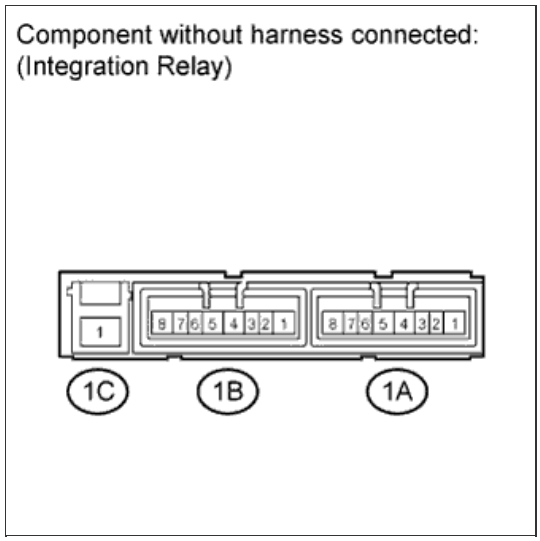
3.INSPECT INTEGRATION NO.1 RELAY (IG2, EFI)

a. Remove the integration relay from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1B-8	Battery voltage is not applied to terminals 1B-6 and 1B-7	10 kΩ or higher
1C-1 - 1B-8	Battery voltage is applied to terminals 1B-6 and 1B-7	Below 1 Ω
1C-1 - 1B-4	Battery voltage is not applied to terminals 1B-2 and 1B-3	10 kΩ or higher
1C-1 - 1B-4	Battery voltage is applied to terminals 1B-2 and 1B-3	Below 1 Ω



NG → REPLACE INTEGRATION NO.1 RELAY

OK

4.CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - ECM, BATTERY AND BODY GROUND)

a. Disconnect the ECM connector.

b. Remove the integration relay from the engine room relay block.

c. Measure the resistance according to the value(s) in the table below.

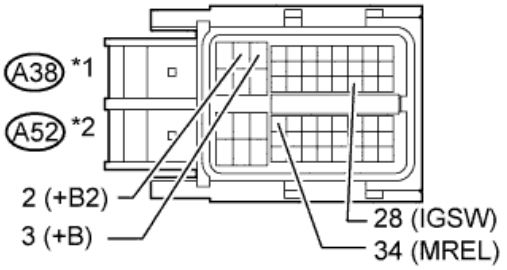
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
A38-28 (IGSW) - 1B-8	Always	Below 1 Ω
A38-3 (+B) - 1B-4	Always	Below 1 Ω
A38-2 (+B2) - 1B-4	Always	Below 1 Ω
A38-34 (MREL) - 1B-2	Always	Below 1 Ω
1B-3 - Body ground	Always	Below 1 Ω
1B-7 - Body ground	Always	Below 1 Ω
A38-28 (IGSW) or 1B-8 - Body ground	Always	10 kΩ or higher
A38-3 (+B) or 1B-4 - Body ground	Always	10 kΩ or higher
A38-2 (+B2) or 1B-4 - Body ground	Always	10 kΩ or higher
A38-34 (MREL) or 1B-2 - Body ground	Always	10 kΩ or higher

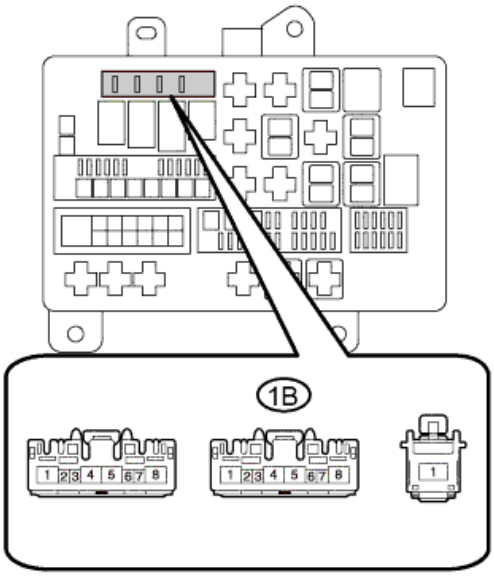
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
A52-28 (IGSW) - 1B-8	Always	Below 1 Ω
A52-3 (+B) - 1B-4	Always	Below 1 Ω
A52-2 (+B2) - 1B-4	Always	Below 1 Ω
A52-34 (MREL) - 1B-2	Always	Below 1 Ω
1B-3 - Body ground	Always	Below 1 Ω
1B-7 - Body ground	Always	Below 1 Ω
A52-28 (IGSW) or 1B-8 - Body ground	Always	10 kΩ or higher
A52-3 (+B) or 1B-4 - Body ground	Always	10 kΩ or higher
A52-2 (+B2) or 1B-4 - Body ground	Always	10 kΩ or higher
A52-34 (MREL) or 1B-2 - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to ECM)



Front view of wire harness connector:
(to Integration Relay)



*1: for LHD

*2: for RHD

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

5.CHECK HARNESS AND CONNECTOR (ECM - BODY GROUND)

a. Disconnect the ECM connector.

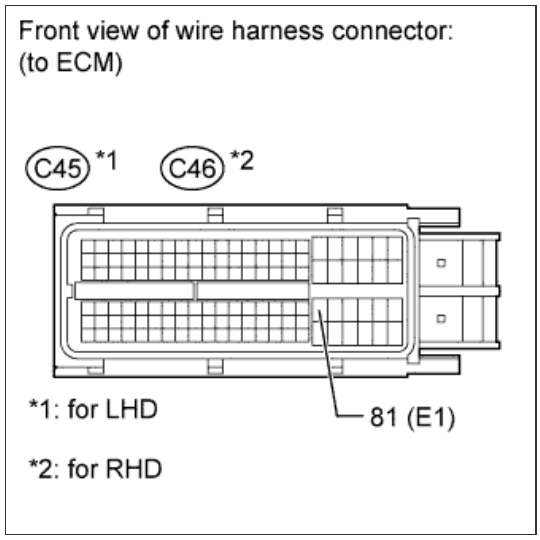
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C45-81 (E1) - Body ground	Always	Below 1 Ω

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C46-81 (E1) - Body ground	Always	Below 1 Ω



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6.INSPECT ECM (IGSW VOLTAGE)

a. Disconnect the ECM connectors.

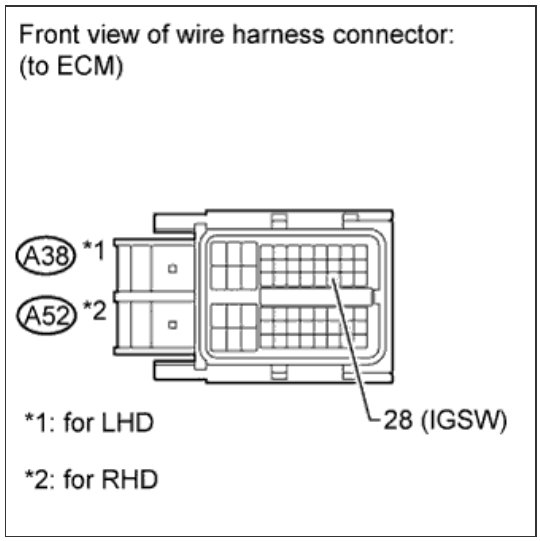
b. Measure the voltage according to the value(s) in the table below.

Standard Voltage (for LHD):

Tester Connection	Switch Condition	Specified Condition
A38-28 (IGSW) - Body ground	Engine switch on (IG)	11 to 14 V

Standard Voltage (for RHD):

Tester Connection	Switch Condition	Specified Condition
A52-28 (IGSW) - Body ground	Engine switch on (IG)	11 to 14 V



NG → Go to step 9

OK

7.REPLACE ECM

a. Replace the ECM (Click here).

NEXT

8.CHECK PROBLEM SYMPTOM DISAPPEARS

a. Check if the problem symptom disappears.

Result

Result	Proceed to
Problem symptom disappears	A
Problem symptom does not disappear	B

B → GO TO PROBLEM SYMPTOMS TABLE (Click here)

A

END

9.CHECK HARNESS AND CONNECTOR (MAIN BODY ECU - INTEGRATION RELAY)

a. Disconnect the main body ECU connector.

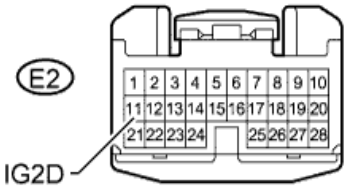
b. Remove the integration relay.

c. Measure the resistance according to the value(s) in the table below.

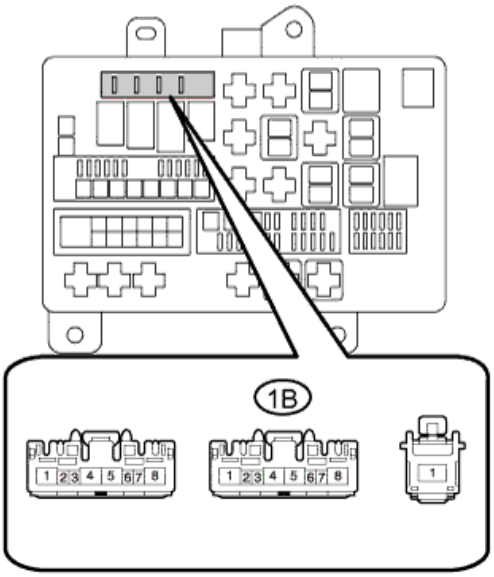
Standard Resistance:

Tester Connection	Condition	Specified Condition
E2-11 (IG2D) - 1B-6	Always	Below 1 Ω
E2-11 (IG2D) or 1B-6 - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Main Body ECU)



Front view of wire harness connector:
(to Integration Relay)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

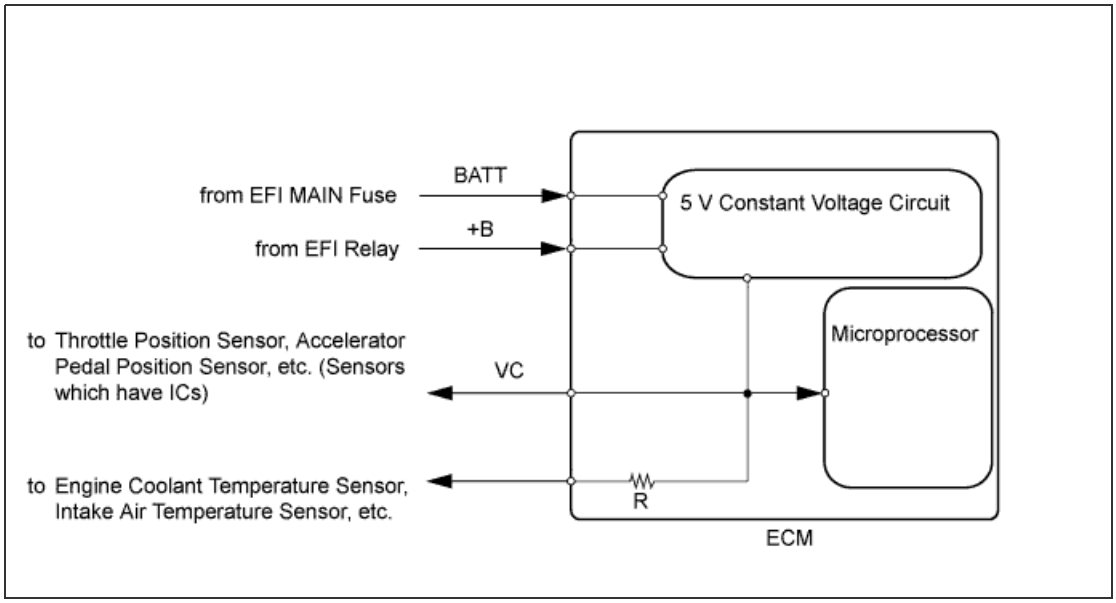
OK

GO TO ENTRY AND START SYSTEM (Click here)

for Preparation Click here

DESCRIPTION

The ECM constantly generates 5 V of power from the battery voltage supplied to the +B (BATT) terminal to operate the microprocessor. The ECM also provides this power to the sensors through the VC output circuit.



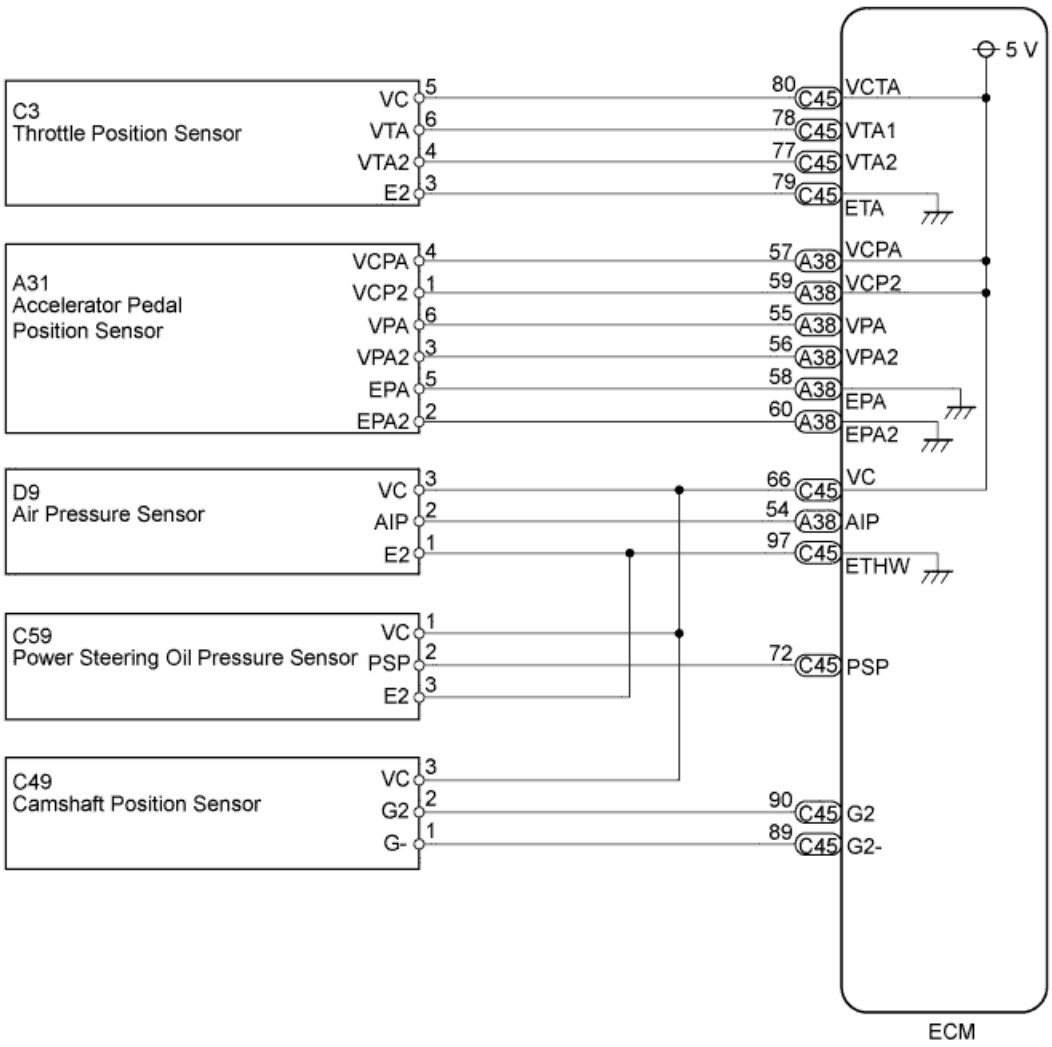
When the VC circuit is short-circuited, the microprocessor in the ECM and sensors that are supplied with power through the VC circuit are inactivated because the power is not supplied from the VC circuit. Under this condition, the system does not start up and the MIL does not illuminate even if the system malfunctions.

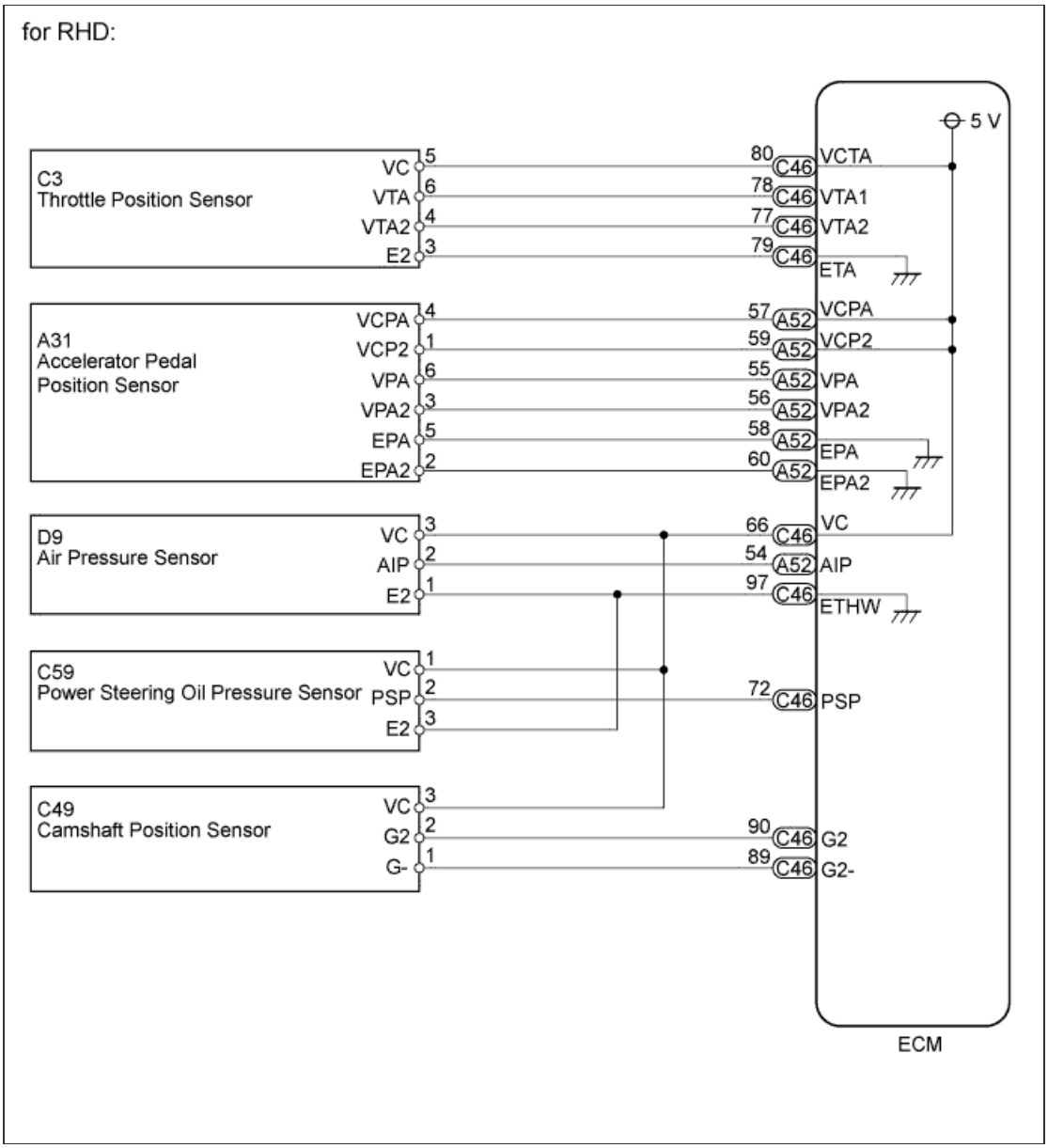
HINT:

Under normal conditions, the MIL is illuminated for several seconds when the engine switch is first turned on (IG). The MIL turns off when the engine is started.

WIRING DIAGRAM

for LHD:


C3
Throttle Position Sensor
VC 5
VTA 6
VTA2 4
E2 3
A31
Accelerator Pedal
Position Sensor
VCPA 4
VCP2 1
VPA 6
VPA2 3
EPA 5
EPA2 2
D9
Air Pressure Sensor
VC 3
AIP 2
E2 1
C59
Power Steering Oil Pressure Sensor
VC 1
PSP 2
E2 3
C49
Camshaft Position Sensor
VC 3
G2 2
G- 1
5 V
80 C45 VCTA
78 C45 VTA1
77 C45 VTA2
79 C45 ETA
57 A38 VCPA
59 A38 VCP2
55 A38 VPA
56 A38 VPA2
58 A38 EPA
60 A38 EPA2
66 C45 VC
54 A38 AIP
97 C45 ETHW
72 C45 PSP
90 C45 G2
89 C45 G2-
ECM



INSPECTION PROCEDURE

1.CHECK MIL

a. Check that the Malfunction Indicator Lamp (MIL) illuminates up when turning the engine switch on (IG).

Result

Result	Proceed to
MIL does not illuminate	A
MIL illuminates	B

B → SYSTEM OK

A

2.CHECK COMMUNICATION BETWEEN INTELLIGENT TESTER AND ECM

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and tester on.

c. Check the communication between the tester and ECM.

Result

Result	Proceed to
Communication is not possible	A
Communication is possible	B

B → GO TO MIL CIRCUIT (Click here)

A

3.CHECK MIL (THROTTLE POSITION SENSOR)

a. Disconnect the throttle body connector.

b. Turn the engine switch on (IG).

c. Check the MIL.

Result

Result	Proceed to
MIL does not illuminate	A
MIL illuminates	B

B → REPLACE THROTTLE BODY ASSEMBLY (Click here)

A

4.CHECK MIL (ACCELERATOR PEDAL POSITION SENSOR)

a. Disconnect the accelerator pedal position sensor connector.

b. Turn the engine switch on (IG).

c. Check the MIL.

Result

Result	Proceed to
MIL does not illuminate	A
MIL illuminates	B

B → REPLACE ACCELERATOR PEDAL SENSOR ASSEMBLY (Click here)

A

5.CHECK MIL (POWER STEERING OIL PRESSURE SWITCH)

a. Disconnect the power steering oil pressure sensor connector.

b. Turn the engine switch on (IG).

c. Check the MIL.

Result:

Result	Proceed to
MIL does not illuminate	A
MIL illuminates	B

B → REPLACE POWER STEERING OIL PRESSURE SWITCH (Click here)

A

6.CHECK MIL (CAMSHAFT POSITION SENSOR)

a. Disconnect the camshaft position sensor connector.

b. Turn the engine switch on (IG).

c. Check the MIL.

Result

Result	Proceed to
MIL does not illuminate	A
MIL illuminates	B

B → REPLACE CAM POSITION SENSOR ASSEMBLY (Click here)

A

7.CHECK MIL (AIR PRESSURE SENSOR)

a. Disconnect the air pressure sensor connector.

b. Turn the engine switch on (IG).

c. Check the MIL.

Result

Result	Proceed to
MIL does not illuminate	A
MIL illuminates	B

B → REPLACE AIR PRESSURE SENSOR (Click here)

A

8.CHECK HARNESS AND CONNECTOR

a. Disconnect the throttle body connector.

b. Disconnect the accelerator pedal position sensor connector.

c. Disconnect the air pressure sensor connector.

d. Disconnect the power steering oil pressure switch connector.

e. Disconnect the camshaft position sensor connector.

f. Disconnect the ECM connectors.

g. Measure the resistance according to the value(s) in the table below.

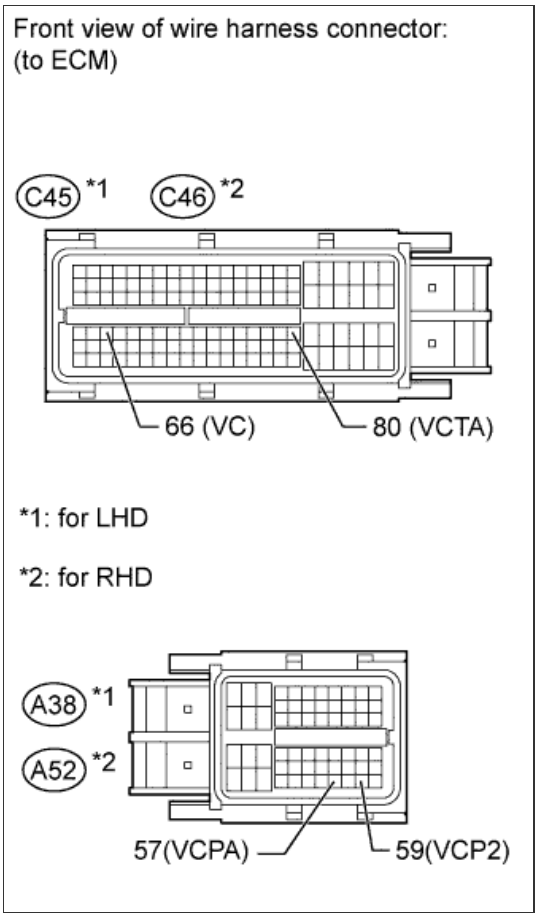
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C45-80 (VCTA) - Body ground	Always	10 kΩ or higher
A38-57 (VCPA) - Body ground	Always	10 kΩ or higher
A38-59 (VCP2) - Body ground	Always	10 kΩ or higher
C45-66 (VC) - Body ground	Always	10 kΩ or higher

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C45-80 (VCTA) - Body ground	Always	10 kΩ or higher
A52-57 (VCPA) - Body ground	Always	10 kΩ or higher
A52-59 (VCP2) - Body ground	Always	10 kΩ or higher

C45-66 (VC) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.REPLACE ECM

a. Replace the ECM (Click here).

NEXT

10.CHECK PROBLEM SYMPTOM DISAPPEARS

a. Check if the problem symptom disappears.

Result

Result	Proceed to
Problem symptom disappears	A
Problem symptom does not disappear	B

B → GO TO PROBLEM SYMPTOMS TABLE (Click here)

A

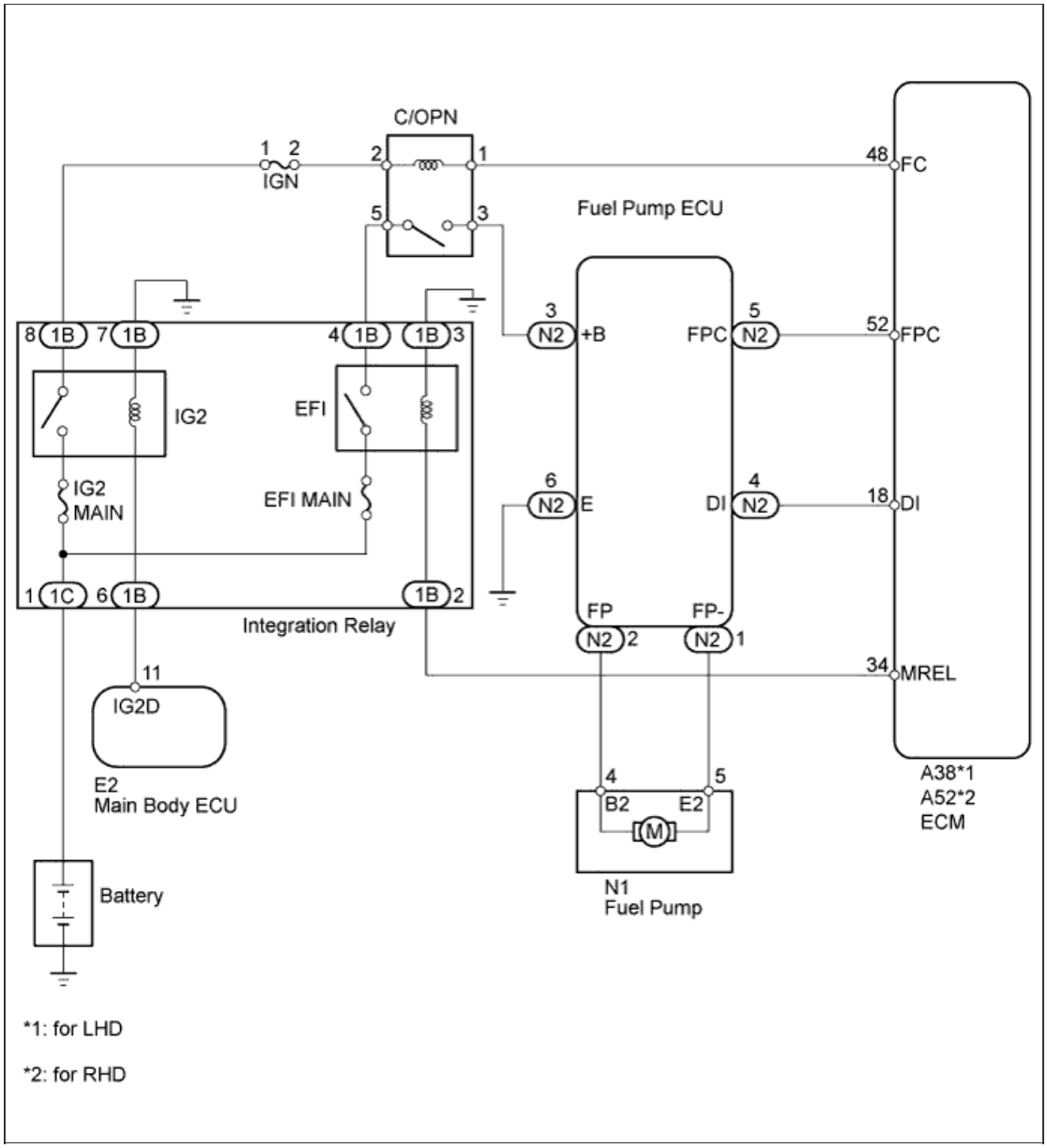
END

for Preparation Click here

DESCRIPTION

The fuel pump circuit consists of the ECM, fuel pump and fuel pump ECU (which operates the fuel pump). Based on the engine output, the ECM determines the fuel pump speed. The speed is then converted to a duty signal and sent to the fuel pump ECU. Based on the signal sent from the ECM, the fuel pump ECU adjusts the fuel pump operation speed between 3 settings.

WIRING DIAGRAM



INSPECTION PROCEDURE

This troubleshooting procedure is based on the premise that the engine is started. If the engine is not started, proceed to the Problem Symptoms Table (Click here).

1.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (FUEL PUMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Fuel Pump / Speed.

d. Check whether operating sounds can be heard while operating the relay using the tester.

OK:

Operating sounds can be heard from relay.

NG → Go to step 5

OK

2.CHECK HARNESS AND CONNECTOR (FUEL PUMP ECU - ECM - FUEL PUMP)

a. Disconnect the fuel pump ECU connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

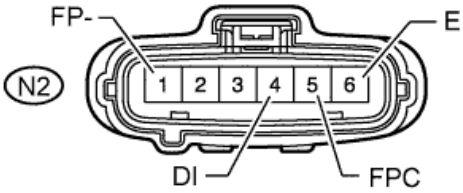
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
N2-5 (FPC) - A38-52 (FPC)	Always	Below 1 Ω
N2-4 (DI) - A38-18 (DI)	Always	Below 1 Ω
N2-6 (E) - Body ground	Always	Below 1 Ω
N2-5 (FPC) or A38-52 (FPC) - Body ground	Always	10 kΩ or more
N2-4 (DI) or A38-18 (DI) - Body ground	Always	10 kΩ or more
N2-1 (FP-) or N1-5 (E2) - Body ground	Always	10 kΩ or more

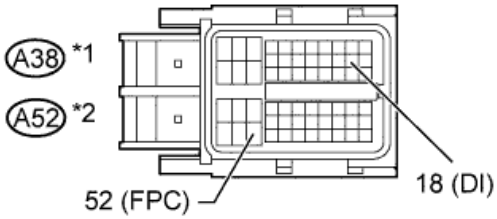
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
N2-5 (FPC) - A52-52 (FPC)	Always	Below 1 Ω
N2-4 (DI) - A52-18 (DI)	Always	Below 1 Ω
N2-6 (E) - Body ground	Always	Below 1 Ω
N2-5 (FPC) or A52-52 (FPC) - Body ground	Always	10 kΩ or more
N2-4 (DI) or A52-18 (DI) - Body ground	Always	10 kΩ or more
N2-1 (FP-) or N1-5 (E2) - Body ground	Always	10 kΩ or more

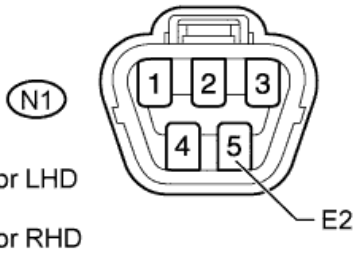
Front view of wire harness connector:
(to Fuel Pump ECU)



Front view of wire harness connector:
(to ECM)



Front view of wire harness connector:
(to Fuel Pump)



*1: for LHD

*2: for RHD

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.REPLACE FUEL PUMP CONTROL ECU

a. Replace the fuel pump control ECU (Click here).

NEXT

4.CHECK PROBLEM SYMPTOM DISAPPEARS

a. Check if the problem symptom disappears.

Result

Result	Proceed to
Problem symptom disappears	A
Problem symptom does not disappear	B

B → Go to step 15

A

END

5.CHECK FUEL PUMP (POWER SOURCE VOLTAGE)

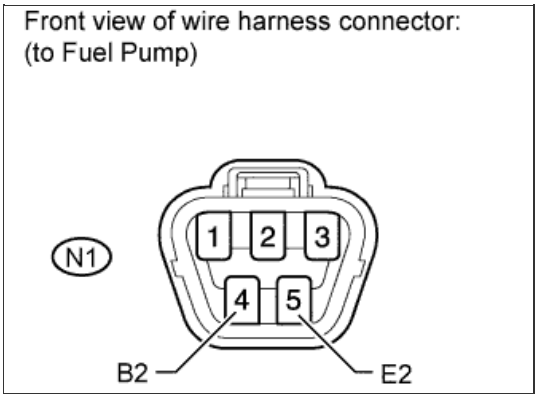
a. Disconnect the fuel pump connector.

b. Connect the intelligent tester to the DLC3.

c. Turn the engine switch on (IG) and turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Fuel Pump / Speed.

e. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

Tester Connection	Condition	Specified Condition
N1-4 - N1-5	Engine switch on (IG) Active Test on	11 to 14 V

Result

Result	Proceed to
OK	A
NG (for Single Tank Type)	B
NG (for Double Tank Type)	C

B → REPLACE FUEL PUMP (Click here)

C → REPLACE FUEL PUMP (Click here)

A

6.CHECK HARNESS AND CONNECTOR (ECM - FUEL PUMP CONTROL ECU - FUEL PUMP)

a. Disconnect the ECM connector.

b. Disconnect the fuel pump ECU connector.

c. Disconnect the fuel pump connector.

d. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

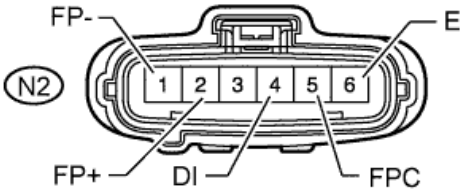
Tester Connection	Condition	Specified Condition
N2-5 (FPC) - A38-52 (FPC)	Always	Below 1 Ω
N2-4 (DI) - A38-18 (DI)	Always	Below 1 Ω
N2-6 (E) - Body ground	Always	Below 1 Ω
N2-2 (FP+) - N1-4 (B2)	Always	Below 1 Ω
N2-1 (FP-) - N1-5		

(E2)	Always	Below 1 Ω
N2-5 (FPC) or A38-52 (FPC) - Body ground	Always	10 kΩ or more
N2-4 (DI) or A38-18 (DI) - Body ground	Always	10 kΩ or more
N2-2 (FP+) or N1-4 (B2) - Body ground	Always	10 kΩ or more
N2-1 (FP-) or N1-5 (E2) - Body ground	Always	10 kΩ or more

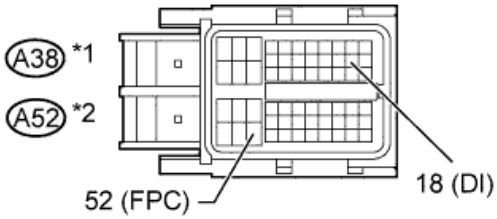
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
N2-5 (FPC) - A52-52 (FPC)	Always	Below 1 Ω
N2-4 (DI) - A52-18 (DI)	Always	Below 1 Ω
N2-6 (E) - Body ground	Always	Below 1 Ω
N2-2 (FP+) - N1-4 (B2)	Always	Below 1 Ω
N2-1 (FP-) - N1-5 (E2)	Always	Below 1 Ω
N2-5 (FPC) or A52-52 (FPC) - Body ground	Always	10 kΩ or more
N2-4 (DI) or A52-18 (DI) - Body ground	Always	10 kΩ or more
N2-2 (FP+) or N1-4 (B2) - Body ground	Always	10 kΩ or more
N2-1 (FP-) or N1-5 (E2) - Body ground	Always	10 kΩ or more

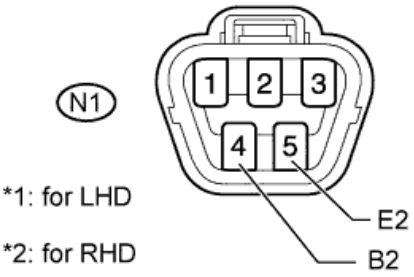
Front view of wire harness connector:
(to Fuel Pump ECU)



Front view of wire harness connector:
(to ECM)



Front view of wire harness connector:
(to Fuel Pump)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

7.CHECK FUEL PUMP CONTROL ECU (POWER SOURCE VOLTAGE)

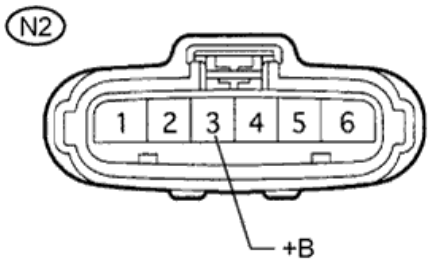
a. Disconnect the fuel pump ECU connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
N2-3 (+B) - Body ground	Engine switch on (IG)	11 to 14 V

Front view of wire harness connector:
(to Fuel Pump ECU)



NG → Go to step 10

OK

8.REPLACE FUEL PUMP CONTROL ECU

a. Replace the fuel pump control ECU (Click here).

NEXT

9.CHECK PROBLEM SYMPTOM DISAPPEARS

a. Check if the problem symptom disappears.

Result

Result	Proceed to
Problem symptom disappears	A
Problem symptom does not disappear	B

B → Go to step 15

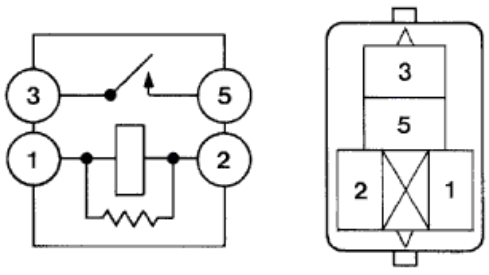
A

END

10.INSPECT CIRCUIT OPENING RELAY (C/OPN)

a. Remove the circuit opening relay (C/OPN) from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied to terminals 1 and 2	10 kΩ or higher
3 - 5	Battery voltage applied to terminals 1 and 2	Below 1 Ω

NG → REPLACE CIRCUIT OPENING RELAY (C/OPN)

OK

11.CHECK CIRCUIT OPENING RELAY

a. Check the operating sound of the relay when the engine switch is turned on (IG).

OK:

Tester Connection	Switch Condition	Specified Condition
C/OPN relay	Engine switch on (IG)	Operating sound heard

NG → Go to step 13

OK

12.CHECK HARNESS AND CONNECTOR (FUEL PUMP ECU - CIRCUIT OPENING RELAY - INTEGRATION RELAY)

a. Remove the circuit opening relay (C/OPN) and integration relay from the engine room relay block.

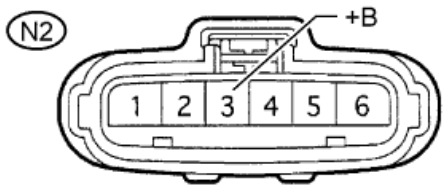
b. Disconnect the fuel pump ECU connector.

c. Measure the resistance according to the value(s) in the table below.

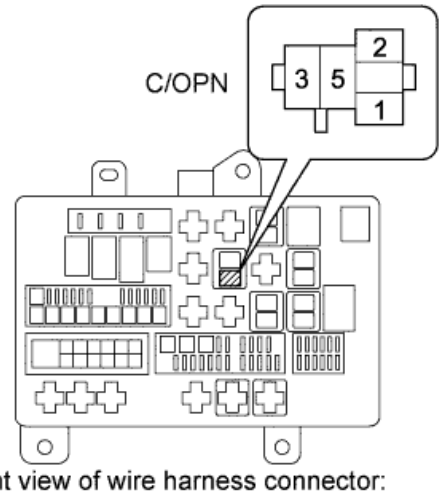
Standard Resistance:

Tester Connection	Condition	Specified Condition
N2-3 (+B) - C/OPN relay terminal 3	Always	Below 1 Ω
1B-4 - C/OPN relay terminal 5	Always	Below 1 Ω
N2 or 3 (+B) - C/OPN relay terminal 3 - Body ground	Always	10 kΩ or more
1B or 4 - C/OPN relay terminal 5 - Body ground	Always	10 kΩ or more

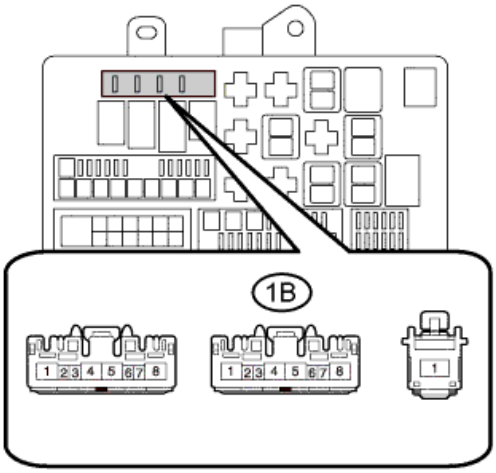
Front view of wire harness connector:
(to Fuel Pump ECU)



Engine Room Relay Block:



Front view of wire harness connector:
(to Integration Relay)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

GO TO ECU POWER SOURCE CIRCUIT (Click here)

13.INSPECT FUSE (IGN)

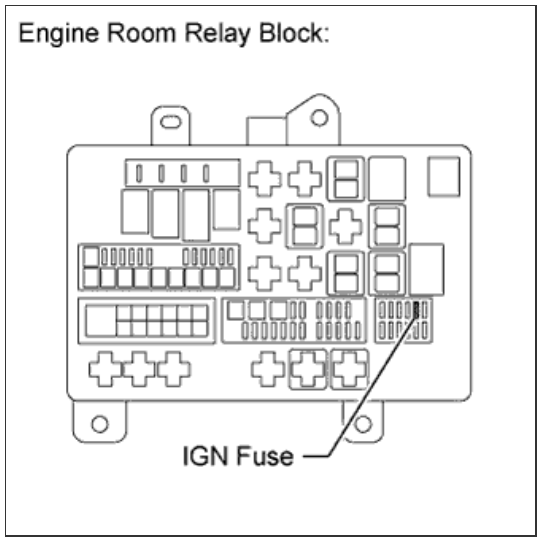
a. Remove the IGN fuse from the integration relay.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
IGN fuse	Always	Below 1 Ω

c. Reinstall the IGN fuse.



NG → CHECK FOR SHORTS IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

OK

14.CHECK HARNESS AND CONNECTOR (ECM - CIRCUIT OPENING RELAY - INTEGRATION)

a. Remove the circuit opening relay (C/OPN) and integration relay from the engine room relay block.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

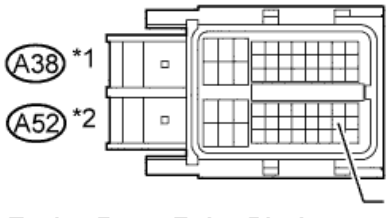
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
A38-48(FC) - 1	Always	Below 1 Ω
1B-8 - 2	Always	Below 1 Ω
A38-48(FC) - 1 or Body ground	Always	10 kΩ or more
1B-8 or 2 - Body ground	Always	10 kΩ or more

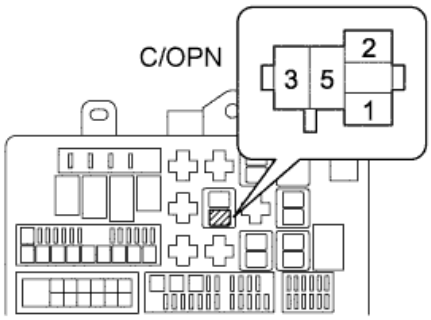
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
A52-48(FC) - 1	Always	Below 1 Ω
1B-8 - 2	Always	Below 1 Ω
A52-48(FC) - 1 or Body ground	Always	10 kΩ or more
1B-8 or 2 - Body ground	Always	10 kΩ or more

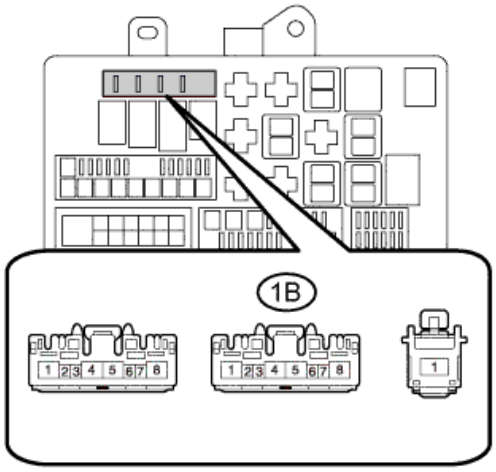
Front view of wire harness connector:
(to ECM)



Engine Room Relay Block:



Front view of wire harness connector:
(to Integration Relay)



*1: for LHD

*2: for RHD

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

15.REPLACE ECM

a. Replace the ECM (Click here).

NEXT

16.CHECK PROBLEM SYMPTOM DISAPPEARS

a. Check if the problem symptom disappears.

Result

Result	Proceed to
Problem symptom disappears	A

Problem symptom does not disappear	B

B

GO TO PROBLEM SYMPTOMS TABLE (Click here)

A

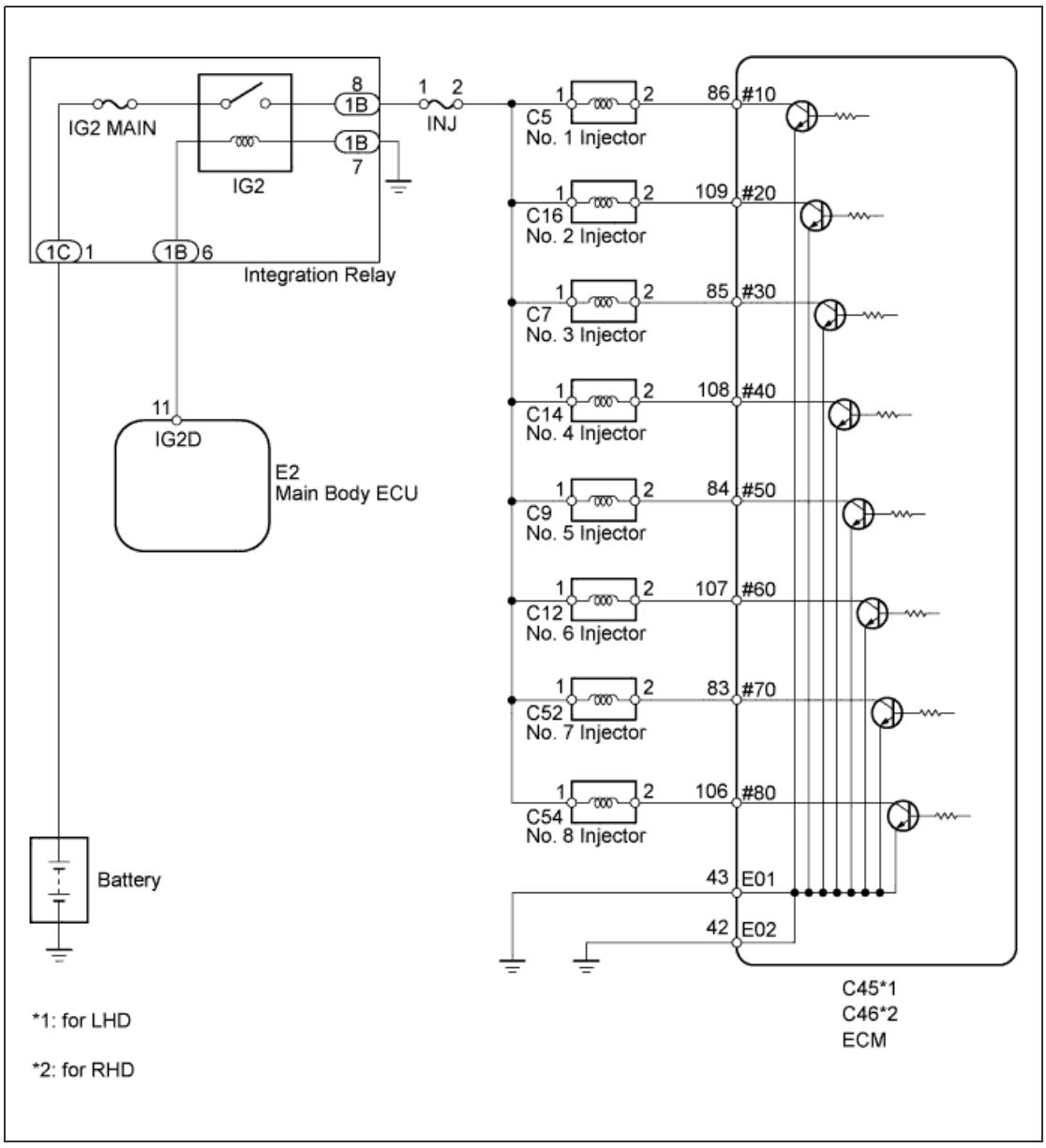
END

for Preparation Click here

DESCRIPTION

The fuel injectors are located on the intake manifold. They inject fuel into the cylinders based on the signals from the ECM.

WIRING DIAGRAM



INSPECTION PROCEDURE

1.CHECK INJECTOR ASSEMBLY (POWER SOURCE)

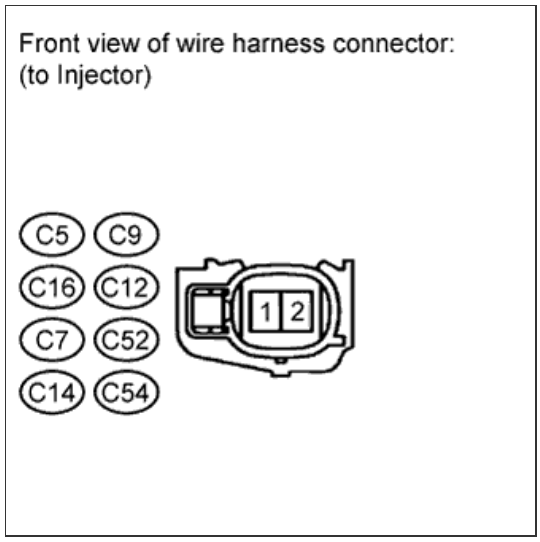
a. Disconnect the fuel injector connector.

b. Measure the voltage according to the value(s) in the table below.

Standard voltage:

Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	C5-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 2	C16-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 3	C7-1 - Ground	Engine switch on (IG)	11 to 14 V

No. 4	C14-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 5	C9-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 6	C12-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 7	C52-1 - Ground	Engine switch on (IG)	11 to 14 V
No. 8	C54-1 - Ground	Engine switch on (IG)	11 to 14 V



NG → Go to step 6

OK

2.INSPECT FUEL INJECTOR ASSEMBLY

a. Inspect the fuel injector (Click here).

NG → REPLACE FUEL INJECTOR ASSEMBLY (Click here)

OK

3.CHECK HARNESS AND CONNECTOR (FUEL INJECTOR ASSEMBLY - ECM)

a. Disconnect the fuel injector connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

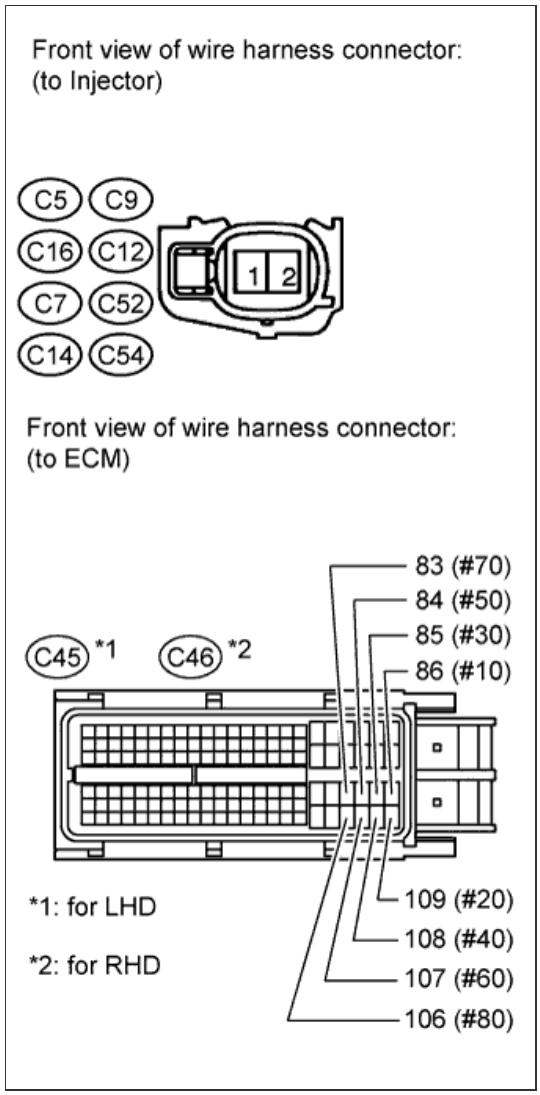
Standard Resistance (for LHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C45-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C45-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C45-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C45-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C45-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C45-107 (#60)	Always	Below 1 Ω

No. 7	C52-2 - Body ground	Always	10 kΩ or higher
	C52-2 - C45-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Body ground	Always	10 kΩ or higher
	C54-2 - C45-106 (#80)	Always	Below 1 Ω

Standard Resistance (for RHD):

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - C46-86 (#10)	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - C46-109 (#20)	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - C46-85 (#30)	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - C46-108 (#40)	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - C46-84 (#50)	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - C46-107 (#60)	Always	Below 1 Ω
No. 7	C52-2 - Body ground	Always	10 kΩ or higher
	C52-2 - C46-83 (#70)	Always	Below 1 Ω
No. 8	C54-2 - Body ground	Always	10 kΩ or higher
	C54-2 - C46-106 (#80)	Always	Below 1 Ω



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4.REPLACE ECM

a. Replace the ECM (Click here).

NEXT

5.CHECK PROBLEM SYMPTOM DISAPPEARS

a. Check if the problem symptom disappears.

Result

Result	Proceed to
Problem symptom disappears	A
Problem symptom does not disappear	B

B

GO TO PROBLEM SYMPTOMS TABLE (Click here)

A

END

6.INSPECT FUSE (INJ)

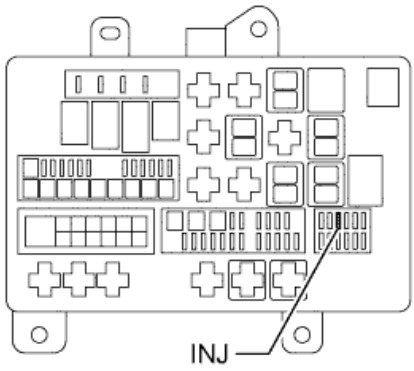
a. Remove the INJ fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
INJ fuse	Always	Below 1 Ω

Engine Room Relay Block:



NG

CHECK FOR SHORT IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

OK

7.CHECK HARNESS AND CONNECTOR (FUEL INJECTOR ASSEMBLY - INTEGRATION RELAY)

a. Disconnect the fuel injector connector.

b. Remove the integration relay from the engine room relay block.

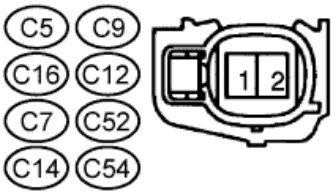
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

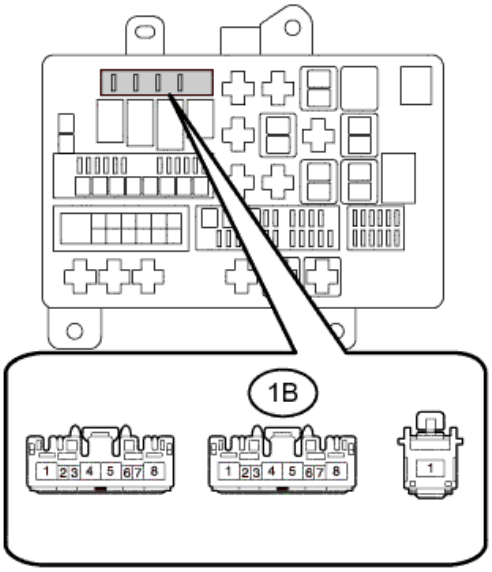
Cylinder	Tester Connection	Condition	Specified Condition
No. 1	C5-2 - Body ground	Always	10 kΩ or higher
	C5-2 - 1B-8	Always	Below 1 Ω
No. 2	C16-2 - Body ground	Always	10 kΩ or higher
	C16-2 - 1B-8	Always	Below 1 Ω
No. 3	C7-2 - Body ground	Always	10 kΩ or higher
	C7-2 - 1B-8	Always	Below 1 Ω
No. 4	C14-2 - Body ground	Always	10 kΩ or higher
	C14-2 - 1B-8	Always	Below 1 Ω
No. 5	C9-2 - Body ground	Always	10 kΩ or higher
	C9-2 - 1B-8	Always	Below 1 Ω
No. 6	C12-2 - Body ground	Always	10 kΩ or higher
	C12-2 - 1B-8	Always	Below 1 Ω
No. 7	C52-2 - Body ground	Always	10 kΩ or higher
	C52-2 - 1B-8	Always	Below 1 Ω
No. 8	C54-2 - Body ground	Always	10 kΩ or higher

	C54-2 - 1B-8	Always	Below 1 Ω

Front view of wire harness connector:
(to Injector)



Front view of wire harness connector:
(to Integration Relay)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

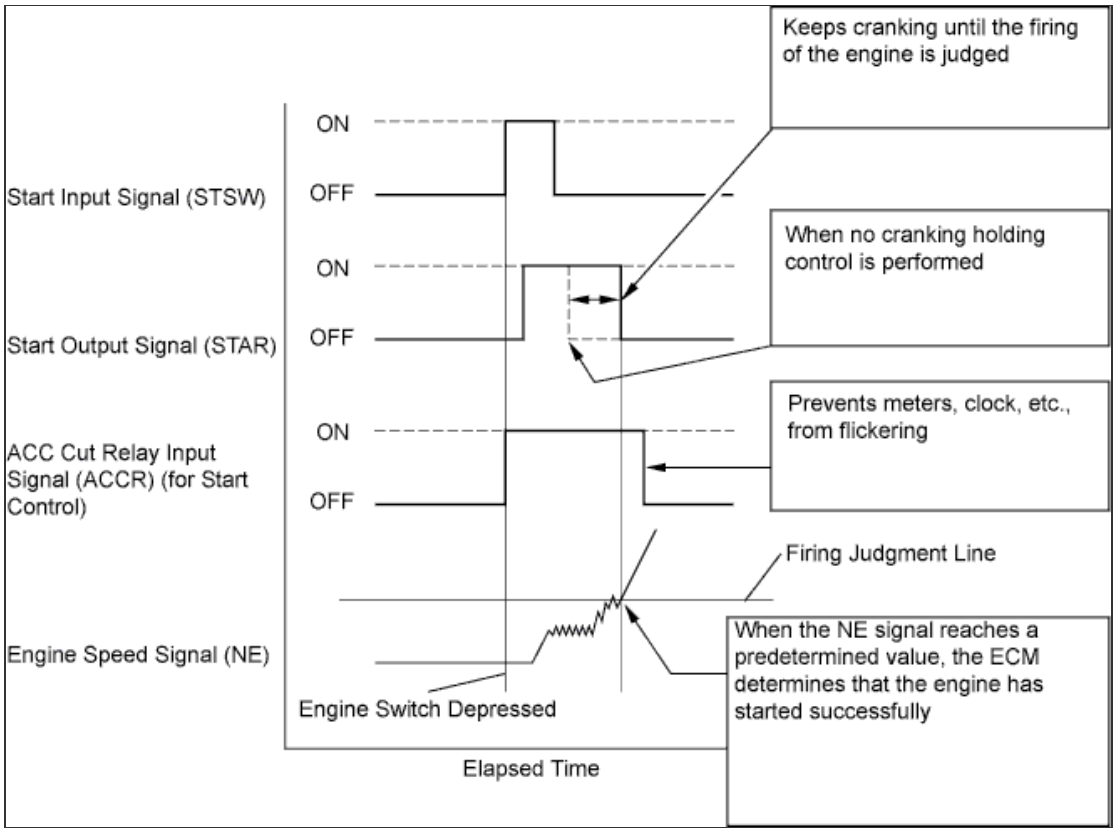
OK

CHECK ECU POWER SOURCE CIRCUIT (Click here)

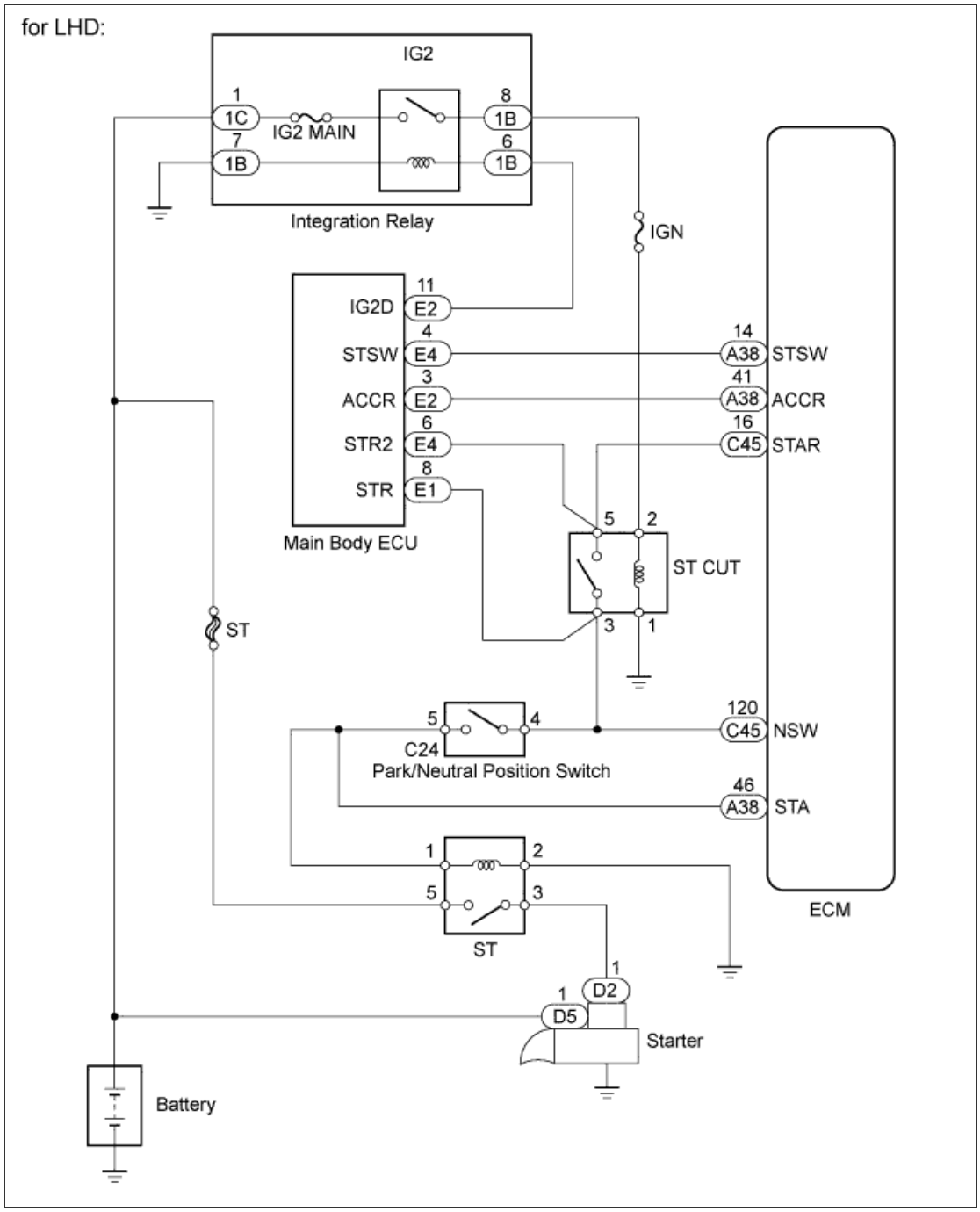
for Preparation Click here

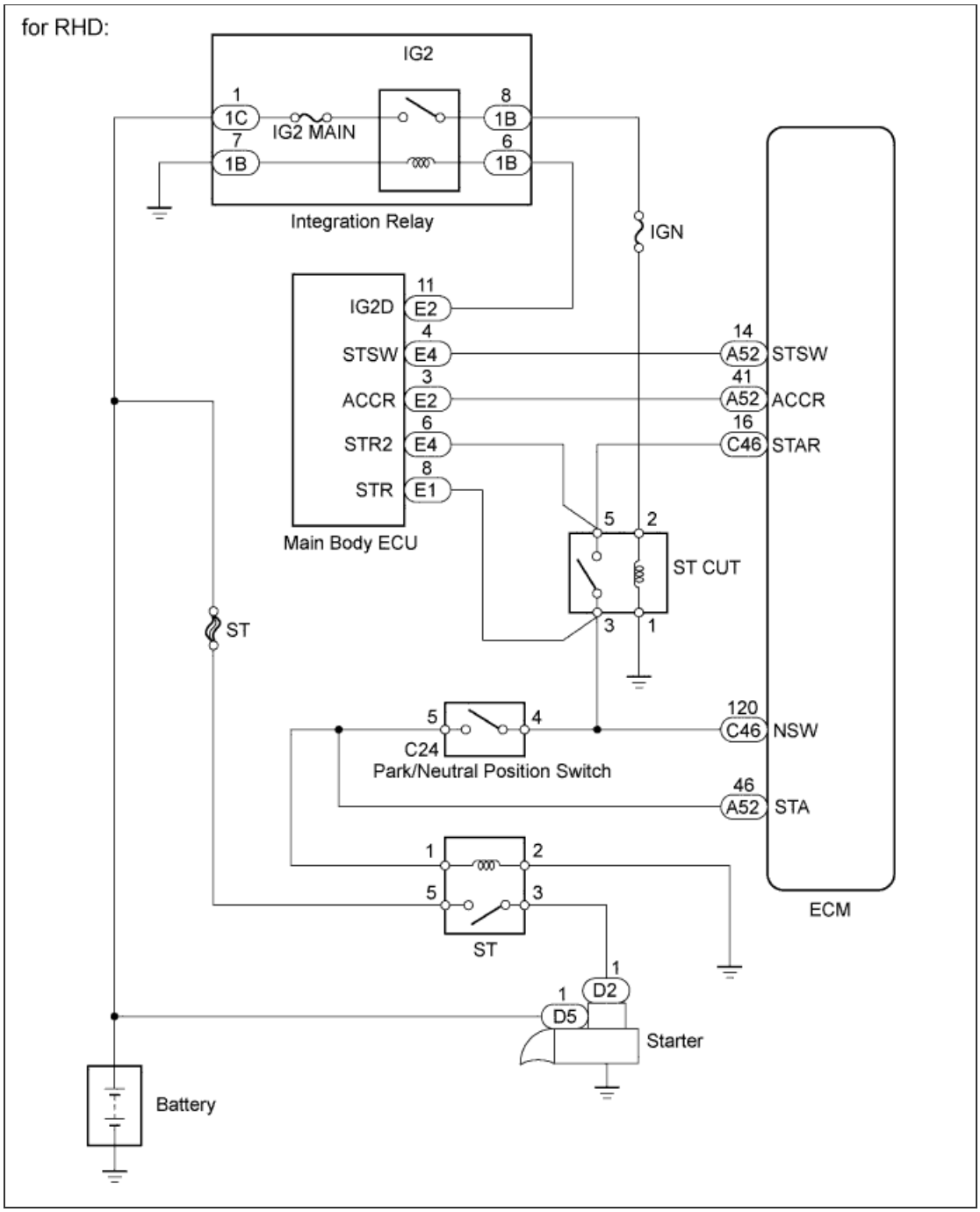
DESCRIPTION

The cranking holding control system provides current to the starter when the ECM detects the engine switch start signal (STSW). When the ECM performs a firing judgment, the system cuts current to the starter. When an ECM receives the STSW signal, it turns on the ACC Cut relay, which prevents flickering of the combination meter, clock, audio system, etc. Also, the ECM sends a signal to the STAR terminal of the ECM. Then the STAR output signal travels through the Park/Neutral Position (PNP) switch to the STARTER relay, causing the starter to activate.
When the engine is cranking, the starter operation signal is sent to the STA terminal of the ECM.



WIRING DIAGRAM


for LHD:
IG2
1
1C
IG2 MAIN
8
1B
7
1B
6
1B
Integration Relay
IGN
IG2D
11
E2
STSW
4
E4
14
A38
STSW
ACCR
3
E2
41
A38
ACCR
STR2
6
E4
16
C45
STAR
STR
8
E1
Main Body ECU
5
2
ST CUT
3
1
ST
5
4
C24
Park/Neutral Position Switch
120
C45
NSW
46
A38
STA
1
2
5
3
ST
ECM
1
D2
1
D5
Starter
Battery



INSPECTION PROCEDURE

1.CHECK CRANKING

a. Check the cranking of the engine.

OK:
Engine cranks.

NG → [Go to step 2]

OK

GO TO PROBLEM SYMPTOMS TABLE (Click here)

2.READ VALUE USING INTELLIGENT TESTER (STARTER SIGNAL)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / Activate Test / Activate the Starter Relay.

d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Starter Signal.

e. Check the Starter Signal on the intelligent tester.

OK:

Activate Test	Starter Signal
ON	ON
OFF	OFF

Result

Result	Proceed to
NG	A
OK	B

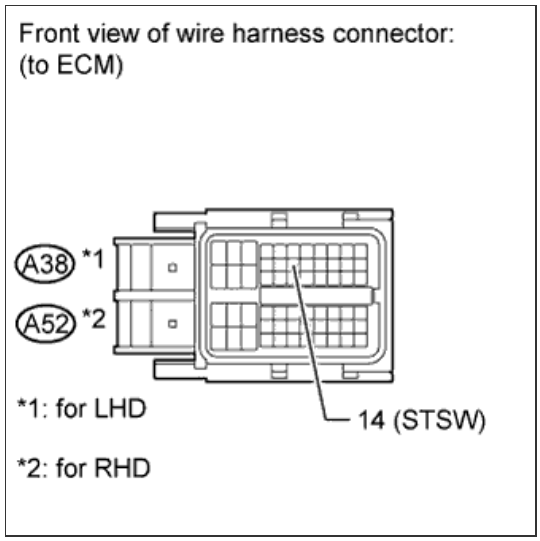
B → Go to step 9

A

3.CHECK MAIN BODY ECU RH (COWL SIDE JUNCTION BLOCK RH) (STSW VOLTAGE)

a. Disconnect the ECM connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage (for LHD):

Tester Connection	Condition	Specified Condition
A38-14 (STSW) - Body ground	Engine switch pressed and held with brake pedal depressed	6.0 V or higher

Standard Voltage (for RHD):

Tester Connection	Condition	Specified Condition
A52-14 (STSW) - Body ground	Engine switch pressed and held with brake pedal depressed	6.0 V or higher

HINT:

Output voltage at terminal STSW is output for 0.3 seconds when the engine starts.

NG → Go to step 13

OK

4.CHECK HARNESS AND CONNECTOR (ST CUT RELAY)

a. Remove the starter cut relay (ST CUT) from the engine room relay block.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage (Relay Contact Side):

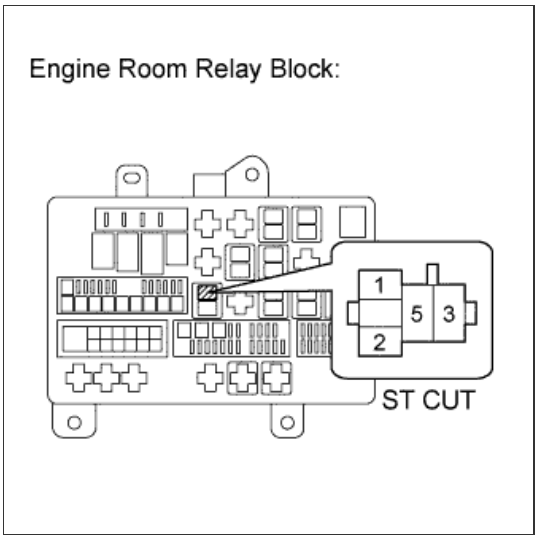
Tester Connection	Condition	Specified Condition
ST CUT relay terminal 3 - Body ground	While engine is cranking	11 to 14 V

Standard Voltage (Relay Coil Side):

Tester Connection	Condition	Specified Condition
ST CUT relay terminal 3 - Body ground	Always	11 to 14 V

Result

Result	Proceed to
OK	A
NG (Relay Contact Side)	B
NG (Relay Coil Side)	C



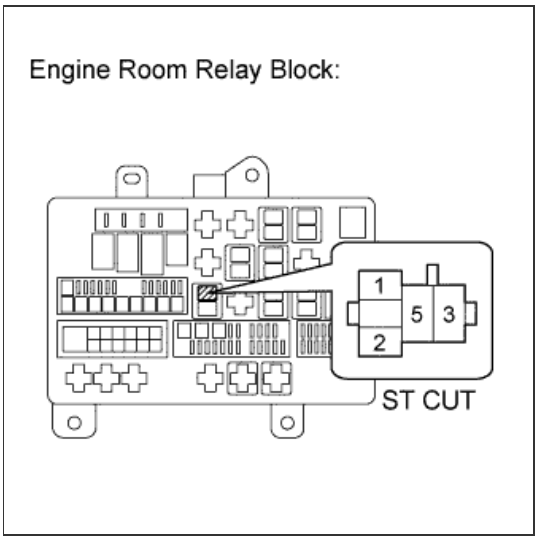
B → Go to step 14

C → Go to step 17

A

5.INSPECT STARTER CUT RELAY (ST CUT)

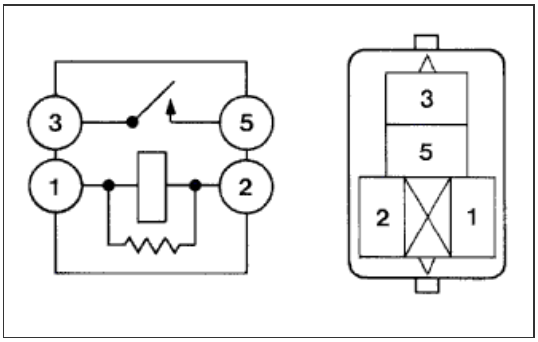
a. Remove the starter cut relay (ST C) from the engine room relay block.



b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied to terminals 1 and 2	10 kΩ or higher
3 - 5	Battery voltage applied to terminals 1 and 2	Below 1 Ω



NG → REPLACE STARTER CUT RELAY (ST CUT)

OK

6.INSPECT PARK/NEUTRAL POSITION SWITCH ASSEMBLY

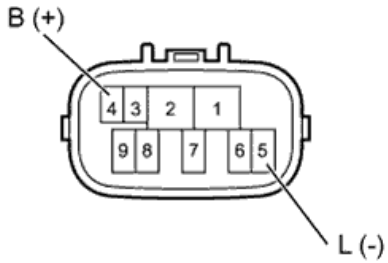
a. Disconnect the PNP switch connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
4 (B) - 5 (L)	Shift lever in P or N	Below 1 Ω
4 (B) - 5 (L)	Shift lever not in P or N	10 kΩ or higher

Component without harness connected:
(PNP Switch)



NG → REPLACE PARK/NEUTRAL POSITION SWITCH ASSEMBLY (Click here)

OK

7.CHECK HARNESS AND CONNECTOR (ST CUT RELAY - PNP SWITCH)

a. Disconnect the PNP switch connector.

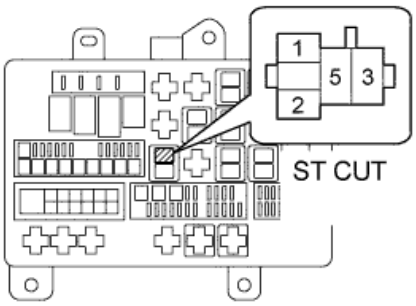
b. Remove the starter cut relay (ST CUT) from the engine room relay block.

c. Measure the resistance according to the value(s) in the table below.

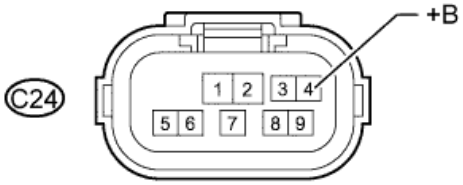
Standard Resistance:

Tester Connection	Condition	Specified Condition
ST CUT relay terminal 5 - C24-4 (B)	Always	Below 1 Ω
ST CUT relay terminal 5 or C24-4 (B) - Body ground	Always	10 kΩ or higher

Engine Room Relay Block:



Front view of wire harness connector:
(to PNP Switch)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

8.CHECK HARNESS AND CONNECTOR (ECM - ST CUT RELAY)

a. Move the shift lever to P or N.

b. Disconnect the ECM connector.

c. Remove the ST CUT relay from the engine room relay block.

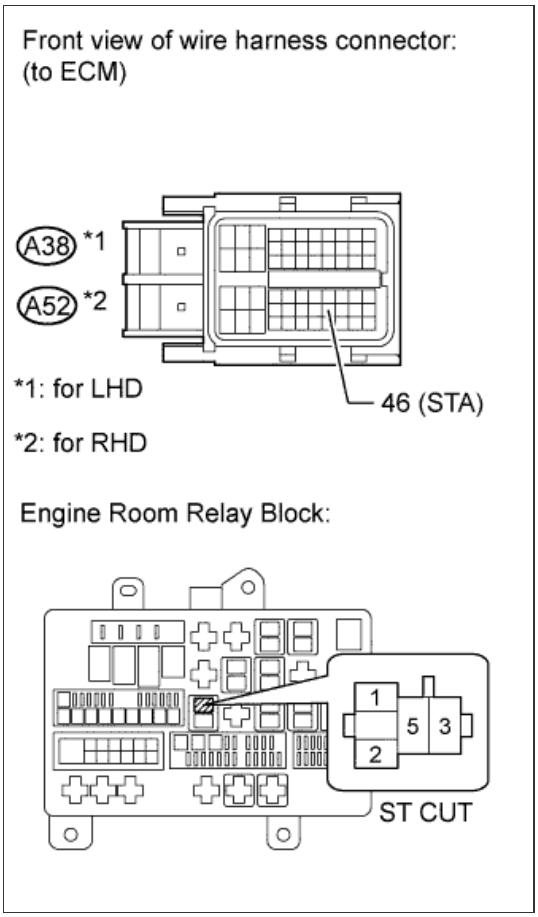
d. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
A38-46 (STA) - ST CUT relay terminal 3	Always	Below 1 Ω
A38-46 (STA) or ST CUT relay terminal 3 - Body ground	Always	10 kΩ or more

Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
A52-46 (STA) - ST CUT relay terminal 3	Always	Below 1 Ω
A52-46 (STA) or ST CUT relay terminal 3 - Body ground	Always	10 kΩ or more

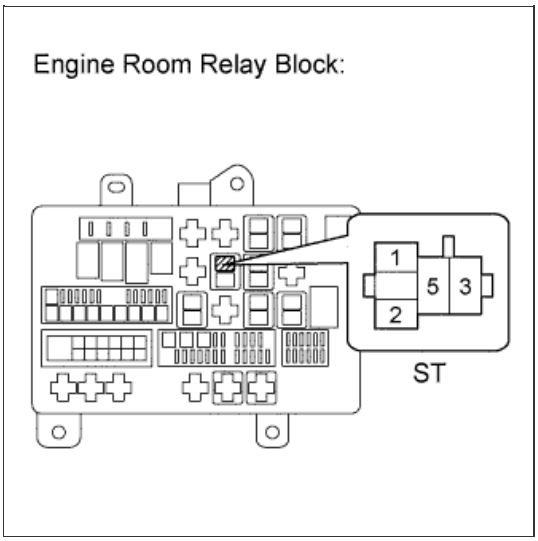


NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.INSPECT STARTER RELAY (ST)

a. Remove the starter relay (ST) from the engine room relay block.

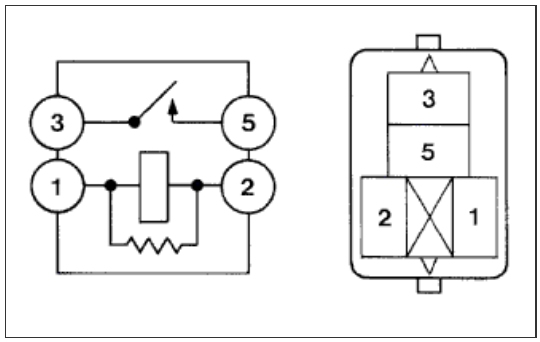


b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage	

3 - 5	applied to terminals 1 and 2	Below 1 Ω



NG → REPLACE STARTER RELAY

OK

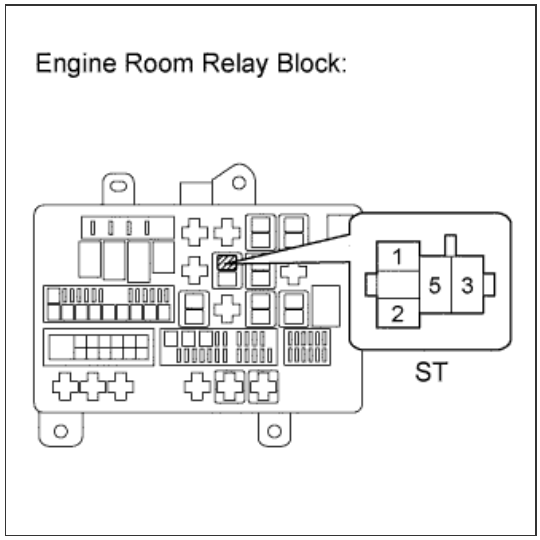
10.CHECK HARNESS AND CONNECTOR (ST RELAY)

a. Remove the starter relay (ST) from the engine room relay block.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
ST relay terminal 1 - 2	While engine is cranking	11 to 14 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (PNP SWITCH - ST RELAY BODY GROUND)

OK

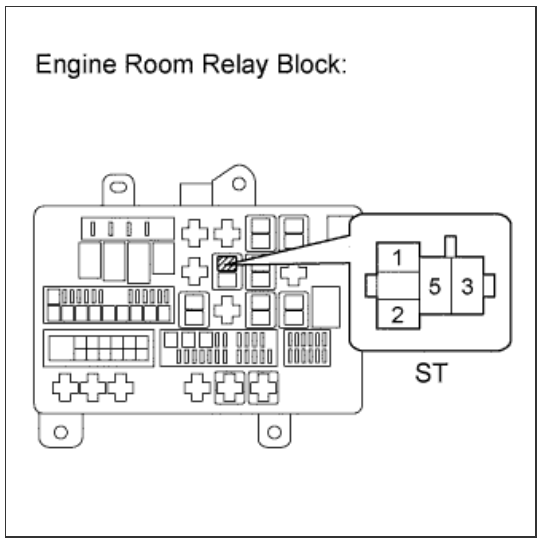
11.CHECK HARNESS AND CONNECTOR (STARTER VOLTAGE)

a. Remove the starter relay (ST) from the engine room relay block.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
ST relay terminal 5 - Body ground	Always	11 to 14 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (STARTER RELAY (ST) - BATTERY)

OK

12.CHECK HARNESS AND CONNECTOR (STARTER - ST RELAY)

a. Disconnect the starter connector.

b. Remove the starter relay (ST) from the engine room relay block.

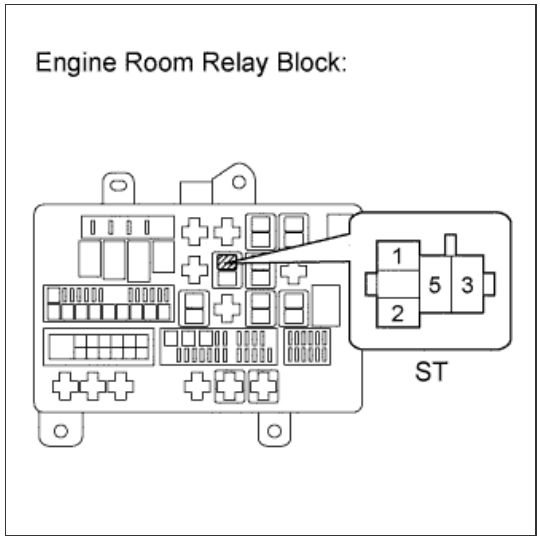
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
D2 - ST relay terminal 3	Always	Below 1 Ω
D2 or ST relay terminal 3 - Body ground	Always	10 kΩ or higher

Result

Result	Proceed to
NG	A
OK (for 1.4 kW type)	B
OK (for 2.0 kW type)	C



B → REPAIR OR REPLACE STARTER ASSEMBLY (Click here)

C → REPAIR OR REPLACE STARTER ASSEMBLY (Click here)

A → REPAIR OR REPLACE HARNESS OR CONNECTOR

13.CHECK HARNESS AND CONNECTOR (ECM - MAIN BODY ECU)

a. Disconnect the ECM connector.

b. Disconnect the main body ECU connector.

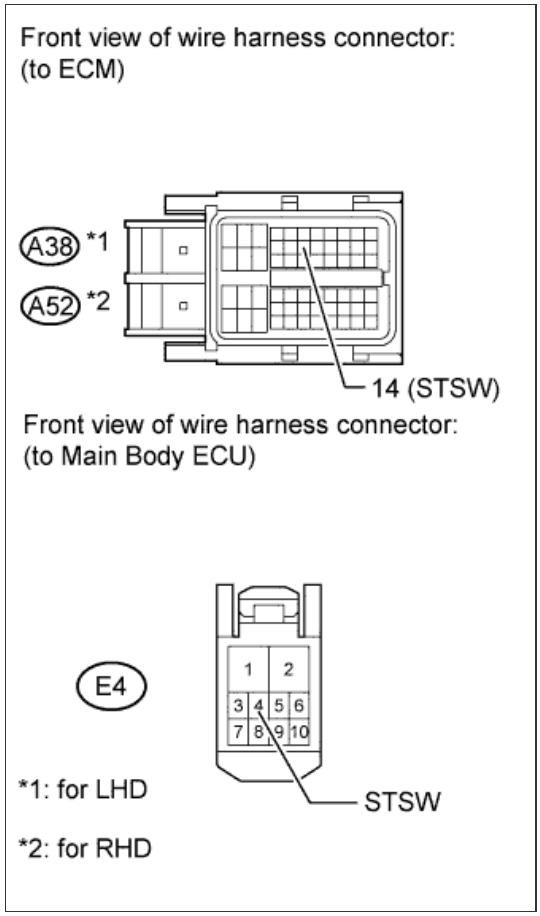
c. Measure the resistance according to the value(s) in the table below.

Standard resistance (for LHD):

Tester Connection	Condition	Specified Condition
A38-14 (STSW) - E4-4 (STSW)	Always	Below 1 Ω
A38-14 (STSW) or E4-4 (STSW) - Body ground	Always	10 kΩ or higher

Standard resistance (for RHD):

Tester Connection	Condition	Specified Condition
A52-14 (STSW) - E4-4 (STSW)	Always	Below 1 Ω
A52-14 (STSW) or E4-4 (STSW) - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

GO TO ENTRY AND START SYSTEM (Click here)

14.CHECK HARNESS AND CONNECTOR (ECM - ST CUT RELAY)

a. Disconnect the ECM connector.

b. Remove the starter cut relay (ST C) from the engine room relay block.

c. Measure the resistance according to the value(s) in the table below.

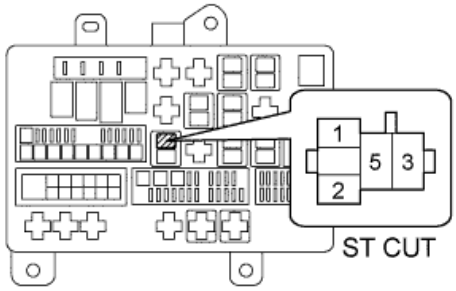
Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
C45-16 (STAR) - ST CUT relay terminal 5	Always	Below 1 Ω
C45-16 (STAR) or ST CUT relay terminal 5 - Body ground	Always	10 kΩ or higher

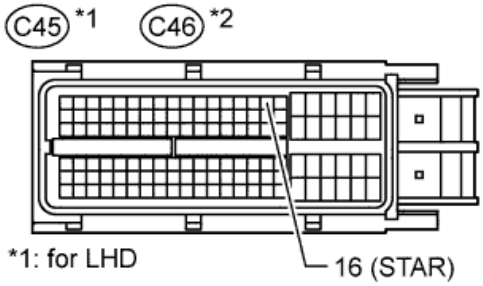
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C46-16 (STAR) - ST CUT relay terminal 5	Always	Below 1 Ω
C46-16 (STAR) or ST CUT relay terminal 5 - Body ground	Always	10 kΩ or higher

Engine Room Relay Block:



Front view of wire harness connector: (to ECM)



*1: for LHD

*2: for RHD

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

15.REPLACE ECM

a. Replace the ECM (Click here).

NEXT

16.CHECK PROBLEM SYMPTOM DISAPPEARS

a. Check if the problem symptom disappears.

Result

Result	Proceed to
Problem symptom disappears	A
Problem symptom does not disappear	B

B → GO TO PROBLEM SYMPTOMS TABLE (Click here)

A

END

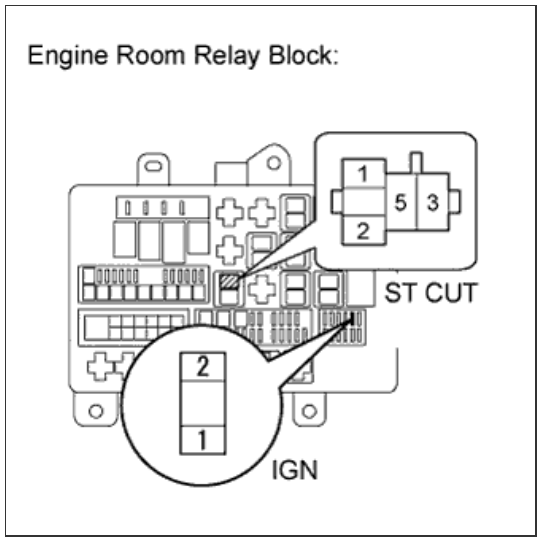
17.CHECK HARNESS AND CONNECTOR (ST CUT RELAY - IGN FUSE)

a. Remove the starter cut relay (ST C T) and IGN fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
ST C T relay terminal 2 - IGN fuse terminal 2	Always	Below 1 Ω
ST CUT relay terminal 1 - Body ground	Always	Below 1 Ω
ST CUT relay terminal 2 or IGN fuse terminal 2 - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

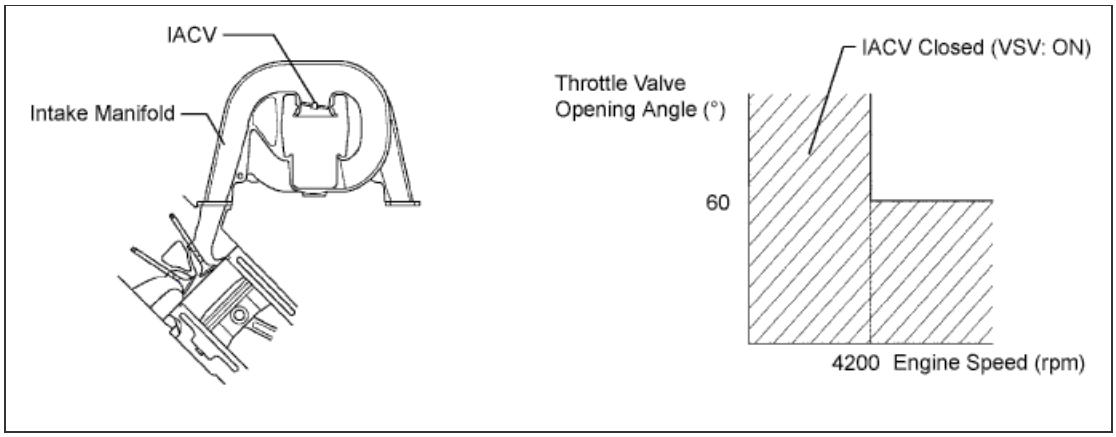
OK

GO TO ECU POWER SOURCE CIRCUIT (Click here)

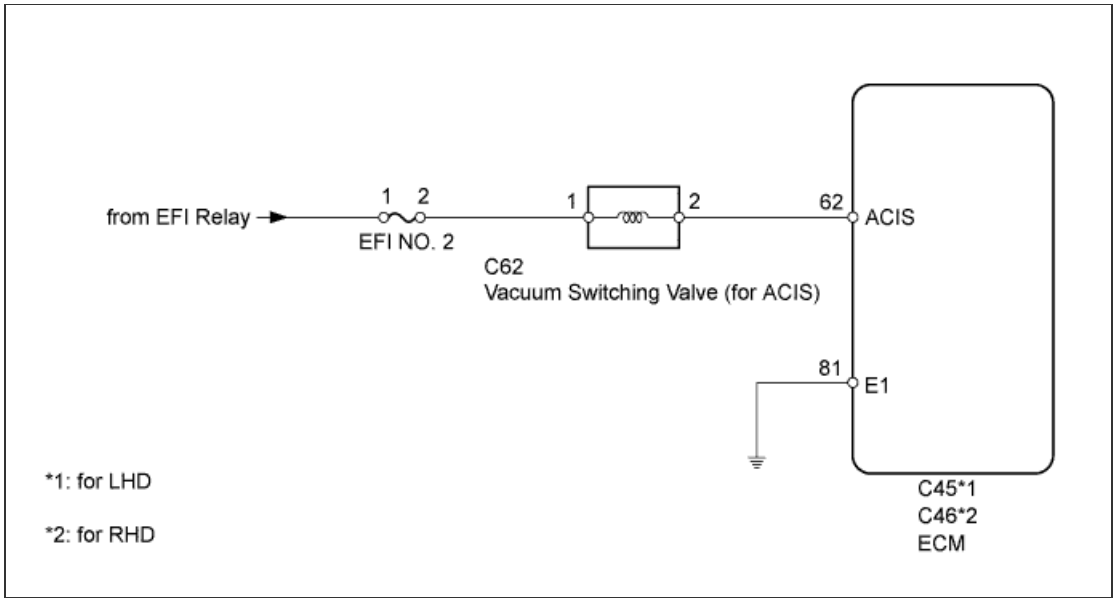
for Preparation Click here

DESCRIPTION

This circuit opens and closes the Intake Air Control Valve (IACV) in response to the engine load in order to increase the intake efficiency (ACIS: Acoustic Control Induction System).
When the engine speed is 4200 rpm or more and the throttle valve opening angle is 60° or more, the IACV is open (VSV: OFF). At all other times, the IACV is closed (VSV: ON).

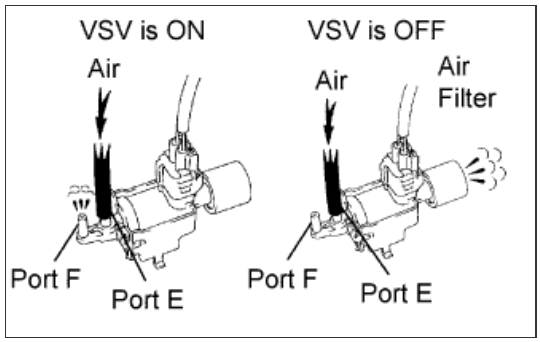


WIRING DIAGRAM



INSPECTION PROCEDURE

1.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE VSV (for ACIS))



a. Disconnect the vacuum hose from port F on the vacuum switching valve (for ACIS).

b. Connect the intelligent tester to the DLC3.

c. Start the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Active the VSV for Intake Control.

e. Operate the VSV for ACIS.

f. Check the VSV air flow when switching the VSV.

OK:

Test Condition	Specified Condition

VSV is ON	Air from port E flows out through port F
VSV is OFF	Air from port E flows out through air filter

NG → Go to step 3

OK

2.INSPECT INTAKE MANIFOLD (INTAKE AIR CONTROL VALVE OPERATION)

a. Inspect the intake air control valve operation (Click here).

NG → REPLACE INTAKE MANIFOLD (Click here)

OK

REPLACE VACUUM HOSES

3.INSPECT VACUUM SWITCHING VALVE (for ACIS)

a. Inspect the vacuum switching valve (Click here).

NG → REPLACE VACUUM SWITCHING VALVE (Click here)

OK

4.INSPECT VACUUM SWITCHING VALVE (POWER SOURCE VOLTAGE)

a. Disconnect the VSV connector.

b. Turn the engine switch on (IG).

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C62-1 - Body ground	Engine switch on (IG)	11 to 14 V

Front view of wire harness connector: (to VSV)



NG → Go to step 8

OK

5.CHECK HARNESS AND CONNECTOR (VSV - ECM))

a. Disconnect the VSV connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

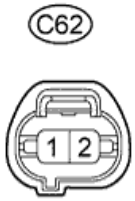
Tester Connection	Condition	Specified Condition

C62-2 - C45-62 (ACIS)	Always	Below 1 Ω
C62-2 or C45-62 (ACIS) - Body ground	Always	10 kΩ or higher

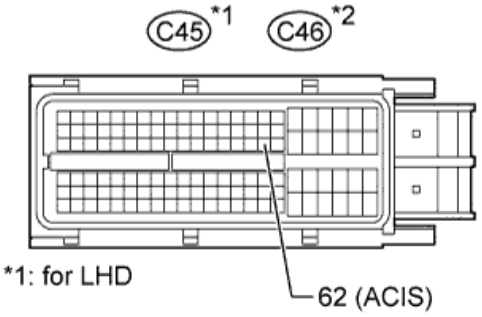
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
C62-2 - C46-62 (ACIS)	Always	Below 1 Ω
C62-2 or C46-62 (ACIS) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector: (to VSV)



Front view of wire harness connector: (to ECM)



*1: for LHD

*2: for RHD

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT

7.CHECK PROBLEM SYMPTOM DISAPPEARS

a. Check if the problem symptom disappears.

Result

Result	Proceed to
Problem symptom disappears	A
Problem symptom does not disappear	B

B → GO TO PROBLEM SYMPTOMS TABLE (Click here)

A

END

8.CHECK HARNESS AND CONNECTOR (VSV - EFI NO. 2 FUSE)

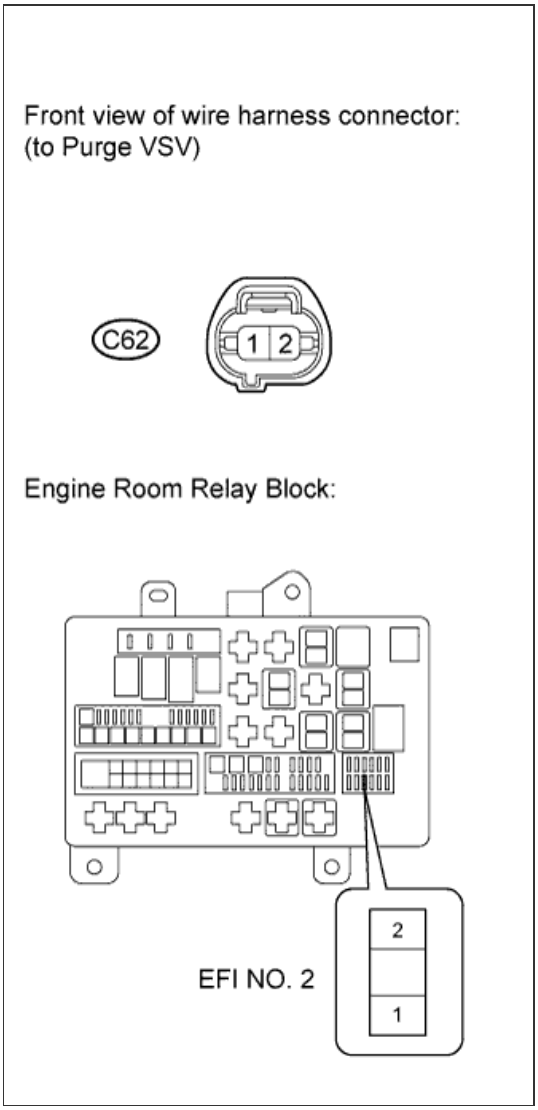
a. Disconnect the VSV connector.

b. Remove the EFI No. 2 fuse from the engine room relay block.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
C62-1 - EFI No. 2 fuse terminal 2	Always	Below 1 Ω
C62-1 or EFI No. 2 fuse terminal 2 - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

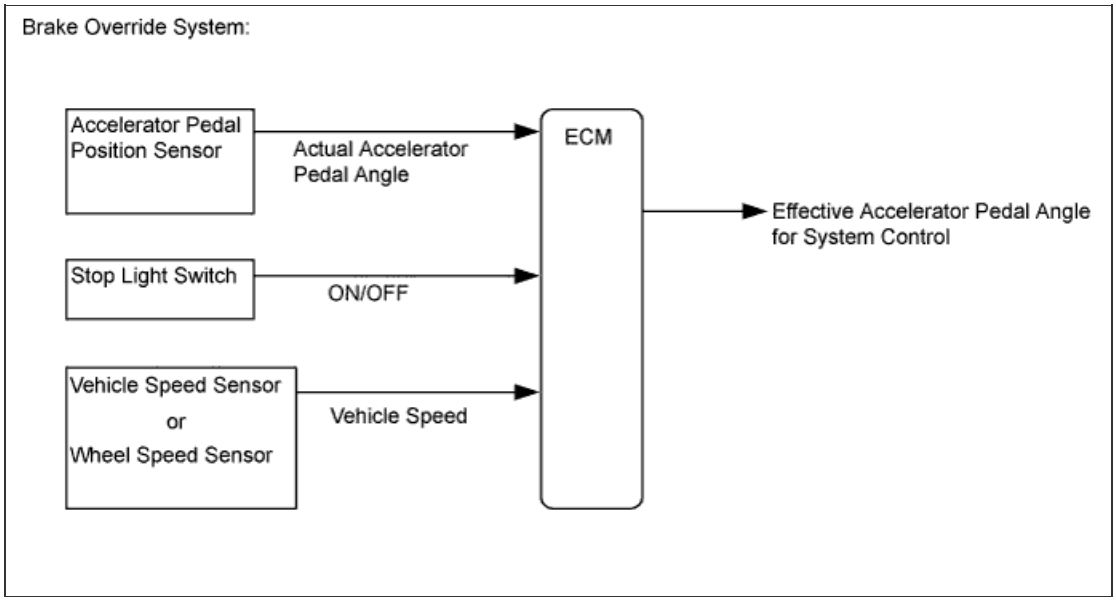
OK

GO TO ECM POWER SOURCE CIRCUIT (Click here)

for Preparation Click here

DESCRIPTION

When the vehicle is being driven with the accelerator pedal depressed, depressing the brake pedal without releasing the accelerator pedal will activate the brake override system to restrict driving torque. The conditions for activating the brake override system as well as the items that are controlled are explained below.



Activation Conditions:

- Vehicle is running at or above the specified speed.
- The accelerator pedal is depressed beyond a specified level, and then the brake pedal is depressed.

NOTICE:

The vehicle may not enter the brake override system control due to the relation of the accelerator pedal angle and the vehicle's speed.

Items Controlled:

- Driving torque is restricted.

HINT:

During brake override system control, the value for the accelerator pedal angle (which is used for engine control) is forcibly reduced to a specified value. For this reason, the Data List value for Accelerator Position (applied to electronic throttle control) will be replaced with a specified value regardless of the actual accelerator pedal angle (Accel Sens. No. 1 Volt %, Accel Sens. No. 2 Volt %)

Deactivation Conditions:

- When the Stop Light Switch turns OFF or the actual accelerator pedal angle increases or decreases beyond the specified range.

INSPECTION PROCEDURE

Inspection Method

Drive at 10km/h (6.25mph), depress the accelerator pedal by 1/2 to 3/4 and keep it in that position. Under these conditions, if the engine speed decreases to 1000rpm when the brake pedal is depressed, then the brake override system has been activated.

CAUTION:

When carrying out the inspection, use a place where you are able to carry it out safely and also pay close attention to your surroundings.

Also, when driving make absolutely sure that all road traffic laws, such as speed limits, are observed.

HINT:

- **Under normal conditions, the Accelerator Position value changes in response to the Accel Sens. No. 1 Volt % value. For more information on the numerical values, refer to the Data List (Click here).**
- **If the Data List values of Accelerator Position and Accel Sens. No. 1 Volt % do not match, and the value of Accelerator Position changes but the value of Accel Sens. No. 1 Volt % is constant, this confirms that brake override system has activated. (Data can be captured relatively easily by using the snapshot function in the Data List. Confirm the data after performing the drive test.)**

NOTICE:

The brake override system restricts driving torque if the brake pedal is depressed when driving with the accelerator pedal depressed. If a customer reports experiencing loss of torque after the accelerator and brake pedals have both been intentionally depressed, explain to the customer that this is not a malfunction, and that the customer should avoid depressing both the accelerator and brake pedals at the same time.

Example: While operating the accelerator pedal, the customer uses their left foot to operate the brake pedal.

1.CHECK DTC OUTPUT

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the intelligent tester on.

c. Enter the following menus: System Select / Health Check.

d. Check DTCs.

Result

Result	Proceed to
No DTC output	A
DTC output	B

B → **GO TO DTC CHART**

A

2.READ VALUE USING INTELLIGENT TESTER (STOP LIGHT SWITCH AND ST1)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Stop Light Switch and ST1.

d. Check the Data List indication when the brake pedal is depressed and released.

OK:

Tester Display	Condition	Specified Condition
Stop Light Switch	Brake pedal released	OFF
	Brake pedal depressed	ON
ST1	Brake pedal released	OFF
	Brake pedal depressed	ON

NG → **INSPECT STOP LIGHT SWITCH ASSEMBLY (Click here)**

OK

3.INSPECT BRAKE PEDAL

a. Inspect and adjust the brake pedal (for LHD) (Click here).

b. Inspect and adjust the brake pedal (for RHD) (Click here).

HINT:

If the stop light switch turns ON too late, the start of brake override system control may be delayed; if it turns ON too soon, brake override system control may begin too early, so conduct inspection of the brake pedal and stop light switch assembly.

Result

Result	Proceed to
OK	A
NG (for LHD)	B
NG (for RHD)	C

B → **REPAIR OR REPLACE BRAKE PEDAL (Click here)**

C → REPAIR OR REPLACE BRAKE PEDAL (Click here)

A

4.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR PEDAL POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Accel Sens. No. 1 Volt % and Accel Sens. No. 2 Volt %.

d. Read the value displayed on the intelligent tester.

OK:

Tester Display	Condition	Specified Condition
Accel Sens. No. 1 Volt %	Accelerator Pedal Released → Depressed → Released	Values smoothly change following accelerator pedal operation
Accel Sens. No. 2 Volt %		

HINT:

For numerical values of Accel Sens. No. 1 Volt % and Accel Sens. No. 2 Volt %, refer to the Data List (Click here).

NG → REPLACE ACCELERATOR PEDAL SENSOR ASSEMBLY (Click here)

OK

5.READ VALUE USING INTELLIGENT TESTER (VEHICLE SPEED)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the intelligent tester on.

c. Start the engine.

d. Enter the following menus: Powertrain / Engine / Data List / Vehicle Speed.

e. Read the value displayed on the intelligent tester.

Standard:

Tester Display	Condition	Specified Condition
Vehicle Speed	Vehicle stopped, engine running	0 km/h (0 mph)
	Vehicle running at constant speed between 16.1 to 64.4 km/h (10 to 40 mph)	No large fluctuations when driving at a constant speed

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

Data can be captured relatively easily by using the snapshot function in the Data List. Confirm the data after performing the drive test.

NG → GO TO VEHICLE SPEED SENSOR "A" (Click here)

OK

6.READ VALUE USING INTELLIGENT TESTER (FR, FL, RR, RL WHEEL SPEED)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the intelligent tester on.

c. Start the engine.

d. Enter the following menus: Chassis / ABS/VSC/TRC / Data List / FR Wheel Speed, FL Wheel Speed, RR Wheel Speed and RL Wheel Speed.

e. Read the value displayed on the intelligent tester.

Standard:

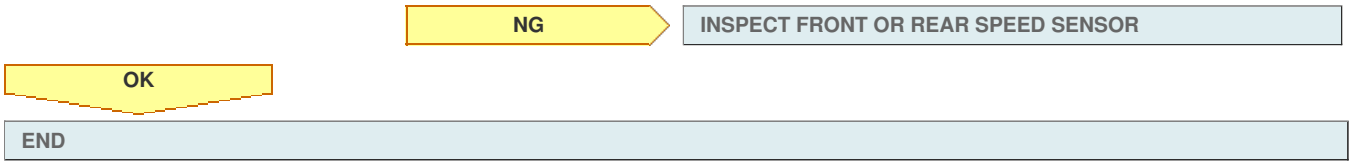
Tester Display	Condition	Specified Condition
FR Wheel Speed FL Wheel Speed RR Wheel Speed RL Wheel Speed	Vehicle stopped, engine running	0 km/h (0 mph)
	Vehicle running at constant speed between 16.1 to 64.4 km/h (10 to 40 mph)	No large fluctuations when driving at a constant speed

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

Data can be captured relatively easily by using the snapshot function in the Data List. Confirm the data after performing the drive test.

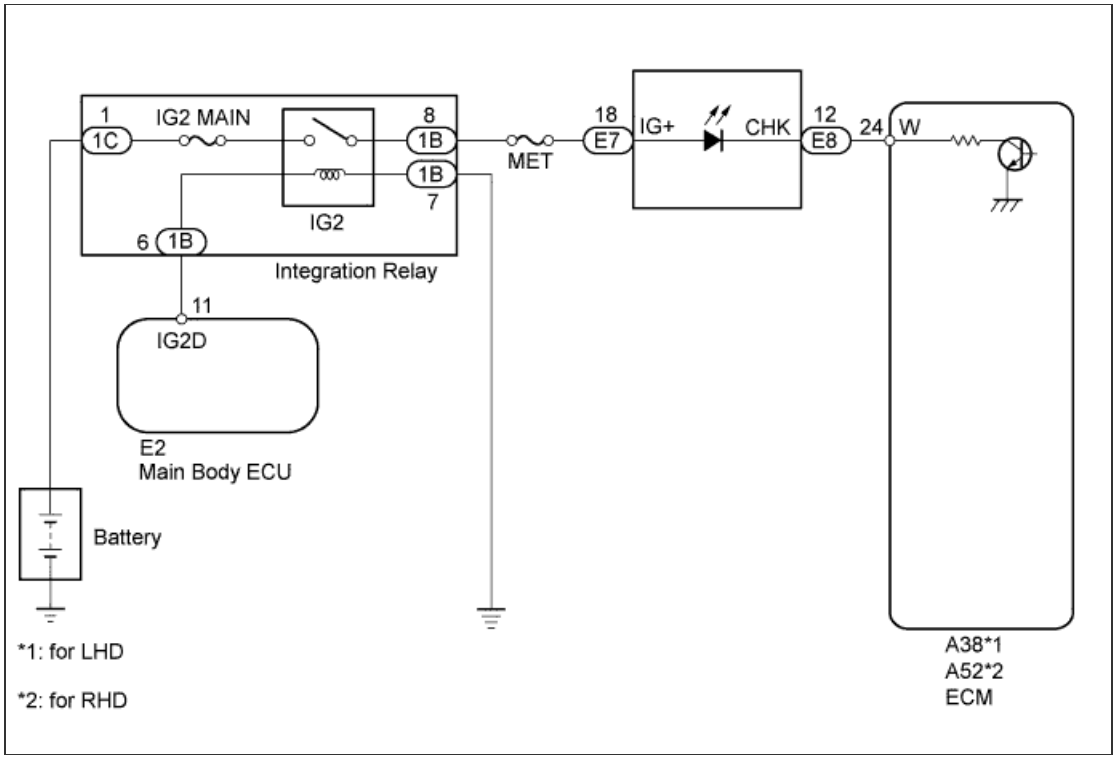


for Preparation Click here

DESCRIPTION

The MIL (Malfunction Indicator Lamp) is used to indicate vehicle malfunction detections by the ECM. When the engine switch is turned on (IG), power is supplied to the MIL circuit, and the ECM provides the circuit ground which illuminates the MIL.
The MIL operation can be checked visually: When the engine switch is first turned on (IG), the MIL should be illuminated and should then turn off when the engine is started. If the MIL remains illuminated or is not illuminated, conduct the following troubleshooting procedure using the intelligent tester.

WIRING DIAGRAM



INSPECTION PROCEDURE

1.CHECK THAT MIL IS ILLUMINATED

a. Check the MIL illumination condition.

Result

Result	Proceed to
MIL remains on	A
MIL does not illuminate	B
MIL remains on → MIL turns off	C

B → Go to step 5

C → SYSTEM OK

A

2.CHECK WHETHER MIL TURNS OFF

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Check if any DTCs have been stored. Note down any DTCs.

e. Clear DTCs (Click here).

f. Check if the MIL turns off.

OK:
MIL turns off.

NG → Go to step 3

OK

REPAIR CIRCUITS INDICATED BY OUTPUT DTCS (Click here)

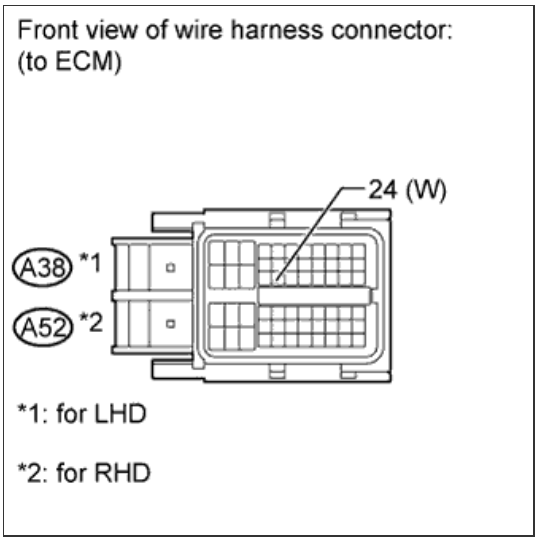
3.CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the ECM connector.

b. Turn the engine switch on (IG).

c. Check that the MIL is not illuminated.

OK:
MIL is not illuminated.



NG → Go to step 4

OK

REPLACE ECM (Click here)

4.CHECK HARNESS AND CONNECTOR (COMBINATION METER - ECM)

a. Disconnect the ECM connector.

b. Disconnect the combination meter connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
A38-24 (W) or E8-12 (CHK) - Body ground	Always	10 kΩ or higher

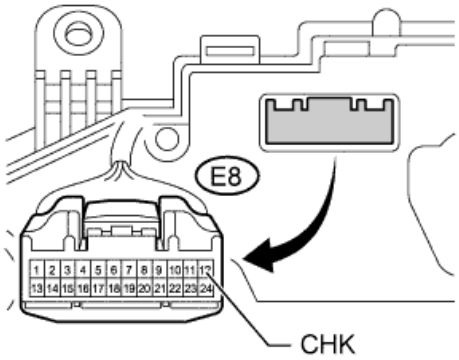
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
A52-24 (W) or E8-12 (CHK) - Body ground	Always	10 kΩ or higher

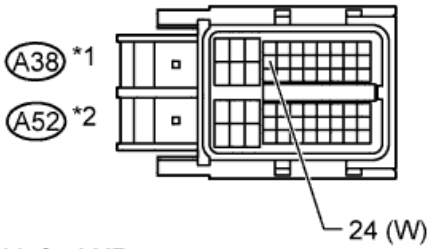
Result

Result	Proceed to
NG	A
OK (w/ Multi-information Display)	B
OK (w/o Multi-information Display)	C

Front view of wire harness connector:
(to Combination Meter)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

B	REPLACE COMBINATION METER ASSEMBLY (Click here)
C	REPLACE COMBINATION METER ASSEMBLY (Click here)

A

REPAIR OR REPLACE HARNESS OR CONNECTOR

5.CHECK THAT MIL IS ILLUMINATED

a. Check if the MIL is illuminated when the engine switch is turned on (IG).

OK:
MIL is illuminated.

NG	Go to step 6

OK

SYSTEM OK

6.CHECK THAT ENGINE STARTS

a. Turn the engine switch on (IG).

b. Start the engine.

Result

Result	Proceed to
Engine starts	A
Engine does not start*	B

HINT:

*: The intelligent tester cannot communicate with the ECM.

B → GO TO VC OUTPUT CIRCUIT (Click here)

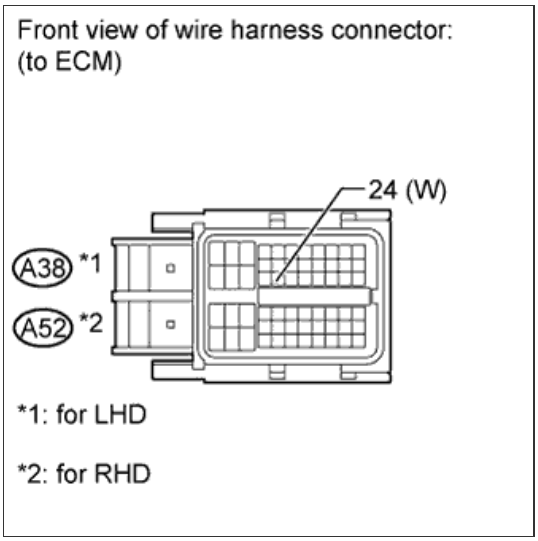
A

7.CHECK HARNESS AND CONNECTOR (W VOLTAGE)

a. Disconnect the ECM connector.

b. Disconnect the combination meter connector.

c. Measure the voltage according to the value(s) in the table below.



Standard Voltage (for LHD):

Tester Connection	Switch Condition	Specified Condition
A38-24 (W) - Body ground	Engine switch on (IG)	11 to 14 V

Standard Voltage (for RHD):

Tester Connection	Switch Condition	Specified Condition
A52-24 (W) - Body ground	Engine switch on (IG)	11 to 14 V

NG → Go to step 8

OK

REPLACE ECM (Click here)

8.CHECK HARNESS AND CONNECTOR (COMBINATION METER - ECM)

a. Disconnect the ECM connector.

b. Disconnect the combination meter connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (for LHD):

Tester Connection	Condition	Specified Condition
A38-24 (W) - E8-12 (CHK)	Always	Below 1 Ω

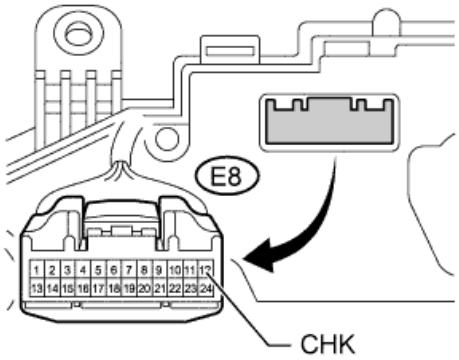
Standard Resistance (for RHD):

Tester Connection	Condition	Specified Condition
A52-24 (W) - E8-12 (CHK)	Always	Below 1 Ω

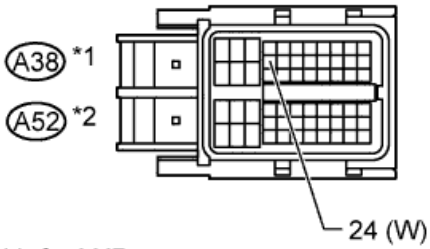
Result

Result	Proceed to
NG	A
OK (w/ Multi-information Display)	B
OK (w/o Multi-information Display)	C

Front view of wire harness connector:
(to Combination Meter)



Front view of wire harness connector:
(to ECM)



*1: for LHD

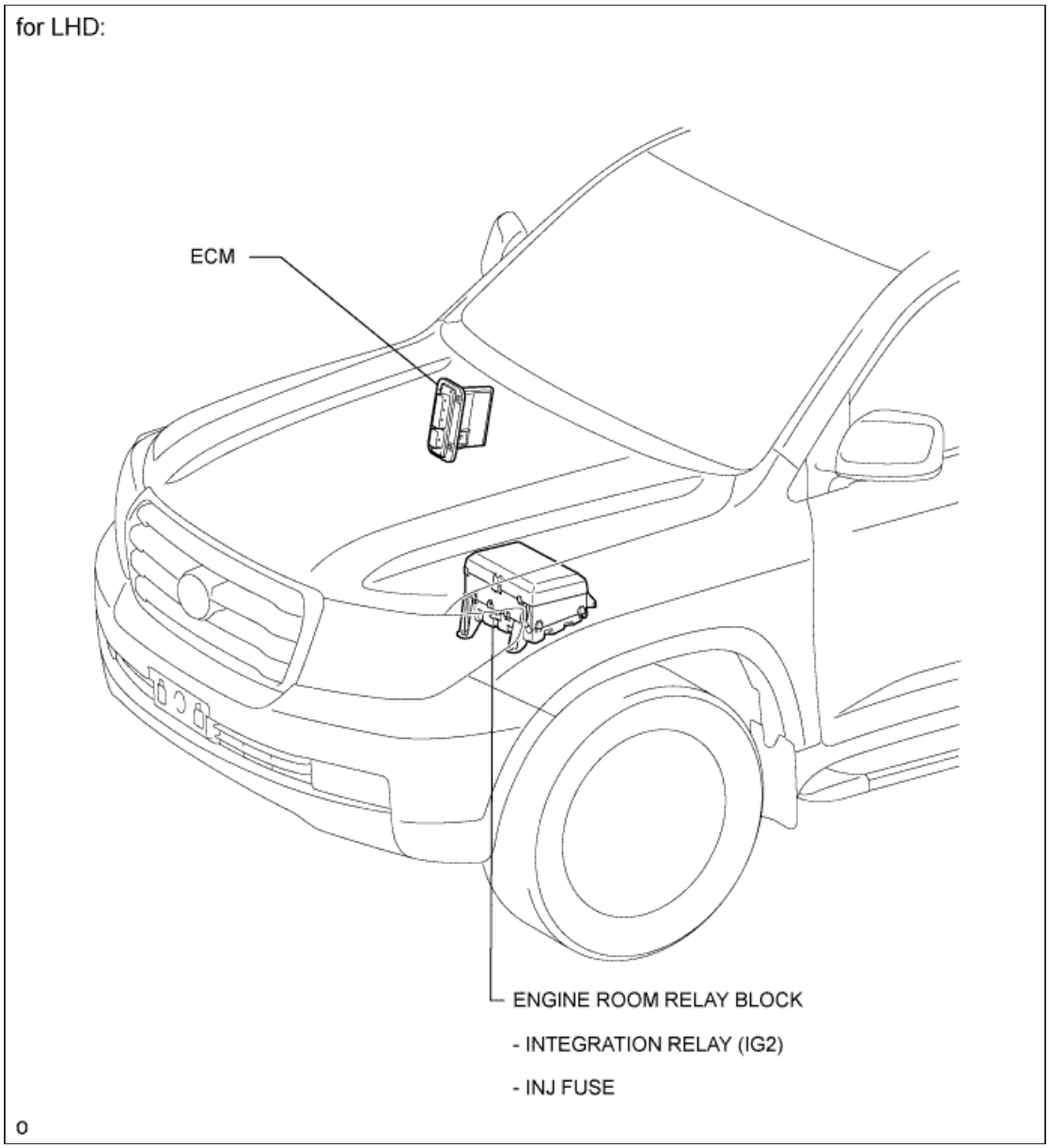
*2: for RHD

B	REPLACE COMBINATION METER ASSEMBLY (Click here)
C	REPLACE COMBINATION METER ASSEMBLY (Click here)

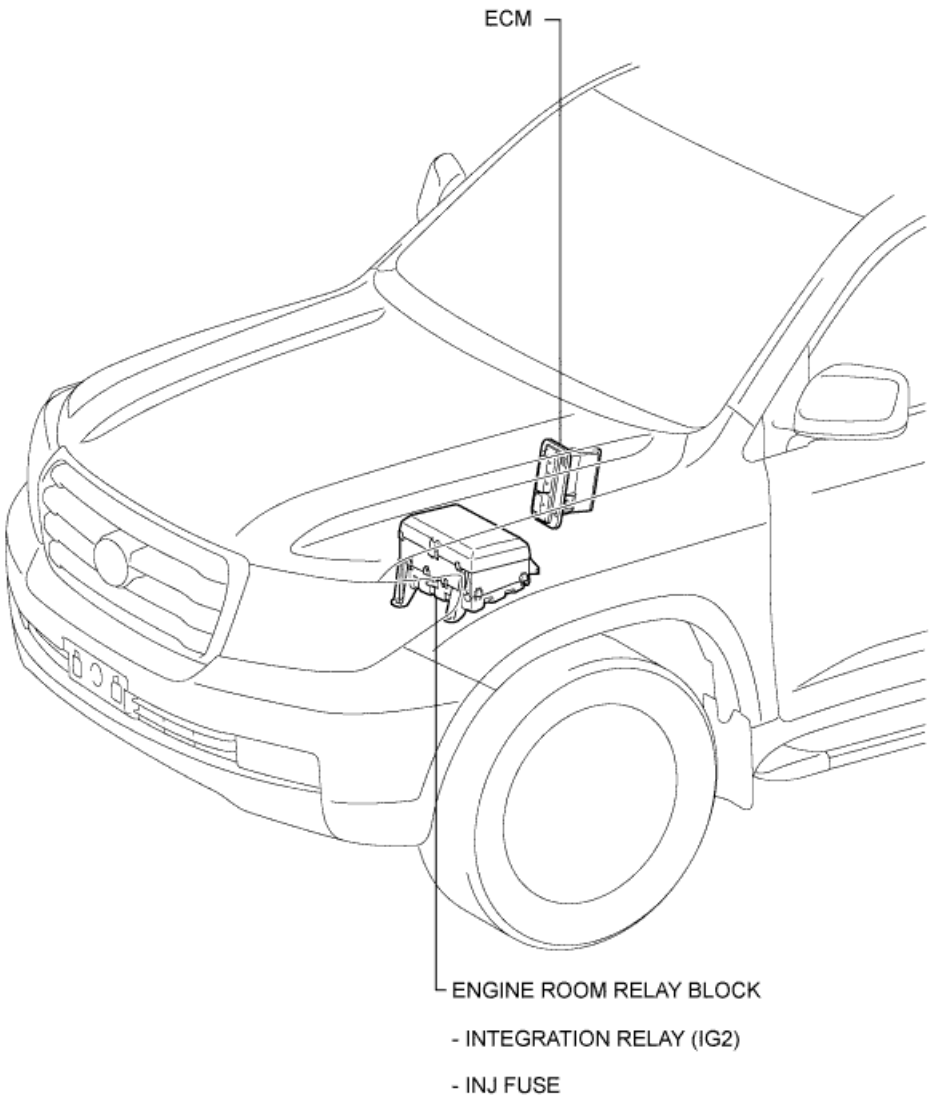
A

REPAIR OR REPLACE HARNESS OR CONNECTOR

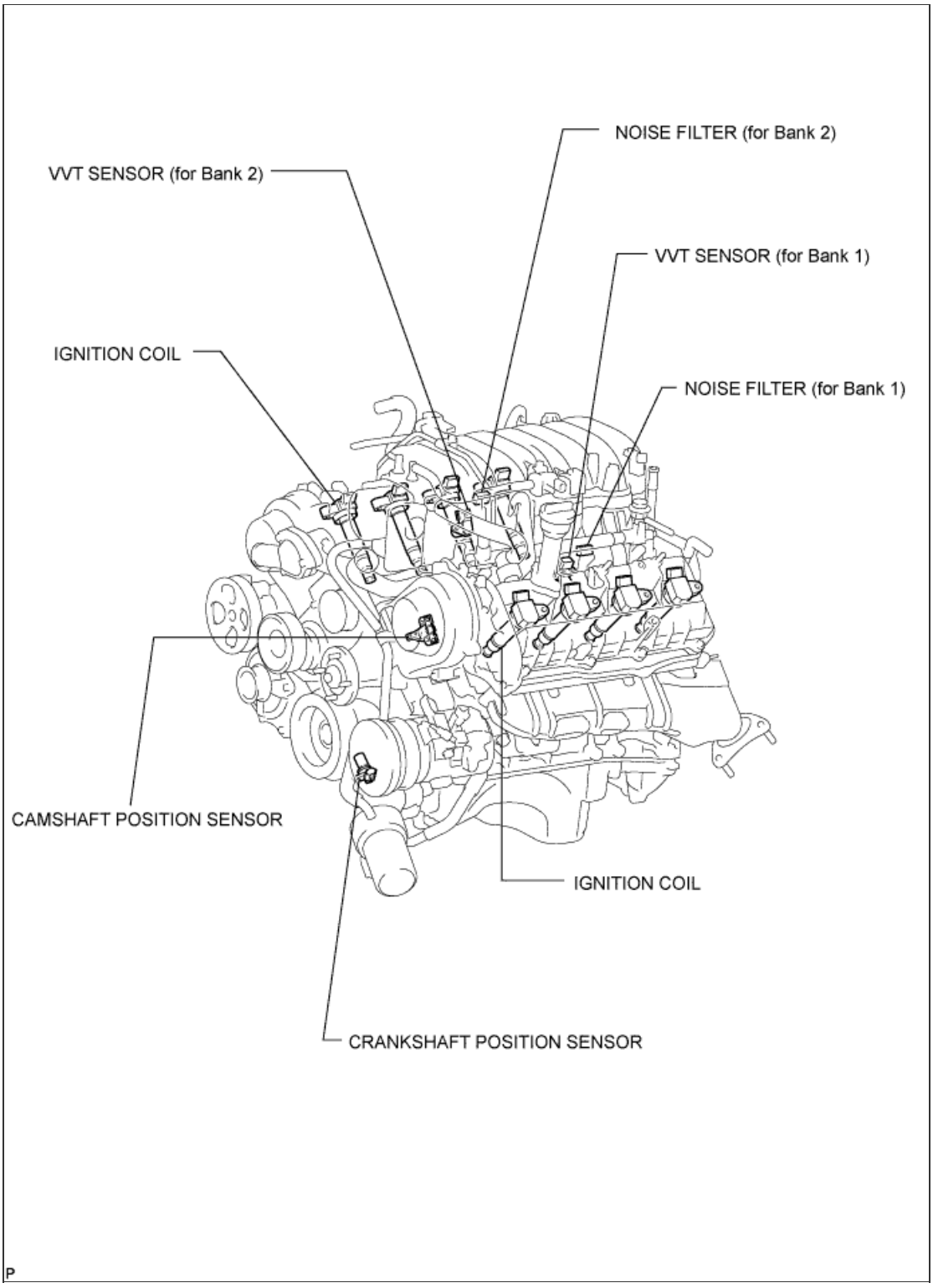
for Preparation Click here



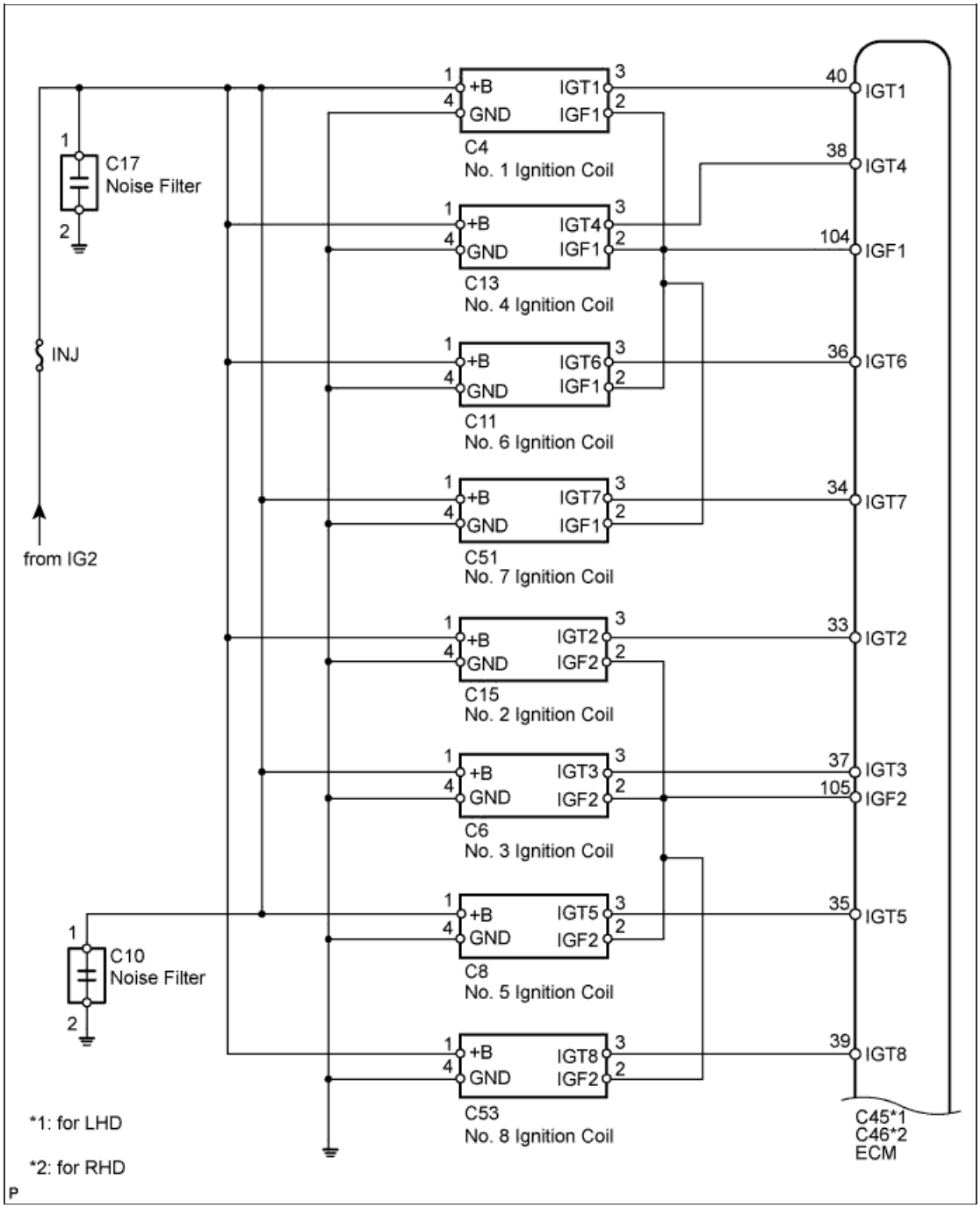
for RHD:

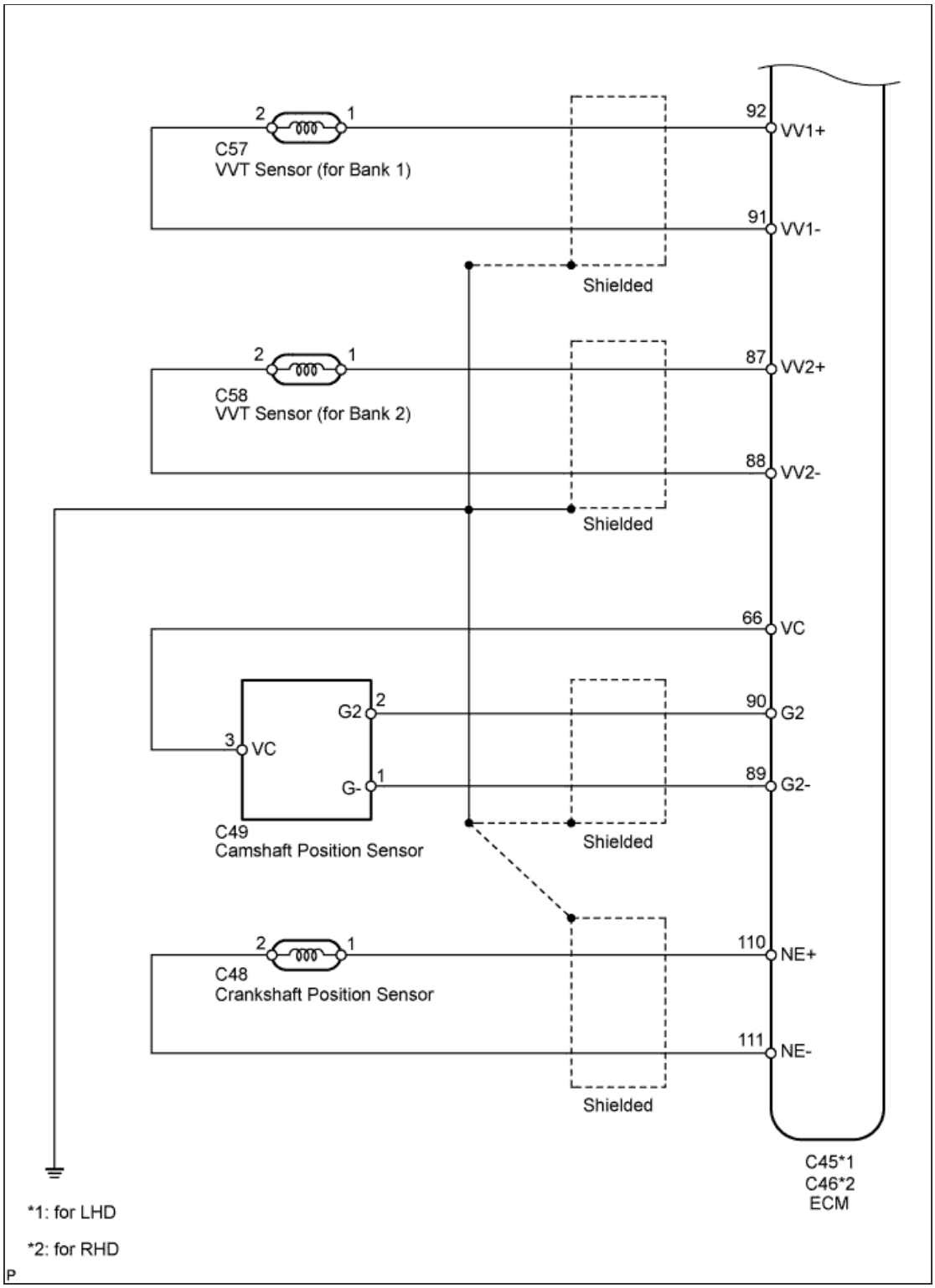


o


NOISE FILTER (for Bank 2)
VVT SENSOR (for Bank 2)
VVT SENSOR (for Bank 1)
IGNITION COIL
NOISE FILTER (for Bank 1)
CAMSHAFT POSITION SENSOR
IGNITION COIL
CRANKSHAFT POSITION SENSOR
P

for Preparation Click here




2
1
C57
VVT Sensor (for Bank 1)
92
VV1+
91
VV1-
Shielded
2
1
C58
VVT Sensor (for Bank 2)
87
VV2+
88
VV2-
Shielded
66
VC
G2
2
90
G2
3
VC
G-
1
89
G2-
C49
Camshaft Position Sensor
Shielded
2
1
C48
Crankshaft Position Sensor
110
NE+
111
NE-
Shielded
C45*1
C46*2
ECM
*1: for LHD
*2: for RHD
P

for Preparation Click here

1. PERFORM SPARK TEST

a. Check for DTCs (Click here).

NOTICE:

If any DTC is output, perform troubleshooting procedures for that DTC.

b. Check if sparks occur.

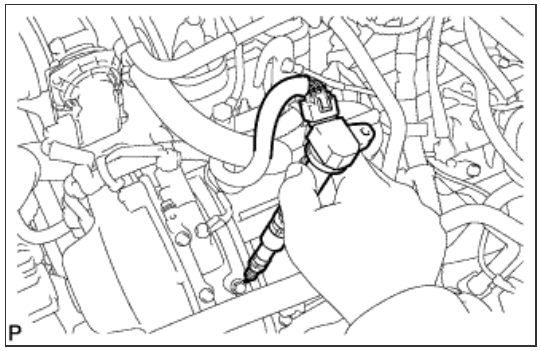
i. Remove the ignition coils and spark plugs (Click here).

ii. Install the spark plug to the ignition coil and connect the ignition coil connector.

iii. Disconnect the 8 injector connectors.

iv. Ground the spark plugs.

v. Visually check that sparks occur while the engine is being cranked.



NOTICE:

- **Be sure to ground the spark plug when checking.**
- **If the ignition coil has been struck or dropped, replace it.**
- **Do not crank the engine for more than 2 seconds.**

c. Check that the wire harness side connector of the ignition coil with igniter is securely connected.

Result

Result	Proceed to
NG	Connect securely
OK	Go to next step

d. Perform a spark test on each ignition coil with igniter.

i. If there is a cylinder where sparks do not occur, replace its ignition coil with the ignition coil of a cylinder where sparks occur normally.

ii. Crank the engine and visually check that sparks occur at the cylinder with the normally operating ignition coil.

Result

Result	Proceed to
OK	Replace ignition coil with igniter
NG	Go to next step

e. Inspect the spark plug.

i. Replace the spark plug with a normal one.

ii. Perform spark teat again.

Result

Result	Proceed to
OK	Replace spark plug
NG	Go to next step

f. Check power supply to the ignition coil with igniter.

i. Turn the engine switch on (IG).

ii. Check that there is battery voltage at the ignition coil positive (+) terminal.

Result

Result	Proceed to
NG	Check wiring between engine switch and ignition coil with igniter
OK	Go to next step

g. Check the VVT sensor (Click here).

h. Check the crankshaft position sensor (Click here).

i. Check the IGT signal circuit (Click here).

j. Connect the 8 injector connectors.

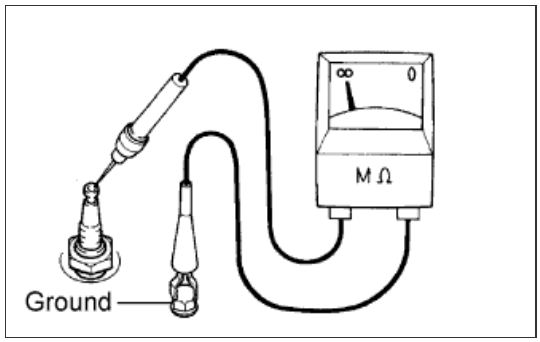
k. Install the 8 ignition coils and 8 spark plugs (Click here).

2. INSPECT SPARK PLUG

NOTICE:

Do not use a wire brush for cleaning.

a. Check the electrode.



i. Using a megohmmeter, measure the insulation resistance.

Standard Insulation Resistance:

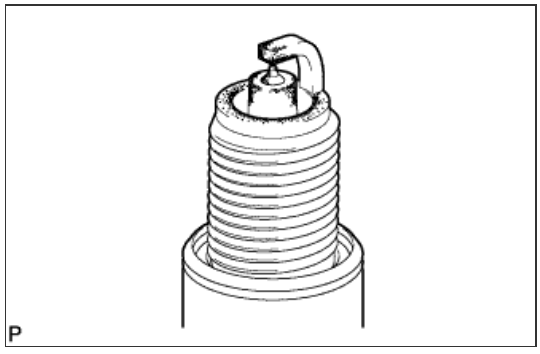
Tester Connection	Condition	Specified Condition
Spark Plug (terminal part) - Body Ground	Always	10 MΩ or higher

If the insulation resistance is below the specified range, replace the spark plug.

HINT:

If a megohmmeter is not available, perform the following simple inspection instead.

b. Alternative inspection method:



i. Quickly accelerate the engine to 4000 rpm 5 times.

ii. Remove the spark plug.

iii. Visually check the spark plug.
If the electrode is dry, the spark plug is functioning properly. If the electrode is damp, proceed to the next step.

c. Check the spark plug for any damage on its threads and insulator.
If there is any damage, replace the spark plug.

Recommended Spark Plug

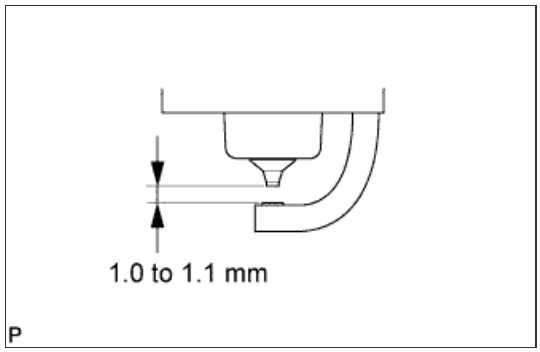
Manufacturer	Type
DENSO made	SK20R11
NGK made	IFR6A11

HINT:

Maximum electrode gap for a used spark plug: 1. mm (0.0512 in.)

If the gap is more than the maximum, replace the spark plug.

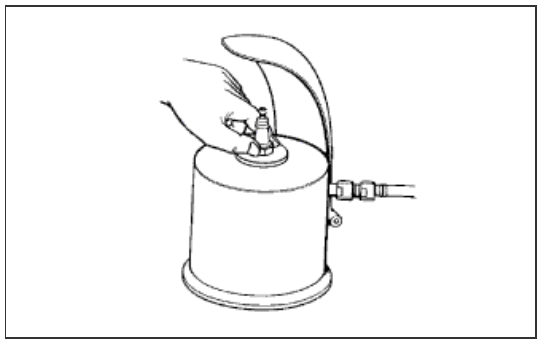
Electrode gap for a new spark plug: 1.0 to 1.1 mm (0.0394 to 0.04 in.)



NOTICE:

Do not adjust the electrode gap of any spark plug, as the ground electrode tip will be damaged.

d. If the electrode has traces of wet carbon, allow it to dry and then clean it with a spark plug cleaner.



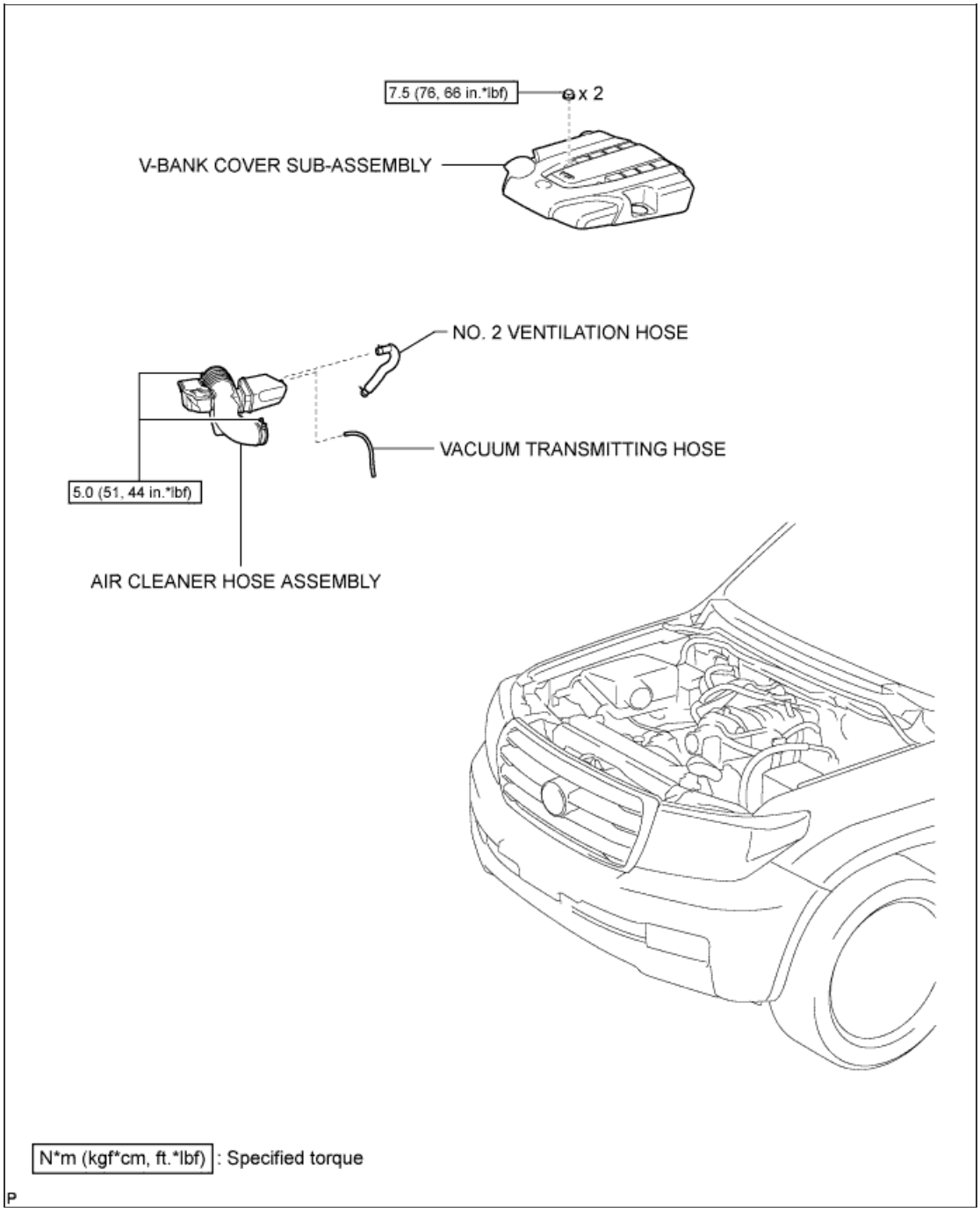
Standard air pressure:
588 kPa (6.0 kgf/cm^2, 85 psi)

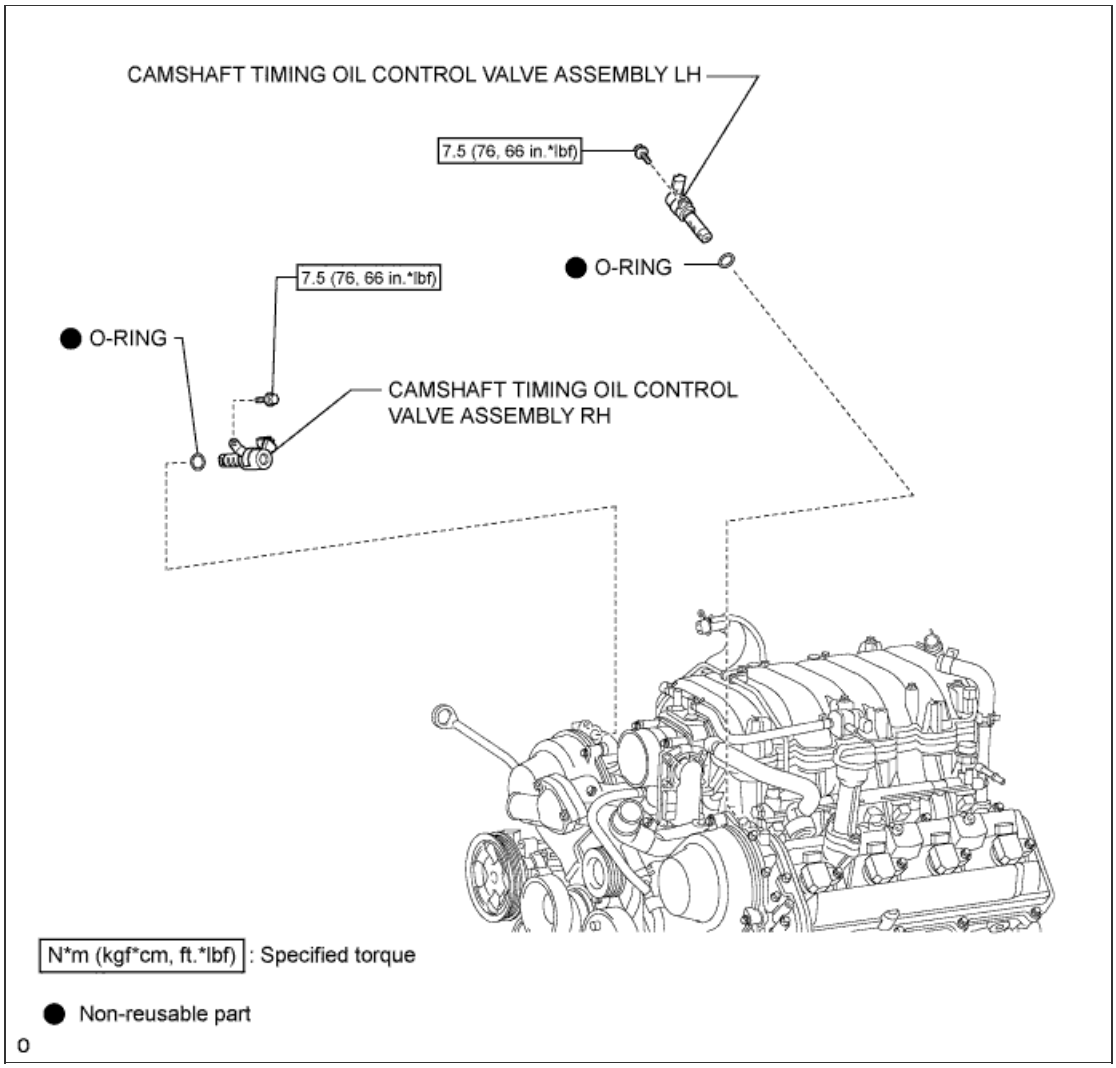
Standard duration:
20 seconds or less

HINT:

Only use the spark plug cleaner when the electrode is free of oil. If the electrode has traces of oil, use gasoline to clean off the oil before using the spark plug cleaner.

for Preparation Click here




CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY LH
7.5 (76, 66 in.*lbf)
O-RING
7.5 (76, 66 in.*lbf)
O-RING
CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY RH
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

0

for Preparation Click here

1. INSPECT CAMSHAFT OIL CONTROL VALVE

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the intelligent tester on.

c. Warm up the engine.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1) or Control the VVT System (Bank 2).

e. Check the engine speed while operating the Oil Control Valve (OCV) using the intelligent tester.

OK:

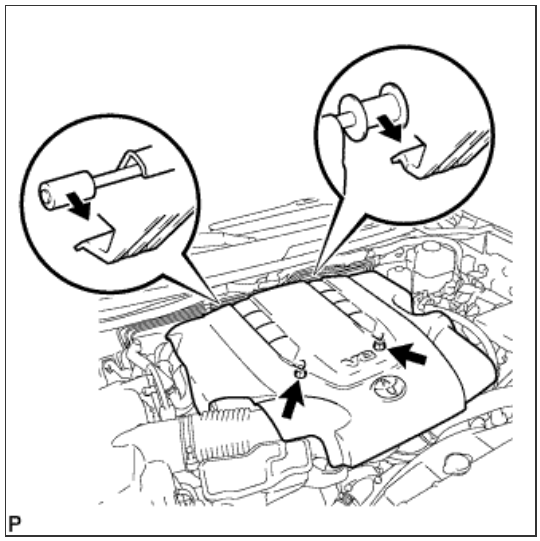
Tester Operation	Specified Condition
OCV OFF	Normal engine speed
OCV ON	Soon after OCV switched from OFF to ON, engine idles roughly or stalls

If the result is not as specified, check the oil control valve, wirings and camshaft timing gear.

for Preparation Click here

1. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Remove the 2 nuts and V-bank cover.

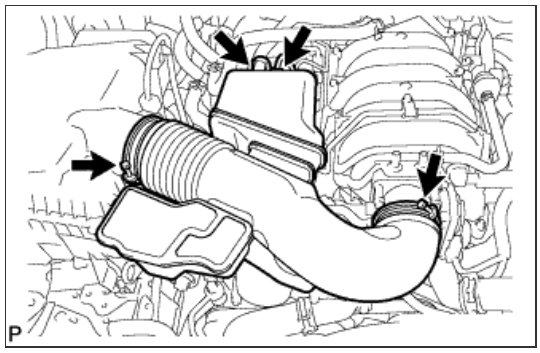


2. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum transmitting hose and No. 2 ventilation hose.

b. Loosen the 2 hose clamps.

c. Remove the air cleaner hose.

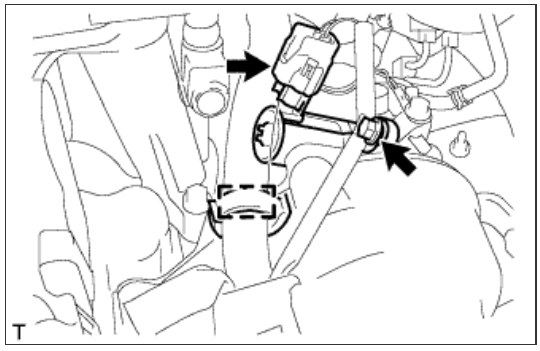


3. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY LH

a. Disconnect the oil control valve connector and wire harness clamp.

b. Remove the bolt and camshaft timing oil control valve.

c. Remove the O-ring from the camshaft timing oil control valve.

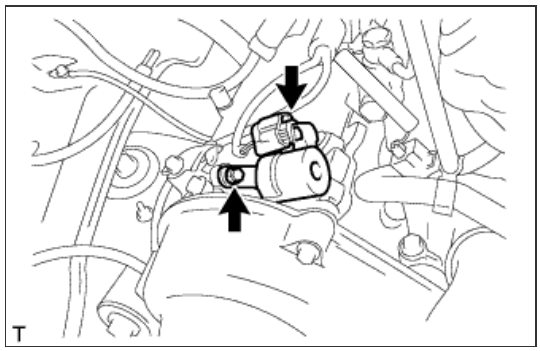


4. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY RH

a. Disconnect the oi contro va ve connector.

b. Remove the bo t and camshaft timing oi contro va ve.

c. Remove the -ring from the camshaft timing oi contro va ve.



for Preparation Click here

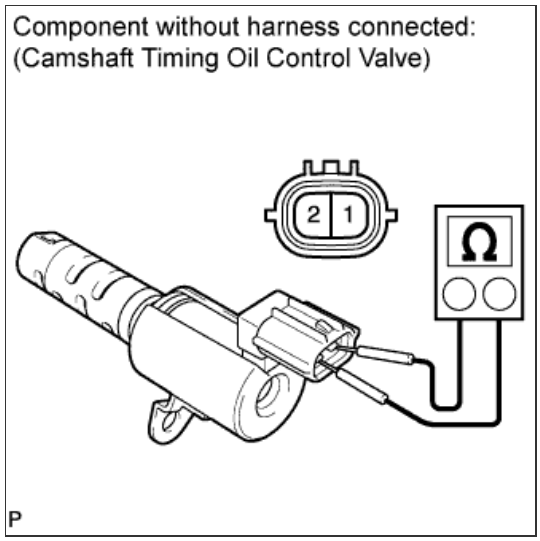
1. INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

If the result is not as specified, replace the oil control valve assembly.

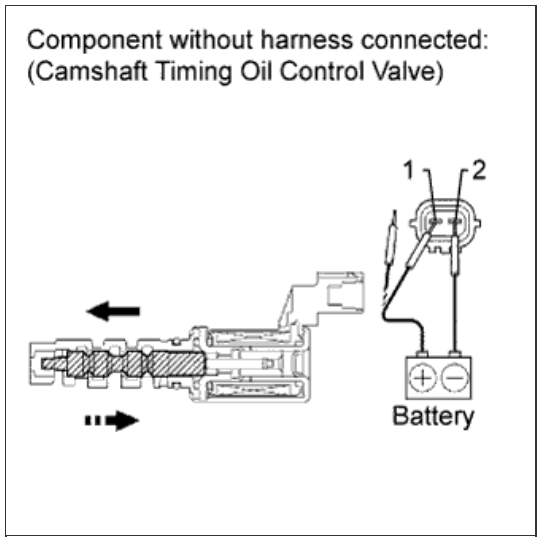


b. Connect the battery positive (+) lead to terminal 1 and the negative (-) lead to terminal 2, and check the movement of the valve.

OK:

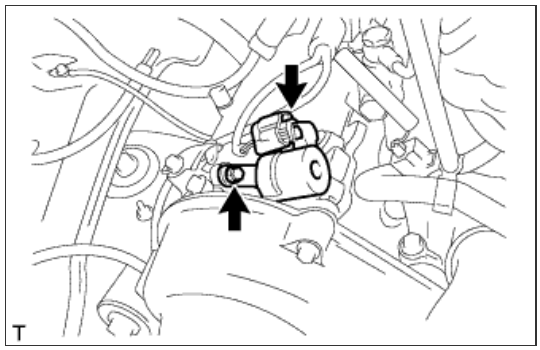
Condition	Specified Condition
Battery positive (+) voltage is applied	Valve moves in the direction of the left arrow shown in the illustration
Battery positive (+) voltage is cut off	Valve moves in the direction of the right arrow shown in the illustration

If the result is not as specified, replace the camshaft timing oil control valve. If the valve cannot return properly because of foreign matter, a small pressure leak in the advanced direction may occur and a DTC may be stored.



for Preparation Click here

1. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY RH



a. Install a new O-ring to the camshaft timing oil control valve.

b. ly a light coat of engine oil to the O-ring.

c. Install the oil control valve with the bolt.

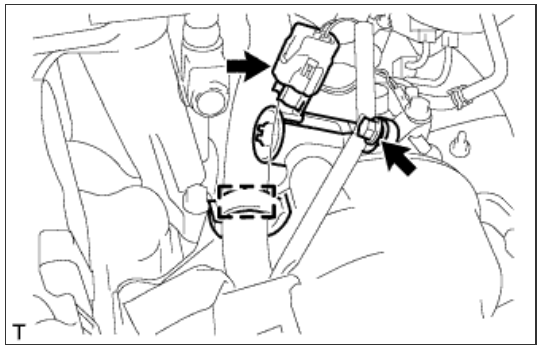
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

NOTICE:

- **Do not allow foreign matter to contact the oil seal face of the oil control valve (connecting surface with cylinder head cover).**
- **Be careful that the O-ring is not cracked when installing the oil control valve.**

d. Connect the camshaft timing oil control valve connector.

2. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY LH



a. Install a new O-ring to the camshaft timing oil control valve.

b. ly a light coat of engine oil to the O-ring.

c. Install the camshaft timing oil control valve with the bolt.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

NOTICE:

- **Do not allow foreign matter to contact the oil seal face of the oil control valve (connecting surface with cylinder head cover).**
- **Be careful that the O-ring is not cracked when installing the oil control valve.**

d. Connect the camshaft timing oil control valve connector and wire harness clamp.

3. INSTALL AIR CLEANER HOSE ASSEMBLY

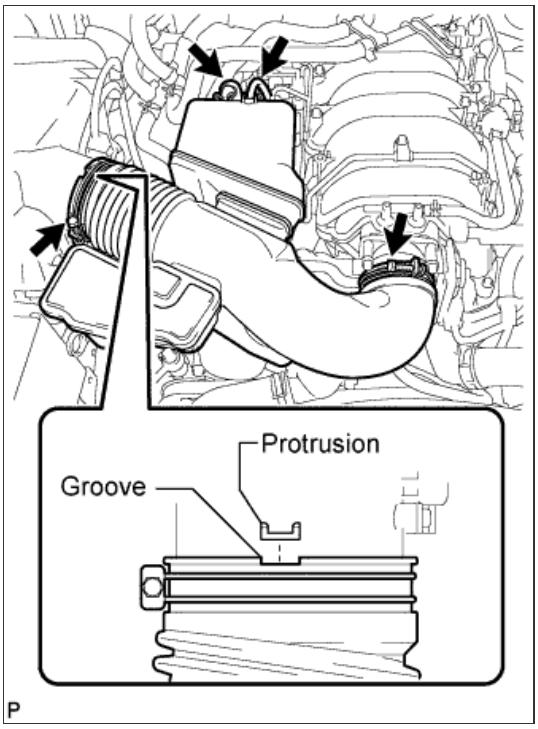
a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum transmitting hose.

d. Connect the No. 2 ventilation hose.

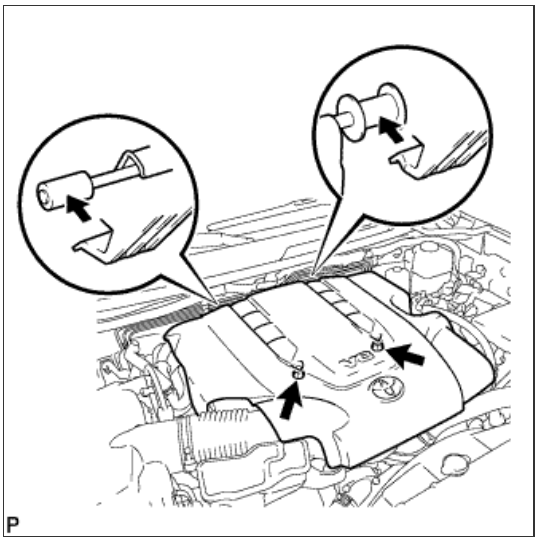


. INSTALL V BAN COVER S B ASSEMBLY

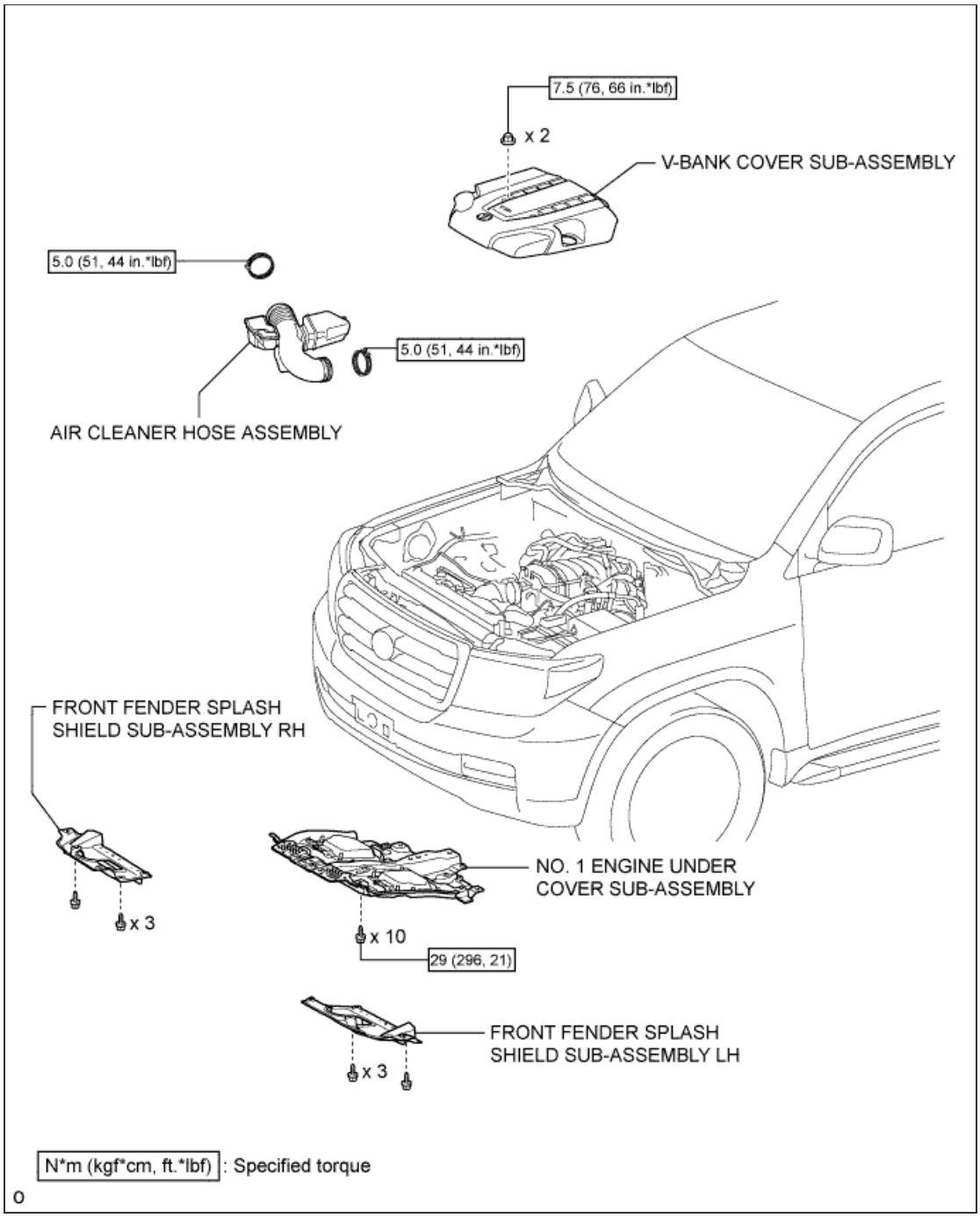
a. ttach the 2 V-bank cover hooks to the bracket.

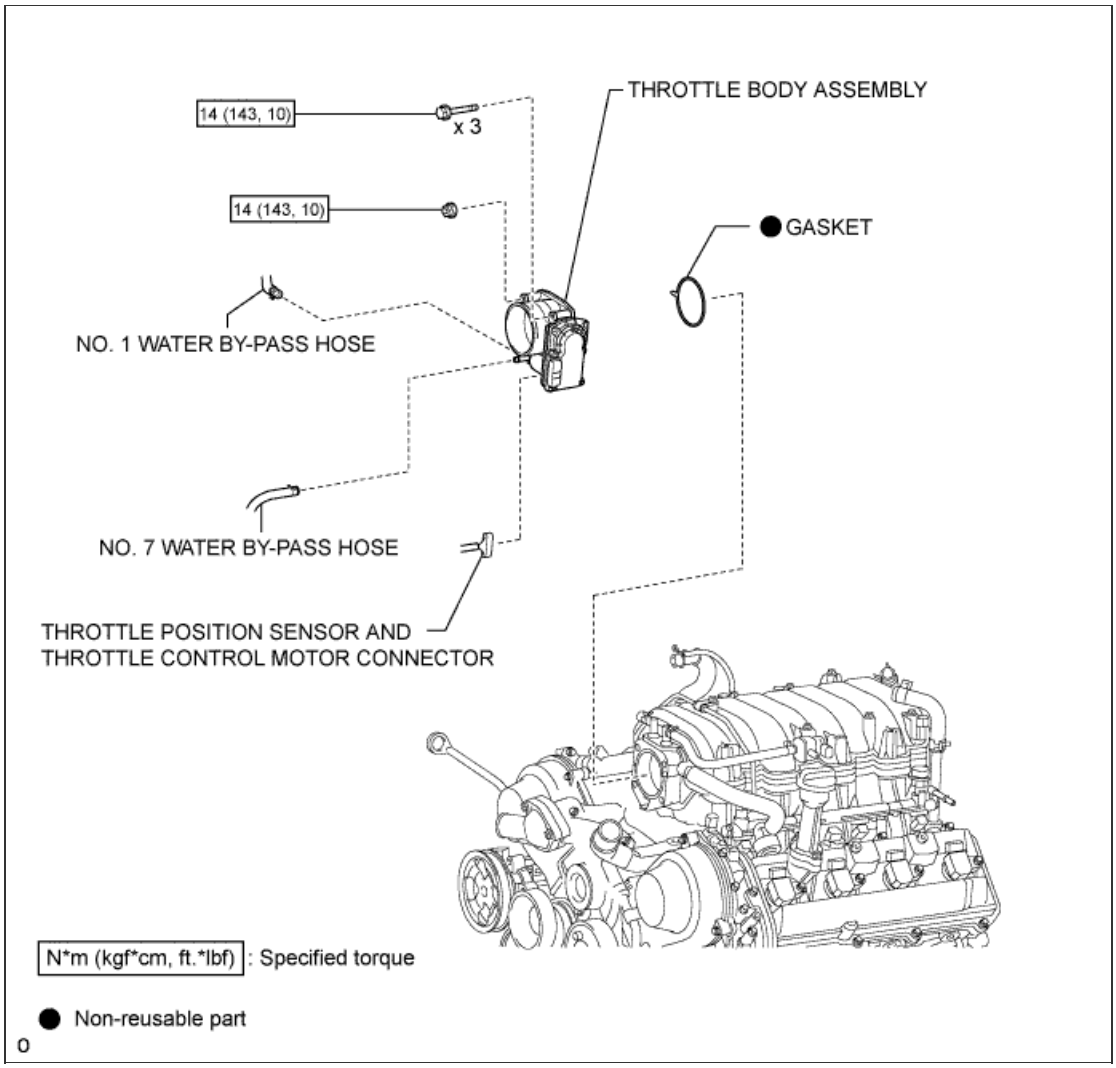
b. Install the V-bank cover with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



for Preparation Click here




14 (143, 10)
x 3
14 (143, 10)
THROTTLE BODY ASSEMBLY
GASKET
NO. 1 WATER BY-PASS HOSE
NO. 7 WATER BY-PASS HOSE
THROTTLE POSITION SENSOR AND
THROTTLE CONTROL MOTOR CONNECTOR
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

o

for Preparation Click here

1. CHECK THROTTLE BODY ASSEMBLY

a. Check the throttle control motor operating sounds.

i. Turn the engine switch on (IG).

ii. When depressing the accelerator pedal, check the operating sound of the running motor. Make sure that no friction noises are emitted from the motor. If friction noise exists, replace the throttle body.

b. Check the throttle position sensor.

i. Connect the intelligent tester to the DLC3.

ii. Turn the engine switch on (IG).

iii. Turn the intelligent tester on.

iv. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Throttle Sensor Position.

v. Depress the accelerator pedal. When the throttle valve is fully opened, check that the value of the "Throttle Sensor Position" is within the specification.

Standard throttle valve opening percentage:
60% or more

HINT:

When checking the standard throttle valve opening percentage, the shift lever should be in N.

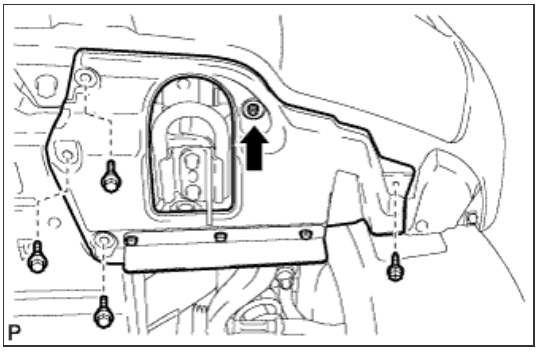
If the percentage is less than 60%, replace the throttle body.

for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



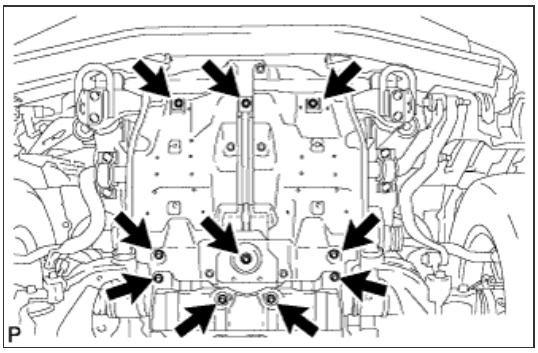
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

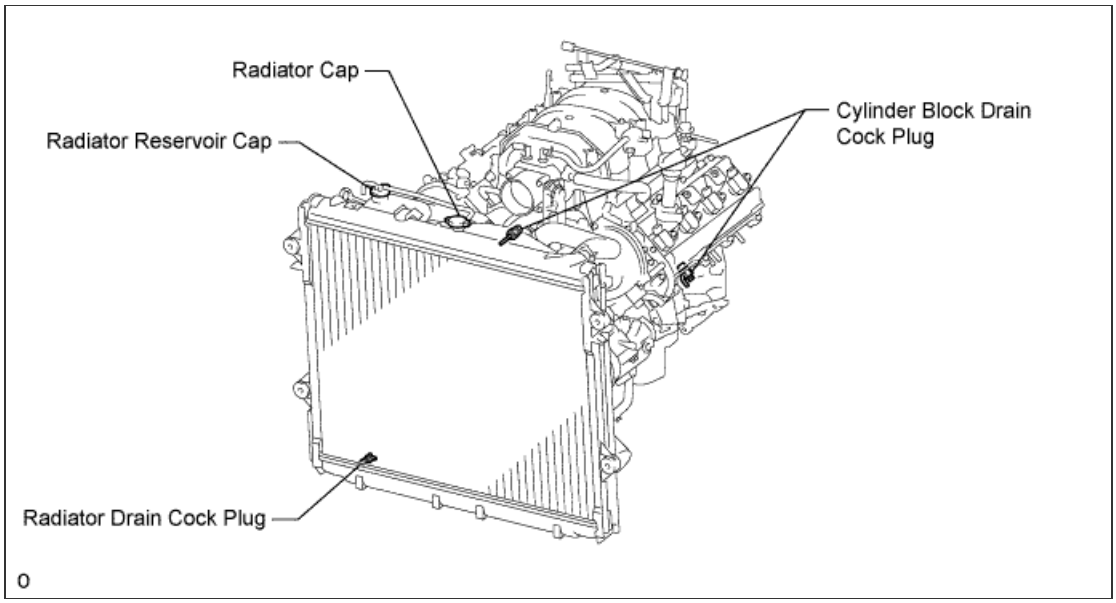
a. Remove the 10 bolts and No. 1 engine under cover.



4. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.



a. Loosen the radiator drain cock plug.

b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

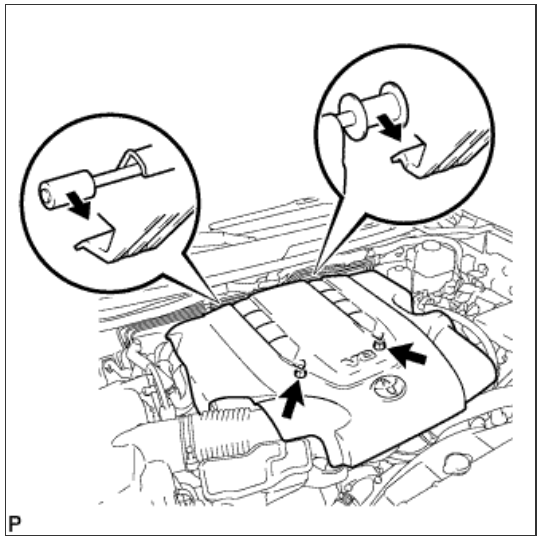
d. Tighten the 2 cylinder block drain cock plugs.

Torque:
13 N*m{ 130 kgf*cm , 9 ft.*lbf }

e. Tighten the radiator drain cock plug by hand.

5. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Remove the 2 nuts and V-bank cover.

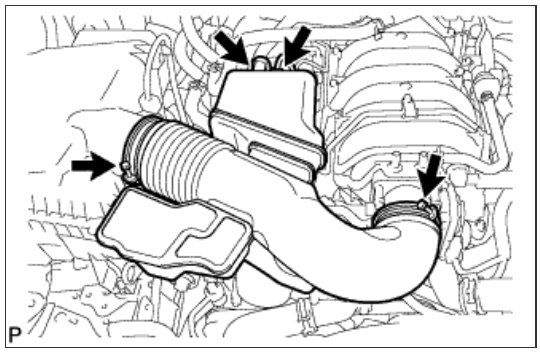


. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum transmitting hose and No. 2 ventilation hose.

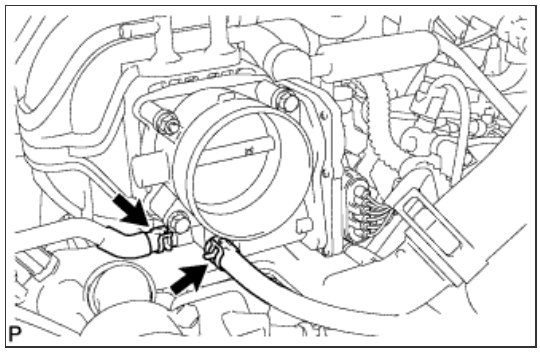
b. Loosen the 2 hose clamps.

c. Remove the air cleaner hose.



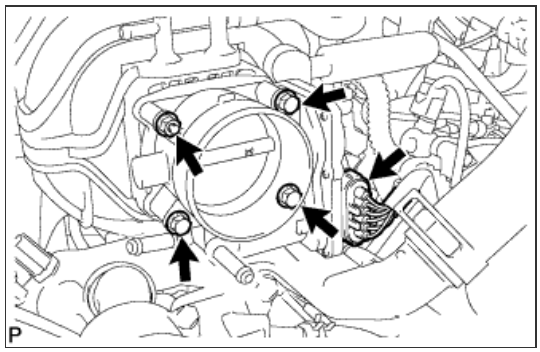
7. REMOVE THROTTLE BODY ASSEMBLY

a. Disconnect the No. 1 water by-pass hose and No. 7 water by-pass hose from the throttle body.



b. Disconnect the throttle position sensor and throttle control motor connector.

c. Remove the 3 bolts, nut, throttle body and gasket.



for Preparation Click here

1. INSPECT THROTTLE BODY ASSEMBLY

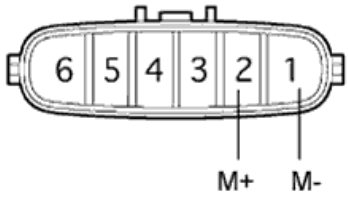
a. Measure the resistance according to the value(s) in the table below.

Stan ar Resistance:

Tester Connection	Condition	Specified Condition
1 (M-) - 2 (M+)	20°C (68°F)	0.3 to 100 Ω

If the result is not as specified, replace the throttle body assembly.

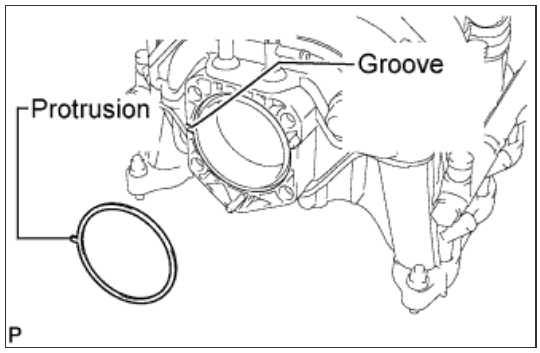
Component without harness connected:
(Throttle Body)



for Preparation Click here

1. INSTALL THROTTLE BODY ASSEMBLY

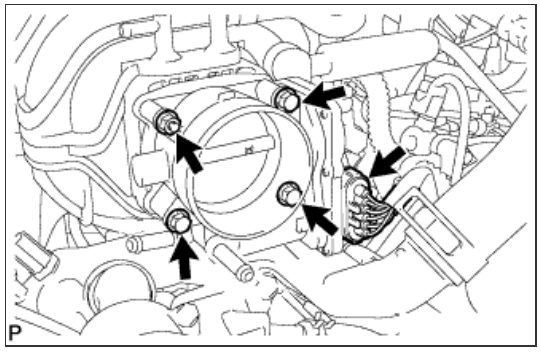
a. Align the protrusion of a new gasket with the groove of the intake manifold, and install the gasket.



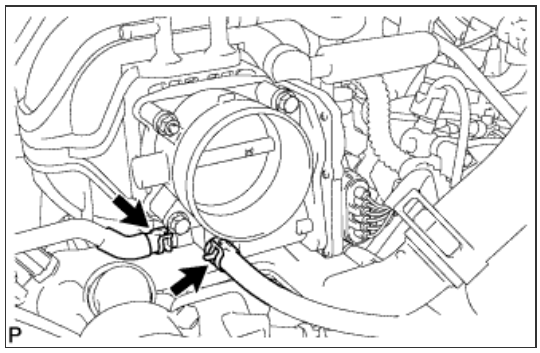
b. Install the throttle body with the 3 bolts and nut.

Torque:
14 N*m{ 143 kgf*cm , 10 ft.*lbf }

c. Connect the throttle position sensor and throttle control motor connector.



d. Connect the No. 1 water by-pass hose and No. 7 water by-pass hose to the throttle body.



2. INSTALL AIR CLEANER HOSE ASSEMBLY

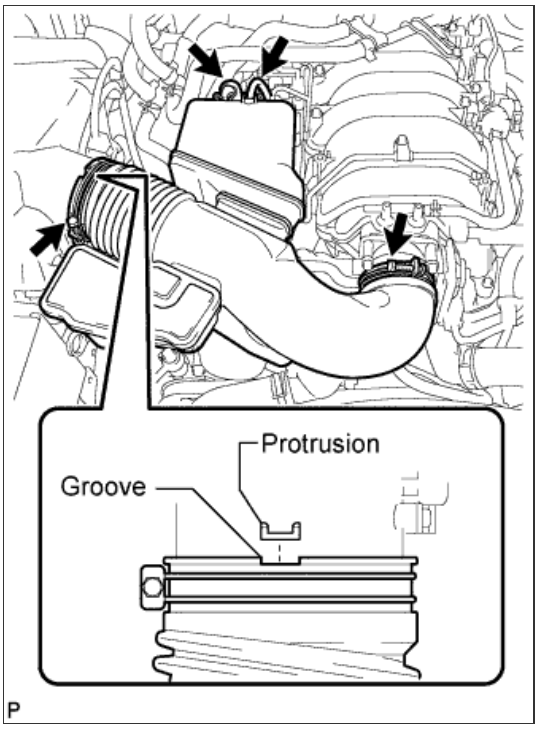
a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum transmitting hose.

d. Connect the No. 2 ventilation hose.



3. ADD ENGINE COOLANT

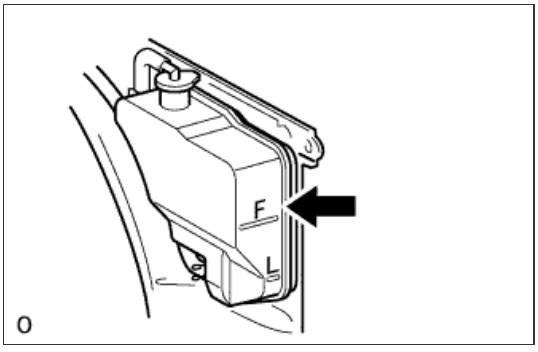
a. Add engine coolant.

Standard Capacity:

Item		Specified Condition
w/o Transmission oil cooler	w/o Rear Heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)
	w/ Rear Heater	16.3 liters (17.2 US qts, 14.3 Imp. qts)
w/ Transmission oil cooler	w/o Rear Heater	14.1 liters (14.9 US qts, 12.4 Imp. qts)
	w/ Rear Heater	16.9 liters (17.9 US qts, 14.9 Imp. qts)

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).



b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the radiator reservoir cap.

d. Press the inlet and outlet radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.

NOTICE:

Switch off the A/C.

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

h. Press the inlet and outlet radiator hoses several times by hand to bleed air.

CAUTION:

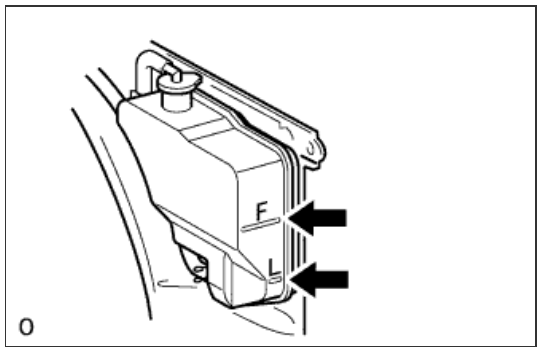
- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the cooling fan.**

i. Stop the engine, and wait until the engine coolant cools down to the ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

j. Check that the coolant level is between the F and L lines. If the coolant level is below the L line, repeat all of the procedures above. If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.

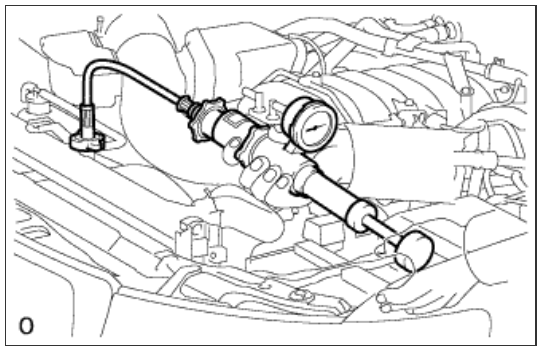


4. INSPECT FOR COOLANT LEAK

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



5. CHECK THROTTLE BODY ASSEMBLY

a. Check the throttle control motor operating sounds.

i. Turn the engine switch on (IG).

ii. When depressing the accelerator pedal, check the operating sound of the running motor. Make sure that no friction noises are emitted from the motor. If friction noise exists, replace the throttle body.

b. Check the throttle position sensor.

i. Connect the intelligent tester to the DLC3.

ii. Turn the engine switch on (IG).

iii. Turn the intelligent tester on.

iv. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Throttle Sensor Position.

v. Depress the accelerator pedal. When the throttle valve is fully opened, check that the value of the "Throttle Sensor Position" is within the specification.

Standard throttle valve opening percentage:
60% or more

HINT:

When checking the standard throttle valve opening percentage, the shift lever should be in N.

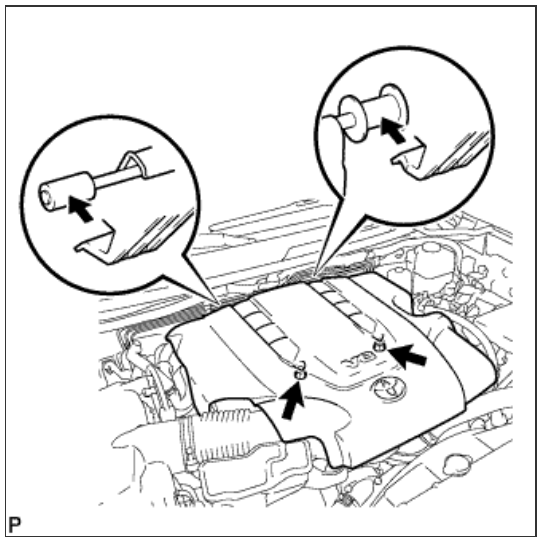
If the percentage is less than 60%, replace the throttle body.

6. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket.

b. Install the V-bank cover with the 2 nuts.

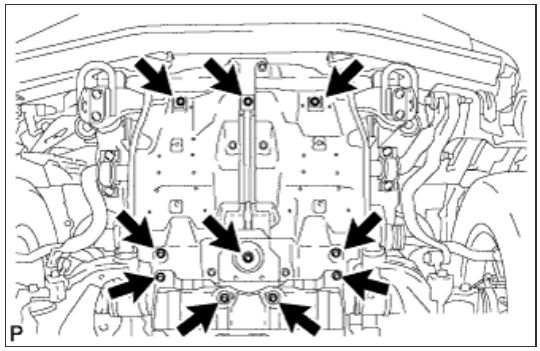
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



7. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the No. 1 engine under cover with the 10 bolts.

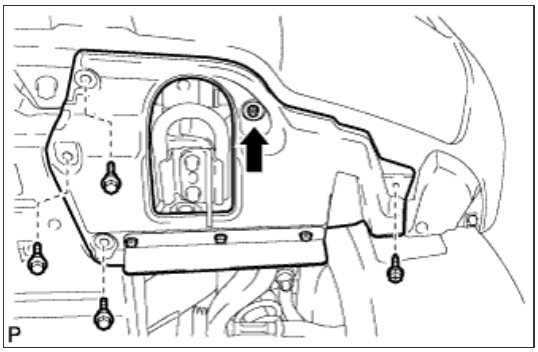
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



8. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.

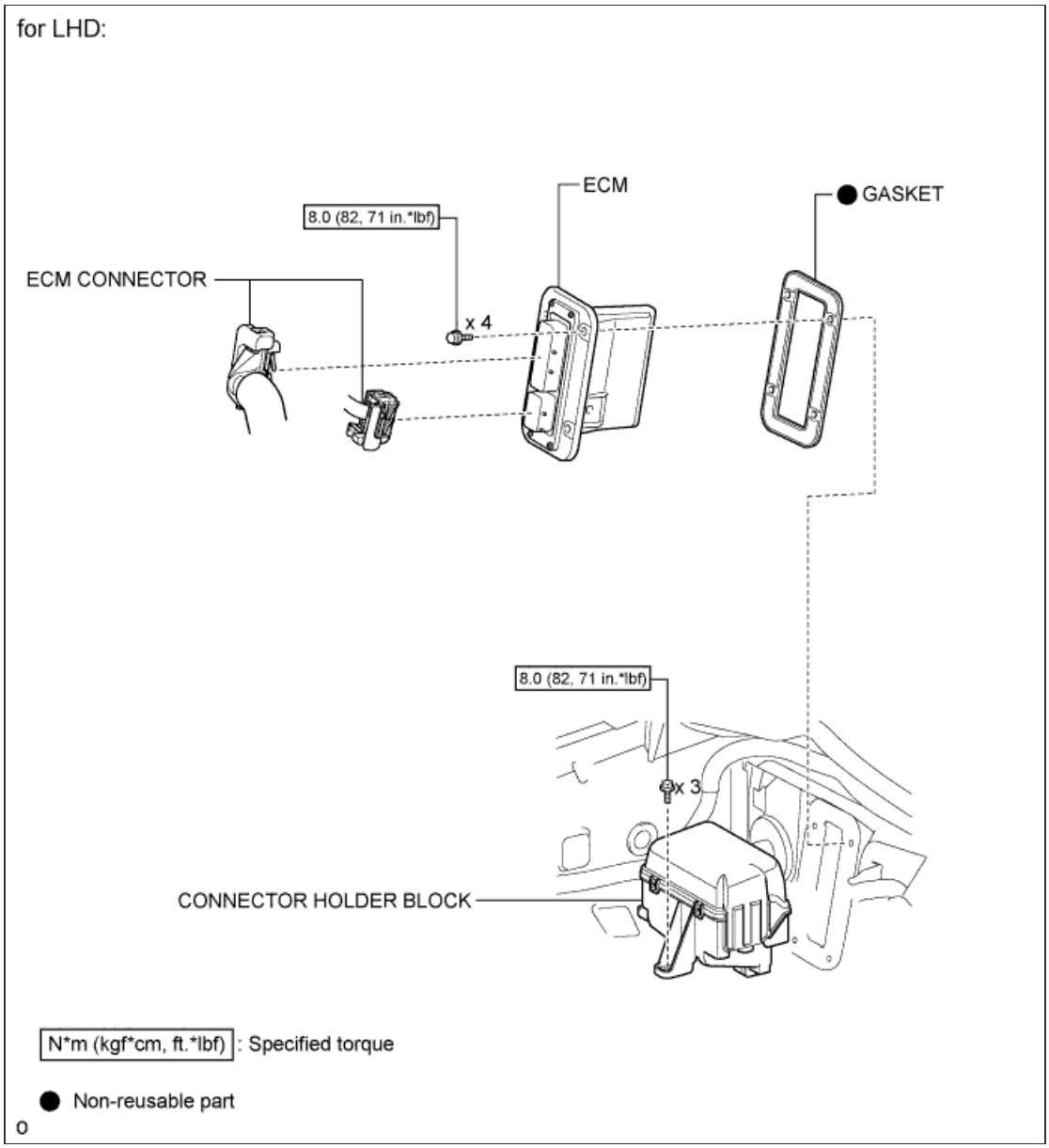


9. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

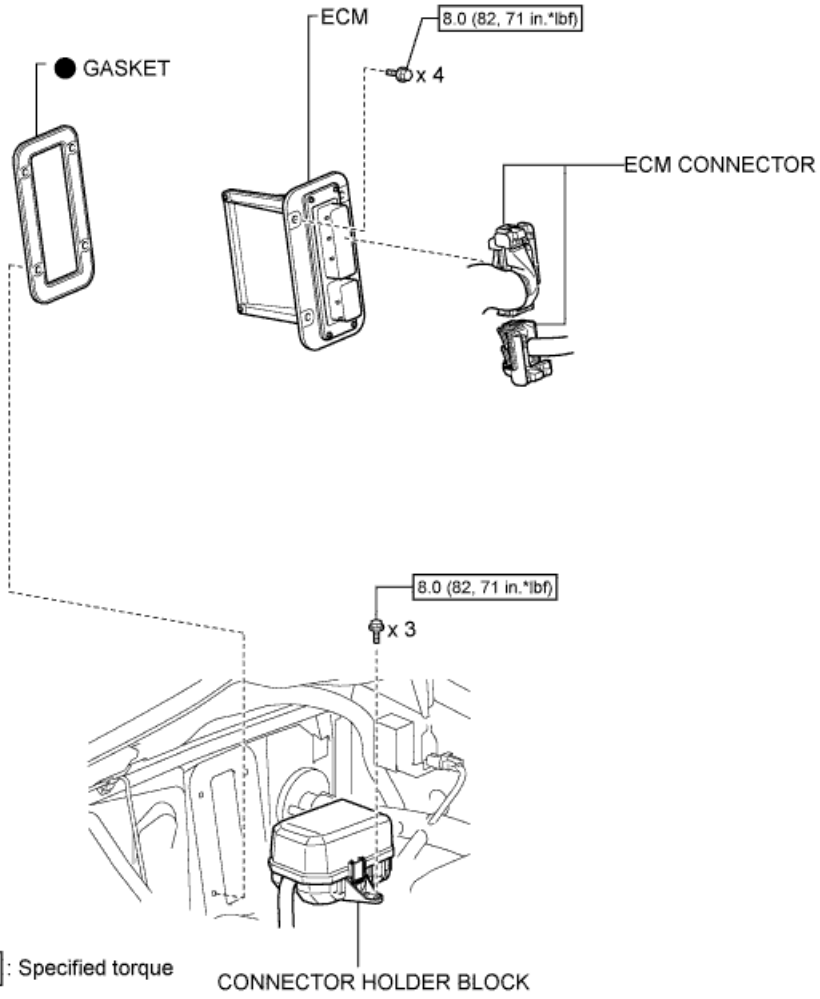
HINT:

Use the same procedures described for the LH side.

for Preparation Click here



for RHD:



N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

o

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

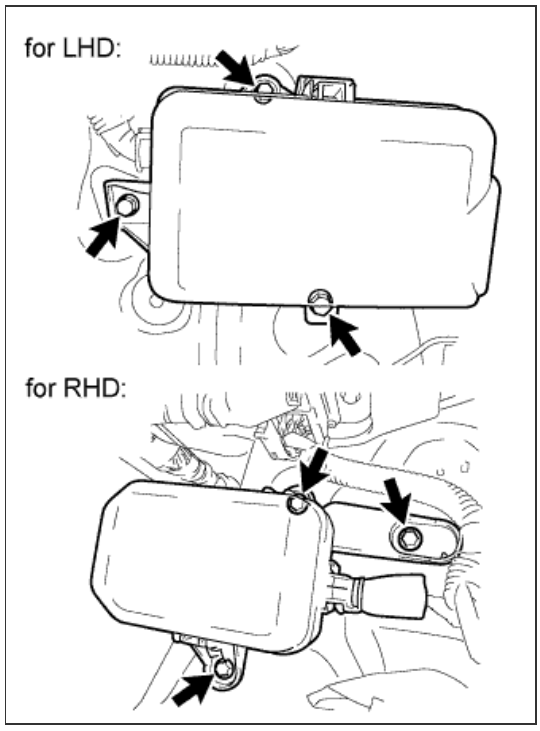
Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

2. DISCONNECT CONNECTOR HOLDER BLOCK

a. Remove the 3 bolts and move the connector holder block so that the ECM can be removed in the next step.



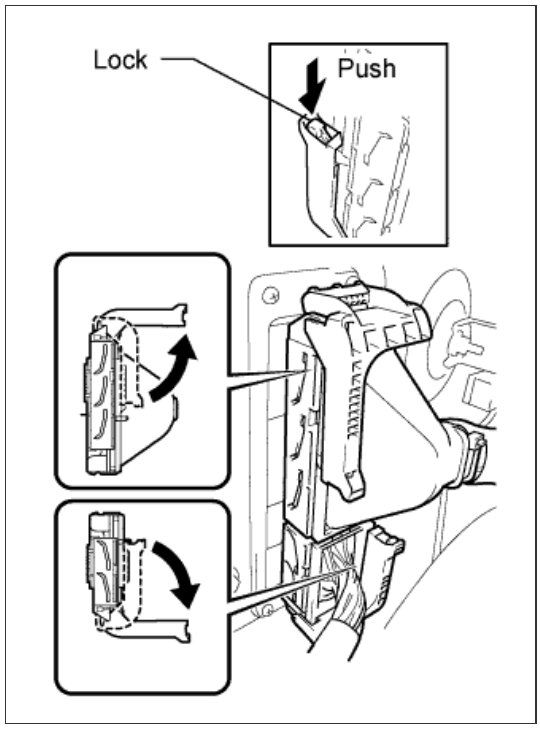
3. REMOVE ECM

a. Raise the 2 levers while pushing the locks on the 2 levers.

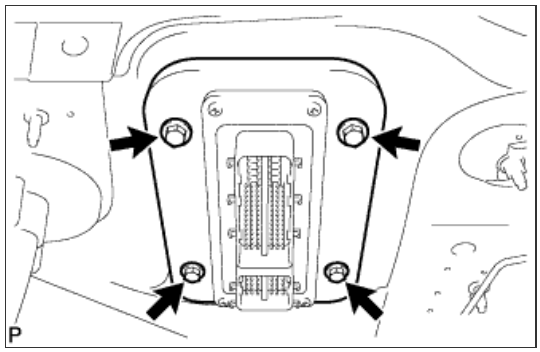
NOTICE:

Make sure that the lock levers are raised 90° as shown in the illustration before disconnecting the ECM connectors. Failure to do this may cause the ECM connectors to break.

b. Disconnect the 2 connectors.

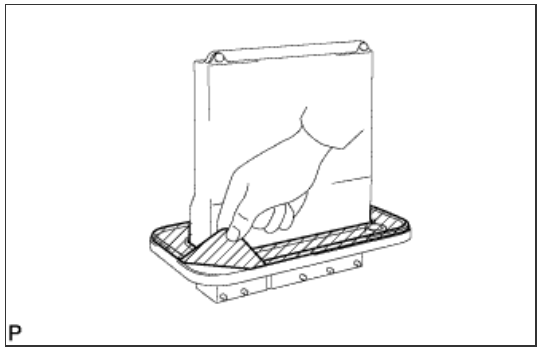


c. Remove the 4 bolts and ECM.



4. REMOVE GASKET

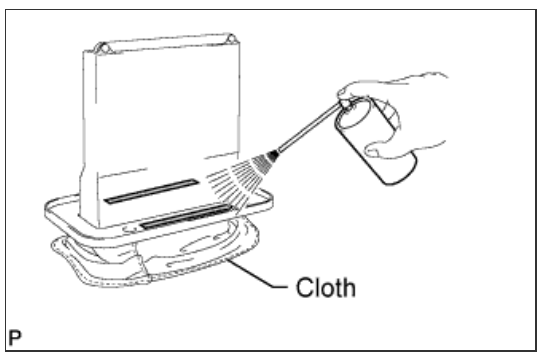
a. Peel off the gasket.



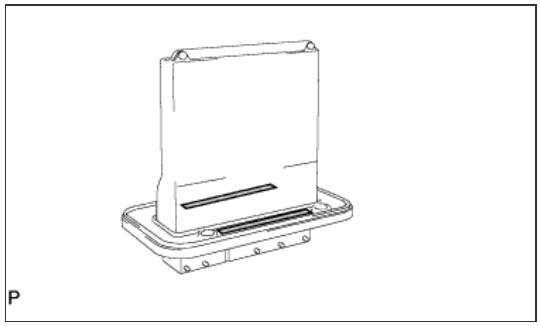
b. Spray gasket remover or equivalent on the remaining tape of the gasket.

NOTICE:

When using gasket remover or equivalent, cover the ECM connectors with a cloth.



c. Remove the tape of the gasket without using bladed objects.



P

for Preparation Click here

1. INSTALL GASKET

a. Clean the ECM seal surface with non-residue solvent.

b. Attach a new gasket to the ECM.

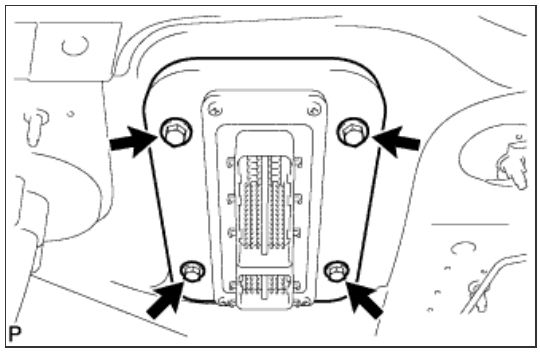
2. INSTALL ECM

a. Install the ECM with the 4 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

NOTICE:

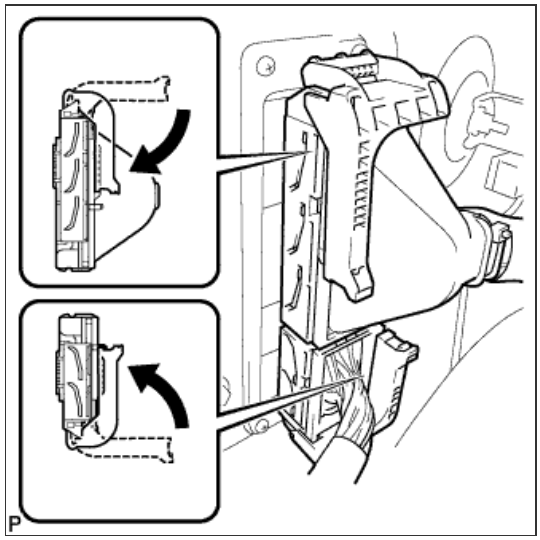
- **Make sure the gasket is not folded or caught on any area of the surrounding part.**
- **Make sure there is no foreign matter caught between the gasket and surrounding part.**
- **Do not damage the gasket.**



b. Connect the 2 ECM connectors and push each lock lever down to lock the ECM connectors.

NOTICE:

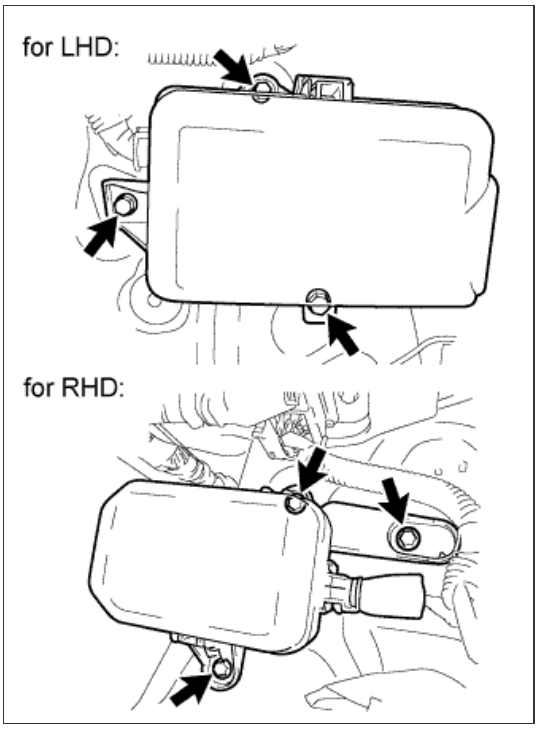
- **Be careful not to allow dirt, water, or other foreign matter to adhere to the connecting parts when connecting the connectors.**
- **Do not twist the wire harness when connecting the ECM connectors.**
- **Make sure that the lock lever is raised 90° before connecting the ECM connectors. Failure to do this may cause the lock lever and terminals to break.**
- **Make sure that the levers are securely locked.**



3. CONNECT CONNECTOR HOLDER BLOCK

a. Connect the connector holder block with the 3 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

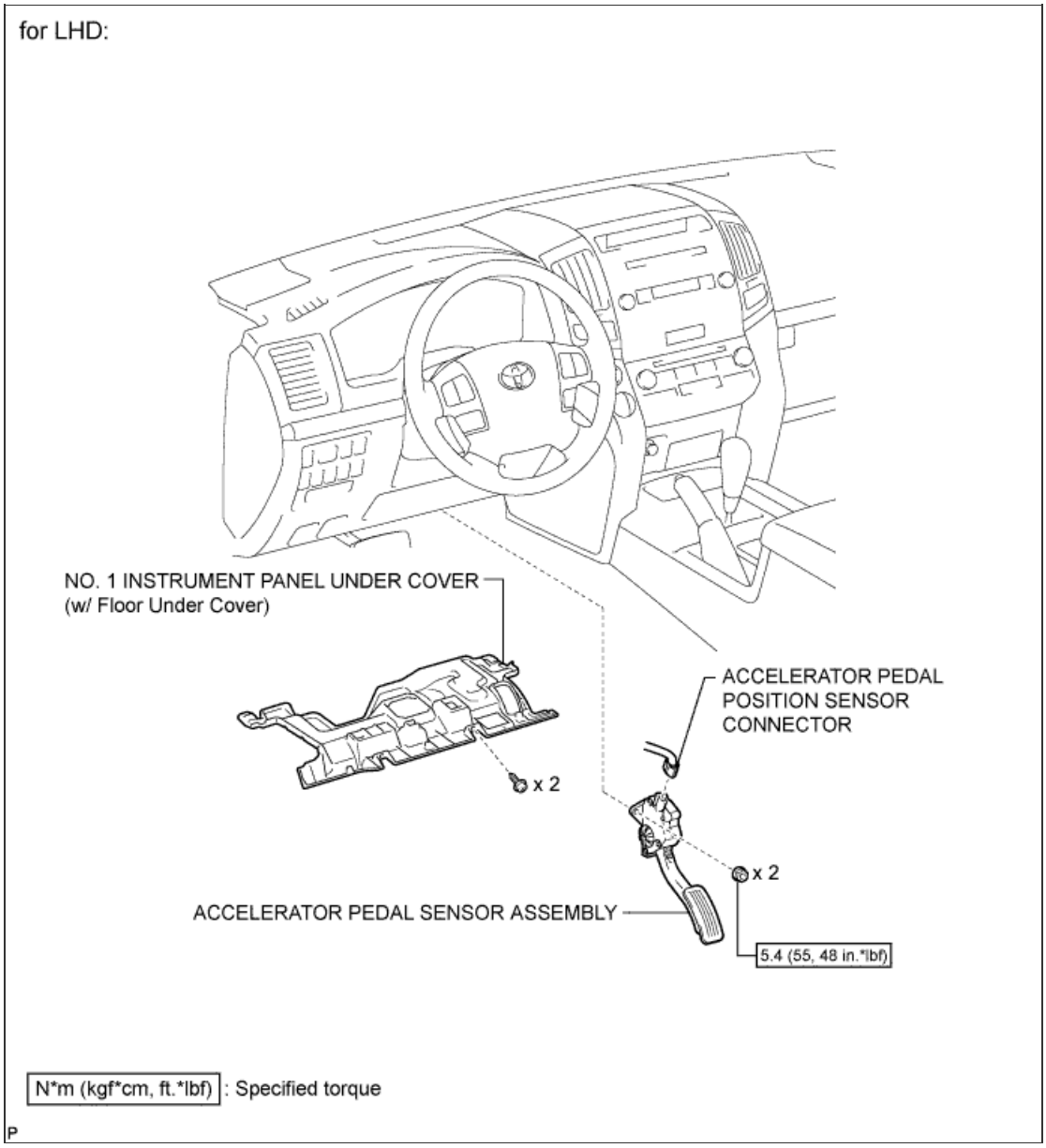


4. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

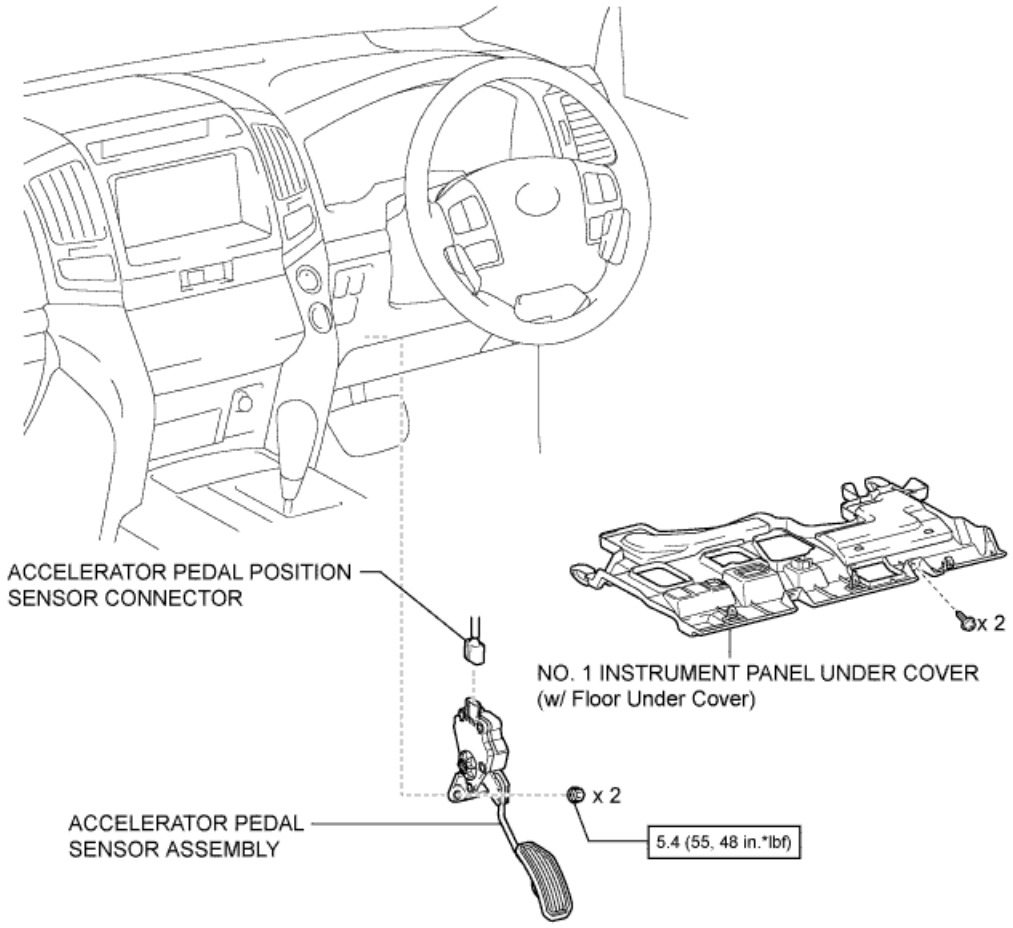
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

for Preparation Click here



for RHD:



N*m (kgf*cm, ft.*lbf) : Specified torque

P

for Preparation Click here

1. INSPECT ACCELERATOR PEDAL SENSOR ASSEMBLY

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the intelligent tester on.

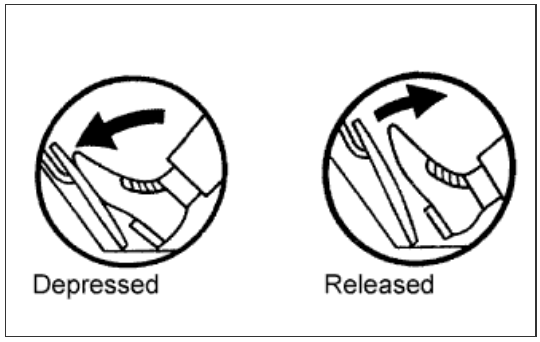
d. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No. 1 and Accelerator Position No. 2.

e. Read the value displayed on the intelligent tester.

Standard Voltage:

Accelerator Pedal Operation	Accelerator Position No. 1	Accelerator Position No. 2
Released	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2.6 to 4.5 V	3.4 to 5.0 V

If the result is not as specified, check the accelerator pedal, wire harness and ECM.



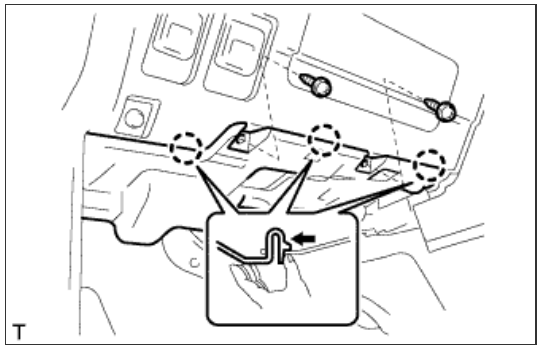
for Preparation Click here

1. REMOVE NO. 1 INSTRUMENT PANEL UNDER COVER (Under Cover)

a. Remove the 2 screws.

b. Detach the 3 claws.

c. Disconnect the connectors and remove the No. 1 instrument panel under cover.



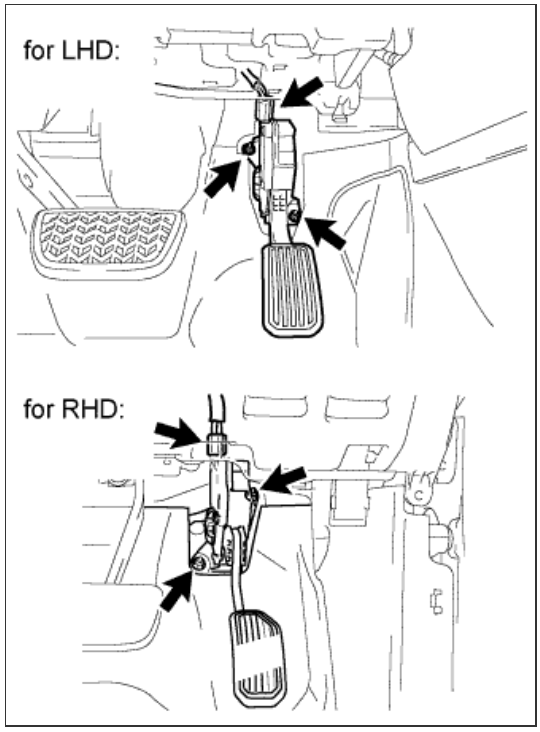
2. REMOVE ACCELERATOR PEDAL SENSOR ASSEMBL

NOTICE:

- **Avoid physical shocks to the accelerator pedal sensor assembly.**
- **Do not disassemble the accelerator pedal sensor assembly.**

a. Disconnect the accelerator pedal position sensor connector.

b. Remove the 2 nuts and accelerator pedal sensor.



for Preparation Click here

1. INSTALL ACCELERATOR PEDAL SENSOR ASSEMBLY

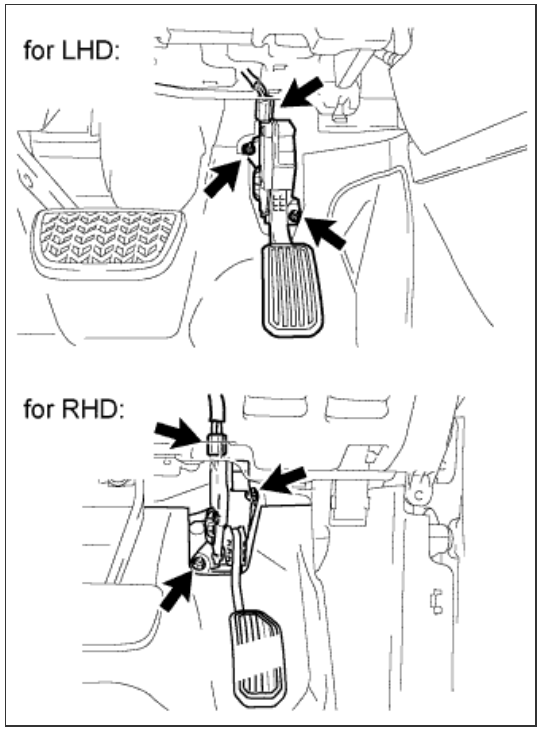
NOTICE:

- **Avoid physical shocks to the accelerator pedal sensor assembly.**
- **Do not disassemble the accelerator pedal sensor assembly.**

a. Install the accelerator pedal sensor with the 2 nuts.

Torque:
5.4 N*m{ 55 kgf*cm , 48 in.*lbf }

b. Connect the accelerator pedal position sensor connector.

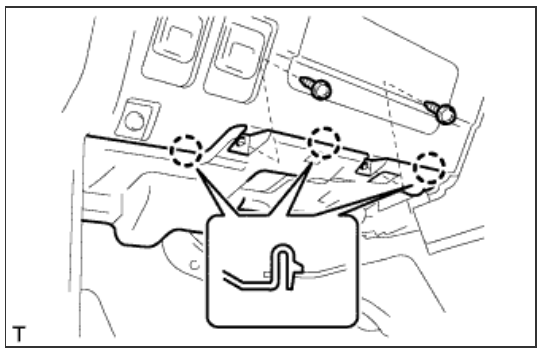


2. INSTALL NO. 1 INSTRUMENT PANEL UNDER COVER (w/ Floor Under Cover

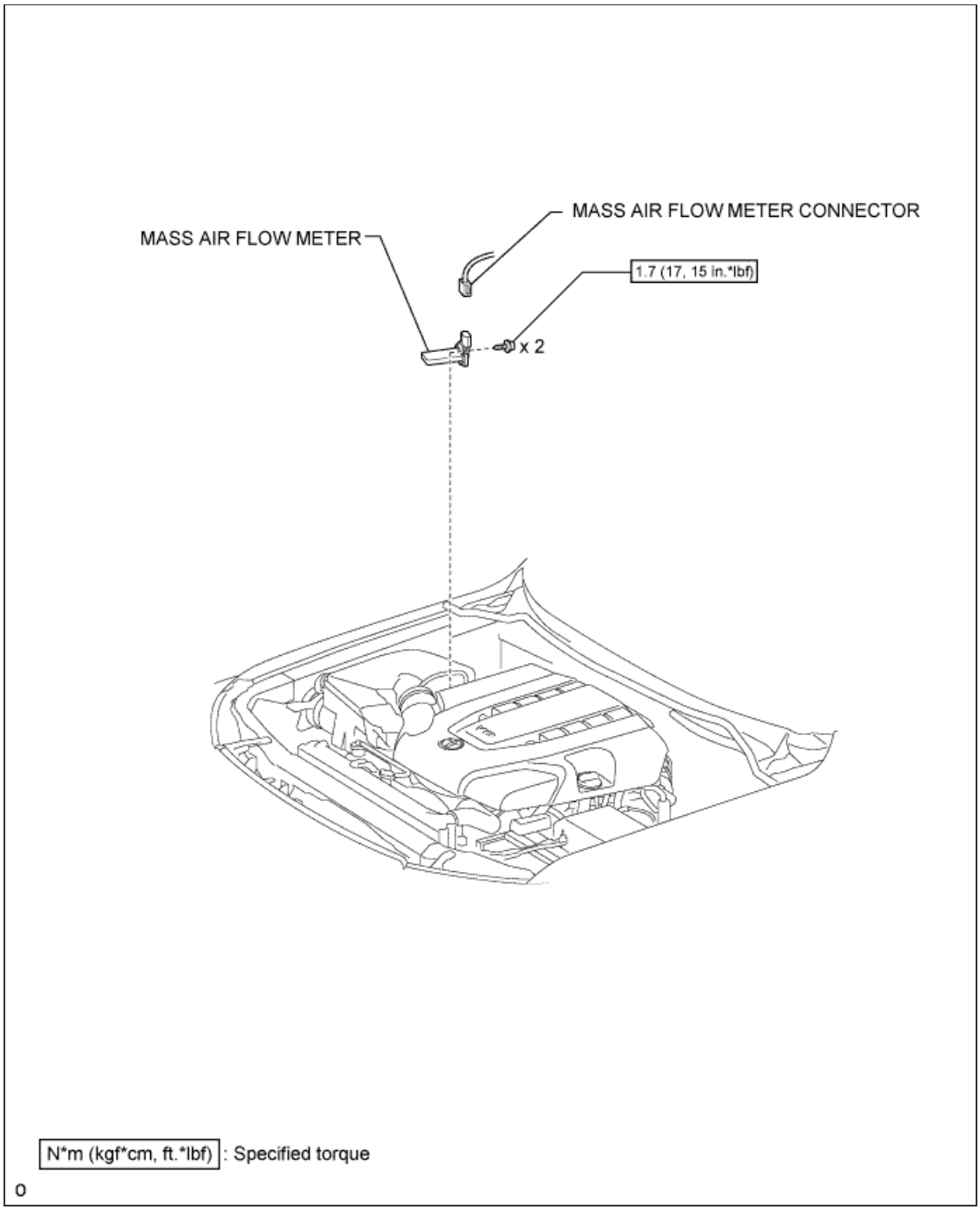
a. Connect the connectors.

b. Attach the 3 claws to install the No. 1 instrument panel under cover.

c. Install the 2 screws.



for Preparation [Click here]



for Preparation Click here

1. CHECK MASS AIR FLOW METER

a. Check the mass air flow value.

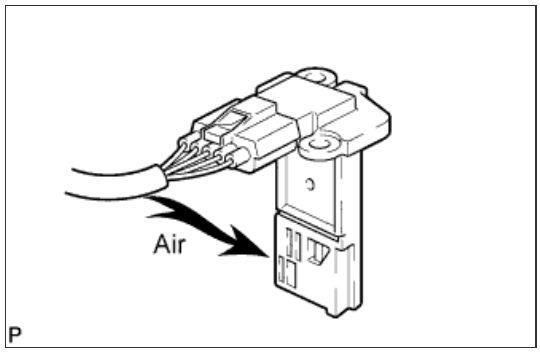
i. Connect the intelligent tester the DLC3.

ii. Turn the engine switch on (IG).

iii. Turn the intelligent tester on.

iv. Enter the following menus: Powertrain / Engine / Data List / All Data / MAF.

v. Blow air into the MAF meter, and check that the MAF value fluctuates. If the result is not as specified, check the MAF meter (Click here), or wiring and ECM (Click here).

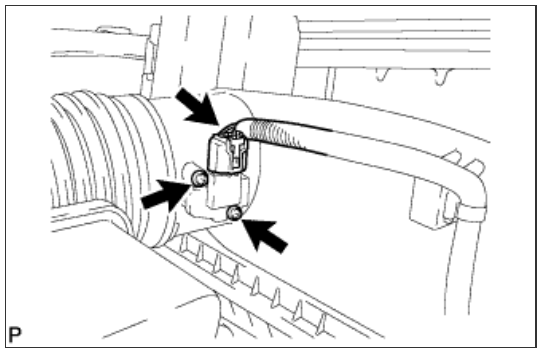


for Preparation Click here

1. REMOVE MASS AIR FLOW METER

a. Disconnect the MAF meter connector.

b. Remove the 2 screws and MAF meter.



for Preparation Click here

1. INSPECT MASS AIR FLOW METER

a. Check the output voltage.

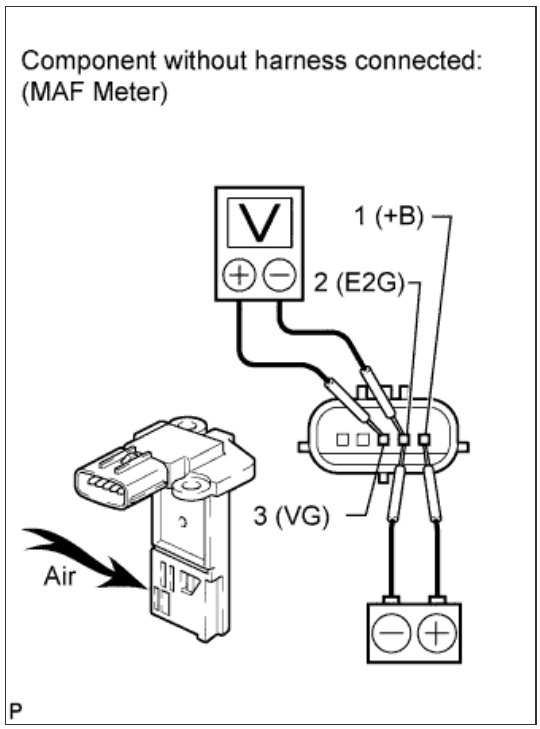
i. Apply battery voltage across terminals 1 (+B) and 2 (E2G).

NOTICE:

While using the battery during inspection, do not bring the positive and negative tester probes too close to each other as a short circuit may occur.

ii. Using a voltmeter, connect the positive (+) tester probe to terminal 3 (VG), and negative (-) tester probe to terminal 2 (E2G).

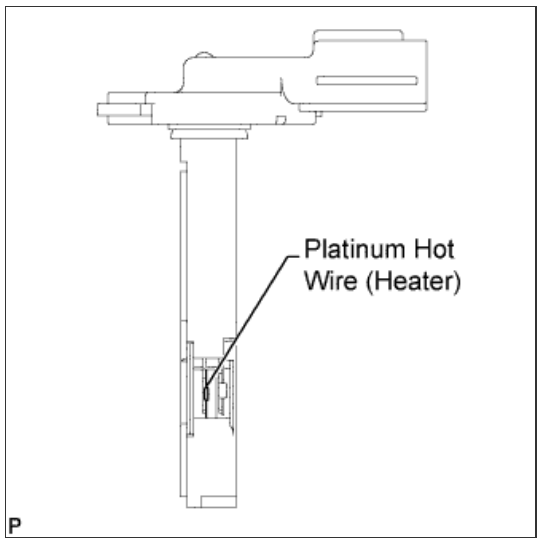
iii. Blow air into the MAF meter, and check that the voltage fluctuates.
If the result is not as specified, replace the MAF meter.



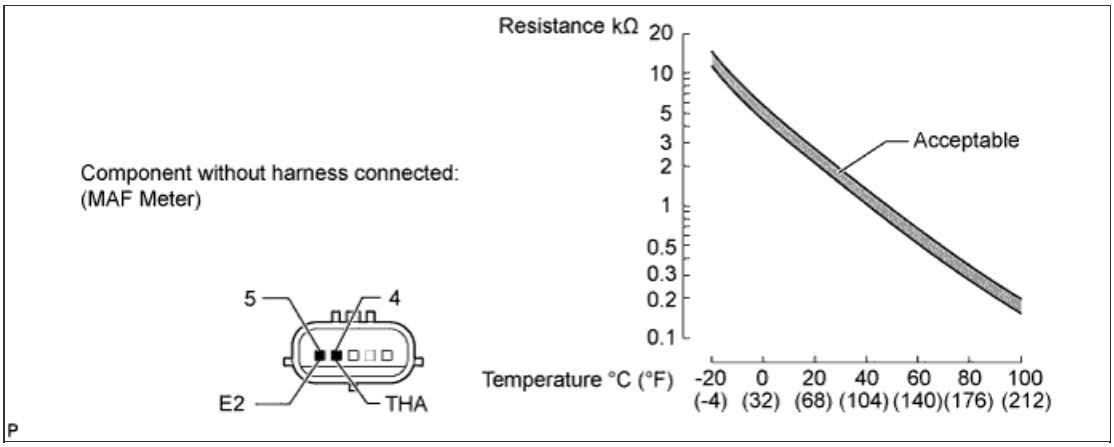
b. Perform a visual check for any foreign matter on the platinum hot wire (heater) of the mass air flow meter shown in the illustration.

OK:
There is no foreign material.

If the result is not as specified, replace the mass air flow meter.



c. Check the IAT sensor.



i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
4 (THA) - 5 (E2)	-20°C (-4°F)	12.5 to 16.9 kΩ
	20°C (68°F)	2.19 to 2.67 kΩ
	60°C (140°F)	0.50 to 0.68 kΩ

If the result is not as specified, replace the MAF meter.

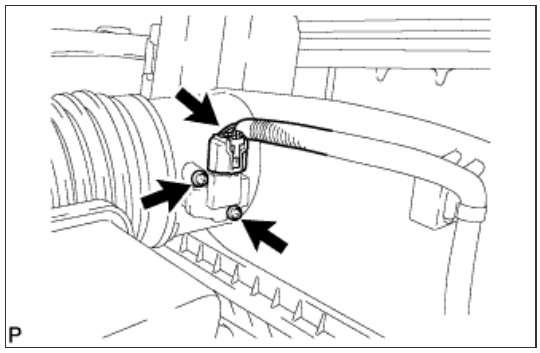
for Preparation Click here

1. INSTALL MASS AIR FLOW METER

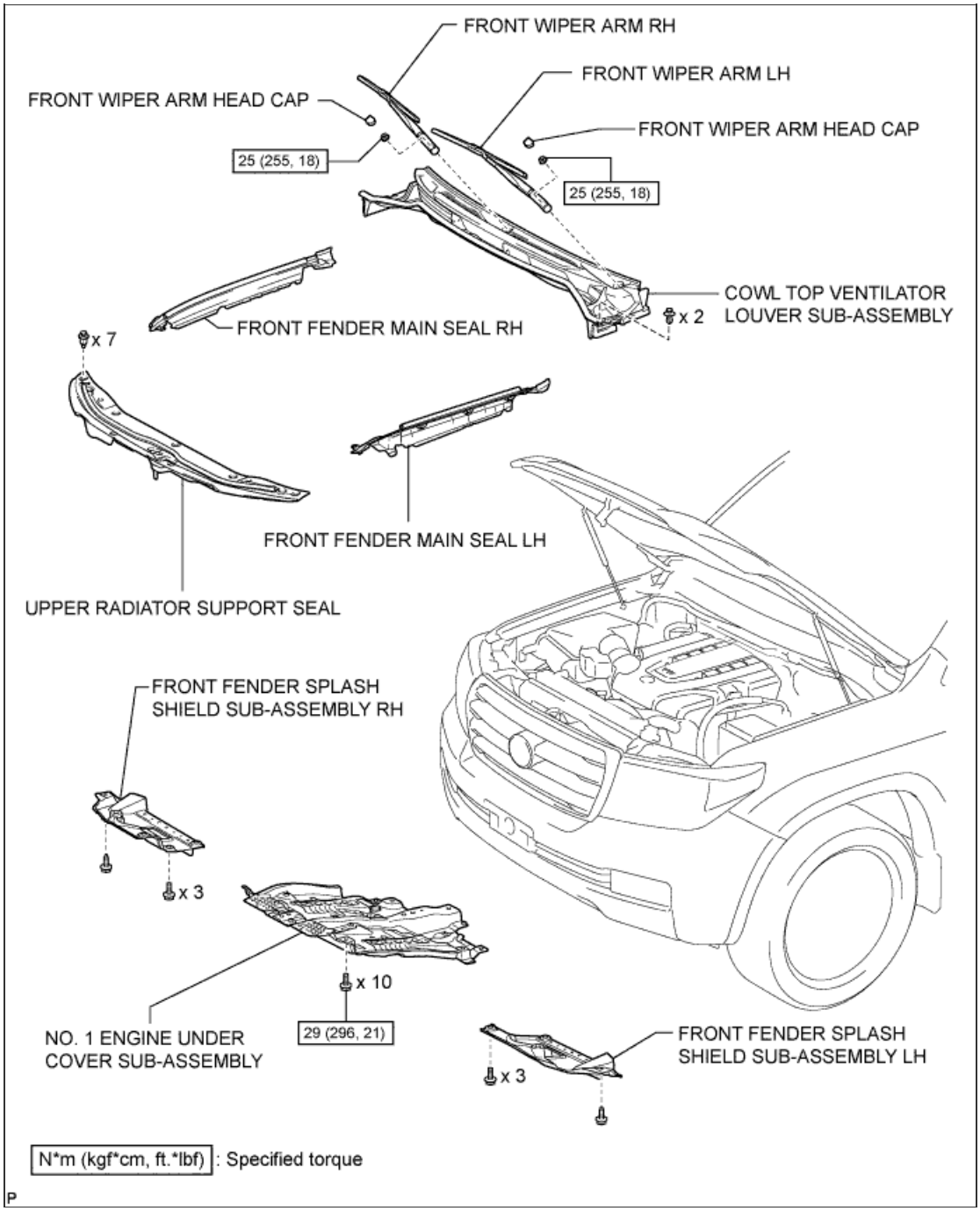
a. Install the MAF meter with the 2 screws.

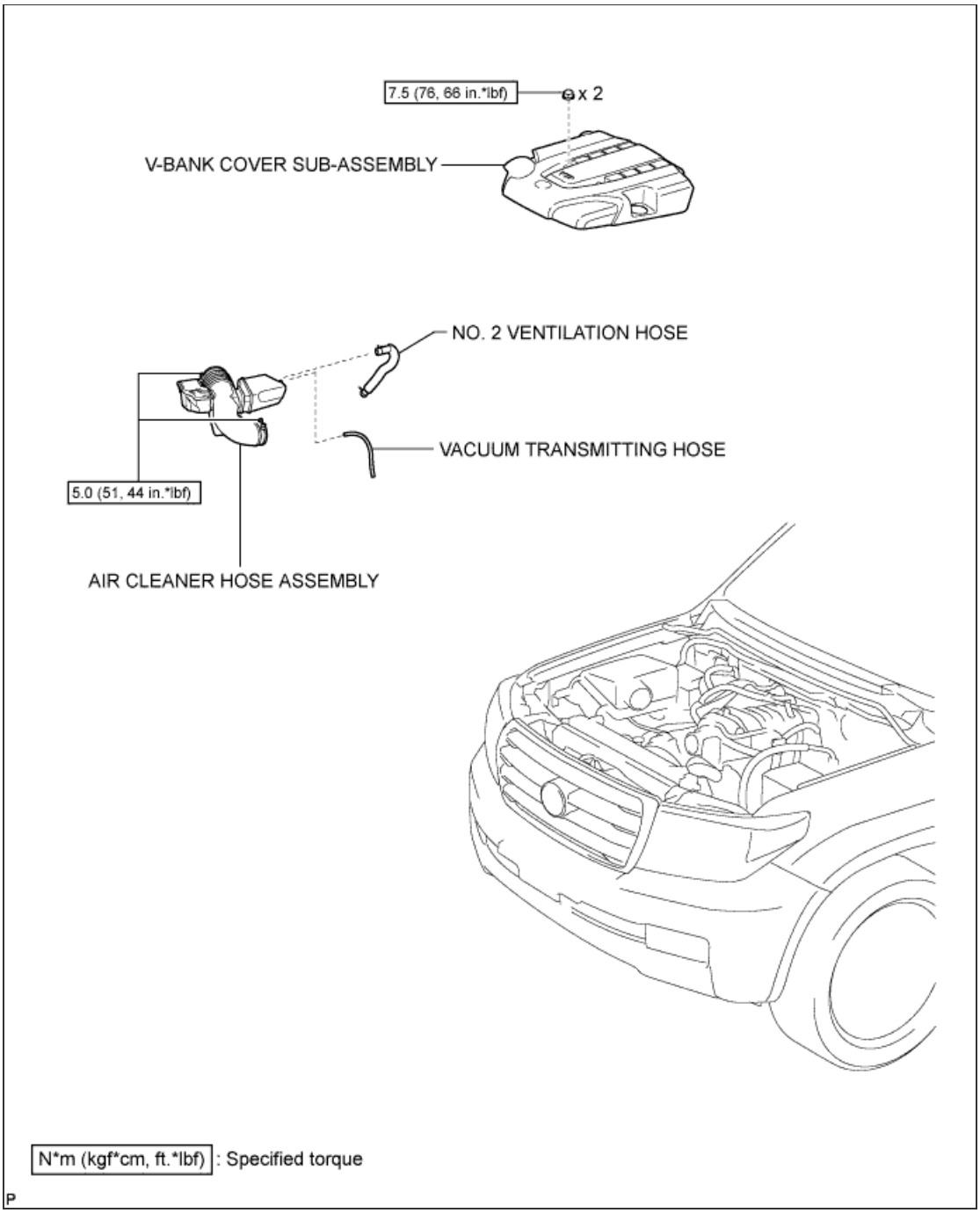
Torque:
1.7 N*m{ 17 kgf*cm , 15 in.*lbf }

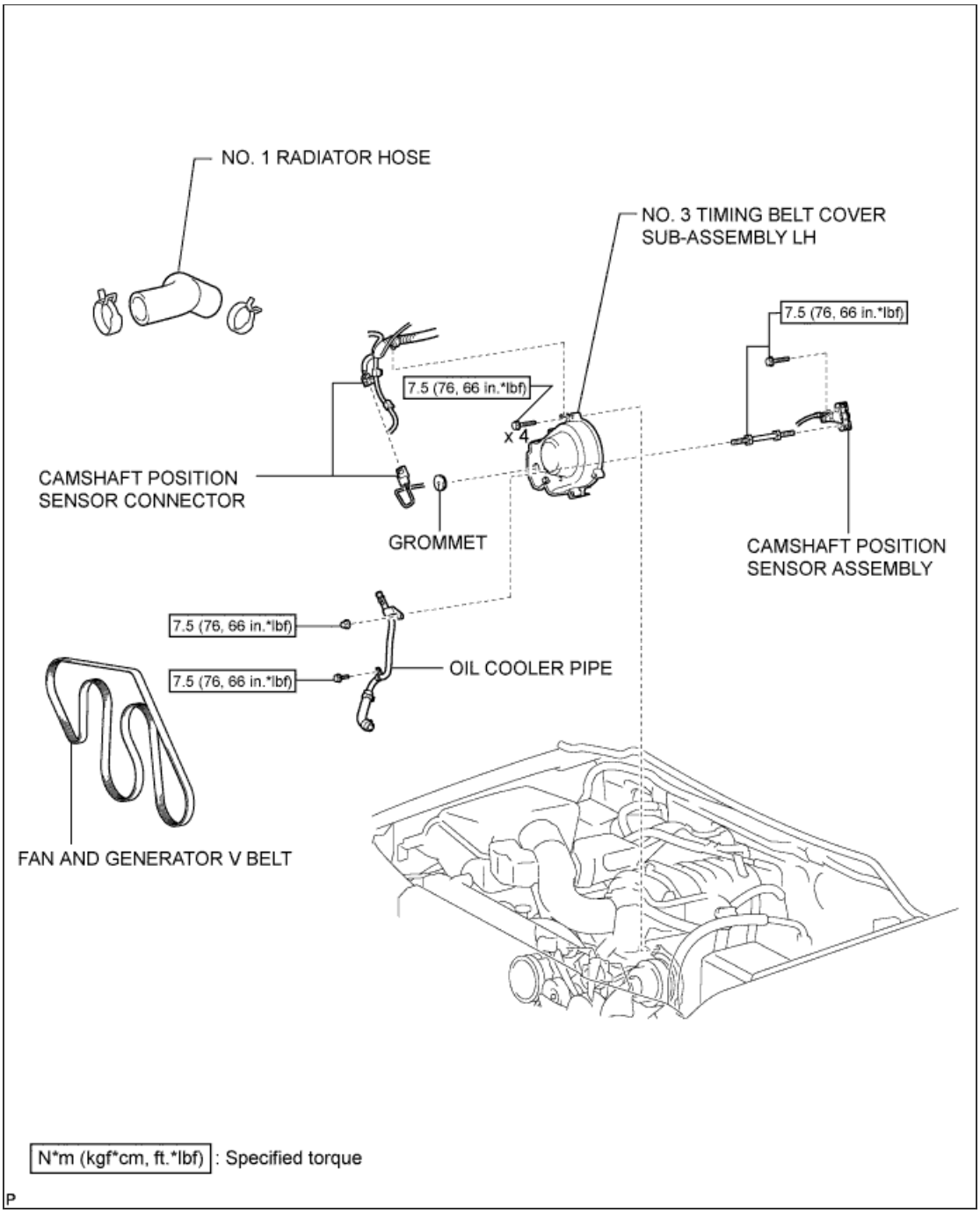
b. Connect the MAF meter connector.

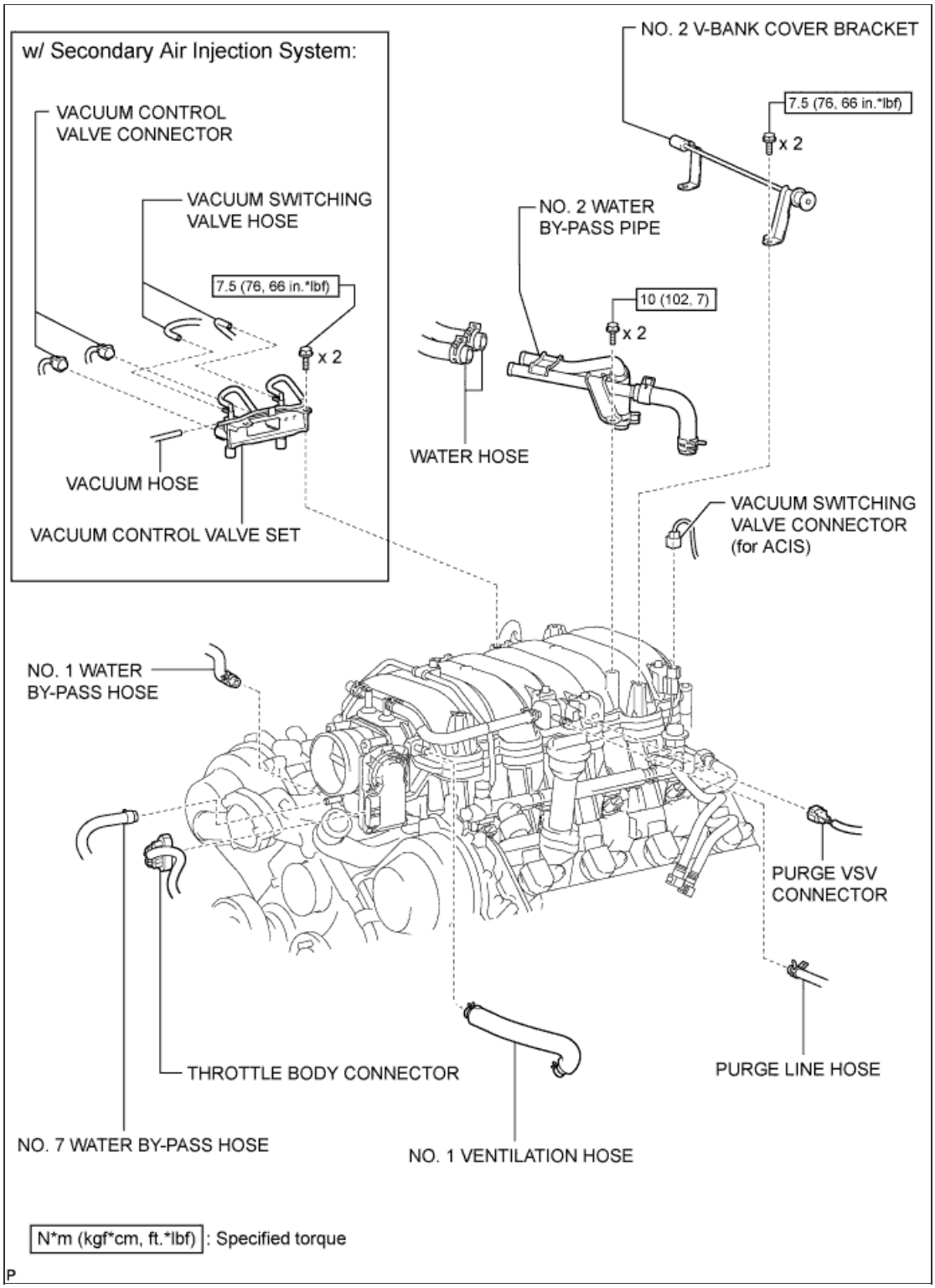


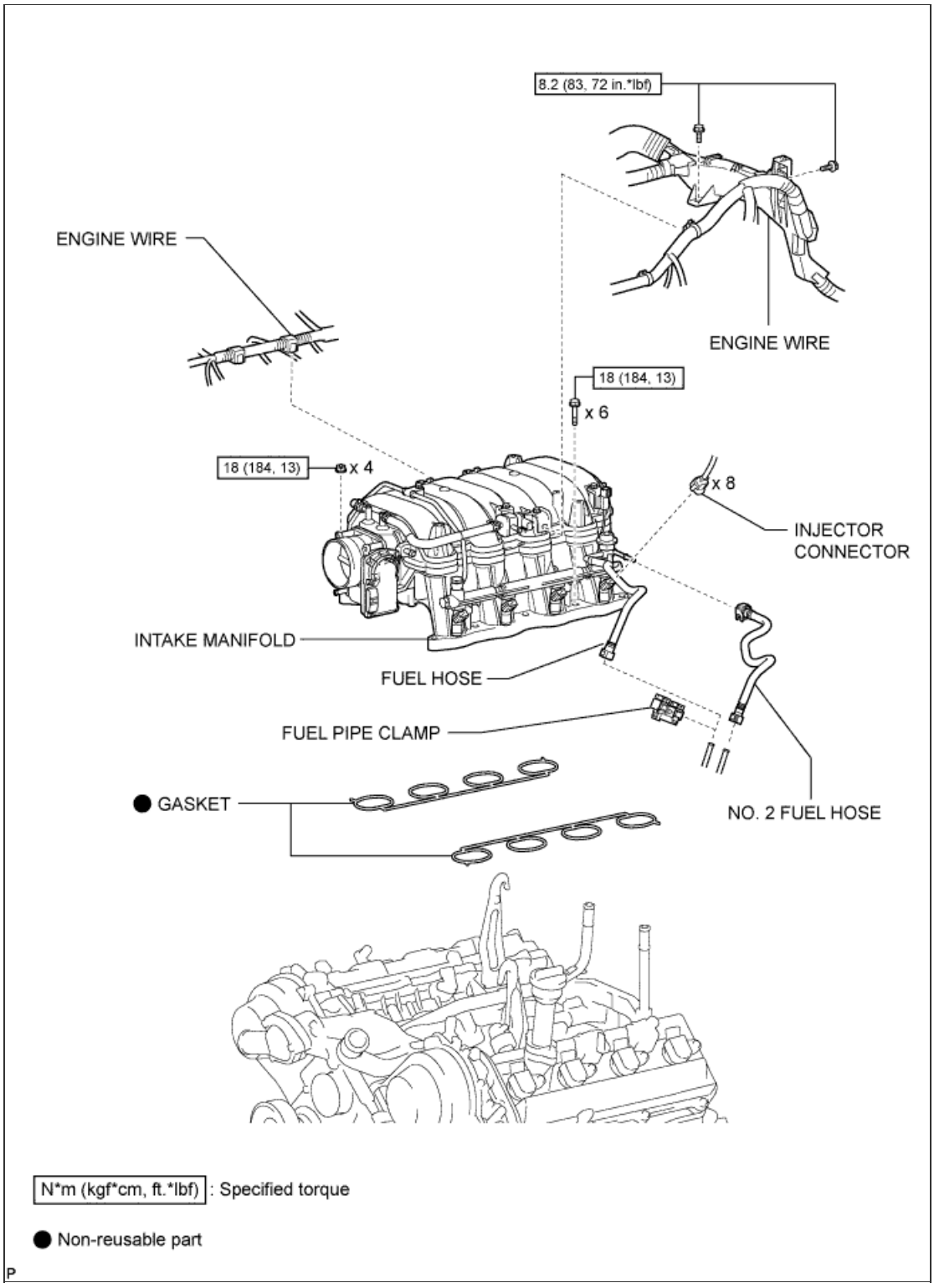
for Preparation Click here




7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER SUB-ASSEMBLY
NO. 2 VENTILATION HOSE
VACUUM TRANSMITTING HOSE
5.0 (51, 44 in.*lbf)
AIR CLEANER HOSE ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
P


NO. 1 RADIATOR HOSE
NO. 3 TIMING BELT COVER SUB-ASSEMBLY LH
7.5 (76, 66 in.*lbf)
7.5 (76, 66 in.*lbf)
x 4
CAMSHAFT POSITION SENSOR CONNECTOR
GROMMET
CAMSHAFT POSITION SENSOR ASSEMBLY
7.5 (76, 66 in.*lbf)
7.5 (76, 66 in.*lbf)
OIL COOLER PIPE
FAN AND GENERATOR V BELT
N*m (kgf*cm, ft.*lbf) : Specified torque
P

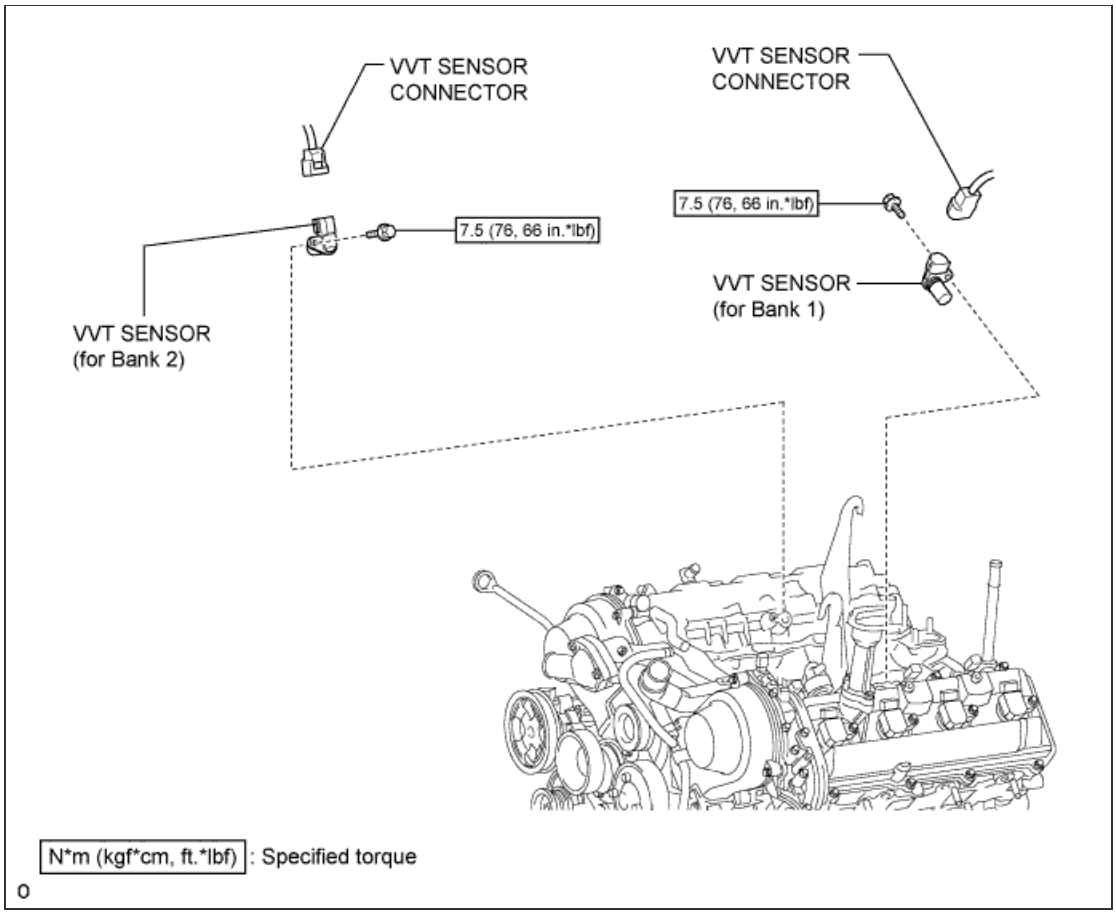

w/ Secondary Air Injection System:
VACUUM CONTROL VALVE CONNECTOR
VACUUM SWITCHING VALVE HOSE
7.5 (76, 66 in.*lbf)
x 2
VACUUM HOSE
VACUUM CONTROL VALVE SET
NO. 2 V-BANK COVER BRACKET
7.5 (76, 66 in.*lbf)
x 2
NO. 2 WATER BY-PASS PIPE
10 (102, 7)
x 2
WATER HOSE
VACUUM SWITCHING VALVE CONNECTOR (for ACIS)
NO. 1 WATER BY-PASS HOSE
PURGE VSV CONNECTOR
THROTTLE BODY CONNECTOR
PURGE LINE HOSE
NO. 7 WATER BY-PASS HOSE
NO. 1 VENTILATION HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
P



N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P


VVT SENSOR
CONNECTOR
VVT SENSOR
CONNECTOR
7.5 (76, 66 in.*lbf)
7.5 (76, 66 in.*lbf)
VVT SENSOR
(for Bank 1)
VVT SENSOR
(for Bank 2)
N*m (kgf*cm, ft.*lbf) : Specified torque

o

for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

a. Discharge the fuel system pressure (Click here).

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least seco after disc ecti g the cable from the egative (-) battery termi al to disable SRS system.

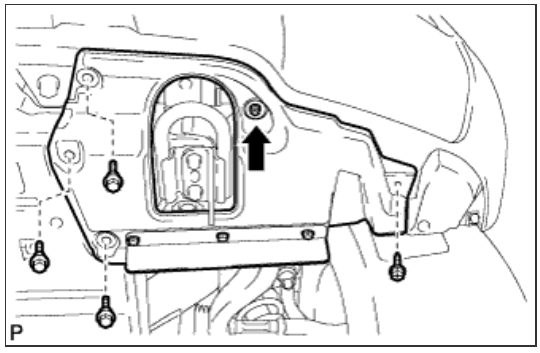
NOTICE:

Whe disc ecti g the cable, some systems eed to be i tialized after the cable is reco ected (Click here).

3. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 b lts a screw.

b. ur the clip i ated by the arrow i the illustratio to remove the fe er splash shield.



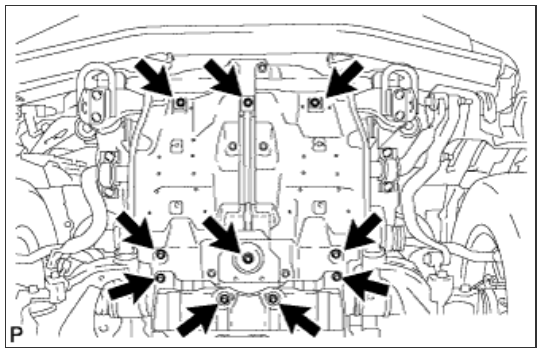
4. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

5. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

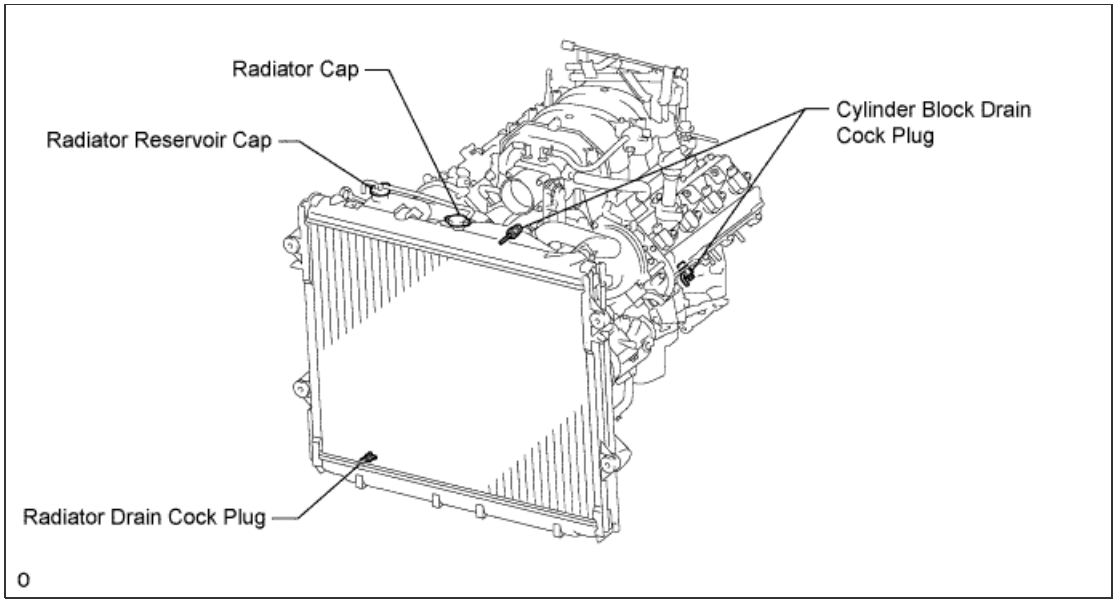
a. Rem e the 1 b lts a N . 1 e gi e u er cover.



6. DRAIN ENGINE COOLANT

CAUTION:

D t remove the radiat r cap while the e gi e a radiat r are still hot. Pressurized, hot e gi e coola t a steam may be released a cause serious bur s



a. L es the radiat r drai cock plug.

b. Remove the radiat r cap. he drai the coola t.

HINT:

C llect the coola t i a co tai er a disp e of it accordi g to the regulatio s your area.

c. L es the 2 cyli er bl k drai cock plugs. he drai the coola t from the e gi e.

d. ghte the 2 cyli er bl k drai cock plugs.

Torque:
13 N*m{ 130 kgf*cm , 9 ft.*lbf }

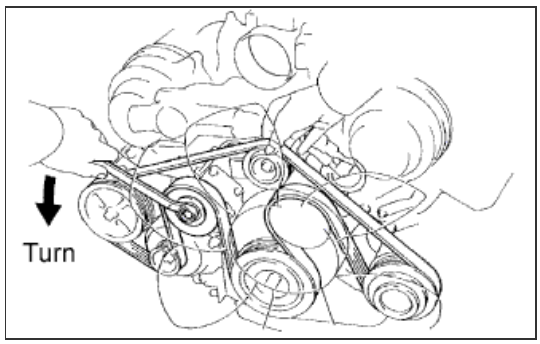
e. ghte the radiat r drai cock plug by ha .

7. REMOVE FAN & GENERATOR V BELT

a. L es the belt te si by tur ig the belt te si er cou tercl kwise, a the rem e the fa a ge erat r V belt.

HINT:

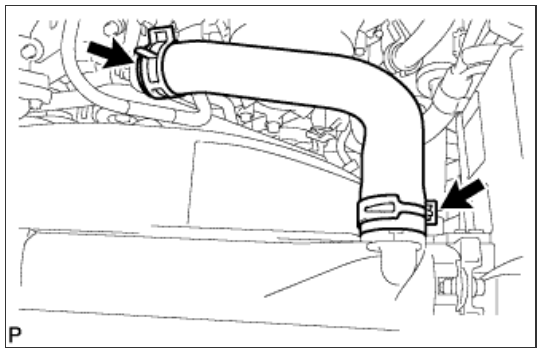
he pulley b lt for the belt te si er has left-ha thread.



8. REMOVE NO. 1 RADIATOR HOSE

a. Usi g eedle- espliers, grip the claws of the clamps a slide the clamps to

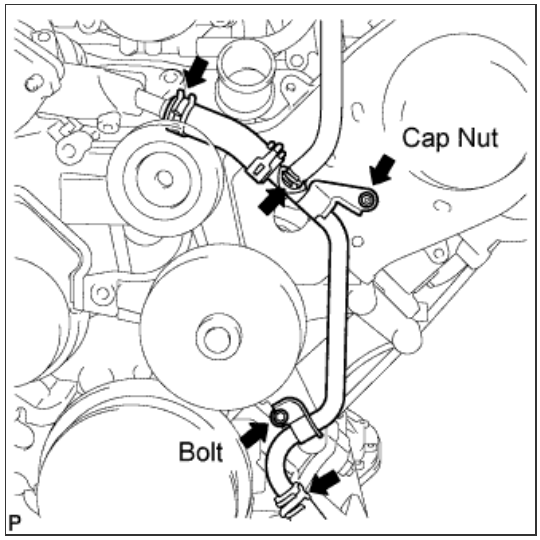
rem e the radiat r hose.



9. REMOVE OIL COOLER PIPE

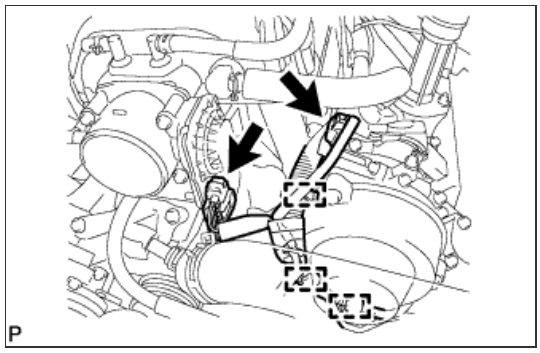
a. Remove the cap ut a b lt.

b. Usi g eedle- espliers, grip the claws of the clamps a slide the clamps to disc ect the 3 water by-pass hoses a remove the oil cooler pipe.



10. REMOVE NO. 3 TIMING BELT COVER SUB-ASSEMBLY LH

a. Detach the 3 wire clamps a disc ect the camshaft timi g oil co tr l valve c ect r a co tr l motor co ect r.



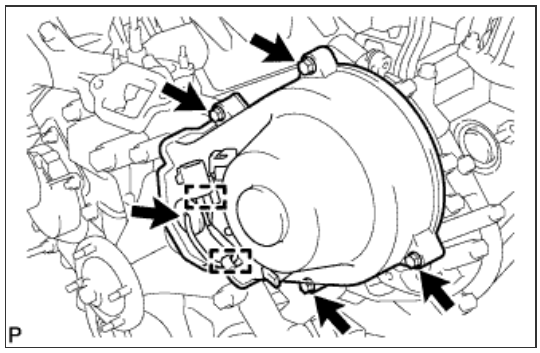
b. Disc ect the camshaft positio se sr co ect r.

c. Disc ect the camshaft positio se sr wire from the 2 wire clamps o the timi g belt cover.

d. Rem e the wire grommet from the timi g belt cover.

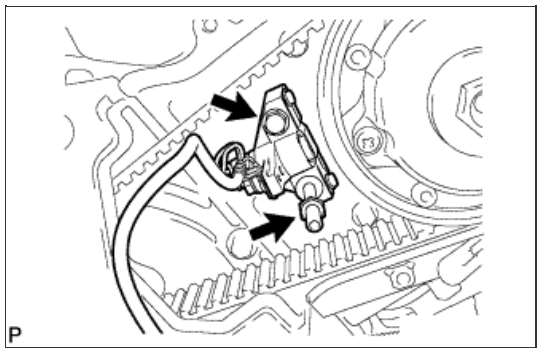
e. Rem e the 4 b lts.

f. Pull the cover outward, pull the camshaft positio se sr wire out of the cover, a remove the cover.



11. REMOVE CAMSHAFT POSITION SENSOR ASSEMBLY

a. Rem e the b lt, stud b lt a camshaft positio se sr.



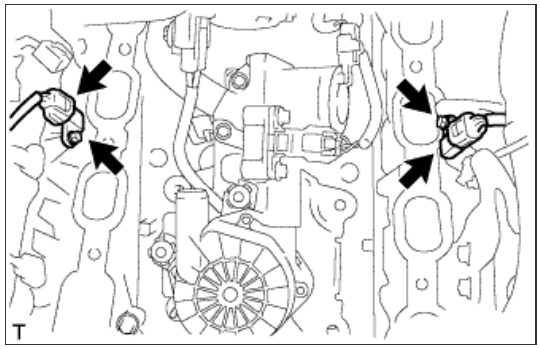
12. REMOVE INTAKE MANIFOLD

a. Rem e the i take ma fi ld (Click here).

13. REMOVE VVT SENSOR

a. Disco ect the 2 se sr co ect rs.

b. Rem e the 2 b lts a 2 se srs.



for Preparation Click here

1. INSPECT VVT SENSOR

a. Measure the resistance according to the value(s) in the table below.

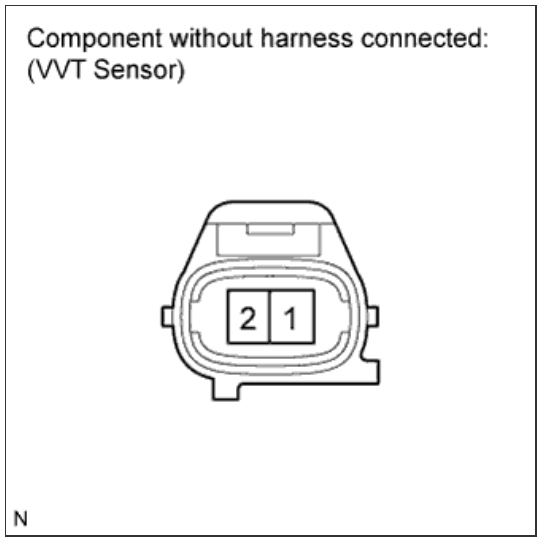
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	Cold	835 to 1400 Ω
1 - 2	Hot	1060 to 1645 Ω

NOTICE:

In the table above, the terms "cold" and "hot" refer to the temperature of the sensor. "Cold" means approximately -10 to 50°C (14 to 122°F). "Hot" means approximately 50 to 100°C (122 to 212°F).

If the result is not as specified, replace the sensor.



for Preparation Click here

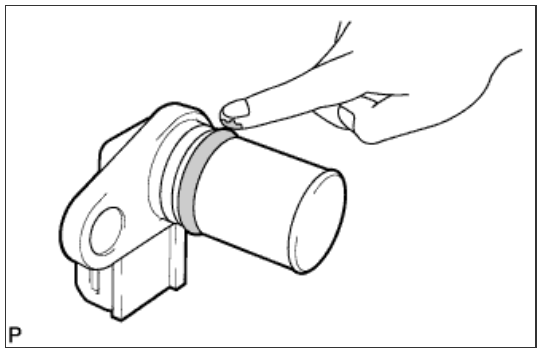
1. INSTALL VVT SENSOR

a. Apply a light coat of engine oil to the O-ring.

NOTICE:

When reusing the sensor, inspect the O-ring.

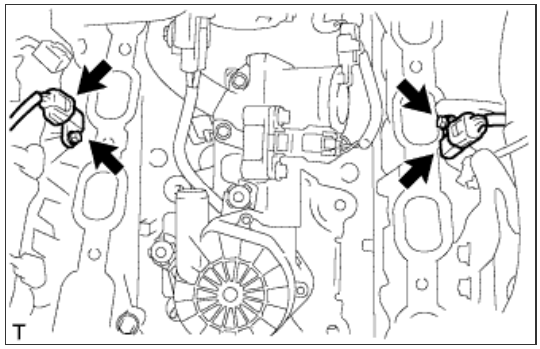
If the O-ring has scratches or cuts, replace the sensor.



b. Install the 2 sensors with the 2 bolts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

c. Connect the 2 sensor connectors.



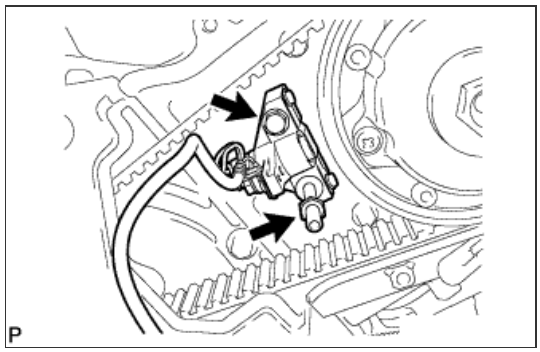
2. INSTALL INTAKE MANIFOLD

a. Install the intake manifold (Click here).

3. INSTALL CAMSHAFT POSITION SENSOR ASSEMBLY

a. Install the camshaft position sensor with the bolt and stud bolt.

Torque:
7.5 N*m{ 80 kgf*cm , 66 in.*lbf }



4. INSTALL NO. 3 TIMING BELT COVER SUB-ASSEMBLY LH

a. Pass the camshaft position sensor wire through the cover hole.

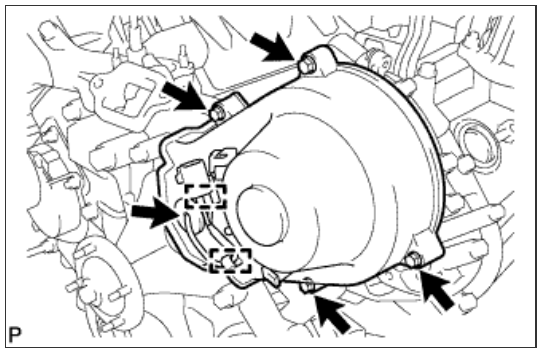
b. Install the timing belt cover with the 4 bolts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

c. Install the wire grommet to the timing belt cover.

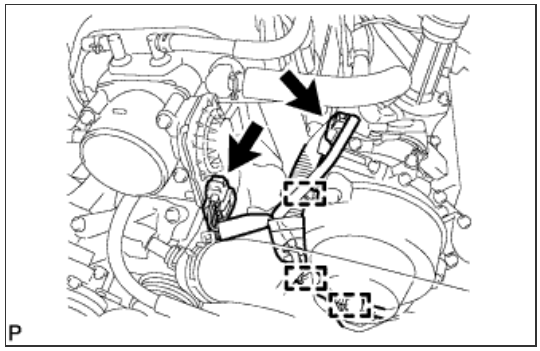
d. Connect the sensor connector.

e. Install the sensor wire to the 2 wire clamps on the cover.



f. Connect the engine wire to the 3 wire clamps.

g. Connect the camshaft timing oil control valve connector and control motor connector.

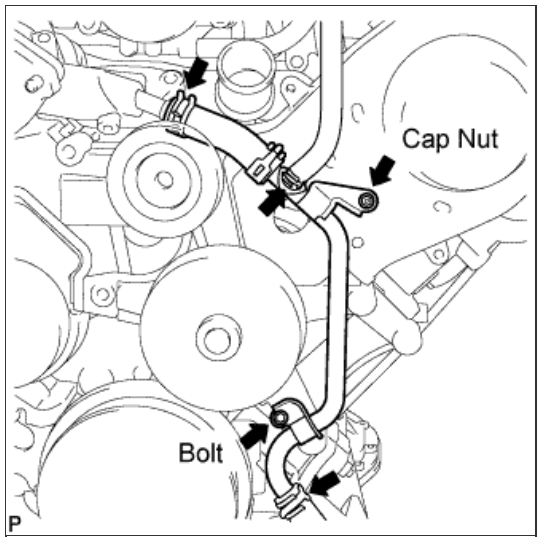


5. INSTALL OIL COOLER PIPE

a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to connect the 3 water by-pass hoses.

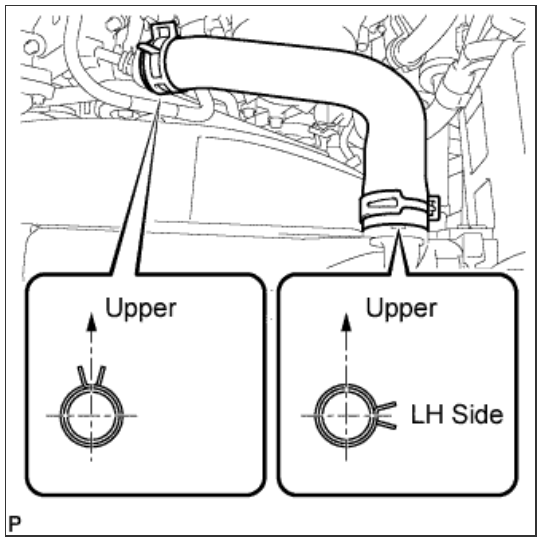
b. Install the oil cooler pipe with the cap nut and bolt.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



6. INSTALL NO. 1 RADIATOR HOSE

a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to install the radiator hose.

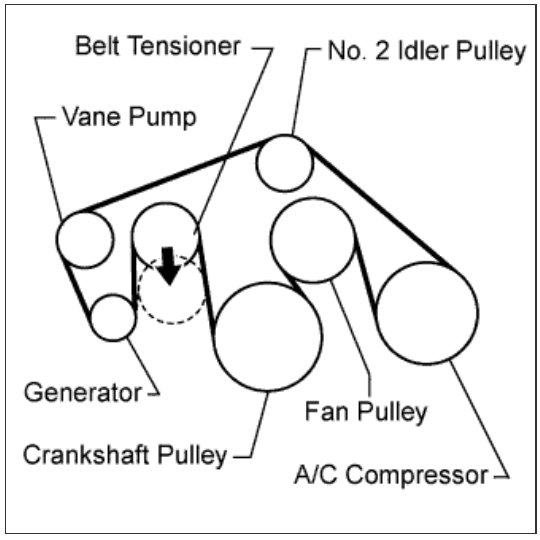


7. INSTALL FAN & GENERATOR V BELT

a. Set the V belt onto every part except the belt tensioner, as shown in the illustration.

b. Loosen the V belt by turning the belt tensioner counterclockwise.

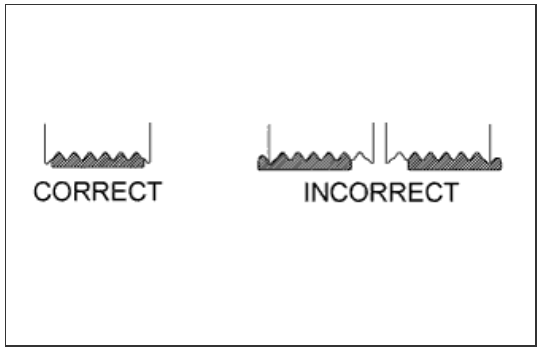
c. Set the V belt to the belt tensioner.



d. Check that the belt fits properly in the ribbed grooves.

HINT:

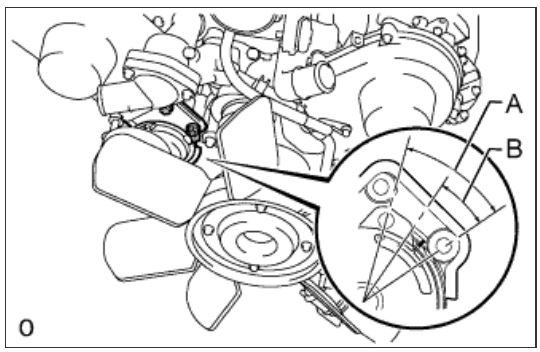
Make sure to check by hand that the belt has not slipped out of the grooves on the bottom of the pulley.



e. Check that the arrow on the belt tensioner is within area "A".
If the arrow is outside area "A", replace the fan and generator V belt.

HINT:

When a new belt is installed, the arrow should be within area "B". If not, the fan and generator V belt is not installed correctly.



8. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

9. ADD ENGINE COOLANT

a. Add engine coolant.

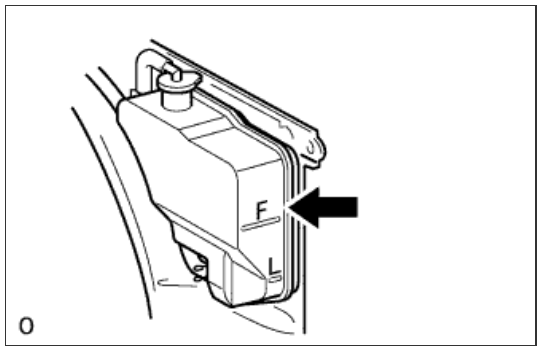
Standard Capacity:

Item		Specified Condition
w/o Transmission oil cooler	w/o Rear Heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)
	w/ Rear Heater	16.3 liters (17.2 US qts, 14.3 Imp. qts)
w/ Transmission oil cooler	w/o Rear Heater	14.1 liters (14.9 US qts, 12.4 Imp. qts)
	w/ Rear Heater	16.9 liters (17.9 US qts, 14.9 Imp. qts)

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.



c. Install the radiator reservoir cap.

d. Press the inlet and outlet radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.

NOTICE:

Switch off the A/C.

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

h. Press the inlet and outlet radiator hoses several times by hand to bleed air.

CAUTION:

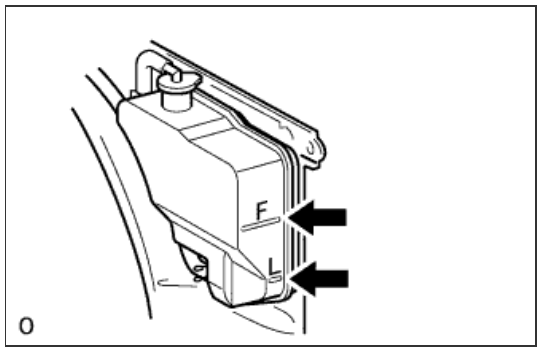
- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the cooling fan.**

i. Stop the engine, and wait until the engine coolant cools down to the ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

j. Check that the coolant level is between the F and L lines. If the coolant level is below the L line, repeat all of the procedures above. If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.



10. INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and intelligent tester ON.

NOTICE:

Do not start the engine.

c. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the Fuel Pump Speed Control.

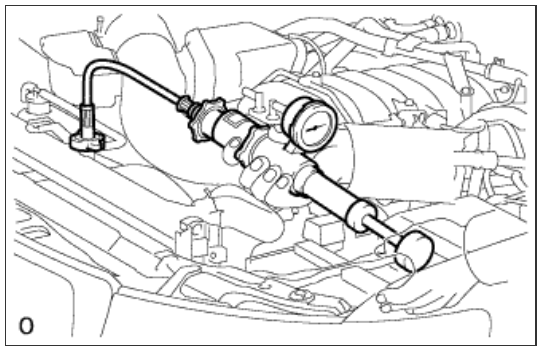
d. Check that there are no fuel leaks after doing maintenance anywhere on the fuel system.

11. INSPECT FOR COOLANT LEAK

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

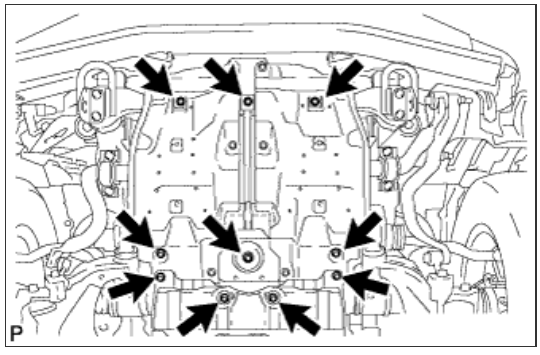
c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



12. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the No. 1 engine under cover with the 10 bolts.

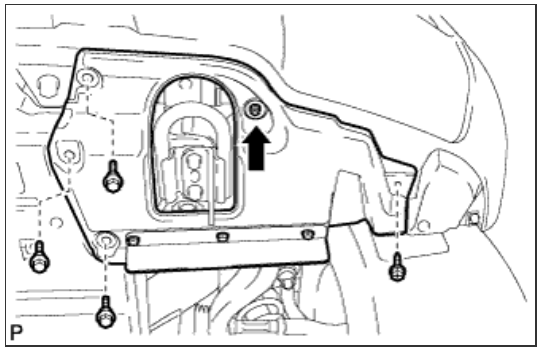
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



13. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.

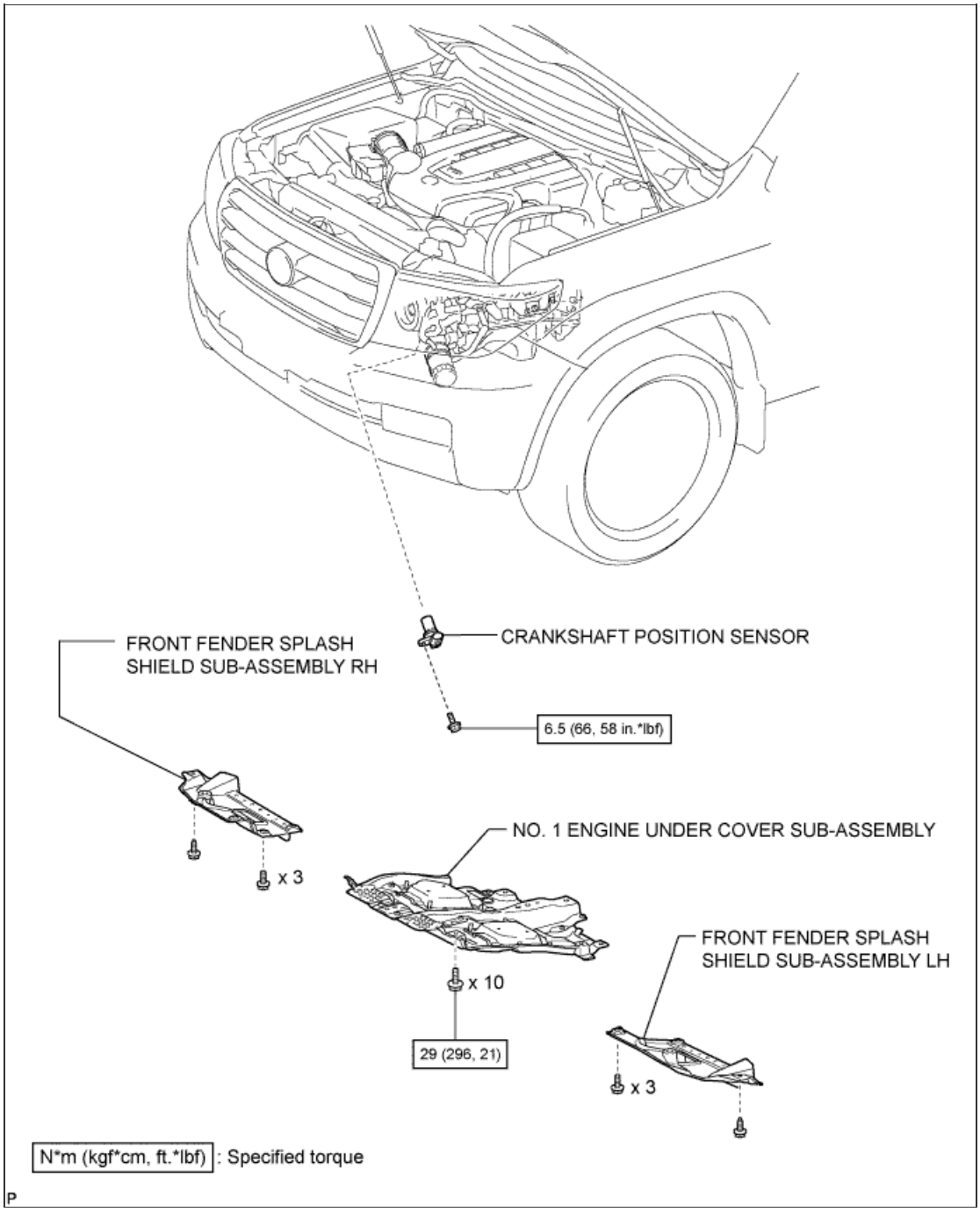


14. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

for Preparation Click here

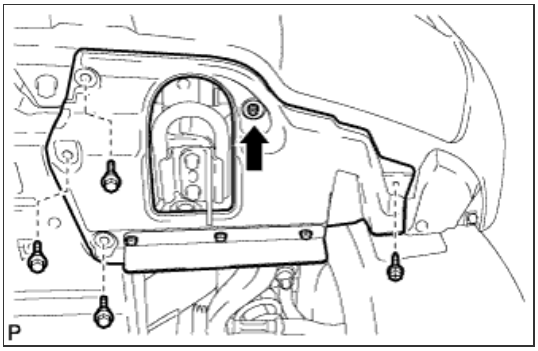


for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



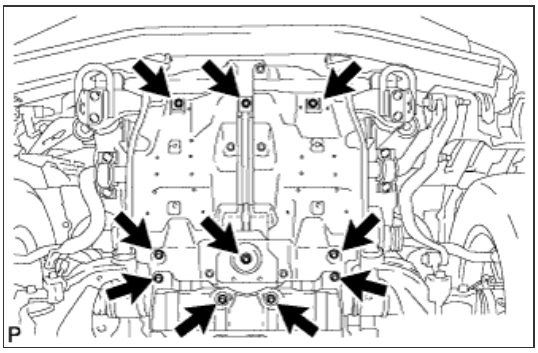
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

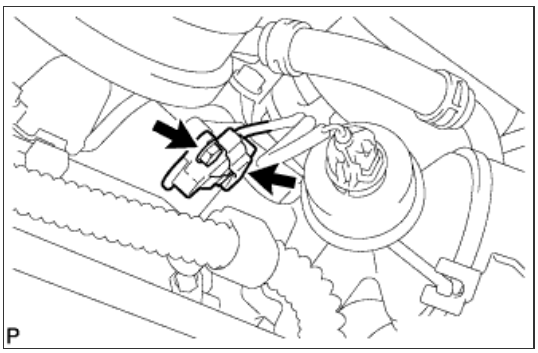
a. Remove the 10 bolts and No. 1 engine under cover.



4. REMOVE CRANKSHAFT POSITION SENSOR

a. Disconnect the sensor connector.

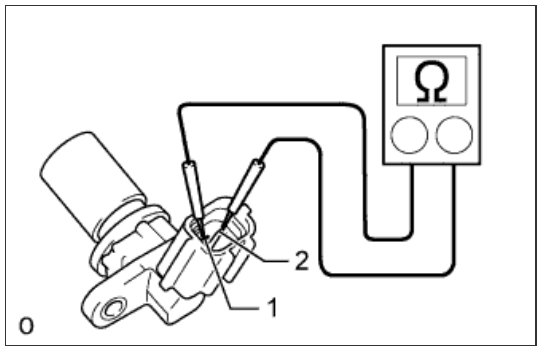
b. Remove the bolt and sensor.



for Preparation Click here

1. INSPECT CRANKSHAFT POSITION SENSOR

a. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	Cold	1 to 2 Ω
1 - 2	Hot	20 to 3225 Ω

NOTICE:

In the table above, the terms "cold" and "hot" refer to the temperature of the sensor. "Cold" means approximately -10 to 50°C (1 to 122°F). "Hot" means approximately 50 to 100°C (122 to 212°F).

If the result is not as specified, replace the cran shaft position sensor.

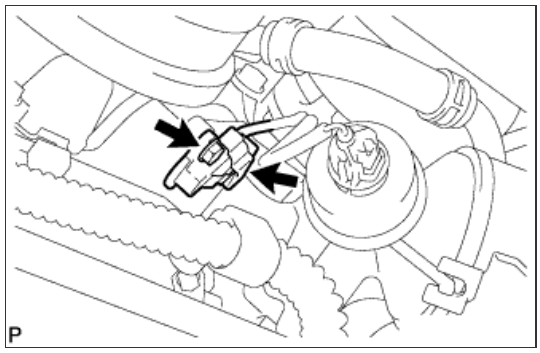
for Preparation Click here

1. INSTALL CRANKSHAFT POSITION SENSOR

a. Install the sensor with the bolt.

Torque:
6.5 N*m{ 66 kgf*cm , 58 in.*lbf }

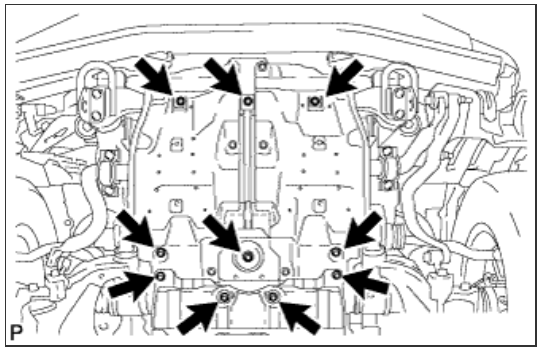
b. Connect the sensor connector.



2. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the No. 1 engine under cover with the 10 bolts.

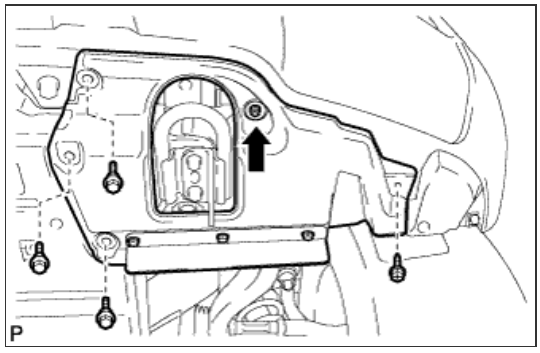
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



3. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.

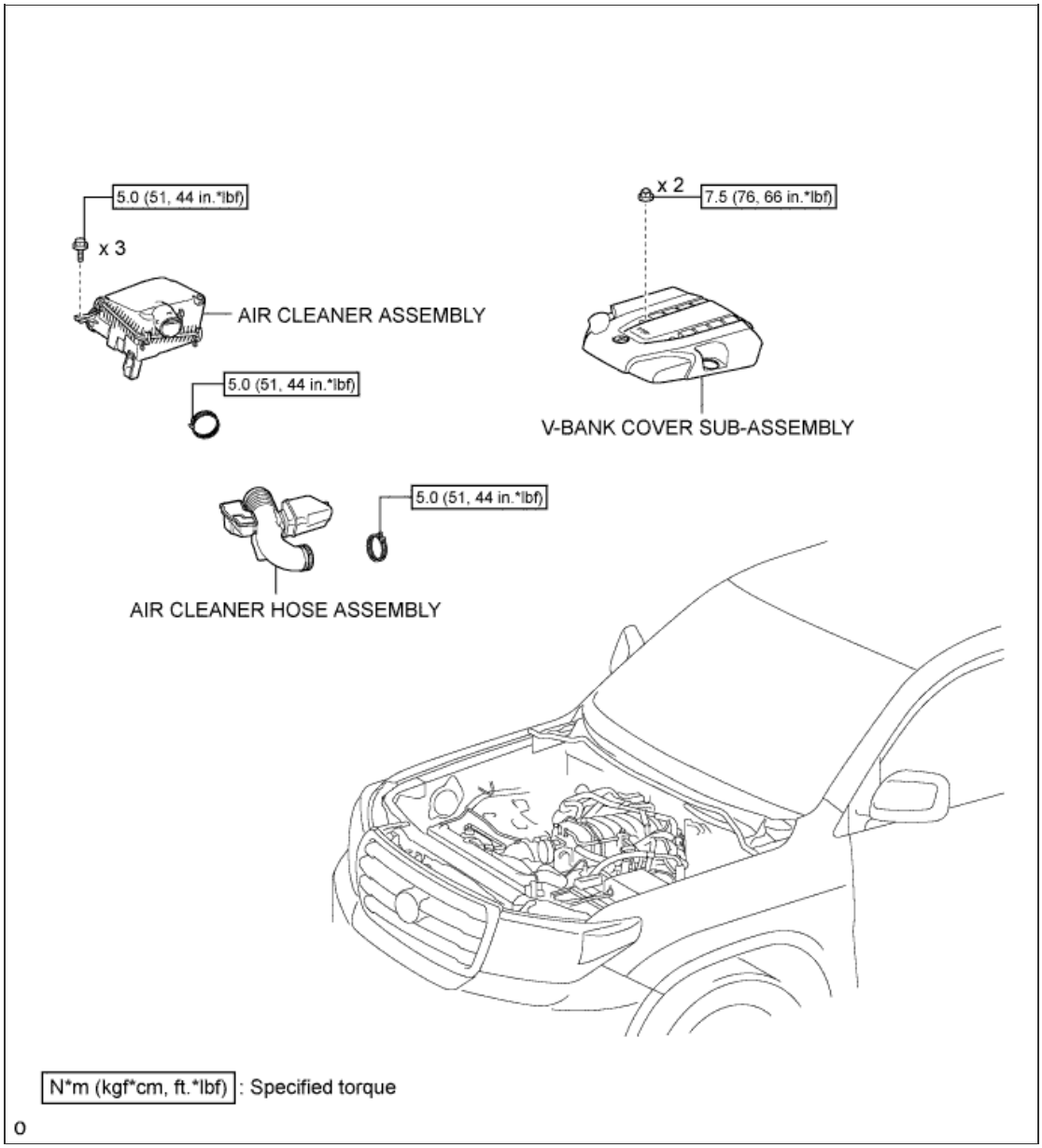


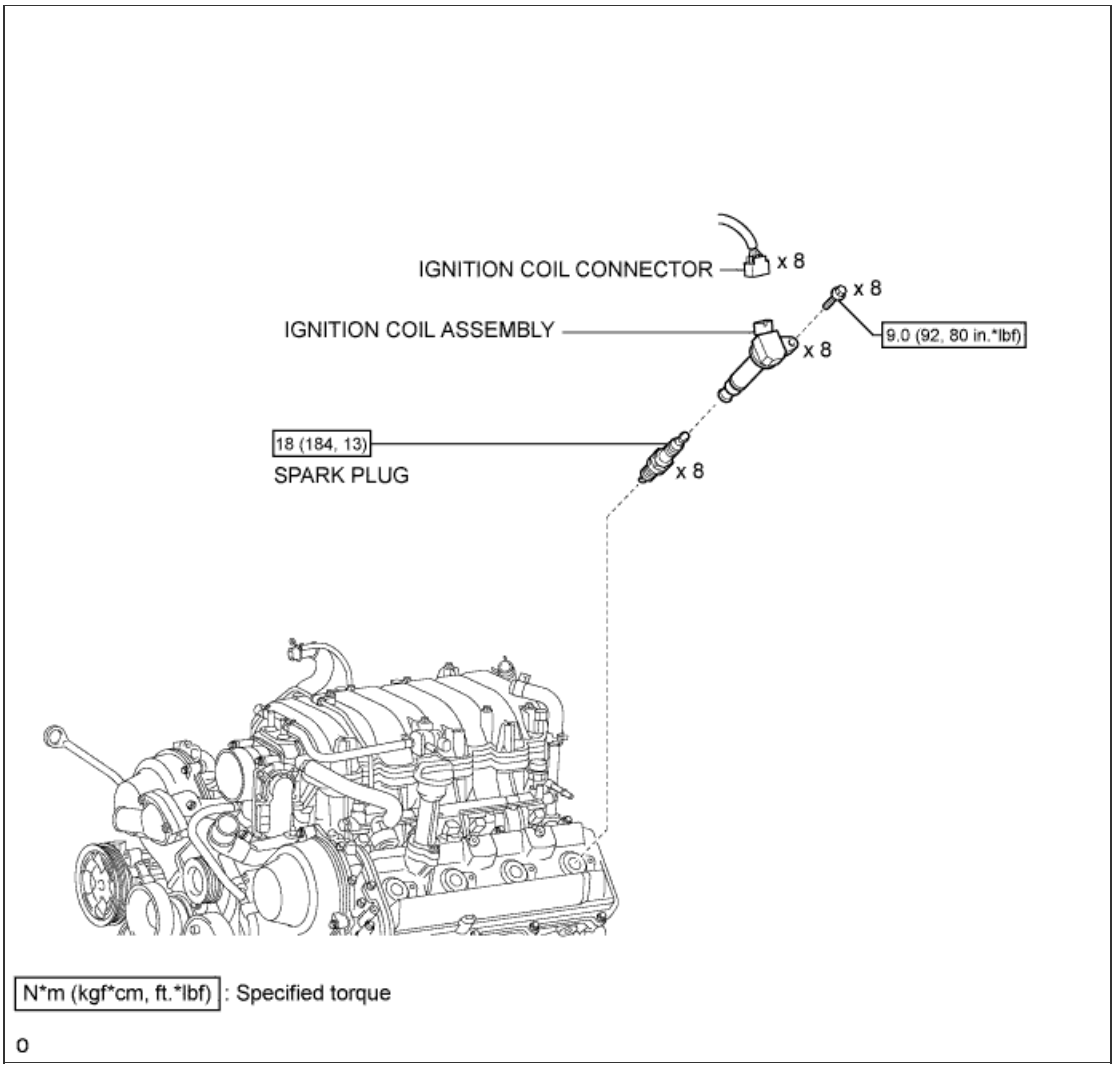
4. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

for Preparation [Click here]





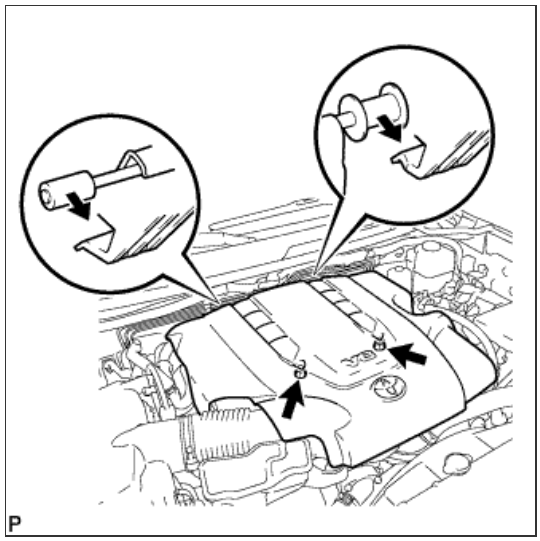
N*m (kgf*cm, ft.*lbf) : Specified torque

o

for Preparation Click here

1. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Remove the 2 nuts and V-bank cover.

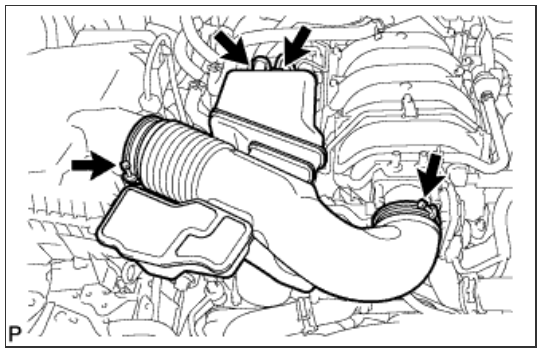


2. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum transmitting hose and No. 2 ventilation hose.

b. Loosen the 2 hose clamps.

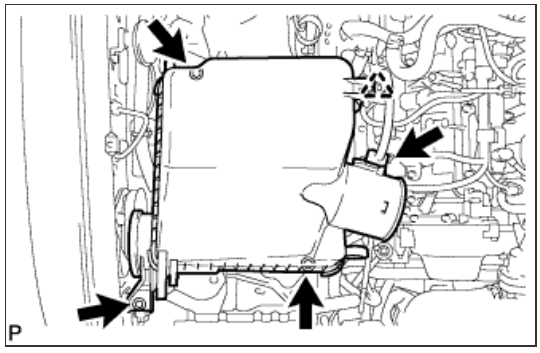
c. Remove the air cleaner hose.



3. REMOVE AIR CLEANER ASSEMBLY

a. Disconnect the clamp and MAF connector.

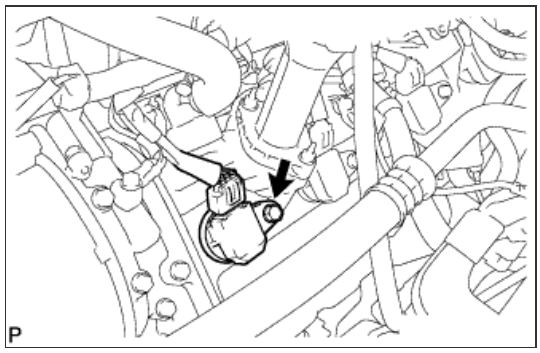
b. Remove the 3 bolts and air cleaner.



4. REMOVE IGNITION COIL ASSEMBLY

a. Disconnect the 8 ignition coil connectors.

b. Remove the 8 bolts and pull out the 8 ignition coils.



5. REMOVE SPARK PLUG

a. Remove the 8 spark plugs.

for Preparation Click here

1. INSTALL SPARK PLUG

a. Install the 8 spark plugs.

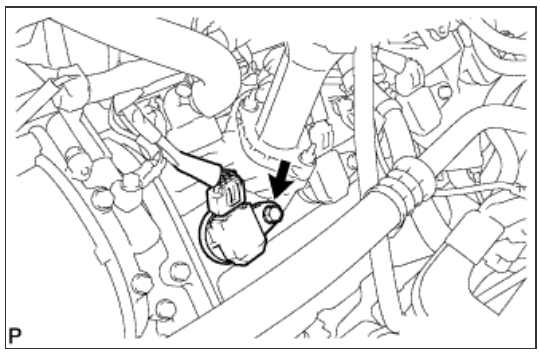
Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

2. INSTALL IGNITION COIL ASSEMBLY

a. Install the 8 ignition coils with the 8 bolts.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }

b. Connect the 8 ignition coil connectors.

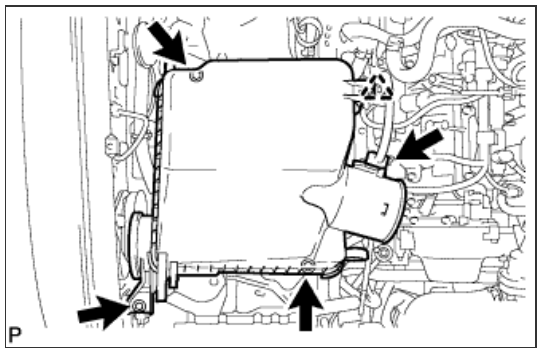


3. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner with the 3 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

b. Connect the clamp and MAF connector.



4. INSTALL AIR CLEANER HOSE ASSEMBLY

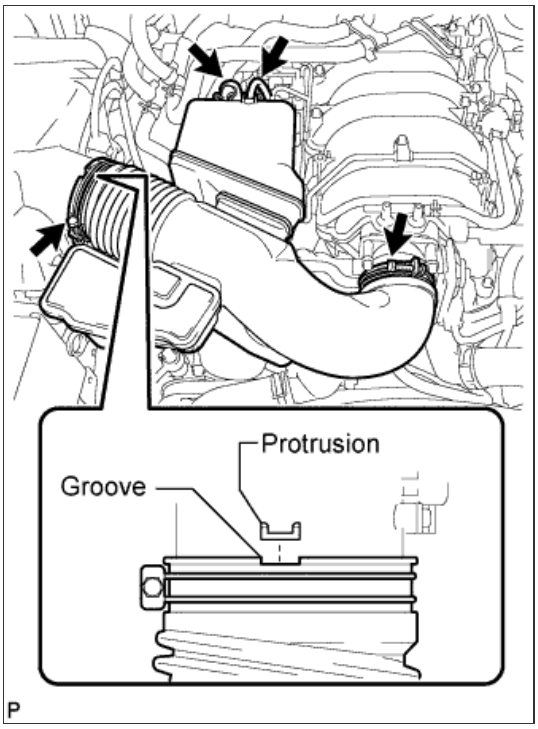
a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum transmitting hose.

d. Connect the No. 2 ventilation hose.

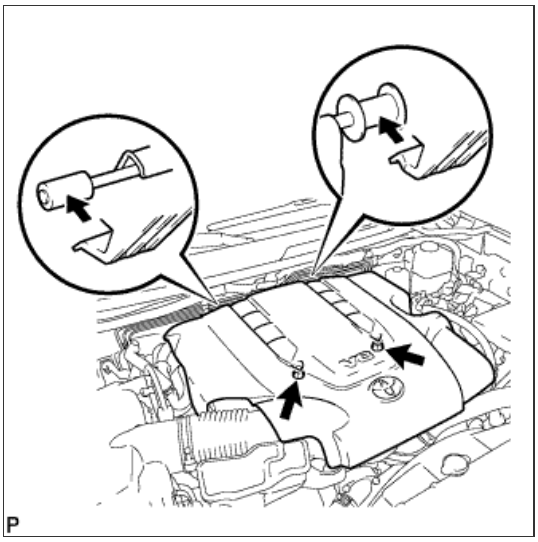


5. INSTALL V-BANK COVER SUB-ASSEMBLY

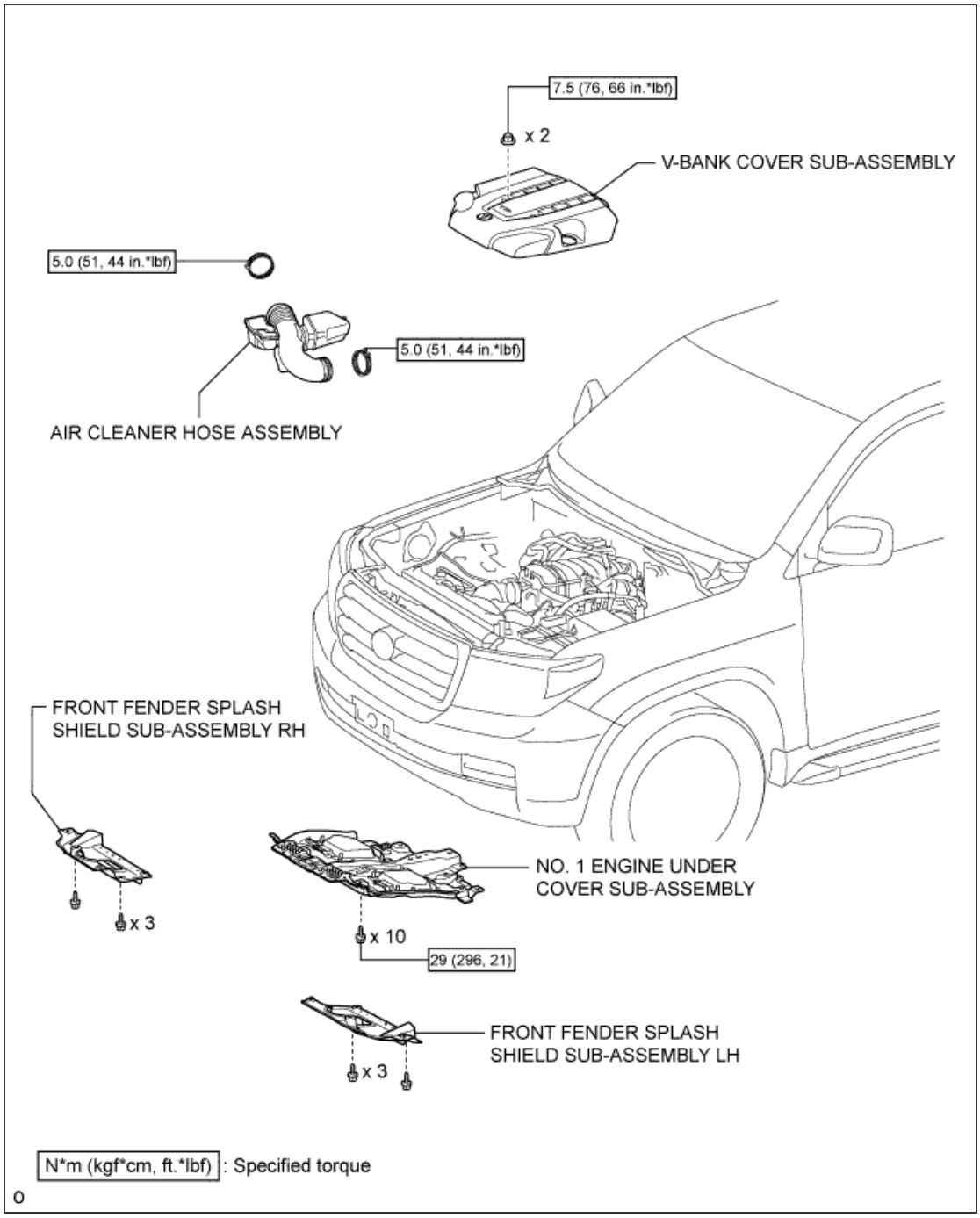
a. Attach the 2 V-bank cover hooks to the bracket.

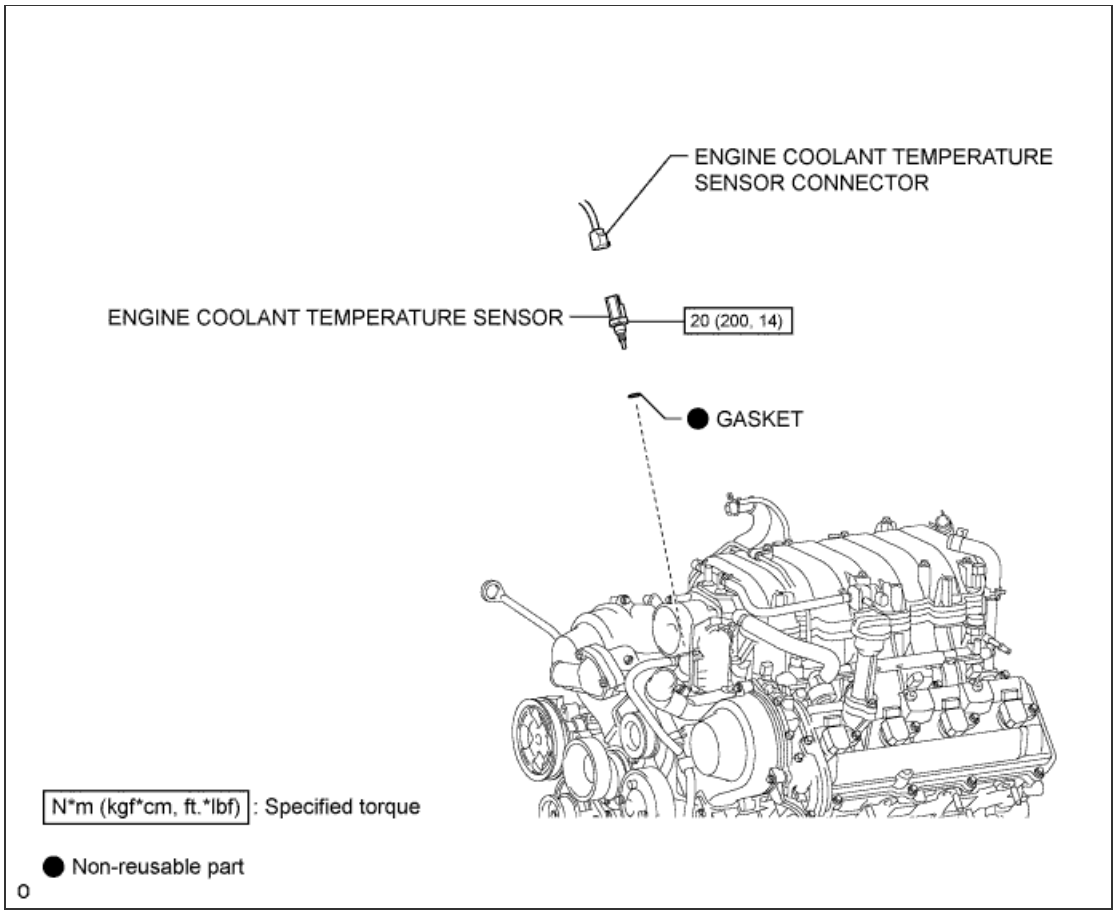
b. Install the V-bank cover with the 2 nuts.

Torque:
7.5 N*m{ kgf*cm , in.*lbf }



for Preparation Click here




ENGINE COOLANT TEMPERATURE SENSOR CONNECTOR
ENGINE COOLANT TEMPERATURE SENSOR
20 (200, 14)
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

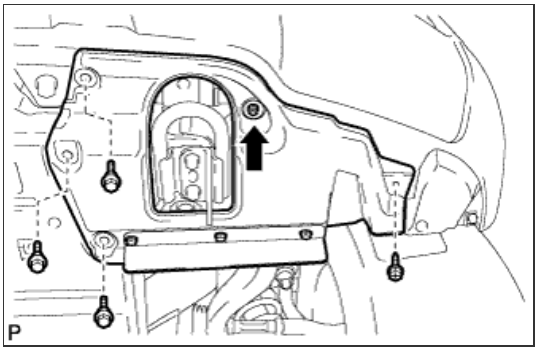
0

for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



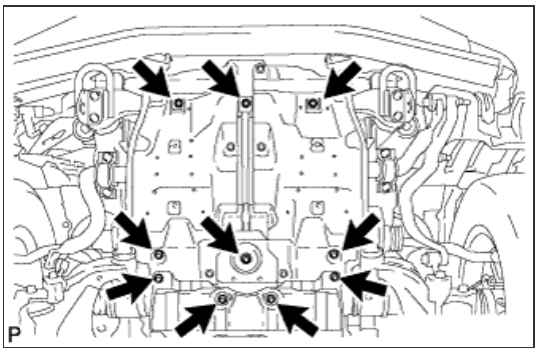
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

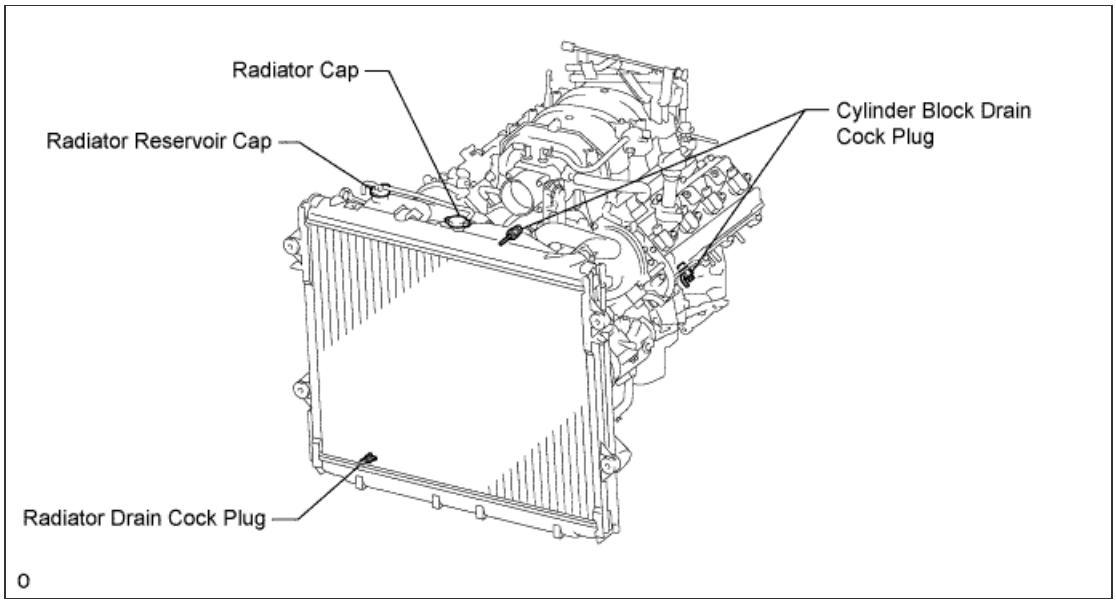
a. Remove the 10 bolts and No. 1 engine under cover.



4. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.



a. Loosen the radiator drain cock plug.

b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

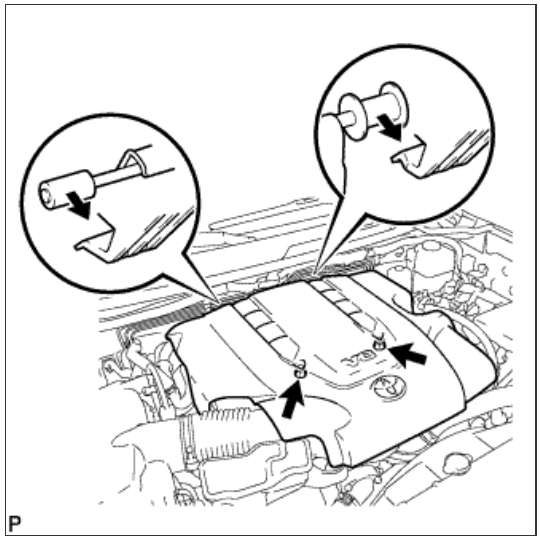
d. Tighten the 2 cylinder block drain cock plugs.

Torque:
13 N*m{ 130 kgf*cm , 9 ft.*lbf }

e. Tighten the radiator drain cock plug by hand.

5. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Remove the 2 nuts and V-bank cover.

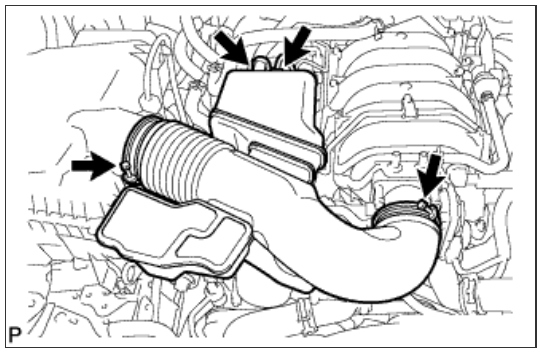


. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum transmitting hose and No. 2 ventilation hose.

b. Loosen the 2 hose clamps.

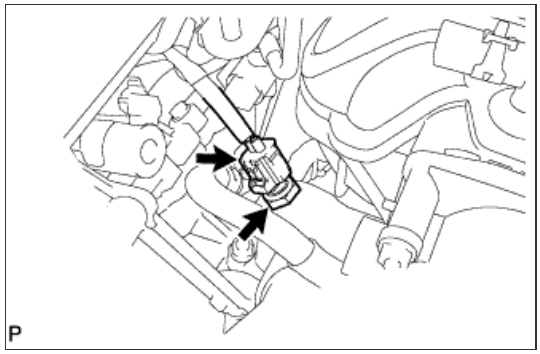
c. Remove the air cleaner hose.



7. REMOVE ENGINE COOLANT TEMPERATURE SENSOR

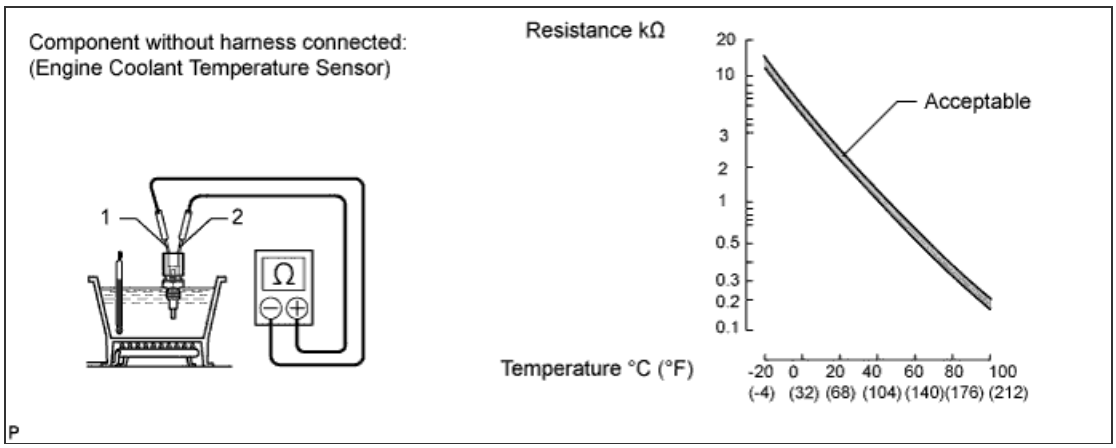
a. Disconnect the sensor connector.

b. Using a 1 mm deep socket wrench, remove the sensor and gasket.



for Preparation Click here

1. INSPECT ENGINE COOLANT TEMPERATURE SENSOR



a. Partially immerse the sensor in water and warm up the water.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	Approximately. 20°C (68°F)	2.32 to 2.59 kΩ
1 - 2	Approximately. 80°C (176°F)	0.310 to 0.326 kΩ

If the result is not as specified, replace the sensor.

NOTICE:

When checking the sensor in water, keep the terminals dry. After the check, wipe the sensor dry.

for Preparation Click here

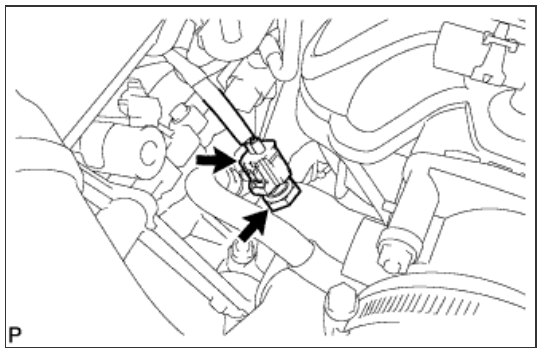
1. INSTALL ENGINE COOLANT TEMPERATURE SENSOR

a. Install a new gasket to the sensor.

b. Using a 19 mm deep socket wrench, install the sensor.

Torque:
20 N*m{ 200 kgf*cm , 14 ft.*lbf }

c. Connect the sensor connector.



2. INSTALL AIR CLEANER HOSE ASSEMBLY

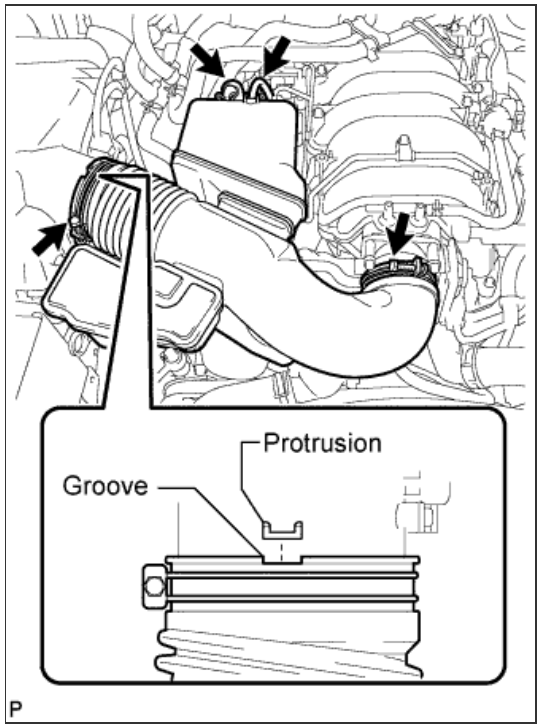
a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum transmitting hose.

d. Connect the No. 2 ventilation hose.



3. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

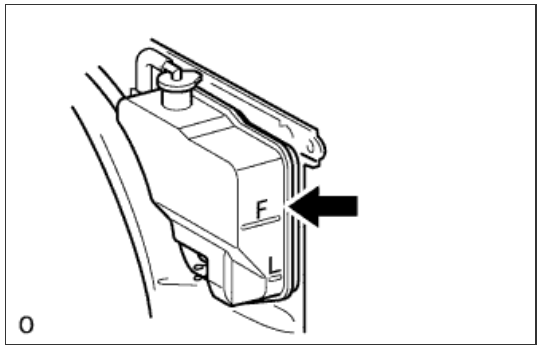
Item		Specified Condition
w/o Transmission oil cooler	w/o Rear Heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)
	w/ Rear Heater	1 .3 liters (17.2 US qts, 14.3 Imp. qts)

w/ Transmission oil cooler	w/o Rear Heater	14.1 liters (14.9 US qts, 12.4 Imp. qts)
	w/ Rear Heater	1 .9 liters (17.9 US qts, 14.9 Imp. qts)

HINT:

TO OTA vehicles are filled with TO OTA SLLC at the factor . In order to avoid damage to the engine cooling s stem and other technical pro lems, onl use TO OTA SLLC or similar high qualit eth lene gl col ased non-silicate, non-amine, non-nitrite, non- orate coolant with long-life h rid organic acid technolog (coolant with long-life h rid organic acid technolog consists of a com ination of low phosphates and organic acids).

b. Slowl pour coolant into the radiator reservoir until it reaches the F line.



c. Install the radiator reservoir cap.

d. ress the inlet and outlet radiator hoses several times hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.

NOTICE:

Switch off the A/C.

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

h. ress the inlet and outlet radiator hoses several times hand to leed air.

CAUTION:

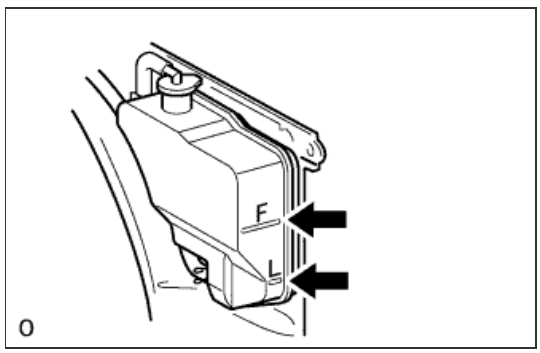
- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the cooling fan.**

i. Stop the engine, and wait until the engine coolant cools down to the am ient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. ressurized, hot engine coolant and steam ma e released and cause serious urns.

j. Check that the coolant level is etween the F and L lines. If the coolant level is elow the L line, repeat all of the procedures a ove. If the coolant level is a ove the F line, drain coolant so that the coolant level is etween the F and L lines.

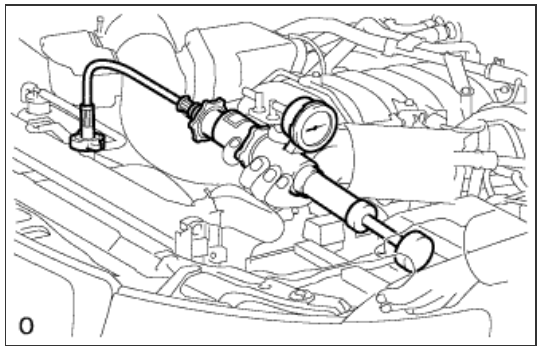


4. INSPECT FOR ENGINE COOLANT LEAK

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 k a (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, c linder lock and head.

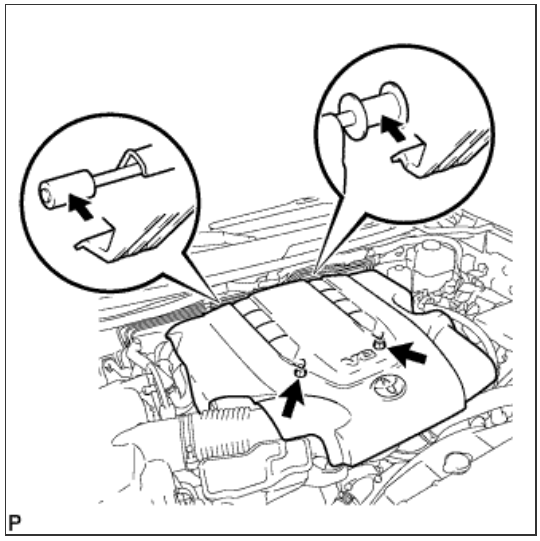


5. INSTALL BAN CO ER SUB ASSEMBLY

a. Attach the 2 V- ank cover hooks to the racket.

b. Install the V- ank cover with the 2 nuts.

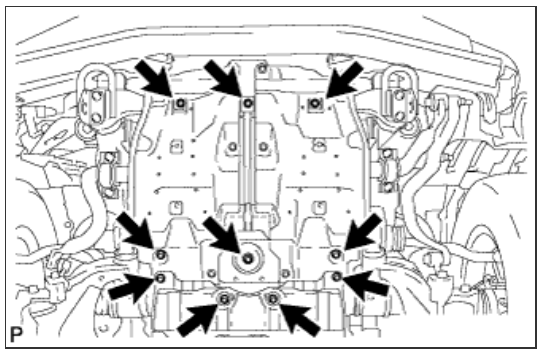
Torque:
5 N*m{ kgf*cm , in.*lbf }



INSTALL NO. 1 ENGINE UNDER CO ER SUB ASSEMBLY

a. Install the No. 1 engine under cover with the 10 olts.

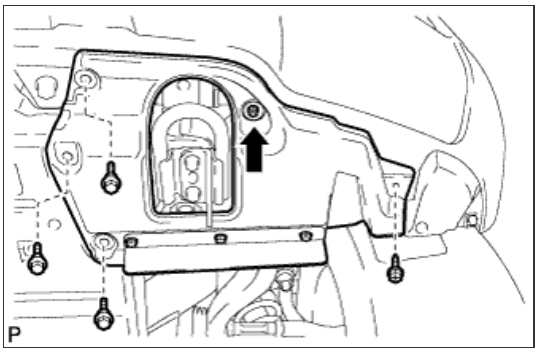
Torque:
2 N*m{ 2 kgf*cm , 21 ft.*lbf }



INSTALL RONT ENDER SPLASH SHIELD SUB ASSEMBLY LH

a. ush in the clip indicated the arrow in the illustration to install the fender splash shield.

b. Install the 3 olts and screw.

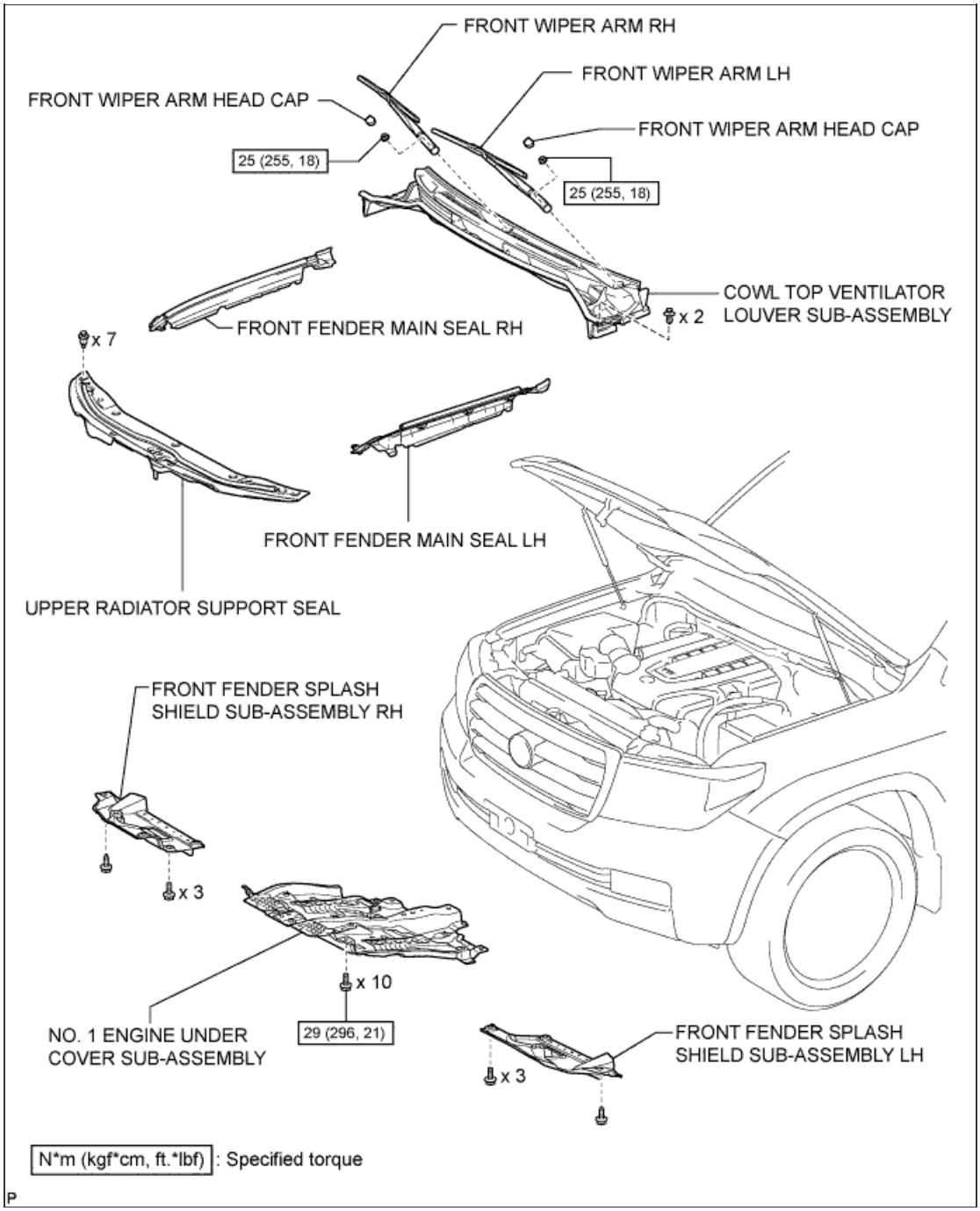


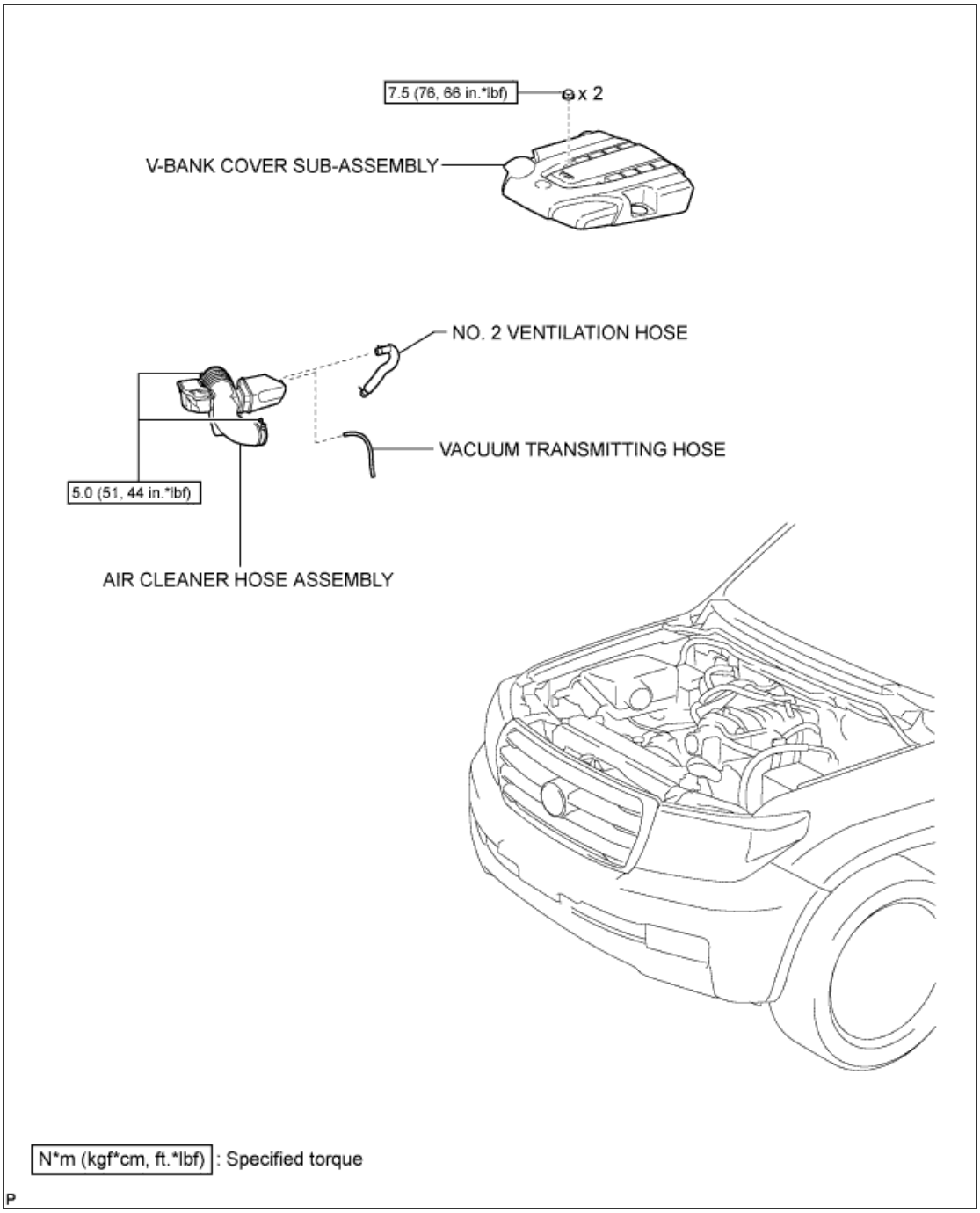
INSTALL RONT ENDER SPLASH SHIELD SUB ASSEMBLY RH

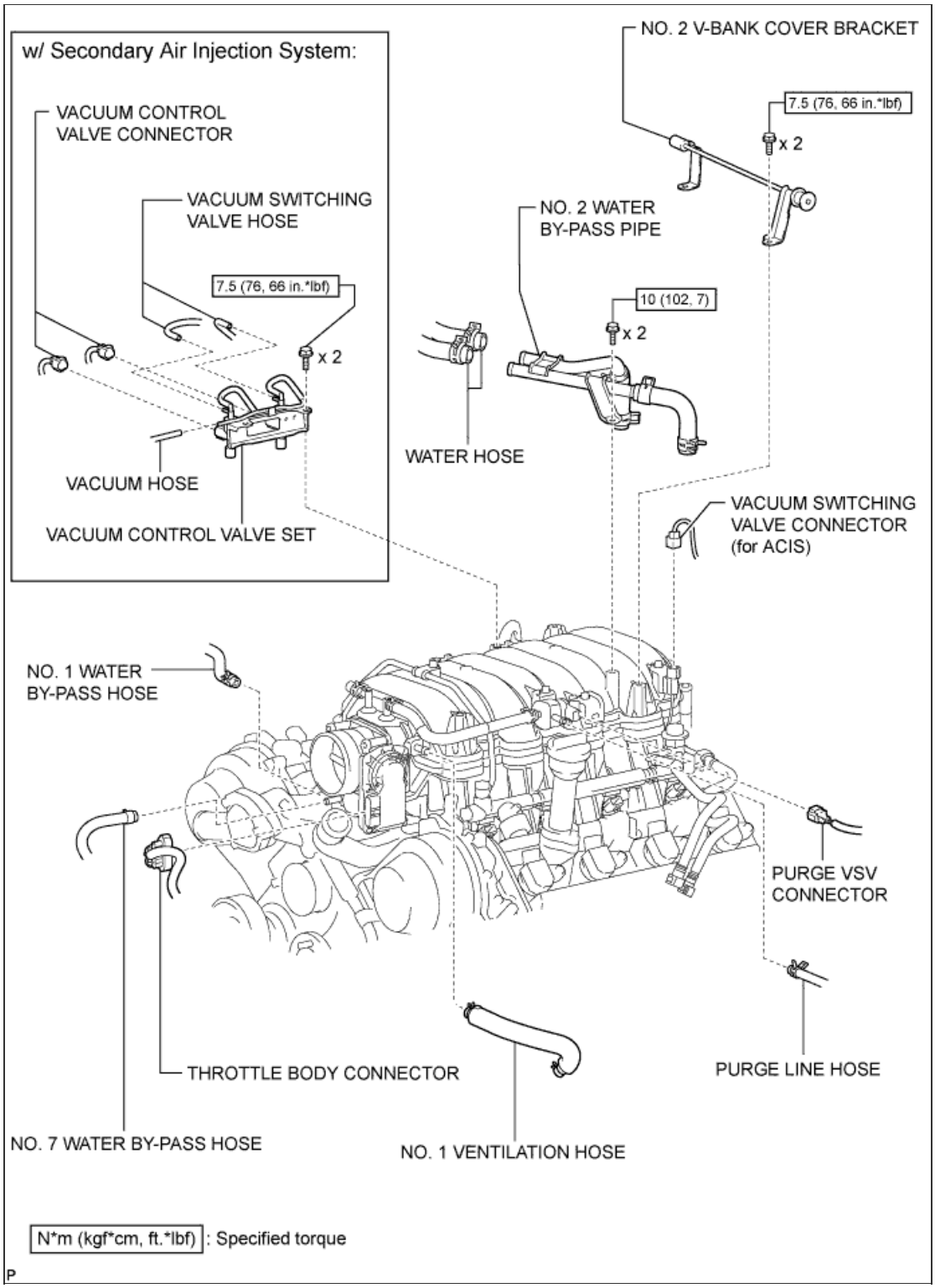
HINT:

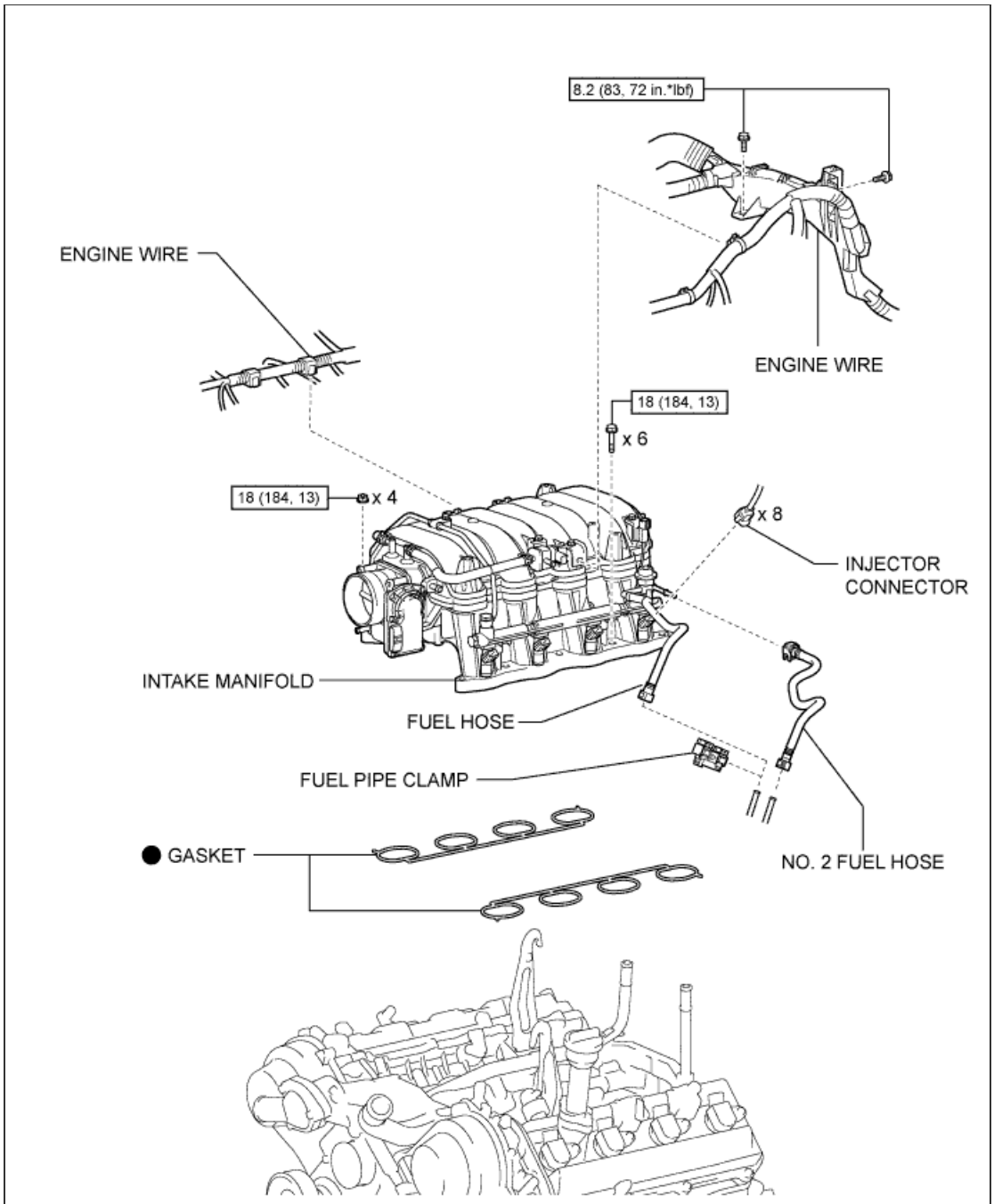
Use the same procedures descri ed for the LH side.

for Preparation Click here




7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER SUB-ASSEMBLY
NO. 2 VENTILATION HOSE
VACUUM TRANSMITTING HOSE
5.0 (51, 44 in.*lbf)
AIR CLEANER HOSE ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
P

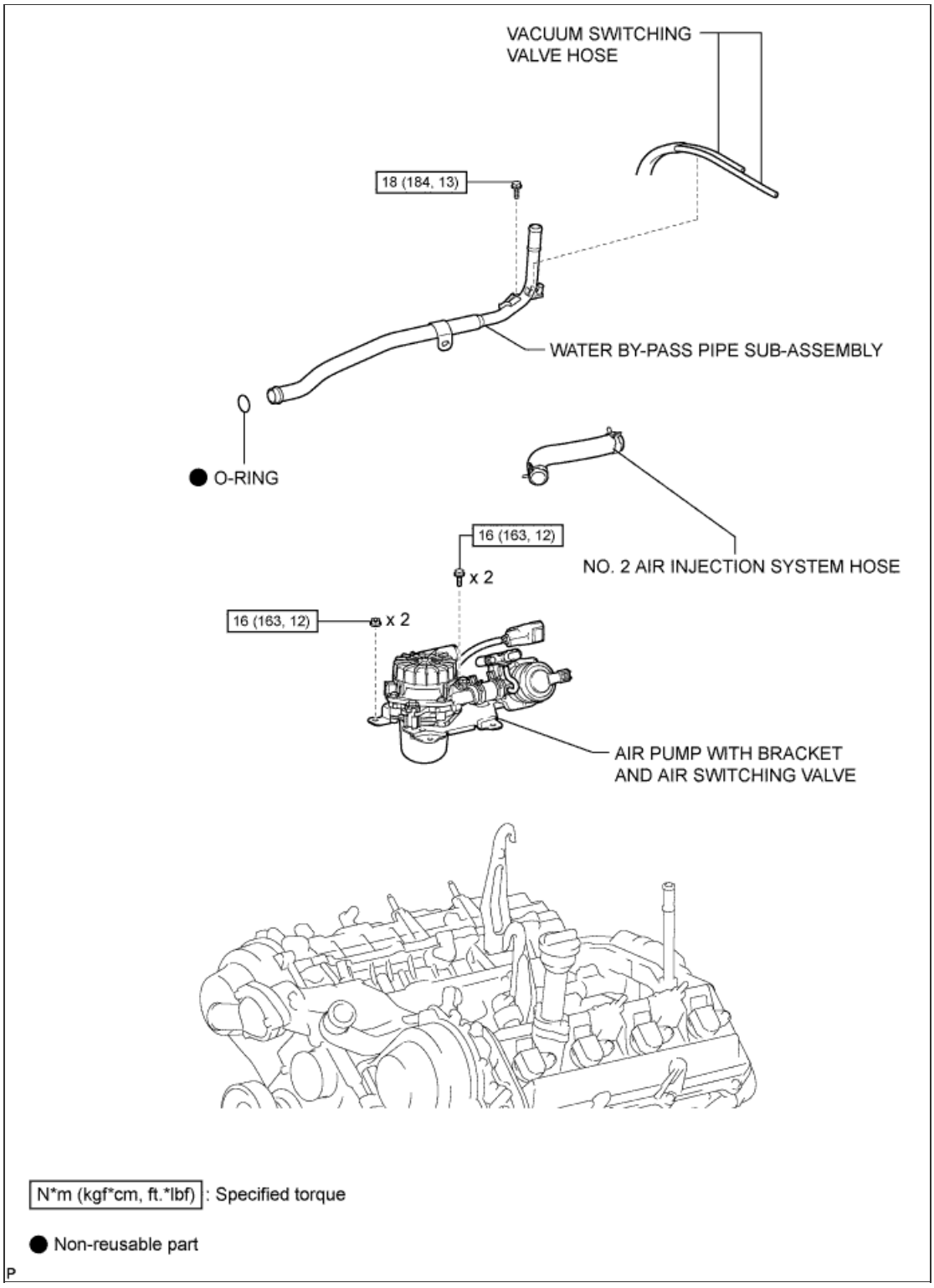

w/ Secondary Air Injection System:
VACUUM CONTROL VALVE CONNECTOR
VACUUM SWITCHING VALVE HOSE
7.5 (76, 66 in.*lbf)
x 2
VACUUM HOSE
VACUUM CONTROL VALVE SET
NO. 2 V-BANK COVER BRACKET
7.5 (76, 66 in.*lbf)
x 2
NO. 2 WATER BY-PASS PIPE
10 (102, 7)
x 2
WATER HOSE
VACUUM SWITCHING VALVE CONNECTOR (for ACIS)
NO. 1 WATER BY-PASS HOSE
PURGE VSV CONNECTOR
PURGE LINE HOSE
THROTTLE BODY CONNECTOR
NO. 7 WATER BY-PASS HOSE
NO. 1 VENTILATION HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
P



N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

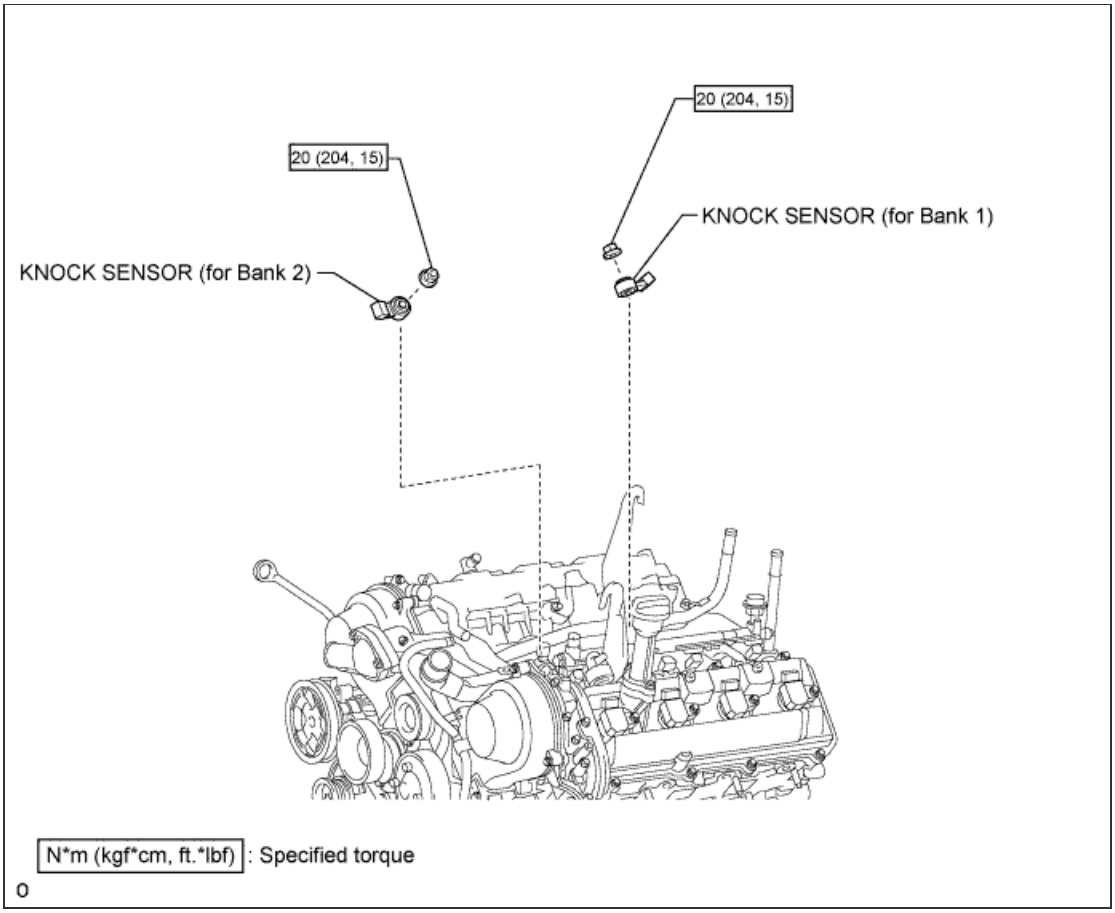
P



N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P


20 (204, 15)
20 (204, 15)
KNOCK SENSOR (for Bank 1)
KNOCK SENSOR (for Bank 2)
N*m (kgf*cm, ft.*lbf) : Specified torque
o

for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

a. Discharge the fuel system pressure (Click here).

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least seconds after disconnecting the cable from the negative (-) battery terminal to disable SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE INTAKE MANIFOLD

a. Remove the intake manifold (Click here).

4. REMOVE WATER BY-PASS PIPE SUB-ASSEMBLY

a. Disconnect the connector.

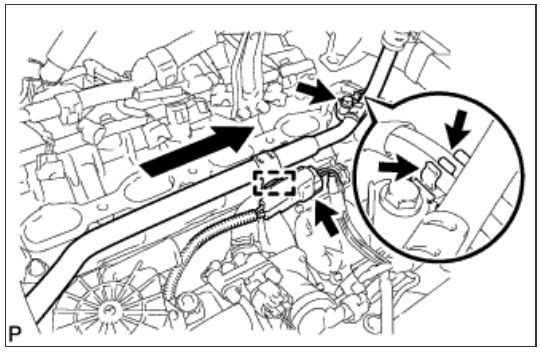
b. Disconnect the ire harness clamp from the ater by-pass pipe.

c. Disconnect the acuum s itching valve hoses from the ater by-pass pipe clamp.

d. Remove the bolt.

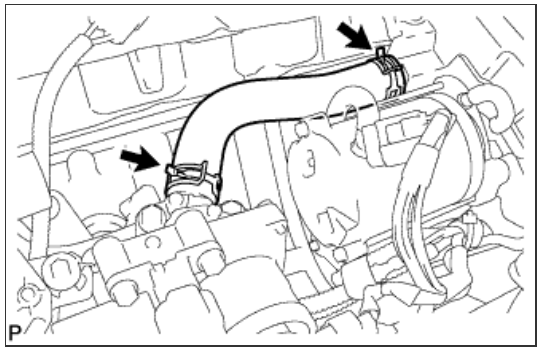
e. Pull out the ater by-pass pipe.

f. Remove the -ring from the ater by-pass pipe.



5. REMOVE NO. 2 AIR INJECTION SYSTEM HOSE

a. Remove the o air in etion system hose from the rear ater by-pass int and air s itching valve.

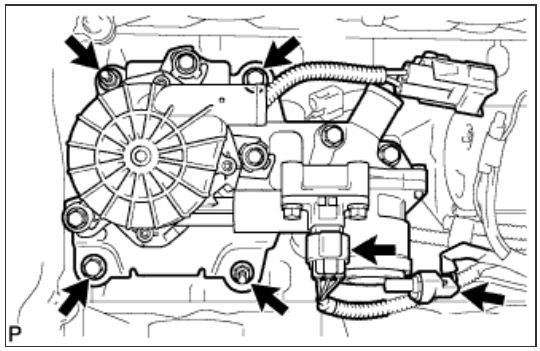


6. REMOVE AIR PUMP WITH BRACKET AND AIR SWITCHING VALVE

a. Disconnect the air s itching valve connector.

b. Disconnect the air pressure sensor connector.

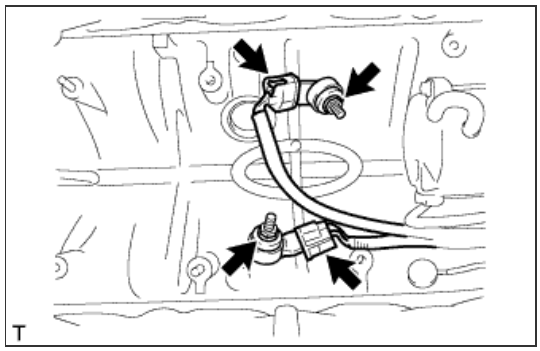
c. Remove the bolts, uts and air pump ith bracket.



7. REMOVE KNOCK SENSOR

a. Disconnect the senso connectors.

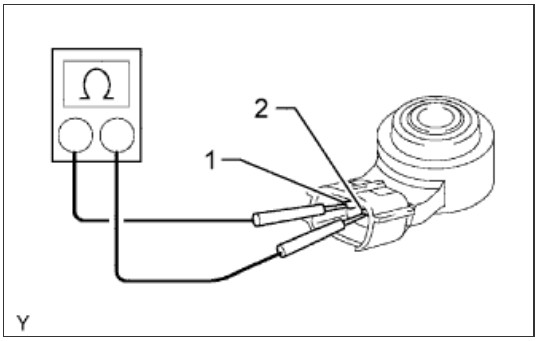
b. Remove the uts and senso s.



for Preparation Click here

1. INSPECT KNOCK SENSOR

a. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	120 to 280 kΩ

f the result is not as specified, replace the sensor.

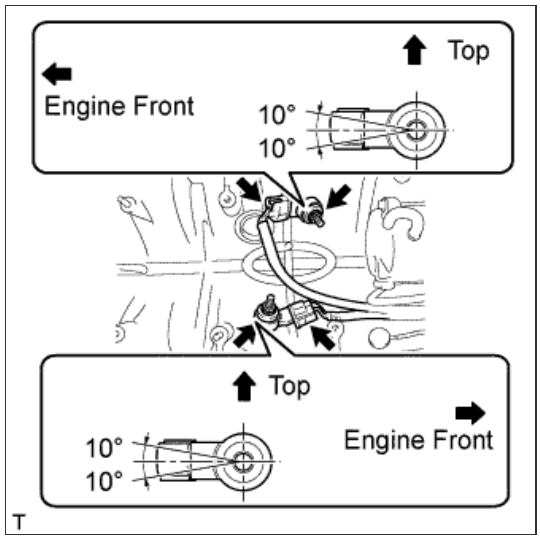
for Preparation Click here

1. INSTALL KNOCK SENSOR

a. Install the 2 sensors with the 2 nuts as shown in the illustration.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

b. Connect the 2 sensor connectors.



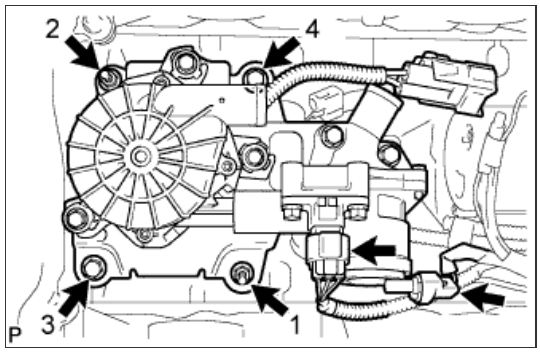
2. INSTALL AIR PUMP WITH BRACKET AND AIR SWITCHING VALVE

a. Install the air pump with bracket with the 2 bolts and 2 nuts in the order shown in the illustration.

Torque:
16 N*m{ 163 kgf*cm , 12 ft.*lbf }

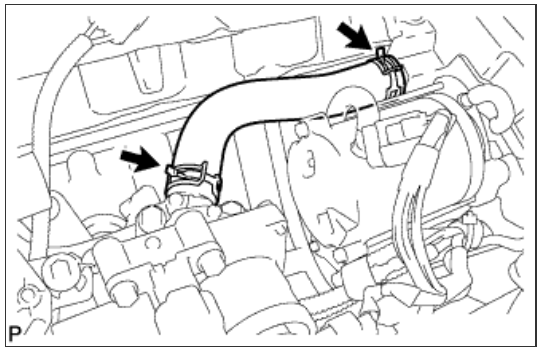
b. Connect the pressure sensor connector.

c. Connect the air switching valve connector.



3. INSTALL NO. 2 AIR INJECTION SYSTEM HOSE

a. Install the hose.



4. INSTALL WATER BY-PASS PIPE SUB-ASSEMBLY

a. Apply soapy water to the ring.

b. Install a new ring to the water by-pass pipe.

c. Push in the water by-pass pipe.

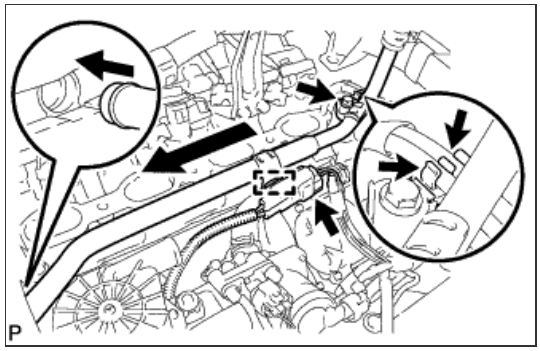
d. Install the water by-pass pipe with the bolt.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

e. Connect the 2 vacuum switching valve hoses to the water by-pass pipe clamp.

f. Connect the wire harness clamp.

g. Connect the connector.



5. INSTALL INTAKE MANIFOLD

a. Install the intake manifold (Click here).

6. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

hen disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

7. INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the D C3.

b. Turn the engine switch on (IG) and intelligent tester .

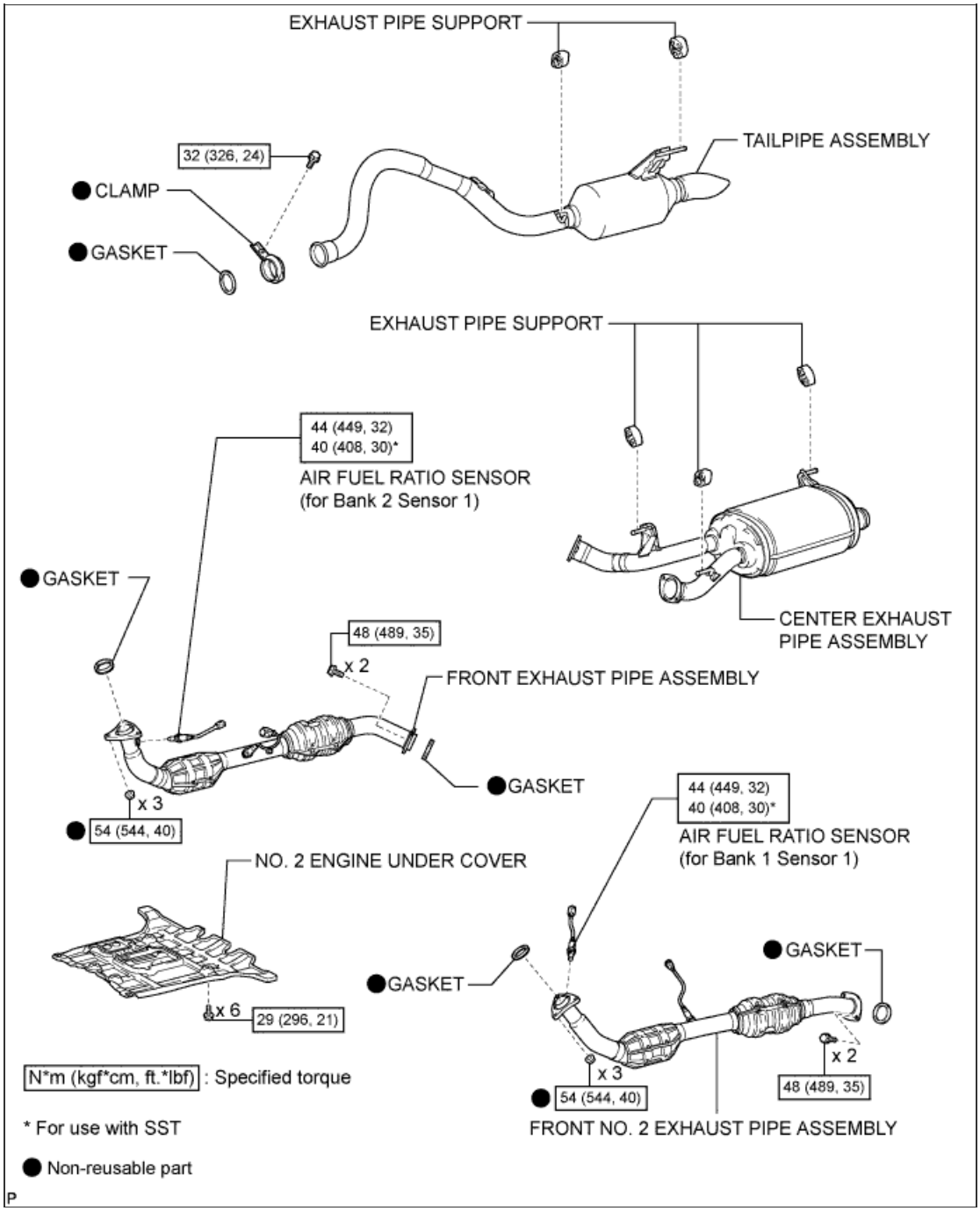
NOTICE:

o not start the engine.

c. nter the following menus: Powertrain / gine and CT / Active Test / Activate the Fuel Pump Speed Control.

d. Check that there are no fuel leaks after doing maintenance anywhere on the fuel system.

for Preparation Click here



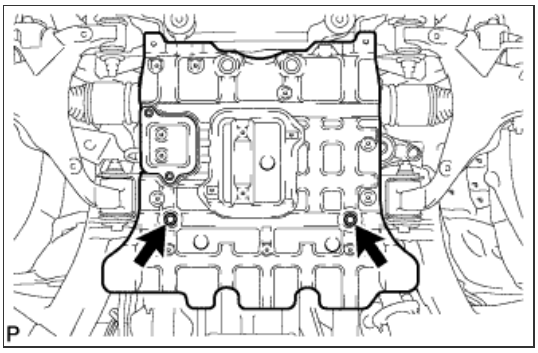
for Preparation Click here

CAUTION:

- **The procedures should be performed by at least 2 people.**
- **Wear protective gloves when removing the exhaust pipe.**
- **The exhaust pipe is extremely hot immediately after the engine has stopped.**
- **Confirm that the exhaust pipe has cooled down before removing it.**

1. REMOVE NO. 2 ENGINE UNDER COVER

a. Remove the 2 bolts and No. 2 engine under cover.



2. REMOVE TAILPIPE ASSEMBLY

a. Remove the bolt, clamp and gasket.

b. Remove the tailpipe from the 2 exhaust pipe supports.

3. REMOVE CENTER EXHAUST PIPE ASSEMBLY

a. Remove the 4 bolts.

b. Remove the center exhaust pipe from the 3 exhaust pipe supports.

c. Remove the 2 gaskets from the front exhaust pipe and front No. 2 exhaust pipe.

4. REMOVE FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Disconnect the air fuel ratio sensor connector.

b. Disconnect the heated oxygen sensor connector.

c. Remove the 3 nuts, front No. 2 exhaust pipe and gasket.

5. REMOVE FRONT EXHAUST PIPE ASSEMBLY

a. Disconnect the air fuel ratio sensor connector.

b. Disconnect the heated oxygen sensor connector.

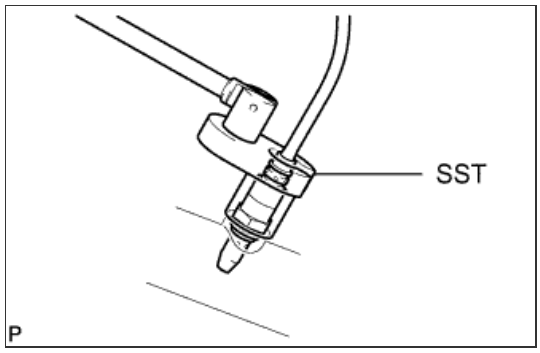
c. Detach the heated oxygen sensor wire clamp.

d. Remove the 3 nuts, front exhaust pipe and gasket.

6. REMOVE AIR FUEL RATIO SENSOR for Bank 1 Sensor 1)

a. Using remove the sensor.

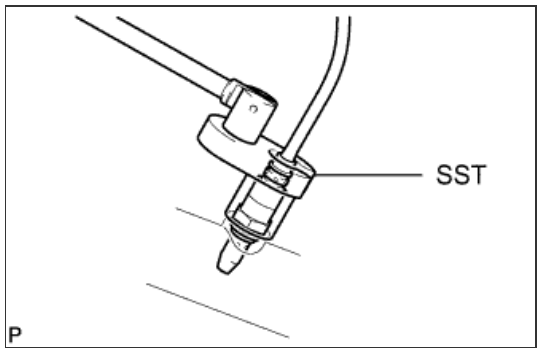
SST
09224-00010



7. REMOVE AIR FUEL RATIO SENSOR (for Bank 2 Sensor 1)

a. Using remove the sensor.

SST
09224-00010



for Preparation Click here

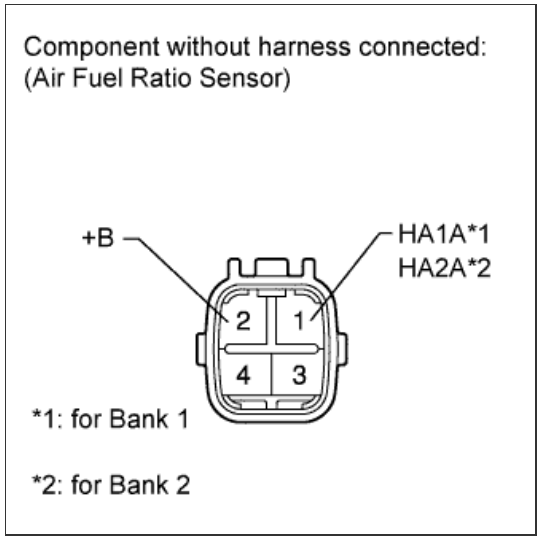
1. INSPECT AIR FUEL RATIO SENSOR

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B) for Bank 1	20°C (68°F)	1.8 to 3. Ω
1 (HA2A) - 2 (+B) for Bank 2		

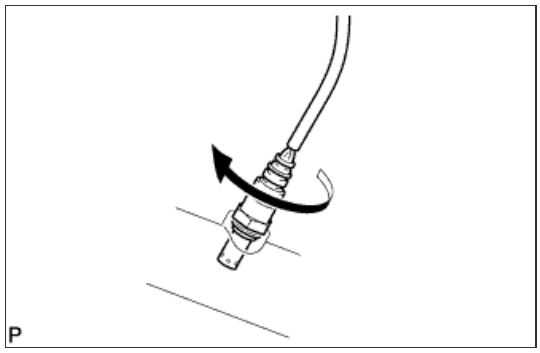
If the result is not as specified, replace the sensor.



for Preparation Click here

1. INSTALL AIR FUEL RATIO SENSOR (for Bank 2 Sensor 1)

a. Temporarily install the sensor to the exhaust pipe by hand.



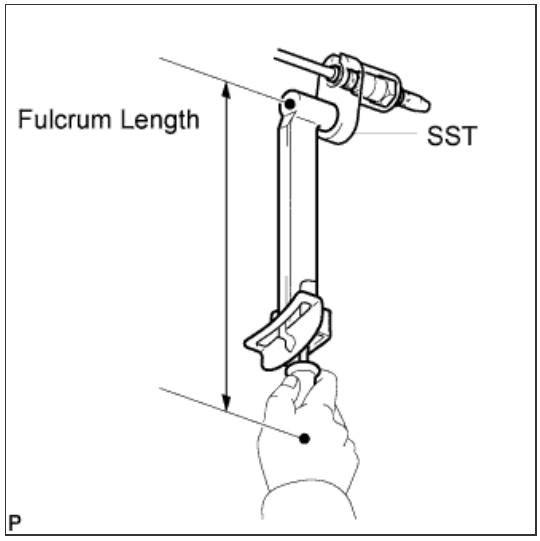
b. Using SST, tighten the sensor.

SST
09224-00010

Torque:
without SST:
44 N*m{ 449 kgf*cm , 32 ft.*lbf }
with SST:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

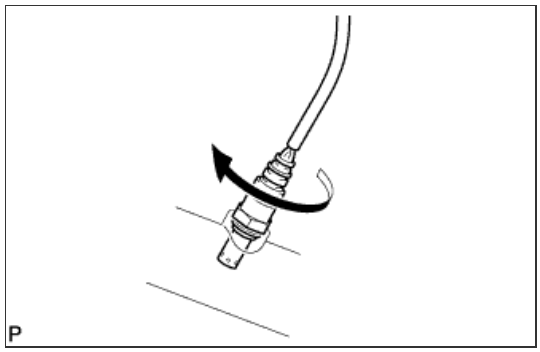
HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.). If using a torque wrench with a length that is not 30 cm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the "without SST" torque specification (Click here).**
- **Make sure SST and the wrench are connected in a straight line.**



2. INSTALL AIR FUEL RATIO SENSOR (for Bank 1 Sensor 1)

a. Temporarily install the sensor to the exhaust pipe by hand.



b. Using SST, tighten the sensor.

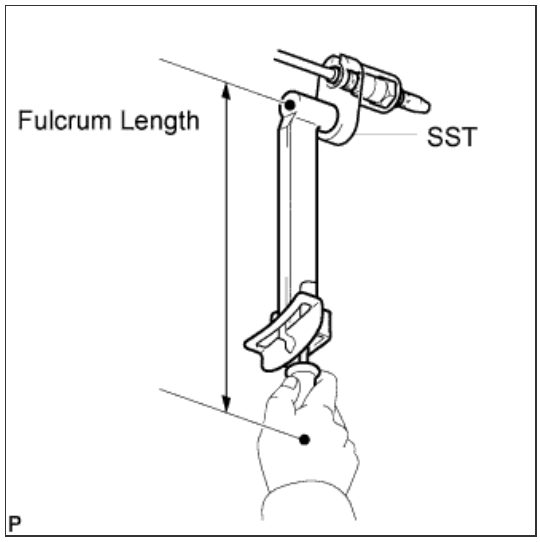
SST
09224-00010

Torque:
without SST:

44 N*m{ 449 kgf*cm , 32 ft.*lbf }
with SST:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

HINT:

- Use a torque wrench with a fulcrum length of 30 cm (11.8 in.). If using a torque wrench with a length that is not 30 cm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the "without SST" torque specification (Click here).
- Make sure SST and the wrench are connected in a straight line.



3. INSTALL FRONT EXHAUST PIPE ASSEMBL

a. Install a new gasket and the front exhaust pipe to the exhaust manifold with 3 new nuts.

Torque:
4 N*m{ 4 kgf*cm , 40 ft.*lbf }

b. Conne t the air fuel ratio sensor one tor.

c. Conne t the heated oxygen sensor one tor.

d. Atta h the heated oxygen sensor wire lamp.

4. INSTALL FRONT NO. 2 EXHAUST PIPE ASSEMBL

a. Install a new gasket and the front No. 2 exhaust pipe to the exhaust manifold with 3 new nuts.

Torque:
4 N*m{ 4 kgf*cm , 40 ft.*lbf }

b. Conne t the air fuel ratio sensor one tor.

c. Conne t the heated oxygen sensor one tor.

. INSTALL CENTER EXHAUST PIPE ASSEMBL

a. Install the enter exhaust pipe to the 3 exhaust pipe supports.

b. Install 2 new gaskets to the front exhaust pipe and front No. 2 exhaust pipe.

c. Install the 4 bolts.

Torque:
48 N*m{ 489 kgf*cm , 3 ft.*lbf }

6. INSTALL TAILPIPE ASSEMBL

a. Install the tailpipe to the 2 exhaust pipe supports.

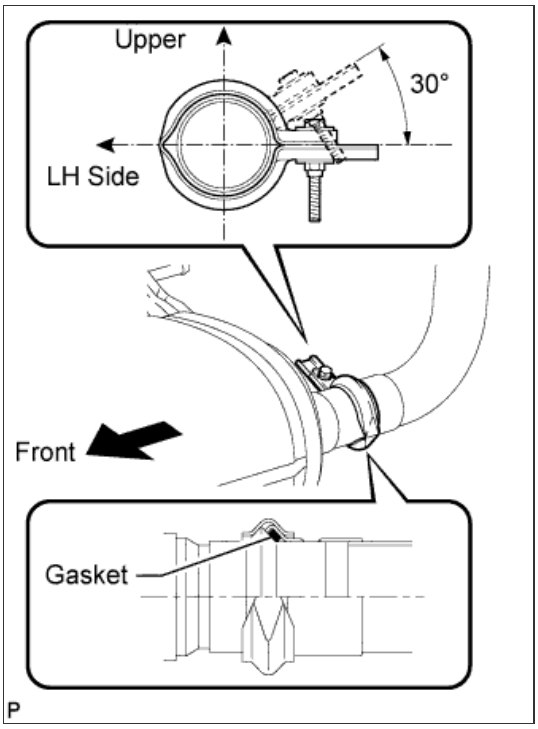
b. Install a new gasket to the enter exhaust pipe.

c. Conne t the tailpipe and enter exhaust pipe with a new lamp.

Torque:
32 N*m{ 326 kgf*cm , 24 ft.*lbf }

HINT:

Install the lamp within the angle range shown in the illustration.



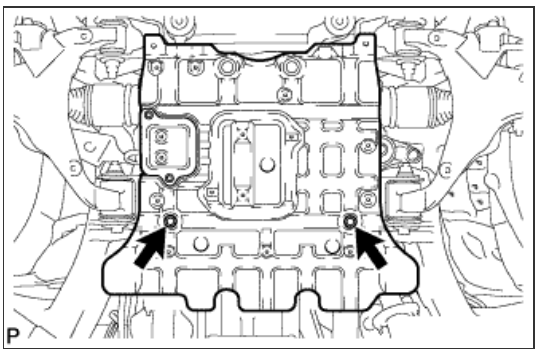
. INSPECT FOR EXHAUST AS LEA

If gas is leaking, tighten the areas ne essary to stop the leak. Repla e damaged parts as ne essary.

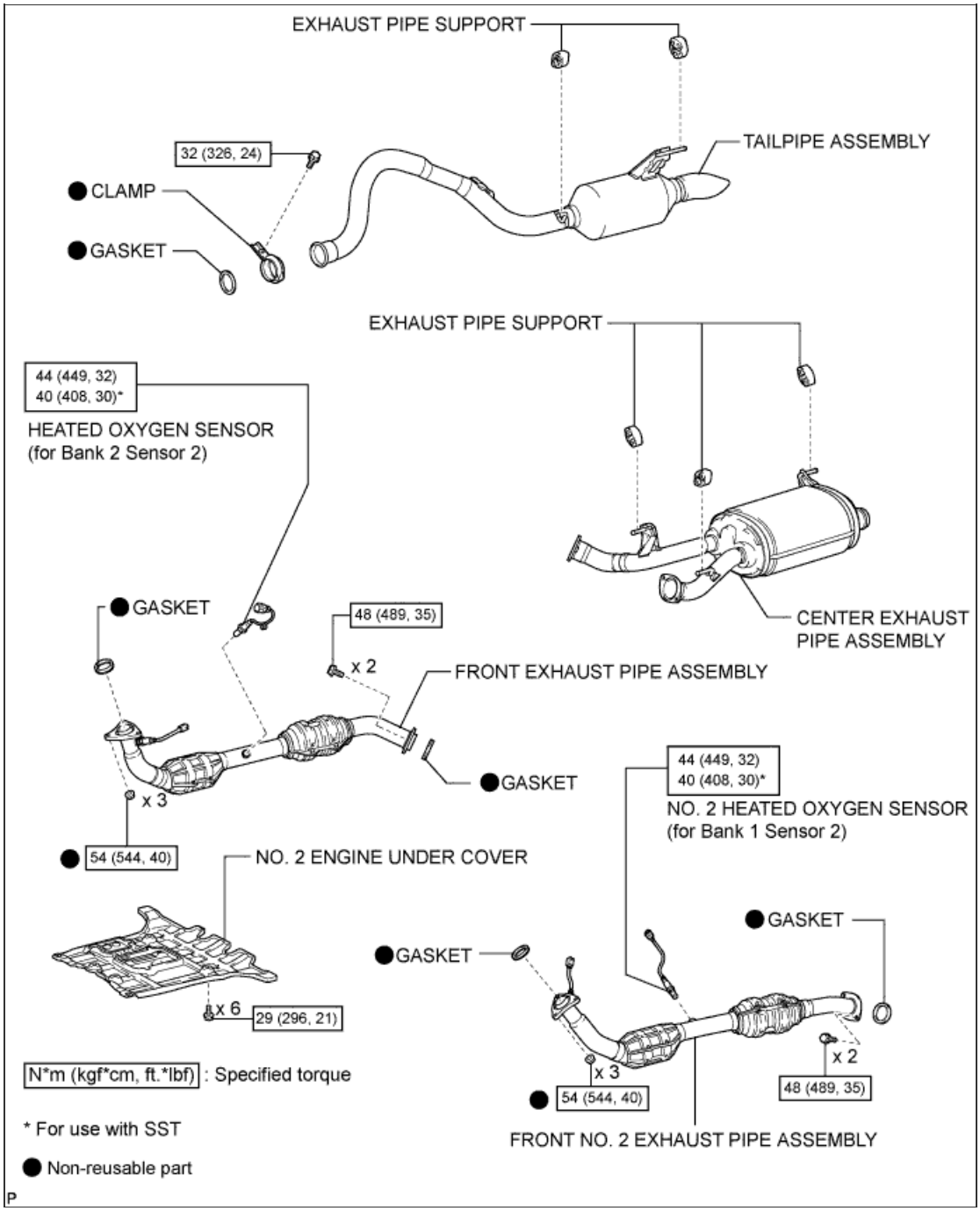
8. INSTALL NO. 2 EN INE UN B COVER

a. Install the No. 2 engine under oer with the 2 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



for Preparation Click here



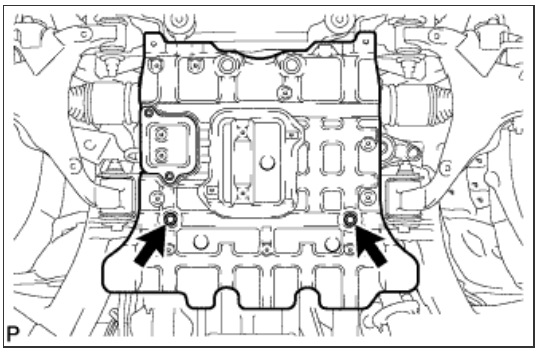
for Preparation Click here

CAUTION:

- **The procedures should be performed by at least 2 people.**
- **Wear protective gloves when removing the exhaust pipe.**
- **The exhaust pipe is extremely hot immediately after the engine has stopped.**
- **Confirm that the exhaust pipe has cooled down before removing it.**

1. REMOVE NO. 2 ENGINE UNDER COVER

a. Remove the 2 bolts and No. 2 engine under cover.



2. REMOVE TAILPIPE ASSEMBLY

a. Remove the bolt, clamp and gasket.

b. Remove the tailpipe from the 2 exhaust pipe supports.

3. REMOVE CENTER EXHAUST PIPE ASSEMBLY

a. Remove the 4 bolts.

b. Remove the center exhaust pipe from the 3 exhaust pipe supports.

c. Remove the 2 gaskets from the front exhaust pipe and front No. 2 exhaust pipe.

4. REMOVE FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Disconnect the air fuel ratio sensor connector.

b. Disconnect the heated oxygen sensor connector.

c. Remove the 3 nuts, front No. 2 exhaust pipe and gasket.

5. REMOVE FRONT EXHAUST PIPE ASSEMBLY

a. Disconnect the air fuel ratio sensor connector.

b. Disconnect the heated oxygen sensor connector.

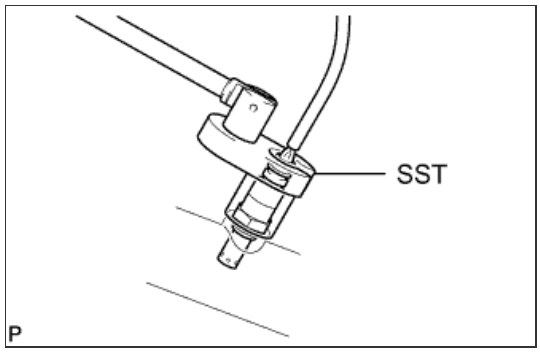
c. Detach the heated oxygen sensor wire clamp.

d. Remove the 3 nuts, front exhaust pipe and gasket.

6. REMOVE NO. 2 HEATED OXYGEN SENSOR for Bank 1 Sensor 2)

a. Using remove the sensor.

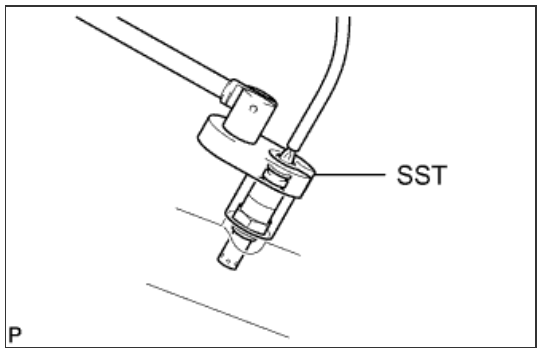
SST
09224-00010



7. REMOVE HEATED OXYGEN SENSOR (for Bank 2 Sensor 2)

a. Using remove the sensor.

SST
09224-00010



for Preparation Click here

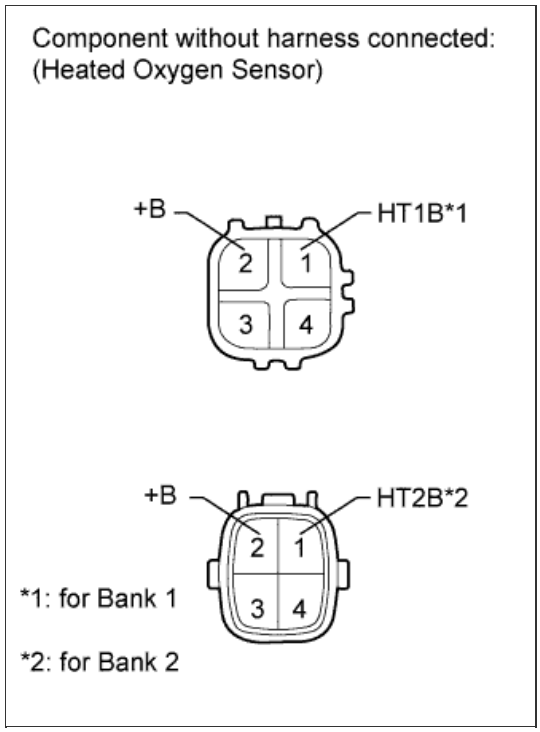
1. INSPECT HEATED OXYGEN SENSOR

a. Measure the heater resistance according to the value(s) in the table below.

Standard Resistance

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B) for Bank 1	20°C (68°F)	11 to 16 Ω
1 (HT2B) - 2 (+B) for Bnak 2		

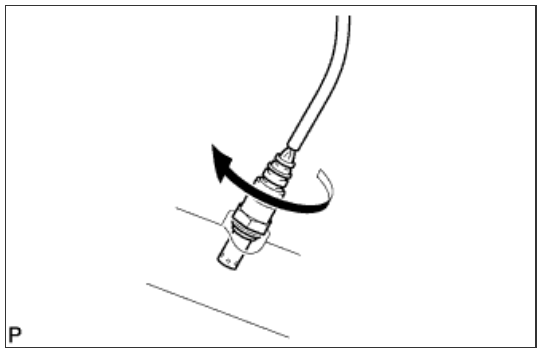
If the result is not as specified, replace the sensor.



for Preparation Click here

1. INSTALL HEATED OXYGEN SENSOR (for Bank 2 Sensor 2)

a. Temporarily install the sensor to the exhaust pipe by hand.



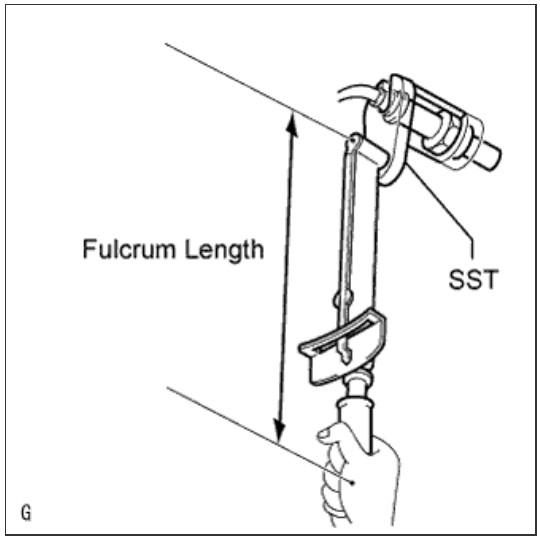
b. Using SST, tighten the sensor.

SST
09224-00010

Torque:
without SST:
44 N*m{ 449 kgf*cm , 32 ft.*lbf }
with SST:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

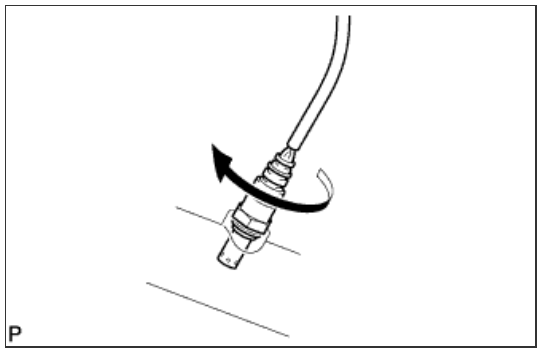
HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.). If using a torque wrench with a length that is not 30 cm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the "without SST" torque specification (Click here).**
- **Make sure SST and the wrench are connected in a straight line.**



2. INSTALL NO. 2 HEATED OXYGEN SENSOR (for Bank 1 Sensor 2)

a. Temporarily install the sensor to the exhaust pipe by hand.



b. Using SST, tighten the sensor.

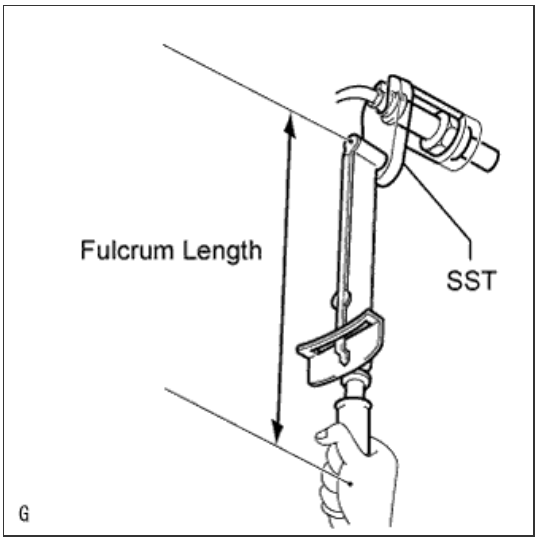
SST
09224-00010

Torque:
without SST:

44 N*m{ 449 kgf*cm , 32 ft.*lbf }
with SST:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.). If using a torque wrench with a length that is not 30 cm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the "without SST" torque specification (Click here).**
- **Make sure SST and the wrench are connected in a straight line.**



3. INSTALL FRONT EXHAUST PIPE ASSEMBLY

a. Install a new gasket and the front exhaust pipe to the exhaust manifold with 3 new nuts.

Torque:
54 N*m{ 554 kgf*cm , 40 ft.*lbf }

b. Conne t the air fuel ratio sensor one tor.

c. Conne t the heated oxygen sensor one tor.

d. Atta h the heated oxygen sensor wire lamp.

4. INSTALL FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Install a new gasket and the front No. 2 exhaust pipe to the exhaust manifold with 3 new nuts.

Torque:
54 N*m{ 554 kgf*cm , 40 ft.*lbf }

b. Conne t the air fuel ratio sensor one tor.

c. Conne t the heated oxygen sensor one tor.

5. INSTALL CENTER EXHAUST PIPE ASSEMBLY

a. Install the enter exhaust pipe to the 3 exhaust pipe supports.

b. Install 2 new gaskets to the front exhaust pipe and front No. 2 exhaust pipe.

c. Install the 4 bolts.

Torque:
48 N*m{ 489 kgf*cm , 35 ft.*lbf }

. INSTALL TAILPIPE ASSEMBLY

a. Install the tailpipe to the 2 exhaust pipe supports.

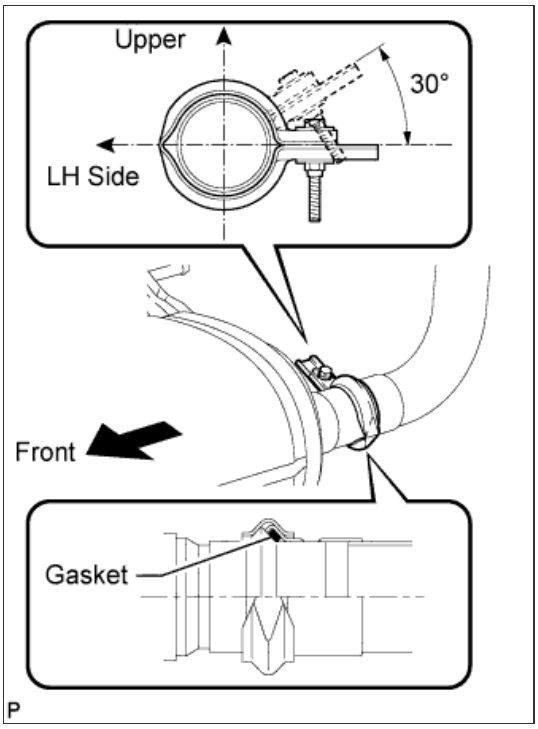
b. Install a new gasket to the enter exhaust pipe.

c. Conne t the tailpipe and enter exhaust pipe with a new lamp.

Torque:
32 N*m{ 32 kgf*cm , 24 ft.*lbf }

HINT:

Install the lamp within the angle range shown in the illustration.



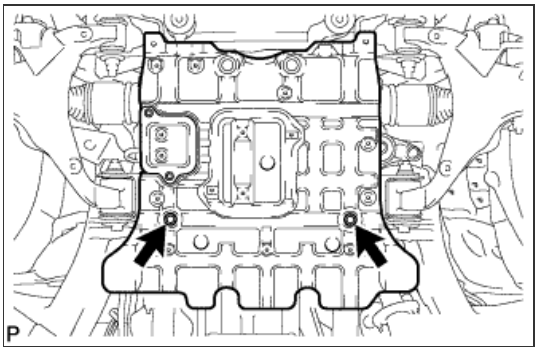
. INSPECT FOR EXHAUST GAS LEAK

If gas is leaking, tighten the areas ne essary to stop the leak. Repla e damaged parts as ne essary.

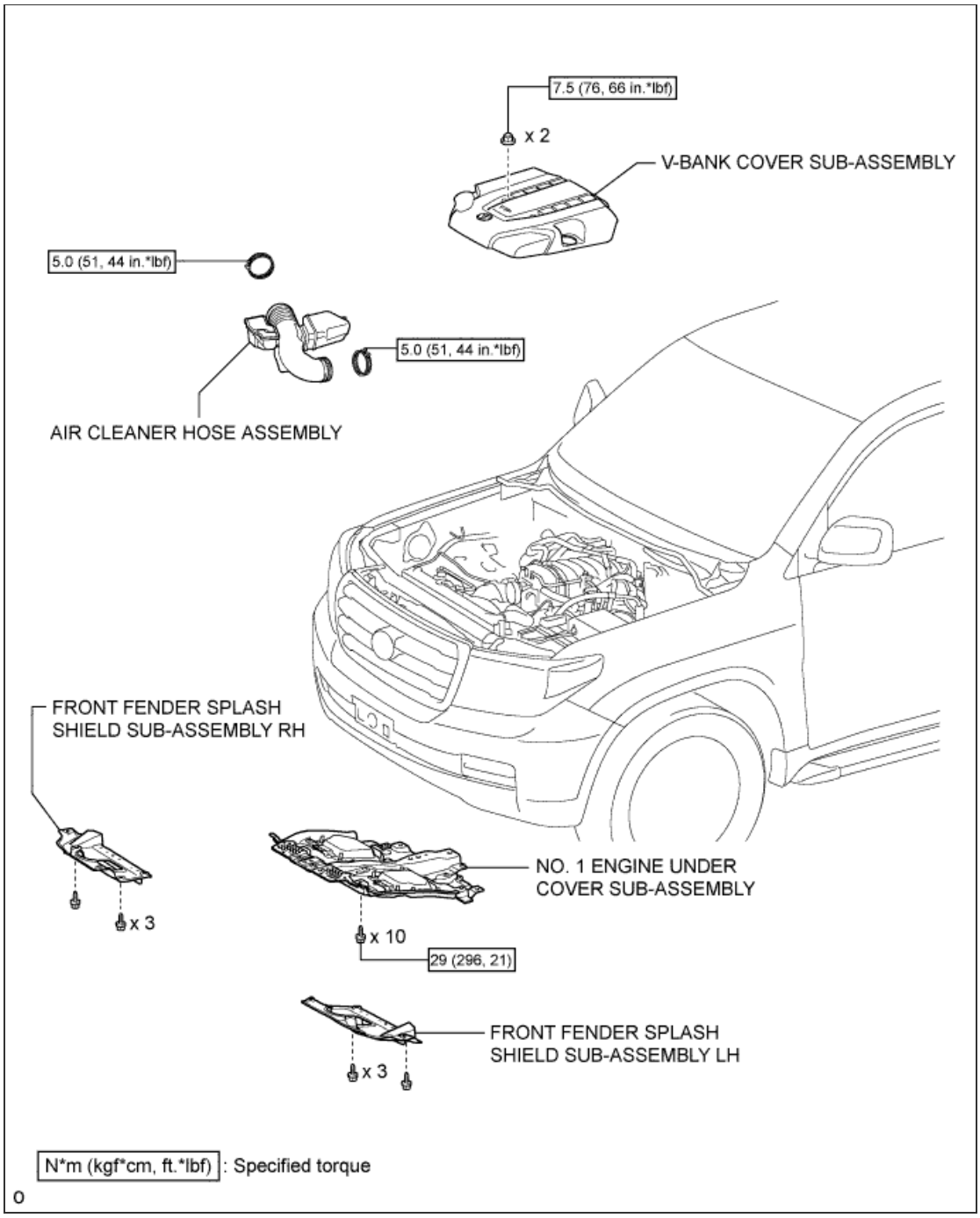
8. INSTALL NO. 2 ENGINE UNDER COVER

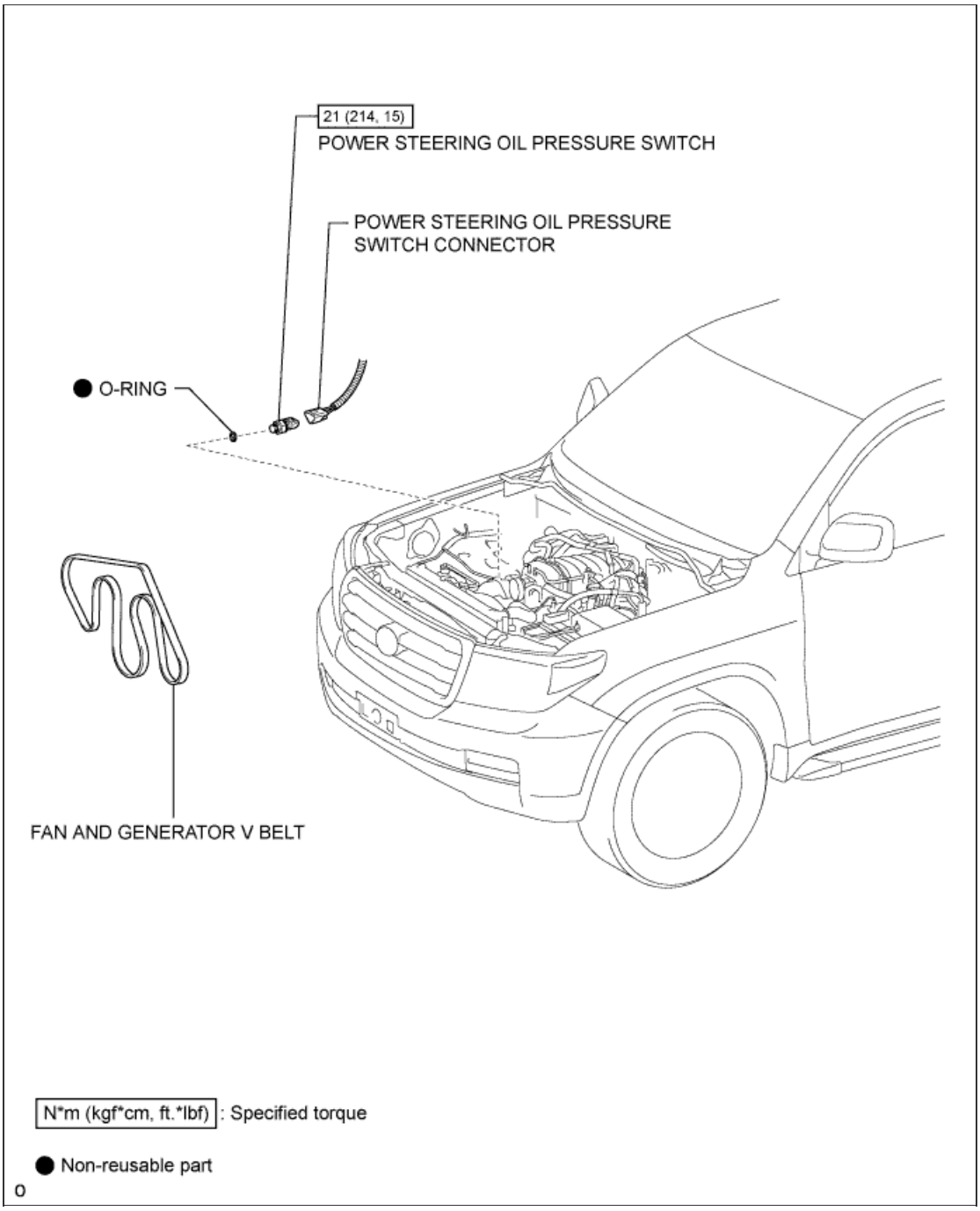
a. Install the No. 2 engine under oer with the 2 bolts.

Torque:
29 N*m{ 29 kgf*cm , 21 ft.*lbf }



for Preparation Click here




21 (214, 15)
POWER STEERING OIL PRESSURE SWITCH
POWER STEERING OIL PRESSURE SWITCH CONNECTOR
● O-RING
FAN AND GENERATOR V BELT
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part

o

for Preparation Click here

1. INSPECT POWER STEERING OIL PRESSURE SWITCH

a. Check the oil pressure switch.

i. Connect the intelligent tester to the DLC3.

ii. Turn the engine switch on (IG).

iii. Turn the intelligent tester on.

iv. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Power Steering Pressure.

v. Start the engine.

vi. Operate the steering wheel while idling, and read the alue on the intelligent tester.

Standard:

Condition	Specified Condition
Power steering not operating	0 to 2 MPa
Power steering operating	Values change from a o e alue

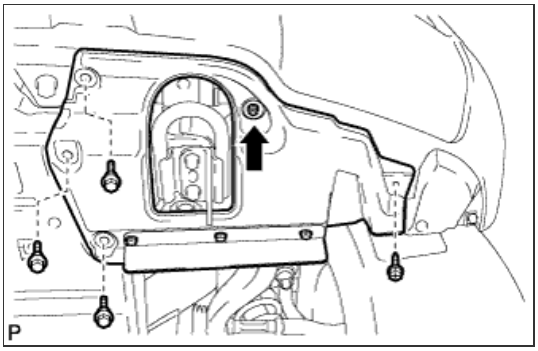
If not as specified, check for DTCs (Click here). If the power steering system inspection results are normal and a DTC is not output, replace the power steering oil pressure switch.
Inspect the power steering system (Click here). If the power steering system inspection results are normal and a DTC is not output, replace the power steering oil pressure switch.

for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



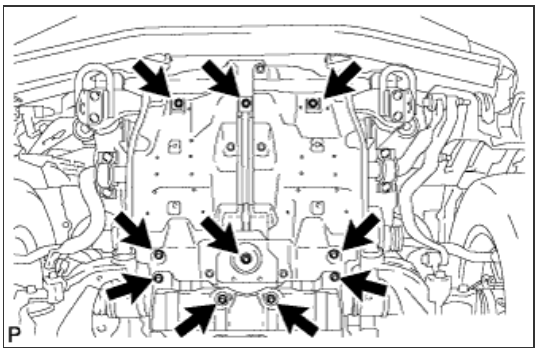
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

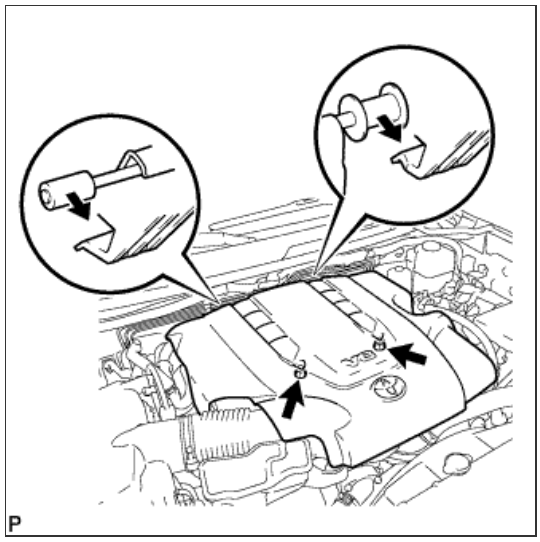
3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and No. 1 engine under cover.



4. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Remove the 2 nuts and V-bank cover.

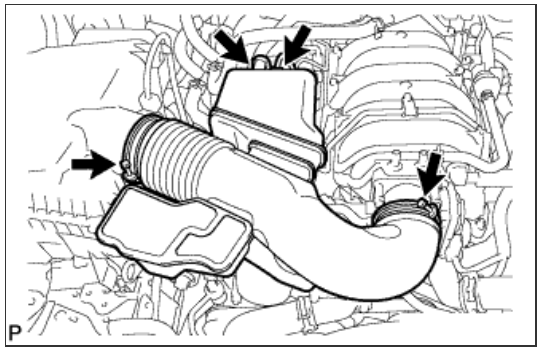


5. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum transmitting hose and No. 2 ventilation hose.

b. Loosen the 2 hose clamps.

c. Remove the air cleaner hose.

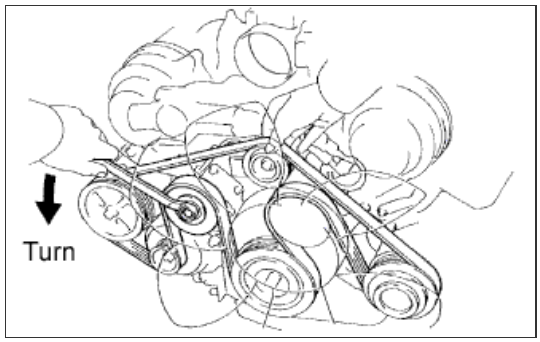


6. REMOVE FAN & GENERATOR V BELT

a. Loosen the belt tension by turning the belt tensioner counterclockwise, and then remove the fan and generator V belt.

HINT:

The pulley bolt for the belt tensioner has left-hand thread.



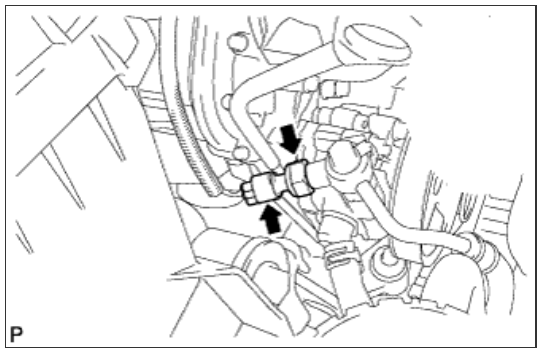
7. DRAIN POWER STEERING FLUID

8. REMOVE POWER STEERING OIL PRESSURE SWITCH

a. Disconnect the sensor connector.

b. Using a 24 mm deep socket wrench, remove the oil pressure switch.

c. Remove the ring.


P

for Preparation Click here

1. INSTALL POWER STEERING OIL PRESSURE SWITCH

a. Install a new O-ring to the oil pressure switch.

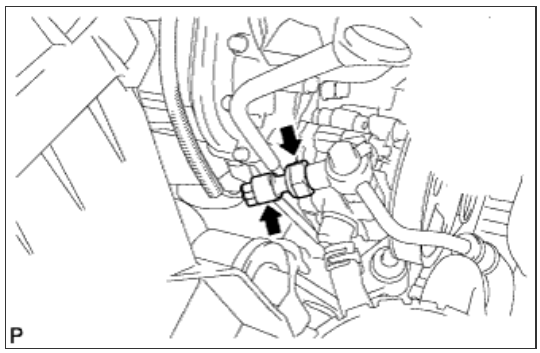
b. Apply a light coat of engine oil to the O-ring of the oil pressure switch.

c. Using a 24 mm deep socket wrench, install the oil pressure switch.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

NOTICE:

- **Do not allow foreign matter to contact the oil seal face of the power steering oil pressure switch (connecting surface with pressure feed tube).**
- **Be careful not to damage the O-ring when installing the power steering oil pressure switch.**



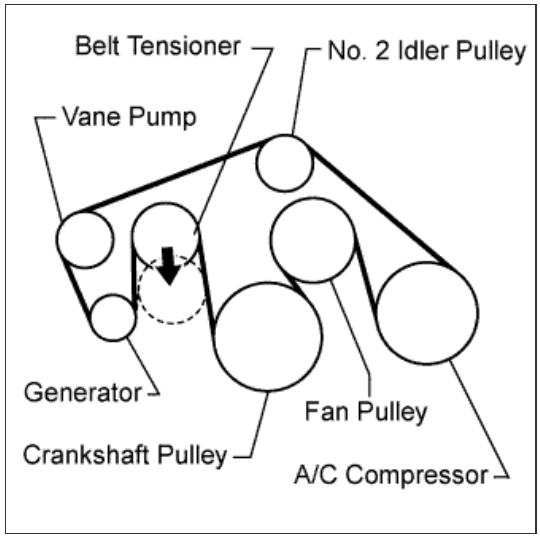
d. Connect the oil pressure switch connector.

2. INSTALL FAN & GENERATOR V BELT

a. Set the V belt onto every part e ept the belt tensioner, as shown in the illustration.

b. oosen the V belt by turning the belt tensioner counterclockwise.

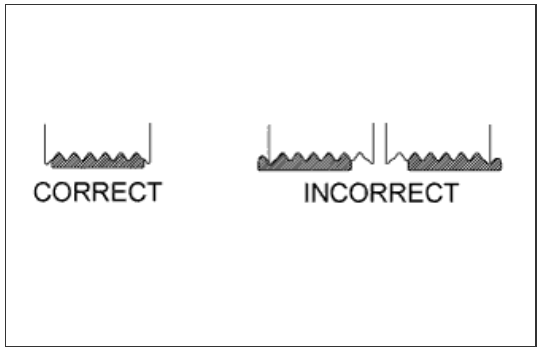
c. Set the V belt to the belt tensioner.



d. Check that the belt fits properly in the ribbed grooves.

HINT:

Make sure to check by hand that the belt has not slipped out of the grooves on the bottom of the pulley.

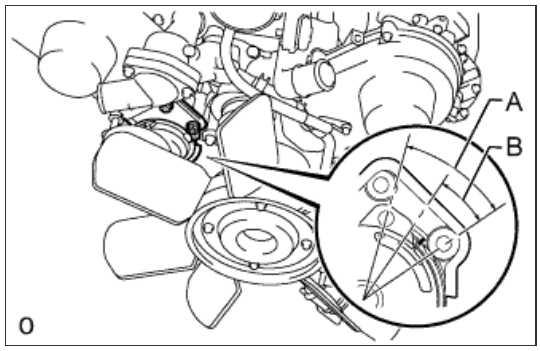


e. Check that the arrow on the belt tensioner is within area A .

If the arrow is outside area A , replace the fan and generator V belt.

HINT:

When a new belt is installed, the arrow should be within area . If not, the fan and generator V belt is not installed correctly.



3. INSTALL AIR CLEANER HOSE ASSEMBLY

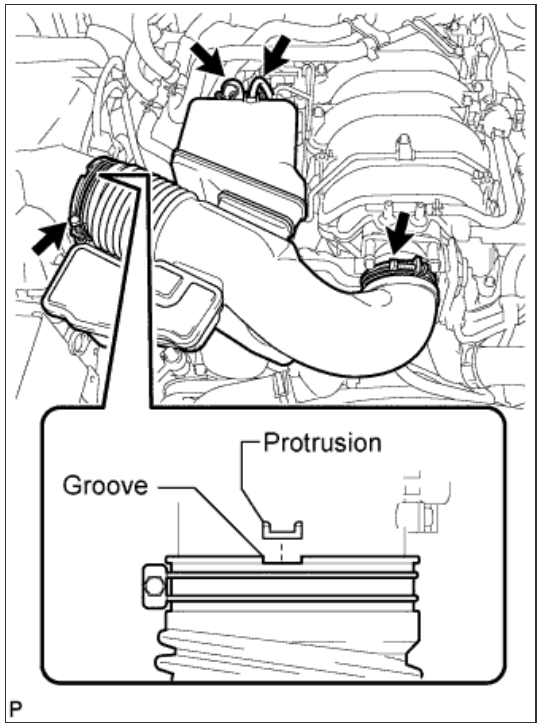
a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

b. ighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum transmitting hose.

d. Connect the No. 2 ventilation hose.



4. ADD POWER STEERING FLUID

5. BLEED POWER STEERING FLUID

a. Check the fluid level.

b. ak up the front of the vehicle and support it with stands.

c. urn the steering wheel.

i. With the engine stopped, turn the wheel slowly from lock to lock several times.

d. ower the vehicle.

e. Start the engine.

f. Idle the engine for a few minutes.

g. urn the steering wheel.

i. With the engine idling, turn the wheel left or right to the full lock position and keep it there for 2 to econds, then turn the wheel to the opposite full lock position and keep it there for 2 to econds.

ii. epeat several times.

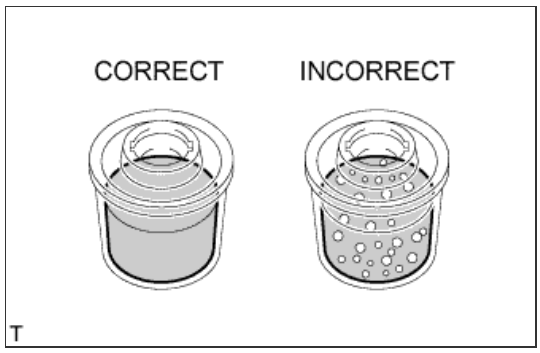
NOTICE:

For vehicles with VG S, if the steering wheel is turned from lock to lock repeatedly, the system may stop operating and the amount of rotation before the steering wheel locks may increase due to operation of the overheating prevention function. When the system temperature drops, the system operation automatically returns to normal.

h. Stop the engine.

i. Check for foaming or emulsification.
If the system has to be bled twice because of foaming or emulsification, check for fluid leaks in the system.

j. Check the fluid level.



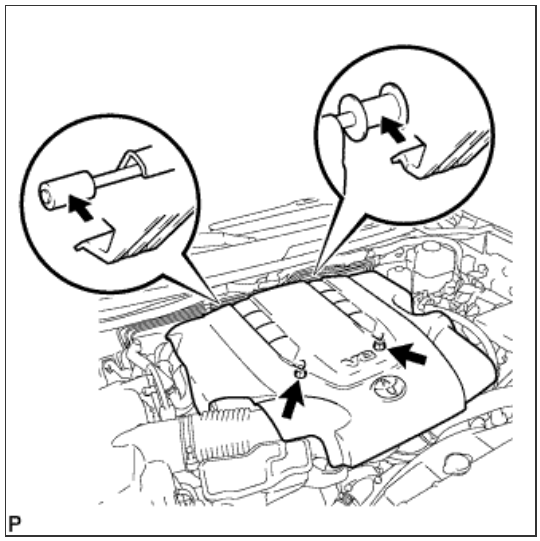
6. INSPECT FOR POWER STEERING FLUID LEAK

7. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket.

b. Install the V-bank cover with the 2 nuts.

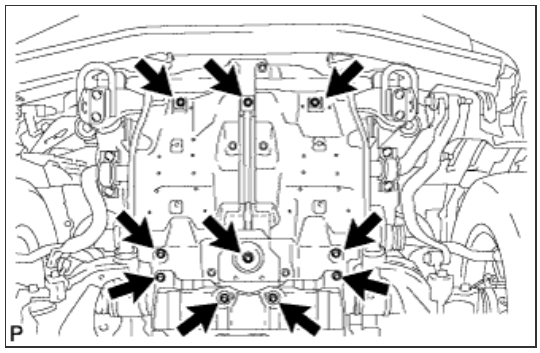
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



8. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the No. 1 engine under cover with the 10 bolts.

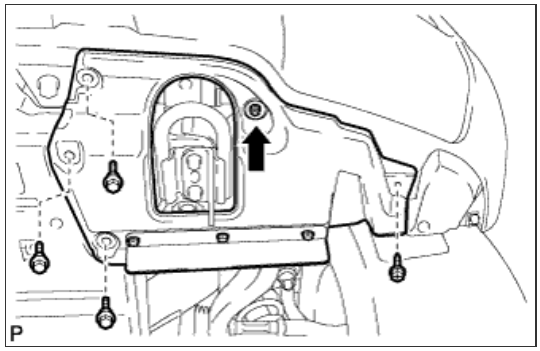
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



9. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. ush in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the bolts and screw.



10. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the ide.

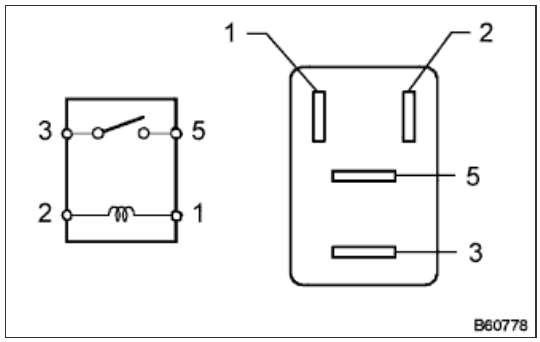
for Preparation Click here

1. INSPECT CIRCUIT OPENING RELAY (C/OPN)

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage is not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage is applied to terminals 1 and 2	Below 1 Ω



If the result is not as specified, replace the relay.

2. INSPECT INTEGRATION RELAY (IG2)

a. Measure the resistance of the IG2 MAIN fuse.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
IG2 MAIN fuse	Always	Below 1 Ω

If the result is not as specified, replace the IG2 MAIN fuse.

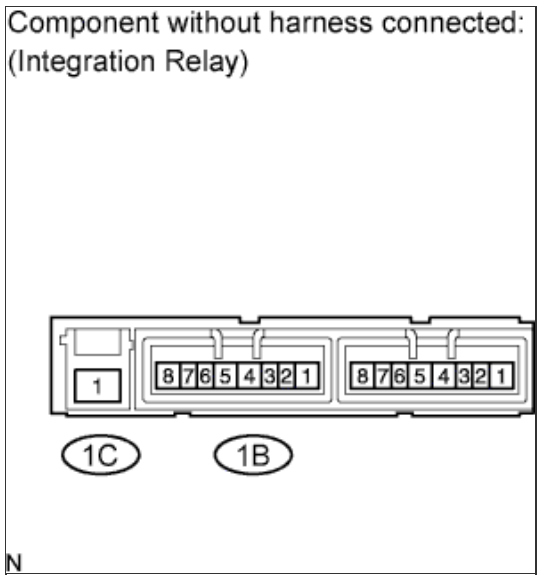
b. Measure the resistance of the ignition relay No. 2 (IG2) circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1B-8	Battery voltage is not applied to terminals 1B-6 and 1B-7	10 kΩ or higher
	Battery voltage is applied to terminals 1B-6 and 1B-7	Below 1 Ω

If the result is not as specified, replace the integration relay.



3. INSPECT INTEGRATION RELAY (EFI)

a. Measure the resistance of the EFI MAIN fuse.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
IAM fuse	Always	Below 1 Ω

If the result is not as specified, replace the EFI MAIN fuse.

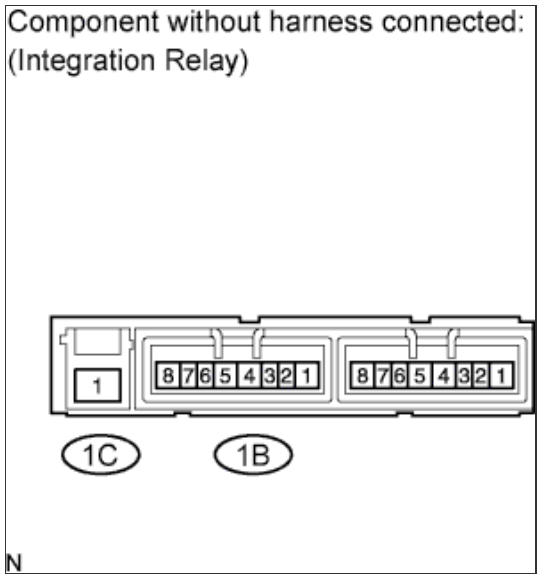
b. Measure the resistance of the EFI relay circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1B-4	Battery voltage is not applied to terminals 1B-2 and 1B-3	10 kΩ or higher
	Battery voltage is applied to terminals 1B-2 and 1B-3	Below 1 Ω

If the result is not as specified, replace the integration relay.



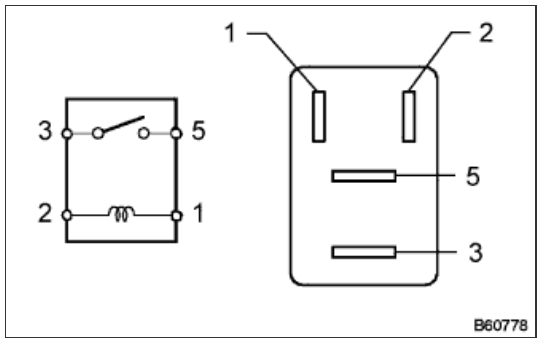
4. INSPECT EFI NO. 2 RELAY (EFI NO. 2)

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage is not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage is applied to terminals 1 and 2	Below 1 Ω

If the result is not as specified, replace the relay.



5. INSPECT INTEGRATION RELAY (A/F)

a. Measure the resistance of the A/F fuse.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 Ω

If the result is not as specified, replace the A/F fuse.

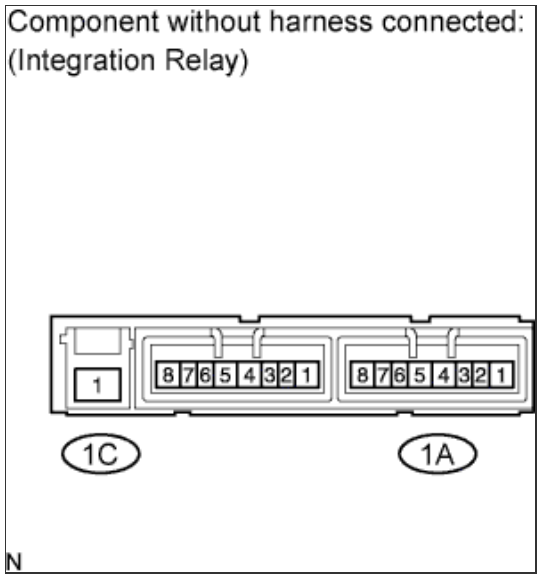
b. Measure the resistance of the A/F sensor heater relay circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

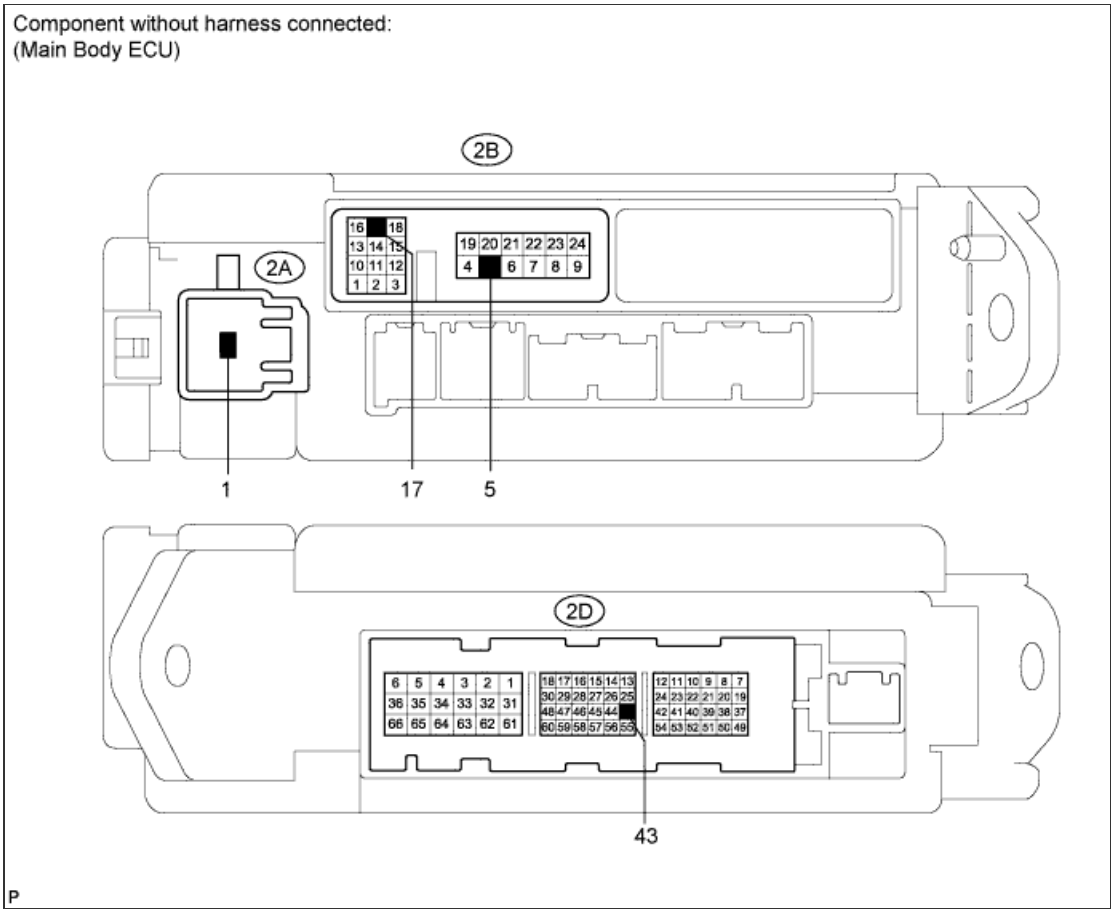
Tester Connection	Condition	Specified Condition
1C-1 - 1A-	Battery voltage is not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage is applied to terminals 1A-2 and 1A-3	Below 1 Ω

If the result is not as specified, replace the integration relay.



6. INSPECT MAIN BODY ECU (IG1 NO. 1)

a. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

Tester Condition	Condition	Specified Condition
2A-1 - 2B-17	Battery voltage is not applied to terminals 2B-5 and 2D-43	10 kΩ or higher
	Battery voltage is applied to	

	terminals 2B-5 and 2D-43	Below 1 Ω

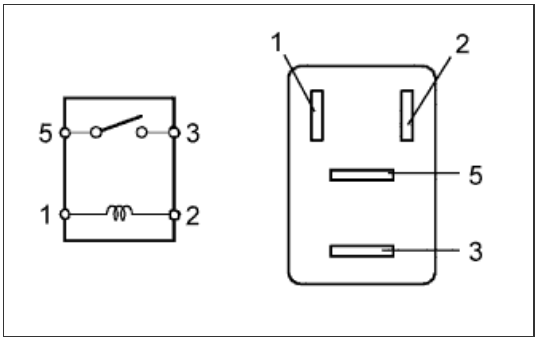
If the result is not as specified, replace the cowl side junction block LH.

7. INSPECT STARTER RELAY (ST)

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage applied to terminals 1 and 2	Below 1 Ω



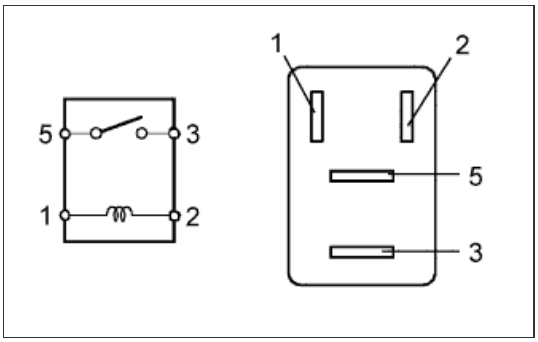
If the result is not as specified, replace the relay.

8. INSPECT STARTER CUT RELAY (ST CUT)

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

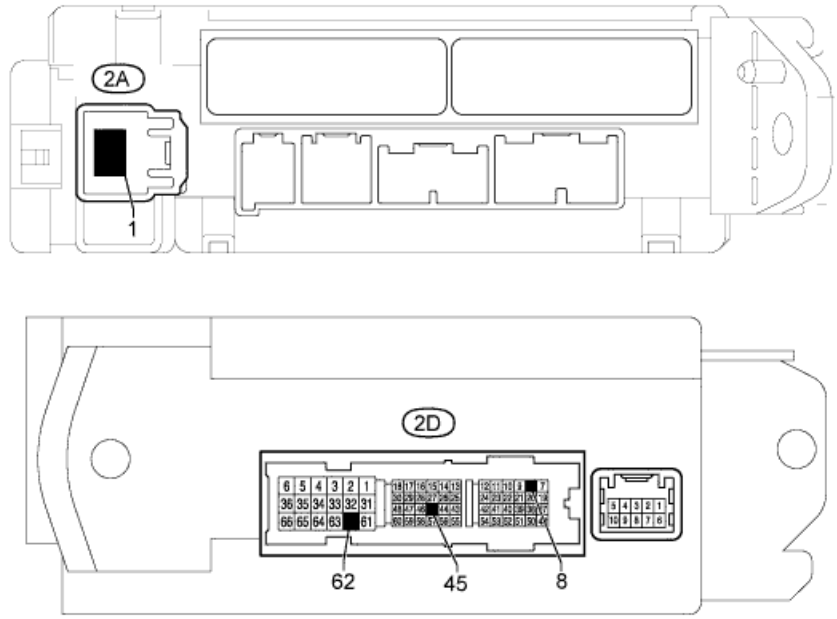
Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage applied to terminals 1 and 2	Below 1 Ω



If the result is not as specified, replace the relay.

9. INSPECT MAIN BODY ECU (ACC RELAY)

Component without harness connected: (Main Body ECU)



P

a. Measure the resistance of the ACC relay circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
2A-1 - 2D-8	Battery voltage not applied between 2D-45 and 2D-62	10 kΩ or higher
	Battery voltage applied between 2D-45 and 2D-62	Below 1 Ω

If the result is not as specified, replace the main body ECU.

for Preparation Click here

1.IGNITION SWITCH EXPRESSION

HINT:

The type of ignition switch used on this model differs according to the specifications of the vehicle. The e pressions listed in the table below are used in this section.

E pression	Ignition Switch (position)	Engine Switch (condition)
Ignition Switch off	ff	ff
Ignition Switch		n (IG)
Ignition Switch ACC	ACC	n (ACC)
Engine Start	STA T	Start

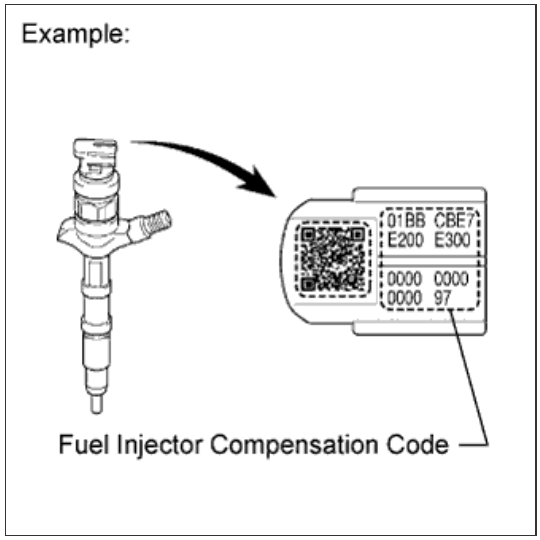
2.FUEL INJECTOR COMPENSATION CODE

a. Each fuel in ector has different fuel in ection characteristics. In order to optimize fuel in ection performance, the ECM compensates for these differences by ad usting the fuel in ection duration of each fuel in ector according to its compensation code. Fuel in ector compensation codes are unique, 30 digit, alphanumeric values printed on the head portion of each fuel in ector.

b. hen a fuel in ector is replaced, the new fuel in ector compensation code must be input into the ECM.

c. hen the ECM is changed, all of the e isting fuel in ector compensation codes must be input into the new ECM.

d. If an incorrect fuel in ector compensation code is input into the ECM, the engine assembly may rattle or engine idling may become rough. In addition, engine failure may occur and the life of the engine may be shortened.



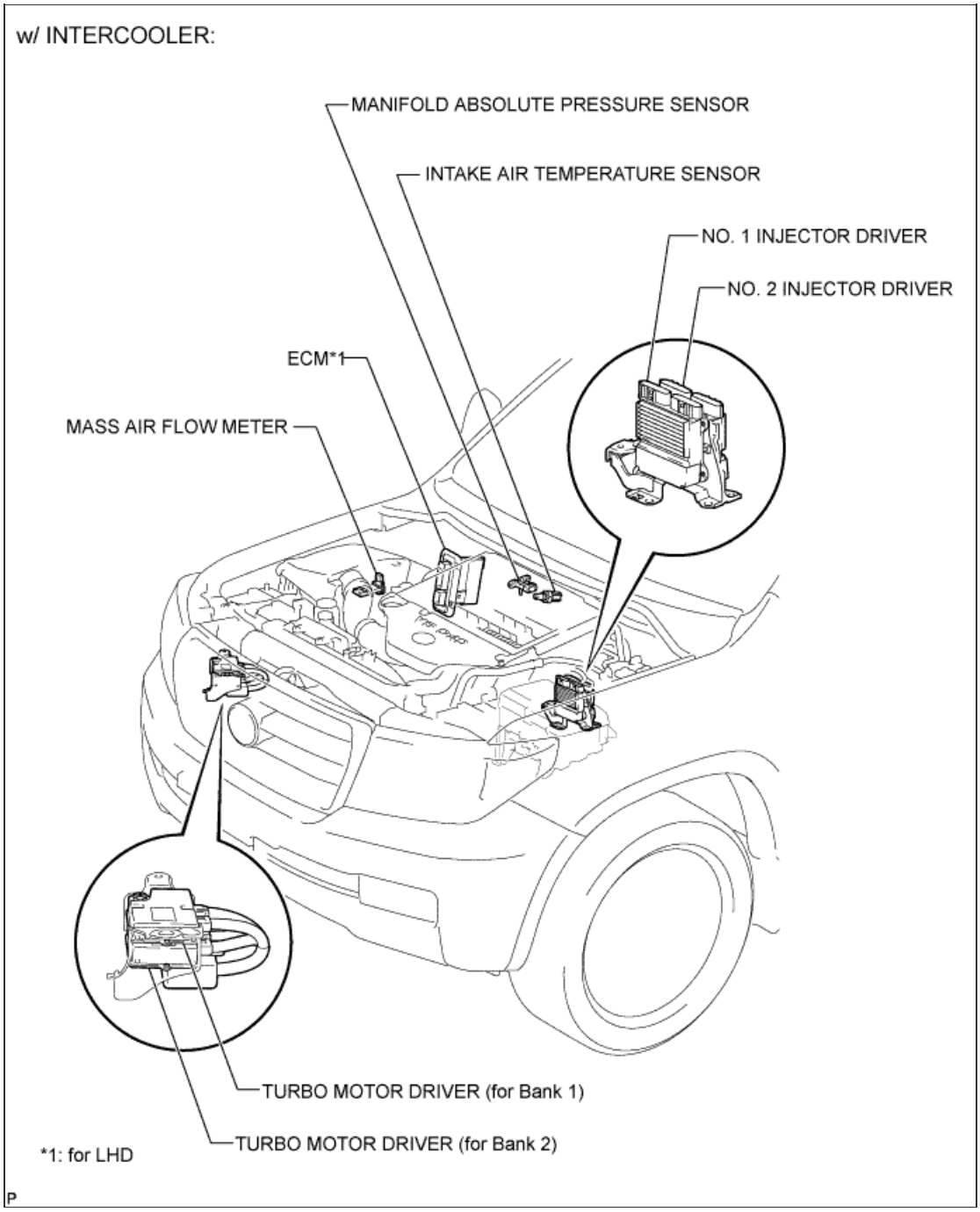
3.FOR USING INTELLIGENT TESTER

CAUTION:

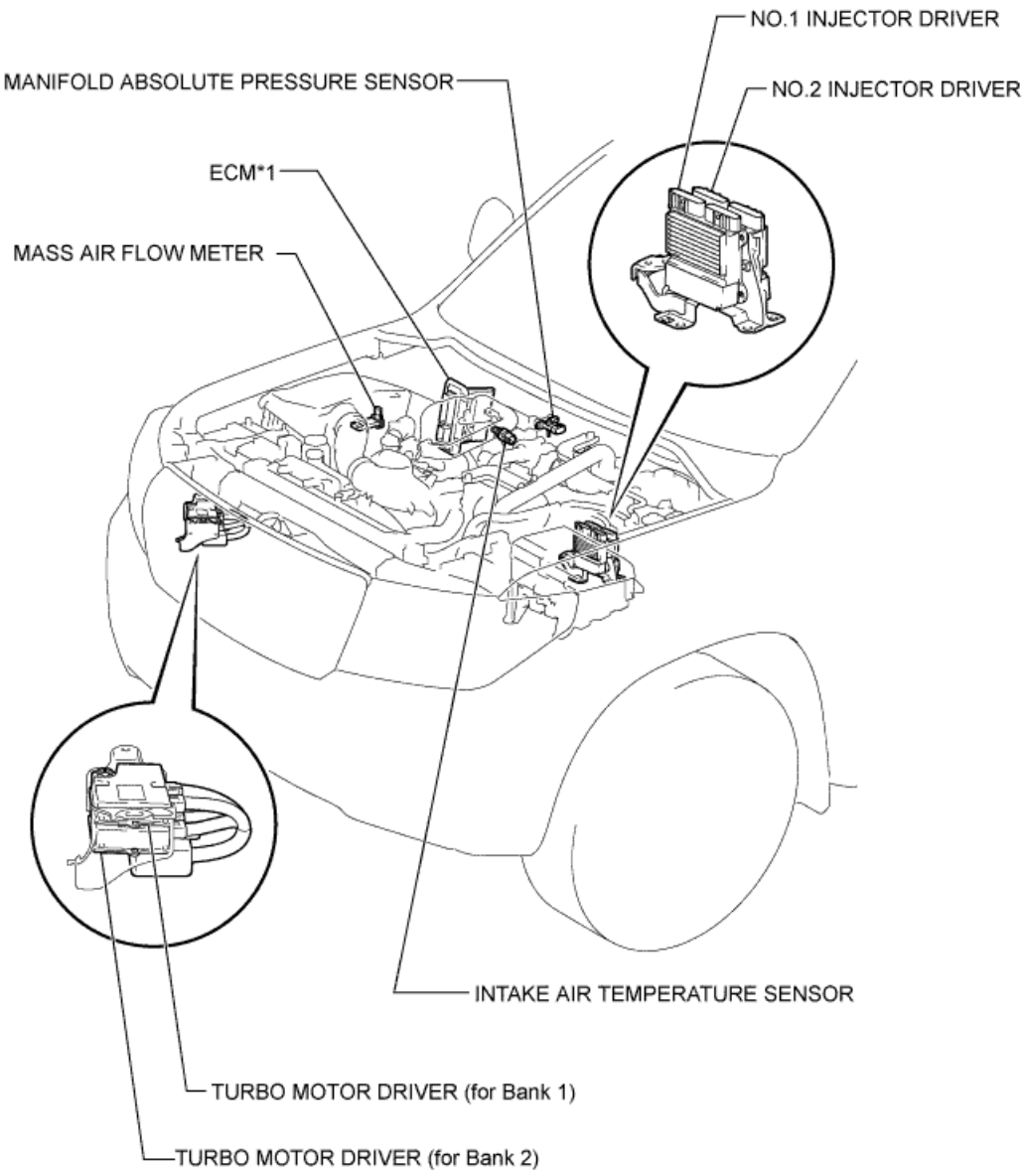
Observe the following items for safety reasons:

- **Before using the tester, read its instruction manual.**
- **Prevent the tester cable from being caught on the pedals, shift lever or steering wheel when driving with the tester connected to the vehicle.**
- **When driving the vehicle for testing purposes using the tester, two persons are required. One person drives the vehicle, and the other operates the tester.**

for Preparation Click here

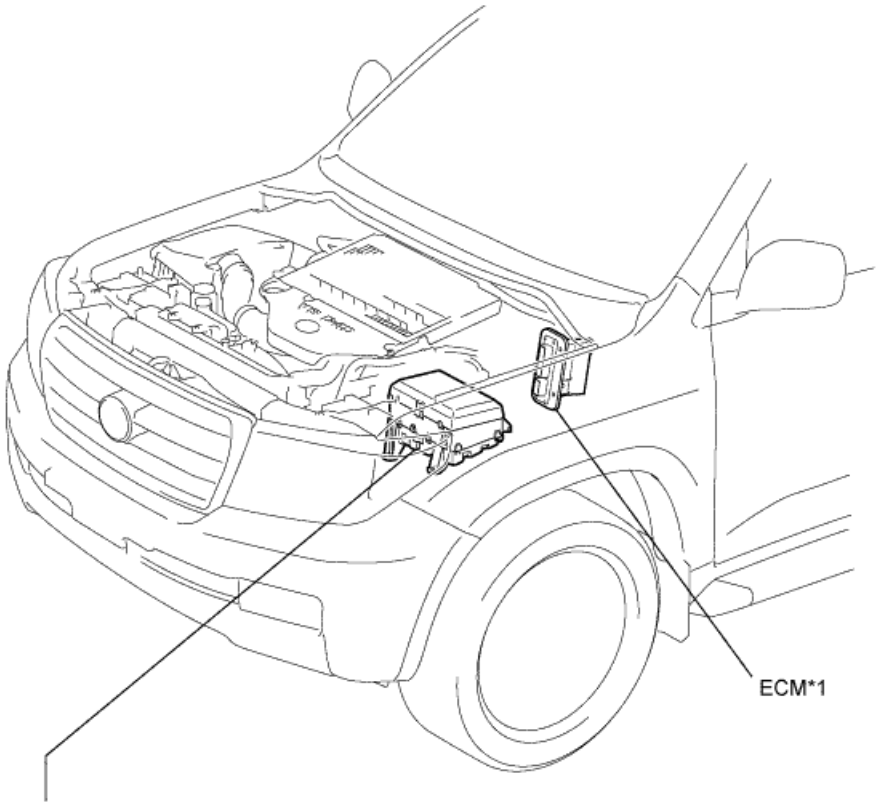


w/o INTERCOOLER:



*1:for LHD

P

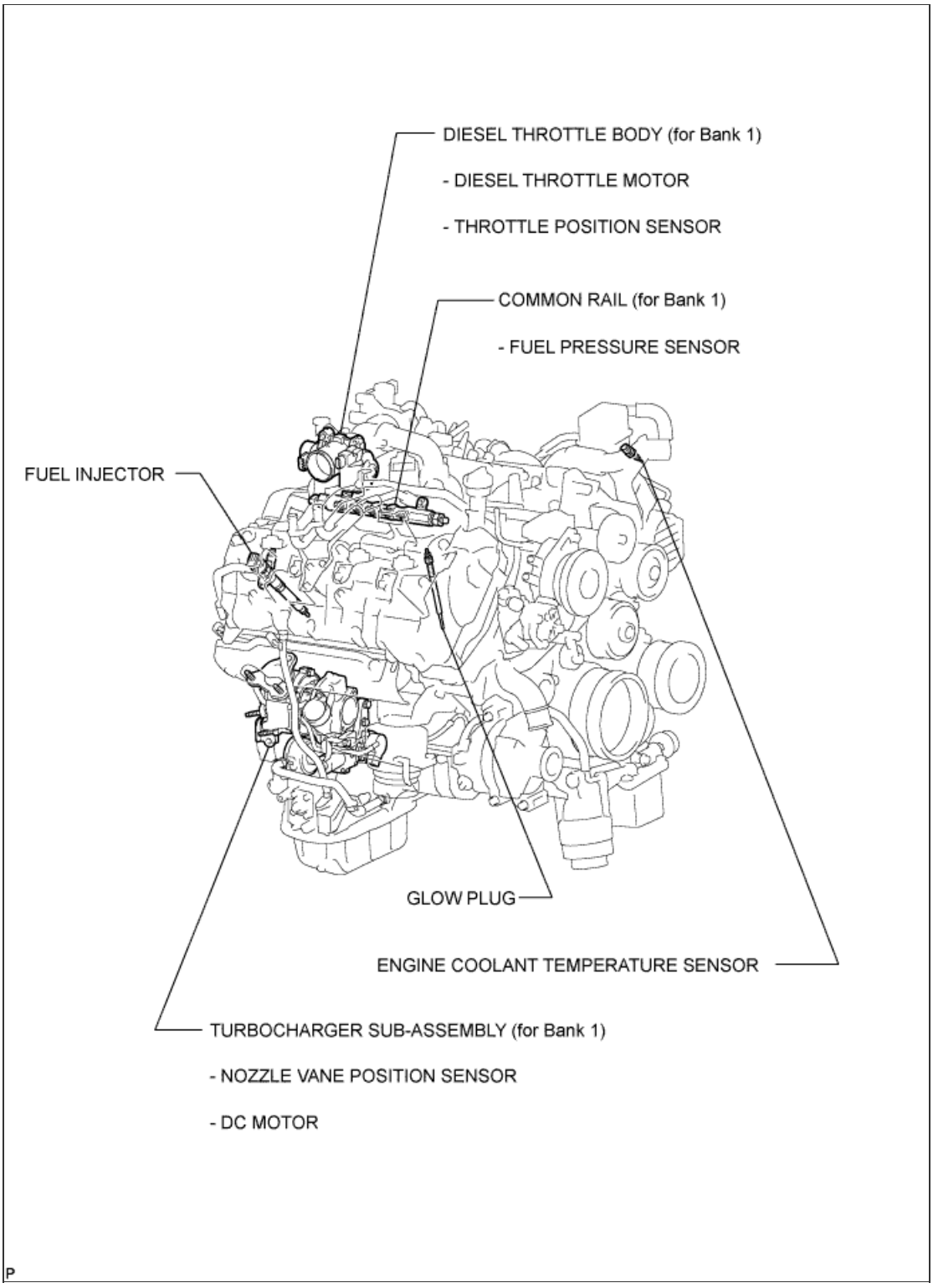


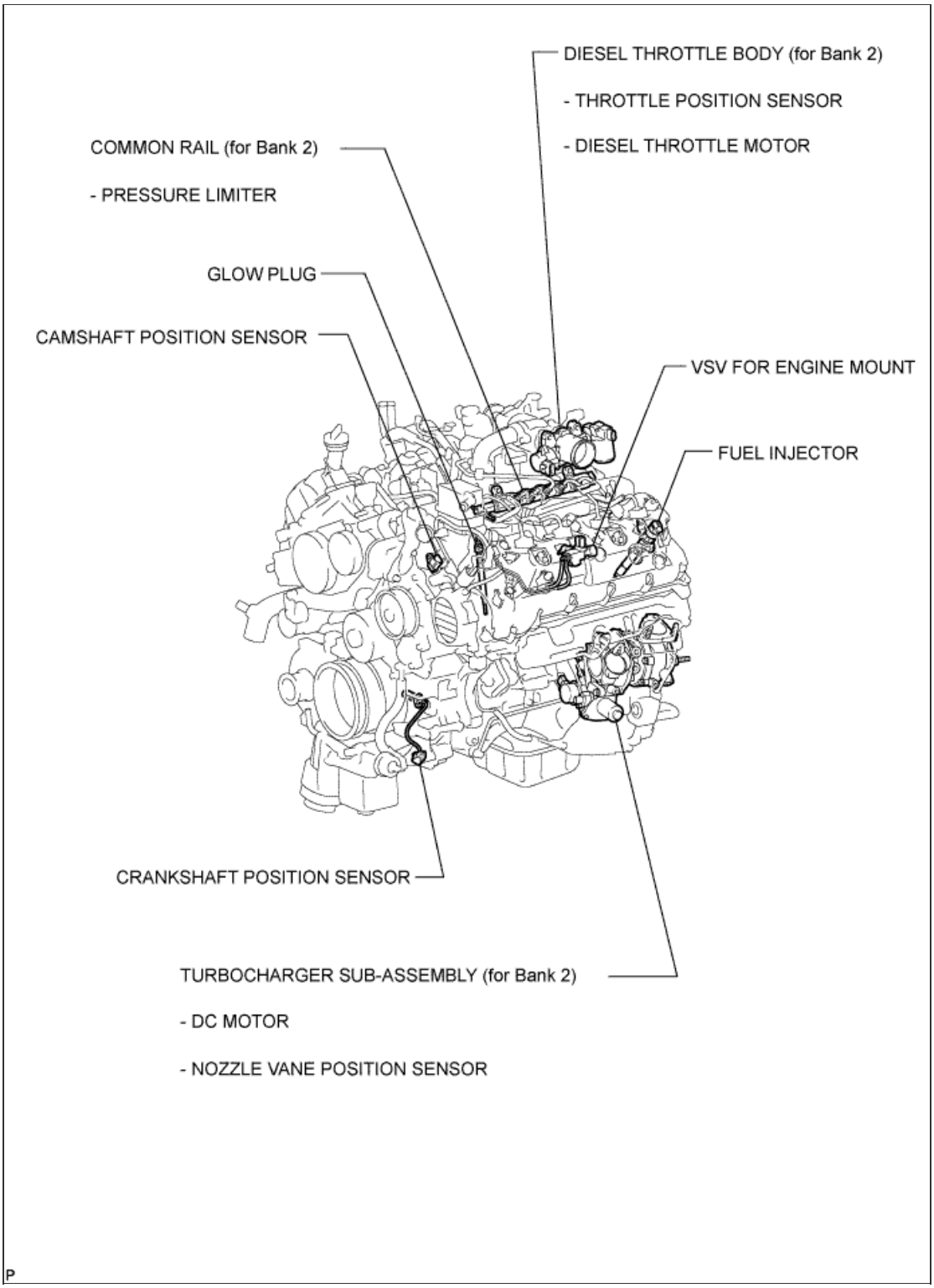
- EFI RELAY - IGNITION RELAY NO. 2 (IG2) - EDU RELAY (EDU 1) - EDU RELAY (EDU 2)
- STARTER RELAY (ST) - STARTER CUT RELAY (ST CUT) - NO. 1 GLOW RELAY (GLOW 1)
- NO. 2 GLOW RELAY (GLOW 2) - FUEL PUMP RELAY (SUB PUMP)*2 - EFI MAIN FUSE
- EFI MAIN 2 FUSE - IGN FUSE - EFI NO. 2 FUSE - IG2 MAIN FUSE - EFI NO. 2 FUSE
- STOP FUSE - GLOW 1 FUSE - GLOW 2 FUSE - STOP FUSE

*1: for RHD

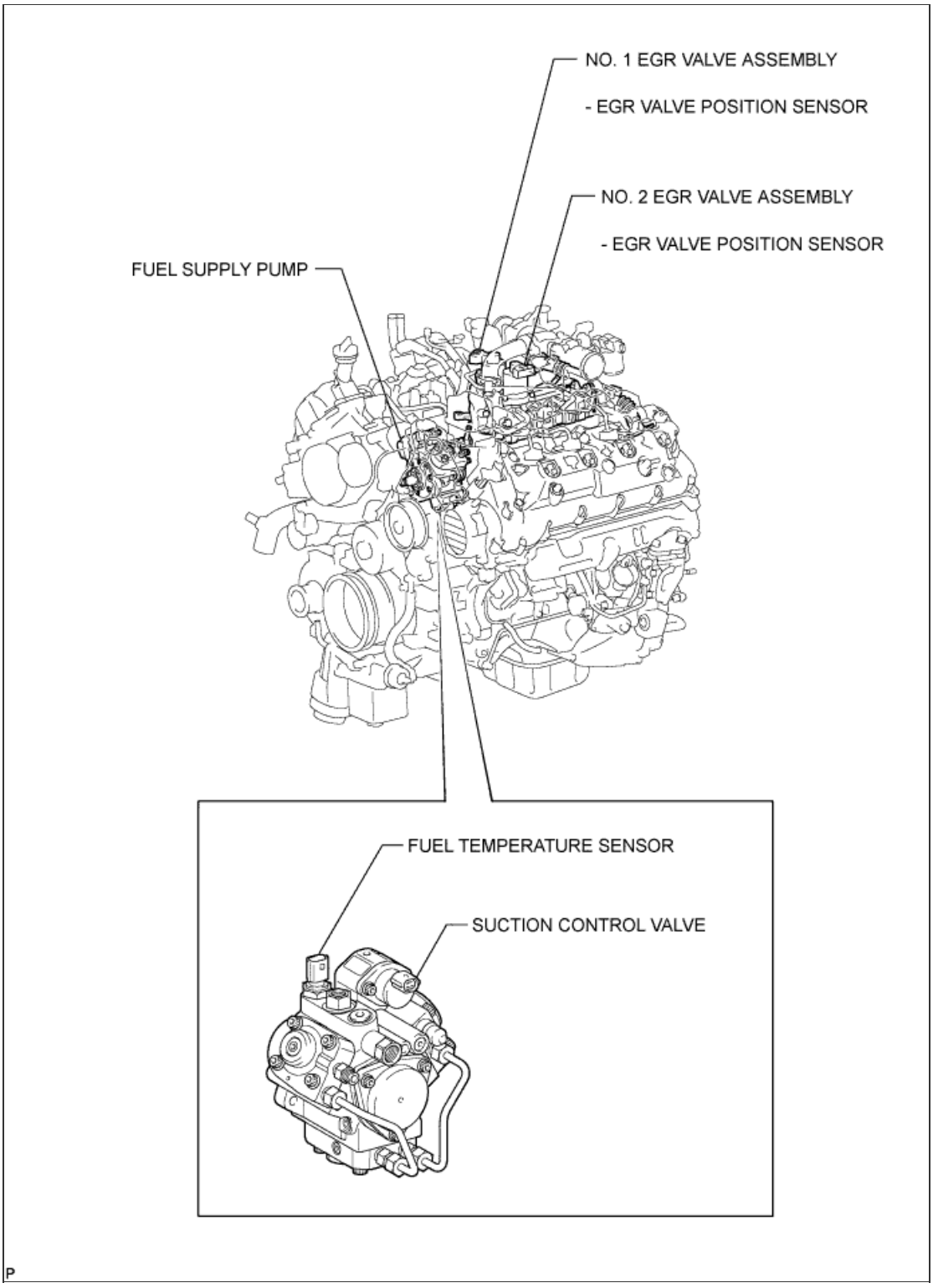
*2: Double Tank Type

P

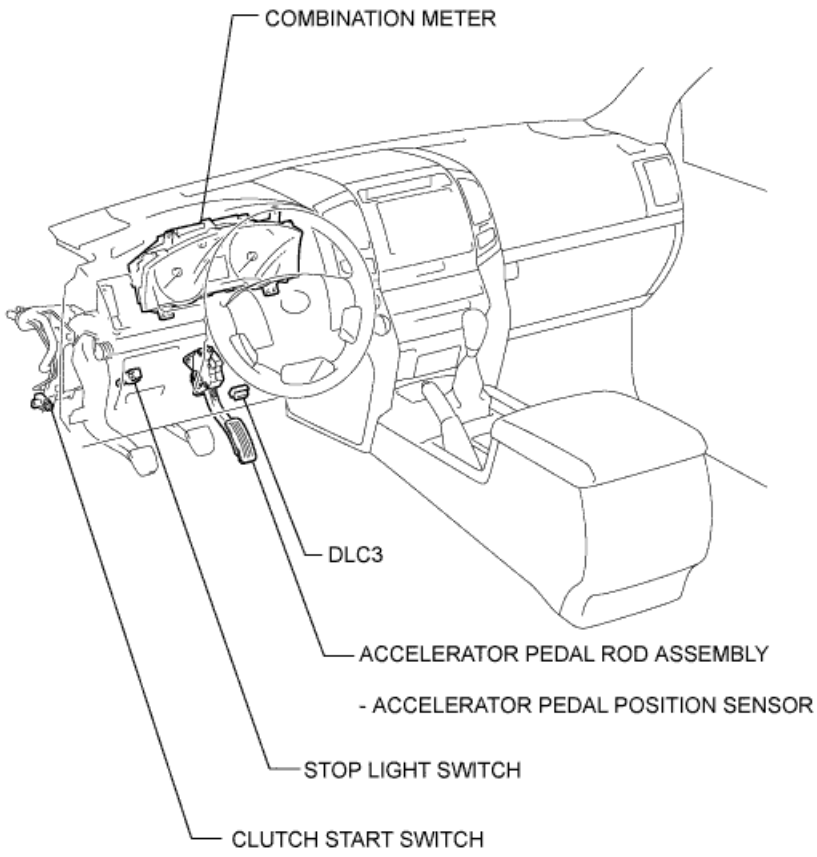

DIESEL THROTTLE BODY (for Bank 1)
- DIESEL THROTTLE MOTOR
- THROTTLE POSITION SENSOR
COMMON RAIL (for Bank 1)
- FUEL PRESSURE SENSOR
FUEL INJECTOR
GLOW PLUG
ENGINE COOLANT TEMPERATURE SENSOR
TURBOCHARGER SUB-ASSEMBLY (for Bank 1)
- NOZZLE VANE POSITION SENSOR
- DC MOTOR
P


DIESEL THROTTLE BODY (for Bank 2)
- THROTTLE POSITION SENSOR
- DIESEL THROTTLE MOTOR
COMMON RAIL (for Bank 2)
- PRESSURE LIMITER
GLOW PLUG
CAMSHAFT POSITION SENSOR
VSV FOR ENGINE MOUNT
FUEL INJECTOR
CRANKSHAFT POSITION SENSOR
TURBOCHARGER SUB-ASSEMBLY (for Bank 2)
- DC MOTOR
- NOZZLE VANE POSITION SENSOR

P

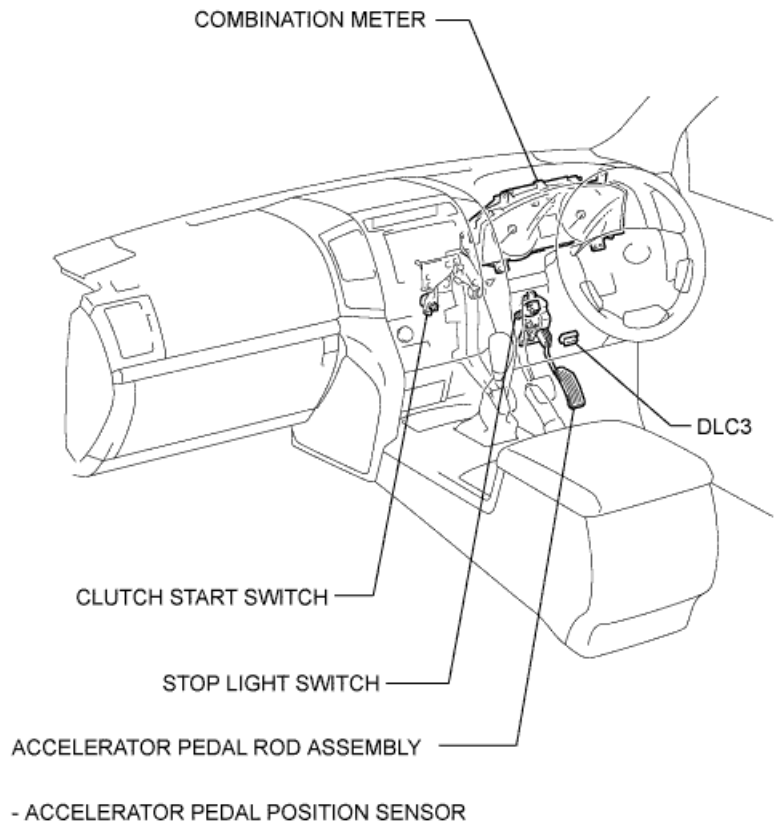

NO. 1 EGR VALVE ASSEMBLY
- EGR VALVE POSITION SENSOR
NO. 2 EGR VALVE ASSEMBLY
- EGR VALVE POSITION SENSOR
FUEL SUPPLY PUMP
FUEL TEMPERATURE SENSOR
SUCTION CONTROL VALVE
P

for LHD:


COMBINATION METER
DLC3
ACCELERATOR PEDAL ROD ASSEMBLY
- ACCELERATOR PEDAL POSITION SENSOR
STOP LIGHT SWITCH
CLUTCH START SWITCH

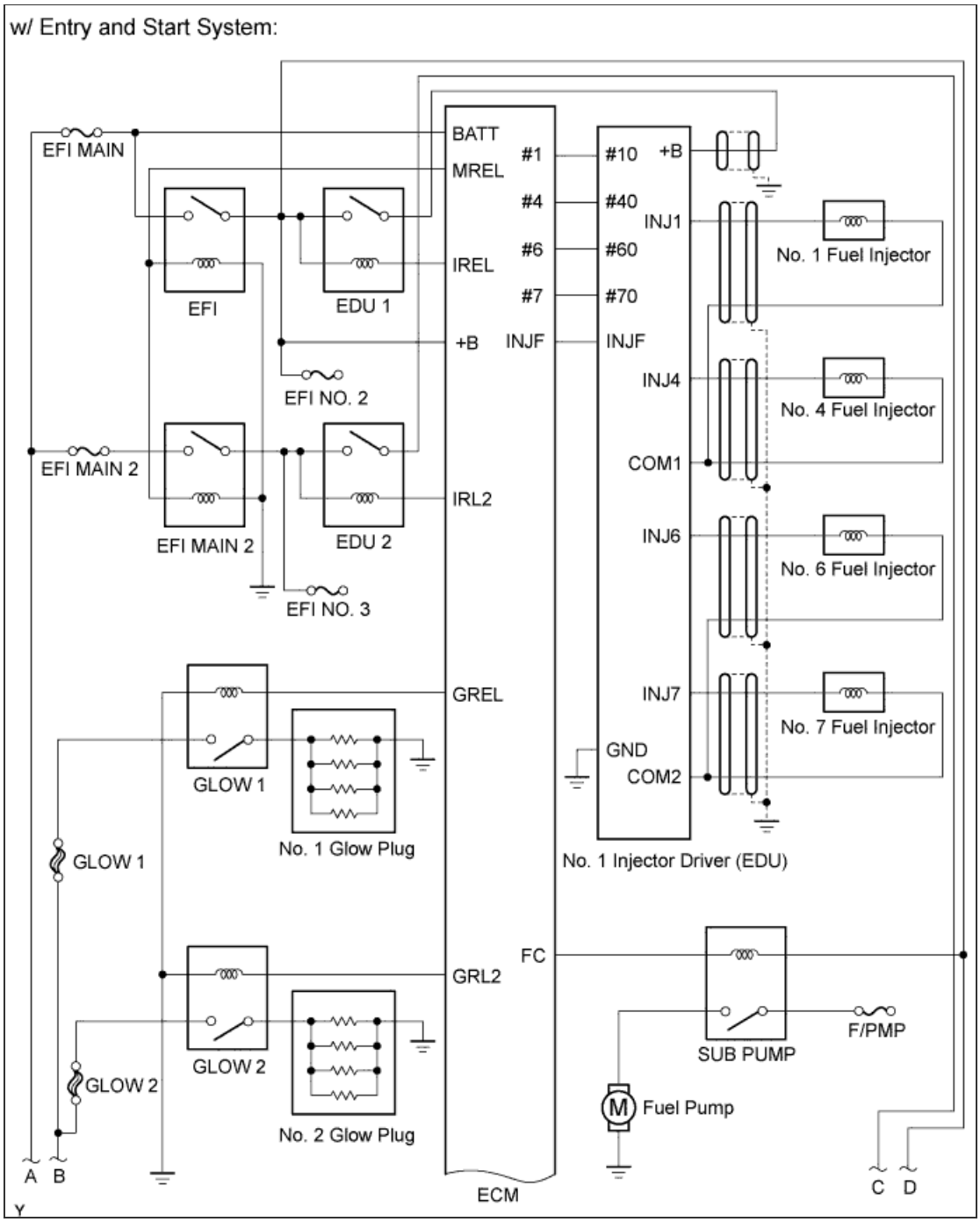
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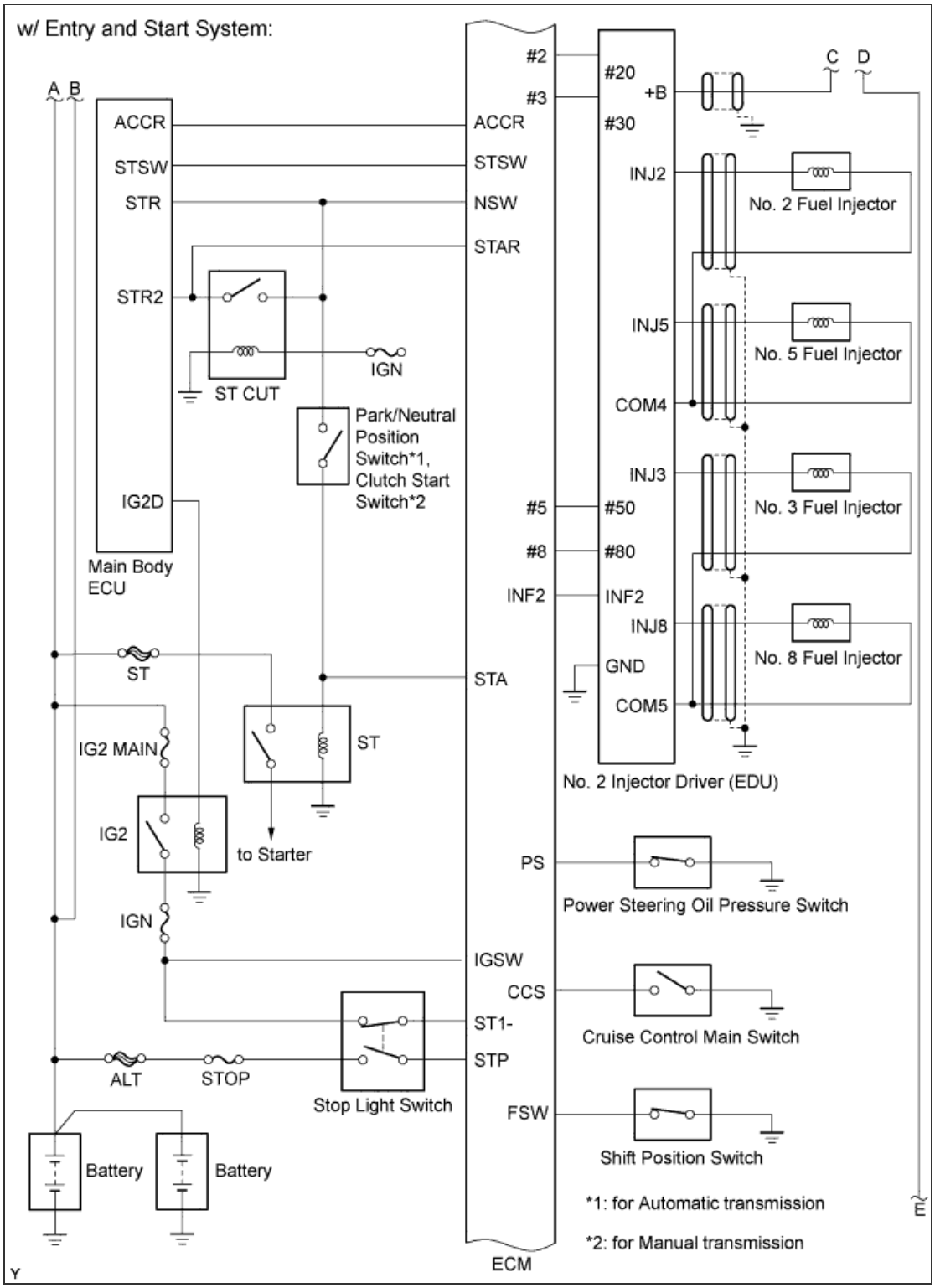
for RHD:


COMBINATION METER
DLC3
CLUTCH START SWITCH
STOP LIGHT SWITCH
ACCELERATOR PEDAL ROD ASSEMBLY
- ACCELERATOR PEDAL POSITION SENSOR

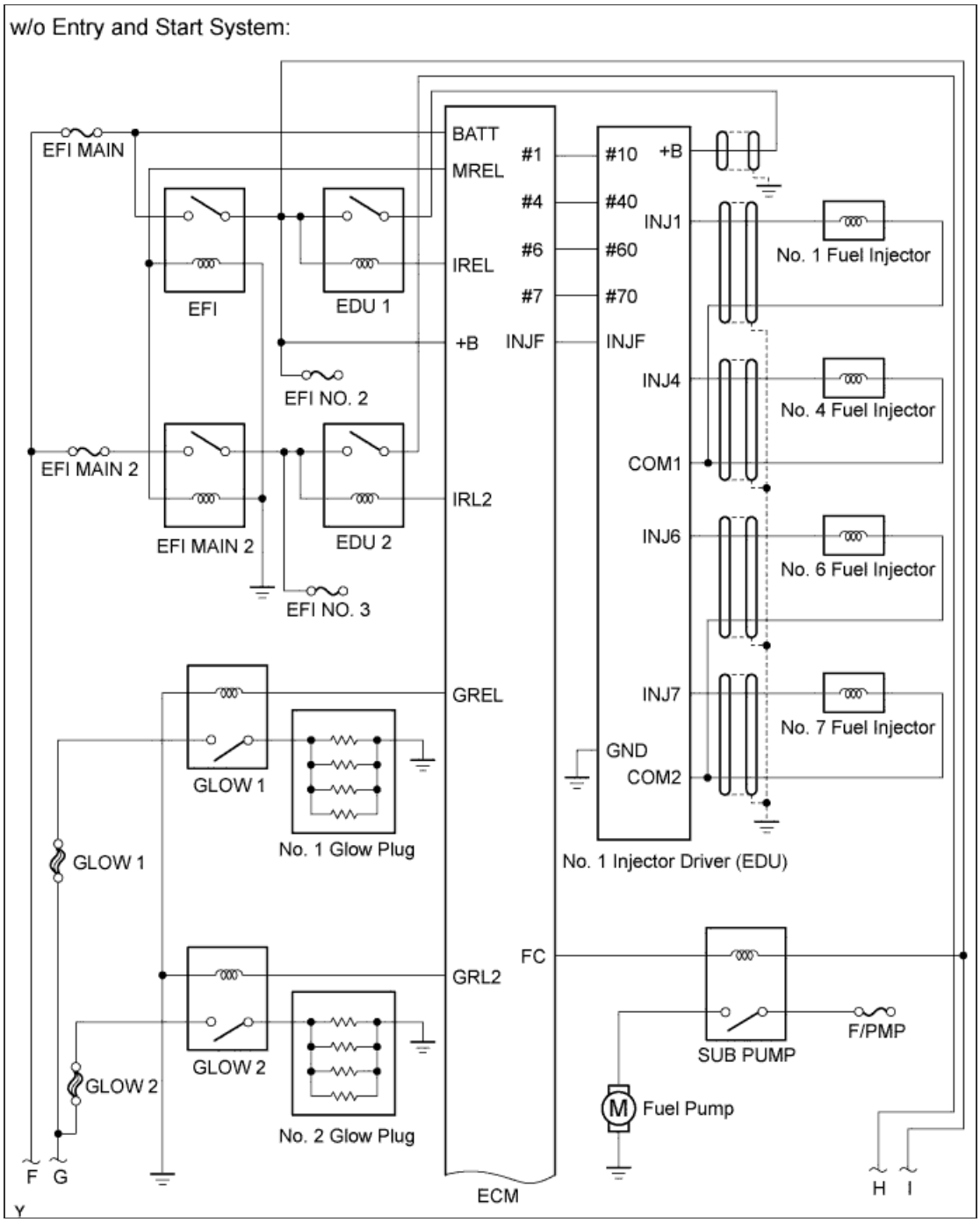
P

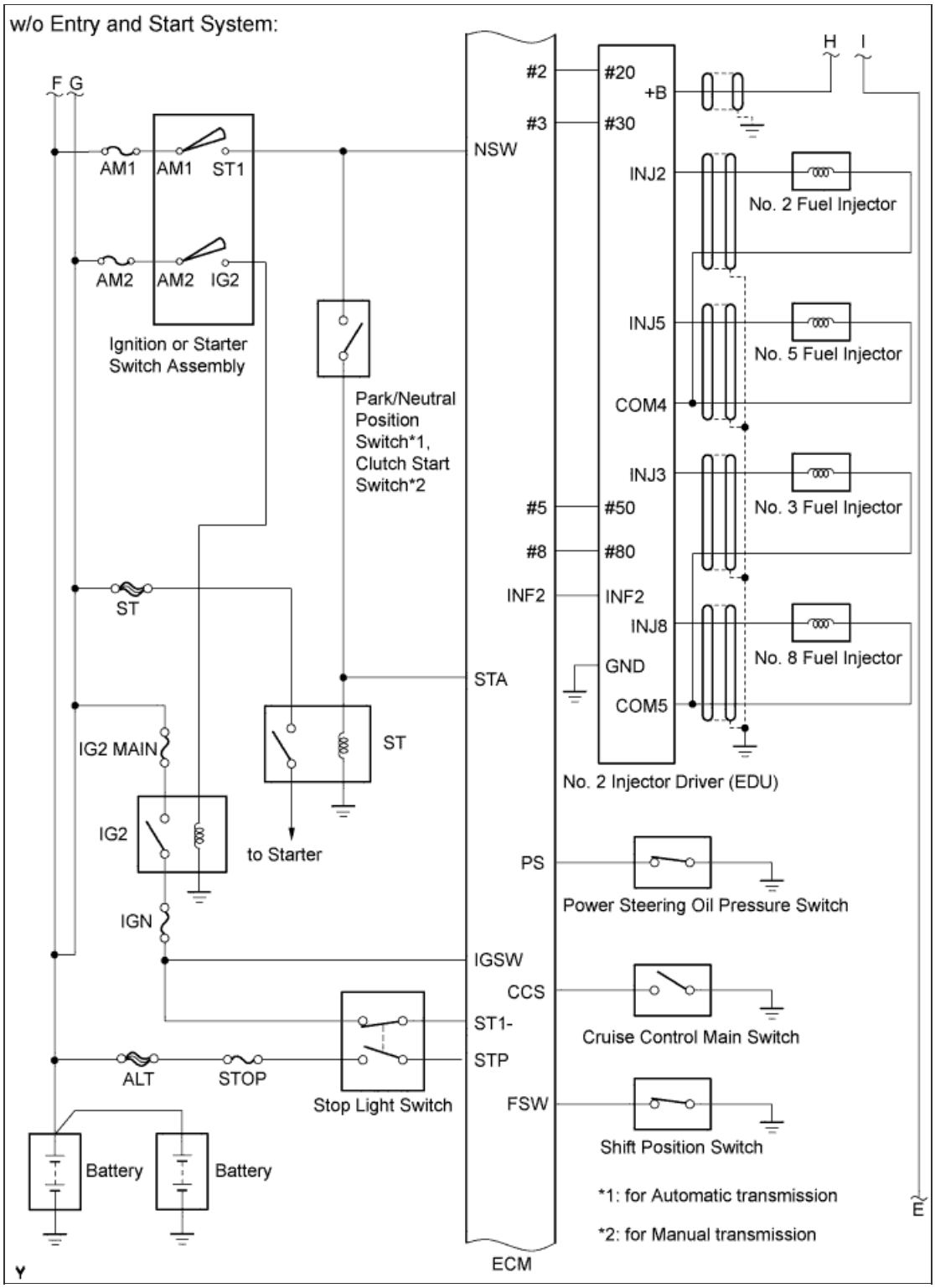
for Preparation Click here

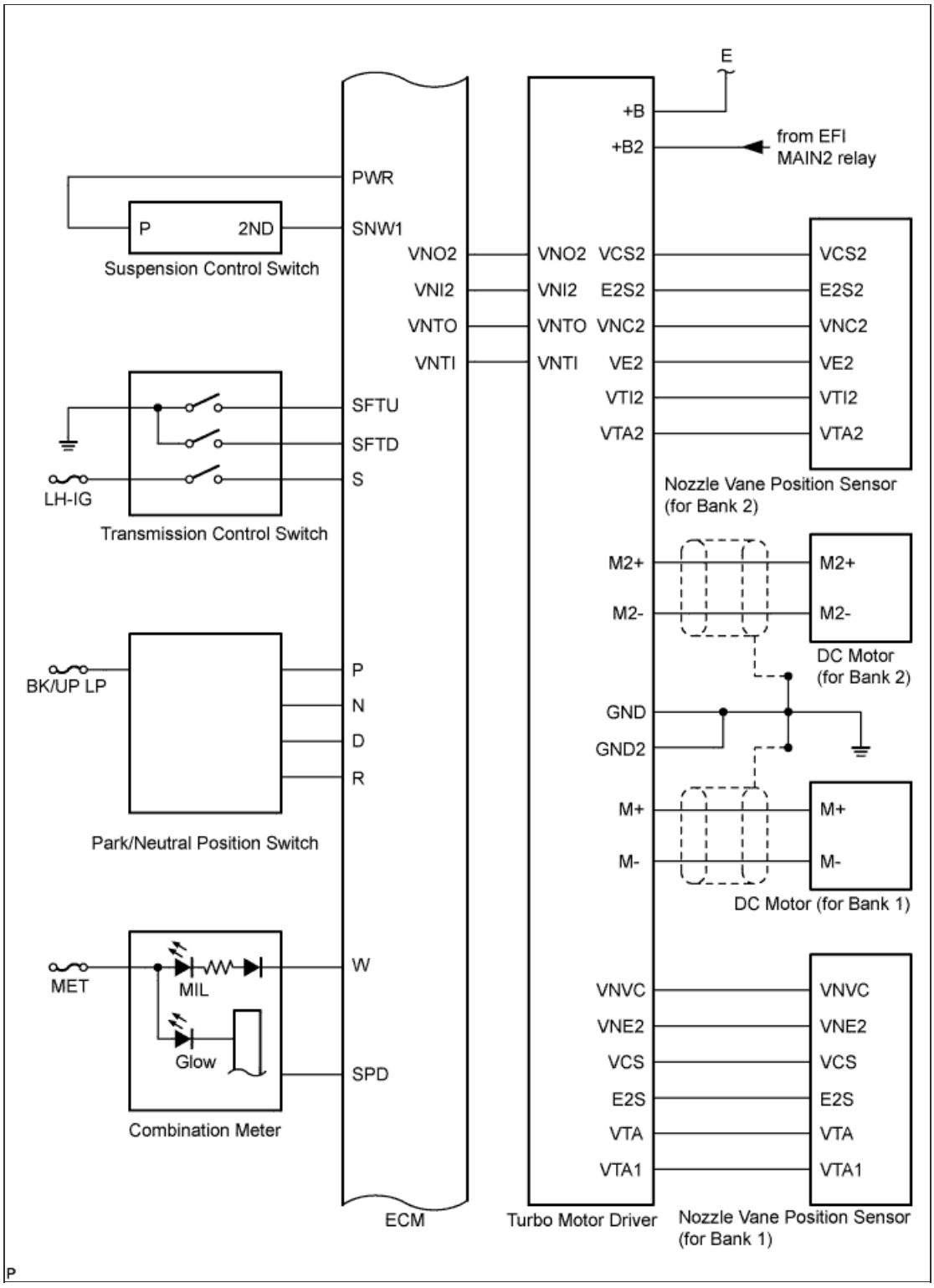


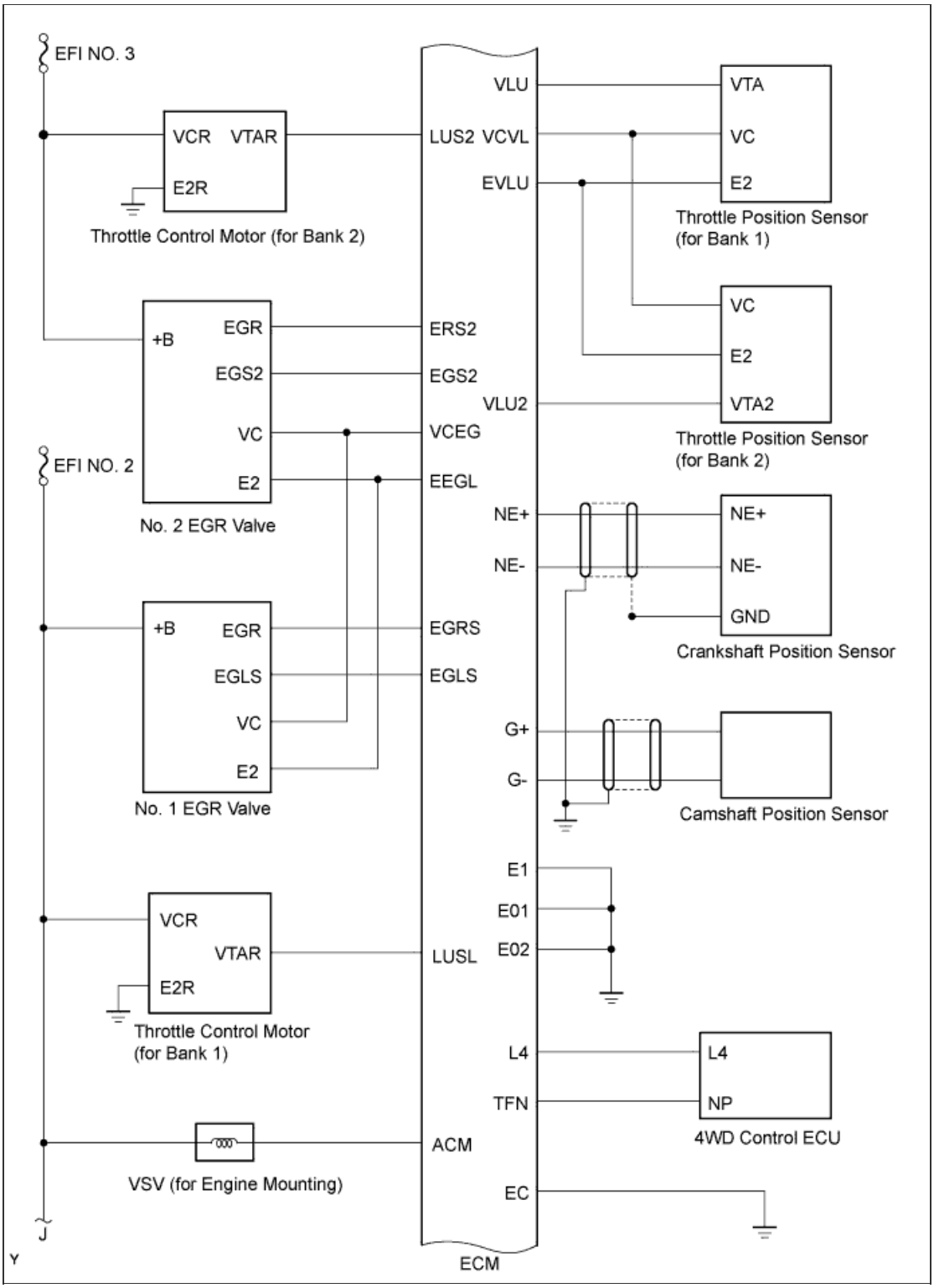

w/ Entry and Start System:
A B
ACCR
STSW
STR
STR2
IG2D
Main Body ECU
ST CUT
IGN
Park/Neutral Position Switch*1, Clutch Start Switch*2
ST
IG2 MAIN
IG2
to Starter
ST
IGN
ALT
STOP
Stop Light Switch
Battery
Battery
#2
#3
ACCR
STSW
NSW
STAR
#5
#8
INF2
STA
IGSW
ST1-
STP
ECM
#20
#30
+B
INJ2
INJ5
COM4
INJ3
#50
#80
INF2
INJ8
GND
COM5
No. 2 Injector Driver (EDU)
C D
No. 2 Fuel Injector
No. 5 Fuel Injector
No. 3 Fuel Injector
No. 8 Fuel Injector
PS
Power Steering Oil Pressure Switch
CCS
Cruise Control Main Switch
FSW
Shift Position Switch
E
*1: for Automatic transmission
*2: for Manual transmission
Y

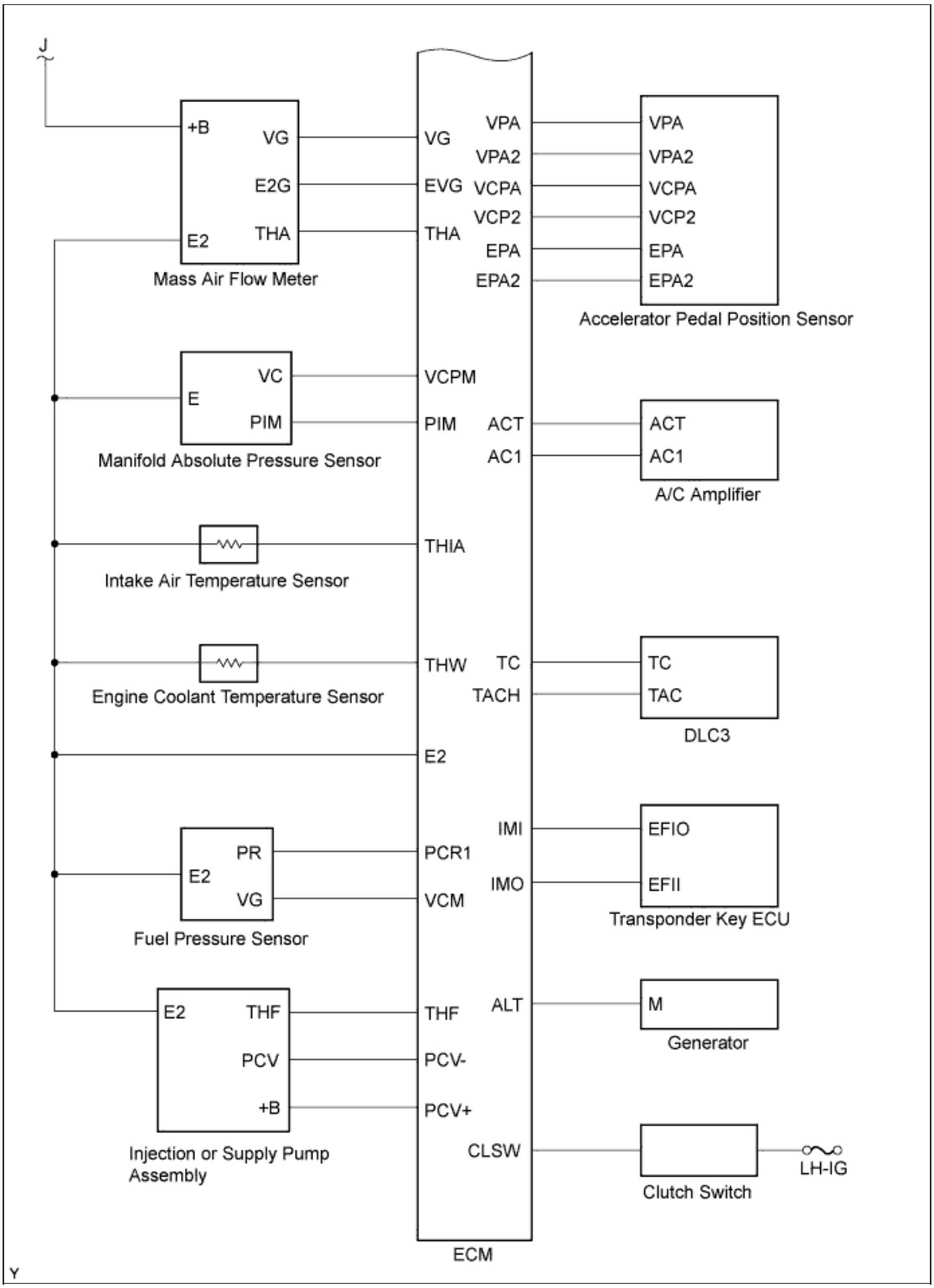
w/o Entry and Start System:




w/o Entry and Start System:
F G
AM1
AM1
ST1
AM2
AM2
IG2
Ignition or Starter Switch Assembly
Park/Neutral Position Switch*1, Clutch Start Switch*2
ST
IG2 MAIN
IG2
IGN
ST
to Starter
ALT
STOP
Stop Light Switch
Battery
Battery
#2
#3
NSW
STA
IGSW
ST1-
STP
#5
#8
INF2
PS
CCS
FSW
ECM
#20
#30
+B
INJ2
INJ5
COM4
INJ3
#50
#80
INF2
INJ8
GND
COM5
No. 2 Injector Driver (EDU)
No. 2 Fuel Injector
No. 5 Fuel Injector
No. 3 Fuel Injector
No. 8 Fuel Injector
Power Steering Oil Pressure Switch
Cruise Control Main Switch
Shift Position Switch
H
I
E
*1: for Automatic transmission
*2: for Manual transmission
Y

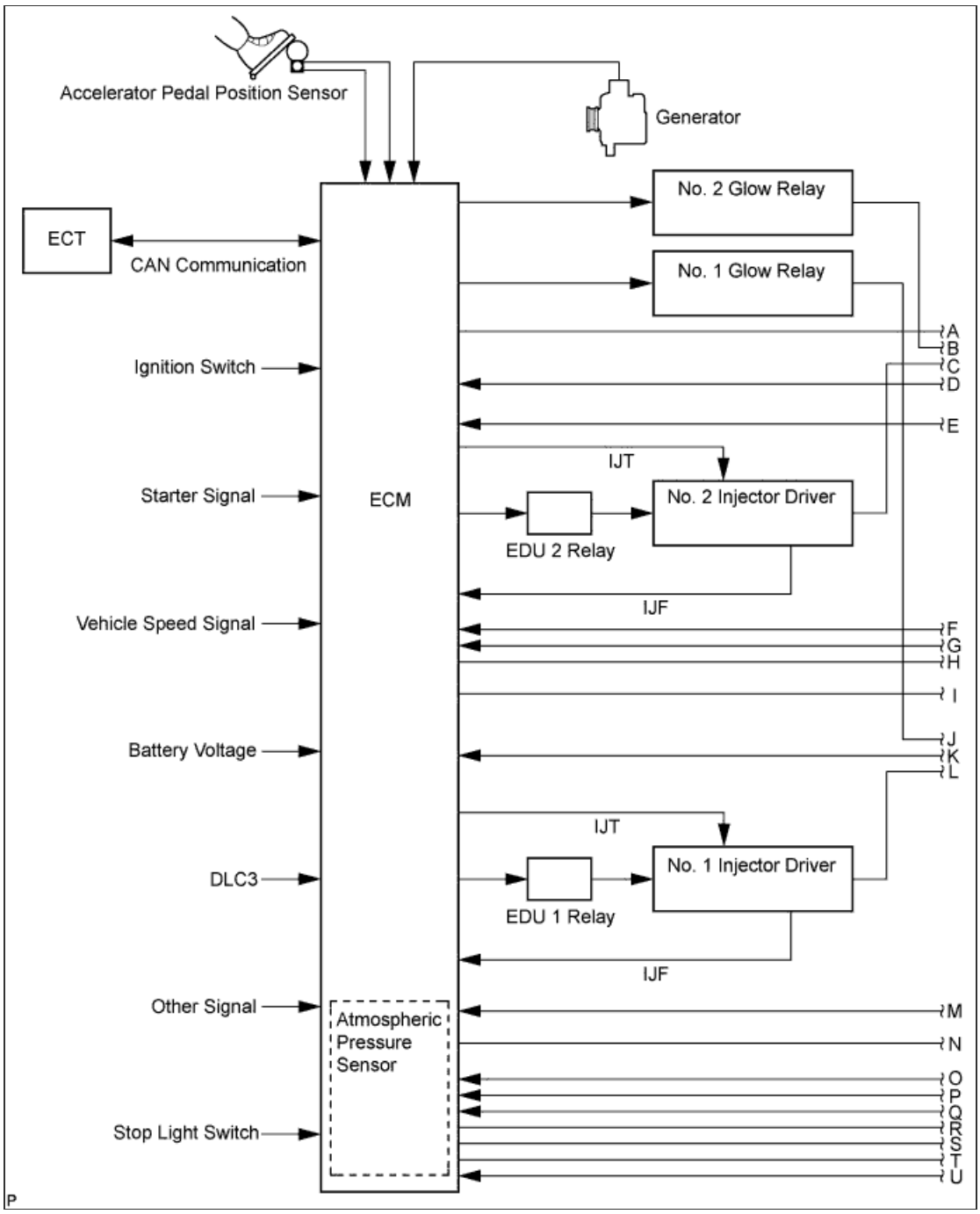

E
+B
+B2
from EFI
MAIN2 relay
PWR
P
2ND
SNW1
Suspension Control Switch
VNO2
VNI2
VNTO
VNTI
VNO2
VNI2
VNTO
VNTI
VCS2
E2S2
VNC2
VE2
VTI2
VTA2
VCS2
E2S2
VNC2
VE2
VTI2
VTA2
Nozzle Vane Position Sensor
(for Bank 2)
SFTU
SFTD
S
LH-IG
Transmission Control Switch
M2+
M2-
M2+
M2-
DC Motor
(for Bank 2)
BK/UP LP
P
N
D
R
Park/Neutral Position Switch
GND
GND2
M+
M-
M+
M-
DC Motor (for Bank 1)
MET
MIL
Glow
W
SPD
Combination Meter
VNVC
VNE2
VCS
E2S
VTA
VTA1
VNVC
VNE2
VCS
E2S
VTA
VTA1
ECM
Turbo Motor Driver
Nozzle Vane Position Sensor
(for Bank 1)
P

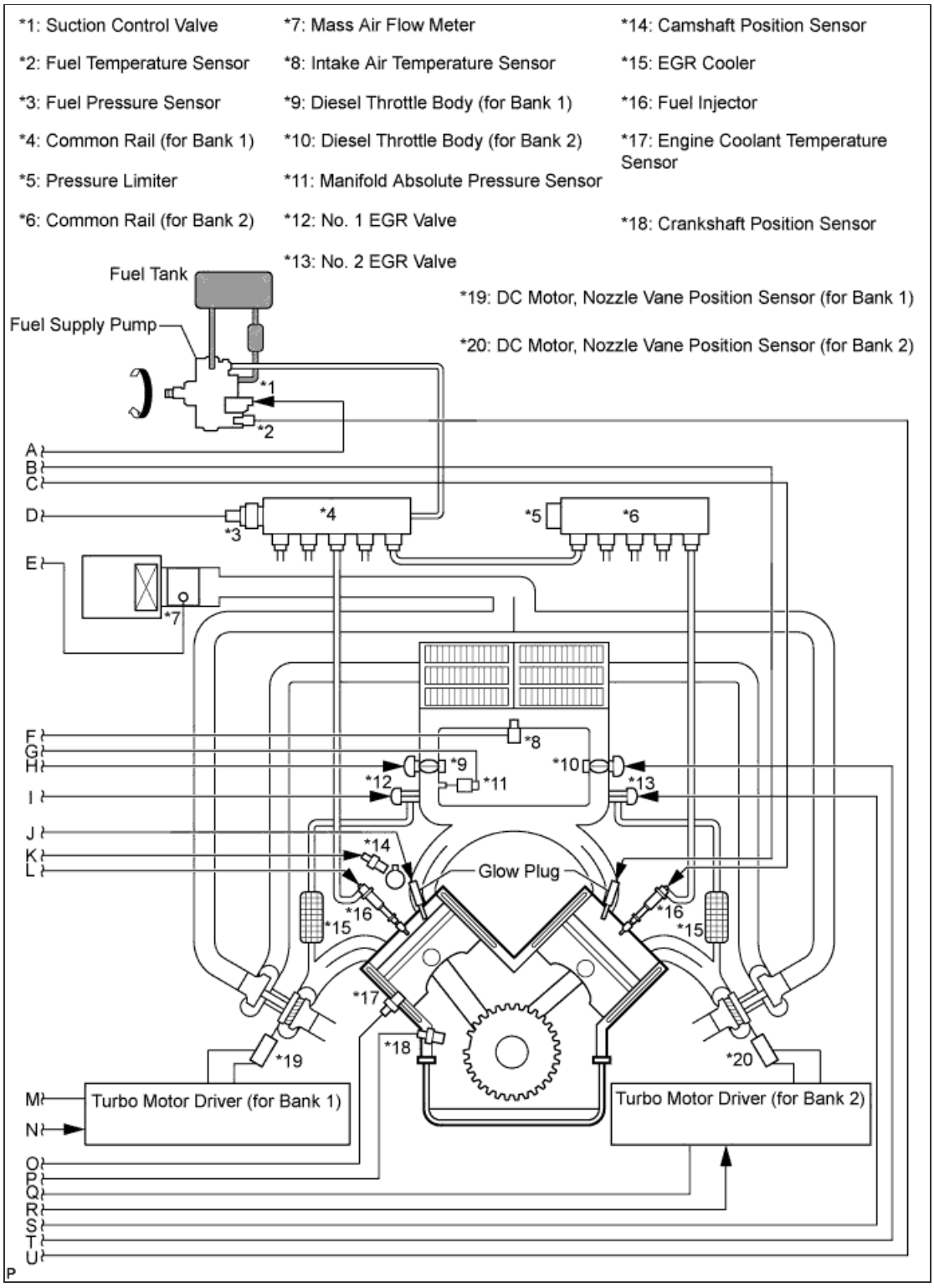

EFI NO. 3
VCR
VTAR
E2R
Throttle Control Motor (for Bank 2)
+B
EGR
EGS2
VC
E2
EFI NO. 2
No. 2 EGR Valve
+B
EGR
EGLS
VC
E2
No. 1 EGR Valve
VCR
VTAR
E2R
Throttle Control Motor
(for Bank 1)
VSV (for Engine Mounting)
J
Y
VLU
LUS2
VCVL
EVLU
ERS2
EGS2
VLU2
VCEG
EEGL
NE+
NE-
EGRS
EGLS
G+
G-
E1
E01
E02
LUSL
L4
TFN
ACM
EC
ECM
VTA
VC
E2
Throttle Position Sensor
(for Bank 1)
VC
E2
VTA2
Throttle Position Sensor
(for Bank 2)
NE+
NE-
GND
Crankshaft Position Sensor
Camshaft Position Sensor
L4
NP
4WD Control ECU


J
+B
VG
E2G
E2
THA
Mass Air Flow Meter
VC
E
PIM
Manifold Absolute Pressure Sensor
Intake Air Temperature Sensor
Engine Coolant Temperature Sensor
PR
E2
VG
Fuel Pressure Sensor
E2
THF
PCV
+B
Injection or Supply Pump Assembly
VG
EVG
THA
VCPM
PIM
THIA
THW
E2
PCR1
VCM
THF
PCV-
PCV+
CLSW
VPA
VPA2
VCPA
VCP2
EPA
EPA2
ACT
AC1
TC
TACH
IMI
IMO
ALT
ECM
VPA
VPA2
VCPA
VCP2
EPA
EPA2
Accelerator Pedal Position Sensor
ACT
AC1
A/C Amplifier
TC
TAC
DLC3
EFIO
EFII
Transponder Key ECU
M
Generator
Clutch Switch
LH-IG
Y

for Preparation Click here

SYSTEM DIAGRAM





COMMON RAIL INJECTION SYSTEM

Common Rail Injection System:

The common rail injection system uses high-pressure fuel to improve fuel economy and to provide robust engine power, while suppressing engine vibration and noise.

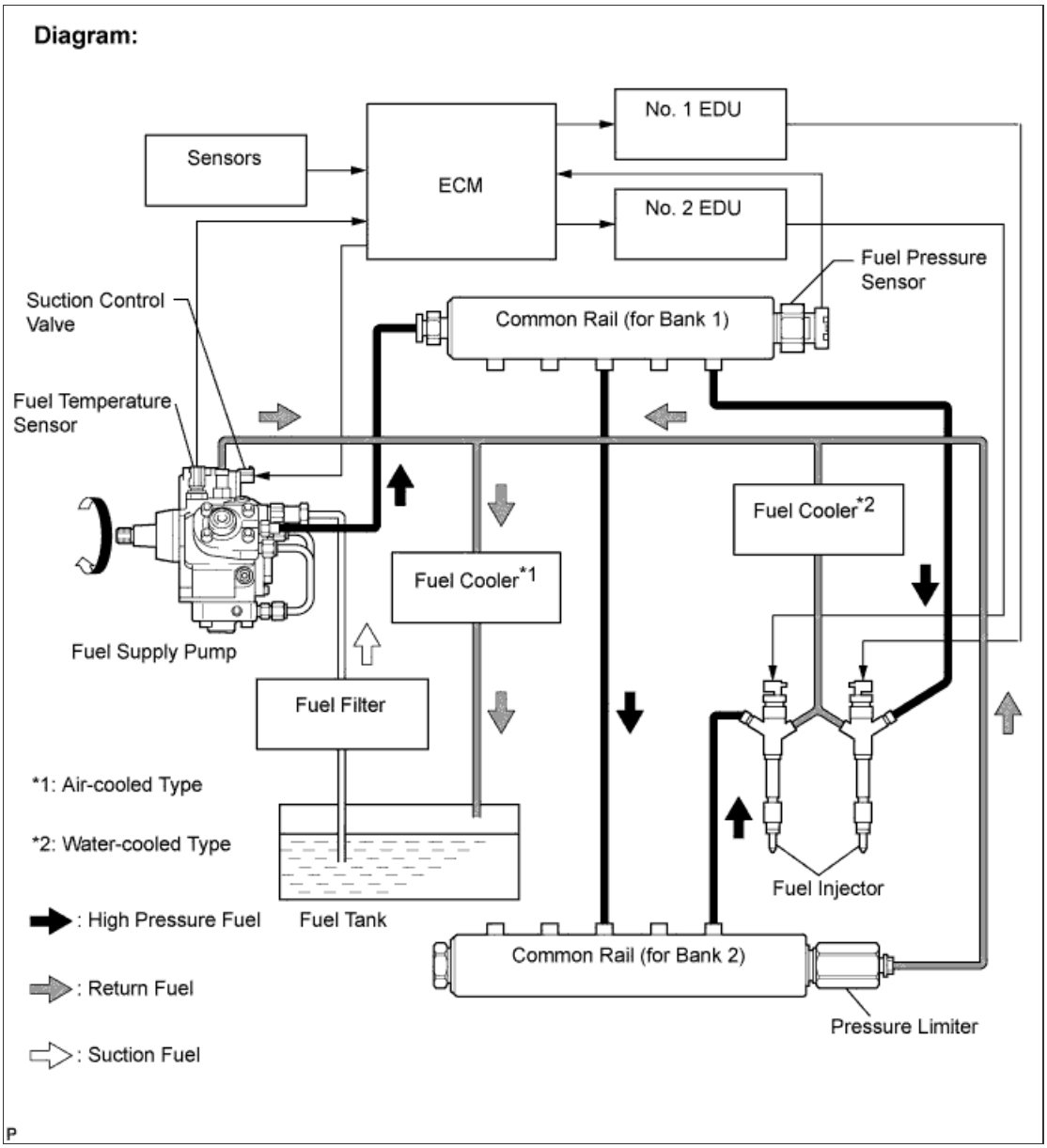
This system stores fuel, which has been pressurized and supplied by the fuel supply pump, in the common rail. By storing fuel at high-pressure, the common rail system can provide fuel at stable fuel injection pressures, regardless of engine speed or engine load.

The ECM regulates the fuel injection timing and volume by using the EDU to provide an electric current to the solenoid valve in the fuel injector. The ECM also monitors the internal fuel pressure of the common rail using the fuel pressure sensor. The ECM causes the fuel supply pump to supply the fuel necessary to obtain the target fuel pressure.

In addition, this system has a 2-Way Valve (TWV) inside the fuel injector to open and close the fuel passage. As a result, both fuel injection timing and fuel injection volume can be precisely regulated by the ECM.

The common rail system provides two split fuel injections. In order to soften combustion shock, this system performs "pilot-injection" as the subsidiary fuel injection prior to the main fuel injection. This helps to reduce engine vibration and noise.

Diagram:



Components:

Component	Description
Common rail	Stores high-pressure fuel produced by fuel supply pump
Fuel supply pump	Operated by crankshaft. Supplies high-pressure fuel to common rail.
Fuel injector	Injects fuel to combustion chamber based on signals from ECM
Fuel pressure sensor	Monitors internal fuel pressure of common rail and sends signals to ECM
Pressure limiter	Opens pressure limiter valve to reduce internal pressure in common rail when common rail pressure exceeds specified level
Suction control valve	Based on signals from ECM, adjusts fuel volume supplied to common rail and regulates internal fuel pressure

Diagnostic Trouble Code (DTC) Table for Common Rail System:

HINT:

This table indicates typical DTCs for each malfunction.

Component	Trouble Area	DTC No.
Fuel injector	Open or short in fuel injector circuit	P062D, P062E, P1238, P0093*
	Stuck open	P0093, P1238
	Stuck closed	P1238
Fuel pressure sensor	Open or short in fuel pressure sensor circuit or pressure sensor output fixed	P0087, P0190, P0192, P0193
	Stuck open	P0093

Pressure limiter	Stuck closed	P0088*
Suction control valve	Open or short in suction control valve circuit	P0627, P1229, P0088*
	Stuck open	P1229, P0088*
	Stuck closed	-
Injector driver (EDU)	Faulty EDU	P0093*, P062D*, P062E*, P1238*
Common rail system (Fuel system)	Fuel leaks in high-pressure areas	P0093

HINT:

*: There may be no DTC output depending on the condition of the malfunction.

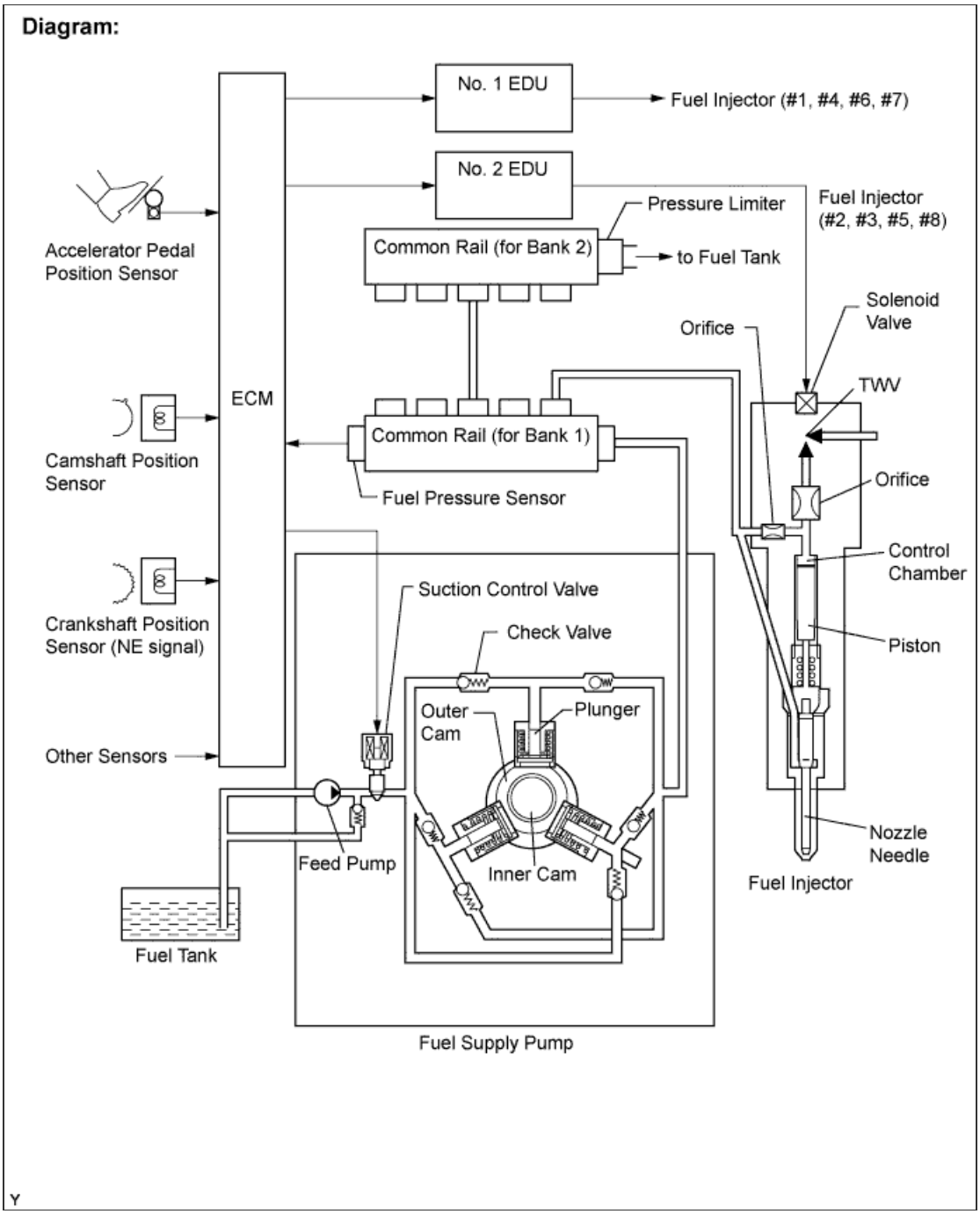
Diagnostic Trouble Code Description for Common Rail System:

DTC No.	Description
P0087	Fuel pressure sensor output does not change
P0088	Internal fuel pressure too high (230 MPa [2345 kgf/cm ^{2}, 33350 psi] or more)
P0093	Fuel leaks in high-pressure areas
P0190	Open or short in fuel pressure sensor circuit (Low or high output)
P0192	Open or short in fuel pressure sensor circuit (Low output)
P0193	Open or short in fuel pressure sensor circuit (High output)
P062D	Open or short in No. 1 injector driver or fuel injector circuit
P062E	Open or short in No. 2 injector driver or fuel injector circuit
P0627	Open or short in suction control valve circuit
P1229	Fuel over-feed
P1238	Injection malfunction; excludes open or short in fuel injector circuit
P1601	Fuel injector compensation code malfunction

INJECTION CONTROL

The ECM controls the fuel injection system by using the fuel injectors and fuel supply pump. The ECM regulates the fuel injection volume and fuel injection timing by controlling the duration and timing of the electric current provided to the solenoid valve in the fuel injector. The ECM regulates injection pressure by controlling the suction control valve located in the fuel supply pump.
The feed pump is used to pump fuel from the fuel tank to the fuel supply pump.

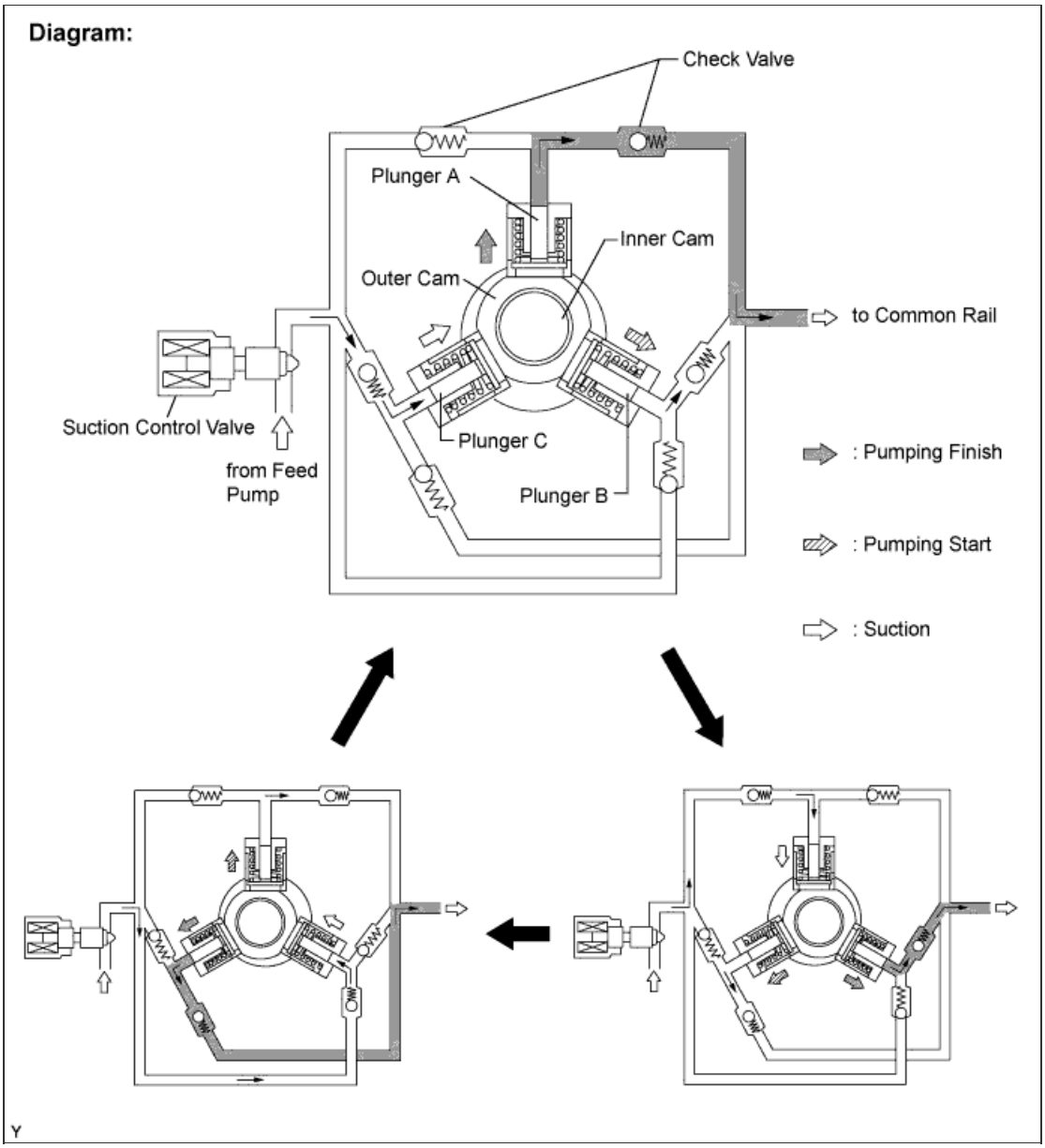
Diagram:



FUEL SUPPLY PUMP

Due to the rotation of the inner cam (eccentric cam), the outer cam pushes plunger A upward as illustrated below. The force of the spring pulls plunger B and C. As a result, plunger B and C draw fuel in, and plunger A pumps fuel at the same time.

Diagram:



SUCTION CONTROL VALVE

HINT:

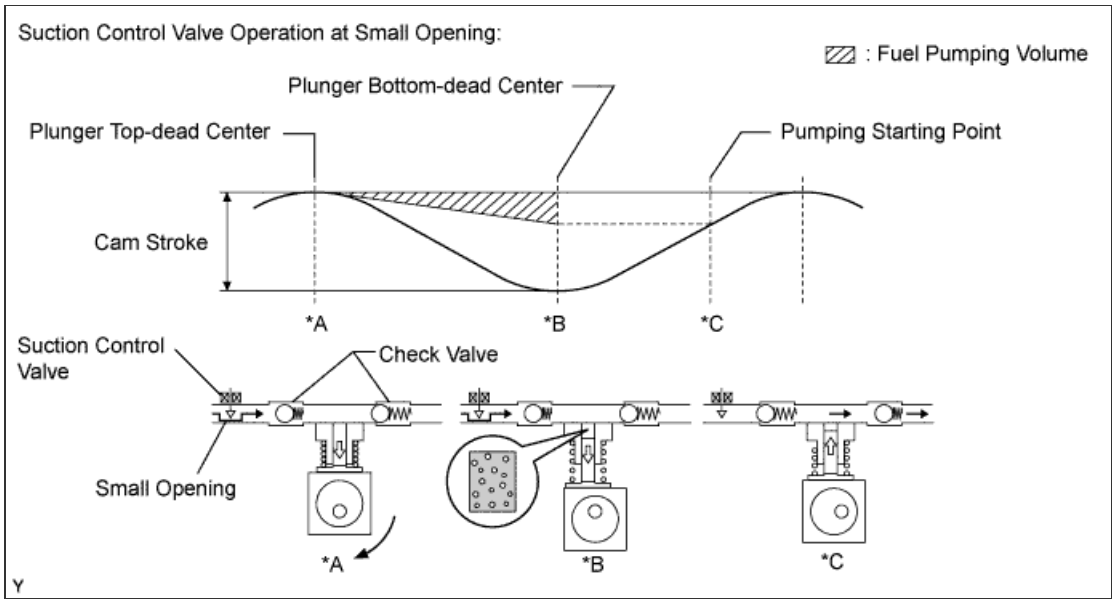
The ECM controls the suction control valve operation to regulate the fuel volume that is pumped by the fuel supply pump to the common rail. This control is performed to adjust the internal fuel pressure of the common rail to the targeted injection pressure.

a. Small opening of the suction control valve:

i. When the opening of the suction control valve is small, the fuel suction path is kept narrow. Therefore the transferable fuel volume is reduced*A.

ii. The suction volume becomes small due to the narrow path despite the plunger stroke being full. The difference between the geometrical volume and suction volume creates a vacuum*B.

iii. Pumping will start when the fuel pressure becomes higher than the common rail pressure*C.

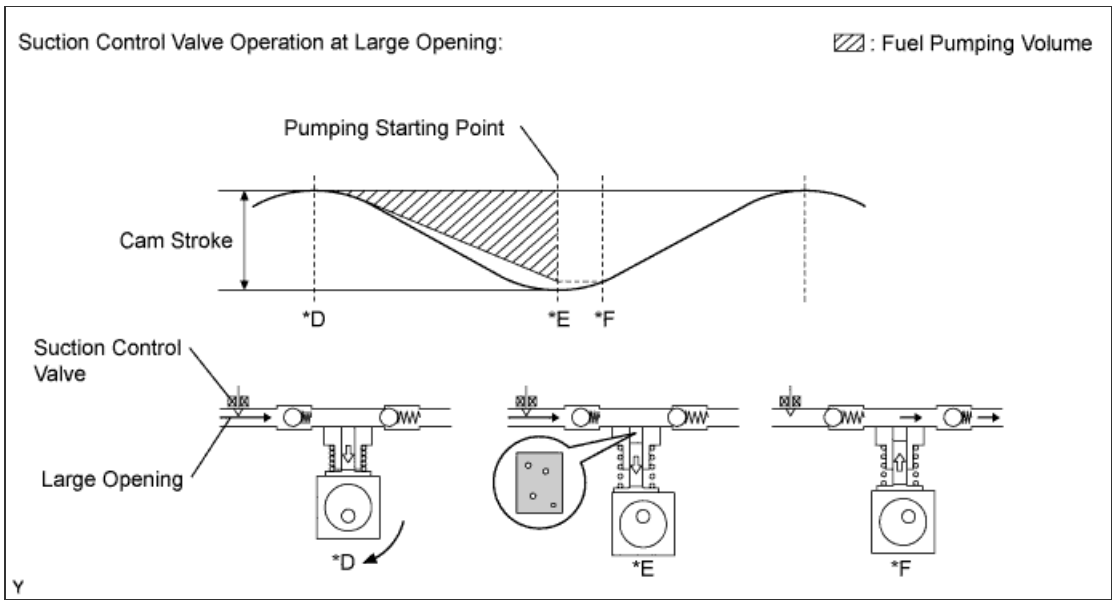


b. Large opening of the suction control valve:

i. When the opening of the suction control valve is large, the fuel suction path is kept wide. Therefore the transferable fuel volume is increased*D.

ii. If the plunger stroke is full, the suction volume becomes large because of the wide path*E.

iii. Pumping will start when the fuel pressure becomes higher than the common rail pressure*F.



for Preparation Click here

HINT:

*: Use the intelligent tester.

1.VEHICLE BROUGHT TO WORKSHOP

NEXT

2.CUSTOMER PROBLEM ANALYSIS

NEXT

3.CONNECT INTELLIGENT TESTER TO DLC3

HINT:

If the display indicates a communication fault with the tester, inspect the DLC3.

NEXT

4.CHECK DTC AND FREEZE FRAME DATA*

HINT:

Record or print DTCs and freeze frame data if necessary.

NEXT

5.CLEAR DTC AND FREEZE FRAME DATA*

NEXT

6.VISUAL INSPECTION

NEXT

7.SET CHECK MODE DIAGNOSIS*

a. Refer to the check mode procedure (Click here).

NEXT

8.CONFIRM PROBLEM SYMPTOMS

HINT:

If the engine does not start, first perform the Check DTC" procedures and "Basic Inspection" procedures below.

Result

Result	Proceed to
Malfunction occurs	A
Malfunction does not occur	B

B. → SIMULATE SYMPTOMS

A

9.CHECK DTC*

Result

Result	Proceed to
Trouble code	A
No trouble code	B

B. → Go to step 11

A

10.REFER TO DTC CHART

NEXT

Go to step 13

11.BASIC INSPECTION

Result

Result	Proceed to
Malfunctioning parts not confirmed	A
Malfunctioning parts confirmed	B

B. → Go to step 16

A

12.REFER TO PROBLEM SYMPTOMS TABLE

HINT:

Refer to the Problem Symptoms Table (Click here).

Result

Result	Proceed to
Malfunctioning circuit confirmed	A
Malfunctioning parts confirmed	B

B. → Go to step 16

A

13.CHECK ECM POWER SOURCE CIRCUIT

NEXT

14.CONDUCT CIRCUIT INSPECTION

Result

Result	Proceed to
Malfunction not confirmed	A
Malfunction confirmed	B

B. Go to step 17

A

15.CHECK FOR INTERMITTENT PROBLEMS

NEXT

Go to step 18

16.PARTS INSPECTION

NEXT

17.IDENTIFY PROBLEM

NEXT

18.ADJUST AND/OR REPAIR

NEXT

19.CONFIRMATION TEST

NEXT

END

for Preparation Click here

HINT:

Intelligent tester only:

Inspect the vehicle ECM using check mode. Intermittent problems are easier to detect with the intelligent tester when the ECM is in check mode. In check mode, the ECM uses 1 trip detection logic, which is more sensitive to malfunctions than normal mode (default), which uses 2 trip detection logic.

1. Clear DTCs (Click here).
2. Switch the ECM from normal mode to check mode using the intelligent tester (Click here).
3. Perform a simulation test.
4. Check and wiggle the harness(es), connector(s) and terminal(s).

for Preparation Click here

HINT:

When a malfunction cannot be confirmed by the DTC check, troubleshooting should be performed on all circuits that are possible causes of the problem. However, in most cases, performing the basic engine check shown below can help you find the problem quickly and efficiently. Always perform this check first when troubleshooting the engine.

1.CHECK BATTERY VOLTAGE

NOTICE:

Perform the battery voltage check with the engine stopped and ignition switch off.

Result

Result	Proceed to
11 V or higher	OK
Below 11 V	NG

NG. → CHARGE OR REPLACE BATTERY

OK ↓

2.CHECK IF ENGINE WILL CRANK

NG. → PROCEED TO PROBLEM SYMPTOMS TABLE

OK ↓

3.CHECK AIR FILTER

a. Visually check that the air filter is not excessively contaminated with dirt or oil.

NG. → CLEAN OR REPLACE AIR FILTER

OK ↓

4.CHECK FUEL QUALITY

a. Check that only diesel fuel is being used.

b. Check that the fuel does not contain any impurities.

NG. → REPLACE FUEL

OK ↓

5.CHECK FUEL FOR AIR

NG. → BLEED FUEL OF AIR

OK ↓

6.CHECK FUEL PIPES AND HOSES

a. Check that the fuel pipes and fuel hoses are not blocked, damaged, disconnected or bent.

NG. → REPAIR OR REPLACE

OK

7.CHECK FUEL FILTER FOR BLOCKAGE

NG. → REPAIR OR REPLACE

OK

8.CHECK ENGINE OIL

NG. → ADD OR REPLACE

OK

9.CHECK ENGINE COOLANT

NG. → ADD OR REPLACE ENGINE COOLANT

OK

10.CHECK IDLING SPEED AND MAXIMUM SPEED

NG. → REPLACE FUEL SUPPLY PUMP

OK

11.CHECK DIAGNOSTIC CIRCUIT

NG. → REPAIR OR REPLACE

OK

12.CHECK VACUUM PUMP

NG. → REPAIR OR REPLACE VACUUM PUMP

OK

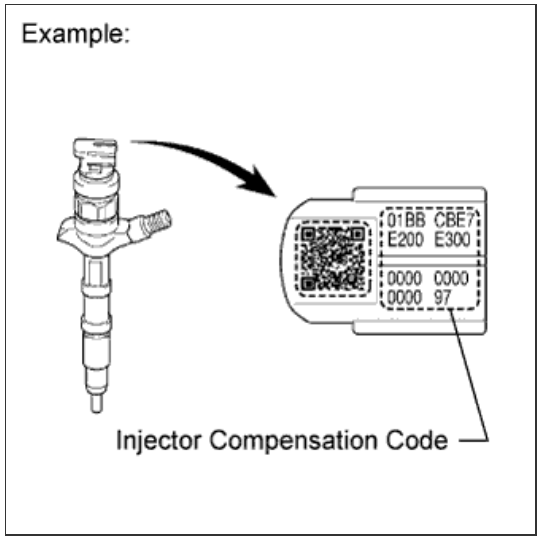
PROCEED TO PROBLEM SYMPTOMS TABLE

for Preparation Click here

1. REGISTRATION

NOTICE:

- **When a fuel injector is replaced, the new fuel injector compensation code must be input into the ECM. When the ECM is replaced, all of the existing fuel injector compensation codes must be input into the new ECM.**
- **Fuel injector compensation codes are unique, 30 digit, alphanumeric values printed on the head portion of each fuel injector. If an incorrect fuel injector compensation code is input into the ECM, the engine assembly may rattle or engine idling may become rough. In addition, engine failure may occur and the life of the engine may be shortened.**



a. After replacing fuel injector(s) with new one(s), input compensation code(s) of fuel injector(s) into ECM as follows

HINT:

- **Each fuel injector has different fuel injection characteristics. In order to optimize the fuel injections, the ECM uses the compensation codes to balance the different fuel injections between each fuel injector.**
- **When you first turn the ignition switch to ON after replacing the ECM or a fuel injector(s), DTC P1601 is set. This is to inform you that registration of a fuel injector compensation code(s) is/are required. Manually clear the DTC upon completion of the compensation code registration.**

i. nput the compensation code(s), which is are imprinted on the head portion(s) of the new fuel injector(s), into the intelligent tester.

ii. nput the new compensation code(s) into the ECM using the tester.

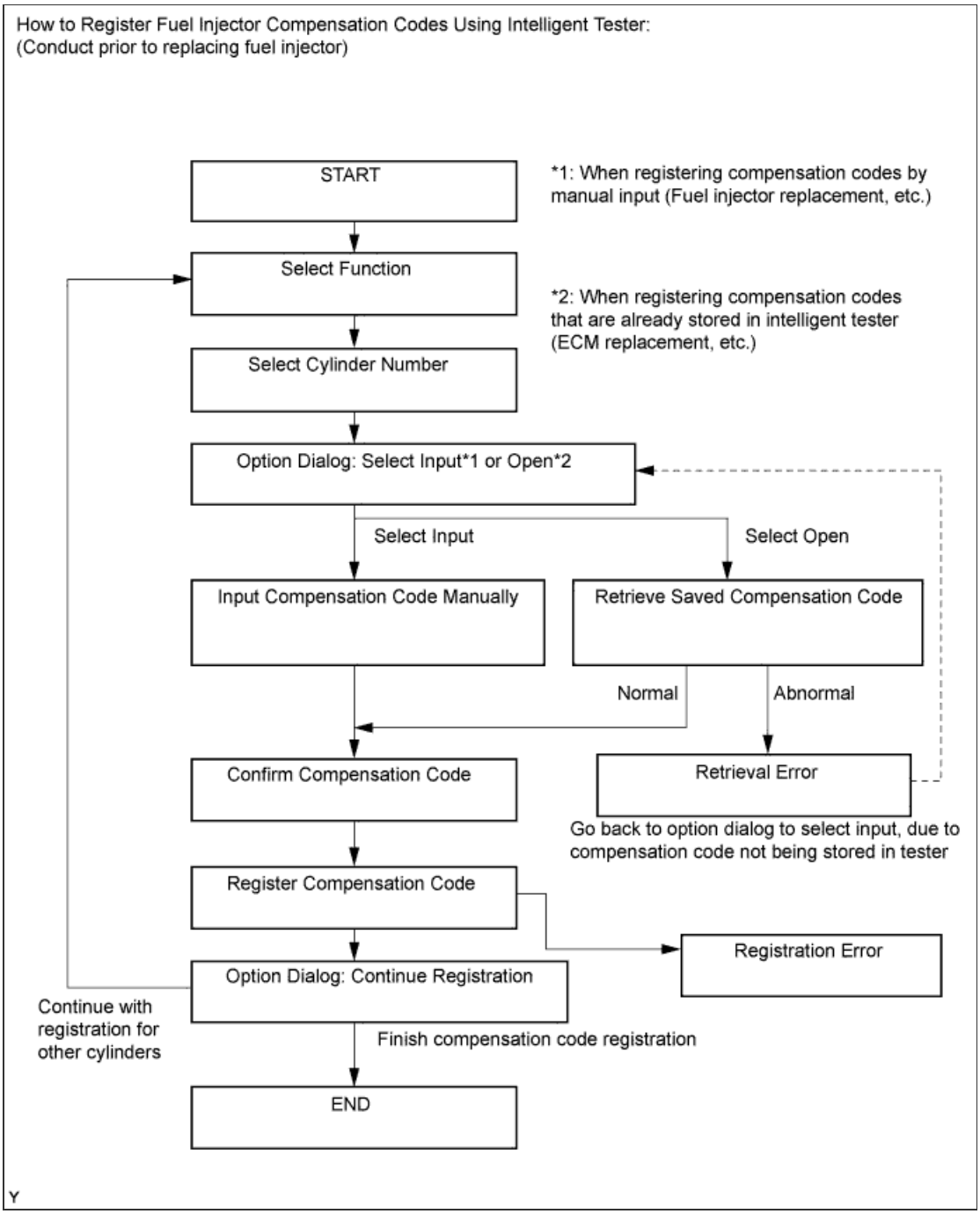
iii. Turn the tester off and turn the ignition switch off.

iv. Wait for at least 30 seconds.

v. Turn the ignition switch to O and turn the tester on.

vi. Clear DTC P1 01 stored in the ECM using the tester (Click here).

b. Register compensation code.



i. Connect the intelligent tester to the DLC3.

ii. Turn the ignition switch to O .

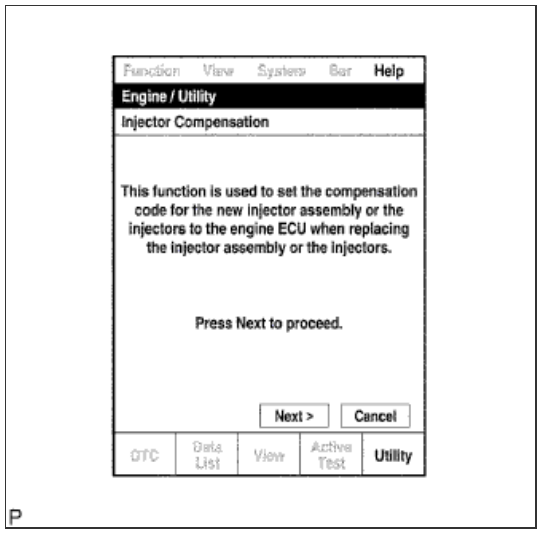
NOTICE:

Do not start the engine.

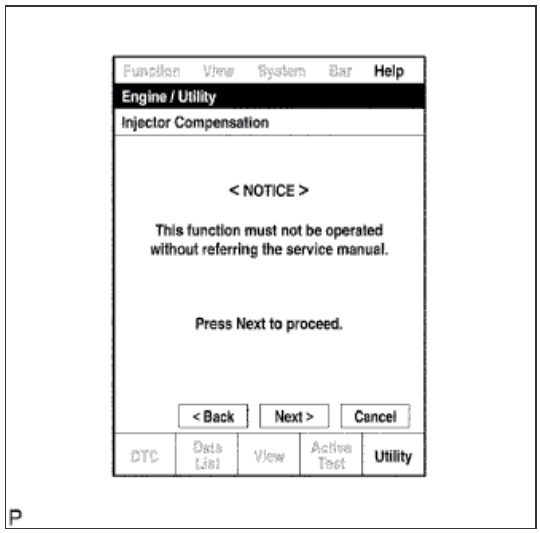
iii. Turn the tester on.

iv. Enter the following menus Powertrain Engine Utilit njector Compensation.

v. Press e t.

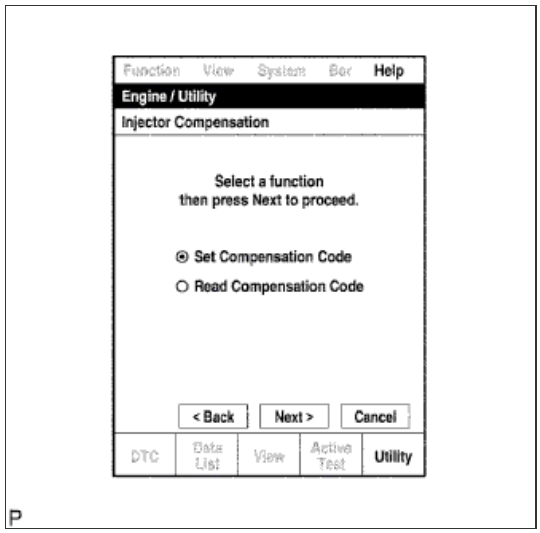


vi. Press e t again to proceed.



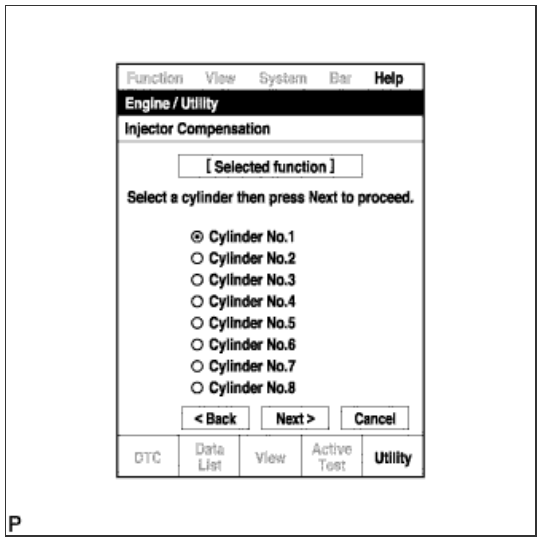
vii. Select et Compensation Code .

viii. Press e t.



ix. Select the num er of the c linder corresponding to the fuel injector compensation code that ou want to read.

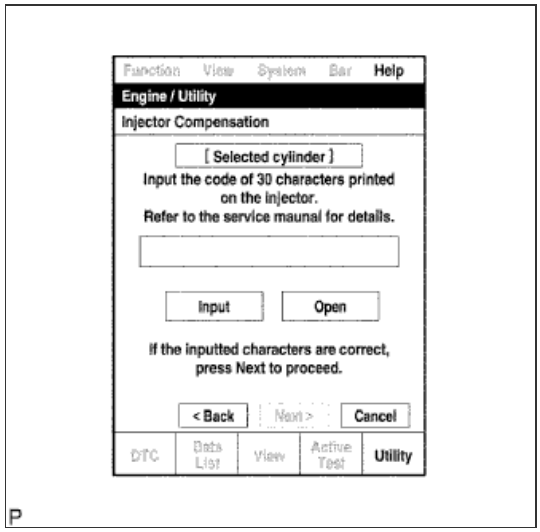
x. Press e t.



P

xi. Register compensation code.

1. Press nput.



P

2. Manuall input the c linder compensation code using the ke oard on the tester screen. The code is a 30 digit, alphanumeric value printed on the injector head portion.

HINT:

Each fuel injector compensation code is uni e. The compensation code for each selected c linder must e input into the tester correctl .

3. Confirm that the compensation code for the selected c linder is correct, and then press O .



P

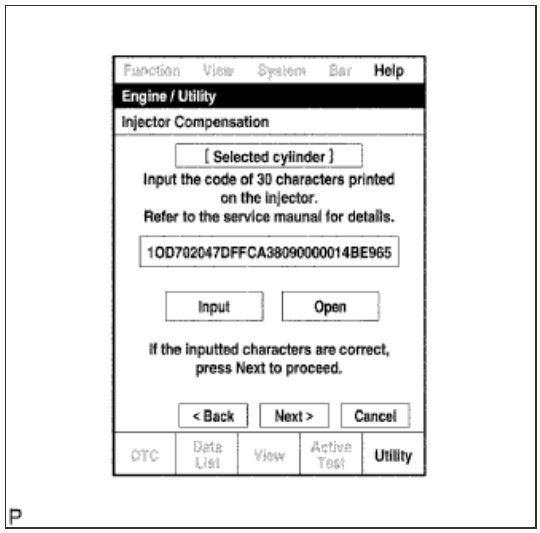
xii. Check that the compensation code displa ed on the screen is correct comparing it with the 30 digit alphanumeric value on the head portion of the fuel injector.

NOTICE:

f an incorrect fuel injector compensation code is input into the ECM, the engine ma rattle or engine idling ma ecome rough. n addition, engine failure ma occur and the life of the engine ma e shortened.

HINT:

- **If a wrong compensation code is input or read, return to the Input Value screen by pressing Input.**
- **The saving process may fail due to a problem with the wire harness or a bad connection with the DLC3. Check the wire harness and DLC3 connection. If no problem is found with either, the ECM may be malfunctioning. Check the ECM and repeat this operation.**



xiii. Press e t to register the compensation code in the ECM.

HINT:

- **If the registration process fails, the compensation code may be incorrect. Check the compensation code again.**
- **If the input compensation code fails to register even though it is input correctly, there may be a problem with the wire harness or a bad connection with the DLC3. Check the wire harness and DLC3 connection. If no problem is found with either, the ECM may be malfunctioning. Check the ECM and restart this operation.**

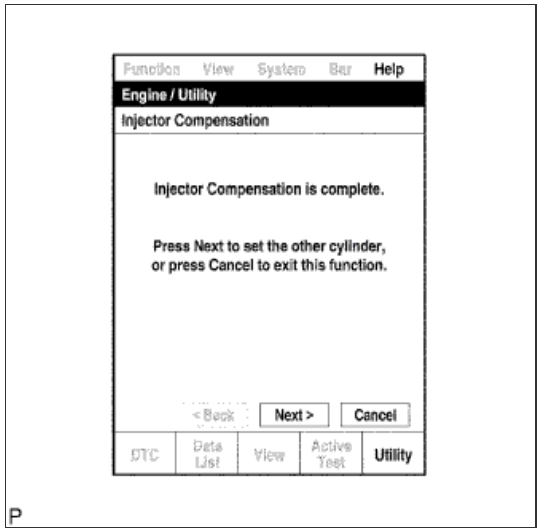
xiv. f ou want to continue with other compensation code registrations, press e t. To finish the registration, press Cancel.

xv. Turn the ignition switch off and then turn the tester off.

xvi. Wait for at least 30 seconds.

xvii. Turn the ignition switch to O and then turn the tester on.

xviii. Clear DTC P1 01 stored in the ECM using the tester (Click here).



2. READING REGISTERED DATA

NOTICE:

- **When a fuel injector is replaced, the new fuel injector compensation code must be input into the ECM. When the ECM is changed, all of the existing fuel injector compensation codes must be input into the new ECM.**
- **Fuel injector compensation codes are unique, 30 digit, alphanumeric values printed on the head portion of each fuel injector. If an incorrect fuel injector compensation code is input into the ECM, the engine may rattle or engine idling may become rough. In addition, engine failure may occur and the life of the engine may be shortened.**

a. When replacing ECM with a new one, input all fuel injector compensation codes into new ECM as follows

HINT:

- **Each fuel injector has different fuel injection characteristics. In order to optimize the fuel injections, the ECM uses the compensation codes to balance the different fuel injections between each injector.**
- **When you first turn the ignition switch to ON after replacing the ECM or a fuel injector(s), DTC P1601 is set. This is to inform you that registration of a fuel injector compensation codes(s) is/are required. Manually clear the DTC upon completion of the compensation code registration.**

i. rior to replacing the ECM, read and save each fuel injector compensation code, stored in the original ECM, using the intelligent tester.

ii. After installing a new ECM, input the saved compensation codes into the new ECM using the tester.

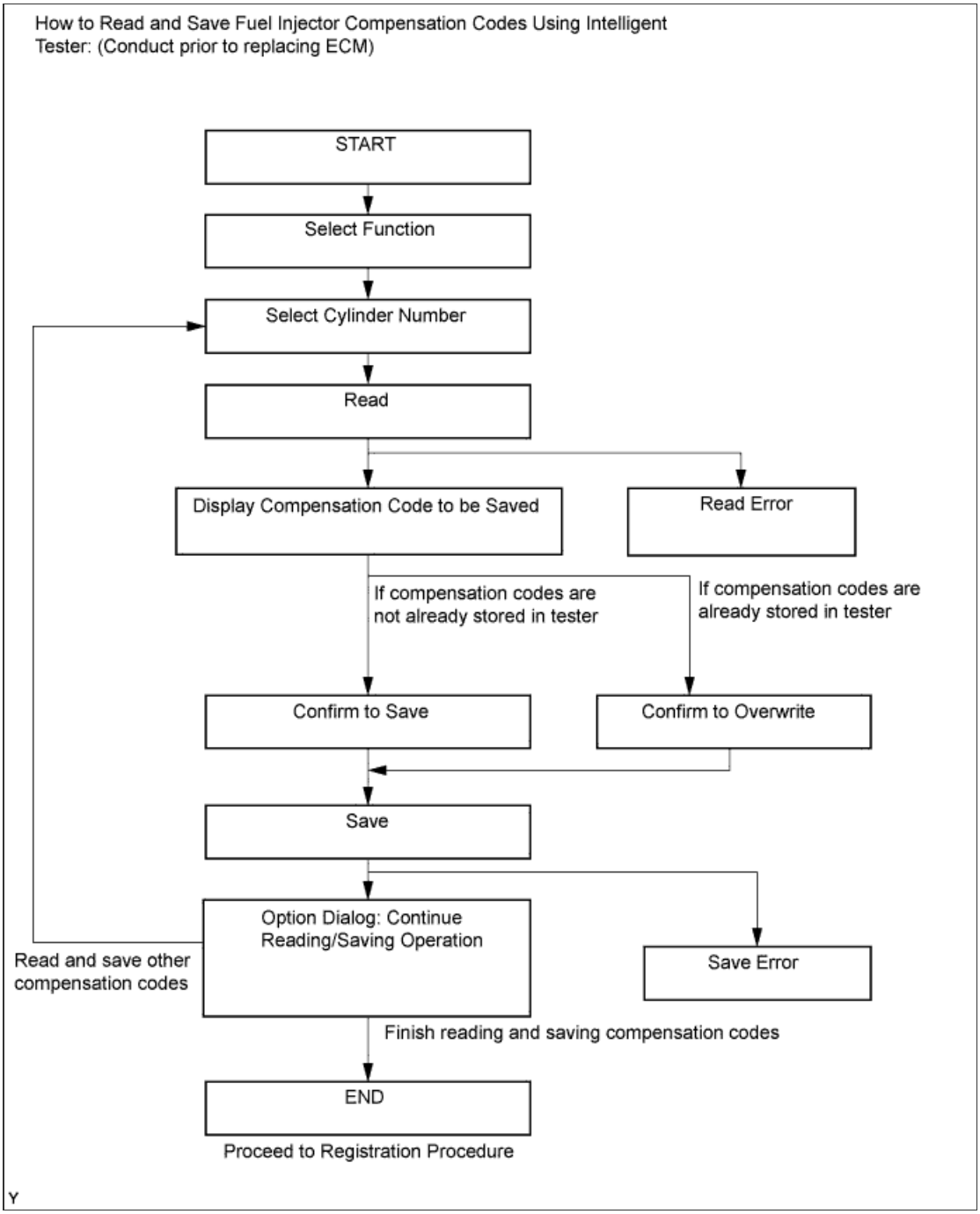
iii. Turn the tester off and turn the ignition switch off.

iv. Wait for at least 30 seconds.

v. Turn the ignition switch to O and turn the tester on.

vi. Clear DTC P1 01 stored in the ECM using the tester (Click here).

b. Read and save fuel injector compensation codes.



HINT:

The following operation is availa le with ECMs that can transmit the registered fuel injector compensation codes to the intelligent tester.

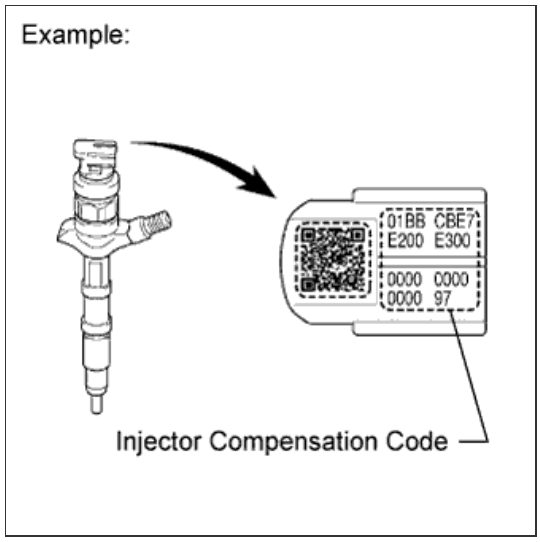
i. Connect the intelligent tester to the DLC3.

ii. Turn the ignition switch to O .

NOTICE:

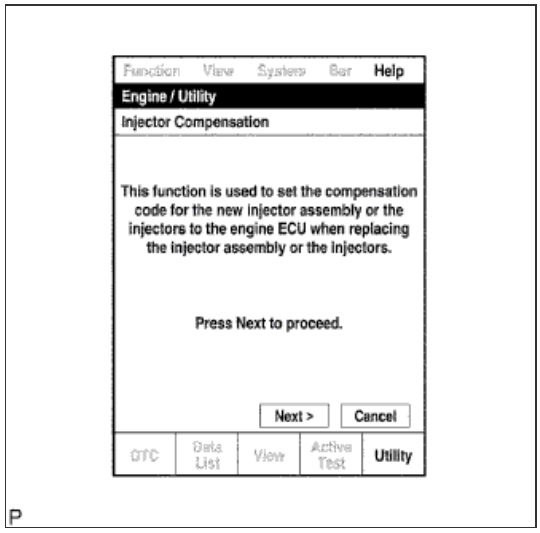
Do not start the engine.

iii. Turn the tester on.

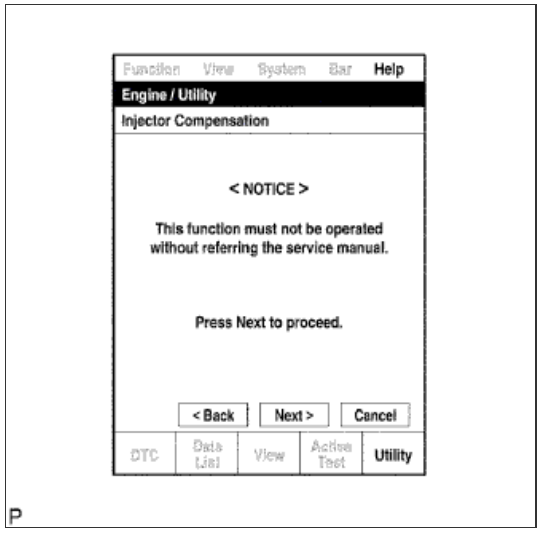


iv. Enter the following menus Powertrain Engine Utilit njector Compensation.

v. Press e t.

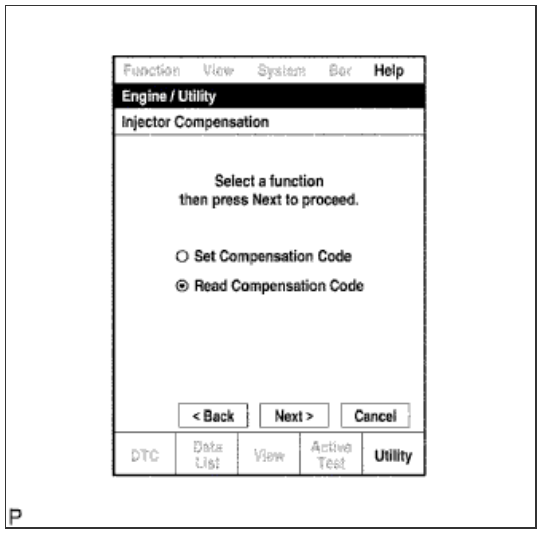


vi. Press e t again to proceed.



vii. Select Read Compensation Code.

viii. Press e t.

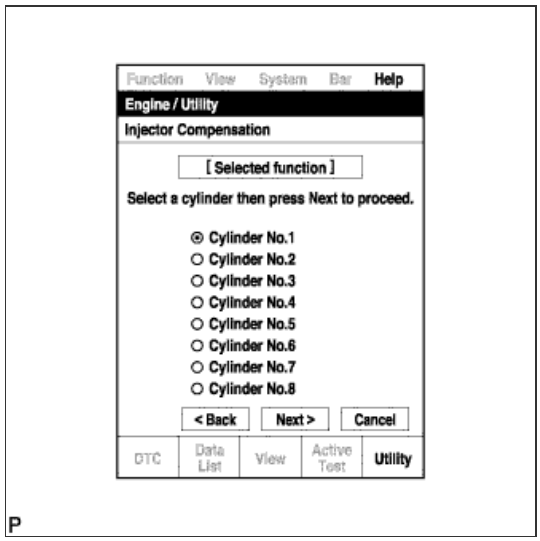


ix. Select the num er of the c linder corresponding to the fuel injector compensation code that ou want to read.

x. Press e t.

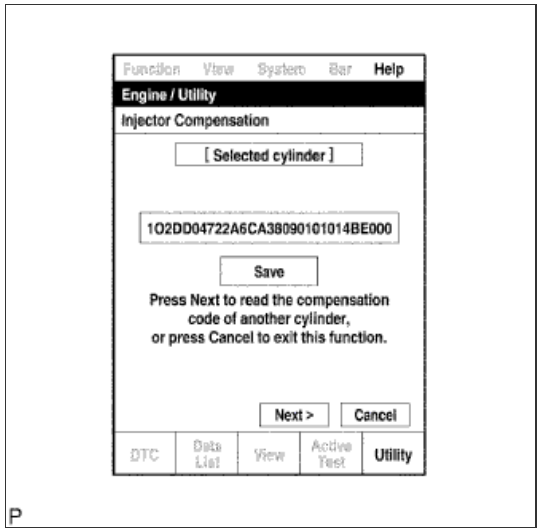
HINT:

The reading process ma fail due to a pro lem with the wire harness or a ad connection with the DLC3. Check the wire harness and DLC3 connection. f no pro lem is found, the ECM ma e malfunctioning. Check the ECM and restart this operation.



xi. Check the fuel injector compensation code (30 digit alphanumeric value) displa ed on the tester screen.

xii. Press Save.



xiii. Check that the compensation code displa ed on the tester screen is correct.

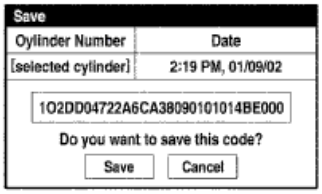
xiv. Press Save or Replace to save the fuel injector compensation code.

HINT:

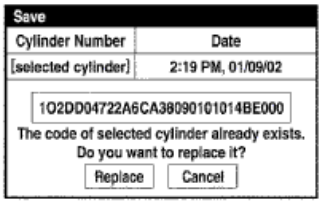
- **The existing compensation code is overwritten with the new compensation code and is deleted from the tester.**
- **The saving process may fail due to a problem with the**

wire harness or a bad connection with the DLC3. Check the wire harness and DLC3 connection. If no problem is found with either, the ECM may be malfunctioning. Check the ECM and restart this operation.

When no fuel injector compensation code for the cylinder exists in the tester:



When another fuel injector compensation code for the cylinder exists in the tester:

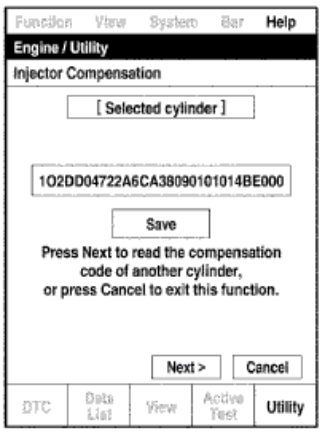


xv. f ou want to read and save other fuel injector compensation codes for other c linders, press e t to continue. To finish this operation, press Cancel.

xvi. Turn the ignition switch off.

xvii. Turn the tester off.

xviii. Replace the ECM.



P

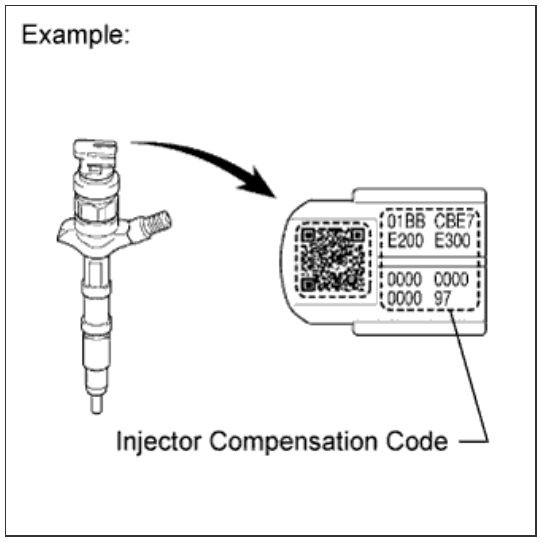
xix. Connect the intelligent tester to the DLC3.

xx. Turn the ignition switch to O .

NOTICE:

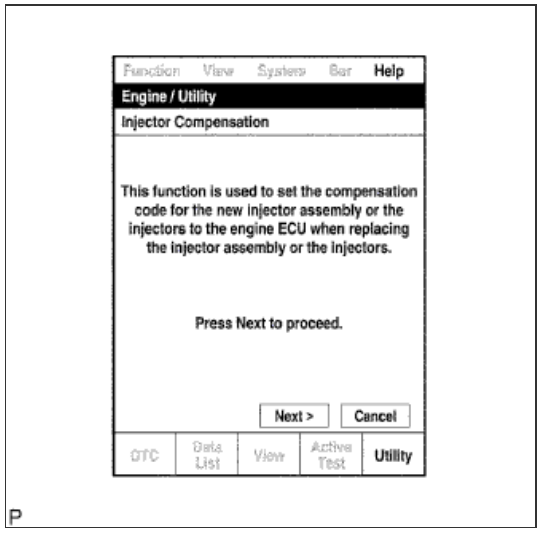
Do not start the engine.

xxi. Turn the tester on.

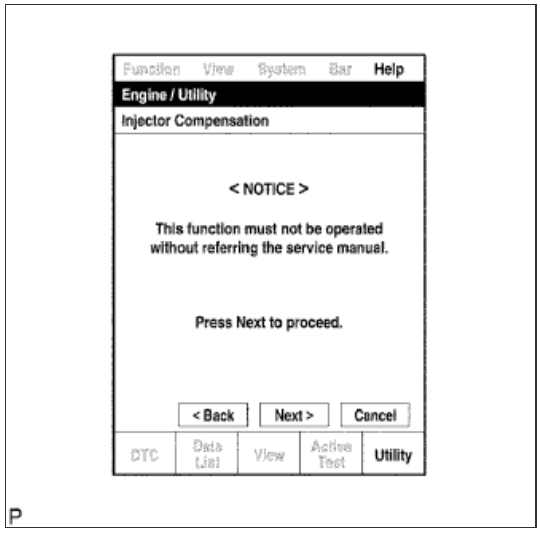


xxii. Enter the following menus Powertrain Engine Utilit njector Compensation.

xxiii. Press e t.

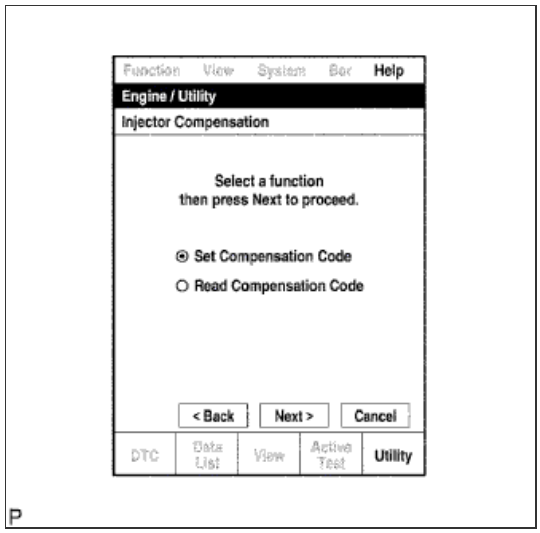


xxiv. Press e t again to proceed.



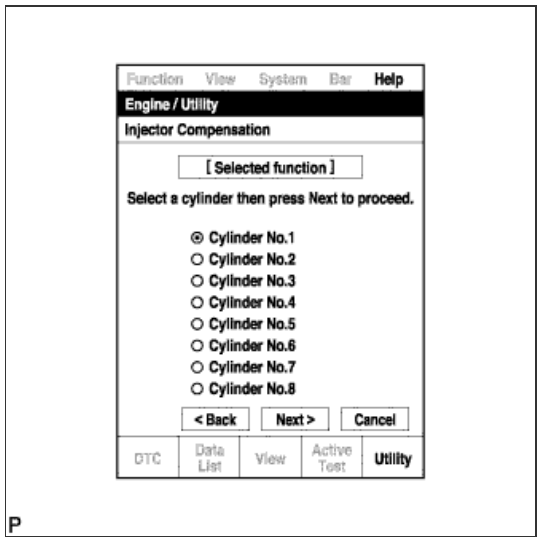
xxv. Select Set Compensation Code.

xxvi. Press e t.



xxvii. Select the num er of the c linder corresponding to the fuel injector compensation code that ou want to read.

xxviii. Press e t.



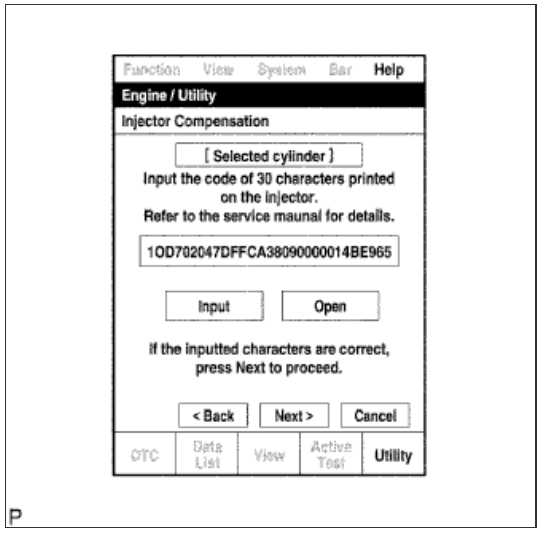
xxix. Check that the compensation code displa ed on the screen is correct comparing it with the 30 digit alphanumeric value on the head portion of the fuel injector.

NOTICE:

f an incorrect fuel injector compensation code is input into the ECM, the engine ma rattle or engine idling ma ecome rough. n addition, engine failure ma occur and the life of the engine ma e shortened.

HINT:

- **If a wrong compensation code is input or read, return to the Input Value screen by pressing input.**
- **The saving process may fail due to a problem with the wire harness or a bad connection with the DLC3. Check the wire harness and DLC3 connection. If no problem is found with either, the ECM may be malfunctioning. Check the ECM and repeat this operation.**



xxx. Press e t to register the compensation code in the ECM.

HINT:

- **If the registration process fails, the compensation code may be incorrect. Check the compensation code again.**
- **If the input compensation code fails to register even though it is input correctly, there may be a problem with the wire harness or a bad connection with the DLC3. Check the wire harness and DLC3 connection. If no problem is found with either, the ECM may be malfunctioning. Check the ECM and restart this operation.**

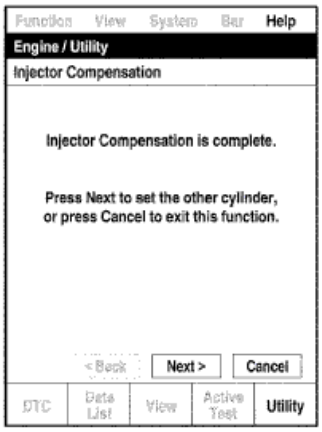
xxxi. f ou want to continue with other compensation code registrations, press e t. To finish the registration, press Cancel.

xxxii. Turn the ignition switch off and then turn the tester off.

xxxiii. Wait for at least 30 seconds.

xxxiv. Turn the ignition switch to O and then turn the tester on.

xxxv. Clear DTC P1 01 stored in the ECM using the tester (Click here).



P

for Preparation Click here

HINT:

After replacing the supply pump and/or the ECM, the ECM learned values must be initialized.

The engine can be initialized through the intelligent tester or by connecting DLC3 terminals.

FUEL SUPPLY PUMP INITIALIZATION PROCEDURE

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

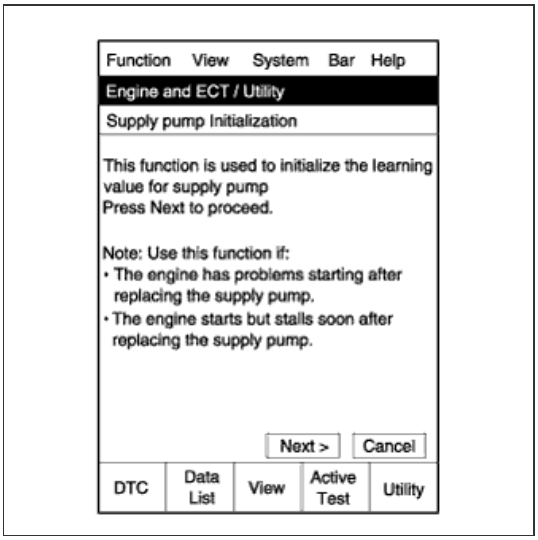
NOTICE:

Do not start the engine.

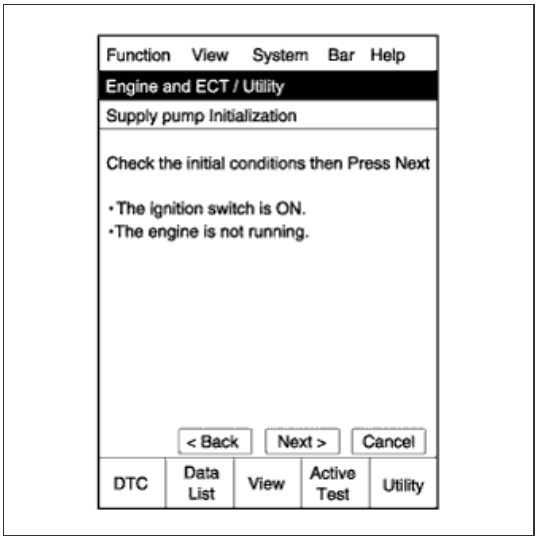
c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine / Utility / Supply Pump Initialization.

e. Press "Next".



f. Press "Next".



g. Press "Exit".

h. Start the engine to check if the initialization is complete. If the engine cannot be started, repeat the initialization procedures from the beginning.

i. Idle the engine for at least 1 minute under the following conditions:

- The engine coolant temperature is 60°C (140°F) or more.
- The fuel temperature is 20°C (68°F) or more.

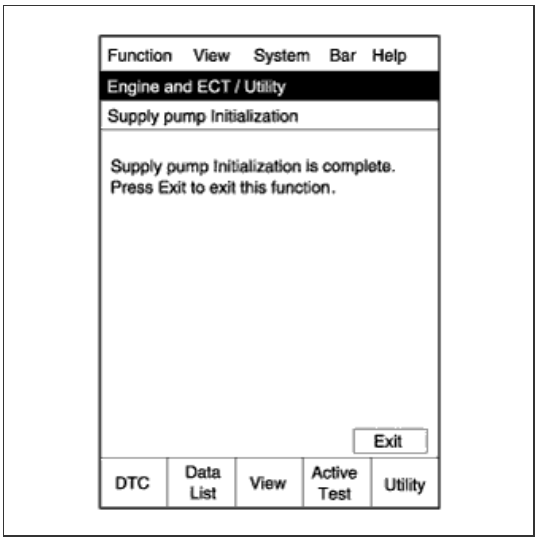
NOTICE:

Do not race the engine immediately after starting the engine. After warming up the engine, racing the engine is acceptable.

HINT:

If the engine coolant temperature is difficult to estimate, use the intelligent tester and enter the following menus: Powertrain / Engine / Data List / Coolant Temp and Fuel Temperature.

j. Initialization is complete.



for Preparation Click here

HINT:

Use the table below to help determine the cause of problem symptoms. If multiple suspected areas are listed, the potential causes of the symptoms are listed in order of probability in the "Suspected Area" column of the table. Check each symptom by checking the suspected areas in the order they are listed. Replace parts as necessary.

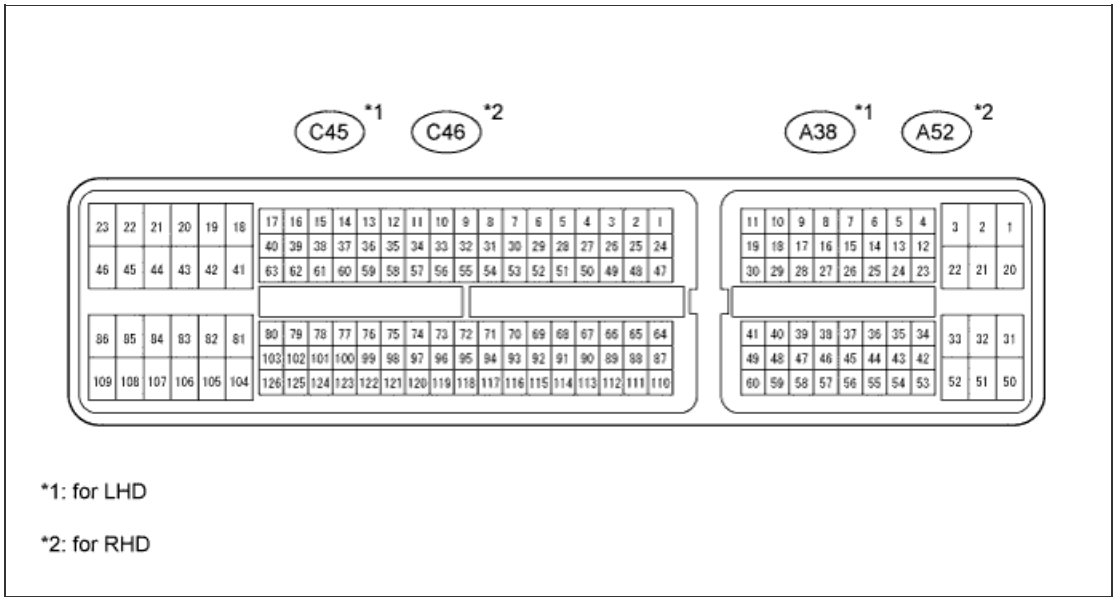
ECD System

Symptom	Suspected Area	See page
Engine does not crank (does not start)	Battery	Click here
	Starter	Click here
	Starter relay	Click here
	Park neutral position switch	Click here
	Clutch start switch (for)	Click here
	Clutch start switch (for R)	Click here
	Immobiliser system	Click here
	Entry and start system	Click here
Difficult to start with cold engine	Engine difficult to start or stalling	Click here
	Cranking holding function circuit	Click here
	Pre-heating control circuit	Click here
	Fuel injector	Click here
	Fuel filter	Click here
	Compression	Click here
	ECM	Click here
	Fuel supply pump	Click here
	Fuel pressure sensor	Click here
	Diesel throttle body	Click here
	EDU relay	Click here
	Fuel with low cetane number used	-
	Fuel frozen	-
	Air mixed into fuel pipe	-
Difficult to start with hot engine	Engine difficult to start or stalling	Click here
	Cranking holding function circuit	Click here
	Fuel injector	Click here
	Fuel filter	Click here
	Compression	Click here
	ECM	Click here
	Fuel sypply pump	Click here
	Fuel pressure sensor	Click here
	Diesel throttle body	Click here
	EDU relay	Click here
	Air mixed into fuel pipe	-
	Battery deteriorated	-
Engine stalls soon after starting	Engine difficult to start or stalling	Click here
	Fuel filter	Click here
	Fuel injector	Click here
	ECM power source circuit	Click here
	ECM	Click here
	Fuel supply pump	Click here
	Fuel pressure sensor	Click here
	Diesel throttle body	Click here
	Air mixed into fuel pipe	-
	Immobiliser system acti ated	-

Engine stalls (not including the condition listed abo e)	Engine difficult to start or stalling	Click here
Abnormal initial idling (poor idling)	Rough idling or excessi e engine ibration	Click here
	Fuel filter	Click here
	Fuel injector	Click here
	ECM	Click here
	Fuel supply pump	Click here
	Fuel pressure sensor	Click here
	Mass air flow meter deteriorated	-
	Fuel with low cetane number used	-
	A C signal circuit to ECM open and generator signal circuit open	-
igh engine idling speed	Rough idling or excessi e engine ibration	Click here
	A C signal circuit	Click here
	Fuel injector	Click here
	Cranking holding function circuit	Click here
	ECM	Click here
	Fuel supply pump	Click here
	Fuel pressure sensor	Click here
	Speed sensor circuit open	Click here
	Accelerator pedal	Click here
ow engine idling speed (poor idling)	Rough idling or excessi e engine ibration	Click here
	A C signal circuit	Click here
	Fuel injector	Click here
	EGR system	Click here
	Compression	Click here
	Fuel line (air bleeding)	-
	ECM	Click here
	Fuel supply pump	Click here
	Fuel pressure sensor	Click here
	Diesel throttle body	Click here
	Mass air flow meter deteriorated	-
Rough idling (poor idling)	Rough idling or excessi e ibration	Click here
unting with hot engine (poor idling)	Fuel injector	Click here
	ECM power source circuit	Click here
	Compression	Click here
	Fuel line (air bleeding)	-
	ECM	Click here
	Fuel supply pump	Click here
	Fuel pressure sensor	Click here
	Diesel throttle body	Click here
unting with cold engine (poor idling)	Fuel injector	Click here
	ECM power source circuit	Click here
	Compression	Click here
	Fuel line (air bleeding)	-
	ECM	Click here
	Fuel supply pump	Click here
	Fuel pressure sensor	Click here
	Diesel throttle body	Click here
	Fuel with low cetane number used	-
esitation oor acceleration (poor dri eability)	ack of power or hesitation	Click here
	Fuel injector	Click here
	Fuel filter	Click here
	EGR system	Click here
	Compression	Click here
	ECM	Click here
	Fuel supply pump	Click here
	Fuel pressure sensor	Click here
	Diesel throttle body	Click here

	Accelerator pedal	Click here
	urbocharger system	Click here
	Mass air flow meter deteriorated	-
	Intake system blockage	-
	Exhaust system blockage	-
	Brake o erride system	Click here
nocking (poor dri eability)	Engine knocking or rattling	Click here
Black smoke emitted (poor dri eability)	Black smoke emitted	Click here
	EGR system	Click here
	Fuel injector	Click here
	Accumulation in exhaust system	-
	Exhaust system blockage	-
hite smoke emitted (poor dri eability)	EGR system	Click here
	Fuel injector	Click here
	Fuel filter	Click here
	ECM	Click here
	Fuel supply pump	Click here
	Fuel pressure sensor	Click here
	Diesel throttle body	Click here
	Pre-heating control circuit	Click here
	ow quality fuel	-
Surging unting (poor dri eability)	Fuel injector	Click here
	ECM	Click here
	Mass air flow meter deteriorated	-
	Fuel supply pump	Click here
	Fuel pressure sensor	Click here
	urbocharger system	Click here

for Preparation Click here



Measure the voltage according to the value(s) in the table below.

HINT:

The standard normal voltage between each pair of ECM terminals is shown in the table below. The appropriate conditions for checking each pair of terminals are also indicated.

The result of the checks should be compared with the standard normal voltage for that pair of terminals, which is displayed in the Specified Condition column.

The illustration above can be used as a reference to identify the ECM terminal locations.

Terminal No. (Symbol)	Wiring Color	Terminal Description	Condition	Specified Condition
A38*1-20 (BATT) - C45*1-81 (E1) A52*2-20 (BATT) - C46*2-81 (E1)	L - BR	Battery (for measuring the battery voltage and for the ECM memory)	Always	11 to 14 V
A38*1-28 (IGSW) - C45 (E1) A52 (IGSW) - C46 (E1)	B - BR	Ignition switch	Ignition switch ON	11 to 14 V
A3 (+B) - C45 (E1) A52 (+B) - C46 (E1)	B - BR	Power source of ECM	Ignition switch ON	11 to 14 V
A3 (MRE) - C45 (E1) A52 (MRE) - C46 (E1)	W-R - BR	E relay	Ignition switch ON	11 to 14 V
			10 seconds elapsed after ignition switch turned off	0 to 1.5 V
C45 (VCPM) - C45 (E2) C46 (VCPM) - C46 (E2)		ower source of manifold absolute pressure sensor (for PIM)	Ignition switch ON	4.5 to 5.5 V
C45 (VCM) - C45 (E2) C46 (VCM) - C46 (E2)		ower source of fuel pressure sensor (for PCR1)	Ignition switch ON	4.5 to 5.5 V
C45 (VCEG) - C45 (EEG) C46 (VCEG) - C46 (EEG)		ower source of EGR valve position sensor	Ignition switch ON	4.5 to 5.5 V
C45 (VCV) - C45 (EV) C46 (VCV) - C46 (EV)		ower source of throttle position sensor	Ignition switch ON	4.5 to 5.5 V
C45 (VG) - C45				

(EVG) C46 (VG) - C46 (EVG)	W	Mass air flow meter	Engine warmed up and idling, A C switch off	0.5 to 3.4 V
C45 (T) - C45 (E2) C46 (T) - C46 (E2)		ntake air temperature sensor (built into mass air flow meter)	Engine warmed up and idling, intake air temperature at 0 to C (32 to 176°)	0.5 to 3.4 V
A3 (VPA) - A3 (EPA) A52 (VPA) - A52 (EPA)	R - W-	ccelerator pedal position sensor (for engine control)	Ignition switch ON, accelerator pedal fully released	0.6 to 1.0 V
			Ignition switch ON, accelerator pedal fully depressed	3.0 to 4.6 V
A3 (VPA2) - A3 (EPA2) A52 (VPA2) - A52 (EPA2)	GR-G - BR	Accelerator pedal position sensor (for sensor malfunction detection)	Ignition switch ON, accelerator pedal fully released	1.4 to 1.
			gnition switch ON, accelerator pedal fully depressed	3.7 to 5.0 V
A3 (VCPA) - A3 (EPA) A52 (VCPA) - A52 (EPA)	W - W-	ower source of accelerator pedal position sensor (for VPA)	Ignition switch ON	4.5 to 5.5 V
A3 (VCP2) - A3 (EPA2) A52 (VCP2) - A52 (EPA2)	V - BR	Power source of accelerator pedal position sensor (for VPA2)	Ignition switch ON	4.5 to 5.5 V
C45 (T) - C45 (E2) C46 (T) - C46 (E2)	W-G - BR	Intake air temperature sensor (after turbocharged)	Engine warmed up and idling, intake air temperature sensor (after turbocharged) at 0 to C (32 to 176°)	0.5 to 3.4 V
C45 (T W) - C45 (E2) C46 (T W) - C46 (E2)	G-B - BR	Engine coolant temperature sensor	Engine warmed up and idling, engine coolant temperature at 60 to 120°C (140 to 24)	0.2 to 1.2 V
C45 (#1) - C45 (E1)		uel in ector	Idling	Pulse generation (see waveform 1)
C46*2-40 (#1) - C46 (E1)				
C45 (#2) - C45 (E1)	B - BR			
C46 (#2) - C46 (E1)				
C45 (#3) - C45 (E1)				
C46 (#3) - C46 (E1)				
C45 (#4) - C45 (E1)	R - BR			
C46 (#4) - C46 (E1)				
C45 (#5) - C45 (E1)	G - BR			
C46 (#5) - C46 (E1)				
C45 (#6) - C45 (E1)	V - BR			
C46 (#6) - C46 (E1)				
C45 (#7) - C45 (E1)	W - BR			
C46 (#7) - C46 (E1)				
C45 (#) - C45 (E1)	P - BR			
C46 (#) - C46 (E1)				
C45 (G+) - C45 (G-) C46 (G+) - C46 (G-)	W - B	Camshaft position sensor	Idling	Pulse generation (see waveform)
C45*1-7 (NE+) - C45 (NE-) C46 (NE+) - C46 (NE-)	B - W	Crankshaft position sensor	Idling	Pulse generation (see waveform)
C45*1-114 (PIM) - C45 (E2) C46 (PIM) - C46 (E2)	P-	Manifold absolute pressure sensor	Negative pressure of 40 kPa (300 mm g, 11. in. g) applied	0.1 to 0.7 V
			Same as atmospheric pressure	0. to 1.4 V
			Positive pressure of 170 kPa (1275 mm g, 50.2 in. g) applied	1.6 to 2.2 V
A3 (IRE) - C45 (E1) A52 (IRE) - C46 (E1)	P-	ED relay (ED)	Ignition switch off	11 to 14 V
			Idling	0 to 1.5 V
A3 (IR) - C45 (E1) A52 (IR) - C46 (E1)	P-B - BR	ED relay (ED)	Ignition switch off	11 to 14 V
			Idling	0 to 1.5 V
C45 (PCR1) - C45 (E2) C46 (PCR1) - C46 (E2)	B - BR	uel pressure sensor	Idling (Appro imately 35 MPa (357 kgf cm^2, 507 psi))	1.3 to 1.8 V

C45*1-63 (GREL) - C45*1-81 (E1) C46*2-63 (GREL) - C46*2-81 (E1)	R-B - BR	No. 1 glow relay	Cranking	11 to 14 V
			Idling	0 to 1.5 V
C45*1-62 (GRL2) - C45*1-81 (E1) C46*2-62 (GRL2) - C46*2-81 (E1)	R - BR	No. 2 glow relay	Cranking	11 to 14 V
			Idling	0 to 1.5 V
C45*1-116 (T -)C45*1-75 (E2) C46*2-116 (T -)C46*2-75 (E2)	G-R - BR	Fuel temperature sensor	Ignition switch ON	0.5 to 3.4 V
C45*1-106 (PCV+) - C45*1-105 (PCV-) C46*2-106 (PCV+) - C46*2-105 (PCV-)	W - BR	Suction control valve	Idling	Pulse generation (see waveform 2)
C45*1-61 (IN -)C45*1-81 (E1) C46*2-61 (IN -)C46*2-81 (E1)	G - BR	No. 1 in ector driver	Idling	Pulse generation (see waveform 3)
C45*1-60 (INF2) - C45*1-81 (E1) C46*2-60 (INF2) - C46*2-81 (E1)	W - BR	No. 2 in ector driver	Idling	Pulse generation (see waveform 3)
C45*1-93 (VL) C45*1-75 (E2) C46*2-93 (VL) C46*2-75 (E2)	L-W - BR	Throttle position sensor (for Bank 1)	Ignition switch ON (throttle valve fully opened)	2.8 to 3.8 V
			Idling (throttle valve fully closed)	0.4 to 1.0 V
C45*1-103 (VL 2) - C45*1-75 (E2) C46*2-103 (VL 2) - C46*2-75 (E2)	L-W - BR	Throttle position sensor (for Bank 2)	Ignition switch ON (throttle valve fully opened)	2.8 to 3.8 V
			Idling (throttle valve fully closed)	0.4 to 1.0 V
C45*1-42 (L SL) - C45*1-81 (E1) C46*2-42 (L SL) - C46*2-81 (E1)	B - BR	Diesel throttle duty signal (for Bank 1)	Engine warmed up, racing engine	Pulse generation (see waveform 4)
C45*1-84 (L S2) - C45*1-81 (E1) C46*2-84 (L S2) - C46*2-81 (E1)	B - BR	Diesel throttle duty signal (for Bank 2)	Engine warmed up, racing engine	Pulse generation (see waveform 4)
C45*1-89 (EGLS) - C45*1-75 (E2) C46*2-89 (EGLS) - C46*2-75 (E2)	R-W - BR	No. 1 EGR valve position sensor	Ignition switch ON	3.0 to 4.6 V
C45*1-88 (EGS2) - C45*1-75 (E2) C46*2-88 (EGS2) - C46*2-75 (E2)	R-B - BR	No. 2 EGR valve position sensor	Ignition switch ON	3.0 to 4.6 V
C45*1-107 (EGRS) - C45*1-81 (E1) C46*2-107 (EGRS) - C46*2-81 (E1)	R - BR	No. 1 EGR valve	Engine warmed up and idling	Pulse generation (see waveform 5)
C45*1-108 (ERS2) - C45*1-81 (E1) C46*2-108 (ERS2) - C46*2-81 (E1)	R-W - BR	No. 2 EGR valve	Engine warmed up and idling	Pulse generation (see waveform 5)
C45*1-49 (VNTO) - C45*1-81 (E1) C46*2-49 (VNTO) - C46*2-81 (E1)	R- - BR	Turbo motor driver (for Bank 1)	Idling	Pulse generation (see waveform 6)
C45*1-47 (VNO2) - C45*1-81 (E1) C46*2-47 (VNO2) - C46*2-81 (E1)	R-W - BR	Turbo motor driver (for Bank 2)	Idling	Pulse generation (see waveform 6)
C45*1-50 (VNTI) - C45*1-81 (E1) C46*2-50 (VNTI) - C46*2-81 (E1)	R-L - BR	Turbo motor driver (for Bank 1)	Idling	Pulse generation (see waveform 7)
C45*1-48 (VNI2) - C45*1-81 (E1) C46*2-48 (VNI2) - C46*2-81 (E1)	BR - BR	Turbo motor driver (for Bank 2)	Idling	Pulse generation (see waveform 7)
A38*1-36 (STP) - C45*1-81 (E1) A52*2-36 (STP) - C46*2-81 (E1)	R - BR	Stop light switch	Ignition switch ON, brake pedal depressed	7.5 to 14 V
			Ignition switch ON, brake pedal released	0 to 1.5 V
			Ignition switch ON, brake pedal	

A38*1-35 (ST1-) - C45*1-81 (E1) A52*2-35 (ST1-) - C46*2-81 (E1)	R-W - BR	Stop light switch (opposite to STP)	depressed	0 to 1.5 V
			Ignition switch ON, brake pedal released	7.5 to 14 V
A38*1-15 (TAC) - C45*1-81 (E1) A52*2-15 (TAC) - C46*2-81 (E1)	W-G - BR	Engine speed	Idling	Pulse generation (see waveform 8)
A38*1-8 (SPD) - C45*1-81 (E1) A52*2-8 (SPD) - C46*2-81 (E1)	V-R - BR	Speed signal from combination meter	Ignition switch ON, wheel rotated slowly	Pulse generation (see waveform 9)
A38*1-48 (STA) - C45*1-81 (E1) A52*2-48 (STA) - C46*2-81 (E1)	R-B - BR	Starter signal	Cranking	6.0 V or more
C45*1-1 (ALT) - C45*1-81 (E1) C46*2-1 (ALT) - C46*2-81 (E1)	R - BR	Generator duty ratio	Idling	Pulse generation
A38*1-27 (TC) - C45*1-81 (E1) A52*2-27 (TC) - C46*2-81 (E1)	V-W - BR	Terminal TC of DLC3	Ignition switch ON	11 to 14 V
A38*1-24 (W) - C45*1-81 (E1) A52*2-24 (W) - C46*2-81 (E1)	R- - BR	MIL	MIL illuminated	0 to 3 V
			MIL not illuminated	11 to 14 V
A38*1-30 (AC1) - C45*1-81 (E1) A52*2-30 (AC1) - C46*2-81 (E1)	L-O - BR	A C signal	A C switch on	0 to 1.5 V
			A C switch off	11 to 14 V
A38*1-18 (ACT) - C45*1-81 (E1) A52*2-18 (ACT) - C46*2-81 (E1)	G-R - BR	A C signal	Ignition switch ON	11 to 14 V
			A C cut control on	0 to 3 V
A38*1-42 (CLSW) - C45*1-81 (E1) A52*2-42 (CLSW) - C46*2-81 (E1)	G-B - BR	Clutch start switch	Ignition switch ON, clutch pedal fully depressed	0 to 3 V
			Ignition switch ON, clutch pedal fully released	11 to 14 V
C45*1-2 (PS) - C45*1-81 (E1) C46*2-2 (PS) - C46*2-81 (E1)	P - BR	Power steering oil pressure switch	Steering wheel turned	0 to 3 V
			Steering wheel not turned	11 to 14 V
C45*1-32 (FSW) - C45*1-81 (E1) C46*2-32 (FSW) - C46*2-81 (E1)	L*3 - BR	Shift position switch	Ignition switch ON, shift lever in 1	11 to 14 V
			Ignition switch ON, shift lever not in 1	0 to 3 V
C45*1-45 (ACM) - C45*1-81 (E1) C46*2-45 (ACM) - C46*2-81 (E1)	L - BR	VSV (for engine mounting)	Idling	0 to 1.5 V
A38*1-43 (NSW) - C45*1-81 (E1) A52*2-43 (NSW) - C46*2-81 (E1)	L - BR	Park neutral position switch	Ignition switch ON, shift lever in P or N	Below 3 V
			Ignition switch ON, shift lever not in P and N	11 to 14 V
A38*1-41 (CAN) - C45*1-81 (E1) A52*2-41 (CAN) - C46*2-81 (E1)	P - BR	CAN communication line	Ignition switch ON	Pulse generation) (see waveform 10)
A38*1-49 (CANL) - C45*1-81 (E1) A52*2-49 (CANL) - C46*2-81 (E1)	B - BR	CAN communication line	Ignition switch ON	Pulse generation) (see waveform 11)
A38*1-14 (STSW) - C45*1-81 (E1) A52*2-14 (STSW) - C46*2-81 (E1)	R - BR	Ignition switch signal	Shift lever in P or N, ignition switch pushed	6.0 V or more
A38*1-13 (ACCR) - C45*1-81 (E1) A52*1-13 (ACCR) - C45*1-81 (E1)	L- - BR	ACC (Accessory) relay control signal	Cranking	Below 1.5 V
C45*1-51 (STAR) - C45*1-81 (E1) C46*2-51 (STAR) - C46*2-81 (E1)	L - BR	Starter relay control	Ignition switch ON	Below 1.5 V
			Cranking	6.0 V or more
C45*1-43 (FC) - C45*1-81 (E1) C46*2-43 (FC) - C46*2-81 (E1)	L-B - BR	Sub pump relay	Relay on	0 to 1.5 V
			Relay off	7.5 to 14 V

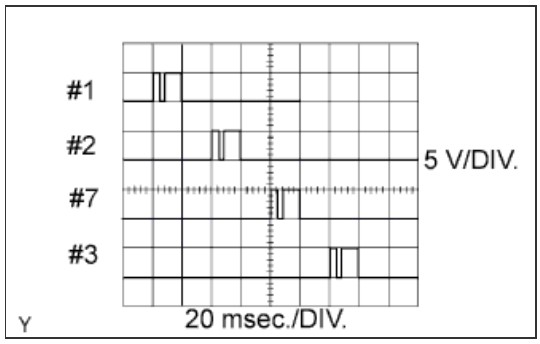
HINT:

- ***1: for LHD**
- ***2: for RHD**
- ***3: for M/T**

WAVEFORM 1

Fuel Injector No. 1 (to No. 8) Injection Signal

ECM Terminal Name	From #1 to #8 and E1
Tester Range	5 V DIV., 20 msec. DIV.
Condition	Idling with warm engine



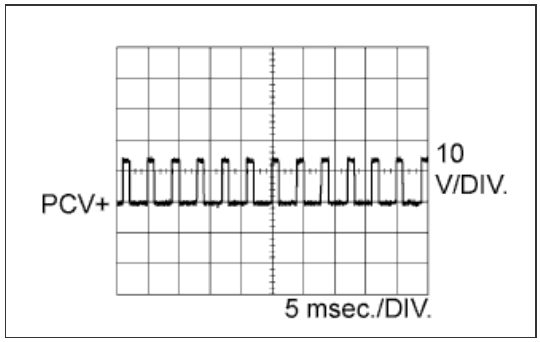
HINT:

The waveform varies depending on the in ector in ection.

WAVEFORM 2

Suction Control Valve Signal

ECM Terminal Name	PCV+ and PCV-
Tester Range	10 V DIV., 5 msec. DIV.
Condition	Idling or cranking with warm engine



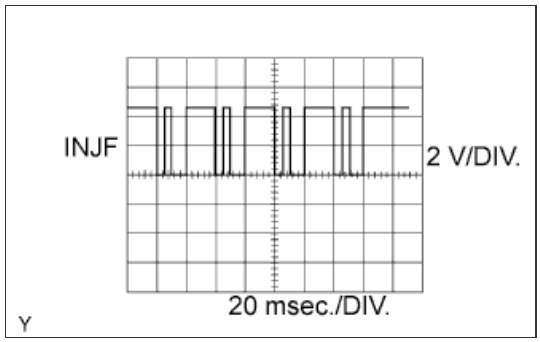
HINT:

The waveform varies depending on the suction control valve operation.

WAVEFORM 3

Injector Injection Confirmation Signal

ECM Terminal Name	IN and E1 INF2 and E1
Tester Range	2 V DIV., 20 msec. DIV.
Condition	Idling with warm engine



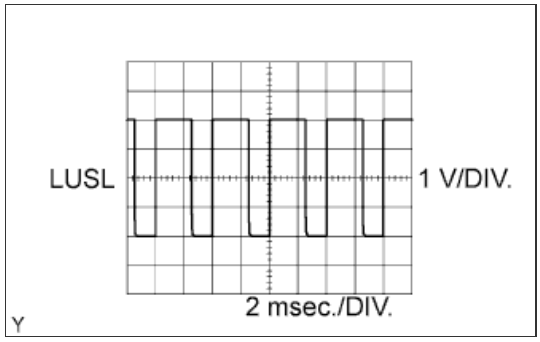
HINT:

The waveform varies depending on the in ector in ection.

WAVEFORM 4

Diesel Throttle Motor Signal

ECM Terminal Name	L SL and E1 L S2 and E1
Tester Range	1 V DIV., 2 msec. DIV.
Condition	Racing with warm engine



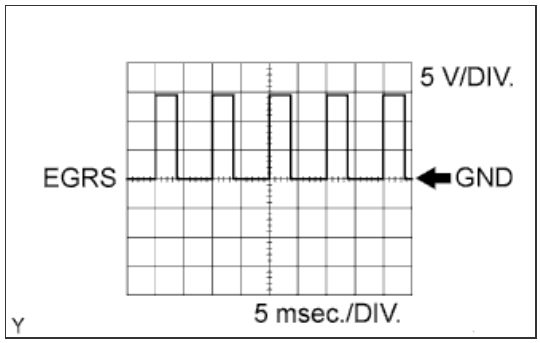
HINT:

The waveform varies depending on the throttle valve operation.

WAVEFORM 5

EGR Position Sensor Signal

ECM Terminal Name	EGRS and E1 ERS2 and E1
Tester Range	5 V DIV., 5 msec. DIV.
Condition	Idling



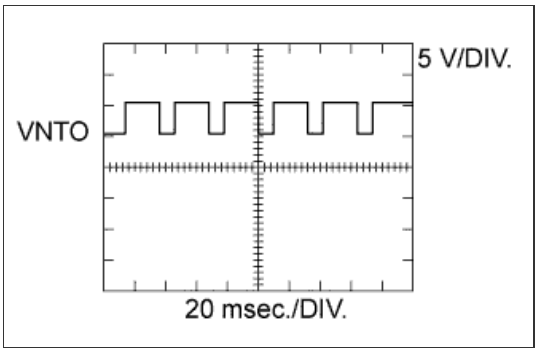
HINT:

The waveform varies depending on the throttle valve operation.

WAVEFORM 6

Turbo Motor Driver Input Signal

ECM Terminal Name	VNTO and E1 VNO2 and E1
Tester Range	5 V DIV., 20 msec. DIV.
Condition	Idling with warm engine



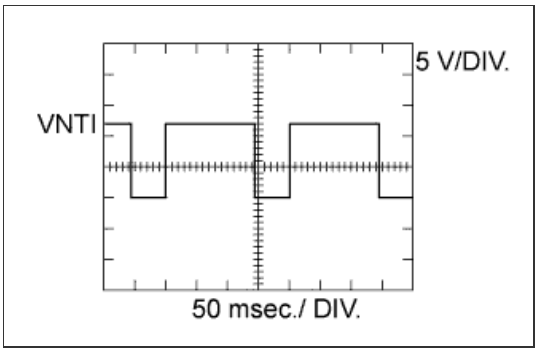
HINT:

The waveform varies depending on the turbocharger operation.

WAVEFORM 7

Turbo Motor Driver Output Signal

ECM Terminal Name	VNTI and E1 VNI2 and E1
Tester Range	5 V DIV., 50 msec. DIV.
Condition	Idling with warm engine



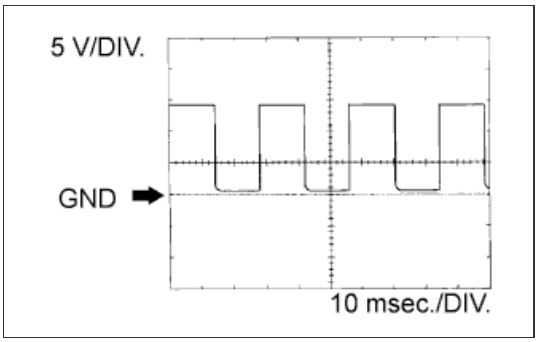
HINT:

The waveform varies depending on the turbocharger status.

WAVEFORM 8

Engine Speed Signal

ECM Terminal Names	TAC and E1
Tester Range	5 V DIV., 10 msec. DIV.
Conditions	Idling



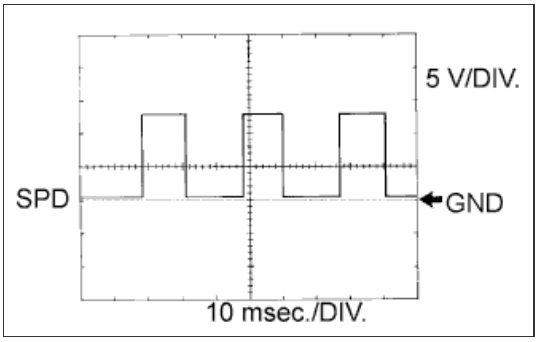
HINT:

The wavelength becomes shorter as the engine speed increases.

WAVEFORM 9

Vehicle Speed Signal

ECM Terminal Name	SPD and E1
Tester Range	5 V DIV., 10 msec. DIV.
Condition	Driving at vehicle speed of 40 km h (25 mph)



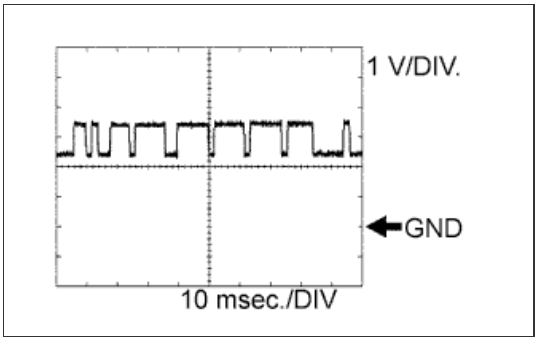
HINT:

The wavelength becomes shorter as the vehicle speed increases.

WAVEFORM 10

CAN Communication Signal

ECM Terminal Name	CAN+ and E1
Tester Range	1 V DIV., 10 msec. DIV.
Condition	Engine stopped, ignition switch ON



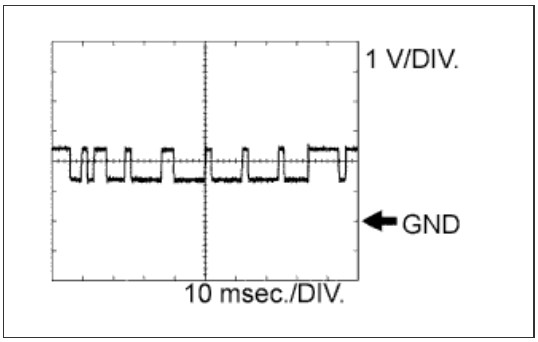
HINT:

The waveform varies depending on the CAN communication signal.

WAVEFORM 11

CAN Communication Signal

ECM Terminal Name	CAN- and E1
Tester Range	1 V DIV., 10 msec. DIV.
Condition	Engine stopped, ignition switch ON



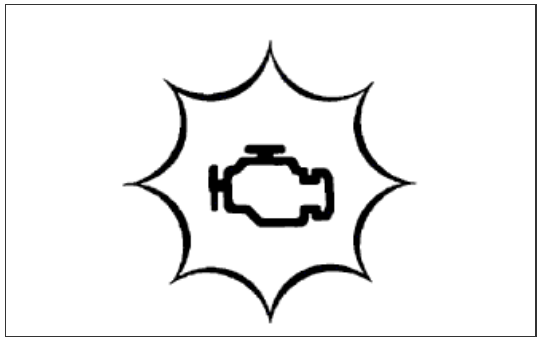
HINT:

The waveform varies depending on the CAN communication signal.

for Preparation Click here

EURO-OBD

When troubleshooting Europe ON-Boarding Diagnostic (Euro-OBD) vehicles, the vehicle must be connected to the intelligent tester. Various data output from the vehicle Engine Control Module (ECM) can then be read.
The Malfunction Indicator Lamp (MIL) is illuminated when the vehicle on-board computer detects a malfunction in the computer itself or in drive system components. In addition, the applicable Diagnostic Trouble Codes (DTCs) are stored in the ECM memory (Click here).
When the malfunction does not reoccur, the MIL stays illuminated until the ignition switch is turned off, and the MIL turns off when the engine is started. Be aware that the DTCs remain stored in the ECM memory.
To check DTCs, connect the intelligent tester to the DLC3 on the vehicle.



M-OBD (EXCEPT EUROPEAN SPEC.)

When troubleshooting Multiplex On-Board Diagnostic (M-OBD) vehicles, the vehicle must be connected to the intelligent tester. Various data output from the vehicle Engine Control Module (ECM) can then be read.
The Malfunction Indicator Lamp (MIL) is illuminated when the vehicle onboard computer detects a malfunction in the computer itself or in drive system components. In addition, the applicable Diagnostic Trouble Codes (DTCs) are stored in the ECM memory (Click here).
When the malfunction does not recur, the MIL stays illuminated until the ignition switch is turned off, and the MIL turns off when the engine is started. Be aware that the DTCs remain stored in the ECM memory.
To check DTCs, connect the intelligent tester to the DLC3 on the vehicle.

NORMAL MODE AND CHECK MODE

The diagnosis system operates in "normal mode" during normal vehicle use. In normal mode, "2 trip detection logic" is used to ensure accurate detection of malfunctions. "Check mode" is also available to technicians as an option. In check mode, "1 trip detection logic" is used for simulating malfunction symptoms and increasing the ability of the system to detect malfunctions, including intermittent malfunctions (Click here).

2 TRIP DETECTION LOGIC

When a malfunction is first detected, the malfunction is temporarily stored in the ECM memory (1st trip). If the same malfunction is detected during the next subsequent drive cycle, the MIL is illuminated (2nd trip).

FREEZE FRAME DATA

The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was moving or stationary, whether the engine was warmed up or not, as well as other data recorded at the time of a malfunction.

BATTERY VOLTAGE

If the voltage is below 11 V, recharge or replace the battery before proceeding.

Standard voltage:
11 to 14 V

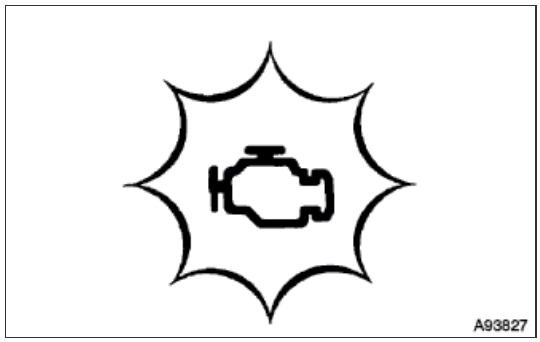
MIL

a. The MIL illuminates when the ignition switch is turned to ON and the engine is not running.

HINT:

If the MIL is not illuminated, check the MIL circuit (Click here).

b. When the engine is started, the MIL should turn off. If the MIL remains on, the diagnosis system has detected a malfunction or abnormality in the ECD system.



ALL READINESS

HINT:

- **With "All Readiness" you can check whether or not the DTC judgment has been completed by using the intelligent tester.**
- **You should check "All Readiness" after simulating malfunction symptoms or for validation after finishing repairs.**

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Perform the DTC judgment driving pattern to run the DTC judgment.

f. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

g. Input the DTCs to be confirmed.

h. Check the DTC judgment result.

Result

Tester Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • You should perform driving after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

for Preparation Click here

NOTICE:

When the diagnosis system is changed from the normal mode to check mode or vice versa, all DTCs and freeze frame data stored in normal mode are erased. Before changing modes, always check and make a note of DTCs and freeze frame data.

HINT:

- **DTCs which are stored in the ECM can be output on the intelligent tester. The intelligent tester can output current and pending DTCs.**
- **The same DTCs are not stored if the ECM does not detect the same malfunction again during a second consecutive driving cycle. However, such malfunctions, detected on only one occasion, are stored as pending DTCs.**

CHECK DTC (Using Intelligent Tester)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine / DTC.

e. Check the DTC(s) and freeze frame data, and then write them down.

f. Check the details of the DTC(s) (Click here).

CLEAR DTC (Using Intelligent Tester)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine / DTC / Clear.

e. Press the button.

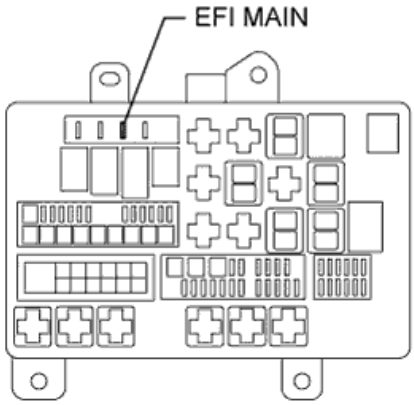
CLEAR DTC (Without using Intelligent Tester)

a. Perform either one of the following operations.

i. Disconnect the cable from the negative ( ) battery terminal for more than 1 minute.

ii. emove the EFI M N fuse from the engine room relay block (located inside the vehicle) for more than 1 minute.

Engine Room Relay Block:



Y

for Preparation Click here

HINT:

Intelligent tester only:

Compared to the normal mode, check mode is more sensitive to malfunctions. Therefore, check mode can detect the malfunctions that cannot be detected by normal mode.

NOTICE:

All the stored DTCs and freeze frame data are erased if: 1) the ECM is changed from normal mode to check mode or vice versa; or 2) the ignition switch is turned from ON to ACC or off while in check mode. Before changing modes, always check and make a note of any DTCs and freeze frame data.

CHECK MODE PROCEDURE (Using Intelligent Tester)

a. Check and ensure the following conditions:

   i. Battery positive voltage 11 V or higher.

   ii. Throttle valve fully closed.

   iii. Transmission in neutral.

   iv. A/C switched off.

b. Turn the ignition switch off.

c. Connect the intelligent tester to the DLC3.

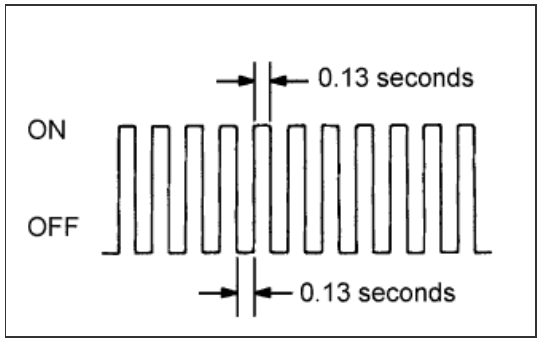
d. Turn the ignition switch to ON.

e. Turn the tester on.

f. Enter the following menus: Utility / Check Mode.

g. Switch the ECM from normal mode to check mode.

h. Make sure the MIL flashes as shown in the illustration.



i. Start the engine.

j. Make sure the MIL turns off.

k. Simulate the conditions of the malfunction described by the customer.

l. Check for DTCs and freeze frame data using the tester.

m. After checking for DTCs, inspect the applicable circuits.

for Preparation Click here

FAIL-SAFE CHART

If any of the following DTCs are stored, the ECM enters fail-safe mode to allow the vehicle to be driven temporarily.

DTC No.	Detection Item	Fail-safe Operation	Fail-safe Deactivation Condition
P00AF	Turbocharger/ Supercharger Boost Control "A" Module Performance	The engine power is limited.	Ignition switch off
P00B0	Turbocharger/ Supercharger Boost Control "B" Module Performance	The engine power is limited.	Ignition switch off
P0046	Turbocharger / Supercharger Boost Control Solenoid Circuit Range / Performance	The engine power is limited.	Ignition switch off
P0047	Turbocharger / Supercharger Boost Control "A" Circuit Low	The engine power is limited.	Ignition switch off
P0048	Turbocharger / Supercharger Boost Control "A" Circuit High	The engine power is limited.	Ignition switch off
P004B	Turbocharger/ Supercharger Boost Control Solenoid "B" Circuit Range/ Performance	The engine power is limited.	Ignition switch off
P004C	Turbocharger/ Supercharger Boost Control Solenoid "B" Circuit Low	The engine power is limited.	Ignition switch off
P004D	Turbocharger/ Supercharger Boost Control Solenoid "B" Circuit High	The engine power is limited.	Ignition switch off
P0087	Fuel Rail/System Pressure - Too Low	The engine power is reduced by 90%.*	Ignition switch off
P0088	Fuel Rail/System Pressure - Too High	The engine power is reduced by 90%.*	Ignition switch off
P0093	Fuel System Leak Detected - Large Leak	The engine power is reduced by 90%.* (Limits the engine power for 30 second and then stalls the engine).	Ignition switch off
P0100	Mass or Volume Air Flow Circuit	The engine power is limited.	Pass condition detected
P0101	Mass or Volume Air Flow Circuit	The engine power is limited.	Ignition switch off
P0102	Mass or Volume Air Flow Circuit Low Input	The engine power is limited.	Pass condition detected
P0103	Mass or Volume Air Flow Circuit High Input	The engine power is limited.	Pass condition detected
P0105	Manifold Absolute Pressure/Barometric Pressure Circuit	The turbo pressure is fixed at a specified value.	Pass condition detected
P0107	Manifold Absolute Pressure/Barometric Pressure Circuit Low Input	The turbo pressure is fixed at a specified value.	Pass condition detected
P0108	Manifold Absolute Pressure/Barometric Pressure Circuit High Input	The turbo pressure is fixed at a specified value.	Pass condition detected
P0110	Intake Air Temperature Circuit	The intake air temperature value is fixed.	Pass condition detected
P0112	Intake Air Temperature Circuit Low Input	The intake air temperature value is fixed.	Pass condition detected
P0113	Intake Air Temperature Circuit High Input	The intake air temperature value is fixed.	Pass condition detected
P0115	Engine Coolant Temperature Circuit	The engine coolant temperature sensor output is fixed at a specified value (the fixed value varies depending on conditions).	Pass condition detected
P0117	Engine Coolant Temperature Circuit Low Input	The engine coolant temperature sensor output is fixed at a specified value (the fixed value varies depending on conditions).	Pass condition detected
P0118	Engine Coolant Temperature Circuit High Input	The engine coolant temperature sensor output is fixed at a specified value (the fixed value varies depending on conditions).	Pass condition detected
P0122	Throttle/Pedal Position Sensor/Switch "A" Circuit Low Input	The engine power is limited.	Ignition switch off
P0123	Throttle/Pedal Position Sensor/Switch "A" Circuit High Input	The engine power is limited.	Ignition switch off
P0168	Fuel Temperature Too High	The engine power is limited.	Pass condition detected

P0180	Fuel Temperature Sensor "A" Circuit	The fuel temperature is fixed at a specified value.	Pass condition detected
P0182	Fuel Temperature Sensor "A" Circuit Low Input	The fuel temperature is fixed at a specified value.	Pass condition detected
P0183	Fuel Temperature Sensor "A" Circuit High Input [Fuel temperature sensor high input]	The fuel temperature is fixed at a specified value.	Pass condition detected
P0190	Fuel Rail Pressure Sensor Circuit	The engine power is limited.	Ignition switch off
P0192	Fuel Rail Pressure Sensor Circuit Low Input	The engine power is limited.	Ignition switch off
P0193	Fuel Rail Pressure Sensor Circuit High Input	The engine power is limited.	Ignition switch off
P0222	Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input	The engine power is limited.	Ignition switch off
P0223	Throttle / Pedal Position Sensor / Switch "B" Circuit High Input	The engine power is limited.	Ignition switch off
P0299	Turbocharger / Supercharger Underboost	The engine power is limited.	Ignition switch off
P0335	Crankshaft Position Sensor "A" Circuit	The engine power is reduced by 90%.*	Pass condition detected
P0340	Camshaft Position Sensor "A" Circuit (Bank 1 or Single Sensor)	The engine power is reduced by 90%.*	Pass condition detected
P0400	Exhaust Gas Recirculation Flow	The engine power is limited.	Ignition switch off
P0405	Exhaust Gas Recirculation Sensor "A" Circuit Low	The engine power is limited.	Ignition switch off
P0406	Exhaust Gas Recirculation Sensor "A" Circuit High	The engine power is limited.	Ignition switch off
P0407	Exhaust Gas Recirculation Sensor "B" Circuit Low	The engine power is limited.	Ignition switch off
P0408	Exhaust Gas Recirculation Sensor "B" Circuit High	The engine power is limited.	Ignition switch off
P0488	Exhaust Gas Recirculation Throttle Position Control Range/Performance	The engine power is limited.	Ignition switch off
P0500	Vehicle Speed Sensor "A"	The vehicle speed is fixed at 0 km/h (0 mph).	Pass condition detected
P0607	Control Module Performance	The engine is stopped.	Ignition switch off
P0627	Fuel Pump Control Circuit / Open	The engine power is limited.	Pass condition detected
P062D	Fuel Injector Driver Circuit Performance Bank 1	The engine power is limited.	Ignition switch off
P062E	Fuel Injector Driver Circuit Performance Bank 2	The engine power is limited.	Ignition switch off
P1229	Fuel Pump System	The engine power is limited.	Ignition switch off
P1248	Exhaust Gas Recirculation Flow Bank 2	The engine power is limited.	Ignition switch off
P1251	Turbocharger / Supercharger Overboost Condition (Too High)	The engine power is limited.	Ignition switch off
P1258	VNT Position Sensor Range/Performance Bank 2 Sensor 1	The engine power is limited.	Ignition switch off
P1259	VNT Position Sensor Low Bank 2 Sensor 1	The engine power is limited.	Ignition switch off
P1260	VNT Position Sensor High Bank 2 Sensor 1	The engine power is limited.	Ignition switch off
P1262	VNT Position Sensor Low Bank 2 Sensor 2	The engine power is limited.	Ignition switch off
P1263	VNT Position Sensor High Bank 2 Sensor 2	The engine power is limited.	Ignition switch off
P1495	Intake Air Temperature Sensor 1 Circuit	The intake air temperature is fixed at a specified value.	Pass condition detected
P1496	Intake Air Temperature Sensor 1 Circuit Low	The intake air temperature is fixed at a specified value.	Pass condition detected
P1497	Intake Air Temperature Sensor 1 Circuit High	The intake air temperature is fixed at a specified value.	Pass condition detected
P1611	Run Pulse	The engine is stopped.	Ignition switch off
P2120	Throttle/Pedal Position Sensor/Switch "D" Circuit	The engine power is limited.	Ignition switch off
P2121	Throttle/Pedal Position Sensor/Switch "D" Circuit Range/Performance	The engine power is limited.	Ignition switch off

P2122	Throttle/Pedal Position Sensor/Switch "D" Circuit Low Input	The engine power is limited.	Ignition switch off
P2123	Throttle/Pedal Position Sensor/Switch "D" Circuit High Input	The engine power is limited.	Ignition switch off
P2125	Throttle/Pedal Position Sensor/Switch "E" Circuit	The engine power is limited.	Ignition switch off
P2127	Throttle/Pedal Position Sensor/Switch "E" Circuit Low Input	The engine power is limited.	Ignition switch off
P2128	Throttle/Pedal Position Sensor/Switch "E" Circuit High Input	The engine power is limited.	Ignition switch off
P2138	Throttle/Pedal Position Sensor/Switch "D"/"E" Voltage Correlation	The engine power is limited.	Ignition switch off
P213B	Exhaust Gas Recirculation Throttle Position Control (Range / Performance)	The engine power is limited.	Ignition switch off
P2226	Barometric Pressure Circuit	The atmospheric pressure is fixed at a specified value.	Pass condition detected
P2228	Barometric Pressure Circuit Low Input	The atmospheric pressure is fixed at a specified value.	Pass condition detected
P2229	Barometric Pressure Circuit High Input	The atmospheric pressure is fixed at a specified value.	Pass condition detected
P2563	Turbocharger / Supercharger Boost Control Position Sensor "A" Circuit Range / Performance	The engine power is limited.	Ignition switch off
P2564	Turbocharger / Supercharger Boost Control Position Sensor "A" Circuit Low	The engine power is limited.	Ignition switch off
P2565	Turbocharger / Supercharger Boost Control Position Sensor "A" Circuit High	The engine power is limited.	Ignition switch off
P2588	Turbocharger / Supercharger Boost Control Position Sensor "B" Circuit Low	The engine power is limited.	Ignition switch off
P2589	Turbocharger / Supercharger Boost Control Position Sensor "B" Circuit High	The engine power is limited.	Ignition switch off

HINT:

*: Engine power is limited immediately after the DTC is stored.

for Preparation Click here

DATA LIST

HINT:

Using the intelligent tester to read the Data List allows the values or states of switches, sensors, actuators and other items to be read without removing any parts. This non-intrusive inspection can be very useful because intermittent conditions or signals may be discovered before parts or wiring is disturbed. Reading the Data List information early in troubleshooting is one way to save diagnostic time.

NOTICE:

In the table below, the values listed under "Normal Condition" are reference values. Do not depend solely on these reference values when deciding whether a part is faulty or not.

a. Warm up the engine.

b. Turn the ignition switch off.

c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON.

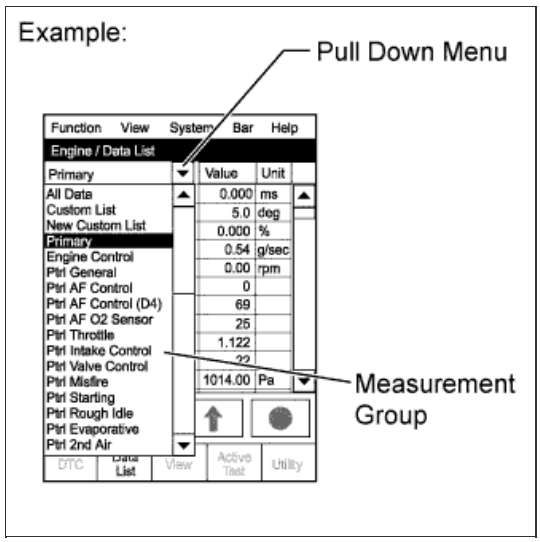
e. Start the engine.

f. Turn the intelligent tester on.

g. Enter the following menus: Powertrain / Engine / Data List.

HINT:

- **To display the list box, press the pull down menu button next to Primary. Then select a measurement group.**
- **When you select a measurement group, the ECU data belonging to that group is displayed.**
- **Measurement Group List / Description**
  - **All Data / All data**
  - **Primary / -**
  - **Engine Control / Engine control system related data**
  - **Diesel General / General data to analyze engine conditions for diesel engine**
  - **Common Rail / Fuel system (common rail system) related data**
  - **Common Rail (All) / Fuel system (common rail system) related data**
  - **Diesel EGR / EGR system related data**
  - **Diesel Throttle / Diesel throttle system related data**
  - **VN Turbo / VN turbo related data**
  - **Diesel Exhaust / Exhaust system related data including intake system**
  - **Diesel Starting / "Difficult to start" related data**
  - **Diesel Rough Idle / "Rough idle" related data**
  - **Diesel Lack of Power / "Lack of power" related data**
  - **Diesel Knocking / "Engine knocking" related data**
  - **Diesel Black Smoke / "Black smoke" related data**
  - **Check Mode / ECM mode related data**
  - **Monitor Status / Monitor status related data**
  - **Charging Control / Charging control system related data**
  - **Compression / Data used during "Check the Cylinder Compression" in "Active Test"**
  - **Vehicle Information / Vehicle information**



h. Check the values by referring to the table below.

HINT:

"Result of real-vehicle check" is the assessment of one vehicle. Use it only for reference.

Engine Control

Calculate Load

<table>
<tr><th>Tester Display</th><th>Measurement Item/Range</th><th>Normal Condition</th><th>Type</th><th>Cause of Out of Range</th></tr>
<tr><td rowspan="3">Calculate Load</td><td>Calculated load by ECM: Min.: 0%, Max.: 100%</td><td>Idling: 15.4 to 20.4%
Running without load (2500 rpm): 20.1 to 25.9%
Driving with the accelerator fully open at 3000 rpm: 80.3 to 99.6%
Driving with the accelerator fully open at 4000 rpm: 96.4 to 98%</td><td>Calculated by ECM</td><td>Malfunction in which turbo pressure or Mass Air Flow (MAF) decreases</td></tr>
<tr><td colspan="4">Results of real-vehicle check:
Ignition switch ON: 0%
Cranking: 70%
Idling (warm up the engine): 18% (2 minutes after starting the vehicle)
Running without load (2500 rpm): 22%
Driving with the accelerator fully open at 2000 rpm: 99%
Driving with the accelerator fully open at 3000 rpm: 100%</td></tr>
<tr><td colspan="4">Diagnostic Note:
Calculate load = (Final injection volume / max. injection volume at current engine speed) x 100.</td></tr>
</table>

MAF

<table>
<tr><th>Tester Display</th><th>Measurement Item/Range</th><th>Normal Condition</th><th>Type</th><th>Cause of Out of Range</th></tr>
<tr><td rowspan="4">MAF</td><td>Air flow rate from MAF meter: Min.: 0 gm/sec., Max.: 400 gm/sec.</td><td>w/ EGR (depending on EGR rate)
Idling: 5 to 12 g/sec.
Running without load (2000 rpm): 28.2 to 130 g/sec.
w/o EGR
Idling: 20 to 28 g/sec.
Running without load (2000 rpm): 90 to 130 g/sec.</td><td>Sensor output (MAF meter)</td><td>MAF meter
MAF meter circuit
Intake related clog or leak
Exhaust related clog
Turbocharger sub-assembly
Leak or clog in passages for turbocharger
Malfunction in which EGR valve does not close</td></tr>
<tr><td colspan="4">Results of real-vehicle check:
w/ EGR:
Ignition switch ON: 1.54 g/sec.
Cranking: 15 g/sec.
Idling (warm up the engine): 9 g/sec. (2 minutes after starting the vehicle)
Running without load (2500 rpm): 80 g/sec.
Driving with the accelerator fully open at 2000 rpm: 110 g/sec.
Driving with the accelerator fully open at 3000 rpm: 230 g/sec.</td></tr>
<tr><td colspan="4">Symptoms when out of range:
Rough idling</td></tr>
<tr><td colspan="4">Diagnostic Note:
Based on the MAF, the ECM controls the fuel injection volume, injection timing, EGR, etc.
If the value is always approximately 0 g/sec.:
Mass air flow meter power source circuit is open.
VG circuit is open or shorted.
If the value is always 200 g/sec. or more:
EVG circuit is open.</td></tr>
</table>

Engine Speed

<table>
<tr><th>Tester Display</th><th>Measurement Item/Range</th><th>Normal Condition</th><th>Type</th><th>Cause of Out of Range</th></tr>
<tr><td rowspan="3">Engine Speed</td><td>Engine speed: Min.: 0 rpm, Max.: 6000 rpm</td><td>Idling: 550 to 650 rpm (A/T)
Idling: 500 to 600 rpm (M/T)</td><td>Sensor output (crankshaft position sensor)</td><td>Crankshaft position sensor
Crankshaft position sensor circuit</td></tr>
<tr><td colspan="4">Symptoms when out of range:
-</td></tr>
<tr><td colspan="4"></td></tr>
</table>

	Diagnostic Note: When the crankshaft position sensor is malfunctioning, "Engine speed" is approximately 0 or varies greatly from the actual engine speed.

Target Idle Engine Speed

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Target Idle Engine Speed	Target engine speed for idling: Min.: 0 rpm, Max.: 51199 rpm	• Idling: 550 to 650 rpm (A/T) • Idling: 500 to 600 rpm (M/T)	Calculated by ECM	-
	Diagnostic Note: • Target engine speed for idling speed control. • The ECM calculates the target engine idling speed in consideration of the air conditioner load, electric load, shift position changes, idle-up control for cold engine start, etc.			

MAP

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
MAP	Absolute pressure inside intake manifold: Min.: 0 kPa, Max.: 255 kPa	• Idling: 90 to 102 kPa (depending on barometric pressure) • Engine running at 3000 rpm: 100 to 150 kPa	Sensor output (manifold absolute pressure sensor)	• Manifold absolute pressure sensor • Intake related clog or leak • Exhaust related clog • Turbocharger sub-assembly • Leak or clog in passages for turbocharger • EGR valve stuck open • Exhaust leak • Throttle valve stuck closed
	Results of real-vehicle check: • Ignition switch ON: 99 kPa • Cranking: 99 kPa • Idling (warm up the engine): 99 kPa (2 minutes after starting the vehicle) • Running without load (2500 rpm): 113 kPa • Running without load (4000 rpm): 150 kPa • Driving with the accelerator fully open at 2000 rpm: 143 kPa • Driving with the accelerator fully open at 3000 rpm: 209 kPa			
	Symptoms when out of range: Lack of power			
	Diagnostic Note: • When the ignition switch is ON or the vehicle is idling, the intake manifold absolute pressure and atmospheric pressure are approximately the same (standard atmospheric pressure = 101 kPa). Above approximately 1500 rpm, the turbo becomes effective, and the pressure becomes higher than atmospheric pressure. • Inspect while comparing with "Target Booster Pressure". • With the accelerator fully open, if the actual manifold absolute pressure (MAP) is low compared to the target booster pressure by at least 20 kPa for 5 seconds or more, a feeling of insufficient power will occur.			

Vehicle Speed

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Vehicle Speed	Vehicle speed: Min.: 0 km/h, Max.: 255 km/h	Actual vehicle speed	Sensor output (speed sensor)	• Speed sensor • Speed sensor circuit
	Symptoms when out of range: -			
	Diagnostic Note: -			

Coolant Temp

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Coolant Temp	Engine coolant temperature: Min.: -40°C, Max.: 140°C	After warming up engine: 75 to 90°C (167 to 194°F)	Sensor output (engine coolant temperature sensor)	• Engine coolant temperature sensor • Thermostat
	Symptoms when out of range: Difficult starting when engine is cold, rough idle, black smoke, lack of power			
	Diagnostic Note: • If the value is -40°C (-40°F) or 140°C (284°F), the sensor circuit is open or shorted. • After a long soak, the coolant temperature, intake air temperature, and ambient air temperature are approximately equal.			

Intake Air

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Intake Air	Intake air temperature: Min.: -40°C, Max.: 140°C	Equivalent to temperature at intake manifold	Sensor output (intake air temperature sensor (built into MAF meter))	Intake air temperature sensor
	Symptoms when out of range: -			
	Diagnostic Note: • After a long soak, the engine coolant temperature, intake air temperature, and ambient air temperature are approximately equal. • If the value is -40°C (-40°F) or 140°C (284°F), the sensor circuit is open or shorted.			

Initial Engine Coolant Temp

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Initial Engine Coolant Temp	Initial engine coolant temperature: Min.: -40°C, Max.: 120°C	Engine coolant temperature when engine started	Sensor output when engine started	-
	Diagnostic Note: For Freeze Frame Data, this tells whether the malfunction happened at a cold start or with a warm engine.			

Initial Intake Air Temp

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Initial Intake Air Temp	Initial intake air temperature: Min.: -40°C, Max.: 120°C	Intake air temperature when engine started	Sensor output when engine started	-
	Diagnostic Note: -			

Intake Air Temp (Turbo)

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Intake Air Temp (Turbo)	Intake air temperature after intercooler: Min.: -40°C, Max.: 190°C	70°C (158°F) or less	Sensor output (intake air temperature sensor after intercooler)	Decreased cooling efficiency of intercooler (contamination, clogging)
	Diagnostic Note: • Intake air temperature at the intake manifold (after intercooler). • During fail-safe operation, the value is set to 165°C (329°F). As the value is set to a high temperature, the turbo pressure may be suppressed and there may be a lack of power.			

Alternate Duty Ratio

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
		• No electrical		

<table>
<tr><td rowspan="4">Alternate Duty Ratio</td><td>Alternator generation duty ratio:
Min.: 0%, Max.: 100%</td><td>load at idling: 10 to 60%
• High electrical load at idling: 100%</td><td>Duty value from ALT terminal</td><td>• Battery deterioration
• Alternator malfunction
• Check for accessory lights, malfunctions, etc.</td></tr>
<tr><td colspan="4">Results of real-vehicle check:
• Idling (No electrical load) (warm up the engine): 30% (2 minutes after starting the vehicle)</td></tr>
<tr><td colspan="4">Symptoms when out of range:
-</td></tr>
<tr><td colspan="4">Diagnostic Note:
• Outputs the alternator generation duty in order to see the electrical load.
• Can be used to determine whether a higher-than-normal injection volume at idle, etc. is resulting from electrical loading or from some other source. For example, when the duty is not high but the idling injection volume is high, there is injector volume degradation or high engine friction.
• Can be used for judging whether or not a malfunctioning component in the electrical system is generating continual generation requests (ex. battery deterioration is causing an unending full recharge request, etc.). Regardless of whether or not an auxiliary device like the A/C or heater is active, the alternator duty is always at MAX status. There is an electrical system abnormality, like battery deterioration.</td></tr>
</table>

Starter Signal

<table>
<tr><th>Tester Display</th><th>Measurement Item/Range</th><th>Normal Condition</th><th>Type</th><th>Cause of Out of Range</th></tr>
<tr><td rowspan="3">Starter Signal</td><td>Starter signal:
ON or OFF</td><td>ON:
Cranking</td><td>-</td><td>• OFF malfunction (ignition switch (STA) is ON but the signal is OFF and the starter is operating): Wire harness is open or shorted to ground
• ON malfunction (ignition switch (STA) is OFF but the signal is ON and the starter is not operating): Wire harness is shorted to +B
• Operation malfunction: Ignition switch malfunction, starter relay malfunction, starter malfunction, battery or battery cable is defective, or wire harness is open or shorted</td></tr>
<tr><td colspan="4">Symptoms when out of range:
• Ignition switch is ON but the starter does not operate: Starting is not possible
• Ignition switch is off but the starter continues to operate: STA signal malfunction (P0617) is stored</td></tr>
<tr><td colspan="4">Diagnostic Note:
• Ignition switch (STA) output:
• ON: Starter is operating.
• OFF: Starter is not operating.</td></tr>
</table>

Power Steering Signal Record

<table>
<tr><th>Tester Display</th><th>Measurement Item/Range</th><th>Normal Condition</th><th>Type</th><th>Cause of Out of Range</th></tr>
<tr><td rowspan="3">Power Steering Signal Record</td><td>Power steering switch status:
ON or OFF</td><td>ON: Power steering operation</td><td>Switch output (power steering switch)</td><td>• OFF malfunction: Wire harness (power steering switch to ECM) is open or shorted to ground
• ON malfunction:
Wire harness (power steering switch to ECM) is shorted to +B
• Power steering switch malfunction</td></tr>
<tr><td colspan="4">Symptoms when out of range:
• OFF malfunction (OFF during power steering operation): Engine speed decreases temporarily when power steering is operating</td></tr>
<tr><td colspan="4">Diagnostic Note:
-</td></tr>
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Power Steer. Sig. Record

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<tr><th>Tester Display</th><th>Measurement Item/Range</th><th>Normal Condition</th><th>Type</th><th>Cause of Out of Range</th></tr>
<tr><td></td><td>Power steering switch status history:</td><td>ON: When steering wheel first turned after ignition switch ON</td><td>Power steering switch output history (after disconnecting and reconnecting the battery)</td><td>-</td></tr>
</table>

Power Steer. Sig Record	ON or OFF			

	Diagnostic Note:
	• Power steering switch output history (after disconnecting and reconnecting the battery):
	  • ON: Power steering operated in the past.
	  • OFF: Power steering did not operate in the past.			

A/C Signal

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
A/C Signal	A/C (Air Conditioner) signal: ON or OFF	ON: A/C on	A/C operation signal output from A/C amplifier • ON: Operating • OFF: Not operating	• A/C switch • A/C amplifier • A/C system malfunction, wire harness between A/C amplifier and ECU open or shorted
	Symptoms when out of range: • OFF malfunction (OFF even when A/C switch is turned on): • Engine speed decreases temporarily when the A/C is operating.			
	Diagnostic Note: -			

Stop Light Switch

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Stop Light Switch	Stop light switch: ON or OFF	• ON: Brake pedal depressed • OFF: Brake pedal released	Switch output (stop light switch)	• OFF malfunction: Wire harness (stop light switch to ECM, stop light switch to +B) open or shorted to ground • ON malfunction: Wire harness (stop light switch to ECM) shorted to +B • Stop light switch
	Symptoms when out of range: • Stop light switch malfunction DTC P0504 is stored			

	Diagnostic Note:
	• Stop light switch (STP) operation condition:
	  • ON: Light is on (Brake pedal is depressed).
	  • OFF: Light is off (Brake pedal is released).			

Intank Fuel Pump

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Intank Fuel Pump	Intank fuel pump status: ON or OFF	Operates according to fuel consumption amount (Operates after about 10 minutes of driving)	Operation command	-
	Symptoms when out of range: -			
	Diagnostic Note: • ON: Intank fuel pump is operating. • Only for vehicles equipped with a double tank.			

Immobiliser Communication

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Immobiliser Communication	Immobiliser communication: ON or OFF	ON: Normal	-	• Use of a non-registered key • Key battery is fully depleted
	Symptoms when out of range: -			
	Diagnostic Note: -			

Low Gear Switch

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Low Gear Switch	Shift position switch: ON or OFF	ON: First position	Switch output (low gear switch)	-
	Symptoms when out of range: • When OFF with the shift lever in 1, the torque increases like the other gears • When OFF with the shift lever not in 1, the torque decreases like 1st gears			
	Diagnostic Note: The shift position switch is used to limit torque for manual transmissions			

Neutral Position SW Signal

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Neutral Position SW Signal	Neutral position switch status: ON or OFF	ON: Neutral position	Switch output (neutral position switch)	-
	Symptoms when out of range: -			
	Diagnostic Note: -			

Clutch Switch

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Clutch Switch	Clutch switch: ON or OFF	ON: Clutch pedal depressed	Switch output (clutch switch)	-
	Symptoms when out of range: When OFF with the clutch pedal depressed, the engine does not start.			
	Diagnostic Note: -			

Battery Voltage

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Battery Voltage	Battery voltage: Min.: 0 V, Max.: 15 V	11 to 14 V	-	-
	Results of real-vehicle check: • Ignition switch ON: 12.5 V • Cranking (with engine warmed up): 9.0 V • Idling (warm up the engine): 13.4 V • Running without load (2500 rpm): 13.5 V • Driving with the accelerator fully open at 2000 rpm: 13 V • Driving with the accelerator fully open at 3000 rpm: 13.2 V			
	Symptoms when out of range: If 5 V or less, starting becomes difficult			
	Diagnostic Note: If 11 V or less, characteristics of some electrical components change.			

Atmosphere Pressure

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Atmosphere Pressure	Atmospheric pressure value: Min.: 50 kPa, Max.: 120 kPa	Actual atmospheric pressure	Sensor output (atmospheric pressure sensor (built into ECM))	Atmospheric pressure sensor itself has failed (atmospheric pressure sensor is inside the ECM)
	Symptoms when out of range: -			
	Diagnostic Note: • With the ignition switch ON, when the difference between the atmospheric pressure sensor and intake manifold absolute pressure is 10 kPa or higher, there is a malfunction in one of the sensors. • With the ignition switch ON, when the atmospheric pressure is 0 kPa or 140 kPa, there is a malfunction in the sensor circuit. • Standard atmospheric pressure: 101 kPa. • For every 100 m increase in altitude, pressure drops by 1 kPa.			

	Varies by weather (high atmospheric pressure, low atmospheric pressure).

ACT VSV

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
ACT VSV	A/C cut status for Active Test: ON or OFF	-	-	-
	Diagnostic Note: Active Test "Control the A/C Cut Signal" support data.			

ACM Inhibit

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
ACM Inhibit	VSV for engine mount status: ON or OFF	-	-	-

	Diagnostic Note:
	• VSV for engine mount status:
	  • Ignition switch is ON: OFF.
	  • Idling: ON.
	• Active Test "Control the ACM Inhibit" support data.			

TC and TE1

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
TC and TE1	Connect the TC and TE1 status for Active Test: ON or OFF	-	-	-
	Diagnostic Note: • When the Active Test "Connect the TC and TE1" is performed, the system behaves as if TC and CG were connected.			

Codes(Include History)

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
# Codes(Include History)	Number of codes: Min.: 0, Max.: 255	-	-	-
	Diagnostic Note: Number of DTCs appearing at least once during the last 40 times the vehicle was warmed up.			

Check Mode

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Check Mode	Check mode: ON or OFF	ON: Check mode ON	-	-
	Diagnostic Note: Check Mode: The mode in which certain DTCs can be detected more easily and with higher sensitivity.			

SPD Test

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
SPD Test	Check mode result for vehicle speed sensor: Compl or Incompl	-	-	-
	Diagnostic Note: SPD Test: Check mode result for vehicle speed sensor.			

MIL

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
MIL	MIL status: ON or OFF	ON: MIL on	-	-

MIL ON Run Distance

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
	MIL on run distance: Min.: 0 km, Max.: 65535 km	Distance after DTC stored	Result of ECU calculations (using the vehicle speed)	-

MIL ON Run Distance	Diagnostic Note: • Distance traveled after a DTC is stored. • Cleared when the negative (-) battery cable is disconnected or when the DTC is cleared using the intelligent tester.

Running Time from MIL ON

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Running Time from MIL ON	Running time from MIL on: Min.: 0 min., Max.: 65535 min.	Running time after MIL turns on	-	-
	Diagnostic Note: • Engine run time since the MIL illumination. • Cleared when the negative (-) battery cable is disconnected or when the DTC is cleared using the intelligent tester.			

Engine Run Time

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Engine Run Time	Engine run time: Min.: 0 sec., Max.: 65535 sec.	Time after the ignition switch turned to ON	ECU calculations (using the engine speed)	-
	Diagnostic Note: Time passed since the ignition switch was turned to ON.			

Time after DTC Cleared

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Time after DTC Cleared	Time after DTC cleared: Min.: 0 min., Max.: 65535 min.	Time after DTCs cleared	-	-
	Diagnostic Note: Time elapsed since the DTCs were cleared (or shipment from the factory).			

Distance from DTC Cleared

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Distance from DTC Cleared	Distance after DTC cleared: Min.: 0 km, Max.: 65535 km	Driving distance after DTCs were cleared	-	-
	Diagnostic Note: • Distance driven since the DTCs were cleared. • (Data List's "Distance from DTC clear") - (Freeze frame data's "Distance from DTC clear") = Distance driven since the abnormality occurred.			

Warmup Cycle Cleared DTC

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Warmup Cycle Cleared DTC	Warmup cycle after DTC cleared: Min.: 0, Max.: 255	-	-	-
	Diagnostic Note: • Number of engine warm ups since DTCs were cleared. • (Data List "Warmup Cycle Cleared DTC") - (Freeze frame data "Warmup Cycle Cleared DTC") = Warmup cycles since the abnormality occurred.			

OBD Requirements

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
OBD Requirements	Identifying OBD requirement	-	-	-
	Diagnostic Note: Euro-OBD.			

Number of Emission DTC

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Number of Emission DTC	Number of emission DTCs	-	-	
	Diagnostic Note:			

	-

Complete Parts Monitor

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Complete Parts Monitor	Complete parts monitor: Not Avl or Avail	-	-	-
	Diagnostic Note: -			

Engine Start Time

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Engine Start Time	Engine start time: Min.: 0 ms, Max.: 267000 ms	-	-	-
	Diagnostic Note: Time necessary for the engine to start. **CAUTION:** This Data List item cannot be used.			

ACC Relay

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
ACC Relay	ACC (accessory) relay: ON or OFF	ON: Cranking	-	-
	Diagnostic Note: -			

Starter Relay

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Starter Relay	Starter relay: ON or OFF	ON: Cranking	-	-
	Diagnostic Note: -			

Accel Position

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Accel Position	Accelerator position status: Min.: 0%, Max.: 100%	• Accelerator pedal released: 0% • Accelerator pedal fully depressed: 100%	• Accelerator pedal position sensor opening position • ETC request opening position • Cruise request opening position • VSC request opening position	-
	Results of real-vehicle check: • Ignition switch ON: 0% (accelerator pedal released) • Running without load (2500 rpm): 24.6% • Running without load (4700 rpm): 99.6% (accelerator pedal fully depressed)			
	Symptoms when out of range: -			
	Diagnostic Note: • "Accel Position" is the accelerator opening angle (%) for engine control use. • When the MIL is illuminated, even with the accelerator pedal fully depressed and an "Accel Position" of around 10% or 25%, it means the fail-safe is restricting the accelerator. • When the accelerator pedal position sensor output itself (Accel Sens. No.1 Volt % and Accel Sens. No.2 Volt %) is in the normal range, another actuator malfunction has caused the fail-safe to restrict the accelerator. • Without cruise or ETC, VSC requests, and without accelerator restriction by the fail-safe, this is adjusted proportionally to the depressing of the accelerator pedal by the driver. • Accelerator fully closed: 0% • Accelerator fully open: 100%			

HINT:

Accel Sens. No.1 Volt % and Accel Sens. No.2 Volt % express the value obtained by dividing the output voltage from the accelerator pedal position sensor by 5 (expressed in percentage). This is used only for diagnosing malfunctions in the accelerator pedal position sensor. Under normal conditions, it is sufficient to only check the accelerator opening angle final value "Accel Position".

Pre Glow

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Pre Glow	Pre-glow operation status (pre-heating control): ON or OFF	Status is ON when the pre-glow is requested	Glow command signal	• Engine coolant temperature sensor • Engine coolant temperature sensor circuit
	Results of real-vehicle check: Ignition switch turned to ON (engine not started), engine coolant temperature 35°C (95°F): ON for about 10 seconds **HINT:** Under above conditions, the glow indicator light is turns on for about 1.0 second.			
	Symptoms when out of range: Difficult to start, rough idling			
	Diagnostic Note: • The pre-glow ON period varies according to the engine coolant temperature. • Whether the glow plug operation is affected or not can be determined by monitoring the glow plug energization command value when a problem occurs during engine start-up. • When the battery voltage value remains the same even if the glow command is changed (ON to OFF, or OFF to ON), it is likely that there may be a malfunction in the glow plug or circuit. (TIPS: Whether the problem causes are related to the glow system or not can be determined only when all cylinders do not operate such as in a case of relay operation problem.)			

After Glow

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
After Glow	After-glow operation status: ON or OFF	Status is ON when the after-glow is requested	Glow command signal	• Engine coolant temperature sensor • Engine coolant temperature sensor circuit
	Results of real-vehicle check: Engine started, engine coolant temperature 35°C (95°F): ON for about 15 seconds			
	Symptoms when out of range: Difficult to start, rough idling			
	Diagnostic Note: • The after-glow ON period varies according to the engine coolant temperature. • Whether the glow plug operation is affected or not can be determined by monitoring the glow plug energization command value when a problem occurs during engine start-up. • When the battery voltage value remains the same even if the glow command is changed (ON to OFF, or OFF to ON), it is likely that there may be a malfunction in the glow plug or circuit. (TIPS: Whether the problem causes are related to the glow system or not can be determined only when all cylinders do not operate such as in a case of relay operation problem.)			

Compression

Engine Speed of Cyl #1

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Engine Speed of Cyl #1	Engine speed for No. 1 cylinder: Min.: 0 rpm, Max.: 51199 rpm	"Engine speed" of all cylinders almost same	-	Cyl #1 compression goes down
	Symptoms when out of range: When the engine speed of all cylinders is not equal, idling will be rough.			
	Diagnostic Note: • Output only when the Active Test "Check the Cylinder Compression" is performed. • Indicates the speed of each cylinder when cranking. Example - Normal: Engine speed of all cylinders is approximately equal. When No. 1 cylinder compression is low, "Engine speed of Cyl #1" is approximately 300 rpm, and "Engine speed of Cyl #2 to #8" is approximately 200 rpm.			

Engine Speed of Cyl #2

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Engine Speed of Cyl #2	Engine speed for No. 2 cylinder: Min.: 0 rpm, Max.: 51199 rpm	-	-	-

Engine Speed of Cyl #3

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Engine Speed of Cyl #3	Engine speed for No. 3 cylinder: Min.: 0 rpm, Max.: 51199 rpm	-	-	-

Engine Speed of Cyl #4

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Engine Speed of Cyl #4	Engine speed for No. 4 cylinder: Min.: 0 rpm, Max.: 51199 rpm	-	-	-

Engine Speed of Cyl #5

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Engine Speed of Cyl #5	Engine speed for No. 5 cylinder: Min.: 0 rpm, Max.: 51199 rpm	-	-	-

Engine Speed of Cyl #6

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Engine Speed of Cyl #6	Engine speed for No. 6 cylinder: Min.: 0 rpm, Max.: 51199 rpm	-	-	-

Engine Speed of Cyl #7

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Engine Speed of Cyl #7	Engine speed for No. 7 cylinder: Min.: 0 rpm, Max.: 51199 rpm	-	-	-

Engine Speed of Cyl #8

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Engine Speed of Cyl #8	Engine speed for No. 8 cylinder: Min.: 0 rpm, Max.: 51199 rpm	-	-	-

Av Engine Speed of All Cyl

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Av Engine Speed of All Cyl	Engine speed for all cylinders: Min.: 0 rpm, Max.: 51199 rpm	-	-	-
	Diagnostic Note: • Output only when the Active Test "Check the Cylinder Compression" is performed. • Indicates the average engine speed of all cylinders during cranking.			

Vehicle Information

Model Code

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Model Code	Model code	-	-	-
	Diagnostic Note: • Identifying model code:			

Engine Type

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Engine Type	Engine type	-	-	-
	Diagnostic Note: • Identifying engine type: 1VDFTV			

Cylinder Number

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Cylinder Number	Cylinder number: Min.: 0, Max.: 255	-	-	-
	Diagnostic Note: • Identifying cylinder number: 8			

Transmission Type

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Transmission Type	Transmission type: MT or ECT 6th	-	-	-
	Diagnostic Note: Identifying transmission type: • MT: Manual transmission • ECT 6th: Automatic transmission			

Destination

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Destination	Destination	-	-	-
	Diagnostic Note: • Identifying destination:			

Model Year

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Model Year	Model year: Min.: 1900, Max.: 2155	-	-	-
	Diagnostic Note: • Identifying model year: 200#			

System Identification

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
System Identification	System identification	-	-	-
	Diagnostic Note: • Identifying engine type: Diesel			

Diesel Injection

Target Common Rail Pressure

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Target Common Rail Pressure	Target common rail pressure: Min.: 0 kPa, Max.: 250000 kPa	25000 to 180000 kPa when engine running	Target common rail pressure (ECU calculated value)	-
	Results of real-vehicle check: • Ignition switch ON: 32000 kPa • Cranking: 29000 kPa • Idling (warm up the engine): 32000 kPa (2 minutes after starting the vehicle) • Running without load (2500 rpm): 62000 kPa • Running without load (3500 rpm): 80200 kPa • Driving with the accelerator fully open at 2000 rpm: 95000 kPa • Driving with the accelerator fully open at 3000 rpm: 155000 kPa			
	Symptoms when out of range: -			

	Diagnostic Note: • Inspect the (actual) fuel pressure, comparing it against the common rail target value. • Considered normal when the actual fuel pressure is within +/-5 MPa of the target fuel pressure under stable conditions.

Fuel Press

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Fuel Press	Fuel pressure: Min.: 0 kPa, Max.: 250000 kPa	Idling: 27000 to 37000 kPa	Sensor output (fuel pressure sensor)	• Fuel supply pump • High pressure pipes • Fuel pressure sensor • Fuel injector • Feed pump (fuel supply pump) • Fuel filter • Pressure limmiter • Air bleed to the fuel • Lack of fuel
	Results of real-vehicle check: • Ignition switch ON: 0 kPa • Cranking: 29000 kPa • Idling (warm up the engine): 32000 kPa (2 minutes after starting the vehicle) • Running without load (2500 rpm): 62000 kPa • Driving with the accelerator fully open at 2000 rpm: 92000 kPa • Driving with the accelerator fully open at 3000 rpm: 155000 kPa			
	Symptoms when out of range: • Difficult to start, poor driveability, lack of power, abnormal combustion noise			
	Diagnostic Note: • Fuel pressure is the actual common rail fuel pressure. • Inspect by comparing the fuel pressure with the target fuel pressure. • When in a stable condition such as when idling, the fuel pressure is within +/-5 MPa of the target fuel pressure. • The ECM uses fuel pressure for feedback control of the target fuel pressure via the supply pump. The injection amount is determined based on the injection timing and fuel pressure. Also, the spray pattern is selected based on the fuel pressure. • For startup, at least 25 MPa of fuel pressure is needed (take care as there is a response lag when the pressure rises). • When the fuel pressure is below 25 MPa, it may cause rough idling. • When the fuel pressure has decreased by 20 MPa from the target fuel pressure, there may be a lack of power. • If actual fuel pressure is 40 MPa higher than the target fuel pressure, P1229 will be stored. When it is lower than the target fuel pressure, "Lack of Power" will occur, but a DTC will not be stored. • When the fuel pressure is higher than 200 MPa, DTC P0088 will be stored.			

Target Pump SCV Current

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Target Pump SCV Current	Pump current target final value: Min.: 0 mA, Max.: 4000 mA	Idling: 923 to 1123 mA	Control target (pump current)	• Suction control valve malfunction • Clogged fuel filter
	Results of real-vehicle check: • Ignition switch ON: 0 mA • Cranking: 1200 mA • Running without load (2500 rpm): 1300 mA • Driving with the accelerator fully open at 2000 rpm: 1440 mA • Driving with the accelerator fully open at 3000 rpm: 1560 mA			
	Symptoms when out of range: Difficult starting, lack of power, or rough idling			
	Diagnostic Note: • ECU-calculated value for the suction control valve actuation target current. • Value is large when a high fuel pressure is desired. • Value becomes stuck at 3 A or more or operation is poor (poor movement due to deposits, etc.).			

	• When this deviates from the standard value, it indicates that for some reason, even though the pump is running hard, the actual fuel pressure is inconsistent with the target fuel pressure.

Inj. FB Vol. for Idle

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Inj. FB Vol. for Idle	Idle stability status integral control volume: Min.: -80 mm^3/st, Max.: 79 mm^3/st	-10 to 10 mm^3/st	-	-
	Results of real-vehicle check: • Idling (warm up the engine): -0.57 mm^3/st			
	Symptoms when out of range: Engine friction problem, compression problem, or injector breakdown			
	Diagnostic Note: • When the actual engine speed does not match the target idling RPM, this corrects the injection volume. Abnormal if +/-10 mm^3/st or more. • Only calculated and reflected at idle.			

Injection Volume

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Injection Volume	Injection volume: Min.: 0 mm^3/st, Max.: 1279.98 mm^3/st	Idling: 3.0 to 10 mm^3/st	Calculated value	-
	Results of real-vehicle check: • Cranking: 21 mm^3/st • Idling (warm up the engine): 6 mm^3/st • Running without load (2500 rpm): 9 mm^3/st • Running without load (4700 rpm): 16 mm^3/st • Driving with the accelerator fully open at 2000 rpm: 50 mm^3/st • Driving with the accelerator fully open at 3000 rpm: 70 mm^3/st			
	Symptoms when out of range: -			
	Diagnostic Note: • Injection amount for each combustion. • If injectors are clogged, fuel quality is poor, the fuel filter is clogged, or engine friction increases, "Injection Volume" will increase. • If there is a malfunction due to low turbocharger pressure or a low intake air volume, the injection volume is limited and there is a lack of power.			

Injection Pressure Correction

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Injection Pressure Correction	Injection pressure feedback compensation volume: Min.: -500 mm^3/st, Max.: 780 mm^3/st	-20 to 20 mm^3/st at standard temperature	Calculated value	• Suction control valve malfunction • Clogged fuel filter
	Results of real-vehicle check: • Ignition switch ON: 0 mm^3/st • Cranking: 0 mm^3/st • Idling (warm up the engine): 8 mm^3/st (2 minutes after starting the vehicle) • Running without load (2500 rpm): 11 mm^3/st • Driving with the accelerator fully open at 2000 rpm: 44 mm^3/st • Driving with the accelerator fully open at 3000 rpm: 71 mm^3/st			
	Symptoms when out of range: -			
	Diagnostic Note: • When the (actual) fuel pressure is equal to the target fuel pressure, this value becomes 0. • This indicator can be used for diagnosing supply pump related malfunctions. • When this value (absolute value) is large, it indicates that the difference between the actual and target fuel pressure is also large. A positive value indicates that the pressure feed is being increased due to insufficient pressure. A			

	negative value indicates that pressure is being reduced due to excessive rail pressure. When the suction control valve does not close properly, it causes rail overpressure, and this value and the "Pump SCV Learning Value" slip to the negative volume side.

Injection Feedback Val #1

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Injection Feedback Val #1	Injection volume correction for No. 1 cylinder: Min.: -10 mm^3/st, Max.: 10 mm^3/st	Idling: -3.0 to 3.0 mm^3/st	Learned value	• Injector clogging • Injector deterioration • Decrease in cylinder compression • Injector compensation code is incorrectly set (forgot to input code after replacement or made mistake during setting of code after replacing ECM with one from another vehicle)
	Results of real-vehicle check: Idling:			
	Symptoms when out of range: Rough idling, black smoke, white smoke, poor driveability, lack of power, abnormal combustion noise, difficult to start			
	Diagnostic Note: • When idling after warm up, the injection amount for each cylinder is corrected to optimize the difference between the engine speed of each cylinder. Example: For cylinders that are slowing the engine speed compared to other cylinders, the injection volume is increased. • "Injection Feedback Val" more than 3.0 mm^3/st: Injector may have a problem which causes injection volume deviation, or insufficient compression which causes poor combustion may exist in the cylinder. If the value is within the correctable range which is controlled by the ECM and symptoms such as engine knocking and rough idling are not present, the system is normal even though the value exceeds 3.0 mm^3/st,			

Injection Feedback Val #2

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Injection Feedback Val #2	Injection volume correction for No. 2 cylinder: Min.: -10 mm^3/st, Max.: 10 mm^3/st	Idling: -3.0 to 3.0 mm^3/st	Learned value	-

Injection Feedback Val #3

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Injection Feedback Val #3	Injection volume correction for No. 3 cylinder: Min.: -10 mm^3/st, Max.: 10 mm^3/st	Idling: -3.0 to 3.0 mm^3/st	Learned value	-

Injection Feedback Val #4

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Injection Feedback Val #4	Injection volume correction for No. 4 cylinder: Min.: -10 mm^3/st, Max.: 10 mm^3/st	Idling: -3.0 to 3.0 mm^3/st	Learned value	-

Injection Feedback Val #5

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Injection Feedback Val #5	Injection volume correction for No. 5 cylinder: Min.: -10 mm^3/st, Max.: 10 mm^3/st	Idling: -3.0 to 3.0 mm^3/st	Learned value	-

Injection Feedback Val #6

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Injection Feedback Val #6	Injection volume correction for No. 6 cylinder: Min.: -10 mm^3/st, Max.: 10 mm^3/st	Idling: -3.0 to 3.0 mm^3/st	Learned value	-

Injection Feedback Val #7

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Injection Feedback Val #7	Injection volume correction for No. 7 cylinder: Min.: -10 mm^3/st, Max.: 10 mm^3/st	Idling: -3.0 to 3.0 mm^3/st	Learned value	-

Injection Feedback Val #8

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
	Injection volume correction for No. 8 cylinder:			

Injection Feedback Val #8	Min.: -10 mm^3/st, Max.: 10 mm^3/st	Idling: -3.0 to 3.0 mm^3/st	Learned value	-

Pilot 1 Injection Period

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Pilot 1 Injection Period	Pilot 1 injection period: Min.: 0 µs, Max.: 65535 µs	Idling: 0 µs	Calculated value	-
	Results of real-vehicle check: • Cranking: 0 µs • Idling (warm up the engine): 0 µs • Running without load (2500 rpm): 0 µs • Running without load (3500 rpm): 363 µs • Driving with the accelerator fully open at 2000 rpm: 380 µs • Driving with the accelerator fully open at 3000 rpm: 0 µs			
	Symptoms when out of range: Combustion noise, poor driveability, white smoke.			
	Diagnostic Note: Check to see if "Pilot 1 Injection Period" is not zero when the symptoms occur.			

Pilot 2 Injection Period

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Pilot 2 Injection Period	Pilot 2 injection period: Min.: 0 µs, Max.: 65535 µs	Idling: 390 to 490 µs	Calculated value	-
	Results of real-vehicle check: • Ignition switch ON: 0 µs • Cranking: 660 µs • Idling (warm up the engine): 440 µs (2 minutes after starting the vehicle) • Running without load (2500 rpm): 380 µs • Driving with the accelerator fully open at 2000 rpm: 0 µs • Driving with the accelerator fully open at 3000 rpm: 0 µs			
	Symptoms when out of range: Combustion noise, poor driveability, white smoke.			
	Diagnostic Note: Check to see if "Pilot 2 Injection Period" is not zero when the symptoms occur.			

Main Injection Period

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Main Injection Period	Main injection period: Min.: 0 µs, Max.: 65535 µs	Idling: 490 to 690 µs	Calculated value	-
	Results of real-vehicle check: • Cranking: 1250 µs • Idling (warm up the engine): 630 µs (2 minutes after starting the vehicle) • Running without load (2500 rpm): 515 µs • Driving with the accelerator fully open at 2000 rpm: 980 µs • Driving with the accelerator fully open at 3000 rpm: 1010 µs			
	Symptoms when out of range: -			
	Diagnostic Note: • When the fuel pressure becomes 15 MPa or less, "Main Injection Period" is set to 0. • When the engine will not start, confirm that injection is performed. • When P0093, P0607, P0627, P062D or P062E is stored, there is an engine stall request. At that time, "Main Injection Period" equals 0. **HINT:** As the engine stalls 1 minute after the MIL illuminates, freeze frame data cannot be checked.			

After Injection Period

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
	After injection period: Min.: 0 µs, Max.: 65535 µs	-	Calculated value	-
	Symptoms when out of range:			

After Injection Period	-
	Diagnostic Note: Check to see if "After Injection Period" is not zero when the following symptoms occur: Black smoke, poor driveability.

Pilot 1 Injection Timing

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Pilot 1 Injection Timing	Pilot 1 injection timing: Min.: -70°CA, Max.: 20°CA	Idling after engine warmed up and vehicle under normal atmospheric pressure: 0°CA	Calculated value	-
	Symptoms when out of range: -			
	Diagnostic Note: -			

Pilot 2 Injection Timing

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Pilot 2 Injection Timing	Pilot 2 injection timing: Min.: -50°CA, Max.: 20°CA	Idling after engine warmed up and vehicle under normal atmospheric pressure: -6 to -2°CA	Calculated value	-
	Results of real-vehicle check: • Ignition switch ON: 0°CA • Cranking: -6.0°CA • Idling (warm up the engine): -3.7°CA • Running without load (2500 rpm): -18°CA • Driving with the accelerator fully open at 2000 rpm: -35.8°CA • Driving with the accelerator fully open at 3000 rpm: -35.8°CA			
	Symptoms when out of range: -			
	Diagnostic Note: -			

Main Injection Timing

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Main Injection Timing	Main injection timing: Min.: -90°CA, Max.: 90°CA	Idling after engine warmed up and vehicle under normal atmospheric pressure: -0.5 to 4°CA	Calculated value	-
	Results of real-vehicle check: • Ignition switch ON: -3.4°CA • Cranking: -3.0°CA • Idling (warm up the engine): 1.0°CA • Running without load (2500 rpm): 0°CA • Driving with the accelerator fully open at 2000 rpm: -7.6°CA • Driving with the accelerator fully open at 3000 rpm: -4.5°CA			
	Symptoms when out of range: -			
	Diagnostic Note: Use "Main Injection Timing" to check poor drivability when the following symptoms are present: Bad injection timing, black smoke, and white smoke.			

After Injection Timing

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
	After injection timing: Min.: -10°CA, Max.: 50°CA	-	Calculated Value	-
	Results of real-vehicle check: • Ignition switch ON: 0°CA • Cranking: 0°CA			

After Injection Timing	• Idling (warm up the engine): 0°CA • Running without load (2500 rpm): 21.9°CA • Driving with the accelerator fully open at 2000 rpm: 17°CA • Driving with the accelerator fully open at 3000 rpm: 22°CA
	Symptoms when out of range:
	Diagnostic Note: Use "Main Injection Timing" to check poor drivability when the following symptoms are present: Bad injection timing, black smoke, and white smoke.

Fuel Temperature

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Fuel Temperature	Fuel temperature: Min.: -40°C, Max.: 140°C	Actual fuel temperature	Sensor output (fuel temperature sensor)	-
	Symptoms when out of range: -			
	Diagnostic Note: After fully cold soaking, the fuel temperature is the same as the outside air temperature.			

Fuel Return Temp

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Fuel Return Temp	Estimated fuel temperature in injector: Min.: -40°C, Max.: 215°C	-	Calculated by ECM	-
	Results of real-vehicle check: • Ignition switch ON, engine coolant temperature 35°C (95°F): 70°C (158°F) • Idling, engine warmed up, fuel temperature 52°C (125°F): 88°C (190°F)			
	Symptoms when out of range: -			
	Diagnostic Note: • The ECM calculates this value based on the fuel temperature sensor output and engine running conditions.			

Fuel System Monitor

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Fuel System Monitor	Fuel system monitor: Not Avl or Avail	-	-	-
	Symptoms when out of range: -			
	Diagnostic Note: This item does not apply to diesel engines.			

Injector Memory Error

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Injector Memory Error	Compensation (QR) code writing error status: No Error or Error	No Error	Calculated by ECM	• Injector compensation (QR) code writing error
	Symptoms when out of range: Poor driveability, rough idling, black smoke, white smoke, abnormal combustion noise			
	Diagnostic Note: This flag displays an error when the injector compensation code is not input for a new ECM or an injector for a different type or a value beyond the compensation setting range is input. This error may not be detected when a wrong compensation (QR) code is input.			

EGR system

Target EGR Valve Pos.

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
	No. 1 EGR valve target opening	Idling after engine	ECU-calculated value based on sensors (MAF meter, manifold	

Target EGR Valve Pos.	angle: Min.: 0%, Max.: 100%	warmed up: 0 to 80%	absolute pressure sensor, intake air temperature (built into MAF meter), etc.)	-
	Results of real-vehicle check: • Ignition switch ON: 0% • Cranking: 0% • Idling (warm up the engine): 43% • Running without load (2500 rpm): 22% • Driving with the accelerator fully open at 2000 rpm: 0% • Driving with the accelerator fully open at 3000 rpm: 0%			
	Symptoms when out of range: • When value is out of range and approaching 0%: MAF meter degradation, intake or exhaust system blockage • When value is out of range and approaching 100%: EGR pipe blockage			
	Diagnostic Note: • Fully open: 100%. • Fully closed: 0%. • Used for comparison to "Actual EGR Valve Pos.".			

Target EGR Valve Pos. #2

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Target EGR Valve Pos. #2	No. 2 EGR valve target opening angle: Min.: 0%, Max.: 100%	Idling after engine warmed up: 0 to 80%	ECU-calculated value based on sensors (MAF meter, manifold absolute pressure sensor, intake air temperature (built into MAF meter), etc)	-
	Diagnostic Note: Used for comparison to "Actual EGR Valve Pos #2".			

Actual EGR Valve Pos.

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Actual EGR Valve Pos.	No. 1 EGR valve position: Min.: 0%, Max.: 100%	Idling after engine warmed up: 0 to 80%	Calculated from EGR valve opening position sensor	
	Results of real-vehicle check: • Ignition switch ON: 0% • Cranking: 0% • Idling (warm up the engine): 84% • Running without load (2500 rpm): 34% • Driving with the accelerator fully open at 2000 rpm: 0% • Driving with the accelerator fully open at 3000 rpm: 0%			
	Symptoms when out of range: • EGR valve stuck open: Poor starts (engine does not stop), black smoke, white smoke, lack of power • EGR valve stuck closed: Increased turbo booster noise			
	Diagnostic Note: • Fully open: 100%. • Fully closed: 0%. • Inspect while comparing to "Target EGR Valve Pos.". • Check the valve movement via the Active Test. • Sometimes the malfunction only occurs around a certain temperature, so refer to the engine coolant temperature and outside temperature at the time the malfunction occurred.			

Actual EGR Valve Pos. #2

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
	No. 2 EGR valve position:	Idling after engine warmed up: 0	Calculated from EGR valve opening	

Actual EGR Valve Pos. #2	Min.: 0%, Max.: 100%	to 80%	position sensor	-
	Results of real-vehicle check: Same as Actual EGR Valve Pos.			
	Symptoms when out of range: Same as Actual EGR Valve Pos.			
	Diagnostic Note: Inspect while comparing to "Target EGR Valve Pos. #2".			

EGR Lift Sensor Volt %

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
EGR Lift Sensor Volt %	No. 1 EGR valve lift position: Min.: 0%, Max.: 100%	Idling: 25 to 90%	Calculated from EGR valve opening position sensor	-
	Results of real-vehicle check: • Ignition switch ON: 77% • Cranking: 77% • Idling (warm up the engine): 53% • Running without load (2500 rpm): 65% • Driving with the accelerator fully open at 2000 rpm: 77% • Driving with the accelerator fully open at 3000 rpm: 77%			
	Symptoms when out of range: -			
	Diagnostic Note: • EGR Lift Sensor Volt % is calculated from the EGR position sensor output voltage. Value is 0 to 5 V converted to 0 to 100%. • Fully open: 33.5 to 35.5%. • Fully closed: 76.9 to 77.3%.			

EGR Lift Sensor Volt % #2

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
EGR Lift Sensor Volt % #2	No. 2 EGR valve lift position: Min.: 0%, Max.: 100%	Idling: 25 to 90%	Calculated from EGR valve opening position sensor	-

EGR Motor Duty #1

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
EGR Motor Duty #1	No. 1 EGR valve actuate duty: Min.: 0%, Max.: 127.5%	Idling after engine warmed-up: 0 to 100%	-	-
	Results of real-vehicle check: -			
	Symptoms when out of range: -			
	Diagnostic Note: • This EGR Motor Duty #1 is calculated based on Target EGR Valve Pos. to actuate the EGR valve. • To 0%: Close side EGR valve actuation. • To 100%: Open side EGR valve actuation. • When this value is large but the actual valve position does not reach the target valve position, there is an unable to open malfunction.			

EGR Motor Duty #2

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
EGR Motor Duty #2	No. 2 EGR valve actuate duty: Min.: 0%, Max.: 127.5%	Idling after engine warmed-up: 0 to 100%	-	-

EGR Operation Prohibit

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
	EGR operation prohibit:	OK: Active Test item "Control the EGR Step Position" and "Activate the EGR	-	-

EGR Operation Prohibit	OK or NG	Valve Close" can be performed
	Symptoms when out of range: -	
	Diagnostic Note: • OK: "EGR Valve Control Active Test Possible" Condition. • NG: "Not Possible" Condition.	

EGR Close Learn Val.

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
EGR Close Learn Val.	No. 1 EGR valve lift volume learned value: Min.: 0 V, Max.: 5 V	Idling: 3.5 to 4.5 V	No. 1 EGR valve position sensor value when EGR valve fully closed	-
	Results of real-vehicle check: 3.85 V			
	Symptoms when out of range: -			
	Diagnostic Note: At the upper and lower limits of the normal range, it is possible that a foreign object is lodged in the EGR valve seat area.			

EGR Close Lrn. Val. #2

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
EGR Close Lrn. Val. #2	No. 2 EGR valve lift volume learned value: Min.: 0 V, Max.: 5 V	Idling: 3.5 to 4.5 V	No. 2 EGR valve position sensor value when EGR valve fully closed	-
	Results of real-vehicle check: 3.85 V			
	Symptoms when out of range: -			
	Diagnostic Note: • This value is the EGR position sensor output voltage. • At the upper and lower limits of the normal range, it is possible that a foreign object is lodged in the EGR valve seat area.			

EGR Close Lrn. Val.

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
EGR Close Lrn. Val.	No. 1 EGR valve fully closed position learned value: Min.: 0 V, Max.: 5 V	3.5 to 4.5 V	No. 1 EGR valve position sensor value when EGR valve fully closed	-
	Results of real-vehicle check: 3.85 V			
	Symptoms when out of range: -			
	Diagnostic Note: • This value is the EGR position sensor output voltage. • At the upper and lower limits of the normal range, it is possible that a foreign object is lodged in the EGR valve seat area. • As the lower and upper limits are 3.5 V and 4.5 V respectively, if the value becomes stuck at either of these values, there is a malfunction in the lift sensor or the valve position may be misaligned (foreign matter is present, etc.).			

EGR Close Lrn. Val. #2

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
	No. 2 EGR valve fully closed position learned value: Min.: 0 V, Max.: 5 V	3.5 to 4.5 V	No. 2 EGR valve position sensor value when EGR valve fully closed	-
	Results of real-vehicle check: 3.85 V			

EGR Close Lrn. Val. #2	Symptoms when out of range: -
	Diagnostic Note: • This value is the EGR position sensor output voltage. • At the upper and lower limits of the normal range, it is possible that a foreign object is lodged in the EGR valve seat area. • As the lower and upper limits are 3.5 V and 4.5 V respectively, if the value becomes stuck at either of these values, there is a malfunction in the lift sensor or the valve position may be misaligned (foreign matter is present, etc.).

EGR Close Lrn. Status

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
EGR Close Lrn. Status	No. 1 EGR valve fully closed position learning status: OK or NG	OK	-	-
	Symptoms when out of range: -			
	Diagnostic Note: • "OK" means the fully closed position learning has completed normally. • When NG, the learned fully closed position may be outside of the normal range. When NG, there may be foreign matter stuck in the valve. **HINT:** After disconnecting and reconnecting the battery cable, if the ignition switch has not been turned off once, learning may not be completed.			

EGR Close Lrn. Status #2

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
EGR Close Lrn. Status #2	No. 2 EGR valve fully closed position learning status: OK or NG	OK	-	-
	Symptoms when out of range: -			
	Diagnostic Note: • "OK" means the fully closed position learning has completed normally. • When NG, the learned fully closed position may be outside of the normal range. When NG, there may be foreign matter stuck in the valve. **HINT:** After disconnecting and reconnecting the battery cable, if the ignition switch has not been turned off once, learning may not be completed.			

EGR/VVT Monitor

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
EGR/VVT Monitor	EGR Monitor: Not Avl or Avail	-	Result of ECU calculations	-
	Symptoms when out of range: -			
	Diagnostic Note: EGR monitor indicates that the storage of related DTCs is complete.			

Diesel throttle system

Throttle Sensor Volt %

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
	Absolute throttle position sensor (bank 1): Min.: 0%, Max.: 100%	• Ignition switch ON: 60 to 80% • Warmed-up and idling: 10 to 80%	Sensor output (throttle position sensor (bank 1))	-
	Results of real-vehicle check: • Ignition switch ON: 70%			

Throttle Sensor Volt %	• Cranking: 70% • Idling (warm up the engine): 21.9% • Running without load (2500 rpm): 51% • Driving with the accelerator fully open at 2000 rpm: 69.8% • Driving with the accelerator fully open at 3000 rpm: 69.8%
	Symptoms when out of range: • Stuck closed: Engine stall, difficult to start, rough idling, lack of power, black smoke, white smoke • Stuck open: Loud turbocharging sound, bad vibration when engine stopped • When the ECM detects a malfunction with the diesel throttle (MIL on), engine power is restricted but city driving is possible.
	Diagnostic Note: • Throttle position sensor output voltage is converted using 5 V = 100%. • When fully closed: 14%. • When fully open: 70%. • When the ignition switch is turned from off to ON, the throttle valve fully opens once. • When the ignition switch is turned from ON to off, the throttle valve fully closes once.

Throttle Sensor #2 Volt %

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Throttle Sensor #2 Volt %	Absolute throttle position sensor (bank 2): Min.: 0%, Max.: 100%	• Ignition switch ON: 60 to 80% • Warmed-up and idling: 10 to 80%	Sensor output (throttle position sensor (bank 2))	Same as Throttle Sensor Volt %

Actual Throttle Position

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Actual Throttle Position	Actual diesel throttle (bank 1) angle: Min.: -20%, Max.: 120%	Idling after engine warmed-up: 0 to 90%	-	-
	Results of real-vehicle check: • Ignition switch ON: 0% • Cranking: 0% • Idling (warm up the engine): 84% • Running without load (2500 rpm): 32% • Driving with the accelerator fully open at 2000 rpm: 0% • Driving with the accelerator fully open at 3000 rpm: 0%			
	Symptoms when out of range: • Stuck closed: Engine stall, difficult to start, lack of power, black smoke, rough idle • Stuck open: Loud turbocharging sound, bad vibration when engine stopped • When ECM detects a malfunction of diesel throttle (MIL on), engine power is restricted so that the vehicle can drive with a maximum speed of 80 to 120 km/h.			
	Diagnostic Note: Closing percentage of the throttle valve. • Fully closed: 100%. • Fully open: 0%. **HINT:** There is no connection with the accelerator. However, under full load, the throttle is usually fully open (0%).			

Actual Throttle Position #2

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Actual Throttle Position #2	Actual diesel throttle (bank 2) angle: Min.: -20%, Max.: 120%	Idling after engine warmed-up: 0 to 90%	-	-

Target Throttle Position

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
	Target diesel throttle valve (bank 1) opening angle:	Idling after engine warmed-up: 0	Calculated by	-

Target Throttle Position	Min.: -20%, Max.: 120%	to 90%	ECM	
	Results of real-vehicle check: Actual Throttle Position follows this value			
	Symptoms when out of range: -			
	Diagnostic Note: • If the actual throttle position follows this value, it is normal. • Fully closed: 100% • Fully open: 0% • The value should not largely differ from the actual throttle position.			

Target Throttle Position #2

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Target Throttle Position #2	Target diesel throttle valve (bank 2) opening angle: Min.: -20%, Max.: 120%	Idling after engine warmed-up: 0 to 90%	Calculated by ECM	-

Throttle Motor Duty #1

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Throttle Motor Duty #1	Diesel throttle motor actuate duty (bank 1): Min.: 0%, Max.: 100%	Idling after engine warmed-up: 10 to 90%	-	-
	Results of real-vehicle check: • Ignition switch ON: 61.5% • Cranking: 63% • Idling (warm up the engine): 37% • Running without load (2500 rpm): 53% • Driving with the accelerator fully open at 2000 rpm: 62.5% • Driving with the accelerator fully open at 3000 rpm: 64%			
	Symptoms when out of range: -			
	Diagnostic Note: • To 0%: Closed side diesel throttle actuation. • To 100%: Open side diesel throttle actuation. • When this value is large but the actual opening angle does not reach the target opening angle, there is an unable to close malfunction. • If it is small, but the actual opening angle does not reach the target opening angle, there is an unable to open malfunction. • Usually this value is at approximately 50 +/-20%, but momentary jumps outside this range do occur. • If a duty outside 50 +/-40% continues for several seconds, it will be judged that the diesel throttle does not move properly and the MIL will be illuminated.			

Throttle Motor Duty #2

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Throttle Motor Duty #2	Diesel throttle motor actuate duty (bank 2): Min.: 0%, Max.: 100%	Idling after engine warmed-up: 10 to 90%	-	-

Throttle Close Learning Val.

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Throttle Close Learning Val.	Throttle fully closed position learned value (bank 1): Min.: 0 deg, Max.: 84 deg	14 to 22 deg	-	-
	Results of real-vehicle check: 17 deg			
	Symptoms when out of range: Ignition switch ON: 17 deg			
	Diagnostic Note: • When the ignition is turned from switch ON to off and 5 seconds elapse, learning of "Throttle Close Learning Val." will be complete. • When "Throttle Close Learning Val." is outside of the normal range, a foreign object may lodged in the throttle valve. • Fully closed: 17.25 deg. • Fully open: 87.25 deg.			

	• If the value is stuck at the upper limit of 21.25 deg, there is a chance that a malfunction is present. However, as the initial value for the learned value is 21.25 deg, it is necessary to check the value after learning is completed.

Throttle Close Learning Val. #2

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Throttle Close Learning Val. #2	Throttle fully closed position learned value (bank 2): Min.: 0 deg, Max.: 84 deg	14 to 22 deg	-	-

Diesel Throttle Learn Status

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Diesel Throttle Learn Status	Diesel throttle learning history (bank 1): OK or NG	OK	-	-
	Symptoms when out of range: -			
	Diagnostic Note: • If the system is functioning properly, learning will be performed when the ignition switch is turned from ON to off. • NG indicates that a foreign object may be lodged in the throttle valve or actuator components, or a disconnect/short exists in the signal wires.			

Diesel Throttle Learn Status #2

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Diesel Throttle Learn Status #2	Diesel throttle learning history (bank 2): OK or NG	OK	-	-

VN Turbo system

Target Booster Pressure

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Target Booster Pressure	Target boost pressure: Min.: 0 kPa, Max.: 320 kPa	Idling and vehicle under normal atmospheric pressure: 87 to 103 kPa	Calculated Value by ECM	-
	Results of real-vehicle check: • Ignition switch ON: 96 kPa • Cranking: 100 kPa • Idling (warm up the engine): 99.5 kPa • Running without load (2500 rpm): 119 kPa • Running without load (4700 rpm): 151 kPa (accelerator pedal depressed) • Driving with the accelerator fully open at 2000 rpm: 185 kPa • Driving with the accelerator fully open at 3000 rpm: 222 kPa			
	Symptoms when out of range: -			
	Diagnostic Note: • Inspect while comparing with "MAP". • With the accelerator fully open, if the actual manifold absolute pressure (MAP) is low compared to the target booster pressure by at least 20 kPa for 5 sec. or more, a feeling of a lack of power will occur.			

Boost Pressure Deviation

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Boost Pressure Deviation	Boost pressure deviation: Min.: -320 kPa, Max.: 320 kPa	Idling after engine warmed up and vehicle under normal atmospheric pressure: -3 to 10 kPa	-	-
	Diagnostic Note: Difference between target and actual supercharging pressure.			

VN Turbo Command

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
VN Turbo Command	VN turbo command value: Min.: 20%, Max.: 100%	20 to 100%	Controls the VN turbo vane opening position.	-
	Results of real-vehicle check: • Ignition switch ON: 100% • Cranking: 100% • Idling (warm up the engine): 88% • Running without load (2500 rpm): 76% • Running without load (4700 rpm): 50% (accelerator pedal depressed) • Driving with the accelerator fully open at 2000 rpm: 85% • Driving with the accelerator fully open at 3000 rpm: 46%			
	Symptoms when out of range: -			
	Diagnostic Note: • "VN Turbo command" is a command value. • 0%: Full open vanes (contraction of actuation-use rods) • 90% or more: Full closed vanes (extension of actuation-use rods) • When this value is large, the turbo works well. • There is no actual opening angle data to handle the VN Turbo command value.			

VN Turbo Error Level

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
VN Turbo Error Level	VN turbo driver opening angle level when abnormality detected: 1, 2 or 3	0: Normal	-	-
	Symptoms when out of range: -			
	Diagnostic Note: • 3: Nearly fully closed (supercharging pressure and pre-turbine pressure are incredibly high and there is a risk of engine damage). • 2: Roughly intermediate opening angle (not as bad as "3", but long-term usage is problematic). • 1: Nearly fully open (will not cause engine damage, but at a low RPM, turbocharging pressure will not rise and insufficient power will be felt).			

VN Turbo Max Angle

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
VN Turbo Max Angle	VN turbo maximum opening angle: Min.: 0%, Max.: 100%	100% **HINT:** As this value displays the ideal constant upper limit, no matter what happens, this value should not change.	-	-
	Results of real-vehicle check: • Ignition switch ON: 99.6%			
	Symptoms when out of range: -			
	Diagnostic Note: • Vane maximum angle expressed in % (Fully open: to 100%). • VD engine is usually 100%.			

VN Turbo Min Angle

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
	VN turbo minimum opening angle: Min.: 0%, Max.: 100%	0% **HINT:** As this value displays the ideal constant lower limit, no matter what happens, this value should not change.	-	-

VN Turbo Min Angle	Results of real-vehicle check: • Ignition switch ON: 51.9%
	Symptoms when out of range: -
	Diagnostic Note: • Vane maximum angle expressed in % (Fully open: to 100%). • VD engine is usually 52%.

VN Turbo Operation prohibit

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
VN Turbo Operation prohibit	VN turbo operation prohibit: OK or NG	OK: Active Test item "Test the Turbo Charger Step Motor" can be performed	-	-
	Symptoms when out of range: -			
	Diagnostic Note: When NG, indicates a condition where the engine software does not allow the VN turbo Active Test.			

VN Turbo Type

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
VN Turbo Type	VN turbo type: Not, Commo or Vacuum	Commo	-	-
	Symptoms when out of range: -			
	Diagnostic Note: Indicates the VN turbo vane actuation method. • DC motor system. • Negative-pressure diaphragm system. • Step motor system.			

Diesel Starting

Engine Speed (Starter Off)

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Engine Speed (Starter Off)	Engine speed when starter off: Min.: 0 rpm, Max.: 1594 rpm	-	-	-
	Diagnostic Note: Engine speed immediately after starting the engine.			

Starter Count

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Starter Count	Starter on count: Min.: 0, Max.: 255	-	-	-
	Diagnostic Note: Number of times the starter turned on from the time the ignition switch was turned to ON.			

Run Dist of Previous Trip

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
Run Dist of Previous Trip	Distance driven during previous trip: Min.: 0 km, Max.: 261 km	-	-	-
	Diagnostic Note: Used to confirm the driving conditions of the previous trip (before the malfunction occurred).			

Diesel Rough

Electric Duty Feedback Value

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range

Electric Duty Feedback Value	Electric load feedback value: Min.: 0 mm^3/st, Max.: 39.8 mm^3/st	0 to 2.5 mm^3/st	-	-
	Symptoms when out of range: -			
	Diagnostic Note: Expected injection volume increase after the electrical load turns from off to on.			

A/C Duty Feedback Value

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
A/C Duty Feedback Value	A/C load feedback value: Min.: 0 mm^3/st, Max.: 39.8 mm^3/st	• 0 to 4.1 mm^3/st (A/T) • 0 to 2.6 mm^3/st (M/T)	-	-
	Symptoms when out of range: -			
	Diagnostic Note: Expected injection volume increase after the A/C turns from off to on.			

PS Duty Feedback Value

Tester Display	Measurement Item/Range	Normal Condition	Type	Cause of Out of Range
PS Duty Feedback Value	Power steering load feedback value: Min.: 0 mm^3/st, Max.: 39.8 mm^3/st	0 mm^3/st	-	-
	Symptoms when out of range: -			
	Diagnostic Note: Expected injection volume increase after the power steering turns from off to on.			

ACTIVE TEST

HINT:

Using the intelligent tester to perform Active Tests allows relays, VSVs, actuators and other items to be operated without removing any parts. This non-intrusive functional inspection can be very useful because intermittent operation may be discovered before parts or wiring is disturbed. Performing Active Tests early in troubleshooting is one way to save diagnostic time. Data List information can be displayed while performing Active Tests.

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain / Engine / Active Test.

e. Perform the Active Test.

Tester Display	Test Part	Control Range	Diagnostic Note
Control the A/C Cut Signal	Control the A/C signal	ON/OFF	-
Control the ACM Inhibit	Control the VSV for engine mount	ON/OFF	-
Connect the TC and TE1	Turn on TC and TE1 connection	ON/OFF	-
Activate the ACC Cut Relay	Activate ACC (accessory) relay	ON/OFF	-
Activate the Starter Relay	Activate Starter relay	ON/OFF	-
Control the EGR Step Position	Control the No. 1 EGR valve	0 to 100%	Test is possible when the following conditions are met: • Ignition switch is ON. • Engine is stopped.
Control the EGR Step Position #2	Control the No. 2 EGR valve	0 to 100%	Test is possible when the following conditions are met: • Ignition switch is ON. • Engine is stopped.
Test the Turbo Charger Step Motor	Activate the turbocharger (for Bank 1)	52 to 100%	Test is possible when the following conditions are met: • Ignition switch is ON. • Engine is stopped.
			Test is possible when the

Test the Turbo Charger Step Motor #2	Activate the turbocharger (for Bank 2)	52 to 100%	following conditions are met: • Ignition switch is ON. • Engine is stopped.
Test the Fuel Leak	Pressurizes common rail internal fuel pressure, and checks for fuel leaks	Stop/Start	Performs inspection of the high pressure fuel system. • Engine Speed: 2050 rpm • Fuel Pressure: 172000 kPa • Target Common Rail Pressure: 176000 kPa • Target Pump SCV Current: 1.4 A • MAP: 176 kPa • MAF: 39 g/sec.
Diesel Throttle Target Angle	Control the diesel throttle valve (bank 1)	0 to 90%	Test is possible when the following conditions are met: • Ignition switch is ON. • Engine is stopped.
Diesel Throttle Target Angle #2	Control the diesel throttle valve (bank 2)	0 to 90%	Test is possible when the following conditions are met: • Ignition switch is ON. • Engine is stopped.
Activate the VN Turbo Open	Activate the turbocharger	ON/OFF	Confirm that the engine is running.
Activate the EGR Valve Close	Activate the electric EGR control valve assembly	ON/OFF	Confirm that the vehicle is stopped and the engine is idling
Activate the Intank Fuel Pump Relay	Activate SUB PUMP relay	ON/OFF	• Engine is stopped. • This test activates the relay for only 60 seconds. • After finishing this test, the vehicle does not permit activating the relay again within 60 seconds.
Control the Cylinder#1 Fuel Cut	Cut off fuel injection from No. 1 injector	ON/OFF	Fuel injection is stopped while the test is ON. • Confirm that the vehicle is stopped and the engine is idling. • If the running condition of the engine does not worsen even though injection of the designated cylinder is stopped, the cylinder can be confirmed to be malfunctioning.
Control the Cylinder#2 Fuel Cut	Cut off fuel injection from No. 2 injector	ON/OFF	Fuel injection is stopped while the test is ON. • Confirm that the vehicle is stopped and the engine is idling. • If the running condition of the engine does not worsen even though injection of the designated cylinder is stopped, the cylinder can be confirmed to be malfunctioning.

Control the Cylinder#3 Fuel Cut	Cut off fuel injection from No. 3 injector	ON/OFF	Fuel injection is stopped while the test is ON. • Confirm that the vehicle is stopped and the engine is idling. • If the running condition of the engine does not worsen even though injection of the designated cylinder is stopped, the cylinder can be confirmed to be malfunctioning.
Control the Cylinder#4 Fuel Cut	Cut off fuel injection from No. 4 injector	ON/OFF	Fuel injection is stopped while the test is ON. • Confirm that the vehicle is stopped and the engine is idling. • If the running condition of the engine does not worsen even though injection of the designated cylinder is stopped, the cylinder can be confirmed to be malfunctioning.
Control the Cylinder#5 Fuel Cut	Cut off fuel injection from No. 5 injector	ON/OFF	Fuel injection is stopped while the test is ON. • Confirm that the vehicle is stopped and the engine is idling. • If the running condition of the engine does not worsen even though injection of the designated cylinder is stopped, the cylinder can be confirmed to be malfunctioning.
Control the Cylinder#6 Fuel Cut	Cut off fuel injection from No. 6 injector	ON/OFF	Fuel injection is stopped while the test is ON. • Confirm that the vehicle is stopped and the engine is idling. • If the running condition of the engine does not worsen even though injection of the designated cylinder is stopped, the cylinder can be confirmed to be malfunctioning.
Control the Cylinder#7 Fuel Cut	Cut off fuel injection from No. 7 injector	ON/OFF	Fuel injection is stopped while the test is ON. • Confirm that the vehicle is stopped and the engine is idling. • If the running condition of the engine does not worsen even though injection of

			the designated cylinder is stopped, the cylinder can be confirmed to be malfunctioning.
Control the Cylinder#8 Fuel Cut	Cut off fuel injection from No. 8 injector	ON/OFF	Fuel injection is stopped while the test is ON. • Confirm that the vehicle is stopped and the engine is idling. • If the running condition of the engine does not worsen even though injection of the designated cylinder is stopped, the cylinder can be confirmed to be malfunctioning.
Control the All Cylinders Fuel Cut	All cylinder injector fuel cut	ON/OFF	Used when the cylinder compression is measured. Test possible during vehicle stopping
Check the Cylinder Compression*	Check the cylinder compression pressure	ON/OFF	Fuel injection stop in all cylinders.

HINT:

*: When cranking the engine, the Active Test measures the speed of each cylinder.

In this Active Test, the fuel of all cylinders is cut, and cranking occurs for approximately 10 seconds. At this time, the speed of each cylinder is measured. If the speed of one cylinder is higher than the other cylinders, the compression pressure of that cylinder is determined to be lower than the other cylinders.

1. Warm up the engine.
2. Turn the ignition switch off.
3. Connect the intelligent tester to the DLC3.
4. Turn the ignition switch to ON and turn the tester on.
5. Enter the following menus: Powertrain / Engine / Active Test / Check the Cylinder Compression.

   HINT:

   If the results are not displayed normally, select the display items from the Data List before performing the Active Test. Enter the following menus: Powertrain / Engine / Data List / Compression / Engine Speed of Cyl #1, Engine Speed of Cyl #2, Engine Speed of Cyl #3, Engine Speed of Cyl #4, Engine Speed of Cyl #5, Engine Speed of Cyl #6, Engine Speed of Cyl #7, Engine Speed of Cyl #8 and Av Engine Speed of All Cyl.

6. While the engine is not running, press the RIGHT or LEFT button to change Check the Cylinder Compression to ON.

   HINT:

   After performing the above procedure, the Active Test Check the Cylinder Compression will start. Fuel injection for all cylinders is prohibited, and the engine speed measurement of each cylinder will enter standby mode.

7. Crank the engine for about 10 seconds.
8. Monitor the engine speed (Engine Speed of Cyl #1 to #8, Av Engine Speed of All Cyl) displayed on the tester.

   HINT:

   At first, the tester's display will show the engine speed measurement of each cylinder to be extremely high. After approximately 10 seconds of engine cranking, the engine speed measurement of each cylinder will change to the actual engine speed.

   NOTICE:

   - **After the Active Test Check the Cylinder Compression is turned on, it will automatically turn off after 255 seconds.**
   - **When the Check the Cylinder Compression test is off and the engine is cranked, the engine will start.**
   - **If the Check the Cylinder Compression test needs to be performed after it is turned on and performed once, press EXIT to return to the Active Test menu screen. Then perform the Check the Cylinder Compression test again.**
   - **Use a fully-charged battery.**

for Preparation Click here

HINT:

Parameters listed in the chart may be different than your readings depending on the type of instrument and other factors.

If any DTCs are output during a check mode DTC check, check the circuit for the DTCs listed in the table below. For details of each DTC, refer to the page indicated.

ECD s te

DTC Code	Detection Item	MIL	Memory	See page
P	urbocharger / Supercharger Boost Control Solenoid Circuit Range / Performance	Comes on	DTC stored	Click here
P	urbocharger/Supercharger Boost Control "A" Circuit Low	Comes on	DTC stored	Click here
P	urbocharger/Supercharger Boost Control "A" Circuit igh	Comes on	DTC stored	Click here
P	urbocharger/Supercharger Boost Control Solenoid "B" Circuit Range/Performance	Comes on	DTC stored	Click here
P C	Turbocharger/Supercharger Boost Control Solenoid "B" Circuit Low	Comes on	DTC stored	Click here
P D	Turbocharger/Supercharger Boost Control Solenoid "B" Circuit igh	Comes on	DTC stored	Click here
P	MAP Sensor Too igh or Too Low	Comes on	DTC stored	Click here
P	Fuel Rail / System Pressure - Too Low	Comes on	DTC stored	Click here
P	Fuel Rail / System Pressure - Too igh	Comes on	DTC stored	Click here
P	Fuel System Leak Detected - Large Leak	Comes on	DTC stored	Click here
P F	Turbocharger/Supercharger Boost Control "A" Module Performance	Comes on	DTC stored	Click here
P	urbocharger/Supercharger Boost Control "B" Module Performance	Comes on	DTC stored	Click here
P	Mass or Volume Air Flow Circuit	Comes on	DTC stored	Click here
P	Mass or Volume Air Flow Circuit Range / Performance Problem	Comes on	DTC stored	Click here
P	Mass or Volume Air Flow Circuit Low Input	Comes on	DTC stored	Click here
P	Mass or Volume Air Flow Circuit igh Input	Comes on	DTC stored	Click here
P	Manifold Absolute Pressure / Barometric Pressure Circuit	Comes on	DTC stored	Click here
P	Manifold Absolute Pressure / Barometric Pressure Circuit Range / Performance Problem	Comes on	DTC stored	Click here
P	Manifold Absolute Pressure / Barometric Pressure Circuit Low Input	Comes on	DTC stored	Click here
P	Manifold Absolute Pressure / Barometric Pressure Circuit igh Input	Comes on	DTC stored	Click here
P	Intake Air Temperature Circuit	Comes on	DTC stored	Click here
P	Intake Air Temperature Circuit Low Input	Comes on	DTC stored	Click here
P	Intake Air Temperature Circuit igh Input	Comes on	DTC stored	Click here
P	ngine Coolant Temperature Circuit	Comes on	DTC stored	Click here
P	ngine Coolant Temperature Circuit Range / Performance Problem	Comes on	DTC stored	Click here
P	ngine Coolant Temperature Circuit Low Input	Comes on	DTC stored	Click here
P	ngine Coolant Temperature Circuit igh Input	Comes on	DTC stored	Click here
P	hrottle / Pedal Position Sensor / Switch "A" Circuit Low Input	Comes on	DTC stored	Click here
P	hrottle / Pedal Position Sensor / Switch "A" Circuit igh Input	Comes on	DTC stored	Click here
P	Fuel Temperature Too igh	Comes on	DTC stored	Click here
P	Fuel Temperature Sensor "A" Circuit	Comes on	DTC stored	Click here
P	Fuel Temperature Sensor "A" Circuit Low Input	Comes on	DTC stored	Click here
P	Fuel Temperature Sensor "A" Circuit igh Input	Comes on	DTC stored	Click here
P	Fuel Rail Pressure Sensor Circuit	Comes on	DTC stored	Click here
P	Fuel Rail Pressure Sensor Circuit Low Input	Comes on	DTC stored	Click here
P	Fuel Rail Pressure Sensor Circuit igh Input	Comes on	DTC stored	Click here
P	hrottle / Pedal Position Sensor / Switch "B" Circuit Low Input	Comes on	DTC stored	Click here
P	hrottle / Pedal Position Sensor / Switch "B" Circuit igh Input	Comes on	DTC stored	Click here
P	urbocharger / Supercharger Underboost	Comes on	DTC stored	Click here
P	Crankshaft Position Sensor "A" Circuit	Comes on	DTC stored	Click here
P	Crankshaft Position Sensor "A" Circuit Intermittent	-	DTC stored	Click here
P	Camshaft Position Sensor "A" Circuit (Bank 1 or Single Sensor)	Comes on	DTC stored	Click here
P	haust Gas Recirculation Flow	Comes on/-	DTC stored	Click here

P	haust Gas Recirculation Sensor "A" Circuit Low	Comes on	DTC stored	Click here
P	haust Gas Recirculation Sensor "A" Circuit igh	Comes on	DTC stored	Click here
P	haust Gas Recirculation Sensor "B" Circuit Low	Comes on	DTC stored	Click here
P	haust Gas Recirculation Sensor "B" Circuit igh	Comes on	DTC stored	Click here
P	haust Gas Recirculation Throttle Position Control Range / Performance	Comes on	DTC stored	Click here
P	ehicle Speed Sensor "A"	Comes on	DTC stored	Click here
P	rake Switch "A" / "B" Correlation	-	DTC stored	Click here
P	System Voltage	Comes on	DTC stored	Click here
P	CM / PCM Processor	Comes on	DTC stored	Click here
P	Control Module Performance	Comes on	DTC stored	Click here
P	Starter Relay Circuit igh	Comes on	DTC stored	Click here
P	Fuel Pump Control Circuit / pen	Comes on	DTC stored	Click here
P D	Fuel Injector Dri er Circuit Performance Bank1	Comes on	DTC stored	Click here
P	Fuel Injector Dri er Circuit Performance Bank2	Comes on	DTC stored	Click here
P122	Fuel Pump System	Comes on	DTC stored	Click here
P1238	Injector Malfunction	Comes on	DTC stored	Click here
P12	haust Gas Recirculation Flow Bank 2	Comes on	DTC stored	Click here
P1251	Turbocharger / Supercharger erboost Condition (Too igh)	Comes on	DTC stored	Click here
P1258	VNT Position Sensor Range/Performance Bank 2 Sensor 1	Comes on	DTC stored	Click here
P125	T Position Sensor Low Bank 2 Sensor 1	Comes on	DTC stored	Click here
P126	Position Sensor igh Bank 2 Sensor 1	Comes on	DTC stored	Click here
P1262	VNT Position Sensor Low Bank 2 Sensor 2	Comes on	DTC stored	Click here
P1263	VNT Position Sensor igh Bank 2 Sensor 2	Comes on	DTC stored	Click here
P1	Intake Air Temperature Sensor 1 Circuit	Comes on	DTC stored	Click here
P1	Intake Air Temperature Sensor 1 Circuit Low	Comes on	DTC stored	Click here
P1	Intake Air Temperature Sensor 1 Circuit igh	Comes on	DTC stored	Click here
P16	Injector Correction Circuit Malfunction (EEPR M)	Comes on	DTC stored	Click here
P16	Startability Malfunction	-	DTC stored	Click here
P16	ough Idling	-	DTC stored	Click here
P1611	IC Circuit Malfunction	Comes on	DTC stored	Click here
P212	hrottle / Pedal Position Sensor / Switch "D" Circuit	Comes on	DTC stored	Click here
P2121	Throttle / Pedal Position Sensor / Switch "D" Circuit Range / Performance	Comes on	DTC stored	Click here
P2122	Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input	Comes on	DTC stored	Click here
P2123	Throttle / Pedal Position Sensor / Switch "D" Circuit igh Input	Comes on	DTC stored	Click here
P2125	Throttle / Pedal Position Sensor / Switch "E" Circuit	Comes on	DTC stored	Click here
P2127	Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input	Comes on	DTC stored	Click here
P2128	Throttle / Pedal Position Sensor / Switch "E" Circuit igh Input	Comes on	DTC stored	Click here
P2138	Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation	Comes on	DTC stored	Click here
P213B	E haust Gas Recirculation Throttle Position Control (Range / Performance)	Comes on	DTC stored	Click here
P2226	Barometric Pressure Circuit	Comes on	DTC stored	Click here
P2228	Barometric Pressure Circuit Low Input	Comes on	DTC stored	Click here
P222	Barometric Pressure Circuit igh Input	Comes on	DTC stored	Click here
P2563	Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit Range/Performance	Comes on	DTC stored	Click here
P256	urbocharger/Supercharger Boost Control Position Sensor "A" Circuit Low	Comes on	DTC stored	Click here
P2565	Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit igh	Comes on	DTC stored	Click here
P2588	Turbocharger/Supercharger Boost Control Position Sensor "B" Circuit Low	Comes on	DTC stored	Click here
P258	Turbocharger/Supercharger Boost Control Position Sensor "B" Circuit igh	Comes on	DTC stored	Click here
U	Lost Communication with TCM	Comes on	DTC stored	Click here

DTC P0046 Turbocharger / Supercharger Boost Control Solenoid Circuit Range / Performance

DTC P0047 Turbocharger/Supercharger Boost Control "A" Circuit Low

DTC P0048 Turbocharger/Supercharger Boost Control "A" Circuit High

DTC P004B Turbocharger/Supercharger Boost Control Solenoid "B" Circuit Range/Performance

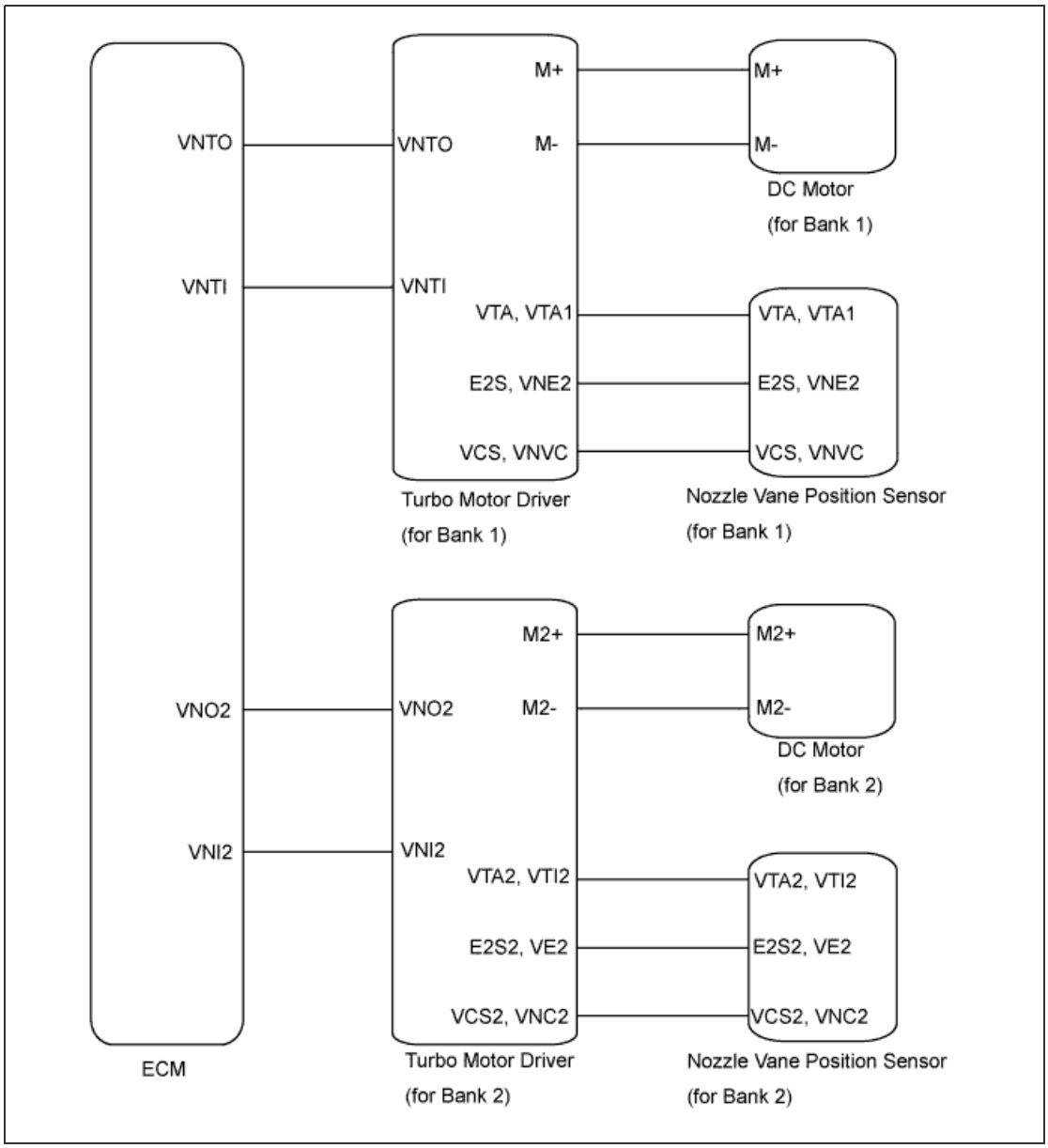
DTC P004C Turbocharger/Supercharger Boost Control Solenoid "B" Circuit Low

DTC P004D Turbocharger/Supercharger Boost Control Solenoid "B" Circuit High

for Preparation Click here

DESCRIPTION

These DTCs indicates that the DC motor of the turbocharger is malfunctioning. The ECM monitors the DC motor current to detect an open or short in the DC motor circuit. If the current meets the criteria, the ECM sets a DTC and illuminates the MIL immediately.
The DC motor is used to operate the nozzle vane of the turbocharger. The nozzle vane opens and closes to change the velocity of exhaust emissions in order to control the turbo pressure. The ECM varies the duty-cycle of the DC motor in accordance with the driving condition.
If the nozzle vane is stuck closed (DC motor stuck off), the drivability may deteriorate at wide open throttle. If the nozzle vane is stuck open (DC motor stuck on), the drivability may deteriorate at intermediate throttle or the engine power may be in sufficient.



P0046, P004B

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area

Ignition switch ON for 5 seconds	Either of the following conditions are met when the motor is driving (1 trip detection logic): • DC motor duty ratio is +/-100% for 1.3 seconds or more. • DC motor current is 2.2 A or more for 5 seconds or more.	• Open or short in DC motor (turbocharger sub-assembly) circuit • Turbo motor driver • DC motor (turbocharger sub-assembly) • Turbocharger nozzle vane is stuck or movement is irregular

P0047, P004C

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	Both of following conditions are met for 1 second or more when the motor is driving (1 trip detection logic): • DC motor duty ratio is 100%. • DC motor current is 0.5 A or less.	• Open in DC motor (turbocharger sub-assembly) circuit • Turbo motor driver • DC Motor (turbocharger sub-assembly) • Turbocharger nozzle vane is stuck or movement is irregular

P0048, P004D

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	DC motor current is 6.5 A or more for 0.5 seconds or more when the motor is operating (1 trip detection logic).	• Short in DC motor (turbocharger sub-assembly) circuit • Turbo motor driver • DC Motor (turbocharger sub-assembly) • Turbocharger nozzle vane is stuck or movement is irregular

HINT:

If DTC P0046, P0047, P0048, P004B, P004C and/or P004D is stored, the following symptoms may appear.

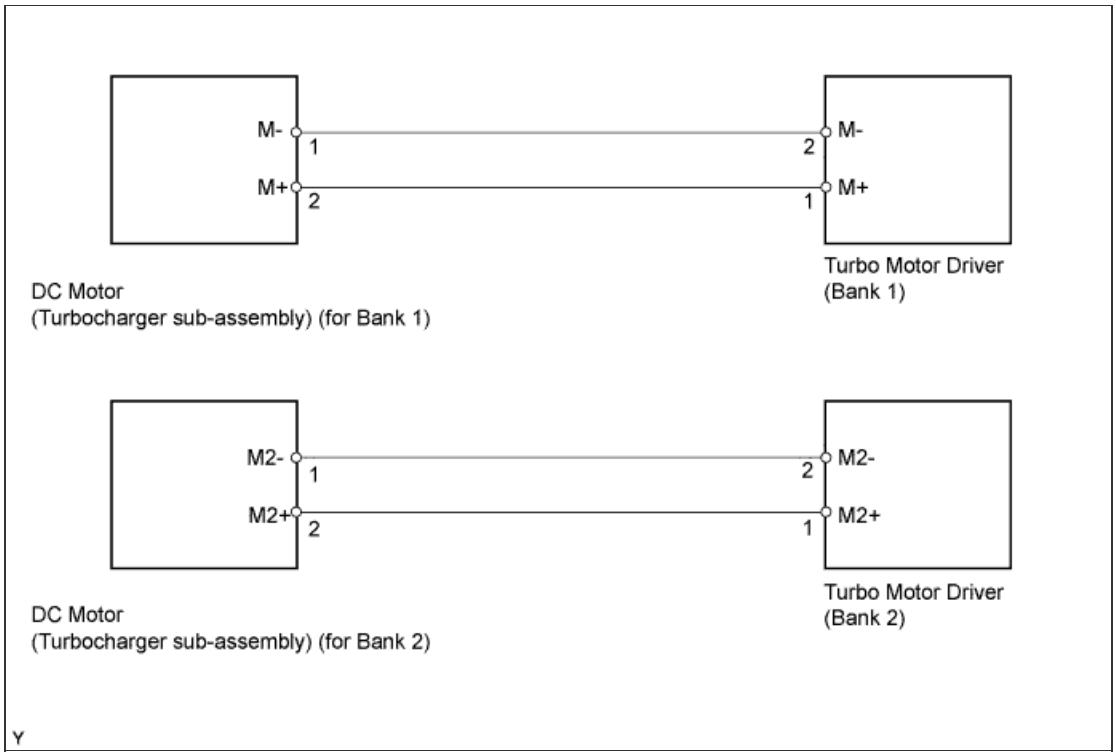
Stuck closed malfunction:

- **Vehicle surge when driving with full load**

Stuck open malfunction:

- **Lack of power**
- **Vehicle surge or hesitation under light or medium load**
- **White smoke**

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.INSPECT TURBO MOTOR DRIVER (for Bank 1 and Bank 2)

a. Remove the rear fender splash shield sub-assembly RH.

b. Remove the front fender liner LH.

c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

HINT:

Record the output DTCs.

g. Clear the DTCs (Click here).

h. Turn the ignition switch off.

i. Interchange the connectors for the turbo motor driver of bank 1 and bank 2.

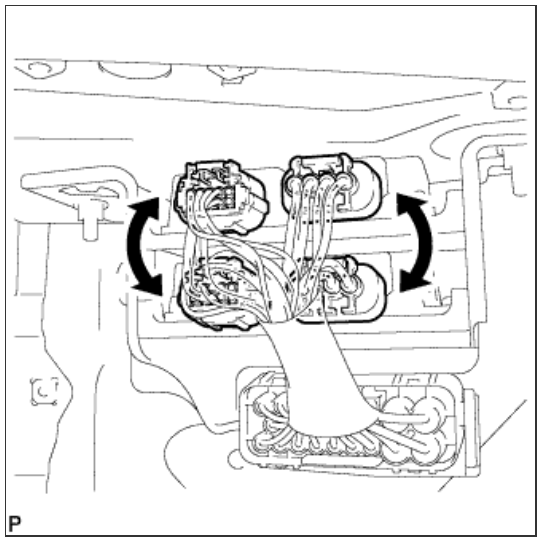
j. Turn the ignition switch to ON for 5 seconds or more.

k. Enter the following menus: Powertrain / Engine / DTC.

l. Read the DTCs.

Result:

Display (DTC Output)	Proceed to
DTCs do not change	A
DTCs change	B
No DTC output	C



B → Go to step

C → Go to step 8

A

2.INSPECT TURBOCHARGER SUB-ASSEMBLY (DC MOTOR) (for Bank 1 or Bank 2)

a. Disconnect the DC motor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

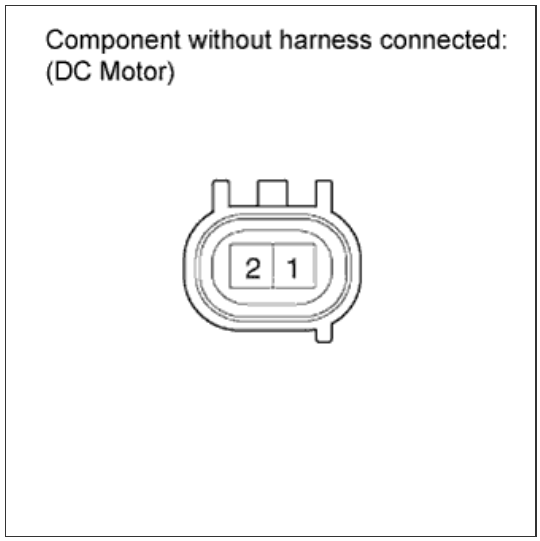
for Bank 1

Tester Connection	Condition	Specified Condition
1 (M-) - 2 (M+)	Always	1 to 100 Ω

Standard Resistance:

for Bank 2

Tester Connection	Condition	Specified Condition
1 (M2-) - 2 (M2+)	Always	1 to 100 Ω



NG → Go to step 4

OK

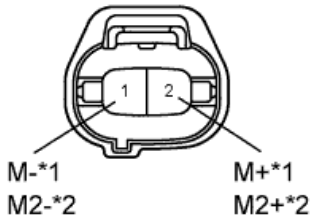
3.CHECK HARNESS AND CONNECTOR (DC MOTOR - TURBO MOTOR DRIVER)

a. Disconnect the DC motor connector.

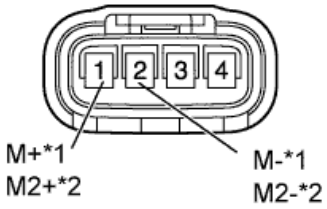
b. Disconnect the turbo motor driver connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to DC Motor)



Front view of wire harness connector:
(to Turbo Motor Driver)



*1: for Bank 1

*2: for Bank 2

Standard Resistance (Check for Open):

for Bank 1

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M-) - Turbo motor driver connector-2 (M-)	Always	Below 1 Ω
DC motor connector-2 (M+) - Turbo motor driver connector-1 (M+)	Always	Below 1 Ω

for Bank 2

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M2-) - Turbo motor driver connector-2 (M2-)	Always	Below 1 Ω
DC motor connector-2 (M2+) - Turbo motor driver connector-1 (M2+)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for Bank 1

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M-) or Turbo motor driver connector-2 (M-) - Body ground	Always	10 kΩ or higher
DC motor connector-2 (M+) or Turbo motor driver connector-1 (M+) - Body ground	Always	10 kΩ or higher

for Bank 2

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M2-) or Turbo motor driver connector-2 (M2-) - Body ground	Always	10 kΩ or higher
DC motor connector-2 (M2+) or Turbo motor driver connector-1 (M2+)	Always	10 kΩ or

- Body ground		higher

OK → Go to step 8

NG → Go to step 6

4.REPLACE TURBOCHARGER SUB-ASSEMBLY (for Bank 1 or Bank 2)

a. Replace turbocharger sub-assembly (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 7

5.REPLACE TURBO MOTOR DRIVER (for Bank 1 or Bank 2)

a. Replace turbo motor driver (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 7

6.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

7.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 5 seconds or more.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

8.INSPECT TURBOCHARGER SUB - ASSEMBLY

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Start the engine and warm up.

d. Move the shift lever to 3rd and accelerate the vehicle with the accelerator fully open.

e. Stop the vehicle

f. Enter the following menus: Powertrain / Engine / DTC.

g. Read the DTCs.

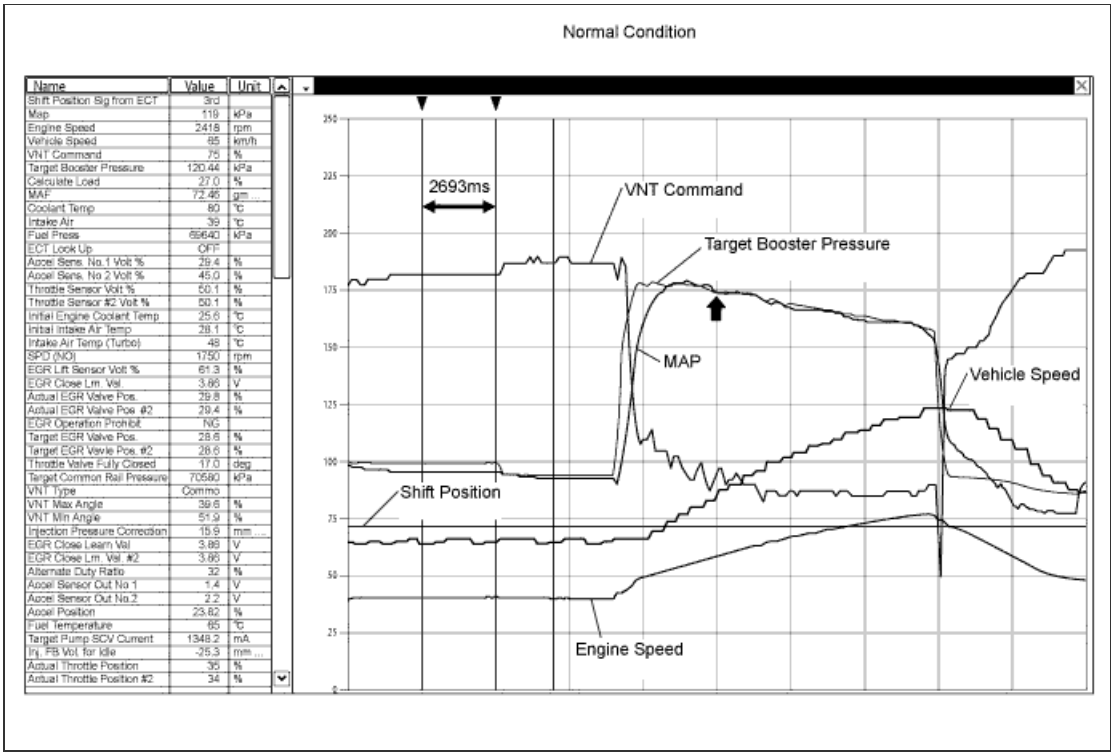
Result:

Display (DTC Output)	Proceed to
DTC P0046, P0047, P0048, P004B, P004C and/or P004D are output	A

No DTC output	B

HINT:

- **A snapshot can be used to compare vehicle data from the time of the malfunction to normal data and is very useful for troubleshooting.**
- **"Target Booster Pressure" and "MAP" in the snapshot can be used to heck the operation of the turbocharger. If "MAP" does not follow "Target Booster Pressure", the turbocharger nozzle vane may be stuck or the movement may be irregular.**
- **When the engine speed is 2500 to 3000 rpm with the accelerator pedal fully depressed, "MAP" is within +/- 10 kPa * of "Target Booster Pressure" (not immediately after beginning of acceleration).**
- *** If the turbocharger pressure does not reach a specified value, it cannot be determined whether the system is normal by checking whether "MAP" is within +/-10 kPa of "Target Booster Pressure"**



HINT:

Compare "MAP" with "Target Booster Pressure" at the point indicated by the arrow (↑) in the illustration.

A	REPLACE TURBOCHARGER SUB - ASSEMBLY

B

CHECK FOR INTERMITTENT PROBLEMS

DTC P0405 Exhaust Gas Recirculation Sensor "A" Circuit Low

DTC P0406 Exhaust Gas Recirculation Sensor "A" Circuit High

DTC P0407 Exhaust Gas Recirculation Sensor "B" Circuit Low

DTC P0408 Exhaust Gas Recirculation Sensor "B" Circuit High

for Preparation Click here

DESCRIPTION

The EGR valve position sensor is mounted on the EGR valve and used for detecting the lift amount of the valve. The lift amount detected by the sensor is provided to the ECM as feedback. The ECM then regulates the lift amount of the valve in accordance with engine running conditions.

P0405

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 5 seconds	No. 1 EGR valve position sensor output voltage is less than 0.1 V for 5 seconds (1 trip detection logic).	• Open in No. 1 EGR valve position sensor circuit • No. 1 EGR valve (EGR valve position sensor) • ECM

P0406

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 5 seconds	No. 1 EGR valve position sensor output voltage is more than 4.9 V for 5 seconds (1 trip detection logic).	• Short in No. 1 EGR valve position sensor circuit • No. 1 EGR valve (EGR valve position sensor) • ECM

P0407

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 5 seconds	No. 2 EGR valve position sensor output voltage is less than 0.1 V for 5 seconds (1 trip detection logic).	• Open in No. 2 EGR valve position sensor circuit • No. 2 EGR valve (EGR valve position sensor) • ECM

P0408

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 5 seconds	No. 2 EGR valve position sensor output voltage is more than 4.9 V for 5 seconds (1 trip detection logic).	• Short in No. 2 EGR valve position sensor circuit • No. 2 EGR valve (EGR valve position sensor) • ECM

MONITOR DESCRIPTION

When the output voltage of the EGR valve position sensor deviates from the normal operating range of 0.1 to 4.9 V for more than 5 seconds, the ECM interprets this as a malfunction of the sensor circuit, and illuminates the MIL.

WIRING DIAGRAM

Refer to DTC P0400 (Click here).

INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

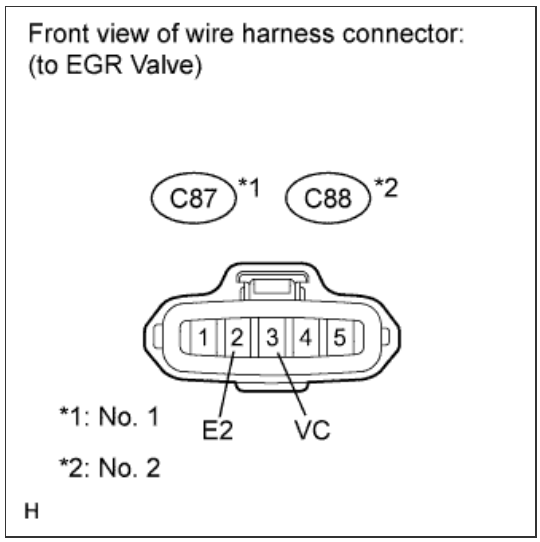
HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**
- **Data List items "EGR Lift Sensor Volt %" and "EGR Lift Sensor Volt % #2" are values calculated by converting the EGR position sensor output voltage of 0 to 5 V to a percentage from 0 to 100%.**

1.CHECK HARNESS AND CONNECTOR (POWER SOURCE)

a. Disconnect the EGR valve connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

No. 1

Tester Connection	Switch Condition	Specified Condition
C87-3 (VC) - C87-2 (E2)	Ignition switch ON	4.5 to 5.5 V

No. 2

Tester Connection	Switch Condition	Specified Condition
C88-3 (VC) - C88-2 (E2)	Ignition switch ON	4.5 to 5.5 V

NG → Go to step 3

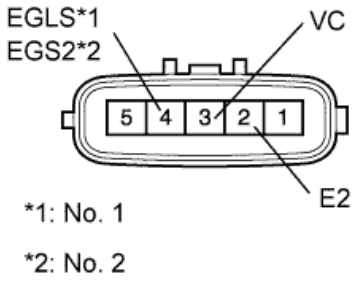
OK

2.INSPECT EGR VALVE ASSEMBLY (No. 1 or No. 2) (POSITION SENSOR)

a. Disconnect the EGR valve connector.

b. Measure the resistance according to the value(s) in the table below.

Component without harness connected:
(EGR Valve)



*1: No. 1

*2: No. 2

Standard Resistance:

No. 1

Tester Connection	Condition	Specified Condition
3 (VC) - 2 (E2)	20°C (68°F)	2.45 to 4.55 kΩ
4 (EGLS) - 2 (E2)	20°C (68°F)	2.45 to 4.55 kΩ

No. 2

Tester Connection	Condition	Specified Condition
3 (VC) - 2 (E2)	20°C (68°F)	2.45 to 4.55 kΩ
4 (EGS2) - 2 (E2)	20°C (68°F)	2.45 to 4.55 kΩ

NG → Go to step 5

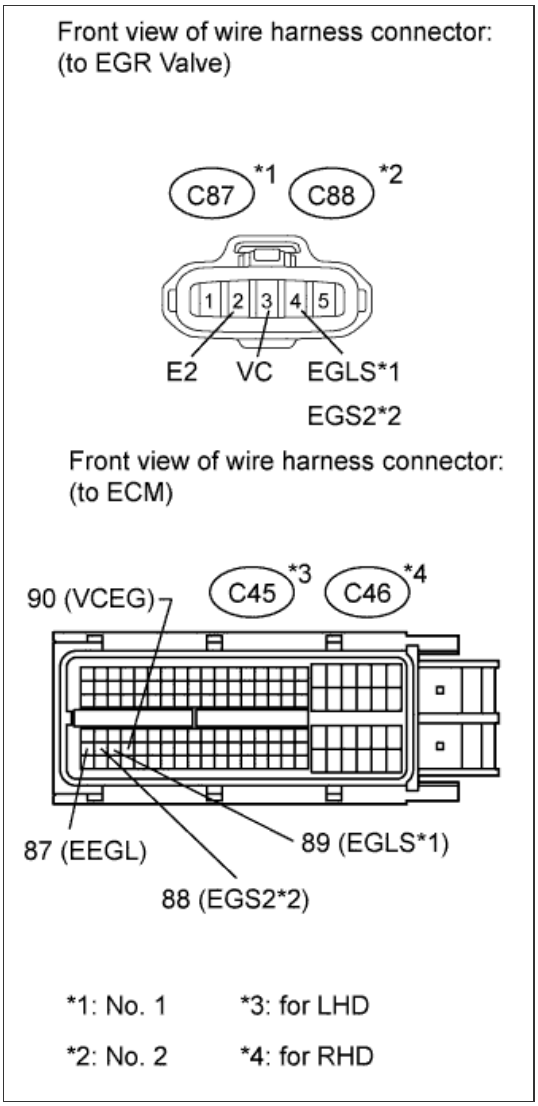
OK

3.CHECK HARNESS AND CONNECTOR (EGR VALVE POSITION SENSOR - ECM)

a. Disconnect the EGR valve connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

No. 1 (LHD)

Tester Connection	Condition	Specified Condition
C87-3 (VC) - C45-90 (VCEG)	Always	Below 1 Ω
C87-4 (EGLS) - C45-89 (EGLS)	Always	Below 1 Ω
C87-2 (E2) - C45-87 (EEGL)	Always	Below 1 Ω

No. 2 (LHD)

Tester Connection	Condition	Specified Condition
C88-3 (VC) - C45-90 (VCEG)	Always	Below 1 Ω
C88-4 (EGS2) - C45-88 (EGS2)	Always	Below 1 Ω
C88-2 (E2) - C45-87 (EEGL)	Always	Below 1 Ω

No. 1 (RHD)

Tester Connection	Condition	Specified Condition
C87-3 (VC) - C46-90 (VCEG)	Always	Below 1 Ω
C87-4 (EGLS) - C46-89 (EGLS)	Always	Below 1 Ω
C87-2 (E2) - C46-87 (EEGL)	Always	Below 1 Ω

No. 2 (RHD)

Tester Connection	Condition	Specified Condition
C88-3 (VC) - C46-90 (VCEG)	Always	Below 1 Ω
C88-4 (EGS2) - C46-88 (EGS2)	Always	Below 1 Ω

C88-2 (E2) - C46-87 (EEGL)	Always	Below 1 Ω

Standard Resistance (Check for Short):

No. 1 (LHD)

Tester Connection	Condition	Specified Condition
C87-3 (VC) or C45-90 (VCEG) - Body ground	Always	10 kΩ or higher
C87-4 (EGLS) or C45-89 (RGLS) - Body ground	Always	10 kΩ or higher

No. 2 (LHD)

Tester Connection	Condition	Specified Condition
C88-3 (VC) or C45-90 (VCEG) - Body ground	Always	10 kΩ or higher
C88-4 (EGS2) or C45-88 (EGS2) - Body ground	Always	10 kΩ or higher

No. 1 (RHD)

Tester Connection	Condition	Specified Condition
C87-3 (VC) or C46-90 (VCEG) - Body ground	Always	10 kΩ or higher
C87-4 (EGLS) or C46-89 (EGLS) - Body ground	Always	10 kΩ or higher

No. 2 (RHD)

Tester Connection	Condition	Specified Condition
C88-3 (VC) or C46-90 (VCEG) - Body ground	Always	10 kΩ or higher
C88-4 (EGS2) or C46-88 (EGS2) - Body ground	Always	10 kΩ or higher

NG → Go to step 6

OK

4.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 7

5.REPLACE EGR VALVE ASSEMBLY (No. 1 or No. 2)

a. Replace the EGR valve assembly (No. 1 or No. 2) (Click here).

NEXT → Go to step 7

6.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

7.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 5 seconds.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

DTC P0046 Turbocharger / Supercharger Boost Control Solenoid Circuit Range / Performance

DTC P0047 Turbocharger/Supercharger Boost Control "A" Circuit Low

DTC P0048 Turbocharger/Supercharger Boost Control "A" Circuit High

DTC P004B Turbocharger/Supercharger Boost Control Solenoid "B" Circuit Range/Performance

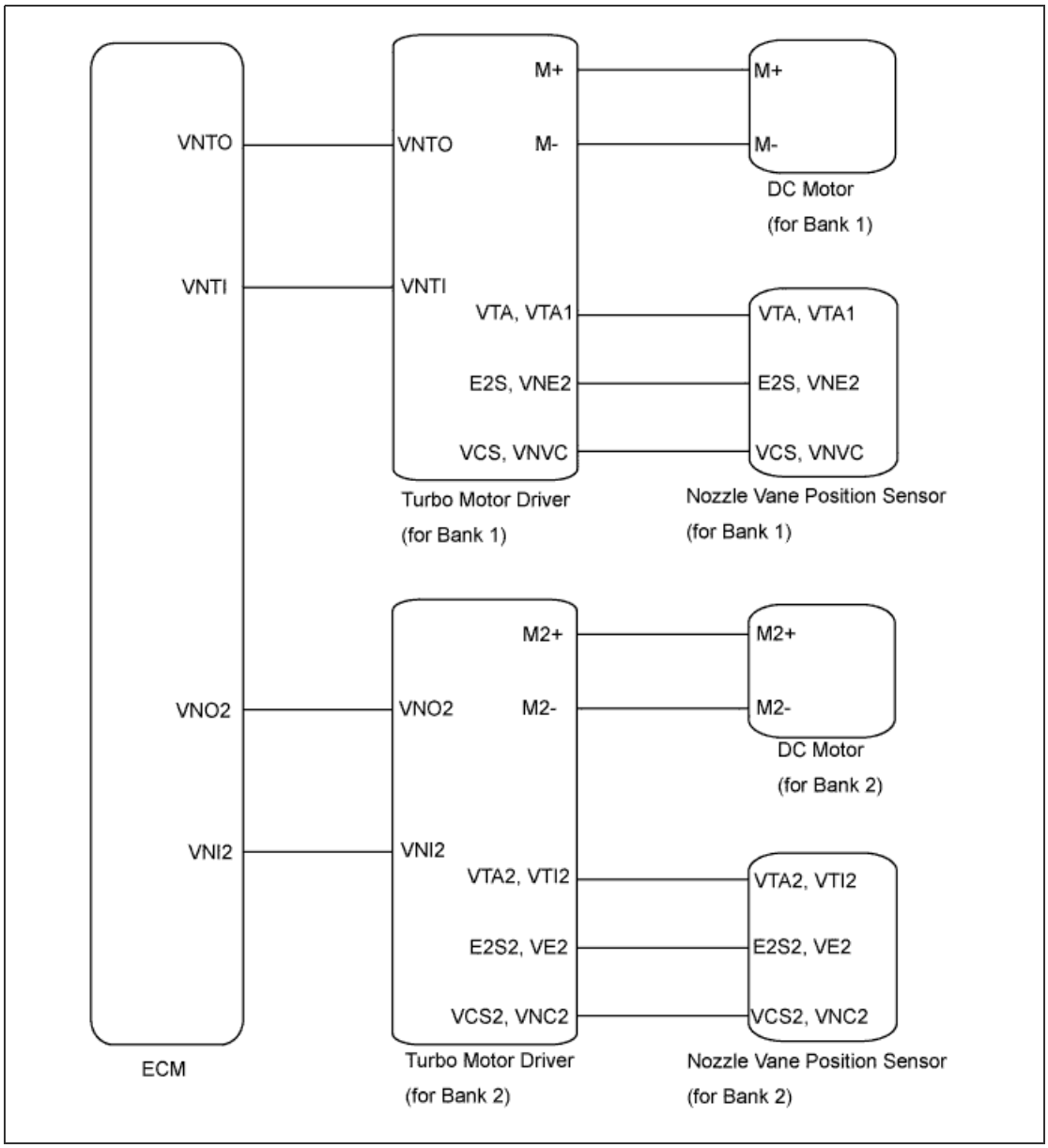
DTC P004C Turbocharger/Supercharger Boost Control Solenoid "B" Circuit Low

DTC P004D Turbocharger/Supercharger Boost Control Solenoid "B" Circuit High

for Preparation Click here

DESCRIPTION

These DTCs indicates that the DC motor of the turbocharger is malfunctioning. The ECM monitors the DC motor current to detect an open or short in the DC motor circuit. If the current meets the criteria, the ECM sets a DTC and illuminates the MIL immediately.
The DC motor is used to operate the nozzle vane of the turbocharger. The nozzle vane opens and closes to change the velocity of exhaust emissions in order to control the turbo pressure. The ECM varies the duty-cycle of the DC motor in accordance with the driving condition.
If the nozzle vane is stuck closed (DC motor stuck off), the drivability may deteriorate at wide open throttle. If the nozzle vane is stuck open (DC motor stuck on), the drivability may deteriorate at intermediate throttle or the engine power may be in sufficient.



P0046, P004B

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area

Ignition switch ON for 5 seconds	Either of the following conditions are met when the motor is driving (1 trip detection logic): • DC motor duty ratio is +/-100% for 1.3 seconds or more. • DC motor current is 2.2 A or more for 5 seconds or more.	• Open or short in DC motor (turbocharger sub-assembly) circuit • Turbo motor driver • DC motor (turbocharger sub-assembly) • Turbocharger nozzle vane is stuck or movement is irregular

P0047, P004C

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	Both of following conditions are met for 1 second or more when the motor is driving (1 trip detection logic): • DC motor duty ratio is 100%. • DC motor current is 0.5 A or less.	• Open in DC motor (turbocharger sub-assembly) circuit • Turbo motor driver • DC Motor (turbocharger sub-assembly) • Turbocharger nozzle vane is stuck or movement is irregular

P0048, P004D

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	DC motor current is 6.5 A or more for 0.5 seconds or more when the motor is operating (1 trip detection logic).	• Short in DC motor (turbocharger sub-assembly) circuit • Turbo motor driver • DC Motor (turbocharger sub-assembly) • Turbocharger nozzle vane is stuck or movement is irregular

HINT:

If DTC P0046, P0047, P0048, P004B, P004C and/or P004D is stored, the following symptoms may appear.

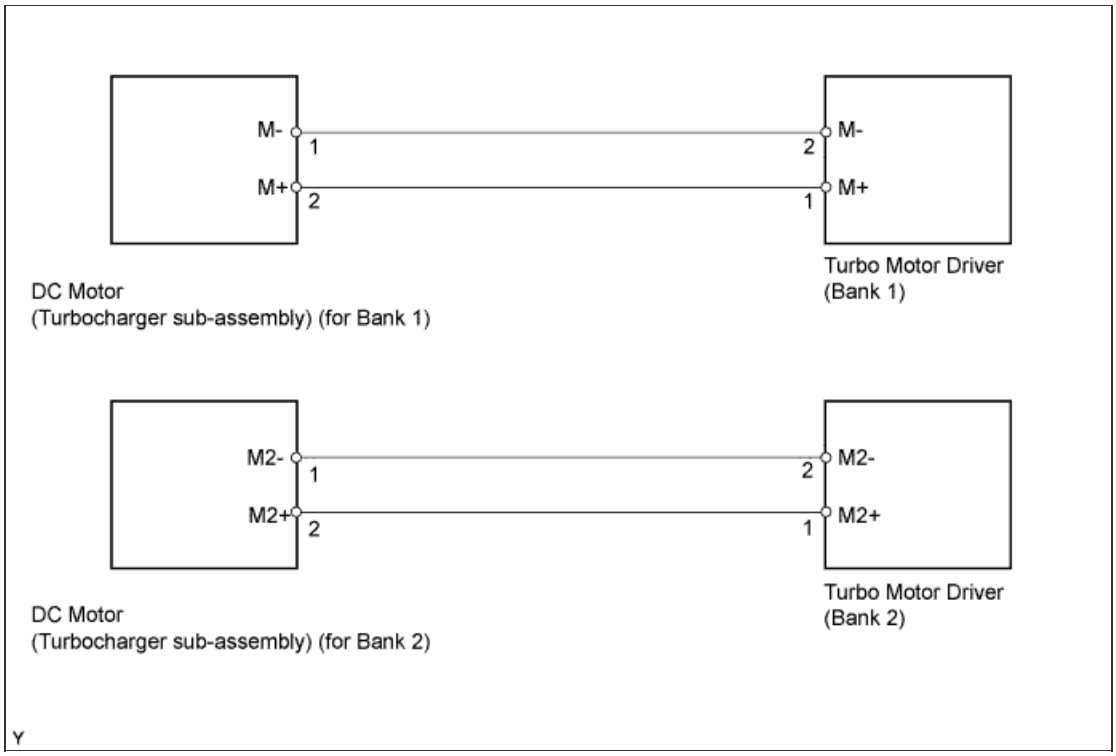
Stuck closed malfunction:

- **Vehicle surge when driving with full load**

Stuck open malfunction:

- **Lack of power**
- **Vehicle surge or hesitation under light or medium load**
- **White smoke**

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.INSPECT TURBO MOTOR DRIVER (for Bank 1 and Bank 2)

a. Remove the rear fender splash shield sub-assembly RH.

b. Remove the front fender liner LH.

c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

HINT:

Record the output DTCs.

g. Clear the DTCs (Click here).

h. Turn the ignition switch off.

i. Interchange the connectors for the turbo motor driver of bank 1 and bank 2.

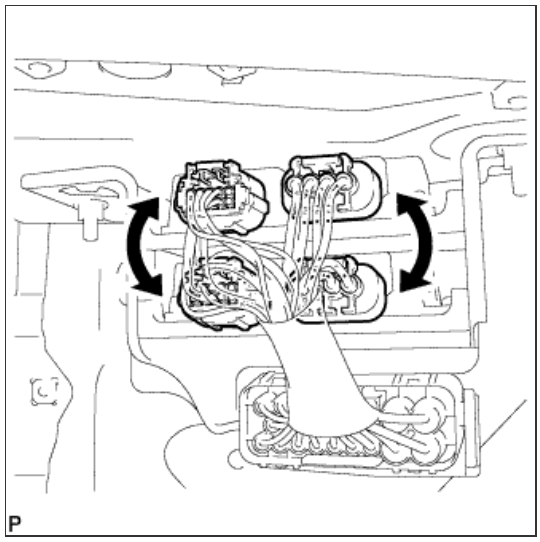
j. Turn the ignition switch to ON for 5 seconds or more.

k. Enter the following menus: Powertrain / Engine / DTC.

l. Read the DTCs.

Result:

Display (DTC Output)	Proceed to
DTCs do not change	A
DTCs change	B
No DTC output	C



B → Go to step

C → Go to step 8

A

2.INSPECT TURBOCHARGER SUB-ASSEMBLY (DC MOTOR) (for Bank 1 or Bank 2)

a. Disconnect the DC motor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

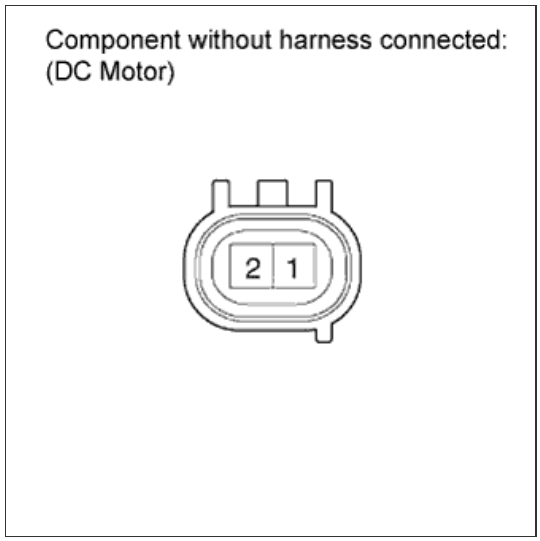
for Bank 1

Tester Connection	Condition	Specified Condition
1 (M-) - 2 (M+)	Always	1 to 100 Ω

Standard Resistance:

for Bank 2

Tester Connection	Condition	Specified Condition
1 (M2-) - 2 (M2+)	Always	1 to 100 Ω



NG → Go to step 4

OK

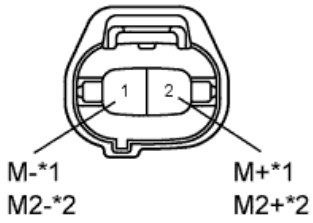
3.CHECK HARNESS AND CONNECTOR (DC MOTOR - TURBO MOTOR DRIVER)

a. Disconnect the DC motor connector.

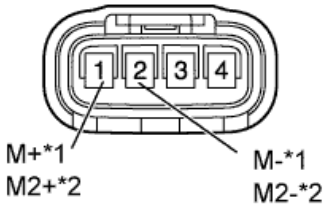
b. Disconnect the turbo motor driver connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to DC Motor)



Front view of wire harness connector:
(to Turbo Motor Driver)



*1: for Bank 1

*2: for Bank 2

Standard Resistance (Check for Open):

for Bank 1

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M-) - Turbo motor driver connector-2 (M-)	Always	Below 1 Ω
DC motor connector-2 (M+) - Turbo motor driver connector-1 (M+)	Always	Below 1 Ω

for Bank 2

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M2-) - Turbo motor driver connector-2 (M2-)	Always	Below 1 Ω
DC motor connector-2 (M2+) - Turbo motor driver connector-1 (M2+)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for Bank 1

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M-) or Turbo motor driver connector-2 (M-) - Body ground	Always	10 kΩ or higher
DC motor connector-2 (M+) or Turbo motor driver connector-1 (M+) - Body ground	Always	10 kΩ or higher

for Bank 2

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M2-) or Turbo motor driver connector-2 (M2-) - Body ground	Always	10 kΩ or higher
DC motor connector-2 (M2+) or Turbo motor driver connector-1 (M2+)	Always	10 kΩ or

- Body ground		higher

OK → Go to step 8

NG → Go to step 6

4.REPLACE TURBOCHARGER SUB-ASSEMBLY (for Bank 1 or Bank 2)

a. Replace turbocharger sub-assembly (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 7

5.REPLACE TURBO MOTOR DRIVER (for Bank 1 or Bank 2)

a. Replace turbo motor driver (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 7

6.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

7.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 5 seconds or more.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

8.INSPECT TURBOCHARGER SUB - ASSEMBLY

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Start the engine and warm up.

d. Move the shift lever to 3rd and accelerate the vehicle with the accelerator fully open.

e. Stop the vehicle

f. Enter the following menus: Powertrain / Engine / DTC.

g. Read the DTCs.

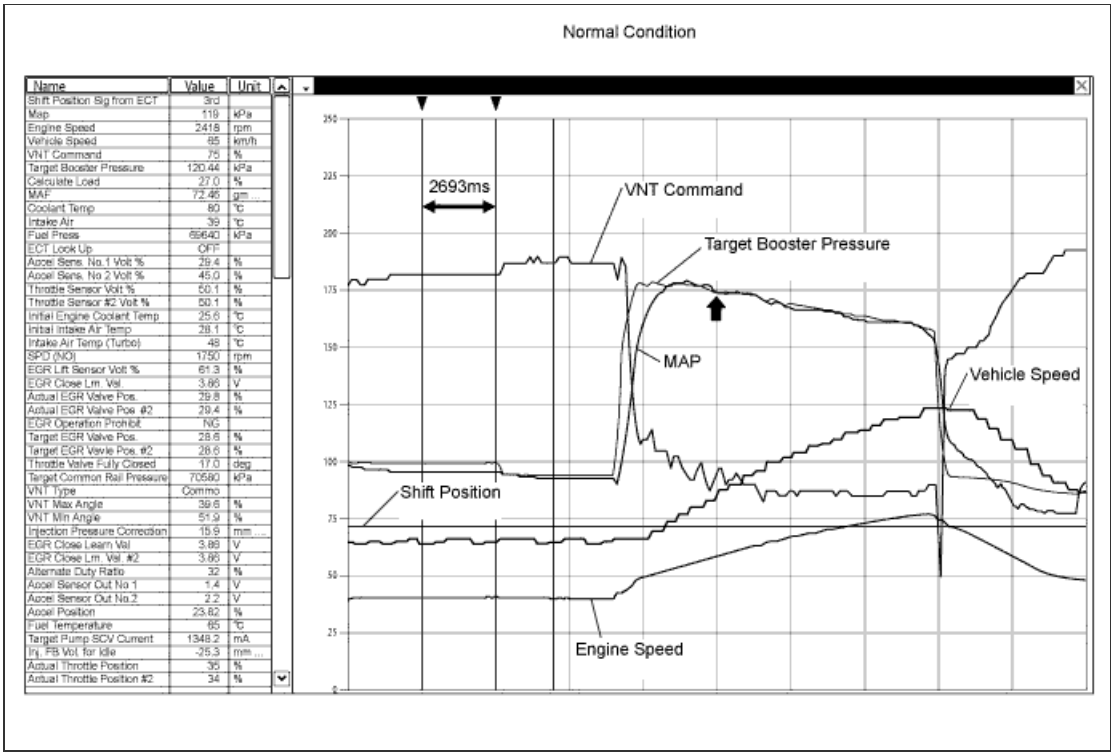
Result:

Display (DTC Output)	Proceed to
DTC P0046, P0047, P0048, P004B, P004C and/or P004D are output	A

No DTC output	B

HINT:

- **A snapshot can be used to compare vehicle data from the time of the malfunction to normal data and is very useful for troubleshooting.**
- **"Target Booster Pressure" and "MAP" in the snapshot can be used to heck the operation of the turbocharger. If "MAP" does not follow "Target Booster Pressure", the turbocharger nozzle vane may be stuck or the movement may be irregular.**
- **When the engine speed is 2500 to 3000 rpm with the accelerator pedal fully depressed, "MAP" is within +/- 10 kPa * of "Target Booster Pressure" (not immediately after beginning of acceleration).**
- *** If the turbocharger pressure does not reach a specified value, it cannot be determined whether the system is normal by checking whether "MAP" is within +/-10 kPa of "Target Booster Pressure"**



HINT:

Compare "MAP" with "Target Booster Pressure" at the point indicated by the arrow (↑) in the illustration.

A	REPLACE TURBOCHARGER SUB - ASSEMBLY

B

CHECK FOR INTERMITTENT PROBLEMS

DTC P0405 Exhaust Gas Recirculation Sensor "A" Circuit Low

DTC P0406 Exhaust Gas Recirculation Sensor "A" Circuit High

DTC P0407 Exhaust Gas Recirculation Sensor "B" Circuit Low

DTC P0408 Exhaust Gas Recirculation Sensor "B" Circuit High

for Preparation Click here

DESCRIPTION

The EGR valve position sensor is mounted on the EGR valve and used for detecting the lift amount of the valve. The lift amount detected by the sensor is provided to the ECM as feedback. The ECM then regulates the lift amount of the valve in accordance with engine running conditions.

P0405

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 5 seconds	No. 1 EGR valve position sensor output voltage is less than 0.1 V for 5 seconds (1 trip detection logic).	• Open in No. 1 EGR valve position sensor circuit • No. 1 EGR valve (EGR valve position sensor) • ECM

P0406

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 5 seconds	No. 1 EGR valve position sensor output voltage is more than 4.9 V for 5 seconds (1 trip detection logic).	• Short in No. 1 EGR valve position sensor circuit • No. 1 EGR valve (EGR valve position sensor) • ECM

P0407

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 5 seconds	No. 2 EGR valve position sensor output voltage is less than 0.1 V for 5 seconds (1 trip detection logic).	• Open in No. 2 EGR valve position sensor circuit • No. 2 EGR valve (EGR valve position sensor) • ECM

P0408

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 5 seconds	No. 2 EGR valve position sensor output voltage is more than 4.9 V for 5 seconds (1 trip detection logic).	• Short in No. 2 EGR valve position sensor circuit • No. 2 EGR valve (EGR valve position sensor) • ECM

MONITOR DESCRIPTION

When the output voltage of the EGR valve position sensor deviates from the normal operating range of 0.1 to 4.9 V for more than 5 seconds, the ECM interprets this as a malfunction of the sensor circuit, and illuminates the MIL.

WIRING DIAGRAM

Refer to DTC P0400 (Click here).

INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

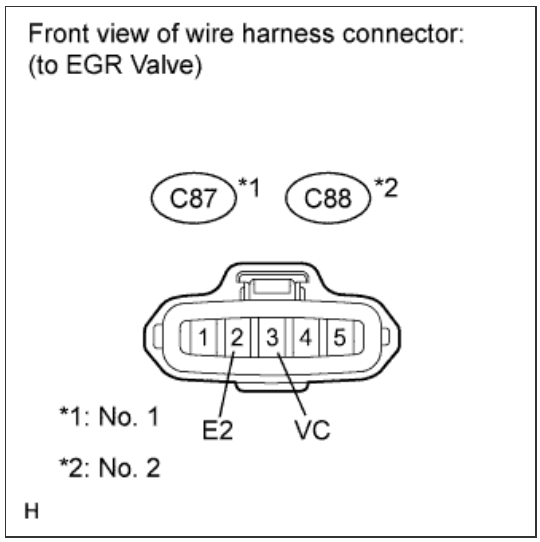
HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**
- **Data List items "EGR Lift Sensor Volt %" and "EGR Lift Sensor Volt % #2" are values calculated by converting the EGR position sensor output voltage of 0 to 5 V to a percentage from 0 to 100%.**

1.CHECK HARNESS AND CONNECTOR (POWER SOURCE)

a. Disconnect the EGR valve connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

No. 1

Tester Connection	Switch Condition	Specified Condition
C87-3 (VC) - C87-2 (E2)	Ignition switch ON	4.5 to 5.5 V

No. 2

Tester Connection	Switch Condition	Specified Condition
C88-3 (VC) - C88-2 (E2)	Ignition switch ON	4.5 to 5.5 V

NG → Go to step 3

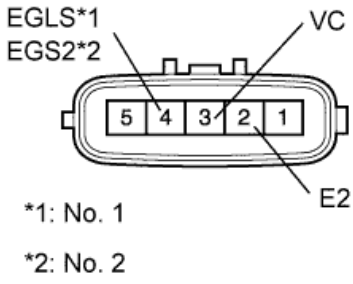
OK

2.INSPECT EGR VALVE ASSEMBLY (No. 1 or No. 2) (POSITION SENSOR)

a. Disconnect the EGR valve connector.

b. Measure the resistance according to the value(s) in the table below.

Component without harness connected:
(EGR Valve)



*1: No. 1

*2: No. 2

Standard Resistance:

No. 1

Tester Connection	Condition	Specified Condition
3 (VC) - 2 (E2)	20°C (68°F)	2.45 to 4.55 kΩ
4 (EGLS) - 2 (E2)	20°C (68°F)	2.45 to 4.55 kΩ

No. 2

Tester Connection	Condition	Specified Condition
3 (VC) - 2 (E2)	20°C (68°F)	2.45 to 4.55 kΩ
4 (EGS2) - 2 (E2)	20°C (68°F)	2.45 to 4.55 kΩ

NG → Go to step 5

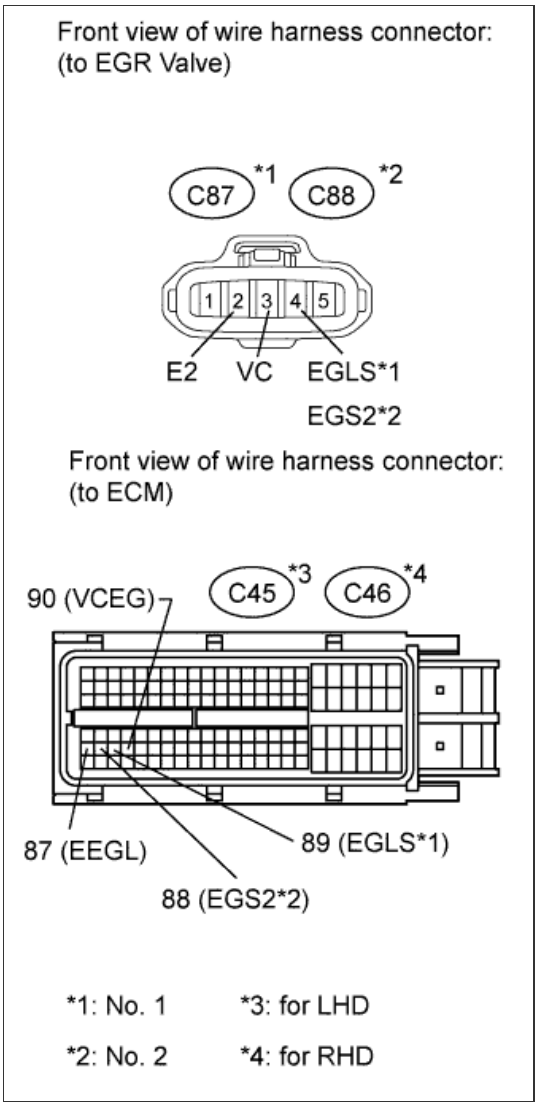
OK

3.CHECK HARNESS AND CONNECTOR (EGR VALVE POSITION SENSOR - ECM)

a. Disconnect the EGR valve connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

No. 1 (LHD)

Tester Connection	Condition	Specified Condition
C87-3 (VC) - C45-90 (VCEG)	Always	Below 1 Ω
C87-4 (EGLS) - C45-89 (EGLS)	Always	Below 1 Ω
C87-2 (E2) - C45-87 (EEGL)	Always	Below 1 Ω

No. 2 (LHD)

Tester Connection	Condition	Specified Condition
C88-3 (VC) - C45-90 (VCEG)	Always	Below 1 Ω
C88-4 (EGS2) - C45-88 (EGS2)	Always	Below 1 Ω
C88-2 (E2) - C45-87 (EEGL)	Always	Below 1 Ω

No. 1 (RHD)

Tester Connection	Condition	Specified Condition
C87-3 (VC) - C46-90 (VCEG)	Always	Below 1 Ω
C87-4 (EGLS) - C46-89 (EGLS)	Always	Below 1 Ω
C87-2 (E2) - C46-87 (EEGL)	Always	Below 1 Ω

No. 2 (RHD)

Tester Connection	Condition	Specified Condition
C88-3 (VC) - C46-90 (VCEG)	Always	Below 1 Ω
C88-4 (EGS2) - C46-88 (EGS2)	Always	Below 1 Ω

C88-2 (E2) - C46-87 (EEGL)	Always	Below 1 Ω

Standard Resistance (Check for Short):

No. 1 (LHD)

Tester Connection	Condition	Specified Condition
C87-3 (VC) or C45-90 (VCEG) - Body ground	Always	10 kΩ or higher
C87-4 (EGLS) or C45-89 (RGLS) - Body ground	Always	10 kΩ or higher

No. 2 (LHD)

Tester Connection	Condition	Specified Condition
C88-3 (VC) or C45-90 (VCEG) - Body ground	Always	10 kΩ or higher
C88-4 (EGS2) or C45-88 (EGS2) - Body ground	Always	10 kΩ or higher

No. 1 (RHD)

Tester Connection	Condition	Specified Condition
C87-3 (VC) or C46-90 (VCEG) - Body ground	Always	10 kΩ or higher
C87-4 (EGLS) or C46-89 (EGLS) - Body ground	Always	10 kΩ or higher

No. 2 (RHD)

Tester Connection	Condition	Specified Condition
C88-3 (VC) or C46-90 (VCEG) - Body ground	Always	10 kΩ or higher
C88-4 (EGS2) or C46-88 (EGS2) - Body ground	Always	10 kΩ or higher

NG → Go to step 6

OK

4.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 7

5.REPLACE EGR VALVE ASSEMBLY (No. 1 or No. 2)

a. Replace the EGR valve assembly (No. 1 or No. 2) (Click here).

NEXT → Go to step 7

6.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

7.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 5 seconds.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

DTC P0046 Turbocharger / Supercharger Boost Control Solenoid Circuit Range / Performance

DTC P0047 Turbocharger/Supercharger Boost Control "A" Circuit Low

DTC P0048 Turbocharger/Supercharger Boost Control "A" Circuit High

DTC P004B Turbocharger/Supercharger Boost Control Solenoid "B" Circuit Range/Performance

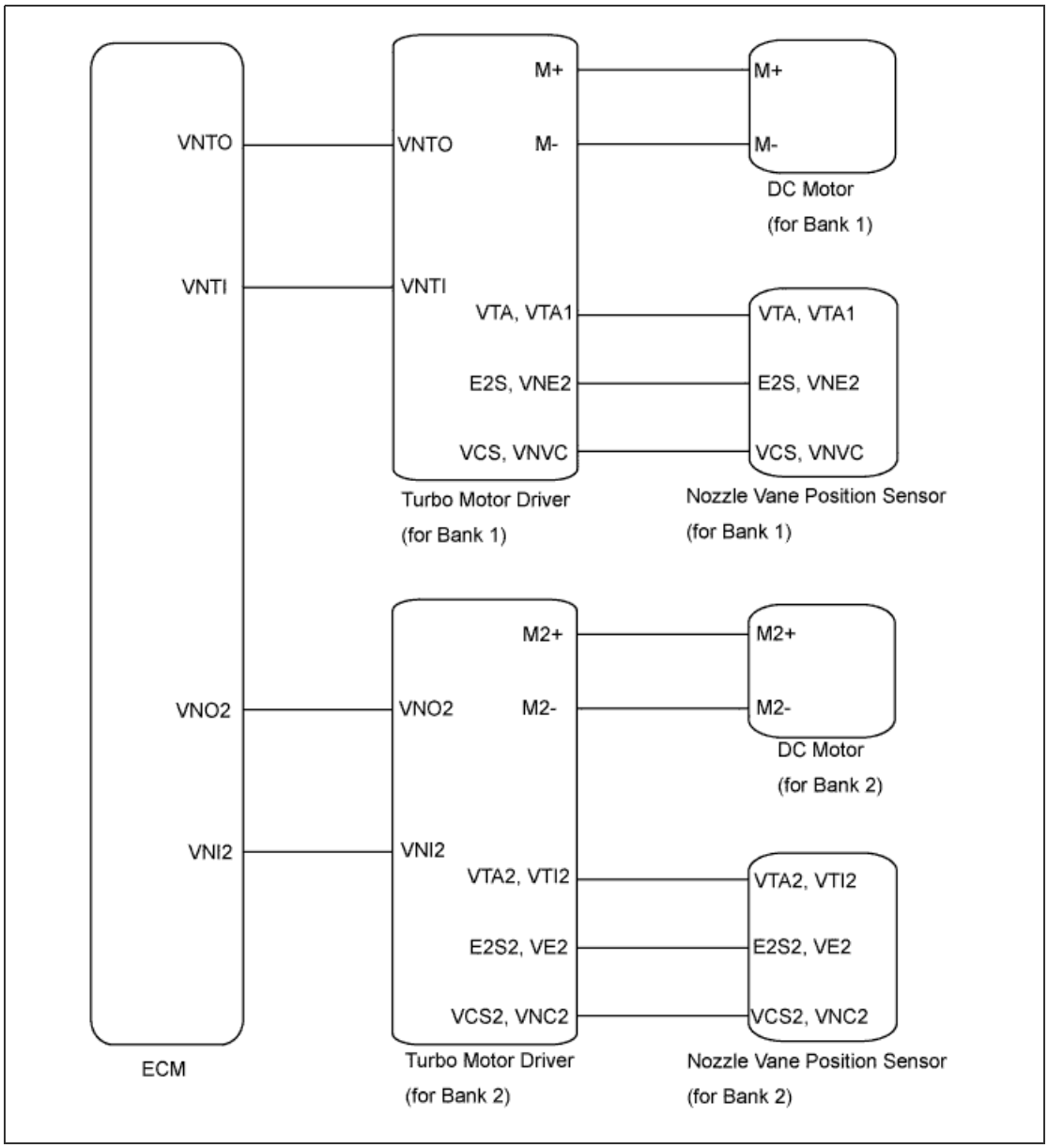
DTC P004C Turbocharger/Supercharger Boost Control Solenoid "B" Circuit Low

DTC P004D Turbocharger/Supercharger Boost Control Solenoid "B" Circuit High

for Preparation Click here

DESCRIPTION

These DTCs indicates that the DC motor of the turbocharger is malfunctioning. The ECM monitors the DC motor current to detect an open or short in the DC motor circuit. If the current meets the criteria, the ECM sets a DTC and illuminates the MIL immediately.
The DC motor is used to operate the nozzle vane of the turbocharger. The nozzle vane opens and closes to change the velocity of exhaust emissions in order to control the turbo pressure. The ECM varies the duty-cycle of the DC motor in accordance with the driving condition.
If the nozzle vane is stuck closed (DC motor stuck off), the drivability may deteriorate at wide open throttle. If the nozzle vane is stuck open (DC motor stuck on), the drivability may deteriorate at intermediate throttle or the engine power may be in sufficient.



P0046, P004B

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area

Ignition switch ON for 5 seconds	Either of the following conditions are met when the motor is driving (1 trip detection logic): • DC motor duty ratio is +/-100% for 1.3 seconds or more. • DC motor current is 2.2 A or more for 5 seconds or more.	• Open or short in DC motor (turbocharger sub-assembly) circuit • Turbo motor driver • DC motor (turbocharger sub-assembly) • Turbocharger nozzle vane is stuck or movement is irregular

P0047, P004C

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	Both of following conditions are met for 1 second or more when the motor is driving (1 trip detection logic): • DC motor duty ratio is 100%. • DC motor current is 0.5 A or less.	• Open in DC motor (turbocharger sub-assembly) circuit • Turbo motor driver • DC Motor (turbocharger sub-assembly) • Turbocharger nozzle vane is stuck or movement is irregular

P0048, P004D

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	DC motor current is 6.5 A or more for 0.5 seconds or more when the motor is operating (1 trip detection logic).	• Short in DC motor (turbocharger sub-assembly) circuit • Turbo motor driver • DC Motor (turbocharger sub-assembly) • Turbocharger nozzle vane is stuck or movement is irregular

HINT:

If DTC P0046, P0047, P0048, P004B, P004C and/or P004D is stored, the following symptoms may appear.

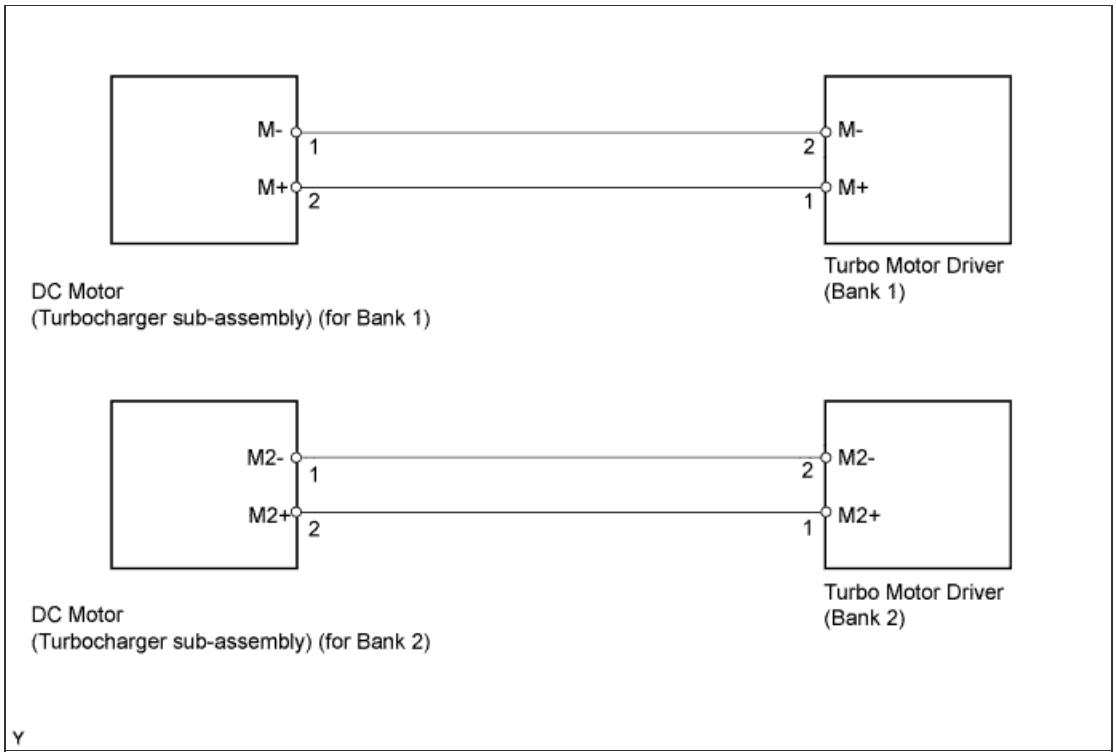
Stuck closed malfunction:

- **Vehicle surge when driving with full load**

Stuck open malfunction:

- **Lack of power**
- **Vehicle surge or hesitation under light or medium load**
- **White smoke**

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.INSPECT TURBO MOTOR DRIVER (for Bank 1 and Bank 2)

a. Remove the rear fender splash shield sub-assembly RH.

b. Remove the front fender liner LH.

c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

HINT:

Record the output DTCs.

g. Clear the DTCs (Click here).

h. Turn the ignition switch off.

i. Interchange the connectors for the turbo motor driver of bank 1 and bank 2.

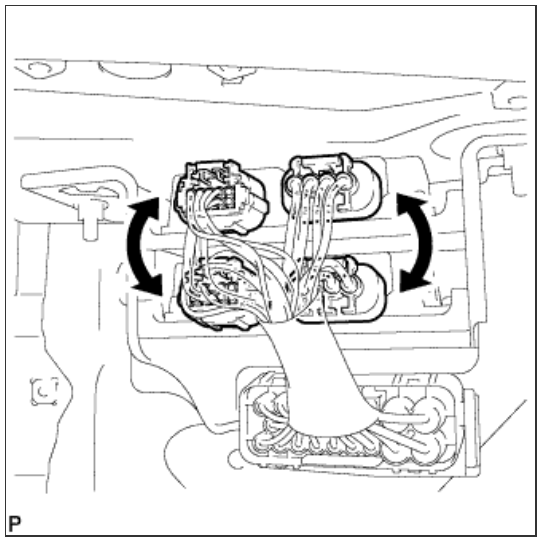
j. Turn the ignition switch to ON for 5 seconds or more.

k. Enter the following menus: Powertrain / Engine / DTC.

l. Read the DTCs.

Result:

Display (DTC Output)	Proceed to
DTCs do not change	A
DTCs change	B
No DTC output	C



B → Go to step

C → Go to step 8

A

2.INSPECT TURBOCHARGER SUB-ASSEMBLY (DC MOTOR) (for Bank 1 or Bank 2)

a. Disconnect the DC motor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

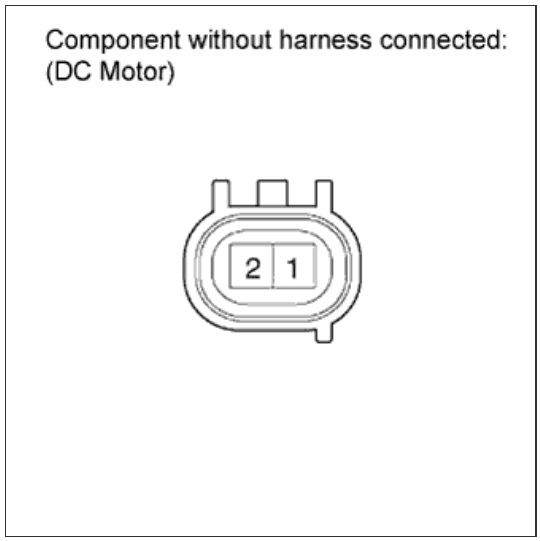
for Bank 1

Tester Connection	Condition	Specified Condition
1 (M-) - 2 (M+)	Always	1 to 100 Ω

Standard Resistance:

for Bank 2

Tester Connection	Condition	Specified Condition
1 (M2-) - 2 (M2+)	Always	1 to 100 Ω



NG → Go to step 4

OK

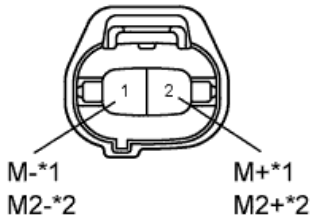
3.CHECK HARNESS AND CONNECTOR (DC MOTOR - TURBO MOTOR DRIVER)

a. Disconnect the DC motor connector.

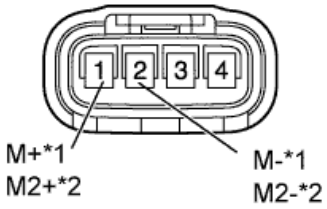
b. Disconnect the turbo motor driver connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to DC Motor)



Front view of wire harness connector:
(to Turbo Motor Driver)



*1: for Bank 1

*2: for Bank 2

Standard Resistance (Check for Open):

for Bank 1

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M-) - Turbo motor driver connector-2 (M-)	Always	Below 1 Ω
DC motor connector-2 (M+) - Turbo motor driver connector-1 (M+)	Always	Below 1 Ω

for Bank 2

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M2-) - Turbo motor driver connector-2 (M2-)	Always	Below 1 Ω
DC motor connector-2 (M2+) - Turbo motor driver connector-1 (M2+)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for Bank 1

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M-) or Turbo motor driver connector-2 (M-) - Body ground	Always	10 kΩ or higher
DC motor connector-2 (M+) or Turbo motor driver connector-1 (M+) - Body ground	Always	10 kΩ or higher

for Bank 2

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M2-) or Turbo motor driver connector-2 (M2-) - Body ground	Always	10 kΩ or higher
DC motor connector-2 (M2+) or Turbo motor driver connector-1 (M2+)	Always	10 kΩ or

- Body ground		higher

OK → Go to step 8

NG → Go to step 6

4.REPLACE TURBOCHARGER SUB-ASSEMBLY (for Bank 1 or Bank 2)

a. Replace turbocharger sub-assembly (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 7

5.REPLACE TURBO MOTOR DRIVER (for Bank 1 or Bank 2)

a. Replace turbo motor driver (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 7

6.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

7.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 5 seconds or more.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

8.INSPECT TURBOCHARGER SUB - ASSEMBLY

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Start the engine and warm up.

d. Move the shift lever to 3rd and accelerate the vehicle with the accelerator fully open.

e. Stop the vehicle

f. Enter the following menus: Powertrain / Engine / DTC.

g. Read the DTCs.

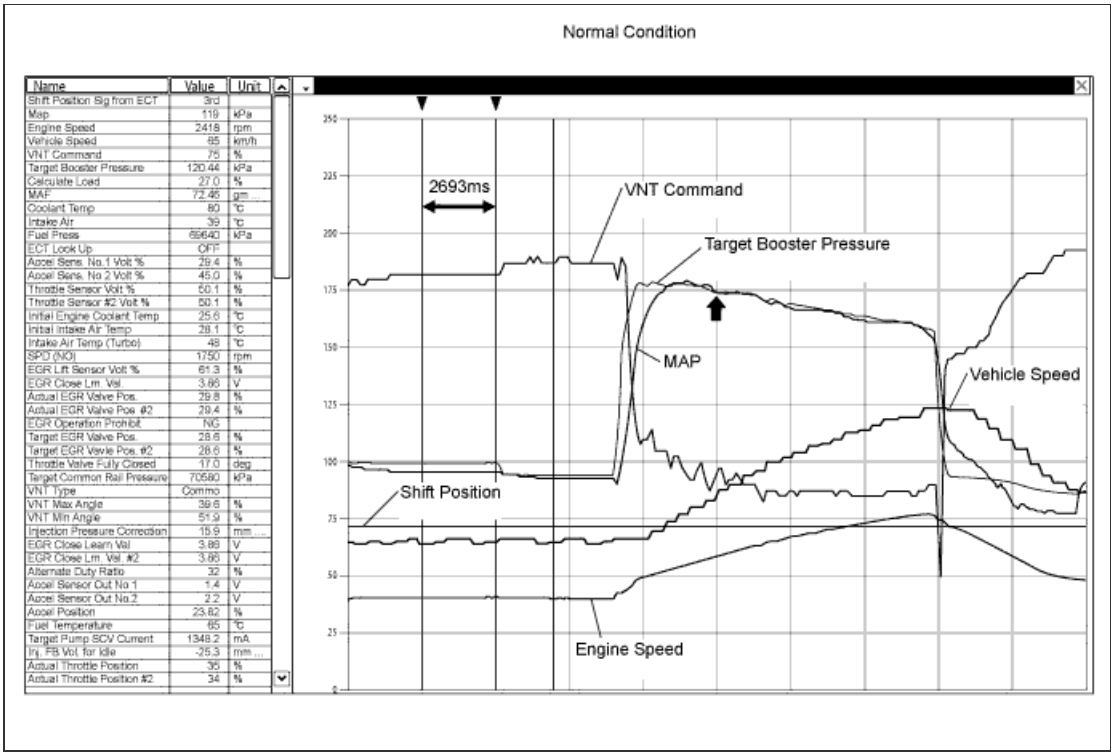
Result:

Display (DTC Output)	Proceed to
DTC P0046, P0047, P0048, P004B, P004C and/or P004D are output	A

No DTC output	B

HINT:

- **A snapshot can be used to compare vehicle data from the time of the malfunction to normal data and is very useful for troubleshooting.**
- **"Target Booster Pressure" and "MAP" in the snapshot can be used to heck the operation of the turbocharger. If "MAP" does not follow "Target Booster Pressure", the turbocharger nozzle vane may be stuck or the movement may be irregular.**
- **When the engine speed is 2500 to 3000 rpm with the accelerator pedal fully depressed, "MAP" is within +/- 10 kPa * of "Target Booster Pressure" (not immediately after beginning of acceleration).**
- *** If the turbocharger pressure does not reach a specified value, it cannot be determined whether the system is normal by checking whether "MAP" is within +/-10 kPa of "Target Booster Pressure"**



HINT:

Compare "MAP" with "Target Booster Pressure" at the point indicated by the arrow (↑) in the illustration.

A	REPLACE TURBOCHARGER SUB - ASSEMBLY

B

CHECK FOR INTERMITTENT PROBLEMS

DTC P0488 Exhaust Gas Recirculation Throttle Position Control Range / Performance

DTC P213B Exhaust Gas Recirculation Throttle Position Control (Range / Performance)

for Preparation Click here

DESCRIPTION

The ECM opens and closes the throttle valve using a rotary solenoid type actuator. Due to the opening and closing of the valve, the exhaust gas recirculation volume can be properly controlled. Also, engine vibration and noise will be reduced by closing the valve when the engine is stopped.

P0488

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Over a period of 10 seconds or more, slowly raise engine speed to 3000 rpm and lower it	The throttle motor activation duty is less than 10% or 90% or more for 30 seconds (1 trip detection logic). **HINT:** The throttle valve commanded duty can be read using the tester as the Data List item Throttle Motor Duty.	• Throttle valve (for Bank 1) stuck • Throttle valve (for Bank 1) does not move smoothly • Open or short in throttle control motor (for Bank 1) circuit • ECM

P213B

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Over a period of 10 seconds or more, slowly raise engine speed to 3000 rpm and lower it	The throttle motor activation duty is less than 10% or 90% or more for 30 seconds (1 trip detection logic). **HINT:** The throttle valve commanded duty can be read using the tester as the Data List item Throttle Motor Duty.	• Throttle valve (for Bank 2) stuck • Throttle valve (for Bank 2) does not move smoothly • Open or short in throttle control motor (for Bank 2) circuit • ECM

Related Data List

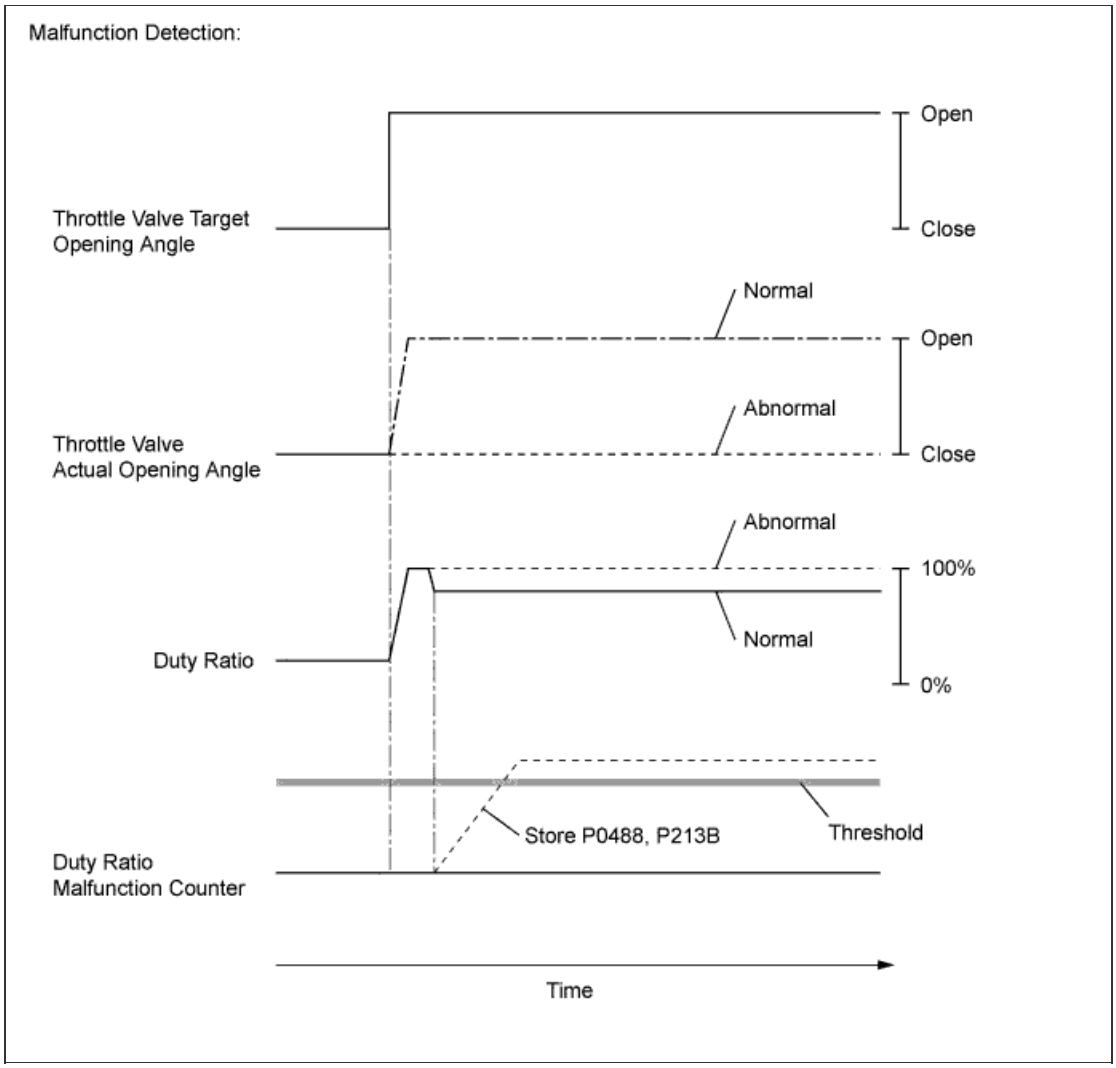
DTC No.	Data List
P0488	• Throttle Motor Duty #1 • Throttle Motor Duty #2 • Actual Throttle Position • Actual Throttle Position #2
P213B	

Reference

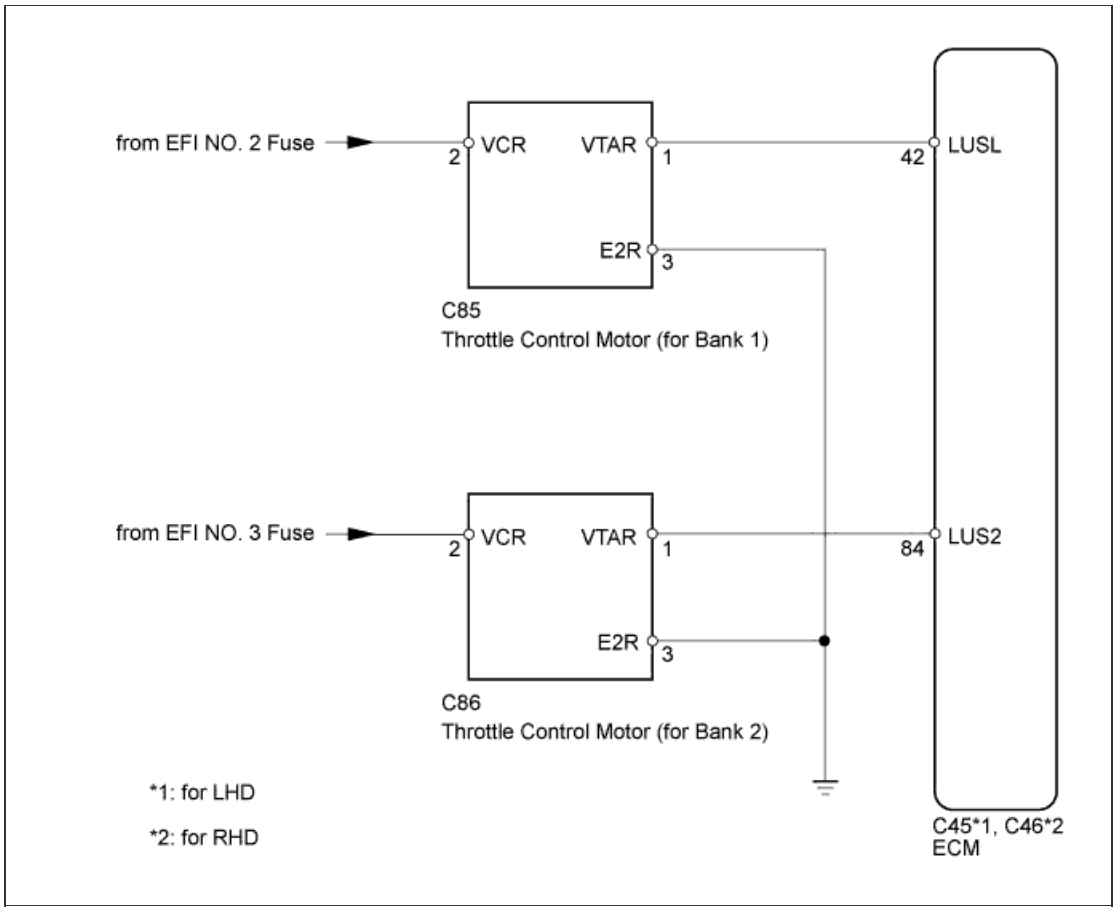
Condition	Throttle Valve Position
Moment when accelerator pedal is depressed further or released at 3000 rpm	Throttle valve opening angle varies smoothly

MONITOR DESCRIPTION

The ECM opens and closes the throttle valve by adjusting the current flowing to the rotary solenoid with a duty ratio. If the throttle valve does not move smoothly or is stuck, the duty ratio used during valve movement control increases or decreases greatly. The ECM will determine that the throttle valve is malfunctioning and illuminate the MIL.



WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

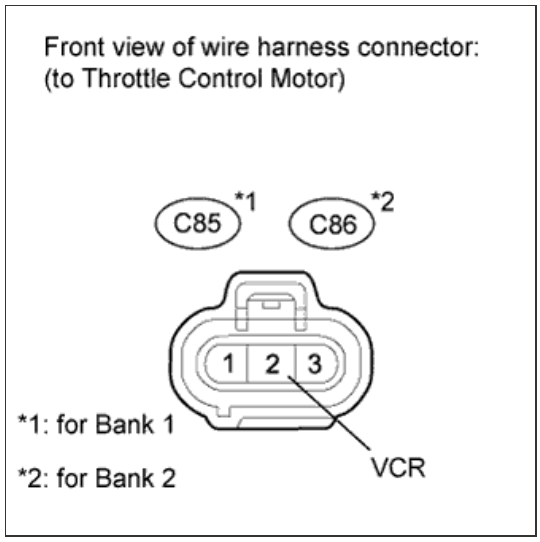
HINT:

- **Although the DTC titles say Exhaust Gas Recirculation Throttle Position Control Range / Performance, these DTCs relate to the throttle valve**
- **After warming up the engine, DTC P0488 and P213B can be stored when 1 second or more passes after quickly accelerating the engine from idling.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.CHECK HARNESS AND CONNECTOR (THROTTLE CONTROL MOTOR POWER SOURCE)

a. Disconnect the throttle control motor connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for Bank 1

Tester Connection	Switch Condition	Specified Condition
C85-2 (VCR) - Body ground	Ignition switch ON	11 to 14 V

for Bank 2

Tester Connection	Switch Condition	Specified Condition
C86-2 (VCR) - Body ground	Ignition switch ON	11 to 14 V

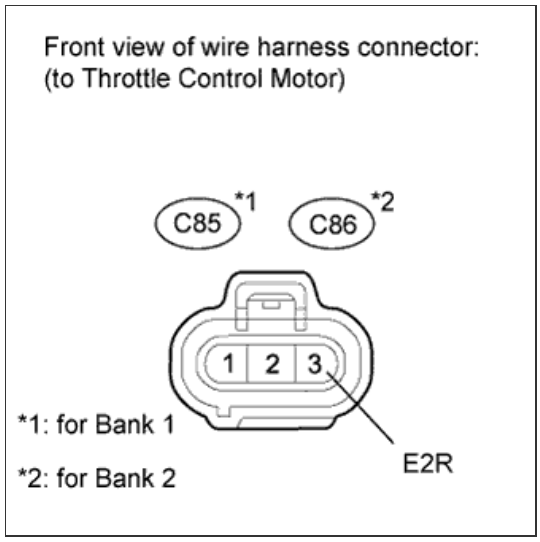
NG → Go to step 7

OK

2.CHECK HARNESS AND CONNECTOR (GROUND CIRCUIT)

a. Disconnect the throttle control motor connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for Bank 1

Tester Connection	Condition	Specified Condition
C85-3 (E2R) - Body ground	Always	Below 1 Ω

for Bank 2

Tester Connection	Condition	Specified Condition
C86-3 (E2R) - Body ground	Always	Below 1 Ω

NG → Go to step 8

OK

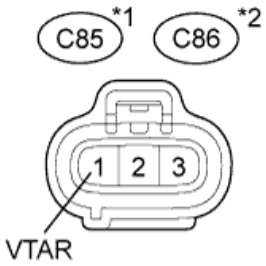
3.CHECK HARNESS AND CONNECTOR (THROTTLE CONTROL MOTOR - ECM)

a. Disconnect the throttle control motor connector.

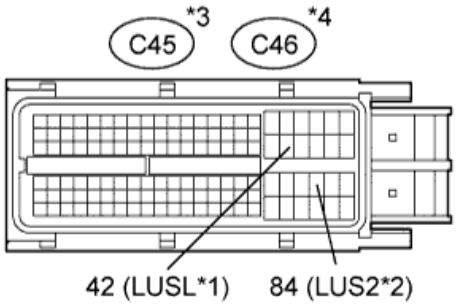
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Throttle Control Motor)



Front view of wire harness connector:
(to ECM)



*1: for Bank 1
*2: for Bank 2
*3: for LHD
*4: for RHD

Standard Resistance (Check for Open):

for Bank 1 (LHD)

Tester Connection	Condition	Specified Condition
C85-1 (VTAR) - C45-42 (LUSL)	Always	Below 1 Ω

for Bank 2 (LHD)

Tester Connection	Condition	Specified Condition
C86-1 (VTAR) - C45-84 (LUS2)	Always	Below 1 Ω

for Bank 1 (RHD)

Tester Connection	Condition	Specified Condition
C85-1 (VTAR) - C46-42 (LUSL)	Always	Below 1 Ω

for Bank 2 (RHD)

Tester Connection	Condition	Specified Condition
C86-1 (VTAR) - C46-84 (LUS2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for Bank 1 (LHD)

Tester Connection	Condition	Specified Condition
C85-1 (VTAR) or C45-42 (LUSL) - Body ground	Always	10 kΩ or higher

for Bank 2 (LHD)

Tester Connection	Condition	Specified Condition
C86-1 (VTAR) or C45-84 (LUS2) - Body ground	Always	10 kΩ or higher

for Bank 1 (RHD)

Tester Connection	Condition	Specified Condition
C85-1 (VTAR) or C46-42 (LUSL) - Body ground	Always	10 kΩ or higher

for Bank 2 (RHD)

Tester Connection	Condition	Specified Condition
C86-1 (VTAR) or C46-84 (LUS2) - Body ground	Always	10 kΩ or higher

NG → Go to step 8

OK

4.REPLACE DIESEL THROTTLE BODY ASSEMBLY (for Bank 1 or Bank 2)

a. Replace the diesel throttle body assembly (for Bank 1 or Bank 2) (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS

a. Clear DTCs (Click here).

b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON and turn the tester on.

d. Start the engine.

e. Over a period of 10 seconds or more, slowly raise the engine speed to 3000 rpm and lower it.

f. Enter the following menus: Powertrain / Engine / DTC.

g. Read the DTCs.

Result

Result	Proceed to
P0488 and/or P213B is output	A
No DTC is output	B

B → Go to step 9

A

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 9

7.REPAIR OR REPLACE HARNESS OR CONNECTOR (THROTTLE CONTROL MOTOR - BATTERY)

NEXT

Go to step 9

8.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

9.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Start the engine.

e. Over a period of 10 seconds or more, slowly raise the engine speed to 3000 rpm and lower it.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P0488 and/or P213B.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, over a period of 10 seconds or more, slowly raise the engine speed to 3000 rpm again and then idle the engine for 5 minutes.

NEXT

END

DTC P0046 Turbocharger / Supercharger Boost Control Solenoid Circuit Range / Performance

DTC P0047 Turbocharger/Supercharger Boost Control "A" Circuit Low

DTC P0048 Turbocharger/Supercharger Boost Control "A" Circuit High

DTC P004B Turbocharger/Supercharger Boost Control Solenoid "B" Circuit Range/Performance

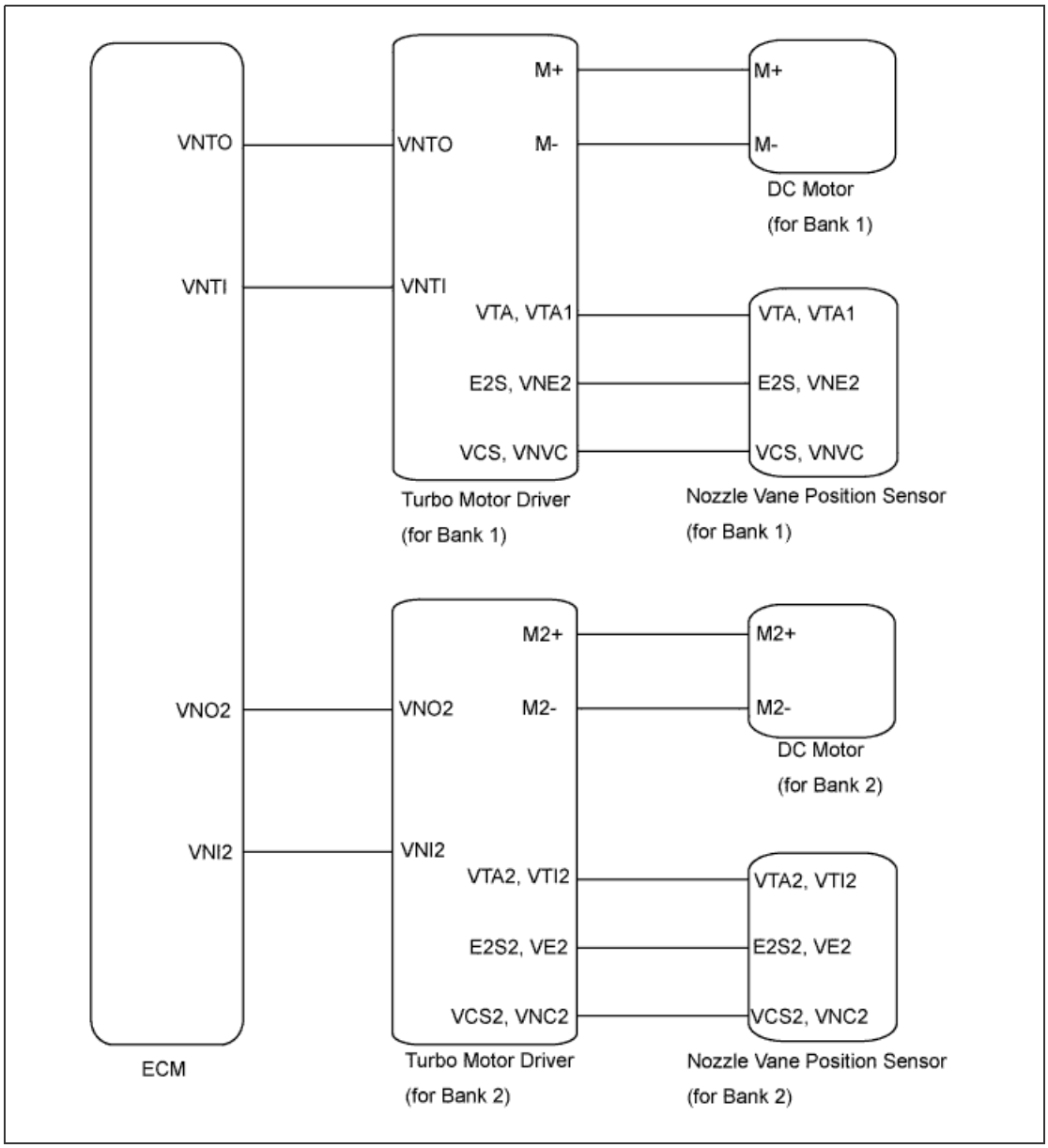
DTC P004C Turbocharger/Supercharger Boost Control Solenoid "B" Circuit Low

DTC P004D Turbocharger/Supercharger Boost Control Solenoid "B" Circuit High

for Preparation Click here

DESCRIPTION

These DTCs indicates that the DC motor of the turbocharger is malfunctioning. The ECM monitors the DC motor current to detect an open or short in the DC motor circuit. If the current meets the criteria, the ECM sets a DTC and illuminates the MIL immediately.
The DC motor is used to operate the nozzle vane of the turbocharger. The nozzle vane opens and closes to change the velocity of exhaust emissions in order to control the turbo pressure. The ECM varies the duty-cycle of the DC motor in accordance with the driving condition.
If the nozzle vane is stuck closed (DC motor stuck off), the drivability may deteriorate at wide open throttle. If the nozzle vane is stuck open (DC motor stuck on), the drivability may deteriorate at intermediate throttle or the engine power may be in sufficient.



P0046, P004B

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area

Ignition switch ON for 5 seconds	Either of the following conditions are met when the motor is driving (1 trip detection logic): • DC motor duty ratio is +/-100% for 1.3 seconds or more. • DC motor current is 2.2 A or more for 5 seconds or more.	• Open or short in DC motor (turbocharger sub-assembly) circuit • Turbo motor driver • DC motor (turbocharger sub-assembly) • Turbocharger nozzle vane is stuck or movement is irregular

P0047, P004C

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	Both of following conditions are met for 1 second or more when the motor is driving (1 trip detection logic): • DC motor duty ratio is 100%. • DC motor current is 0.5 A or less.	• Open in DC motor (turbocharger sub-assembly) circuit • Turbo motor driver • DC Motor (turbocharger sub-assembly) • Turbocharger nozzle vane is stuck or movement is irregular

P0048, P004D

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	DC motor current is 6.5 A or more for 0.5 seconds or more when the motor is operating (1 trip detection logic).	• Short in DC motor (turbocharger sub-assembly) circuit • Turbo motor driver • DC Motor (turbocharger sub-assembly) • Turbocharger nozzle vane is stuck or movement is irregular

HINT:

If DTC P0046, P0047, P0048, P004B, P004C and/or P004D is stored, the following symptoms may appear.

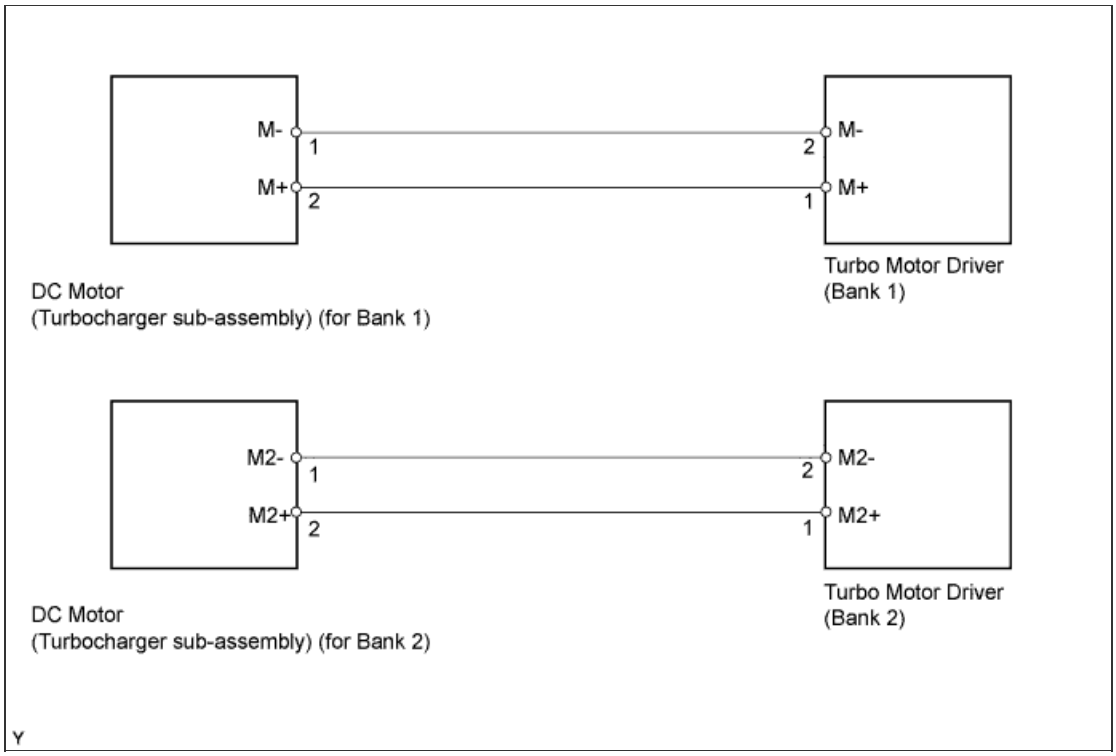
Stuck closed malfunction:

- **Vehicle surge when driving with full load**

Stuck open malfunction:

- **Lack of power**
- **Vehicle surge or hesitation under light or medium load**
- **White smoke**

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.INSPECT TURBO MOTOR DRIVER (for Bank 1 and Bank 2)

a. Remove the rear fender splash shield sub-assembly RH.

b. Remove the front fender liner LH.

c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

HINT:

Record the output DTCs.

g. Clear the DTCs (Click here).

h. Turn the ignition switch off.

i. Interchange the connectors for the turbo motor driver of bank 1 and bank 2.

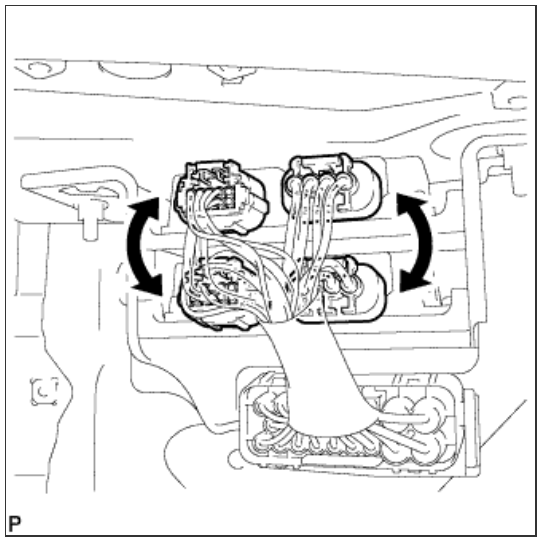
j. Turn the ignition switch to ON for 5 seconds or more.

k. Enter the following menus: Powertrain / Engine / DTC.

l. Read the DTCs.

Result:

Display (DTC Output)	Proceed to
DTCs do not change	A
DTCs change	B
No DTC output	C



B → Go to step

C → Go to step 8

A

2.INSPECT TURBOCHARGER SUB-ASSEMBLY (DC MOTOR) (for Bank 1 or Bank 2)

a. Disconnect the DC motor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

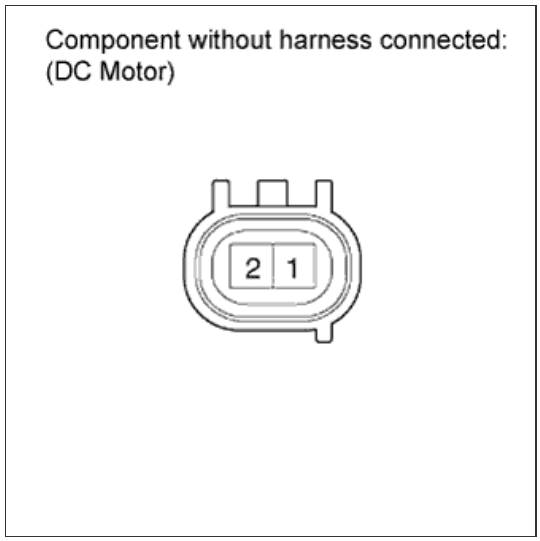
for Bank 1

Tester Connection	Condition	Specified Condition
1 (M-) - 2 (M+)	Always	1 to 100 Ω

Standard Resistance:

for Bank 2

Tester Connection	Condition	Specified Condition
1 (M2-) - 2 (M2+)	Always	1 to 100 Ω



NG → Go to step 4

OK

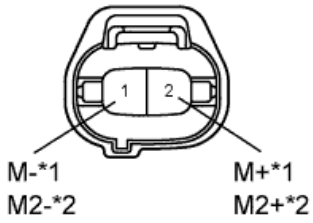
3.CHECK HARNESS AND CONNECTOR (DC MOTOR - TURBO MOTOR DRIVER)

a. Disconnect the DC motor connector.

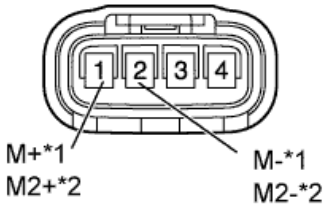
b. Disconnect the turbo motor driver connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to DC Motor)



Front view of wire harness connector:
(to Turbo Motor Driver)



*1: for Bank 1

*2: for Bank 2

Standard Resistance (Check for Open):

for Bank 1

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M-) - Turbo motor driver connector-2 (M-)	Always	Below 1 Ω
DC motor connector-2 (M+) - Turbo motor driver connector-1 (M+)	Always	Below 1 Ω

for Bank 2

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M2-) - Turbo motor driver connector-2 (M2-)	Always	Below 1 Ω
DC motor connector-2 (M2+) - Turbo motor driver connector-1 (M2+)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for Bank 1

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M-) or Turbo motor driver connector-2 (M-) - Body ground	Always	10 kΩ or higher
DC motor connector-2 (M+) or Turbo motor driver connector-1 (M+) - Body ground	Always	10 kΩ or higher

for Bank 2

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M2-) or Turbo motor driver connector-2 (M2-) - Body ground	Always	10 kΩ or higher
DC motor connector-2 (M2+) or Turbo motor driver connector-1 (M2+)	Always	10 kΩ or

- Body ground		higher

OK → Go to step 8

NG → Go to step 6

4.REPLACE TURBOCHARGER SUB-ASSEMBLY (for Bank 1 or Bank 2)

a. Replace turbocharger sub-assembly (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 7

5.REPLACE TURBO MOTOR DRIVER (for Bank 1 or Bank 2)

a. Replace turbo motor driver (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 7

6.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

7.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 5 seconds or more.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

8.INSPECT TURBOCHARGER SUB - ASSEMBLY

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Start the engine and warm up.

d. Move the shift lever to 3rd and accelerate the vehicle with the accelerator fully open.

e. Stop the vehicle

f. Enter the following menus: Powertrain / Engine / DTC.

g. Read the DTCs.

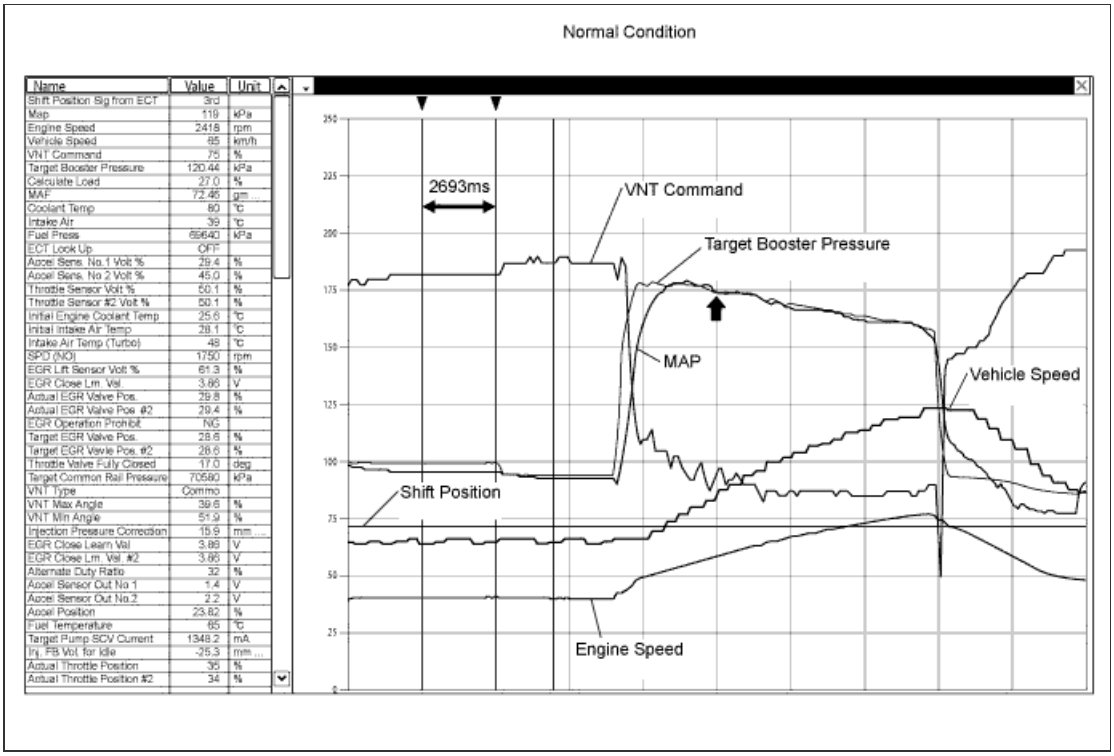
Result:

Display (DTC Output)	Proceed to
DTC P0046, P0047, P0048, P004B, P004C and/or P004D are output	A

No DTC output	B

HINT:

- **A snapshot can be used to compare vehicle data from the time of the malfunction to normal data and is very useful for troubleshooting.**
- **"Target Booster Pressure" and "MAP" in the snapshot can be used to heck the operation of the turbocharger. If "MAP" does not follow "Target Booster Pressure", the turbocharger nozzle vane may be stuck or the movement may be irregular.**
- **When the engine speed is 2500 to 3000 rpm with the accelerator pedal fully depressed, "MAP" is within +/- 10 kPa * of "Target Booster Pressure" (not immediately after beginning of acceleration).**
- *** If the turbocharger pressure does not reach a specified value, it cannot be determined whether the system is normal by checking whether "MAP" is within +/-10 kPa of "Target Booster Pressure"**



HINT:

Compare "MAP" with "Target Booster Pressure" at the point indicated by the arrow (↑) in the illustration.

A	REPLACE TURBOCHARGER SUB - ASSEMBLY

B

CHECK FOR INTERMITTENT PROBLEMS

DTC P0488 Exhaust Gas Recirculation Throttle Position Control Range / Performance

DTC P213B Exhaust Gas Recirculation Throttle Position Control (Range / Performance)

for Preparation Click here

DESCRIPTION

The ECM opens and closes the throttle valve using a rotary solenoid type actuator. Due to the opening and closing of the valve, the exhaust gas recirculation volume can be properly controlled. Also, engine vibration and noise will be reduced by closing the valve when the engine is stopped.

P0488

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Over a period of 10 seconds or more, slowly raise engine speed to 3000 rpm and lower it	The throttle motor activation duty is less than 10% or 90% or more for 30 seconds (1 trip detection logic). **HINT:** The throttle valve commanded duty can be read using the tester as the Data List item Throttle Motor Duty.	• Throttle valve (for Bank 1) stuck • Throttle valve (for Bank 1) does not move smoothly • Open or short in throttle control motor (for Bank 1) circuit • ECM

P213B

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Over a period of 10 seconds or more, slowly raise engine speed to 3000 rpm and lower it	The throttle motor activation duty is less than 10% or 90% or more for 30 seconds (1 trip detection logic). **HINT:** The throttle valve commanded duty can be read using the tester as the Data List item Throttle Motor Duty.	• Throttle valve (for Bank 2) stuck • Throttle valve (for Bank 2) does not move smoothly • Open or short in throttle control motor (for Bank 2) circuit • ECM

Related Data List

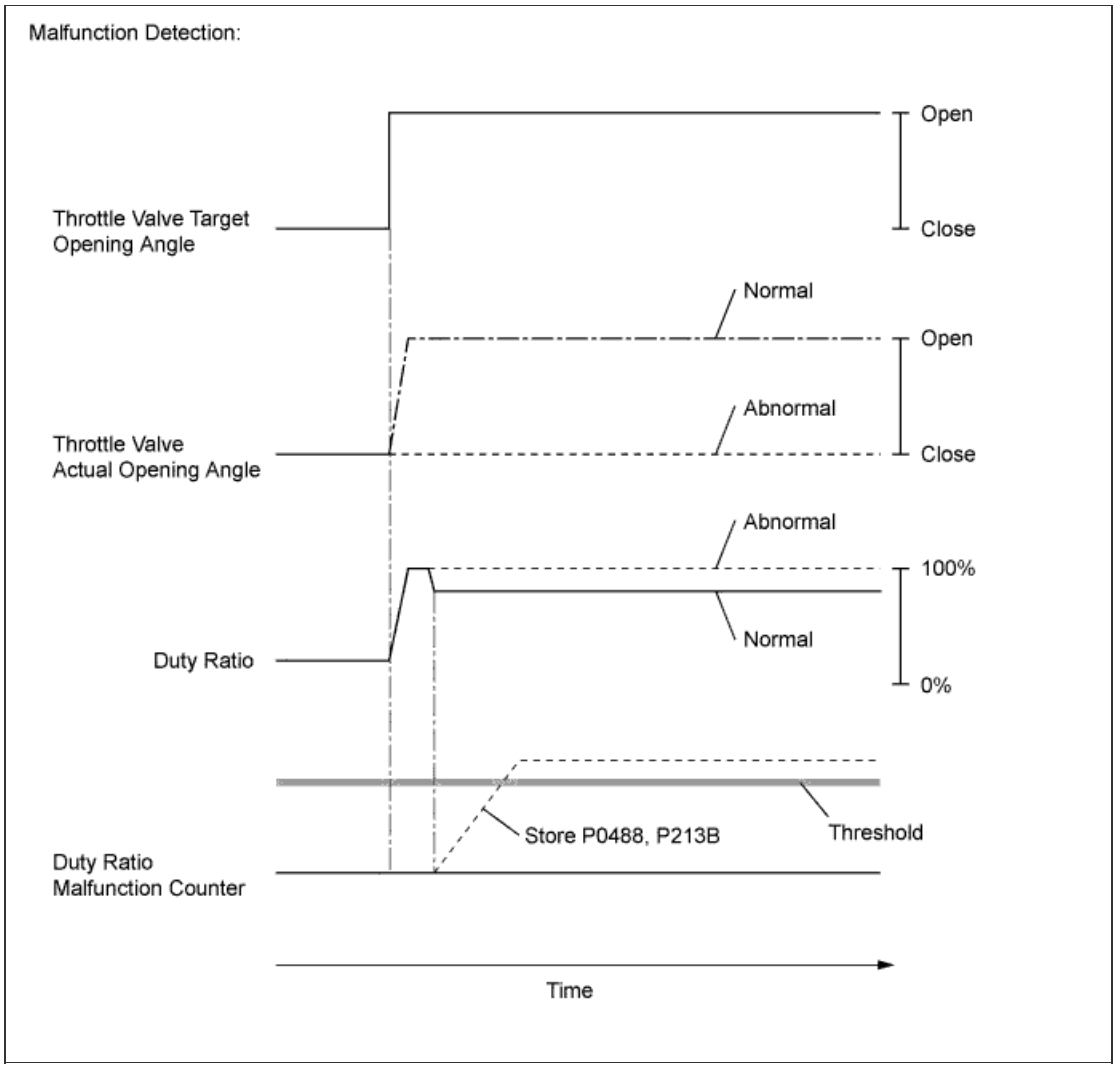
DTC No.	Data List
P0488	• Throttle Motor Duty #1 • Throttle Motor Duty #2 • Actual Throttle Position • Actual Throttle Position #2
P213B	

Reference

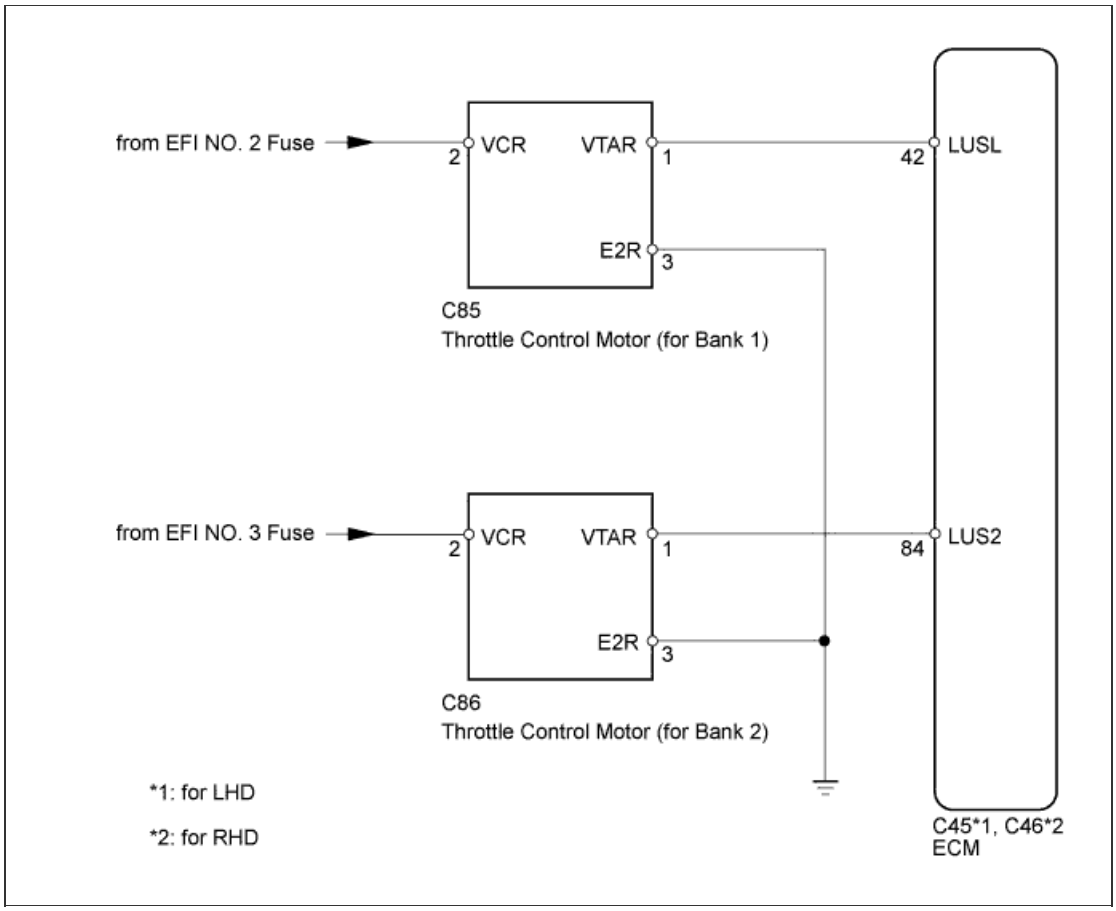
Condition	Throttle Valve Position
Moment when accelerator pedal is depressed further or released at 3000 rpm	Throttle valve opening angle varies smoothly

MONITOR DESCRIPTION

The ECM opens and closes the throttle valve by adjusting the current flowing to the rotary solenoid with a duty ratio. If the throttle valve does not move smoothly or is stuck, the duty ratio used during valve movement control increases or decreases greatly. The ECM will determine that the throttle valve is malfunctioning and illuminate the MIL.



WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

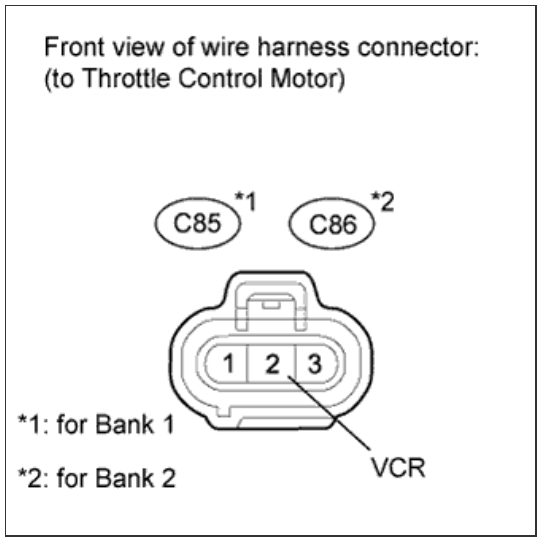
HINT:

- **Although the DTC titles say Exhaust Gas Recirculation Throttle Position Control Range / Performance, these DTCs relate to the throttle valve**
- **After warming up the engine, DTC P0488 and P213B can be stored when 1 second or more passes after quickly accelerating the engine from idling.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.CHECK HARNESS AND CONNECTOR (THROTTLE CONTROL MOTOR POWER SOURCE)

a. Disconnect the throttle control motor connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for Bank 1

Tester Connection	Switch Condition	Specified Condition
C85-2 (VCR) - Body ground	Ignition switch ON	11 to 14 V

for Bank 2

Tester Connection	Switch Condition	Specified Condition
C86-2 (VCR) - Body ground	Ignition switch ON	11 to 14 V

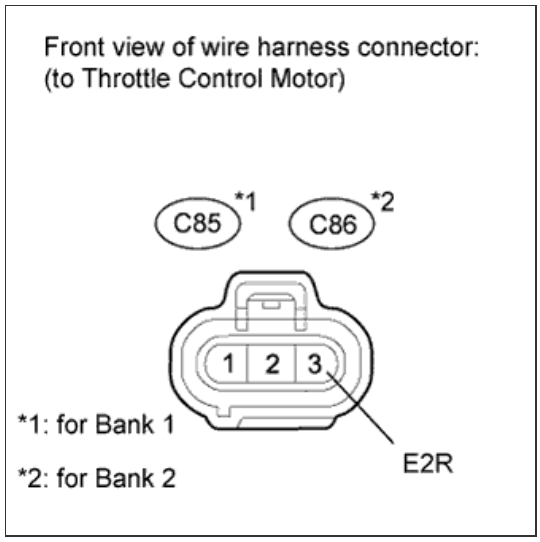
NG → Go to step 7

OK

2.CHECK HARNESS AND CONNECTOR (GROUND CIRCUIT)

a. Disconnect the throttle control motor connector.

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for Bank 1

Tester Connection	Condition	Specified Condition
C85-3 (E2R) - Body ground	Always	Below 1 Ω

for Bank 2

Tester Connection	Condition	Specified Condition
C86-3 (E2R) - Body ground	Always	Below 1 Ω

NG → Go to step 8

OK

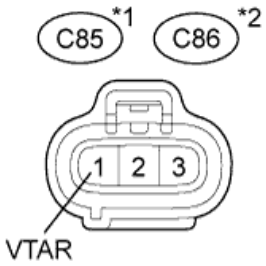
3.CHECK HARNESS AND CONNECTOR (THROTTLE CONTROL MOTOR - ECM)

a. Disconnect the throttle control motor connector.

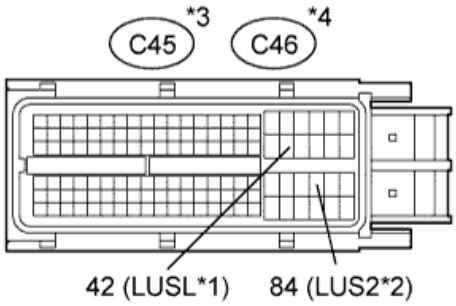
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Throttle Control Motor)



Front view of wire harness connector:
(to ECM)



*1: for Bank 1
*2: for Bank 2
*3: for LHD
*4: for RHD

Standard Resistance (Check for Open):

for Bank 1 (LHD)

Tester Connection	Condition	Specified Condition
C85-1 (VTAR) - C45-42 (LUSL)	Always	Below 1 Ω

for Bank 2 (LHD)

Tester Connection	Condition	Specified Condition
C86-1 (VTAR) - C45-84 (LUS2)	Always	Below 1 Ω

for Bank 1 (RHD)

Tester Connection	Condition	Specified Condition
C85-1 (VTAR) - C46-42 (LUSL)	Always	Below 1 Ω

for Bank 2 (RHD)

Tester Connection	Condition	Specified Condition
C86-1 (VTAR) - C46-84 (LUS2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for Bank 1 (LHD)

Tester Connection	Condition	Specified Condition
C85-1 (VTAR) or C45-42 (LUSL) - Body ground	Always	10 kΩ or higher

for Bank 2 (LHD)

Tester Connection	Condition	Specified Condition
C86-1 (VTAR) or C45-84 (LUS2) - Body ground	Always	10 kΩ or higher

for Bank 1 (RHD)

Tester Connection	Condition	Specified Condition
C85-1 (VTAR) or C46-42 (LUSL) - Body ground	Always	10 kΩ or higher

for Bank 2 (RHD)

Tester Connection	Condition	Specified Condition
C86-1 (VTAR) or C46-84 (LUS2) - Body ground	Always	10 kΩ or higher

NG → Go to step 8

OK

4.REPLACE DIESEL THROTTLE BODY ASSEMBLY (for Bank 1 or Bank 2)

a. Replace the diesel throttle body assembly (for Bank 1 or Bank 2) (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS

a. Clear DTCs (Click here).

b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON and turn the tester on.

d. Start the engine.

e. Over a period of 10 seconds or more, slowly raise the engine speed to 3000 rpm and lower it.

f. Enter the following menus: Powertrain / Engine / DTC.

g. Read the DTCs.

Result

Result	Proceed to
P0488 and/or P213B is output	A
No DTC is output	B

B → Go to step 9

A

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 9

7.REPAIR OR REPLACE HARNESS OR CONNECTOR (THROTTLE CONTROL MOTOR - BATTERY)

NEXT

Go to step 9

8.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

9.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Start the engine.

e. Over a period of 10 seconds or more, slowly raise the engine speed to 3000 rpm and lower it.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P0488 and/or P213B.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, over a period of 10 seconds or more, slowly raise the engine speed to 3000 rpm again and then idle the engine for 5 minutes.

NEXT

END

DTC P0046 Turbocharger / Supercharger Boost Control Solenoid Circuit Range / Performance

DTC P0047 Turbocharger/Supercharger Boost Control "A" Circuit Low

DTC P0048 Turbocharger/Supercharger Boost Control "A" Circuit High

DTC P004B Turbocharger/Supercharger Boost Control Solenoid "B" Circuit Range/Performance

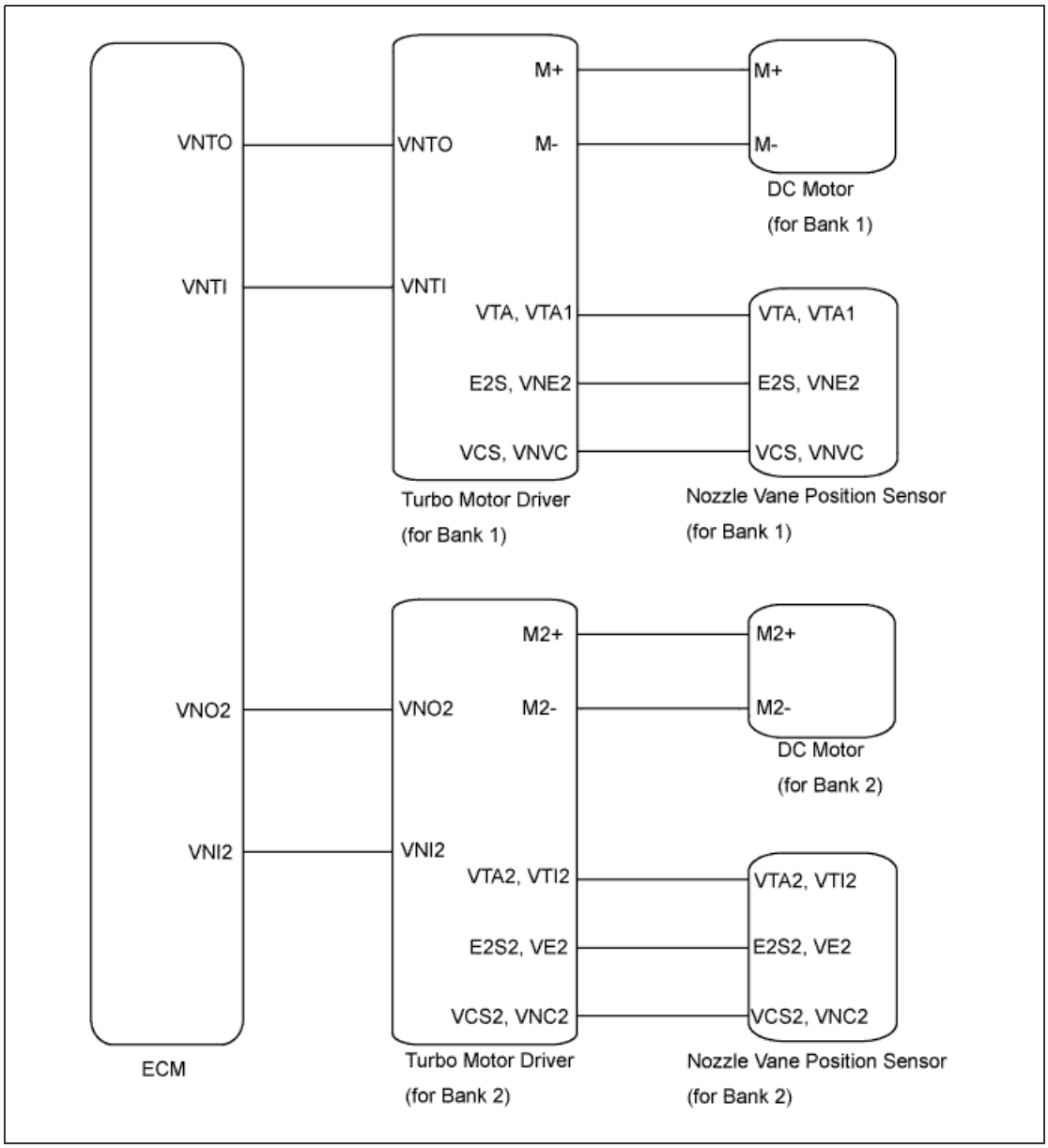
DTC P004C Turbocharger/Supercharger Boost Control Solenoid "B" Circuit Low

DTC P004D Turbocharger/Supercharger Boost Control Solenoid "B" Circuit High

for Preparation Click here

DESCRIPTION

These DTCs indicates that the DC motor of the turbocharger is malfunctioning. The ECM monitors the DC motor current to detect an open or short in the DC motor circuit. If the current meets the criteria, the ECM sets a DTC and illuminates the MIL immediately.
The DC motor is used to operate the nozzle vane of the turbocharger. The nozzle vane opens and closes to change the velocity of exhaust emissions in order to control the turbo pressure. The ECM varies the duty-cycle of the DC motor in accordance with the driving condition.
If the nozzle vane is stuck closed (DC motor stuck off), the drivability may deteriorate at wide open throttle. If the nozzle vane is stuck open (DC motor stuck on), the drivability may deteriorate at intermediate throttle or the engine power may be in sufficient.



P0046, P004B

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area

Ignition switch ON for 5 seconds	Either of the following conditions are met when the motor is driving (1 trip detection logic): • DC motor duty ratio is +/-100% for 1.3 seconds or more. • DC motor current is 2.2 A or more for 5 seconds or more.	• Open or short in DC motor (turbocharger sub-assembly) circuit • Turbo motor driver • DC motor (turbocharger sub-assembly) • Turbocharger nozzle vane is stuck or movement is irregular

P0047, P004C

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	Both of following conditions are met for 1 second or more when the motor is driving (1 trip detection logic): • DC motor duty ratio is 100%. • DC motor current is 0.5 A or less.	• Open in DC motor (turbocharger sub-assembly) circuit • Turbo motor driver • DC Motor (turbocharger sub-assembly) • Turbocharger nozzle vane is stuck or movement is irregular

P0048, P004D

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	DC motor current is 6.5 A or more for 0.5 seconds or more when the motor is operating (1 trip detection logic).	• Short in DC motor (turbocharger sub-assembly) circuit • Turbo motor driver • DC Motor (turbocharger sub-assembly) • Turbocharger nozzle vane is stuck or movement is irregular

HINT:

If DTC P0046, P0047, P0048, P004B, P004C and/or P004D is stored, the following symptoms may appear.

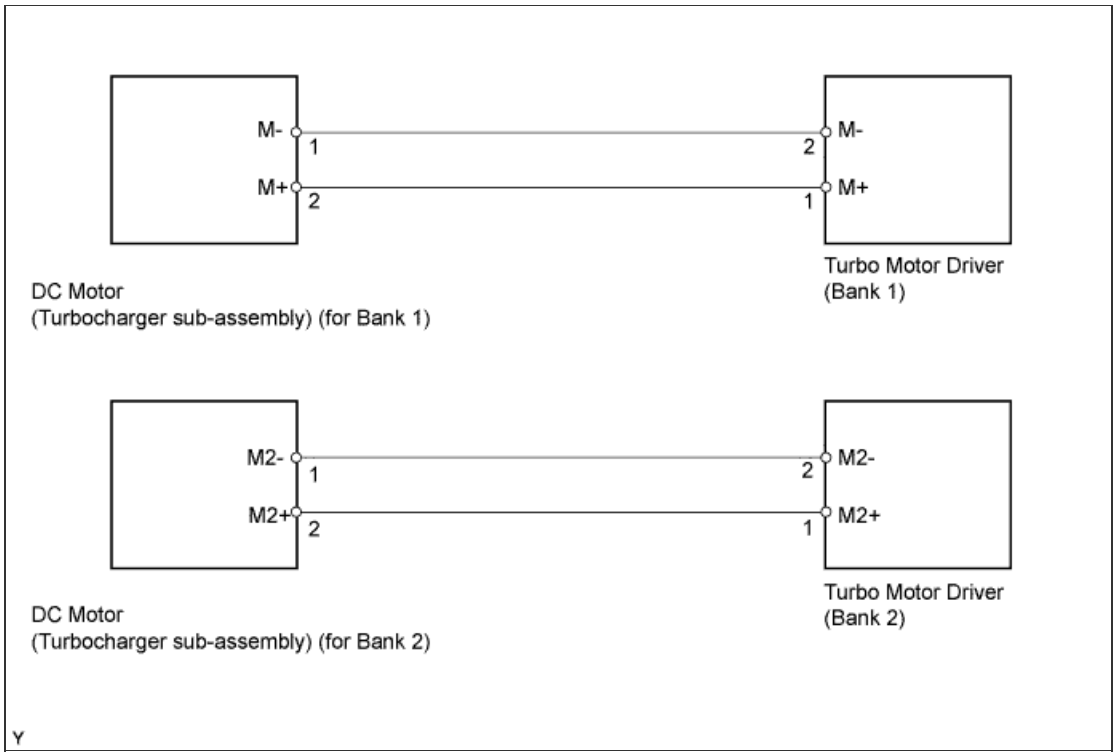
Stuck closed malfunction:

- **Vehicle surge when driving with full load**

Stuck open malfunction:

- **Lack of power**
- **Vehicle surge or hesitation under light or medium load**
- **White smoke**

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.INSPECT TURBO MOTOR DRIVER (for Bank 1 and Bank 2)

a. Remove the rear fender splash shield sub-assembly RH.

b. Remove the front fender liner LH.

c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

HINT:

Record the output DTCs.

g. Clear the DTCs (Click here).

h. Turn the ignition switch off.

i. Interchange the connectors for the turbo motor driver of bank 1 and bank 2.

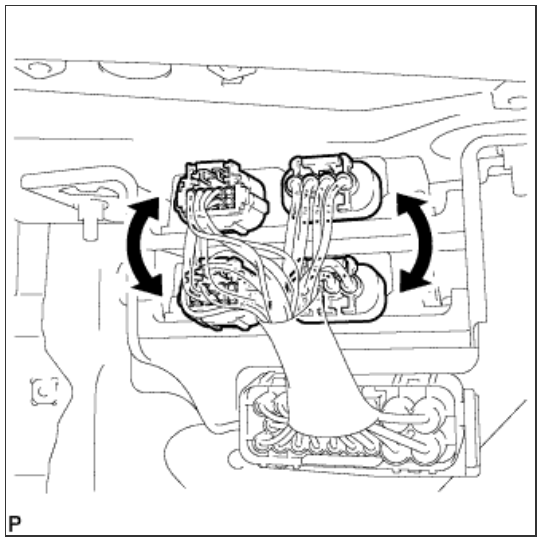
j. Turn the ignition switch to ON for 5 seconds or more.

k. Enter the following menus: Powertrain / Engine / DTC.

l. Read the DTCs.

Result:

Display (DTC Output)	Proceed to
DTCs do not change	A
DTCs change	B
No DTC output	C



B → Go to step

C → Go to step 8

A

2.INSPECT TURBOCHARGER SUB-ASSEMBLY (DC MOTOR) (for Bank 1 or Bank 2)

a. Disconnect the DC motor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

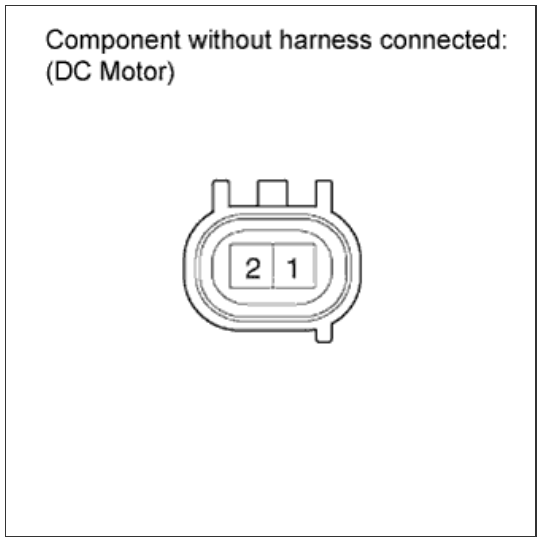
for Bank 1

Tester Connection	Condition	Specified Condition
1 (M-) - 2 (M+)	Always	1 to 100 Ω

Standard Resistance:

for Bank 2

Tester Connection	Condition	Specified Condition
1 (M2-) - 2 (M2+)	Always	1 to 100 Ω



NG → Go to step 4

OK

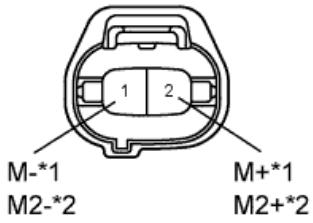
3.CHECK HARNESS AND CONNECTOR (DC MOTOR - TURBO MOTOR DRIVER)

a. Disconnect the DC motor connector.

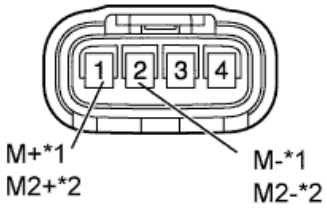
b. Disconnect the turbo motor driver connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to DC Motor)



Front view of wire harness connector:
(to Turbo Motor Driver)



*1: for Bank 1

*2: for Bank 2

Standard Resistance (Check for Open):

for Bank 1

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M-) - Turbo motor driver connector-2 (M-)	Always	Below 1 Ω
DC motor connector-2 (M+) - Turbo motor driver connector-1 (M+)	Always	Below 1 Ω

for Bank 2

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M2-) - Turbo motor driver connector-2 (M2-)	Always	Below 1 Ω
DC motor connector-2 (M2+) - Turbo motor driver connector-1 (M2+)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for Bank 1

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M-) or Turbo motor driver connector-2 (M-) - Body ground	Always	10 kΩ or higher
DC motor connector-2 (M+) or Turbo motor driver connector-1 (M+) - Body ground	Always	10 kΩ or higher

for Bank 2

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M2-) or Turbo motor driver connector-2 (M2-) - Body ground	Always	10 kΩ or higher
DC motor connector-2 (M2+) or Turbo motor driver connector-1 (M2+)	Always	10 kΩ or

- Body ground		higher

OK → Go to step 8

NG → Go to step 6

4.REPLACE TURBOCHARGER SUB-ASSEMBLY (for Bank 1 or Bank 2)

a. Replace turbocharger sub-assembly (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 7

5.REPLACE TURBO MOTOR DRIVER (for Bank 1 or Bank 2)

a. Replace turbo motor driver (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 7

6.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

7.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 5 seconds or more.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

8.INSPECT TURBOCHARGER SUB - ASSEMBLY

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Start the engine and warm up.

d. Move the shift lever to 3rd and accelerate the vehicle with the accelerator fully open.

e. Stop the vehicle

f. Enter the following menus: Powertrain / Engine / DTC.

g. Read the DTCs.

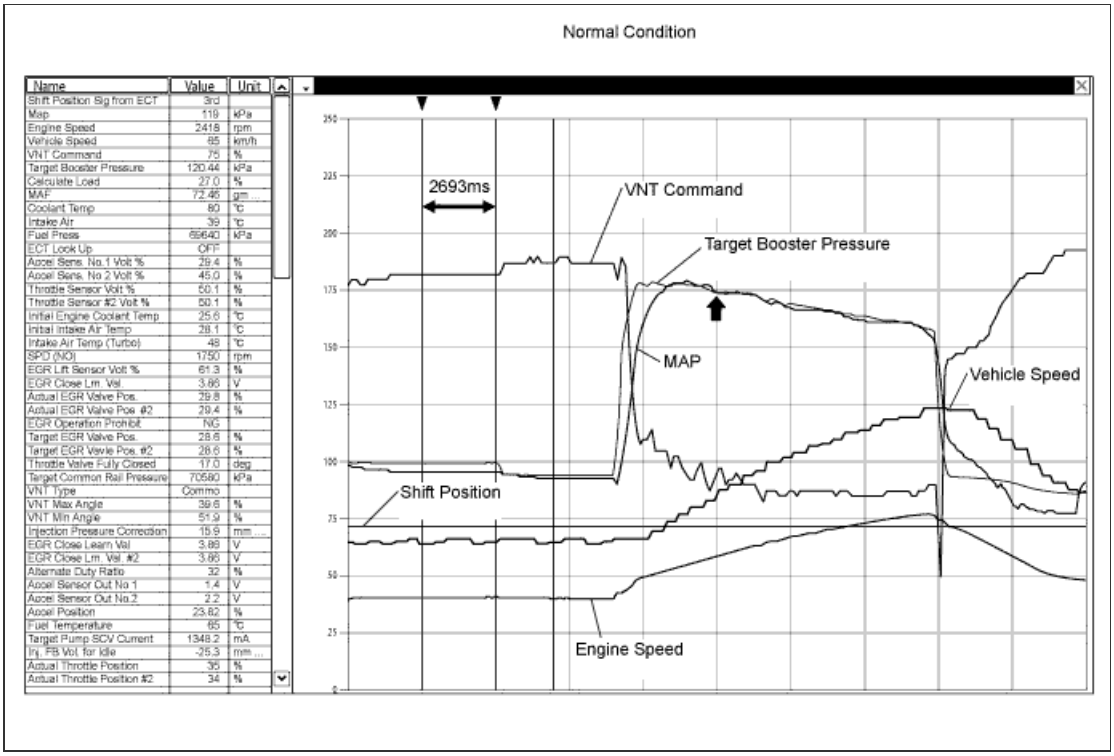
Result:

Display (DTC Output)	Proceed to
DTC P0046, P0047, P0048, P004B, P004C and/or P004D are output	A

No DTC output	B

HINT:

- **A snapshot can be used to compare vehicle data from the time of the malfunction to normal data and is very useful for troubleshooting.**
- **"Target Booster Pressure" and "MAP" in the snapshot can be used to heck the operation of the turbocharger. If "MAP" does not follow "Target Booster Pressure", the turbocharger nozzle vane may be stuck or the movement may be irregular.**
- **When the engine speed is 2500 to 3000 rpm with the accelerator pedal fully depressed, "MAP" is within +/- 10 kPa * of "Target Booster Pressure" (not immediately after beginning of acceleration).**
- *** If the turbocharger pressure does not reach a specified value, it cannot be determined whether the system is normal by checking whether "MAP" is within +/-10 kPa of "Target Booster Pressure"**



HINT:

Compare "MAP" with "Target Booster Pressure" at the point indicated by the arrow (↑) in the illustration.

A	REPLACE TURBOCHARGER SUB - ASSEMBLY

B

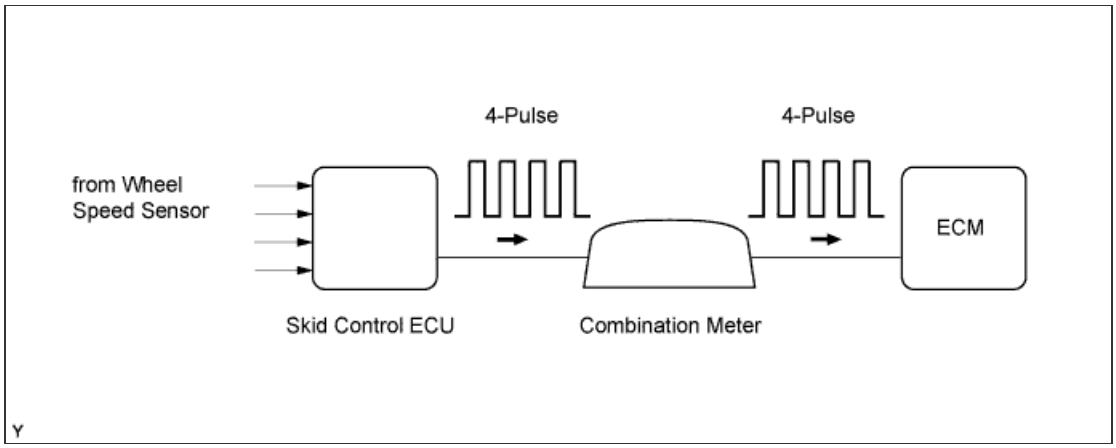
CHECK FOR INTERMITTENT PROBLEMS

DTC P0500 Vehicle Speed Sensor "A"

for Preparation Click here

DESCRIPTION

Vehicles which are equipped with a manual transmission detect the vehicle speed using the speed sensor. The speed sensor transmits a 4-pulse signal for every revolution of the rotor shaft, which is rotated by the transmission output shaft via the driven gear. The 4-pulse signal is converted into a more precise rectangular waveform by the waveform shaping circuit inside the combination meter. The signal is then transmitted to the ECM. The ECM determines the vehicle speed based on the frequency of the pulse signal.



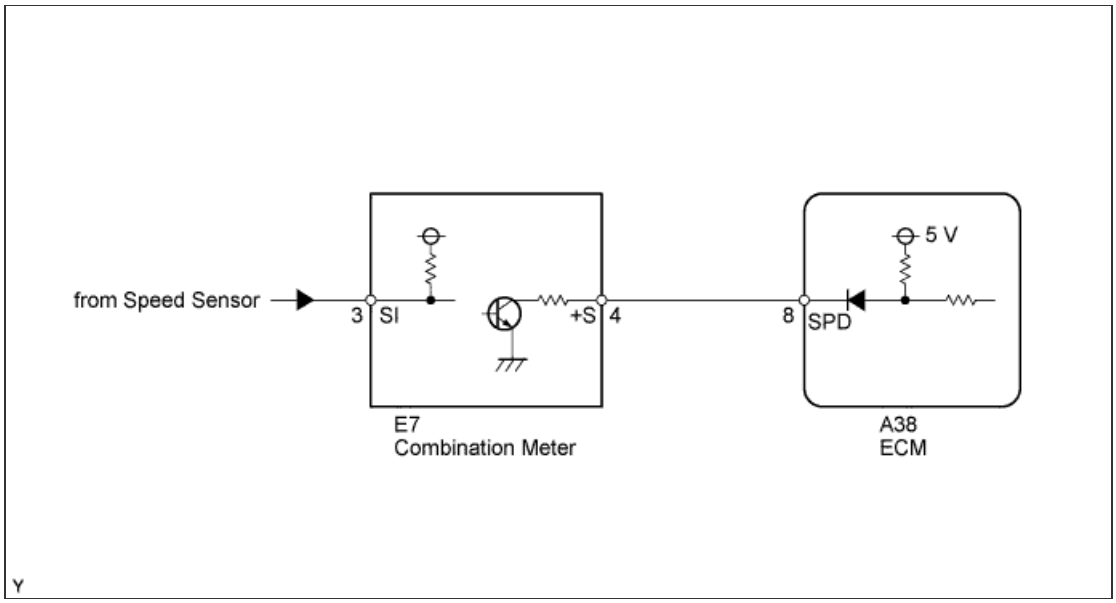
P0500

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Vehicle being driven	Conditions (a), (b), (c) and (d) are met for 8 seconds or more (2 trip detection logic): (a) Engine coolant temperature is more than 70°C (158°F). (b) Engine speed is between 1500 and 4000 rpm. (c) Vehicle is running. (d) No speed signal is input to the ECM.	• Open or short in speedometer circuit • Speedometer assembly • ECM
Drive vehicle during fuel-cut operation	Conditions (a), (b) and (c) are met for 5 seconds or more (2 trip detection logic): (a) Vehicle is running. (b) During the fuel-cut operation. (c) No speed signal is input to the ECM.	

Related Data List

DTC No.	Data List
P0500	Vehicle Speed

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.CHECK OPERATION OF SPEEDOMETER

a. Drive the vehicle and check whether the operation of the speedometer in the combination meter is normal.

HINT:

The vehicle speed sensor is operating normally if the speedometer reading is normal.

If the speedometer does not operate, check it by following the procedure described in Speedometer Malfunction.

NG → GO TO SPEEDOMETER MALFUNCTION (Click here)

OK

2.READ VALUE USING INTELLIGENT TESTER (VEHICLE SPEED)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and start the engine.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine / Data List / All Data / Vehicle Speed.

e. Drive the vehicle.

f. Read the value displayed on the tester.

OK:

Vehicle speeds displayed on tester and speedometer display are equal.

OK → CHECK FOR INTERMITTENT PROBLEMS (Click here)

NG → Go to step 3

3.CHECK HARNESS AND CONNECTOR (COMBINATION METER ASSEMBLY - ECM)

a. Disconnect the combination meter connector.

b. Disconnect the ECM connector.

c. Measure the resistance according the value(s) in the table below.

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
E7-4 (+S) - A38-8 (SPD)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
E7-4 (+S) - A52-8 (SPD)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
E7-4 (+S) or A38-8 (SPD) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
E7-4 (+S) or A52-8 (SPD) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (OTHER SYSTEMS RELATED TO SPEED SIGNAL)

OK

4.CHECK COMBINATION METER ASSEMBLY (S VOLTAGE)

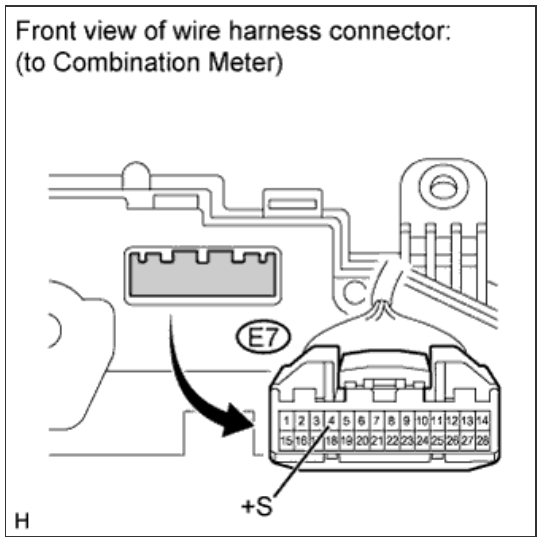
a. Disconnect the combination meter connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Volta e

Tester Connection	Switch Condition	Specified Condition
E7-4 (+S) - Body ground	Ignition switch ON	4.5 to 5.5 V

c. Reconnect the combination meter connector.



NG → REPLACE ECM (Click here)

OK

5.CHECK COMBINATION METER ASSEMBLY (SPD SIGNAL OUTPUT WAVEFORM)

a. Remove the combination meter.

b. Connect the combination meter connector.

c. Move the shift lever to N.

d. Jack up the vehicle.

e. Check the voltage between the terminal of the combination meter and the body ground while a wheel is turned slowly.

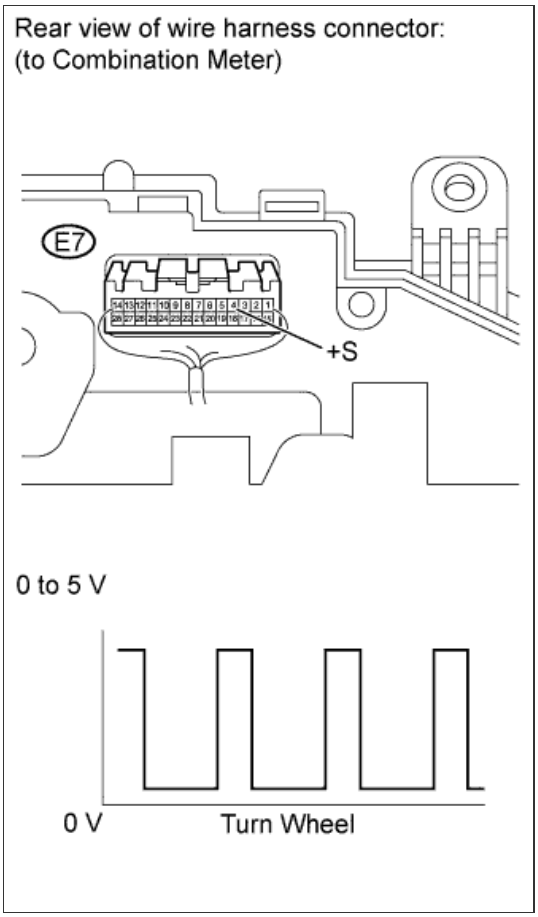
Standard Volta e

Tester Connection	Switch Condition	Specified Condition
E7-4 (+S) - Body ground	Ignition switch ON	Voltage generated intermittently

HINT:

The output voltage should fluctuate up and down, similarly to the diagram, when the wheel is turned slowly.

f. Reinstall the combination meter.



OK	REPLACE ECM (Click here)
NG	Go to step 6

6.CHECK COMBINATION METER ASSEMBLY (SPD SIGNAL INPUT WAVEFORM)

a. Remove the combination meter.

b. Connect the combination meter connector.

c. Move the shift lever to N.

d. Jack up the vehicle.

e. Check the voltage between the terminal of the combination meter and the body ground while a wheel is turned slowly.

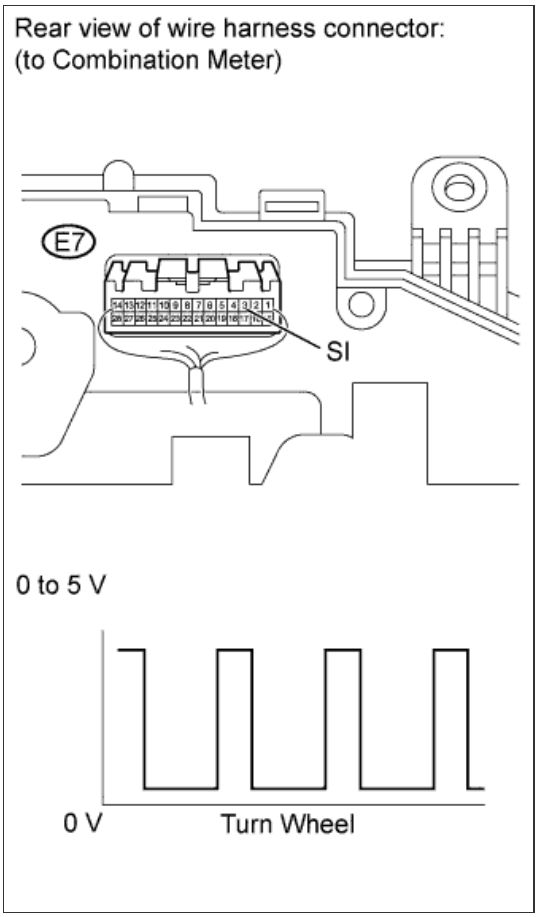
Standard Volta e:

Tester Connection	Switch Condition	Specified Condition
E7-4 (SI) - Body ground	Ignition switch ON	Voltage generated intermittently

HINT:

The output voltage should fluctuate up and down, similarly to the diagram, when the wheel is turned slowly.

f. Reinstall the combination meter.



Result

Test result	Proceed to
OK (w/ Multi-information Display)	A
OK (w/o Multi-information Display)	B
NG	C

A	REPLACE COMBINATION METER ASSEMBLY (Multi-information Display) (Click here)
B	REPLACE COMBINATION METER ASSEMBLY (o Multi-information Display) (Click here)
C	Go to step

.CHECK HARNESS AND CONNECTOR (COMBINATION METER - BRAKE ACTUATOR)

a. Disconnect the combination meter connector.

b. Disconnect the brake actuator connector.

c. Measure the resistance according the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
E7-3 (SI) - A24-12 (SP1)	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
E7-3 (SI) or A24-12 (SP1) - Body ground	Always	10 kΩ or higher

d. Reconnect the combination meter connector.

e. Reconnect the brake actuator connector.

NG	REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE BRAKE ACTUATOR

DTC P0046 Turbocharger / Supercharger Boost Control Solenoid Circuit Range / Performance

DTC P0047 Turbocharger/Supercharger Boost Control "A" Circuit Low

DTC P0048 Turbocharger/Supercharger Boost Control "A" Circuit High

DTC P004B Turbocharger/Supercharger Boost Control Solenoid "B" Circuit Range/Performance

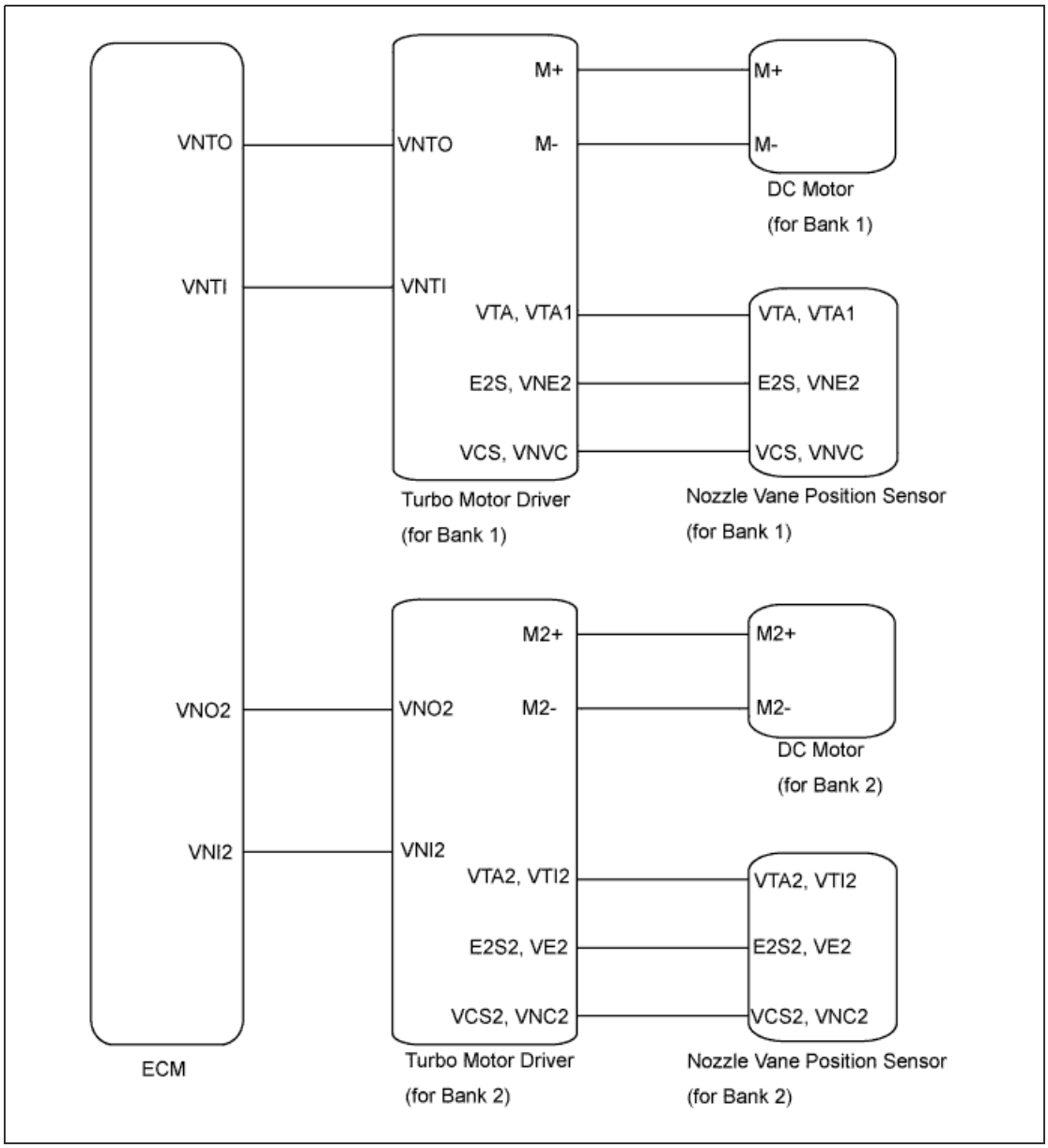
DTC P004C Turbocharger/Supercharger Boost Control Solenoid "B" Circuit Low

DTC P004D Turbocharger/Supercharger Boost Control Solenoid "B" Circuit High

for Preparation Click here

DESCRIPTION

These DTCs indicates that the DC motor of the turbocharger is malfunctioning. The ECM monitors the DC motor current to detect an open or short in the DC motor circuit. If the current meets the criteria, the ECM sets a DTC and illuminates the MIL immediately.
The DC motor is used to operate the nozzle vane of the turbocharger. The nozzle vane opens and closes to change the velocity of exhaust emissions in order to control the turbo pressure. The ECM varies the duty-cycle of the DC motor in accordance with the driving condition.
If the nozzle vane is stuck closed (DC motor stuck off), the drivability may deteriorate at wide open throttle. If the nozzle vane is stuck open (DC motor stuck on), the drivability may deteriorate at intermediate throttle or the engine power may be in sufficient.



P0046, P004B

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area

Ignition switch ON for 5 seconds	Either of the following conditions are met when the motor is driving (1 trip detection logic): • DC motor duty ratio is +/-100% for 1.3 seconds or more. • DC motor current is 2.2 A or more for 5 seconds or more.	• Open or short in DC motor (turbocharger sub-assembly) circuit • Turbo motor driver • DC motor (turbocharger sub-assembly) • Turbocharger nozzle vane is stuck or movement is irregular

P0047, P004C

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	Both of following conditions are met for 1 second or more when the motor is driving (1 trip detection logic): • DC motor duty ratio is 100%. • DC motor current is 0.5 A or less.	• Open in DC motor (turbocharger sub-assembly) circuit • Turbo motor driver • DC Motor (turbocharger sub-assembly) • Turbocharger nozzle vane is stuck or movement is irregular

P0048, P004D

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	DC motor current is 6.5 A or more for 0.5 seconds or more when the motor is operating (1 trip detection logic).	• Short in DC motor (turbocharger sub-assembly) circuit • Turbo motor driver • DC Motor (turbocharger sub-assembly) • Turbocharger nozzle vane is stuck or movement is irregular

HINT:

If DTC P0046, P0047, P0048, P004B, P004C and/or P004D is stored, the following symptoms may appear.

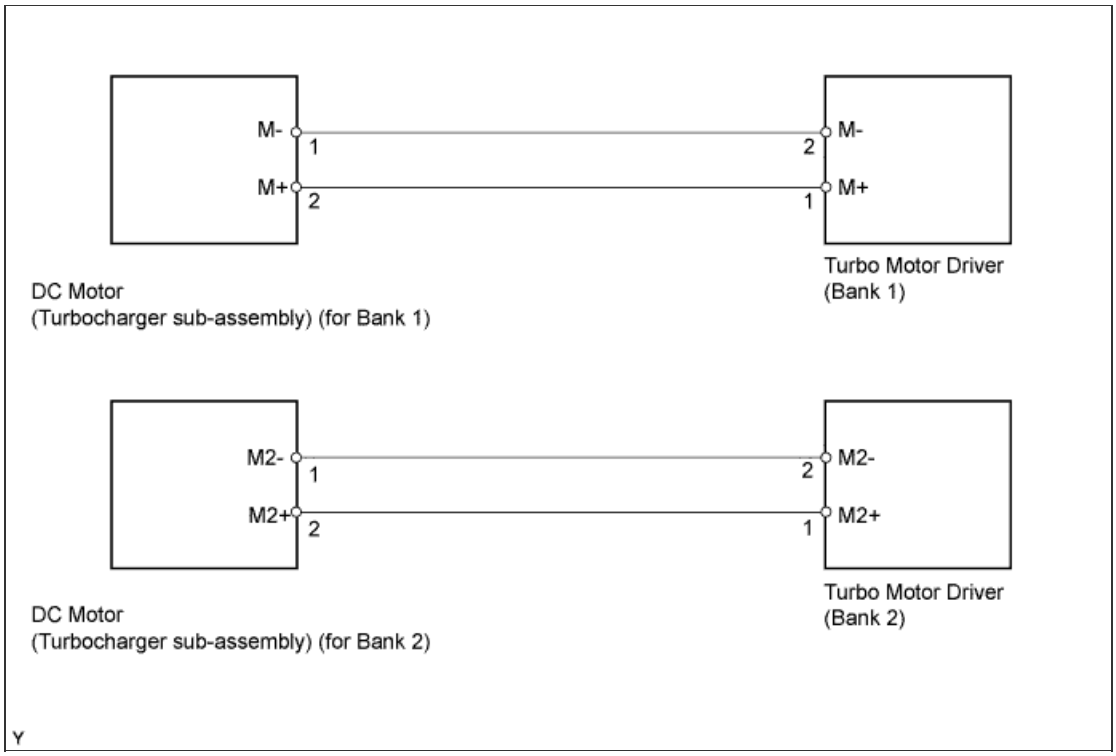
Stuck closed malfunction:

- **Vehicle surge when driving with full load**

Stuck open malfunction:

- **Lack of power**
- **Vehicle surge or hesitation under light or medium load**
- **White smoke**

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.INSPECT TURBO MOTOR DRIVER (for Bank 1 and Bank 2)

a. Remove the rear fender splash shield sub-assembly RH.

b. Remove the front fender liner LH.

c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

HINT:

Record the output DTCs.

g. Clear the DTCs (Click here).

h. Turn the ignition switch off.

i. Interchange the connectors for the turbo motor driver of bank 1 and bank 2.

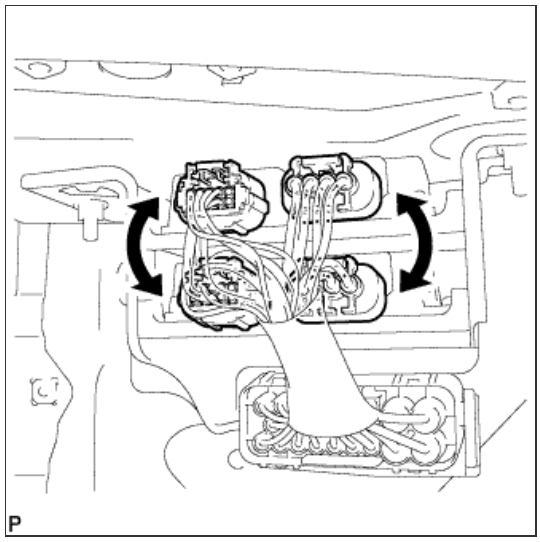
j. Turn the ignition switch to ON for 5 seconds or more.

k. Enter the following menus: Powertrain / Engine / DTC.

l. Read the DTCs.

Result:

Display (DTC Output)	Proceed to
DTCs do not change	A
DTCs change	B
No DTC output	C



B	Go to step 5
C	Go to step 8

A

2.INSPECT TURBOCHARGER SUB-ASSEMBLY (DC MOTOR) (for Bank 1 or Bank 2)

a. Disconnect the DC motor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

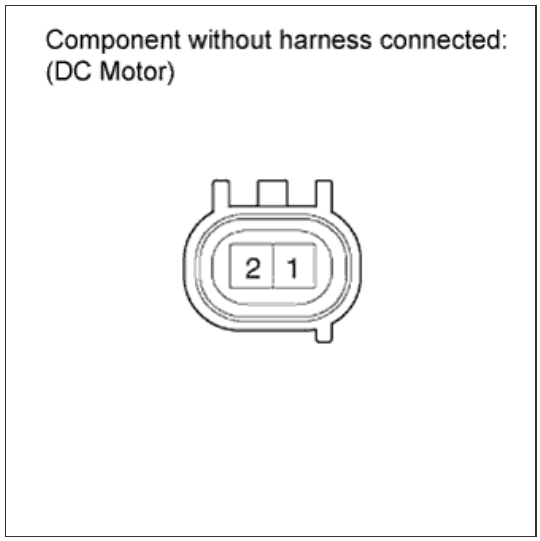
for Bank 1

Tester Connection	Condition	Specified Condition
1 (M-) - 2 (M+)	Always	1 to 100 Ω

Standard Resistance:

for Bank 2

Tester Connection	Condition	Specified Condition
1 (M2-) - 2 (M2+)	Always	1 to 100 Ω



NG	Go to step 4

OK

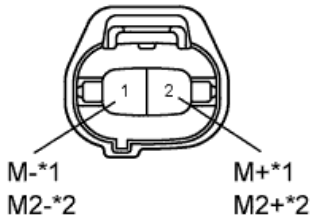
3.CHECK HARNESS AND CONNECTOR (DC MOTOR - TURBO MOTOR DRIVER)

a. Disconnect the DC motor connector.

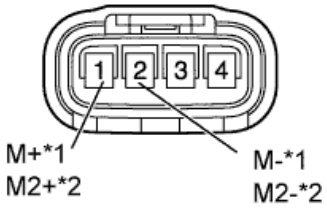
b. Disconnect the turbo motor driver connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to DC Motor)



Front view of wire harness connector:
(to Turbo Motor Driver)



*1: for Bank 1

*2: for Bank 2

Standard Resistance (Check for Open):

for Bank 1

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M-) - Turbo motor driver connector-2 (M-)	Always	Below 1 Ω
DC motor connector-2 (M+) - Turbo motor driver connector-1 (M+)	Always	Below 1 Ω

for Bank 2

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M2-) - Turbo motor driver connector-2 (M2-)	Always	Below 1 Ω
DC motor connector-2 (M2+) - Turbo motor driver connector-1 (M2+)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for Bank 1

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M-) or Turbo motor driver connector-2 (M-) - Body ground	Always	10 kΩ or higher
DC motor connector-2 (M+) or Turbo motor driver connector-1 (M+) - Body ground	Always	10 kΩ or higher

for Bank 2

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M2-) or Turbo motor driver connector-2 (M2-) - Body ground	Always	10 kΩ or higher
DC motor connector-2 (M2+) or Turbo motor driver connector-1 (M2+)	Always	10 kΩ or

- Body ground		higher

OK → Go to step 8

NG → Go to step 6

4.REPLACE TURBOCHARGER SUB-ASSEMBLY (for Bank 1 or Bank 2)

a. Replace turbocharger sub-assembly (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 7

5.REPLACE TURBO MOTOR DRIVER (for Bank 1 or Bank 2)

a. Replace turbo motor driver (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 7

6.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

7.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 5 seconds or more.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

8.INSPECT TURBOCHARGER SUB - ASSEMBLY

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Start the engine and warm up.

d. Move the shift lever to 3rd and accelerate the vehicle with the accelerator fully open.

e. Stop the vehicle

f. Enter the following menus: Powertrain / Engine / DTC.

g. Read the DTCs.

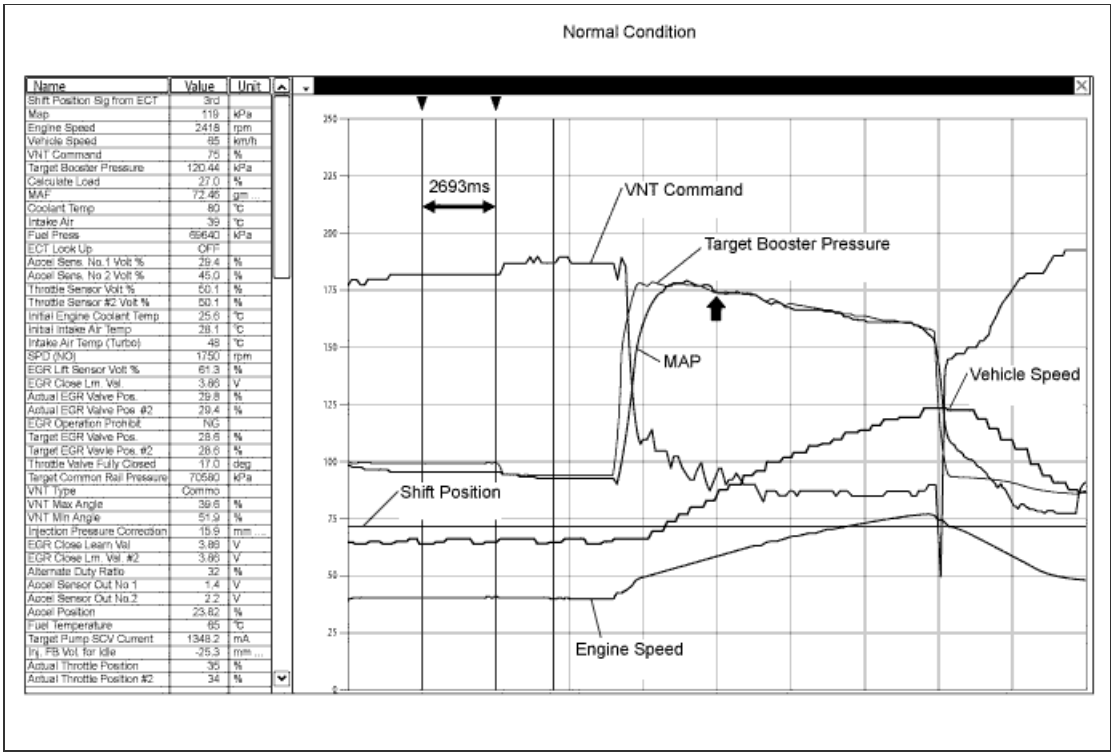
Result:

Display (DTC Output)	Proceed to
DTC P0046, P0047, P0048, P004B, P004C and/or P004D are output	A

No DTC output	B

HINT:

- **A snapshot can be used to compare vehicle data from the time of the malfunction to normal data and is very useful for troubleshooting.**
- **"Target Booster Pressure" and "MAP" in the snapshot can be used to heck the operation of the turbocharger. If "MAP" does not follow "Target Booster Pressure", the turbocharger nozzle vane may be stuck or the movement may be irregular.**
- **When the engine speed is 2500 to 3000 rpm with the accelerator pedal fully depressed, "MAP" is within +/- 10 kPa * of "Target Booster Pressure" (not immediately after beginning of acceleration).**
- *** If the turbocharger pressure does not reach a specified value, it cannot be determined whether the system is normal by checking whether "MAP" is within +/-10 kPa of "Target Booster Pressure"**



HINT:

Compare "MAP" with "Target Booster Pressure" at the point indicated by the arrow (↑) in the illustration.

A	REPLACE TURBOCHARGER SUB - ASSEMBLY

B

CHECK FOR INTERMITTENT PROBLEMS

DTC P0504 Brake Switch "A" / "B" Correlation

for Preparation Click here

DESCRIPTION

The stop light switch is a duplex system that transmits two signals: STP and ST1-. These two signals are used by the ECM to monitor whether or not the brake system is working properly. If the signals, which indicate that the brake pedal is being depressed and released, are detected simultaneously, the ECM interprets this as a malfunction in the stop light switch and sets the DTC.

HINT:

The normal conditions are as shown in the table below.

Signals	Brake Pedal Released	In Transition	Brake Pedal Depressed
STP	OFF	ON	ON
ST1-	ON	ON	OFF

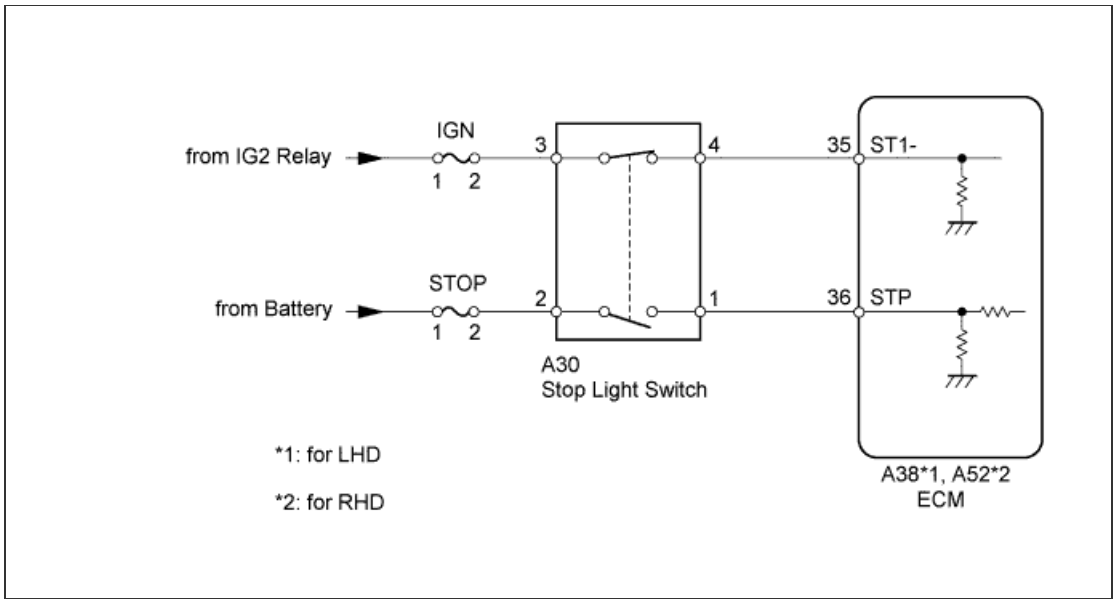
P0504

DTC Detection Dri e Pattern	DTC Detection Condition	Trouble Area
Release and depress brake pedal with ignition switch ON	Conditions (a), (b) and (c) continue for 0.5 seconds or more (1 trip detection logic): (a) Ignition switch is ON. (b) Brake pedal is released. (c) The STP signal is off when the ST1- signal is off, or the STP signal is on when the ST1- signal is on.	• Open or short in stop light switch signal circuit • STOP fuse • IGN fuse • Stop light switch • ECM

Related Data List

DTC No.	Data List
P0504	Stop Light Switch

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**
- **Stop light switch conditions can be checked using the intelligent tester.**
  1. **Connect the intelligent tester to the DLC3.**

2. Turn the ignition switch to ON.
3. Turn the tester on.
4. Enter the following menus: Powertrain / Engine / Data List / Stop Light Switch.
5. Check Stop Light Switch when the brake pedal is depressed and released.

Brake Pedal Operation	Specified Condition
Depressed	ON
Released	OFF

1.CHECK STOP LIGHT SWITCH ASSEMBLY (TERMINAL B VOLTAGE)

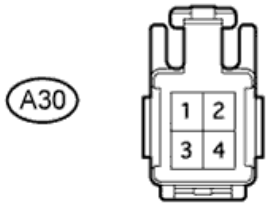
a. Disconnect the stop light switch connector.

b. Measure the oltage according to the alue(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
A30-2 - Body ground	Always	11 to 14
A30-3 - Body ground	Ignition switch ON	11 to 14

Front view of wire harness connector:
(to Stop Light Switch)



NG → Go to step 4

OK

2.INSPECT STOP LIGHT SWITCH ASSEMBLY

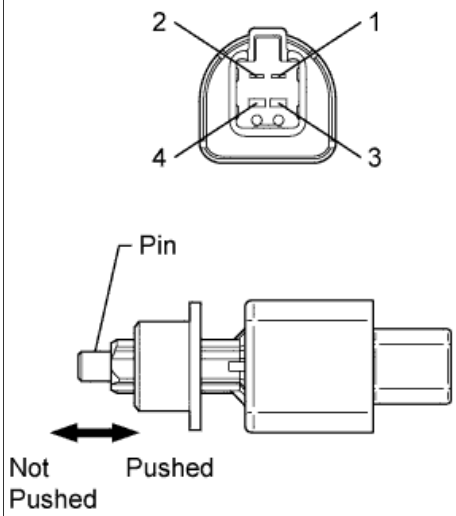
a. Remo e the stop light switch.

b. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

Tester Connection	Switch Condition	Specified Condition
1 - 2	Switch pin not pushed	Below 1 Ω
	Switch pin pushed	10 kΩ or higher
3 - 4	Switch pin not pushed	10 kΩ or higher
	Switch pin pushed	Below 1 Ω

Component without harness connected:
(Stop Light Switch)



NG → Go to step 5

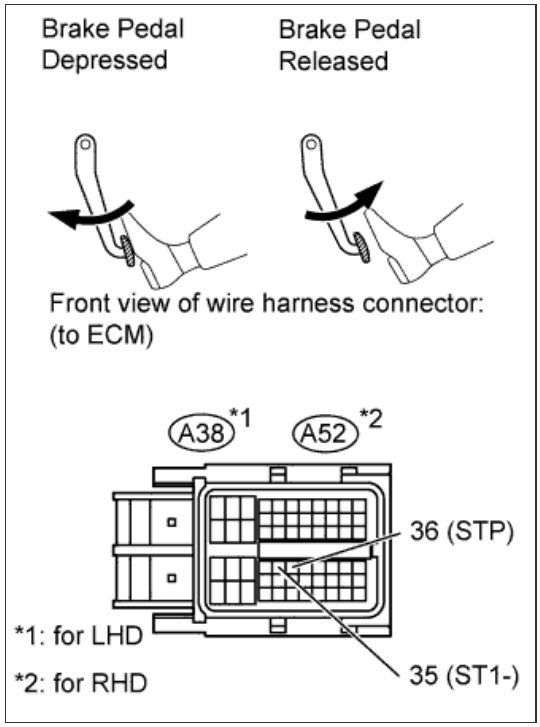
OK

3.CHECK ECM (STP AND ST1- VOLTAGE)

a. Disconnect the ECM connector.

b. Turn the ignition switch to ON.

c. Measure the oltage according to the alue(s) in the table below.



Standard Voltage:

for LHD

Tester Connection	Brake Pedal Condition	Specified Condition
A38-35 (ST1-) - Body ground	Released	11 to 14
	Depressed	0 to 3
A38-36 (STP) - Body ground	Released	0 to 3
	Depressed	11 to 14

for RHD

Tester Connection	Brake Pedal Condition	Specified Condition
A52-35 (ST1-) - Body ground	Released	11 to 14
	Depressed	0 to 3
A52-36 (STP) - Body ground	Released	0 to 3
	Depressed	11 to 14

OK	Go to step 6
NG	Go to step 7

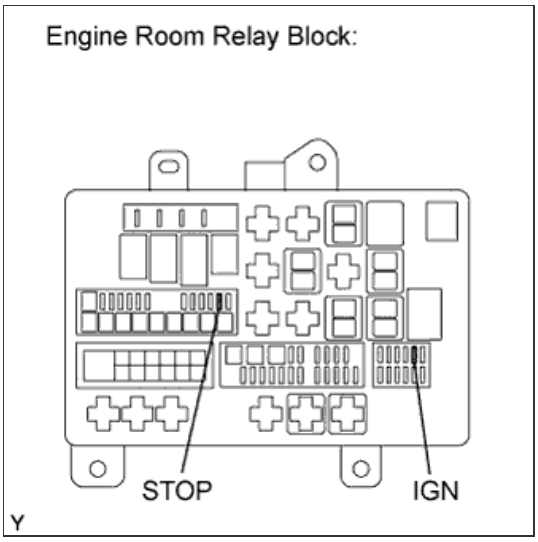
4.INSPECT FUSE (STOP, IGN)

a. Remo e the STOP and IGN fuses from the engine room relay block.

b. Measure the resistance according to the alue(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
STOP fuse	Always	Below 1 Ω
IGN fuse		



OK	Go to step 7
NG	Go to step

5.REPLACE STOP LIGHT SWITCH ASSEMBLY

a. Replace the stop light switch assembly (Click here).

NEXT	Go to step 9

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT	Go to step 9

7.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT	Go to step 9

8.CHECK FOR SHORTS IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

NEXT

9.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON and turn the tester on.

e. Brake pedal released and depressed.

f. Enter the following menus: Powertrain / Engine / DTC.

g. Confirm that the DTC is not output again.

NEXT

END

DTC P0069 MAP Sensor Too High or Too Low

for Preparation Click here

DESCRIPTION

To detect atmospheric pressure, the atmospheric pressure sensor built into the ECM is used in the common rail system. Following the changes in the atmospheric pressure, the ECM corrects the fuel injection volume, timing and duration, and adjusts the common rail internal fuel pressure to optimize combustion.

P0069

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
1 second elapses after ignition switch turned from off to ON (starter remains off)	After the ignition switch is turned to ON, the difference between the atmospheric pressure sensor output and manifold absolute pressure sensor output exceeds the range of Pa for 0.5 seconds.	ECM

Related Data List

DTC No.	Data List
P0069	• Atmosphere Pressure • MAP

HINT:

- **Turn the ignition switch to ON and check the Atmosphere Pressure and MAP items in the Data List. If the atmospheric pressure displayed on the tester differs greatly from the actual atmospheric pressure (standard: 101 kPa), the sensor (atmospheric pressure sensor or manifold absolute pressure sensor) is malfunctioning.**
- **If DTC P0069 is stored, the following symptoms may appear:**
  - **Misfire**
  - **Combustion noise**
  - **Black smoke**
  - **White smoke**
  - **Lack of power**

INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Clic here) and initialization (Clic here).

HINT:

- **Although the DTC titles say MAP Sensor Too High or Too Low, these DTCs relate to the atmospheric pressure sensor.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P0069)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P0069 and other DTCs are output	A
P0069 is output	B

HINT:

If codes other than P0069 are output, perform troubleshooting for those DTCs first.

A → GO TO DTC CHART (Click here)

B

2.REPLACE ECM

a. Replace the ECM (Clic here).

NEXT

.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULL REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTC (Clic here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 1 second.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

for Preparation Click here

DESCRIPTION

The battery supplies electricity to the ECM even when the ignition switch is off. This power allows the ECM to store data such as DTC history, freeze frame data and fuel trim values. If the battery voltage falls below a minimum level, the ECM memory is cleared and the ECM determines that there is a malfunction in the power supply circuit. When the engine is next started, the ECM illuminates the MIL and stores the DTC.

P0560

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3 seconds	The voltage at terminal BATT drops excessively for 3 seconds and part of the stored values in the ECU are initialized (1 trip detection logic).	• Open in bac up power source circuit (to BATT terminal) • Battery • Battery terminals • EFI MAIN fuse • ECM

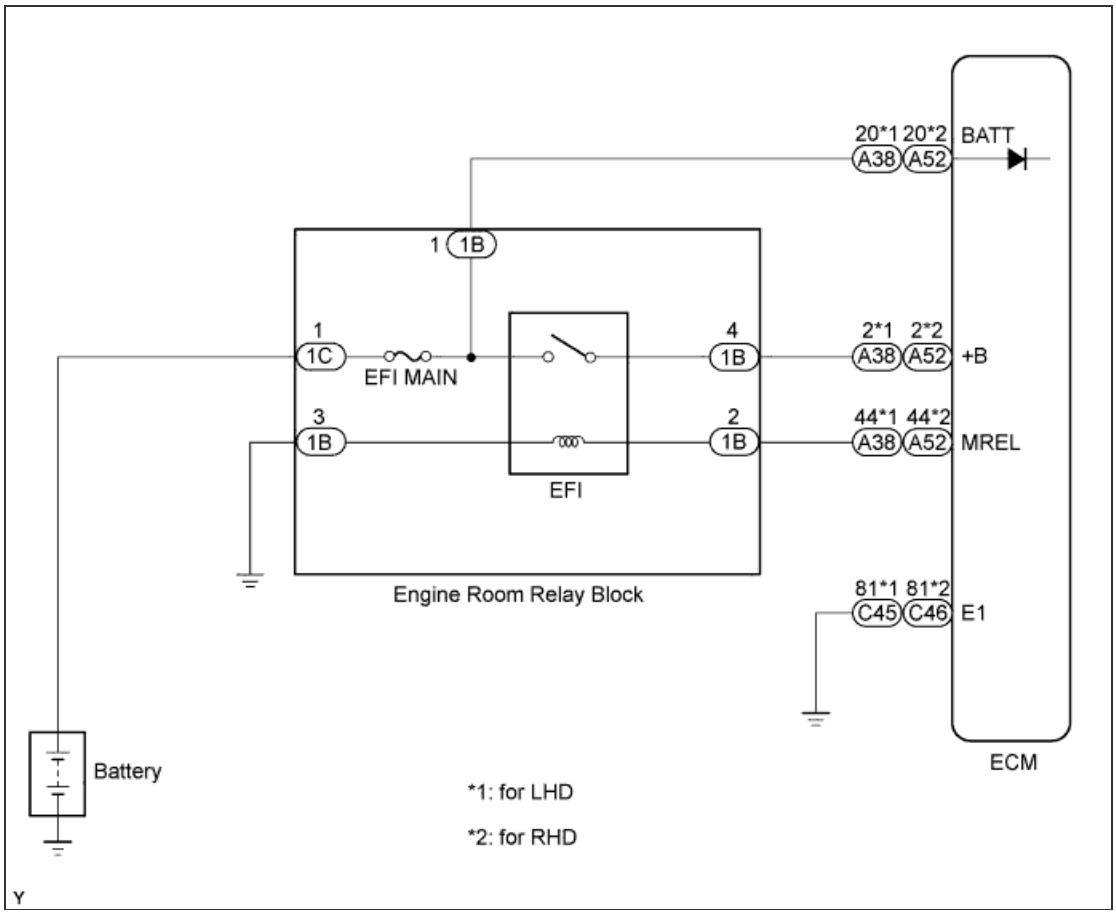
Related Data List

DTC No.	Data List
P0560	Battery Voltage

HINT:

If DTC P0560 is stored, the ECM does not store other DTCs or the data stored in the ECM is partly erased.

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**
- **When the ignition switch is ON, even though +B voltage is present, when the voltage at terminal BATT (power supply for maintaining memorized values in the ECM) drops excessively, a DTC is stored.**

1.INSPECT FUSE (EFI MAIN)

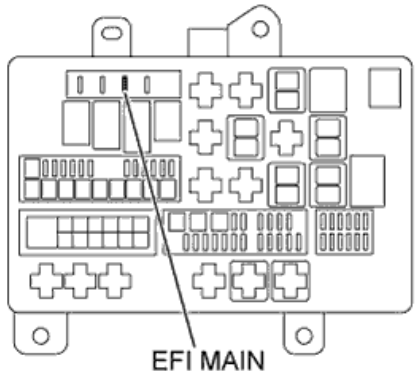
a. Remove the EFI MAIN fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAIN Fuse	Always	Below 1 Ω

Engine Room Relay Block:



NG → Go to step 7

OK

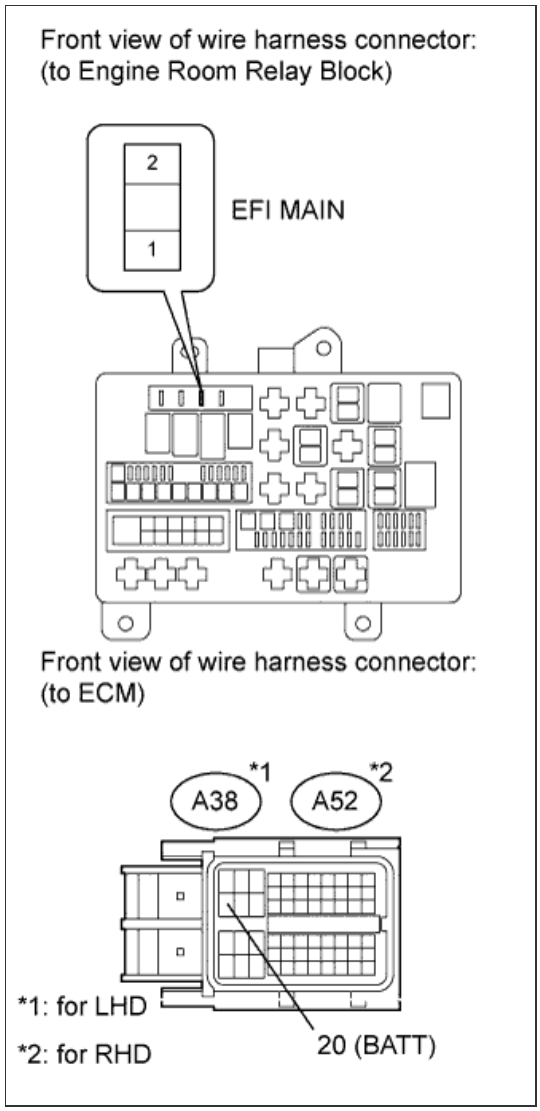
2.CHECK HARNESS AND CONNECTOR (ENGINE ROOM RELAY BLOCK - ECM, BATTERY)

a. Check the harness and the connector between the EFI MAIN fuse and ECM.

i. Remove the EFI MAIN fuse from the engine room relay block.

ii. Disconnect the ECM connector.

iii. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
EFI MAIN fuse (2) - A38-20 (BATT)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
EFI MAIN fuse (2) - A52-20 (BATT)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
EFI MAIN fuse (2) or A38-20 (BATT) - Body ground	Always	10 Ω or higher

for RHD

Tester Connection	Condition	Specified Condition
EFI MAIN fuse (2) or A52-20 (BATT) - Body ground	Always	10 Ω or higher

b. Check the harness and the connector between the EFI MAIN fuse and battery.

i. Remove the EFI MAIN fuse from the engine room relay block.

ii. Disconnect the cable from the positive (+) battery terminal.

iii. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
Battery positive terminal - EFI MAIN fuse (1)	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
Battery positive terminal or EFI MAIN fuse (1) - Body ground	Always	10 Ω or higher

NG → Go to step 8

OK

3.INSPECT BATTERY

a. Check that the battery is not depleted.

OK:
Battery is not depleted.

NG → Go to step 9

OK

4.CHECK BATTERY TERMINAL

a. Check that the battery terminals are not loose or corroded.

OK:
Battery terminals are not loose or corroded.

NG → Go to step 10

OK

5.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Turn the ignition switch off.

e. Turn the ignition switch to ON for 3 seconds.

f. Enter the following menus: Powertrain / Engine / DTC.

g. Read the DTCs.

Result

Result	Proceed to
P0560 is output	A
No DTC is output	B

B → END

A

6.REPLACE ECM

a. Replace the ECM (Clic here).

NEXT → Go to step 11

7.CHECK FOR SHORTS IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

NEXT → Go to step 11

8.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT → Go to step 11

9.REPLACE BATTERY

NEXT → Go to step 11

10.REPAIR OR REPLACE BATTERY TERMINAL

NEXT

11.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Clic here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 3 seconds.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

DTC P0087 Fuel Rail / System Pressure - Too Low

DTC P0190 Fuel Rail Pressure Sensor Circuit

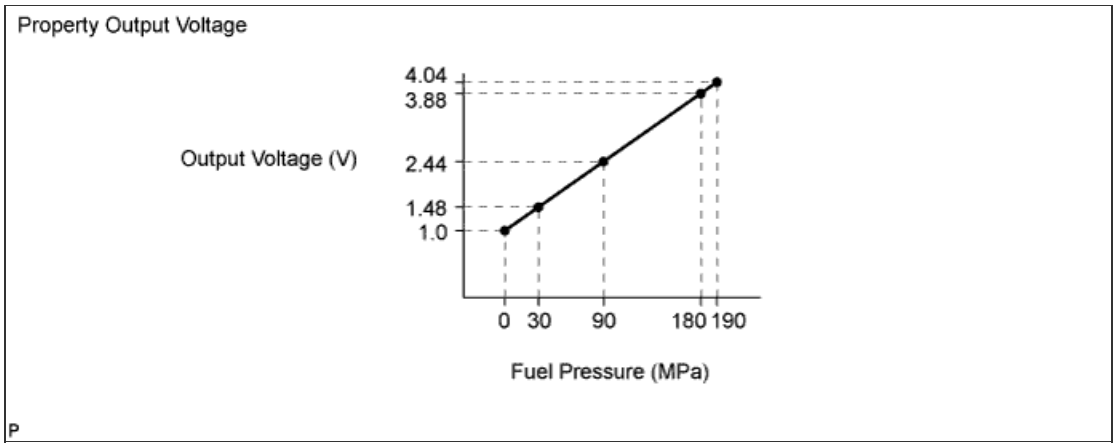
DTC P0192 Fuel Rail Pressure Sensor Circuit Low Input

DTC P0193 Fuel Rail Pressure Sensor Circuit High Input

for Preparation Click here

DESCRIPTION

The ECM monitors the internal fuel pressure of the common rail using the fuel pressure sensor, and controls the suction control valve to regulate the internal pressure to the target pressure. The pressure sensor is a semiconductor that varies electrical resistance when pressure is applied to its silicon chip. This sensor outputs the voltage in proportion to the internal fuel pressure.



P0087

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After idling for 60 seconds, repeat quick engine speed accelerations (to 2500 rpm) for 30 seconds	Fuel pressure sensor output voltage stays at fixed value for 90 seconds (1 trip detection logic).	• Open or short in fuel pressure sensor circuit • Fuel pressure sensor (common rail (for Bank 1)) • ECM **HINT:** Breakdown points are electrically related only (pumps are not involved)

P0190

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	Fuel pressure sensor output voltage is 0.55 V or less, or 4.9 V or more for 0.5 seconds (1 trip detection logic).	• Open or short in fuel pressure sensor circuit • Fuel pressure sensor (common rail (for Bank 1)) • ECM **HINT:** Breakdown points are electrically related only (pumps are not involved)

P0192

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for	Fuel pressure sensor output voltage is 0.55 V or less for 0.5	• Open or short in fuel pressure sensor circuit • Fuel pressure sensor (common rail (for Bank 1)) • ECM

1 second	seconds (1 trip detection logic).	**HINT:** Breakdown points are electrically related only (pumps are not involved)

P0193

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	Fuel pressure sensor output voltage is 4.9 V or more for 0.5 seconds (1 trip detection logic).	• Open or short in fuel pressure sensor circuit • Fuel pressure sensor (common rail (for Bank 1)) • ECM **HINT:** Breakdown points are electrically related only (pumps are not involved)

Related Data List

DTC No.	Data List
P0087	• Fuel Press • Target Common Rail Pressure
P0190	
P0192	
P0193	

HINT:

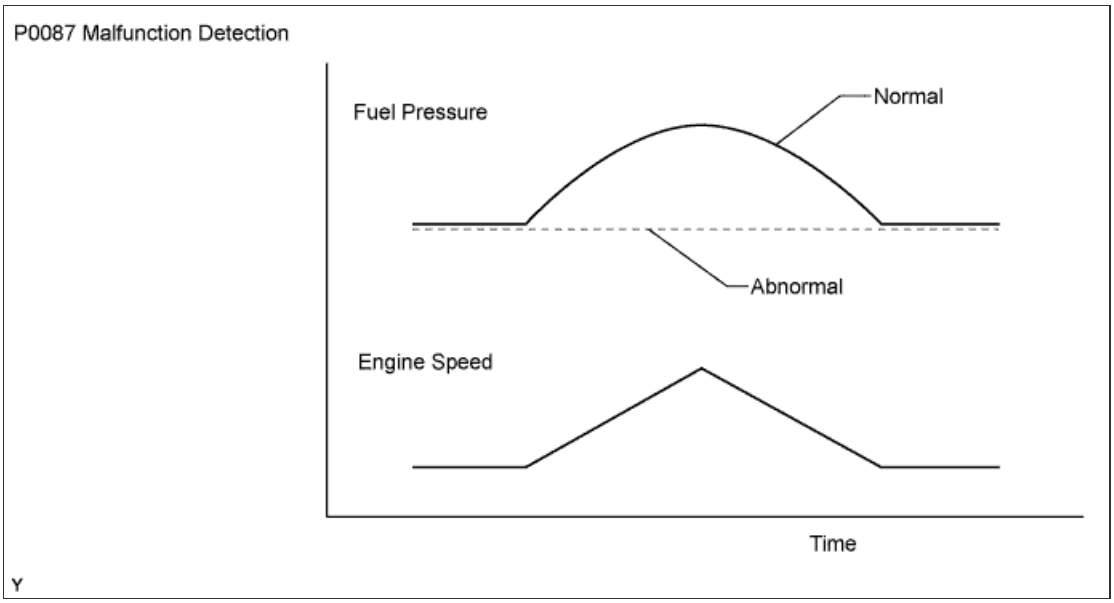
- **Check Fuel Press compared to Target Common Rail Pressure in the Data List by enter the following menus: Powertrain / Engine / Data List / Fuel Press, Target Common Rail Pressure. Under stable conditions, the difference between Fuel Press and Target Common Rail Pressure is within +/-5 MPa.**
- **For more information on the fuel pressure sensor and common rail system, refer to the System Description (Click here).**
- **If DTC P0087 is stored, the following symptoms may appear:**
  - **Black smoke**
  - **Poor drivability**
  - **Lack of power**
- **If DTC P0190, P0192 and/or P0193 is stored, the following symptoms may appear.**
  - **Lack of power due to accelerator restriction of fail-safe function**

MONITOR DESCRIPTION

P0087 (Fuel pressure sensor output stays at fixed value):

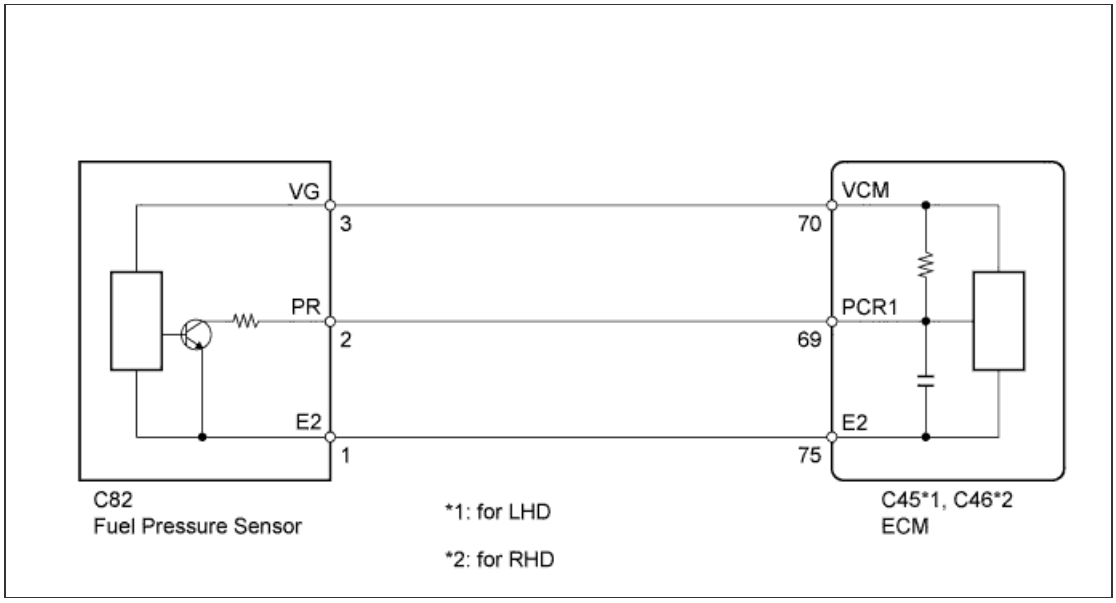
- Under normal conditions, the internal fuel pressure of the common rail usually fluctuates 1 to 2 MPa (10 to 20 kgf/cm ^{2}, 145 to 290 psi) even when the driving conditions are constant. This DTC is stored if there is no fluctuation of the fuel pressure. The internal fuel pressure is approximately 27 to 37 MPa (275 to 377 kgf/cm^2, 3915 to 5365 psi) when idling, and it increases to approximately 50 to 70 MPa (510 to 714 kgf/cm^2, 7250 to 10150 psi) when running the engine at 2500 rpm.
  If this DTC is stored, the ECM enters fail-safe mode and limits engine power. The fail-safe mode continues until the ignition switch is turned off.

- The diagram below indicates that fuel pressure rises as engine speed increases, but for the malfunction indicated by this DTC, that does not happen.



P0190, P0192 and P0193 (Open or short in fuel pressure sensor circuit):
These DTCs are stored if the fuel pressure sensor output voltage is out of the standard range due to an open or short malfunction of the sensor circuit.
If these DTCs are stored, the ECM enters fail-safe mode and limits the engine power. The fail-safe mode continues until the ignition switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- **If DTCs relating to different systems are stored, and they share terminal E2 as their ground, check this ground circuit first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.CHECK DTC OUTPUT

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read the DTCs.

Result

Display (DTC output)	Proceed to
P0190, P0192, P0193	A
P0087	B

B → Go to step 4

A

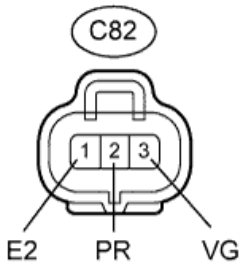
2.CHECK HARNESS AND CONNECTOR (FUEL PRESSURE SENSOR - ECM)

a. Disconnect the fuel pressure sensor connector.

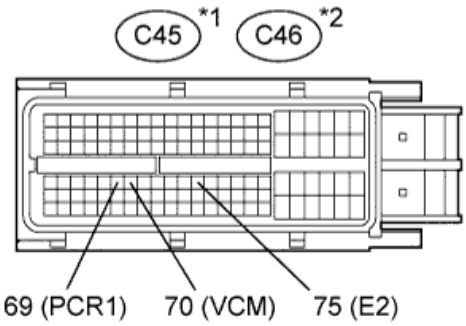
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Fuel Pressure Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C82-2 (PR) - C45-69 (PCR1)	Always	Below 1 Ω
C82-3 (VG) - C45-70 (VCM)	Always	Below 1 Ω
C82-1 (E2) - C45-75 (E2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition

C82-2 (PR) - C46-69 (PCR1)	Always	Below 1 Ω
C82-3 (VG) - C46-70 (VCM)	Always	Below 1 Ω
C82-1 (E2) - C46-75 (E2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C82-2 (PR) or C45-69 (PCR1) - Body ground	Always	10 kΩ or higher
C82-3 (VG) or C45-70 (VCM) - Body ground	Always	10 kΩ or higher
C82-1 (E2) or C45-75 (E2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C82-2 (PR) or C46-69 (PCR1) - Body ground	Always	10 kΩ or higher
C82-3 (VG) or C46-70 (VCM) - Body ground	Always	10 kΩ or higher
C82-1 (E2) or C46-75 (E2) - Body ground	Always	10 kΩ or higher

NG → Go to step 7

OK

3.CHECK ECM (FUEL PRESSURE SENSOR VOLTAGE)

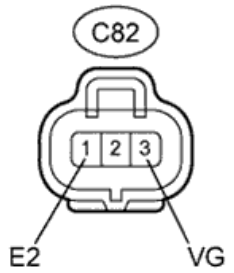
a. Disconnect the fuel pressure sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C82-3 (VG) - C82-1 (E2)	Ignition switch ON	4.5 to 5.5 V

Front view of wire harness connector: (to Fuel Pressure Sensor)



NG → Go to step 6

OK

4.REPLACE FUEL PRESSURE SENSOR (COMMON RAIL (for Bank 1))

a. Replace the common rail (for bank 1) (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (DTC P0087, P0190, P0192, P0193)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Let the engine idle for 60 seconds, and then repeat quick engine speed accelerations (to 2500 rpm) for 30 seconds.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

Result

Result	Proceed to
P0087, P0190, P0192 or P0193 is output	A
No DTC is output	B

B → END

A

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 8

7.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

8.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON.

e. Let the engine idle for 60 seconds, and then repeat quick engine speed accelerations (to 2500 rpm) for 30 seconds.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P0087, P0190, P0192 and/or P0193.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, increase idling time.

NEXT

END

DTC P0606 ECM / PCM Processor

DTC P0607 Control Module Performance

DTC P1611 IC Circuit Malfunction

for Preparation Click here

DESCRIPTION

P0606, P0607, P1611

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	ECM internal error continues for 1 second (1 trip detection logic).	ECM

INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0606, P0607 AND/OR P1611)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P0606, P0607 or P1611 is output	A
P0606, P0607 or P1611 and other DTCs are output	B

B → GO TO DTC CHART (Click here)

A

2.REPLACE ECM

a. Replace the ECM (Click here).

NEXT

3.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 1 second.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.


NEXT
END

DTC P0087 Fuel Rail / System Pressure - Too Low

DTC P0190 Fuel Rail Pressure Sensor Circuit

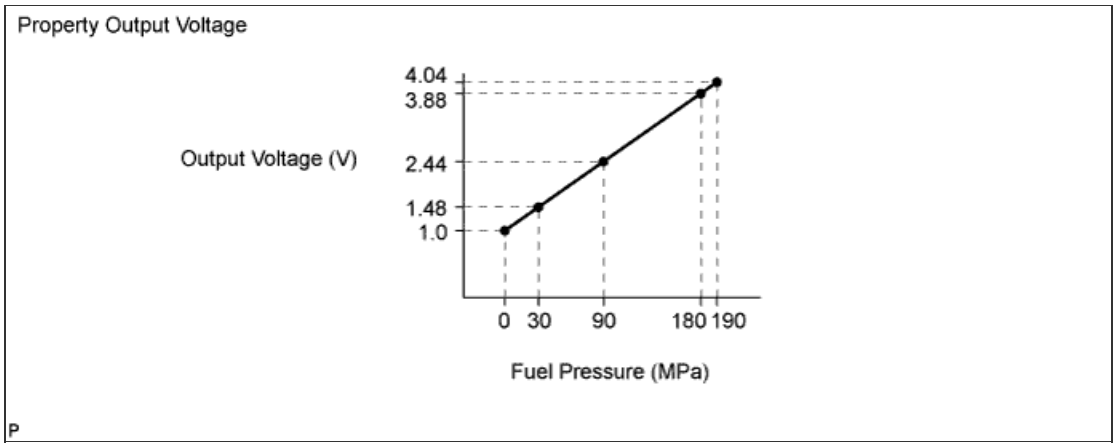
DTC P0192 Fuel Rail Pressure Sensor Circuit Low Input

DTC P0193 Fuel Rail Pressure Sensor Circuit High Input

for Preparation Click here

DESCRIPTION

The ECM monitors the internal fuel pressure of the common rail using the fuel pressure sensor, and controls the suction control valve to regulate the internal pressure to the target pressure. The pressure sensor is a semiconductor that varies electrical resistance when pressure is applied to its silicon chip. This sensor outputs the voltage in proportion to the internal fuel pressure.



P0087

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After idling for 60 seconds, repeat quick engine speed accelerations (to 2500 rpm) for 30 seconds	Fuel pressure sensor output voltage stays at fixed value for 90 seconds (1 trip detection logic).	• Open or short in fuel pressure sensor circuit • Fuel pressure sensor (common rail (for Bank 1)) • ECM **HINT:** Breakdown points are electrically related only (pumps are not involved)

P0190

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	Fuel pressure sensor output voltage is 0.55 V or less, or 4.9 V or more for 0.5 seconds (1 trip detection logic).	• Open or short in fuel pressure sensor circuit • Fuel pressure sensor (common rail (for Bank 1)) • ECM **HINT:** Breakdown points are electrically related only (pumps are not involved)

P0192

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for	Fuel pressure sensor output voltage is 0.55 V or less for 0.5	• Open or short in fuel pressure sensor circuit • Fuel pressure sensor (common rail (for Bank 1)) • ECM

1 second	seconds (1 trip detection logic).	**HINT:** Breakdown points are electrically related only (pumps are not involved)

P0193

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	Fuel pressure sensor output voltage is 4.9 V or more for 0.5 seconds (1 trip detection logic).	• Open or short in fuel pressure sensor circuit • Fuel pressure sensor (common rail (for Bank 1)) • ECM **HINT:** Breakdown points are electrically related only (pumps are not involved)

Related Data List

DTC No.	Data List
P0087	• Fuel Press • Target Common Rail Pressure
P0190	
P0192	
P0193	

HINT:

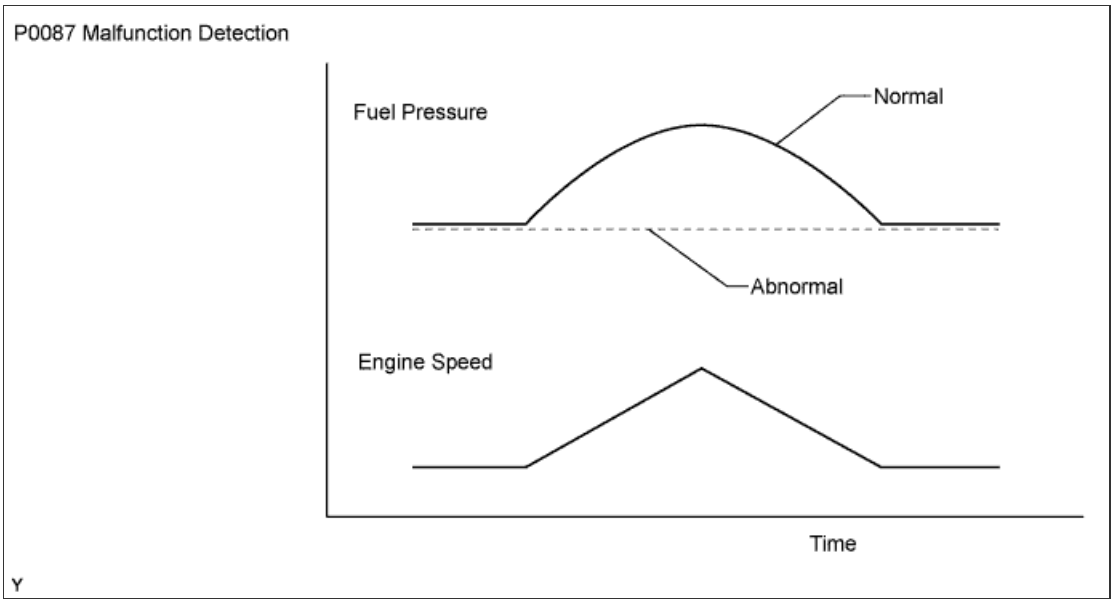
- **Check Fuel Press compared to Target Common Rail Pressure in the Data List by enter the following menus: Powertrain / Engine / Data List / Fuel Press, Target Common Rail Pressure. Under stable conditions, the difference between Fuel Press and Target Common Rail Pressure is within +/-5 MPa.**
- **For more information on the fuel pressure sensor and common rail system, refer to the System Description (Click here).**
- **If DTC P0087 is stored, the following symptoms may appear:**
  - **Black smoke**
  - **Poor drivability**
  - **Lack of power**
- **If DTC P0190, P0192 and/or P0193 is stored, the following symptoms may appear.**
  - **Lack of power due to accelerator restriction of fail-safe function**

MONITOR DESCRIPTION

P0087 (Fuel pressure sensor output stays at fixed value):

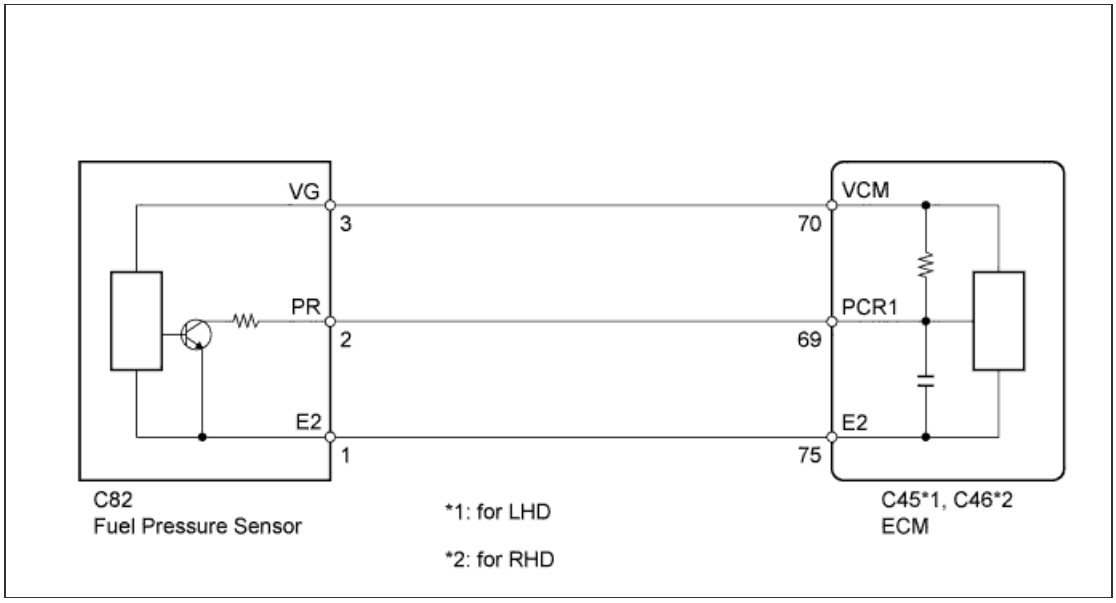
- Under normal conditions, the internal fuel pressure of the common rail usually fluctuates 1 to 2 MPa (10 to 20 kgf/cm ^{2}, 145 to 290 psi) even when the driving conditions are constant. This DTC is stored if there is no fluctuation of the fuel pressure. The internal fuel pressure is approximately 27 to 37 MPa (275 to 377 kgf/cm^2, 3915 to 5365 psi) when idling, and it increases to approximately 50 to 70 MPa (510 to 714 kgf/cm^2, 7250 to 10150 psi) when running the engine at 2500 rpm.
  If this DTC is stored, the ECM enters fail-safe mode and limits engine power. The fail-safe mode continues until the ignition switch is turned off.

- The diagram below indicates that fuel pressure rises as engine speed increases, but for the malfunction indicated by this DTC, that does not happen.



P0190, P0192 and P0193 (Open or short in fuel pressure sensor circuit):
These DTCs are stored if the fuel pressure sensor output voltage is out of the standard range due to an open or short malfunction of the sensor circuit.
If these DTCs are stored, the ECM enters fail-safe mode and limits the engine power. The fail-safe mode continues until the ignition switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- **If DTCs relating to different systems are stored, and they share terminal E2 as their ground, check this ground circuit first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.CHECK DTC OUTPUT

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read the DTCs.

Result

Display (DTC output)	Proceed to
P0190, P0192, P0193	A
P0087	B

B → Go to step 4

A

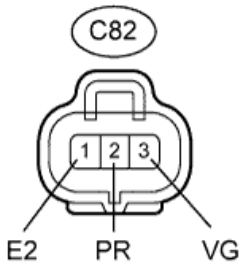
2.CHECK HARNESS AND CONNECTOR (FUEL PRESSURE SENSOR - ECM)

a. Disconnect the fuel pressure sensor connector.

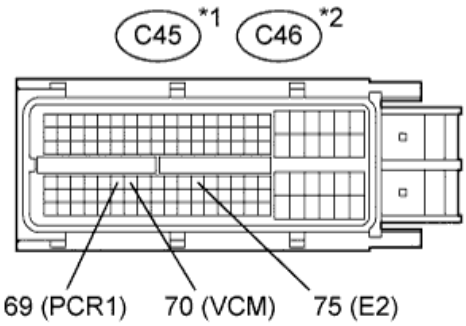
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Fuel Pressure Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C82-2 (PR) - C45-69 (PCR1)	Always	Below 1 Ω
C82-3 (VG) - C45-70 (VCM)	Always	Below 1 Ω
C82-1 (E2) - C45-75 (E2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition

C82-2 (PR) - C46-69 (PCR1)	Always	Below 1 Ω
C82-3 (VG) - C46-70 (VCM)	Always	Below 1 Ω
C82-1 (E2) - C46-75 (E2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C82-2 (PR) or C45-69 (PCR1) - Body ground	Always	10 kΩ or higher
C82-3 (VG) or C45-70 (VCM) - Body ground	Always	10 kΩ or higher
C82-1 (E2) or C45-75 (E2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C82-2 (PR) or C46-69 (PCR1) - Body ground	Always	10 kΩ or higher
C82-3 (VG) or C46-70 (VCM) - Body ground	Always	10 kΩ or higher
C82-1 (E2) or C46-75 (E2) - Body ground	Always	10 kΩ or higher

NG → Go to step 7

OK

3.CHECK ECM (FUEL PRESSURE SENSOR VOLTAGE)

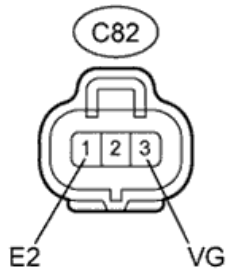
a. Disconnect the fuel pressure sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C82-3 (VG) - C82-1 (E2)	Ignition switch ON	4.5 to 5.5 V

Front view of wire harness connector: (to Fuel Pressure Sensor)



NG → Go to step 6

OK

4.REPLACE FUEL PRESSURE SENSOR (COMMON RAIL (for Bank 1))

a. Replace the common rail (for bank 1) (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (DTC P0087, P0190, P0192, P0193)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Let the engine idle for 60 seconds, and then repeat quick engine speed accelerations (to 2500 rpm) for 30 seconds.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

Result

Result	Proceed to
P0087, P0190, P0192 or P0193 is output	A
No DTC is output	B

B → END

A

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 8

7.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

8.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON.

e. Let the engine idle for 60 seconds, and then repeat quick engine speed accelerations (to 2500 rpm) for 30 seconds.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P0087, P0190, P0192 and/or P0193.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, increase idling time.

NEXT

END

DTC P0606 ECM / PCM Processor

DTC P0607 Control Module Performance

DTC P1611 IC Circuit Malfunction

for Preparation Click here

DESCRIPTION

P0606, P0607, P1611

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	ECM internal error continues for 1 second (1 trip detection logic).	ECM

INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0606, P0607 AND/OR P1611)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P0606, P0607 or P1611 is output	A
P0606, P0607 or P1611 and other DTCs are output	B

B → GO TO DTC CHART (Click here)

A

2.REPLACE ECM

a. Replace the ECM (Click here).

NEXT

3.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 1 second.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.


NEXT
END

DTC P0087 Fuel Rail / System Pressure - Too Low

DTC P0190 Fuel Rail Pressure Sensor Circuit

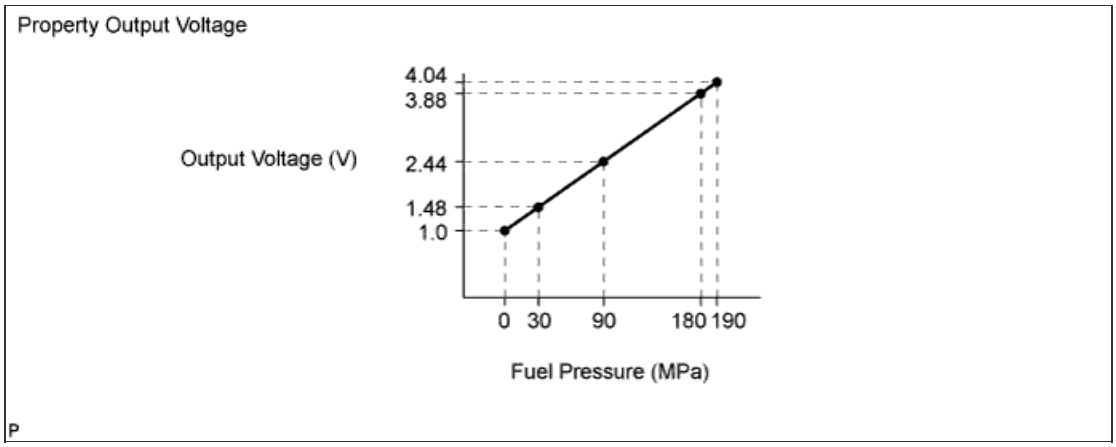
DTC P0192 Fuel Rail Pressure Sensor Circuit Low Input

DTC P0193 Fuel Rail Pressure Sensor Circuit High Input

for Preparation Click here

DESCRIPTION

The ECM monitors the internal fuel pressure of the common rail using the fuel pressure sensor, and controls the suction control valve to regulate the internal pressure to the target pressure. The pressure sensor is a semiconductor that varies electrical resistance when pressure is applied to its silicon chip. This sensor outputs the voltage in proportion to the internal fuel pressure.



P0087

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After idling for 60 seconds, repeat quick engine speed accelerations (to 2500 rpm) for 30 seconds	Fuel pressure sensor output voltage stays at fixed value for 90 seconds (1 trip detection logic).	• Open or short in fuel pressure sensor circuit • Fuel pressure sensor (common rail (for Bank 1)) • ECM **HINT:** Breakdown points are electrically related only (pumps are not involved)

P0190

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	Fuel pressure sensor output voltage is 0.55 V or less, or 4.9 V or more for 0.5 seconds (1 trip detection logic).	• Open or short in fuel pressure sensor circuit • Fuel pressure sensor (common rail (for Bank 1)) • ECM **HINT:** Breakdown points are electrically related only (pumps are not involved)

P0192

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for	Fuel pressure sensor output voltage is 0.55 V or less for 0.5	• Open or short in fuel pressure sensor circuit • Fuel pressure sensor (common rail (for Bank 1)) • ECM

1 second	seconds (1 trip detection logic).	**HINT:** Breakdown points are electrically related only (pumps are not involved)

P0193

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	Fuel pressure sensor output voltage is 4.9 V or more for 0.5 seconds (1 trip detection logic).	• Open or short in fuel pressure sensor circuit • Fuel pressure sensor (common rail (for Bank 1)) • ECM **HINT:** Breakdown points are electrically related only (pumps are not involved)

Related Data List

DTC No.	Data List
P0087	• Fuel Press • Target Common Rail Pressure
P0190	
P0192	
P0193	

HINT:

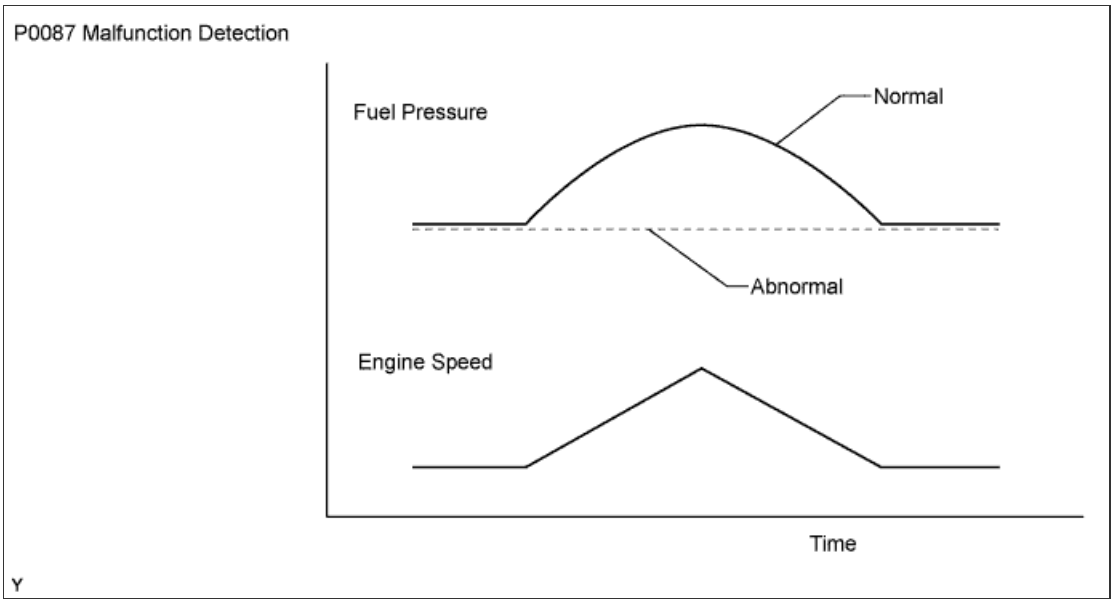
- **Check Fuel Press compared to Target Common Rail Pressure in the Data List by enter the following menus: Powertrain / Engine / Data List / Fuel Press, Target Common Rail Pressure. Under stable conditions, the difference between Fuel Press and Target Common Rail Pressure is within +/-5 MPa.**
- **For more information on the fuel pressure sensor and common rail system, refer to the System Description (Click here).**
- **If DTC P0087 is stored, the following symptoms may appear:**
  - **Black smoke**
  - **Poor drivability**
  - **Lack of power**
- **If DTC P0190, P0192 and/or P0193 is stored, the following symptoms may appear.**
  - **Lack of power due to accelerator restriction of fail-safe function**

MONITOR DESCRIPTION

P0087 (Fuel pressure sensor output stays at fixed value):

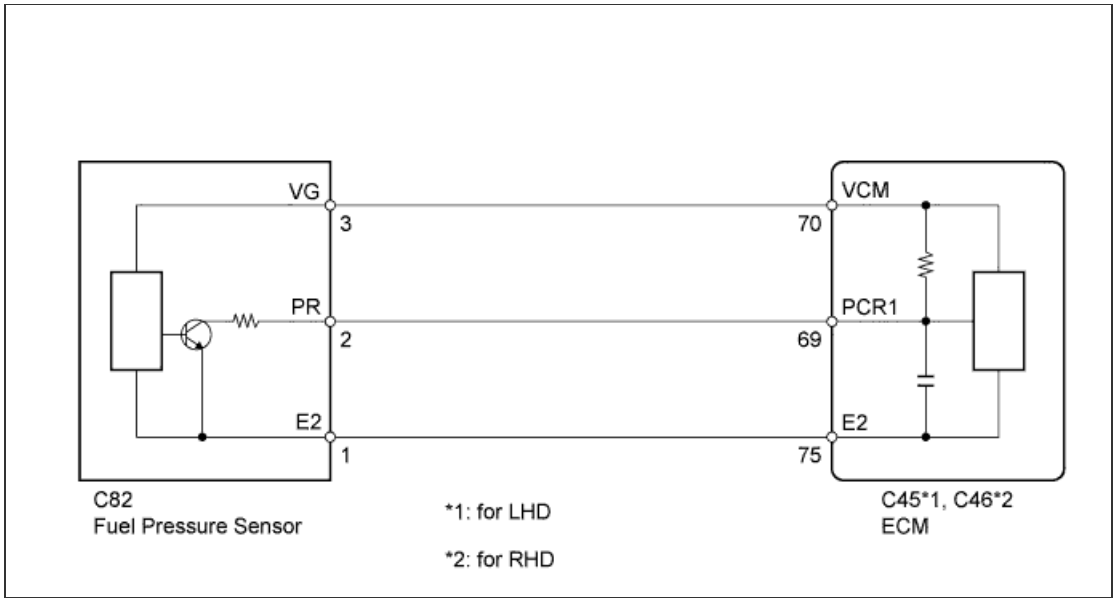
- Under normal conditions, the internal fuel pressure of the common rail usually fluctuates 1 to 2 MPa (10 to 20 kgf/cm ^{2}, 145 to 290 psi) even when the driving conditions are constant. This DTC is stored if there is no fluctuation of the fuel pressure. The internal fuel pressure is approximately 27 to 37 MPa (275 to 377 kgf/cm^2, 3915 to 5365 psi) when idling, and it increases to approximately 50 to 70 MPa (510 to 714 kgf/cm^2, 7250 to 10150 psi) when running the engine at 2500 rpm.
  If this DTC is stored, the ECM enters fail-safe mode and limits engine power. The fail-safe mode continues until the ignition switch is turned off.

- The diagram below indicates that fuel pressure rises as engine speed increases, but for the malfunction indicated by this DTC, that does not happen.



P0190, P0192 and P0193 (Open or short in fuel pressure sensor circuit):
These DTCs are stored if the fuel pressure sensor output voltage is out of the standard range due to an open or short malfunction of the sensor circuit.
If these DTCs are stored, the ECM enters fail-safe mode and limits the engine power. The fail-safe mode continues until the ignition switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- **If DTCs relating to different systems are stored, and they share terminal E2 as their ground, check this ground circuit first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.CHECK DTC OUTPUT

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read the DTCs.

Result

Display (DTC output)	Proceed to
P0190, P0192, P0193	A
P0087	B

B → Go to step 4

A

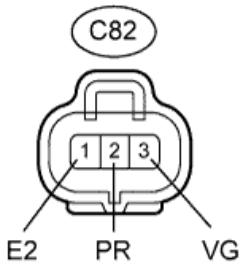
2.CHECK HARNESS AND CONNECTOR (FUEL PRESSURE SENSOR - ECM)

a. Disconnect the fuel pressure sensor connector.

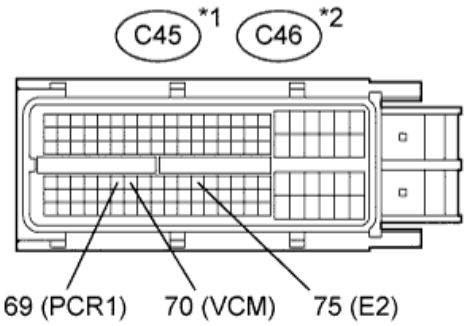
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Fuel Pressure Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C82-2 (PR) - C45-69 (PCR1)	Always	Below 1 Ω
C82-3 (VG) - C45-70 (VCM)	Always	Below 1 Ω
C82-1 (E2) - C45-75 (E2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition

C82-2 (PR) - C46-69 (PCR1)	Always	Below 1 Ω
C82-3 (VG) - C46-70 (VCM)	Always	Below 1 Ω
C82-1 (E2) - C46-75 (E2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C82-2 (PR) or C45-69 (PCR1) - Body ground	Always	10 kΩ or higher
C82-3 (VG) or C45-70 (VCM) - Body ground	Always	10 kΩ or higher
C82-1 (E2) or C45-75 (E2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C82-2 (PR) or C46-69 (PCR1) - Body ground	Always	10 kΩ or higher
C82-3 (VG) or C46-70 (VCM) - Body ground	Always	10 kΩ or higher
C82-1 (E2) or C46-75 (E2) - Body ground	Always	10 kΩ or higher

NG → Go to step 7

OK

3.CHECK ECM (FUEL PRESSURE SENSOR VOLTAGE)

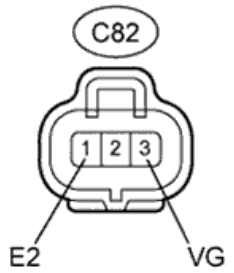
a. Disconnect the fuel pressure sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C82-3 (VG) - C82-1 (E2)	Ignition switch ON	4.5 to 5.5 V

Front view of wire harness connector: (to Fuel Pressure Sensor)



NG → Go to step 6

OK

4.REPLACE FUEL PRESSURE SENSOR (COMMON RAIL (for Bank 1))

a. Replace the common rail (for bank 1) (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (DTC P0087, P0190, P0192, P0193)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Let the engine idle for 60 seconds, and then repeat quick engine speed accelerations (to 2500 rpm) for 30 seconds.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

Result

Result	Proceed to
P0087, P0190, P0192 or P0193 is output	A
No DTC is output	B

B → END

A

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 8

7.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

8.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON.

e. Let the engine idle for 60 seconds, and then repeat quick engine speed accelerations (to 2500 rpm) for 30 seconds.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P0087, P0190, P0192 and/or P0193.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, increase idling time.

NEXT

END

DTC P0606 ECM / PCM Processor

DTC P0607 Control Module Performance

DTC P1611 IC Circuit Malfunction

for Preparation Click here

DESCRIPTION

P0606, P0607, P1611

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	ECM internal error continues for 1 second (1 trip detection logic).	ECM

INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0606, P0607 AND/OR P1611)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P0606, P0607 or P1611 is output	A
P0606, P0607 or P1611 and other DTCs are output	B

B → GO TO DTC CHART (Click here)

A

2.REPLACE ECM

a. Replace the ECM (Click here).

NEXT

3.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 1 second.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.


NEXT
END

DTC P0087 Fuel Rail / System Pressure - Too Low

DTC P0190 Fuel Rail Pressure Sensor Circuit

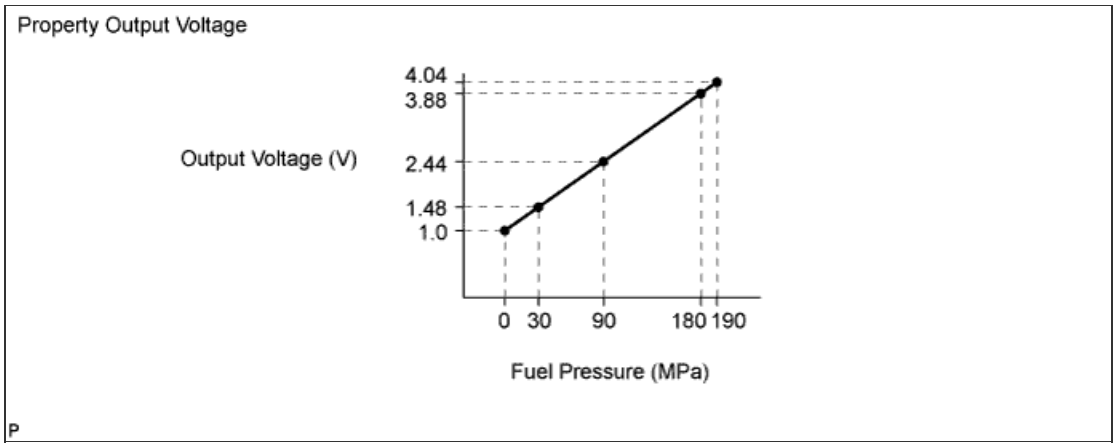
DTC P0192 Fuel Rail Pressure Sensor Circuit Low Input

DTC P0193 Fuel Rail Pressure Sensor Circuit High Input

for Preparation Click here

DESCRIPTION

The ECM monitors the internal fuel pressure of the common rail using the fuel pressure sensor, and controls the suction control valve to regulate the internal pressure to the target pressure. The pressure sensor is a semiconductor that varies electrical resistance when pressure is applied to its silicon chip. This sensor outputs the voltage in proportion to the internal fuel pressure.



P0087

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After idling for 60 seconds, repeat quick engine speed accelerations (to 2500 rpm) for 30 seconds	Fuel pressure sensor output voltage stays at fixed value for 90 seconds (1 trip detection logic).	• Open or short in fuel pressure sensor circuit • Fuel pressure sensor (common rail (for Bank 1)) • ECM **HINT:** Breakdown points are electrically related only (pumps are not involved)

P0190

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	Fuel pressure sensor output voltage is 0.55 V or less, or 4.9 V or more for 0.5 seconds (1 trip detection logic).	• Open or short in fuel pressure sensor circuit • Fuel pressure sensor (common rail (for Bank 1)) • ECM **HINT:** Breakdown points are electrically related only (pumps are not involved)

P0192

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for	Fuel pressure sensor output voltage is 0.55 V or less for 0.5	• Open or short in fuel pressure sensor circuit • Fuel pressure sensor (common rail (for Bank 1)) • ECM

1 second	seconds (1 trip detection logic).	**HINT:** Breakdown points are electrically related only (pumps are not involved)

P0193

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	Fuel pressure sensor output voltage is 4.9 V or more for 0.5 seconds (1 trip detection logic).	• Open or short in fuel pressure sensor circuit • Fuel pressure sensor (common rail (for Bank 1)) • ECM **HINT:** Breakdown points are electrically related only (pumps are not involved)

Related Data List

DTC No.	Data List
P0087	• Fuel Press • Target Common Rail Pressure
P0190	
P0192	
P0193	

HINT:

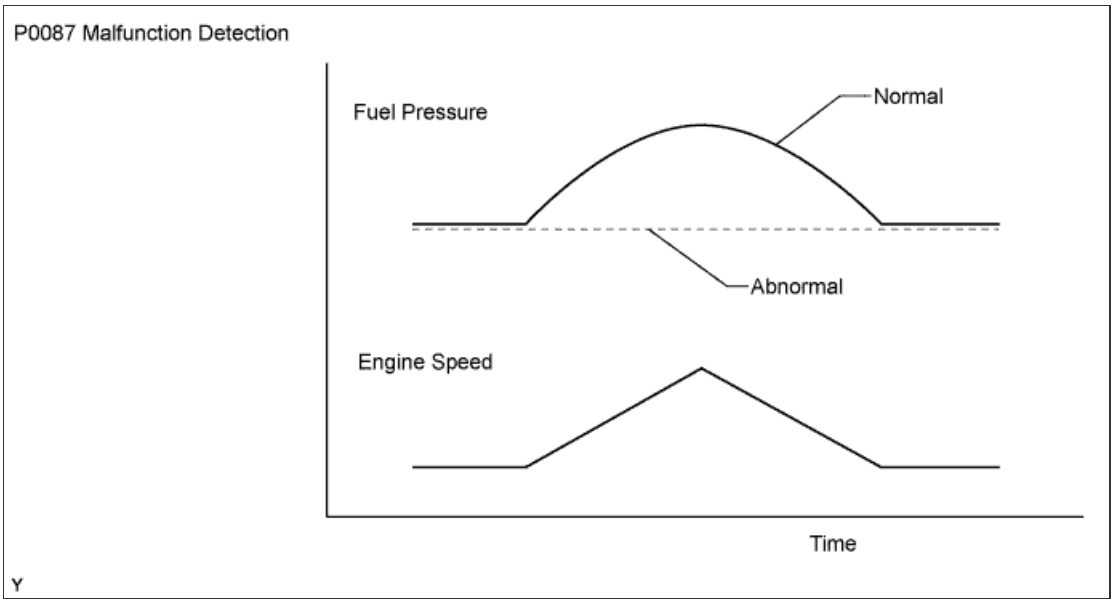
- **Check Fuel Press compared to Target Common Rail Pressure in the Data List by enter the following menus: Powertrain / Engine / Data List / Fuel Press, Target Common Rail Pressure. Under stable conditions, the difference between Fuel Press and Target Common Rail Pressure is within +/-5 MPa.**
- **For more information on the fuel pressure sensor and common rail system, refer to the System Description (Click here).**
- **If DTC P0087 is stored, the following symptoms may appear:**
  - **Black smoke**
  - **Poor drivability**
  - **Lack of power**
- **If DTC P0190, P0192 and/or P0193 is stored, the following symptoms may appear.**
  - **Lack of power due to accelerator restriction of fail-safe function**

MONITOR DESCRIPTION

P0087 (Fuel pressure sensor output stays at fixed value):

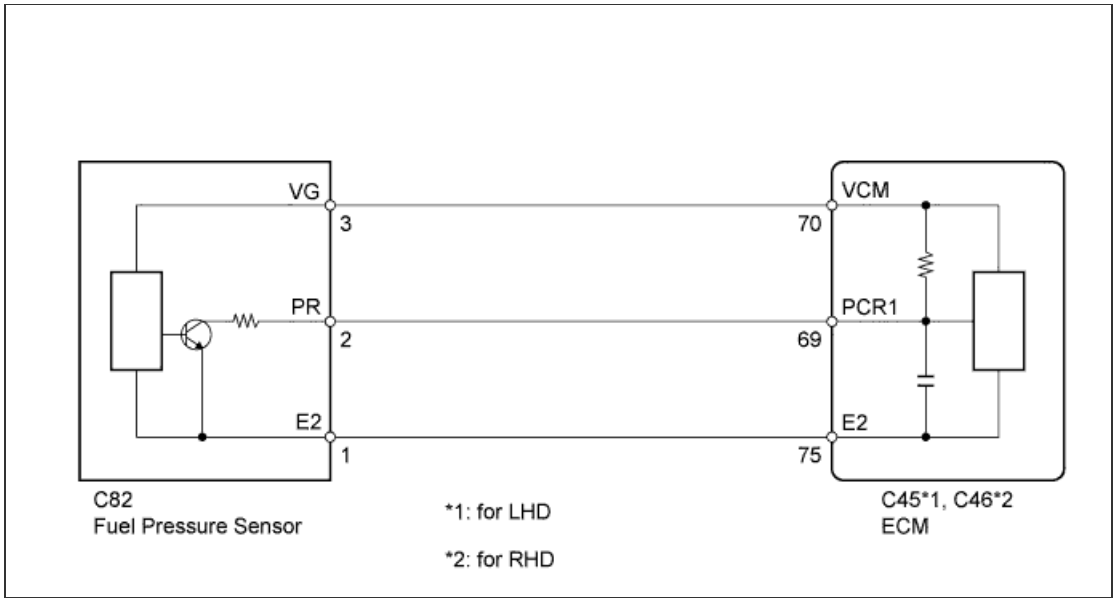
- Under normal conditions, the internal fuel pressure of the common rail usually fluctuates 1 to 2 MPa (10 to 20 kgf/cm ^{2}, 145 to 290 psi) even when the driving conditions are constant. This DTC is stored if there is no fluctuation of the fuel pressure. The internal fuel pressure is approximately 27 to 37 MPa (275 to 377 kgf/cm^2, 3915 to 5365 psi) when idling, and it increases to approximately 50 to 70 MPa (510 to 714 kgf/cm^2, 7250 to 10150 psi) when running the engine at 2500 rpm.
  If this DTC is stored, the ECM enters fail-safe mode and limits engine power. The fail-safe mode continues until the ignition switch is turned off.

- The diagram below indicates that fuel pressure rises as engine speed increases, but for the malfunction indicated by this DTC, that does not happen.



P0190, P0192 and P0193 (Open or short in fuel pressure sensor circuit):
These DTCs are stored if the fuel pressure sensor output voltage is out of the standard range due to an open or short malfunction of the sensor circuit.
If these DTCs are stored, the ECM enters fail-safe mode and limits the engine power. The fail-safe mode continues until the ignition switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- **If DTCs relating to different systems are stored, and they share terminal E2 as their ground, check this ground circuit first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.CHECK DTC OUTPUT

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read the DTCs.

Result

Display (DTC output)	Proceed to
P0190, P0192, P0193	A
P0087	B

B → Go to step 4

A

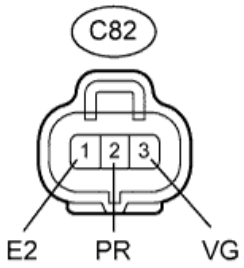
2.CHECK HARNESS AND CONNECTOR (FUEL PRESSURE SENSOR - ECM)

a. Disconnect the fuel pressure sensor connector.

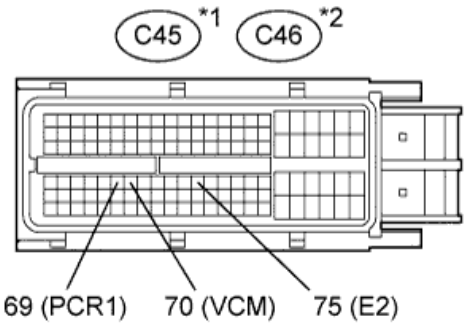
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Fuel Pressure Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C82-2 (PR) - C45-69 (PCR1)	Always	Below 1 Ω
C82-3 (VG) - C45-70 (VCM)	Always	Below 1 Ω
C82-1 (E2) - C45-75 (E2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition

C82-2 (PR) - C46-69 (PCR1)	Always	Below 1 Ω
C82-3 (VG) - C46-70 (VCM)	Always	Below 1 Ω
C82-1 (E2) - C46-75 (E2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C82-2 (PR) or C45-69 (PCR1) - Body ground	Always	10 kΩ or higher
C82-3 (VG) or C45-70 (VCM) - Body ground	Always	10 kΩ or higher
C82-1 (E2) or C45-75 (E2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C82-2 (PR) or C46-69 (PCR1) - Body ground	Always	10 kΩ or higher
C82-3 (VG) or C46-70 (VCM) - Body ground	Always	10 kΩ or higher
C82-1 (E2) or C46-75 (E2) - Body ground	Always	10 kΩ or higher

NG → Go to step 7

OK

3.CHECK ECM (FUEL PRESSURE SENSOR VOLTAGE)

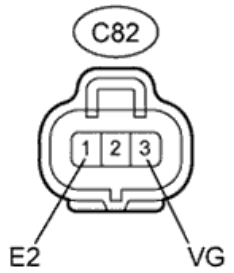
a. Disconnect the fuel pressure sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C82-3 (VG) - C82-1 (E2)	Ignition switch ON	4.5 to 5.5 V

Front view of wire harness connector: (to Fuel Pressure Sensor)



NG → Go to step 6

OK

4.REPLACE FUEL PRESSURE SENSOR (COMMON RAIL (for Bank 1))

a. Replace the common rail (for bank 1) (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS (DTC P0087, P0190, P0192, P0193)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Let the engine idle for 60 seconds, and then repeat quick engine speed accelerations (to 2500 rpm) for 30 seconds.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

Result

Result	Proceed to
P0087, P0190, P0192 or P0193 is output	A
No DTC is output	B

B → END

A

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 8

7.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

8.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON.

e. Let the engine idle for 60 seconds, and then repeat quick engine speed accelerations (to 2500 rpm) for 30 seconds.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P0087, P0190, P0192 and/or P0193.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, increase idling time.

NEXT

END

DTC P0617 Starter Relay Circuit High

for Preparation Click here

DESCRIPTION

While the engine is being cranked, positive battery voltage is applied to terminal STA of the ECM.
If the ECM detects the starter control (STA) signal while the vehicle is being driven, it determines that there is a malfunction in the STA circuit. The ECM then illuminates the MIL and stores the DTC.
This monitor runs when the vehicle has been driven at 20 km/h (12.4 mph) or more for more than 20 seconds.

P0617

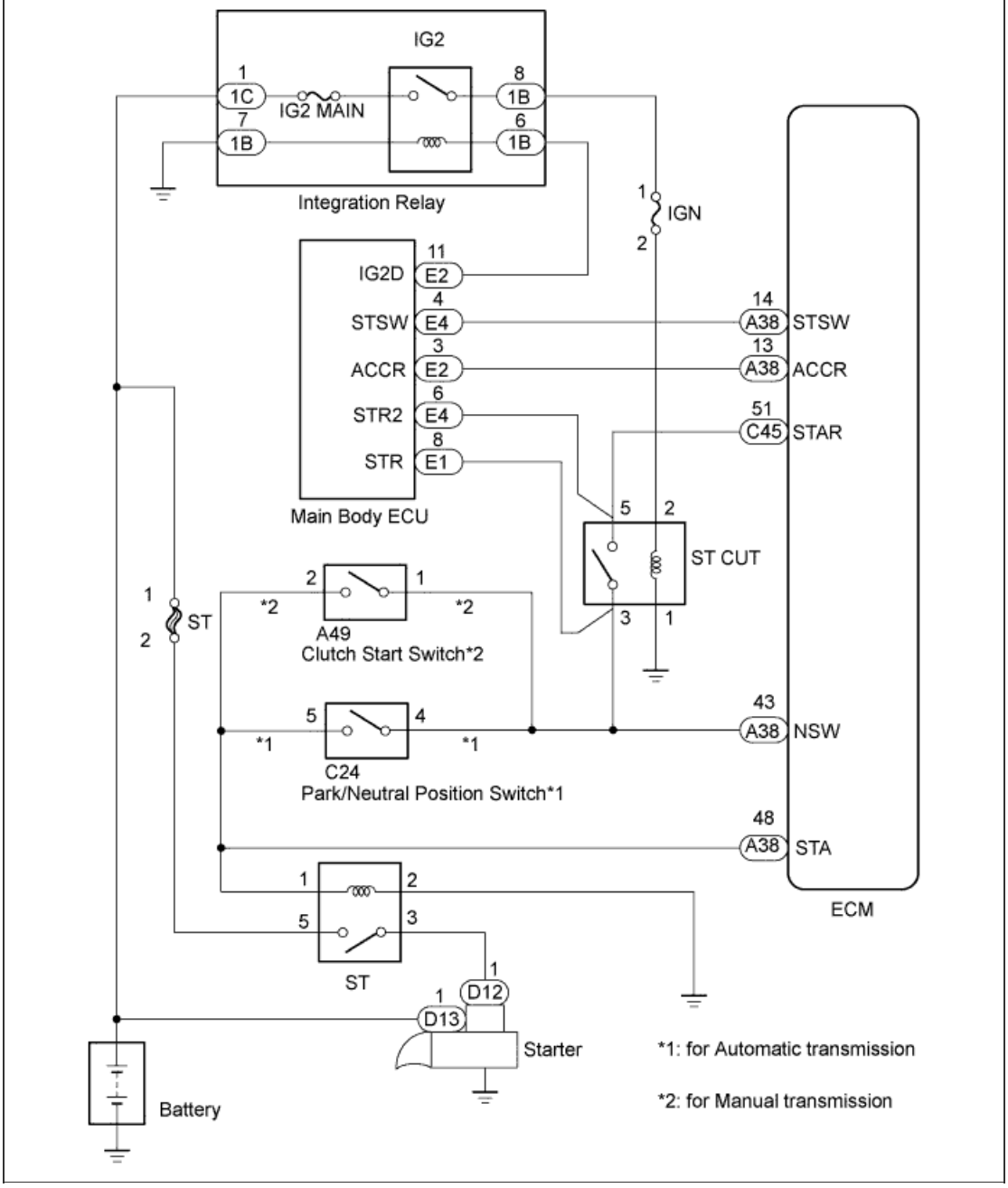
DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Drive vehicle for 25 seconds or more at a speed of 20 km/h (12.4 mph) or more and an engine speed of 1000 rpm or more	Conditions (a), (b) and (c) are met for 20 seconds (a) Vehicle speed is more than 20 km/h (12.4 mph). (b) Engine speed is more than 1000 rpm. (c) STA signal is on.	• Park/neutral position switch (A/T) • Starter relay circuit • Clutch start switch (M/T)

Related Data List

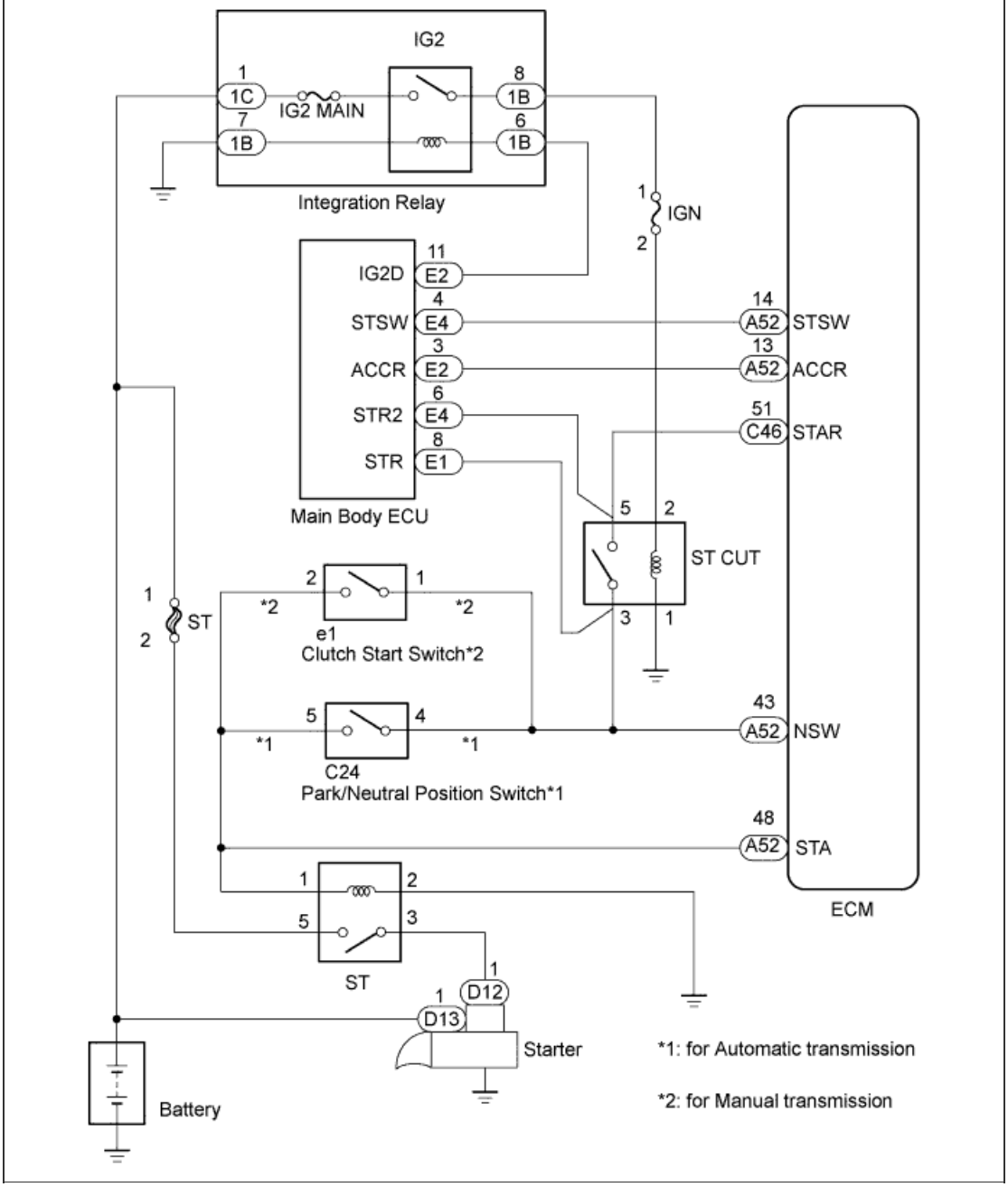
DTC No.	Data List
P0617	Starter Signal

WIRING DIAGRAM

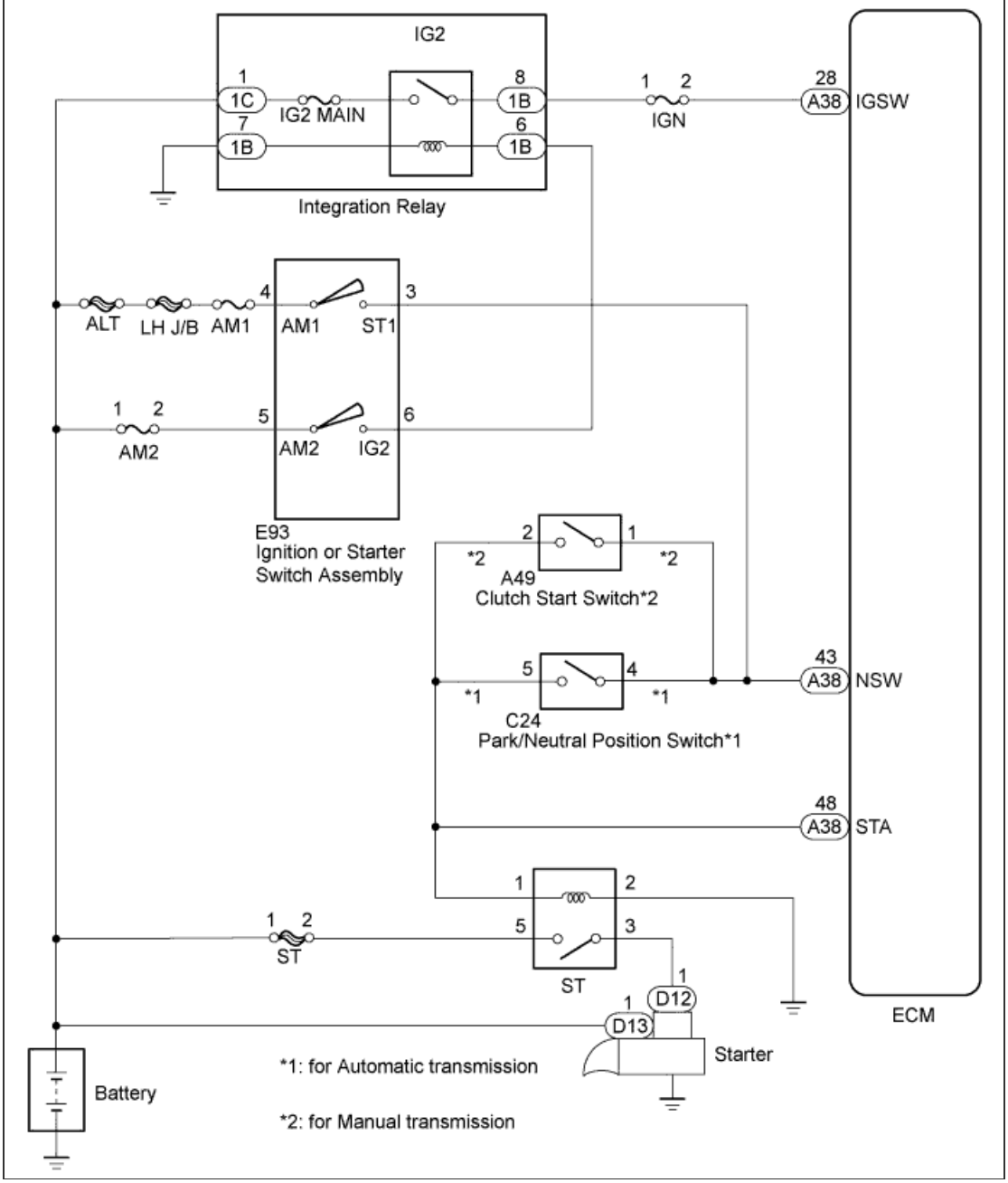
for LHD, w/ Entry and Start System:

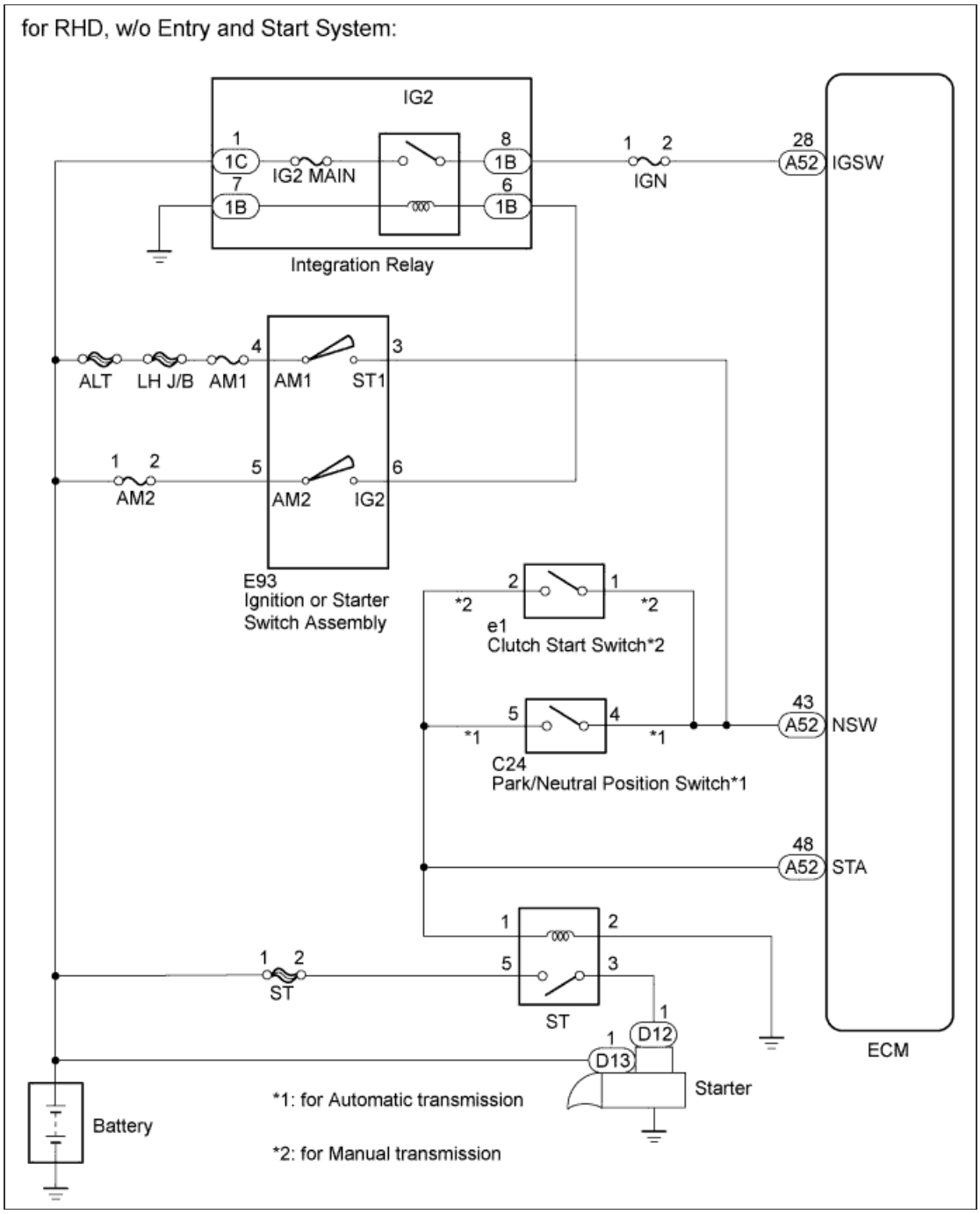


for RHD, w/ Entry and Start System:



for LHD, w/o Entry and Start System:





INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- **The following troubleshooting process is based on the premise that the engine can crank normally. If the engine does not crank, proceed to the Problem Symptoms Table (Click here).**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.CHECK IF VEHICLE IS EQUIPPED WITH ENTRY AND START SYSTEM

a. Check if the vehicle is e uipped with the entry and start system.

Result

Result	Proceed to
w/ Entry and Start System	A
w/o Entry and Start System	

B → Go to step 10

A

.READ VALUE USING INTELLIGENT TESTER (STARTER SIGNAL)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / All Data / Starter Signal.

d. Check the value displayed on the tester when the ignition switch is turned to and the engine is started.

OK:

Ignition Switch Condition	Starter Signal
Engine started	

Result

esult	Proceed to
NG (A/T)	A
NG (M/T)	
	C

B → Go to step 5

C → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

3.INSPECT PARK NEUTRAL POSITION SWITCH ASSEMBLY

a. Inspect the park/neutral position switch (Click here).

Result

Result	Proceed to
NG	A

B → Go to step 8

A

4.REPLACE PARK/NEUTRAL POSITION SWITCH ASSEMBLY

a. eplace the park/neutral position switch (Click here).

NEXT → Go to step 7

5.INSPECT CLUTCH START SWITCH

a. Check the clutch start switch (for LHD) (Click here).

b. Check the clutch start switch (for RHD) (Click here).

Result

Result	Proceed to
NG	A

B → Go to step

A

6.REPLACE CLUTCH START SWITCH

a. eplace the clutch start switch (for LHD) (Click here).

b. Replace the clutch start switch (for RHD) (Click here).

NEXT

7.READ VALUE USING INTELLIGENT TESTER (STARTER SIGNAL)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / All Data / Starter Signal.

d. Check the value displayed on the tester when the ignition switch is turned to and the engine is started.

OK:

Ignition Switch Condition	Starter Signal
Engine started	

Result

esult	Proceed to
NG	A

B → SYSTEM OK

A

8.CHECK HARNESS AND CONNECTOR (PNP SWITCH OR CLUTCH START SWITCH - STA TERMINAL OF ECM)

NG → REPLACE HARNESS OR CONNECTOR

OK

9.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to .

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Drive the vehicle at 20 km/h (12.4 mph) or more for 20 seconds or more.

f. Enter the following menus: Powertrain / Engine / DTC.

g. Read the DTCs.

Result

Display (DTC utput)	Proceed to
P0617	A
No output	

B → SYSTEM OK

A

GO TO CRANKING HOLDING FUNCTION CIRCUIT (Click here)

10.READ VALUE USING INTELLIGENT TESTER (STARTER SIGNAL)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / All Data / Starter Signal.

d. Check the value displayed on the tester when the ignition switch is turned to and the engine is started.

OK:

Ignition Switch Condition	Starter Signal
Engine started	

Result

esult	Proceed to
NG (A/T)	A
NG (M/T)	
	C

B → Go to step 13

C → CHECK FOR INTERMITTENT PROBLEMS (Click here)

A

11.INSPECT PARK NEUTRAL POSITION SWITCH ASSEMBLY

a. Inspect the park/neutral position switch (Click here).

Result

Result	Proceed to
NG	A

B → Go to step 15

A

12.REPLACE PARK/NEUTRAL POSITION SWITCH ASSEMBLY

a. eplace the park/neutral position switch (Click here).

NEXT → Go to step 17

13.INSPECT CLUTCH START SWITCH ASSEMBLY

a. Check the clutch start switch (for LHD) (Click here).

b. Check the clutch start switch (for RHD) (Click here).

Result

Result	Proceed to
NG	A

B → Go to step 15

A

14.REPLACE CLUTCH START SWITCH ASSEMBLY

a. eplace the clutch start switch (for LHD) (Click here).

b. Replace the clutch start switch (for RHD) (Click here).

NEXT → Go to step 17

15.INSPECT IGNITION OR STARTER SWITCH ASSEMBLY

a. Inspect the Ignition or Starter Switch Assembly (Click here).

Result

Result	Proceed to
NG	A

B → Go to step 18

A

16.REPLACE IGNITION OR STARTER SWITCH ASSEMBLY

a. eplace the Ignition or Starter Switch Assembly (Click here).

NEXT

17.READ VALUE USING INTELLIGENT TESTER (STARTER SIGNAL)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / All Data / Starter Signal.

d. Check the value displayed on the tester when the ignition switch is turned to and the engine is started.

OK:

Ignition Switch Condition	Starter Signal
Engine started	

Result

Result	Proceed to
NG	A

B → SYSTEM OK

A

1 .CHECK HARNESS AND CONNECTOR (PNP SWITCH OR CLUTCH START SWITCH - STA TERMINAL OF ECM)

NG → REPLACE HARNESS OR CONNECTOR

OK

19.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to .

c. Turn the tester on.

d. Clear the DTCs (Click here).

e. Drive the vehicle at 20 km/h (12.4 mph) or more for 20 seconds or more.

f. Enter the following menus: Powertrain / Engine / DTC.

g. Read the DTCs.

Result

Display (DTC utput)	Proceed to
P0617	A
No output	

B → SYSTEM OK

A

REPLACE ECM (**Click here**)

DTC P0088 Fuel Rail / System Pressure - Too High

for Preparation Click here

DESCRIPTION

Refer to System Description (Click here).

P0088

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After idling for 60 seconds, repeat quick engine speed accelerations (to 2500 rpm) for 30 seconds	The fuel pressure of common rail is too high The fuel pressure exceeds 230 MPa (2345 kgf/cm^2, 33358 psi) (1 trip detection logic).	• Fuel supply pump (suction control valve) • Pressure limiter (common rail (for Bank 2)) • Open or short in fuel supply pump (suction control valve) circuit • ECM

Related Data List

DTC No.	Data List
P0088	• Fuel Press • Target Common Rail Pressure • Injection Pressure Correction • Target Pump SCV Current

HINT:

- **For more information on the fuel supply pump (suction control valve) and common rail system, refer to System Description (Click here).**
- **When DTC P0088 is stored, check the internal fuel pressure of the common rail by entering the following menus: Powertrain / Engine / Data List / Fuel Press.**

  Reference

Engine Speed	Fuel Press
Idling	Approximately 27 to 37 MPa
2500 rpm (No engine load)	Approximately 50 to 70 MPa

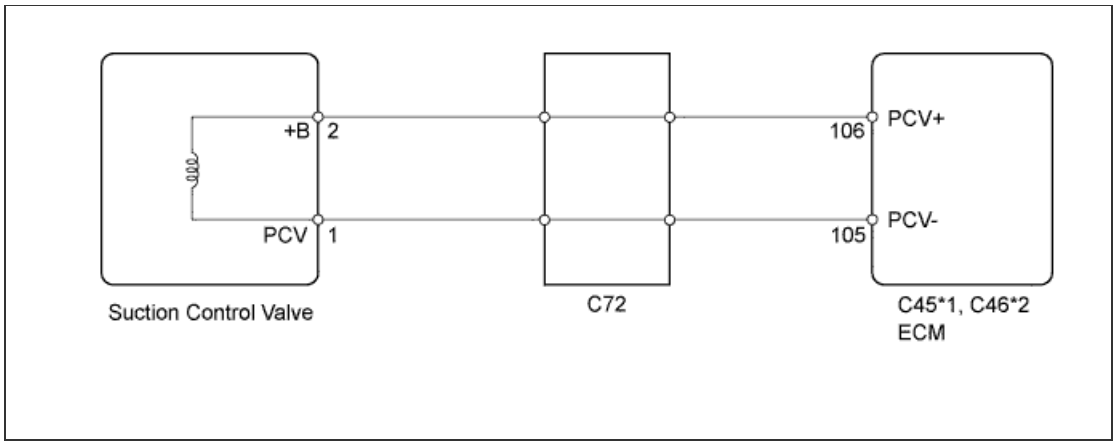
- **When there is an operating problem with the fuel supply pump (when Fuel Press is more than Target Common Rail Pressure due to a problem with the closing of the suction valve), the values of Injection Pressure Correction and Target Pump SCV Current decrease.**

MONITOR DESCRIPTION

P0088 (Internal fuel pressure too high):

The ECM stores this DTC if the fuel pressure inside the common rail is more than 230 MPa (2345 kgf/cm ^{2}, 33350 psi). This DTC indicates that: 1) the suction control valve may be stuck open, or 2) there may be a short in the suction control valve circuit.
If this DTC is stored, the ECM enters fail-safe mode and limits the engine power. The fail-safe mode continues until the ignition switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

- **After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).**
- **After replacing the fuel supply pump, the ECM needs initialization (Click here).**

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.INSPECT FUEL SUPPLY PUMP (SUCTION CONTROL VALVE)

a. Disconnect the suction control valve connector and then start the engine.

OK:
Engine does not start.

NG → Go to step 6

OK

2.READ VALUE USING INTELLIGENT TESTER

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine / Data List / Target Pump SCV Current.

e. Read the value.

Standard

Engine Speed	Target Pump SCV Current
Idling	923 to 1123 mA
2500 rpm (No engine load)	1013 to 1212 mA

NG → Go to step 6

OK

3.READ VALUE USING INTELLIGENT TESTER (FUEL PRESS)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine / Data List / Fuel Press, Target Common Rail Pressure.

e. Check the difference in pressure between Fuel Press and Target Common Rail Pressure.

OK:

Difference in pressure between Fuel Press and Target Common Rail Pressure is within +/-5 MPa.

NG	Go to step 5

OK

4.REPLACE PRESSURE LIMITER (COMMON RAIL (for Bank 2))

a. Replace the common rail (for Bank 2) (Click here).

NEXT	Go to step 10

5.CHECK HARNESS AND CONNECTOR (SUCTION CONTROL VALVE CONNECTOR - ECM)

a. Disconnect the suction control valve connector.

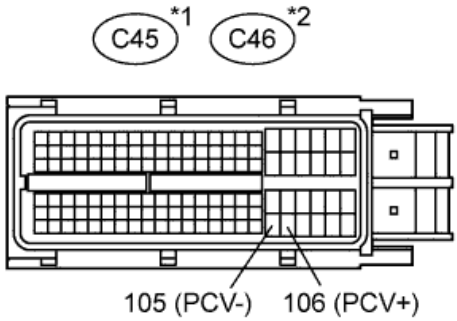
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Suction Control Valve)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for open):

for LHD

Tester Connection	Condition	Specified Condition
Suction control valve-1 (PCV) - C45-105 (PCV-)	Always	Below 1 Ω

Suction control valve-2 (+B) - C45-106 (PCV+)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
Suction control valve-1 (PCV) - C46-105 (PCV-)	Always	Below 1 Ω
Suction control valve-2 (+B) - C46-106 (PCV+)	Always	Below 1 Ω

Standard Resistance (Check for short):

for LHD

Tester Connection	Condition	Specified Condition
Suction control valve-1 (PCV) or C45-105 (PCV-) - Body ground	Always	10 kΩ or higher
Suction control valve-2 (+B) or C45-106 (PCV+) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
Suction control valve-1 (PCV) or C46-105 (PCV-) - Body ground	Always	10 kΩ or higher
Suction control valve-2 (+B) or C46-106 (PCV+) - Body ground	Always	10 kΩ or higher

NG → Go to step 9

OK

6.REPLACE FUEL SUPPLY PUMP

a. Replace the fuel supply pump (Click here).

NEXT

7.CHECK DTC OUTPUT

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Start the engine.

e. After idling for 60 seconds, repeat engine speed accelerations (from idling to 2500 rpm) for 30 seconds.

f. Enter the following menus: Powertrain / Engine / DTC.

g. Read the DTCs.

Result

Display (DTC output)	Proceed to
P0088 is output	A
No DTC is output	B

B → END

A

8.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 10

9.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

10.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON and start the engine.

e. After idling for 60 seconds, repeat engine speed accelerations (from idling to 2500 rpm) for 30 seconds.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P0088.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, race the engine to 2500 rpm repeatedly for 30 seconds and increase idling time.

NEXT

END

DTC P0627 Fuel Pump Control Circuit / Open

for Preparation Click here

DESCRIPTION

Refer to the System Description (Click here).

P0627

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Idling for 1 second	Even though the CPU (command area inside ECU) is outputting the suction control valve operation duty, the output monitor signal is absent for 0.5 seconds (1 trip detection logic).	• Open or short in suction control valve circuit • Suction control valve • ECM

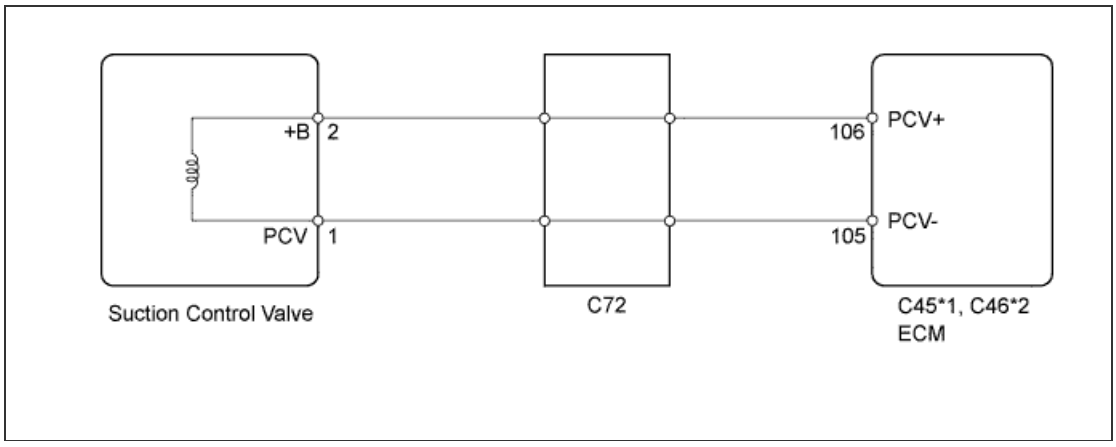
Related Data List

DTC No.	Data List
P0627	Fuel Press

HINT:

- **For more information on the fuel supply pump (suction control valve) and the common rail system, refer to the System Description (Click here).**
- **When DTC P0627 is stored, check the internal fuel pressure of the common rail by entering the following menus on the intelligent tester: Powertrain / Engine / Data List / Fuel Press.**
  Under a stable operating condition such as idling, Fuel Press is within +/-5 MPa of Target Common Rail Pressure.

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

- **After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).**
- **After replacing the fuel supply pump, the ECM needs initialization (Click here).**

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

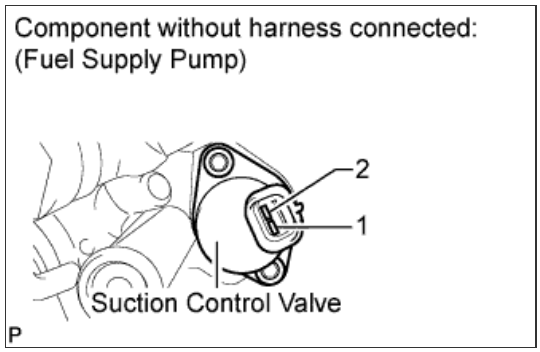
1.INSPECT FUEL SUPPLY PUMP (SUCTION CONTROL VALVE)

a. Disconnect the suction control valve connector.

b. Measure the resistance according to the value(s) in the table belo .

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	1.9 to 2.3 Ω



NG → Go to step 4

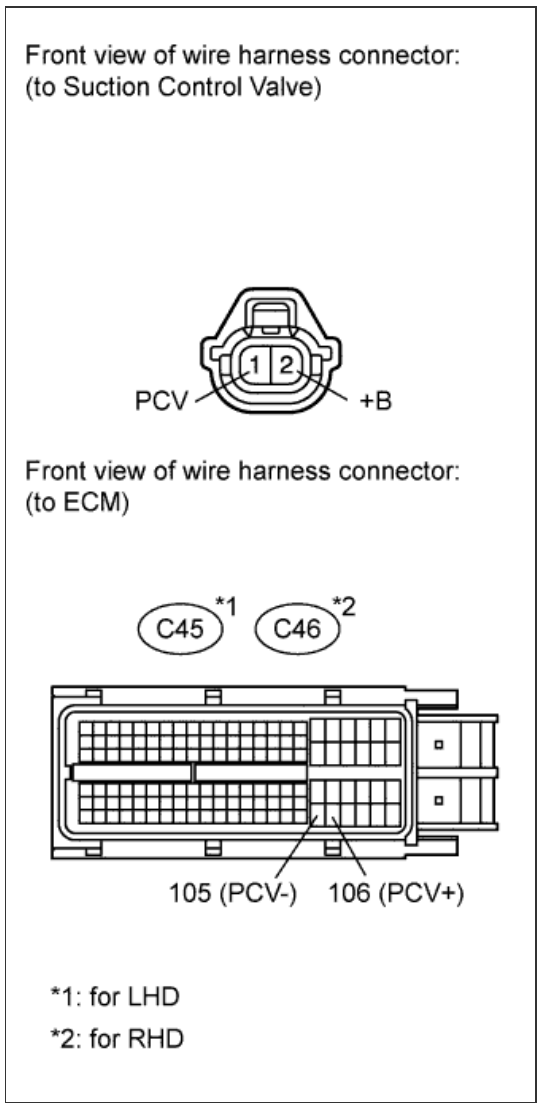
OK

2.CHECK HARNESS AND CONNECTOR (SUCTION CONTROL VALVE - ECM)

a. Disconnect the suction control valve connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
Suction control valve connector-1 (PCV) - C45-105 (PCV-)	Always	Below 1 Ω
Suction control valve connector-2 (+B) - C45-106 (PCV+)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
Suction control valve connector-1 (PCV) - C46-105 (PCV-)	Always	Below 1 Ω
Suction control valve connector-2 (+B) - C46-106 (PCV+)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
Suction control valve connector-1 (PCV) or C45-105 (PCV-) - Body ground	Always	10 kΩ or higher
Suction control valve connector-2 (+B) or C45-106 (PCV+) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
Suction control valve connector-1 (PCV) or C46-105 (PCV-) - Body ground	Always	10 kΩ or higher
Suction control valve connector-2 (+B) or C46-106 (PCV+) - Body ground	Always	10 kΩ or higher

NG → Go to step 5

OK

3.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Start the engine and idle it for 1 second.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

Result

Result	Proceed to
P0627 is output	A
No DTC is output	B

A → Go to step 6

B → END

4.REPLACE FUEL SUPPLY PUMP

a. Replace the fuel supply pump (Click here).

NEXT → Go to step 7

5.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT → Go to step 7

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 7

7.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Start the engine and idle it for 1 second.

e. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P0627.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, increase idling time.

NEXT

END

DTC P0093 Fuel System Leak Detected - Large Leak

for Preparation Click here

DESCRIPTION

Refer to System Description (Click here).

P0093

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After idling for 60 seconds, run engine at 2500 rpm for 30 seconds	The fuel pressure decreases greatly when the engine is running (1 trip detection logic).	• Fuel line between fuel supply pump and common rail • Fuel line between common rail and fuel in etor • Fuel supply pump • Common rail (for Bank 2) (pressure limiter) • Fuel in etor (P1238 set simultaneously) • Open or short in EDU circuit (P062D and/or P062E set simultaneously) • Open or short in fuel in etor circuit (P062D, P062E and/or P1238 set simultaneously) • EDU (P062D and/or P062E set simultaneously) • Fuel line (air bleeding) • ECM

Related Data List

DTC No.	Data List
P0093	• Fuel Press • Target Common Rail Pressure • In etion Pressure Correction • Target Pump SCV Current

HINT:

- **For more information on the common rail system, refer to System Description (Click here).**
- **If DTC P0093 is present, refer to the "Diagnostic Trouble Code (DTC) Table for Common Rail System" (Click here).**
- **When DTC P0093 is stored, check the internal fuel pressure of the common rail by entering the following menus: Powertrain / Engine / Data List / Fuel Press.**

  Reference

Engine Speed	Fuel Press
Idling	Approximately 27 to 37 MPa
2500 rpm (No engine load)	Approximately 50 to 70 MPa

- **When there is an operating problem with the fuel supply pump (Fuel Press is less than Target Common Rail Pressure), the values of Injection Pressure Correction and Target Pump SCV Current will increase.**

MONITOR DESCRIPTION

P0093 (Fuel leaks in high-pressure areas):
This DTC indicates that fuel leaks exist in highly-pressurized areas in the common rail system. The ECM constantly monitors the internal fuel pressure of the common rail after the engine is started. The ECM stores this DTC if the drop in the internal fuel pressure is large when the fuel is in eted.
In the common rail system, high-pressure fuel is always supplied to the high-pressure areas including the fuel supply pump, common rail, fuel in etors, and piping. The ECM ad usts the suction control valve opening angle to obtain the desired fuel pressure.
If this DTC is stored, the ECM enters fail-safe mode. The fail-safe mode suspends both fuel in etion and fuel supply pump operation, and then stops the engine. Before stopping the engine, the ECM permits the vehicle to be driven for 60 seconds. The fail-safe mode continues until the ignition switch is turned to off.

INSPECTION PROCEDURE

NOTICE:

- **After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).**
- **After replacing the fuel supply pump, the ECM needs initialization (Click here).**
- **After replacing the fuel injector, the ECM needs registration (Click here).**

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0093)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read the DTCs.

Result

Display (DTC Output)	Proceed to
P0093 is output	A
P0093 and other DTCs are output	B

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (FUEL LEAK TEST)

HINT:

By performing this Active Test, the engine speed is maintained at 2000 rpm and the common rail internal fuel pressure is raised to the maximum operating pressure. As a result, a fuel leak check can be conducted while retaining the high common rail pressure.

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Active Test / Test the Fuel Leak.

d. Visually check the fuel supply pump, fuel in etor and fuel line located between the fuel supply pump and common rail for fuel leaks and fuel pressure leaks. Also, perform the same check on the fuel line between the common rail and the fuel in etor.

OK:
No leakage.

NG → Go to step 9

OK

3.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (FUEL LEAK TEST)

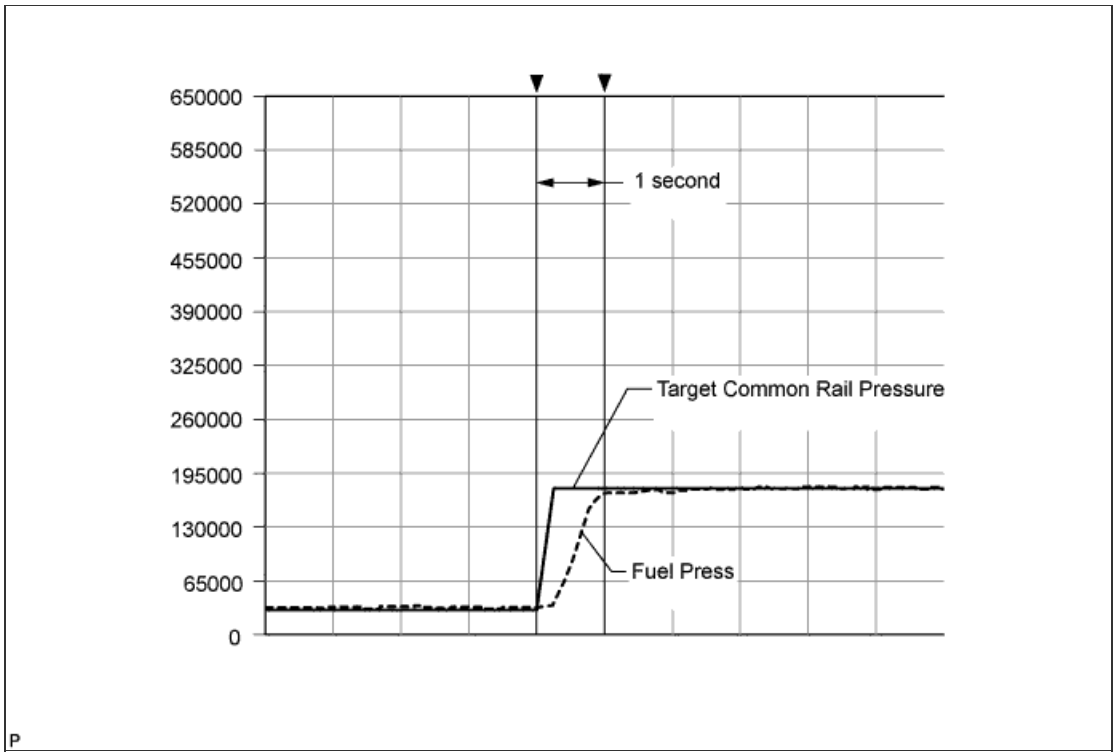
a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Active Test / Test the Fuel Leak / Data List / Fuel Press and Target Common Rail Pressure.

d. When the Active Test is started, check that Fuel Press follows Target Common Rail Pressure and that the fuel pressure increases.

OK:
Fuel pressure reaches target pressure within 1 second.



OK	o to step 8
NG	Go to step 4

4.CHECK WHETHER DTC OUTPUT RECURS (DTC P0093)

a. Check the fuel receiver gauge. If the indicator is illuminated, add fuel.

b. Operate the hand pump of the fuel filter, and bleed air from the fuel line.

c. Connect the intelligent tester to the DLC3.

d. Clear the DTCs (Click here).

e. Start the engine, and accelerate the engine at full throttle several times.

f. Enter the following menus: Powertrain / Engine / DTC.

g. Read the DTCs.

Result

Result	Proceed to
P0093 is output	A
No DTC is output	B

B	Go to step 10

A

5.CHECK WHETHER DTC OUTPUT RECURS (DTC P0093)

a. Start the engine, and allow the engine to idle for 20 seconds or more.

b. Stop the engine, and wait for 15 seconds or more.

c. Perform the procedures above 3 times or more in succession.

d. Enter the following menus: Powertrain / Engine / DTC.

e. Read the DTCs.

Result

Result	Proceed to
P0093 is output	A
No DTC is output	B

HINT:

If the MIL turns off, accelerate the engine at full throttle several times.

B → Go to step 10

A

6.READ VALUE USING INTELLIGENT TESTER (COMPENSATORY INJECTION VOLUME FOR EACH CYLINDER)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Start the engine.

d. After warming up the engine (engine coolant temperature is 75°C (167°F) or more), idle the engine (A/C off and electrical load off) for 1 minute or more.

e. Enter the following menus: Powertrain / Engine / Data List / In etion Feedback Val #1 to #8.

f. Read the values.

OK:

Compensatory injection volume is between -3.0 mm^3/st to 3.0 mm^3/st.

HINT:

- **If the fuel injector is malfunctioning, the compensatory injection volume remains at -5.0 mm^3/st or 5.0 mm^3/st.**
- **The compensatory injection volume is usually between -3.0 mm^3/st to 3.0 mm^3/st.**
- **Any cylinders that have a higher compensatory injection volume than shown above are considered to be faulty.**

NG → Go to step 11

OK

7.REPLACE FUEL SUPPLY PUMP

a. Replace the fuel supply pump (Click here).

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS (DTC P0093 OUTPUT AREA)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Allow the engine to idle for 1 minute and then run it at 2500 rpm for 30 seconds.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

Result

Result	Proceed to
No DTC is output	A
P0093 is output	B

B → Go to step 12

A

END

9.REPAIR OR REPLACE FUEL LEAKAGE POINT

NEXT → Go to step 13

10.DTC CAUSED BY RUNNING OUT OF FUEL

NEXT → Go to step 13

11.REPLACE FUEL INJECTOR

a. Replace the fuel in etor (Click here).

NEXT → Go to step 13

12.REPLACE ECM

a. Replace the ECM (Click here).

NEXT

13.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON and start the engine.

e. Allow the engine to idle for 1 minute and then run it at 2500 rpm for 30 seconds.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC udgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P0093.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, maintain the engine at 2500 rpm for 30 seconds and then increase idling time.

NEXT

END

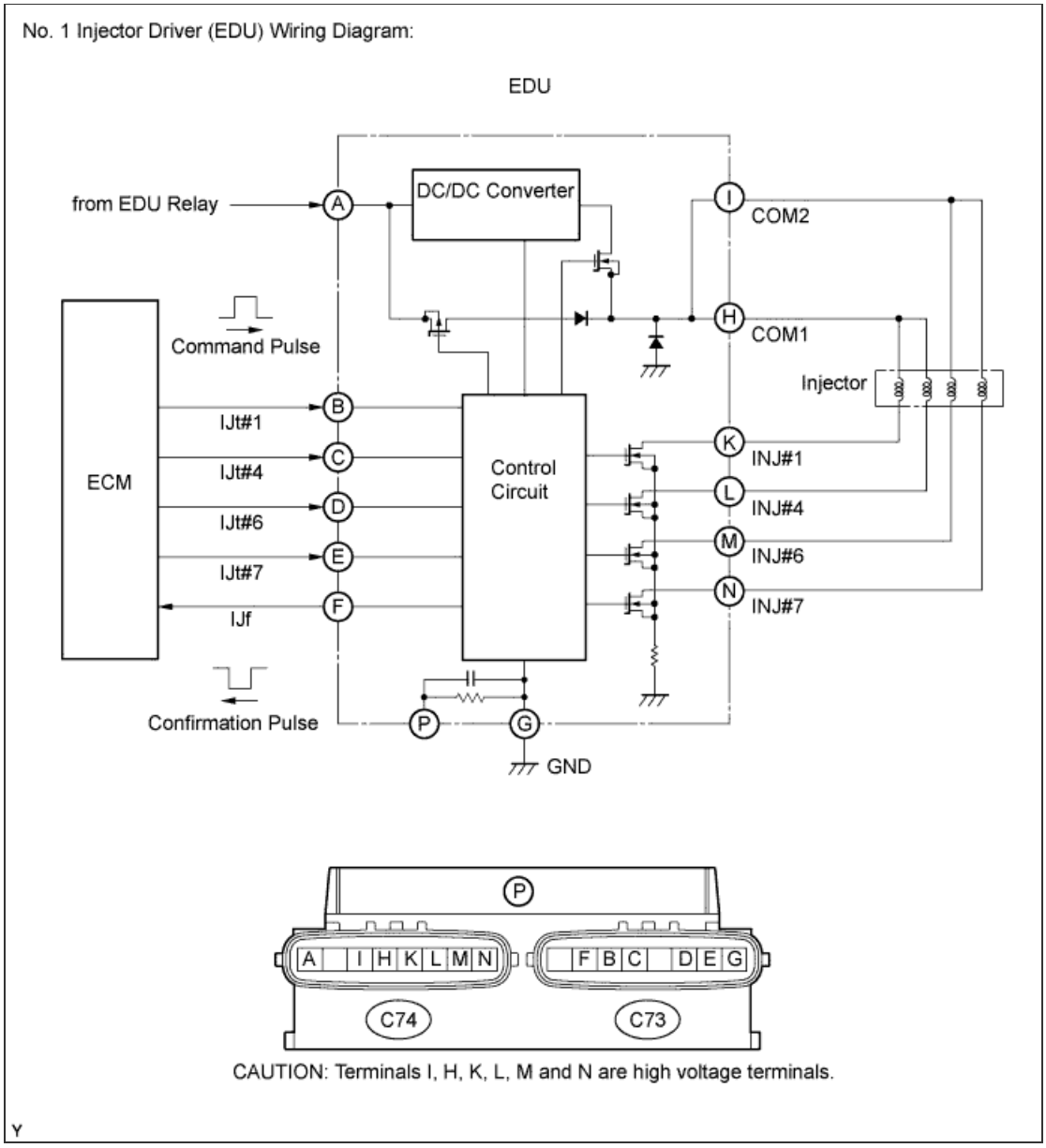
DTC P062D Fuel Injector Driver Circuit Performance Bank1

DTC P062E Fuel Injector Driver Circuit Performance Bank2

for Preparation Click here

DESCRIPTION

The EDU delivers drive signals to fuel injectors using the DC/DC converter, which provides a high-voltage and quick-charging system.
Soon after the EDU receives a fuel injection command (IJT) signal from the ECM, the EDU responds to the command with an injector injection confirmation (IJF) signal when the current is applied to the fuel injector.



P062D

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Idling for 10 seconds	Open or short in the No. 1 injector driver (EDU) or fuel injector circuit (1 trip detection logic).	• Open or short in No. 1 injector driver (EDU) circuit • Fuel injector • No. 1 EDU • ECM

P062E

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
		• Open or short in No. 2 injector driver

Idling for 10 seconds	Open or short in the No. 2 injector driver (EDU) or fuel injector circuit (1 trip detection logic).	• Open or short in No. 2 injector driver (EDU) circuit • Fuel injector • No. 2 EDU • ECM

MONITOR DESCRIPTION

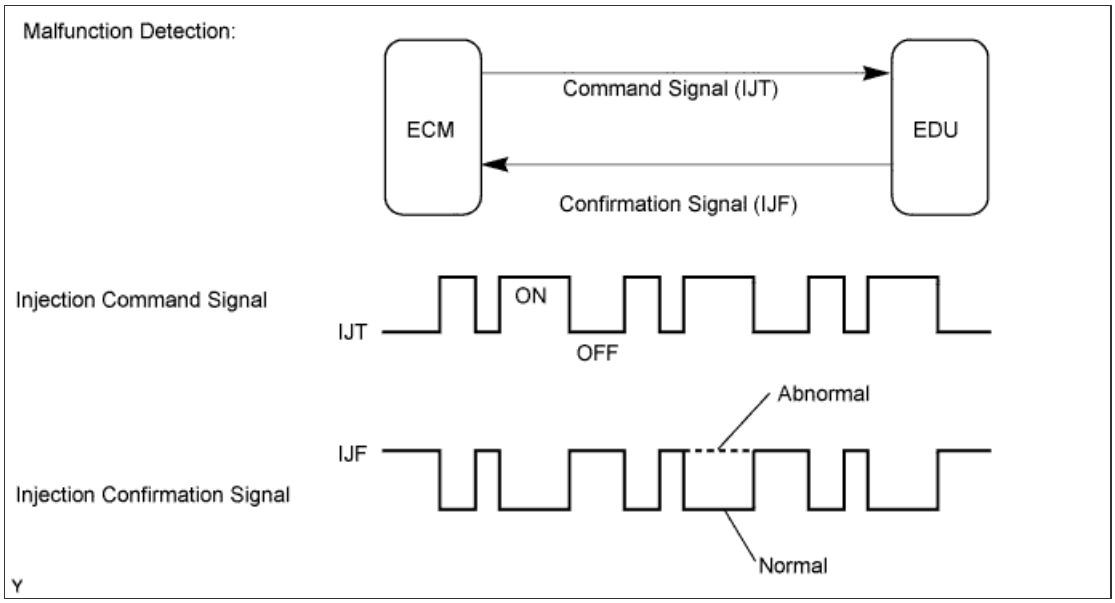
P062D, P062E (Open or short in EDU or fuel injector circuit):

The ECM continuously monitors both injection command (IJT) signals and injection confirmation (IJF) signals. This DTC will be stored if the ECM determines that the number of IJT signals and IJF signals are inconsistent.

The fuel injectors are grounded over a Field Effect Transistor (FET) and a serial resistor. This resistor creates a voltage drop, which is monitored by the EDU (injector drive circuit) in relation to the current drawn by the fuel injector. When the fuel injector current becomes too high, the voltage drop over the resistor exceeds a specified level and no IJF signal for that cylinder is sent to the ECM.

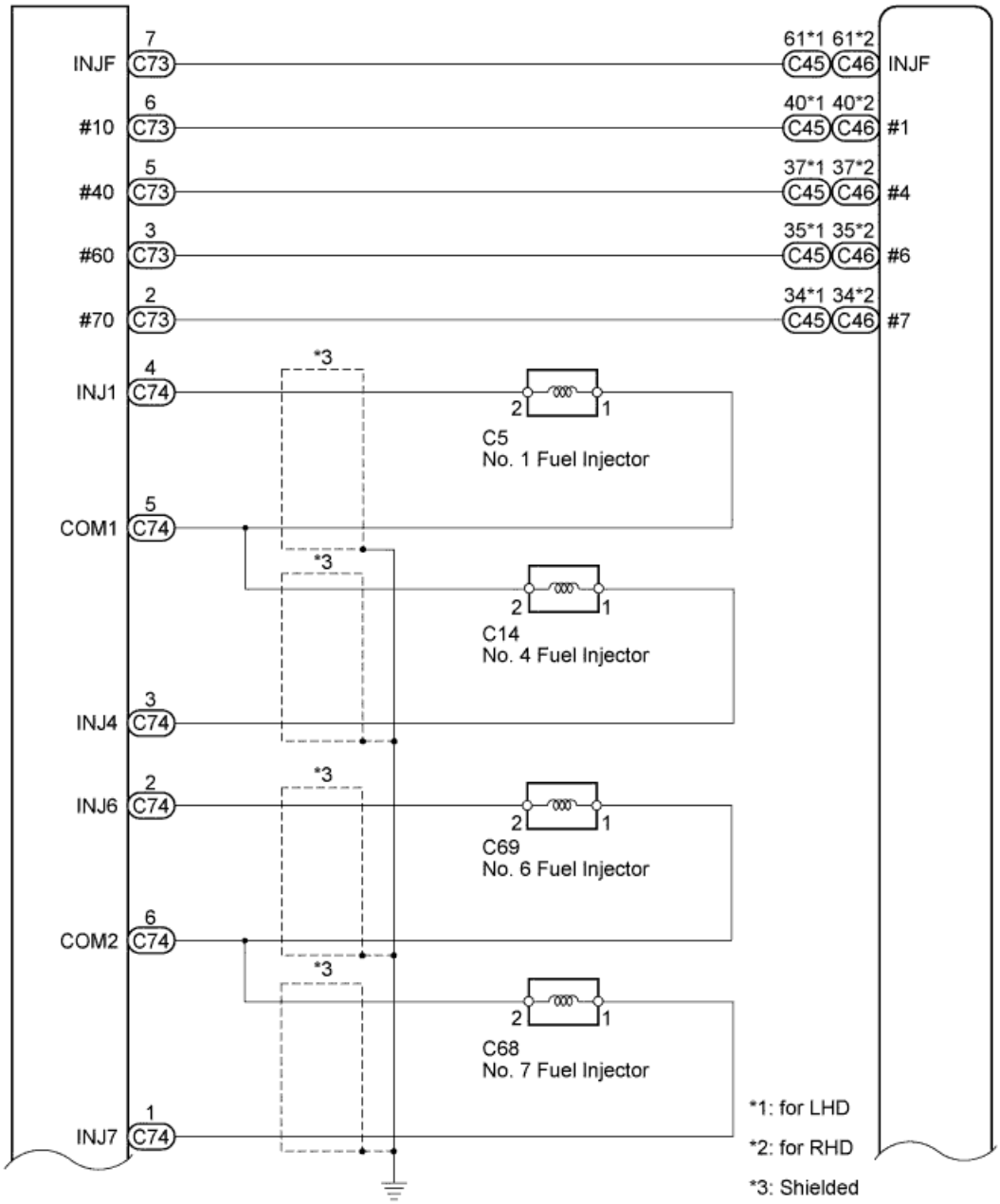
After the engine is started, when there is no injection confirmation (IJF) signal from the No. 1 or No. 2 EDU to the ECM even though the ECM sends injection command (IJT) signals to the No. 1 or No. 2 EDU, DTC P062D or DTC P062E is stored.

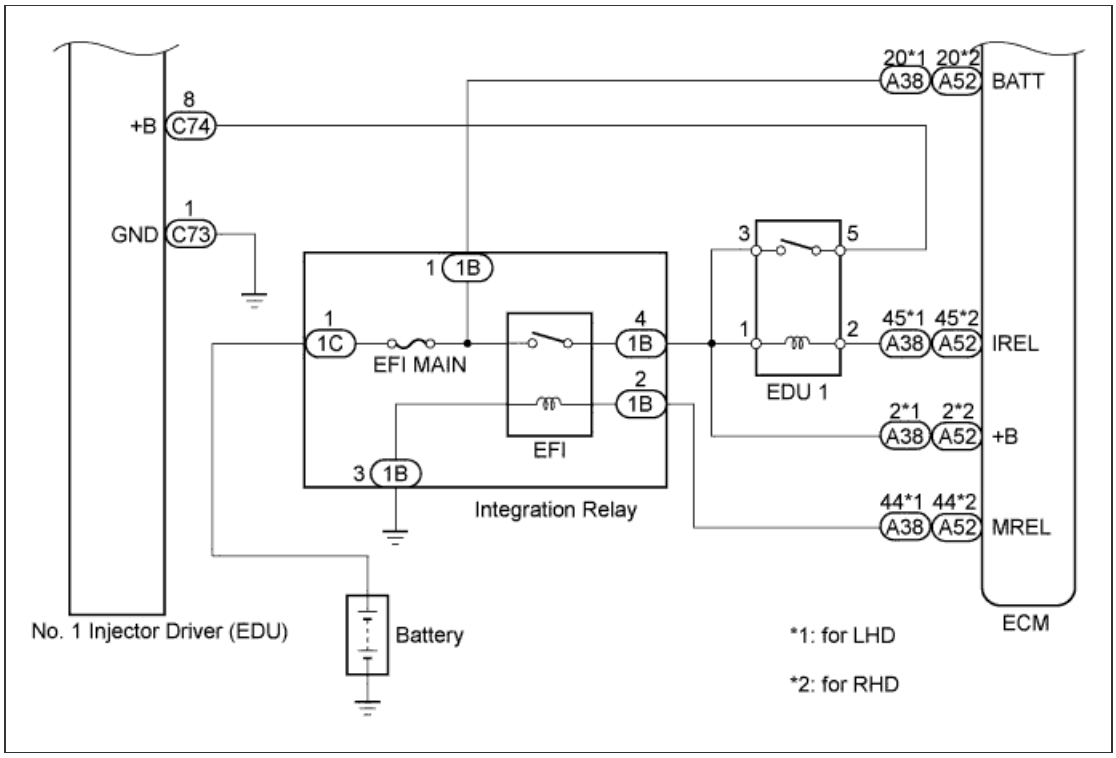
If this DTC is stored, the ECM enters fail-safe mode and limits engine power or stops the engine. The fail-safe mode continues until the ignition switch is turned off.



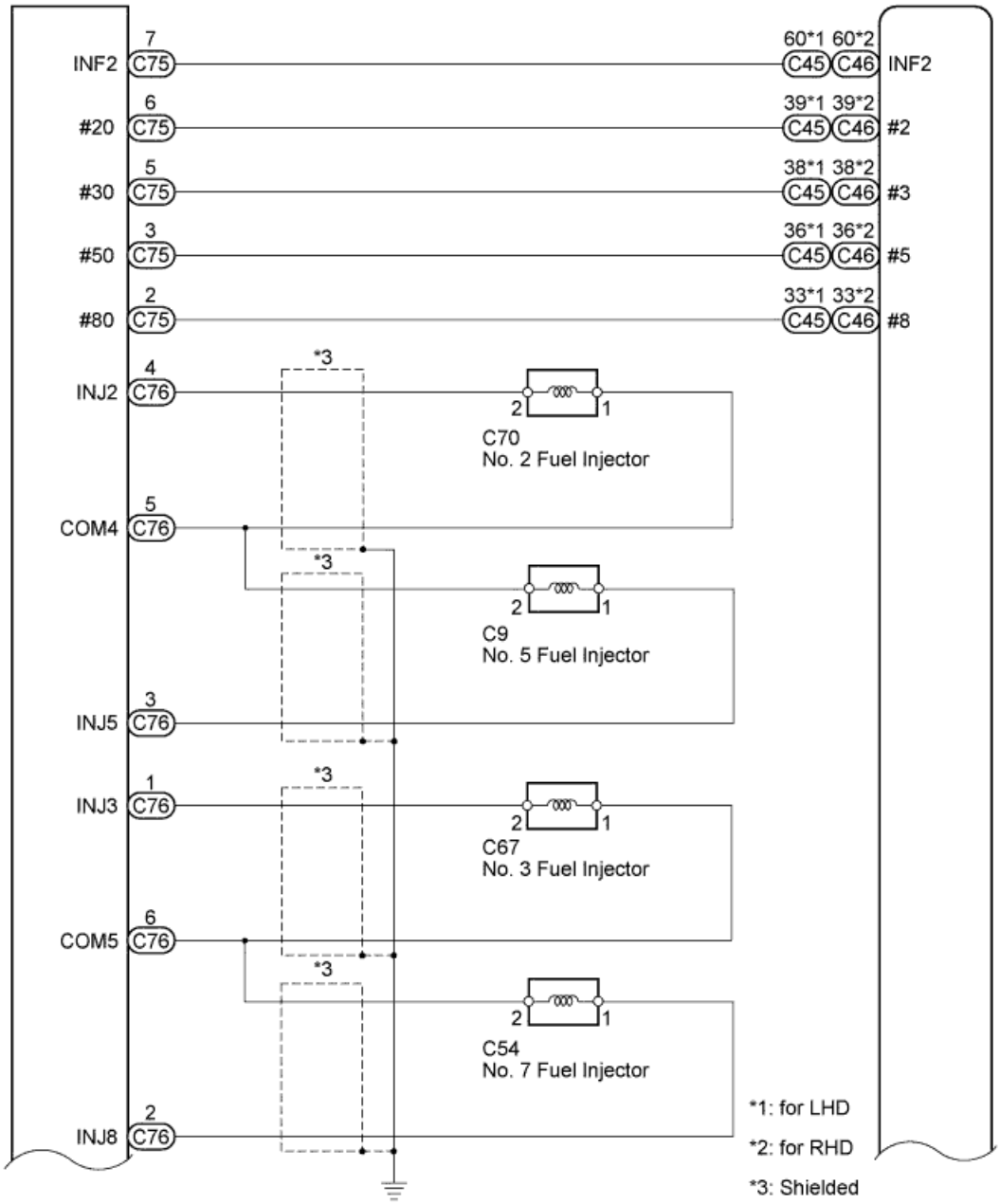
WIRING DIAGRAM

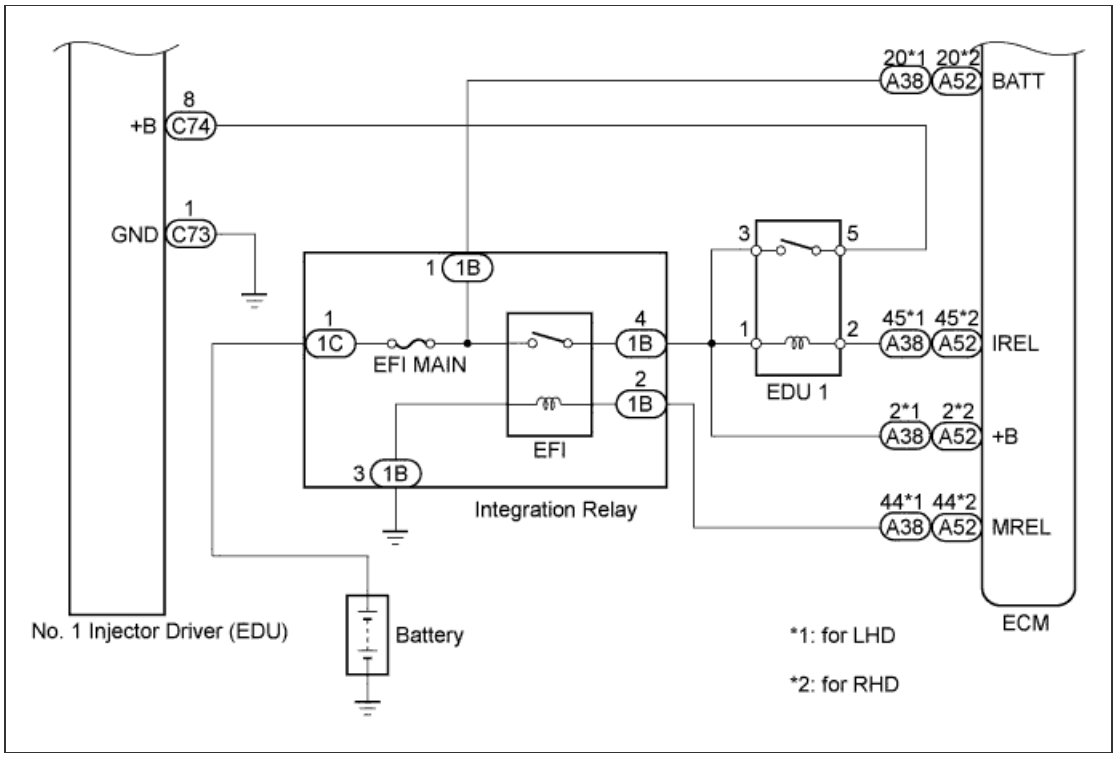
No. 1:


INJF
7
C73
61*1 61*2
C45 C46
INJF
#10
6
C73
40*1 40*2
C45 C46
#1
#40
5
C73
37*1 37*2
C45 C46
#4
#60
3
C73
35*1 35*2
C45 C46
#6
#70
2
C73
34*1 34*2
C45 C46
#7
INJ1
4
C74
*3
2
1
C5
No. 1 Fuel Injector
COM1
5
C74
*3
2
1
C14
No. 4 Fuel Injector
INJ4
3
C74
INJ6
2
C74
*3
2
1
C69
No. 6 Fuel Injector
COM2
6
C74
*3
2
1
C68
No. 7 Fuel Injector
INJ7
1
C74
*1: for LHD
*2: for RHD
*3: Shielded


20*1 20*2
A38 A52
BATT
8
+B C74
1
GND C73
1 1B
1
1C
EFI MAIN
4
1B
2
1B
EFI
3 1B
Integration Relay
3
5
1
2
EDU 1
45*1 45*2
A38 A52
IREL
2*1 2*2
A38 A52
+B
44*1 44*2
A38 A52
MREL
ECM
No. 1 Injector Driver (EDU)
Battery
*1: for LHD
*2: for RHD

No. 2:


INF2
7
C75
60*1 60*2
C45 C46
INF2
#20
6
C75
39*1 39*2
C45 C46
#2
#30
5
C75
38*1 38*2
C45 C46
#3
#50
3
C75
36*1 36*2
C45 C46
#5
#80
2
C75
33*1 33*2
C45 C46
#8
INJ2
4
C76
*3
2
1
C70
No. 2 Fuel Injector
COM4
5
C76
*3
2
1
C9
No. 5 Fuel Injector
INJ5
3
C76
INJ3
1
C76
*3
2
1
C67
No. 3 Fuel Injector
COM5
6
C76
*3
2
1
C54
No. 7 Fuel Injector
INJ8
2
C76
*1: for LHD
*2: for RHD
*3: Shielded



INSPECTION PROCEDURE

NOTICE:

- **After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).**
- **After replacing a fuel injector, the ECM needs registration (Click here).**

HINT:

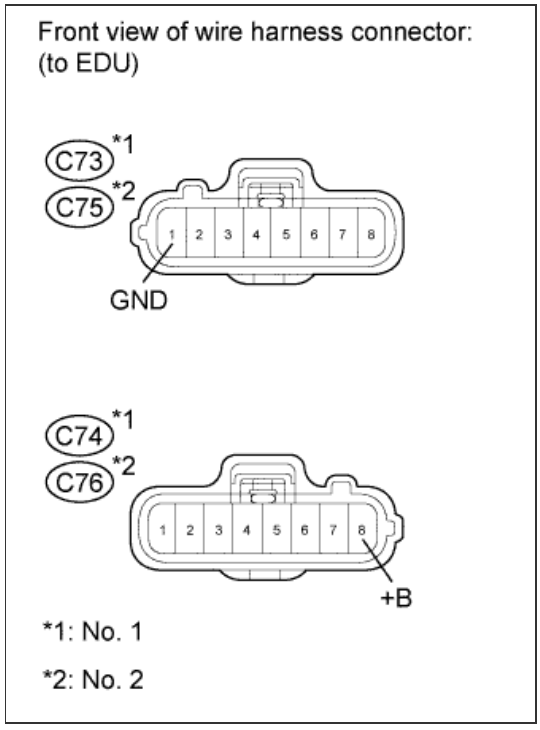
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.CHECK TERMINAL VOLTAGE EDU POWER SOURCE

a. Disconnect the No. 1 injector driver (EDU) connectors.

b. Disconnect the No. 2 injector driver (EDU) connectors.

c. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

No. 1

Tester Connection	Switch Condition	Specified Condition
C74-8 (+B) - C73-1 (GND)	Ignition switch ON	11 to 14 V

No. 2

Tester Connection	Switch Condition	Specified Condition
C76-8 (+B) - C75-1 (GND)	Ignition switch ON	11 to 14 V

NG → Go to step 7

OK

2.INSPECT INJECTOR DRIVER (No. 1 and No. 2)

a. Interchange the No. 1 and No. 2 EDU connectors.

b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON and turn the tester on.

d. Clear the DTCs (Click here).

NOTICE:

Before clearing the DTCs, write them down.

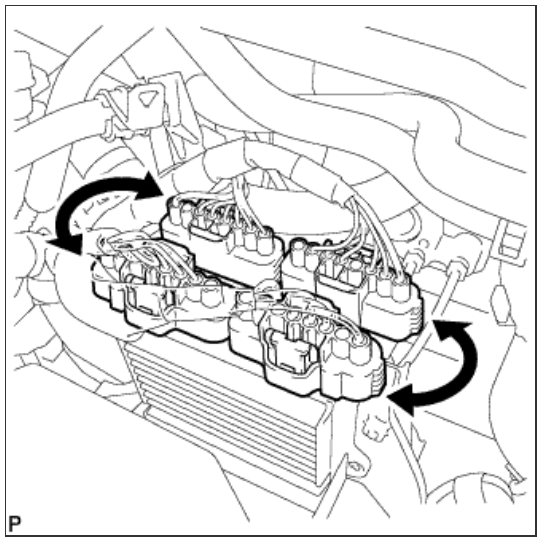
e. Start the engine.

f. Enter the following menus: Powertrain / Engine / DTC.

g. Read the DTCs.

Result

Result	Proceed to
DTCs do not change	A
DTCs change (change in malfunctioning cylinder or EDU code)	B



B → Go to step 8

A

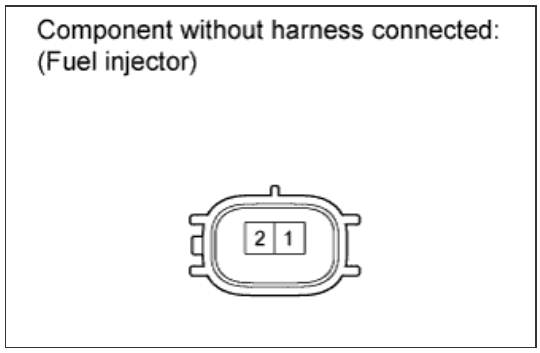
3.INSPECT FUEL INJECTOR (RESISTANCE)

a. Disconnect the fuel injector connectors.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	0.85 to 1.05 Ω



NG → Go to step 9

OK

4.CHECK HARNESS AND CONNECTOR (FUEL INJECTOR - EDU)

a. Disconnect the fuel injector connectors.

b. Disconnect the No. 1 EDU connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

No. 1

Tester Connection	Condition	Specified Condition
C5-2 - C74-4 (INJ1)	Always	Below 1 Ω
C14-2 - C74-3 (INJ4)	Always	Below 1 Ω
C69-2 - C74-2 (INJ6)	Always	Below 1 Ω
C68-2 - C74-1 (INJ7)	Always	Below 1 Ω
C5-1 - C74-5 (COM1)	Always	Below 1 Ω
C14-1 - C74-5 (COM1)	Always	Below 1 Ω
C69-1 - C74-6 (COM2)	Always	Below 1 Ω
C68-1 - C74-6 (COM2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

No. 1

Tester Connection	Condition	Specified Condition
C5-2 or C74-4 (INJ1) - Body ground	Always	10 kΩ or higher
C14-2 or C74-3 (INJ4) - Body ground	Always	10 kΩ or higher
C69-2 or C74-2 (INJ6) - Body ground	Always	10 kΩ or higher
C68-2 or C74-1 (INJ7) - Body ground	Always	10 kΩ or higher
C5-1 or C74-5 (COM1) - Body ground	Always	10 kΩ or higher
C14-1 or C74-5 (COM1) - Body ground	Always	10 kΩ or higher
C69-1 or C74-6 (COM2) - Body ground	Always	10 kΩ or higher
C68-1 or C74-6 (COM2) - Body ground	Always	10 kΩ or higher

d. Disconnect the fuel injector connectors.

e. Disconnect the No. 2 EDU connector.

f. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

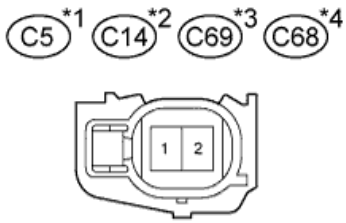
No. 2

Tester Connection	Condition	Specified Condition
C70-2 - C76-4 (INJ2)	Always	Below 1 Ω
C9-2 - C76-3 (INJ5)	Always	Below 1 Ω
C67-2 - C76-1 (INJ3)	Always	Below 1 Ω
C54-2 - C76-2 (INJ8)	Always	Below 1 Ω
C70-1 - C76-5 (COM4)	Always	Below 1 Ω
C9-1 - C76-5 (COM4)	Always	Below 1 Ω
C67-1 - C76-6 (COM5)	Always	Below 1 Ω
C54-1 - C76-6 (COM5)	Always	Below 1 Ω

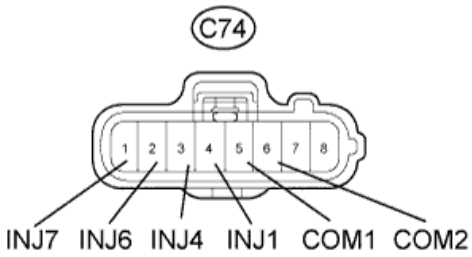
Standard Resistance (Check for Short):

No. 2

Front view of wire harness connector: (to Fuel injector)



Front view of wire harness connector: (to No. 1 EDU)



*1: No. 1 Fuel Injector

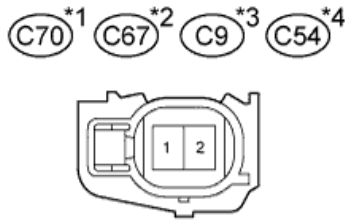
*2: No. 4 Fuel Injector

*3: No. 6 Fuel Injector

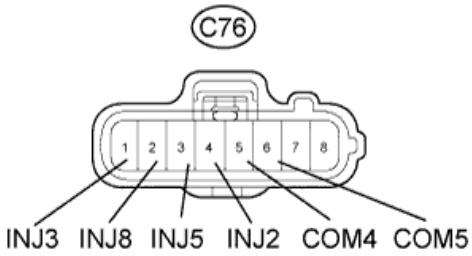
*4: No. 7 Fuel Injector

Tester Connection	Condition	Specified Condition
C70-2 or C76-4 (INJ2) - Body ground	Always	10 kΩ or higher
C9-2 or C76-3 (INJ5) - Body ground	Always	10 kΩ or higher
C67-2 or C76-1 (INJ3) - Body ground	Always	10 kΩ or higher
C54-2 or C76-2 (INJ8) - Body ground	Always	10 kΩ or higher
C70-1 or C76-5 (COM4) - Body ground	Always	10 kΩ or higher
C9-1 or C76-5 (COM4) - Body ground	Always	10 kΩ or higher
C67-1 or C76-6 (COM5) - Body ground	Always	10 kΩ or higher
C54-1 or C76-6 (COM5) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Fuel injector)



Front view of wire harness connector:
(to No. 2 EDU)



*1: No. 2 Fuel Injector

*2: No. 3 Fuel Injector

*3: No. 5 Fuel Injector

*4: No. 8 Fuel Injector

NG → Go to step 10

OK

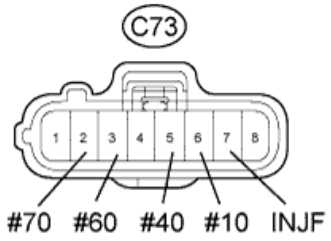
5.CHECK HARNESS AND CONNECTOR (EDU - ECM)

a. Disconnect the No. 1 EDU connector.

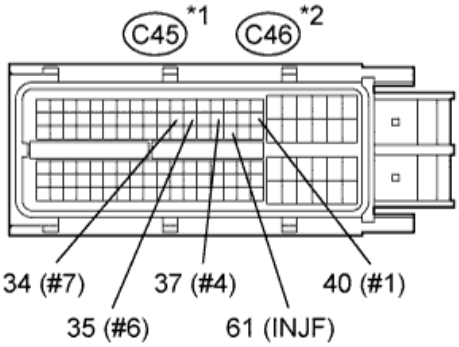
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to No. 1 EDU)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

No. 1 (for LHD)

Tester Connection	Condition	Specified Condition
C73-6 (#10) - C45-40 (#1)	Always	Below 1 Ω
C73-5 (#40) - C45-37 (#4)	Always	Below 1 Ω
C73-3 (#60) - C45-35 (#6)	Always	Below 1 Ω
C73-2 (#70) - C45-34 (#7)	Always	Below 1 Ω
C73-7 (INJF) - C45-61 (INJF)	Always	Below 1 Ω

No. 1 (for RHD)

Tester Connection	Condition	Specified Condition
C73-6 (#10) - C46-40 (#1)	Always	Below 1 Ω
C73-5 (#40) - C46-37 (#4)	Always	Below 1 Ω
C73-3 (#60) - C46-35 (#6)	Always	Below 1 Ω
C73-2 (#70) - C46-34 (#7)	Always	Below 1 Ω
C73-7 (INJF) - C46-61 (INJF)	Always	Below 1 Ω

Standard Resistance (Check for Short):

No. 1 (for LHD)

Tester Connection	Condition	Specified Condition
C73-6 (#10) or C45-40 (#1) - Body ground	Always	10 kΩ or higher
C73-5 (#40) or C45-37 (#4) - Body		10 kΩ or

ground	Always	higher
C73-3 (#60) or C45-35 (#6) - Body ground	Always	10 kΩ or higher
C73-2 (#70) or C45-34 (#7) - Body ground	Always	10 kΩ or higher
C73-7 (INJF) or C45-61 (INJF) - Body ground	Always	10 kΩ or higher

No. 1 (for RHD)

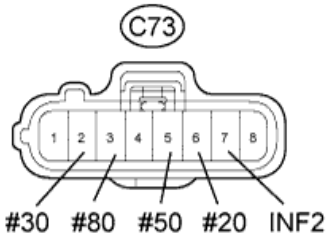
Tester Connection	Condition	Specified Condition
C73-6 (#10) or C46-40 (#1) - Body ground	Always	10 kΩ or higher
C73-5 (#40) or C46-37 (#4) - Body ground	Always	10 kΩ or higher
C73-3 (#60) or C46-35 (#6) - Body ground	Always	10 kΩ or higher
C73-2 (#70) or C46-34 (#7) - Body ground	Always	10 kΩ or higher
C73-7 (INJF) or C46-61 (INJF) - Body ground	Always	10 kΩ or higher

d. Disconnect the No. 2 EDU connector.

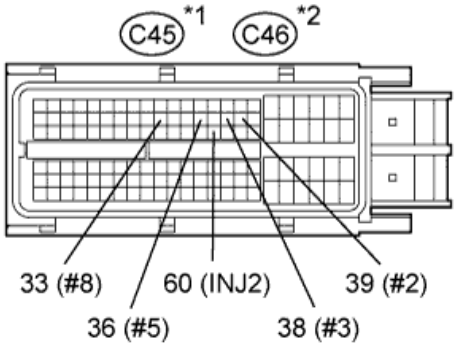
e. Disconnect the ECM connector.

f. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to No. 2 EDU)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

No. 2 (for LHD)

Tester Connection	Condition	Specified Condition
C75-6 (#20) - C45-39 (#2)	Always	Below 1 Ω
C75-2 (#30) - C45-38 (#3)	Always	Below 1 Ω

C75-5 (#50) - C45-36 (#5)	Always	Below 1 Ω
C75-3 (#80) - C45-33 (#8)	Always	Below 1 Ω
C75-7 (INF2) - C45-60 (INF2)	Always	Below 1 Ω

No. 2 (for RHD)

Tester Connection	Condition	Specified Condition
C75-6 (#20) - C46-39 (#2)	Always	Below 1 Ω
C75-2 (#30) - C46-38 (#3)	Always	Below 1 Ω
C75-5 (#50) - C46-36 (#5)	Always	Below 1 Ω
C75-3 (#80) - C46-33 (#8)	Always	Below 1 Ω
C75-7 (INF2) - C46-60 (INF2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

No. 2 (for LHD)

Tester Connection	Condition	Specified Condition
C75-6 (#20) or C45-39 (#2) - Body ground	Always	10 kΩ or higher
C75-2 (#30) or C45-38 (#3) - Body ground	Always	10 kΩ or higher
C75-5 (#50) or C45-36 (#5) - Body ground	Always	10 kΩ or higher
C75-3 (#80) or C45-33 (#8) - Body ground	Always	10 kΩ or higher
C75-7 (INF2) or C45-60 (INF2) - Body ground	Always	10 kΩ or higher

No. 2 (for RHD)

Tester Connection	Condition	Specified Condition
C75-6 (#20) or C46-39 (#2) - Body ground	Always	10 kΩ or higher
C75-2 (#30) or C46-38 (#3) - Body ground	Always	10 kΩ or higher
C75-5 (#50) or C46-36 (#5) - Body ground	Always	10 kΩ or higher
C75-3 (#80) or C46-33 (#8) - Body ground	Always	10 kΩ or higher
C75-7 (INF2) or C46-60 (INF2) - Body ground	Always	10 kΩ or higher

NG → Go to step 10

OK

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

7.GO TO INJECTOR CIRCUIT

a. Go to the injector circuit (Click here).

NEXT → Go to step 11

8.REPLACE INJECTOR DRIVER (No. 1 or No. 2)

a. Replace the injector driver (No. 1 or No. 2) (Click here).

NEXT → Go to step 11

9.REPLACE FUEL INJECTOR

a. Replace the fuel injector (Click here).

NEXT → Go to step 11

10.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

11.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Start the engine and idle it for 10 seconds.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

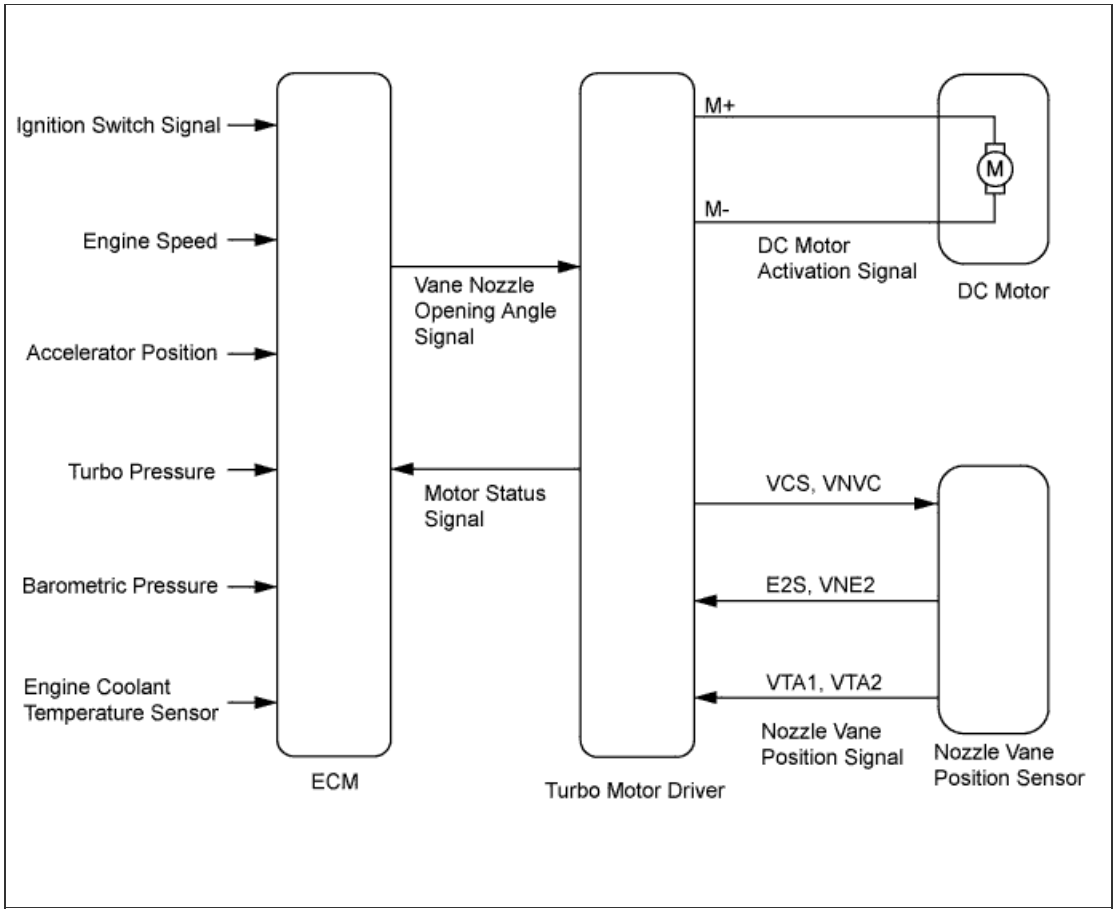
DTC P00AF Turbocharger/Supercharger Boost Control "A" Module Performance

DTC P00B0 Turbocharger/Supercharger Boost Control "B" Module Performance

for Preparation Click here

DESCRIPTION

The turbocharger system is comprised of the Variable Nozzle (VN) type turbocharger, turbo motor driver and ECM.
The turbocharger has a nozzle vane which opens and closes to control the volume of the exhaust gas flowing into the turbine. This, in turn, controls the boost pressure. When the nozzle vane moves towards the closing direction, the pressure increases. When the vane moves towards the opening direction, the pressure decreases.
The turbocharger actuator, which consists of the DC motor and the nozzle vane position sensor, is built on the turbocharger sub-assembly, and activates the nozzle vane. The nozzle vane position sensor detects the opening angle of the nozzle vane. The turbo motor driver receives an opening angle request from the ECM and a nozzle vane position signal from the nozzle vane position sensor. Based on these signals, the turbo motor driver operates the DC motor and adjusts the nozzle vane opening angle. The turbo motor driver sends the status as a turbo driver status signal to the ECM
The ECM sends a target nozzle vane position signal to the turbo motor driver to obtain the nozzle vane position for the optimal boost pressure in accordance with the driving conditions.



P00AF

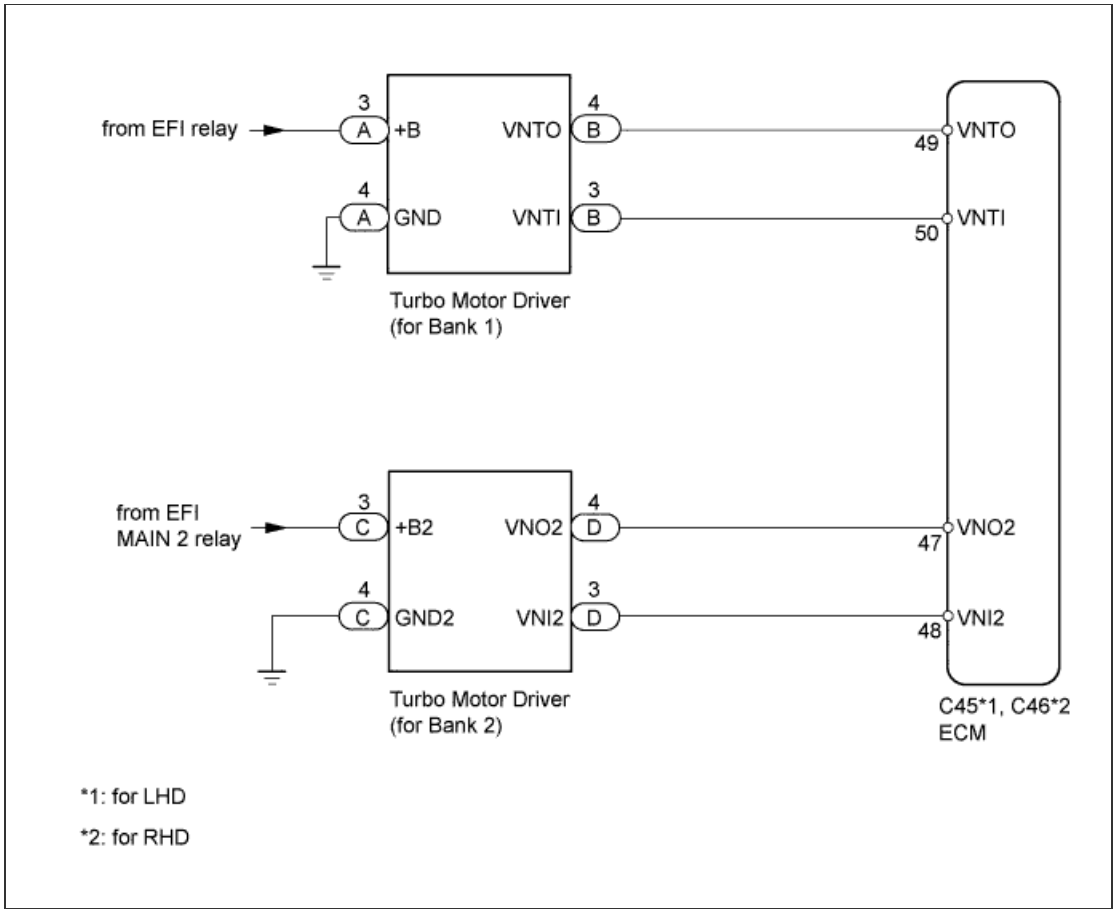
DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After idling for 5 seconds	When a communication error occurs between the turbo motor driver (for Bank 1) and ECM (1 trip detection logic).	• Turbo motor driver (for Bank 1) • Open or short in turbo motor driver (for Bank 1) circuit • Turbo motor driver (for Bank 1) ground problem • ECM

P00B0

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After idling for 5 seconds	When a communication error occurs between the turbo motor driver (for Bank 2) and ECM (1 trip detection logic).	• Turbo motor driver (for Bank 2) • Open or short in turbo motor driver (for Bank 2) circuit • Turbo motor driver (for Bank 2)

		ground problem • ECM

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Excessive electrical noise, such as from wireless radios or electrical modifications, may cause a DTC to be stored.**

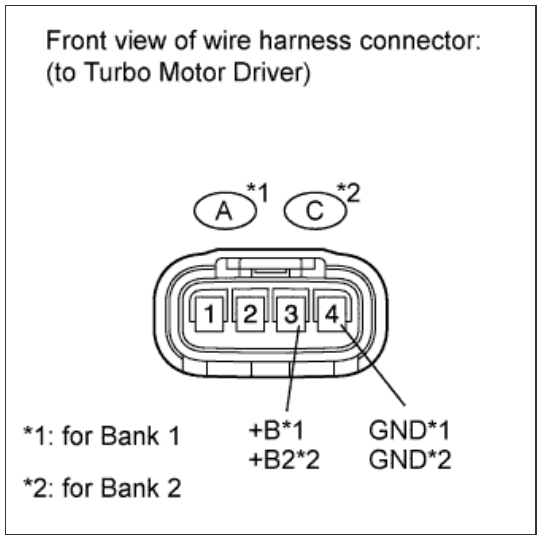
NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

1.INSPECT TURBO MOTOR DRIVER (POWER SOURCE CIRCUIT)

a. Disconnect the turbo motor driver connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-3 (+B) - Turbo motor driver connector-4 (GND)	Ignition switch ON	11 to 14 V

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-3 (+B2) - Turbo motor driver connector-4 (GND2)	Ignition switch ON	11 to 14 V

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-4 (GND) - Body ground	Always	Below 1 Ω

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-4 (GND2) - Body ground	Always	Below 1 Ω

NG → Go to step 5

OK

2.INSPECT TURBO MOTOR DRIVER (for Bank 1 and Bank 2)

a. Remove the rear fender splash shield sub-assembly RH.

b. Remove the front fender liner LH.

c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

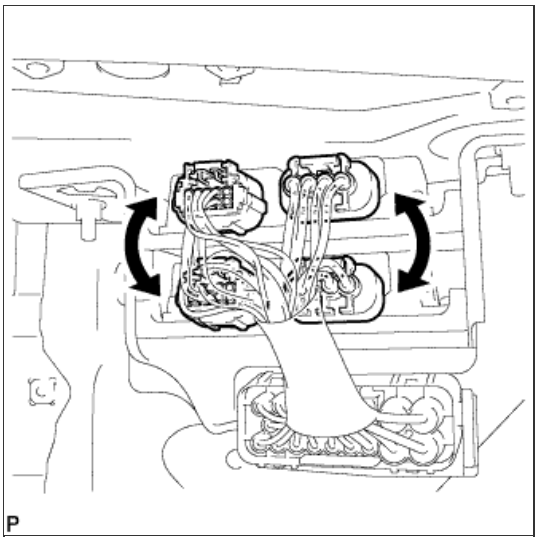
HINT:

Record the output DTCs.

g. Clear the DTCs (Click here).

h. Turn the ignition switch off.

i. Interchange the connectors for the turbo motor driver of bank 1 and bank 2.



j. Start the engine.

k. Enter the following menus: Powertrain / Engine / DTC.

l. Read the DTCs.

Result:

Display (DTC Output)	Proceed to
DTCs change	B
DTCs do not change	A

B → Go to step 6

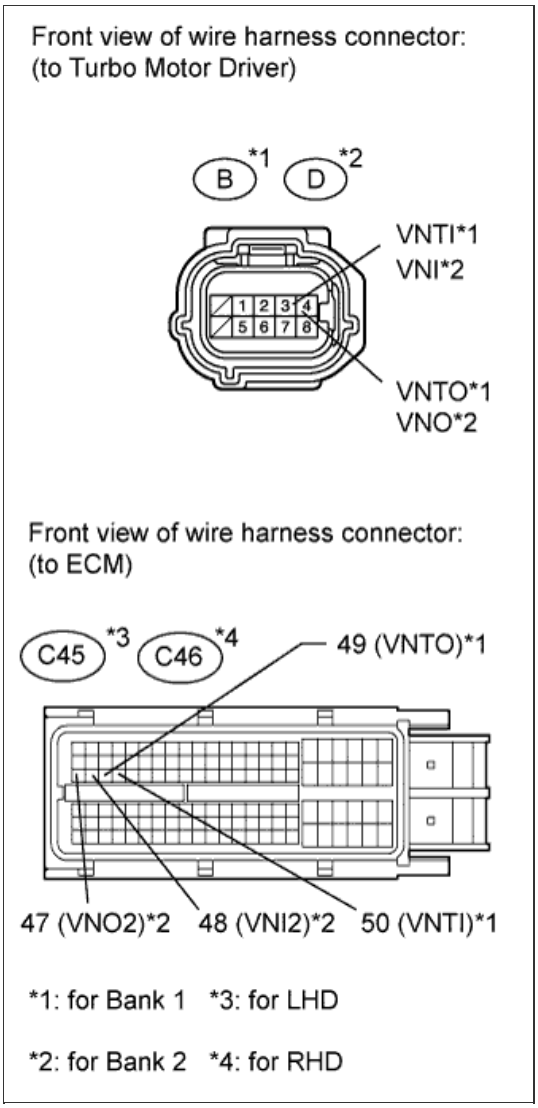
A

3.CHECK HARNESS AND CONNECTOR (TURBO MOTOR DRIVER - ECM)

a. Disconnect the turbo motor driver connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C45-49 (VNTO) - B-4 (VNTO)	Always	Below 1 Ω
C45-50 (VNTI) - B-3 (VNTI)	Always	Below 1 Ω
C45-47 (VNO2) - D-4 (VNO2)	Always	Below 1 Ω
C45-48 (VNI2) - D-3 (VNI2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C46-49 (VNTO) - B-4 (VNTO)	Always	Below 1 Ω
C46-50 (VNTI) - B-3 (VNTI)	Always	Below 1 Ω
C46-47 (VNO2) - D-4 (VNO2)	Always	Below 1 Ω
C46-48 (VNI2) - D-3 (VNI2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C45-49 (VNTO) or B-4 (VNTO) - Body ground	Always	10 kΩ or higher
C45-50 (VNTI) or B-3 (VNTI) -		10 kΩ or

Body ground	Always	higher
C45-47 (VNO2) or D-4 (VNO2) - Body ground	Always	10 kΩ or higher
C45-48 (VNI2) or D-3 (VNI2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C46-49 (VNTO) or B-4 (VNTO) - Body ground	Always	10 kΩ or higher
C46-50 (VNTI) or B-3 (VNTI) - Body ground	Always	10 kΩ or higher
C46-47 (VNO2) or D-4 (VNO2) - Body ground	Always	10 kΩ or higher
C46-48 (VNI2) or D-3 (VNI2) - Body ground	Always	10 kΩ or higher

NG → Go to step 5

OK

4.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 7

5.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT → Go to step 7

6.REPLACE TURBO MOTOR DRIVER (for Bank 1 or Bank 2)

a. Replace the turbo motor driver (for Bank 1 or Bank 2) (Click here).

NEXT

7.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. After starting the engine, idle it for 5 seconds.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

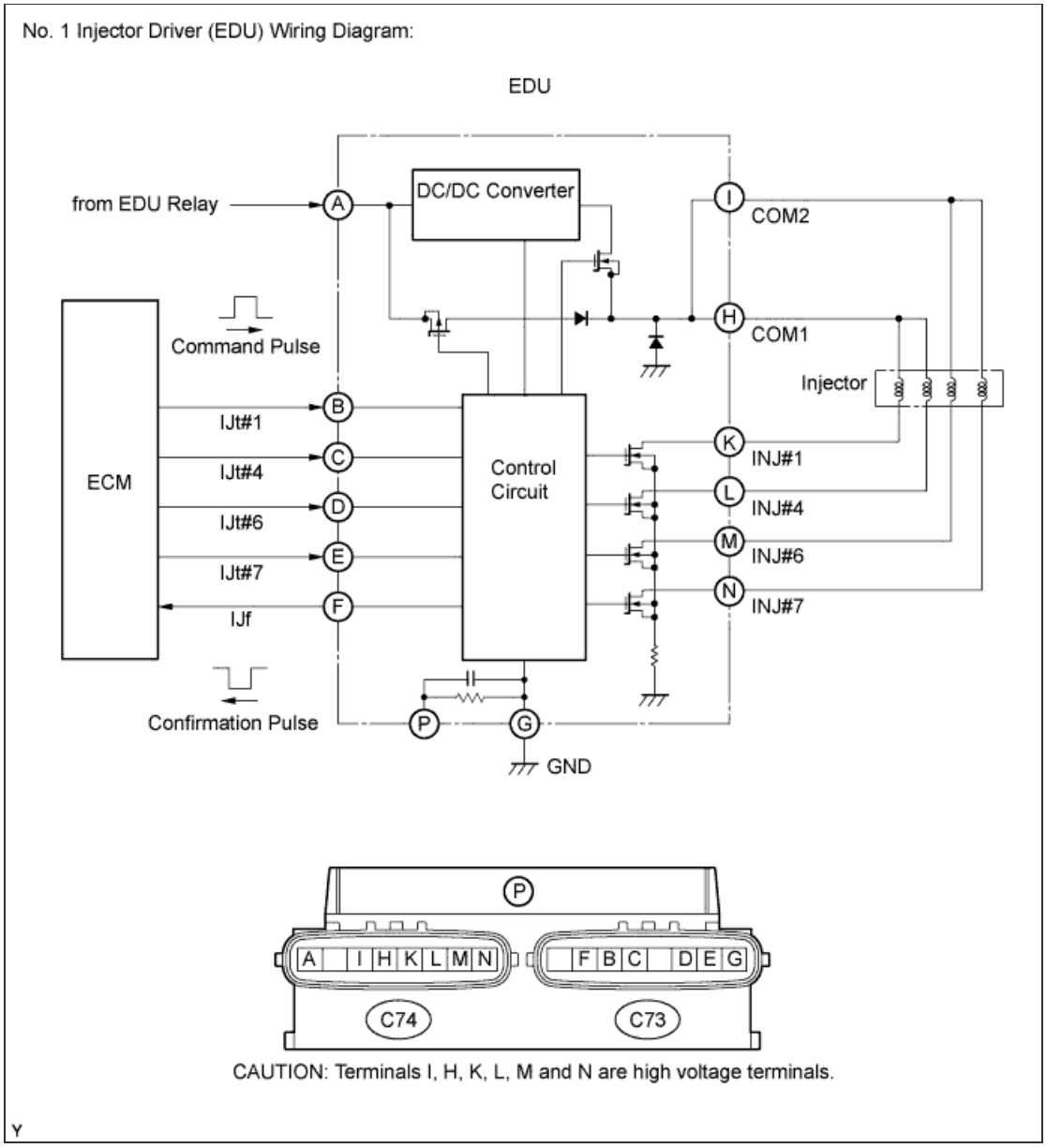
DTC P062D Fuel Injector Driver Circuit Performance Bank1

DTC P062E Fuel Injector Driver Circuit Performance Bank2

for Preparation Click here

DESCRIPTION

The EDU delivers drive signals to fuel injectors using the DC/DC converter, which provides a high-voltage and quick-charging system.
Soon after the EDU receives a fuel injection command (IJT) signal from the ECM, the EDU responds to the command with an injector injection confirmation (IJF) signal when the current is applied to the fuel injector.



P062D

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Idling for 10 seconds	Open or short in the No. 1 injector driver (EDU) or fuel injector circuit (1 trip detection logic).	• Open or short in No. 1 injector driver (EDU) circuit • Fuel injector • No. 1 EDU • ECM

P062E

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
		• Open or short in No. 2 injector driver

Idling for 10 seconds	Open or short in the No. 2 injector driver (EDU) or fuel injector circuit (1 trip detection logic).	• Open or short in No. 2 injector driver (EDU) circuit • Fuel injector • No. 2 EDU • ECM

MONITOR DESCRIPTION

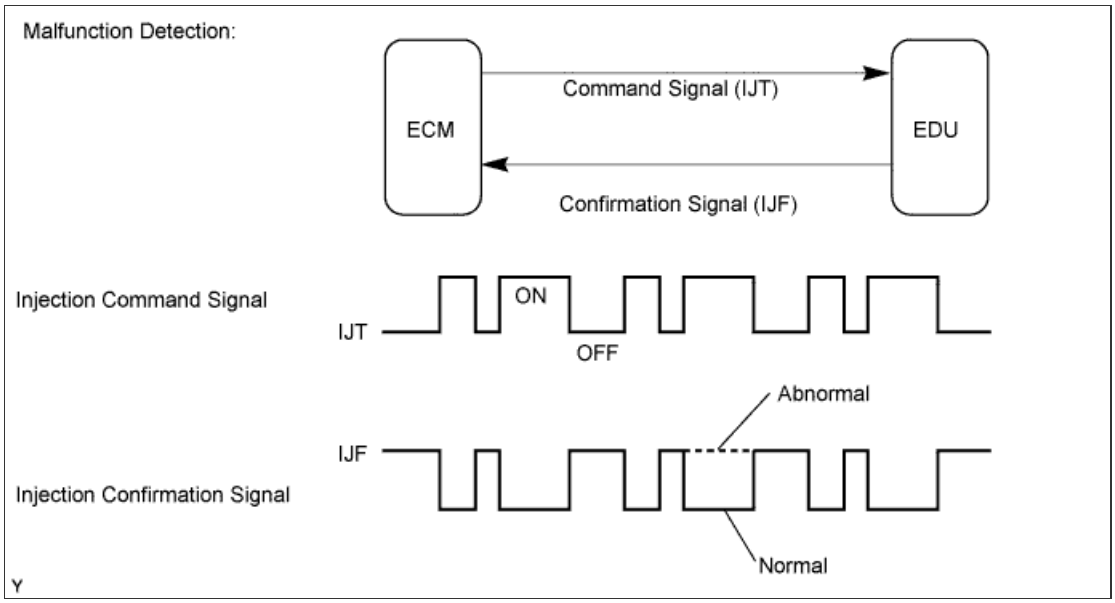
P062D, P062E (Open or short in EDU or fuel injector circuit):

The ECM continuously monitors both injection command (IJT) signals and injection confirmation (IJF) signals. This DTC will be stored if the ECM determines that the number of IJT signals and IJF signals are inconsistent.

The fuel injectors are grounded over a Field Effect Transistor (FET) and a serial resistor. This resistor creates a voltage drop, which is monitored by the EDU (injector drive circuit) in relation to the current drawn by the fuel injector. When the fuel injector current becomes too high, the voltage drop over the resistor exceeds a specified level and no IJF signal for that cylinder is sent to the ECM.

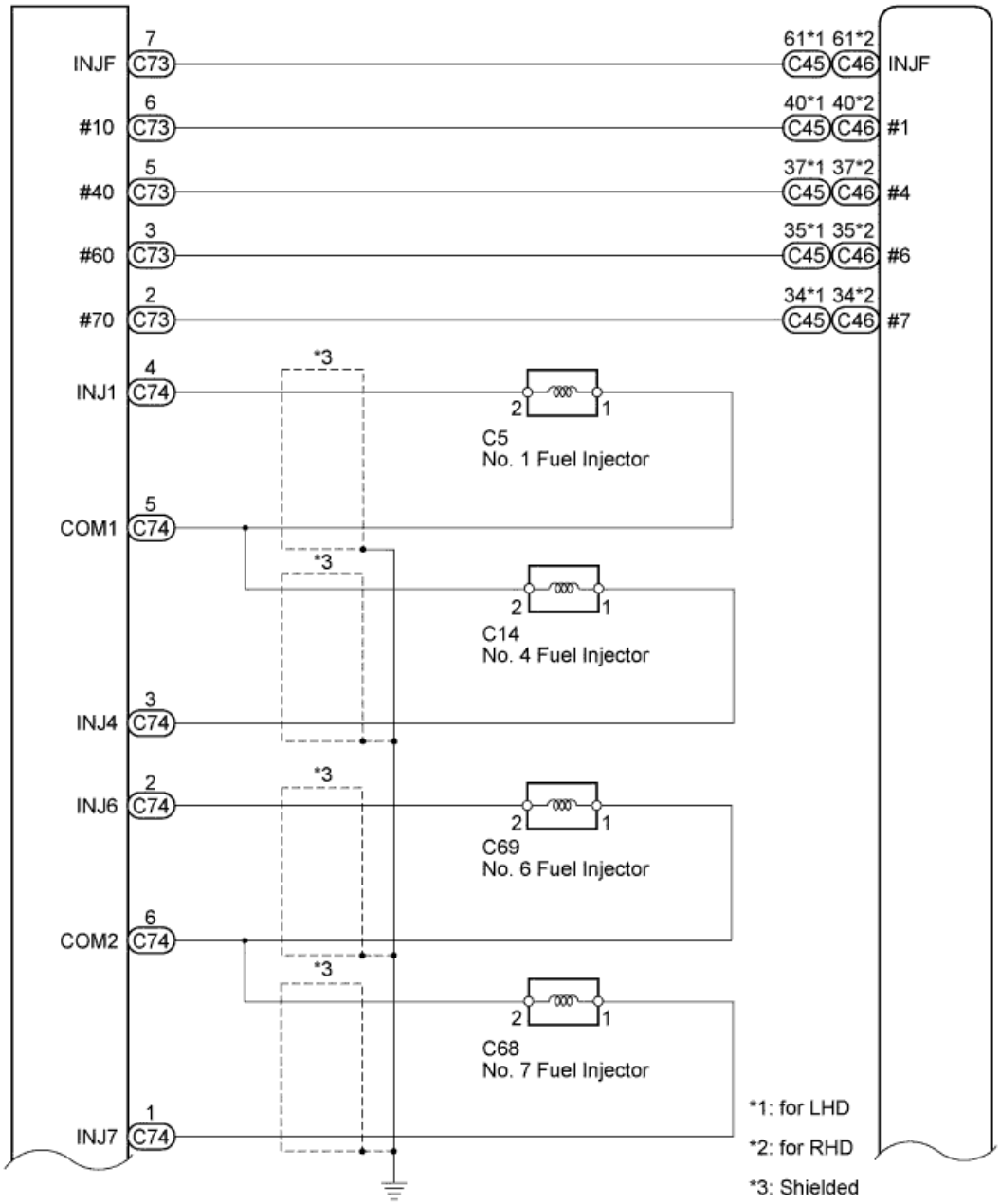
After the engine is started, when there is no injection confirmation (IJF) signal from the No. 1 or No. 2 EDU to the ECM even though the ECM sends injection command (IJT) signals to the No. 1 or No. 2 EDU, DTC P062D or DTC P062E is stored.

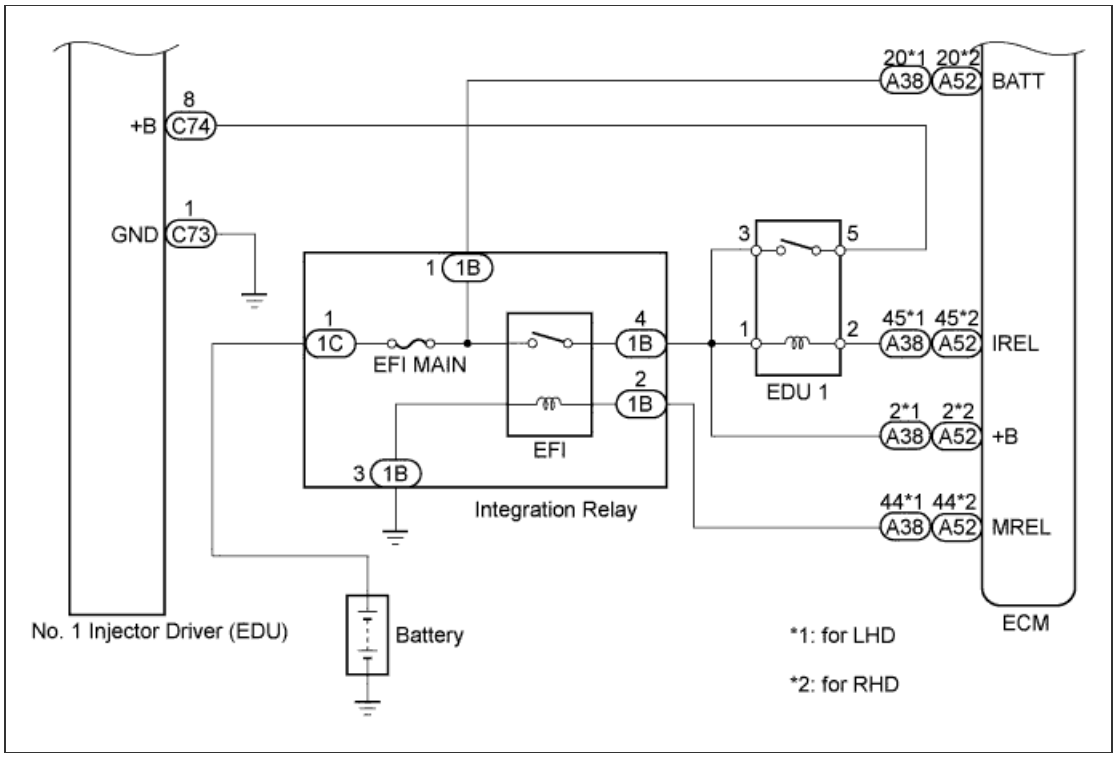
If this DTC is stored, the ECM enters fail-safe mode and limits engine power or stops the engine. The fail-safe mode continues until the ignition switch is turned off.



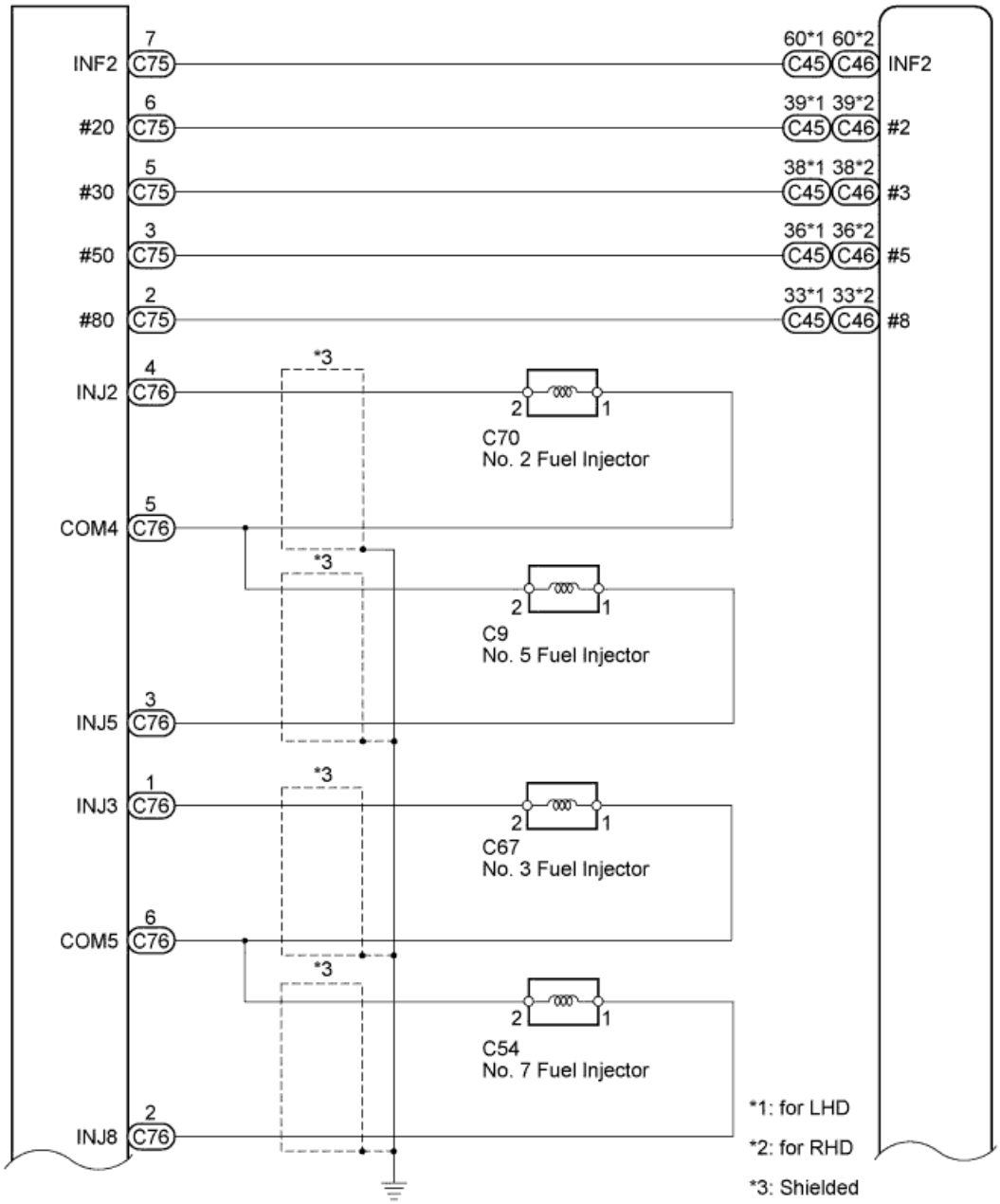
WIRING DIAGRAM

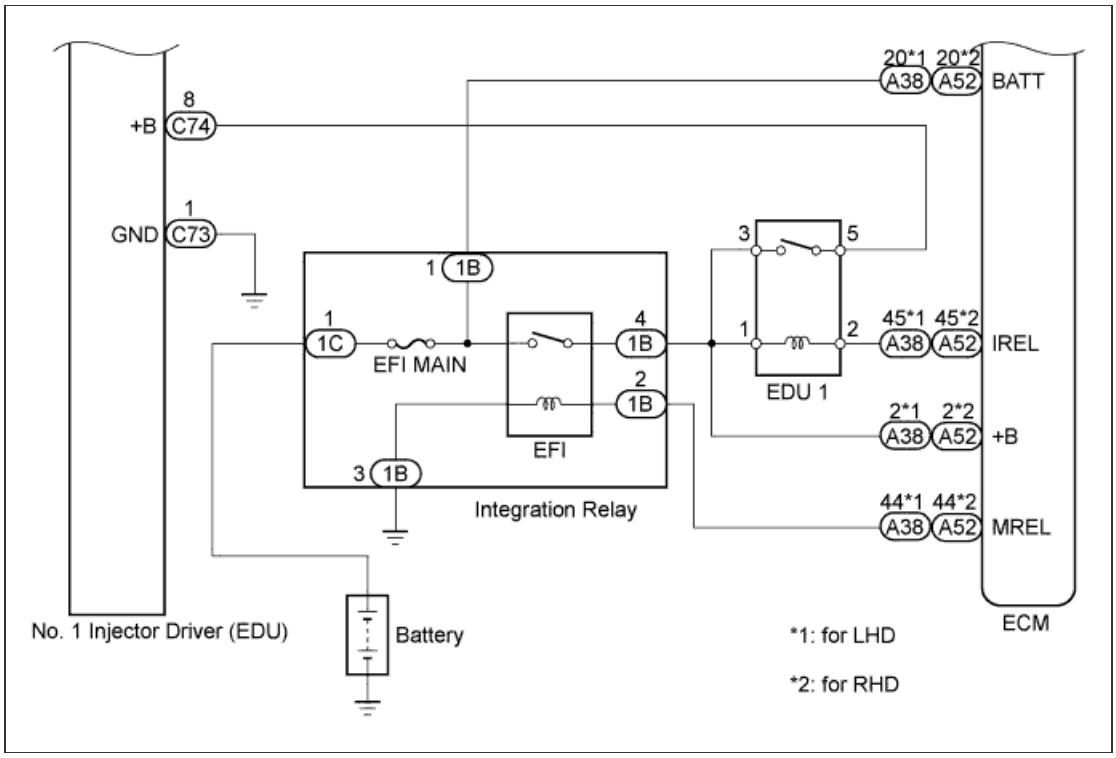
No. 1:


INJF
7
C73
61*1 61*2
C45 C46
INJF
#10
6
C73
40*1 40*2
C45 C46
#1
#40
5
C73
37*1 37*2
C45 C46
#4
#60
3
C73
35*1 35*2
C45 C46
#6
#70
2
C73
34*1 34*2
C45 C46
#7
INJ1
4
C74
*3
2
1
C5
No. 1 Fuel Injector
COM1
5
C74
*3
2
1
C14
No. 4 Fuel Injector
INJ4
3
C74
INJ6
2
C74
*3
2
1
C69
No. 6 Fuel Injector
COM2
6
C74
*3
2
1
C68
No. 7 Fuel Injector
INJ7
1
C74
*1: for LHD
*2: for RHD
*3: Shielded


20*1 20*2
A38 A52
BATT
8
+B C74
1
GND C73
1 1B
1
1C
EFI MAIN
4
1B
2
1B
EFI
3 1B
Integration Relay
3
5
1
2
EDU 1
45*1 45*2
A38 A52
IREL
2*1 2*2
A38 A52
+B
44*1 44*2
A38 A52
MREL
ECM
No. 1 Injector Driver (EDU)
Battery
*1: for LHD
*2: for RHD

No. 2:


INF2
7
C75
60*1 60*2
C45 C46
INF2
#20
6
C75
39*1 39*2
C45 C46
#2
#30
5
C75
38*1 38*2
C45 C46
#3
#50
3
C75
36*1 36*2
C45 C46
#5
#80
2
C75
33*1 33*2
C45 C46
#8
INJ2
4
C76
*3
2
1
C70
No. 2 Fuel Injector
COM4
5
C76
*3
2
1
C9
No. 5 Fuel Injector
INJ5
3
C76
INJ3
1
C76
*3
2
1
C67
No. 3 Fuel Injector
COM5
6
C76
*3
2
1
C54
No. 7 Fuel Injector
INJ8
2
C76
*1: for LHD
*2: for RHD
*3: Shielded



INSPECTION PROCEDURE

NOTICE:

- **After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).**
- **After replacing a fuel injector, the ECM needs registration (Click here).**

HINT:

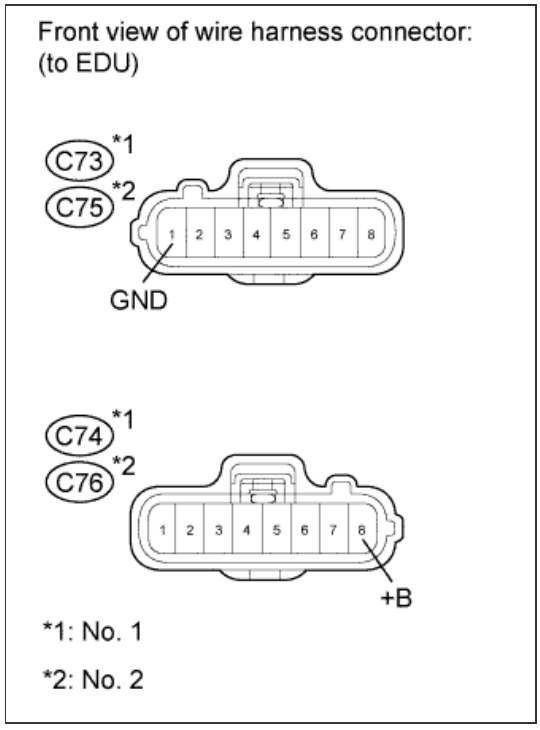
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.CHECK TERMINAL VOLTAGE EDU POWER SOURCE

a. Disconnect the No. 1 injector driver (EDU) connectors.

b. Disconnect the No. 2 injector driver (EDU) connectors.

c. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

No. 1

Tester Connection	Switch Condition	Specified Condition
C74-8 (+B) - C73-1 (GND)	Ignition switch ON	11 to 14 V

No. 2

Tester Connection	Switch Condition	Specified Condition
C76-8 (+B) - C75-1 (GND)	Ignition switch ON	11 to 14 V

NG → Go to step 7

OK

2.INSPECT INJECTOR DRIVER (No. 1 and No. 2)

a. Interchange the No. 1 and No. 2 EDU connectors.

b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON and turn the tester on.

d. Clear the DTCs (Click here).

NOTICE:

Before clearing the DTCs, write them down.

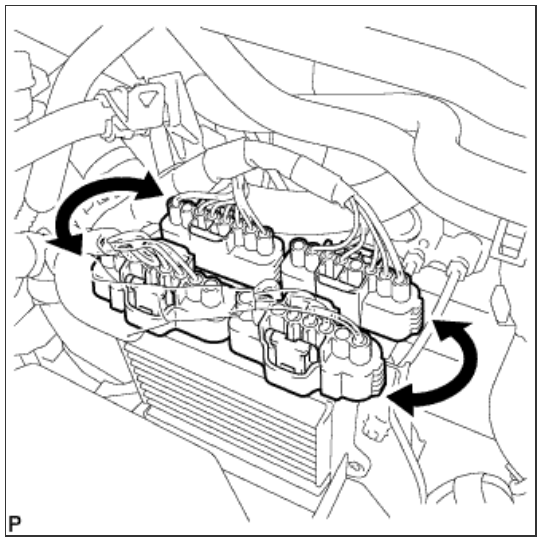
e. Start the engine.

f. Enter the following menus: Powertrain / Engine / DTC.

g. Read the DTCs.

Result

Result	Proceed to
DTCs do not change	A
DTCs change (change in malfunctioning cylinder or EDU code)	B



B → Go to step 8

A

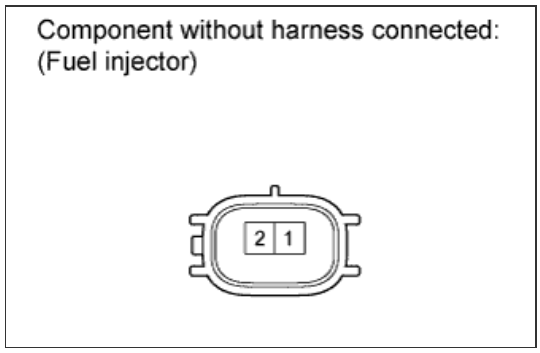
3.INSPECT FUEL INJECTOR (RESISTANCE)

a. Disconnect the fuel injector connectors.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	0.85 to 1.05 Ω



NG → Go to step 9

OK

4.CHECK HARNESS AND CONNECTOR (FUEL INJECTOR - EDU)

a. Disconnect the fuel injector connectors.

b. Disconnect the No. 1 EDU connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

No. 1

Tester Connection	Condition	Specified Condition
C5-2 - C74-4 (INJ1)	Always	Below 1 Ω
C14-2 - C74-3 (INJ4)	Always	Below 1 Ω
C69-2 - C74-2 (INJ6)	Always	Below 1 Ω
C68-2 - C74-1 (INJ7)	Always	Below 1 Ω
C5-1 - C74-5 (COM1)	Always	Below 1 Ω
C14-1 - C74-5 (COM1)	Always	Below 1 Ω
C69-1 - C74-6 (COM2)	Always	Below 1 Ω
C68-1 - C74-6 (COM2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

No. 1

Tester Connection	Condition	Specified Condition
C5-2 or C74-4 (INJ1) - Body ground	Always	10 kΩ or higher
C14-2 or C74-3 (INJ4) - Body ground	Always	10 kΩ or higher
C69-2 or C74-2 (INJ6) - Body ground	Always	10 kΩ or higher
C68-2 or C74-1 (INJ7) - Body ground	Always	10 kΩ or higher
C5-1 or C74-5 (COM1) - Body ground	Always	10 kΩ or higher
C14-1 or C74-5 (COM1) - Body ground	Always	10 kΩ or higher
C69-1 or C74-6 (COM2) - Body ground	Always	10 kΩ or higher
C68-1 or C74-6 (COM2) - Body ground	Always	10 kΩ or higher

d. Disconnect the fuel injector connectors.

e. Disconnect the No. 2 EDU connector.

f. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

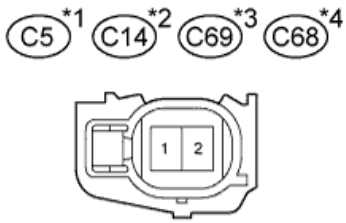
No. 2

Tester Connection	Condition	Specified Condition
C70-2 - C76-4 (INJ2)	Always	Below 1 Ω
C9-2 - C76-3 (INJ5)	Always	Below 1 Ω
C67-2 - C76-1 (INJ3)	Always	Below 1 Ω
C54-2 - C76-2 (INJ8)	Always	Below 1 Ω
C70-1 - C76-5 (COM4)	Always	Below 1 Ω
C9-1 - C76-5 (COM4)	Always	Below 1 Ω
C67-1 - C76-6 (COM5)	Always	Below 1 Ω
C54-1 - C76-6 (COM5)	Always	Below 1 Ω

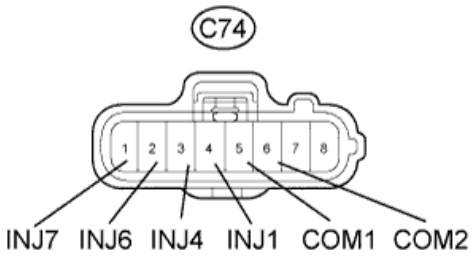
Standard Resistance (Check for Short):

No. 2

Front view of wire harness connector: (to Fuel injector)



Front view of wire harness connector: (to No. 1 EDU)



*1: No. 1 Fuel Injector

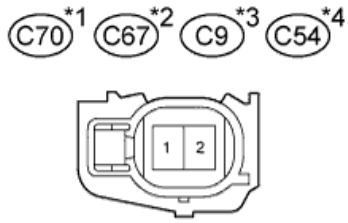
*2: No. 4 Fuel Injector

*3: No. 6 Fuel Injector

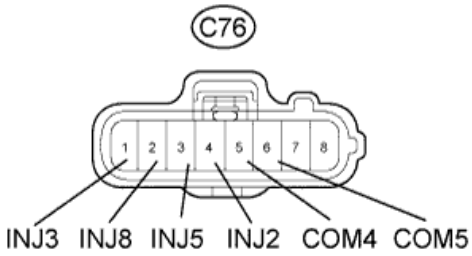
*4: No. 7 Fuel Injector

Tester Connection	Condition	Specified Condition
C70-2 or C76-4 (INJ2) - Body ground	Always	10 kΩ or higher
C9-2 or C76-3 (INJ5) - Body ground	Always	10 kΩ or higher
C67-2 or C76-1 (INJ3) - Body ground	Always	10 kΩ or higher
C54-2 or C76-2 (INJ8) - Body ground	Always	10 kΩ or higher
C70-1 or C76-5 (COM4) - Body ground	Always	10 kΩ or higher
C9-1 or C76-5 (COM4) - Body ground	Always	10 kΩ or higher
C67-1 or C76-6 (COM5) - Body ground	Always	10 kΩ or higher
C54-1 or C76-6 (COM5) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Fuel injector)



Front view of wire harness connector:
(to No. 2 EDU)



*1: No. 2 Fuel Injector

*2: No. 3 Fuel Injector

*3: No. 5 Fuel Injector

*4: No. 8 Fuel Injector

NG → Go to step 10

OK

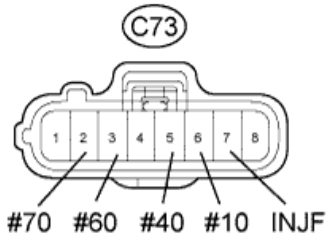
5.CHECK HARNESS AND CONNECTOR (EDU - ECM)

a. Disconnect the No. 1 EDU connector.

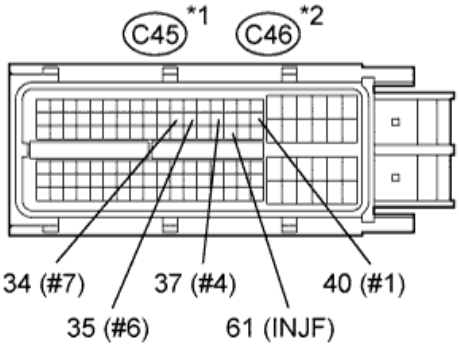
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to No. 1 EDU)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

No. 1 (for LHD)

Tester Connection	Condition	Specified Condition
C73-6 (#10) - C45-40 (#1)	Always	Below 1 Ω
C73-5 (#40) - C45-37 (#4)	Always	Below 1 Ω
C73-3 (#60) - C45-35 (#6)	Always	Below 1 Ω
C73-2 (#70) - C45-34 (#7)	Always	Below 1 Ω
C73-7 (INJF) - C45-61 (INJF)	Always	Below 1 Ω

No. 1 (for RHD)

Tester Connection	Condition	Specified Condition
C73-6 (#10) - C46-40 (#1)	Always	Below 1 Ω
C73-5 (#40) - C46-37 (#4)	Always	Below 1 Ω
C73-3 (#60) - C46-35 (#6)	Always	Below 1 Ω
C73-2 (#70) - C46-34 (#7)	Always	Below 1 Ω
C73-7 (INJF) - C46-61 (INJF)	Always	Below 1 Ω

Standard Resistance (Check for Short):

No. 1 (for LHD)

Tester Connection	Condition	Specified Condition
C73-6 (#10) or C45-40 (#1) - Body ground	Always	10 kΩ or higher
C73-5 (#40) or C45-37 (#4) - Body		10 kΩ or

ground	Always	higher
C73-3 (#60) or C45-35 (#6) - Body ground	Always	10 kΩ or higher
C73-2 (#70) or C45-34 (#7) - Body ground	Always	10 kΩ or higher
C73-7 (INJF) or C45-61 (INJF) - Body ground	Always	10 kΩ or higher

No. 1 (for RHD)

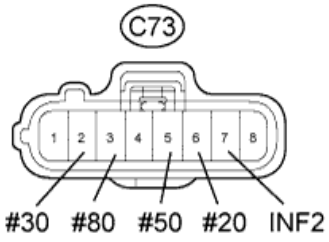
Tester Connection	Condition	Specified Condition
C73-6 (#10) or C46-40 (#1) - Body ground	Always	10 kΩ or higher
C73-5 (#40) or C46-37 (#4) - Body ground	Always	10 kΩ or higher
C73-3 (#60) or C46-35 (#6) - Body ground	Always	10 kΩ or higher
C73-2 (#70) or C46-34 (#7) - Body ground	Always	10 kΩ or higher
C73-7 (INJF) or C46-61 (INJF) - Body ground	Always	10 kΩ or higher

d. Disconnect the No. 2 EDU connector.

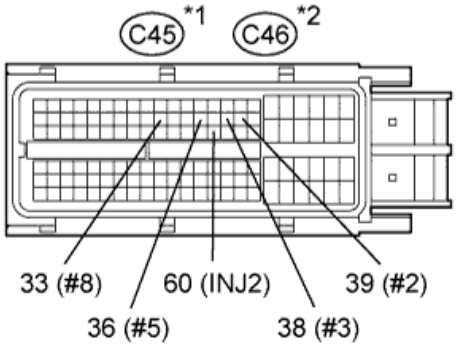
e. Disconnect the ECM connector.

f. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to No. 2 EDU)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

No. 2 (for LHD)

Tester Connection	Condition	Specified Condition
C75-6 (#20) - C45-39 (#2)	Always	Below 1 Ω
C75-2 (#30) - C45-38 (#3)	Always	Below 1 Ω

C75-5 (#50) - C45-36 (#5)	Always	Below 1 Ω
C75-3 (#80) - C45-33 (#8)	Always	Below 1 Ω
C75-7 (INF2) - C45-60 (INF2)	Always	Below 1 Ω

No. 2 (for RHD)

Tester Connection	Condition	Specified Condition
C75-6 (#20) - C46-39 (#2)	Always	Below 1 Ω
C75-2 (#30) - C46-38 (#3)	Always	Below 1 Ω
C75-5 (#50) - C46-36 (#5)	Always	Below 1 Ω
C75-3 (#80) - C46-33 (#8)	Always	Below 1 Ω
C75-7 (INF2) - C46-60 (INF2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

No. 2 (for LHD)

Tester Connection	Condition	Specified Condition
C75-6 (#20) or C45-39 (#2) - Body ground	Always	10 kΩ or higher
C75-2 (#30) or C45-38 (#3) - Body ground	Always	10 kΩ or higher
C75-5 (#50) or C45-36 (#5) - Body ground	Always	10 kΩ or higher
C75-3 (#80) or C45-33 (#8) - Body ground	Always	10 kΩ or higher
C75-7 (INF2) or C45-60 (INF2) - Body ground	Always	10 kΩ or higher

No. 2 (for RHD)

Tester Connection	Condition	Specified Condition
C75-6 (#20) or C46-39 (#2) - Body ground	Always	10 kΩ or higher
C75-2 (#30) or C46-38 (#3) - Body ground	Always	10 kΩ or higher
C75-5 (#50) or C46-36 (#5) - Body ground	Always	10 kΩ or higher
C75-3 (#80) or C46-33 (#8) - Body ground	Always	10 kΩ or higher
C75-7 (INF2) or C46-60 (INF2) - Body ground	Always	10 kΩ or higher

NG → Go to step 10

OK

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

7.GO TO INJECTOR CIRCUIT

a. Go to the injector circuit (Click here).

NEXT → Go to step 11

8.REPLACE INJECTOR DRIVER (No. 1 or No. 2)

a. Replace the injector driver (No. 1 or No. 2) (Click here).

NEXT → Go to step 11

9.REPLACE FUEL INJECTOR

a. Replace the fuel injector (Click here).

NEXT → Go to step 11

10.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

11.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Start the engine and idle it for 10 seconds.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

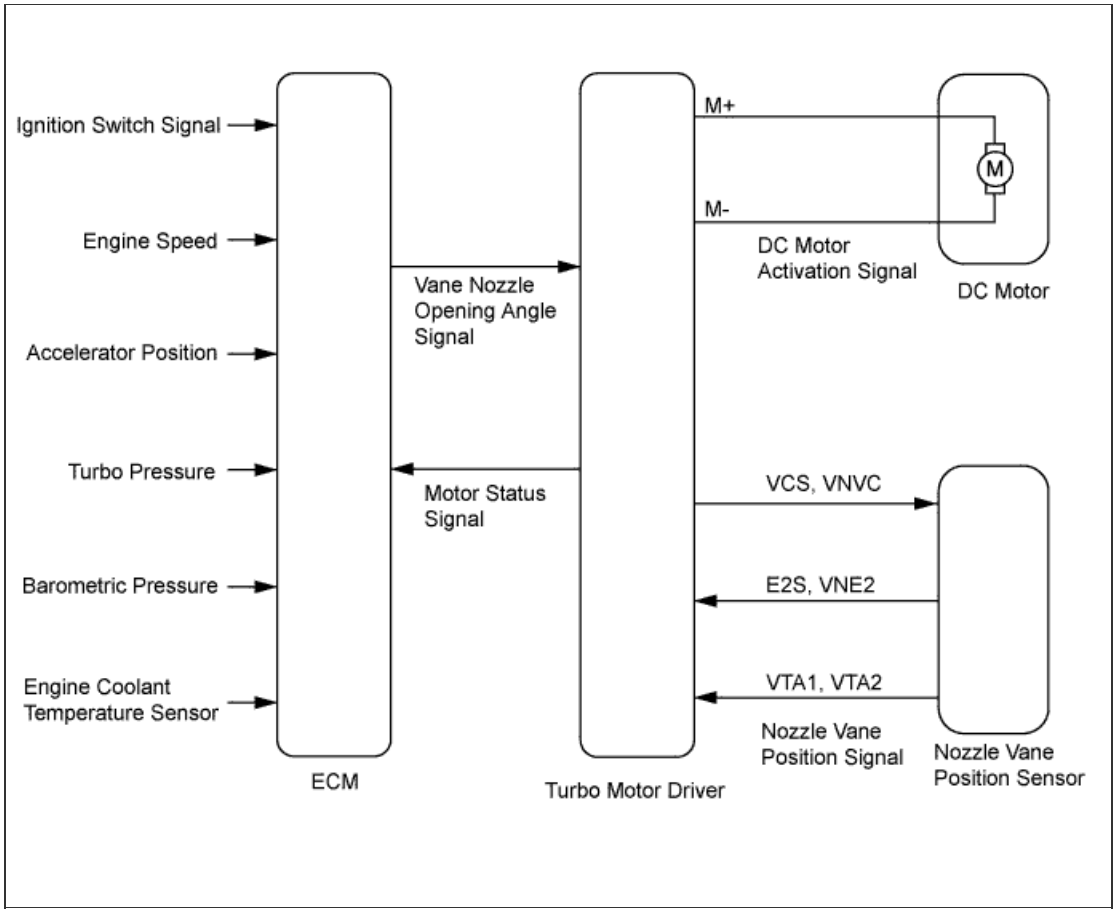
DTC P00AF Turbocharger/Supercharger Boost Control "A" Module Performance

DTC P00B0 Turbocharger/Supercharger Boost Control "B" Module Performance

for Preparation Click here

DESCRIPTION

The turbocharger system is comprised of the Variable Nozzle (VN) type turbocharger, turbo motor driver and ECM.
The turbocharger has a nozzle vane which opens and closes to control the volume of the exhaust gas flowing into the turbine. This, in turn, controls the boost pressure. When the nozzle vane moves towards the closing direction, the pressure increases. When the vane moves towards the opening direction, the pressure decreases.
The turbocharger actuator, which consists of the DC motor and the nozzle vane position sensor, is built on the turbocharger sub-assembly, and activates the nozzle vane. The nozzle vane position sensor detects the opening angle of the nozzle vane. The turbo motor driver receives an opening angle request from the ECM and a nozzle vane position signal from the nozzle vane position sensor. Based on these signals, the turbo motor driver operates the DC motor and adjusts the nozzle vane opening angle. The turbo motor driver sends the status as a turbo driver status signal to the ECM
The ECM sends a target nozzle vane position signal to the turbo motor driver to obtain the nozzle vane position for the optimal boost pressure in accordance with the driving conditions.



P00AF

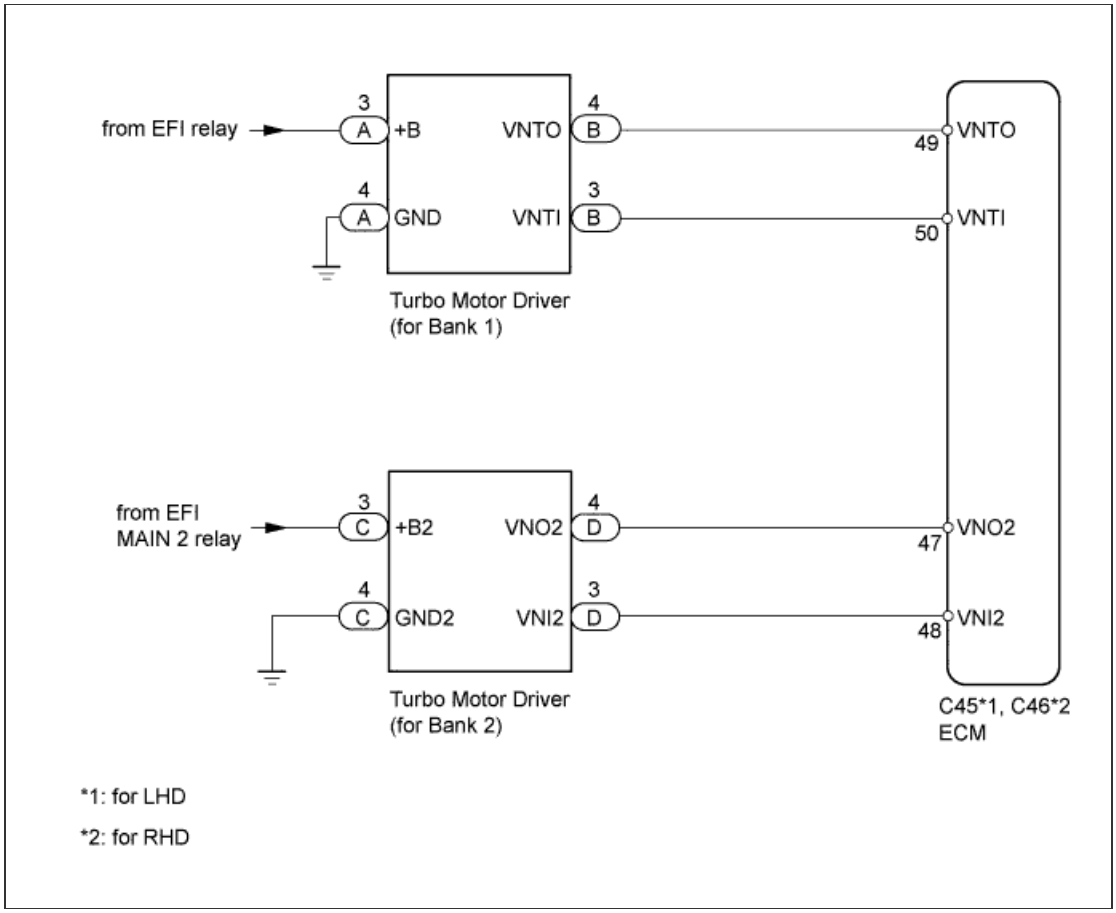
DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After idling for 5 seconds	When a communication error occurs between the turbo motor driver (for Bank 1) and ECM (1 trip detection logic).	• Turbo motor driver (for Bank 1) • Open or short in turbo motor driver (for Bank 1) circuit • Turbo motor driver (for Bank 1) ground problem • ECM

P00B0

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After idling for 5 seconds	When a communication error occurs between the turbo motor driver (for Bank 2) and ECM (1 trip detection logic).	• Turbo motor driver (for Bank 2) • Open or short in turbo motor driver (for Bank 2) circuit • Turbo motor driver (for Bank 2)

		ground problem • ECM

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.**
- **Excessive electrical noise, such as from wireless radios or electrical modifications, may cause a DTC to be stored.**

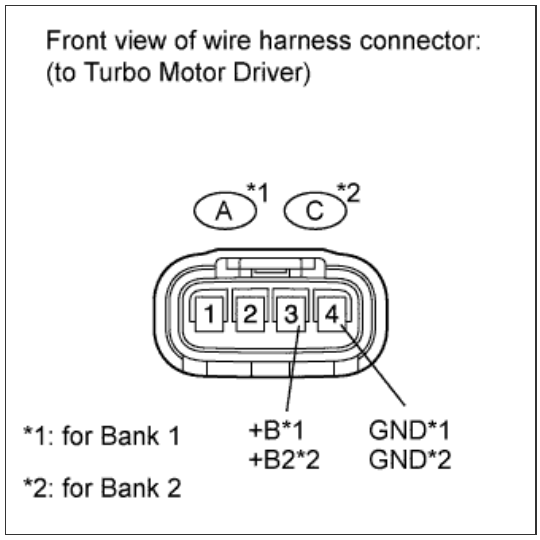
NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

1.INSPECT TURBO MOTOR DRIVER (POWER SOURCE CIRCUIT)

a. Disconnect the turbo motor driver connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-3 (+B) - Turbo motor driver connector-4 (GND)	Ignition switch ON	11 to 14 V

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-3 (+B2) - Turbo motor driver connector-4 (GND2)	Ignition switch ON	11 to 14 V

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-4 (GND) - Body ground	Always	Below 1 Ω

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-4 (GND2) - Body ground	Always	Below 1 Ω

NG → Go to step 5

OK

2.INSPECT TURBO MOTOR DRIVER (for Bank 1 and Bank 2)

a. Remove the rear fender splash shield sub-assembly RH.

b. Remove the front fender liner LH.

c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

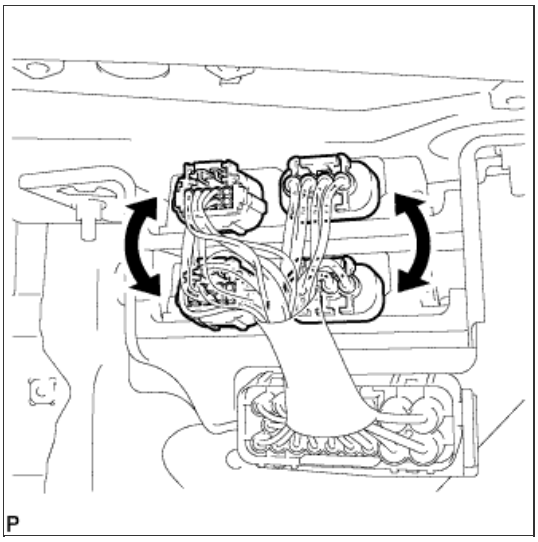
HINT:

Record the output DTCs.

g. Clear the DTCs (Click here).

h. Turn the ignition switch off.

i. Interchange the connectors for the turbo motor driver of bank 1 and bank 2.



j. Start the engine.

k. Enter the following menus: Powertrain / Engine / DTC.

l. Read the DTCs.

Result:

Display (DTC Output)	Proceed to
DTCs change	B
DTCs do not change	A

B → Go to step 6

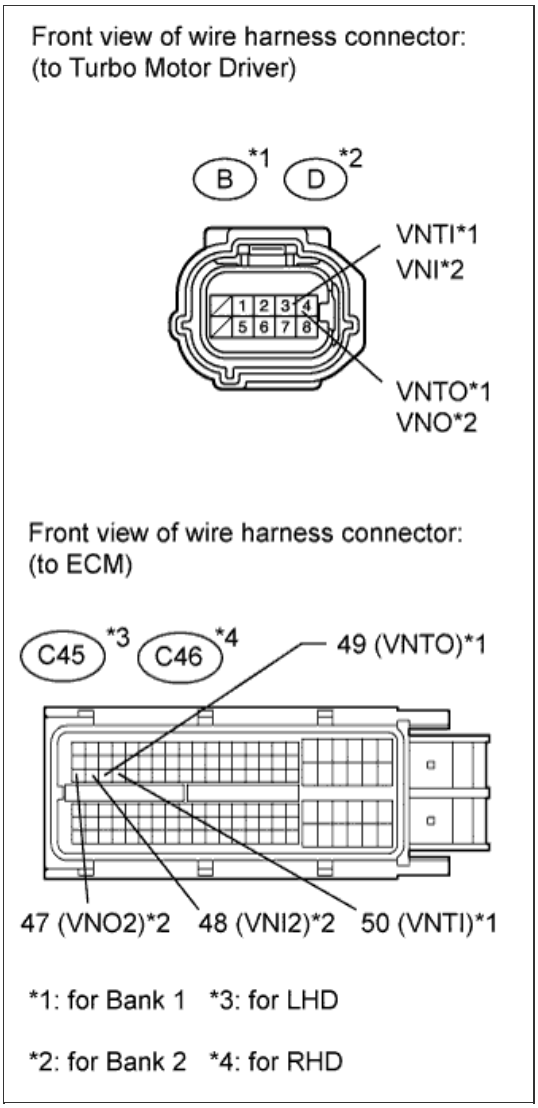
A

3.CHECK HARNESS AND CONNECTOR (TURBO MOTOR DRIVER - ECM)

a. Disconnect the turbo motor driver connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C45-49 (VNTO) - B-4 (VNTO)	Always	Below 1 Ω
C45-50 (VNTI) - B-3 (VNTI)	Always	Below 1 Ω
C45-47 (VNO2) - D-4 (VNO2)	Always	Below 1 Ω
C45-48 (VNI2) - D-3 (VNI2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C46-49 (VNTO) - B-4 (VNTO)	Always	Below 1 Ω
C46-50 (VNTI) - B-3 (VNTI)	Always	Below 1 Ω
C46-47 (VNO2) - D-4 (VNO2)	Always	Below 1 Ω
C46-48 (VNI2) - D-3 (VNI2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C45-49 (VNTO) or B-4 (VNTO) - Body ground	Always	10 kΩ or higher
C45-50 (VNTI) or B-3 (VNTI) -		10 kΩ or

Body ground	Always	higher
C45-47 (VNO2) or D-4 (VNO2) - Body ground	Always	10 kΩ or higher
C45-48 (VNI2) or D-3 (VNI2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C46-49 (VNTO) or B-4 (VNTO) - Body ground	Always	10 kΩ or higher
C46-50 (VNTI) or B-3 (VNTI) - Body ground	Always	10 kΩ or higher
C46-47 (VNO2) or D-4 (VNO2) - Body ground	Always	10 kΩ or higher
C46-48 (VNI2) or D-3 (VNI2) - Body ground	Always	10 kΩ or higher

NG → Go to step 5

OK

4.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 7

5.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT → Go to step 7

6.REPLACE TURBO MOTOR DRIVER (for Bank 1 or Bank 2)

a. Replace the turbo motor driver (for Bank 1 or Bank 2) (Click here).

NEXT

7.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. After starting the engine, idle it for 5 seconds.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

DTC P1229 Fuel Pump System

for Preparation Click here

DESCRIPTION

Refer to the System Description (Click here).

P1229

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Idling for 60 seconds	The actual fuel pressure e ceeds the target fuel pressure by 40 MPa or more for 10 seconds (1 trip detection logic).	• Short in fuel supply pump (suction control valve) circuit • Fuel supply pump (suction control valve) • Fuel pressure sensor (common rail (for Bank 1)) • ECM

Related Data List

DTC No.	Data List
P122	• Fuel Press • Target Common Rail Pressure • Injection Pressure Correction • Target Pump SCV Current

HINT:

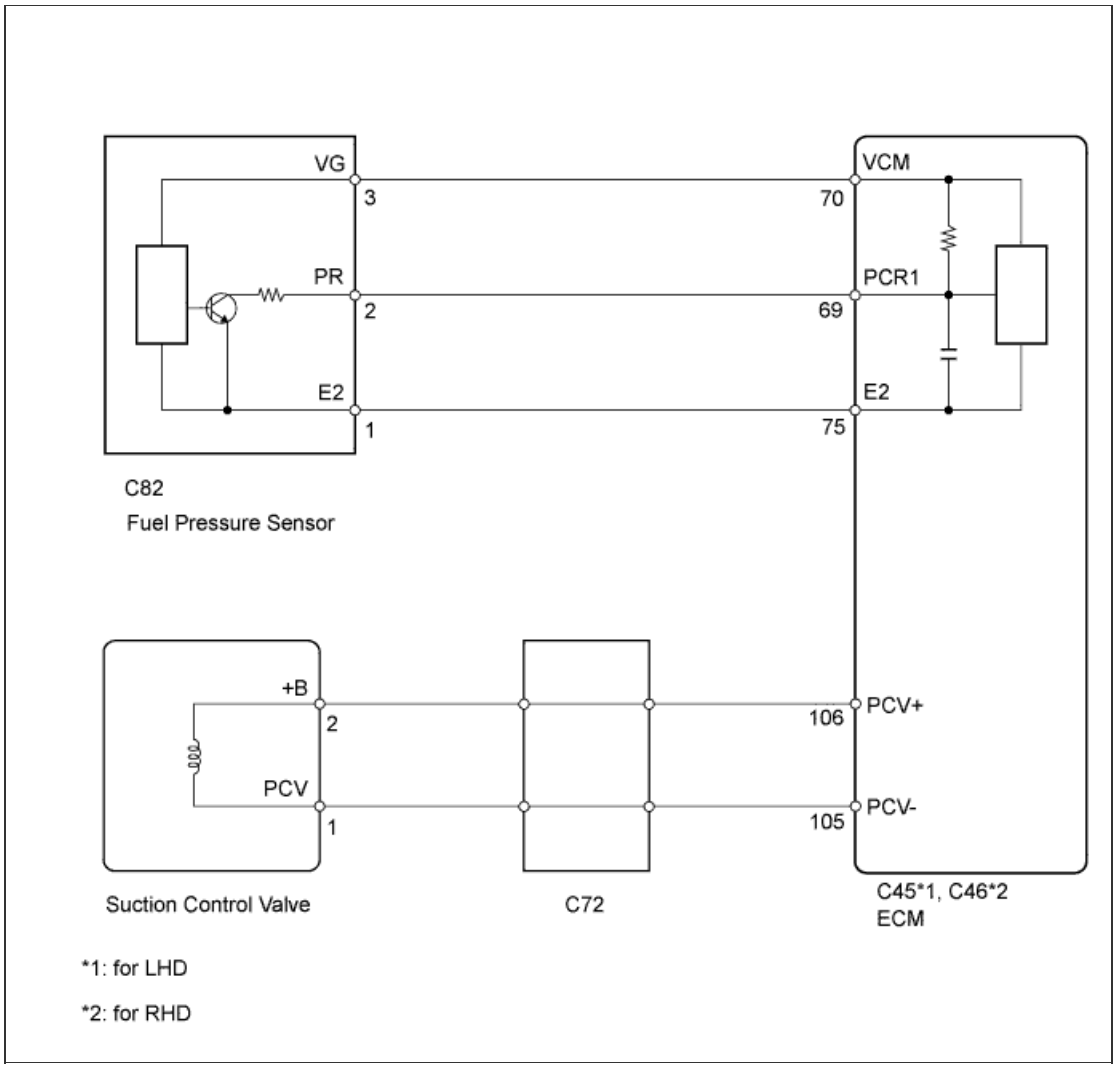
- **For more information on the fuel supply pump (suction control valve) and common rail system, refer to the System Description (Click here).**
- **When DTC P1229 is stored, check the internal fuel pressure of the common rail by entering the following menus: Powertrain / Engine / Data List / Fuel Press, Target Common Rail Pressure.**
  Under a stable condition such as idling or running the engine at 2500 rpm without load, Fuel Press is within +/-5 MPa of Target Common Rail Pressure.
- **When there is an operating problem with the fuel supply pump (when Fuel Press is more than Target Common Rail Pressure due to a problem with the closing of the suction valve), the values of Injection Pressure Correction and Target Pump SCV Current decrease.**

MONITOR DESCRIPTION

P122 (Fuel over-feed):

The ECM stores this DTC if the actual fuel pressure inside the common rail remains higher than the target fuel pressure, despite the ECM closing the suction control valve. This DTC indicates that the suction control valve may be stuck open, or there may be a short in its circuit. If this DTC is stored, the ECM enters fail-safe mode and limits the engine po er. The fail-safe mode continues until the ignition s itch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

- **After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).**
- **After replacing the fuel supply pump, the ECM needs initialization (Click here).**

HINT:

Read free e frame data using the intelligent tester. Free e frame data records the engine condition n malfunctions are detected. When troubleshooting, free e frame data can help determine if the vehicle as moving or stationary, if the engine as armed up or not, and other data from the time the malfunction occurred.

1.INSPECT FUEL SUPPLY PUMP (SUCTION CONTROL VALVE)

a. Disconnect the suction control valve connector and then check if the engine starts.

OK:
Engine does not start.

NG → Go to step 6

OK

2.READ VALUE USING INTELLIGENT TESTER (TARGET PUMP SCV CURRENT)

a. Connect the intelligent tester to the DLC3.

b. Start the engine.

c. Turn the tester on.

d. Enter the follo ing menus: Po ertrain / Engine / Data List / Target Pump SCV Current.

e. Read the value.

OK:

Engine Speed	Target Pump SCV Current
Idling	to 1123 mA
2500 rpm (No engine load)	1013 to 1212 mA

NG → Go to step 4

OK

3.READ VALUE USING INTELLIGENT TESTER (FUEL PRESS)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the follo ing menus: Po ertrain / Engine / Data List / Fuel Press.

d. Check that the internal fuel pressure of the common rail is ithin the specification belo .

OK:
Fuel Press is within +/-5 MPa of Target Common Rail Pressure when engine is idling and running at 2500 rpm without load.

OK → Go to step 5

NG → Go to step 4

4.CHECK HARNESS AND CONNECTOR (SUCTION CONTROL VALVE CONNECTOR - ECM)

a. Disconnect the suction control valve connector.

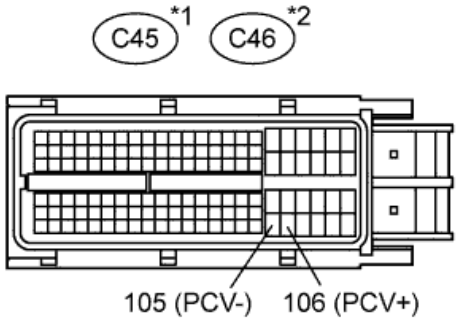
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table belo .

Front view of wire harness connector:
(to Suction Control Valve)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
Suction control valve connector-1 (PCV) - C45-105 (PCV-)	Al ays	Belo 1 Ω
Suction control valve connector-2 (+B) - C45-106 (PCV+)	Al ays	Belo 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
Suction control valve connector-1 (PCV) - C46-105 (PCV-)	Al ays	Belo 1 Ω
Suction control valve connector-2 (+B) - C46-106 (PCV+)	Al ays	Belo 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
Suction control valve connector-1 (PCV) or C45-105 (PCV-) - Body ground	Al ays	10 kΩ or higher
Suction control valve connector-2 (+B) or C45-106 (PCV+) - Body ground	Al ays	10 kΩ or higher

for RHD

		Specified

Tester Connection	Condition	Condition
Suction control valve connector-1 (PCV) or C46-105 (PCV-) - Body ground	Al ays	10 kΩ or higher
Suction control valve connector-2 (+B) or C46-106 (PCV+) - Body ground	Al ays	10 kΩ or higher

NG → Go to step 11

OK ↓

5.CHECK WHETHER DTC OUTPUT RECURS

a. Clear DTCs (Click here).

b. Connect the intelligent tester to the DLC3.

c. Turn the ignition s itch to ON and turn the tester on.

d. Start the engine.

e. Idle the engine for 60 seconds.

f. Enter the follo ing menus: Po ertrain / Engine / DTC.

g. Read the DTCs.

Result

Result	Proceed to
P122 is output	A
No DTC is output	B

B → END

A ↓

6.REPLACE FUEL SUPPLY PUMP

a. Replace the fuel supply pump (Click here).

NEXT ↓

7.READ VALUE USING INTELLIGENT TESTER (FUEL PRESS)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the follo ing menus: Po ertrain / Engine / Data List / Fuel Press.

d. Check that the internal fuel pressure of the common rail is ithin the specification belo .

OK:
Fuel Press is within +/-5 MPa of Target Common Rail Pressure when engine is idling and running at 2500 rpm without load.

NG → Go to step 10

OK ↓

8.CHECK WHETHER DTC OUTPUT RECURS

a. Clear the DTCs (Click here).

b. Connect the intelligent tester to the DLC3.

c. Turn the ignition s itch to ON and turn the tester on.

d. Start the engine.

e. Idle the engine for 60 seconds.

f. Enter the follo ing menus: Po ertrain / Engine / DTC.

g. Read the DTCs.

Result

Result	Proceed to
P122 is output	A
No DTC is output	B

B → END

A

9.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 12

10.REPLACE COMMON RAIL (for Bank 1) (FUEL PRESSURE SENSOR)

a. Replace common rail (for Bank 1) (Click here).

NEXT → Go to step 12

11.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

12.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition s itch off.

d. Start the engine.

e. Idle the engine for 60 seconds.

f. Confirm that the DTC is not output again.

HINT:

Perform the follo ing procedure using the tester to determine ether or not the DTC judgment has been carried out.

i. Enter the follo ing menus: Po ertrain / Engine / Utility / All Readiness.

ii. Input DTC P122 .

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, increase idling time.

NEXT

END

DTC P0100 Mass or Volume Air Flow Circuit

DTC P0102 Mass or Volume Air Flow Circuit Low Input

DTC P0103 Mass or Volume Air Flow Circuit High Input

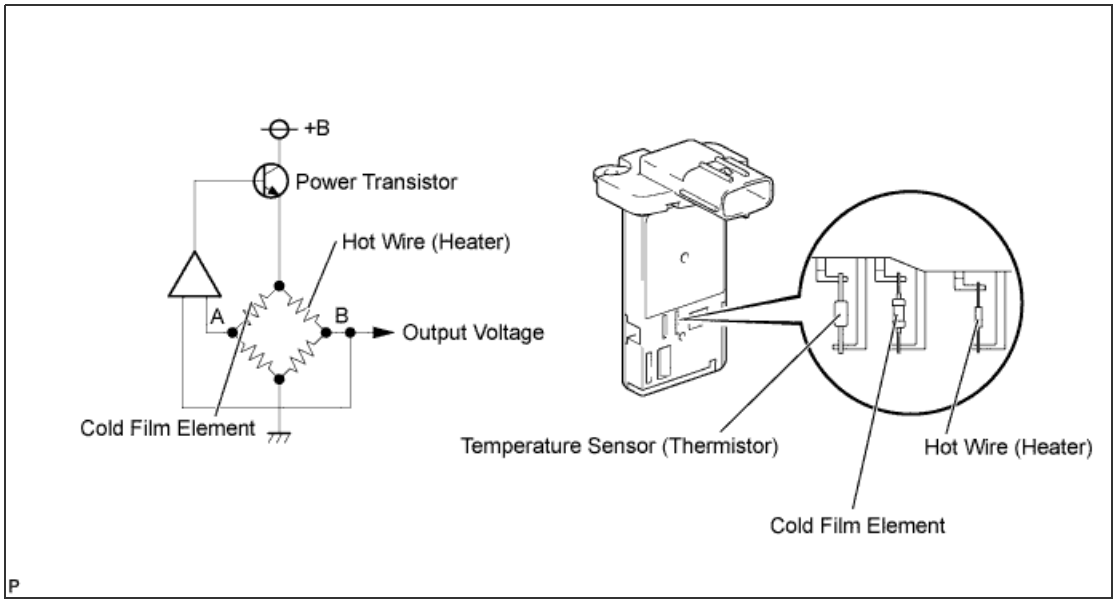
for Preparation Click here

DESCRIPTION

The Mass Air Flow (MAF) meter uses a platinum hot wire. The mass air flow meter consists of a platinum hot wire, a temperature sensor and a control circuit installed in a plastic housing. The mass air flow meter hot wire and temperature sensor (located in the intake air by-pass of the housing) detect changes in the intake air temperature.

The hot wire is maintained at the predetermined temperature by controlling the current flow through the hot wire. This current flow is then used as the output voltage of the mass air flow meter.

The circuit is constructed so that the platinum hot wire and temperature sensor provide a bridge circuit, with the power transistor controlled so that the potential of A and B remains equal to maintain the predetermined temperature.



P0100

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3 seconds	Mass air flow (MAF) meter voltage is 0.2 V or less, or 4. V or more with the engine speed at 4000 rpm or less for 3 seconds (1 trip detection logic).	• Open or short in Mass Air Flow (MAF) meter circuit • Mass air flow meter • ECM

P0102

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3 seconds	MAF meter voltage is 0.2 V or less with the engine speed at 4000 rpm or less for 3 seconds (1 trip detection logic).	• Open in Mass Air Flow (MAF) meter circuit • Mass air flow meter • ECM

P0103

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3 seconds	MAF meter voltage is 4. V or more with the engine speed at 4000 rpm or less for 3 seconds (1 trip detection logic).	• Shot in Mass Air Flow (MAF) meter circuit • Mass air flow meter • ECM

Related Data List

DTC No.	Data List
P0100	MAF
P0102	
P0103	

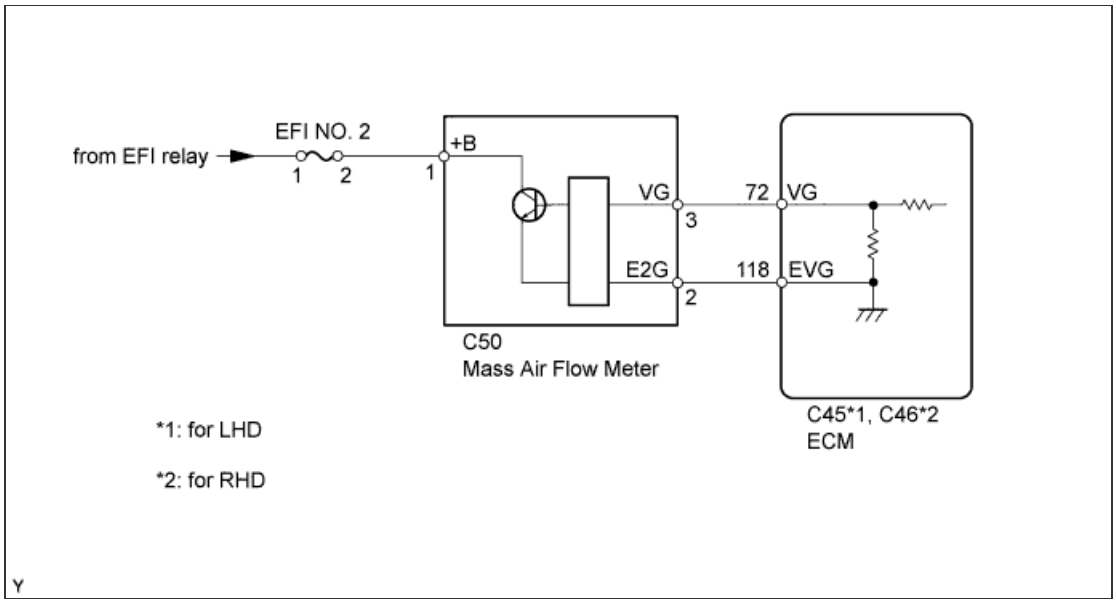
HINT:

- **If DTC P0100, and/or P0102 is stored, the following symptoms may appear (as the ECU mistakenly determines that there is less air than the actual intake air amount, EGR is decreased to match the target EGR):**
  - **Combustion noise worsens**
- **If DTC P0100, and/or P0103 is stored, the following symptoms may appear (as the ECU mistakenly determines that there is more air than the actual intake air amount, EGR is increased to match the target EGR):**
  - **Misfire**
  - **White smoke**
  - **Black smoke**
- **After confirming DTC P0100, P0102 or P0103, check the mass air flow ratio by entering the following menus: Powertrain / Engine / Data List / MAF.**

Reference:

Air Flow Value (g/sec.)	Malfunction
Approximately 0.0	• **Open in mass air flow meter power source circuit** • **Open or short in VG circuit**
174.0 or more	Open in EVG circuit

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (MASS AIR FLOW RATE)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / MAF.

d. Read the value.

Result

Result	Proceed to
0.0	A
174.0 or more	B
Between 1 and 173.0*	C

HINT:

*: The value should change when the throttle valve is opened or closed.

B → Go to step 8

C → Go to step 15

A

2.INSPECT MASS AIR FLOW METER (POWER SOURCE CIRCUIT)

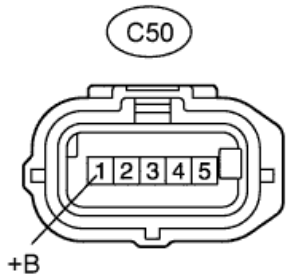
a. Disconnect the mass air flow meter connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C50-1 (+B) - Body ground	Ignition switch ON	11 to 14 V

Front view of wire harness connector:
(to Mass Air Flow Meter)



NG → Go to step 5

OK

3.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → Go to step 11

OK

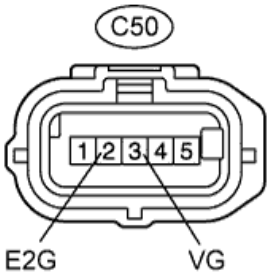
4.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the mass air flow meter connector.

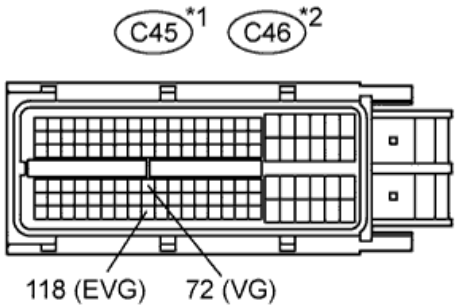
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Mass Air Flow Meter)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C45-72 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C45-118 (EVG)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C46-72 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C46-118 (EVG)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) or C45-72 (VG) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) or C46-72 (VG) - Body ground	Always	10 kΩ or higher

OK → Go to step 10

NG → Go to step 12

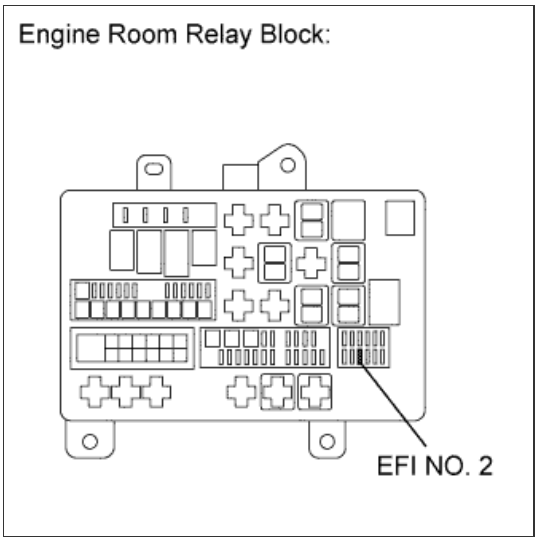
5.INSPECT FUSE (EFI NO. 2)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse	Always	Below 1 Ω



NG → Go to step 13

OK

6.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ENGINE ROOM RELAY BLOCK)

a. Disconnect the mass air flow meter connector.

b. Remove the EFI NO. 2 fuse from the engine room relay block.

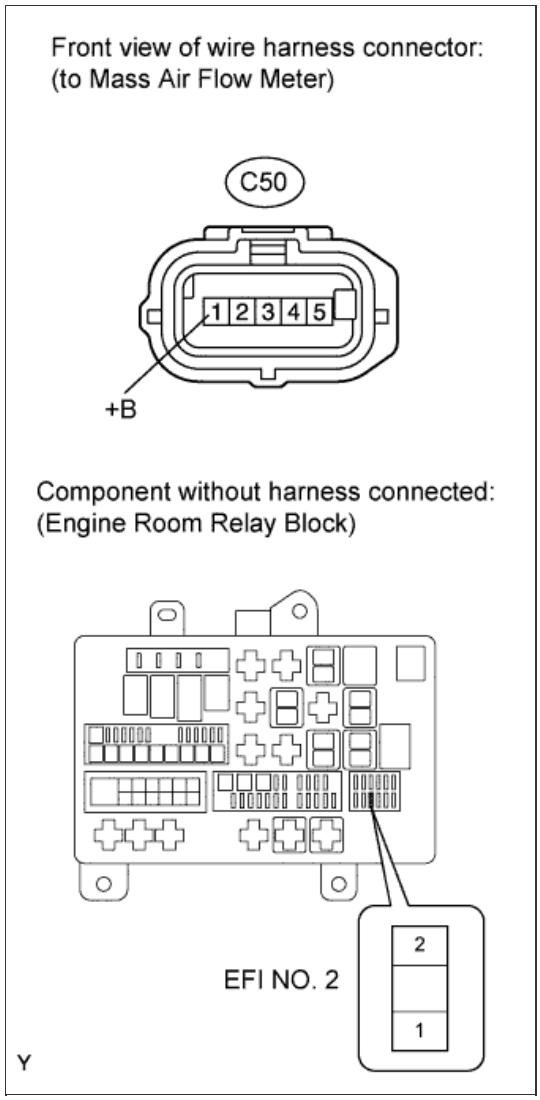
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C50-1 (+B) - EFI NO. 2 fuse (2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
C50-1 (+B) or EFI NO. 2 fuse (2) - Body ground	Always	10 kΩ or higher



NG → Go to step 12

OK

7.CHECK HARNESS AND CONNECTOR (ENGINE ROOM RELAY BLOCK)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

b. Remove the integration relay from the engine room relay block.

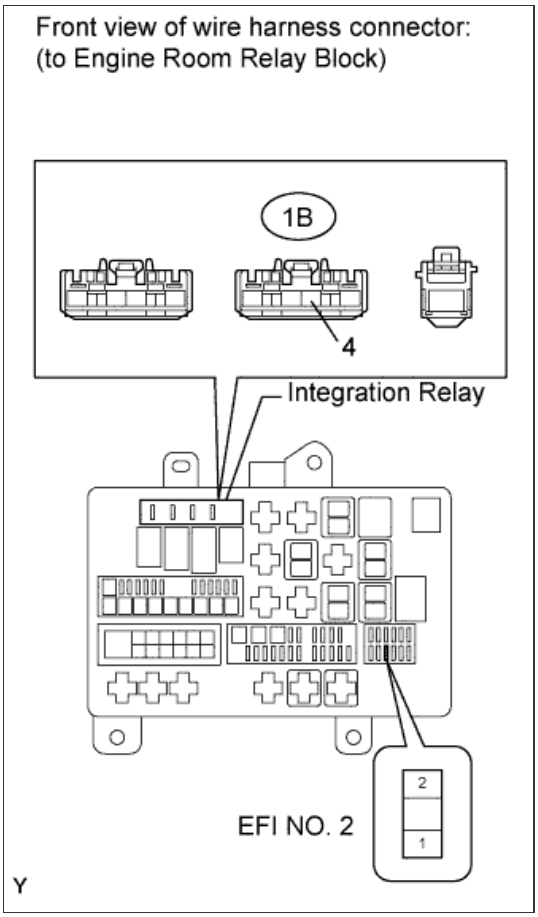
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse (1) - 1B-4	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse (1) or 1B-4 - Body ground	Always	10 kΩ or higher



OK	Go to step 14
NG	Go to step 12

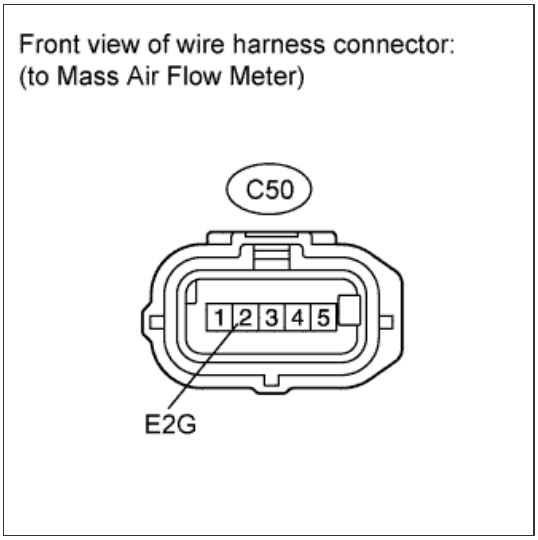
8.CHECK HARNESS AND CONNECTOR (SENSOR GROUND)

a. Disconnect the mass air flow meter connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C50-2 (E2G) - Body ground	Always	Below 1 Ω



OK	Go to step 11
NG	Go to step 9

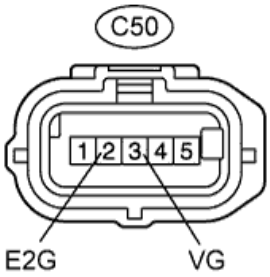
9.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the mass air flow meter connector.

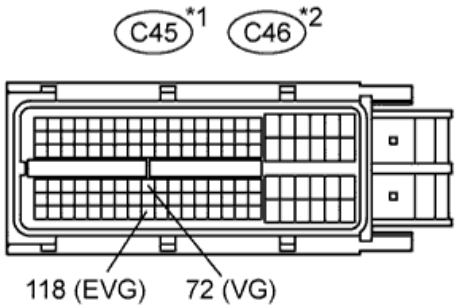
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Mass Air Flow Meter)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C45-72 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C45-118 (EVG)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C46-72 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C46-118 (EVG)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) or C45-72 (VG) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) or C46-72 (VG) - Body ground	Always	10 kΩ or higher

NG → Go to step 12

OK

10.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 15

11.REPLACE MASS AIR FLOW METER

a. Replace the mass air flow meter (Click here).

NEXT → Go to step 15

12.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT → Go to step 15

13.CHECK FOR SHORTS IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

NEXT → Go to step 15

14.CHECK ECM POWER SOURCE CIRCUIT

a. Check the ECM power source circuit (Click here).

NEXT

15.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 3 seconds

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

DTC P1238 Injector Malfunction

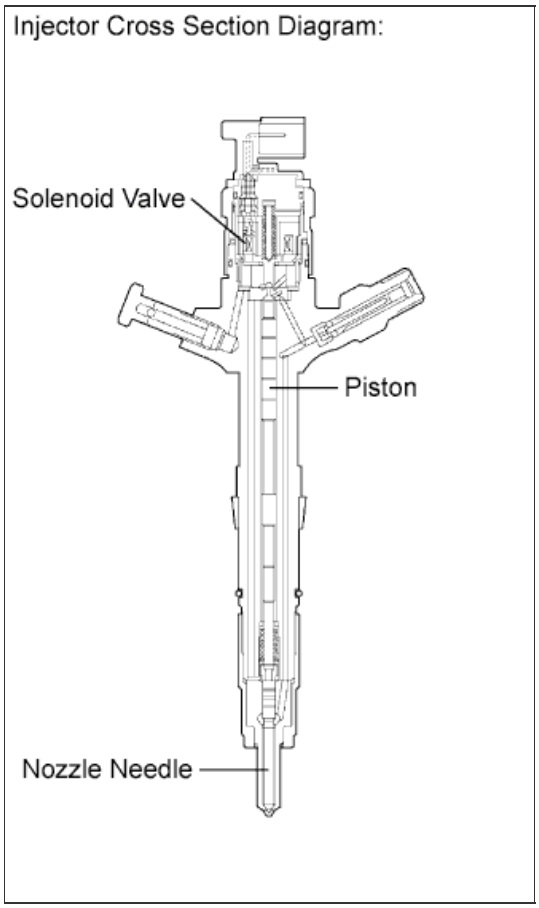
for Preparation Click here

DESCRIPTION

HINT:

- **For more information on the fuel injector and the common rail system refer to the System Description (Click here).**
- **If DTC P1238 has been stored, refer to the Diagnostic Trouble Code (DTC) Table for Common Rail System (Click here).**

The ECM detects combustion deterioration for a specific cylinder.



HINT:

- **The cylinder which has the compensation value for Injection Feedback Val #1, #2, #3, #4, #5, #6, #7 and #8 that varies from the other cylinders may be malfunctioning.**
- **If DTC P0093 (fuel leaks from high-pressure area) is stored simultaneously, a leakage malfunction of the cylinder has probably occurred.**
- **If DTC P062D (open or short in the No. 1 injector driver (EDU) or fuel injector circuit) is stored simultaneously, there is probably a faulty circuit located between the ECM and the fuel injector including the No. 1 EDU.**
- **If DTC P062E (open or short in the No. 2 injector driver (EDU) or fuel injector circuit) is stored simultaneously, there is probably a faulty circuit located between the ECM and the fuel injector including the No. 2 EDU.**
- **If only DTC P1238 (injector malfunction) has been stored, a fuel injector mechanical malfunction or insufficient compression (valve clearance, etc.) has probably occurred. An open or short malfunction of the ECM, EDU or fuel injector circuit is unlikely.**

P1238

DTC Detection Drive Pattern	DTC Detection Condition	Main Trouble Area	Related Trouble Area
Warm up the engine and idle it for 60 seconds	A large engine speed fluctuation when idling continues for 60 seconds (2 trip detection logic).	• Fuel injector • Injector driver (EDU) (P062D and/or P062E set simultaneously) • Connector connection (P062D and/or P062E set simultaneously) • Compression pressure	• Valve timing • Fuel with low cetane number used • ECM

Related Data List

DTC No.	Data List
P1238	• Injection Volume • Injection Feedback Val #1 to #8

HINT:

- **If DTC P1238 is stored, the following symptoms may appear:**
  - **Rough idle**
  - **Poor driveability**
- **After confirming DTC P1238, check the internal fuel pressure on the intelligent tester by entering the following menus: Powertrain / Engine / Data List / Fuel Press, Target Common Rail Pressure.**
  Under a stable condition such as idling or running the engine at 2500 rpm without load, Fuel Press is within +/-5 MPa of Target Common Rail Pressure.

MONITOR DESCRIPTION

P1238 (Injection malfunction, except open or short in fuel injector circuit):
This DTC will be stored if the engine speed fluctuation between each cylinder is large. The ECM monitors changes in the crankshaft rotation speed using the crankshaft position sensor in order to detect improper combustion. The camshaft position sensor also plays a role in determining which cylinder has the problem. The fluctuation counter increases when irregular crankshaft rotation speed variation exceeds the threshold with the engine idling. Therefore, if any one of the cylinders is operating poorly (rough idle), the ECM stores this DTC.

WIRING DIAGRAM

Refer to DTC P062D (Click here).

INSPECTION PROCEDURE

NOTICE:

After replacing a fuel injector, the ECM needs registration (Click here).

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P1238)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P1238 is output	A
P1238 and other DTCs are output	B

HINT:

- **If any DTCs other than P1238 are output, troubleshoot those DTCs first.**
- **If DTCs other than P1238 are not output, check the fuel condition before proceeding to the next step.**

B → GO TO DTC CHART (Click here)

A

2.CHECK HARNESS AND CONNECTOR (ENGINE WIRE HARNESS)

a. Check the wire harness and connector connections.

OK:
The wire harness and connectors have been connected securely and there are good connections.

NG → Go to step 9

OK

3.READ VALUE USING INTELLIGENT TESTER (COMPENSATORY INJECTION VOLUME FOR EACH CYLINDER)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Start the engine and warm it up (engine coolant temperature is 75°C (167°F) or more), and then idle the engine for 1 minute or more.

d. Enter the following menus: Powertrain / Engine / Data List / Injection Feedback Val #1 to #8.

e. Read the value.

Standard value:
The compensatory injection volume is from -3.0 to 3.0 mm^3/st.

HINT:

- **If the fuel injector is malfunctioning, the compensatory injection volume remains at -5.0 or 5.0 mm^3/st.**
- **The compensatory injection volume is usually from -3.0 to 3.0 mm^3/st.**
- **The numbers of the Data List item Injection Feedback Val #1 to #8 do not match the cylinder numbers (refer to the Diesel Injection section of the Data List) (Click here).**

f. Any cylinders that have a higher compensatory injection volume than shown above are considered to be faulty. Use the following steps to inspect and repair the cylinders.

NEXT

4.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (FUEL CUT FOR IDENTIFYING MALFUNCTION CYLINDER)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Active Test / Control the Cylinder #1 to #8 Fuel Cut.

d. Check the 8 cylinders in sequence to identify a faulty cylinder by performing the power-balance inspection.

HINT:

- **If the engine idle speed does not change when a fuel injector is disabled, the cylinder being tested is malfunctioning.**
- **If the cylinder being tested is normal, there will be a significant change in idle speed when the fuel injection is stopped for that cylinder.**

NEXT

5.CHECK CYLINDER COMPRESSION PRESSURE OF MALFUNCTIONING CYLINDER

a. Check the cylinder compression pressure (Click here).

NG → Go to step 10

OK

6.REPLACE FUEL INJECTOR

a. Replace the fuel injector (Click here).

NEXT

7.CHECK WHETHER DTC OUTPUT RECURS (DTC P1238)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Turn the ignition switch off.

e. Start the engine.

f. Switch the ECM from normal mode to check mode (Click here).

g. Warm up the engine (engine coolant temperature is 75°C (167°F) or more) and idle it for 60 seconds.

h. Enter the following menus: Powertrain / Engine / DTC.

i. Read the DTCs.

Result

Result	Proceed to
P1238 is output	A
No DTC is output	B

B → END

A

8.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

9.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT → Go to step 11

10.CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

NEXT

11.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Start the engine.

e. Warm up the engine and idle it for 60 seconds.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P1238.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, increase idling time.

NEXT

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END
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DTC P0100 Mass or Volume Air Flow Circuit

DTC P0102 Mass or Volume Air Flow Circuit Low Input

DTC P0103 Mass or Volume Air Flow Circuit High Input

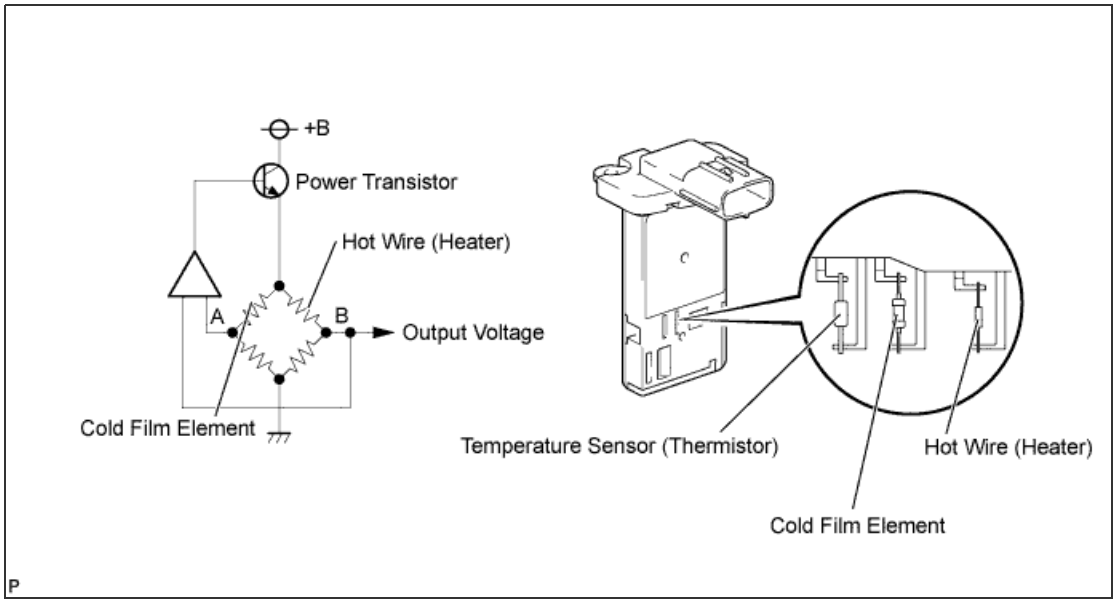
for Preparation Click here

DESCRIPTION

The Mass Air Flow (MAF) meter uses a platinum hot wire. The mass air flow meter consists of a platinum hot wire, a temperature sensor and a control circuit installed in a plastic housing. The mass air flow meter hot wire and temperature sensor (located in the intake air by-pass of the housing) detect changes in the intake air temperature.

The hot wire is maintained at the predetermined temperature by controlling the current flow through the hot wire. This current flow is then used as the output voltage of the mass air flow meter.

The circuit is constructed so that the platinum hot wire and temperature sensor provide a bridge circuit, with the power transistor controlled so that the potential of A and B remains equal to maintain the predetermined temperature.



P0100

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3 seconds	Mass air flow (MAF) meter voltage is 0.2 V or less, or 4. V or more with the engine speed at 4000 rpm or less for 3 seconds (1 trip detection logic).	• Open or short in Mass Air Flow (MAF) meter circuit • Mass air flow meter • ECM

P0102

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3 seconds	MAF meter voltage is 0.2 V or less with the engine speed at 4000 rpm or less for 3 seconds (1 trip detection logic).	• Open in Mass Air Flow (MAF) meter circuit • Mass air flow meter • ECM

P0103

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3 seconds	MAF meter voltage is 4. V or more with the engine speed at 4000 rpm or less for 3 seconds (1 trip detection logic).	• Shot in Mass Air Flow (MAF) meter circuit • Mass air flow meter • ECM

Related Data List

DTC No.	Data List
P0100	MAF
P0102	
P0103	

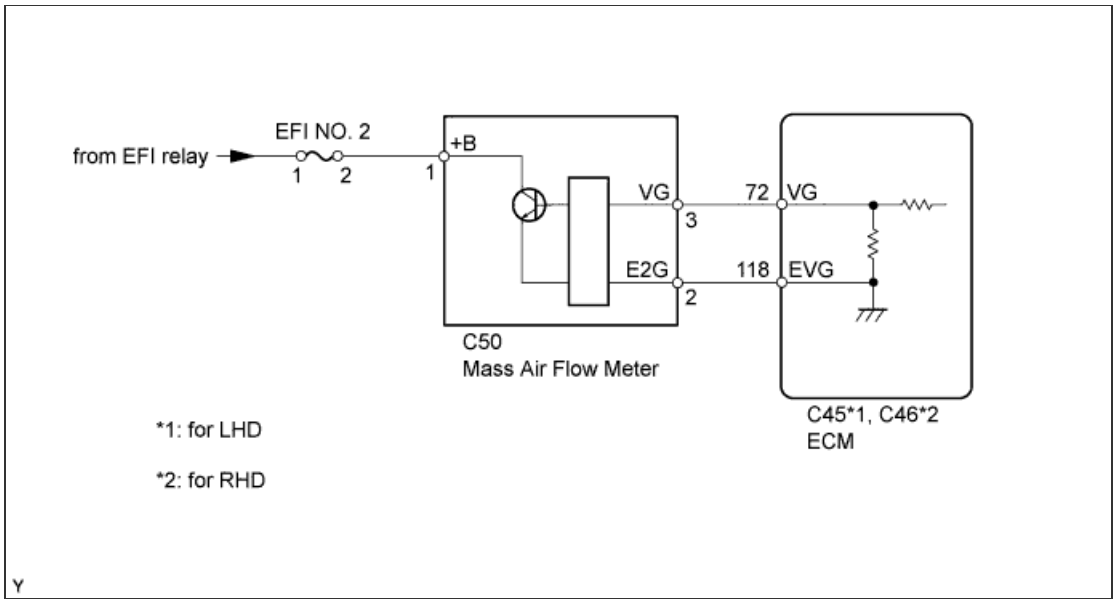
HINT:

- **If DTC P0100, and/or P0102 is stored, the following symptoms may appear (as the ECU mistakenly determines that there is less air than the actual intake air amount, EGR is decreased to match the target EGR):**
  - **Combustion noise worsens**
- **If DTC P0100, and/or P0103 is stored, the following symptoms may appear (as the ECU mistakenly determines that there is more air than the actual intake air amount, EGR is increased to match the target EGR):**
  - **Misfire**
  - **White smoke**
  - **Black smoke**
- **After confirming DTC P0100, P0102 or P0103, check the mass air flow ratio by entering the following menus: Powertrain / Engine / Data List / MAF.**

Reference:

Air Flow Value (g/sec.)	Malfunction
Approximately 0.0	• **Open in mass air flow meter power source circuit** • **Open or short in VG circuit**
174.0 or more	Open in EVG circuit

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (MASS AIR FLOW RATE)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / MAF.

d. Read the value.

Result

Result	Proceed to
0.0	A
174.0 or more	B
Between 1 and 173.0*	C

HINT:

*: The value should change when the throttle valve is opened or closed.

B → Go to step 8

C → Go to step 15

A

2.INSPECT MASS AIR FLOW METER (POWER SOURCE CIRCUIT)

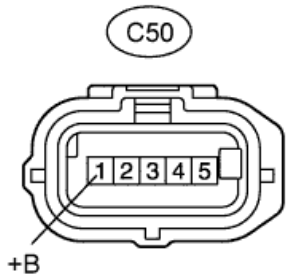
a. Disconnect the mass air flow meter connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C50-1 (+B) - Body ground	Ignition switch ON	11 to 14 V

Front view of wire harness connector:
(to Mass Air Flow Meter)



NG → Go to step 5

OK

3.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → Go to step 11

OK

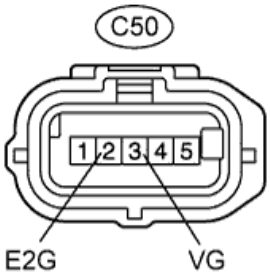
4.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the mass air flow meter connector.

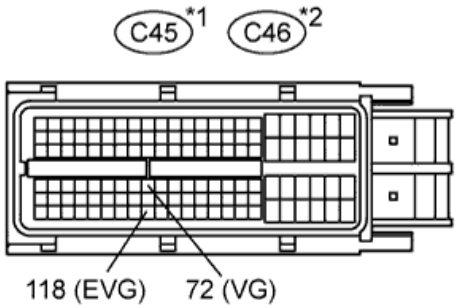
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Mass Air Flow Meter)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C45-72 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C45-118 (EVG)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C46-72 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C46-118 (EVG)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) or C45-72 (VG) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) or C46-72 (VG) - Body ground	Always	10 kΩ or higher

OK → Go to step 10

NG → Go to step 12

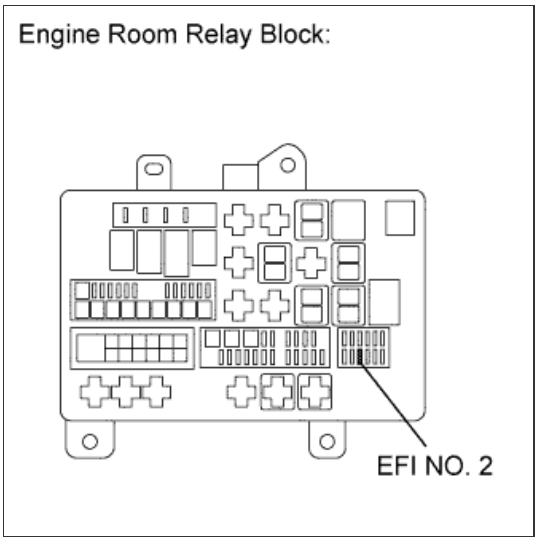
5.INSPECT FUSE (EFI NO. 2)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse	Always	Below 1 Ω



NG → Go to step 13

OK

6.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ENGINE ROOM RELAY BLOCK)

a. Disconnect the mass air flow meter connector.

b. Remove the EFI NO. 2 fuse from the engine room relay block.

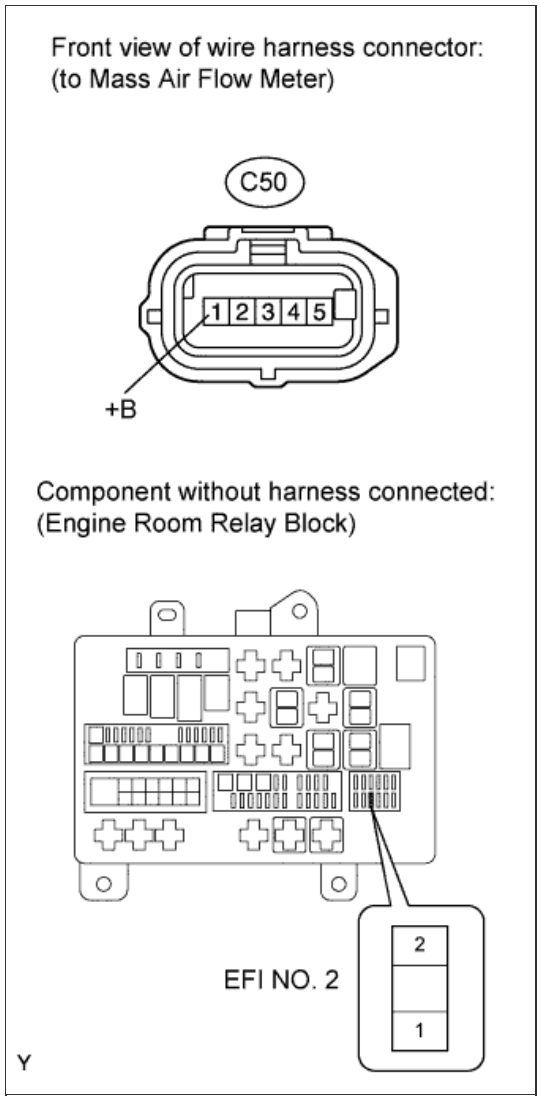
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C50-1 (+B) - EFI NO. 2 fuse (2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
C50-1 (+B) or EFI NO. 2 fuse (2) - Body ground	Always	10 kΩ or higher



NG → Go to step 12

OK

7.CHECK HARNESS AND CONNECTOR (ENGINE ROOM RELAY BLOCK)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

b. Remove the integration relay from the engine room relay block.

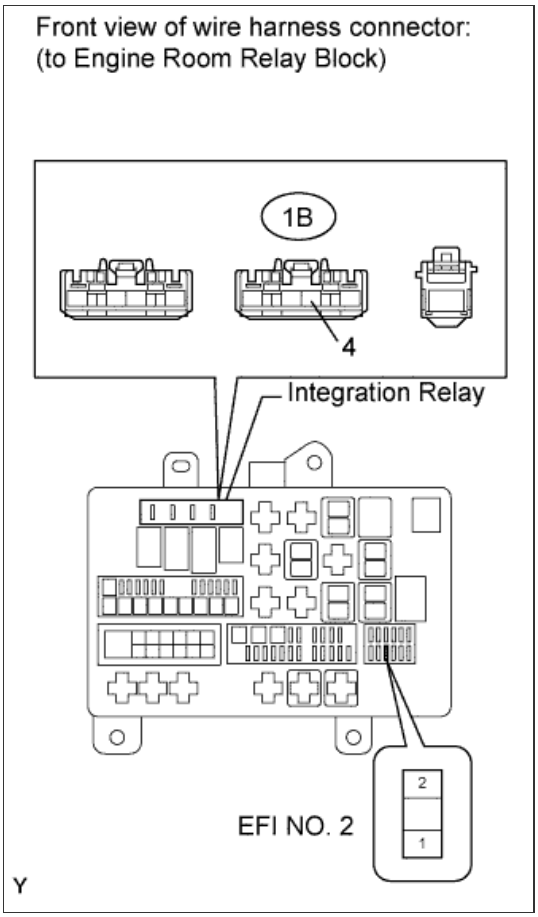
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse (1) - 1B-4	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse (1) or 1B-4 - Body ground	Always	10 kΩ or higher



OK	Go to step 14
NG	Go to step 12

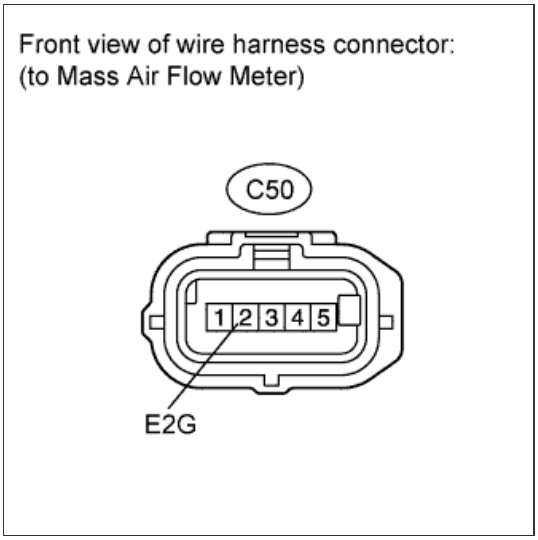
8.CHECK HARNESS AND CONNECTOR (SENSOR GROUND)

a. Disconnect the mass air flow meter connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C50-2 (E2G) - Body ground	Always	Below 1 Ω



OK	Go to step 11
NG	Go to step 9

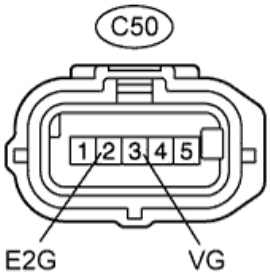
9.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the mass air flow meter connector.

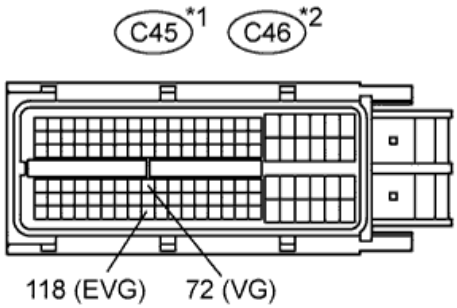
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Mass Air Flow Meter)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C45-72 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C45-118 (EVG)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C46-72 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C46-118 (EVG)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) or C45-72 (VG) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) or C46-72 (VG) - Body ground	Always	10 kΩ or higher

NG → Go to step 12

OK

10.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 15

11.REPLACE MASS AIR FLOW METER

a. Replace the mass air flow meter (Click here).

NEXT → Go to step 15

12.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT → Go to step 15

13.CHECK FOR SHORTS IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

NEXT → Go to step 15

14.CHECK ECM POWER SOURCE CIRCUIT

a. Check the ECM power source circuit (Click here).

NEXT

15.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 3 seconds

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

DTC P1251 Turbocharger / Supercharger Overboost Condition (Too High)

for Preparation Click here

DESCRIPTION

HINT:

Refer to DTC P0046 (Click here).

Refer to DTC P00AF (Click here).

P1251

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Vehicle being driven	The turbo motor driver detects an overcurrent caused by the DC motor being stuck (1 trip detection logic).	• Turbocharger sub-assembly • Turbo motor driver • Turbo motor driver power source • VN turbo link stuck malfunction • Extremely low battery voltage (P0560 stored simultaneously) • ECM

Related Data List

DTC No.	Data List
P1251	• MAP • Target Booster Pressure

If DTC P1251 is stored, the following symptoms may appear:

- VN turbo vane stuck closed malfunction
  - Vehicle surge when driving with full load
  - Sudden lack of power due to power being limited

WIRING DIAGRAM

Refer to DTC P0046 (Click here).
Refer to DTC P00AF (Click here).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P1251)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read the DTCs.

Result:

Display (DTC Output)	Proceed to
P1251	A
P1251 and other DTCs	B

B → GO TO DTC CHART (Click here)

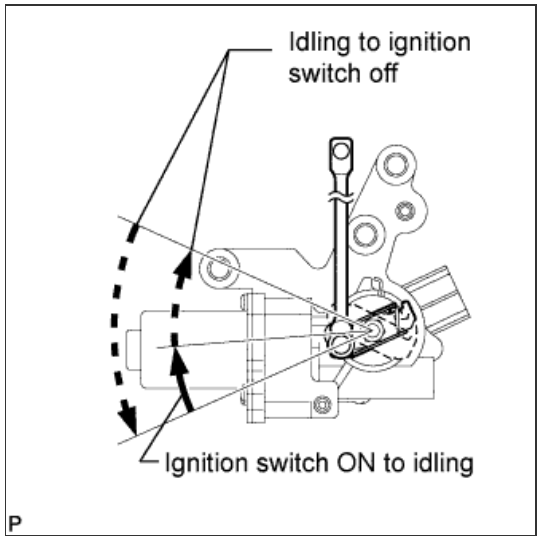
A

2.INSPECT TURBOCHARGER SUB-ASSEMBLY (for Bank 1 and/or Bank 2)

a. Check the motor movement when turning the ignition switch to ON, when starting the engine and then when turning the ignition switch off.

OK:

Motor moves as shown in the illustration.



NG → Go to step 4

OK

3.CHECK WHETHER DTC OUTPUT RECURS (DTC P1251)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following: Powertrain / Engine / DTC / Clear.

d. Clear DTCs (Click here).

e. Turn the ignition switch off.

f. Start the engine and warm it up.

g. Drive the vehicle.

h. Enter the following menus: Powertrain / Engine / DTC.

i. Read the DTCs.

Result:

Display (DTC Output)	Proceed to
P1251	A
No output	B

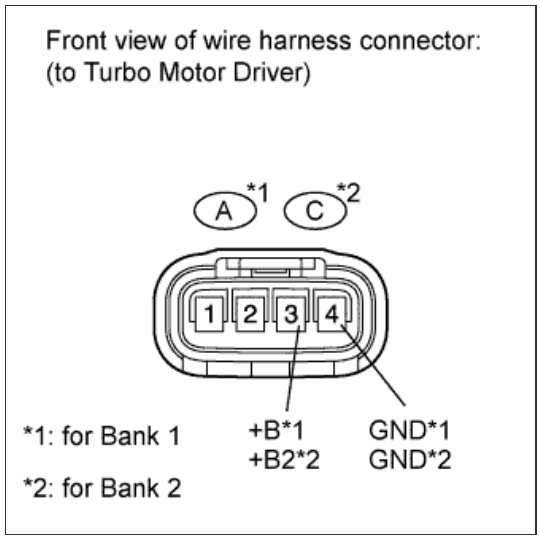
A → Go to step 11

B → END

4.INSPECT TURBO MOTOR DRIVER (POWER SOURCE CIRCUIT)

a. Disconnect the turbo motor driver connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-3 (+B) - Turbo motor driver connector-4 (GND)	Ignition switch ON	11 to 14 V

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-3 (+B2) - Turbo motor driver connector-4 (GND2)	Ignition switch ON	11 to 14 V

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-4 (GND) - Body ground	Always	Below 1 Ω

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-4 (GND2) - Body ground	Always	Below 1 Ω

NG → Go to step 10

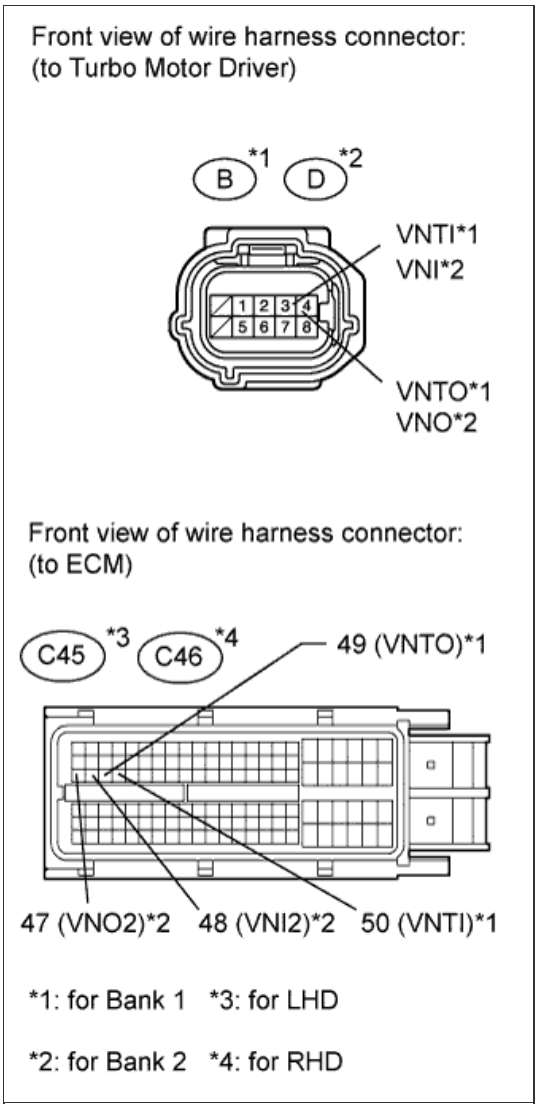
OK

5.CHECK HARNESS AND CONNECTOR (TURBO MOTOR DRIVER - ECM)

a. Disconnect the turbo motor driver connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C45-49 (VNTO) - B-4 (VNTO)	Always	Below 1 Ω
C45-50 (VNTI) - B-3 (VNTI)	Always	Below 1 Ω
C45-47 (VNO2) - D-4 (VNO2)	Always	Below 1 Ω
C45-48 (VNI2) - D-3 (VNI2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C46-49 (VNTO) - B-4 (VNTO)	Always	Below 1 Ω
C46-50 (VNTI) - B-3 (VNTI)	Always	Below 1 Ω
C46-47 (VNO2) - D-4 (VNO2)	Always	Below 1 Ω
C46-48 (VNI2) - D-3 (VNI2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C45-49 (VNTO) or B-4 (VNTO) - Body ground	Always	10 kΩ or higher
C45-50 (VNTI) or B-3 (VNTI) -		10 kΩ or

Body ground	Always	higher
C45-47 (VNO2) or D-4 (VNO2) - Body ground	Always	10 kΩ or higher
C45-48 (VNI2) or D-3 (VNI2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C46-49 (VNTO) or B-4 (VNTO) - Body ground	Always	10 kΩ or higher
C46-50 (VNTI) or B-3 (VNTI) - Body ground	Always	10 kΩ or higher
C46-47 (VNO2) or D-4 (VNO2) - Body ground	Always	10 kΩ or higher
C46-48 (VNI2) or D-3 (VNI2) - Body ground	Always	10 kΩ or higher

NG → Go to step 10

OK

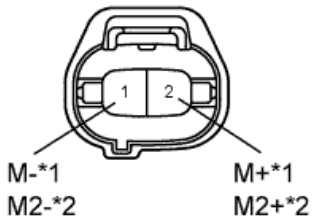
6.CHECK HARNESS AND CONNECTOR (DC MOTOR - TURBO MOTOR DRIVER)

a. Disconnect the DC motor connector.

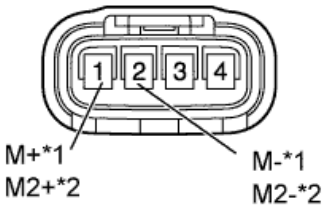
b. Disconnect the turbo motor driver connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to DC Motor)



Front view of wire harness connector:
(to Turbo Motor Driver)



*1: for Bank 1

*2: for Bank 2

Standard Resistance (Check for Open):

for Bank 1

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M-) - Turbo motor driver connector-2 (M-)	Always	Below 1 Ω
DC motor connector-2 (M+) - Turbo motor driver connector-1 (M+)	Always	Below 1 Ω

for Bank 2

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M2-) - Turbo motor driver connector-2 (M2-)	Always	Below 1 Ω
DC motor connector-2 (M2+) - Turbo motor driver connector-1 (M2+)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for Bank 1

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M-) or Turbo motor driver connector-2 (M-) - Body ground	Always	10 kΩ or higher
DC motor connector-2 (M+) or Turbo motor driver connector-1 (M+) - Body ground	Always	10 kΩ or higher

for Bank 2

Tester Connection	Condition	Specified Condition
DC motor connector-1 (M2-) or Turbo motor driver connector-2 (M2-) - Body ground	Always	10 kΩ or higher
DC motor connector-2 (M2+) or Turbo motor driver connector-1 (M2+) - Body ground	Always	10 kΩ or higher

NG → Go to step 10

OK

7.REPLACE TURBO MOTOR DRIVER (for Bank 1 and/or Bank 2)

a. Replace the turbo motor driver (for Bank 1 and/or Bank 2) (Click here).

NEXT

8.CHECK WHETHER DTC OUTPUT RECURS (DTC P1251)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC / Clear.

d. Clear the DTCs (Click here).

e. Turn the ignition switch off.

f. Start the engine and warm it up.

g. Drive the vehicle.

h. Enter the following menus: Powertrain / Engine / DTC.

i. Read the DTCs.

Result

Display (DTC Output)	Proceed to
P1251	A
No output	B

B → END

A

9.REPLACE TURBOCHARGER SUB-ASSEMBLY (for Bank 1 and/or Bank 2) (DC MOTOR)

a. Replace the turbocharger sub-assembly (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 12

10.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT → Go to step 12

11.REPLACE ECM

a. Replace the ECM (Click here).

NEXT

12.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Start the engine and warm it up.

e. Run the engine with a heavy load at a mid to high engine speed.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P1251.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, increase the time spent running the engine with a heavy load at a mid to high engine speed.

NEXT

END

DTC P0100 Mass or Volume Air Flow Circuit

DTC P0102 Mass or Volume Air Flow Circuit Low Input

DTC P0103 Mass or Volume Air Flow Circuit High Input

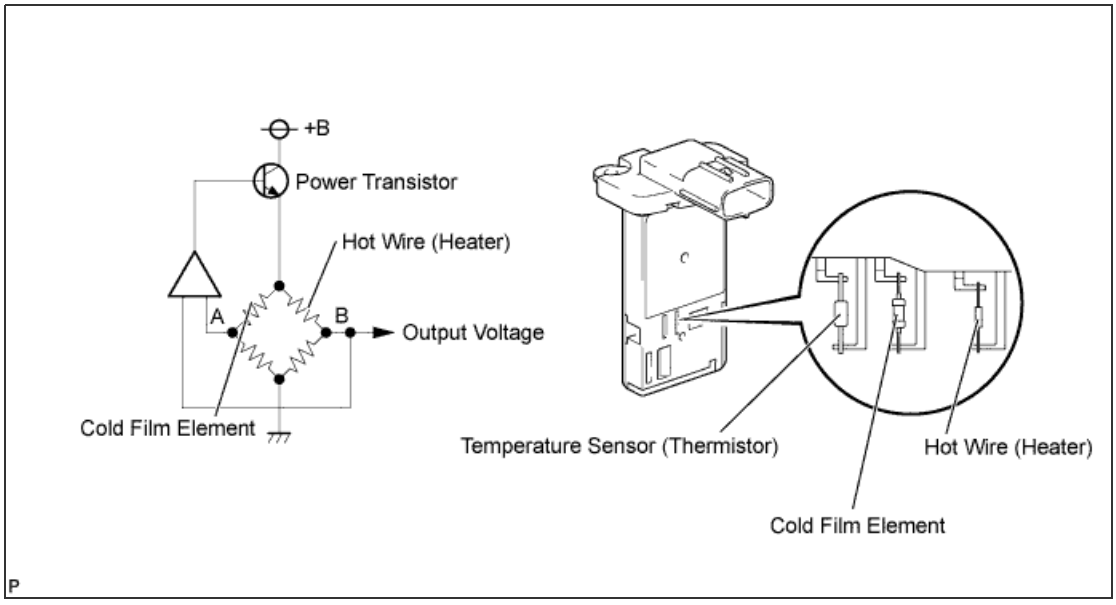
for Preparation Click here

DESCRIPTION

The Mass Air Flow (MAF) meter uses a platinum hot wire. The mass air flow meter consists of a platinum hot wire, a temperature sensor and a control circuit installed in a plastic housing. The mass air flow meter hot wire and temperature sensor (located in the intake air by-pass of the housing) detect changes in the intake air temperature.

The hot wire is maintained at the predetermined temperature by controlling the current flow through the hot wire. This current flow is then used as the output voltage of the mass air flow meter.

The circuit is constructed so that the platinum hot wire and temperature sensor provide a bridge circuit, with the power transistor controlled so that the potential of A and B remains equal to maintain the predetermined temperature.



P0100

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3 seconds	Mass air flow (MAF) meter voltage is 0.2 V or less, or 4. V or more with the engine speed at 4000 rpm or less for 3 seconds (1 trip detection logic).	• Open or short in Mass Air Flow (MAF) meter circuit • Mass air flow meter • ECM

P0102

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3 seconds	MAF meter voltage is 0.2 V or less with the engine speed at 4000 rpm or less for 3 seconds (1 trip detection logic).	• Open in Mass Air Flow (MAF) meter circuit • Mass air flow meter • ECM

P0103

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3 seconds	MAF meter voltage is 4. V or more with the engine speed at 4000 rpm or less for 3 seconds (1 trip detection logic).	• Shot in Mass Air Flow (MAF) meter circuit • Mass air flow meter • ECM

Related Data List

DTC No.	Data List
P0100	MAF
P0102	
P0103	

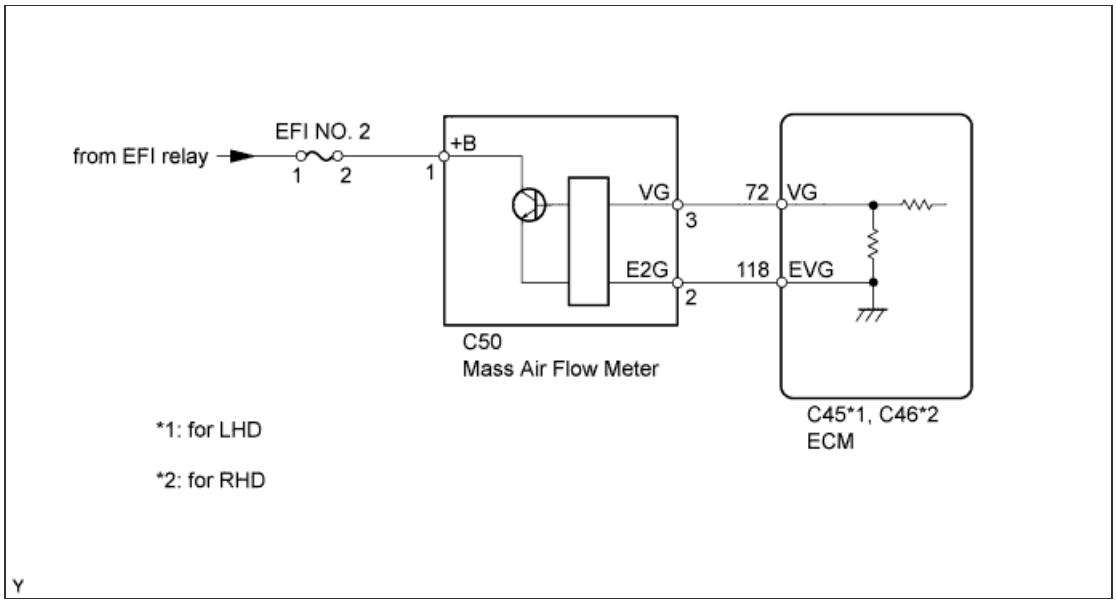
HINT:

- **If DTC P0100, and/or P0102 is stored, the following symptoms may appear (as the ECU mistakenly determines that there is less air than the actual intake air amount, EGR is decreased to match the target EGR):**
  - **Combustion noise worsens**
- **If DTC P0100, and/or P0103 is stored, the following symptoms may appear (as the ECU mistakenly determines that there is more air than the actual intake air amount, EGR is increased to match the target EGR):**
  - **Misfire**
  - **White smoke**
  - **Black smoke**
- **After confirming DTC P0100, P0102 or P0103, check the mass air flow ratio by entering the following menus: Powertrain / Engine / Data List / MAF.**

Reference:

Air Flow Value (g/sec.)	Malfunction
Approximately 0.0	• **Open in mass air flow meter power source circuit** • **Open or short in VG circuit**
174.0 or more	Open in EVG circuit

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (MASS AIR FLOW RATE)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / MAF.

d. Read the value.

Result

Result	Proceed to
0.0	A
174.0 or more	B
Between 1 and 173.0*	C

HINT:

*: The value should change when the throttle valve is opened or closed.

B → Go to step 8

C → Go to step 15

A

2.INSPECT MASS AIR FLOW METER (POWER SOURCE CIRCUIT)

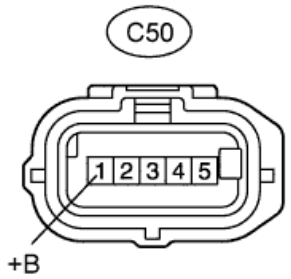
a. Disconnect the mass air flow meter connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C50-1 (+B) - Body ground	Ignition switch ON	11 to 14 V

Front view of wire harness connector:
(to Mass Air Flow Meter)



NG → Go to step 5

OK

3.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → Go to step 11

OK

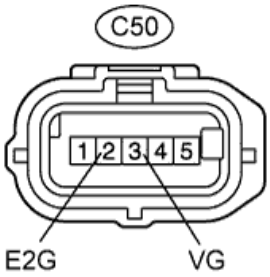
4.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the mass air flow meter connector.

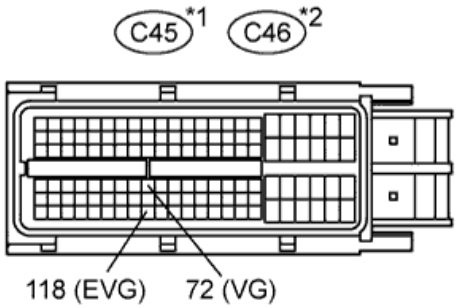
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Mass Air Flow Meter)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C45-72 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C45-118 (EVG)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C46-72 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C46-118 (EVG)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) or C45-72 (VG) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) or C46-72 (VG) - Body ground	Always	10 kΩ or higher

OK → Go to step 10

NG → Go to step 12

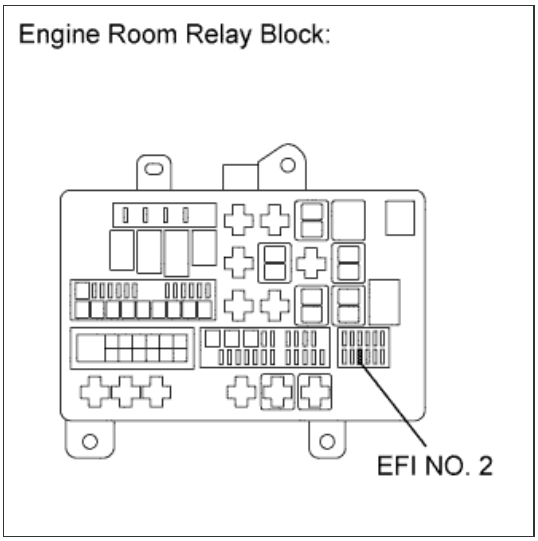
5.INSPECT FUSE (EFI NO. 2)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse	Always	Below 1 Ω



NG → Go to step 13

OK

6.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ENGINE ROOM RELAY BLOCK)

a. Disconnect the mass air flow meter connector.

b. Remove the EFI NO. 2 fuse from the engine room relay block.

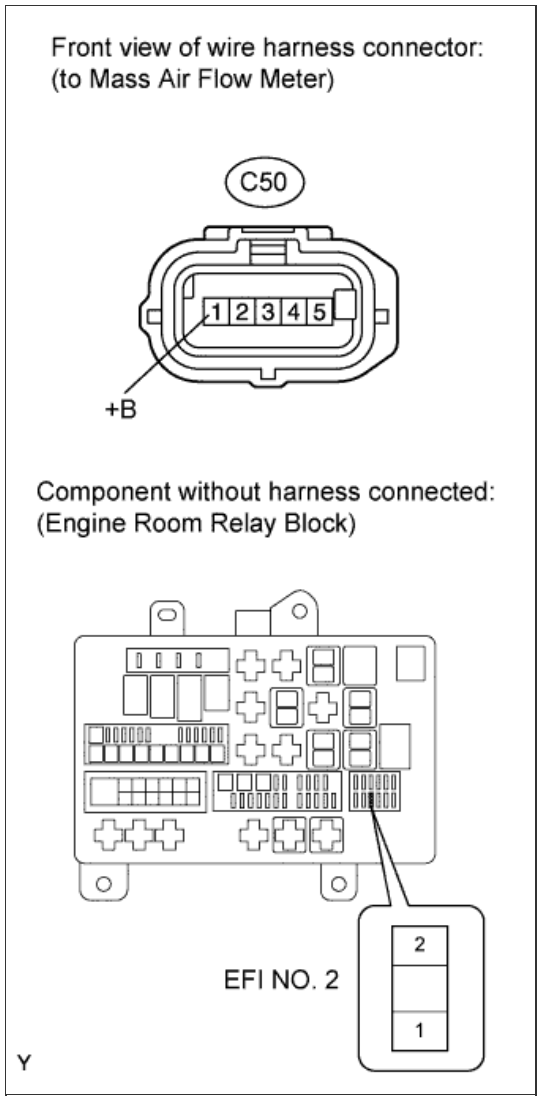
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C50-1 (+B) - EFI NO. 2 fuse (2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
C50-1 (+B) or EFI NO. 2 fuse (2) - Body ground	Always	10 kΩ or higher



NG → Go to step 12

OK

7.CHECK HARNESS AND CONNECTOR (ENGINE ROOM RELAY BLOCK)

a. Remove the EFI NO. 2 fuse from the engine room relay block.

b. Remove the integration relay from the engine room relay block.

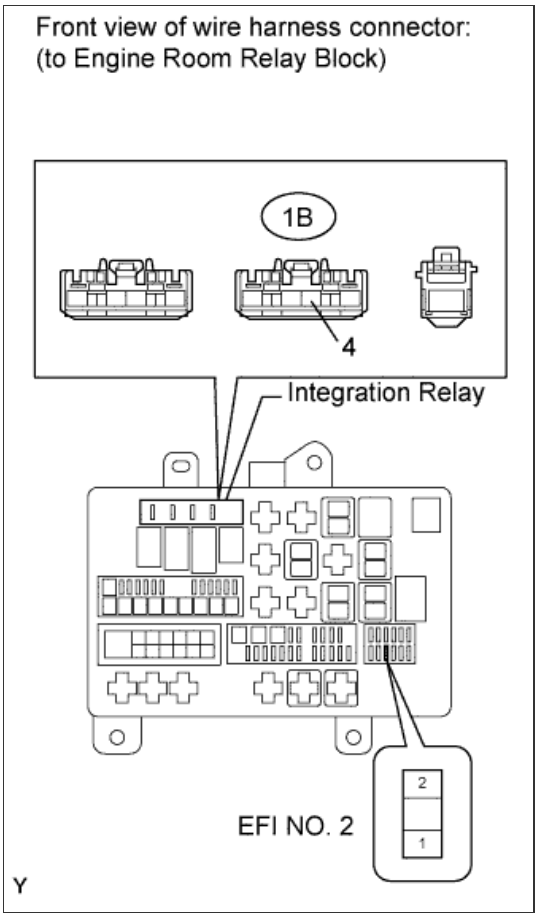
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse (1) - 1B-4	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse (1) or 1B-4 - Body ground	Always	10 kΩ or higher



OK	Go to step 14
NG	Go to step 12

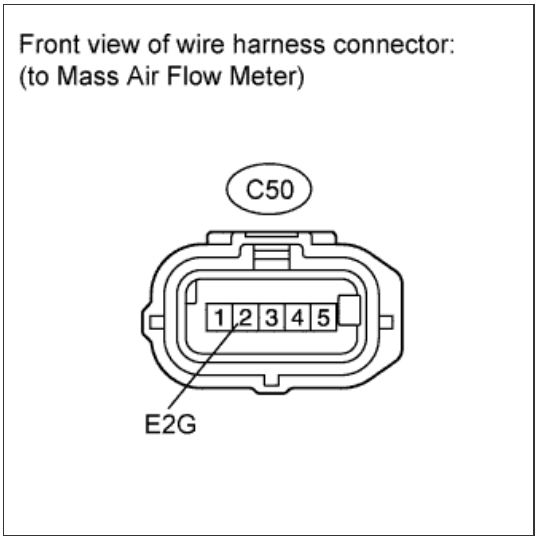
8.CHECK HARNESS AND CONNECTOR (SENSOR GROUND)

a. Disconnect the mass air flow meter connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
C50-2 (E2G) - Body ground	Always	Below 1 Ω



OK	Go to step 11
NG	Go to step 9

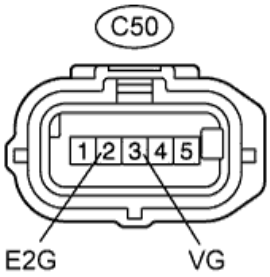
9.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the mass air flow meter connector.

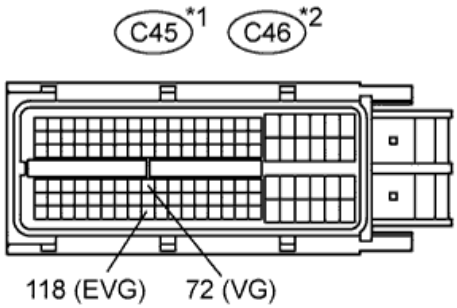
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Mass Air Flow Meter)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C45-72 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C45-118 (EVG)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) - C46-72 (VG)	Always	Below 1 Ω
C50-2 (E2G) - C46-118 (EVG)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) or C45-72 (VG) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C50-3 (VG) or C46-72 (VG) - Body ground	Always	10 kΩ or higher

NG → Go to step 12

OK

10.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 15

11.REPLACE MASS AIR FLOW METER

a. Replace the mass air flow meter (Click here).

NEXT → Go to step 15

12.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT → Go to step 15

13.CHECK FOR SHORTS IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

NEXT → Go to step 15

14.CHECK ECM POWER SOURCE CIRCUIT

a. Check the ECM power source circuit (Click here).

NEXT

15.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 3 seconds

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

DTC P1258 VNT Position Sensor Range/Performance Bank 2 Sensor 1

DTC P1259 VNT Position Sensor Low Bank 2 Sensor 1

DTC P1260 VNT Position Sensor High Bank 2 Sensor 1

DTC P1262 VNT Position Sensor Low Bank 2 Sensor 2

DTC P1263 VNT Position Sensor High Bank 2 Sensor 2

DTC P2563 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit Range/Performance

DTC P2564 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit Low

DTC P2565 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit High

DTC P2588 Turbocharger/Supercharger Boost Control Position Sensor "B" Circuit Low

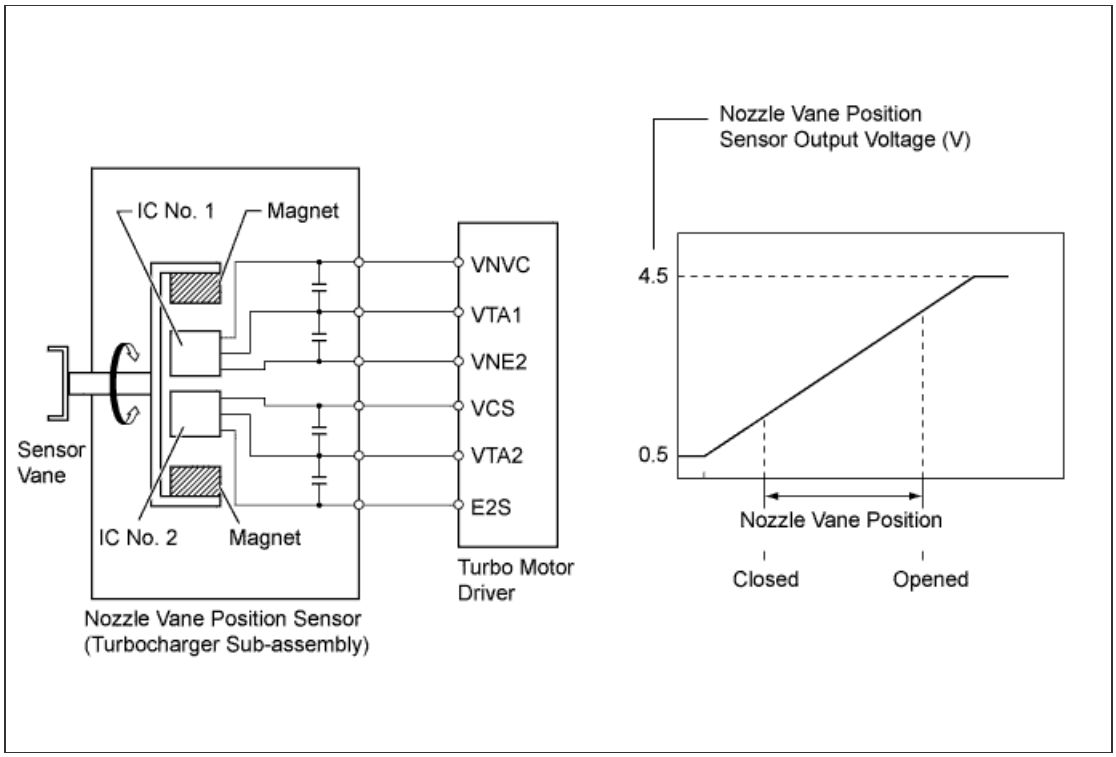
DTC P2589 Turbocharger/Supercharger Boost Control Position Sensor "B" Circuit High

for Preparation Click here

DESCRIPTION

The variable nozzle vane type turbocharger consists primarily of a compressor wheel, turbine wheel, nozzle vane, unison ring, DC motor and nozzle vane position sensor.

The nozzle vane position sensor consists of a Hall IC and a magnetic yoke that rotates in unison with the movement of the linkage that actuates the nozzle vane. The nozzle vane position sensor converts the changes in the magnetic flux that are caused by the rotation of the DC motor (hence, the rotation of the magnetic yoke) into electric signals, and outputs them to the turbo motor driver. The turbo motor driver determines the actual nozzle vane position from the electric signals in order to calculate the target nozzle vane position.



P1258

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	The difference between VTI2 and VTA2 voltage is 0.8 V or more for 0.5 seconds (1 trip detection logic).	Nozzle vane position sensor (turbocharger sub-assembly)

P1259

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area

Ignition switch ON for 1 second	VTI2 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1260

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTI2 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1262

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA2 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1263

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA2 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2563

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	The difference between VTA1 and VTA voltage is 0.8 V or more for 0.5 seconds (1 trip detection logic).	Nozzle vane position sensor (turbocharger sub-assembly)

P2564

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA1 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2565

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA1 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2588

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
		• Nozzle vane position sensor (turbocharger sub-assembly)

Ignition switch ON for 1 second	VTA voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2589

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

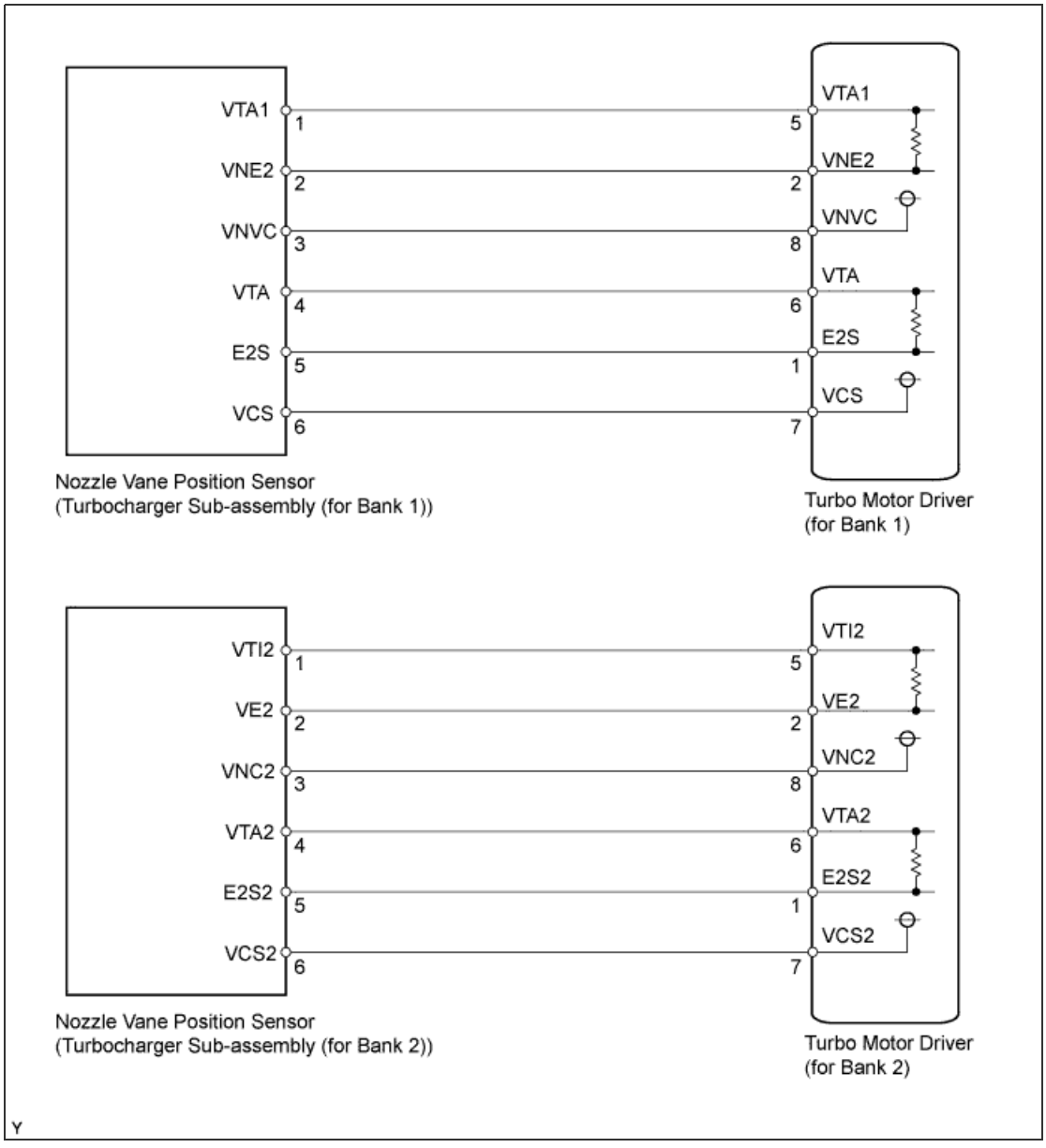
HINT:

If DTC P1258, P1259, P1260, P1262, P1263, P2563, P2564, P2565, P2588 and/or P2589 is stored, the following symptoms may appear:

Stuck open malfunction:

- Lack of power
- Vehicle surge or hesitation under light or medium load
- White smoke

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.INSPECT TURBO MOTOR DRIVER (for Bank 1 and Bank 2)

a. Remove the rear fender splash shield sub-assembly RH.

b. Remove the front fender liner LH.

c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

HINT:

Record the output DTCs.

g. Clear the DTCs (Click here).

h. Turn the ignition switch off.

i. Interchange the connectors for the turbo motor driver of bank 1 and bank 2.

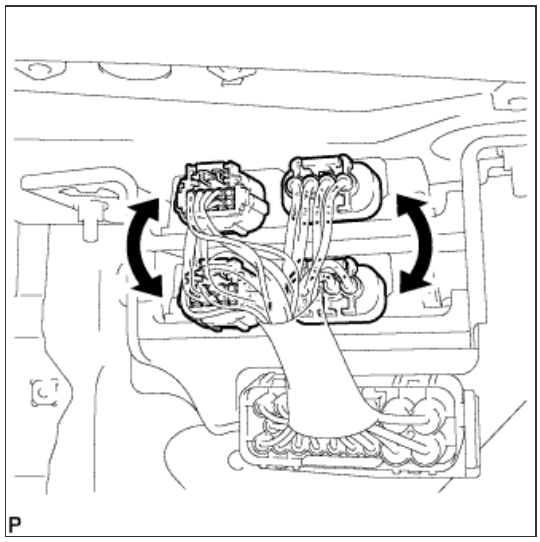
j. Turn the ignition switch to ON for 1 second.

k. Enter the following menus: Powertrain / Engine / DTC.

l. Read the DTCs.

Result:

Display (DTC Output)	Proceed to
DTCs change	B
DTCs do not change	A



B → Go to step 4

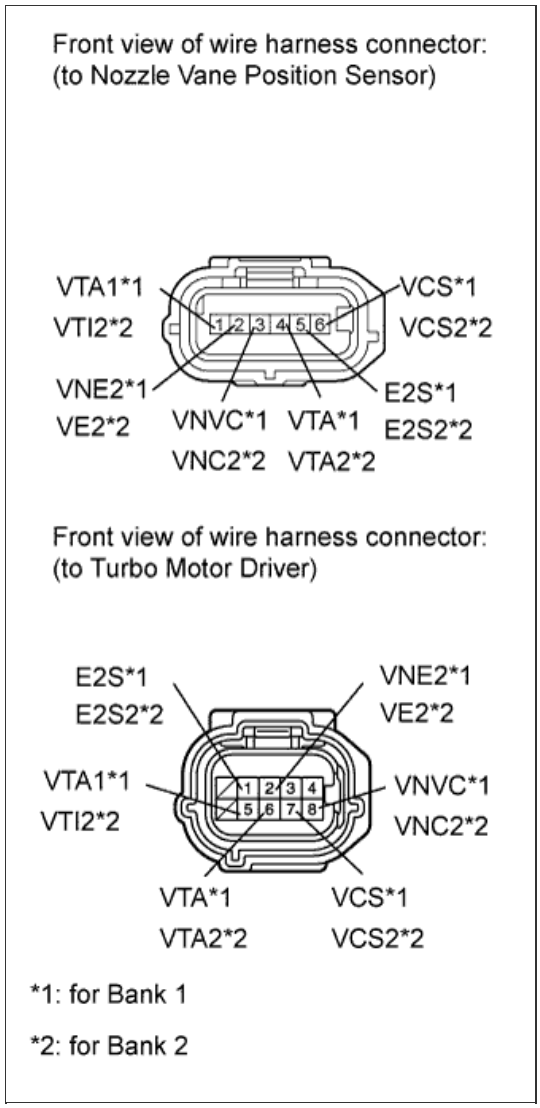
A

2.CHECK HARNESS AND CONNECTOR (TURBO MOTOR DRIVER - NOZZLE VANE POSITION SENSOR)

a. Disconnect the nozzle vane position sensor connector.

b. Disconnect the turbo motor driver connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTA1) - Nozzle vane position sensor connector-1 (VTA1)	Always	Below 1 Ω
Turbo motor driver connector-2 (VNE2) - Nozzle vane position sensor connector-2 (VNE2)	Always	Below 1 Ω
Turbo motor driver connector-8 (VNVC) - Nozzle vane position sensor connector-3 (VNVC)	Always	Below 1 Ω
Turbo motor driver connector-6 (VTA) - Nozzle vane position sensor connector-4 (VTA)	Always	Below 1 Ω
Turbo motor driver connector-1 (E2S) - Nozzle vane position sensor connector-5 (E2S)	Always	Below 1 Ω
Turbo motor driver connector-7 (VCS) - Nozzle vane position sensor connector-6 (VCS)	Always	Below 1 Ω

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTI2) - Nozzle vane position sensor connector-1 (VTI2)	Always	Below 1 Ω
Turbo motor driver connector-2 (VE2) - Nozzle vane position sensor	Always	Below 1 Ω

connector-2 (VE2)		
Turbo motor driver connector-8 (VNC2) - Nozzle vane position sensor connector-3 (VNC2)	Always	Below 1 Ω
Turbo motor driver connector-6 (VTA2) - Nozzle vane position sensor connector-4 (VTA2)	Always	Below 1 Ω
Turbo motor driver connector-1 (E2S2) - Nozzle vane position sensor connector-5 (E2S2)	Always	Below 1 Ω
Turbo motor driver connector-7 (VCS2) - Nozzle vane position sensor connector-6 (VCS2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTA1) or Nozzle vane position sensor connector-1 (VTA1) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-2 (VNE2) or Nozzle vane position sensor connector-2 (VNE2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-8 (VNVC) or Nozzle vane position sensor connector-3 (VNVC) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-6 (VTA) or Nozzle vane position sensor connector-4 (VTA) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-1 (E2S) or Nozzle vane position sensor connector-5 (E2S) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-7 (VCS) or Nozzle vane position sensor connector-6 (VCS) - Body ground	Always	10 kΩ or higher

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTI2) or Nozzle vane position sensor connector-1 (VTI2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-2 (VE2) or Nozzle vane position sensor connector-2 (VE2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-8 (VNC2) or Nozzle vane position sensor connector-3 (VNC2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-6 (VTA2) or Nozzle vane position sensor connector-4 (VTA2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-1 (E2S2) or Nozzle vane position sensor connector-5 (E2S2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-7 (VCS2) or Nozzle vane position sensor connector-6 (VCS2) - Body ground	Always	10 kΩ or higher

NG → Go to step 5

OK

3.REPLACE TURBOCHARGER SUB-ASSEMBLY (for Bank 1 or Bank 2) (NOZZLE VANE POSITION SENSOR)

a. Replace the turbocharger sub-assembly (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 6

4.REPLACE TURBO MOTOR DRIVER (for Bank 1 or Bank 2)

a. Replace the turbo motor driver (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 6

5.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

6.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch off and leave the vehicle for 15 seconds.

e. Turn the ignition switch to ON for 1 second.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P1258, P1259, P1260, P1262, P1263, P2563, P2564, P2565, P2588 and/or P2589.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, idle the engine.

NEXT

END

DTC P0101 Mass or Volume Air Flow Circuit Range / Performance Problem

for Preparation Click here

DESCRIPTION

Refer to DTC P0100 (Click here).

P0101

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After warming up engine, idle engine for 20 seconds, then maintain engine at 3000 rpm for 20 seconds	After the engine is warmed up, condition (a) continues for more than 10 seconds when idling (2 trip detection logic): (a) Mass air flow meter output is more than 4.4 V.	Mass air flow meter
	Conditions (a) and (b) continue for more than 10 seconds with the engine speed at 1250 rpm or more (2 trip detection logic): (a) VTA is more than 0.1 V. (b) Mass air flow meter output is less than 0.7 V.	

Related Data List

DTC No.	Data List
P0101	• MAF • Actual EGR Valve Pos. • Actual EGR Valve Pos. #2 • Actual Throttle position • Actual Throttle position #2

HINT:

If DTC P0101 is stored, either of the following symptoms may appear:

1. **As the ECU mistakenly determines that there is less air than the actual intake air amount, EGR is decreased to match the target EGR.**
   - **Combustion noise worsens**
2. **As the ECU mistakenly determines that there is more air than the actual intake air amount, EGR is increased to match the target EGR):**
   - **Misfire**
   - **White smoke**
   - **Black smoke**

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P0101)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P0101 and other DTCs are output	A
P0101 is output	B

HINT:

If codes other than P0101 are output, perform troubleshooting for those DTCs first.

A → GO TO DTC CHART (Click here)

B

2.CHECK AIR INDUCTION SYSTEM

a. Check the air induction system for vacuum leakage (Click here).

OK:
No leakage from air induction system.

NG → Go to step 4

OK

3.REPLACE MASS AIR FLOW METER

a. Replace the mass air flow meter (Click here).

NEXT → Go to step

4.REPAIR OR REPLACE AIR INDUCTION SYSTEM

NEXT

5.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Start the engine.

e. After warming up the engine, idle the engine for 20 seconds, then maintain the engine at 3000 rpm for 20 seconds.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P0101.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, maintain the engine at 3000 rpm for 30 seconds and then idle the engine for 5 minutes.

NEXT

END

DTC P1258 VNT Position Sensor Range/Performance Bank 2 Sensor 1

DTC P1259 VNT Position Sensor Low Bank 2 Sensor 1

DTC P1260 VNT Position Sensor High Bank 2 Sensor 1

DTC P1262 VNT Position Sensor Low Bank 2 Sensor 2

DTC P1263 VNT Position Sensor High Bank 2 Sensor 2

DTC P2563 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit Range/Performance

DTC P2564 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit Low

DTC P2565 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit High

DTC P2588 Turbocharger/Supercharger Boost Control Position Sensor "B" Circuit Low

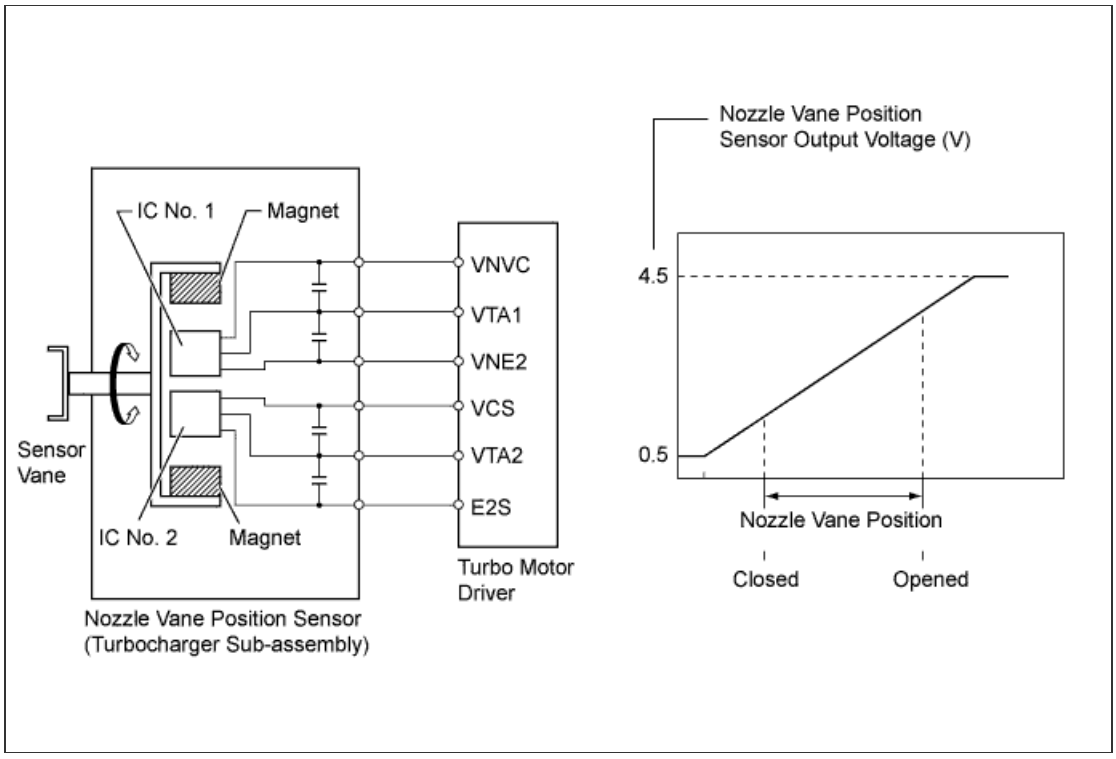
DTC P2589 Turbocharger/Supercharger Boost Control Position Sensor "B" Circuit High

for Preparation Click here

DESCRIPTION

The variable nozzle vane type turbocharger consists primarily of a compressor wheel, turbine wheel, nozzle vane, unison ring, DC motor and nozzle vane position sensor.

The nozzle vane position sensor consists of a Hall IC and a magnetic yoke that rotates in unison with the movement of the linkage that actuates the nozzle vane. The nozzle vane position sensor converts the changes in the magnetic flux that are caused by the rotation of the DC motor (hence, the rotation of the magnetic yoke) into electric signals, and outputs them to the turbo motor driver. The turbo motor driver determines the actual nozzle vane position from the electric signals in order to calculate the target nozzle vane position.



P1258

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	The difference between VTI2 and VTA2 voltage is 0.8 V or more for 0.5 seconds (1 trip detection logic).	Nozzle vane position sensor (turbocharger sub-assembly)

P1259

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area

Ignition switch ON for 1 second	VTI2 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1260

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTI2 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1262

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA2 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1263

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA2 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2563

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	The difference between VTA1 and VTA voltage is 0.8 V or more for 0.5 seconds (1 trip detection logic).	Nozzle vane position sensor (turbocharger sub-assembly)

P2564

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA1 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2565

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA1 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2588

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
		• Nozzle vane position sensor (turbocharger sub-assembly)

Ignition switch ON for 1 second	VTA voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2589

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

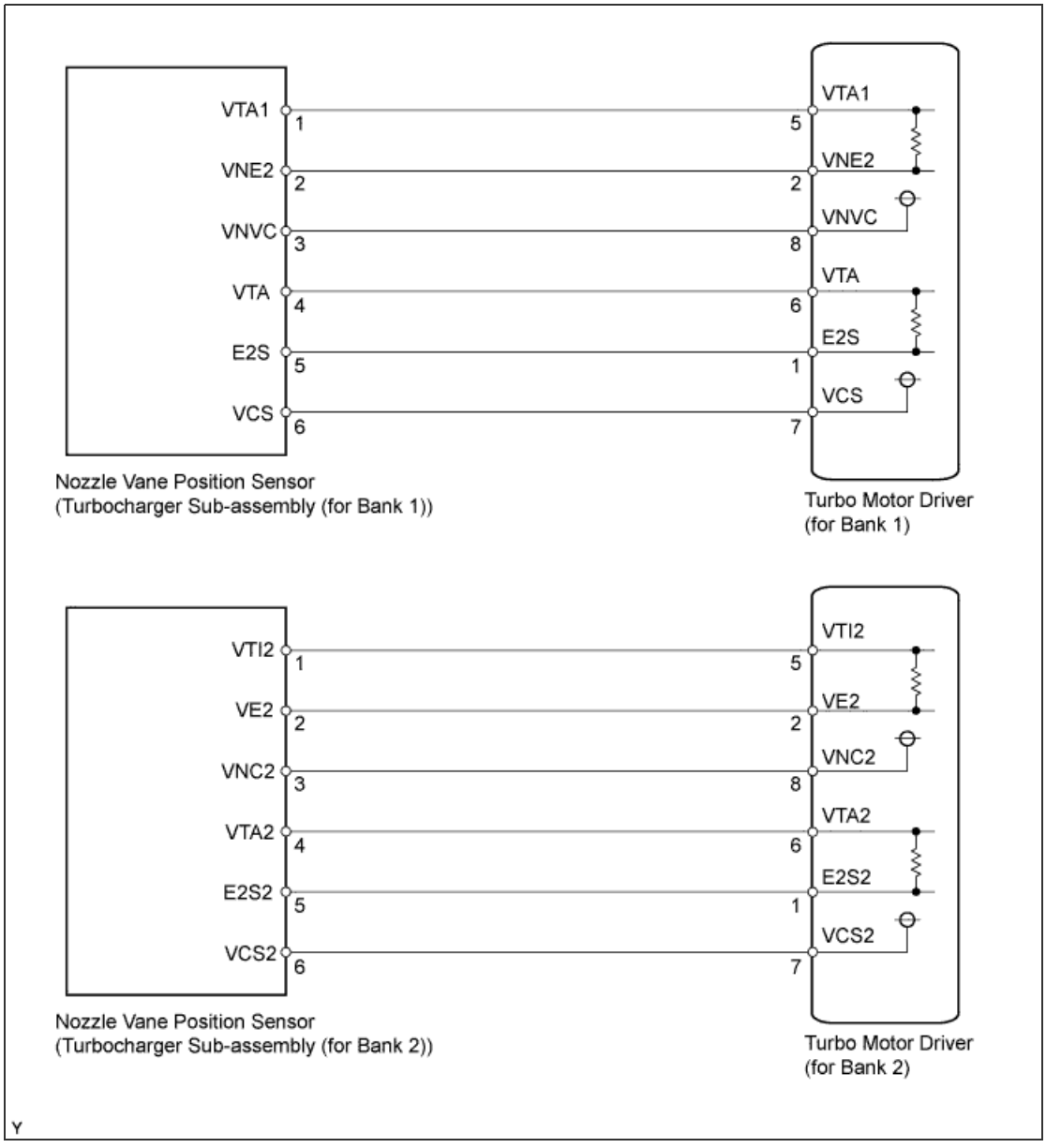
HINT:

If DTC P1258, P1259, P1260, P1262, P1263, P2563, P2564, P2565, P2588 and/or P2589 is stored, the following symptoms may appear:

Stuck open malfunction:

- Lack of power
- Vehicle surge or hesitation under light or medium load
- White smoke

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.INSPECT TURBO MOTOR DRIVER (for Bank 1 and Bank 2)

a. Remove the rear fender splash shield sub-assembly RH.

b. Remove the front fender liner LH.

c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

HINT:

Record the output DTCs.

g. Clear the DTCs (Click here).

h. Turn the ignition switch off.

i. Interchange the connectors for the turbo motor driver of bank 1 and bank 2.

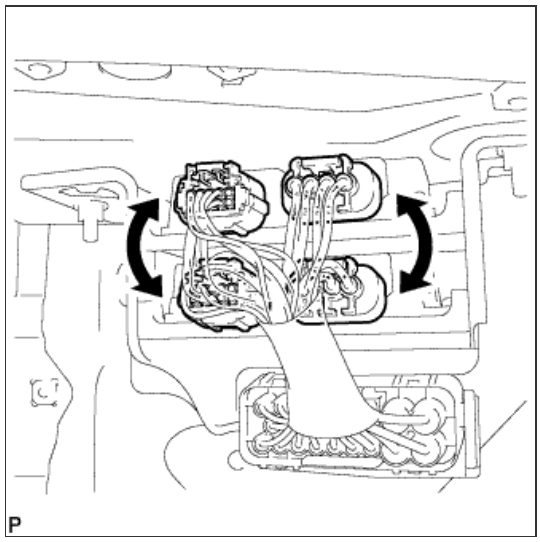
j. Turn the ignition switch to ON for 1 second.

k. Enter the following menus: Powertrain / Engine / DTC.

l. Read the DTCs.

Result:

Display (DTC Output)	Proceed to
DTCs change	B
DTCs do not change	A



B → Go to step 4

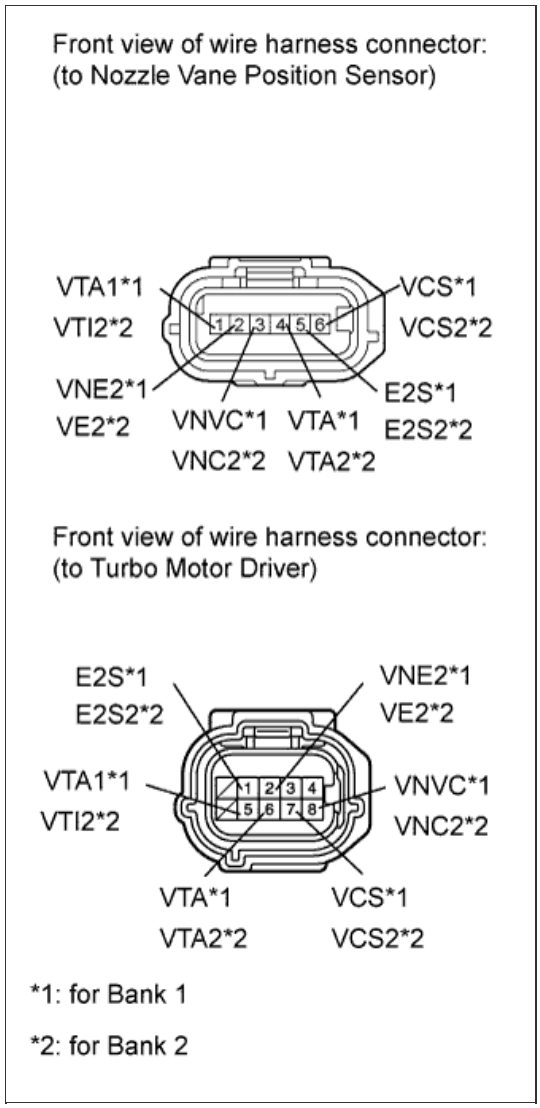
A

2.CHECK HARNESS AND CONNECTOR (TURBO MOTOR DRIVER - NOZZLE VANE POSITION SENSOR)

a. Disconnect the nozzle vane position sensor connector.

b. Disconnect the turbo motor driver connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTA1) - Nozzle vane position sensor connector-1 (VTA1)	Always	Below 1 Ω
Turbo motor driver connector-2 (VNE2) - Nozzle vane position sensor connector-2 (VNE2)	Always	Below 1 Ω
Turbo motor driver connector-8 (VNVC) - Nozzle vane position sensor connector-3 (VNVC)	Always	Below 1 Ω
Turbo motor driver connector-6 (VTA) - Nozzle vane position sensor connector-4 (VTA)	Always	Below 1 Ω
Turbo motor driver connector-1 (E2S) - Nozzle vane position sensor connector-5 (E2S)	Always	Below 1 Ω
Turbo motor driver connector-7 (VCS) - Nozzle vane position sensor connector-6 (VCS)	Always	Below 1 Ω

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTI2) - Nozzle vane position sensor connector-1 (VTI2)	Always	Below 1 Ω
Turbo motor driver connector-2 (VE2) - Nozzle vane position sensor	Always	Below 1 Ω

connector-2 (VE2)		
Turbo motor driver connector-8 (VNC2) - Nozzle vane position sensor connector-3 (VNC2)	Always	Below 1 Ω
Turbo motor driver connector-6 (VTA2) - Nozzle vane position sensor connector-4 (VTA2)	Always	Below 1 Ω
Turbo motor driver connector-1 (E2S2) - Nozzle vane position sensor connector-5 (E2S2)	Always	Below 1 Ω
Turbo motor driver connector-7 (VCS2) - Nozzle vane position sensor connector-6 (VCS2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTA1) or Nozzle vane position sensor connector-1 (VTA1) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-2 (VNE2) or Nozzle vane position sensor connector-2 (VNE2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-8 (VNVC) or Nozzle vane position sensor connector-3 (VNVC) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-6 (VTA) or Nozzle vane position sensor connector-4 (VTA) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-1 (E2S) or Nozzle vane position sensor connector-5 (E2S) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-7 (VCS) or Nozzle vane position sensor connector-6 (VCS) - Body ground	Always	10 kΩ or higher

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTI2) or Nozzle vane position sensor connector-1 (VTI2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-2 (VE2) or Nozzle vane position sensor connector-2 (VE2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-8 (VNC2) or Nozzle vane position sensor connector-3 (VNC2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-6 (VTA2) or Nozzle vane position sensor connector-4 (VTA2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-1 (E2S2) or Nozzle vane position sensor connector-5 (E2S2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-7 (VCS2) or Nozzle vane position sensor connector-6 (VCS2) - Body ground	Always	10 kΩ or higher

NG → Go to step 5

OK

3.REPLACE TURBOCHARGER SUB-ASSEMBLY (for Bank 1 or Bank 2) (NOZZLE VANE POSITION SENSOR)

a. Replace the turbocharger sub-assembly (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 6

4.REPLACE TURBO MOTOR DRIVER (for Bank 1 or Bank 2)

a. Replace the turbo motor driver (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 6

5.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

6.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch off and leave the vehicle for 15 seconds.

e. Turn the ignition switch to ON for 1 second.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P1258, P1259, P1260, P1262, P1263, P2563, P2564, P2565, P2588 and/or P2589.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, idle the engine.

NEXT

END

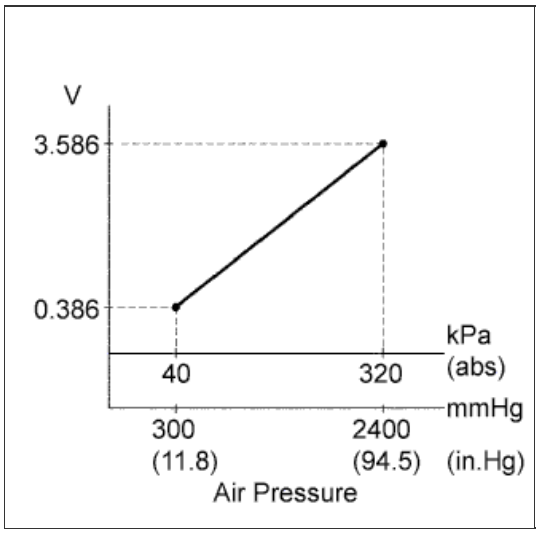
DTC P0105 Manifold Absolute Pressure / Barometric Pressure Circuit

DTC P0107 Manifold Absolute Pressure / Barometric Pressure Circuit Low Input

DTC P0108 Manifold Absolute Pressure / Barometric Pressure Circuit High Input

for Preparation Click here

DESCRIPTION



The manifold absolute pressure sensor detects the intake manifold pressure by using its built-in sensor unit. The ECM determines the basic injection duration and injection advance timing based on the voltage output by the manifold absolute pressure sensor.
The manifold absolute pressure sensor monitors the absolute pressure inside the intake manifold (default is 0 kPa [0 mmHg, 0 in.Hg]). As a result the ECM controls the air-fuel ratio at the proper level under any driving conditions.

P0105

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After engine is started, race engine for 1 second	After the engine is started, condition (a) continues for more than 2.0 seconds (1 trip detection logic): (a) Manifold absolute pressure sensor voltage is 0.1 V or less, or 4.8 V or more.	• Open or short in manifold absolute pressure sensor circuit • Manifold absolute pressure sensor • ECM

P0107

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After engine is started, race engine for 1 second	After the engine is started, condition (a) continues for more than 2.0 seconds (1 trip detection logic): (a) Manifold absolute pressure sensor voltage is 0.1 V or less.	• Open or short in manifold absolute pressure sensor circuit • Manifold absolute pressure sensor • ECM

P0108

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After engine is started, race engine for 1 second	After engine is started, condition (a) continues for more than 2.0 seconds (1 trip detection logic): (a) Manifold absolute pressure sensor voltage is 4.8 V or more.	• Open or short in manifold absolute pressure sensor circuit • Manifold absolute pressure sensor • ECM

Related Data List

DTC No.	Data List
P0105	MAP
P0107	
P0108	

HINT:

- **If DTC P0105, P0107 and/or P0108 is stored, the following symptoms may appear:**

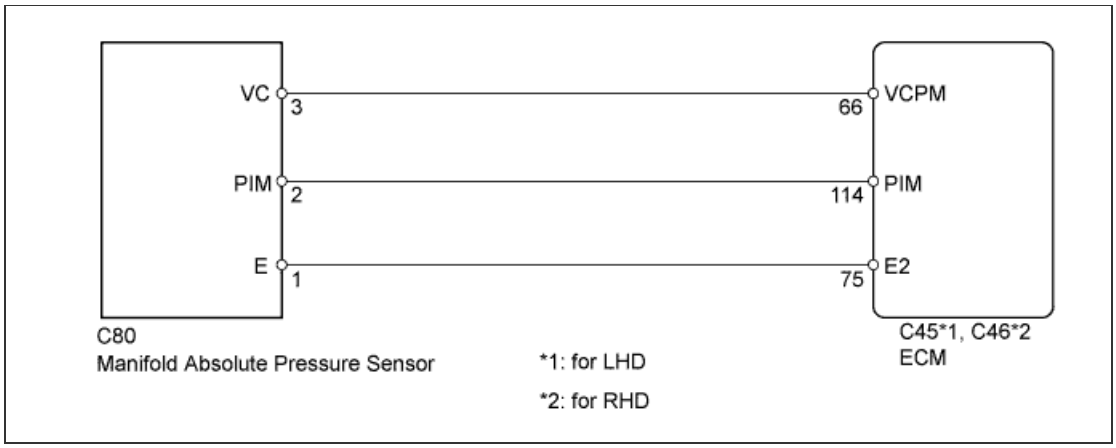
- Misfire
- Combustion noise
- Black smoke
- White smoke
- Lack of power

- When DTC P0105, P0107 or P0108 is stored, check the intake manifold pressure by entering the following menus: Powertrain / Engine / Data List / MAP.

Reference

Intake Manifold Pressure	Malfunction
Approximately 0 kPa	• Open in VC circuit • Short in PIM circuit
250 kPa (1875 mmHg, 73.8 in.Hg) or higher	• Open in PIM circuit • Open in E2 circuit

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- If DTCs relating to different systems are stored, and they share terminal E2 as their ground, check this ground circuit first.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (MANIFOLD ABSOLUTE PRESSURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / MAP.

d. Read the value.

OK:
Same value as the actual atmospheric pressure.

HINT:

Standard atmospheric pressure is 101 kPa. For every 100 m increase in altitude, pressure drops by 1 kPa. Varies by weather (high atmospheric pressure, low atmospheric pressure).

OK	Go to step 8
NG	Go to step 2

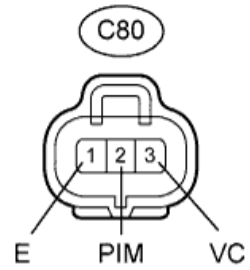
2.CHECK HARNESS AND CONNECTOR (MANIFOLD ABSOLUTE PRESSURE SENSOR - ECM)

a. Disconnect the manifold absolute pressure sensor connector.

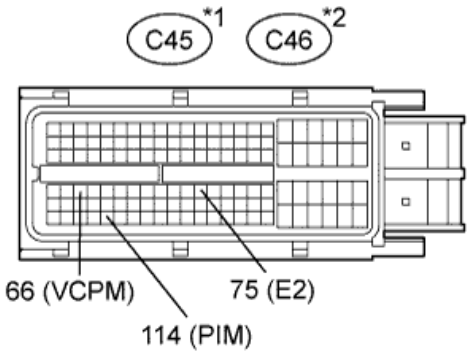
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Manifold Absolute Pressure Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C80-2 (PIM) - C45-114 (PIM)	Always	Below 1 Ω
C80-3 (VC) - C45-66 (VCPM)	Always	Below 1 Ω
C80-1 (E) - C45-75 (E2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C80-2 (PIM) - C46-114 (PIM)	Always	Below 1 Ω
C80-3 (VC) - C46-66 (VCPM)	Always	Below 1 Ω
C80-1 (E) - C46-75 (E2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C80-2 (PIM) or C45-114 (PIM)) - Body ground	Always	10 kΩ or higher
C80-3 (VC) or C45-66 (VCPM) -		10 kΩ or

Body ground	Always	higher
C80-1 (E) or C45-75 (E2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C80-2 (PIM) or C46-114 (PIM)) - Body ground	Always	10 kΩ or higher
C80-3 (VC) or C46-66 (VCPM) - Body ground	Always	10 kΩ or higher
C80-1 (E) or C46-75 (E2) - Body ground	Always	10 kΩ or higher

NG → Go to step 7

OK

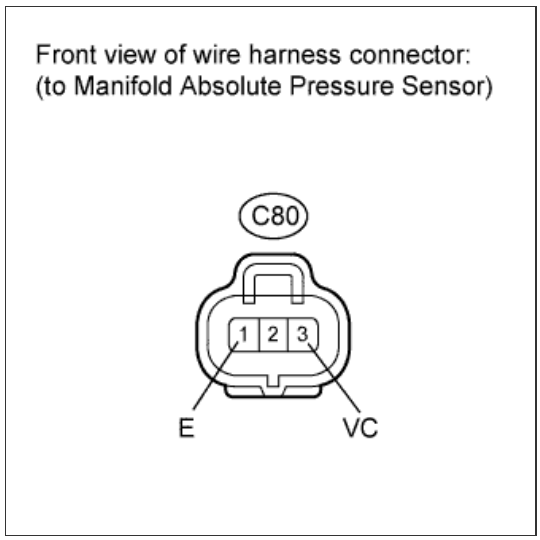
3.CHECK ECM TERMINAL VOLTAGE (VC TERMINAL)

a. Disconnect the manifold absolute pressure sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C80-3 (VC) - C80-1 (E)	Ignition switch ON	4.5 to 5.5 V



NG → Go to step 6

OK

4.REPLACE MANIFOLD ABSOLUTE PRESSURE SENSOR

a. Replace the manifold absolute pressure sensor (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON and turn the tester on.

e. After the engine is started, race the engine for 1 second.

f. Enter the following menus: Powertrain / Engine / DTC.

g. Read the DTCs.

Result:

Display (DTC output)	Proceed to
P0105, P0107 and/or P0108	A
No output	B

B → END

A

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 8

7.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

8.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 3 seconds and turn the tester on.

e. After the engine is started, race the engine for 1 second.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P0105, P0107 and/or P0108.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, race the engine for 1 minute and then idle the engine for 5 minutes.

NEXT

END

DTC P1258 VNT Position Sensor Range/Performance Bank 2 Sensor 1

DTC P1259 VNT Position Sensor Low Bank 2 Sensor 1

DTC P1260 VNT Position Sensor High Bank 2 Sensor 1

DTC P1262 VNT Position Sensor Low Bank 2 Sensor 2

DTC P1263 VNT Position Sensor High Bank 2 Sensor 2

DTC P2563 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit Range/Performance

DTC P2564 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit Low

DTC P2565 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit High

DTC P2588 Turbocharger/Supercharger Boost Control Position Sensor "B" Circuit Low

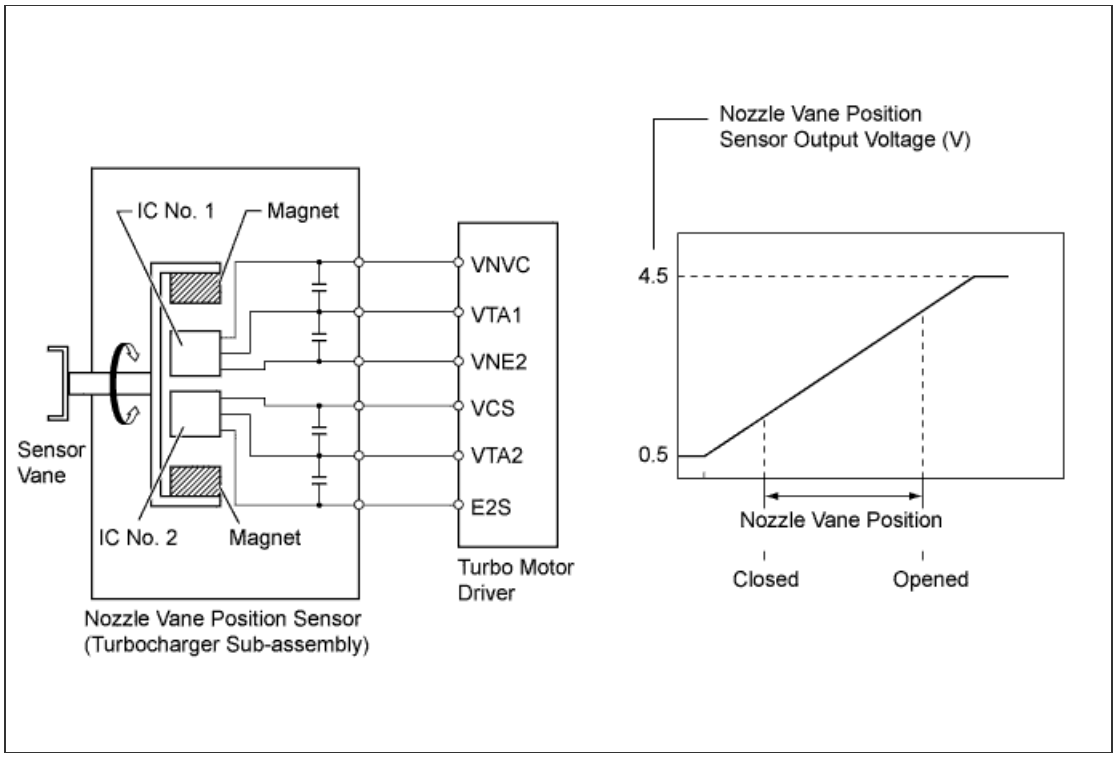
DTC P2589 Turbocharger/Supercharger Boost Control Position Sensor "B" Circuit High

for Preparation Click here

DESCRIPTION

The variable nozzle vane type turbocharger consists primarily of a compressor wheel, turbine wheel, nozzle vane, unison ring, DC motor and nozzle vane position sensor.

The nozzle vane position sensor consists of a Hall IC and a magnetic yoke that rotates in unison with the movement of the linkage that actuates the nozzle vane. The nozzle vane position sensor converts the changes in the magnetic flux that are caused by the rotation of the DC motor (hence, the rotation of the magnetic yoke) into electric signals, and outputs them to the turbo motor driver. The turbo motor driver determines the actual nozzle vane position from the electric signals in order to calculate the target nozzle vane position.



P1258

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	The difference between VTI2 and VTA2 voltage is 0.8 V or more for 0.5 seconds (1 trip detection logic).	Nozzle vane position sensor (turbocharger sub-assembly)

P1259

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area

Ignition switch ON for 1 second	VTI2 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1260

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTI2 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1262

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA2 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1263

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA2 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2563

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	The difference between VTA1 and VTA voltage is 0.8 V or more for 0.5 seconds (1 trip detection logic).	Nozzle vane position sensor (turbocharger sub-assembly)

P2564

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA1 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2565

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA1 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2588

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
		• Nozzle vane position sensor (turbocharger sub-assembly)

Ignition switch ON for 1 second	VTA voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2589

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

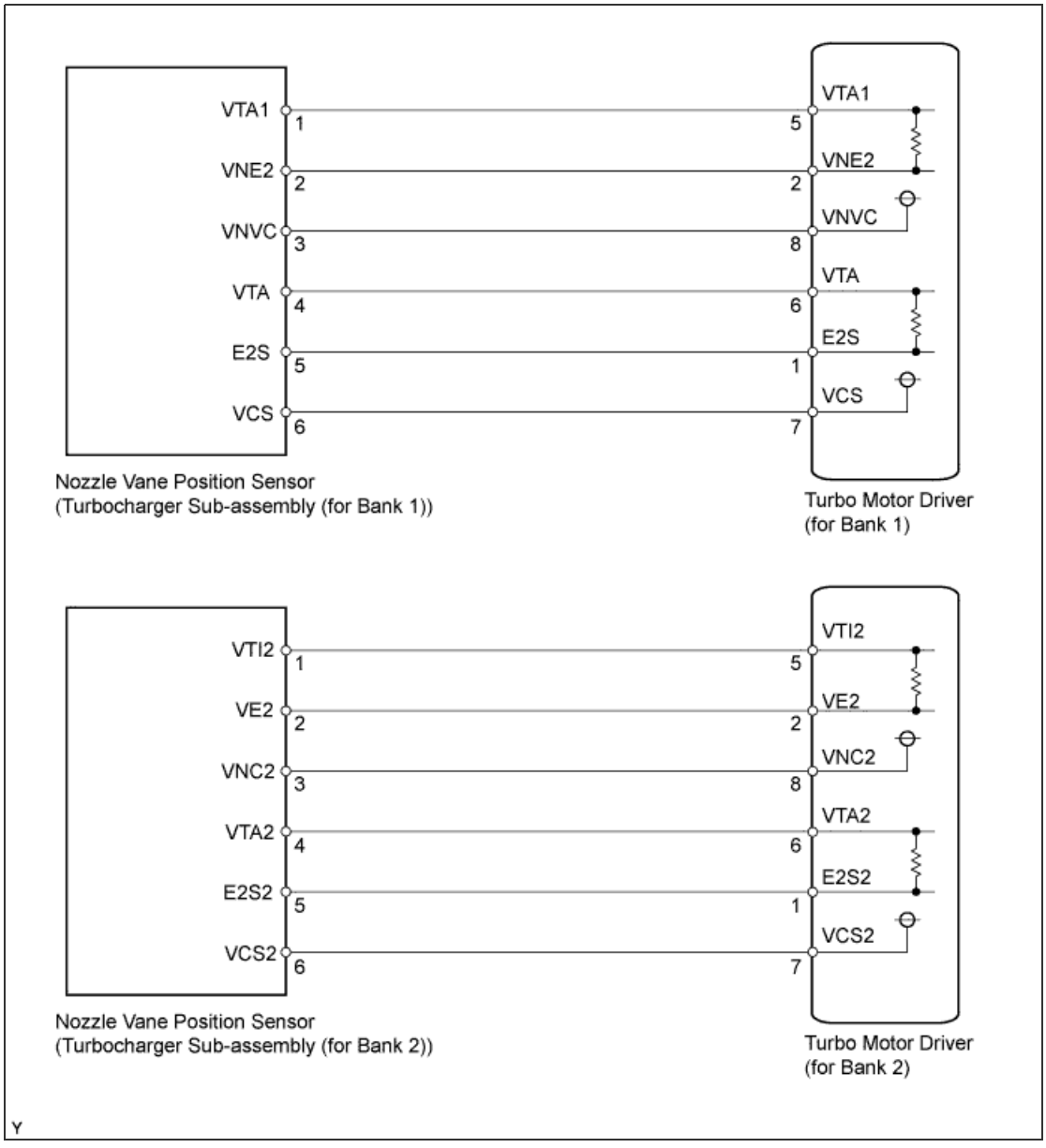
HINT:

If DTC P1258, P1259, P1260, P1262, P1263, P2563, P2564, P2565, P2588 and/or P2589 is stored, the following symptoms may appear:

Stuck open malfunction:

- Lack of power
- Vehicle surge or hesitation under light or medium load
- White smoke

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.INSPECT TURBO MOTOR DRIVER (for Bank 1 and Bank 2)

a. Remove the rear fender splash shield sub-assembly RH.

b. Remove the front fender liner LH.

c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

HINT:

Record the output DTCs.

g. Clear the DTCs (Click here).

h. Turn the ignition switch off.

i. Interchange the connectors for the turbo motor driver of bank 1 and bank 2.

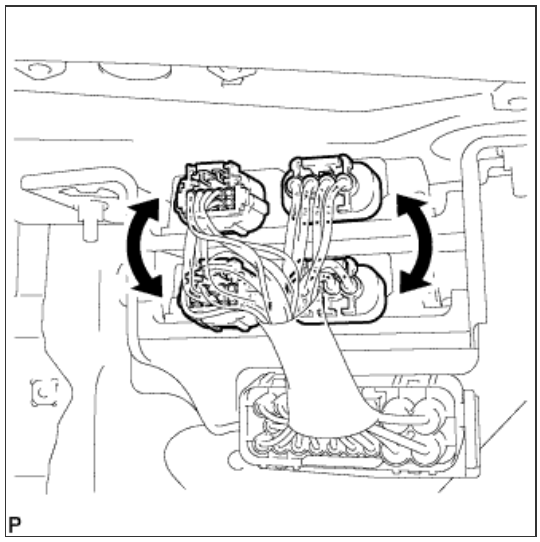
j. Turn the ignition switch to ON for 1 second.

k. Enter the following menus: Powertrain / Engine / DTC.

l. Read the DTCs.

Result:

Display (DTC Output)	Proceed to
DTCs change	B
DTCs do not change	A



B → Go to step 4

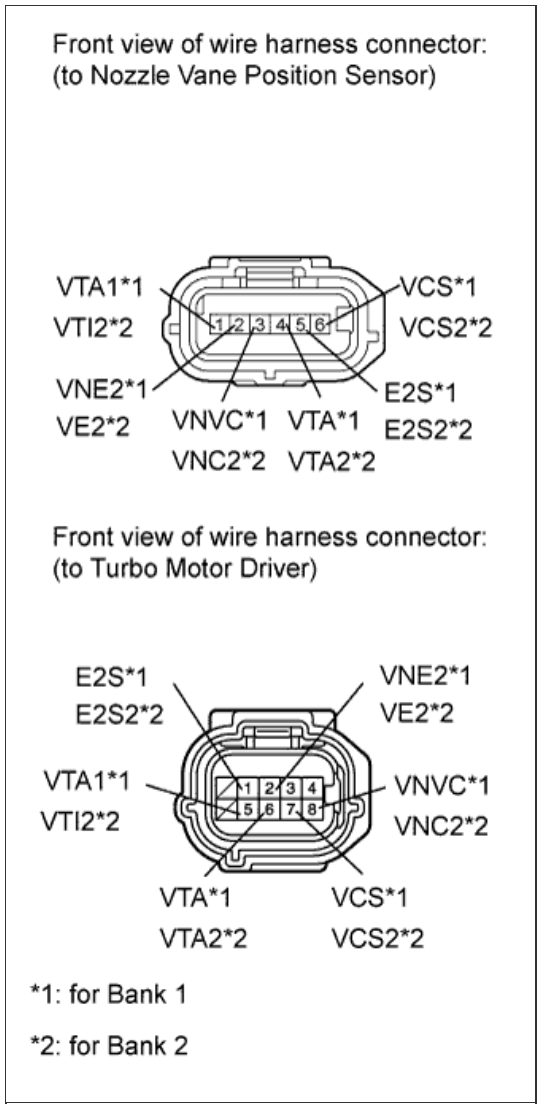
A

2.CHECK HARNESS AND CONNECTOR (TURBO MOTOR DRIVER - NOZZLE VANE POSITION SENSOR)

a. Disconnect the nozzle vane position sensor connector.

b. Disconnect the turbo motor driver connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTA1) - Nozzle vane position sensor connector-1 (VTA1)	Always	Below 1 Ω
Turbo motor driver connector-2 (VNE2) - Nozzle vane position sensor connector-2 (VNE2)	Always	Below 1 Ω
Turbo motor driver connector-8 (VNVC) - Nozzle vane position sensor connector-3 (VNVC)	Always	Below 1 Ω
Turbo motor driver connector-6 (VTA) - Nozzle vane position sensor connector-4 (VTA)	Always	Below 1 Ω
Turbo motor driver connector-1 (E2S) - Nozzle vane position sensor connector-5 (E2S)	Always	Below 1 Ω
Turbo motor driver connector-7 (VCS) - Nozzle vane position sensor connector-6 (VCS)	Always	Below 1 Ω

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTI2) - Nozzle vane position sensor connector-1 (VTI2)	Always	Below 1 Ω
Turbo motor driver connector-2 (VE2) - Nozzle vane position sensor	Always	Below 1 Ω

connector-2 (VE2)		
Turbo motor driver connector-8 (VNC2) - Nozzle vane position sensor connector-3 (VNC2)	Always	Below 1 Ω
Turbo motor driver connector-6 (VTA2) - Nozzle vane position sensor connector-4 (VTA2)	Always	Below 1 Ω
Turbo motor driver connector-1 (E2S2) - Nozzle vane position sensor connector-5 (E2S2)	Always	Below 1 Ω
Turbo motor driver connector-7 (VCS2) - Nozzle vane position sensor connector-6 (VCS2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTA1) or Nozzle vane position sensor connector-1 (VTA1) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-2 (VNE2) or Nozzle vane position sensor connector-2 (VNE2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-8 (VNVC) or Nozzle vane position sensor connector-3 (VNVC) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-6 (VTA) or Nozzle vane position sensor connector-4 (VTA) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-1 (E2S) or Nozzle vane position sensor connector-5 (E2S) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-7 (VCS) or Nozzle vane position sensor connector-6 (VCS) - Body ground	Always	10 kΩ or higher

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTI2) or Nozzle vane position sensor connector-1 (VTI2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-2 (VE2) or Nozzle vane position sensor connector-2 (VE2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-8 (VNC2) or Nozzle vane position sensor connector-3 (VNC2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-6 (VTA2) or Nozzle vane position sensor connector-4 (VTA2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-1 (E2S2) or Nozzle vane position sensor connector-5 (E2S2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-7 (VCS2) or Nozzle vane position sensor connector-6 (VCS2) - Body ground	Always	10 kΩ or higher

NG → Go to step 5

OK

3.REPLACE TURBOCHARGER SUB-ASSEMBLY (for Bank 1 or Bank 2) (NOZZLE VANE POSITION SENSOR)

a. Replace the turbocharger sub-assembly (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 6

4.REPLACE TURBO MOTOR DRIVER (for Bank 1 or Bank 2)

a. Replace the turbo motor driver (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 6

5.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

6.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch off and leave the vehicle for 15 seconds.

e. Turn the ignition switch to ON for 1 second.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P1258, P1259, P1260, P1262, P1263, P2563, P2564, P2565, P2588 and/or P2589.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, idle the engine.

NEXT

END

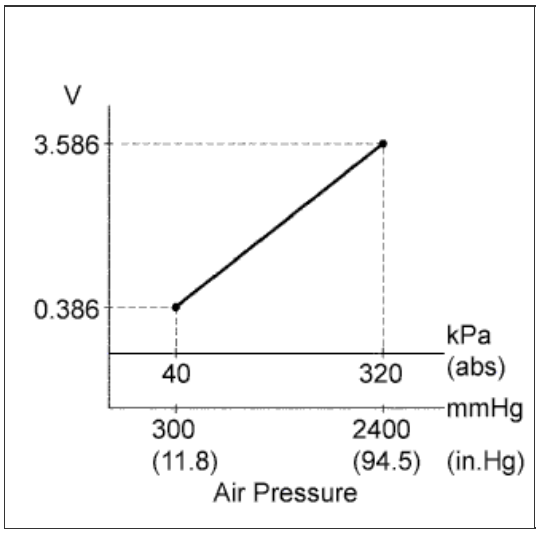
DTC P0105 Manifold Absolute Pressure / Barometric Pressure Circuit

DTC P0107 Manifold Absolute Pressure / Barometric Pressure Circuit Low Input

DTC P0108 Manifold Absolute Pressure / Barometric Pressure Circuit High Input

for Preparation Click here

DESCRIPTION



The manifold absolute pressure sensor detects the intake manifold pressure by using its built-in sensor unit. The ECM determines the basic injection duration and injection advance timing based on the voltage output by the manifold absolute pressure sensor.
The manifold absolute pressure sensor monitors the absolute pressure inside the intake manifold (default is 0 kPa [0 mmHg, 0 in.Hg]). As a result the ECM controls the air-fuel ratio at the proper level under any driving conditions.

P0105

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After engine is started, race engine for 1 second	After the engine is started, condition (a) continues for more than 2.0 seconds (1 trip detection logic): (a) Manifold absolute pressure sensor voltage is 0.1 V or less, or 4.8 V or more.	• Open or short in manifold absolute pressure sensor circuit • Manifold absolute pressure sensor • ECM

P0107

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After engine is started, race engine for 1 second	After the engine is started, condition (a) continues for more than 2.0 seconds (1 trip detection logic): (a) Manifold absolute pressure sensor voltage is 0.1 V or less.	• Open or short in manifold absolute pressure sensor circuit • Manifold absolute pressure sensor • ECM

P0108

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After engine is started, race engine for 1 second	After engine is started, condition (a) continues for more than 2.0 seconds (1 trip detection logic): (a) Manifold absolute pressure sensor voltage is 4.8 V or more.	• Open or short in manifold absolute pressure sensor circuit • Manifold absolute pressure sensor • ECM

Related Data List

DTC No.	Data List
P0105	MAP
P0107	
P0108	

HINT:

- **If DTC P0105, P0107 and/or P0108 is stored, the following symptoms may appear:**

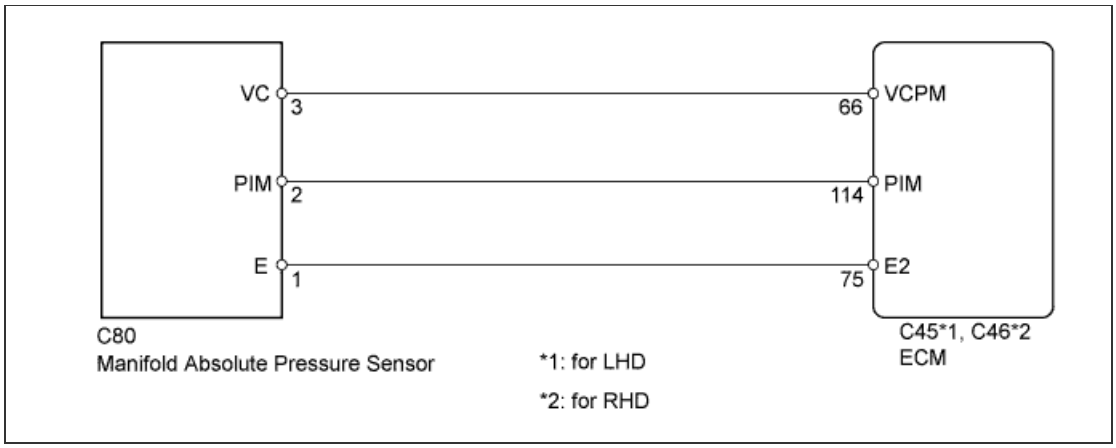
- Misfire
- Combustion noise
- Black smoke
- White smoke
- Lack of power

- When DTC P0105, P0107 or P0108 is stored, check the intake manifold pressure by entering the following menus: Powertrain / Engine / Data List / MAP.

Reference

Intake Manifold Pressure	Malfunction
Approximately 0 kPa	• Open in VC circuit • Short in PIM circuit
250 kPa (1875 mmHg, 73.8 in.Hg) or higher	• Open in PIM circuit • Open in E2 circuit

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- If DTCs relating to different systems are stored, and they share terminal E2 as their ground, check this ground circuit first.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (MANIFOLD ABSOLUTE PRESSURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / MAP.

d. Read the value.

OK:
Same value as the actual atmospheric pressure.

HINT:

Standard atmospheric pressure is 101 kPa. For every 100 m increase in altitude, pressure drops by 1 kPa. Varies by weather (high atmospheric pressure, low atmospheric pressure).

OK	Go to step 8
NG	Go to step 2

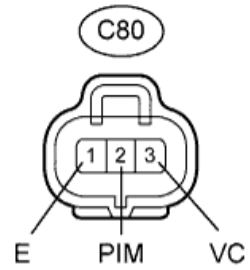
2.CHECK HARNESS AND CONNECTOR (MANIFOLD ABSOLUTE PRESSURE SENSOR - ECM)

a. Disconnect the manifold absolute pressure sensor connector.

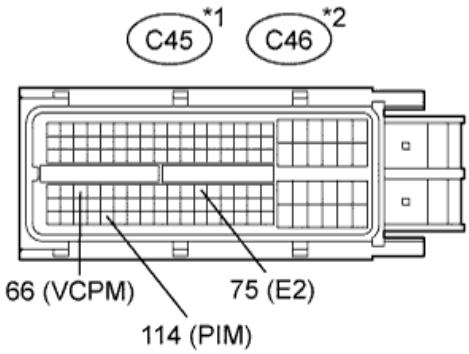
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Manifold Absolute Pressure Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C80-2 (PIM) - C45-114 (PIM)	Always	Below 1 Ω
C80-3 (VC) - C45-66 (VCPM)	Always	Below 1 Ω
C80-1 (E) - C45-75 (E2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C80-2 (PIM) - C46-114 (PIM)	Always	Below 1 Ω
C80-3 (VC) - C46-66 (VCPM)	Always	Below 1 Ω
C80-1 (E) - C46-75 (E2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C80-2 (PIM) or C45-114 (PIM)) - Body ground	Always	10 kΩ or higher
C80-3 (VC) or C45-66 (VCPM) -		10 kΩ or

Body ground	Always	higher
C80-1 (E) or C45-75 (E2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C80-2 (PIM) or C46-114 (PIM)) - Body ground	Always	10 kΩ or higher
C80-3 (VC) or C46-66 (VCPM) - Body ground	Always	10 kΩ or higher
C80-1 (E) or C46-75 (E2) - Body ground	Always	10 kΩ or higher

NG → Go to step 7

OK

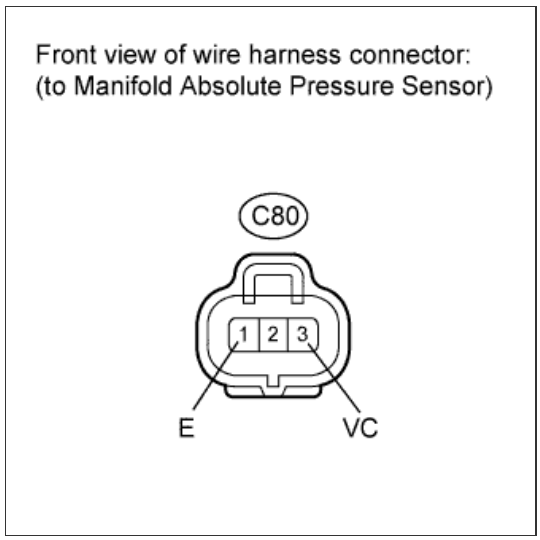
3.CHECK ECM TERMINAL VOLTAGE (VC TERMINAL)

a. Disconnect the manifold absolute pressure sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C80-3 (VC) - C80-1 (E)	Ignition switch ON	4.5 to 5.5 V



NG → Go to step 6

OK

4.REPLACE MANIFOLD ABSOLUTE PRESSURE SENSOR

a. Replace the manifold absolute pressure sensor (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON and turn the tester on.

e. After the engine is started, race the engine for 1 second.

f. Enter the following menus: Powertrain / Engine / DTC.

g. Read the DTCs.

Result:

Display (DTC output)	Proceed to
P0105, P0107 and/or P0108	A
No output	B

B → END

A

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 8

7.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

8.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 3 seconds and turn the tester on.

e. After the engine is started, race the engine for 1 second.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P0105, P0107 and/or P0108.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, race the engine for 1 minute and then idle the engine for 5 minutes.

NEXT

END

DTC P1258 VNT Position Sensor Range/Performance Bank 2 Sensor 1

DTC P1259 VNT Position Sensor Low Bank 2 Sensor 1

DTC P1260 VNT Position Sensor High Bank 2 Sensor 1

DTC P1262 VNT Position Sensor Low Bank 2 Sensor 2

DTC P1263 VNT Position Sensor High Bank 2 Sensor 2

DTC P2563 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit Range/Performance

DTC P2564 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit Low

DTC P2565 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit High

DTC P2588 Turbocharger/Supercharger Boost Control Position Sensor "B" Circuit Low

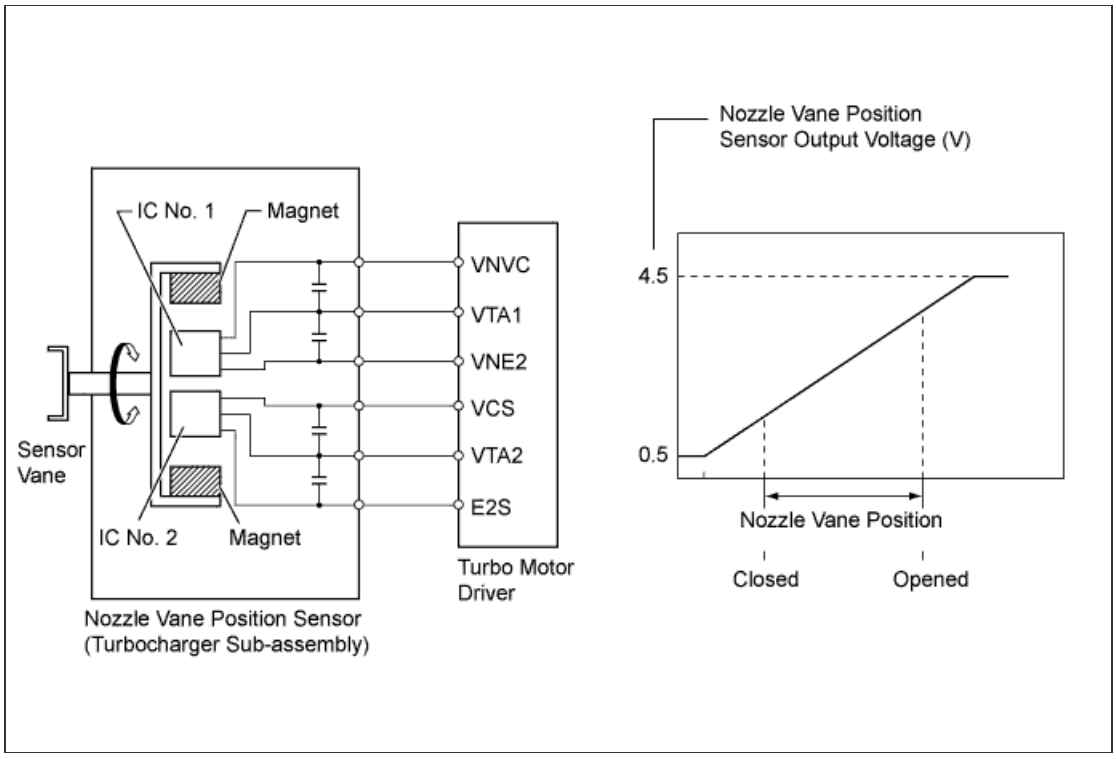
DTC P2589 Turbocharger/Supercharger Boost Control Position Sensor "B" Circuit High

for Preparation Click here

DESCRIPTION

The variable nozzle vane type turbocharger consists primarily of a compressor wheel, turbine wheel, nozzle vane, unison ring, DC motor and nozzle vane position sensor.

The nozzle vane position sensor consists of a Hall IC and a magnetic yoke that rotates in unison with the movement of the linkage that actuates the nozzle vane. The nozzle vane position sensor converts the changes in the magnetic flux that are caused by the rotation of the DC motor (hence, the rotation of the magnetic yoke) into electric signals, and outputs them to the turbo motor driver. The turbo motor driver determines the actual nozzle vane position from the electric signals in order to calculate the target nozzle vane position.



P1258

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	The difference between VTI2 and VTA2 voltage is 0.8 V or more for 0.5 seconds (1 trip detection logic).	Nozzle vane position sensor (turbocharger sub-assembly)

P1259

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area

Ignition switch ON for 1 second	VTI2 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1260

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTI2 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1262

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA2 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1263

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA2 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2563

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	The difference between VTA1 and VTA voltage is 0.8 V or more for 0.5 seconds (1 trip detection logic).	Nozzle vane position sensor (turbocharger sub-assembly)

P2564

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA1 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2565

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA1 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2588

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
		• Nozzle vane position sensor (turbocharger sub-assembly)

Ignition switch ON for 1 second	VTA voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2589

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

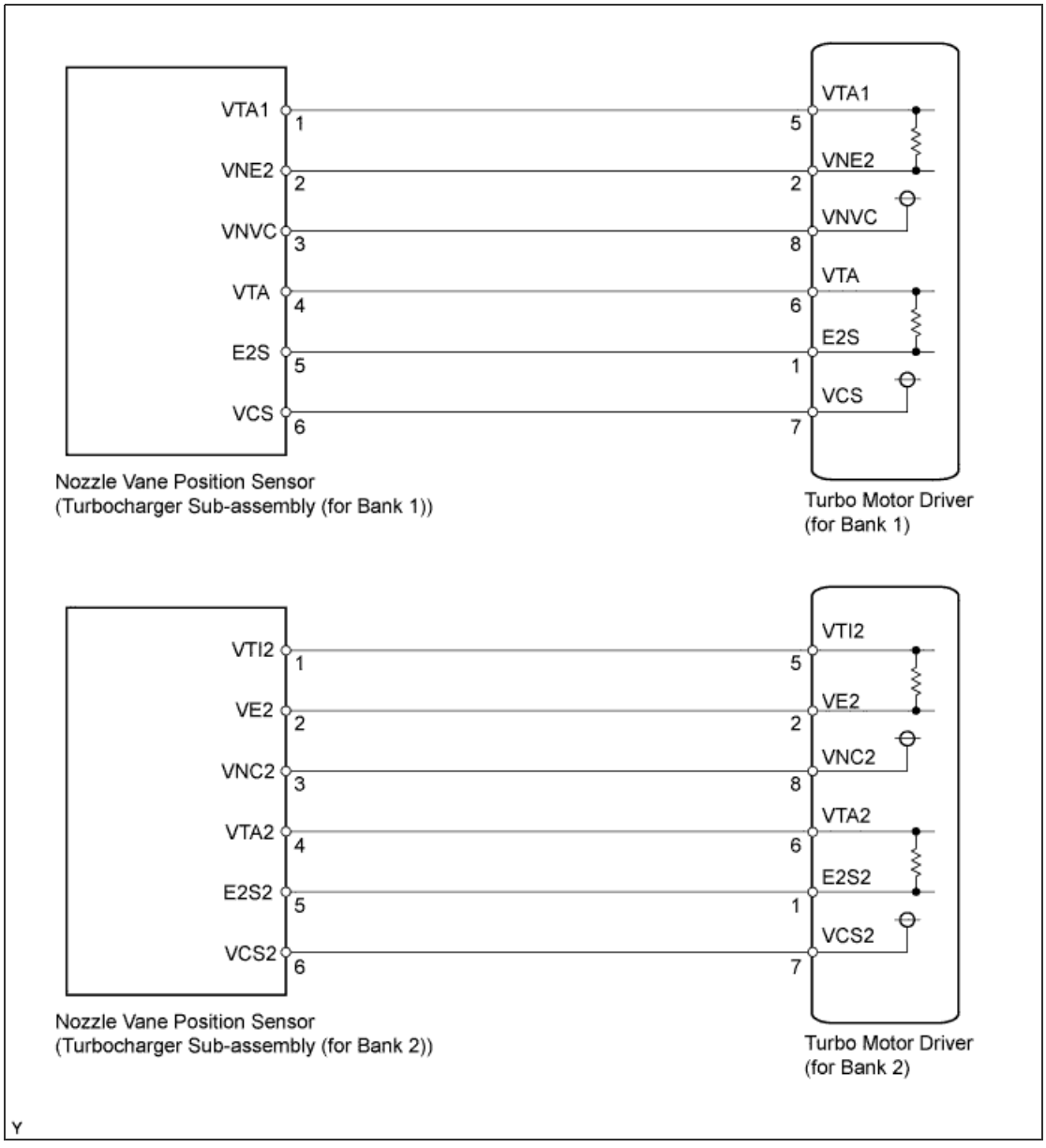
HINT:

If DTC P1258, P1259, P1260, P1262, P1263, P2563, P2564, P2565, P2588 and/or P2589 is stored, the following symptoms may appear:

Stuck open malfunction:

- Lack of power
- Vehicle surge or hesitation under light or medium load
- White smoke

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.INSPECT TURBO MOTOR DRIVER (for Bank 1 and Bank 2)

a. Remove the rear fender splash shield sub-assembly RH.

b. Remove the front fender liner LH.

c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

HINT:

Record the output DTCs.

g. Clear the DTCs (Click here).

h. Turn the ignition switch off.

i. Interchange the connectors for the turbo motor driver of bank 1 and bank 2.

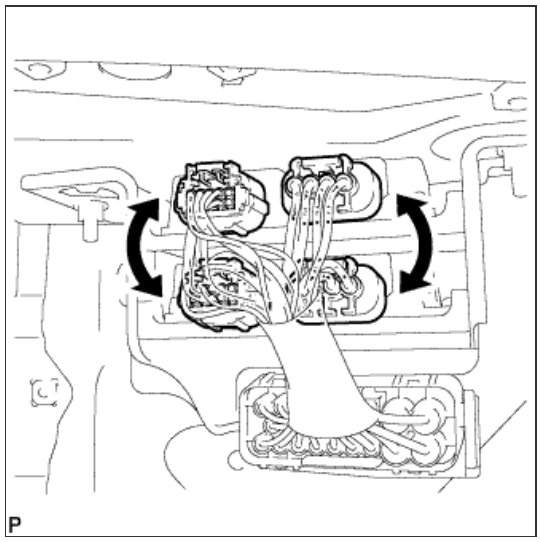
j. Turn the ignition switch to ON for 1 second.

k. Enter the following menus: Powertrain / Engine / DTC.

l. Read the DTCs.

Result:

Display (DTC Output)	Proceed to
DTCs change	B
DTCs do not change	A



B → Go to step 4

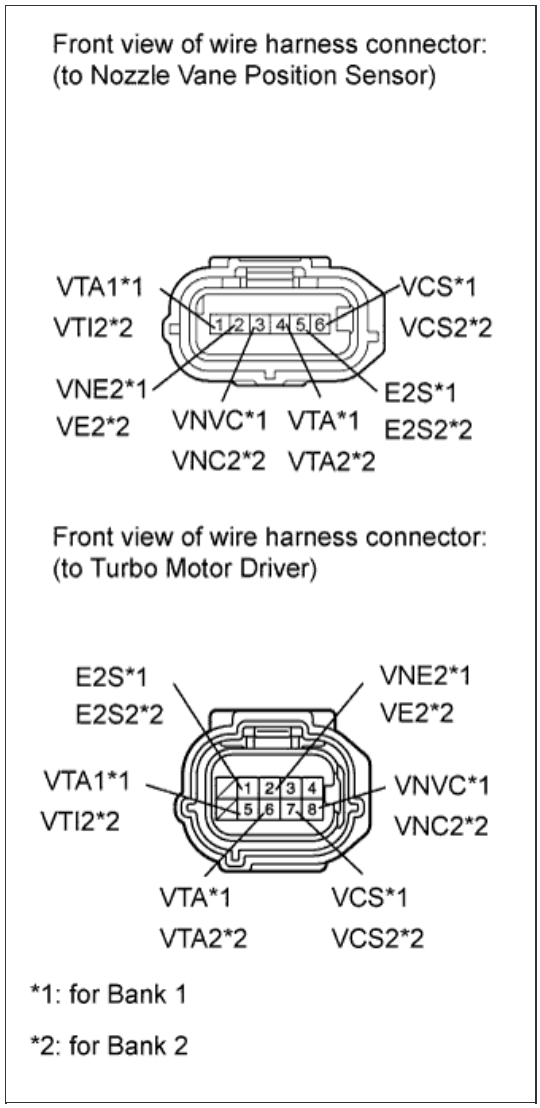
A

2.CHECK HARNESS AND CONNECTOR (TURBO MOTOR DRIVER - NOZZLE VANE POSITION SENSOR)

a. Disconnect the nozzle vane position sensor connector.

b. Disconnect the turbo motor driver connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTA1) - Nozzle vane position sensor connector-1 (VTA1)	Always	Below 1 Ω
Turbo motor driver connector-2 (VNE2) - Nozzle vane position sensor connector-2 (VNE2)	Always	Below 1 Ω
Turbo motor driver connector-8 (VNVC) - Nozzle vane position sensor connector-3 (VNVC)	Always	Below 1 Ω
Turbo motor driver connector-6 (VTA) - Nozzle vane position sensor connector-4 (VTA)	Always	Below 1 Ω
Turbo motor driver connector-1 (E2S) - Nozzle vane position sensor connector-5 (E2S)	Always	Below 1 Ω
Turbo motor driver connector-7 (VCS) - Nozzle vane position sensor connector-6 (VCS)	Always	Below 1 Ω

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTI2) - Nozzle vane position sensor connector-1 (VTI2)	Always	Below 1 Ω
Turbo motor driver connector-2 (VE2) - Nozzle vane position sensor	Always	Below 1 Ω

connector-2 (VE2)		
Turbo motor driver connector-8 (VNC2) - Nozzle vane position sensor connector-3 (VNC2)	Always	Below 1 Ω
Turbo motor driver connector-6 (VTA2) - Nozzle vane position sensor connector-4 (VTA2)	Always	Below 1 Ω
Turbo motor driver connector-1 (E2S2) - Nozzle vane position sensor connector-5 (E2S2)	Always	Below 1 Ω
Turbo motor driver connector-7 (VCS2) - Nozzle vane position sensor connector-6 (VCS2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTA1) or Nozzle vane position sensor connector-1 (VTA1) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-2 (VNE2) or Nozzle vane position sensor connector-2 (VNE2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-8 (VNVC) or Nozzle vane position sensor connector-3 (VNVC) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-6 (VTA) or Nozzle vane position sensor connector-4 (VTA) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-1 (E2S) or Nozzle vane position sensor connector-5 (E2S) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-7 (VCS) or Nozzle vane position sensor connector-6 (VCS) - Body ground	Always	10 kΩ or higher

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTI2) or Nozzle vane position sensor connector-1 (VTI2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-2 (VE2) or Nozzle vane position sensor connector-2 (VE2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-8 (VNC2) or Nozzle vane position sensor connector-3 (VNC2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-6 (VTA2) or Nozzle vane position sensor connector-4 (VTA2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-1 (E2S2) or Nozzle vane position sensor connector-5 (E2S2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-7 (VCS2) or Nozzle vane position sensor connector-6 (VCS2) - Body ground	Always	10 kΩ or higher

NG → Go to step 5

OK

3.REPLACE TURBOCHARGER SUB-ASSEMBLY (for Bank 1 or Bank 2) (NOZZLE VANE POSITION SENSOR)

a. Replace the turbocharger sub-assembly (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 6

4.REPLACE TURBO MOTOR DRIVER (for Bank 1 or Bank 2)

a. Replace the turbo motor driver (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 6

5.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

6.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch off and leave the vehicle for 15 seconds.

e. Turn the ignition switch to ON for 1 second.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P1258, P1259, P1260, P1262, P1263, P2563, P2564, P2565, P2588 and/or P2589.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, idle the engine.

NEXT

END

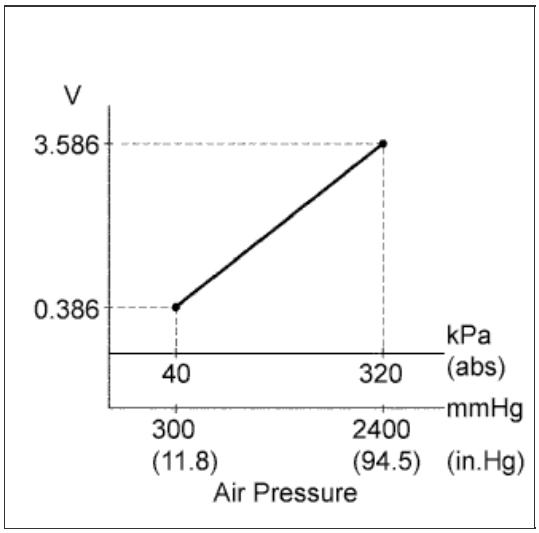
DTC P0105 Manifold Absolute Pressure / Barometric Pressure Circuit

DTC P0107 Manifold Absolute Pressure / Barometric Pressure Circuit Low Input

DTC P0108 Manifold Absolute Pressure / Barometric Pressure Circuit High Input

for Preparation Click here

DESCRIPTION



The manifold absolute pressure sensor detects the intake manifold pressure by using its built-in sensor unit. The ECM determines the basic injection duration and injection advance timing based on the voltage output by the manifold absolute pressure sensor.
The manifold absolute pressure sensor monitors the absolute pressure inside the intake manifold (default is 0 kPa [0 mmHg, 0 in.Hg]). As a result the ECM controls the air-fuel ratio at the proper level under any driving conditions.

P0105

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After engine is started, race engine for 1 second	After the engine is started, condition (a) continues for more than 2.0 seconds (1 trip detection logic): (a) Manifold absolute pressure sensor voltage is 0.1 V or less, or 4.8 V or more.	• Open or short in manifold absolute pressure sensor circuit • Manifold absolute pressure sensor • ECM

P0107

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After engine is started, race engine for 1 second	After the engine is started, condition (a) continues for more than 2.0 seconds (1 trip detection logic): (a) Manifold absolute pressure sensor voltage is 0.1 V or less.	• Open or short in manifold absolute pressure sensor circuit • Manifold absolute pressure sensor • ECM

P0108

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After engine is started, race engine for 1 second	After engine is started, condition (a) continues for more than 2.0 seconds (1 trip detection logic): (a) Manifold absolute pressure sensor voltage is 4.8 V or more.	• Open or short in manifold absolute pressure sensor circuit • Manifold absolute pressure sensor • ECM

Related Data List

DTC No.	Data List
P0105	MAP
P0107	
P0108	

HINT:

- **If DTC P0105, P0107 and/or P0108 is stored, the following symptoms may appear:**

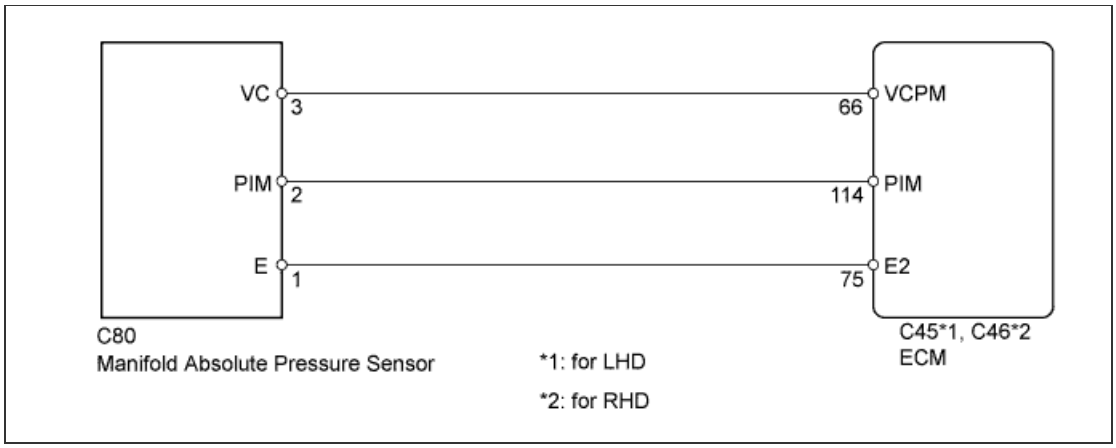
- Misfire
- Combustion noise
- Black smoke
- White smoke
- Lack of power

- When DTC P0105, P0107 or P0108 is stored, check the intake manifold pressure by entering the following menus: Powertrain / Engine / Data List / MAP.

Reference

Intake Manifold Pressure	Malfunction
Approximately 0 kPa	• Open in VC circuit • Short in PIM circuit
250 kPa (1875 mmHg, 73.8 in.Hg) or higher	• Open in PIM circuit • Open in E2 circuit

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- If DTCs relating to different systems are stored, and they share terminal E2 as their ground, check this ground circuit first.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.READ VALUE USING INTELLIGENT TESTER (MANIFOLD ABSOLUTE PRESSURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / MAP.

d. Read the value.

OK:
Same value as the actual atmospheric pressure.

HINT:

Standard atmospheric pressure is 101 kPa. For every 100 m increase in altitude, pressure drops by 1 kPa. Varies by weather (high atmospheric pressure, low atmospheric pressure).

OK	Go to step 8
NG	Go to step 2

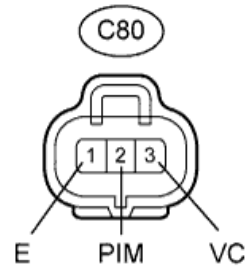
2.CHECK HARNESS AND CONNECTOR (MANIFOLD ABSOLUTE PRESSURE SENSOR - ECM)

a. Disconnect the manifold absolute pressure sensor connector.

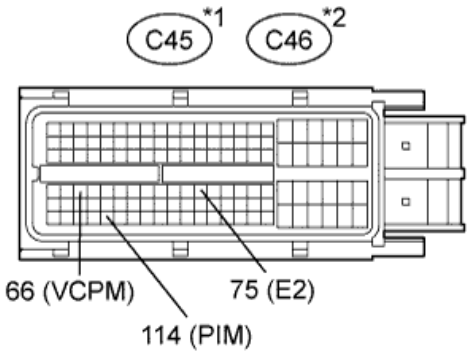
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Manifold Absolute Pressure Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C80-2 (PIM) - C45-114 (PIM)	Always	Below 1 Ω
C80-3 (VC) - C45-66 (VCPM)	Always	Below 1 Ω
C80-1 (E) - C45-75 (E2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C80-2 (PIM) - C46-114 (PIM)	Always	Below 1 Ω
C80-3 (VC) - C46-66 (VCPM)	Always	Below 1 Ω
C80-1 (E) - C46-75 (E2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C80-2 (PIM) or C45-114 (PIM)) - Body ground	Always	10 kΩ or higher
C80-3 (VC) or C45-66 (VCPM) -		10 kΩ or

Body ground	Always	higher
C80-1 (E) or C45-75 (E2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C80-2 (PIM) or C46-114 (PIM)) - Body ground	Always	10 kΩ or higher
C80-3 (VC) or C46-66 (VCPM) - Body ground	Always	10 kΩ or higher
C80-1 (E) or C46-75 (E2) - Body ground	Always	10 kΩ or higher

NG → Go to step 7

OK

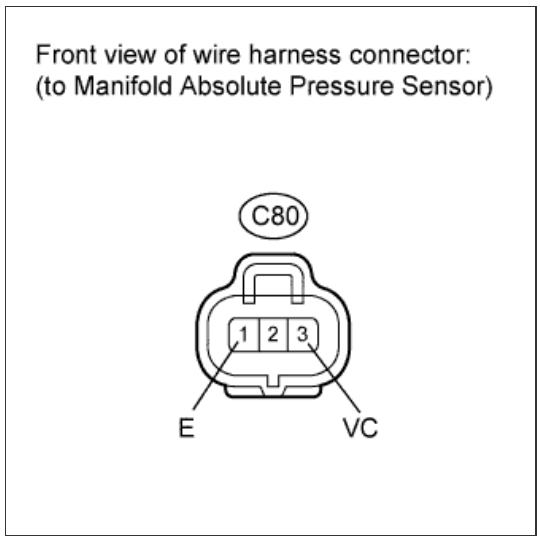
3.CHECK ECM TERMINAL VOLTAGE (VC TERMINAL)

a. Disconnect the manifold absolute pressure sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C80-3 (VC) - C80-1 (E)	Ignition switch ON	4.5 to 5.5 V



NG → Go to step 6

OK

4.REPLACE MANIFOLD ABSOLUTE PRESSURE SENSOR

a. Replace the manifold absolute pressure sensor (Click here).

NEXT

5.CHECK WHETHER DTC OUTPUT RECURS

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON and turn the tester on.

e. After the engine is started, race the engine for 1 second.

f. Enter the following menus: Powertrain / Engine / DTC.

g. Read the DTCs.

Result:

Display (DTC output)	Proceed to
P0105, P0107 and/or P0108	A
No output	B

B → END

A

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 8

7.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

8.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 3 seconds and turn the tester on.

e. After the engine is started, race the engine for 1 second.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P0105, P0107 and/or P0108.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, race the engine for 1 minute and then idle the engine for 5 minutes.

NEXT

END

DTC P1258 VNT Position Sensor Range/Performance Bank 2 Sensor 1

DTC P1259 VNT Position Sensor Low Bank 2 Sensor 1

DTC P1260 VNT Position Sensor High Bank 2 Sensor 1

DTC P1262 VNT Position Sensor Low Bank 2 Sensor 2

DTC P1263 VNT Position Sensor High Bank 2 Sensor 2

DTC P2563 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit Range/Performance

DTC P2564 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit Low

DTC P2565 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit High

DTC P2588 Turbocharger/Supercharger Boost Control Position Sensor "B" Circuit Low

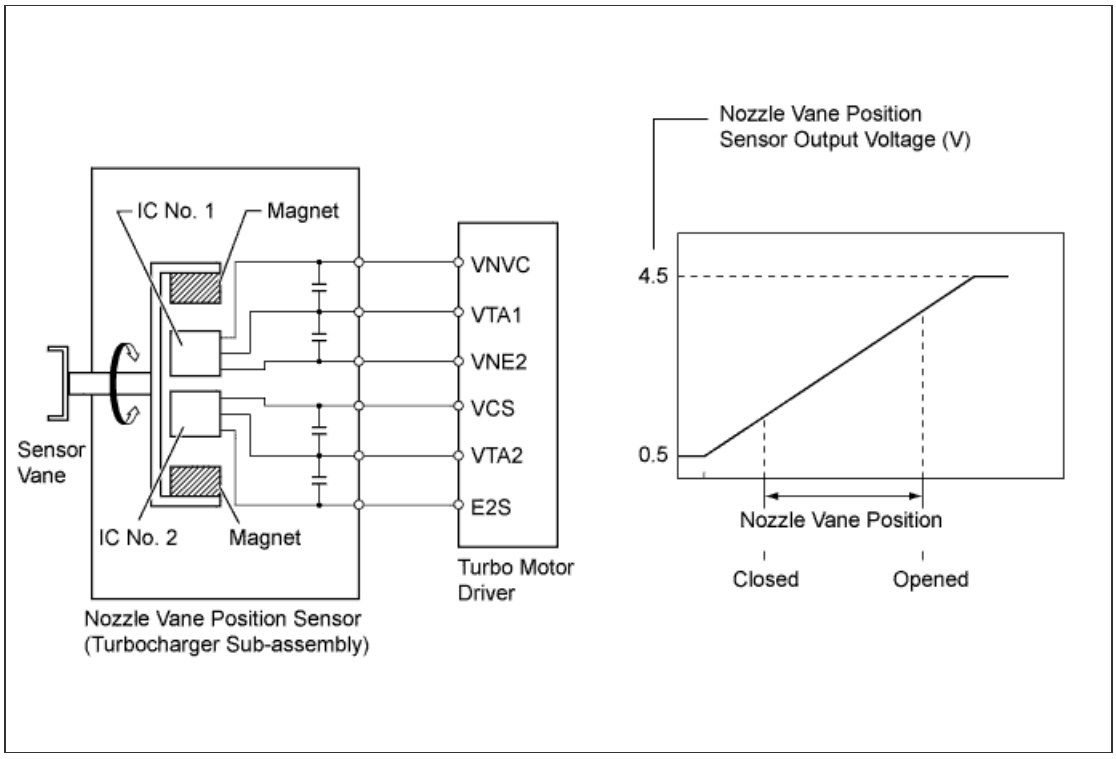
DTC P2589 Turbocharger/Supercharger Boost Control Position Sensor "B" Circuit High

for Preparation Click here

DESCRIPTION

The variable nozzle vane type turbocharger consists primarily of a compressor wheel, turbine wheel, nozzle vane, unison ring, DC motor and nozzle vane position sensor.

The nozzle vane position sensor consists of a Hall IC and a magnetic yoke that rotates in unison with the movement of the linkage that actuates the nozzle vane. The nozzle vane position sensor converts the changes in the magnetic flux that are caused by the rotation of the DC motor (hence, the rotation of the magnetic yoke) into electric signals, and outputs them to the turbo motor driver. The turbo motor driver determines the actual nozzle vane position from the electric signals in order to calculate the target nozzle vane position.



P1258

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	The difference between VTI2 and VTA2 voltage is 0.8 V or more for 0.5 seconds (1 trip detection logic).	Nozzle vane position sensor (turbocharger sub-assembly)

P1259

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area

Ignition switch ON for 1 second	VTI2 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1260

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTI2 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1262

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA2 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1263

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA2 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2563

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	The difference between VTA1 and VTA voltage is 0.8 V or more for 0.5 seconds (1 trip detection logic).	Nozzle vane position sensor (turbocharger sub-assembly)

P2564

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA1 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2565

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA1 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2588

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
		• Nozzle vane position sensor (turbocharger sub-assembly)

Ignition switch ON for 1 second	VTA voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2589

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

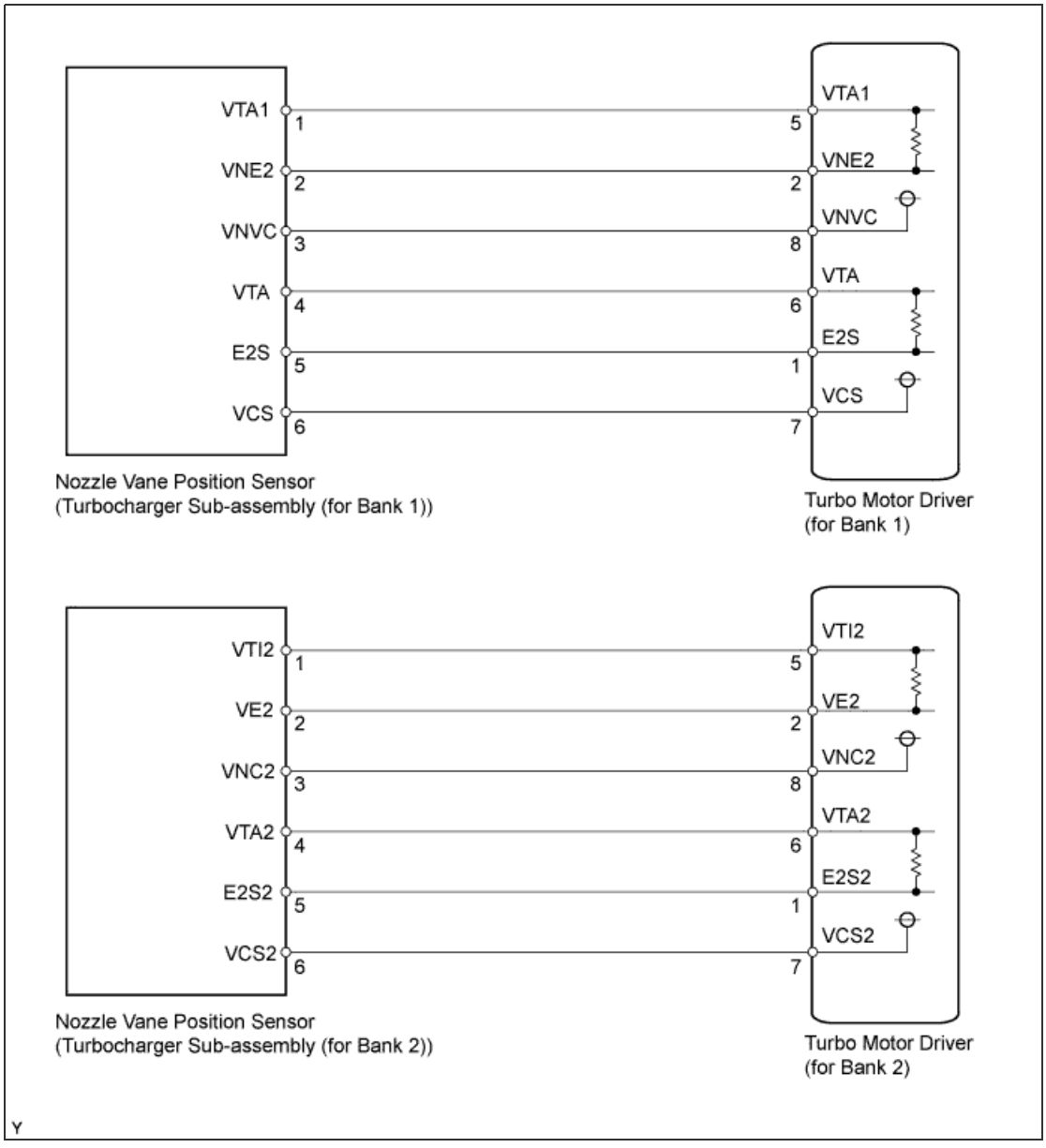
HINT:

If DTC P1258, P1259, P1260, P1262, P1263, P2563, P2564, P2565, P2588 and/or P2589 is stored, the following symptoms may appear:

Stuck open malfunction:

- Lack of power
- Vehicle surge or hesitation under light or medium load
- White smoke

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.INSPECT TURBO MOTOR DRIVER (for Bank 1 and Bank 2)

a. Remove the rear fender splash shield sub-assembly RH.

b. Remove the front fender liner LH.

c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

HINT:

Record the output DTCs.

g. Clear the DTCs (Click here).

h. Turn the ignition switch off.

i. Interchange the connectors for the turbo motor driver of bank 1 and bank 2.

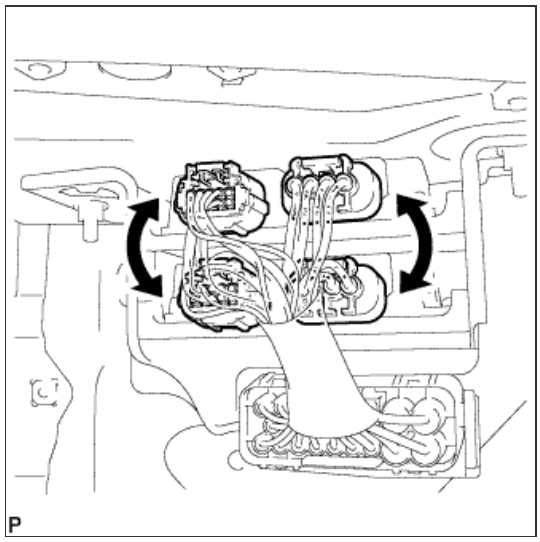
j. Turn the ignition switch to ON for 1 second.

k. Enter the following menus: Powertrain / Engine / DTC.

l. Read the DTCs.

Result:

Display (DTC Output)	Proceed to
DTCs change	B
DTCs do not change	A



B → Go to step 4

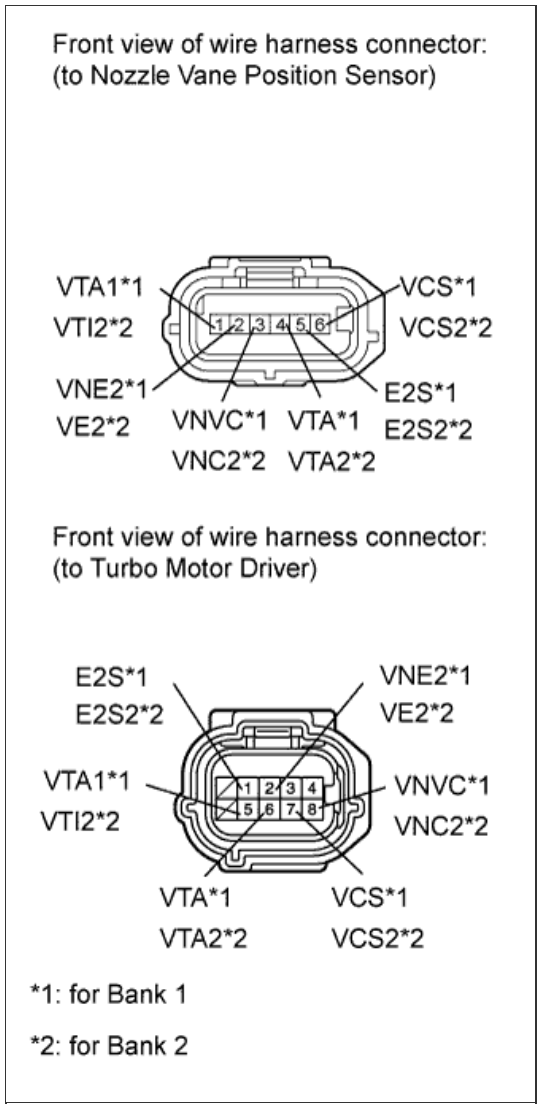
A

2.CHECK HARNESS AND CONNECTOR (TURBO MOTOR DRIVER - NOZZLE VANE POSITION SENSOR)

a. Disconnect the nozzle vane position sensor connector.

b. Disconnect the turbo motor driver connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTA1) - Nozzle vane position sensor connector-1 (VTA1)	Always	Below 1 Ω
Turbo motor driver connector-2 (VNE2) - Nozzle vane position sensor connector-2 (VNE2)	Always	Below 1 Ω
Turbo motor driver connector-8 (VNVC) - Nozzle vane position sensor connector-3 (VNVC)	Always	Below 1 Ω
Turbo motor driver connector-6 (VTA) - Nozzle vane position sensor connector-4 (VTA)	Always	Below 1 Ω
Turbo motor driver connector-1 (E2S) - Nozzle vane position sensor connector-5 (E2S)	Always	Below 1 Ω
Turbo motor driver connector-7 (VCS) - Nozzle vane position sensor connector-6 (VCS)	Always	Below 1 Ω

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTI2) - Nozzle vane position sensor connector-1 (VTI2)	Always	Below 1 Ω
Turbo motor driver connector-2 (VE2) - Nozzle vane position sensor	Always	Below 1 Ω

connector-2 (VE2)		
Turbo motor driver connector-8 (VNC2) - Nozzle vane position sensor connector-3 (VNC2)	Always	Below 1 Ω
Turbo motor driver connector-6 (VTA2) - Nozzle vane position sensor connector-4 (VTA2)	Always	Below 1 Ω
Turbo motor driver connector-1 (E2S2) - Nozzle vane position sensor connector-5 (E2S2)	Always	Below 1 Ω
Turbo motor driver connector-7 (VCS2) - Nozzle vane position sensor connector-6 (VCS2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTA1) or Nozzle vane position sensor connector-1 (VTA1) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-2 (VNE2) or Nozzle vane position sensor connector-2 (VNE2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-8 (VNVC) or Nozzle vane position sensor connector-3 (VNVC) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-6 (VTA) or Nozzle vane position sensor connector-4 (VTA) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-1 (E2S) or Nozzle vane position sensor connector-5 (E2S) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-7 (VCS) or Nozzle vane position sensor connector-6 (VCS) - Body ground	Always	10 kΩ or higher

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTI2) or Nozzle vane position sensor connector-1 (VTI2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-2 (VE2) or Nozzle vane position sensor connector-2 (VE2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-8 (VNC2) or Nozzle vane position sensor connector-3 (VNC2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-6 (VTA2) or Nozzle vane position sensor connector-4 (VTA2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-1 (E2S2) or Nozzle vane position sensor connector-5 (E2S2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-7 (VCS2) or Nozzle vane position sensor connector-6 (VCS2) - Body ground	Always	10 kΩ or higher

NG → Go to step 5

OK

3.REPLACE TURBOCHARGER SUB-ASSEMBLY (for Bank 1 or Bank 2) (NOZZLE VANE POSITION SENSOR)

a. Replace the turbocharger sub-assembly (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 6

4.REPLACE TURBO MOTOR DRIVER (for Bank 1 or Bank 2)

a. Replace the turbo motor driver (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 6

5.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

6.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch off and leave the vehicle for 15 seconds.

e. Turn the ignition switch to ON for 1 second.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P1258, P1259, P1260, P1262, P1263, P2563, P2564, P2565, P2588 and/or P2589.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, idle the engine.

NEXT

END

DTC P0106 Manifold Absolute Pressure / Barometric Pressure Circuit Range / Performance Problem

for Preparation Click here

DESCRIPTION

Refer to DTC P0105 (Click here).

P0106

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After warming up engine, idle engine for 10 seconds or more, then drive vehicle under load (accelerator opening angle 10% or more) with engine speed at 2500 rpm or less for 10 seconds	When either of the following conditions is met (2 trip detection logic): (a) The manifold absolute pressure output is 3.3 V or more for 10 seconds when idling the engine after warming it up. (b) The manifold absolute pressure sensor output is 1.5 V or less for 10 seconds when the throttle position sensor output is 1 V or more.	Manifold absolute pressure sensor

Related Data List

DTC No.	Data List
P0106	MAP

HINT:

- **If DTC P0106 is stored, the following symptoms may appear:**
  - **Misfire**
  - **Combustion noise**
  - **Black smoke**
  - **White smoke**
  - **Lack of power**

INSPECTION PROCEDURE

HINT:

- **If DTCs P0105, P0107 and P0108 are output simultaneously, the manifold absolute pressure sensor circuit may have an open or short. Perform troubleshooting for these DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P0106)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read the DTCs.

Result

Display (DTC Output)	Proceed to
P0106 is output	A
P0106 and other DTCs are output	B

B → GO TO DTC CHART (Click here)

A

2.REPLACE MANIFOLD ABSOLUTE PRESSURE SENSOR

a. Replace the manifold absolute pressure sensor (Click here).

NEXT

3.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Start the engine.

e. After warming up the engine, idle the engine for 10 seconds or more, then drive the vehicle under load (accelerator opening angle 10% or more) with the engine speed at 2500 rpm or less for 10 seconds.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P0106.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, drive the vehicle for 5 minutes and then idle the engine for 5 minutes.

NEXT

END

DTC P1258 VNT Position Sensor Range/Performance Bank 2 Sensor 1

DTC P1259 VNT Position Sensor Low Bank 2 Sensor 1

DTC P1260 VNT Position Sensor High Bank 2 Sensor 1

DTC P1262 VNT Position Sensor Low Bank 2 Sensor 2

DTC P1263 VNT Position Sensor High Bank 2 Sensor 2

DTC P2563 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit Range/Performance

DTC P2564 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit Low

DTC P2565 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit High

DTC P2588 Turbocharger/Supercharger Boost Control Position Sensor "B" Circuit Low

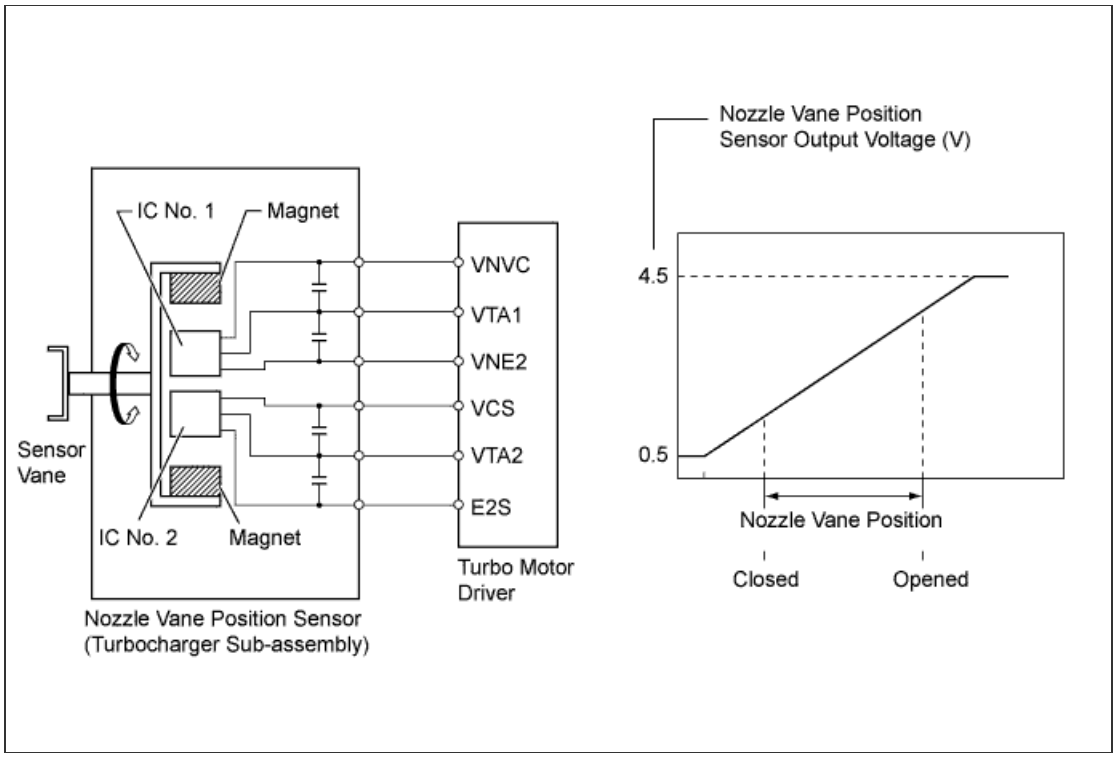
DTC P2589 Turbocharger/Supercharger Boost Control Position Sensor "B" Circuit High

for Preparation Click here

DESCRIPTION

The variable nozzle vane type turbocharger consists primarily of a compressor wheel, turbine wheel, nozzle vane, unison ring, DC motor and nozzle vane position sensor.

The nozzle vane position sensor consists of a Hall IC and a magnetic yoke that rotates in unison with the movement of the linkage that actuates the nozzle vane. The nozzle vane position sensor converts the changes in the magnetic flux that are caused by the rotation of the DC motor (hence, the rotation of the magnetic yoke) into electric signals, and outputs them to the turbo motor driver. The turbo motor driver determines the actual nozzle vane position from the electric signals in order to calculate the target nozzle vane position.



P1258

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	The difference between VTI2 and VTA2 voltage is 0.8 V or more for 0.5 seconds (1 trip detection logic).	Nozzle vane position sensor (turbocharger sub-assembly)

P1259

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area

Ignition switch ON for 1 second	VTI2 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1260

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTI2 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1262

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA2 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1263

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA2 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2563

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	The difference between VTA1 and VTA voltage is 0.8 V or more for 0.5 seconds (1 trip detection logic).	Nozzle vane position sensor (turbocharger sub-assembly)

P2564

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA1 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2565

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA1 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2588

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
		• Nozzle vane position sensor (turbocharger sub-assembly)

Ignition switch ON for 1 second	VTA voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2589

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

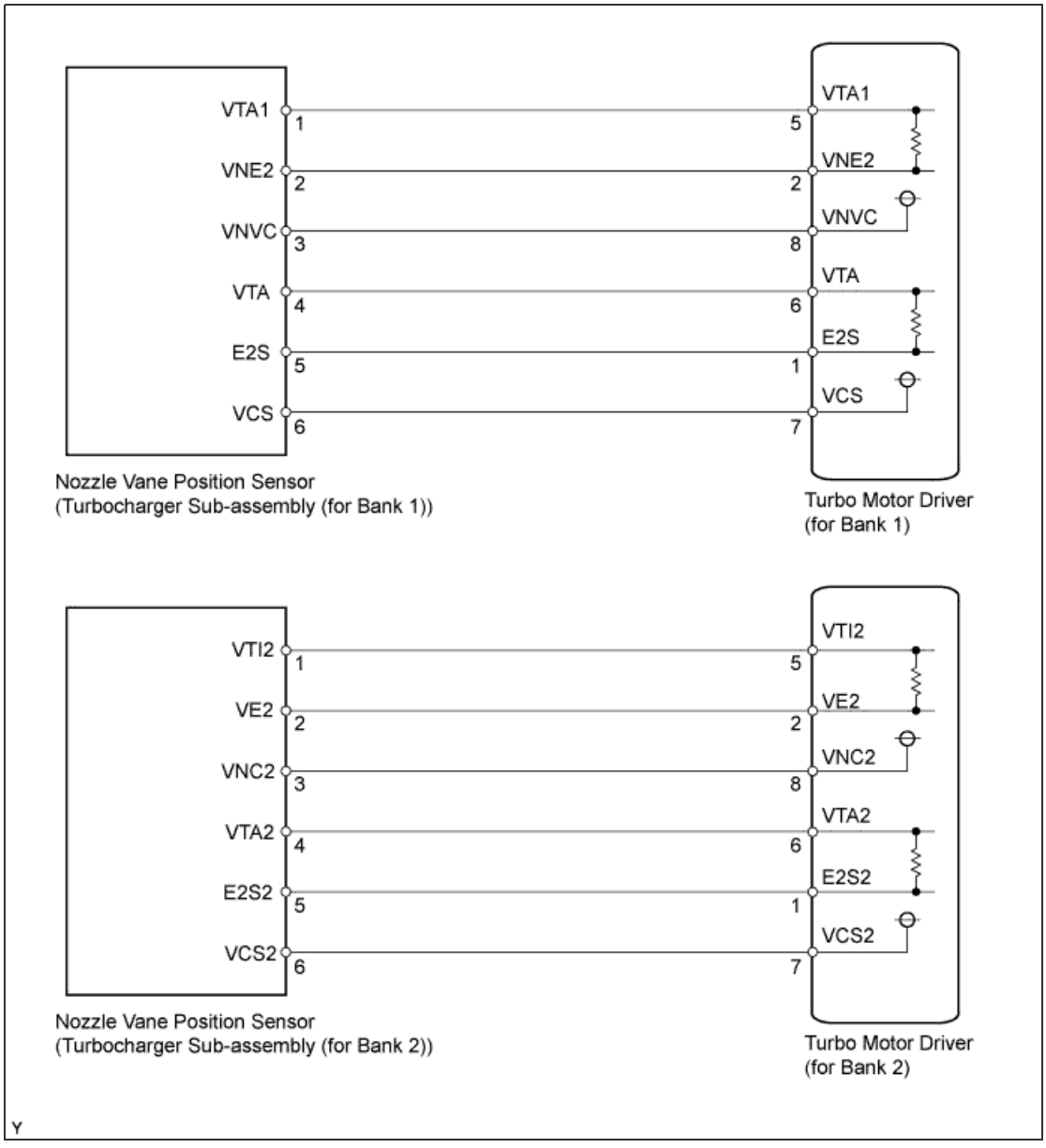
HINT:

If DTC P1258, P1259, P1260, P1262, P1263, P2563, P2564, P2565, P2588 and/or P2589 is stored, the following symptoms may appear:

Stuck open malfunction:

- Lack of power
- Vehicle surge or hesitation under light or medium load
- White smoke

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.INSPECT TURBO MOTOR DRIVER (for Bank 1 and Bank 2)

a. Remove the rear fender splash shield sub-assembly RH.

b. Remove the front fender liner LH.

c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

HINT:

Record the output DTCs.

g. Clear the DTCs (Click here).

h. Turn the ignition switch off.

i. Interchange the connectors for the turbo motor driver of bank 1 and bank 2.

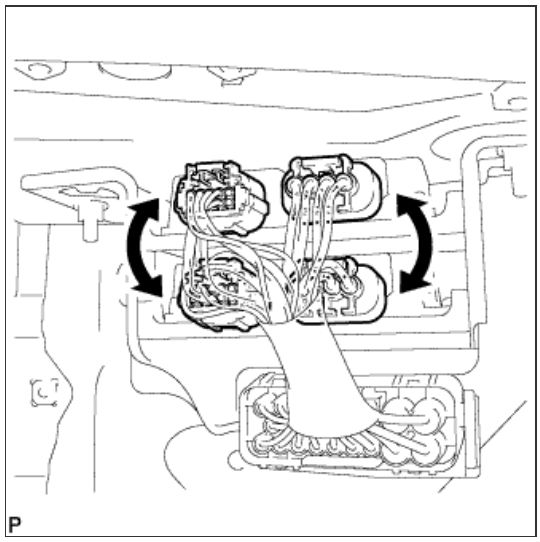
j. Turn the ignition switch to ON for 1 second.

k. Enter the following menus: Powertrain / Engine / DTC.

l. Read the DTCs.

Result:

Display (DTC Output)	Proceed to
DTCs change	B
DTCs do not change	A



B → Go to step 4

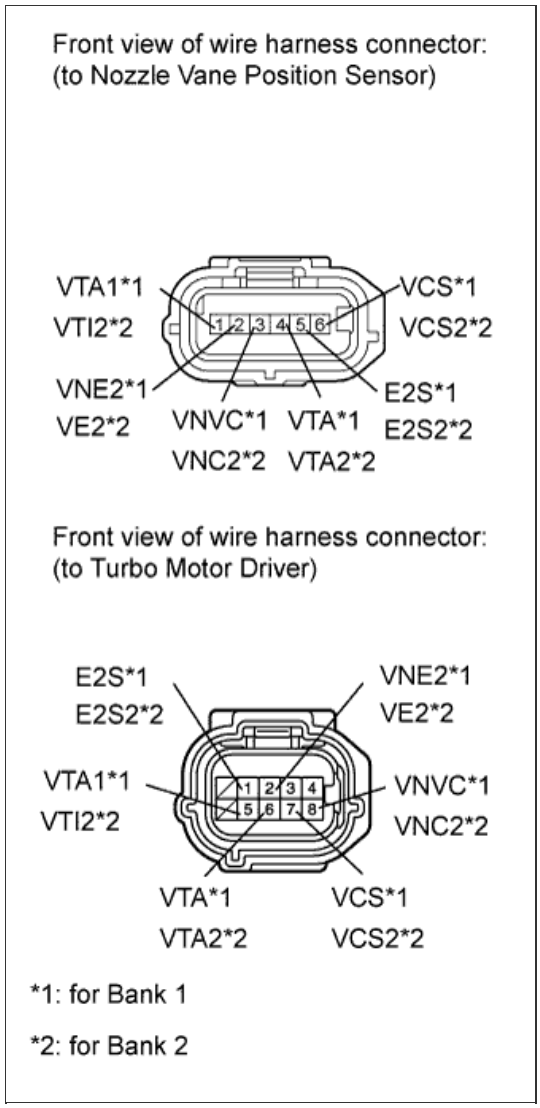
A

2.CHECK HARNESS AND CONNECTOR (TURBO MOTOR DRIVER - NOZZLE VANE POSITION SENSOR)

a. Disconnect the nozzle vane position sensor connector.

b. Disconnect the turbo motor driver connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTA1) - Nozzle vane position sensor connector-1 (VTA1)	Always	Below 1 Ω
Turbo motor driver connector-2 (VNE2) - Nozzle vane position sensor connector-2 (VNE2)	Always	Below 1 Ω
Turbo motor driver connector-8 (VNVC) - Nozzle vane position sensor connector-3 (VNVC)	Always	Below 1 Ω
Turbo motor driver connector-6 (VTA) - Nozzle vane position sensor connector-4 (VTA)	Always	Below 1 Ω
Turbo motor driver connector-1 (E2S) - Nozzle vane position sensor connector-5 (E2S)	Always	Below 1 Ω
Turbo motor driver connector-7 (VCS) - Nozzle vane position sensor connector-6 (VCS)	Always	Below 1 Ω

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTI2) - Nozzle vane position sensor connector-1 (VTI2)	Always	Below 1 Ω
Turbo motor driver connector-2 (VE2) - Nozzle vane position sensor	Always	Below 1 Ω

connector-2 (VE2)		
Turbo motor driver connector-8 (VNC2) - Nozzle vane position sensor connector-3 (VNC2)	Always	Below 1 Ω
Turbo motor driver connector-6 (VTA2) - Nozzle vane position sensor connector-4 (VTA2)	Always	Below 1 Ω
Turbo motor driver connector-1 (E2S2) - Nozzle vane position sensor connector-5 (E2S2)	Always	Below 1 Ω
Turbo motor driver connector-7 (VCS2) - Nozzle vane position sensor connector-6 (VCS2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTA1) or Nozzle vane position sensor connector-1 (VTA1) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-2 (VNE2) or Nozzle vane position sensor connector-2 (VNE2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-8 (VNVC) or Nozzle vane position sensor connector-3 (VNVC) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-6 (VTA) or Nozzle vane position sensor connector-4 (VTA) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-1 (E2S) or Nozzle vane position sensor connector-5 (E2S) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-7 (VCS) or Nozzle vane position sensor connector-6 (VCS) - Body ground	Always	10 kΩ or higher

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTI2) or Nozzle vane position sensor connector-1 (VTI2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-2 (VE2) or Nozzle vane position sensor connector-2 (VE2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-8 (VNC2) or Nozzle vane position sensor connector-3 (VNC2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-6 (VTA2) or Nozzle vane position sensor connector-4 (VTA2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-1 (E2S2) or Nozzle vane position sensor connector-5 (E2S2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-7 (VCS2) or Nozzle vane position sensor connector-6 (VCS2) - Body ground	Always	10 kΩ or higher

NG → Go to step 5

OK

3.REPLACE TURBOCHARGER SUB-ASSEMBLY (for Bank 1 or Bank 2) (NOZZLE VANE POSITION SENSOR)

a. Replace the turbocharger sub-assembly (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 6

4.REPLACE TURBO MOTOR DRIVER (for Bank 1 or Bank 2)

a. Replace the turbo motor driver (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 6

5.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

6.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch off and leave the vehicle for 15 seconds.

e. Turn the ignition switch to ON for 1 second.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P1258, P1259, P1260, P1262, P1263, P2563, P2564, P2565, P2588 and/or P2589.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, idle the engine.

NEXT

END

DTC P0110 Intake Air Temperature Circuit

DTC P0112 Intake Air Temperature Circuit Low Input

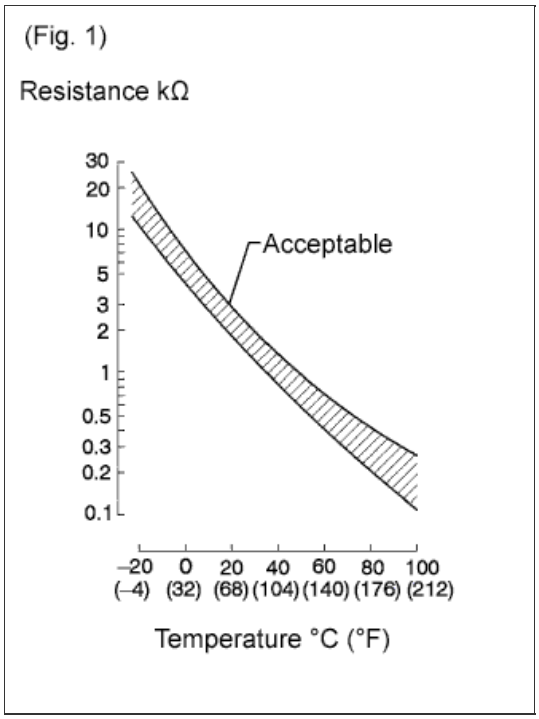
DTC P0113 Intake Air Temperature Circuit High Input

for Preparation Click here

DESCRIPTION

The intake air temperature sensor is built into the Mass Air Flow (MAF) meter and senses the intake air temperature.
A thermistor built into the sensor changes its resistance value according to the intake air temperature.
The lower the intake air temperature, the greater the thermistor resistance value. The higher the intake air temperature, the lower the thermistor resistance value (See Fig. 1).
The intake air temperature sensor is connected to the ECM.
The 5 V power source voltage in the ECM is applied to the intake air temperature sensor from terminal THA via resistor R.
Resistor R and the intake air temperature sensor are connected in series. When the resistance value of the intake air temperature sensor changes in accordance with changes in the intake air temperature, the potential at terminal THA also changes. Based on this signal, the ECM increases the fuel injection volume to improve driveability with a cold engine.

(Fig. 1)



P0110

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Open or short in the intake air temperature (IAT) sensor for 0.5 seconds (1 trip detection logic).	• Open or short in intake air temperature (IAT) sensor circuit • IAT sensor (built into mass air flow meter) • ECM

P0112

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Short in the IAT sensor for 0.5 seconds (1 trip detection logic).	• Short in IAT sensor circuit • IAT sensor (built into mass air flow meter) • ECM

P0113

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Open in the IAT sensor for 0.5 seconds (1 trip detection logic).	• Open in IAT sensor circuit • IAT sensor (built into mass air flow meter)

		• ECM

Related Data List

DTC No.	Data List
P0110	Intake Air
P0112	
P0113	

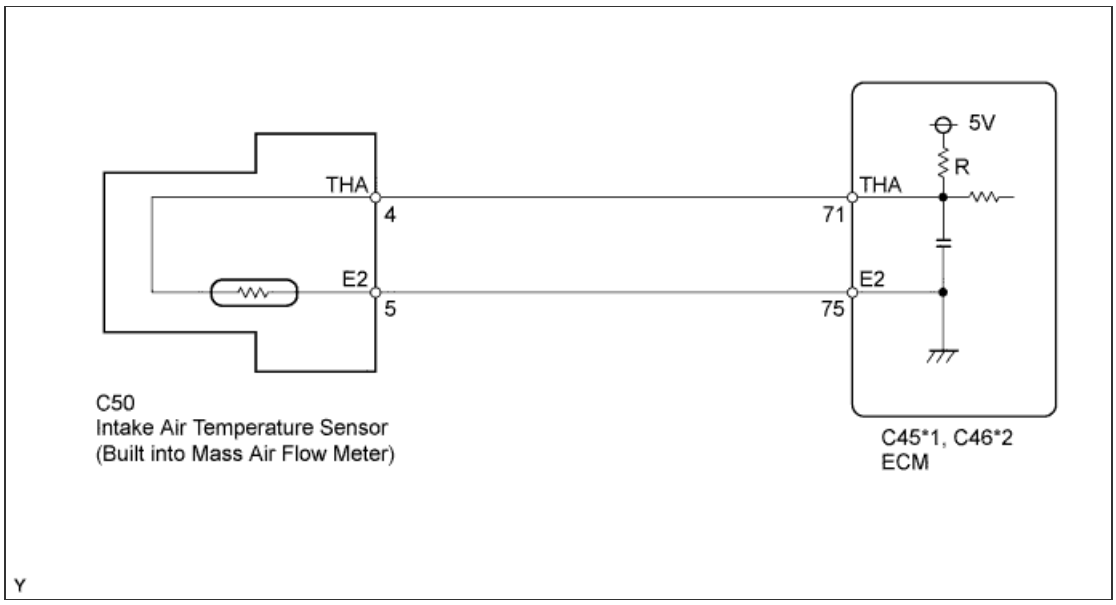
HINT:

- **If DTC P0110, P0112 and/or P0113 is stored, the following symptoms may appear:**
  - **Misfire**
  - **Combustion noise**
  - **Black smoke**
  - **White smoke**
  - **Lack of power**
- **When DTC P0110, P0112 or P0113 is stored, check the intake air temperature by entering the following menus: Powertrain / Engine / Data List / Intake Air.**

Reference

Temperature Displayed	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- **If DTCs relating to different systems are stored, and they share terminal E2 as their ground, check this ground circuit first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (INTAKE AIR TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Intake Air.

d. Read the value.

OK:
Same as actual intake air temperature.

Result

Result	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
OK (same as actual intake air temperature)	C

HINT:

- **If there is an open circuit, the tester indicates -40°C (-40°F).**
- **If there is a short circuit, the tester indicates 140°C (284°F) or more.**

B	Go to step 4
C	Go to step 11

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the mass air flow meter connector.

b. Connect terminals 4 (THA) and 5 (E2) of the mass air flow meter wire harness side connector.

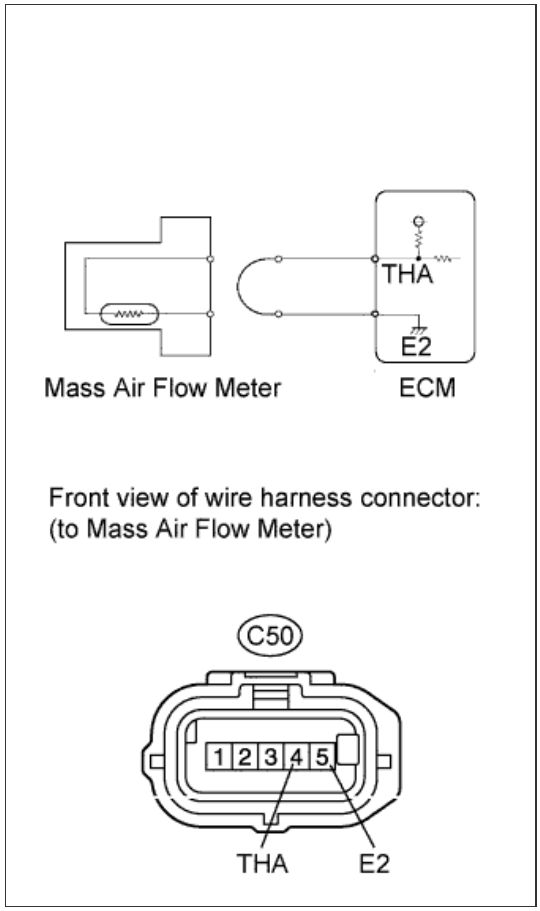
c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / Data List / Intake Air.

f. Read the value.

OK:
140°C (284°F) or higher



OK	Go to step 7
NG	Go to step 3

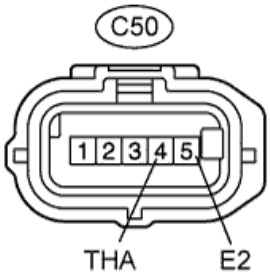
3.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the mass air flow meter connector.

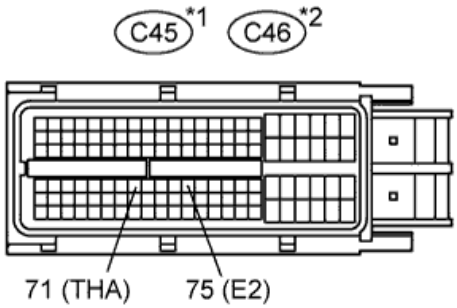
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Mass Air Flow Meter)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C50-4 (THA) - C45-71 (THA)	Always	Below 1 Ω
C50-5 (E2) - C45-75 (E2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C50-4 (THA) - C46-71 (THA)	Always	Below 1 Ω
C50-5 (E2) - C46-75 (E2)	Always	Below 1 Ω

OK	Go to step 9
NG	Go to step 8

4.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the mass air flow meter connector.

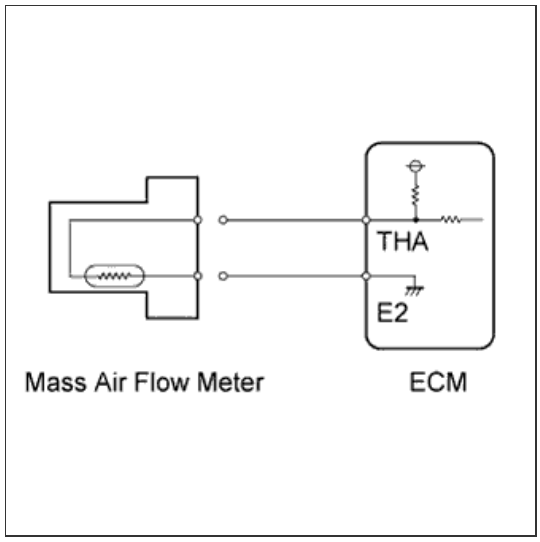
b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON and turn the tester on.

d. Enter the following menus: Powertrain / Engine / Data List / Intake Air.

e. Read the value.

OK:
-40°C (-40°F)



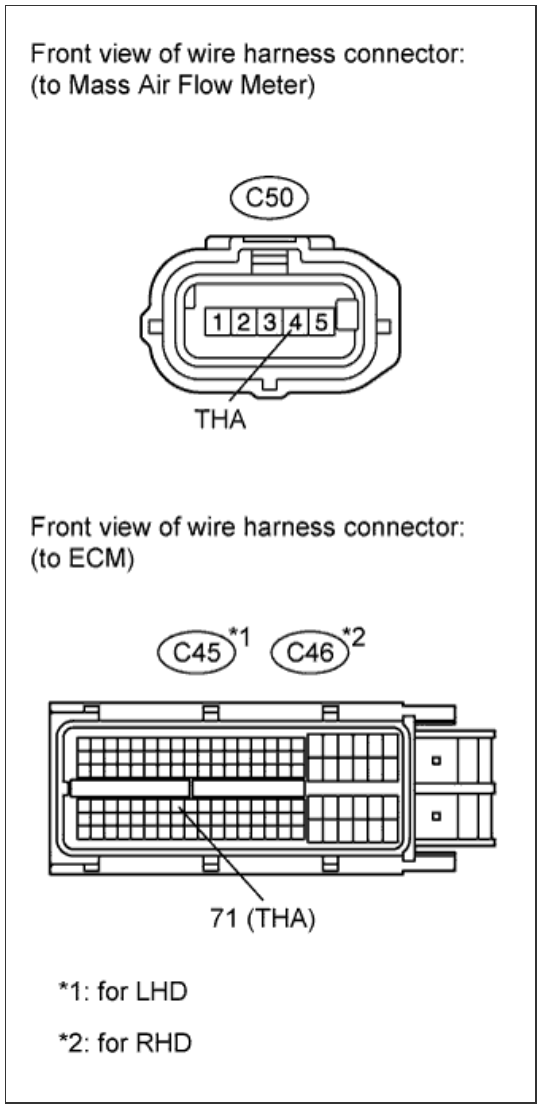
OK	Go to step 10
NG	Go to step 5

5.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the mass air flow meter connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Short):

for LHD

		Specified

Tester Connection	Condition	Condition
C50-4 (THA) or C45-71 (THA) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C50-4 (THA) or C46-71 (THA) - Body ground	Always	10 kΩ or higher

NG → Go to step 8

OK

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

7.CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE MASS AIR FLOW METER

a. Replace the mass air flow meter (Click here).

NEXT → Go to step 11

8.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT → Go to step 11

9.CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

10.REPLACE MASS AIR FLOW METER

a. Replace the mass air flow meter (Click here).

NEXT

11.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 1 second.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

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END
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DTC P1258 VNT Position Sensor Range/Performance Bank 2 Sensor 1

DTC P1259 VNT Position Sensor Low Bank 2 Sensor 1

DTC P1260 VNT Position Sensor High Bank 2 Sensor 1

DTC P1262 VNT Position Sensor Low Bank 2 Sensor 2

DTC P1263 VNT Position Sensor High Bank 2 Sensor 2

DTC P2563 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit Range/Performance

DTC P2564 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit Low

DTC P2565 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit High

DTC P2588 Turbocharger/Supercharger Boost Control Position Sensor "B" Circuit Low

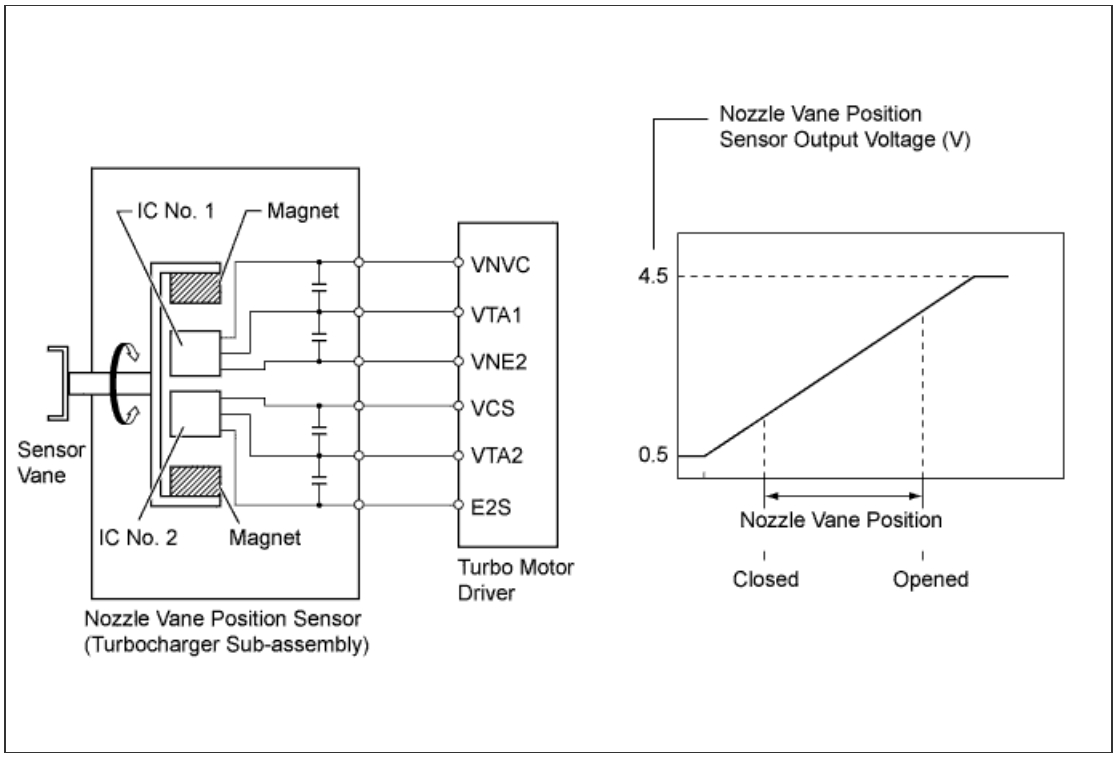
DTC P2589 Turbocharger/Supercharger Boost Control Position Sensor "B" Circuit High

for Preparation Click here

DESCRIPTION

The variable nozzle vane type turbocharger consists primarily of a compressor wheel, turbine wheel, nozzle vane, unison ring, DC motor and nozzle vane position sensor.

The nozzle vane position sensor consists of a Hall IC and a magnetic yoke that rotates in unison with the movement of the linkage that actuates the nozzle vane. The nozzle vane position sensor converts the changes in the magnetic flux that are caused by the rotation of the DC motor (hence, the rotation of the magnetic yoke) into electric signals, and outputs them to the turbo motor driver. The turbo motor driver determines the actual nozzle vane position from the electric signals in order to calculate the target nozzle vane position.



P1258

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	The difference between VTI2 and VTA2 voltage is 0.8 V or more for 0.5 seconds (1 trip detection logic).	Nozzle vane position sensor (turbocharger sub-assembly)

P1259

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area

Ignition switch ON for 1 second	VTI2 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1260

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTI2 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1262

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA2 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1263

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA2 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2563

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	The difference between VTA1 and VTA voltage is 0.8 V or more for 0.5 seconds (1 trip detection logic).	Nozzle vane position sensor (turbocharger sub-assembly)

P2564

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA1 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2565

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA1 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2588

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
		• Nozzle vane position sensor (turbocharger sub-assembly)

Ignition switch ON for 1 second	VTA voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2589

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

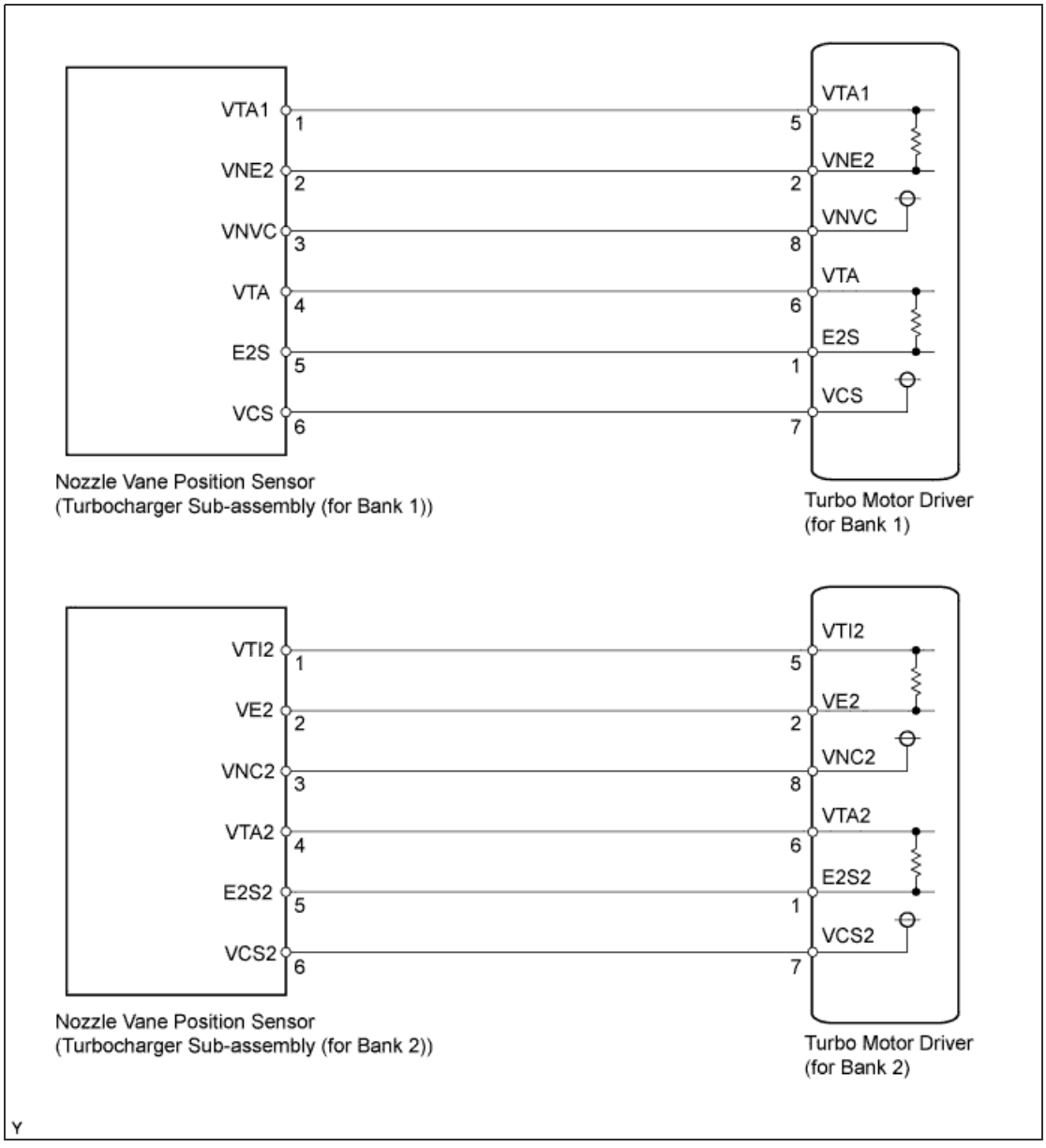
HINT:

If DTC P1258, P1259, P1260, P1262, P1263, P2563, P2564, P2565, P2588 and/or P2589 is stored, the following symptoms may appear:

Stuck open malfunction:

- Lack of power
- Vehicle surge or hesitation under light or medium load
- White smoke

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.INSPECT TURBO MOTOR DRIVER (for Bank 1 and Bank 2)

a. Remove the rear fender splash shield sub-assembly RH.

b. Remove the front fender liner LH.

c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

HINT:

Record the output DTCs.

g. Clear the DTCs (Click here).

h. Turn the ignition switch off.

i. Interchange the connectors for the turbo motor driver of bank 1 and bank 2.

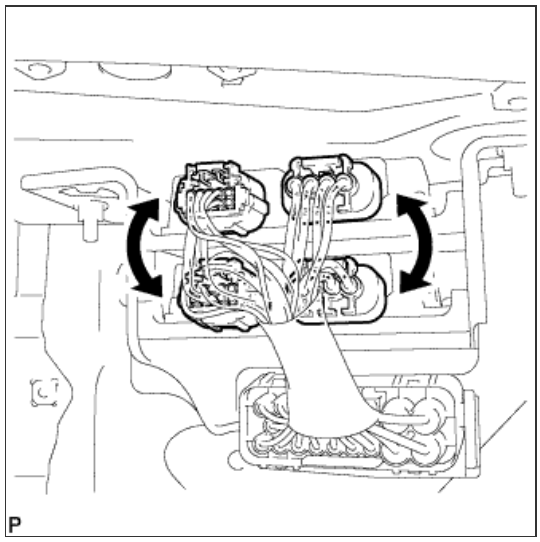
j. Turn the ignition switch to ON for 1 second.

k. Enter the following menus: Powertrain / Engine / DTC.

l. Read the DTCs.

Result:

Display (DTC Output)	Proceed to
DTCs change	B
DTCs do not change	A



B → Go to step 4

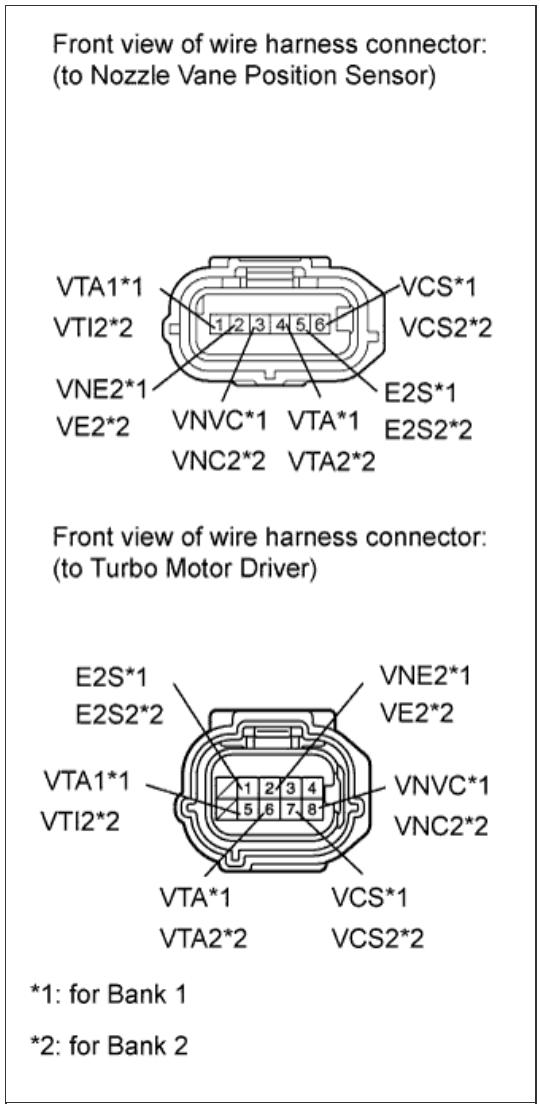
A

2.CHECK HARNESS AND CONNECTOR (TURBO MOTOR DRIVER - NOZZLE VANE POSITION SENSOR)

a. Disconnect the nozzle vane position sensor connector.

b. Disconnect the turbo motor driver connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTA1) - Nozzle vane position sensor connector-1 (VTA1)	Always	Below 1 Ω
Turbo motor driver connector-2 (VNE2) - Nozzle vane position sensor connector-2 (VNE2)	Always	Below 1 Ω
Turbo motor driver connector-8 (VNVC) - Nozzle vane position sensor connector-3 (VNVC)	Always	Below 1 Ω
Turbo motor driver connector-6 (VTA) - Nozzle vane position sensor connector-4 (VTA)	Always	Below 1 Ω
Turbo motor driver connector-1 (E2S) - Nozzle vane position sensor connector-5 (E2S)	Always	Below 1 Ω
Turbo motor driver connector-7 (VCS) - Nozzle vane position sensor connector-6 (VCS)	Always	Below 1 Ω

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTI2) - Nozzle vane position sensor connector-1 (VTI2)	Always	Below 1 Ω
Turbo motor driver connector-2 (VE2) - Nozzle vane position sensor	Always	Below 1 Ω

connector-2 (VE2)		
Turbo motor driver connector-8 (VNC2) - Nozzle vane position sensor connector-3 (VNC2)	Always	Below 1 Ω
Turbo motor driver connector-6 (VTA2) - Nozzle vane position sensor connector-4 (VTA2)	Always	Below 1 Ω
Turbo motor driver connector-1 (E2S2) - Nozzle vane position sensor connector-5 (E2S2)	Always	Below 1 Ω
Turbo motor driver connector-7 (VCS2) - Nozzle vane position sensor connector-6 (VCS2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTA1) or Nozzle vane position sensor connector-1 (VTA1) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-2 (VNE2) or Nozzle vane position sensor connector-2 (VNE2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-8 (VNVC) or Nozzle vane position sensor connector-3 (VNVC) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-6 (VTA) or Nozzle vane position sensor connector-4 (VTA) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-1 (E2S) or Nozzle vane position sensor connector-5 (E2S) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-7 (VCS) or Nozzle vane position sensor connector-6 (VCS) - Body ground	Always	10 kΩ or higher

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTI2) or Nozzle vane position sensor connector-1 (VTI2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-2 (VE2) or Nozzle vane position sensor connector-2 (VE2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-8 (VNC2) or Nozzle vane position sensor connector-3 (VNC2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-6 (VTA2) or Nozzle vane position sensor connector-4 (VTA2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-1 (E2S2) or Nozzle vane position sensor connector-5 (E2S2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-7 (VCS2) or Nozzle vane position sensor connector-6 (VCS2) - Body ground	Always	10 kΩ or higher

NG → Go to step 5

OK

3.REPLACE TURBOCHARGER SUB-ASSEMBLY (for Bank 1 or Bank 2) (NOZZLE VANE POSITION SENSOR)

a. Replace the turbocharger sub-assembly (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 6

4.REPLACE TURBO MOTOR DRIVER (for Bank 1 or Bank 2)

a. Replace the turbo motor driver (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 6

5.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

6.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch off and leave the vehicle for 15 seconds.

e. Turn the ignition switch to ON for 1 second.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P1258, P1259, P1260, P1262, P1263, P2563, P2564, P2565, P2588 and/or P2589.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, idle the engine.

NEXT

END

DTC P0110 Intake Air Temperature Circuit

DTC P0112 Intake Air Temperature Circuit Low Input

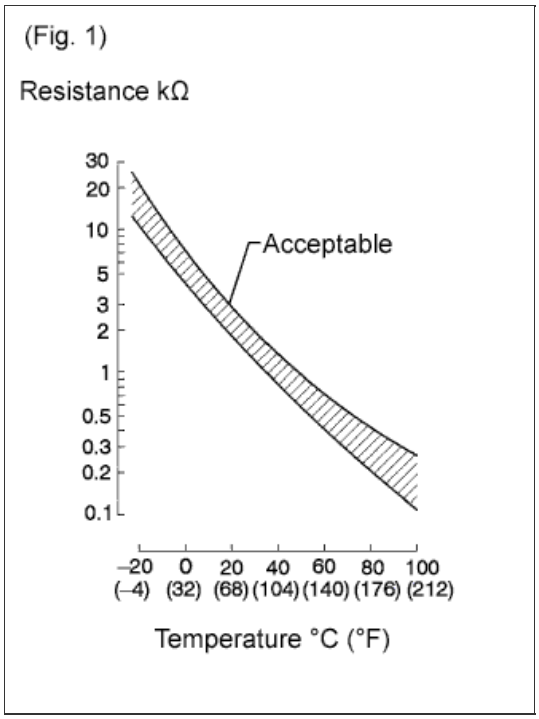
DTC P0113 Intake Air Temperature Circuit High Input

for Preparation Click here

DESCRIPTION

The intake air temperature sensor is built into the Mass Air Flow (MAF) meter and senses the intake air temperature.
A thermistor built into the sensor changes its resistance value according to the intake air temperature.
The lower the intake air temperature, the greater the thermistor resistance value. The higher the intake air temperature, the lower the thermistor resistance value (See Fig. 1).
The intake air temperature sensor is connected to the ECM.
The 5 V power source voltage in the ECM is applied to the intake air temperature sensor from terminal THA via resistor R.
Resistor R and the intake air temperature sensor are connected in series. When the resistance value of the intake air temperature sensor changes in accordance with changes in the intake air temperature, the potential at terminal THA also changes. Based on this signal, the ECM increases the fuel injection volume to improve driveability with a cold engine.

(Fig. 1)



P0110

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Open or short in the intake air temperature (IAT) sensor for 0.5 seconds (1 trip detection logic).	• Open or short in intake air temperature (IAT) sensor circuit • IAT sensor (built into mass air flow meter) • ECM

P0112

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Short in the IAT sensor for 0.5 seconds (1 trip detection logic).	• Short in IAT sensor circuit • IAT sensor (built into mass air flow meter) • ECM

P0113

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Open in the IAT sensor for 0.5 seconds (1 trip detection logic).	• Open in IAT sensor circuit • IAT sensor (built into mass air flow meter)

		• ECM

Related Data List

DTC No.	Data List
P0110	Intake Air
P0112	
P0113	

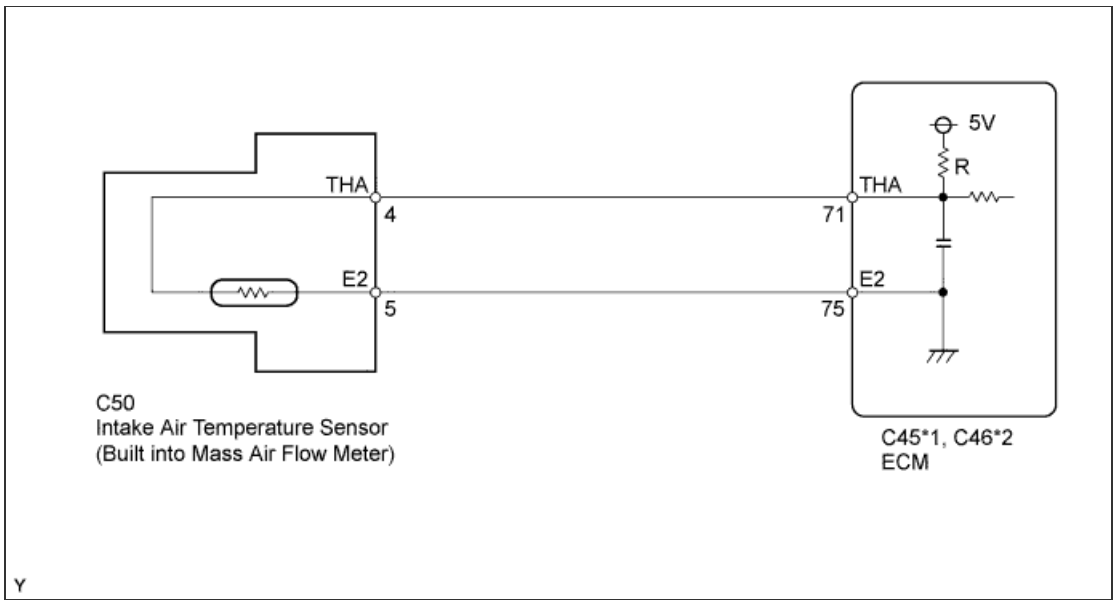
HINT:

- **If DTC P0110, P0112 and/or P0113 is stored, the following symptoms may appear:**
  - **Misfire**
  - **Combustion noise**
  - **Black smoke**
  - **White smoke**
  - **Lack of power**
- **When DTC P0110, P0112 or P0113 is stored, check the intake air temperature by entering the following menus: Powertrain / Engine / Data List / Intake Air.**

Reference

Temperature Displayed	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- **If DTCs relating to different systems are stored, and they share terminal E2 as their ground, check this ground circuit first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (INTAKE AIR TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Intake Air.

d. Read the value.

OK:
Same as actual intake air temperature.

Result

Result	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
OK (same as actual intake air temperature)	C

HINT:

- **If there is an open circuit, the tester indicates -40°C (-40°F).**
- **If there is a short circuit, the tester indicates 140°C (284°F) or more.**

B	Go to step 4
C	Go to step 11

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the mass air flow meter connector.

b. Connect terminals 4 (THA) and 5 (E2) of the mass air flow meter wire harness side connector.

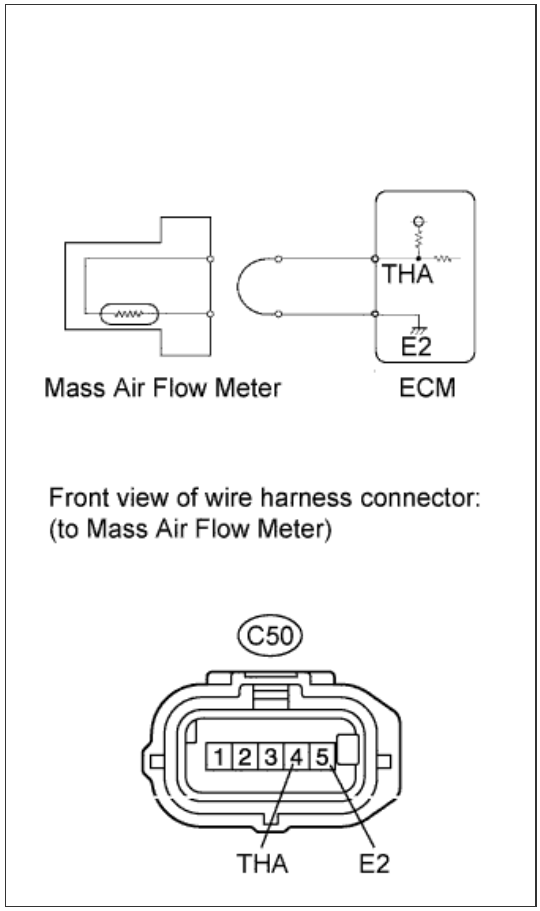
c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / Data List / Intake Air.

f. Read the value.

OK:
140°C (284°F) or higher



OK	Go to step 7
NG	Go to step 3

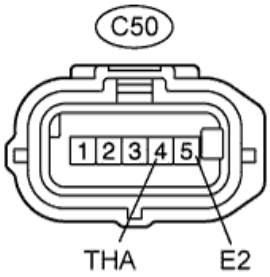
3.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the mass air flow meter connector.

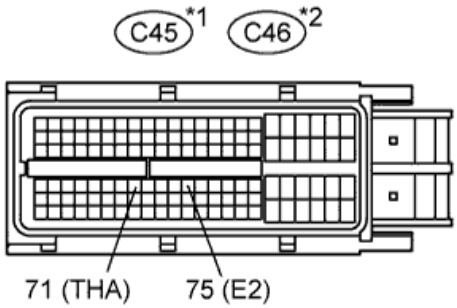
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Mass Air Flow Meter)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C50-4 (THA) - C45-71 (THA)	Always	Below 1 Ω
C50-5 (E2) - C45-75 (E2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C50-4 (THA) - C46-71 (THA)	Always	Below 1 Ω
C50-5 (E2) - C46-75 (E2)	Always	Below 1 Ω

OK	Go to step 9
NG	Go to step 8

4.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the mass air flow meter connector.

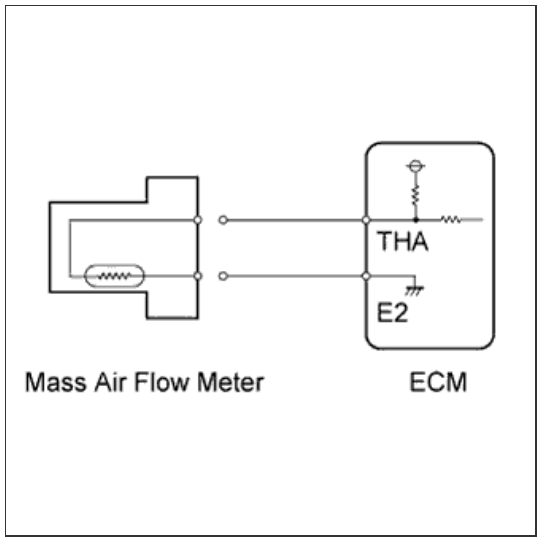
b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON and turn the tester on.

d. Enter the following menus: Powertrain / Engine / Data List / Intake Air.

e. Read the value.

OK:
-40°C (-40°F)



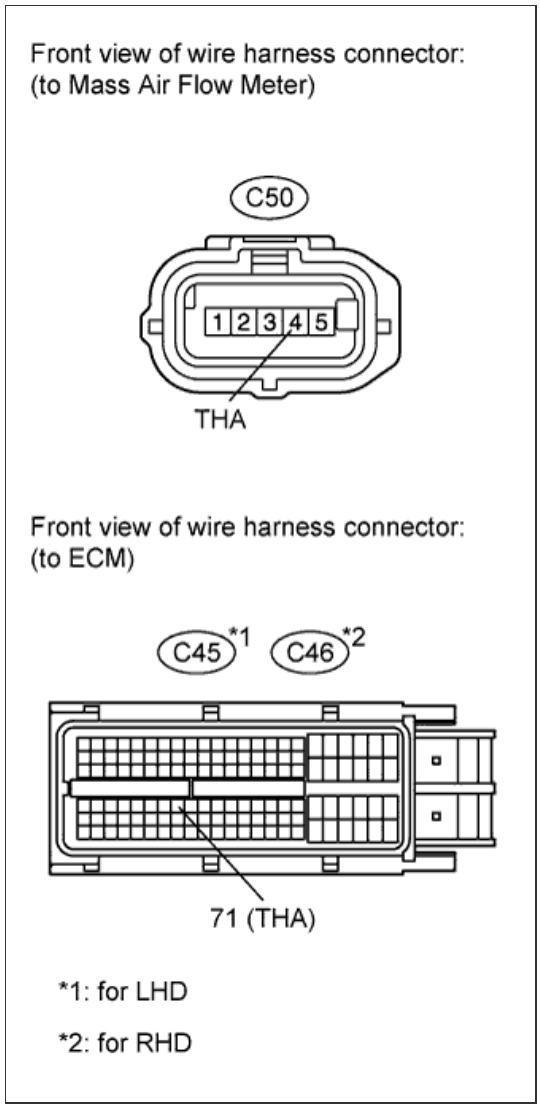
OK	Go to step 10
NG	Go to step 5

5.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the mass air flow meter connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Short):

for LHD

		Specified

Tester Connection	Condition	Condition
C50-4 (THA) or C45-71 (THA) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C50-4 (THA) or C46-71 (THA) - Body ground	Always	10 kΩ or higher

NG → Go to step 8

OK

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

7.CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE MASS AIR FLOW METER

a. Replace the mass air flow meter (Click here).

NEXT → Go to step 11

8.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT → Go to step 11

9.CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

10.REPLACE MASS AIR FLOW METER

a. Replace the mass air flow meter (Click here).

NEXT

11.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 1 second.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

```
END
```

DTC P1258 VNT Position Sensor Range/Performance Bank 2 Sensor 1

DTC P1259 VNT Position Sensor Low Bank 2 Sensor 1

DTC P1260 VNT Position Sensor High Bank 2 Sensor 1

DTC P1262 VNT Position Sensor Low Bank 2 Sensor 2

DTC P1263 VNT Position Sensor High Bank 2 Sensor 2

DTC P2563 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit Range/Performance

DTC P2564 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit Low

DTC P2565 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit High

DTC P2588 Turbocharger/Supercharger Boost Control Position Sensor "B" Circuit Low

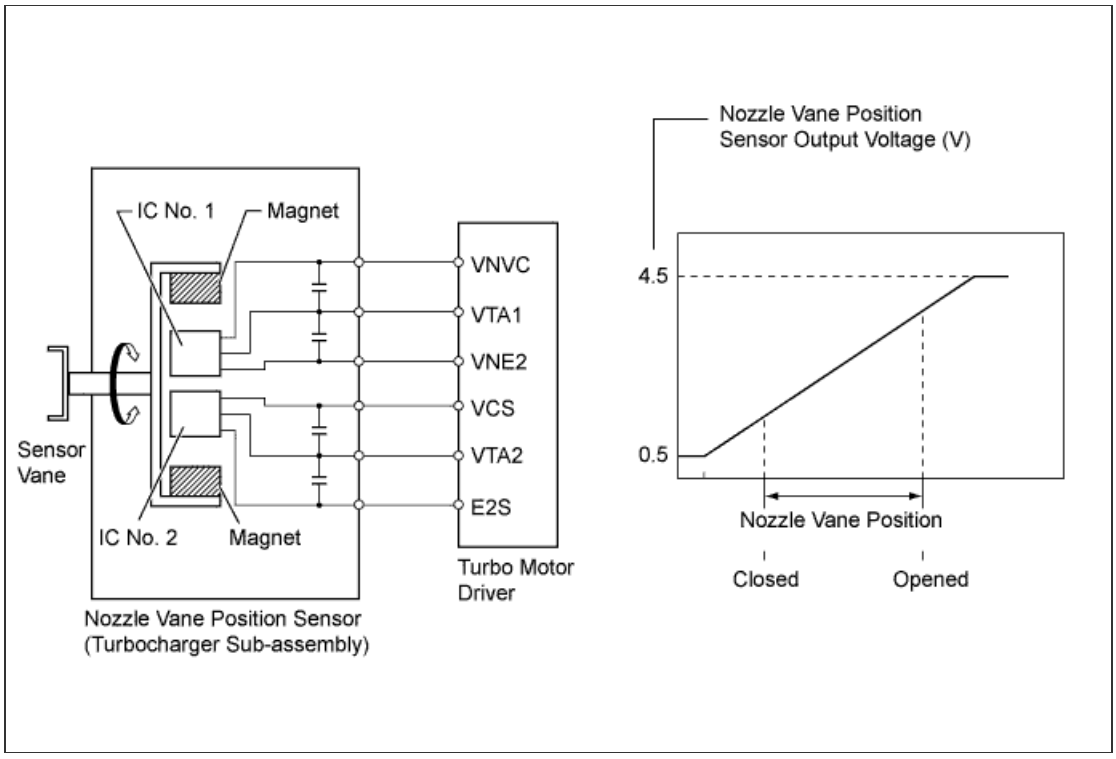
DTC P2589 Turbocharger/Supercharger Boost Control Position Sensor "B" Circuit High

for Preparation Click here

DESCRIPTION

The variable nozzle vane type turbocharger consists primarily of a compressor wheel, turbine wheel, nozzle vane, unison ring, DC motor and nozzle vane position sensor.

The nozzle vane position sensor consists of a Hall IC and a magnetic yoke that rotates in unison with the movement of the linkage that actuates the nozzle vane. The nozzle vane position sensor converts the changes in the magnetic flux that are caused by the rotation of the DC motor (hence, the rotation of the magnetic yoke) into electric signals, and outputs them to the turbo motor driver. The turbo motor driver determines the actual nozzle vane position from the electric signals in order to calculate the target nozzle vane position.



P1258

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	The difference between VTI2 and VTA2 voltage is 0.8 V or more for 0.5 seconds (1 trip detection logic).	Nozzle vane position sensor (turbocharger sub-assembly)

P1259

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area

Ignition switch ON for 1 second	VTI2 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1260

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTI2 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1262

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA2 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1263

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA2 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2563

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	The difference between VTA1 and VTA voltage is 0.8 V or more for 0.5 seconds (1 trip detection logic).	Nozzle vane position sensor (turbocharger sub-assembly)

P2564

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA1 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2565

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA1 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2588

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
		• Nozzle vane position sensor (turbocharger sub-assembly)

Ignition switch ON for 1 second	VTA voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2589

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

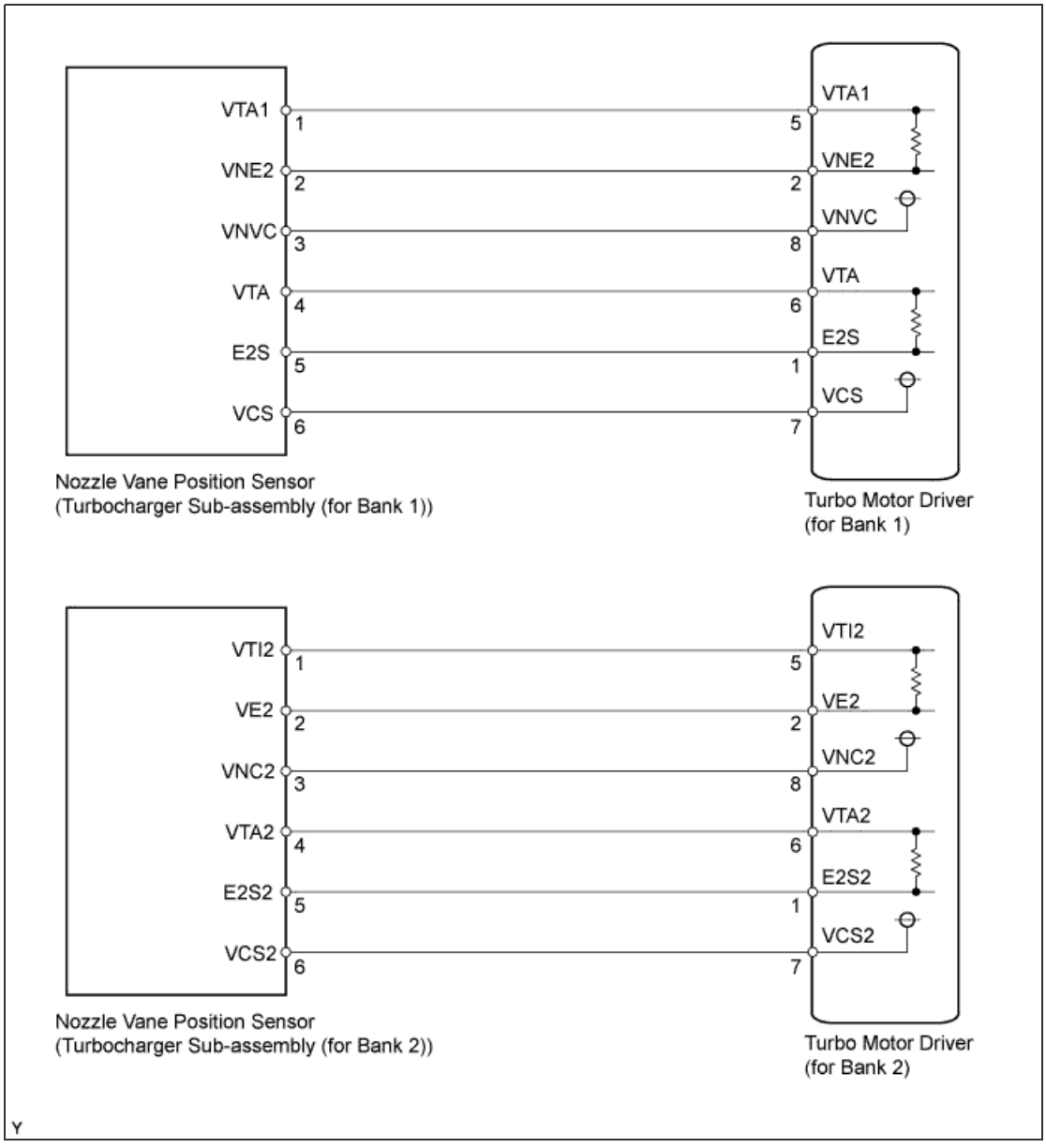
HINT:

If DTC P1258, P1259, P1260, P1262, P1263, P2563, P2564, P2565, P2588 and/or P2589 is stored, the following symptoms may appear:

Stuck open malfunction:

- Lack of power
- Vehicle surge or hesitation under light or medium load
- White smoke

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.INSPECT TURBO MOTOR DRIVER (for Bank 1 and Bank 2)

a. Remove the rear fender splash shield sub-assembly RH.

b. Remove the front fender liner LH.

c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

HINT:

Record the output DTCs.

g. Clear the DTCs (Click here).

h. Turn the ignition switch off.

i. Interchange the connectors for the turbo motor driver of bank 1 and bank 2.

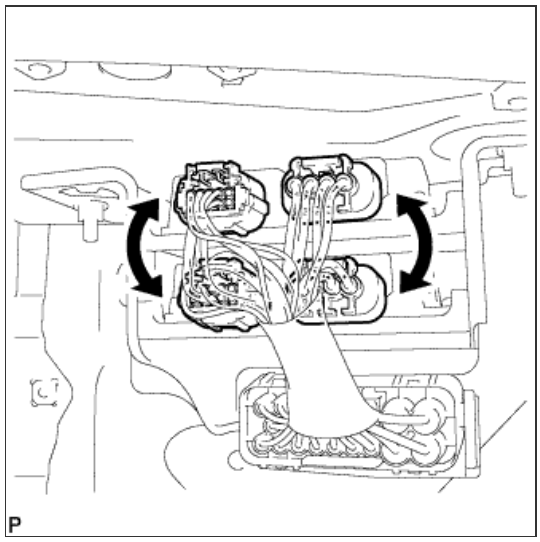
j. Turn the ignition switch to ON for 1 second.

k. Enter the following menus: Powertrain / Engine / DTC.

l. Read the DTCs.

Result:

Display (DTC Output)	Proceed to
DTCs change	B
DTCs do not change	A



B → Go to step 4

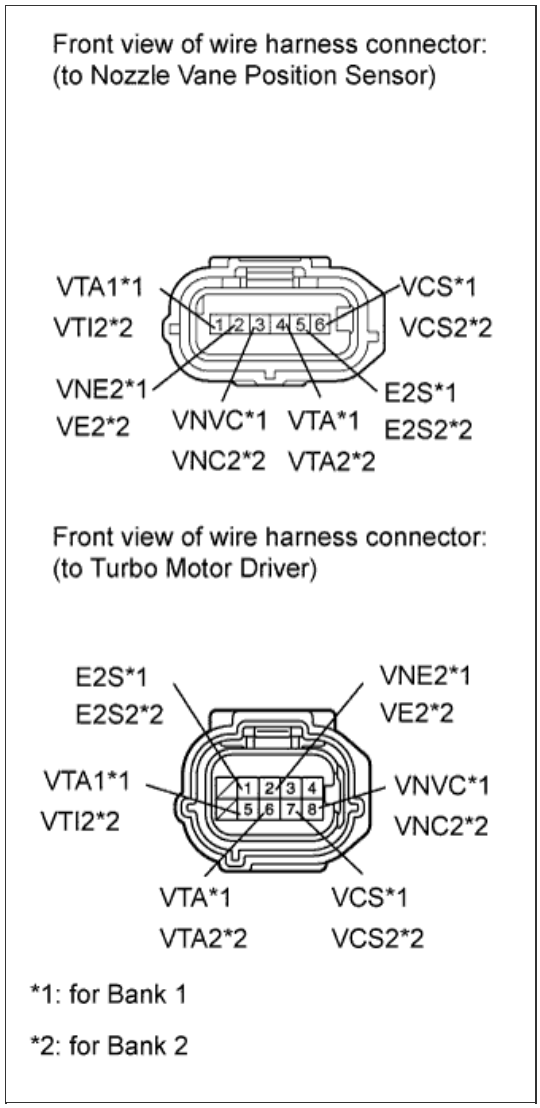
A

2.CHECK HARNESS AND CONNECTOR (TURBO MOTOR DRIVER - NOZZLE VANE POSITION SENSOR)

a. Disconnect the nozzle vane position sensor connector.

b. Disconnect the turbo motor driver connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTA1) - Nozzle vane position sensor connector-1 (VTA1)	Always	Below 1 Ω
Turbo motor driver connector-2 (VNE2) - Nozzle vane position sensor connector-2 (VNE2)	Always	Below 1 Ω
Turbo motor driver connector-8 (VNVC) - Nozzle vane position sensor connector-3 (VNVC)	Always	Below 1 Ω
Turbo motor driver connector-6 (VTA) - Nozzle vane position sensor connector-4 (VTA)	Always	Below 1 Ω
Turbo motor driver connector-1 (E2S) - Nozzle vane position sensor connector-5 (E2S)	Always	Below 1 Ω
Turbo motor driver connector-7 (VCS) - Nozzle vane position sensor connector-6 (VCS)	Always	Below 1 Ω

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTI2) - Nozzle vane position sensor connector-1 (VTI2)	Always	Below 1 Ω
Turbo motor driver connector-2 (VE2) - Nozzle vane position sensor	Always	Below 1 Ω

connector-2 (VE2)		
Turbo motor driver connector-8 (VNC2) - Nozzle vane position sensor connector-3 (VNC2)	Always	Below 1 Ω
Turbo motor driver connector-6 (VTA2) - Nozzle vane position sensor connector-4 (VTA2)	Always	Below 1 Ω
Turbo motor driver connector-1 (E2S2) - Nozzle vane position sensor connector-5 (E2S2)	Always	Below 1 Ω
Turbo motor driver connector-7 (VCS2) - Nozzle vane position sensor connector-6 (VCS2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTA1) or Nozzle vane position sensor connector-1 (VTA1) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-2 (VNE2) or Nozzle vane position sensor connector-2 (VNE2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-8 (VNVC) or Nozzle vane position sensor connector-3 (VNVC) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-6 (VTA) or Nozzle vane position sensor connector-4 (VTA) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-1 (E2S) or Nozzle vane position sensor connector-5 (E2S) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-7 (VCS) or Nozzle vane position sensor connector-6 (VCS) - Body ground	Always	10 kΩ or higher

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTI2) or Nozzle vane position sensor connector-1 (VTI2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-2 (VE2) or Nozzle vane position sensor connector-2 (VE2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-8 (VNC2) or Nozzle vane position sensor connector-3 (VNC2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-6 (VTA2) or Nozzle vane position sensor connector-4 (VTA2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-1 (E2S2) or Nozzle vane position sensor connector-5 (E2S2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-7 (VCS2) or Nozzle vane position sensor connector-6 (VCS2) - Body ground	Always	10 kΩ or higher

NG → Go to step 5

OK

3.REPLACE TURBOCHARGER SUB-ASSEMBLY (for Bank 1 or Bank 2) (NOZZLE VANE POSITION SENSOR)

a. Replace the turbocharger sub-assembly (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 6

4.REPLACE TURBO MOTOR DRIVER (for Bank 1 or Bank 2)

a. Replace the turbo motor driver (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 6

5.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

6.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch off and leave the vehicle for 15 seconds.

e. Turn the ignition switch to ON for 1 second.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P1258, P1259, P1260, P1262, P1263, P2563, P2564, P2565, P2588 and/or P2589.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, idle the engine.

NEXT

END

DTC P0110 Intake Air Temperature Circuit

DTC P0112 Intake Air Temperature Circuit Low Input

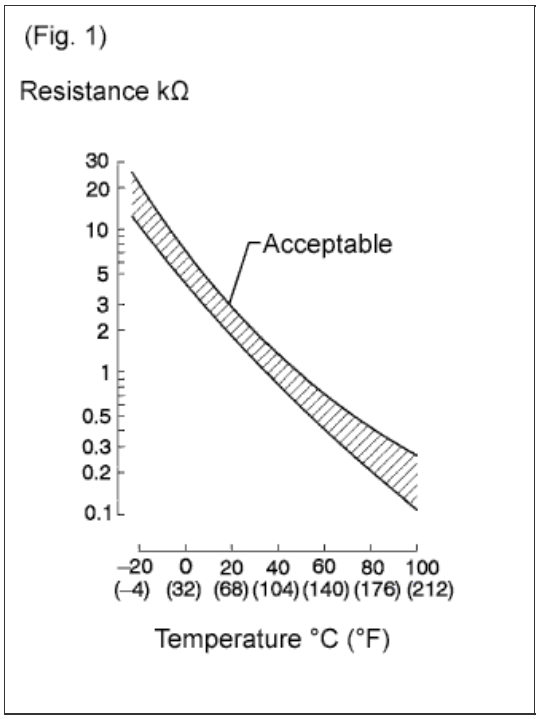
DTC P0113 Intake Air Temperature Circuit High Input

for Preparation Click here

DESCRIPTION

The intake air temperature sensor is built into the Mass Air Flow (MAF) meter and senses the intake air temperature.
A thermistor built into the sensor changes its resistance value according to the intake air temperature.
The lower the intake air temperature, the greater the thermistor resistance value. The higher the intake air temperature, the lower the thermistor resistance value (See Fig. 1).
The intake air temperature sensor is connected to the ECM.
The 5 V power source voltage in the ECM is applied to the intake air temperature sensor from terminal THA via resistor R.
Resistor R and the intake air temperature sensor are connected in series. When the resistance value of the intake air temperature sensor changes in accordance with changes in the intake air temperature, the potential at terminal THA also changes. Based on this signal, the ECM increases the fuel injection volume to improve driveability with a cold engine.

(Fig. 1)



P0110

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Open or short in the intake air temperature (IAT) sensor for 0.5 seconds (1 trip detection logic).	• Open or short in intake air temperature (IAT) sensor circuit • IAT sensor (built into mass air flow meter) • ECM

P0112

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Short in the IAT sensor for 0.5 seconds (1 trip detection logic).	• Short in IAT sensor circuit • IAT sensor (built into mass air flow meter) • ECM

P0113

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Open in the IAT sensor for 0.5 seconds (1 trip detection logic).	• Open in IAT sensor circuit • IAT sensor (built into mass air flow meter)

		• ECM

Related Data List

DTC No.	Data List
P0110	Intake Air
P0112	
P0113	

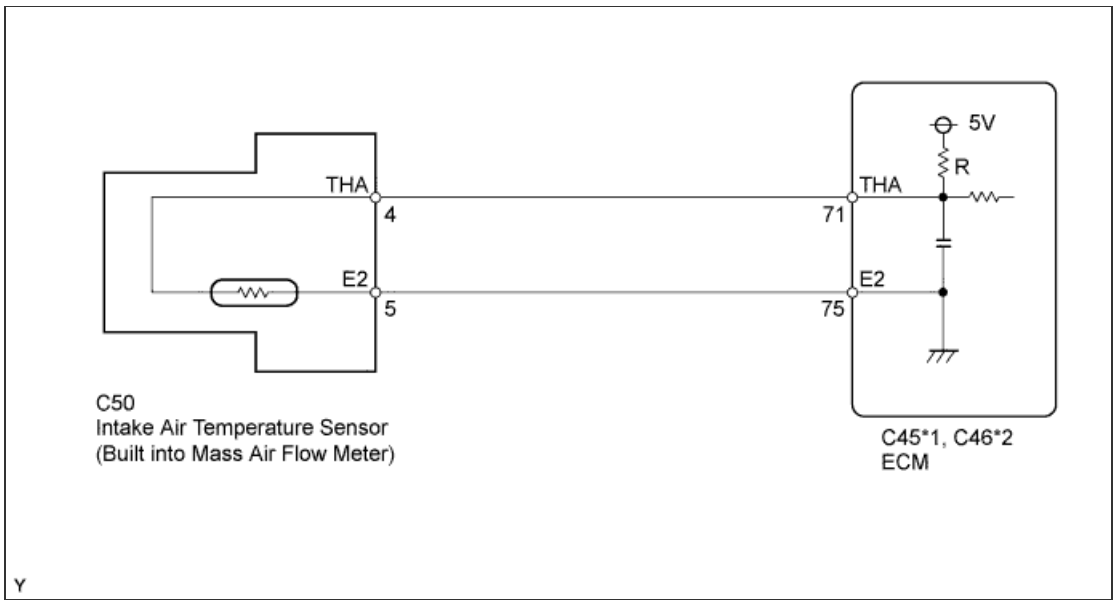
HINT:

- **If DTC P0110, P0112 and/or P0113 is stored, the following symptoms may appear:**
  - **Misfire**
  - **Combustion noise**
  - **Black smoke**
  - **White smoke**
  - **Lack of power**
- **When DTC P0110, P0112 or P0113 is stored, check the intake air temperature by entering the following menus: Powertrain / Engine / Data List / Intake Air.**

Reference

Temperature Displayed	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- **If DTCs relating to different systems are stored, and they share terminal E2 as their ground, check this ground circuit first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (INTAKE AIR TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Intake Air.

d. Read the value.

OK:
Same as actual intake air temperature.

Result

Result	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
OK (same as actual intake air temperature)	C

HINT:

- **If there is an open circuit, the tester indicates -40°C (-40°F).**
- **If there is a short circuit, the tester indicates 140°C (284°F) or more.**

B	Go to step 4
C	Go to step 11

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the mass air flow meter connector.

b. Connect terminals 4 (THA) and 5 (E2) of the mass air flow meter wire harness side connector.

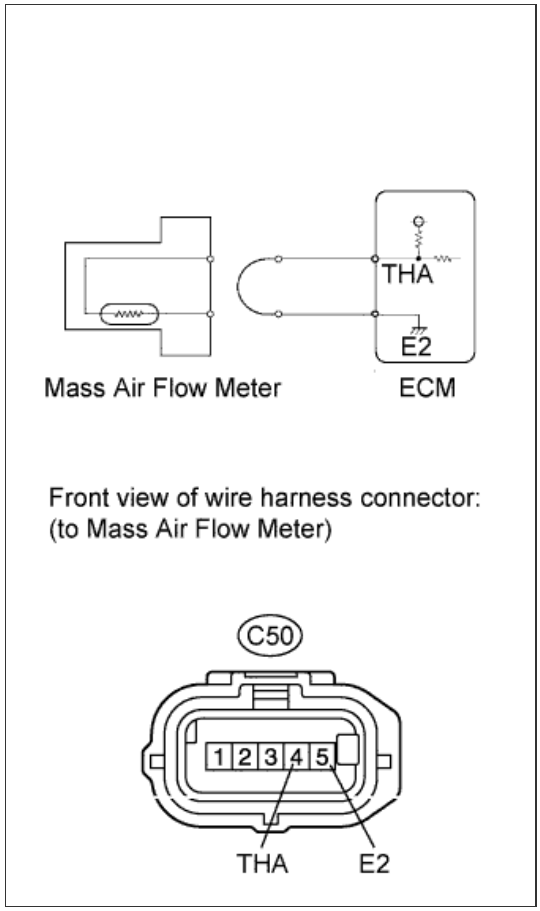
c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / Data List / Intake Air.

f. Read the value.

OK:
140°C (284°F) or higher



OK	Go to step 7
NG	Go to step 3

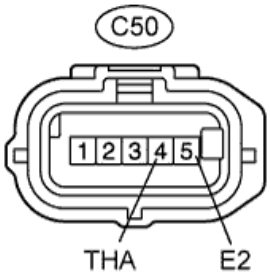
3.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the mass air flow meter connector.

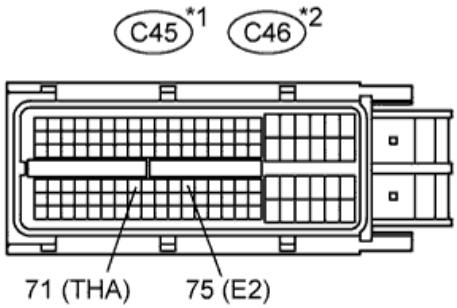
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Mass Air Flow Meter)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C50-4 (THA) - C45-71 (THA)	Always	Below 1 Ω
C50-5 (E2) - C45-75 (E2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C50-4 (THA) - C46-71 (THA)	Always	Below 1 Ω
C50-5 (E2) - C46-75 (E2)	Always	Below 1 Ω

OK	Go to step 9
NG	Go to step 8

4.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the mass air flow meter connector.

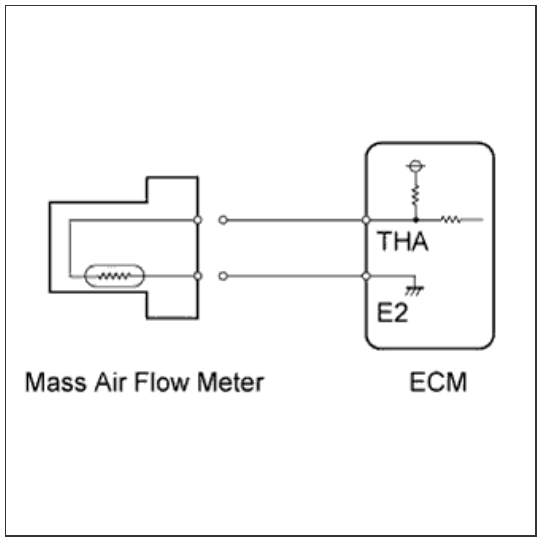
b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON and turn the tester on.

d. Enter the following menus: Powertrain / Engine / Data List / Intake Air.

e. Read the value.

OK:
-40°C (-40°F)



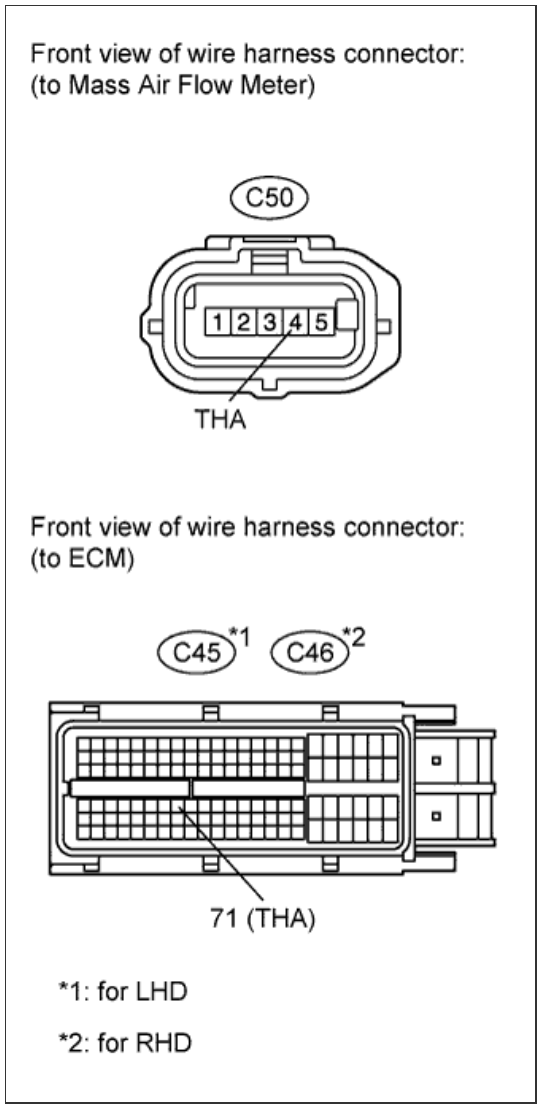
OK	Go to step 10
NG	Go to step 5

5.CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

a. Disconnect the mass air flow meter connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Short):

for LHD

		Specified

Tester Connection	Condition	Condition
C50-4 (THA) or C45-71 (THA) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C50-4 (THA) or C46-71 (THA) - Body ground	Always	10 kΩ or higher

NG → Go to step 8

OK

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

7.CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE MASS AIR FLOW METER

a. Replace the mass air flow meter (Click here).

NEXT → Go to step 11

8.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT → Go to step 11

9.CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

10.REPLACE MASS AIR FLOW METER

a. Replace the mass air flow meter (Click here).

NEXT

11.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 1 second.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

```
END
```

DTC P1258 VNT Position Sensor Range/Performance Bank 2 Sensor 1

DTC P1259 VNT Position Sensor Low Bank 2 Sensor 1

DTC P1260 VNT Position Sensor High Bank 2 Sensor 1

DTC P1262 VNT Position Sensor Low Bank 2 Sensor 2

DTC P1263 VNT Position Sensor High Bank 2 Sensor 2

DTC P2563 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit Range/Performance

DTC P2564 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit Low

DTC P2565 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit High

DTC P2588 Turbocharger/Supercharger Boost Control Position Sensor "B" Circuit Low

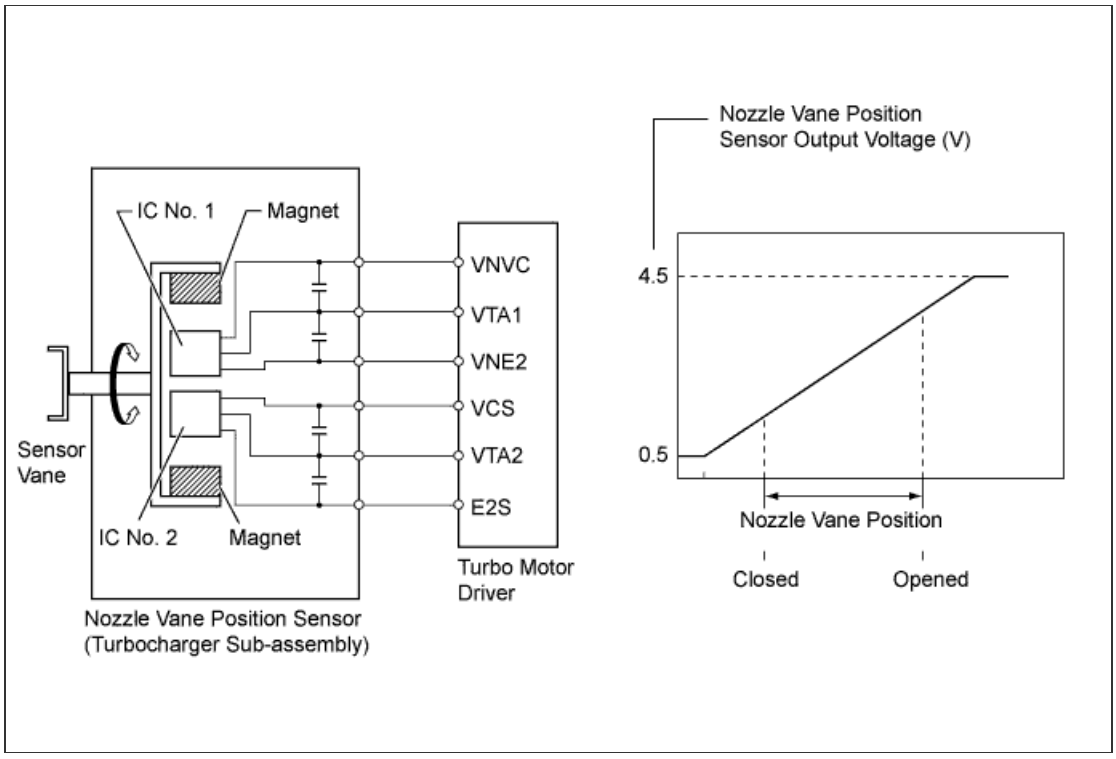
DTC P2589 Turbocharger/Supercharger Boost Control Position Sensor "B" Circuit High

for Preparation Click here

DESCRIPTION

The variable nozzle vane type turbocharger consists primarily of a compressor wheel, turbine wheel, nozzle vane, unison ring, DC motor and nozzle vane position sensor.

The nozzle vane position sensor consists of a Hall IC and a magnetic yoke that rotates in unison with the movement of the linkage that actuates the nozzle vane. The nozzle vane position sensor converts the changes in the magnetic flux that are caused by the rotation of the DC motor (hence, the rotation of the magnetic yoke) into electric signals, and outputs them to the turbo motor driver. The turbo motor driver determines the actual nozzle vane position from the electric signals in order to calculate the target nozzle vane position.



P1258

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	The difference between VTI2 and VTA2 voltage is 0.8 V or more for 0.5 seconds (1 trip detection logic).	Nozzle vane position sensor (turbocharger sub-assembly)

P1259

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area

Ignition switch ON for 1 second	VTI2 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1260

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTI2 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1262

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA2 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1263

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA2 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2563

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	The difference between VTA1 and VTA voltage is 0.8 V or more for 0.5 seconds (1 trip detection logic).	Nozzle vane position sensor (turbocharger sub-assembly)

P2564

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA1 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2565

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA1 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2588

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
		• Nozzle vane position sensor (turbocharger sub-assembly)

Ignition switch ON for 1 second	VTA voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2589

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

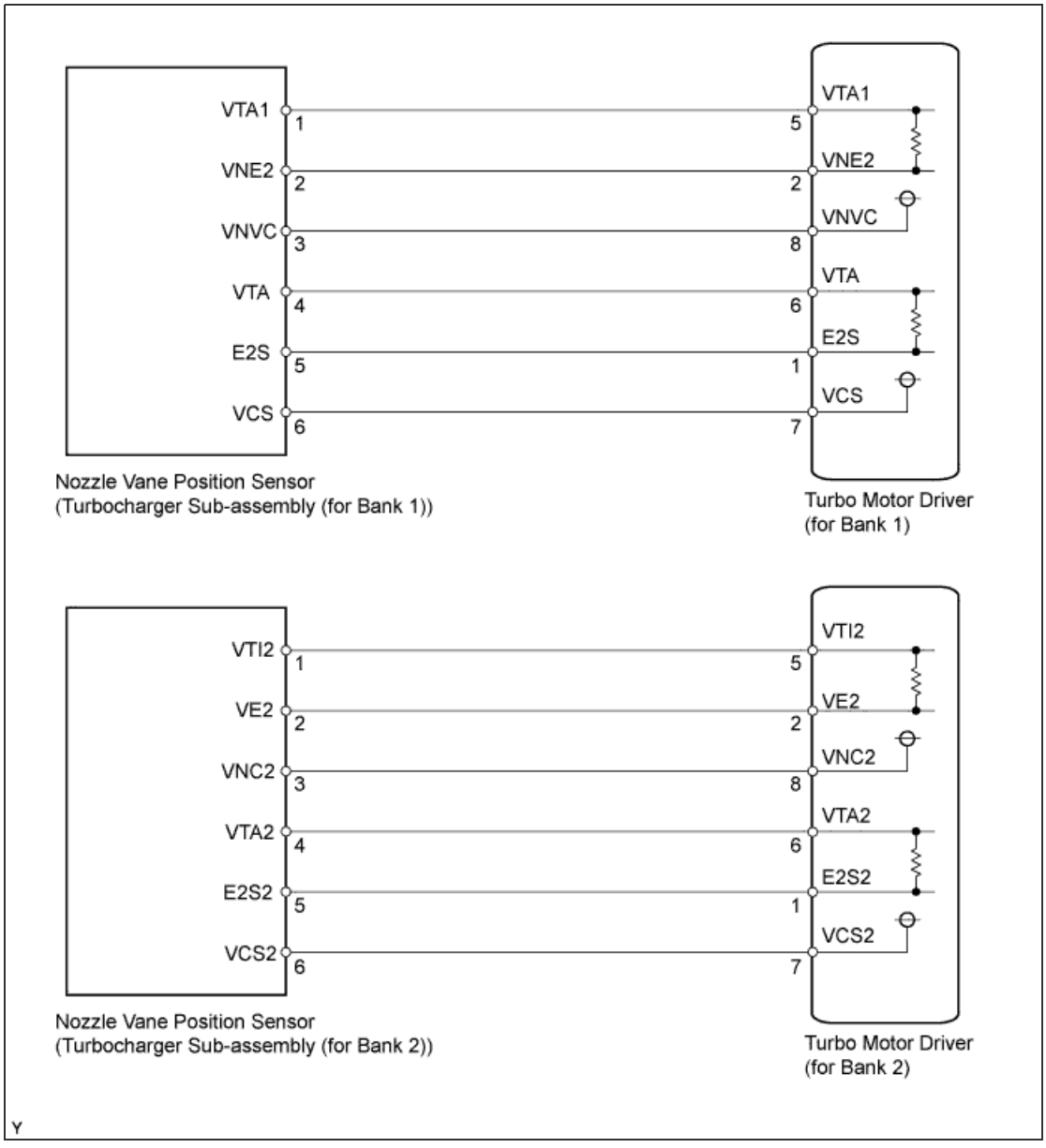
HINT:

If DTC P1258, P1259, P1260, P1262, P1263, P2563, P2564, P2565, P2588 and/or P2589 is stored, the following symptoms may appear:

Stuck open malfunction:

- Lack of power
- Vehicle surge or hesitation under light or medium load
- White smoke

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.INSPECT TURBO MOTOR DRIVER (for Bank 1 and Bank 2)

a. Remove the rear fender splash shield sub-assembly RH.

b. Remove the front fender liner LH.

c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

HINT:

Record the output DTCs.

g. Clear the DTCs (Click here).

h. Turn the ignition switch off.

i. Interchange the connectors for the turbo motor driver of bank 1 and bank 2.

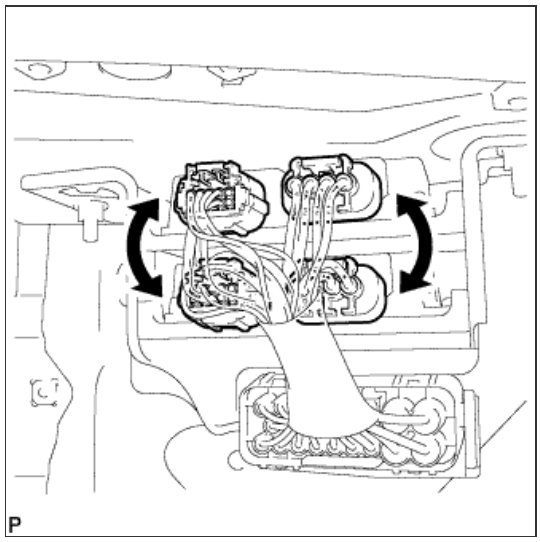
j. Turn the ignition switch to ON for 1 second.

k. Enter the following menus: Powertrain / Engine / DTC.

l. Read the DTCs.

Result:

Display (DTC Output)	Proceed to
DTCs change	B
DTCs do not change	A



B → Go to step 4

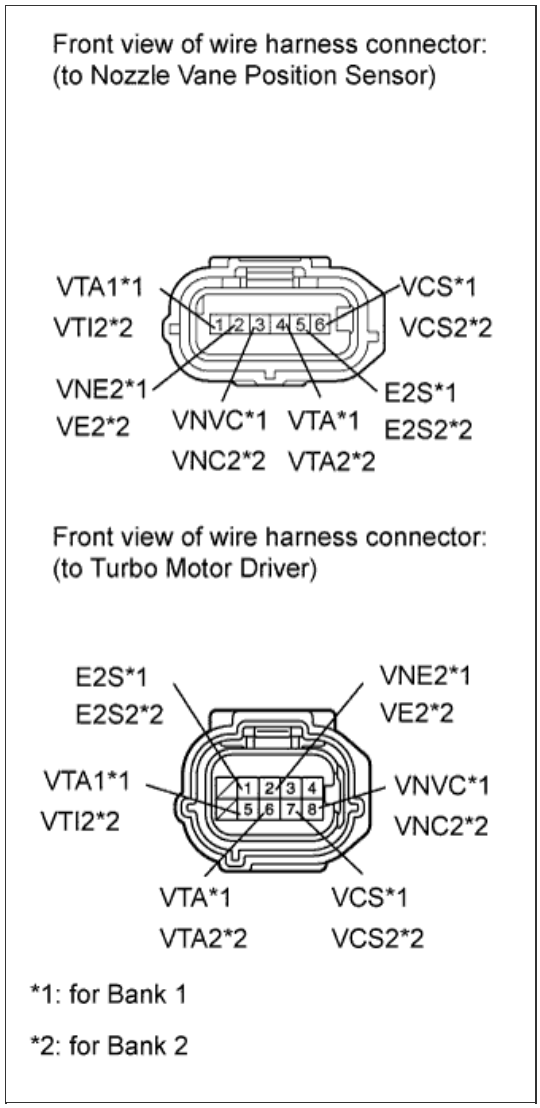
A

2.CHECK HARNESS AND CONNECTOR (TURBO MOTOR DRIVER - NOZZLE VANE POSITION SENSOR)

a. Disconnect the nozzle vane position sensor connector.

b. Disconnect the turbo motor driver connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTA1) - Nozzle vane position sensor connector-1 (VTA1)	Always	Below 1 Ω
Turbo motor driver connector-2 (VNE2) - Nozzle vane position sensor connector-2 (VNE2)	Always	Below 1 Ω
Turbo motor driver connector-8 (VNVC) - Nozzle vane position sensor connector-3 (VNVC)	Always	Below 1 Ω
Turbo motor driver connector-6 (VTA) - Nozzle vane position sensor connector-4 (VTA)	Always	Below 1 Ω
Turbo motor driver connector-1 (E2S) - Nozzle vane position sensor connector-5 (E2S)	Always	Below 1 Ω
Turbo motor driver connector-7 (VCS) - Nozzle vane position sensor connector-6 (VCS)	Always	Below 1 Ω

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTI2) - Nozzle vane position sensor connector-1 (VTI2)	Always	Below 1 Ω
Turbo motor driver connector-2 (VE2) - Nozzle vane position sensor	Always	Below 1 Ω

connector-2 (VE2)		
Turbo motor driver connector-8 (VNC2) - Nozzle vane position sensor connector-3 (VNC2)	Always	Below 1 Ω
Turbo motor driver connector-6 (VTA2) - Nozzle vane position sensor connector-4 (VTA2)	Always	Below 1 Ω
Turbo motor driver connector-1 (E2S2) - Nozzle vane position sensor connector-5 (E2S2)	Always	Below 1 Ω
Turbo motor driver connector-7 (VCS2) - Nozzle vane position sensor connector-6 (VCS2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTA1) or Nozzle vane position sensor connector-1 (VTA1) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-2 (VNE2) or Nozzle vane position sensor connector-2 (VNE2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-8 (VNVC) or Nozzle vane position sensor connector-3 (VNVC) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-6 (VTA) or Nozzle vane position sensor connector-4 (VTA) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-1 (E2S) or Nozzle vane position sensor connector-5 (E2S) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-7 (VCS) or Nozzle vane position sensor connector-6 (VCS) - Body ground	Always	10 kΩ or higher

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTI2) or Nozzle vane position sensor connector-1 (VTI2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-2 (VE2) or Nozzle vane position sensor connector-2 (VE2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-8 (VNC2) or Nozzle vane position sensor connector-3 (VNC2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-6 (VTA2) or Nozzle vane position sensor connector-4 (VTA2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-1 (E2S2) or Nozzle vane position sensor connector-5 (E2S2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-7 (VCS2) or Nozzle vane position sensor connector-6 (VCS2) - Body ground	Always	10 kΩ or higher

NG → Go to step 5

OK

3.REPLACE TURBOCHARGER SUB-ASSEMBLY (for Bank 1 or Bank 2) (NOZZLE VANE POSITION SENSOR)

a. Replace the turbocharger sub-assembly (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 6

4.REPLACE TURBO MOTOR DRIVER (for Bank 1 or Bank 2)

a. Replace the turbo motor driver (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 6

5.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

6.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch off and leave the vehicle for 15 seconds.

e. Turn the ignition switch to ON for 1 second.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P1258, P1259, P1260, P1262, P1263, P2563, P2564, P2565, P2588 and/or P2589.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, idle the engine.

NEXT

END

DTC P0115 Engine Coolant Temperature Circuit

DTC P0117 Engine Coolant Temperature Circuit Low Input

DTC P0118 Engine Coolant Temperature Circuit High Input

for Preparation Click here

DESCRIPTION

A thermistor is built into the Engine Coolant Temperature (ECT) sensor and it changes its resistance value according to the engine coolant temperature. The structure of the sensor and connection to the ECM is the same as the intake air temperature sensor.

HINT:

If DTC P0115, P0117 or P0118 is stored, the ECM operates the fail-safe function in which the ECT is assumed to be 80 C (176).

P0115

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Open or short in the engine coolant temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in engine coolant temperature (ECT) sensor circuit • ECT sensor • ECM

P0117

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Short in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in ECT sensor circuit • ECT sensor • ECM

P0118

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Open in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in ECT sensor circuit • ECT sensor • ECM

Related Data List

DTC No.	Data List
P0115	Coolant Temp
P0117	
P0118	

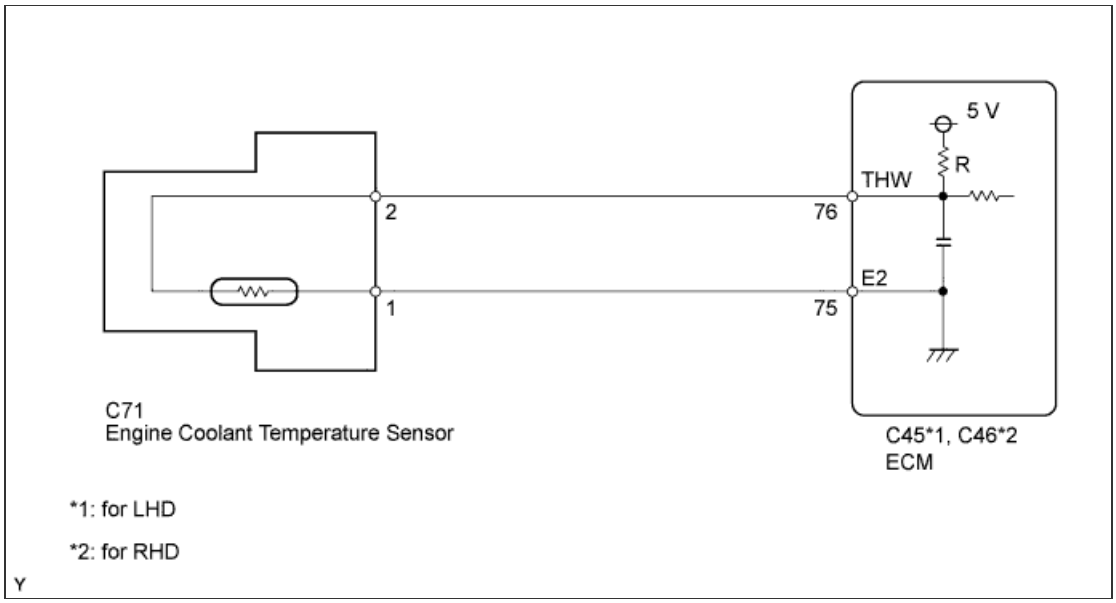
HINT:

- **If DTC P0115, P0117and/or P0118 is stored, the following symptoms may appear:**
  - **Misfire**
  - **Combustion noise**
  - **Black smoke**
  - **White smoke**
  - **Lack of power**
- **When DTC P0115, P0117 and/or P0118 is stored, check the engine coolant temperature by entering the following menus: Powertrain / Engine / Data List / Coolant Temp.**

Reference:

Temperature Displa ed	Malfunction
-40 C (-40)	Open circuit
140 C (284) or higher	Short circuit

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- **If DTCs relating to different systems are stored, and they share terminal E2 as their ground, check this ground circuit first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (ENGINE COOLANT TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Coolant Temp.

d. Read the value.

OK:

75 to 90°C (167 to 194°F) with warm engine.

Result

Result	Proceed to
-40 C (-40)	A
140 C (284) or higher	B
75 to 90 C (167 to 194)	C

HINT:

- **If there is an open circuit, the tester indicates -40°C (-40°F).**
- **If there is a short circuit, the tester indicates 140°C (284°F) or more.**

B	Go to step 4
C	Go to step 11

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the engine coolant temperature (ECT) sensor connector.

a. Disconnect the engine coolant temperature (ECT) sensor connector.

b. Connect terminals 1 and 2 of the ECT sensor wire harness side connector.

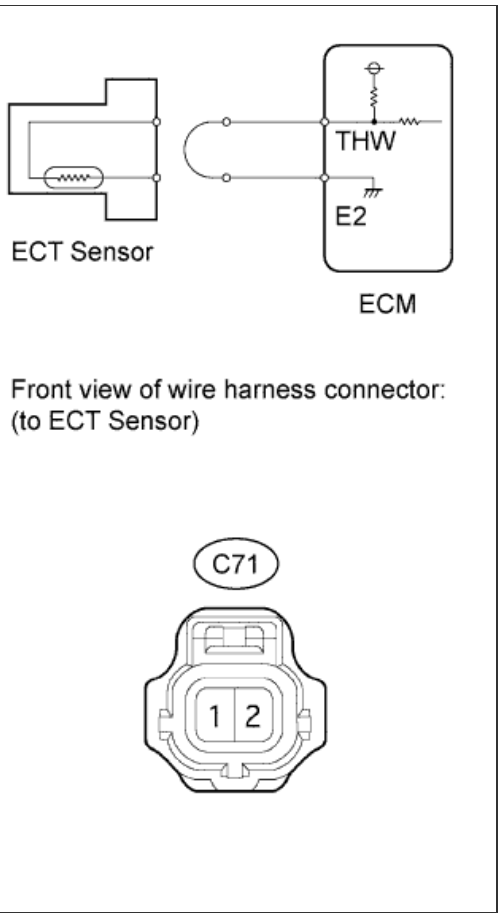
c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / Data List / Coolant Temp.

f. Read the value.

OK:
140°C (284°F) or higher



OK	Go to step 7
NG	Go to step 3

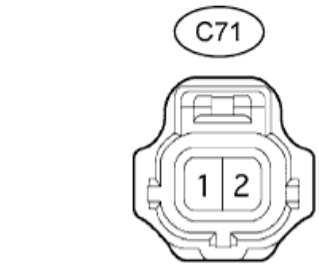
3.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the ECT sensor connector.

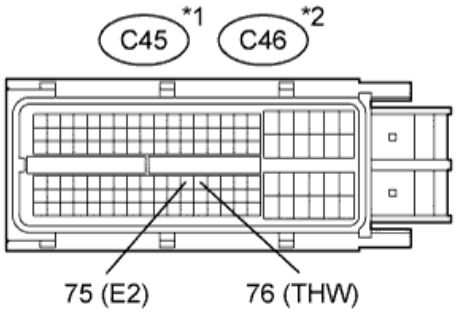
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to ECT Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C71-2 - C45-76 (THW)	Alwa s	Below 1 Ω
C71-1 - C45-75 (E2)	Alwa s	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C71-2 - C46-76 (THW)	Alwa s	Below 1 Ω
C71-1 - C46-75 (E2)	Alwa s	Below 1 Ω

OK	Go to step 9
NG	Go to step 8

4.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the ECT sensor connector.

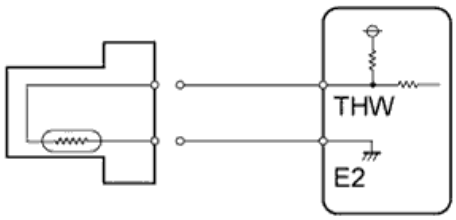
b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON and turn the tester on.

d. Enter the following menus: Powertrain / Engine / Data List / Coolant Temp.

e. Read the value.

OK:
-40°C (-40°F)



OK	Go to step 10
NG	Go to step 5

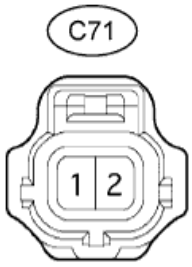
5.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the ECT sensor connector.

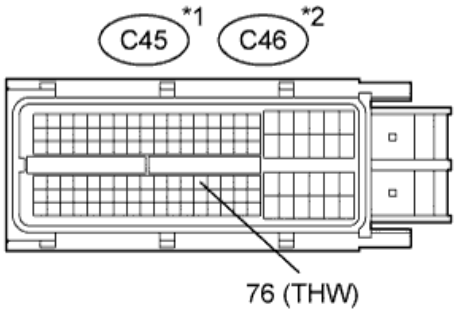
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to ECT Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Short):

for LHD

		Specified

Tester Connection	Condition	Condition
C71-2 or C45-76 (THW) - Bod ground	Alwa s	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C71-2 or C46-76 (THW) - Bod ground	Alwa s	10 kΩ or higher

NG → Go to step 8

OK

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

7.CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE ENGINE COOLANT TEMPERATURE SENSOR

a. Replace the engine coolant temperature sensor (Click here).

NEXT → Go to step 11

8.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT → Go to step 11

9.CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

10.REPLACE ENGINE COOLANT TEMPERATURE SENSOR

a. Replace the engine coolant temperature sensor (Click here).

NEXT

11.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 1 second.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

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END
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DTC P1258 VNT Position Sensor Range/Performance Bank 2 Sensor 1

DTC P1259 VNT Position Sensor Low Bank 2 Sensor 1

DTC P1260 VNT Position Sensor High Bank 2 Sensor 1

DTC P1262 VNT Position Sensor Low Bank 2 Sensor 2

DTC P1263 VNT Position Sensor High Bank 2 Sensor 2

DTC P2563 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit Range/Performance

DTC P2564 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit Low

DTC P2565 Turbocharger/Supercharger Boost Control Position Sensor "A" Circuit High

DTC P2588 Turbocharger/Supercharger Boost Control Position Sensor "B" Circuit Low

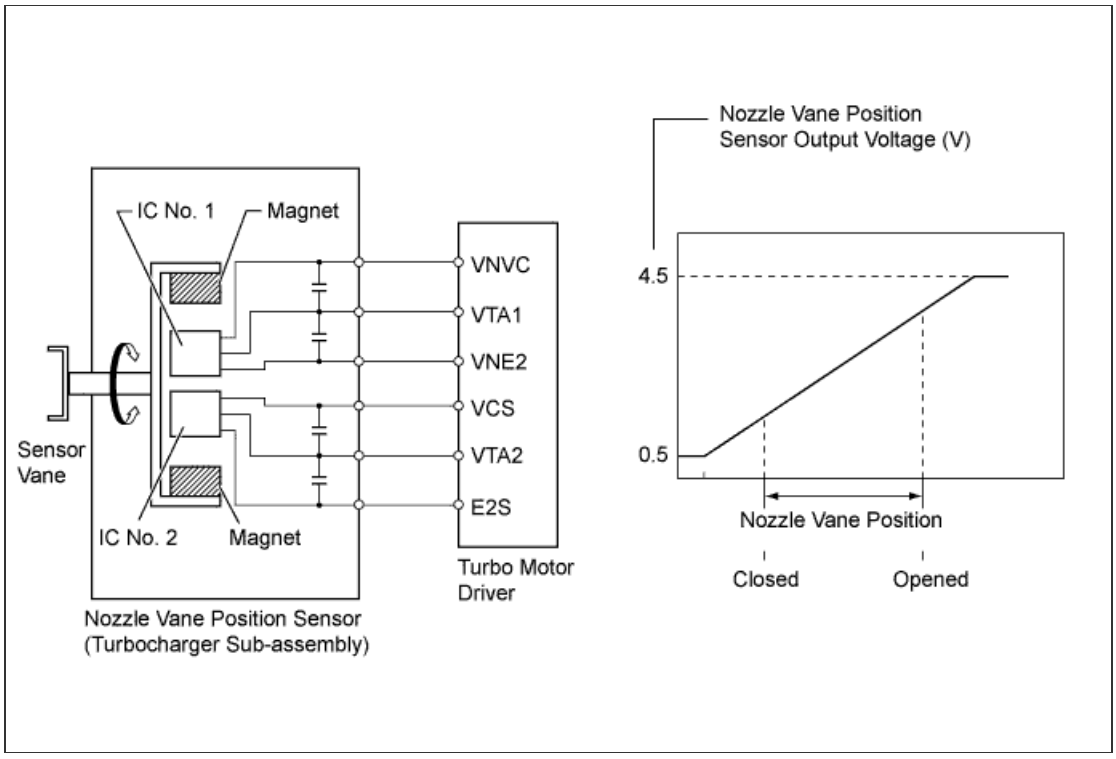
DTC P2589 Turbocharger/Supercharger Boost Control Position Sensor "B" Circuit High

for Preparation Click here

DESCRIPTION

The variable nozzle vane type turbocharger consists primarily of a compressor wheel, turbine wheel, nozzle vane, unison ring, DC motor and nozzle vane position sensor.

The nozzle vane position sensor consists of a Hall IC and a magnetic yoke that rotates in unison with the movement of the linkage that actuates the nozzle vane. The nozzle vane position sensor converts the changes in the magnetic flux that are caused by the rotation of the DC motor (hence, the rotation of the magnetic yoke) into electric signals, and outputs them to the turbo motor driver. The turbo motor driver determines the actual nozzle vane position from the electric signals in order to calculate the target nozzle vane position.



P1258

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	The difference between VTI2 and VTA2 voltage is 0.8 V or more for 0.5 seconds (1 trip detection logic).	Nozzle vane position sensor (turbocharger sub-assembly)

P1259

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area

Ignition switch ON for 1 second	VTI2 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1260

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTI2 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1262

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA2 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P1263

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA2 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2563

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	The difference between VTA1 and VTA voltage is 0.8 V or more for 0.5 seconds (1 trip detection logic).	Nozzle vane position sensor (turbocharger sub-assembly)

P2564

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA1 voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2565

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA1 voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2588

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
		• Nozzle vane position sensor (turbocharger sub-assembly)

Ignition switch ON for 1 second	VTA voltage is 0.5 V or less for 0.5 seconds (1 trip detection logic).	• Open or short in nozzle vane position sensor circuit • Turbo motor driver

P2589

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	VTA voltage is 4.5 V or more for 0.5 seconds (1 trip detection logic).	• Nozzle vane position sensor (turbocharger sub-assembly) • Open or short in nozzle vane position sensor circuit • Turbo motor driver

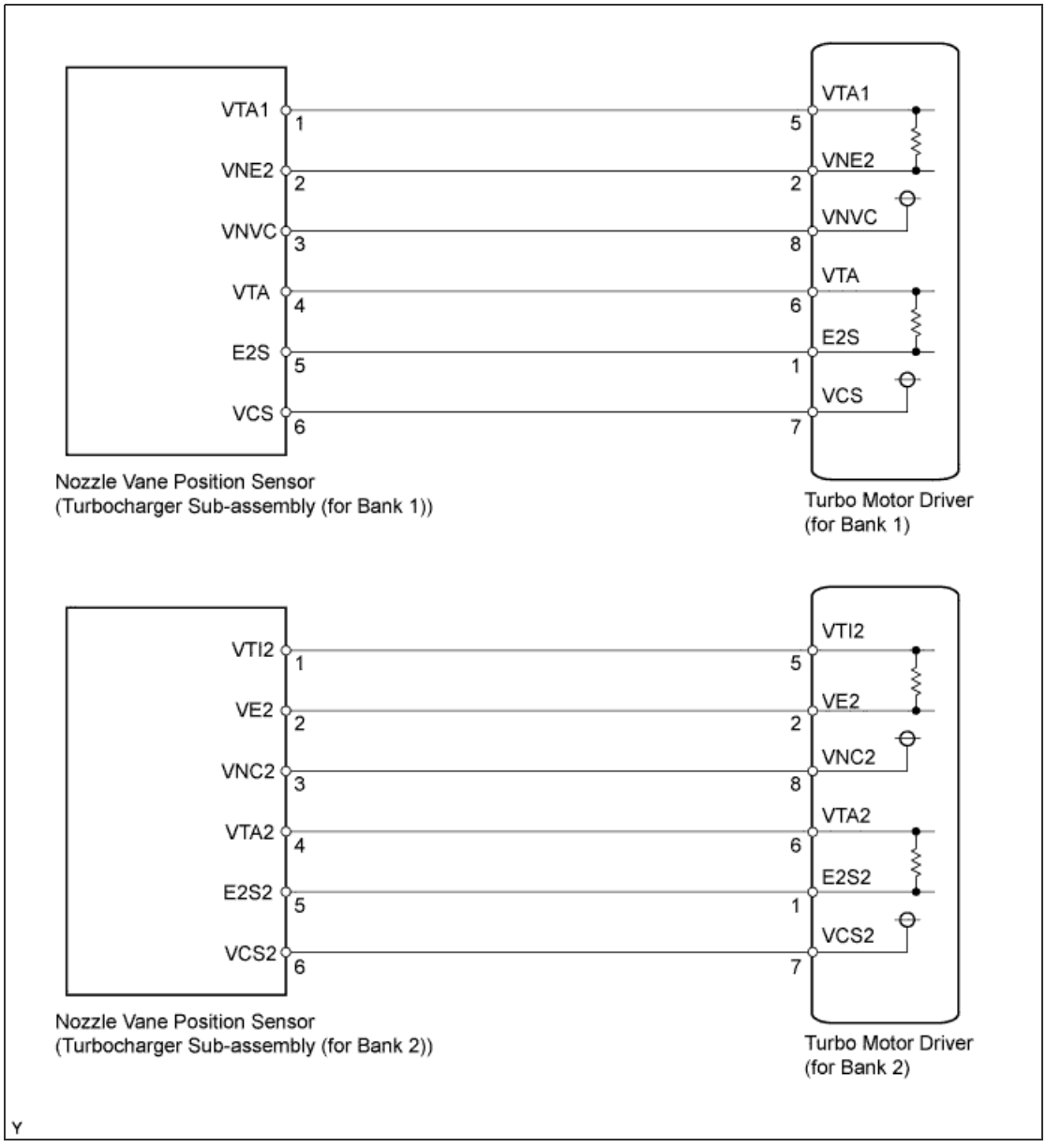
HINT:

If DTC P1258, P1259, P1260, P1262, P1263, P2563, P2564, P2565, P2588 and/or P2589 is stored, the following symptoms may appear:

Stuck open malfunction:

- Lack of power
- Vehicle surge or hesitation under light or medium load
- White smoke

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.INSPECT TURBO MOTOR DRIVER (for Bank 1 and Bank 2)

a. Remove the rear fender splash shield sub-assembly RH.

b. Remove the front fender liner LH.

c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Read the DTCs.

HINT:

Record the output DTCs.

g. Clear the DTCs (Click here).

h. Turn the ignition switch off.

i. Interchange the connectors for the turbo motor driver of bank 1 and bank 2.

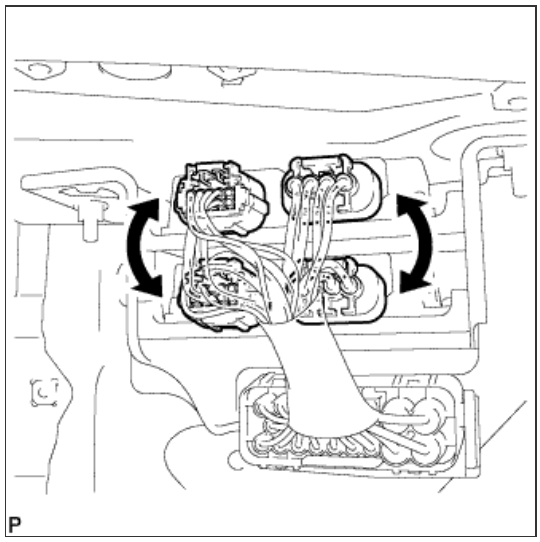
j. Turn the ignition switch to ON for 1 second.

k. Enter the following menus: Powertrain / Engine / DTC.

l. Read the DTCs.

Result:

Display (DTC Output)	Proceed to
DTCs change	B
DTCs do not change	A



B → Go to step 4

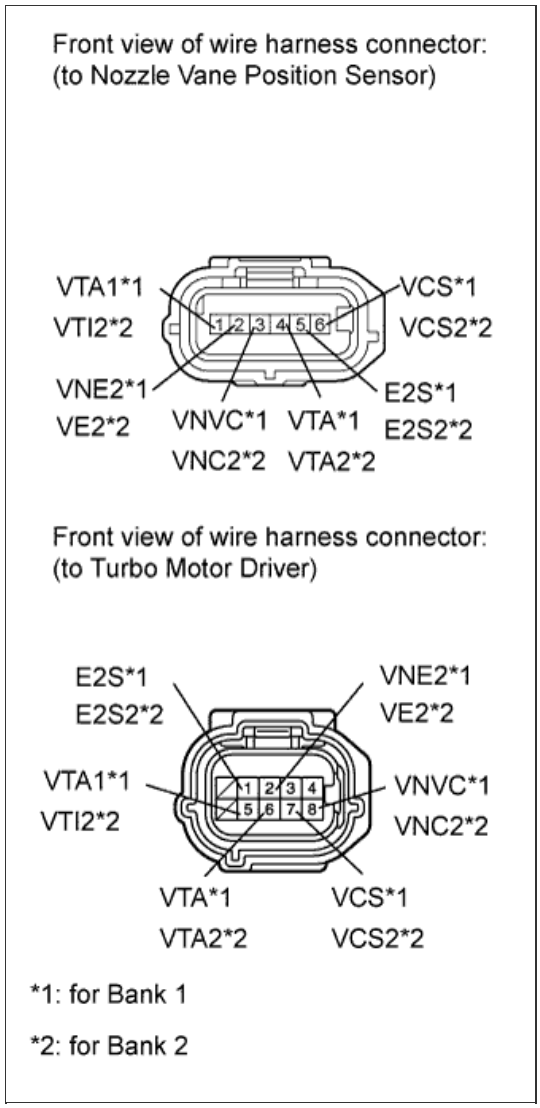
A

2.CHECK HARNESS AND CONNECTOR (TURBO MOTOR DRIVER - NOZZLE VANE POSITION SENSOR)

a. Disconnect the nozzle vane position sensor connector.

b. Disconnect the turbo motor driver connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTA1) - Nozzle vane position sensor connector-1 (VTA1)	Always	Below 1 Ω
Turbo motor driver connector-2 (VNE2) - Nozzle vane position sensor connector-2 (VNE2)	Always	Below 1 Ω
Turbo motor driver connector-8 (VNVC) - Nozzle vane position sensor connector-3 (VNVC)	Always	Below 1 Ω
Turbo motor driver connector-6 (VTA) - Nozzle vane position sensor connector-4 (VTA)	Always	Below 1 Ω
Turbo motor driver connector-1 (E2S) - Nozzle vane position sensor connector-5 (E2S)	Always	Below 1 Ω
Turbo motor driver connector-7 (VCS) - Nozzle vane position sensor connector-6 (VCS)	Always	Below 1 Ω

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTI2) - Nozzle vane position sensor connector-1 (VTI2)	Always	Below 1 Ω
Turbo motor driver connector-2 (VE2) - Nozzle vane position sensor	Always	Below 1 Ω

connector-2 (VE2)		
Turbo motor driver connector-8 (VNC2) - Nozzle vane position sensor connector-3 (VNC2)	Always	Below 1 Ω
Turbo motor driver connector-6 (VTA2) - Nozzle vane position sensor connector-4 (VTA2)	Always	Below 1 Ω
Turbo motor driver connector-1 (E2S2) - Nozzle vane position sensor connector-5 (E2S2)	Always	Below 1 Ω
Turbo motor driver connector-7 (VCS2) - Nozzle vane position sensor connector-6 (VCS2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for Bank 1

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTA1) or Nozzle vane position sensor connector-1 (VTA1) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-2 (VNE2) or Nozzle vane position sensor connector-2 (VNE2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-8 (VNVC) or Nozzle vane position sensor connector-3 (VNVC) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-6 (VTA) or Nozzle vane position sensor connector-4 (VTA) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-1 (E2S) or Nozzle vane position sensor connector-5 (E2S) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-7 (VCS) or Nozzle vane position sensor connector-6 (VCS) - Body ground	Always	10 kΩ or higher

for Bank 2

Tester Connection	Condition	Specified Condition
Turbo motor driver connector-5 (VTI2) or Nozzle vane position sensor connector-1 (VTI2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-2 (VE2) or Nozzle vane position sensor connector-2 (VE2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-8 (VNC2) or Nozzle vane position sensor connector-3 (VNC2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-6 (VTA2) or Nozzle vane position sensor connector-4 (VTA2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-1 (E2S2) or Nozzle vane position sensor connector-5 (E2S2) - Body ground	Always	10 kΩ or higher
Turbo motor driver connector-7 (VCS2) or Nozzle vane position sensor connector-6 (VCS2) - Body ground	Always	10 kΩ or higher

NG → Go to step 5

OK

3.REPLACE TURBOCHARGER SUB-ASSEMBLY (for Bank 1 or Bank 2) (NOZZLE VANE POSITION SENSOR)

a. Replace the turbocharger sub-assembly (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 6

4.REPLACE TURBO MOTOR DRIVER (for Bank 1 or Bank 2)

a. Replace the turbo motor driver (for Bank 1 or Bank 2) (Click here).

NEXT → Go to step 6

5.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

6.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch off and leave the vehicle for 15 seconds.

e. Turn the ignition switch to ON for 1 second.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P1258, P1259, P1260, P1262, P1263, P2563, P2564, P2565, P2588 and/or P2589.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, idle the engine.

NEXT

END

DTC P0115 Engine Coolant Temperature Circuit

DTC P0117 Engine Coolant Temperature Circuit Low Input

DTC P0118 Engine Coolant Temperature Circuit High Input

for Preparation Click here

DESCRIPTION

A thermistor is built into the Engine Coolant Temperature (ECT) sensor and it changes its resistance value according to the engine coolant temperature. The structure of the sensor and connection to the ECM is the same as the intake air temperature sensor.

HINT:

If DTC P0115, P0117 or P0118 is stored, the ECM operates the fail-safe function in which the ECT is assumed to be 80 C (176).

P0115

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Open or short in the engine coolant temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in engine coolant temperature (ECT) sensor circuit • ECT sensor • ECM

P0117

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Short in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in ECT sensor circuit • ECT sensor • ECM

P0118

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Open in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in ECT sensor circuit • ECT sensor • ECM

Related Data List

DTC No.	Data List
P0115	Coolant Temp
P0117	
P0118	

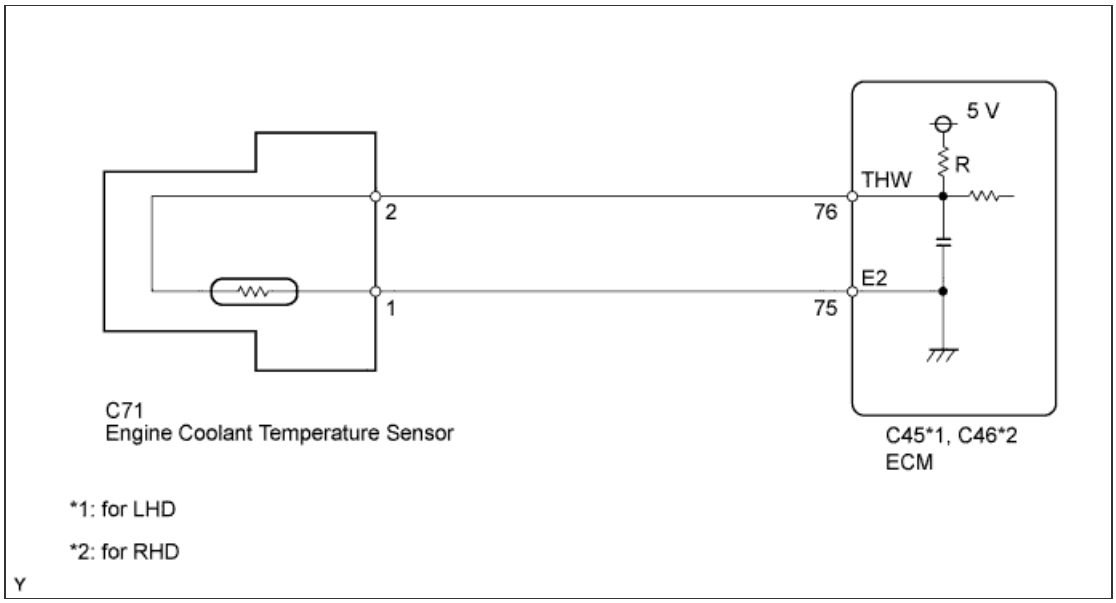
HINT:

- **If DTC P0115, P0117and/or P0118 is stored, the following symptoms may appear:**
  - **Misfire**
  - **Combustion noise**
  - **Black smoke**
  - **White smoke**
  - **Lack of power**
- **When DTC P0115, P0117 and/or P0118 is stored, check the engine coolant temperature by entering the following menus: Powertrain / Engine / Data List / Coolant Temp.**

Reference:

Temperature Displa ed	Malfunction
-40 C (-40)	Open circuit
140 C (284) or higher	Short circuit

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- **If DTCs relating to different systems are stored, and they share terminal E2 as their ground, check this ground circuit first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (ENGINE COOLANT TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Coolant Temp.

d. Read the value.

OK:

75 to 90°C (167 to 194°F) with warm engine.

Result

Result	Proceed to
-40 C (-40)	A
140 C (284) or higher	B
75 to 90 C (167 to 194)	C

HINT:

- **If there is an open circuit, the tester indicates -40°C (-40°F).**
- **If there is a short circuit, the tester indicates 140°C (284°F) or more.**

B	Go to step 4
C	Go to step 11

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the engine coolant temperature (ECT) sensor connector.

a. Disconnect the engine coolant temperature (ECT) sensor connector.

b. Connect terminals 1 and 2 of the ECT sensor wire harness side connector.

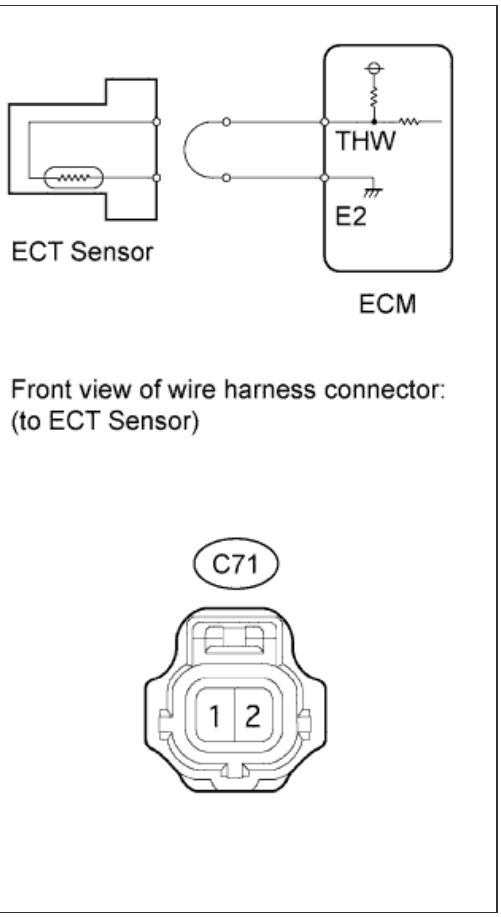
c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / Data List / Coolant Temp.

f. Read the value.

OK:
140°C (284°F) or higher



OK	Go to step 7
NG	Go to step 3

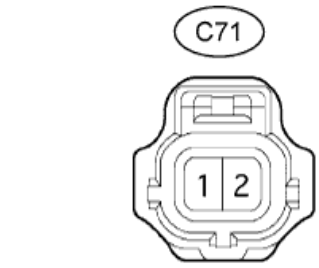
3.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the ECT sensor connector.

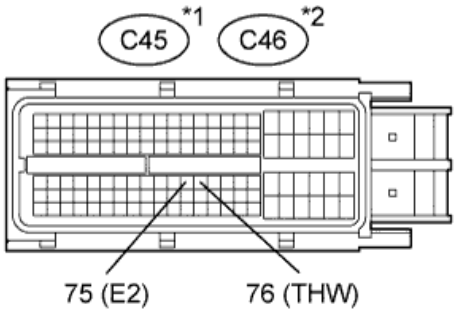
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to ECT Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C71-2 - C45-76 (THW)	Alwa s	Below 1 Ω
C71-1 - C45-75 (E2)	Alwa s	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C71-2 - C46-76 (THW)	Alwa s	Below 1 Ω
C71-1 - C46-75 (E2)	Alwa s	Below 1 Ω

OK	Go to step 9
NG	Go to step 8

4.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the ECT sensor connector.

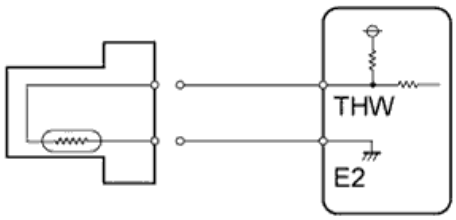
b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON and turn the tester on.

d. Enter the following menus: Powertrain / Engine / Data List / Coolant Temp.

e. Read the value.

OK:
-40°C (-40°F)



OK	Go to step 10
NG	Go to step 5

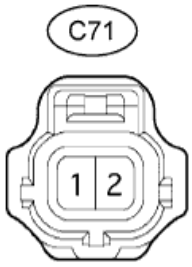
5.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the ECT sensor connector.

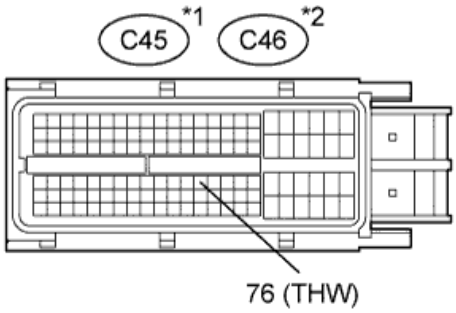
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to ECT Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Short):

for LHD

		Specified

Tester Connection	Condition	Condition
C71-2 or C45-76 (THW) - Bod ground	Alwa s	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C71-2 or C46-76 (THW) - Bod ground	Alwa s	10 kΩ or higher

NG → Go to step 8

OK

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

7.CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE ENGINE COOLANT TEMPERATURE SENSOR

a. Replace the engine coolant temperature sensor (Click here).

NEXT → Go to step 11

8.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT → Go to step 11

9.CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

10.REPLACE ENGINE COOLANT TEMPERATURE SENSOR

a. Replace the engine coolant temperature sensor (Click here).

NEXT

11.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 1 second.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

```
END
```

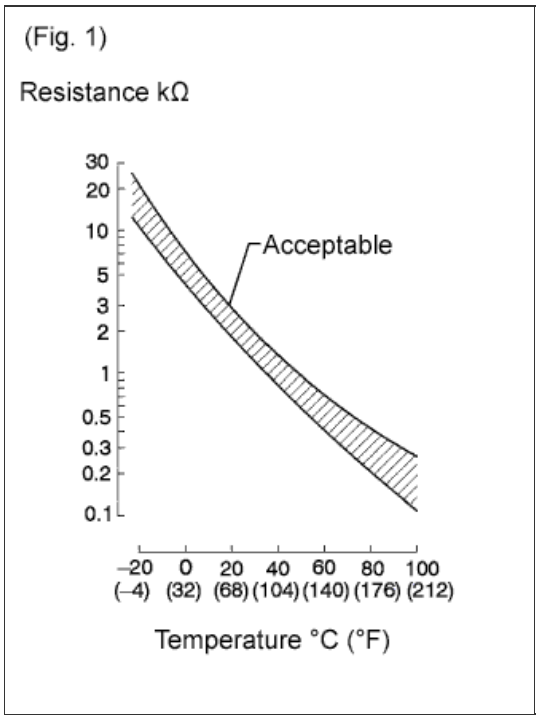
DTC P1495 Intake Air Temperature Sensor 1 Circuit

DTC P1496 Intake Air Temperature Sensor 1 Circuit Low

DTC P1497 Intake Air Temperature Sensor 1 Circuit High

for Preparation Click here

DESCRIPTION



The Intake Air Temperature (IAT) sensor is built into the charge air cooler and senses the IAT. A built-in thermistor in the sensor changes its resistance value according to the intake air temperature. The lower the intake air temperature, the greater the thermistor resistance value. The higher the intake air temperature, the lower the thermistor resistance value (See Fig. 1).
The sensor is connected to the ECM. The 5 V power source voltage in the ECM is applied to the sensor rom terminal THIA via resistor R. Resistor R and the sensor are connected in series. When the resistance value o the sensor changes in accordance with changes in the IAT, the potential at terminal THIA also changes. Based on this signal, the ECM corrects the el injection volume to improve driveability with a cold engine.

P1495

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON or 1 second	Open or short in the intake air temperature (IAT) sensor circuit or 0.5 seconds (1 trip detection logic).	• Open or short in intake air temperature (IAT) sensor circuit • IAT sensor • ECM

P1496

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON or 1 second	Short in the IAT sensor circuit or 0.5 seconds (1 trip detection logic).	• Short in IAT sensor circuit • IAT sensor • ECM

P1497

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON or 1 second	Open in the IAT sensor circuit or 0.5 seconds (1 trip detection logic).	• Open in IAT sensor circuit • IAT sensor • ECM

Related Data List

DTC No.	Data List

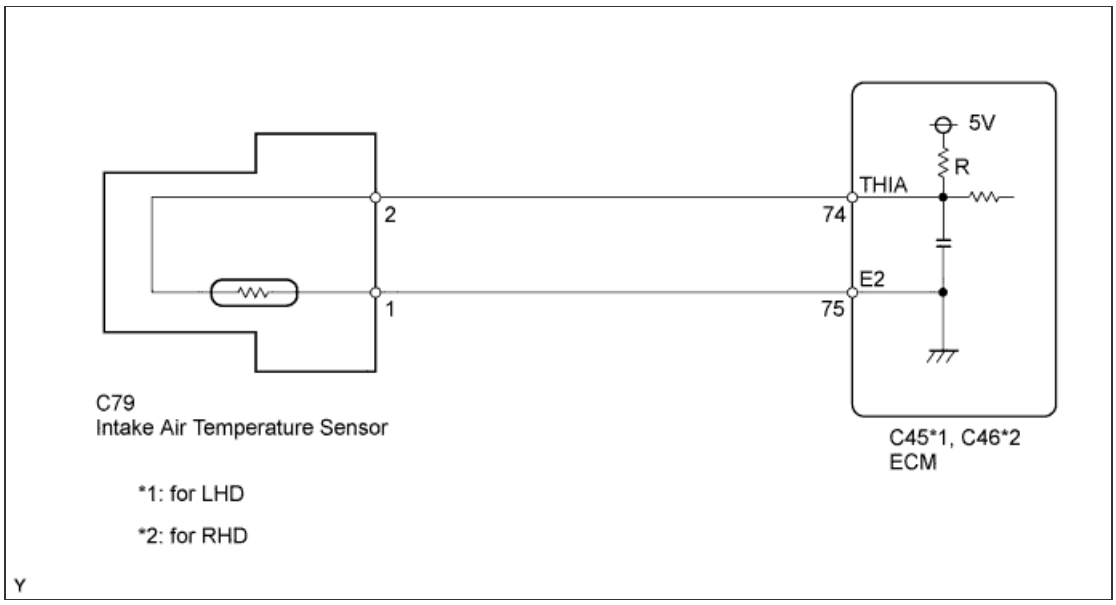
P1495	Intake Air Temp (Turbo)
P1496	
P1497	

HINT:

I DTC P1495, P1496 and/or P1497 is stored, the ollowing symptoms may appear:

- Mis ire
- Combustion noise
- Black smoke
- White smoke
- Lack o power

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

A dr replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- **If DTCs relating to different systems are stored, and they share terminal E2 as their ground, check this ground circuit first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (INTAKE AIR TEMPERATURE [TURBO])

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the ollowing menus: Powertrain / Engine / Data List / Intake Air Temp (Turbo).

d. Read the value.

OK:

Same as air temperature near intake manifold.

Result

Result	Proceed to
-40 C (-40 F)	A
140 C (284 F) or higher	B
OK (same as air temperature near intake mani old)	C

HINT:

- **If there is an open circuit, the tester indicates -40 C (-40 F).**
- **If there is a short circuit, the tester indicates 140 C (284 F) or more.**

B	Go to step 4
C	Go to step 11

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the intake air temperature (IAT) sensor connector.

b. Connect terminals 1 and 2 o the IAT sensor wire harness side connector.

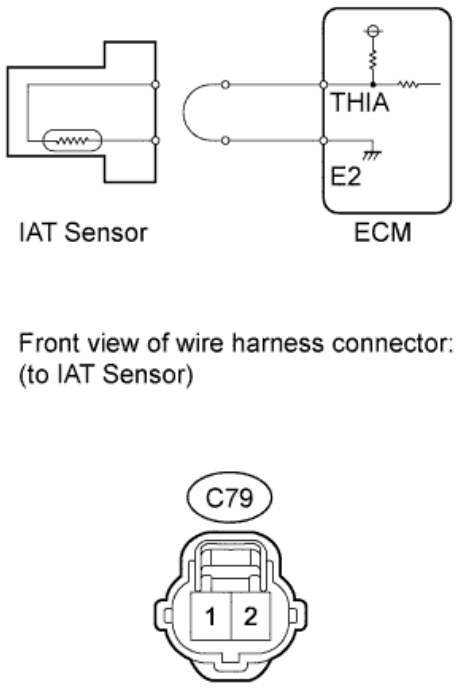
c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the ollowing menus: Powertrain / Engine / Data List / Intake Air Temp (Turbo).

f. Read the value.

OK:
140°C (284°F) or higher



OK	Go to step 7
NG	Go to step 3

3.CHECK HARNESS AND CONNECTOR (INTAKE AIR TEMPERATURE SENSOR - ECM)

a. Disconnect the IAT sensor connector.

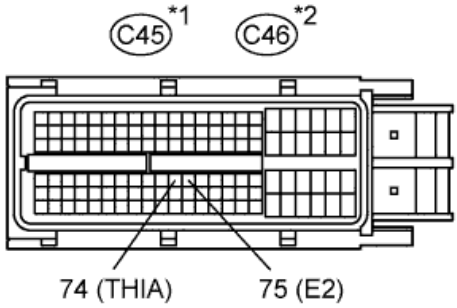
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to IAT Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Speci ied Condition
C79-2 - C45-74 (THIA)	Always	Below 1 Ω
C79-1 - C45-75 (E2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Speci ied Condition
C79-2 - C46-74 (THIA)	Always	Below 1 Ω
C79-1 - C46-75 (E2)	Always	Below 1 Ω

OK	**Go to step 9**
NG	**Go to step 8**

4.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the IAT sensor connector.

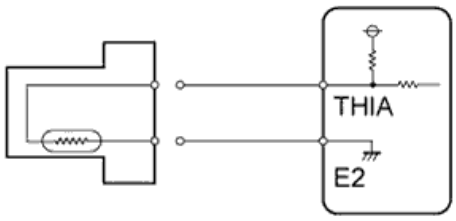
b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON and turn the tester on.

d. Enter the ollowing menus: Powertrain / Engine / Data List / Intake Air Temp (Turbo).

e. Read the value.

OK:
-40 C (-40 F)



OK	Go to step 10
NG	Go to step 5

5.CHECK HARNESS AND CONNECTOR (INTAKE AIR TEMPERATURE SENSOR - ECM)

a. Disconnect the IAT sensor connector.

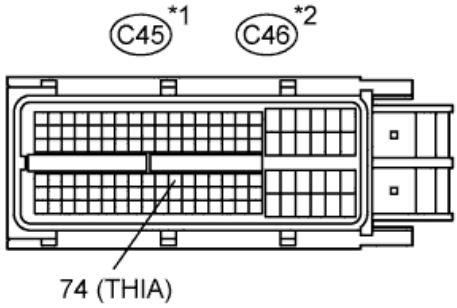
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to IAT Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Short):

for LHD

		Speci ied

Tester Connection	Condition	Condition
C79-2 or C45-74 (THIA) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Speci ied Condition
C79-2 or C46-74 (THIA) - Body ground	Always	10 kΩ or higher

NG → Go to step 8

OK

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

7.CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE INTAKE AIR TEMPERATURE SENSOR

a. Replace the intake air temperature sensor (Click here).

NEXT → Go to step 11

8.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT → Go to step 11

9.CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM.

a. Replace the ECM (Click here).

NEXT → Go to step 11

10.REPLACE INTAKE AIR TEMPERATURE SENSOR

a. Replace the intake air temperature sensor (Click here).

NEXT

11.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch o .

d. Turn the ignition switch to ON or 1 second.

e. Enter the ollowing menus: Powertrain / Engine / DTC.

f. Con irm that the DTC is not output again.

NEXT

```
END
```

DTC P0115 Engine Coolant Temperature Circuit

DTC P0117 Engine Coolant Temperature Circuit Low Input

DTC P0118 Engine Coolant Temperature Circuit High Input

for Preparation Click here

DESCRIPTION

A thermistor is built into the Engine Coolant Temperature (ECT) sensor and it changes its resistance value according to the engine coolant temperature. The structure of the sensor and connection to the ECM is the same as the intake air temperature sensor.

HINT:

If DTC P0115, P0117 or P0118 is stored, the ECM operates the fail-safe function in which the ECT is assumed to be 80 C (176).

P0115

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Open or short in the engine coolant temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in engine coolant temperature (ECT) sensor circuit • ECT sensor • ECM

P0117

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Short in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in ECT sensor circuit • ECT sensor • ECM

P0118

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Open in the ECT sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in ECT sensor circuit • ECT sensor • ECM

Related Data List

DTC No.	Data List
P0115	Coolant Temp
P0117	
P0118	

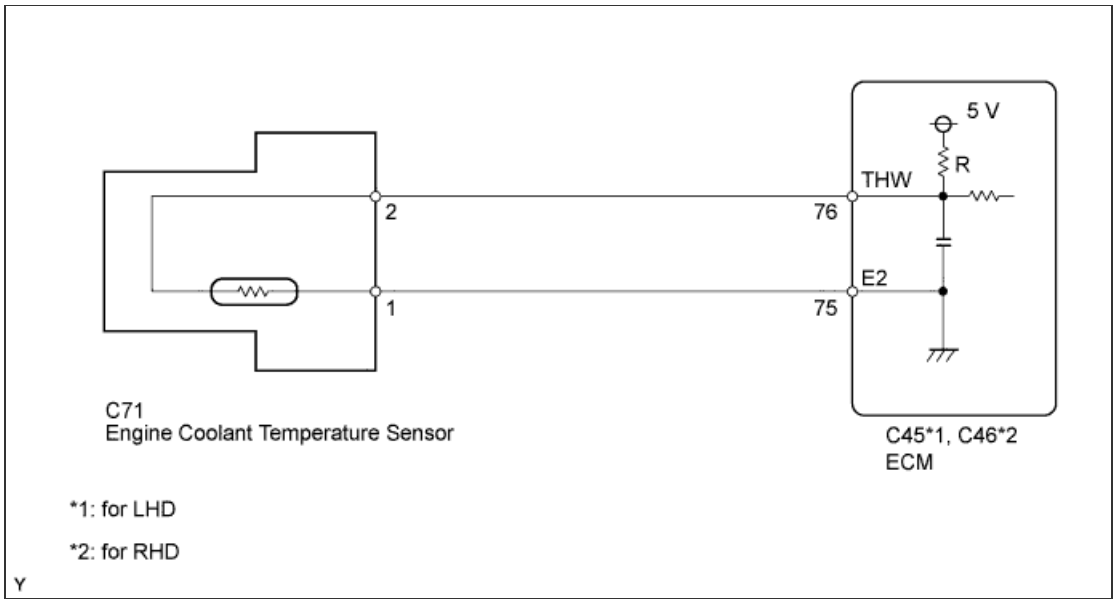
HINT:

- **If DTC P0115, P0117and/or P0118 is stored, the following symptoms may appear:**
  - **Misfire**
  - **Combustion noise**
  - **Black smoke**
  - **White smoke**
  - **Lack of power**
- **When DTC P0115, P0117 and/or P0118 is stored, check the engine coolant temperature by entering the following menus: Powertrain / Engine / Data List / Coolant Temp.**

Reference:

Temperature Displa ed	Malfunction
-40 C (-40)	Open circuit
140 C (284) or higher	Short circuit

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- **If DTCs relating to different systems are stored, and they share terminal E2 as their ground, check this ground circuit first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (ENGINE COOLANT TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Coolant Temp.

d. Read the value.

OK:

75 to 90°C (167 to 194°F) with warm engine.

Result

Result	Proceed to
-40 C (-40)	A
140 C (284) or higher	B
75 to 90 C (167 to 194)	C

HINT:

- **If there is an open circuit, the tester indicates -40°C (-40°F).**
- **If there is a short circuit, the tester indicates 140°C (284°F) or more.**

B	Go to step 4
C	Go to step 11

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the engine coolant temperature (ECT) sensor connector.

a. Disconnect the engine coolant temperature (ECT) sensor connector.

b. Connect terminals 1 and 2 of the ECT sensor wire harness side connector.

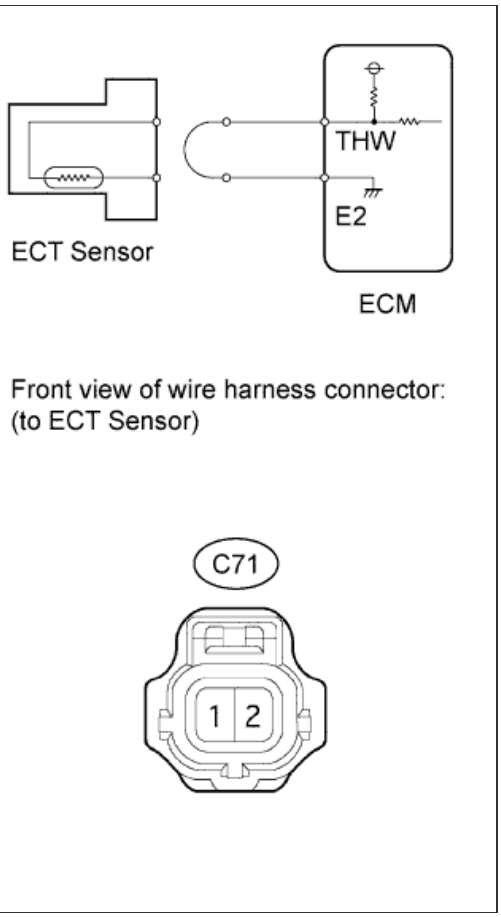
c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / Data List / Coolant Temp.

f. Read the value.

OK:
140°C (284°F) or higher



OK	Go to step 7
NG	Go to step 3

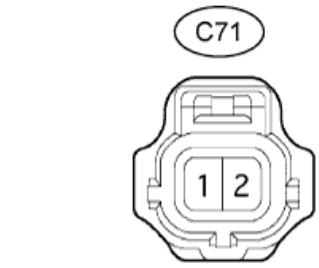
3.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the ECT sensor connector.

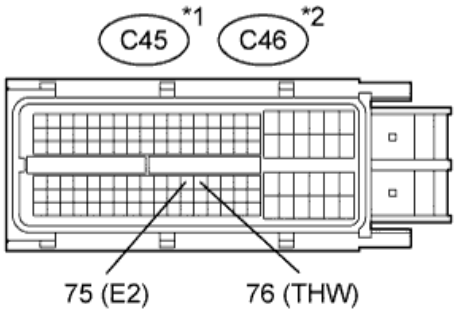
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to ECT Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C71-2 - C45-76 (THW)	Alwa s	Below 1 Ω
C71-1 - C45-75 (E2)	Alwa s	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C71-2 - C46-76 (THW)	Alwa s	Below 1 Ω
C71-1 - C46-75 (E2)	Alwa s	Below 1 Ω

OK	Go to step 9
NG	Go to step 8

4.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the ECT sensor connector.

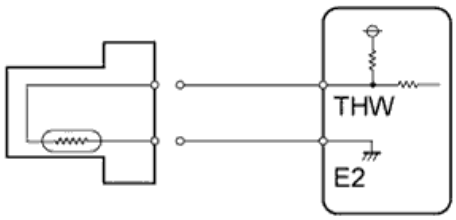
b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON and turn the tester on.

d. Enter the following menus: Powertrain / Engine / Data List / Coolant Temp.

e. Read the value.

OK:
-40°C (-40°F)



OK	Go to step 10
NG	Go to step 5

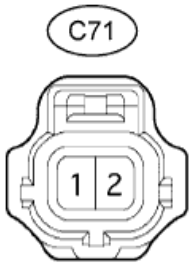
5.CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

a. Disconnect the ECT sensor connector.

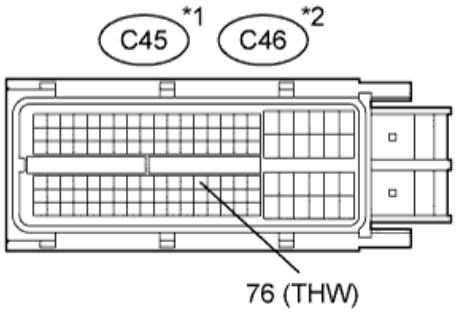
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to ECT Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Short):

for LHD

		Specified

Tester Connection	Condition	Condition
C71-2 or C45-76 (THW) - Bod ground	Alwa s	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C71-2 or C46-76 (THW) - Bod ground	Alwa s	10 kΩ or higher

NG → Go to step 8

OK

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

7.CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE ENGINE COOLANT TEMPERATURE SENSOR

a. Replace the engine coolant temperature sensor (Click here).

NEXT → Go to step 11

8.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT → Go to step 11

9.CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

10.REPLACE ENGINE COOLANT TEMPERATURE SENSOR

a. Replace the engine coolant temperature sensor (Click here).

NEXT

11.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 1 second.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

```
END
```

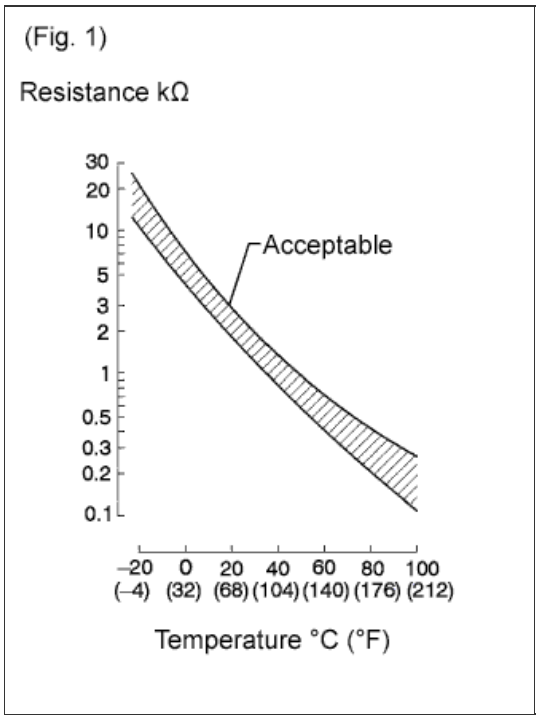
DTC P1495 Intake Air Temperature Sensor 1 Circuit

DTC P1496 Intake Air Temperature Sensor 1 Circuit Low

DTC P1497 Intake Air Temperature Sensor 1 Circuit High

for Preparation Click here

DESCRIPTION



The Intake Air Temperature (IAT) sensor is built into the charge air cooler and senses the IAT. A built-in thermistor in the sensor changes its resistance value according to the intake air temperature. The lower the intake air temperature, the greater the thermistor resistance value. The higher the intake air temperature, the lower the thermistor resistance value (See Fig. 1).
The sensor is connected to the ECM. The 5 V power source voltage in the ECM is applied to the sensor rom terminal THIA via resistor R. Resistor R and the sensor are connected in series. When the resistance value o the sensor changes in accordance with changes in the IAT, the potential at terminal THIA also changes. Based on this signal, the ECM corrects the el injection volume to improve driveability with a cold engine.

P1495

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON or 1 second	Open or short in the intake air temperature (IAT) sensor circuit or 0.5 seconds (1 trip detection logic).	• Open or short in intake air temperature (IAT) sensor circuit • IAT sensor • ECM

P1496

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON or 1 second	Short in the IAT sensor circuit or 0.5 seconds (1 trip detection logic).	• Short in IAT sensor circuit • IAT sensor • ECM

P1497

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON or 1 second	Open in the IAT sensor circuit or 0.5 seconds (1 trip detection logic).	• Open in IAT sensor circuit • IAT sensor • ECM

Related Data List

DTC No.	Data List

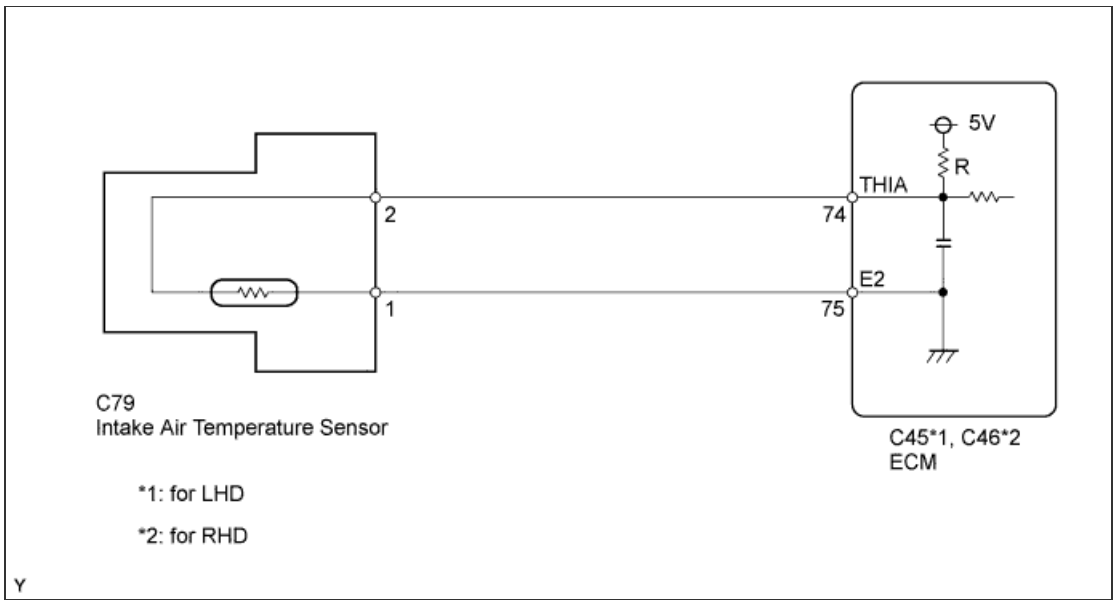
P1495	Intake Air Temp (Turbo)
P1496	
P1497	

HINT:

I DTC P1495, P1496 and/or P1497 is stored, the ollowing symptoms may appear:

- Mis ire
- Combustion noise
- Black smoke
- White smoke
- Lack o power

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

A dr replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- **If DTCs relating to different systems are stored, and they share terminal E2 as their ground, check this ground circuit first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (INTAKE AIR TEMPERATURE [TURBO])

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the ollowing menus: Powertrain / Engine / Data List / Intake Air Temp (Turbo).

d. Read the value.

OK:

Same as air temperature near intake manifold.

Result

Result	Proceed to
-40 C (-40 F)	A
140 C (284 F) or higher	B
OK (same as air temperature near intake mani old)	C

HINT:

- **If there is an open circuit, the tester indicates -40 C (-40 F).**
- **If there is a short circuit, the tester indicates 140 C (284 F) or more.**

B	Go to step 4
C	Go to step 11

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the intake air temperature (IAT) sensor connector.

b. Connect terminals 1 and 2 o the IAT sensor wire harness side connector.

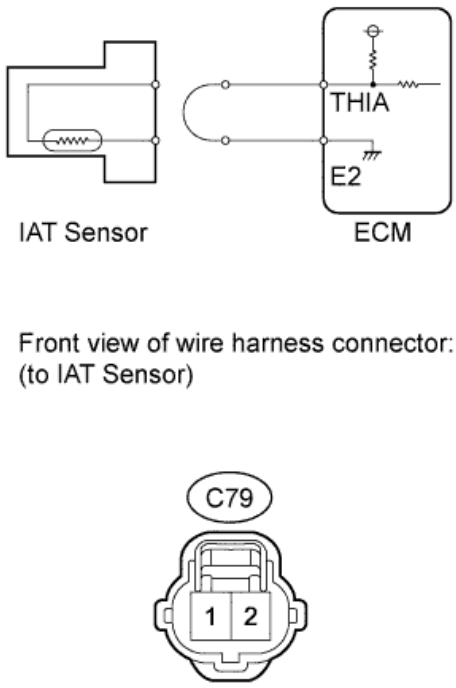
c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the ollowing menus: Powertrain / Engine / Data List / Intake Air Temp (Turbo).

f. Read the value.

OK:
140°C (284°F) or higher



OK	Go to step 7
NG	Go to step 3

3.CHECK HARNESS AND CONNECTOR (INTAKE AIR TEMPERATURE SENSOR - ECM)

a. Disconnect the IAT sensor connector.

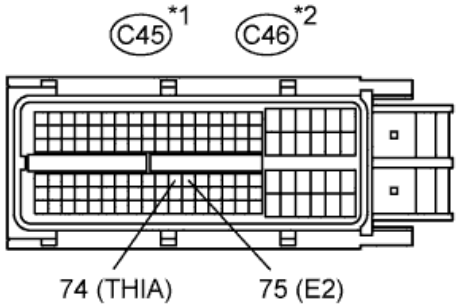
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to IAT Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Speci ied Condition
C79-2 - C45-74 (THIA)	Always	Below 1 Ω
C79-1 - C45-75 (E2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Speci ied Condition
C79-2 - C46-74 (THIA)	Always	Below 1 Ω
C79-1 - C46-75 (E2)	Always	Below 1 Ω

OK	**Go to step 9**
NG	**Go to step 8**

4.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the IAT sensor connector.

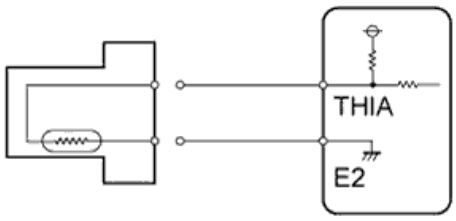
b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON and turn the tester on.

d. Enter the ollowing menus: Powertrain / Engine / Data List / Intake Air Temp (Turbo).

e. Read the value.

OK:
-40 C (-40 F)



OK	Go to step 10
NG	Go to step 5

5.CHECK HARNESS AND CONNECTOR (INTAKE AIR TEMPERATURE SENSOR - ECM)

a. Disconnect the IAT sensor connector.

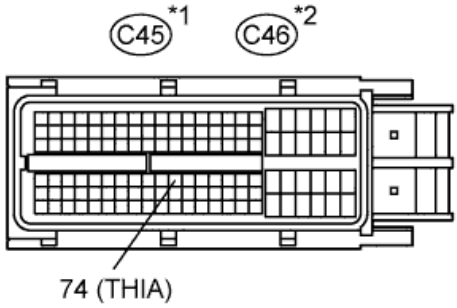
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to IAT Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Short):

for LHD

		Speci ied

Tester Connection	Condition	Condition
C79-2 or C45-74 (THIA) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Speci ied Condition
C79-2 or C46-74 (THIA) - Body ground	Always	10 kΩ or higher

NG → Go to step 8

OK

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

7.CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE INTAKE AIR TEMPERATURE SENSOR

a. Replace the intake air temperature sensor (Click here).

NEXT → Go to step 11

8.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT → Go to step 11

9.CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM.

a. Replace the ECM (Click here).

NEXT → Go to step 11

10.REPLACE INTAKE AIR TEMPERATURE SENSOR

a. Replace the intake air temperature sensor (Click here).

NEXT

11.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch o .

d. Turn the ignition switch to ON or 1 second.

e. Enter the ollowing menus: Powertrain / Engine / DTC.

f. Con irm that the DTC is not output again.

NEXT

```
END
```

DTC P0116 Engine Coolant Temperature Circuit Range / Performance Problem

for Preparation Click here

DESCRIPTION

A thermistor is built into the Engine Coolant Temperature (ECT) sensor and it changes its resistance value according to the engine coolant temperature. The structure of the sensor and connection to the ECM is the same as the intake air temperature sensor.

P0116

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
City driving for 10 minutes or more	If the engine coolant temperature is between -40°C (-40°F) and 60°C (140°F) at engine start and conditions (a) and (b) are met (2 trip detection logic): (a) Vehicle is driven at varying speeds (accelerating and decelerating) for 10 seconds. (b) Engine coolant temperature remains within 3°C (5.4°F) of the engine starting temperature.	Engine coolant temperature sensor
	If the engine coolant temperature is more than 60°C (140°F) at engine start and conditions (a) and (b) are met (6 trip detection logic): (a) Vehicle is driven at varying speeds (accelerating and decelerating) for 10 seconds. (b) Engine coolant temperature remains within 1°C (1.8°F) of the engine starting temperature.	

Related Data List

DTC No.	Data List
P0116	Coolant Temp

HINT:

- **If DTC P0116 is stored, the following symptoms may appear:**
  - **Misfire**
  - **Combustion noise**
  - **Black smoke**
  - **White smoke**
  - **Lack of power**

MONITOR DESCRIPTION

The engine coolant temperature sensor is used to monitor the engine coolant temperature. The engine coolant temperature sensor has a thermistor that varies its resistance depending on the temperature of the engine coolant. When the coolant temperature is low the resistance of the thermistor increases. When the temperature is high the resistance drops. The variations in resistance are reflected in the voltage output from the sensor. The ECM monitors the sensor voltage and uses this value to calculate the engine coolant temperature. When the sensor voltage output varies slightly the ECM interprets this as a fault in the engine coolant temperature sensor and sets a DTC.
Examples:

1. Upon starting the engine the engine coolant temperature is between -40°C (-40°F) and 60°C (140°F). If after driving for a few minutes the engine coolant temperature still remains within 3°C (5.4°F) of the starting temperature a DTC is stored (2 trip detection logic).
2. Upon starting the engine the engine coolant temperature is more than 60°C (140°F). If after driving for a few minutes the engine coolant temperature still remains within 1°C (1.8°F) of the starting temperature a DTC is stored (6 trip detection logic).

INSPECTION PROCEDURE

HINT:

- **If DTCs P0115, P0117 and P0118 are stored simultaneously, the engine coolant temperature sensor circuit may have an open or short. Perform troubleshooting for these DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0116)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read the DTCs.

Result

Result	Proceed to

P0116 is output	A
P0116 and other DTCs are output	B

B → GO TO DTC CHART (Click here)

A

2.REPLACE ENGINE COOLANT TEMPERATURE SENSOR

a. Replace the engine coolant temperature sensor (Click here).

NEXT

3.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. After starting the engine perform city driving for 10 minutes or more.

e. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P0116.

iii. Check that STATUS is N MAL. If STATUS is INC MPLETE or UNKN increase city driving time by 10 minutes and check.

NEXT

END

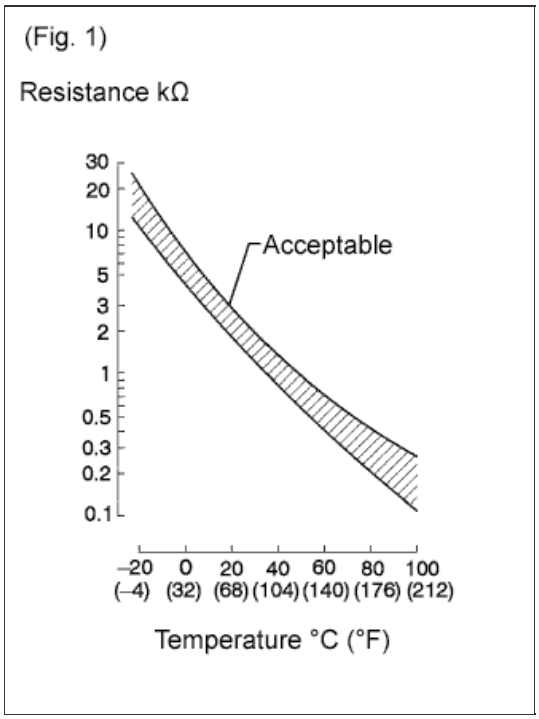
DTC P1495 Intake Air Temperature Sensor 1 Circuit

DTC P1496 Intake Air Temperature Sensor 1 Circuit Low

DTC P1497 Intake Air Temperature Sensor 1 Circuit High

for Preparation Click here

DESCRIPTION



The Intake Air Temperature (IAT) sensor is built into the charge air cooler and senses the IAT. A built-in thermistor in the sensor changes its resistance value according to the intake air temperature. The lower the intake air temperature, the greater the thermistor resistance value. The higher the intake air temperature, the lower the thermistor resistance value (See Fig. 1).
The sensor is connected to the ECM. The 5 V power source voltage in the ECM is applied to the sensor rom terminal THIA via resistor R. Resistor R and the sensor are connected in series. When the resistance value o the sensor changes in accordance with changes in the IAT, the potential at terminal THIA also changes. Based on this signal, the ECM corrects the el injection volume to improve driveability with a cold engine.

P1495

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON or 1 second	Open or short in the intake air temperature (IAT) sensor circuit or 0.5 seconds (1 trip detection logic).	• Open or short in intake air temperature (IAT) sensor circuit • IAT sensor • ECM

P1496

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON or 1 second	Short in the IAT sensor circuit or 0.5 seconds (1 trip detection logic).	• Short in IAT sensor circuit • IAT sensor • ECM

P1497

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON or 1 second	Open in the IAT sensor circuit or 0.5 seconds (1 trip detection logic).	• Open in IAT sensor circuit • IAT sensor • ECM

Related Data List

DTC No.	Data List

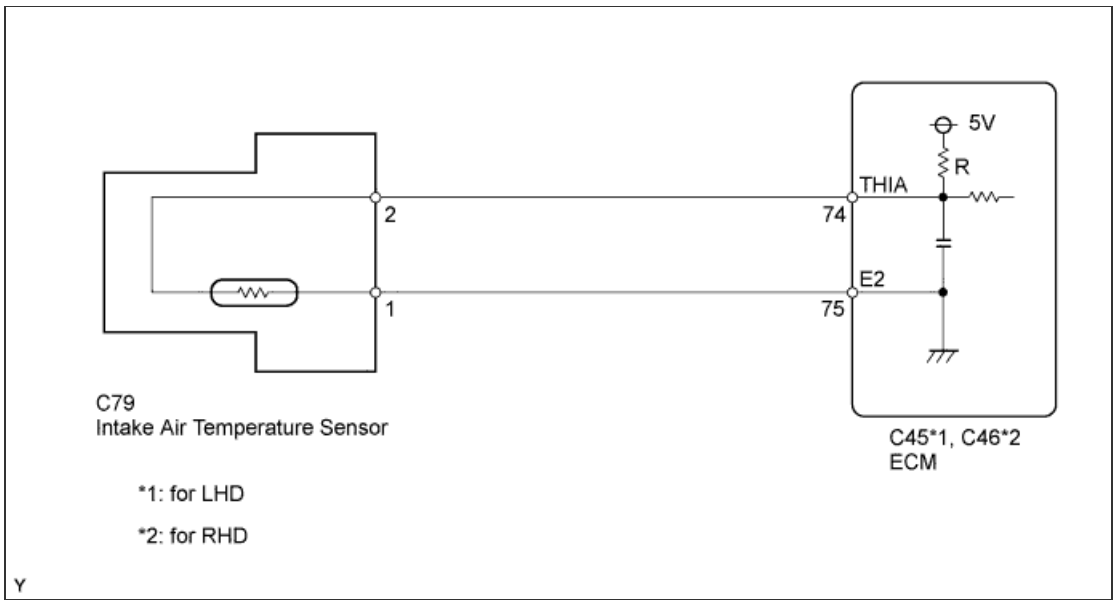
P1495	Intake Air Temp (Turbo)
P1496	
P1497	

HINT:

I DTC P1495, P1496 and/or P1497 is stored, the ollowing symptoms may appear:

- Mis ire
- Combustion noise
- Black smoke
- White smoke
- Lack o power

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

A dr replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- **If DTCs relating to different systems are stored, and they share terminal E2 as their ground, check this ground circuit first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (INTAKE AIR TEMPERATURE [TURBO])

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the ollowing menus: Powertrain / Engine / Data List / Intake Air Temp (Turbo).

d. Read the value.

OK:

Same as air temperature near intake manifold.

Result

Result	Proceed to
-40 C (-40 F)	A
140 C (284 F) or higher	B
OK (same as air temperature near intake mani old)	C

HINT:

- If there is an open circuit, the tester indicates -4 (-4 F).
- If there is a short circuit, the tester indicates 14 (2 4 F) or more.

B	Go to step 4
C	Go to step 11

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the intake air temperature (IAT) sensor connector.

b. Connect terminals 1 and 2 o the IAT sensor wire harness side connector.

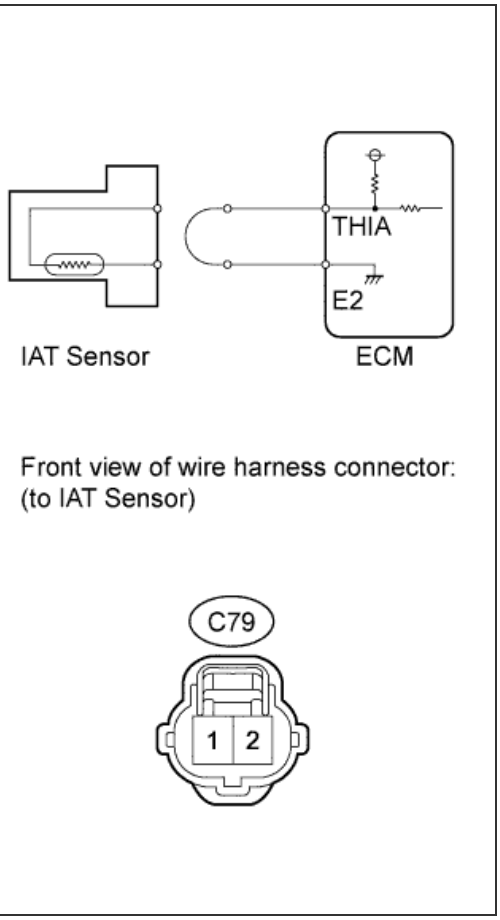
c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the ollowing menus: Powertrain / Engine / Data List / Intake Air Temp (Turbo).

f. Read the value.

OK:
140°C (284°F) or higher



OK	Go to step 7
NG	Go to step 3

3.CHECK HARNESS AND CONNECTOR (INTAKE AIR TEMPERATURE SENSOR - ECM)

a. Disconnect the IAT sensor connector.

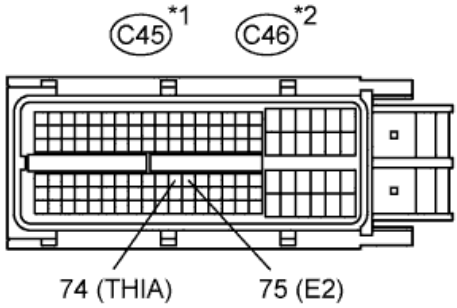
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to IAT Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Speci ied Condition
C79-2 - C45-74 (THIA)	Always	Below 1 Ω
C79-1 - C45-75 (E2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Speci ied Condition
C79-2 - C46-74 (THIA)	Always	Below 1 Ω
C79-1 - C46-75 (E2)	Always	Below 1 Ω

OK	**Go to step 9**
NG	**Go to step 8**

4.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the IAT sensor connector.

b. Connect the intelligent tester to the DLC3.

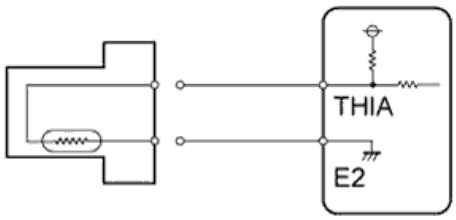
c. Turn the ignition switch to ON and turn the tester on.

d. Enter the ollowing menus: Powertrain / Engine / Data List / Intake Air Temp (Turbo).

e. Read the value.

OK:

-4 (C4 F)



OK	Go to step 1
NG	Go to step 5

5.CHECK HARNESS AND CONNECTOR (INTAKE AIR TEMPERATURE SENSOR - ECM)

a. Disconnect the IAT sensor connector.

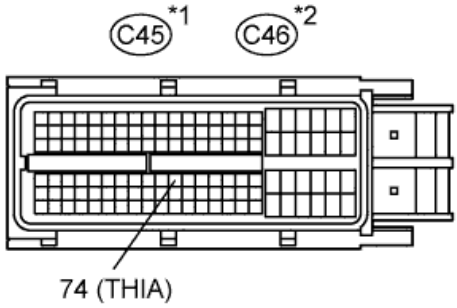
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to IAT Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Short):

for LHD

		Speci ied

Tester Connection	Condition	Condition
C79-2 or C45-74 (THIA) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Speci ied Condition
C79-2 or C46-74 (THIA) - Body ground	Always	10 kΩ or higher

NG → Go to step 8

OK

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

7.CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE INTAKE AIR TEMPERATURE SENSOR

a. Replace the intake air temperature sensor (Click here).

NEXT → Go to step 11

8.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT → Go to step 11

9.CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM.

a. Replace the ECM (Click here).

NEXT → Go to step 11

10.REPLACE INTAKE AIR TEMPERATURE SENSOR

a. Replace the intake air temperature sensor (Click here).

NEXT

11.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch o .

d. Turn the ignition switch to ON or 1 second.

e. Enter the ollowing menus: Powertrain / Engine / DTC.

f. Con irm that the DTC is not output again.

NEXT

```
END
```

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

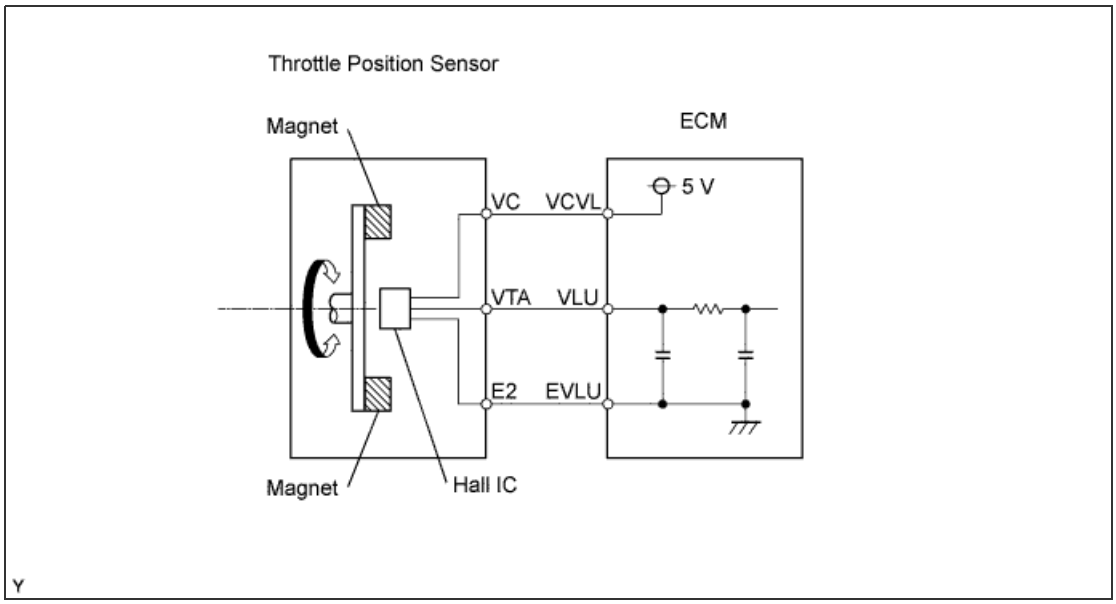
for Preparation Click here

DESCRIPTION

The throttle position sensor is mounted on the diesel throttle body and detects the opening angle of the throttle valve. This sensor is an electronic sensor and uses Hall-effect elements.

When the throttle valve is fully closed, a voltage of approximately 0.7 V is applied to terminal VLU of the ECM. The voltage applied to terminal VLU of the ECM increases in proportion to the opening angle of the throttle valve and becomes approximately 3.5 to 4.0 V when the throttle valve is fully opened.

The ECM determines the vehicle driving conditions from the signals input to its VLU terminal. The data is one of the inputs used for EGR control, etc.



P0122

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3 seconds	Throttle position sensor (for Bank 1) output (VLU) is less than 0.2 V for 3 seconds (1 trip detection logic).	• Throttle position sensor (for Bank 1) • Open or short in VLU circuit • Open in VC circuit • ECM

P0123

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3 seconds	Throttle position sensor (for Bank 1) output (VLU) is more than 4.8 V for 3 seconds (1 trip detection logic).	• Throttle position sensor (for Bank 1) • Open in E2 circuit • VC and VLU circuits are short-circuited • ECM

P0222

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3	Throttle position sensor (for Bank 2) output (VLU2) is less than 0.2 V for 3 seconds	• Throttle position sensor (for Bank 2) • Open or short in VLU2

seconds	(1 trip detection logic).	circuit • Open in VC circuit • ECM

P0223

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3 seconds	Throttle position sensor (for Bank 2) output (VLU2) is more than 4.8 V for 3 seconds (1 trip detection logic).	• Throttle position sensor (for Bank 2) • Open in E2 circuit • VC and VLU2 circuits are short-circuited • ECM

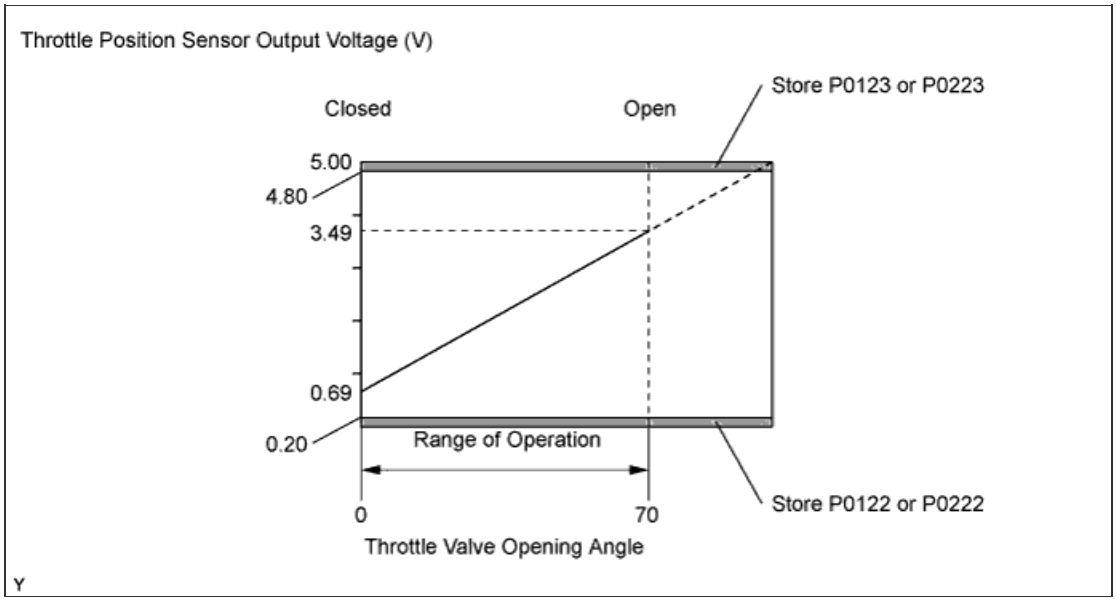
HINT:

If DTC P0122, P0123, P0222 and/or P0223 is stored, the following symptoms may appear:

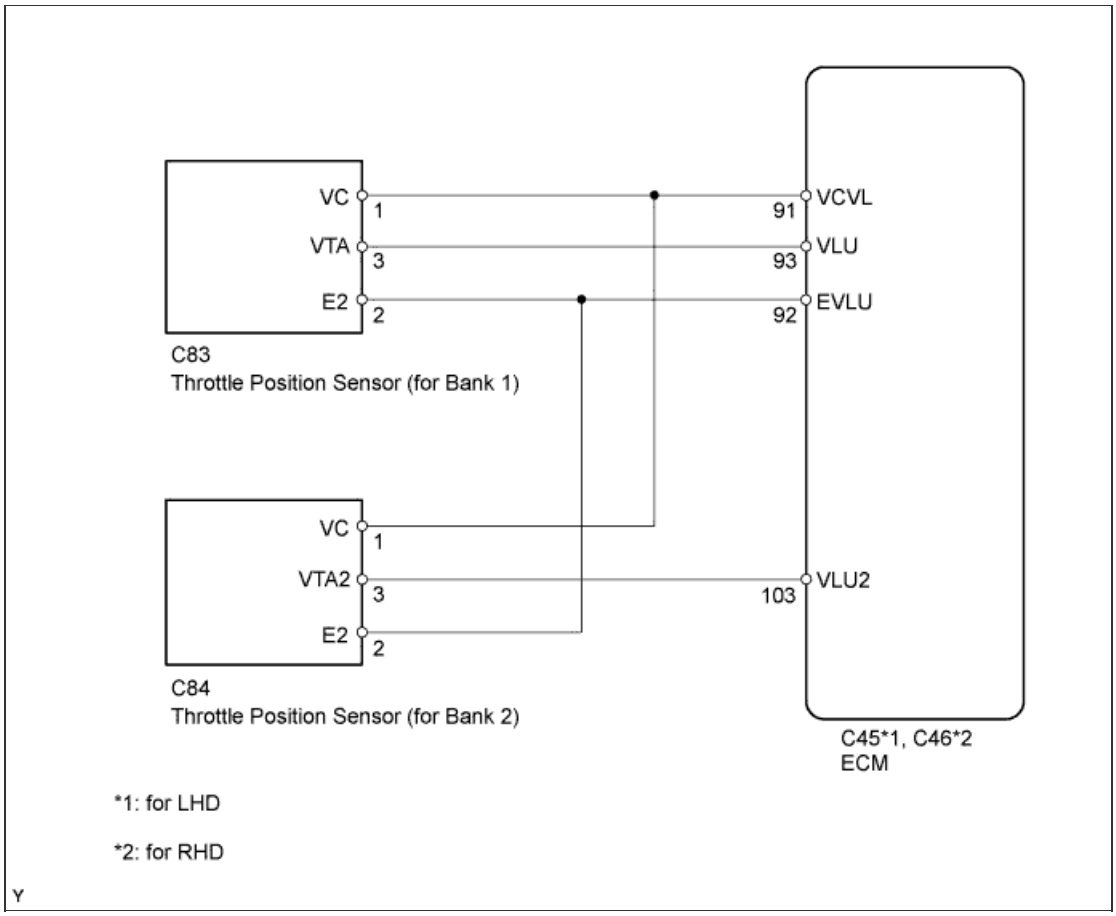
- Intake booming noise
- Black smoke
- Lack of power
- Vibration at engine stop
- Turbo overspeed, turbo damage

MONITOR DESCRIPTION

When the output voltage of the throttle position sensor deviates from the normal operating range (between 0.2 V and 4.8 V) for more than 3 seconds, the ECM interprets this as a malfunction of the sensor circuit and illuminates the MIL.



WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

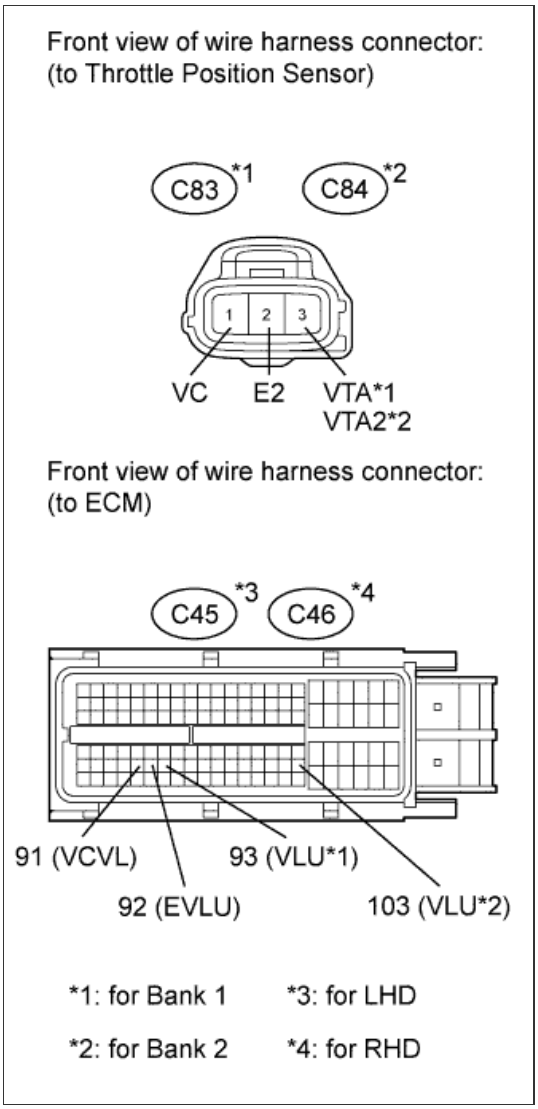
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the throttle position sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for Bank 1 (LHD)

Tester Connection	Condition	Specified Condition
C83-1 (VC) - C45-91 (VCVL)	Always	Below 1 Ω
C83-3 (VTA) - C45-93 (VLU)	Always	Below 1 Ω
C83-2 (E2) - C45-92 (EVLU)	Always	Below 1 Ω

for Bank 2 (LHD)

Tester Connection	Condition	Specified Condition
C84-1 (VC) - C45-91 (VCVL)	Always	Below 1 Ω
C84-3 (VTA2) - C45-103 (VLU2)	Always	Below 1 Ω
C84-2 (E2) - C45-92 (EVLU)	Always	Below 1 Ω

for Bank 1 (RHD)

Tester Connection	Condition	Specified Condition
C83-1 (VC) - C46-91 (VCVL)	Always	Below 1 Ω
C83-3 (VTA) - C46-93 (VLU)	Always	Below 1 Ω
C83-2 (E2) - C46-92 (EVLU)	Always	Below 1 Ω

for Bank 2 (RHD)

Tester Connection	Condition	Specified Condition
C84-1 (VC) - C46-91 (VCVL)	Always	Below 1 Ω

C84-3 (VTA2) - C46-103 (VLU2)	Always	Below 1 Ω
C84-2 (E2) - C46-92 (EVLU)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for Bank 1 (LHD)

Tester Connection	Condition	Specified Condition
C83-1 (VC) or C45-91 (VCVL) - Body ground	Always	10 kΩ or higher
C83-3 (VTA) or C45-93 (VLU) - Body ground	Always	10 kΩ or higher
C83-2 (E2) or C45-92 (EVLU) - Body ground	Always	10 kΩ or higher

for Bank 2 (LHD)

Tester Connection	Condition	Specified Condition
C84-1 (VC) or C45-91 (VCVL) - Body ground	Always	10 kΩ or higher
C84-3 (VTA2) or C45-103 (VLU2) - Body ground	Always	10 kΩ or higher
C84-2 (E2) or C45-92 (EVLU) - Body ground	Always	10 kΩ or higher

for Bank 1 (RHD)

Tester Connection	Condition	Specified Condition
C83-1 (VC) or C46-91 (VCVL) - Body ground	Always	10 kΩ or higher
C83-3 (VTA) or C46-93 (VLU) - Body ground	Always	10 kΩ or higher
C83-2 (E2) or C46-92 (EVLU) - Body ground	Always	10 kΩ or higher

for Bank 2 (RHD)

Tester Connection	Condition	Specified Condition
C84-1 (VC) or C46-91 (VCVL) - Body ground	Always	10 kΩ or higher
C84-3 (VTA2) or C46-103 (VLU2) - Body ground	Always	10 kΩ or higher
C84-2 (E2) or C46-92 (EVLU) - Body ground	Always	10 kΩ or higher

NG → Go to step 6

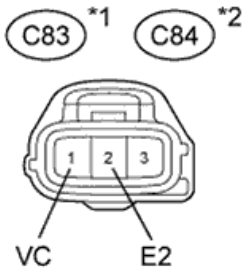
OK

2.CHECK ECM TERMINAL VOLTAGE (VC TERMINAL)

a. Disconnect the throttle position sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Front view of wire harness connector:
(to Throttle Position Sensor)



*1: for Bank 1

*2: for Bank 2

Standard Voltage:

for Bank 1

Tester Connection	Switch Condition	Specified Condition
C83-1 (VC) - C83-2 (E2)	Ignition switch ON	4.5 to 5.5 V

for Bank 2

Tester Connection	Switch Condition	Specified Condition
C84-1 (VC) - C84-2 (E2)	Ignition switch ON	4.5 to 5.5 V

NG → Go to step 5

OK

3.REPLACE DIESEL THROTTLE BODY ASSEMBLY (for Bank 1 or Bank 2)

a. Replace the diesel throttle body assembly (for Bank 1 or Bank 2) (Click here).

NEXT

4.READ VALUE USING INTELLIGENT TESTER

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Enter the following menus: Powertrain / Engine / Data List / Actual Throttle position or Actual Throttle position #2.

e. Check the movement of the throttle valve when idling the engine after starting it from ignition switch ON.

OK

Condition	Tester Display
Ignition switch ON	-5 to 5%
Idling	0 to 90%

OK → END

NG → Go to step 5

5.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 7

6.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

7.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 3 seconds.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

DTC P1601 Injector Correction Circuit Malfunction (EEPROM)

for Preparation Click here

DESCRIPTION

P1601

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 seconds	When either condition below is met (1 trip detection logic) • uel in ector compensation code is not registered. • Wrong in ector compensation code is registered.	• Fuel in ector compensation code • ECM

NOTICE:

- **When a fuel injector is replaced, the new fuel injector compensation code must be input into the ECM. When the ECM is replaced, all of the existing fuel injector compensation codes must be input into the new ECM.**
- **Fuel injector compensation codes are unique, 30-digit, alphanumeric values printed on the head portion of each fuel injector. If an incorrect fuel injector compensation code is input into the ECM, the engine assembly may rattle or engine idling may become rough. In addition, engine failure may occur and the life of the engine may be shortened.**

HINT:

When replacing the ECM with a new one, if the in ector compensation codes are not entered, DTC P1 will be stored.

When replacing the ECM with a new one, input all fuel injector compensation codes into the new ECM as follows:

a. Prior to replacing the ECM, use the intelligent tester to read and save each fuel in ector compensation code from the original ECM (Click here).

b. After installing a new ECM, input the saved compensation codes into the new ECM using the tester (Click here).

c. Turn the ignition switch off and then turn the tester off.

d. Wait for at least 30 seconds.

e. Turn the ignition switch to ON and then turn the tester on.

f. Clear DTC P1 stored in the ECM using the tester (Click here).

HINT:

- **Each fuel injector has different fuel injection characteristics. In order to optimize the fuel injections, the ECM uses the compensation codes to balance the different fuel injections between each injector.**
- **When you first turn ON the ignition switch after replacing the ECM or a fuel injector(s), DTC P1601 is stored. If a fuel injector was replaced, the compensation code for the new fuel injector will need to be registered in the ECM. If the ECM was replaced, the compensation codes for the fuel injectors must be registered to the new ECM. Manually clear the DTC upon completion of compensation code registration.**

INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

ead freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.CHECK FUEL INJECTOR COMPENSATION CODE

a. ead the fuel in ector compensation codes (Click here).

OK:
Compensation codes stored in the ECM match compensation codes of the installed fuel injectors.

NG → Go to step 3

OK

2.REPLACE ECM

a. eplace the ECM (Click here).

NEXT → Go to step 4

3.PERFORM REGISTRATION OF FUEL INJECTOR COMPENSATION CODE

a. Perform registration of the fuel in ector compensation code (Click here).

NEXT

4.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch off and leave the vehicle for 15 seconds.

e. Turn the ignition switch to ON for 1 second.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC udgment has been carried out.

i. Enter the following menus Powertrain / Engine / Utility / All eadiness.

ii. Input DTC P1

iii. Check that TATU is NO AL. If TATU is INCOMPLETE or UNKNOWN, idle the engine.

NEXT

END

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

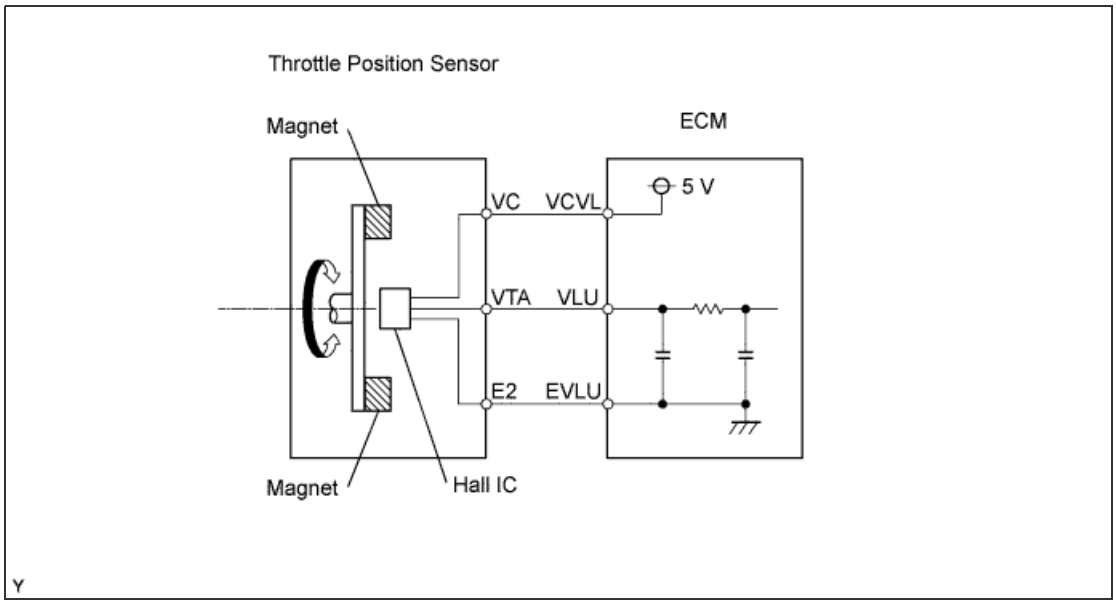
for Preparation Click here

DESCRIPTION

The throttle position sensor is mounted on the diesel throttle body and detects the opening angle of the throttle valve. This sensor is an electronic sensor and uses Hall-effect elements.

When the throttle valve is fully closed, a voltage of approximately 0.7 V is applied to terminal VLU of the ECM. The voltage applied to terminal VLU of the ECM increases in proportion to the opening angle of the throttle valve and becomes approximately 3.5 to 4.0 V when the throttle valve is fully opened.

The ECM determines the vehicle driving conditions from the signals input to its VLU terminal. The data is one of the inputs used for EGR control, etc.



P0122

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3 seconds	Throttle position sensor (for Bank 1) output (VLU) is less than 0.2 V for 3 seconds (1 trip detection logic).	• Throttle position sensor (for Bank 1) • Open or short in VLU circuit • Open in VC circuit • ECM

P0123

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3 seconds	Throttle position sensor (for Bank 1) output (VLU) is more than 4.8 V for 3 seconds (1 trip detection logic).	• Throttle position sensor (for Bank 1) • Open in E2 circuit • VC and VLU circuits are short-circuited • ECM

P0222

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3	Throttle position sensor (for Bank 2) output (VLU2) is less than 0.2 V for 3 seconds	• Throttle position sensor (for Bank 2) • Open or short in VLU2

seconds	(1 trip detection logic).	circuit • Open in VC circuit • ECM

P0223

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3 seconds	Throttle position sensor (for Bank 2) output (VLU2) is more than 4.8 V for 3 seconds (1 trip detection logic).	• Throttle position sensor (for Bank 2) • Open in E2 circuit • VC and VLU2 circuits are short-circuited • ECM

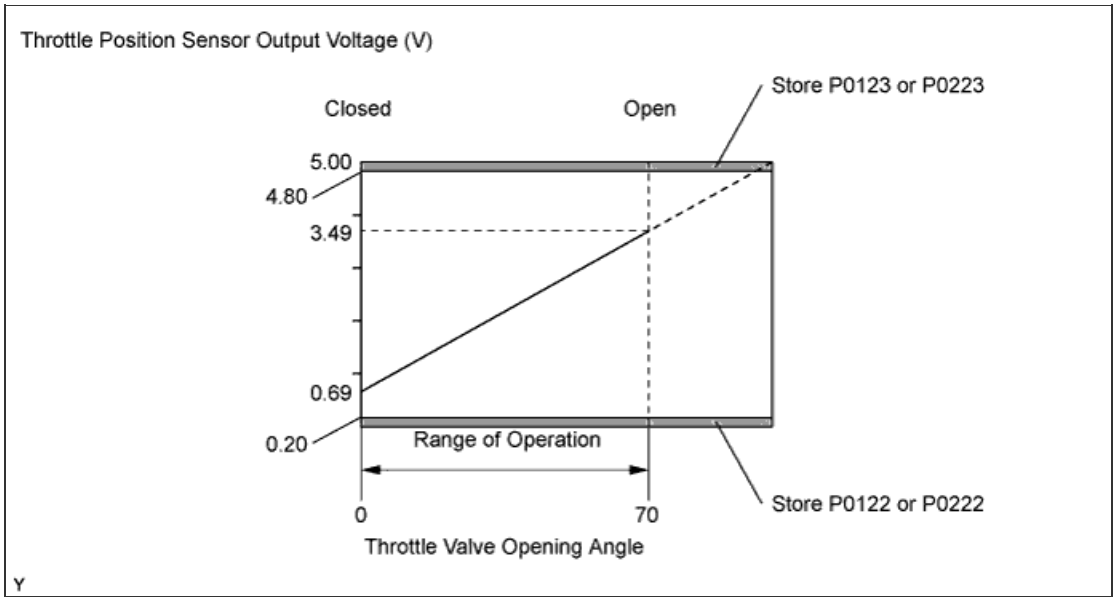
HINT:

If DTC P0122, P0123, P0222 and/or P0223 is stored, the following symptoms may appear:

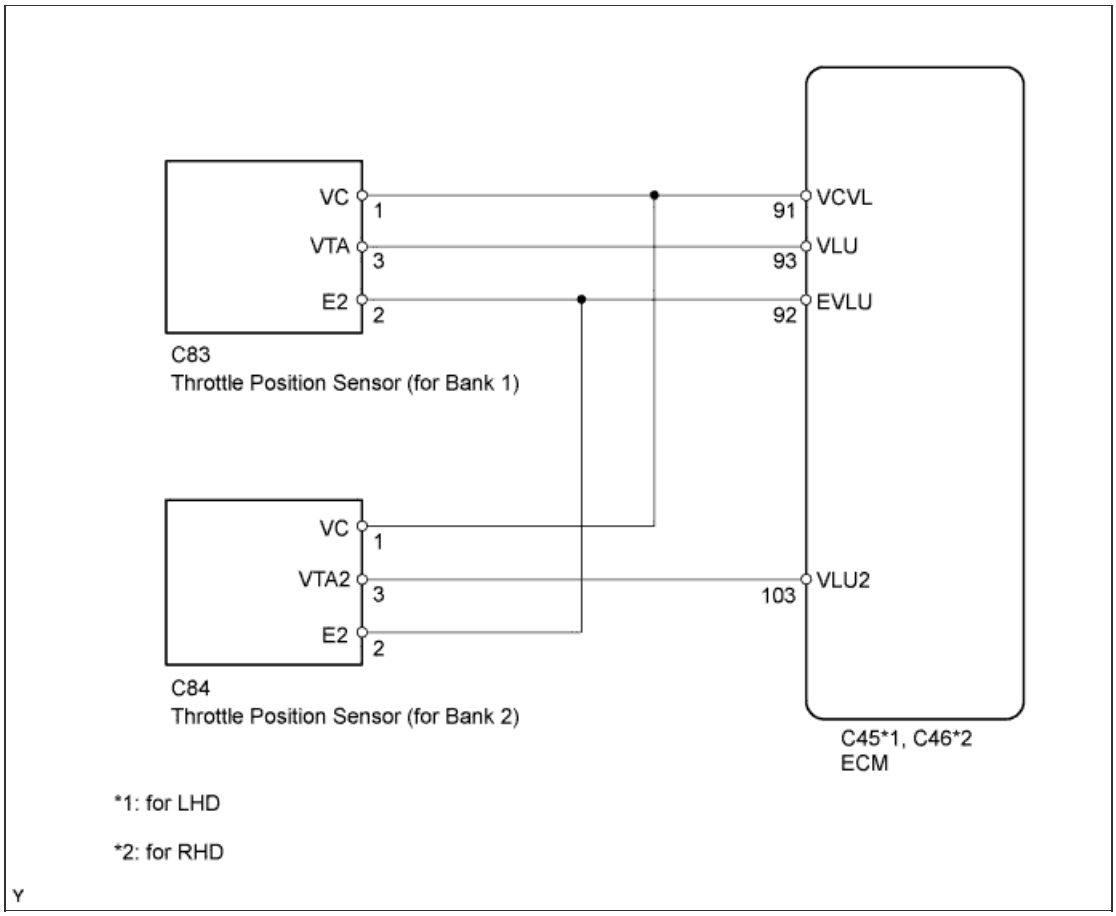
- Intake booming noise
- Black smoke
- Lack of power
- Vibration at engine stop
- Turbo overspeed, turbo damage

MONITOR DESCRIPTION

When the output voltage of the throttle position sensor deviates from the normal operating range (between 0.2 V and 4.8 V) for more than 3 seconds, the ECM interprets this as a malfunction of the sensor circuit and illuminates the MIL.



WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

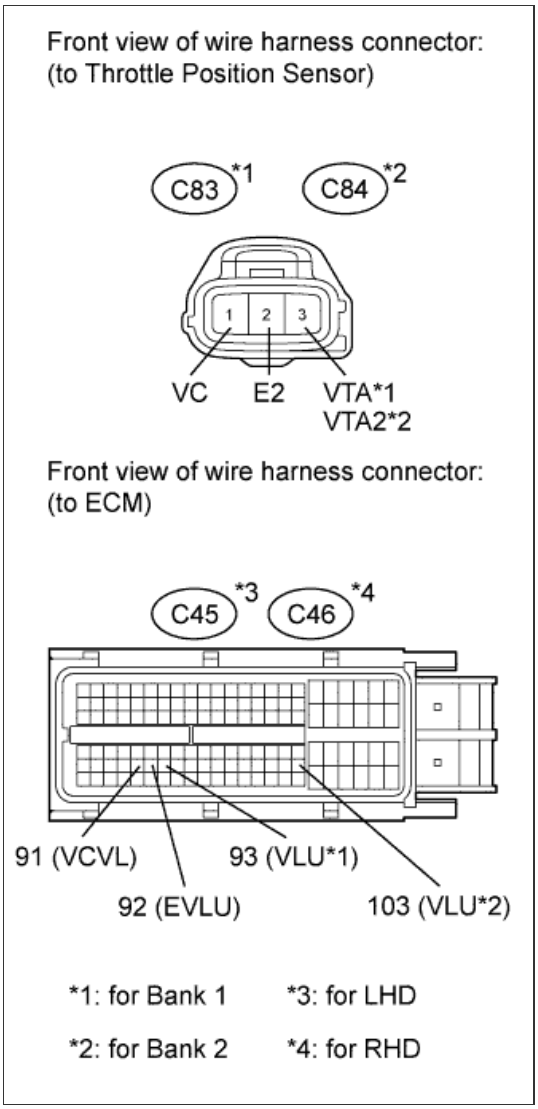
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the throttle position sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for Bank 1 (LHD)

Tester Connection	Condition	Specified Condition
C83-1 (VC) - C45-91 (VCVL)	Always	Below 1 Ω
C83-3 (VTA) - C45-93 (VLU)	Always	Below 1 Ω
C83-2 (E2) - C45-92 (EVLU)	Always	Below 1 Ω

for Bank 2 (LHD)

Tester Connection	Condition	Specified Condition
C84-1 (VC) - C45-91 (VCVL)	Always	Below 1 Ω
C84-3 (VTA2) - C45-103 (VLU2)	Always	Below 1 Ω
C84-2 (E2) - C45-92 (EVLU)	Always	Below 1 Ω

for Bank 1 (RHD)

Tester Connection	Condition	Specified Condition
C83-1 (VC) - C46-91 (VCVL)	Always	Below 1 Ω
C83-3 (VTA) - C46-93 (VLU)	Always	Below 1 Ω
C83-2 (E2) - C46-92 (EVLU)	Always	Below 1 Ω

for Bank 2 (RHD)

Tester Connection	Condition	Specified Condition
C84-1 (VC) - C46-91 (VCVL)	Always	Below 1 Ω

C84-3 (VTA2) - C46-103 (VLU2)	Always	Below 1 Ω
C84-2 (E2) - C46-92 (EVLU)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for Bank 1 (LHD)

Tester Connection	Condition	Specified Condition
C83-1 (VC) or C45-91 (VCVL) - Body ground	Always	10 kΩ or higher
C83-3 (VTA) or C45-93 (VLU) - Body ground	Always	10 kΩ or higher
C83-2 (E2) or C45-92 (EVLU) - Body ground	Always	10 kΩ or higher

for Bank 2 (LHD)

Tester Connection	Condition	Specified Condition
C84-1 (VC) or C45-91 (VCVL) - Body ground	Always	10 kΩ or higher
C84-3 (VTA2) or C45-103 (VLU2) - Body ground	Always	10 kΩ or higher
C84-2 (E2) or C45-92 (EVLU) - Body ground	Always	10 kΩ or higher

for Bank 1 (RHD)

Tester Connection	Condition	Specified Condition
C83-1 (VC) or C46-91 (VCVL) - Body ground	Always	10 kΩ or higher
C83-3 (VTA) or C46-93 (VLU) - Body ground	Always	10 kΩ or higher
C83-2 (E2) or C46-92 (EVLU) - Body ground	Always	10 kΩ or higher

for Bank 2 (RHD)

Tester Connection	Condition	Specified Condition
C84-1 (VC) or C46-91 (VCVL) - Body ground	Always	10 kΩ or higher
C84-3 (VTA2) or C46-103 (VLU2) - Body ground	Always	10 kΩ or higher
C84-2 (E2) or C46-92 (EVLU) - Body ground	Always	10 kΩ or higher

NG → Go to step 6

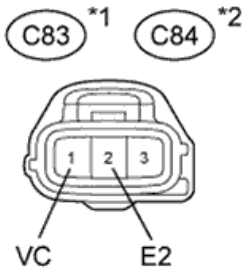
OK

2.CHECK ECM TERMINAL VOLTAGE (VC TERMINAL)

a. Disconnect the throttle position sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Front view of wire harness connector:
(to Throttle Position Sensor)



*1: for Bank 1

*2: for Bank 2

Standard Voltage:

for Bank 1

Tester Connection	Switch Condition	Specified Condition
C83-1 (VC) - C83-2 (E2)	Ignition switch ON	4.5 to 5.5 V

for Bank 2

Tester Connection	Switch Condition	Specified Condition
C84-1 (VC) - C84-2 (E2)	Ignition switch ON	4.5 to 5.5 V

NG → Go to step 5

OK

3.REPLACE DIESEL THROTTLE BODY ASSEMBLY (for Bank 1 or Bank 2)

a. Replace the diesel throttle body assembly (for Bank 1 or Bank 2) (Click here).

NEXT

4.READ VALUE USING INTELLIGENT TESTER

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Enter the following menus: Powertrain / Engine / Data List / Actual Throttle position or Actual Throttle position #2.

e. Check the movement of the throttle valve when idling the engine after starting it from ignition switch ON.

OK

Condition	Tester Display
Ignition switch ON	-5 to 5%
Idling	0 to 90%

OK → END

NG → Go to step 5

5.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 7

6.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

7.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 3 seconds.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

DTC P1604 Startability Malfunction

for Preparation Click here

DESCRIPTION

This DTC is stored if the engine does not start or continues to crash without starting for certain period of time. This DTC is also stored if the vehicle has run out of fuel. It is necessary to check whether there was enough fuel in the fuel tank before inspection.

P1604

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After engine is started	Both conditions are met for 2 seconds or more*1 (1 trip detection logic): • STA signal is input to the ECM. • Engine speed is 500 rpm or less. *1: The time required for DTC detection may be as much as 30 seconds depending on the engine coolant temperature and atmospheric pressure.	• Battery • Entry and start system • Engine immobiliser system • Irregular fuel • Lack of fuel • Suction control valve (fuel supply pump assembly) • Injector assembly • Fuel filter element sub-assembly • Glow system • Injector driver • Engine coolant temperature sensor • Intake system • Exhaust system • Engine damaged, seized up • Loss of compression • Pressure discharge valve (common rail assembly) • Fuel pressure sensor (common rail assembly) • EGR system • Diesel throttle system
	After starting the engine (engine speed is 500 rpm or more), the engine speed drops to 200 rpm or less within 2 seconds*2 (1 trip detection logic). *2: This DTC may be stored when the engine stalls due to clutch misoperation.	

Related Data List

DTC No.	Data List
P1604	• MAP • MAF • Intake Air • Coolant Temp • Battery Voltage • Starter Signal • Engine Speed of Cyl 1 (to) • Immobiliser Communication • Target Common Rail Pressure • Fuel Press • Target Pump SCV Current • Injection Feedback Val 1 (to) • Injection Volume • Actual Throttle Position • Throttle Motor Duty 1, 2 • Target EGR Valve Position • Actual EGR Valve Pos. • EGR Close Lrn. Status • Pre Glow • After Glow

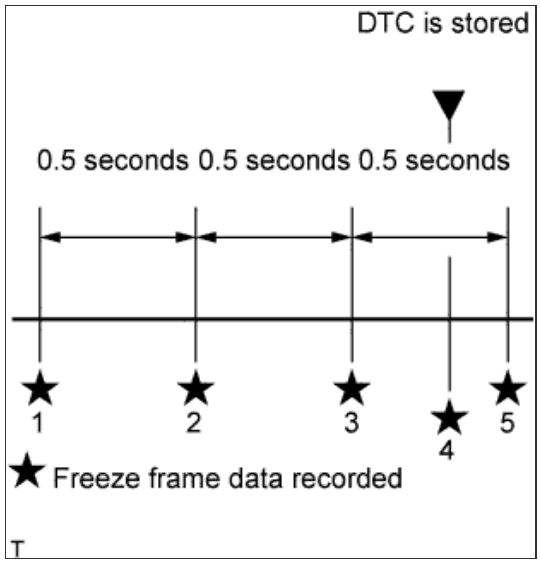
INSPECTION PROCEDURE

HINT:

- **In contrast to normal malfunction diagnosis for components, circuits and systems, DTC P1604 is used to determine the malfunctioning area from the problem symptoms and freeze frame data when the user mentions problems such as starting difficulty.**
  As these DTCs can be stored as a result of certain user actions, even if these DTCs are output, if the customer makes no mention

of problems, clear these DTCs without performing any troubleshooting and return the vehicle to the customer.

- **When confirming the freeze frame data, be sure to check all 5 data sets of freeze frame data.**
- **The fourth set of freeze frame data is the data recorded when the DTC is stored.**



In order to start the engine, the starting system, glow system, fuel system and the components related to compression must be functioning properly.

The cause of the problem can be narrowed down by checking if the engine cranks normally.

Starting system (when cranking is abnormal)

a. The engine cannot be started if a sufficient cranking speed cannot be obtained. The following are possible causes of an insufficient cranking speed.

i. Problem with the entry and start system (Engine does not crank).

ii. Problem with the immobiliser system (Engine does not crank).

iii. Problem with the battery (Cranking speed is low).

iv. Problem with the starter (Cranking speed is low).

Glow system (when cranking is normal)

a. When there is a problem with the glow system, the intake air temperature does not rise adequately and the fuel combustion temperature is not reached. Therefore, there is no initial combustion or it takes time for the engine to start. The following are possible causes.

i. Engine coolant temperature sensor malfunction.

ii. Glow plug malfunction.

HINT:

If the glow plug has deteriorated, the engine may be less likely to start when the outside temperature is lower than 0°C.

iii. Glow relay malfunction.

Fuel system (when cranking is normal)

a. The engine cannot be started if fuel is not supplied. A minimum fuel pressure of 25000 kPa or higher must be supplied to start the engine. The following are possible causes of insufficient fuel pressure.

i. Fuel line clog.

ii. Lack of fuel.

iii. Fuel frozen.

iv. Low quality fuel.

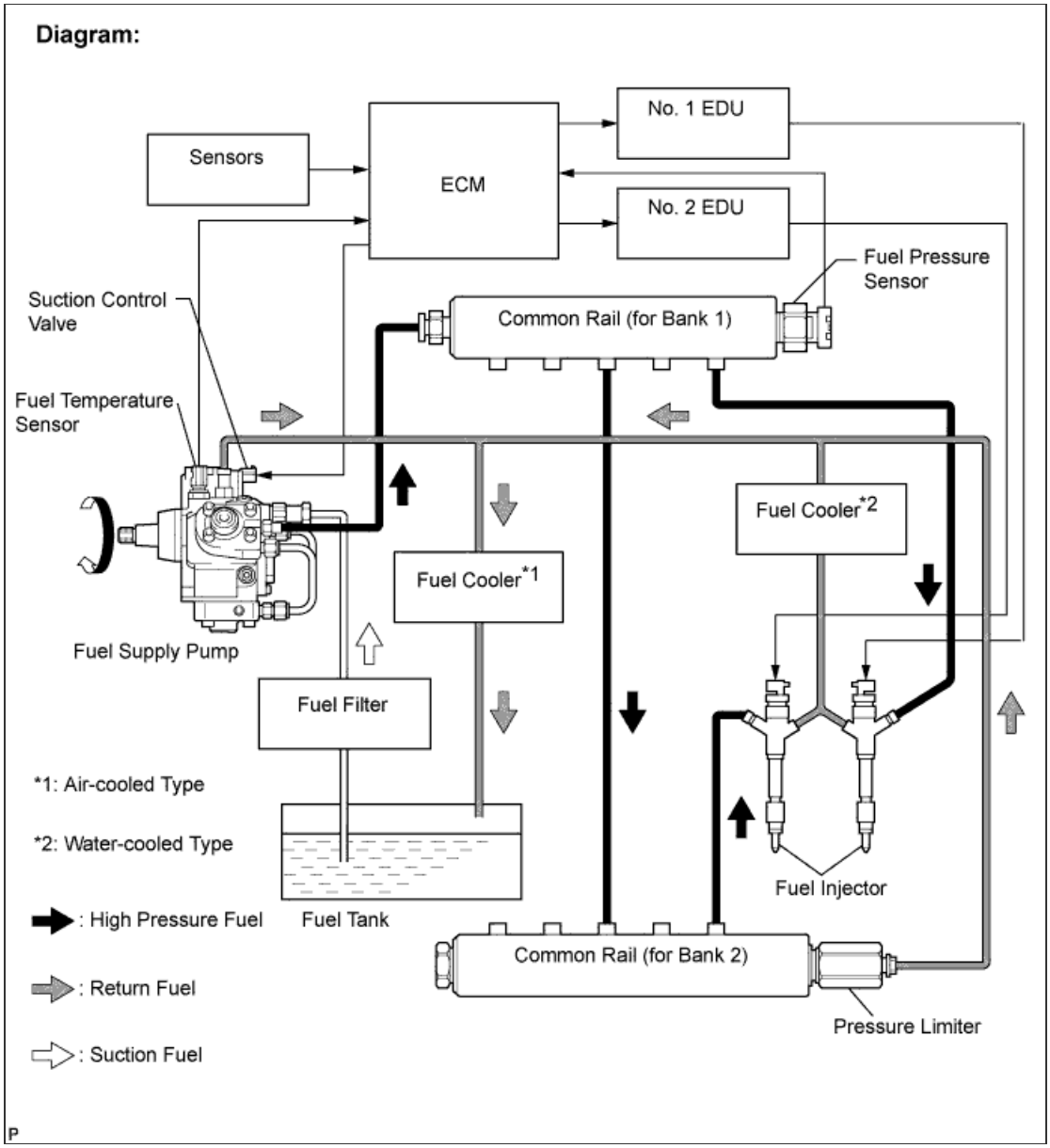
v. Air in fuel pipe.

vi. Fuel filter element sub-assembly clog.

vii. Problem with fuel supply pump assembly.

viii. Problem with common rail assembly.

ix. Problem with injector assemblies.



Engine assembly

a. There may be a problem with the engine unit itself if there is no problem with cranking, the glow system or fuel system.

i. Engine friction too high.

ii. Insufficient compression.

1.READ OUTPUT DTC (RECORD STORED DTC AND FREEZE FRAME DATA) (PROCEDURE 1)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Record the stored DTCs and freeze frame data.

HINT:

Freeze frame data shows the actual engine conditions when engine starting trouble occurred.

NEXT

2.CHECK FOR ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P1604)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P1604 is output	A
P1604 and other DTCs are output	B

HINT:

If any DTCs other than DTC P1604 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

ENGINE DIFFICULT TO START OR STALLING (Click here)

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

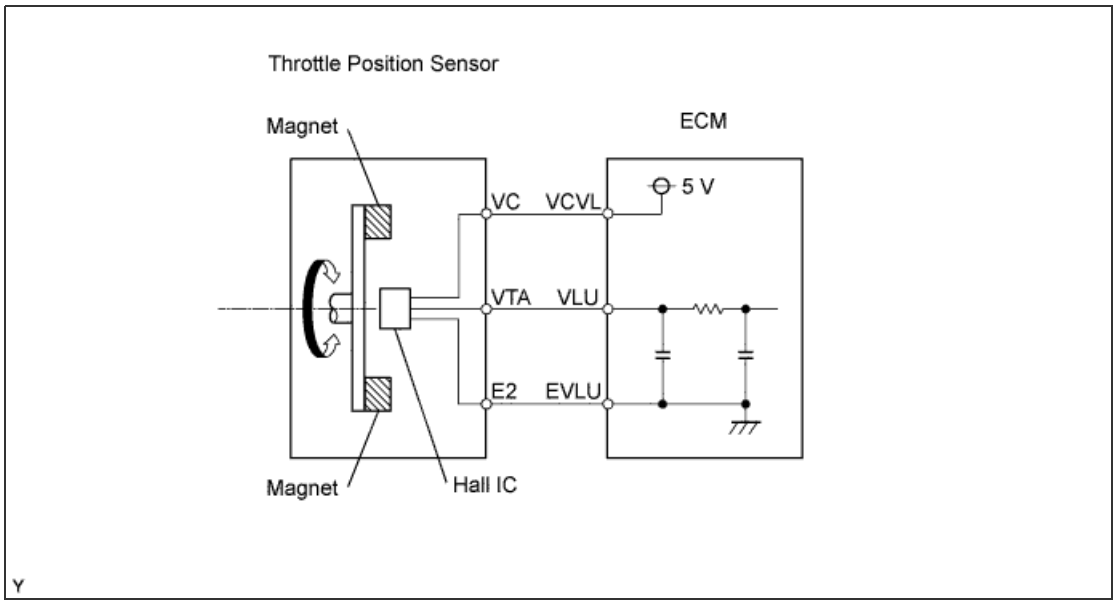
for Preparation Click here

DESCRIPTION

The throttle position sensor is mounted on the diesel throttle body and detects the opening angle of the throttle valve. This sensor is an electronic sensor and uses Hall-effect elements.

When the throttle valve is fully closed, a voltage of approximately 0.7 V is applied to terminal VLU of the ECM. The voltage applied to terminal VLU of the ECM increases in proportion to the opening angle of the throttle valve and becomes approximately 3.5 to 4.0 V when the throttle valve is fully opened.

The ECM determines the vehicle driving conditions from the signals input to its VLU terminal. The data is one of the inputs used for EGR control, etc.



P0122

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3 seconds	Throttle position sensor (for Bank 1) output (VLU) is less than 0.2 V for 3 seconds (1 trip detection logic).	• Throttle position sensor (for Bank 1) • Open or short in VLU circuit • Open in VC circuit • ECM

P0123

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3 seconds	Throttle position sensor (for Bank 1) output (VLU) is more than 4.8 V for 3 seconds (1 trip detection logic).	• Throttle position sensor (for Bank 1) • Open in E2 circuit • VC and VLU circuits are short-circuited • ECM

P0222

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3	Throttle position sensor (for Bank 2) output (VLU2) is less than 0.2 V for 3 seconds	• Throttle position sensor (for Bank 2) • Open or short in VLU2

seconds	(1 trip detection logic).	circuit • Open in VC circuit • ECM

P0223

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3 seconds	Throttle position sensor (for Bank 2) output (VLU2) is more than 4.8 V for 3 seconds (1 trip detection logic).	• Throttle position sensor (for Bank 2) • Open in E2 circuit • VC and VLU2 circuits are short-circuited • ECM

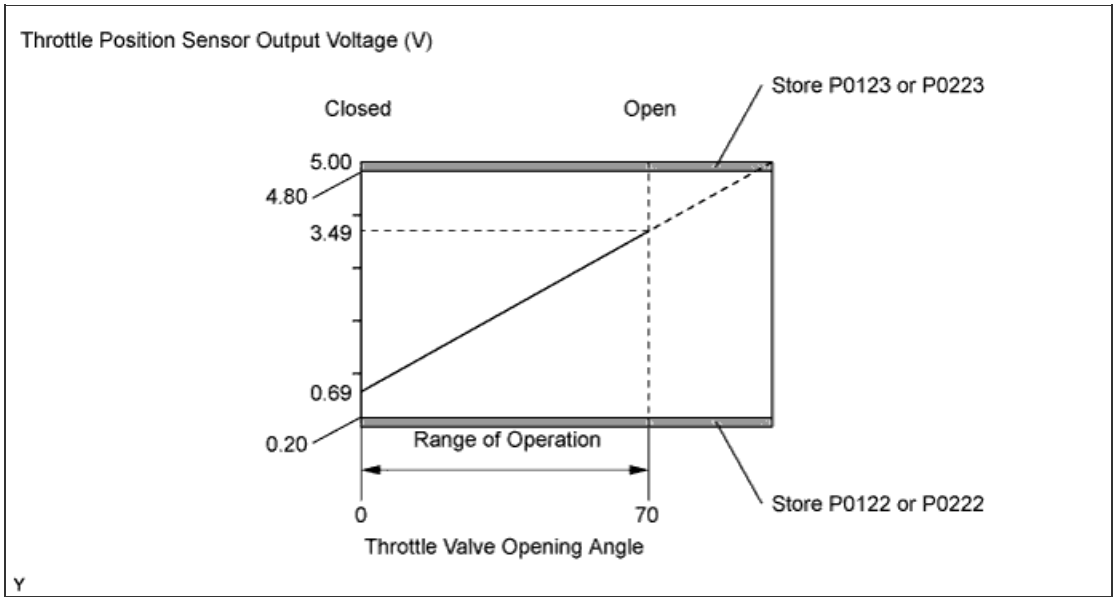
HINT:

If DTC P0122, P0123, P0222 and/or P0223 is stored, the following symptoms may appear:

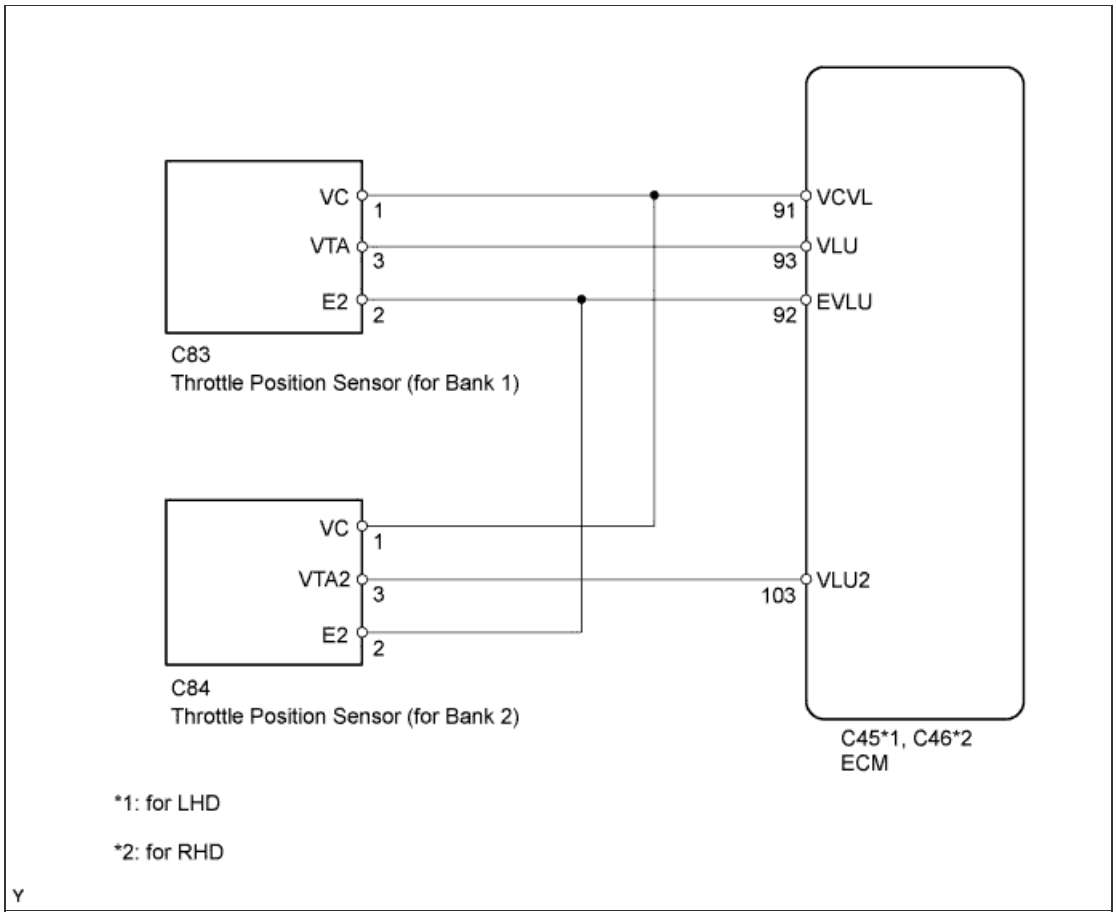
- Intake booming noise
- Black smoke
- Lack of power
- Vibration at engine stop
- Turbo overspeed, turbo damage

MONITOR DESCRIPTION

When the output voltage of the throttle position sensor deviates from the normal operating range (between 0.2 V and 4.8 V) for more than 3 seconds, the ECM interprets this as a malfunction of the sensor circuit and illuminates the MIL.



WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

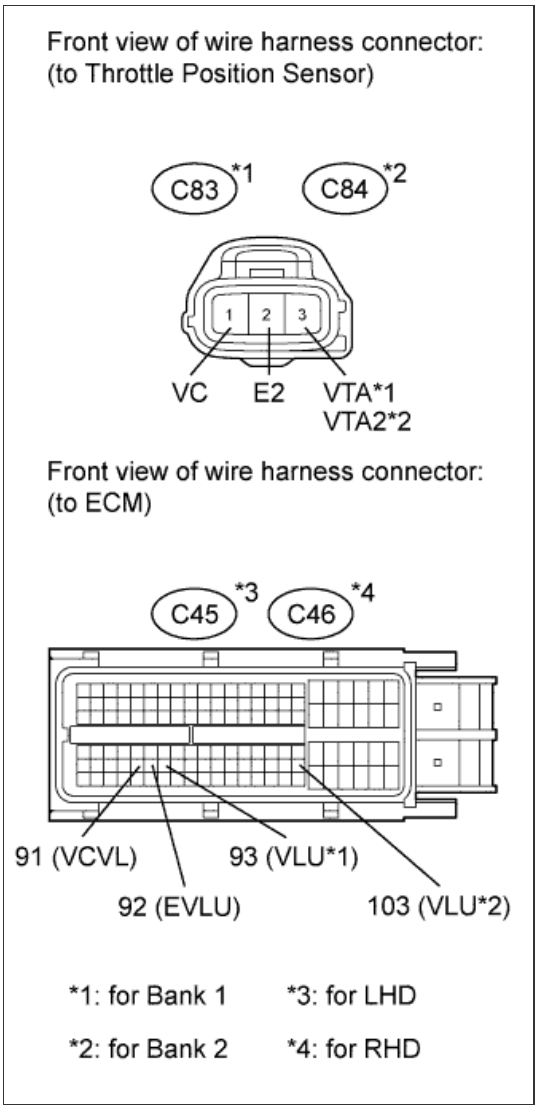
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the throttle position sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for Bank 1 (LHD)

Tester Connection	Condition	Specified Condition
C83-1 (VC) - C45-91 (VCVL)	Always	Below 1 Ω
C83-3 (VTA) - C45-93 (VLU)	Always	Below 1 Ω
C83-2 (E2) - C45-92 (EVLU)	Always	Below 1 Ω

for Bank 2 (LHD)

Tester Connection	Condition	Specified Condition
C84-1 (VC) - C45-91 (VCVL)	Always	Below 1 Ω
C84-3 (VTA2) - C45-103 (VLU2)	Always	Below 1 Ω
C84-2 (E2) - C45-92 (EVLU)	Always	Below 1 Ω

for Bank 1 (RHD)

Tester Connection	Condition	Specified Condition
C83-1 (VC) - C46-91 (VCVL)	Always	Below 1 Ω
C83-3 (VTA) - C46-93 (VLU)	Always	Below 1 Ω
C83-2 (E2) - C46-92 (EVLU)	Always	Below 1 Ω

for Bank 2 (RHD)

Tester Connection	Condition	Specified Condition
C84-1 (VC) - C46-91 (VCVL)	Always	Below 1 Ω

C84-3 (VTA2) - C46-103 (VLU2)	Always	Below 1 Ω
C84-2 (E2) - C46-92 (EVLU)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for Bank 1 (LHD)

Tester Connection	Condition	Specified Condition
C83-1 (VC) or C45-91 (VCVL) - Body ground	Always	10 kΩ or higher
C83-3 (VTA) or C45-93 (VLU) - Body ground	Always	10 kΩ or higher
C83-2 (E2) or C45-92 (EVLU) - Body ground	Always	10 kΩ or higher

for Bank 2 (LHD)

Tester Connection	Condition	Specified Condition
C84-1 (VC) or C45-91 (VCVL) - Body ground	Always	10 kΩ or higher
C84-3 (VTA2) or C45-103 (VLU2) - Body ground	Always	10 kΩ or higher
C84-2 (E2) or C45-92 (EVLU) - Body ground	Always	10 kΩ or higher

for Bank 1 (RHD)

Tester Connection	Condition	Specified Condition
C83-1 (VC) or C46-91 (VCVL) - Body ground	Always	10 kΩ or higher
C83-3 (VTA) or C46-93 (VLU) - Body ground	Always	10 kΩ or higher
C83-2 (E2) or C46-92 (EVLU) - Body ground	Always	10 kΩ or higher

for Bank 2 (RHD)

Tester Connection	Condition	Specified Condition
C84-1 (VC) or C46-91 (VCVL) - Body ground	Always	10 kΩ or higher
C84-3 (VTA2) or C46-103 (VLU2) - Body ground	Always	10 kΩ or higher
C84-2 (E2) or C46-92 (EVLU) - Body ground	Always	10 kΩ or higher

NG → Go to step 6

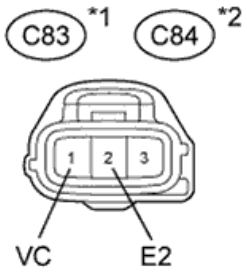
OK

2.CHECK ECM TERMINAL VOLTAGE (VC TERMINAL)

a. Disconnect the throttle position sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Front view of wire harness connector:
(to Throttle Position Sensor)



*1: for Bank 1

*2: for Bank 2

Standard Voltage:

for Bank 1

Tester Connection	Switch Condition	Specified Condition
C83-1 (VC) - C83-2 (E2)	Ignition switch ON	4.5 to 5.5 V

for Bank 2

Tester Connection	Switch Condition	Specified Condition
C84-1 (VC) - C84-2 (E2)	Ignition switch ON	4.5 to 5.5 V

NG → Go to step 5

OK

3.REPLACE DIESEL THROTTLE BODY ASSEMBLY (for Bank 1 or Bank 2)

a. Replace the diesel throttle body assembly (for Bank 1 or Bank 2) (Click here).

NEXT

4.READ VALUE USING INTELLIGENT TESTER

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Enter the following menus: Powertrain / Engine / Data List / Actual Throttle position or Actual Throttle position #2.

e. Check the movement of the throttle valve when idling the engine after starting it from ignition switch ON.

OK

Condition	Tester Display
Ignition switch ON	-5 to 5%
Idling	0 to 90%

OK → END

NG → Go to step 5

5.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 7

6.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

7.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 3 seconds.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

DTC P1605 Rough Idling

for Preparation Click here

DESCRIPTION

If the idle speed drops or becomes unstable when the engine is running at idle with a low load, this DTC is stored. This DTC is also stored if the vehicle runs out of fuel. Be sure to check whether there is enough fuel in the fuel tank before inspection.

P1605

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
-	The engine speed drops to less than 400 rpm (1 trip detection logic).	• Injector assembly • Injector compensation code • Fuel leak • Glow system • Intake air system leakage • Intake air system blockage • EGR system • Throttle valve system • Suction control valve (fuel supply pump assembly) • Low quality fuel • Fuel filter element sub-assembly air bleed problem • Accessory problem (A/C, generator, etc.) • Engine assembly • ECM

Related Data List

DTC No.	Data List
P1605	• Engine Speed • MAP • MAF • Coolant Temp • Battery Voltage • Engine Speed of Cyl 1 (to) • Intake Air • Target Common Rail Pressure • Fuel Press • Target Pump SCV Current • Injection Feedback Val 1 (to) • Injection Volume • Actual Throttle Position • Target EGR Valve Pos. • Actual EGR Valve Pos. • EGR Close Lrn. Status • After Glow

INSPECTION PROCEDURE

In order for idling to be stable, glow system operation, fuel system operation and compression sufficient to maintain the target idling speed are necessary.

Glow system

a. The following malfunctions may be present in the glow system.

i. Engine coolant temperature sensor malfunction.

ii. Glow plug malfunction.

iii. Glow relay malfunction.

Fuel system

a. The following malfunctions may be present in the fuel system.

i. Fuel leakage.

ii. Problem with injector assemblies.

iii. Problem with fuel supply pump assembly.

iv. Air in fuel pipe.

Engine assembly

a. The following malfunctions may be present in the engine assembly.

i. Insufficient compression.

HINT:

- **In contrast to normal malfunction diagnosis for components, circuits and systems, DTCs P1603 and P1605 are used to determine the malfunctioning area from the problem symptoms and freeze frame data when the user mentions problems such as engine stall. As these DTCs can be stored as a result of certain user actions, even if these DTCs are output, if the customer makes no mention of problems, clear these DTCs without performing any troubleshooting and return the vehicle to the customer.**
- **If any other DTCs are output, perform troubleshooting for those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**
- **When confirming the freeze frame data, be sure to check all 5 sets of freeze frame data.**

1.CHECK FOR ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P1605)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine and ECT / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P1605 is output	A
P1605 and other DTCs are output	B

HINT:

If any DTCs other than P1605 are output, troubleshoot those DTCs first.

B → **GO TO DTC CHART (Click here)**

A

GO TO ROUGH IDLING OR EXCESSIVE ENGINE VIBRATIONS (Click here)

DTC P0122 Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input

DTC P0123 Throttle / Pedal Position Sensor / Switch "A" Circuit High Input

DTC P0222 Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

DTC P0223 Throttle / Pedal Position Sensor / Switch "B" Circuit High Input

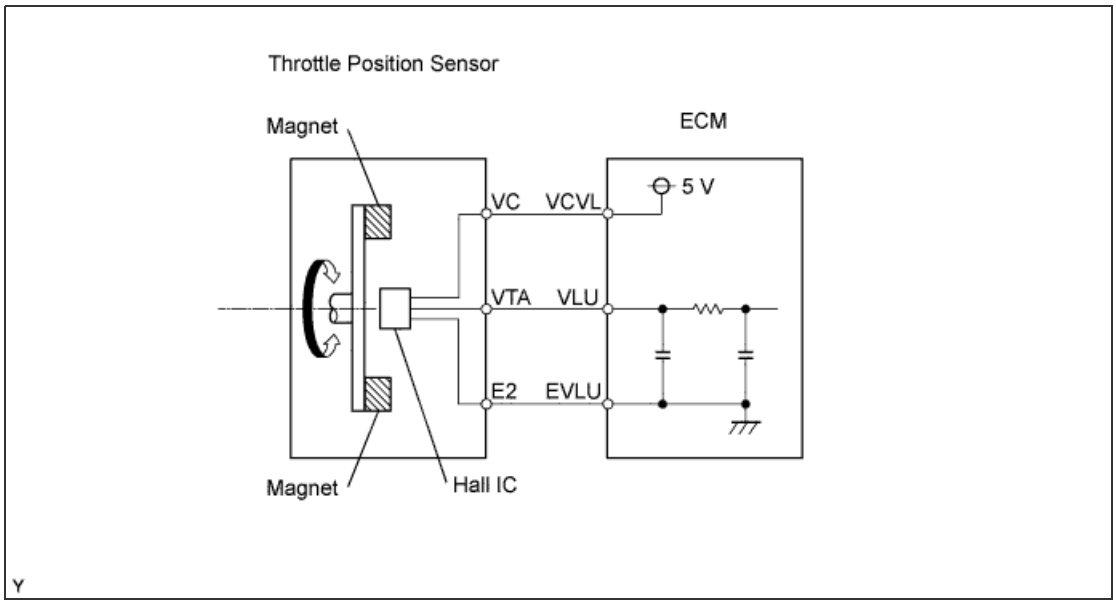
for Preparation Click here

DESCRIPTION

The throttle position sensor is mounted on the diesel throttle body and detects the opening angle of the throttle valve. This sensor is an electronic sensor and uses Hall-effect elements.

When the throttle valve is fully closed, a voltage of approximately 0.7 V is applied to terminal VLU of the ECM. The voltage applied to terminal VLU of the ECM increases in proportion to the opening angle of the throttle valve and becomes approximately 3.5 to 4.0 V when the throttle valve is fully opened.

The ECM determines the vehicle driving conditions from the signals input to its VLU terminal. The data is one of the inputs used for EGR control, etc.



P0122

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3 seconds	Throttle position sensor (for Bank 1) output (VLU) is less than 0.2 V for 3 seconds (1 trip detection logic).	• Throttle position sensor (for Bank 1) • Open or short in VLU circuit • Open in VC circuit • ECM

P0123

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3 seconds	Throttle position sensor (for Bank 1) output (VLU) is more than 4.8 V for 3 seconds (1 trip detection logic).	• Throttle position sensor (for Bank 1) • Open in E2 circuit • VC and VLU circuits are short-circuited • ECM

P0222

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3	Throttle position sensor (for Bank 2) output (VLU2) is less than 0.2 V for 3 seconds	• Throttle position sensor (for Bank 2) • Open or short in VLU2

seconds	(1 trip detection logic).	circuit • Open in VC circuit • ECM

P0223

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 3 seconds	Throttle position sensor (for Bank 2) output (VLU2) is more than 4.8 V for 3 seconds (1 trip detection logic).	• Throttle position sensor (for Bank 2) • Open in E2 circuit • VC and VLU2 circuits are short-circuited • ECM

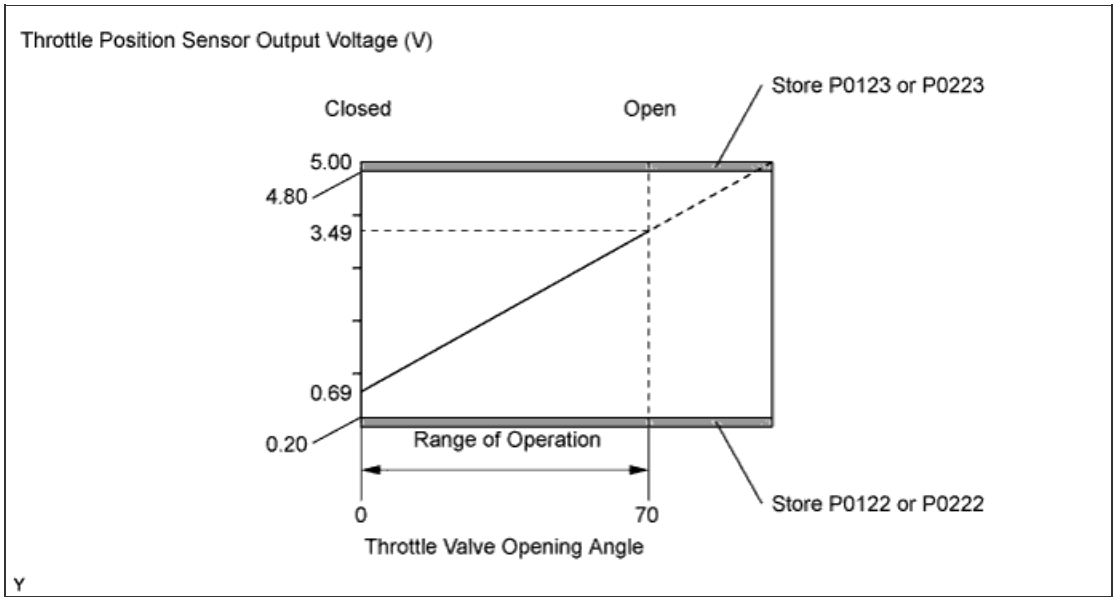
HINT:

If DTC P0122, P0123, P0222 and/or P0223 is stored, the following symptoms may appear:

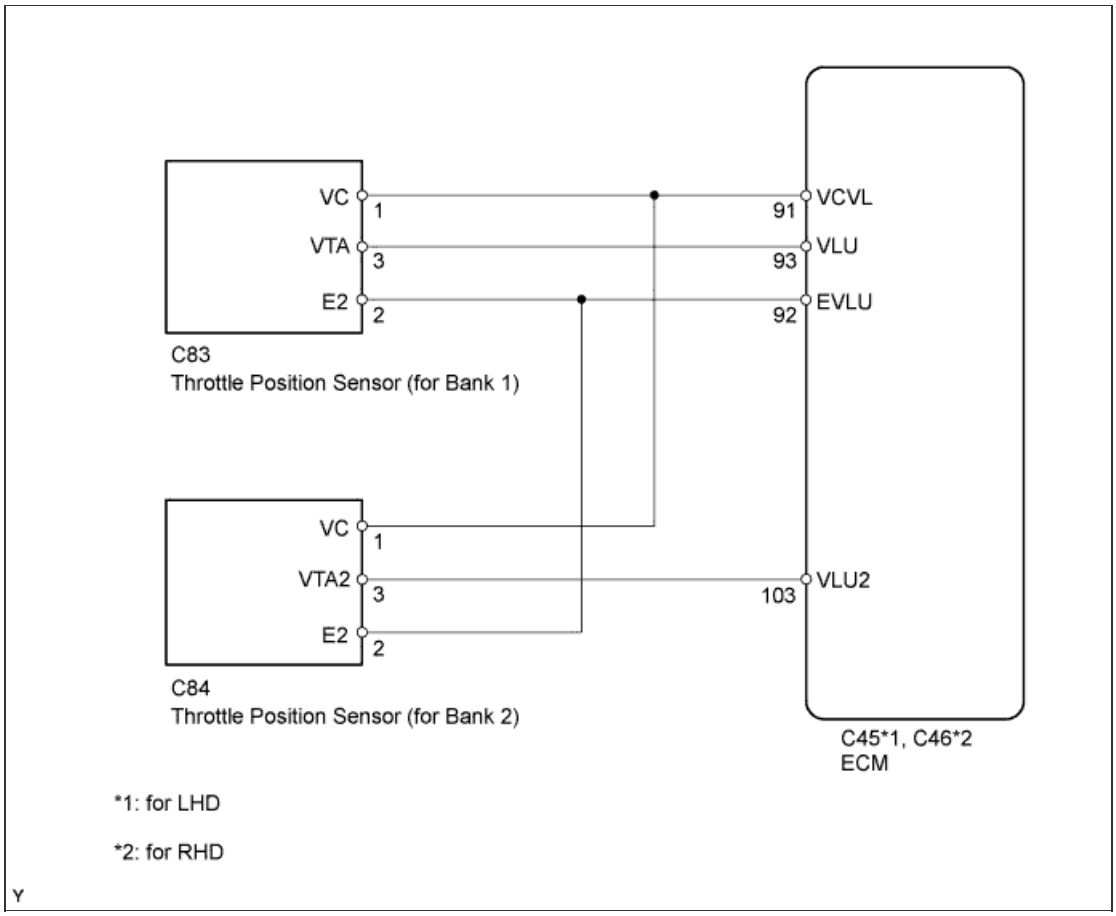
- Intake booming noise
- Black smoke
- Lack of power
- Vibration at engine stop
- Turbo overspeed, turbo damage

MONITOR DESCRIPTION

When the output voltage of the throttle position sensor deviates from the normal operating range (between 0.2 V and 4.8 V) for more than 3 seconds, the ECM interprets this as a malfunction of the sensor circuit and illuminates the MIL.



WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

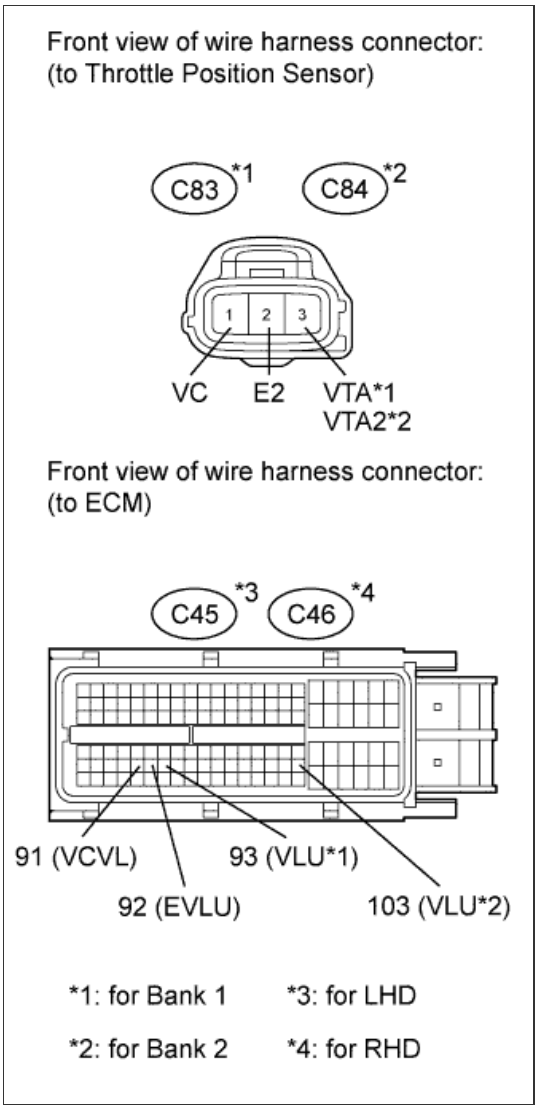
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

a. Disconnect the throttle position sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for Bank 1 (LHD)

Tester Connection	Condition	Specified Condition
C83-1 (VC) - C45-91 (VCVL)	Always	Below 1 Ω
C83-3 (VTA) - C45-93 (VLU)	Always	Below 1 Ω
C83-2 (E2) - C45-92 (EVLU)	Always	Below 1 Ω

for Bank 2 (LHD)

Tester Connection	Condition	Specified Condition
C84-1 (VC) - C45-91 (VCVL)	Always	Below 1 Ω
C84-3 (VTA2) - C45-103 (VLU2)	Always	Below 1 Ω
C84-2 (E2) - C45-92 (EVLU)	Always	Below 1 Ω

for Bank 1 (RHD)

Tester Connection	Condition	Specified Condition
C83-1 (VC) - C46-91 (VCVL)	Always	Below 1 Ω
C83-3 (VTA) - C46-93 (VLU)	Always	Below 1 Ω
C83-2 (E2) - C46-92 (EVLU)	Always	Below 1 Ω

for Bank 2 (RHD)

Tester Connection	Condition	Specified Condition
C84-1 (VC) - C46-91 (VCVL)	Always	Below 1 Ω

C84-3 (VTA2) - C46-103 (VLU2)	Always	Below 1 Ω
C84-2 (E2) - C46-92 (EVLU)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for Bank 1 (LHD)

Tester Connection	Condition	Specified Condition
C83-1 (VC) or C45-91 (VCVL) - Body ground	Always	10 kΩ or higher
C83-3 (VTA) or C45-93 (VLU) - Body ground	Always	10 kΩ or higher
C83-2 (E2) or C45-92 (EVLU) - Body ground	Always	10 kΩ or higher

for Bank 2 (LHD)

Tester Connection	Condition	Specified Condition
C84-1 (VC) or C45-91 (VCVL) - Body ground	Always	10 kΩ or higher
C84-3 (VTA2) or C45-103 (VLU2) - Body ground	Always	10 kΩ or higher
C84-2 (E2) or C45-92 (EVLU) - Body ground	Always	10 kΩ or higher

for Bank 1 (RHD)

Tester Connection	Condition	Specified Condition
C83-1 (VC) or C46-91 (VCVL) - Body ground	Always	10 kΩ or higher
C83-3 (VTA) or C46-93 (VLU) - Body ground	Always	10 kΩ or higher
C83-2 (E2) or C46-92 (EVLU) - Body ground	Always	10 kΩ or higher

for Bank 2 (RHD)

Tester Connection	Condition	Specified Condition
C84-1 (VC) or C46-91 (VCVL) - Body ground	Always	10 kΩ or higher
C84-3 (VTA2) or C46-103 (VLU2) - Body ground	Always	10 kΩ or higher
C84-2 (E2) or C46-92 (EVLU) - Body ground	Always	10 kΩ or higher

NG → Go to step 6

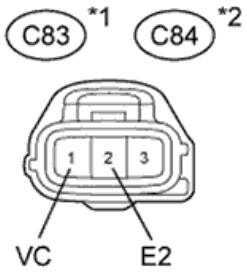
OK

2.CHECK ECM TERMINAL VOLTAGE (VC TERMINAL)

a. Disconnect the throttle position sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Front view of wire harness connector:
(to Throttle Position Sensor)



*1: for Bank 1

*2: for Bank 2

Standard Voltage:

for Bank 1

Tester Connection	Switch Condition	Specified Condition
C83-1 (VC) - C83-2 (E2)	Ignition switch ON	4.5 to 5.5 V

for Bank 2

Tester Connection	Switch Condition	Specified Condition
C84-1 (VC) - C84-2 (E2)	Ignition switch ON	4.5 to 5.5 V

NG → Go to step 5

OK

3.REPLACE DIESEL THROTTLE BODY ASSEMBLY (for Bank 1 or Bank 2)

a. Replace the diesel throttle body assembly (for Bank 1 or Bank 2) (Click here).

NEXT

4.READ VALUE USING INTELLIGENT TESTER

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Clear the DTCs (Click here).

d. Enter the following menus: Powertrain / Engine / Data List / Actual Throttle position or Actual Throttle position #2.

e. Check the movement of the throttle valve when idling the engine after starting it from ignition switch ON.

OK

Condition	Tester Display
Ignition switch ON	-5 to 5%
Idling	0 to 90%

OK → END

NG → Go to step 5

5.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 7

6.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

7.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 3 seconds.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

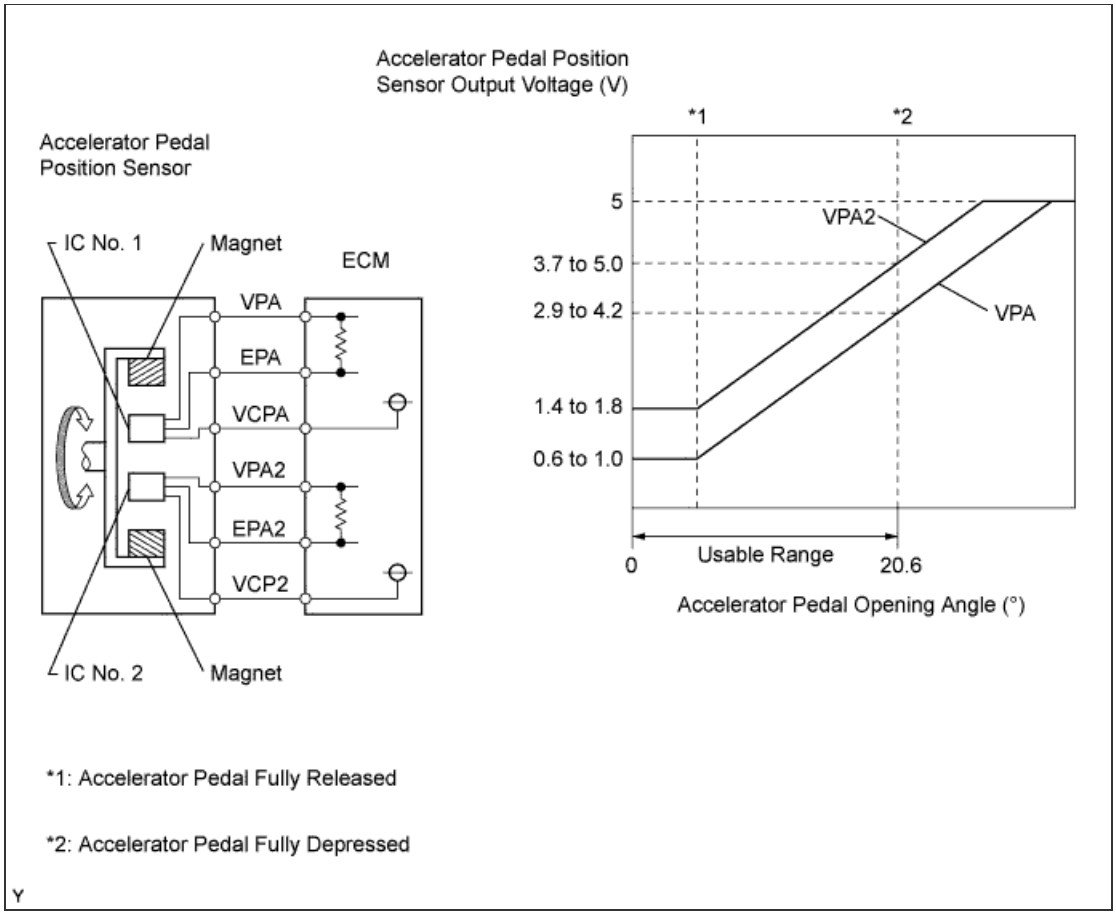
for Preparation Click here

DESCRIPTION

HINT:

- **This is the repair procedure for the accelerator pedal position sensor.**
- **This electrical throttle system does not use a throttle cable.**
- **This accelerator pedal position sensor is a non-contact type.**

The accelerator pedal position sensor is mounted on the accelerator pedal and detects the opening angle of the accelerator pedal. Since this sensor is electronically controlled with Hall-effect elements, accurate control and reliability can be obtained. It has 2 sensors to detect the accelerator position and a malfunction of the accelerator pedal position sensor.
In the accelerator pedal position sensor, the voltage applied to pedal terminals VPA and VPA2 of the ECM changes between 0 V and 5 V in proportion to the opening angle of the accelerator pedal. The VPA is a signal to indicate the actual accelerator pedal opening angle which is used for the engine control, and the VPA2 is a signal to indicate information about the opening angle which is used for detecting malfunctions. The ECM judges the current opening angle of the accelerator pedal using signals from terminals VPA and VPA2, and the ECM controls the throttle motor based on these signals.



P2120

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON		• Accelerator pedal

• Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) continues for 0.5 seconds (1 trip detection logic): (a) VPA is less than 0.4 V and VPA2 is more than 0.97 deg, or VPA is more than 4.8 V.	position sensor • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2122

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) and (b) continue for 0.5 seconds (1 trip detection logic): (a) VPA is less than 0.4 V. (b) VPA2 is more than 0.97 deg.	• Accelerator pedal position sensor • Open in VCPA circuit • VPA circuit open or ground short • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2123

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) continues for 2.0 seconds (1 trip detection logic): (a) VPA is more than 4.8 V.	• Accelerator pedal position sensor • Open in EPA circuit • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2125

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) continues for 0.5 seconds (1 trip detection logic): (a) VPA2 is less than 1.2 V and VPA is more than 2.7 deg, or VPA2 is more than 4.8 V and VPA is more than 0.4 V but less than 3.45 V.	• Accelerator pedal position sensor • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2127

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) and (b) continue for 0.5 seconds (1 trip detection logic): (a) VPA2 is less than 1.2 V. (b) VPA2 is more than 2.7 deg.	• Accelerator pedal position sensor • Open in VCP2 circuit • VPA2 circuit open or ground short • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2128

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Conditions (a) and (b) continue for 2.0 seconds (1 trip detection logic): (a) VPA2 is more than 4.8 V. (b) VPA is more than 0.4 V but less than 3.45 V.	• Accelerator pedal position sensor • Open in EPA2 circuit • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2138

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) or (b) continues for 2.0 seconds (1 trip detection logic): (a) The difference between VPA and VPA2 is less than 0.02 V. (b) VPA is less than 0.4 V and VPA2 is less than 1.2 V.	• VPA and VPA2 circuits are short-circuited • Accelerator pedal position sensor • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

Related Data List

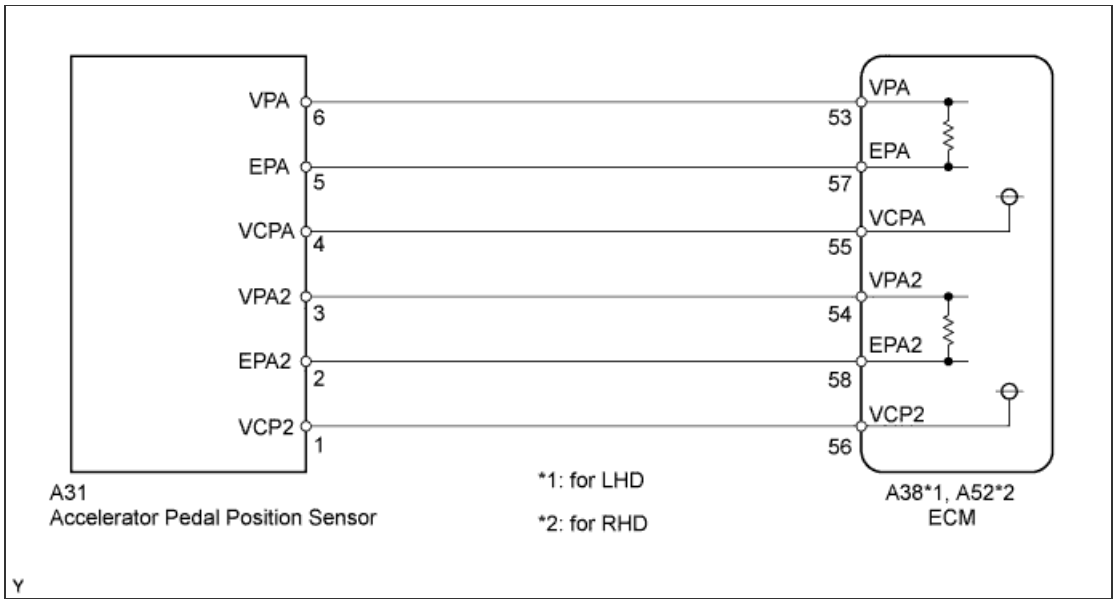
DTC No.	Data List
P2120	• Accel Sens. No.1 Volt % • Accel Sens. No.2 Volt % • Accel Sensor Out No.1 • Accel Sensor Out No.2
P2122	
P2123	
P2125	
P2127	
P2128	
P2138	

HINT:

When DTC P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138 is stored, check the output voltage of the accelerator pedal position sensor by entering the following menus: Powertrain / Engine / Data List / Accel Sensor Out No.1 and Accel Sensor Out No.2.

Trouble Area	Accelerator Pedal Position Expressed as Voltage Output			
	Accelerator Pedal Released		Accelerator Pedal Depressed	
	Accel Sensor Out No.1	Accel Sensor Out No.2	Accel Sensor Out No.1	Accel Sensor Out No.2
VC circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
VPA circuit open or ground short	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.0 V
VPA2 circuit open or ground short	0.5 to 1.1 V	0 to 0.2 V	2.9 to 3.6 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

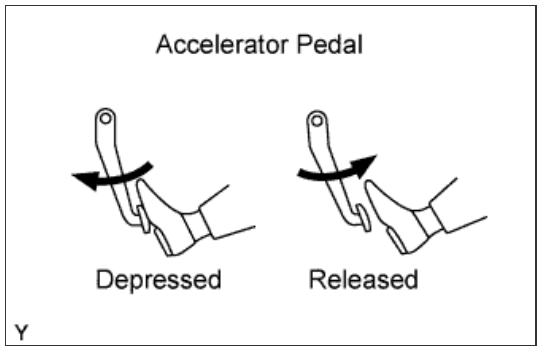
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR PEDAL POSITION)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Accel Sens. No.1 Volt % and Accel Sens. No.2 Volt %.

d. Read the values.



Standard:

Accelerator Pedal	Accel Sens. No.1 Volt %	Accel Sens. No.2 Volt %
Released	8 to 28%	30 to 55%
Depressed	51 to 86%	73 to 98%

Result

Result	Proceed to
NG	A
OK	B

B → Go to step 8

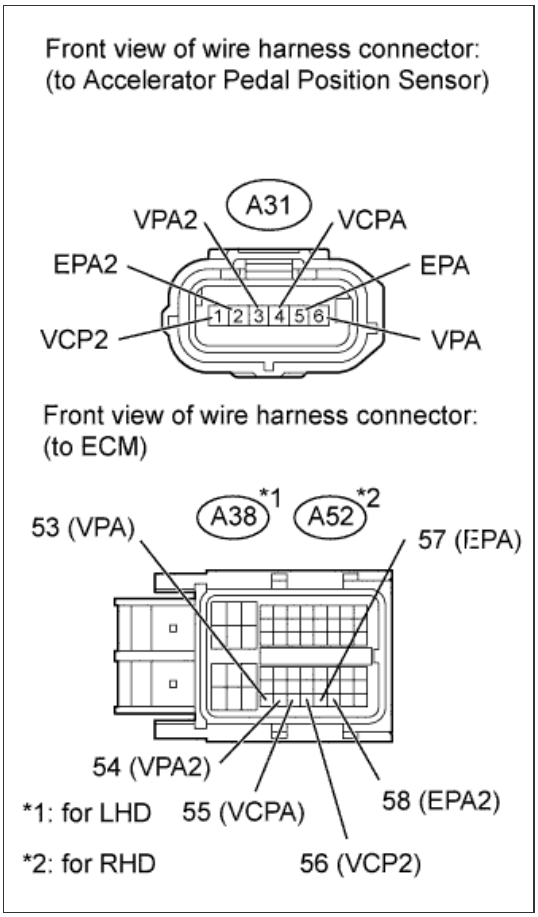
A

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the accelerator pedal position sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) - A38-56 (VCP2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-58 (EPA2)	Always	Below 1 Ω
A31-3 (VPA2) - A38-54 (VPA2)	Always	Below 1 Ω
A31-4 (VCPA) - A38-55 (VCPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-57 (EPA)	Always	Below 1 Ω
A31-6 (VPA) - A38-53 (VPA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) - A52-56 (VCP2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-58 (EPA2)	Always	Below 1 Ω
A31-3 (VPA2) - A52-54 (VPA2)	Always	Below 1 Ω
A31-4 (VCPA) - A52-55 (VCPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-57 (EPA)	Always	Below 1 Ω
A31-6 (VPA) - A52-53 (VPA)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) or A38-56 (VCP2) -		10 kΩ or

Body ground	Always	higher
A31-2 (EPA2) or A38-58 (EPA2) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-54 (VPA2) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-55 (VCPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-57 (EPA) - Body ground	Always	10 kΩ or higher
A31-6 (VPA) or A38-53 (VPA) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) or A52-56 (VCP2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-58 (EPA2) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-54 (VPA2) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-55 (VCPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-57 (EPA) - Body ground	Always	10 kΩ or higher
A31-6 (VPA) or A52-53 (VPA) - Body ground	Always	10 kΩ or higher

NG → Go to step 7

OK

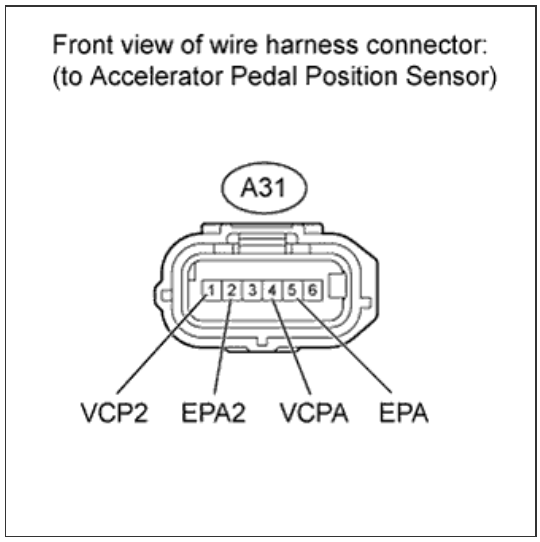
3.INSPECT ECM TERMINAL VOLTAGE (VCPA AND VCP2 TERMINALS)

a. Disconnect the accelerator pedal position sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Ignition switch ON	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Ignition switch ON	4.5 to 5.5 V



NG → Go to step 6

OK

4.REPLACE ACCELERATOR PEDAL ROD ASSEMBLY

a. Replace the accelerator pedal rod assembly (Click here).

NEXT

5.CHECK IF OUTPUT DTC RECURS

a. Connect the intelligent tester to the DLC3.

b. Clear the DTC (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON.

e. Fully close the accelerator pedal for 3 seconds, then hold it partway open for 3 seconds, then fully open it for 3 seconds.

f. Read the DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138 are output again	A
No output	B

B → END

A

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 8

7.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

8.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch off and leave the vehicle for 15 seconds.

e. Turn the ignition switch to ON.

f. Fully close the accelerator pedal for 3 seconds, then hold it partway open for 3 seconds, then fully open it for 3 seconds.

g. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, idle the engine.

NEXT

END

DTC P0168 Fuel Temperature Too High

for Preparation Click here

DESCRIPTION

Refer to DTC P0180 (Click here).

P0168

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Drive vehicle at high speed or with heavy load (Use freeze frame data from time malfunction occurred as reference while driving)	If the fuel temperature is between 35°C (95°F) and 60°C (140°F) at engine start, and conditions (a) and (b) are met: (a) Vehicle is driven at varying speeds (accelerating and decelerating). (b) Fuel temperature remains within 3°C (5.4°F) of the engine starting temperature.	Fuel temperature sensor
	If the fuel temperature is more than 60°C (140°F) at engine start, and conditions (a) and (b) are met: (a) Vehicle is driven at varying speeds (accelerating and decelerating). (b) Fuel temperature remains within 1°C (1.8°F) of the engine starting temperature, and this is continuously recorded 6 times.	

Related Data List

DTC No.	Data List
P0168	Fuel Temp

INSPECTION PROCEDURE

HINT:

- **If DTC P0180, P0182 and/or P0183 is stored at the same time as P0168, the fuel temperature sensor may have an open or short circuit. Troubleshoot those DTCs first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P0168)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P0168 is output	A
P0168 and other DTCs are output	B

HINT:

If DTCs other than P0168 are output, perform troubleshooting for those codes first.

B → GO TO DTC CHART (Click here)

A

2.REPLACE FUEL TEMPERATURE SENSOR

a. Replace the fuel temperature sensor (Click here).

NEXT

3.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON.

e. Drive the vehicle at a high speed or with a heavy load (Use freeze frame data from the time the malfunction occurred as a reference while driving).

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P0168.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, drive the vehicle at a high speed or with a heavy load.

NEXT

END

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

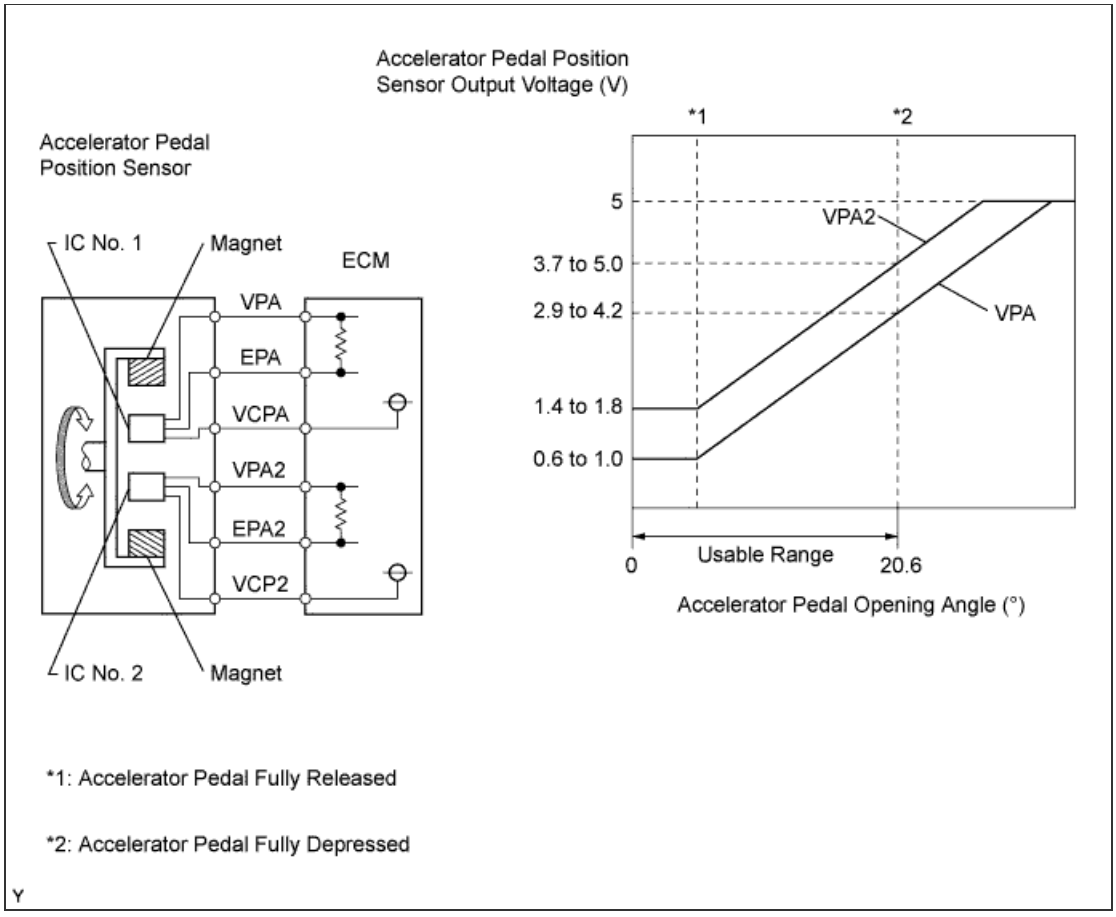
for Preparation Click here

DESCRIPTION

HINT:

- **This is the repair procedure for the accelerator pedal position sensor.**
- **This electrical throttle system does not use a throttle cable.**
- **This accelerator pedal position sensor is a non-contact type.**

The accelerator pedal position sensor is mounted on the accelerator pedal and detects the opening angle of the accelerator pedal. Since this sensor is electronically controlled with Hall-effect elements, accurate control and reliability can be obtained. It has 2 sensors to detect the accelerator position and a malfunction of the accelerator pedal position sensor.
In the accelerator pedal position sensor, the voltage applied to pedal terminals VPA and VPA2 of the ECM changes between 0 V and 5 V in proportion to the opening angle of the accelerator pedal. The VPA is a signal to indicate the actual accelerator pedal opening angle which is used for the engine control, and the VPA2 is a signal to indicate information about the opening angle which is used for detecting malfunctions. The ECM judges the current opening angle of the accelerator pedal using signals from terminals VPA and VPA2, and the ECM controls the throttle motor based on these signals.



P2120

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON		• Accelerator pedal

• Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) continues for 0.5 seconds (1 trip detection logic): (a) VPA is less than 0.4 V and VPA2 is more than 0.97 deg, or VPA is more than 4.8 V.	position sensor • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2122

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) and (b) continue for 0.5 seconds (1 trip detection logic): (a) VPA is less than 0.4 V. (b) VPA2 is more than 0.97 deg.	• Accelerator pedal position sensor • Open in VCPA circuit • VPA circuit open or ground short • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2123

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) continues for 2.0 seconds (1 trip detection logic): (a) VPA is more than 4.8 V.	• Accelerator pedal position sensor • Open in EPA circuit • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2125

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) continues for 0.5 seconds (1 trip detection logic): (a) VPA2 is less than 1.2 V and VPA is more than 2.7 deg, or VPA2 is more than 4.8 V and VPA is more than 0.4 V but less than 3.45 V.	• Accelerator pedal position sensor • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2127

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) and (b) continue for 0.5 seconds (1 trip detection logic): (a) VPA2 is less than 1.2 V. (b) VPA2 is more than 2.7 deg.	• Accelerator pedal position sensor • Open in VCP2 circuit • VPA2 circuit open or ground short • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2128

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Conditions (a) and (b) continue for 2.0 seconds (1 trip detection logic): (a) VPA2 is more than 4.8 V. (b) VPA is more than 0.4 V but less than 3.45 V.	• Accelerator pedal position sensor • Open in EPA2 circuit • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2138

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) or (b) continues for 2.0 seconds (1 trip detection logic): (a) The difference between VPA and VPA2 is less than 0.02 V. (b) VPA is less than 0.4 V and VPA2 is less than 1.2 V.	• VPA and VPA2 circuits are short-circuited • Accelerator pedal position sensor • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

Related Data List

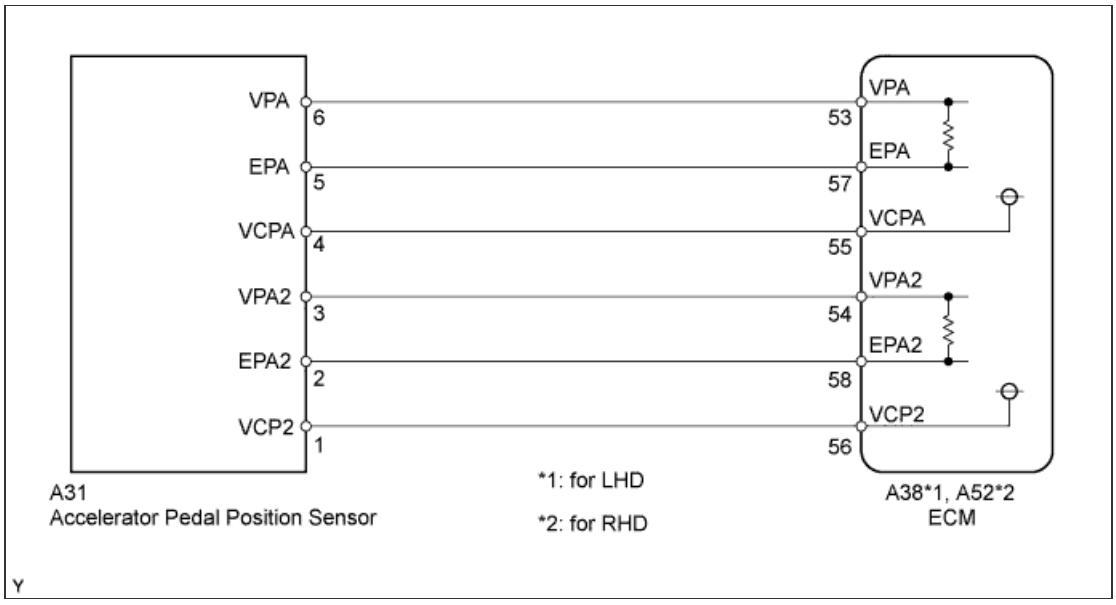
DTC No.	Data List
P2120	• Accel Sens. No.1 Volt % • Accel Sens. No.2 Volt % • Accel Sensor Out No.1 • Accel Sensor Out No.2
P2122	
P2123	
P2125	
P2127	
P2128	
P2138	

HINT:

When DTC P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138 is stored, check the output voltage of the accelerator pedal position sensor by entering the following menus: Powertrain / Engine / Data List / Accel Sensor Out No.1 and Accel Sensor Out No.2.

Trouble Area	Accelerator Pedal Position Expressed as Voltage Output			
	Accelerator Pedal Released		Accelerator Pedal Depressed	
	Accel Sensor Out No.1	Accel Sensor Out No.2	Accel Sensor Out No.1	Accel Sensor Out No.2
VC circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
VPA circuit open or ground short	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.0 V
VPA2 circuit open or ground short	0.5 to 1.1 V	0 to 0.2 V	2.9 to 3.6 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

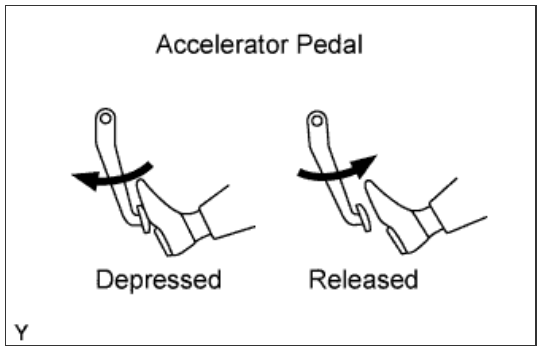
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR PEDAL POSITION)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Accel Sens. No.1 Volt % and Accel Sens. No.2 Volt %.

d. Read the values.



Standard:

Accelerator Pedal	Accel Sens. No.1 Volt %	Accel Sens. No.2 Volt %
Released	8 to 28%	30 to 55%
Depressed	51 to 86%	73 to 98%

Result

Result	Proceed to
NG	A
OK	B

B → Go to step 8

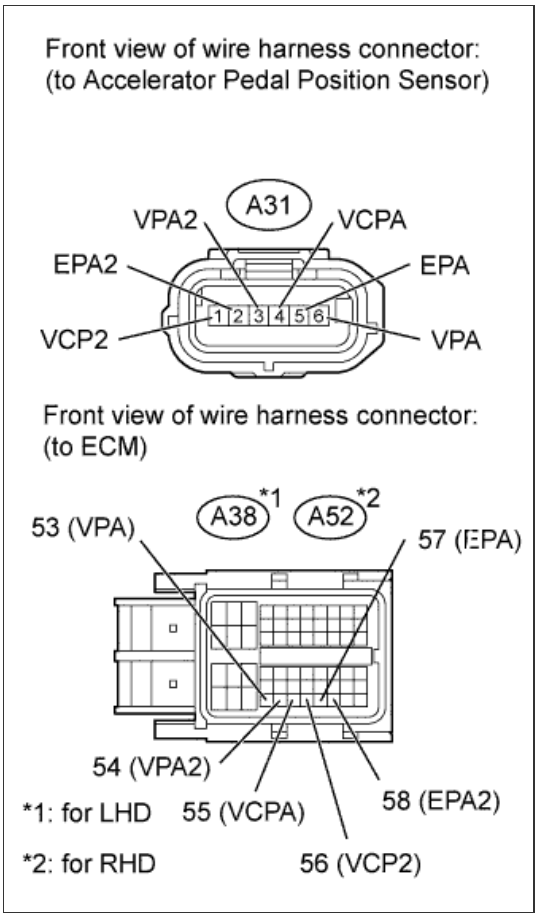
A

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the accelerator pedal position sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) - A38-56 (VCP2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-58 (EPA2)	Always	Below 1 Ω
A31-3 (VPA2) - A38-54 (VPA2)	Always	Below 1 Ω
A31-4 (VCPA) - A38-55 (VCPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-57 (EPA)	Always	Below 1 Ω
A31-6 (VPA) - A38-53 (VPA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) - A52-56 (VCP2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-58 (EPA2)	Always	Below 1 Ω
A31-3 (VPA2) - A52-54 (VPA2)	Always	Below 1 Ω
A31-4 (VCPA) - A52-55 (VCPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-57 (EPA)	Always	Below 1 Ω
A31-6 (VPA) - A52-53 (VPA)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) or A38-56 (VCP2) -		10 kΩ or

Body ground	Always	higher
A31-2 (EPA2) or A38-58 (EPA2) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-54 (VPA2) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-55 (VCPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-57 (EPA) - Body ground	Always	10 kΩ or higher
A31-6 (VPA) or A38-53 (VPA) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) or A52-56 (VCP2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-58 (EPA2) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-54 (VPA2) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-55 (VCPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-57 (EPA) - Body ground	Always	10 kΩ or higher
A31-6 (VPA) or A52-53 (VPA) - Body ground	Always	10 kΩ or higher

NG → Go to step 7

OK

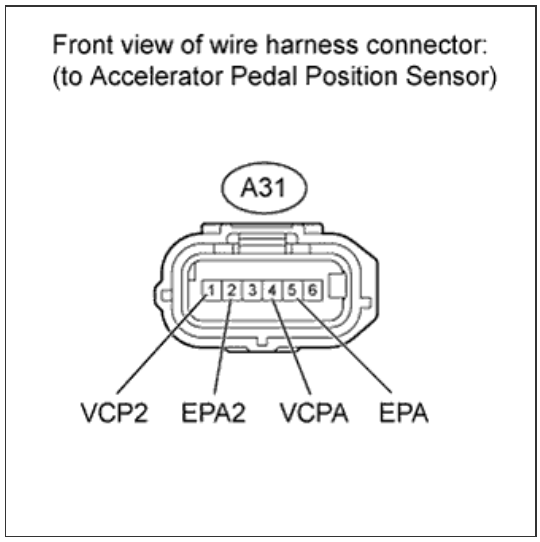
3.INSPECT ECM TERMINAL VOLTAGE (VCPA AND VCP2 TERMINALS)

a. Disconnect the accelerator pedal position sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Ignition switch ON	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Ignition switch ON	4.5 to 5.5 V



NG → Go to step 6

OK

4.REPLACE ACCELERATOR PEDAL ROD ASSEMBLY

a. Replace the accelerator pedal rod assembly (Click here).

NEXT

5.CHECK IF OUTPUT DTC RECURS

a. Connect the intelligent tester to the DLC3.

b. Clear the DTC (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON.

e. Fully close the accelerator pedal for 3 seconds, then hold it partway open for 3 seconds, then fully open it for 3 seconds.

f. Read the DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138 are output again	A
No output	B

B → END

A

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 8

7.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

8.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch off and leave the vehicle for 15 seconds.

e. Turn the ignition switch to ON.

f. Fully close the accelerator pedal for 3 seconds, then hold it partway open for 3 seconds, then fully open it for 3 seconds.

g. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, idle the engine.

NEXT

END

DTC P0180 Fuel Temperature Sensor "A" Circuit

DTC P0182 Fuel Temperature Sensor "A" Circuit Low Input

DTC P0183 Fuel Temperature Sensor "A" Circuit High Input

for Preparation Click here

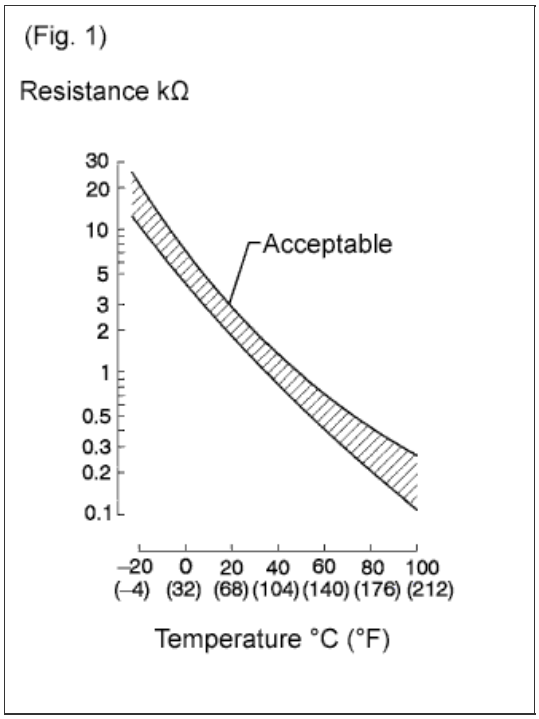
DESCRIPTION

The fuel temperature sensor monitors the fuel temperature. The fuel temperature sensor has a thermistor that varies its resistance depending on the fuel temperature. When the fuel temperature is low, the resistance of the thermistor is high. When the temperature is high, the resistance is low. The variations of resistance are communicated to the ECM as changes of voltage (See Fig. 1).

The fuel temperature sensor is connected to the ECM. The 5 V power source voltage in the ECM is applied to the fuel temperature sensor from terminal THF via resistor R.

Resistor R and the fuel temperature sensor are connected in series. When the resistance value of the fuel temperature sensor changes due to a change of fuel temperature, the voltage at terminal THF also changes. Based on this signal, the ECM corrects the pressure control compensation of the fuel supply pump and determines if there are errors.

(Fig. 1)



P0180

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Open or short in the fuel temperature sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in fuel temperature sensor circuit • Fuel temperature sensor • ECM

P0182

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Short in the fuel temperature sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in fuel temperature sensor circuit • Fuel temperature sensor • ECM

P0183

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Open in the fuel temperature sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in fuel temperature sensor circuit • Fuel temperature sensor • ECM

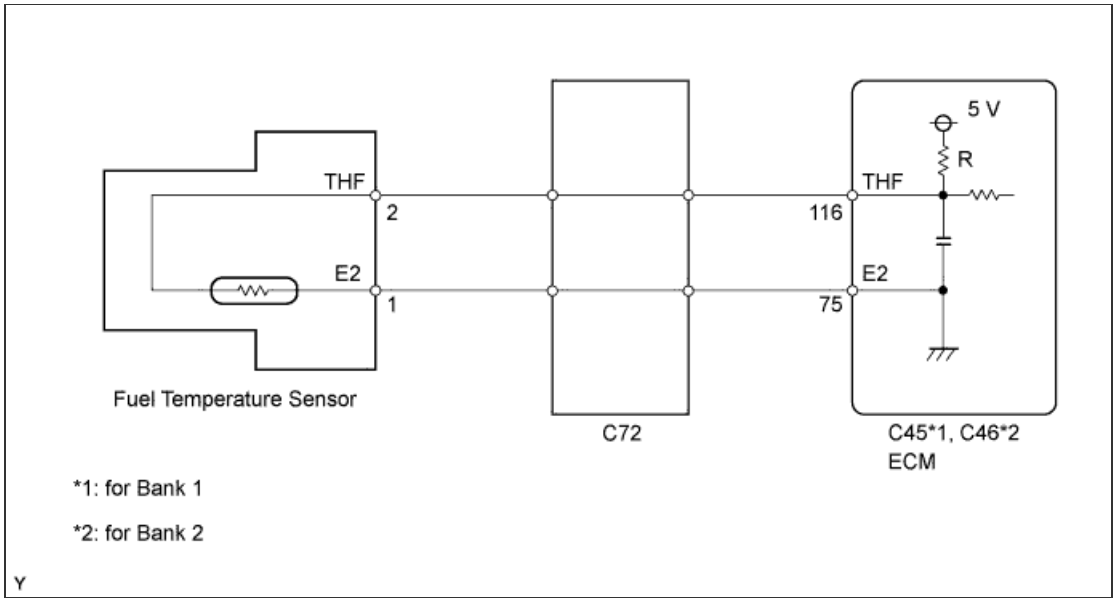
Related Data List

DTC No.	Data List
P0180	Fuel Temp
P0182	
P0183	

HINT:

- **If DTC P0180, P0182 and/or P0183 is stored, the following symptoms may appear:**
  - **Misfire**
  - **Combustion noise**
  - **Black smoke**
  - **Lack of power**

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- **If DTCs relating to different systems are stored, and they share terminal E2 as their ground, check this ground circuit first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (FUEL TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Fuel Temp.

d. Read the value.

OK:

Same value as the actual fuel temperature.

Result

Result	Proceed to
-40°C (-40°F)	A
140°C (284°F) or more	B
OK (Same as actual fuel temperature)	C

HINT:

- **If there is an open circuit, the tester indicates -40°C (-40°F).**
- **If there is a short circuit, the tester indicates 140°C (284°F) or more.**

B	Go to step 6
C	Go to step 11

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the fuel temperature sensor connector.

b. Connect terminals 2 (THF) and 1 (E2) of the fuel temperature sensor connector.

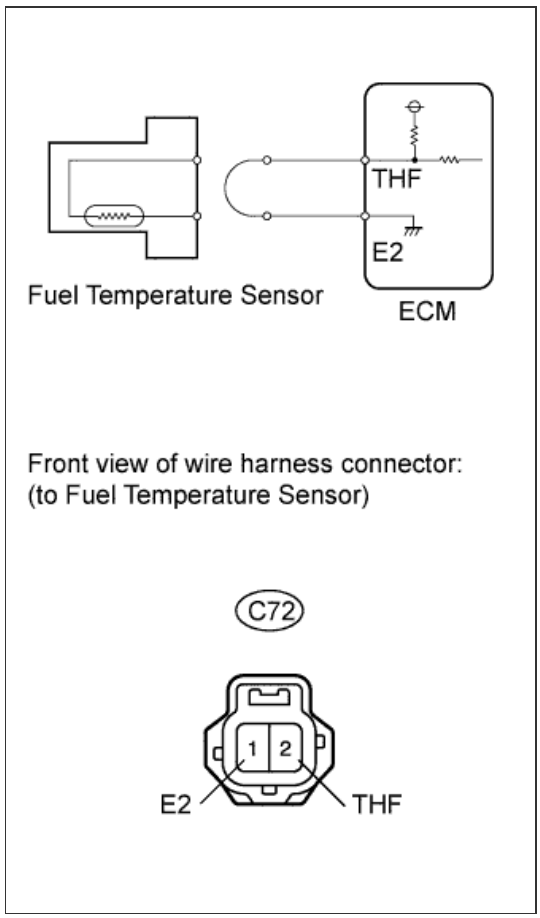
c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / Data List / Fuel Temp.

f. Read the value.

OK:
140°C (284°F) or higher



NG	Go to step 4

OK

3.CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE FUEL TEMPERATURE SENSOR

a. Replace the fuel temperature sensor (Click here).

NEXT	Go to step 11

4.CHECK HARNESS AND CONNECTOR (FUEL TEMPERATURE SENSOR - ECM)

a. Disconnect the fuel temperature sensor connector.

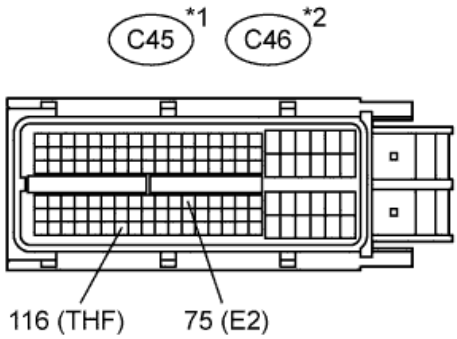
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Fuel Temperature Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
Fuel temperature sensor connector-2 (THF) - C45-116 (THF)	Always	Below 1 Ω
Fuel temperature sensor connector-1 (E2) - C45-75 (E2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
Fuel temperature sensor connector-2 (THF) - C46-116 (THF)	Always	Below 1 Ω
Fuel temperature sensor connector-1 (E2) - C46-75 (E2)	Always	Below 1 Ω

NG → Go to step 10

OK

5.CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

6.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the fuel temperature sensor connector.

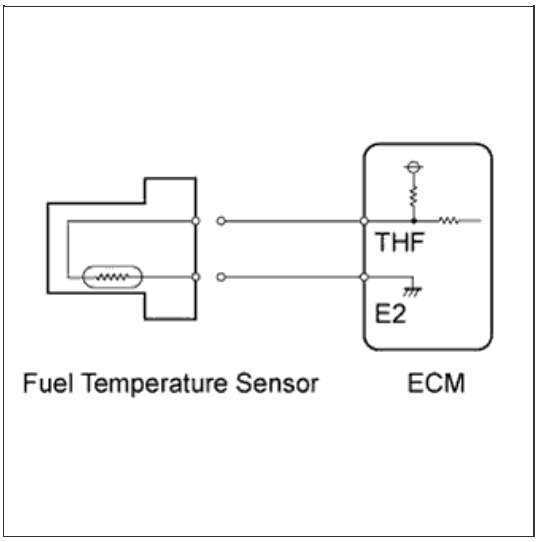
b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON and turn the tester on.

d. Enter the following menus: Powertrain / Engine / Data List / Fuel Temp.

e. Read the value.

OK:
-40°C (-40°F)



NG → **Go to step 8**

OK

7.REPLACE FUEL TEMPERATURE SENSOR

a. Replace the fuel temperature sensor (Click here).

NEXT → **Go to step 11**

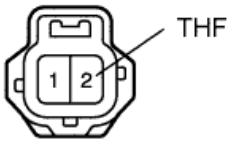
8.CHECK HARNESS AND CONNECTOR (FUEL TEMPERATURE SENSOR - ECM)

a. Disconnect the fuel temperature sensor connector.

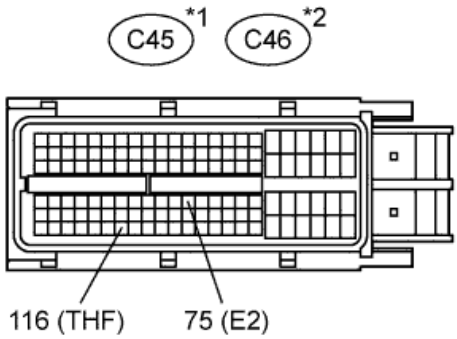
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Fuel Temperature Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
Fuel temperature sensor connector-2 (THF) or C45-116 (THF) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
Fuel temperature sensor connector-2 (THF) or C46-116 (THF) - Body ground	Always	10 kΩ or higher

NG → Go to step 10

OK

9.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

10.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

11.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 1 second.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

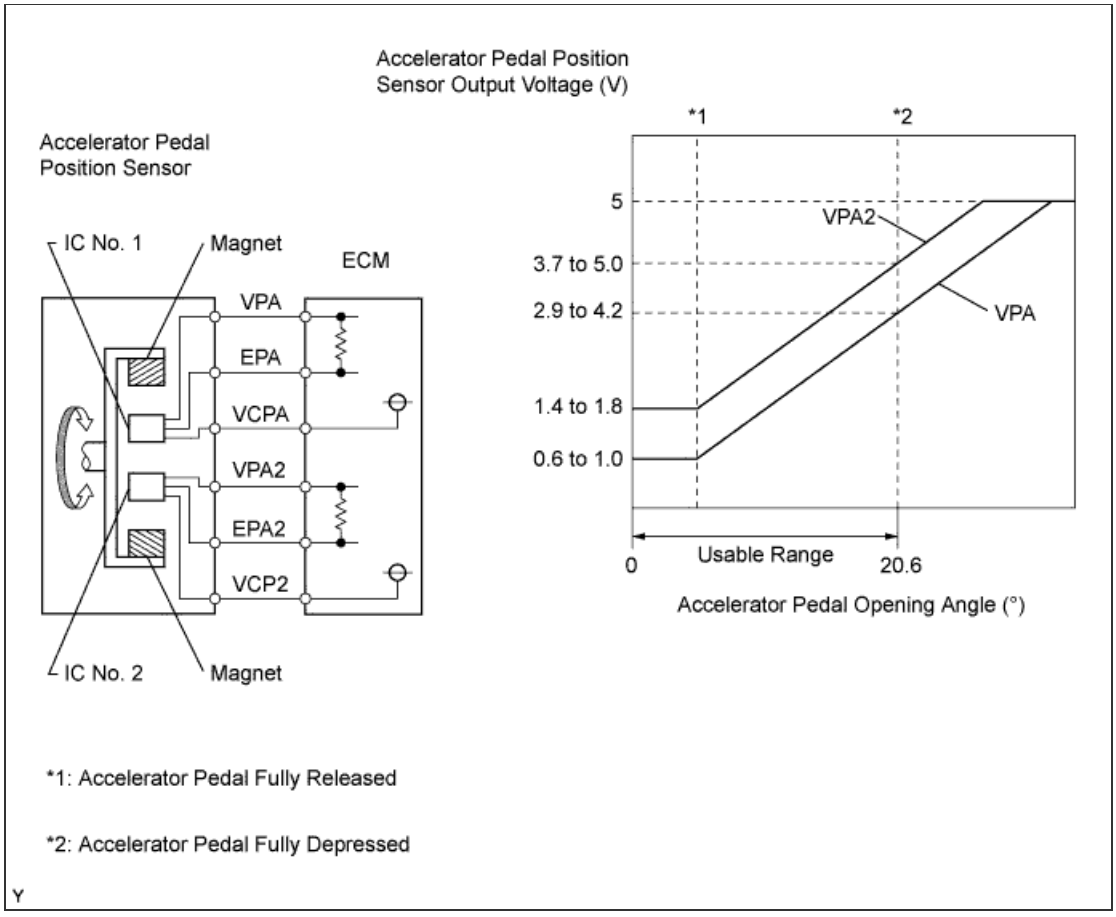
for Preparation Click here

DESCRIPTION

HINT:

- **This is the repair procedure for the accelerator pedal position sensor.**
- **This electrical throttle system does not use a throttle cable.**
- **This accelerator pedal position sensor is a non-contact type.**

The accelerator pedal position sensor is mounted on the accelerator pedal and detects the opening angle of the accelerator pedal. Since this sensor is electronically controlled with Hall-effect elements, accurate control and reliability can be obtained. It has 2 sensors to detect the accelerator position and a malfunction of the accelerator pedal position sensor.
In the accelerator pedal position sensor, the voltage applied to pedal terminals VPA and VPA2 of the ECM changes between 0 V and 5 V in proportion to the opening angle of the accelerator pedal. The VPA is a signal to indicate the actual accelerator pedal opening angle which is used for the engine control, and the VPA2 is a signal to indicate information about the opening angle which is used for detecting malfunctions. The ECM judges the current opening angle of the accelerator pedal using signals from terminals VPA and VPA2, and the ECM controls the throttle motor based on these signals.



P2120

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON		• Accelerator pedal

• Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) continues for 0.5 seconds (1 trip detection logic): (a) VPA is less than 0.4 V and VPA2 is more than 0.97 deg, or VPA is more than 4.8 V.	position sensor • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2122

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) and (b) continue for 0.5 seconds (1 trip detection logic): (a) VPA is less than 0.4 V. (b) VPA2 is more than 0.97 deg.	• Accelerator pedal position sensor • Open in VCPA circuit • VPA circuit open or ground short • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2123

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) continues for 2.0 seconds (1 trip detection logic): (a) VPA is more than 4.8 V.	• Accelerator pedal position sensor • Open in EPA circuit • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2125

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) continues for 0.5 seconds (1 trip detection logic): (a) VPA2 is less than 1.2 V and VPA is more than 2.7 deg, or VPA2 is more than 4.8 V and VPA is more than 0.4 V but less than 3.45 V.	• Accelerator pedal position sensor • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2127

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) and (b) continue for 0.5 seconds (1 trip detection logic): (a) VPA2 is less than 1.2 V. (b) VPA2 is more than 2.7 deg.	• Accelerator pedal position sensor • Open in VCP2 circuit • VPA2 circuit open or ground short • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2128

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Conditions (a) and (b) continue for 2.0 seconds (1 trip detection logic): (a) VPA2 is more than 4.8 V. (b) VPA is more than 0.4 V but less than 3.45 V.	• Accelerator pedal position sensor • Open in EPA2 circuit • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2138

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) or (b) continues for 2.0 seconds (1 trip detection logic): (a) The difference between VPA and VPA2 is less than 0.02 V. (b) VPA is less than 0.4 V and VPA2 is less than 1.2 V.	• VPA and VPA2 circuits are short-circuited • Accelerator pedal position sensor • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

Related Data List

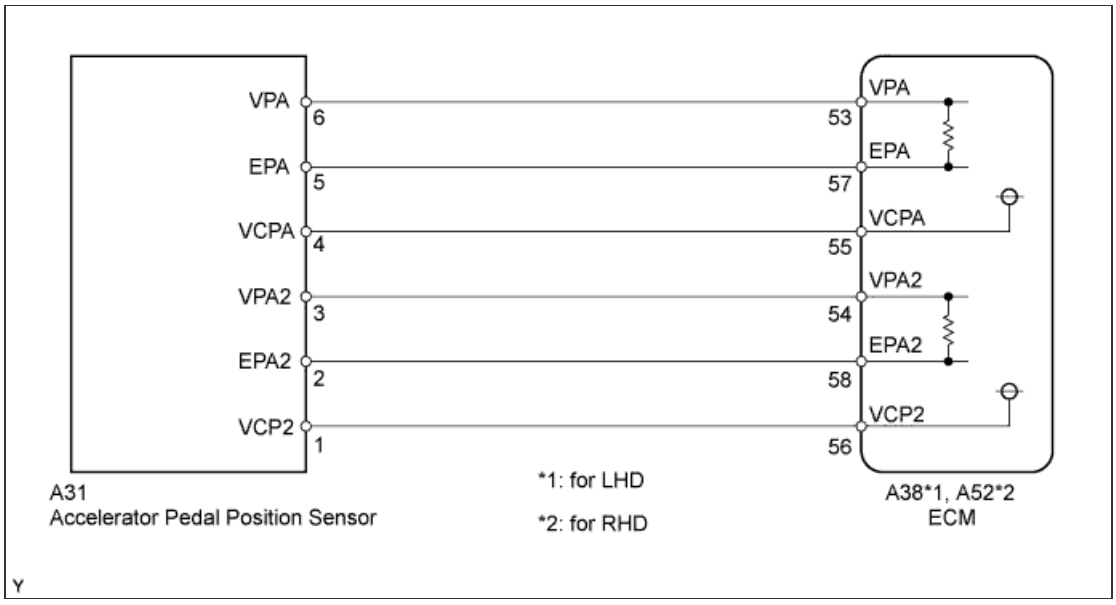
DTC No.	Data List
P2120	• Accel Sens. No.1 Volt % • Accel Sens. No.2 Volt % • Accel Sensor Out No.1 • Accel Sensor Out No.2
P2122	
P2123	
P2125	
P2127	
P2128	
P2138	

HINT:

When DTC P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138 is stored, check the output voltage of the accelerator pedal position sensor by entering the following menus: Powertrain / Engine / Data List / Accel Sensor Out No.1 and Accel Sensor Out No.2.

Trouble Area	Accelerator Pedal Position Expressed as Voltage Output			
	Accelerator Pedal Released		Accelerator Pedal Depressed	
	Accel Sensor Out No.1	Accel Sensor Out No.2	Accel Sensor Out No.1	Accel Sensor Out No.2
VC circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
VPA circuit open or ground short	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.0 V
VPA2 circuit open or ground short	0.5 to 1.1 V	0 to 0.2 V	2.9 to 3.6 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

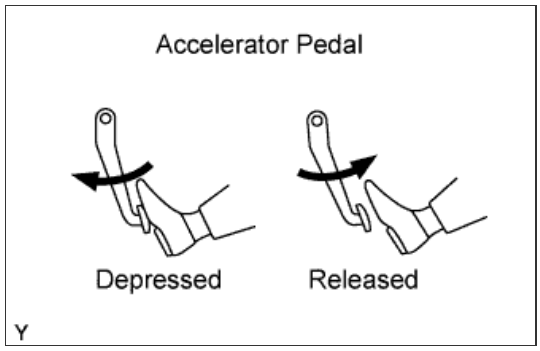
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR PEDAL POSITION)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Accel Sens. No.1 Volt % and Accel Sens. No.2 Volt %.

d. Read the values.



Standard:

Accelerator Pedal	Accel Sens. No.1 Volt %	Accel Sens. No.2 Volt %
Released	8 to 28%	30 to 55%
Depressed	51 to 86%	73 to 98%

Result

Result	Proceed to
NG	A
OK	B

B → Go to step 8

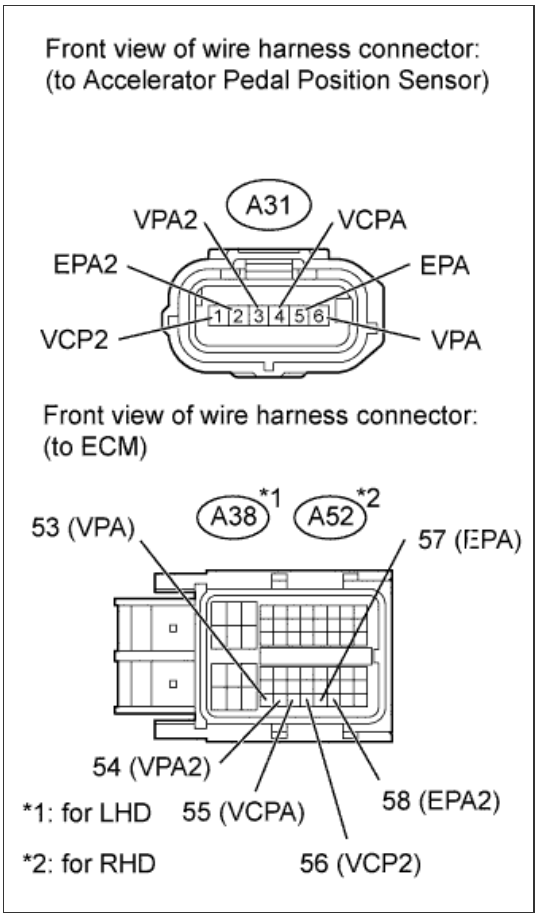
A

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the accelerator pedal position sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) - A38-56 (VCP2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-58 (EPA2)	Always	Below 1 Ω
A31-3 (VPA2) - A38-54 (VPA2)	Always	Below 1 Ω
A31-4 (VCPA) - A38-55 (VCPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-57 (EPA)	Always	Below 1 Ω
A31-6 (VPA) - A38-53 (VPA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) - A52-56 (VCP2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-58 (EPA2)	Always	Below 1 Ω
A31-3 (VPA2) - A52-54 (VPA2)	Always	Below 1 Ω
A31-4 (VCPA) - A52-55 (VCPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-57 (EPA)	Always	Below 1 Ω
A31-6 (VPA) - A52-53 (VPA)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) or A38-56 (VCP2) -		10 kΩ or

Body ground	Always	higher
A31-2 (EPA2) or A38-58 (EPA2) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-54 (VPA2) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-55 (VCPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-57 (EPA) - Body ground	Always	10 kΩ or higher
A31-6 (VPA) or A38-53 (VPA) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) or A52-56 (VCP2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-58 (EPA2) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-54 (VPA2) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-55 (VCPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-57 (EPA) - Body ground	Always	10 kΩ or higher
A31-6 (VPA) or A52-53 (VPA) - Body ground	Always	10 kΩ or higher

NG → Go to step 7

OK

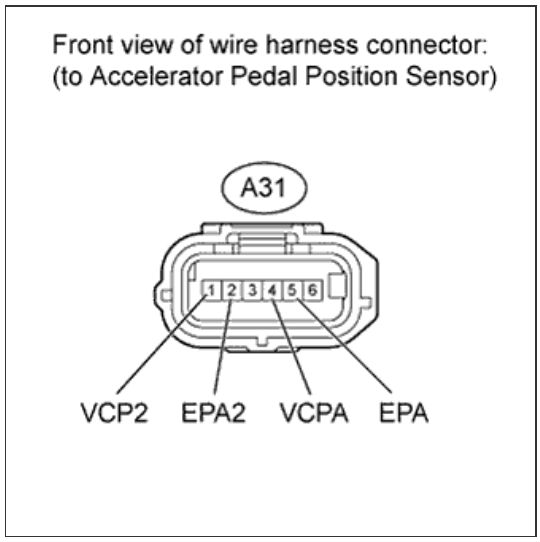
3.INSPECT ECM TERMINAL VOLTAGE (VCPA AND VCP2 TERMINALS)

a. Disconnect the accelerator pedal position sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Ignition switch ON	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Ignition switch ON	4.5 to 5.5 V



NG → Go to step 6

OK

4.REPLACE ACCELERATOR PEDAL ROD ASSEMBLY

a. Replace the accelerator pedal rod assembly (Click here).

NEXT

5.CHECK IF OUTPUT DTC RECURS

a. Connect the intelligent tester to the DLC3.

b. Clear the DTC (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON.

e. Fully close the accelerator pedal for 3 seconds, then hold it partway open for 3 seconds, then fully open it for 3 seconds.

f. Read the DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138 are output again	A
No output	B

B → END

A

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 8

7.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

8.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch off and leave the vehicle for 15 seconds.

e. Turn the ignition switch to ON.

f. Fully close the accelerator pedal for 3 seconds, then hold it partway open for 3 seconds, then fully open it for 3 seconds.

g. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, idle the engine.

NEXT

END

DTC P0180 Fuel Temperature Sensor "A" Circuit

DTC P0182 Fuel Temperature Sensor "A" Circuit Low Input

DTC P0183 Fuel Temperature Sensor "A" Circuit High Input

for Preparation Click here

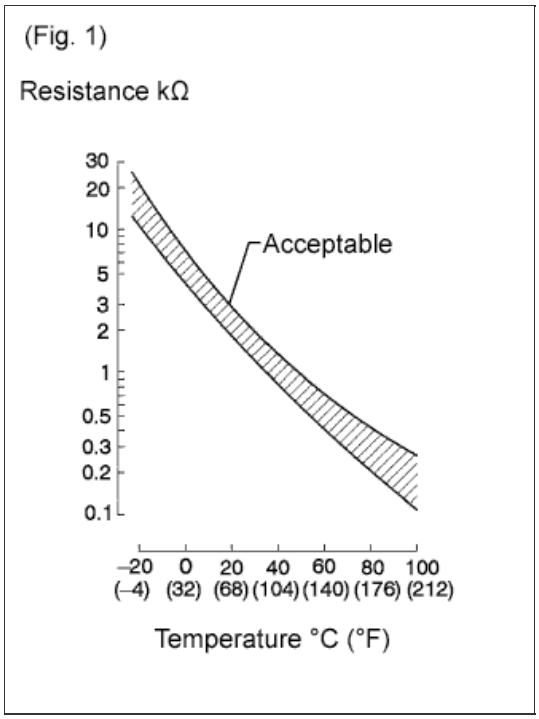
DESCRIPTION

The fuel temperature sensor monitors the fuel temperature. The fuel temperature sensor has a thermistor that varies its resistance depending on the fuel temperature. When the fuel temperature is low, the resistance of the thermistor is high. When the temperature is high, the resistance is low. The variations of resistance are communicated to the ECM as changes of voltage (See Fig. 1).

The fuel temperature sensor is connected to the ECM. The 5 V power source voltage in the ECM is applied to the fuel temperature sensor from terminal THF via resistor R.

Resistor R and the fuel temperature sensor are connected in series. When the resistance value of the fuel temperature sensor changes due to a change of fuel temperature, the voltage at terminal THF also changes. Based on this signal, the ECM corrects the pressure control compensation of the fuel supply pump and determines if there are errors.

(Fig. 1)



P0180

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Open or short in the fuel temperature sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in fuel temperature sensor circuit • Fuel temperature sensor • ECM

P0182

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Short in the fuel temperature sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in fuel temperature sensor circuit • Fuel temperature sensor • ECM

P0183

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Open in the fuel temperature sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in fuel temperature sensor circuit • Fuel temperature sensor • ECM

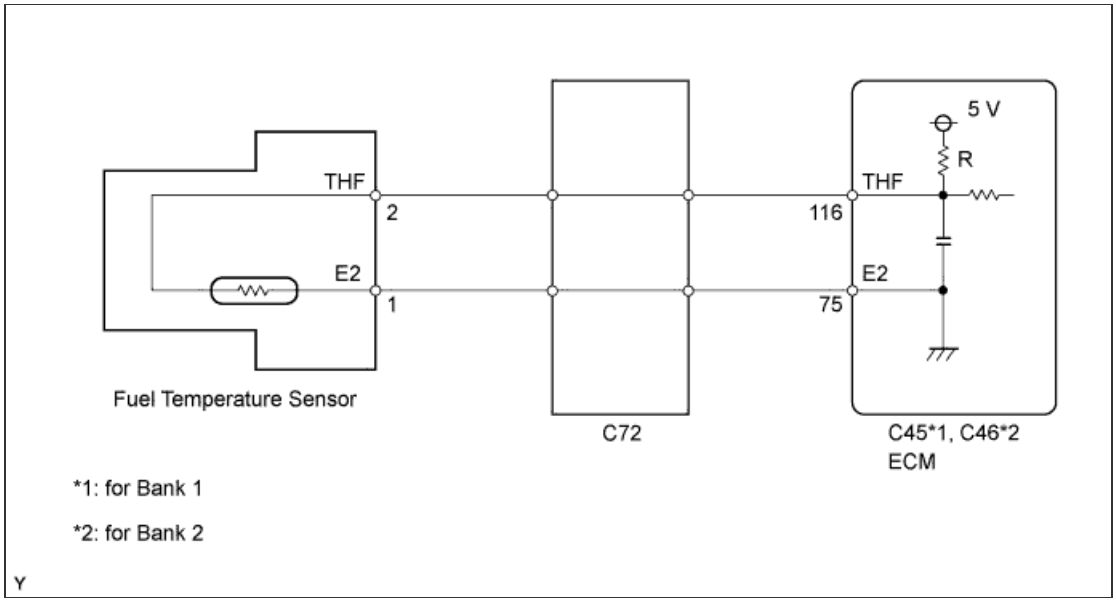
Related Data List

DTC No.	Data List
P0180	Fuel Temp
P0182	
P0183	

HINT:

- **If DTC P0180, P0182 and/or P0183 is stored, the following symptoms may appear:**
  - **Misfire**
  - **Combustion noise**
  - **Black smoke**
  - **Lack of power**

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- **If DTCs relating to different systems are stored, and they share terminal E2 as their ground, check this ground circuit first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (FUEL TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Fuel Temp.

d. Read the value.

OK:

Same value as the actual fuel temperature.

Result

Result	Proceed to
-40°C (-40°F)	A
140°C (284°F) or more	B
OK (Same as actual fuel temperature)	C

HINT:

- **If there is an open circuit, the tester indicates -40°C (-40°F).**
- **If there is a short circuit, the tester indicates 140°C (284°F) or more.**

B	Go to step 6
C	Go to step 11

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the fuel temperature sensor connector.

b. Connect terminals 2 (THF) and 1 (E2) of the fuel temperature sensor connector.

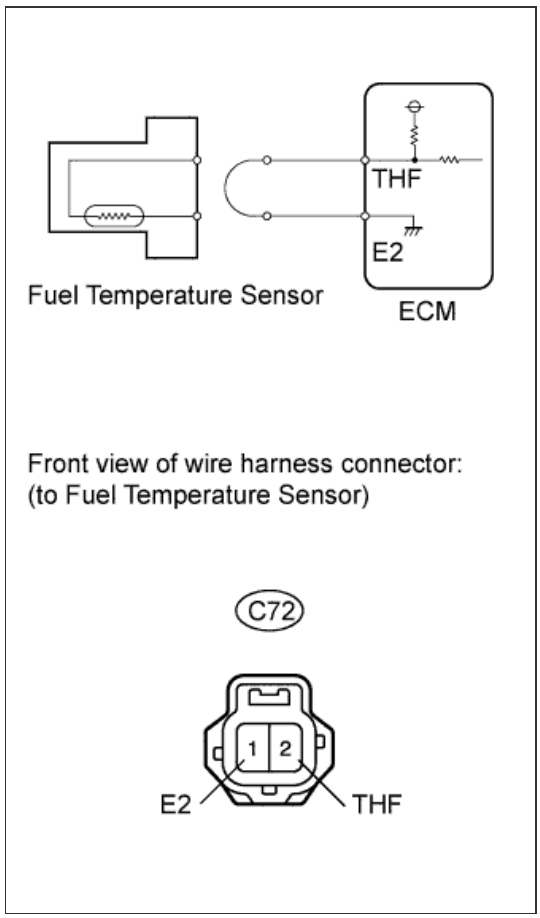
c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / Data List / Fuel Temp.

f. Read the value.

OK:
140°C (284°F) or higher



NG	Go to step 4

OK

3.CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE FUEL TEMPERATURE SENSOR

a. Replace the fuel temperature sensor (Click here).

NEXT	Go to step 11

4.CHECK HARNESS AND CONNECTOR (FUEL TEMPERATURE SENSOR - ECM)

a. Disconnect the fuel temperature sensor connector.

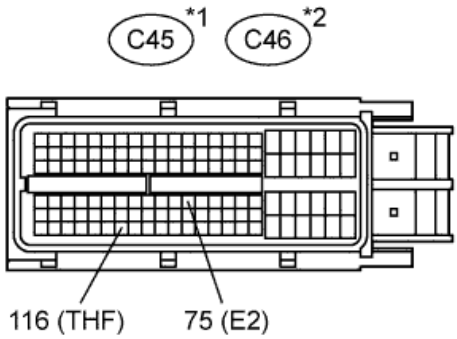
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Fuel Temperature Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
Fuel temperature sensor connector-2 (THF) - C45-116 (THF)	Always	Below 1 Ω
Fuel temperature sensor connector-1 (E2) - C45-75 (E2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
Fuel temperature sensor connector-2 (THF) - C46-116 (THF)	Always	Below 1 Ω
Fuel temperature sensor connector-1 (E2) - C46-75 (E2)	Always	Below 1 Ω

NG → Go to step 10

OK

5.CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

6.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the fuel temperature sensor connector.

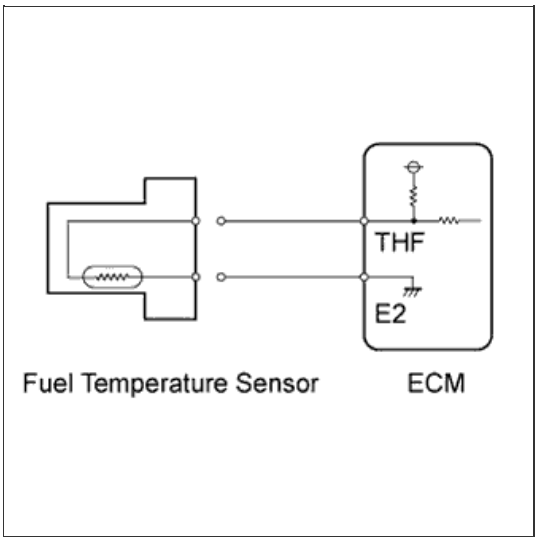
b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON and turn the tester on.

d. Enter the following menus: Powertrain / Engine / Data List / Fuel Temp.

e. Read the value.

OK:
-40°C (-40°F)



NG → **Go to step 8**

OK

7.REPLACE FUEL TEMPERATURE SENSOR

a. Replace the fuel temperature sensor (Click here).

NEXT → **Go to step 11**

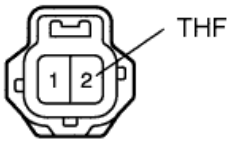
8.CHECK HARNESS AND CONNECTOR (FUEL TEMPERATURE SENSOR - ECM)

a. Disconnect the fuel temperature sensor connector.

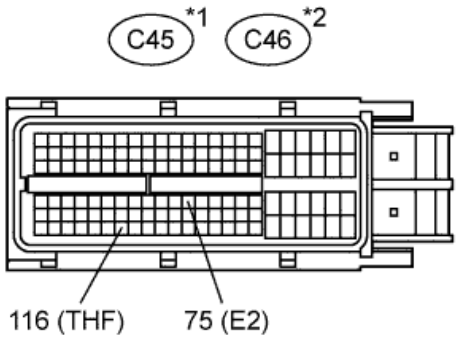
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Fuel Temperature Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
Fuel temperature sensor connector-2 (THF) or C45-116 (THF) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
Fuel temperature sensor connector-2 (THF) or C46-116 (THF) - Body ground	Always	10 kΩ or higher

NG → Go to step 10

OK

9.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

10.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

11.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 1 second.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

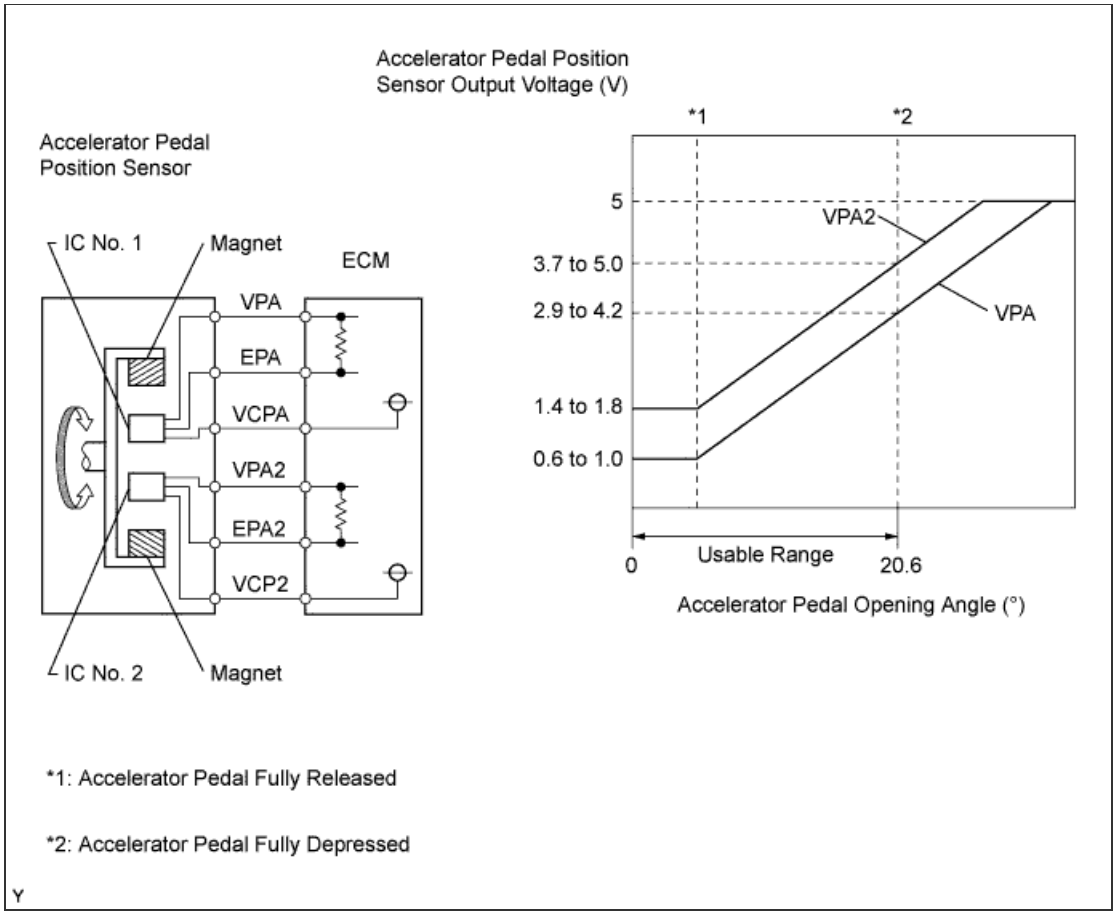
for Preparation Click here

DESCRIPTION

HINT:

- **This is the repair procedure for the accelerator pedal position sensor.**
- **This electrical throttle system does not use a throttle cable.**
- **This accelerator pedal position sensor is a non-contact type.**

The accelerator pedal position sensor is mounted on the accelerator pedal and detects the opening angle of the accelerator pedal. Since this sensor is electronically controlled with Hall-effect elements, accurate control and reliability can be obtained. It has 2 sensors to detect the accelerator position and a malfunction of the accelerator pedal position sensor.
In the accelerator pedal position sensor, the voltage applied to pedal terminals VPA and VPA2 of the ECM changes between 0 V and 5 V in proportion to the opening angle of the accelerator pedal. The VPA is a signal to indicate the actual accelerator pedal opening angle which is used for the engine control, and the VPA2 is a signal to indicate information about the opening angle which is used for detecting malfunctions. The ECM judges the current opening angle of the accelerator pedal using signals from terminals VPA and VPA2, and the ECM controls the throttle motor based on these signals.



P2120

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON		• Accelerator pedal

• Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) continues for 0.5 seconds (1 trip detection logic): (a) VPA is less than 0.4 V and VPA2 is more than 0.97 deg, or VPA is more than 4.8 V.	position sensor • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2122

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) and (b) continue for 0.5 seconds (1 trip detection logic): (a) VPA is less than 0.4 V. (b) VPA2 is more than 0.97 deg.	• Accelerator pedal position sensor • Open in VCPA circuit • VPA circuit open or ground short • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2123

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) continues for 2.0 seconds (1 trip detection logic): (a) VPA is more than 4.8 V.	• Accelerator pedal position sensor • Open in EPA circuit • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2125

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) continues for 0.5 seconds (1 trip detection logic): (a) VPA2 is less than 1.2 V and VPA is more than 2.7 deg, or VPA2 is more than 4.8 V and VPA is more than 0.4 V but less than 3.45 V.	• Accelerator pedal position sensor • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2127

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) and (b) continue for 0.5 seconds (1 trip detection logic): (a) VPA2 is less than 1.2 V. (b) VPA2 is more than 2.7 deg.	• Accelerator pedal position sensor • Open in VCP2 circuit • VPA2 circuit open or ground short • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2128

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Conditions (a) and (b) continue for 2.0 seconds (1 trip detection logic): (a) VPA2 is more than 4.8 V. (b) VPA is more than 0.4 V but less than 3.45 V.	• Accelerator pedal position sensor • Open in EPA2 circuit • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2138

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) or (b) continues for 2.0 seconds (1 trip detection logic): (a) The difference between VPA and VPA2 is less than 0.02 V. (b) VPA is less than 0.4 V and VPA2 is less than 1.2 V.	• VPA and VPA2 circuits are short-circuited • Accelerator pedal position sensor • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

Related Data List

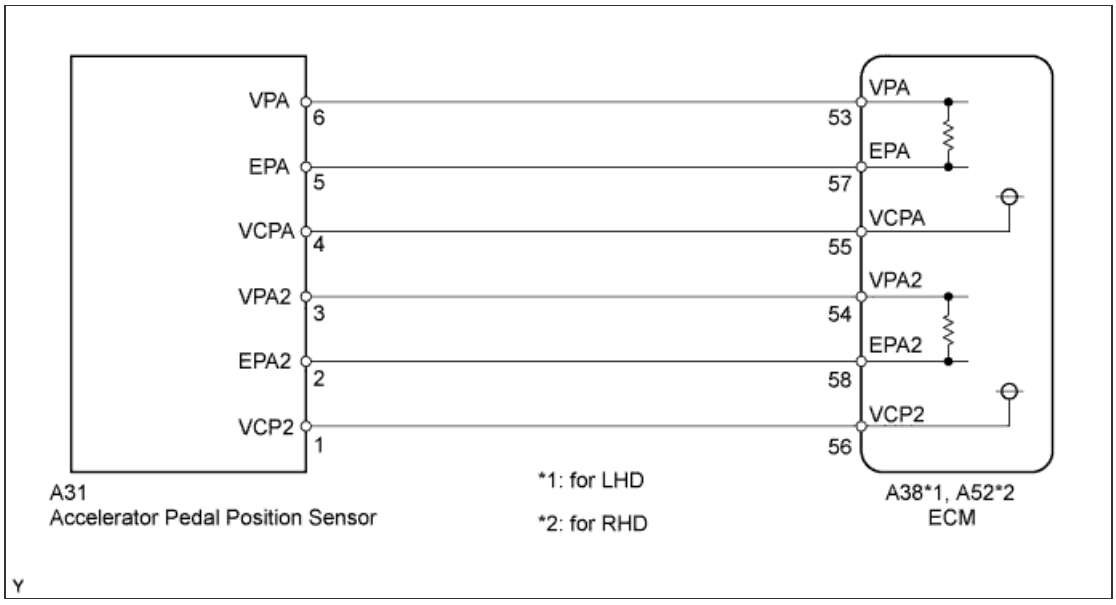
DTC No.	Data List
P2120	• Accel Sens. No.1 Volt % • Accel Sens. No.2 Volt % • Accel Sensor Out No.1 • Accel Sensor Out No.2
P2122	
P2123	
P2125	
P2127	
P2128	
P2138	

HINT:

When DTC P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138 is stored, check the output voltage of the accelerator pedal position sensor by entering the following menus: Powertrain / Engine / Data List / Accel Sensor Out No.1 and Accel Sensor Out No.2.

Trouble Area	Accelerator Pedal Position Expressed as Voltage Output			
	Accelerator Pedal Released		Accelerator Pedal Depressed	
	Accel Sensor Out No.1	Accel Sensor Out No.2	Accel Sensor Out No.1	Accel Sensor Out No.2
VC circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
VPA circuit open or ground short	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.0 V
VPA2 circuit open or ground short	0.5 to 1.1 V	0 to 0.2 V	2.9 to 3.6 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

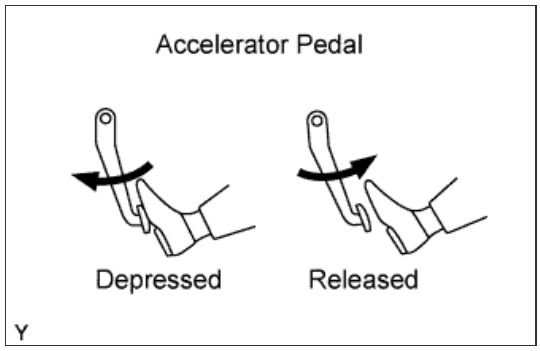
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR PEDAL POSITION)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Accel Sens. No.1 Volt % and Accel Sens. No.2 Volt %.

d. Read the values.



Standard:

Accelerator Pedal	Accel Sens. No.1 Volt %	Accel Sens. No.2 Volt %
Released	8 to 28%	30 to 55%
Depressed	51 to 86%	73 to 98%

Result

Result	Proceed to
NG	A
OK	B

B → Go to step 8

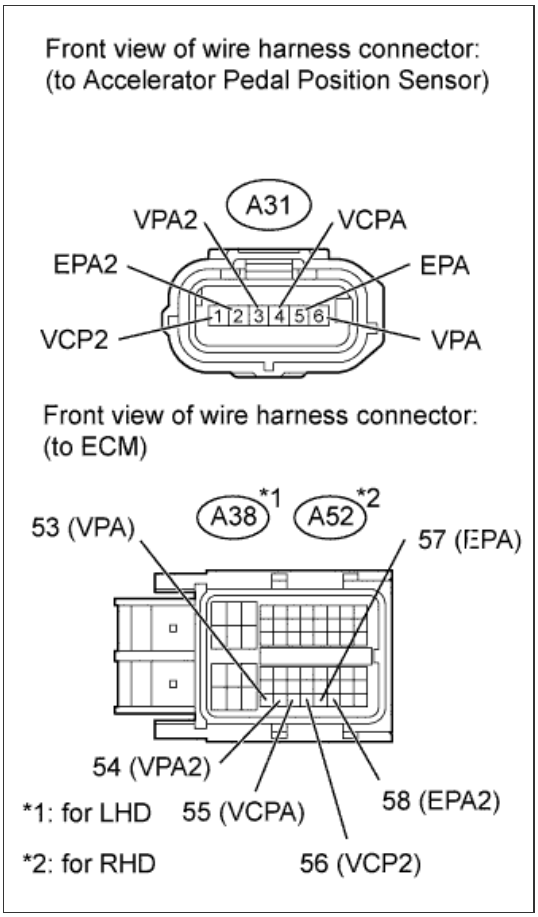
A

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the accelerator pedal position sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) - A38-56 (VCP2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-58 (EPA2)	Always	Below 1 Ω
A31-3 (VPA2) - A38-54 (VPA2)	Always	Below 1 Ω
A31-4 (VCPA) - A38-55 (VCPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-57 (EPA)	Always	Below 1 Ω
A31-6 (VPA) - A38-53 (VPA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) - A52-56 (VCP2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-58 (EPA2)	Always	Below 1 Ω
A31-3 (VPA2) - A52-54 (VPA2)	Always	Below 1 Ω
A31-4 (VCPA) - A52-55 (VCPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-57 (EPA)	Always	Below 1 Ω
A31-6 (VPA) - A52-53 (VPA)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) or A38-56 (VCP2) -		10 kΩ or

Body ground	Always	higher
A31-2 (EPA2) or A38-58 (EPA2) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-54 (VPA2) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-55 (VCPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-57 (EPA) - Body ground	Always	10 kΩ or higher
A31-6 (VPA) or A38-53 (VPA) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) or A52-56 (VCP2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-58 (EPA2) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-54 (VPA2) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-55 (VCPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-57 (EPA) - Body ground	Always	10 kΩ or higher
A31-6 (VPA) or A52-53 (VPA) - Body ground	Always	10 kΩ or higher

NG → Go to step 7

OK

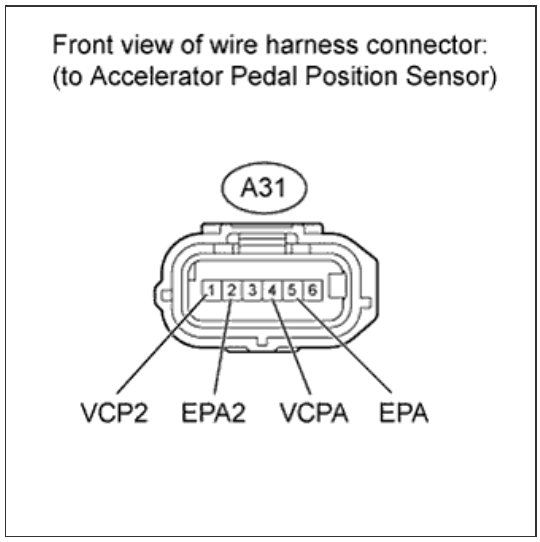
3.INSPECT ECM TERMINAL VOLTAGE (VCPA AND VCP2 TERMINALS)

a. Disconnect the accelerator pedal position sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Ignition switch ON	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Ignition switch ON	4.5 to 5.5 V



NG → Go to step 6

OK

4.REPLACE ACCELERATOR PEDAL ROD ASSEMBLY

a. Replace the accelerator pedal rod assembly (Click here).

NEXT

5.CHECK IF OUTPUT DTC RECURS

a. Connect the intelligent tester to the DLC3.

b. Clear the DTC (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON.

e. Fully close the accelerator pedal for 3 seconds, then hold it partway open for 3 seconds, then fully open it for 3 seconds.

f. Read the DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138 are output again	A
No output	B

B → END

A

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 8

7.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

8.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch off and leave the vehicle for 15 seconds.

e. Turn the ignition switch to ON.

f. Fully close the accelerator pedal for 3 seconds, then hold it partway open for 3 seconds, then fully open it for 3 seconds.

g. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, idle the engine.

NEXT

END

DTC P0180 Fuel Temperature Sensor "A" Circuit

DTC P0182 Fuel Temperature Sensor "A" Circuit Low Input

DTC P0183 Fuel Temperature Sensor "A" Circuit High Input

for Preparation Click here

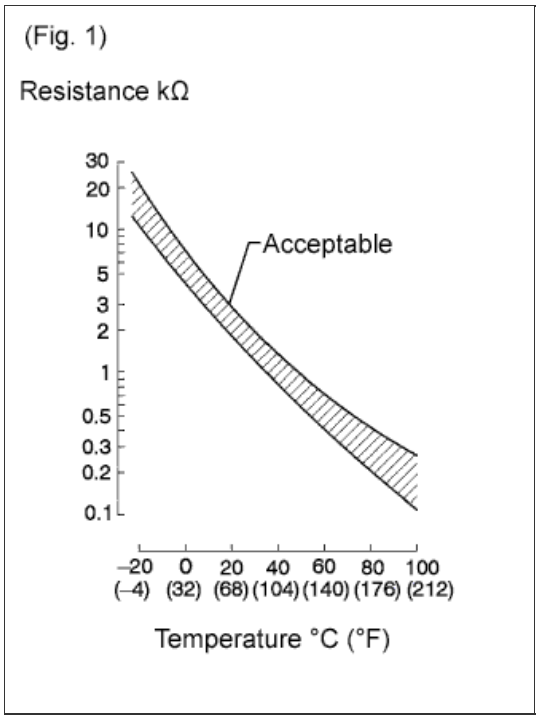
DESCRIPTION

The fuel temperature sensor monitors the fuel temperature. The fuel temperature sensor has a thermistor that varies its resistance depending on the fuel temperature. When the fuel temperature is low, the resistance of the thermistor is high. When the temperature is high, the resistance is low. The variations of resistance are communicated to the ECM as changes of voltage (See Fig. 1).

The fuel temperature sensor is connected to the ECM. The 5 V power source voltage in the ECM is applied to the fuel temperature sensor from terminal THF via resistor R.

Resistor R and the fuel temperature sensor are connected in series. When the resistance value of the fuel temperature sensor changes due to a change of fuel temperature, the voltage at terminal THF also changes. Based on this signal, the ECM corrects the pressure control compensation of the fuel supply pump and determines if there are errors.

(Fig. 1)



P0180

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Open or short in the fuel temperature sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in fuel temperature sensor circuit • Fuel temperature sensor • ECM

P0182

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Short in the fuel temperature sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in fuel temperature sensor circuit • Fuel temperature sensor • ECM

P0183

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 0.5 seconds	Open in the fuel temperature sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in fuel temperature sensor circuit • Fuel temperature sensor • ECM

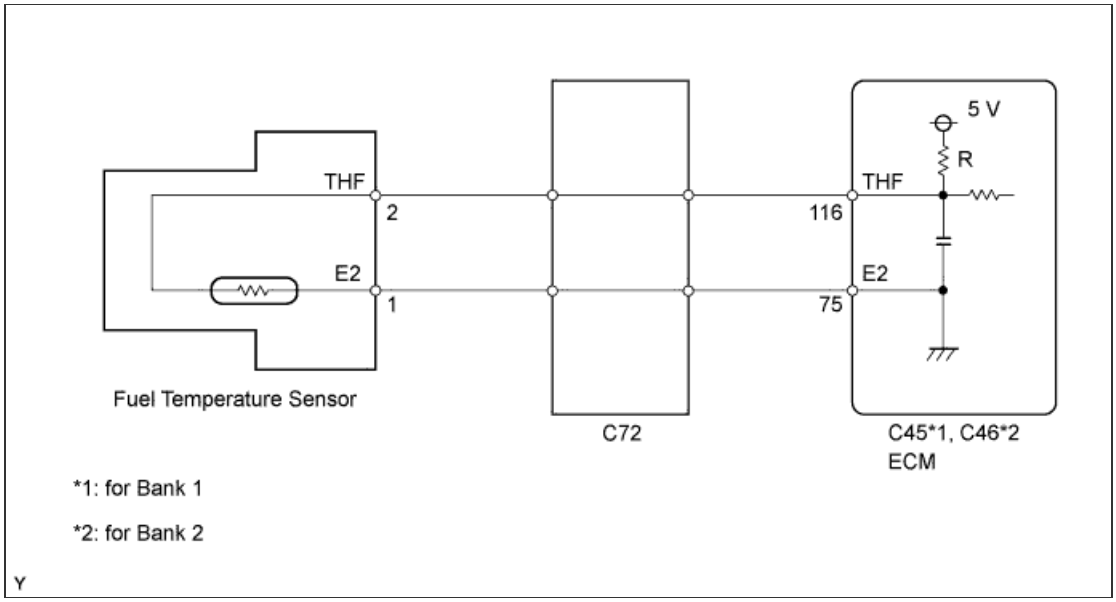
Related Data List

DTC No.	Data List
P0180	Fuel Temp
P0182	
P0183	

HINT:

- **If DTC P0180, P0182 and/or P0183 is stored, the following symptoms may appear:**
  - **Misfire**
  - **Combustion noise**
  - **Black smoke**
  - **Lack of power**

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- **If DTCs relating to different systems are stored, and they share terminal E2 as their ground, check this ground circuit first.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.READ VALUE USING INTELLIGENT TESTER (FUEL TEMPERATURE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Fuel Temp.

d. Read the value.

OK:

Same value as the actual fuel temperature.

Result

Result	Proceed to
-40°C (-40°F)	A
140°C (284°F) or more	B
OK (Same as actual fuel temperature)	C

HINT:

- **If there is an open circuit, the tester indicates -40°C (-40°F).**
- **If there is a short circuit, the tester indicates 140°C (284°F) or more.**

B	Go to step 6
C	Go to step 11

A

2.READ VALUE USING INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)

a. Disconnect the fuel temperature sensor connector.

b. Connect terminals 2 (THF) and 1 (E2) of the fuel temperature sensor connector.

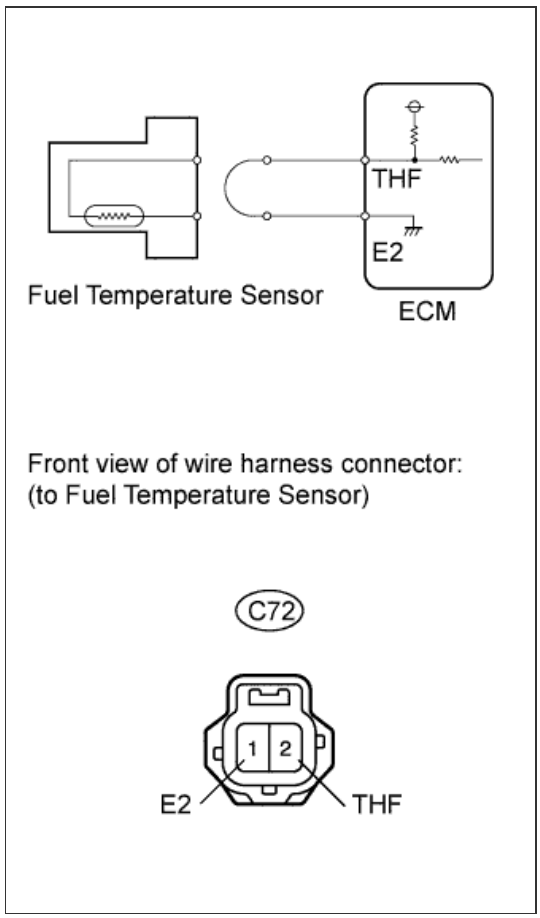
c. Connect the intelligent tester to the DLC3.

d. Turn the ignition switch to ON and turn the tester on.

e. Enter the following menus: Powertrain / Engine / Data List / Fuel Temp.

f. Read the value.

OK:
140°C (284°F) or higher



NG	Go to step 4

OK

3.CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE FUEL TEMPERATURE SENSOR

a. Replace the fuel temperature sensor (Click here).

NEXT	Go to step 11

4.CHECK HARNESS AND CONNECTOR (FUEL TEMPERATURE SENSOR - ECM)

a. Disconnect the fuel temperature sensor connector.

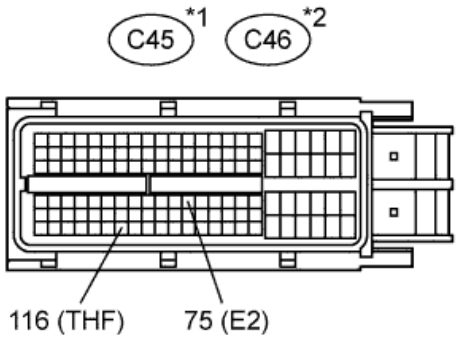
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Fuel Temperature Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
Fuel temperature sensor connector-2 (THF) - C45-116 (THF)	Always	Below 1 Ω
Fuel temperature sensor connector-1 (E2) - C45-75 (E2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
Fuel temperature sensor connector-2 (THF) - C46-116 (THF)	Always	Below 1 Ω
Fuel temperature sensor connector-1 (E2) - C46-75 (E2)	Always	Below 1 Ω

NG → Go to step 10

OK

5.CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

6.READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

a. Disconnect the fuel temperature sensor connector.

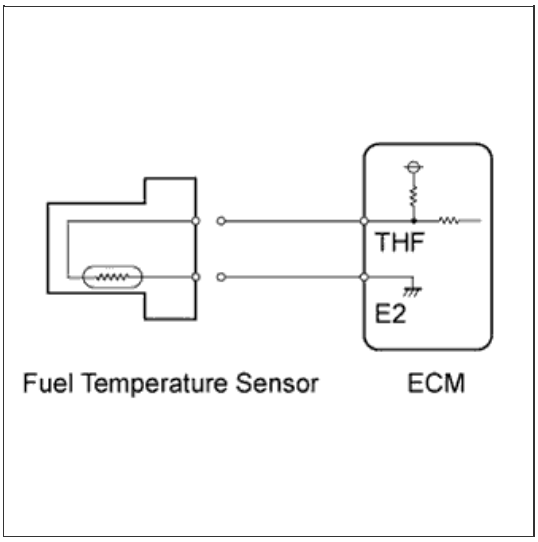
b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON and turn the tester on.

d. Enter the following menus: Powertrain / Engine / Data List / Fuel Temp.

e. Read the value.

OK:
-40°C (-40°F)



NG → **Go to step 8**

OK

7.REPLACE FUEL TEMPERATURE SENSOR

a. Replace the fuel temperature sensor (Click here).

NEXT → **Go to step 11**

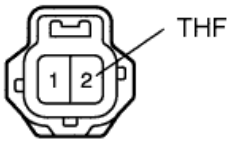
8.CHECK HARNESS AND CONNECTOR (FUEL TEMPERATURE SENSOR - ECM)

a. Disconnect the fuel temperature sensor connector.

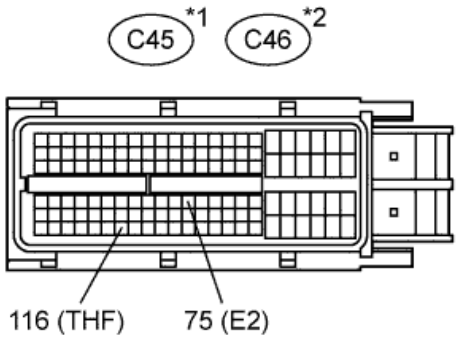
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Fuel Temperature Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
Fuel temperature sensor connector-2 (THF) or C45-116 (THF) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
Fuel temperature sensor connector-2 (THF) or C46-116 (THF) - Body ground	Always	10 kΩ or higher

NG → Go to step 10

OK

9.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 11

10.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

11.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 1 second.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

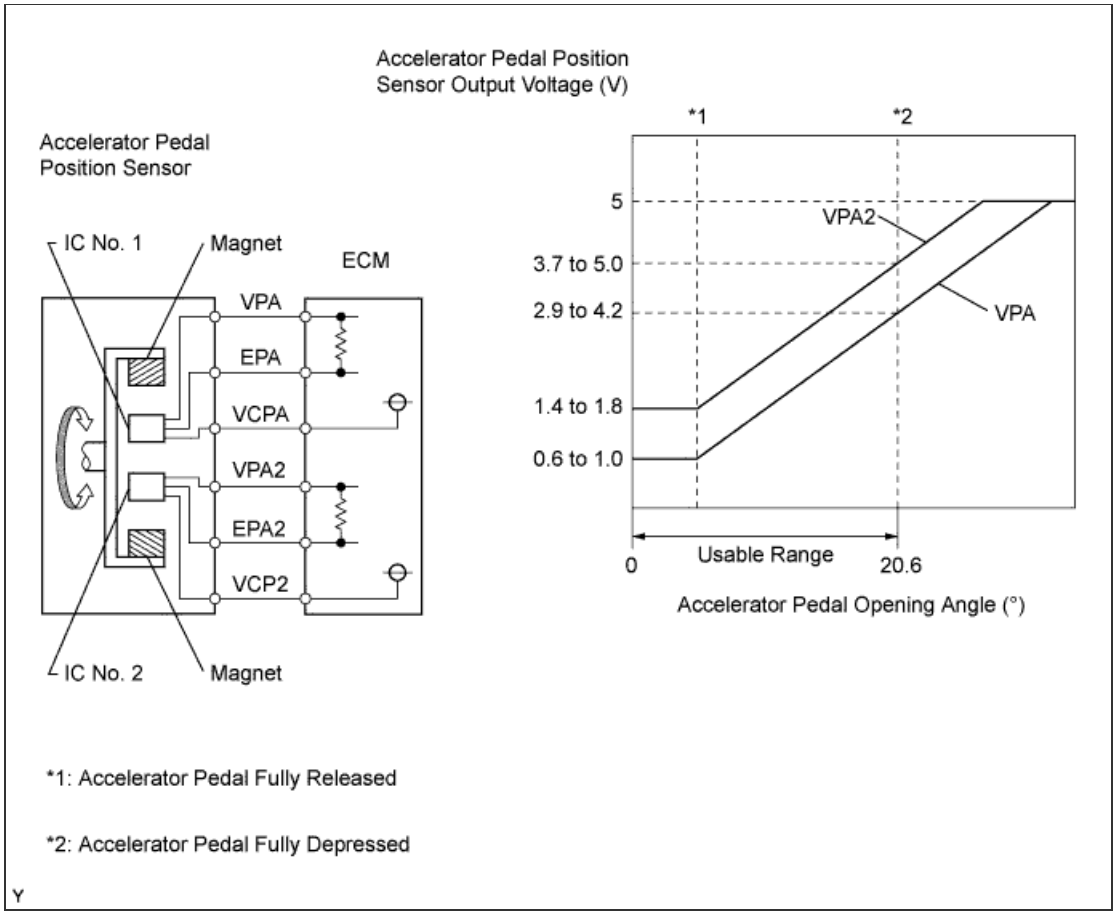
for Preparation Click here

DESCRIPTION

HINT:

- **This is the repair procedure for the accelerator pedal position sensor.**
- **This electrical throttle system does not use a throttle cable.**
- **This accelerator pedal position sensor is a non-contact type.**

The accelerator pedal position sensor is mounted on the accelerator pedal and detects the opening angle of the accelerator pedal. Since this sensor is electronically controlled with Hall-effect elements, accurate control and reliability can be obtained. It has 2 sensors to detect the accelerator position and a malfunction of the accelerator pedal position sensor.
In the accelerator pedal position sensor, the voltage applied to pedal terminals VPA and VPA2 of the ECM changes between 0 V and 5 V in proportion to the opening angle of the accelerator pedal. The VPA is a signal to indicate the actual accelerator pedal opening angle which is used for the engine control, and the VPA2 is a signal to indicate information about the opening angle which is used for detecting malfunctions. The ECM judges the current opening angle of the accelerator pedal using signals from terminals VPA and VPA2, and the ECM controls the throttle motor based on these signals.



P2120

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON		• Accelerator pedal

• Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) continues for 0.5 seconds (1 trip detection logic): (a) VPA is less than 0.4 V and VPA2 is more than 0.97 deg, or VPA is more than 4.8 V.	position sensor • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2122

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) and (b) continue for 0.5 seconds (1 trip detection logic): (a) VPA is less than 0.4 V. (b) VPA2 is more than 0.97 deg.	• Accelerator pedal position sensor • Open in VCPA circuit • VPA circuit open or ground short • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2123

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) continues for 2.0 seconds (1 trip detection logic): (a) VPA is more than 4.8 V.	• Accelerator pedal position sensor • Open in EPA circuit • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2125

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) continues for 0.5 seconds (1 trip detection logic): (a) VPA2 is less than 1.2 V and VPA is more than 2.7 deg, or VPA2 is more than 4.8 V and VPA is more than 0.4 V but less than 3.45 V.	• Accelerator pedal position sensor • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2127

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) and (b) continue for 0.5 seconds (1 trip detection logic): (a) VPA2 is less than 1.2 V. (b) VPA2 is more than 2.7 deg.	• Accelerator pedal position sensor • Open in VCP2 circuit • VPA2 circuit open or ground short • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2128

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Conditions (a) and (b) continue for 2.0 seconds (1 trip detection logic): (a) VPA2 is more than 4.8 V. (b) VPA is more than 0.4 V but less than 3.45 V.	• Accelerator pedal position sensor • Open in EPA2 circuit • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2138

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) or (b) continues for 2.0 seconds (1 trip detection logic): (a) The difference between VPA and VPA2 is less than 0.02 V. (b) VPA is less than 0.4 V and VPA2 is less than 1.2 V.	• VPA and VPA2 circuits are short-circuited • Accelerator pedal position sensor • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

Related Data List

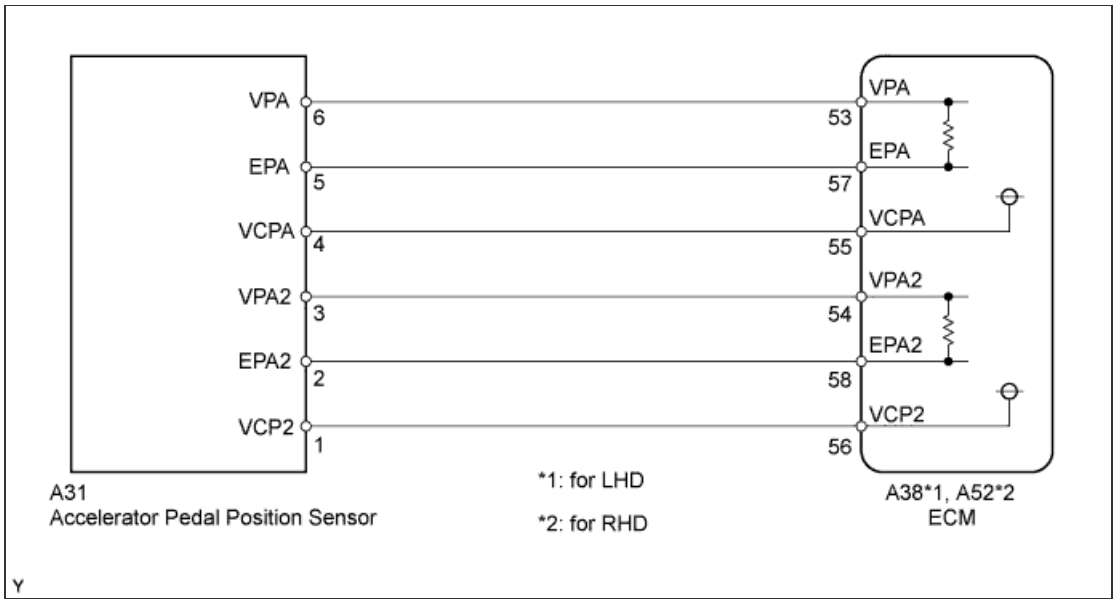
DTC No.	Data List
P2120	• Accel Sens. No.1 Volt % • Accel Sens. No.2 Volt % • Accel Sensor Out No.1 • Accel Sensor Out No.2
P2122	
P2123	
P2125	
P2127	
P2128	
P2138	

HINT:

When DTC P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138 is stored, check the output voltage of the accelerator pedal position sensor by entering the following menus: Powertrain / Engine / Data List / Accel Sensor Out No.1 and Accel Sensor Out No.2.

Trouble Area	Accelerator Pedal Position Expressed as Voltage Output			
	Accelerator Pedal Released		Accelerator Pedal Depressed	
	Accel Sensor Out No.1	Accel Sensor Out No.2	Accel Sensor Out No.1	Accel Sensor Out No.2
VC circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
VPA circuit open or ground short	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.0 V
VPA2 circuit open or ground short	0.5 to 1.1 V	0 to 0.2 V	2.9 to 3.6 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

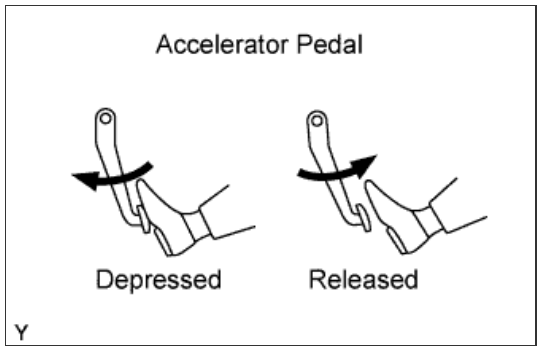
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR PEDAL POSITION)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Accel Sens. No.1 Volt % and Accel Sens. No.2 Volt %.

d. Read the values.



Standard:

Accelerator Pedal	Accel Sens. No.1 Volt %	Accel Sens. No.2 Volt %
Released	8 to 28%	30 to 55%
Depressed	51 to 86%	73 to 98%

Result

Result	Proceed to
NG	A
OK	B

B → Go to step 8

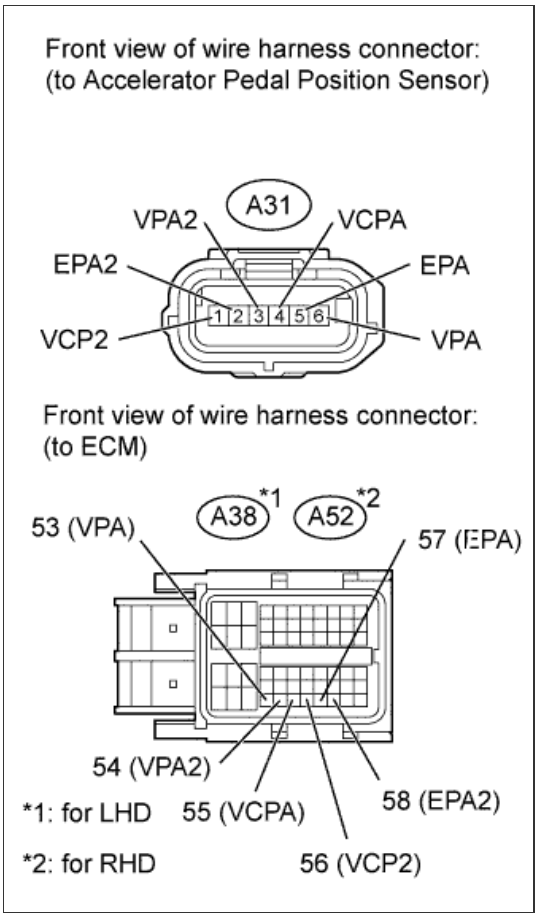
A

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the accelerator pedal position sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) - A38-56 (VCP2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-58 (EPA2)	Always	Below 1 Ω
A31-3 (VPA2) - A38-54 (VPA2)	Always	Below 1 Ω
A31-4 (VCPA) - A38-55 (VCPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-57 (EPA)	Always	Below 1 Ω
A31-6 (VPA) - A38-53 (VPA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) - A52-56 (VCP2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-58 (EPA2)	Always	Below 1 Ω
A31-3 (VPA2) - A52-54 (VPA2)	Always	Below 1 Ω
A31-4 (VCPA) - A52-55 (VCPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-57 (EPA)	Always	Below 1 Ω
A31-6 (VPA) - A52-53 (VPA)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) or A38-56 (VCP2) -		10 kΩ or

Body ground	Always	higher
A31-2 (EPA2) or A38-58 (EPA2) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-54 (VPA2) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-55 (VCPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-57 (EPA) - Body ground	Always	10 kΩ or higher
A31-6 (VPA) or A38-53 (VPA) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) or A52-56 (VCP2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-58 (EPA2) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-54 (VPA2) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-55 (VCPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-57 (EPA) - Body ground	Always	10 kΩ or higher
A31-6 (VPA) or A52-53 (VPA) - Body ground	Always	10 kΩ or higher

NG → Go to step 7

OK

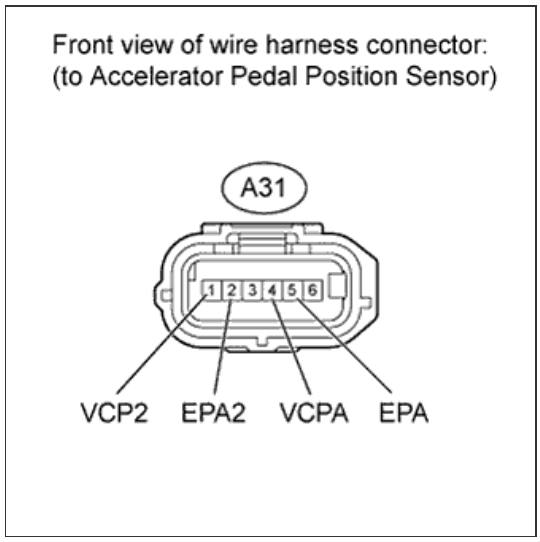
3.INSPECT ECM TERMINAL VOLTAGE (VCPA AND VCP2 TERMINALS)

a. Disconnect the accelerator pedal position sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Ignition switch ON	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Ignition switch ON	4.5 to 5.5 V



NG → Go to step 6

OK

4.REPLACE ACCELERATOR PEDAL ROD ASSEMBLY

a. Replace the accelerator pedal rod assembly (Click here).

NEXT

5.CHECK IF OUTPUT DTC RECURS

a. Connect the intelligent tester to the DLC3.

b. Clear the DTC (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON.

e. Fully close the accelerator pedal for 3 seconds, then hold it partway open for 3 seconds, then fully open it for 3 seconds.

f. Read the DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138 are output again	A
No output	B

B → END

A

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 8

7.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

8.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch off and leave the vehicle for 15 seconds.

e. Turn the ignition switch to ON.

f. Fully close the accelerator pedal for 3 seconds, then hold it partway open for 3 seconds, then fully open it for 3 seconds.

g. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, idle the engine.

NEXT

END

DTC P0299 Turbocharger / Supercharger Underboost

for Preparation Click here

DESCRIPTION

HINT:

Refer to DTC P0046 (Click here).

Refer to DTC P00AF (Click here).

P0299

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Accelerate vehicle with accelerator halfway open or more starting from a speed of 120 km/h (192 mph) or more for 2 minutes (make sure gear is fixed and does not change)	The pressure is 55 kPa below the Target Boost Pressure for 40 seconds at an engine speed of 2800 to 4400 rpm (2 trip detection logic).	• Turbocharger sub-assembly • Turbo motor driver • Turbo motor driver power source • Extremely low battery voltage (P0560 output simultaneously) • Disconnected pipe between turbo and intake manifold • Disconnected MAP sensor hose • Throttle valve stuck closed • EGR does not close • Exhaust system or intake system modified (leading to increased pressure loss, etc.) • Manifold absolute pressure sensor • Injection system (reduction in fuel injection volume) • ECM

Related Data List

DTC No.	Data List
P0299	• Target Booster Pressure • MAP

HINT:

If DTC P0299 is stored, the following symptoms may appear:

- **Variable nozzle stuck open malfunction**
  - **Lack of power**
  - **Vehicle surge or hesitation under light or medium load**
  - **White smoke**

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

Comparison of the Data List items MAP and Target Booster Pressure during acceleration under medium to high engine speeds can be used to determine the state of the problem.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0299)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read the DTCs.

Result:

Display (DTC Output)	Proceed to
P0299 is output	A
P0299 and other DTCs are output	B

B → GO TO DTC CHART (Click here)

A

2.CHECK INTAKE AND EXHAUST SYSTEM

a. Check the intake and exhaust system modifications.

OK:
No modifications.

NG → REPAIR OR REPLACE INTAKE AND EXHAUST SYSTEM

OK

3.INSPECT TURBOCHARGER SUB-ASSEMBLY (for Bank 1 or Bank 2)

a. Check the turbocharger sub-assembly (for Bank 1 or Bank 2) (Click here).

HINT:

Check if the VN is stuck, if there are abnormal noises from the turbo (impeller is damaged), if there is turbo shaft rattle, and if the turbo shaft rotates smoothly.

NG → REPLACE TURBOCHARGER SUB-ASSEMBLY (for Bank 1 or Bank 2) (Click here)

OK

4.CHECK CONNECTION OF VACUUM HOSE

a. Check the vacuum hoses of manifold absolute pressure sensor connections.

NG → REPAIR OR REPLACE VACUUM HOSE

OK

5.READ VALUE USING INTELLIGENT TESTER (MAP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / MAP.

d. Read the value.

Standard Value:

Condition	Standard Value
Idling	90 to 102 kPa
3000 rpm	100 to 150 kPa

NG → REPLACE MANIFOLD ABSOLUTE PRESSURE SENSOR

OK

6.READ VALUE USING INTELLIGENT TESTER (ACTUAL THROTTLE POSITION)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Actual Throttle Position, Actual Throttle Position #2.

d. Read the value.

Standard Value:

Condition	Standard Value
Ignition switch ON	-5 to 5%
Idling	0 to 90%

NG → REPLACE DIESEL THROTTLE BODY ASSEMBLY (for Bank 1 or Bank 2)

OK

7.READ VALUE USING INTELLIGENT TESTER (ACTUAL EGR VALVE POS.)

HINT:

For vehicles without EGR valve, perform troubleshooting from the next step.

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Active Test / Control the EGR Step Position or Control the EGR Step Position #2 / Data List / Actual EGR Valve Pos. or Actual EGR Valve Pos. #2.

d. When changing the Active Test value from 0 to 100%, check that Actual EGR Valve Pos. or Actual EGR Valve Pos. #2 smoothly changes to the set opening angle.

Standard Value:
Value smoothly changes to within +/-10% of set opening angle.

HINT:

- **EGR valve closed: Actual EGR Valve Pos. is 0%.**
- **EGR valve open: Actual EGR Valve Pos. is 94.9%.**

e. Next, after the engine is warmed up, stop the engine and wait for 15 seconds. After that, start the engine again and idle it for 30 seconds. Then stop the engine and wait for 15 seconds. After starting the engine again, read the Data List values while idling.

Standard Value:

Tester Display	Standard Value
EGR Close Learn Val.	3.5 to 4.5 V
EGR Close Lrn. Val. #2	3.5 to 4.5 V

EGR Close Lrn. Status	ON

NG → REPLACE EGR VALVE ASSEMBLY (No. 1 or No. 2)

OK

8.READ VALUE USING INTELLIGENT TESTER (INJECTION FEEDBACK VAL #1 TO #8)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Start the engine and warm it up.

d. Enter the following menus: Powertrain / Engine / Data List / Injection Feedback Val #1 to #8.

e. Read the values.

Standard Value:

Item	Engine Speed*	Reference Value
Injection Feedback Val #1 to #8	Idling	-3.0 to 3.0 mm^3/st

HINT:

- ***: The A/C switch and all accessory switches should be OFF, and the engine should be fully warmed up.**
- **When the values are outside the standard range, deposits inside the fuel injector may be causing the problem.**

OK:
Values are within the standard range.

NG → REPLACE FUEL INJECTOR OF MALFUNCTIONING CYLINDER

OK

9.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Start the engine and warm it up.

e. Accelerate the vehicle with the accelerator halfway open or more starting from a speed of 120 km/h (192 mph) or more for 2 minutes (make sure the gear is fixed and does not change).

f. Enter the following menus: Powertrain / Engine / DTC / Pending.

g. Read the DTC.

Result

Display (DTC Output)	Proceed to
No output	A
P0299	B

B → REPLACE ECM (Click here)

A

CHECK FOR INTERMITTENT PROBLEMS (Click here)

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

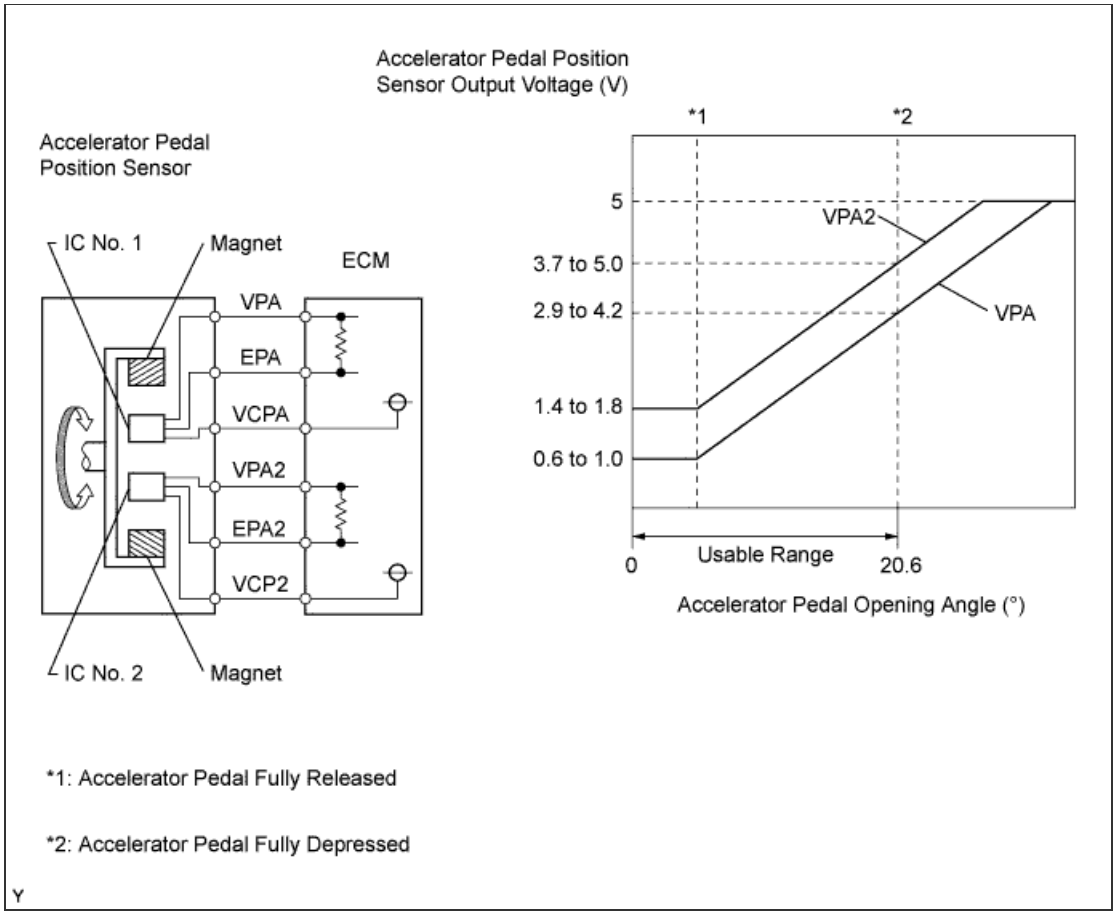
for Preparation Click here

DESCRIPTION

HINT:

- **This is the repair procedure for the accelerator pedal position sensor.**
- **This electrical throttle system does not use a throttle cable.**
- **This accelerator pedal position sensor is a non-contact type.**

The accelerator pedal position sensor is mounted on the accelerator pedal and detects the opening angle of the accelerator pedal. Since this sensor is electronically controlled with Hall-effect elements, accurate control and reliability can be obtained. It has 2 sensors to detect the accelerator position and a malfunction of the accelerator pedal position sensor.
In the accelerator pedal position sensor, the voltage applied to pedal terminals VPA and VPA2 of the ECM changes between 0 V and 5 V in proportion to the opening angle of the accelerator pedal. The VPA is a signal to indicate the actual accelerator pedal opening angle which is used for the engine control, and the VPA2 is a signal to indicate information about the opening angle which is used for detecting malfunctions. The ECM judges the current opening angle of the accelerator pedal using signals from terminals VPA and VPA2, and the ECM controls the throttle motor based on these signals.



P2120

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON		• Accelerator pedal

• Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) continues for 0.5 seconds (1 trip detection logic): (a) VPA is less than 0.4 V and VPA2 is more than 0.97 deg, or VPA is more than 4.8 V.	position sensor • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2122

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) and (b) continue for 0.5 seconds (1 trip detection logic): (a) VPA is less than 0.4 V. (b) VPA2 is more than 0.97 deg.	• Accelerator pedal position sensor • Open in VCPA circuit • VPA circuit open or ground short • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2123

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) continues for 2.0 seconds (1 trip detection logic): (a) VPA is more than 4.8 V.	• Accelerator pedal position sensor • Open in EPA circuit • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2125

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) continues for 0.5 seconds (1 trip detection logic): (a) VPA2 is less than 1.2 V and VPA is more than 2.7 deg, or VPA2 is more than 4.8 V and VPA is more than 0.4 V but less than 3.45 V.	• Accelerator pedal position sensor • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2127

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) and (b) continue for 0.5 seconds (1 trip detection logic): (a) VPA2 is less than 1.2 V. (b) VPA2 is more than 2.7 deg.	• Accelerator pedal position sensor • Open in VCP2 circuit • VPA2 circuit open or ground short • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2128

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Conditions (a) and (b) continue for 2.0 seconds (1 trip detection logic): (a) VPA2 is more than 4.8 V. (b) VPA is more than 0.4 V but less than 3.45 V.	• Accelerator pedal position sensor • Open in EPA2 circuit • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2138

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) or (b) continues for 2.0 seconds (1 trip detection logic): (a) The difference between VPA and VPA2 is less than 0.02 V. (b) VPA is less than 0.4 V and VPA2 is less than 1.2 V.	• VPA and VPA2 circuits are short-circuited • Accelerator pedal position sensor • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

Related Data List

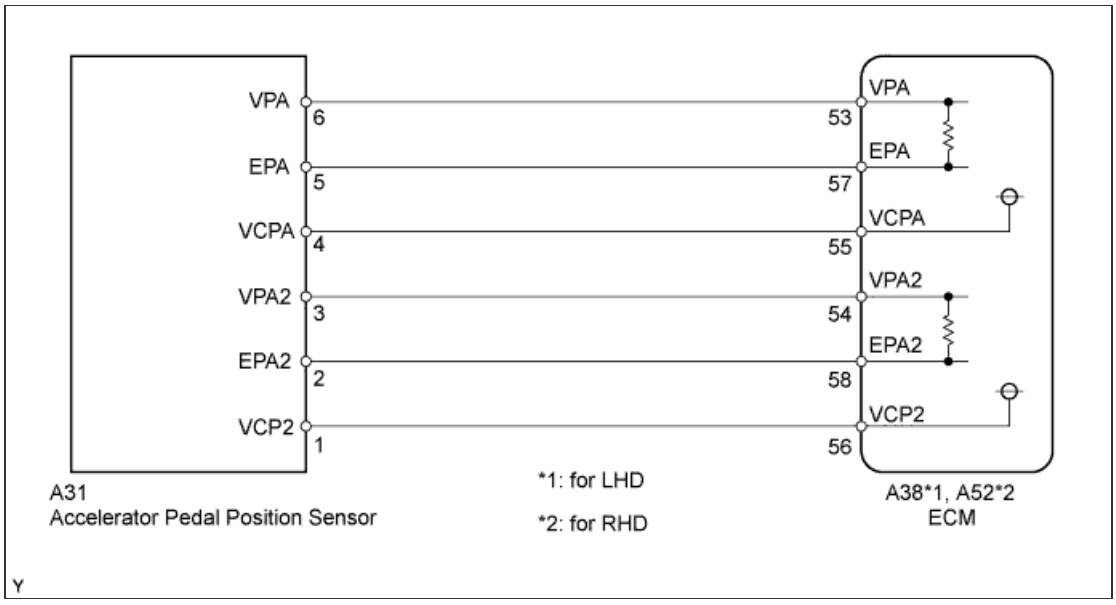
DTC No.	Data List
P2120	• Accel Sens. No.1 Volt % • Accel Sens. No.2 Volt % • Accel Sensor Out No.1 • Accel Sensor Out No.2
P2122	
P2123	
P2125	
P2127	
P2128	
P2138	

HINT:

When DTC P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138 is stored, check the output voltage of the accelerator pedal position sensor by entering the following menus: Powertrain / Engine / Data List / Accel Sensor Out No.1 and Accel Sensor Out No.2.

Trouble Area	Accelerator Pedal Position Expressed as Voltage Output			
	Accelerator Pedal Released		Accelerator Pedal Depressed	
	Accel Sensor Out No.1	Accel Sensor Out No.2	Accel Sensor Out No.1	Accel Sensor Out No.2
VC circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
VPA circuit open or ground short	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.0 V
VPA2 circuit open or ground short	0.5 to 1.1 V	0 to 0.2 V	2.9 to 3.6 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

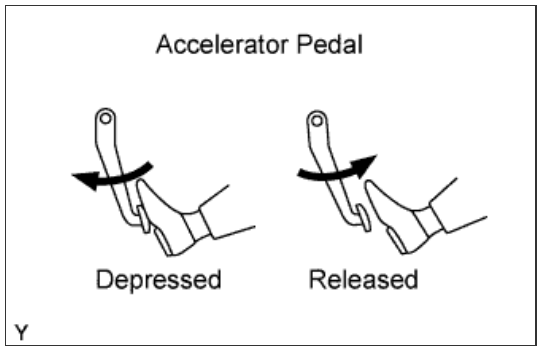
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR PEDAL POSITION)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Accel Sens. No.1 Volt % and Accel Sens. No.2 Volt %.

d. Read the values.



Standard:

Accelerator Pedal	Accel Sens. No.1 Volt %	Accel Sens. No.2 Volt %
Released	8 to 28%	30 to 55%
Depressed	51 to 86%	73 to 98%

Result

Result	Proceed to
NG	A
OK	B

B → Go to step 8

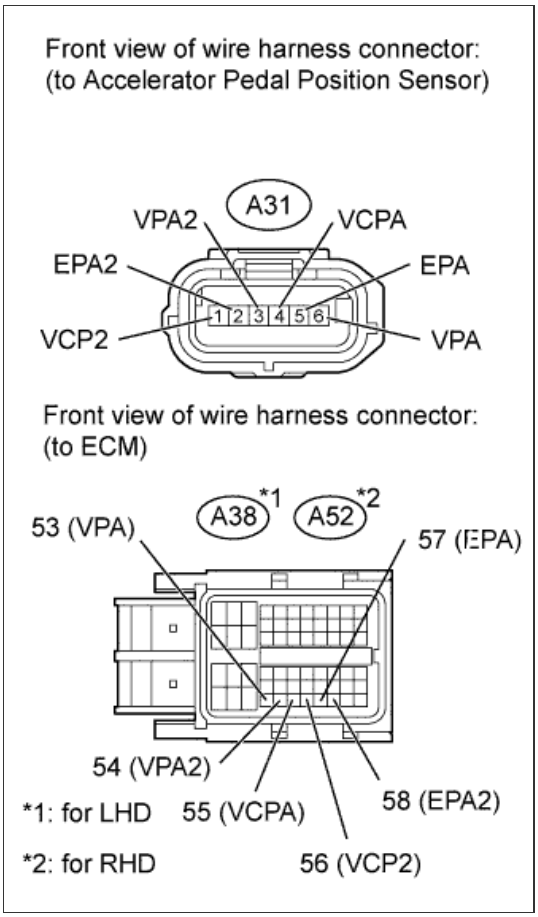
A

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the accelerator pedal position sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) - A38-56 (VCP2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-58 (EPA2)	Always	Below 1 Ω
A31-3 (VPA2) - A38-54 (VPA2)	Always	Below 1 Ω
A31-4 (VCPA) - A38-55 (VCPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-57 (EPA)	Always	Below 1 Ω
A31-6 (VPA) - A38-53 (VPA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) - A52-56 (VCP2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-58 (EPA2)	Always	Below 1 Ω
A31-3 (VPA2) - A52-54 (VPA2)	Always	Below 1 Ω
A31-4 (VCPA) - A52-55 (VCPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-57 (EPA)	Always	Below 1 Ω
A31-6 (VPA) - A52-53 (VPA)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) or A38-56 (VCP2) -		10 kΩ or

Body ground	Always	higher
A31-2 (EPA2) or A38-58 (EPA2) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-54 (VPA2) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-55 (VCPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-57 (EPA) - Body ground	Always	10 kΩ or higher
A31-6 (VPA) or A38-53 (VPA) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) or A52-56 (VCP2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-58 (EPA2) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-54 (VPA2) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-55 (VCPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-57 (EPA) - Body ground	Always	10 kΩ or higher
A31-6 (VPA) or A52-53 (VPA) - Body ground	Always	10 kΩ or higher

NG → Go to step 7

OK

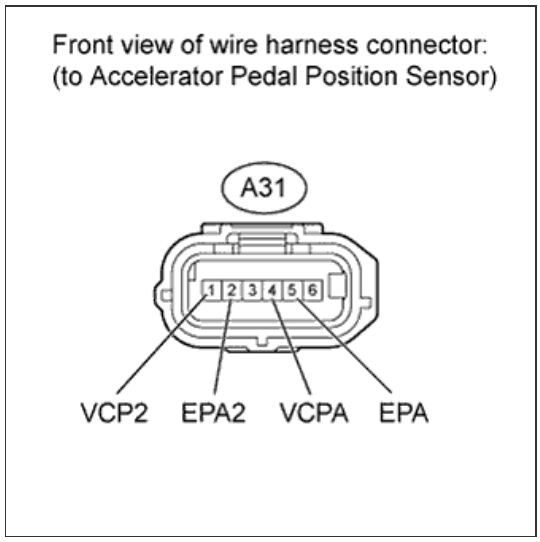
3.INSPECT ECM TERMINAL VOLTAGE (VCPA AND VCP2 TERMINALS)

a. Disconnect the accelerator pedal position sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Ignition switch ON	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Ignition switch ON	4.5 to 5.5 V



NG → Go to step 6

OK

4.REPLACE ACCELERATOR PEDAL ROD ASSEMBLY

a. Replace the accelerator pedal rod assembly (Click here).

NEXT

5.CHECK IF OUTPUT DTC RECURS

a. Connect the intelligent tester to the DLC3.

b. Clear the DTC (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON.

e. Fully close the accelerator pedal for 3 seconds, then hold it partway open for 3 seconds, then fully open it for 3 seconds.

f. Read the DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138 are output again	A
No output	B

B → END

A

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 8

7.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

8.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch off and leave the vehicle for 15 seconds.

e. Turn the ignition switch to ON.

f. Fully close the accelerator pedal for 3 seconds, then hold it partway open for 3 seconds, then fully open it for 3 seconds.

g. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, idle the engine.

NEXT

END

DTC P0335 Crankshaft Position Sensor "A" Circuit

DTC P0339 Crankshaft Position Sensor "A" Circuit Intermittent

for Preparation Click here

DESCRIPTION

The crankshaft position sensor system consists of a crankshaft position sensor plate and a pickup coil. The sensor plate has 34 teeth and is installed on the crankshaft. The pickup coil is made of an iron core and magnet. The sensor plate rotates, and a pulse signal is created as each tooth passes by the pickup coil. The pickup coil generates 34 signals for each revolution. Based on these signals, the ECM calculates the crankshaft position and engine speed. Using these calculations, the common rail injection system is controlled.

P0335

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Crank or start engine	When one of the following conditions is met (for 5 seconds during cranking or 0.5 seconds during engine start) (1 trip detection logic): • No crankshaft position sensor signal is sent to the ECM while cranking.	• Open or short in crankshaft position sensor circuit • Crankshaft position sensor • No. 1 crankshaft position sensor plate (crankshaft) • ECM

P0339

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Engine running at 1000 rpm or more with vehicle stationary	No crankshaft position sensor signal is input to the ECM for 0.05 seconds or more, and conditions (a), (b) and (c) are met (1 trip detection logic): (a) Engine speed is 1000 rpm or more. (b) STA signal is off. (c) 3 seconds or more have elapsed after STA signal is switched from on to off.	• Open or short in crankshaft position sensor circuit • Crankshaft position sensor • No. 1 crankshaft position sensor plate (crankshaft) • ECM

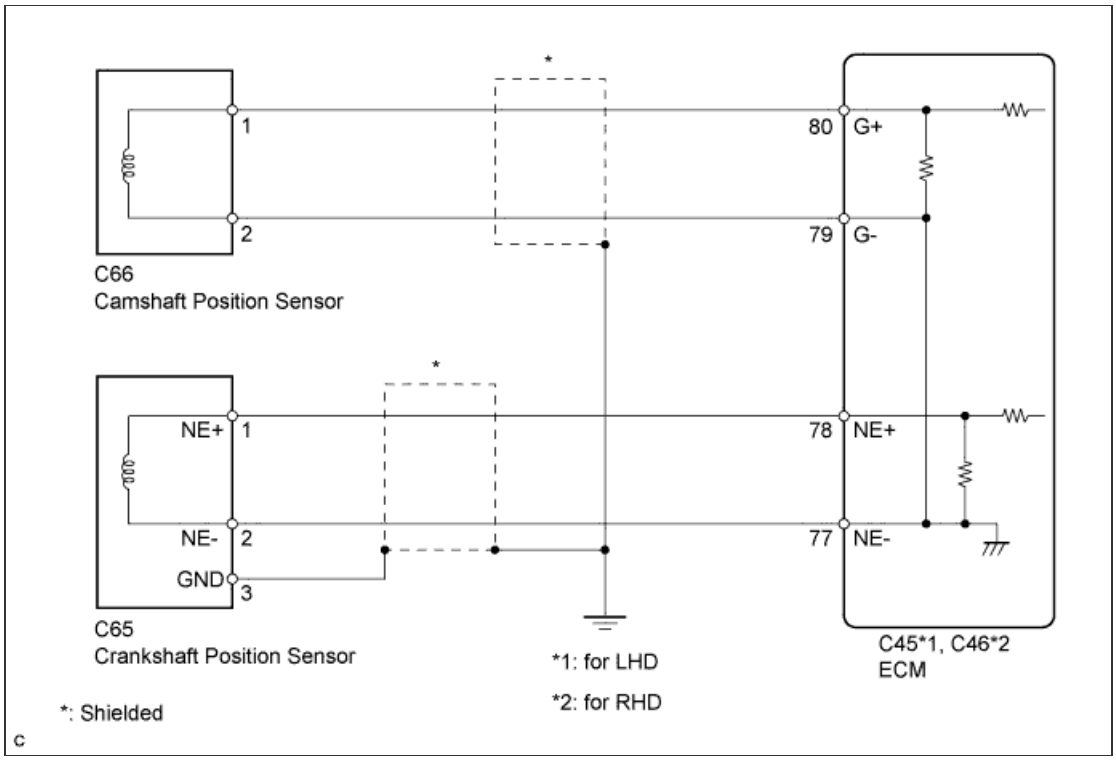
Related Data List

DTC No.	Data List
P0335	Engine Speed
P0339	

HINT:

- **If DTC P0335 and/or P0339 is stored, the following symptoms may appear:**
  - **Difficult starting**
  - **Misfire**
  - **Combustion noise**
  - **Black smoke**
  - **White smoke**
  - **Lack of power**

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**
- **The Data List item Engine Speed is calculated from the output of the crankshaft position sensor.**
- **A DTC is also stored when the ground of a shielded wire is faulty.**

1.INSPECT CRANKSHAFT POSITION SENSOR

a. Disconnect the crankshaft position sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (NE+) - 2 (NE-)	Cold	1630 to 2740 Ω
1 (NE+) - 2 (NE-)	Hot	2065 to 3225 Ω

HINT:

In the table above, the terms "Cold" and "Hot" refer to the temperature of the coils in the sensor. "Cold" means approximately -10 to 50°C (14 to 122°F). "Hot" means approximately 50 to 100°C (122 to 212°F).

Component without harness connected:
(Crankshaft Position Sensor)



NG → Go to step 6

OK

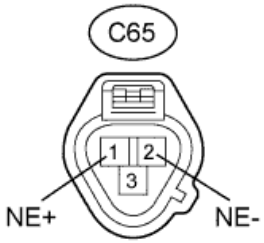
2.CHECK HARNESS AND CONNECTOR (CRANKSHAFT POSITION SENSOR - ECM)

a. Disconnect the crankshaft position sensor connector.

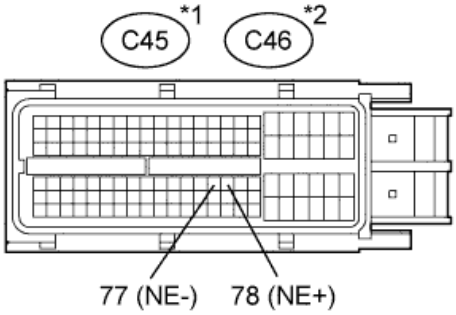
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Crankshaft Position Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C65-1 (NE+) - C45-78 (NE+)	Always	Below 1 Ω
C65-2 (NE-) - C45-77 (NE-)	Always	Below 1 Ω
C65-3 - Body ground	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C65-1 (NE+) - C46-78 (NE+)	Always	Below 1 Ω
C65-2 (NE-) - C46-77 (NE-)	Always	Below 1 Ω
C65-3 - Body ground	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C65-1 (NE+) or C45-78 (NE+) - Body ground	Always	10 kΩ or higher
C65-2 (NE-) or C45-77 (NE-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C65-1 (NE+) or C46-78 (NE+) - Body ground	Always	10 kΩ or higher
C65-2 (NE-) or C46-77 (NE-) - Body ground	Always	10 kΩ or higher

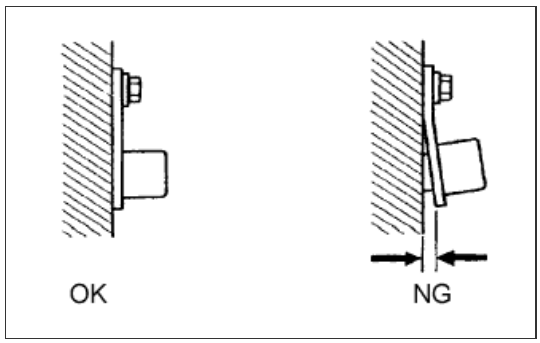
NG → Go to step 7

OK

3.CHECK CRANKSHAFT POSITION SENSOR (SENSOR INSTALLATION)

a. Check the sensor installation.

OK:
Sensor is installed correctly.



NG → Go to step 8

OK

4.CHECK NO. 1 CRANKSHAFT POSITION SENSOR PLATE

a. Check the teeth of the sensor plate.

OK:
The sensor plate teeth do not have any cracks or deformation.

NG → Go to step 9

OK

5.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 10

6.REPLACE CRANKSHAFT POSITION SENSOR

a. Replace the crankshaft position sensor (Click here).

NEXT → Go to step 10

7.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT → Go to step 10

8.SECURELY REINSTALL SENSOR

a. Securely reinstall sensor (Click here).

NEXT → Go to step 10

9.REPLACE CRANKSHAFT

a. Replace the crankshaft (Click here).

NEXT

10.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Start the engine and run it at 1000 rpm or more.

e. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P0335 and/or P0339.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, after increasing the engine speed to 1000 rpm for approximately 1 second, idle the engine for 5 minutes.

NEXT

END

DTC P2120 Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC P2122 Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC P2123 Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC P2125 Throttle / Pedal Position Sensor / Switch "E" Circuit

DTC P2127 Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC P2128 Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC P2138 Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

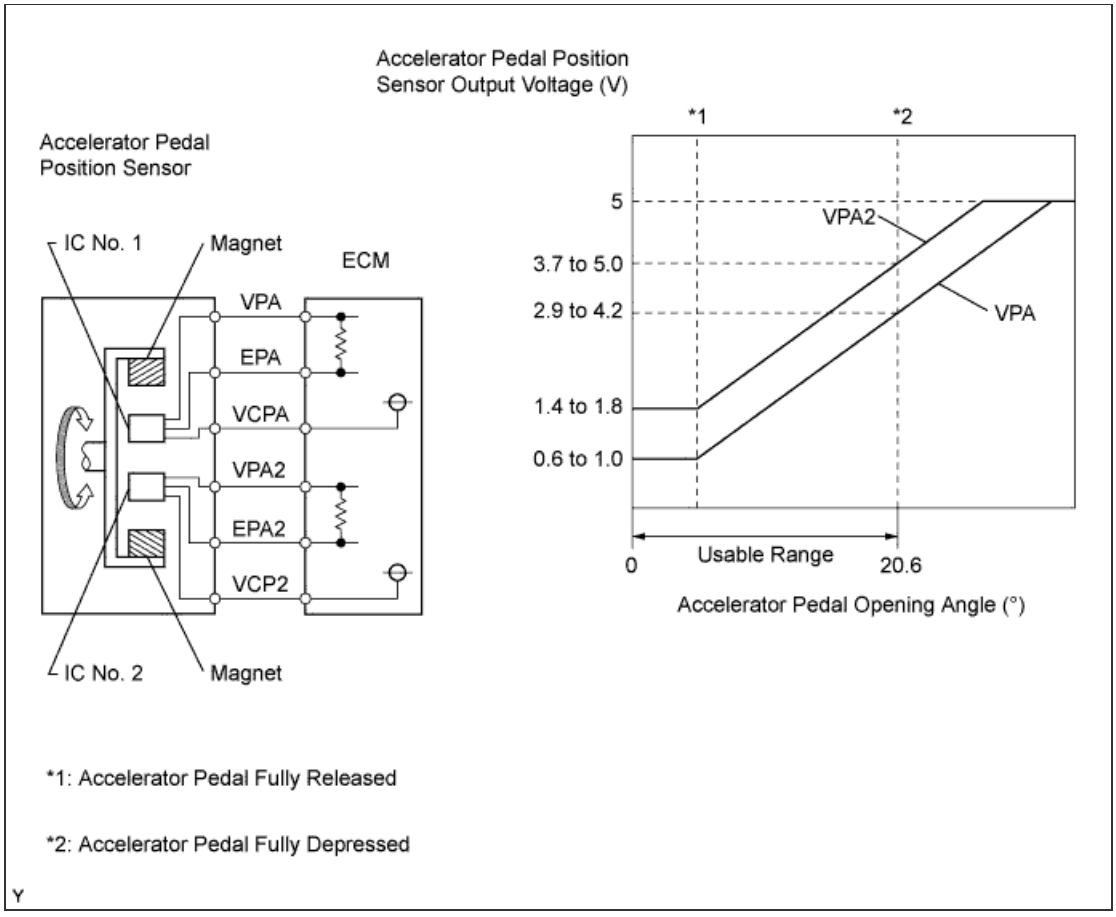
for Preparation Click here

DESCRIPTION

HINT:

- **This is the repair procedure for the accelerator pedal position sensor.**
- **This electrical throttle system does not use a throttle cable.**
- **This accelerator pedal position sensor is a non-contact type.**

The accelerator pedal position sensor is mounted on the accelerator pedal and detects the opening angle of the accelerator pedal. Since this sensor is electronically controlled with Hall-effect elements, accurate control and reliability can be obtained. It has 2 sensors to detect the accelerator position and a malfunction of the accelerator pedal position sensor.
In the accelerator pedal position sensor, the voltage applied to pedal terminals VPA and VPA2 of the ECM changes between 0 V and 5 V in proportion to the opening angle of the accelerator pedal. The VPA is a signal to indicate the actual accelerator pedal opening angle which is used for the engine control, and the VPA2 is a signal to indicate information about the opening angle which is used for detecting malfunctions. The ECM judges the current opening angle of the accelerator pedal using signals from terminals VPA and VPA2, and the ECM controls the throttle motor based on these signals.



P2120

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON		• Accelerator pedal

• Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) continues for 0.5 seconds (1 trip detection logic): (a) VPA is less than 0.4 V and VPA2 is more than 0.97 deg, or VPA is more than 4.8 V.	position sensor • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2122

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) and (b) continue for 0.5 seconds (1 trip detection logic): (a) VPA is less than 0.4 V. (b) VPA2 is more than 0.97 deg.	• Accelerator pedal position sensor • Open in VCPA circuit • VPA circuit open or ground short • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2123

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) continues for 2.0 seconds (1 trip detection logic): (a) VPA is more than 4.8 V.	• Accelerator pedal position sensor • Open in EPA circuit • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2125

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) continues for 0.5 seconds (1 trip detection logic): (a) VPA2 is less than 1.2 V and VPA is more than 2.7 deg, or VPA2 is more than 4.8 V and VPA is more than 0.4 V but less than 3.45 V.	• Accelerator pedal position sensor • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2127

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) and (b) continue for 0.5 seconds (1 trip detection logic): (a) VPA2 is less than 1.2 V. (b) VPA2 is more than 2.7 deg.	• Accelerator pedal position sensor • Open in VCP2 circuit • VPA2 circuit open or ground short • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2128

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Conditions (a) and (b) continue for 2.0 seconds (1 trip detection logic): (a) VPA2 is more than 4.8 V. (b) VPA is more than 0.4 V but less than 3.45 V.	• Accelerator pedal position sensor • Open in EPA2 circuit • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

P2138

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	Condition (a) or (b) continues for 2.0 seconds (1 trip detection logic): (a) The difference between VPA and VPA2 is less than 0.02 V. (b) VPA is less than 0.4 V and VPA2 is less than 1.2 V.	• VPA and VPA2 circuits are short-circuited • Accelerator pedal position sensor • Accelerator pedal • Accelerator pedal rod (arm) deformed • ECM

Related Data List

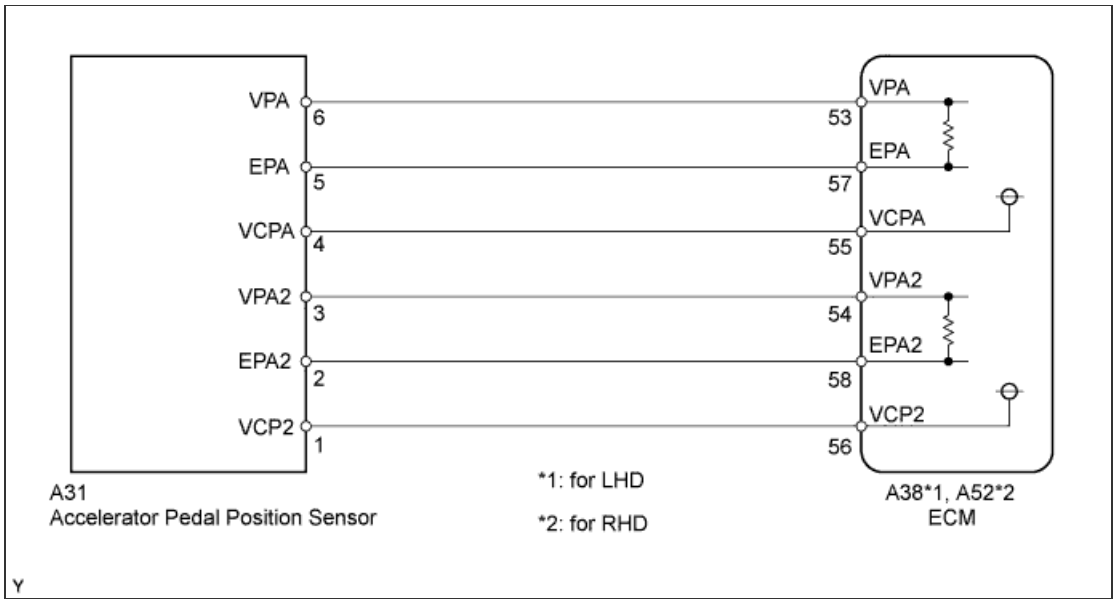
DTC No.	Data List
P2120	• Accel Sens. No.1 Volt % • Accel Sens. No.2 Volt % • Accel Sensor Out No.1 • Accel Sensor Out No.2
P2122	
P2123	
P2125	
P2127	
P2128	
P2138	

HINT:

When DTC P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138 is stored, check the output voltage of the accelerator pedal position sensor by entering the following menus: Powertrain / Engine / Data List / Accel Sensor Out No.1 and Accel Sensor Out No.2.

Trouble Area	Accelerator Pedal Position Expressed as Voltage Output			
	Accelerator Pedal Released		Accelerator Pedal Depressed	
	Accel Sensor Out No.1	Accel Sensor Out No.2	Accel Sensor Out No.1	Accel Sensor Out No.2
VC circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
VPA circuit open or ground short	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.0 V
VPA2 circuit open or ground short	0.5 to 1.1 V	0 to 0.2 V	2.9 to 3.6 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

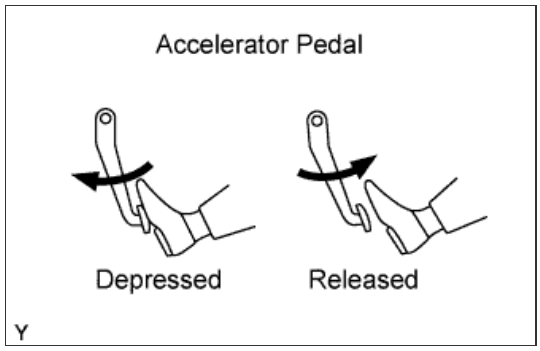
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR PEDAL POSITION)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Accel Sens. No.1 Volt % and Accel Sens. No.2 Volt %.

d. Read the values.



Standard:

Accelerator Pedal	Accel Sens. No.1 Volt %	Accel Sens. No.2 Volt %
Released	8 to 28%	30 to 55%
Depressed	51 to 86%	73 to 98%

Result

Result	Proceed to
NG	A
OK	B

B → Go to step 8

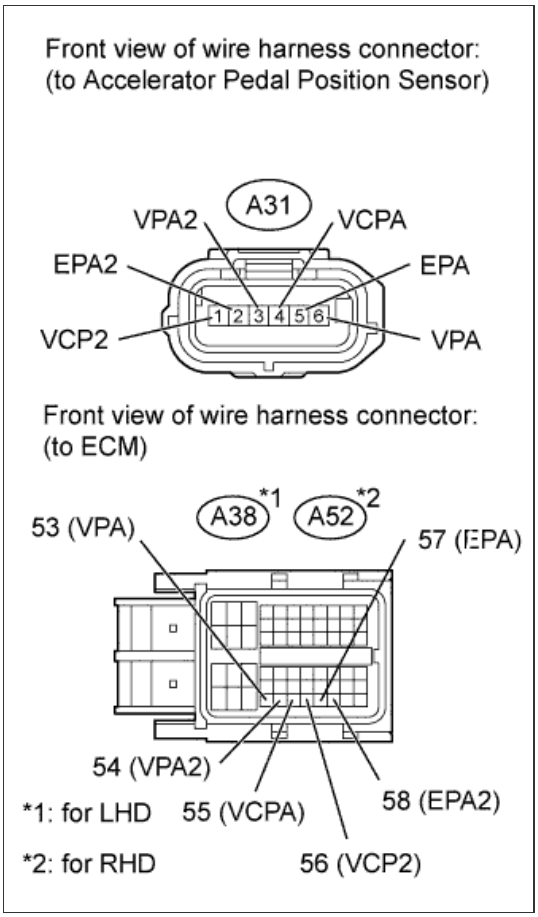
A

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the accelerator pedal position sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) - A38-56 (VCP2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-58 (EPA2)	Always	Below 1 Ω
A31-3 (VPA2) - A38-54 (VPA2)	Always	Below 1 Ω
A31-4 (VCPA) - A38-55 (VCPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-57 (EPA)	Always	Below 1 Ω
A31-6 (VPA) - A38-53 (VPA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) - A52-56 (VCP2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-58 (EPA2)	Always	Below 1 Ω
A31-3 (VPA2) - A52-54 (VPA2)	Always	Below 1 Ω
A31-4 (VCPA) - A52-55 (VCPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-57 (EPA)	Always	Below 1 Ω
A31-6 (VPA) - A52-53 (VPA)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) or A38-56 (VCP2) -		10 kΩ or

Body ground	Always	higher
A31-2 (EPA2) or A38-58 (EPA2) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-54 (VPA2) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-55 (VCPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-57 (EPA) - Body ground	Always	10 kΩ or higher
A31-6 (VPA) or A38-53 (VPA) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) or A52-56 (VCP2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-58 (EPA2) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-54 (VPA2) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-55 (VCPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-57 (EPA) - Body ground	Always	10 kΩ or higher
A31-6 (VPA) or A52-53 (VPA) - Body ground	Always	10 kΩ or higher

NG → Go to step 7

OK

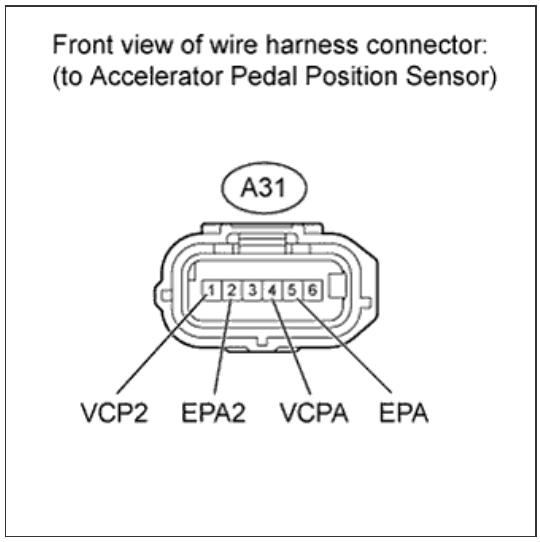
3.INSPECT ECM TERMINAL VOLTAGE (VCPA AND VCP2 TERMINALS)

a. Disconnect the accelerator pedal position sensor connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
A31-4 (VCPA) - A31-5 (EPA)	Ignition switch ON	4.5 to 5.5 V
A31-1 (VCP2) - A31-2 (EPA2)	Ignition switch ON	4.5 to 5.5 V



NG → Go to step 6

OK

4.REPLACE ACCELERATOR PEDAL ROD ASSEMBLY

a. Replace the accelerator pedal rod assembly (Click here).

NEXT

5.CHECK IF OUTPUT DTC RECURS

a. Connect the intelligent tester to the DLC3.

b. Clear the DTC (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON.

e. Fully close the accelerator pedal for 3 seconds, then hold it partway open for 3 seconds, then fully open it for 3 seconds.

f. Read the DTCs.

Result

Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138 are output again	A
No output	B

B → END

A

6.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 8

7.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

8.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch off and leave the vehicle for 15 seconds.

e. Turn the ignition switch to ON.

f. Fully close the accelerator pedal for 3 seconds, then hold it partway open for 3 seconds, then fully open it for 3 seconds.

g. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, idle the engine.

NEXT

END

DTC P0335 Crankshaft Position Sensor "A" Circuit

DTC P0339 Crankshaft Position Sensor "A" Circuit Intermittent

for Preparation Click here

DESCRIPTION

The crankshaft position sensor system consists of a crankshaft position sensor plate and a pickup coil. The sensor plate has 34 teeth and is installed on the crankshaft. The pickup coil is made of an iron core and magnet. The sensor plate rotates, and a pulse signal is created as each tooth passes by the pickup coil. The pickup coil generates 34 signals for each revolution. Based on these signals, the ECM calculates the crankshaft position and engine speed. Using these calculations, the common rail injection system is controlled.

P0335

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Crank or start engine	When one of the following conditions is met (for 5 seconds during cranking or 0.5 seconds during engine start) (1 trip detection logic): • No crankshaft position sensor signal is sent to the ECM while cranking.	• Open or short in crankshaft position sensor circuit • Crankshaft position sensor • No. 1 crankshaft position sensor plate (crankshaft) • ECM

P0339

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Engine running at 1000 rpm or more with vehicle stationary	No crankshaft position sensor signal is input to the ECM for 0.05 seconds or more, and conditions (a), (b) and (c) are met (1 trip detection logic): (a) Engine speed is 1000 rpm or more. (b) STA signal is off. (c) 3 seconds or more have elapsed after STA signal is switched from on to off.	• Open or short in crankshaft position sensor circuit • Crankshaft position sensor • No. 1 crankshaft position sensor plate (crankshaft) • ECM

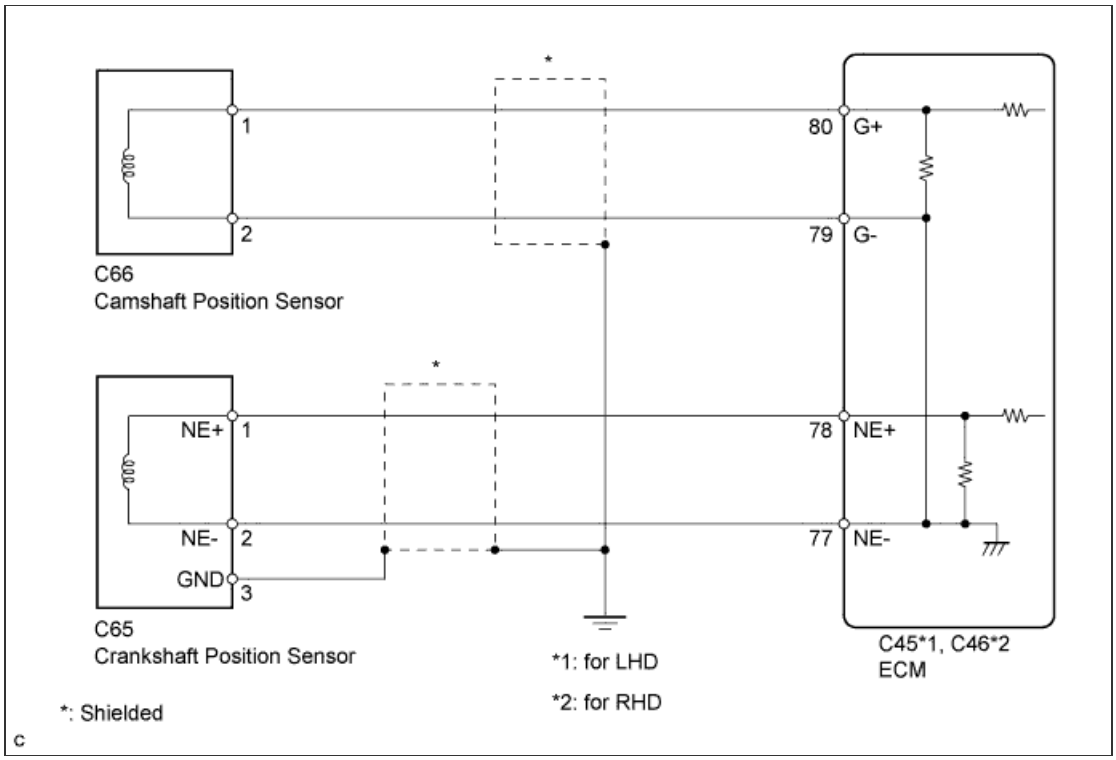
Related Data List

DTC No.	Data List
P0335	Engine Speed
P0339	

HINT:

- **If DTC P0335 and/or P0339 is stored, the following symptoms may appear:**
  - **Difficult starting**
  - **Misfire**
  - **Combustion noise**
  - **Black smoke**
  - **White smoke**
  - **Lack of power**

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**
- **The Data List item Engine Speed is calculated from the output of the crankshaft position sensor.**
- **A DTC is also stored when the ground of a shielded wire is faulty.**

1.INSPECT CRANKSHAFT POSITION SENSOR

a. Disconnect the crankshaft position sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (NE+) - 2 (NE-)	Cold	1630 to 2740 Ω
1 (NE+) - 2 (NE-)	Hot	2065 to 3225 Ω

HINT:

In the table above, the terms "Cold" and "Hot" refer to the temperature of the coils in the sensor. "Cold" means approximately -10 to 50°C (14 to 122°F). "Hot" means approximately 50 to 100°C (122 to 212°F).

Component without harness connected:
(Crankshaft Position Sensor)



NG → Go to step 6

OK

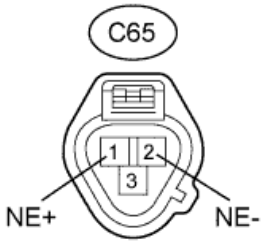
2.CHECK HARNESS AND CONNECTOR (CRANKSHAFT POSITION SENSOR - ECM)

a. Disconnect the crankshaft position sensor connector.

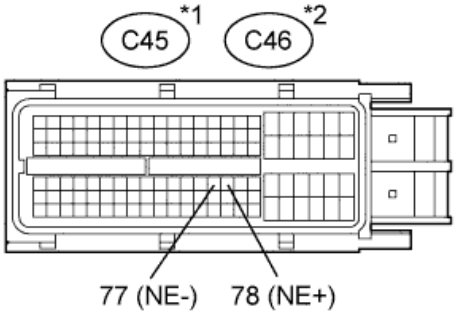
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Crankshaft Position Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C65-1 (NE+) - C45-78 (NE+)	Always	Below 1 Ω
C65-2 (NE-) - C45-77 (NE-)	Always	Below 1 Ω
C65-3 - Body ground	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C65-1 (NE+) - C46-78 (NE+)	Always	Below 1 Ω
C65-2 (NE-) - C46-77 (NE-)	Always	Below 1 Ω
C65-3 - Body ground	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C65-1 (NE+) or C45-78 (NE+) - Body ground	Always	10 kΩ or higher
C65-2 (NE-) or C45-77 (NE-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C65-1 (NE+) or C46-78 (NE+) - Body ground	Always	10 kΩ or higher
C65-2 (NE-) or C46-77 (NE-) - Body ground	Always	10 kΩ or higher

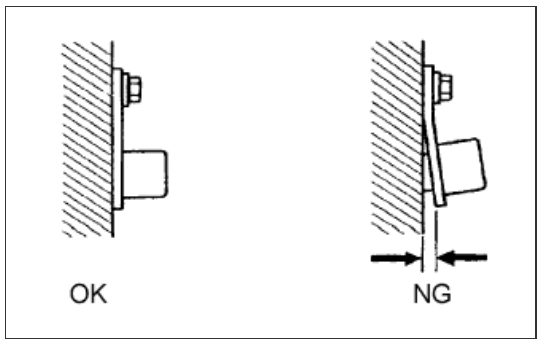
NG → Go to step 7

OK

3.CHECK CRANKSHAFT POSITION SENSOR (SENSOR INSTALLATION)

a. Check the sensor installation.

OK:
Sensor is installed correctly.



NG → Go to step 8

OK

4.CHECK NO. 1 CRANKSHAFT POSITION SENSOR PLATE

a. Check the teeth of the sensor plate.

OK:
The sensor plate teeth do not have any cracks or deformation.

NG → Go to step 9

OK

5.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 10

6.REPLACE CRANKSHAFT POSITION SENSOR

a. Replace the crankshaft position sensor (Click here).

NEXT → Go to step 10

7.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT → Go to step 10

8.SECURELY REINSTALL SENSOR

a. Securely reinstall sensor (Click here).

NEXT → Go to step 10

9.REPLACE CRANKSHAFT

a. Replace the crankshaft (Click here).

NEXT

10.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Start the engine and run it at 1000 rpm or more.

e. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P0335 and/or P0339.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, after increasing the engine speed to 1000 rpm for approximately 1 second, idle the engine for 5 minutes.

NEXT

END

DTC P2121 Throttle / Pedal Position Sensor / Switch "D" Circuit Range / Performance

for Preparation Click here

DESCRIPTION

Refer to DTC P2120 (Click here).

P2121

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON • Accelerator pedal fully closed for 3 seconds • Accelerator pedal open partway for 3 seconds • Accelerator pedal fully open for 3 seconds	The difference between VPA and VPA2 is less than 0.4 V, or more than 1.2 V for 0.5 seconds (1 trip detection logic).	• Accelerator pedal position sensor circuit • Accelerator pedal position sensor • ECM

Related Data List

DTC No.	Data List
P2121	• Accel Sens. No.1 Volt % • Accel Sens. No.2 Volt % • Accel Sensor Out No.1 • Accel Sensor Out No.2

WIRING DIAGRAM

Refer to DTC P2120 (Click here).

INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

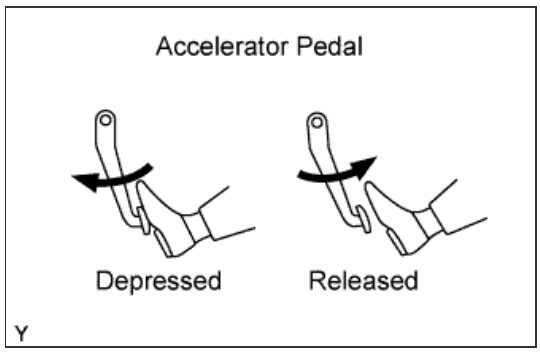
1.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR PEDAL POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Accel Sens. No.1 Volt % and Accel Sens. No.2 Volt %.

d. Read the values.



Standard:

Accelerator Pedal	Accel Sens. No.1 Volt %	Accel Sens. No.2 Volt %
Released	8 to 28%	30 to 55%
Depressed	51 to 86%	73 to 98%

Result

Result	Proceed to
NG	A
OK	B

B → Go to step 7

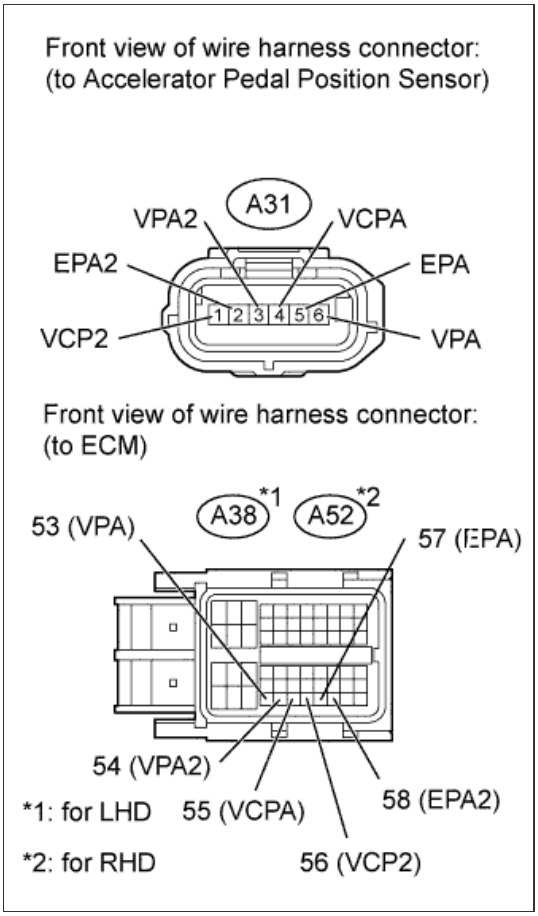
A

2.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the accelerator pedal position sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) - A38-56 (VCP2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-58 (EPA2)	Always	Below 1 Ω
A31-3 (VPA2) - A38-54 (VPA2)	Always	Below 1 Ω
A31-4 (VCPA) - A38-55 (VCPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-57 (EPA)	Always	Below 1 Ω
A31-6 (VPA) - A38-53 (VPA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) - A52-56 (VCP2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-58 (EPA2)	Always	Below 1 Ω
A31-3 (VPA2) - A52-54 (VPA2)	Always	Below 1 Ω
A31-4 (VCPA) - A52-55 (VCPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-57 (EPA)	Always	Below 1 Ω

A31-6 (VPA) - A52-53 (VPA)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) or A38-56 (VCP2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A38-58 (EPA2) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-54 (VPA2) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-55 (VCPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-57 (EPA) - Body ground	Always	10 kΩ or higher
A31-6 (VPA) or A38-53 (VPA) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) or A52-56 (VCP2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-58 (EPA2) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-54 (VPA2) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-55 (VCPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-57 (EPA) - Body ground	Always	10 kΩ or higher
A31-6 (VPA) or A52-53 (VPA) - Body ground	Always	10 kΩ or higher

NG → Go to step 6

OK

3.REPLACE ACCELERATOR PEDAL ROD ASSEMBLY

a. Replace the accelerator pedal rod assembly (Click here).

NEXT

4.CHECK WHETHER DTC OUTPUT RECURS (DTC P2121)

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON.

e. Fully close the accelerator pedal for 3 seconds, then hold it partway open for 3 seconds, then fully open it for 3 seconds.

f. Enter the following menus: Powertrain / Engine / DTC.

g. Read the DTCs.

Result

Result	Proceed to
P2121 is output	A

No DTC is output	B

B → END

A

5.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 7

6.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

7.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON.

e. Fully close the accelerator pedal for 3 seconds, then hold it partway open for 3 seconds, then fully open it for 3 seconds.

f. Enter the following menus: Powertrain / Engine / DTC.

g. Confirm that the DTC is not output again.

NEXT

END

DTC P0340 Camshaft Position Sensor "A" Circuit (Bank 1 or Single Sensor)

for Preparation Click here

DESCRIPTION

The camshaft position sensor (G signal) consists of a magnet, iron core and pickup coil.
The G signal plate (timing sprocket) has one tooth on its outer circumference and is installed on the camshaft timing chain gear. When the timing gear rotates, the protrusion on the signal plate and the air gap on the pickup coil change, causing fluctuations in the magnetic field that generate a voltage in the pickup coil.
The NE signal plate has 34 teeth and is mounted on the crank angle sensor plate. The NE signal sensor generates 34 signals for every revolution. The ECM detects the standard crankshaft angle based on the G signal, and detects the actual crankshaft angle and engine speed based on the NE signal.

P0340

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Crank engine for 4 seconds (STA on)	STA on: No camshaft position sensor signal is sent to the ECM while cranking for 4 seconds or more (2 trip detection logic).	• Open or short in camshaft position sensor circuit • Camshaft position sensor • No. 2 camshaft timing sprocket • ECM
Idle engine for 1 second (STA off)	STA off: When either condition below is met for 1 second (1 trip detection logic): • G signal is not input with an engine speed of 500 rpm or more. • No camshaft position sensor signal is sent to the ECM with an engine speed of 500 to 3000 rpm 20 times or more.	

HINT:

If DTC P0340 is stored, the following symptoms may appear:

- Difficult starting
- Misfire
- Combustion noise
- Black smoke
- White smoke
- Lack of power

WIRING DIAGRAM

Refer to DTC P0335 (Click here).

INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.INSPECT CAMSHAFT POSITION SENSOR

a. Disconnect the camshaft position sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	Cold	835 to 1400 Ω
1 - 2	Hot	1060 to 1645 Ω

HINT:

In the table above, the terms "Cold" and "Hot" refer to the temperature of the coils in the sensor. "Cold" means approximately -10 to 50°C (14 to 122°F).

"Hot" means approximately 50 to 100°C (122 to 212°F).

Component without harness connected:
(Camshaft Position Sensor)



NG → Go to step 6

OK

.CHECK HARNESS AND CONNECTOR (CAMSHAFT POSITION SENSOR - ECM)

a. Disconnect the camshaft position sensor connector.

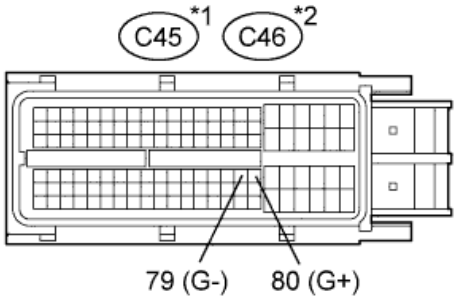
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Camshaft Position Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition

C66-1 - C45-80 (G+)	Always	Below 1 Ω
C66-2 - C45-79 (G-)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C66-1 - C46-80 (G+)	Always	Below 1 Ω
C66-2 - C46-79 (G-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C66-1 or C45-80 (G+) - Body ground	Always	10 kΩ or higher
C66-2 or C45-79 (G-) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C66-1 or C46-80 (G+) - Body ground	Always	10 kΩ or higher
C66-2 or C46-79 (G-) - Body ground	Always	10 kΩ or higher

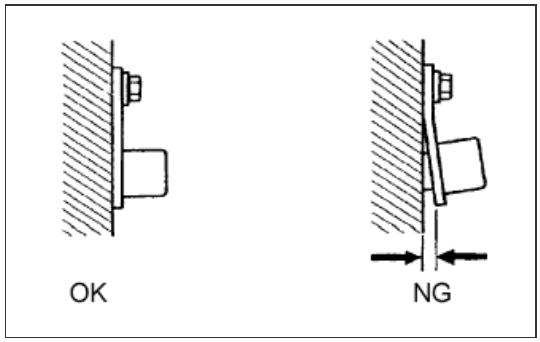
NG → Go to step 7

OK

3.CHECK CAMSHAFT POSITION SENSOR (SENSOR INSTALLATION)

a. Check the sensor installation.

OK:
Sensor is installed correctly.



NG → Go to step 8

OK

4.CHECK NO. CAMSHAFT TIMING SPROCKET

a. Check the condition of the timing sprocket.

OK:
Timing sprocket does not have any cracks or deformation.

NG → Go to step 9

OK

5.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 10

6.REPLACE CAMSHAFT POSITION SENSOR

a. Replace the camshaft position sensor (Click here).

NEXT → Go to step 10

7.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT → Go to step 10

8.SECURELY REINSTALL SENSOR

a. Securely reinstall the sensor (Click here).

NEXT → Go to step 10

9.REPLACE NO. CAMSHAFT TIMING SPROCKET

a. Replace the No. 2 camshaft timing sprocket (Click here).

NEXT

10.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Start the engine and idle it for 2 seconds.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

DTC P2226 Barometric Pressure Circuit

DTC P2228 Barometric Pressure Circuit Low Input

DTC P2229 Barometric Pressure Circuit High Input

for Preparation Click here

DESCRIPTION

To detect atmospheric pressure, the built-in atmospheric pressure sensor in the ECM is used for the common rail system. Following the changes in the atmospheric pressure, the ECM corrects the injection volume, timing and duration, and adjusts the common rail internal fuel pressure in order to optimize engine combustion.

P2226

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	Atmospheric pressure sensor voltage is 1.4 V or less, or 4.0 V or more for 0.5 seconds (1 trip detection logic).	ECM

P2228

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	Atmospheric pressure sensor voltage is 1.4 V or less for 0.5 seconds (1 trip detection logic).	ECM

P2229

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	Atmospheric pressure sensor voltage is 4.0 V or more for 0.5 seconds (1 trip detection logic).	ECM

Related Data List

DTC No.	Data List
P2226	• Atmosphere Pressure • MAP
P2228	
P2229	

HINT:

- **When the ignition switch is ON, the intake air pipe pressure is approximately equal to atmospheric pressure.**
- **Under standard atmospheric pressure conditions, the output of the atmospheric pressure sensor is 101 kPa. For every 100 m increase in altitude, pressure drops by 1 kPa. Varies by weather (high atmospheric pressure, low atmospheric pressure).**
- **If DTC P2226, P2228 and/or P2229 is stored, the following symptoms may appear:**
  - **Misfire**
  - **Combustion noise**
  - **Black smoke**
  - **White smoke**

INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2226, P2228 OR P2229)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P2226, P2228 or P2229 is output	A
P2226, P2228 or P2229 and other DTCs are output	B

HINT:

If any DTCs other than P2226, P2228 and P2229 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.REPLACE ECM

a. Replace the ECM (Click here).

NEXT

3.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch off and leave the vehicle for 15 seconds.

e. Turn the ignition switch to ON for 1 second.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P2226, P2228 and/or P2229.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, idle the engine.

NEXT

END

DTC P0400 Exhaust Gas Recirculation Flow

DTC P1248 Exhaust Gas Recirculation Flow Bank 2

for Preparation Click here

DESCRIPTION

The EGR system recirculates exhaust gases. The recirculated gas mingles with the intake air so that the EGR system can slow combustion speed and keep the combustion temperature down. This helps reduce NOx emissions.
In order to increase EGR circulation efficiency, the ECM adjusts the lift amount of the EGR valve and the throttle valve angle.

P0400 (No. 1 EGR valve malfunction)

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After warming up engine and idling for 60 seconds, maintain engine speed at 2500 rpm for 40 seconds, drive vehicle and perform engine break deceleration by fully closing accelerator when engine speed is 2000 rpm or more	The target and actual positions of the No. 1 EGR valve assembly are different for 30 seconds or more (1 trip detection logic).	• EGR valve stuck • EGR valve does not move smoothly • Open or short in EGR valve circuit • EGR valve deposit • EGR valve passage • ECM

P1248 (No. 2 EGR valve malfunction)

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After warming up engine and idling for 60 seconds, maintain engine speed at 2500 rpm for 40 seconds, drive vehicle and perform engine break deceleration by fully closing accelerator when engine speed is 2000 rpm or more	The target and actual positions of the No. 1 EGR valve assembly are different for 30 seconds or more (1 trip detection logic).	• EGR valve stuck • EGR valve does not move smoothly • Open or short in EGR valve circuit • EGR valve deposit • EGR valve passage • ECM

P0400 (Flow malfunction)

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Decelerate from a speed of 50 km/h (80 mph) or more (release accelerator pedal for approximately 5 seconds)	Mass air flow rate is not changed when turning on the electric EGR control valve while decelerating (2 trip detection logic).	• EGR valve stuck • EGR valve does not move smoothly • Open or short in EGR valve

		circuit • EGR valve deposit • EGR valve passage • ECM

Related Data List

DTC No.	Data List
P0400 (No. 1 EGR valve malfunction)	• MAF • MAP • Actual EGR Valve Pos. • Actual EGR Valve Pos. #2 • Target EGR Valve Pos. • Target EGR Valve Pos. #2 • EGR Close Lrn. Val. • EGR Close Lrn. Val. #2 • EGR Close Learn Val. • EGR Close Lrn. Val. #2 • EGR Close Lrn. Status • EGR Close Lrn. Status #2 • EGR Lift Sensor Volt % • EGR Lift Sensor Volt % #2 • EGR Motor Duty #1 • EGR Motor Duty #2
P1248 (No. 2 EGR valve malfunction)	
P0400 (Flow malfunction)	

HINT:

If DTC P0400 and/or P1238 is stored, the following symptoms may appear:

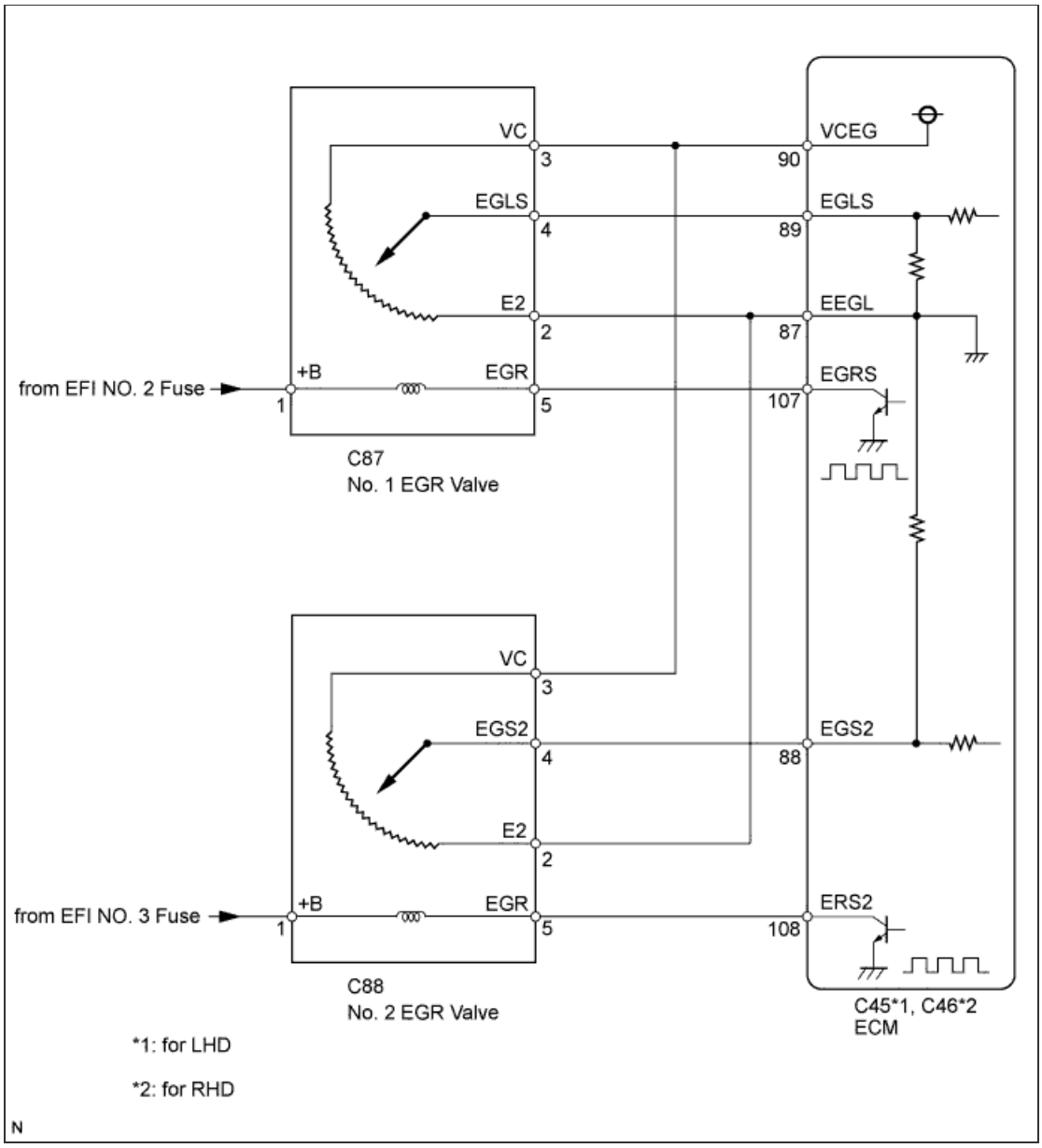
Stuck closed malfunction
- **Intake booming noise**
- **Slight combustion noise**

Stuck open malfunction
- **Black smoke**
- **Lack of power**
- **Vibration at engine stop**
- **Hesitation**

MONITOR DESCRIPTION

- When the target and actual positions of the EGR valve are different, the ECM interprets this as a malfunction of the EGR valve and illuminates the MIL (1 trip detection logic).
- If the electric EGR control valve is forcibly operated but the intake air amount does not vary, the ECM determines that the electric EGR control valve is malfunctioning. The ECM then illuminates the MIL (2 trip detection logic).

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- **The Data List item Actual EGR Valve Pos. changes to follow Target EGR Position. When the ignition switch is ON (engine stopped), the EGR valve is fully closed (Actual EGR Valve Pos. = 0), and when idling, the EGR valve is open partway (neither fully closed nor fully open).**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P0400, P1248)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P0400 and/or P1248 are output	A
P0400, P1248 and other DTCs are output	B

HINT:

If codes other than P0400 and P1248 are output, perform troubleshooting for those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (CONTROL THE EGR STEP POSITION)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Active Test / Control the EGR Step Position or Control the EGR Step Position #2 / Data List / Actual EGR Valve Pos. or Actual EGR Valve Pos. #2.

d. When changing the Active Test value from 0 to 100%, check that Actual EGR Valve Pos. or Actual EGR Valve Pos. #2 smoothly changes to the set opening angle.

OK:

Value smoothly changes to within +/-10% of set opening angle.

HINT:

- **EGR valve closed: Actual EGR Valve Pos. is 0%**
- **EGR valve open: Actual EGR Valve Pos. is 94.9%**

NG → Go to step 6

OK

3.READ VALUE USING INTELLIGENT TESTER (EGR VALVE LEARNING VALUE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch from ON to off, and wait 5 seconds. Then turn the ignition switch to ON and the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / EGR Close Learn Val. or EGR Close Lrn. Val. #2, and EGR Lift Sensor Volt % or EGR Lift Sensor Volt % #2.

d. Check the value.

OK:

Tester Display	Standard value
EGR Close Learn Val.	3.5 to 4.5 V
EGR Close Lrn. Val. #2	3.5 to 4.5 V
EGR Lift Sensor Volt %	70 to 90%
EGR Lift Sensor Volt % #2	70 to 90%

HINT:

- **When EGR Close Lrn. Status is OFF (learning is incomplete) or EGR Close Lrn. Value is 3.5 V (lower limit), there is foreign matter stuck in the valve.**
- **The median value of EGR Close Lrn. Value is 4.0 V.**

NG → Go to step 10

OK

4.CHECK FOR DEPOSIT (EGR PASSAGE)

a. Check for any deposits.

OK:

No deposits.

NG → Go to step 11

OK

5.CHECK FOR EXHAUST GAS LEAKS

a. Check for exhaust gas leaks.

OK:
No leaks.

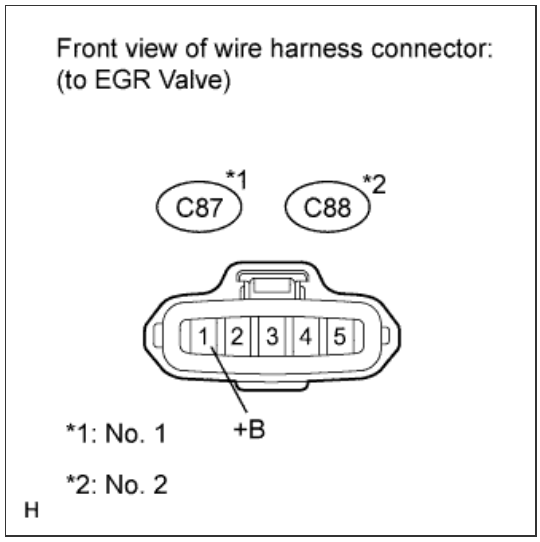
OK → Go to step 9

NG → Go to step 12

6.INSPECT EGR VALVE ASSEMBLY (POWER SOURCE)

a. Disconnect the EGR valve connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

No. 1

Tester Connection	Switch Condition	Specified Condition
C87-1 (+B) - Body ground	Ignition switch ON	11 to 14 V

No. 2

Tester Connection	Switch Condition	Specified Condition
C88-1 (+B) - Body ground	Ignition switch ON	11 to 14 V

NG → Go to step 13

OK

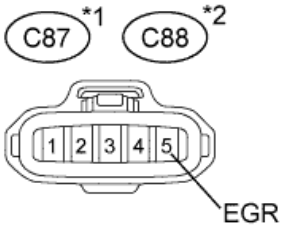
7.CHECK HARNESS AND CONNECTOR (EGR VALVE ASSEMBLY - ECM)

a. Disconnect the EGR valve connector.

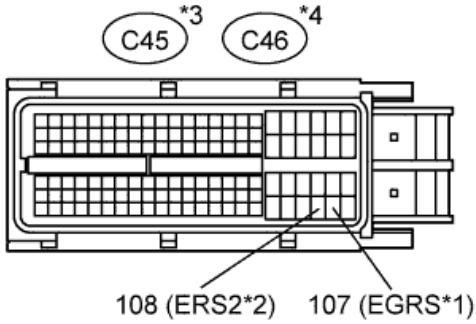
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to EGR Valve)



Front view of wire harness connector:
(to ECM)



*1: No. 1

*2: No. 2

*3: for LHD

*4: for RHD

Standard Resistance (Check for Open):

No. 1 (LHD)

Tester Connection	Condition	Specified Condition
C87-5 (EGR) - C45-107 (EGRS)	Always	Below 1 Ω

No. 2 (LHD)

Tester Connection	Condition	Specified Condition
C88-5 (EGR) - C45-108 (ERS2)	Always	Below 1 Ω

No. 1 (RHD)

Tester Connection	Condition	Specified Condition
C87-5 (EGR) - C46-107 (EGRS)	Always	Below 1 Ω

No. 2 (RHD)

Tester Connection	Condition	Specified Condition
C88-5 (EGR) - C46-108 (ERS2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

No. 1 (LHD)

Tester Connection	Condition	Specified Condition
C87-5 (EGR) or C45-107 (EGRS) - Body ground	Always	10 kΩ or higher

No. 2 (LHD)

Tester Connection	Condition	Specified Condition
C88-5 (EGR) or C45-108 (ERS2) - Body ground	Always	10 kΩ or higher

No. 1 (RHD)

Tester Connection	Condition	Specified Condition
C87-5 (EGR) or C46-107 (EGRS) - Body ground	Always	10 kΩ or higher

No. 2 (RHD)

Tester Connection	Condition	Specified Condition
C88-5 (EGR) or C46-108 (ERS2) - Body ground	Always	10 kΩ or higher

NG → Go to step 14

OK

8.REPLACE EGR VALVE ASSEMBLY (No. 1 or No. 2)

a. Replace the EGR valve assembly (No. 1 or No. 2) (Click here).

NEXT

9.CHECK WHETHER DTC OUTPUT RECURS

a. Clear the DTCs (Click here).

b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON and turn the tester on.

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. After warming up the engine and idling for 60 seconds, maintain the engine speed at 2500 rpm for 40 seconds, decelerate from a speed of 50 km/h (80 mph) or more (release accelerator pedal for approximately 5 seconds).

g. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P0400 and/or P1248.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, after warming up the engine and idling for 60 seconds, maintain the engine speed at 2500 rpm for 40 seconds, decelerate from a speed of 50 km/h (80 mph) or more (release accelerator pedal for approximately 5 seconds).

Result

Result	Proceed to
NORMAL	A
ABNORMAL	B

A → END

B → Go to step 15

10.REMOVE FOREIGN OBJECT AND CLEAN EGR VALVE (No. 1 or No. 2)

NEXT → Go to step 16

11.REPAIR OR REPLACE MALFUNCTIONING PARTS, COMPONENT AND AREA

NEXT → Go to step 16

12.REPAIR EXHAUST GAS LEAKAGE POINT

NEXT → Go to step 16

13.REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - EGR VALVE CONNECTOR)

NEXT → Go to step 16

14.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT → Go to step 16

15.REPLACE ECM

a. Replace the ECM (Click here).

NEXT

16.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Start the engine.

e. After warming up the engine and idling for 60 seconds, maintain the engine speed at 2500 rpm for 40 seconds, decelerate from a speed of 50 km/h (80 mph) or more (release accelerator pedal for approximately 5 seconds).

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P0400 and/or P1248.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, after warming up the engine and idling for 60 seconds, maintain the engine speed at 2500 rpm for 40 seconds, decelerate from a speed of 50 km/h (80 mph) or more (release accelerator pedal for approximately 5 seconds).

NEXT

END

DTC P2226 Barometric Pressure Circuit

DTC P2228 Barometric Pressure Circuit Low Input

DTC P2229 Barometric Pressure Circuit High Input

for Preparation Click here

DESCRIPTION

To detect atmospheric pressure, the built-in atmospheric pressure sensor in the ECM is used for the common rail system. Following the changes in the atmospheric pressure, the ECM corrects the injection volume, timing and duration, and adjusts the common rail internal fuel pressure in order to optimize engine combustion.

P2226

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	Atmospheric pressure sensor voltage is 1.4 V or less, or 4.0 V or more for 0.5 seconds (1 trip detection logic).	ECM

P2228

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	Atmospheric pressure sensor voltage is 1.4 V or less for 0.5 seconds (1 trip detection logic).	ECM

P2229

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	Atmospheric pressure sensor voltage is 4.0 V or more for 0.5 seconds (1 trip detection logic).	ECM

Related Data List

DTC No.	Data List
P2226	• Atmosphere Pressure • MAP
P2228	
P2229	

HINT:

- **When the ignition switch is ON, the intake air pipe pressure is approximately equal to atmospheric pressure.**
- **Under standard atmospheric pressure conditions, the output of the atmospheric pressure sensor is 101 kPa. For every 100 m increase in altitude, pressure drops by 1 kPa. Varies by weather (high atmospheric pressure, low atmospheric pressure).**
- **If DTC P2226, P2228 and/or P2229 is stored, the following symptoms may appear:**
  - **Misfire**
  - **Combustion noise**
  - **Black smoke**
  - **White smoke**

INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2226, P2228 OR P2229)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P2226, P2228 or P2229 is output	A
P2226, P2228 or P2229 and other DTCs are output	B

HINT:

If any DTCs other than P2226, P2228 and P2229 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.REPLACE ECM

a. Replace the ECM (Click here).

NEXT

3.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch off and leave the vehicle for 15 seconds.

e. Turn the ignition switch to ON for 1 second.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P2226, P2228 and/or P2229.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, idle the engine.

NEXT

END

DTC P0400 Exhaust Gas Recirculation Flow

DTC P1248 Exhaust Gas Recirculation Flow Bank 2

for Preparation Click here

DESCRIPTION

The EGR system recirculates exhaust gases. The recirculated gas mingles with the intake air so that the EGR system can slow combustion speed and keep the combustion temperature down. This helps reduce NOx emissions.
In order to increase EGR circulation efficiency, the ECM adjusts the lift amount of the EGR valve and the throttle valve angle.

P0400 (No. 1 EGR valve malfunction)

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After warming up engine and idling for 60 seconds, maintain engine speed at 2500 rpm for 40 seconds, drive vehicle and perform engine break deceleration by fully closing accelerator when engine speed is 2000 rpm or more	The target and actual positions of the No. 1 EGR valve assembly are different for 30 seconds or more (1 trip detection logic).	• EGR valve stuck • EGR valve does not move smoothly • Open or short in EGR valve circuit • EGR valve deposit • EGR valve passage • ECM

P1248 (No. 2 EGR valve malfunction)

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
After warming up engine and idling for 60 seconds, maintain engine speed at 2500 rpm for 40 seconds, drive vehicle and perform engine break deceleration by fully closing accelerator when engine speed is 2000 rpm or more	The target and actual positions of the No. 1 EGR valve assembly are different for 30 seconds or more (1 trip detection logic).	• EGR valve stuck • EGR valve does not move smoothly • Open or short in EGR valve circuit • EGR valve deposit • EGR valve passage • ECM

P0400 (Flow malfunction)

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Decelerate from a speed of 50 km/h (80 mph) or more (release accelerator pedal for approximately 5 seconds)	Mass air flow rate is not changed when turning on the electric EGR control valve while decelerating (2 trip detection logic).	• EGR valve stuck • EGR valve does not move smoothly • Open or short in EGR valve

		circuit • EGR valve deposit • EGR valve passage • ECM

Related Data List

DTC No.	Data List
P0400 (No. 1 EGR valve malfunction)	• MAF • MAP • Actual EGR Valve Pos. • Actual EGR Valve Pos. #2 • Target EGR Valve Pos. • Target EGR Valve Pos. #2 • EGR Close Lrn. Val. • EGR Close Lrn. Val. #2 • EGR Close Learn Val. • EGR Close Lrn. Val. #2 • EGR Close Lrn. Status • EGR Close Lrn. Status #2 • EGR Lift Sensor Volt % • EGR Lift Sensor Volt % #2 • EGR Motor Duty #1 • EGR Motor Duty #2
P1248 (No. 2 EGR valve malfunction)	
P0400 (Flow malfunction)	

HINT:

If DTC P0400 and/or P1238 is stored, the following symptoms may appear:

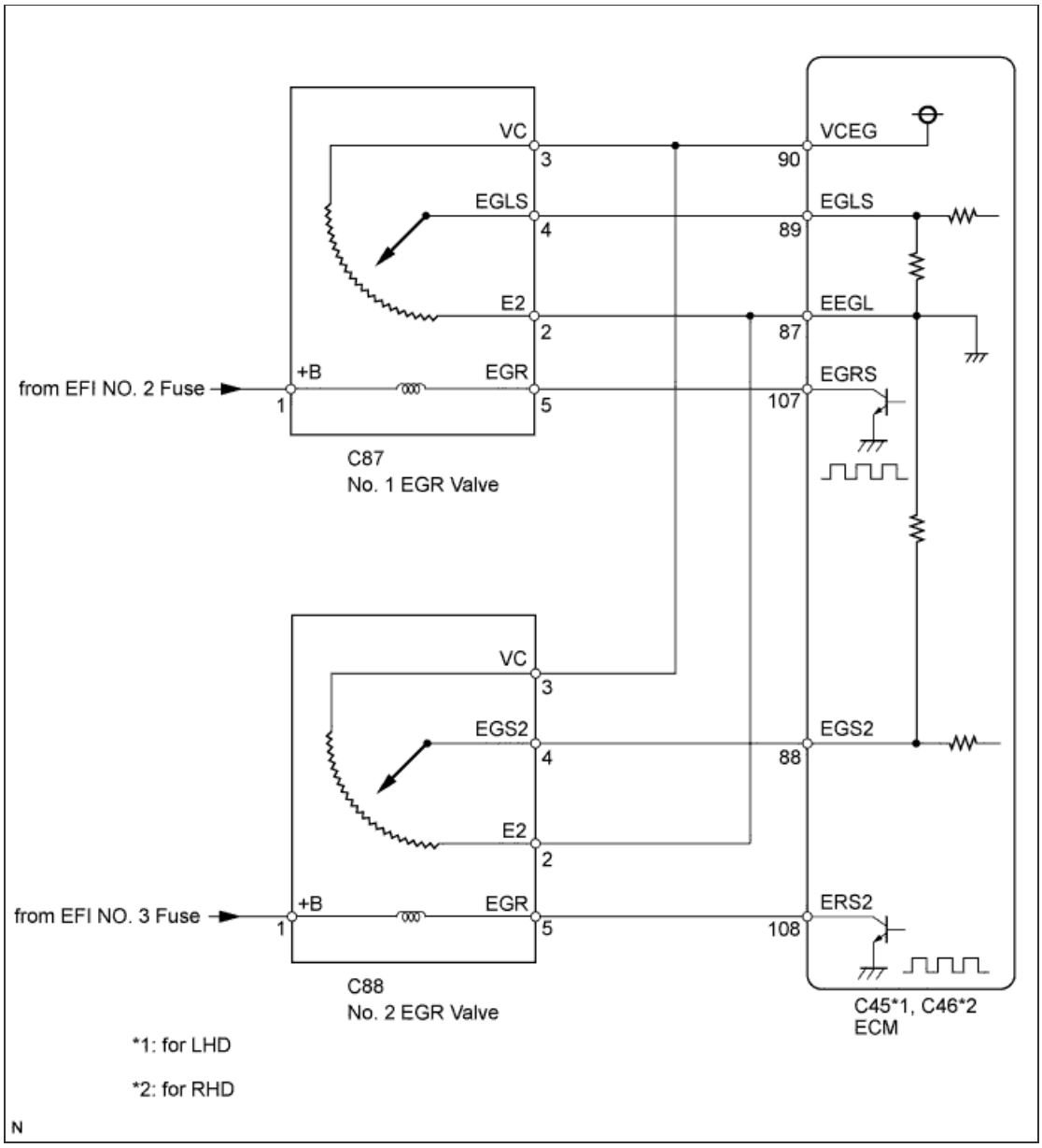
Stuck closed malfunction
- **Intake booming noise**
- **Slight combustion noise**

Stuck open malfunction
- **Black smoke**
- **Lack of power**
- **Vibration at engine stop**
- **Hesitation**

MONITOR DESCRIPTION

- When the target and actual positions of the EGR valve are different, the ECM interprets this as a malfunction of the EGR valve and illuminates the MIL (1 trip detection logic).
- If the electric EGR control valve is forcibly operated but the intake air amount does not vary, the ECM determines that the electric EGR control valve is malfunctioning. The ECM then illuminates the MIL (2 trip detection logic).

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

- **The Data List item Actual EGR Valve Pos. changes to follow Target EGR Position. When the ignition switch is ON (engine stopped), the EGR valve is fully closed (Actual EGR Valve Pos. = 0), and when idling, the EGR valve is open partway (neither fully closed nor fully open).**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**

1.CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P0400, P1248)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P0400 and/or P1248 are output	A
P0400, P1248 and other DTCs are output	B

HINT:

If codes other than P0400 and P1248 are output, perform troubleshooting for those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (CONTROL THE EGR STEP POSITION)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Active Test / Control the EGR Step Position or Control the EGR Step Position #2 / Data List / Actual EGR Valve Pos. or Actual EGR Valve Pos. #2.

d. When changing the Active Test value from 0 to 100%, check that Actual EGR Valve Pos. or Actual EGR Valve Pos. #2 smoothly changes to the set opening angle.

OK:

Value smoothly changes to within +/-10% of set opening angle.

HINT:

- **EGR valve closed: Actual EGR Valve Pos. is 0%**
- **EGR valve open: Actual EGR Valve Pos. is 94.9%**

NG → Go to step 6

OK

3.READ VALUE USING INTELLIGENT TESTER (EGR VALVE LEARNING VALUE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch from ON to off, and wait 5 seconds. Then turn the ignition switch to ON and the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / EGR Close Learn Val. or EGR Close Lrn. Val. #2, and EGR Lift Sensor Volt % or EGR Lift Sensor Volt % #2.

d. Check the value.

OK:

Tester Display	Standard value
EGR Close Learn Val.	3.5 to 4.5 V
EGR Close Lrn. Val. #2	3.5 to 4.5 V
EGR Lift Sensor Volt %	70 to 90%
EGR Lift Sensor Volt % #2	70 to 90%

HINT:

- **When EGR Close Lrn. Status is OFF (learning is incomplete) or EGR Close Lrn. Value is 3.5 V (lower limit), there is foreign matter stuck in the valve.**
- **The median value of EGR Close Lrn. Value is 4.0 V.**

NG → Go to step 10

OK

4.CHECK FOR DEPOSIT (EGR PASSAGE)

a. Check for any deposits.

OK:

No deposits.

NG → Go to step 11

OK

5.CHECK FOR EXHAUST GAS LEAKS

a. Check for exhaust gas leaks.

OK:
No leaks.

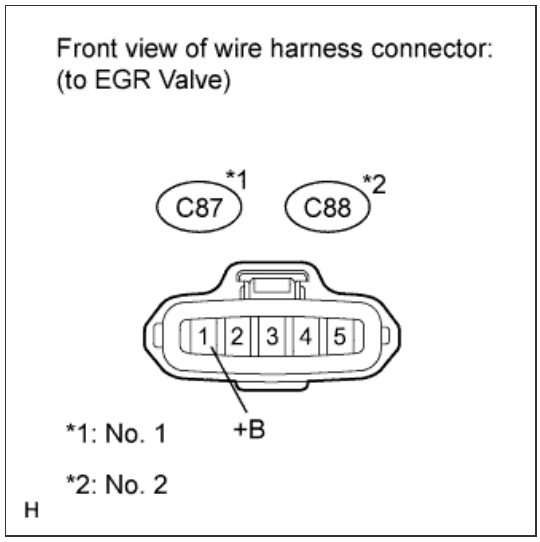
OK → Go to step 9

NG → Go to step 12

6.INSPECT EGR VALVE ASSEMBLY (POWER SOURCE)

a. Disconnect the EGR valve connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

No. 1

Tester Connection	Switch Condition	Specified Condition
C87-1 (+B) - Body ground	Ignition switch ON	11 to 14 V

No. 2

Tester Connection	Switch Condition	Specified Condition
C88-1 (+B) - Body ground	Ignition switch ON	11 to 14 V

NG → Go to step 13

OK

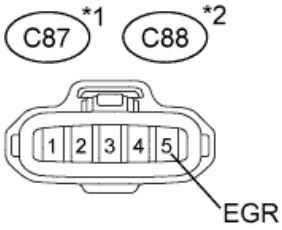
7.CHECK HARNESS AND CONNECTOR (EGR VALVE ASSEMBLY - ECM)

a. Disconnect the EGR valve connector.

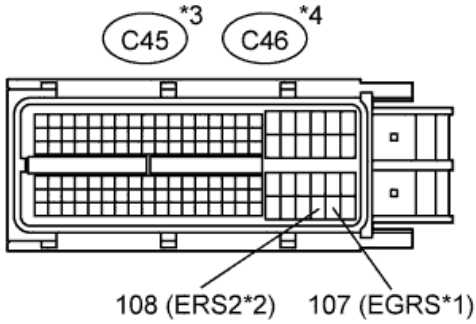
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to EGR Valve)



Front view of wire harness connector:
(to ECM)



*1: No. 1

*2: No. 2

*3: for LHD

*4: for RHD

Standard Resistance (Check for Open):

No. 1 (LHD)

Tester Connection	Condition	Specified Condition
C87-5 (EGR) - C45-107 (EGRS)	Always	Below 1 Ω

No. 2 (LHD)

Tester Connection	Condition	Specified Condition
C88-5 (EGR) - C45-108 (ERS2)	Always	Below 1 Ω

No. 1 (RHD)

Tester Connection	Condition	Specified Condition
C87-5 (EGR) - C46-107 (EGRS)	Always	Below 1 Ω

No. 2 (RHD)

Tester Connection	Condition	Specified Condition
C88-5 (EGR) - C46-108 (ERS2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

No. 1 (LHD)

Tester Connection	Condition	Specified Condition
C87-5 (EGR) or C45-107 (EGRS) - Body ground	Always	10 kΩ or higher

No. 2 (LHD)

Tester Connection	Condition	Specified Condition
C88-5 (EGR) or C45-108 (ERS2) - Body ground	Always	10 kΩ or higher

No. 1 (RHD)

Tester Connection	Condition	Specified Condition
C87-5 (EGR) or C46-107 (EGRS) - Body ground	Always	10 kΩ or higher

No. 2 (RHD)

Tester Connection	Condition	Specified Condition
C88-5 (EGR) or C46-108 (ERS2) - Body ground	Always	10 kΩ or higher

NG → Go to step 14

OK

8.REPLACE EGR VALVE ASSEMBLY (No. 1 or No. 2)

a. Replace the EGR valve assembly (No. 1 or No. 2) (Click here).

NEXT

9.CHECK WHETHER DTC OUTPUT RECURS

a. Clear the DTCs (Click here).

b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON and turn the tester on.

d. Start the engine and warm it up.

e. Switch the ECM from normal mode to check mode using the tester (Click here).

f. After warming up the engine and idling for 60 seconds, maintain the engine speed at 2500 rpm for 40 seconds, decelerate from a speed of 50 km/h (80 mph) or more (release accelerator pedal for approximately 5 seconds).

g. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P0400 and/or P1248.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, after warming up the engine and idling for 60 seconds, maintain the engine speed at 2500 rpm for 40 seconds, decelerate from a speed of 50 km/h (80 mph) or more (release accelerator pedal for approximately 5 seconds).

Result

Result	Proceed to
NORMAL	A
ABNORMAL	B

A → END

B → Go to step 15

10.REMOVE FOREIGN OBJECT AND CLEAN EGR VALVE (No. 1 or No. 2)

NEXT → Go to step 16

11.REPAIR OR REPLACE MALFUNCTIONING PARTS, COMPONENT AND AREA

NEXT → Go to step 16

12.REPAIR EXHAUST GAS LEAKAGE POINT

NEXT → Go to step 16

13.REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - EGR VALVE CONNECTOR)

NEXT → Go to step 16

14.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT → Go to step 16

15.REPLACE ECM

a. Replace the ECM (Click here).

NEXT

16.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Start the engine.

e. After warming up the engine and idling for 60 seconds, maintain the engine speed at 2500 rpm for 40 seconds, decelerate from a speed of 50 km/h (80 mph) or more (release accelerator pedal for approximately 5 seconds).

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P0400 and/or P1248.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, after warming up the engine and idling for 60 seconds, maintain the engine speed at 2500 rpm for 40 seconds, decelerate from a speed of 50 km/h (80 mph) or more (release accelerator pedal for approximately 5 seconds).

NEXT

END

DTC P2226 Barometric Pressure Circuit

DTC P2228 Barometric Pressure Circuit Low Input

DTC P2229 Barometric Pressure Circuit High Input

for Preparation Click here

DESCRIPTION

To detect atmospheric pressure, the built-in atmospheric pressure sensor in the ECM is used for the common rail system. Following the changes in the atmospheric pressure, the ECM corrects the injection volume, timing and duration, and adjusts the common rail internal fuel pressure in order to optimize engine combustion.

P2226

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	Atmospheric pressure sensor voltage is 1.4 V or less, or 4.0 V or more for 0.5 seconds (1 trip detection logic).	ECM

P2228

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	Atmospheric pressure sensor voltage is 1.4 V or less for 0.5 seconds (1 trip detection logic).	ECM

P2229

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 1 second	Atmospheric pressure sensor voltage is 4.0 V or more for 0.5 seconds (1 trip detection logic).	ECM

Related Data List

DTC No.	Data List
P2226	• Atmosphere Pressure • MAP
P2228	
P2229	

HINT:

- **When the ignition switch is ON, the intake air pipe pressure is approximately equal to atmospheric pressure.**
- **Under standard atmospheric pressure conditions, the output of the atmospheric pressure sensor is 101 kPa. For every 100 m increase in altitude, pressure drops by 1 kPa. Varies by weather (high atmospheric pressure, low atmospheric pressure).**
- **If DTC P2226, P2228 and/or P2229 is stored, the following symptoms may appear:**
  - **Misfire**
  - **Combustion noise**
  - **Black smoke**
  - **White smoke**

INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.

1.CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2226, P2228 OR P2229)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read the DTCs.

Result

Result	Proceed to
P2226, P2228 or P2229 is output	A
P2226, P2228 or P2229 and other DTCs are output	B

HINT:

If any DTCs other than P2226, P2228 and P2229 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART (Click here)

A

2.REPLACE ECM

a. Replace the ECM (Click here).

NEXT

3.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch off and leave the vehicle for 15 seconds.

e. Turn the ignition switch to ON for 1 second.

f. Confirm that the DTC is not output again.

HINT:

Perform the following procedure using the tester to determine whether or not the DTC judgment has been carried out.

i. Enter the following menus: Powertrain / Engine / Utility / All Readiness.

ii. Input DTC P2226, P2228 and/or P2229.

iii. Check that STATUS is NORMAL. If STATUS is INCOMPLETE or UNKNOWN, idle the engine.

NEXT

END

DTC P0405 Exhaust Gas Recirculation Sensor "A" Circuit Low

DTC P0406 Exhaust Gas Recirculation Sensor "A" Circuit High

DTC P0407 Exhaust Gas Recirculation Sensor "B" Circuit Low

DTC P0408 Exhaust Gas Recirculation Sensor "B" Circuit High

for Preparation Click here

DESCRIPTION

The EGR valve position sensor is mounted on the EGR valve and used for detecting the lift amount of the valve. The lift amount detected by the sensor is provided to the ECM as feedback. The ECM then regulates the lift amount of the valve in accordance with engine running conditions.

P0405

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 5 seconds	No. 1 EGR valve position sensor output voltage is less than 0.1 V for 5 seconds (1 trip detection logic).	• Open in No. 1 EGR valve position sensor circuit • No. 1 EGR valve (EGR valve position sensor) • ECM

P0406

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 5 seconds	No. 1 EGR valve position sensor output voltage is more than 4.9 V for 5 seconds (1 trip detection logic).	• Short in No. 1 EGR valve position sensor circuit • No. 1 EGR valve (EGR valve position sensor) • ECM

P0407

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 5 seconds	No. 2 EGR valve position sensor output voltage is less than 0.1 V for 5 seconds (1 trip detection logic).	• Open in No. 2 EGR valve position sensor circuit • No. 2 EGR valve (EGR valve position sensor) • ECM

P0408

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 5 seconds	No. 2 EGR valve position sensor output voltage is more than 4.9 V for 5 seconds (1 trip detection logic).	• Short in No. 2 EGR valve position sensor circuit • No. 2 EGR valve (EGR valve position sensor) • ECM

MONITOR DESCRIPTION

When the output voltage of the EGR valve position sensor deviates from the normal operating range of 0.1 to 4.9 V for more than 5 seconds, the ECM interprets this as a malfunction of the sensor circuit, and illuminates the MIL.

WIRING DIAGRAM

Refer to DTC P0400 (Click here).

INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

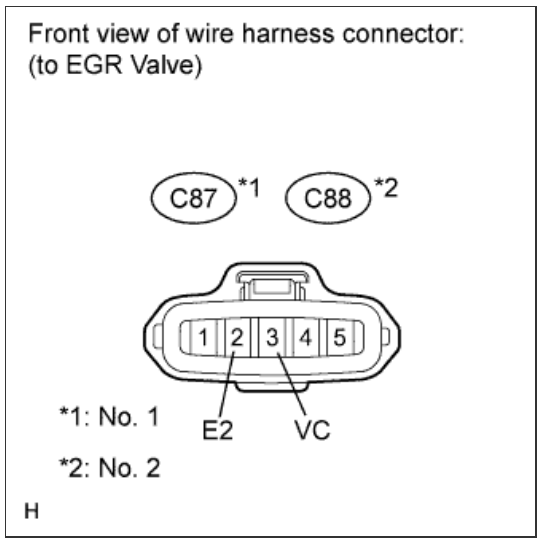
HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**
- **Data List items "EGR Lift Sensor Volt %" and "EGR Lift Sensor Volt % #2" are values calculated by converting the EGR position sensor output voltage of 0 to 5 V to a percentage from 0 to 100%.**

1.CHECK HARNESS AND CONNECTOR (POWER SOURCE)

a. Disconnect the EGR valve connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

No. 1

Tester Connection	Switch Condition	Specified Condition
C87-3 (VC) - C87-2 (E2)	Ignition switch ON	4.5 to 5.5 V

No. 2

Tester Connection	Switch Condition	Specified Condition
C88-3 (VC) - C88-2 (E2)	Ignition switch ON	4.5 to 5.5 V

NG → Go to step 3

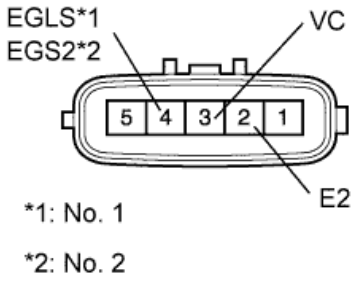
OK

2.INSPECT EGR VALVE ASSEMBLY (No. 1 or No. 2) (POSITION SENSOR)

a. Disconnect the EGR valve connector.

b. Measure the resistance according to the value(s) in the table below.

Component without harness connected:
(EGR Valve)



*1: No. 1

*2: No. 2

Standard Resistance:

No. 1

Tester Connection	Condition	Specified Condition
3 (VC) - 2 (E2)	20°C (68°F)	2.45 to 4.55 kΩ
4 (EGLS) - 2 (E2)	20°C (68°F)	2.45 to 4.55 kΩ

No. 2

Tester Connection	Condition	Specified Condition
3 (VC) - 2 (E2)	20°C (68°F)	2.45 to 4.55 kΩ
4 (EGS2) - 2 (E2)	20°C (68°F)	2.45 to 4.55 kΩ

NG → Go to step 5

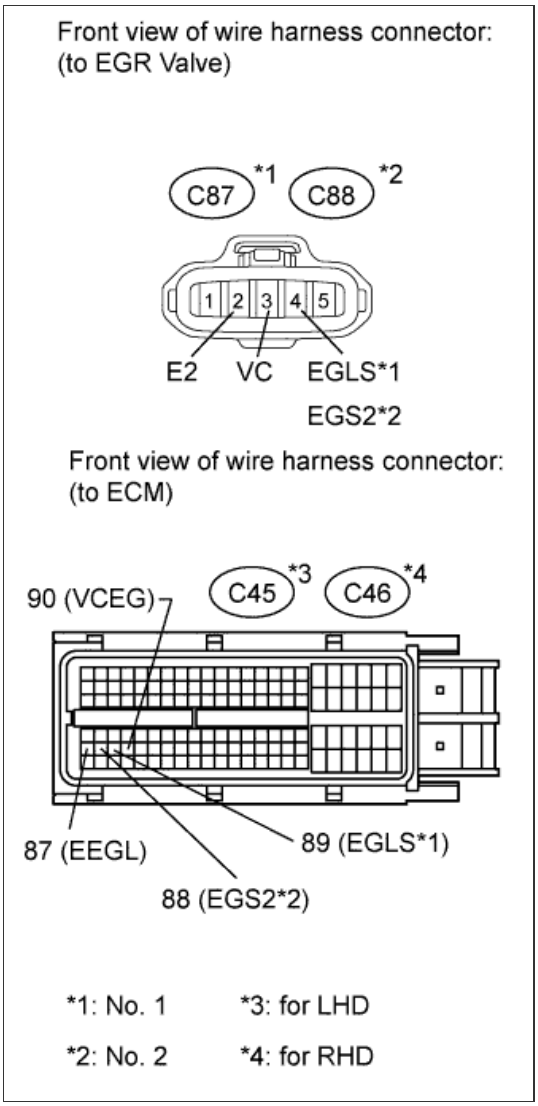
OK

3.CHECK HARNESS AND CONNECTOR (EGR VALVE POSITION SENSOR - ECM)

a. Disconnect the EGR valve connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

No. 1 (LHD)

Tester Connection	Condition	Specified Condition
C87-3 (VC) - C45-90 (VCEG)	Always	Below 1 Ω
C87-4 (EGLS) - C45-89 (EGLS)	Always	Below 1 Ω
C87-2 (E2) - C45-87 (EEGL)	Always	Below 1 Ω

No. 2 (LHD)

Tester Connection	Condition	Specified Condition
C88-3 (VC) - C45-90 (VCEG)	Always	Below 1 Ω
C88-4 (EGS2) - C45-88 (EGS2)	Always	Below 1 Ω
C88-2 (E2) - C45-87 (EEGL)	Always	Below 1 Ω

No. 1 (RHD)

Tester Connection	Condition	Specified Condition
C87-3 (VC) - C46-90 (VCEG)	Always	Below 1 Ω
C87-4 (EGLS) - C46-89 (EGLS)	Always	Below 1 Ω
C87-2 (E2) - C46-87 (EEGL)	Always	Below 1 Ω

No. 2 (RHD)

Tester Connection	Condition	Specified Condition
C88-3 (VC) - C46-90 (VCEG)	Always	Below 1 Ω
C88-4 (EGS2) - C46-88 (EGS2)	Always	Below 1 Ω

C88-2 (E2) - C46-87 (EEGL)	Always	Below 1 Ω

Standard Resistance (Check for Short):

No. 1 (LHD)

Tester Connection	Condition	Specified Condition
C87-3 (VC) or C45-90 (VCEG) - Body ground	Always	10 kΩ or higher
C87-4 (EGLS) or C45-89 (RGLS) - Body ground	Always	10 kΩ or higher

No. 2 (LHD)

Tester Connection	Condition	Specified Condition
C88-3 (VC) or C45-90 (VCEG) - Body ground	Always	10 kΩ or higher
C88-4 (EGS2) or C45-88 (EGS2) - Body ground	Always	10 kΩ or higher

No. 1 (RHD)

Tester Connection	Condition	Specified Condition
C87-3 (VC) or C46-90 (VCEG) - Body ground	Always	10 kΩ or higher
C87-4 (EGLS) or C46-89 (EGLS) - Body ground	Always	10 kΩ or higher

No. 2 (RHD)

Tester Connection	Condition	Specified Condition
C88-3 (VC) or C46-90 (VCEG) - Body ground	Always	10 kΩ or higher
C88-4 (EGS2) or C46-88 (EGS2) - Body ground	Always	10 kΩ or higher

NG → Go to step 6

OK

4.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 7

5.REPLACE EGR VALVE ASSEMBLY (No. 1 or No. 2)

a. Replace the EGR valve assembly (No. 1 or No. 2) (Click here).

NEXT → Go to step 7

6.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

7.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 5 seconds.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

DTC U0101 Lost Communication with TCM

for Preparation Click here

DESCRIPTION

The engine control unit and the transmission control unit are located inside the ECM. The engine control unit intercommunicates with the transmission control unit with the Controller Area Network (CAN). If there is a problem in this intercommunication, the ECM stores a DTC.

DTC Code	DTC Detection Condition	Trouble Area
U0101	No communication with the ECM continues.	ECM

INSPECTION PROCEDURE

1.CHECK DTC OUTPUT (IN ADDITION TO DTC P0101)

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain / ECT / Trouble Codes.

e. Read the DTCs using the tester.

Result

Result	Proceed to
Only U0101 is output	A
U0101 and other DTCs are output	B

HINT:

If any other codes besides U0101 are output, perform troubleshooting for those DTCs first.

O TO DTC CHART (Click here)

A

2.REPLACE ECM

a. Replace the ECM (Click here).

NE T

EC IF DTC RECURS

a. Clear the DTC (Click here).

b. Start the engine.

c. Read the DTCs using the tester.

Result

Result	Proceed to
No DTC output	A
Other DTCs output	B

O TO DTC CHART (Click here)

A

END

DTC P0405 Exhaust Gas Recirculation Sensor "A" Circuit Low

DTC P0406 Exhaust Gas Recirculation Sensor "A" Circuit High

DTC P0407 Exhaust Gas Recirculation Sensor "B" Circuit Low

DTC P0408 Exhaust Gas Recirculation Sensor "B" Circuit High

for Preparation Click here

DESCRIPTION

The EGR valve position sensor is mounted on the EGR valve and used for detecting the lift amount of the valve. The lift amount detected by the sensor is provided to the ECM as feedback. The ECM then regulates the lift amount of the valve in accordance with engine running conditions.

P0405

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 5 seconds	No. 1 EGR valve position sensor output voltage is less than 0.1 V for 5 seconds (1 trip detection logic).	• Open in No. 1 EGR valve position sensor circuit • No. 1 EGR valve (EGR valve position sensor) • ECM

P0406

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 5 seconds	No. 1 EGR valve position sensor output voltage is more than 4.9 V for 5 seconds (1 trip detection logic).	• Short in No. 1 EGR valve position sensor circuit • No. 1 EGR valve (EGR valve position sensor) • ECM

P0407

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 5 seconds	No. 2 EGR valve position sensor output voltage is less than 0.1 V for 5 seconds (1 trip detection logic).	• Open in No. 2 EGR valve position sensor circuit • No. 2 EGR valve (EGR valve position sensor) • ECM

P0408

DTC Detection Drive Pattern	DTC Detection Condition	Trouble Area
Ignition switch ON for 5 seconds	No. 2 EGR valve position sensor output voltage is more than 4.9 V for 5 seconds (1 trip detection logic).	• Short in No. 2 EGR valve position sensor circuit • No. 2 EGR valve (EGR valve position sensor) • ECM

MONITOR DESCRIPTION

When the output voltage of the EGR valve position sensor deviates from the normal operating range of 0.1 to 4.9 V for more than 5 seconds, the ECM interprets this as a malfunction of the sensor circuit, and illuminates the MIL.

WIRING DIAGRAM

Refer to DTC P0400 (Click here).

INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

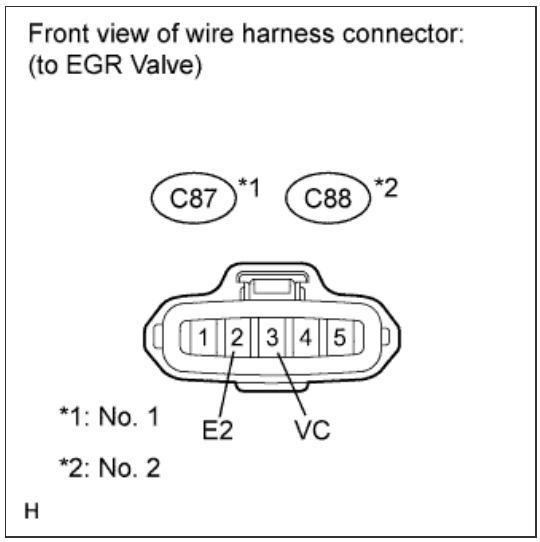
HINT:

- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, and other data from the time the malfunction occurred.**
- **Data List items "EGR Lift Sensor Volt %" and "EGR Lift Sensor Volt % #2" are values calculated by converting the EGR position sensor output voltage of 0 to 5 V to a percentage from 0 to 100%.**

1.CHECK HARNESS AND CONNECTOR (POWER SOURCE)

a. Disconnect the EGR valve connector.

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

No. 1

Tester Connection	Switch Condition	Specified Condition
C87-3 (VC) - C87-2 (E2)	Ignition switch ON	4.5 to 5.5 V

No. 2

Tester Connection	Switch Condition	Specified Condition
C88-3 (VC) - C88-2 (E2)	Ignition switch ON	4.5 to 5.5 V

NG → Go to step 3

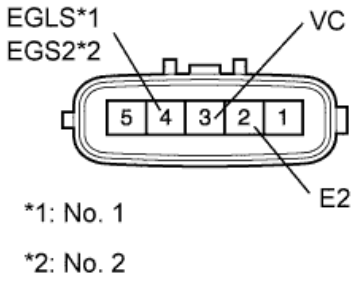
OK

2.INSPECT EGR VALVE ASSEMBLY (No. 1 or No. 2) (POSITION SENSOR)

a. Disconnect the EGR valve connector.

b. Measure the resistance according to the value(s) in the table below.

Component without harness connected:
(EGR Valve)



*1: No. 1

*2: No. 2

Standard Resistance:

No. 1

Tester Connection	Condition	Specified Condition
3 (VC) - 2 (E2)	20°C (68°F)	2.45 to 4.55 kΩ
4 (EGLS) - 2 (E2)	20°C (68°F)	2.45 to 4.55 kΩ

No. 2

Tester Connection	Condition	Specified Condition
3 (VC) - 2 (E2)	20°C (68°F)	2.45 to 4.55 kΩ
4 (EGS2) - 2 (E2)	20°C (68°F)	2.45 to 4.55 kΩ

NG → Go to step 5

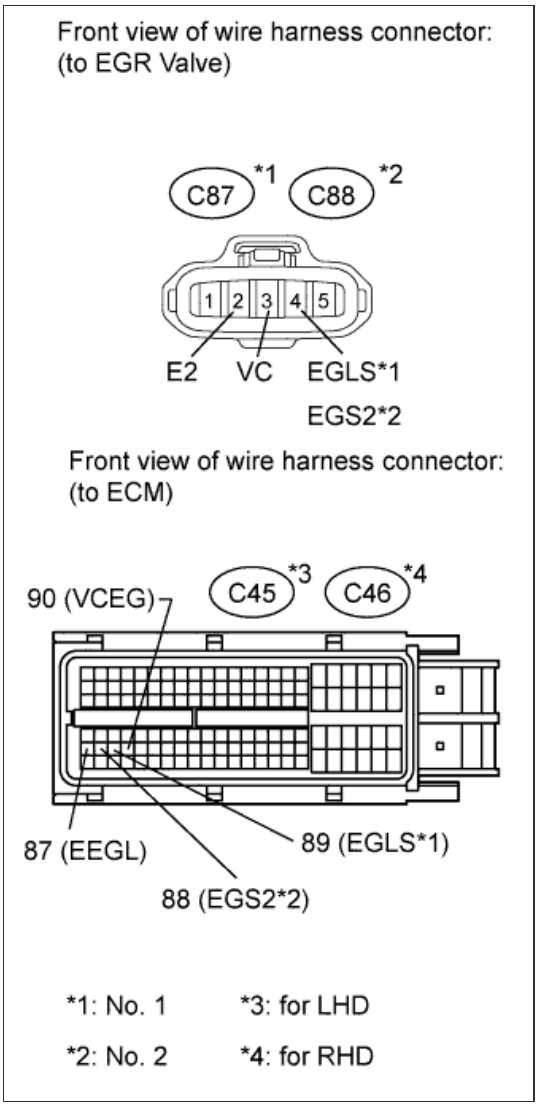
OK

3.CHECK HARNESS AND CONNECTOR (EGR VALVE POSITION SENSOR - ECM)

a. Disconnect the EGR valve connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

No. 1 (LHD)

Tester Connection	Condition	Specified Condition
C87-3 (VC) - C45-90 (VCEG)	Always	Below 1 Ω
C87-4 (EGLS) - C45-89 (EGLS)	Always	Below 1 Ω
C87-2 (E2) - C45-87 (EEGL)	Always	Below 1 Ω

No. 2 (LHD)

Tester Connection	Condition	Specified Condition
C88-3 (VC) - C45-90 (VCEG)	Always	Below 1 Ω
C88-4 (EGS2) - C45-88 (EGS2)	Always	Below 1 Ω
C88-2 (E2) - C45-87 (EEGL)	Always	Below 1 Ω

No. 1 (RHD)

Tester Connection	Condition	Specified Condition
C87-3 (VC) - C46-90 (VCEG)	Always	Below 1 Ω
C87-4 (EGLS) - C46-89 (EGLS)	Always	Below 1 Ω
C87-2 (E2) - C46-87 (EEGL)	Always	Below 1 Ω

No. 2 (RHD)

Tester Connection	Condition	Specified Condition
C88-3 (VC) - C46-90 (VCEG)	Always	Below 1 Ω
C88-4 (EGS2) - C46-88 (EGS2)	Always	Below 1 Ω

C88-2 (E2) - C46-87 (EEGL)	Always	Below 1 Ω

Standard Resistance (Check for Short):

No. 1 (LHD)

Tester Connection	Condition	Specified Condition
C87-3 (VC) or C45-90 (VCEG) - Body ground	Always	10 kΩ or higher
C87-4 (EGLS) or C45-89 (RGLS) - Body ground	Always	10 kΩ or higher

No. 2 (LHD)

Tester Connection	Condition	Specified Condition
C88-3 (VC) or C45-90 (VCEG) - Body ground	Always	10 kΩ or higher
C88-4 (EGS2) or C45-88 (EGS2) - Body ground	Always	10 kΩ or higher

No. 1 (RHD)

Tester Connection	Condition	Specified Condition
C87-3 (VC) or C46-90 (VCEG) - Body ground	Always	10 kΩ or higher
C87-4 (EGLS) or C46-89 (EGLS) - Body ground	Always	10 kΩ or higher

No. 2 (RHD)

Tester Connection	Condition	Specified Condition
C88-3 (VC) or C46-90 (VCEG) - Body ground	Always	10 kΩ or higher
C88-4 (EGS2) or C46-88 (EGS2) - Body ground	Always	10 kΩ or higher

NG → Go to step 6

OK

4.REPLACE ECM

a. Replace the ECM (Click here).

NEXT → Go to step 7

5.REPLACE EGR VALVE ASSEMBLY (No. 1 or No. 2)

a. Replace the EGR valve assembly (No. 1 or No. 2) (Click here).

NEXT → Go to step 7

6.REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

7.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Connect the intelligent tester to the DLC3.

b. Clear the DTCs (Click here).

c. Turn the ignition switch off.

d. Turn the ignition switch to ON for 5 seconds.

e. Enter the following menus: Powertrain / Engine / DTC.

f. Confirm that the DTC is not output again.

NEXT

END

for Preparation Click here

DESCRIPTION

Faults and Symptoms of Common Rail Diesel Components

a. Engine Control

Mass Air Flow Meter

Component	Mass air flow meter
Main fault	Decrease in performance (foreign matter is stuck)
Symptoms	Lack of power, black smoke
Data List	MAF
HINT: The maximum fuel injection volume is controlled according to the output from the mass air flow meter.	

Intake System

Component	Intake system
Symptom: Main fault	• Lack of power (No black smoke): Air filter blockage, Air duct is crushed/leaking • Black smoke (No lack of power): Leakage between the turbo and the intake manifold
Data List	• MAP (inside intake air pressure) • Target Booster Pressure When the accelerator is fully depressed, if the MAP is 20 kPa lower than Target Booster Pressure for more than 5 seconds then a lack of power will be felt.

Turbocharger System

Component	Turbocharger system
Main fault	• Air leak in the turbocharged air passage • Turbo motor driver not operating well • Turbocharger (turbine, bearing)
Symptoms	Lack of power (when vehicle starting, when heavy load) (Black smoke is not emitted when racing while vehicle stopped)
Data List	MAP (inside intake air pressure), Target Booster Pressure • When the accelerator is fully depressed, if MAP is 20 kPa lower than Target Booster Pressure for more than 5 seconds then a lack of power will be felt. • With the ignition switch ON or idling, MAP = Atmospheric Pressure (standard atmospheric pressure = 101 kPa). When the engine speed is about 1500 rpm or more, the turbocharger starts to take effect and the MAP becomes higher than atmospheric pressure. • Atmospheric pressure increases 1 kPa each time altitude increases by 100 m, and is also affected by the current weather conditions. VN Turbo Command • 0%: Fully open vanes (drive rod contracts) • Over 90%: Fully closed (drive rod expands and turbo operates effectively)
Diagnostic Point	• Using the Active Test "Test the Turbo Charger Step Motor", check the drive rod movement. • Check the drive rod movement when the ignition switch is turned from ON to off.

Exhaust System

Component	Exhaust system
Main fault	Blockage
Symptoms	Lack of power (high engine speed, when heavy load)
Data List	MAP (inside intake air pressure) When the accelerator is fully depressed, if the MAP is 20 kPa lower than Target Booster Pressure for more than 5 seconds then a lack of power will be felt.

Glow System

Component	Glow system
Main fault	Open circuit, glow plug relay fault
Symptoms	Difficult to start, rough idle, knocking, white smoke (when cold)
Data List	Check the glow plug indicator light
Diagnostic Point	Try to measure the resistance of the glow plug

Battery

Component	Battery
Main fault	Battery is depleted
Symptoms	Difficult to start (cannot crank, crank speed is low), horn is quiet.
Data List	Battery Voltage When cranking, battery voltage is less than 5 V

Engine - 1

Component	Engine
Main fault	Damaged, Seized up
Symptoms	Cannot crank, crank speed is low, strange noise

Engine - 2

Component	Engine
Main fault	Loss of compression
Symptoms	Rough idle (lack of power always)
Data List	Engine Speed of Cyl • When cranking during the "Check the Cylinder Compression" Active Test, if there is a high speed cylinder, approx. 100 rpm more than the other cylinders, that cylinder may loose compression. Injection Feedback Val • If Injection Feedback Val is more than 3 mm^3/st, the cylinder may have a fault.

Start System

Component	Entry and Start system
Main fault	Starter system malfunction
Symptoms	Difficult to start
Data List	Starter Signal • Ignition switch (STA) operation ON: Starter is operating OFF: Starter is not operating

Immobiliser system

Component	Engine immobiliser system
Main fault	Engine immobiliser system/Problem Symptoms Table (Click here)
Symptoms	Engine does not start
Data List	Immobiliser Communication • ON: Normal • OFF: GND short or immobiliser is set Engine Immobiliser System/Data List (Click here)

b. Diesel Injection

Fuel Supply Pump

Component	Fuel supply pump
Main fault	-
Symptoms	Difficult to start, engine stalling, rough idle, lack of power
Data List	Fuel Press, Target Common Rail Pressure, Target Pump SCV Current • At a stable condition (e.g. Idling), Fuel Press is within +/-5000 kPa of "Target Common Rail Pressure". • If the fuel pressure is 20000 kPa below the target pressure then a lack of power will be felt. • If the fuel pressure is below 25000 kPa then idling will be rough. **HINT:**

	• **The fuel pressure changes at engine starting, but is approx. 25000 kPa at engine start after the engine is warmed up.** • **When Target Pump SCV Current is 3000 mA or more, the suction control valve has a tendency to become stuck.**
Diagnostic Trouble Code	Even if Fuel Press is less than Target Common Rail Pressure, a DTC will not be stored.

Fuel Filter

Component	Fuel filter
Main fault	Blockage
Symptoms	Difficult to start, engine stalling, rough idle, lack of power
Data List	Fuel Press, Target Common Rail Pressure • At a stable condition (e.g. Idling), the fuel pressure is within +/-5000 kPa of "Target Common Rail Pressure ". • If the fuel pressure is 20000 kPa below the target pressure then a lack of power will be felt. • If the fuel pressure is below 25000 kPa then idling will be rough. **HINT:** The fuel pressure changes at engine starting, but is approx. 25000 kPa at engine start after the engine is warmed up.
Diagnostic Trouble Code	Even if Fuel Press is less than Target Common Rail Pressure, a DTC will not be stored.

Fuel Injector

Component	Fuel injector
Main fault	Blockage
Symptoms	Rough idle, lack of power, black smoke, white smoke, knocking
Data List	Injection Feedback Val • When an Injection Feedback Val is more than 3 mm ^{3}/st, the cylinder is not normal. This can be read after idling for 1 minute with the engine warmed up (engine coolant temperature is more than 70°C (158°F)).

Pressure Limiter

Component	Pressure limiter
Main fault	Does not completely close
Symptoms	Difficult to start, engine stall, rough idle, lack of power

Injector Driver (EDU)

Component	Injector Driver (EDU)
Main fault	Circuit fault: The fuel injector does not open.
Symptoms	Difficult to start, rough idle, lack of power, black smoke, white smoke, knocking
Data List	Same as fuel injector
Diagnostic Trouble Code	When the EDU has a fault, some DTCs may be stored.

Fuel Pressure Sensor

Component	Fuel pressure sensor
Main fault	Open circuit, Decrease in performance (foreign matters is stuck)
Symptoms	Difficult to start, rough idle, engine stall, lack of power
Data List	Fuel Press, Target Common Rail Pressure • Slowly raise the engine speed from idling to 3000 rpm with the vehicle stopped, and check that Fuel Press follows Target Common Rail Pressure. If the fuel pressure sensor malfunctions, the actual fuel pressure may deviate from the target fuel pressure. (However, the value may not deviate even when a malfunction is present).
Diagnostic Trouble Code	When the fuel pressure sensor has a fault, some DTCs may be stored.

Irregular Fuel

Component	Irregular fuel
Main fault	-
Symptoms	Difficult to start, rough idle (especially when cold)

c. Diesel EGR

EGR System

Component	EGR system
Main fault	• Does not move smoothly • Does not close completely
Symptoms	• Rough idle • EGR valve stuck closed: A loud turbocharger sound. • EGR valve stuck open: Difficult to start (does not stall), black smoke, lack of power (if there is an excess in the quantity of EGR and there is a heavy load, when the vehicle starts moving, a lack of power will be felt).
Data List	Actual EGR Valve Pos., Target EGR Pos. • Generally, Actual EGR Valve Pos. = Target EGR Pos. +/-5% (fully closed 0%, fully open 100%) • Using EGR valve Active Test, check whether Actual EGR Valve Pos. follows Target EGR Pos. (The engine coolant temperature and intake air temperature should be considered when a malfunction occurs). • EGR valve is fully closed when the ignition switch is ON (engine stopped). • EGR valve opens to halfway point at idling after engine warmed up. EGR Close Lrn. Val., EGR Close Lrn. Status • Leaving the vehicle idling, when EGR Close Lrn. Status is OK, the normal range of EGR Close Lrn. Val. is 3.5 to 4.5 V. • In cases when EGR Close Lrn. Status. is NG or EGR Close Lrn. Val. is out of the normal range (3.5 to 4.5 V), it is possible that the EGR valve cannot completely close.

d. Diesel Throttle

Diesel Throttle System

Component	Diesel throttle system
Main fault	Stuck, does not move smoothly
Symptoms	• Stuck closed: Lack of power, difficult to start, rough idle, engine stall, black smoke. It may occur when stuck almost fully closed. • Stuck open: Turbocharger sound increases. When the engine is stopped, engine vibrations may occur.
Data List	• Actual Throttle Position, Actual Throttle Position #2 0%: Fully open 100%: Fully closed • Throttle Motor Duty Normally operates at 50 +/-20%. If outside the range of 50 +/-40% for a few seconds, the throttle may not be sliding properly. 0%: Open diesel throttle 100%: Close diesel throttle • When ignition switch is ON (engine stopped), diesel throttle is fully open. When idling, diesel throttle is at halfway point. When ignition switch is turned from ON to off, temporarily closed fully.

Data List Related to Starting Trouble

NOTICE:

The Data List values in the table are the results of checking one vehicle under a specific condition (engine coolant temperature, intake air temperature, atmosphere pressure etc.). That is why use these values for reference only.

a. Engine Control

MAP

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
	• When MAP is low, there will be difficulty starting. • With ignition switch ON or idling, MAP is nearly equal to Atmosphere Pressure (standard	When MAP is low, the following conditions are possible: • The diesel throttle is nearly fully closed. • Intake system blocked (turbocharger	• When the ignition switch is ON or the vehicle is idling, MAP (intake manifold absolute pressure) and Atmosphere Pressure are mostly the same (standard atmospheric pressure = 101 kPa). Above approx. 1500 rpm, the turbo becomes effective, and the pressure becomes higher than atmospheric pressure. • Inspect while comparing with "Target Booster Pressure".

MAP	atmospheric pressure = 101 kPa).	system also). • Exhaust system blocked.	• With the accelerator fully open, if the actual Manifold Absolute Pressure (MAP) is low compared to the target booster pressure by at least 20 kPa for 5 seconds or more, a feeling of insufficient power will occur.
	Results of real-vehicle check: • Ignition switch ON: 99 kPa • Cranking: 99 kPa • Idling (warm up the engine): 99 kPa (2 minutes after starting the vehicle) • Running without load (2500 rpm): 113 kPa • Driving with the accelerator fully open at 2000 rpm: 143 kPa • Driving with the accelerator fully open at 3000 rpm: 209 kPa		

MAF

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
MAF	-	• MAF meter • MAF meter circuit • Intake system clogging, leaking • Exhaust system clogging • Turbocharger sub-assembly • Leaking or clogging of turbocharger passages • EGR valve does not close	• Based on the MAF, the ECM controls the fuel injection volume, injection timing, EGR, etc. • If the value is always approximately 0 g/sec.: • Mass air flow meter power source circuit is open. • VG circuit is open or shorted. • If the value is always 200 g/sec. or more: • EVG circuit is open.
	Results of real-vehicle check: w/ EGR • Ignition switch ON: 1.54 g/sec. • Cranking: 15 g/sec. • Idling (warm up the engine): 9 g/sec. (2 minutes after starting the vehicle) • Running without load (2500 rpm): 80 g/sec. • Driving with the accelerator fully open at 2000 rpm: 110 g/sec. • Driving with the accelerator fully open at 3000 rpm: 230 g/sec.		
	HINT: The maximum fuel injection volume is controlled according to the output from the mass air flow meter.		

Intake Air

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
Intake Air	-	Intake air temperature sensor.	• After a long soak, the engine coolant temperature, intake air temperature, and ambient air temperature are approximately equal. • If the value is -40°C (-40°F) or 140°C (284°F), the sensor circuit is open or shorted.
	-		

Coolant Temp

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
Coolant Temp	• Engine coolant temperature is approximately equal to intake air temperature after leaving overnight. After warm-up: Engine coolant temperature is 70°C (158°F) or more. • In cases when the engine coolant temperature output is obviously higher than the actual engine coolant temperature, when it is cold, there will be difficulty starting due to problems with glow plugs or insufficient fuel injection. • In cases when the engine coolant	Engine coolant temperature sensor	• If the value is -40°C (-40°F) or 140°C (284°F), the sensor circuit is open or shorted. • After a long soak, the coolant temperature, intake air

	temperature sensor output is obviously lower than the actual engine coolant temperature, when it is warm, there will be difficulty starting (black smoke will also occur) due to an excess of injected fuel.		temperature, and ambient air temperature are approximately equal.
	-		

Battery Voltage

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
Battery Voltage	When cranking, in cases when Battery Voltage becomes less than 5 V, the battery is depleted.	Battery	If 11 V or less, characteristics of some electrical components change.
	Results of real-vehicle check: • Ignition switch ON: 12.5 V • Cranking (with engine warmed up): 9.0 V • Idling (warm up the engine): 13.4 V • Running without load (2500 rpm): 13.5 V • Driving with the accelerator fully open at 2000 rpm: 13 V • Driving with the accelerator fully open at 3000 rpm: 13.2 V		

Starter Signal

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note

Starter Signal	Operation of ignition switch (STA)
	ON: Starter is operating
	OFF: Starter is not operating
		Entry and Start system	• Ignition switch (STA) output:
			  • ON: Starter is operating
			  • OFF: Starter is not operating

	-		

Engine Speed of Cyl #1 (to #8)

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
Engine Speed of Cyl #1 (to #8)	When cranking, the engine speed of each cylinder is the same under normal conditions. When a cylinder is approximately 100 rpm higher than the other cylinders, it is conceivable that the compression of that cylinder is being lost. **HINT:** This data is output only when the Active Test "Check the Cylinder Compression" is performed.	-	• Output only when the Active Test "Check the Cylinder Compression" is performed. • With this Active Test, the fuel injection is stopped. • Indicates the speed of each cylinder when cranking. Example - Normal: "Engine speed" of all cylinders is approximately equal. No. 1 cylinder compression low: "Engine speed of Cyl#1" = approximately 300 rpm, "Engine speed of Cyl #2 to #8 cylinder" = approximately 200 rpm.
	-		

Immobiliser Communication

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
Immobiliser Communication	Engine immobiliser system/Data List (Click here)	Engine immobiliser system/Problem Symptoms Table (Click here)	When there is a malfunction in the immobiliser system, a DTC is stored (Click here)
	-		

b. Diesel Injection

Target Common Rail Pressure

Data List	Judgment of Data List	Faulty	Diagnosis Note

	Values	Component	
Target Common Rail Pressure	-	-	• Inspect the (actual) fuel pressure, comparing it against the common rail target value. • Considered normal when the actual fuel pressure is within +/-5000 kPa of the target fuel pressure under stable conditions.
	Results of real-vehicle check: • Ignition switch ON: 32000 kPa • Cranking: 29000 kPa • Idling (warm up the engine): 32000 kPa (2 minutes after starting the vehicle) • Running without load (2500 rpm): 62000 kPa • Running without load (3500 rpm): 80200 kPa • Driving with the accelerator fully open at 2000 rpm: 95000 kPa • Driving with the accelerator fully open at 3000 rpm: 155000 kPa		

Fuel Press

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
Fuel Press	• In a stable operating condition (e.g. idling), Fuel Press is Target Common Rail Pressure +/-5000 kPa. • During cranking, if Fuel Press is lower than 25000 kPa, there may be difficulty starting. (Take care as there is a response lag when the pressure rises). • When Fuel Press is lower than 25000 kPa, rough idling will occur.	• If there is a fault with the fuel supply pump (lack of discharge quantity) or pressure limiter (will not fully close), the fuel pressure will drop. Also, a blocked fuel filter, leakage from fuel pipes, and lack of fuel will also make the fuel pressure drop. • If air mixes with the fuel, the fuel pressure will shift away from the target fuel pressure. • When there is a fault with the fuel supply pump, there is a possibility of lack of power, engine stall, rough idle and difficulty starting.	• Fuel press is the actual common rail fuel pressure. • Inspect by comparing Fuel Press with Target Common Rail Pressure. • The ECM uses Fuel Press for feedback control of Target Fuel Pressure via the supply pump. The injection amount is determined based on the injection timing and fuel pressure. Also, the spray pattern is selected based on the fuel pressure.
	Results of real-vehicle check: • Ignition switch ON: 0 kPa • Cranking: 29000 kPa • Idling (warm up the engine): 32000 kPa (2 minutes after starting the vehicle) • Running without load (2500 rpm): 62000 kPa • Driving with the accelerator fully open at 2000 rpm: 92000 kPa • Driving with the accelerator fully open at 3000 rpm: 155000 kPa		

Target Pump SCV Current

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
		• With this data, component fault not	• ECU-calculated value for the

Target Pump SCV Current	Idling after warming up, roughly 923 to 1123 mA. When this value is large, the pump is trying to increase the fuel discharge rate.	specified, use this data as a reference. • If the current is 3000 mA or more, there is a possibility the suction control valve is stuck.	suction control valve actuation target current. • Value is large when a high fuel pressure is desired. • When this deviates from the standard value, it indicates that for some reason, even though the pump is running hard, the actual fuel pressure is inconsistent with the target fuel pressure.
	Results of real-vehicle check: • Ignition switch ON: 0 mA • Cranking: 1200 mA • Running without load (2500 rpm): 1300 mA • Driving with the accelerator fully open at 2000 rpm: 1440 mA • Driving with the accelerator fully open at 3000 rpm: 1560 mA		

Injection Feedback Val #1 (to #8)

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
Injection Feedback Val #1 (to #8)	• When idling after the engine is warmed up, the fuel quantity of each fuel injector is corrected to make each cylinder engine speed equal. • Cylinders more than 3 mm^3/st may have a fault. **HINT:** Read the value after one minute of idling after warm up (engine coolant temperature above 70°C (158°F)). This value is only calculated when idling.	• Fault with a fuel injector or lack of compression of a cylinder with a large Injection Feedback Val. • Do a compression Active Test. If there is a cylinder that is around 100 rpm more than the other cylinder, there is a possibility that the compression of that cylinder is being lost. • If all the cylinder speeds are even according to the compression Active Test result, then the fuel injector of the cylinder may have a fault. • With fuel injector faults, other than difficulty starting, there is a possibility of rough idling, lack of power, black smoke, white smoke and knocking.	• When idling after warm up, the injection amount for each cylinder is corrected to optimize the difference of each cylinder engine speed. Example: For cylinders that are slowing the engine speed compared to other cylinders, the injection volume is increased. • "Injection Feedback Val" more than 3.0 mm^3/st: Injector breakdown or insufficient compression is causing poor combustion.
	-		

Injection Volume

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
Injection Volume	-	-	After warming up the engine, when Injection Volume during idling is 10 mm^3/st or more, there is tendency for the injector to clog.
	Results of real-vehicle check: • Cranking: 21 mm^3/st (Note: Varies depending on coolant temperature) • Idling (warm up the engine): 6 mm^3/st • Running without load (2500 rpm): 9 mm^3/st • Running without load (4700 rpm): 16 mm^3/st • Driving with the accelerator fully open at 2000 rpm: 50 mm^3/st • Driving with the accelerator fully open at 3000 rpm: 70 mm^3/st		

c. Diesel Throttle

Actual Throttle Position, Actual Throttle Position #2

		Faulty	

Data List	Judgment of Data List Values	Component	Diagnosis Note
Actual Throttle Position Actual Throttle Position #2	• When the ignition switch is turned to ON (engine stopped), the diesel throttle is fully open. When the ignition switch is turned from ON to off, the diesel throttle will be fully closed temporarily. • With the diesel throttle stuck almost fully closed, there is a possibility of rough idling, engine stall, black smoke, difficulty starting and lack of power.	Diesel throttle body	Actual Throttle Position is the closing percentage of the throttle valve. • Fully closed: 100% • Fully open: 0% **HINT:** There is no connection with the accelerator. However, under full load, the throttle is usually fully open (0%).
	Results of real-vehicle check: • Ignition switch ON: 0% • Cranking: 0% • Idling (warm up the engine): 84% • Running without load (2500 rpm): 32% • Driving with the accelerator fully open at 2000 rpm: 0% • Driving with the accelerator fully open at 3000 rpm: 0%		

Throttle Motor Duty #1, Throttle Motor Duty #2

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
Throttle Motor Duty #1 Throttle Motor Duty #2	• Normally operates at 50 +/-20%. • If 50 +/-40% continues for a few seconds, it is conceivable that the throttle valve is not sliding properly. • 0%: Drive throttle to open side • 100%: Drive throttle to closed side	-	• When this value is large but the actual opening angle does not move smoothly, there is an unable to close malfunction. • If this value is small but the actual opening angle does not move smoothly, there is an unable to open malfunction. • Usually this value is at approx. 50 +/-20%, but momentary jumps outside this range do occur. • If a duty is outside 50 +/-40% for several seconds, it will be judged that the diesel throttle does not move properly and the MIL will be illuminated.
	Results of real-vehicle check: • Ignition switch ON: 61.5% • Cranking: 63% • Idling (warm up the engine): 37% • Running without load (2500 rpm): 53% • Driving with the accelerator fully open at 2000 rpm: 62.5% • Driving with the accelerator fully open at 3000 rpm: 64%		

d. Diesel EGR

Target EGR Valve Pos., Target EGR Valve Pos. #2

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
Target EGR Valve Pos. Target EGR Valve Pos. #2	-	-	• Fully open: 100% • Fully closed: 0% • Used for comparison to "Actual EGR Valve Pos".
	Results of real-vehicle check: • Ignition switch ON: 0% • Cranking: 0% • Idling (warm up the engine): 43% • Running without load (2500 rpm): 22% • Driving with the accelerator fully open at 2000 rpm: 0% • Driving with the accelerator fully open at 3000 rpm: 0%		

Actual EGR Valve Pos., Actual EGR Valve Pos. #2

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
	• Generally Actual		

Actual EGR Valve Pos. Actual EGR Valve Pos. #2	EGR Valve Pos. = Target EGR Pos. (Fully closed = 0%, Fully open = 100%) • The EGR valve Active Test can be used to check whether the Actual EGR Valve Pos. = Target EGR Pos.	EGR valve assembly	• Inspect while comparing to "Target EGR Valve Pos.". • Sometimes the malfunction only occurs around a certain temperature, so refer to the engine coolant temperature and outside temperature at the time the malfunction occurred.
	Results of real-vehicle check: • Ignition switch ON: 0% • Cranking: 0% • Idling (warm up the engine): 84% • Running without load (2500 rpm): 34% • Driving with the accelerator fully open at 2000 rpm: 0% • Driving with the accelerator fully open at 3000 rpm: 0%		

EGR Close Lrn. Status

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
EGR Close Lrn. Status	• "OK" means the fully closed position learning has completed normally. • When NG, the learned fully closed position may be outside of the normal range.	-	After disconnecting and reconnecting the battery cable, if the ignition switch has not been turned off once, learning may not be completed.
	-		

EGR Close Lrn. Val.

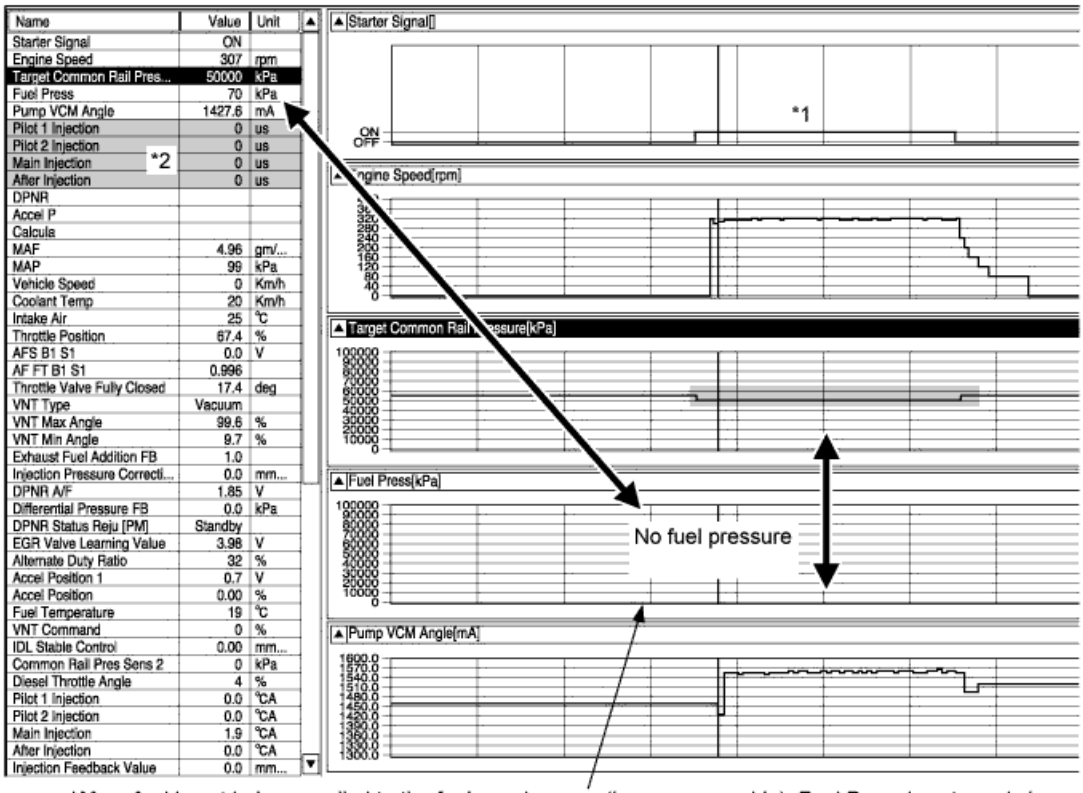
Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
EGR Close Lrn. Val.	Leave the vehicle idling, with the EGR Close Lrn. Status OK, the normal range of EGR Close Lrn. Val. is within 3.5 to 4.5 V. In cases when EGR Close Lrn. Status is NG or EGR Close Lrn. Val. is at the maximum or minimum (3.5 to 4.5 V) of normal range, it is possible that the EGR valve is not completely closed or a foreign object is lodged in the EGR valve seat area.	-	• This value is the EGR position sensor output voltage. • As the maximum and minimum settings are 3.5 V and 4.5 V, if the value becomes stuck at either of these, there is a malfunction in the lift sensor or the valve position is shifted (due to foreign matter, etc.).
	-		

Actual Examples of Malfunction

HINT:

- **The purpose of the following examples is help you to understand the relationship between each data list item when a certain malfunction occurs. Understanding this relationship helps you to find the real root cause easier.**
- **The following are examples of actual malfunctions of a common rail diesel engine.**
- **Use them for reference when diagnosing malfunctions.**
- **These are not data from the Land Cruiser 1VD-FTV**

a. Fuel is not being supplied to supply pump (Low pressure fuel line clogged)



When fuel is not being supplied to the fuel supply pump (low pressure side), Fuel Press is extremely low.

HINT:

*1: Engine is being cranked

*2: ECM does not send IJT signal

- All Data List items are OK, but Fuel Press remains 0 kPa.

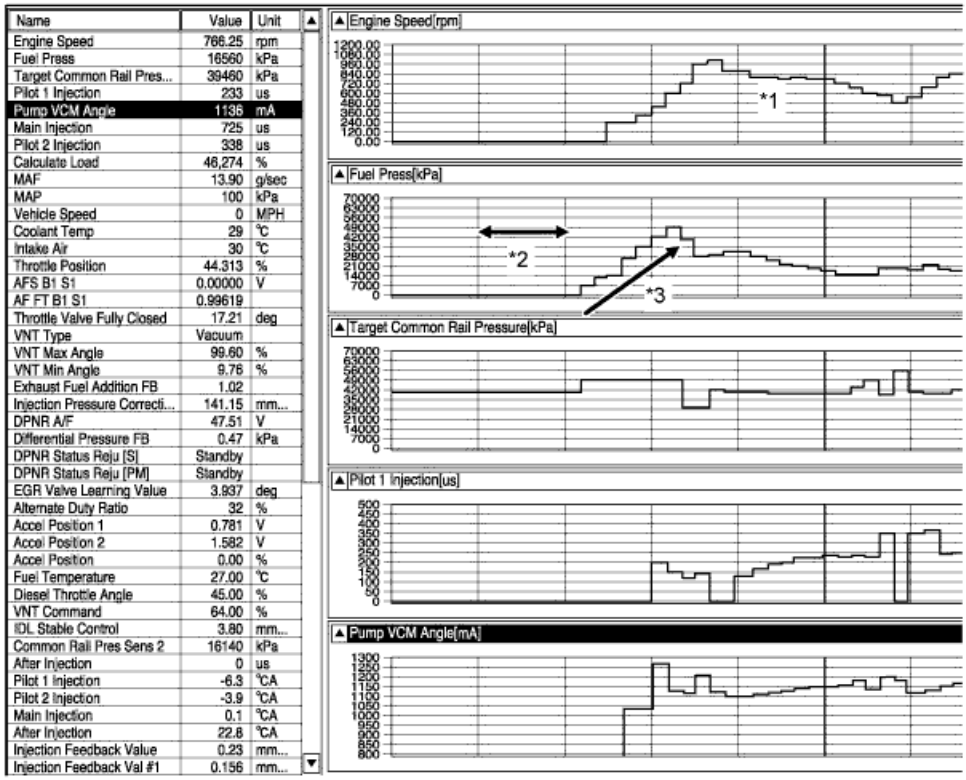
- As long as the fuel pressure remains below 10000 kPa, the ECM stops sending IJT signals to the EDU and that is why actual injection duration remains 0 µsecond.

Areas that need to be inspected:

Check the fuel line from the tank to the fuel filter and from the filter to the fuel supply pump.

P

b. Fuel is not being injected (Injectors are leaking)



Name	Value	Unit
Engine Speed	766.25	rpm
Fuel Press	16560	kPa
Target Common Rail Pres...	39460	kPa
Pilot 1 Injection	233	us
Pump VCM Angle	1136	mA
Main Injection	725	us
Pilot 2 Injection	338	us
Calculate Load	46.274	%
MAF	13.90	g/sec
MAP	100	kPa
Vehicle Speed	0	MPH
Coolant Temp	29	°C
Intake Air	30	°C
Throttle Position	44.313	%
AFS B1 S1	0.00000	V
AF FT B1 S1	0.99619	
Throttle Valve Fully Closed	17.21	deg
VNT Type	Vacuum	
VNT Max Angle	99.60	%
VNT Min Angle	9.76	%
Exhaust Fuel Addition FB	1.02	
Injection Pressure Correcti...	141.15	mm...
DPNR A/F	47.51	V
Differential Pressure FB	0.47	kPa
DPNR Status Reju [S]	Standby	
DPNR Status Reju [PM]	Standby	
EGR Valve Learning Value	3.937	deg
Alternate Duty Ratio	32	%
Accel Position 1	0.781	V
Accel Position 2	1.582	V
Accel Position	0.00	%
Fuel Temperature	27.00	°C
Diesel Throttle Angle	45.00	%
VNT Command	64.00	%
IDL Stable Control	3.80	mm...
Common Rail Pres Sens 2	16140	kPa
After Injection	0	us
Pilot 1 Injection	-6.3	°CA
Pilot 2 Injection	-3.9	°CA
Main Injection	0.1	°CA
After Injection	22.8	°CA
Injection Feedback Value	0.23	mm...
Injection Feedback Val #1	0.156	mm...

HINT:

*1: Engine is running unstabie

*2: 0.5 second

*3: Pressure is increasing slowly

- All Data List items are OK but Fuel Press does not increase or increases very slowly.

- As long as the fuel pressure remains below 10000 kPa, the ECM stops sending IJT signals to the EDU. From the moment fuel pressure exceeds 25000 kPa, fuel injection will take place and the engine starts.

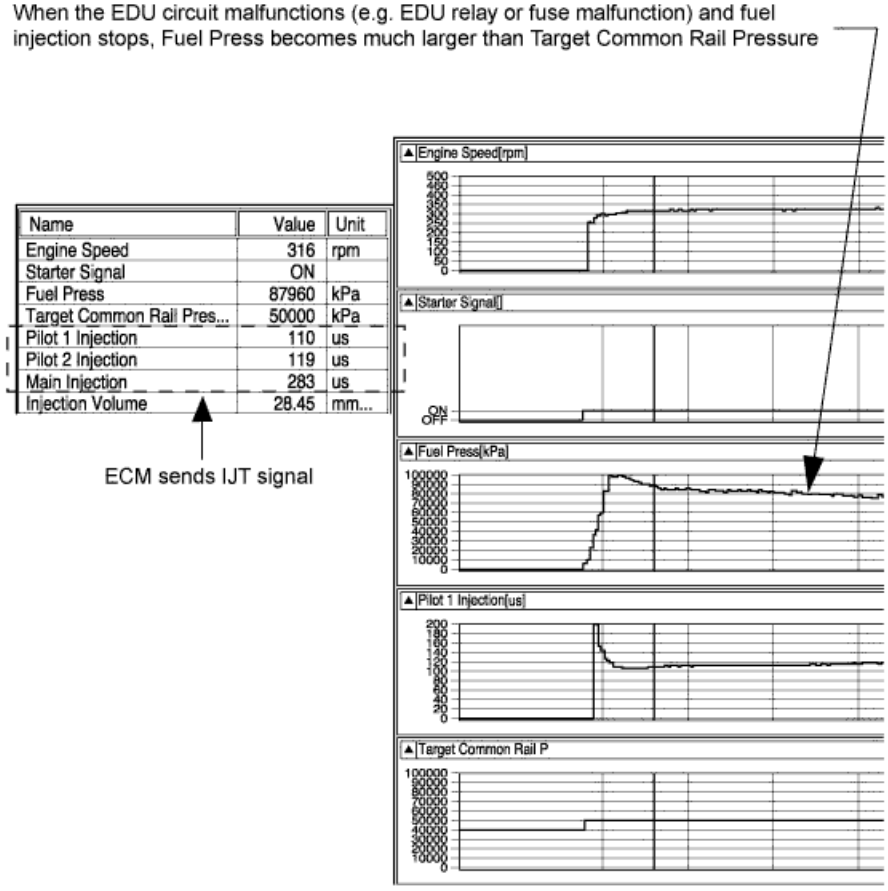
Areas that may be malfunctioning:

- One or more injectors are leaking and fuel returns via the leakage pipe to the tank.

P

c. Fuel is not being injected (EDU circuit malfunction)

When the EDU circuit malfunctions (e.g. EDU relay or fuse malfunction) and fuel injection stops, Fuel Press becomes much larger than Target Common Rail Pressure



HINT:

- All Data List items are OK.
- If Fuel Press exceeds the target value, this indicates that the fuel supply pump operates properly.
- Pilot 1 and 2 Injection and Main Injection signals confirm that the ECM sends IJT signals to the EDU.
- No injection → No fuel smell

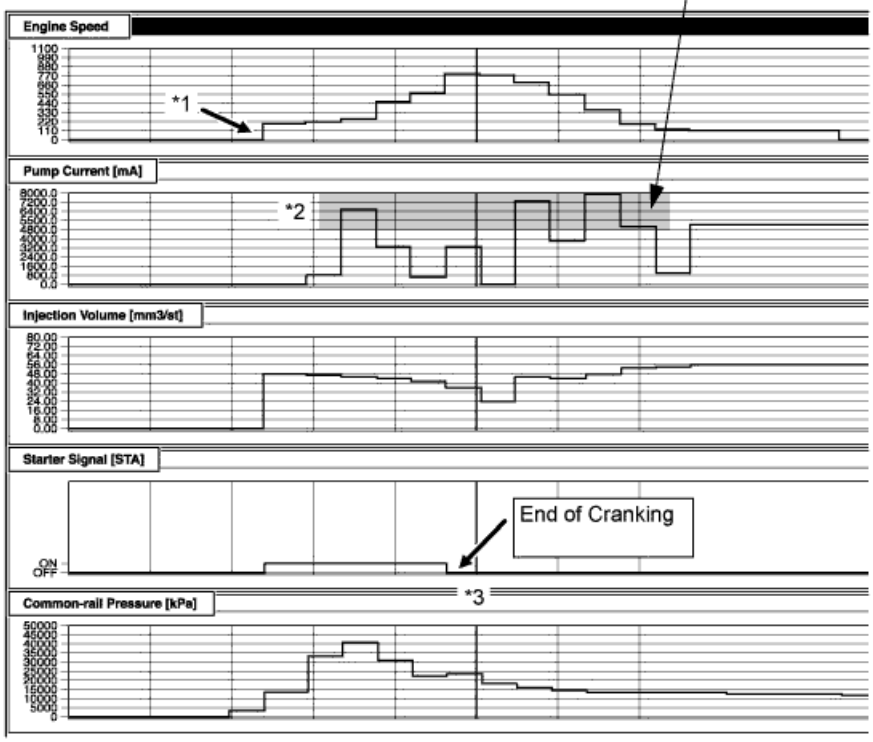
Areas that need to be inspected:

- Check EDU circuits (power source, IJT, IJF signal circuit).
- Check the fuel injectors.

P

d. Fuel supply pump malfunction (Suction control valve momentary sticking)

When Target Pump SCV Current is 3000 mA or more, the suction control valve plunger may be stuck



HINT:

*1: Start of cranking

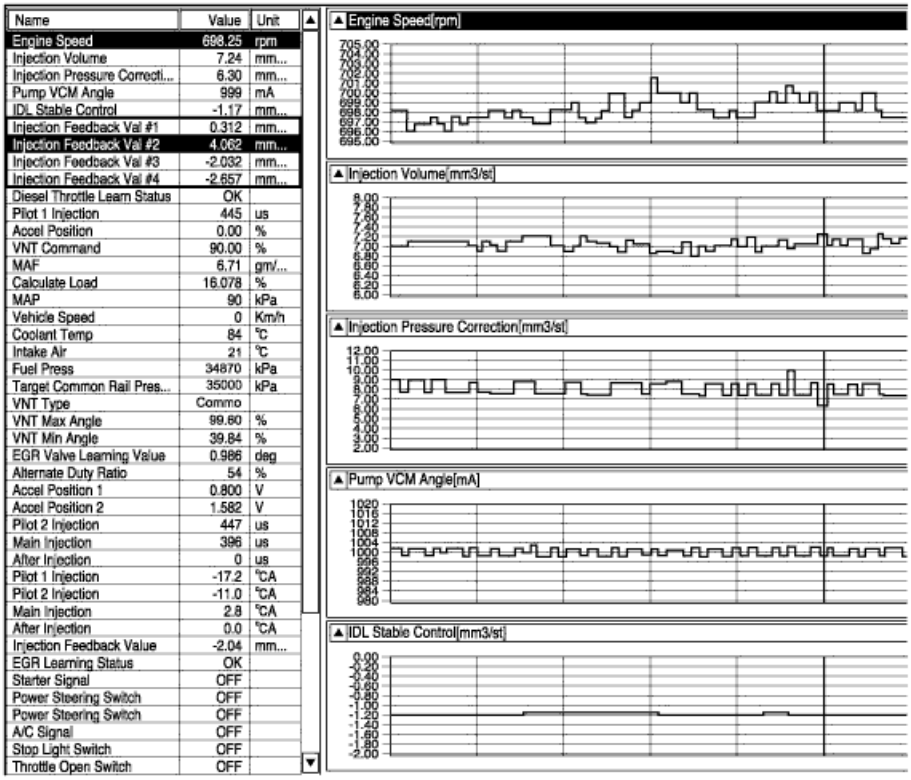
*2: In order to reach Target Common Rail Pressure high current is applied to the SCV valve

*3: After cranking has finished, common rail pressure drops below 25000 kPa (despite the high SCV current). This pressure is insufficient to open the injectors and that is why ECM stops injecting and engine finally stalls

- When the suction control valve is stuck, Fuel Press increases slowly during cranking, and the difference between Target Common Rail Pressure and Fuel Press remains large. In order for Fuel Press to reach the Target Common Rail Pressure value, the ECM must increase Target Pump SCV Current.

P

e. Increased opening delay of injectors (Internal contamination)



Name	Value	Unit
Engine Speed	698.25	rpm
Injection Volume	7.24	mm...
Injection Pressure Correcti...	6.30	mm...
Pump VCM Angle	999	mA
IDL Stable Control	-1.17	mm...
Injection Feedback Val #1	0.312	mm...
Injection Feedback Val #2	4.062	mm...
Injection Feedback Val #3	-2.032	mm...
Injection Feedback Val #4	-2.657	mm...
Diesel Throttle Learn Status	OK	
Pilot 1 Injection	445	us
Accel Position	0.00	%
VNT Command	90.00	%
MAF	6.71	gm/...
Calculate Load	16.078	%
MAP	90	kPa
Vehicle Speed	0	Km/h
Coolant Temp	84	°C
Intake Air	21	°C
Fuel Press	34870	kPa
Target Common Rail Pres...	35000	kPa
VNT Type	Commo	
VNT Max Angle	99.60	%
VNT Min Angle	39.84	%
EGR Valve Learning Value	0.986	deg
Alternate Duty Ratio	54	%
Accel Position 1	0.800	V
Accel Position 2	1.582	V
Pilot 2 Injection	447	us
Main Injection	396	us
After Injection	0	us
Pilot 1 Injection	-17.2	°CA
Pilot 2 Injection	-11.0	°CA
Main Injection	2.8	°CA
After Injection	0.0	°CA
Injection Feedback Value	-2.04	mm...
EGR Learning Status	OK	
Starter Signal	OFF	
Power Steering Switch	OFF	
Power Steering Switch	OFF	
A/C Signal	OFF	
Stop Light Switch	OFF	
Throttle Open Switch	OFF	

HINT:

- If a fuel injector has internal contamination, the engine will not run smoothly. At this time, Injection Feedback Val # of the corresponding cylinder is 3 mm3/st or more.

- If the fuel injectors are contaminated, the response of the internal moving parts (plunger, command piston and nozzle) will be delayed. Such a delayed response results in an insufficient amount of fuel being injected. Once the engine has started, this problem usually causes irregular idling and loud knocking.

Inspection method:

Determine the malfunctioning injector(s) by using Control the Cylinder # Fuel Cut and replace the malfunctioning fuel injector.

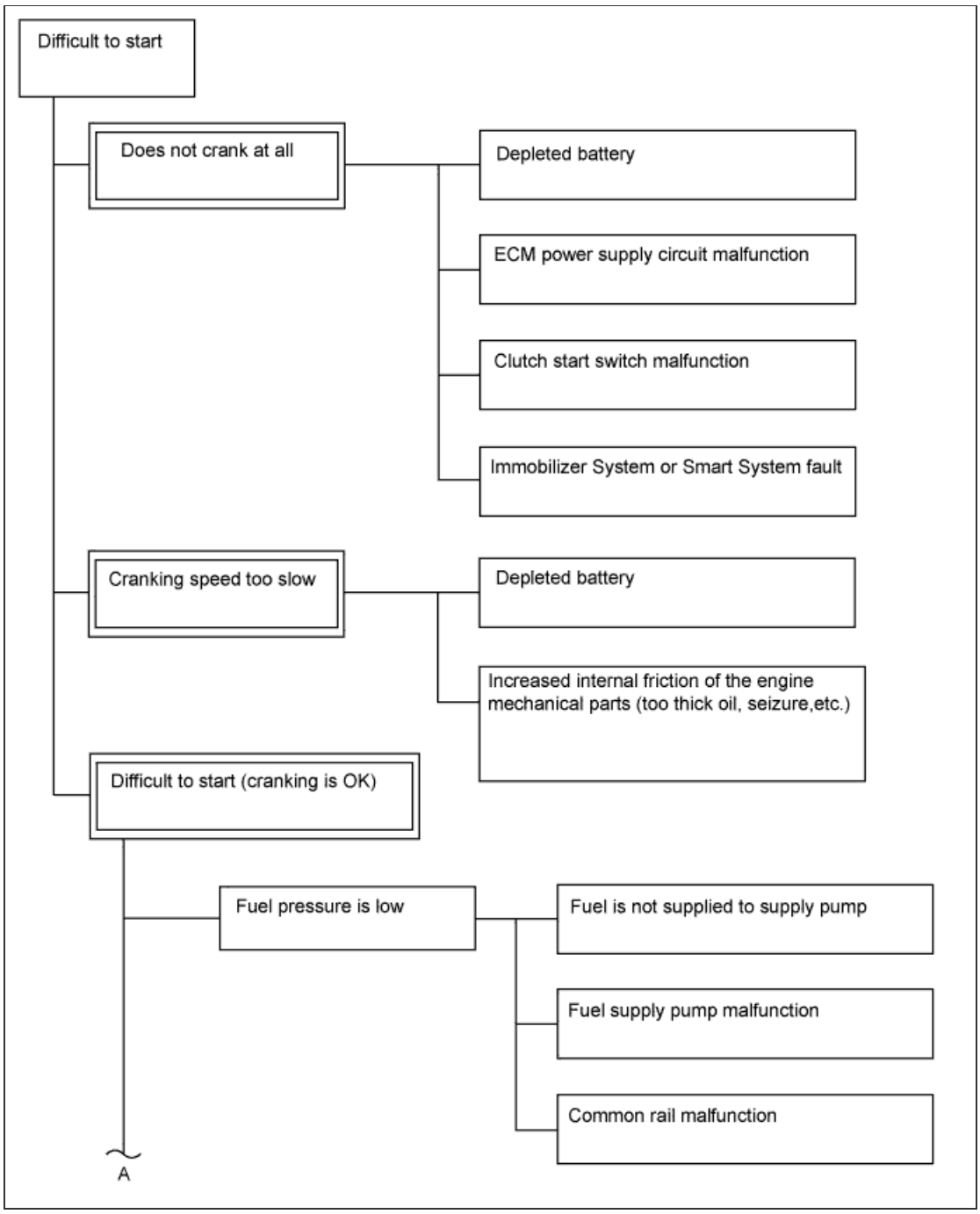
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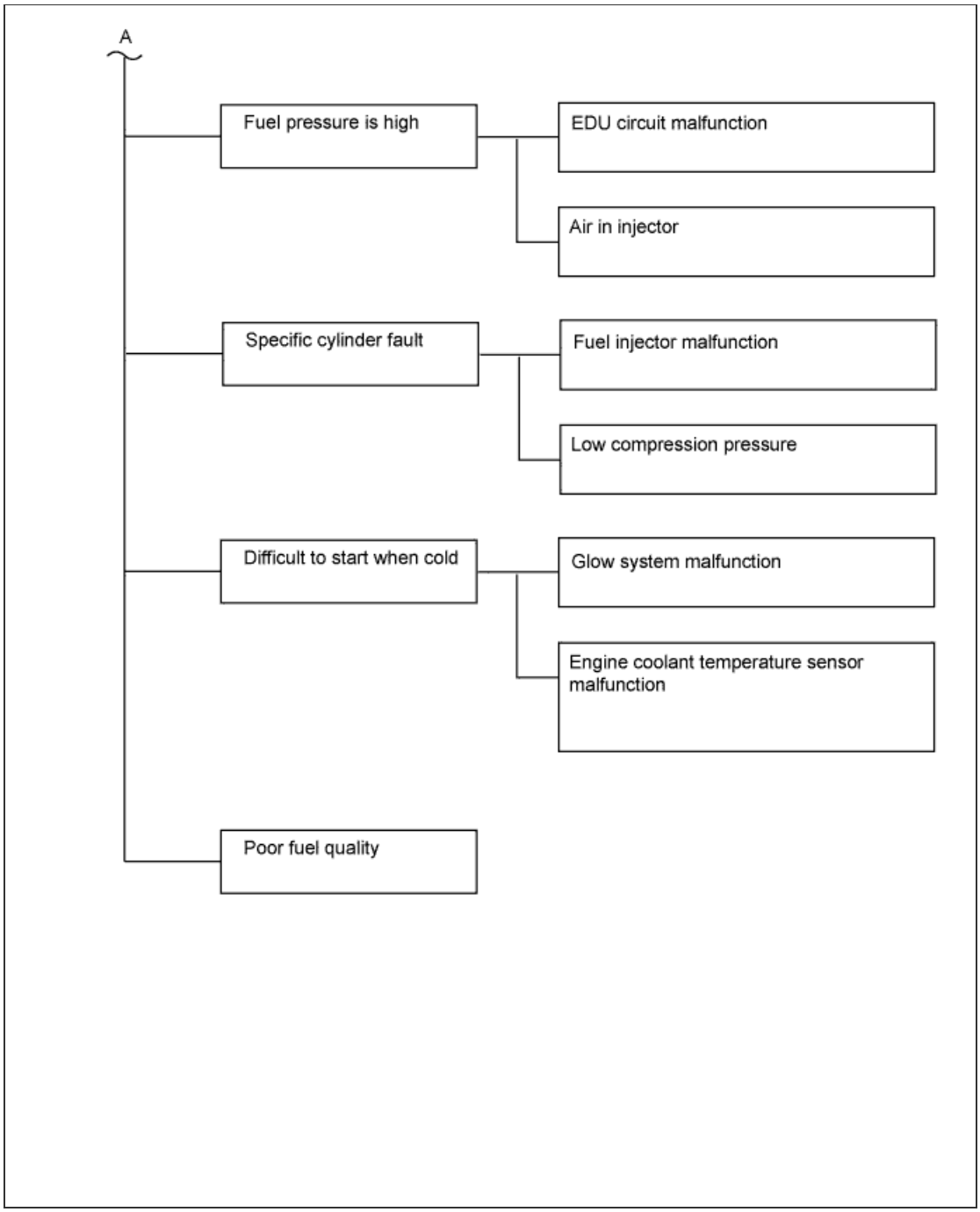
INSPECTION PROCEDURE

Explanation of Symptom

Starting Trouble	For good starting it is essential to have: • Sufficient cranking speed. • Properly operating engine preheating system. • Good quality fuel. The fuel is ignited by the heat which is generated with compression pressure. With problems such as a depleted battery, the crankshaft speed can become low, or if the engine compression is leaking, the compression pressure will not rise and there will be difficulty starting. When the engine is cold, even if there is compression heat, it will escape from the combustion chamber. For this reason, when the engine is started when it is cold, the glow plugs heat the compressed air. Also after starting the engine, by charging the glow plugs for a fixed time set according to the engine coolant temperature, diesel knocking and white smoke are prevented. The quantity of fuel injected is determined by the fuel pressure and also the amount of time the fuel injector is open.

Trouble Area Chart According to Problem Cause





NOTICE:

- **After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).**
- **After replacing the fuel supply pump, the ECM needs initialization (Click here).**
- **After replacing the fuel injector, the ECM needs registration (Click here).**

HINT:

- **Specified values in the following troubleshooting flowchart are for reference only. Variations in the Data List values may occur depending on the measuring conditions or the vehicle age. Do not assume the vehicle is normal when the Data List outputs standard values. There may be concealed factors of the malfunction.**

1.CHECK ENGINE CRANKING CONDITION

a. Check the engine cranking condition.

Result

Result	Proceed to
Does not crank at all.	A
Low cranking speed. **HINT:**	B

When cranking speed is low, especially when the temperature is low, check if the engine oil grade matches the recommendation.	
Cranking is OK.	C

B → CHECK BATTERY CONDITION (Click here)

C → Go to step 8

A

2.CHECK BATTERY CONDITION

a. Check battery condition (Click here).

NG → REPLACE BATTERY

OK

3.CHECK COMMUNICATION BETWEEN INTELLIGENT TESTER AND ECM

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Check if the normal starting screen appears (check whether communication with the ECM is possible).

HINT:

Use a tester that is able to communicate with other vehicles.

OK:

Communication is possible (Vehicle can be recognized).

NG → GO TO ECM POWER SOURCE CIRCUIT (Click here)

OK

4.READ VALUE USING INTELLIGENT TESTER (CLUTCH SWITCH)

HINT:

This inspection is not necessary for A/T vehicles.

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / All Data / Clutch Switch.

d. Read the value displayed on the tester.

Standard Value:

Tester Display	Condition	Specified Condition
Clutch Switch	Clutch pedal depressed	ON

Result:

Result	Proceed to
OK	A
NG (for LHD)	B

NG (for RHD)	C

B → REPLACE CLUTCH START SWITCH (for LHD) (Click here)

C → REPLACE CLUTCH START SWITCH (for RHD) (Click here)

A

5.READ ALL OUTPUT DTCS

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Utility / All Codes.

Result

Result	Proceed to
No DTC is output	A
DTCs related to engine are output	B

B → GO TO RELATED DTC

A

6.INSPECT SMART START SYSTEM (IN CASE OF VEHICLES EQUIPPED WITH SMART ENTRY AND START SYSTEM)

Check if the "Door Control Transmitter" functions of each key functions properly.

HINT:

- **Check if the engine starts properly with another key.**
- **If the doors can not be opened/closed by using the "Door Control Transmitter" function of the key, the battery inside the key may be depleted. In such a case the engine can not be started by pushing the ENGINE START/STOP button.**
- **When the door control transmitter battery is depleted, the engine can only be started by holding the door control transmitter against the ENGINE START/STOP button.**
- **If the inspection result is that the problem only occurs in certain locations or times of day, the possibility of wave interference is high. Also, added vehicle components may cause wave interference. If any component installed, remove them and perform the operation check.**
  Near broadcasting stations, large screens, airports, transformer stations, gasoline stations, etc., the door control transmitter may not operate due to electric wave interference.

NEXT

7.INSPECT CRANKING HOLDING FUNCTION CIRCUIT

HINT:

Check that "Starter Signal" in the Data List changes to ON when the engine is started.

a. Inspect the cranking holding function circuit (Click here).

NEXT

END

8.CHECK INITIALIZATION (FUEL SUPPLY PUMP)

When the engine does not start or another problem such as rough idling is present, perform initialization and check to see if the problem symptoms disappear. If the problem symptoms do not disappear, perform the next procedure.

HINT:

When replacing the ECM, the supply pump initialization must be performed (Click here).

NEXT

9.READ OUTPUT DTC (RELATED TO ENGINE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read the DTCs.

Result

Result	Proceed to
No DTC is output	A
DTCs related to engine are output	B

B → REPAIR OR REPLACE ENGINE CONTROL SYSTEM ACCORDING TO DTC OUTPUT (Click here)

A

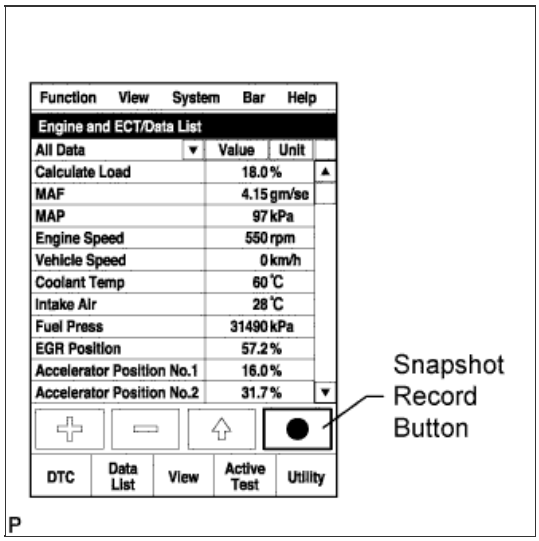
10.TAKE DATA LIST DURING STARTING AND IDLING

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / All Data.

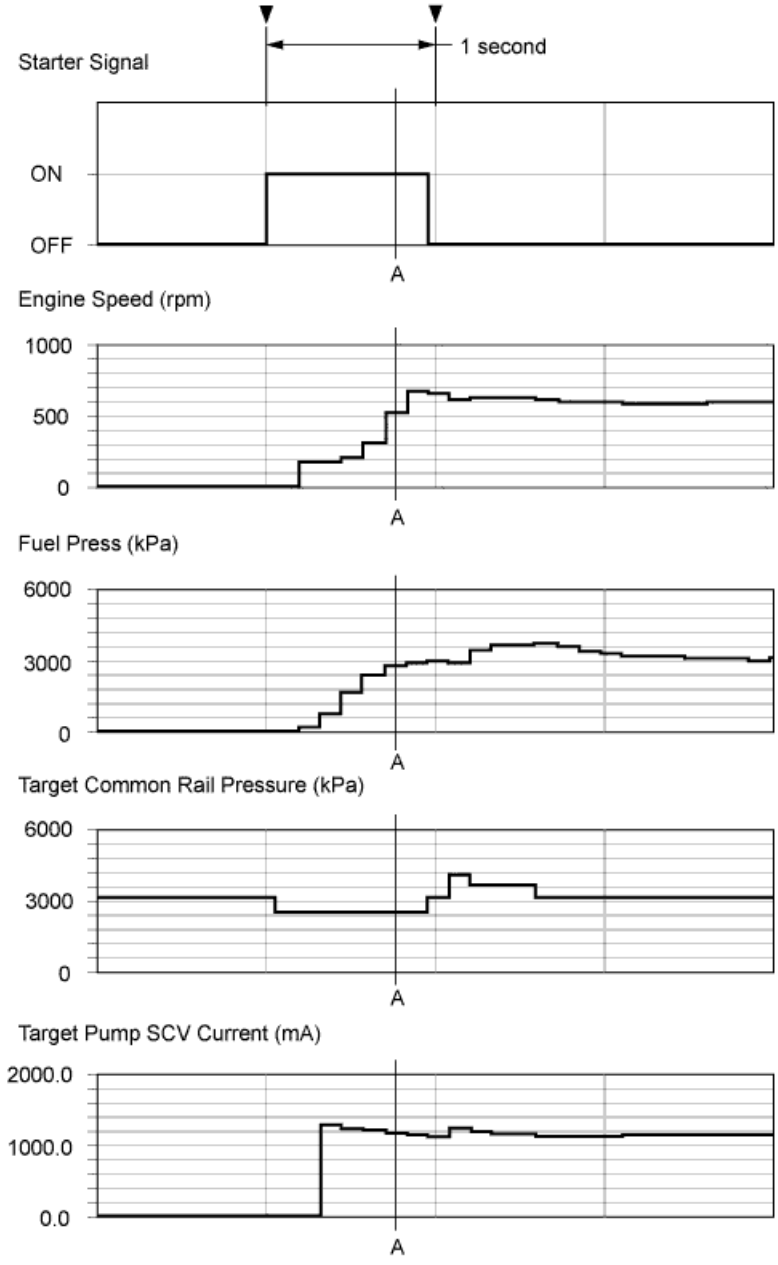
d. Take a snapshot of the following Data Lists with the intelligent tester during "Ignition switch ON (5 seconds) → Starting → Idling (10 seconds)".



HINT:

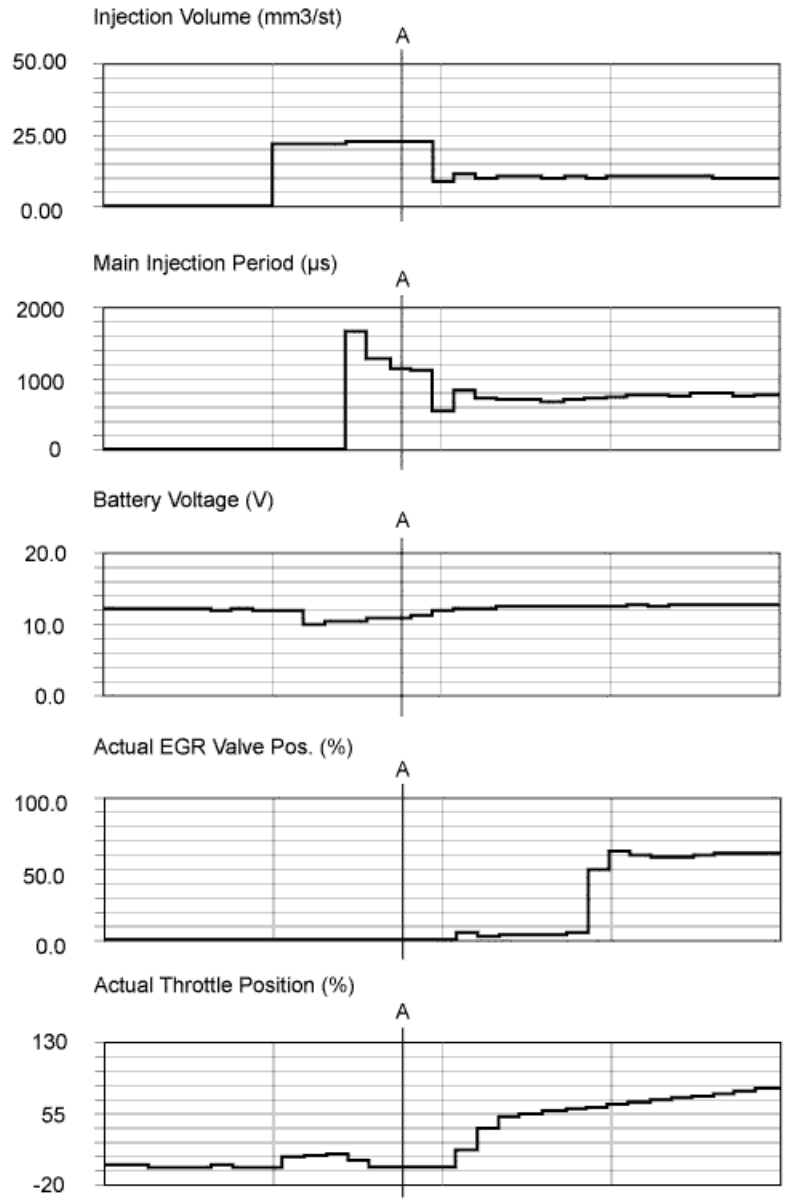
- **A**

Ignition switch ON, cranking, idling snapshot (1)

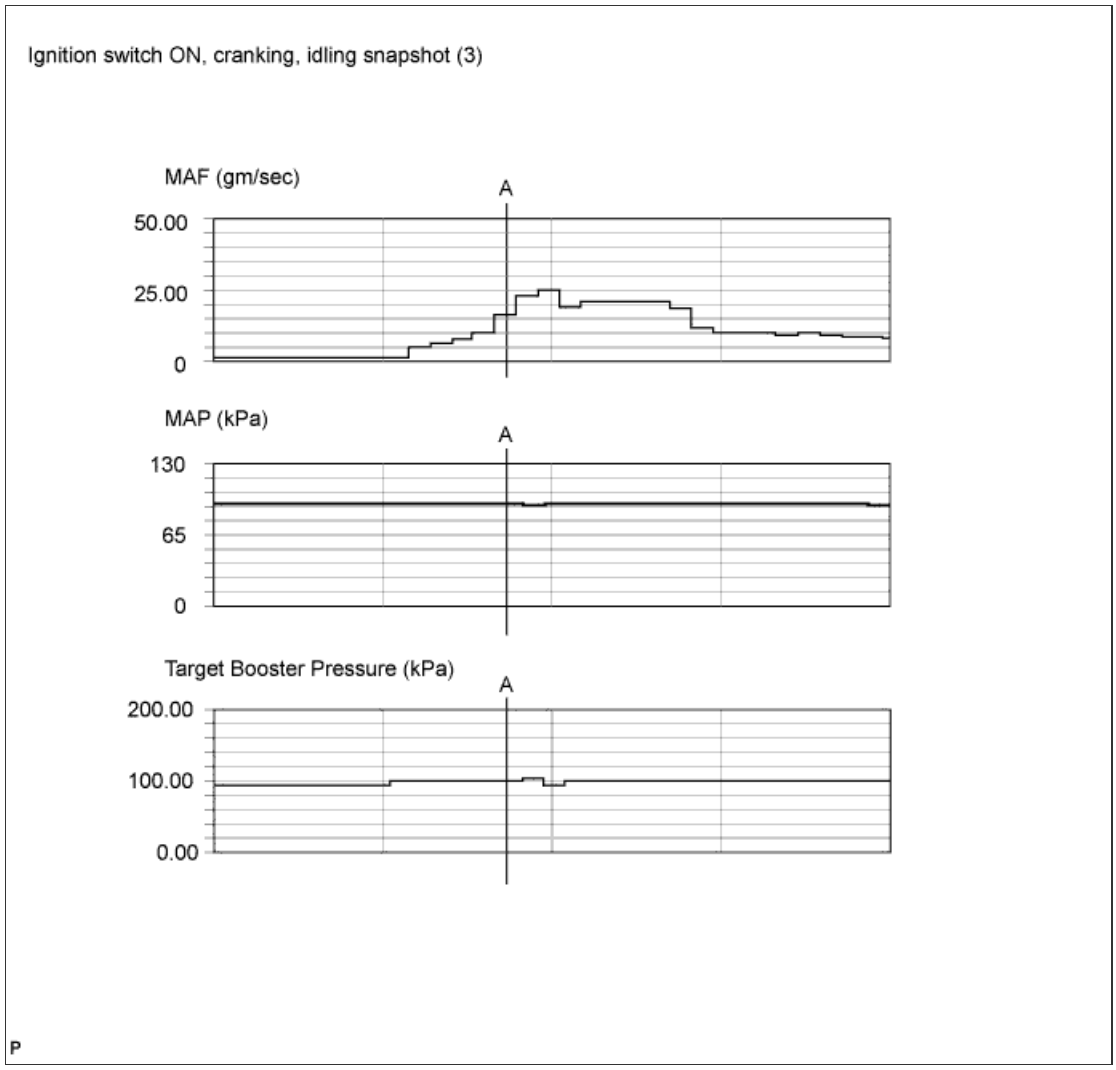


P

Ignition switch ON, cranking, idling snapshot (2)



P



snapshot can be used to compare vehicle data from the time of the malfunction to normal data and is very useful for troubleshooting. The data in the illustration below is that of a normal vehicle, but as the data varies between individual vehicles, this data should only be used for reference.

- **When there is trouble starting with a cold engine, take the snapshot when the engine is cold. Then warm up the engine (engine coolant temperature 70°C (158°F) or more) and after idling the vehicle for 1 minute (A/C off, electrical load off), take a snapshot of the data for 15 seconds while idling.**
- **Graphs like the ones shown below can be displayed by transferring the stored snapshot from the tester to a PC. Intelligent Viewer must be installed on the PC.**

Data List
Starter Signal
Engine Speed
Fuel Press
Target Common Rail Pressure
Target Pump SCV Current
Injection Volume
Main Injection Period
Inj. FB Vol. for Idle
Injection Feedback Val #1
Injection Feedback Val #2
Injection Feedback Val #3
Injection Feedback Val #4
Injection Feedback Val #5
Injection Feedback Val #6
Injection Feedback Val #7
Injection Feedback Val #8
Battery Voltage
Actual EGR Valve Pos. Actual EGR Valve Pos. #2
Target EGR Pos

Target EGR Pos. #2
Actual Throttle Position Actual Throttle Position #2
MAF
Target Booster Pressure
MAP

Reference Values during Engine Start (Point A)

Data List	Value	Unit
Starter Signal	ON	-
Engine Speed	524	rpm
Fuel Press	27820	kPa
Target Common Rail Pressure	25000	kPa
Injection Volume	22.71	µs
Main Injection Period	1142	µs
Inj. FB Vol. for Idle	-1.33	mm^3/st
Battery Voltage	11.0	V
Target EGR Pos. Target EGR Pos. #2	0	%
Actual EGR Valve Pos. Actual EGR Valve Pos. #2	0.0	%
Actual Throttle Position Actual Throttle Position #2	-1	%
MAF	16.45	g/sec
MAP	99	kPa
Target Boost Pressure	100.91	kPa
Coolant Temp	40	°C

Data Condition at Idling (Engine Warmed Up)

Data List	Value	Unit
Engine Speed	599	rpm
Target Booster Pressure	99.23	kPa
MAP	97	kPa
MAF	8.39	g/sec
Target Common Rail Pressure	32000	kPa
Fuel Press	32100	kPa
Injection Volume	6.13	mm^3/st
Actual EGR Valve Pos. Actual EGR Valve Pos. #2	43.5	%
Actual Throttle Position Actual Throttle Position #2	84	%
Injection Feedback Val #1	0.0	mm^3/st
Injection Feedback Val #2	0.3	mm^3/st
Injection Feedback Val #3	0.0	mm^3/st
Injection Feedback Val #4	-0.4	mm^3/st
Injection Feedback Val #5	-0.4	mm^3/st
Injection Feedback Val #6	0.3	mm^3/st
Injection Feedback Val #7	0.0	mm^3/st
Injection Feedback Val #8	-0.5	mm^3/st
Target EGR Pos. Target EGR Pos. #2	43.5	%
Coolant Temp	78	°C

HINT:

Actual Examples of Malfunction (See "Diagnostic Help" menu)

- **Starting is not possible**
  - **Fuel is not supplied to supply pump.**

Fuel Press: Approximately 1000 kPa or less during cranking.

- **Fuel is not being injected due to EDU circuit malfunction.**
  Fuel Press: 80000 to 90000 kPa during cranking.
- **Air in injectors.**
  Fuel Press: 60000 to 70000 kPa during cranking.

- **Cranking time is long**
  - **Suction control valve is stuck.**
    Target Pump SCV Current intermittently reaches 3000 mA or more. The suction control valve plunger intermittently becomes stuck. If there is difficult to start when the engine is cold, cool the engine and inspect it.
    Injector clogging or internal contamination:
  - **Injector clogging or internal contamination:**
    Injection Feedback Val # of one or more of the cylinders is 3 mm ^{3}/st or more.
    Injection Feedback Val # can be read when the engine is idling after being warmed up.

NEXT

11.CHECK SNAPSHOT (FUEL PRESS, TARGET COMMON RAIL PRESSURE ETC.)

a. Check Fuel Press and Target Common Rail Pressure in the snapshot taken when the engine was starting.

Result

Result	Proceed to
2 seconds after Starter Signal turns from OFF to ON, Fuel Press is less than "Target Common Rail Pressure -5000 kPa" **HINT:** As long as the fuel pressure remains below 5000 kPa, the ECM stops sending the injection open signal (IJT) to the EDU, and then the actual injection duration remains 0 microseconds.	A
2 seconds after Starter Signal turns from OFF to ON, Fuel Press is 5000 kPa or more higher than Target Common Rail Pressure	B
2 seconds after Starter Signal turns from OFF to ON, Fuel Press is within +/-5000 kPa of Target Common Rail Pressure	C

HINT:

Fuel pressure is about 20000 to 35000 kPa when engine cranking and engine coolant temperature 0°C (32°F) or more.

Fuel pressure increases rapidly during cranking.

B → Go to step 31

C → Go to step 19

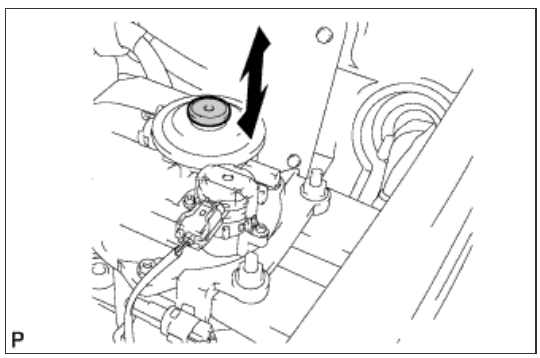
A

12.BLEED AIR FROM FUEL SYSTEM

a. Using the hand pump as indicated by the arrow in the illustration, bleed air from the fuel system. Continue pumping until pumping becomes difficult.

HINT:

When the fuel pressure during cranking is extremely low (1000 kPa or less), it is possible that fuel is not being supplied to the supply pump.



NEXT

13.CHECK IF FUEL IS BEING SUPPLIED TO FUEL SUPPLY PUMP

a. Disconnect the inlet hose from the fuel supply pump.

b. Operate the priming pump and check that fuel is being supplied to the fuel supply pump.

OK:
Fuel is properly supplied to the fuel supply pump when the priming pump is operated.

HINT:

- **When lack on fuel, fuel pressure drops.**
- **Inspect for fuel filter clogging.**
  (Check that the fuel filter is not clogged)

NG → CHECK AND REPLACE CLOGGED FUEL PIPE (INCLUDING FUEL FREEZING) (FUEL TANK - FUEL SUPPLY PUMP)

OK

14.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Check whether the difficulty starting has been successfully repaired by starting the engine.

HINT:

Fuel pressure during cranking is within +/-5000 kPa of target fuel pressure.

OK:
Malfunction has been repaired successfully.

NG → Go to step 15

OK

END

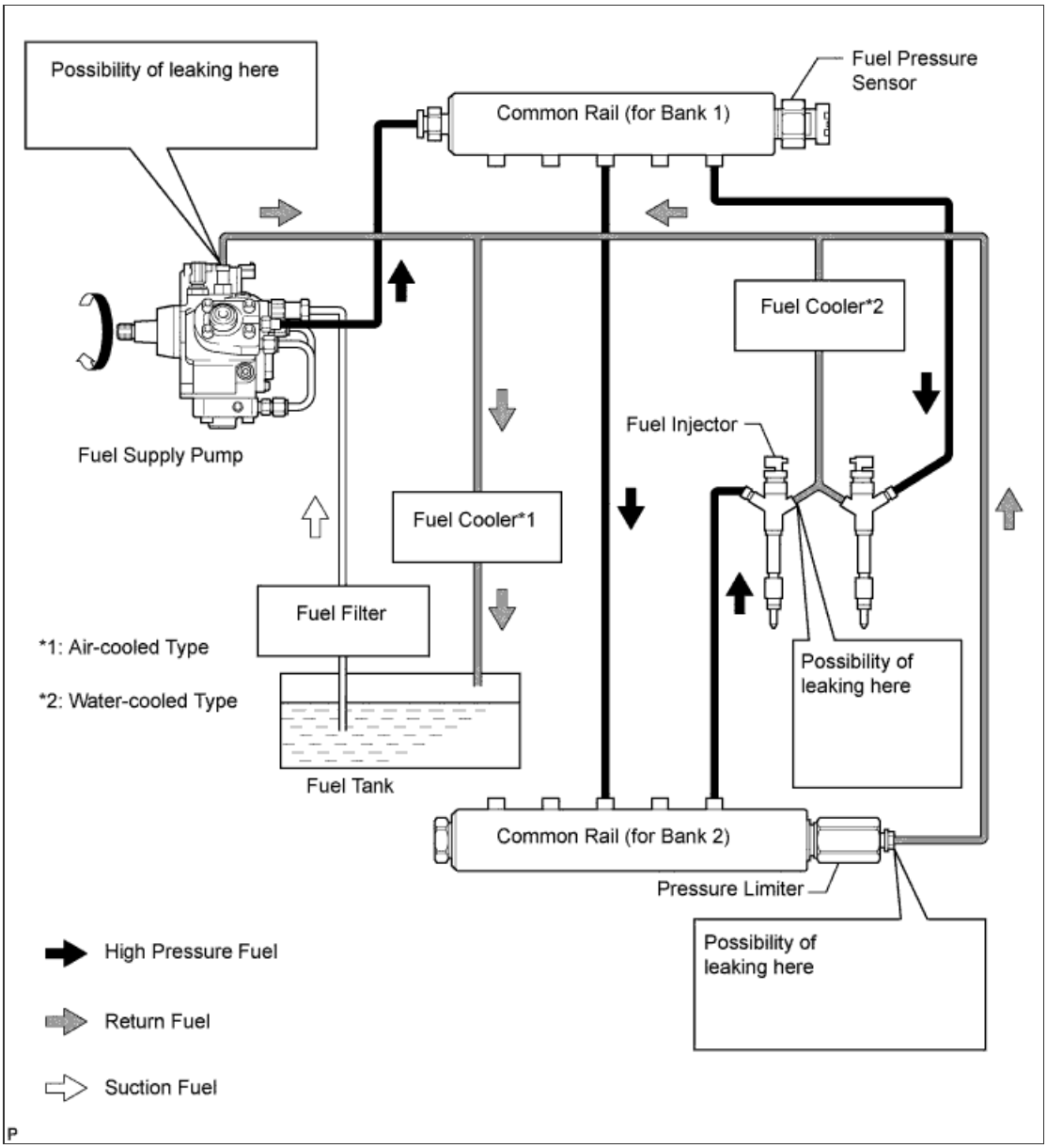
15.CHECK FUEL LEAK (FUEL SUPPLY PUMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester ON.

c. Enter the following menus: Powertrain / Engine / Data List / Fuel Press.

d. Pinch the supply pump return hose and check that Fuel Press during cranking increases.



Result

Result	Proceed to
Fuel Press increases	A
No change	B

A → REPLACE FUEL SUPPLY PUMP (Click here)

B

16.CHECK FUEL LEAK (PRESSURE LIMITER (COMMON RAIL (for Bank 2))

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester ON.

c. Enter the following menus: Powertrain / Engine / Data List / Fuel Press.

d. Pinch the pressure limiter return hose and check that Fuel Press during cranking increases.

Result

Result	Proceed to
Fuel Press increases	A
No change	B

A → REPLACE COMMON RAIL (for Bank 2) (Click here)

B

17.REPLACE FUEL SUPPLY PUMP

a. Replace fuel supply pump (Click here).

NEXT

18.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Check whether the difficulty starting has been successfully repaired by starting the engine.

HINT:

Fuel pressure during cranking is within +/-5000 kPa of target fuel pressure.

NEXT

END

19.CHECK SNAPSHOT (TARGET PUMP SCV CURRENT)

a. Check Target Pump SCV Current in the snapshot taken when the engine was starting.

Result:

Result	Proceed to
Target Pump SCV Current is 3000 mA or more	A
Target Pump SCV Current is less than 3000 mA	B

A → REPLACE FUEL SUPPLY PUMP (Click here)

B

20.CHECK DATA LIST

a. Check Injection Feedback Val # and Injection Volume in the snapshot taken when the engine was idling.

Result:

Result	Proceed to
Injection Feedback Val #1 to #8 is outside the range of +/-3 mm ^{3}/st **HINT:** There may be malfunction in the corresponding cylinder.	A
Injection Feedback Val #1 to #8 is within the range of +/-3 mm ^{3}/st and Injection Volume is more than 10 mm^3/st	B*
Injection Feedback Val #1 to #8 is within the range +/-3 mm ^{3}/st and Injection Volume is 10 mm ^{3}/st or less	C

HINT:

*: When case "B" occurs usually symptoms may be noticeable, such as difficult starting, rough idling, knocking or black smoke at high common rail pressure.

B → REPLACE FUEL INJECTORS OF ALL CYLINDERS (Click here)

C	Go to step 25

A

21.PERFORM ACTIVE TEST USING INTELLIGENT TESTER

HINT:

Use this Active Test to determine the malfunctioning cylinder.

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Active Test / Control the Cylinder #1 to #8 Fuel Cut.

HINT:

- **If the engine idle speed does not change when a fuel injector is disabled, the cylinder being tested is malfunctioning.**
- **If the cylinder being tested is normal, there will be a significant change in idle speed when the fuel injection is stopped for that cylinder.**

NEXT

22.PERFORM ACTIVE TEST USING INTELLIGENT TESTER

HINT:

Use this Active Test to help determine whether a cylinder has compression loss or not.

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Active Test / Check the Cylinder Compression / Data List / Compression / Engine Speed of Cyl #1 to #8.

d. Check the engine speed during the Active Test.

OK:
If the values of Engine Speed Cyl #1 to #8 are within +/-10 rpm of each other.

HINT:

When cranking, if the speed of a cylinder is approximately 100 rpm more than the other cylinders, there is probably a loss of compression in that cylinder.

OK	Go to step 24
NG	Go to step 23

23.CHECK CYLINDER COMPRESSION PRESSURE OF MALFUNCTIONING CYLINDER

HINT:

Measure the compression of the cylinder that had a high speed during the Active Test "Check the Cylinder Compression".

a. Check the cylinder compression pressure (Click here).

NG	CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

24.REPLACE FUEL INJECTOR OF MALFUNCTIONING CYLINDER

HINT:

The injector is determined to be faulty as the corresponding cylinder is malfunctioning, but has no compression loss.

NEXT

END

25.CHECK TEMPERATURE WHEN STARTING TROUBLE OCCURS

a. Check the temperature when starting trouble occurs.

Result

Result	Proceed to
Difficult to start only for cold engine.	A
Difficult to start both for cold and warmed up engine.	B

B → Go to step 29

A

26.INSPECT ENGINE COOLANT TEMPERATURE SENSOR

a. Inspect the engine coolant temperature sensor (Click here).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

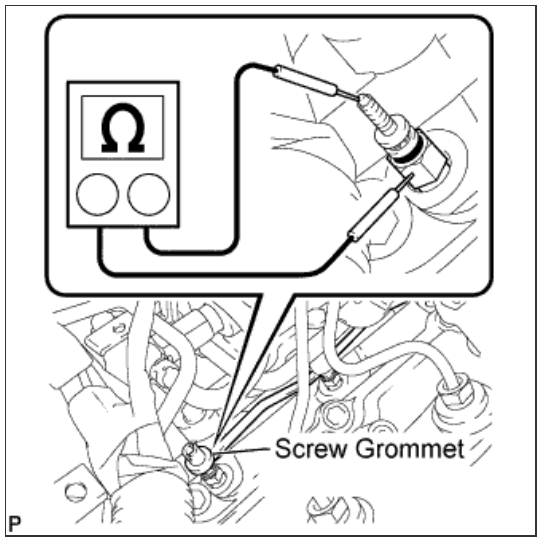
27.INSPECT GLOW PLUG ASSEMBLY (RESISTANCE)

a. Disconnect the glow plug connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Glow plug terminal - Body ground	20°C (68°F)	Approximately 1 Ω



HINT:

If any of the glow plugs has an open circuit, the engine power will be insufficient only when the engine is cold.

NOTICE:

- **Exercise extreme care not to damage the glow plug pipes. Damaging them could cause an open circuit or shorten the life of the glow plugs.**
- **Keep the glow plugs free of oil and fuel while cleaning.**
- **Wipe any oil off of the terminal and Bakelite washer with a clean, dry cloth during inspection.**
- **Do not apply more than 11 V to the glow plugs as it may cause an open circuit.**

NG → REPLACE GLOW PLUG ASSEMBLY (Click here)

OK

28.INSPECT INJECTOR COMPENSATION CODE

a. Read the injector compensation code (Click here).

OK:

Compensation codes stored in the ECM match compensation codes of the installed fuel injectors.

NG → PERFORM REGISTRATION FUEL INJECTOR COMPENSATION CODE (Click here)

OK

29.CHECK FUEL QUALITY

a. Check that fuel with cetane number is used.

NEXT

30.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Check whether the difficulty starting has been successfully repaired by starting the engine.

NEXT

END

31.CHECK SNAPSHOT

HINT:

When all Data List values are OK and Fuel Press is higher than Target Common Rail Pressure, perform the following inspection.

NEXT

32.INSPECT INJECTOR DRIVER (EDU POWER SOURCE)

a. Disconnect the C73 and C74 No. 1 injector driver (EDU) connectors.

b. Disconnect the C75 and C76 No. 2 injector driver (EDU) connectors.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

No. 1

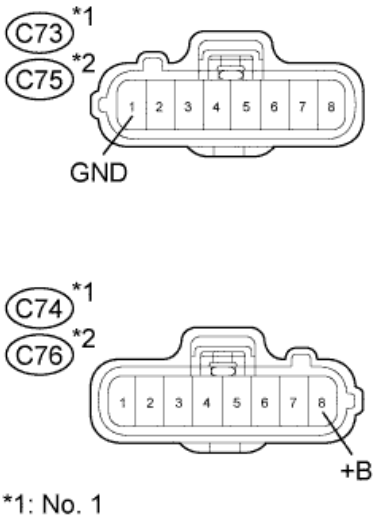
Tester Connection	Switch Condition	Specified Condition
C74-8 (+B) - C73-1 (GND)	Ignition switch ON	11 to 14 V

Standard Voltage:

No. 2

Tester Connection	Switch Condition	Specified Condition
C76-8 (+B) - C75-1 (GND)	Ignition switch ON	11 to 14 V

Front view of wire harness connector: (to EDU)



*1: No. 1

*2: No. 2

NG → GO TO INJECTOR CIRCUIT (Click here)

OK

33.INSPECT FUEL INJECTOR

HINT:

If there is no initial combustion during cranking, there may be air in the injectors.

NEXT

END

for Preparation Click here

INSPECTION PROCEDURE

NOTICE:

- **After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).**
- **After replacing a fuel supply pump, the ECM needs initialization (Click here).**
- **After replacing a fuel injector, the ECM needs registration (Click here).**

HINT:

Specified values in the following troubleshooting flowchart are for reference only. Variations in the Data List values may occur depending on the measuring conditions or the vehicle age. Do not assume the vehicle to be normal when the Data List outputs standard values. There may be concealed factors of the malfunction.

1.READ OUTPUT DTC (RELATED TO ENGINE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read the DTCs.

Result

Result	Proceed to
No DTC is output	A
DTCs related to the engine are output	B

B → REPAIR OR REPLACE ENGINE CONTROL SYSTEM ACCORDING TO DTC OUTPUT (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (INJECTION VOLUME AND INJECTION FEEDBACK VAL #1 TO #8)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List.

d. Select the following menu items in order and read the values.

- Injection Volume
- Injection Feedback Val #1, #2, #3, #4, #5, #6, #7 and #8

Standard Value:

Item	Engine Speed*	Reference Value
Injection Volume	Idling (No engine load)	3.0 to 10 mm^3/st
Injection Feedback Val #1 to #8	Idling (No engine load)	-3.0 to 3.0 mm^3/st

HINT:

*: If no idling conditions are specified, the shift lever should be in N, and the A/C switch and all accessory switches should be off.

NG → Go to step 11

OK

3.PERFORM ENGINE SPEED ACCELERATION

HINT:

If the exhaust gas contains excessive black smoke, perform the following operations.

a. Accelerate the engine to the maximum speed with no load 20 times.

b. Check the volume of black smoke in the exhaust gas.

Result

Result	Proceed to
Black smoke is not present	OK
Black smoke remains in the exhaust gas	NG

HINT:

Soot deposits in the exhaust system may cause excessive black smoke.

NG → Go to step 4

OK →

END

4.CHECK INTAKE AIR CONTROL SYSTEM AND EXHAUST SYSTEM

a. Inspect the engine condition (Click here).

NG → REPAIR OR REPLACE LOCATIONS WHERE MALFUNCTIONS EXIST

OK →

5.INSPECT MASS AIR FLOW METER

a. Inspect the mass air flow meter (Click here).

NG → REPLACE MASS AIR FLOW METER (Click here)

OK →

6.CHECK TURBOCHARGING PRESSURE

a. Check the turbocharging pressure (Click here).

OK:

The turbocharger pressure is within the standard range.

NG → REPLACE TURBOCHARGER SUB-ASSEMBLY (for Bank 1 or Bank 2) (Click here)

OK →

7.READ VALUE USING INTELLIGENT TESTER (DATA LIST)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List.

d. Select the following menu items in order and read the values.

- Fuel Press
- Injection Volume

- Main Injection Period
- Pilot 2 Injection Period
- Injection Feedback Val #1, #2, #3, #4, #5, #6, #7 and #8

Reference:

Item	Engine Speed*	Reference Value
Fuel Press	Idling	27 to 37 MPa
Fuel Press	2000 rpm (no engine load)	50 to 70 MPa
Fuel Press	3000 rpm (no engine load)	52 to 76 MPa
Injection Volume	Idling	3.0 to 10 mm^3/st
Injection Volume	2000 rpm (no engine load)	3.5 to 11 mm^3/st
Injection Volume	3000 rpm (no engine load)	6.5 to 13 mm^3/st
Main Injection Period	Idling	430 to 730 µs
Pilot 2 Injection Period	Idling	390 to 490 µs
Injection Feedback Val #1 to #8	Idling	-3.0 to 3.0 mm^3

HINT:

*: If no idling conditions are specified, the shift lever should be in N, and the A/C switch and all accessory switches should be off.

Result

Result	Proceed to
Within reference value	A
One of Injection Feedback Val #1 to #8 is not within reference value	B
Other result	C

B → REPLACE MALFUNCTIONING FUEL INJECTOR (Click here)

C → Go to step 11

A

8.CHECK CYLINDER COMPRESSION PRESSURE

a. Check the cylinder compression pressure (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

9.CHECK HARNESS AND CONNECTOR (FUEL INJECTOR - EDU)

a. Disconnect the fuel injector connectors.

b. Disconnect the No. 1 EDU connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

No. 1

Tester Connection	Condition	Specified Condition
C5-2 - C74-4 (INJ1)	Always	Below 1 Ω
C14-2 - C74-3 (INJ4)	Always	Below 1 Ω
C69-2 - C74-2 (INJ6)	Always	Below 1 Ω
C68-2 - C74-1 (INJ7)	Always	Below 1 Ω
C5-1 - C74-5 (COM1)	Always	Below 1 Ω
C14-1 - C74-5 (COM1)	Always	Below 1 Ω
C69-1 - C74-6 (COM2)	Always	Below 1 Ω

C68-1 - C74-6 (COM2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

No. 1

Tester Connection	Condition	Specified Condition
C5-2 or C74-4 (INJ1) - Body ground	Always	10 kΩ or higher
C14-2 or C74-3 (INJ4) - Body ground	Always	10 kΩ or higher
C69-2 or C74-2 (INJ6) - Body ground	Always	10 kΩ or higher
C68-2 or C74-1 (INJ7) - Body ground	Always	10 kΩ or higher
C5-1 or C74-5 (COM1) - Body ground	Always	10 kΩ or higher
C14-1 or C74-5 (COM1) - Body ground	Always	10 kΩ or higher
C69-1 or C74-6 (COM2) - Body ground	Always	10 kΩ or higher
C68-1 or C74-6 (COM2) - Body ground	Always	10 kΩ or higher

d. Disconnect the fuel injector connectors.

e. Disconnect the No. 2 EDU connector.

f. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

No. 2

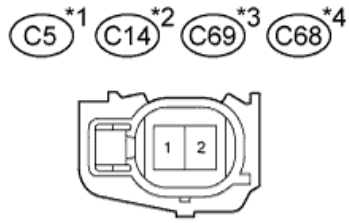
Tester Connection	Condition	Specified Condition
C70-2 - C76-4 (INJ2)	Always	Below 1 Ω
C9-2 - C76-3 (INJ5)	Always	Below 1 Ω
C67-2 - C76-1 (INJ3)	Always	Below 1 Ω
C54-2 - C76-2 (INJ8)	Always	Below 1 Ω
C70-1 - C76-5 (COM4)	Always	Below 1 Ω
C9-1 - C76-5 (COM4)	Always	Below 1 Ω
C67-1 - C76-6 (COM5)	Always	Below 1 Ω
C54-1 - C76-6 (COM5)	Always	Below 1 Ω

Standard Resistance (Check for Short):

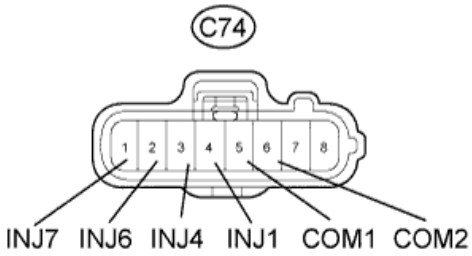
No. 2

Tester Connection	Condition	Specified Condition
C70-2 or C76-4 (INJ2) - Body ground	Always	10 kΩ or higher
C9-2 or C76-3 (INJ5) - Body ground	Always	10 kΩ or higher
C67-2 or C76-1 (INJ3) - Body ground	Always	10 kΩ or higher
C54-2 or C76-2 (INJ8) - Body ground	Always	10 kΩ or higher
C70-1 or C76-5 (COM4) - Body ground	Always	10 kΩ or higher
C9-1 or C76-5 (COM4) - Body ground	Always	10 kΩ or higher
C67-1 or C76-6 (COM5) - Body ground	Always	10 kΩ or higher
C54-1 or C76-6 (COM5) - Body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Fuel injector)



Front view of wire harness connector:
(to No. 1 EDU)



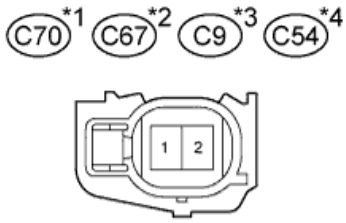
*1: No. 1 Fuel Injector

*2: No. 4 Fuel Injector

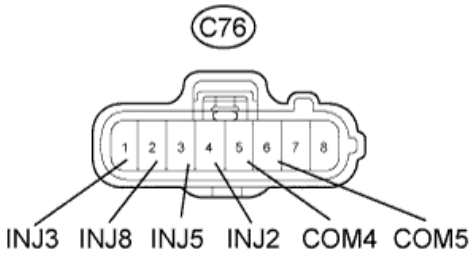
*3: No. 6 Fuel Injector

*4: No. 7 Fuel Injector

Front view of wire harness connector:
(to Fuel injector)



Front view of wire harness connector:
(to No. 2 EDU)



*1: No. 2 Fuel Injector

*2: No. 3 Fuel Injector

*3: No. 5 Fuel Injector

*4: No. 8 Fuel Injector

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

10.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (CONTROL THE CYLINDER FUEL CUT)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Active Test / Control the Cylinder #1, #2, #3, #4, #5, #6, #7 and #8 Fuel Cut.

d. Check the engine idling condition while the fuel injection of each cylinder is cut using the tester.

Result

Engine Idling Condition	Proceed to
Becomes unstable	A
Does not change	B

HINT:

Replace the fuel injector mounted on the cylinder that causes no significant idle speed change.

B → REPLACE MALFUNCTIONING FUEL INJECTOR (Click here)

A

REPLACE INJECTOR DRIVER (No. 1 and/or No. 2) (Click here)

11.READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Start the engine and warm it up.

d. Enter the following menus: Powertrain / Engine / Data List / Coolant Temp.

e. Read the value.

Standard Value:

Item	Inspection Condition	Reference Value
Coolant Temp	Idling with warm engine (A/C switch off)	75 to 90°C (167 to 194°F)

NG → Go to step 17

OK

12.READ VALUE USING INTELLIGENT TESTER (MAP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Start the engine and warm it up.

d. Enter the following menus: Powertrain / Engine / Data List / MAP.

e. Read the value.

OK:
Same value as the actual atmospheric pressure.

NG → Go to step 18

OK

13.READ VALUE USING INTELLIGENT TESTER (ENGINE SPEED)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Engine Speed.

d. Read the value.

Standard Value:

Item	Inspection Condition	Reference Value
Engine Speed	Idling with warm engine (A/C switch off)	• 500 to 600 rpm (M/T) • 550 to 650 rpm (A/T)

NG → Go to step 19

OK

14.READ VALUE USING INTELLIGENT TESTER (ACCEL SENS. NO.# VOLT %)

a. Connect the intelligent tester to the DLC3.

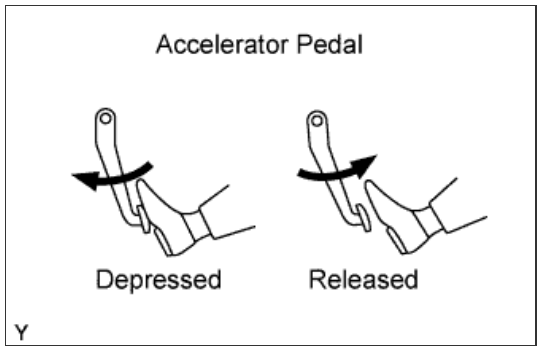
b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Accel Sens. No.1 Volt % and Accel Sens. No.2 Volt %.

d. Read the values.

Standard:

Accelerator Pedal	Accel Sens. No.1 Volt %	Accel Sens. No.2 Volt %
Released	8 to 28%	30 to 55%
Depressed	51 to 86%	73 to 98%



NG → Go to step 20

OK ↓

15.READ VALUE USING INTELLIGENT TESTER (INTAKE AIR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Inlet Air.

d. Read the value.

OK:
Same as air temperature near intake manifold.

NG → Go to step 21

OK ↓

16.READ VALUE USING INTELLIGENT TESTER (FUEL PRESS)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Start the engine and warm it up.

d. Enter the following menus: Powertrain / Engine / Data List / Fuel Press.

e. Read the value.

Standard Value:

Item	Inspection Condition	Reference Value
Fuel Press	Idling	27 to 37 MPa

NG → Go to step 22

OK ↓

REPLACE ECM (Click here)

17.INSPECT ENGINE COOLANT TEMPERATURE SENSOR

a. Inspect the engine coolant temperature sensor (Click here).

NG → **REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)**

OK ↓

REPAIR OR REPLACE HARNESS OR CONNECTOR

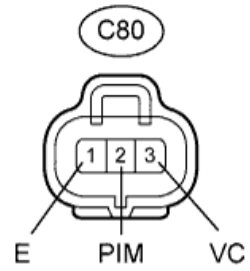
18.CHECK HARNESS AND CONNECTOR (MANIFOLD ABSOLUTE PRESSURE SENSOR - ECM)

a. Disconnect the manifold absolute pressure sensor connector.

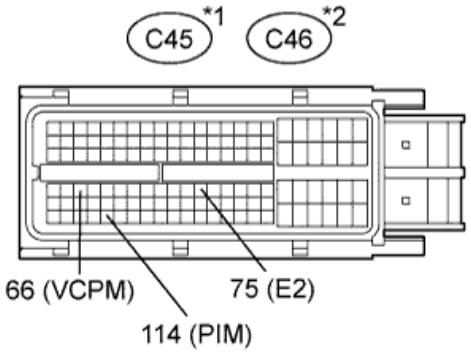
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Manifold Absolute Pressure Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C80-2 (PIM) - C45-114 (PIM)	Always	Below 1 Ω
C80-3 (VC) - C45-66 (VCPM)	Always	Below 1 Ω
C80-1 (E) - C45-75 (E2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C80-2 (PIM) - C46-114 (PIM)	Always	Below 1 Ω
C80-3 (VC) - C46-66 (VCPM)	Always	Below 1 Ω
C80-1 (E) - C46-75 (E2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition

C80-2 (PIM) or C45-114 (PIM)) - Body ground	Always	10 kΩ or higher
C80-3 (VC) or C45-66 (VCPM) - Body ground	Always	10 kΩ or higher
C80-1 (E) or C45-75 (E2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C80-2 (PIM) or C46-114 (PIM)) - Body ground	Always	10 kΩ or higher
C80-3 (VC) or C46-66 (VCPM) - Body ground	Always	10 kΩ or higher
C80-1 (E) or C46-75 (E2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE MANIFOLD ABSOLUTE PRESSURE SENSOR (Click here)

19.INSPECT CRANKSHAFT POSITION SENSOR

a. Disconnect the crankshaft position sensor connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (NE+) - 2 (NE-)	Cold	1630 to 2740 Ω
1 (NE+) - 2 (NE-)	Hot	2065 to 3225 Ω

HINT:

In the table above, the terms "Cold" and "Hot" refer to the temperature of the coils in the sensor. "Cold" means approximately -10 to 50°C (14 to 122°F). "Hot" means approximately 50 to 100°C (122 to 212°F).

Component without harness connected:
(Crankshaft Position Sensor)



NG → REPLACE CRANKSHAFT POSITION SENSOR (Click here)

OK

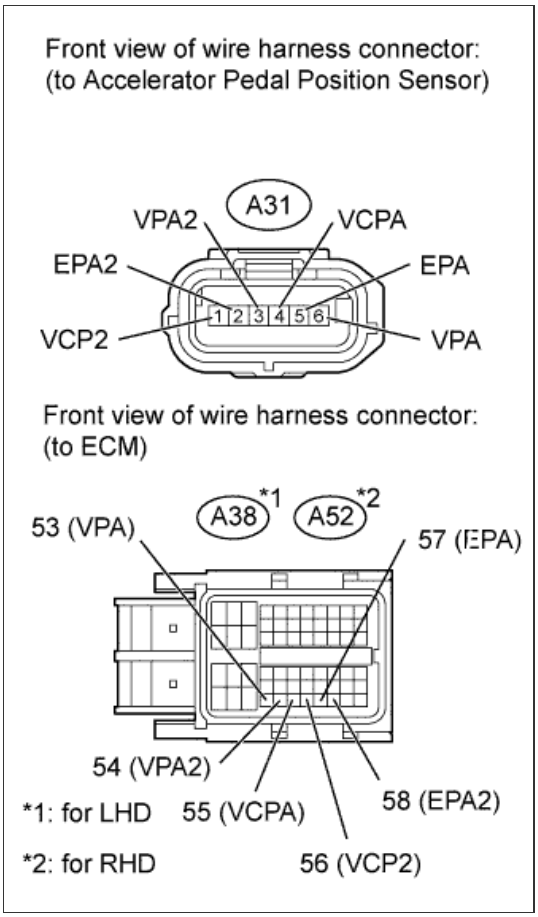
REPAIR OR REPLACE HARNESS OR CONNECTOR

20.CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

a. Disconnect the accelerator pedal position sensor connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) - A38-56 (VCP2)	Always	Below 1 Ω
A31-2 (EPA2) - A38-58 (EPA2)	Always	Below 1 Ω
A31-3 (VPA2) - A38-54 (VPA2)	Always	Below 1 Ω
A31-4 (VCPA) - A38-55 (VCPA)	Always	Below 1 Ω
A31-5 (EPA) - A38-57 (EPA)	Always	Below 1 Ω
A31-6 (VPA) - A38-53 (VPA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) - A52-56 (VCP2)	Always	Below 1 Ω
A31-2 (EPA2) - A52-58 (EPA2)	Always	Below 1 Ω
A31-3 (VPA2) - A52-54 (VPA2)	Always	Below 1 Ω
A31-4 (VCPA) - A52-55 (VCPA)	Always	Below 1 Ω
A31-5 (EPA) - A52-57 (EPA)	Always	Below 1 Ω
A31-6 (VPA) - A52-53 (VPA)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) or A38-56 (VCP2) -		10 kΩ or

Body ground	Always	higher
A31-2 (EPA2) or A38-58 (EPA2) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A38-54 (VPA2) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A38-55 (VCPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A38-57 (EPA) - Body ground	Always	10 kΩ or higher
A31-6 (VPA) or A38-53 (VPA) - Body ground	Always	10 kΩ or higher

for LHD

Tester Connection	Condition	Specified Condition
A31-1 (VCP2) or A52-56 (VCP2) - Body ground	Always	10 kΩ or higher
A31-2 (EPA2) or A52-58 (EPA2) - Body ground	Always	10 kΩ or higher
A31-3 (VPA2) or A52-54 (VPA2) - Body ground	Always	10 kΩ or higher
A31-4 (VCPA) or A52-55 (VCPA) - Body ground	Always	10 kΩ or higher
A31-5 (EPA) or A52-57 (EPA) - Body ground	Always	10 kΩ or higher
A31-6 (VPA) or A52-53 (VPA) - Body ground	Always	10 kΩ or higher

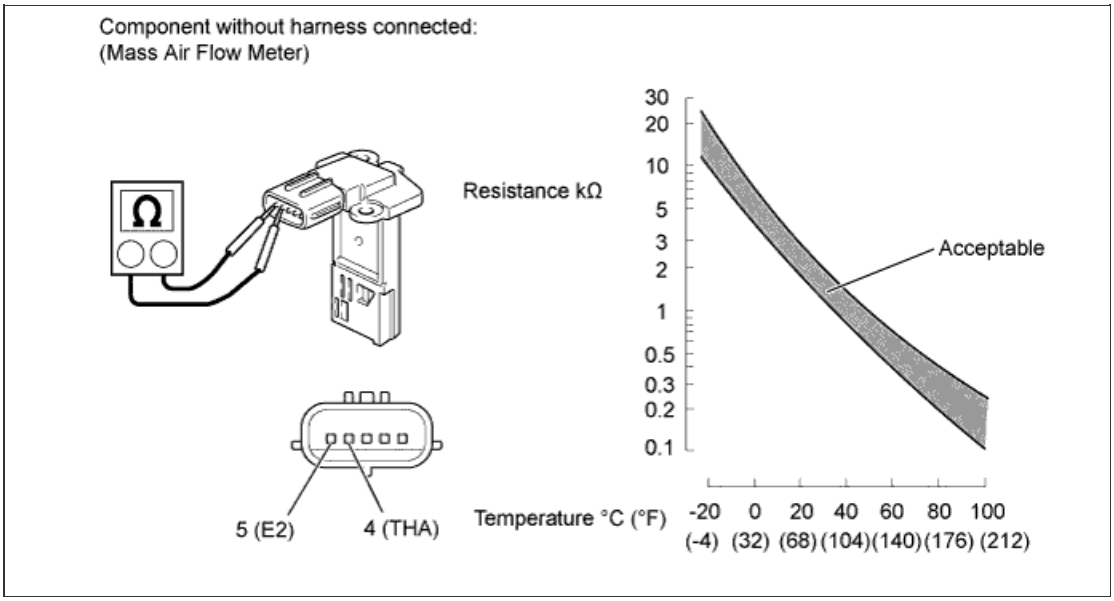
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ACCELERATOR PEDAL ROD ASSEMBLY (ACCELERATOR PEDAL POSITION SENSOR) (Click here)

21.INSPECT INTAKE AIR TEMPERATURE SENSOR

a. Remove the mass air flow meter (Click here).



b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition

4 - 5	-20°C (-4°F)	13.6 to 18.4 kΩ
	20°C (68°F)	2.21 to 2.69 kΩ
	60°C (140°F)	0.49 to 0.67 kΩ

NG → REPLACE MASS AIR FLOW METER (Click here)

OK →

REPAIR OR REPLACE HARNESS OR CONNECTOR

22.INSPECT COMMON RAIL (for Bank 1) (FUEL PRESSURE SENSOR)

a. Inspect the fuel pressure sensor (Click here).

NG → REPLACE COMMON RAIL (for Bank 1) (Click here)

OK →

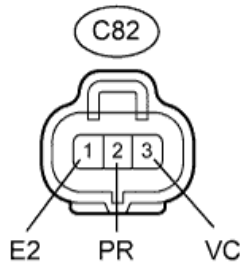
23.CHECK HARNESS AND CONNECTOR (FUEL PRESSURE SENSOR - ECM)

a. Disconnect the fuel pressure sensor connector.

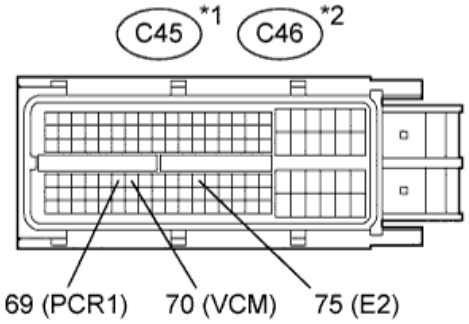
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Fuel Pressure Sensor)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition

C82-2 (PR) - C45-69 (PCR1)	Always	Below 1 Ω
C82-3 (VC) - C45-70 (VCM)	Always	Below 1 Ω
C82-1 (E2) - C45-75 (E2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C82-2 (PR) - C46-69 (PCR1)	Always	Below 1 Ω
C82-3 (VC) - C46-70 (VCM)	Always	Below 1 Ω
C82-1 (E2) - C46-75 (E2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C82-2 (PR) or C45-69 (PCR1) - Body ground	Always	10 kΩ or higher
C82-3 (VC) or C45-70 (VCM) - Body ground	Always	10 kΩ or higher
C82-1 (E2) or C45-75 (E2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C82-2 (PR) or C46-69 (PCR1) - Body ground	Always	10 kΩ or higher
C82-3 (VC) or C46-70 (VCM) - Body ground	Always	10 kΩ or higher
C82-1 (E2) or C46-75 (E2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

24.REPLACE ECM

a. Replace the ECM (Click here).

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

b. Check if the engine starts smoothly or if the engine stalls.

OK:

The engine starts smoothly and does not stall.

NG → REPLACE FUEL SUPPLY PUMP (**Click here**)

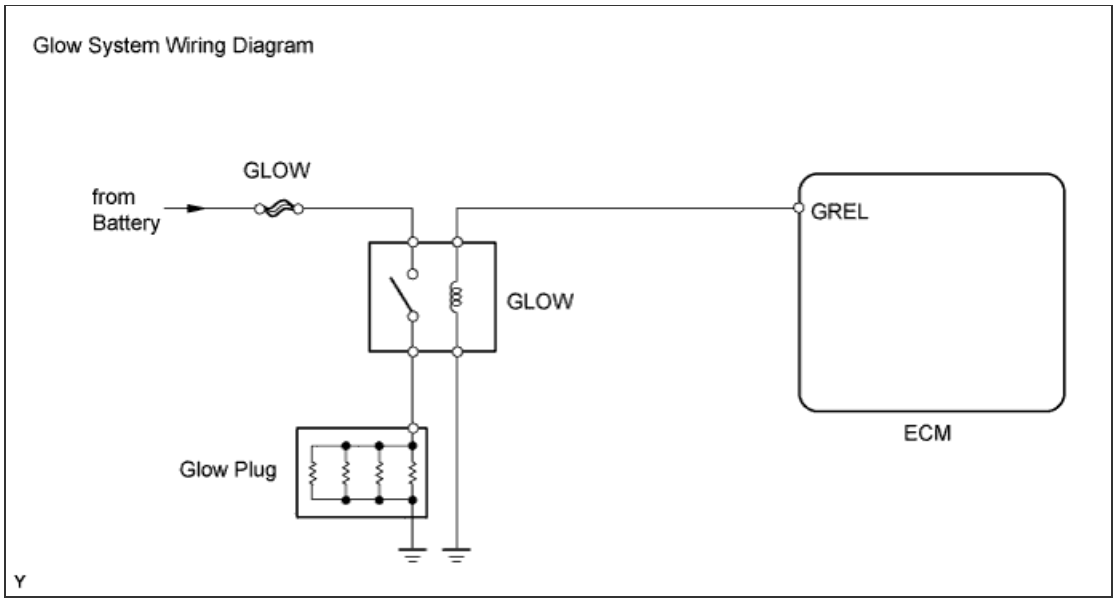
OK

END

for Preparation Click here

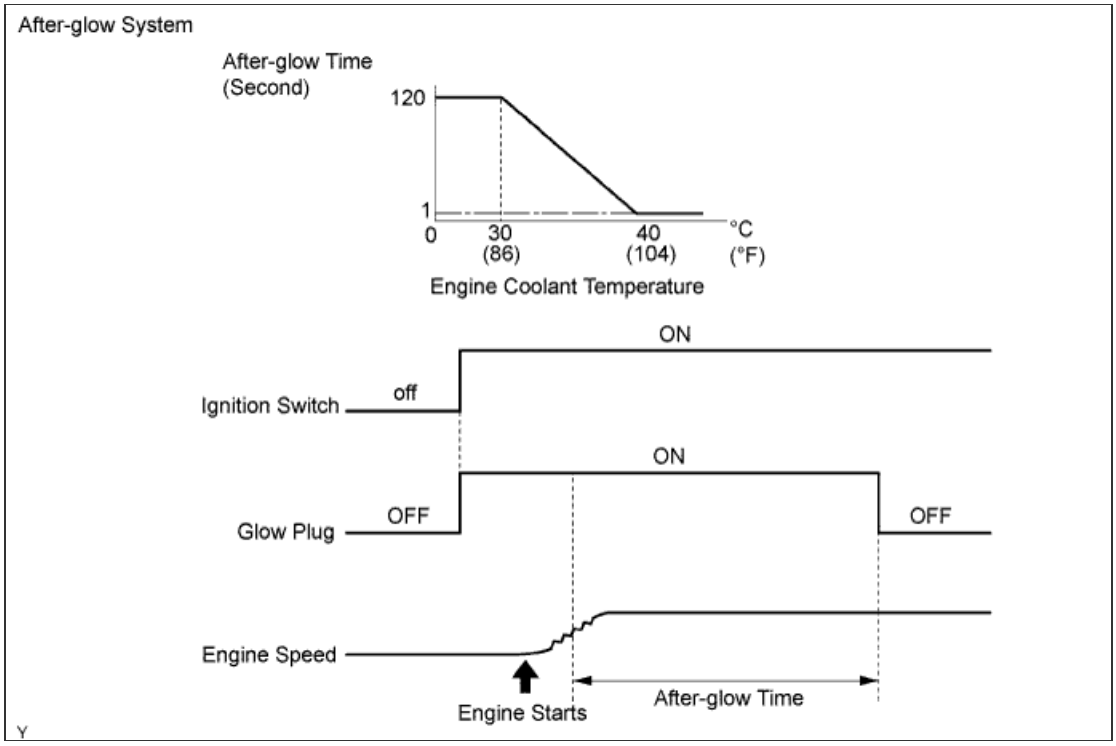
DESCRIPTION

The glow plug is mounted inside the engine combustion chamber. To ensure efficient engine starting with a cold engine, the ECM calculates a time interval of the current that needs to flow through the glow plug depending on the starting engine coolant temperature when the ignition switch is turned to ON. The ECM then turns on the glow plug relay and permits current to flow through the glow plug based on the ECM calculated time. The glow plug is then heated, and enhances fuel combustion with a cold engine.
This DTC will be stored if the glow plug or the circuit is open.

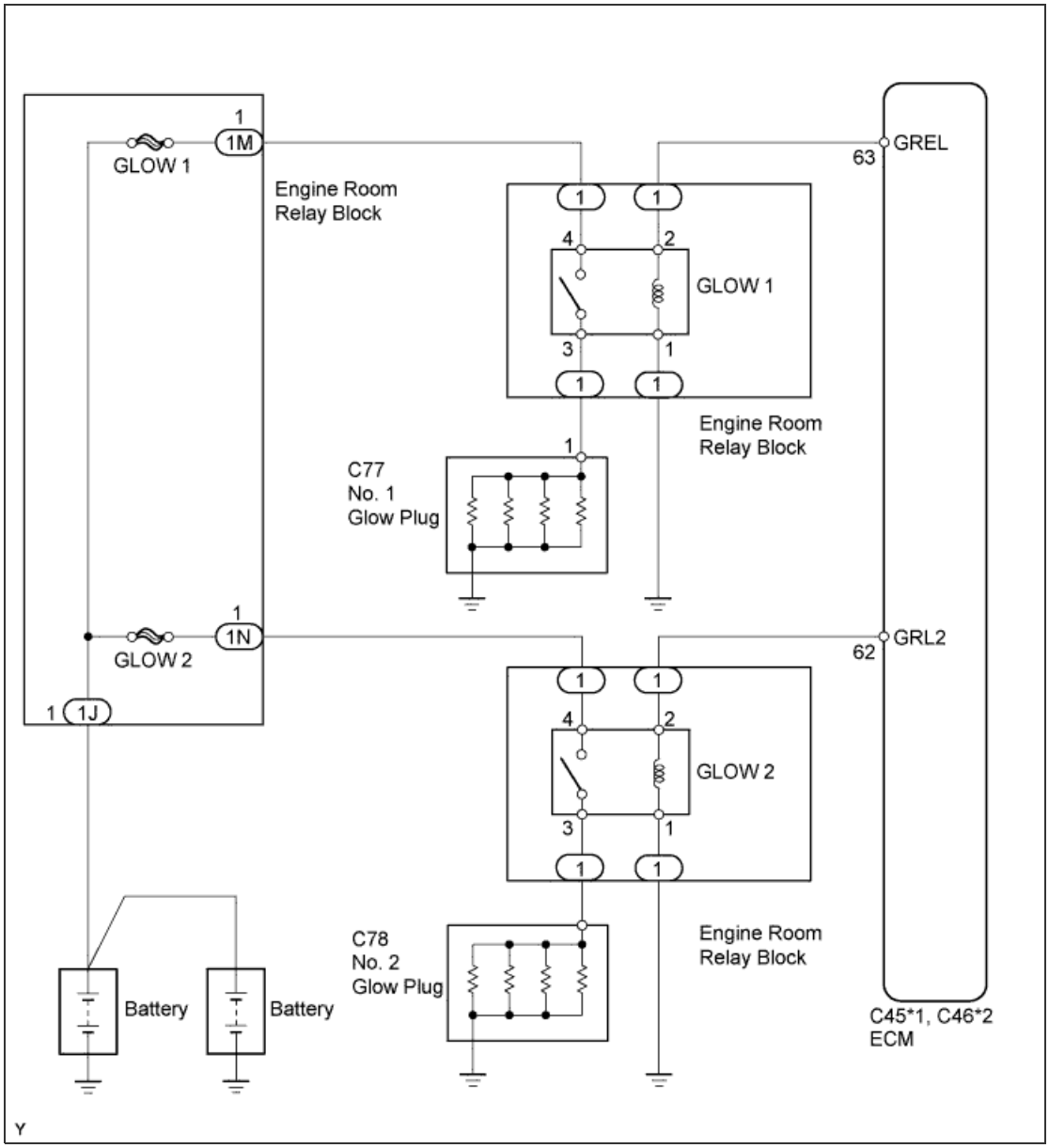


HINT:

- **These troubleshooting procedures are for: 1) difficult engine starting in cold weather, and 2) difficulty driving/vehicle malfunctions in cold weather immediately after engine is started.**
- **After the engine is started, the ECM performs an "after-glow" for a certain period of time. In proportion to the actual engine coolant temperature, the time period varies. The after-glow reduces diesel engine knocking, white smoke emissions and engine noises when the engine is cold.**



WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

1.CHECK ECM TERMINAL VOLTAGE (GREL TERMINAL)

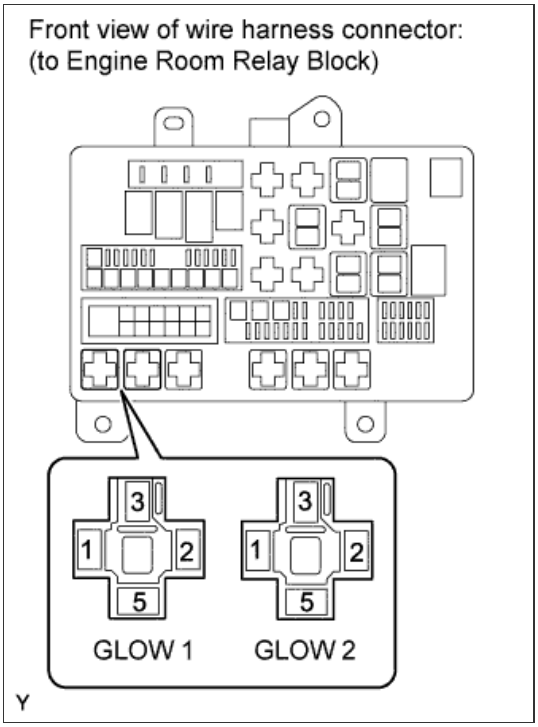
a. Remove the GLOW 1 relay from the engine room relay block.

b. Remove the GLOW 2 relay from the engine room relay block.

c. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
GLOW 1 relay (2) - Body ground	Ignition switch ON	11 to 14 V
GLOW 2 relay (2) - Body ground	Ignition switch ON	11 to 14 V



NG → Go to step 7

OK

2.INSPECT GLOW RELAY (GLOW 1 or 2)

a. Inspect the GLOW 1 relay (Click here).

b. Inspect the GLOW 2 relay (Click here).

NG → REPLACE GLOW RELAY (GLOW 1 or 2)

OK

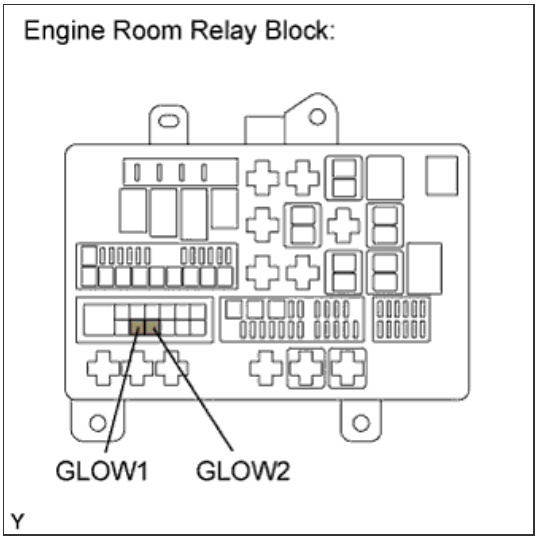
3.INSPECT FUSE (GLOW 1 and GLOW 2)

a. Remove the GLOW 1 and GLOW 2 fuses from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Component	Condition	Specified Condition
GLOW 1 H-fuse	Always	Below 1 Ω
GLOW 2 H-fuse	Always	Below 1 Ω



NG → CHECK FOR SHORT IN ALL HARNESSES AND COMPONENTS CONNECTED TO FUSE, AND REPLACE FUSE

OK

4.INSPECT GLOW PLUG ASSEMBLY (RESISTANCE)

a. Inspect the glow plug assembly (Click here).

NG → REPLACE GLOW PLUG ASSEMBLY (Click here)

OK

5.CHECK GLOW PLUG ASSEMBLY (INSTALLATION)

a. Check the glow plug installation (Click here).

OK:
Glow plugs are installed securely.

NG → TIGHTEN GLOW PLUG (Click here)

OK

6.CHECK HARNESS AND CONNECTOR (GLOW PLUG RELAY - GLOW PLUG - BATTERY AND BODY GROUND)

a. Remove the GLOW 1 relay from the engine room relay block.

b. Disconnect the C77 glow plug connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

No. 1

Tester Connection	Condition	Specified Condition
GLOW 1 relay (3) - C77-1	Always	Below 1 Ω
GLOW 1 relay (4) - Positive (+) battery terminal cable	Always	Below 1 Ω
GLOW 1 relay (1) - Body ground	Always	Below 1 Ω

d. Remove the GLOW 2 relay from the engine room relay block.

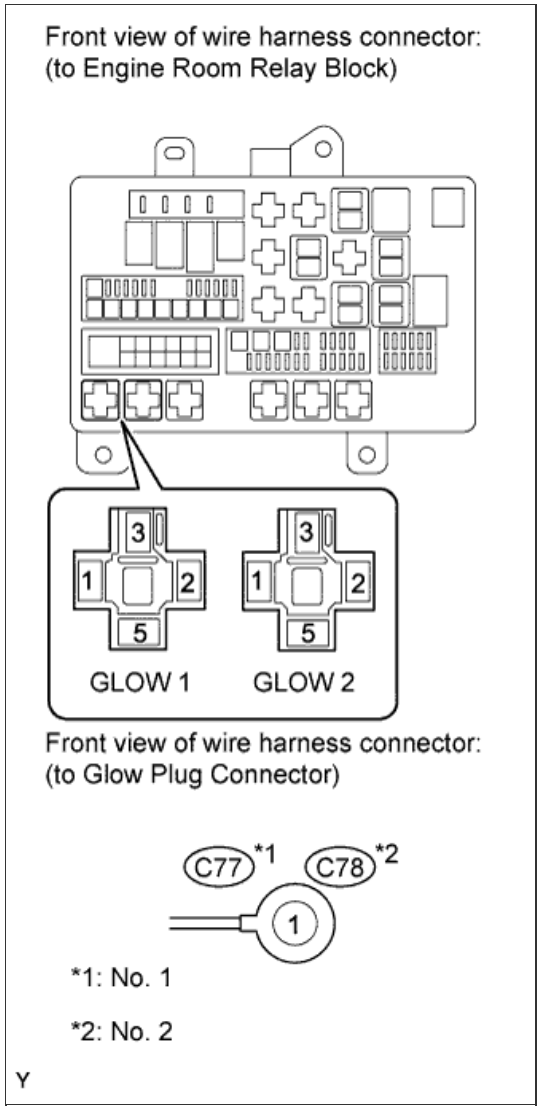
e. Disconnect the C78 glow plug connector.

f. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

No. 2

Tester Connection	Condition	Specified Condition
GLOW 2 relay (3) - C78-1	Always	Below 1 Ω
GLOW 2 relay (4) - Positive (+) battery terminal cable	Always	Below 1 Ω
GLOW 2 relay (1) - Body ground	Always	Below 1 Ω



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK FOR INTERMITTENT PROBLEMS (Click here)

7.CHECK HARNESS AND CONNECTOR (GLOW PLUG RELAY - ECM AND BODY GROUND)

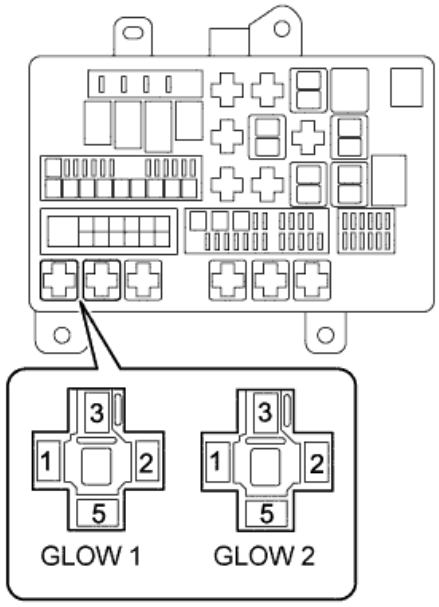
a. Remove the GLOW 1 relay from the engine room relay block.

b. Remove the GLOW 2 relay from the engine room relay block.

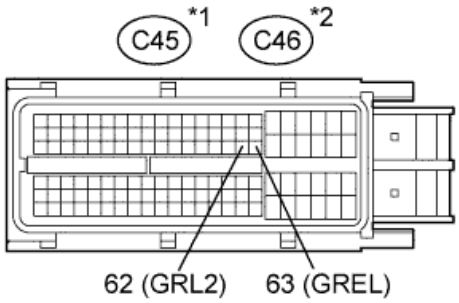
c. Disconnect the ECM connector.

d. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Engine Room Relay Block)



Front view of wire harness connector:
(to ECM)



*1: for LHD

*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
GLOW 1 relay (2) - C45-63 (GREL)	Always	Below 1 Ω
GLOW 2 relay (2) - C45-62 (GRL2)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
GLOW 1 relay (2) - C46-63 (GREL)	Always	Below 1 Ω

GLOW 2 relay (2) - C46-62 (GRL2)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
GLOW 1 relay (2) or C45-63 (GREL) - Body ground	Always	10 kΩ or higher
GLOW 2 relay (2) or C45-62 (GRL2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
GLOW 1 relay (2) or C46-63 (GREL) - Body ground	Always	10 kΩ or higher
GLOW 2 relay (2) or C46-62 (GRL2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (Click here)

for Preparation Click here

DESCRIPTION

Malfunction Condition	Main Trouble Area	Related Trouble Area
• Rough idling or shuddering due to abnormal combustion • Shuddering when starting vehicle due to clutch system malfunctions	1. Fuel injector malfunctions • Fuel injector sliding malfunction • Fuel injector stuck closed • Fuel injector stuck open • Deposit in fuel injector • Fuel injector circuit malfunction 2. Clutch system malfunctions • Clutch system (shuddering when starting)	• Fuel injector compensation code • Fuel leak • Engine mounting insulator • Intake air system leakage • Intake air system blockage • EGR system • Throttle valve system • Fuel supply pump • Low quality fuel • Vehicle modifications • Fuel filter air bleed problem • Accessory problem (A/C, generator, etc.) • ECM

HINT:

- **Rough idling and excessive engine vibrations are checked in this troubleshooting procedure.**
- **Specified values in the following troubleshooting flowchart are for reference only. Variations in the Data List result values may occur depending on the measuring conditions or the vehicle age. Do not judge the vehicle to be normal even when the Data List values indicate a standard level. There are possibly some concealed factors of the malfunction.**
- **Check that the vehicle has not been modified in any way prior to the vehicle inspection.**

INSPECTION PROCEDURE

NOTICE:

- **After replacing the fuel supply pump, the ECM needs initialization (Click here).**
- **After replacing the fuel injector, the ECM needs registration (Click here).**

HINT:

Before troubleshooting, conduct the following:

(a) Check the fuel quality.
(b) Check the fuel for air.
(c) Check the fuel system for blockages.
(d) Check the air filter.
(e) Check the engine oil.
(f) Check the engine coolant.
(g) Check the engine idling speed and the maximum engine speed.
(h) Check the vacuum pump.

1.CHECK MALFUNCTION CONDITION

a. Identify when shuddering occurs.

Result

Result	Proceed to
When idling	A
When engaging engine clutch at vehicle start	B (Clutch system shudders)

B → REPAIR OR REPLACE CLUTCH SYSTEM (Click here)

A

2.CHECK WIRE HARNESS AND CONNECTOR IN ENGINE COMPARTMENT

a. Check the wire harness and connector connections of common rail system components.

OK:

The wire harnesses and connectors are connected securely.

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.PERFORM CONFIRMATION DRIVING PATTERN

HINT:

Drive the vehicle according to the driving pattern below to allow the ECM to store DTCs relating to malfunctions of the fuel system, EGR system, and throttle valve. If DTCs are stored, problem areas can be identified.

a. Enter Check Mode (Click here).

b. Fully warm up the engine.

c. Allow the engine to idle for 5 minutes or more.

d. Drive the vehicle at more than 40 km/h (25 mph) for 1 minute or more (procedure "A").

e. Decelerate and stop the vehicle (procedure "B").

f. Repeat procedure "A" and procedure "B" 4 times or more.

g. Stop the engine and wait for at least 10 seconds (procedure "C").

h. Repeat procedure "A" and procedure "C" described above to store DTCs relating to the EGR system and throttle valve.

i. Drive the vehicle at more than 70 km/h (43 mph) for at least 1 minute (to store DTCs relating to the fuel supply pump).

NEXT

4.READ OUTPUT DTC (RELATING TO ENGINE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read pending DTCs.

Result

Result	Proceed to
No DTCs are output	A
Engine related DTCs are output	B

B → GO TO DTC CHART (**Click here**)

A

5.READ VALUE USING INTELLIGENT TESTER (INJECTION FEEDBACK VAL AND INJECTION VOLUME)

a. Connect the intelligent tester to the DLC3.

b. Start the engine, warm it up and turn the tester on.

c. Select the following menu items in order and read the values.

- Injection Feedback Val #1 to #8
- Injection Volume

Standard Value:

Item	Engine Speed*	Standard Range	Description
			Value of fuel injector injection

Injection Feedback Val #1 to #8	Idling	-3.0 to 3.0 mm^3/st	volume compensates for differences in combustion condition of cylinders • Positive values indicate control which corrects combustion degradation • Negative values indicate control which corrects excessive combustion pressure • If problems exist, "Injection Feedback Val" may deviate from the -3.0 to 3.0 mm^3/st range
Injection Volume	Idling	3.0 to 10 mm^3/st	Injection volume value controlled by ECU • Controls NE signal, fuel temperature, engine coolant temperature, intake air temperature, boost pressure, atmospheric pressure, EGR volume, and MAF • If problems exist, "Injection Volume" may be outside the standard range

Result

Result	Proceed to
Standard range	A
Injection Feedback Val #1 to #8 and/or Injection Volume outside standard range	B

HINT:

*: The A/C switch and all accessory switches should be off with a fully warm engine.

B → Go to step 13

A

6.CHECK FUEL INJECTOR COMPENSATION CODE

a. Read the fuel injector compensation code (Click here).

HINT:

If the fuel injector compensation code is not correctly registered, it may cause malfunctions.

b. Check the fuel injector compensation code.

OK:

Compensation code of the installed fuel injector is the same as the code registered in the ECM.

NG → PERFORM REGISTRATION OF FUEL INJECTOR COMPENSATION CODE (Click here)

OK

7.RESET ECM

a. Disconnect the cable from the negative (-) battery terminal for at least 2 minutes.

b. Reconnect the cable to the negative (-) battery terminal.

c. Check whether the malfunction has been successfully repaired by performing a driving test using the freeze frame data recorded at the time the malfunction occurred.

OK:
Malfunction has been repaired successfully.

NG → Go to step 8

OK ↓

CHECK FOR INTERMITTENT PROBLEMS (Click here)

8.BASIC INSPECTION

a. Check the fuel quality.

b. Check the fuel for air.

c. Check the fuel system for blockages.

d. Check the air filter.

e. Check the engine oil.

f. Check the engine coolant.

g. Check the engine idling speed and the maximum engine speed.

h. Check the vacuum pump.

OK:
Each inspection result is normal.

NG → REPAIR OR REPLACE MALFUNCTIONING PARTS

OK ↓

9.CHECK ENGINE MOUNTING INSULATOR

a. Visually check that the engine mounting insulator is installed correctly and is not crooked or twisted.

OK:
No abnormalities.

NG → REPAIR OR REPLACE ENGINE MOUNTING INSULATOR FRONT (Click here)

OK ↓

10.CHECK INTAKE SYSTEM

a. Check for air leakage and blockage between the air cleaner and turbocharger, and between the turbocharger and intake manifold.

OK:
No air leakage or blockage.

NG → REPAIR OR REPLACE MALFUNCTIONING PARTS

OK ↓

11.CHECK EGR VALVE ASSEMBLY (No. 1 AND No. 2)

HINT:

For vehicles without EGR valve, perform troubleshooting from the next step.

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Active Test / Control the EGR Step Position or Control the EGR Step Position #2 / Data List / Actual EGR Valve Pos. or Actual EGR Valve Pos. #2.

d. When changing the Active Test value from 0 to 100%, check that Actual EGR Valve Pos. or Actual EGR Valve Pos. #2 smoothly changes to the set opening angle.

OK:
Value smoothly changes to within +/-10% of set opening angle.

HINT:

- **EGR valve closed: Actual EGR Valve Pos. is 0%**
- **EGR valve open: Actual EGR Valve Pos. is 94.9%**

NG → REPLACE EGR VALVE ASSEMBLY (No. 1 and/or No. 2) (Click here)

OK

12.READ VALUE USING INTELLIGENT TESTER (ACTUAL THROTTLE POSITION)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Actual Throttle Position and Actual Throttle Position #2.

d. Read the value.

OK:
Ignition switch ON:
-5 to 5%
Idling (warmed up engine):
0 to 90%
Accelerator pedal fully depressed:
-5 to 5%

Result

Result	Proceed to
NG	A
OK	B

B → Go to step 15

A

REPLACE DIESEL THROTTLE BODY ASSEMBLY (for Bank 1 or Bank 2) (Click here)

13.IDENTIFY MALFUNCTIONING CYLINDER INJECTOR

a. Follow the instructions in the table below according to the check result of the intelligent tester.

HINT:

This operation is based on the premise that the common rail pressure is normal.

Standard Value:

Item	Engine Speed*	Reference Value

Injection Feedback Val #1 to #8	Idling	-3.0 to 3.0 mm^3/st
Injection Volume	Idling	3.0 to 10 mm^3/st

HINT:

*: The A/C switch and all accessory switches should be off, and the engine should be fully warmed up.

Result

Injection Feedback Val #1 to #8	Injection Volume	Proceed to
3.0 mm^3/st or more, -3.0 mm^3/st or less	Less than 3.0 mm^3/st	A
	Between 3.0 to 10 mm^3/st (Normal)	B
	More than 10 mm^3/st	B
Between -3.0 and 3.0 mm^3/st	Less than 3.0 mm^3/st	-
	Between 3.0 to 10 mm^3/st (Normal)	Normal
	More than 10 mm^3/st	C*

HINT:

*: When the Injection Volume displayed on the tester is large despite the Fuel Press and Injection Feedback Val #1 to #8 in the Data List being normal, the fuel injector may be clogged. In this case, there may be deposits inside or outside the tip of the fuel injector.

Proceed to	Inspection Area	Description
A	Inspect and repair cylinder fuel injector with revised injection volume of less than 3.0 mm^3: • Perform power balance inspection and identify malfunctioning cylinder • Replace malfunctioning cylinder fuel injector	Fuel injector of cylinder with abnormal value injects excessively large quantity of fuel
B	Identify malfunctioning cylinders by conducting power balance inspection: • Perform power balance inspection to identify malfunctioning cylinders • Clean malfunctioning cylinder fuel injector, then check and repair it	Fuel injector of cylinder with abnormal value injects excessively large quantity of fuel • Fuel injection volume too low due to fuel injector nozzle being blocked by deposits • Compression of cylinder with abnormal value decreases • Fuel injector of cylinder with abnormal value injects excessively large quantity of fuel
C	Inspect and repair all cylinder fuel injectors: Clean all cylinder fuel injectors, and then inspect and repair them	All cylinder fuel injectors inject excessively small quantity of fuel: Injection volume too low due to all cylinder fuel injector nozzles being blocked by deposits

HINT:

- **Despite the fuel injector functioning normally, the indicated Injection Feedback Val #1 to #8 value may be outside the normal operating range due to compensation for other problems (such as low compression).**
- **Injection Feedback Val #1 to #8 is the value used to correct the injection volumes of each cylinder, in order to optimize (compensate for the unevenness between) all the cylinder combustion conditions. If any of the cylinders malfunction, the injection volumes for the normal cylinders are corrected simultaneously. As a result, the Injection Feedback Val #1 to #8 may deviate from the standard range.**

B	Go to step 15
C	Go to step 20

A

14.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (FUEL CUT FOR IDENTIFYING MALFUNCTIONING CYLINDER)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Active Test / Control the Cylinder #1, #2, #3, #4, #5, #6, #7 and #8 Fuel Cut.

d. Check the 8 cylinders in sequence to identify any faulty cylinders by performing the power balance inspection.

HINT:

- **If the engine idle speed does not change when a fuel injector is disabled, the cylinder being tested is malfunctioning.**
- **If the cylinder being tested is normal, there will be a significant change in idle speed when the fuel injection is stopped for that cylinder.**

NEXT

REPLACE FUEL INJECTOR OF MALFUNCTIONING CYLINDER (Click here)

15.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (FUEL CUT FOR IDENTIFYING MALFUNCTION)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Active Test / Control the Cylinder #1, #2, #3, #4, #5, #6, #7 and #8 Fuel Cut.

d. Check the 8 cylinders in sequence to identify any faulty cylinders by performing the power balance inspection.

HINT:

- **If the engine idle speed does not change when a fuel injector is disabled, the cylinder being tested is malfunctioning.**
- **If the cylinder being tested is normal, there will be a significant change in idle speed when the fuel injection is stopped for that cylinder.**

NEXT

16.CHECK CYLINDER COMPRESSION PRESSURE

a. Check the cylinder compression pressure (Click here).

NG → **CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION**

OK

17.CHECK MALFUNCTIONING CYLINDER INJECTOR FOR DEPOSITS

HINT:

If a fuel injector is contaminated with deposits, the injection volume deviates from the standard range. This may cause malfunctions.

a. Check the fuel injector for any deposits.

Result

Result	Proceed to
Deposits	A
No deposits	B

B → **REPLACE FUEL INJECTOR OF MALFUNCTIONING CYLINDER (Click here)**

A

18.CLEAN FUEL INJECTOR

a. Wipe away deposits from the tips of the fuel injectors.

HINT:

Solvent or carbon removal agents help remove the deposits easily.

NOTICE:

Exercise extreme care not to damage the fuel injectors while wiping off the deposits.

NEXT

19.READ VALUE USING INTELLIGENT TESTER (INJECTION FEEDBACK VAL AND INJECTION VOLUME)

a. Reinstall the fuel injector to the cylinder head.

b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON and turn the tester on.

d. Start the engine and warm it up.

e. Enter the following menus: Powertrain / Engine / Data List.

f. Select the following menu items in order and read the values.

- Injection Feedback Val #1 to #8
- Injection Volume

Standard Value:

Item	Engine Speed*	Reference Value
Injection Feedback Val #1 to #8	Idling	-3.0 to 3.0 mm^3/st
Injection Volume	Idling	3.0 to 10 mm^3/st

HINT:

*: The A/C switch and all accessory switches should be off, and the engine should be fully warmed up. When the values are outside the standard range, deposits inside the fuel injector may be causing the problem.

OK:
Values are within the standard range.

NG → REPLACE FUEL INJECTOR OF MALFUNCTIONING CYLINDER (Click here)

OK

END

20.CHECK FUEL INJECTORS FOR DEPOSITS

HINT:

If a fuel injector is contaminated with deposits, the fuel injection volume deviates from the standard range. This may cause malfunctions.

a. Check the fuel injector for any deposits.

Result

Result	Proceed to
Deposits	A
No deposits	B

B → REPLACE FUEL INJECTOR OF MALFUNCTIONING CYLINDER (Click here)

A

21.CLEAN FUEL INJECTOR

a. Wipe away deposits from the tips of the fuel injectors.

HINT:

Solvent or carbon removal agents help remove the deposits easily.

NOTICE:

Exercise extreme care not to damage the fuel injectors while wiping off the deposits.

NEXT

22.READ VALUE USING INTELLIGENT TESTER (INJECTION FEEDBACK VAL AND INJECTION VOLUME)

a. Reinstall the fuel injector to the cylinder head.

b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON and turn the tester on.

d. Start the engine and warm it up.

e. Enter the following menus: Powertrain / Engine / Data List.

f. Select the following menu items in order and read the values.

- Injection Feedback Val #1 to #8
- Injection Volume

Standard Value:

Item	Engine Speed*	Reference Value
Injection Feedback Val #1 to #8	Idling	-3.0 to 3.0 mm^3/st
Injection Volume	Idling	3.0 to 10 mm^3/st

HINT:

*: The A/C switch and all accessory switches should be off, and the engine should be fully warmed up. When the values are outside the standard range, deposits inside the fuel injector may be causing the problem.

OK:

Values are within the standard range.

NG → **REPLACE FUEL INJECTOR OF MALFUNCTIONING CYLINDER (Click here)**

OK

END

for Preparation Click here

DESCRIPTION

Malfunction Condition	Main Trouble Area	Related Trouble Area
• Knocking and abnormal sound due to extremely rich combustion • Abnormal sound due to friction between parts	1. Fuel injector malfunctions • Fuel injector sliding malfunction • Fuel injector stuck closed • Fuel injector stuck open • Deposits in fuel injector • Fuel injector circuit malfunction 2. Abnormal common rail pressure • Fuel supply pump • Fuel pulsation sound • Air in fuel 3. Friction between parts 4. Compression pressure	• Fuel injector compensation codes • Fuel leakage • Intake air system leakage • Intake air system blockage • EGR system • Throttle valve system • Fuel pressure sensor • Manifold absolute pressure sensor • Atmospheric pressure sensor (built into ECM) • Vehicle modifications • Low quality fuel • Lack of fuel • ECM

HINT:

- **Specified values in the following troubleshooting flowchart are for reference only. Variations in the Data List values may occur depending on the measuring conditions or the vehicle's age. Do not judge the vehicle to be normal even when the Data List values indicate a standard level. There are possibly some concealed factors of the malfunction.**
- **Check that the vehicle has not been modified in any way prior to the vehicle inspection.**

INSPECTION PROCEDURE

NOTICE:

- **After replacing the fuel supply pump, the ECM needs initialization (Click here).**
- **After replacing a fuel injector, the ECM needs registration (Click here).**

HINT:

- **This troubleshooting procedure checks for knocking and rattling.**
- **Knocking is most likely to occur while the engine is idling.**

1.CHECK SOUND AREA

a. Find the source of the abnormal sound using a mechanic's stethoscope.

Result

Result	Proceed to
Sound from fuel supply pump	A
Sound from parts other than fuel supply pump	B

B → REPAIR OR REPLACE MALFUNCTIONING PARTS

A

2.CHECK HARNESS AND CONNECTOR IN ENGINE COMPARTMENT

a. Check the wire harness connections.

OK:
Wire harnesses are connected securely.

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3.PERFORM CONFIRMATION DRIVING PATTERN

HINT:

Drive the vehicle according to the driving pattern below to allow the ECM to store DTCs relating to malfunctions of the fuel system, EGR system and throttle valve. If DTCs are stored, problem areas can be identified.

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter Check Mode (Click here).

d. Fully warm up the engine.

e. Allow the engine to idle for 5 minutes or more.

f. Drive the vehicle at more than 40 km/h (25 mph) for 1 minute or more (procedure "A").

g. Decelerate and stop the vehicle (procedure "B").

h. Repeat procedure "A" and procedure "B" 4 times or more.

i. Stop the engine and wait for at least 10 seconds (procedure "C").

j. Repeat procedure "A" and procedure "C" described above to store DTCs relating to the EGR system and throttle valve.

k. Drive the vehicle at more than 70 km/h (43 mph) for at least 1 minute (to store DTCs relating to the fuel supply pump).

NEXT

4.READ OUTPUT DTC (RELATING TO ENGINE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read pending DTCs.

Result

Result	Proceed to
No DTCs are output	A
Engine related DTCs are output	B

B → GO TO DTC CHART (**Click here**)

A

5.READ VALUE USING INTELLIGENT TESTER (INJECTION FEEDBACK VAL AND INJECTION VOLUME)

a. Connect the intelligent tester to the DLC3.

b. Start the engine, warm it up, and turn the tester on.

c. Select the following menu items in order and read the values.

- Injection Feedback Val #1 to #8
- Injection Volume

Standard Value:

Item	Engine Speed*	Standard Range	Description
			Value of fuel injector injection volume compensates for differences in combustion condition of cylinders

Injection Feedback Val #1 to #8	Idling	-3.0 to 3.0 mm^3/st	• Positive values indicate control which corrects combustion degradation • Negative values indicate control which corrects excessive combustion pressure • If problems exist, Injection Feedback Val may deviate from the -3.0 to 3.0 mm^3/st range
Injection Volume	Idling	3.0 to 10 mm^3/st	Fuel injection volume value controlled by ECU • Controls NE signal, fuel temperature, engine coolant temperature, intake air temperature, boost pressure, atmospheric pressure, EGR volume, and MAF • If problems exist, Injection Volume may be outside standard range

Result

Result	Proceed to
Standard range	A
Injection Feedback Val #1 to #8 and/or Injection Volume outside standard range	B

HINT:

*: The A/C switch and all accessory switches should be off, and the engine should be fully warmed up.

B → **Go to step 18**

A

6.CHECK FUEL INJECTOR COMPENSATION CODE

a. Read the fuel injector compensation code (Click here).

HINT:

If the fuel injector compensation code is not correctly registered, it may cause malfunctions (Click here).

b. Check the fuel injector compensation code.

OK:

Compensation code of the installed fuel injector is the same as the code registered in the ECM.

NG → REGISTER FUEL INJECTOR COMPENSATION CODE (**Click here**)

OK

7.RESET ECM

a. Disconnect the cable from the negative (-) battery terminal for at least 2 minutes.

b. Reconnect the cable to the negative (-) battery terminal.

c. Check whether the malfunction has been successfully repaired by performing a driving test using the freeze frame data recorded at the time the malfunction occurred.

OK:
Malfunction has been repaired successfully.

NG → Go to step 8

OK ↓

CHECK FOR INTERMITTENT PROBLEMS (Click here)

8.BASIC INSPECTION

a. Check the fuel quality.

b. Check the fuel for air.

c. Check the fuel system for blockages.

d. Check the air filter.

e. Check the engine oil.

f. Check the engine coolant.

g. Check the engine idling speed and the maximum engine speed.

h. Check the vacuum pump.

OK:
Each inspection result is normal.

NG → REPAIR OR REPLACE MALFUNCTIONING PARTS

OK ↓

9.CHECK INTAKE SYSTEM

a. Check for air leakage and blockage between the air cleaner and turbocharger, and between the turbocharger and intake manifold.

OK:
No air leakage or blockage.

NG → REPAIR OR REPLACE MALFUNCTIONING PARTS

OK ↓

10.CHECK EGR VALVE ASSEMBLY (No. 1 or No. 2)

HINT:

For vehicles without EGR valve, perform troubleshooting from the next step.

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Active Test / Control the EGR Step Position or Control the EGR Step Position #2 / Data List / Actual EGR Valve Pos. or Actual EGR Valve Pos. #2.

d. When changing the Active Test value from 0 to 100%, check that Actual EGR Valve Pos. or Actual EGR Valve Pos. #2 smoothly changes to the set opening angle.

OK:
Value smoothly changes to within +/-10% of set opening angle.

HINT:

- **EGR valve closed: Actual EGR Valve Pos. is 0%**
- **EGR valve open: Actual EGR Valve Pos. is 94.9%**

NG → REPLACE EGR VALVE ASSEMBLY (for No. 1 or No. 2) (Click here)

OK

11.READ VALUE USING INTELLIGENT TESTER (ACTUAL THROTTLE POSITION)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Actual Throttle Position and Actual Throttle Position #2.

d. Read the value.

OK:
Ignition switch ON:
-5 to 5%
Idling (Warmed up engine):
0 to 90%
Accelerator pedal fully depressed:
-5 to 5%

NG → REPLACE DIESEL THROTTLE BODY ASSEMBLY (for Bank 1 or Bank 2) (Click here)

OK

12.CHECK COMBUSTION SOUND

a. Confirm type of sound emitted.

Result

Result	Proceed to
Knocking	A
Mechanical sound other than knocking	B

B → Go to step 23

A

13.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (FUEL CUT FOR IDENTIFYING MALFUNCTION)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Active Test / Control the Cylinder #1, #2, #3, #4, #5, #6, #7 and #8 Fuel Cut.

d. Check the 8 cylinders in sequence to identify any faulty cylinders by performing the power balance inspection.

HINT:

- **While the engine is idling, if the idling stability variation is small despite cutting off the fuel injection, the cylinder is malfunctioning.**
- **With normal cylinders, the engine idles roughly when the fuel injection is cut off.**

NEXT

14.CHECK CYLINDER COMPRESSION PRESSURE

a. Check the cylinder compression pressure (Click here).

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

15.CHECK MALFUNCTIONING CYLINDER FUEL INJECTOR FOR DEPOSITS

HINT:

If a fuel injector is contaminated with deposits, the injection volume deviates from the standard range. This may cause malfunctions.

a. Check the fuel injector for any deposits.

Result

Result	Proceed to
Deposits	A
No deposits	B

B → REPLACE FUEL INJECTOR OF MALFUNCTIONING CYLINDER (Click here)

A

16.CLEAN FUEL INJECTOR

a. Wipe away deposits from the tips of the fuel injectors.

HINT:

Solvent or carbon removal agents help remove the deposits easily.

NOTICE:

Exercise extreme care not to damage the fuel injectors while wiping off the deposits.

NEXT

17.READ VALUE USING INTELLIGENT TESTER (INJECTION FEEDBACK VAL AND INJECTION VOLUME)

a. Reinstall the fuel injector to the cylinder head.

b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON and turn the tester on.

d. Start the engine and warm it up.

e. Enter the following menus: Powertrain / Engine / Data List.

f. Select the following menu items in order and read the values.

- Injection Feedback Val #1 to #8
- Injection Volume

Standard Value:

Item	Engine Speed*	Reference Value
Injection Feedback Val #1 to #8	Idling	-3.0 to 3.0 mm^3/st
Injection Volume	Idling	3.0 to 10 mm^3/st

HINT:

- ***: The A/C switch and all accessory switches should be off, and the engine should be fully warmed up.**
- **When the values are outside the standard range, deposits inside the fuel injector may be causing the problem.**

OK:

Values are within the standard range.

NG → REPLACE FUEL INJECTOR OF MALFUNCTIONING CYLINDER (Click here)

OK → END

18.IDENTIFY MALFUNCTIONING CYLINDER FUEL INJECTOR

a. Follow the instructions in the table below according to the check result of the intelligent tester.

HINT:

This operation is based on the premise that the common rail pressure is normal.

Standard Value:

Item	Engine Speed*	Reference Value
Injection Feedback Val #1 to #8	Idling	-3.0 to 3.0 mm^3/st
Injection Volume	Idling	3.0 to 10 mm^3/st

HINT:

*: The A/C switch and all accessory switches should be off, and the engine should be fully warmed up.

Result

Injection Feedback Val #1 to #8	Injection Volume	Proceed to
3.0 mm^3/st or more, -3.0 mm^3/st or less	Less than 3.0 mm^3/st	A
	Between 3.0 and 10 mm^3/st (Normal)	B
	More than 10 mm^3/st	B
Between -3.0 and 3.0 mm^3/st	Less than 3.0 mm^3/st	-
	Between 3.0 and 10 mm^3/st (Normal)	Normal
	More than 10 mm^3/st	C*

HINT:

*: When the Injection Volume displayed on the tester is large despite the Fuel Press and Injection Feedback Val #1 to #8 in the Data List being normal, the fuel injector may be clogged. In this case, there may be deposits inside or outside the tip of the fuel injector.

Proceed to	Inspection Area	Description
A	Inspect and repair cylinder fuel injector with revised injection volume of less than 3.0 mm^3: • Perform power balance inspection and identify malfunctioning cylinder • Replace malfunctioning cylinder fuel injector	Fuel injector of cylinder with abnormal value injects excessively large quantity of fuel
B	Identify malfunctioning cylinders by conducting power balance inspection: • Perform power balance inspection to identify malfunctioning cylinders • Clean malfunctioning cylinder fuel injector, then check and repair it	Fuel injector of cylinder with abnormal value injects excessively large quantity of fuel • Injection volume too low due to fuel injector nozzle being blocked by deposits • Compression of cylinder with abnormal value decreases • Fuel injector of cylinder with abnormal value injects excessively large quantity of fuel
C	Inspect and repair all cylinder fuel injectors: Clean all cylinder fuel injectors, and then inspect and repair them	All cylinder fuel injectors inject excessively small quantity of fuel: Injection volume too low due to all cylinder fuel injector nozzles being blocked by deposits

HINT:

- **Despite the fuel injector functioning normally, the indicated Injection Feedback Val #1 to #8 value may be outside the normal operating range due to compensation for other problems (such as low compression).**
- **Injection Feedback Val #1 to #8 is the value used to correct the injection volumes of each cylinder, in order to optimize (compensate for the unevenness between) all the cylinder combustion conditions. If any of the cylinders malfunction, the injection volumes for the normal cylinders are corrected simultaneously. As a result, the Injection Feedback Val #1 to #8 may deviate from the standard range.**

B	Go to step 15
C	Go to step 20

A

19.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (FUEL CUT FOR IDENTIFYING MALFUNCTIONING CYLINDER)

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Active Test / Control the Cylinder #1, #2, #3, #4, #5, #6, #7 and #8 Fuel Cut.

d. Check the 8 cylinders in sequence to identify any faulty cylinders by performing the power balance inspection.

HINT:

- **If the engine idle speed does not change when a fuel injector is disabled, the cylinder being tested is malfunctioning.**
- **If the cylinder being tested is normal, there will be a significant change in idle speed when the fuel injection is stopped for that cylinder.**

NEXT

REPLACE FUEL INJECTOR OF MALFUNCTIONING CYLINDER (Click here)

20.CHECK FUEL INJECTORS FOR DEPOSITS

HINT:

If a fuel injector is contaminated with deposits, the injection volume deviates from the standard range. This may cause malfunctions.

a. Check the fuel injector for any deposits.

Result

Result	Proceed to
Deposits	A
No Deposits	B

B	REPLACE FUEL INJECTOR OF MALFUNCTIONING CYLINDER (Click here)

A

21.CLEAN FUEL INJECTOR

a. Wipe away deposits from the tips of the fuel injectors.

HINT:

Solvent or carbon removal agents help remove the deposits easily.

NOTICE:

Exercise extreme care not to damage the fuel injectors while wiping off the deposits.

NEXT

22.READ VALUE USING INTELLIGENT TESTER (INJECTION FEEDBACK VAL AND INJECTION VOLUME)

a. Reinstall the fuel injector to the cylinder head.

b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON and turn the tester on.

d. Start the engine and warm it up.

e. Enter the following menus: Powertrain / Engine / Data List.

f. Select the following menu items in order and read the values displayed on the tester respectively.

- Injection Feedback Val #1 to #8
- Injection Volume

Standard Value:

Item	Engine Speed*	Reference Value
Injection Feedback Val #1 to #8	Idling	-3.0 to 3.0 mm^3/st
Injection Volume	Idling	3.0 to 10 mm^3/st

HINT:

- ***: The A/C switch and all accessory switches should be off, and the engine should be fully warmed up.**
- **When the values are outside the standard range, deposits inside the fuel injector may be causing the problem.**

OK:
Values are within the standard range.

NG → REPLACE FUEL INJECTOR OF MALFUNCTIONING CYLINDER (Click here)

OK → END

23.CHECK SOUND AREA

a. Find the source of the abnormal sound using a mechanic's stethoscope.

Result

Result	Proceed to
Sound from fuel supply pump	A
Sound from parts other than fuel supply pump	B

B → REPAIR OR REPLACE MALFUNCTIONING PARTS

A

24.BLEED AIR FROM FUEL SYSTEM

a. To bleed air from the priming pump, pump the priming pump until it becomes hard and cannot be pumped any more.

NEXT

25.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Check whether the knocking has been successfully repaired by performing a driving test.

OK:
Malfunction has been repaired successfully.


NEXT
END

for Preparation Click here

DESCRIPTION

Description

Malfunction Condition	Main Trouble Area	Related Trouble Area
• Lack of power caused by abnormal injection volume (fuel supply pump malfunction or fuel injector malfunction etc.) • Lack of power caused by intake air volume shortage (turbocharger malfunction, front exhaust pipe or exhaust manifold converter blocked)	1. Fuel injector malfunctions • Fuel injector sliding malfunction • Fuel injector stuck closed • Fuel injector stuck open • Deposits in fuel injector 2. Abnormal common rail pressure • Fuel supply pump 3. Abnormal intake air volume • Turbocharger sub-assembly • Front exhaust pipe blockage • Exhaust manifold converter blockage • Diesel throttle does not open • EGR valve does not close 4. Shift position switch malfunction	• Intake air system leakage • Intake air system blockage • Fuel filter element is clogged • Fuel is not supplied to supply pump • Fuel injector compensation code • Mass air flow meter • Manifold absolute pressure sensor • Vehicle modifications • Glow (Poor acceleration when engine is cold) • Low quality fuel • Shift position switch • ECM

HINT:

- **Specified values in the following troubleshooting flowchart are for reference only. Variations in the Data List values may occur depending on the measuring conditions or the vehicle age. Do not judge the vehicle to be normal even when the Data List values indicate a standard level. There are possibly some concealed factors of the malfunction.**
- **Check that the vehicle has not been modified in any way prior to the vehicle inspection.**
- **This troubleshooting procedure checks for the cause of an obvious lack of engine power (e.g. the vehicle speed does not reach the target speed in the high speed range) while the vehicle is being driven.**

Faults and Symptoms of Common Rail Diesel Components

a. Engine Control

Mass Air Flow Meter

Component	Mass air flow meter
Main fault	Decrease in performance (foreign matter is stuck)
Symptoms	Lack of power, black smoke
Data List	MAF
HINT: The maximum fuel injection volume is controlled according to the output from the mass air flow meter.	

Intake System

Component	Intake system

Symptom: Main fault	• Lack of power (No black smoke): Air filter blockage, Air duct is crushed/leaking • Black smoke (No lack of power): Leakage between the turbo and the intake manifold
Data List	• MAP (inside intake air pressure) • Target Booster Pressure When the accelerator is fully depressed, if the MAP is 20 kPa lower than Target Booster Pressure for more than 5 seconds then a lack of power will be felt.

Turbocharger System

Component	Turbocharger system
Main fault	• Air leak in the turbocharged air passage • Turbo motor driver not operating well • Turbocharger (turbine, bearing)
Symptoms	Lack of power (when vehicle starting, when heavy load) (Black smoke is not emitted when racing while vehicle stopped)
Data List	MAP (inside intake air pressure), Target Booster Pressure • When the accelerator is fully depressed, if MAP is 20 kPa lower than Target Booster Pressure for more than 5 seconds then a lack of power will be felt. • With the ignition switch ON or idling, MAP = Atmospheric Pressure (standard atmospheric pressure = 101 kPa). When the engine speed is about 1500 rpm or more, the turbocharger starts to take effect and the MAP becomes higher than atmospheric pressure. • Atmospheric pressure increases 1 kPa each time altitude increases by 100 m, and is also affected by the current weather conditions. VN Turbo Command • Using the Active Test "Test the Turbo Charger Step Motor", check the drive rod movement. • Check the drive rod movement when the ignition switch is turned from ON to off.
Diagnostic Point	• Use Active Test of Test the Turbo Charger Step Motor, check the drive rod's movement. • Check the drive rod's movement when turning the ignition switch off from idling.

Exhaust System

Component	Exhaust system
Main fault	Blockage
Symptoms	Lack of power (high engine speed, when heavy load)
Data List	MAP (inside intake air pressure), Target Booster Pressure When the accelerator is fully depressed, if the MAP is 20 kPa lower than Target Booster Pressure for more than 5 seconds then a lack of power will be felt.

Glow System

Component	Glow system
Main fault	Open circuit, glow plug relay fault
Symptoms	Difficult to start, rough idle, knocking, white smoke (when cold)
Data List	Check the glow plug indicator light
Diagnostic Point	Try to measure the resistance of the glow plug

Engine - 1

Component	Engine
Main fault	Damaged, Seized up
Symptoms	Cannot crank, crank speed is low, strange noise

Engine - 2

Component	Engine
Main fault	Loss of compression
Symptoms	Rough idle (lack of power always)
Data List	Engine Speed of Cyl# • When cranking during the "Check the Cylinder Compression" Active Test, if there is a high speed cylinder, approx. 100 rpm more than the other cylinders, that cylinder loose compression. Injection Feedback Val

	• If Injection Feedback Val is more than 3 mm ^{3}/st, the cylinder may have a fault.

b. Diesel Injection

Fuel Supply Pump

Component	Fuel supply pump
Main fault	-
Symptoms	Difficult to start, engine stalling, rough idle, lack of power
Data List	Fuel Press, Target Common Rail Pressure, Target Pump SCV Current • At a stable condition (e.g. Idling), Fuel Press is within +/-5000 kPa of "Target Common Rail Pressure". • If the fuel pressure is 20000 kPa below the target pressure then a lack of power will be felt. • If the fuel pressure is below 25000 kPa then idling will be rough. • If Target Pump SCV Current is 3000 mA or more, the suction control valve may be stuck. **HINT:** • **The fuel pressure changes at engine starting, but is approx. 25000 kPa at engine start after the engine is warmed up.** • **When Target Pump SCV Current is 3000 mA or more, the suction control valve has a tendency to become stuck.**
Diagnostic Trouble Code	Even if Fuel Press is less than Target Common Rail Pressure, a DTC will not be stored.

Fuel Filter

Component	Fuel filter
Main fault	Blockage
Symptoms	Difficult to start, engine stalling, rough idle, lack of power
Data List	Fuel Press, Target Common Rail Pressure • At a stable condition (e.g. Idling), the fuel pressure is within +/-5000 kPa of "Target Common Rail Pressure ". • If the fuel pressure is 20000 kPa below the target pressure then a lack of power will be felt. • If the fuel pressure is below 25000 kPa then idling will be rough. **HINT:** The fuel pressure changes at engine starting, but is approx. 25 MPa at engine start after the engine is warmed up.
Diagnostic Trouble Code	Even if Fuel Press is less than Target Common Rail Pressure, a DTC will not be stored.

Fuel Injector

Component	Fuel injector
Main fault	Blockage
Symptoms	Rough idle, lack of power, black smoke, white smoke, knocking
Data List	Injection Feedback Val • When an Injection Feedback Val is more than 3 mm ^{3}/st, the cylinder is not normal. This can be read after idling for 1 minute with the engine warmed up (engine coolant temperature is more than 70°C (158°F)).

Pressure Limiter

Component	Pressure limiter
Main fault	Does not completely close
Symptoms	Difficult to start, engine stall, rough idle, lack of power

Injector Driver (EDU)

Component	Injector Driver (EDU)
Main fault	Circuit fault: The fuel injector does not open.
Symptoms	Difficult to start, rough idle, lack of power, black smoke, white smoke, knocking
Data List	Same as fuel injector
Diagnostic Trouble Code	When the EDU has a fault, some DTCs may be storedr.

Fuel Pressure Sensor

Component	Fuel pressure sensor
Main fault	Open circuit, decrease in performance (foreign matter is stuck)
Symptoms	Difficult to start, rough idle, engine stall, lack of power
Data List	Fuel Press, Target Common Rail Pressure • At a stable condition (e.g. Idling), Fuel Press is within +/-5000 kPa of "Target Common Rail Pressure".
Diagnostic Code	When the fuel pressure sensor has a fault, some DTCs may be stored.

Irregular Fuel

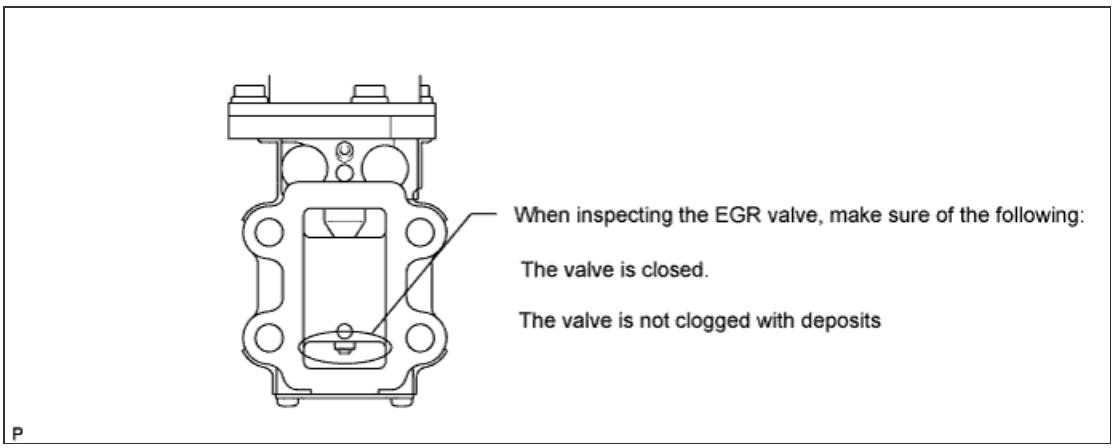
Component	Irregular fuel
Main fault	-
Symptoms	Difficult to start, rough idle (especially when cold)

c. Diesel EGR

EGR System

Component	EGR system
Main fault	• Does not move smoothly • Does not close fully
Symptoms	• Rough Idle • EGR valve stuck closed: A loud turbocharger sound. • EGR valve stuck open: Difficult to start (does not stall), black smoke, lack of power, jerking (If there is an excess in the quantity of EGR and there is a heavy load, when the vehicle starts moving, a lack of power will be felt. Also, when racing the engine, there will be some black smoke).
Data List	Actual EGR Valve Pos., Target EGR Pos. • Generally, Actual EGR Valve Pos. = Target EGR Pos. +/-5% (fully closed 0%, fully open 100%) • Using EGR valve Active Test, check whether Actual EGR Valve Pos. follows Target EGR Pos. (The engine coolant temperature and intake air temperature should be considered when a malfunction occurs). • EGR valve is fully closed when the ignition switch is ON (engine stopped). • EGR valve opens to a halfway point at idling after engine warmed up. • When the EGR valve does not close, MAF (Mass Air Flow) decreases when the vehicle is accelerated at full throttle. MAP also decreases in comparison to Target Booster Pressure, however there is not a large difference. EGR Close Lrn. Val., EGR Close Lrn. Status • In cases when EGR Close Lrn. Status. is NG or EGR Close Lrn. Val. is out of the normal range (3.5 to 4.5 V), it is possible that the EGR valve cannot completely close.

Inspect EGR valve assembly



d. Diesel Throttle

Diesel Throttle System

Component	Diesel throttle system
Main fault	Stuck, does not move smoothly
Symptoms	• Stuck closed: Lack of power, difficult to start, rough idle, engine stall, black smoke. It may occur when stuck almost fully closed. • Stuck open: Turbocharger sound increases. When the engine is stopped, engine vibrations may occur.
Data List	• Actual Throttle Position (fully closed 100%, fully open 0%) • Throttle Motor Duty Normally operates at 50 +/-20%. If outside the range of 50 +/-40% for a few seconds, the throttle may not be sliding properly. 0%: Open diesel throttle 100%: Close diesel throttle • When ignition switch is ON (engine stopped), diesel throttle is fully open. When idling, diesel throttle is at halfway point. When ignition switch is turned ON to off, temporarily closed fully.

Data List Related to Lack of Power

NOTICE:

The Data List values in the table are the results of checking one vehicle after warmed up. Only use these values for reference.

a. Engine Control

Engine Speed

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
Engine Speed	• Idling: 500 to 600 rpm (M/T) • Idling: 550 to 650 rpm (A/T)	Crankshaft position sensor	When the crankshaft position sensor is malfunctioning, "Engine Speed" is approximately 0 or varies greatly from the actual engine speed.

MAP

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
MAP	MAP (inside intake air pressure) • When the accelerator is fully depressed, if MAP is 20 kPa lower than Target Booster Pressure for more than 5 seconds, a lack of power will be felt. • With the ignition switch ON or vehicle idling, MAP is nearly equal to Atmospheric Pressure (standard atmospheric pressure = 101 kPa). Atmospheric pressure increases 1 kPa each time altitude increases by 100 m, and is also affected by the current weather conditions). When the engine speed is about 1500 rpm or more, the turbocharger starts to take effect and MAP becomes higher than atmospheric pressure. The Data List item "Atmosphere Pressure" displays the output of the atmospheric pressure sensor. VN Turbo Command • 0%: Fully open vanes (drive rod contracts) • Over 90%: Fully closed vanes (drive rod expands)	• Turbocharger fault • Diesel throttle does not open • Intake system blocked • Exhaust system blocked	• Inspect while comparing with "Target Booster Pressure". • With the accelerator fully open, if the actual Manifold Absolute Pressure (MAP) is low compared to the target booster pressure by at least 20 kPa for 5 seconds or more, a feeling of insufficient power will occur.
	Results of real-vehicle check: • Ignition switch ON: 99 kPa • Cranking: 99 kPa • Idling (warm up the engine): 99 kPa (2 minutes after starting the vehicle) • Running without load (2500 rpm): 113 kPa • Running without load (4000 rpm): 150 kPa • Driving with the accelerator fully open at 2000 rpm: 143 kPa • Driving with the accelerator fully open at 3000 rpm: 209 kPa		

MAF

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note

MAF	-	• MAF meter
		• MAF meter circuit
		• Intake system clogging, leaking
		• Exhaust system clogging
		• Turbocharger sub-assembly
		• Leaking or clogging of turbocharger passages
		• EGR valve does not close
			• Based on MAF, the ECM controls the fuel injection volume, injection timing, EGR, etc.
			• If the value is always approximately 0 g/sec.:
			  • Mass air flow meter power source circuit is open.
			  • VG circuit is open or shorted.
			• If the value is always 200 g/sec. or more:
			  • EVG circuit is open.

	Results of real-vehicle check: w/ EGR • Ignition switch ON: 1.54 g/sec. • Cranking: 15 g/sec. • Idling (warm up the engine): 9 g/sec. (2 minutes after starting the vehicle) • Running without load (2500 rpm): 80 g/sec. • Driving with the accelerator fully open at 2000 rpm: 110 g/sec. • Driving with the accelerator fully open at 3000 rpm: 230 g/sec.		
	HINT: The maximum fuel injection volume is controlled according to the output from the mass air flow meter.		

Intake Air

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
Intake Air	After a long soak, the engine coolant temperature, intake air temperature, and ambient air temperature are approximately equal.	Intake air temperature sensor	• If the value is -40°C (-40°F) or 140°C (284°F), the sensor circuit is open or shorted.
	-		

Coolant Temp

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
Coolant Temp	• Engine coolant temperature is approximately equal to intake air temperature after leaving overnight. After warm-up: Engine coolant temperature is 70°C (158°F) or more. • In cases when the engine coolant temperature sensor output is obviously higher than the actual engine coolant temperature, when it is cold, there will be difficulty starting due to problems with glow plugs or insufficient fuel injection. • In cases when the engine coolant temperature sensor output is obviously lower than the actual engine coolant temperature, when it is warm, there will be difficulty starting (black smoke will also occur) due to an excess of injected fuel.	Engine coolant temperature sensor	If the value is -40°C (-40°F) or 140°C (284°F), the sensor circuit is open or shorted.
	-		

b. Diesel Injection

Target Common Rail Pressure

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
	-	-	• Inspect the (actual) fuel pressure, comparing it against the common rail target value. • Considered normal when the actual fuel pressure is within +/-5000 kPa of the target fuel pressure under stable conditions.

Target Common Rail Pressure	Results of real-vehicle check: • Ignition switch ON: 32000 kPa • Cranking: 29000 kPa • Idling (warm up the engine): 32000 kPa (2 minutes after starting the vehicle) • Running without load (2500 rpm): 62000 kPa • Running without load (3500 rpm): 80200 kPa • Driving with the accelerator fully open at 2000 rpm: 95000 kPa • Driving with the accelerator fully open at 3000 rpm: 155000 kPa

Fuel Press

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
Fuel Press	• In a stable operating condition (e.g. idling), Fuel Press is Target Common Rail Pressure +/-5000 kPa. • When the Fuel Press is 20000 kPa lower than Target Common Rail Pressure, a lack of power will be felt. • When Fuel Press is lower than 25000 kP, rough idling will occur.	• If there is a the fuel supply pump (lack of discharge quantity) or pressure limiter (will not fully close) breakdown, the fuel pressure will drop. Also, a blocked fuel filter, leakage from fuel pipes, and an empty fuel tank will also make the fuel pressure drop. • When there is a fault with the fuel supply pump, there is a possibility of lack of power, starting trouble, engine stall, rough idle, etc.	• Fuel Press is the actual common rail fuel pressure. • Inspect by comparing the fuel pressure with Target Fuel Pressure. • The ECM uses Fuel Press for feedback control of Target Fuel Pressure via the supply pump. The injection amount is determined based on the injection timing and fuel pressure. Also, the spray pattern is selected based on the fuel pressure.
	Results of real-vehicle check: • Ignition switch ON: 0 kPa • Cranking: 29000 kPa • Idling (warm up the engine): 32000 kPa • Running without load (2500 rpm): 62000 kPa • Driving with the accelerator fully open at 2000 rpm: 92000 kPa • Driving with the accelerator fully open at 3000 rpm: 155000 kPa		

Target Pump SCV Current

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
Target Pump SCV Current	• Idling after warming up, around 923 to 1123 mA. When this value is large, the fuel supply pump is trying to increase the fuel discharge rate. • If the value becomes 3000 mA or more, the suction control valve	With this data, component fault not specified, use this data as a reference	• ECU-calculated value for the suction control valve actuation target current. • Value is large when a high fuel pressure is desired. • When this deviates from the standard value, it indicates that for some reason, even though the pump is running hard, the actual fuel pressure is

	may become stuck.		inconsistent with the target fuel pressure.
	Results of real-vehicle check: • Ignition switch ON: 0 mA • Cranking: 1200 mA • Running without load (2500 rpm): 1300 mA • Driving with the accelerator fully open at 2000 rpm: 1440 mA • Driving with the accelerator fully open at 3000 rpm: 1560 mA		

Injection Feedback Val #1 (to #8)

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
Injection Feedback Val #1 (to #8)	Injection Feedback Val: • When idling after the engine is warmed up, to make each cylinder engine speed equal, the fuel quantity of each fuel injector is corrected. • Cylinders more than 3 mm^3/st may have a fault. **HINT:** Read the value after one minute of idling after warm up (engine coolant temperature above 70°C (158°F)). This value is only calculated when idling.	• "Breakdown of injector or lack of compression" of a cylinder with an irregular Injection Feedback Val # value. • Do a compression Active Test. If there is a cylinder that is around 100 rpm more than the other cylinders, there is a possibility that that cylinder has a fault. • If all the cylinder speeds are even according to the compression Active Test result, then consider the injector of the cylinder that has a fault. • With fuel injector faults, there is a possibility of rough idling, lack of power, difficulty starting, black smoke, white smoke and knocking.	With Injection Feedback Val, find the malfunctioning cylinders. However, before replacing the injector, identify the malfunctioning cylinders with a power balance test.
	-		

Injection Volume

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
Injection Volume	• Diagnose the fuel injector faults from the Injection Feedback Val #, Injection Volume at idling. • When Injection Volume is more than 10 mm^3/st at idle with the engine warmed up and Injection Feedback Val # of all cylinders is less than 2.0 mm^3/st, the following malfunctions are possible: - All cylinder fuel injectors are slightly blocked. - Fuel filter is blocked. - Poor quality fuel, increase in engine friction.	All cylinders	-
	Results of real-vehicle check: • Cranking: 21 mm^3/st • Idling (warm up the engine): 6 mm^3/st • Running without load (2500 rpm): 9 mm^3/st • Running without load (4700 rpm): 16 mm^3/st • Driving with the accelerator fully open at 2000 rpm: 50 mm^3/st • Driving with the accelerator fully open at 3000 rpm: 70 mm^3/st		

c. Diesel Throttle

Actual Throttle Position, Actual Throttle Position #2

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
			Actual Throttle Position is the closing percentage of the throttle valve.

Actual Throttle Position Actual Throttle Position #2	• When the ignition switch is turned to ON (engine stopped), the diesel throttle is fully open, when the ignition switch is turned from ON to off, it will be fully closed temporarily. • During idling, the throttle is open partway. • When stuck closed (almost fully closed), there is a possibility of lack of power, rough idling, engine stall, and black smoke.	Throttle valve	• Fully closed: 100% • Fully open: 0% **HINT:** There is no connection with the accelerator. However, under full load, the throttle is usually fully open (0%).
	Results of real-vehicle check: • Ignition switch ON: 0% • Cranking: 0% • Idling (warm up the engine): 84% • Running without load (2500 rpm): 32% • Driving with the accelerator fully open at 2000 rpm: 0% • Driving with the accelerator fully open at 3000 rpm: 0%		

Throttle Motor Duty #1, Throttle Motor Duty #2

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
Throttle Motor Duty #1 Throttle Motor Duty #2	Normally operates at 50 +/-20%. If 50 +/-40% continues for a few seconds, it is conceivable that the throttle valve is not sliding properly and the MIL will be illuminated. 0%: Drive diesel throttle to open side 100%: Drive diesel throttle to closed side	• Throttle valve • ECM	• When this value is large but the actual opening angle does not move smoothly, there is an unable to close malfunction. • If this value is small but the actual opening angle does not move smoothly, there is an unable to open malfunction. • Usually this value is at approx. 50 +/-20%, but momentary jumps outside this range do occur.
	Results of real-vehicle check: • Ignition switch ON: 61.5% • Cranking: 63% • Idling (warm up the engine): 37% • Running without load (2500 rpm): 53% • Driving with the accelerator fully open at 2000 rpm: 62.5% • Driving with the accelerator fully open at 3000 rpm: 64%		

d. Diesel EGR

Target EGR Valve Pos., Target EGR Valve Pos. #2

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
Target EGR Valve Pos. Target EGR Valve Pos. #2	-	-	• Fully open: 100% • Fully closed: 0% • Used for comparison to "Actual EGR Valve Pos".
	Results of real-vehicle check: • Ignition switch ON: 0% • Cranking: 0% • Idling (warm up the engine): 43% • Running without load (2500 rpm): 22% • Driving with the accelerator fully open at 2000 rpm: 0% • Driving with the accelerator fully open at 3000 rpm: 0%		

Actual EGR Valve Pos., Actual EGR Valve Pos. #2

Data List	Judgment of Data List Values	Faulty Component	Diagnosis Note
	Generally Actual EGR Valve Pos. = Target EGR Pos. +/-5% (completely closed = 0%, completely open = 100%) The EGR valve Active Test can be used to check whether the Actual EGR Valve Pos. = Target EGR Pos. (Take into consideration the temperature of the intake air and the coolant temperature when the malfunction occurs). Sometimes the malfunction only occurs around a certain	EGR valve	Inspect while comparing to "Target EGR Valve Pos.".

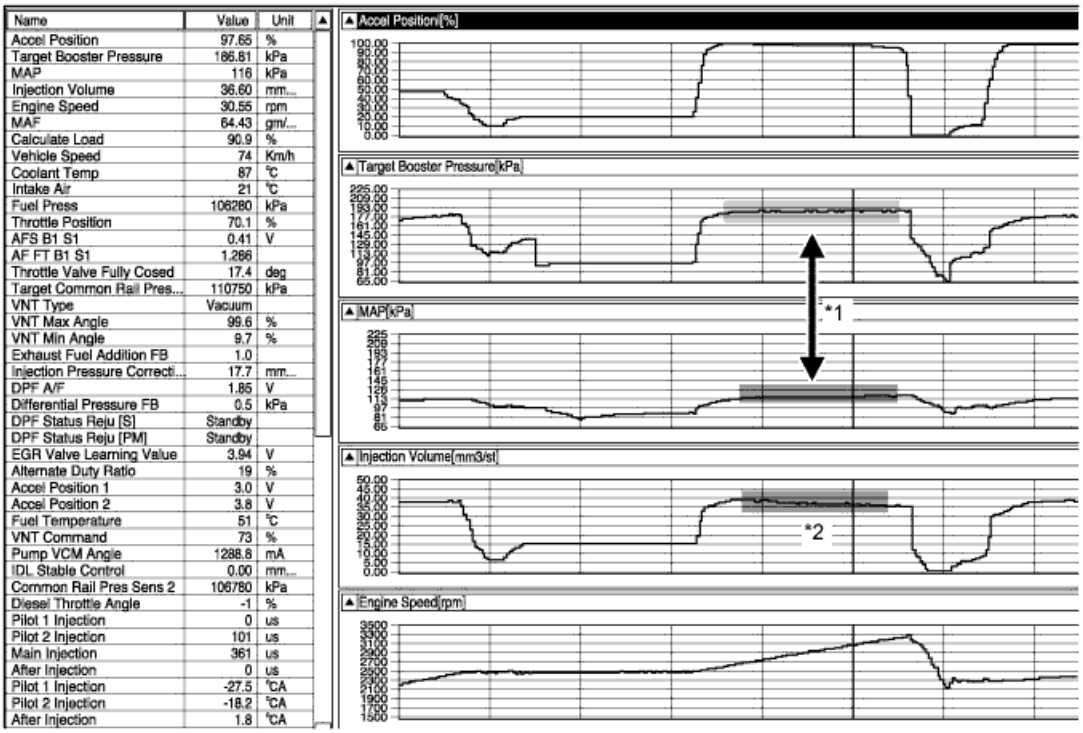
Actual EGR Valve Pos. Actual EGR Valve Pos. #2	temperature. Take into consideration the temperature of the intake air and the coolant temperature when the malfunction occurs.		
	Results of real-vehicle check: • Ignition switch ON: 0% • Cranking: 0% • Idling (warm up the engine): 84% • Running without load (2500 rpm): 34% • Driving with the accelerator fully open at 2000 rpm: 0% • Driving with the accelerator fully open at 3000 rpm: 0%		

Actual Examples of Malfunction

HINT:

- **The purpose of the following examples is to help you to understand the relationship between each data list item when a certain malfunction occurs. Understanding this relationship helps you to find the real root cause easier.**
- **The following are examples of actual malfunctions of a common rail diesel engine.**
- **Use them for reference when diagnosing malfunctions.**
- **These are not data of the Land Cruiser 1VD-FTV**

a. Lack of power caused by overly low boost pressure



Name	Value	Unit
Accel Position	97.65	%
Target Booster Pressure	186.81	kPa
MAP	116	kPa
Injection Volume	36.60	mm...
Engine Speed	30.55	rpm
MAF	64.43	gm/...
Calculate Load	90.9	%
Vehicle Speed	74	Km/h
Coolant Temp	87	°C
Intake Air	21	°C
Fuel Press	106280	kPa
Throttle Position	70.1	%
AFS B1 S1	0.41	V
AF FT B1 S1	1.266	
Throttle Valve Fully Cosed	17.4	deg
Target Common Rail Pres...	110750	kPa
VNT Type	Vacuum	
VNT Max Angle	99.6	%
VNT Min Angle	9.7	%
Exhaust Fuel Addition FB	1.0	
Injection Pressure Correcti...	17.7	mm...
DPF A/F	1.85	V
Differential Pressure FB	0.5	kPa
DPF Status Reju [S]	Standby	
DPF Status Reju [PM]	Standby	
EGR Valve Learning Value	3.94	V
Alternate Duty Ratio	19	%
Accel Position 1	3.0	V
Accel Position 2	3.8	V
Fuel Temperature	51	°C
VNT Command	73	%
Pump VCM Angle	1288.8	mA
IDL Stable Control	0.00	mm...
Common Rail Pres Sens 2	106780	kPa
Diesel Throttle Angle	-1	%
Pilot 1 Injection	0	us
Pilot 2 Injection	101	us
Main Injection	361	us
After Injection	0	us
Pilot 1 Injection	-27.5	°CA
Pilot 2 Injection	-18.2	°CA
After Injection	1.8	°CA

HINT:

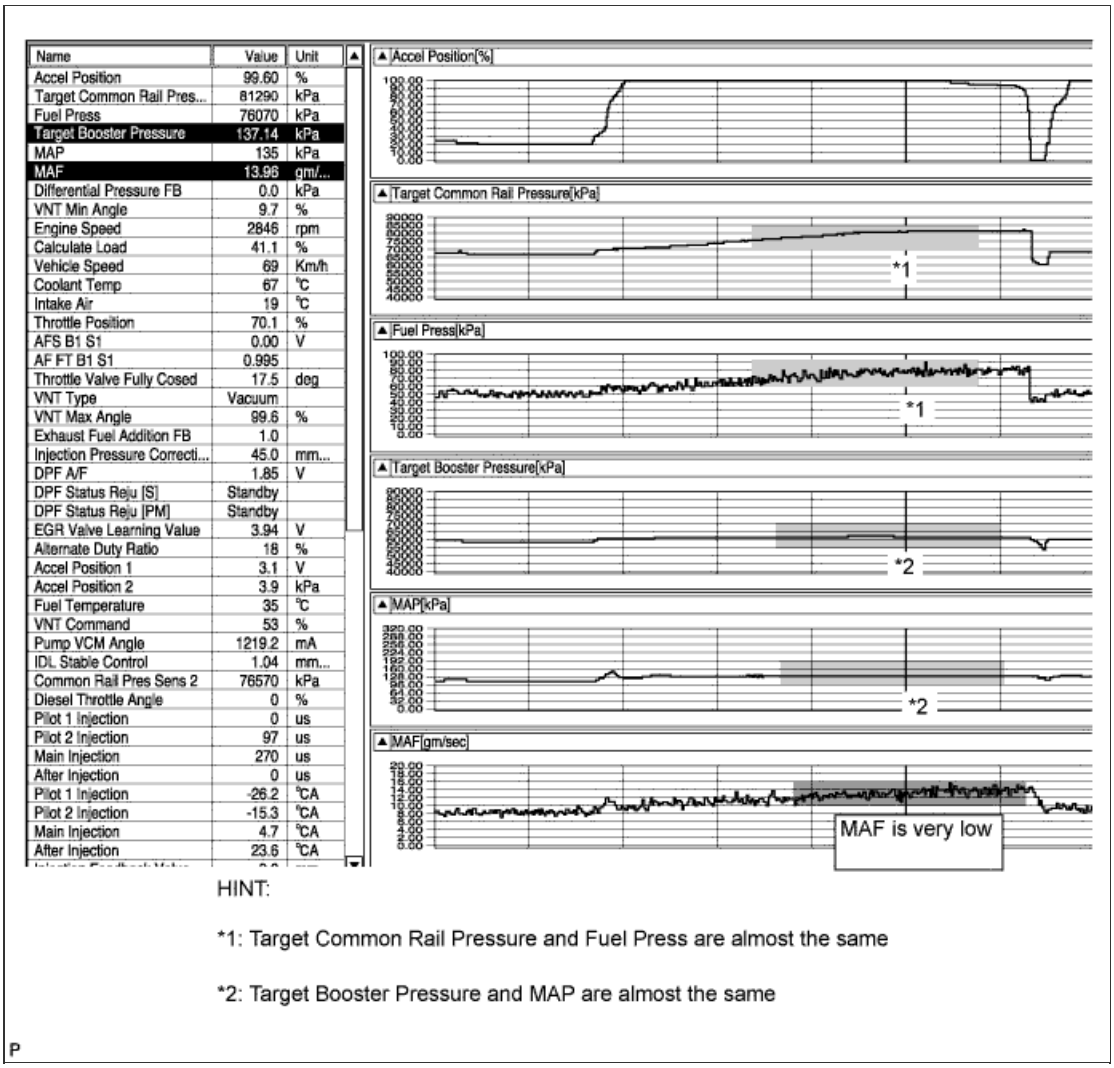
*1: -70 kPa difference

*2: Injection Volume greatly reduced

By observing the difference between MAP and Target Booster Pressure, the lack of power due to a decrease in mass air flow can be seen. A decrease in mass air flow occurs due to a turbo malfunction, clogging or leaking in the intake system pipes and hoses, or clogging in the exhaust system. (In this example, the hose of the variable nozzle assembly of the turbo is disconnected).

P

b. Lack of power caused by overly low MAF

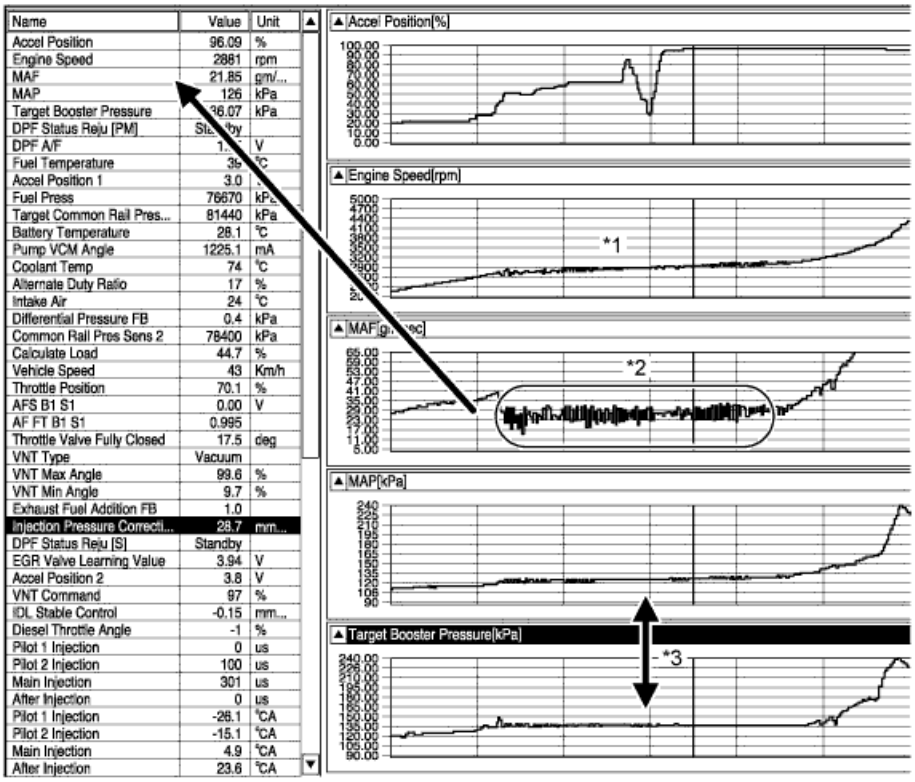


In this example, the MAF (Mass Air Flow) value decreases greatly due to foreign matter being stuck to the MAF sensor and causes a lack of power. The maximum fuel injection volume value is limited by the MAF value. As a result, there is a lack of power due to a lack of injection volume.

In this case, even when the accelerator is fully open, the calculated load is low. (Calculated Load = Injection Volume / Maximum Injection Volume at Current Engine Speed)

Basically the Manifold Absolute Pressure (MAP) is approximately equal to the Target Booster Pressure and this indicates that the turbo charger functions properly.

c. EGR valve stuck in open position



HINT:

*1: Severe jerking *2: Very unstable and low MAF signal

*3: Signal difference (-10 kPa)

P

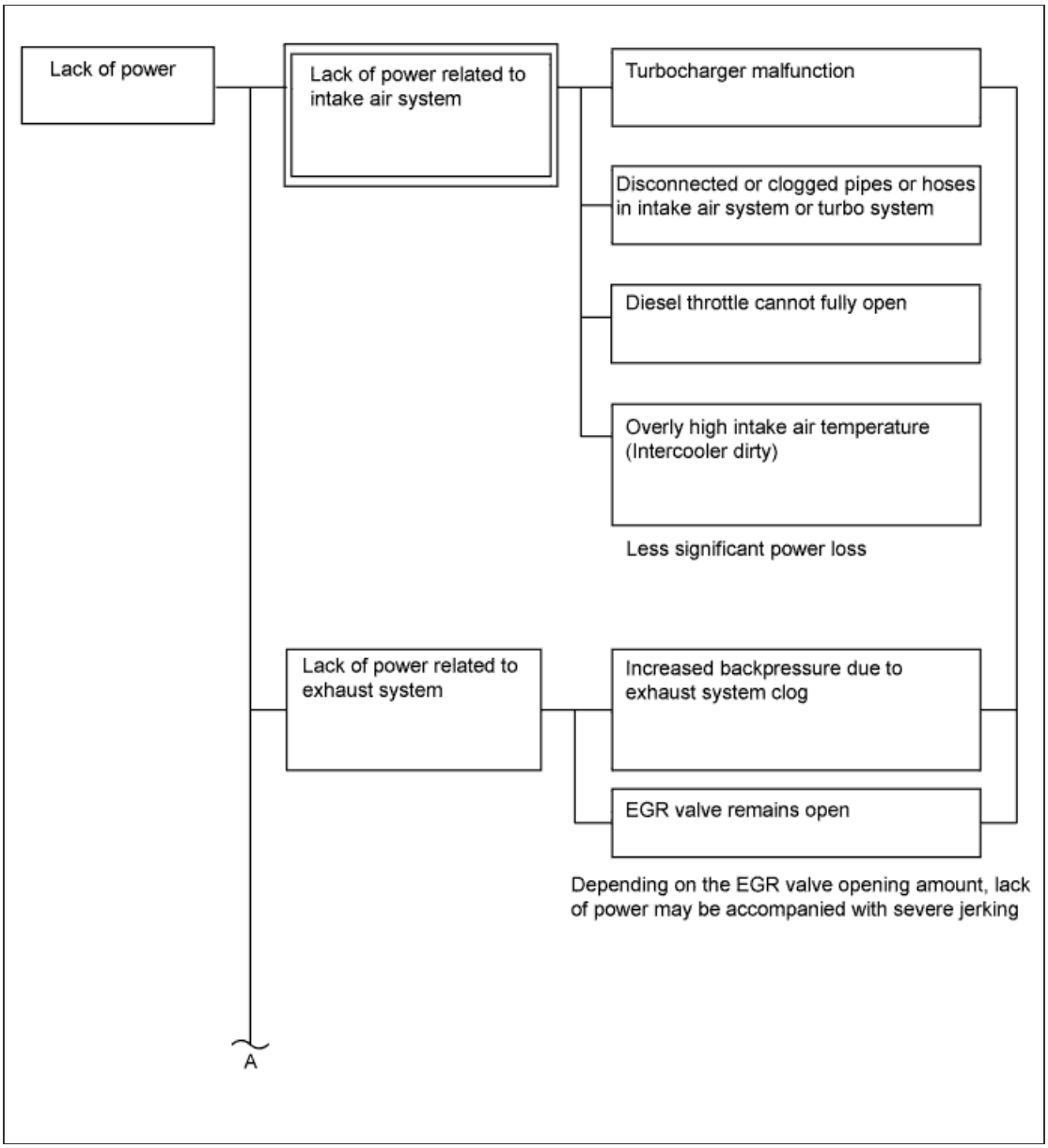
In this example, the EGR valve stuck in open position. Even with the accelerator pedal fully depressed, the EGR does not fully closed and the MAF signal is low.
Therefore, the fuel injection volume becomes limited and there is a lack of power. Jerking is also evident. At this time, even while accelerating with the accelerator fully open, the calculated load is low. (Calculated Load = Current Injection Volume / Maximum Injection Volume at Current Engine Speed)
Basically the Manifold Absolute Pressure (MAP) is approximately equal to the Target Booster Pressure and this indicates that the turbo charger functions properly.

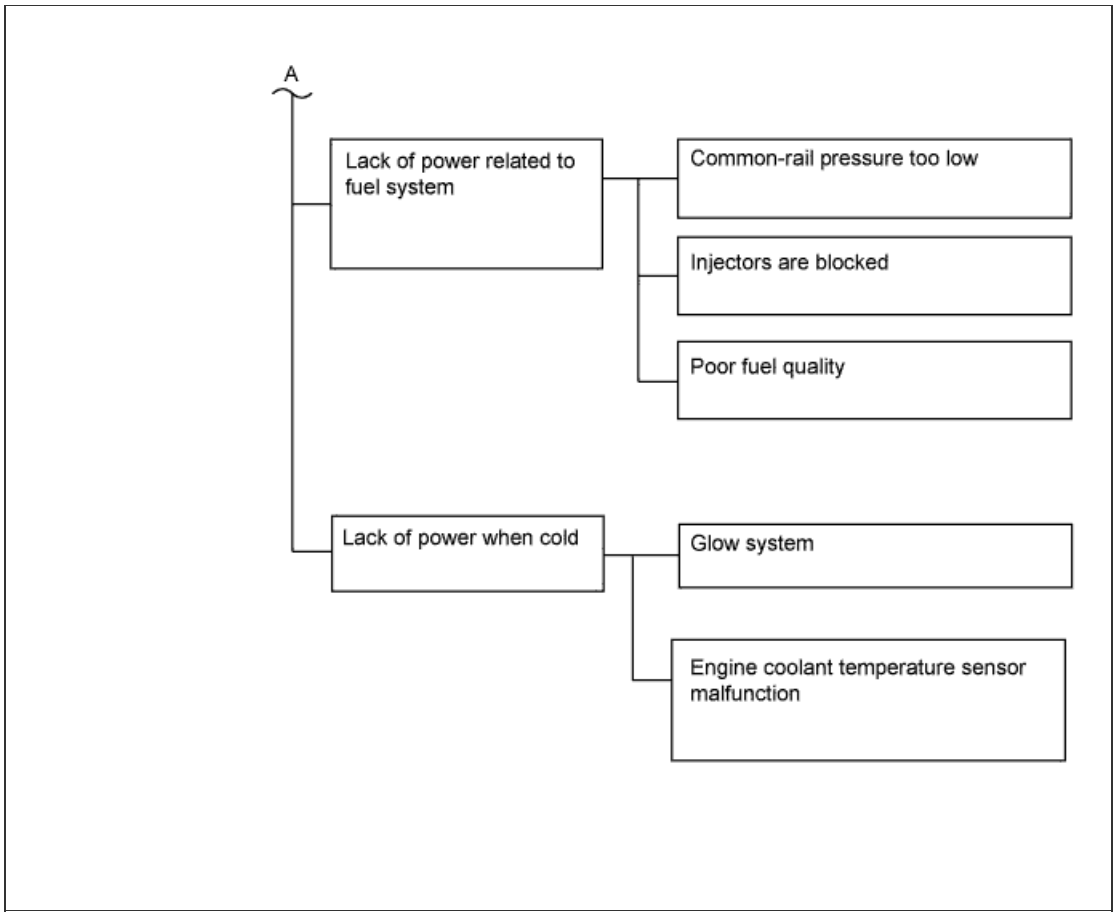
INSPECTION PROCEDURE

Explanation of Symptom

Lack of Power	The power of the diesel engine is determined by the quantity of injected fuel and the quantity of intake air. The quantity of injected fuel is determined by the fuel pressure and the amount of time the injector is open for. Basically, the fuel pressure is controlled to reach the target fuel pressure. The throttle valve does not restrict air flow volume, so the manifold absolute pressure is almost the same as atmospheric pressure when idling. At more than approximately 1500 rpm, the turbo starts to operate causing the manifold absolute pressure to become higher than atmospheric pressure. The manifold absolute pressure is controlled to reach the Target Booster Pressure. Also, When accelerating the vehicle at full throttle, the throttle is fully open and the EGR valve is fully closed, preserving the mass air flow.

Trouble Area Chart According to Problem Cause


Lack of power
Lack of power related to intake air system
Turbocharger malfunction
Disconnected or clogged pipes or hoses in intake air system or turbo system
Diesel throttle cannot fully open
Overly high intake air temperature (Intercooler dirty)
Less significant power loss
Lack of power related to exhaust system
Increased backpressure due to exhaust system clog
EGR valve remains open
Depending on the EGR valve opening amount, lack of power may be accompanied with severe jerking
A



NOTICE:

- **After replacing the fuel supply pump, the ECM needs initialization (Click here).**
- **After replacing the fuel injector, the ECM needs registration (Click here).**

HINT:

Before troubleshooting, conduct the following:

1. **Check the fuel quality.**
2. **Check the fuel for air.**
3. **Check the fuel system for blockages.**
4. **Check the air filter.**
5. **Check the engine oil.**
6. **Check the engine coolant.**
7. **Check the engine idling speed and the maximum engine speed.**

1.READ OUTPUT DTC (RELATED TO ENGINE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read pending DTCs.

Result

Result	Proceed to
No DTCs are output	A
Engine related DTCs are output	B

B → **GO TO DTC CHART (Click here)**

A

2.READ VALUE USING INTELLIGENT TESTER

HINT:

This inspection is not necessary for A/T vehicles.

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Low Gear Switch.

d. Check the Data List when the shift lever is moved to 1 or any position other than 1.

OK

Data List	Shift Position	Specified Condition
Low Gear Switch	1	ON
Low Gear Switch	Not in 1	OFF

NG → REPLACE SHIFT POSITION SWITCH (Click here)

OK

3.TAKE DATA LIST DURING LACK OF POWER

a. Connect the intelligent tester to the DLC3.

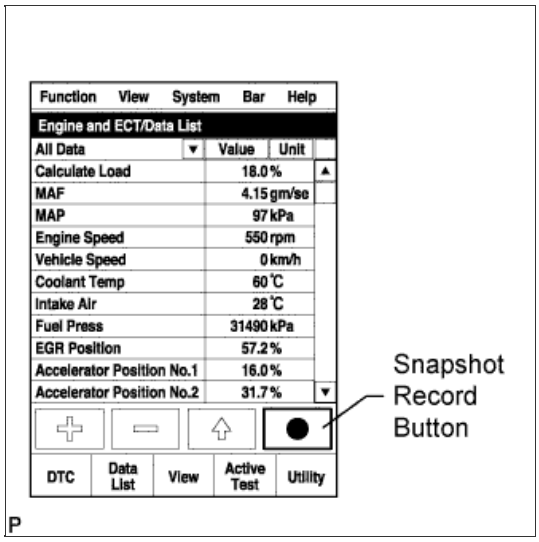
b. Start the engine and turn the tester on.

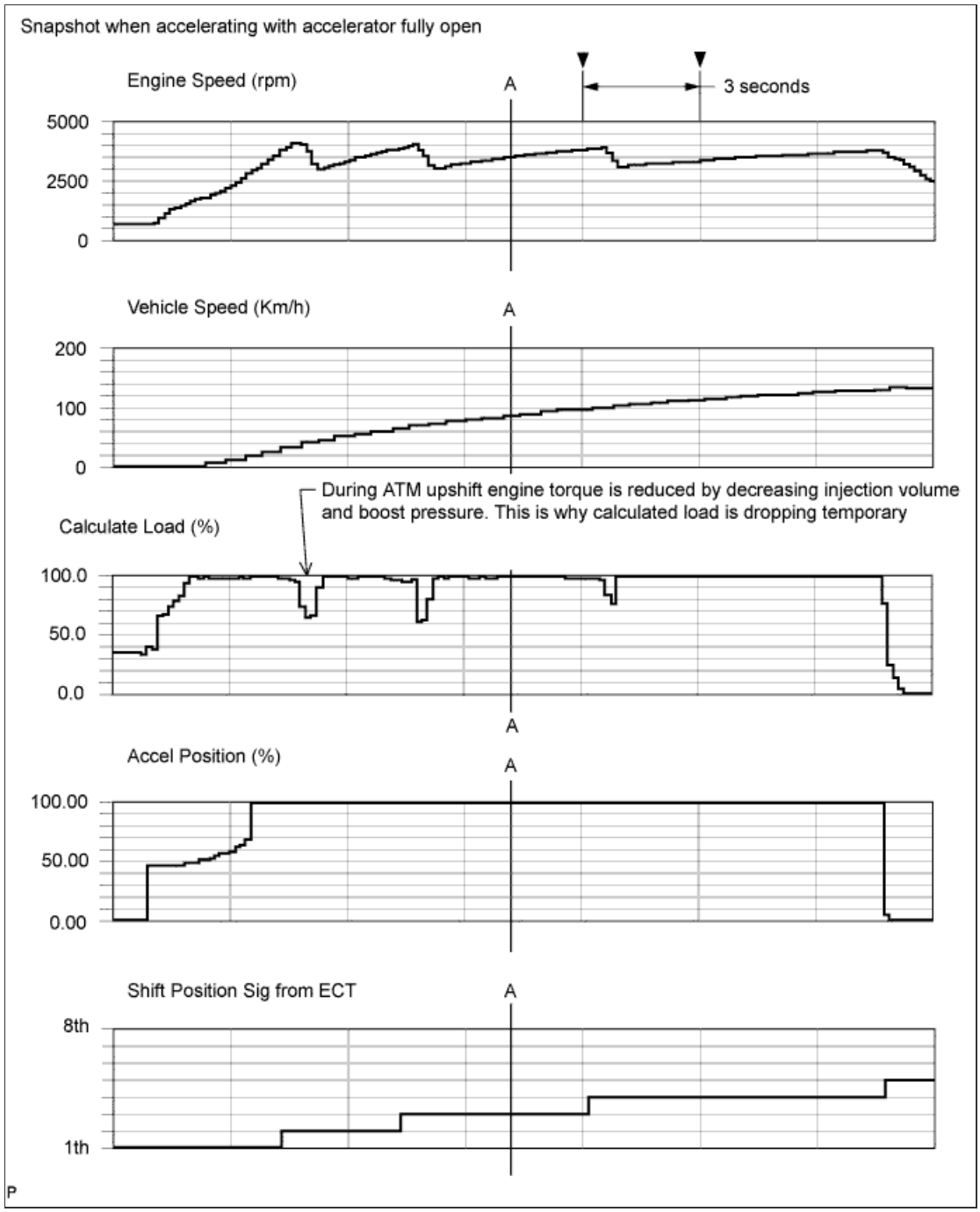
c. Enter the following menus: Powertrain / Engine / Data List / All Data.

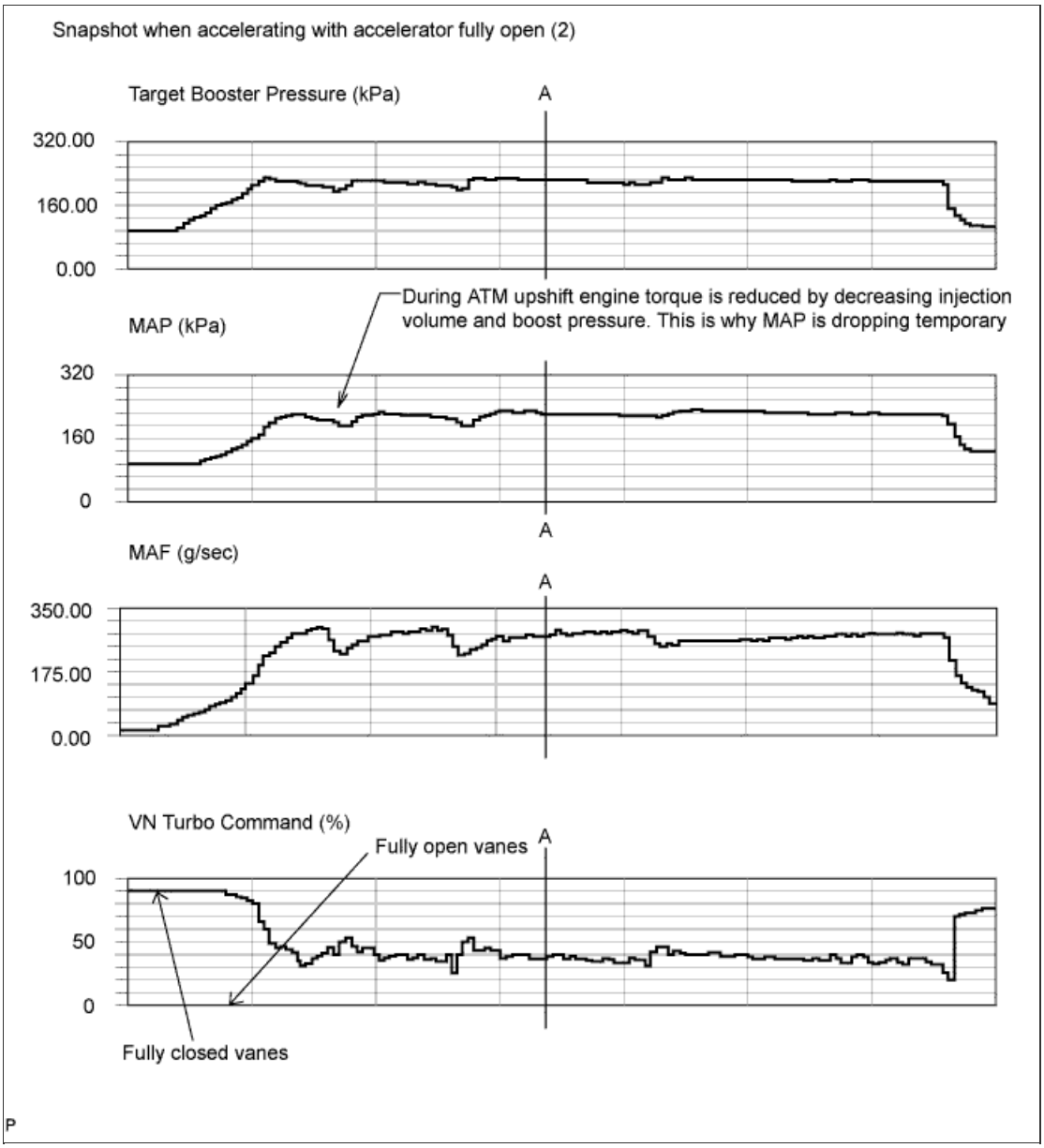
d. Take a snapshot of the following Data Lists with the intelligent tester during lack of power.

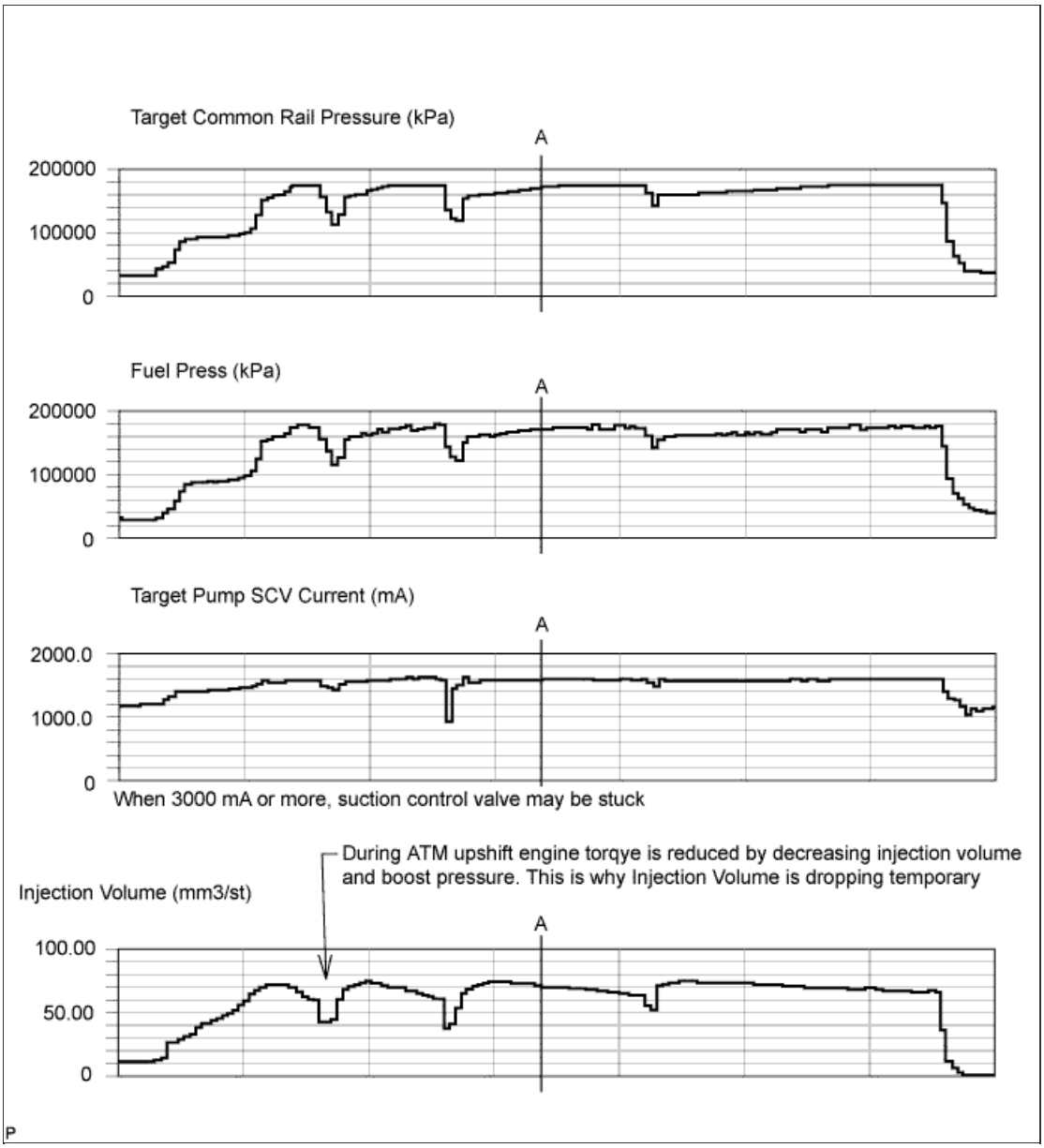
HINT:

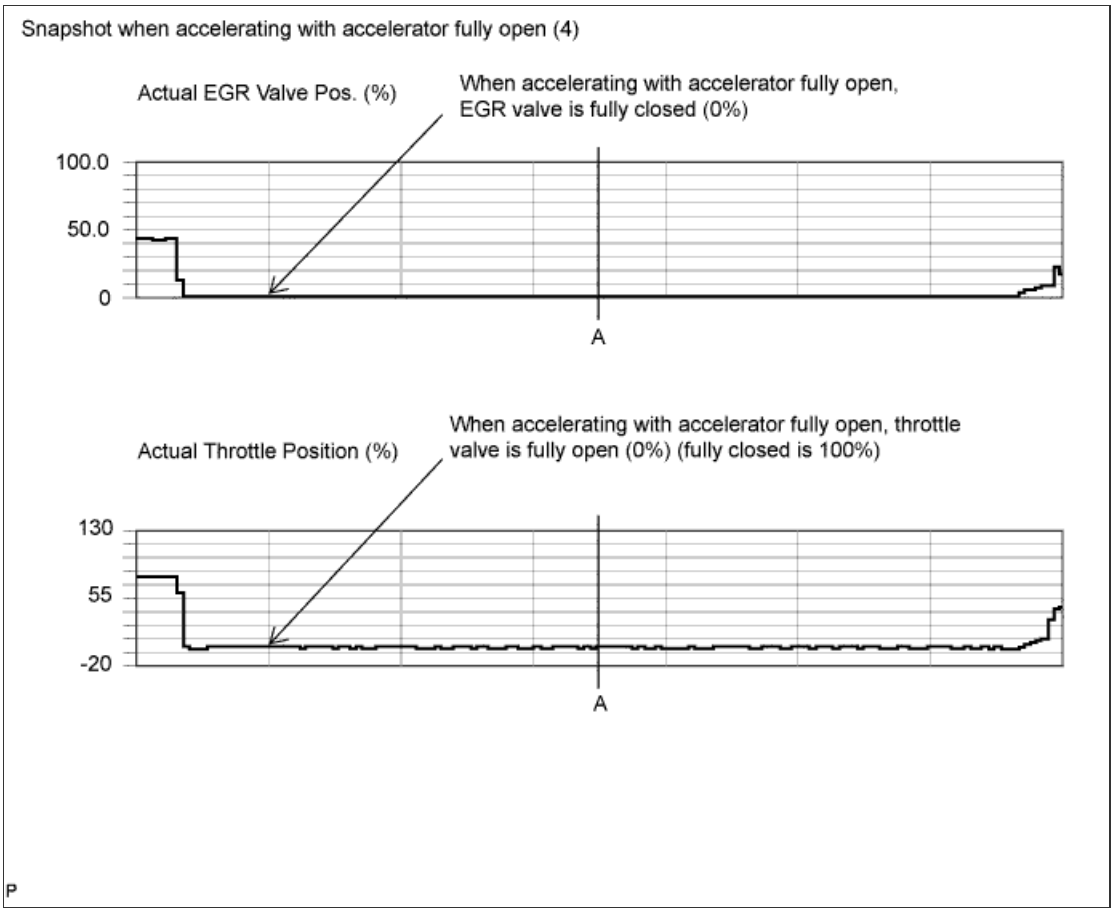
- **A**




Snapshot when accelerating with accelerator fully open
Engine Speed (rpm)
A
3 seconds
5000
2500
0
Vehicle Speed (Km/h)
A
200
100
0
During ATM upshift engine torque is reduced by decreasing injection volume and boost pressure. This is why calculated load is dropping temporary
Calculate Load (%)
100.0
50.0
0.0
A
Accel Position (%)
A
100.00
50.00
0.00
Shift Position Sig from ECT
A
8th
1th
P


Snapshot when accelerating with accelerator fully open (2)
Target Booster Pressure (kPa)
A
320.00
160.00
0.00
During ATM upshift engine torque is reduced by decreasing injection volume and boost pressure. This is why MAP is dropping temporary
MAP (kPa)
320
160
0
A
MAF (g/sec)
A
350.00
175.00
0.00
VN Turbo Command (%)
Fully open vanes
A
100
50
0
Fully closed vanes
P


Target Common Rail Pressure (kPa)
A
200000
100000
0
Fuel Press (kPa)
A
200000
100000
0
Target Pump SCV Current (mA)
A
2000.0
1000.0
0
When 3000 mA or more, suction control valve may be stuck
During ATM upshift engine torqye is reduced by decreasing injection volume and boost pressure. This is why Injection Volume is dropping temporary
Injection Volume (mm3/st)
A
100.00
50.00
0
P



snapshot can be used to compare vehicle data from the time of the malfunction to normal data and is very useful for troubleshooting. The data in the illustration below is that of a normal vehicle, but as the data varies between individual vehicles, this data should only be used for reference.

- **Graphs like the ones shown below can be displayed by transferring the stored snapshot from the tester to a PC. Intelligent Viewer must be installed on the PC.**
- **Move the shift lever to D and accelerate the vehicle with the accelerator fully open. (Obey all laws and regulations, and pay attention to driving conditions while driving the vehicle). Then, check the Data List with the engine warmed up and idling.**

Reference Values with Engine Speed at 3500 rpm (Point A)

Data List	Value	Unit
Vehicle Speed	85	km/h
Engine Speed	3500	rpm
Accel Position	99.60	%
Shift position SIG from ECT	3	th
Target Booster Pressure	222.26	kPa
MAP	224	kPa
MAF	271.51	g/sec
Calculate Load	99.6	%
Target Common Rail Pressure	171150	kPa
Fuel Press	171870	kPa
Target Pump SCV Current	1594.6	mA
Injection Volume	71.34	mm^3/st
VN Turbo Command	38	%
Actual EGR Valve Pos. Actual EGR Valve Pos. #2	0	%
Actual Throttle Position Actual Throttle Position #2	0	%

Data Condition Idling (Engine warmed up)

Data List	Value	Unit
Engine Speed	599	rpm
Target Booster Pressure	99.23	kPa

MAP	97	kPa
MAF	8.39	g/sec
Target Common Rail Pressure	32000	kPa
Fuel Press	32100	kPa
Injection Volume	6.13	mm^3/st
VN Turbo Command	87	%
Actual EGR Valve Pos. Actual EGR Valve Pos. #2	43.5	%
Actual Throttle Position Actual Throttle Position #2	84	%
Accel Position	0	%
Injection Feedback Val #1	0.0	mm^3/st
Injection Feedback Val #2	0.3	mm^3/st
Injection Feedback Val #3	0.0	mm^3/st
Injection Feedback Val #4	-0.4	mm^3/st
Injection Feedback Val #5	-0.4	mm^3/st
Injection Feedback Val #6	0.3	mm^3/st
Injection Feedback Val #7	0.0	mm^3/st
Injection Feedback Val #8	-0.5	mm^3/st
Target EGR Pos. Target EGR Pos. #2	43.5	%
Atmosphere Pressure	99	kPa
Coolant Temp	78	°C

HINT:

Actual Examples of Malfunction (See "Diagnostic Help" menu)

- **Lack of power caused by overly low boost pressure**
- **Lack of power caused by overly low MAF**
- **EGR valve stuck in open position**

NEXT

4.CHECK SNAPSHOT

a. Check the condition of the vehicle using the snapshot taken during the lack of power.

Result

Result	Proceed to
Fuel Press is less than "Target Common Rail Pressure -20000 kPa" when accelerating with accelerator fully open	A
Target Pump SCV Current 3000 mA or more	B
One of the Injection Feedback Val #1 to 8 values is outside the range of +/-3 mm ^{3}/st when idling after warm up	C
Injection Feedback Val #1 to #8 is within the range of +/-3 mm ^{3}/st and the Injection Volume is more than 10 mm ^{3}/st when idling after warm up	D
None of the above conditions apply	E

A	**Go to step 17**
B	**REPLACE FUEL SUPPLY PUMP (Click here)**
C	**Go to step 30**
D	**REPLACE FUEL INJECTORS OF ALL CYLINDER (Click here)**

E

5.CHECK SNAPSHOT

a. Check the condition of the vehicle using the snapshot taken during the lack of power.

Result

Result	Proceed to
MAP is less than "Target Booster Pressure -20 kPa" (MAF is normal) when accelerating with accelerator fully open	A
MAF is low when accelerating with accelerator fully open (MAP is normal) • 3000 rpm: 150 g/sec or less • 3500 rpm: 160 g/sec or less • 4000 rpm: 160 g/sec or less **HINT:** • **If the MAF (Mass Air Flow) decreases, Calculate Load will be 80% or less when accelerating with the accelerator fully open.** • **During acceleration with the accelerator fully open, MAF (Mass Air Flow) is 40 g/sec or more less than the estimated MAF value* calculated based on MAP.**	B
MAP and MAF are both low when accelerating with the accelerator fully open	C
None of the above conditions apply	D

$$\text{Estimated MAF Value*} = \frac{\text{Engine speed (rpm)} \times \text{MAP (kPa)} \times \text{Engine Displacement (L)} \times K}{100 \times 60 \times 2}$$

Engine Desplacement = 4.461 (L)

$$K = \frac{1.225 \times (273 + 15)}{273 + \text{Intake Air Temperature (°C)}}$$

HINT:

Calculate the Estimated MAF Value by substituting Engine Speed (rpm), MAP (kPa) and Intake Air Temperature (°C) from the Snapshot recorded by Intelligent Tester earlier into the above formula.

B	Go to step 8
C	Go to step 10
D	Go to step 24

A

6.INSPECT VACUUM HOSE

a. Check the vacuum hose connection (manifold absolute pressure sensor).

OK:

Vacuum hose is connected securely.

NG → REPLACE VACUUM HOSE

OK

7.READ VALUE USING INTELLIGENT TESTER

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / MAP and Atmosphere Pressure.

d. Compare MAP to Atmosphere Pressure when the ignition switch is ON (engine stopped).

HINT:

- **If MAP and Atmosphere Pressure have the same value, both are normal. If there is a difference of 10 kPa or more, compare the values to the atmospheric pressure for that day. The sensor whose deviation is the greatest is malfunctioning.**
- **Standard atmospheric pressure is 101 kPa. For every 100 m increase in altitude, pressure drops by 1 kPa. Varies by weather (high atmospheric pressure, low atmospheric pressure).**

Result

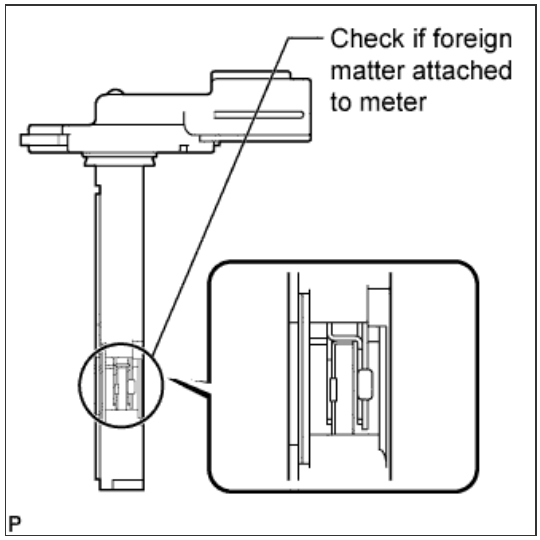
Result	Proceed to
Atmosphere Pressure is different from actual atmospheric pressure	A
MAP is different from actual atmospheric pressure	B
MAP and Atmosphere Pressure have the same value	C

A	REPLACE ECM (Click here)
B	REPLACE MANIFOLD ABSOLUTE PRESSURE SENSOR (Click here)
C	Go to step 10

8.INSPECT MASS AIR FLOW METER

a. Using a work light, check that the platinum filament (heater portion) in the mass air flow meter has no foreign matter attached.

Standard:
No foreign matter attached.



b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON and turn the tester on.

d. Enter the following menus: Powertrain / Engine / Data List / MAF.

e. Read the value.

OK:
2 g/sec or less.

NG	REPLACE MASS AIR FLOW METER (Click here)

OK

9.INSPECT EGR VALVE ASSEMBLY (No. 1 or No. 2)

HINT:

For vehicles without EGR valve, perform troubleshooting from the next step.

a. Check the EGR valve condition using the snapshot taken when accelerating with the accelerator fully open.

Standard Value

Tester Display	Standard Value
Actual EGR Valve Pos.	0%
Actual EGR Valve Pos. #2	0%

b. Next, after the engine is warmed up, stop the engine and wait for 15 seconds. After that, start the engine again and idle it for 30 seconds.

Then stop the engine and wait for 15 seconds. After starting the engine again, read the Data List values while idling.

Standard Value

Tester Display	Standard Value
EGR Close Learn Val.	3.5 to 4.5 V
EGR Close Lrn. Val. #2	3.5 to 4.5 V
EGR Close Lrn. Status	ON

Result:

Result	Suspected Trouble Area	Proceed to
A: Actual EGR Valve Pos with the ignition switch ON and the engine stopped is 0%. During idling, EGR valve is partially open. (Basically, it smoothly follows Target EGR Position).	When A is not met: EGR valve is stuck	B
B: EGR Close Learn Val is within the standard value and EGR Close Lrn Status is ON.	When B is not met: EGR valve does not close	B
Both A and B are OK	-	A

HINT:

- **The 1VD engine has 2 EGR valves. Comparing the movements of the 2 valves can be a useful reference for diagnosing malfunctions. If 1 of the 2 valves becomes unable to close, the turbo will perform compensation control and a lack of power will not be felt but surging may be felt.**

B → REPLACE EGR VALVE ASSEMBLY (No. 1 or No. 2) (Click here)

A

10.READ VALUE USING INTELLIGENT TESTER

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Accel Position.

d. Read the value.

Standard Value:

Condition	Standard Value
Accelerator pedal released	0%
Accelerator pedal depressed	100%
Accelerator pedal released → depressed **HINT:** Make sure the Accel Position opening angle moves smoothly.	0 to 100%

NG → REPLACE ACCELERATOR PEDAL ROD ASSEMBLY (Click here)

OK

11.READ VALUE USING INTELLIGENT TESTER

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Actual Throttle Position, Actual Throttle Position #2.

d. Read the value.

Standard Value:

Condition	Standard Value
Ignition switch ON	-5 to 5 %
Idling (warmed up engine)	0 to 90%
Accelerator pedal fully depressed **HINT:** Make sure the Accel Position opening angle moves smoothly.	-5 to 5 %

HINT:

- **Fully open: 0%**
- **Fully close: 100%**
- **The 1VD engine has 2 throttles. Diagnosis of malfunctions can be performed by comparing the movements of the 2 diesel throttles. If the Throttle Motor Duty of an operating diesel throttle is not within 50 +/-40%, the throttle is not sliding properly.**

NG → REPLACE DIESEL THROTTLE BODY (for Bank 1 or Bank 2) (Click here)

OK

12.CHECK INTAKE SYSTEM

a. Check for air leakage and blockage between the air cleaner and turbocharger, and between the turbocharger and intake manifold.

HINT:

- **Check that the intercooler is not clogged with foreign matter.**
- **Check that there are no disconnected, pinched or leaking hoses or pipes.**
- **Check that there are no modifications made by the user.**

OK:
No leakage or blockage.

NG → REPAIR OR REPLACE MALFUNCTIONING PARTS

OK

13.CHECK TURBOCHARGER SUB-ASSEMBLY (MECHANICAL PROBLEM (for Bank 1 or Bank 2))

a. Disconnect the air cleaner hose.

b. Use a mirror to visually check the turbocharger for any mechanical problems.

c. When the engine is cold, check that the impeller of the turbocharger rotates smoothly, and confirm whether there is any damage to it.

OK:
Impeller rotates smoothly and is not damaged.

d. Reconnect the air cleaner hose.

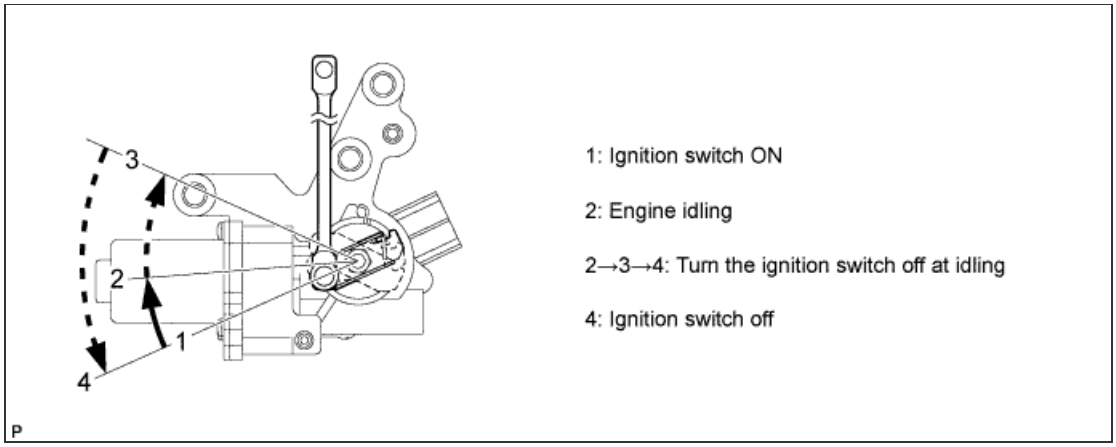
NG → REPLACE TURBOCHARGER SUB-ASSEMBLY (for Bank 1 or Bank 2) (Click here)

OK

14.INSPECT TURBOCHARGER SUB-ASSEMBLY (for Bank 1 or Bank 2)

a. Check the motor movement when turning the ignition switch to ON, when starting the engine and then when turning the ignition switch off.

OK:
Motor moves as shown in the illustration.



NG → REPLACE TURBOCHARGER SUB-ASSEMBLY (for Bank 1 or Bank 2) (Click here)

OK

15.CHECK MONOLITHIC CONVERTER ASSEMBLY (for Bank 1 or Bank 2)

a. Check that there are no clogs, dents, etc. in the monolithic converter assembly.

OK:
No clogs, dents, etc.

NG → REPLACE MONOLITHIC CONVERTER ASSEMBLY (for Bank 1 or Bank 2)

OK

16.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Check whether the lack of power has been successfully repaired.

OK:
Malfunction has been repaired successfully.

HINT:

Symptoms may have appeared due to carbon deposits, etc.

NG → Go to step 34

OK

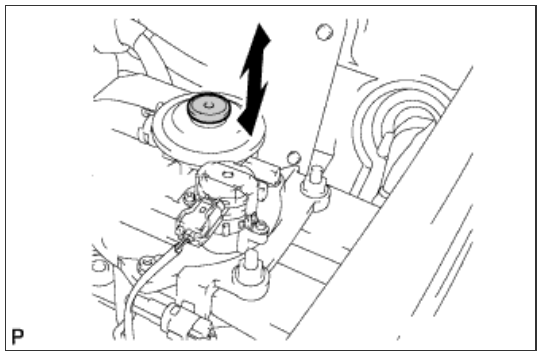
END

17.BLEED AIR FROM FUEL SYSTEM

a. Using the hand pump as indicated by the arrow in the illustration, bleed the fuel system. Continue pumping until pumping becomes difficult.

HINT:

When the fuel pressure during cranking is extremely low (1000 kPa or less), it is possible that fuel is not being supplied to the supply pump.



NEXT

18.CHECK IF FUEL IS BEING SUPPLIED TO FUEL SUPPLY PUMP

a. Disconnect the inlet hose from the fuel supply pump.

b. Operate the priming pump and check that fuel is being supplied to the fuel supply pump.

OK:
Fuel is properly supplied to the fuel supply pump when the priming pump is operated.

HINT:

- **When lack on fuel, fuel pressure drops.**
- **Inspect for fuel filter clogging.**
  (Check that the fuel filter is not clogged)

NG → CHECK AND REPLACE CLOGGED FUEL PIPE (INCLUDING FUEL FREEZING) (FUEL TANK - FUEL SUPPLY PUMP)

OK

19.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Check whether the lack of power has been successfully repaired.

HINT:

The Fuel Press is within +/-5000 kPa of Target Common Rail Pressure.

OK:
Malfunction has been repaired successfully.

OK

END

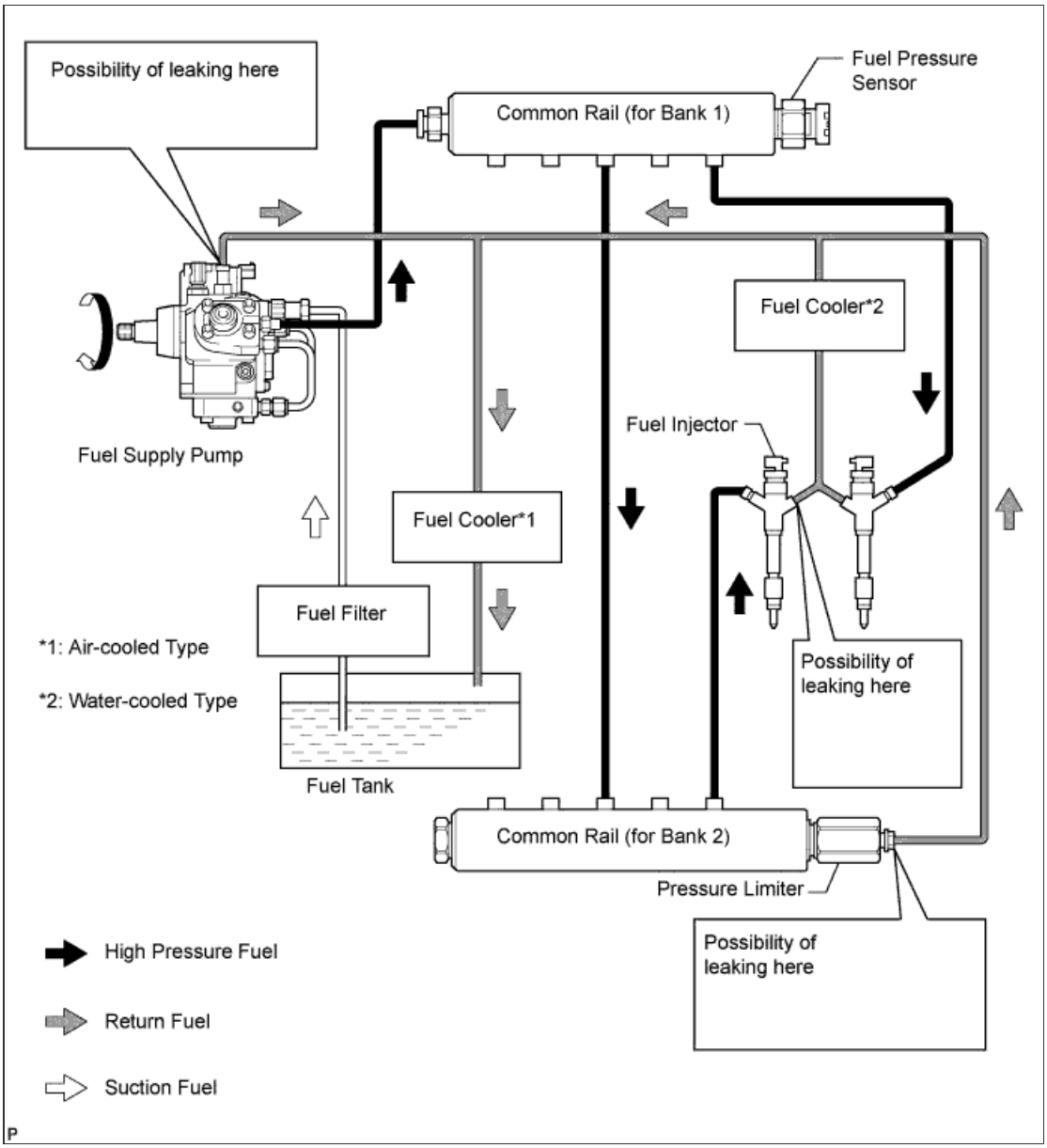
20.CHECK FUEL LEAK (FUEL SUPPLY PUMP)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Fuel Press.

d. Pinch the fuel supply pump return hose and check that Fuel Press during cranking increases.



Result

Result	Proceed to
No change	A
Fuel Press increases	B

B → REPLACE FUEL SUPPLY PUMP (Click here)

A

21.CHECK FUEL LEAK (PRESSURE LIMITER) (COMMON RAIL (for Bank 2))

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Fuel Press.

d. Pinch the pressure limiter return hose and check that Fuel Press during cranking increases.

Result

Result	Proceed to
No change	A
Fuel Press increases	B

B → REPLACE COMMON RAIL (for Bank 2) (Click here)

A

22.REPLACE FUEL SUPPLY PUMP

a. Replace the fuel supply pump (Click here).

NEXT

23.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Check whether the lack of power has been successfully repaired.

HINT:

The Fuel Press is within +/-5000 kPa of Target Common Rail Pressure.

NEXT

END

24.CHECK TEMPERATURE WHEN LACK OF POWER OCCURS

a. Check the temperature when lack of power occurs.

Result

Result	Proceed to
Poor acceleration only when engine is cold	A
Poor acceleration when engine is cold and warm	B

B → Go to step 27

A

25.INSPECT ENGINE COOLANT TEMPERATURE SENSOR

a. Inspect the engine coolant temperature sensor (Click here).

HINT:

After warming up the engine, the engine coolant temperature should be 70°C (158°F) or more. After leaving the vehicle overnight, the engine coolant temperature should be nearly equal to the intake air temperature.

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR (Click here)

OK

26.INSPECT GLOW PLUG ASSEMBLY (RESISTANCE)

a. Disconnect the glow plug connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

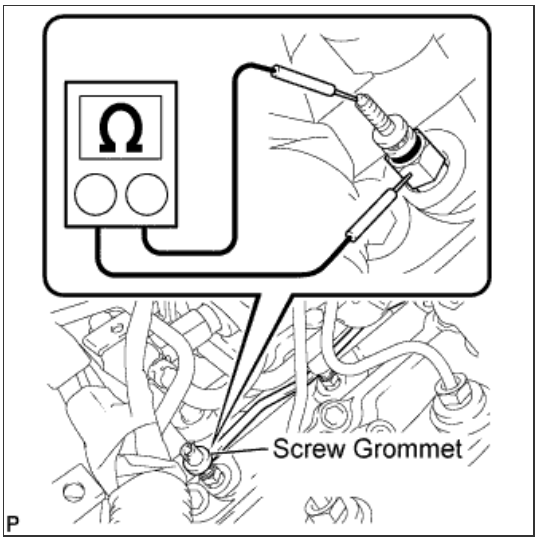
Tester Connection	Condition	Specified Condition
Glow plug terminal - Body ground	20°C (68°F)	Approximately 1 Ω

HINT:

If any of the glow plugs has an open circuit, the engine power will be insufficient only when the engine is cold.

NOTICE:

- **Exercise extreme care not to damage the glow plug pipes. Damaging them could cause an open circuit, or shorten the life of the glow plugs,**
- **Keep the glow plugs free of oil and fuel while cleaning.**
- **Wipe any oil off of the terminal and Bakelite washer with a clean, dry cloth during inspection.**
- **Do not apply more than 11 V to the glow plugs as it may cause an open circuit.**



NG → REPLACE GLOW PLUG ASSEMBLY (Click here)

OK

27.INSPECT INJECTOR COMPENSATION CODE

a. Read the injector compensation code (Click here).

OK:
Compensation codes stored in the ECM match compensation codes of the installed fuel injectors.

NG → PERFORM REGISTRATION FUEL INJECTOR COMPENSATION CODE (Click here)

OK

28.CHECK FUEL QUALITY

a. Check that fuel with a low cetane number is used.

NEXT

29.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Check whether the lack of power has been successfully repaired by starting the engine.

NEXT

END

30.PERFORM ACTIVE TEST USING INTELLIGENT TESTER

HINT:

Use this Active Test to determine the malfunctioning cylinder.

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Active Test / Control the Cylinder #1 to #8 Fuel Cut.

HINT:

- **If the engine idle speed does not change when a fuel injector is disabled, the cylinder being tested is malfunctioning.**
- **If the cylinder being tested is normal, there will be a significant change in idle speed when the fuel injection is stopped for that cylinder.**

NEXT

31.PERFORM ACTIVE TEST USING INTELLIGENT TESTER

HINT:

Use this Active Test to help determine whether a cylinder has compression loss or not.

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Active Test / Check the Cylinder Compression / Data List / Compression / Engine Speed of Cyl #1 to #8.

d. Check the engine speed during the Active Test.

OK:
If the values of Engine Speed Cyl #1 to #8 are within +/-10 rpm of each other.

HINT:

When cranking, if the speed of a cylinder is approximately 100 rpm more than the other cylinders, there is probably a loss of compression in that cylinder.

OK	Go to step 33
NG	Go to step 32

32.CHECK CYLINDER COMPRESSION PRESSURE OF MALFUNCTIONING CYLINDER

HINT:

Measure the compression of the cylinder that had a high speed during the Active Test "Check the Cylinder Compression".

a. Check the cylinder compression pressure (Click here).

NG	CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

33.REPLACE FUEL INJECTOR OF MALFUNCTIONING CYLINDER

HINT:

The injector is determined to be faulty as the corresponding cylinder is malfunctioning, but has no compression loss.

NEXT

END

34.CHECK INTAKE SYSTEM DEPOSIT

a. Check if 3 mm or more of carbon is accumulating on the intake manifold, cylinder head, etc. and if so, clean it off.

NEXT

35.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

HINT:

Symptoms may have appeared due to carbon deposits, etc.

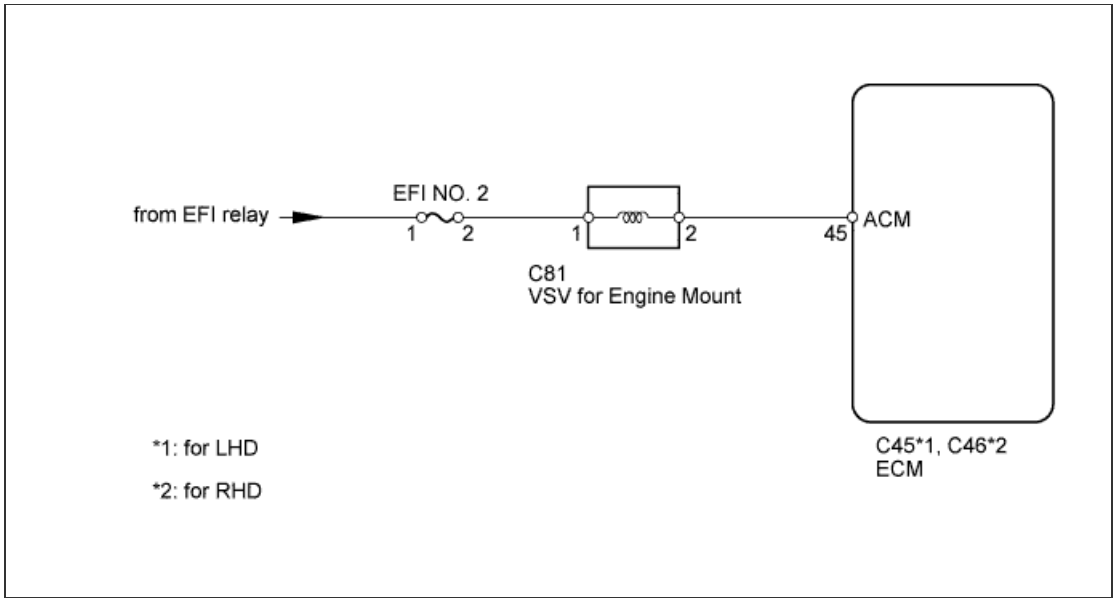

NEXT
END

for Preparation Click here

DESCRIPTION

The Active Control Engine Mount (ACM) system decreases engine vibration at low engine speed using the VSV for engine mount. The VSV is controlled by a pulse signal transmitted to the VSV from the ECM. The frequency of this pulse signal is matched to the engine speed to decrease engine vibration.

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

1.PERFORM ACTIVE TEST USING INTELLIGENT TESTER

a. Warm up the engine.

b. Connect the intelligent tester to the DLC3.

c. Move the shift lever to N or P.

d. Enter the following menus: Powertrain / Engine / Active Test / Control the ACM Inhibit.

e. Hold the top part of the steering wheel, and turn the Active Test from OFF to ON. Check the engine vibration.

Result:

Engine Vibration	Proceed to
Increases	A
Does not increase	B

A → CHECK FOR INTERMITTENT PROBLEMS (Click here)

B

2.CHECK VACUUM

a. Check if the vacuum hose cap is missing, if the hose is damaged, and if the air and vacuum hoses have looseness, disconnection or blockage.

OK:

Vacuum hose cap is not missing and hoses are normal.

NG → REPLACE VACUUM HOSE

OK

3.INSPECT VSV FOR ENGINE MOUNT

a. Inspect the VSV for engine mount (Click here).

NG → REPLACE VSV FOR ENGINE MOUNT (Click here)

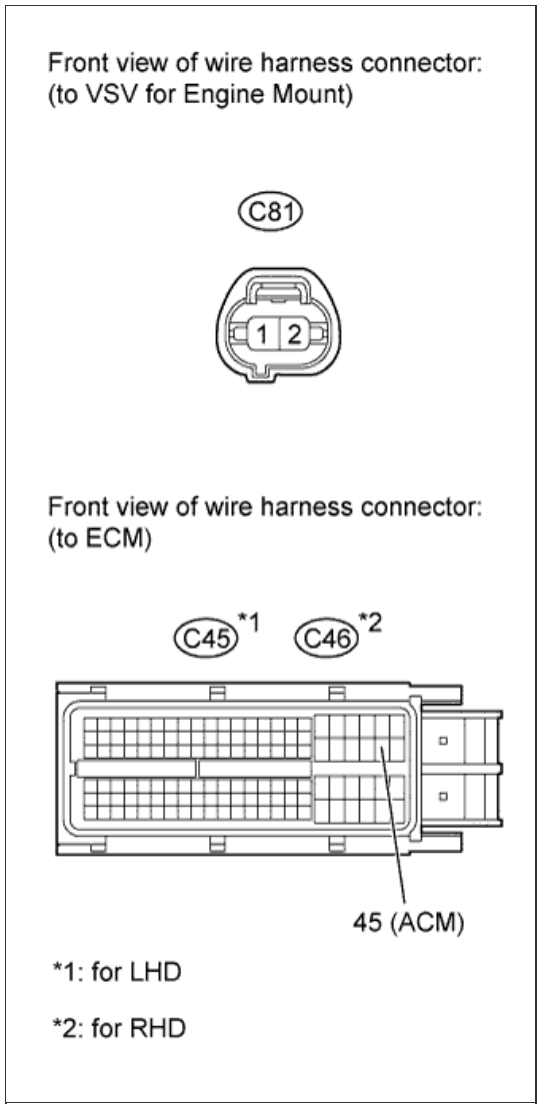
OK

4.CHECK HARNESS AND CONNECTOR (VSV FOR ENGINE MOUNT - ECM, EFI NO. 2 FUSE - VSV FOR ENGINE MOUNT)

a. Disconnect the VSV for engine mount connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C81-2 - C45-45 (ACM)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C81-2 - C46-45 (ACM)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C81-2 or C45-45 (ACM) - Body ground	Always	10 kΩ or higher

for RHD

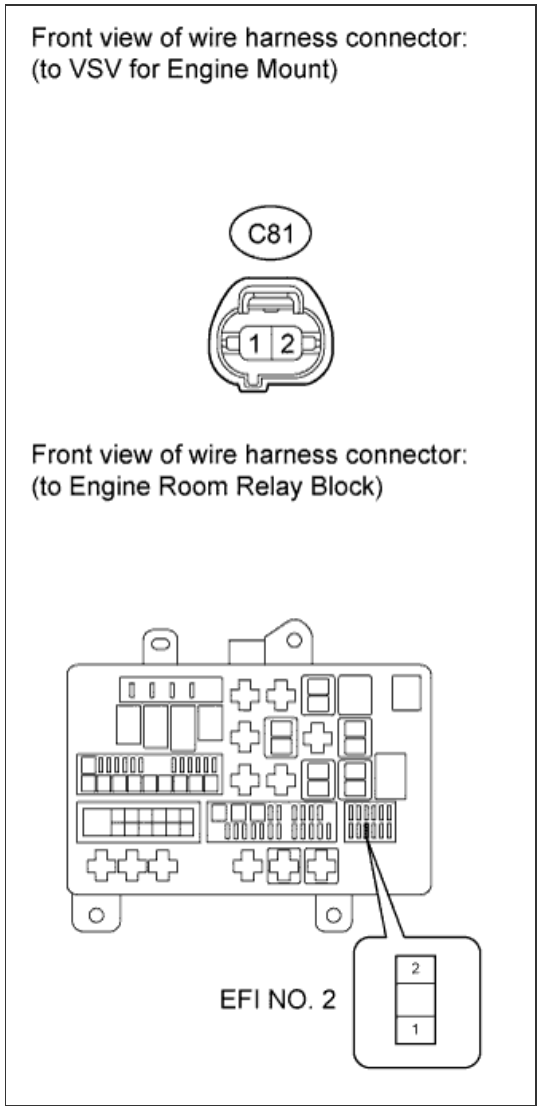
Tester Connection	Condition	Specified Condition
C81-2 or C46-45 (ACM) - Body ground	Always	10 kΩ or higher

d. Remove the EFI NO. 2 fuse from the engine room relay block.

e. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI NO. 2 fuse (2) - C81-1	Always	Below 1 Ω



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

5.INSPECT ENGINE MOUNTING INSULATOR FRONT

a. Inspect the engine mounting insulator front (Click here).

NG → REPLACE ENGINE MOUNTING INSULATOR FRONT (Click here)

OK

REPLACE ECM (Click here)

for Preparation Click here

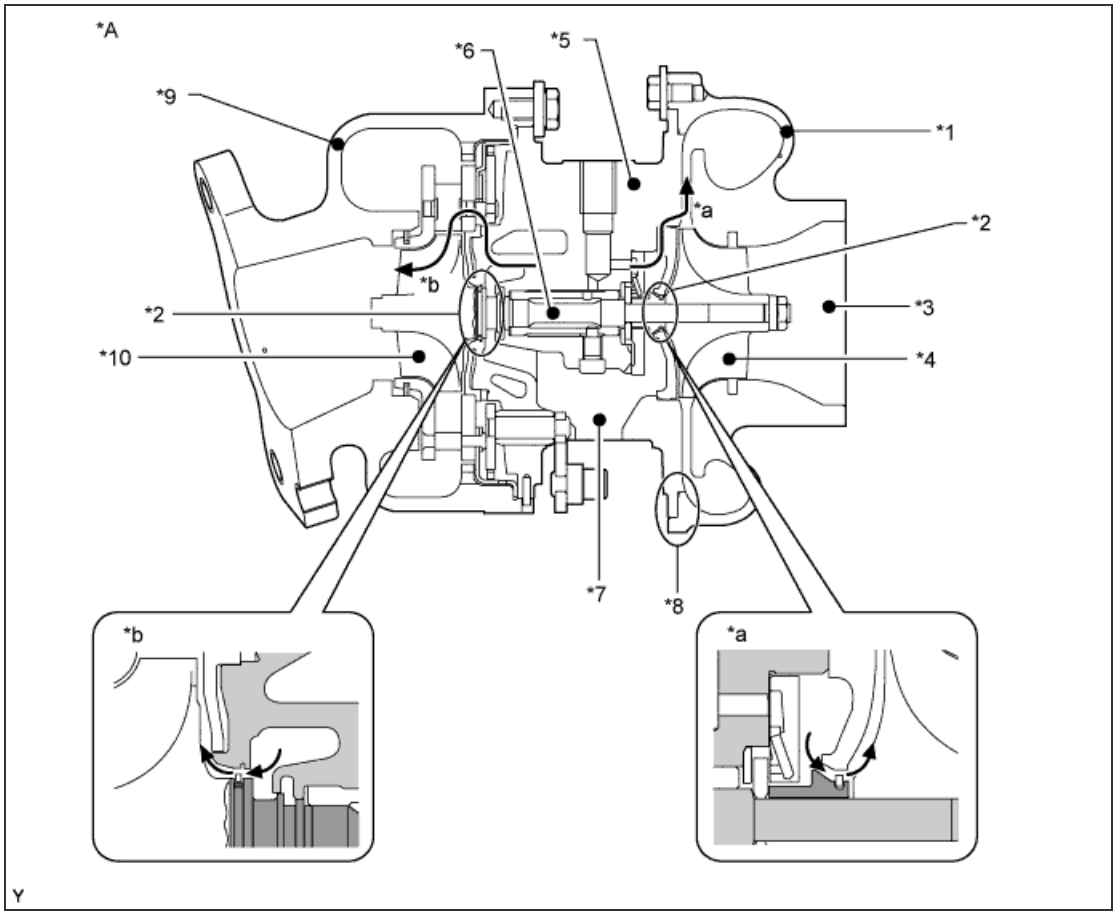
DESCRIPTION

Description

Oil Leak Type	Description	Main Trouble Area
Internal oil leak (White smoke)	Oil leak from bearing housing to compressor housing (intake side) or turbine housing (exhaust side) through seal rings. Internal oil leak is not visible from outside of turbocharger. If oil leak occurs from turbine side seal, large amount of white smoke will be emitted from exhaust pipe.	• Compressor side seal ring • Turbine side seal ring • Clogging of oil drain • Shaft breakage • Shaft and bearing seizure • Compressor impeller damage • Low quality fuel
External oil leak	Oil leak from inside of turbocharger to outside of turbocharger (e.g. from FIPG seal, oil pipe flange or oil pipe union). Includes oil leak visible from outside of turbocharger.	• FIPG sealing part • Oil pipe flange • Oil pipe union • Hose connection of intake pipe

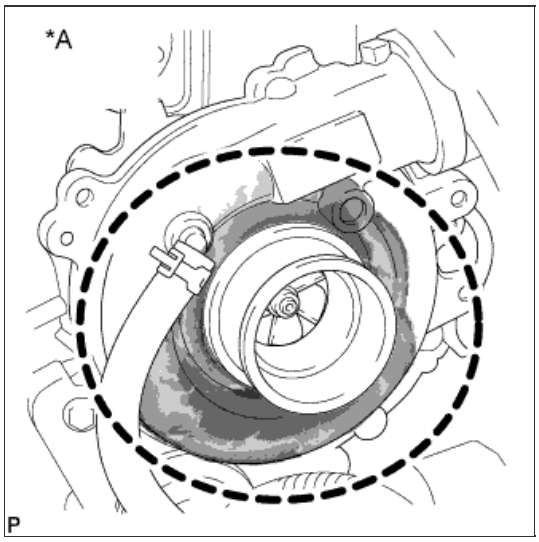
HINT:

- **Turbocharger oil leaks are classified into 2 types. One is an internal oil leak, and the other is an external oil leak.**
- **When oil leaks and smoke occur, sometimes the turbocharger is mistakenly replaced, even though the turbocharger is not the cause of the problem.**
- **When there are oil marks on the surface of the compressor housing, or oil in the compressor inlet or outlet, the problem may mistakenly be determined to be a turbocharger oil leak.**
- **Each part of the turbocharger is shown below.**



Text in Illustration

*A	DC Motor Type Turbocharger (No. 1)	-	-
*1	Compressor Housing	*2	Seal Ring
*3	Compressor Inlet	*4	Compressor Impeller
*5	Bearing Housing	*6	Turbine Shaft
*7	Oil Drain (Outlet)	*8	FIPG Sealing Part
*9	Turbine Housing	*10	Turbine Wheel
*a	Internal oil leak to compressor housing	*b	Internal oil leak to turbine housing

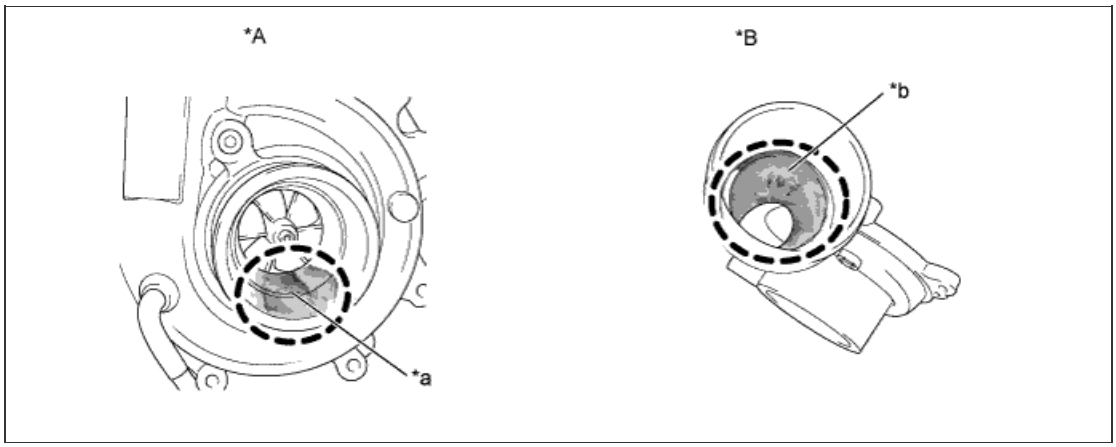


Text in Illustration

*A	Fig. 1	-	-

HINT:

- **Above illustration is an example.**
- **If the oil stain is similar to the one shown in the illustration (fig. 1), it may be oil spray from parts surrounding the turbocharger or oil leaking from the air cleaner hose. Therefore, this kind of oil stain on the outer surface of the turbocharger is not an oil leak from the turbocharger (external oil leak), and is not related to white smoke. For identification of an actual turbocharger outer oil leak, check only the sealing part shown below.**



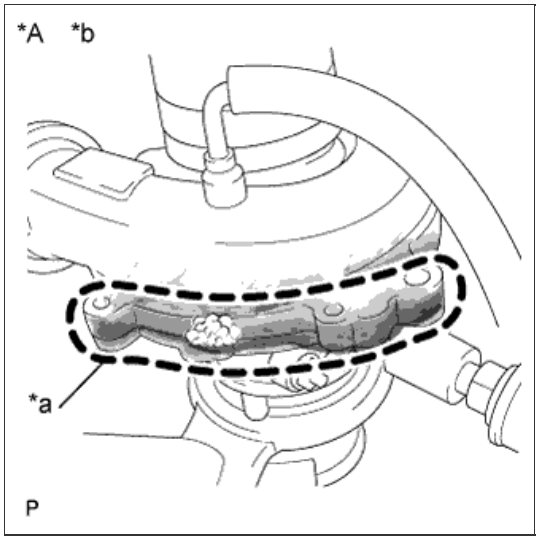
Text in Illustration

*A	Fig. 2	*B	Fig. 3
*a	Oil existence at compressor inlet (Max. 5 cm^3)	*b	Oil existence at compressor outlet

HINT:

- **Above illustration is an example.**
- **A certain amount of oil is contained in the intake system because blow-by gas containing oil mist is returned to the intake system by the PCV. Therefore, the oil amount at the compressor inlet shown in the left figure (fig. 2) is normal and not an oil leak from the turbocharger (internal oil leak). Also, oil at the compressor outlet as shown in fig. 3 is normal.**
  In addition, the compressor impeller surface may blacken due to blow-by gas but this is not abnormal.
- **Oil mist contained in the PCV flows to the No. 2 turbocharger sub-assembly (for bank 2) because of the intake air piping route.**

Therefore, it is normal that a certain amount of oil exists at the compressor inlet and outlet of the No. 2 turbocharger sub-assembly.



Text in Illustration

*A	Fig. 4	-	-
*a	In the case of an actual oil leak, oil leaks from the sealed part	*b	Oil Leak Check Point (FIPG Sealing Part)

HINT:

- **Above illustration is an example.**
- **This is an illustration (fig. 4) of an air leak test performed by applying soapy water to the area of the leak. Bubbles indicate the leak point.**

Faults and Symptoms of Turbocharger Parts

Compressor Side Seal Ring

Main fault	Seal ring breakage
Symptoms	• Oil leak to compressor housing • Excessive oil consumption
Note	• In case of compressor seal ring failure, large amount of oil would be found between compressor outlet and intercooler, and between intercooler and intake manifold, but not found at compressor inlet. • If large amount of oil is found at compressor inlet, it is not from turbocharger and may indicate a problem in the PCV system.

Turbine Side Seal Ring

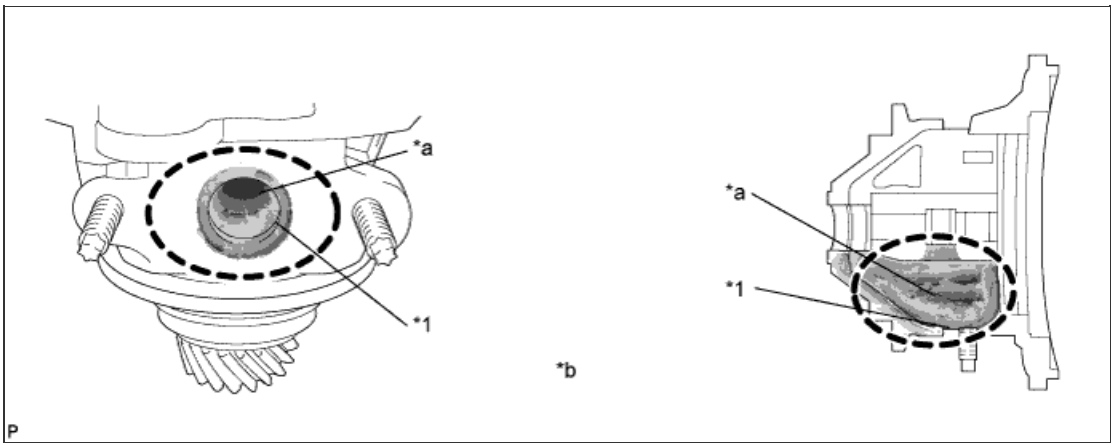
Main fault	Seal ring breakage
Symptoms	• Oil leak to turbine housing • Large amount of white smoke from exhaust pipe • Excessive oil consumption
Note	• In case of turbine seal ring failure, large amount of white smoke would be emitted continuously. • If white smoke is emitted only just after engine start (and it disappears later), or small amount of white smoke is emitted intermittently, it is not from turbocharger. It is due to failure of other parts. • If wet oil is found at turbine inlet, it is not from turbocharger. It is due to problem in other parts.

Bearing Housing (Oil Drain Clogging)

Main fault	Oil drain clogging by coked oil
Symptoms	Large amount of white smoke from exhaust pipe

HINT:

- **Oil coking is caused by insufficient oil maintenance.**
- **If the oil drain is clogged by coked oil, oil cannot be drained smoothly, and it overflows from the bearing housing to the compressor housing and turbine housing. This results in a large amount of white smoke from the exhaust pipe.**
  If any solid (coked oil) is visually confirmed inside the bearing housing, it can be assumed to be the cause of internal oil leak.



Text in Illustration

*1	Oil Drain	-	-
*a	Coked oil	*b	Oil drain clogged with coked oil

HINT:

Above illustration is an example.

Turbine Shaft

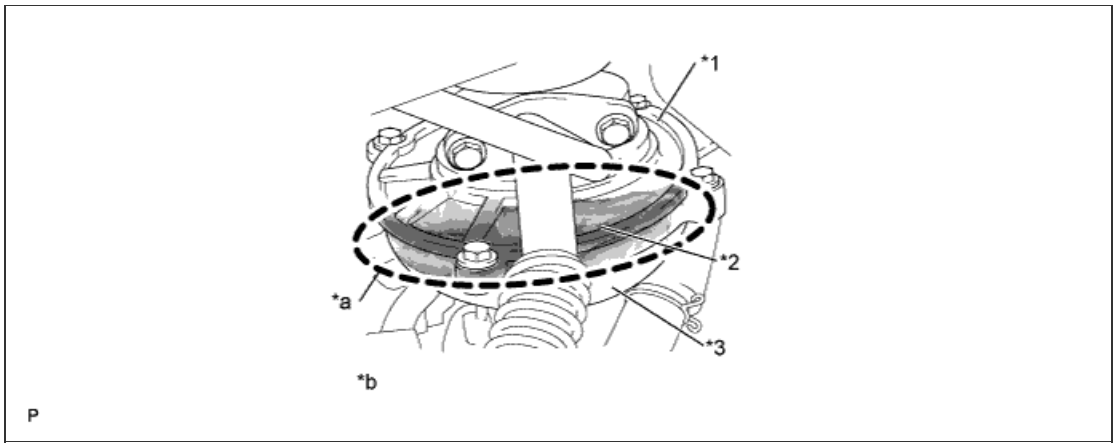
Main fault	• Breakage • Seizure
Symptoms	• Shaft does not rotate • Oil leak to compressor housing • Large amount of white smoke from exhaust pipe • Lack of power • Turbocharger noise changes
Note	• In case of turbine shaft failure, lack of power due to lack of boost pressure will be felt. • In cold conditions, shaft rotation can feel somewhat clingy due to viscosity of oil. Be sure not to mistake it for unsmooth shaft rotation.

Compressor Impeller

Main fault	Breakage
Symptoms	• Shaft does not rotate • Oil leak to compressor housing • Lack of power
Note	• In case of compressor impeller failure, large amount of oil would be found between compressor outlet and intercooler, and between intercooler and intake manifold, but not found at compressor inlet. • Oil is blocked by boost pressure at compressor seal ring. Therefore, if boost pressure does not increase due to breakage of compressor impeller, oil flows out to compressor housing.

Compressor Housing FIPG Sealing Part

Symptoms	Oil leak from FIPG sealing part
Note	• If oil stain is separated from FIPG sealing part, it can be determined to be due to oil spray from other parts surrounding turbocharger. • If oil stain is traced to hose connection part, it can be determined to be due to hose connection failure.



Text in Illustration

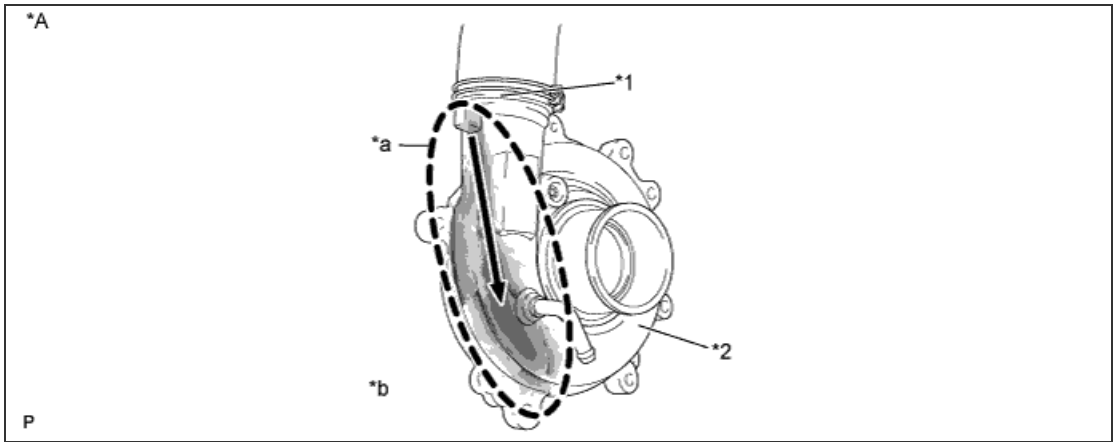
*1	Compressor Back Plate	*2	FIPG Sealing Part
*3	Compressor Housing	-	-
*a	Oil Leak	*b	Oil Leak from FIPG Sealing Part

HINT:

Above illustration is an example.

Intake Hoses

Symptoms	Oil leak from hose connection between hose and compressor housing
Note	If oil stain is traced to hose connection part, it can be determined to be due to hose connection failure.



Text in Illustration

*A	Fig. 5	-	-
*1	Compressor Outlet	*2	Compressor Housing
*a	Trace of oil leak from hose connection part	*b	Oil leak from hose connection part

HINT:

Above illustration is an example.

INSPECTION PROCEDURE

1.CHECK TYPE OF OIL LEAK

a. Check whether the oil leak is an internal or external oil leak.

HINT:

White smoke is not related to an external oil leak.

Oil Leak Type	Description

Internal oil leak (White smoke)	Oil leak from bearing housing to compressor housing (intake side) or turbine housing (exhaust side) through seal rings. Internal oil leak is not visible from outside of turbocharger. If oil leak occurs from turbine side seal, large amount of white smoke will be emitted from exhaust pipe.
External oil leak	Oil leak from inside of turbocharger to outside of turbocharger (e.g. from FIPG seal, oil pipe flange or oil pipe union). Includes oil leaks visible from outside of turbocharger.

Result

Result	Proceed to
External oil leak	A
Internal oil leak	B

B → Go to step 3

A

2.REPLACE THE PART WHICH IS LEAKING OIL

a. Replace the part which is leaking oil.

NEXT

END

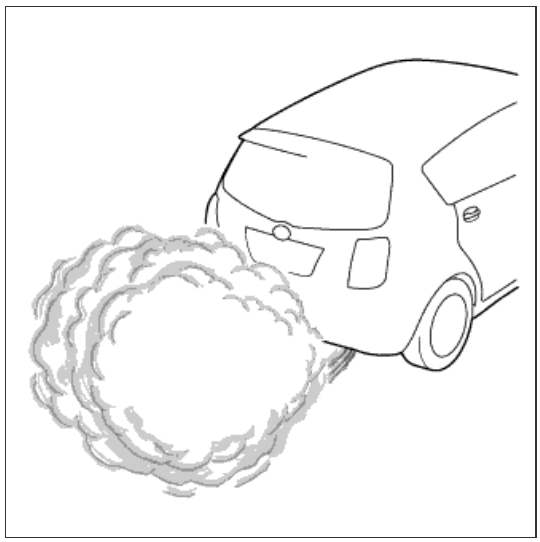
3.CHECK WHETHER WHITE SMOKE IS EMITTED

a. Fully depress the accelerator pedal, and then release it.

b. Check whether white smoke is emitted or not when racing the engine.

CAUTION:

Be sure not to check for white smoke indoors.



Result

Result	Proceed to
White smoke is emitted	A
White smoke is not emitted	B

B → Go to step 14

A

4.READ OUTPUT DTC (RELATED TO ENGINE)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester ON.

c. Enter the following menus: Powertrain / Engine / DTC.

d. Read DTCs.

Result

Result	Proceed to
No DTCs are output	A
DTCs related to engine are output	B

B → GO TO DTC CHART (Click here)

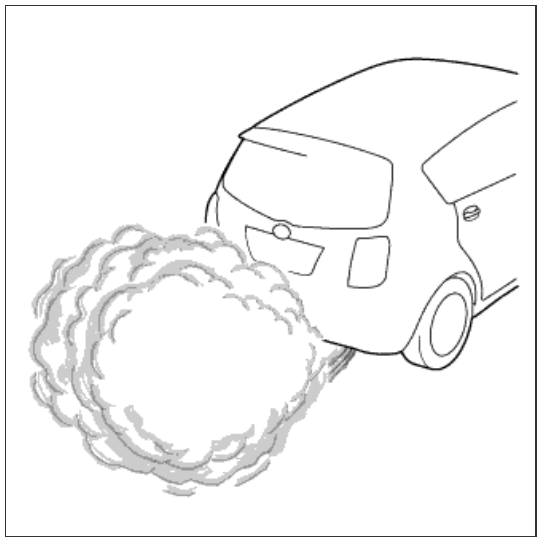
A

5.CHECK WHITE SMOKE (ACCORDING TO ENGINE CONDITION)

a. Remove the center exhaust pipe assembly.

b. Check whether the white smoke is emitted only just after engine start and disappears later, or not.

c. Identify the malfunctioning bank which emits the white smoke.



HINT:

- **If white smoke appears for only a short period of time immediately after the engine is started, the white smoke is not from the turbocharger.**
- **If the turbocharger is the cause of the problem, regardless of whether the engine is cold or warmed up, there will be a large amount of white smoke to the extent that visibility is obstructed for a few meters in the area of the smoke (as shown in the illustration).**
- **Depending on whether there is oil mixed with the fuel, or whether there is unburned fuel present, the smell of the exhaust gas differs. When oil is mixed in, the exhaust gas smells like burning oil.**
- **The engines equipped with the DC motor type turbochargers have a turbocharger on each bank. Identifying the malfunctioning bank is necessary to repair the engine.**

Result

Result	Proceed to
Yes (white smoke is emitted only just after engine start)	A
No (white smoke is always and continuously emitted)	B

B → Go to step 18

A

6.CHECK TEMPERATURE WHEN WHITE SMOKE IS EMITTED

a. Check whether the white smoke is emitted only in cold weather when the temperature is less than 0°C (32°F).

HINT:

- **If the white smoke is emitted only in cold conditions, the smoke is not from the turbocharger and may be the smoke of unburned fuel.**
- **If misfiring occurs, unburned fuel is emitted.**

Result

Result	Proceed to
Yes (white smoke is emitted in only cold conditions)	A
No (white smoke is emitted in both cold and warm conditions)	B

B → Go to step 8

A

7.INSPECT GLOW PLUG ASSEMBLY (RESISTANCE)

a. Inspect the glow plug assembly (Click here).

NG → REPLACE GLOW PLUG ASSEMBLY (Click here)

OK

8.CHECK INJECTOR COMPENSATION CODE

a. Read the injector compensation codes (Click here).

OK:
Compensation codes stored in the ECM match compensation codes of the installed fuel injectors.

HINT:

If those do not match, register correct compensation code.

NG → REGISTER INJECTOR COMPENSATION CODE (Click here)

OK

9.CHECK FUEL SYSTEM (DIESEL INJECTION SYSTEM)

a. Check the fuel system (Click here).

NG → REPAIR OR REPLACE FUEL SYSTEM

OK

10.CHECK EGR VALVE ASSEMBLY (NO. 1 AND NO. 2)

HINT:

- **If the amount of EGR is excessive due to a failure of the EGR valve, combustion when the coolant temperature is cold becomes unstable and leads to misfire.**
- **When the EGR valve cannot completely close, a lack of power is felt and the MAF sensor value deviates from the standard value.**

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester ON.

c. Enter the following menus: Powertrain / Engine / Data List / EGR Close Lrn. Status and EGR Close Lrn. Status #2.

d. Read the values.

OK:
EGR Close Lrn. Status and EGR Close Lrn. Status #2 are OK

e. Enter the following menus: Powertrain / Engine / Active Test / Control the EGR Step Position or Control the EGR Step Position #2.

f. When changing the Active Test value, check that Actual EGR Valve Pos. or Actual EGR Valve Pos. #2 smoothly changes to the set opening angle.

OK:
Values smoothly change to set opening angle.

g. Remove the EGR valves (Click here).

h. Visually check the EGR valves for deposits. If there are deposits, clean the EGR valve and EGR passage (intake/exhaust manifold, EGR cooler, EGR pipes, etc.).

NOTICE:

- **When cleaning the EGR valve, make sure the valve is completely closed.**
- **Do not forcibly open the valve, as it may be damaged or deformed.**

- **When cleaning the EGR valve, use a piece of cloth soaked with cleaning solvent. Spraying the solvent directly onto these parts or soaking the parts in the solvent may damage the parts.**

i. Hold the EGR valve up to a light, and visually check that there is no gap between the valve and body.

OK:
No light passes through (there is no gap between the valve and body).

HINT:

- **If light passes through (there is a gap between the valve and body), replace the EGR valve assembly.**
- **If any inspection result above is NG, check the EGR system, referring to the inspection procedure for DTC P0400 (P1248).**

NG → GO TO EGR SYSTEM INSPECTION PROCEDURE (DTC P0400/P1248) (Click here)

OK

11.CHECK CYLINDER COMPRESSION PRESSURE

a. Check the cylinder compression pressure (Click here).

HINT:

- **Active Test function "Check the Cylinder Compression" helps determine whether a cylinder has compression loss or not.**
  1. **Connect the intelligent tester to the DLC3.**
  2. **Turn the ignition switch to ON and turn the tester ON.**
  3. **Enter the following menus: Powertrain / Engine / Active Test / Check the Cylinder Compression / Data List / Compression / Engine Speed of Cyl #1 to #8.**
  4. **Press the RIGHT or LEFT button to change the Check the Cylinder Compression to ON.**
  5. **Crank the engine until the monitor item values Engine speed of Cyl #1 to #8 and Av Engine Speed of All Cyl change.**
  6. **Check the engine speed.**

     Standard:
     The values of Engine Speed Cyl #1 to #8 are within +/-10 rpm of each other.

  7. **When cranking, if the speed of a cylinder is approximately 100 rpm more than the other cylinders, there is probably a complete loss of compression in that cylinder.**

HINT:

- **If any of following malfunctions occurs, white smoke is emitted.**
  1. **Nozzle seat sealing failure**
  2. **Piston cracking**
  3. **Piston rings breakage**
- **To check whether the pistons and piston rings have a malfunction, remove the oil level dipstick. If oil sprays out, the pressure inside the crankcase has risen which indicates that there is a malfunction in a piston or piston ring.**

NG → CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

12.REPLACE TURBOCHARGER SUB-ASSEMBLY (NO. 1 OR NO. 2)

a. Replace either No. 1 or No. 2 turbocharger sub-assembly which is on the malfunctioning bank confirmed in procedure 5 (Click here).

NEXT

13.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Check whether the white smoke problem has been successfully repaired by starting the engine.

NEXT

END

14.INSPECT COMPRESSOR INLET

a. Remove the air cleaner hose from the compressor inlet (remove the inlet compressor elbow if necessary).

b. Check whether an excessive amount of oil is present or not, and whether excessive oil deposits are attached to the compressor impeller or not.

HINT:

- **A certain amount of oil may be present as shown in fig. 2 in "Description", because a certain amount of oil mist is contained in the PCV gas and this oil accumulates just before the compressor inlet.**
- **If an excessive amount of oil is present at the compressor inlet, there may be a problem in the PCV system.**

c. Reinstall the air cleaner hose (inlet compressor elbow).

NEXT

15.INSPECT COMPRESSOR OUTLET

a. Remove the air hose from the compressor outlet.

b. Check whether or not an excessive amount of oil or excessive oil deposits are present at the compressor outlet.

HINT:

A certain amount of oil may be present as shown in fig. 3 in "Description", because a certain amount of oil mist is contained in the PCV gas.

Result

Result	Proceed to
Excessive amount of oil present at both compressor inlet and outlet	C
Excessive amount of oil present only at compressor outlet	B
Excessive amount of oil not present at compressor inlet and outlet	A

c. Reinstall the air hose.

B	Go to step 18
C	CHECK PCV SYSTEM

A

16.INSPECT TURBINE OUTLET

a. Check whether an excessive amount of wet oil or excessive oil deposits are present at the turbine outlet.

HINT:

Be sure not to mistake carbon soot for oil.

NEXT

17.INSPECT TURBINE INLET

a. Remove the turbocharger from the engine.

b. Check whether an excessive amount of wet oil or excessive oil deposits are present at the turbine inlet.

HINT:

- **Be sure not to mistake carbon soot for oil.**
- **If the turbocharger shaft is tilted, some amount of oil will flow out from the bearing housing. Therefore, be sure not to mistake oil that flowed out from the bearing housing during or after the removal of the turbocharger for oil that was present before the removal of the turbocharger.**
- **If an excessive amount of oil or excessive oil deposits are present at the turbine inlet, this oil is coming from the exhaust port of the cylinders, and may indicate a problem in 1 or more cylinders.**

Result

Result	Proceed to
Excessive amount of oil present at both turbine inlet and outlet	B
Excessive amount of oil present only at turbine outlet	A

B → CHECK ENGINE TO DETERMINE CAUSE OF OIL IN TURBOCHARGER

A

18.REPLACE TURBOCHARGER SUB-ASSEMBLY (NO. 1 OR NO. 2)

a. Replace either No. 1 or No. 2 turbocharger sub-assembly which is on the malfunctioning bank confirmed in procedure 5 / procedures 14 to 17 (Click here).

NEXT

19.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Check whether the oil leakage problem has been successfully repaired.

NEXT

END

for Preparation Click here

DESCRIPTION

HINT:

Turbocharger noise is classified into 2 types. One is whistling noise, and the other is whining noise. When troubleshooting, the type of noise should be determined first.

Description

Noise Type	Noise Description	Main Trouble Area
Whistling noise	The volume and pitch of this noise are proportional to turbocharger speed or engine speed. Therefore, the noise level will become more obvious when engine speed increases.	• Turbocharger (e.g. shaft imbalance) • Gears inside engine • Transmission gear • Intake air system leakage • Intake air system breakage
Whining noise	This noise has a lower pitch than whistling noise. It generally occurs in the engine speed range of 1500 to 2500 rpm, and has a relatively constant pitch, independent of engine speed and vehicle speed.	Turbocharger **HINT:** • **Example: Vibration of turbocharger is transferred to exhaust pipe which causes resonation and noise.** • **Example: Vibration of turbocharger is transferred through exhaust pipe to vehicle body (floor) which then vibrates causing noise.**

Faults and Symptoms of Diesel Engine Components

Turbocharger System

Main fault	Turbocharger turbine shaft imbalance
Symptoms	High-pitched whistling noise **HINT:** The pitch and volume change in proportion to the turbocharger speed.

Intake System

Main fault	Leakage
Symptoms	Leak flow noise

Gear inside Engine

Symptoms	Gear noise **HINT:** The pitch and volume change in proportion to the engine speed.

Transmission Gear

Symptoms	Gear noise **HINT:** The pitch and volume change in proportion to the transmission gear speed.

INSPECTION PROCEDURE

1.CONFIRM CONDITION IN WHICH NOISE OCCURRED

a. Confirm with the customer the conditions in which the noise occurred.

HINT:

To clearly understand the conditions in which the noise occurred, the items in the table below are useful.

Item	Note
Engine speed	Engine speed range
Vehicle speed	Vehicle speed range
Transmission gear	Which gear?
Accelerator pedal position	During acceleration or deceleration?
Temperature	• Ambient temperature • Engine temperature (cold, warmed up, etc.)
Road conditions	• City or highway driving • Uphill or downhill
Noise level	• Did the noise occur suddenly, or build gradually? • Has the noise gradually been getting louder?
Other symptoms	• Lack of power • High fuel consumption, etc.
Noise recognition	What made the customer determine the noise to be abnormal?

NEXT

2.CONFIRM NOISE CUSTOMER MENTIONED (PROCEDURE 2)

a. Check for the noise described by the customer.

HINT:

If a noise is heard, make sure that the noise matches the noise described by the customer.

Result

Result	Proceed to
Obvious abnormal noise matching noise described by customer is confirmed	A
Obvious abnormal noise matching noise described by customer is not confirmed	B

B → Go to step 12

A

3.CHECK INTAKE SYSTEM

a. Check for air leakage between the air cleaner and turbocharger, and between the turbocharger and intake manifold.

HINT:

- **Check for disconnected or improperly connected hoses, and gaps between hoses and parts.**
- **Check for foreign matter between the air cleaner and turbocharger.**

NG → REPAIR OR REPLACE MALFUNCTIONING PARTS

OK

4.CONFIRM NOISE SOURCE (FROM TURBOCHARGER OR NOT)

a. Connect the intelligent tester to the DLC3.

HINT:

The software version installed on the intelligent tester must be V2009.2 or later.

b. Start the engine and warm it up.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine / Active Test / Activate the VN Turbo Open.

HINT:

This Active Test function operates both the turbocharger actuators (bank 1 and bank 2) at the same time.

e. Perform the Active Test and rev the engine up several times.

f. Check whether the noise is reduced or not compared with the noise under the condition that the Active Test is not performed.

Result

Result	Proceed to
The noise is reduced (or disappears)	A
The noise is the same as in Procedure 2 (The noise does not change)	B

HINT:

- **When the variable nozzle of the turbocharger opens fully regardless of the engine condition, the turbocharger speed slows down and the cause of noise can be confirmed that is from the turbocharger or not.**
- **If the turbocharger is the cause of the noise, the noise will be reduced when the variable nozzle opens because turbocharger speed does not increase.**

B → Go to step 9

A

5.CONFIRM THE NOISE TYPE (PROCEDURE 5)

a. Check whether the noise can be heard even when the engine speed is more than 3000 rpm, and whether the noise gradually gets louder as the engine speed increases.

HINT:

If so, the noise is likely to be whistling noise. If not, the noise is likely to be whining noise.

b. If whistling noise is confirmed on the above inspection, identify the malfunctioning turbocharger (No. 1 or No. 2) using a sound scope.

Result

Result	Proceed to
Yes (The noise is likely to be whistling noise)	A
No (The noise is likely to be whining noise)	B

B → Go to step 8

A

6.REPLACE TURBOCHARGER SUB-ASSEMBLY (NO. 1 OR NO. 2)

a. Replace either No. 1 or No. 2 turbocharger sub-assembly which is on the malfunctioning bank confirmed in procedure 5 (Click here).

NEXT

7.CONFIRM WHETHER THE NOISE PROBLEM HAS BEEN SUCCESSFULLY SOLVED

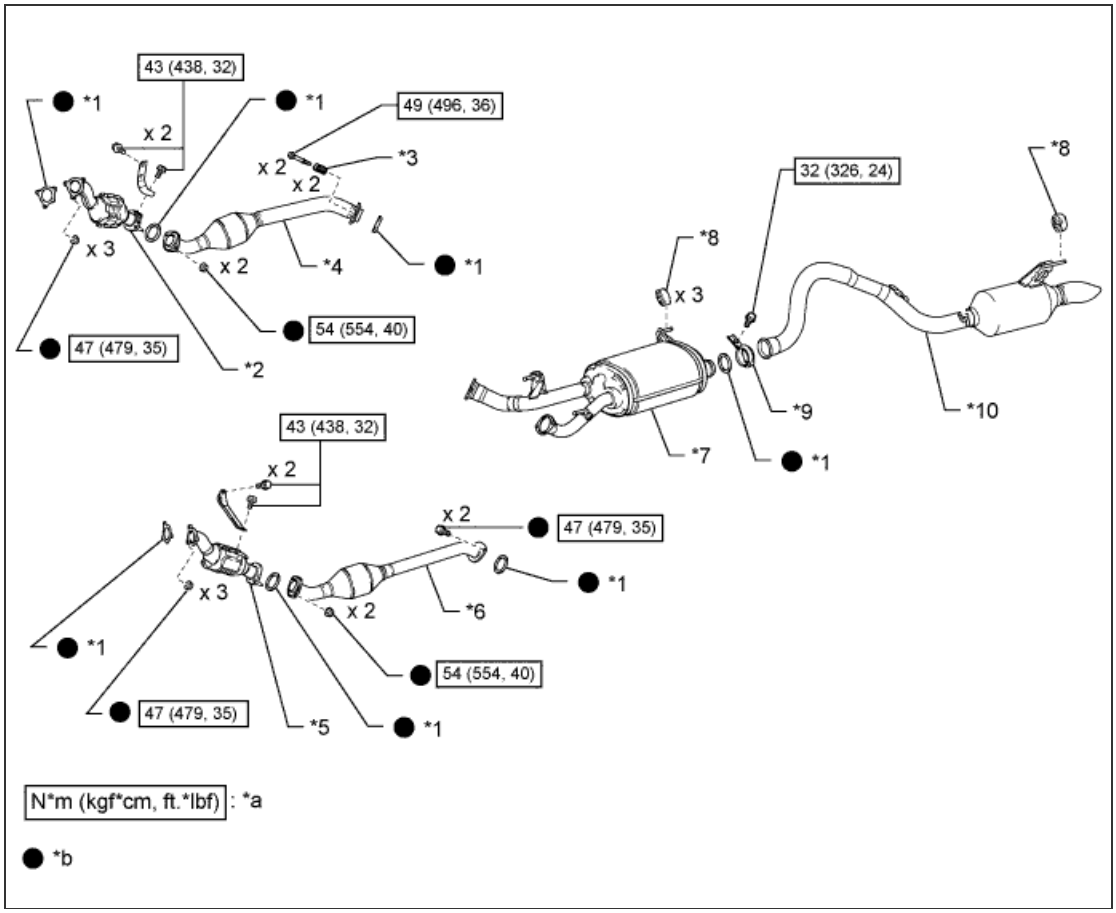
a. Check whether the noise problem has been successfully solved.

NEXT

END

8.PERFORM ALIGNMENT OF EXHAUST PIPE AND CONFIRM THE NOISE

a. Disconnect the exhaust pipe at the ball joint and from each exhaust pipe support, and then realign the exhaust pipe and reconnect it to each exhaust pipe support and at the ball joint (Click here).



Text in Illustration

*1	Gasket	*2	Monolithic Converter Assembly RH
*3	Compression Spring	*4	Front No. 1 Exhaust Pipe Assembly
*5	Monolithic Converter Assembly LH	*6	Front No. 2 Exhaust Pipe Assembly
*7	Center Exhaust Pipe Assembly	*8	Exhaust Pipe Support
*9	Clamp	*10	Tail Pipe Assembly
*a	Specified torque	*b	Non-reusable part

HINT:

Above illustration is an example.

b. Confirm whether the noise problem is solved or not.

HINT:

The alignment of the exhaust pipe affects whining noise.

Result

Result	Proceed to
The noise problem is solved	A
The noise problem remains	B*

HINT:

*: If the noise problem still remains, replace both the No. 1 and No. 2 turbocharger sub-assembly.

B → REPLACE TURBOCHARGER SUB-ASSEMBLY (Click here)

A → END

9.CHECK FOR NOISE FROM SOURCE OTHER THAN TURBOCHARGER (PROCEDURE 9)

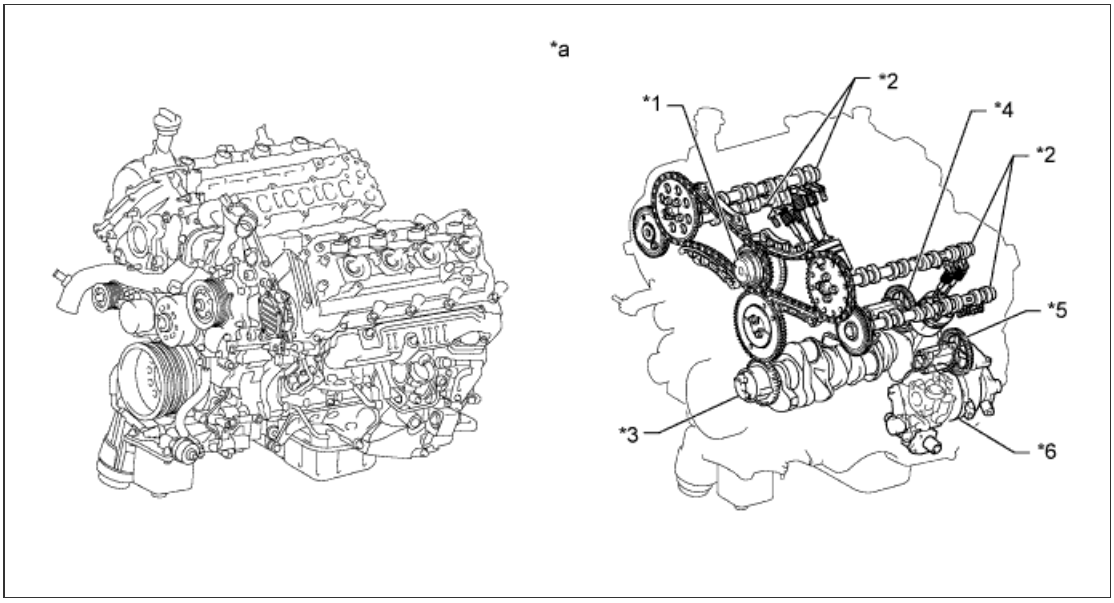
a. Check for the noise source with a sound scope.

NOTICE:

When performing this check, make sure that the sound scope, your body, etc., do not get caught on the V-belt.

HINT:

- **The source of the noise is not the turbocharger, but a part other than the turbocharger (e.g. a part inside the engine, transmission, or vacuum pump).**
- **Sometimes gear noise may be mistaken for turbocharger noise. For gear noise, pay attention to the gear inside the engine and transmission gear.**
- **Rev the engine up and check if the noise reduces at the same time the engine speed decreases. If the noise reduces at the same time the engine speed decreases, it is gear noise. If the noise reduces a short time after the engine speed decreases, it is turbocharger noise.**
- **The following illustration is a reference for checking whether the noise source is from the engine.**



Text in Illustration

*1	Supply Pump Drive Gear	*2	Camshafts
*3	Crankshaft	*4	Oil Pump
*5	Scavenging Pump	*6	Turbocharger
*a	Gear Location inside Engine	-	-

HINT:

- **Above illustration is an example.**
- **Gear noise can be confirmed with a sound scope. Put the sound scope on the cylinder block near the gear, and if the noise heard through the sound scope has the same timing as the noise heard without the sound scope, it is gear noise.**

NEXT

10.REPLACE THE PARTS DETECTED IN PROCEDURE 9

a. Replace the parts detected in Procedure 9 as the noise source.

NEXT

11.CONFIRM WHETHER THE NOISE PROBLEM HAS BEEN SUCCESSFULLY SOLVED

a. Check whether the noise problem has been successfully solved.

NEXT

END

12.EXPLAIN TO THE CUSTOMER THAT THE NOISE IS NORMAL

a. Explain to the customer that the noise the customer mentioned is not abnormal.

HINT:

To help the customer understand, test driving another car with the customer may be helpful.

NEXT

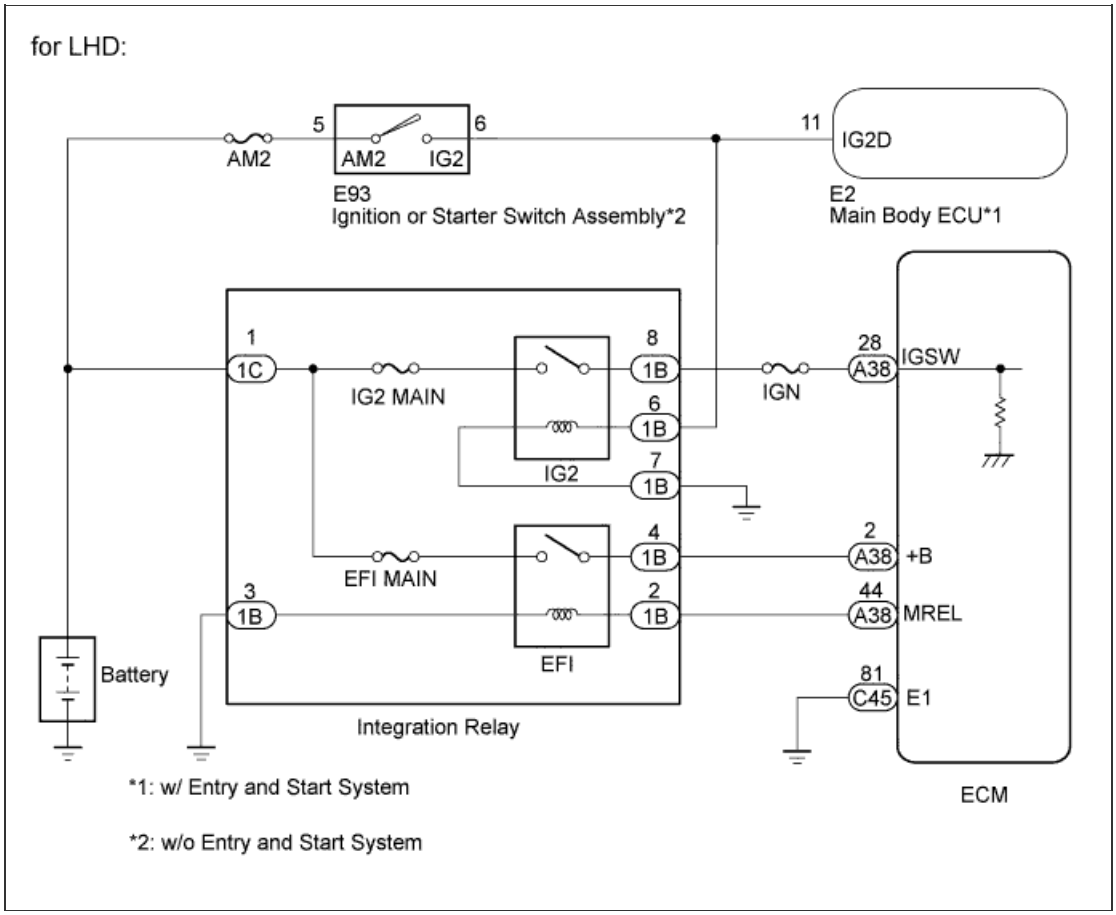
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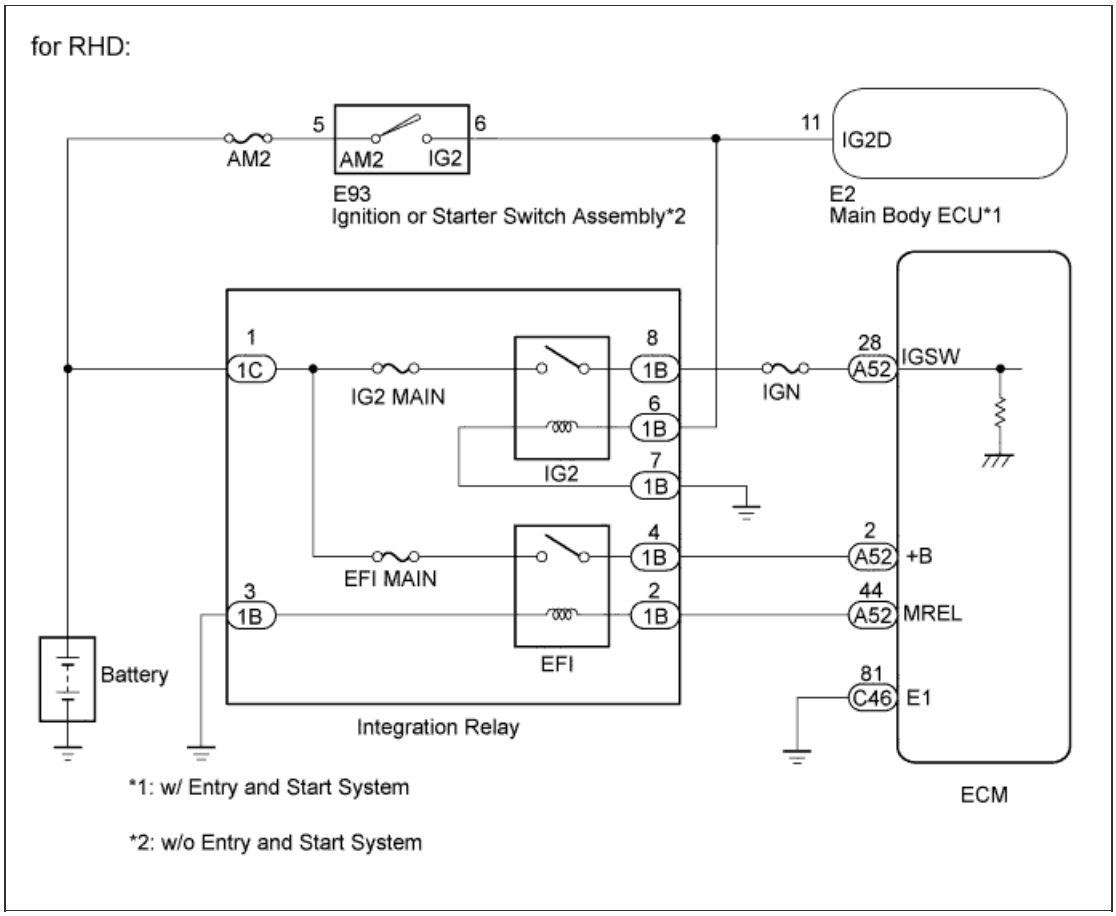
for Preparation Click here

DESCRIPTION

When the ignition switch is turned to ON, the battery voltage is applied to the IGSW terminal of the ECM. The output signal from the MREL terminal of the ECM causes current to flow to the coil, closing the contacts of the integration relay (EFI MAIN relay) and supplying power to terminal of the ECM.

WIRING DIAGRAM





INSPECTION PROCEDURE

1.INSPECT INTEGRATION NO.1 RELAY (INTEGRATION RELAY - BODY GROUND)

a. Remove the integration relay from the engine room relay block.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

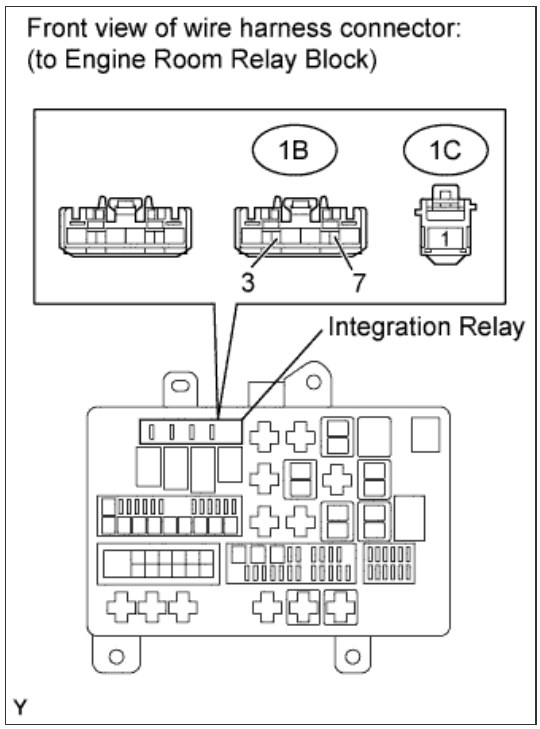
Tester Connection	Condition	Specified Condition
1C-1 - Body ground	Always	11 to 14 V

c. Measure the voltage according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1B-3 - Body ground	Always	Below 1 Ω
1B-7 - Body ground	Always	Below 1 Ω

d. Reinstall the integration relay.



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2.INSPECT INTEGRATION NO.1 RELAY (EFI RELAY AND IG2 RELAY)

a. Remove the integration relay from the engine room relay block.

b. Inspect the EFI MAIN fuse and the IG2 MAIN fuse.

i. Remove the EFI MAIN fuse and IG2 MAIN fuse from the integration relay.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

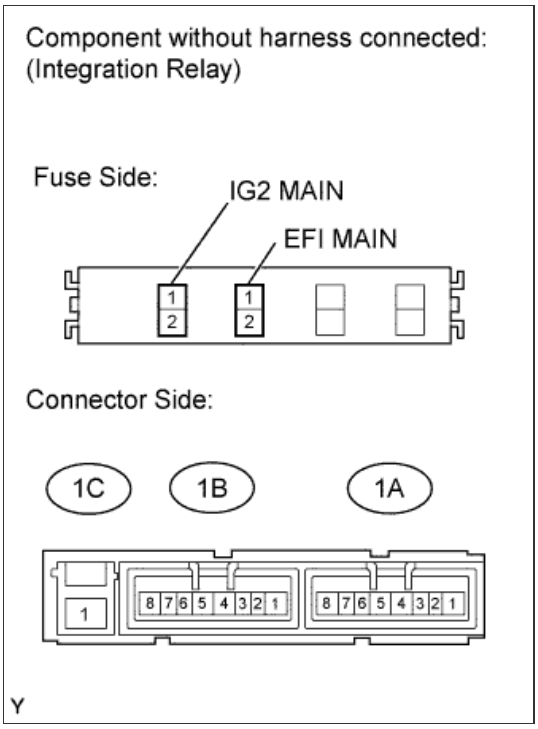
Tester Connection	Condition	Specified Condition
EFI MAIN fuse	Always	Below 1 Ω
IG2 MAIN fuse	Always	Below 1 Ω

c. Inspect the EFI relay and the IG2 relay.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1B-4	Battery voltage not applied to terminals 1B-2 and 1B-3	10 kΩ or higher
	Battery voltage applied to terminals 1B-2 and 1B-3	Below 1 Ω
1C-1 - 1B-8	Battery voltage not applied to terminals 1B-7 and 1B-6	10 kΩ or higher
	Battery voltage applied to terminals 1B-7 and 1B-6	Below 1 Ω



NG → REPLACE INTEGRATION RELAY

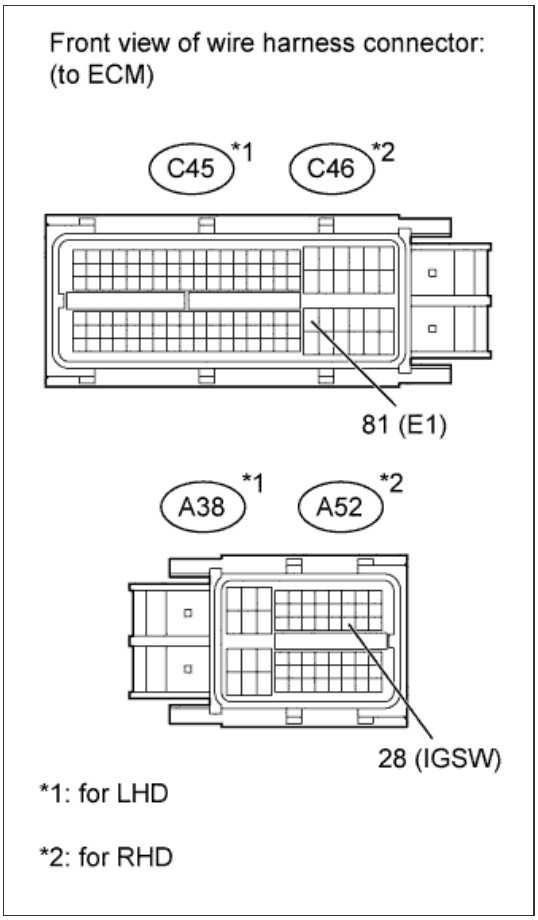
OK

3.INSPECT ECM (IGSW VOLTAGE)

a. Disconnect the ECM connectors.

b. Turn the ignition switch to ON.

c. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for LHD

Tester Connection	Switch Condition	Specified Condition
A38-28 (IGSW) - C45-81 (E1)	Ignition switch ON	11 to 14 V

for RHD

Tester Connection	Switch Condition	Specified Condition
A52-28 (IGSW) - C46-81 (E1)	Ignition switch ON	11 to 14 V

NG → Go to step 5

OK

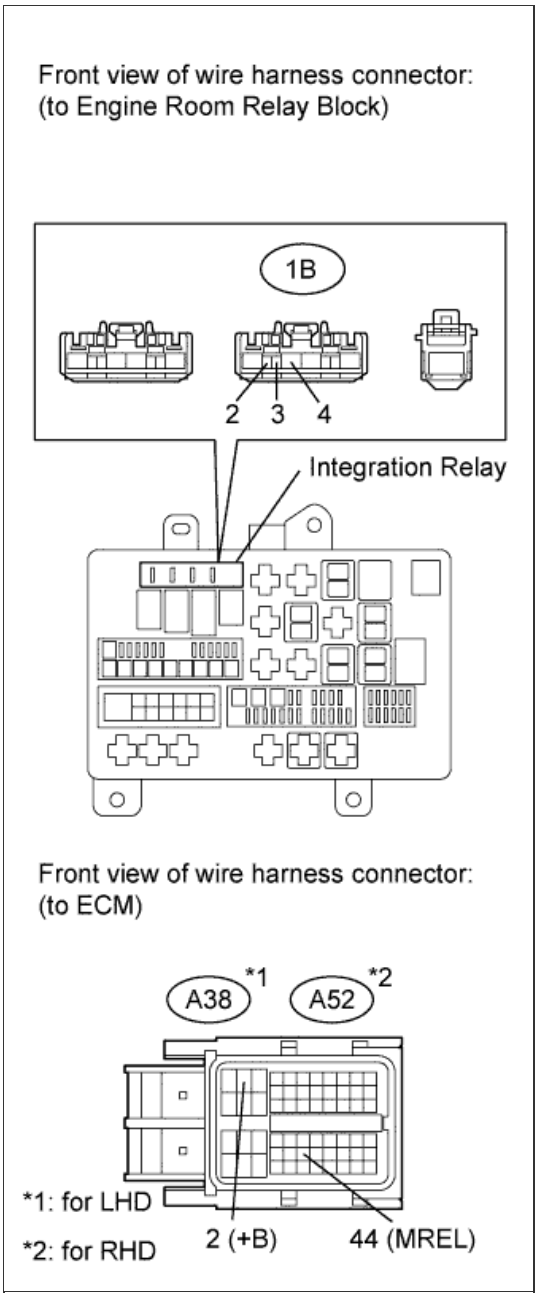
4.CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - ECM)

a. Check the harness and the connectors between the integration relay and the ECM.

b. Remove the integration relay from the engine room relay block.

c. Disconnect the ECM connector.

d. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A38-44 (MREL) - 1B-2	Always	Below 1 Ω
A38-2 (- 1B-4	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
A52-44 (MREL) - 1B-2	Always	Below 1 Ω
A52-2 (- 1B-4	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A38-44 (MREL) or 1B-2 - Body ground	Always	10 kΩ or higher
A38-2 (or 1B-4 - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition

A52-44 (MREL) or 1B-2 - Body ground	Always	10 kΩ or higher
A52-2 (or 1B-4 - Body ground	Always	10 kΩ or higher

e. Reconnect the ECM connector.

f. Reinstall the integration relay.

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM

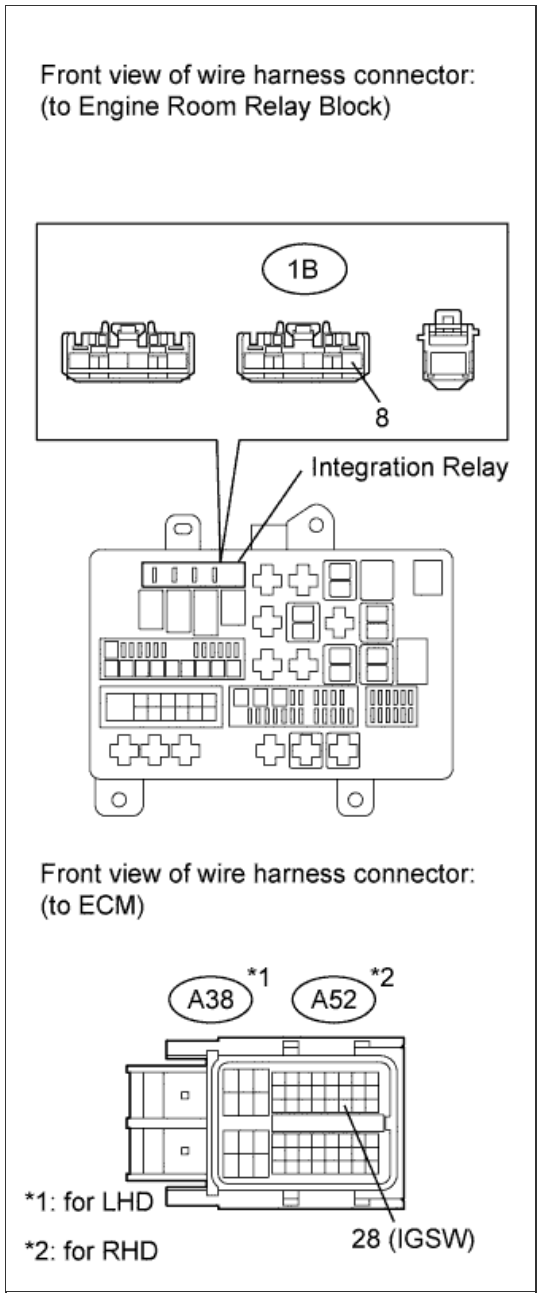
5.CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - ECM)

a. Check the harness and the connectors between the integration relay and the ECM.

b. Remove the integration relay from the engine room relay block.

c. Disconnect the ECM connector.

d. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
A38-28 (IGSW) - 1B-8	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition

A52-28 (IGSW) - 1B-8	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
A38-28 (IGSW) or 1B-8 - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
A52-28 (IGSW) or 1B-8 - Body ground	Always	10 kΩ or higher

e. Reconnect the ECM connector.

f. Reinstall the integration relay.

Result

Result	Proceed to
OK (w/ Entry and Start System)	A
OK (w/o Entry and Start System)	B
NG	C

B → Go to step 7

C → REPAIR OR REPLACE HARNESS OR CONNECTOR

A

6.CHECK HARNESS AND CONNECTOR (MAIN BODY ECU - INTEGRATION RELAY)

a. Remove the integration relay from the engine room relay block.

b. Disconnect the IG2D main body ECU connector.

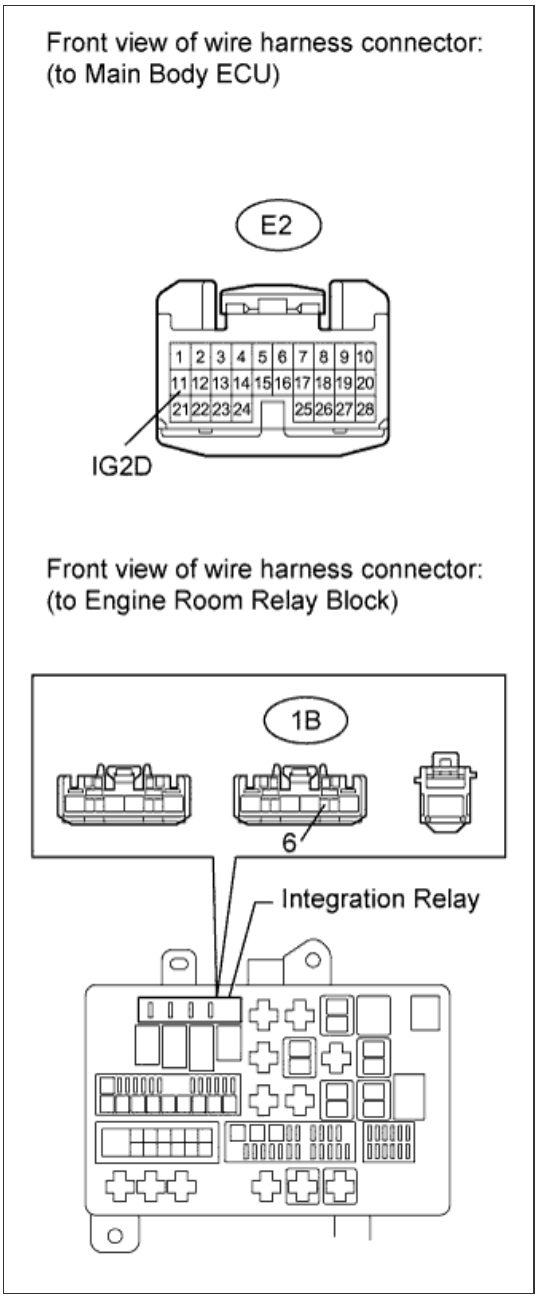
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
E2-11 (IG2D) - 1B-6	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
E2-11 (IG2D) or 1B-6 - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK ENTRY AND START SYSTEM

7.CHECK HARNESS AND CONNECTOR (IGNITION OR STARTER SWITCH ASSEMBLY - INTEGRATION RELAY)

a. Remove the integration relay from the engine room relay block.

b. Disconnect the Ignition or Starter Switch Assembly connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
E93-6 (IG2) - 1B-6	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
E93-6 (IG2) or 1B-6 - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

8.INSPECT IGNITION OR STARTER SWITCH ASSEMBLY

a. Inspect the Ignition or Starter Switch Assembly (Click here).

NG → REPLACE IGNITION OR STARTER SWITCH ASSEMBLY

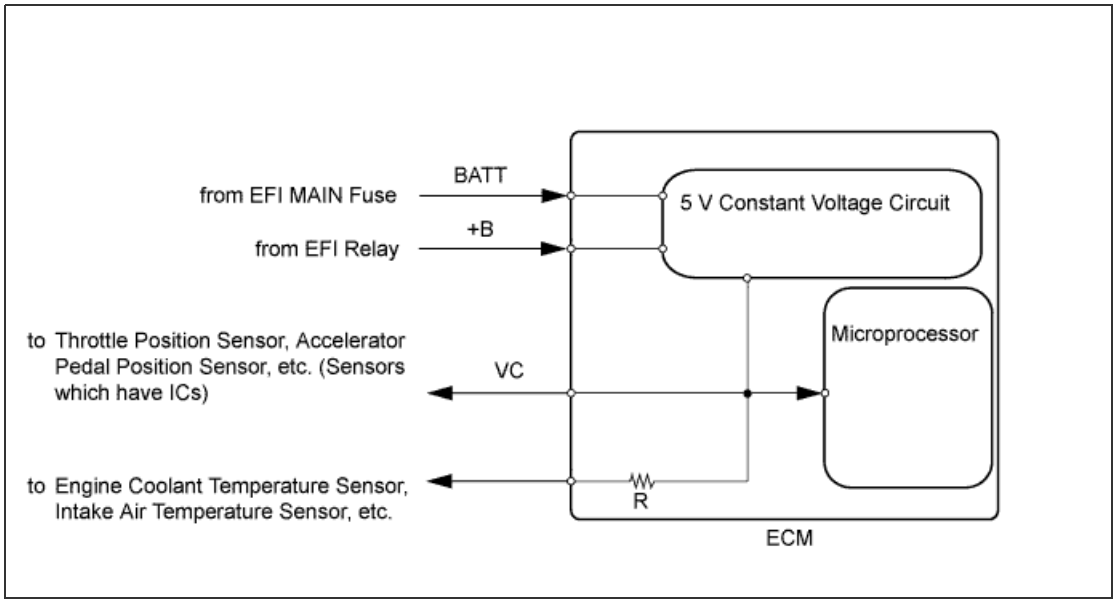
OK

REPAIR OR REPLACE HARNESS OR CONNECTOR (IGNITION SWITCH - BATTERY)

for Preparation Click here

DESCRIPTION

The ECM constantly generates 5 V of power from the battery voltage supplied to the +B (BATT) terminal to operate the microprocessor. The ECM also provides this power to the sensors through the VC output circuit.



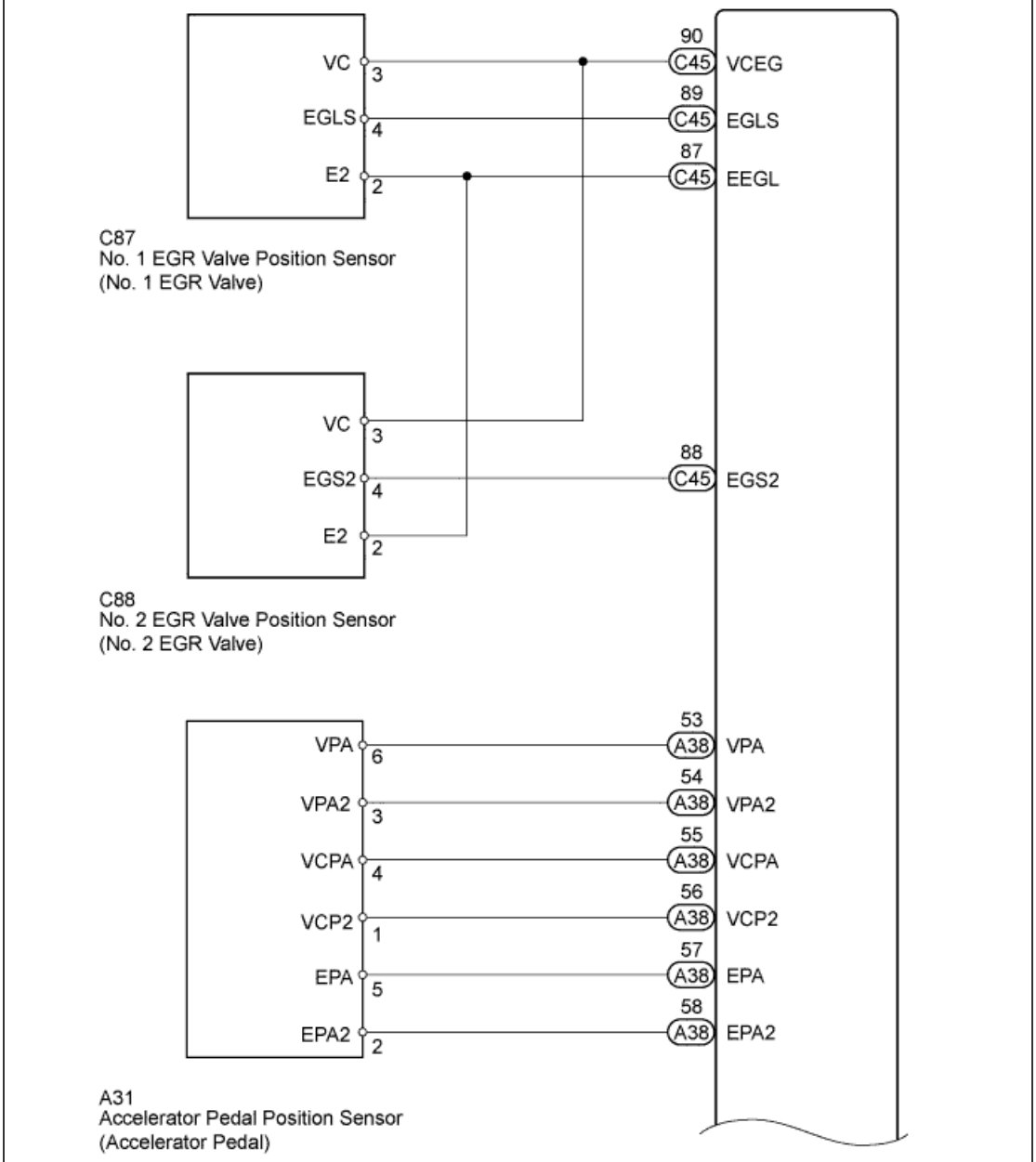
When the VC circuit is short-circuited, the microprocessor in the ECM and sensors that are supplied with power through the VC circuit are inactivated because the power is not supplied from the VC circuit. Under this condition, the system does not start up and the MIL does not illuminate even if the system malfunctions.

HINT:

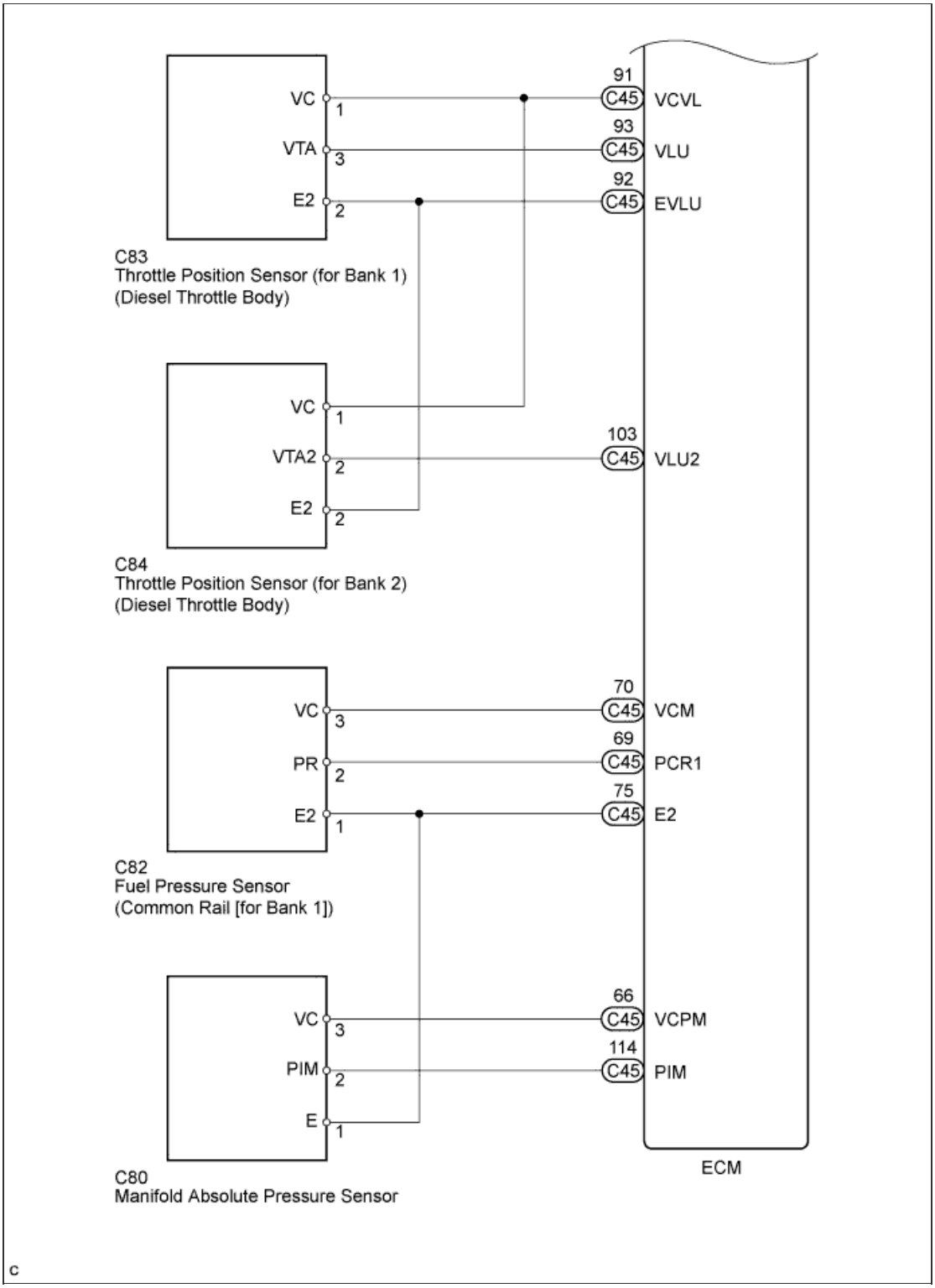
Under normal conditions, the MIL is illuminated for several seconds when the ignition switch is first turned to ON. The MIL goes off when the engine is started.

WIRING DIAGRAM

for LHD:

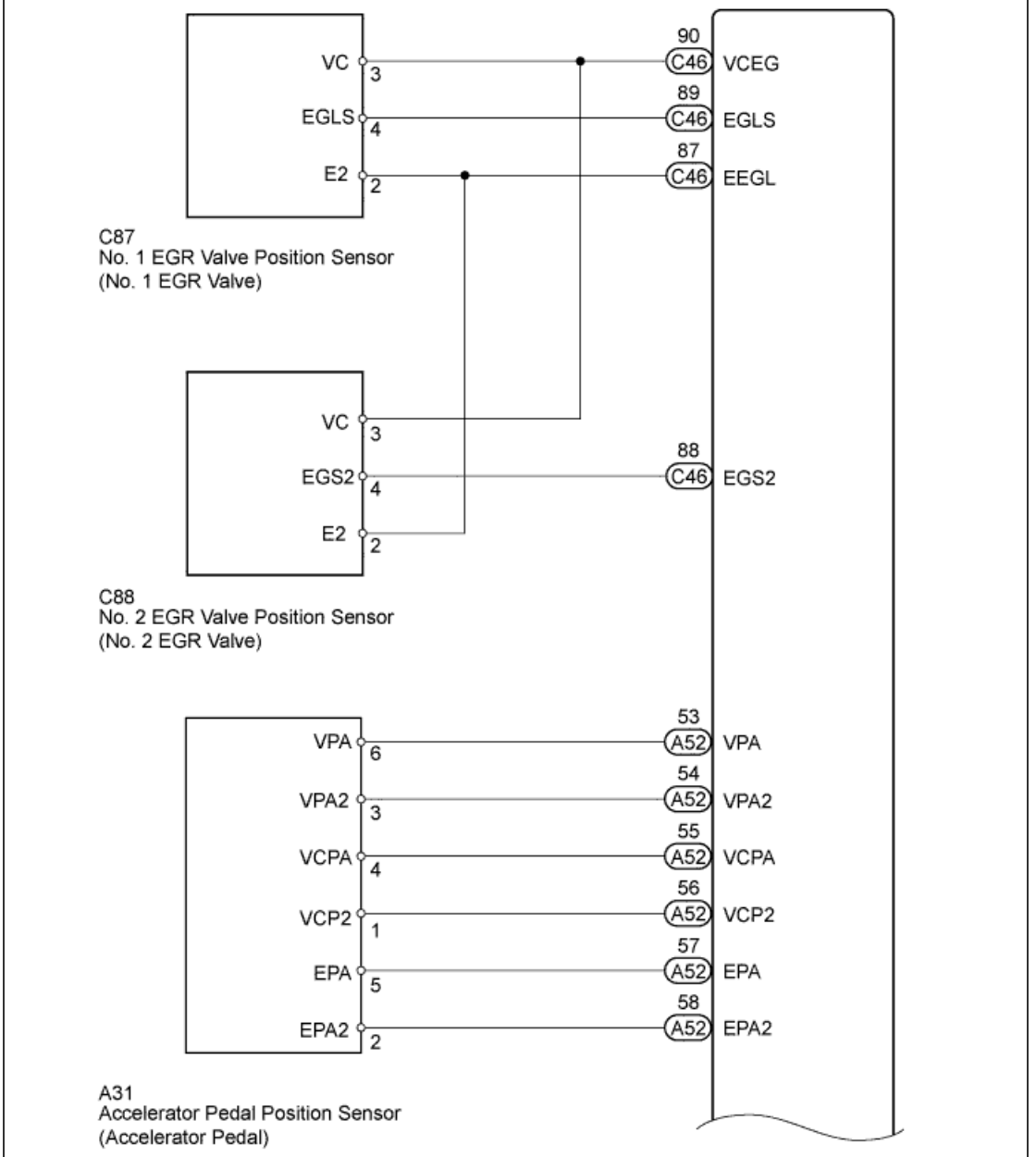

VC
3
EGLS
4
E2
2
90
C45
VCEG
89
C45
EGLS
87
C45
EEGL
C87
No. 1 EGR Valve Position Sensor
(No. 1 EGR Valve)
VC
3
EGS2
4
E2
2
88
C45
EGS2
C88
No. 2 EGR Valve Position Sensor
(No. 2 EGR Valve)
VPA
6
VPA2
3
VCPA
4
VCP2
1
EPA
5
EPA2
2
53
A38
VPA
54
A38
VPA2
55
A38
VCPA
56
A38
VCP2
57
A38
EPA
58
A38
EPA2
A31
Accelerator Pedal Position Sensor
(Accelerator Pedal)

c

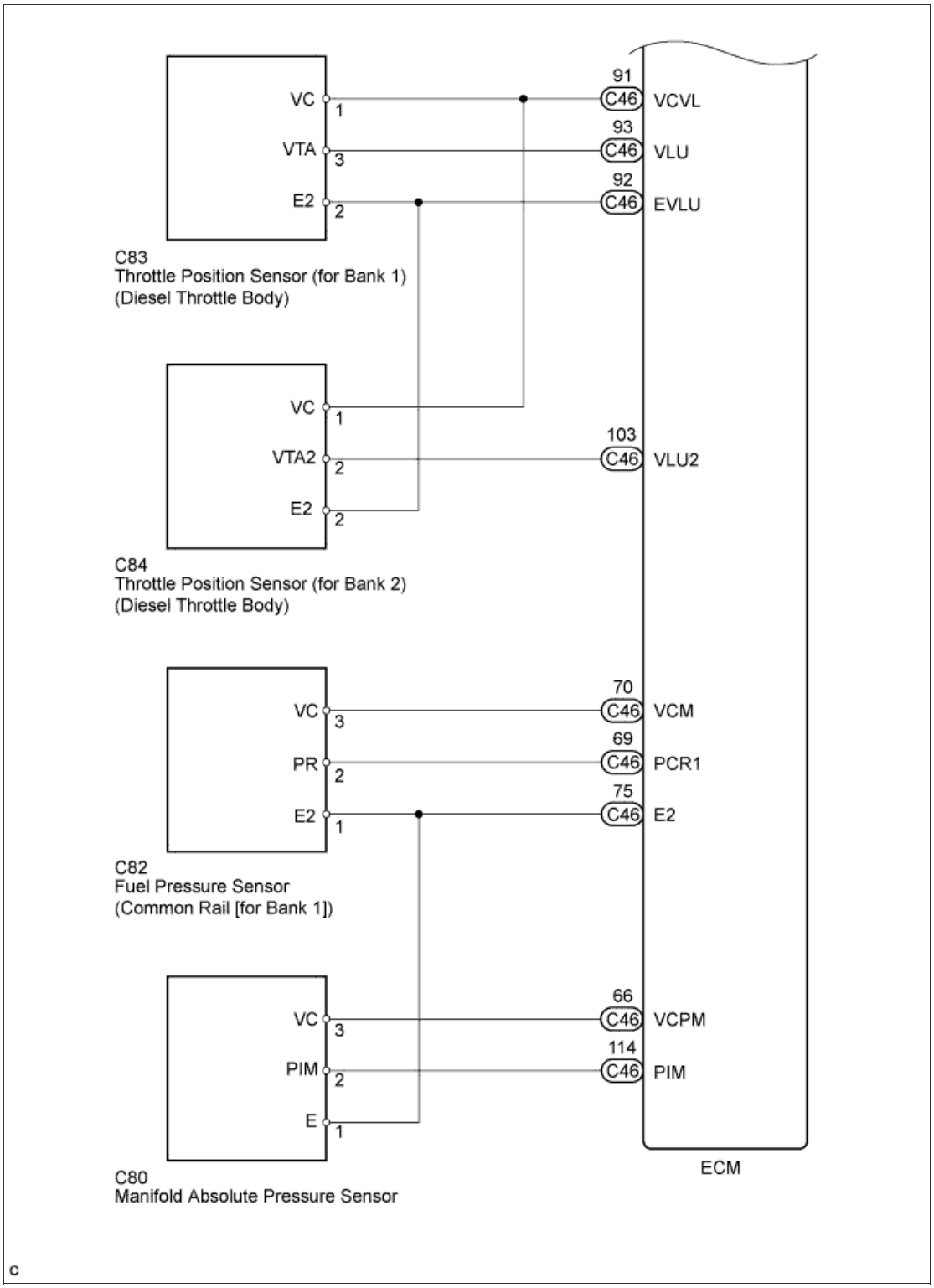

VC
1
VTA
3
E2
2
C83
Throttle Position Sensor (for Bank 1)
(Diesel Throttle Body)
91
C45
VCVL
93
C45
VLU
92
C45
EVLU
VC
1
VTA2
2
E2
2
C84
Throttle Position Sensor (for Bank 2)
(Diesel Throttle Body)
103
C45
VLU2
VC
3
PR
2
E2
1
C82
Fuel Pressure Sensor
(Common Rail [for Bank 1])
70
C45
VCM
69
C45
PCR1
75
C45
E2
VC
3
PIM
2
E
1
C80
Manifold Absolute Pressure Sensor
66
C45
VCPM
114
C45
PIM
ECM

c

for RHD:


VC
3
EGLS
4
E2
2
90
C46
VCEG
89
C46
EGLS
87
C46
EEGL
C87
No. 1 EGR Valve Position Sensor
(No. 1 EGR Valve)
VC
3
EGS2
4
E2
2
88
C46
EGS2
C88
No. 2 EGR Valve Position Sensor
(No. 2 EGR Valve)
VPA
6
VPA2
3
VCPA
4
VCP2
1
EPA
5
EPA2
2
53
A52
VPA
54
A52
VPA2
55
A52
VCPA
56
A52
VCP2
57
A52
EPA
58
A52
EPA2
A31
Accelerator Pedal Position Sensor
(Accelerator Pedal)

c



INSPECTION PROCEDURE

NOTICE:

After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).

1.CHECK MIL

a. Check that the Malfunction Indicator Lamp (MIL) lights up when turning the ignition switch to ON.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

A → END

B

2.CHECK COMMUNICATION BETWEEN INTELLIGENT TESTER AND ECM

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and tester on.

c. Check the communication between the tester and ECM.

Result

Result	Proceed to
Communication is possible	A
Communication is not possible	B

A → GO TO MIL CIRCUIT (Click here)

B

3.CHECK MIL (THROTTLE POSITION SENSOR (for Bank 1))

a. Disconnect the C83 throttle position sensor (for Bank 1) connector.

b. Turn the ignition switch to ON.

c. Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

d. Reconnect the C83 throttle position sensor (for Bank 1) connector.

A → REPLACE DIESEL THROTTLE BODY ASSEMBLY (for Bank 1) (Click here)

B

4.CHECK MIL (THROTTLE POSITION SENSOR (for Bank 2))

a. Disconnect the C84 throttle position sensor (for Bank 2) connector.

b. Turn the ignition switch to ON.

c. Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

d. Reconnect the C84 throttle position sensor (for Bank 2) connector.

A → REPLACE DIESEL THROTTLE BODY ASSEMBLY (for Bank 2) (Click here)

B

5.CHECK MIL (NO. 1 EGR VALVE POSITION SENSOR)

HINT:

For vehicles without EGR valve, perform troubleshooting from the next step.

a. Disconnect the C87 No. 1 EGR valve connector.

b. Turn the ignition switch to ON.

c. Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

d. Reconnect the C87 No. 1 EGR valve connector.

A → REPLACE NO. 1 EGR VALVE ASSEMBLY (Click here)

B →

6.CHECK MIL (NO. 2 EGR VALVE POSITION SENSOR)

HINT:

For vehicles without EGR valve, perform troubleshooting from the next step.

a. Disconnect the C88 No. 2 EGR valve connector.

b. Turn the ignition switch to ON.

c. Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

d. Reconnect the C88 No. 2 EGR valve connector.

A → REPLACE NO. 2 EGR VALVE ASSEMBLY (Click here)

B →

7.CHECK MIL (ACCELERATOR PEDAL POSITION SENSOR)

a. Disconnect the A31 accelerator pedal position sensor connector.

b. Turn the ignition switch to ON.

c. Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

d. Reconnect the A31 accelerator pedal position sensor connector.

A → REPLACE ACCELERATOR PEDAL ROD ASSEMBLY (Click here)

B →

8.CHECK MIL (MANIFOLD ABSOLUTE PRESSURE SENSOR)

a. Disconnect the C80 manifold absolute pressure sensor connector.

b. Turn the ignition switch to ON.

c. Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

d. Reconnect the C80 manifold absolute pressure sensor connector.

A → REPLACE MANIFOLD ABSOLUTE PRESSURE SENSOR (Click here)

B

9.CHECK MIL (FUEL PRESSURE SENSOR)

a. Disconnect the C82 fuel pressure sensor connector.

b. Turn the ignition switch to ON.

c. Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

d. Reconnect the C82 fuel pressure sensor connector.

A → REPLACE COMMON RAIL (for Bank 1) (Click here)

B

10.CHECK HARNESS AND CONNECTOR

a. Disconnect the throttle position sensor (for Bank 1) connector.

b. Disconnect the throttle position sensor (for Bank 2) connector.

c. Disconnect the No. 1 EGR valve connector.

d. Disconnect the No. 2 EGR valve connector.

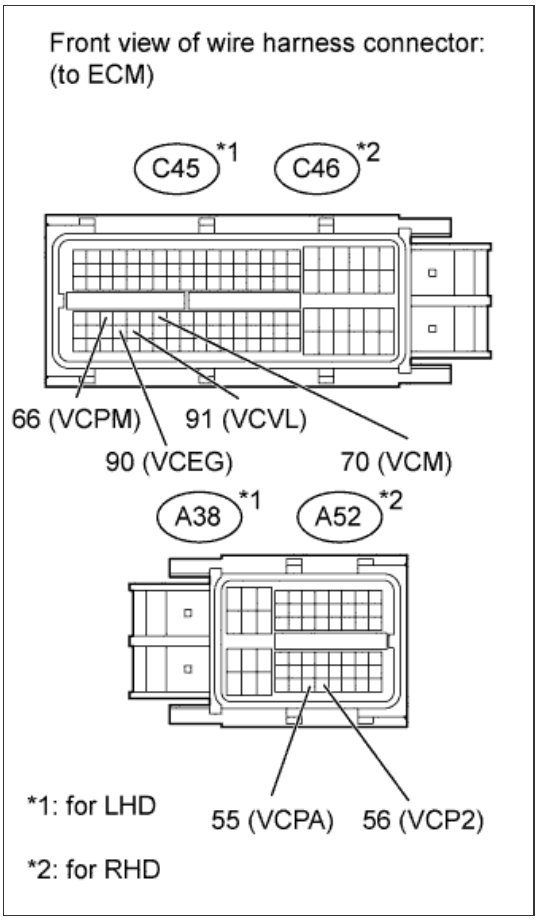
e. Disconnect the accelerator pedal position sensor connector.

f. Disconnect the manifold absolute pressure sensor connector.

g. Disconnect the fuel pressure sensor connector.

h. Disconnect the ECM connectors.

i. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C45-90 (VCEG) - Body ground	Always	10 kΩ or higher
C45-91 (VCVL) - Body ground	Always	10 kΩ or higher
C45-70 (VCM) - Body ground	Always	10 kΩ or higher
C45-66 (VCPM) - Body ground	Always	10 kΩ or higher
A38-55 (VCPA) - Body ground	Always	10 kΩ or higher
A38-56 (VCP2) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C46-90 (VCEG) - Body ground	Always	10 kΩ or higher
C46-91 (VCVL) - Body ground	Always	10 kΩ or higher
C46-70 (VCM) - Body ground	Always	10 kΩ or higher
C46-66 (VCPM) - Body ground	Always	10 kΩ or higher
A52-55 (VCPA) - Body ground	Always	10 kΩ or higher
A52-56 (VCP2) - Body ground	Always	10 kΩ or higher

j. Reconnect the throttle position sensor (for Bank 1) connector.

k. Reconnect the throttle position sensor (for Bank 2) connector.

l. Reconnect the No. 1 EGR valve connector.

m. Reconnect the No. 2 EGR valve connector.

n. Reconnect the accelerator pedal position sensor connector.

o. Reconnect the manifold absolute pressure sensor connector.

p. Reconnect the fuel pressure sensor connector.

q. Reconnect the ECM connectors.

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

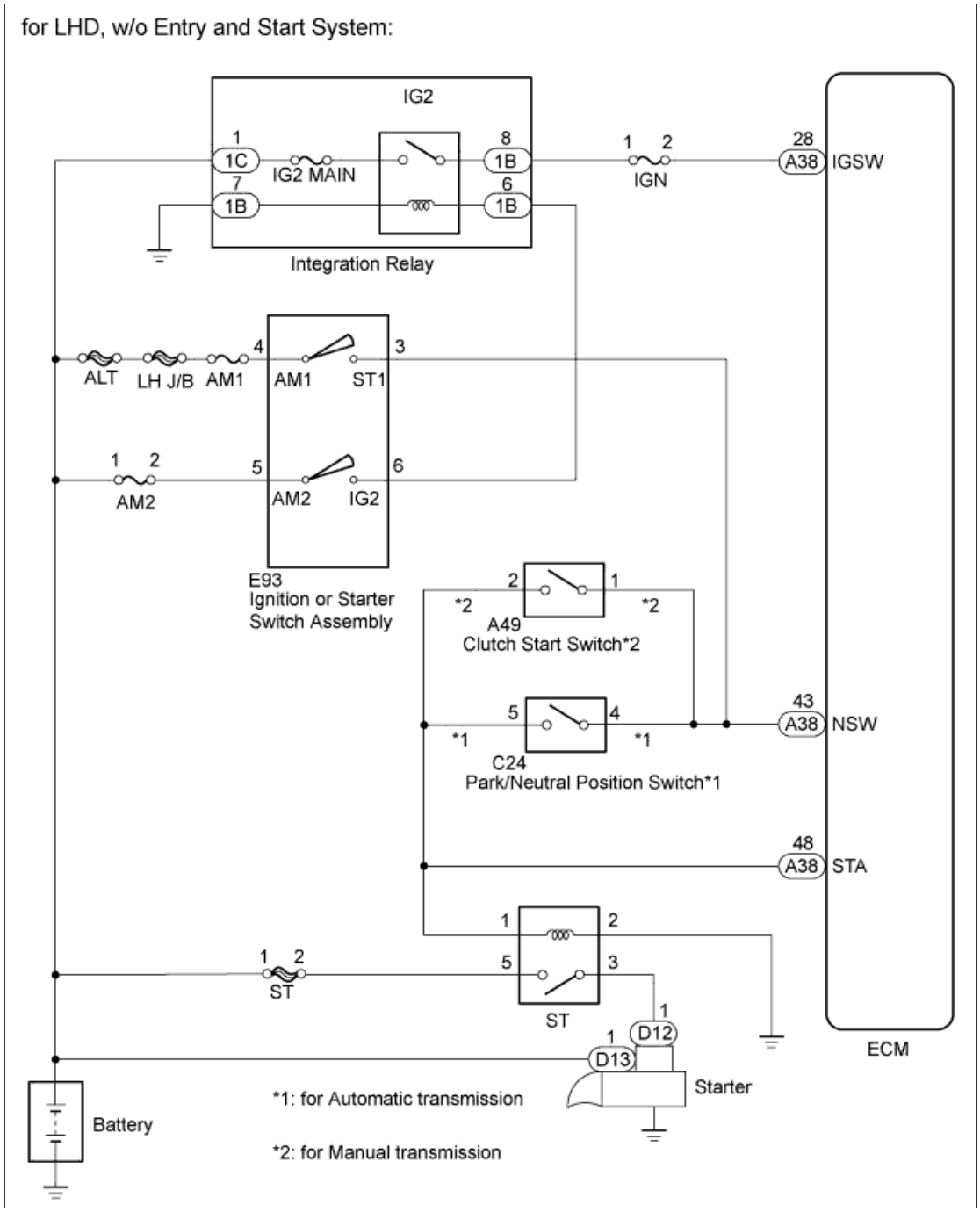
REPLACE ECM (Click here)

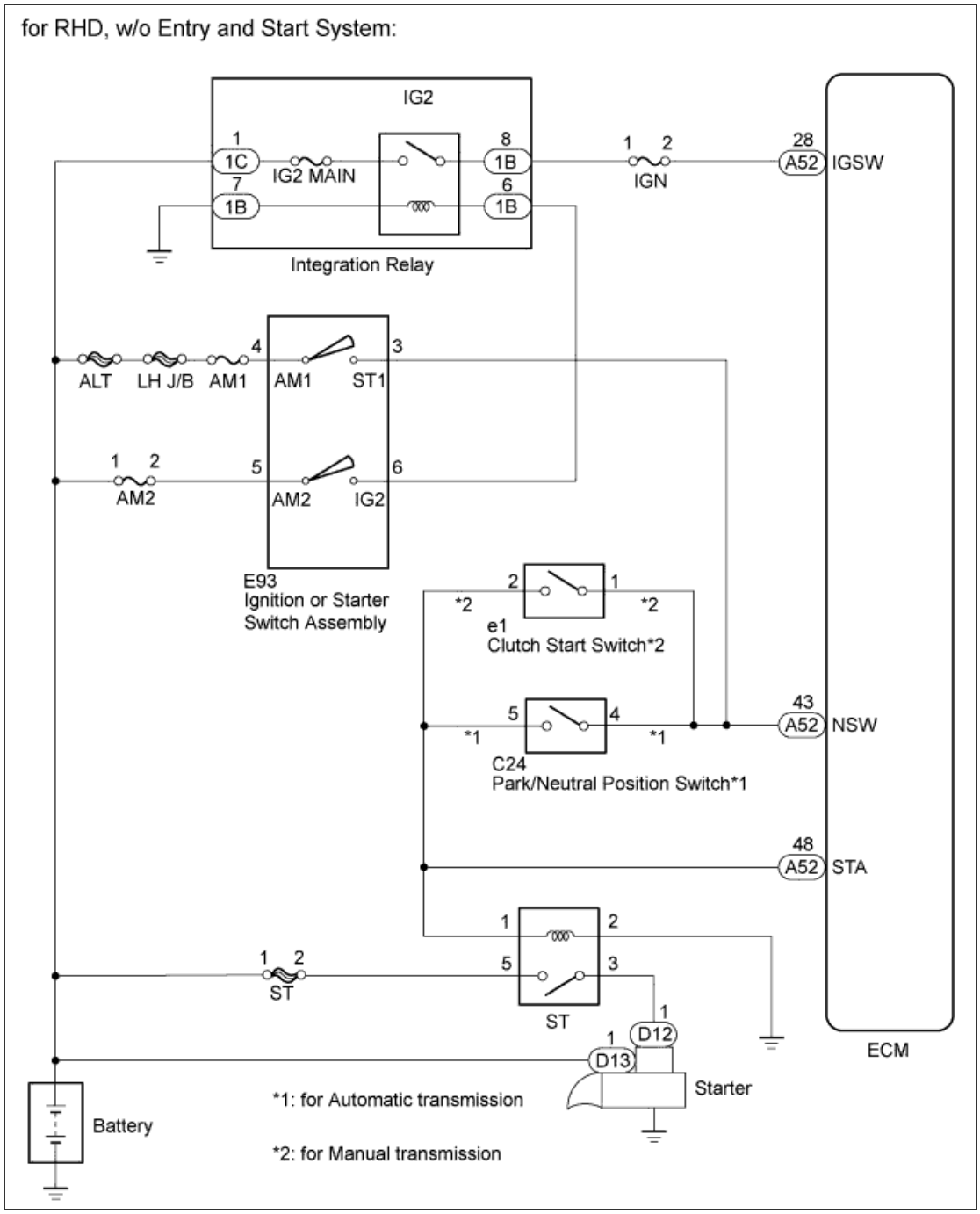
for Preparation Click here

DESCRIPTION

While the engine is being cranked, current flows from terminal ST2 of the ignition switch to the park/neutral position switch and also flows to terminal STA of the ECM (STA Signal).

WIRING DIAGRAM





INSPECTION PROCEDURE

NOTICE:

- **Inspect the fuses of circuits related to this system before performing the following inspection procedure.**
- **After replacing the ECM, the new ECM needs registration (Click here) and initialization (Click here).**

HINT:

This chart is based on the premise that the engine can crank normally. If the engine cannot crank normally, proceed to Problem Symptoms Table (Click here).

1.READ VALUE USING INTELLIGENT TESTER (STARTER SIGNAL)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine / Data List / Starter Signal.

e. Read the value.

OK:

Ignition Switch Condition	Starter Signal
ON	OFF
START	ON

NG → Go to step 2

OK

PROCEED TO NEXT SUSPECTED AREA SHOWN IN PROBLEM SYMPTOMS TABLE (Click here)

2.CHECK HARNESS AND CONNECTOR (STARTER RELAY ST] - ECM)

a. Remove the ST relay from the engine room relay block.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

for LHD

Tester Connection	Condition	Specified Condition
ST relay terminal 1 - A38-48 (STA)	Always	Below 1 Ω

for RHD

Tester Connection	Switch Condition	Specified Condition
ST relay terminal 1 - A52-48 (STA)	Always	Below 1 Ω

d. Reinstall the starter relay (ST).

e. Reconnect the ECM connector.

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (STARTER RELAY ST] - ECM)

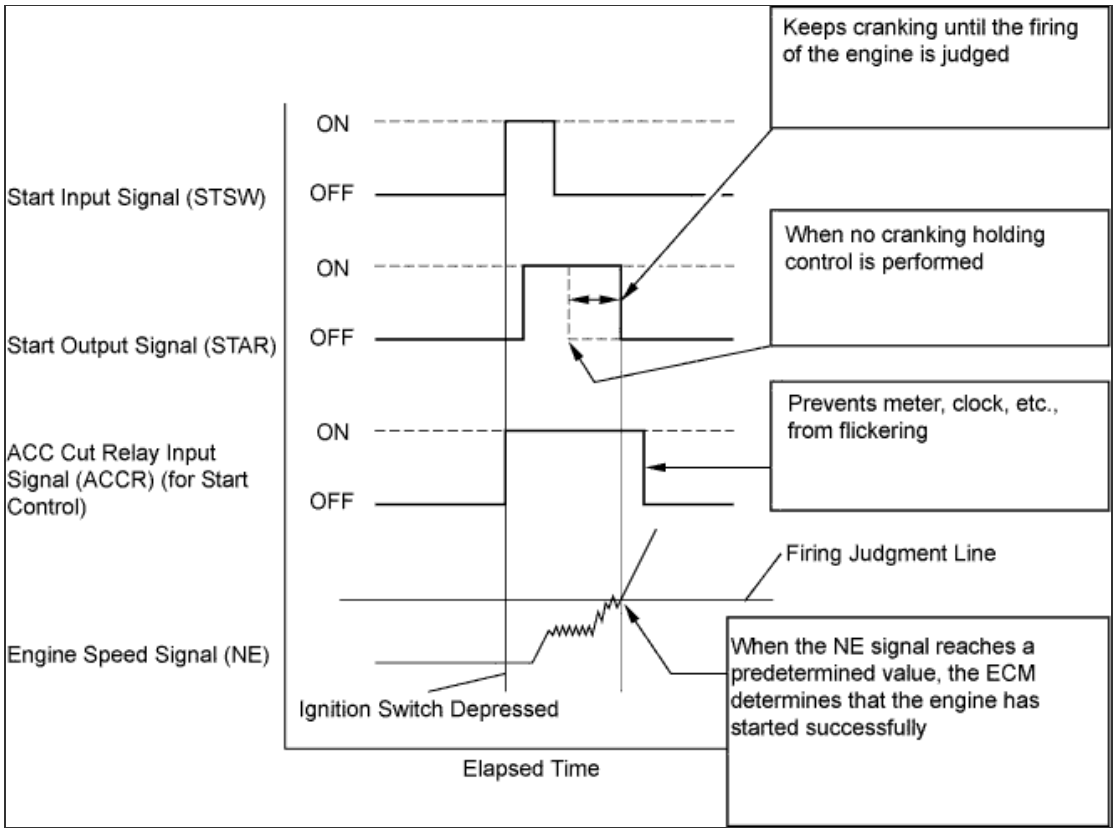
OK

REPLACE ECM (Click here)

for Preparation Click here

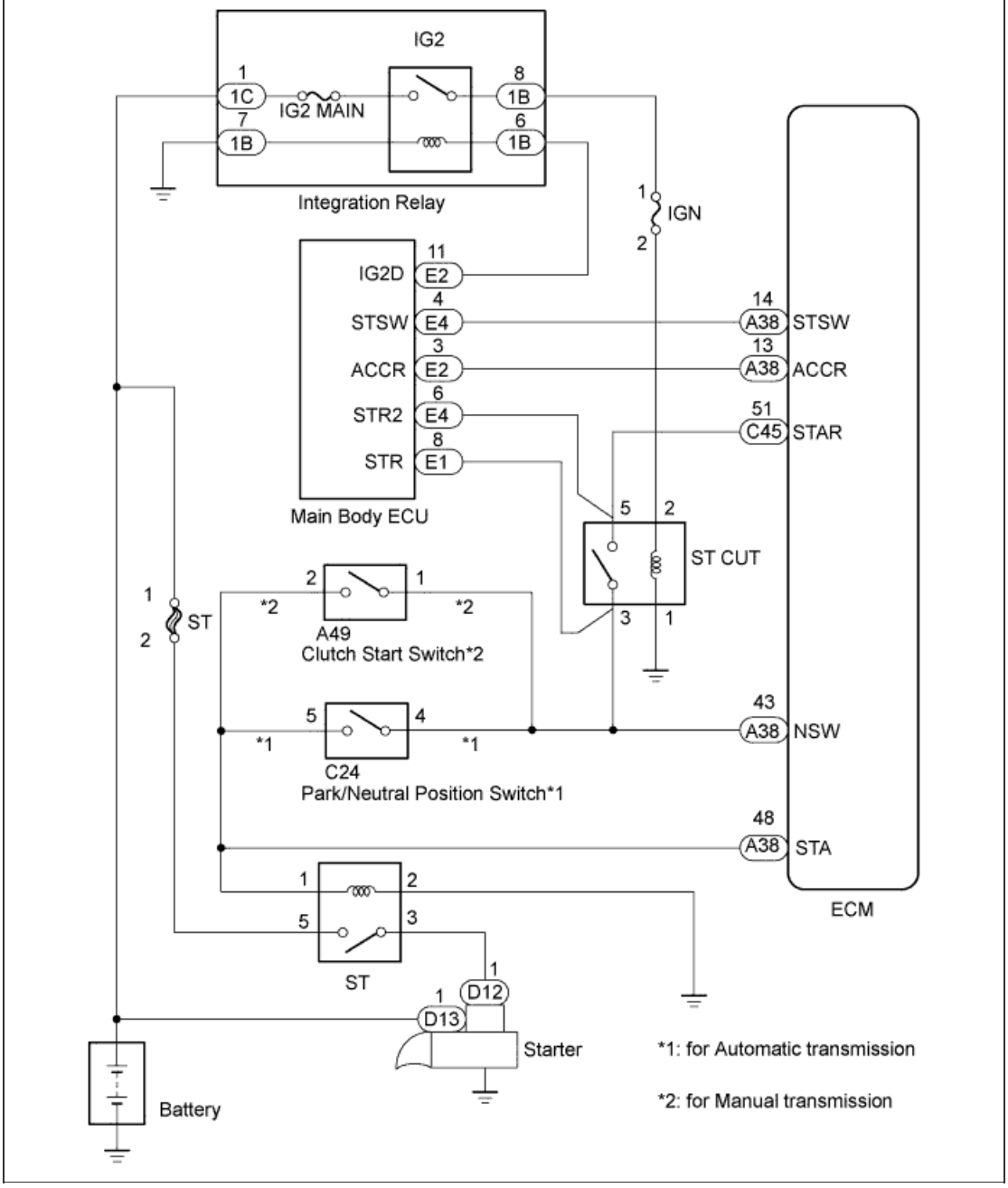
DESCRIPTION

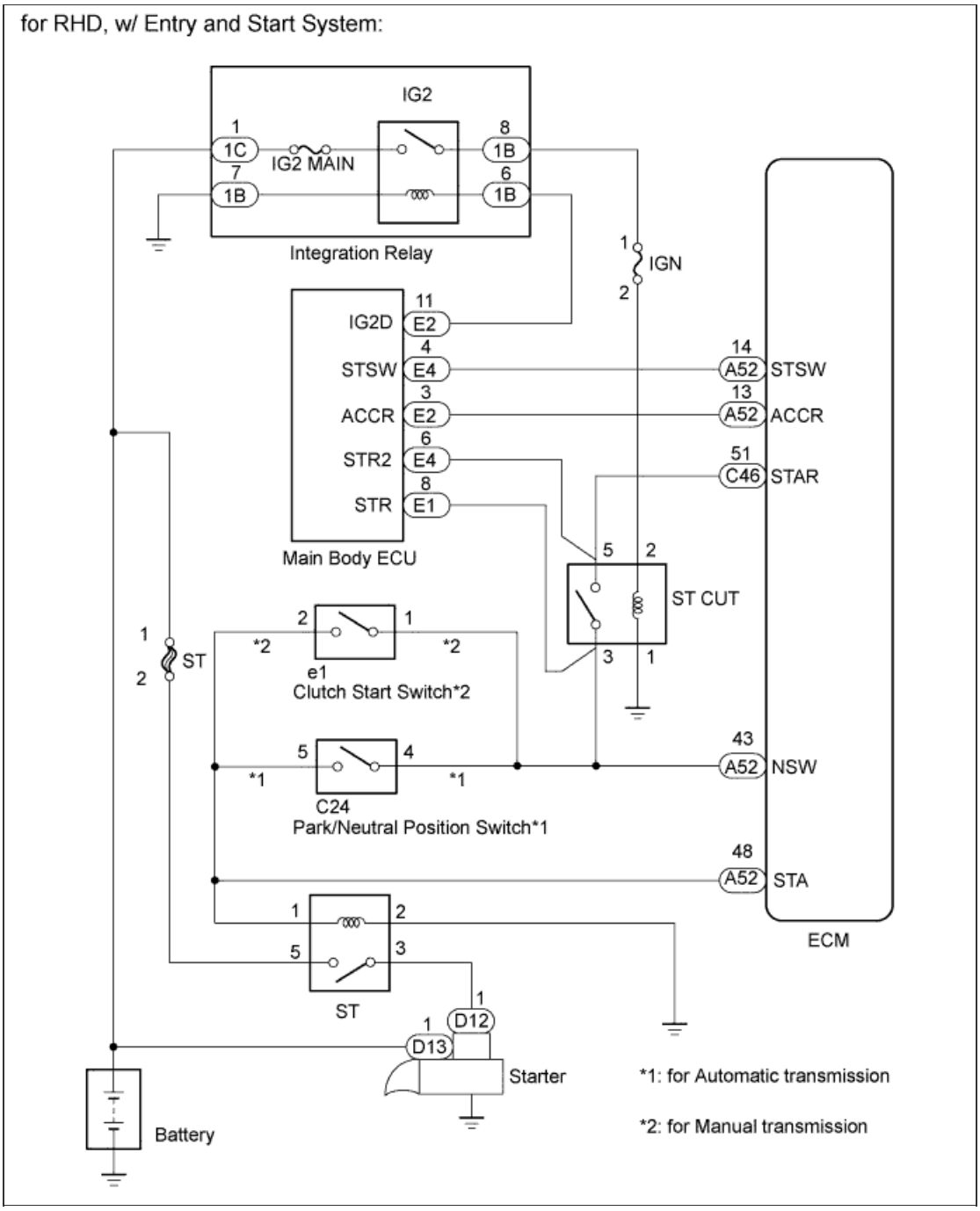
The cranking holding control system provides current to the starter when the ECM detects the ignition switch start signal (STSW). When the ECM performs a firing judgment, the system cuts current to the starter. When an ECM receives the STSW signal, it turns on the ST CUT relay, which prevents flickering of the combination meter, clock, audio system, etc. Also, the ECM sends a signal to the ECM STAR terminal of the ECMI. Then the STAR output signal travels through the park/neutral position (PNP) switch to the ST relay, causing the starter to activate.
When the engine is cranking, the starter operation signal is sent to the ECM STA terminal of the ECM.



WIRING DIAGRAM

for LHD, w/ Entry and Start System:





INSPECTION PROCEDURE

1.CHECK CRANKING

a. Check the cranking of the engine.

Result:

Test Result	Proceed to
Cranking possible and holding control operates	A
Does not crank	B
Cranking possible but holding control does not operate	C

B → Go to step 2

C → Go to step 11

A

PROCEED TO NEXT CIRCUIT INSPECTION SHOWN IN PROBLEM SYMPTOMS TABLE (Click here)

2.READ VALUE USING INTELLIGENT TESTER (STARTER SIGNAL)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain / Engine / Data List / Starter Signal.

e. Read the values.

f. Check the result when the ignition switch is turned to ON and when the engine is started.

OK:

Ignition Switch Condition	Display (Starter Signal)
ON	OFF
Engine started	ON

NG → Go to step 7

OK

3.INSPECT STARTER RELAY (ST)

a. Inspect the starter relay (ST) (Click here).

NG → REPLACE STARTER RELAY (ST)

OK

4.CHECK HARNESS AND CONNECTOR (PNP SWITCH - ST RELAY)

a. Disconnect the Park/Neutral Position (PNP) switch.

b. Remove the ST relay from the engine room relay block.

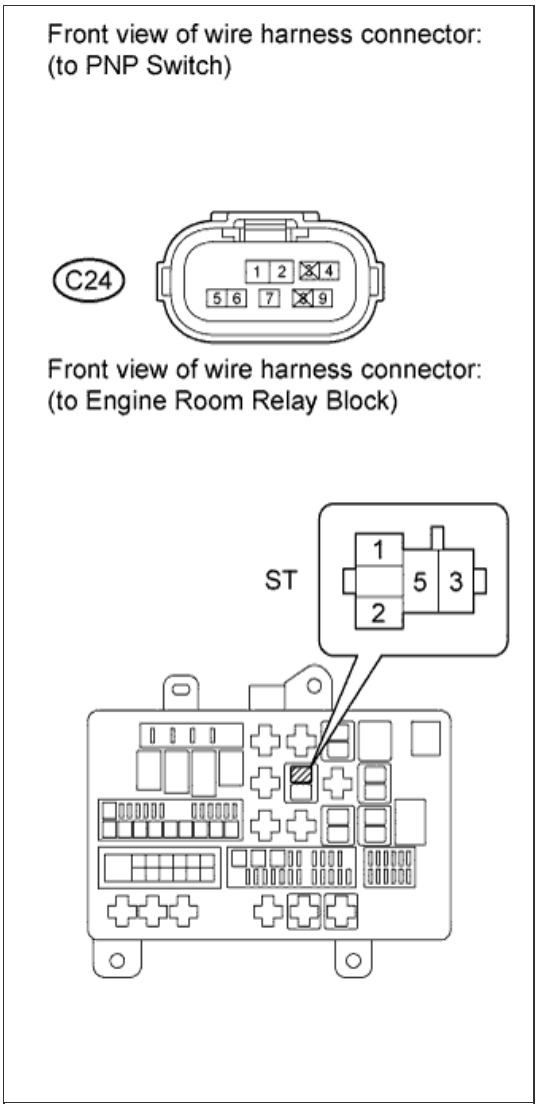
c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
ST relay (1) - C24-5	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
ST relay (1) or D24-5 - Body ground	Always	10 kΩ or higher



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

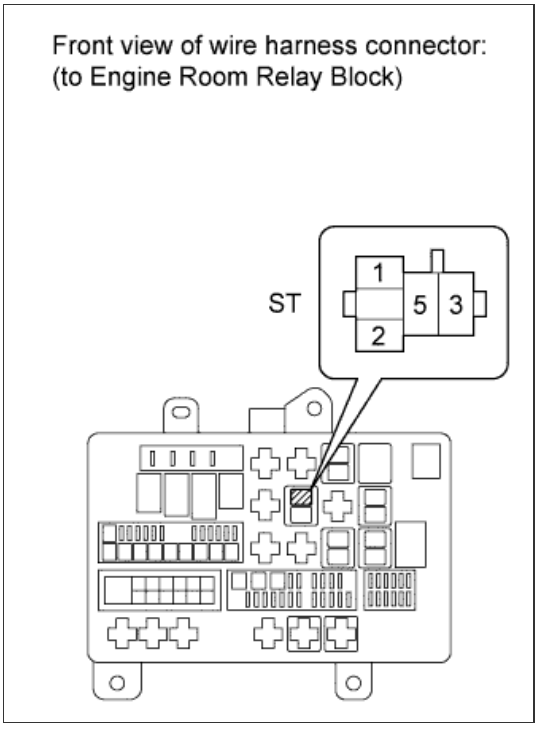
5.CHECK HARNESS AND CONNECTOR (POWER SOURCE)

a. Remove the ST relay from the engine room relay block.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
ST relay (2) - ST relay (5)	Always	11 to 14 V



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (STARTER RELAY (ST) - BATTERY, BODY GROUND)

OK

6.INSPECT STARTER

a. Inspect the starter (Click here).

Result:

Test Result	Proceed to
O	A
N	B

B → REPLACE STARTER (**Click here**)

A

REPAIR OR REPLACE HARNESS OR CONNECTOR (STARTER - STARTER RELAY (ST), BATTERY)

7.INSPECT STARTER CUT RELAY (ST CUT)

a. Inspect the starter cut relay (ST CUT) (Click here).

NG → REPLACE STARTER CUT RELAY (ST CUT)

OK

8.CHECK HARNESS AND CONNECTOR (ST CUT RELAY - PNP SWITCH, ECM)

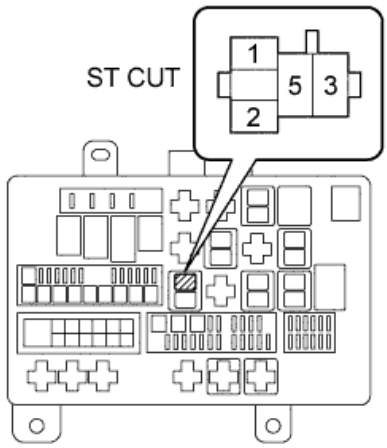
a. Remove the starter cut relay (ST CUT) from the engine room relay block.

b. Disconnect the PNP switch connector.

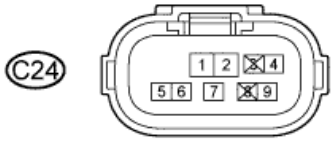
c. Disconnect the ECM connector.

d. Measure the resistance according to the value(s) in the table below.

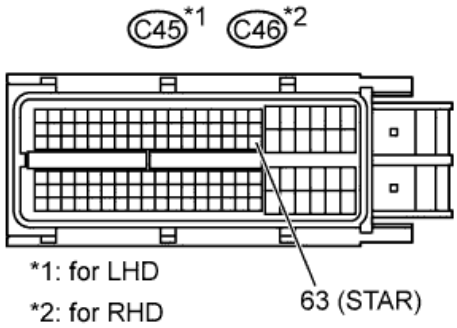
Engine Room Relay Block



Front view of wire harness connector:
(to PNP Switch)



Front view of wire harness connector:
(to ECM)



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
ST CUT relay (5) - C45-63 (STAR)	Always	Below 1 Ω
ST CUT relay (3) - C24-4	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
ST CUT relay (5) - C46-63 (STAR)	Always	Below 1 Ω
ST CUT relay (3) - C24-4	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
ST CUT relay (5) or C45-63 (STAR) - Body ground	Always	10 kΩ or higher
ST CUT relay (3) or C24-4 - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
ST CUT relay (5) or C46-63 (STAR) - Body ground	Always	10 kΩ or higher
ST CUT relay (3) or C24-4 - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

9.INSPECT PARK/NEUTRAL POSITION SWITCH

a. Inspect the Park/Neutral Position (PNP) switch.

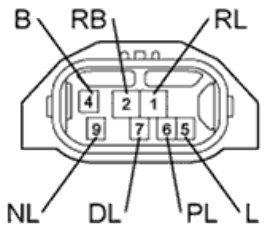
i. Disconnect the PNP switch connector.

ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
4 (B) - 5 (L)	Shift lever in P	Below 1 Ω
	Shift lever in N	Below 1 Ω

Component without harness connected:
(Park/Neutral Position Switch)



NG → REPLACE PARK/NEUTRAL POSITION SWITCH ASSEMBLY (Click here)

OK

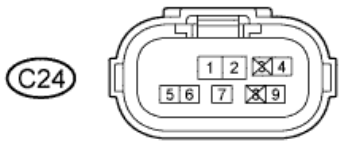
10.CHECK HARNESS AND CONNECTOR (PNP SWITCH - ECM)

a. Disconnect the PNP switch connector.

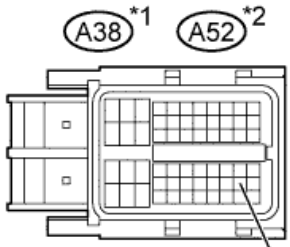
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Park/Neutral Position Switch)



Front view of wire harness connector:
(to ECM)



*1: for LHD
*2: for RHD

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
C24-5 - A38-46 (STA)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
C24-5 - A52-46 (STA)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
C24-5 or A38-46 (STA) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
C24-5 or A52-46 (STA) - Body ground	Always	10 kΩ or higher

Result

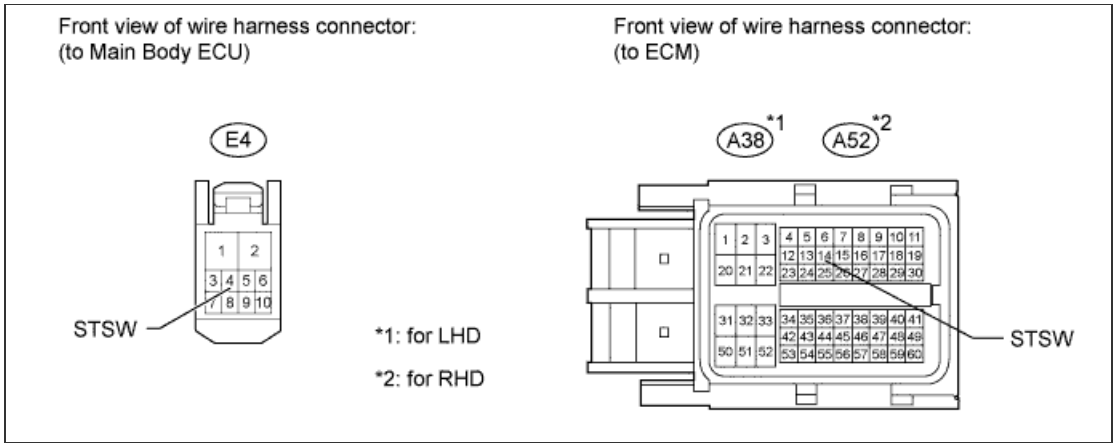
Result	Proceed to
NG	A
O	B

B → Go to step 13

A

REPAIR OR REPLACE HARNESS OR CONNECTOR

11.CHECK HARNESS AND CONNECTOR (MAIN BODY ECU - ECM)



a. Disconnect the main body ECU connector.

b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
E4-4 (STSW) - A38-14 (STSW)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
E4-4 (STSW) - A52-14 (STSW)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
E4-4 (STSW) or A38-14 (STSW) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
E4-4 (STSW) or A52-14 (STSW) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

12.CHECK HARNESS AND CONNECTOR (ST CUT RELAY - PNP SWITCH, ECM)

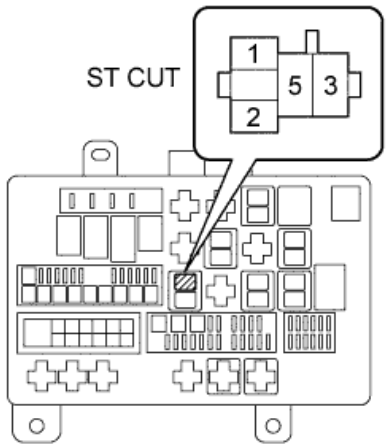
a. Remove the starter cut relay (ST CUT) from the engine room relay block.

b. Disconnect the PNP switch connector.

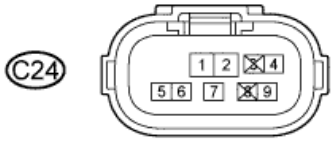
c. Disconnect the ECM connector.

d. Measure the resistance according to the value(s) in the table below.

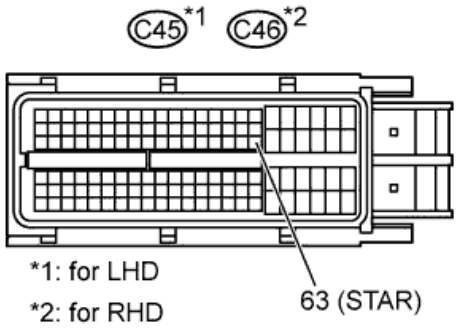
Engine Room Relay Block



Front view of wire harness connector:
(to PNP Switch)



Front view of wire harness connector:
(to ECM)



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
ST CUT relay (5) - C45-63 (STAR)	Always	Below 1 Ω
ST CUT relay (3) - C24-4	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
ST CUT relay (5) - C46-63 (STAR)	Always	Below 1 Ω
ST CUT relay (3) - C24-4	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
ST CUT relay (5) or C45-63 (STAR) - Body ground	Always	10 kΩ or higher
ST CUT relay (3) or C24-4 - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
ST CUT relay (5) or C46-63 (STAR) - Body ground	Always	10 kΩ or higher
ST CUT relay (3) or C24-4 - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (**Click here**)

13.REPLACE ECM

a. Replace the ECM (Click here).

NEXT

14.CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

a. Check the starter operation.

OK:
Malfunction has been repaired successfully.

NG → GO TO ENTRY AND START SYSTEM (ENGINE DOES NOT START) (**Click here**)

OK

END

for Preparation Click here

DESCRIPTION

The injector driver drives the injectors at high speeds with a high-voltage DC/DC converter. The ECM constantly monitors the injector driver and stops the engine if an abnormal condition is detected.

WIRING DIAGRAM

Refer to DTC P062D (Click here).

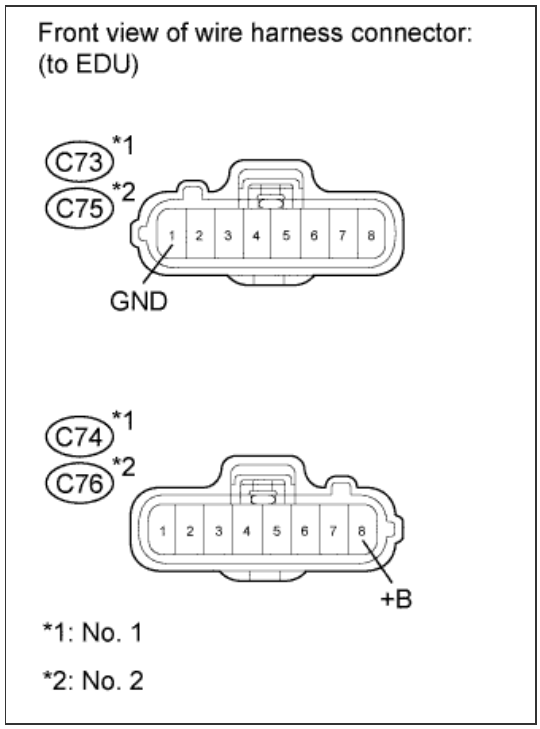
INSPECTION PROCEDURE

1.CHECK EDU (POWER SOURCE)

a. Disconnect the No. 1 injector driver (EDU) connectors.

b. Disconnect the No. 2 injector driver (EDU) connectors.

c. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

No. 1

Tester Connection	Switch Condition	Specified Condition
C74-8 (+B) - C73-1 (GND)	Ignition switch ON	11 to 14 V

No. 2

Tester Connection	Switch Condition	Specified Condition
C76-8 (+B) - C75-1 (GND)	Ignition switch ON	11 to 14 V

NG → Go to step 2

OK

REPLACE INJECTOR DRIVER (No. 1 or No. 2) (Click here)

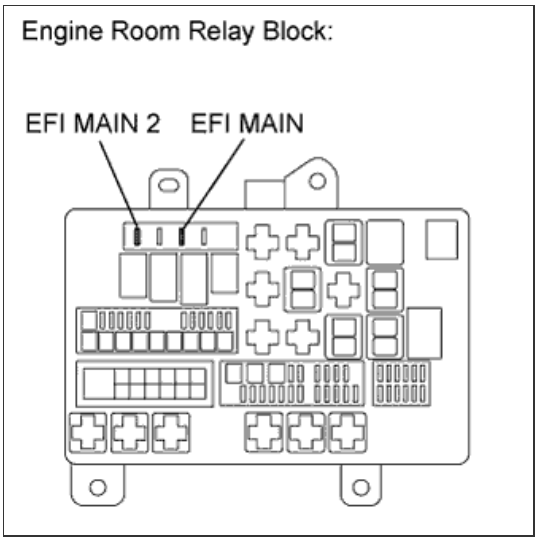
2.INSPECT FUSE (EFI)

a. Remove the EFI MAIN and EFI MAIN 2 fuse from the engine room relay block.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAIN fuse	Always	Below 1 Ω
EFI MAIN 2 fuse	Always	Below 1 Ω



NG → CHECK FOR SHORTS IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

OK

3.INSPECT EDU RELAY (EDU 1 OR EDU 2)

a. Inspect the EDU relay (EDU 1 or EDU 2) (Click here).

NG → REPLACE EDU RELAY (EDU 1 OR EDU 2)

OK

4.INSPECT INTEGRATION NO.1 RELAY (EFI OR EFI MAIN 2)

a. Inspect the Integration relay (EFI or EFI MAIN 2) (Click here).

NG → REPLACE INTEGRATION NO.1 RELAY

OK

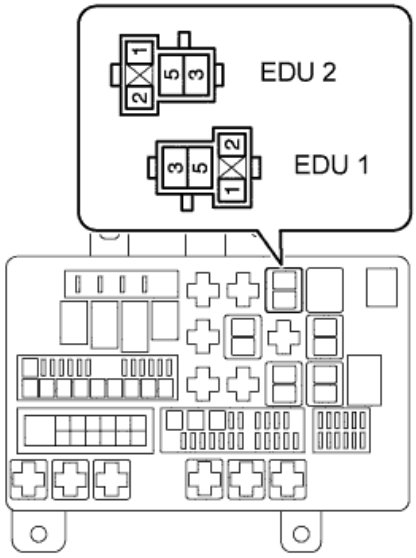
5.CHECK HARNESS AND CONNECTOR (EDU RELAY - EDU)

a. Remove the EDU relay (EDU 1 or EDU 2) from the engine room relay block.

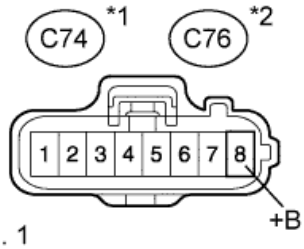
b. Remove the EDU connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Engine Room Relay Block)



Front view of wire harness connector:
(to EDU)



*1: No. 1

*2: No. 2

Standard Resistance (Check for Open):

No. 1

Tester Connection	Condition	Specified Condition
EDU 1 relay (5) - C74-8 (+B)	lways	Below 1 Ω

No. 2

Tester Connection	Condition	Specified Condition
EDU 2 relay (5) - C76-8 (+B)	lways	Below 1 Ω

Standard Resistance (Check for Short):

No. 1

Tester Connection	Condition	Specified Condition
EDU 1 relay (5) or C74-8 (+B) - Body ground	Always	10 kΩ or higher

No. 2

Tester Connection	Condition	Specified Condition
EDU 2 relay (5) or C76-8 (+B) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

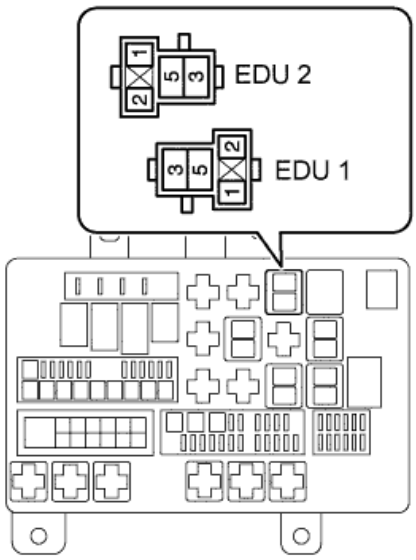
.CHECK HARNESS AND CONNECTOR (EDU RELAY - ECM)

a. Remove the EDU relay (EDU 1 or EDU 2) from the engine room relay block.

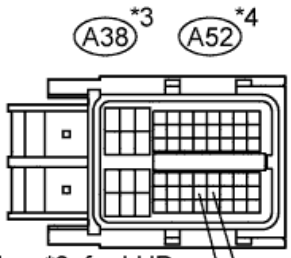
b. Disconnect the ECM connector.

c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to Engine Room Relay Block)



Front view of wire harness connector:
(to ECM)



*1: No. 1 *3: for LHD 46 (IRL2)*2

*2: No. 2 *4: for RHD 45 (IREL)*1

Standard Resistance (Check for Open):

No. 1 (LHD)

Tester Connection	Condition	Specified Condition
EDU 1 relay (2) - A38-45 (IREL)	Always	Below 1 Ω

No. 2 (LHD)

Tester Connection	Condition	Specified Condition
EDU 2 relay (2) - A38-46 (IRL2)	Always	Below 1 Ω

No. 1 (RHD)

Tester Connection	Condition	Specified Condition
EDU 1 relay (2) - A52-45		

(IREL)	lways	Below 1 Ω

No. 2 (RHD)

Tester Connection	Condition	Specified Condition
EDU 2 relay (2) - (IRL2)	lways	Below 1 Ω

Standard Resistance (Check for Short):

No. 1 (LHD)

Tester Connection	Condition	Specified Condition
EDU 1 relay (2) or Body ground	Always	10 kΩ or higher

No. 2 (LHD)

Tester Connection	Condition	Specified Condition
EDU 2 relay (2) or A38-46 (IRL2) - Body ground	Always	10 kΩ or higher

No. 1 (RHD)

Tester Connection	Condition	Specified Condition
EDU 1 relay (2) or A52-45 (IREL) - Body ground	Always	10 kΩ or higher

No. 2 (RHD)

Tester Connection	Condition	Specified Condition
EDU 2 relay (2) or A52-46 (IRL2) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

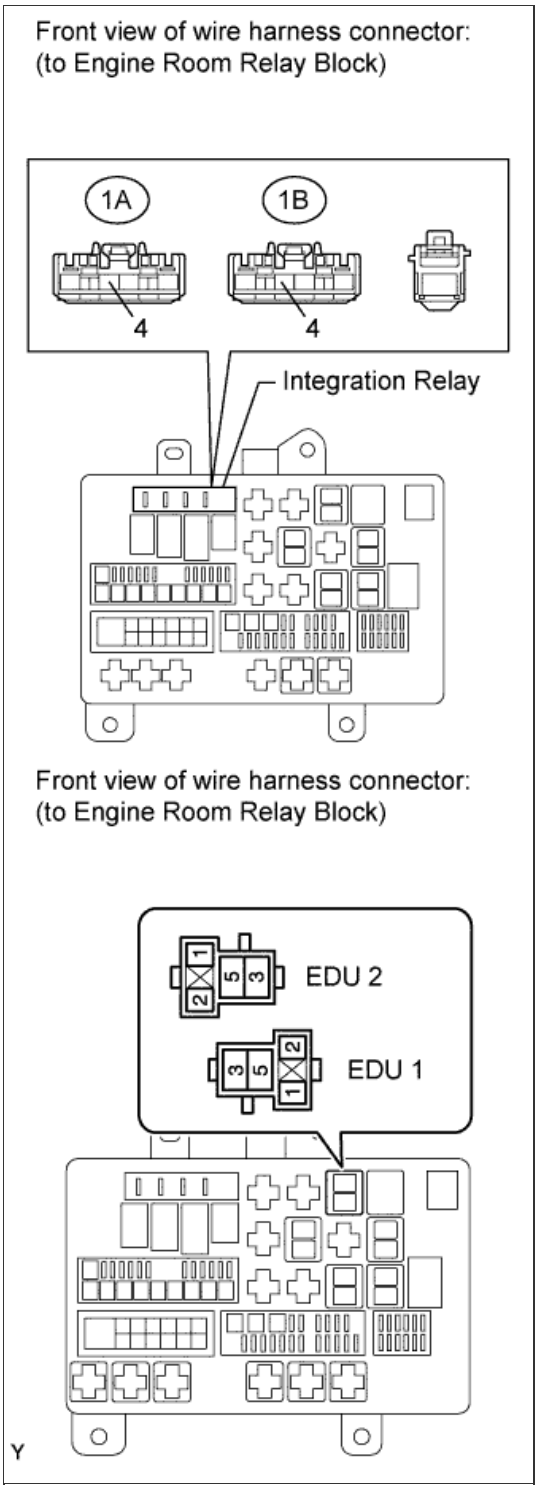
OK

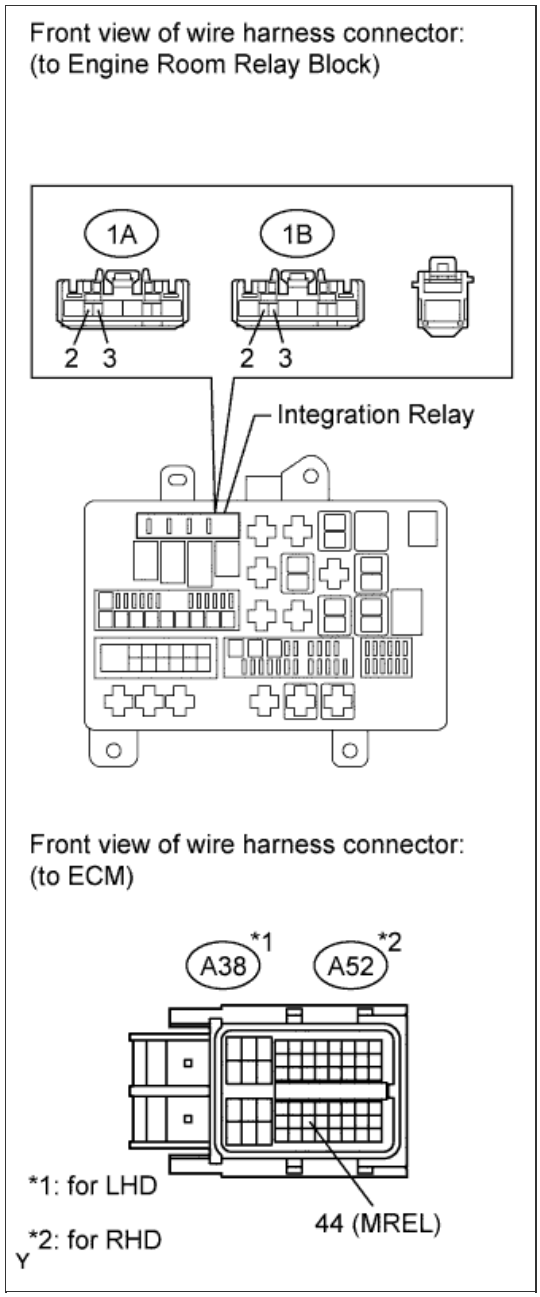
7.CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - EDU RELAY, ECM, ODY GROUND)

a. Remove the integration relay from the engine room relay block.

b. Remove the EDU relay (EDU 1 or EDU 2).

c. Measure the resistance according to the value(s) in the table below.


Front view of wire harness connector:
(to Engine Room Relay Block)
1A
1B
4
4
Integration Relay
Front view of wire harness connector:
(to Engine Room Relay Block)
EDU 2
EDU 1
Y



Standard Resistance (Check for Open):

No. 1

Tester Connection	Condition	Specified Condition
IB-4 - EDU 1 relay (1)	lways	Below 1 Ω
IB-4 - EDU 1 relay (3)	lways	Below 1 Ω

No. 2

Tester Connection	Condition	Specified Condition
I -4 - EDU 2 relay (1)	lways	Below 1 Ω
I -4 - EDU 2 relay (3)	lways	Below 1 Ω

Standard Resistance (Check for Short):

No. 1

Tester Connection	Condition	Specified Condition
EIB-4 or EDU 1 relay (1) - Body ground	Always	10 kΩ or higher
IB-4 or EDU 1 relay (3) - Body ground	Always	10 kΩ or higher

No. 2

Tester Connection	Condition	Specified Condition
IA-4 or EDU 2 relay (1) - Body ground	Always	10 kΩ or higher

I -4 or EDU 2 relay (3) - Body ground	Always	10 kΩ or higher

d. Disconnect the ECM connector.

e. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

No. 1 (LHD)

Tester Connection	Condition	Specified Condition
IB-2 - A38-44 (MREL)	Always	Below 1 Ω
IB-3 - Body ground	Always	Below 1 Ω

No. 2 (LHD)

Tester Connection	Condition	Specified Condition
IA-2 - A38-44 (MREL)	Always	Below 1 Ω
IA-3 - Body ground	Always	Below 1 Ω

No. 1 (RHD)

Tester Connection	Condition	Specified Condition
IB-2 - A52-44 (MREL)	Always	Below 1 Ω
IB-3 - Body ground	Always	Below 1 Ω

No. 2 (RHD)

Tester Connection	Condition	Specified Condition
IA-2 - A52-44 (MREL)	Always	Below 1 Ω
IA-3 - Body ground	Always	Below 1 Ω

Standard Resistance (Check for Short):

No. 1 (LHD)

Tester Connection	Condition	Specified Condition
IB-2 or A38-44 (MREL) - Body ground	Always	10 kΩ or higher

No. 2 (LHD)

Tester Connection	Condition	Specified Condition
IA-2 or A38-44 (MREL) - Body ground	Always	10 kΩ or higher

No. 1 (RHD)

Tester Connection	Condition	Specified Condition
IB-2 or A52-44 (MREL) - Body ground	Always	10 kΩ or higher

No. 2 (RHD)

Tester Connection	Condition	Specified Condition
IA-2 or A52-44 (MREL) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

8.CHECK HARNESS AND CONNECTOR (EDU - ODY GROUND)

a. Disconnect the EDU connector.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

No. 1

Tester Connection	Condition	Specified Condition

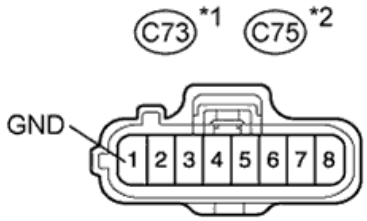
C73-1 (GND) - Body ground	Always	Below 1 Ω

Standard Resistance:

No. 2

Tester Connection	Condition	Specified Condition
C75-1 (GND) - Body ground	Always	Below 1 Ω

Front view of wire harness connector:
(to EDU)



*1: No. 1

*2: No. 2

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (EDU - ODY GROUND)

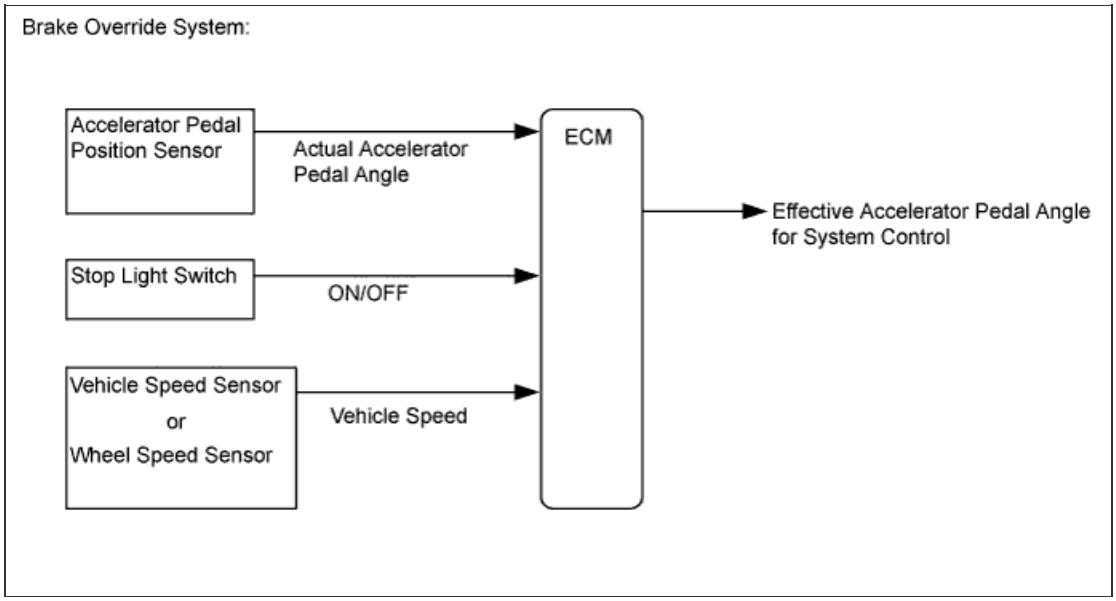
OK

CHECK ECM POWER SOURCE CIRCUIT (Click here)

for Preparation Click here

DESCRIPTION

When the vehicle is being driven with the accelerator pedal depressed, depressing the brake pedal without releasing the accelerator pedal will activate the brake override system to restrict driving torque. The conditions for activating the brake override system as well as the items that are controlled are explained below.



Activation Conditions:

- Vehicle is running at or above the specified speed.
- The accelerator pedal is depressed beyond a specified level, and then the brake pedal is depressed.

NOTICE:

The vehicle may not enter the brake override system control due to the relation of the accelerator pedal angle and the vehicle's speed.

Items Controlled:

- Driving torque is restricted.

HINT:

During brake override system control, the value for the accelerator pedal angle (which is used for engine control) is forcibly reduced to a specified value. For this reason, the Data List value for Accelerator Position will be replaced with a specified value regardless of the actual accelerator pedal angle (Accel Sens. No. 1 Volt %, Accel Sens. No. 2 Volt %)

Deactivation Conditions:

- When the Stop Light Switch turns OFF or the actual accelerator pedal angle increases or decreases beyond the specified range.

INSPECTION PROCEDURE

Inspection Method

Drive at 10 km/h (6.25 mph), depress the accelerator pedal by 1/2 to 3/4 and keep it in that position. Under these conditions, if the engine speed decreases to 1000 rpm when the brake pedal is depressed, then the brake override system has been activated.

CAUTION:

When carrying out the inspection, use a place where you are able to carry it out safely and also pay close attention to your surroundings.

Also, when driving, make absolutely sure that all road traffic laws, such as speed limits, are observed.

HINT:

- **Under normal conditions, the Accelerator Position value changes in response to the Accel Sens. No. 1 Volt % value. For more information on the numerical values, refer to the Data List (Click here).**
- **If the Data List values of Accelerator Position and Accel Sens. No. 1 Volt % do not match, and the value of Accelerator Position changes but the value of Accel Sens. No. 1 Volt % is constant, this confirms that brake override system has activated. (Data can be captured relatively easily by using the snapshot function in the Data List. Confirm the data after performing the drive test.)**

NOTICE:

The brake override system restricts driving torque if the brake pedal is depressed when driving with the accelerator pedal depressed. If a customer reports experiencing loss of torque after the accelerator and brake pedals have both been intentionally depressed, explain to the customer that this is not a malfunction, and that the customer should avoid depressing both the accelerator and brake pedals at the same time.

Example: While operating the accelerator pedal, the customer uses their left foot to operate the brake pedal.

1.CHECK DTC OUTPUT

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Utility / All Codes.

d. Check DTCs.

Result

Result	Proceed to
No DTC is output	A
DTC is output	B

B → **GO TO DTC CHART**

A

2.READ VALUE USING INTELLIGENT TESTER (STOP LIGHT SWITCH)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Stop Light Switch.

d. Check the Data List indication when the brake pedal is depressed and released.

OK:

Tester Display	Condition	Specified Condition
Stop Light Switch	Brake pedal released	OFF
	Brake pedal depressed	ON

NG → **INSPECT STOP LIGHT SWITCH ASSEMBLY (Click here)**

OK

3.INSPECT BRAKE PEDAL

a. Inspect and adjust the brake pedal (for LHD) (Click here).

b. Inspect and adjust the brake pedal (for RHD) (Click here).

HINT:

If the stop light switch turns ON too late, the start of brake override system control may be delayed; if it turns ON too soon, brake override system control may begin too early, so conduct inspection of the brake pedal and stop light switch assembly.

Result:

Result	Proceed to
OK	A
NG (for LHD)	B
NG (for RHD)	C

B → REPAIR OR REPLACE BRAKE PEDAL (for LHD) (Click here)

C → REPAIR OR REPLACE BRAKE PEDAL (for RHD) (Click here)

A

4.READ VALUE USING INTELLIGENT TESTER (ACCELERATOR PEDAL POSITION SENSOR)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Enter the following menus: Powertrain / Engine / Data List / Accel Sens. No. 1 Volt % and Accel Sens. No. 2 Volt %.

d. Read the value displayed on the tester.

OK:

Tester Display	Condition	Specified Condition
Accel Sens. No. 1 Volt %	Accelerator Pedal Released → Depressed → Released	Values smoothly change following accelerator pedal operation
Accel Sens. No. 2 Volt %		

HINT:

For numerical values of Accel Sens. No. 1 Volt % and Accel Sens. No. 2 Volt %, refer to the Data List (Click here).

NG → REPLACE ACCELERATOR PEDAL SENSOR ASSEMBLY (Click here)

OK

5.READ VALUE USING INTELLIGENT TESTER (VEHICLE SPEED)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Start the engine.

d. Enter the following menus: Powertrain / Engine / Data List / Vehicle Speed.

e. Read the value displayed on the tester.

Standard:

Tester Display	Condition	Specified Condition
Vehicle Speed	Vehicle stopped, engine running	0 km/h (0 mph)
	Vehicle running at constant speed between 16.1 to 64.4 km/h (10 to 40 mph)	No large fluctuations when driving at a constant speed

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

Data can be captured relatively easily by using the snapshot function in the Data List. Confirm the data after performing the drive test.

NG → GO TO GO TO VEHICLE SPEED SENSOR "A" (Click here)

OK

6.READ VALUE USING INTELLIGENT TESTER (FR, FL, RR, RL WHEEL SPEED)

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Start the engine.

d. Enter the following menus: Chassis / ABS/VSC/TRC / Data List / FR Wheel Speed, FL Wheel Speed, RR Wheel Speed and RL Wheel Speed.

e. Read the value displayed on the tester.

Standard:

Tester Display	Condition	Specified Condition
FR Wheel Speed FL Wheel Speed RR Wheel Speed RL Wheel Speed	Vehicle stopped, engine running	0 km/h (0 mph)
	Vehicle running at constant speed between 16.1 to 64.4 km/h (10 to 40 mph)	No large fluctuations when driving at a constant speed

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

Data can be captured relatively easily by using the snapshot function in the Data List. Confirm the data after performing the drive test.

NG → INSPECT FRONT OR REAR SPEED SENSOR

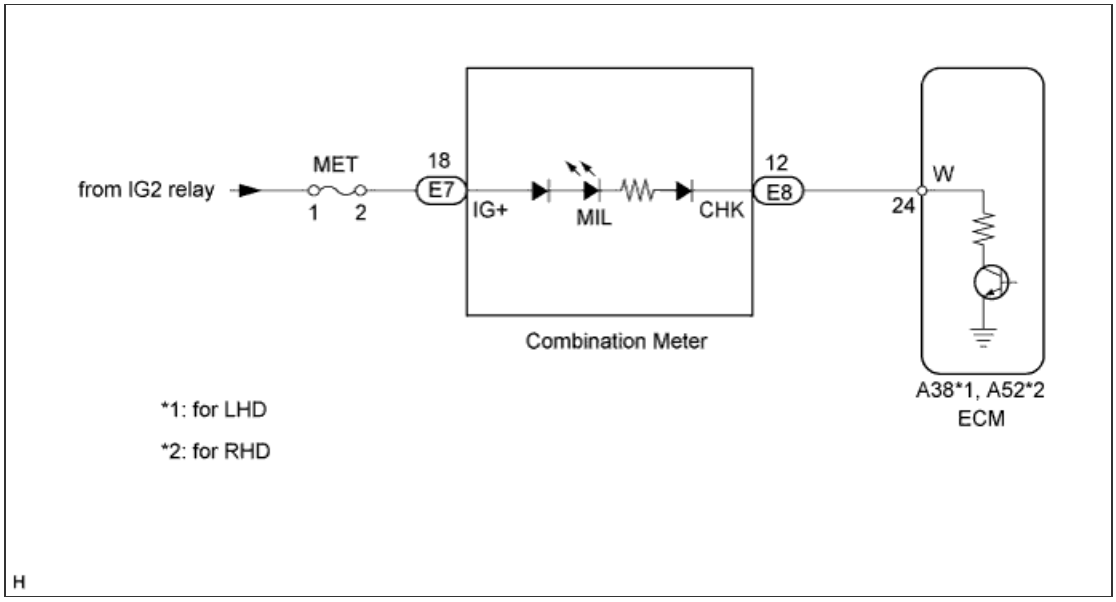
OK → END

for Preparation Click here

DESCRIPTION

The MIL (Malfunction Indicator Lamp) is used to indicate vehicle malfunctions detected by the ECM. When the ignition switch is turned to ON, power is supplied to the MIL circuit, and the ECM provides the circuit ground which illuminates the MIL.
The MIL operation can be checked visually. When the ignition switch is first turned to ON, the MIL should be illuminated and should then turn off when the engine is started. If the MIL remains illuminated or is not illuminated, conduct the following troubleshooting procedure using the intelligent tester.

WIRING DIAGRAM



INSPECTION PROCEDURE

1.CHECK THAT MIL IS ILLUMINATED

a. Perform troubleshooting in accordance with the table below.

Result

Condition	Proceed to
MIL remains on	A
MIL does not illuminate	B

B → Go to step 5

A

2.CHECK WHETHER MIL TURNS OFF

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and turn the tester on.

c. Check if DTCs have been stored (Click here). If DTCs are present, write them down.

d. Clear DTCs (Click here).

e. Check that the MIL turns off.

Standard:
MIL turns off.

NG → Go to step 3

OK

REPAIR CIRCUITS INDICATED BY OUTPUT DTCS (Click here)

3.CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT IN WIRE HARNESS)

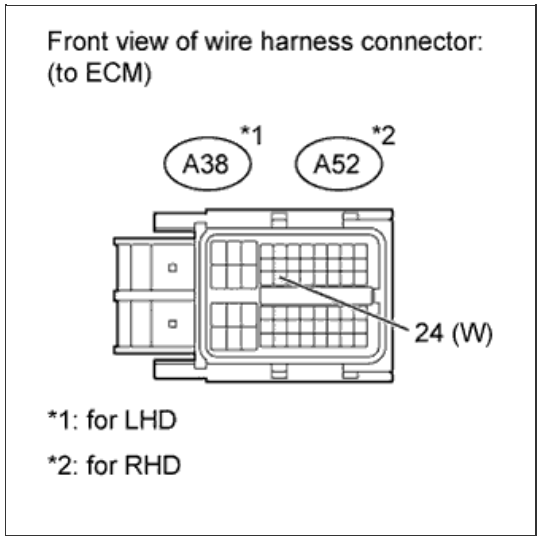
a. Disconnect the ECM connector.

b. Turn the ignition switch to ON.

c. Check that the MIL is not illuminated.

OK:
MIL is not illuminated.

d. Reconnect the ECM connector.



NG → Go to step 4

OK

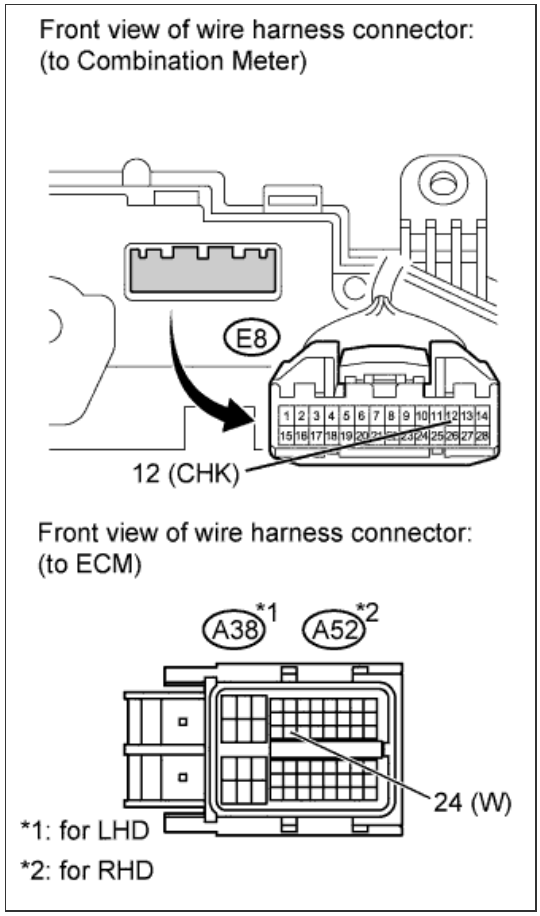
REPLACE ECM (Click here)

4.CHECK HARNESS AND CONNECTOR (COMBINATION METER - ECM)

a. Disconnect the ECM connector.

b. Disconnect the combination meter connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for Open):

for LHD

Tester Connection	Condition	Specified Condition
E8-5 (CHK) - A38-24 (W)	Always	Below 1 Ω

for RHD

Tester Connection	Condition	Specified Condition
E8-5 (CHK) - A52-24 (W)	Always	Below 1 Ω

Standard Resistance (Check for Short):

for LHD

Tester Connection	Condition	Specified Condition
E8-5 (CHK) or A38-24 (W) - Body ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
E8-5 (CHK) or A52-24 (W) - Body ground	Always	10 kΩ or higher

d. Reconnect the ECM connector.

e. Reconnect the combination meter connector.

Result

Result	Proceed to
OK (w/ Multi-information Display)	A
OK (w/o Multi-information Display)	B
NG	C

A → REPLACE COMBINATION METER ASSEMBLY (w/ Multi-information Display) (Click here)

B → REPLACE COMBINATION METER ASSEMBLY (w/o Multi-information Display) (Click here)

C → REPAIR OR REPLACE HARNESS OR CONNECTOR

5.CHECK THAT MIL IS ILLUMINATED

a. Check if the MIL is illuminated when the ignition switch is turned to ON.

OK:
MIL is illuminated.

NG → Go to step 6

OK → SYSTEM OK

6.CHECK THAT ENGINE STARTS

a. Turn the ignition switch to ON.

b. Start the engine.

Result

Result	Proceed to
Engine starts	A
Engine does not start*	B

HINT:

*: The intelligent tester cannot communicate with the ECM.

B → GO TO VC OUTPUT CIRCUIT (Click here)

A

7.INSPECT COMBINATION METER ASSEMBLY (MIL CIRCUIT)

a. See the combination meter troubleshooting procedure (Click here).

Result

Result	Proceed to
NG	A
OK (w/ Multi-information Display)	B
OK (w/o Multi-information Display)	C

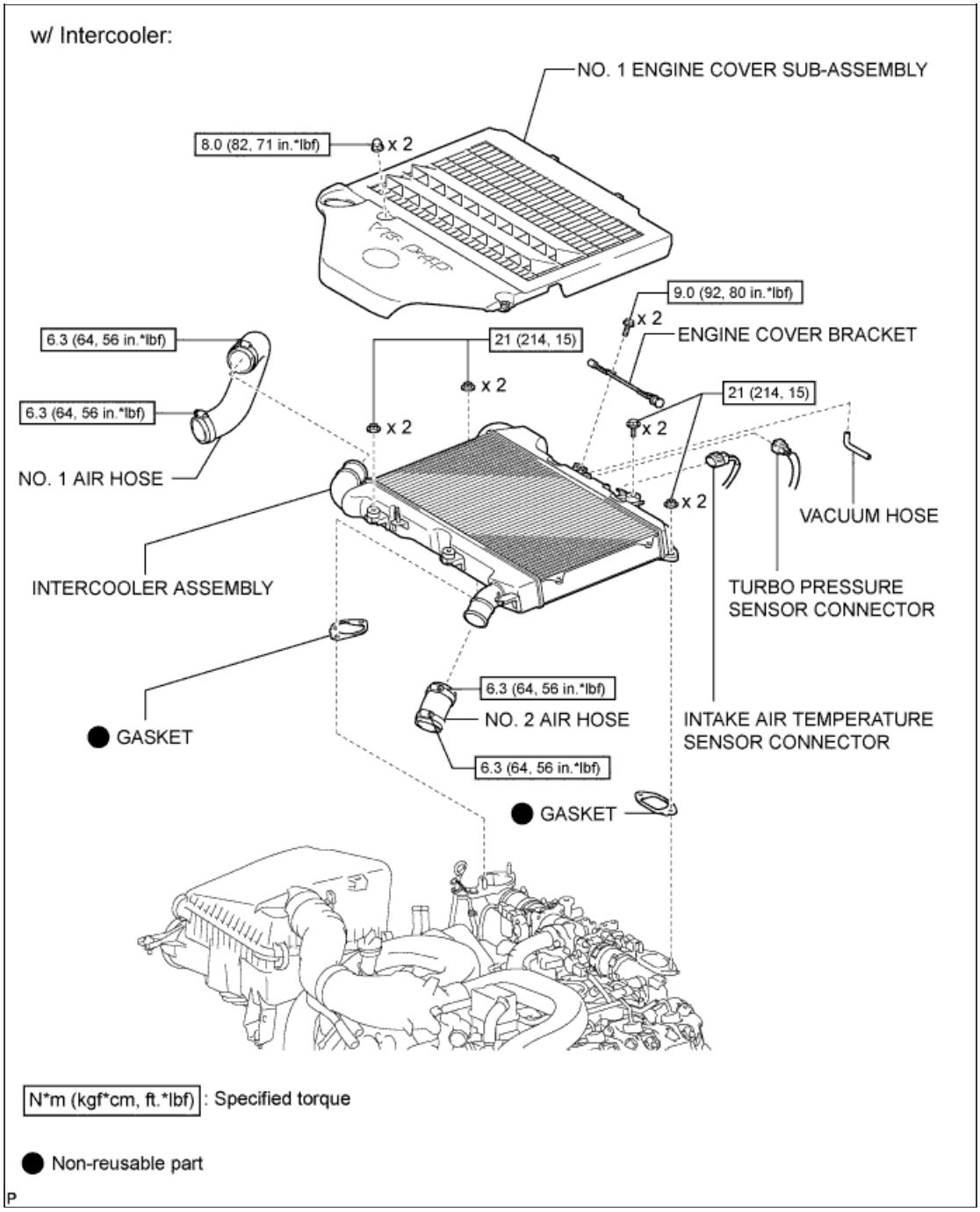
B → REPLACE COMBINATION METER ASSEMBLY (w/ Multi-information Display) (Click here)

C → REPLACE COMBINATION METER ASSEMBLY (w/o Multi-information Display) (Click here)

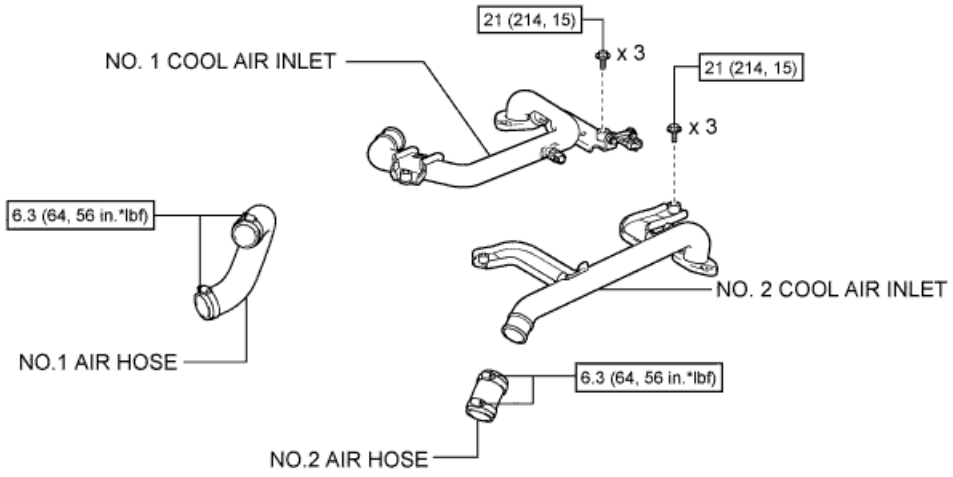
A

REPAIR OR REPLACE HARNESS OR CONNECTOR (COMBINATION METER - ECM)

for Preparation Click here

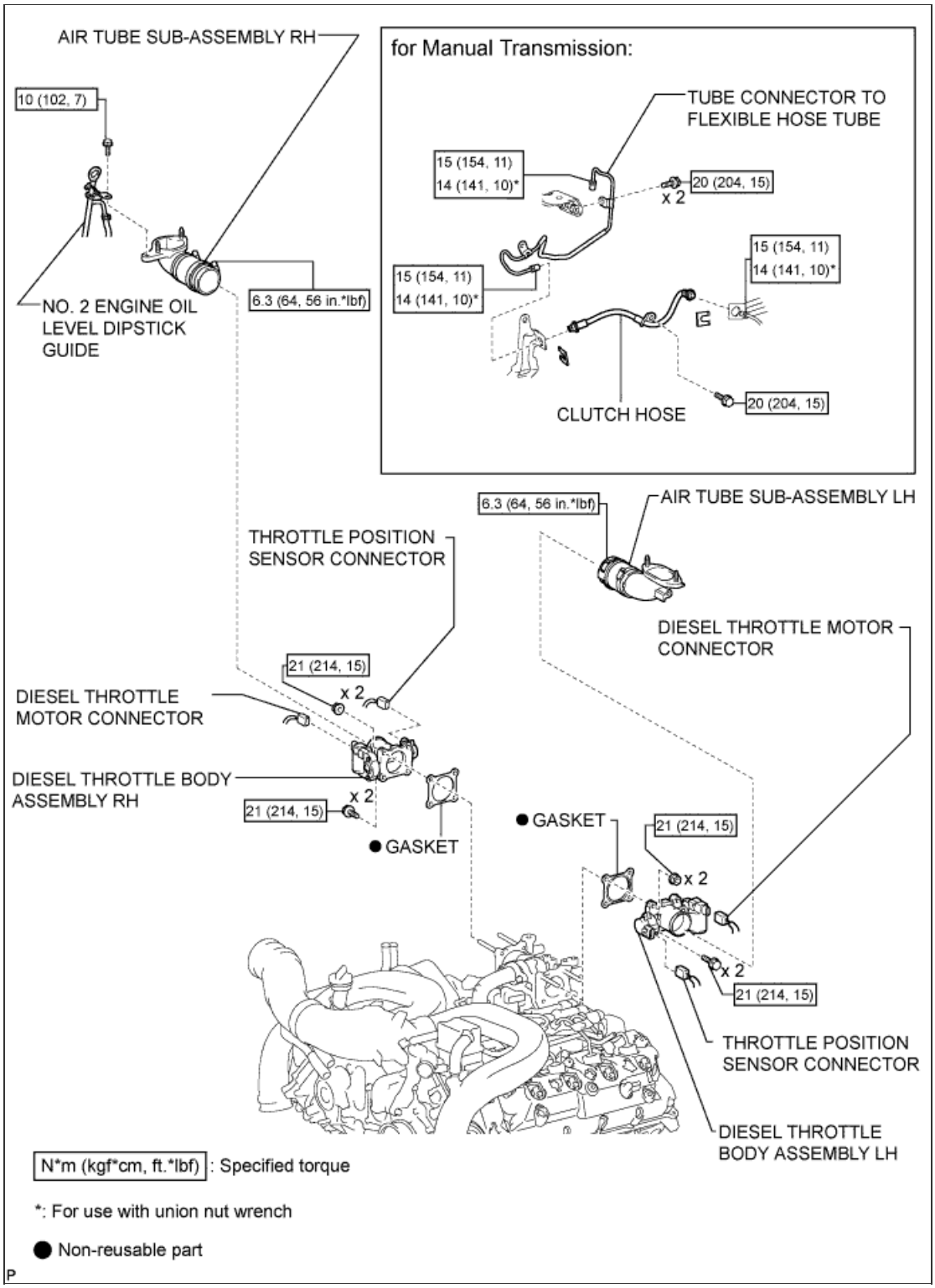


w/o Intercooler:





N*m (kgf*cm, ft.*lbf) : Specified torque


AIR TUBE SUB-ASSEMBLY RH
10 (102, 7)
NO. 2 ENGINE OIL LEVEL DIPSTICK GUIDE
6.3 (64, 56 in.*lbf)
for Manual Transmission:
TUBE CONNECTOR TO FLEXIBLE HOSE TUBE
15 (154, 11) 14 (141, 10)*
20 (204, 15)
x 2
15 (154, 11) 14 (141, 10)*
15 (154, 11) 14 (141, 10)*
CLUTCH HOSE
20 (204, 15)
6.3 (64, 56 in.*lbf)
AIR TUBE SUB-ASSEMBLY LH
THROTTLE POSITION SENSOR CONNECTOR
DIESEL THROTTLE MOTOR CONNECTOR
21 (214, 15)
x 2
DIESEL THROTTLE MOTOR CONNECTOR
DIESEL THROTTLE BODY ASSEMBLY RH
21 (214, 15)
x 2
● GASKET
● GASKET
21 (214, 15)
x 2
x 2
21 (214, 15)
THROTTLE POSITION SENSOR CONNECTOR
DIESEL THROTTLE BODY ASSEMBLY LH
N*m (kgf*cm, ft.*lbf) : Specified torque
*: For use with union nut wrench
● Non-reusable part
P

for Preparation Click here

1. INSPECT DIESEL THROTTLE BODY ASSEMBLY

a. Inspect the diesel throttle valve.

i. Turn the engine switch on (IG).

ii. Turn the engine switch off and wait 5 seconds.

HINT:

Be sure to turn off the engine switch before performing this inspection. The fully closed position of the diesel throttle valve is learned when the engine switch is turned off.

iii. Connect the intelligent tester to the DLC3.

iv. Turn the engine switch on (IG).

v. Turn the intelligent tester on.

vi. Enter the following menus: Powertrain / Engine / Data List / All Data / Diesel Throttle Angle.

vii. Check that the value of "Diesel Throttle Angle" is within the specification.

Standard Diesel Throttle Angle:

Tester Display	Specified Condition
Diesel Throttle Angle	Throttle Angle: -5 to 5%

If the result is not as specified, replace the throttle body.

viii. Enter the following menus: Powertrain / Engine / Data List / All Data / Throttle Close Learning Val.

ix. Check that the value of "Throttle Close Learning Val" is within the specification.

Standard Throttle Valve Fully Closed:

Tester Display	Specified Condition
Throttle Close Learning Val.	14.25 to 21.25 deg

If the result is not as specified, replace the throttle body.

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

- **When disconnecting the cable some systems need to be initialized after the cable is reconnected (Click here).**
- **Disconnect the cable from the negative (-) battery terminal to clear the diesel throttle valve fully closed position learned value.**

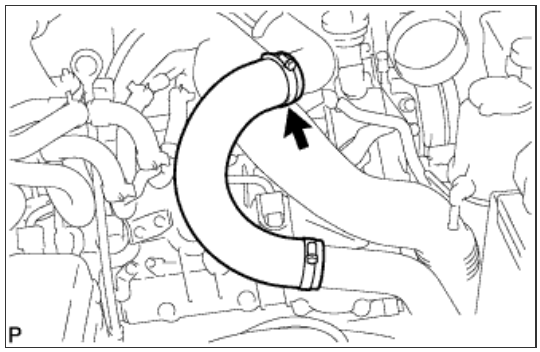
2. REMOVE INTERCOOLER ASSEMBLY (w/ Intercooler)

a. (Click here)

3. REMOVE NO. 1 COOL AIR INLET (w/o Intercooler)

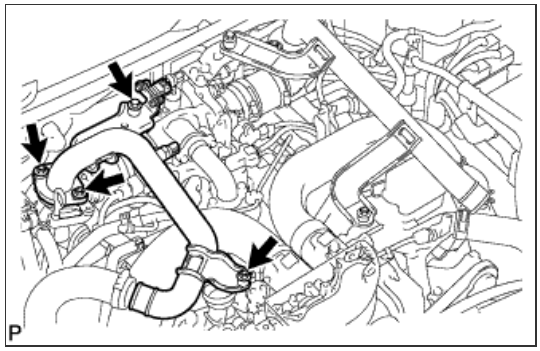
a. Loosen the No. 1 air hose clamp.

b. Disconnect the turbo pressure sensor connector, intake air temperature sensor connector and vacuum hose.



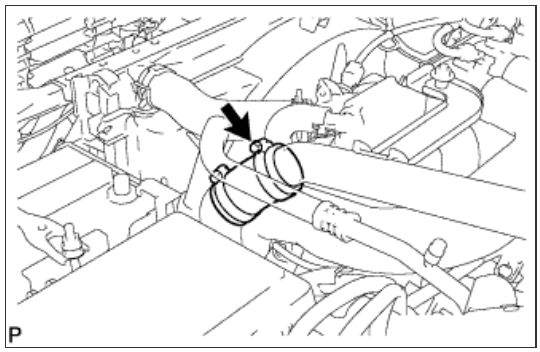
c. Remove the 3 nuts, bolt and No. 1 cool air inlet.

d. Remove the gasket from the air tube R



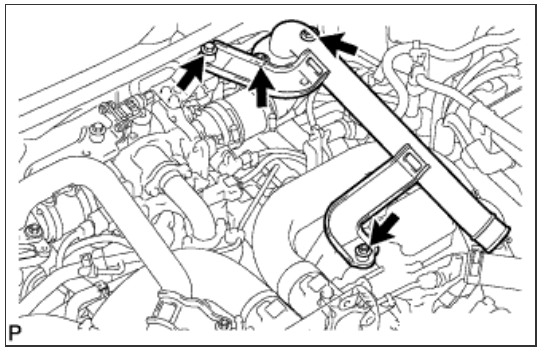
4. REMOVE NO. 2 COOL AIR INLET (w/o Intercooler)

a. oosen the No. 2 air hose clamp.



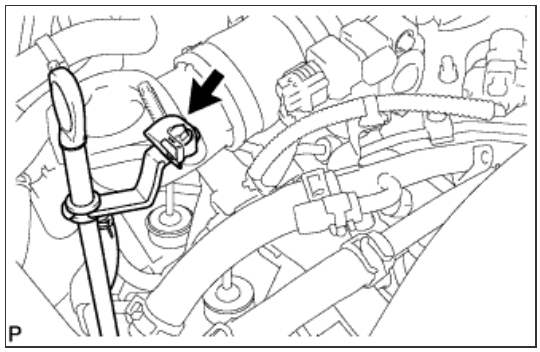
b. Remove the 3 nuts, bolt and No. 2 cool air inlet.

c. Remove the gasket from the air tube L



5. DISCONNECT NO. 2 ENGINE OIL LEVEL DIPSTICK GUIDE

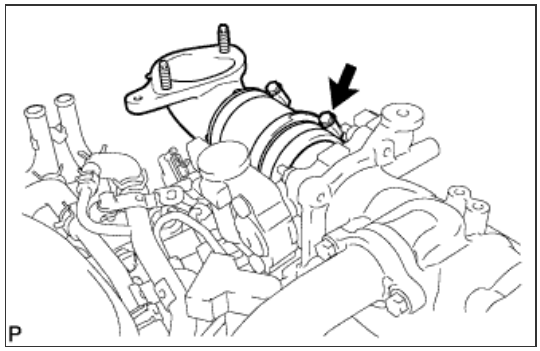
a. Remove the bolt and disconnect the oil level dipstick guide.



6. REMOVE AIR TUBE SUB-ASSEMBLY RH

a. Loosen the hose clamp.

b. Remove the air tube from the throttle body.



7. DRAIN CLUTCH FLUID (for Manual Transmission)

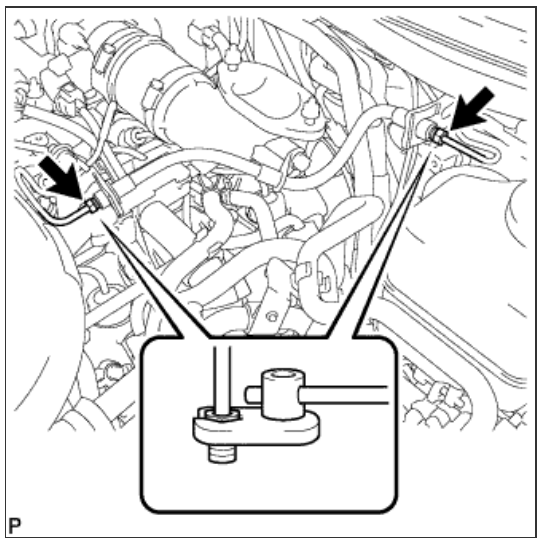
8. REMOVE CLUTCH HOSE (for Manual Transmission)

a. Disconnect the 2 flexible hose tubes from the clutch hose with a 10 mm union nut wrench while holding the flexible hose with a wrench.

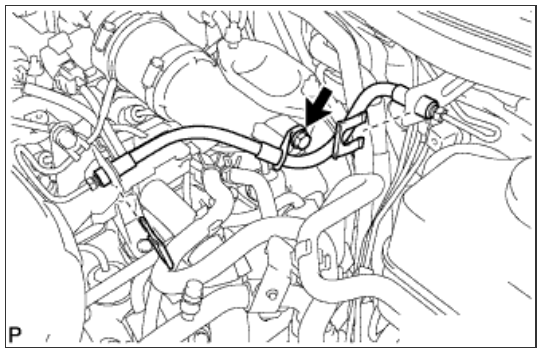
NOTICE:

- **Do not bend or damage the flexible hose tubes.**
- **Do not allow any foreign matter such as dirt and dust to enter the flexible hose tubes from the connecting point.**

b. Remove the 2 clips.



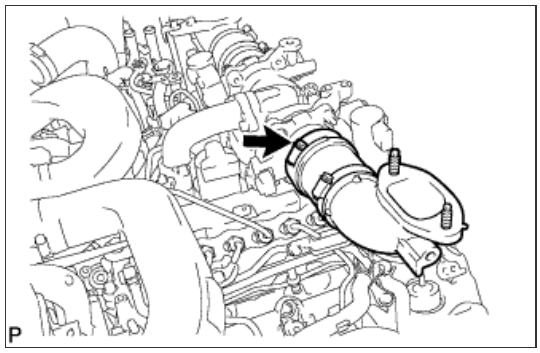
c. Remove the bolt and clutch hose.



9. REMOVE AIR TUBE SUB-ASSEMBLY LH

a. Loosen the hose clamp.

b. Remove the air tube from the throttle body.

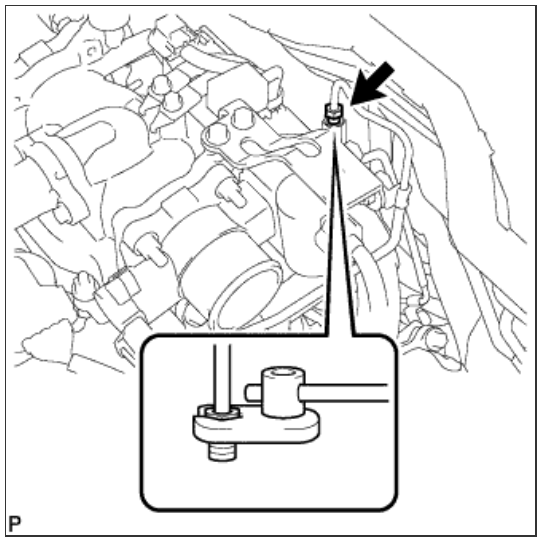


10. REMOVE TUBE CONNECTOR TO FLEXIBLE HOSE TUBE (for Manual Transmission)

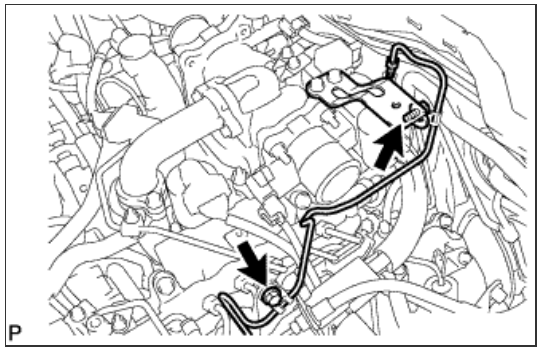
a. Using a 10 mm union nut wrench, disconnect the tube connector to flexible hose tube from the clutch tube to release cylinder 2 way.

NOTICE:

- **Do not bend or damage the flexible hose tube.**
- **Do not allow any foreign matter such as dirt and dust to enter the flexible hose tube from the connecting point.**



b. Remove the 2 bolts and tube connector to flexible hose tube.



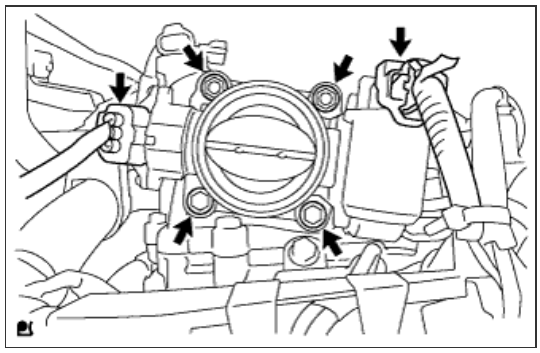
11. REMOVE DIESEL THROTTLE BODY ASSEMBLY RH

a. Disconnect the throttle position sensor connector.

b. Disconnect the throttle motor connector.

c. Remove the 2 bolts, 2 nuts and throttle body.

d. Remove the gasket from the intake pipe.



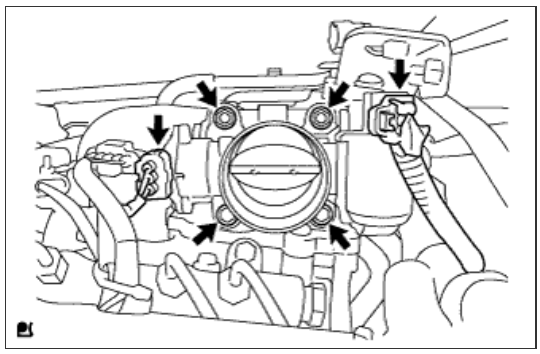
12. REMOVE DIESEL THROTTLE BODY ASSEMBLY LH

a. Disconnect the throttle position sensor connector.

b. Disconnect the throttle motor connector.

c. Remove the 2 bolts, 2 nuts and throttle body.

d. Remove the gasket from the intake pipe.



for Preparation Click here

NOTICE:

Disconnect the cable from the negative (-) battery terminal to clear the diesel throttle valve fully closed position learned value.

1. INSTALL DIESEL THROTTLE BODY ASSEMBLY LH

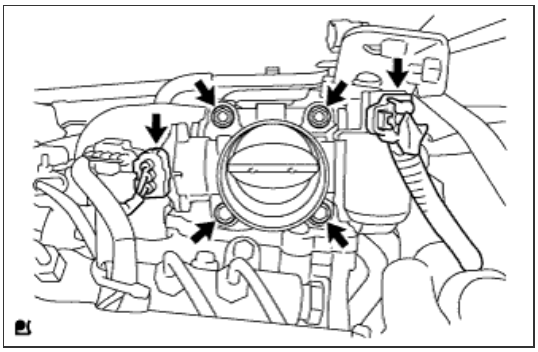
a. Install a new gasket to the intake pipe.

b. Install the throttle body with the 2 bolts and 2 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Connect the throttle position sensor connector.

d. Connect the throttle motor connector.



2. INSTALL DIESEL THROTTLE BODY ASSEMBLY RH

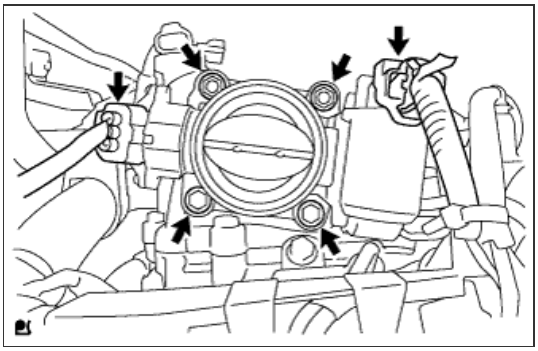
a. Install a new gasket to the intake pipe.

b. Install the throttle body with the 2 bolts and 2 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

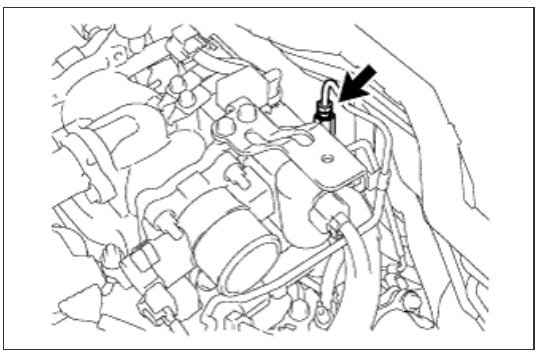
c. Connect the throttle position sensor connector.

d. Connect the throttle motor connector.



3. INSTALL TUBE CONNECTOR TO FLEXIBLE HOSE TUBE (for Manual Transmission)

a. Temporarily install the flare nut of the tube connector to flexible hose tube to the clutch tube to release cylinder 2 way by hand.



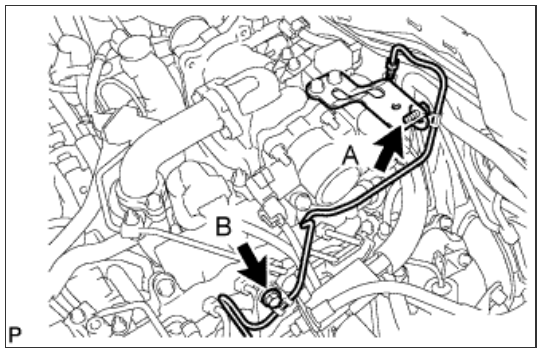
b. Temporarily install the tube connector to flexible hose tube with the 2 bolts.

c. Tighten the bolt labeled A.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

NOTICE:

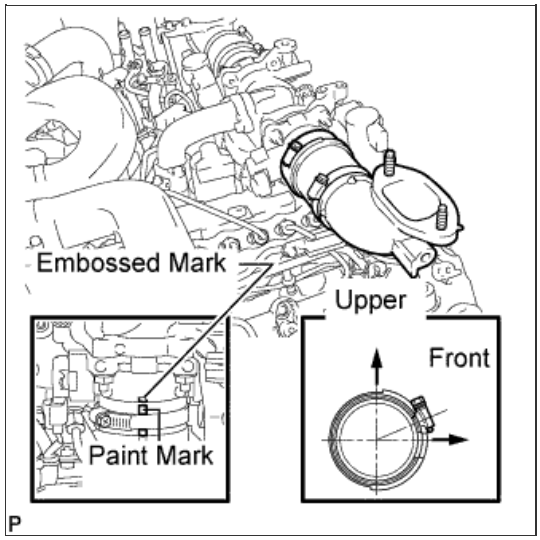
Tighten the bolt labeled B after installing the clutch hose.



4. INSTALL AIR TUBE SUB-ASSEMBLY LH

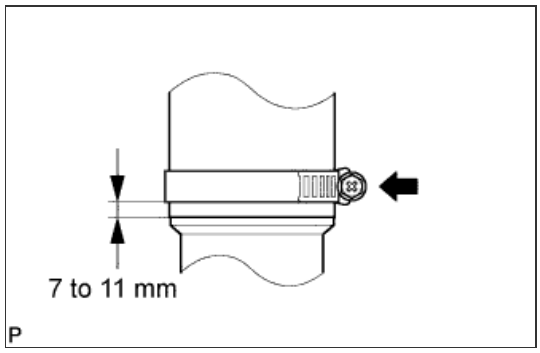
a. Install the air tube to the throttle body.

b. Align the embossed mark of the throttle body with the paint mark of the No. 4 air hose.



c. Tighten the hose clamp so that it is 7 to 11 mm (0.276 to 0.433 in.) from the end of the hose as shown in the illustration.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



5. INSTALL CLUTCH HOSE (for Manual Transmission)

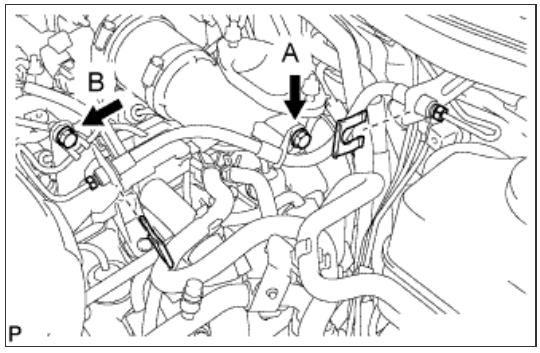
a. Connect the clutch hose to the air tube with the bolt labeled A.

b. Temporarily install the clutch hose to the clutch master cylinder tube to flexible hose tube and tube connector to flexible hose tube, and fix it in place with the 2 clips.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

c. Tighten the bolt labeled B.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }



d. Tighten the flexible hose tube.

NOTICE:

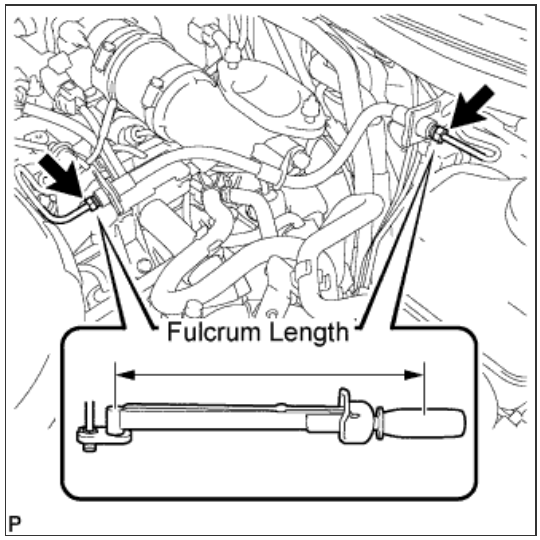
- **Do not bend or damage the flexible hose tube.**
- **Do not allow any foreign matter such as dirt and dust to enter the flexible hose tube from the connecting points.**

HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.). If using a torque wrench with a length that is not 30 cm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the "without SST" torque specification (Click here).**
- **Make sure union nut wrench and the wrench are connected in a straight line.**

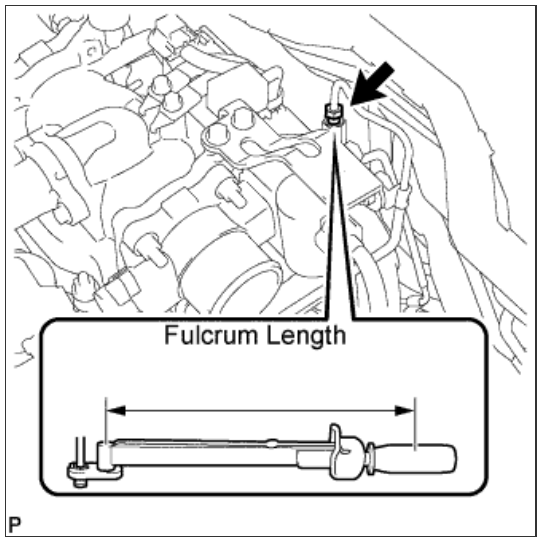
i. Using a 10 mm union nut wrench, tighten the 2 flare nuts of the flexible hose tube.

Torque:
without union nut wrench:
15 N*m{ 154 kgf*cm , 11 ft.*lbf }
with union nut wrench:
14 N*m{ 141 kgf*cm , 10 ft.*lbf }



ii. Using a 10 mm union nut wrench, tighten the flare nut of the flexible hose tube.

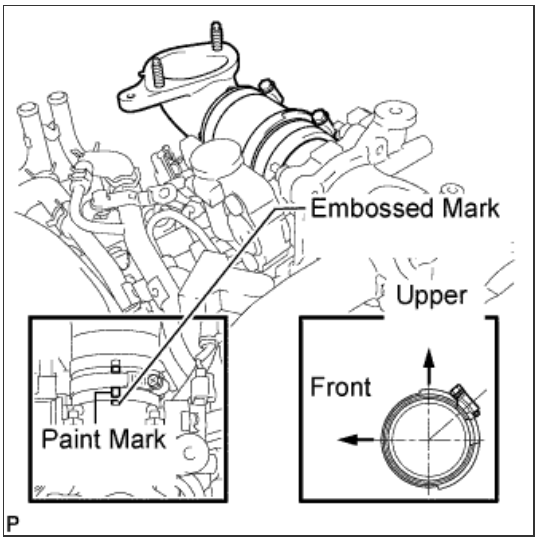
Torque:
without union nut wrench:
15 N*m{ 154 kgf*cm , 11 ft.*lbf }
with union nut wrench:
14 N*m{ 141 kgf*cm , 10 ft.*lbf }



6. INSTALL AIR TUBE SUB-ASSEMBLY RH

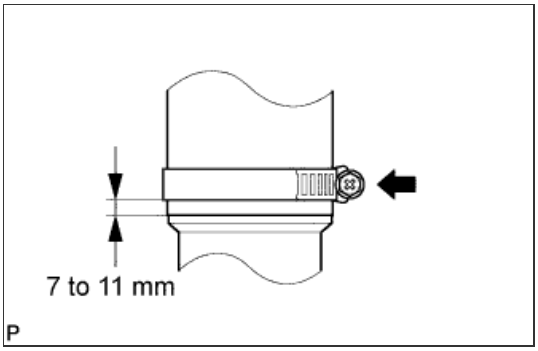
a. Install the air tube to the throttle body.

b. Align the embossed mark of the throttle body with the paint mark of the No. 4 air hose.



c. Tighten the hose clamp so that it is 7 to 11 mm (0.276 to 0.433 in.) from the end of the hose as shown in the illustration.

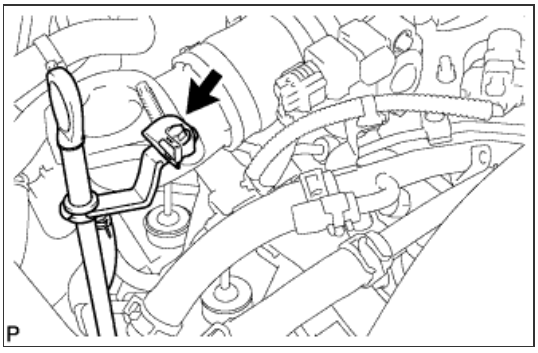
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



7. CONNECT NO. 2 ENGINE OIL LEVEL DIPSTICK GUIDE

a. Connect the dipstick guide with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

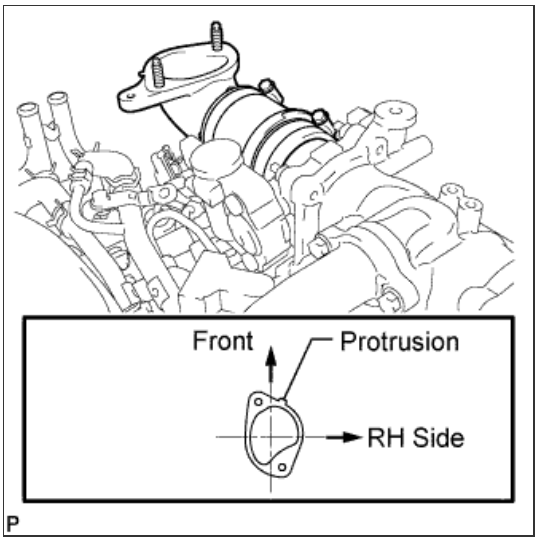


8. INSTALL NO. 1 COOL AIR INLET (w/o Intercooler)

a. Install a new gasket to the air tube RH.

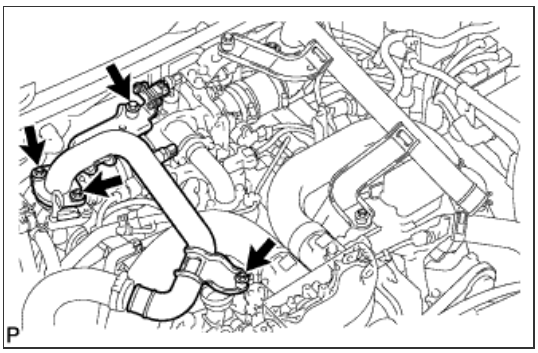
HINT:

Install the gasket with the protrusion facing as shown in the illustration.



b. Install the No. 1 cool air inlet with the 3 nuts and bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



c. Connect the vacuum hose, intake air temperature sensor connector and turbo pressure sensor connector.

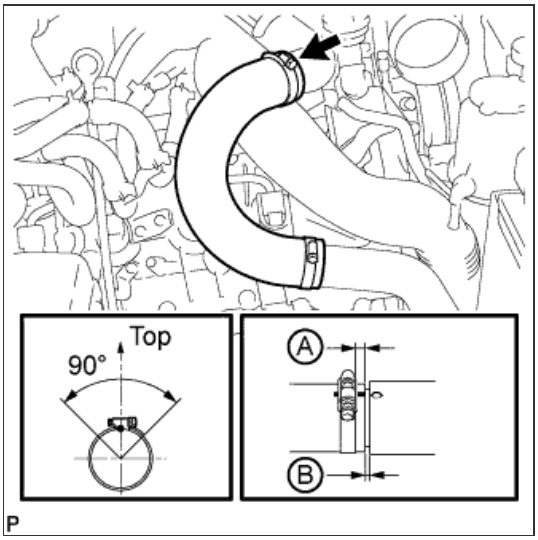
d. Connect the No. 1 air hose to the No. 1 cool air inlet.

e. Tighten the No. 1 air hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion and push on the air hose so that distance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that distance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make sure the direction of the hose clamp is as shown in the illustration.**

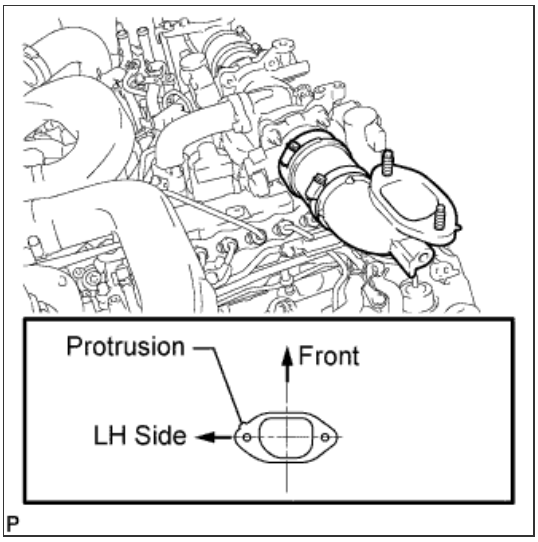


9. INSTALL NO. 2 COOL AIR INLET (w/o Intercooler)

a. Install a new gasket to the air tube LH.

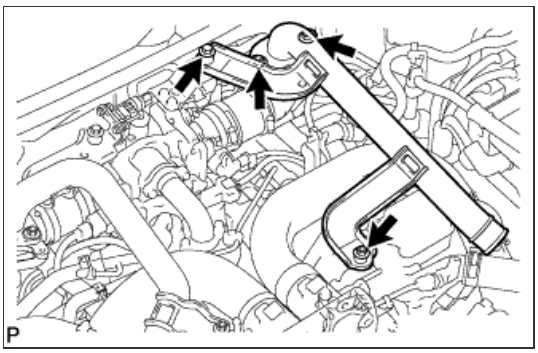
HINT:

Install the gasket with the protrusion facing as shown in the illustration.



b. Install the No. 2 cool air inlet with the 3 nuts and bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



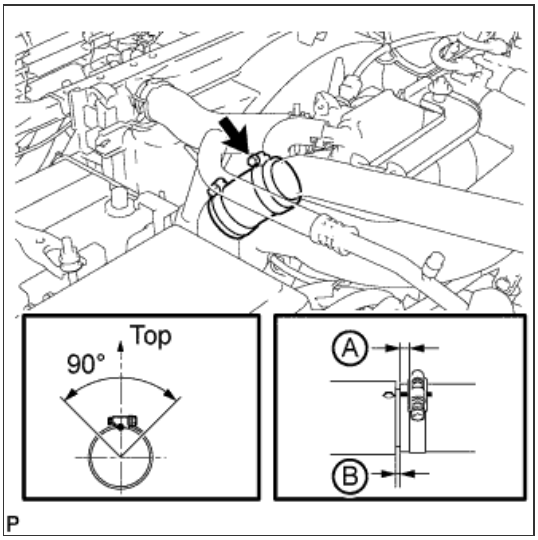
c. Connect the No. 2 air hose to the No. 2 cool air inlet.

d. Tighten the No. 2 air hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion and push on the air hose so that distance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that distance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make sure the direction of the hose clamp is as shown in the illustration.**



10. INSTALL INTERCOOLER ASSEMBLY (w/ Intercooler)

a. (Click here)

11. FILL BRAKE FLUID RESERVOIR

a. Fill the reservoir with brake fluid.

Brake Fluid:
SAE J1703 or FMVSS No. 116 DOT 3

12. BLEED CLUTCH LINE

a. Remove the release cylinder bleeder plug cap.

b. Connect a vinyl tube to the bleeder plug.

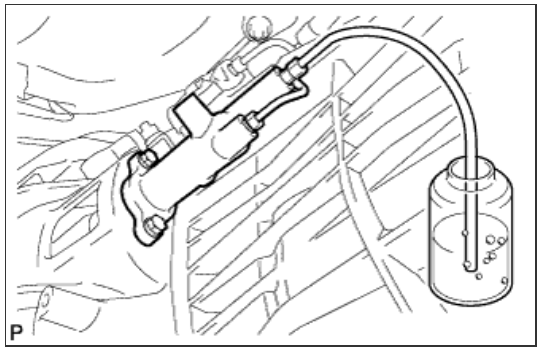
c. Depress the clutch pedal several times, and then loosen the bleeder plug while the pedal is depressed.

d. When fluid no longer comes out, tighten the bleeder plug, and then release the clutch pedal.

e. Repeat the previous 2 steps until all the air in the fluid is completely bled.

f. Tighten the bleeder plug.

Torque:
11 N*m{ 110 kgf*cm , 8 ft.*lbf }



g. Install the bleeder plug cap.

h. Check that all the air has been bled from the clutch line.

13. CHECK FLUID LEVEL IN RESERVOIR

a. Check the fluid level.
If the brake fluid level is low, check for leaks and inspect the disc brake pad. If necessary, refill the reservoir with brake fluid after repair or replacement.

Brake fluid:
SAE J1703 or FMVSS No. 116 DOT 3

14. INSPECT FOR CLUTCH FLUID LEAK

15. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

16. CHECK DIESEL THROTTLE BODY ASSEMBLY

a. Inspect the diesel throttle valve.

i. Turn the engine switch on (IG).

ii. Turn the engine switch off and wait 5 seconds.

HINT:

Be sure to turn off the engine switch before performing this inspection. The fully closed position of the diesel throttle valve is learned when the engine switch is turned off.

iii. Connect the intelligent tester to the DLC3.

iv. Turn the engine switch on (IG).

v. Turn the intelligent tester on.

vi. Enter the following menus: Powertrain / Engine / Data List / All Data / Diesel Throttle Angle.

vii. Check that the value of "Diesel Throttle Angle" is within the specification.

Standard Diesel Throttle Angle:

Tester Display	Specified Condition
Diesel Throttle Angle	Throttle Angle: -5 to 5%

If the result is not as specified, replace the throttle body.

viii. Enter the following menus: Powertrain / Engine / Data List / All Data / Throttle Close Learning Val.

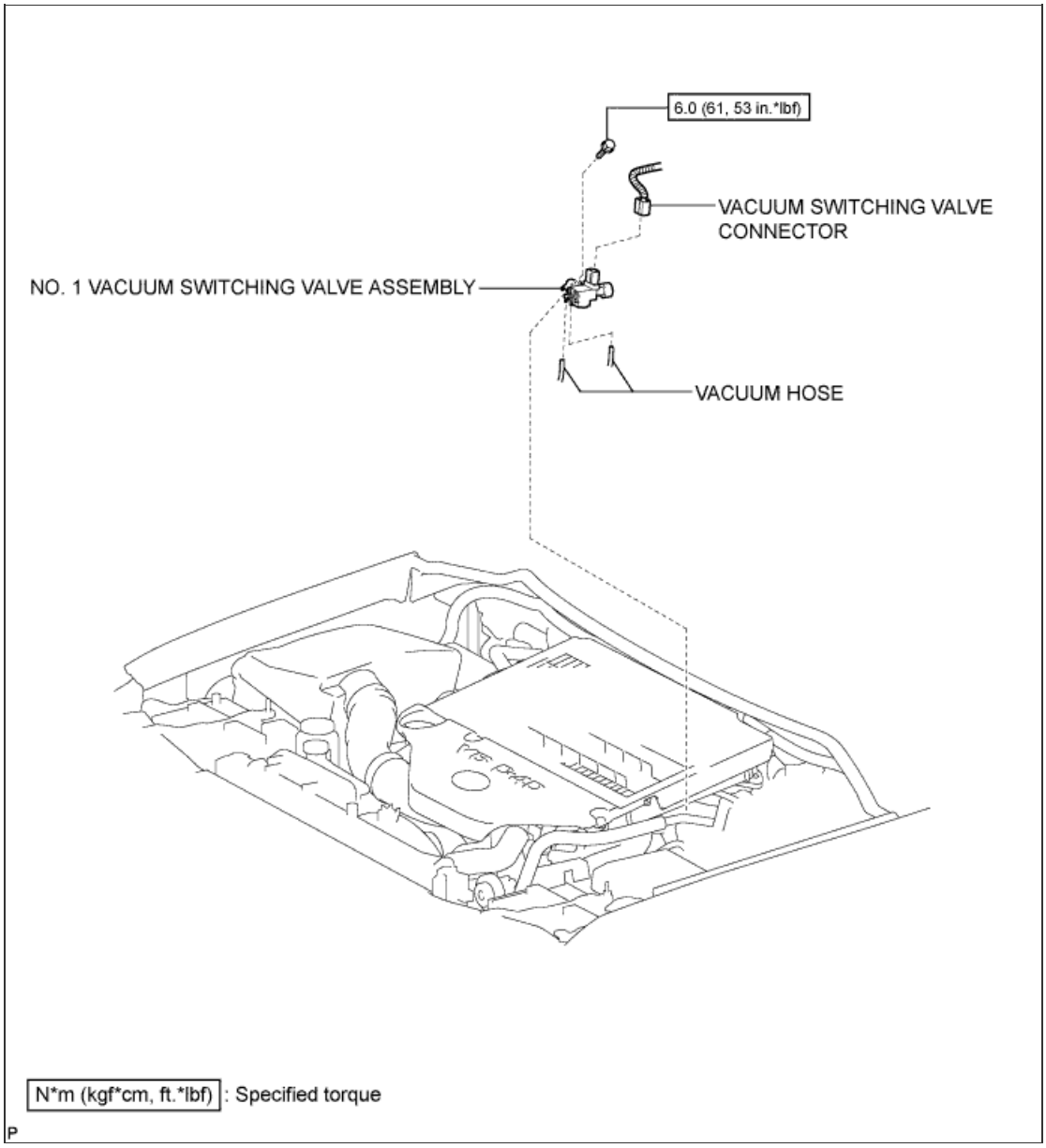
ix. Check that the value of "Throttle Close Learning Val" is within the specification.

Standard Throttle Valve Fully Closed:

Tester Display	Specified Condition
Throttle Close Learning Val.	14.25 to 21.25 deg

If the result is not as specified, replace the throttle body.

for Preparation Click here

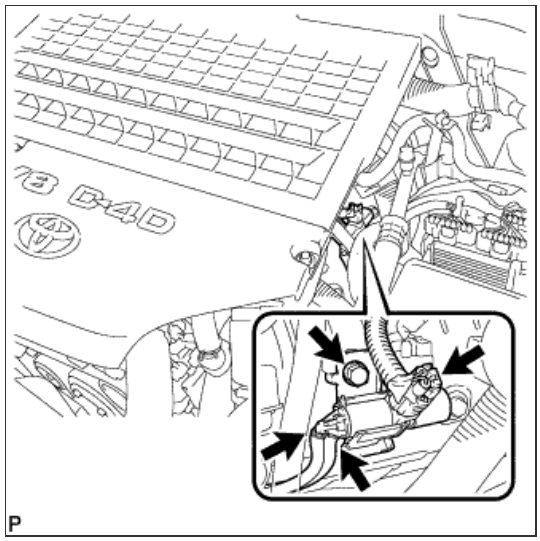


for Preparation Click here

1. REMOVE NO. 1 VACUUM SWITCHING VALVE ASSEMBLY

a. Disconnect the connector and 2 vacuum hoses.

b. Remove the bolt and VSV.



for Preparation Click here

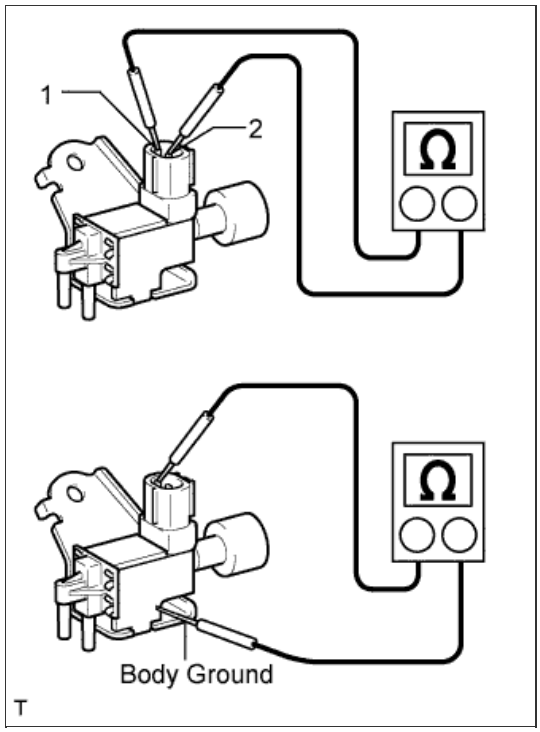
1. INSPECT NO. 1 VACUUM SWITCHING VALVE ASSEMBLY

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

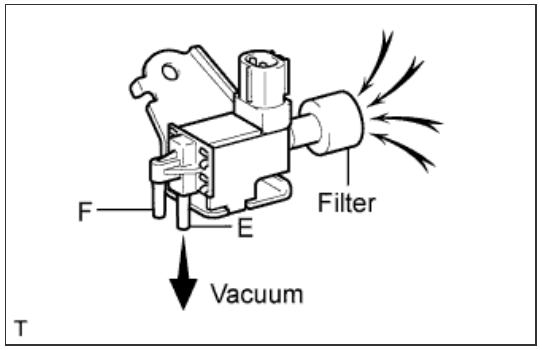
Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	37 to 44 Ω
1 - Body Ground 2 - Body Ground	Always	10 kΩ or higher

If result is not as specified, replace the vacuum switching valve assembly.



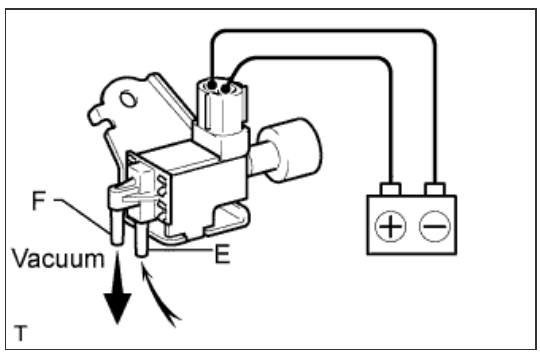
b. Check the VSV operation.

i. When applying vacuum to port E, check that air is sucked into the filter.
If the result is not as specified, replace the vacuum switching valve assembly.



ii. Apply voltage across the terminals.

iii. When applying vacuum to port F, check that air is sucked into port E.
If the result is not as specified, replace the vacuum switching valve assembly.



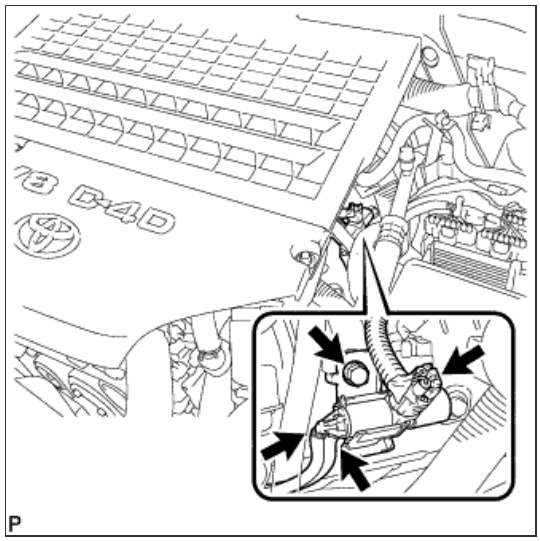
for Preparation Click here

1. INSTALL NO. 1 VACUUM SWITCHING VALVE ASSEMBLY

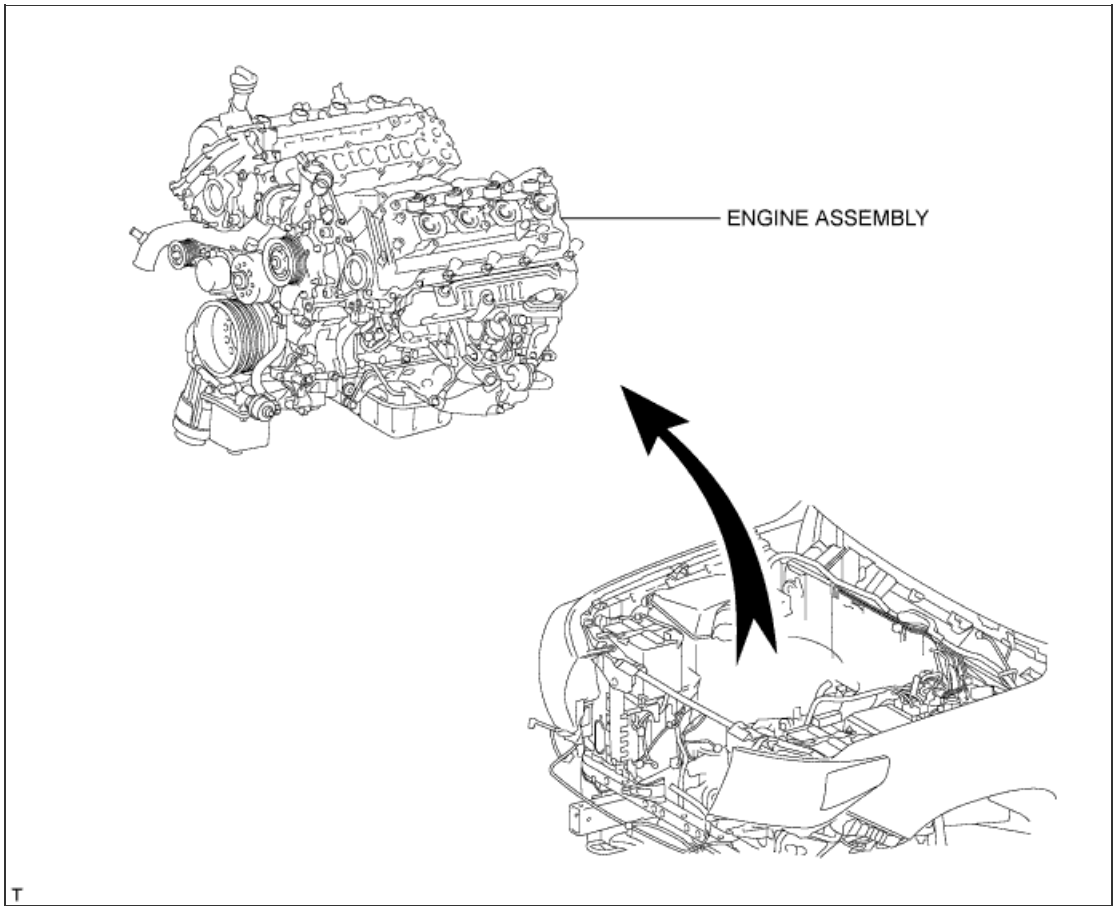
a. Install the VSV with the bolt.

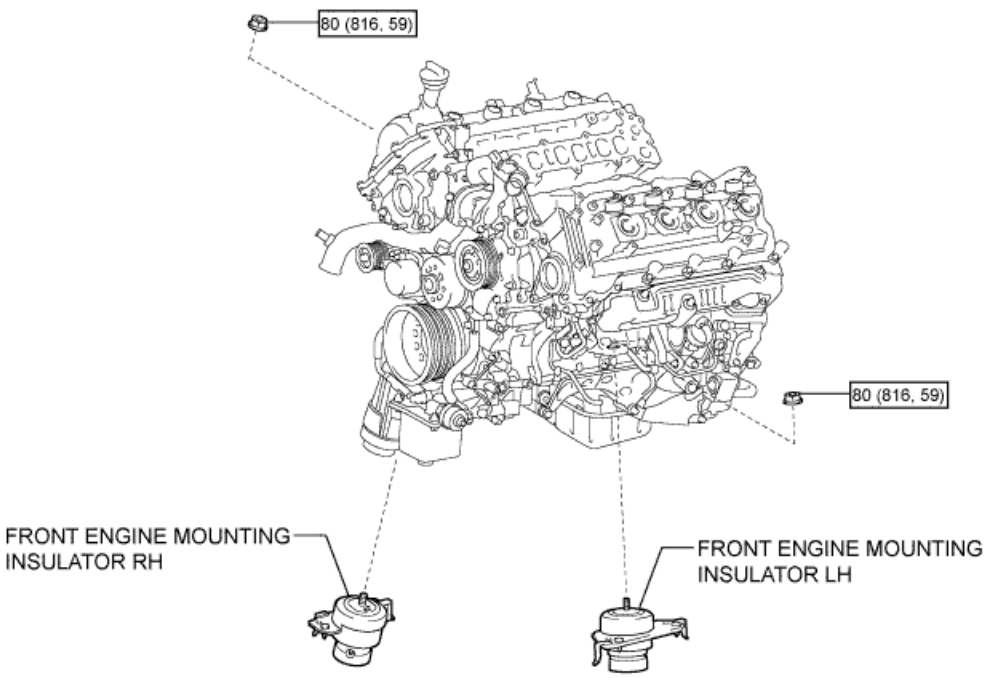
Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }

b. Connect the 2 vacuum hoses and connector.



for Preparation [Click here]





N*m (kgf*cm, ft.*lbf) : Specified torque

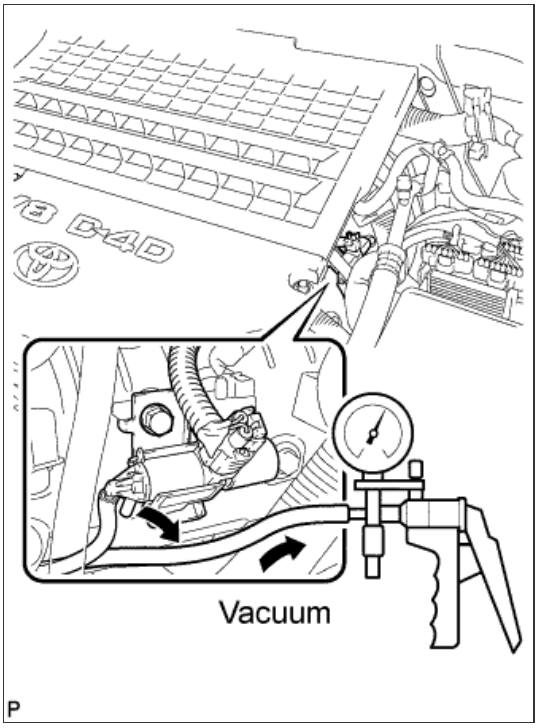
for Preparation Click here

1. CHECK VACUUM HOSE

a. Disconnect the vacuum hose shown in the illustration from the vacuum switching valve.

Using a vacuum pump, apply a vacuum of 80 kPa (600 mmHg, 25 in.Hg) and wait 1 minute.

c. Check that there is no change in the needle movement of the vacuum pump gauge.



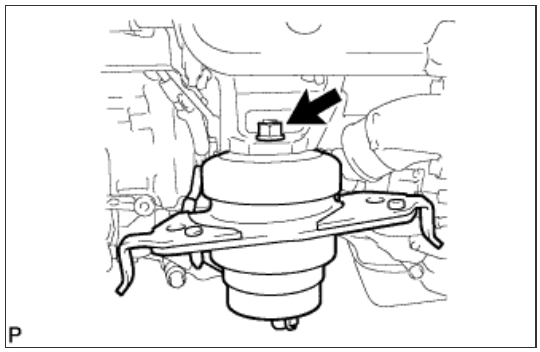
for Preparation Click here

1. REMOVE ENGINE ASSEMBLY

a. Remove the engine assembly (Click here).

2. REMOVE FRONT ENGINE MOUNTING INSULATOR LH

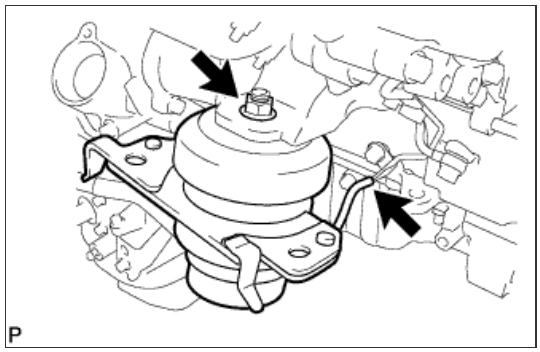
a. Remove the nut and mounting insulator.



3. REMOVE FRONT ENGINE MOUNTING INSULATOR RH

a. Disconnect the vacuum hose.

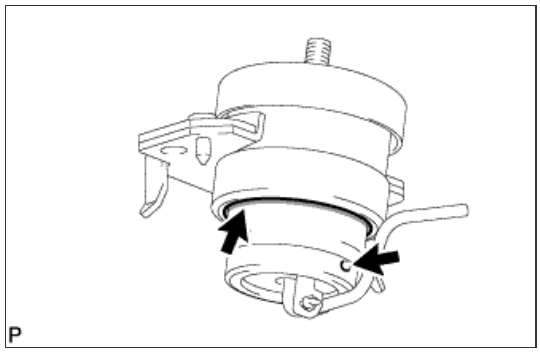
b. Remove the nut and mounting insulator.



for Preparation Click here

1. INSPECT RONT ENGINE MOUNTING INSULATOR

a. Visually check the front engine mounting insulator for leaks.
If the fluid leaks, replace the front engine mounting insulator.

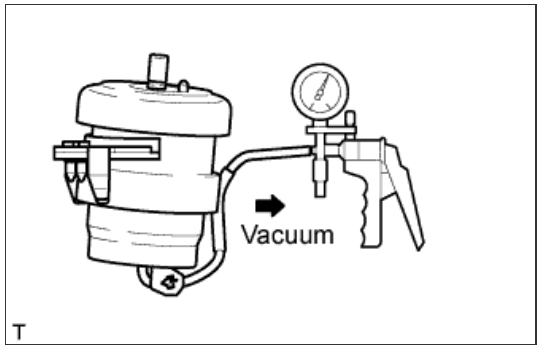


. INSPECT RONT ENGINE MOUNTING INSULATOR

a. Connect a vacuum pump to the engine mount insulator.

b. Using the vacuum pump, apply a vacuum of 80 kPa (600 mmHg. 25 in.Hg) and wait for 1 minute.

c. Check that there is no change in the needle movement of the vacuum pump gauge.
If the result is not as specified, replace the front engine mounting insulator.



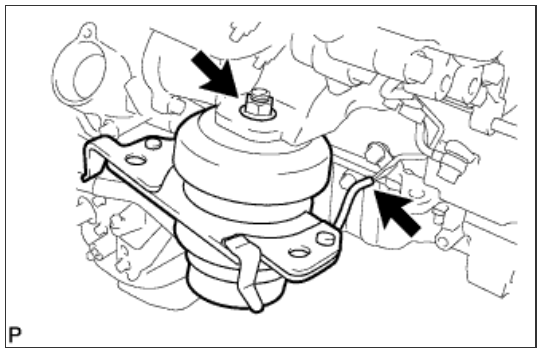
for Preparation Click here

1. INSTALL FRONT ENGINE MOUNTING INSULATOR RH

a. Install the mounting insulator with the nut.

Torque:
80 N*m{ 816 kgf*cm , 59 ft.*lbf }

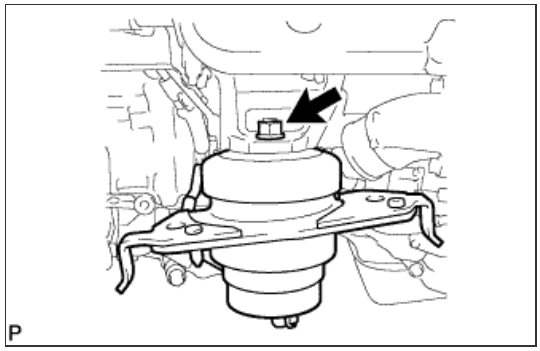
b. Connect the vacuum hose.



2. INSTALL FRONT ENGINE MOUNTING INSULATOR LH

a. Install the mounting insulator with the nut.

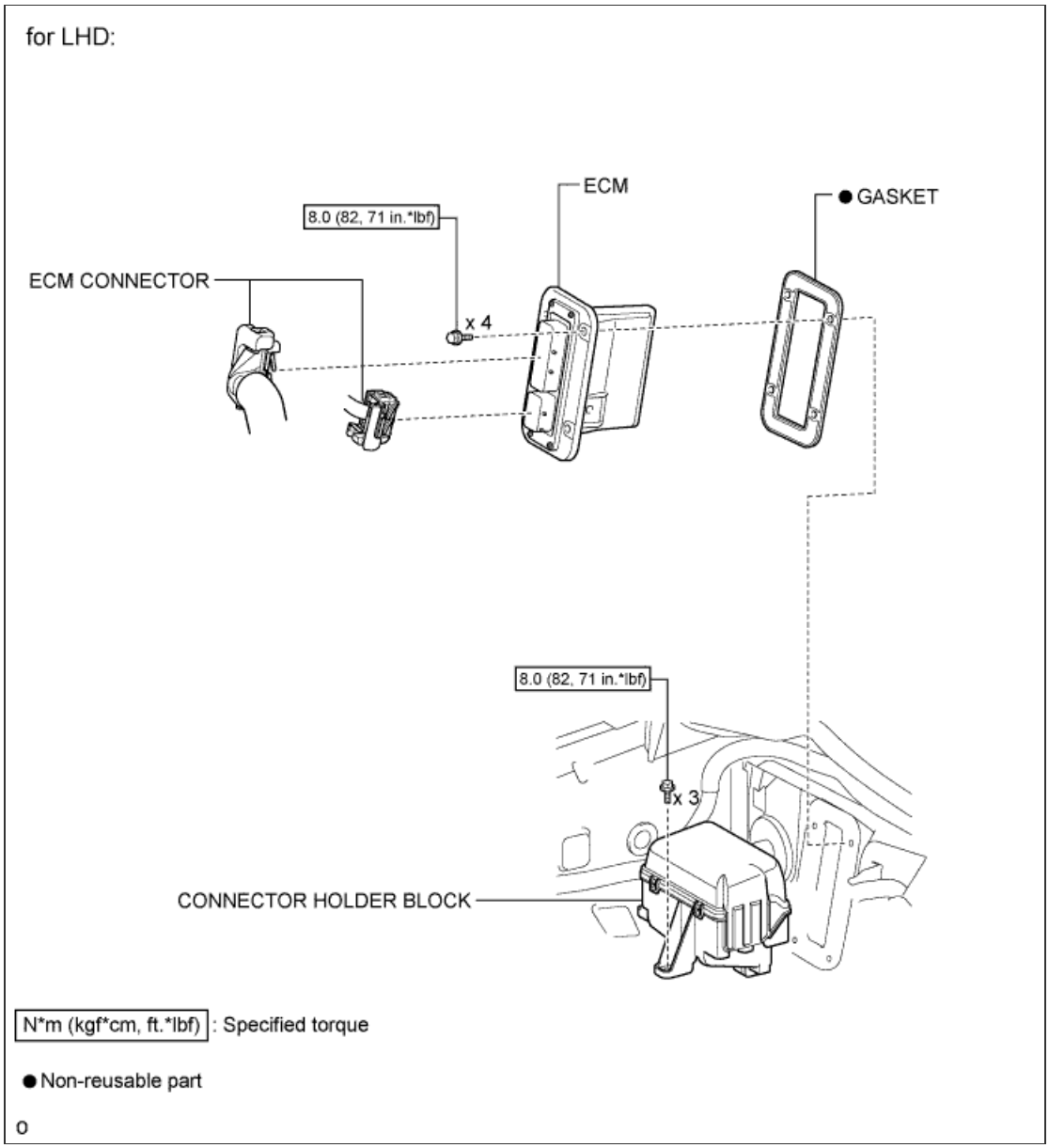
Torque:
80 N*m{ 816 kgf*cm , 59 ft.*lbf }



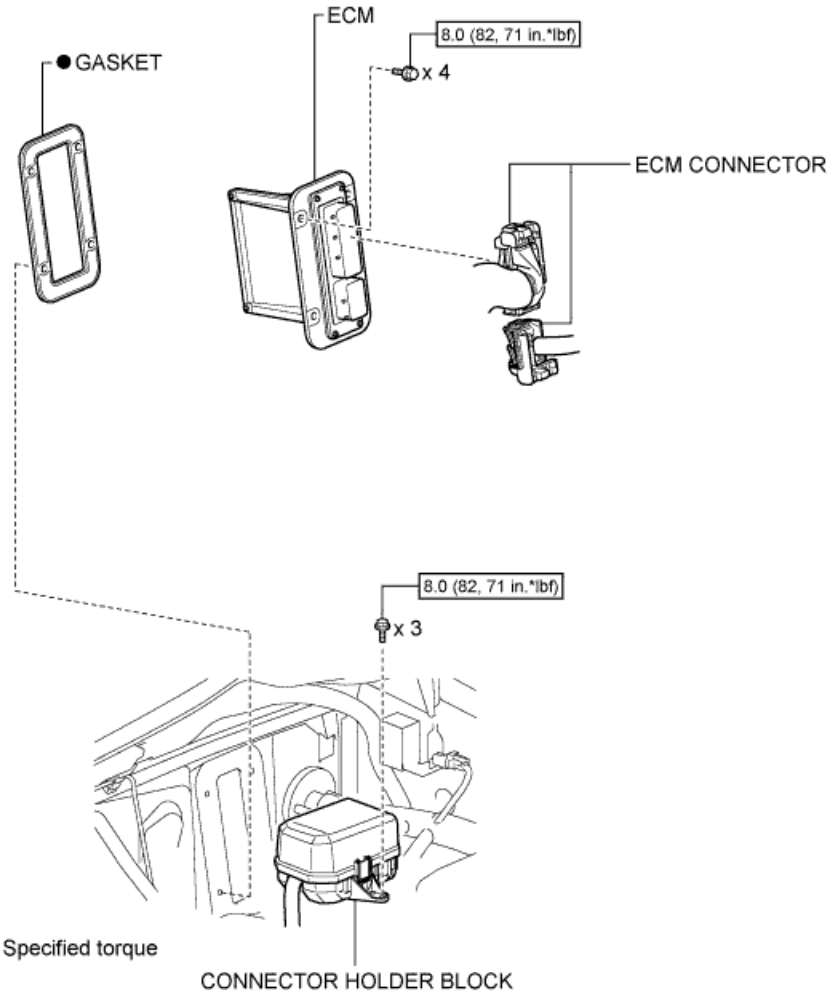
3. INSTALL ENGINE ASSEMBLY

a. Install the engine assembly (Click here).

for Preparation Click here



for RHD:



N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

o

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

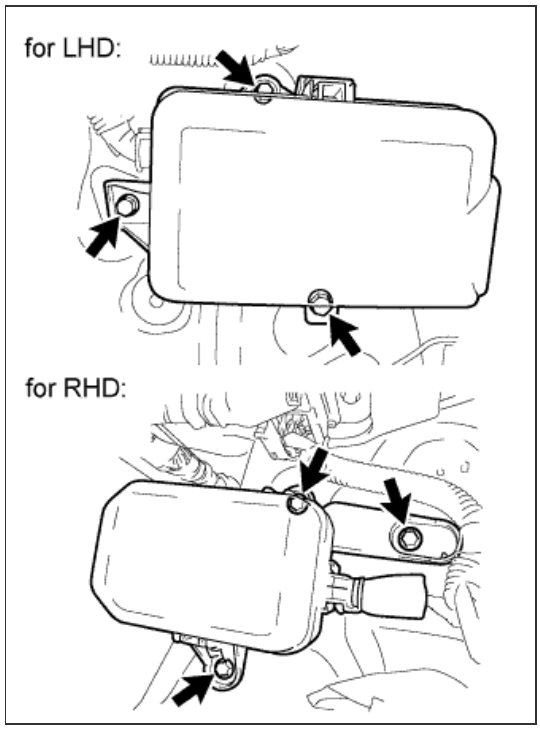
Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable some systems need to be initialized after the cable is reconnected (Click here).

2. DISCONNECT CONNECTOR HOLDER BLOCK

a. Remove the 3 bolts and move the connector holder block so that the ECM can be removed in the next step.



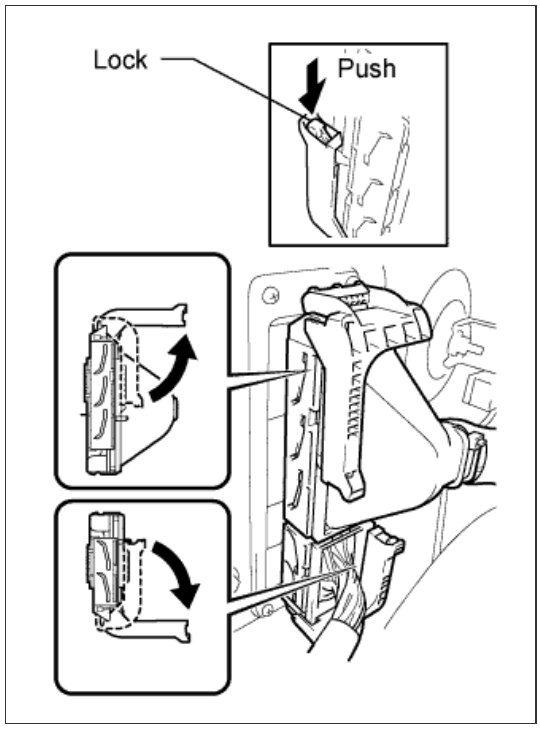
3. REMOVE ECM

a. Raise the 2 levers while p shing the locks on the 2 levers.

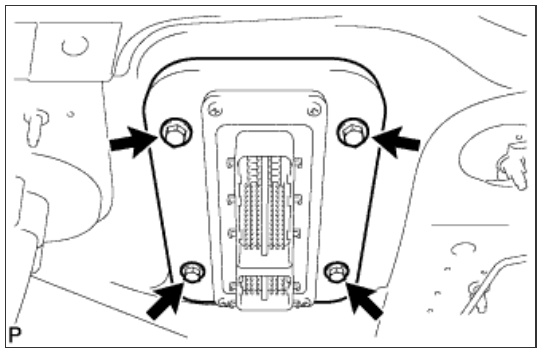
NOTICE:

Make s re that the lock levers are raised 90° as shown in the ill stration before disconnecting the ECM connectors. Fail re to do this may ca se the ECM connectors to break.

b. Disconnect the 2 connectors.

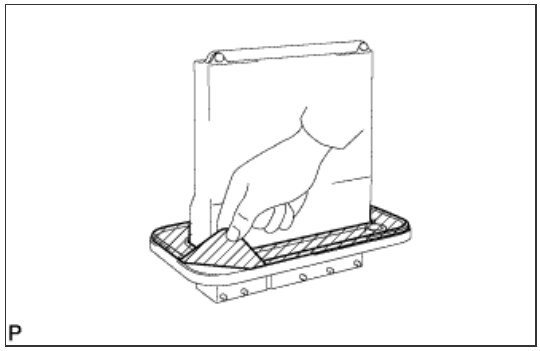


c. Remove the 4 bolts and ECM.



4. REMOVE GASKET

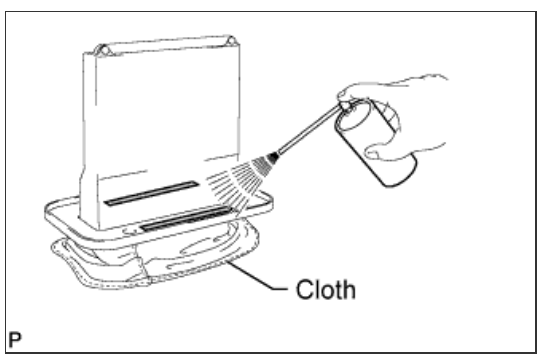
a. Peel off the gasket.



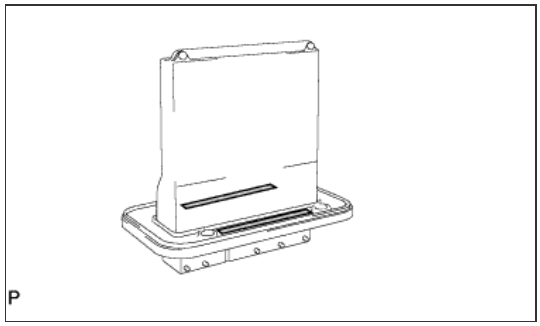
b. Spray gasket remover or eq ivalent on the remaining tape of the gasket.

NOTICE:

When sing gasket remover or eq ivalent, cover the ECM connector with a cloth.



c. Remove the tape of the gasket witho t sing bladed ob ects.



P

for Preparation Click here

1. INSTALL GASKET

a. Clean the ECM seal surface with non-residue solvent.

b. Install a new gasket to the ECM.

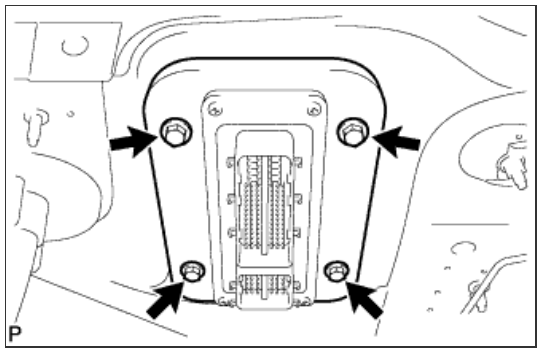
2. INSTALL ECM

a. Install the ECM with the bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

NOTICE:

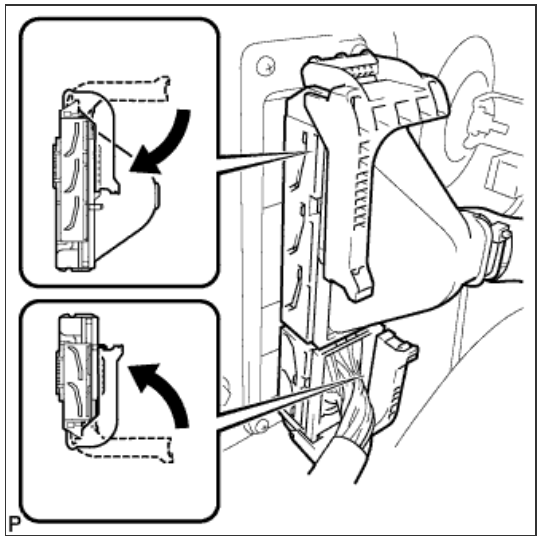
- **Make sure the gasket is not folded or caught on any area on the surrounding part.**
- **Make sure there is no foreign matter caught between the gasket and surrounding part.**
- **Do not damage the gasket.**



b. Connect the 2 ECM connectors and push each lock lever down to lock the ECM connectors.

NOTICE:

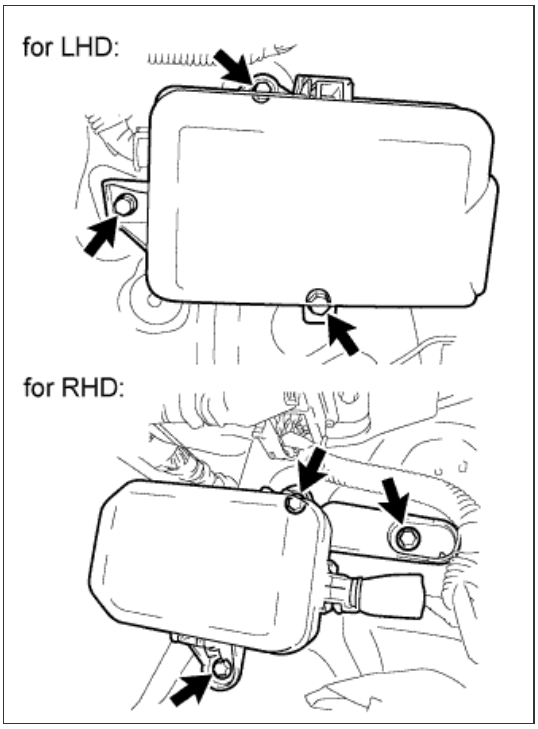
- **Be careful not to allow dirt, water, or other foreign matter to adhere to the connecting parts when connecting the connectors.**
- **Do not twist the wire harness when connecting the ECM connectors.**
- **Make sure that the lock lever is raised 90° before connecting the ECM connectors. Failure to do this may cause the lock lever and terminals to break.**
- **Make sure that the levers are securely locked.**



3. CONNECT CONNECTOR HOLDER BLOCK

a. Connect the connector holder block with the 3 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }



4. REGISTER IN ECDR COMPENSATION CODE

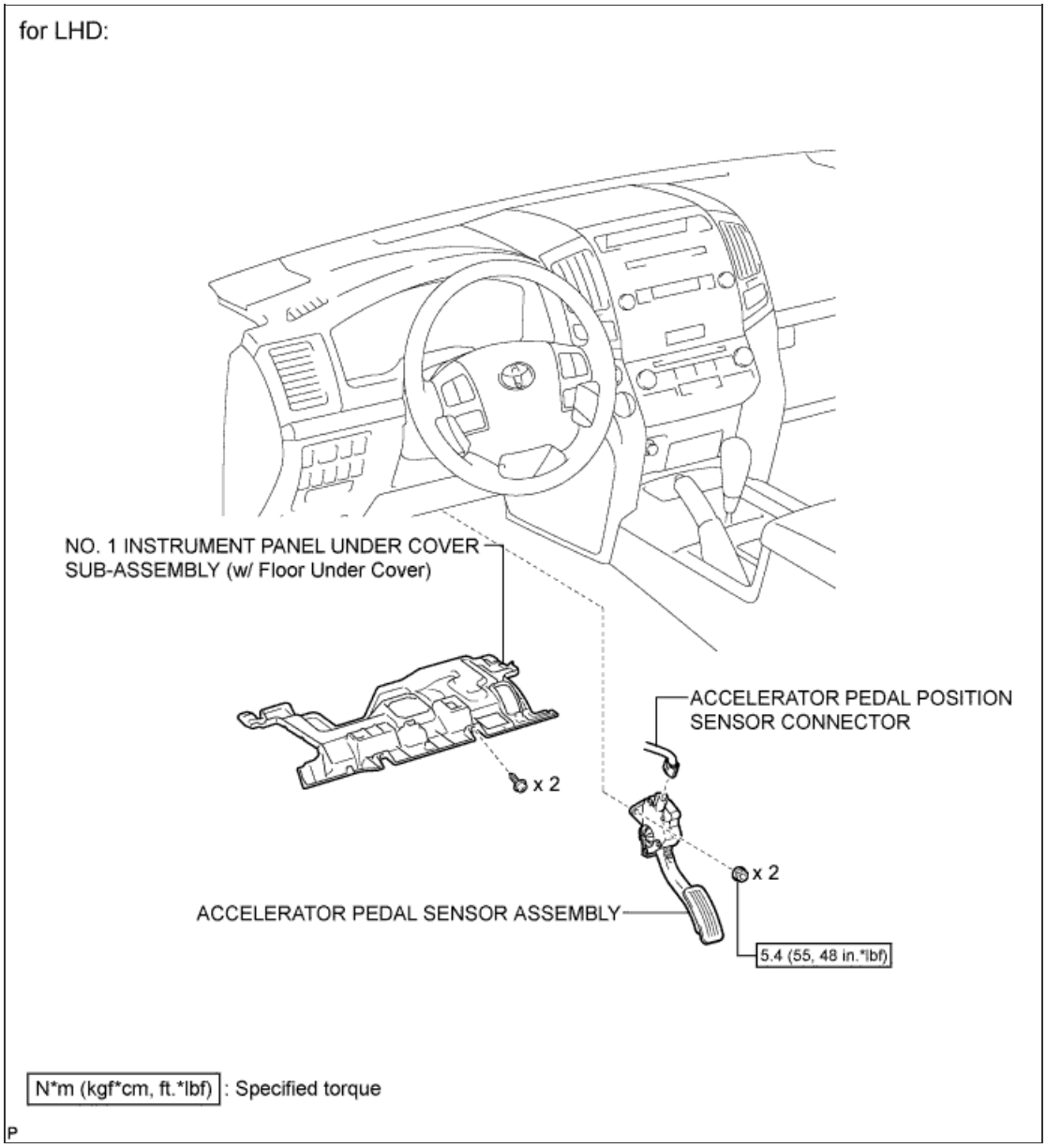
a. Register the injector co ensation code (Click here).

5. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

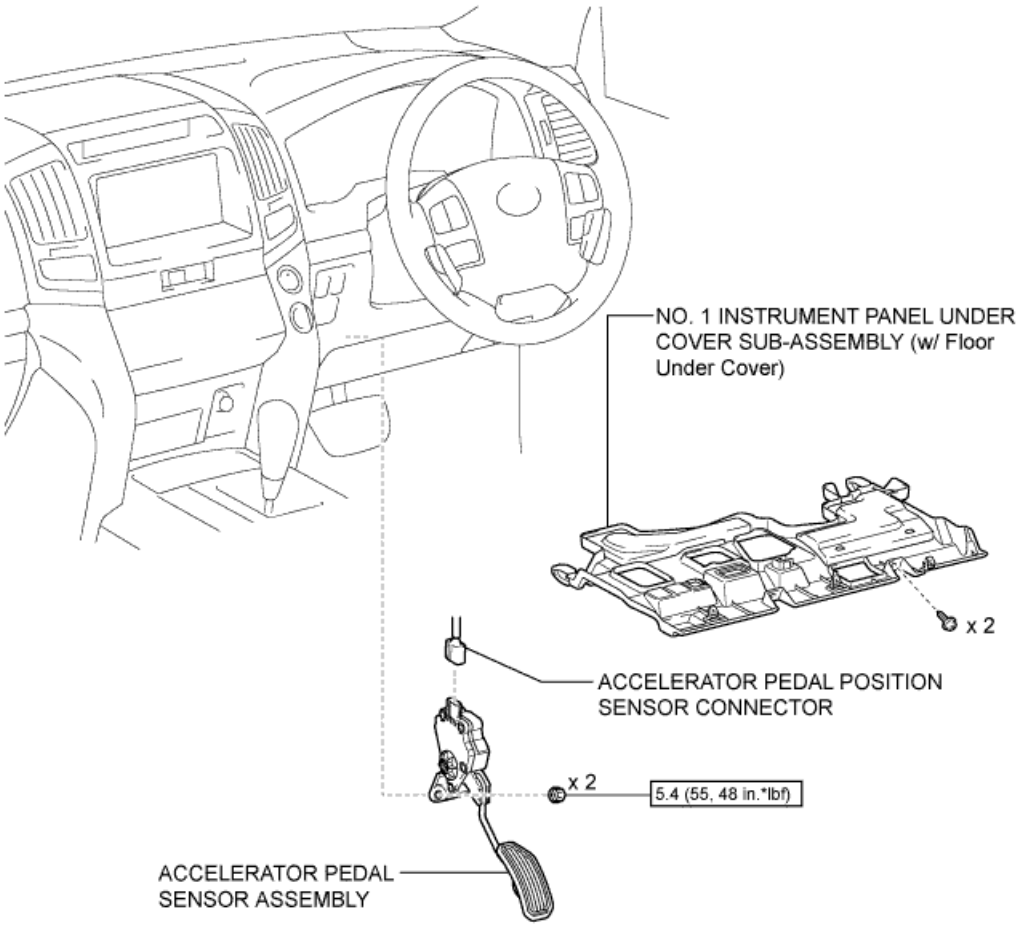
NOTICE:

bn disconnecting the cable, so e syste s need to be initiali ed after the cable is reconnected (Click here).

for Preparation Click here



for RHD:



N*m (kgf*cm, ft.*lbf) : Specified torque

P

for Preparation Click here

1. INSPECT ACCELERATOR PEDAL SENSOR ASSEMBLY

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain / Engine / Data List / All Data / Acceler tor Position No. 1 nd Acceler tor Position No. 2.

e. Re the v lue displ ed on the tester.

Standard Voltage:

Acceler tor Ped l Oper tions	Acceler tor Position No. 1	Acceler tor Position No. 2
Rele sed	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2. to 4.5 V	3.4 to 5.0 V

If the result is not as specified, chec the cceler tor ped l, wire h rness or ECM.

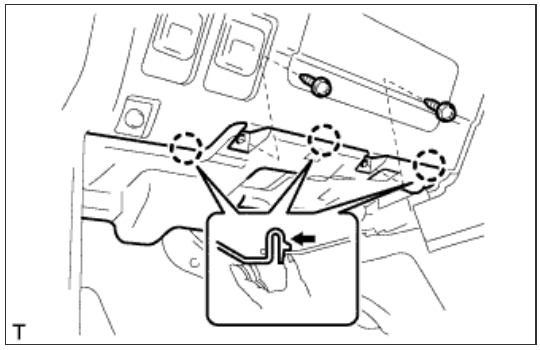
for Preparation Click here

1. REMOVE NO. 1 INSTRUMENT PANEL UNDER COVER SUB-ASSEMBLY (w/ Floor Under Cover)

a. Remove the 2 screws.

b. Detach the 3 claws.

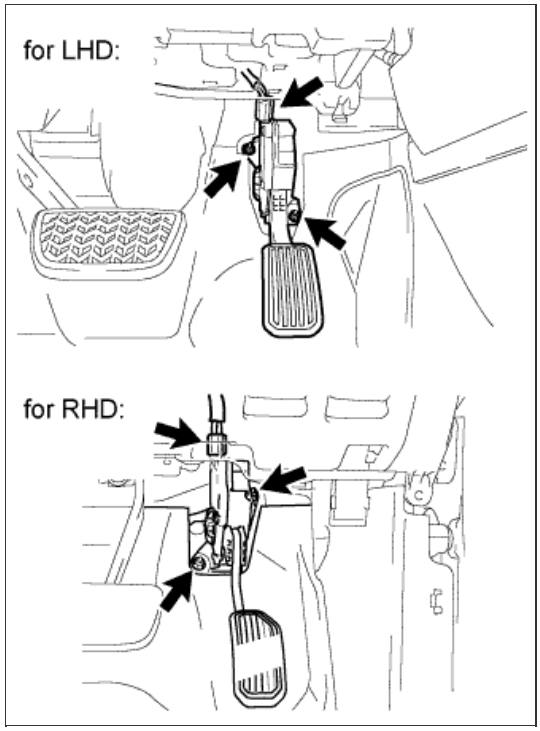
c. Disconnect the connectors and remove the No. 1 instrument panel under cover.



2. REMOVE ACCELERATOR PEDAL SENSOR ASSEMBLY

a. Disconnect the accelerator pedal position sensor connector.

b. Remove the 2 nuts and accelerator pedal.



for Preparation Click here

1. INSTALL ACCELERATOR PEDAL SENSOR ASSEMBLY

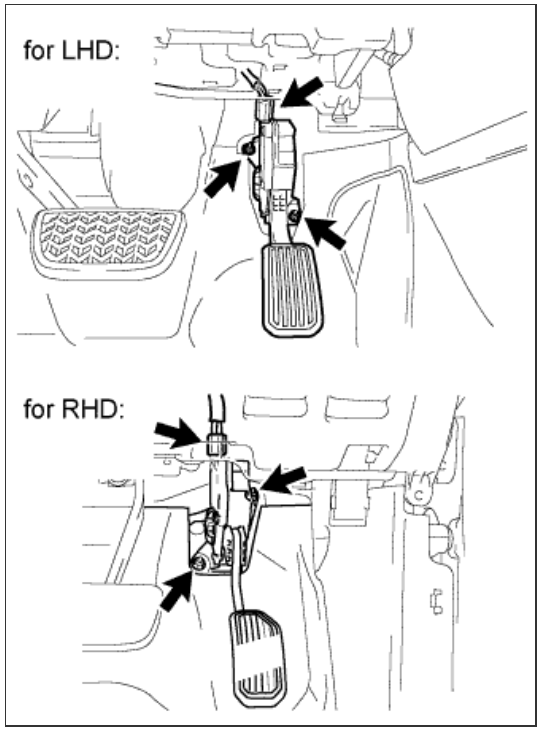
NOTICE:

- **Avoid physical shocks to the accelerator pedal assembly.**
- **Do not disassemble the accelerator pedal assembly.**

a. Install the accelerator pedal with the 2 nuts.

Torque:
5.4 N*m{ 55 kgf*cm , 48 in.*lbf }

b. Connect the accelerator pedal position sensor connector.

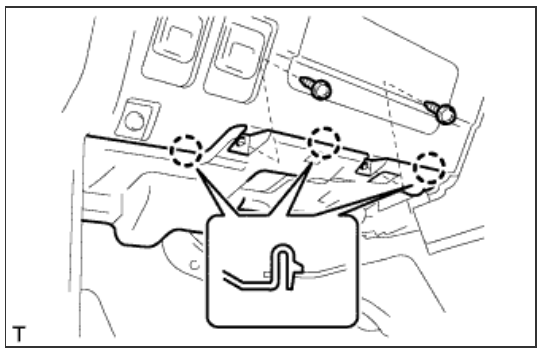


2. INSTALL NO. 1 INSTRUMENT PANEL UNDER COVER SUB-ASSEMBLY (w/ Floor Under Cover)

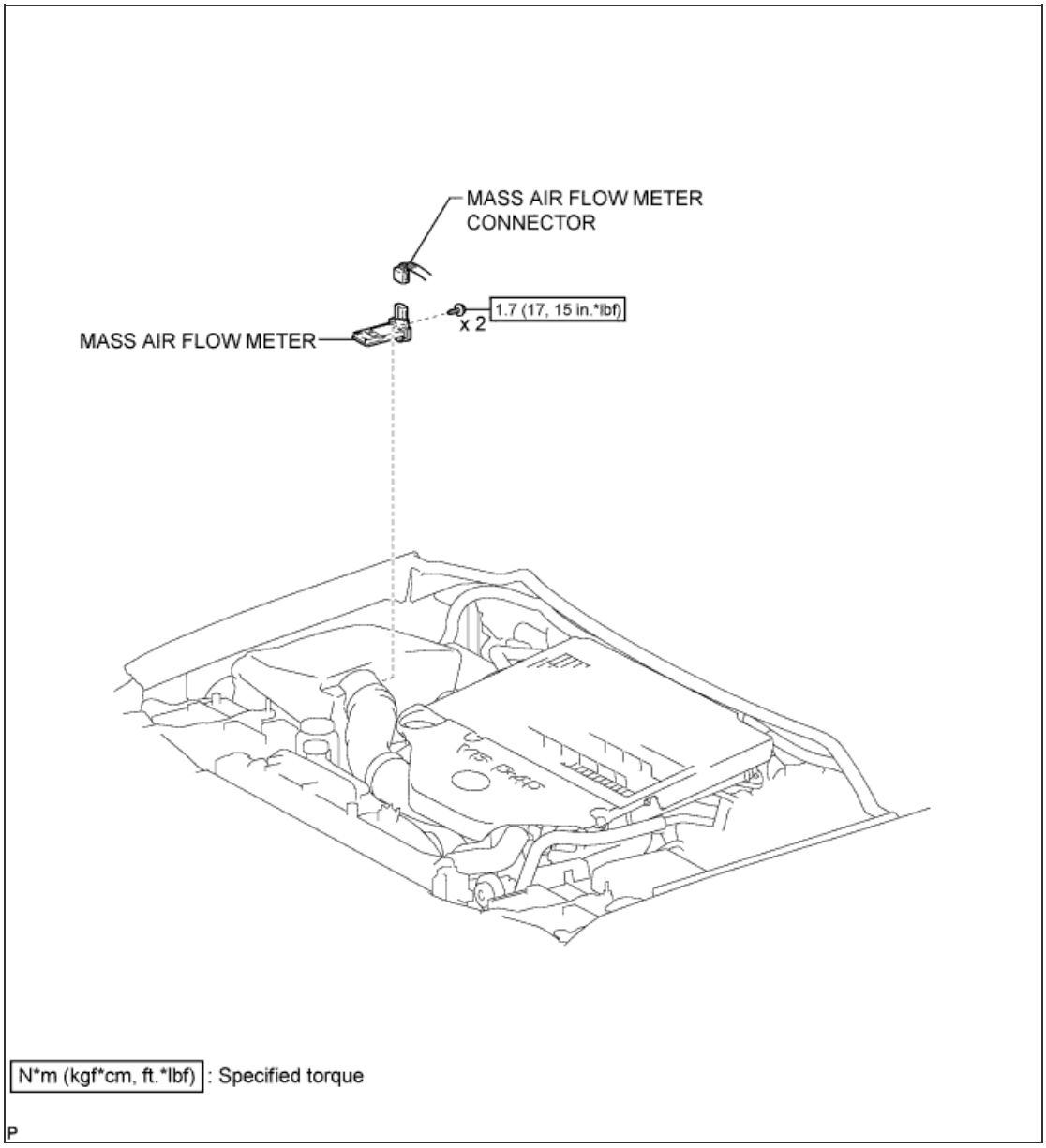
a. Connect the connectors.

b. Attach the 3 claws to install the o. 1 instrument panel under cover.

c. Install the 2 screws.



for Preparation Click here



for Preparation Click here

1. CHECK MASS AIR FLOW METER

a. Check the mass air flow value.

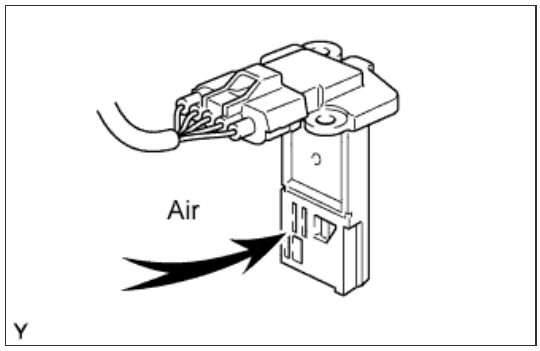
i. Connect the intelligent tester to the DLC3.

ii. Turn the engine switch on (IG).

iii. Turn the intelligent tester on.

i Enter the following menus: Powertrain / Engine / Data List / All Data / MAF.

Blow air into the MAF meter, and check that the MAF value fluctuates. If the result is not as specified, check the MAF meter (Click here), or wiring and ECM (Click here).

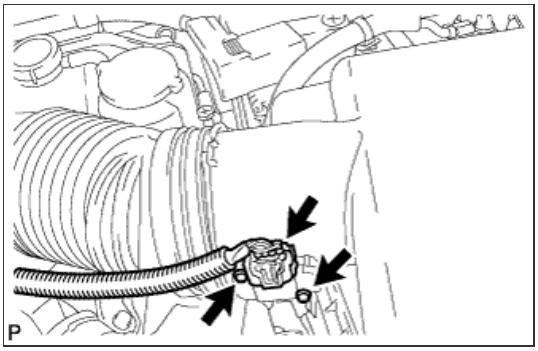


for Preparation Click here

1. REMOVE MASS AIR FLOW METER

a. Disconnect the MAF meter connector.

b. Remove the 2 screws and MAF meter.



for Preparation Click here

1. INSPECT MASS AIR FLOW METER

a. Check the output voltage.

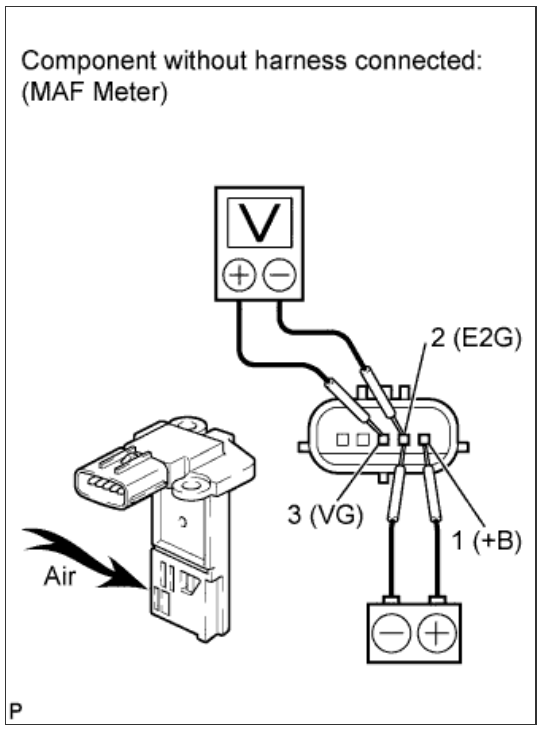
i. Apply battery voltage across terminals 1 (+B) and 2 (E2G).

NOTICE:

While using the battery during inspection, do not bring the positive and negative tester probes too close to each other as a short circuit may occur.

ii. Using a voltmeter, connect the positive (+) tester probe to terminal 3 (VG), and negative (-) tester probe to terminal 2 (E2G).

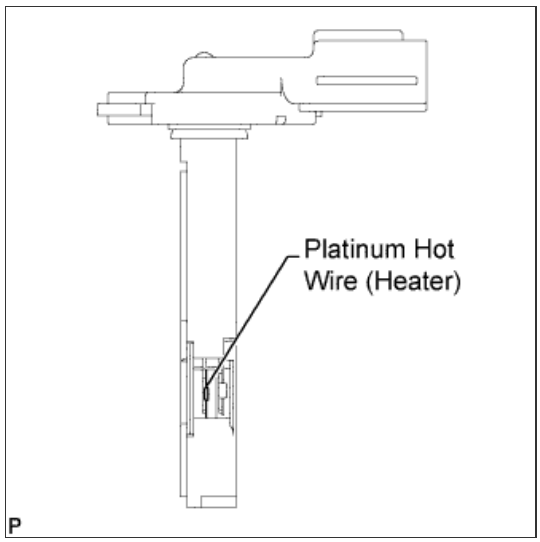
iii. Blow air into the MAF meter, and check that the voltage fluctuates.
If the result is not as specified, replace the MAF meter.



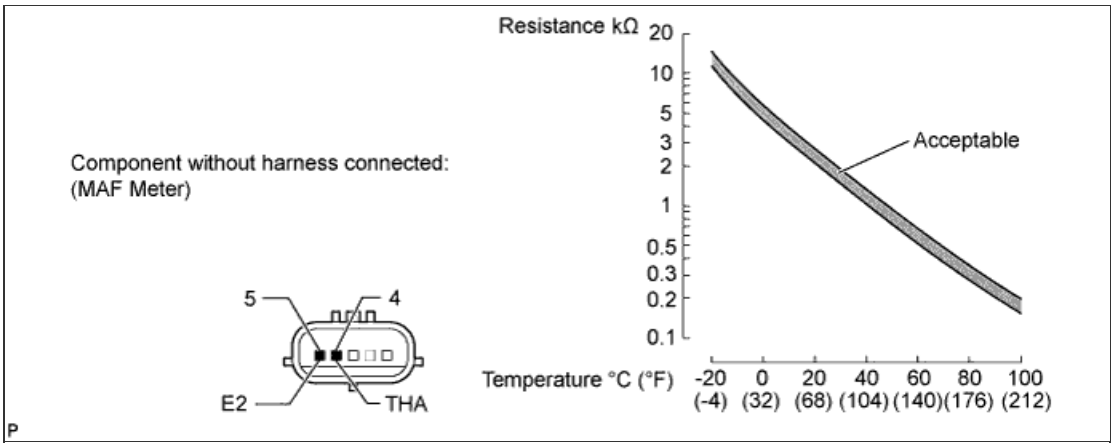
b. Perform a visual check for any foreign matter on the platinum hot wire (heater) of the mass air flow meter shown in the illustration.

OK:
There is no foreign material.

If the result is not as specified, replace the mass air flow meter.



c. Check the IAT sensor.



i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
4 (THA) - 5 (E2)	-20°C (-4°F)	12.5 to 16.9 kΩ
	20°C (68°F)	2.19 to 2.67 kΩ
	60°C (140°F)	0.5 to 0.68 kΩ

If the result is not as specified, replace the MAF meter.

for Preparation Click here

1. INSTALL MASS AIR FLOW METER

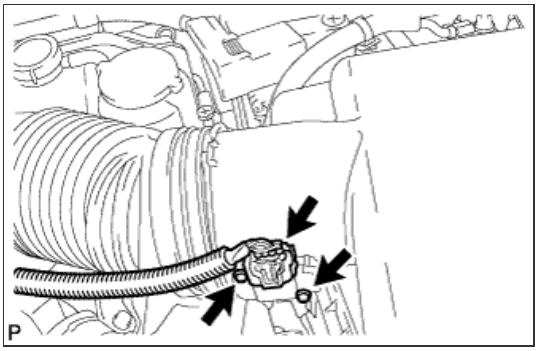
a. Install the MAF meter with the 2 screws.

Torque:
1.7 N*m{ 17 kgf*cm , 15 in.*lbf }

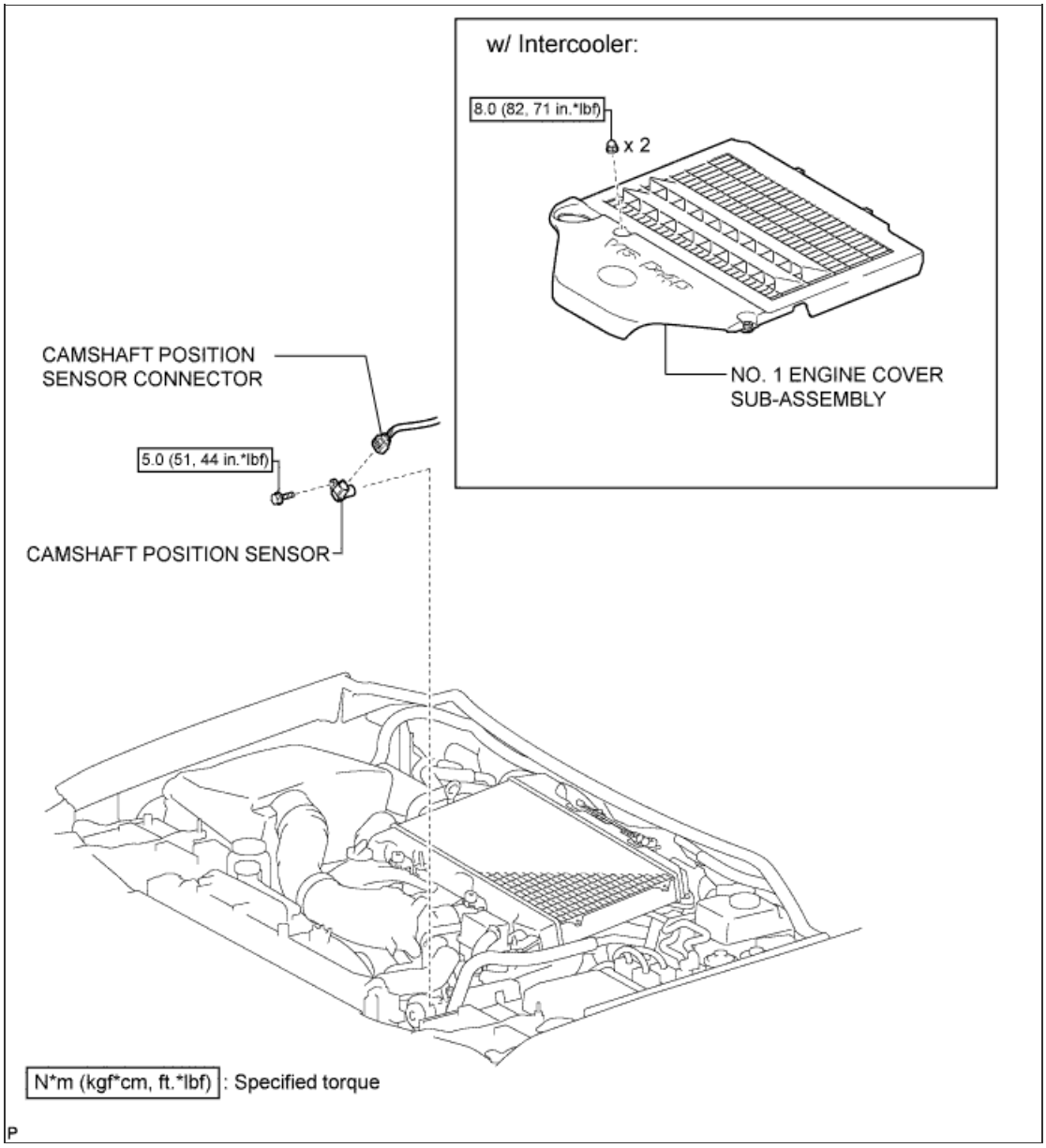
NOTICE:

Make sure the gasket is not pinched.

b. Connect the MAF meter connector.



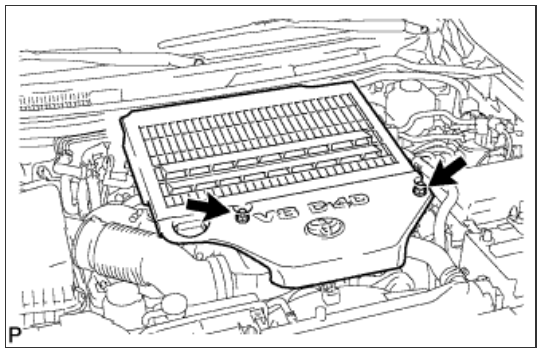
for Preparation Click here



for Preparation Click here

1. REMOVE NO. 1 ENGINE COVER SUB-ASSEMBLY (w/ Intercooler)

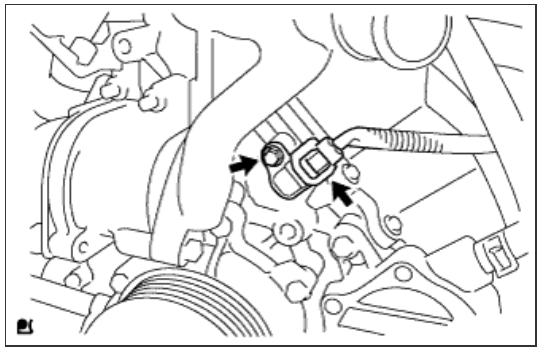
a. Remove the 2 nuts and No. 1 engine cover.



2. REMOVE CAMSHAFT POSITION SENSOR

a. Disconnect the sensor connector.

b. Remove the bolt and sensor.



for Preparation Click here

1. INSPECT CAMSHAFT POSITION SENSOR

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

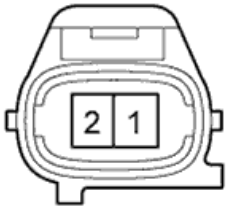
Tester Connection	Condition	Specified Condition
1 - 2	Hot	835 to 1 Ω
	Cold	1060 to 16 Ω

NOTICE:

In the table above, the terms "cold" and "hot" refer to the temperature of the sensor. "Cold" means approximately -10 to 50°C (1 to 122°F). "Hot" means approximately 50 to 100°C (122 to 212°F).

If the result is not as specified, replace the sensor.

Component without harness connected:
(Camshaft Position Sensor)



N

for Preparation Click here

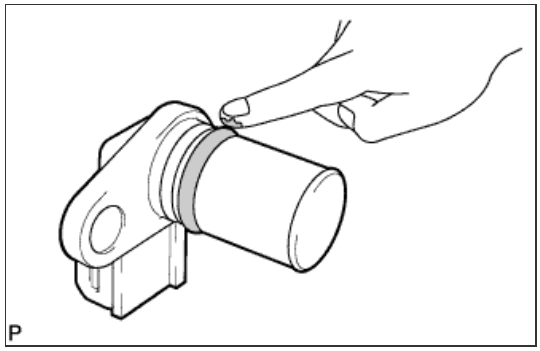
1. INSTALL CAMSHAFT POSITION SENSOR

a. Apply a light coat of engine oil to the O-ring.

NOTICE:

When reusing the sensor, inspect the O-ring.

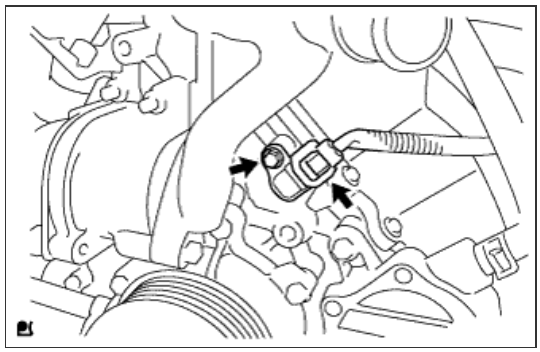
If the O-ring has scratches or cuts, replace the sensor.



b. Install the sensor with the bolt.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

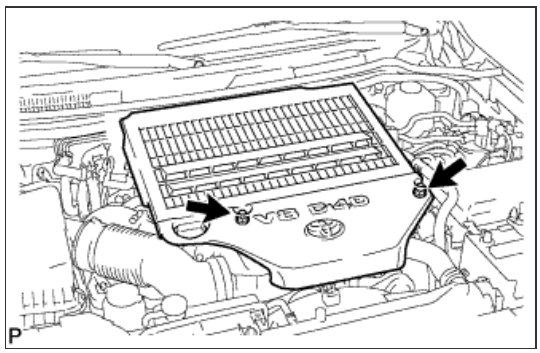
c. Connect the sensor connector.



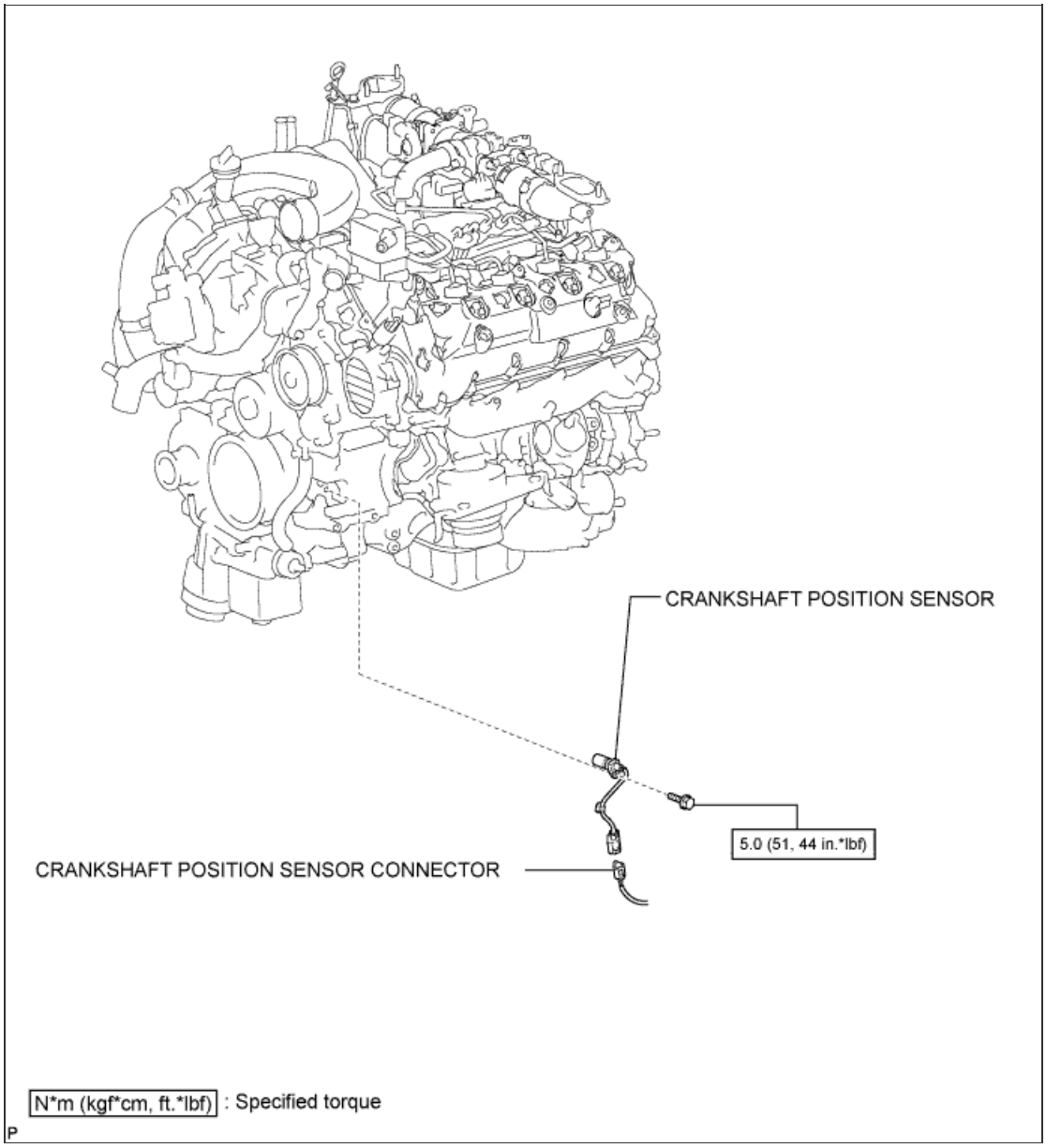
2. INSTALL NO. 1 ENGINE COVER SUB-ASSEMBLY (w/ Intercooler)

a. Install the engine cover with the 2 nuts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }



for Preparation Click here



for Preparation Click here

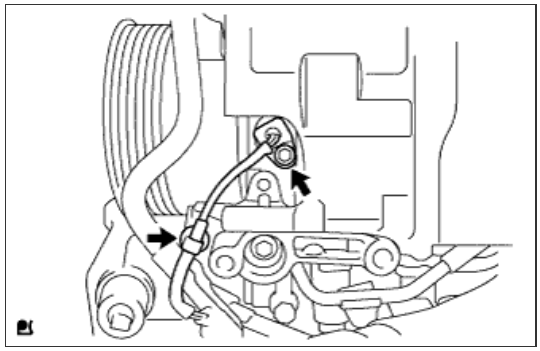
1. REMOVE COOLER COMPRESSOR ASSEMBLY

a. Remove the cooler compressor (Click here).

2. REMOVE CRANKSHAFT POSITION SENSOR

a. Disconnect the sensor wire harness clamp.

b. Remove the bolt and sensor.



for Preparation Click here

1. INSPECT CRANKSHAFT POSITION SENSOR

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (NE) - 2 (NE-)	Hot	1 to 2 Ω
	Cold	20 to 3225 Ω

NOTICE:

In the table above the terms "cold" and "hot" refer to the temperature of the sensor. "Cold" means approximatel to 50 C (14 to 122). "Hot" means approximatel to 100 C (122 to 212).

If the result is not as specified replace the sensor.

Component without harness connected:
(Crankshaft Position Sensor)



for Preparation Click here

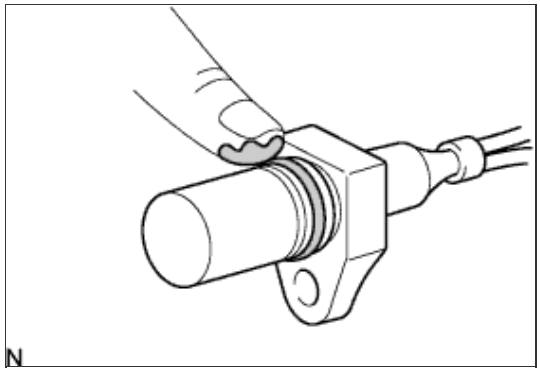
1. INSTALL CRANKSHAFT POSITION SENSOR

a. Apply a light coat of engine oil to the O-ring.

NOTICE:

When reusing the sensor, inspect the O-ring.

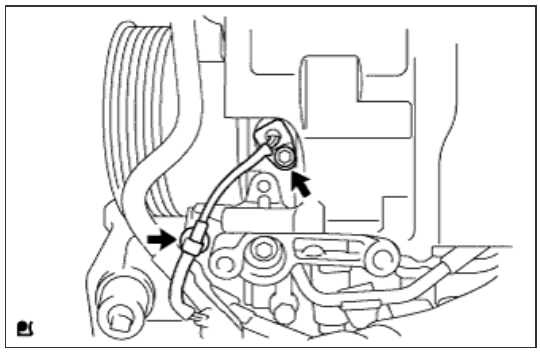
If the O-ring has scratches or cuts, replace the sensor.



b. Install the sensor with the bolt.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

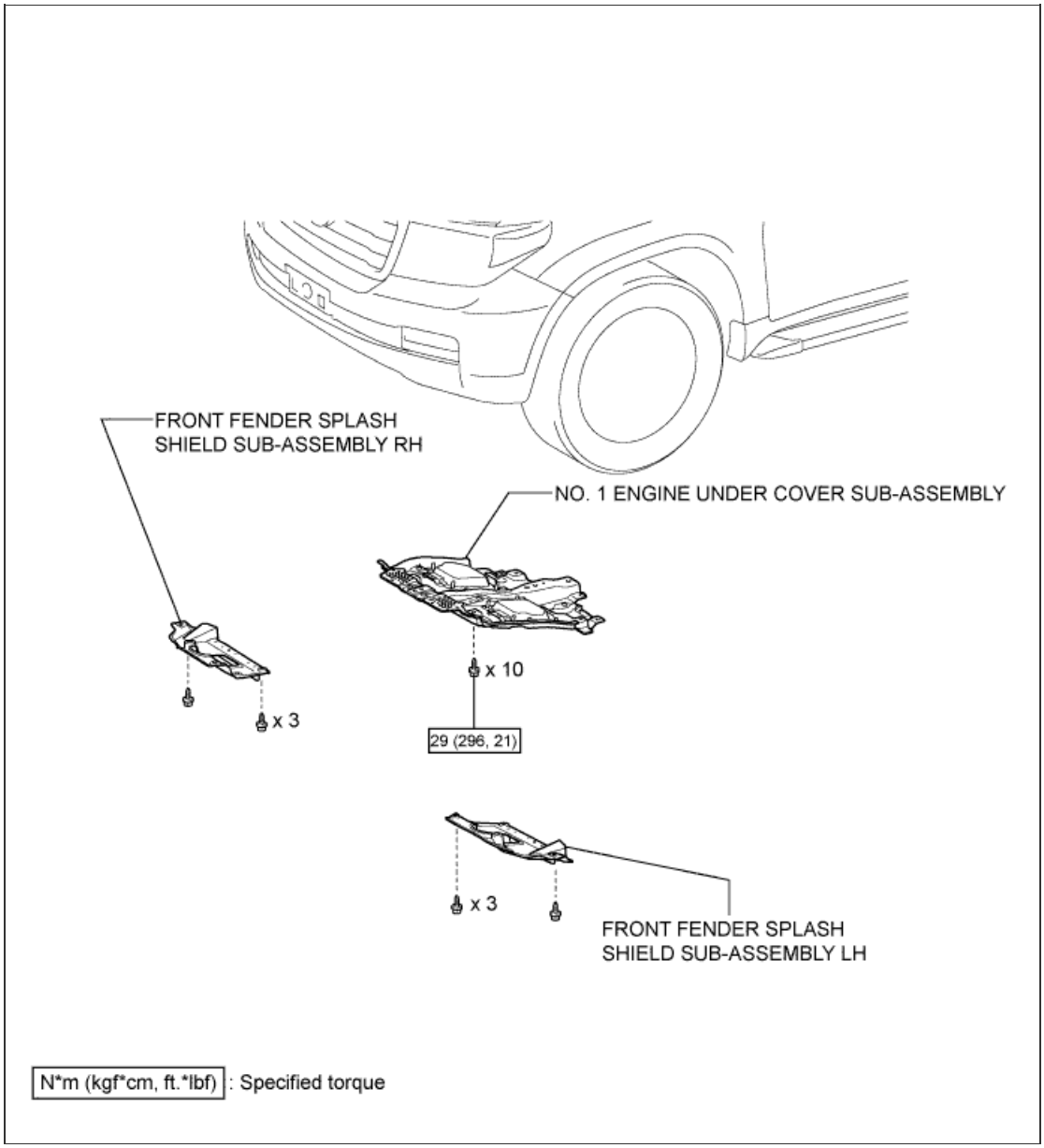
c. Connect the sensor wire harness clamp.

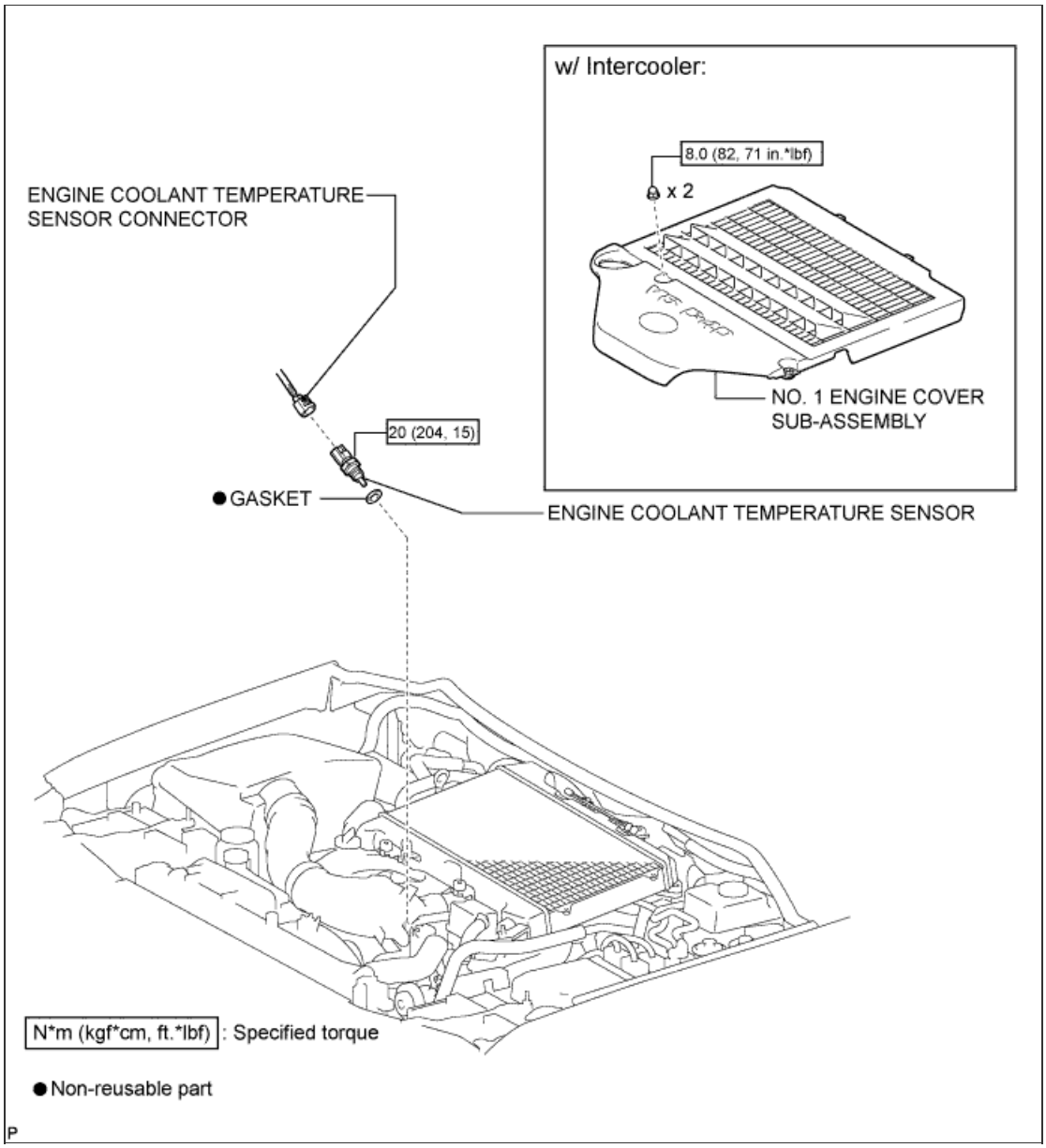


2. INSTALL COOLER CO PRESSOR ASSE L

a. Install the cooler compressor (Click here).

for Preparation [Click here]




w/ Intercooler:
8.0 (82, 71 in.*lbf)
x 2
NO. 1 ENGINE COVER SUB-ASSEMBLY
ENGINE COOLANT TEMPERATURE SENSOR CONNECTOR
20 (204, 15)
● GASKET
ENGINE COOLANT TEMPERATURE SENSOR
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
P

for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

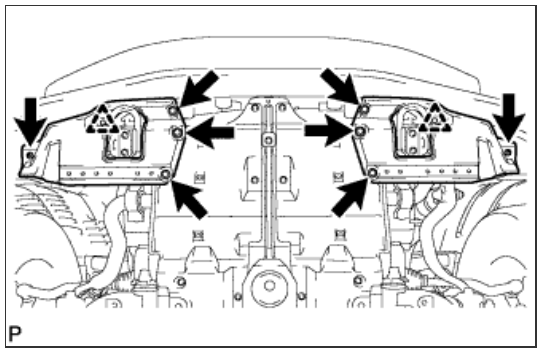
a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.

2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

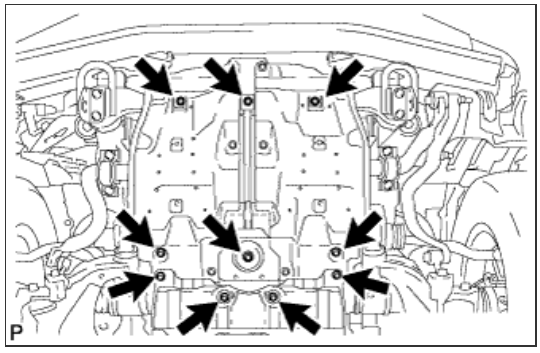
a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.



3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



4. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

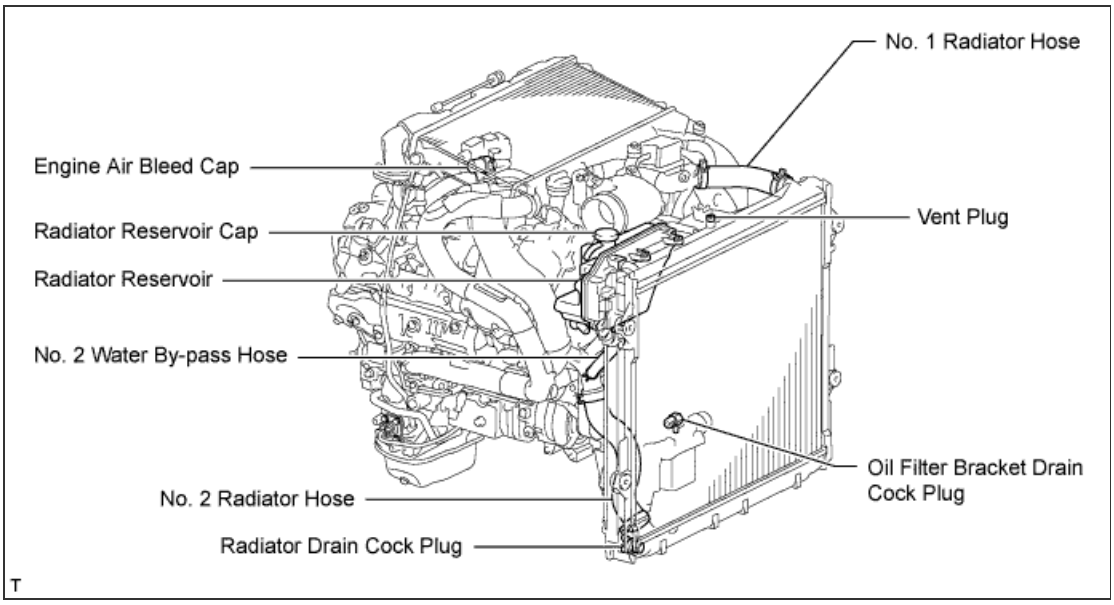
HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

a. Loosen the radiator drain cock plug.

b. Remove the radiator reservoir cap to drain the coolant in the radiator.

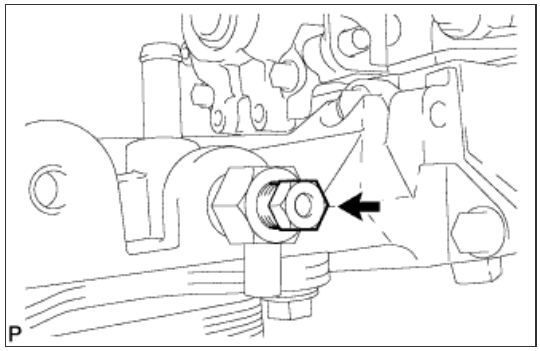
c. Loosen the oil filter bracket drain cock plug to drain the coolant in the engine.



d. Tighten the radiator drain cock plug by hand.

e. Tighten the oil filter bracket drain cock plug.

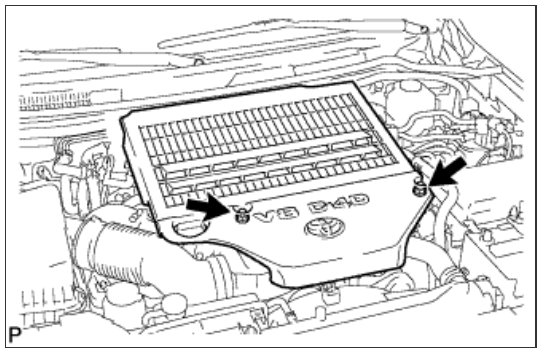
Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



5. REMOVE NO. 1 ENGINE COVER SUB-ASSEMBLY (w/ Intercooler)

a. Install the engine cover with the 2 nuts.

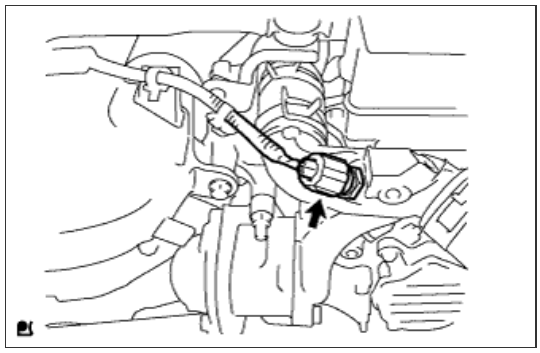
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }



6. REMOVE ENGINE COOLANT TEMPERATURE SENSOR

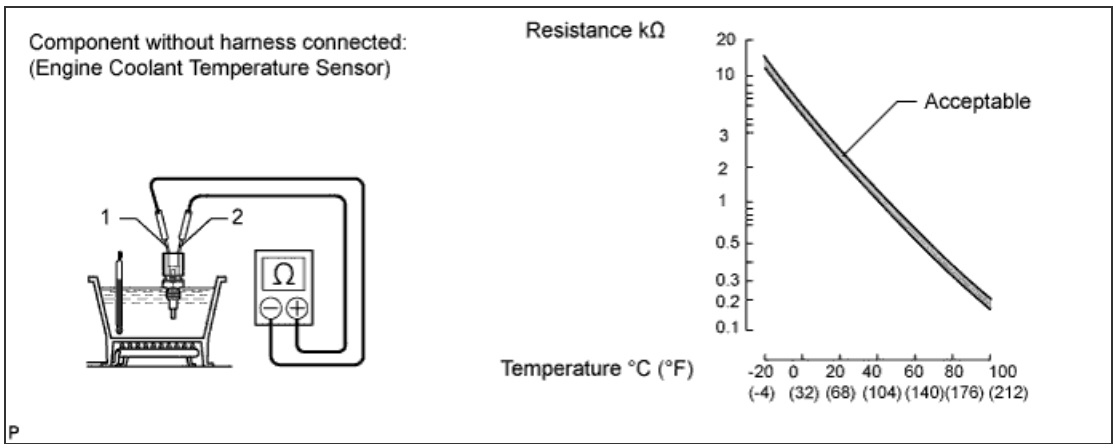
a. Disconnect the sensor connector.

b. Using a 19 mm deep socket wrench, remove the sensor and gasket.



for Preparation Click here

1. INSPECT ENGINE COOLANT TEMPERATURE SENSOR



a. Partially immerse the sensor in water and warm up the water.

b. Measure the resistance according to the value(s) in the table below.

Standard Re i tance:

Tester Connection	Condition	Specified Condition
1 - 2	Approximately 20°C (68°F)	2.32 to 2.59 kΩ
1 - 2	Approximately 80°C (176°F)	0.310 to 0.326 kΩ

If the result is not as specified, replace the sensor.

NOTICE:

When checking the sensor in water, keep the terminals dry. After the check, wipe the sensor dry.

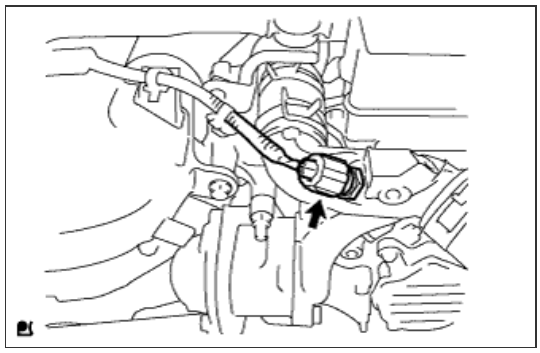
for Preparation Click here

1. INSTALL ENGINE COOLANT TEMPERATURE SENSOR

a. Install a new gasket to the sensor.

b. Using a 19 mm deep socket wrench, install the sensor.

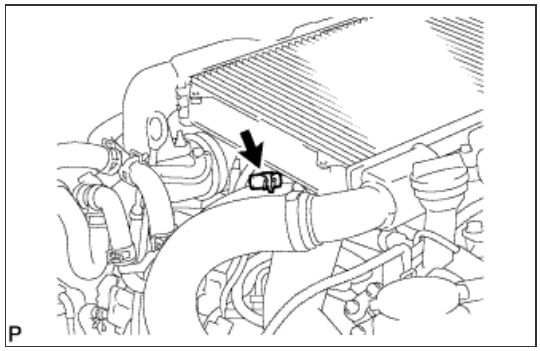
Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }



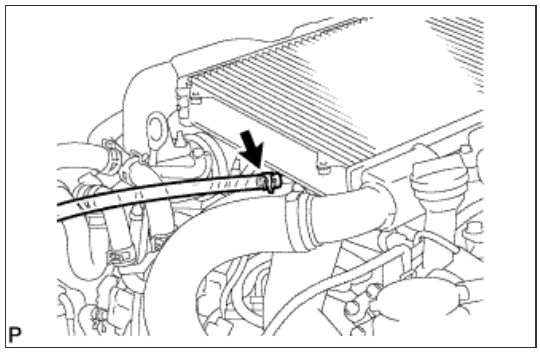
c. Connect the sensor connector.

2. ADD ENGINE COOLANT

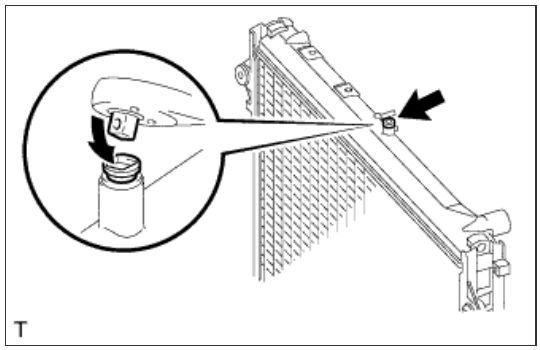
a. Remove the engine air bleed cap.



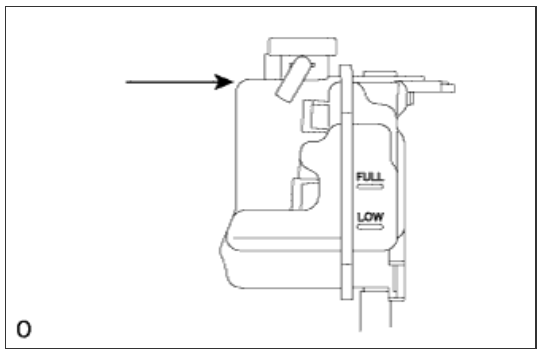
b. Connect a clear hose to the engine air bleed pipe.



c. Using a wrench, remove the vent plug.



d. Fill the radiator with TOYOTA SLLC to the radiator reservoir filler neck.



HINT:

Pour TOYOTA SLLC until it spills out of the engine air bleed pipe.

Standard Capacity (for Automatic Transmission):

Item	Specified Condition
Front heater only	14.8 liters (15.6 US qts, 13.0 Imp. qts)
Front heater and rear heater	17.6 liters (18.6 US qts, 15.5 Imp. qts)
Front heater with viscous heater	15.2 liters (16.1 US qts, 13.4 Imp. qts)
Front heater and rear heater with viscous heater	18.0 liters (19.0 US qts, 15.4 Imp. qts)

Standard capacity (for Manual Transmission):
15.4 liters (16.3 US qts, 13.6 Imp. qts)

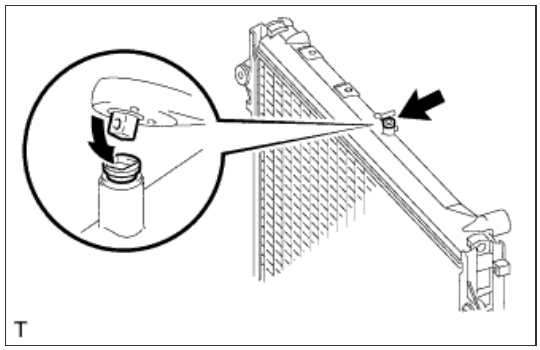
NOTICE:

Do not substitute plain water for engine coolant.

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

e. Install the vent plug.

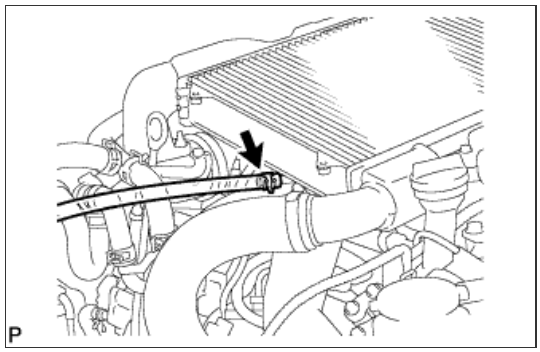


Torque:
2.0 N*m{ 20 kgf*cm , 18 in.*lbf }

NOTICE:

Do not tighten the plug to 5.0 N*m (51 kgf*cm, 44 in.*lbf) or more, as the plug will be damaged.

f. Disconnect the clear hose from the engine air bleed pipe.



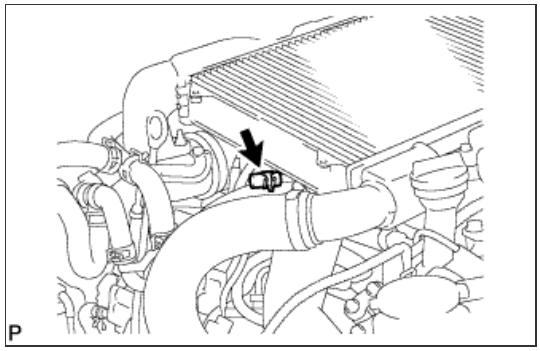
g. Install the engine air bleed cap when coolant comes out.

h. Install the radiator reservoir cap.

i. Start the engine.

NOTICE:

Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the FULL line.



j. Maintain an engine speed of 3000 rpm for approximately 10 minutes so that the thermostat opens and air bleeding is performed.

CAUTION:

When pressing the radiator hoses:

- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the radiator fan**

NOTICE:

- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**

HINT:

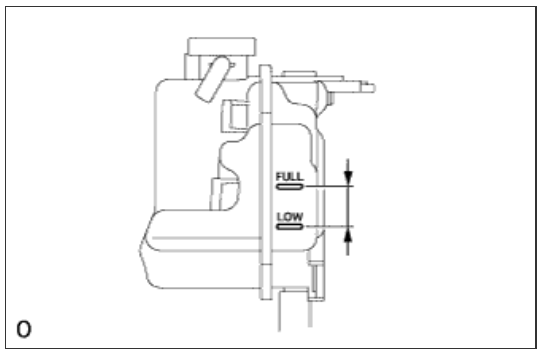
The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

k. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

l. Check that the coolant level is between the FULL and LOW lines.
If the coolant level is above the FULL line, drain coolant so that the coolant level is between the FULL and LOW lines.



3. INSPECT FOR COOLANT LEAK

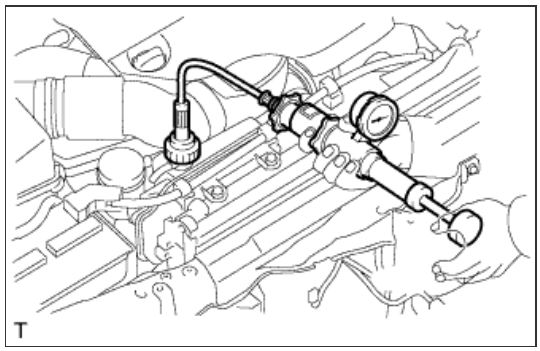
CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester to the radiator reservoir.

b. Warm up the engine.

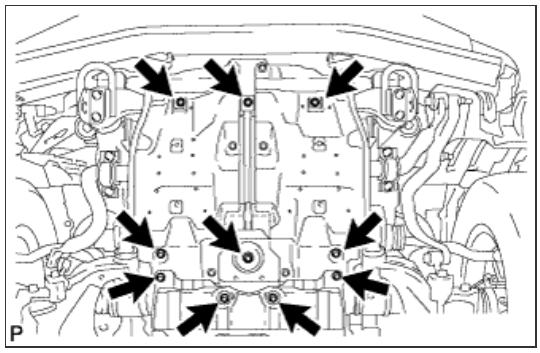
c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 17.8 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks.
If no external leaks are found, check the cylinder block and cylinder head.



4. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

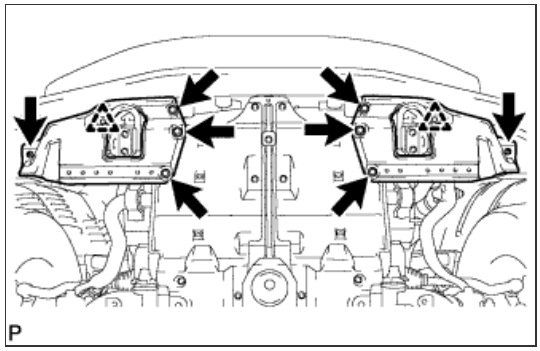
a. Install the engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



5. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

a. Install the splash shield with the clip, and then install the 3 bolts and screw.



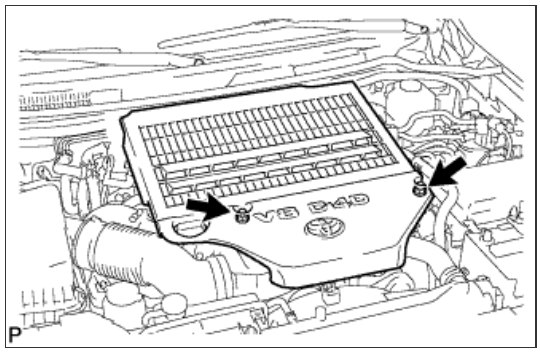
6. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Install the splash shield with the clip, and then install the 3 bolts and screw.

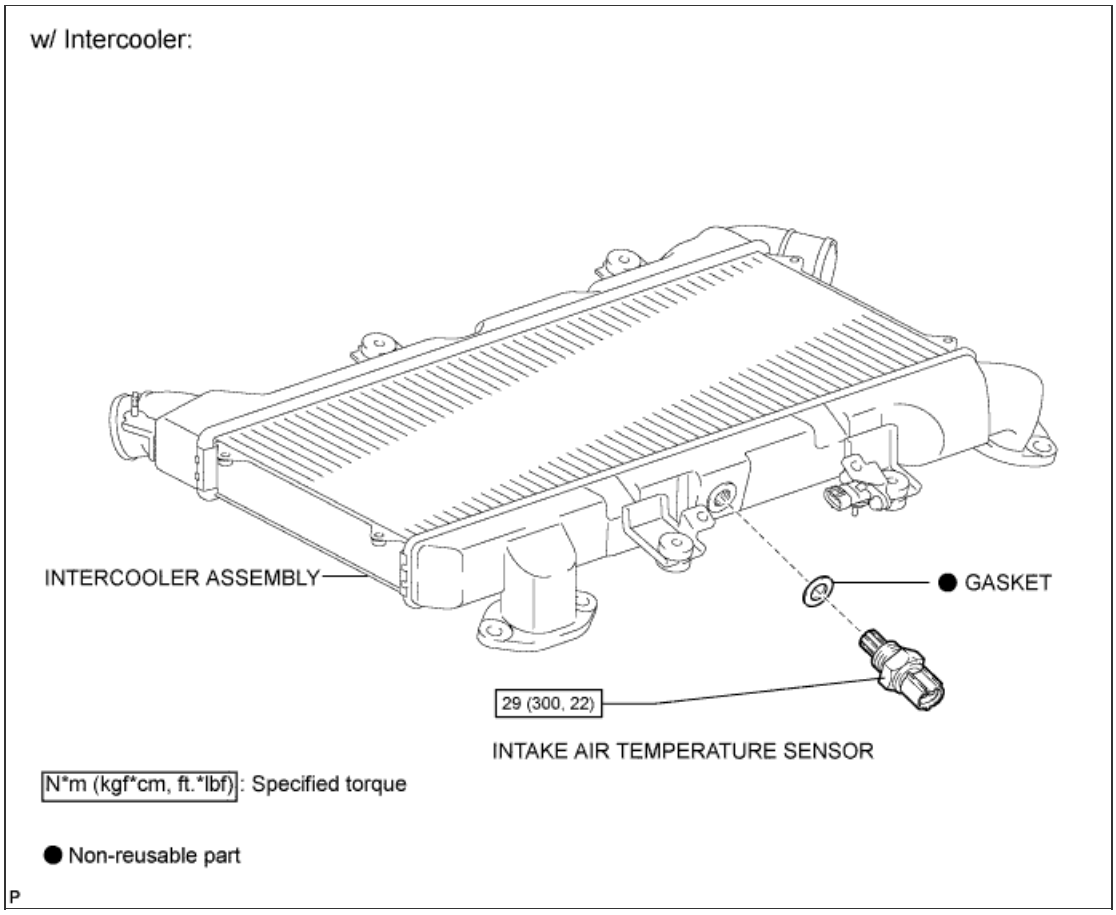
7. INSTALL NO. 1 ENGINE COVER SUB-ASSEMBLY (w/ Intercooler)

a. Install the engine cover with the 2 nuts.

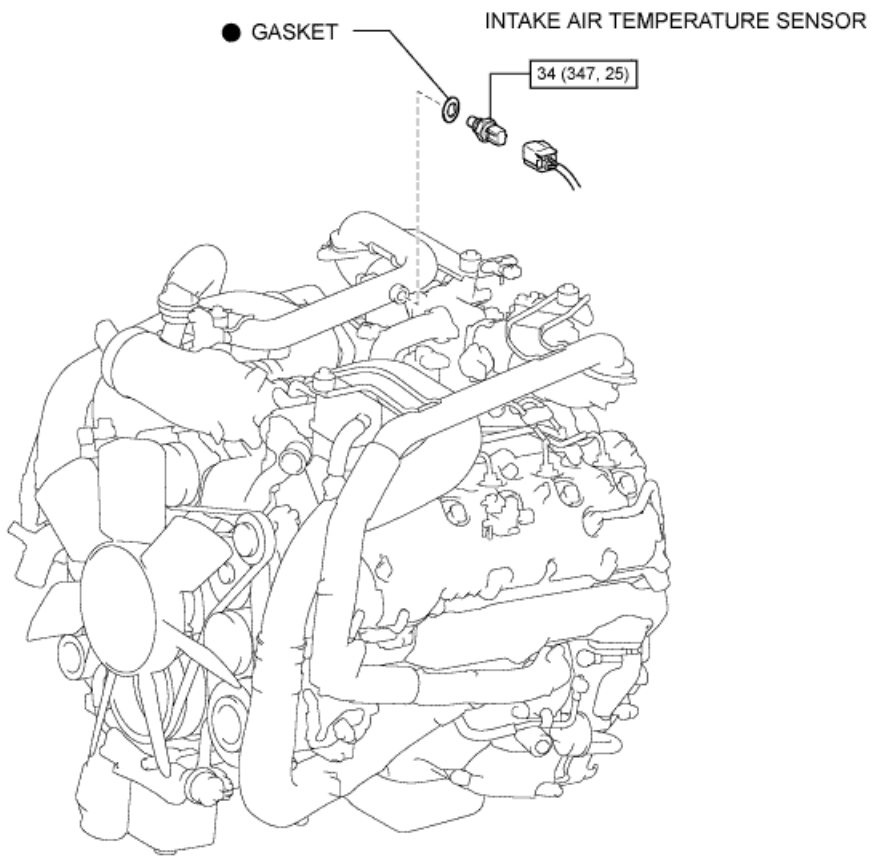
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }


V8 D4D

for Preparation Click here



w/o Intercooler:



N*m (kgf*cm, ft.*lbf): Specified torque

● Non-reusable part

H

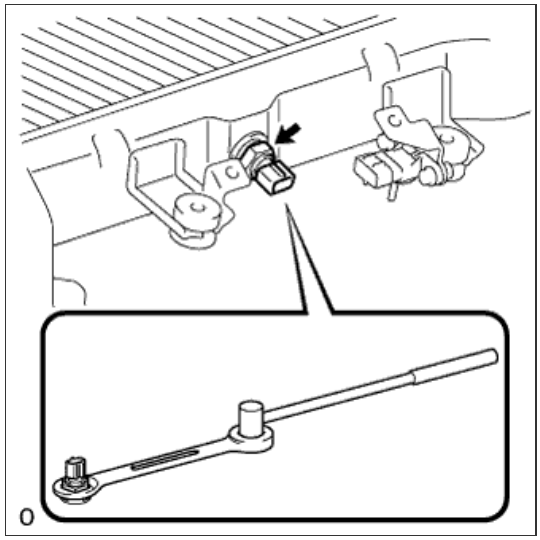
for Preparation Click here

1. REMOVE INTERCOOLER ASSEMBLY (w/ Intercooler)

(Click here)

2. REMOVE INTAKE AIR TEMPERATURE SENSOR (w/ Intercooler)

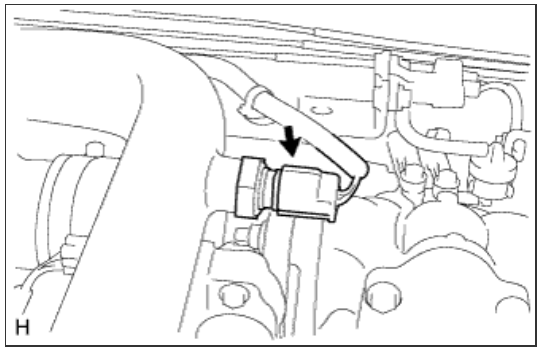
a. Using a ball joint lock nut wrench, remove the sensor and gasket.



3. REMOVE INTAKE AIR TEMPERATURE SENSOR (w/o Intercooler)

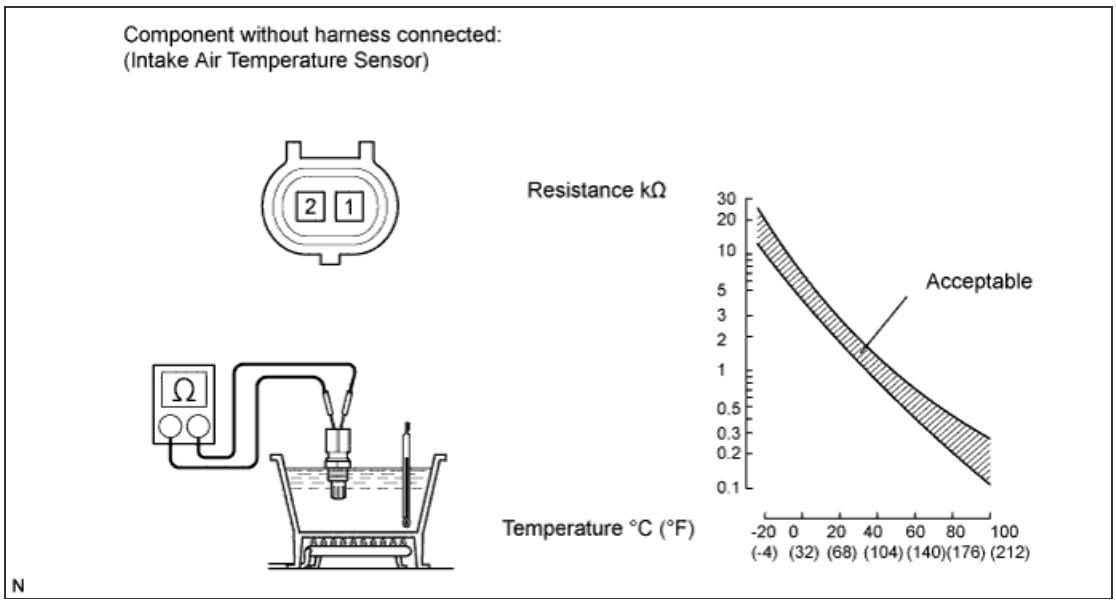
a. Disconnect the connector.

b. Using a 22 mm deep socket wrench, remove the sensor and gasket.



for Preparation Click here

1. INSPECT INTAKE AIR TEMPERATURE SENSOR



a. Partially immerse the sensor in water and warm up the water.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	Approximately 20°C (68°F)	2.21 to 2.65 kΩ
1 - 2	Approximately 60°C (140°F)	0.55 to 0.61 kΩ

If the result is not as specified, replace the sensor.

NOTICE:

When checking the sensor in water, keep the terminals dry. After the check, wipe the sensor dry.

for Preparation Click here

1. INSTALL INTAKE AIR TEMPERATURE SENSOR (w/o Intercooler)

a. Using a 22mm deep socket wrench, install the sensor and a new gasket.

Torque:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }

2. INSTALL INTAKE AIR TEMPERATURE SENSOR (w/ Intercooler)

a. Using a ball oint lock nut wrench, install the sensor and a new gasket.

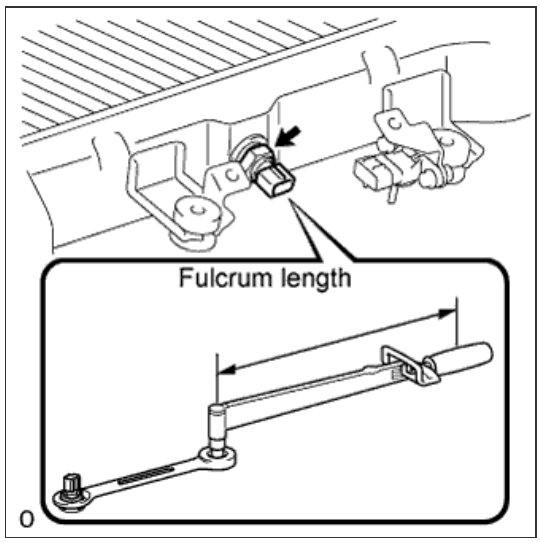
Torque:
29 N*m{ 300 kgf*cm , 22 ft.*lbf }

NOTICE:

Do not use a tool such as an impact wrench or equivalent.

HINT:

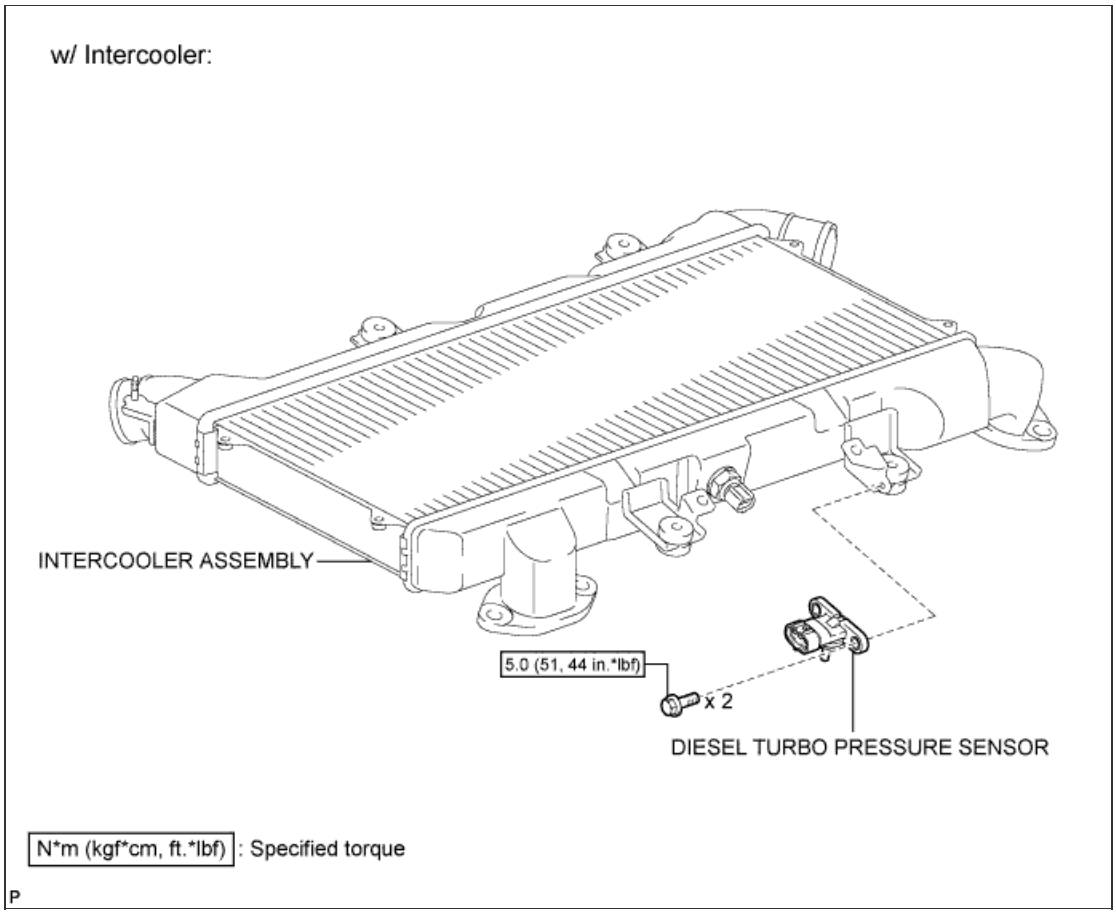
- **Use a torque wrench with a fulcrum length of 300 mm (11.8 in.). When using a torque wrench with a fulcrum length that is not 300 mm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the "without SST" torque specification (Click here).**
- **Make sure SST and the wrench are connected in a straight line.**



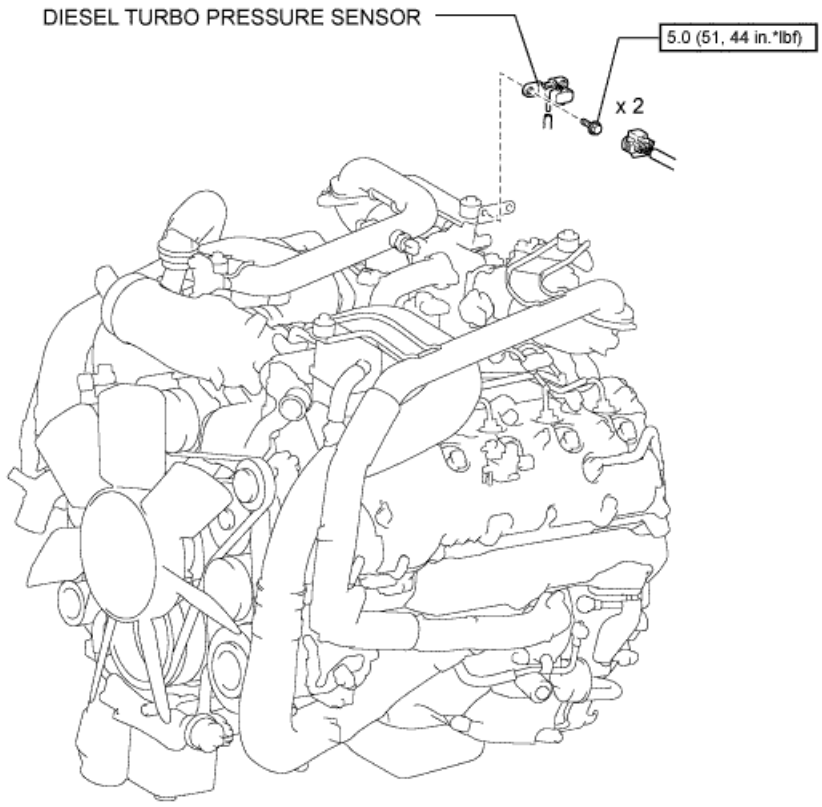
3. INSTALL INTERCOOLER ASSEMBLY (w/ Intercooler)

(Click here)

for Preparation Click here



w/o Intercooler:



N*m (kgf*cm, ft.*lbf): Specified torque

H

for Preparation Click here

1. CHECK DIESEL TURBO PRESSURE SENSOR

a. Inspect the power source voltage.

i. Disconnect the sensor connector.

ii. Measure the voltage according to the value(s) in the table below.

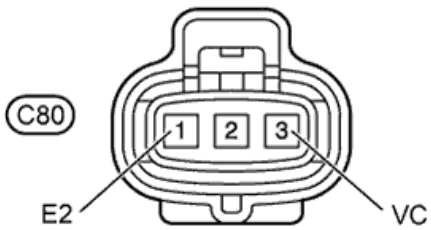
Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
C80-3 (VC) - C80-1 (E2)	Engine switch on (IG)	4.5 to 5.5 V

iii. Turn the engine switch off.

iv. Connect the sensor connector.

Front view of wire harness connector:
(to Diesel Turbo Pressure Sensor)



b. Check the vacuum and pressure.

i. Connect the intelligent tester to the DLC3.

ii. Turn the engine switch on (IG) and turn the intelligent tester on.

iii. Enter the following menus: Powertrain / Engine / Data List / Map and Atmosphere Pressure.

iv. Read the value.

OK:

Condition	Map and Atmosphere Pressure Value
No pressure applied	Same as atmospheric pressure
Vacuum applied	Becomes vacuum
Pressure applied	Becomes pressurized

If the result is not as specified, replace the sensor.

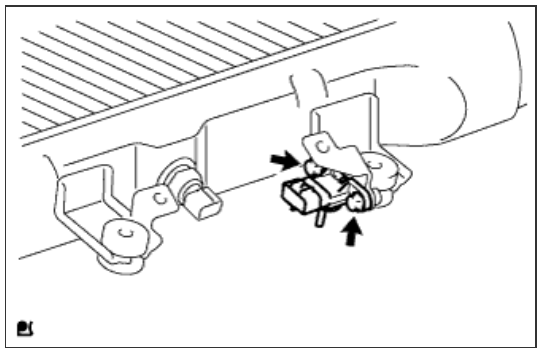
for Preparation Click here

1. REMOVE INTERCOOLER ASSEMBLY (w/ Intercooler)

(Click here)

2. REMOVE DIESEL TURBO PRESSURE SENSOR (w/ Intercooler)

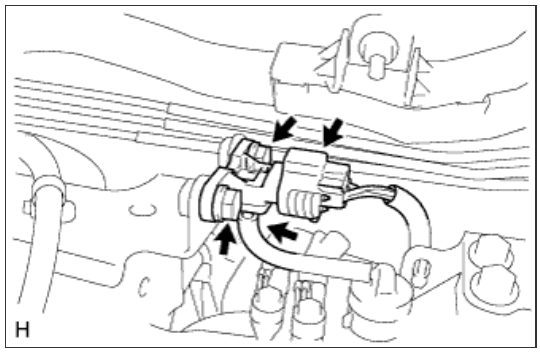
a. Remove the 2 bolts and sensor.



3. REMOVE DIESEL TURBO PRESSURE SENSOR (w/o Intercooler)

a. Disconnect the connector and hose.

b. Remove the 2 bolts and sensor.



for Preparation Click here

1. INSTALL DIESEL TURBO PRESSURE SENSOR (w/o Intercooler)

a. Install the sensor with the 2 bolts.

Torque:
5.0 N*m{ 51 k f*cm 44 in.*lbf

. Connect the hose and connector.

2. INSTALL DIESEL TURBO PRESSURE SENSOR (w/ Intercooler)

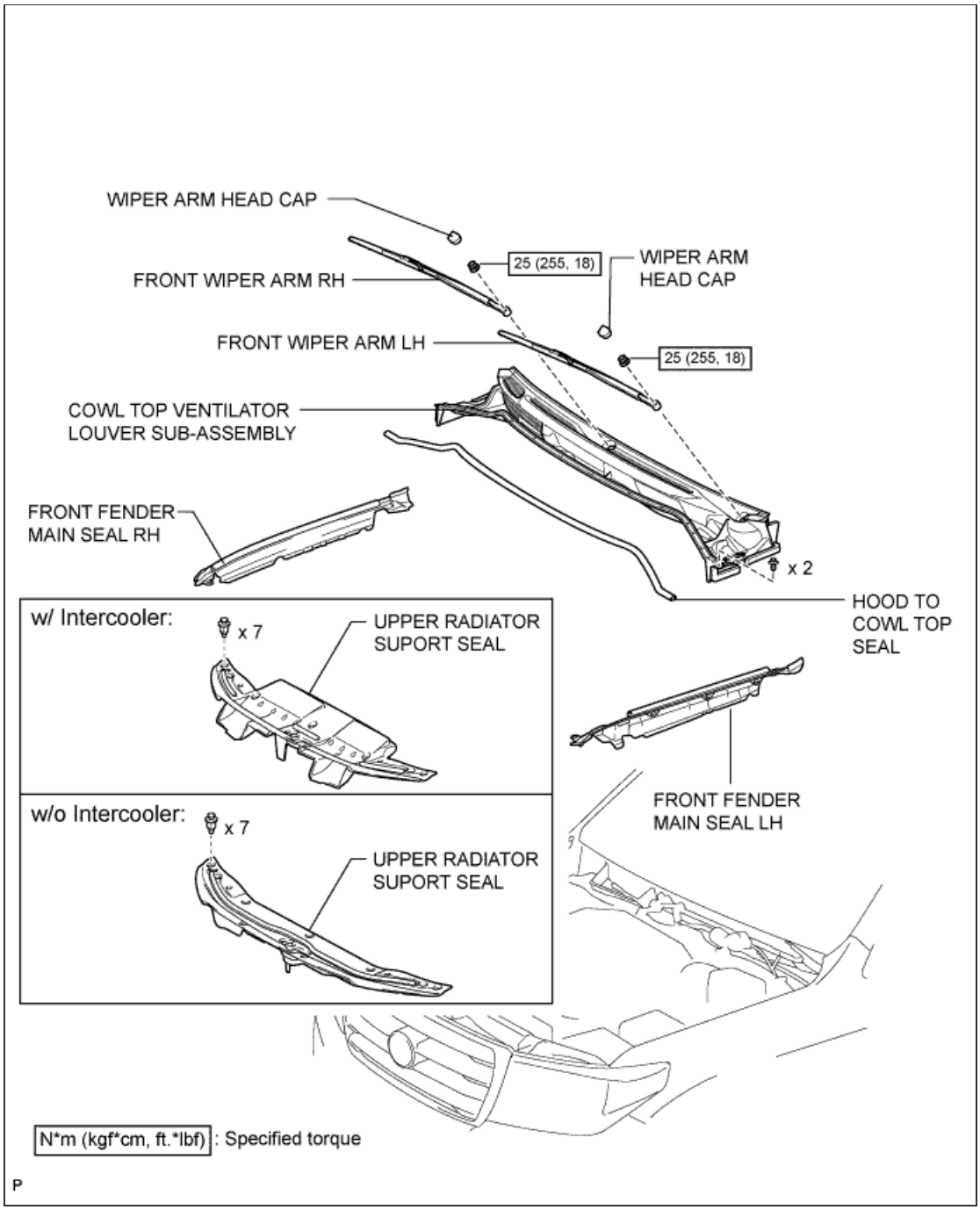
a. Install the sensor with the 2 bolts.

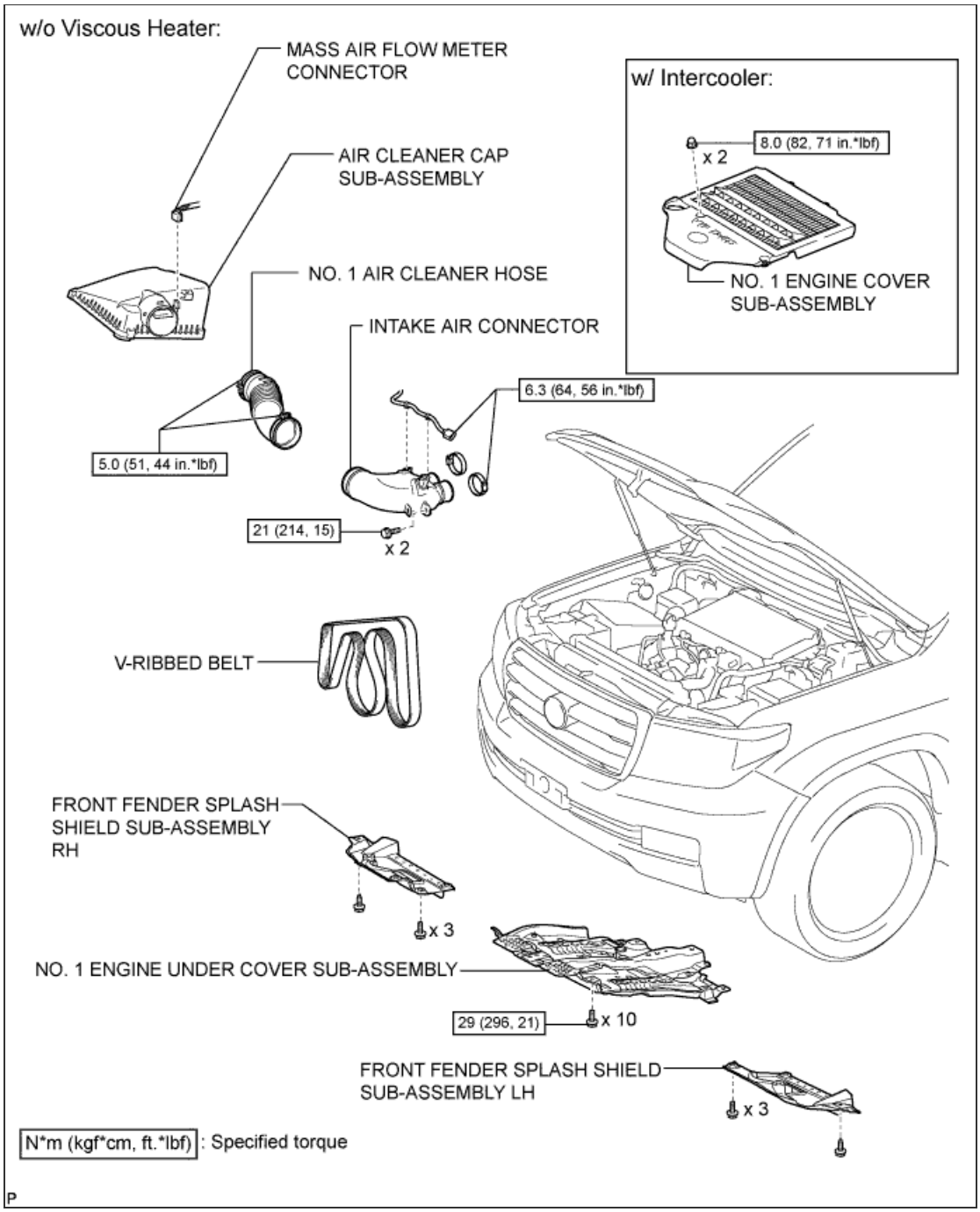
Torque:
5.0 N*m{ 51 k f*cm 44 in.*lbf

. INSTALL INTERCOOLER ASSEMBLY (w/ Intercooler)

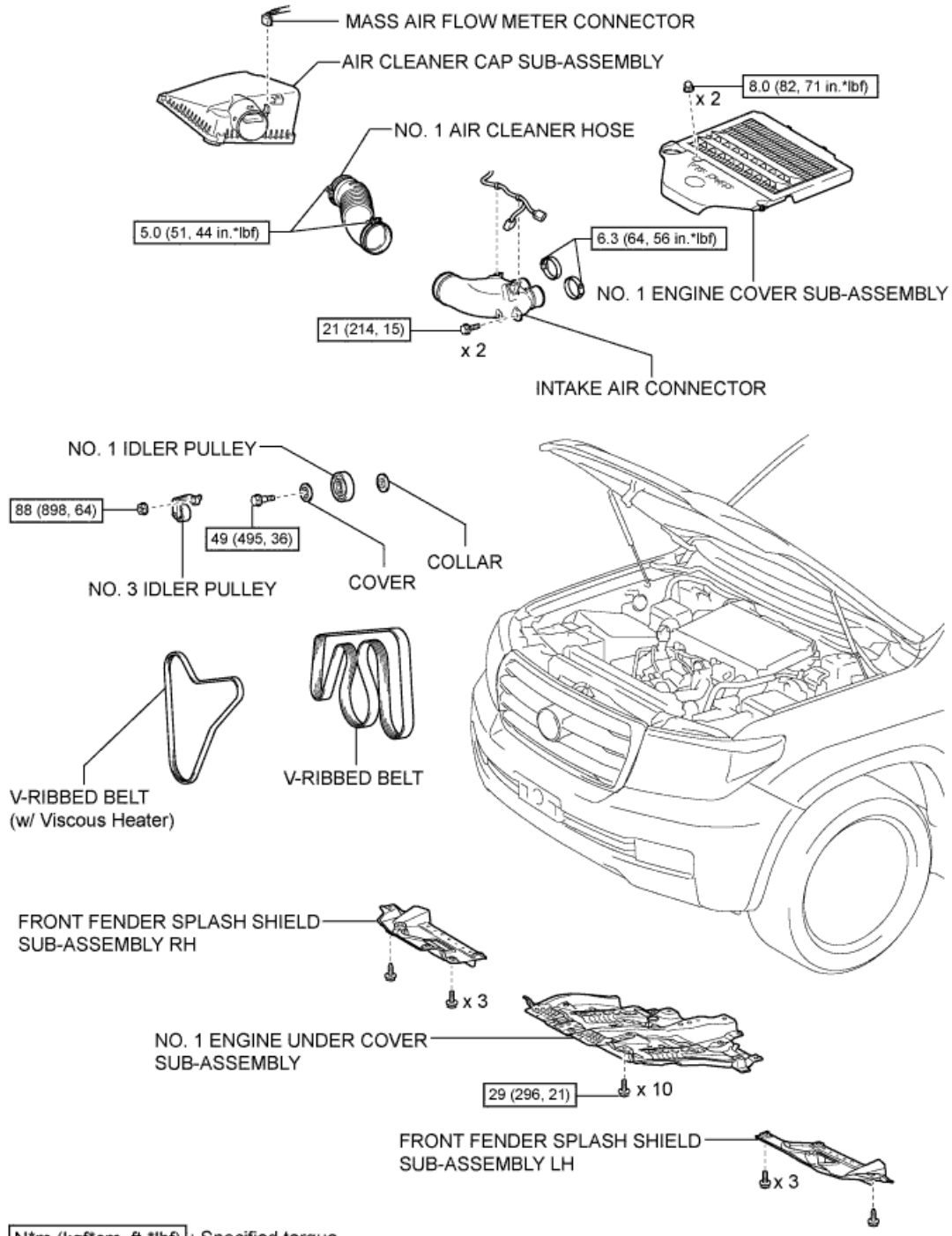
(Click here)

for Preparation Click here




w/o Viscous Heater:
MASS AIR FLOW METER CONNECTOR
AIR CLEANER CAP SUB-ASSEMBLY
NO. 1 AIR CLEANER HOSE
INTAKE AIR CONNECTOR
5.0 (51, 44 in.*lbf)
6.3 (64, 56 in.*lbf)
21 (214, 15)
x 2
V-RIBBED BELT
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH
x 3
NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY
29 (296, 21)
x 10
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH
x 3
w/ Intercooler:
8.0 (82, 71 in.*lbf)
x 2
NO. 1 ENGINE COVER SUB-ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
P

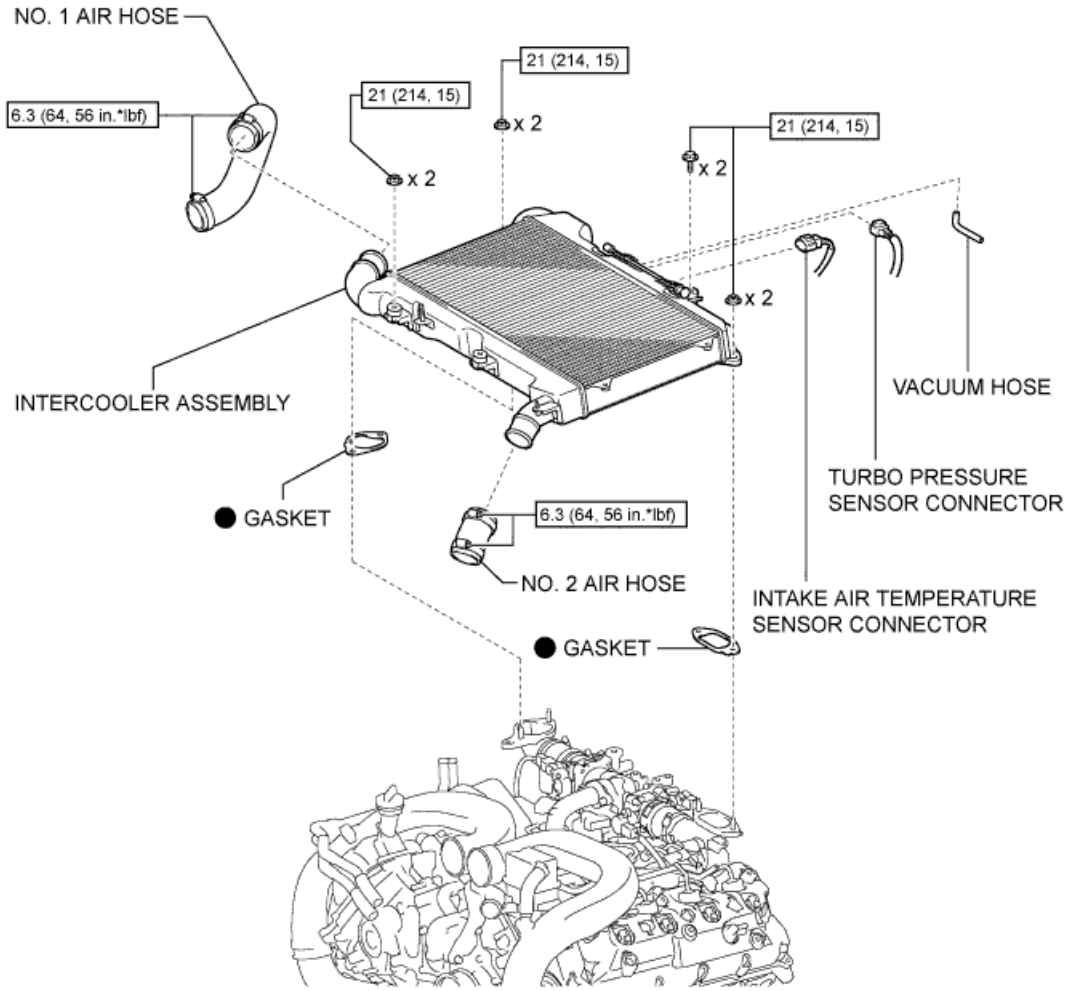
w/ Viscous Heater:



N*m (kgf*cm, ft.*lbf) : Specified torque

P

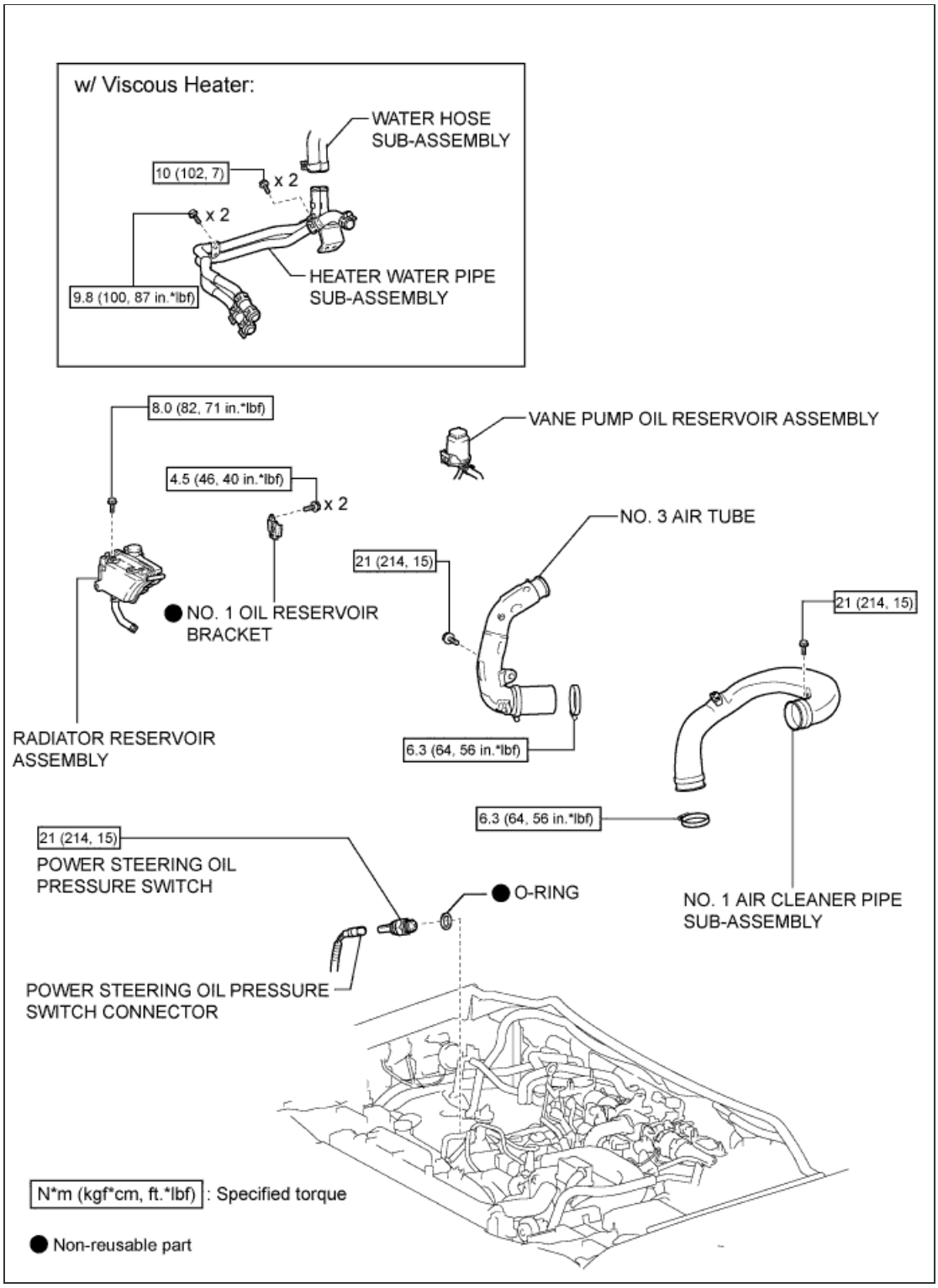
w/ Intercooler:



N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P


w/ Viscous Heater:
WATER HOSE SUB-ASSEMBLY
10 (102, 7)
x 2
x 2
9.8 (100, 87 in.*lbf)
HEATER WATER PIPE SUB-ASSEMBLY
8.0 (82, 71 in.*lbf)
VANE PUMP OIL RESERVOIR ASSEMBLY
4.5 (46, 40 in.*lbf)
x 2
NO. 3 AIR TUBE
21 (214, 15)
NO. 1 OIL RESERVOIR BRACKET
21 (214, 15)
RADIATOR RESERVOIR ASSEMBLY
6.3 (64, 56 in.*lbf)
6.3 (64, 56 in.*lbf)
21 (214, 15)
POWER STEERING OIL PRESSURE SWITCH
O-RING
NO. 1 AIR CLEANER PIPE SUB-ASSEMBLY
POWER STEERING OIL PRESSURE SWITCH CONNECTOR
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

for Preparation Click here

1. INSPECT POWER STEERING OIL PRESSURE SWITCH

a. Check the oil pressure switch.

i. Connect the intelligent tester to the DLC3.

ii. Turn the engine switch on (IG).

iii. Turn the intelligent tester on.

iv. Enter the following menus: Powertrain / Engine / Data List / All Data / Power Steering Switch.

v. Start the engine.

vi. Operate the steering wheel while idling, and read the lue on the intelligent tester.

OK:

Condition	Specified Condition
Power steering operation	ON
Power steering not operation	OFF

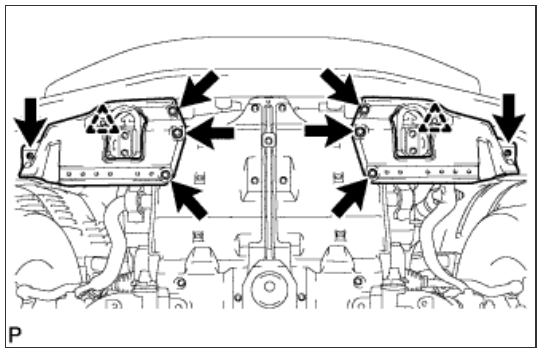
If not as specified, check for DTCs (Click here). If the power steering system inspection results are normal and a DTC is not output, replace the power steering oil pressure switch.
Inspect the power steering system (Click here). If the power steering system inspection results are normal and a DTC is not output, replace the power steering oil pressure switch.

for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

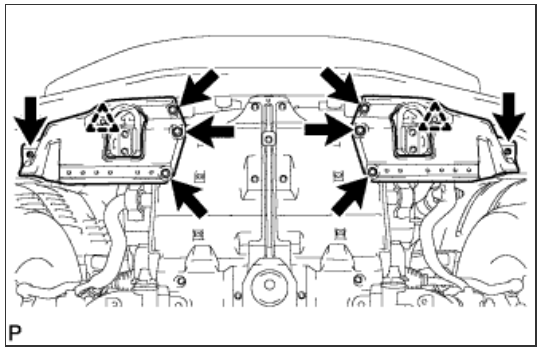
b. Loosen the clip and remove the splash shield.



2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

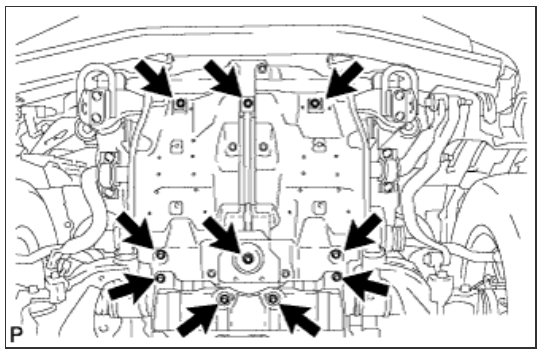
a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.



3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



4. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

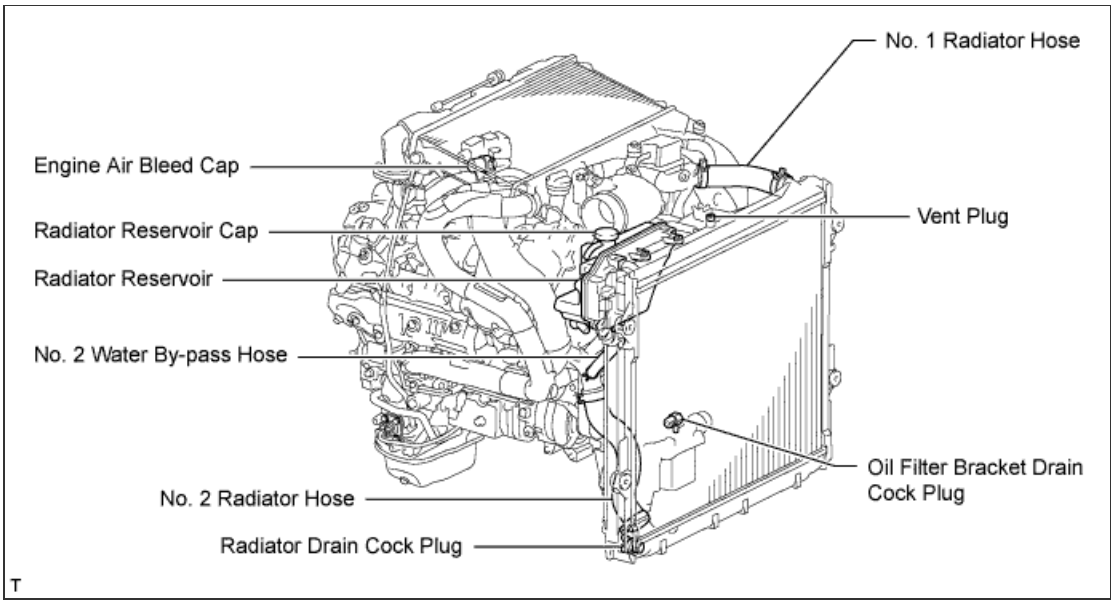
HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

a. Loosen the radiator drain cock plug.

b. Remove the radiator reservoir cap to drain the coolant in the radiator.

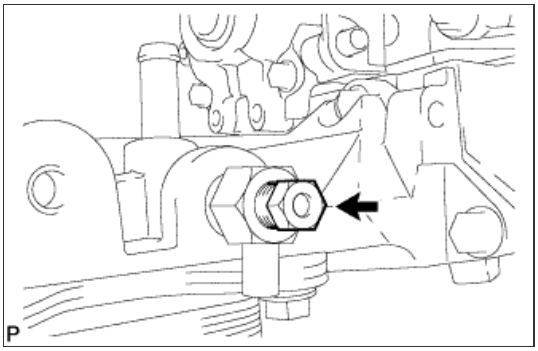
c. Loosen the oil filter bracket drain cock plug to drain the coolant in the engine.



d. Tighten the radiator drain cock plug by hand.

e. Tighten the oil filter bracket drain cock plug.

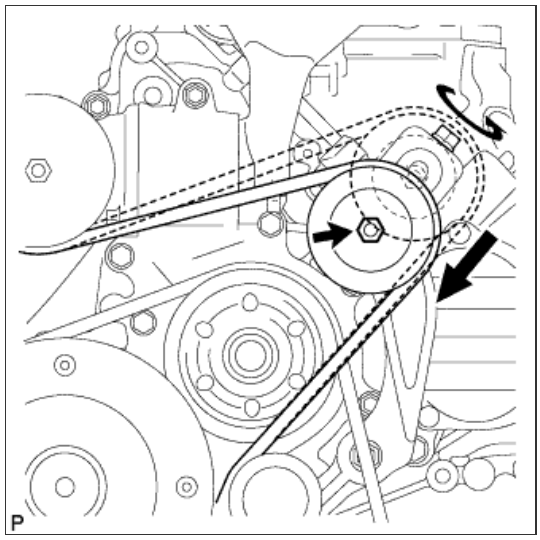
Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



5. REMOVE V-RIBBED BELT i cou Heater

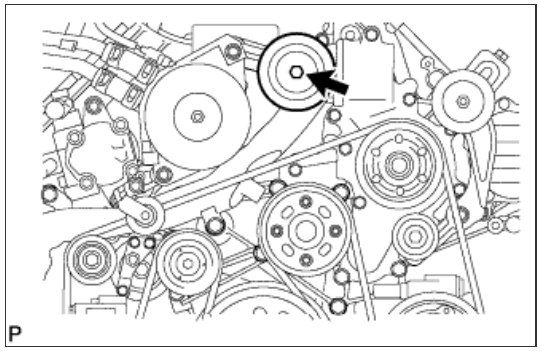
a. Loosen the lock nut and turn the bolt counterclockwise.

b. Remove the V-ribbed belt.



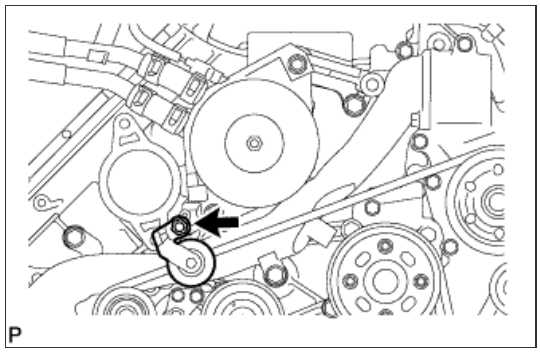
6. REMOVE NO. 1 IDLER PULLEY i cvu Heater

a. Remove the bolt, cover, No. 1 idler pulley and collar.



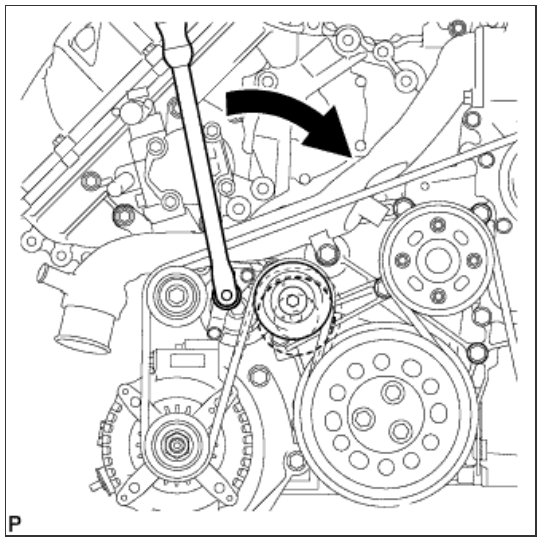
7. REMOVE NO. 3 IDLER PULLEY i cvu Heater

a. Remove the nut and No. 3 idler pulley.



8. REMOVE V-RIBBED BELT

a. Using a wrench to the V-ribbed belt tensioner bracket, turn the wrench clockwise and remove the V-ribbed belt.

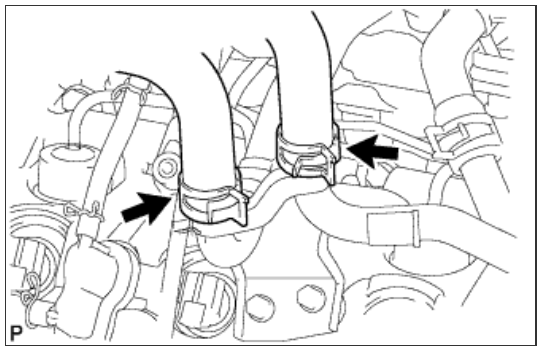


9. REMOVE INTERCOOLER ASSEMBLY nterc ooler

a. Remove the intercooler assembly (lick here).

10. DISCONNECT WATER HOSE SUB-ASSEMBLY i c u Heater

a. Disconnect the 2 water hoses.

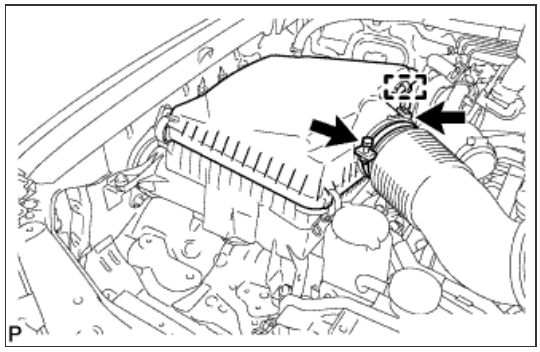


11. REMOVE AIR CLEANER CAP SUB-ASSEMBLY

a. Loosen the hose clamp.

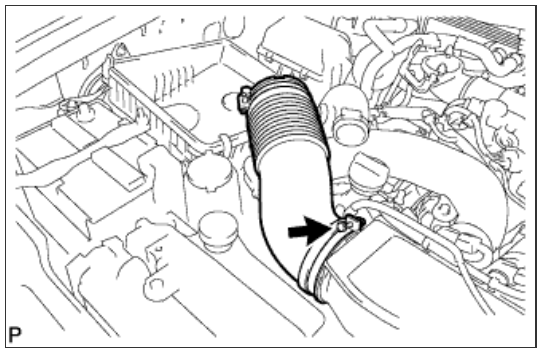
b. Disconnect the mass air flow meter connector and using a clip remover, detach the wire harness clamp from the air cleaner cap.

c. Detach the 4 clamps and remove the air cleaner cap.



12. REMOVE NO. 1 AIR CLEANER HOSE

a. Loosen the hose clamp and remove the No. 1 air cleaner hose.



13. REMOVE INTA E AIR CONNECTOR

a. w/o Viscous Heater:

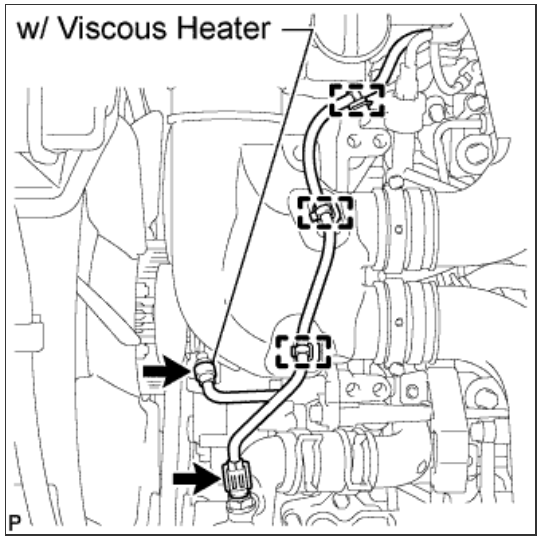
i. Disconnect the connector from the water temperature sensor.

ii. Using a clip remover, detach the 3 wire harness clamps.

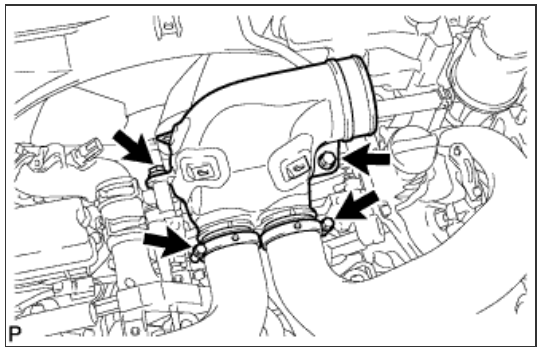
b. w/ Viscous Heater:

i. Disconnect the 2 connectors from the viscous with magnet clutch heater and water temperature sensor.

ii. Using a clip remover, detach the 3 wire harness clamps.

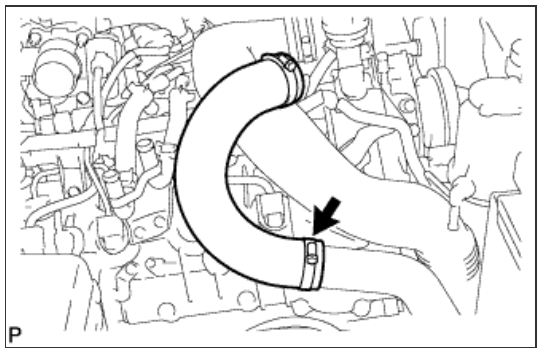


c. Loosen the 2 hose clamps and remove the 2 bolts and intake air connector.



14. REMOVE NO. 1 AIR HOSE

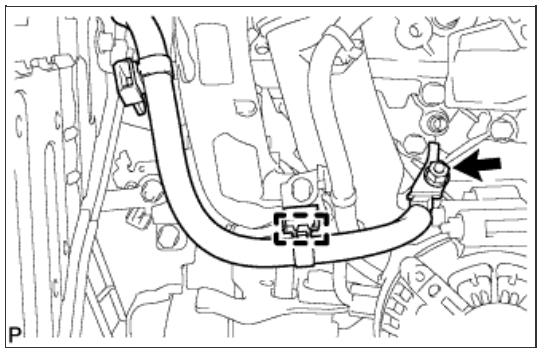
a. Loosen the hose clamp and remove the No. 1 air hose.



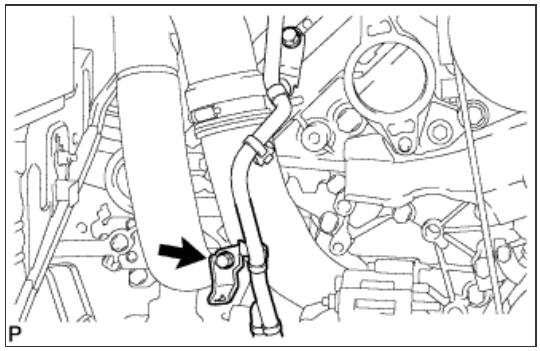
15. REMOVE NO. 3 AIR TUBE

a. Disconnect the wire harness from the clamp.

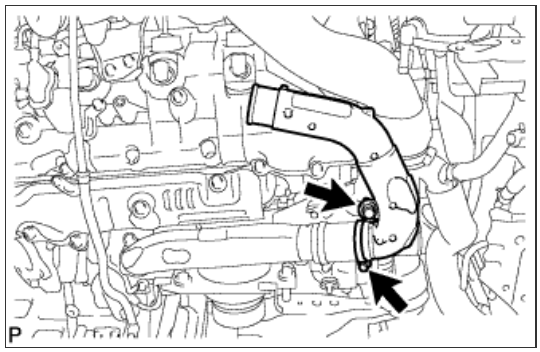
b. Remove the nut and ground wire.



c. Remove the bolt and disconnect the wire harness bracket.

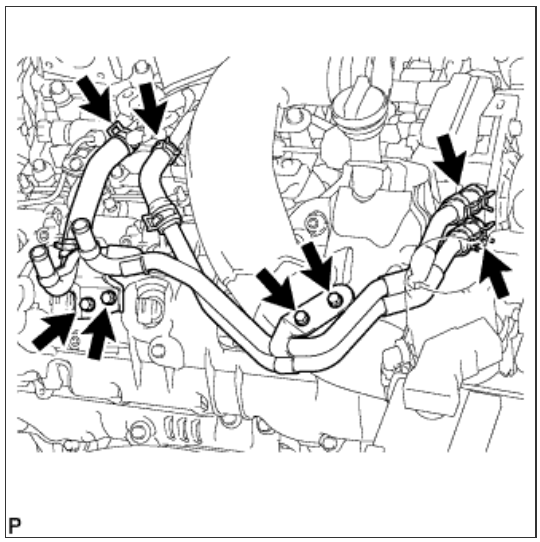


d. Loosen the hose clamp and remove the bolt and No. 3 air tube.



16. REMOVE HEATER WATER PIPE SUB-ASSEMBLY i cou Heater

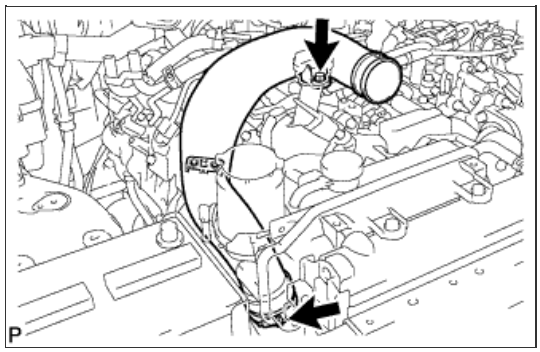
a. Remove the 4 bolts and disconnect the 4 water hose ends, and then remove the heater water pipe.



17. REMOVE NO. 1 AIR CLEANER PIPE SUB-ASSEMBLY

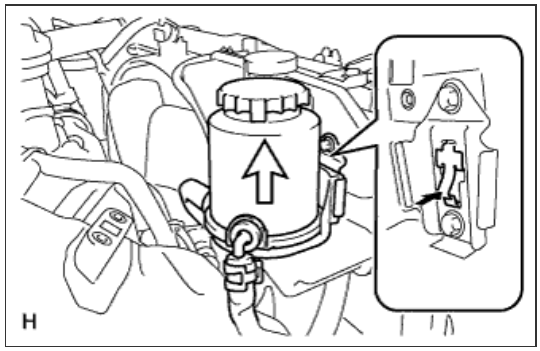
a. Loosen the hose clamp.

b. Remove the bolt and No. 1 air cleaner pipe.



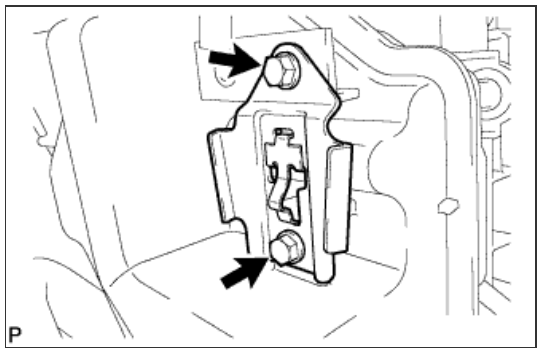
1 . DISCONNECT VANE PUMP OIL RESERVOIR ASSEMBLY

a. Insert a screwdriver between the reservoir and oil reservoir bracket, push the claw, and then disconnect the reservoir by pulling it upwards.



1 . REMOVE NO. 1 OIL RESERVOIR BRAC ET

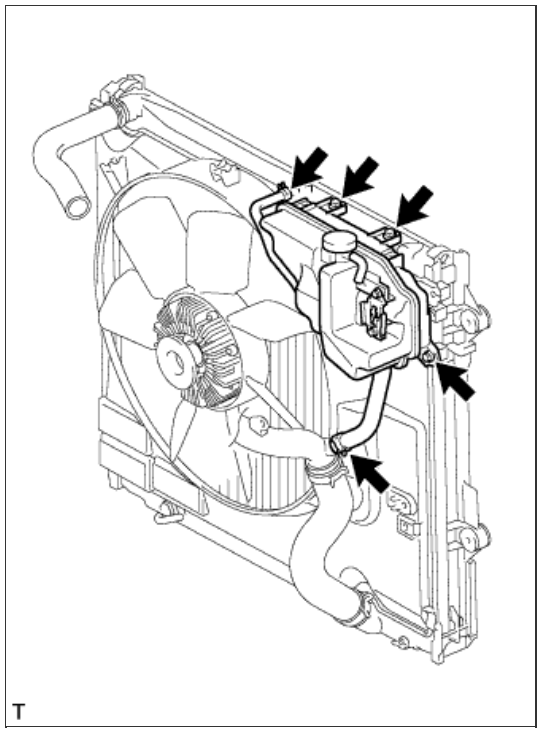
a. Remove the 2 bolts and bracket.



2 . REMOVE RADIATOR RESERVOIR ASSEMBLY

a. Disconnect the 2 hoses.

b. Remove the 3 bolts and radiator reservoir.

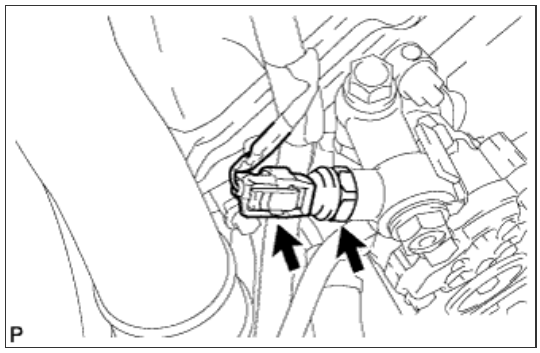


21. REMOVE POWER STEERING OIL PRESSURE SWITCH

a. Disconnect the oil pressure switch connector.

b. Using a 19 mm deep socket wrench, remove the oil pressure switch.

c. Remove the ring from the oil pressure switch.



for Preparation Click here

1. INSTALL POWER STEERING OIL PRESSURE SWITCH

a. Install a new O-ring to the oil pressure switch.

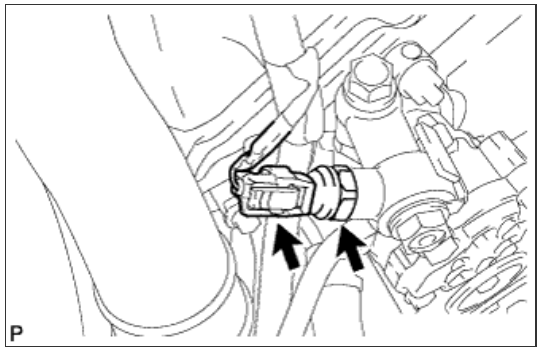
b. Apply a light coat of engine oil to the O-ring of the oil pressure switch.

c. Using a 19 mm deep socket wrench, install the oil pressure switch.

NOTICE:

- **Do not allow foreign matter to contact the oil seal face of the power steering oil pressure switch (connecting surface with pressure feed tube).**
- **Be careful not to damage the O-ring when installing the power steering oil pressure switch.**

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



d. Connect the oil pressure switch connector.

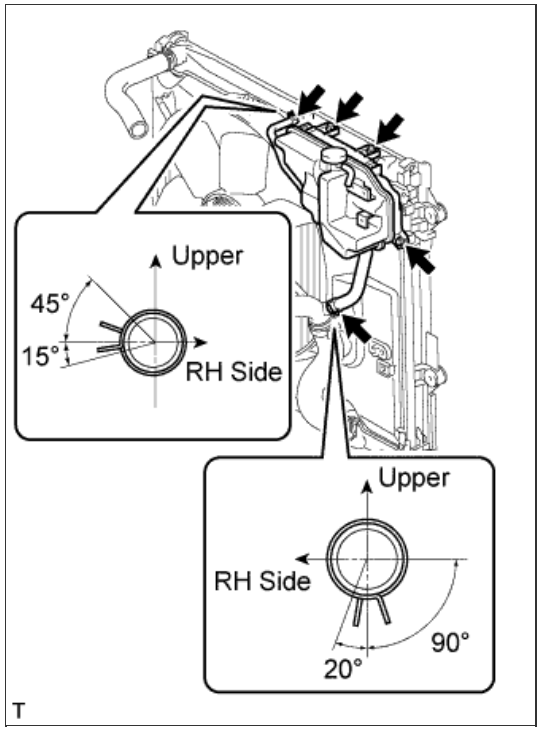
2. INSTALL RADIATOR RESERVOIR ASSEMBLY

a. Install the radiator reservoir with the 3 bolts.

b. Connect the 2 hoses to the upper radiator tank and water inlet.

HINT:

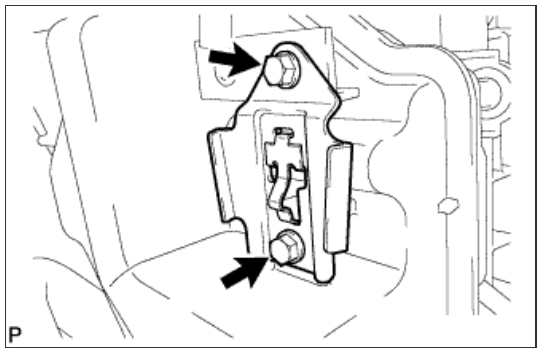
Make sure the directions of the hose clamps are as shown in the illustration.



3. INSTALL NO. 1 OIL RESERVOIR BRACKET

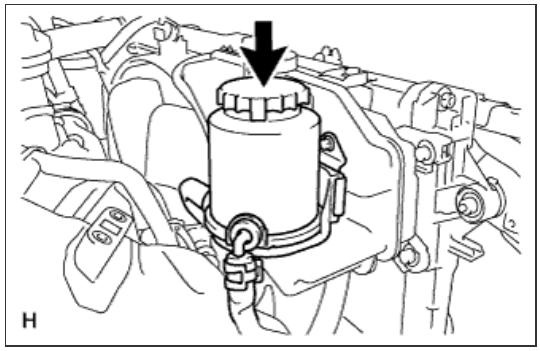
a. Install a new bracket with the 2 bolts.

Torque:
4.5 N*m{ 46 kgf*cm , 40 in.*lbf }



4. INSTALL VANE PUMP OIL RESERVOIR ASSEMBLY

a. Install the vane pump oil reservoir to the bracket.



5. INSTALL NO. 1 AIR CLEANER PIPE SUB-ASSEMBLY

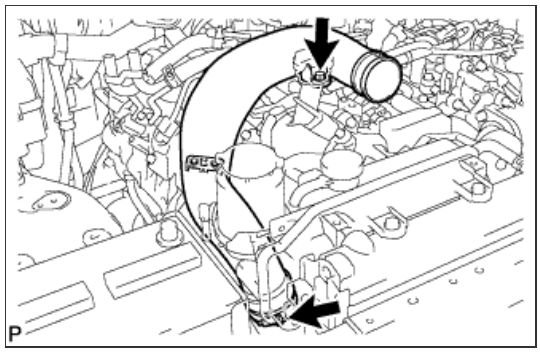
a. Connect the No. 1 air cleaner pipe to the No. 1 intake air connector pipe.

b. Install the pipe with the bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Tighten the hose clamp.

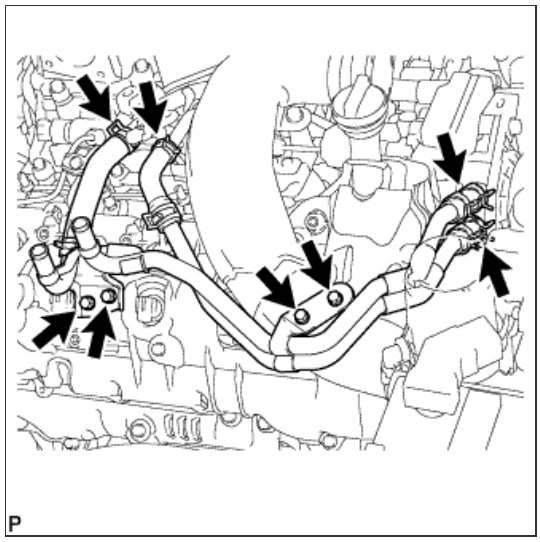
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



6. INSTALL HEATER WATER PIPE SUB-ASSEMBLY (w/ Viscous Heater)

a. Connect the 4 water hose ends, and install the water pipe with the 4 bolts.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }



7. INSTALL NO. 3 AIR TUBE

a. Install the No. 3 air tube with the bolt.

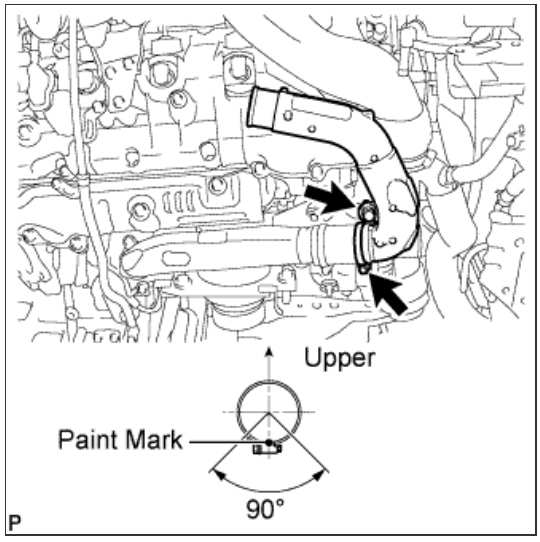
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

b. Tighten the hose clamp.

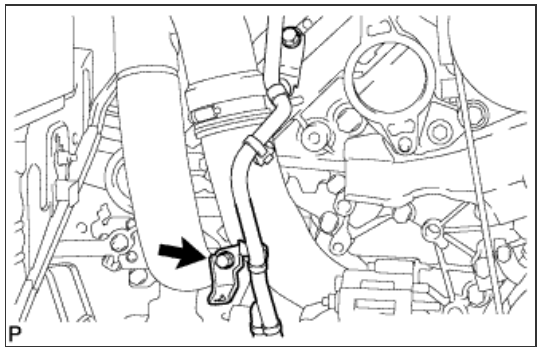
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

Make sure the direction of the hose clamp is as shown in the illustration.

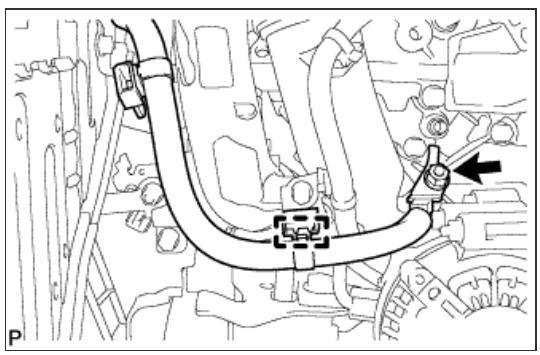


c. Install the wire harness bracket with the bolt.



d. Install the ground wire with the nut, and attach the wire harness clamp.

Torque:
8.4 N*m{ 87 kgf*cm , 74 in.*lbf }



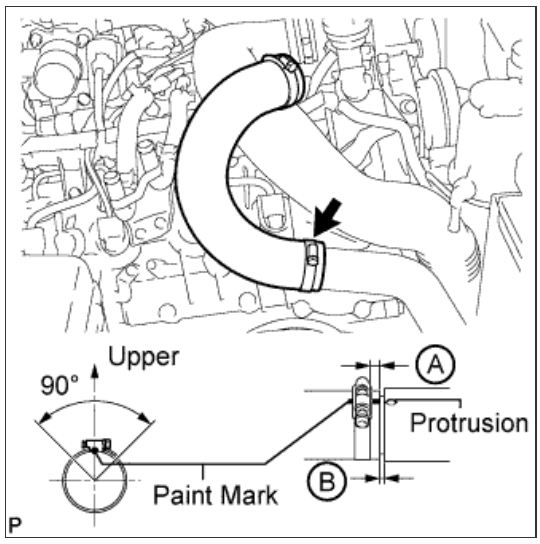
8. INSTALL NO. 1 AIR HOSE

a. Connect the No. 1 air hose with the hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion and push in the air hose so that distance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that distance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make sure the direction of the hose clamp is as shown in the illustration.**



9. INSTALL INTAKE AIR CONNECTOR

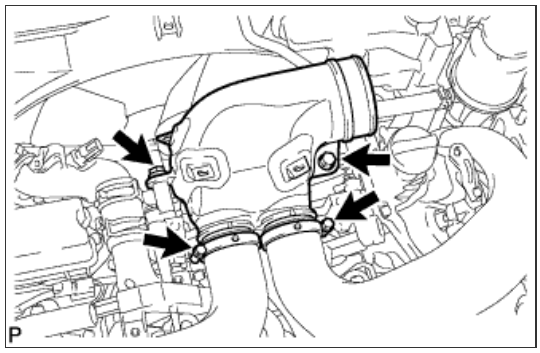
a. Connect the intake air connector to the No. 1 and No. 2 air cleaner pipes.

b. Install the connector with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Tighten the 2 hose clamps.

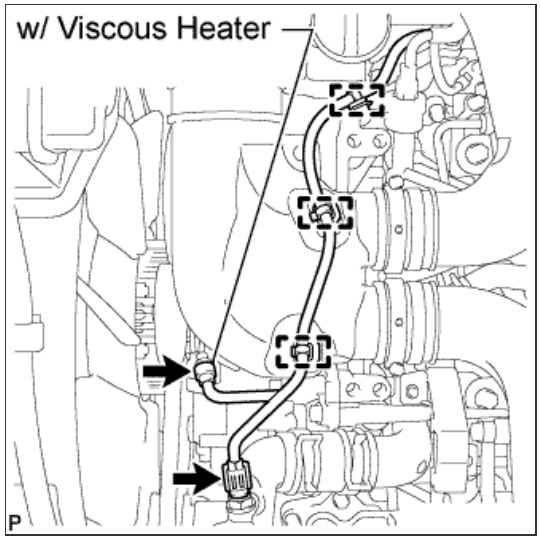
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



d. Attach the 3 wire harness clamps.

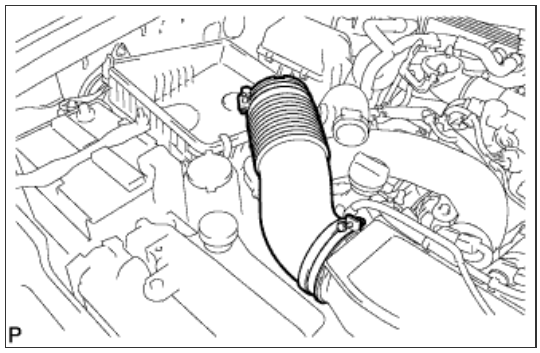
e. w/o Viscous Heater:
Connect the connector to the water temperature sensor.

f. w/ Viscous Heater:
Connect the 2 connectors to the water temperature sensor and viscous with magnet clutch heater.



10. TEMPORARILY INSTALL NO. 1 AIR CLEANER HOSE

a. Temporarily install the air cleaner hose to the intake air connector.

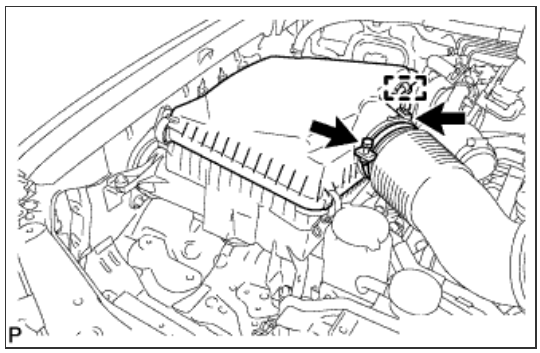


11. INSTALL AIR CLEANER CAP SUB-ASSEMBLY

a. Connect the air cleaner cap to the air cleaner hose, and install the air cleaner cap with the 4 clamps.

b. Connect the mass air flow meter connector and attach the wire harness clamp to the air cleaner cap.

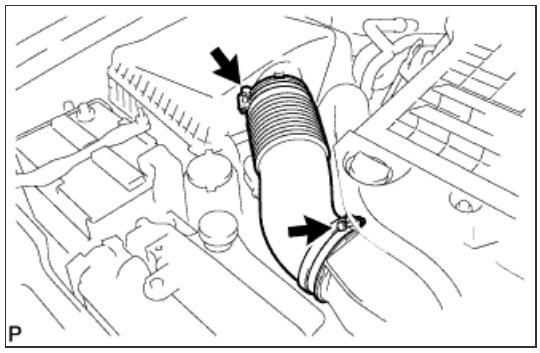
c. Attach the wire harness clamp.



d. Align the protrusion of air cleaner cap and concave portion of air cleaner hose.

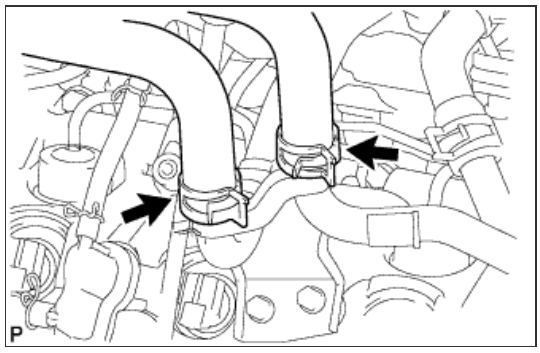
e. Tighten the 2 hose clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



12. CONNECT WATER HOSE SUB-ASSEMBLY (w/ Viscous Heater)

a. Connect the 2 water hoses.

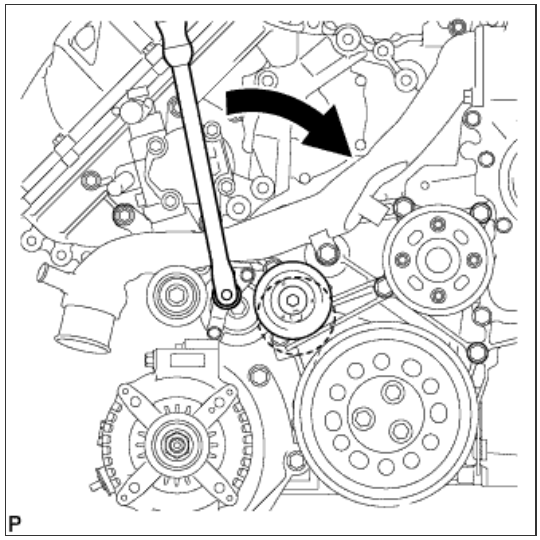


13. INSTALL INTERCOOLER ASSEMBLY (w/ Intercooler)

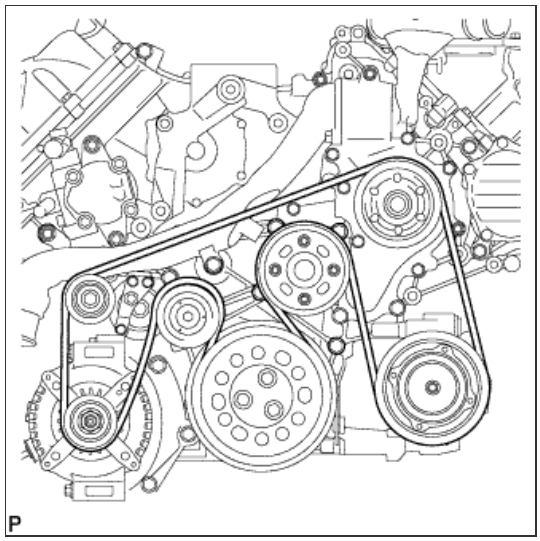
a. Install the intercooler assembly (Click here).

14. INSTALL V-RIBBED BELT

a. Attach a wrench to the V-ribbed belt tensioner bracket and turn the wrench clockwise.



b. Install the V-ribbed belt as shown in the illustration.

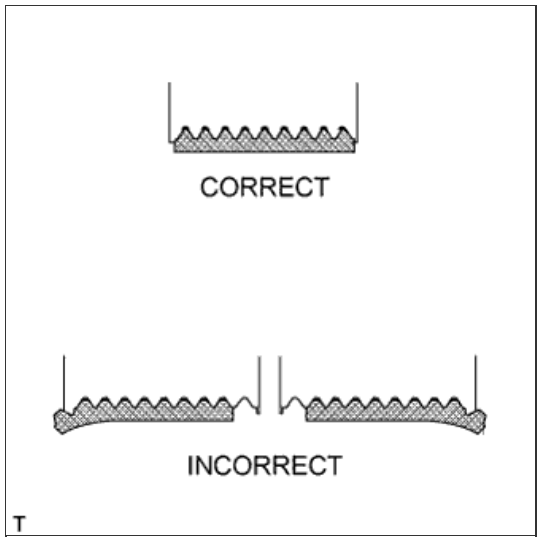


c. Check that the belt fits properly in the ribbed grooves.

HINT:

Check with your hand to confirm that the belt has not slipped out of the groove on the bottom of the pulley.

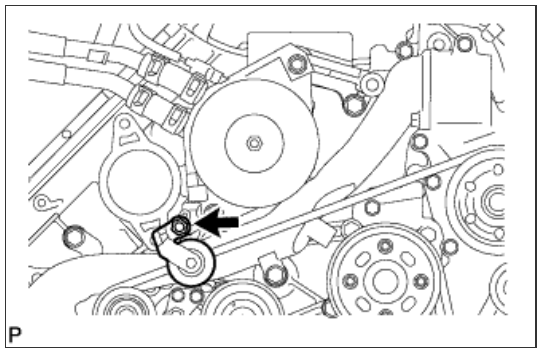
If it has slipped out, replace the V-ribbed belt. Install a new V-ribbed belt.



15. INSTALL NO. 3 IDLER PULLEY (w/ Viscous Heater)

a. Align the No. 3 idler pulley bracket knock pin and No. 1 idler pulley bracket knock pin hole and install the No. 3 idler pulley with the nut.

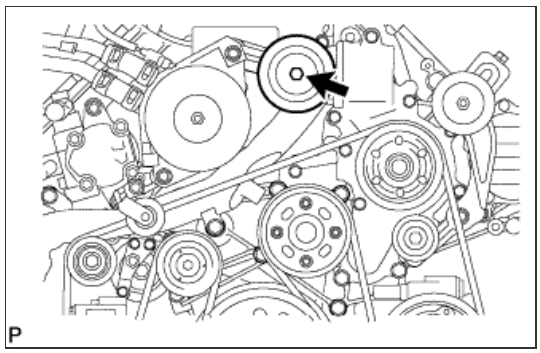
Torque:
88 N*m{ 898 kgf*cm , 64 ft.*lbf }



16. INSTALL NO. 1 IDLER PULLEY (w/ Viscous Heater)

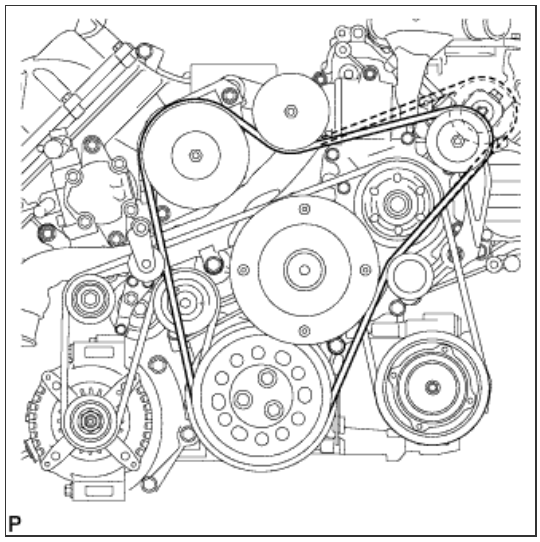
a. Install the collar, No. 1 idler pulley and cover with the bolt.

Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }

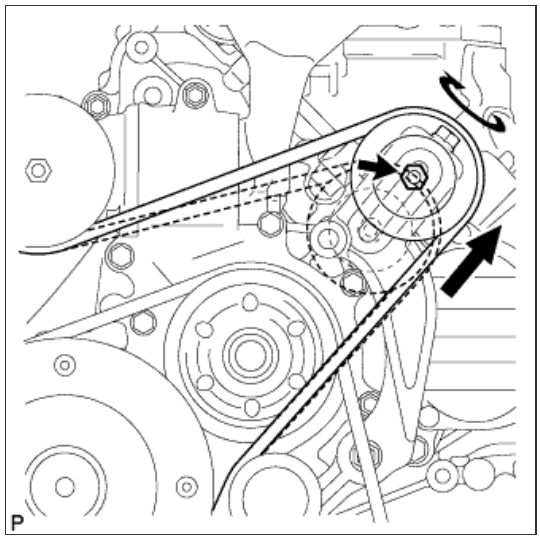


1 INSTALL V-RIBBED BELT (w/ Viscous Heater)

a. Install the V-ribbed belt as shown in the illustration.



b. Temporarily install the lock nut, and turn the bolt clockwise.



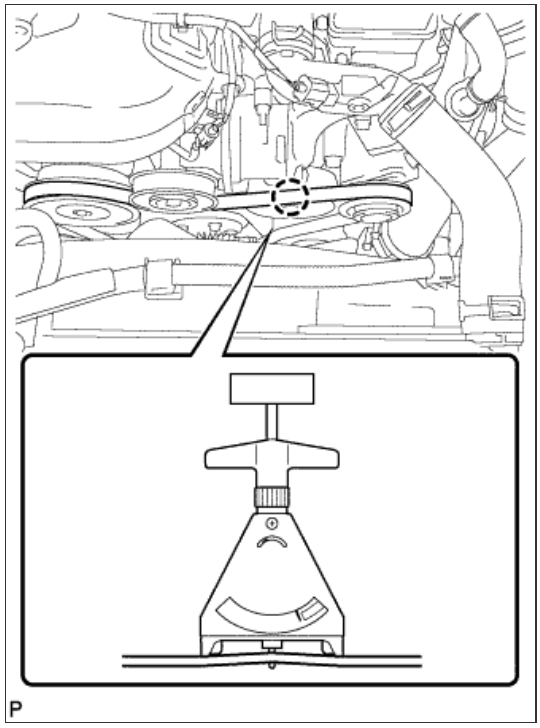
c. Using a belt tension gauge, adjust belt tension.

Standard Belt Tension:

Item	Specified Condition
New belt	400 to 650 N (41 to 66 kgf, 89.9 to 146.1 lbf)
Used belt	300 to 500 N (31 to 51 kgf, 67.4 to 112.4 lbf)

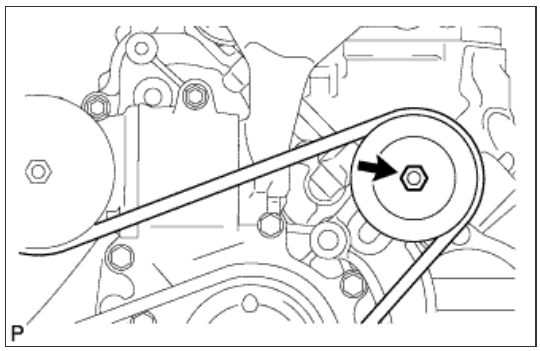
HINT:

- **A new belt is a belt which has been used for less than 5 minutes on a running engine.**
- **A used belt is a belt which has been used on a running engine for 5 minutes or more.**
- **After installing a new belt, run the engine for appro imatel 5 minutes and then recheck the tension.**



d. Tighten the nut.

Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

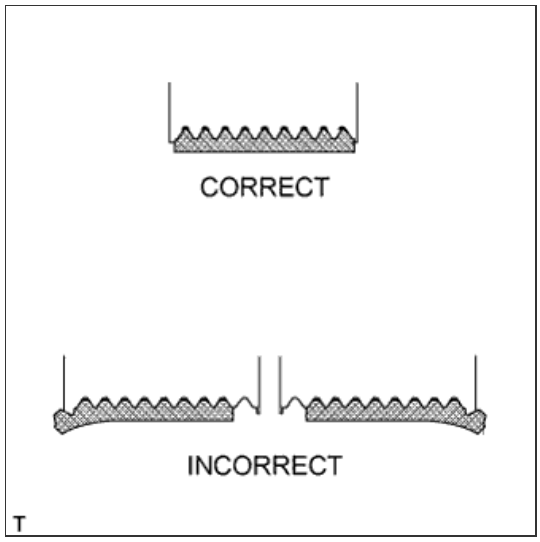


e. Check that the belt fits properly in the ribbed grooves.

HINT:

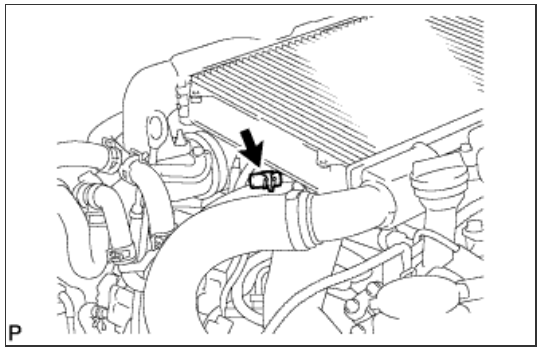
Check with your hand to confirm that the belt has not slipped out of the groove on the bottom of the pulley.

If it has slipped out, replace the V-ribbed belt. Install a new V-ribbed belt.

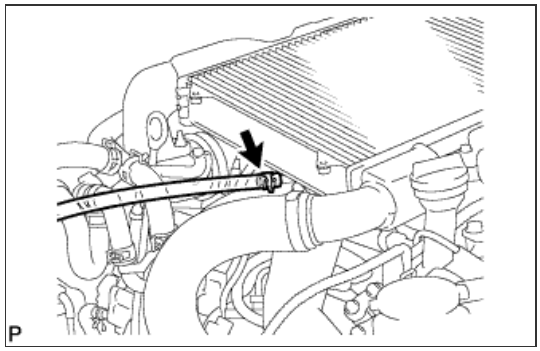


18. ADD ENGINE COOLANT

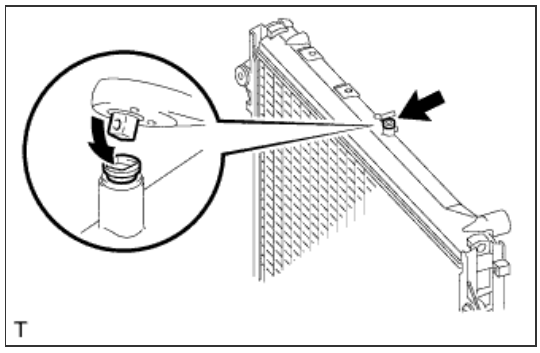
a. Remove the engine air bleed cap.



b. Connect a clear hose to the engine air bleed pipe.



c. Using a wrench, remove the vent plug.



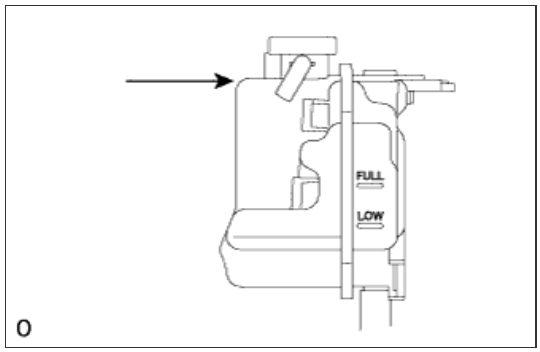
d. Fill the radiator with TOYOTA SLLC to the radiator reservoir filler neck.

HINT:

Pour TOYOTA SLLC until it spills out of the engine air bleed pipe.

Standard Capacit (for Automatic Transmission):

Item	Specified Condition
Front heater only	14.8 liters (15.6 US qts, 13.0 Imp. qts)
Front heater and rear heater	17.6 liters (18.6 US qts, 15.5 Imp. qts)
Front heater with viscous heater	15.2 liters (16.1 US qts, 13.4 Imp. qts)
Front heater and rear heater with viscous heater	18.0 liters (19.0 US qts, 15.4 Imp. qts)



Standard capacit (for Manual Transmission):
15.4 liters (16.3 US qts, 13.6 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

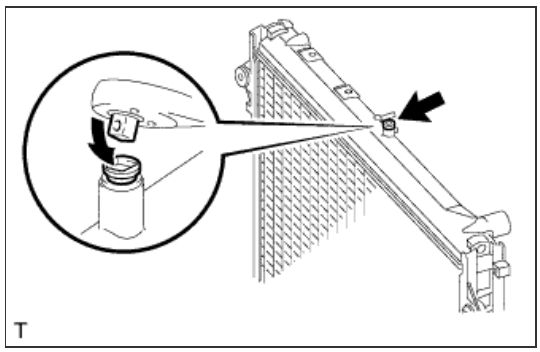
TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

e. Install the vent plug.

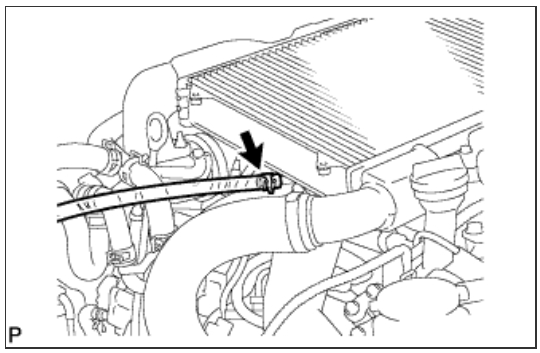
Torque:
2.0 N*m{ 20 kgf*cm , 18 in.*lbf }

NOTICE:

Do not tighten the plug to 5.0 N*m (51 kgf*cm, 44 in.*lbf) or more, as the plug will be damaged.



f. Disconnect the clear hose from the engine air bleed pipe.



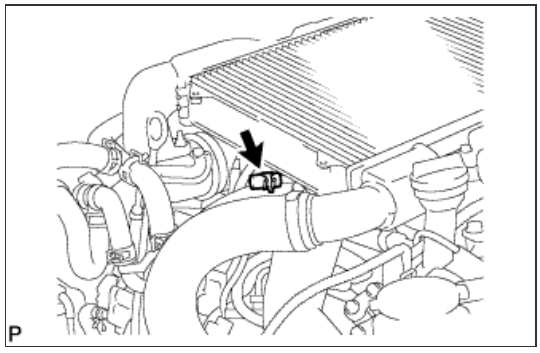
g. Install the engine air bleed cap when coolant comes out.

h. Install the radiator reservoir cap.

i. Start the engine.

NOTICE:

Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the FULL line.



j. Maintain an engine speed of 3000 rpm for approximately 10 minutes so that the thermostat opens and air bleeding is performed.

CAUTION:

When pressing the radiator hoses:
- **Wear protecti e glo es.**

- **Be careful as the radiator hoses are hot.**
- **Keep our hands awa from the radiator fan**

NOTICE:

- **Pa attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormall high temperature.**
- **If there is not enough coolant, the engine ma burn out or o erheat.**

HINT:

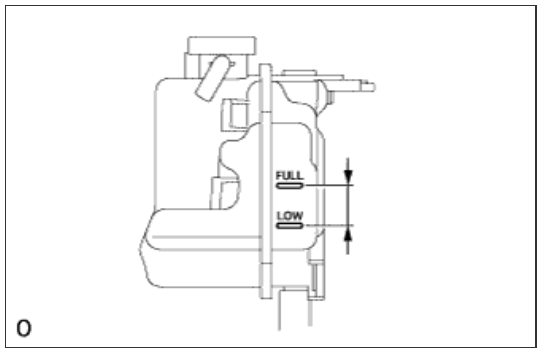
The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

k. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

l. Check that the coolant level is between the FULL and LOW lines.
If the coolant level is above the FULL line, drain coolant so that the coolant level is between the FULL and LOW lines.



19. INSPECT OR COOLANT LEAK

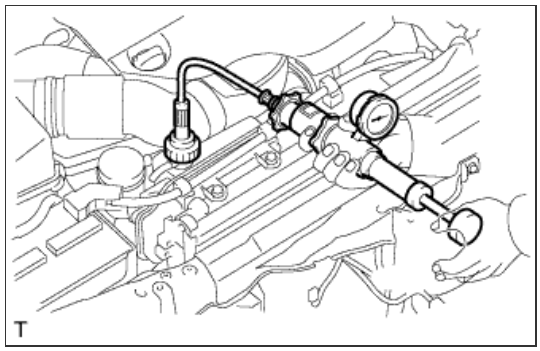
CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester to the radiator reservoir.

b. Warm up the engine.

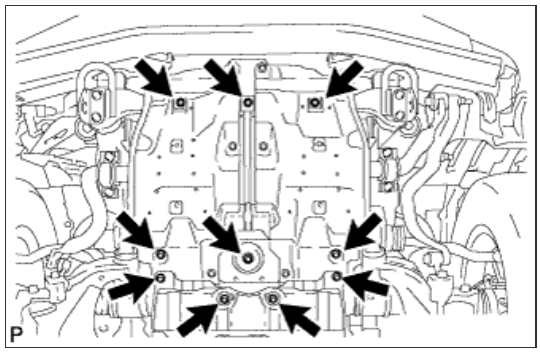
c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 17.8 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks.
If no external leaks are found, check the cylinder block and cylinder head.



20. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

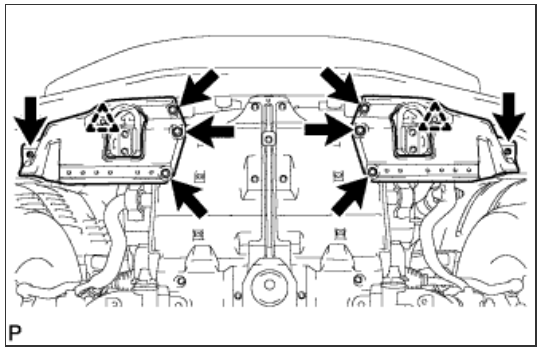
a. Install the engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



21. INSTALL RONT ENDER SPLASH SHIELD SUB-ASSEMBLY RH

a. Install the splash shield with the clip, and then install the 3 bolts and screw.



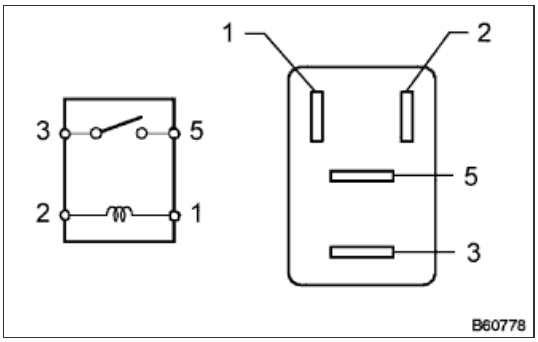
22. INSTALL RONT ENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Install the splash shield with the clip, and then install the 3 bolts and screw.

for Preparation Click here

1. INSPECT FUEL PUMP RELAY (SUB PUMP)

a. Measure the resistance according to the value(s) in the table below.



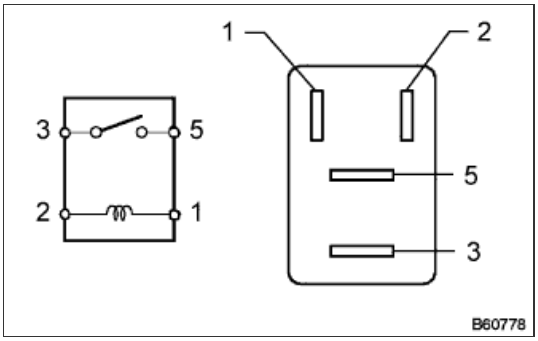
Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage is not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage is applied to terminals 1 and 2	Below 1 Ω

If the result is not as specified, replace the relay.

2. INSPECT EDU RELAY (EDU 1, EDU 2)

a. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage is not applied between 1 and 2	10 kΩ or higher
3 - 5	Battery voltage is applied between 1 and 2	Below 1 Ω

If the result is not as specified, replace the relay.

3. INSPECT INTEGRATION RELAY (IG2)

a. Measure the resistance of the IG2 MAIN fuse.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
IG2 MAIN fuse	Always	Below 1 Ω

If the result is not as specified, replace the IG2 MAIN fuse.

b. Measure the resistance of the ignition relay No. 2 (IG2) circuit.

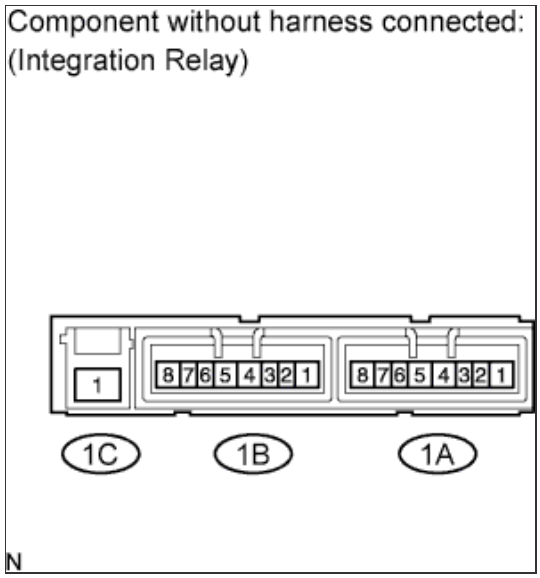
i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition

1C-1 - 1B-8	Battery voltage is not applied to terminals 1B-6 and 1B-7	10 kΩ or higher
	Battery voltage is applied to terminals 1B-6 and 1B-7	Below 1 Ω

If the result is not as specified, replace the integration relay.



4. REMOVE INTEGRATION RELAY (EFI MAIN)

a. Measure the resistance of the EFI MAIN fuse.

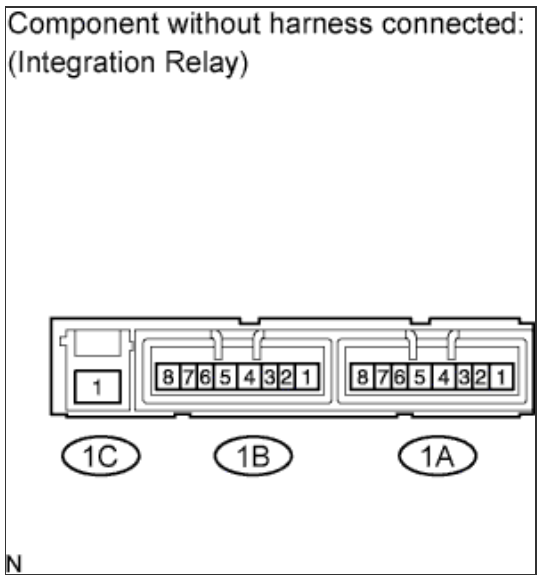
i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAIN fuse	Always	Below 1 Ω

If the result is not as specified, replace the EFI MAIN fuse.

b. Measure the resistance of the EFI MAIN relay circuit.



i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1C-1 - 1B-4	Battery voltage is not applied to terminals 1B-2 and 1B-3	10 kΩ or higher
	Battery voltage is applied to terminals 1B-2 and 1B-3	Below 1 Ω

If the result is not as specified, replace the integration relay.

5. INSPECT INTEGRATION RELAY (EFI MAIN 2)

a. Measure the resistance of the EFI MAIN 2 fuse.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
EFI MAIN 2 fuse	Always	Below 1 Ω

If the result is not as specified, replace the EFI MAIN 2 fuse.

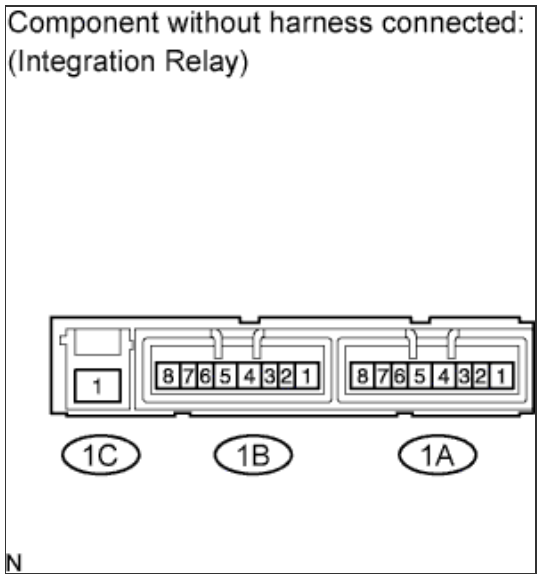
b. Measure the resistance of the EFI MAIN 2 relay circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

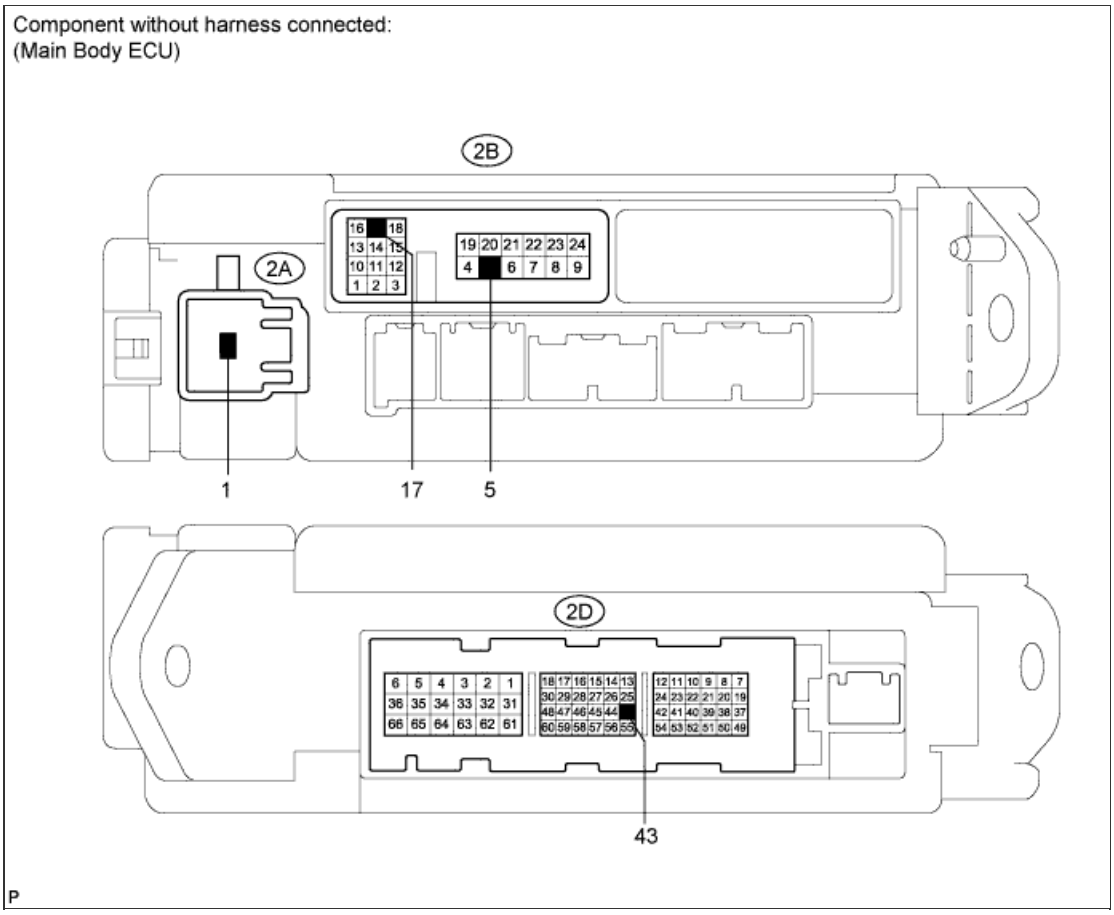
Tester Connection	Condition	Specified Condition
1C-1 - 1A-4	Battery voltage is not applied to terminals 1A-2 and 1A-3	10 kΩ or higher
	Battery voltage is applied to terminals 1A-2 and 1A-3	Below 1 Ω

If the result is not as specified, replace the integration relay.



6. INSPECT MAIN BODY ECU (IG1 NO. 1)

a. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

Tester Connection	Condition	Specified Condition
	Battery voltage is not applied to terminals 2B-5 and	10 kΩ or higher

2A1 - 2B17	2D-43	
	Battery voltage is applied to terminals 2B-5 and 2D-43	Below 1 Ω

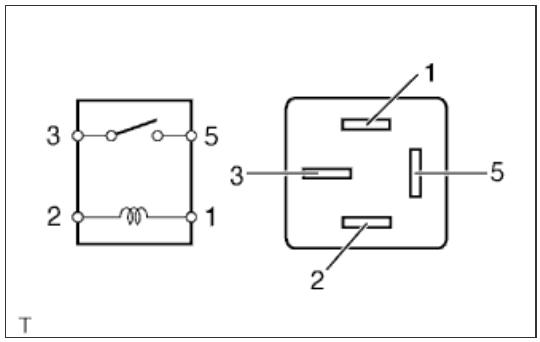
If the result is not as specified, replace the cowl side junction block LH.

7. INSPECT STARTER RELAY (ST)

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage applied to terminals 1 and 2	Below 1 Ω



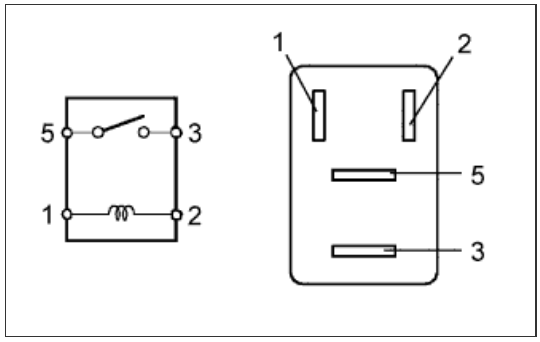
If the result is not as specified, replace the relay.

8. INSPECT STARTER CUT RELAY (ST CUT)

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage applied to terminals 1 and 2	Below 1 Ω



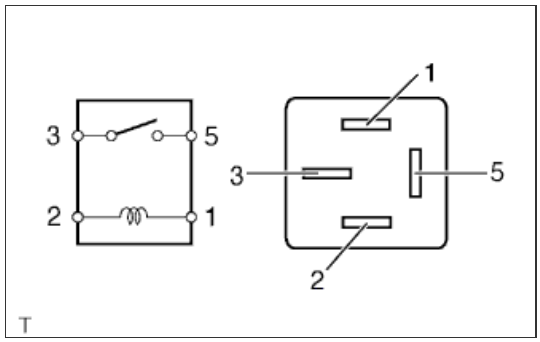
If the result is not as specified, replace the relay.

9. INSPECT NO. 1 GLOW RELAY (GLOW1)

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

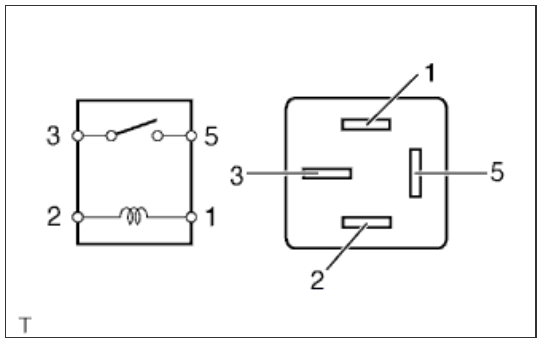
Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage applied to terminals 1 and 2	Below 1 Ω



If the result is not as specified, replace the relay.

10. INSPECT NO. 2 GLOW RELAY (GLOW2)

a. Measure the resistance according to the value(s) in the table below.

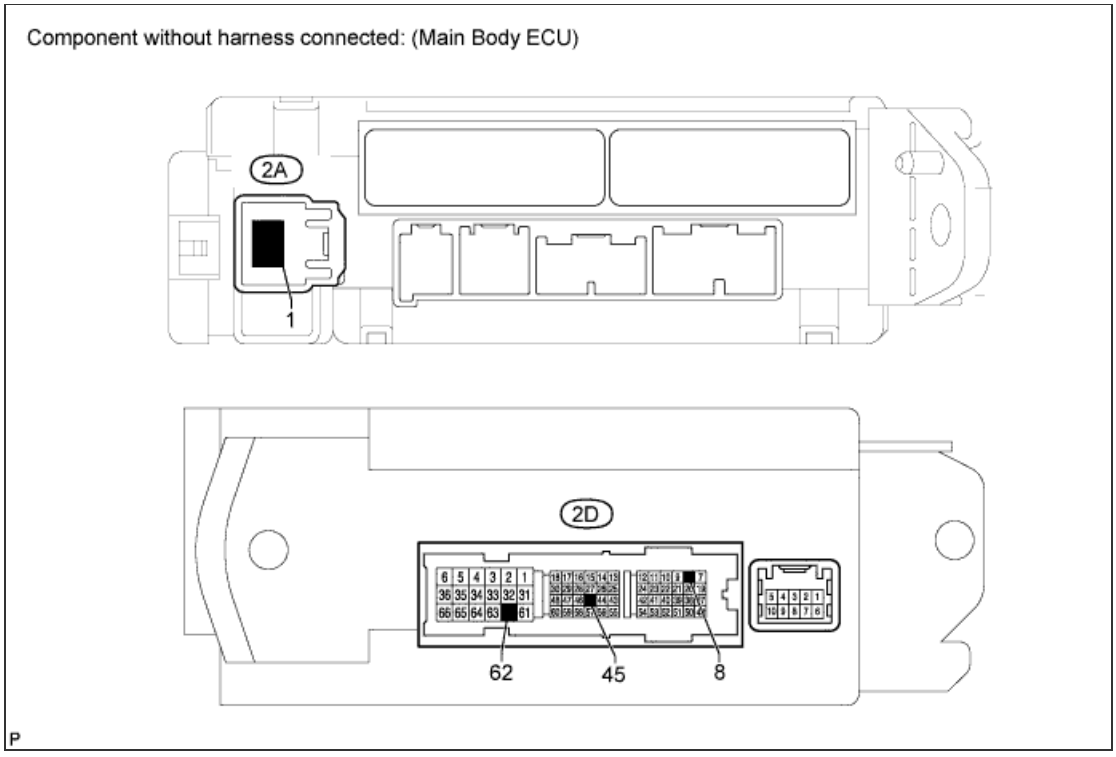


Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage applied to terminals 1 and 2	Below 1 Ω

If the result is not as specified, replace the relay.

11. INSPECT MAIN BODY ECU (ACC RELAY)



a. Measure the resistance of the ACC relay circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
2A-1 - 2D-8	Battery voltage not applied between 2D-45 and 2D-62	10 kΩ or higher
	Battery voltage applied between 2D-45 and 2D-62	Below 1 Ω

If the result is not as specified, replace the main body ECU.

for Preparation Click here

1. INSPECT IGNITION TIMING

NOTICE:

- **Turn all electrical systems off.**
- **Perform the inspection when the cooling fan motor is turned off.**

a. Warm up the engine.

b. When using the intelligent tester:

i. Connect the intelligent tester to the DLC3.

ii. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / IGN Advance.

iii. Inspect the ignition timing during idling.

Standard ignition timing:
8 to 12° BTDC @ idling (transmission in neutral position and A/C switch off)

iv. Check that the ignition timing advances immediately when the engine speed is increased.

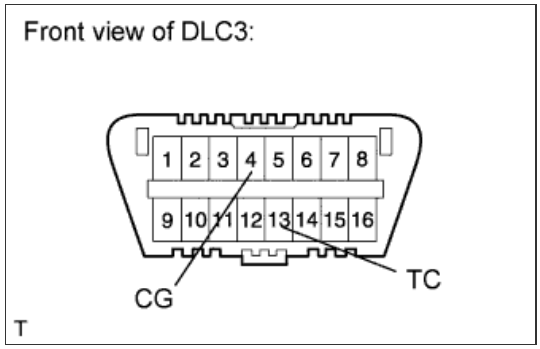
c. When not using the intelligent tester:

i. Using SST, connect terminals 13 (TC) and 4 (CG) of the DLC3.

SST
09843-18040

NOTICE:

Be sure not to improperly connect the terminals. This may damage the engine.



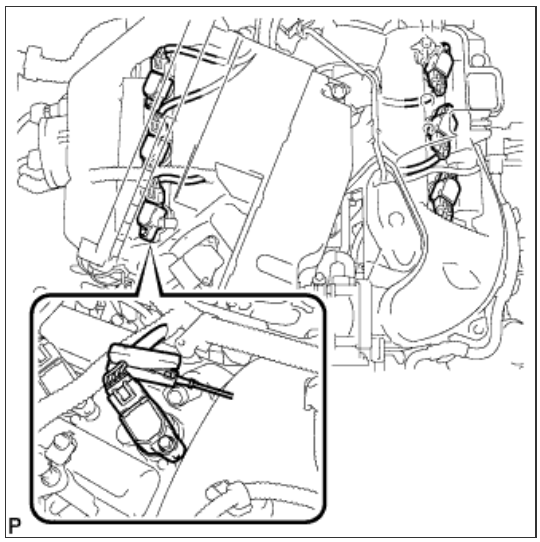
ii. Remove the air cleaner cap.

iii. Pull out the wire harness shown in the illustration.

iv. Connect the tester probe of a timing light to the wire of the ignition coil connector for the No. 1 cylinder.

NOTICE:

- **Use a timing light that detects primary signals.**
- **After checking, be sure to wrap the wire harness with tape.**



v. Inspect the ignition timing during idling.

Standard ignition timing:
8 to 12° BTDC @ idling (transmission in neutral position and A/C switch off)

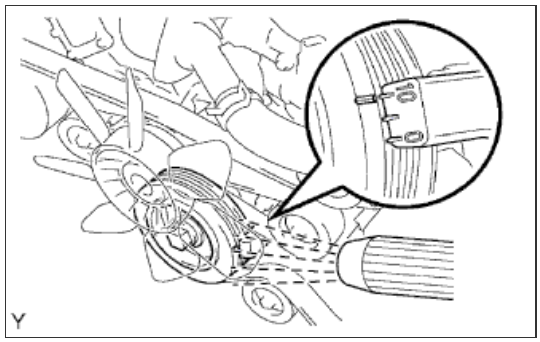
vi. Remove SST from the DLC3.

vii. Inspect the ignition timing during idling.

Standard ignition timing:
7 to 24° BTDC @ idling (transmission in neutral position and A/C switch off)

viii. Disconnect the timing light from the engine.

ix. Install the air cleaner cap.



2. INSPECT ENGINE IDLING SPEED

NOTICE:

- **Turn all the electrical systems off.**
- **Perform the inspection when the cooling fan motor is turned off.**

a. Warm up the engine.

b. When using the intelligent tester:

i. Connect the intelligent tester to the DLC3.

ii. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Engine Speed.

iii. Inspect the engine idling speed.

Standard idling speed:
650 to 750 rpm (transmission in neutral position and A/C switch off)

c. When not using the intelligent tester:

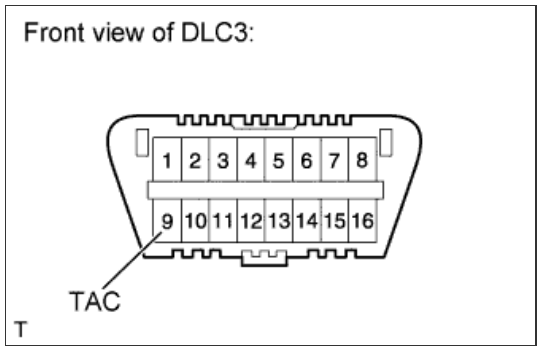
i. Connect SST to terminal 9 (TAC) of the DLC3.

SST
09843-18030

ii. Race the engine at 2500 rpm for approximately 90 seconds.

iii. Inspect the engine idling speed.

Standard idling speed:
650 to 750 rpm (transmission in neutral position and A/C switch off)



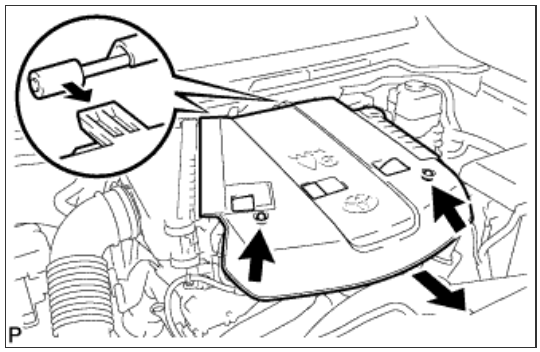
3. INSPECT COMPRESSION

a. Warm up and stop the engine.

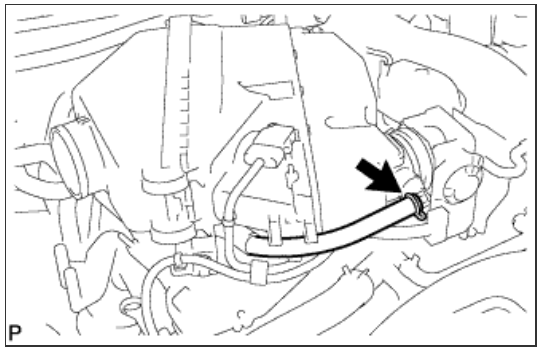
b. Drain the engine coolant (Click here).

c. Remove the 2 cap nuts and V-bank cover.

d. Loosen the clamp and remove the No. 2 air cleaner hose.



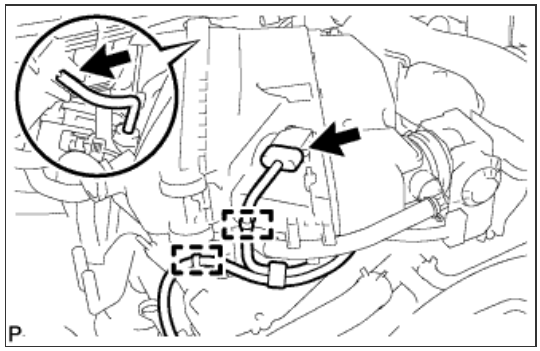
e. Disconnect the ventilation hose.



f. Disconnect the MAF connector.

g. Using a clip remover, detach the 2 wire harness clamps.

h. Disconnect the vacuum hose.



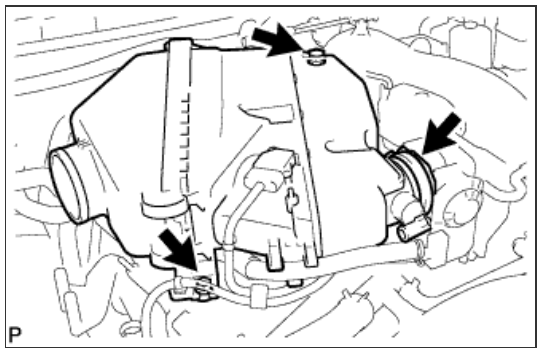
i. Loosen the hose clamp and remove the 2 bolts and air cleaner.

j. Remove the intake air surge tank (Click here).

k. Remove the 6 ignition coils.

l. Remove the 6 spark plugs.

m. Disconnect the 6 fuel injector connectors.



n. Inspect the cylinder compression pressure.

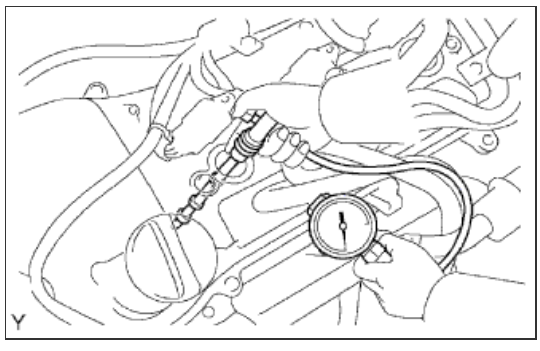
i. Insert a compression gauge into the spark plug hole (Procedure "A").

ii. While cranking the engine, measure the compression pressure (Procedure "B").

Compression pressure:
1300 kPa (13.3 kgf/cm^2, 189 psi)

Minimum pressure:
1000 kPa (10.2 kgf/cm^2, 145 psi)

Difference between each cylinder:
100 kPa (1.0 kgf/cm^2, 15 psi)



HINT:

- **Use a fully-charged battery so that the engine speed can be increased to 250 rpm or more.**
- **Measure the compression in as short a time as possible.**

iii. Repeat procedures "A" and "B" for each cylinder.

iv. If the cylinder compression is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat procedures "A" and "B" for cylinders with low compression.

- If adding oil increases the compression, the piston rings and/or cylinder bore may be worn or damaged.
- If pressure stays low, a valve may be stuck or seated improperly, or there may be leakage from the gasket.

o. Connect the 6 injector connectors.

p. Install the 6 spark plugs.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

q. Install the 6 ignition coils.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

r. Install the intake air surge tank (Click here).

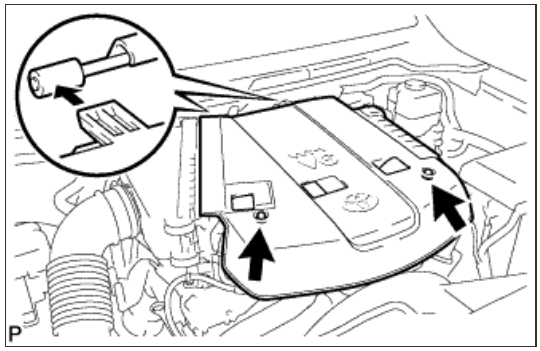
s. Install the air cleaner (Click here).

t. Install the No. 2 air cleaner hose (Click here).

u. Install the V-bank cover with the 2 cap nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

v. Add engine coolant (Click here).



4. INSPECT CO/HC

HINT:

This check is to determine whether or not the idle CO/HC concentration complies with regulations.

a. Start the engine.

b. Run the engine at 2500 rpm for approximately 180 seconds.

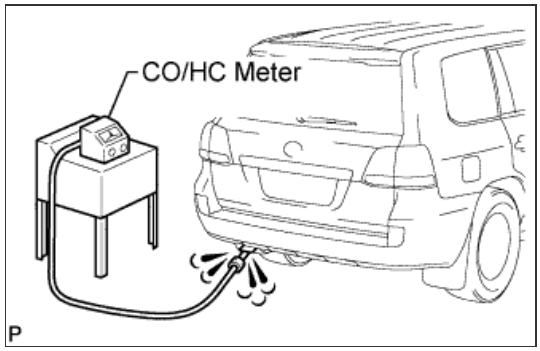
c. Insert the CO/HC meter testing probe at least 40 cm (1.31 ft) into the tailpipe during idling.

d. Immediately check the CO/HC concentration during idling and/or at 2500 rpm.

HINT:

When carrying out the 2 tests (idling and 2500 rpm), the measurement orders are prescribed by the applicable local regulations.

e. If the CO/HC concentration does not comply with regulations, perform troubleshooting in the order given below.

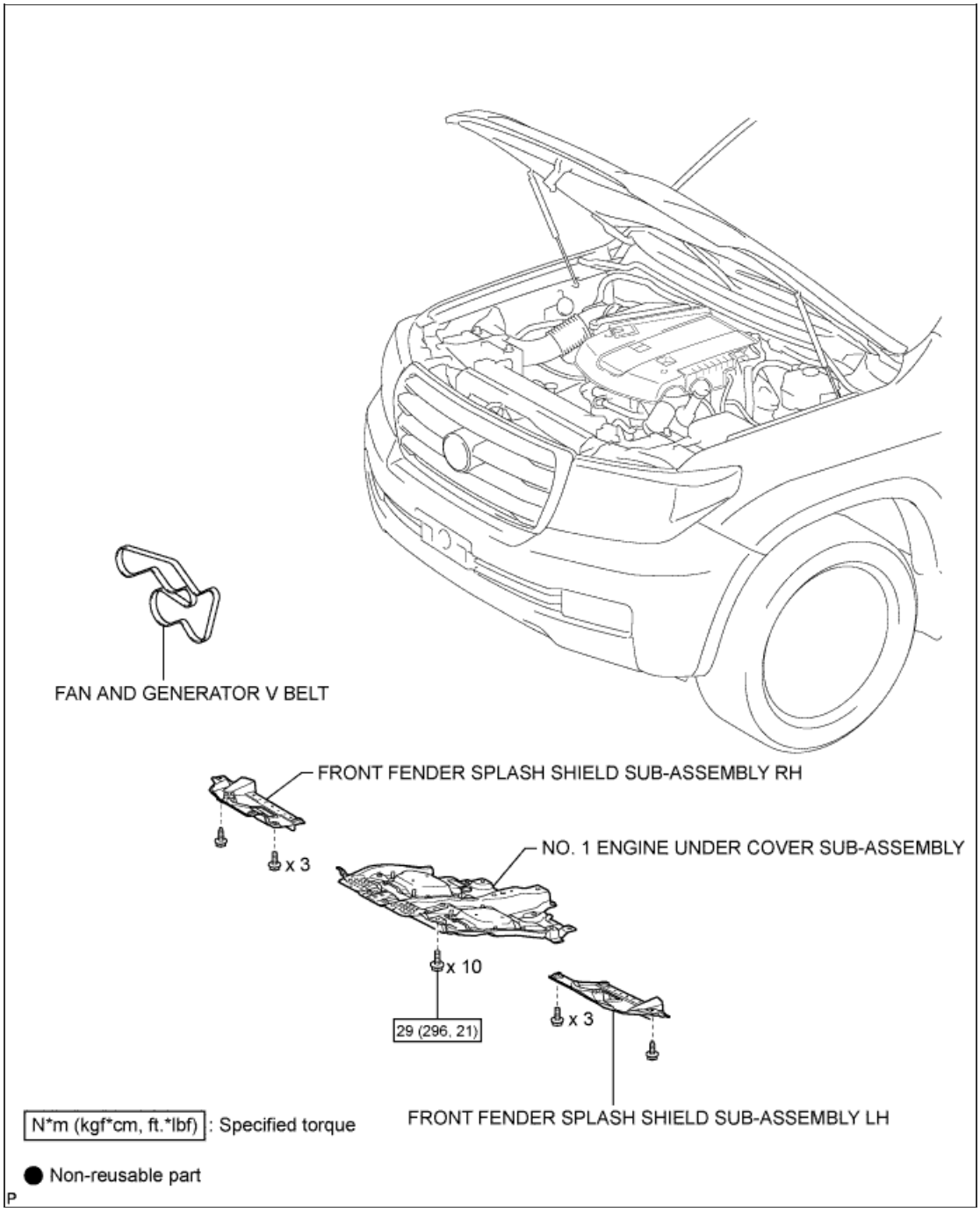


i. Check the A/F sensor operation (Click here) and heated oxygen sensor operation (Click here).

ii. See the table below for possible causes, and then inspect and correct the corresponding causes if necessary.

CO	HC	Symptom	Causes
Normal	High	Rough idling	1. Faulty ignition: • Incorrect timing • Plugs are contaminated or shorted, or plug gaps are defective 2. Incorrect valve clearance 3. Leaky intake and exhaust valves 4. Leaky cylinders
Low	High	Rough idling (Fluctuating HC reading)	1. Vacuum leaks: • Ventilation hoses • Intake manifold • Throttle body 2. Lean mixture causing misfire
High	High	Rough idle (Black smoke from exhaust)	1. Restricted air filter 2. Faulty SFI system: • Faulty pressure regulator • Defective engine coolant temperature sensor • Faulty mass air flow meter • Faulty ECM • Faulty injectors • Faulty throttle position sensor

for Preparation Click here

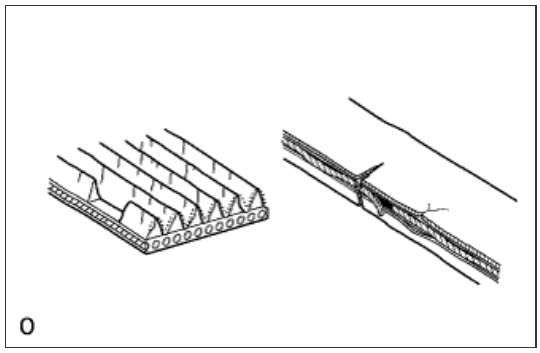


for Preparation Click here

1. INSPECT FAN & GENERATOR V BELT

a. Check the belt for wear, cracks or other signs of damage.
If any of the following defects is found, replace the fan and generator belt.

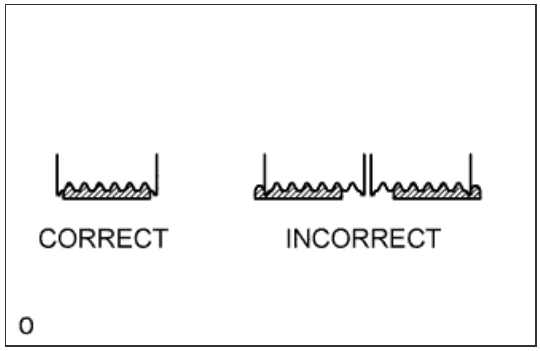
- The belt is cracked.
- The belt is worn out to the extent that the cords are exposed.
- The belt has chunks missing from the ribs.



b. Check that the belt fits properly in the ribbed grooves.

HINT:

Check with your hand to confirm that the belt has not slipped out of the groove on the bottom of the pulley. If it has slipped out, replace the fan and generator belt. Install a new fan and generator belt correctly.



2. INSPECT V-RIBBED BELT TENSIONER ASSEMBLY

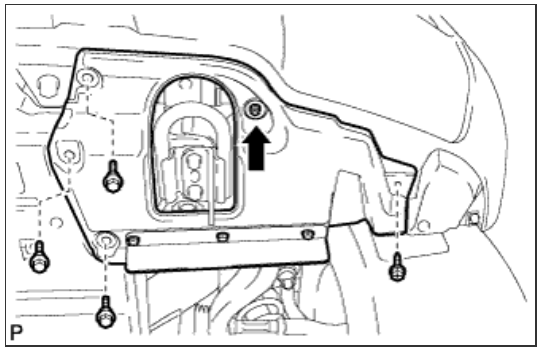
a. Turn the tensioner clockwise and counterclockwise. Check that the tensioner moves smoothly.
If a malfunction exists, replace the tensioner.

for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

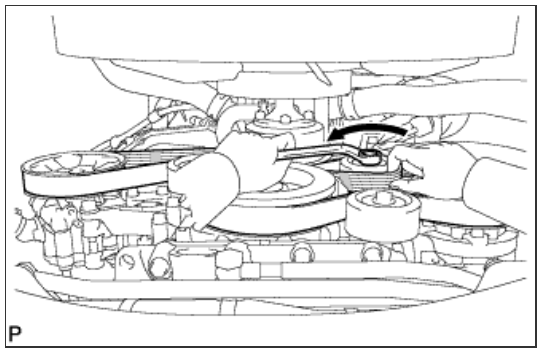
Use the same procedures described for the LH side.

3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and engine under cover.

4. REMOVE FAN & GENERATOR V BELT

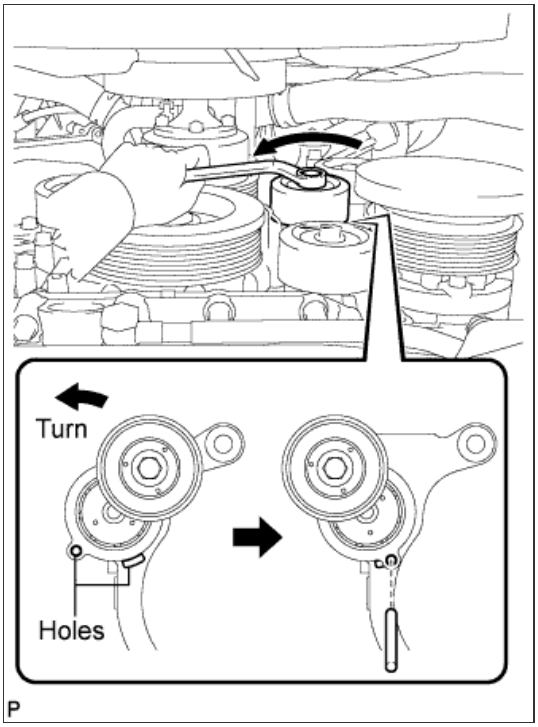
a. While releasing the belt tension by turning the belt tensioner counterclockwise, remove the fan and generator belt from the belt tensioner.



for Preparation Click here

1. INSTALL FAN & GENERATOR V BELT

a. While turning the belt tensioner counterclockwise, align the holes, and then insert a bar of φ mm (in.) into the holes to fi the belt tensioner in place.



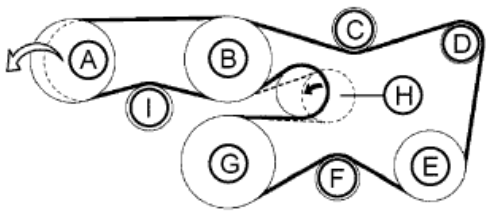
b. Install the fan and generator V belt.

HINT:

If it is hard to install the fan and generator V belt, perform the following procedures.

1. **Put the fan and generator V belt on all parts except the vane pump, as shown in the illustration.**
2. **While releasing the belt tension by turning the belt tensioner counterclockwise, put the fan and generator V belt on the vane pump.**

c. While turning the belt tensioner counterclockwise, remove the bar.



A: Vane Pump

B: Water Pump

C: No. 2 Idler

D: Generator

E: Cooler Compressor

F: No. 1 Idler

G: Crankshaft

H: V-Ribbed Belt Tensioner

I: No. 2 Idler

2. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the engine under cover with the 1 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

3. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

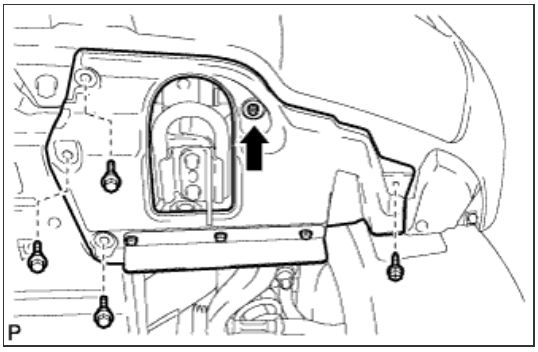
HINT:

Use the same procedures described for the L side.

4. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the bolts and screw.

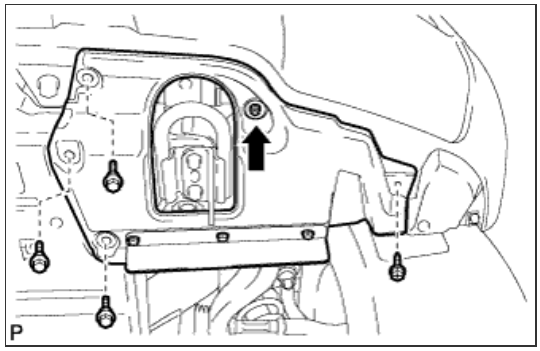


for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



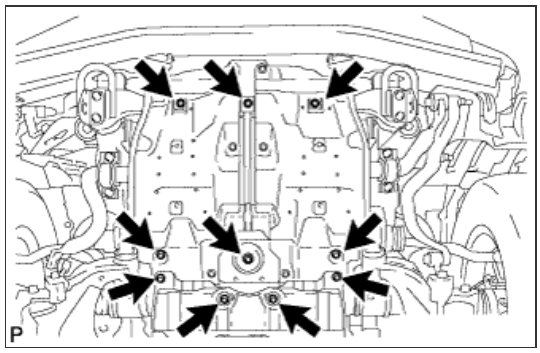
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

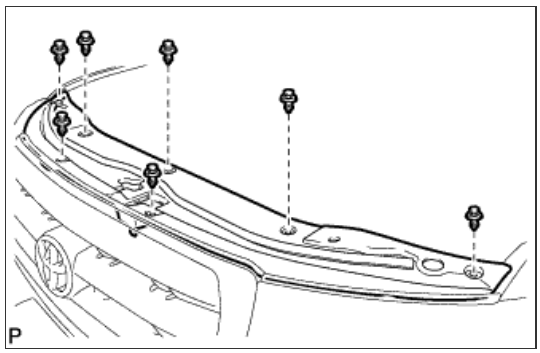
3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



4. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and radiator support seal.



5. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug and 2 cylinder block drain cock plugs.

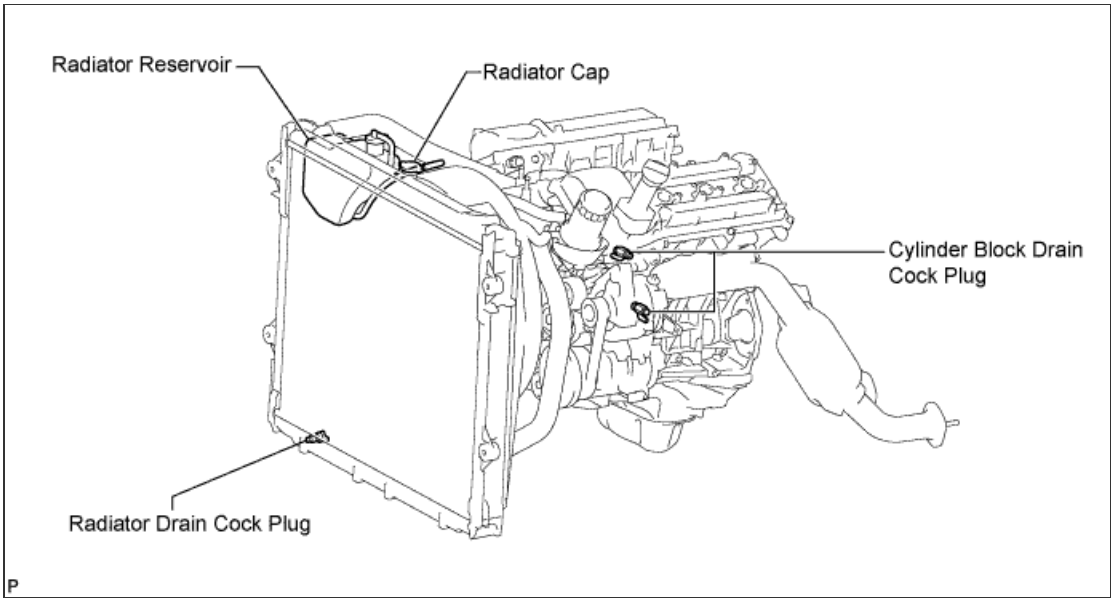
b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Tighten the 2 cylinder block drain cock plugs.

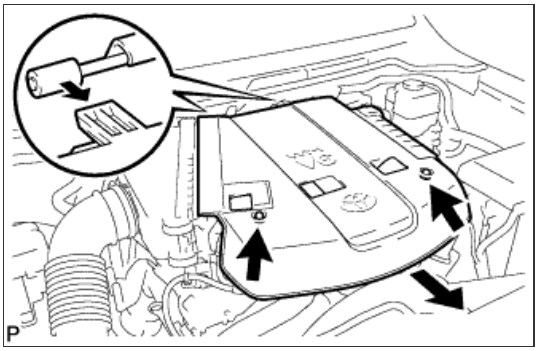
Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



d. Tighten the radiator drain cock plug by hand.

6. REMOVE V-BANK COVER

a. Remove the 2 cap nuts and V-bank cover.

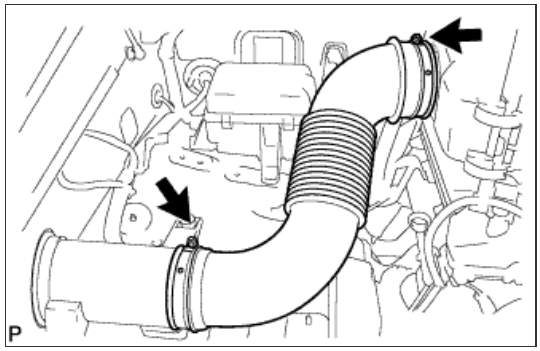


7. REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Remove the cowl top ventilator louver (lick here).

8. REMOVE NO. 2 AIR CLEANER HOSE

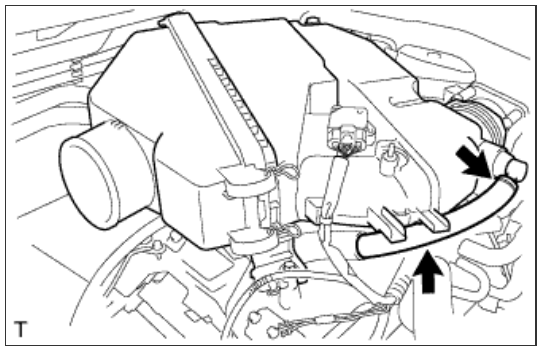
a. Loosen the 2 hose clamps and remove the air cleaner hose.



9. REMOVE AIR CLEANER ASSEMBLY

a. Disconnect the No. 2 ventilation hose.

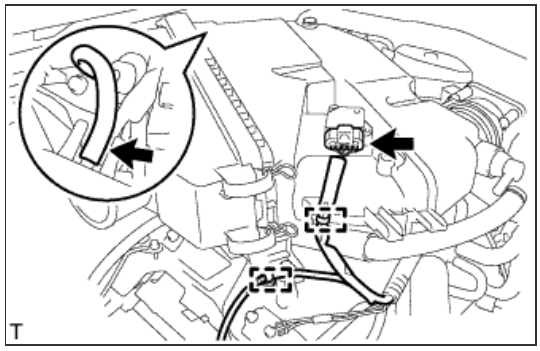
b. Detach the hose clamp.



c. Disconnect the vacuum hose.

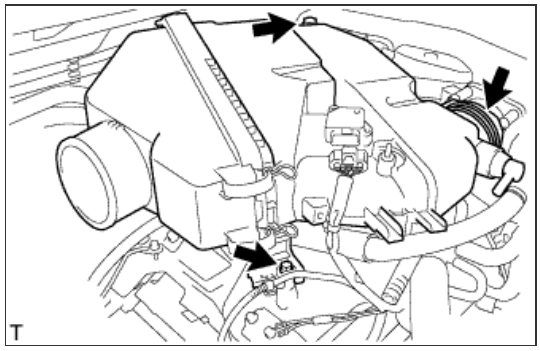
d. Disconnect the MAF meter connector.

e. Using a clip remover, detach the 2 wire harness clamps.



f. Loosen the hose clamp.

g. Remove the 2 bolts and air cleaner assembly.

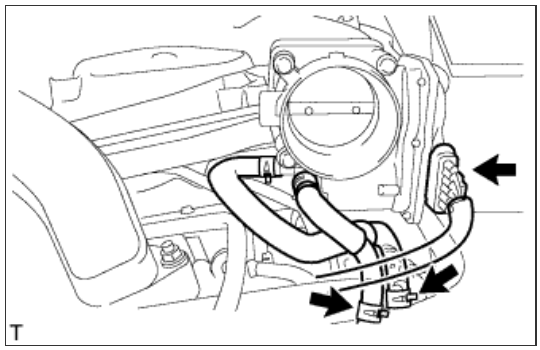


10. REMOVE INTAKE AIR SURGE TANK

a. Disconnect the throttle body connector.

b. Disconnect the No. 4 water by-pass hose.

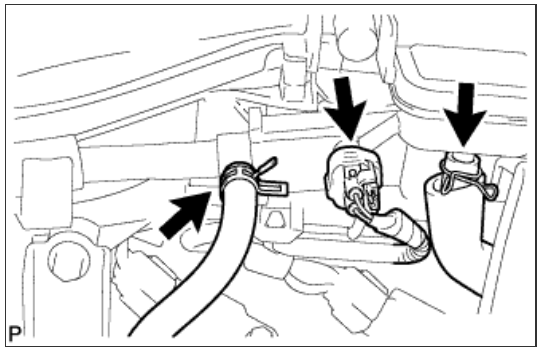
c. Disconnect the No. 5 water by-pass hose.



d. Disconnect the purge line hose.

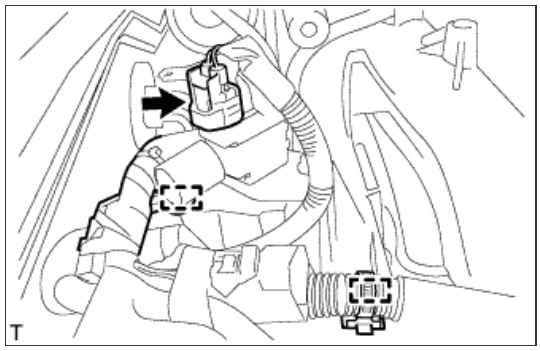
e. Disconnect the purge VSV connector.

f. Disconnect the No. 1 ventilation hose.

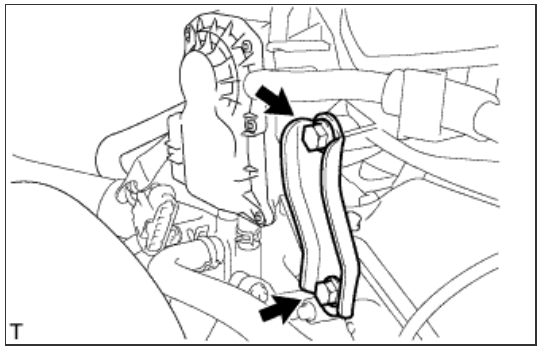


g. Disconnect the vacuum switching valve (for A nnector.

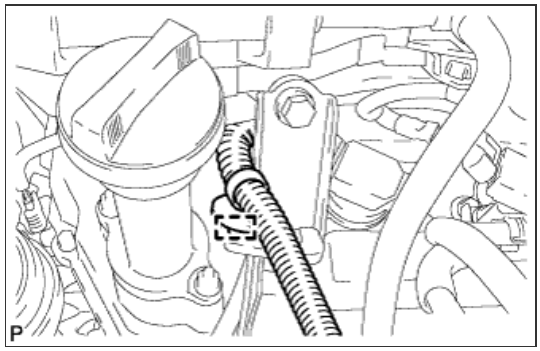
h. Using a clip remover, detach the 2 wire harness clamps.



i. Remove the 2 bolts and throttle body bracket.

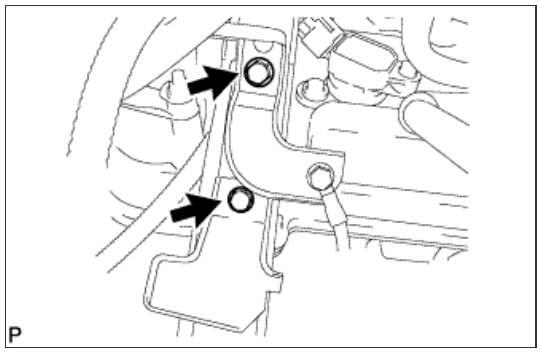


j. Using a clip remover, detach the wire harness clamp.

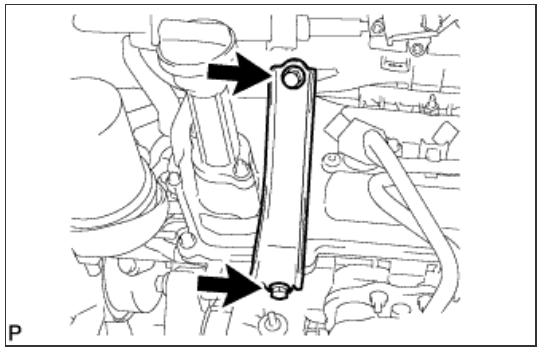


k. Remove the bolt and bracket from the No. 1 surge tank stay.

l. Remove the bolt and oil baffle plate.

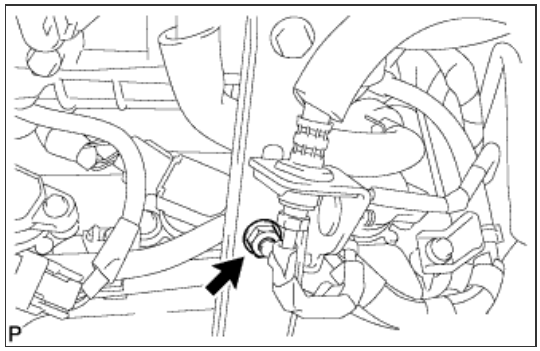


m. Remove the 2 bolts and No. 1 surge tank stay.

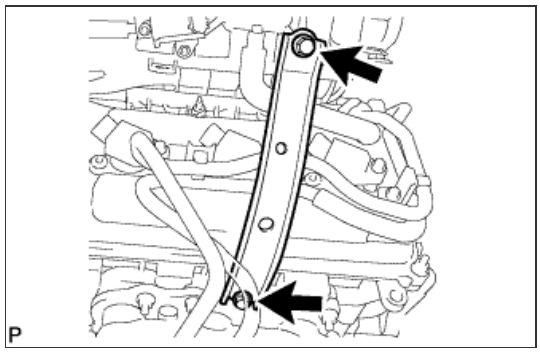


n. for Manual Transmission:

i. Remove the nut.

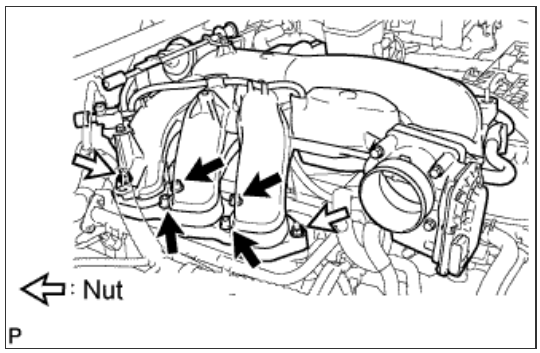


o. Remove the 2 bolts and No. 2 surge tank stay.



p. Remove the 2 nuts.

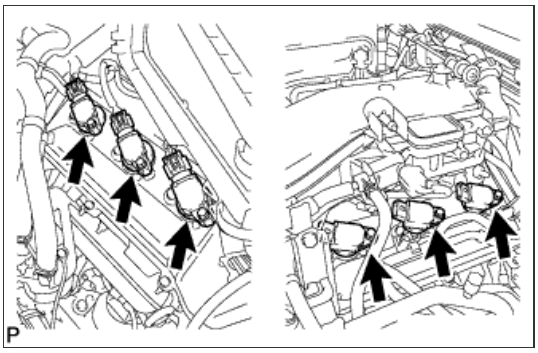
q. Using an 8 mm he agon wrench, remove the 4 bolts. Then remove the intake air surge tank and gasket.



11. REMOVE IGNITION COIL ASSEMBLY

a. Disconnect the 6 ignition coil connectors.

b. Remove the 6 bolts and 6 ignition coils.

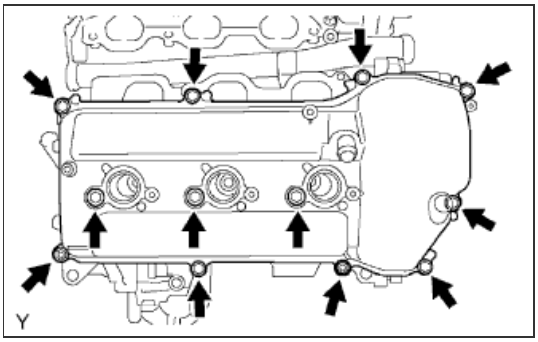


12. REMOVE SPARK PLUG

a. Remove the 6 spark plugs.

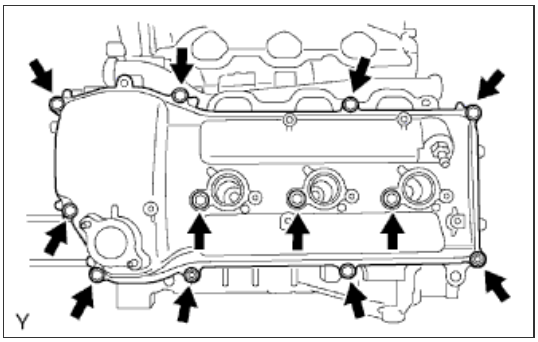
13. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY RH

a. Remove the 10 bolts, 3 seal washers, 2 nuts, cylinder head cover and gasket.



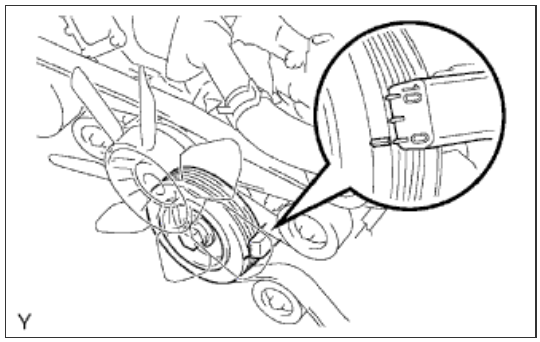
14. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY LH

a. Remove the 10 bolts, 3 seal washers, 2 nuts, cylinder head cover and gasket.

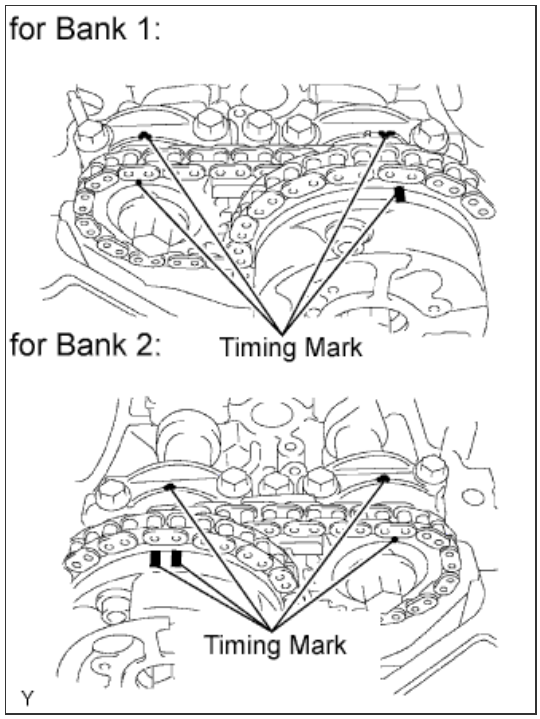


15. SET NO. 1 CYLINDER TO TDC/COMPRESSION

a. Turn the crankshaft pulley, and align its groove with the timing mark 0 of the timing chain cover.



b. Check that the timing marks of the camshaft timing gears and sprockets are aligned with the timing marks of the bearing caps as shown in the illustration. If not, turn the crankshaft 1 complete revolution (360°) and align the timing marks as above.



16. INSPECT VALVE CLEARANCE

a. Check the valves indicated in the illustration.

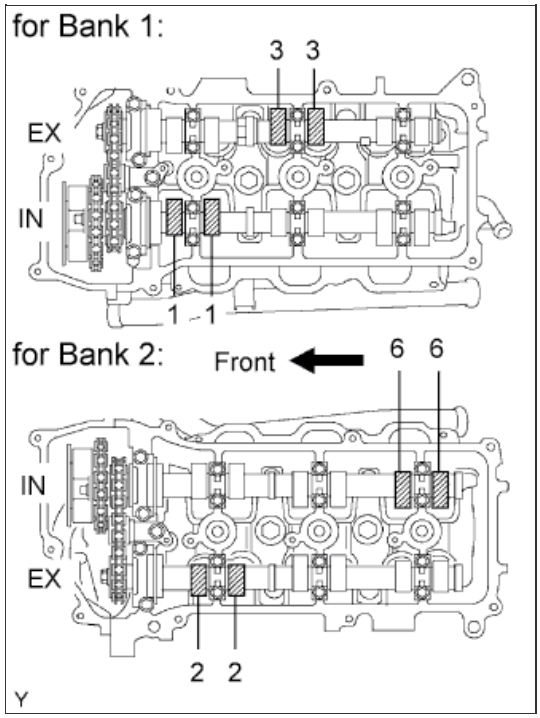
i. Using a feeler gauge, measure the clearance between the valve lifter and camshaft.

Standard Valve Clearance (Cold):

Item	Specified Condition
Intake	0.15 to 0.25 mm (0.00591 to 0.00984 in.)
Exhaust	0.29 to 0.39 mm (0.0114 to 0.0154 in.)

ii. Record the out-of-specification valve clearance measurements. They will be used later to determine the required replacement valve lifter.

b. Turn the crankshaft 2/3 of a revolution (240°).



c. Check the valves indicated in the illustration.

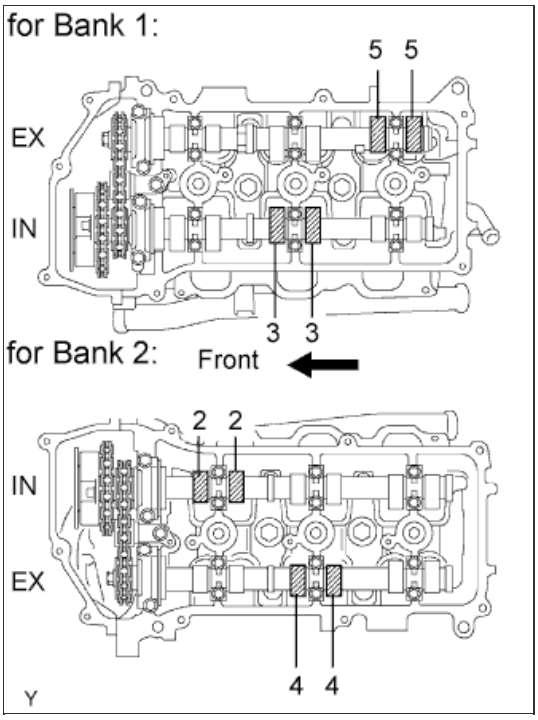
c. Check the valves indicated in the illustration.

i. Using a feeler gauge, measure the clearance between the valve lifter and camshaft.

Standard Valve Clearance (Cold):

Item	Specified Condition
Intake	0.15 to 0.25 mm (0.00591 to 0.00984 in.)
Exhaust	0.29 to 0.39 mm (0.0114 to 0.0154 in.)

ii. Record the out-of-specification valve clearance measurements. They will be used later to determine the required replacement valve lifter.



d. Turn the crankshaft 2/3 of a revolution (240°).

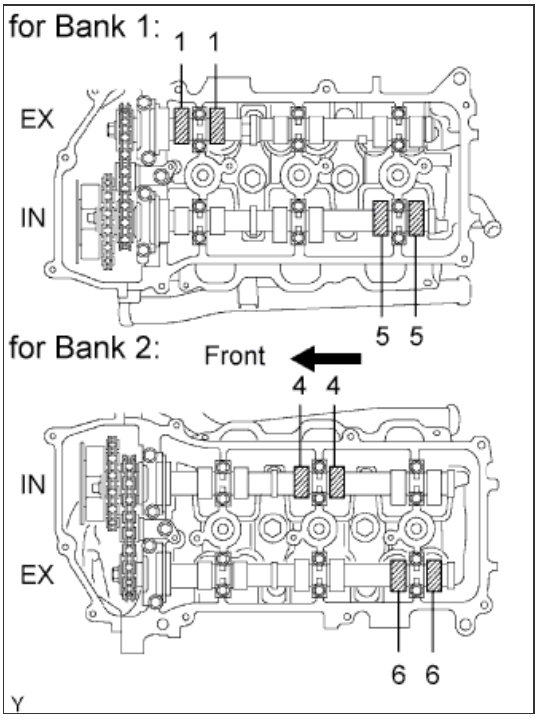
e. Check the valves indicated in the illustration.

i. Using a feeler gauge, measure the clearance between the valve lifter and camshaft.

Standard Valve Clearance (Cold):

Item	Specified Condition
Intake	0.15 to 0.25 mm (0.00591 to 0.00984 in.)
Exhaust	0.29 to 0.39 mm (0.0114 to 0.0154 in.)

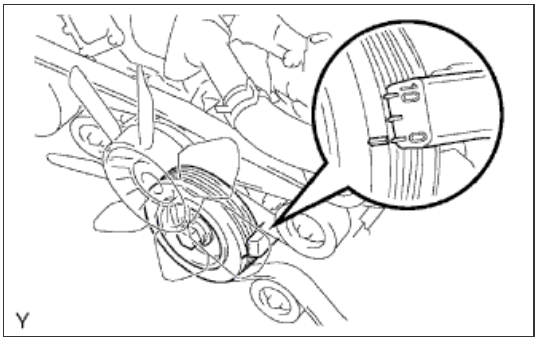
ii. Record the out-of-specification valve clearance measurements. They will be used later to determine the required replacement valve lifter.



17. ADJUST VALVE CLEARANCE

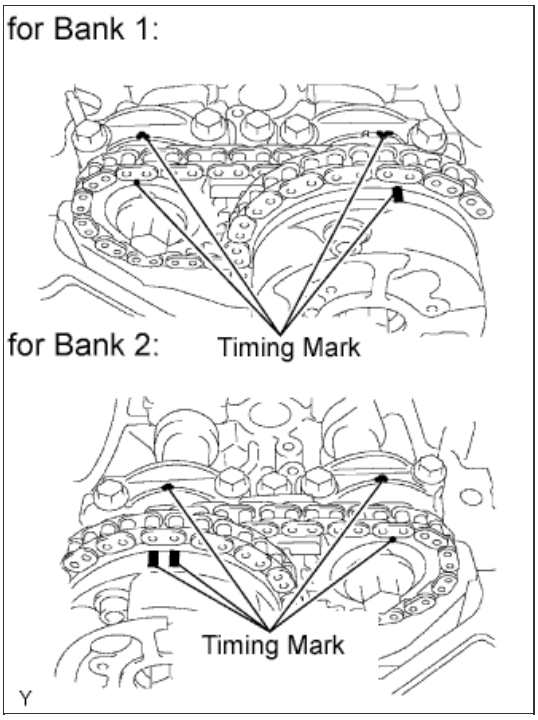
a. Set the No. 1 cylinder to TDC/compression.

i. Turn the crankshaft pulley, and align the notch with the timing mark "0" of the timing chain cover.

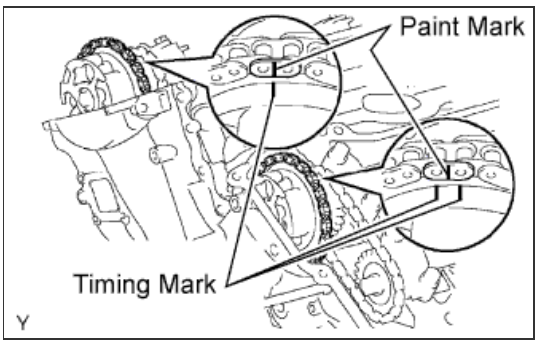


ii. Check that the timing marks of the camshaft timing gears and

ii. Check that the timing marks of the camshaft timing gears and sprockets are aligned with the timing marks of the bearing caps as shown in the illustration.
If not, turn the crankshaft 1 complete revolution (360°) and align the timing marks as above.



iii. Place paint marks on the chain links that correspond with the timing marks of the camshaft timing gears.

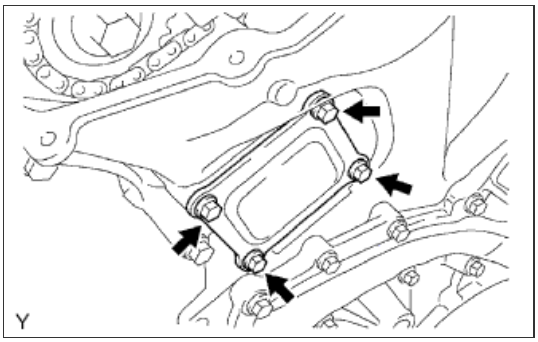


b. Remove the No. 1 chain tensioner.

NOTICE:

- **Never rotate the crankshaft with the No. 1 chain tensioner removed.**
- **When rotating the camshaft with the No. 1 chain removed, turn the crankshaft counterclockwise 40° from TDC first.**

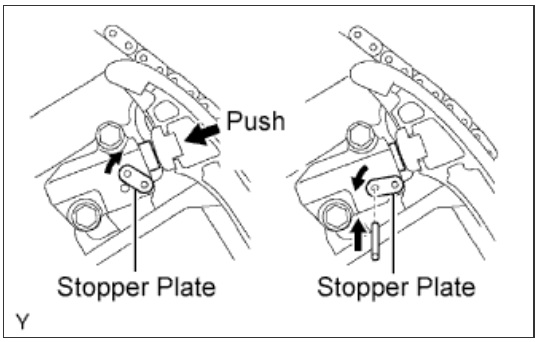
i. Remove the 4 bolts, timing chain cover plate and gasket.



ii. While rotating the stopper plate of the No. 1 chain tensioner clockwise, push in the plunger of the No. 1 chain tensioner as shown in the illustration.

iii. While rotating the stopper plate of the tensioner counterclockwise downward, insert a bar of φ3.5 mm (0.138 in.) into the holes in the stopper plate and tensioner to fix the stopper plate in place.

iv. Remove the 2 bolts and No. 1 chain tensioner.

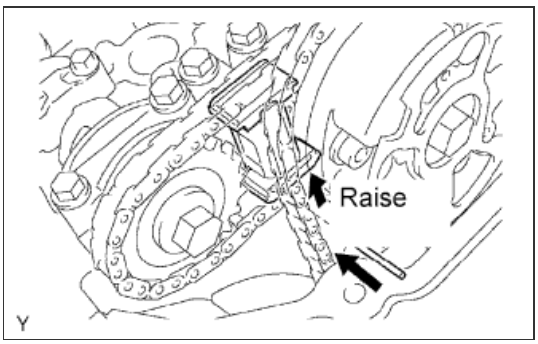


c. Remove the No. 2 camshaft.

NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

i. While raising the No. 2 chain tensioner, insert a pin of φ1.0 mm (0.0394 in.) into the hole to fix the tensioner in place.

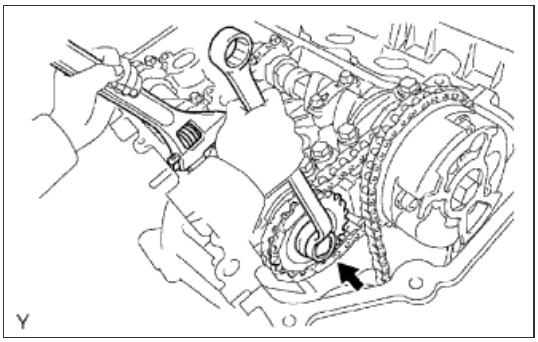


ii. Hold the hexagonal portion of the No. 2 camshaft with a wrench, and remove the camshaft timing sprocket set bolt.

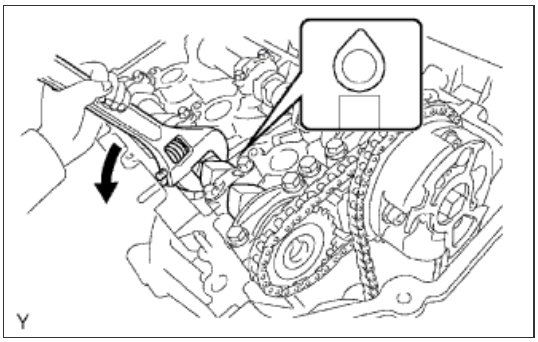
NOTICE:

Be careful not to damage the cylinder head and valve lifter with the wrench.

iii. Separate the camshaft timing sprocket from the No. 2 camshaft.

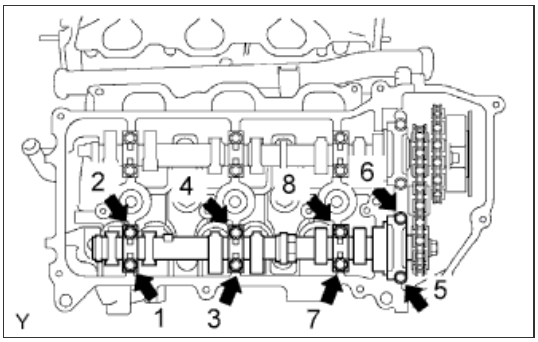


iv. Rotate the camshaft counterclockwise using the wrench so that the cam lobes of the No. 1 cylinder face upward as shown in the illustration.



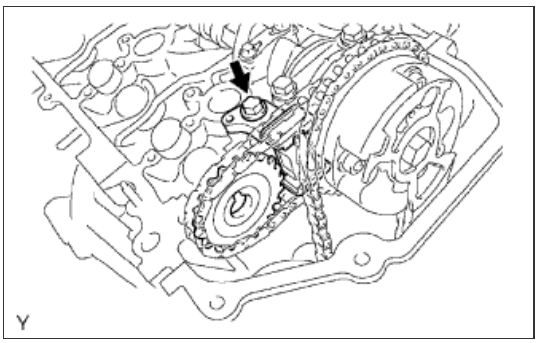
v. Uniformly loosen and remove the 8 bearing cap bolts in the sequence shown in the illustration.

vi. Remove the 4 bearing caps and No. 2 camshaft.



d. Remove the No. 2 chain tensioner.

i. Remove the No. 2 chain tensioner bolt, No. 2 chain tensioner and camshaft timing sprocket.



e. Remove the No. 1 camshaft.

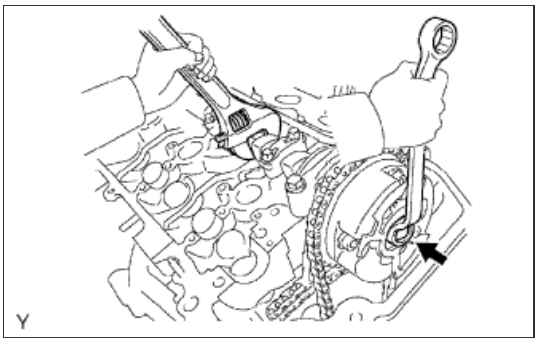
NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

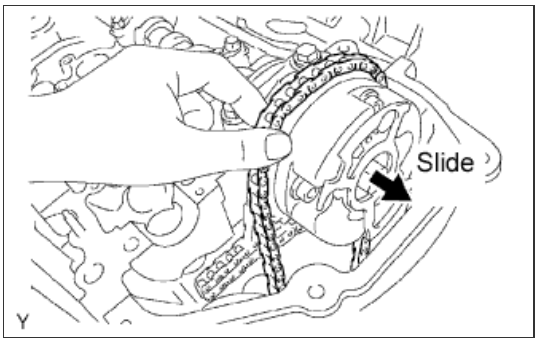
i. Hold the hexagonal portion of the No. 1 camshaft with a wrench, and loosen the camshaft timing gear set bolt.

NOTICE:

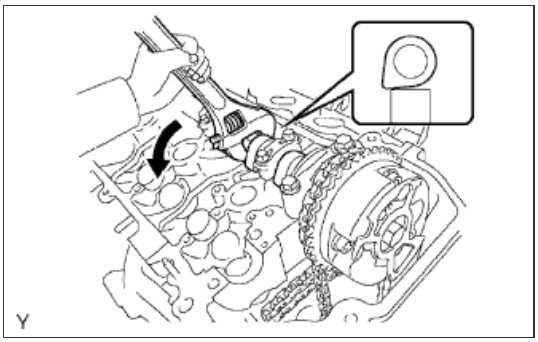
- **Be careful not to damage the cylinder head and valve lifter with the wrench.**
- **Do not disassemble the camshaft timing gear.**



ii. Slide the camshaft timing gear and separate the No. 1 chain from the camshaft timing gear.

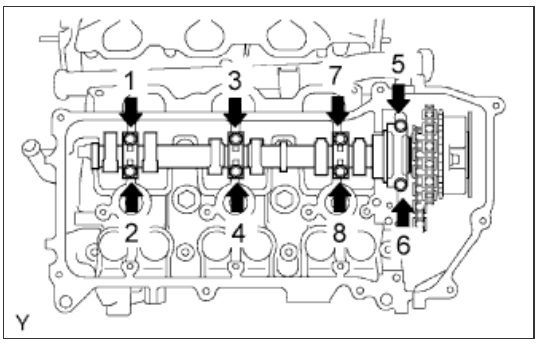


iii. Rotate the No. 1 camshaft counterclockwise using a wrench so that the cam lobes of the No. 1 cylinder face downward as shown in the illustration.

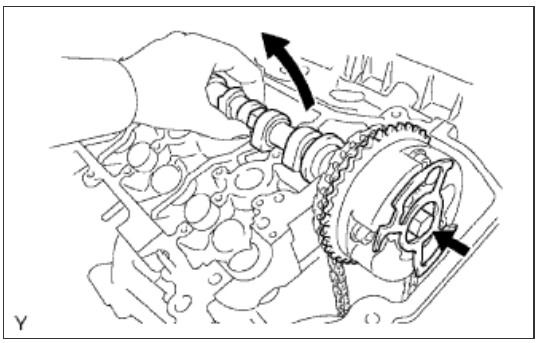


iv. Uniformly loosen and remove the 8 bearing cap bolts in the sequence shown in the illustration.

v. Remove the 4 bearing caps.



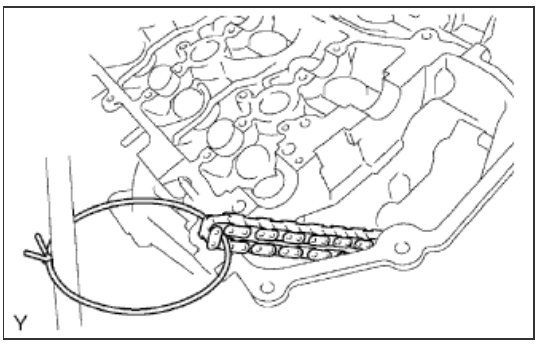
vi. Remove the camshaft timing gear set bolt with the No. 1 camshaft lifted up, and then remove the No. 1 camshaft and camshaft timing gear with the No. 2 chain.



vii. Tie the No. 1 chain with a string as shown in the illustration.

NOTICE:

Be careful not to drop anything inside the timing chain cover.

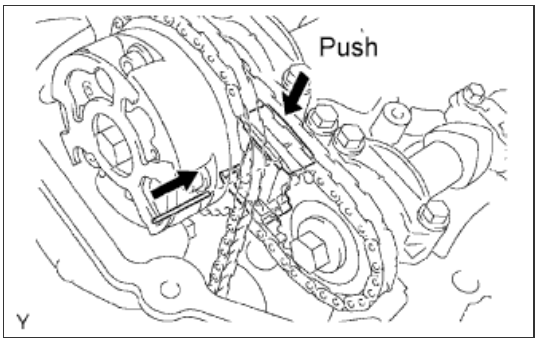


f. Remove the No. 4 camshaft.

NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

i. While pushing down the No. 3 chain tensioner, insert a pin of φ1.0 mm (0.0394 in.) into the hole to fix the tensioner in place.

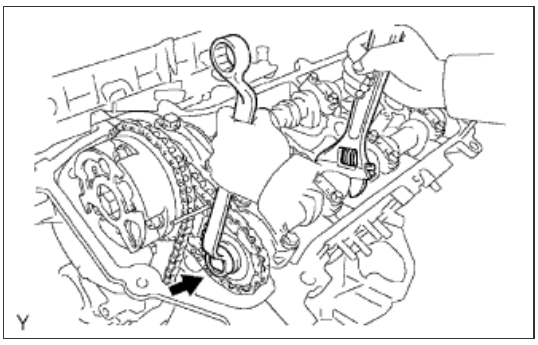


ii. Hold the hexagonal portion of the No. 4 camshaft with a wrench, and remove the camshaft timing sprocket set bolt.

NOTICE:

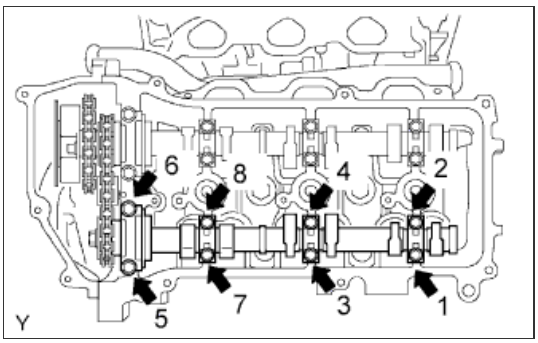
Be careful not to damage the cylinder head and valve lifter with the wrench.

iii. Separate the camshaft timing sprocket from the No. 4 camshaft.



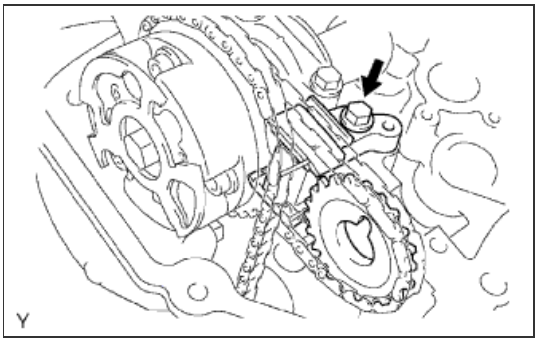
iv. Uniformly loosen and remove the 8 bearing cap bolts in the sequence shown in the illustration.

v. Remove the 4 bearing caps and No. 4 camshaft.



g. Remove the No. 3 chain tensioner.

i. Remove the No. 3 chain tensioner bolt, No. 3 chain tensioner and camshaft timing sprocket.



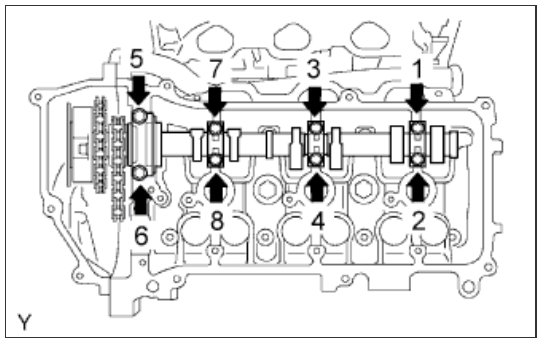
h. Remove the No. 3 camshaft.

NOTICE:

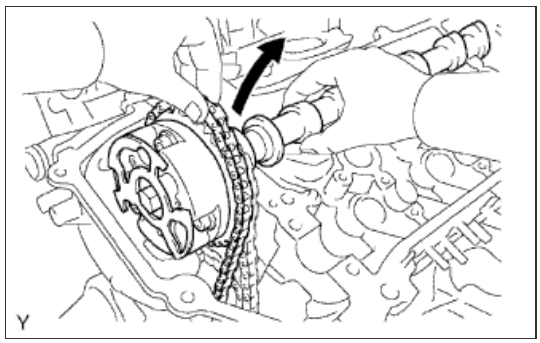
As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

i. Using several steps, loosen and remove the 8 bearing cap bolts uniformly in the sequence shown in the illustration.

ii. Remove the 4 bearing caps.



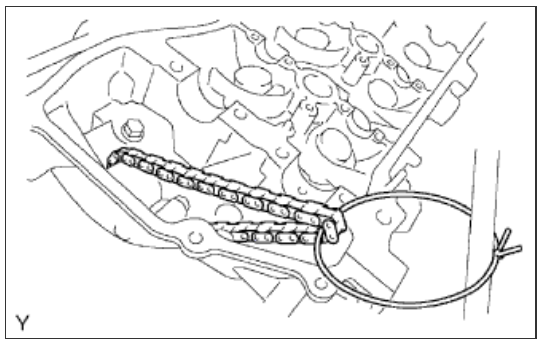
iii. Hold the No. 1 chain, and remove the No. 3 camshaft with camshaft timing gear and No. 2 chain.



iv. Tie the No. 1 chain with a string as shown in the illustration.

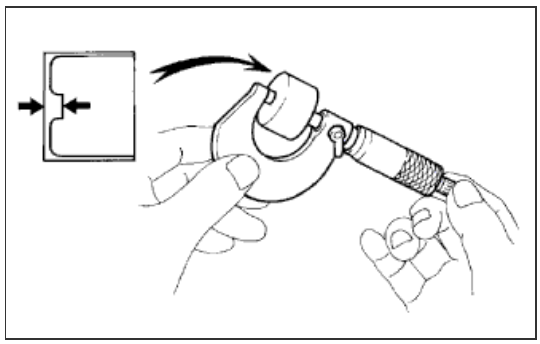
NOTICE:

Be careful not to drop anything inside the timing chain cover.



i. Remove the 24 valve lifters from the cylinder head LH and RH.

j. Determine the size of the valve lifter to be installed according to the following formulas or charts.



i. Using a micrometer, measure the thickness of the removed lifter.

ii. Calculate the thickness of a new lifter so that the valve clearance comes within the specified value.

T:
Thickness of removed lifter

A:
Measured valve clearance

N:
Thickness of new lifter

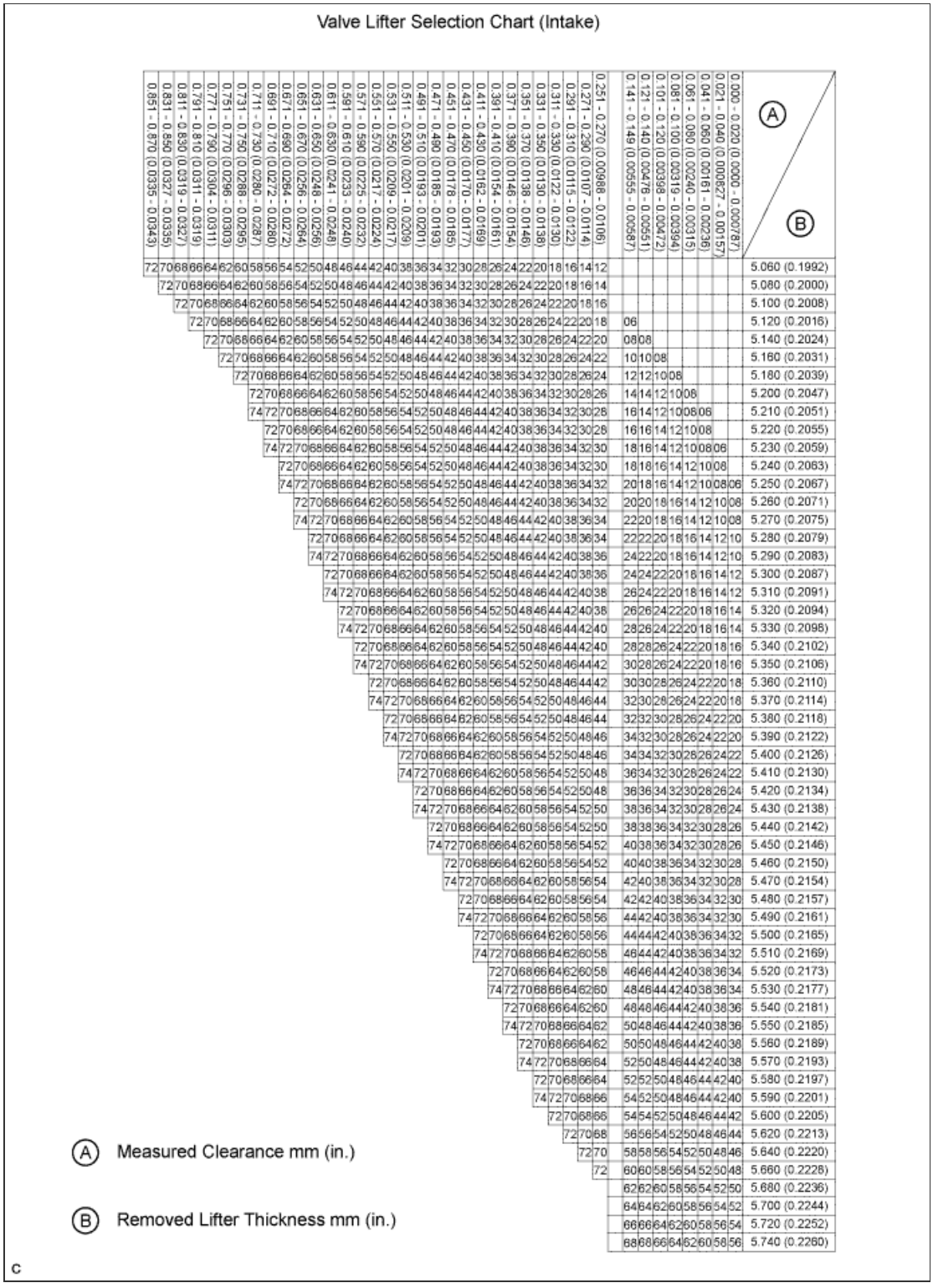
Intake:
N = T + (A - 0.20 mm (0.00787 in.))

Exhaust:
N = T + (A - 0.34 mm (0.0131 in.))

iii. Select a new lifter with a thickness as close as possible to the calculated value.

HINT:

Lifters are available in 35 sizes in increments of 0.020 mm (0.000787 in.), from 5.060 mm (0.1992 in.) to 5.740 mm (0.2260 in.).

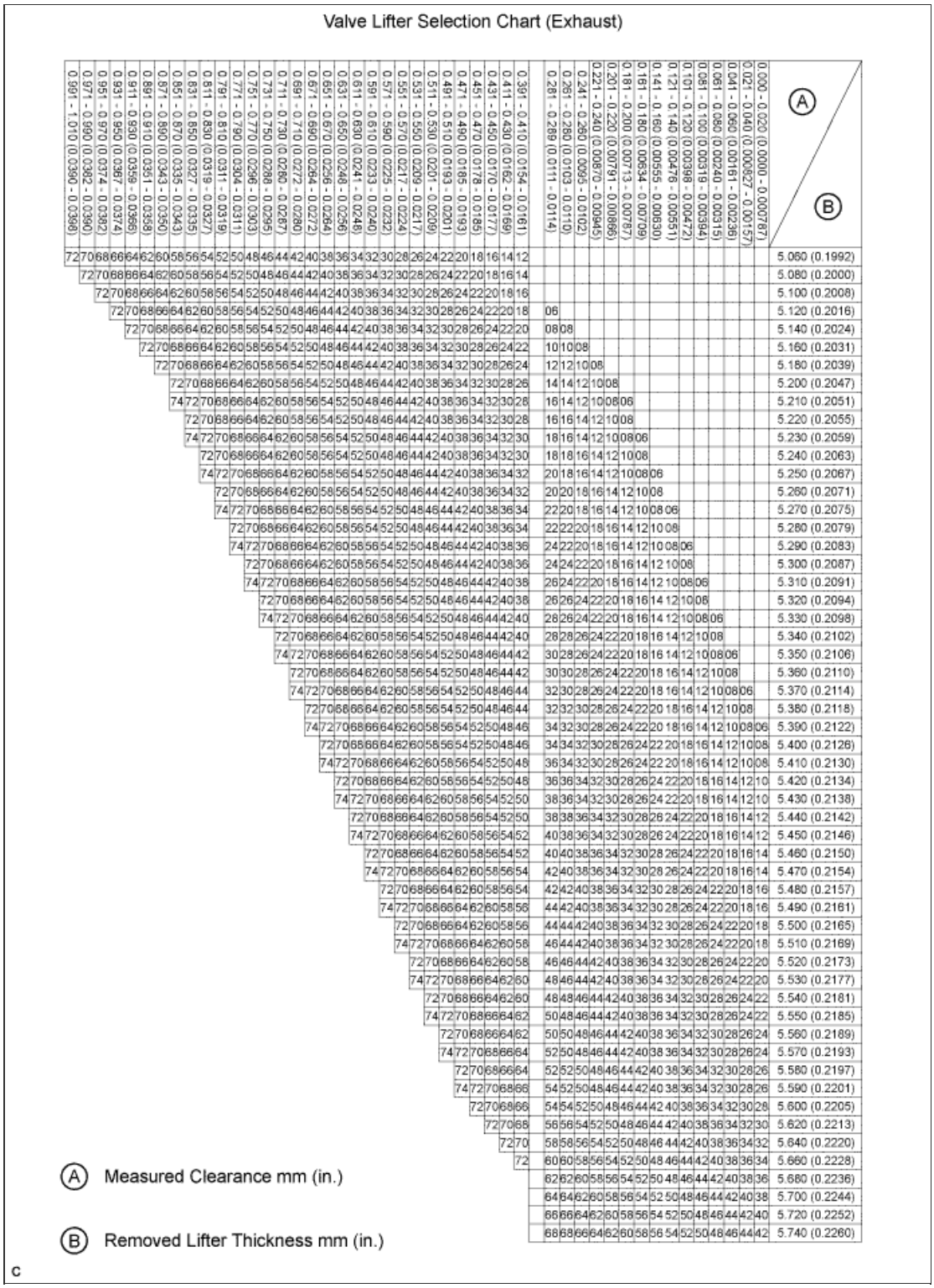


Intake valve clearance (Cold):
0.15 to 0.25 mm (0.00591 to 0.00984 in.)
EXAMPLE:
The 5.250 mm (0.2067 in.) lifter is installed, and the measured clearance is 0.400 mm (0.0157 in.). Replace the 5.250 mm (0.2067 in.) lifter with a No. 46 lifter.

New Lifter Thickness:

Lifter No.	Thickness	Lifter No.	Thickness	Lifter No.	Thickness
06	5.060 mm (0.1992 in.)	30	5.300 mm (0.2087 in.)	54	5.540 mm (0.2181 in.)
08	5.080 mm (0.2000 in.)	32	5.320 mm (0.2094 in.)	56	5.560 mm (0.2189 in.)
10	5.100 mm (0.2008 in.)	34	5.340 mm (0.2102 in.)	58	5.580 mm (0.2197 in.)

12	5.120 mm (0.2016 in.)	36	5.360 mm (0.2110 in.)	60	5.600 mm (0.2205 in.)
14	5.140 mm (0.2024 in.)	38	5.380 mm (0.2118 in.)	62	5.620 mm (0.2213 in.)
16	5.160 mm (0.2031 in.)	40	5.400 mm (0.2126 in.)	64	5.640 mm (0.2220 in.)
18	5.180 mm (0.2039 in.)	42	5.420 mm (0.2134 in.)	66	5.660 mm (0.2228 in.)
20	5.200 mm (0.2047 in.)	44	5.440 mm (0.2142 in.)	68	5.680 mm (0.2236 in.)
22	5.220 mm (0.2055 in.)	46	5.460 mm (0.2150 in.)	70	5.700 mm (0.2244 in.)
24	5.240 mm (0.2063 in.)	48	5.480 mm (0.2157 in.)	72	5.720 mm (0.2252 in.)
26	5.260 mm (0.2071 in.)	50	5.500 mm (0.2165 in.)	74	5.740 mm (0.2260 in.)
28	5.280 mm (0.2079 in.)	52	5.520 mm (0.2173 in.)	-	-



Exhaust valve clearance (Cold):
0.29 to 0.39 mm (0.0114 to 0.0154 in.)
EXAMPLE:
The 5.340 mm (0.210 in.) lifter is installed, and the measured clearance is 0.480 mm (0.0189 in.). Replace the 5.340 mm (0.210 in.) lifter with a No. 48 lifter.

New Lifter Thickness:

Lifter No.	Thickness	Lifter No.	Thickness	Lifter No.	Thickness
06	5.060 mm (0.1992 in.)	30	5.300 mm (0.2087 in.)	54	5.540 mm (0.2181 in.)
08	5.080 mm (0.2000 in.)	32	5.320 mm (0.2094 in.)	56	5.560 mm (0.2189 in.)
10	5.100 mm (0.2008 in.)	34	5.340 mm (0.2102 in.)	58	5.580 mm (0.2197 in.)
	5.120 mm		5.360 mm		5.600 mm

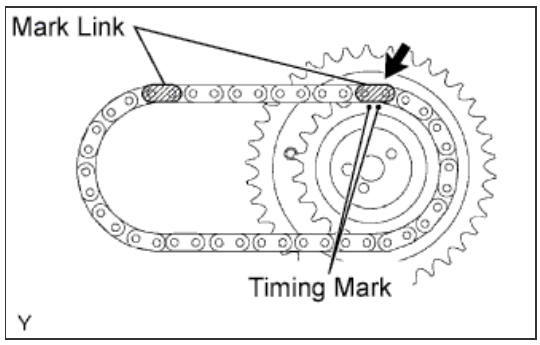
12	(0.2016 in.)	36	(0.2110 in.)	60	(0.2205 in.)
14	5.140 mm (0.2024 in.)	38	5.380 mm (0.2118 in.)	62	5.620 mm (0.2213 in.)
16	5.160 mm (0.2031 in.)	40	5.400 mm (0.2126 in.)	64	5.640 mm (0.2220 in.)
18	5.180 mm (0.2039 in.)	42	5.420 mm (0.2134 in.)	66	5.660 mm (0.2228 in.)
20	5.200 mm (0.2047 in.)	44	5.440 mm (0.2142 in.)	68	5.680 mm (0.2236 in.)
22	5.220 mm (0.2051 in.)	46	5.460 mm (0.2150 in.)	70	5.700 mm (0.2244 in.)
24	5.240 mm (0.2063 in.)	48	5.480 mm (0.2157 in.)	72	5.720 mm (0.2252 in.)
26	5.260 mm (0.2071 in.)	50	5.500 mm (0.2165 in.)	74	5.740 mm (0.2260 in.)
28	5.280 mm (0.2079 in.)	52	5.520 mm (0.2173 in.)	-	-

k. Install the No. 3 camshaft.

NOTICE:

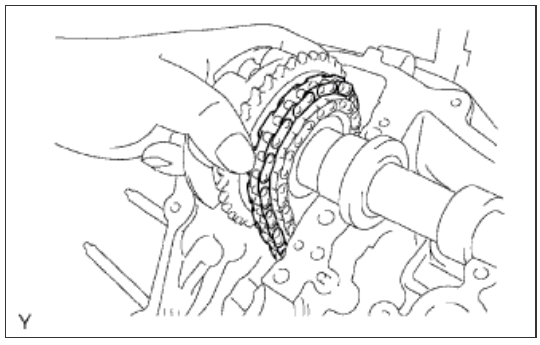
As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

i. Align the mark link (yellow) with the timing mark (2-dot mark) of the camshaft timing gear shown in the illustration.



ii. Apply a light coat of engine oil to the thrust portions and journals of the No. 3 camshaft.

iii. Temporarily put the No. 1 chain on the No. 2 chain of the camshaft timing gear.

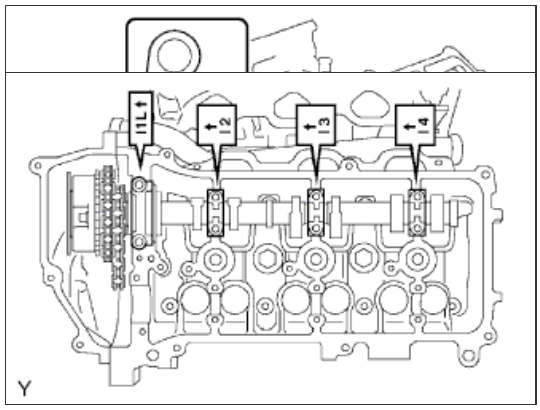


iv. Set the No. 3 camshaft onto the cylinder head LH with the cam lobes of the No. 2 cylinder facing downward as shown in the illustration.

v. Apply a light coat of engine oil to the 4 bearing caps.

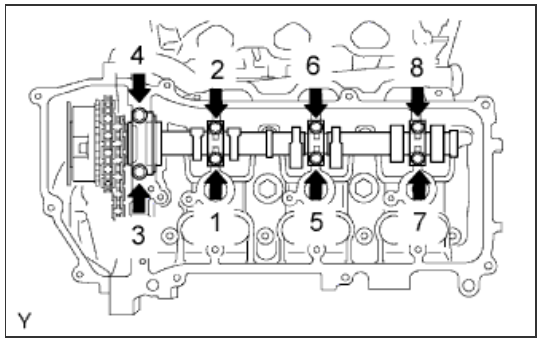
vi. Set the 4 bearing caps in their proper locations.

vii. Apply a light coat of engine oil to the threads of the 8 bearing cap bolts.

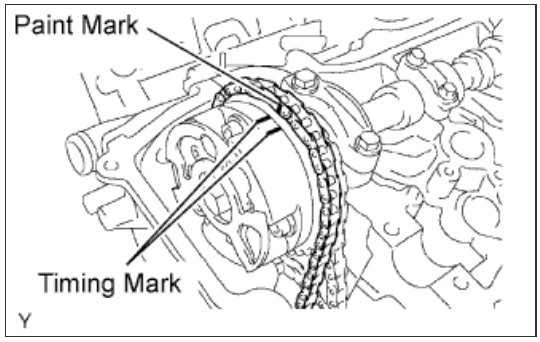


viii. Uniformly install the 8 bearing cap bolts in several steps in the order shown in the illustration.

Torque:
for 10 mm head bolt:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }
for 12 mm head bolt:
24 N*m{ 245 kgf*cm , 18 ft.*lbf }

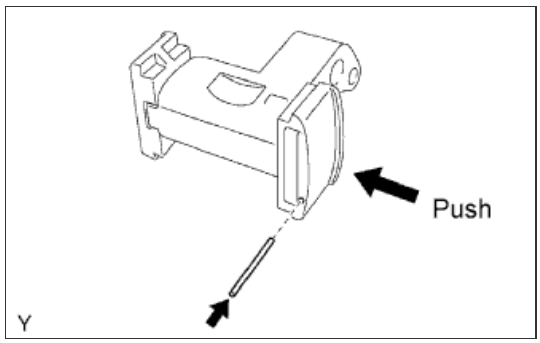


ix. Set the paint mark of the No. 1 chain between the timing marks of the camshaft timing gear.



l. Install the No. 3 chain tensioner.

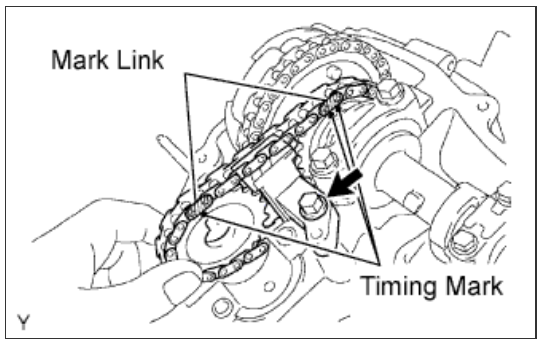
i. While pushing in the tensioner, insert a pin of φ1.0 mm (0.0394 in.) into the hole to fix the tensioner in place.



ii. Temporarily install the camshaft timing sprocket and No. 3 chain tensioner with the bolt and align the mark links (yellow) with the timing marks (1-dot mark and 2-dot mark) of the camshaft timing gear and sprocket.

iii. Tighten the No. 3 chain tensioner bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



m. Install the No. 4 camshaft.

NOTICE:

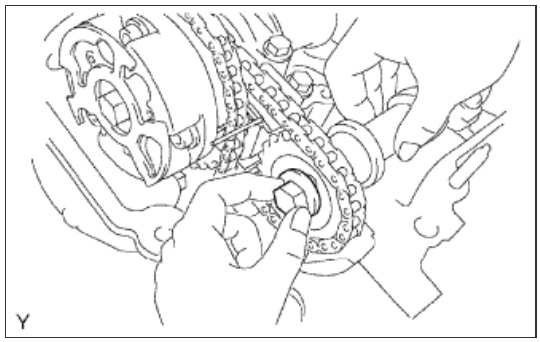
As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

i. Apply a light coat of engine oil to the thrust portions and journals of the No. 4 camshaft.

ii. Apply a light coat of engine oil to the threads and under the head of the camshaft timing sprocket set bolt.

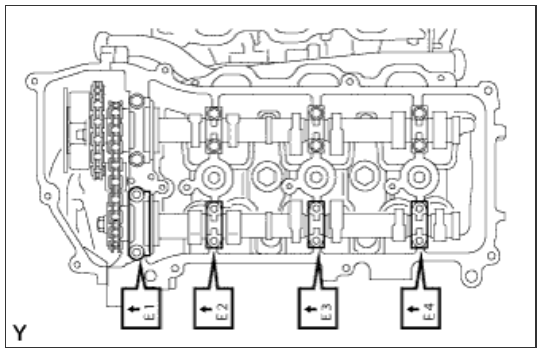
iii. Align the knock pin hole on the camshaft timing sprocket with the knock pin of the No. 4 camshaft, and insert the No. 4 camshaft into the camshaft timing sprocket.

iv. Temporarily install the camshaft timing sprocket set bolt.



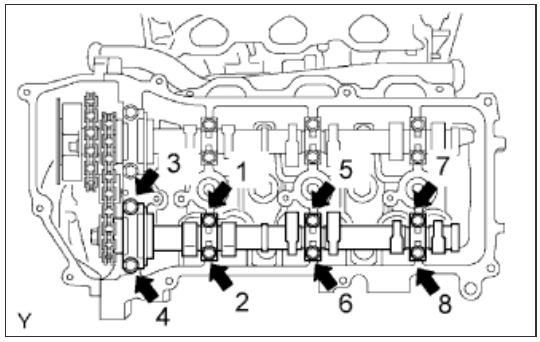
v. Set the 4 bearing caps in their proper locations.

vi. Apply a light coat of engine oil to the threads and under the heads of the 8 bearing cap bolts.



vii. Uniformly install the 8 bearing cap bolts in several steps in the order shown in the illustration.

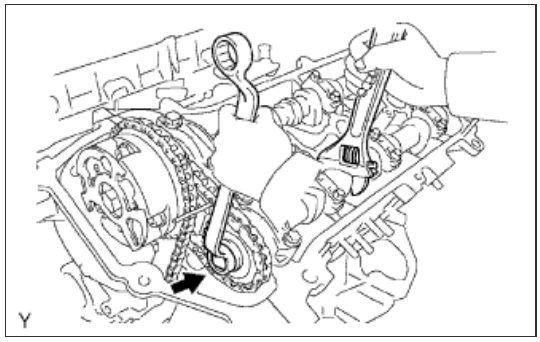
Torque:
for 10 mm head bolt:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }
for 12 mm head bolt:
24 N*m{ 245 kgf*cm , 18 ft.*lbf }



viii. Hold the hexagonal portion of the No. 4 camshaft with a wrench, and tighten the camshaft timing sprocket set bolt.

Torque:
100 N*m{ 1020 kgf*cm , 74 ft.*lbf }

ix. Remove the pin from the No. 3 chain tensioner.



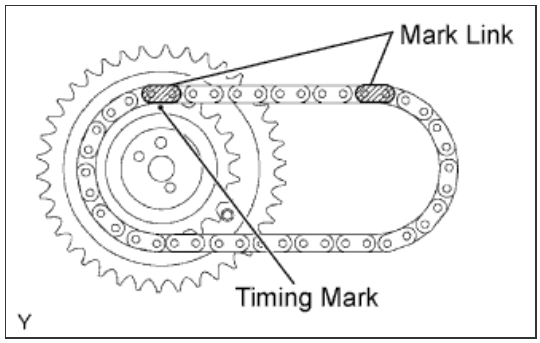
n. Install the No. 1 camshaft.

NOTICE:

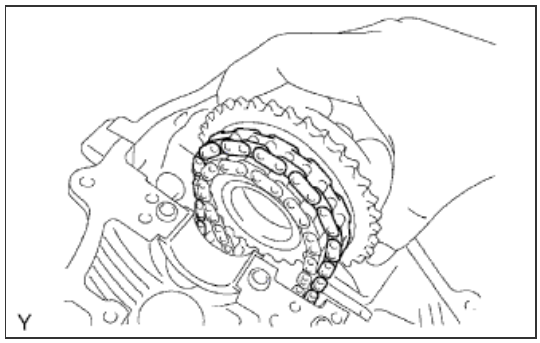
As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

i. Align the mark link (yellow) with the timing mark (1-dot mark) of the camshaft timing gear as shown in the illustration.

ii. Apply a light amount of engine oil to the thrust portions and journals of the camshaft.



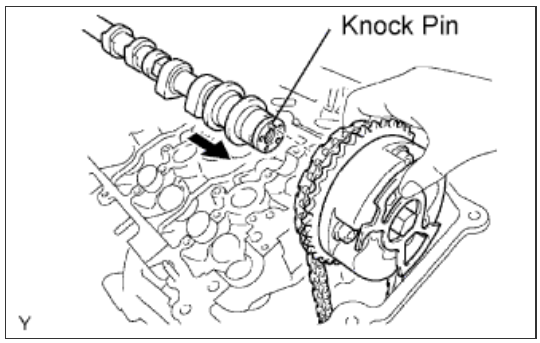
iii. Temporarily put the No. 1 chain on the No. 2 chain of the camshaft timing gear.



iv. Align the knock pin hole of the camshaft timing gear with the knock pin of the No. 1 camshaft, and insert the No. 1 camshaft into the camshaft timing gear.

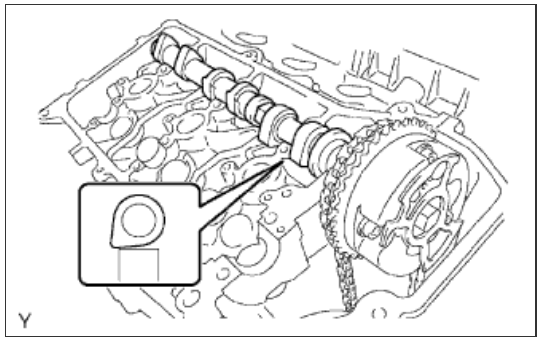
v. Apply a light coat of engine oil to the threads and under the head of the camshaft timing gear set bolt.

vi. Temporarily install the camshaft timing gear set bolt.



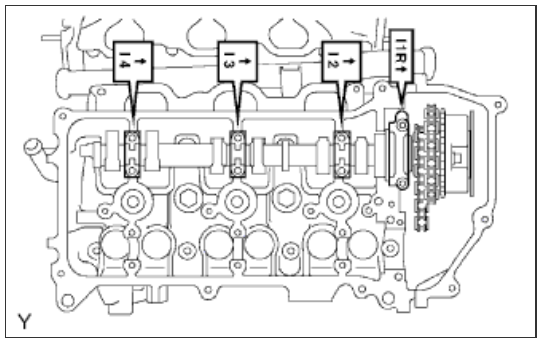
vii. Set the No. 1 camshaft onto the cylinder head RH with the cam lobes of the No. 1 cylinder facing downward as shown in the illustration.

viii. Apply a light coat of engine oil to the 4 bearing caps.



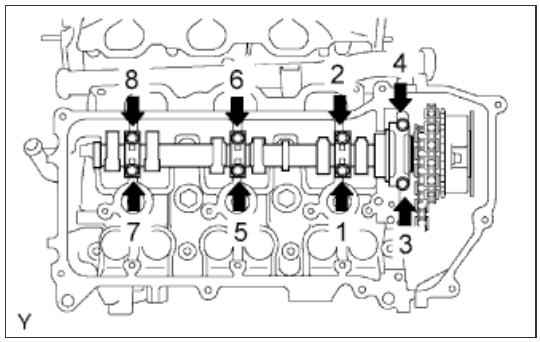
ix. Set the 4 bearing caps in their proper locations.

x. Apply a light coat of engine oil to the threads and under the heads of the 8 bearing cap bolts.

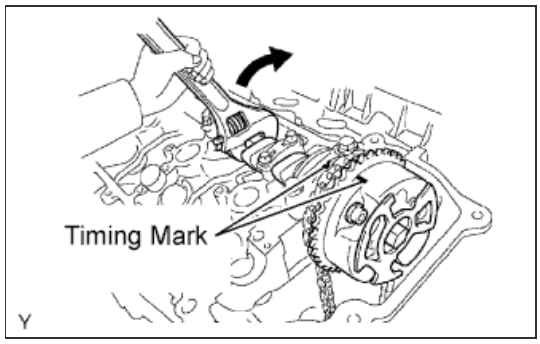


xi. Uniformly install the 8 bearing cap bolts in several steps in the order shown in the illustration.

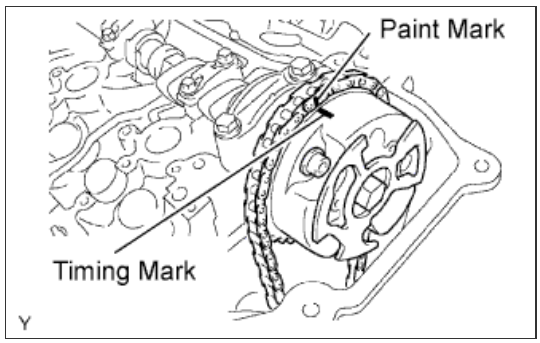
Torque:
for 10 mm head bolt:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }
for 12 mm head bolt:
24 N*m{ 245 kgf*cm , 18 ft.*lbf }



xii. Rotate the No. 1 camshaft clockwise using the hexagonal portion of the No. 1 camshaft so that the timing mark of the camshaft timing gear is aligned with the timing mark of the camshaft bearing cap.

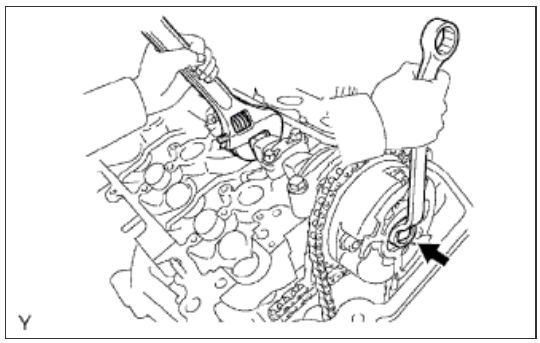


xiii. Align the paint mark of the No. 1 chain with the timing mark of the camshaft timing gear.



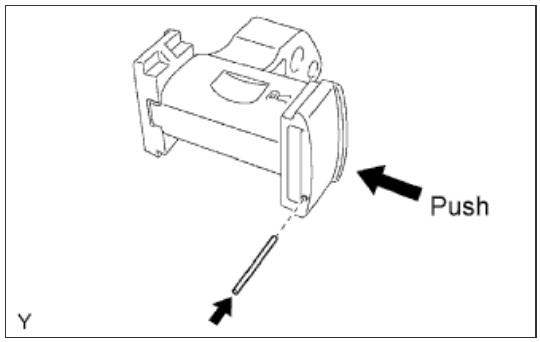
xiv. Hold the hexagonal portion of the No. 1 camshaft with a wrench, and tighten the camshaft timing gear set bolt.

Torque:
100 N*m{ 1020 kgf*cm , 74 ft.*lbf }



o. Install the No. 2 chain tensioner.

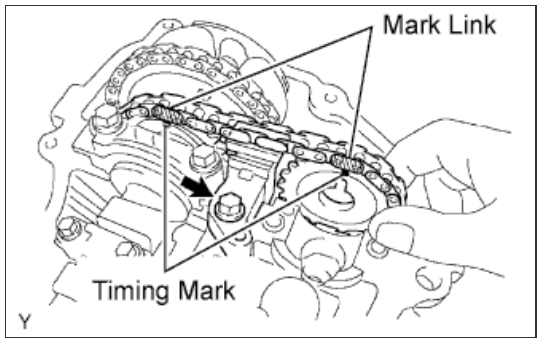
i. While pushing in the tensioner, insert a pin of φ1.0 mm (0.0394 in.) into the hole to fix the tensioner in place.



ii. Temporarily install the camshaft timing sprocket and No. 2 chain tensioner with the bolt and align the mark links (yellow) with the timing marks (1-dot mark and 2-dot mark) of the camshaft timing gear and sprocket.

iii. Tighten the No. 2 chain tensioner bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



p. Install the No. 2 camshaft.

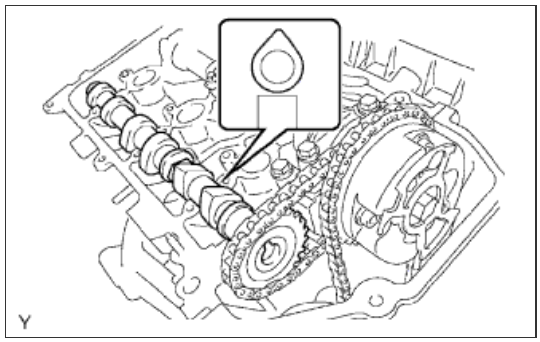
NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

i. Apply a light coat of engine oil to the thrust portions and journals of the No. 2 camshaft.

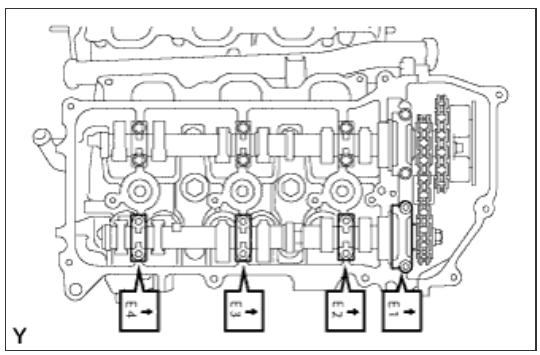
ii. Set the No. 2 camshaft onto the cylinder head RH with the cam lobes of the No. 1 cylinder facing upward as shown in the illustration.

iii. Apply a light coat of engine oil to the 4 bearing caps.



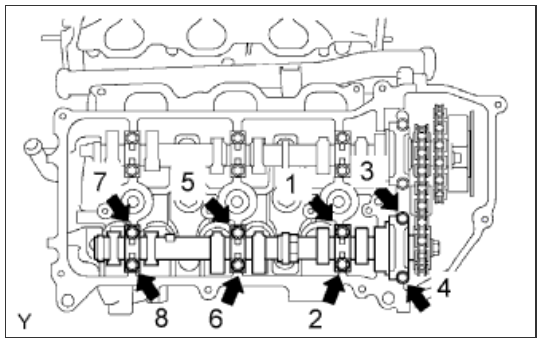
iv. Set the 4 bearing caps in their proper locations.

v. Apply a light coat of engine oil to the threads and under the heads of the 8 bearing cap bolts.



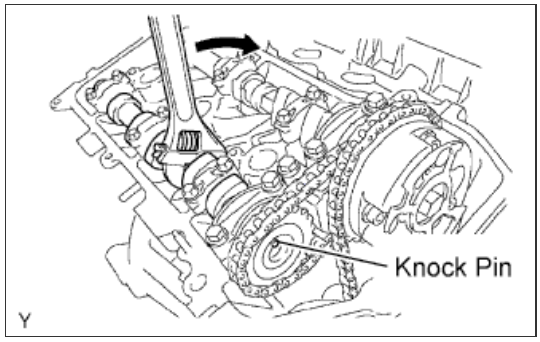
vi. Uniformly install the 8 bearing cap bolts in several steps in the order shown in the illustration.

Torque:
for 10 mm head bolt:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }
for 12 mm head bolt:
24 N*m{ 245 kgf*cm , 18 ft.*lbf }



vii. Rotate the No. 2 camshaft clockwise using a wrench so that the knock pin of the No. 2 camshaft is aligned with the knock pin hole of the camshaft timing sprocket.

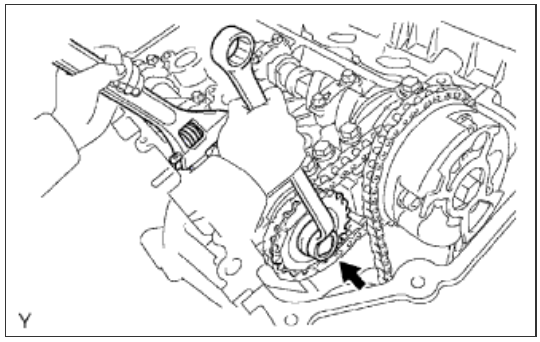
viii. Apply a light coat of engine oil to the threads and under the head of the camshaft timing sprocket set bolt.



ix. Hold the hexagonal portion of the No. 2 camshaft with a wrench, and install the camshaft timing sprocket set bolt.

Torque:
100 N*m{ 1020 kgf*cm , 74 ft.*lbf }

x. Remove the pin from the No. 2 chain tensioner.



q. Install the No. 1 chain tensioner.

i. While turning the stopper plate of the tensioner clockwise, push in the plunger of the tensioner as shown in the illustration.

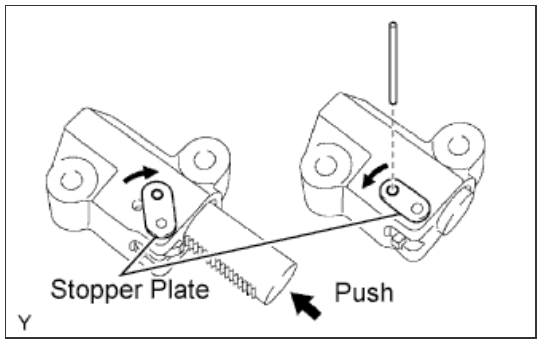
ii. While turning the stopper plate of the tensioner counterclockwise, insert a bar of φ3.5 mm (0.138 in.) into the holes on the stopper plate and tensioner to fix the stopper plate in place.

iii. Apply a light coat of engine oil to the threads and under the heads of the 2 No. 1 chain tensioner bolts.

iv. Install the No. 1 chain tensioner with the 2 bolts.

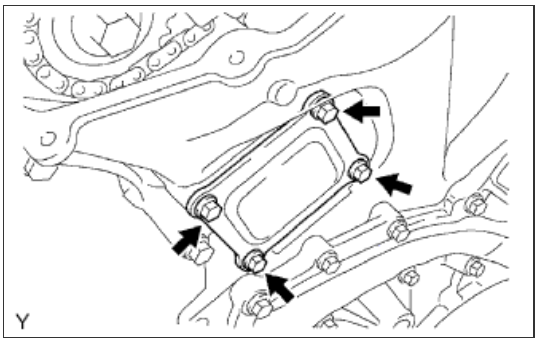
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

v. Remove the bar from the chain tensioner.

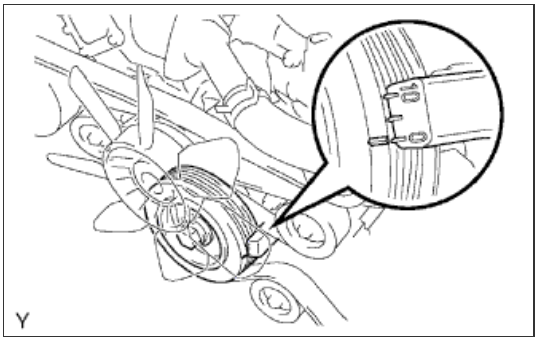


vi. Install a new gasket and the timing chain cover plate with the 4 bolts.

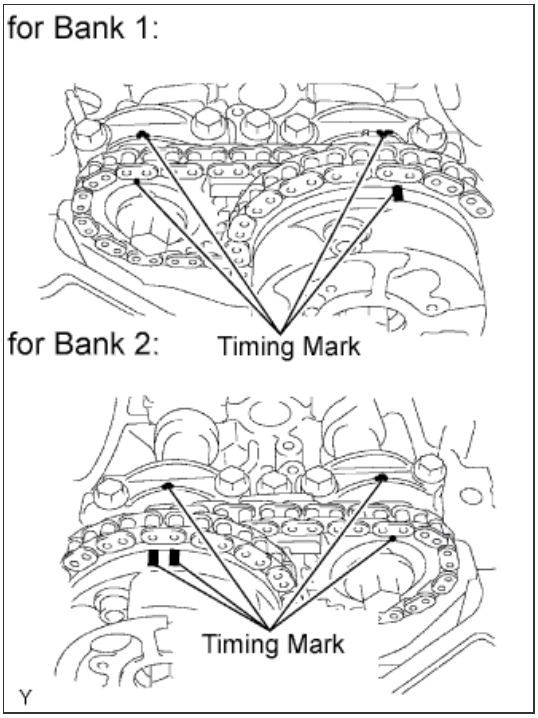
Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



vii. Turn the crankshaft pulley 2 complete revolutions slowly, and align the notch with the timing mark "0" of the timing chain cover.



viii. Check that the timing marks of the camshaft timing gears and sprockets are aligned with the timing marks of the bearing caps as shown in the illustration.



18. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY LH

a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the cylinder head, timing chain cover and cylinder head cover.

b. Apply seal packing as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
2 to 3 mm (0.0787 to 0.118 in.)

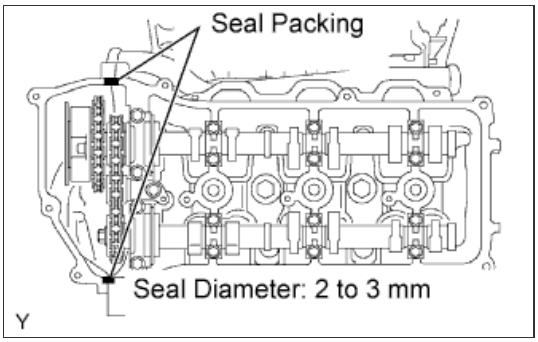
NOTICE:

- **Remove any oil from the contact surface.**

- **Install the head cover within 3 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after the installation.**

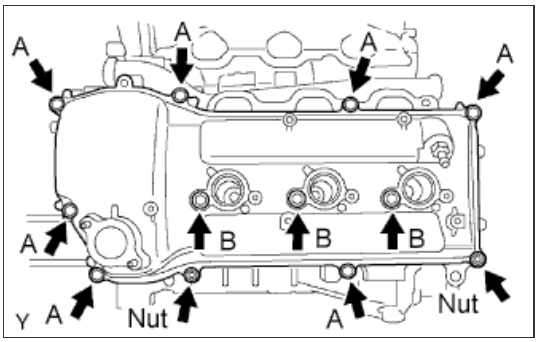
c. Install a new gasket to the cylinder head cover.

d. Install the seal washers to the bolts.



e. Temporarily install the cylinder head cover with the 10 bolts and 2 nuts. Tighten the bolts and nuts uniformly in several steps.

Torque:
for bolt A:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }
for bolt B and nut:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



19. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY RH

a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the cylinder head, timing chain cover and cylinder head cover.

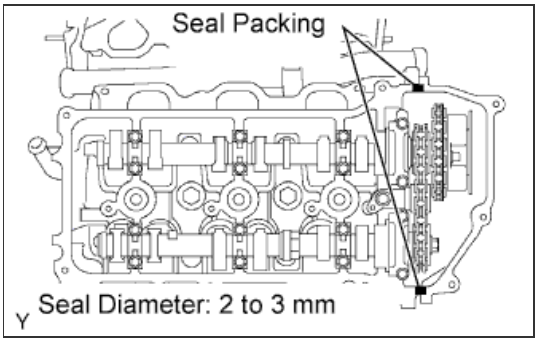
b. Apply seal packing as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
2 to 3 mm (0.0787 to 0.118 in.)

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the head cover within 3 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after the installation.**

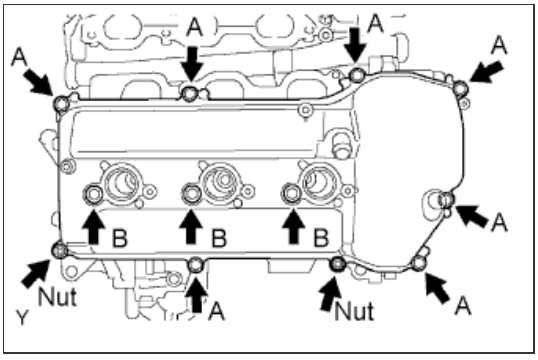


c. Install a new gasket to the cylinder head cover.

d. Install the seal washers to the bolts.

e. Temporarily install the cylinder head cover with the 10 bolts and 2 nuts. Tighten the bolts and nuts uniformly in several steps.

Torque:
for bolt A:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }
for bolt B and nut:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



20. INSTALL SPARK PLUG

a. Install the 6 spark plugs.

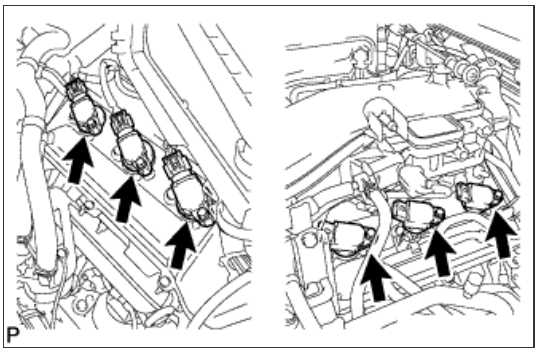
Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

21. INSTALL IGNITION COIL ASSEMBLY

a. Install the 6 ignition coils with the 6 bolts.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }

b. Connect the 6 ignition coil connectors.



22. INSTALL INTAKE AIR SURGE TANK

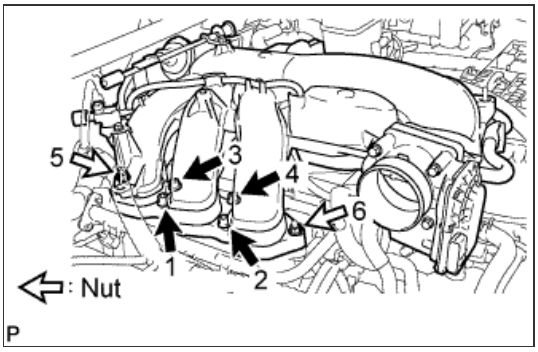
NOTICE:
Do not apply oil to the bolts and nuts listed below: :

Oil Application Prohibited Bolt/Nut
Bolt for surge tank and intake manifold
Nut for surge tank and intake manifold

a. Install a new gasket to the intake air surge tank.

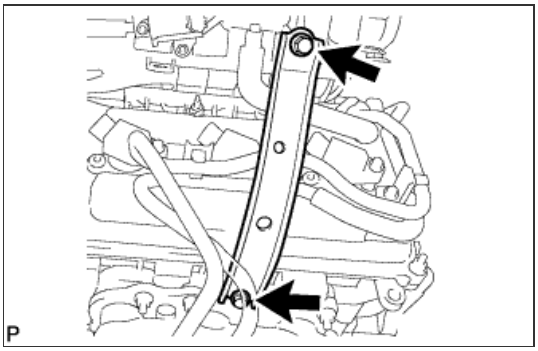
b. Using an 8 mm hexagon wrench, install the intake air surge tank with the 4 bolts and 2 nuts in the order shown in the illustration.

Torque:
28 N*m{ 286 kgf*cm , 21 ft.*lbf }



c. Install the No. 2 surge tank stay with the 2 bolts.

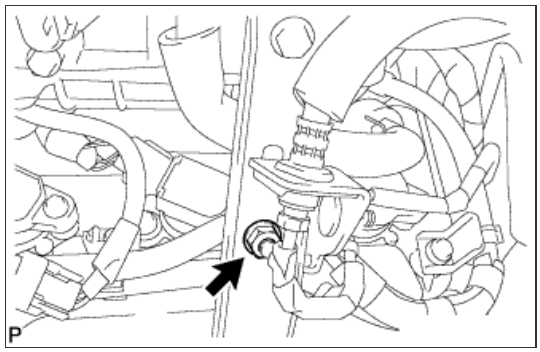
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



d. for Manual Transmission:

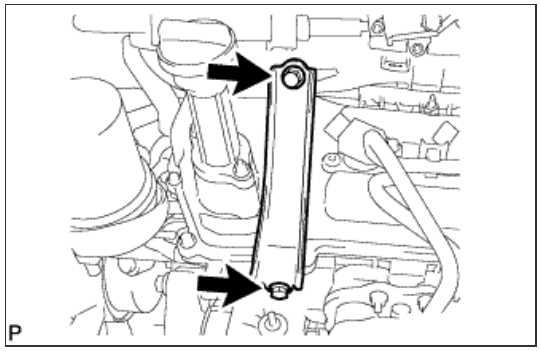
i. Install the bracket to the No. 2 surge tank stay with the nut.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }



e. Install the No. 1 surge tank stay with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

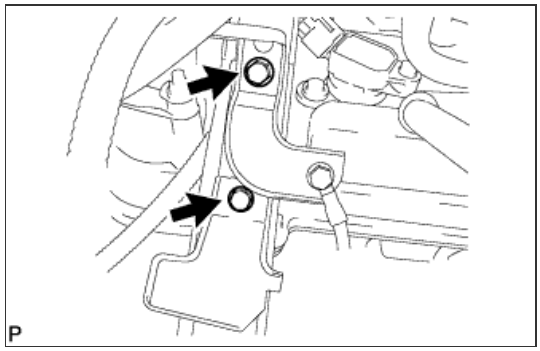


f. Install the oil baffle plate with the bolt.

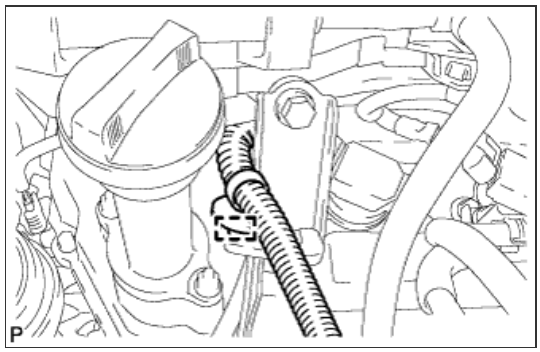
Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }

g. Install the bracket to the No. 1 surge tank stay with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

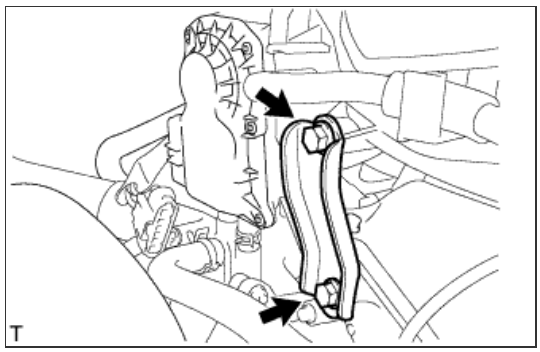


h. Attach the wire harness clamp.



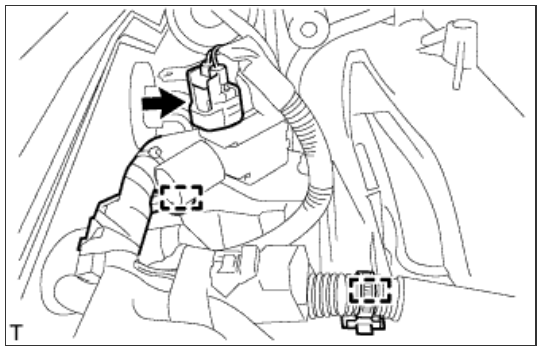
i. Install the throttle body bracket with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



j. Connect the vacuum switching valve (for ACIS) connector.

k. Attach the 2 wire harness clamps.



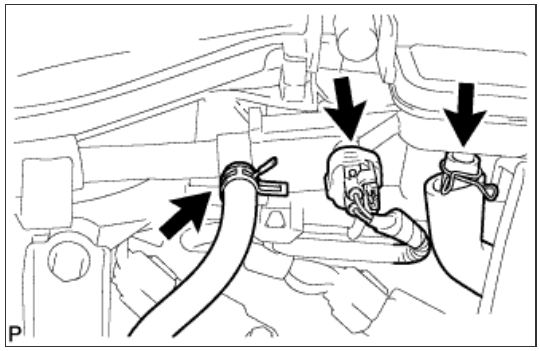
l. Connect the No. 1 ventilation hose.

m. Connect the purge VSV connector.

n. Connect the purge line hose.

HINT:

Connect the hose so that the direction of the hose clamp is as indicated in the illustration.

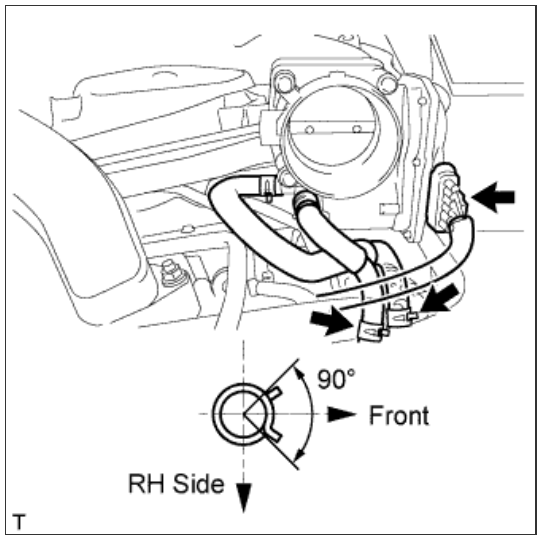


o. Connect the No. 4 and No. 5 water by-pass hose.

HINT:

Connect the hoses so that the direction of the hose clamps is as shown in the illustration.

p. Connect the throttle body connector.



23. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner assembly with the 2 bolts.

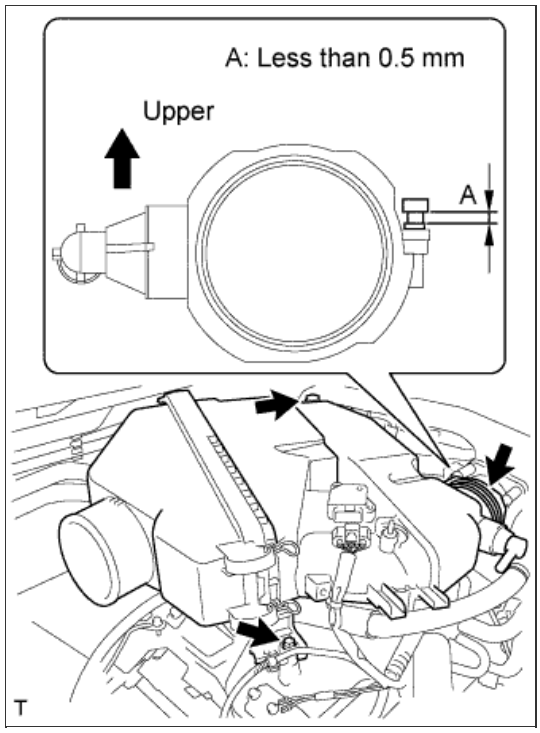
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

b. Tighten the hose clamp.

HINT:

Tighten the hose clamp until it reaches the specified protrusion height labeled A shown in the illustration.

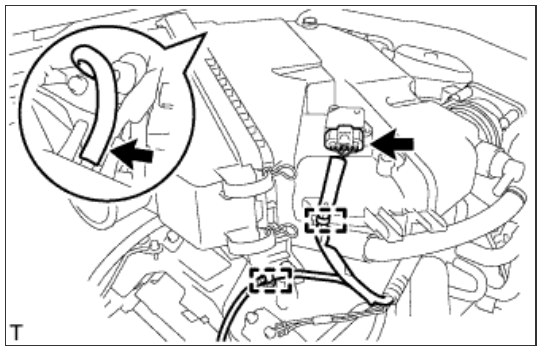
Standard protrusion height:
Less than 0.5 mm (0.0197 in.)



c. Connect the MAF meter connector.

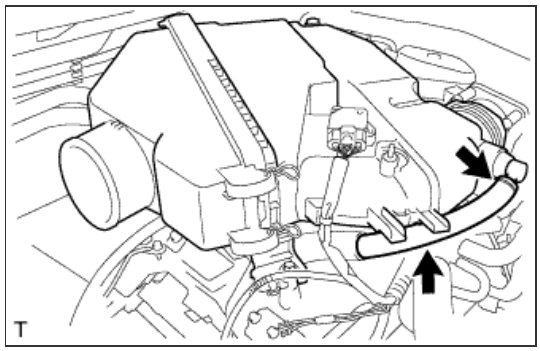
d. Attach the 2 wire harness clamps.

e. Connect the vacuum hose.



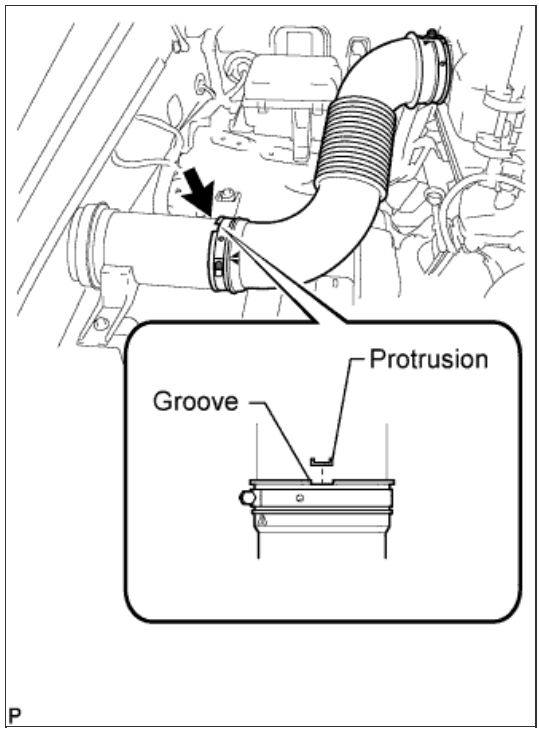
f. Attach the hose clamp.

g. Connect the No. 2 ventilation hose.



24. INSTALL NO. 2 AIR CLEANER HOSE

a. Align the protrusion of the pre-cleaner with the groove of the No. 2 air cleaner hose as shown in the illustration.

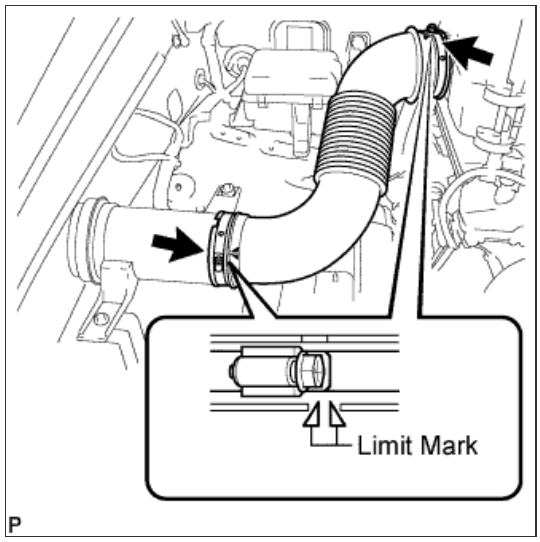


b. Tighten the 2 hose clamps.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }

HINT:

Tighten the clamp until the end of the clamp band is within both limit marks.



25. INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Install the cowl top ventilator louver (Click here).

26. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item		Specified condition
for Automatic transmission	w/o Rear Heater	11.2 liters (11.8 US qts, 9.9 Imp. qts)
	w/ Rear Heater	14.4 liters (15.2 US qts, 12.7 Imp. qts)
for Manual transmission	w/o Rear Heater	12.0 liters (12.7 US qts, 10.6 Imp. qts)
	w/ Rear Heater	14.6 liters (15.4 US qts, 12.8 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

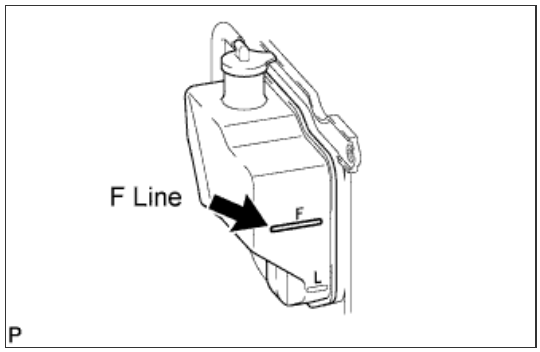
TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.



f. Set the air conditioning as follows while warming up the engine.

Item	Condition
Fan speed	Any setting except off
Temperature	Toward WARM
Air conditioning switch	Off

g. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

h. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

i. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

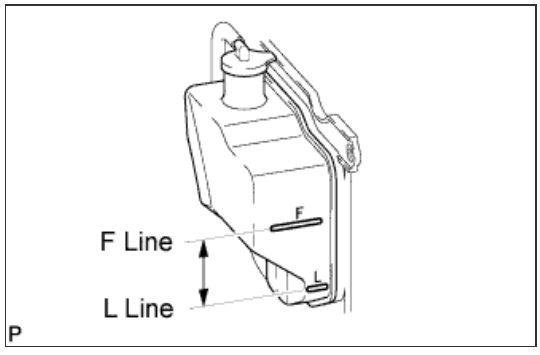
- **Wear protective gloves. Heat areas on the parts may injure your hands.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the fan.**

j. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

k. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.



27. INSPECT FOR COOLANT LEAK

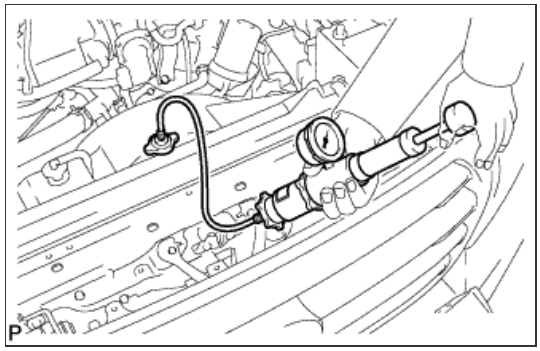
CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

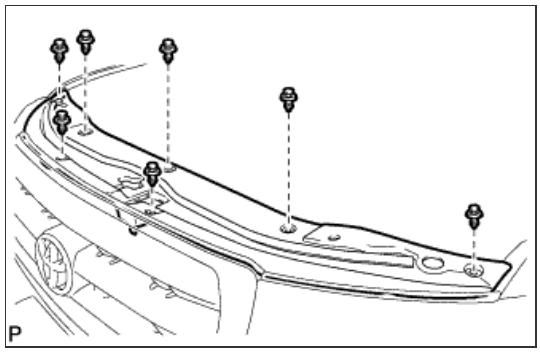
b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



28. INSTALL UPPER RADIATOR SEAL

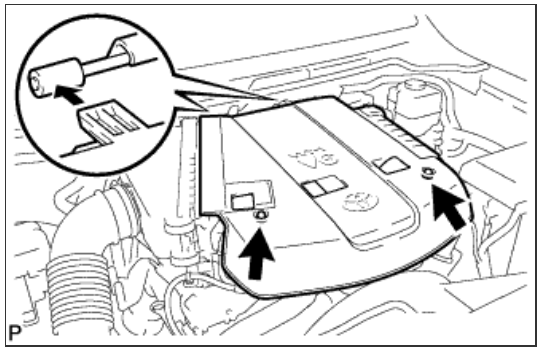
a. Install the radiator support seal with the 7 clips.



29. INSTALL V-BANK COVER

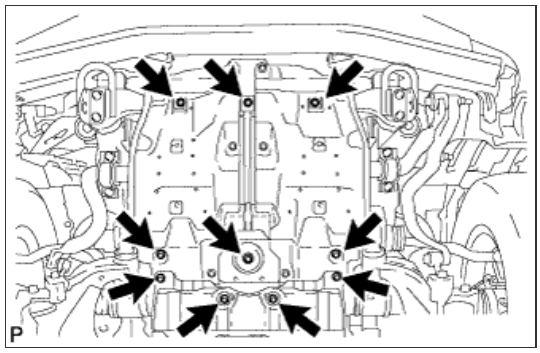
a. Install the V-bank cover with the 2 cap nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



30. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the under cover with the 10 bolts.



31. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

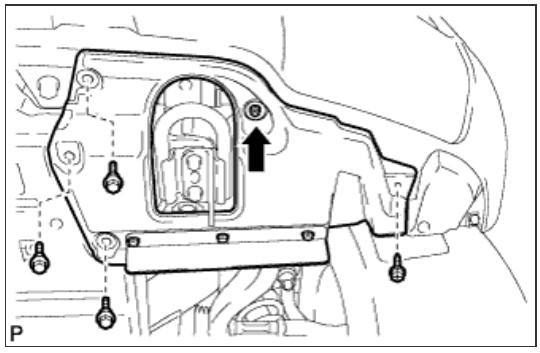
HINT:

Use the same procedures described for the LH side.

32. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



33. INSPECT IGNITION TIMING

NOTICE:

- **Turn all electrical systems off.**
- **Perform the inspection when the cooling fan motor is turned off.**

a. Warm up the engine.

b. When using the intelligent tester:

i. Connect the intelligent tester to the DLC3.

ii. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / IGN Advance.

iii. Inspect the ignition timing during idling.

Standard ignition timing:
8 to 12° BTDC @ idling (transmission in neutral position and A/C switch off)

iv. Check that the ignition timing advances immediately when the engine speed is increased.

c. When not using the intelligent tester:

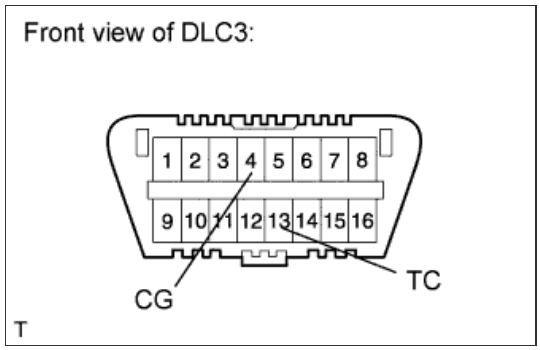
i. Using SST, connect terminals 13 (TC) and 4 (CG) of the DLC3.

SST
09843-18040

NOTICE:

Be sure not to improperly connect the terminals. This may damage the engine.

ii. Remove the air cleaner cap.

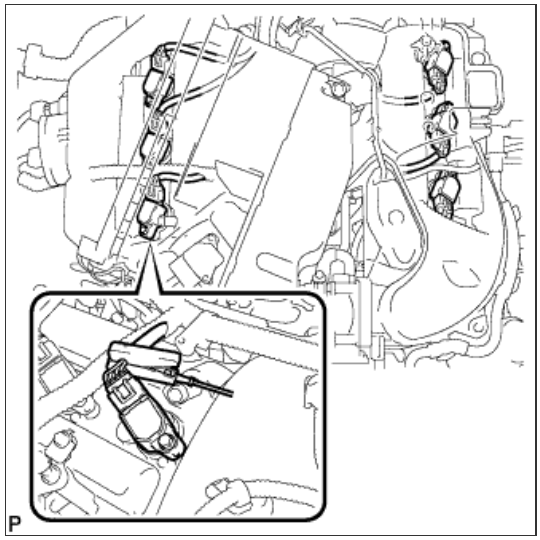


iii. Pull out the wire harness shown in the illustration.

iv. Connect the tester probe of a timing light to the wire of the ignition coil connector for the No. 1 cylinder.

NOTICE:

- **Use a timing light that detects primary signals.**
- **After checking, be sure to wrap the wire harness with tape.**



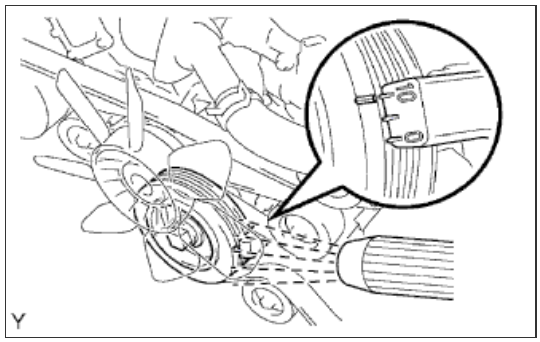
v. Inspect the ignition timing during idling.

Standard ignition timing:
8 to 12° BTDC @ idling (transmission in neutral position and A/C switch off)

vi. Remove SST from the DLC3.

vii. Inspect the ignition timing during idling.

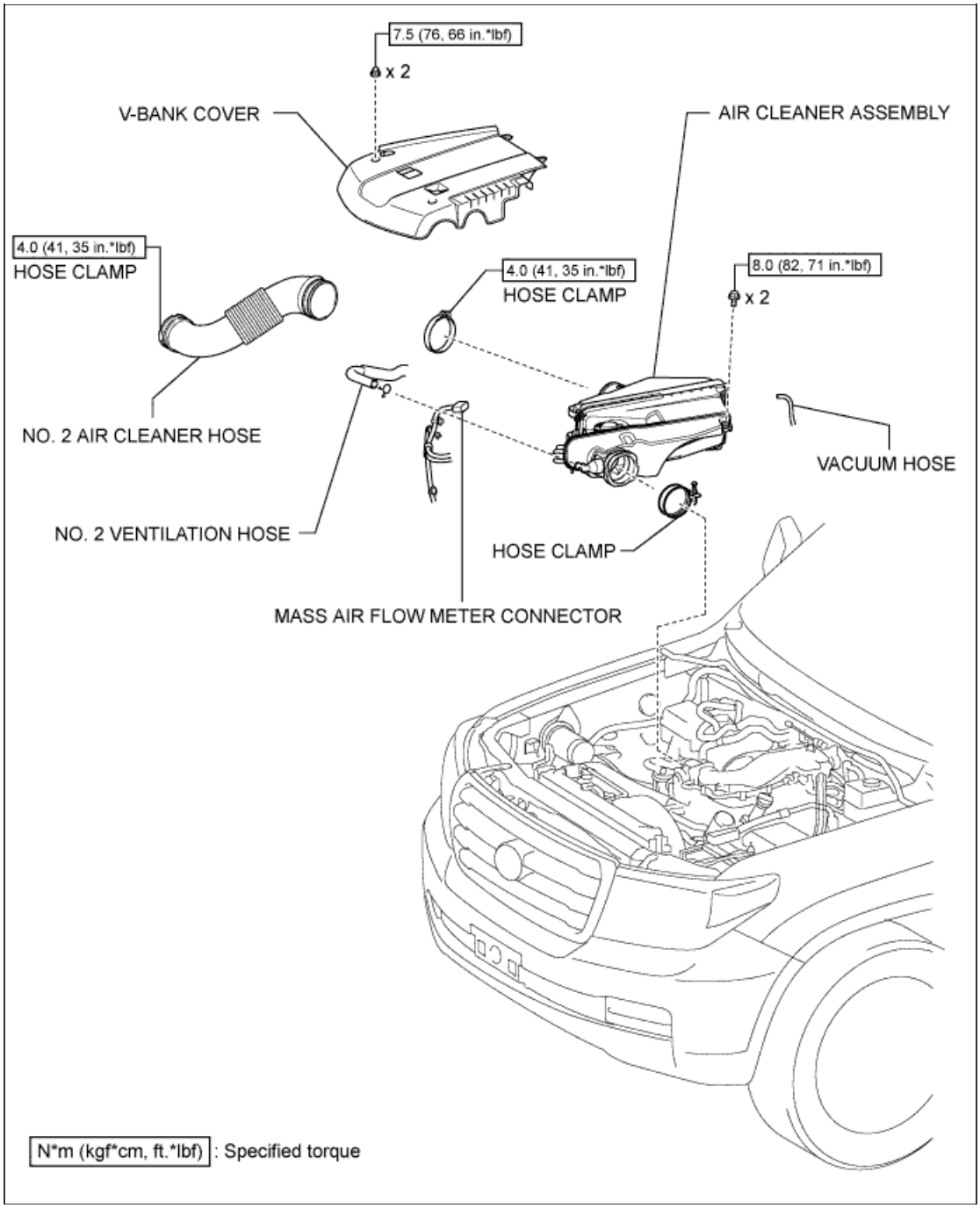
Standard ignition timing:
7 to 24° BTDC @ idling (transmission in neutral position and A/C switch off)

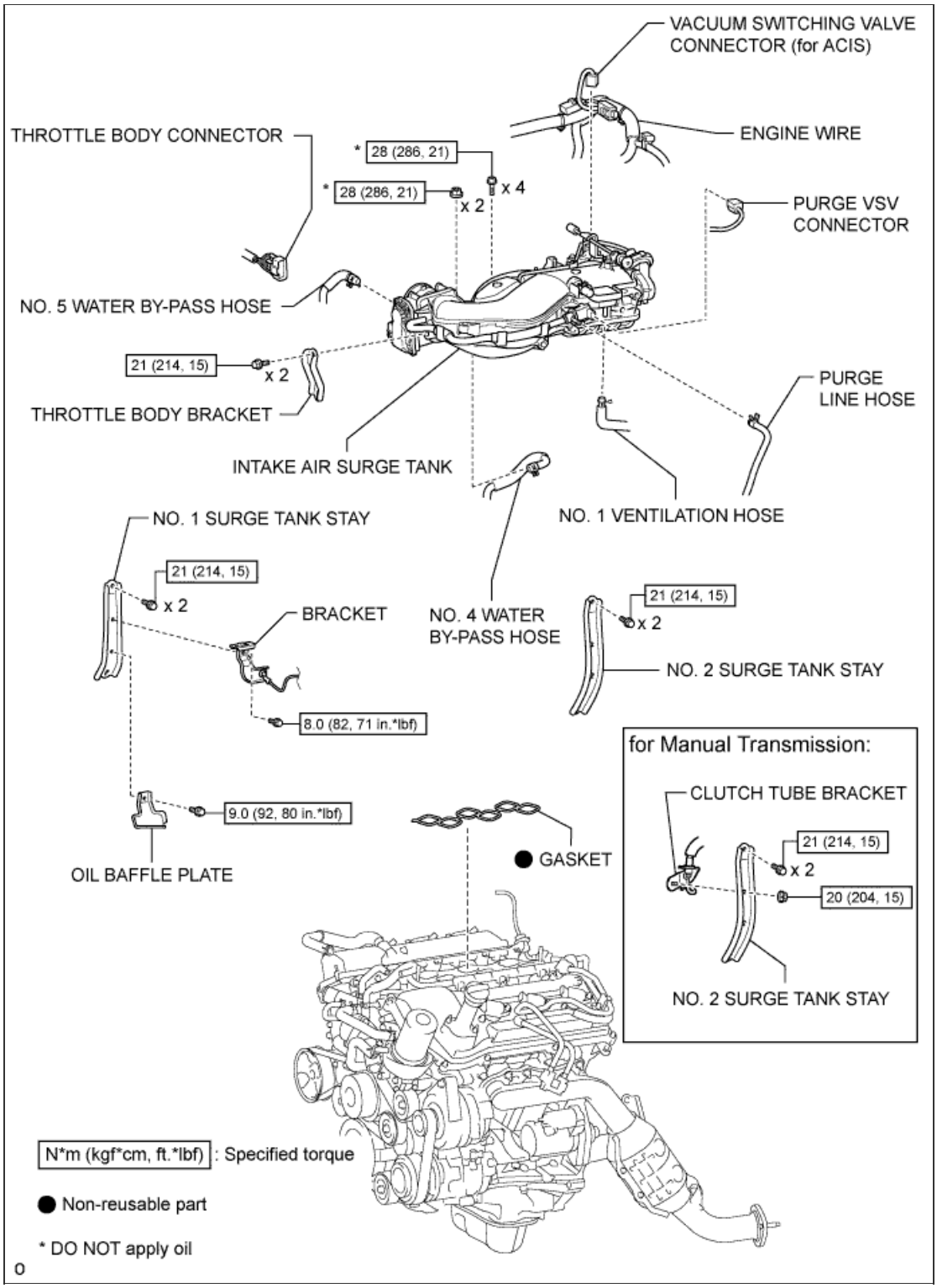


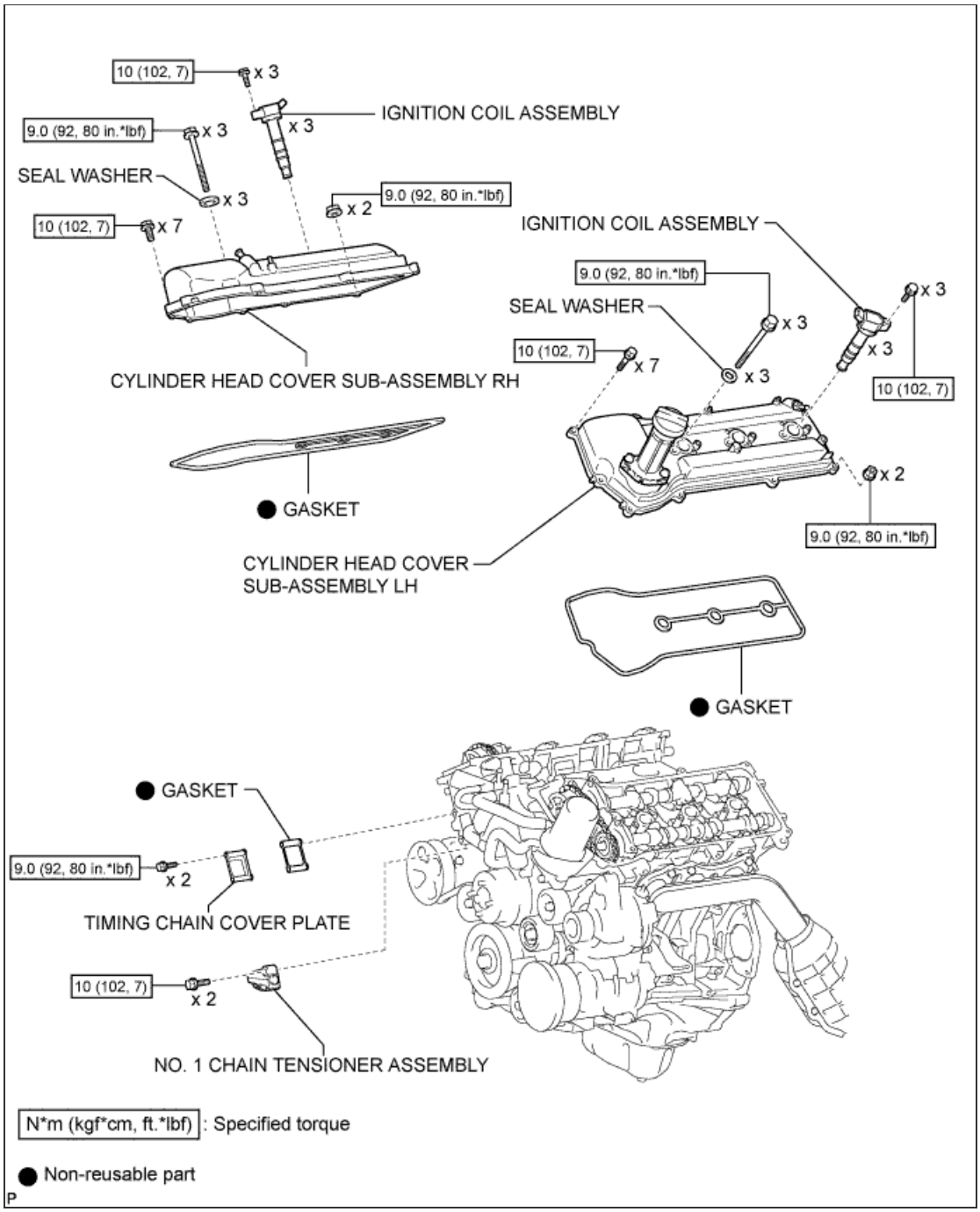
viii. Disconnect the timing light from the engine.

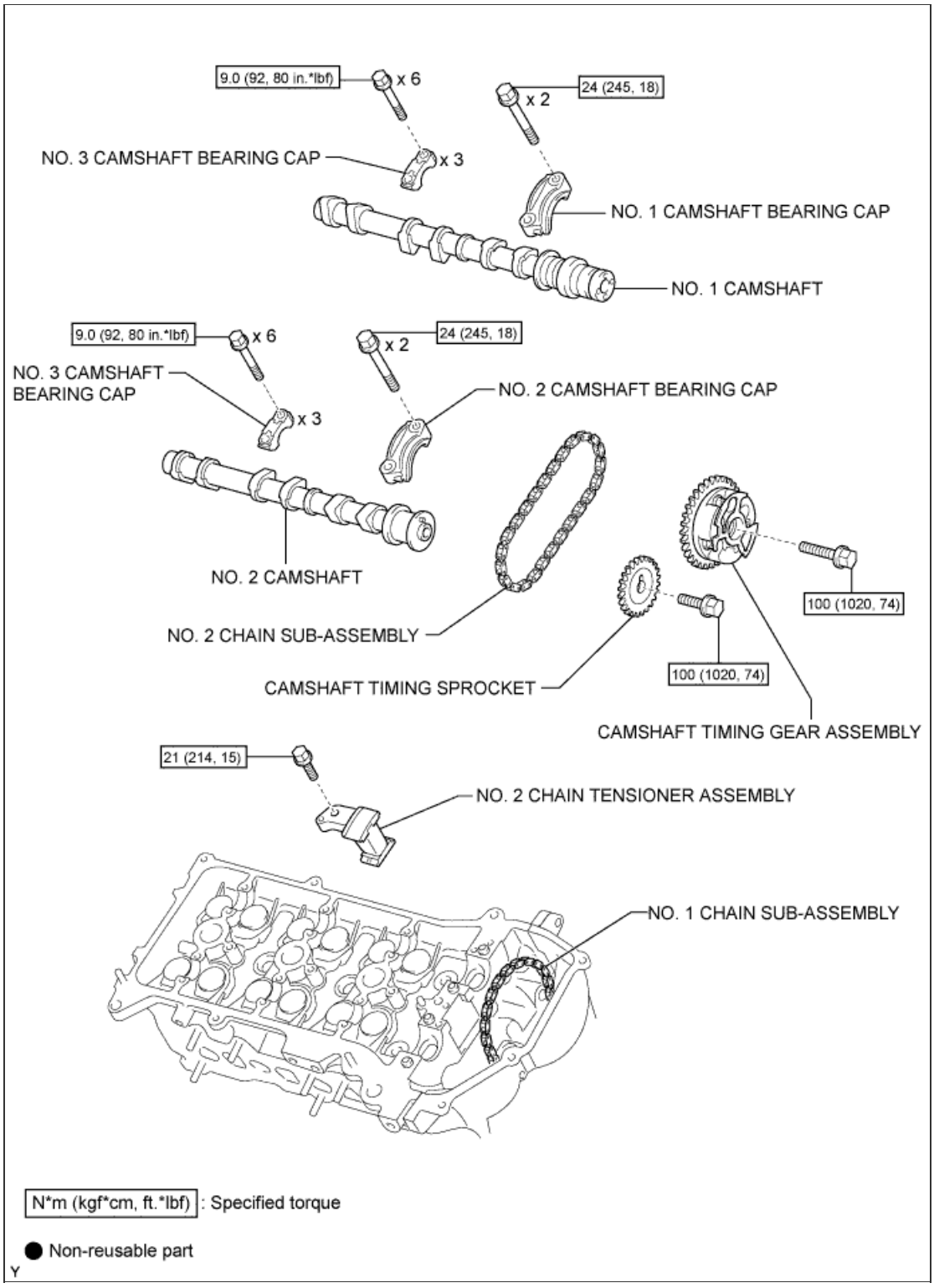
ix. Install the air cleaner cap.

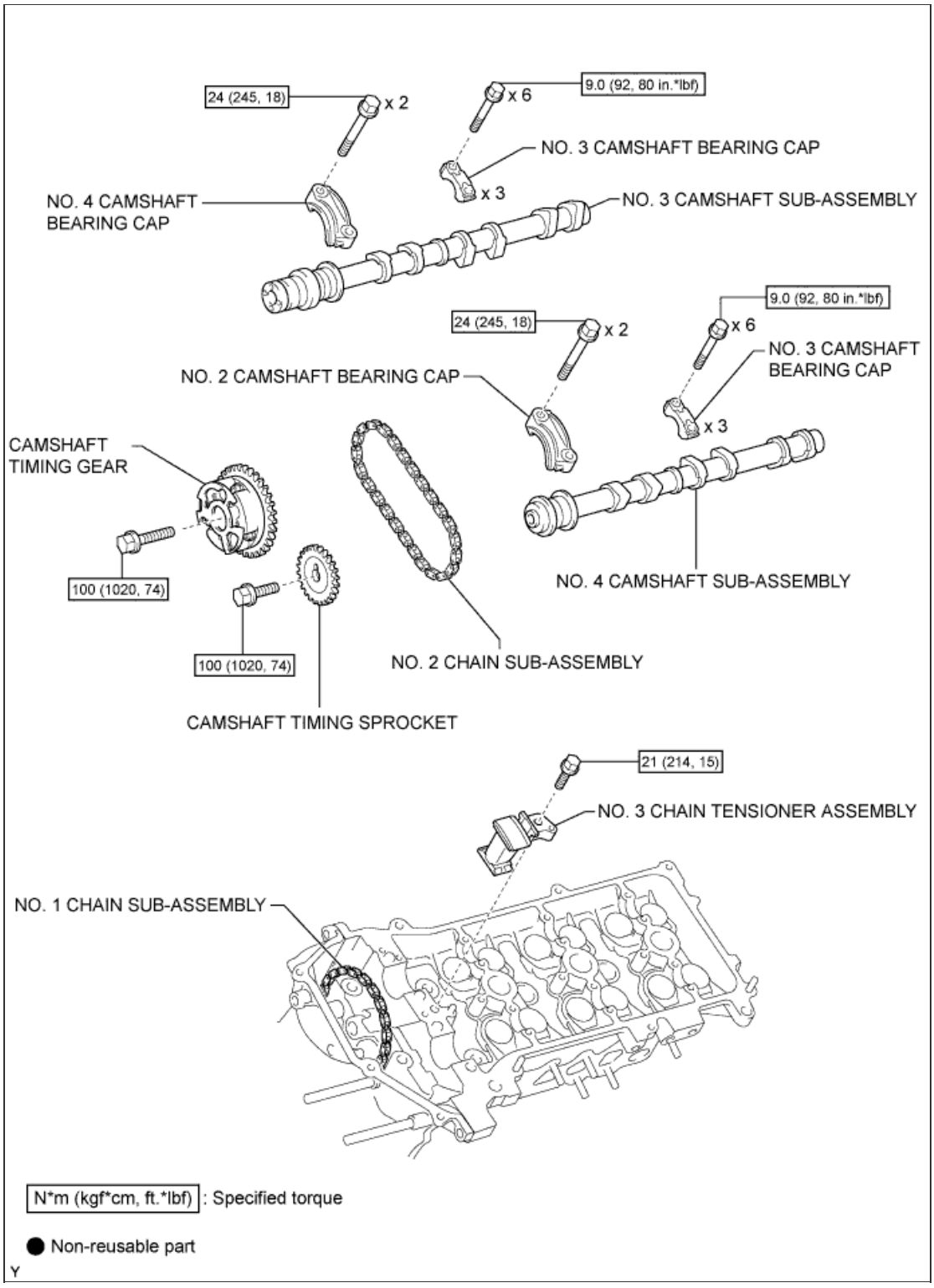
for Preparation Click here




VACUUM SWITCHING VALVE CONNECTOR (for ACIS)
ENGINE WIRE
THROTTLE BODY CONNECTOR
* 28 (286, 21)
* 28 (286, 21)
x 2
x 4
PURGE VSV CONNECTOR
NO. 5 WATER BY-PASS HOSE
21 (214, 15)
x 2
THROTTLE BODY BRACKET
PURGE LINE HOSE
INTAKE AIR SURGE TANK
NO. 1 VENTILATION HOSE
NO. 1 SURGE TANK STAY
21 (214, 15)
x 2
BRACKET
NO. 4 WATER BY-PASS HOSE
21 (214, 15)
x 2
NO. 2 SURGE TANK STAY
8.0 (82, 71 in.*lbf)
for Manual Transmission:
CLUTCH TUBE BRACKET
21 (214, 15)
x 2
20 (204, 15)
NO. 2 SURGE TANK STAY
9.0 (92, 80 in.*lbf)
OIL BAFFLE PLATE
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
* DO NOT apply oil


10 (102, 7)
x 3
IGNITION COIL ASSEMBLY
9.0 (92, 80 in.*lbf)
x 3
SEAL WASHER
x 3
9.0 (92, 80 in.*lbf)
x 2
10 (102, 7)
x 7
CYLINDER HEAD COVER SUB-ASSEMBLY RH
GASKET
IGNITION COIL ASSEMBLY
9.0 (92, 80 in.*lbf)
SEAL WASHER
x 3
x 3
10 (102, 7)
x 7
x 3
x 3
10 (102, 7)
x 2
9.0 (92, 80 in.*lbf)
CYLINDER HEAD COVER
SUB-ASSEMBLY LH
GASKET
GASKET
9.0 (92, 80 in.*lbf)
x 2
TIMING CHAIN COVER PLATE
10 (102, 7)
x 2
NO. 1 CHAIN TENSIONER ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P


9.0 (92, 80 in.*lbf)
x 6
24 (245, 18)
x 2
NO. 3 CAMSHAFT BEARING CAP
x 3
NO. 1 CAMSHAFT BEARING CAP
NO. 1 CAMSHAFT
9.0 (92, 80 in.*lbf)
x 6
24 (245, 18)
x 2
NO. 3 CAMSHAFT BEARING CAP
x 3
NO. 2 CAMSHAFT BEARING CAP
NO. 2 CAMSHAFT
NO. 2 CHAIN SUB-ASSEMBLY
100 (1020, 74)
CAMSHAFT TIMING SPROCKET
100 (1020, 74)
CAMSHAFT TIMING GEAR ASSEMBLY
21 (214, 15)
NO. 2 CHAIN TENSIONER ASSEMBLY
NO. 1 CHAIN SUB-ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
Y

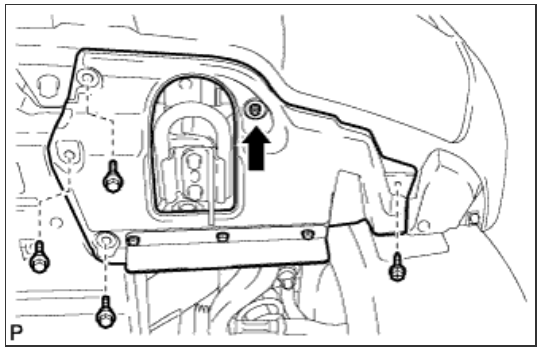

24 (245, 18)
x 2
x 6
9.0 (92, 80 in.*lbf)
NO. 3 CAMSHAFT BEARING CAP
x 3
NO. 4 CAMSHAFT BEARING CAP
NO. 3 CAMSHAFT SUB-ASSEMBLY
24 (245, 18)
x 2
9.0 (92, 80 in.*lbf)
x 6
NO. 3 CAMSHAFT BEARING CAP
NO. 2 CAMSHAFT BEARING CAP
x 3
CAMSHAFT TIMING GEAR
100 (1020, 74)
NO. 4 CAMSHAFT SUB-ASSEMBLY
100 (1020, 74)
NO. 2 CHAIN SUB-ASSEMBLY
CAMSHAFT TIMING SPROCKET
21 (214, 15)
NO. 3 CHAIN TENSIONER ASSEMBLY
NO. 1 CHAIN SUB-ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
Y

for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



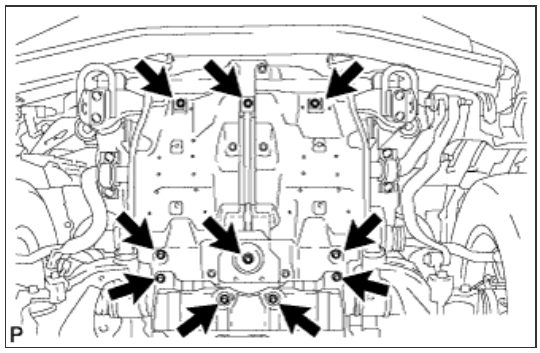
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

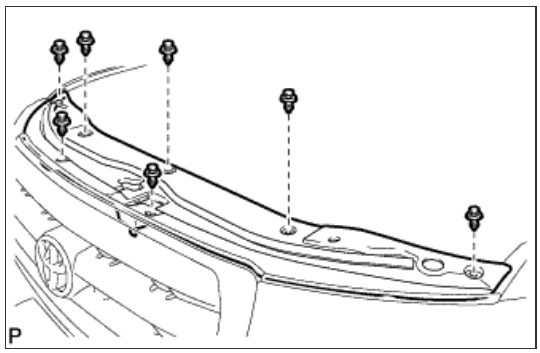
3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



4. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and radiator support seal.



5. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug and 2 cylinder block drain cock plugs.

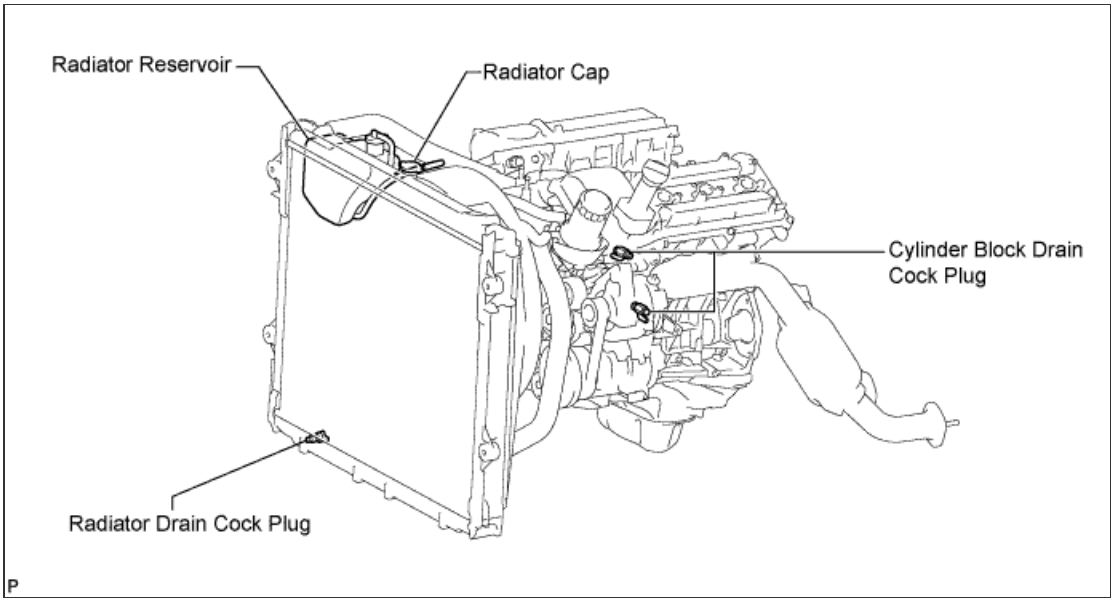
b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Tighten the 2 cylinder block drain cock plugs.

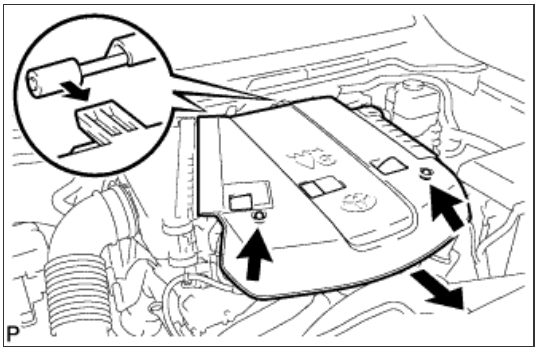
Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



d. Tighten the radiator drain cock plug by hand.

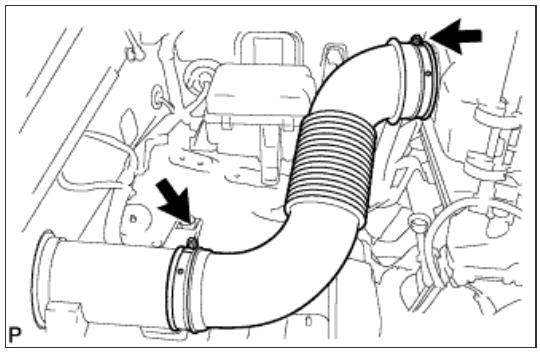
6. REMOVE V-BANK COVER

a. Remove the 2 cap nuts and V-bank cover.



7. REMOVE NO. 2 AIR CLEANER HOSE

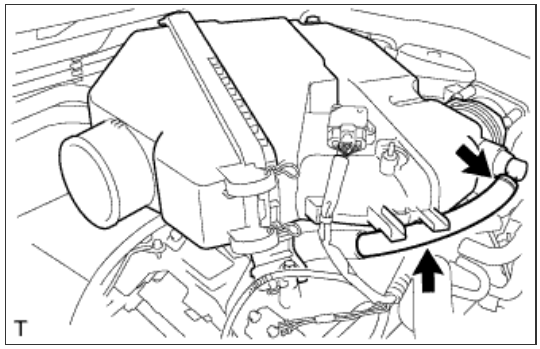
a. Loosen the 2 hose clamps and remove the air cleaner hose.



8. REMOVE AIR CLEANER ASSEMBLY

a. Disconnect the No. 2 ventilation hose.

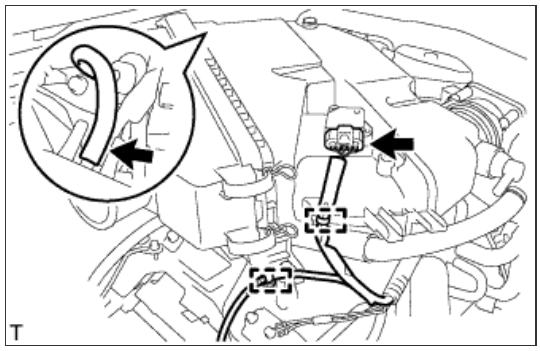
b. Detach the hose clamp.



c. Disconnect the vacuum hose.

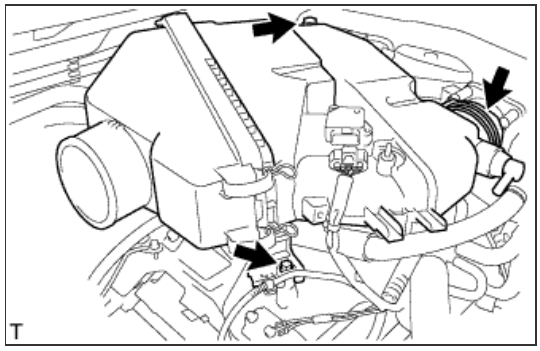
d. Disconnect the MAF meter connector.

e. Using a clip remover, detach the 2 wire harness clamps.



f. Loosen the hose clamp.

g. Remove the 2 bolts and air cleaner assembly.

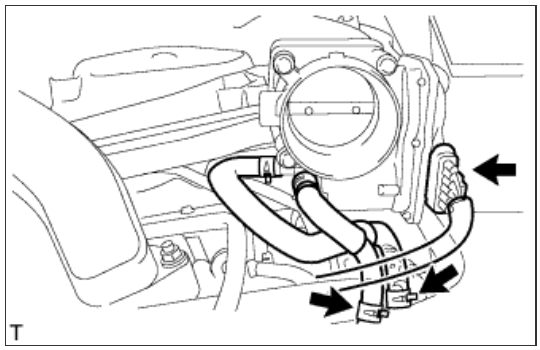


9. REMOVE INTAKE AIR SURGE TANK

a. Disconnect the throttle body connector.

b. Disconnect the No. 4 water by-pass hose.

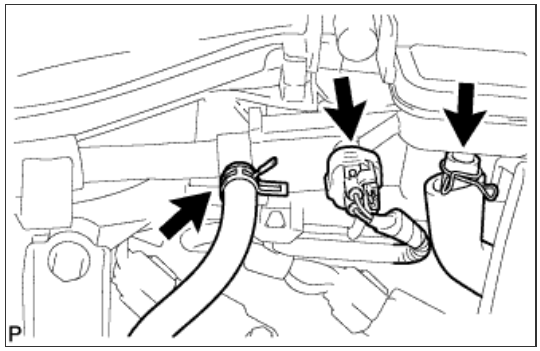
c. Disconnect the No. 5 water by-pass hose.



d. Disconnect the purge line hose.

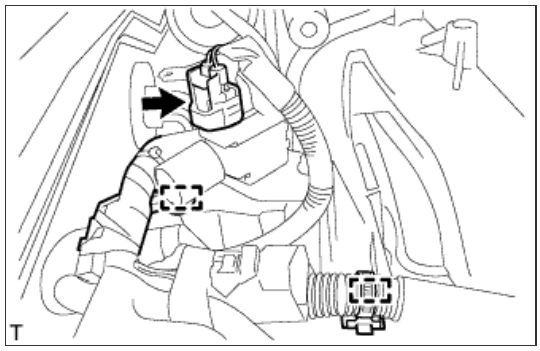
e. Disconnect the purge VSV connector.

f. Disconnect the No. 1 ventilation hose.

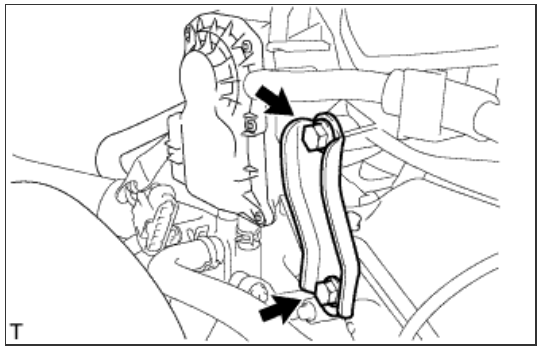


g. Disconnect the vacuum switching valve (for ACIS) connector.

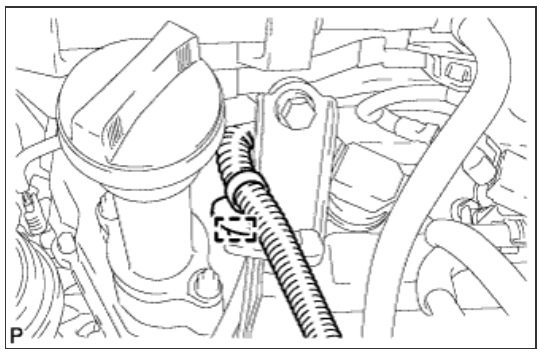
h. Using a clip remover, detach the 2 wire harness clamps.



i. Remove the 2 bolts and throttle body bracket.

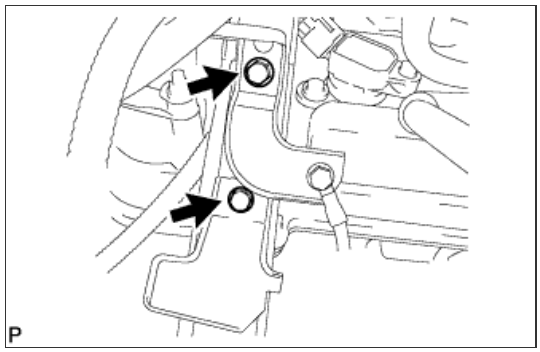


.Using a clip remover, detach the wire harness clamp.

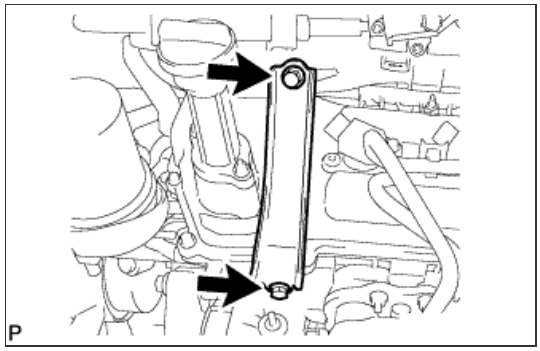


k. Remove the bolt and bracket from the No. 1 surge tank stay.

l. Remove the bolt and oil baffle plate.

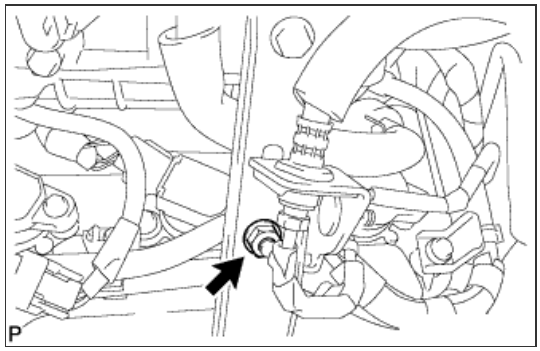


m. Remove the 2 bolts and No. 1 surge tank stay.

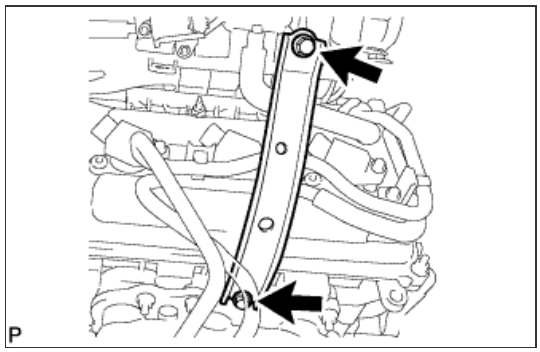


n. for Manual Transmission:

i. Remove the nut.

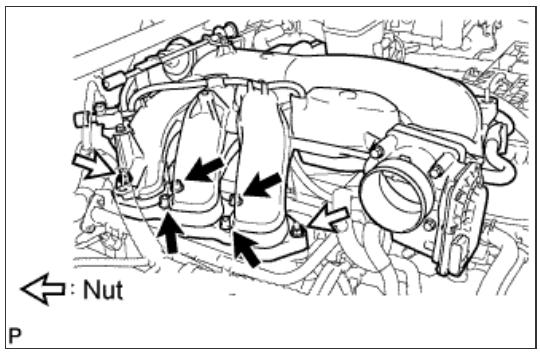


o. Remove the 2 bolts and No. 2 surge tank stay.



p. Remove the 2 nuts.

q. Using an 8 mm hexagon wrench, remove the 4 bolts. Then remove the intake air surge tank and gasket.



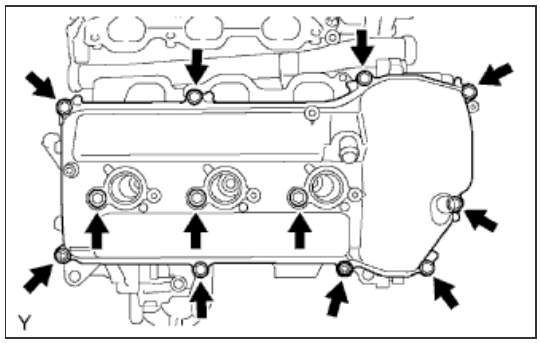
10. REMOVE IGNITION COIL ASSEMBLY

a. Disconnect the 6 connectors.

b. Remove the 6 bolts and ignition coils.

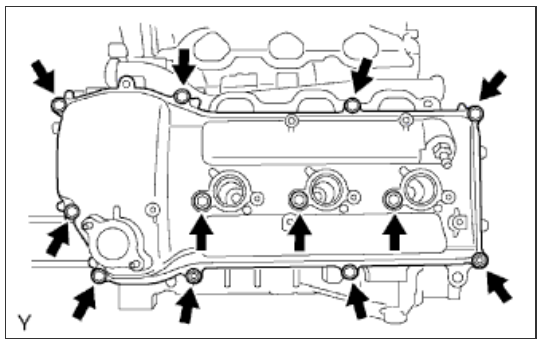
11. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY RH

a. Remove the 10 bolts, 3 seal washers, 2 nuts, cylinder head cover and gasket.



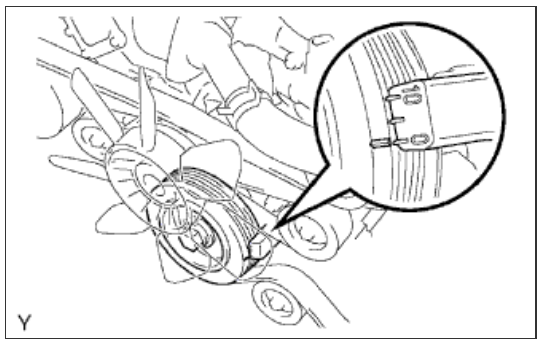
12. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY LH

a. Remove the 10 bolts, 3 seal washers, 2 nuts, cylinder head cover and gasket.

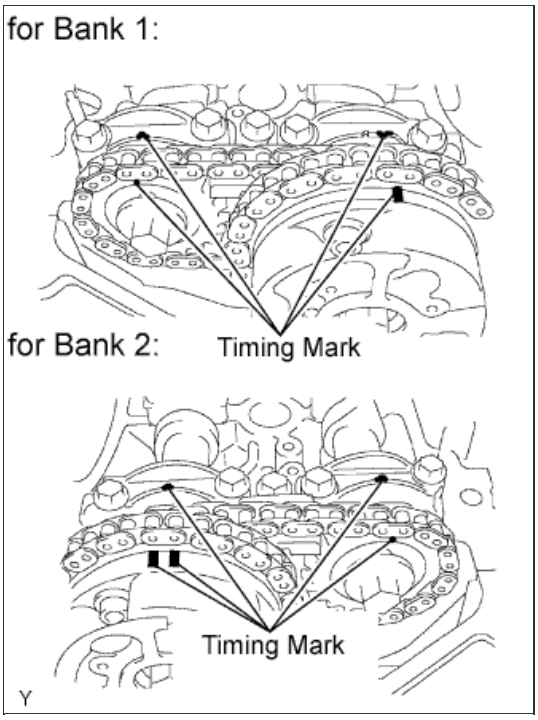


13. SET NO. 1 CYLINDER TO TDC/COMPRESSION

a. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.



b. Check that the timing marks of the camshaft timing gears and sprockets are aligned with the timing marks of the bearing caps as shown in the illustration. If not, turn the crankshaft 1 complete revolution (360°) and align the timing marks as above.

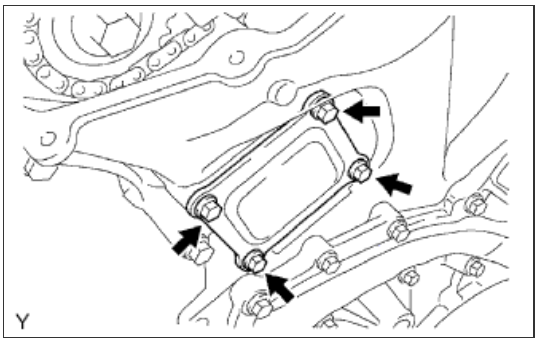


14. REMOVE NO. 1 CHAIN TENSIONER ASSEMBLY

NOTICE:

- **Ne e rotate the crank haft with the chain ten ioner remo d.**
- **hen rotating the cam haft with the timing chain remo d, rotate the crank haft counterclockwi e 40 from TDC fir t.**

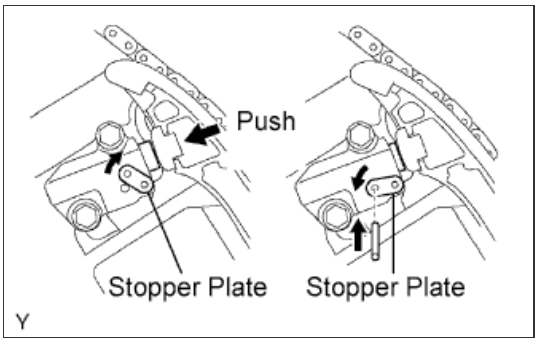
a. Remove the 4 bolts, timing chain cover plate and gasket.



b. While turning the stopper plate of the tensioner clockwise, push in the plunger of the chain tensioner as shown in the illustration.

c. While turning the stopper plate of the tensioner counterclockwise, insert a bar of φ3.5 mm (0.138 in.) into the holes on the stopper plate and tensioner to fix the stopper plate in place.

d. Remove the 2 bolts and chain tensioner.

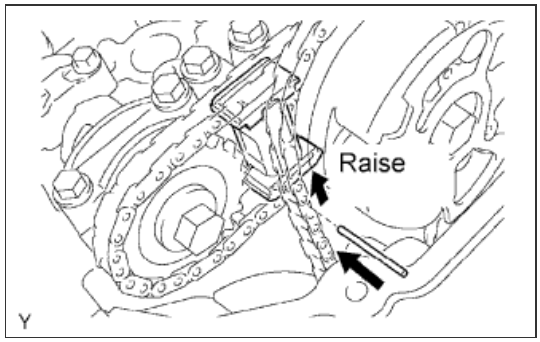


15. REMOVE NO. 2 CAMSHAFT

NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

a. While raising the No. 2 chain tensioner, insert a pin of φ1.0 mm (0.0394 in.) into the hole to fix the tensioner in place.

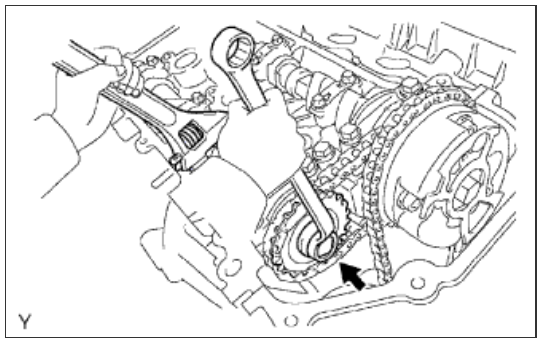


b. Hold the hexagonal portion of the No. 2 camshaft with a wrench, and remove the camshaft timing sprocket set bolt.

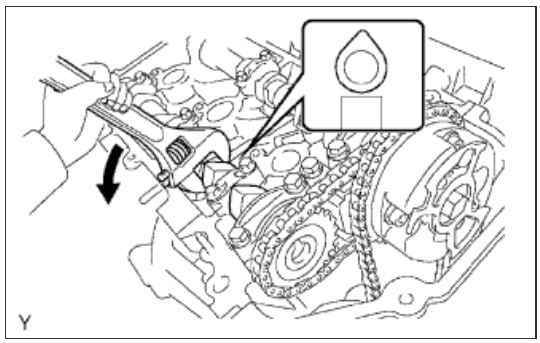
NOTICE:

Be careful not to damage the cylinder head and valve lifter with the wrench.

c. Separate the camshaft timing sprocket from the No. 2 camshaft.

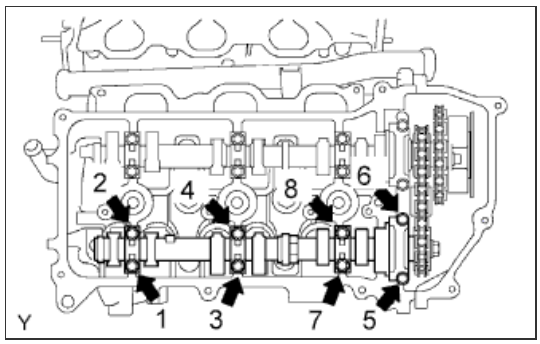


d. Rotate the camshaft counterclockwise using a wrench so that the cam lobes of the No. 1 cylinder face upward as shown in the illustration.



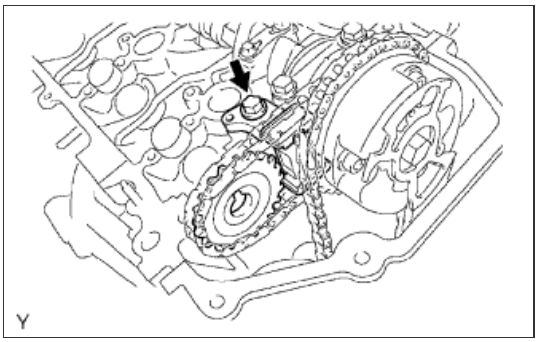
e. Using several steps, loosen and remove the 8 bearing cap bolts uniformly in the sequence shown in the illustration.

f. Remove the 4 bearing caps and No. 2 camshaft.



16. REMOVE NO. 2 CHAIN TENSIONER ASSEMBLY

a. Remove the No. 2 chain tensioner bolt, and then remove the No. 2 chain tensioner and camshaft timing sprocket.

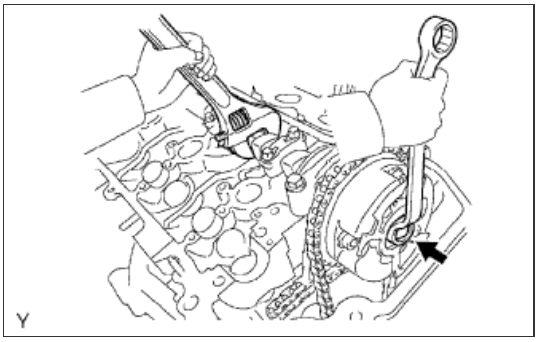


17. REMOVE NO. 1 CAMSHAFT

NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

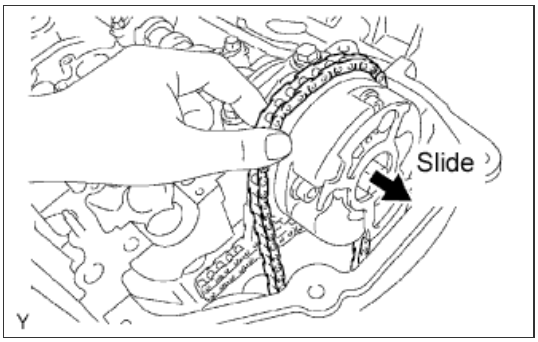
a. Hold the hexagonal portion of the No. 1 camshaft with a wrench, and loosen the camshaft timing gear set bolt.



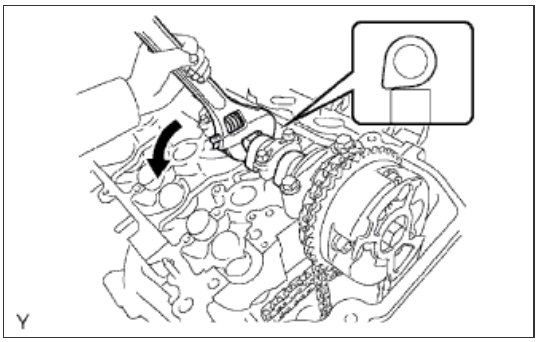
NOTICE:

- **Be careful not to damage the c linder head and al difter with the wrench.**
- **Do not di a dote the cam haft timing gear a doh .**

b. Slide the camshaft timing gear and separate the No. 1 chain from the camshaft timing gear.

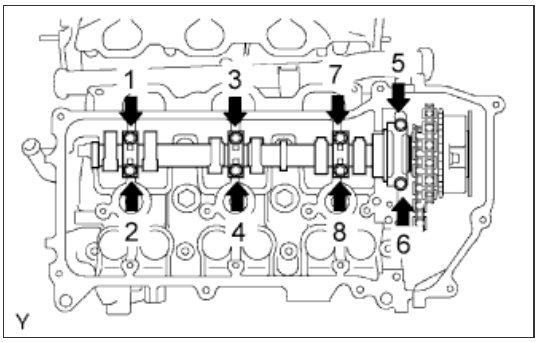


c. Rotate the No. 1 camshaft counterclockwise using a wrench so that the cam lobes of the No. 1 cylinder face downward as shown in the illustration.

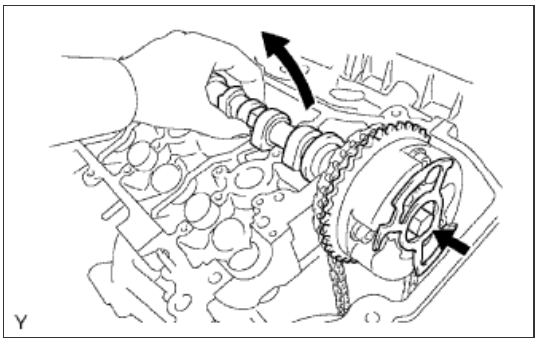


d. Using several steps, loosen and remove the 8 bearing cap bolts in the sequence shown in the illustration.

e. Remove the 4 bearing caps.



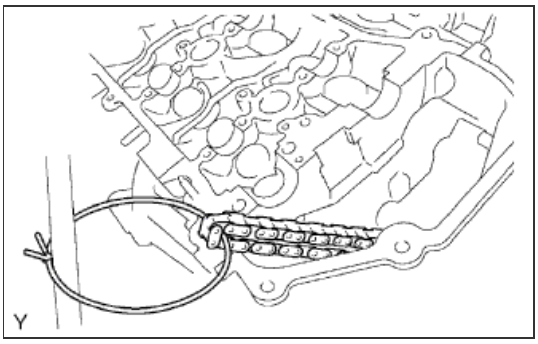
f. Remove the camshaft timing gear set bolt with the No. 1 camshaft lifted up, and then remove the No. 1 camshaft and camshaft timing gear with the No. 2 chain.



g. Tie the No. 1 chain with a string as shown in the illustration.

NOTICE:

Be careful not to drop anything inside the timing chain cover.

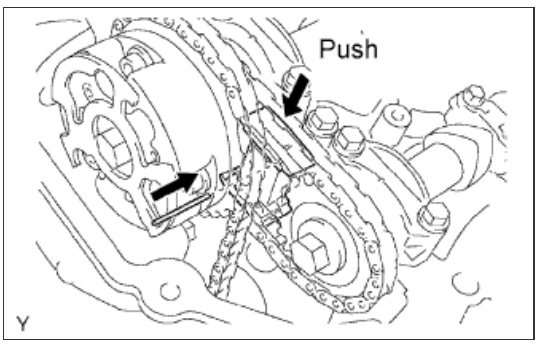


18. REMOVE NO. 4 CAMSHAFT SUB-ASSEMBLY

NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

a. While pushing down the No. 3 chain tensioner, insert a pin of φ1.0 mm (0.0394 in.) into the hole to fix the tensioner in place.

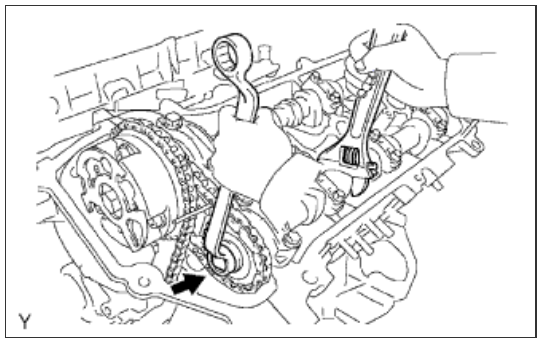


b. Hold the hexagonal portion of the No. 4 camshaft with a wrench, and remove the camshaft timing sprocket set bolt.

NOTICE:

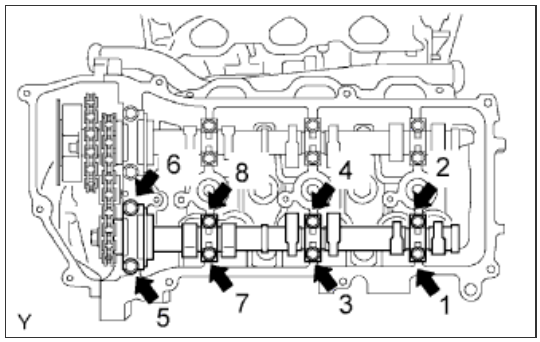
Be careful not to damage the cylinder head and valve lifter with the wrench.

c. Separate the camshaft timing sprocket from the No. 4 camshaft.



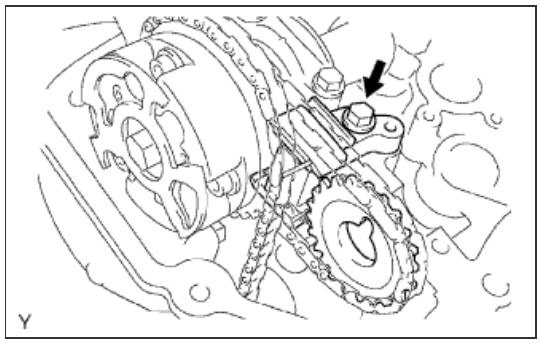
d. Using several steps, loosen and remove the 8 bearing cap bolts uniformly in the sequence shown in the illustration.

e. Remove the 4 bearing caps and No. 4 camshaft.



19. REMOVE NO. 3 CHAIN TENSIONER ASSEMBLY

a. Remove the No. 3 chain tensioner bolt, and then remove the No. 3 chain tensioner and camshaft timing sprocket.

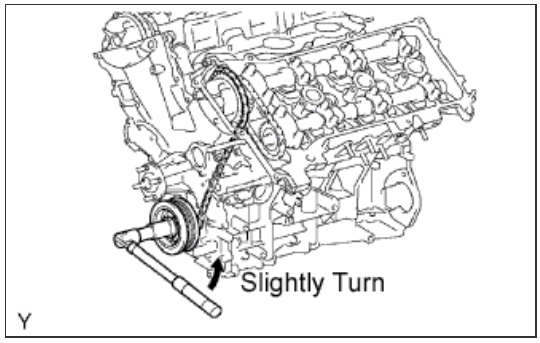


20. REMOVE NO. 3 CAMSHAFT SUB-ASSEMBLY

NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

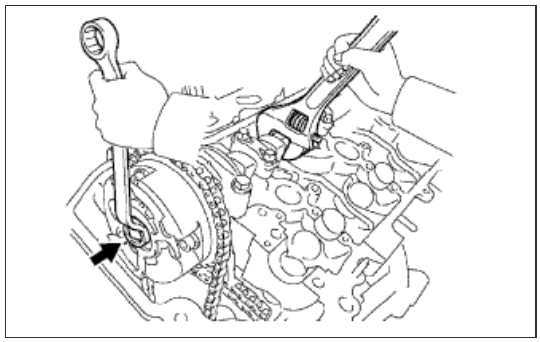
a. Release the chain tension between the camshaft timing gear (LH bank) and crankshaft timing gear by turning the crankshaft pulley counterclockwise slightly.



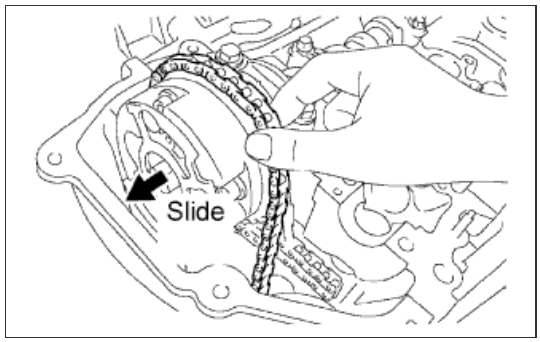
b. Hold the hexagonal portion of the No. 3 camshaft with a wrench, and loosen the camshaft timing gear set bolt.

NOTICE:

- **Be careful not to damage the c linder head and al difter with the wrench.**
- **Do not di a ete the cam haft timing gear a dh .**

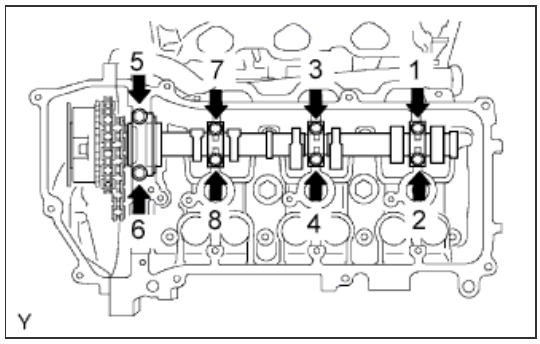


c. Slide the camshaft timing gear and separate the No. 1 chain from the camshaft timing gear.

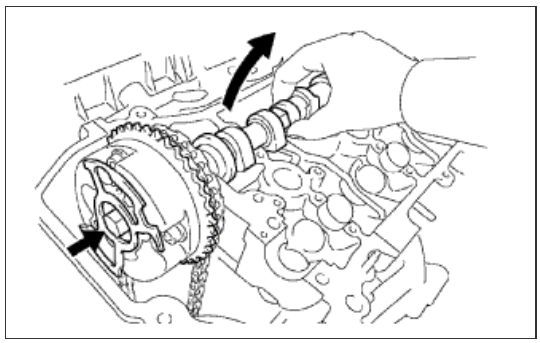


d. Using several steps, loosen and remove the 8 bearing cap bolts uniformly in the sequence shown in the illustration.

e. Remove the 4 bearing caps.



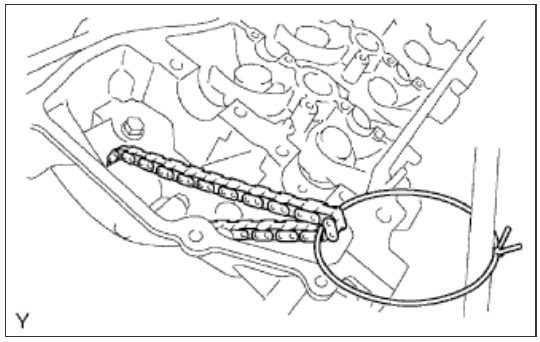
f. Remove the camshaft timing gear set bolt with the No. 3 camshaft lifted up, and then remove the No. 3 camshaft and camshaft timing gear with the No. 2 chain.



g. Tie the No. 1 chain with a string as shown in the illustration.

NOTICE:

Be careful not to drop anything inside the timing chain cover.



for Preparation Click here

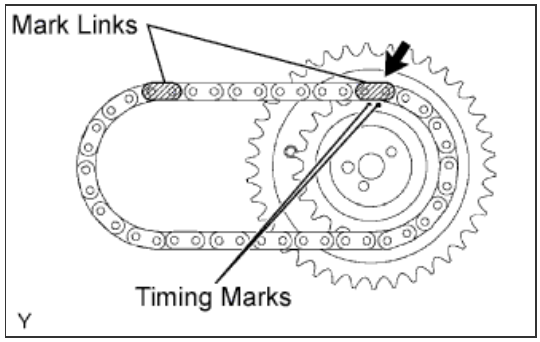
1. INSTALL NO. 3 CAMSHAFT SUB-ASSEMBLY

NOTICE:

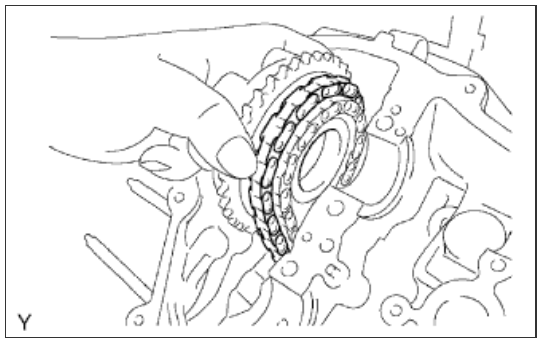
As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

a. Align the mark link (yellow) with the timing mark (2-dot mark) of the camshaft timing gear as shown in the illustration.

b. Apply new engine oil to the thrust portions and journals of the camshaft.

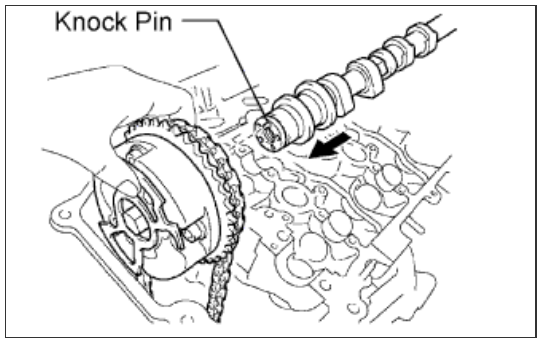


c. Temporarily put the No. 1 chain on the No. 2 chain of the camshaft timing gear.

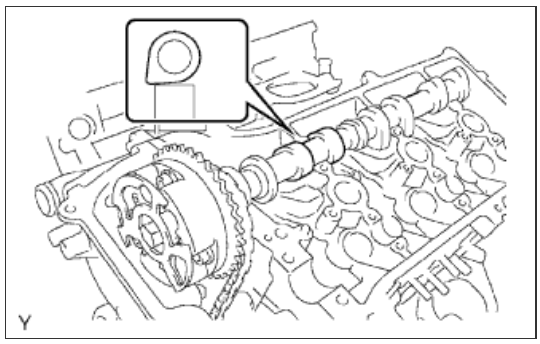


d. Align the knock pin hole of the camshaft timing gear with the knock pin of the No. 3 camshaft, and insert the No. 3 camshaft into the camshaft timing gear.

e. Temporarily install the camshaft timing gear set bolt.

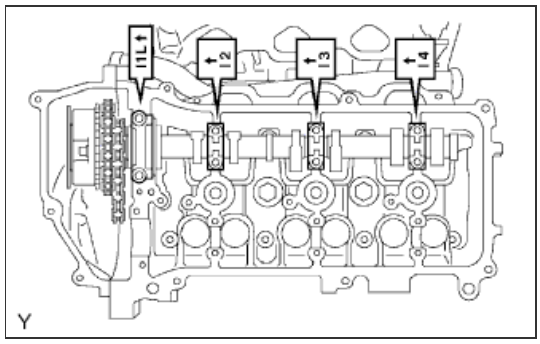


f. Set the No. 3 camshaft onto the cylinder head LH with the cam lobes of the No. 2 cylinder facing downward as shown in the illustration.



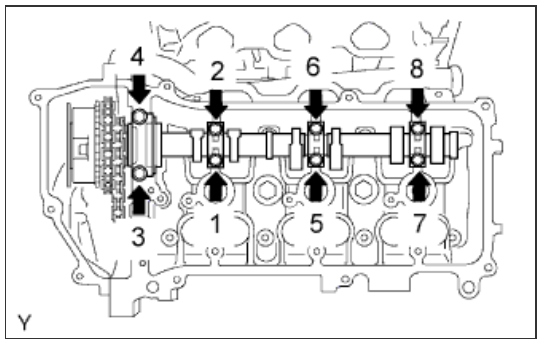
g. Set the 4 bearing caps in their proper locations.

h. Apply a light coat of engine oil to the threads and under the heads of the bearing cap bolts.

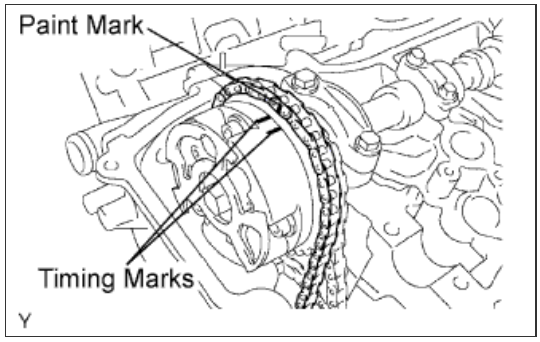


i. Using several steps, install the 8 bearing cap bolts uniformly in the sequence shown in the illustration.

Torque:
for 10 mm head bolt:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }
for 12 mm head bolt:
24 N*m{ 245 kgf*cm , 18 ft.*lbf }

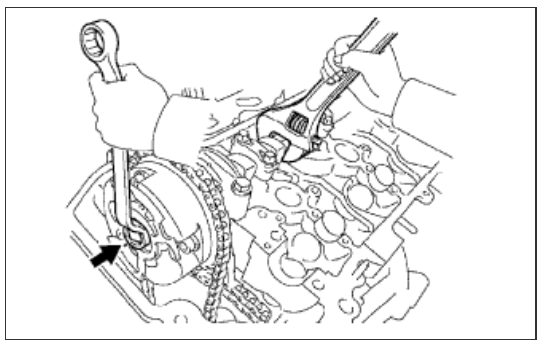


j. Set the paint mark of the No. 1 chain between the timing marks of the camshaft timing gear.



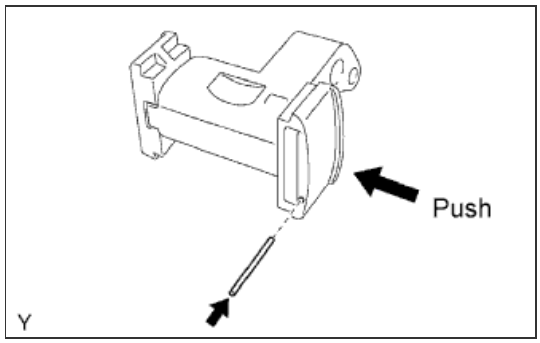
k. Hold the hexagonal portion of the No. 3 camshaft with a wrench, and tighten the camshaft timing gear set bolt.

Torque:
100 N*m{ 1020 kgf*cm , 74 ft.*lbf }



2. INSTALL NO. 3 CHAIN TENSIONER ASSEMBLY

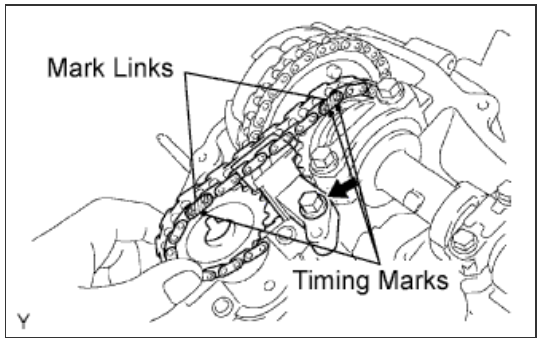
a. While pushing in the tensioner, insert a pin of φ1.0 mm (0.0394 in.) into the hole to fix the tensioner in place.



b. Temporarily install the camshaft timing sprocket and No. 3 chain tensioner with the bolt and align the mark links (yellow) with the timing marks (1-dot mark and 2-dot mark) of the camshaft timing gear and sprocket.

c. Tighten the No. 3 chain tensioner bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



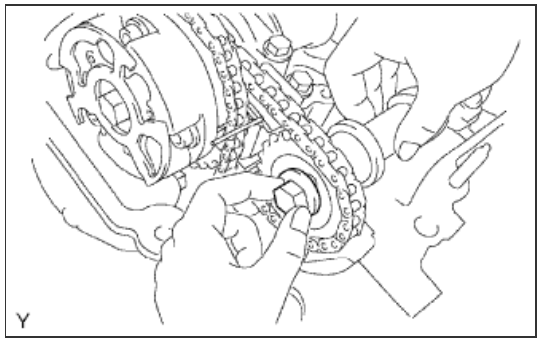
3. INSTALL NO. 4 CAMSHAFT SUB-ASSEMBLY

NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

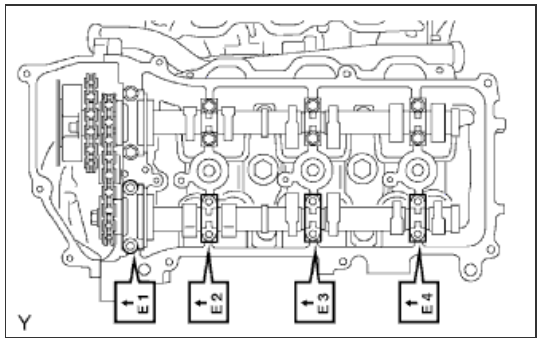
a. Align the knock pin hole of the camshaft timing sprocket with the knock pin of the No. 4 camshaft, and insert the No. 4 camshaft into the camshaft timing sprocket.

b. Temporarily install the camshaft timing sprocket set bolt.



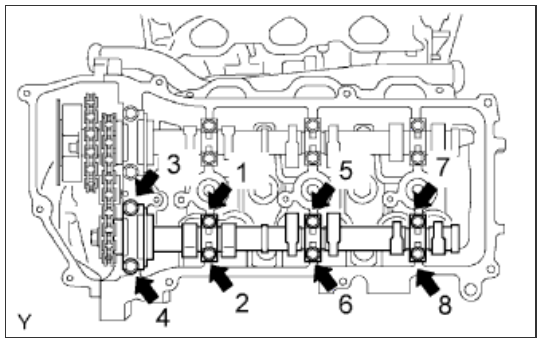
c. Set the 4 bearing caps in their proper locations.

d. Apply a light coat of engine oil to the threads of the bearing cap bolts.



e. Using several steps, install the 8 bearing cap bolts uniformly in the sequence shown in the illustration.

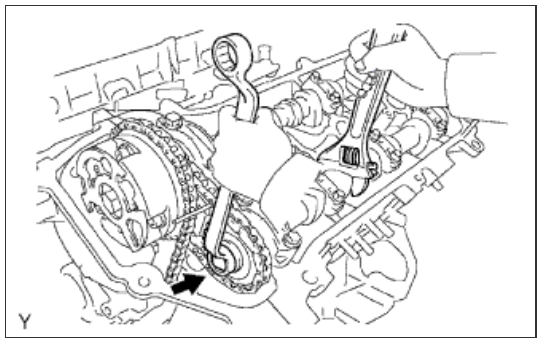
Torque:
for 10 mm head bolt:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }
for 12 mm head bolt:
24 N*m{ 245 kgf*cm , 18 ft.*lbf }



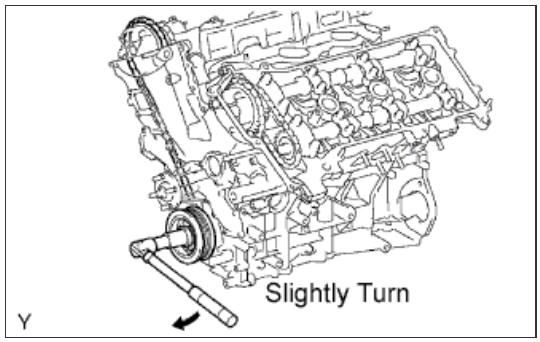
f. Hold the hexagonal portion of the No. 4 camshaft with a wrench, and tighten the camshaft timing sprocket set bolt.

Torque:
100 N*m{ 1020 kgf*cm , 74 ft.*lbf }

g. Remove the pin from the No. 3 chain tensioner



h. Release the chain tension between the camshaft timing gear (RH bank) and crankshaft timing gear by turning the crankshaft pulley clockwise slightly.



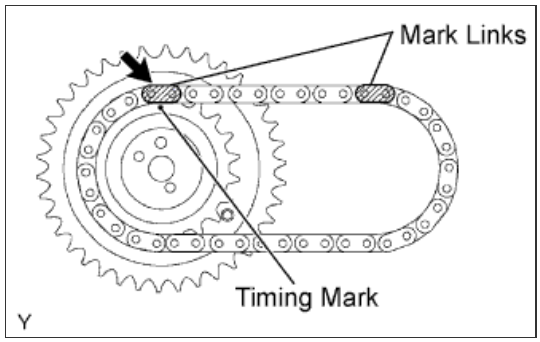
4. INSTALL NO. 1 CAMSHAFT

NOTICE:

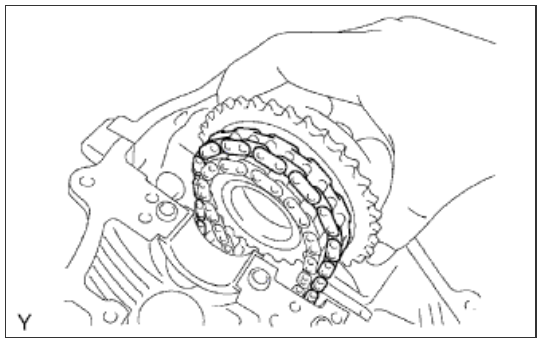
As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

a. Align the mark link (yellow) with the timing mark (1-dot mark) of the camshaft timing gear as shown in the illustration.

b. Apply new engine oil to the thrust portions and journals of the camshaft.

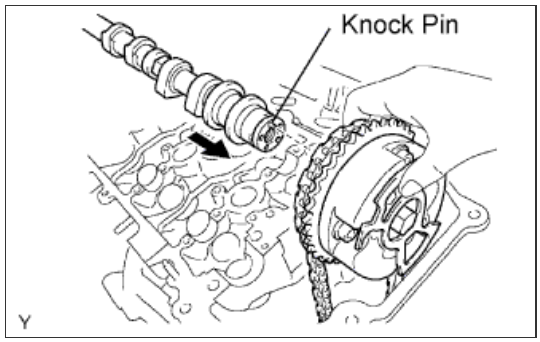


c. Temporarily put the No. 1 chain on the No. 2 chain of the camshaft timing gear.

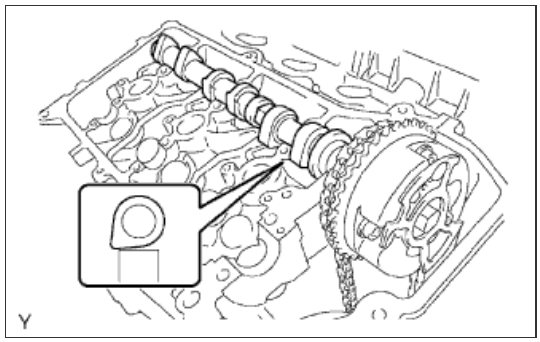


d. Align the knock pin hole of the camshaft timing gear with the knock pin of the No. 1 camshaft, and insert the No. 1 camshaft into the camshaft timing gear.

e. Temporarily install the camshaft timing gear set bolt.

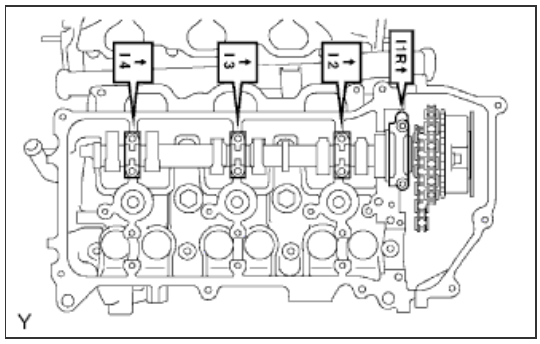


f. Set the No. 1 camshaft onto the cylinder head RH with the cam lobes of the No. 1 cylinder facing downward as shown in the illustration.



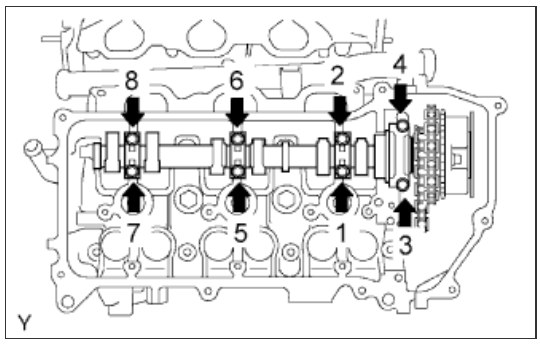
g. Set the 4 bearing caps in their proper locations.

h. Apply a light coat of engine oil to the threads and under the heads of the bearing cap bolts.

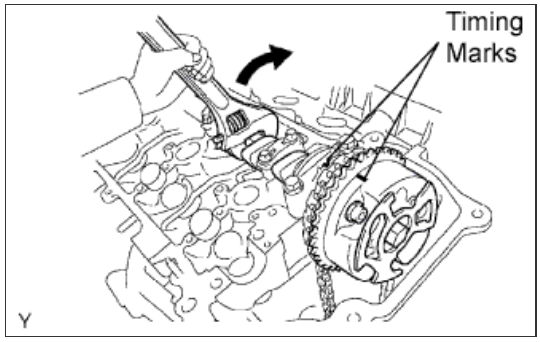


i. Using several steps, install the 8 bearing cap bolts uniformly in the sequence shown in the illustration.

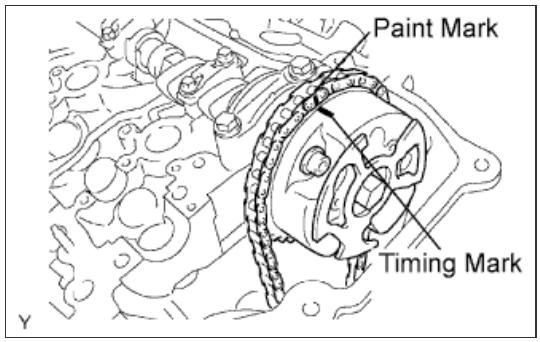
Torque:
for 10 mm head bolt:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }
for 12 mm head bolt:
24 N*m{ 245 kgf*cm , 18 ft.*lbf }



j. Rotate the No. 1 camshaft clockwise using a wrench so that the timing mark of the camshaft timing gear is aligned with the timing mark of the camshaft bearing cap.

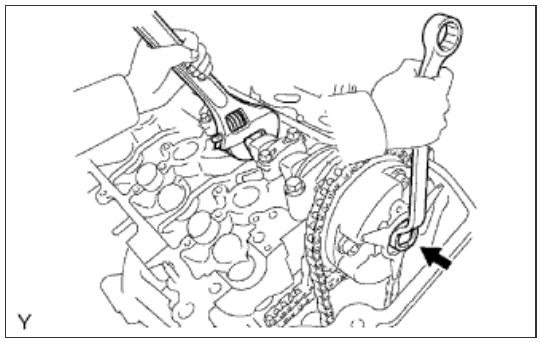


k. Align the paint mark of the No. 1 chain with the timing mark of the camshaft timing gear.



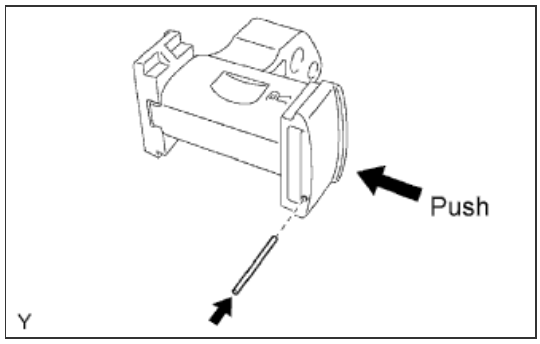
l. Hold the hexagonal portion of the No. 1 camshaft with a wrench, and tighten the camshaft timing gear set bolt.

Torque:
100 N*m{ 1020 kgf*cm , 74 ft.*lbf }



5. INSTALL NO. 2 CHAIN TENSIONER ASSEMBLY

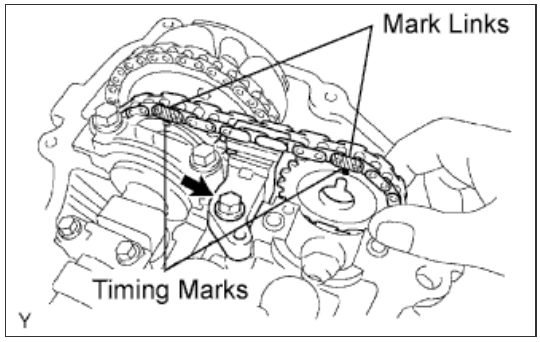
a. While pushing in the tensioner, insert a pin of φ1.0 mm (0.0394 in.) into the hole to fix the tensioner in place.



b. Temporarily install the camshaft timing sprocket and No. 2 chain tensioner with the bolt and align the mark links (yellow) with the timing marks (1-dot mark) of the camshaft timing gear and sprocket.

c. Tighten the No. 2 chain tensioner bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

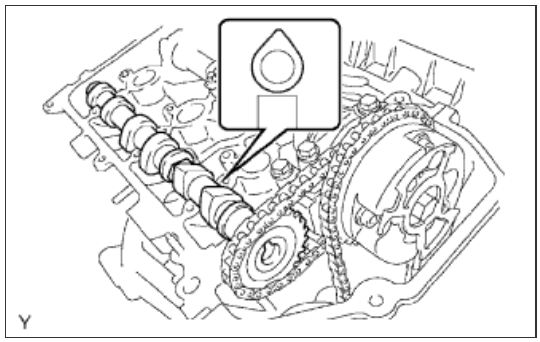


6. INSTALL NO. 2 CAMSHAFT

NOTICE:

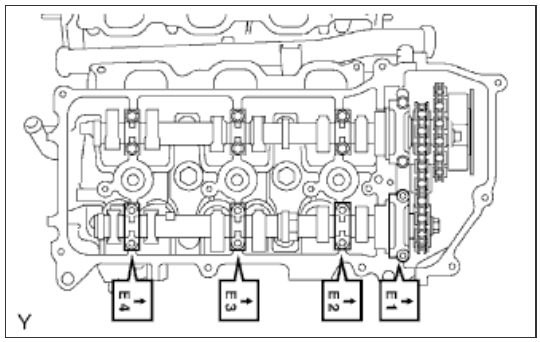
As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

a. Set the No. 2 camshaft onto the cylinder head RH with the cam lobes of the No. 1 cylinder facing upward as shown in the illustration.



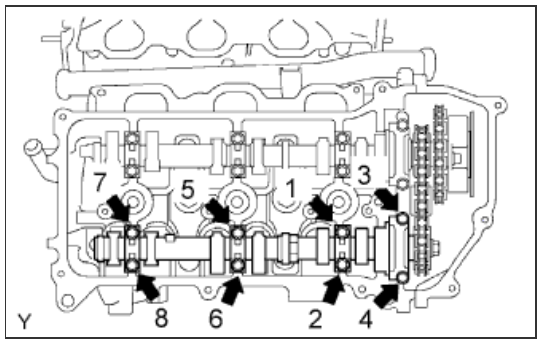
b. Set the 4 bearing caps in their proper locations.

c. Apply a light coat of engine oil to the threads and under the heads of the bearing cap bolts.

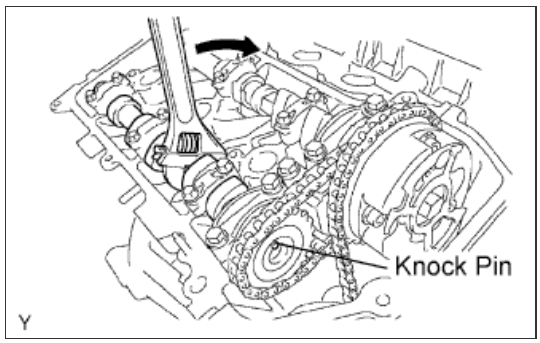


d. Using several steps, install the 8 bearing cap bolts uniformly in the sequence shown in the illustration.

Torque:
for 10 mm head bolt:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }
for 12 mm head bolt:
24 N*m{ 245 kgf*cm , 18 ft.*lbf }



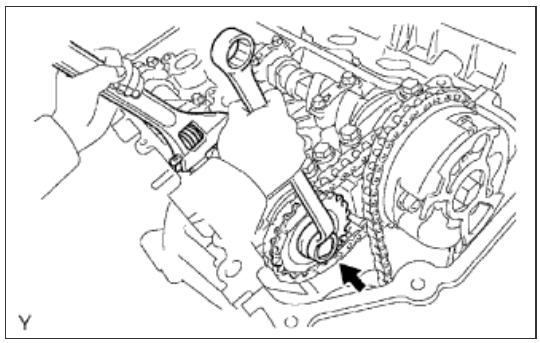
e. Rotate the No. 2 camshaft clockwise using a wrench so that the knock pin of the No. 2 camshaft is aligned with the knock pin hole of the camshaft timing sprocket.



f. Hold the hexagonal portion of the No. 2 camshaft with a wrench, and install the camshaft timing sprocket set bolt.

Torque:
100 N*m{ 1020 kgf*cm , 74 ft.*lbf }

g. Remove the pin from the No. 2 chain tensioner.



7. INSTALL NO. 1 CHAIN TENSIONER ASSEMBLY

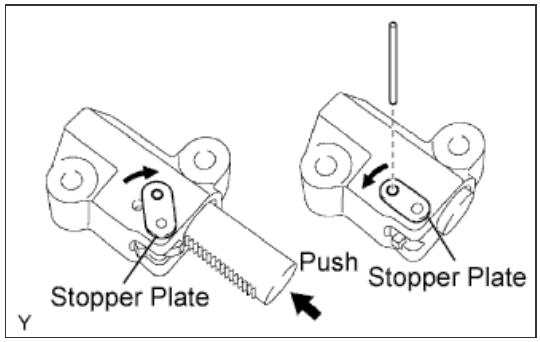
a. While turning the stopper plate of the tensioner clockwise, push in the plunger of the tensioner as shown in the illustration.

b. While turning the stopper plate of the tensioner counterclockwise, insert a bar of φ3.5 mm (0.138 in.) into the holes on the stopper plate and tensioner to fix the stopper plate in place.

c. Install the chain tensioner with the 2 bolts.

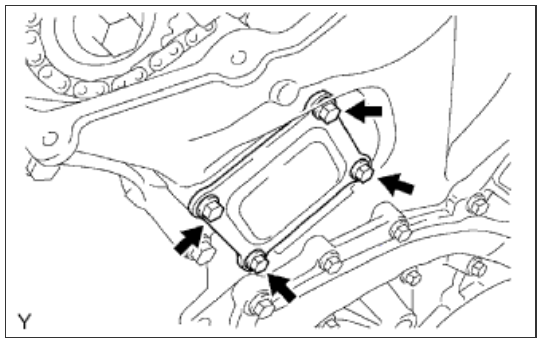
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

d. Remove the bar from the chain tensioner.

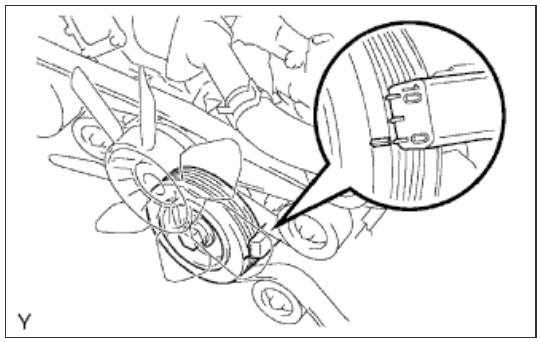


e. Install a new gasket and the timing chain cover plate with the 4 bolts.

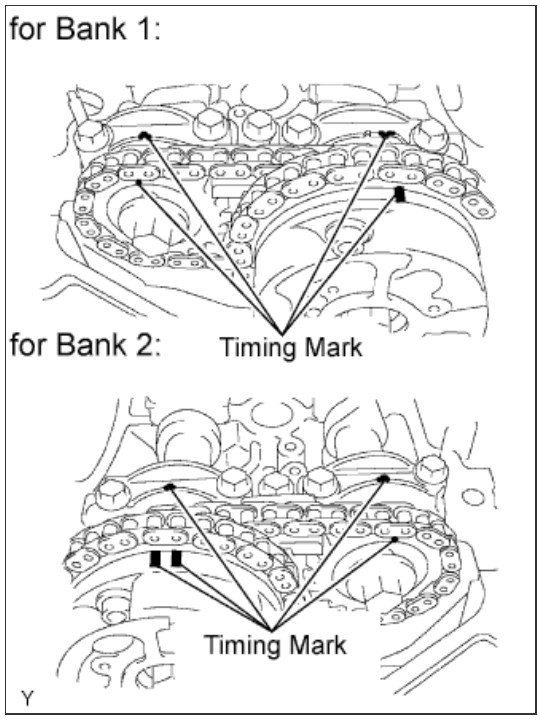
Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



f. Turn the crankshaft pulley 2 complete revolutions slowly, and align the notch with the timing mark "0" of the timing chain cover.

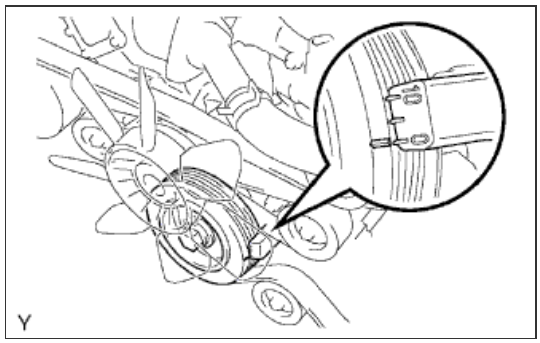


g. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing caps as shown in the illustration.

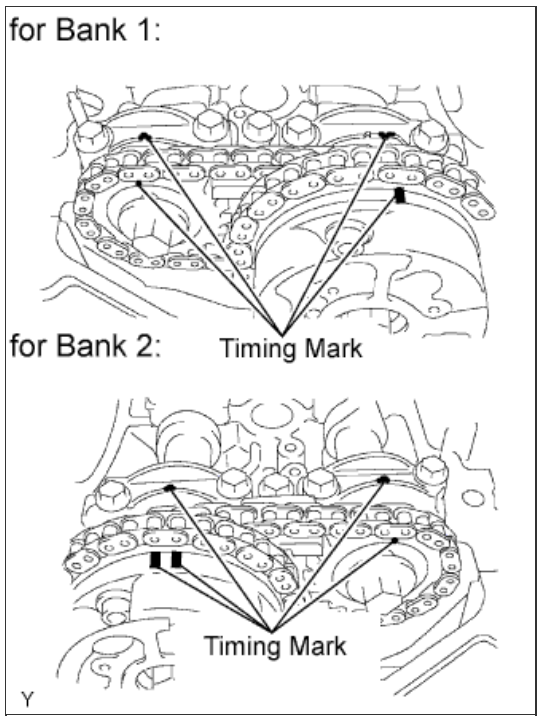


8. SET NO. 1 CYLINDER TO TDC/COMPRESSION

a. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.



b. Check that the timing marks of the camshaft timing gears and sprockets are aligned with the timing marks of the bearing caps as shown in the illustration. If not, turn the crankshaft 1 complete revolution (360°) and align the timing marks as above.



9. INSPECT VALVE CLEARANCE

a. Check the valves indicated in the illustration.

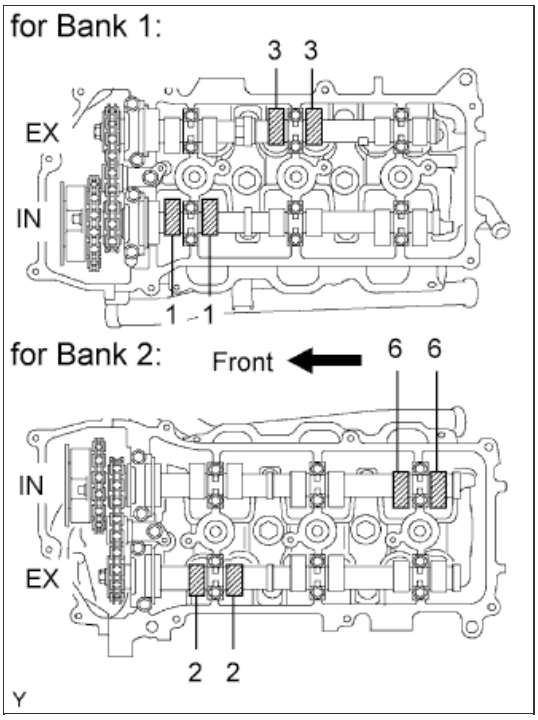
i. Using a feeler gauge, measure the clearance between the valve lifter and camshaft.

Standard Valve Clearance (Cold):

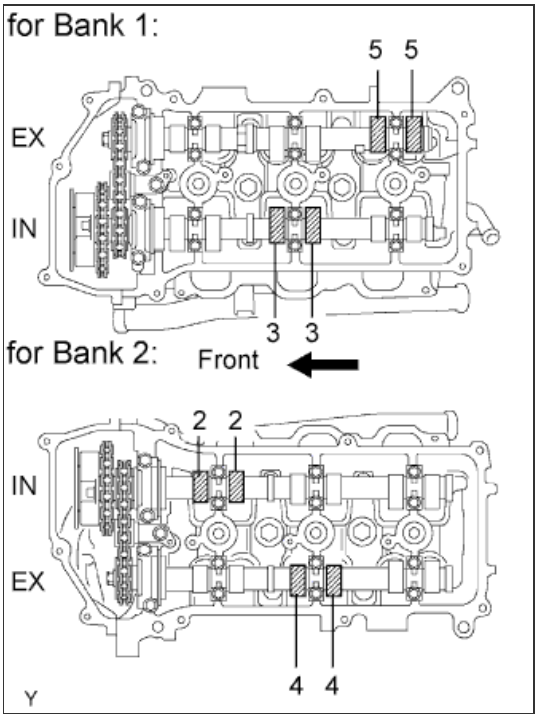
Item	Specified Condition
Intake	0.15 to 0.25 mm (0.00591 to 0.00984 in.)
xhaust	0.29 to 0.39 mm (0.0114 to 0.0154 in.)

ii. Record the out-of-specification valve clearance measurements. They will be used later to determine the required replacement valve lifter.

b. Turn the crankshaft 2/3 of a revolution (240°).



c. Check the valves indicated in the illustration.



i. Using a feeler gauge, measure the clearance between the valve lifter and camshaft.

Standard Valve Clearance (Cold):

Item	Specified Condition
Intake	0.15 to 0.25 mm (0.00591 to 0.00984 in.)
xhaust	0.29 to 0.39 mm (0.0114 to 0.0154 in.)

ii. Record the out-of-specification valve clearance measurements. They will be used later to determine the required replacement valve lifter.

d. Turn the crankshaft 2/3 of a revolution (240°).

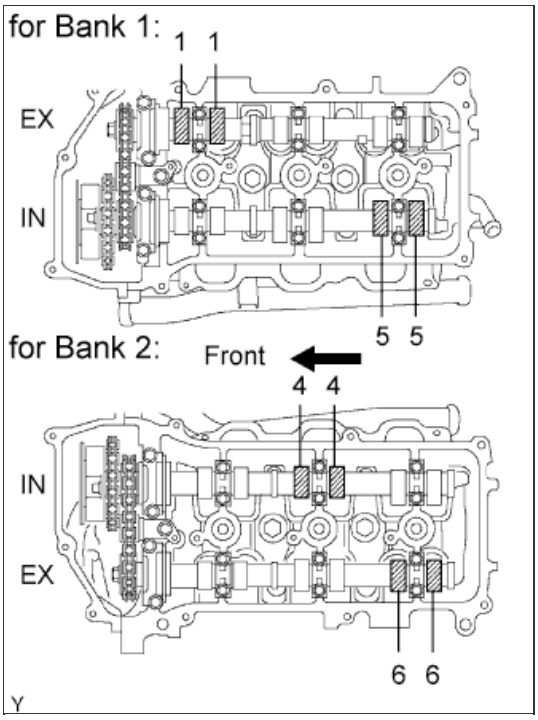
e. Check the valves indicated in the illustration.

i. Using a feeler gauge, measure the clearance between the valve lifter and camshaft.

Standard Valve Clearance (Cold):

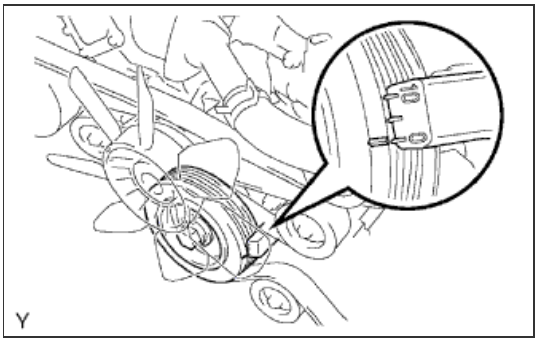
Item	Specified Condition
Intake	0.15 to 0.25 mm (0.00591 to 0.00984 in.)
xhaust	0.29 to 0.39 mm (0.0114 to 0.0154 in.)

ii. Record the out-of-specification valve clearance measurements. They will be used later to determine the required replacement valve lifter.



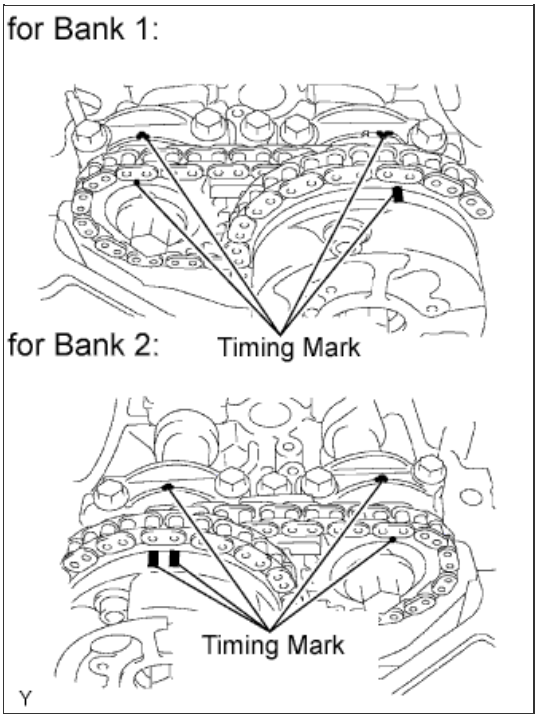
10. ADJUST VALVE CLEARANCE

a. Set the No. 1 cylinder to T Ccompression.



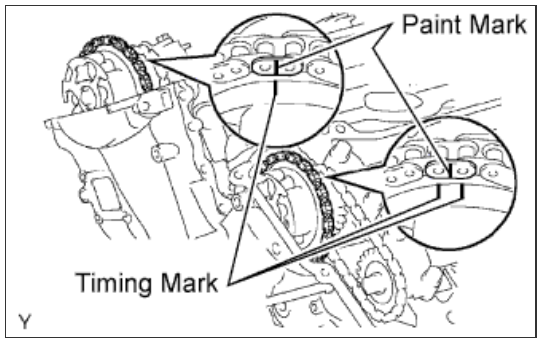
i. Turn the crankshaft pulley, and align the notch with the timing mark "0" of the timing chain cover.

ii. Check that the timing marks of the camshaft timing gears and sprockets are aligned with the timing marks of the bearing caps as shown in the illustration.
If not, turn the crankshaft 1 complete revolution (360°) and align the timing marks as above.



iii. Mark point marks on the chain links that correspond with the timing

iii. Place paint marks on the chain links that correspond with the timing marks of the camshaft timing gears.

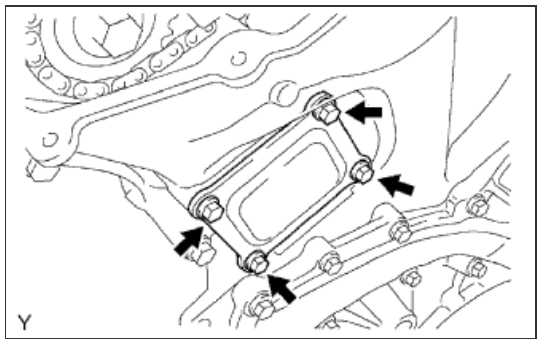


b. Remove the No. 1 chain tensioner.

NOTICE:

- **Never rotate the crankshaft with the No. 1 chain tensioner removed.**
- **When rotating the camshaft with the No. 1 chain removed, turn the crankshaft counterclockwise 40° from TDC first.**

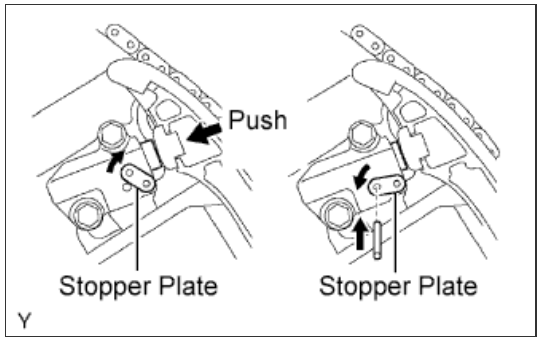
i. Remove the 4 bolts, timing chain cover plate and gasket.



ii. While rotating the stopper plate of the No. 1 chain tensioner clockwise, push in the plunger of the No. 1 chain tensioner as shown in the illustration.

iii. While rotating the stopper plate of the tensioner counterclockwise downward, insert a bar of φ3.5 mm (0.138 in.) into the holes in the stopper plate and tensioner to fix the stopper plate in place.

iv. Remove the 2 bolts and No. 1 chain tensioner.

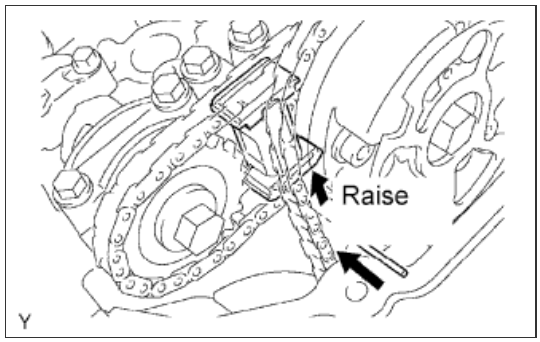


c. Remove the No. 2 camshaft.

NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

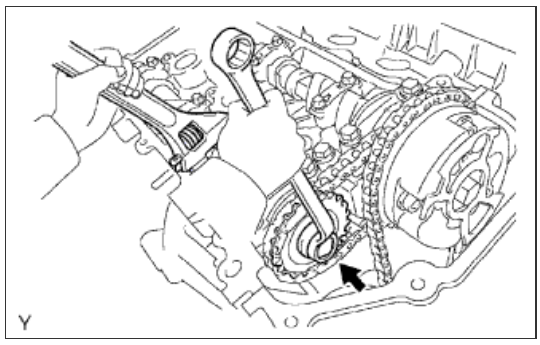
i. While raising the No. 2 chain tensioner, insert a pin of φ1.0 mm (0.0394 in.) into the hole to fix the tensioner in place.



ii. Hold the hexagonal portion of the No. 2 camshaft with a wrench, and remove the camshaft timing sprocket set bolt.

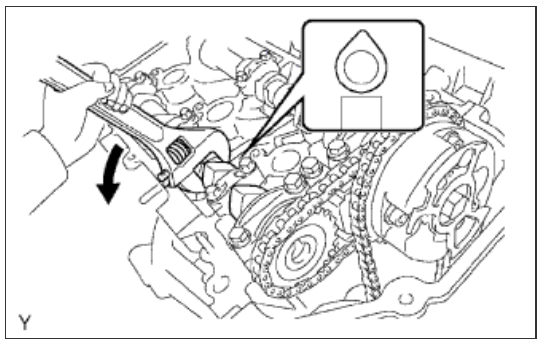
NOTICE:

Be careful not to damage the cylinder head and valve lifter with the wrench.



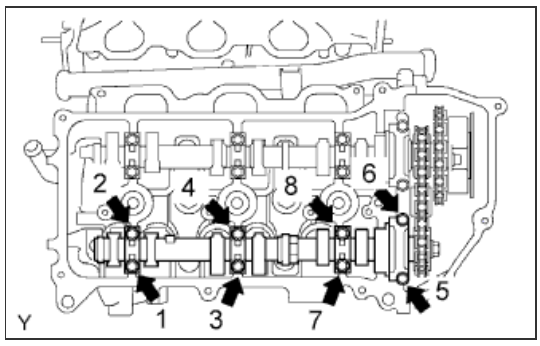
iii. Separate the camshaft timing sprocket from the No. 2 camshaft.

iv. Rotate the camshaft counterclockwise using the wrench so that the cam lobes of the No. 1 cylinder face upward as shown in the illustration.



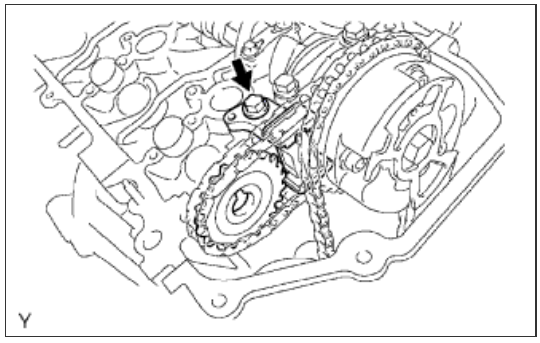
v. Uniformly loosen and remove the 8 bearing cap bolts in the sequence shown in the illustration.

vi. Remove the 4 bearing caps and No. 2 camshaft.



d. Remove the No. 2 chain tensioner.

i. Remove the No. 2 chain tensioner bolt, No. 2 chain tensioner and camshaft timing sprocket.



e. Remove the No. 1 camshaft.

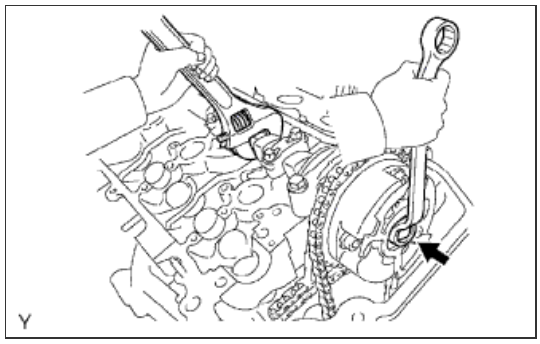
NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

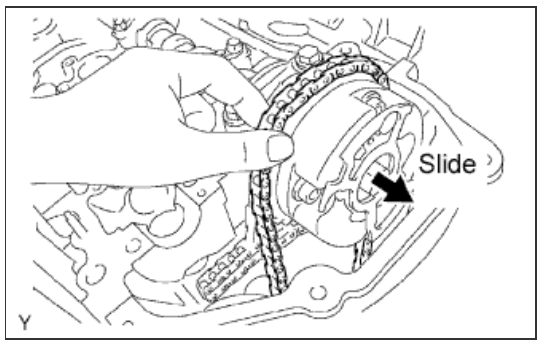
i. Hold the hexagonal portion of the No. 1 camshaft with a wrench, and loosen the camshaft timing gear set bolt.

NOTICE:

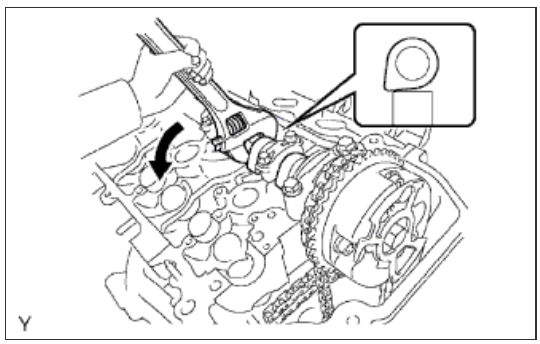
- **Be careful not to damage the cylinder head and valve lifter with the wrench.**
- **Do not disassemble the camshaft timing gear.**



ii. Slide the camshaft timing gear and separate the No. 1 chain from the camshaft timing gear.

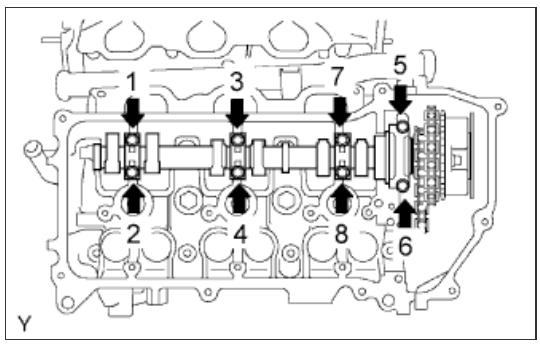


iii. Rotate the No. 1 camshaft counterclockwise using a wrench so that the cam lobes of the No. 1 cylinder face downward as shown in the illustration.

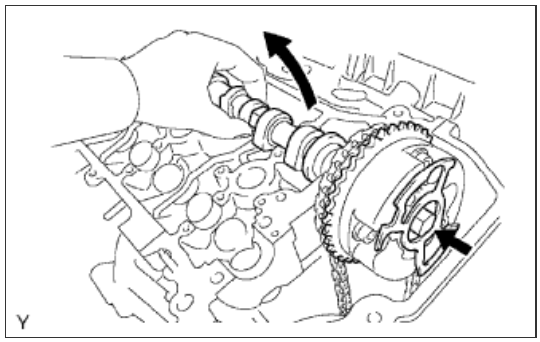


iv. Uniformly loosen and remove the 8 bearing cap bolts in the sequence shown in the illustration.

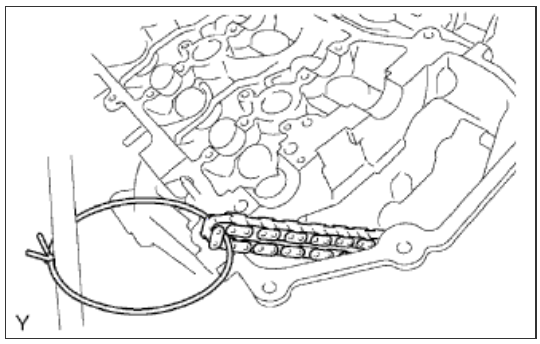
v. Remove the 4 bearing caps.



vi. Remove the camshaft timing gear set bolt with the No. 1 camshaft lifted up, and then remove the No. 1 camshaft and camshaft timing gear with the No. 2 chain.



vii. Tie the No. 1 chain with a string as shown in the illustration.



NOTICE:

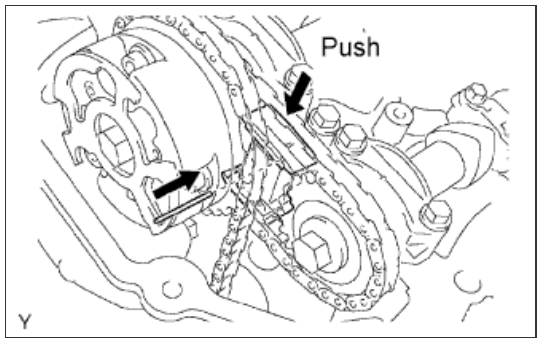
Be careful not to drop anything inside the timing chain cover.

f. Remove the No. 4 camshaft.

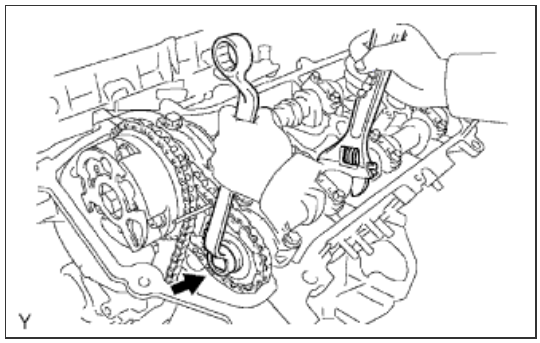
NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

i. While pushing down the No. 3 chain tensioner, insert a pin of φ1.0 mm (0.0394 in.) into the hole to fix the tensioner in place.



ii. Hold the hexagonal portion of the No. 4 camshaft with a wrench, and remove the camshaft timing sprocket set bolt.



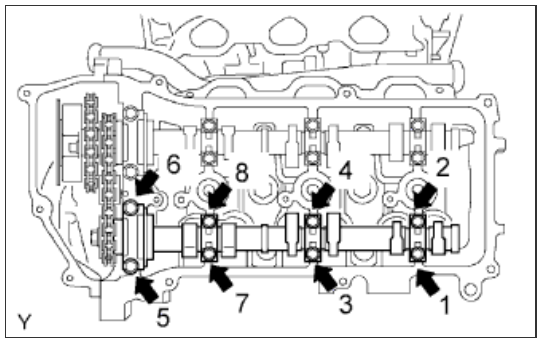
NOTICE:

Be careful not to damage the cylinder head and valve lifter with the wrench.

iii. Separate the camshaft timing sprocket from the No. 4 camshaft.

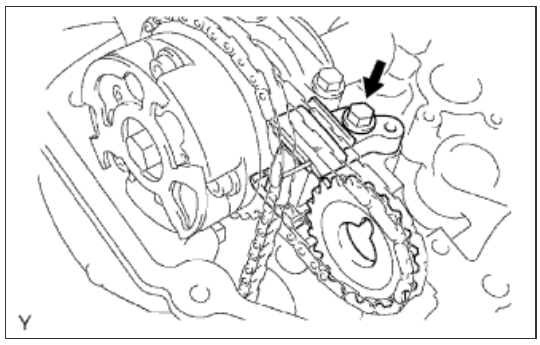
iv. Uniformly loosen and remove the 8 bearing cap bolts in the sequence shown in the illustration.

v. Remove the 4 bearing caps and No. 4 camshaft.



g. Remove the No. 3 chain tensioner.

i. Remove the No. 3 chain tensioner bolt, No. 3 chain tensioner and camshaft timing sprocket.



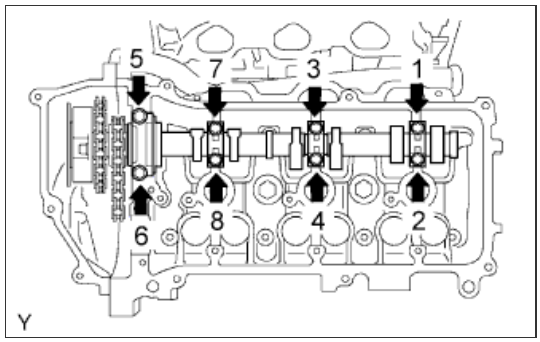
h. Remove the No. 3 camshaft.

NOTICE:

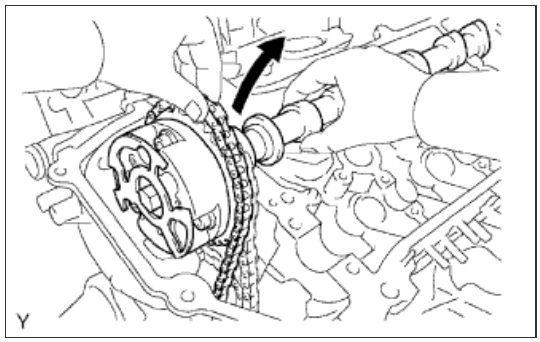
As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

i. Using several steps, loosen and remove the 8 bearing cap bolts uniformly in the sequence shown in the illustration.

ii. Remove the 4 bearing caps.



iii. Hold the No. 1 chain, and remove the No. 3 camshaft with camshaft timing gear and No. 2 chain.

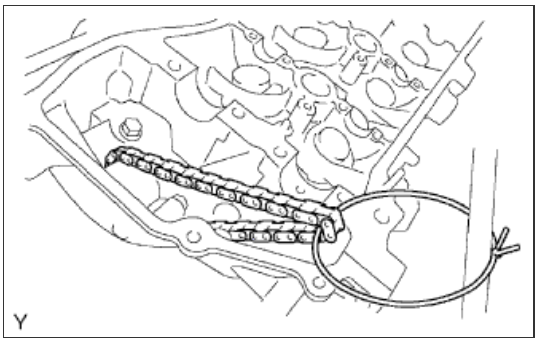


iv. Tie the No. 1 chain with a string as shown in the illustration.

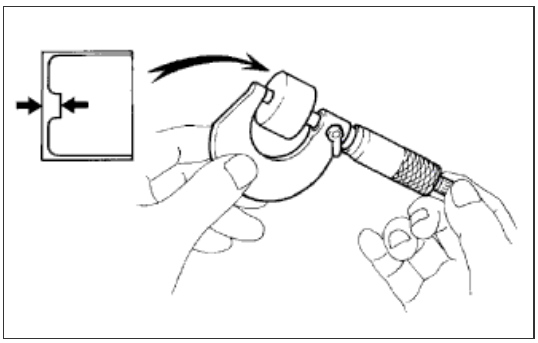
NOTICE:

Be careful not to drop anything inside the timing chain cover.

i. Remove the 24 valve lifters from the cylinder head LH and RH.



j. etermine the size of the valve lifter to be installed according to the following formulas or charts.



i. Using a micrometer, measure the thickness of the removed lifter.

ii. Calculate the thickness of a new lifter so that the valve clearance comes within the specified value.

T:
Thickness of removed lifter

A:
Measured valve clearance

N:
Thickness of new lifter

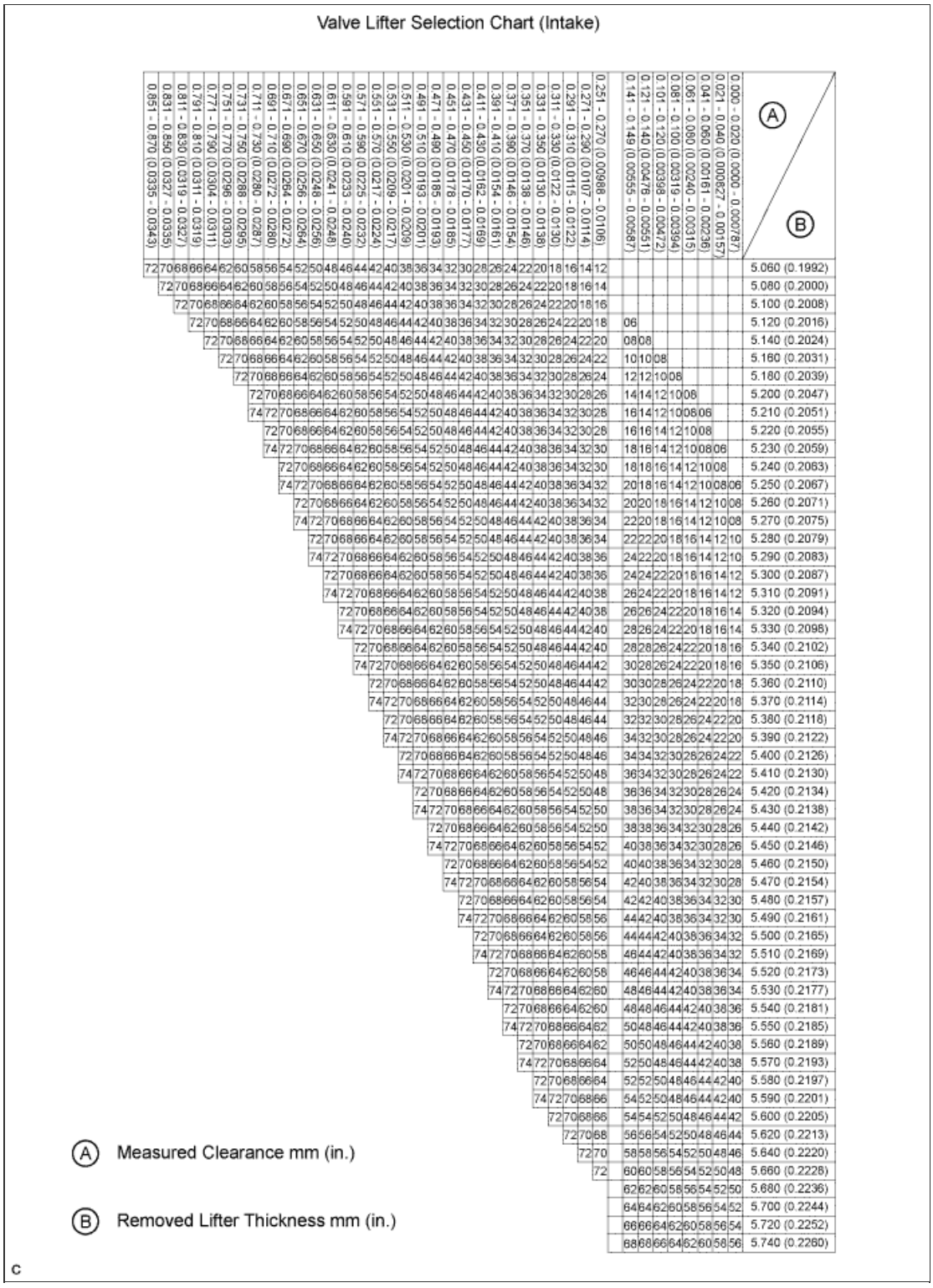
Intake:
N = T + (A - 0.20 mm (0.00787 in.))

Exhaust:
N = T + (A - 0.34 mm (0.0131 in.))

iii. Select a new lifter with a thickness as close as possible to the calculated value.

HINT:

Lifters are available in 35 sizes in increments of 0.020 mm (0.000787 in.), from 5.060 mm (0.1992 in.) to 5.740 mm (0.2260 in.).

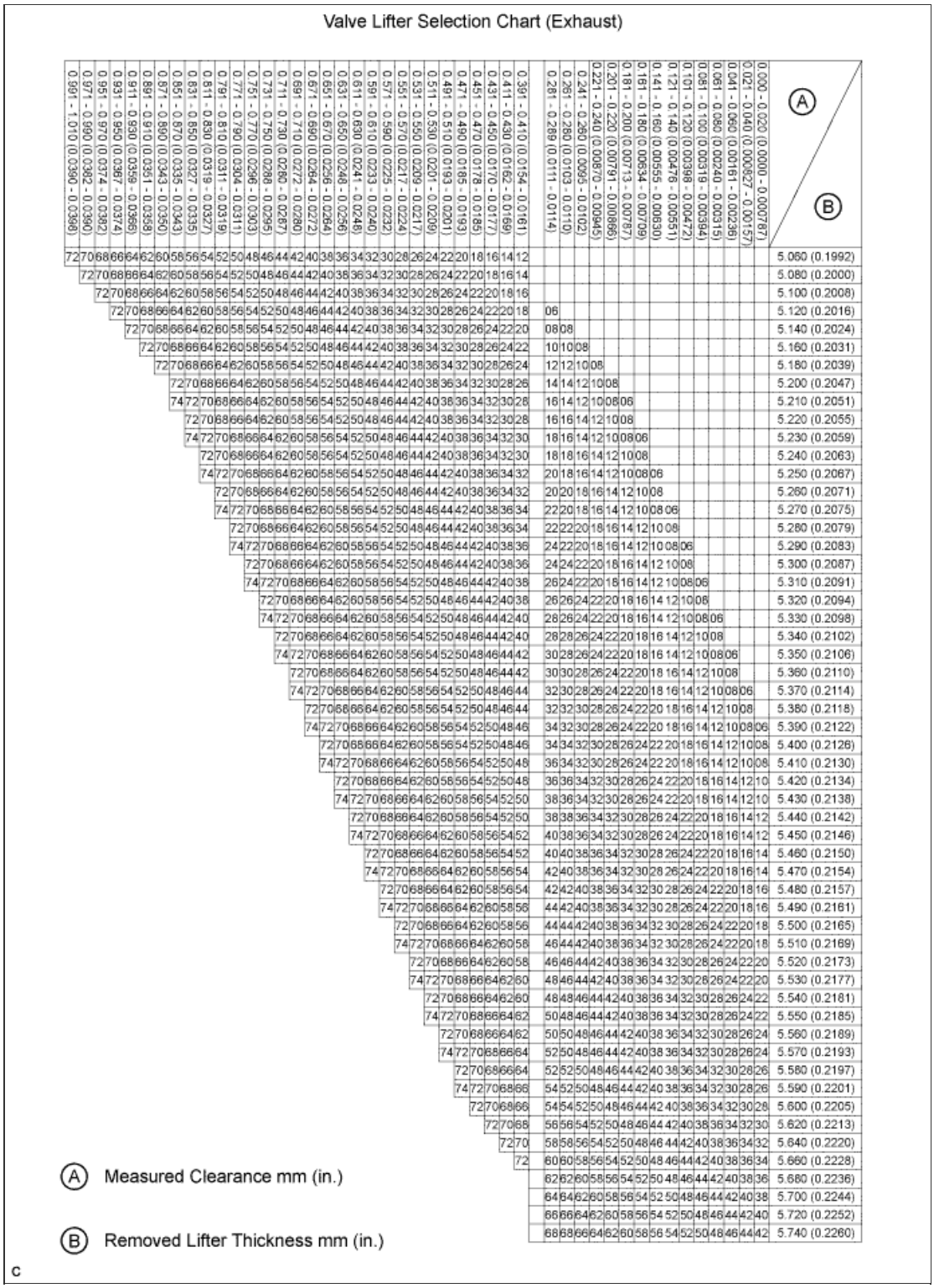


Intake valve clearance (Cold):
0.15 to 0.25 mm (0.00591 to 0.00984 in.)
EXAMPLE:
The 5.250 mm (0.2067 in.) lifter is installed, and the measured clearance is 0.400 mm (0.0157 in.). Replace the 5.250 mm (0.2067 in.) lifter with a No. 46 lifter.

New Lifter Thickness:

Lifter No.	Thickness	Lifter No.	Thickness	Lifter No.	Thickness
06	5.060 mm (0.1992 in.)	30	5.300 mm (0.2087 in.)	54	5.540 mm (0.2181 in.)
08	5.080 mm (0.2000 in.)	32	5.320 mm (0.2094 in.)	56	5.560 mm (0.2189 in.)
10	5.100 mm (0.2008 in.)	34	5.340 mm (0.2102 in.)	58	5.580 mm (0.2197 in.)
	5.120 mm		5.360 mm		5.600 mm

12	(0.2016 in.)	36	(0.2110 in.)	60	(0.2205 in.)
14	5.140 mm (0.2024 in.)	38	5.380 mm (0.2118 in.)	62	5.620 mm (0.2213 in.)
16	5.160 mm (0.2031 in.)	40	5.400 mm (0.2126 in.)	64	5.640 mm (0.2220 in.)
18	5.180 mm (0.2039 in.)	42	5.420 mm (0.2134 in.)	66	5.660 mm (0.2228 in.)
20	5.200 mm (0.2047 in.)	44	5.440 mm (0.2142 in.)	68	5.680 mm (0.2236 in.)
22	5.220 mm (0.2055 in.)	46	5.460 mm (0.2150 in.)	70	5.700 mm (0.2244 in.)
24	5.240 mm (0.2063 in.)	48	5.480 mm (0.2157 in.)	72	5.720 mm (0.2252 in.)
26	5.260 mm (0.2071 in.)	50	5.500 mm (0.2165 in.)	74	5.740 mm (0.2260 in.)
28	5.280 mm (0.2079 in.)	52	5.520 mm (0.2173 in.)	-	-



Exhaust valve clearance (Cold):
0.29 to 0.39 mm (0.0114 to 0.0154 in.)
EXAMPLE:
The 5.340 mm (0.210 in.) lifter is installed, and the measured clearance is 0.480 mm (0.0189 in.). Replace the 5.340 mm (0.210 in.) lifter with a No. 48 lifter.

New Lifter Thickness:

Lifter No.	Thickness	Lifter No.	Thickness	Lifter No.	Thickness
06	5.060 mm (0.1992 in.)	30	5.300 mm (0.2087 in.)	54	5.540 mm (0.2181 in.)
08	5.080 mm (0.2000 in.)	32	5.320 mm (0.2094 in.)	56	5.560 mm (0.2189 in.)
10	5.100 mm (0.2008 in.)	34	5.340 mm (0.2102 in.)	58	5.580 mm (0.2197 in.)
	5.120 mm		5.360 mm		5.600 mm

12	(0.2016 in.)	36	(0.2110 in.)	60	(0.2205 in.)
14	5.140 mm (0.2024 in.)	38	5.380 mm (0.2118 in.)	62	5.620 mm (0.2213 in.)
16	5.160 mm (0.2031 in.)	40	5.400 mm (0.2126 in.)	64	5.640 mm (0.2220 in.)
18	5.180 mm (0.2039 in.)	42	5.420 mm (0.2134 in.)	66	5.660 mm (0.2228 in.)
20	5.200 mm (0.2047 in.)	44	5.440 mm (0.2142 in.)	68	5.680 mm (0.2236 in.)
22	5.220 mm (0.2051 in.)	46	5.460 mm (0.2150 in.)	70	5.700 mm (0.2244 in.)
24	5.240 mm (0.2063 in.)	48	5.480 mm (0.2157 in.)	72	5.720 mm (0.2252 in.)
26	5.260 mm (0.2071 in.)	50	5.500 mm (0.2165 in.)	74	5.740 mm (0.2260 in.)
28	5.280 mm (0.2079 in.)	52	5.520 mm (0.2173 in.)	-	-

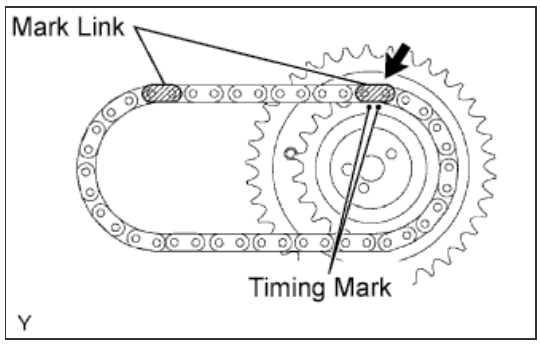
k. Install the No. 3 camshaft.

NOTICE:

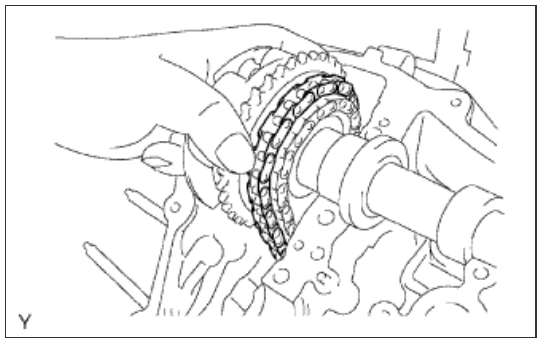
As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

i. Align the mark link (yellow) with the timing mark (2-dot mark) of the camshaft timing gear shown in the illustration.

ii. Apply a light coat of engine oil to the thrust portions and journals of the No. 3 camshaft.



iii. Temporarily put the No. 1 chain on the No. 2 chain of the camshaft timing gear.

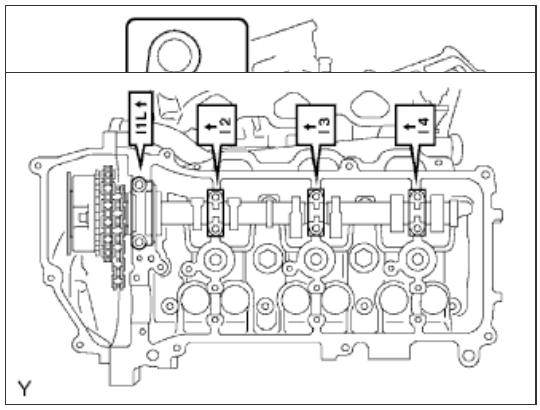


iv. Set the No. 3 camshaft onto the cylinder head LH with the cam lobes of the No. 2 cylinder facing downward as shown in the illustration.

v. Apply a light coat of engine oil to the 4 bearing caps.

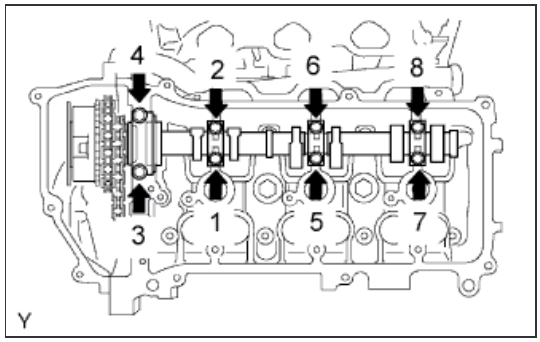
vi. Set the 4 bearing caps in their proper locations.

vii. Apply a light coat of engine oil to the threads of the 8 bearing cap bolts.

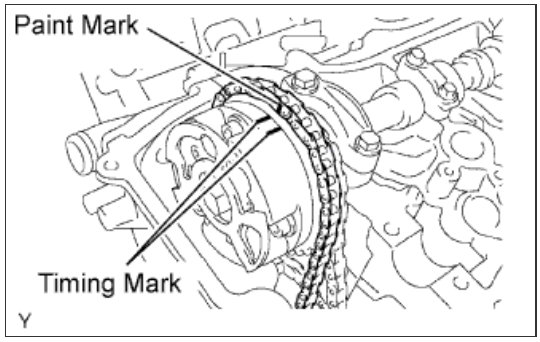


viii. Uniformly install the 8 bearing cap bolts in several steps in the order shown in the illustration.

Torque:
for 10 mm head bolt:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }
for 12 mm head bolt:
24 N*m{ 245 kgf*cm , 18 ft.*lbf }

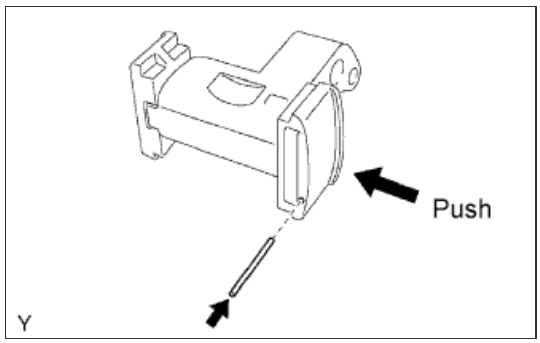


ix. Set the paint mark of the No. 1 chain between the timing marks of the camshaft timing gear.



l. Install the No. 3 chain tensioner.

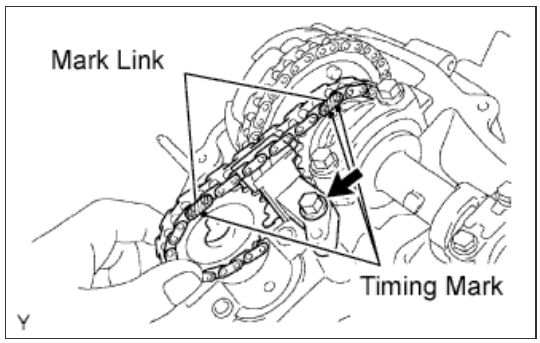
i. While pushing in the tensioner, insert a pin of φ1.0 mm (0.0394 in.) into the hole to fix the tensioner in place.



ii. Temporarily install the camshaft timing sprocket and No. 3 chain tensioner with the bolt and align the mark links (yellow) with the timing marks (1-dot mark and 2-dot mark) of the camshaft timing gear and sprocket.

iii. Tighten the No. 3 chain tensioner bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



m. Install the No. 4 camshaft.

NOTICE:

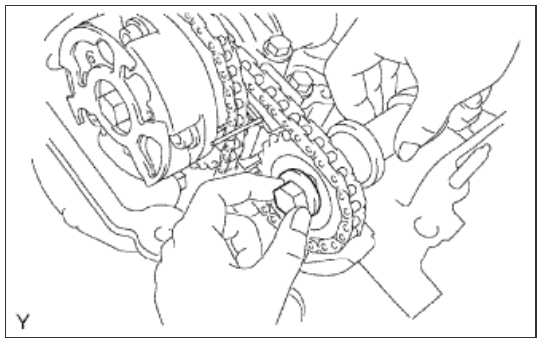
As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

i. Apply a light coat of engine oil to the thrust portions and journals of the No. 4 camshaft.

ii. Apply a light coat of engine oil to the threads and under the head of the camshaft timing sprocket set bolt.

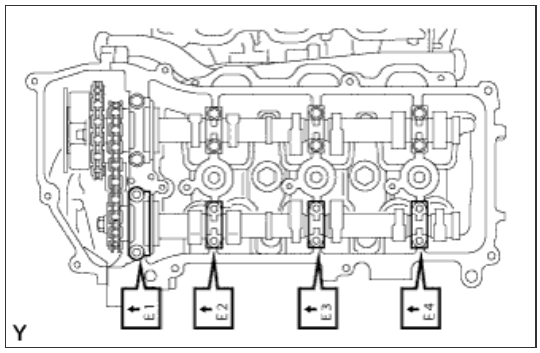
iii. Align the knock pin hole on the camshaft timing sprocket with the knock pin of the No. 4 camshaft, and insert the No. 4 camshaft into the camshaft timing sprocket.

iv. Temporarily install the camshaft timing sprocket set bolt.



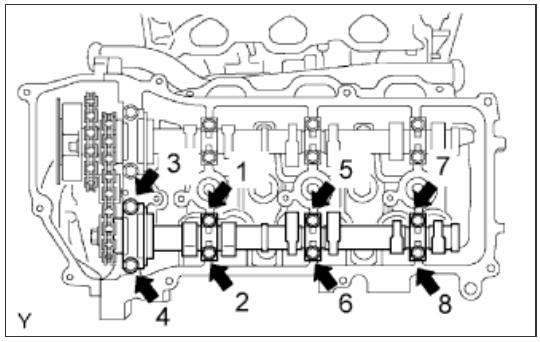
v. Set the 4 bearing caps in their proper locations.

vi. Apply a light coat of engine oil to the threads and under the heads of the 8 bearing cap bolts.



vii. Uniformly install the 8 bearing cap bolts in several steps in the order shown in the illustration.

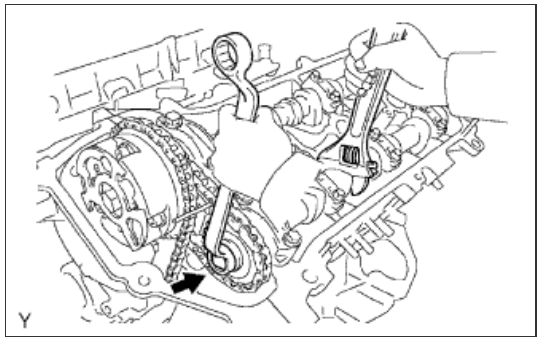
Torque:
for 10 mm head bolt:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }
for 12 mm head bolt:
24 N*m{ 245 kgf*cm , 18 ft.*lbf }



viii. Hold the hexagonal portion of the No. 4 camshaft with a wrench, and tighten the camshaft timing sprocket set bolt.

Torque:
100 N*m{ 1020 kgf*cm , 74 ft.*lbf }

ix. Remove the pin from the No. 3 chain tensioner.



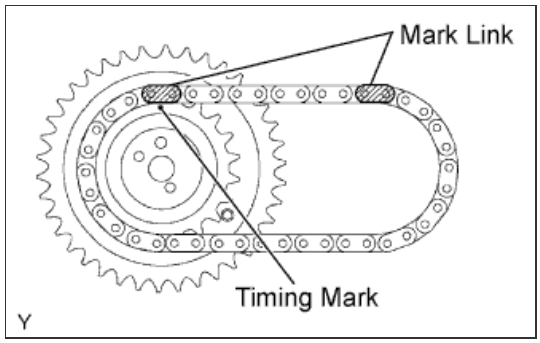
n. Install the No. 1 camshaft.

NOTICE:

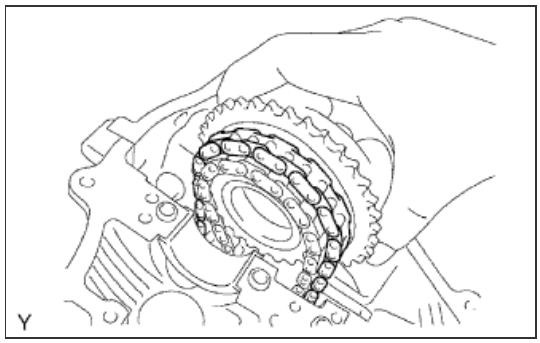
As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

i. Align the mark link (yellow) with the timing mark (1-dot mark) of the camshaft timing gear as shown in the illustration.

ii. Apply a light amount of engine oil to the thrust portions and journals of the camshaft.



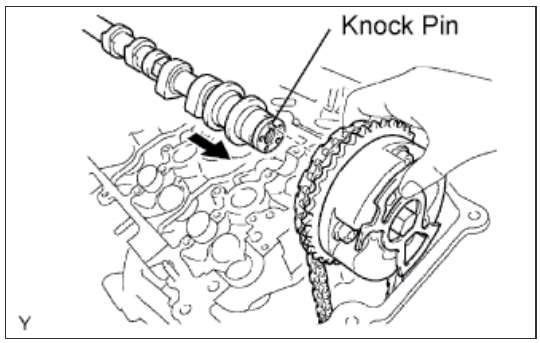
iii. Temporarily put the No. 1 chain on the No. 2 chain of the camshaft timing gear.



iv. Align the knock pin hole of the camshaft timing gear with the knock pin of the No. 1 camshaft, and insert the No. 1 camshaft into the camshaft timing gear.

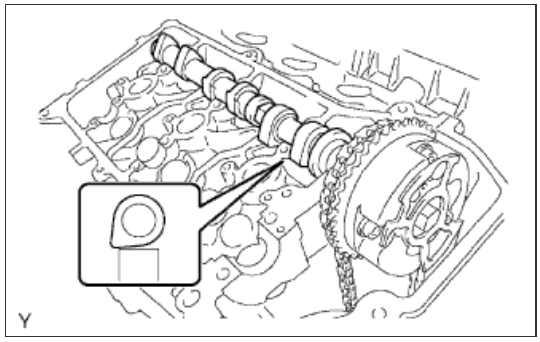
v. Apply a light coat of engine oil to the threads and under the head of the camshaft timing gear set bolt.

vi. Temporarily install the camshaft timing gear set bolt.



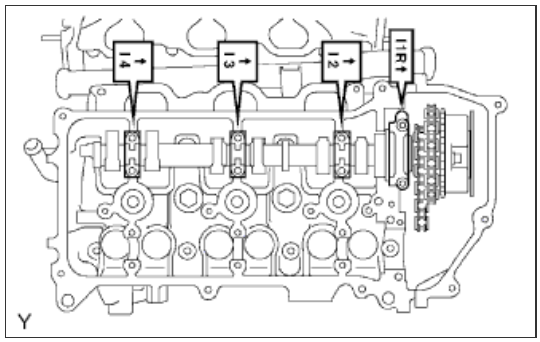
vii. Set the No. 1 camshaft onto the cylinder head RH with the cam lobes of the No. 1 cylinder facing downward as shown in the illustration.

viii. Apply a light coat of engine oil to the 4 bearing caps.



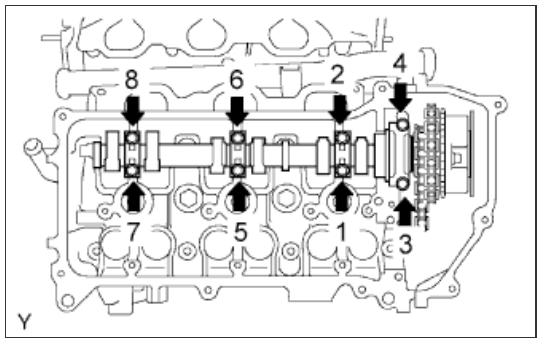
ix. Set the 4 bearing caps in their proper locations.

x. Apply a light coat of engine oil to the threads and under the heads of the 8 bearing cap bolts.

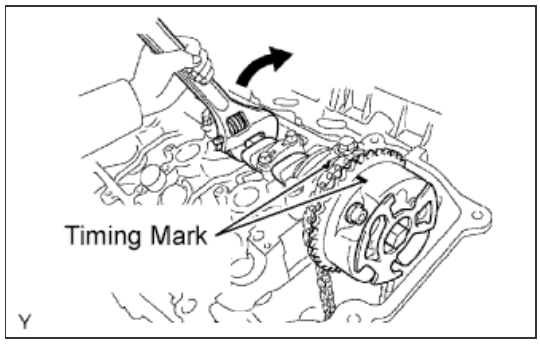


xi. Uniformly install the 8 bearing cap bolts in several steps in the order shown in the illustration.

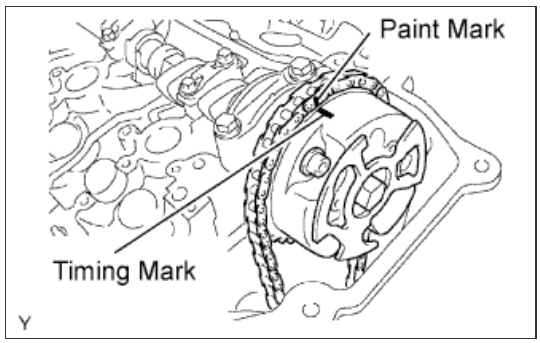
Torque:
for 10 mm head bolt:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }
for 12 mm head bolt:
24 N*m{ 245 kgf*cm , 18 ft.*lbf }



xii. Rotate the No. 1 camshaft clockwise using the hexagonal portion of the No. 1 camshaft so that the timing mark of the camshaft timing gear is aligned with the timing mark of the camshaft bearing cap.

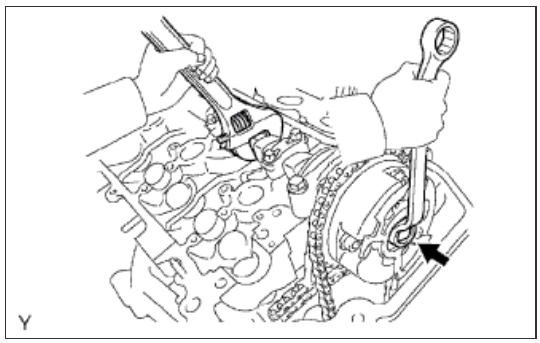


xiii. Align the paint mark of the No. 1 chain with the timing mark of the camshaft timing gear.



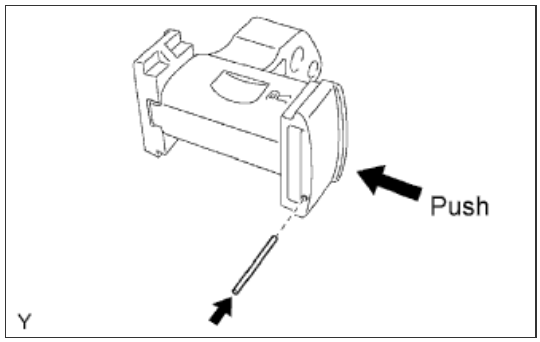
xiv. Hold the hexagonal portion of the No. 1 camshaft with a wrench, and tighten the camshaft timing gear set bolt.

Torque:
100 N*m{ 1020 kgf*cm , 74 ft.*lbf }



o. Install the No. 2 chain tensioner.

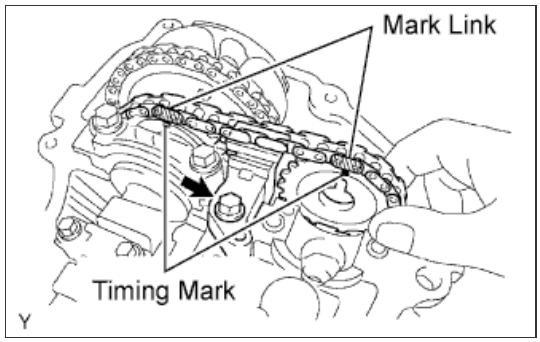
i. While pushing in the tensioner, insert a pin of φ1.0 mm (0.0394 in.) into the hole to fix the tensioner in place.



ii. Temporarily install the camshaft timing sprocket and No. 2 chain tensioner with the bolt and align the mark links (yellow) with the timing marks (1-dot mark and 2-dot mark) of the camshaft timing gear and sprocket.

iii. Tighten the No. 2 chain tensioner bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



p. Install the No. 2 camshaft.

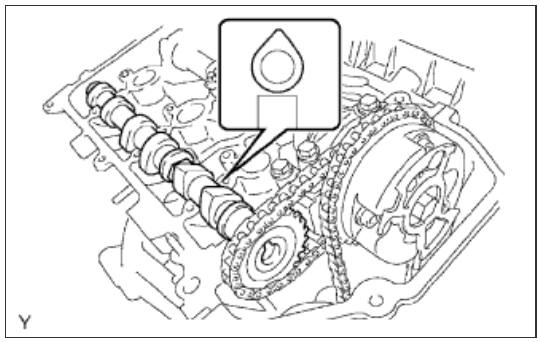
NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

i. Apply a light coat of engine oil to the thrust portions and journals of the No. 2 camshaft.

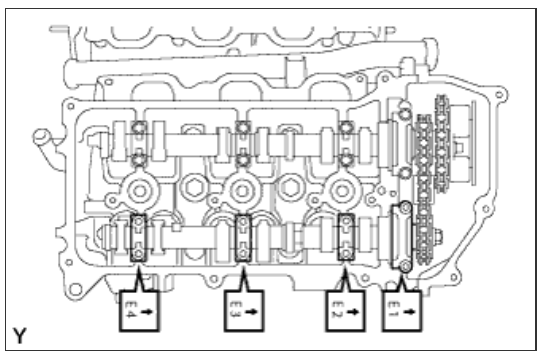
ii. Set the No. 2 camshaft onto the cylinder head RH with the cam lobes of the No. 1 cylinder facing upward as shown in the illustration.

iii. Apply a light coat of engine oil to the 4 bearing caps.



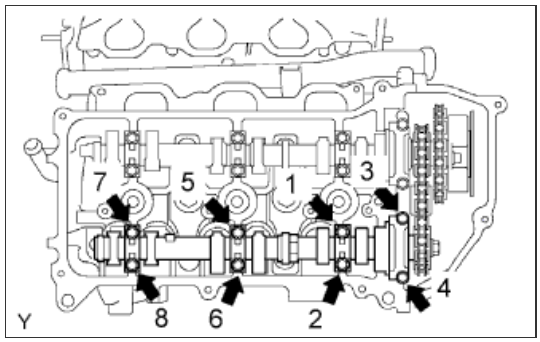
iv. Set the 4 bearing caps in their proper locations.

v. Apply a light coat of engine oil to the threads and under the heads of the 8 bearing cap bolts.



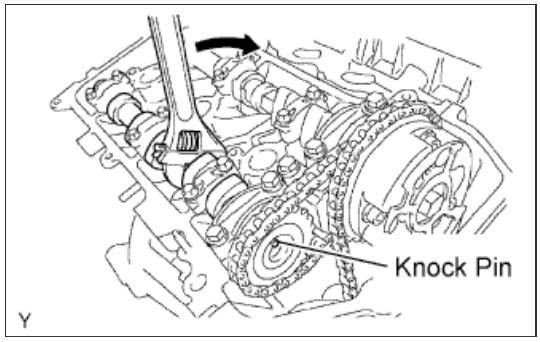
vi. Uniformly install the 8 bearing cap bolts in several steps in the order shown in the illustration.

Torque:
for 10 mm head bolt:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }
for 12 mm head bolt:
24 N*m{ 245 kgf*cm , 18 ft.*lbf }



vii. Rotate the No. 2 camshaft clockwise using a wrench so that the knock pin of the No. 2 camshaft is aligned with the knock pin hole of the camshaft timing sprocket.

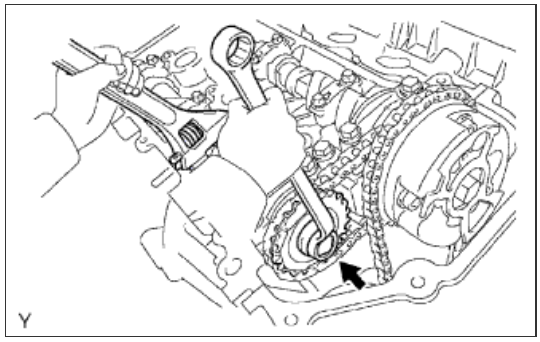
viii. Apply a light coat of engine oil to the threads and under the head of the camshaft timing sprocket set bolt.



ix. Hold the hexagonal portion of the No. 2 camshaft with a wrench, and install the camshaft timing sprocket set bolt.

Torque:
100 N*m{ 1020 kgf*cm , 74 ft.*lbf }

x. Remove the pin from the No. 2 chain tensioner.



q. Install the No. 1 chain tensioner.

i. While turning the stopper plate of the tensioner clockwise, push in the plunger of the tensioner as shown in the illustration.

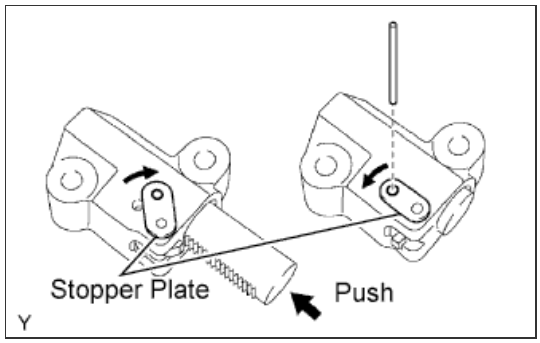
ii. While turning the stopper plate of the tensioner counterclockwise, insert a bar of φ3.5 mm (0.138 in.) into the holes on the stopper plate and tensioner to fix the stopper plate in place.

iii. Apply a light coat of engine oil to the threads and under the heads of the 2 No. 1 chain tensioner bolts.

iv. Install the No. 1 chain tensioner with the 2 bolts.

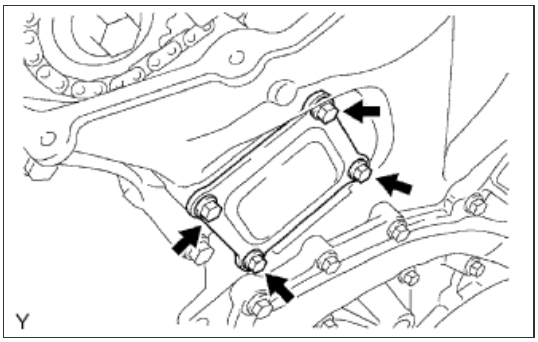
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

v. Remove the bar from the chain tensioner.

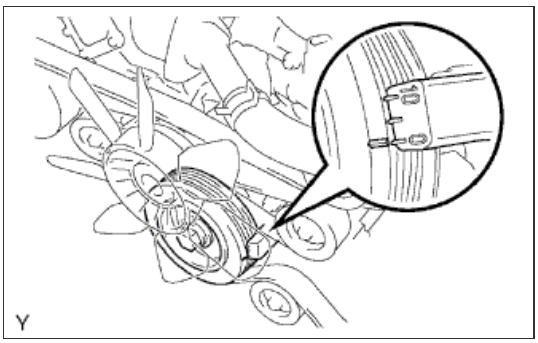


vi. Install a new gasket and the timing chain cover plate with the 4 bolts.

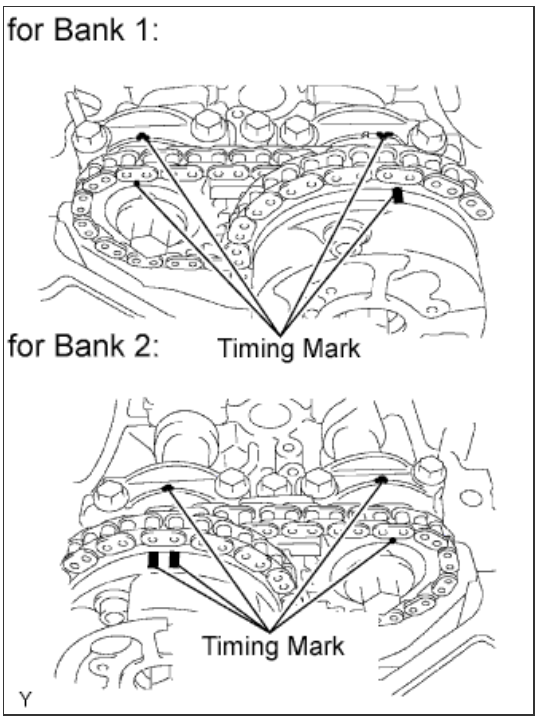
Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



vii. Turn the crankshaft pulley 2 complete revolutions slowly, and align the notch with the timing mark "0" of the timing chain cover.



viii. Check that the timing marks of the camshaft timing gears and sprockets are aligned with the timing marks of the bearing caps as shown in the illustration.



11. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY LH

a. Remove any old packing (FI) material and be careful not to drop any oil on the contact surfaces of the cylinder head, timing chain cover and cylinder head cover.

b. Apply seal packing as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
2 to 3 mm (0.0787 to 0.118 in.)

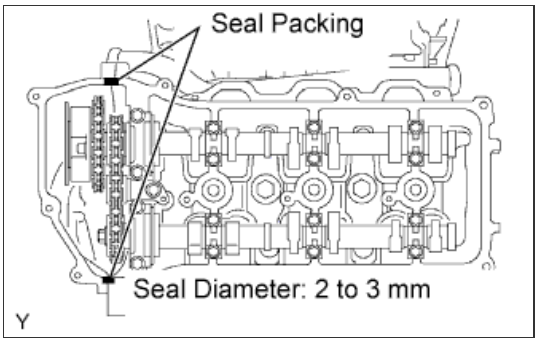
NOTICE:

- **Remove any oil from the contact surface.**

- **Install the head cover within 3 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after the installation.**

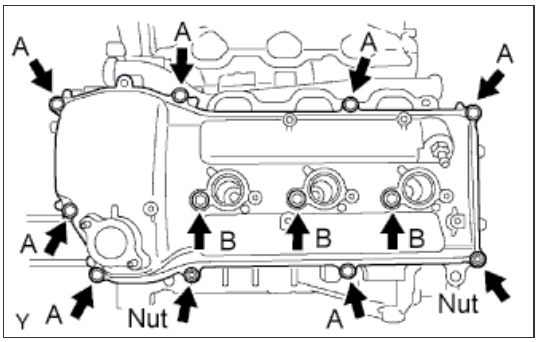
c. Install a new gasket to the cylinder head cover.

d. Install the seal washers to the bolts.



e. Temporarily install the cylinder head cover with the 10 bolts and 2 nuts. Tighten the bolts and nuts uniformly in several steps.

Torque:
for bolt A:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }
for bolt B and nut:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



12. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY RH

a. Remove any old packing (FI) material and be careful not to drop any oil on the contact surfaces of the cylinder head, timing chain cover and cylinder head cover.

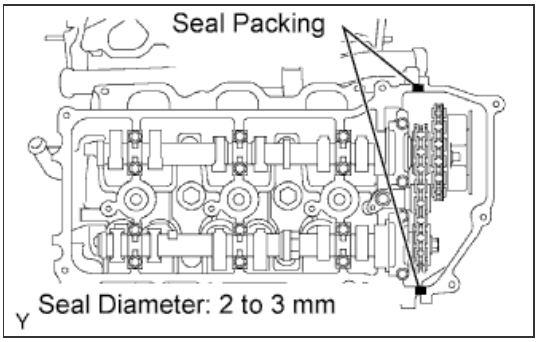
b. Apply seal packing as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
2 to 3 mm (0.0787 to 0.118 in.)

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the head cover within 3 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after the installation.**

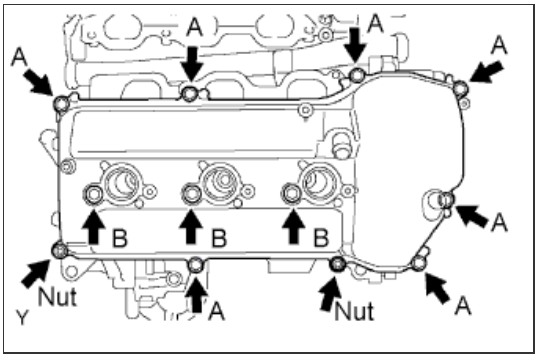


c. Install a new gasket to the cylinder head cover.

d. Install the seal washers to the bolts.

e. Temporarily install the cylinder head cover with the 10 bolts and 2 nuts. Tighten the bolts and nuts uniformly in several steps.

Torque:
for bolt A:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }
for bolt B and nut:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



13. INSTALL IGNITION COIL ASSEMBLY

a. Install the 6 ignition coils with the 6 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Connect the 6 connectors to the 6 ignition coils.

14. INSTALL INTAKE AIR SURGE TANK

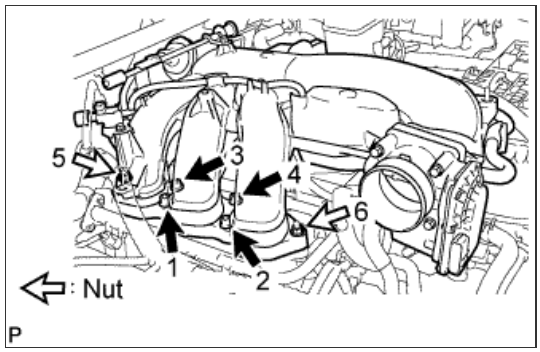
NOTICE:
Do not apply oil to the bolts and nuts listed below: :

il Application rohibited Bolt/Nut
Bolt for surge tank and intake manifold
Nut for surge tank and intake manifold

a. Install a new gasket to the intake air surge tank.

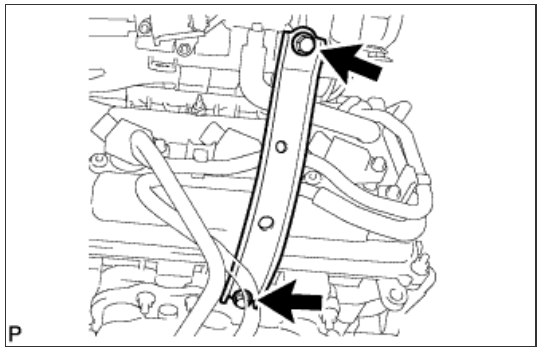
b. Using an 8 mm hexagon wrench, install the intake air surge tank with the 4 bolts and 2 nuts in the order shown in the illustration.

Torque:
28 N*m{ 286 kgf*cm , 21 ft.*lbf }



c. Install the No. 2 surge tank stay with the 2 bolts.

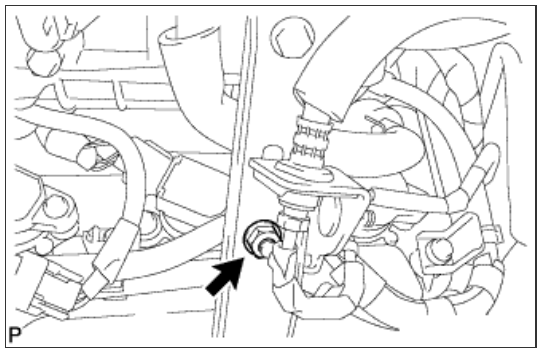
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



d. for aual Transmission:

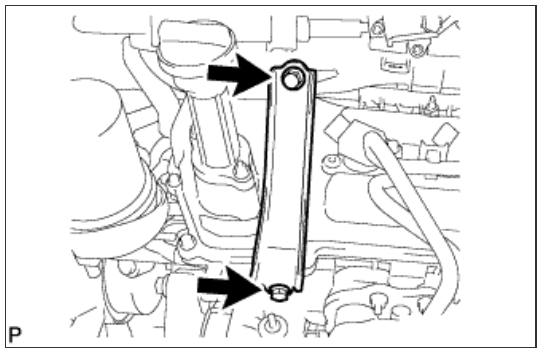
i. Install the bracket to the No. 2 surge tank stay with the nut.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }



e. Install the No. 1 surge tank stay with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

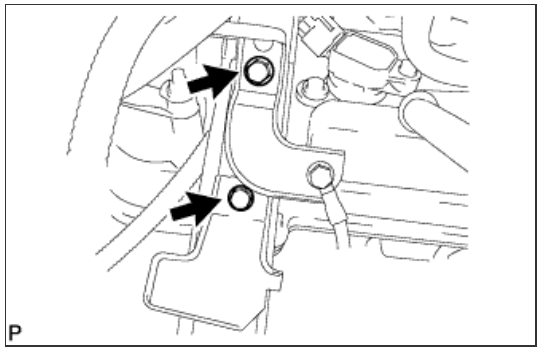


f. Install the oil baffle plate with the bolt.

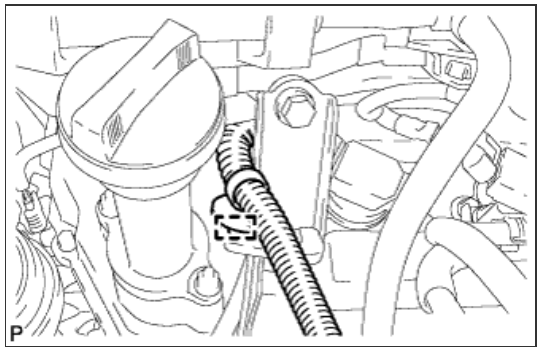
Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }

g. Install the bracket to the No. 1 surge tank stay with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

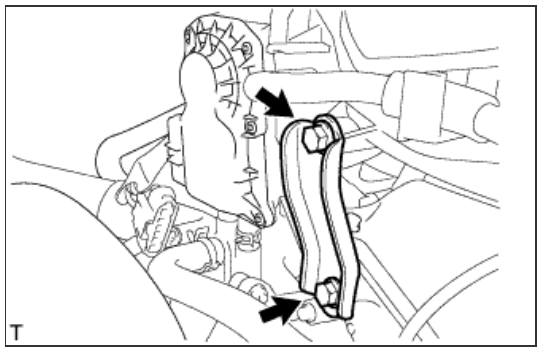


h. Attach the wire harness clamp.



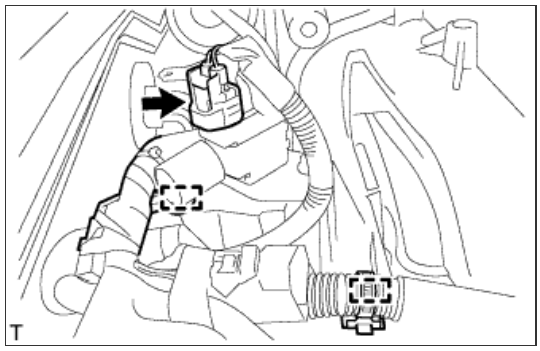
i. Install the throttle body bracket with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



j. Connect the vacuum switching valve (for ACIS) connector.

k. Attach the 2 wire harness clamps.



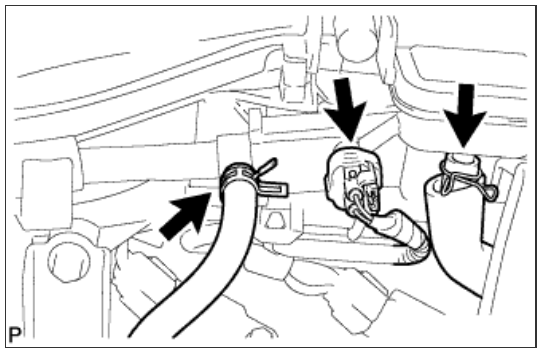
l. Connect the No. 1 ventilation hose.

m. Connect the purge S connector.

n. Connect the purge line hose.

HINT:

Connect the hose so that the direction of the hose clamp is as indicated in the illustration.

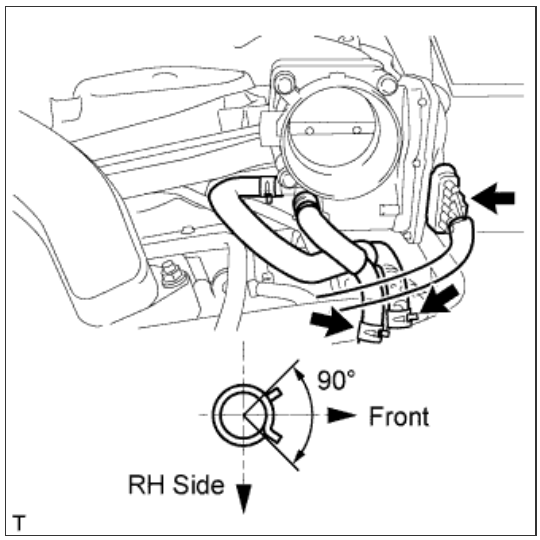


o. Connect the No. 4 and No. 5 water by-pass hose.

HINT:

Connect the hoses so that the direction of the hose clamps is as shown in the illustration.

p. Connect the throttle body connector.



15. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner assembly with the 2 bolts.

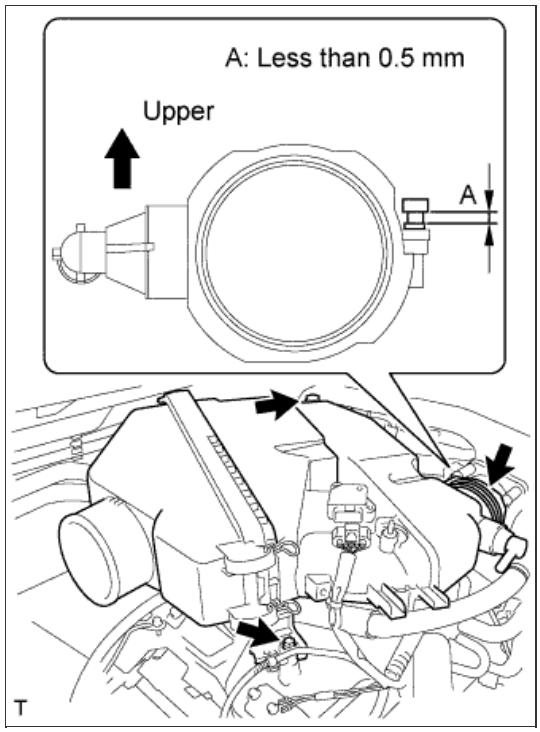
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

b. Tighten the hose clamp.

HINT:

Tighten the hose clamp until it reaches the specified protrusion height labeled A shown in the illustration.

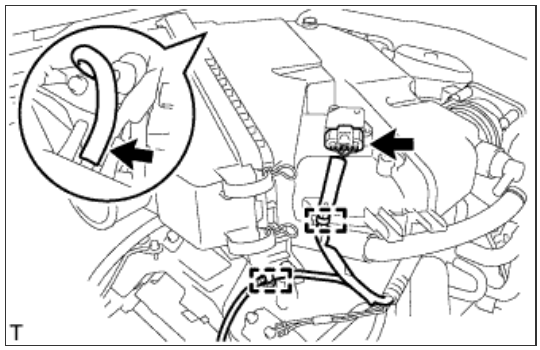
Standard protrusion height:
Less than 0.5 mm (0.0197 in.)



c. Connect the A meter connector.

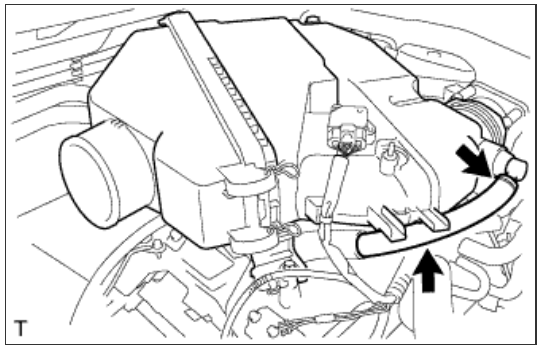
d. Attach the 2 wire harness clamps.

e. Connect the vacuum hose.



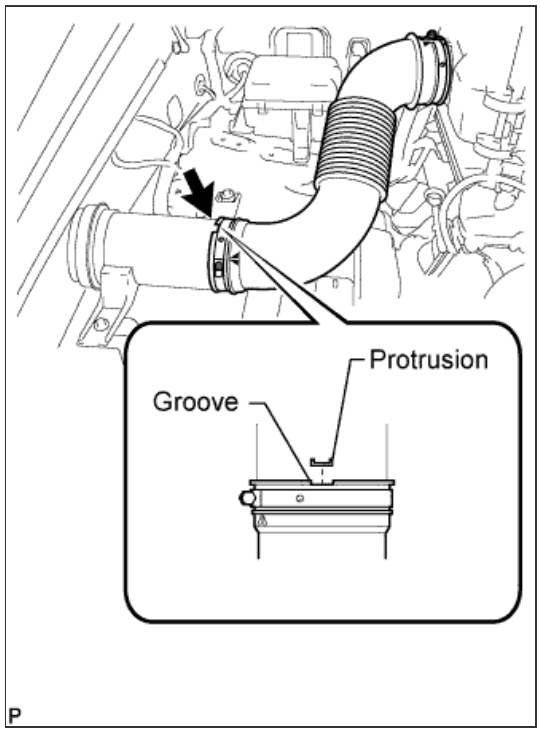
f. Attach the hose clamp.

g. Connect the No. 2 ventilation hose.



16. CONNECT NO. 2 AIR CLEANER HOSE

a. Align the protrusion of the pre-cleaner with the groove of the No. 2 air cleaner hose as shown in the illustration.

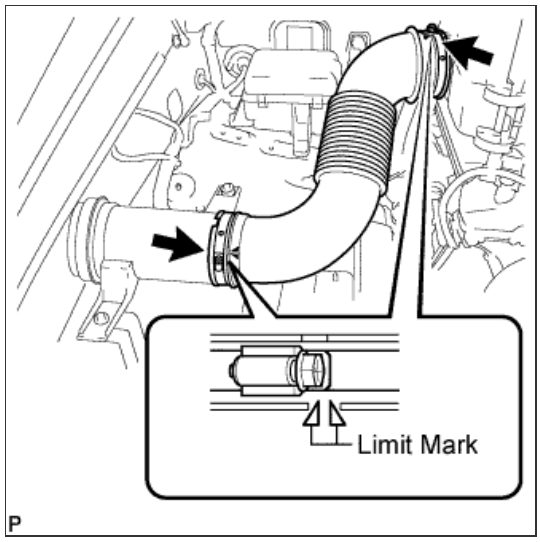


b. Tighten the 2 hose clamps.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }

HINT:

Tighten the clamp until the end of the clamp band is within both limit marks.



17. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item		Specified condition
for Automatic transmission	w/o Rear Heater	11.2 liters (11.8 US qts, 9.9 Imp. qts)
	w/ Rear Heater	14.4 liters (15.2 US qts, 12.7 Imp. qts)
for aual transmission	w/o Rear Heater	12.0 liters (12.7 US qts, 10.6 Imp. qts)
	w/ Rear Heater	14.6 liters (15.4 US qts, 12.8 Imp. qts)

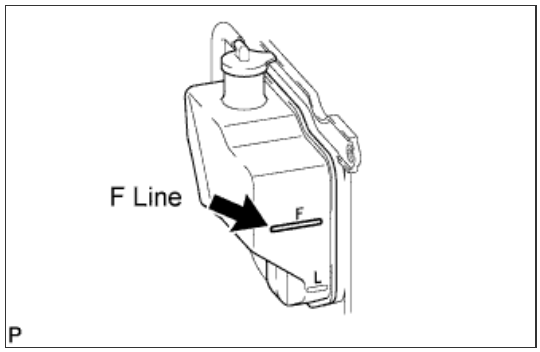
NOTICE:

o not substitute plain water for engine coolant.

HINT:

T TA vehicles are filled with T TA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use T TA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.



c. Install the reservoir cap.

d. ress the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Set the air conditioning as follows while warming up the engine.

Item	Condition
Fan speed	Any setting except off
Temperature	Toward WAR
Air conditioning switch	ff

g. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

h. aintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

i. ress the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

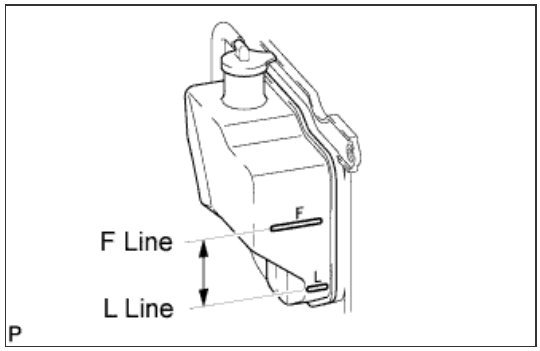
- **Wear protective gloves. Heat areas on the parts may injure your hands.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the fan.**

j. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

o not remove the radiator cap while the engine and radiator are still hot. ressurized, hot engine coolant and steam may be released and cause serious burns.

k. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.



18. INSPECT FOR COOLANT LEAK

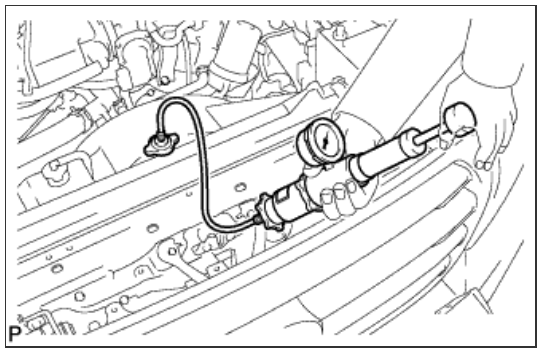
CAUTION:

o not remove the radiator cap while the engine and radiator are still hot. ressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

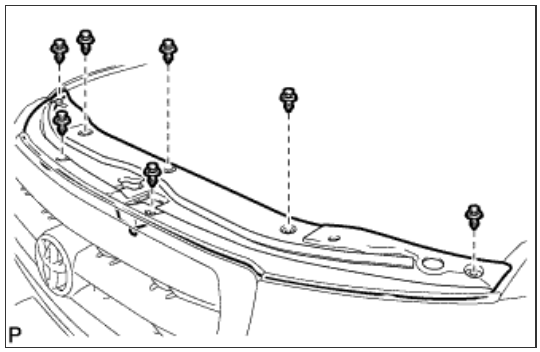
b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 k a(1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



19. INSTALL UPPER RADIATOR SUPPORT SEAL

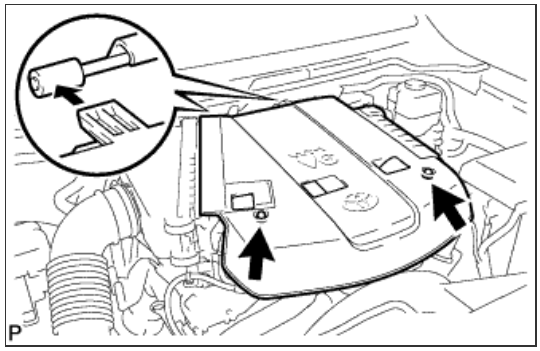
a. Install the radiator support seal with the 7 clips.



20. INSTALL V-BANK COVER

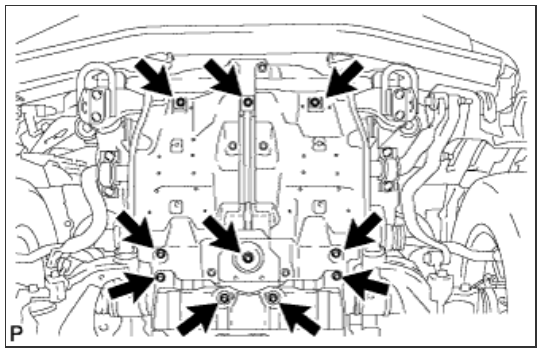
a. Install the -bank cover with the 2 cap nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



21. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the under cover with the 10 bolts.



22. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

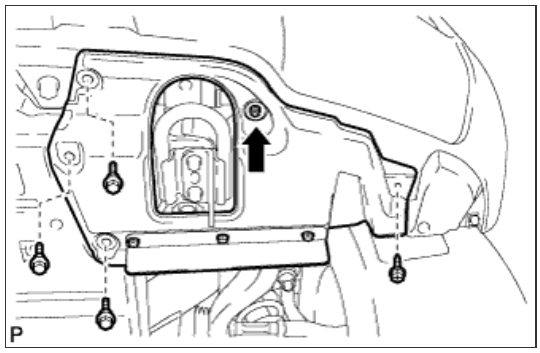
HINT:

Use the same procedures described for the LH side.

23. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. ush in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



24. INSPECT IGNITION TIMING

NOTICE:

- **Turn all electrical systems off.**
- **Perform the inspection when the cooling fan motor is turned off.**

a. Warm up the engine.

b. When using the intelligent tester:

i. Connect the intelligent tester to the LC3

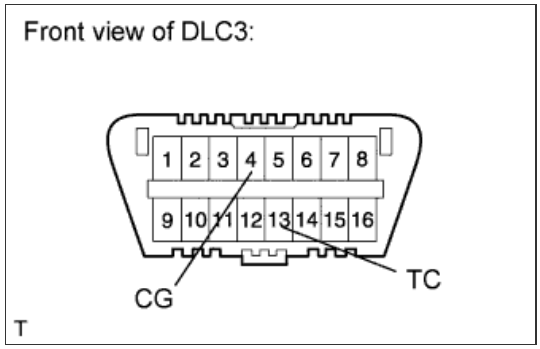
ii. nter the following menus: owertrain / ngine and Ct / ta List / All ta / IGN Advance.

iii. Inspect the ignition timing during idling.

Standard ignition timing:
8 to 12° BTDC @ idling (transmission in neutral position and A/C switch off)

iv. Check that the ignition timing advances immediately when the engine speed is increased.

c. When not using the intelligent tester:



i. Using SST, connect terminals 13 (TC) and 4 (C) of the LC3

SST
09843-18040

NOTICE:

Be sure not to improperly connect the terminals. This may damage the engine.

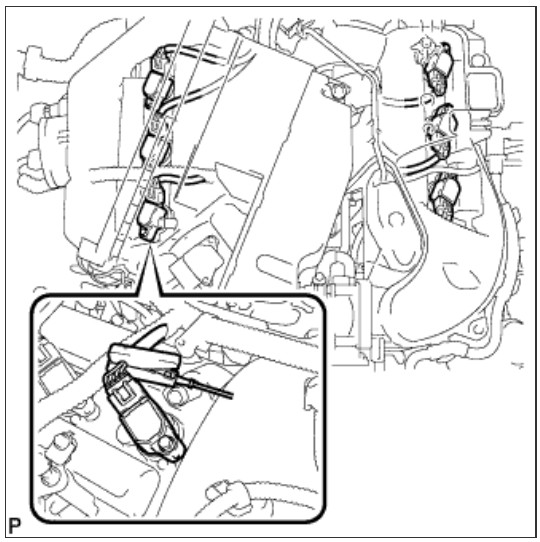
ii. Remove the air cleaner cap.

iii. ull out the wire harness shown in the illustration.

iv. Connect the tester probe of a timing light to the wire of the ignition coil connector for the No. 1 cylinder.

NOTICE:

- **Use a timing light that detects primary signals.**
- **After checking, be sure to wrap the wire harness with tape.**



v. Inspect the ignition timing during idling.

Standard ignition timing:
8 to 12° BTDC @ idling (transmission in neutral position and A/C switch off)

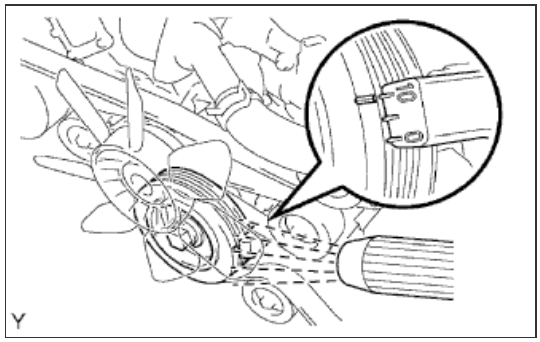
vi. Remove SST from the LC3

vii. Inspect the ignition timing during idling.

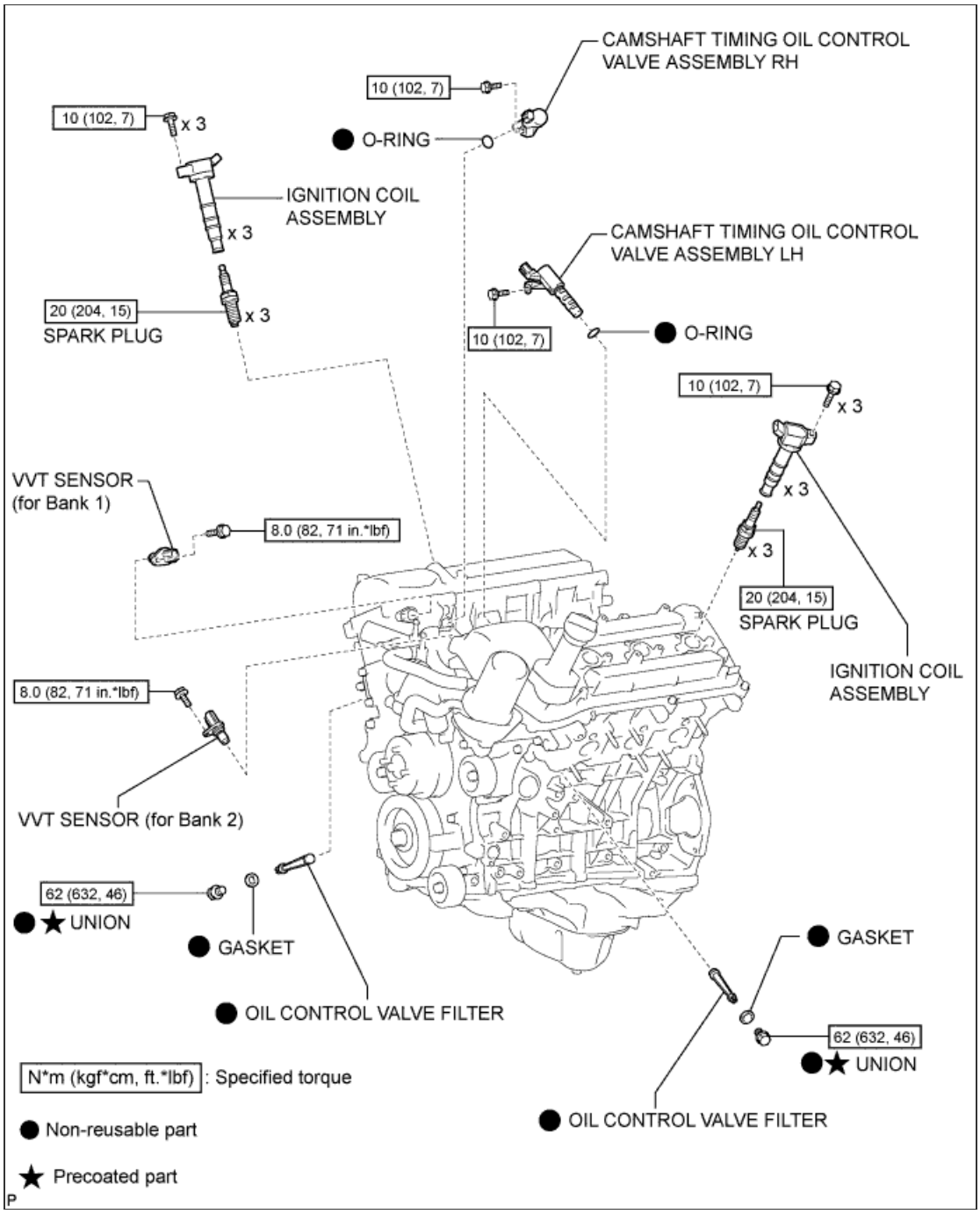
Standard ignition timing:
7 to 24° BTDC @ idling (transmission in neutral position and A/C switch off)

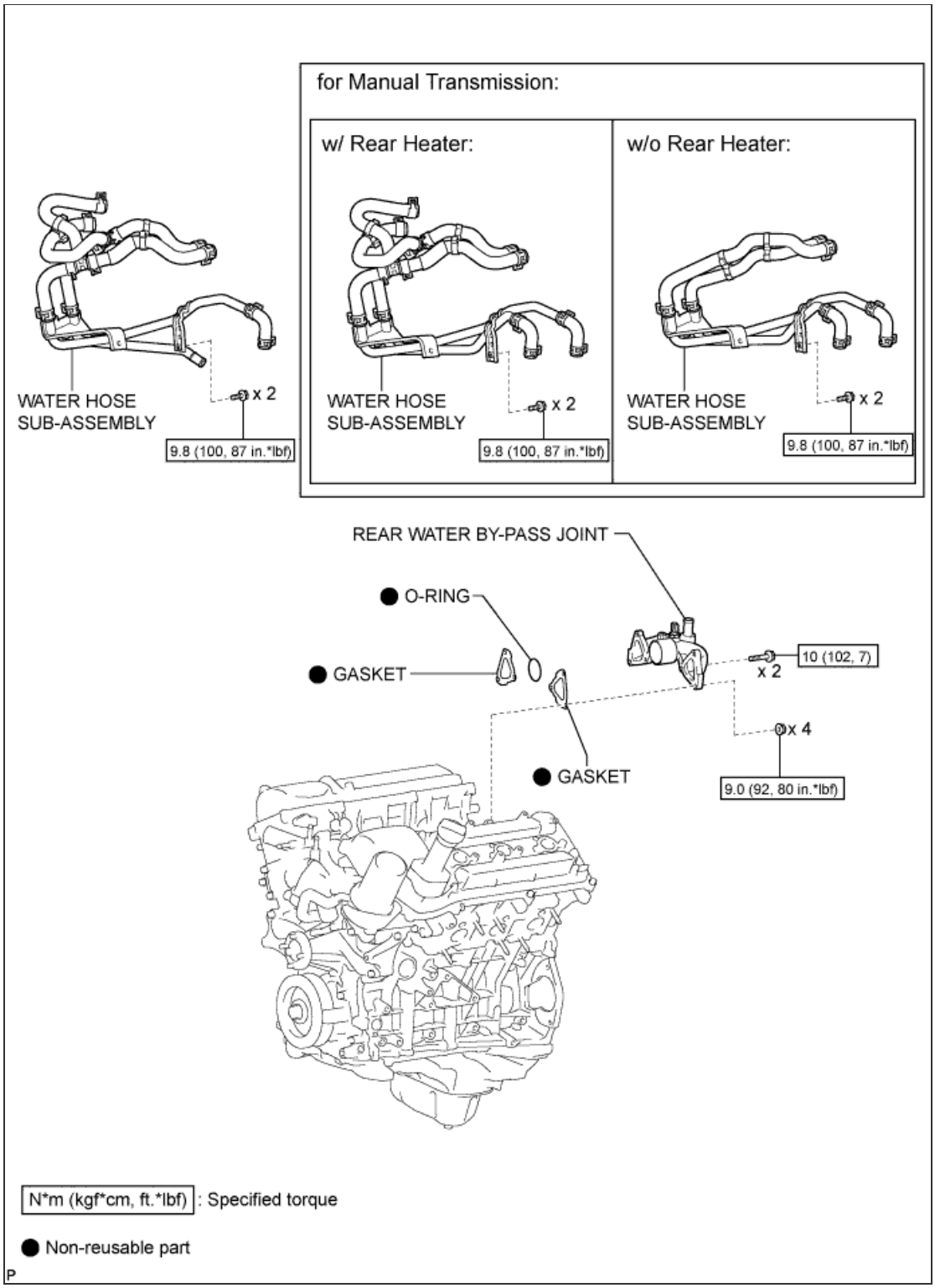
viii. isconnect the timing light from the engine.

ix. Install the air cleaner cap.

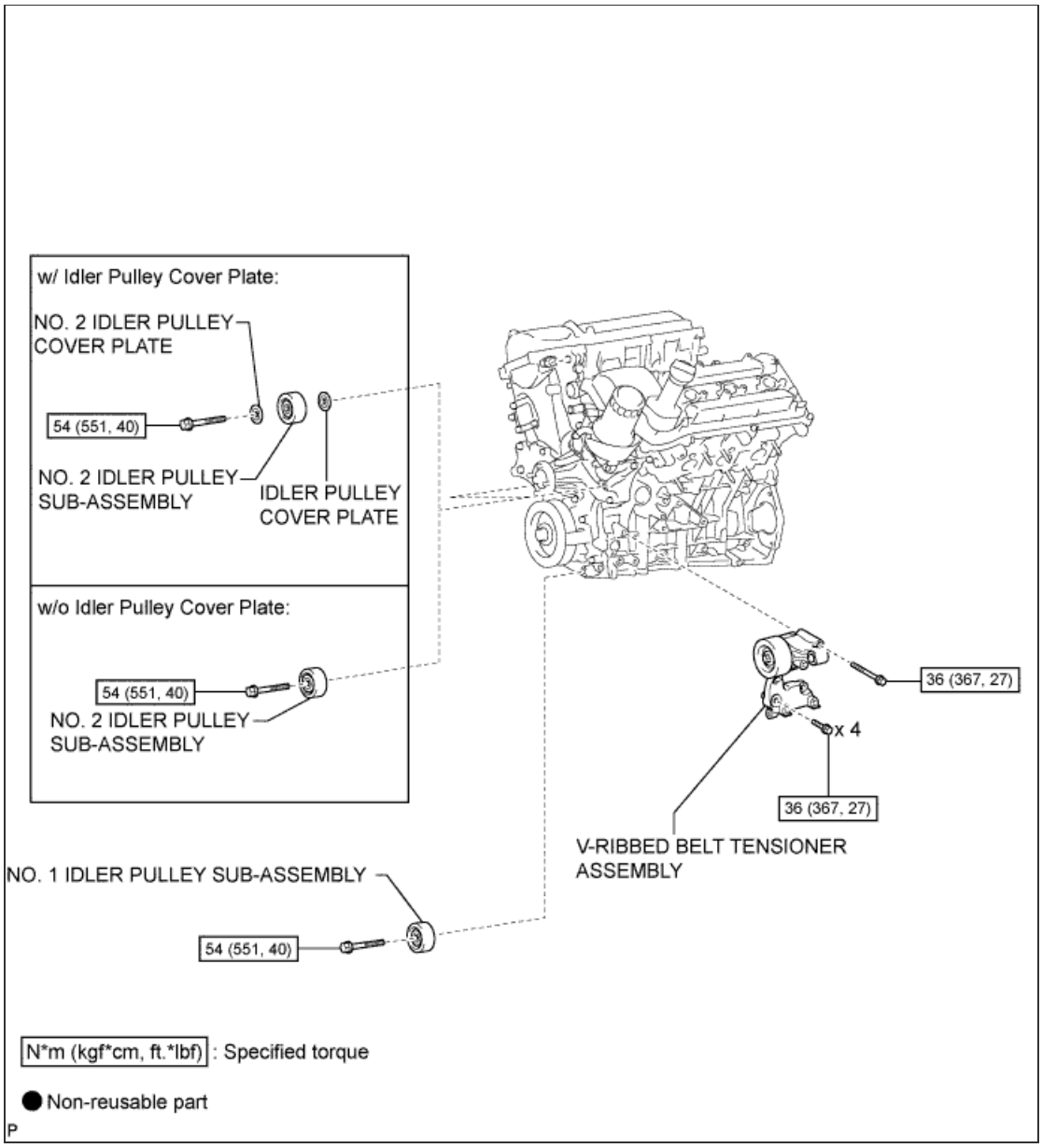


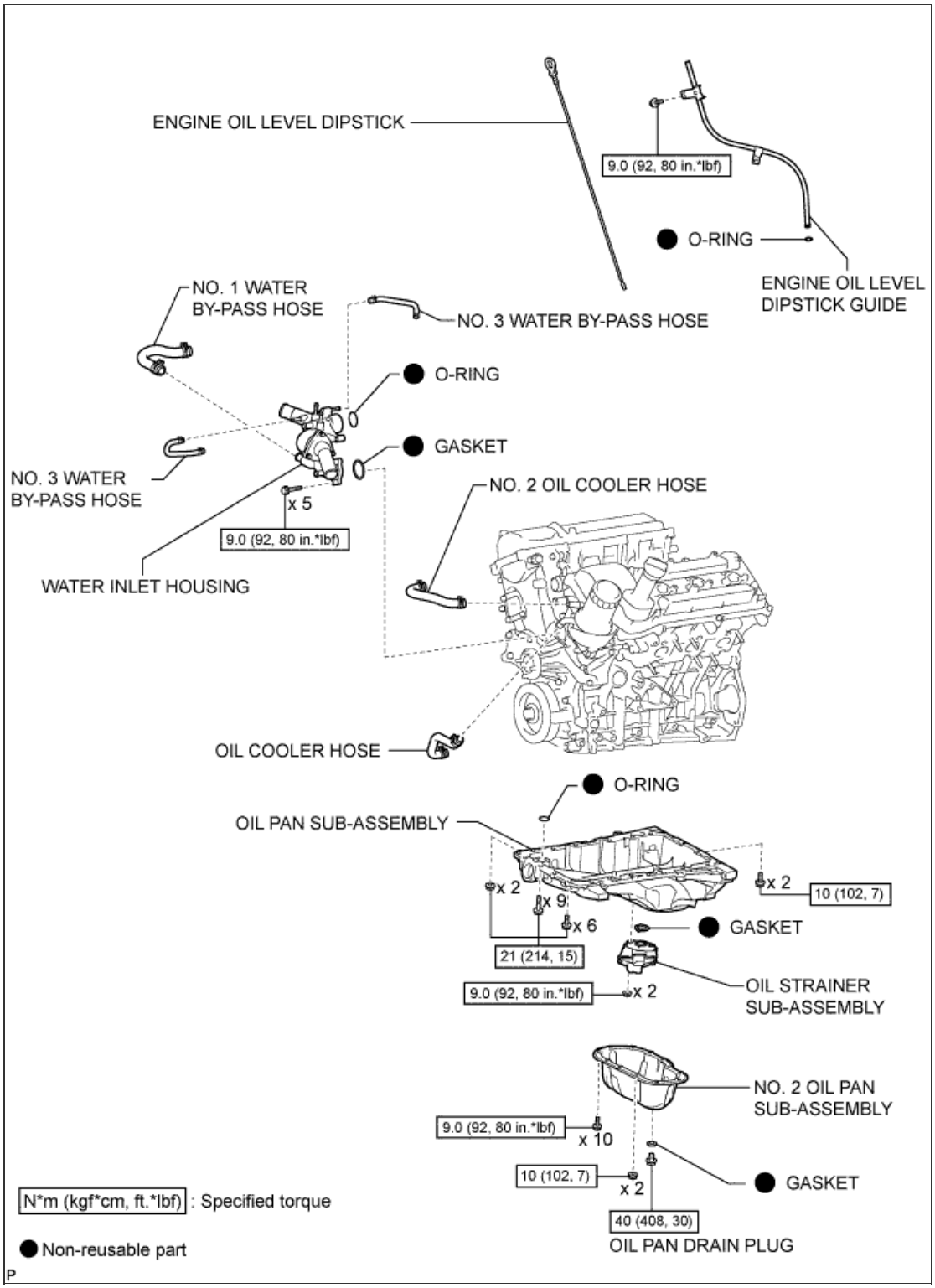
for Preparation Click here

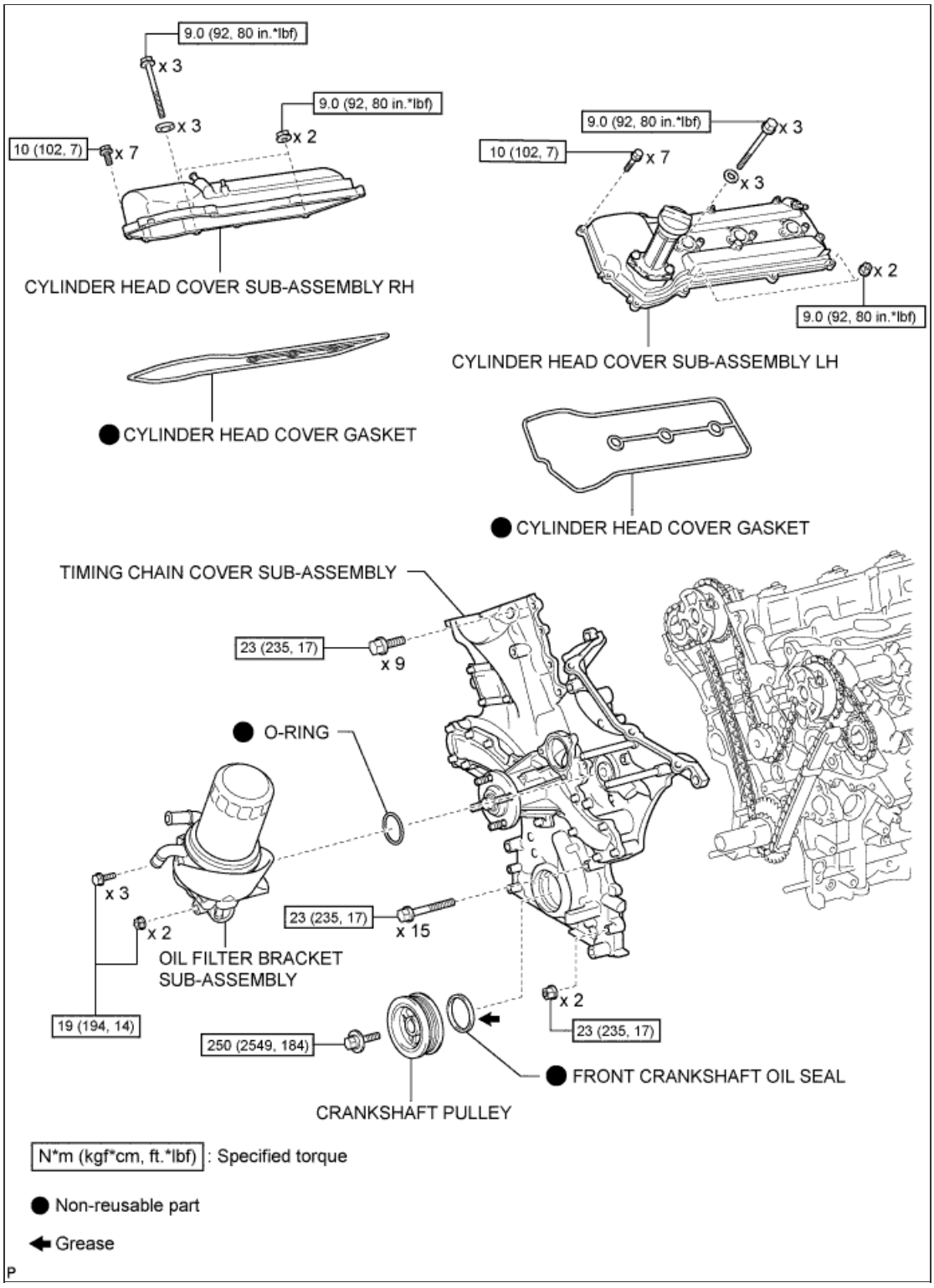


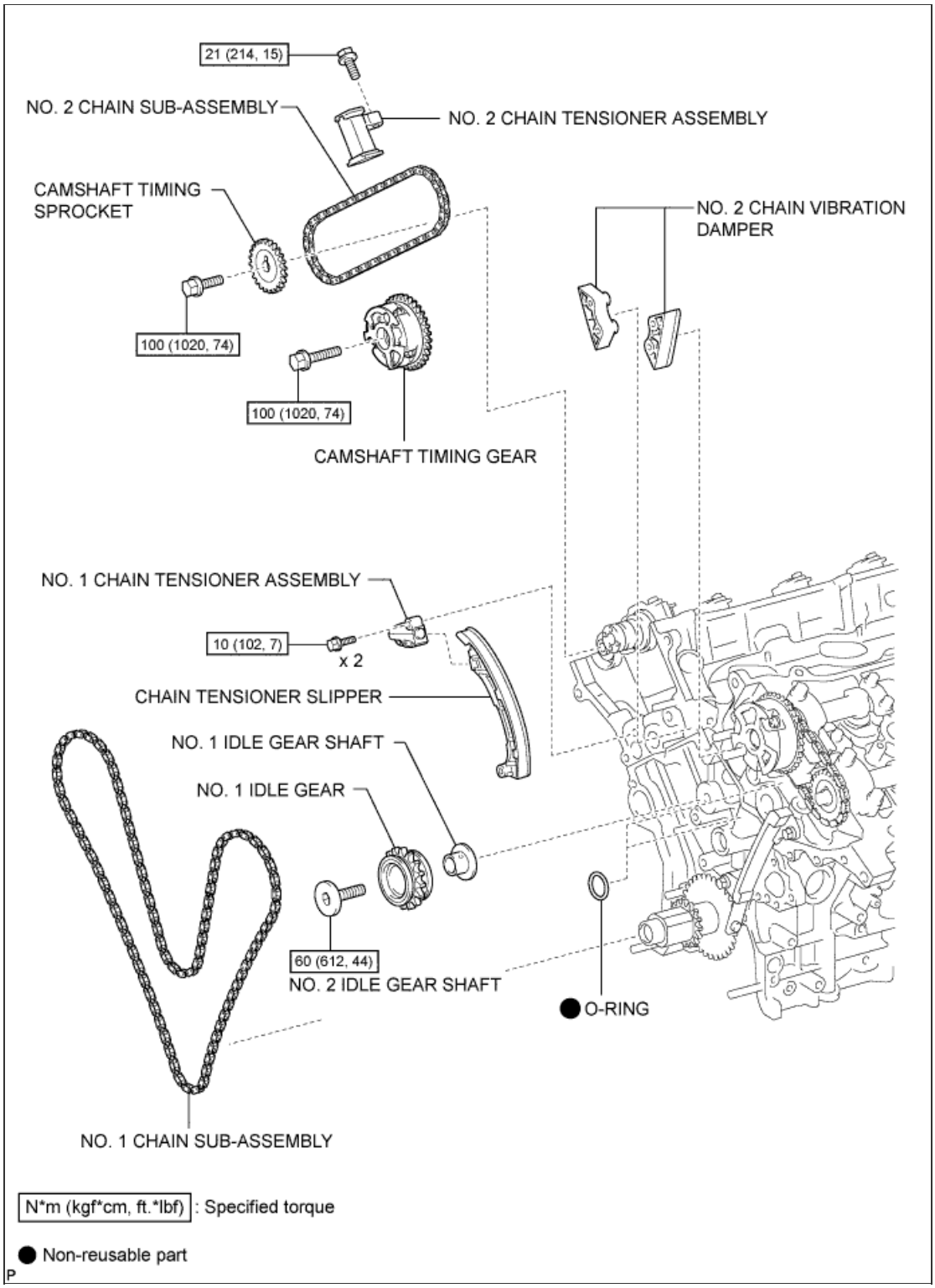

for Manual Transmission:
w/ Rear Heater:
w/o Rear Heater:
WATER HOSE SUB-ASSEMBLY
x 2
9.8 (100, 87 in.*lbf)
WATER HOSE SUB-ASSEMBLY
x 2
9.8 (100, 87 in.*lbf)
WATER HOSE SUB-ASSEMBLY
x 2
9.8 (100, 87 in.*lbf)
REAR WATER BY-PASS JOINT
O-RING
GASKET
GASKET
10 (102, 7)
x 2
x 4
9.0 (92, 80 in.*lbf)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P

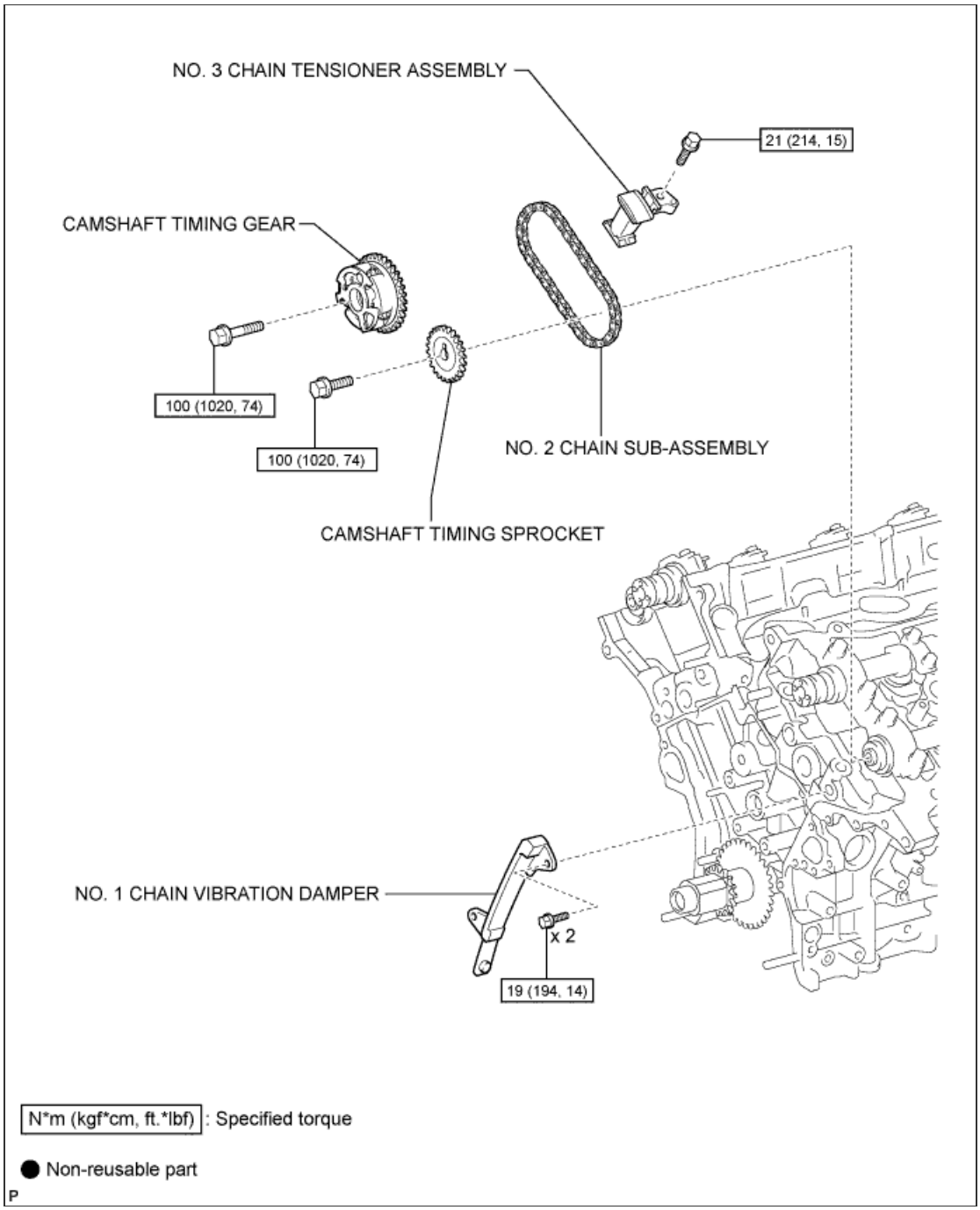

w/ Idler Pulley Cover Plate:
NO. 2 IDLER PULLEY COVER PLATE
54 (551, 40)
NO. 2 IDLER PULLEY SUB-ASSEMBLY
IDLER PULLEY COVER PLATE
w/o Idler Pulley Cover Plate:
54 (551, 40)
NO. 2 IDLER PULLEY SUB-ASSEMBLY
36 (367, 27)
x 4
36 (367, 27)
V-RIBBED BELT TENSIONER ASSEMBLY
NO. 1 IDLER PULLEY SUB-ASSEMBLY
54 (551, 40)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

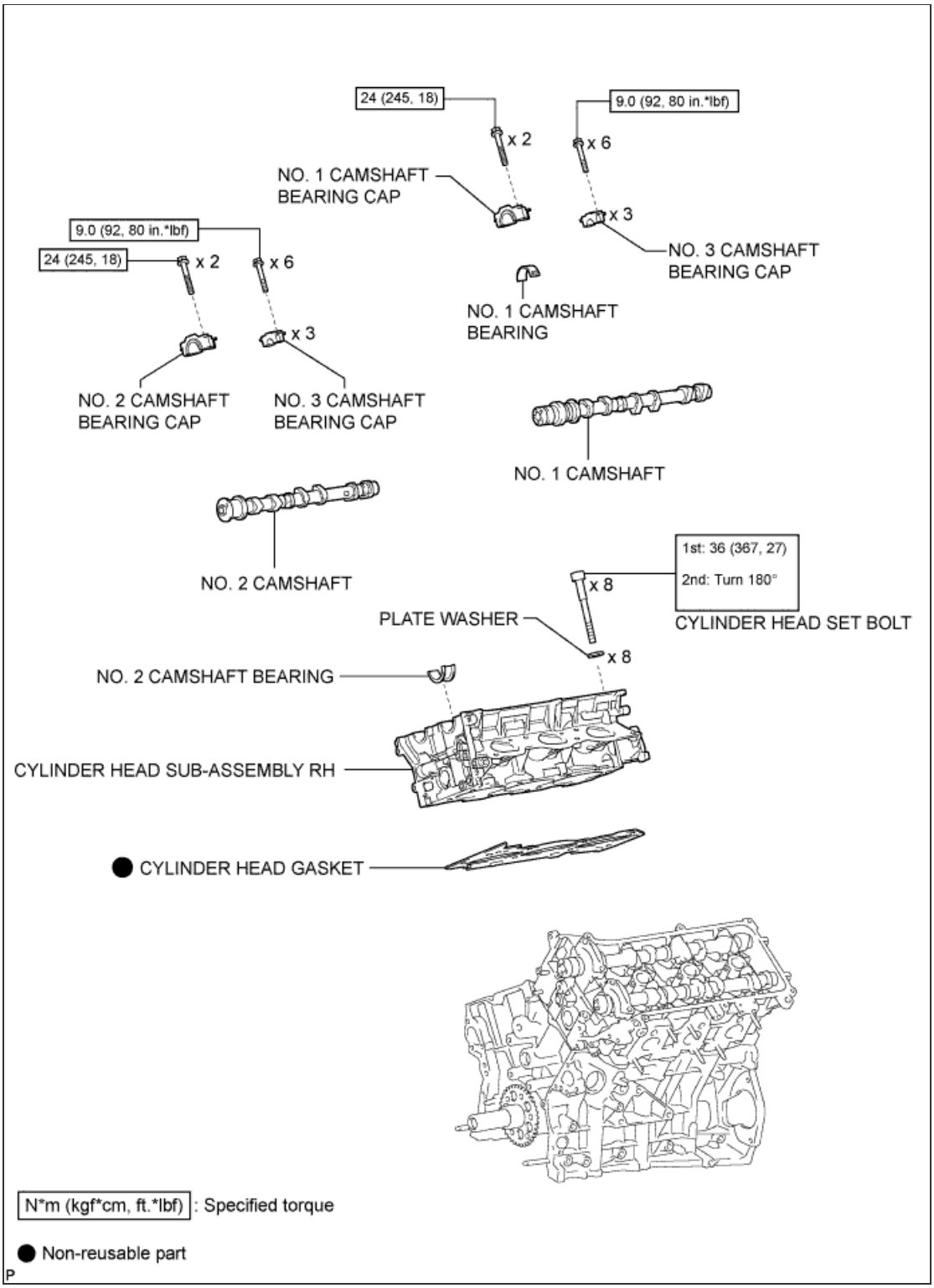

ENGINE OIL LEVEL DIPSTICK
9.0 (92, 80 in.*lbf)
O-RING
ENGINE OIL LEVEL DIPSTICK GUIDE
NO. 1 WATER BY-PASS HOSE
NO. 3 WATER BY-PASS HOSE
O-RING
GASKET
NO. 3 WATER BY-PASS HOSE
x 5
9.0 (92, 80 in.*lbf)
WATER INLET HOUSING
NO. 2 OIL COOLER HOSE
OIL COOLER HOSE
O-RING
OIL PAN SUB-ASSEMBLY
x 2
x 9
x 6
x 2
10 (102, 7)
GASKET
21 (214, 15)
9.0 (92, 80 in.*lbf)
x 2
OIL STRAINER SUB-ASSEMBLY
NO. 2 OIL PAN SUB-ASSEMBLY
9.0 (92, 80 in.*lbf)
x 10
10 (102, 7)
x 2
GASKET
40 (408, 30)
OIL PAN DRAIN PLUG
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

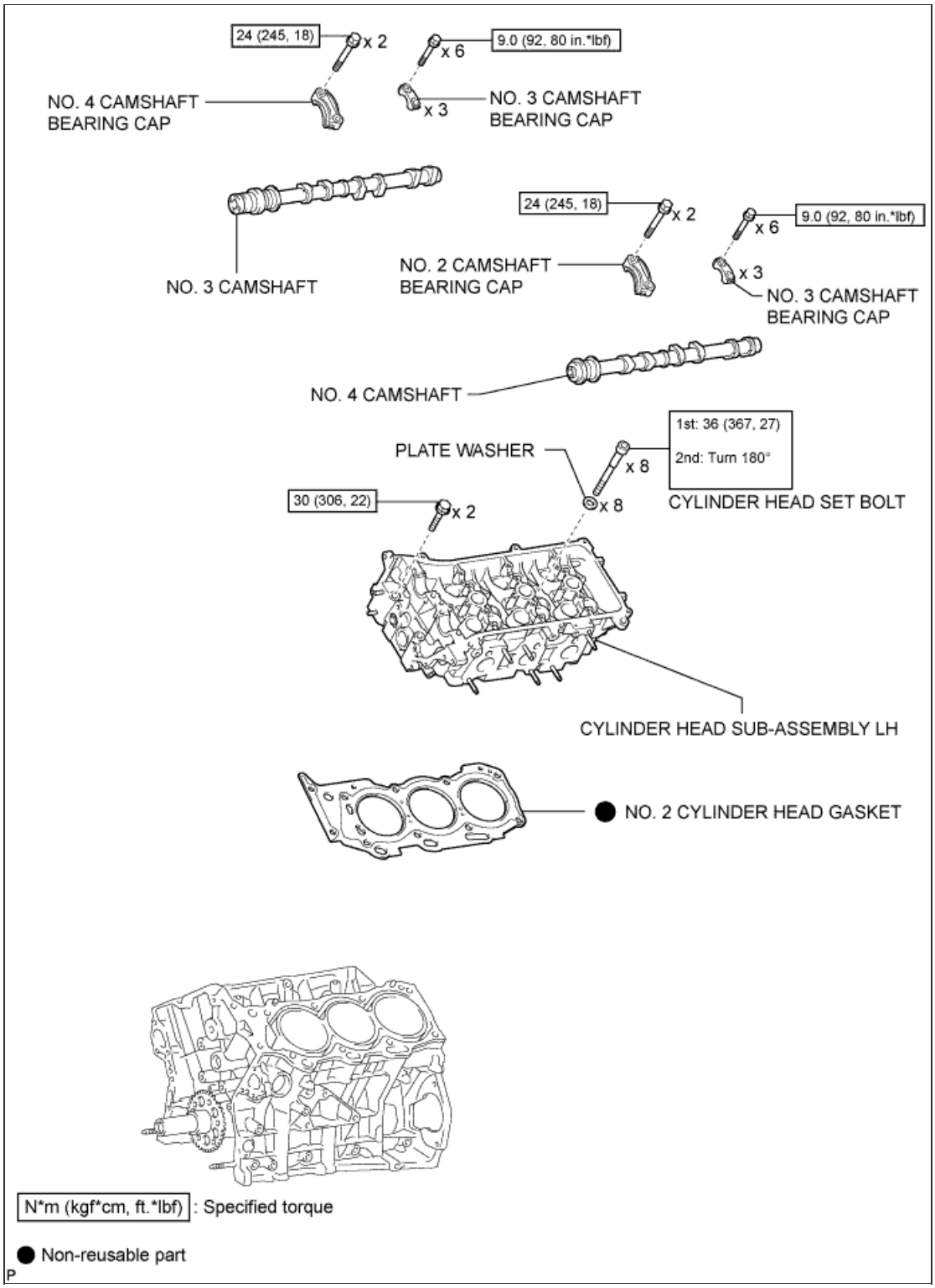

9.0 (92, 80 in.*lbf)
x 3
x 3
9.0 (92, 80 in.*lbf)
x 2
10 (102, 7)
x 7
CYLINDER HEAD COVER SUB-ASSEMBLY RH
9.0 (92, 80 in.*lbf)
x 3
10 (102, 7)
x 7
x 3
x 2
9.0 (92, 80 in.*lbf)
CYLINDER HEAD COVER SUB-ASSEMBLY LH
CYLINDER HEAD COVER GASKET
CYLINDER HEAD COVER GASKET
TIMING CHAIN COVER SUB-ASSEMBLY
23 (235, 17)
x 9
O-RING
x 3
x 2
OIL FILTER BRACKET
SUB-ASSEMBLY
23 (235, 17)
x 15
19 (194, 14)
x 2
23 (235, 17)
250 (2549, 184)
FRONT CRANKSHAFT OIL SEAL
CRANKSHAFT PULLEY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
Grease
P


21 (214, 15)
NO. 2 CHAIN SUB-ASSEMBLY
NO. 2 CHAIN TENSIONER ASSEMBLY
CAMSHAFT TIMING SPROCKET
NO. 2 CHAIN VIBRATION DAMPER
100 (1020, 74)
100 (1020, 74)
CAMSHAFT TIMING GEAR
NO. 1 CHAIN TENSIONER ASSEMBLY
10 (102, 7)
x 2
CHAIN TENSIONER SLIPPER
NO. 1 IDLE GEAR SHAFT
NO. 1 IDLE GEAR
60 (612, 44)
NO. 2 IDLE GEAR SHAFT
O-RING
NO. 1 CHAIN SUB-ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P


NO. 3 CHAIN TENSIONER ASSEMBLY
21 (214, 15)
CAMSHAFT TIMING GEAR
100 (1020, 74)
100 (1020, 74)
NO. 2 CHAIN SUB-ASSEMBLY
CAMSHAFT TIMING SPROCKET
NO. 1 CHAIN VIBRATION DAMPER
x 2
19 (194, 14)
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
P


24 (245, 18)
x 2
9.0 (92, 80 in.*lbf)
x 6
NO. 1 CAMSHAFT BEARING CAP
x 3
NO. 3 CAMSHAFT BEARING CAP
9.0 (92, 80 in.*lbf)
24 (245, 18)
x 2
x 6
NO. 1 CAMSHAFT BEARING
x 3
NO. 2 CAMSHAFT BEARING CAP
NO. 3 CAMSHAFT BEARING CAP
NO. 1 CAMSHAFT
NO. 2 CAMSHAFT
1st: 36 (367, 27)
2nd: Turn 180°
x 8
CYLINDER HEAD SET BOLT
PLATE WASHER
x 8
NO. 2 CAMSHAFT BEARING
CYLINDER HEAD SUB-ASSEMBLY RH
● CYLINDER HEAD GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
P


24 (245, 18)
x 2
x 6
9.0 (92, 80 in.*lbf)
NO. 4 CAMSHAFT BEARING CAP
x 3
NO. 3 CAMSHAFT BEARING CAP
NO. 3 CAMSHAFT
24 (245, 18)
x 2
x 6
9.0 (92, 80 in.*lbf)
NO. 2 CAMSHAFT BEARING CAP
x 3
NO. 3 CAMSHAFT BEARING CAP
NO. 4 CAMSHAFT
PLATE WASHER
x 8
1st: 36 (367, 27)
2nd: Turn 180°
30 (306, 22)
x 2
x 8
CYLINDER HEAD SET BOLT
CYLINDER HEAD SUB-ASSEMBLY LH
NO. 2 CYLINDER HEAD GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P

for Preparation Click here

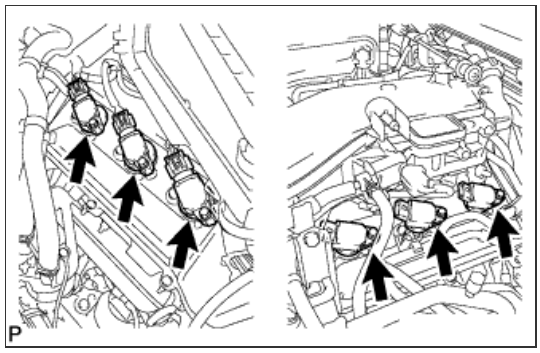
1. REMOVE ENGINE ASSEMBLY

a. Remove the engine assembly (Click here).

2. REMOVE IGNITION COIL ASSEMBLY

a. Disconnect the ignition coil connectors.

b. Remove the bolts and ignition coils.



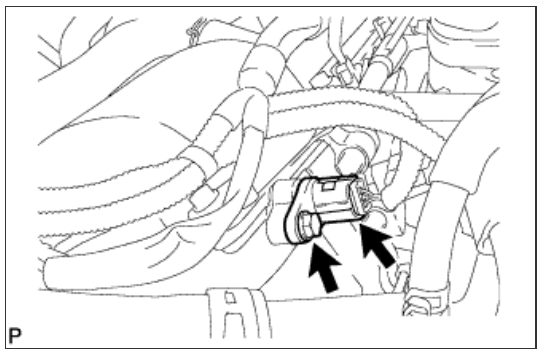
3. REMOVE SPARK PLUG

a. Remove the spark pl gs.

4. REMOVE VVT SENSOR (for Bank 1)

a. Disconnect the sensor connector.

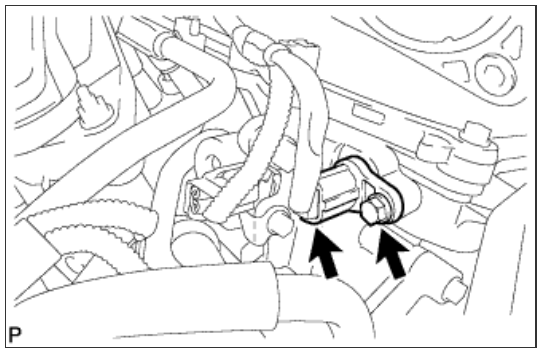
b. Remove the bolt and sensor.



5. REMOVE VVT SENSOR (for Bank 2)

a. Disconnect the sensor connector.

b. Remove the bolt and sensor.

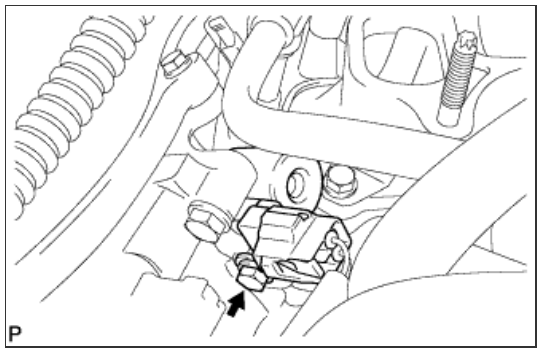


6. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY RH

a. Disconnect the oil control valve connector.

b. Remove the bolt and oil control valve.

c. Remove the O-ring from the oil control valve.

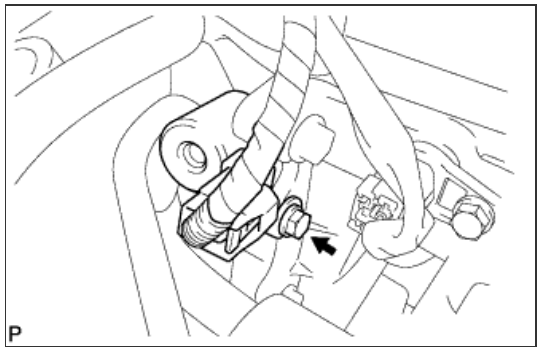


7. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY LH

a. Disconnect the oil control valve connector.

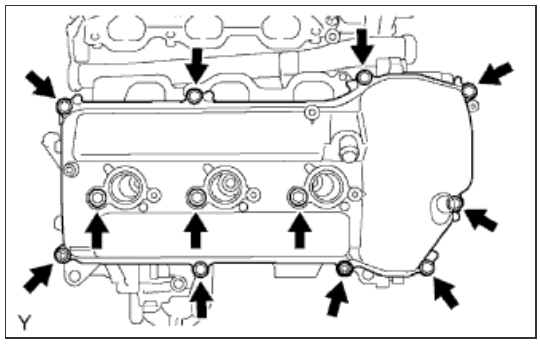
b. Remove the bolt and oil control valve.

c. Remove the O-ring from the oil control valve.



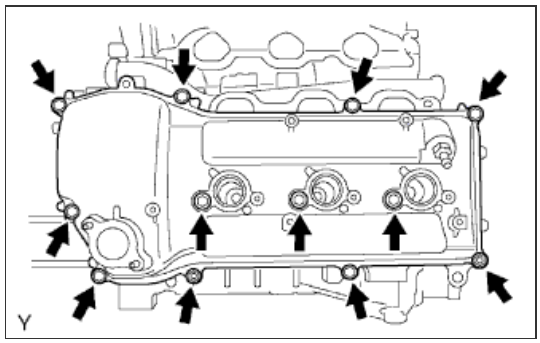
8. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY RH

a. Remove the 10 bolts, 3 seal hers, 2 n ts, cylinder head cover and gasket.



9. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY LH

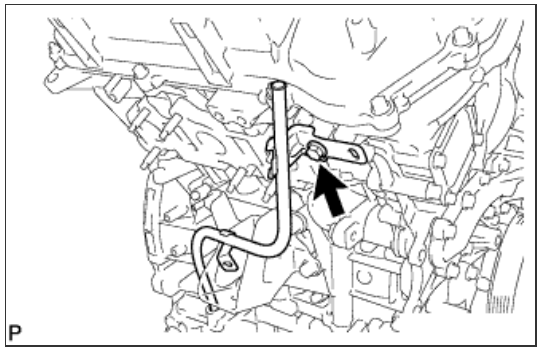
a. Remove the 10 bolts, 3 seal hers, 2 n ts, cylinder head cover and gasket.



10. REMOVE ENGINE OIL LEVEL DIPSTICK GUIDE

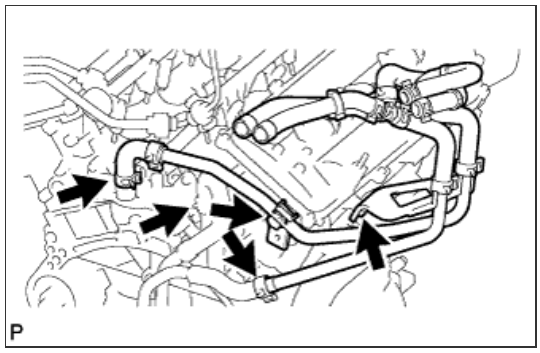
a. Remove the bolt and dipstick g ide.

b. Remove the O-ring from the dipstick g ide.



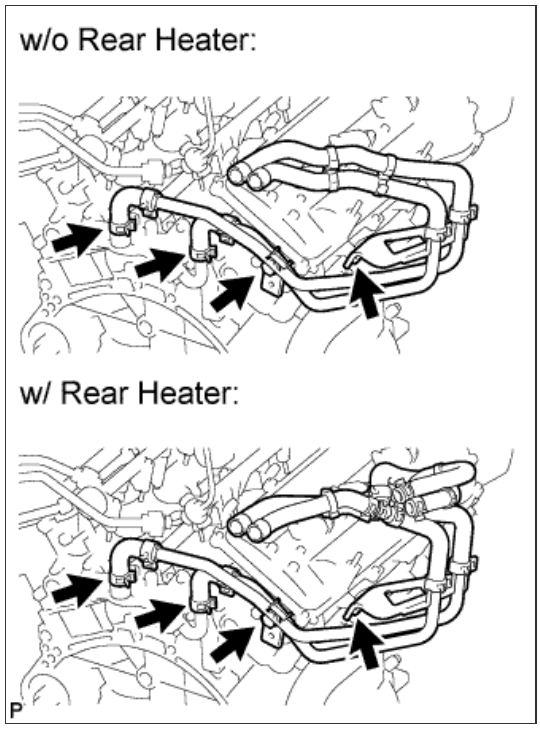
11. DISCONNECT WATER HOSE SUB-ASSEMBLY (for Automatic Transmission)

a. Remove the 2 bolts and disconnect the 3 ter hoses.



12. DISCONNECT WATER HOSE SUB-ASSEMBLY (for Manual Transmission)

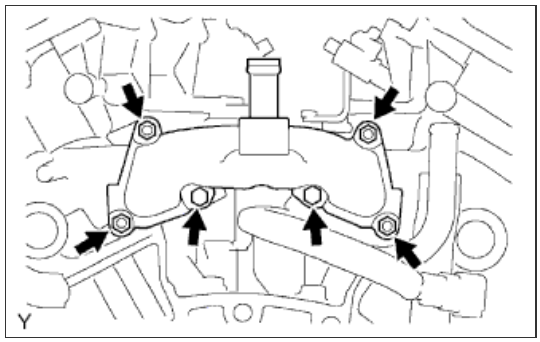
a. Remove the 2 bolts and disconnect the 2 ter hoses.



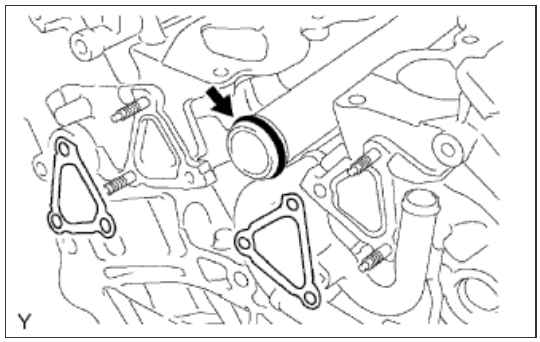
13. REMOVE REAR WATER BY-PASS JOINT

a. Disconnect the engine coolant temperat e sensor connector.

b. Remove the 2 bolts, 4 n ts, rear ter by-pass joint and 2 gaskets.

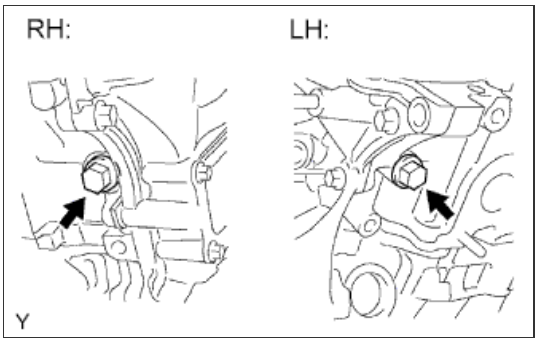


c. Remove the O-ring from the No. 1 ter o tlet pipe.



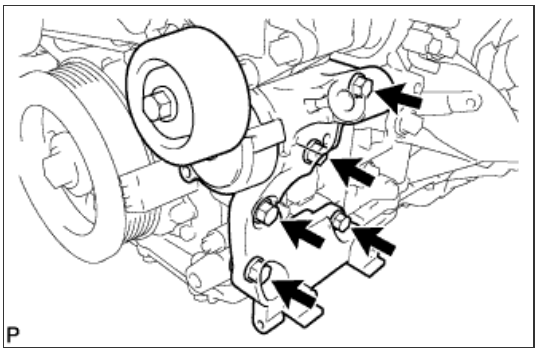
14. REMOVE OIL CONTROL VALVE FILTER

a. Remove the 2 nions, 2 filters and 2 gaskets from the cylinder head LH and RH.



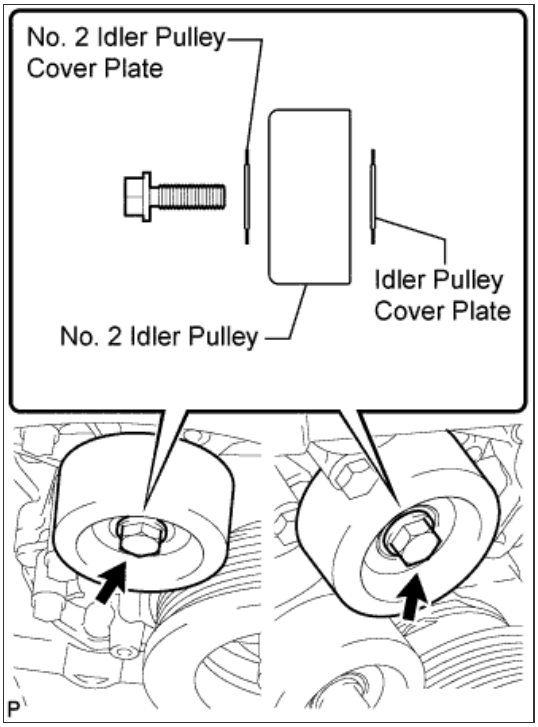
15. REMOVE V-RIBBED BELT TENSIONER ASSEMBLY

a. Remove the 5 bolts and V-ribbed belt tensioner.

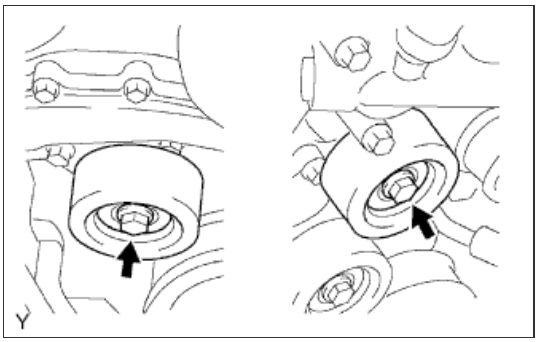


16. REMOVE NO. 2 IDLER PULLEY SUB-ASSEMBLY

a. P ey Cover Plate:
Remove the 2 bolts, 2 No. 2 idler p ey cover plate, 2 idler p ey and 2 idler p ey cover plate.

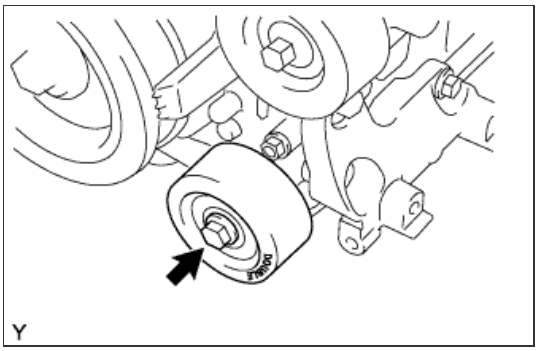


b. o P ey Cover Plate:
Remove the 2 bolts and 2 No. 2 idler p eys.



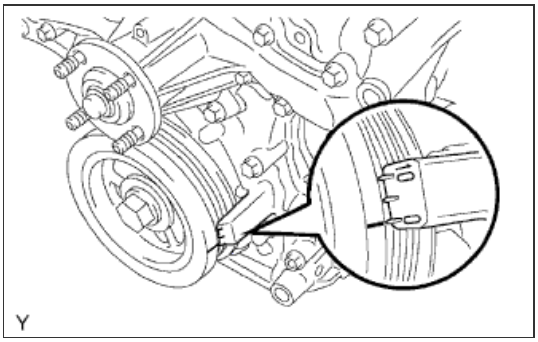
17. REMOVE NO. 1 IDLER PULLEY SUB-ASSEMBLY

a. Remove the bolt and No. 1 idler p ey.

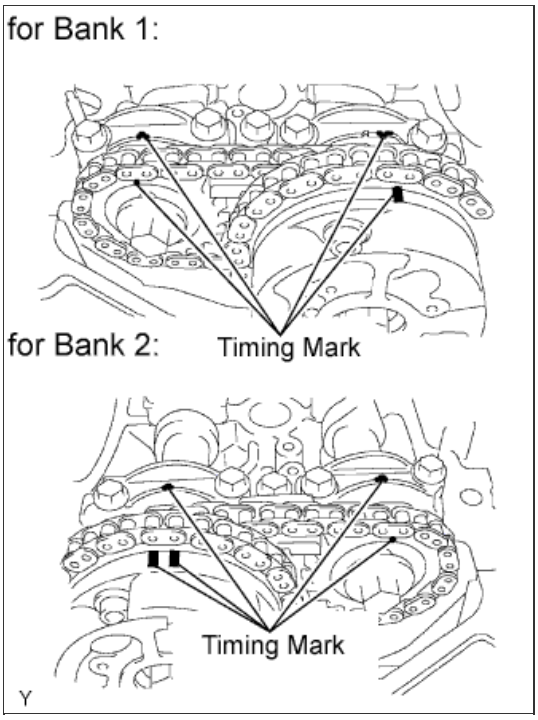


18. REMOVE CRANKSHAFT PULLEY

a. T n the crankshaft p ey, and align the notch ith the timing mark of the timing chain cover.

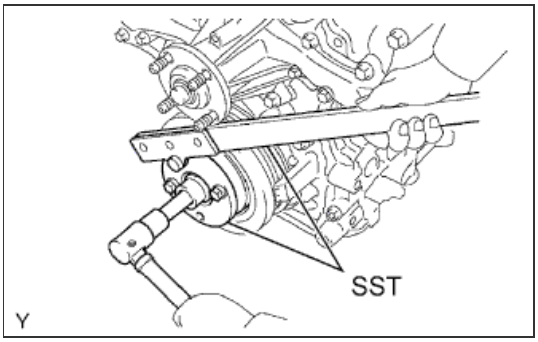


b. Check that the timing marks of the camshaft timing gears and sprockets are aligned ith the timing marks of the bearing caps as sho n in the ill tration.



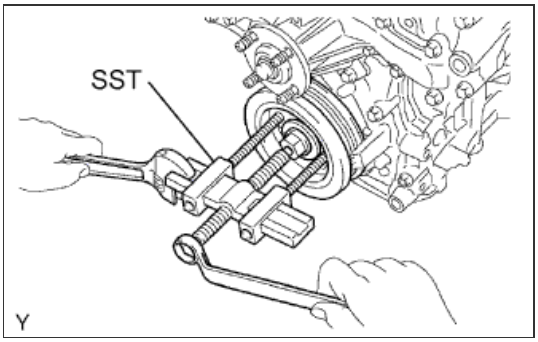
c. ing SST, hold the crankshaft p ey and loosen the p ey set bolt.

SST
09213-54015 (91651-60855)
09330-00021



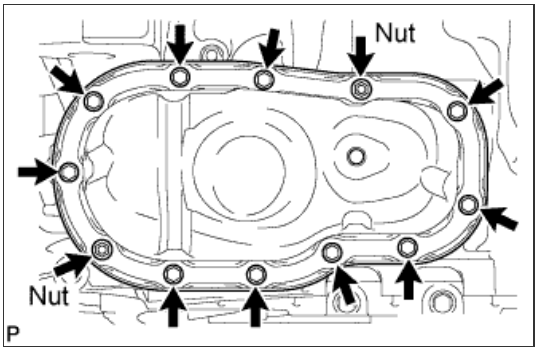
d. ing the p ey set bolt and SST, remove the crankshaft p ey.

SST
09950-50013 (09951-05010, 09952-05010, 09953-05020, 09954-05030)

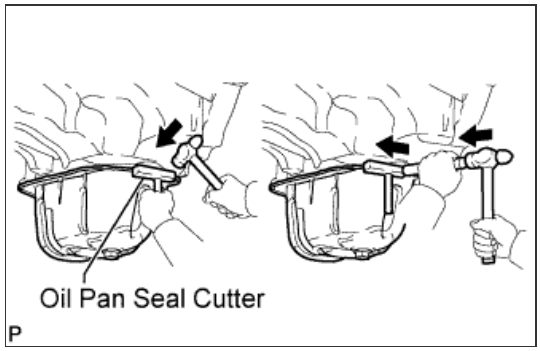


19. REMOVE NO. 2 OIL PAN SUB-ASSEMBLY

a. Remove the 10 bolts and 2 n ts.

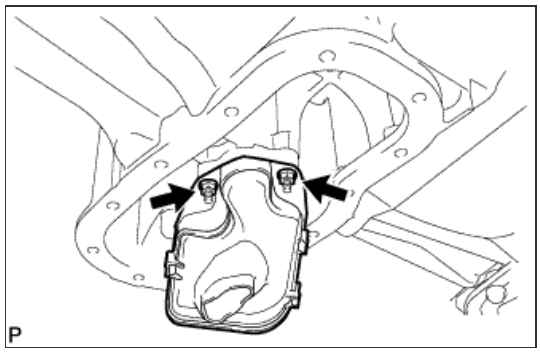


b. nsert the blade of an oil pan seal c tter bet een the oil pans. C t thro gh the applied sealer and remove the No. 2 oil pan.



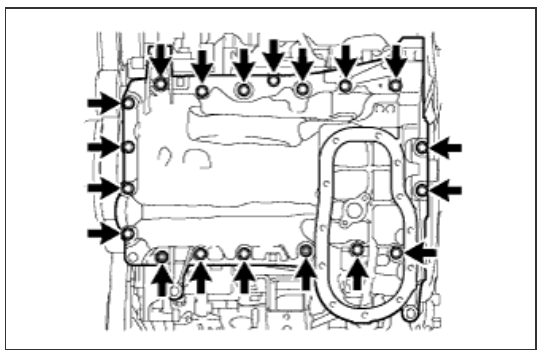
20. REMOVE OIL STRAINER SUB-ASSEMBLY

a. Remove the 2 n ts, oil strainer and gasket.



21. REMOVE OIL PAN SUB-ASSEMBLY

a. Remove the 17 bolts and 2 n ts.



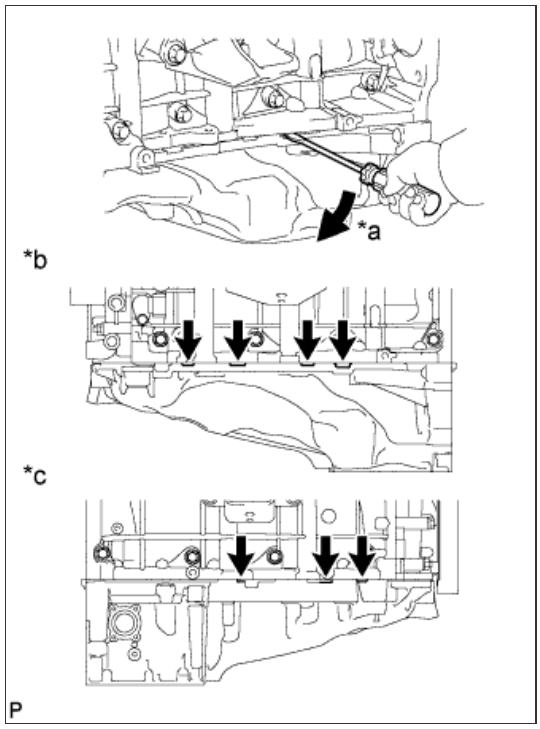
b. ing a scre iver, remove the oil pan by prying bet een the oil pan and cylinder block as sho n in the ill tration.

Text in Illustration

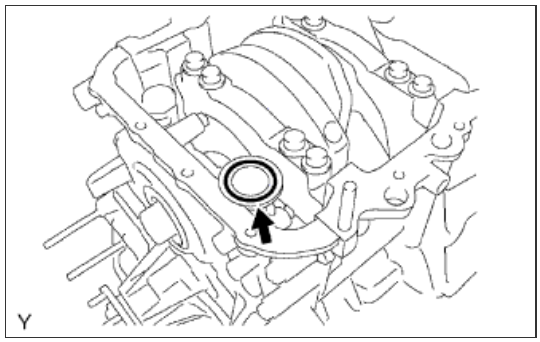
*a	Pry
*b	LH Side
*c	RH Side

NOTICE:

Be caref not to damage the contact s es of the cylinder block and oil pan.

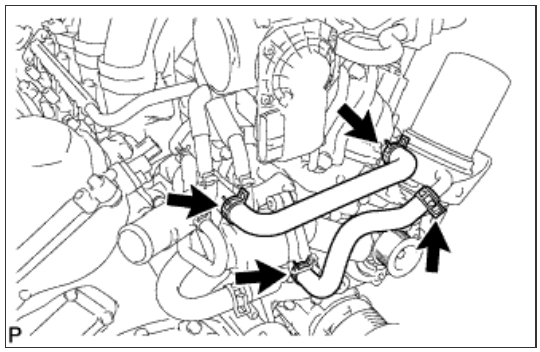


c. Remove the O-ring from the timing chain cover.



22. REMOVE NO. 2 OIL COOLER HOSE

a. Remove the oil cooler hose.



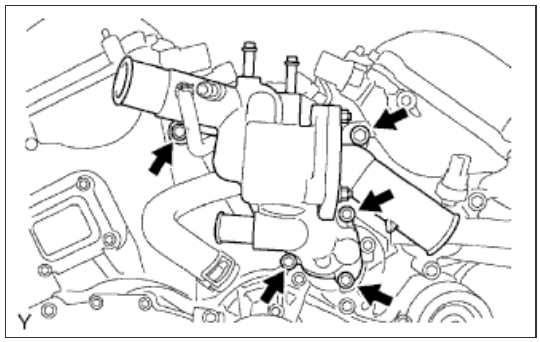
23. REMOVE OIL COOLER HOSE

a. Remove the oil cooler hose.

24. REMOVE WATER INLET HOUSING

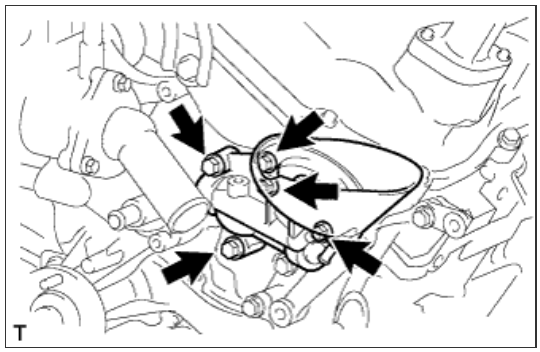
a. Remove the 5 bolts and ter inlet ho ing.

b. Remove the O-ring and gasket from the ter o tlet pipe and ter p mp.



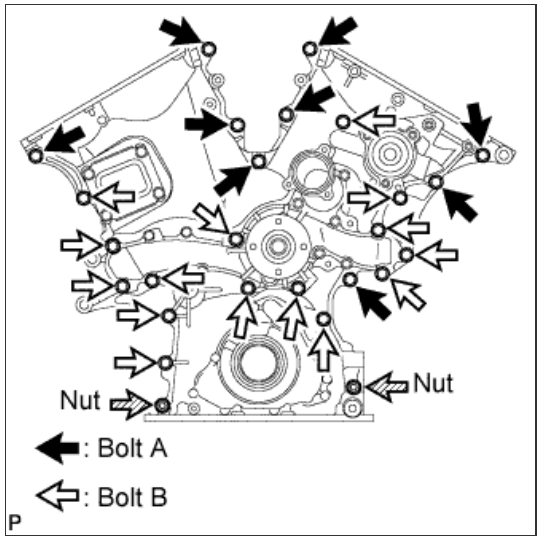
25. REMOVE OIL FILTER BRACKET SUB-ASSEMBLY

a. Remove the 3 bolts, 2 n ts, oil filter bracket and O-ring.



26. REMOVE TIMING CHAIN COVER SUB-ASSEMBLY

a. Remove the 24 bolts labeled and B, and the 2 n ts.

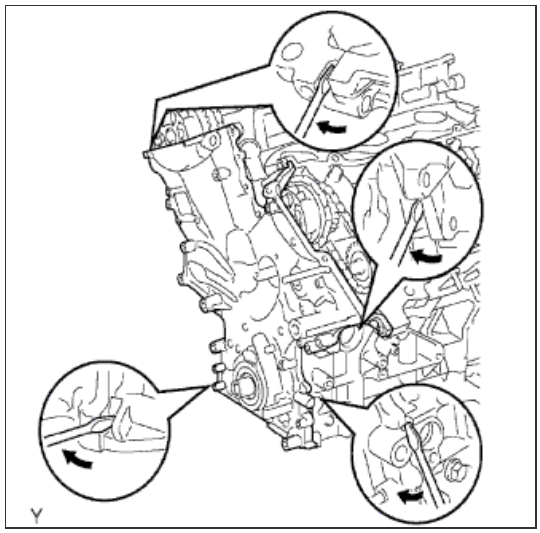


b. Remove the timing chain cover by prying bet een the timing chain cover and cylinder head or cylinder block ith a scre iver.

NOTICE:

Be caref not to damage the contact s es of the timing chain cover, cylinder block and cylinder head.

c. Remove the O-ring from the cylinder head LH side.



27. REMOVE FRONT CRANKSHAFT OIL SEAL

a. the timing chain case is removed:

i. ing a scre iver and ooden block, pry o t the oil seal.

HINT:

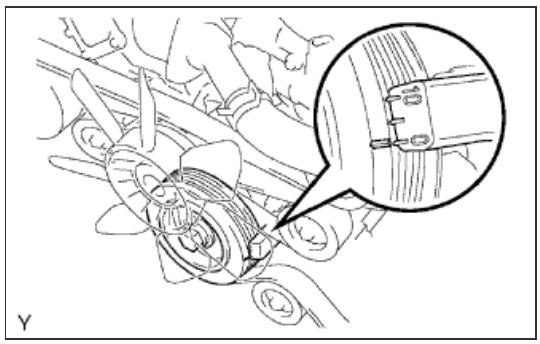
Tape the scre iver tip before e.

NOTICE:

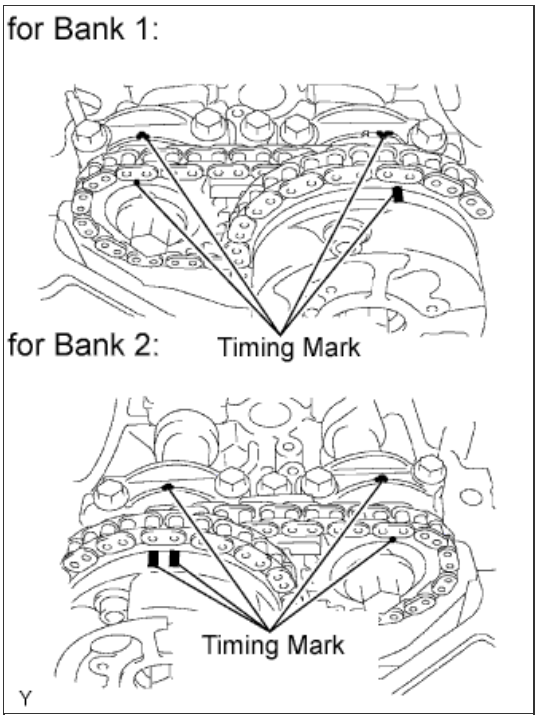
Do not damage the s e of the oil seal press fit hole and crankshaft.

28. SET NO. 1 CYLINDER TO TDC/COMPRESSION

a. T n the crankshaft p ey, and align its groove ith the timing mark of the timing chain cover.



b. Check that the timing marks of the camshaft timing gears and sprockets are aligned ith the timing marks of the bearing caps as sho n in the ill tration. not, t n the crankshaft 1 complete revol tion (3 and align the timing marks as above.



29. REMOVE NO. 1 CHAIN TENSIONER ASSEMBLY

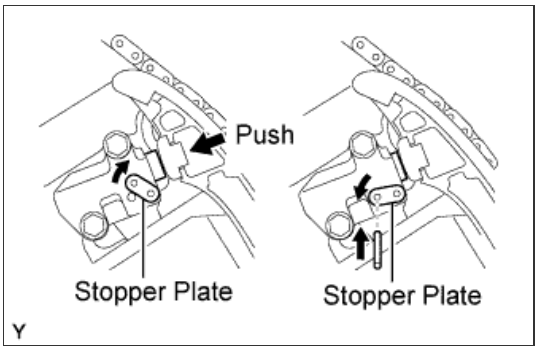
NOTICE:

- **Never rotate the crankshaft with the chain tensioner removed.**
- **When rotating the camshaft with the timing chain removed, rotate the crankshaft counterclockwise 40° from the TDC first.**

a. While t ning the stopper plate of the tensioner clock ise, p h in the pl nger of the chain tensioner as sho n in the ill tration.

b. While t ning the stopper plate of the tensioner co nterclock ise, insert a bar of φ3.5 mm (0.138 in.) into the holes on the stopper plate and tensioner to fix the stopper plate in place.

c. Remove the 2 bolts and chain tensioner.

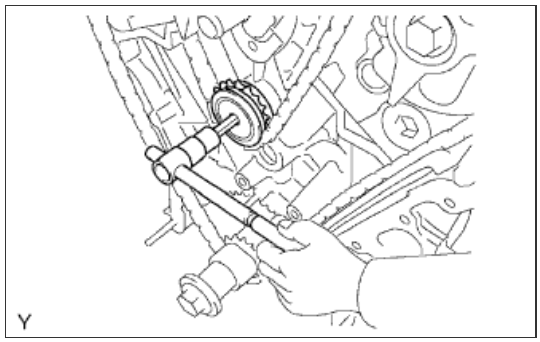


30. REMOVE CHAIN TENSIONER SLIPPER

a. Remove the chain tensioner slipper.

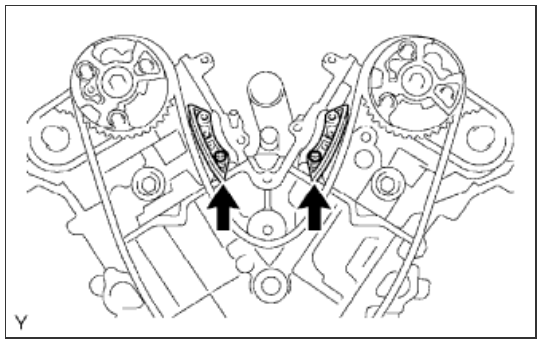
31. REMOVE NO. 1 IDLE GEAR SHAFT

a. ing a 10 mm hexagon ench, remove the No. 2 idle gear shaft, No. 1 idle gear and No. 1 idle gear shaft.



32. REMOVE NO. 2 CHAIN VIBRATION DAMPER

a. Remove the 2 No. 2 chain vibration dampers.

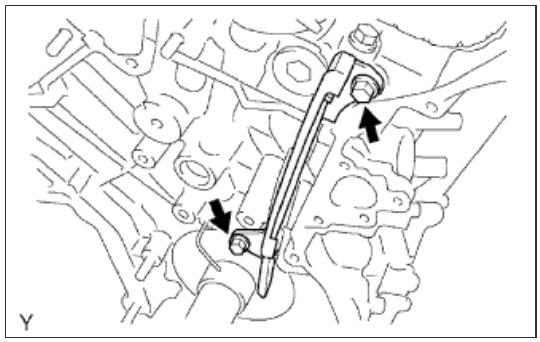


33. REMOVE NO. 1 CHAIN SUB-ASSEMBLY

a. Remove the No. 1 chain.

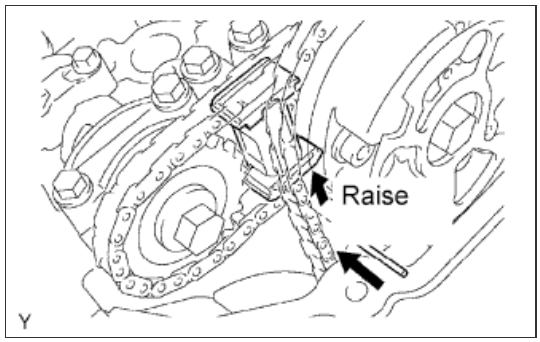
34. REMOVE NO. 1 CHAIN VIBRATION DAMPER

a. Remove the 2 bolts and No. 1 chain vibration damper.

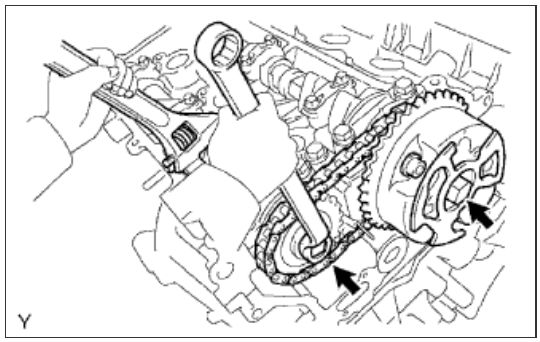


35. REMOVE CAMSHAFT TIMING GEARS AND NO. 2 CHAIN

a. While raising the No. 2 chain tensioner, insert a pin of φ1.0 mm (0.0394 in.) into the hole to fix the tensioner in place.



b. Hold the hexagonal portion of the camshaft ith a ench, and remove the 2 bolts, camshaft timing gear, camshaft timing sprocket and No. 2 chain.

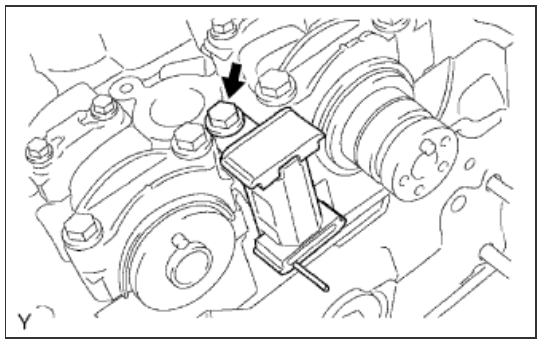


NOTICE:

- **Be careful not to damage the cylinder head and valve lifter with the wrench.**
- **Do not disassemble the camshaft timing gear.**

36. REMOVE NO. 2 CHAIN TENSIONER ASSEMBLY

a. Remove the bolt and No. 2 chain tensioner.

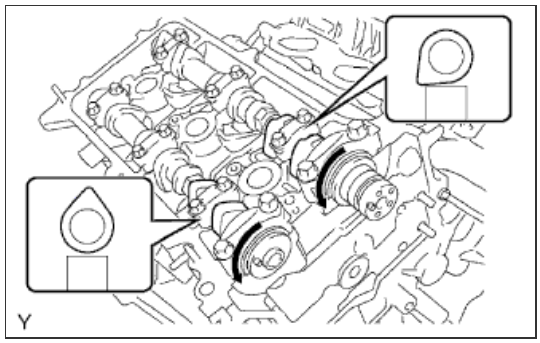


37. REMOVE NO. 1 CAMSHAFT AND NO. 2 CAMSHAFT

NOTICE:

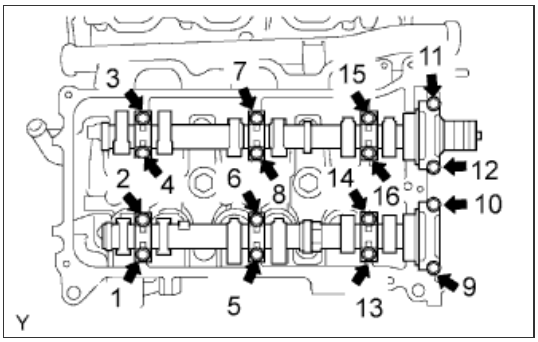
the thr t clearance of the camshaft is small, the camshaft m t be kept level hile it is being removed. the camshaft is not kept level, the portion of the cylinder head hich receives the shaft thr t may crack or be damaged, ca ing the camshaft to seize or break. To avoid this, the follo ing steps sho be carried o t.

a. Rotate the camshafts co nterclock ise ing a ench so that the cam lobes of the No. 1 cylinder face each direction as sho n in the ill tration.



b. niformly loosen and remove the 1 bearing cap bolts in the seq ence sho n in the ill tration.

c. Remove the 8 bearing caps and 2 camshafts.

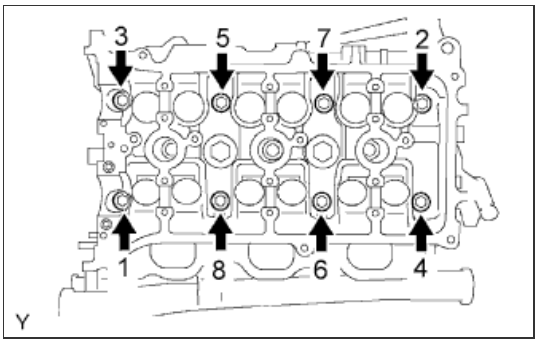


38. REMOVE CYLINDER HEAD SUB-ASSEMBLY RH

a. ing a 10 mm bi-hexagon ench, niformly loosen the 8 cylinder head bolts in the seq ence sho n in the ill tration. Remove the 8 cylinder head bolts and plate hers.

NOTICE:

- **Be careful not to drop the plate washers into the cylinder head.**
- **Cylinder head warpage or cracking could result from removing bolts in the incorrect order.**



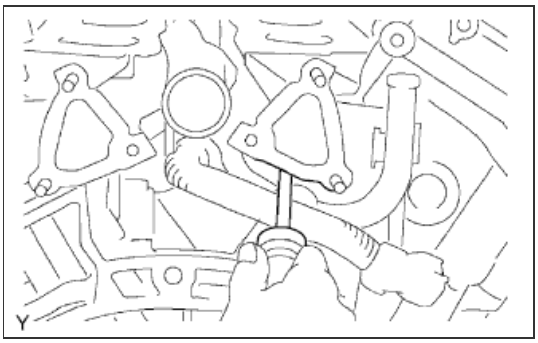
b. Lift the cylinder head from the do els on the cylinder block, and place the cylinder head on ooden blocks on a bench.

NOTICE:

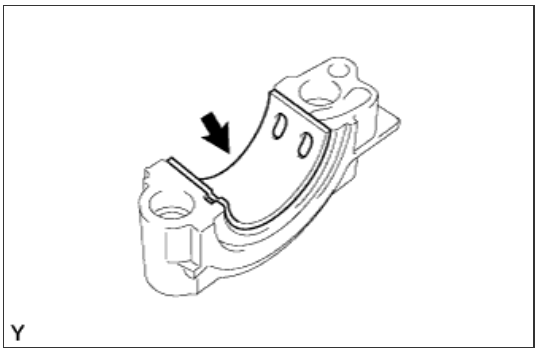
Be caref not to damage the contact s es of the cylinder head and cylinder block.

HINT:

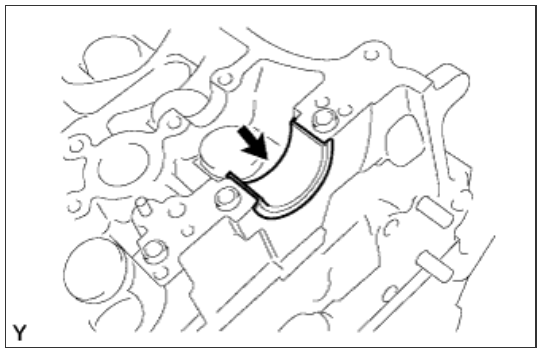
the cylinder head is diffic t to lift off, pry bet een the cylinder head and cylinder block ith a scre iver.



39. REMOVE NO. 1 CAMSHAFT BEARING



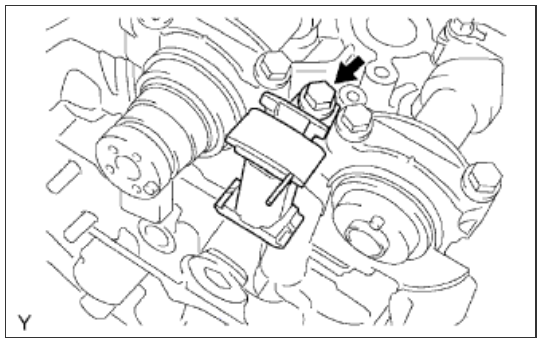
40. REMOVE NO. 2 CAMSHAFT BEARING



41. REMOVE CYLINDER HEAD GASKET

42. REMOVE NO. 3 CHAIN TENSIONER ASSEMBLY

a. Remove the bolt and No. 3 chain tensioner.



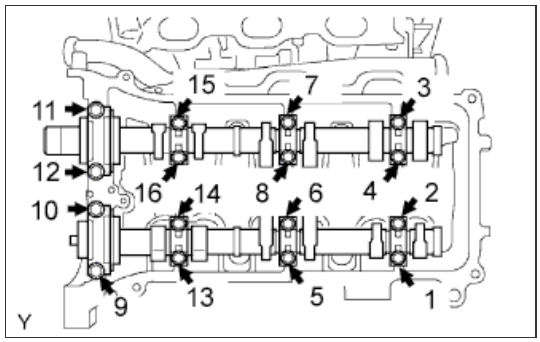
43. REMOVE NO. 3 CAMSHAFT AND NO. 4 CAMSHAFT

NOTICE:

the thr t clearance of the camshaft is small, the camshaft m t be kept level hile it is being removed. the camshaft is not kept level, the portion of the cylinder head hich receives the shaft thr t may crack or be damaged, ca ing the camshaft to seize or break. To avoid this, the follo ing steps sho be carried o t.

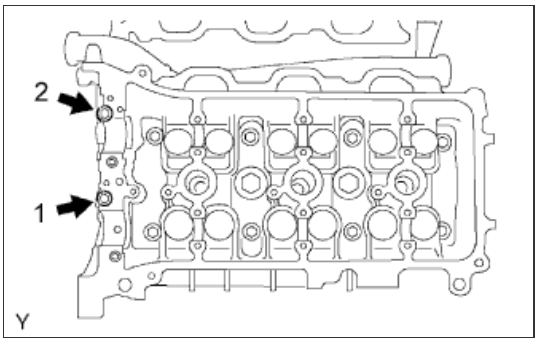
a. niformly loosen and remove the 1 bearing cap bolts in the seq ence sho n in the ill tration.

b. Remove the 8 bearing caps and 2 camshafts.



44. REMOVE CYLINDER HEAD SUB-ASSEMBLY LH

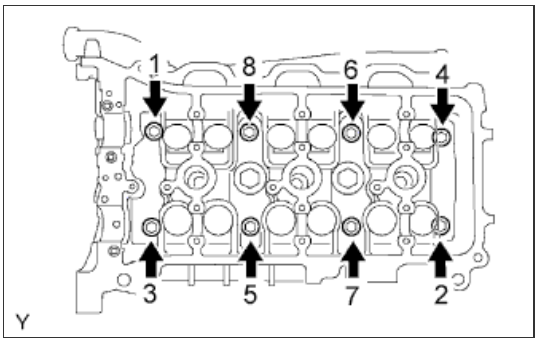
a. niformly loosen and remove the 2 cylinder head bolts in the seq ence sho n in the ill tration.



b. ing a 10 mm bi-hexagon ench, niformly loosen the 8 cylinder head bolts in the seq ence sho n in the ill tration. Remove the 8 cylinder head bolts and plate hers.

NOTICE:

- **Be careful not to drop the plate washers into the cylinder head.**
- **Cylinder head warpage or cracking could result from removing bolts in the incorrect order.**



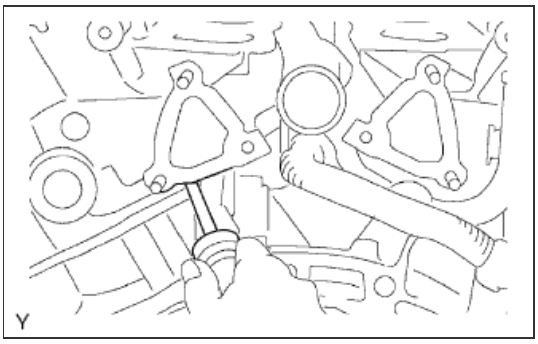
c. Lift the cylinder head from the do els on the cylinder block, and place the cylinder head on ooden blocks on a bench.

NOTICE:

Be caref not to damage the contact s es of the cylinder head and cylinder block.

HINT:

the cylinder head is diffic t to lift off, pry bet een the cylinder head and cylinder block ith a scre iver.



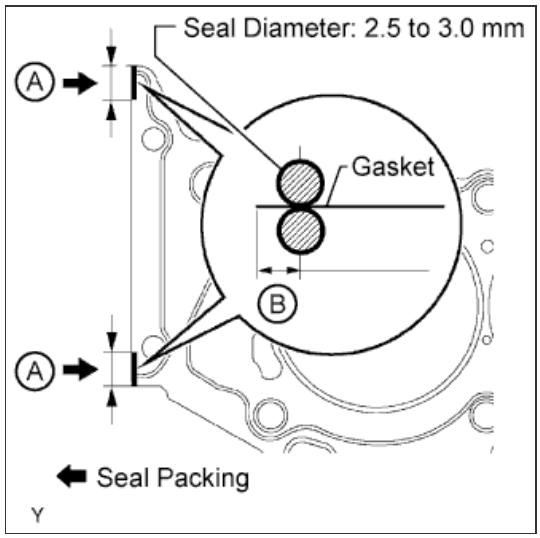
45. REMOVE NO. 2 CYLINDER HEAD GASKET

for Preparation Click here

1. INSTALL NO. 2 CYLINDER HEAD GASKET

a. Remove any old pac ng (ma e al and be ca eful no o d op any oil on e con ac ace of e cylinde ead and cylinde bloc

b. ly eal pac ng o a new cylinde ead ga e a own in e illu a on.



Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
2.5 to 3.0 mm (0.0984 to 0.118 in.)

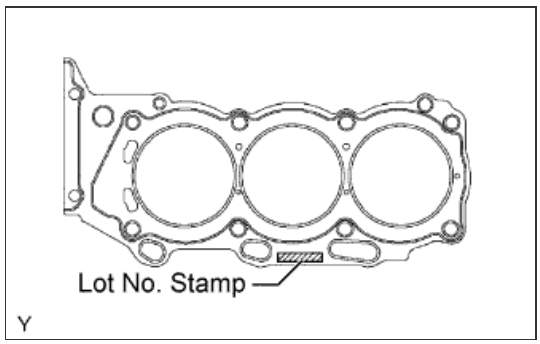
Seal Packing Application Range

em	ecified Condi on
A	10 o 15 mm (0.3 o 0.5 in.)
B	1.25 o 1.5 mm (0.04 o 0.05 in.)

HINT:

- **Remove any oil from the contact surface.**
- **Install the cylinder head gasket within 3 minutes after applying the seal packing.**
- **Do not add engine oil within 2 hours of installation.**

c. lace e cylinde ead ga e on e cylinde bloc ace wi e f on face of e Lo No. amp upwa d.



NOTICE:

Be ca eful of e in alla on di ec on.

2. INSTALL CYLINDER HEAD SUB-ASSEMBLY LH

a. lace e cylinde ead on e cylinde ead ga e

NOTICE:

- **Ensure that no oil is on the mounting surface of the cylinder head.**
- **Gently place the cylinder head in order not to damage the gasket with the bottom part of the cylinder head.**

b. n all e 8 cylinde ead bol and pla e wa e

HINT:

- **The cylinder head bolts are tightened in 3 progressive steps.**
- **If any cylinder head bolt is broken or deformed, replace it.**

i. ly a lig coa of engine oil o e ead and unde e ead of e cylinde ead bol

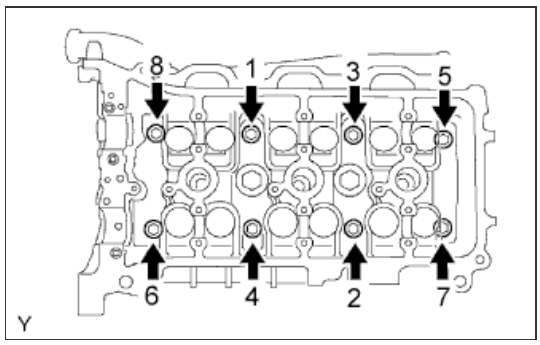
ii. n all e pla e wa e o e cylinde ead bol

c. ep 1:

i. U ng a 10 mm bi- exagon w enc in all and unifo mly en e 8 cylinde ead bol wi pla e wa e in eve al ep in e e ence own in e illu a on.

Torque:
36 N*m 367 kgf*cm , 27 ft.*lbf

any one of e cylinde ead bol doe no mee e o e ecifica on eplace e cylinde ead bol

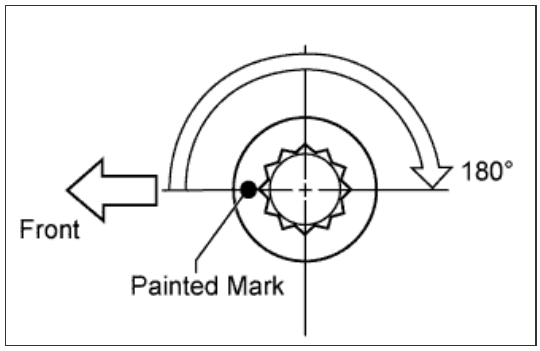


d. ep 2:

i. a e cylinde ead bol ead wi pain a own in e illu a on.

ii. en e cylinde ead bol 180 in e e ence own in ep 1.

e. C ec a e pain ed ma a e now facing ea a d.

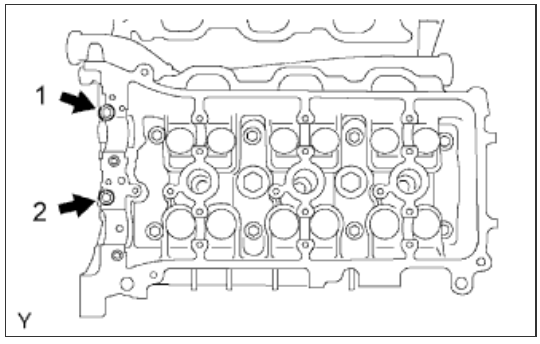


f. n all e 2 bol in e o de own in e illu a on.

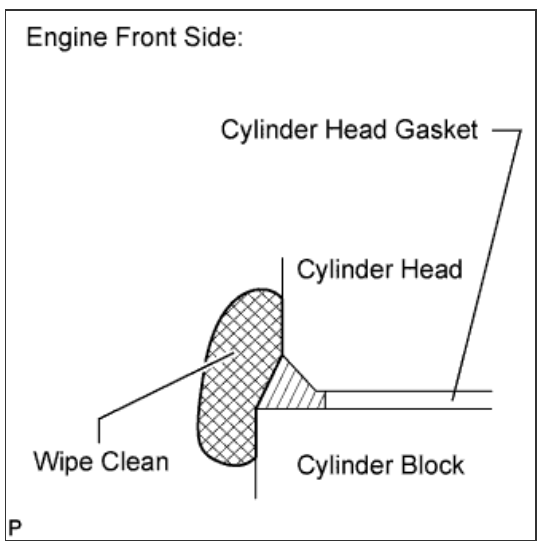
i. Apply a lig coa of engine oil o e ead of e cylinde ead bol

ii. n all e 2 cylinde ead bol U ng eve al ep en e bol nifo mly in e e ence own in e illu a on.

Torque:
30 N*m{ 306 kgf*cm , 22 ft.*lbf }



g. eal pac ng will eep ou f om e f on de of e engine. o oug ly wipe off eal pac ng a eep ou



3. INSTALL NO. 3 CAMSHAFT AND NO. 4 CAMSHAFT

NOTICE:

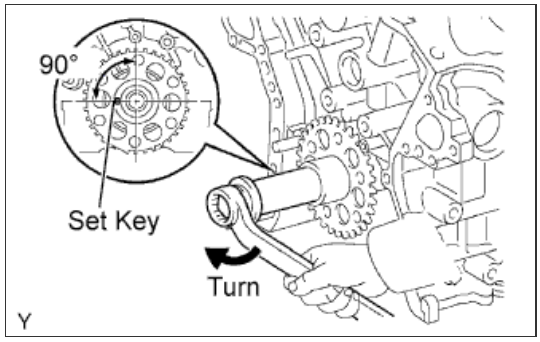
A e clea ance of e cam af i mall e cam af mu be ep level w le i i being in alled. e cam af i no ep level e po on of e cylinde ead w eceive e af may c ac o be damaged cau ng e cam af o eize o b ea o avoid e following ep ould be ca ed ou

a. e e c an af po on.

i. n all e c an af pulley e bol n e c an af and e e c an af e ey in o e lef o on al po on.

NOTICE:

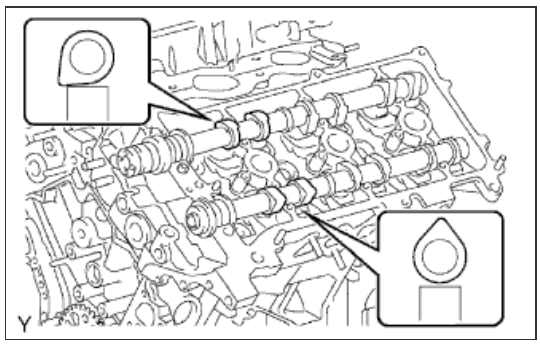
e ng e c an af a a w ong angle can cau e e pi on ead and valve ead o come in o con ac wi eac o e w en e cam af i in alled cau ng damage. Alway e e c an af o e co ec angle.



b. Apply a lig coa of engine oil o e po on and jou nal of e cam af

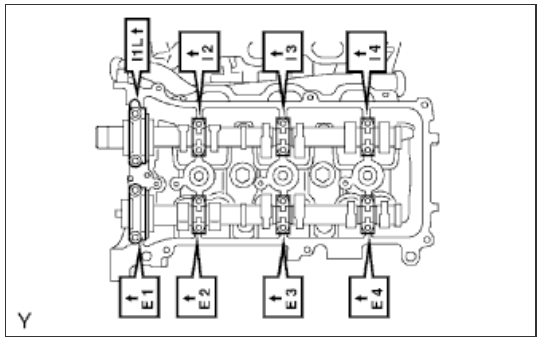
c. lace e 2 cam af on o e cylinde ead wi e cam lobe of e No. 2 cylinde facing eac di ec on a own in e illu a on.

d. Apply a lig coa of engine oil o e 8 bea ng cap



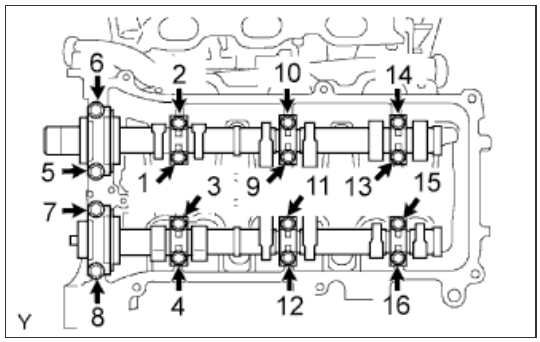
e. e e 8 bea ng cap in ei p ope loca on

f. ly a lig coa of engine oil o e ead and unde e ead of e 16 bea ng cap bol



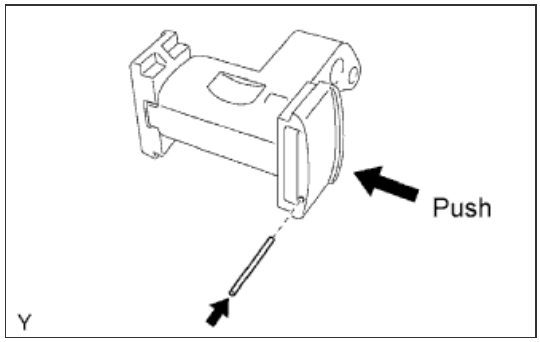
g. nifo mly in all e 16 bea ng cap bol in eve al ep in e o de own in e illu a on.

Torque:
for 10 mm head bolt:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }
for 12 mm head bolt:
24 N*m{ 245 kgf*cm , 18 ft.*lbf }



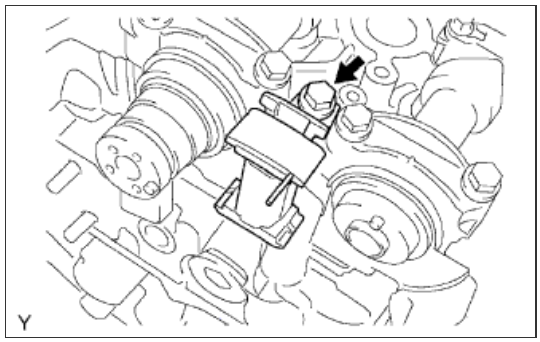
4. INSTALL NO. 3 CHAIN TENSIONER ASSEMBLY

a. W le pu ng in e en one in e a pin of φ1.0 mm (0.03 in.) in o e ole o fix e en one in place.



b. n all e No. 3 c ain en one wi e bol

Torque:
21 N*m 214 kgf*cm , 15 ft.*lbf



5. INSTALL CYLINDER HEAD GASKET

a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the cylinder head and cylinder block.

b. Apply seal packing to a new cylinder head gasket as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

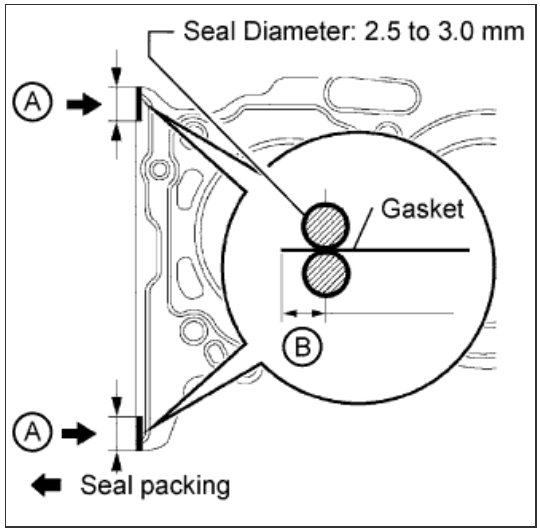
Standard seal diameter:
2.5 to 3.0 mm (0.0984 to 0.118 in.)

Seal Packing Application Range

Item	Specified Condition
A	10 to 15 mm (0.394 to 0.591 in.)
B	1.25 to 1.5 mm (0.0492 to 0.0591 in.)

HINT:

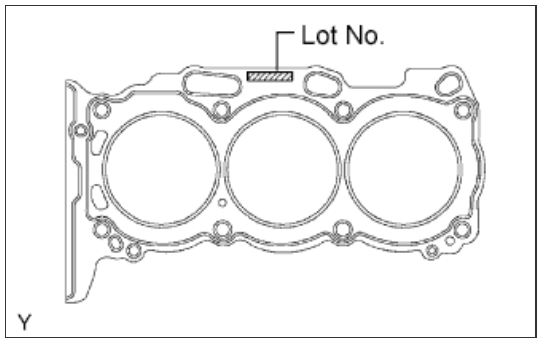
- **Remove any oil from the contact surface.**
- **Install the cylinder head gasket within 3 minutes after applying the seal packing.**
- **Do not add engine oil within 2 hours of installation.**



c. Place the cylinder head gasket on the cylinder block surface with the front face of the Lot No. stamp upward.

NOTICE:

Be careful of the installation direction.



6. INSTALL CYLINDER HEAD SUB-ASSEMBLY RH

a. Place the cylinder head on the cylinder head gasket.

NOTICE:

- **Ensure that no oil is on the mounting surface of the cylinder head.**
- **Gently place the cylinder head in order not to damage the gasket with the bottom part of the cylinder head.**

b. Install the 8 cylinder head bolts and plate washers.

HINT:

- **The cylinder head bolts are tightened in 3 progressive steps.**
- **If any cylinder head bolt is broken or deformed, replace it.**

i. Apply a light coat of engine oil to the threads and under the heads of the cylinder head bolts.

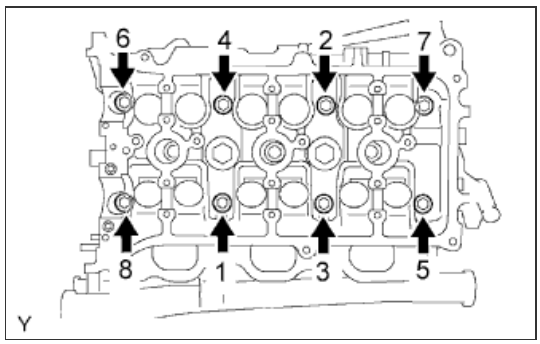
ii. Install the plate washers to the cylinder head bolts.

c. Step 1:

i. Using a 10 mm bi-hexagon wrench, install and uniformly tighten the 8 cylinder head bolts with plate washers in several steps in the sequence shown in the illustration.

Torque:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }

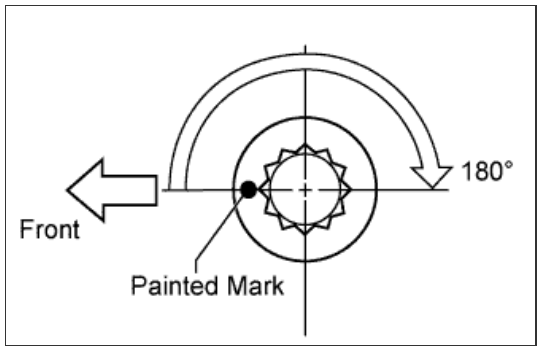
If any one of the cylinder head bolts does not meet the torque specification, replace the cylinder head bolt.



d. Step 2:

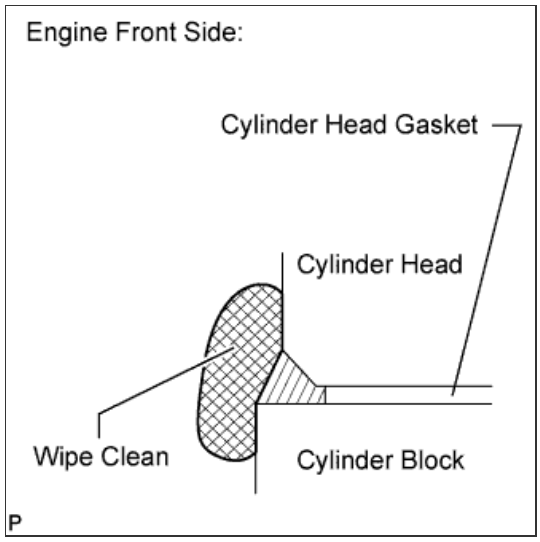
i. Mark the cylinder head bolt heads with paint as shown in the illustration.

ii. Tighten the cylinder head bolts 180° in the sequence shown in step 1.



e. Check that the painted marks are now facing rearward.

f. Seal packing will seep out from the front side of engine. Thoroughly wipe off the seal packing that seeps out.

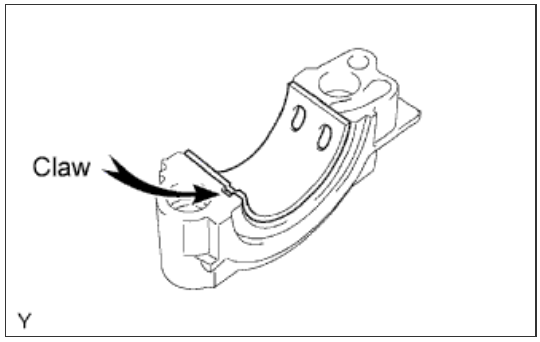


7. INSTALL NO. 1 CAMSHAFT BEARING

a. Align the bearing claw with the claw groove of the bearing cap, and push in the No. 1 camshaft bearing.

NOTICE:

- **Install the bearing while aligning it with the oil hole in the bearing cap.**
- **Clean the backside of the bearing and the contact surface of the bearing cap and prevent oil from adhering to them.**

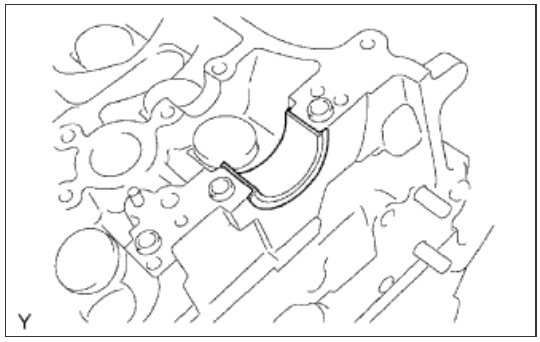


8. INSTALL NO. 2 CAMSHAFT BEARING

a. Install the No. 2 camshaft bearing to the cylinder head.

NOTICE:

Clean the backside of the bearing and the contact surface of the cylinder head and prevent oil from adhering to them.



9. INSTALL NO. 1 CAMSHAFT AND NO. 2 CAMSHAFT

NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

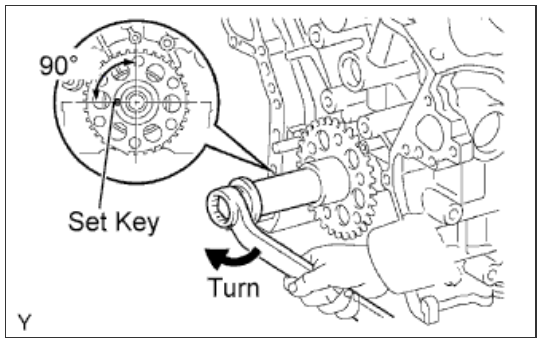
a. Set the crankshaft position.

i. Using the crankshaft pulley set bolt, turn the crankshaft, and set the crankshaft set key into the left horizontal position.

NOTICE:

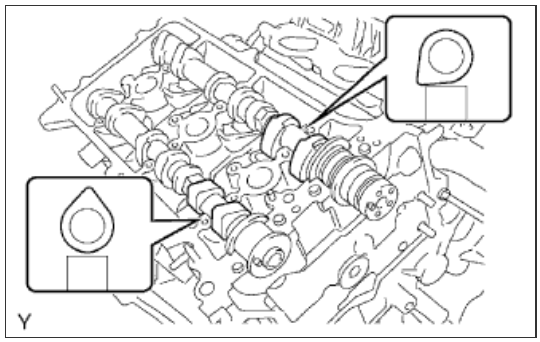
Having the crankshaft at the wrong angle can cause the piston head and valve head to come into contact with each other when the camshaft is installed, causing damage. Always set the crankshaft to the correct angle.

b. Apply a light coat of engine oil to the thrust portions and journals of the camshafts.



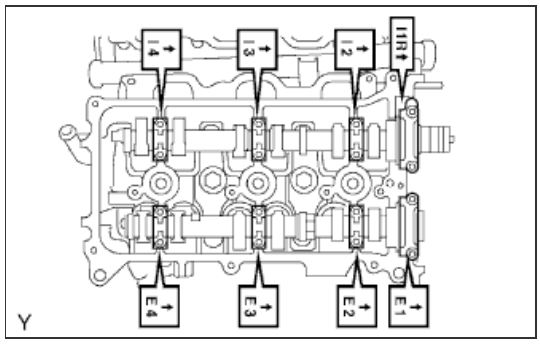
c. Place the 2 camshafts onto the cylinder head with the cam lobes of the No. 1 cylinder facing each direction as shown in the illustration.

d. Apply a light coat of engine oil to the 8 bearing caps.



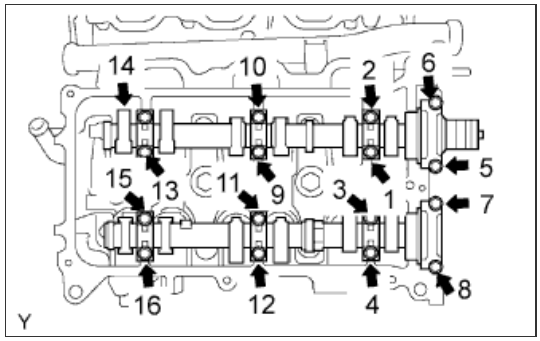
e. Set the 8 bearing caps in their proper locations.

f. Apply a light coat of engine oil to the threads and under the heads of the 16 bearing cap bolts.

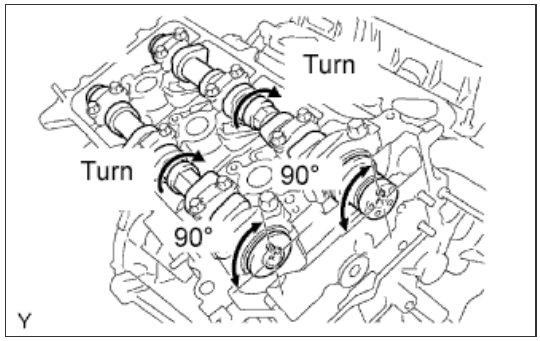


g. Uniformly install the 16 bearing cap bolts in several steps in the order shown in the illustration.

Torque:
for 10 mm head bolt:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }
for 12 mm head bolt:
24 N*m{ 245 kgf*cm , 18 ft.*lbf }

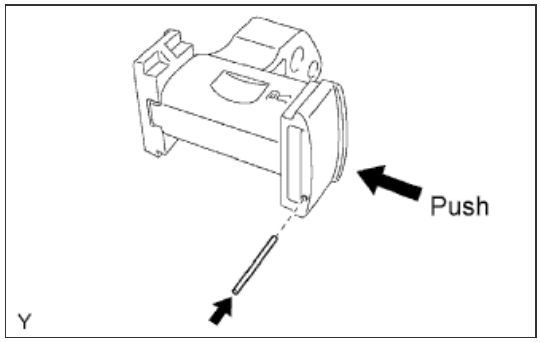


h. Using a wrench, turn the camshafts clockwise until the camshaft knock pin is at a position 90° to the cylinder head.



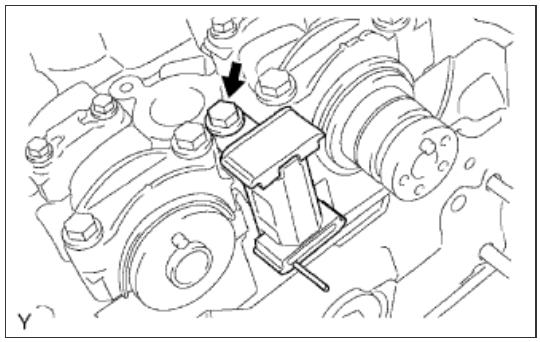
10. INSTALL NO. 2 CHAIN TENSIONER ASSEMBLY

a. While pushing in the tensioner, insert a pin of φ1.0 mm (0.0394 in.) into the hole to fix the tensioner in place.



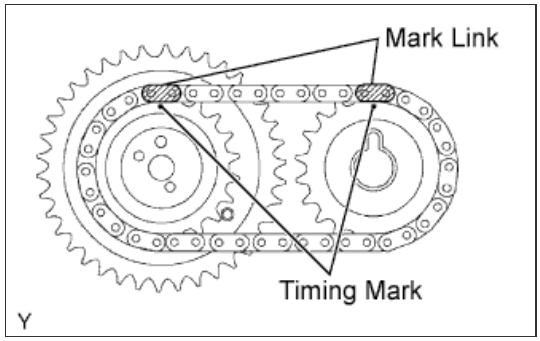
b. Install the No. 2 chain tensioner with the bolt.

Torque:
21 N*m 214 kgf*cm , 15 ft.*lbf



11. INSTALL CAMSHA T TIMING GEARS AND NO. 2 CHAIN

a. Align the mark links (yellow) of the No. 2 chain with the timing marks (1-dot mark) of the camshaft timing gear and sprocket as shown in the illustration.

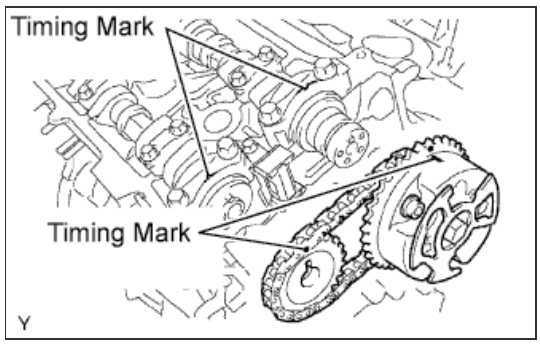


b. Align the timing marks on the camshaft timing gear and sprocket with the timing marks on the bearing caps, and install the camshaft timing gear and sprocket with the No. 2 chain to the camshafts.

c. Temporarily install the camshaft timing gear set bolt and camshaft timing sprocket set bolt.

NOTICE:

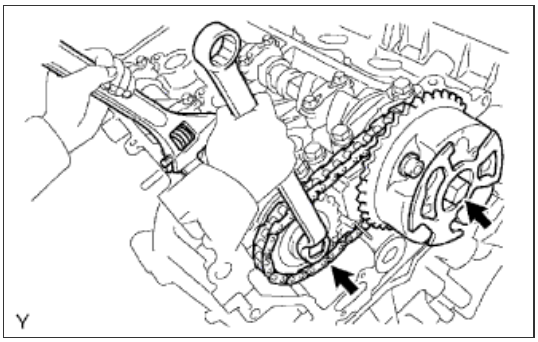
Do not push the camshaft timing gear assembly to the camshaft forcibly when installing it.



d. Hold the hexagonal portion of the camshaft with a wrench, and tighten the 2 bolts.

Torque:
100 N*m{ 1020 kgf*cm , 74 ft.*lbf }

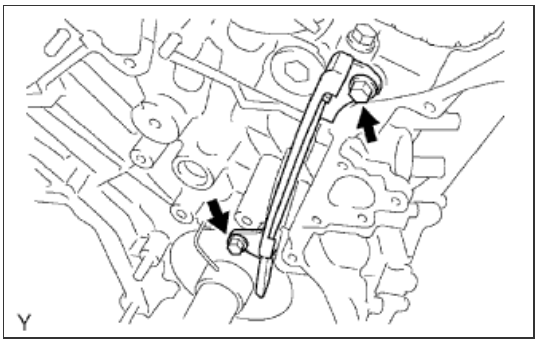
e. Remove the pin from the No. 2 chain tensioner.



12. INSTALL NO. 1 CHAIN VIBRATION DAMPER

a. Install the No. 1 chain vibration damper with the 2 bolts.

Torque:
19 N*m{ 194 kgf*cm , 14 ft.*lbf }



13. INSTALL CHAIN TENSIONER SLIPPER

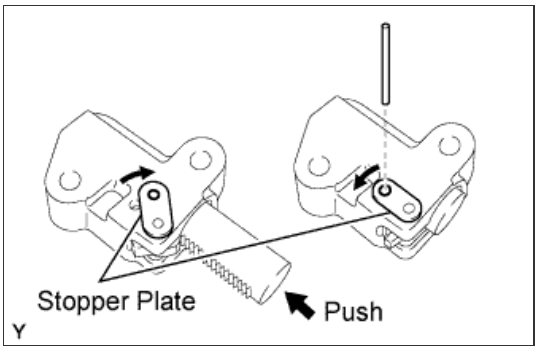
14. INSTALL NO. 1 CHAIN TENSIONER ASSEMBLY

a. While turning the stopper plate of the tensioner clockwise, push in the plunger of the tensioner as shown in the illustration.

b. While turning the stopper plate of the tensioner counterclockwise, insert a bar of φ3.5 mm (0.138 in.) into the holes on the stopper plate and tensioner to fix the stopper plate in place.

c. Install the chain tensioner with the 2 bolts.

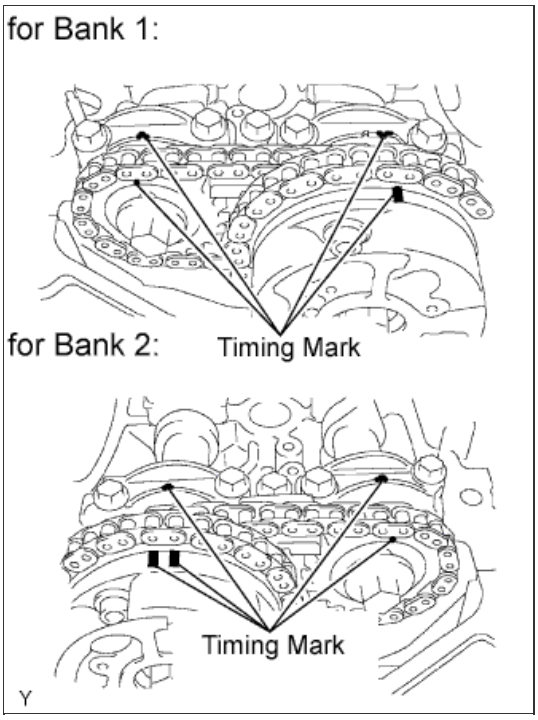
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



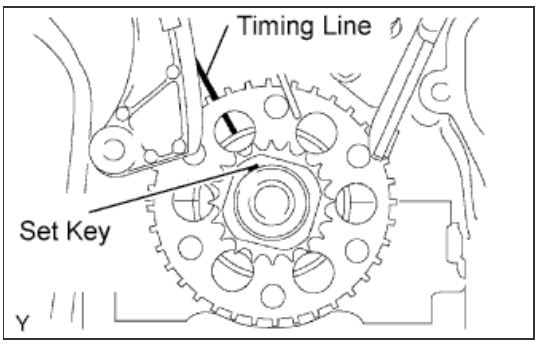
15. INSTALL NO. 1 CHAIN SUB-ASSEMBLY

a. Set the No. 1 cylinder to TDC/compression.

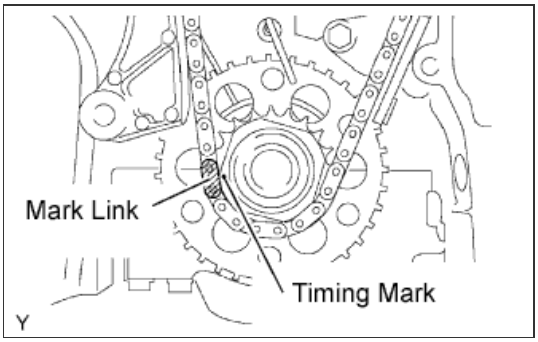
i. Align the timing marks of the camshaft timing gears and sprockets with the timing marks of the bearing caps.



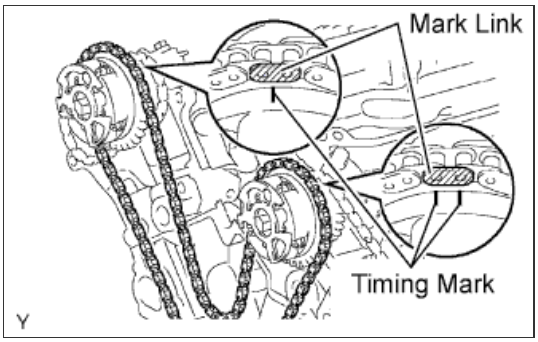
ii. Install the crankshaft pulley set bolt, and turn the crankshaft to align the crankshaft set key with the timing line of the cylinder block.



b. Align the mark link (yellow) with the timing mark of the crankshaft timing gear.

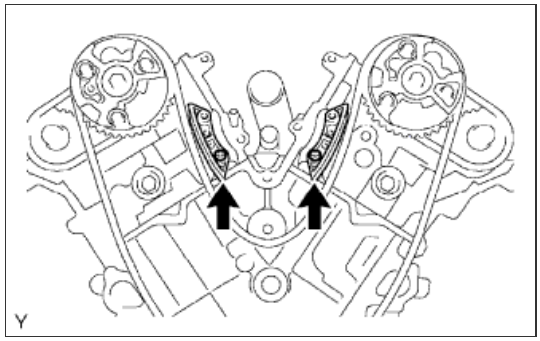


c. Align the mark links (orange) with the timing marks of the camshaft timing gears, and install the No. 1 chain.



16. INSTALL NO. 2 CHAIN VIBRATION DAMPER

a. Install the 2 No. 2 chain vibration dampers.



17. INSTALL NO. 1 IDLE GEAR SHAFT

a. Apply a light coat of engine oil to the rotating surface of the No. 1 idle gear shaft.

b. Temporarily install the No. 1 idle gear shaft and No. 1 idle gear with the No. 2 idle gear shaft while aligning the knock pin of the No. 1 idle gear shaft with the knock pin groove of the cylinder block.

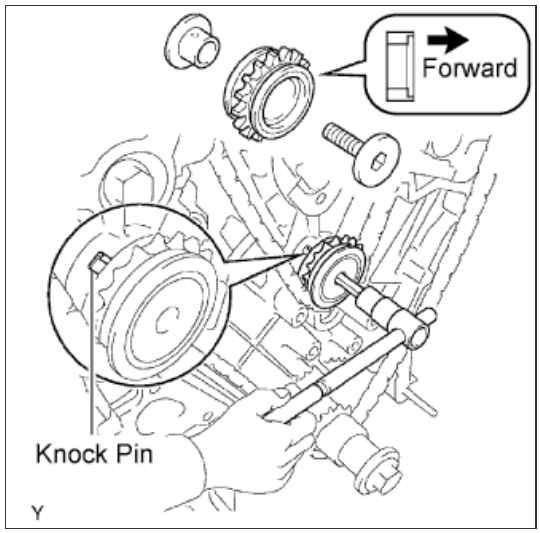
NOTICE:

Be careful of the idle gear direction.

c. Using a 10 mm hexagon wrench, tighten the No. 2 idle gear shaft.

Torque:
60 N*m{ 612 kgf*cm , 44 ft.*lbf }

d. Remove the bar from the chain tensioner.



18. INSTALL FRONT CRANKSHAFT OIL SEAL

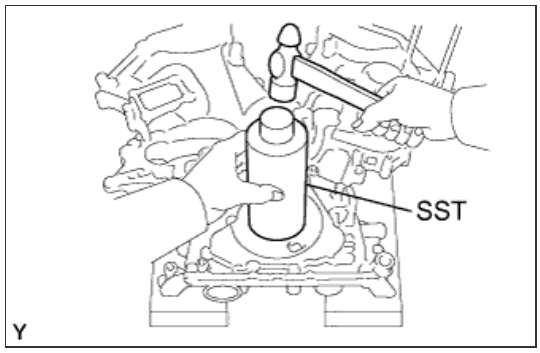
a. Using SST and a hammer, tap in a new oil seal until its surface is flush with the timing chain cover edge.

SST
09226-10010

NOTICE:

- **Keep the lip free from foreign matter.**
- **Do not tap the oil seal at an angle.**

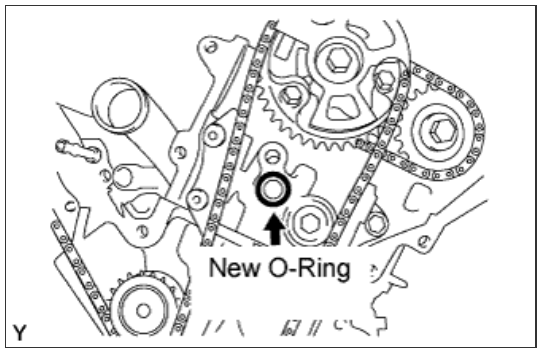
b. Apply MP grease to the lip of the oil seal.



19. INSTALL TIMING CHAIN COVER SUB-ASSEMBLY

a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the timing chain cover, cylinder head and cylinder block.

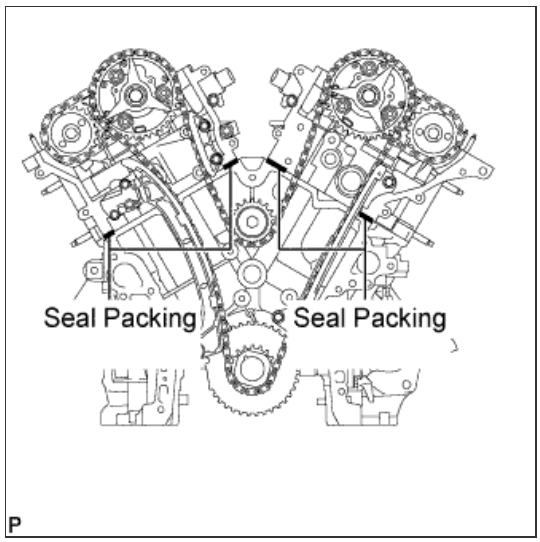
b. Install a new O-ring to the cylinder head for bank 2 as shown in the illustration.



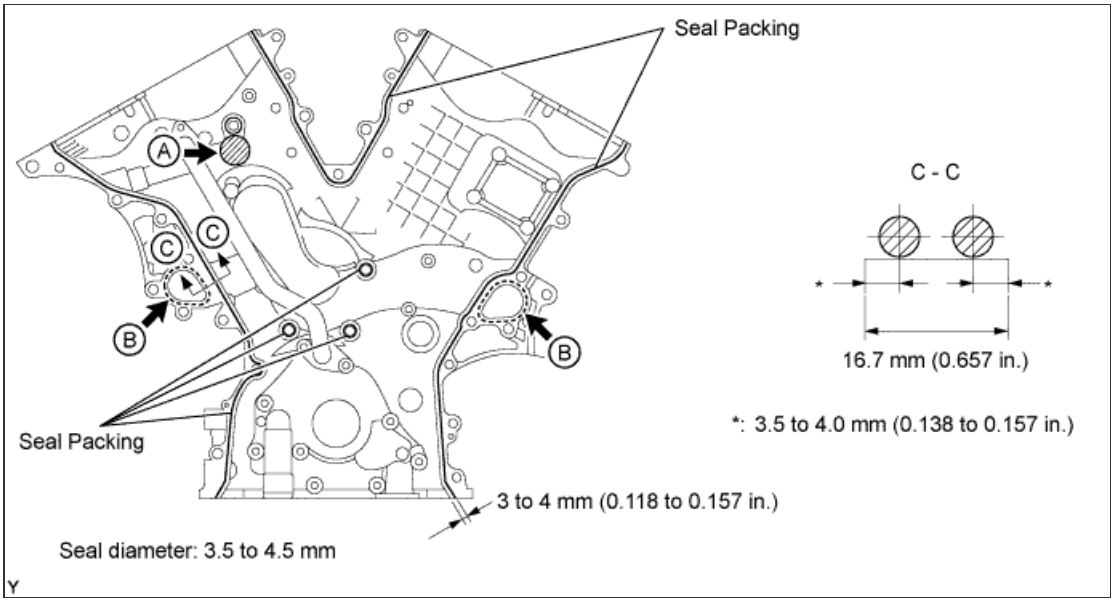
c. Apply seal packing as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
3.0 to 4.0 mm (0.118 to 0.157 in.)



d. Apply seal packing in a continuous line to the timing chain cover as shown in the illustration.



Seal packing:
for water related part:
Toyota Genuine Seal Packing 1282B, Three Bond 1282B or equivalent
for oil related part:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
3.5 to 4.5 mm (0.138 to 0.177 in.)

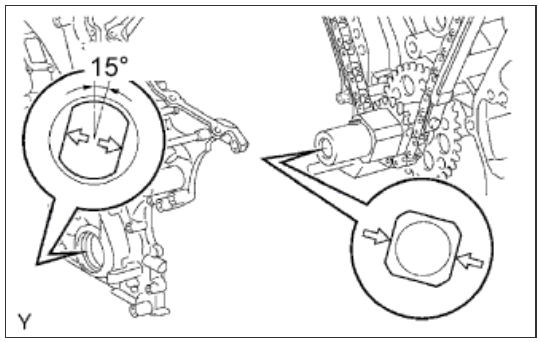
HINT:

Water related parts are labeled "B" in the illustration.

NOTICE:

- **Install the timing chain cover within 3 minutes after applying seal packing. After installing it, the timing chain cover bolts and nuts must be tightened within 15 minutes. Otherwise the seal packing must be removed and reapplied.**
- **Do not apply seal packing to "A" shown in the illustration.**

e. Align the keyway of the oil pump drive rotor with the rectangular portion of the crankshaft timing gear, and slide the timing chain cover into place.



f. Install the timing chain cover with the 24 bolts labeled A and B, and the 2 nuts. Tighten the bolts and nuts uniformly in several steps.

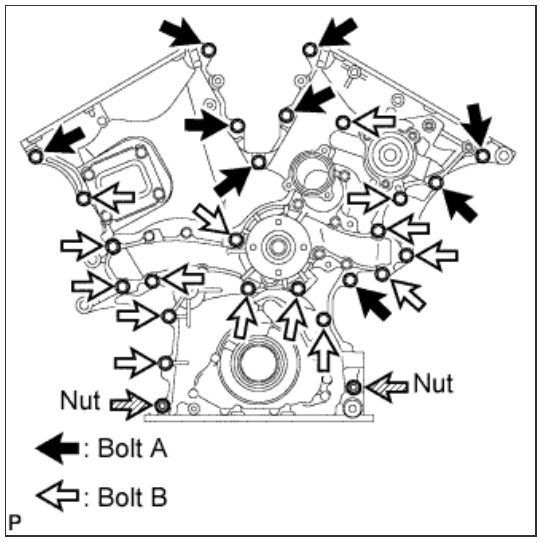
Torque:
23 N*m{ 235 kgf*cm , 17 ft.*lbf }

NOTICE:

- **Make sure not to wrap the No. 1 chain and slipper over the timing chain cover seal line.**
- **Install the timing chain cover 15 minutes or more after installing the water pump.**

Standard Bolt:

Item	Quantity	Length
Bolt A	9	25 mm (0.984 in.)
Bolt B	15	55 mm (2.17 in.)



NOTICE:

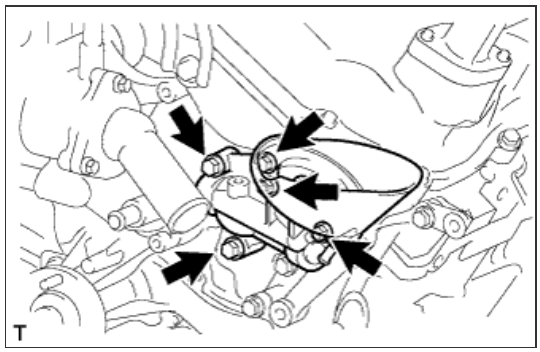
Make sure that there is no oil on the bolt threads.

20. INSTALL OIL FILTER BRACKET SUB-ASSEMBLY

a. Set a new O-ring to the timing chain cover.

b. Install the oil filter bracket with the 3 bolts and 2 nuts.

Torque:
19 N*m{ 194 kgf*cm , 14 ft.*lbf }

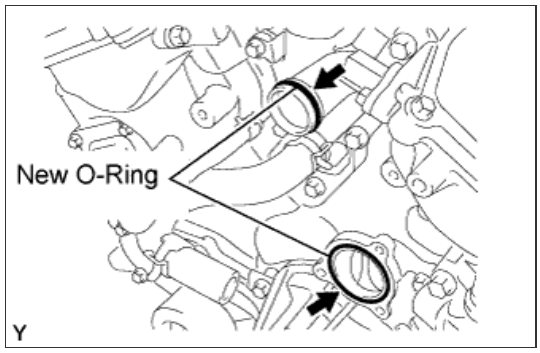


21. INSTALL WATER INLET HOUSING

a. Apply soapy water to a new O-ring, install it to the water outlet pipe.

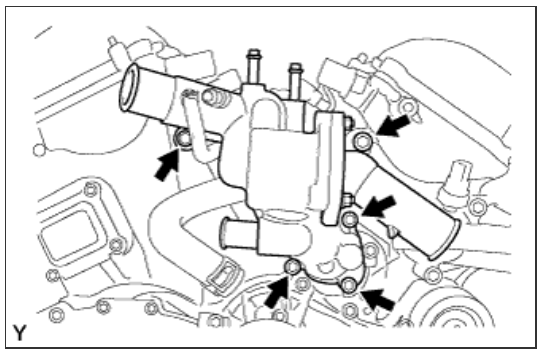
b. Install a new O-ring to the water pump.

c. Install a new gasket to the water pump.



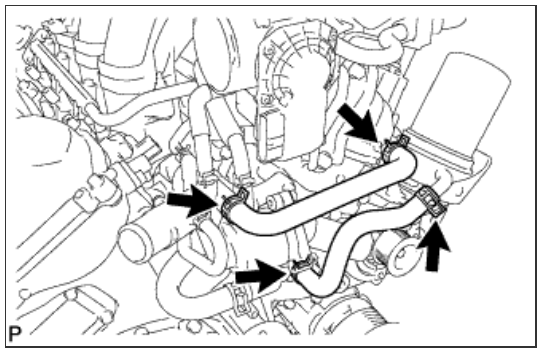
d. Install the water inlet with the 5 bolts.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



22. INSTALL OIL COOLER HOSE

a. Install the oil cooler hose.



23. INSTALL NO. 2 OIL COOLER HOSE

a. Install the oil cooler hose.

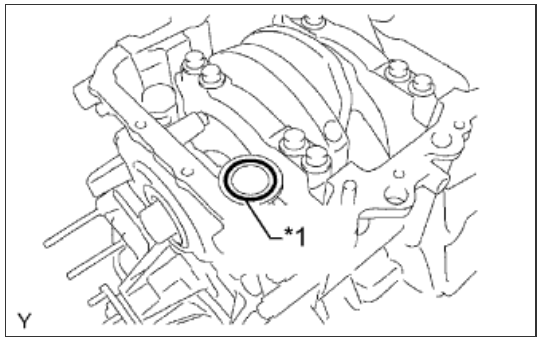
24. INSTALL OIL PAN SUB-ASSEMBLY

a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the cylinder block, rear oil seal retainer and oil pan.

b. Install a new O-ring to the timing chain cover.

Text in Illustration

*1	New O-Ring



c. Apply seal packing in a continuous line as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

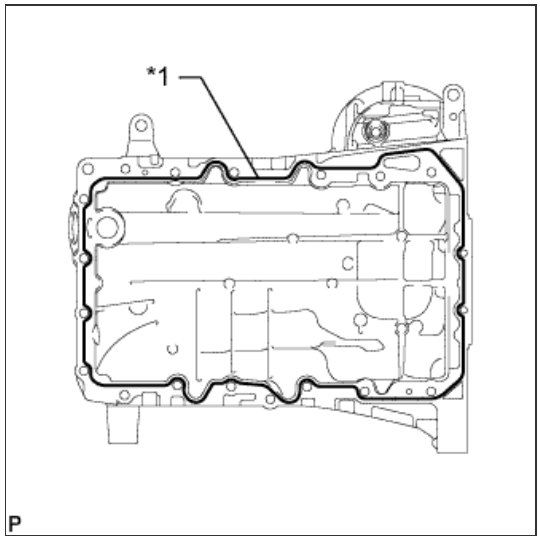
Standard seal diameter:
3 to 4 mm (0.118 to 0.157 in.)

Text in Illustration

*1	Seal Packing

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the oil pan within 3 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after installing.**



d. Install the oil pan with the 17 bolts (A, B and C) and 2 nuts. Tighten the bolts and nuts uniformly in several steps.

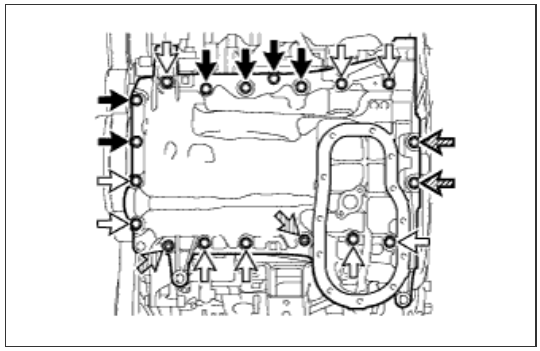
Torque:
for bolt A, B and nut:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for bolt C:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

Text in Illustration

	Bolt A
	Bolt B
	Bolt C
	Nut

Standard Bolt:

Item	Quantity	Length
A	6	25 mm (0.984 in.)
B	9	45 mm (1.77 in.)
C	2	14 mm (0.551 in.)



25. INSTALL OIL STRAINER SUB-ASSEMBLY

a. Install a new gasket to the oil strainer.

Text in Illustration

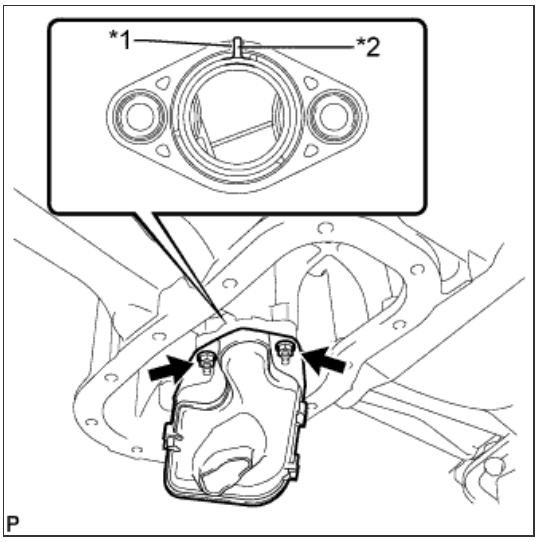
*1	Groove
*2	Protrusion

HINT:

Align the protrusion of the gasket with the groove of the oil strainer.

b. Install the oil strainer with the 2 nuts.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



26. INSTALL NO. 2 OIL PAN SUB-ASSEMBLY

a. Apply seal packing in a continuous line as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
3 to 4 mm (0.118 to 0.157 in.)

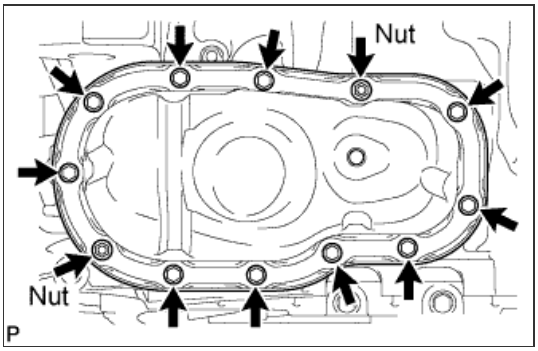
NOTICE:

- **Remove any oil from the contact surface.**
- **Install the No. 2 oil pan within 3 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after the installation.**



b. Install the No. 2 oil pan with the 10 bolts and 2 nuts. Tighten the bolts and nuts uniformly in several steps.

Torque:
for bolt:
9.0 N*m{ 92 kgf*cm , 81 in.*lbf }
for nut:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

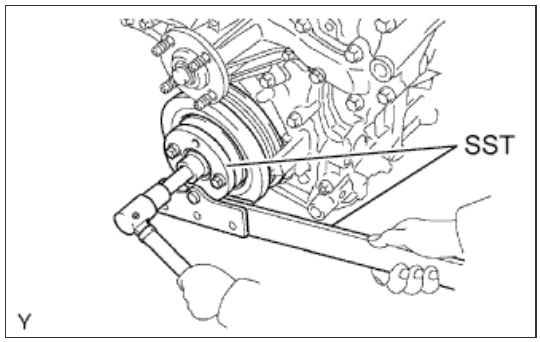


27. INSTALL CRANKSHAFT PULLEY

a. Using SST, install the crankshaft pulley with the pulley set bolt.

SST
09213-54015 (91651-60855)
09330-00021

Torque:
250 N*m{ 2549 kgf*cm , 184 ft.*lbf }



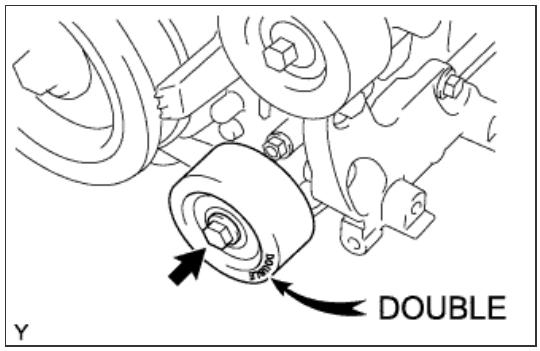
28. INSTALL NO. 1 IDLER PULLEY SUB-ASSEMBLY

a. Install the No. 1 idler pulley with the bolt.

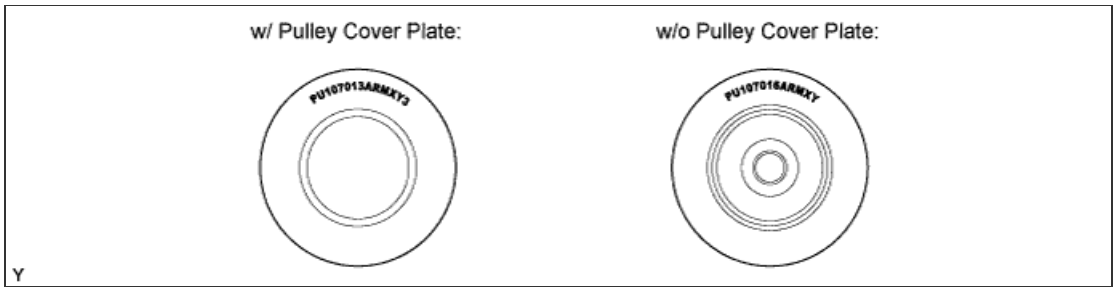
Torque:
54 N*m{ 551 kgf*cm , 40 ft.*lbf }

HINT:

"DOUBLE" is marked on the No. 1 idler pulley to distinguish it from the No. 2 idler pulley.



29. INSTALL NO. 2 IDLER PULLEY SUB-ASSEMBLY



a. w/ Pulley Cover Plate:

i. Install the idler pulley cover plate, idler pulley and No. 2 idler pulley cover plate with the bolt.

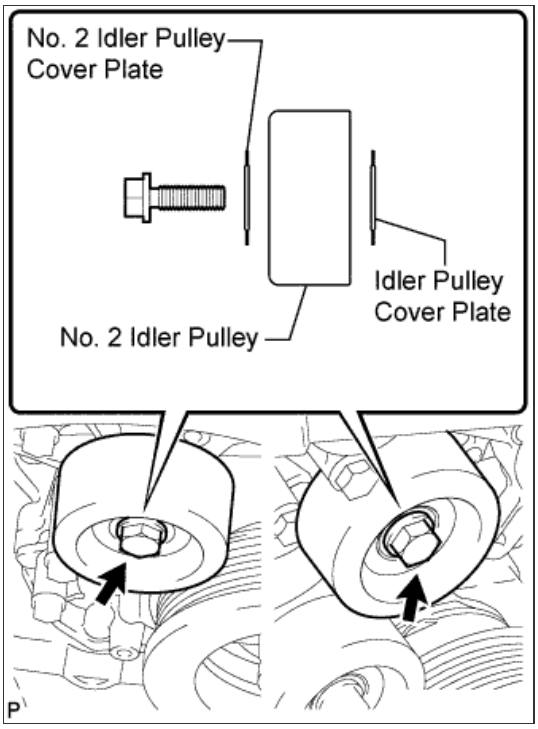
Torque:
54 N*m{ 551 kgf*cm , 40 ft.*lbf }

NOTICE:

If it is necessary to replace the pulley or either plate, replace the No. 2 idler pulley cover plate, No. 2 idler pulley and idler pulley cover plate as a set with new parts.

b. w/o Pulley Cover Plate:
Install the 2 No. 2 idler pulleys with the 2 bolts.

Torque:
54 N*m{ 551 kgf*cm , 40 ft.*lbf }



30. INSTALL V-RIBBED BELT TENSIONER ASSEMBLY

a. emporarily install the V-ribbed belt tensioner with the 5 bolts.

b. Tighten bolt 1 and 2 in numerical order.

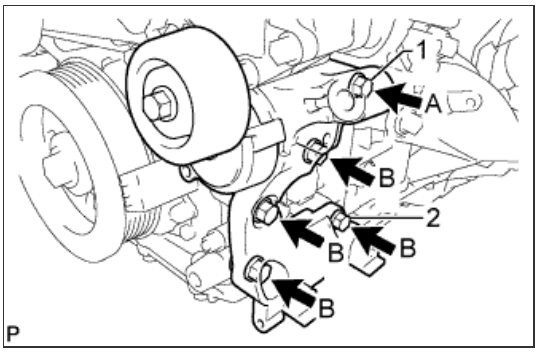
Torque:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }

c. Tighten the other bolts.

Torque:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }

Standard Bolt:

Item	Length
A	70 mm (2.76 in.)
B	33 mm (1.30 in.)



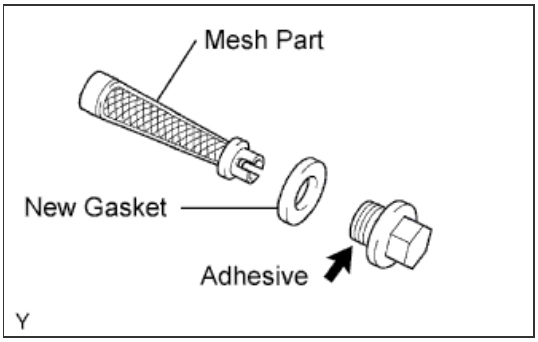
31. INSTALL OIL CONTROL VALVE FILTER

a. Install 2 new gaskets to 2 new unions.

b. Insert new filters to the unions.

c. Apply adhesive to 2 or 3 threads of the unions.

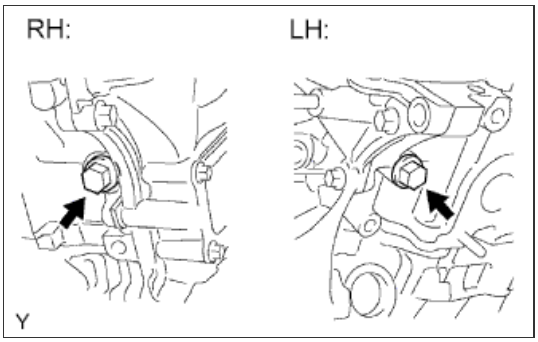
Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent



d. Install the unions to the cylinder head LH and RH.

Torque:

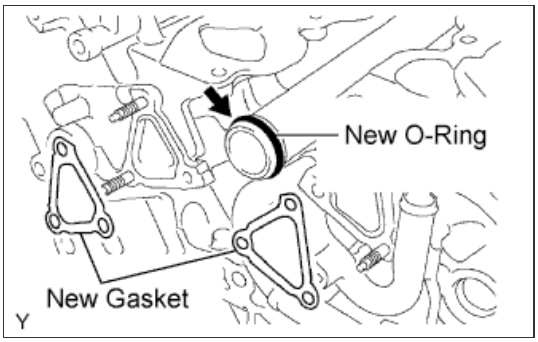
62 N*m 632 kgf*cm , 46 ft.*lbf



32. INSTALL REAR WATER BY-PASS JOINT

a. Apply soapy water to a new ring.

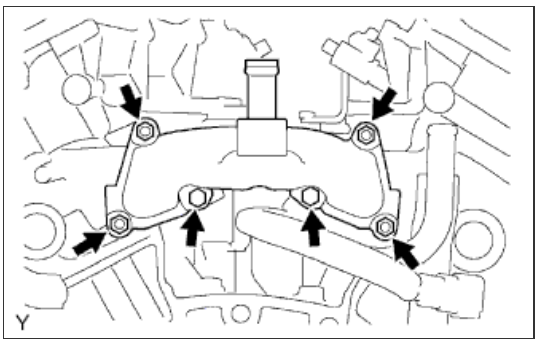
b. Install the O-ring to the water outlet pipe, and set 2 new gaskets to the water ports LH and RH.



c. Install the rear water by-pass joint with the 2 bolts and 4 nuts.

Torque:
for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }
for nut:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }

d. Connect the engine coolant temperature sensor connector.

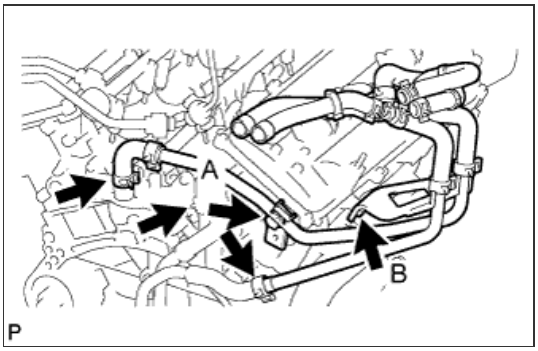


33. INSTALL WATER HOSE SUB-ASSEMBLY (for Automatic Transmission)

a. Temporarily install the heater water pipe, and then tighten the 2 bolts.

Torque:
for bolt A:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }
for bolt B:
13 N*m{ 138 kgf*cm , 10 ft.*lbf }

b. Connect the 3 water hoses.

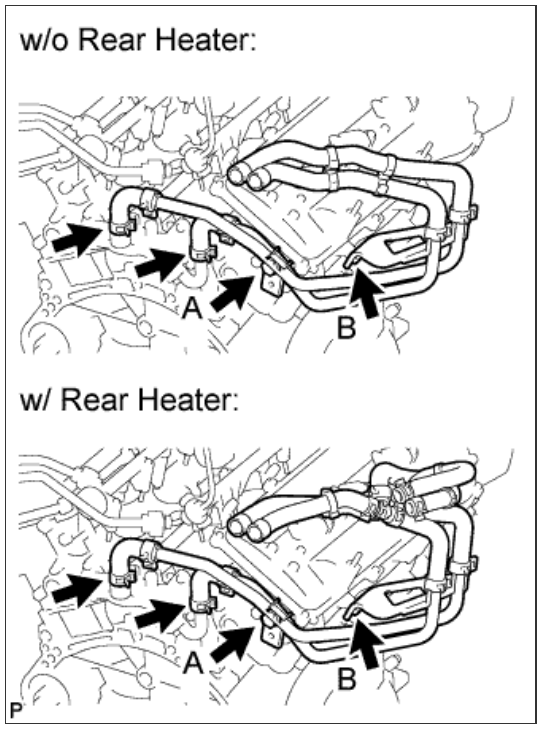


34. INSTALL WATER HOSE SUB-ASSEMBLY (for Manual Transmission)

a. Temporarily install the heater water pipe, and then tighten the 2 bolts.

Torque:
for bolt A:
9.8 N*m 100 kgf*cm , 87 in.*lbf }
for bolt B:
13 N*m{ 138 kgf*cm , 10 ft.*lbf }

b. Connect the 2 water hoses.



35. INSTALL ENGINE OIL LEVEL DIPSTICK GUIDE

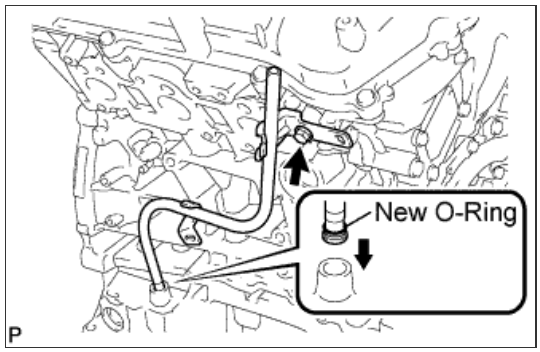
a. Install a new O-ring to the dipstick guide.

b. Apply a light coat of engine oil to the O-ring.

c. Push the dipstick guide end into the guide hole.

d. Install the dipstick guide with the bolt.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



36. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY RH

a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the cylinder head, timing chain cover and cylinder head cover.

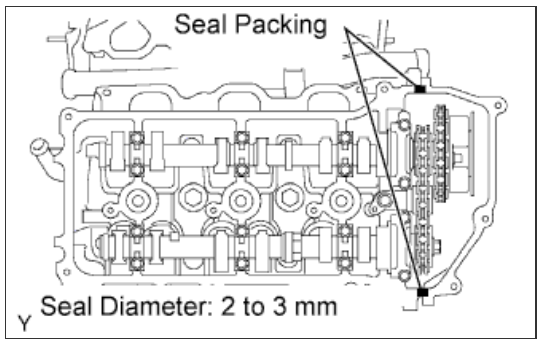
b. Apply seal packing as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
2 to 3 mm (0.0787 to 0.118 in.)

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the head cover within 3 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after the installation.**

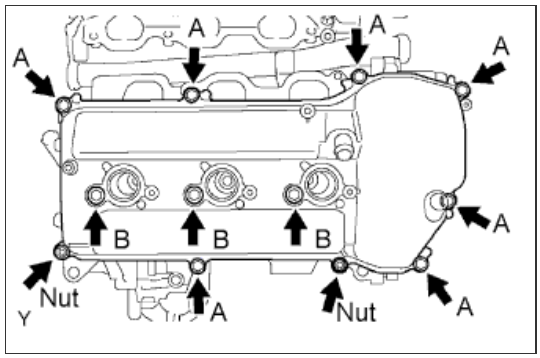


c. Install a new gasket to the cylinder head cover.

d. Install the seal washers to the bolts.

e. emporarily install the cylinder head cover with the 10 bolts and 2 nuts. Tighten the bolts and nuts uniformly in several steps.

Torque:
for bolt A:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }
for bolt B and nut:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



37. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY LH

a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the cylinder head, timing chain cover and cylinder head cover.

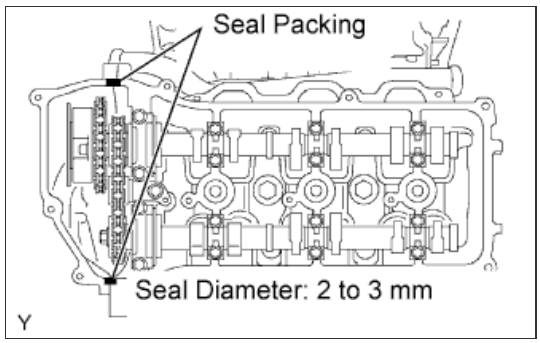
b. Apply seal packing as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
2 to 3 mm (0.0787 to 0.118 in.)

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the head cover within 3 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after the installation.**

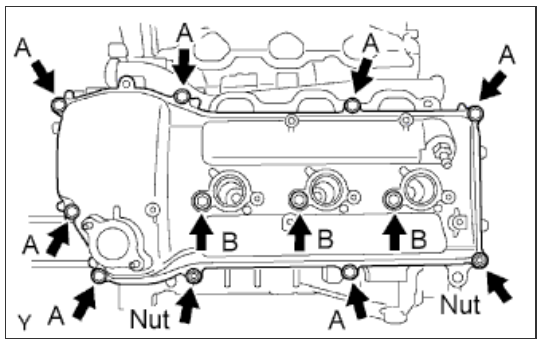


c. Install a new gasket to the cylinder head cover.

d. Install the seal washers to the bolts.

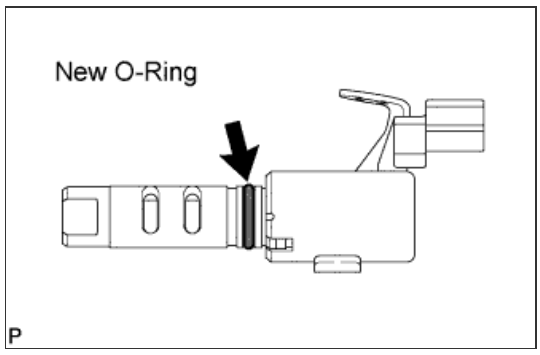
e. Temporarily install the cylinder head cover with the 10 bolts and 2 nuts. Tighten the bolts and nuts uniformly in several steps.

Torque:
for bolt A:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }
for bolt B and nut:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



38. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY LH

a. Apply a light coat of engine oil to a new O-ring and install it to the oil control valve.



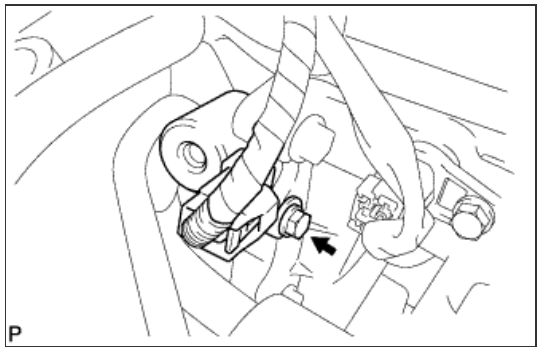
b. Install the oil control valve with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

NOTICE:

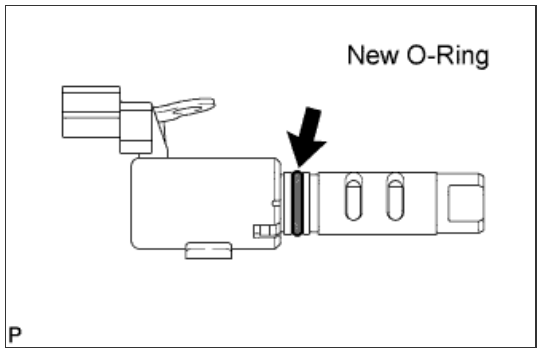
- **Do not allow foreign matter to contact the oil seal face of the oil control valve (connecting surface with cylinder head).**
- **Be careful that the O-ring is not cracked when installing the oil control valve.**

c. Connect the oil control valve connector.



39. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY RH

a. Apply a light coat of engine oil to a new O-ring and install it to the oil control valve.



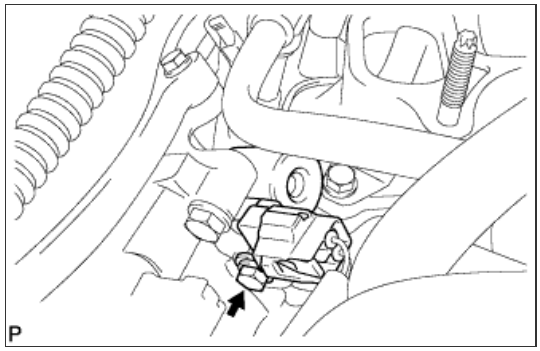
b. Install the oil control valve with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

NOTICE:

- **Do not allow foreign matter to contact the oil seal face of the oil control valve (connecting surface with cylinder head).**
- **Be careful that the O-ring is not cracked when installing the oil control valve.**

c. Connect the camshaft timing oil control valve connector.



40. INSTALL VVT SENSOR (for Bank 2)

a. Apply a light coat of engine oil to the O-ring of the VVT sensor.

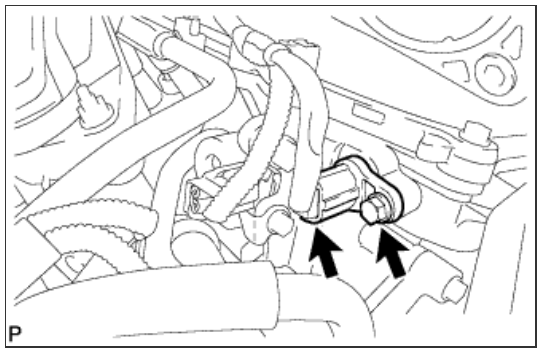
NOTICE:

- **When reusing the sensor, inspect the O-ring.**
- **If the O-ring has scratches or cuts, replace the sensor.**

b. Install the VVT sensor with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

c. Connect the sensor connector.



41. INSTALL VVT SENSOR (for Bank 1)

a. Apply a light coat of engine oil to the O-ring of the sensor.

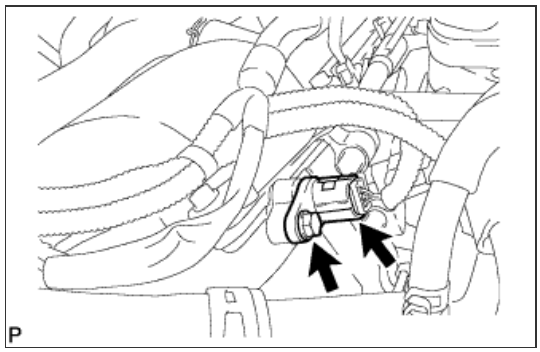
NOTICE:

- **When reusing the sensor, inspect the O-ring.**
- **If the O-ring has scratches or cuts, replace the sensor.**

b. Install the sensor with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

c. Connect the sensor connector.



42. INSTALL SPARK PLUG

a. Install the 6 spark plugs.

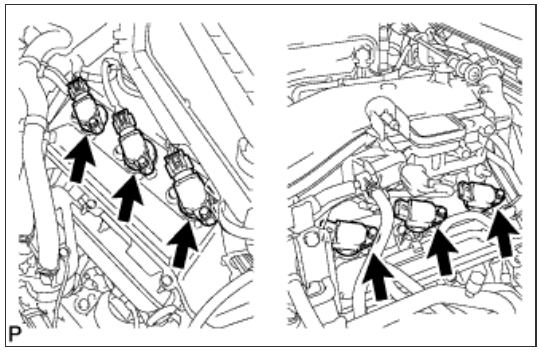
Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

43. INSTALL IGNITION COIL ASSEMBLY

a. Install the 6 ignition coils with the 6 bolts.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }

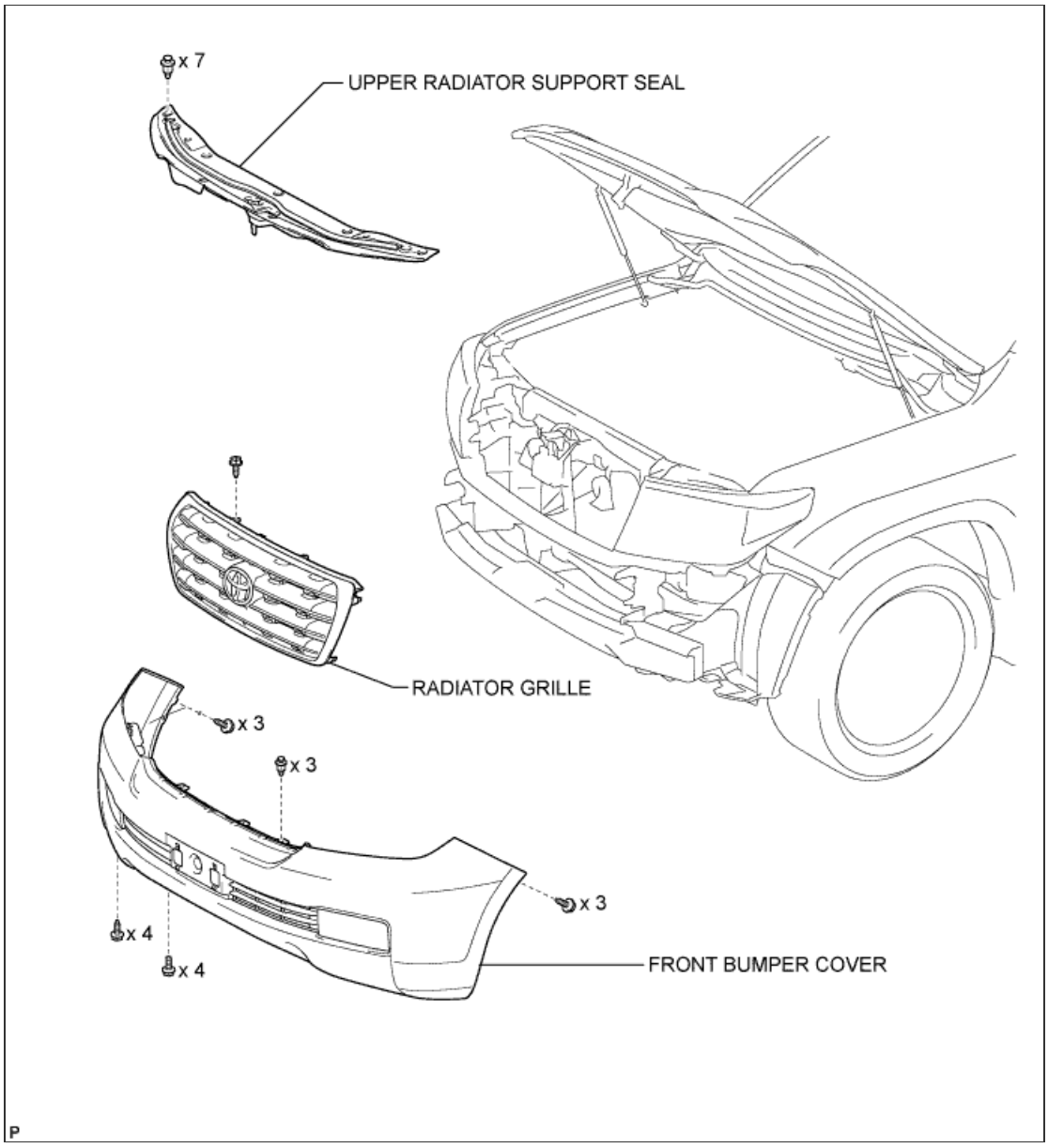
b. Connect the 6 ignition coil connectors.

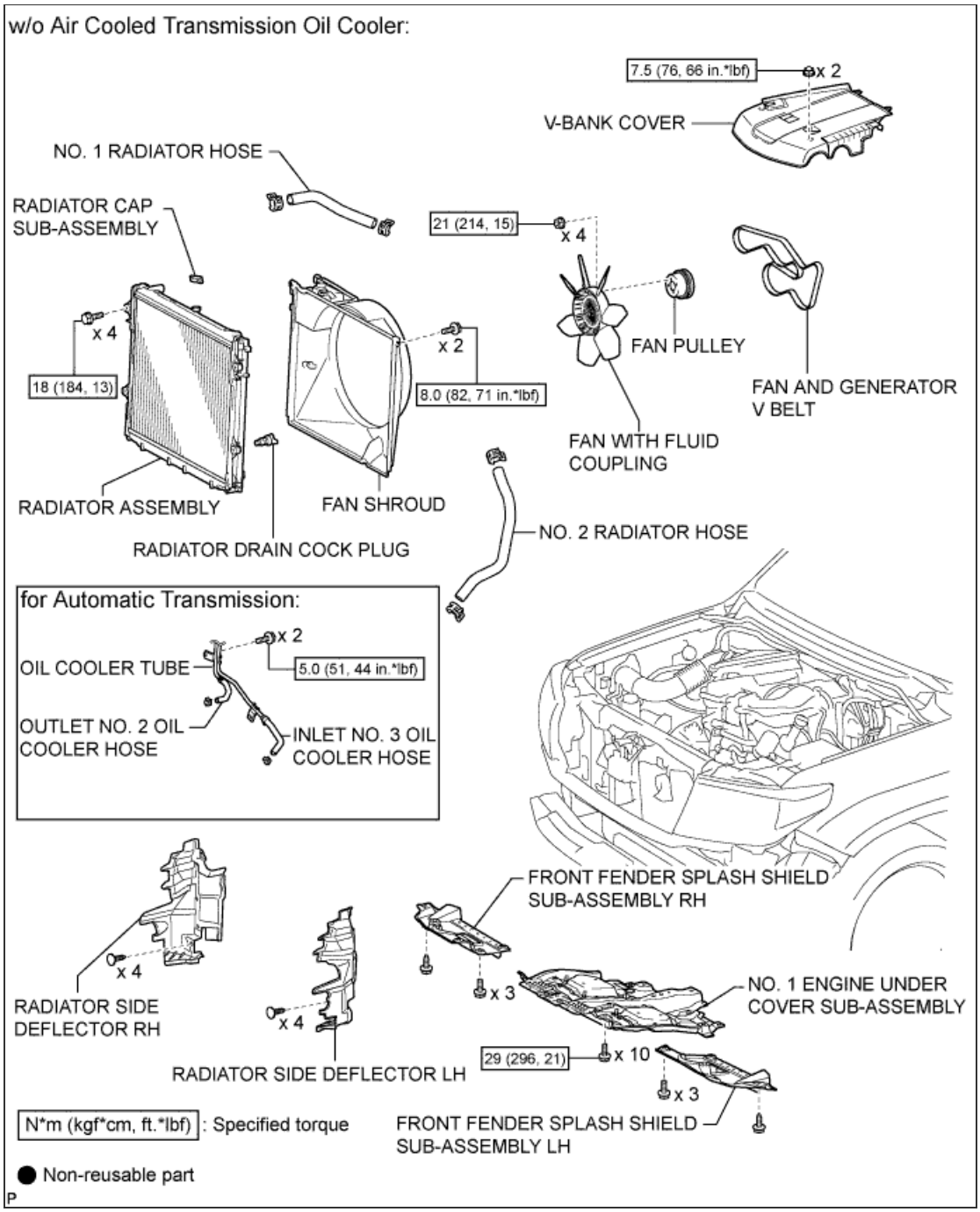


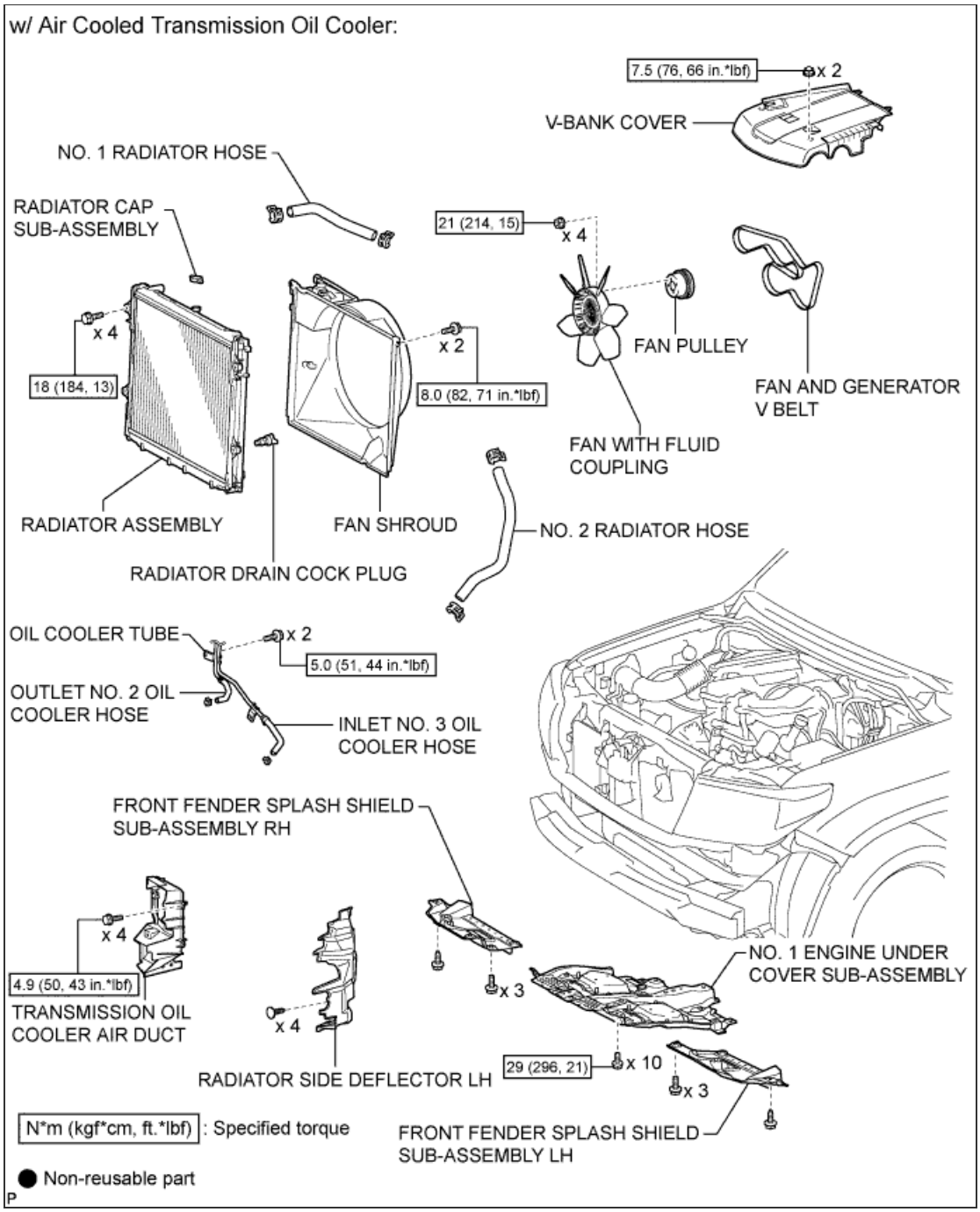
44. INSTALL ENGINE ASSEMBLY

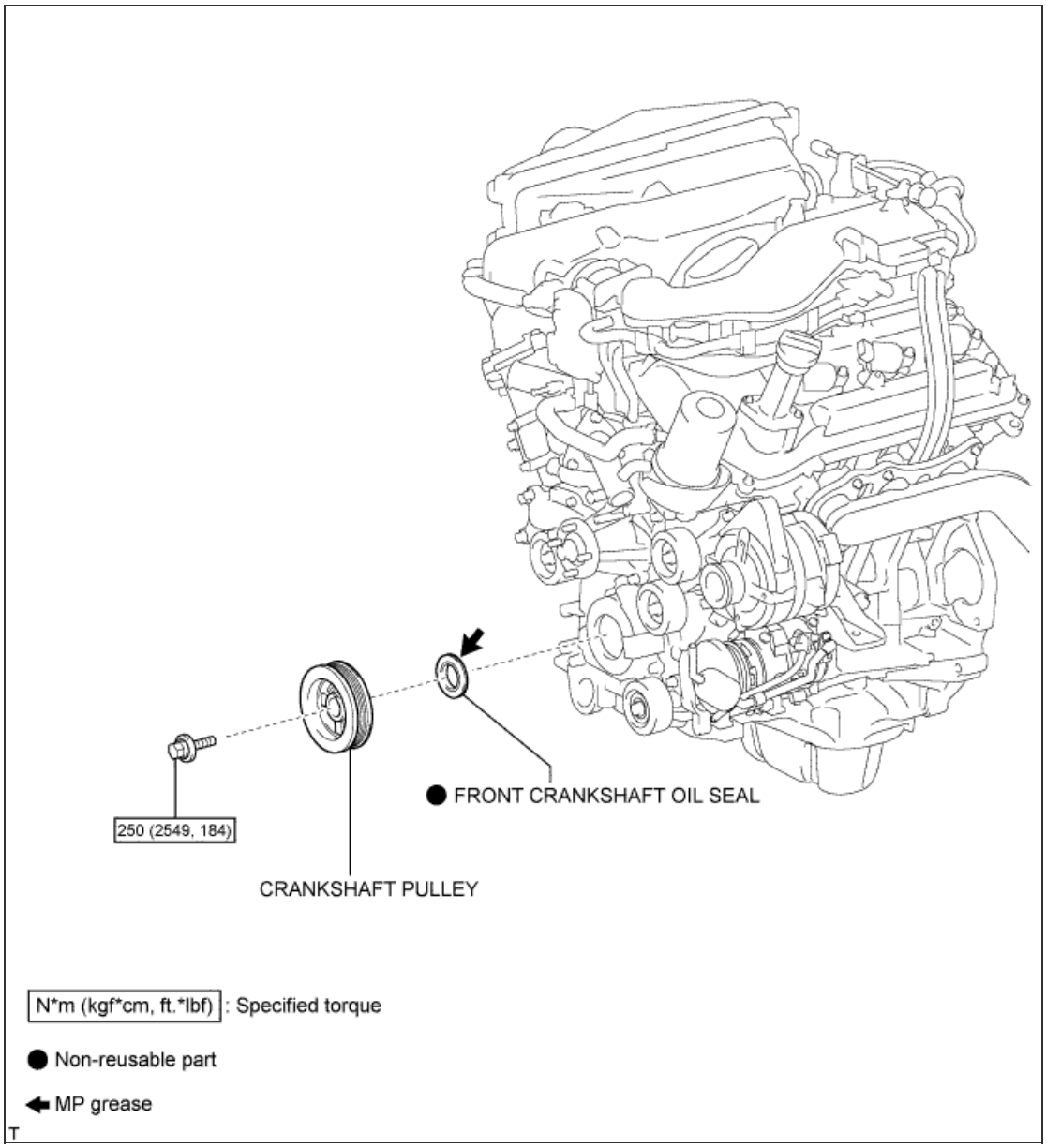
a. Install the engine assembly (Click here).

for Preparation Click here




w/o Air Cooled Transmission Oil Cooler:
7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER
NO. 1 RADIATOR HOSE
RADIATOR CAP SUB-ASSEMBLY
21 (214, 15)
x 4
FAN PULLEY
FAN AND GENERATOR V BELT
x 4
18 (184, 13)
x 2
8.0 (82, 71 in.*lbf)
FAN WITH FLUID COUPLING
RADIATOR ASSEMBLY
FAN SHROUD
NO. 2 RADIATOR HOSE
RADIATOR DRAIN COCK PLUG
for Automatic Transmission:
x 2
OIL COOLER TUBE
5.0 (51, 44 in.*lbf)
OUTLET NO. 2 OIL COOLER HOSE
INLET NO. 3 OIL COOLER HOSE
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH
x 4
RADIATOR SIDE DEFLECTOR RH
x 4
x 3
NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY
RADIATOR SIDE DEFLECTOR LH
29 (296, 21)
x 10
x 3
N*m (kgf*cm, ft.*lbf) : Specified torque
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH
● Non-reusable part
P


w/ Air Cooled Transmission Oil Cooler:
7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER
NO. 1 RADIATOR HOSE
RADIATOR CAP SUB-ASSEMBLY
21 (214, 15)
x 4
FAN PULLEY
FAN AND GENERATOR V BELT
x 4
18 (184, 13)
x 2
8.0 (82, 71 in.*lbf)
FAN WITH FLUID COUPLING
RADIATOR ASSEMBLY
FAN SHROUD
NO. 2 RADIATOR HOSE
RADIATOR DRAIN COCK PLUG
OIL COOLER TUBE
x 2
5.0 (51, 44 in.*lbf)
OUTLET NO. 2 OIL COOLER HOSE
INLET NO. 3 OIL COOLER HOSE
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH
x 4
4.9 (50, 43 in.*lbf)
TRANSMISSION OIL COOLER AIR DUCT
x 4
x 3
NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY
RADIATOR SIDE DEFLECTOR LH
29 (296, 21)
x 10
x 3
N*m (kgf*cm, ft.*lbf) : Specified torque
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH
● Non-reusable part
P


250 (2549, 184)
CRANKSHAFT PULLEY
● FRONT CRANKSHAFT OIL SEAL
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
MP grease

T

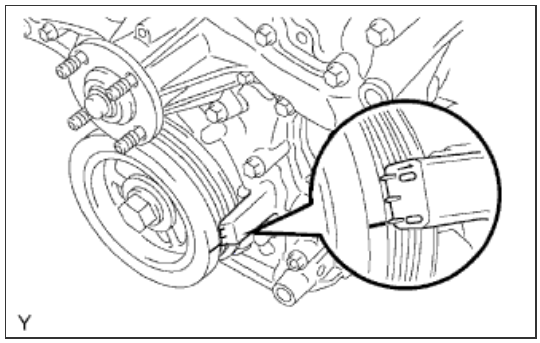
for Preparation Click here

1. REMOVE RADIATOR ASSEMBLY

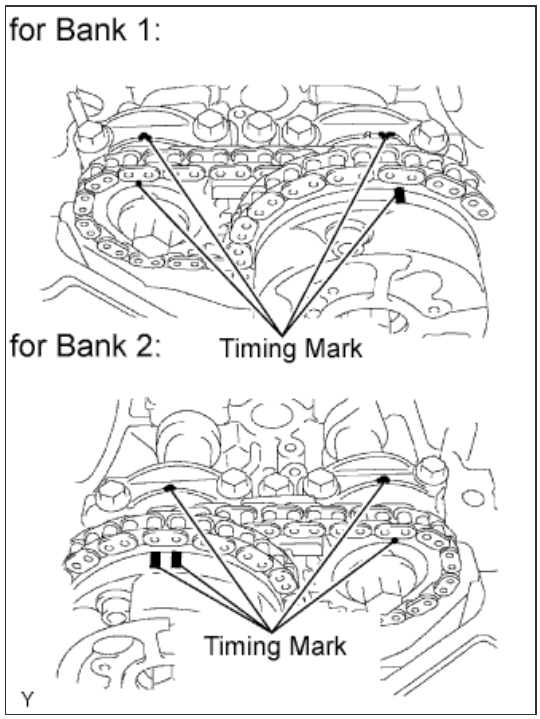
a. Remove the radiator (Click here).

2. REMOVE CRANKSHAFT PULLEY

a. Turn the crankshaft pulley, and align the notch with the timing mark "0" of the timing chain cover.

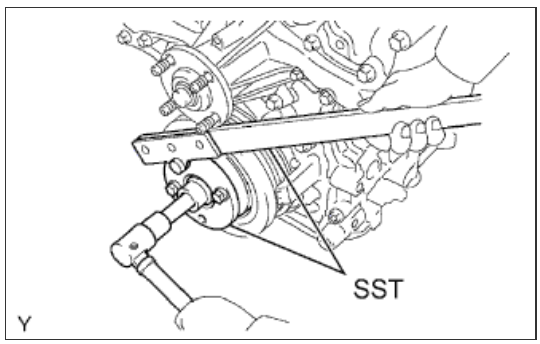


b. Check that the timing marks of the camshaft timing gears and sprockets are aligned with the timing marks of the bearing caps as shown in the illustration.



c. Using SST, hold the crankshaft pulley and loosen the pulley set bolt.

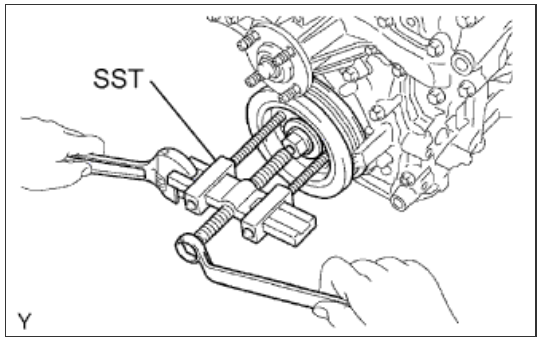
SST
09213-54015 (91651-60855)
09330-00021



d. Using the pulley set bolt and SST, remove the crankshaft pulley.

SST

09950-50013 (09951-05010, 09952-05010, 09953-05020, 09954-05030)

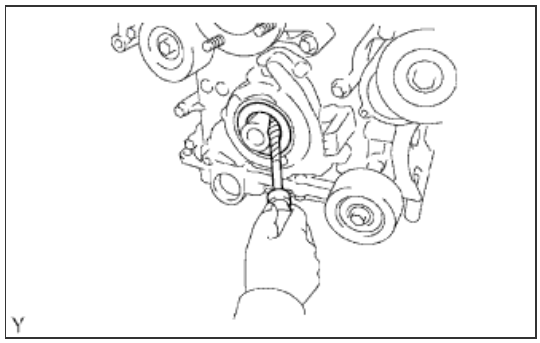


3. REMOVE FRONT CRANKSHAFT OIL SEAL

a. Using a screwdriver, pry out the oil seal.

NOTICE:

Be careful not to damage the crankshaft. Wrap the tip of the screwdriver with tape.



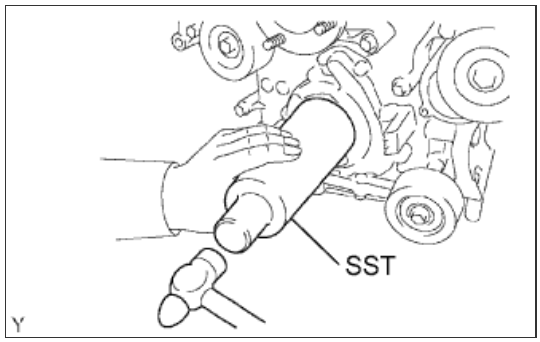
for Preparation Click here

1. INSTALL FRONT CRANKSHAFT OIL SEAL

a. Apply MP grease to the lip of a new oil seal.

b. Using and a hammer, tap in the oil seal until its surface is flush with the timing chain cover edge.

SST
09226-10010

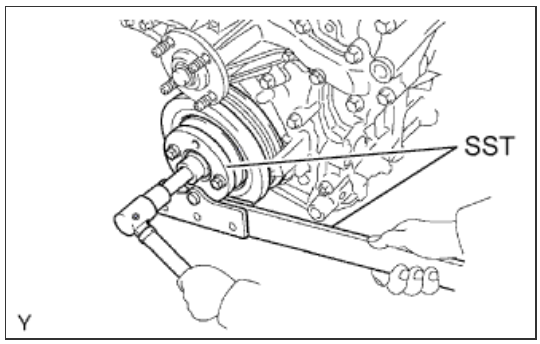


2. INSTALL CRANKSHAFT PULLEY

a. Using install the crankshaft pulley with the pulley set bolt.

SST
09213-54015 (91651-60855)
09330-00021

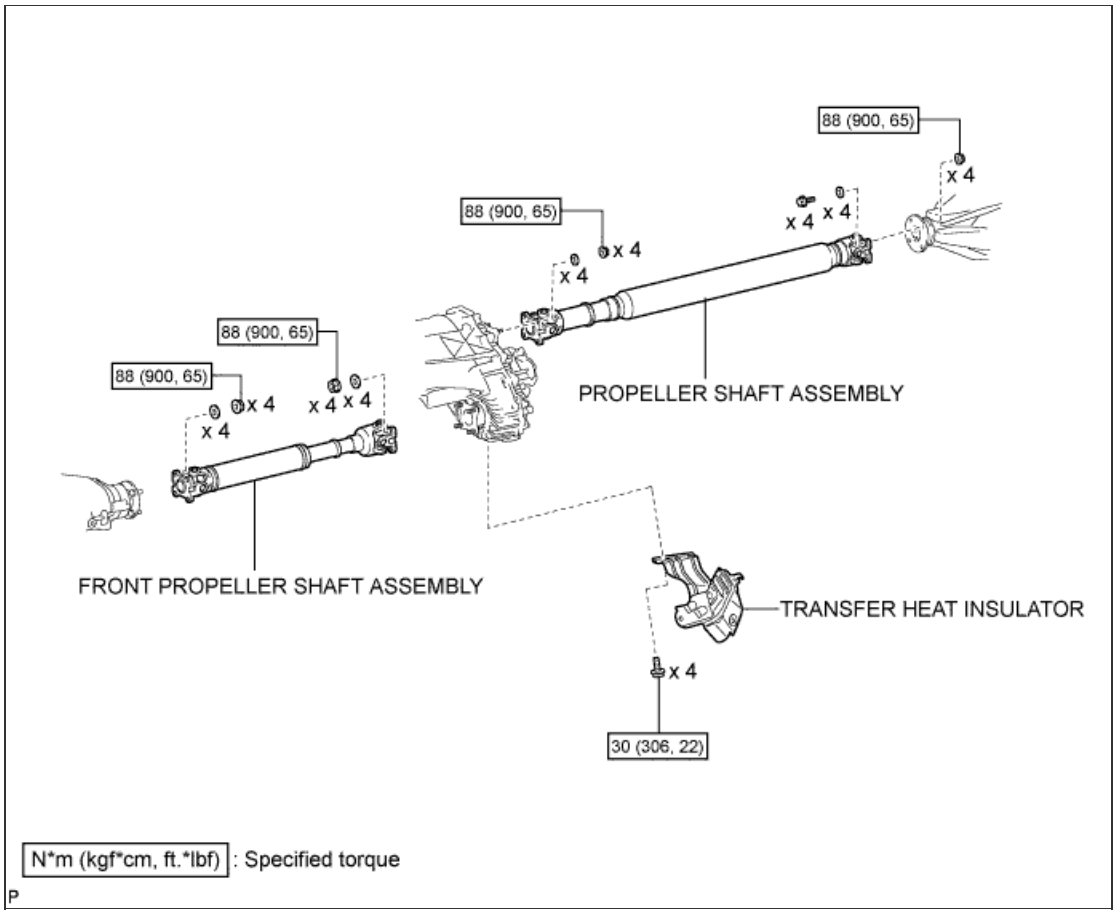
Torque:
250 N*m{ 2549 kgf*cm , 184 ft.*lbf }



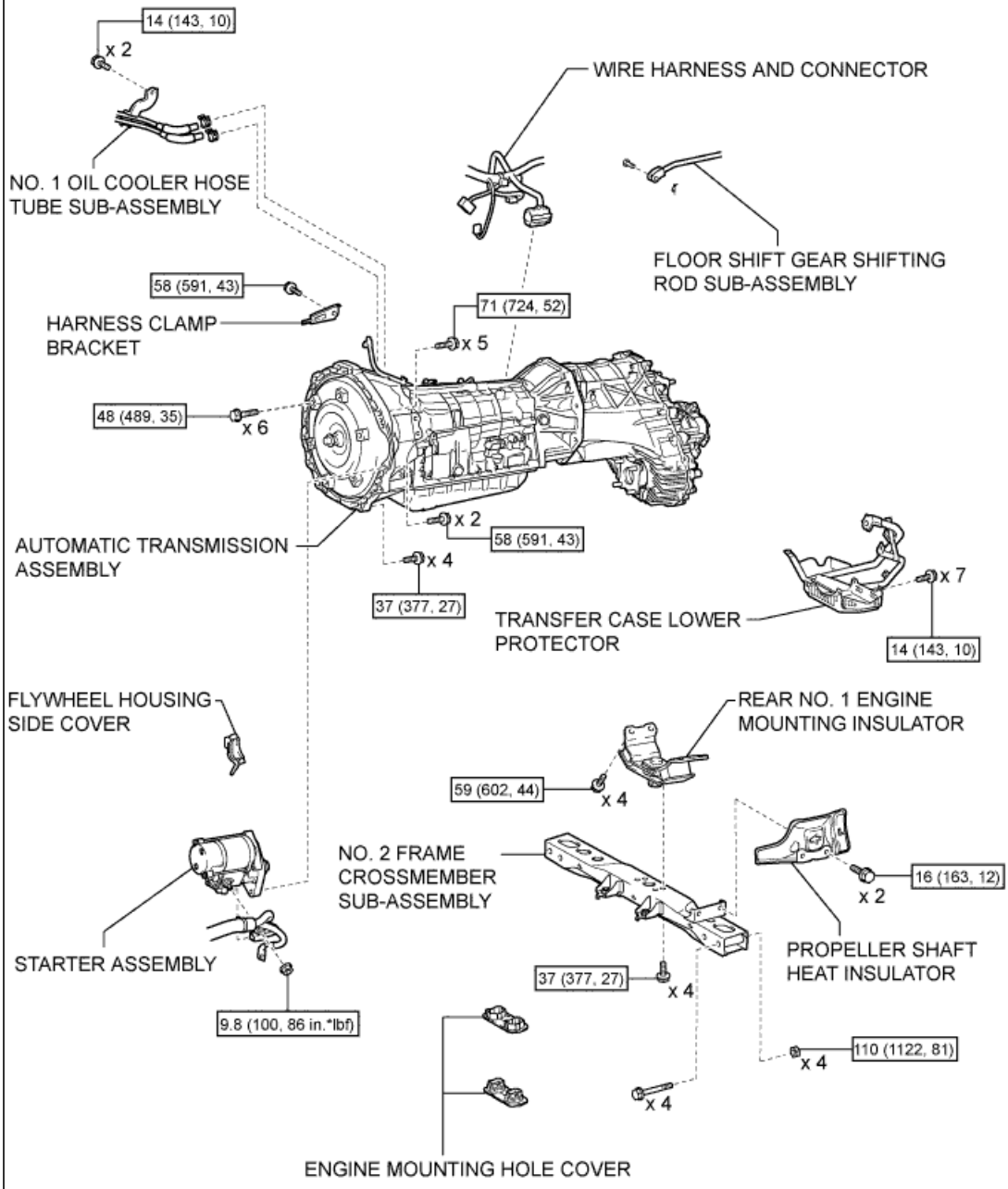
3. INSTALL RADIATOR ASSEMBLY

a. Install the radiator (Click here).

for Preparation [Click here]



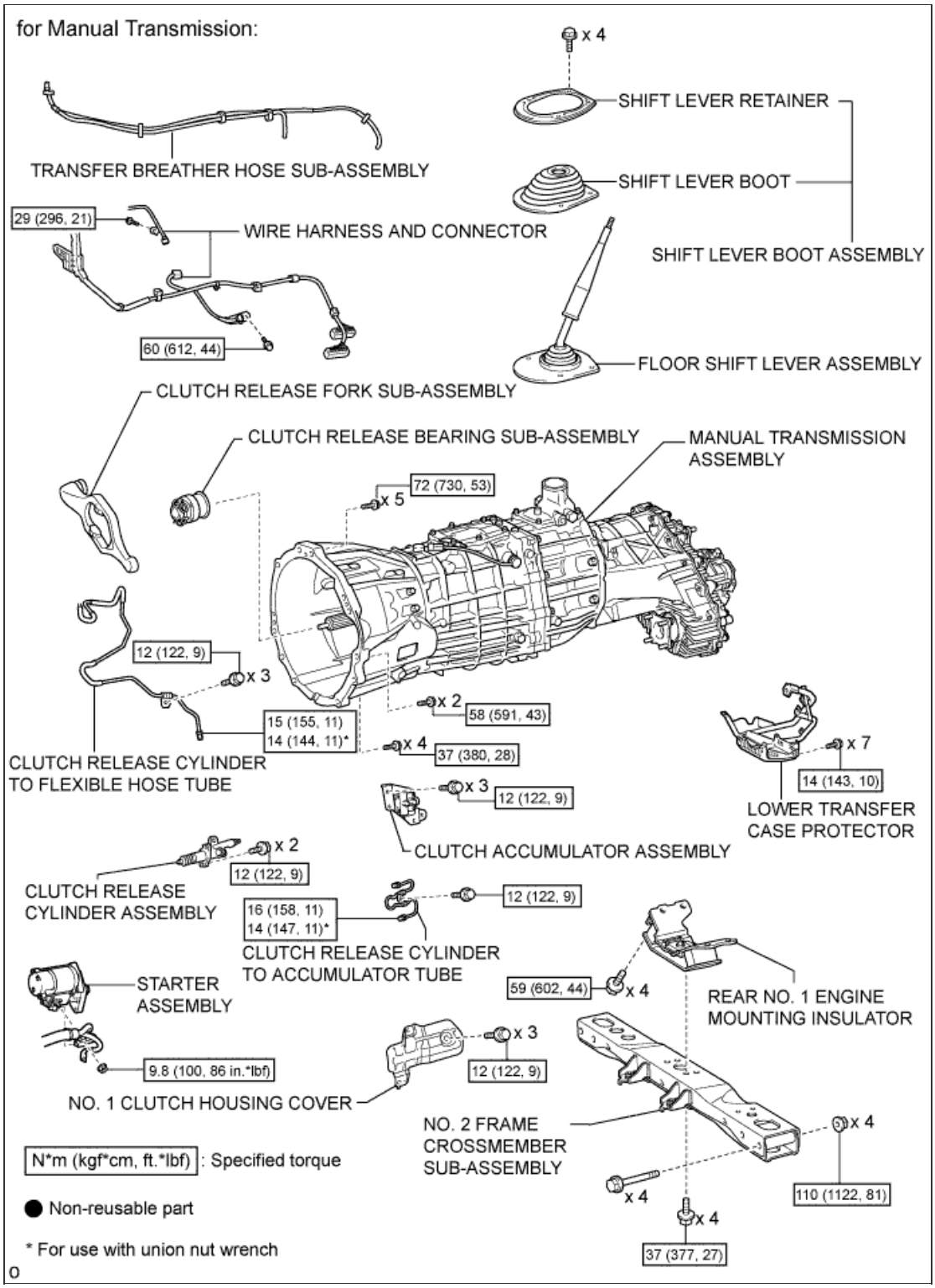
for Automatic Transmission:

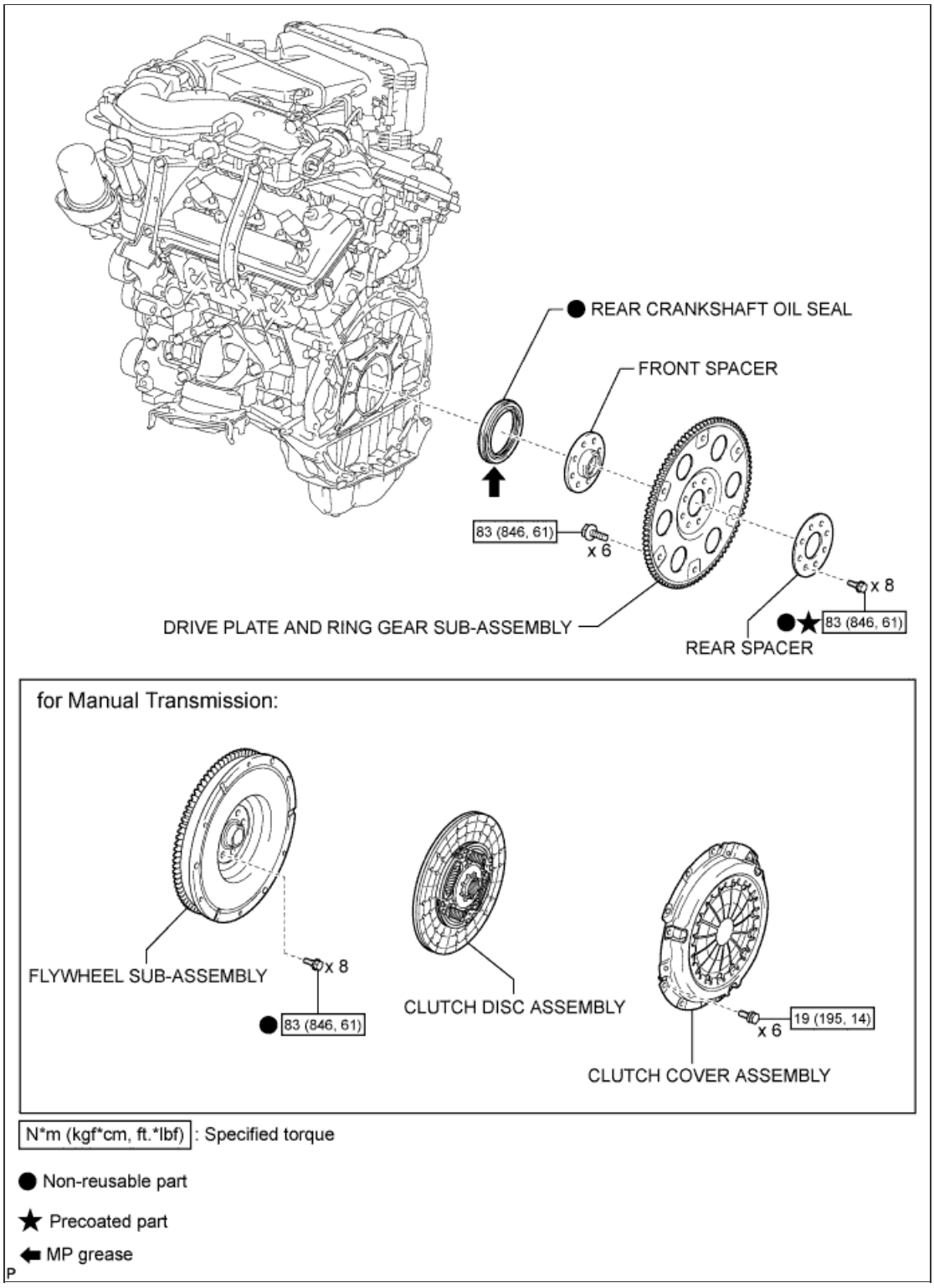


N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P


for Manual Transmission:
x 4
SHIFT LEVER RETAINER
TRANSFER BREATHER HOSE SUB-ASSEMBLY
SHIFT LEVER BOOT
SHIFT LEVER BOOT ASSEMBLY
29 (296, 21)
WIRE HARNESS AND CONNECTOR
60 (612, 44)
FLOOR SHIFT LEVER ASSEMBLY
CLUTCH RELEASE FORK SUB-ASSEMBLY
CLUTCH RELEASE BEARING SUB-ASSEMBLY
MANUAL TRANSMISSION ASSEMBLY
72 (730, 53)
x 5
12 (122, 9)
x 3
x 2
58 (591, 43)
15 (155, 11)
14 (144, 11)*
x 4
37 (380, 28)
CLUTCH RELEASE CYLINDER TO FLEXIBLE HOSE TUBE
x 3
12 (122, 9)
x 7
14 (143, 10)
LOWER TRANSFER CASE PROTECTOR
CLUTCH ACCUMULATOR ASSEMBLY
x 2
12 (122, 9)
CLUTCH RELEASE CYLINDER ASSEMBLY
16 (158, 11)
14 (147, 11)*
12 (122, 9)
CLUTCH RELEASE CYLINDER TO ACCUMULATOR TUBE
STARTER ASSEMBLY
59 (602, 44)
x 4
REAR NO. 1 ENGINE MOUNTING INSULATOR
x 3
12 (122, 9)
9.8 (100, 86 in.*lbf)
NO. 1 CLUTCH HOUSING COVER
NO. 2 FRAME CROSSMEMBER SUB-ASSEMBLY
x 4
110 (1122, 81)
x 4
x 4
37 (377, 27)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
* For use with union nut wrench


REAR CRANKSHAFT OIL SEAL
FRONT SPACER
83 (846, 61)
x 6
x 8
DRIVE PLATE AND RING GEAR SUB-ASSEMBLY
83 (846, 61)
REAR SPACER
for Manual Transmission:
FLYWHEEL SUB-ASSEMBLY
x 8
83 (846, 61)
CLUTCH DISC ASSEMBLY
19 (195, 14)
x 6
CLUTCH COVER ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
Precoated part
MP grease
P

for Preparation Click here

1. REMOVE AUTOMATIC TRANSMISSION ASSEMBLY (for Automatic Transmission)

a. Remove the automatic transmission (Click here).

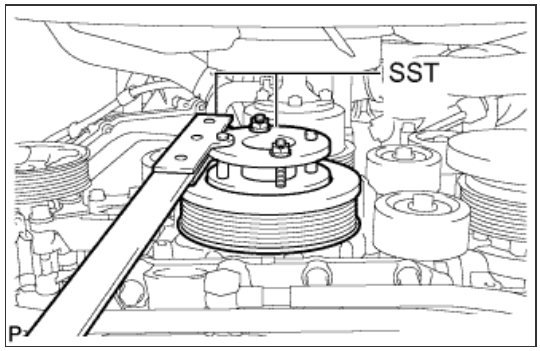
2. REMOVE MANUAL TRANSMISSION ASSEMBLY (for Manual Transmission)

a. Remove the manual transmission (Click here).

3. REMOVE DRIVE PLATE AND RING GEAR SUB-ASSEMBLY (for Automatic Transmission)

a. Using SST, hold the crankshaft.

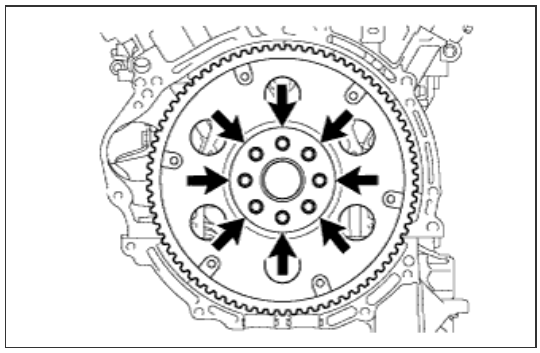
SST
09213-54015 (91651-60855)
09330-00021



b. Remove the 8 bolts, rear spacer, drive plate and front spacer.

NOTICE:

Do not reuse the bolts.



4. REMOVE CLUTCH COVER ASSEMBLY (for Manual Transmission)

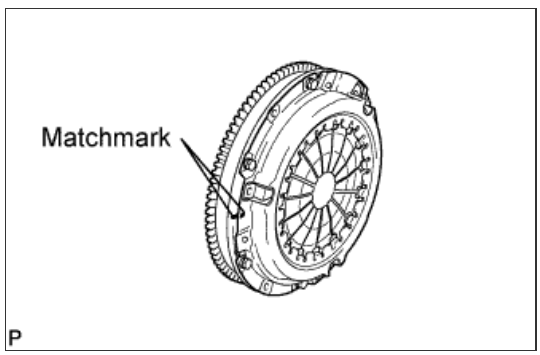
a. Put matchmarks on the clutch cover and flywheel.

b. Loosen each set bolt one turn at a time until spring tension is released.

c. Remove the 6 set bolts, and pull off the clutch cover.

NOTICE:

Do not drop the clutch disc.



5. REMOVE CLUTCH DISC ASSEMBLY (for Manual Transmission)

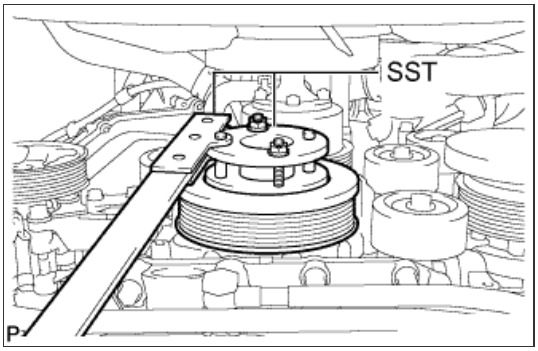
NOTICE:

Keep the lining part of the clutch disc, pressure plate and surface of the flywheel away from oil and foreign matter.

6. REMOVE FLYWHEEL SUB-ASSEMBLY (for Manual Transmission)

a. Using SST, hold the crankshaft.

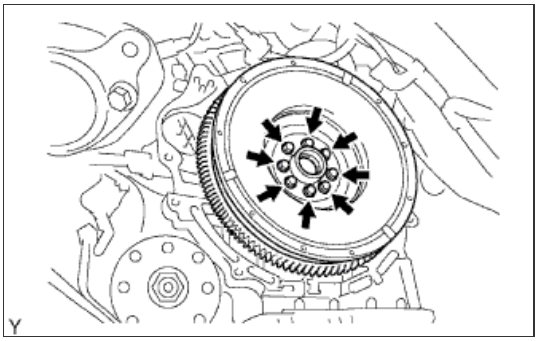
SST
09213-54015 (91651-60855)
09330-00021



b. Remove the 8 bolts and flywheel.

NOTICE:

Do not reuse the bolts.



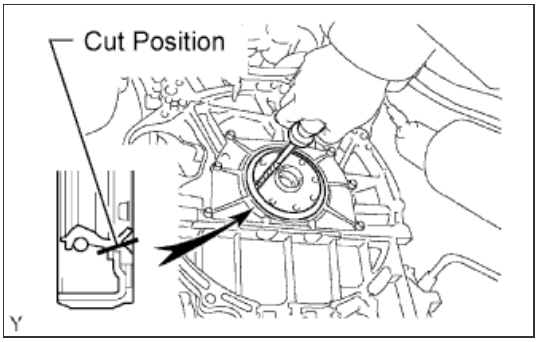
7. REMOVE REAR CRANKSHAFT OIL SEAL

a. Using a knife, cut off the lip of the oil seal.

b. Using a screwdriver, pry out the oil seal.

NOTICE:

Be careful not to damage the crankshaft. Tape the screwdriver tip before use.



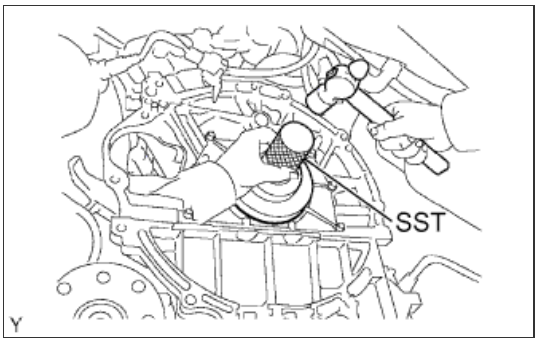
for Preparation Click here

1. INSTALL REAR CRANKSHAFT OIL SEAL

a. Apply MP grease to the lip of a new oil seal.

b. Using SST and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.

SST
09223-78010

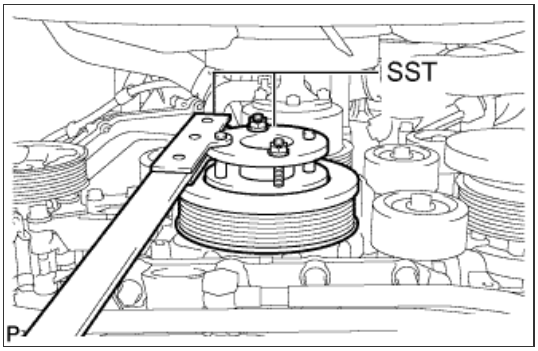


2. INSTALL DRIVE PLATE AND RING GEAR SUB-ASSEMBLY (for Automatic Transmission)

a. Using SST, hold the crankshaft.

SST
09213-54015 (91651-60855)
09330-00021

b. Temporarily install the front spacer, drive plate and rear spacer with the 8 bolts.

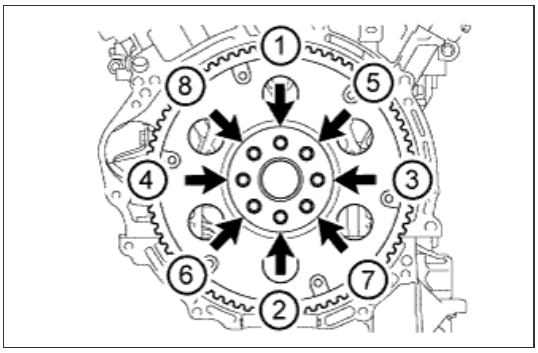


c. Tighten the 8 bolts uniformly in several steps in the order shown in the illustration.

Torque:
83 N*m{ 846 kgf*cm , 61 ft.*lbf }

NOTICE:

Do not start the engine for at least 1 hour after installing.

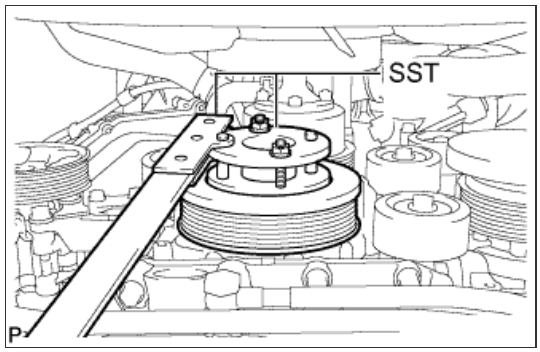


3. INSTALL FLYWHEEL SUB-ASSEMBLY (for Manual Transmission)

a. Using SST, hold the crankshaft.

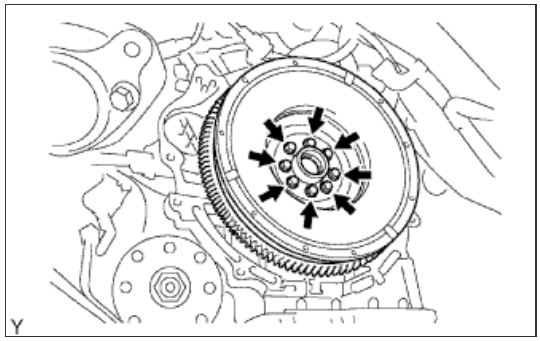
SST
09213-54015 (91651-60855)
09330-00021

b. Temporarily install the flywheel with the 8 bolts.



c. Install and tighten the 8 mounting bolts uniformly in several steps.

Torque
83 N*m{ 846 kgf*cm , 61 ft.*lbf }



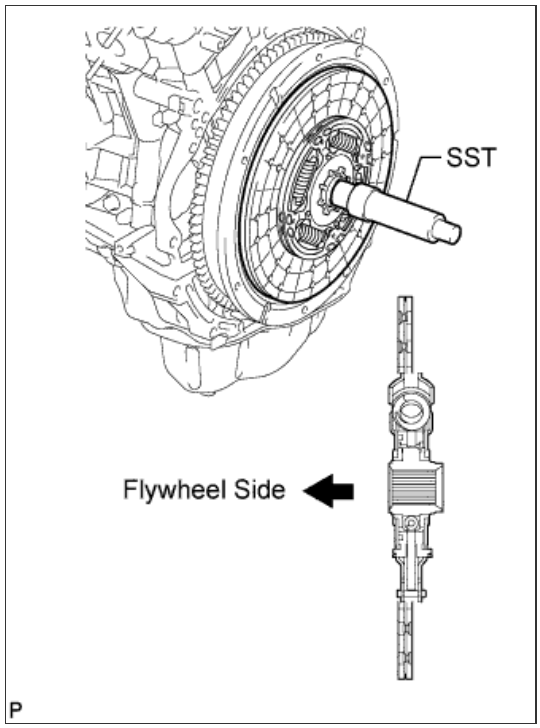
4. INSTALL CLUTCH DISC ASSEMBLY (for Manual Transmission)

a. Insert SST into the clutch disc, then insert the clutch disc into the flywheel.

SST
09301-00110

NOTICE:

Take care not to insert the clutch disc in the wrong direction.



5. INSTALL CLUTCH COVER ASSEMBLY (for Manual Transmission)

a. Align the matchmark on the clutch cover with the one on the flywheel.

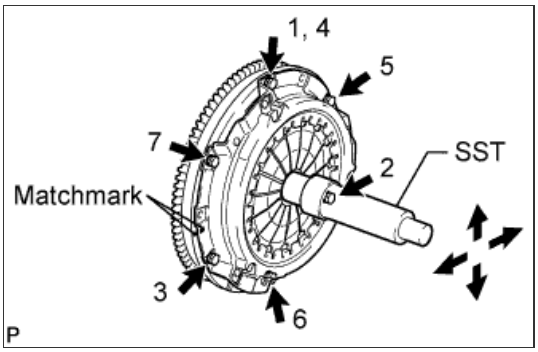
b. In the order shown in the illustration, temporarily install the 6 bolts starting from the bolt located near the knock pin on the top.

c. Check that the disc is in the center by lightly moving SST up and down, and left and right.

SST
09301-00110

.Evenly tighten the bolts by following the order shown in the illustration.

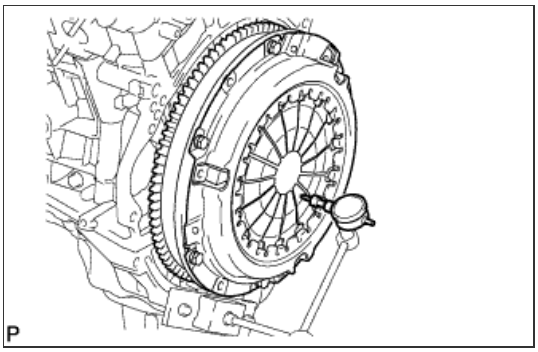
Torque
19 N m 195 k f m 14 ft. lbf



. INSPECT AND ADJUST CLUTCH COVER ASSEMBLY

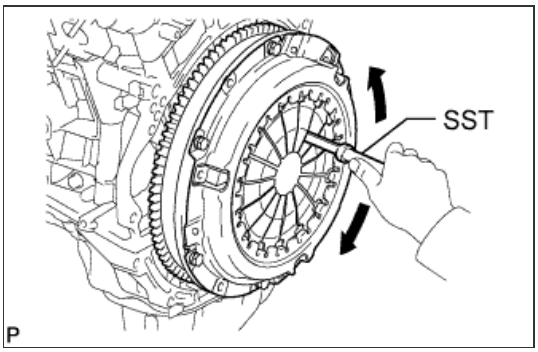
a. Using a dial indicator with a roller instrument, check the diaphragm spring tip alignment.

Maximum Misalignment:
1.3 mm (0.0512 in.)



b. If the alignment is not as specified, adjust the diaphragm spring tip alignment using SST.

SST
09333-00013



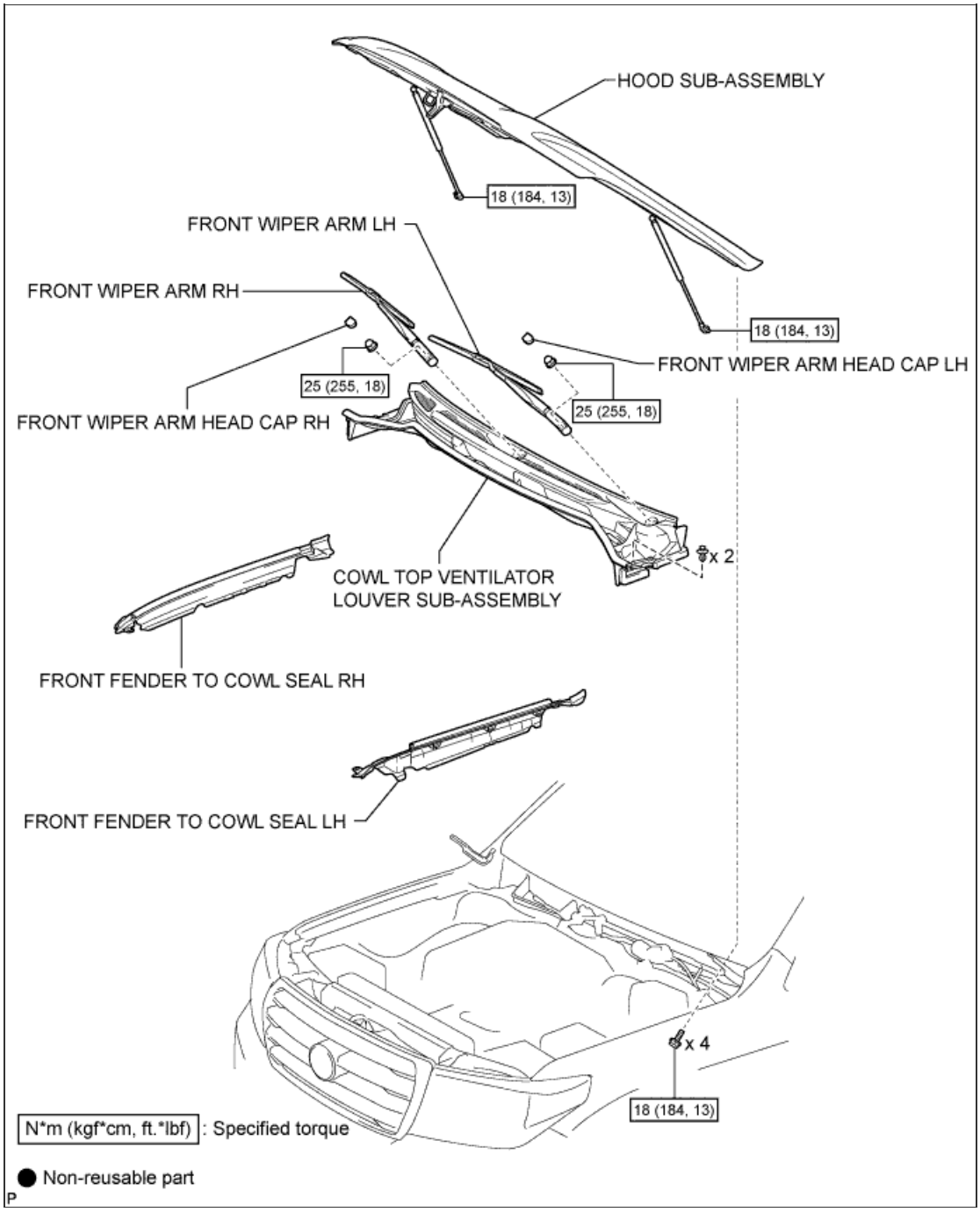
7. INSTALL AUTOMATIC TRANSMISSION ASSEMBLY (for Automatic Transmission)

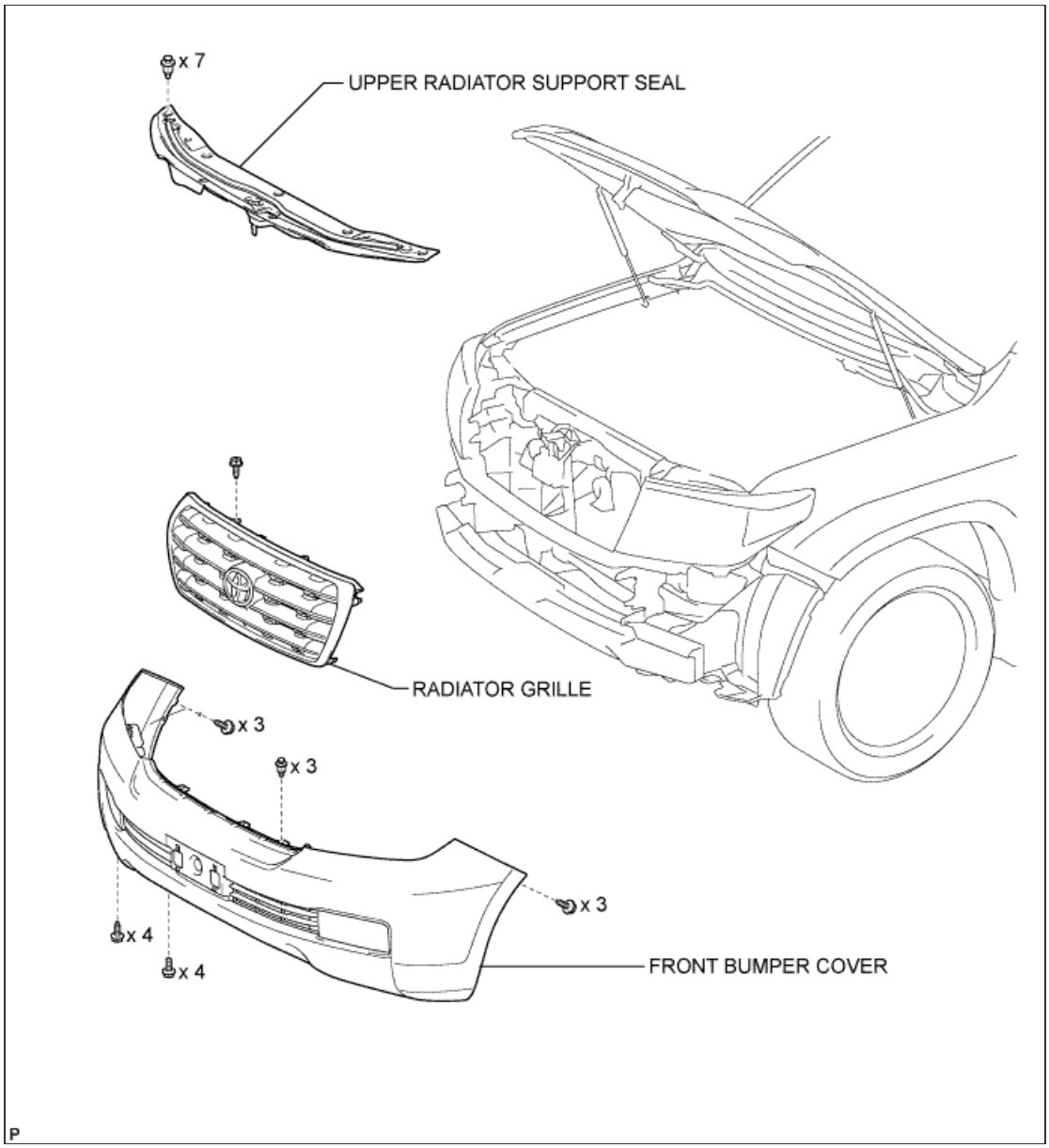
a. Install the automatic transmission (Click here).

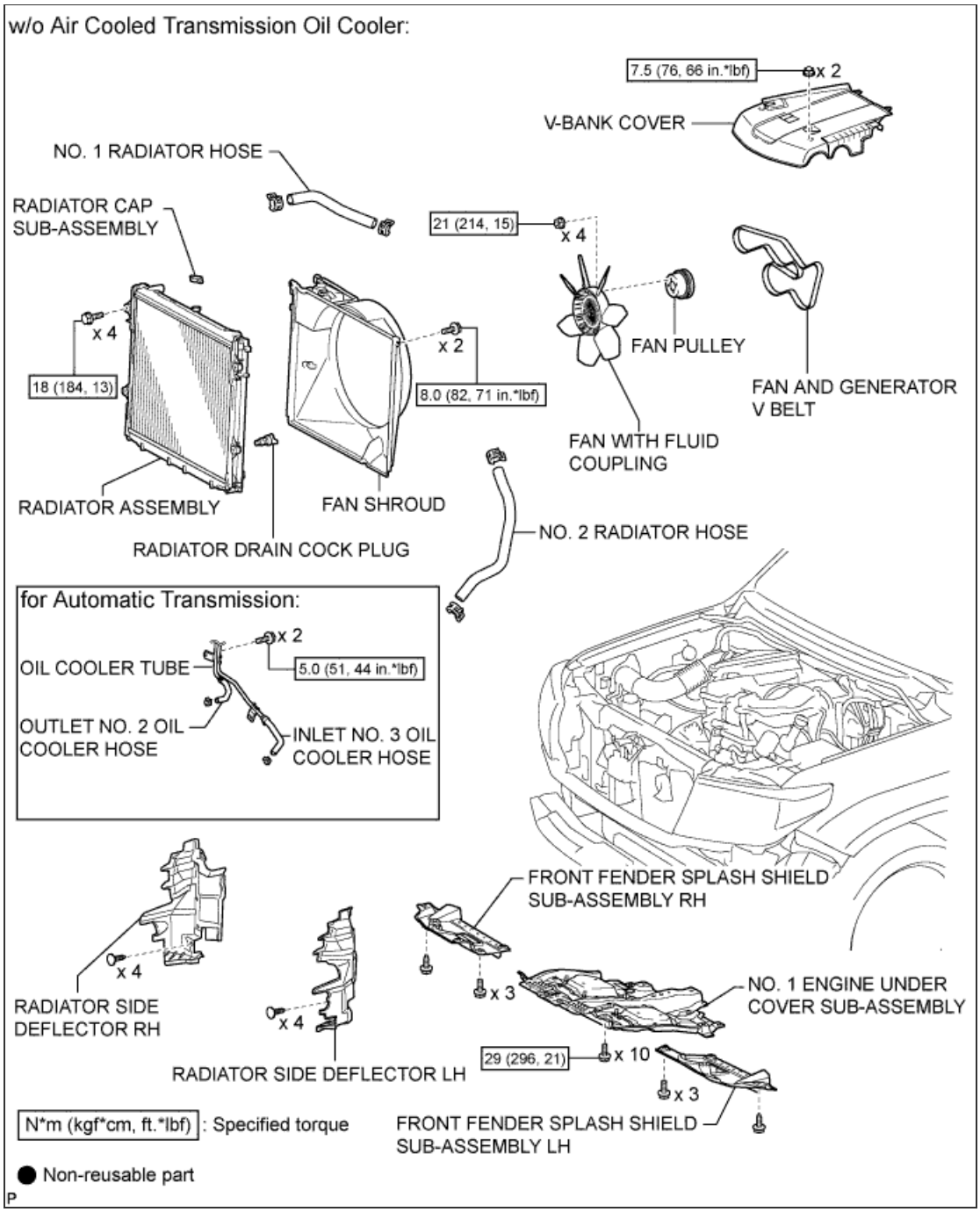
8. INSTALL MANUAL TRANSMISSION ASSEMBLY (for Manual Transmission)

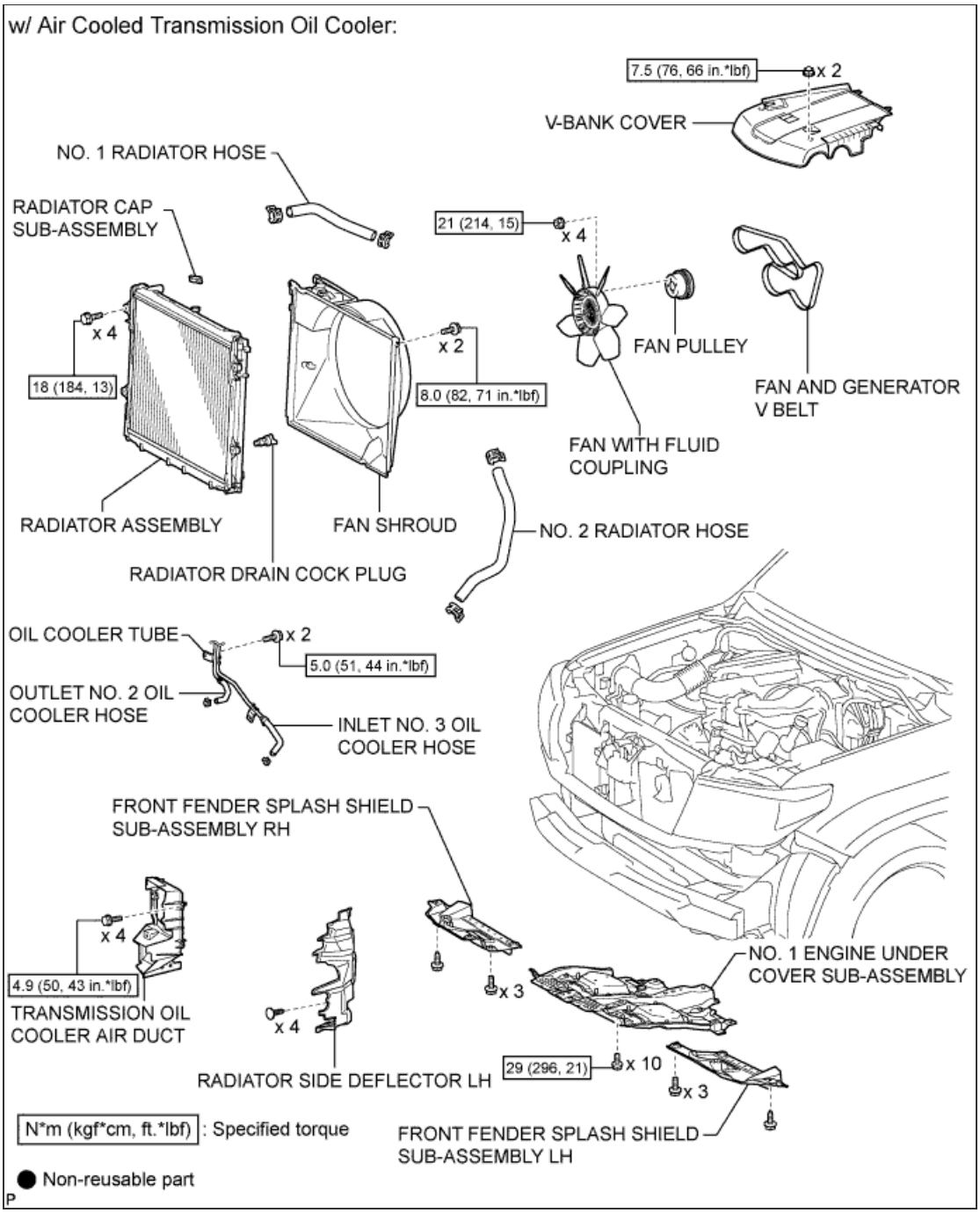
a. Install the manual transmission (Click here).

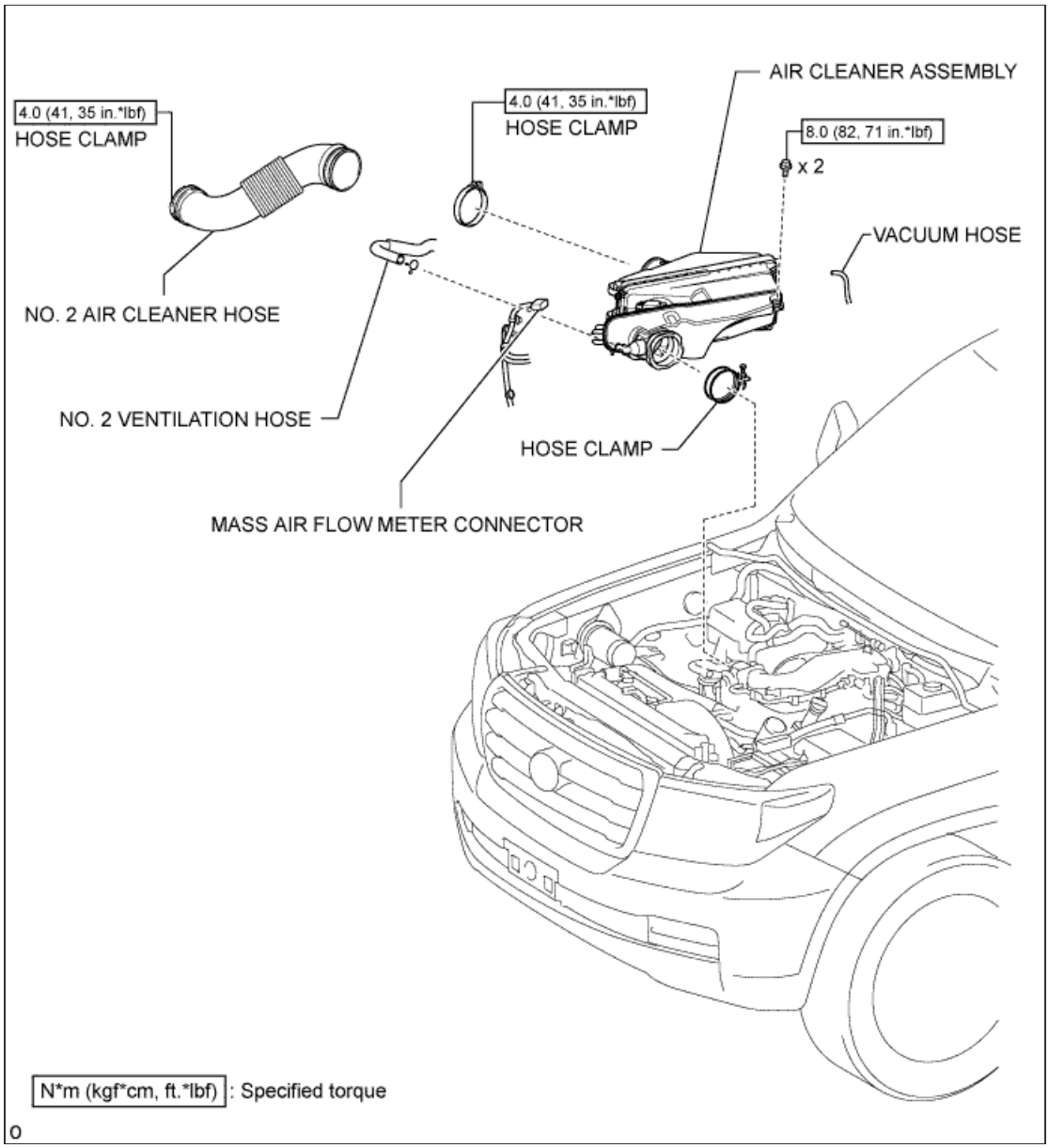
for Preparation Click here



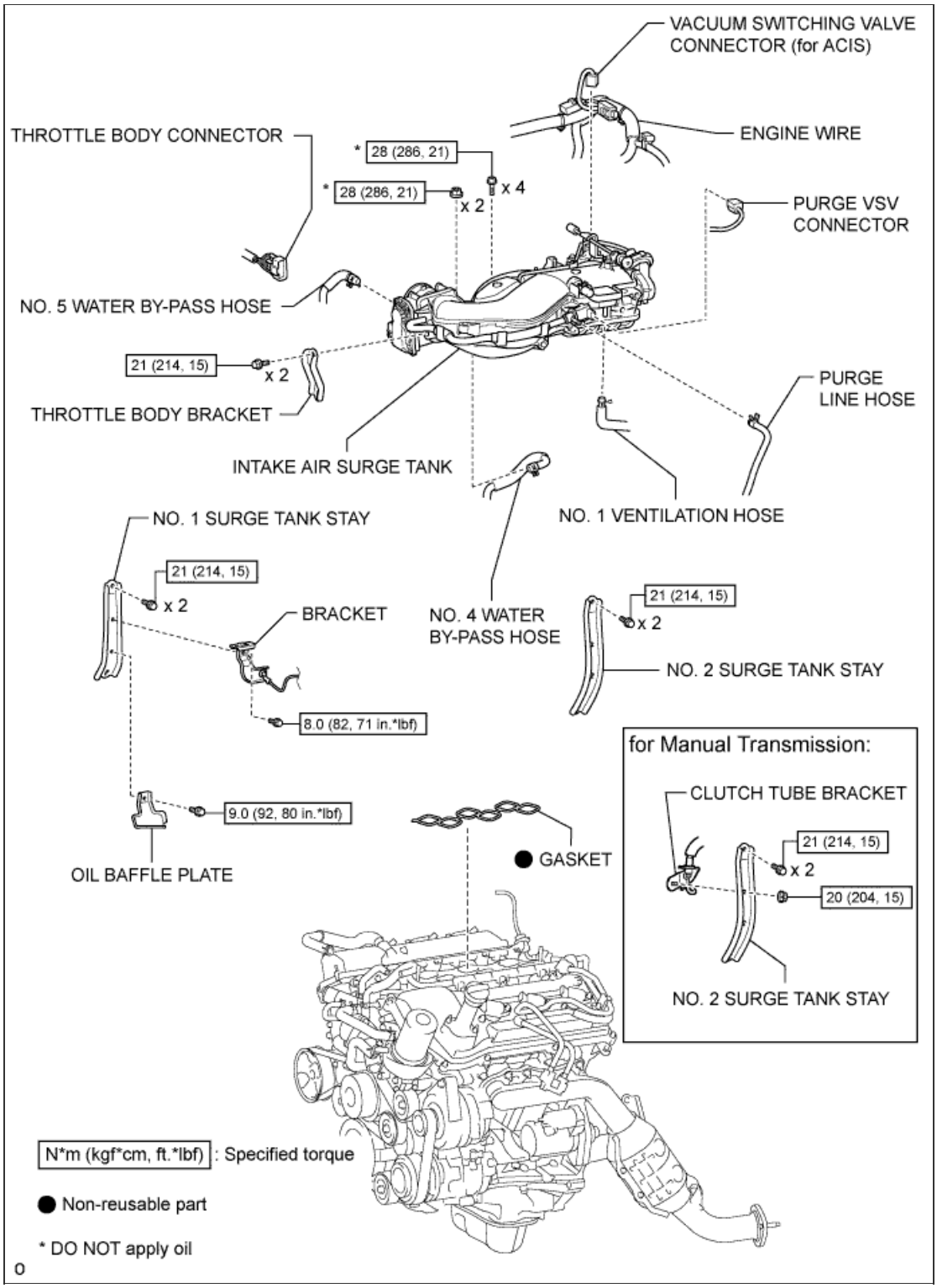

x 7
UPPER RADIATOR SUPPORT SEAL
RADIATOR GRILLE
x 3
x 3
x 3
x 4
x 4
FRONT BUMPER COVER
P

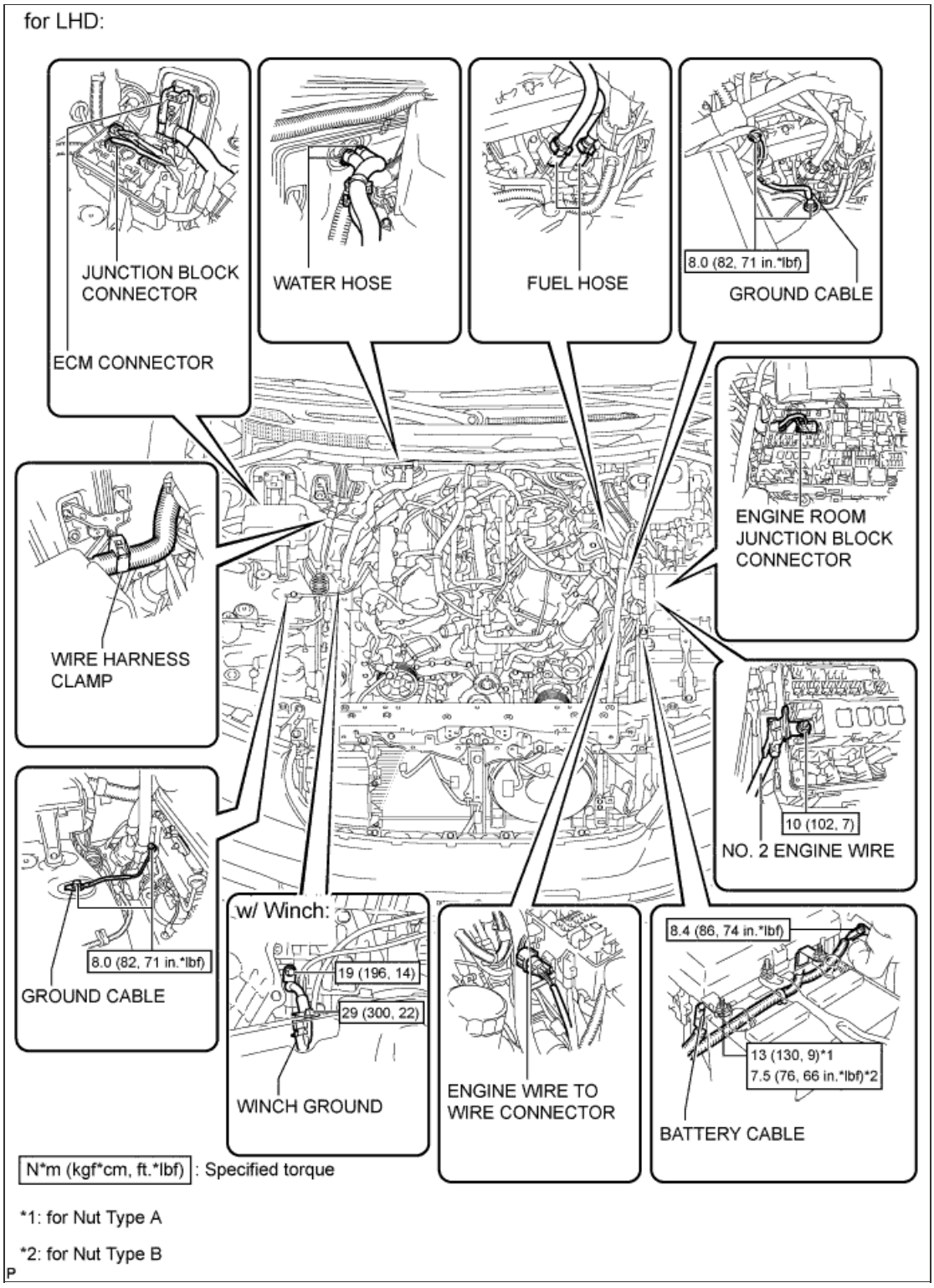

w/o Air Cooled Transmission Oil Cooler:
7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER
NO. 1 RADIATOR HOSE
RADIATOR CAP SUB-ASSEMBLY
21 (214, 15)
x 4
FAN PULLEY
FAN AND GENERATOR V BELT
x 4
18 (184, 13)
x 2
8.0 (82, 71 in.*lbf)
FAN WITH FLUID COUPLING
RADIATOR ASSEMBLY
FAN SHROUD
RADIATOR DRAIN COCK PLUG
NO. 2 RADIATOR HOSE
for Automatic Transmission:
x 2
OIL COOLER TUBE
5.0 (51, 44 in.*lbf)
OUTLET NO. 2 OIL COOLER HOSE
INLET NO. 3 OIL COOLER HOSE
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH
x 4
RADIATOR SIDE DEFLECTOR RH
x 4
x 3
NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY
RADIATOR SIDE DEFLECTOR LH
29 (296, 21)
x 10
x 3
N*m (kgf*cm, ft.*lbf) : Specified torque
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH
● Non-reusable part
P

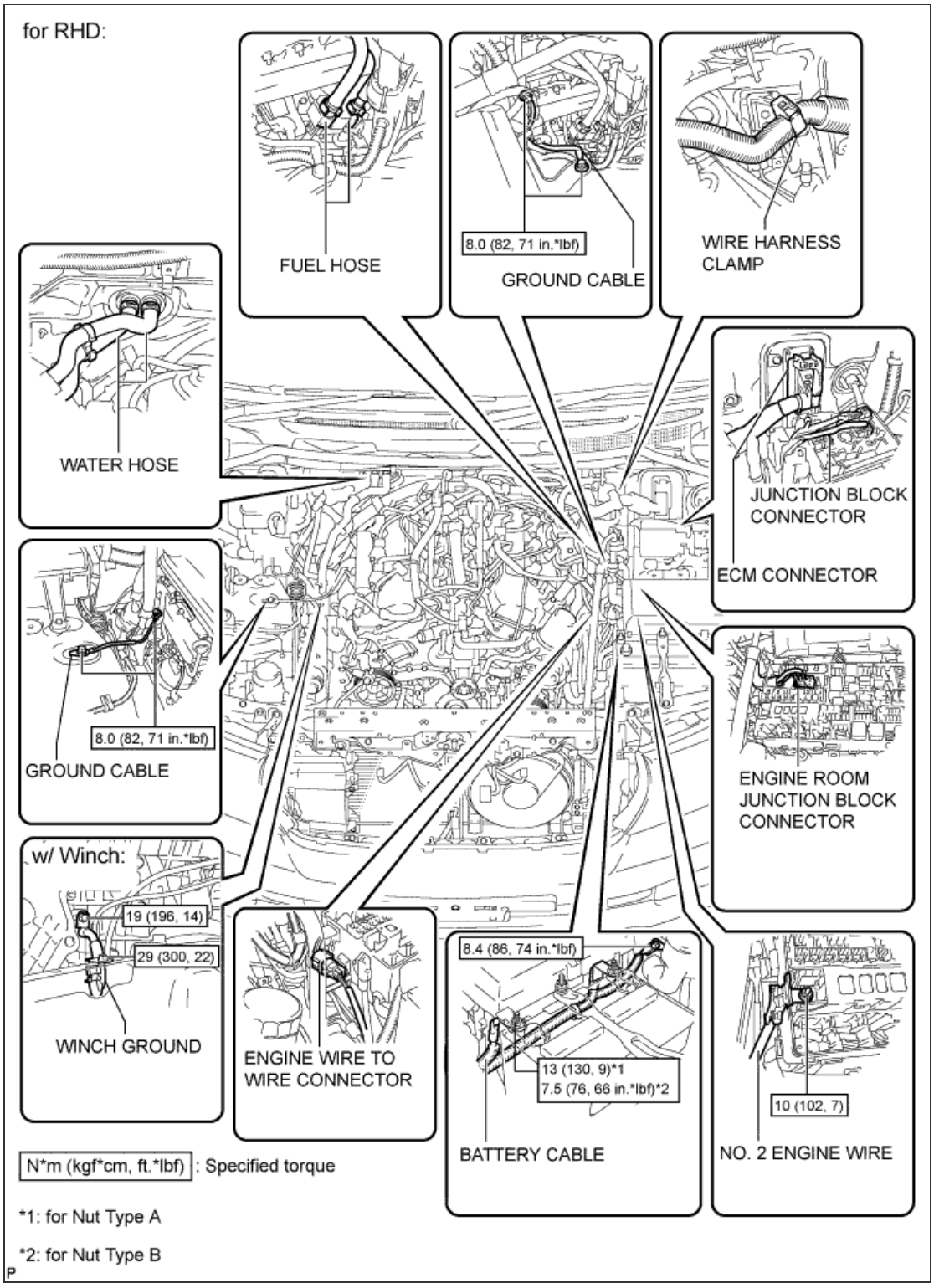

w/ Air Cooled Transmission Oil Cooler:
7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER
NO. 1 RADIATOR HOSE
RADIATOR CAP SUB-ASSEMBLY
21 (214, 15)
x 4
FAN PULLEY
FAN AND GENERATOR V BELT
x 4
18 (184, 13)
x 2
8.0 (82, 71 in.*lbf)
FAN WITH FLUID COUPLING
RADIATOR ASSEMBLY
FAN SHROUD
NO. 2 RADIATOR HOSE
RADIATOR DRAIN COCK PLUG
OIL COOLER TUBE
x 2
5.0 (51, 44 in.*lbf)
OUTLET NO. 2 OIL COOLER HOSE
INLET NO. 3 OIL COOLER HOSE
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH
x 4
4.9 (50, 43 in.*lbf)
TRANSMISSION OIL COOLER AIR DUCT
x 4
x 3
NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY
RADIATOR SIDE DEFLECTOR LH
29 (296, 21)
x 10
x 3
N*m (kgf*cm, ft.*lbf) : Specified torque
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH
Non-reusable part
P

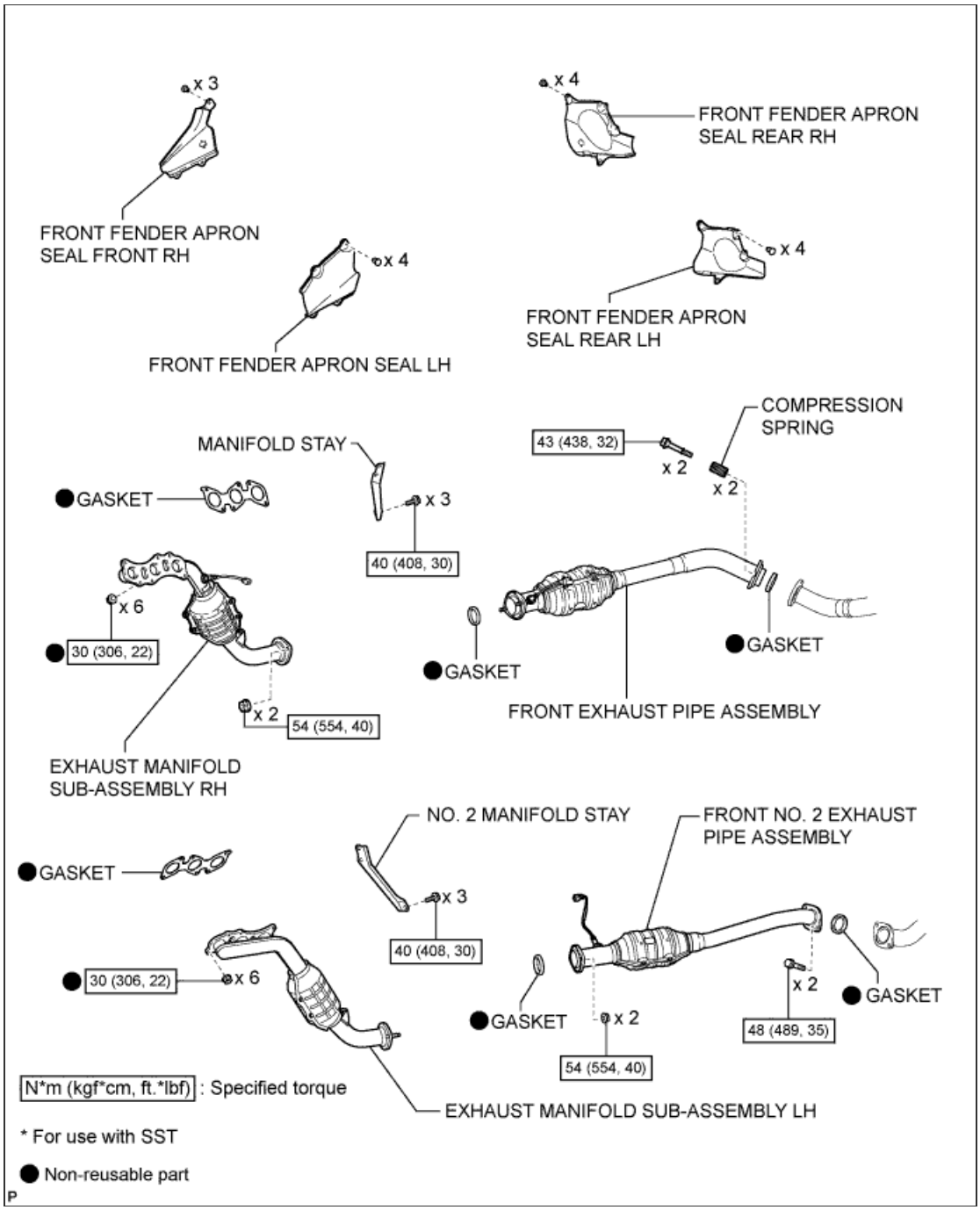

AIR CLEANER ASSEMBLY
4.0 (41, 35 in.*lbf)
HOSE CLAMP
4.0 (41, 35 in.*lbf)
HOSE CLAMP
8.0 (82, 71 in.*lbf)
x 2
VACUUM HOSE
NO. 2 AIR CLEANER HOSE
NO. 2 VENTILATION HOSE
HOSE CLAMP
MASS AIR FLOW METER CONNECTOR
N*m (kgf*cm, ft.*lbf) : Specified torque

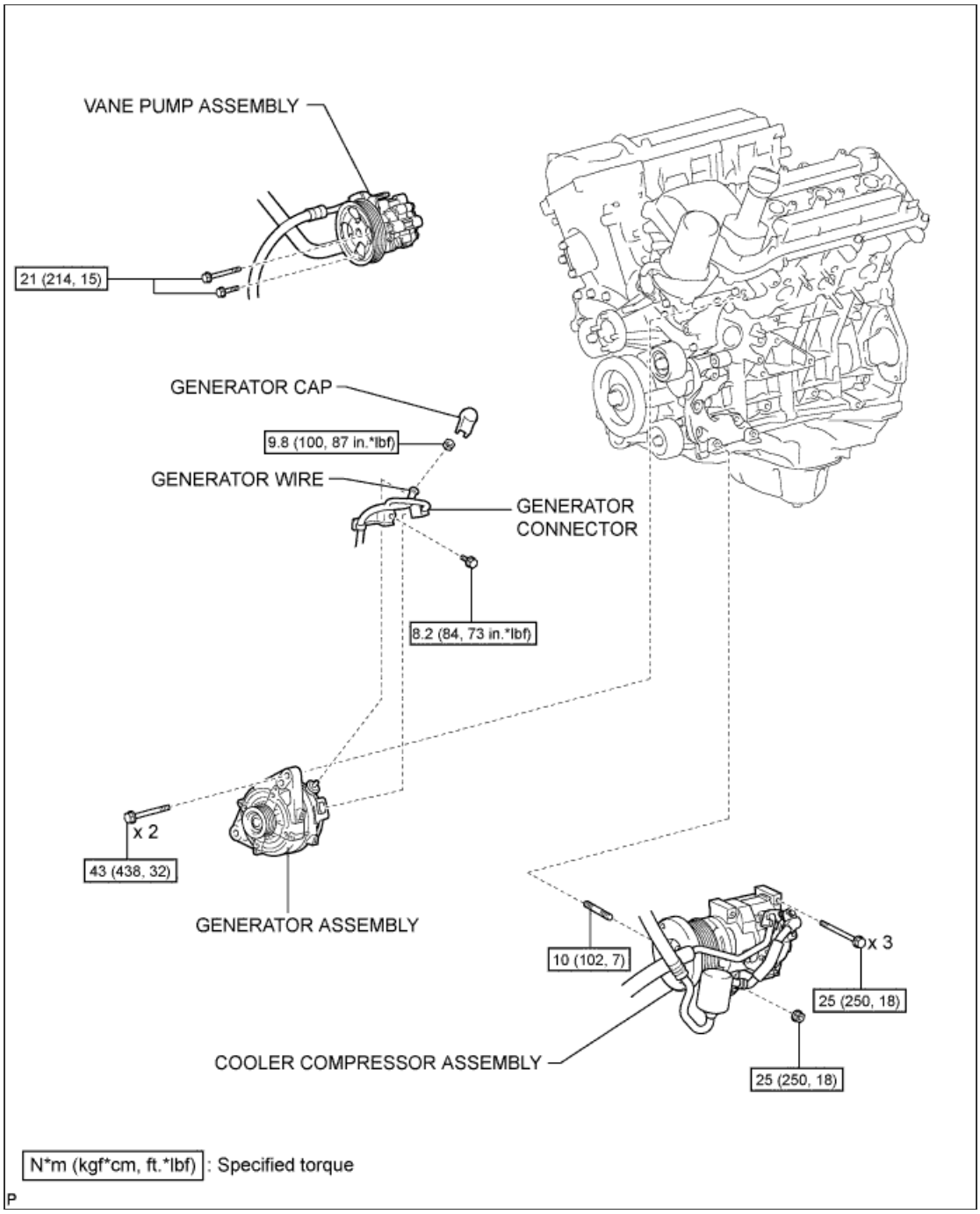
o

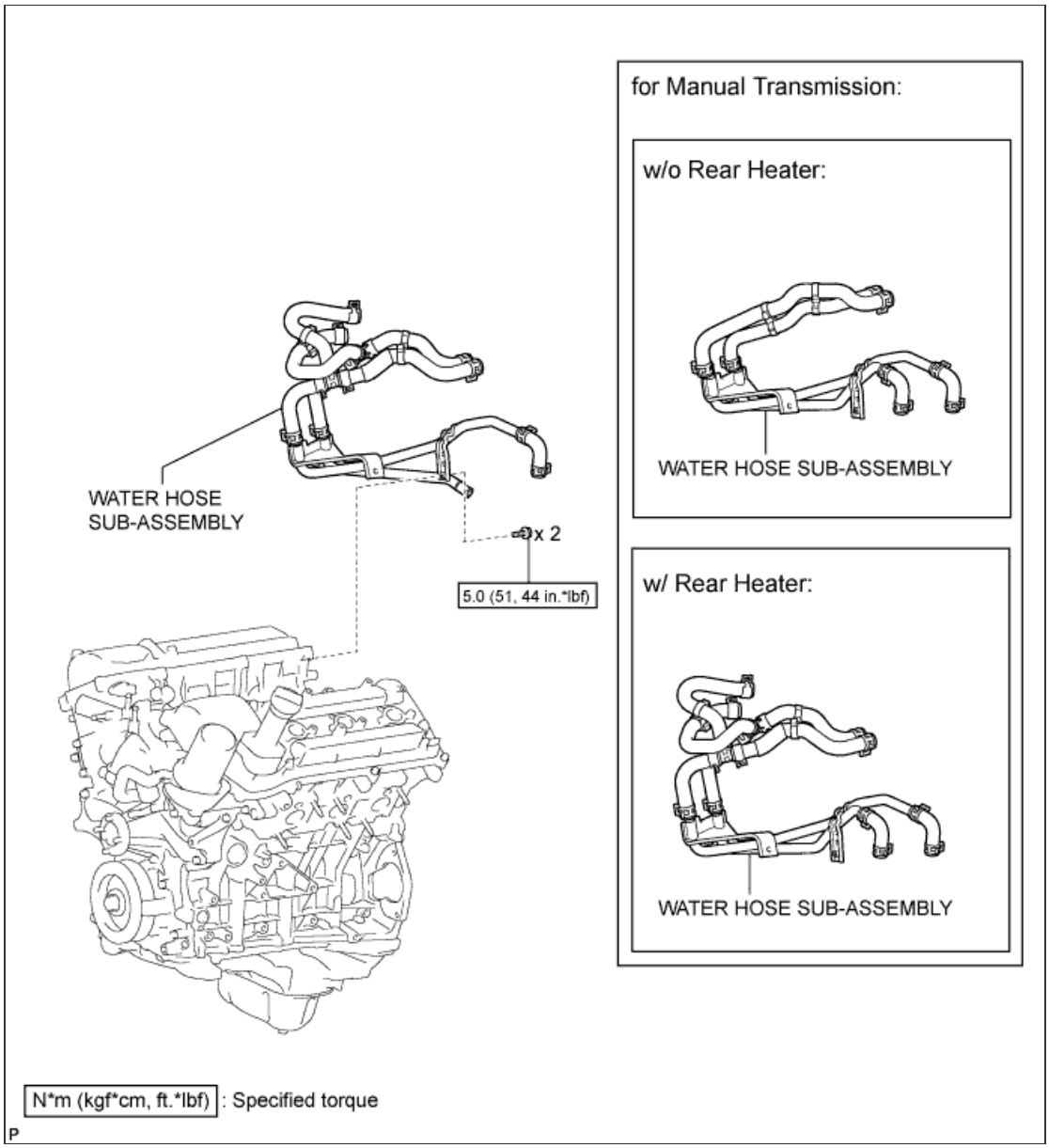

VACUUM SWITCHING VALVE CONNECTOR (for ACIS)
ENGINE WIRE
THROTTLE BODY CONNECTOR
* 28 (286, 21)
* 28 (286, 21)
x 2
x 4
PURGE VSV CONNECTOR
NO. 5 WATER BY-PASS HOSE
21 (214, 15)
x 2
THROTTLE BODY BRACKET
PURGE LINE HOSE
INTAKE AIR SURGE TANK
NO. 1 VENTILATION HOSE
NO. 1 SURGE TANK STAY
21 (214, 15)
x 2
BRACKET
NO. 4 WATER BY-PASS HOSE
21 (214, 15)
x 2
NO. 2 SURGE TANK STAY
8.0 (82, 71 in.*lbf)
for Manual Transmission:
CLUTCH TUBE BRACKET
21 (214, 15)
x 2
20 (204, 15)
NO. 2 SURGE TANK STAY
9.0 (92, 80 in.*lbf)
OIL BAFFLE PLATE
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
* DO NOT apply oil

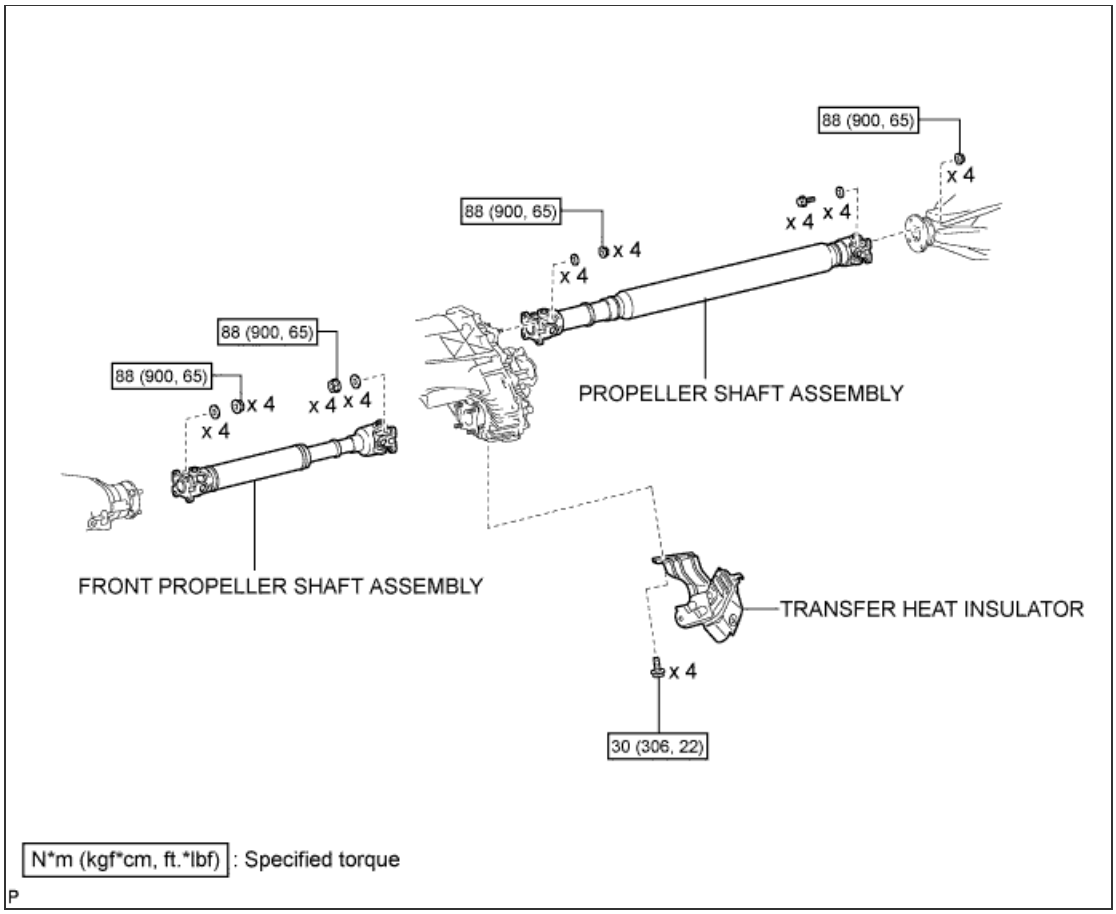

for LHD:
JUNCTION BLOCK CONNECTOR
ECM CONNECTOR
WATER HOSE
FUEL HOSE
8.0 (82, 71 in.*lbf)
GROUND CABLE
ENGINE ROOM JUNCTION BLOCK CONNECTOR
WIRE HARNESS CLAMP
10 (102, 7)
NO. 2 ENGINE WIRE
8.0 (82, 71 in.*lbf)
GROUND CABLE
w/ Winch:
19 (196, 14)
29 (300, 22)
WINCH GROUND
ENGINE WIRE TO WIRE CONNECTOR
8.4 (86, 74 in.*lbf)
13 (130, 9)*1
7.5 (76, 66 in.*lbf)*2
BATTERY CABLE
N*m (kgf*cm, ft.*lbf) : Specified torque
*1: for Nut Type A
*2: for Nut Type B
P


for RHD:
FUEL HOSE
8.0 (82, 71 in.*lbf)
GROUND CABLE
WIRE HARNESS CLAMP
WATER HOSE
JUNCTION BLOCK CONNECTOR
ECM CONNECTOR
8.0 (82, 71 in.*lbf)
GROUND CABLE
ENGINE ROOM JUNCTION BLOCK CONNECTOR
w/ Winch:
19 (196, 14)
29 (300, 22)
WINCH GROUND
ENGINE WIRE TO WIRE CONNECTOR
8.4 (86, 74 in.*lbf)
13 (130, 9)*1
7.5 (76, 66 in.*lbf)*2
BATTERY CABLE
10 (102, 7)
NO. 2 ENGINE WIRE
N*m (kgf*cm, ft.*lbf) : Specified torque
*1: for Nut Type A
*2: for Nut Type B
P

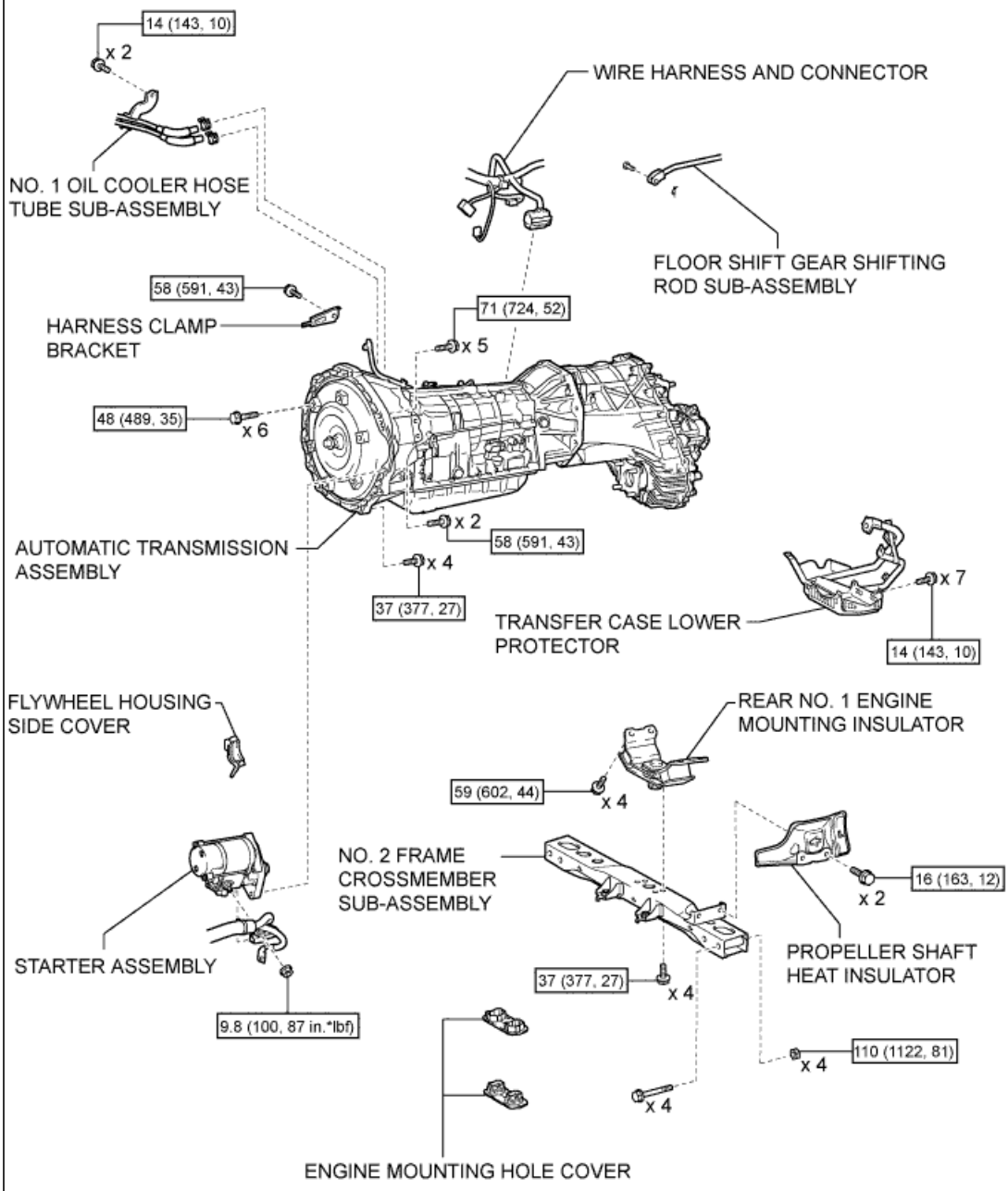

x 3
FRONT FENDER APRON SEAL FRONT RH
x 4
FRONT FENDER APRON SEAL LH
x 4
FRONT FENDER APRON SEAL REAR RH
x 4
FRONT FENDER APRON SEAL REAR LH
MANIFOLD STAY
x 3
40 (408, 30)
GASKET
x 6
30 (306, 22)
x 2
54 (554, 40)
EXHAUST MANIFOLD SUB-ASSEMBLY RH
43 (438, 32)
x 2
COMPRESSION SPRING
x 2
GASKET
GASKET
FRONT EXHAUST PIPE ASSEMBLY
NO. 2 MANIFOLD STAY
x 3
40 (408, 30)
GASKET
30 (306, 22)
x 6
FRONT NO. 2 EXHAUST PIPE ASSEMBLY
x 2
48 (489, 35)
GASKET
GASKET
x 2
54 (554, 40)
EXHAUST MANIFOLD SUB-ASSEMBLY LH
N*m (kgf*cm, ft.*lbf) : Specified torque
* For use with SST
Non-reusable part
P


VANE PUMP ASSEMBLY
21 (214, 15)
GENERATOR CAP
9.8 (100, 87 in.*lbf)
GENERATOR WIRE
GENERATOR CONNECTOR
8.2 (84, 73 in.*lbf)
x 2
43 (438, 32)
GENERATOR ASSEMBLY
10 (102, 7)
x 3
25 (250, 18)
25 (250, 18)
COOLER COMPRESSOR ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
P


for Manual Transmission:
w/o Rear Heater:
WATER HOSE SUB-ASSEMBLY
w/ Rear Heater:
WATER HOSE SUB-ASSEMBLY
WATER HOSE
SUB-ASSEMBLY
x 2
5.0 (51, 44 in.*lbf)
N*m (kgf*cm, ft.*lbf) : Specified torque
P


88 (900, 65)
x 4
88 (900, 65)
x 4
x 4
x 4
88 (900, 65)
x 4
88 (900, 65)
x 4
x 4
x 4
PROPELLER SHAFT ASSEMBLY
FRONT PROPELLER SHAFT ASSEMBLY
TRANSFER HEAT INSULATOR
x 4
30 (306, 22)
N*m (kgf*cm, ft.*lbf) : Specified torque
P

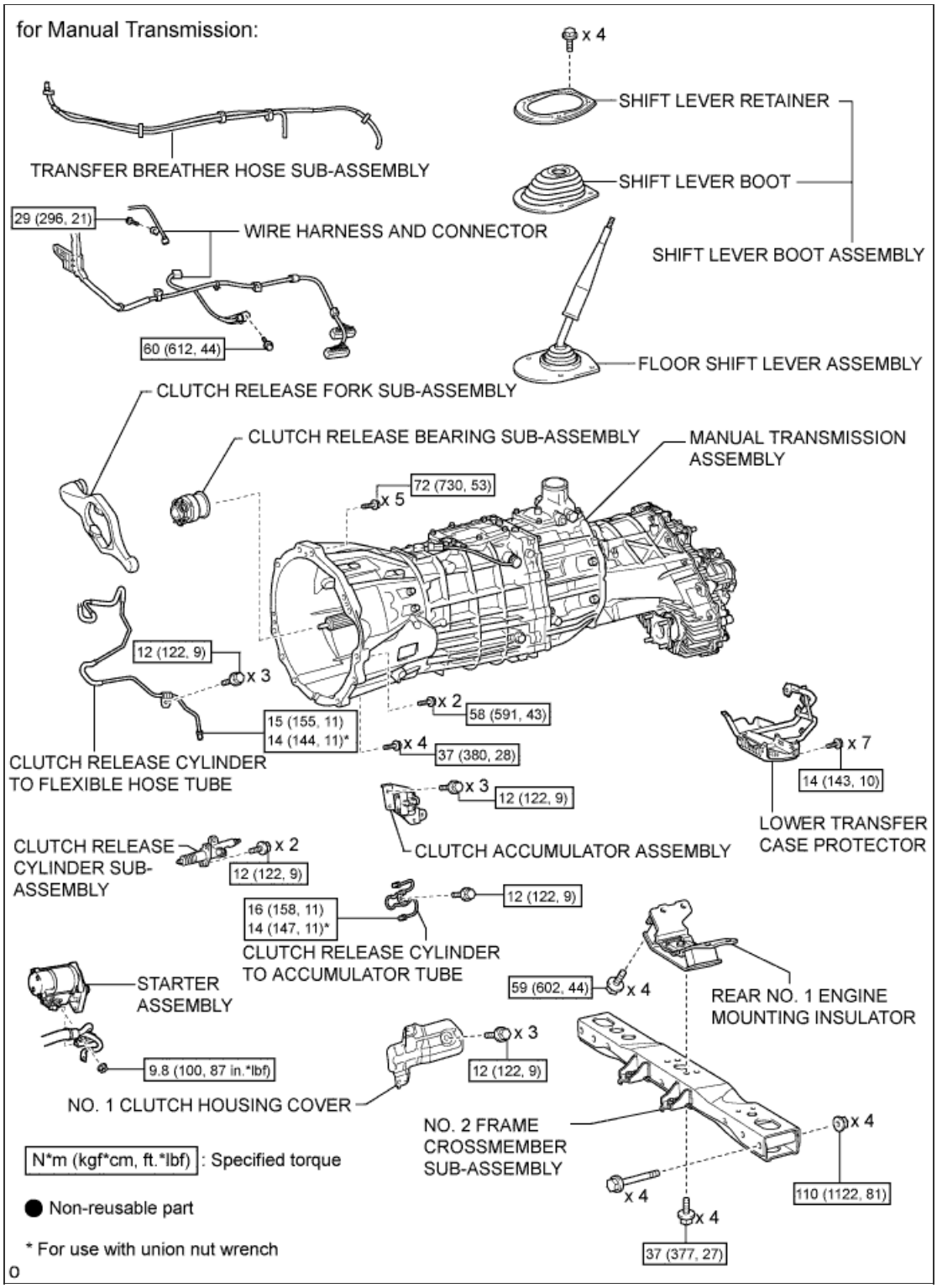
for Automatic Transmission:



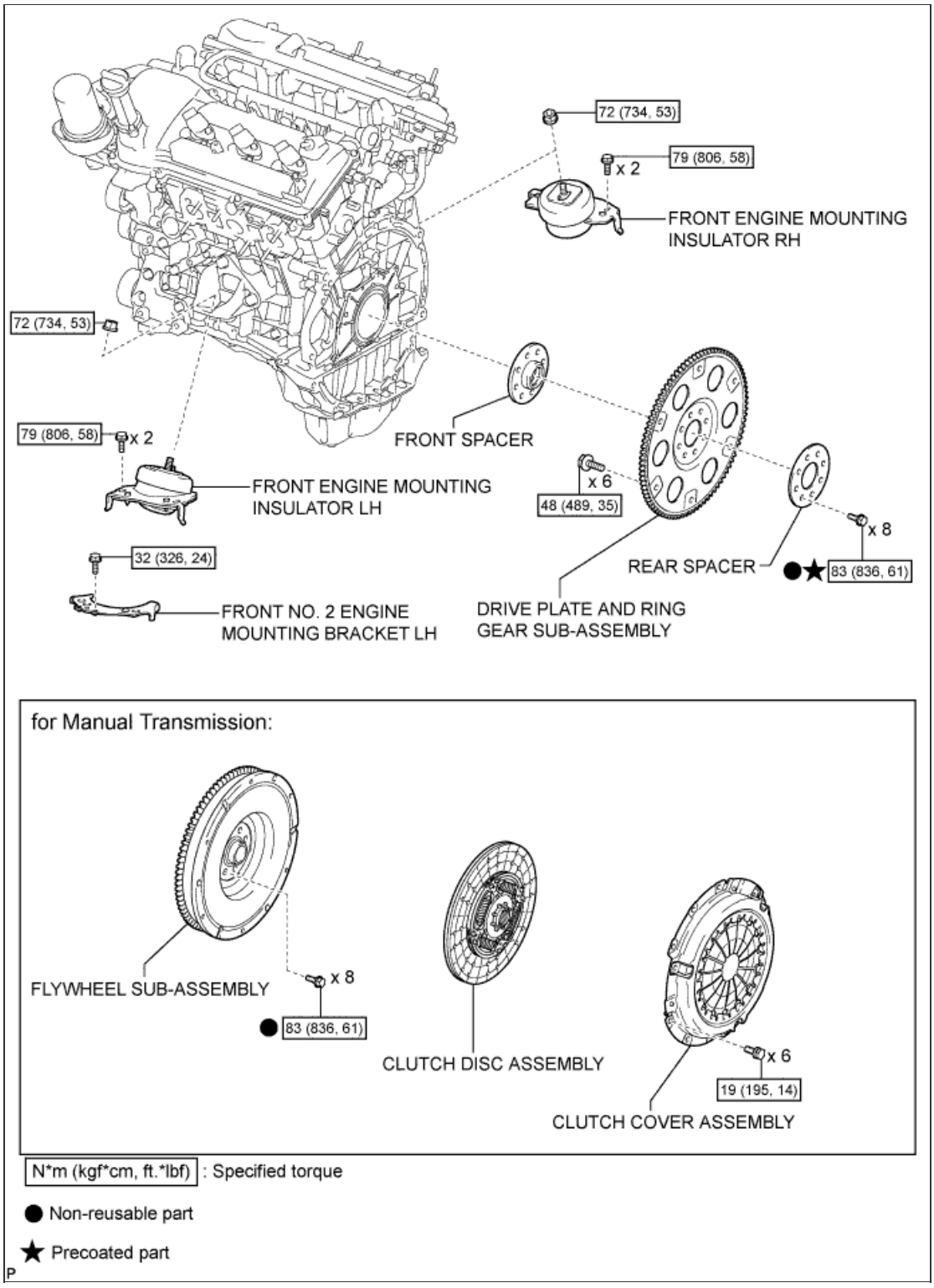
N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P


for Manual Transmission:
x 4
SHIFT LEVER RETAINER
TRANSFER BREATHER HOSE SUB-ASSEMBLY
SHIFT LEVER BOOT
29 (296, 21)
WIRE HARNESS AND CONNECTOR
SHIFT LEVER BOOT ASSEMBLY
60 (612, 44)
FLOOR SHIFT LEVER ASSEMBLY
CLUTCH RELEASE FORK SUB-ASSEMBLY
CLUTCH RELEASE BEARING SUB-ASSEMBLY
MANUAL TRANSMISSION ASSEMBLY
72 (730, 53)
x 5
12 (122, 9)
x 3
x 2
58 (591, 43)
15 (155, 11)
14 (144, 11)*
x 4
37 (380, 28)
CLUTCH RELEASE CYLINDER TO FLEXIBLE HOSE TUBE
x 3
12 (122, 9)
x 7
14 (143, 10)
LOWER TRANSFER CASE PROTECTOR
CLUTCH ACCUMULATOR ASSEMBLY
CLUTCH RELEASE CYLINDER SUB-ASSEMBLY
x 2
12 (122, 9)
16 (158, 11)
14 (147, 11)*
12 (122, 9)
CLUTCH RELEASE CYLINDER TO ACCUMULATOR TUBE
59 (602, 44)
x 4
REAR NO. 1 ENGINE MOUNTING INSULATOR
STARTER ASSEMBLY
x 3
12 (122, 9)
9.8 (100, 87 in.*lbf)
NO. 1 CLUTCH HOUSING COVER
NO. 2 FRAME CROSSMEMBER SUB-ASSEMBLY
x 4
110 (1122, 81)
x 4
x 4
37 (377, 27)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
* For use with union nut wrench

o


72 (734, 53)
79 (806, 58)
x 2
FRONT ENGINE MOUNTING INSULATOR RH
72 (734, 53)
79 (806, 58)
x 2
FRONT ENGINE MOUNTING INSULATOR LH
FRONT SPACER
x 6
48 (489, 35)
x 8
REAR SPACER
83 (836, 61)
32 (326, 24)
FRONT NO. 2 ENGINE MOUNTING BRACKET LH
DRIVE PLATE AND RING GEAR SUB-ASSEMBLY
for Manual Transmission:
FLYWHEEL SUB-ASSEMBLY
x 8
83 (836, 61)
CLUTCH DISC ASSEMBLY
x 6
19 (195, 14)
CLUTCH COVER ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
Precoated part
P

for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

a. Discharge the f el system pressure (Click here).

2. PRECAUTION

NOTICE:

After turning the ignition switch off waiting time may be required bef e disconnecting the cable fr the battery terminal. Theref e, make sure to read the disconnecting the cable fr the battery terminal notice bef e proceeding with work (Click here).

3. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

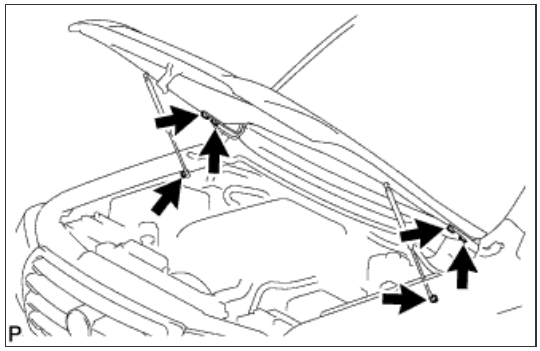
NOTICE:

When disconnecting the cable, some systems need to be initiali ed after the cable is reconnected (Click here).

4. REMOVE HOOD SUB-ASSEMBLY

a. Remove the 2 hood support bolts and disconnect the hood supports.

b. Remove the 4 bolts and hood.



5. REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Remove the cowl top ventilator louver (Click here).

6. REMOVE RADIATOR ASSEMBLY

a. Remove the radiator assembly (Click here).

7. DRAIN ENGINE OIL

a. Remove the oil filler cap.

b. Remove the 2 bolts and service hole cover fr the No. 2 engine under cover.

c. Remove the oil drain plug, and drain the engine oil fr the oil pan.

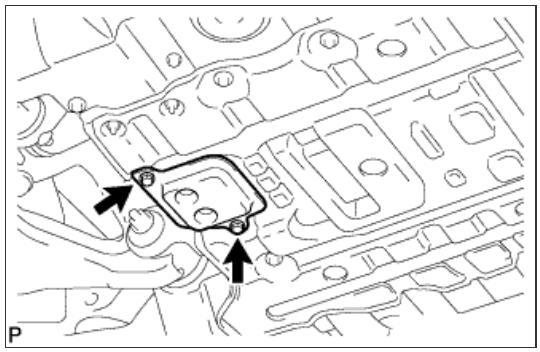
NOTICE:

Collect the oil in an oil disposal container.

d. Wipe the oil pan and drain plug.

e. Install a new gasket and the drain plug.

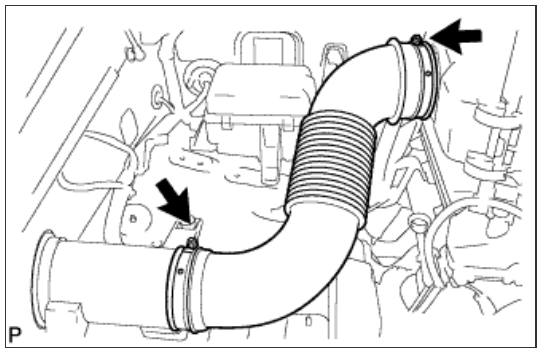
Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }



8. REMOVE NO. 2 ENGINE UNDER COVER

9. REMOVE NO. 2 AIR CLEANER HOSE

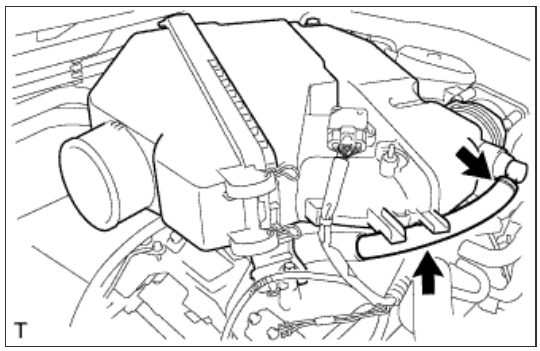
a. Loosen the 2 hose clamps and remove the air cleaner hose.



10. REMOVE AIR CLEANER ASSEMBLY

a. Disconnect the No. 2 ventilation hose.

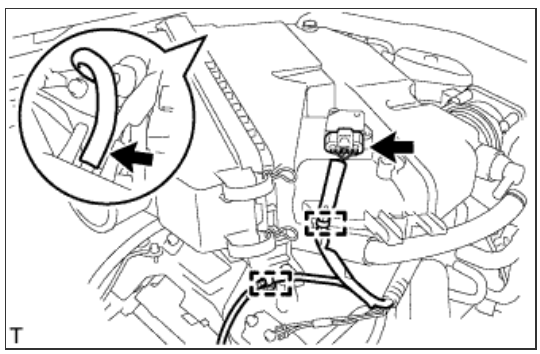
b. Detach the hose clamp.



c. Disconnect the vacuum hose.

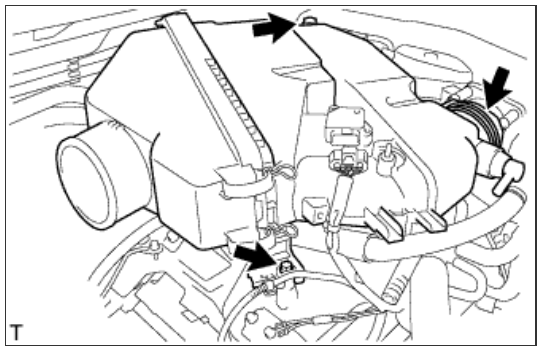
d. Disconnect the MAF meter connector.

e. Using a clip remover, detach the 2 wire harness clamps.



f. Loosen the hose clamp.

g. Remove the 2 bolts and air cleaner assembly.

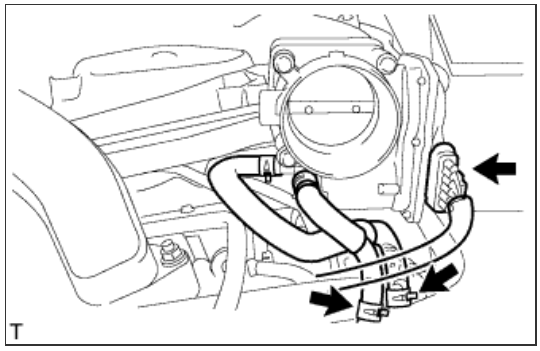


11. REMOVE INTAKE AIR SURGE TANK

a. Disconnect the throttle body connector.

b. Disconnect the No. 4 water by sa hose.

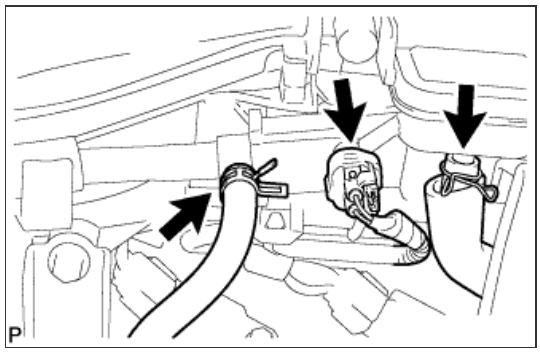
c. Disconnect the No. 5 water by sa hose.



d. Disconnect the purge line hose.

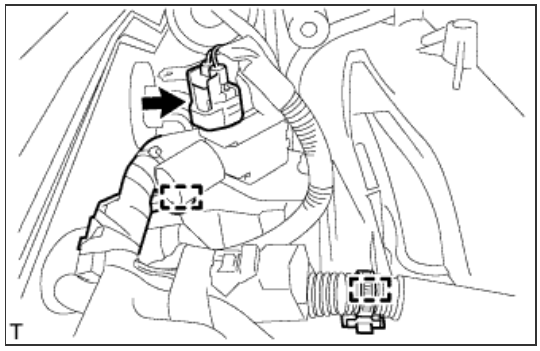
e. Disconnect the purge VSV connector.

f. Disconnect the No. 1 ventilation hose.

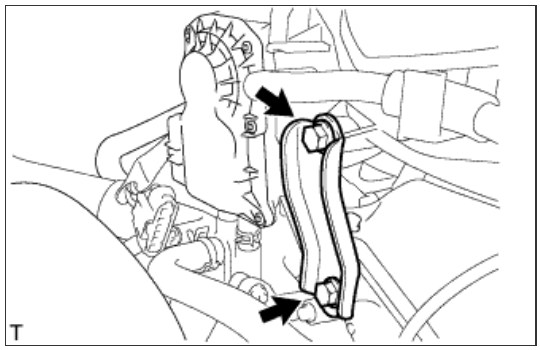


g. Disconnect the vacuum switching valve (f ACIS) connector.

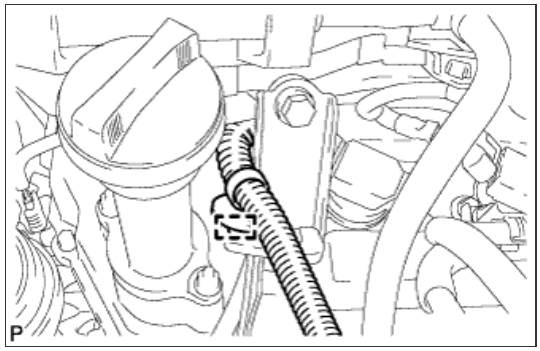
h. Using a clip remover, detach the 2 wire harness clamps.



i. Remove the 2 bolts and throttle body bracket.

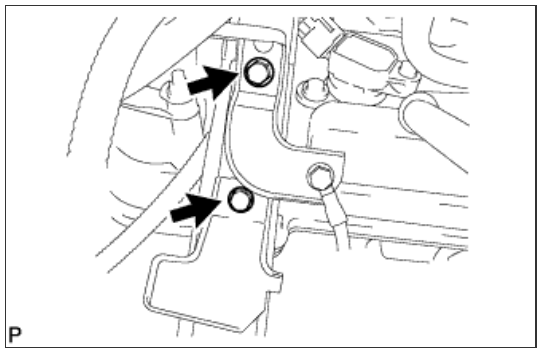


j. Using a clip remover, detach the wire harness clamp.

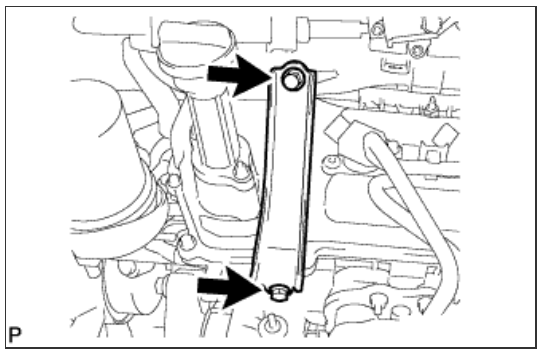


k. Remove the bolt and bracket fr the No. 1 surge tank stay.

l. Remove the bolt and oil baff e plate.

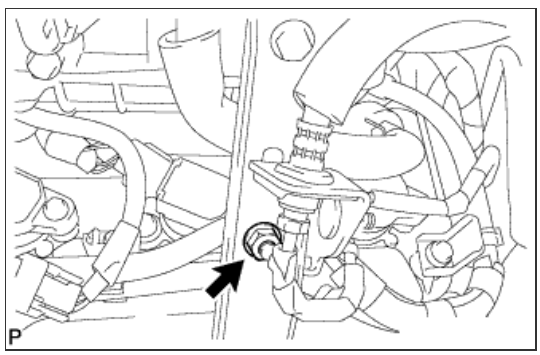


m. Remove the 2 bolts and No. 1 surge tank stay.

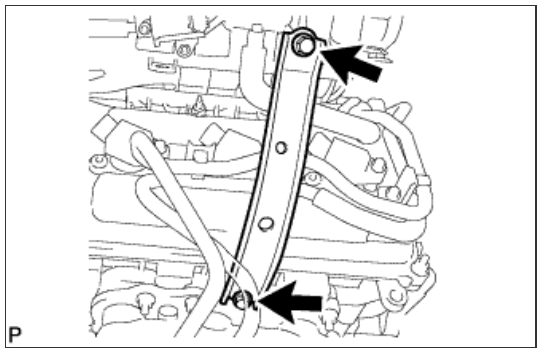


n. f Manual Transmission:

i. Remove the nut.

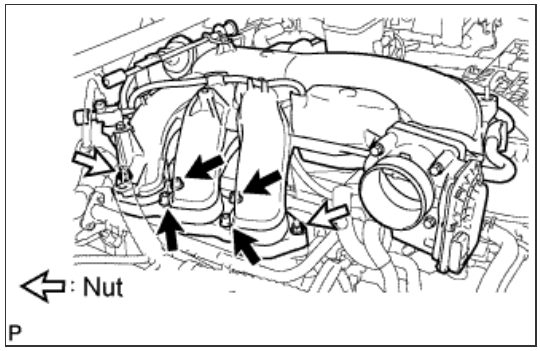


o. Remove the 2 bolts and No. 2 surge tank stay.

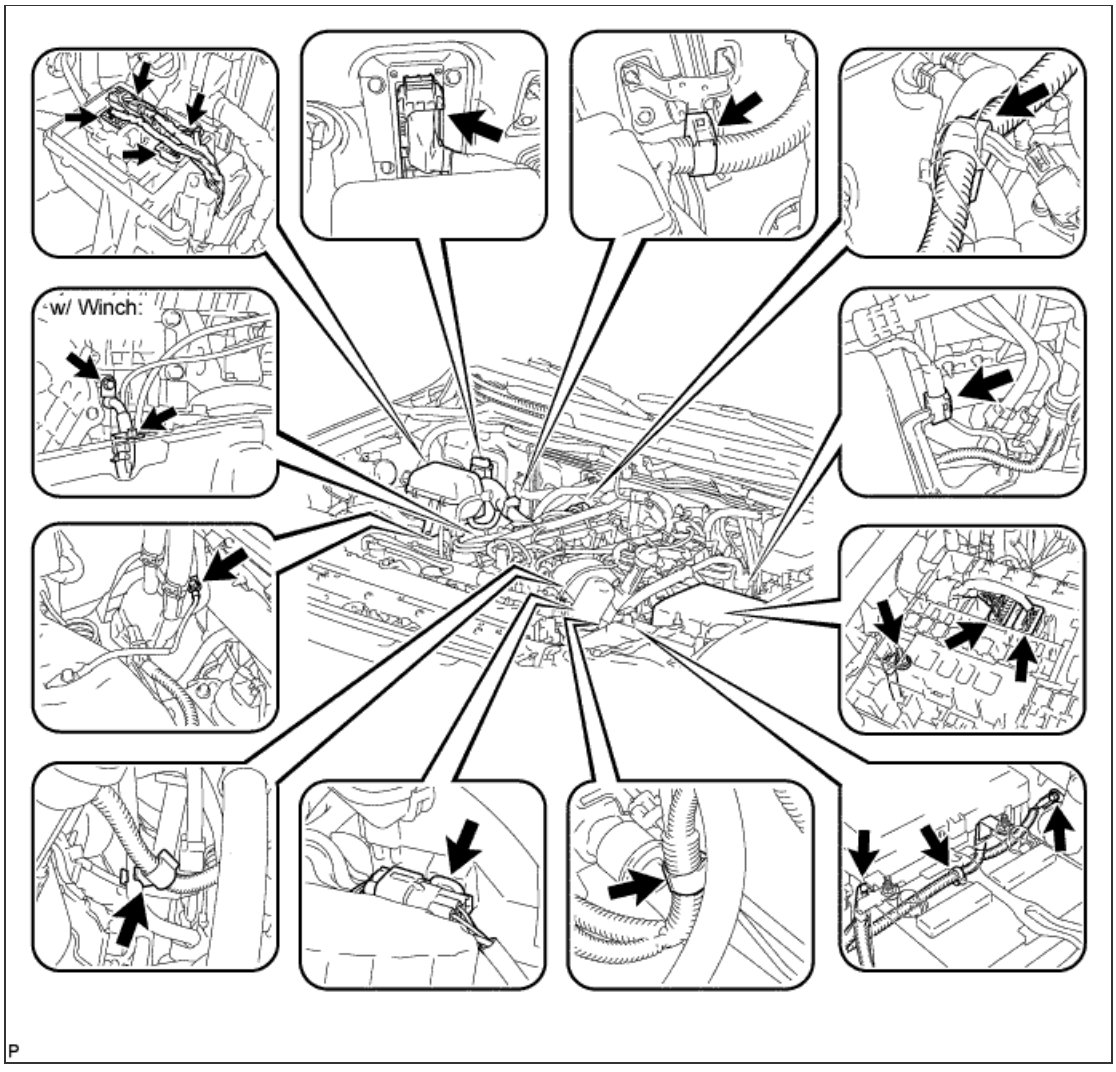


p. Remove the 2 nuts.

q. Using an 8 mm hexagon wrench, remove the 4 bolts. Then remove the intake air surge tank and gasket.



12. DISCONNECT ENGINE WIRE



a. Disconnect the ECM connector.

b. Remove the junction block cover.

c. Disconnect the 4 connectors fr the junction block.

d. Using a clip remover, detach the 2 wire harness clamps and wire harness.

e. Remove the bolt and ground cables.

f. Remove the engine room relay block cover.

g. Disconnect the 2 connectors fr the engine room relay block.

h. Remove the nut fr the engine room relay block, and disconnect the No. 2 engine wire cover.

i. Detach the wire harness fr the clamp.

j. Disconnect the connector, and using a clip remover, detach the engine wire to wire connector clamp fr the engine room relay block.

k. Detach the wire harness fr the body.

l. Detach the wire harness clamp fr the hose.

m. off the battery positive cable cover, and then remove the nut and battery positive cable.

n. Remove the bolt and ground cable and detach the wire harness clamp.

o. w/ Winch:
Remove the 2 bolts and winch ground wire.

13. REMOVE FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Disconnect the heated oxygen sensor connector.

b. Remove the 2 nuts and fr t exhaust pipe.

c. Remove the gasket fr the fr t exhaust pipe.

14. REMOVE FRONT EXHAUST PIPE ASSEMBLY

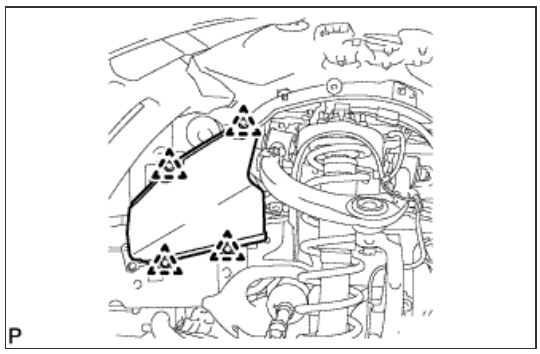
a. Disconnect the heated oxygen sensor connector.

b. Remove the 2 nuts and fr t exhaust pipe.

c. Remove the gasket fr the fr t exhaust pipe.

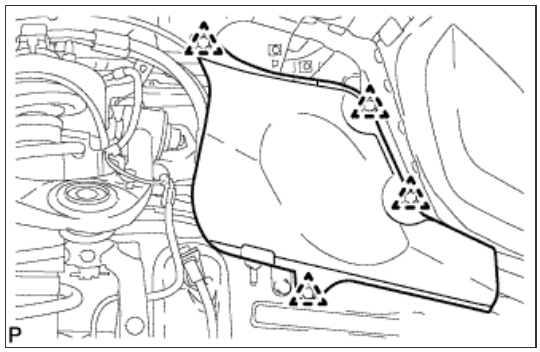
15. REMOVE FRONT FENDER APRON SEAL LH

a. Using a clip remover, remove the 4 clips and fender apron seal.



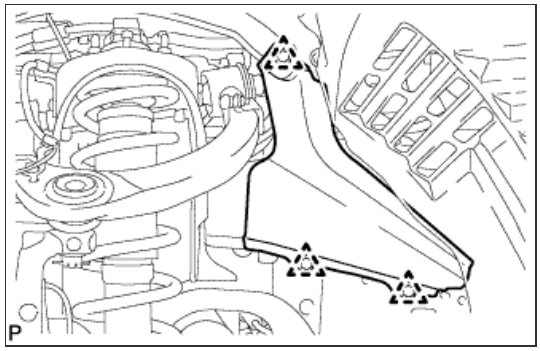
16. REMOVE FRONT FENDER APRON SEAL REAR LH

a. Using a clip remover, remove the 4 clips and fender apron seal.



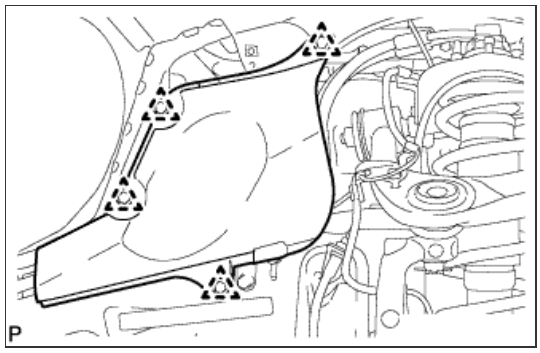
17. REMOVE FRONT FENDER APRON SEAL FRONT RH

a. Using a clip remover, remove the 3 clips and fender apron seal.



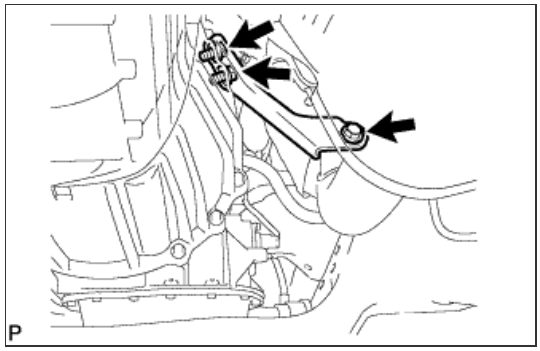
18. REMOVE FRONT FENDER APRON SEAL REAR RH

a. Using a clip remover, remove the 4 clips and fender apron seal.



19. REMOVE MANIFOLD STAY

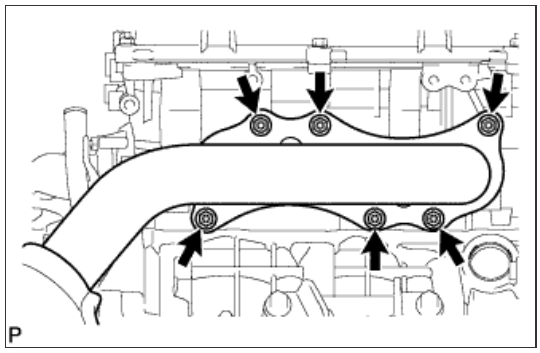
a. Remove the 3 bolts and No. 1 manif stay.



20. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY RH

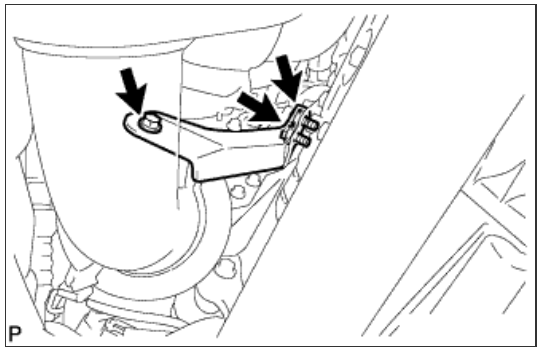
a. Disconnect the air f el ratio sensor connector.

b. Remove the 6 nuts, exhaust manif and gasket fr the cylinder head RH.



21. REMOVE NO. 2 MANIFOLD STAY

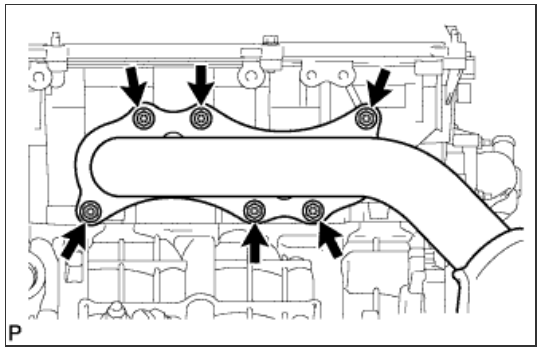
a. Remove the 3 bolts and No. 2 manif stay.



22. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY LH

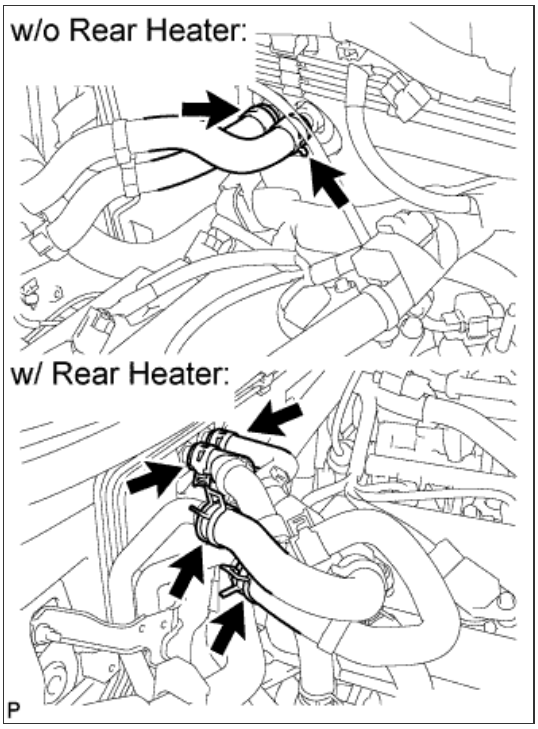
a. Disconnect the air f el ratio sensor connector.

b. Remove the 6 nuts, exhaust manif and gasket fr the cylinder head LH.



23. DISCONNECT WATER HOSE SUB-ASSEMBLY

a. Disconnect the water hoses.



24. DISCONNECT VANE PUMP ASSEMBLY

a. Disconnect the power steering oil pressure switch connector.

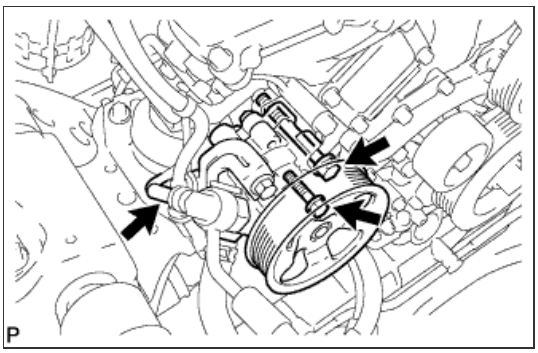
b. Remove the 2 bolts, and disconnect the vane pump.

NOTICE:

Do not hit other parts with the pulley when disconnecting the vane pump.

HINT:

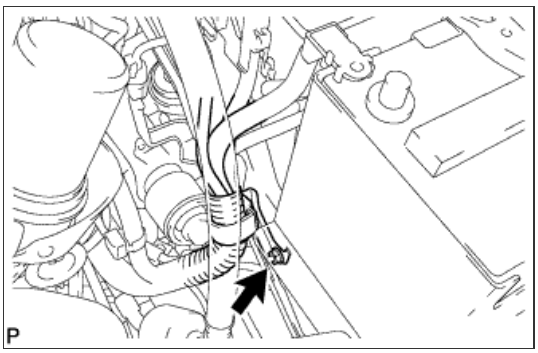
Make sure to suspend the vane pump securely.



25. REMOVE BATTERY

26. REMOVE GENERATOR ASSEMBLY

a. Remove the nut and disconnect the wire harness clamp bracket.



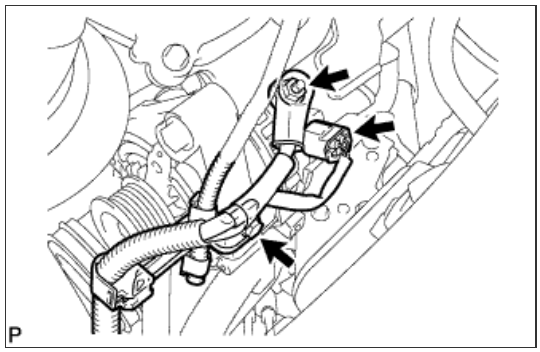
b. Disconnect the generator connector.

c. Remove the terminal cap.

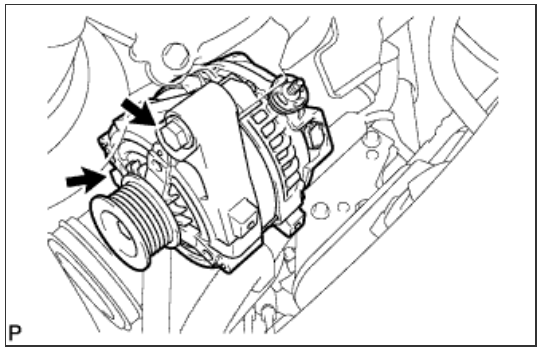
d. Remove the nut and disconnect the generator wire.

e. Remove the wire harness clamp.

f. Remove the bolt and disconnect the wire harness clamp bracket.



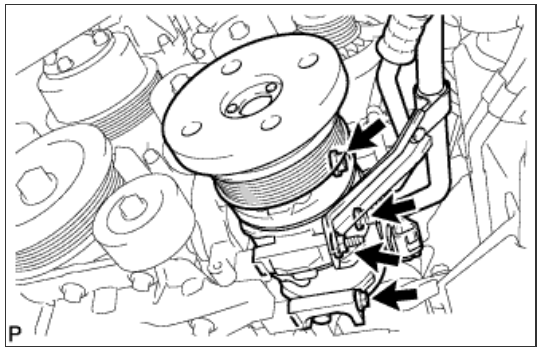
g. Remove the 2 bolts and generator.



27. DISCONNECT COOLER COMPRESSOR ASSEMBLY

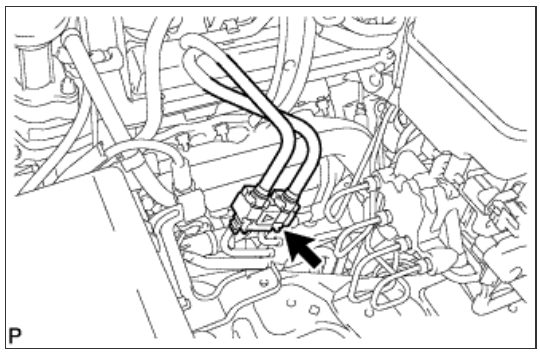
a. Disconnect the cooler compressor connector.

b. Remove the nut, 3 bolts and stud bolt, and disconnect the cooler compressor.



28. DISCONNECT NO. 1 AND NO. 2 FUEL PIPES

a. Disconnect the No. 1 and No. 2 f el pipe.

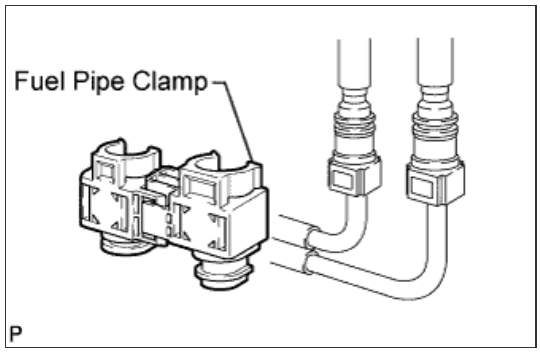


i. Remove the f el pipe clamp fr the f el tube connector.

HINT:

Check f dirt or mud on the pipe and around the connector bef e

disconnecting it. Clean if necessary.



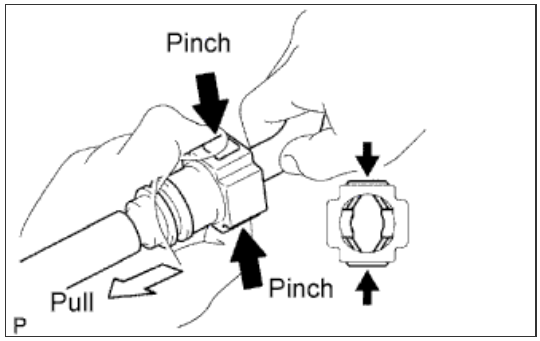
ii. inch the connector and disconnect the connector and pipe.

HINT:

If the connector and the pipe are stuck together, pinch the connector, push and pull the pipe to disconnect the pipe and pull it out.

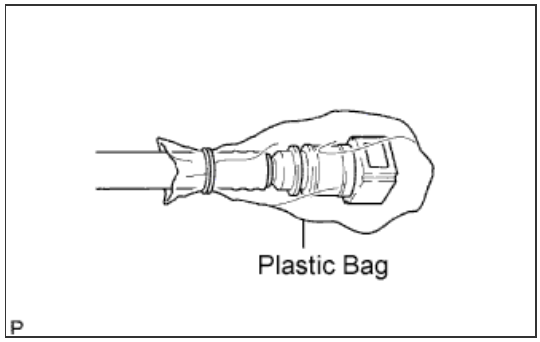
NOTICE:

Do not use any tools.



iii. Check f dirt or mud on the seal surface of the disconnected pipe. Clean if necessary.

iv. To protect the disconnected pipe and connector fr damage and contamination, cover it with a plastic bag.



29. REMOVE MANUAL TRANSMISSION ASSEMBLY (for Manual Transmission)

a. Remove the manual transmission fr the vehicle (Click here).

30. REMOVE AUTOMATIC TRANSMISSION ASSEMBLY (for Automatic Transmission)

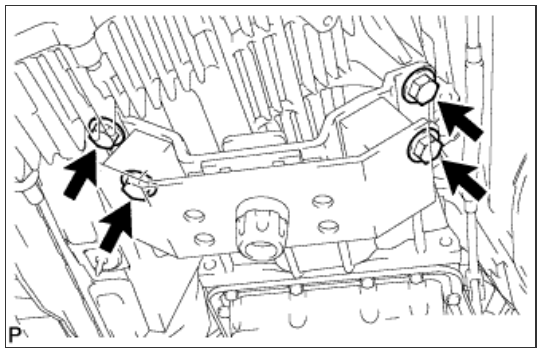
a. Remove the automatic transmission fr the vehicle (Click here).

31. REMOVE REAR NO. 1 ENGINE MOUNTING INSULATOR

HINT:

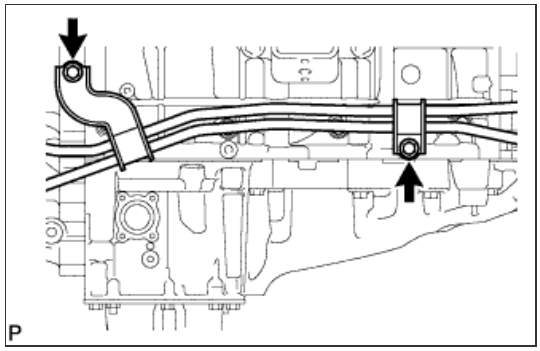
Only perf r this procedure when replacement of the engine mounting insulator is necessary.

a. Remove the 4 bolts and rear engine mounting insulator fr the transmission.



32. DISCONNECT NO. 1 OIL COOLER HOSE TUBE SUB-ASSEMBLY (for Automatic Transmission)

a. Remove the 2 bolts and cooler hose tube.



33. REMOVE CLUTCH COVER ASSEMBLY (for Manual Transmission)

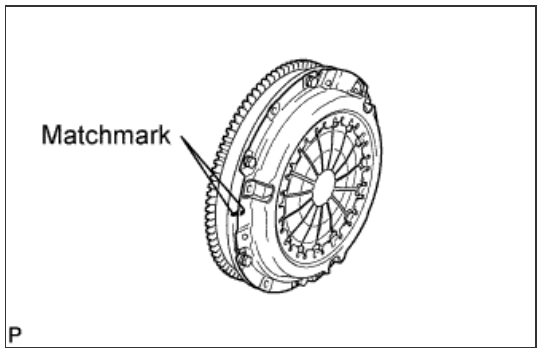
a. t matchmarks on the clutch cover and f eeh

b. Loosen each set bolt one turn at a time until spring tension is released.

c. Remove the 6 set bolts, and pull off the clutch cover.

NOTICE:

Do not drop the clutch disc.



34. REMOVE CLUTCH DISC ASSEMBLY (for Manual Transmission)

NOTICE:

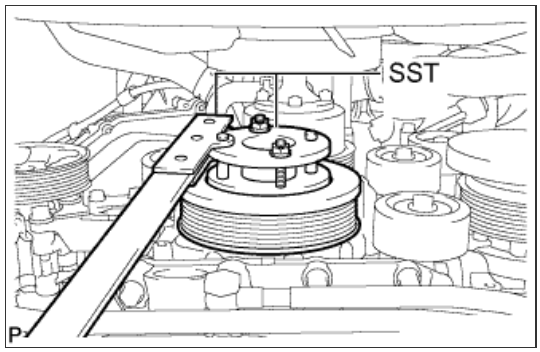
Keep the lining part of the clutch disc, pressure plate and surface of the flywheel away from oil and foreign matter.

35. REMOVE FLYWHEEL SUB-ASSEMBLY (for Manual Transmission)

a. Using SST, hold the crankshaft.

SST

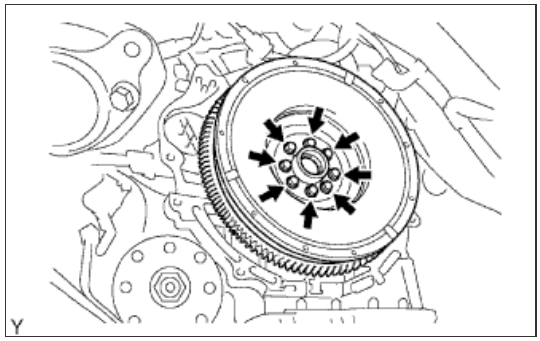
09213-54015 (91651-60855)
09330-00021



b. Remove the 8 bolts and flywheel.

NOTICE:

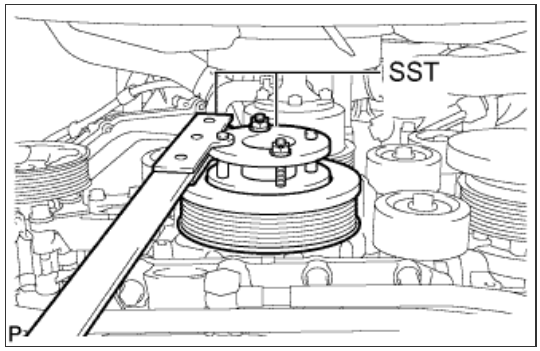
Do not reuse the bolts.



36. REMOVE DRIVE PLATE AND RING GEAR SUB-ASSEMBLY (for Automatic Transmission)

a. Using SST, hold the crankshaft.

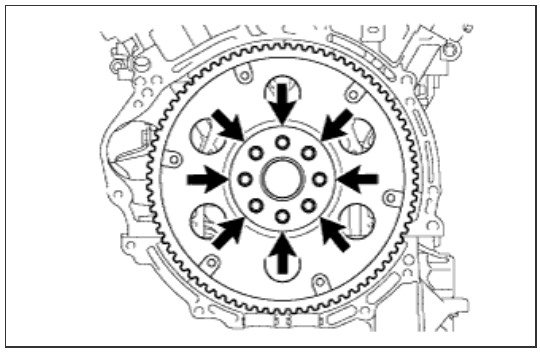
SST
09213-54015 (91651-60855)
09330-00021



b. Remove the 8 bolts, rear spacer, drive plate and front spacer.

NOTICE:

Do not reuse the bolts.



37. REMOVE ENGINE ASSEMBLY

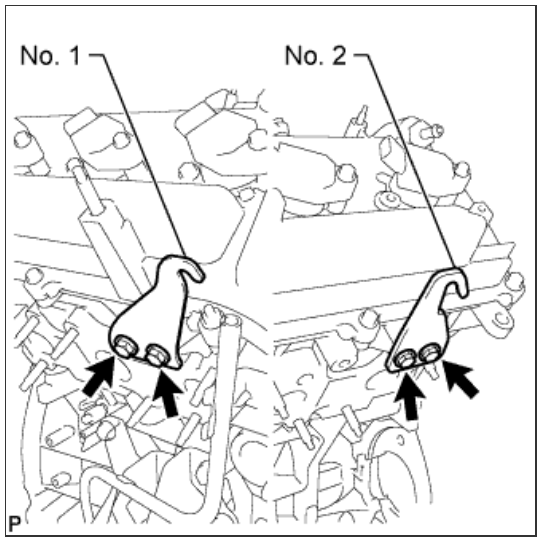
a. Install 2 engine hangers with 4 bolts as shown in the illustration.

Part No.

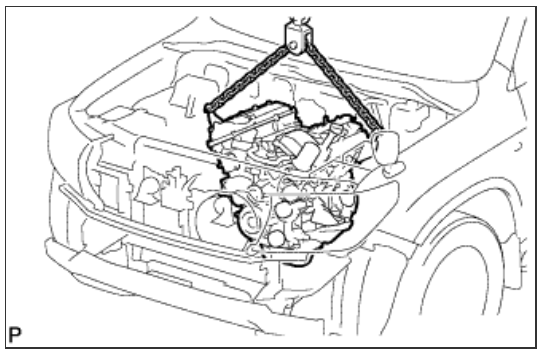
Item	art No.
No. 1 engine hanger	12281
o. 2 engine hanger	12282

Bolt		11	A87

Torque:
33 N*m{ 336 kgf*cm , 24 ft.*lbf }



b. Attach an engine sling device and hang a engine with a chain block.



c. Remove the 2 nuts and 4 bolts from the front engine mounting insulator LH and RH.

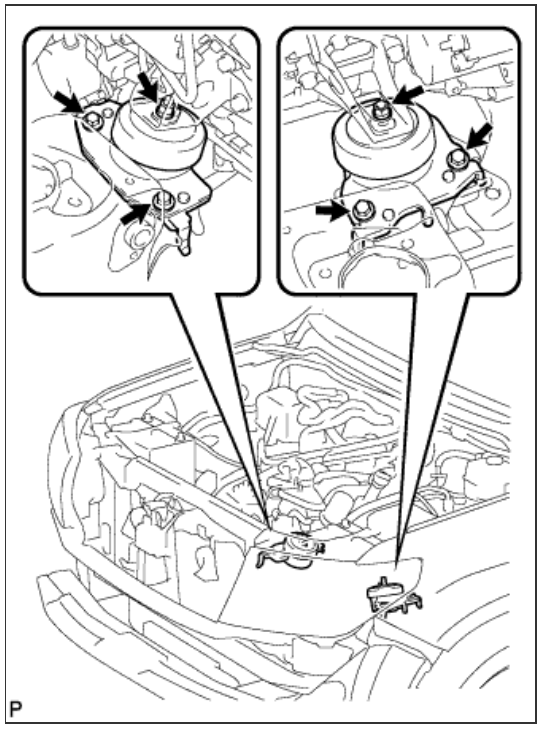
d. Lift the engine out of the vehicle carefully.

NOTICE:

Make sure the engine is clear of all wiring and hoses.

e. Remove the front engine mounting insulator LH and RH.

f. lace the engine onto a working bench.

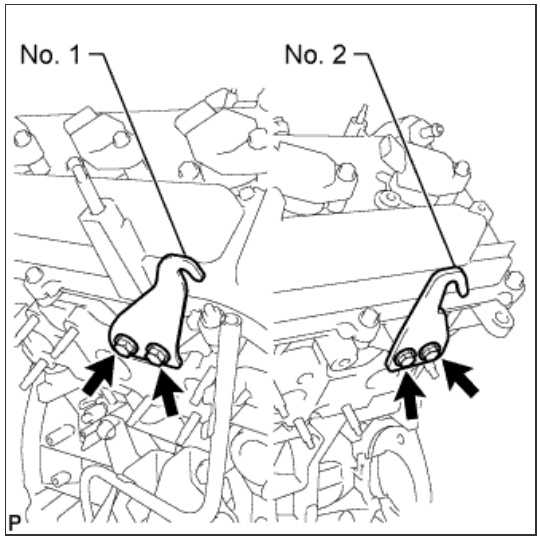


38. INSTALL ENGINE STAND

a. Install the engine onto an engine stand with bolts.

39. REMOVE ENGINE HANGER

a. Remove the 4 bolts and 2 engine hangers.



for Preparation Click here

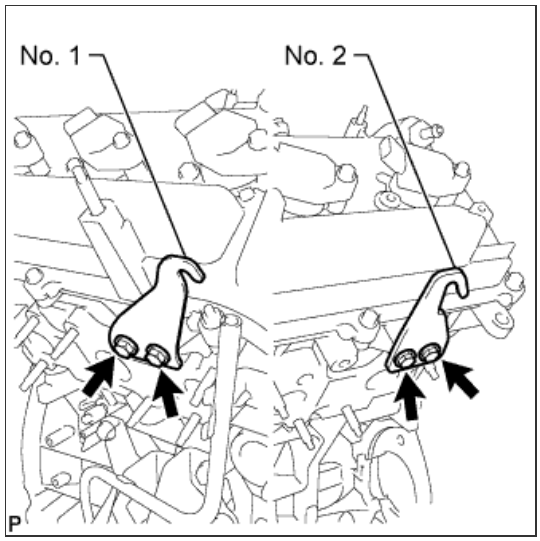
1. INSTALL ENGINE HANGER

a. Install 2 engine hangers with 4 bolts as shown in the illustration.

Part No.

Item	Part No.
No. 1 engine hanger	12281-31070
No. 2 engine hanger	12282-31050
Bolt	90119-08A87

Torque:
33 N*m{ 336 kgf*cm , 24 ft.*lbf }



2. REMOVE ENGINE STAND

a. Attach an engine sling device and hang the engine with a chain block.

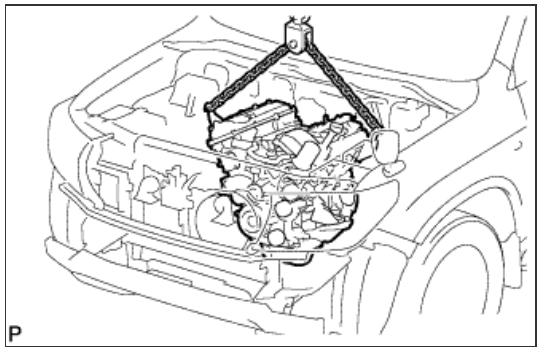
b. Lift the engine, and remove it from the engine stand.

c. Place the engine onto a work bench.

3. INSTALL ENGINE ASSEMBLY

a. Attach an engine sling device and hang the engine with a chain block.

b. Slowly lower the engine into the engine compartment.



c. Install the front engine mounting insulator LH with the 2 bolts and nut.

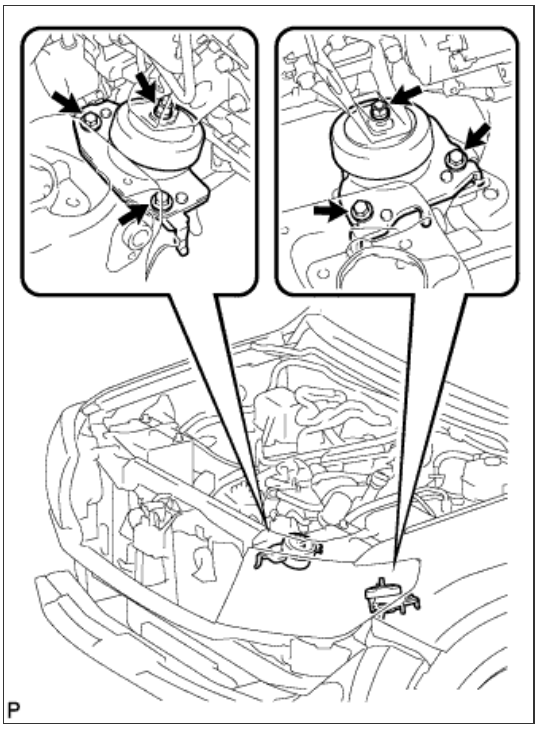
Torque:
for bolt:
79 N*m{ 806 kgf*cm , 58 ft.*lbf }
for nut:
72 N*m{ 734 kgf*cm , 53 ft.*lbf }

d. Install the front engine mounting insulator RH with the 2 bolts and nut.

Torque:
for bolt:

79 N*m{ 806 kgf*cm , 58 ft.*lbf }
for nut:
72 N*m{ 734 kgf*cm , 53 ft.*lbf }

e. Remove the 2 engine hangers and 4 bolts.

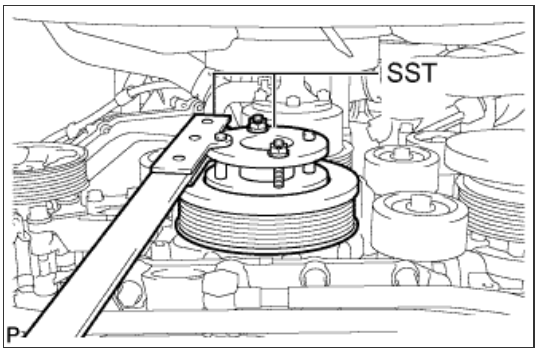


4. INSTALL DRIVE PLATE AND RING GEAR SUB-ASSEMBLY (for Automatic Transmission)

a. Using SST, hold the crankshaft.

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b. Temporarily install the front spacer, drive plate and rear spacer with the 8 bolts.

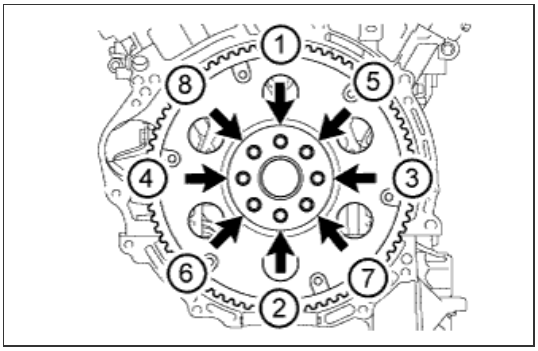


c. Tighten the 8 bolts uniformly in several steps in the order shown in the illustration.

Torque:
83 N*m{ 846 kgf*cm , 61 ft.*lbf }

NOTICE:

Do not start the engine for at least 1 hour after installing.

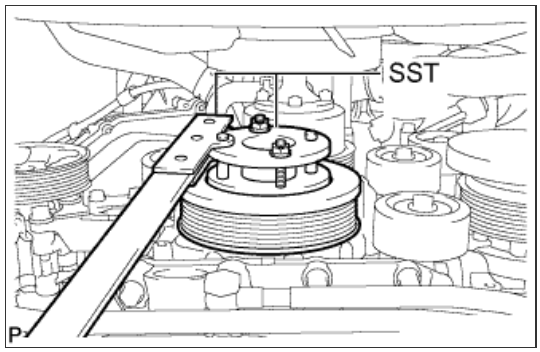


5. INSTALL FLYWHEEL SUB-ASSEMBLY (for Manual Transmission)

a. Using SST, hold the crankshaft.

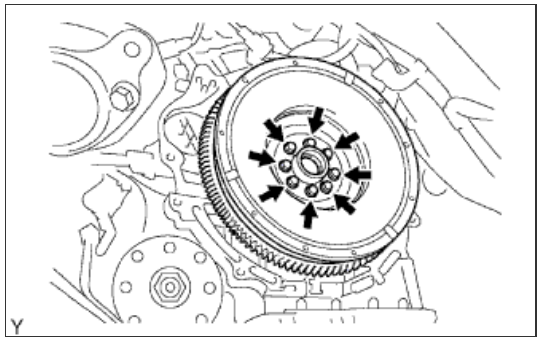
SST
09213-54015 (91651-60855)
09330-00021

b. Temporarily install the flywheel with the 8 bolts.



c. Install and tighten the 8 mounting bolts uniformly in several steps.

Torque:
83 N*m{ 846 kgf*cm , 61 ft.*lbf }



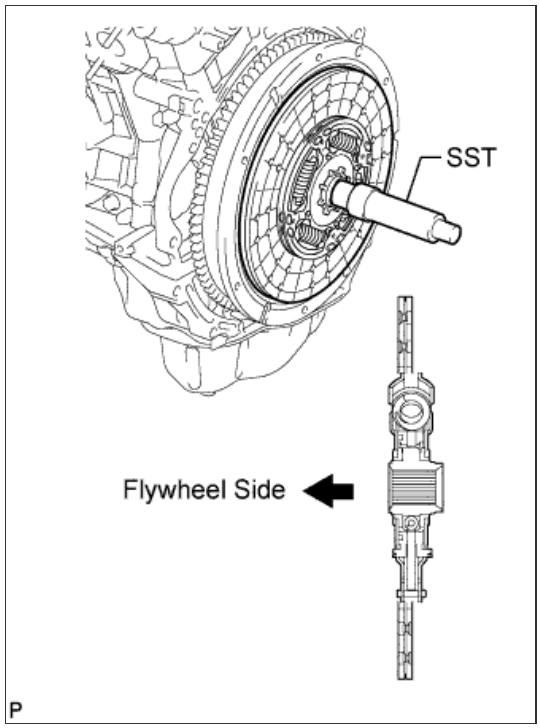
6. INSTALL CLUTCH DISC ASSEMBLY (for Manual Transmission)

a. Insert SST into the clutch disc, then insert the clutch disc into the flywheel.

SST
09301-00110

NOTICE:

Take care not to insert the clutch disc in the wrong direction.



7. INSTALL CLUTCH COVER ASSEMBLY (for Manual Transmission)

a. Align the matchmark on the clutch cover with the one on the flywheel.

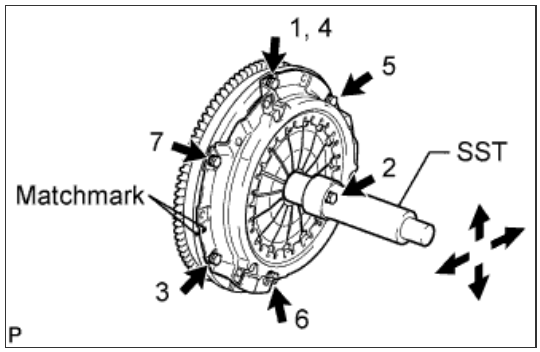
b. In the order shown in the illustration, temporarily install the 6 bolts starting from the bolt located near the knock pin on the top.

c. Check that the disc is in the center by lightly moving SST up and down, and left and right.

SST
09301-00110

d. Evenly tighten the bolts by following the order shown in the illustration.

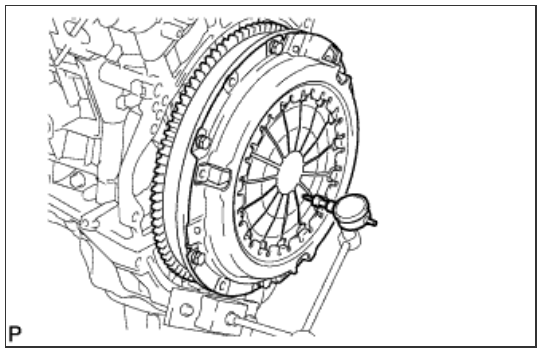
Torque:
19 N*m{ 195 kgf*cm , 14 ft.*lbf }



8. INSPECT AND ADJUST CLUTCH COVER ASSEMBLY (for Manual Transmission)

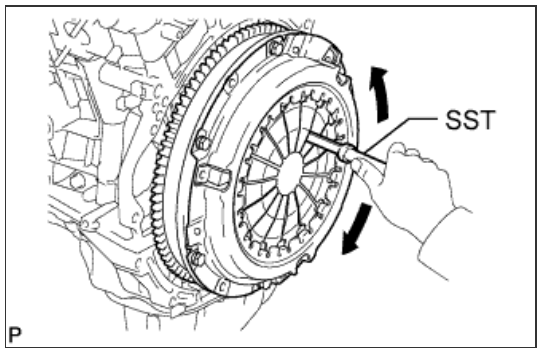
a. Using a dial indicator with a roller instrument, check the diaphragm spring tip alignment.

Maximum Misalignment:
1.3 mm (0.0512 in.)



b. If the alignment is not as specified, adjust the diaphragm spring tip alignment using SST.

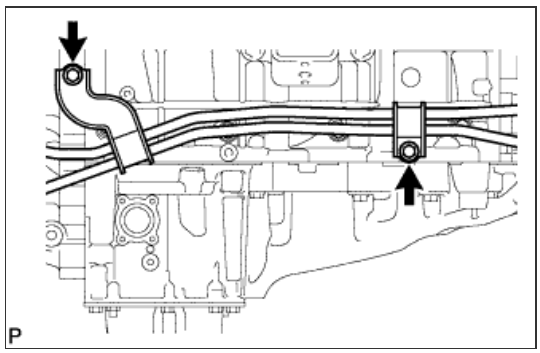
SST
09333-00013



9. CONNECT NO. 1 OIL COOLER HOSE TUBE SUB-ASSEMBLY

a. Connect the cooler hose tube with the 2 bolts.

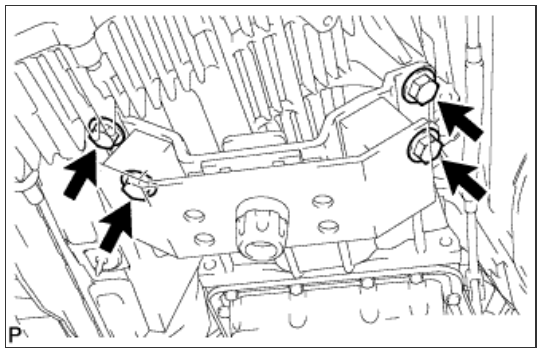
Torque:
14 N*m{ 143 kgf*cm , 10 ft.*lbf }



10. INSTALL REAR NO. 1 ENGINE MOUNTING INSULATOR

a. Install the rear engine mounting insulator to the transmission with the 4 bolts.

Torque:
59 N*m{ 602 kgf*cm , 44 ft.*lbf }



11. INSTALL MANUAL TRANSMISSION ASSEMBLY (for Manual Transmission)

a. Install the manual transmission to the vehicle (Click here).

12. INSTALL AUTOMATIC TRANSMISSION ASSEMBLY (for Automatic Transmission)

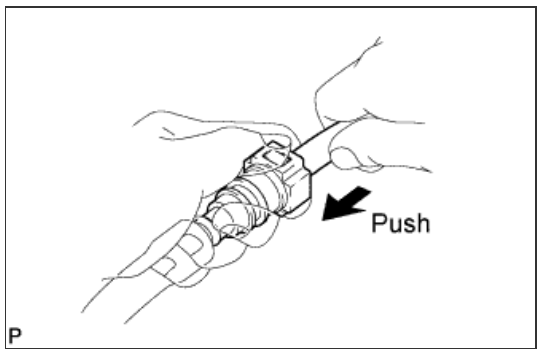
a. Install the automatic transmission to the vehicle (Click here).

13. CONNECT NO. 1 AND NO. 2 FUEL PIPE

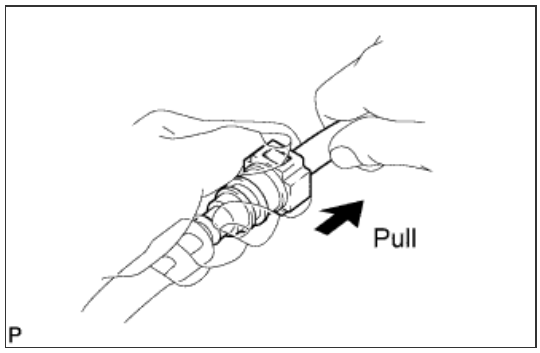
a. Connect the No. 1 and No. 2 fuel pipe.

i. Check that there is no damage or contamination in the connector part of the pipe.

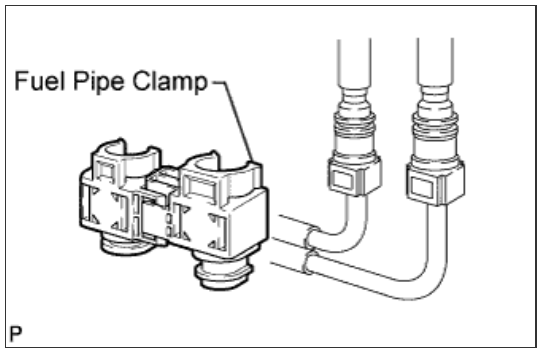
ii. Align the axis of the connector with the axis of the pipe. Push the pipe into the connector until the connector makes a "click" sound. If the connection is tight, apply a small amount of fresh engine oil on the tip of the pipe.



iii. After having finished the connection, try to pull apart the pipe and the connector and confirm that they are securely connected.



b. Install the fuel pipe clamp to the connector.



14. CONNECT COOLER COMPRESSOR ASSEMBLY

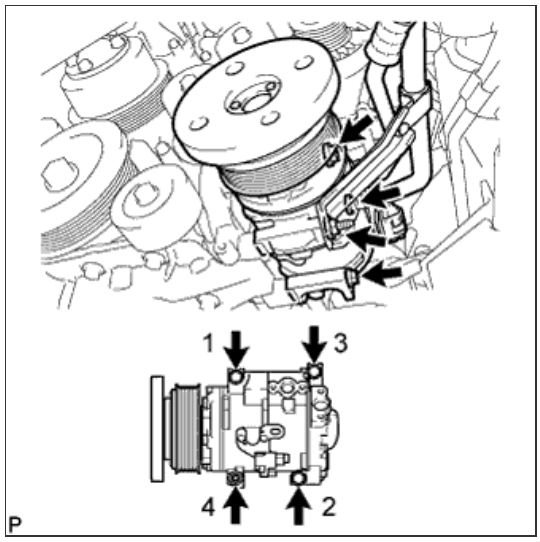
a. Fix the cooler compressor in place with the stud bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Install the cooler compressor with the nut and 3 bolts in several steps in the sequence shown in the illustration.

Torque:
24 N*m{ 250 kgf*cm , 18 ft.*lbf }

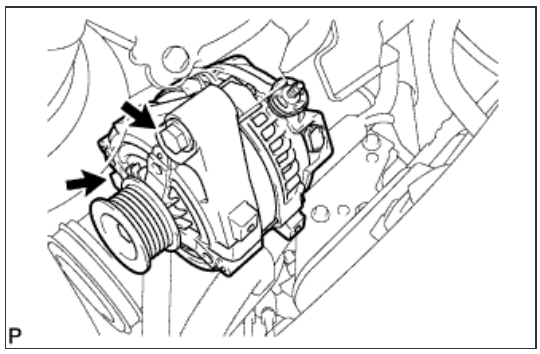
c. Connect the cooler compressor connector.



15. INSTALL GENERATOR ASSEMBLY

a. Install the generator with the 2 bolts.

Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }



b. Connect the wire harness clamp bracket with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

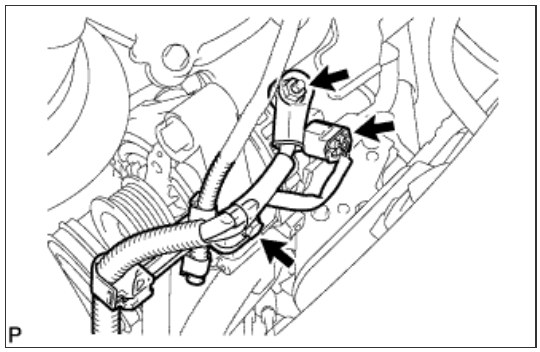
c. Install the wire harness clamp to the bracket.

d. Connect the generator wire with the nut.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }

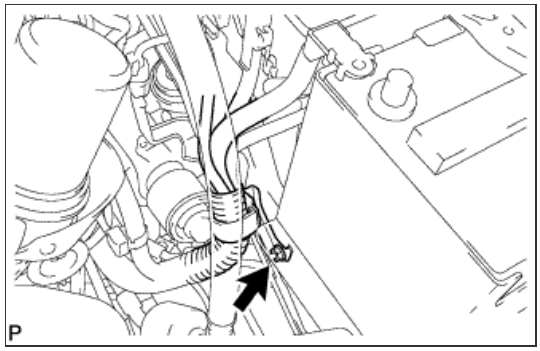
e. Install the terminal cap.

f. Connect the generator connector.



g. Connect the wire harness clamp bracket with the nut.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }



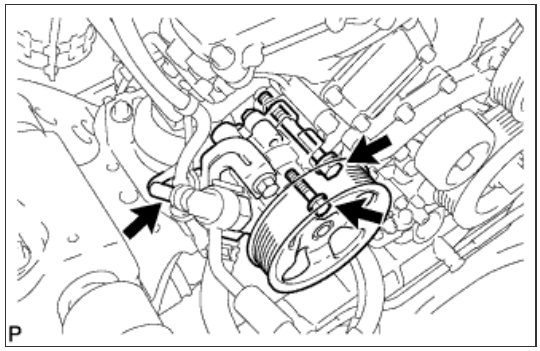
16. INSTALL BATTERY

17. CONNECT VANE PUMP ASSEMBLY

a. Connect the vane pump with the 2 bolts.

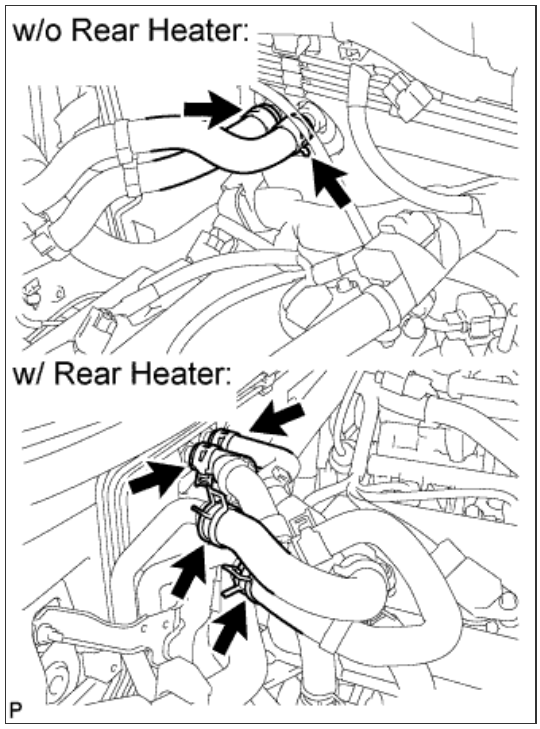
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

b. Connect the power steering oil pressure switch connector.



18. CONNECT WATER HOSE SUB-ASSEMBLY

a. Connect the water hoses.

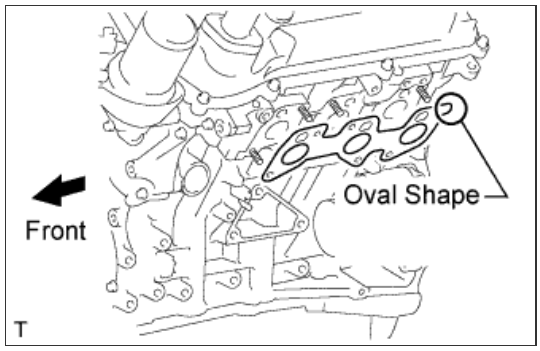


19. INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY LH

a. Set a new gasket to the cylinder head LH with the oval shape facing rearward.

NOTICE:

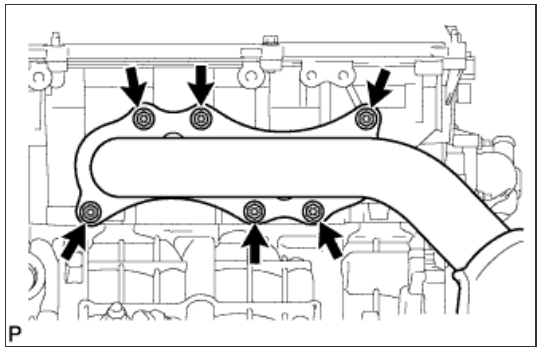
Be careful of the installation direction.



b. Install the exhaust manifold with 6 new nuts.

Torque:
30 N*m{ 306 kgf*cm , 22 ft.*lbf }

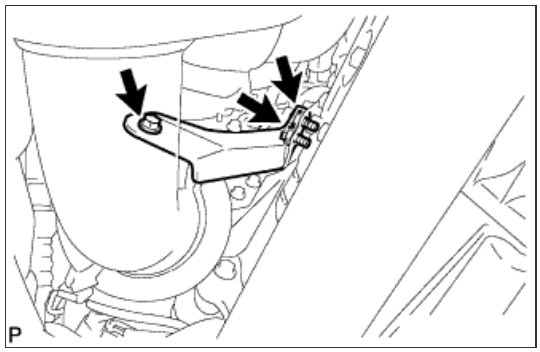
c. Connect the air fuel ratio sensor connector.



20. INSTALL NO. 2 MANIFOLD STAY

a. Install the No. 2 manifold stay with the 3 bolts.

Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

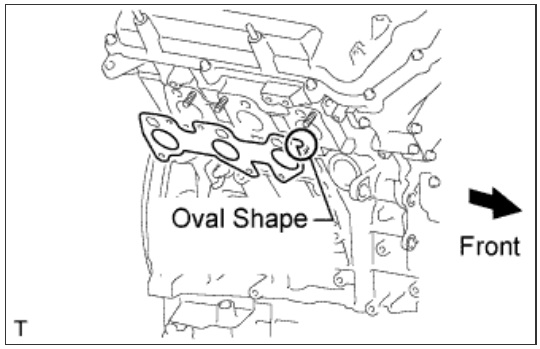


21. INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY RH

a. Set a new gasket to the cylinder head RH with the oval shape facing forward.

NOTICE:

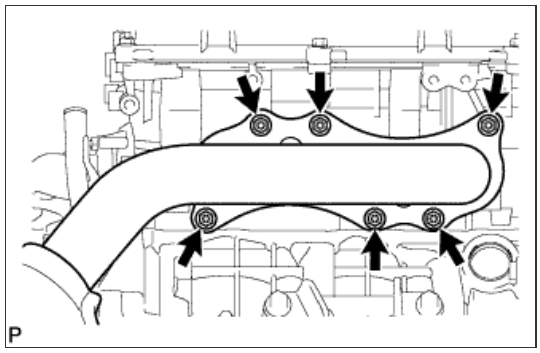
Be careful of the installation direction.



b. Install the exhaust manifold with 6 new nuts.

Torque:
30 N*m{ 306 kgf*cm , 22 ft.*lbf }

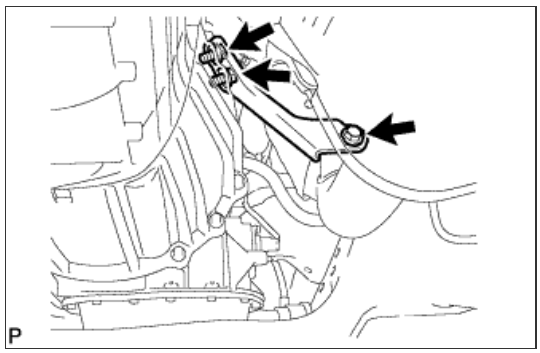
c. Connect the air fuel ratio sensor connector.



22. INSTALL MANIFOLD STAY

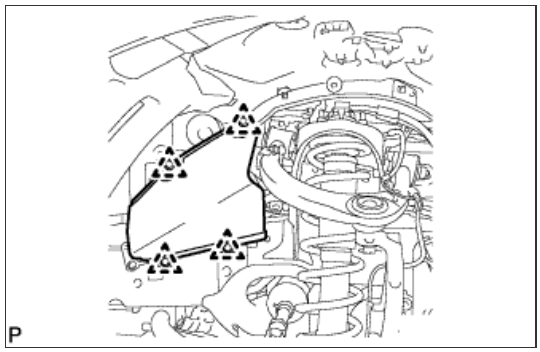
a. Install the No. 1 manifold stay with the 3 bolts.

Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }



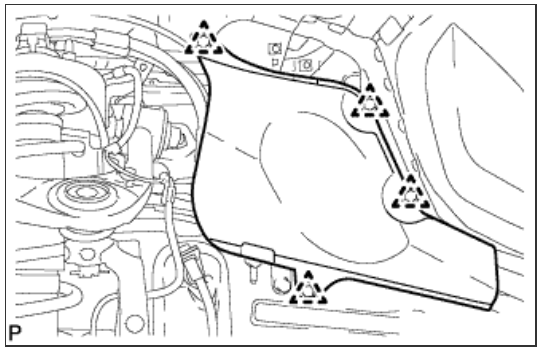
23. INSTALL FRONT FENDER APRON SEAL LH

a. Install the fender apron seal with the 4 clips.



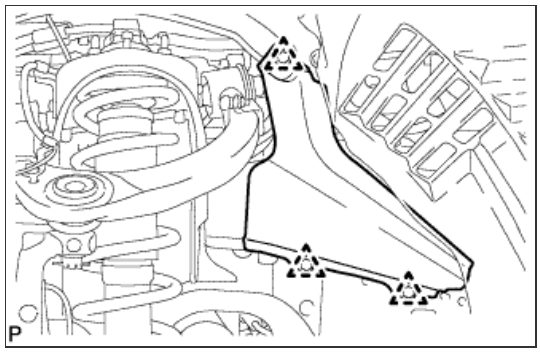
24. INSTALL FRONT FENDER APRON SEAL REAR LH

a. Install the fender apron seal with the 4 clips.



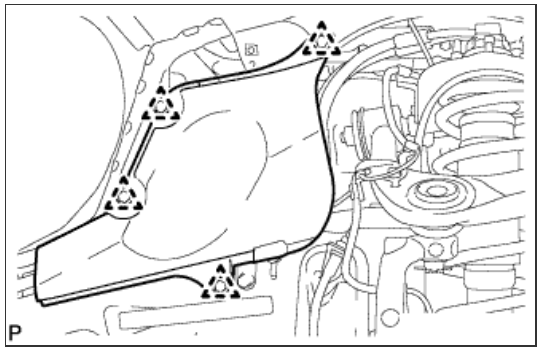
25. INSTALL FRONT FENDER APRON SEAL FRONT RH

a. Install the fender apron seal with the 3 clips.



26. INSTALL FRONT FENDER APRON SEAL REAR RH

a. Install the fender apron seal with the 4 clips.



27. INSTALL FRONT EXHAUST PIPE ASSEMBLY

a. Install a new gasket and the front exhaust pipe to the exhaust manifold RH with 2 new nuts.

Torque:
54 N*m{ 554 kgf*cm , 40 ft.*lbf }

b. Connect the heated oxygen sensor connector.

28. INSTALL FRONT NO. 2 EXHAUST PIPE ASSEMBLY

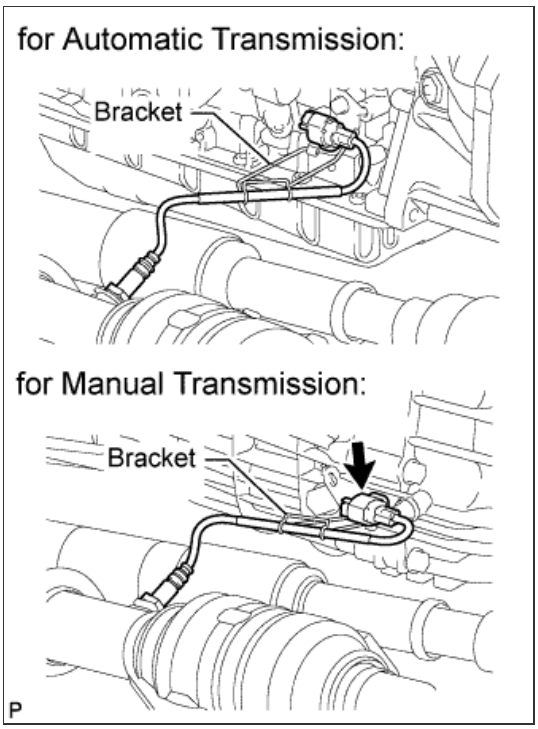
a. Install a new gasket and the front No. 2 exhaust pipe to the exhaust manifold LH with 2 new nuts.

Torque:
54 N*m{ 554 kgf*cm , 40 ft.*lbf }

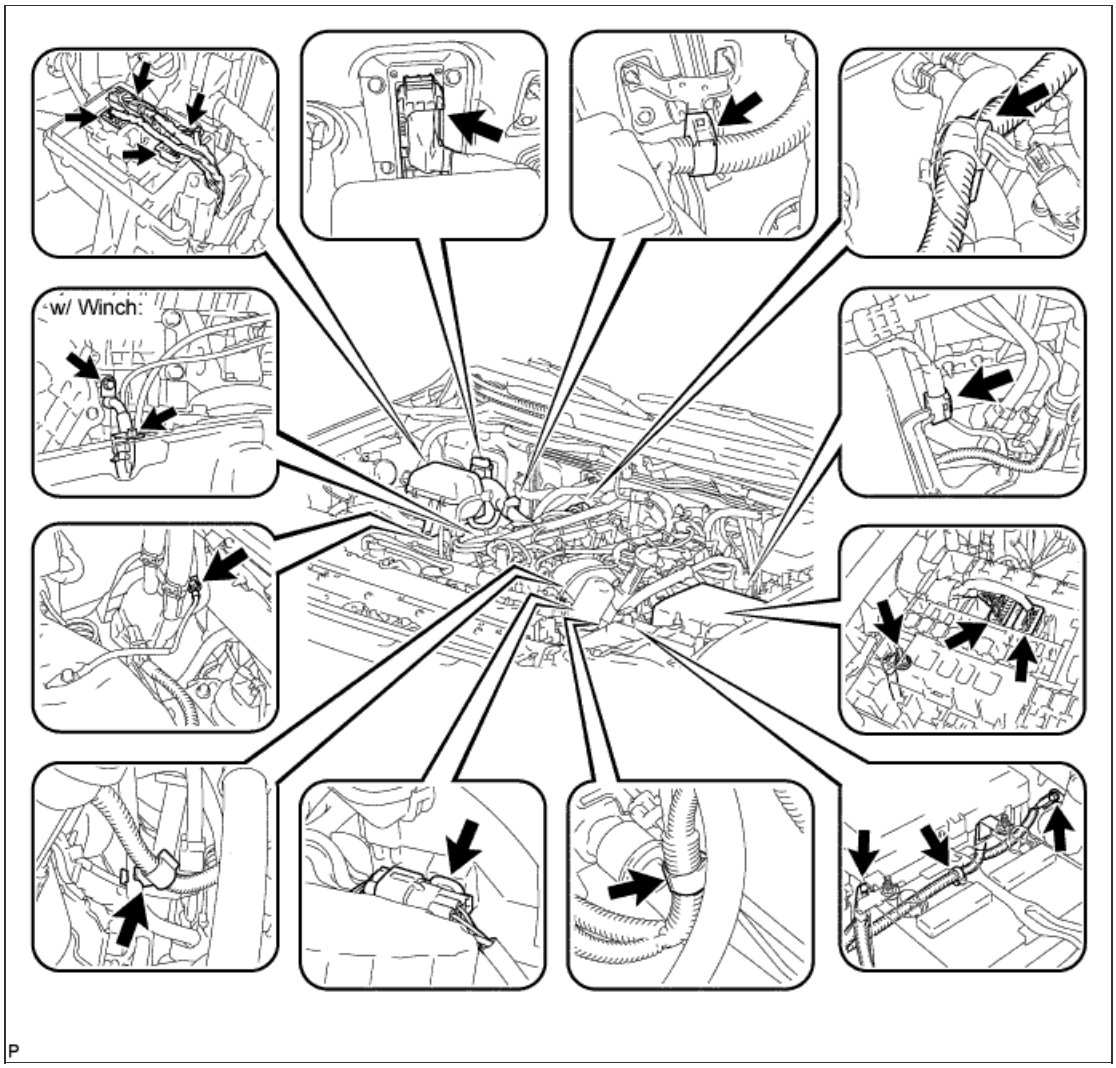
b. Connect the heated oxygen sensor connector.

HINT:

Hook the wire harness to the bracket.



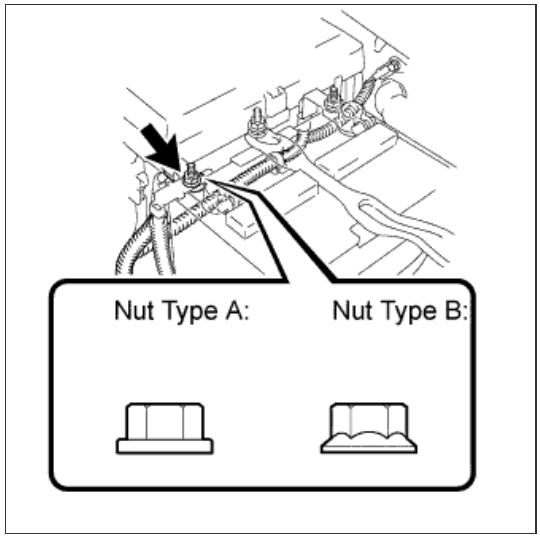
29. CONNECT ENGINE WIRE



a. Install the ground cable with the bolt and attach the wire harness clamp.

Torque:
8.4 N*m{ 86 kgf*cm , 74 in.*lbf }

b. Install the battery positive cable with the nut.



Torque:
for nut type A:
13 N*m{ 130 kgf*cm , 9 ft.*lbf }
for nut type B:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

HINT:

The torque value differs depending on the shape of the nut that came with the vehicle.

c. Connect the battery positive cable cover.

d. Install the 2 ground cables with the 2 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

e. Attach the wire harness clamp to the hose.

f. Attach the wire harness clamp to the body.

g. Attach the engine wire to wire connector clamp to the engine room relay block side, and connect the connector.

h. Connect the wire harness with the clamp.

i. Connect the No. 2 engine wire cover to the engine room relay block, and install the No. 2 engine wire with the nut.

Torque:

10 N*m{ 102 kgf*cm , 7 ft.*lbf }

j. Connect the 2 connectors to the engine room relay block.

k. Attach the 2 wire harness clamps and wire harness.

l. Connect the 4 connectors to the junction block.

m. Connect the ECM connector.

n. w/ Winch:
Install the winch ground wire with the 2 bolts.

Torque:
Cylinder block side:
19 N*m{ 196 kgf*cm , 14 ft.*lbf }
Body side:
29 N*m{ 300 kgf*cm , 22 ft.*lbf }

30. INSTALL INTAKE AIR SURGE TANK

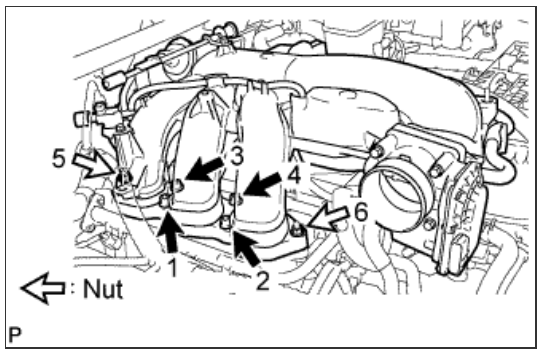
NOTICE:
Do not apply oil to the bolts and nuts listed below: :

Oil Application Prohibited Bolt/Nut
Bolt for surge tank and intake manifold
Nut for surge tank and intake manifold

a. Install a new gasket to the intake air surge tank.

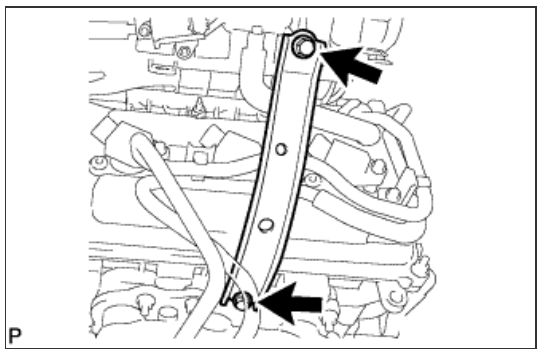
b. Using an 8 mm hexagon wrench, install the intake air surge tank with the 4 bolts and 2 nuts in the order shown in the illustration.

Torque:
28 N*m{ 286 kgf*cm , 21 ft.*lbf }



c. Install the No. 2 surge tank stay with the 2 bolts.

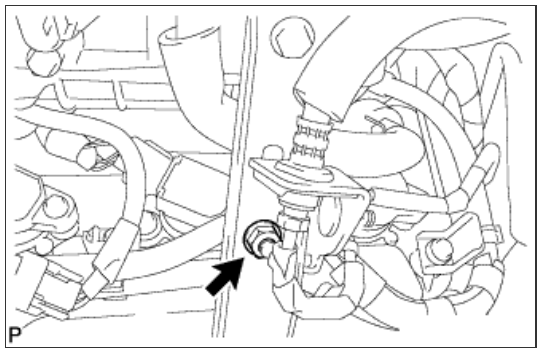
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



d. for Manual Transmission:

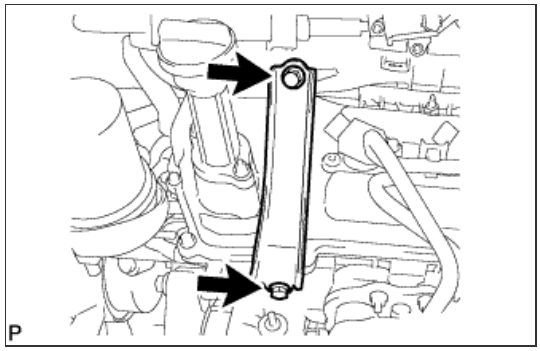
i. Install the bracket to the No. 2 surge tank stay with the nut.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }



e. Install the No. 1 surge tank stay with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

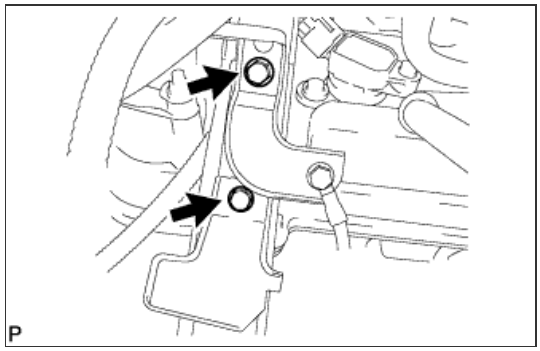


f. Install the oil baffle plate with the bolt.

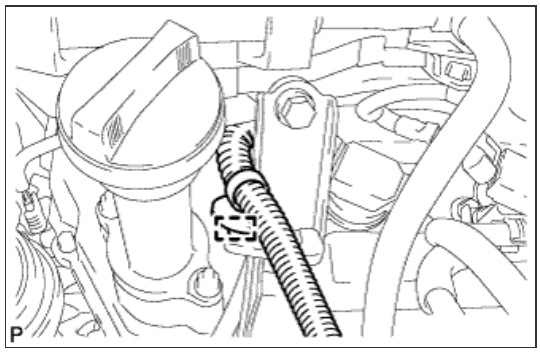
Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }

g. Install the bracket to the No. 1 surge tank stay with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

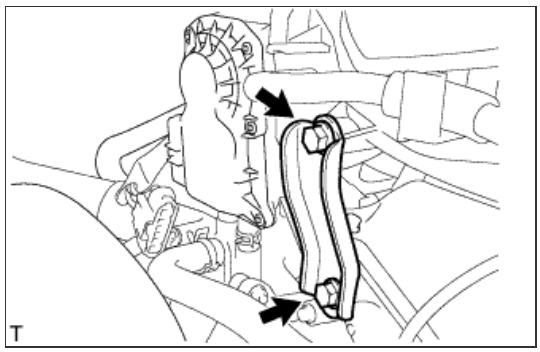


h. Attach the wire harness clamp.



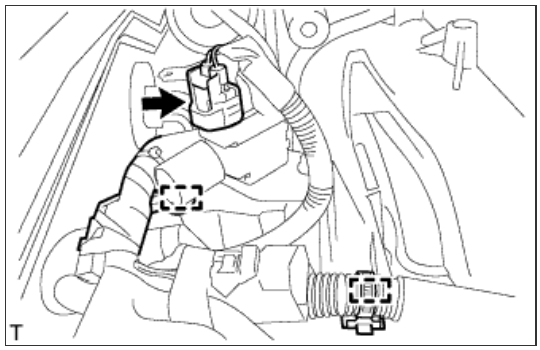
i. Install the throttle body bracket with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



j. Connect the vacuum switching valve (for ACIS) connector.

k. Attach the 2 wire harness clamps.



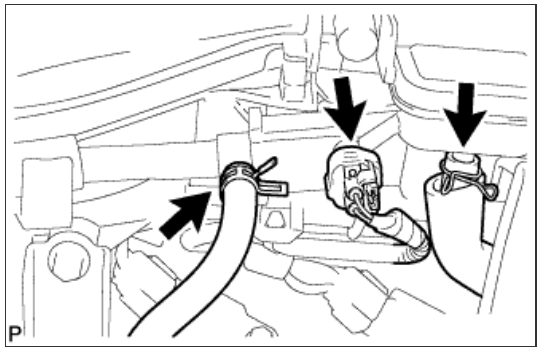
l. Connect the No. 1 ventilation hose.

m. Connect the purge VSV connector.

n. Connect the purge line hose.

HINT:

Connect the hose so that the direction of the hose clamp is as indicated in the illustration.

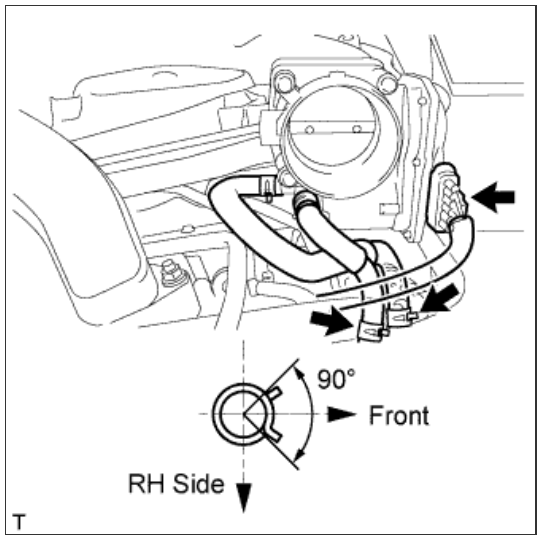


o. Connect the No. 4 and No. 5 water by-pass hose.

HINT:

Connect the hoses so that the direction of the hose clamps is as shown in the illustration.

p. Connect the throttle body connector.



31. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner assembly with the 2 bolts.

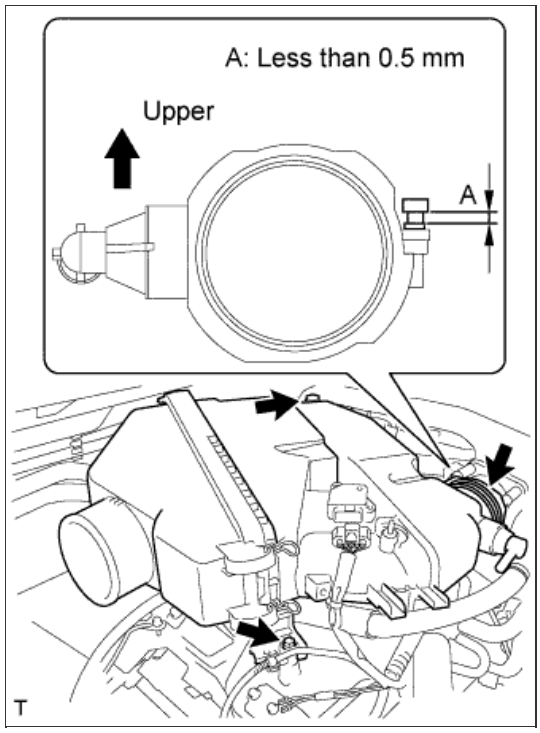
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

b. Tighten the hose clamp.

HINT:

Tighten the hose clamp until it reaches the specified protrusion height labeled A shown in the illustration.

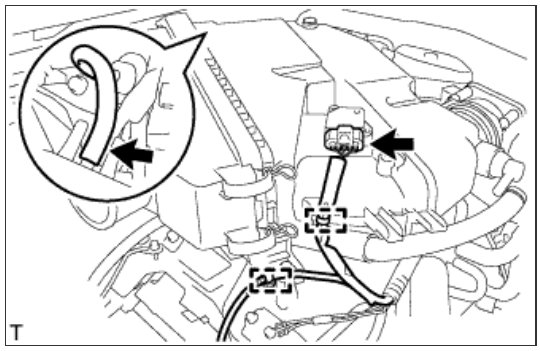
Standard protrusion height:
Less than 0.5 mm (0.0197 in.)



c. Connect the MAF meter connector.

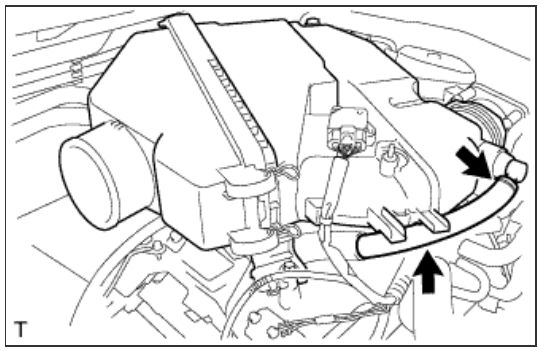
d. Attach the 2 wire harness clamps.

e. Connect the vacuum hose.



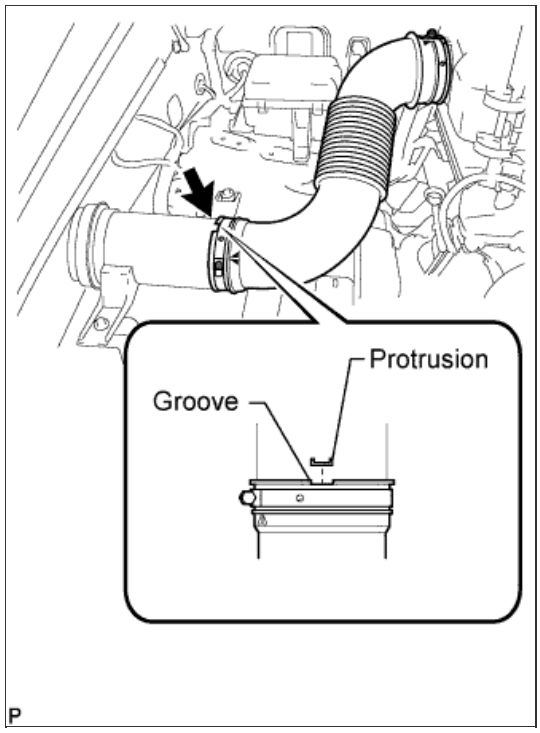
f. Attach the hose clamp.

g. Connect the No. 2 ventilation hose.



32. INSTALL NO. 2 AIR CLEANER HOSE

a. Align the protrusion of the pre-cleaner with the groove of the No. 2 air cleaner hose as shown in the illustration.

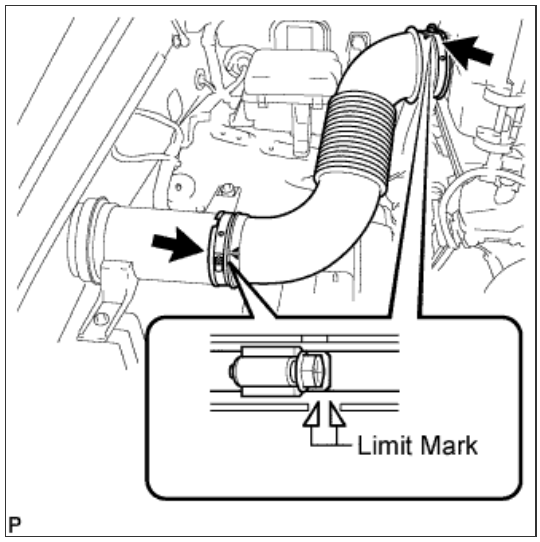


b. Tighten the 2 hose clamps.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }

HINT:

Tighten the clamp until the end of the clamp band is within both limit marks.



33. INSTALL RADIATOR ASSEMBLY

a. Install the radiator assembly (Click here).

34. INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Install the cowl top ventilator louver (Click here).

35. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

36. ADD ENGINE OIL

a. Remove the oil filler cap.

b. Add new oil.

Standard Oil Grade:

Oil Grade	Oil Viscosity (SAE)
API grade SL "Energy-Conserving", SM "Energy-Conserving", SN "Resource-Conserving" or ILSAC multigrade engine oil	5W-30 10W-30
API grade SL, SM or SN multigrade engine oil	15W-40 20W-50

Standard Oil Capacity:

Item	Specified Condition
Drain and refill with oil filter change	5.2 liters (5.5 US qts, 4.6 Imp. qts)
Drain and refill without oil filter change	4.9 liters (5.2 US qts, 4.3 Imp. qts)
Dry fill	6.0 liters (6.3 US qts, 5.3 Imp. qts)

c. Install the oil filler cap.

37. INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and intelligent tester on.

NOTICE:

Do not start the engine.

c. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the Fuel Pump Speed Control.

d. Check that there are no fuel leaks after doing maintenance anywhere on the fuel system.

38. INSPECT FOR OIL LEAK

39. INSPECT FOR EXHAUST GAS LEAK

If gas is leaking, tighten the areas necessary to stop the leak. Replace damaged parts as necessary.

40. CHECK ENGINE OIL LEVEL

a. Warm up the engine so that the coolant temperature is approximately 80°C (176°F). Check the engine oil level dipstick 5 minutes after the engine is stopped. Then add engine oil to the full level of the engine oil level dipstick.

41. INSTALL NO. 2 ENGINE UNDER COVER

42. PERFORM RESET MEMORY (for Automatic Transmission)

a. Perform the Reset Memory procedures (Click here).

43. INSPECT IGNITION TIMING

NOTICE:

- **Turn all electrical systems off.**
- **Perform the inspection when the cooling fan motor is turned off.**

a. Warm up the engine.

b. When using the intelligent tester:

i. Connect the intelligent tester to the DLC3.

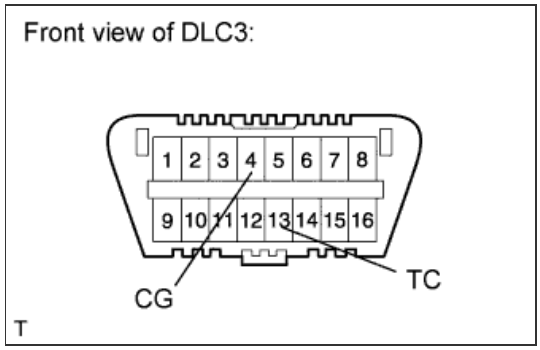
ii. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / IGN Advance.

iii. Inspect the ignition timing during idling.

Standard ignition timing:
8 to 12° BTDC @ idling (transmission in neutral position and A/C switch off)

iv. Check that the ignition timing advances immediately when the engine speed is increased.

c. When not using the intelligent tester:



i. Using SST, connect terminals 13 (TC) and 4 (CG) of the DLC3.

SST
09843-18040

NOTICE:

Be sure not to improperly connect the terminals. This may damage the engine.

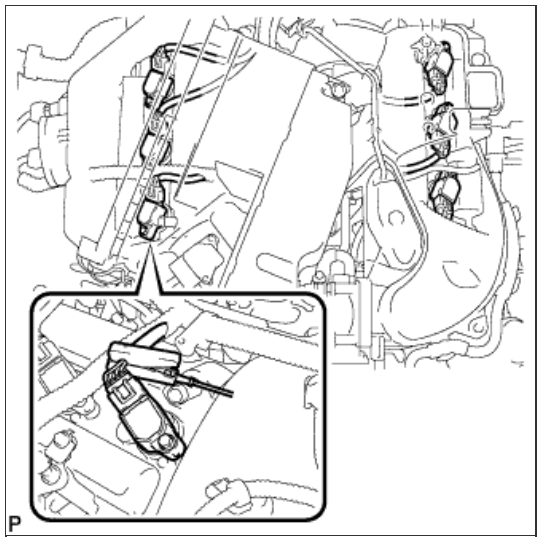
ii. Remove the air cleaner cap.

iii. Pull out the wire harness shown in the illustration.

iv. Connect the tester probe of a timing light to the wire of the ignition coil connector for the No. 1 cylinder.

NOTICE:

- **Use a timing light that detects primary signals.**
- **After checking, be sure to wrap the wire harness with tape.**



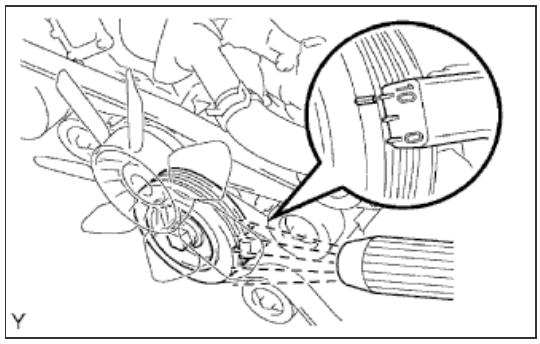
v. Inspect the ignition timing during idling.

Standard ignition timing:
8 to 12° BTDC @ idling (transmission in neutral position and A/C switch off)

vi. Remove SST from the DLC3.

vii. Inspect the ignition timing during idling.

Standard ignition timing:
7 to 24° BTDC @ idling (transmission in neutral position and A/C switch off)



viii. Disconnect the timing light from the engine.

ix. Install the air cleaner cap.

NOTICE:

- **Turn all the electrical systems off.**
- **Perform the inspection when the cooling fan motor is turned off.**

a. Warm up the engine.

b. When using the intelligent tester:

i. Connect the intelligent tester to the DLC3.

ii. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Engine Speed.

iii. Inspect the engine idling speed.

Standard idling speed:
650 to 750 rpm (transmission in neutral position and A/C switch off)

c. When not using the intelligent tester:

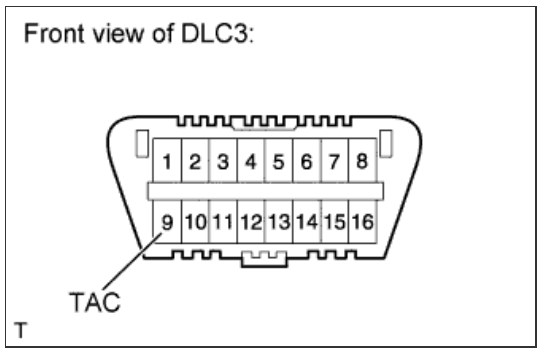
i. Connect SST to terminal 9 (TAC) of the DLC3.

SST
09843-18030

ii. Race the engine at 2500 rpm for approximately 90 seconds.

iii. Inspect the engine idling speed.

Standard idling speed:
650 to 750 rpm (transmission in neutral position and A/C switch off)



45. INSPECT CO/HC

HINT:

This check is to determine whether or not the idle CO/HC concentration complies with regulations.

a. Start the engine.

b. Run the engine at 2500 rpm for approximately 180 seconds.

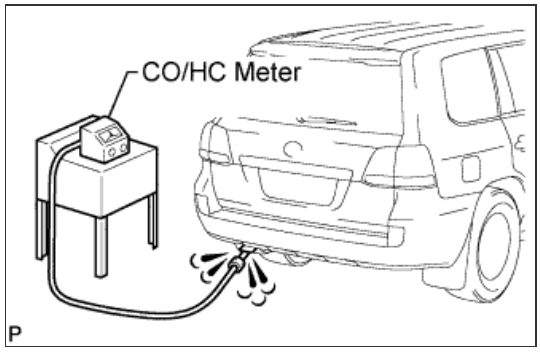
c. Insert the CO/HC meter testing probe at least 40 cm (1.31 ft) into the tailpipe during idling.

d. Immediately check the CO/HC concentration during idling and/or at 2500 rpm.

HINT:

When carrying out the 2 tests (idling and 2500 rpm), the measurement orders are prescribed by the applicable local regulations.

e. If the CO/HC concentration does not comply with regulations, perform troubleshooting in the order given below.



i. Check the A/F sensor operation (Click here) and heated oxygen sensor operation (Click here).

ii. See the table below for possible causes, and then inspect and correct the corresponding causes if necessary.

CO	HC	Symptom	Causes
Normal	High	Rough idling	1. Faulty ignition: • Incorrect timing • Plugs are contaminated or shorted, or plug gaps are defective 2. Incorrect valve clearance

			3. Leaky intake and exhaust valves 4. Leaky cylinders
Low	High	Rough idling (Fluctuating HC reading)	1. Vacuum leaks: • Ventilation hoses • Intake manifold • Throttle body 2. Lean mixture causing misfire
High	High	Rough idle (Black smoke from exhaust)	1. Restricted air filter 2. Faulty SFI system: • Faulty pressure regulator • Defective engine coolant temperature sensor • Faulty mass air flow meter • Faulty ECM • Faulty injectors • Faulty throttle position sensor

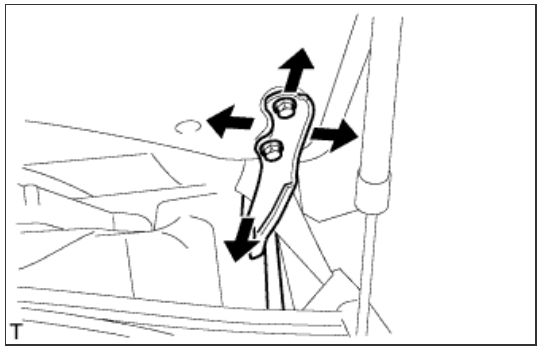
46. INSTALL HOOD SUB-ASSEMBLY

a. Install the hood with the 4 bolts.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }

47. ADJUST HOOD SUB-ASSEMBLY

a. Adjust the hood position.



i. Loosen the 4 hinge bolts of the hood.

ii. Move the hood and adjust the clearance between the hood and front fender.

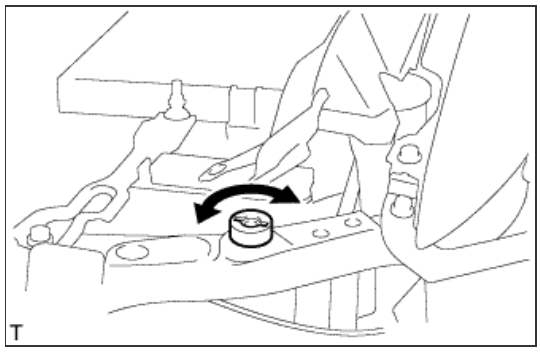
iii. Tighten the 4 hinge bolts of the hood after the adjustment.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }

iv. Adjust the cushion rubber so that the height of the hood and fender are aligned.

HINT:

Raise or lower the hood front end by turning the cushion rubber.

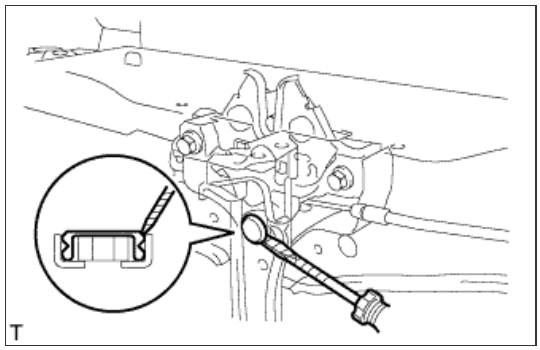


b. Adjust the hood lock.

i. Using a screwdriver, remove the hood lock nut cap as shown in the illustration.

HINT:

Tape the screwdriver tip before use.



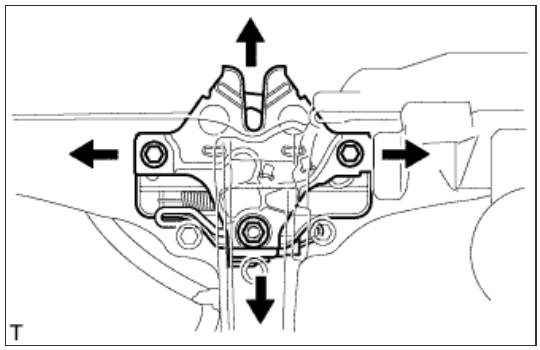
ii. Loosen the 2 bolts and hood lock nut.

iii. Adjust the hood lock position so that the striker can enter it smoothly.

iv. Tighten the bolts and nut after the adjustment.

Torque:
5.5 N*m{ 56 kgf*cm , 49 in.*lbf }

v. Install a new cap.

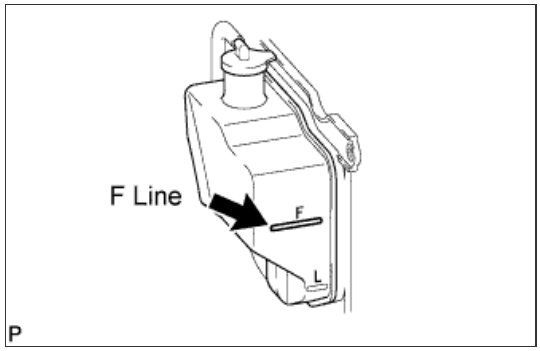


48. INSPECT COOLANT LEVEL AT RESERVOIR

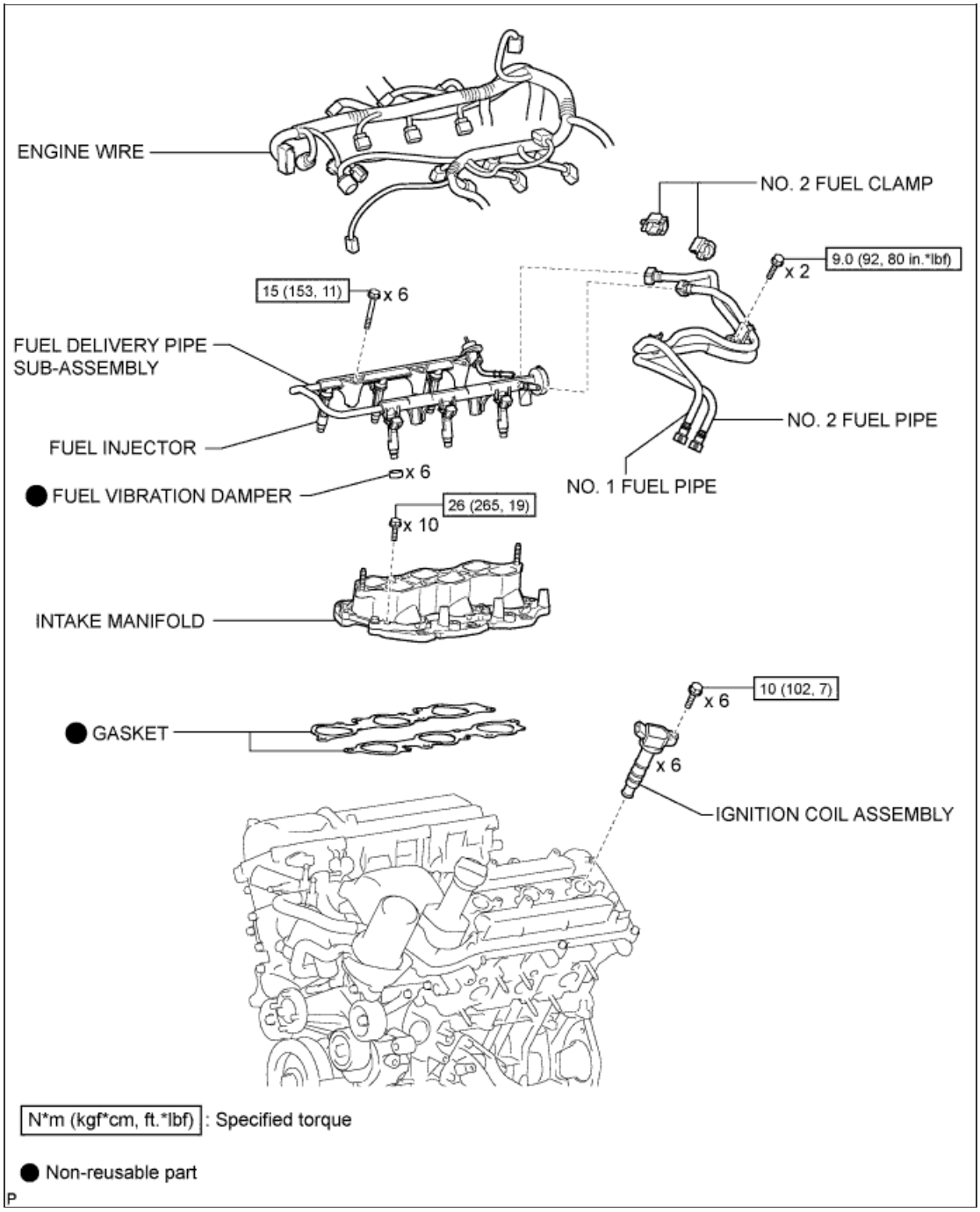
a. Check that the engine coolant level is between the L and F lines when the engine is cold.
If the engine coolant is low, check for leaks and add "TOYOTA Super Long Life Coolant" or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite and non-borate coolant with long-life hybrid organic acid technology to the F line.

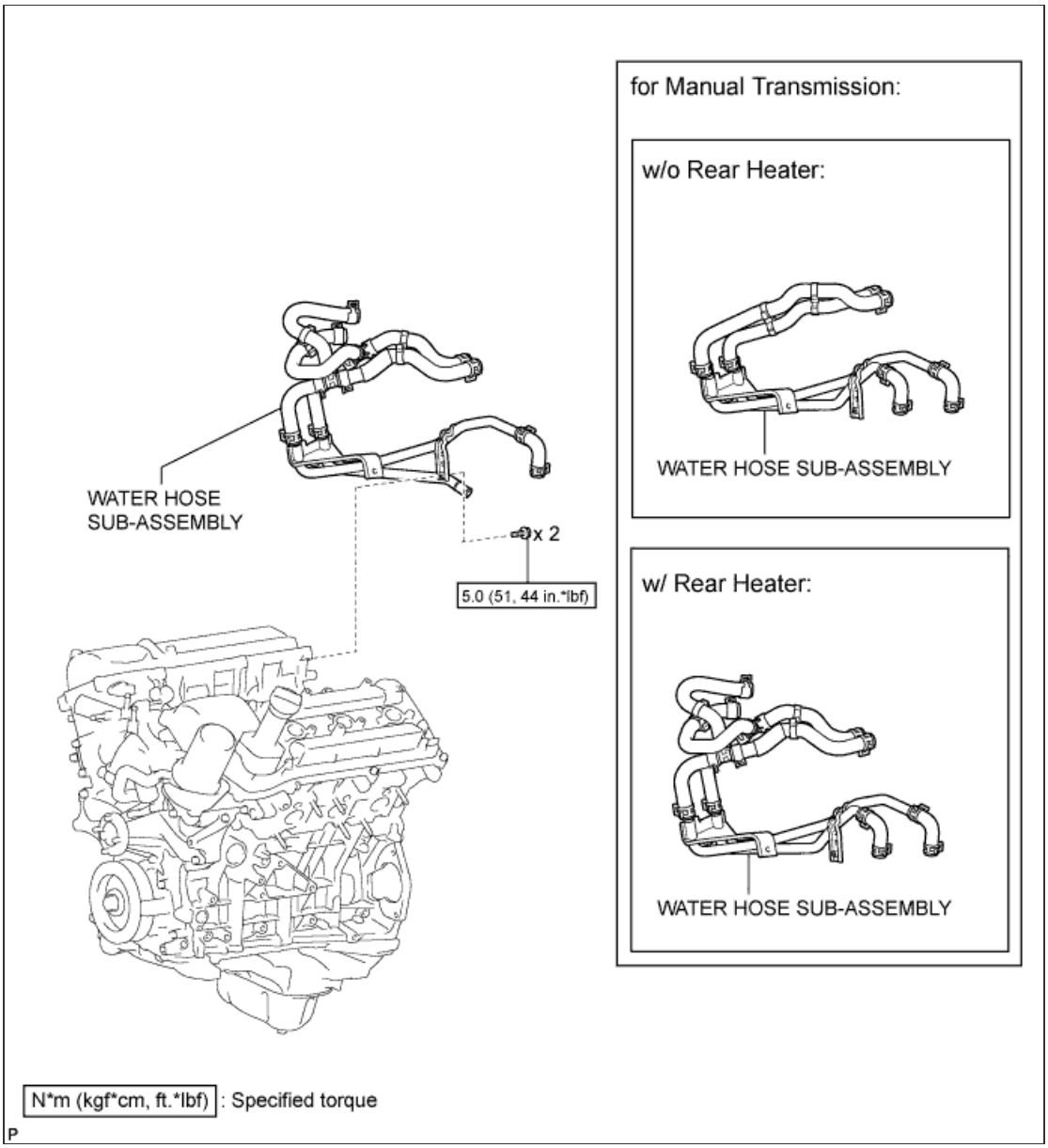
NOTICE:

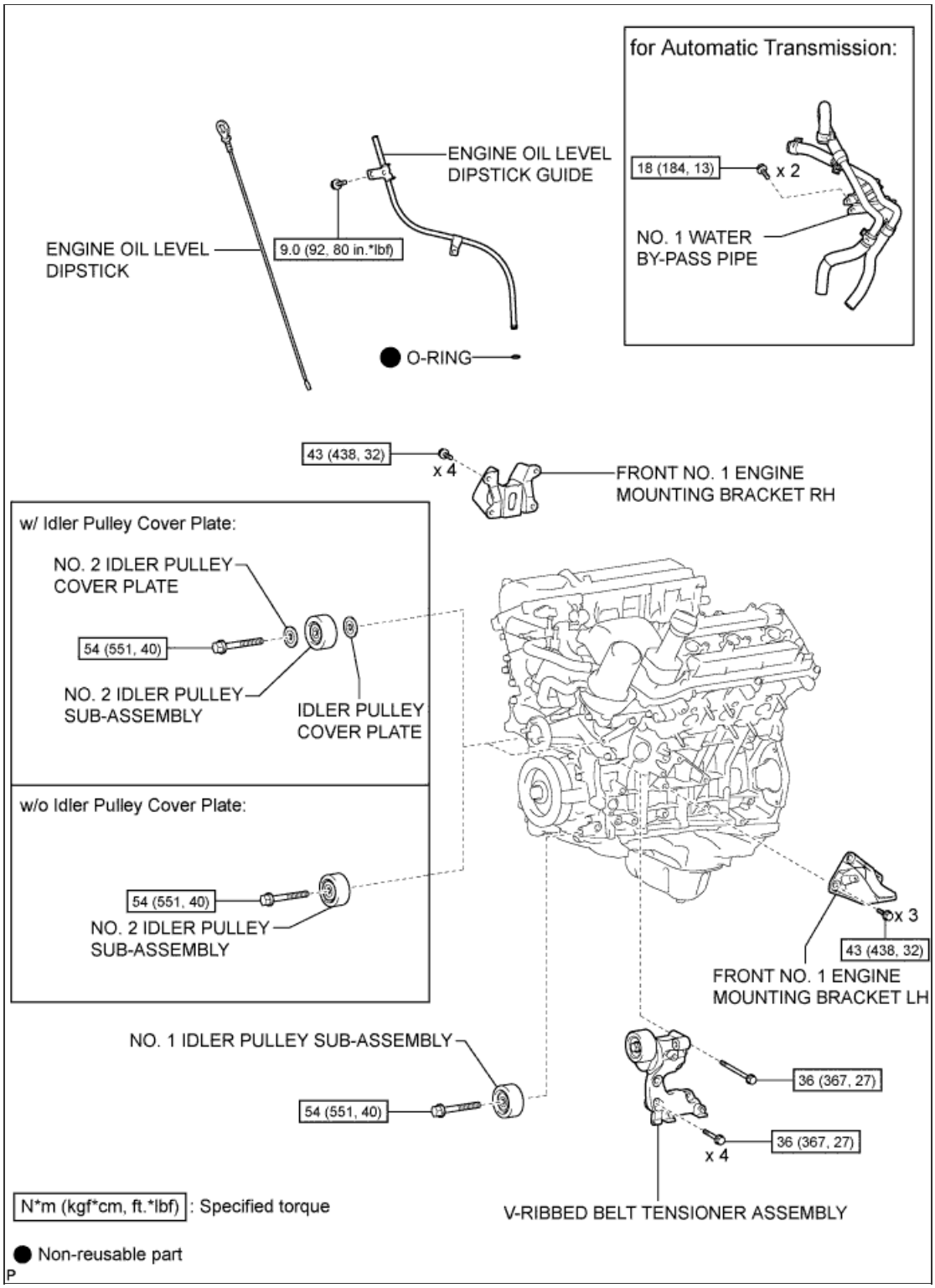
Do not substitute plain water for engine coolant.

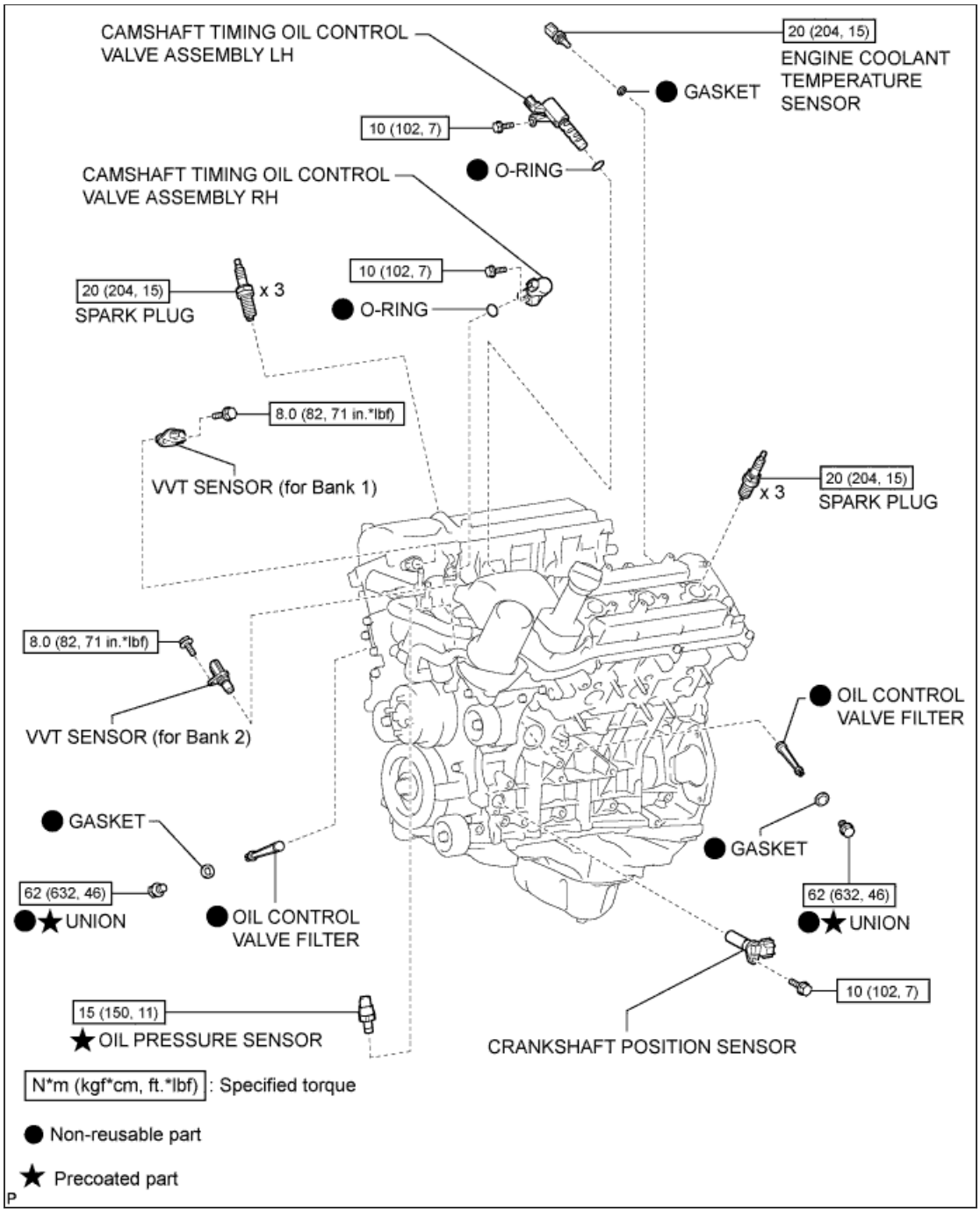


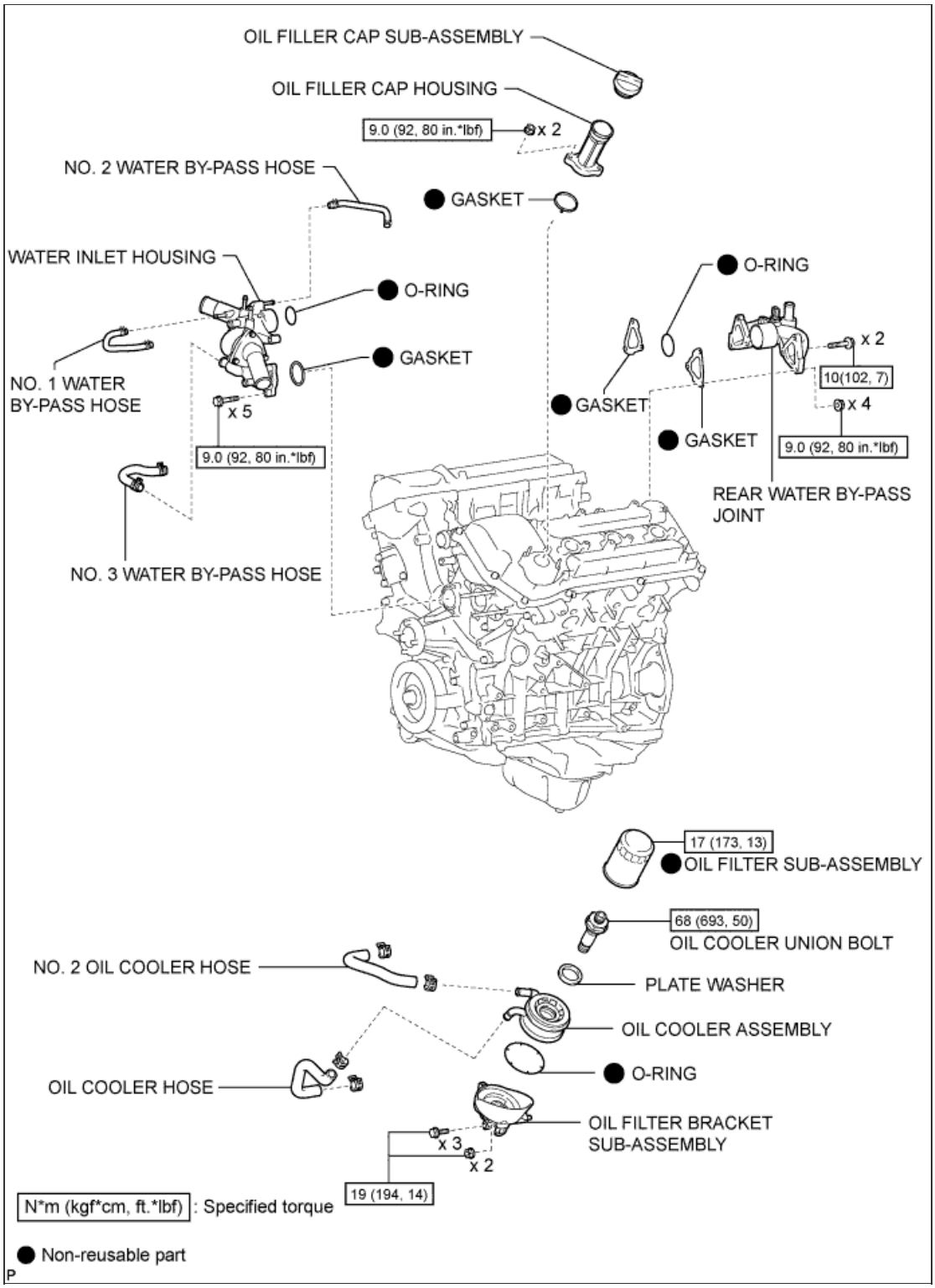
for Preparation Click here

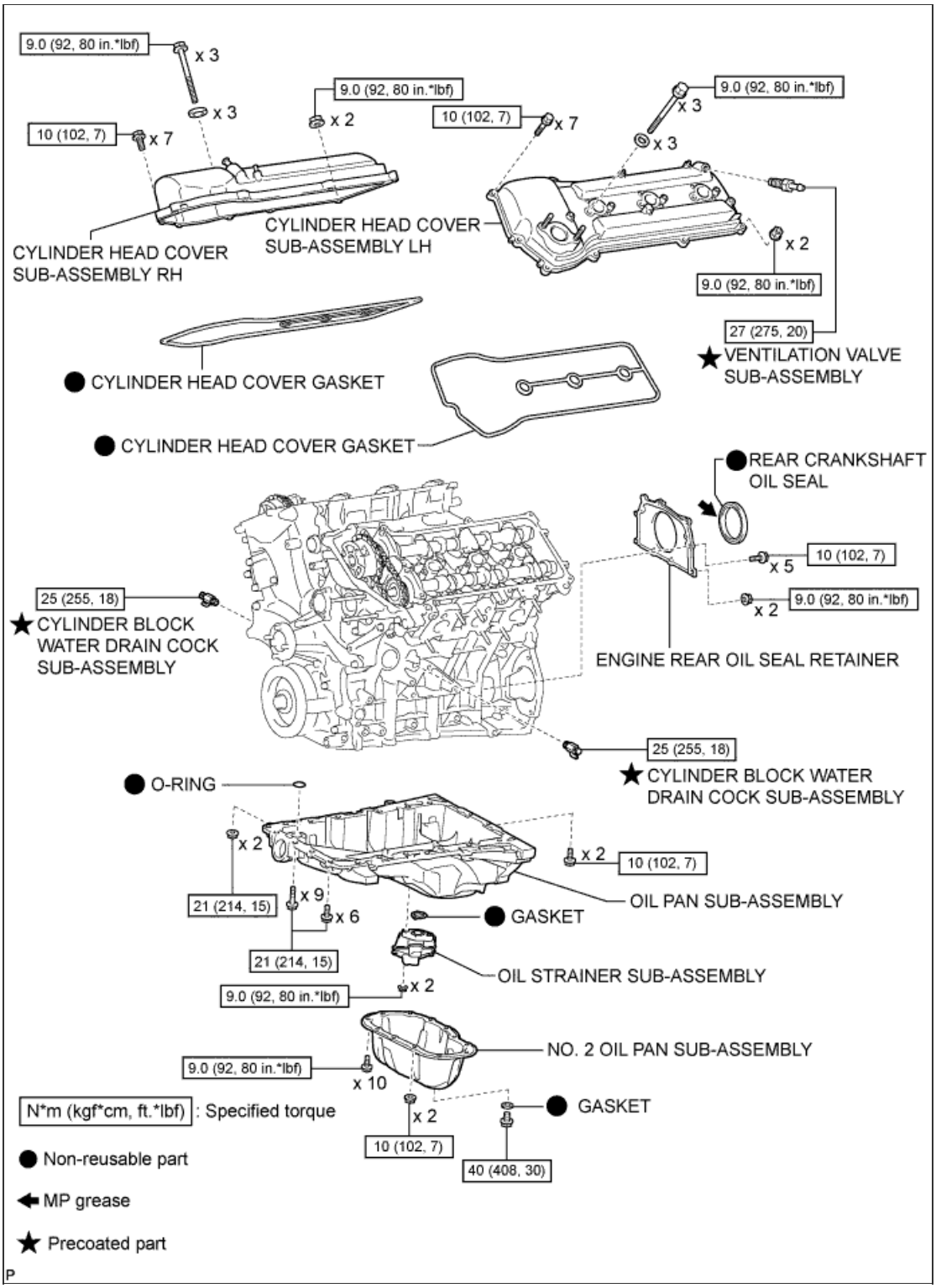


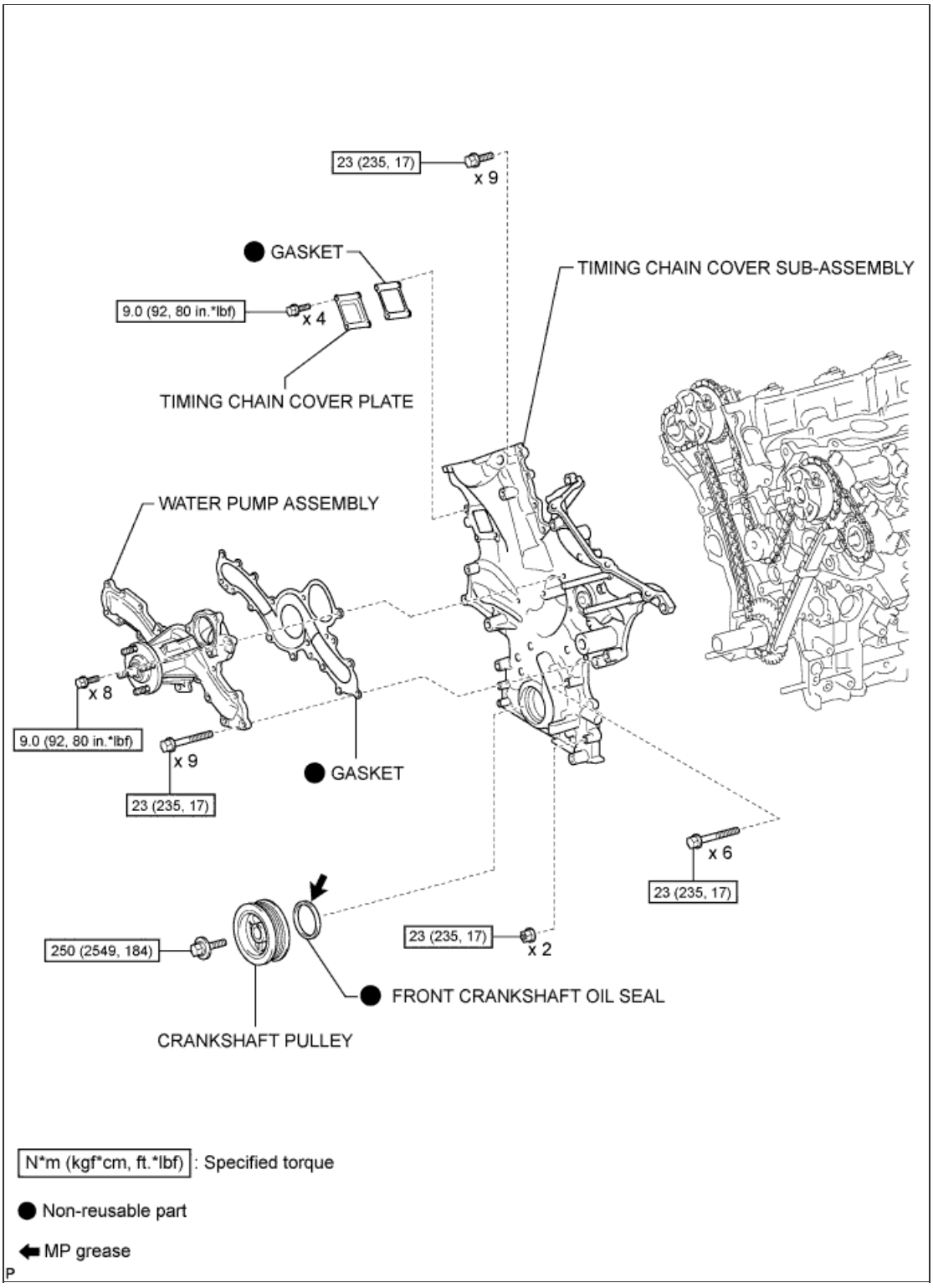

for Manual Transmission:
w/o Rear Heater:
WATER HOSE SUB-ASSEMBLY
w/ Rear Heater:
WATER HOSE SUB-ASSEMBLY
WATER HOSE
SUB-ASSEMBLY
x 2
5.0 (51, 44 in.*lbf)
N*m (kgf*cm, ft.*lbf) : Specified torque
P

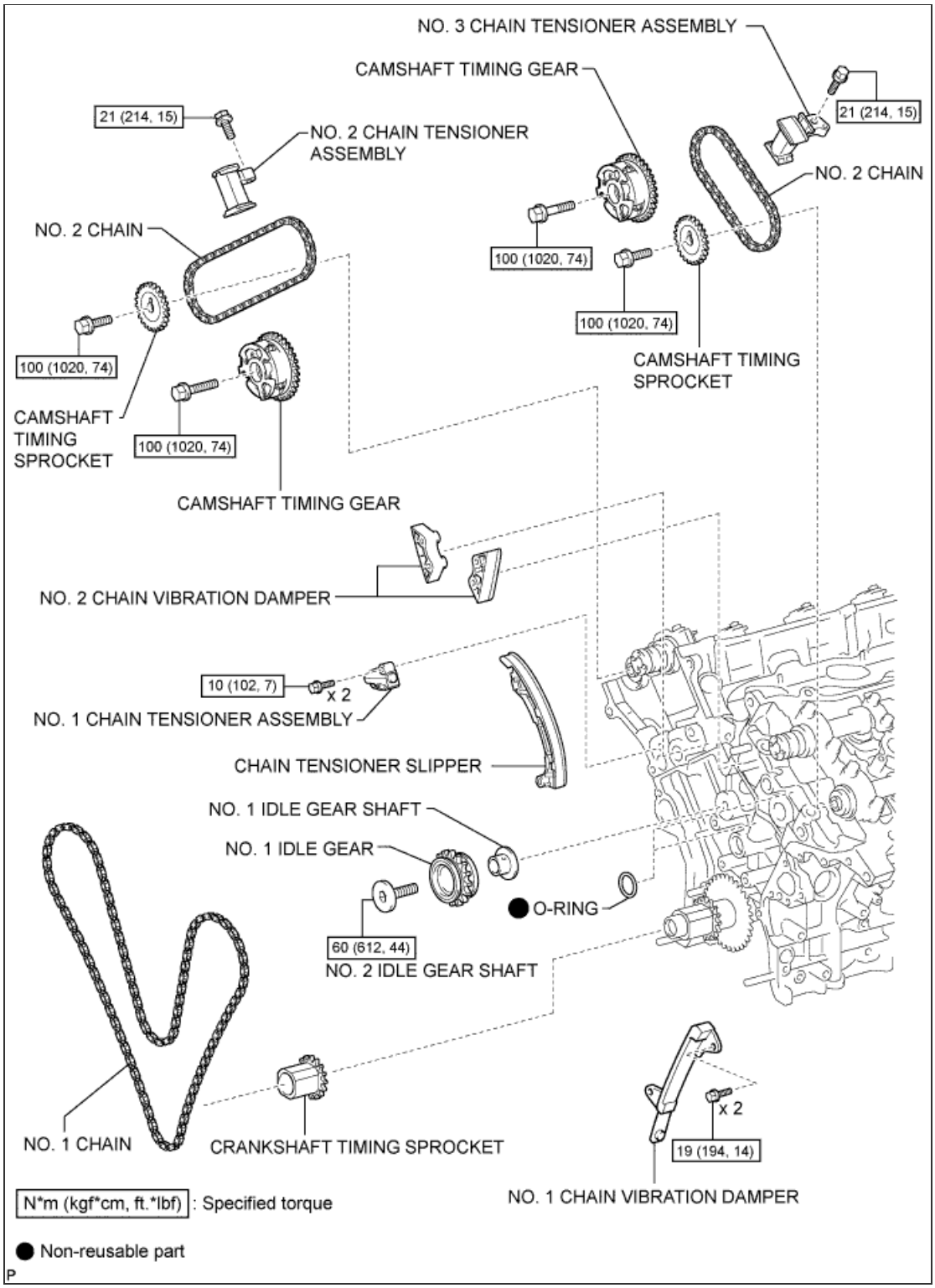

for Automatic Transmission:
18 (184, 13)
x 2
NO. 1 WATER BY-PASS PIPE
ENGINE OIL LEVEL DIPSTICK GUIDE
ENGINE OIL LEVEL DIPSTICK
9.0 (92, 80 in.*lbf)
O-RING
43 (438, 32)
x 4
FRONT NO. 1 ENGINE MOUNTING BRACKET RH
w/ Idler Pulley Cover Plate:
NO. 2 IDLER PULLEY COVER PLATE
54 (551, 40)
NO. 2 IDLER PULLEY SUB-ASSEMBLY
IDLER PULLEY COVER PLATE
w/o Idler Pulley Cover Plate:
54 (551, 40)
NO. 2 IDLER PULLEY SUB-ASSEMBLY
x 3
43 (438, 32)
FRONT NO. 1 ENGINE MOUNTING BRACKET LH
NO. 1 IDLER PULLEY SUB-ASSEMBLY
54 (551, 40)
36 (367, 27)
36 (367, 27)
x 4
V-RIBBED BELT TENSIONER ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

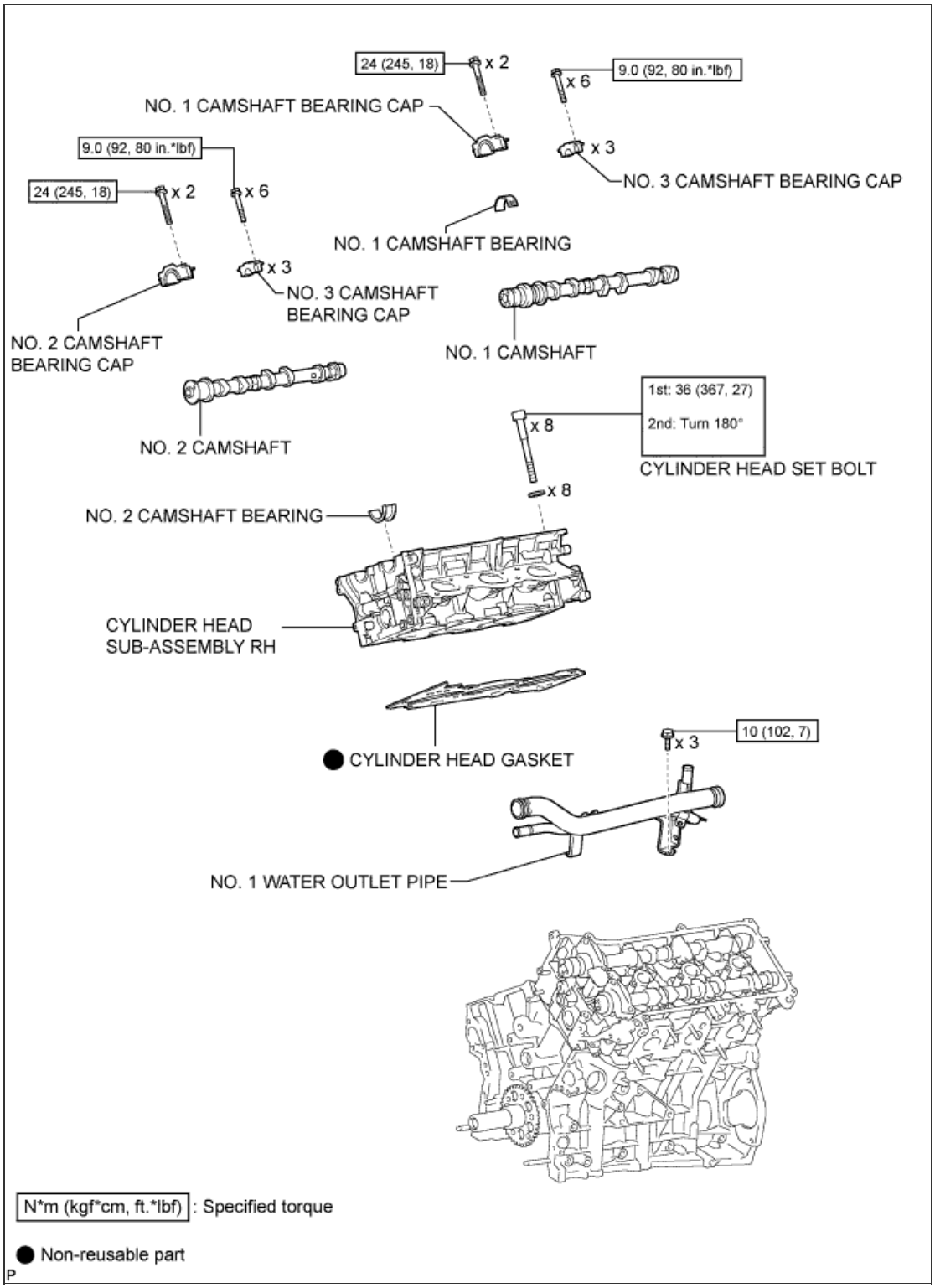

CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY LH
20 (204, 15)
ENGINE COOLANT TEMPERATURE SENSOR
GASKET
10 (102, 7)
O-RING
CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY RH
20 (204, 15)
x 3
SPARK PLUG
10 (102, 7)
O-RING
8.0 (82, 71 in.*lbf)
VVT SENSOR (for Bank 1)
x 3
20 (204, 15)
SPARK PLUG
8.0 (82, 71 in.*lbf)
VVT SENSOR (for Bank 2)
OIL CONTROL VALVE FILTER
GASKET
GASKET
62 (632, 46)
UNION
OIL CONTROL VALVE FILTER
62 (632, 46)
UNION
10 (102, 7)
15 (150, 11)
OIL PRESSURE SENSOR
CRANKSHAFT POSITION SENSOR
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
Precoated part
P


OIL FILLER CAP SUB-ASSEMBLY
OIL FILLER CAP HOUSING
9.0 (92, 80 in.*lbf)
x 2
NO. 2 WATER BY-PASS HOSE
GASKET
WATER INLET HOUSING
O-RING
O-RING
GASKET
NO. 1 WATER BY-PASS HOSE
x 5
9.0 (92, 80 in.*lbf)
GASKET
GASKET
x 2
10(102, 7)
x 4
9.0 (92, 80 in.*lbf)
REAR WATER BY-PASS JOINT
NO. 3 WATER BY-PASS HOSE
17 (173, 13)
OIL FILTER SUB-ASSEMBLY
68 (693, 50)
OIL COOLER UNION BOLT
NO. 2 OIL COOLER HOSE
PLATE WASHER
OIL COOLER ASSEMBLY
O-RING
OIL COOLER HOSE
OIL FILTER BRACKET SUB-ASSEMBLY
x 3
x 2
19 (194, 14)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

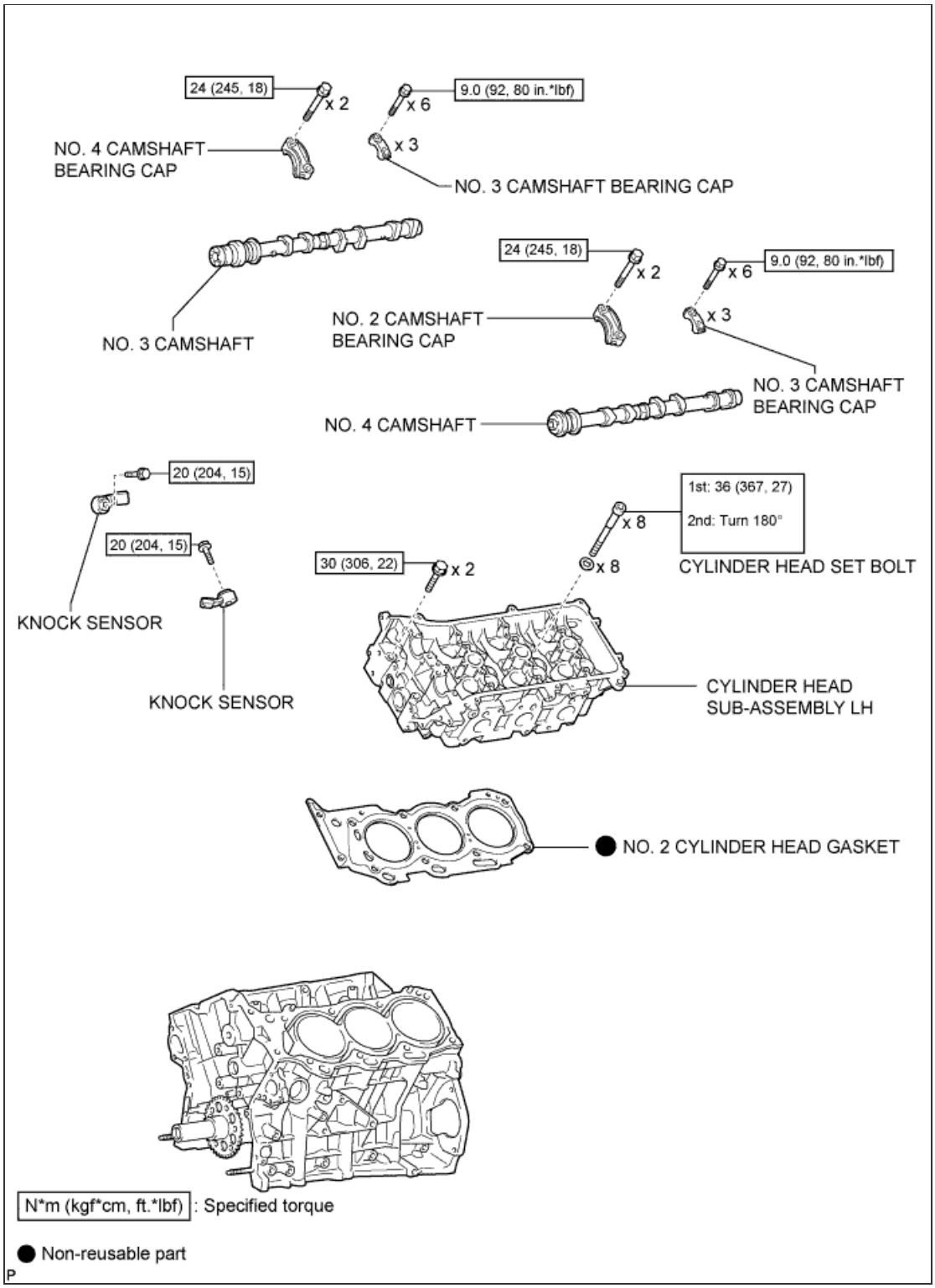

9.0 (92, 80 in.*lbf)
x 3
x 3
10 (102, 7)
x 7
9.0 (92, 80 in.*lbf)
x 2
CYLINDER HEAD COVER SUB-ASSEMBLY RH
CYLINDER HEAD COVER SUB-ASSEMBLY LH
10 (102, 7)
x 7
9.0 (92, 80 in.*lbf)
x 3
x 3
x 2
9.0 (92, 80 in.*lbf)
27 (275, 20)
★ VENTILATION VALVE SUB-ASSEMBLY
● CYLINDER HEAD COVER GASKET
● CYLINDER HEAD COVER GASKET
● REAR CRANKSHAFT OIL SEAL
10 (102, 7)
x 5
9.0 (92, 80 in.*lbf)
x 2
25 (255, 18)
★ CYLINDER BLOCK WATER DRAIN COCK SUB-ASSEMBLY
ENGINE REAR OIL SEAL RETAINER
25 (255, 18)
★ CYLINDER BLOCK WATER DRAIN COCK SUB-ASSEMBLY
● O-RING
x 2
x 2
10 (102, 7)
21 (214, 15)
x 9
x 6
OIL PAN SUB-ASSEMBLY
● GASKET
21 (214, 15)
OIL STRAINER SUB-ASSEMBLY
9.0 (92, 80 in.*lbf)
x 2
NO. 2 OIL PAN SUB-ASSEMBLY
9.0 (92, 80 in.*lbf)
x 10
x 2
● GASKET
10 (102, 7)
40 (408, 30)
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
MP grease
★ Precoated part
P


23 (235, 17)
x 9
GASKET
TIMING CHAIN COVER SUB-ASSEMBLY
9.0 (92, 80 in.*lbf)
x 4
TIMING CHAIN COVER PLATE
WATER PUMP ASSEMBLY
x 8
9.0 (92, 80 in.*lbf)
x 9
23 (235, 17)
GASKET
x 6
23 (235, 17)
250 (2549, 184)
23 (235, 17)
x 2
FRONT CRANKSHAFT OIL SEAL
CRANKSHAFT PULLEY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
MP grease
P


NO. 3 CHAIN TENSIONER ASSEMBLY
CAMSHAFT TIMING GEAR
21 (214, 15)
21 (214, 15)
NO. 2 CHAIN TENSIONER ASSEMBLY
NO. 2 CHAIN
NO. 2 CHAIN
100 (1020, 74)
100 (1020, 74)
100 (1020, 74)
CAMSHAFT TIMING SPROCKET
CAMSHAFT TIMING SPROCKET
100 (1020, 74)
CAMSHAFT TIMING GEAR
NO. 2 CHAIN VIBRATION DAMPER
10 (102, 7)
x 2
NO. 1 CHAIN TENSIONER ASSEMBLY
CHAIN TENSIONER SLIPPER
NO. 1 IDLE GEAR SHAFT
NO. 1 IDLE GEAR
O-RING
60 (612, 44)
NO. 2 IDLE GEAR SHAFT
NO. 1 CHAIN
CRANKSHAFT TIMING SPROCKET
x 2
19 (194, 14)
NO. 1 CHAIN VIBRATION DAMPER
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P


24 (245, 18)
x 2
9.0 (92, 80 in.*lbf)
x 6
NO. 1 CAMSHAFT BEARING CAP
x 3
NO. 3 CAMSHAFT BEARING CAP
9.0 (92, 80 in.*lbf)
24 (245, 18)
x 2
x 6
NO. 1 CAMSHAFT BEARING
x 3
NO. 3 CAMSHAFT BEARING CAP
NO. 2 CAMSHAFT BEARING CAP
NO. 1 CAMSHAFT
NO. 2 CAMSHAFT
1st: 36 (367, 27)
2nd: Turn 180°
x 8
CYLINDER HEAD SET BOLT
x 8
NO. 2 CAMSHAFT BEARING
CYLINDER HEAD SUB-ASSEMBLY RH
● CYLINDER HEAD GASKET
10 (102, 7)
x 3
NO. 1 WATER OUTLET PIPE
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part

P


24 (245, 18)
x 2
9.0 (92, 80 in.*lbf)
x 6
x 3
NO. 4 CAMSHAFT BEARING CAP
NO. 3 CAMSHAFT BEARING CAP
NO. 3 CAMSHAFT
24 (245, 18)
x 2
9.0 (92, 80 in.*lbf)
x 6
x 3
NO. 2 CAMSHAFT BEARING CAP
NO. 3 CAMSHAFT BEARING CAP
NO. 4 CAMSHAFT
20 (204, 15)
20 (204, 15)
KNOCK SENSOR
KNOCK SENSOR
1st: 36 (367, 27)
2nd: Turn 180°
x 8
30 (306, 22)
x 2
x 8
CYLINDER HEAD SET BOLT
CYLINDER HEAD SUB-ASSEMBLY LH
NO. 2 CYLINDER HEAD GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

for Preparation Click here

1. REMOVE OIL PRESSURE SENSOR

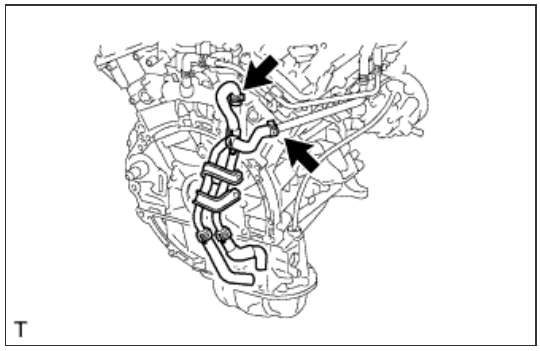
a. Using a 24 mm deep socket wrench, remove the oil pressure sensor.

2. REMOVE ENGINE COOLANT TEMPERATURE SENSOR

a. Remove the engine coolant temperature sensor and gasket.

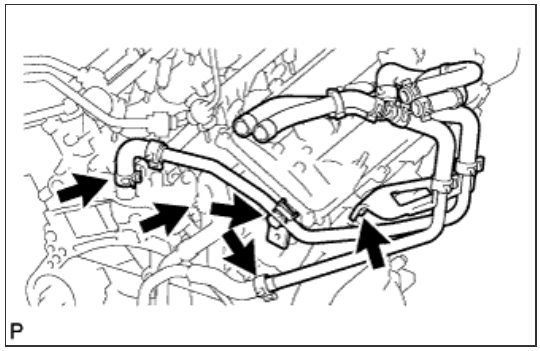
3. DISCONNECT NO. 1 WATER BY-PASS PIPE (for Automatic Transmission)

a. Disconnect the 2 water by-pass pipe hoses and remove the pipe.



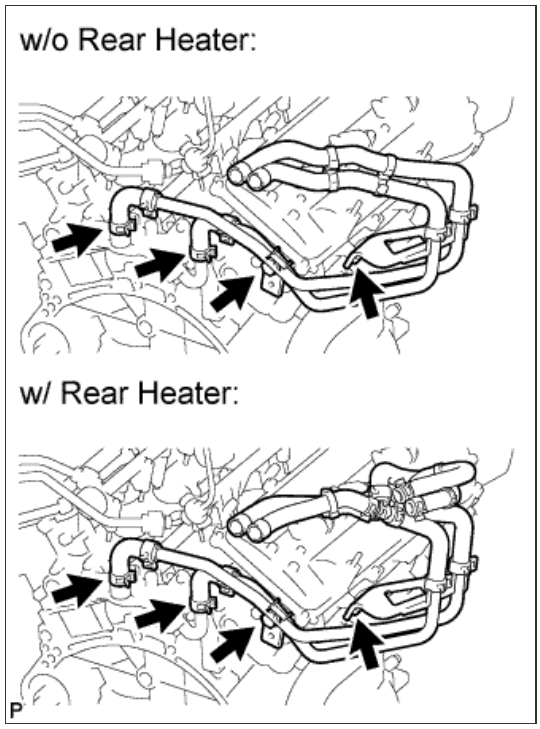
4. DISCONNECT WATER HOSE SUB-ASSEMBLY (for Automatic Transmission)

a. Remove the 2 bolts and disconnect the water hose.



5. DISCONNECT WATER HOSE SUB-ASSEMBLY (for Manual Transmission)

a. Remove the 2 bolts and disconnect the water hose.



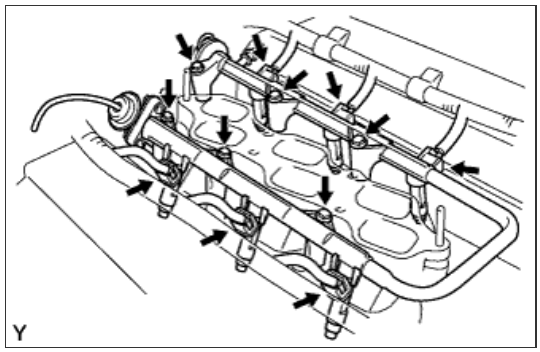
6. REMOVE FUEL DELIVERY PIPE SUB-ASSEMBLY

a. Disconnect the 6 fuel injector connectors.

b. Remove the 6 bolts and fuel delivery pipe together with the 6 fuel injectors.

NOTICE:

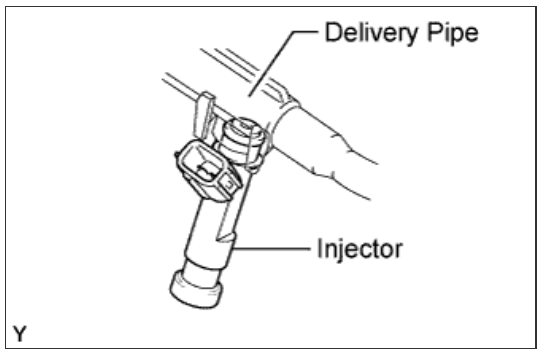
Be careful not to drop the injectors when removing the fuel delivery pipe.



7. REMOVE FUEL INJECTOR

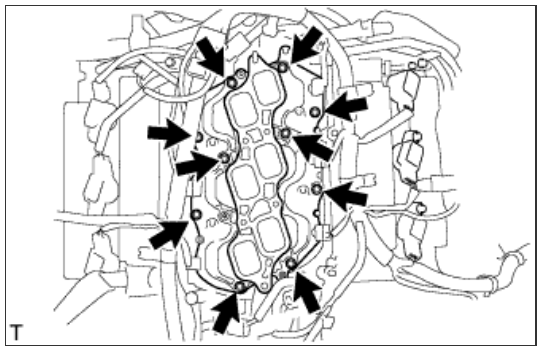
a. Pull the 6 fuel injectors from the fuel delivery pipe.

b. Remove the O-ring and injector vibration insulator from each fuel injector.

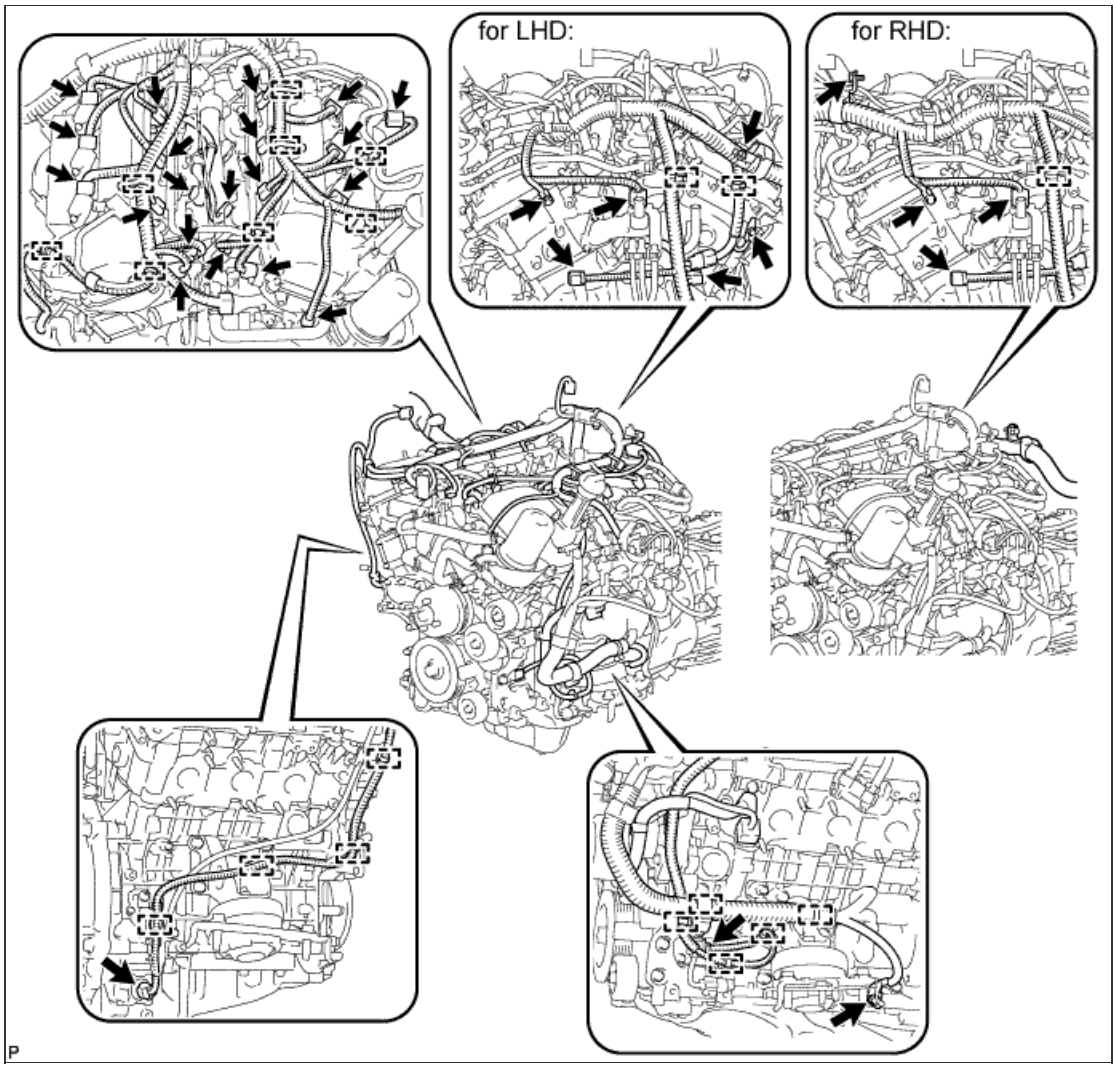


8. REMOVE INTAKE MANIFOLD

a. Remove the 10 bolts, intake manifold and 2 gaskets.



. REMOVE ENGINE WIRE

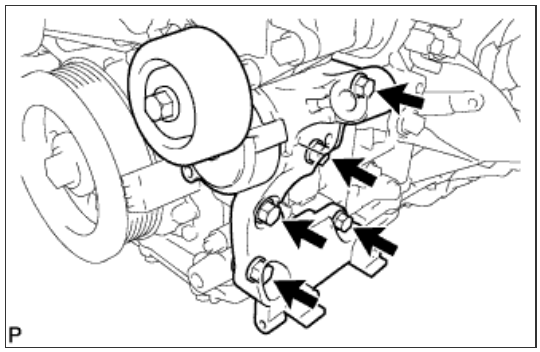


10. REMOVE IGNITION COIL ASSEMBLY

a. Remove the 6 bolts and 6 ignition coils.

11. REMOVE V-RIBBED BELT TENSIONER ASSEMBLY

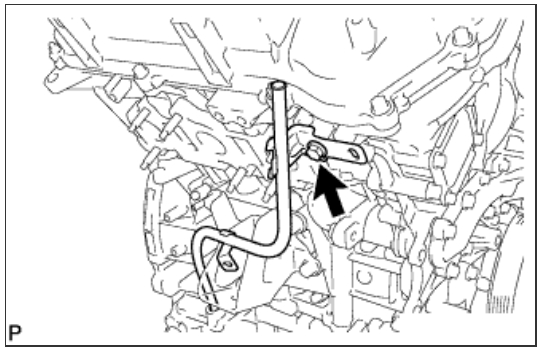
a. Remove the 5 bolts and V-ribbed belt tensioner.



12. REMOVE ENGINE OIL LEVEL DIPSTICK GUIDE

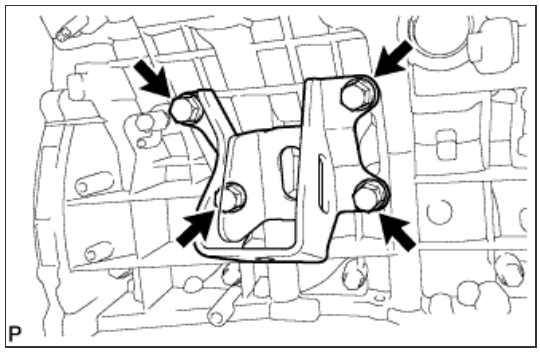
a. Remove the bolt and dipstick guide.

b. Remove the O-ring from the dipstick guide.



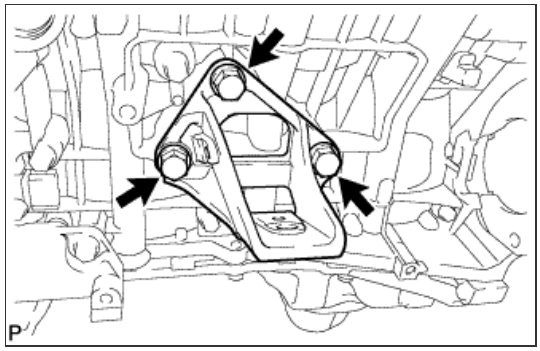
13. REMOVE FRONT NO. 1 ENGINE MOUNTING BRACKET RH

a. Remove the 4 bolts and front No. 1 engine mounting bracket RH.



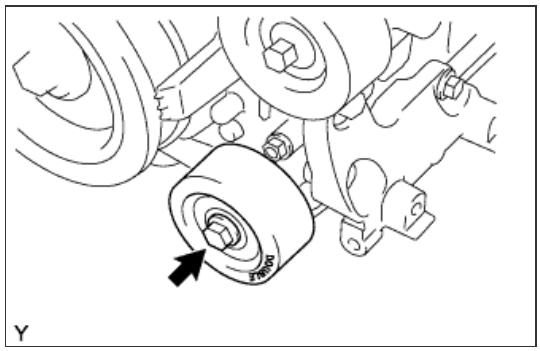
14. REMOVE FRONT NO. 1 ENGINE MOUNTING BRACKET LH

a. Remove the 3 bolts and front No. 1 engine mounting bracket LH.



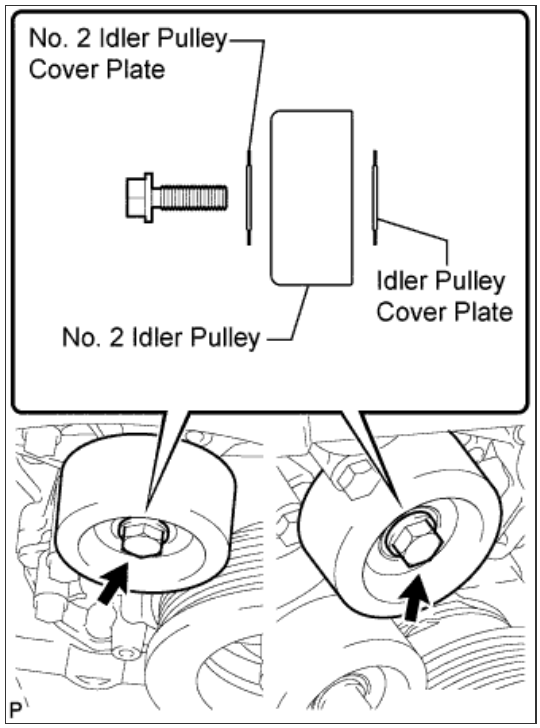
15. REMOVE NO. 1 IDLER PULLEY SUB-ASSEMBLY

a. Remove the bolt and No. 1 idler pulley.

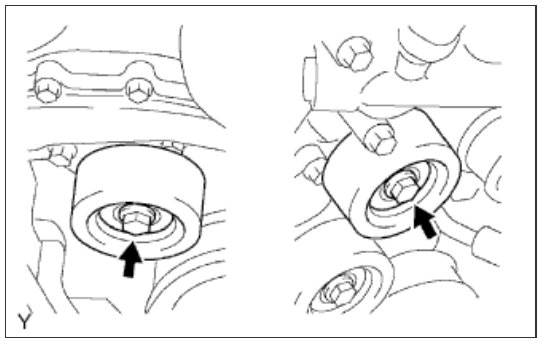


16. REMOVE NO. 2 IDLER PULLEY SUB-ASSEMBLY

a. w/ Pulley Cover Plate:
Remove the 2 bolts, 2 No. 2 idler pulley cover plate, 2 idler pulley and 2 idler pulley cover plate.



b. w/o Pulley Cover Plate:
Remove the 2 bolts and 2 No. 2 idler pulleys.



17. REMOVE FLYWHEEL RING GEAR (for Manual Transmission)

HINT:

If the flywheel ring gear is deformed or the gears are damaged, replace it.

CAUTION:

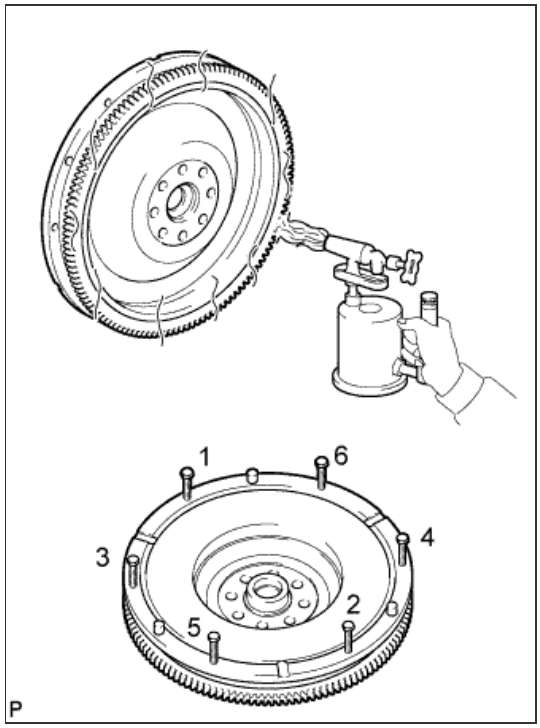
Wear protective gloves. Hot ares on the flywheel ring gear may injure your hands.

a. Using a torch, heat the ring gear evenly to approximately 200°C (392°F).

b. Temporarily install 6 bolts (8 mm x 1.25 pitch) with a length of 70 mm or more to the flywheel.

c. Uniformly tighten the 6 bolts in the order shown in the illustration.

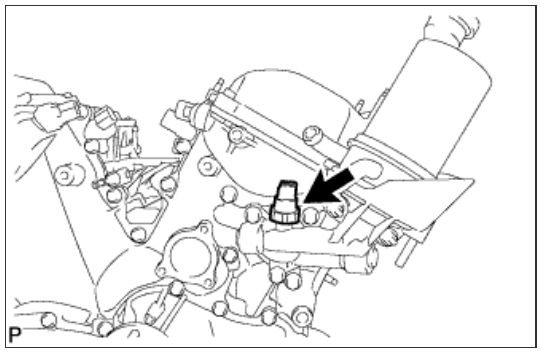
d. Remove the ring gear from the flywheel.



for Preparation Click here

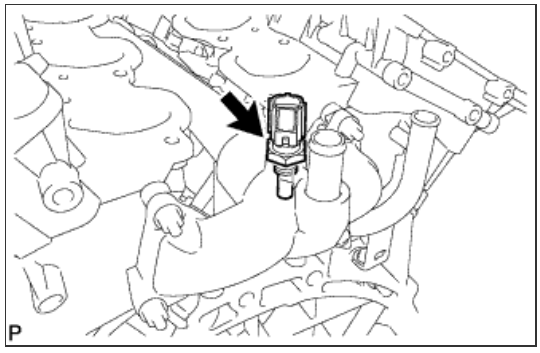
1. REMOVE OIL PRESSURE SENSOR

a. Using a 24 mm deep socket wrench, remove the oil pressure sensor.



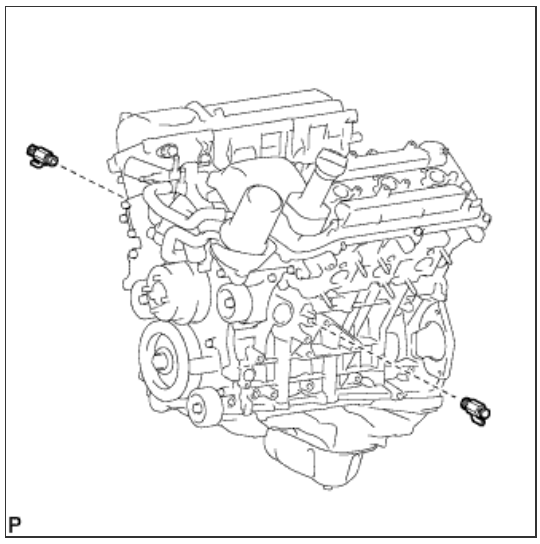
2. REMOVE ENGINE COOLANT TEMPERATURE SENSOR

a. Remove the engine coolant temperature sensor and gasket.



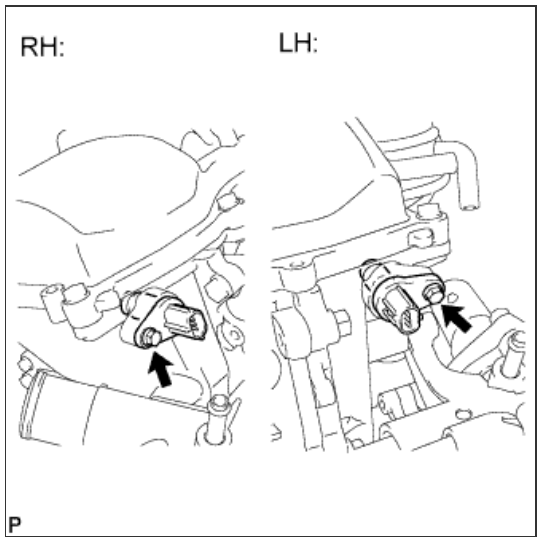
3. REMOVE CYLINDER BLOCK WATER DRAIN COCK SUB-ASSEMBLY

a. Remove the 2 water drain cocks.



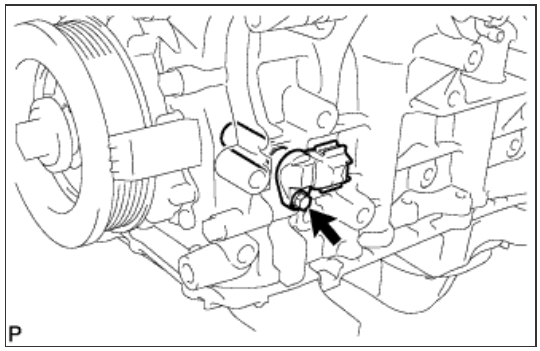
4. REMOVE VVT SENSOR

a. Remove the 2 bolts and 2 VVT sensors from the cylinder head LH and RH.



5. REMOVE CRANKSHAFT POSITION SENSOR

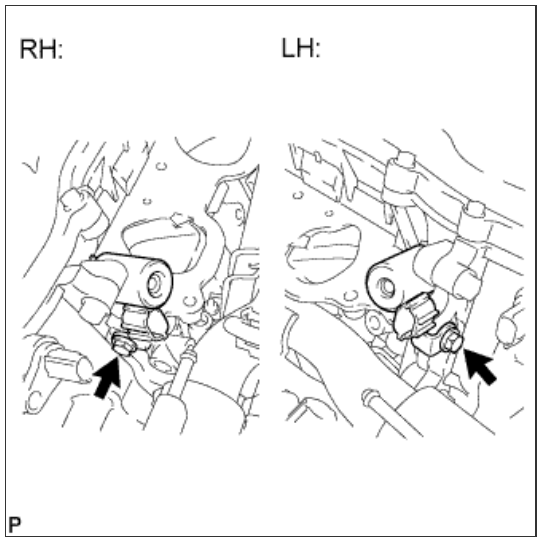
a. Remove the bolt and crankshaft position sensor.



6. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY RH

a. Remove the bolt and camshaft timing oil control valve from the cylinder head.

b. Remove the O-ring.



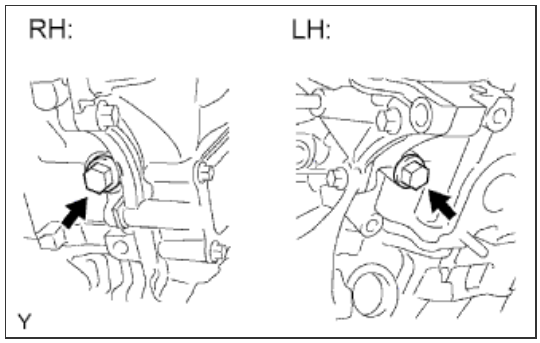
7. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY LH

a. Remove the bolt and camshaft timing oil control valve from the cylinder head.

b. Remove the O-ring.

8. REMOVE OIL CONTROL VALVE FILTER

a. Remove the 2 unions, 2 filters and 2 gaskets from the cylinder head LH and RH.



9. REMOVE OIL FILTER SUB-ASSEMBLY

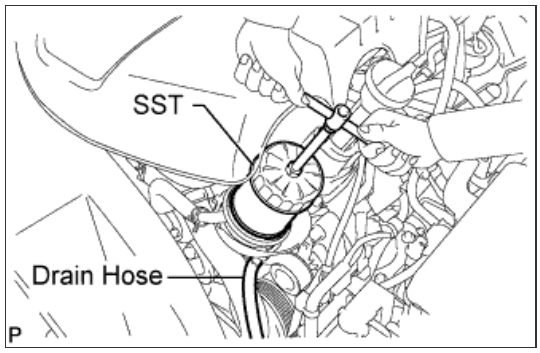
a. Remove the drain pipe cap.

b. Using SST, remove the oil filter.

SST
09228-07501

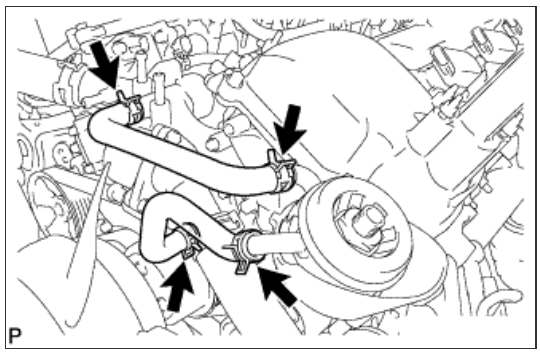
HINT:

- **Put the disposal container beneath the drain hose to collect the oil from the oil filter cover.**
- **Drain hose inside diameter: 8 mm (0.315 in.**
- **Drain hose len h: 900 mm (2.95 ft.**



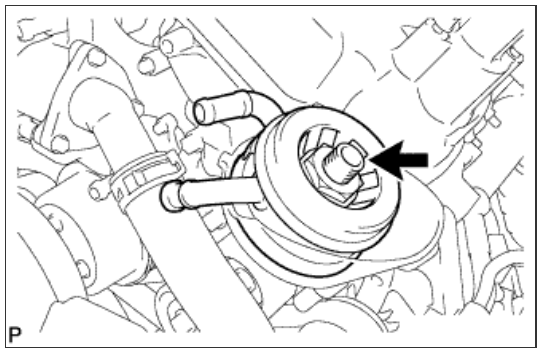
10. REMOVE OIL COOLER ASSEMBLY

a. Remove the oil cooler hose and No. 2 oil cooler hose.



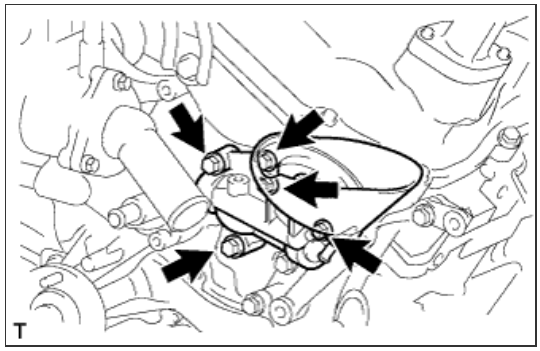
b. Remove the union bolt, plate washer and oil cooler.

c. Remove the O-ring from the oil cooler.



11. REMOVE OIL FILTER BRACKET SUB-ASSEMBLY

a. Remove the 3 bolts, 2 nuts, oil filter bracket and O-ring.



12. DISCONNECT NO. 1 WATER BY-PASS HOSE

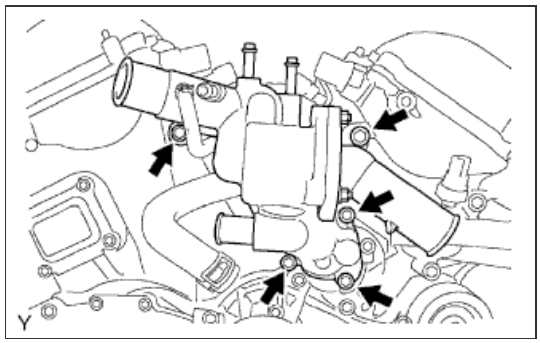
13. DISCONNECT NO. 2 WATER BY-PASS HOSE

14. DISCONNECT NO. 3 WATER BY-PASS HOSE

15. REMOVE WATER INLET HOUSING

a. Remove the 5 bolts and water inlet housing.

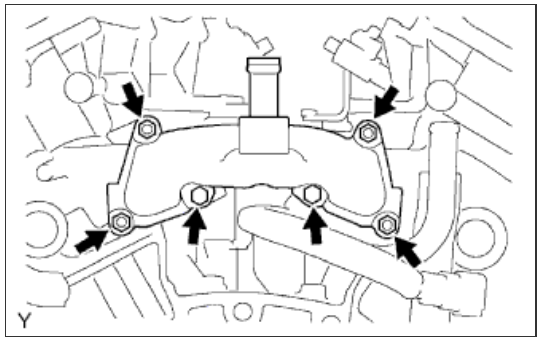
b. Remove the O-ring and gasket from the water outlet pipe and water pump.



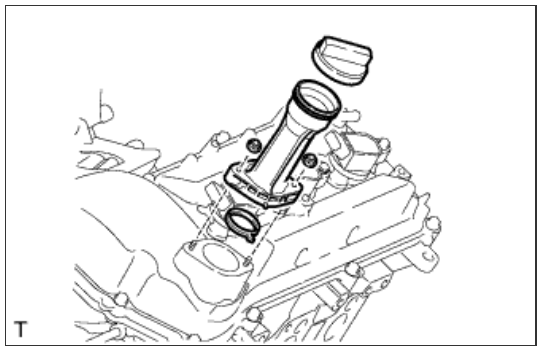
16. REMOVE REAR WATER BY-PASS OINT

a. Remove the 2 bolts, 4 nuts, rear water by-pass joint and 2 gaskets.

b. Remove the O-ring from the No. 1 water outlet pipe.



17. REMOVE OIL FILLER CAP SUB-ASSEMBLY



18. REMOVE OIL FILLER CAP HOUSING

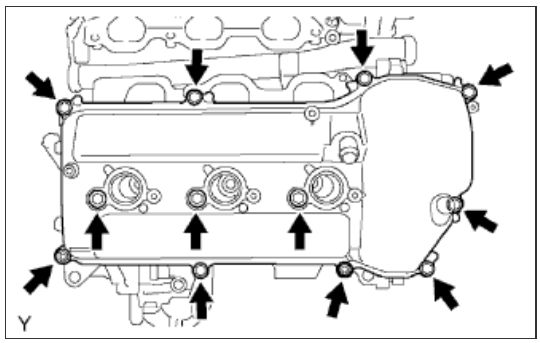
a. Remove the 2 nuts, oil filler cap housing and gasket.

19. REMOVE SPARK PLUG

a. Remove the 6 spark plugs.

20. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY RH

a. Remove the 10 bolts, 3 seal washers, 2 nuts, cylinder head cover and gasket.

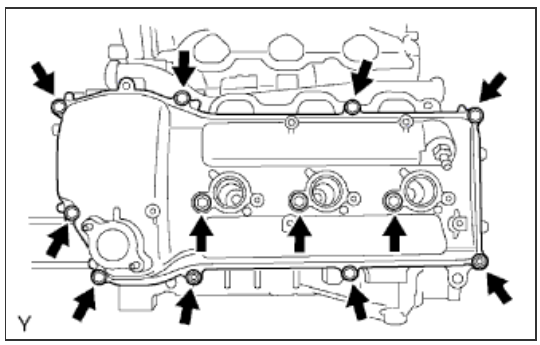


21. REMOVE VENTILATION VALVE SUB-ASSEMBLY

a. Remove the ventilation valve.

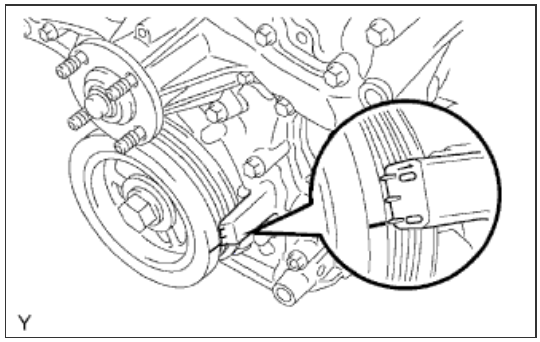
22. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY LH

a. Remove the 10 bolts, 3 seal washers, 2 nuts, cylinder head cover and gasket.

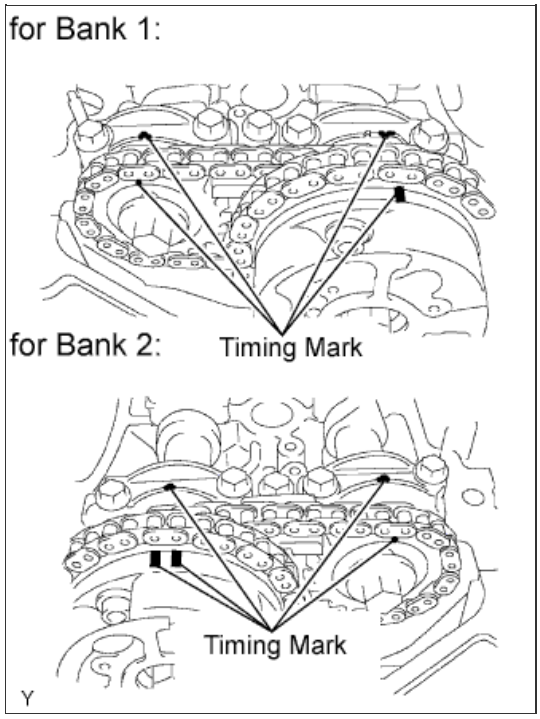


23. REMOVE CRANKSHAFT PULLEY

a. Turn the crankshaft pulley, and align the notch with the timing mark "0" of the timing chain cover.

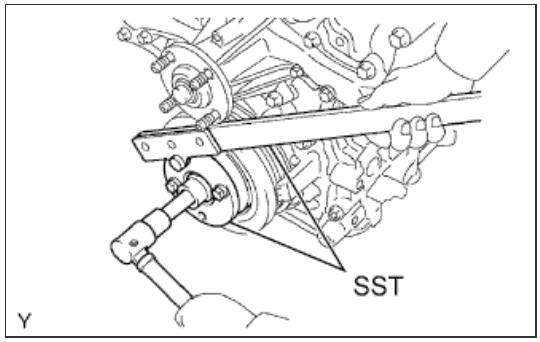


b. Check that the timing marks of the camshaft timing gears and sprockets are aligned with the timing marks of the bearing caps as shown in the illustration.



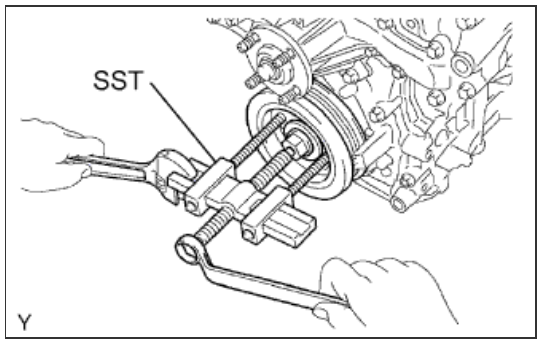
c. Using SST, hold the crankshaft pulley and loosen the pulley set bolt.

SST
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09330-00021



d. Using the pulley set bolt and SST, remove the crankshaft pulley.

SST
09950-50013 (09951-05010, 09952-05010, 09953-05020, 09954-05030)

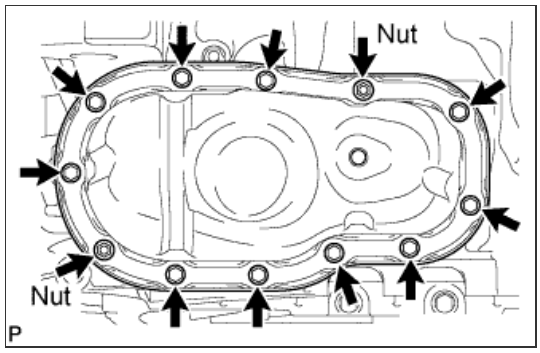


24. REMOVE OIL PAN DRAIN PLUG

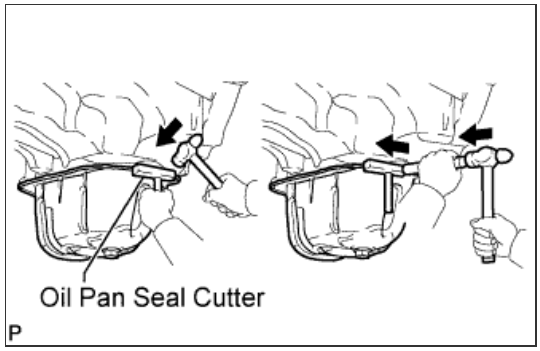
a. Remove the drain plug and gasket.

25. REMOVE NO. 2 OIL PAN SUB-ASSEMBLY

a. Remove the 10 bolts and 2 nuts.

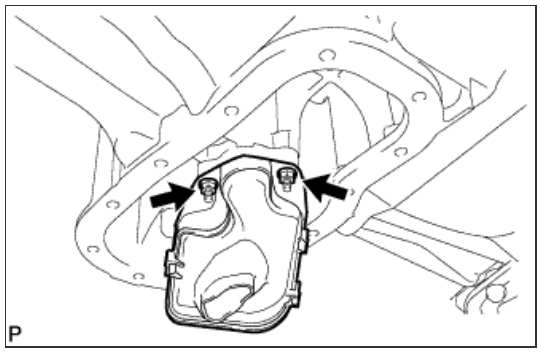


b. Insert the blade of an oil pan seal cutter between the oil pans. Cut through the applied sealer and remove the No. 2 oil pan.



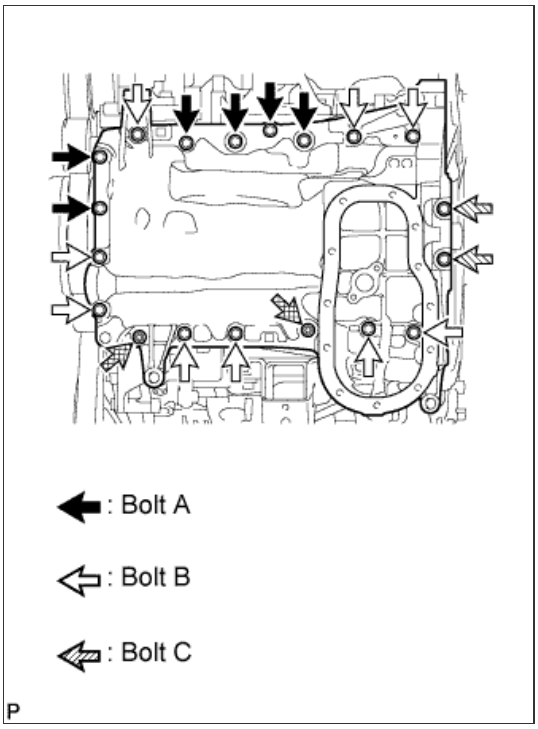
26. REMOVE OIL STRAINER SUB-ASSEMBLY

a. Remove the 2 nuts, oil strainer and gasket.



27. REMOVE OIL PAN SUB-ASSEMBLY

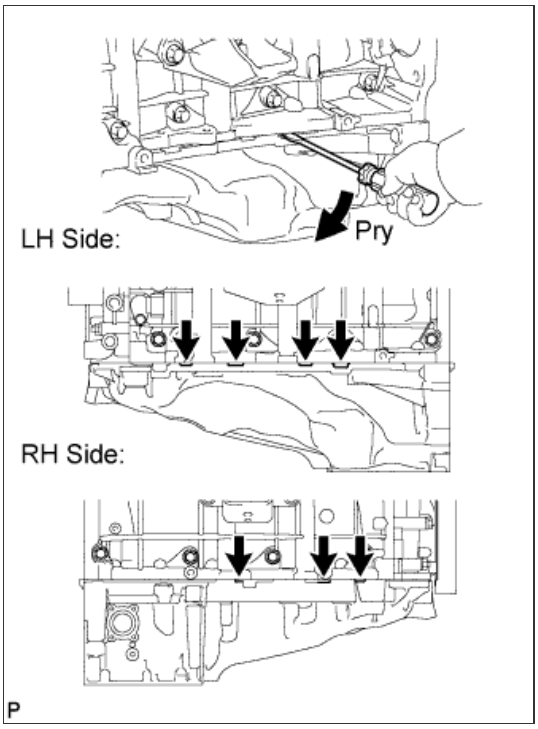
a. Remove the 17 bolts (A, B, C) and 2 nuts.



b. Using a screwdriver, remove the oil pan by prying between the oil pan and cylinder block as shown in the illustration.

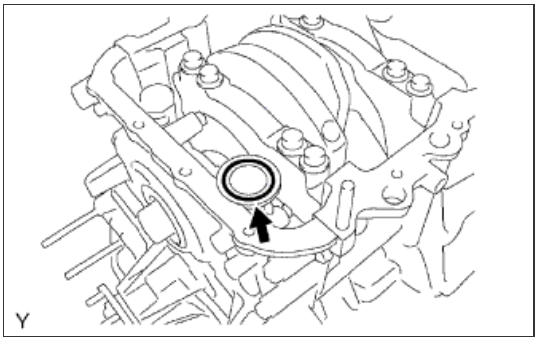
NOTICE:

Be careful not to damage the contact surfaces of the cylinder block and oil pan.



c. Remove the O-ring from the timing chain cover.

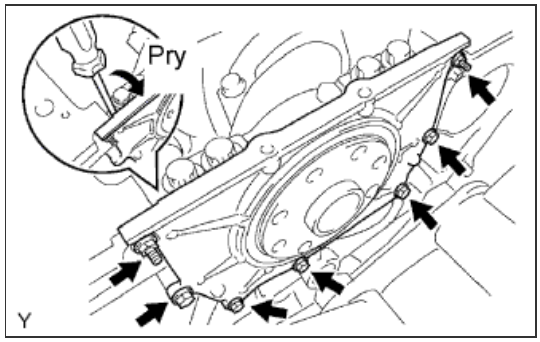
d. Remove the 4 stud bolts from the oil pan.



28. REMOVE ENGINE REAR OIL SEAL RETAINER

a. Remove the 5 bolts and 2 nuts.

b. Using a screwdriver, remove the oil seal retainer by prying between the oil seal retainer and crankshaft bearing cap.

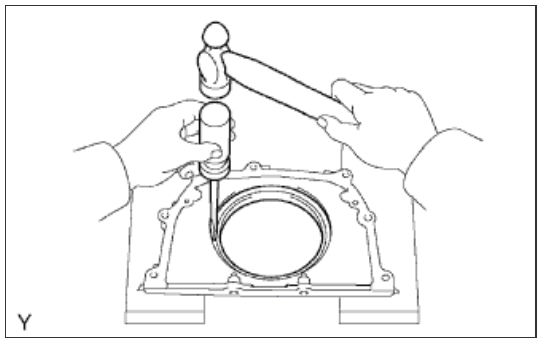


29. REMOVE REAR CRANKSHAFT OIL SEAL

a. Using a screwdriver and hammer, tap out the oil seal.

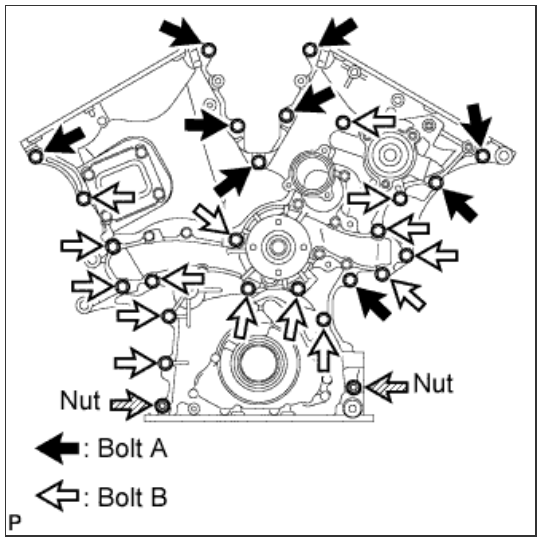
NOTICE:

Be careful not to damage the rear oil seal retainer.



30. REMOVE TIMING CHAIN COVER SUB-ASSEMBLY

a. Remove the 24 bolts labeled A and B, and the 2 nuts.

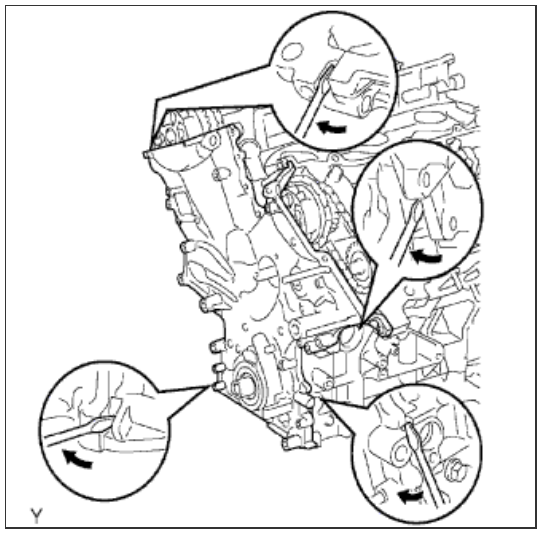


b. Remove the timing chain cover by prying between the timing chain cover and cylinder head or cylinder block with a screwdriver.

NOTICE:

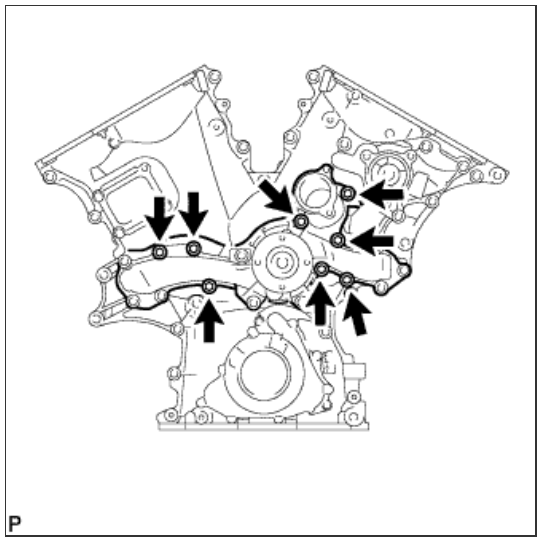
Be careful not to damage the contact surfaces of the timing chain cover, cylinder block and cylinder head.

c. Remove the O-ring from the cylinder head LH side.



31. REMOVE WATER PUMP ASSEMBLY

a. Remove the 8 bolts, water pump and gasket.



32. REMOVE FRONT CRANKSHAFT OIL SEAL

a. If the timing chain case is removed:

i. Using a screwdriver and wooden block, pry out the oil seal.

HINT:

Tape the screwdriver tip before use.

NOTICE:

Do not damage the surface of the oil seal press fit hole and crankshaft.

33. REMOVE NO. 1 CHAIN TENSIONER ASSEMBLY

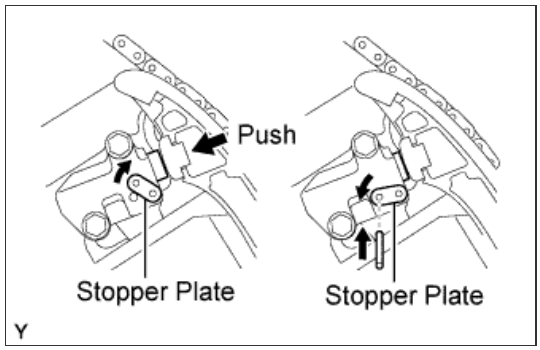
NOTICE:

- **Never rotate the crankshaft with the chain tensioner removed.**
- **When rotatin the camshaft with the timin chain removed, rotate the crankshaft counterclockwise 40 from the TDC first.**

a. While turning the stopper plate of the tensioner clockwise, push in the plunger of the chain tensioner as shown in the illustration.

b. While turning the stopper plate of the tensioner counterclockwise, insert a bar of φ3.5 mm (0.138 in.) into the holes on the stopper plate and tensioner to fi the stopper plate in place.

c. Remove the 2 bolts and chain tensioner.

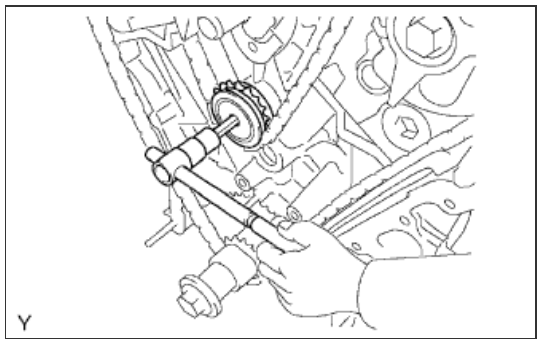


34. REMOVE CHAIN TENSIONER SLIPPER

a. Remove the chain tensioner slipper.

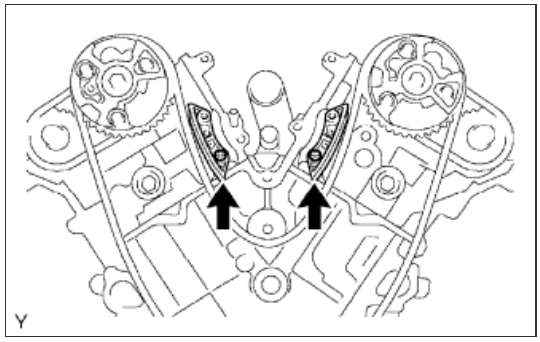
35. REMOVE NO. 1 IDLE GEAR SHAFT

a. Using a 10 mm he agon wrench, remove the No. 2 idle gear shaft, No. 1 idle gear and No. 1 idle gear shaft.



36. REMOVE NO. 2 CHAIN VIBRATION DAMPER

a. Remove the 2 No. 2 chain vibration dampers.

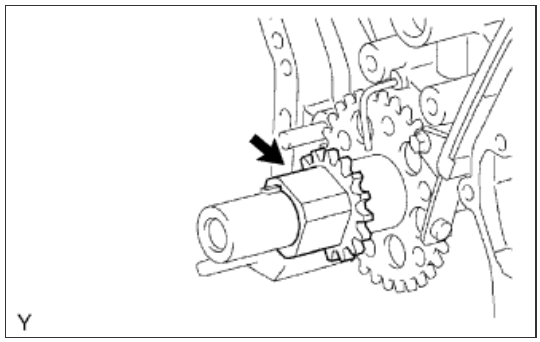


37. REMOVE NO. 1 CHAIN SUB-ASSEMBLY

a. Remove the No. 1 chain.

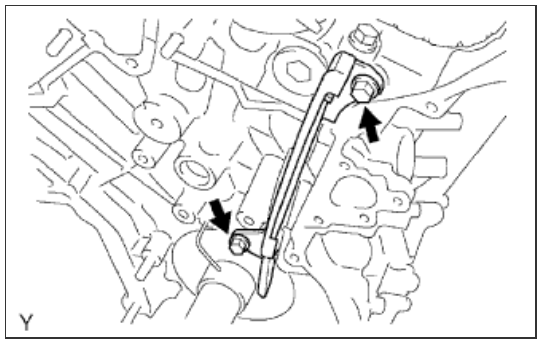
38. REMOVE CRANKSHAFT TIMING SPROCKET

a. Remove the crankshaft timing sprocket.



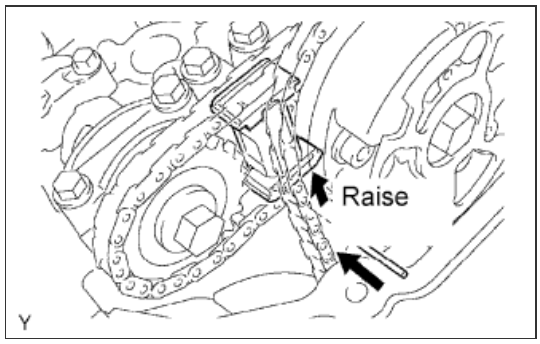
39. REMOVE NO. 1 CHAIN VIBRATION DAMPER

a. Remove the 2 bolts and No. 1 chain vibration damper.



40. REMOVE CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 1

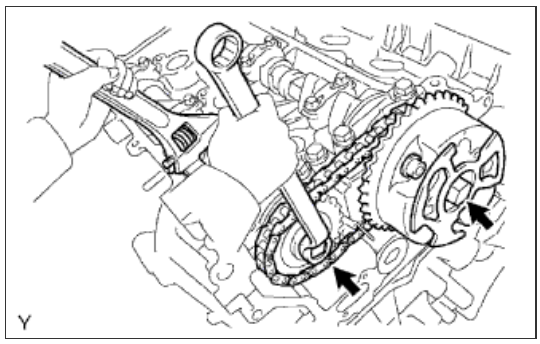
a. While raising the No. 2 chain tensioner, insert a pin of φ1.0 mm (0.0394 in.) into the hole to fi the tensioner in place.



b. Hold the he agonal portion of the camshaft with a wrench, and remove the 2 bolts, camshaft timing gear, camshaft timing sprocket and No. 2 chain.

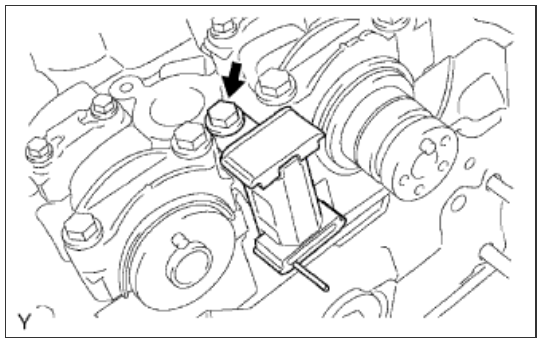
NOTICE:

- **Be careful not to dama the c linder head and valve lifter with the wrench.**
- **Do not disassemble the camshaft timin ear**



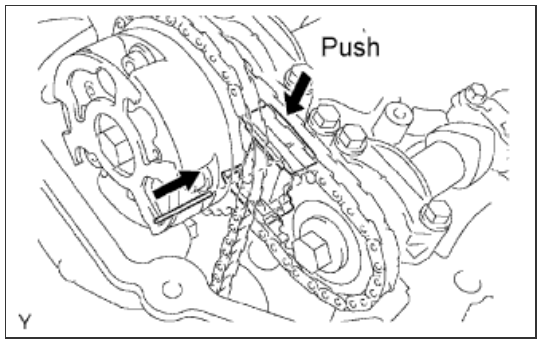
41. REMOVE NO. 2 CHAIN TENSIONER ASSEMBLY

a. Remove the bolt and No. 2 chain tensioner.



42. REMOVE CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 2

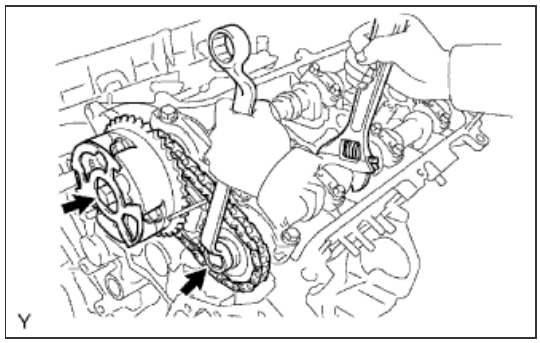
a. While raising the No. 3 chain tensioner, insert a pin of φ1.0 mm (0.0394 in.) into the hole to fi the tensioner in palace.



b. Hold the he agonal portion of the camshaft with a wrench, and remove the 2 bolts, camshaft timing gear, camshaft timing sprocket and No. 2 chain.

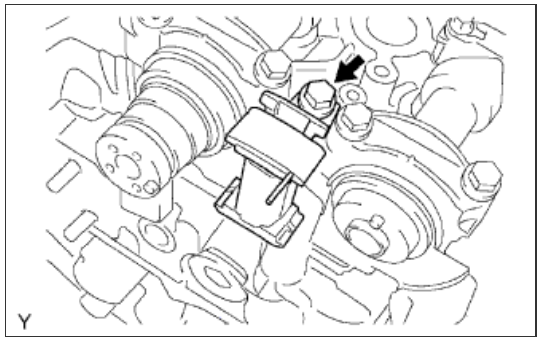
NOTICE:

- **Be careful not to dama the c linder head and valve lifter with the wrench.**
- **Do not disassemble the camshaft timin ear**



43. REMOVE NO. 3 CHAIN TENSIONER ASSEMBLY

a. Remove the bolt and No. 3 chain tensioner.



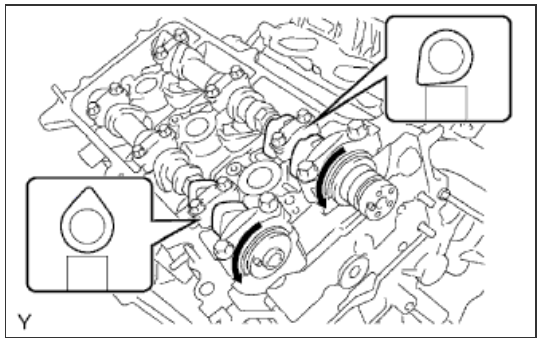
44. REMOVE NO. 1 CAMSHAFT AND NO. 2 CAMSHAFT (for Bank 1

NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

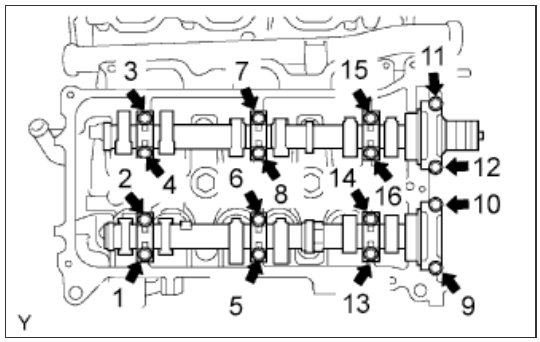
a. Remove the No. 1 and No. 2 camshafts.

i. Rotate the camshafts counterclockwise using a wrench so that the cam lobes of the No. 1 cylinder face each direction as shown in the illustration.

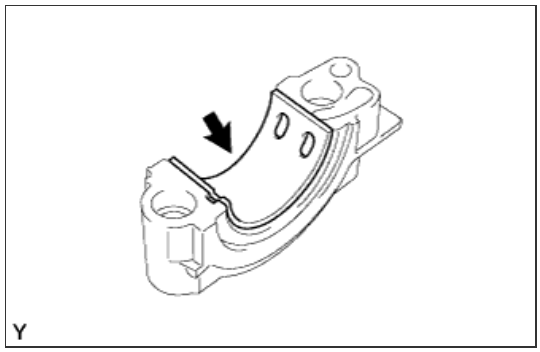


ii. Uniformly loosen and remove the 16 bearing cap bolts in the sequence shown in the illustration.

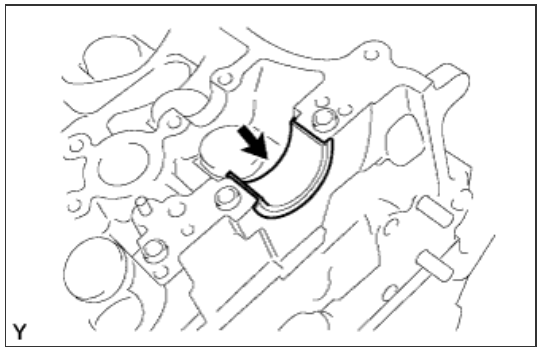
iii. Remove the 8 bearing caps and 2 camshafts.



45. REMOVE NO. 1 CAMSHAFT BEARING (for Bank 1



46. REMOVE NO. 2 CAMSHAFT BEARING (for Bank 1

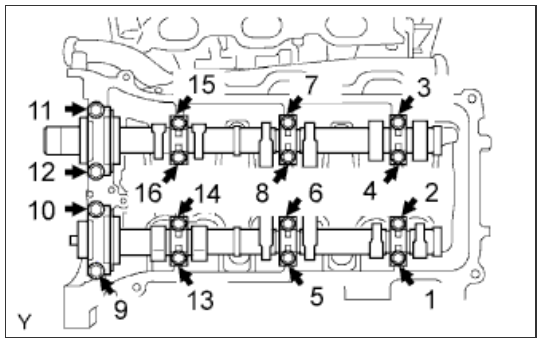


47. REMOVE NO. 3 CAMSHAFT AND NO. 4 CAMSHAFT (for Bank 2

a. Remove the No. 3 and No. 4 camshafts.

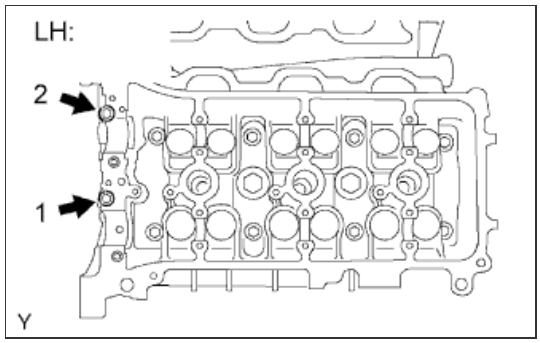
i. Uniformly loosen and remove the 16 bearing cap bolts in the sequence shown in the illustration.

ii. Remove the 8 bearing caps and 2 camshafts.



48. REMOVE CYLINDER HEADS

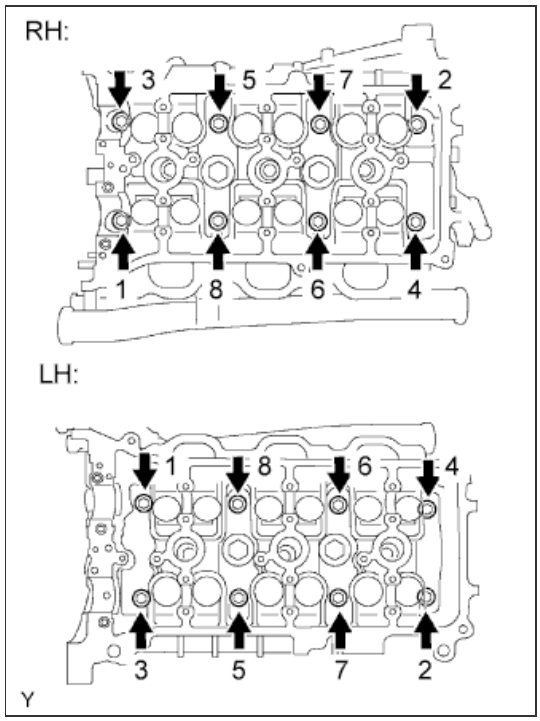
a. Using a 10 mm bi-he agon wrench, uniformly loosen the 2 bolts in the sequence shown in the illustration. Remove the 2 cylinder head bolts and plate washers.



b. Using a 10 mm bi-he agon wrench, uniformly loosen the 16 bolts in the sequence shown in the illustration. Remove the 16 cylinder head bolts and plate washers.

NOTICE:

- **Be careful not to drop the plate washers into the c linder head.**
- **C linder head warpa or crackin could result from removin bolts in the incorrect order.**



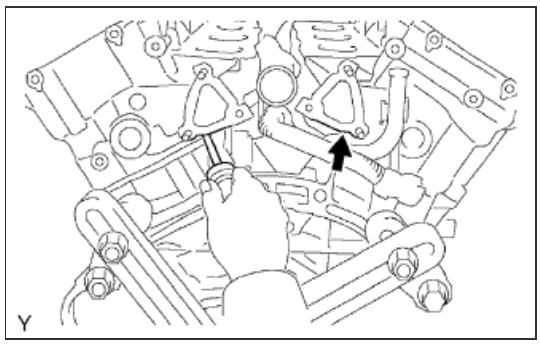
c. Lift the cylinder head from the dowels on the cylinder block, and place the 2 cylinder heads on wooden blocks on a bench.

NOTICE:

Be careful not to damage the contact surfaces of the cylinder head and cylinder block.

HINT:

If the cylinder head is difficult to lift off, pry between the cylinder head and cylinder block with a screwdriver.

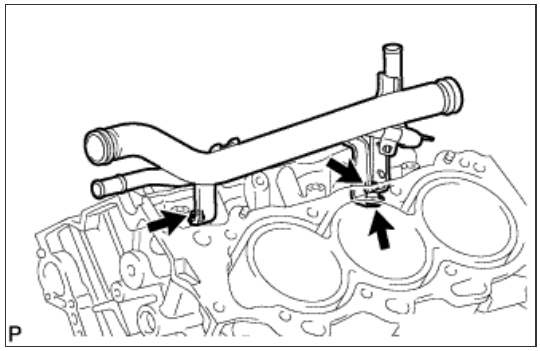


49. REMOVE CYLINDER HEAD GASKET

50. REMOVE NO. 2 CYLINDER HEAD GASKET

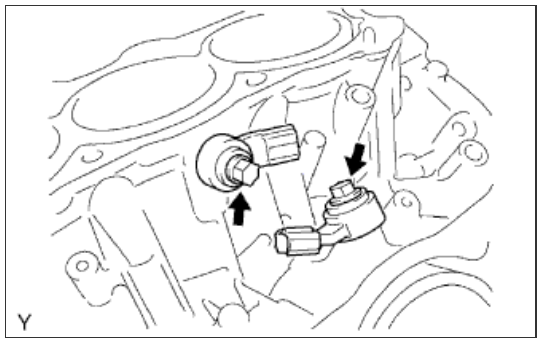
51. REMOVE NO. 1 WATER OUTLET PIPE

a. Remove the 3 bolts and water outlet pipe.



52. REMOVE KNOCK SENSOR

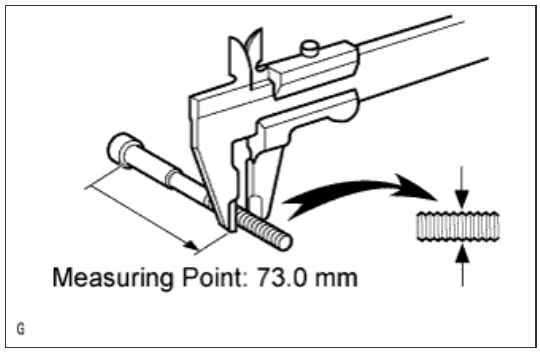
a. Remove the 2 bolts and 2 knock sensors.



for Preparation Click here

1. INSPECT CYLINDER HEAD SET BOLT

a. Using a vernier caliper, measure the outside thread diameter of the bolt.



Measuring point:
73.0 mm (2.87 in.)

Standard outside diameter:
10.85 to 11.0 mm (0.427 to 0.433 in.)

Minimum outside diameter:
10.7 mm (0.421 in.)

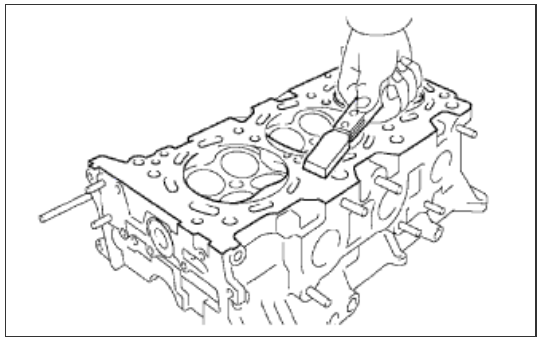
HINT:

If a visual check reveals no excessively thin areas, check the center of the bolt (see illustration) and find the area that has the smallest diameter.

If the diameter is less than the minimum, replace the cylinder head bolt.

2. CLEAN CYLINDER HEAD SUB-ASSEMBLY

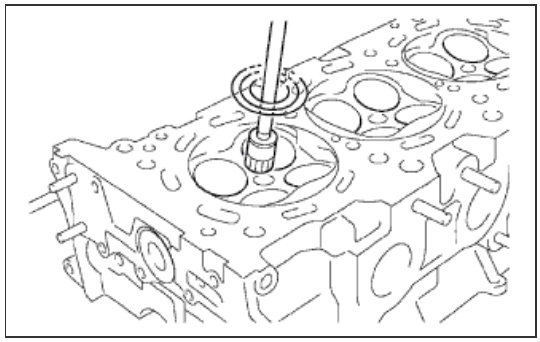
a. Using a gasket scraper, remove all the gasket material from the cylinder block contact surface.



NOTICE:

Be careful not to scratch the cylinder block contact surface.

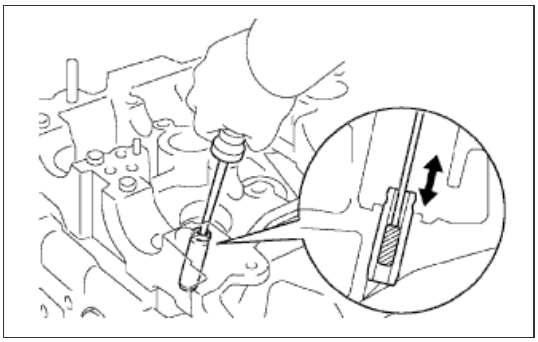
b. Using a wire brush, remove all the carbon from the combustion chambers.



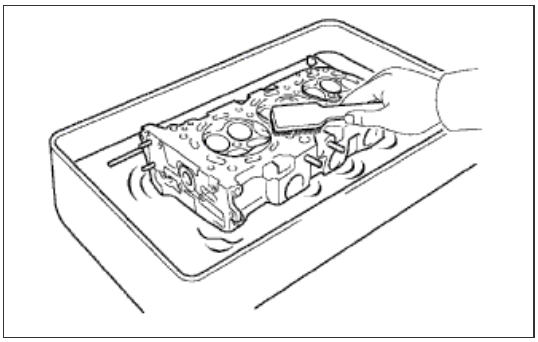
NOTICE:

Be careful not to scratch the combustion chambers.

c. Using a valve guide bushing brush and solvent, clean all the valve guide bushes.



d. Using a soft brush and solvent, thoroughly clean the cylinder head.



3. INSPECT CYLINDER HEAD SUB-ASSEMBLY

a. Using a precision straightedge and feeler gauge, measure the warpage of the contact surfaces of the cylinder block and manifolds.

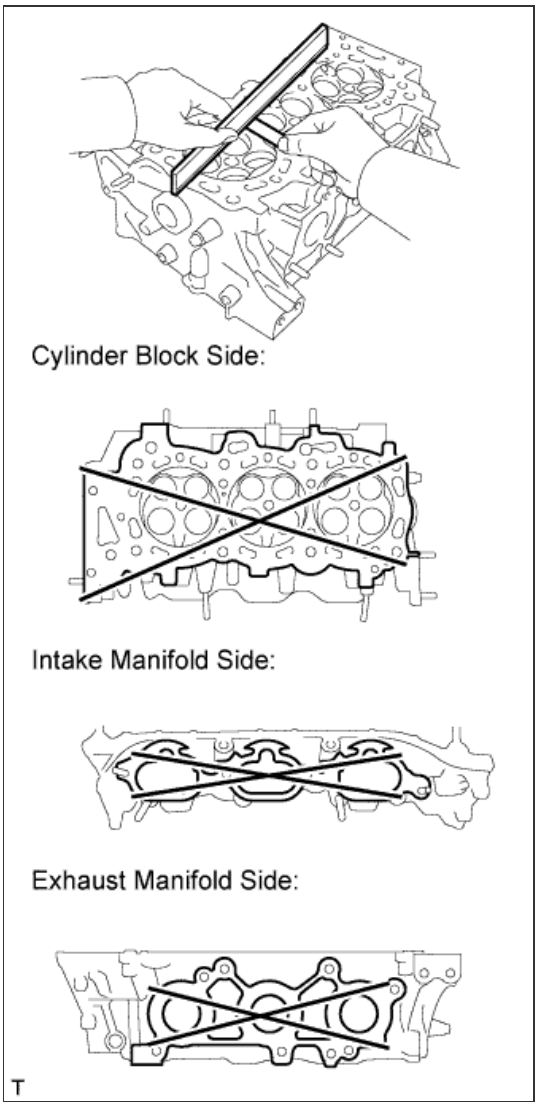
Standard Warpage:

Item	Specified Condition
Cylinder block side	0.05 mm (0.00197 in.)
Intake manifold side	0.08 mm (0.00315 in.)
Exhaust manifold side	0.08 mm (0.00315 in.)

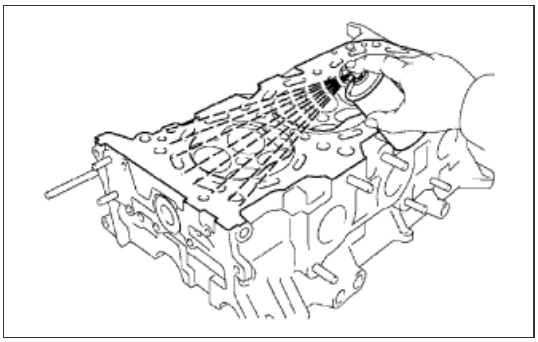
Maximum Warpage:

Item	Specified Condition
Cylinder block side	0.10 mm (0.00394 in.)
Intake manifold side	0.10 mm (0.00394 in.)
Exhaust manifold side	0.10 mm (0.00394 in.)

If the warpage is more than the maximum, replace the cylinder head sub-assembly.



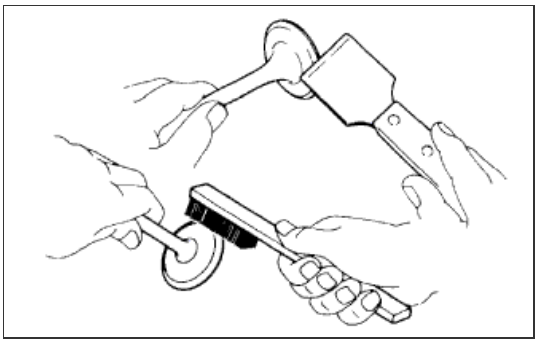
b. Using a dye penetrant, check the intake ports, exhaust ports and cylinder surface for cracks.
If there are cracks, replace the cylinder head sub-assembly.



4. CLEAN VALVE

a. Using a gasket scraper, chip off any carbon from the valve head.

b. Using a wire brush, thoroughly clean the valve.

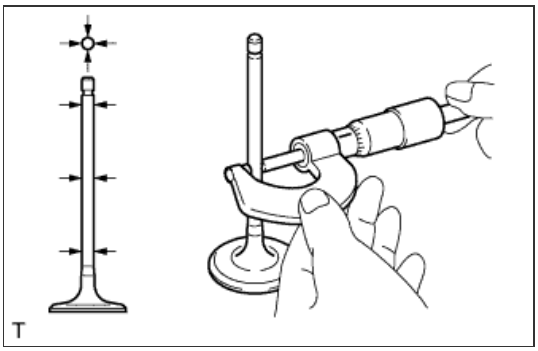


5. INSPECT VALVE

a. Using a micrometer, measure the diameter of the valve stem.

Standard Valve Stem Diameter:

Item	Specified Condition
Intake	5.470 to 5.485 mm (0.2154 to 0.2159 in.)
Exhaust	5.465 to 5.480 mm (0.2152 to 0.2156 in.)

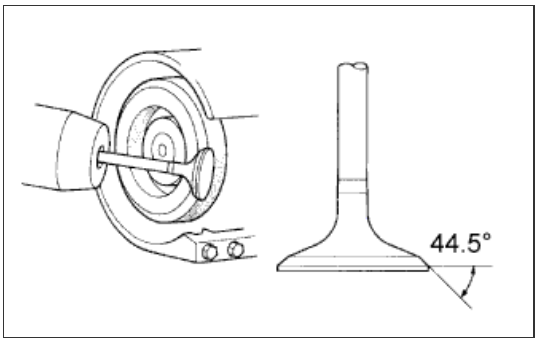


b. Inspect the valve face angle.

i. Grind the valve enough to remove pits and carbon.

ii. Check that the valve is ground to the correct valve face angle.

Standard valve face angle:
44.5°



c. Using a vernier caliper, measure the valve head margin thickness.

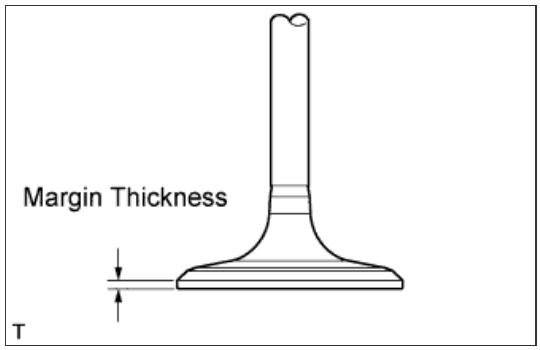
i. Using a vernier caliper, check the valve head margin thickness.

Standard margin thickness:
1.0 mm (0.0394 in.)

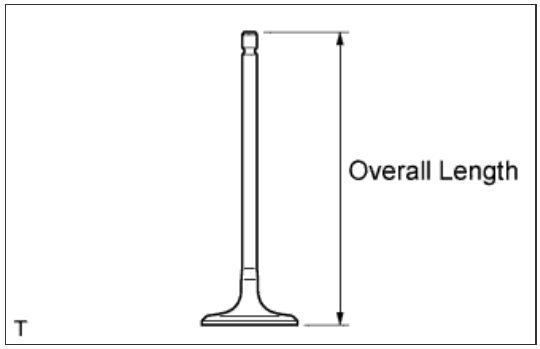
Minimum margin thickness:

0.5 mm (0.0197 in.)

If the margin thickness is less than the minimum, replace the valve.



d. Using a vernier caliper, measure the overall length of the valve.



i. Using a vernier caliper, check the overall length.

Standard Overall Length:

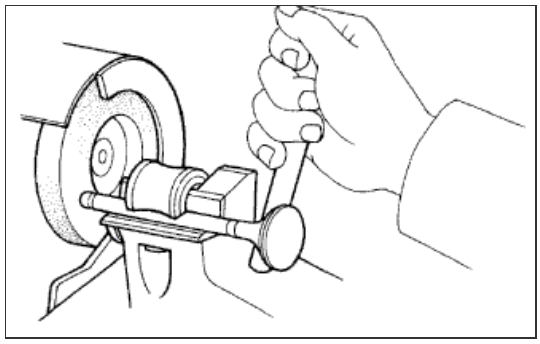
Item	Specified Condition
Intake	106.95 mm (4.21 in.)
Exhaust	105.80 mm (4.15 in.)

Minimum Overall Length:

Item	Specified Condition
Intake	106.40 mm (4.19 in.)
Exhaust	105.30 mm (4.15 in.)

If the overall length is less than the minimum, replace the valve.

e. Inspect the valve stem tip.



i. Check the surface of the valve stem tip for wear.

NOTICE:

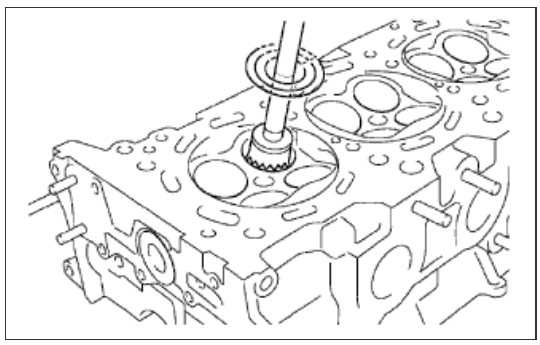
Do not grind the valve so it becomes shorter than the minimum overall length.

If the valve stem tip is worn, resurface the tip with a grinder or replace the valve.

6. CLEAN VALVE SEAT

a. Using a 45° carbide cutter, resurface the valve seats.

b. Clean the valve seats.



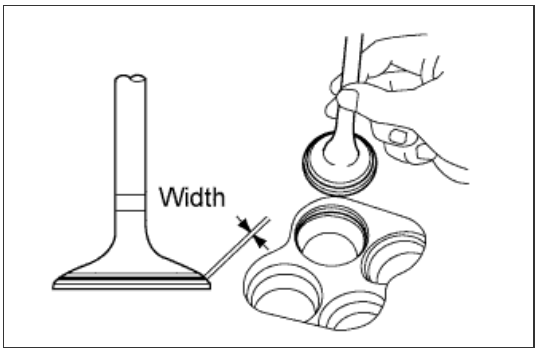
7. INSPECT VALVE SEAT

a. Apply a light coat of Prussian blue to the valve face.

b. Lightly press the valve face against the valve seat.

NOTICE:

Do not rotate the valve.



c. Check the valve face and valve seat by using the following procedure.

i. If Prussian blue appears around the entire valve face, the valve face is concentric. If not, replace the valve.

ii. If Prussian blue appears around the entire valve seat, the guide and valve face are concentric. If not, resurface the valve seat.

iii. Check that the seat contacts the middle of the valve face with the width below.

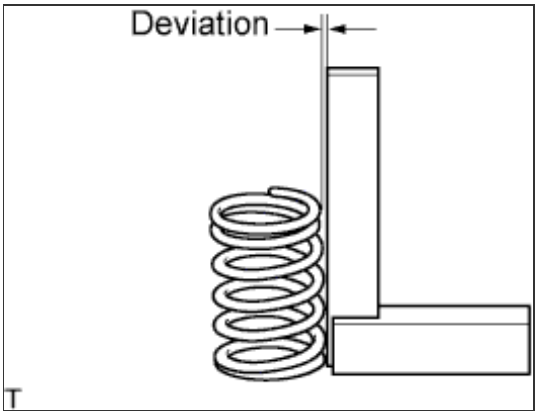
Standard idth:
1.0 to 1.4 mm (0.0394 to 0.0551 in.)

8. INSPECT INNER COMPRESSION SPRING

a. Using a steel square, measure the deviation of the inner compression spring.

Maximum deviation:
2.0 mm (0.0787 in.)

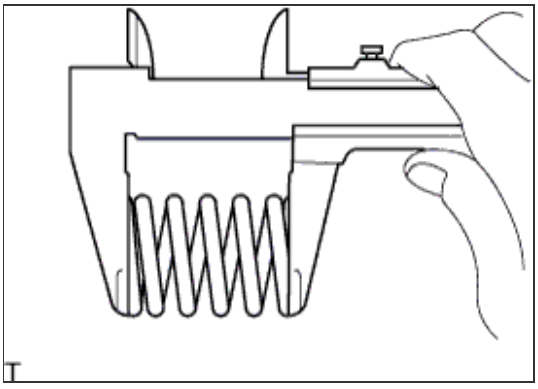
If the deviation is more than the maximum, replace the inner compression spring.



b. Using a vernier caliper, measure the free length of the inner compression spring.

Standard free length:
47.80 mm (1.88 in.)

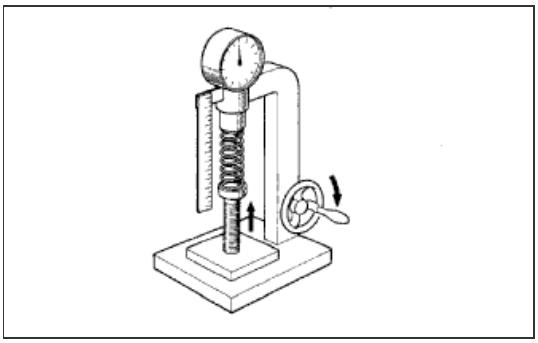
If the free length is not as specified, replace the inner compression spring.



c. Using a spring tester, measure the tension of the inner compression spring at the standard installed length.

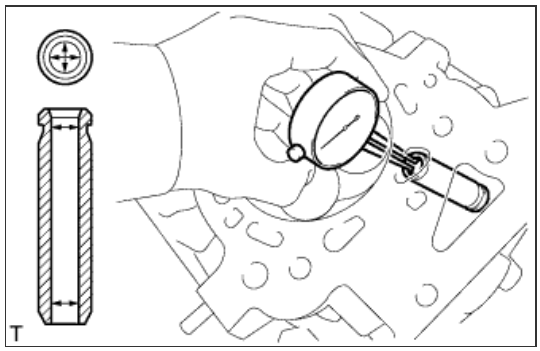
Standard installed tension:
186 to 206 N (19 to 21 kgf, 42 to 46 lbf) at 33.3 mm (1.31 in.)

If the installed tension is not as specified, replace the inner compression spring.



9. INSPECT VALVE GUIDE BUSH OIL CLEARANCE

a. Using a caliper gauge, measure the inside diameter of the guide bush.



Standard bush inside diameter:
5.51 to 5.53 mm (0.217 to 0.218 in.)

b. Subtract the valve stem diameter measurement from the guide bush inside diameter measurement.

Standard Oil Clearance:

Item	Specified Condition
Intake	0.025 to 0.060 mm (0.000984 to 0.00236 in.)
Exhaust	0.030 to 0.065 mm (0.00118 to 0.00256 in.)

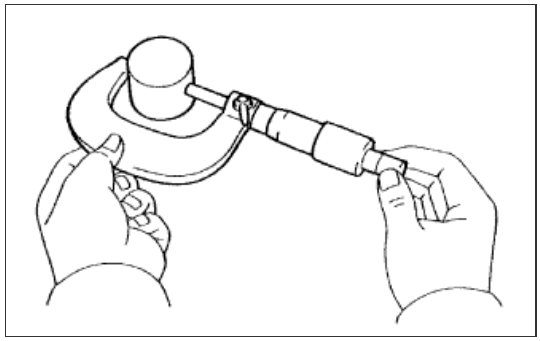
Maximum Oil Clearance:

Item	Specified Condition
Intake	0.08 mm (0.00315 in.)
Exhaust	0.10 mm (0.00394 in.)

If the oil clearance is more than the maximum, replace the valve and valve guide bush.

10. INSPECT VALVE LIFTER

a. Using a micrometer, measure the valve lifter diameter.

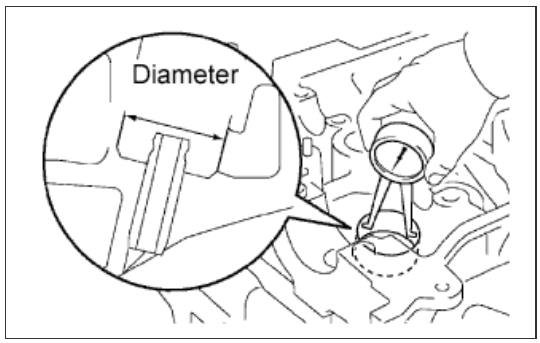


Standard valve lifter diameter:
30.966 to 30.976 mm (1.219 to 1.220 in.)

If the result is not as specified, replace the valve lifter.

11. INSPECT VALVE LIFTER OIL CLEARANCE

a. Using a caliper gauge, measure the lifter bore diameter of the cylinder head.



Standard lifter bore diameter:
31.009 to 31.025 mm (1.220 to 1.221 in.)

b. Subtract the valve lifter diameter measurement (see "Inspect Valve Lifter" procedure) from the lifter bore diameter measurement.

Standard oil clearance:
0.033 to 0.059 mm (0.00130 to 0.00232 in.)

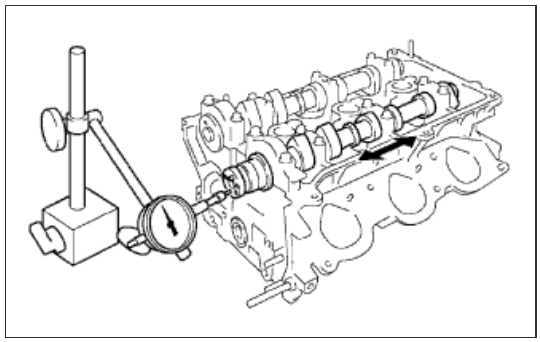
Maximum oil clearance:
0.08 mm (0.00315 in.)

If the oil clearance is more than the maximum, replace the valve lifter.
If necessary, replace the cylinder head.

12. INSPECT CAMSHAFT THRUST CLEARANCE

a. Install the camshafts (Click here).

b. Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.



Standard thrust clearance:
0.04 to 0.09 mm (0.00157 to 0.00354 in.)

Maximum thrust clearance:
0.11 mm (0.00433 in.)

If the thrust clearance is more than the maximum, replace the camshafts.
If necessary, replace the camshaft bearing caps and cylinder head as a set.

13. INSPECT CAMSHAFT OIL CLEARANCE

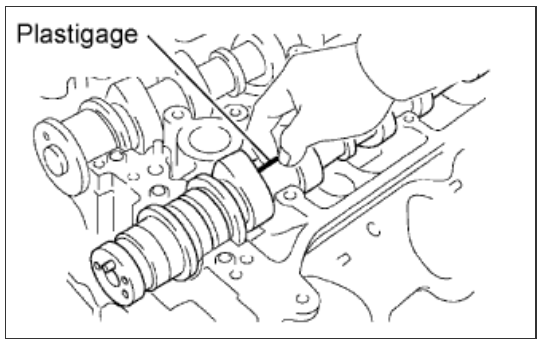
a. Clean the camshaft bearing caps, camshaft bearings and camshaft journals.

b. Install the camshaft bearing (Click here).

c. Place the camshafts on the cylinder head.

d. Lay a strip of Plastigage across each of the camshaft journals.

e. Install the camshaft bearing caps (Click here).

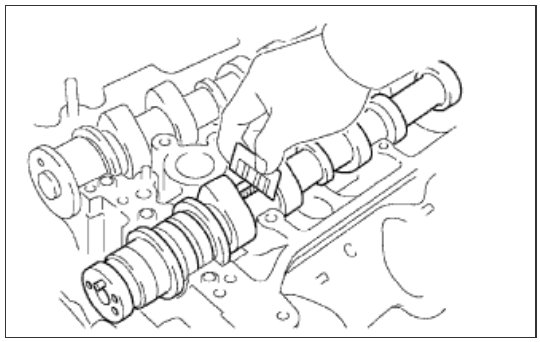


NOTICE:

Do not turn the camshafts.

f. Remove the camshaft bearing caps (Click here).

g. Measure the Plastigage at its widest point.



Standard Oil Clearance (for Cylinder Head RH):

Item	Specified Condition
No. 1 (Intake)	0.008 to 0.038 mm (0.000315 to 0.00150 in.)
No. 1 (Exhaust)	0.040 to 0.079 mm (0.00157 to 0.00311 in.)
Others	0.025 to 0.062 mm (0.000984 to 0.00244 in.)

Standard Oil Clearance (for Cylinder Head LH):

Item	Specified Condition
No. 1	0.040 to 0.079 mm (0.00157 to 0.00311 in.)
Others	0.025 to 0.062 mm (0.000984 to 0.00244 in.)

Maximum Oil Clearance (for Cylinder Head RH):

Item	Specified Condition
No. 1 (Intake)	0.07 mm (0.00276 in.)
Others	0.10 mm (0.00394 in.)

Maximum Oil Clearance (for Cylinder Head LH):

Item	Specified Condition
-	0.10 mm (0.00394 in.)

If the oil clearance is more than the maximum, replace the camshaft bearings and/or camshaft.
If necessary, replace the camshaft bearing caps and cylinder head together.

Reference:

Item	Specified Condition
Cylinder head journal bore diameter	40.009 to 40.017 mm (1.5752 to 1.5755 in.)

Camshaft bearing center wall thickness (Mark "2")	2.004 to 2.008 mm (0.0789 to 0.0791 in.)
Camshaft journal diameter	35.971 to 35.985 mm (1.4162 to 1.4167 in.)

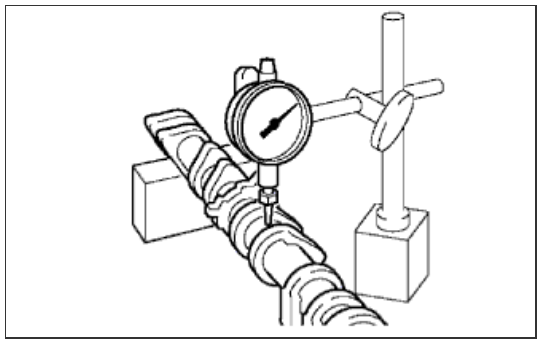
h. Remove the Plastigage completely.

i. Remove the camshafts.

. Remove the camshaft bearing.

14. INSPECT CAMSHAFT

a. Inspect the camshaft runout.



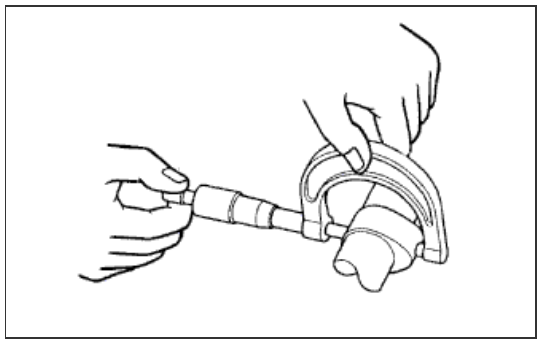
i. Place the camshaft on V-blocks.

ii. Using a dial indicator, measure the runout at the center journal.

Maximum runout:
0.06 mm (0.00236 in.)

If the runout is more than the maximum, replace the camshaft.

b. Inspect the cam lobes.



i. Using a micrometer, measure the cam lobe height.

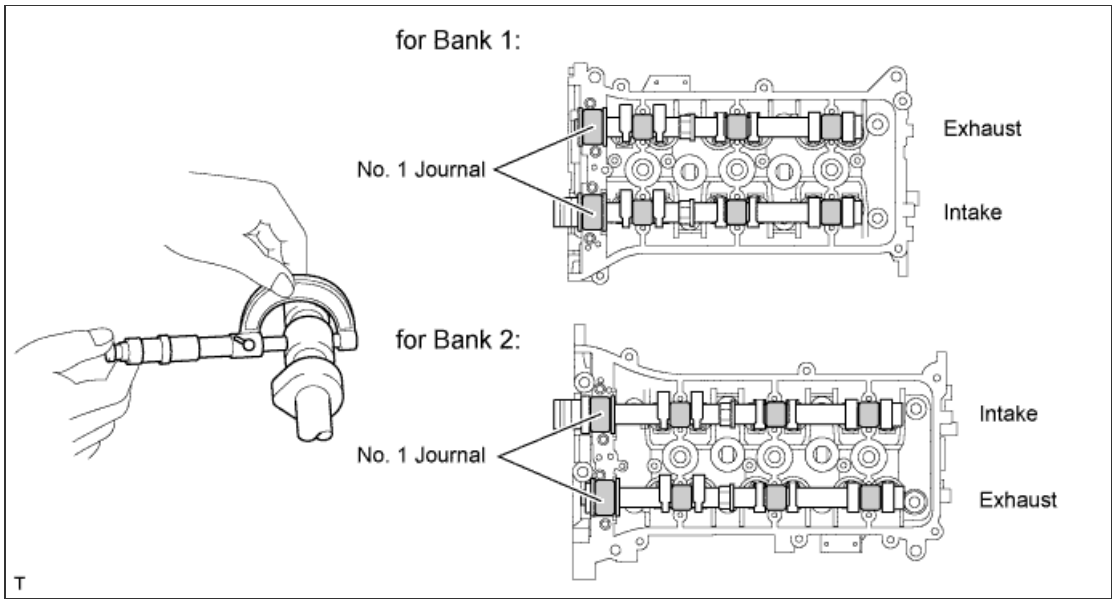
Standard Cam Lobe Height:

Item	Specified Condition
Intake	44.168 to 44.268 mm (1.739 to 1.742 in.)
Exhaust	44.580 to 44.680 mm (1.755 to 1.759 in.

Minimum Cam Lobe Height:

Item	Specified Condition
Intake	44.018 mm (1.73 in.)
Exhaust	44.430 mm (1.75 in.)

If the cam lobe height is less than the minimum, replace the camshaft.



c. Inspect the camshaft journals.

i. Using a micrometer, measure the journal diameter.

Standard ournal Diameter:

Item	Specified Condition
No. 1	35.971 to 35.985 mm (1.416 to 1.417 in.)
Other	22.959 to 22.975 mm (0.904 to 0.905 in.)

If the journal diameter is not as specified, check the oil clearance.

15. INSPECT CAMSHAFT TIMING GEAR ASSEMBLY

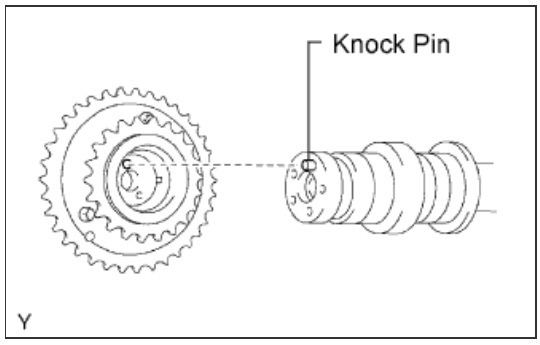
a. Fix the intake camshaft with a vise.

NOTICE:

Be careful not to damage the camshaft.

b. Align the knock pin hole in the camshaft timing gear with the knock pin of the camshaft, and install the camshaft timing gear with the bolt.

Torque:
100 N*m{ 1020 kgf*cm , 74 ft.*lbf }



c. Confirm the camshaft timing gear is locked.

d. Release the lock pin.

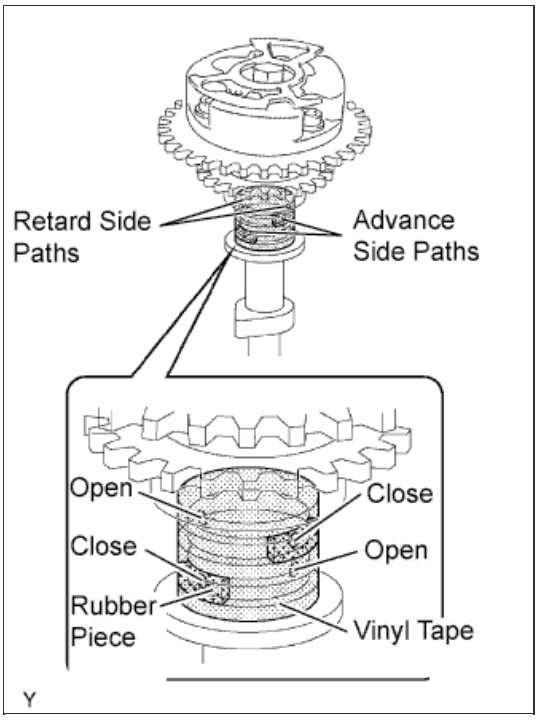
i. Cover the 4 oil paths of the cam journal with vinyl tape as shown in the illustration.

HINT:

One of the 2 grooves on the cam journal is for retard side paths (upper) and the other is for advance side paths (lower). Each groove has 2 oil paths. Plug one of the oil paths for each groove with rubber pieces as shown in the illustration before wrapping the

cam journal with tape.

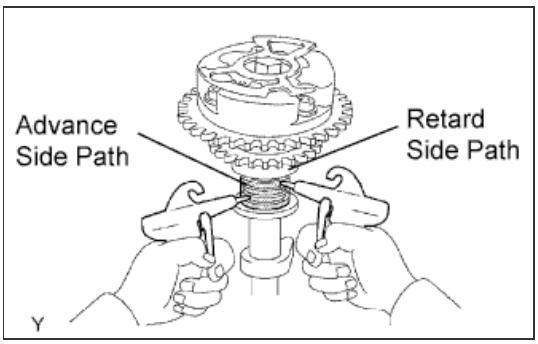
ii. Prink a hole in the tape at the 2 oil holes not plugged with rubber pieces.



iii. Apply about 200 kPa (2.0 kgf/cm^2, 28 psi) of air pressure to the two broken paths (the advance side path and the retard side path).

NOTICE:

Cover the paths with a cloth to avoid oil splashing.

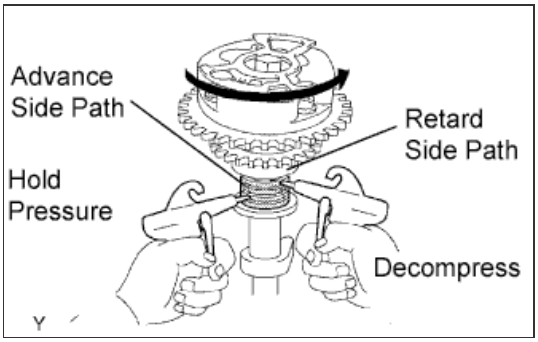


iv. Confirm that the camshaft timing gear rotates in the advance direction when reducing the air pressure applied to the retard path.

HINT:

When the lock pin is released, the camshaft timing gear rotates in the advance direction.

v. When the camshaft timing gear comes to the most advanced position, release the air pressure from the retard side path, and then release the air pressure from the advance side path.



NOTICE:

The camshaft timing gear occasionally shifts to the retard side abruptly if air compression of the advanced side path is released first. This often results in the breakage of the lock pin.

e. Check for smooth rotation.

i. Except the position where the lock pin meets at the most retarded angle, turn the camshaft timing gear back and forth and check the movable range and that there is no disturbance.

Standard:
Movable smoothly in the range of about 31°

NOTICE:

Be sure to perform this check by hand, instead of with air pressure.

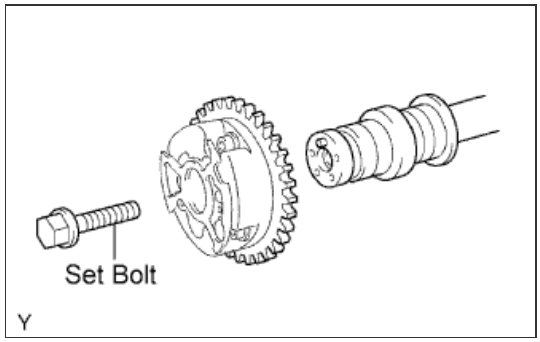
f. Check the lock in the most retarded position.

i. Confirm that the camshaft timing gear is locked at the most retarded position.

g. Remove the set bolt and camshaft timing gear.

NOTICE:

Be sure not to remove the other 3 bolts.



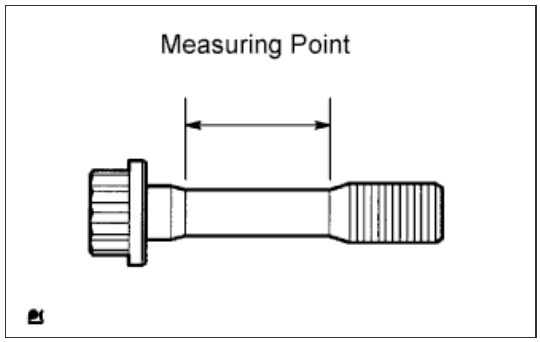
16. INSPECT CONNECTING ROD BOLT

a. Using a vernier caliper, measure the tension portion diameter of the bolt.

Standard diameter:
7.2 to 7.3 mm (0.283 to 0.287 in.)

Minimum diameter:
7.0 mm (0.276 in.)

If the diameter is less than the minimum, replace the connecting rod bolt.

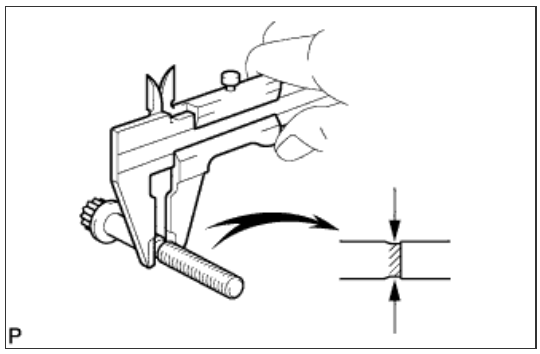


17. INSPECT CRANKSHAFT BEARING CAP SET BOLT

a. Using a vernier caliper, measure the tension portion diameter of the bolt.

Standard diameter:
10.0 to 10.2 mm (0.394 to 0.402 in.)

If the diameter is less than the minimum, replace the crankshaft bearing cap set bolt.

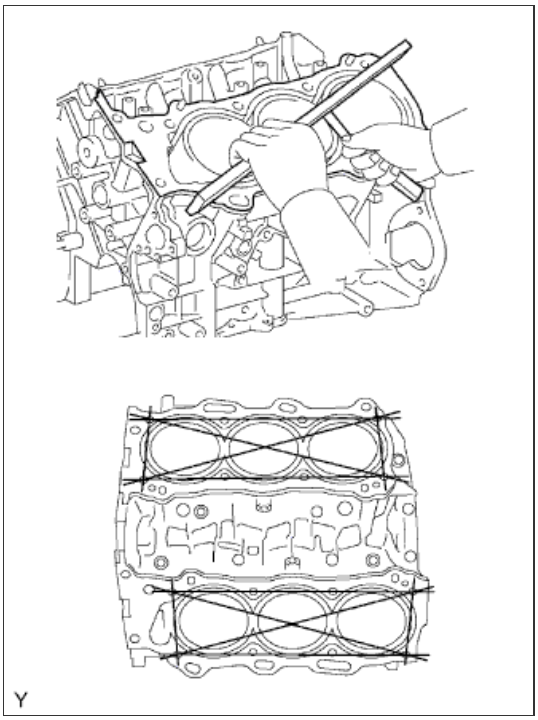


18. INSPECT CYLINDER BLOCK FOR FLATNESS

a. Using a precision straightedge and feeler gauge, measure the warpage of the contact surface of the cylinder head gasket.

Maximum warpage:
0.05 mm (0.00197 in.)

If the warpage is more than the maximum, replace the cylinder block.



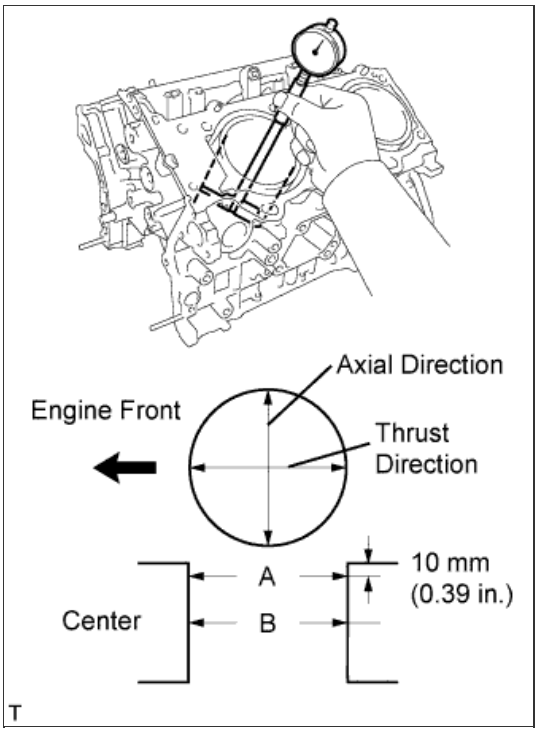
19. INSPECT CYLINDER BORE

a. Using a cylinder gauge, measure the cylinder bore diameter at positions A and B in the thrust and axial directions.

Standard diameter:
94.000 to 94.012 mm (3.7008 to 3.7013 in.)

Maximum diameter:
94.132 mm (3.7060 in.)

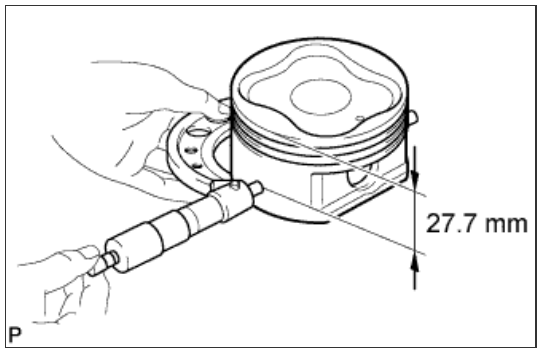
If the diameter is more than the maximum, replace the cylinder block.



20. INSPECT PISTON WITH PIN SUB-ASSEMBLY

a. Using a micrometer, measure the piston diameter at a right angle to the piston pin center line, 27.7 mm (1.091 in.) from the piston head.

Piston diameter:
93.910 to 93.920 mm (3.6972 to 3.6976 in.)



21. INSPECT PISTON OIL CLEARANCE

a. Subtract the piston diameter measurement from the cylinder bore diameter measurement.

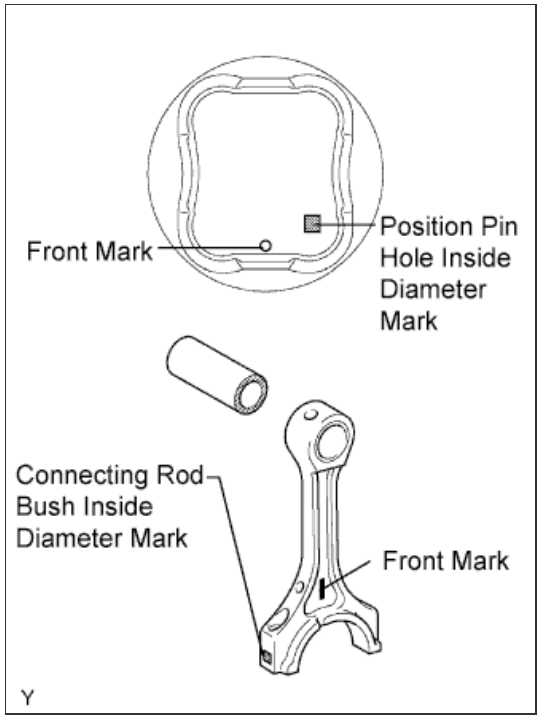
Standard oil clearance:
0.080 to 0.102 mm (0.00315 to 0.00401 in.)

Maximum oil clearance:
0.13 mm (0.00512 in.)

If the oil clearance is more than the maximum, replace all 6 pistons. If necessary, replace the cylinder block.

22. INSPECT PISTON PIN OIL CLEARANCE

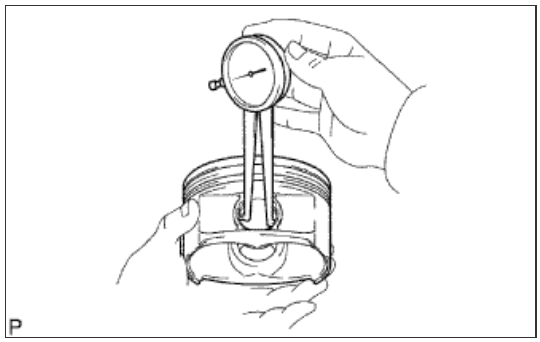
a. Check each mark on the piston and connecting rod.



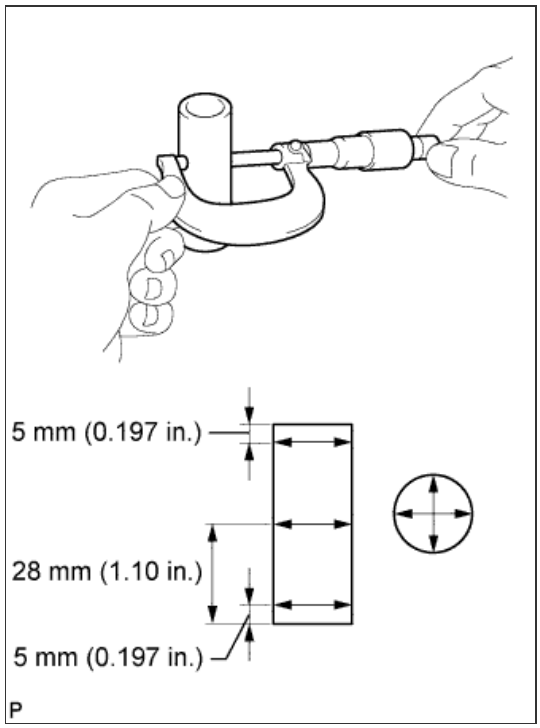
b. Using a caliper gauge, measure the inside diameter of the piston pin hole.

Standard Piston Pin Hole Inside Diameter:

Mark	Specified Condition
A	22.001 to 22.004 mm (0.86618 to 0.86630 in.)
B	22.005 to 22.007 mm (0.86634 to 0.86642 in.)
C	22.008 to 22.010 mm (0.86645 to 0.86653 in.)



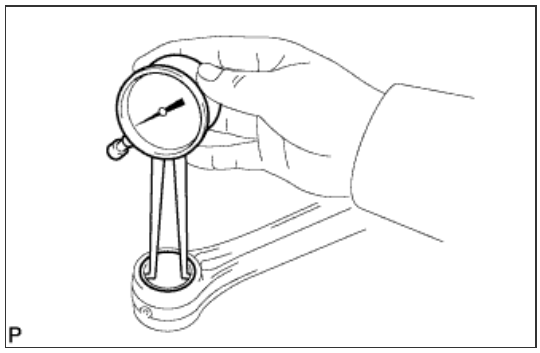
c. Using a micrometer, measure the piston pin diameter.



Standard Piston Pin Diameter:

Mark	Specified Condition
A	21.997 to 22.000 mm (0.86602 to 0.86614 in.)
B	22.001 to 22.003 mm (0.86618 to 0.86626 in.)
C	22.004 to 22.006 mm (0.86630 to 0.86642 in.)

d. Using a caliper gauge, measure the inside diameter of the connecting rod bush.



Standard Bush Inside Diameter:

Mark	Specified Condition
A	22.005 to 22.008 mm (0.86634 to 0.86645 in.)
B	22.009 to 22.011 mm (0.86649 to 0.86657 in.)
C	22.012 to 22.014 mm (0.86661 to 0.86669 in.)

e. Subtract the piston pin diameter measurement from the piston pin hole diameter measurement.

Standard oil clearance:
0.001 to 0.007 mm (0.0000394 to 0.000276 in.)

Maximum oil clearance:
0.040 mm (0.00157 in.)

If the oil clearance is more than the maximum, replace the piston and piston pin as a set.

f. Subtract the piston pin diameter measurement from the bush inside diameter measurement.

Standard oil clearance:
0.005 to 0.011 mm (0.000197 to 0.000433 in.)

Maximum oil clearance:
0.050 mm (0.00197 in.)

If the oil clearance is more than the maximum, replace the bush (Click here). If necessary, replace the connecting rod and piston pin as a set.

23. INSPECT RING GROOVE CLEARANCE

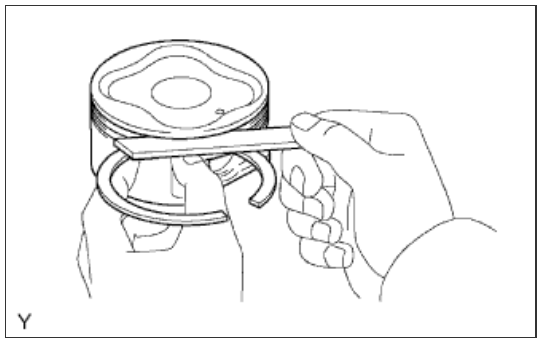
a. Using a feeler gauge, measure the clearance between a new piston ring and the wall of the ring groove.

Standard Ring Groove Clearance:

Item	Specified Condition
No. 1 Compression Ring	0.02 to 0.07 mm (0.000787 to 0.00276 in.)

No. 2 Compression Ring	0.02 to 0.06 mm (0.000787 to 0.00236 in.)
Oil Ring	0.07 to 0.15 mm (0.00276 to 0.00590 in.)

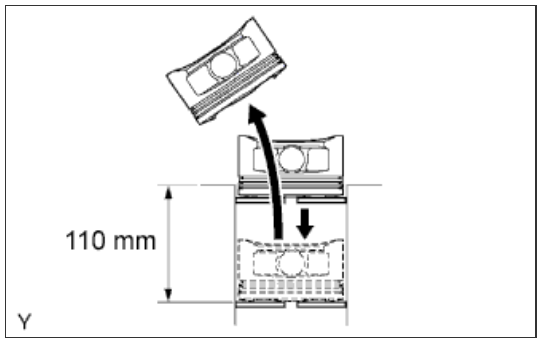
If the clearance is not as specified, replace the piston with pin sub-assembly.



24. INSPECT PISTON RING END GAP

a. Insert the piston ring into the cylinder bore.

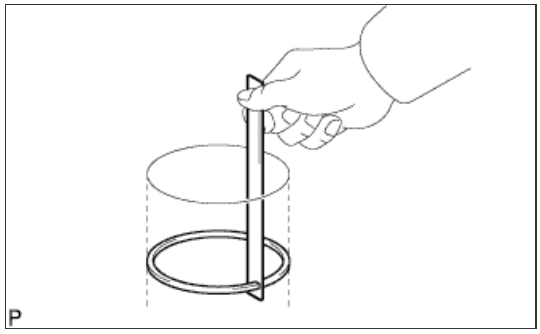
b. Using a piston, push the piston ring a little beyond the bottom of the ring travel, 110 mm (4.33 in.) from the top of the cylinder block.



c. Using a feeler gauge, measure the end gap.

Standard End Gap:

Item	Specified Condition
No. 1 Compression Ring	0.30 to 0.40 mm (0.0118 to 0.0157 in.)
No. 2 Compression Ring	0.40 to 0.50 mm (0.0157 to 0.0197 in.)
Oil Ring (side rail)	0.10 to 0.40 mm (0.00394 to 0.0157 in.)



Maximum End Gap:

Item	Specified Condition
No. 1 Compression Ring	1.0 mm (0.0394 in.)
No. 2 Compression Ring	1.1 mm (0.0433 in.)
Oil Ring (side rail)	1.0 mm (0.0394 in.)

If the end gap is more than the maximum, replace the piston ring. If the end gap is more than the maximum even with a new piston ring, rebore all 6 cylinders or replace the cylinder block sub-assembly.

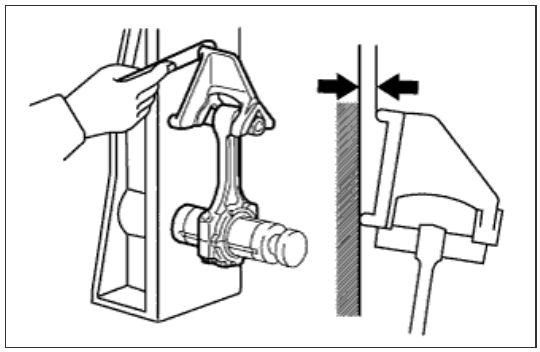
25. INSPECT CONNECTING ROD SUB-ASSEMBLY

a. Using a rod aligner and feeler gauge, check the connecting rod alignment.

i. Check for bend.

Maximum bend:
0.05 mm (0.00197 in.) per 100 mm (3.94 in.)

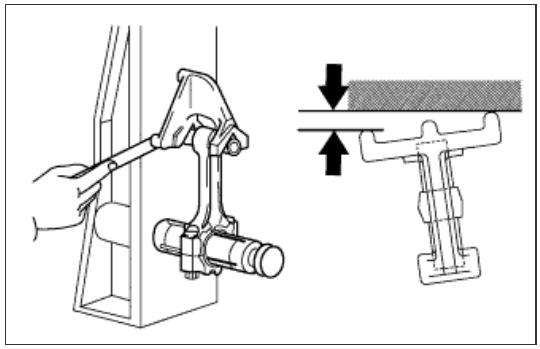
If the bend is more than the maximum, replace the connecting rod sub-assembly.



ii. Check for twist.

Maximum t ist:
0.15 mm (0.00591 in.) per 100 mm (3.94 in.)

If the twist is more than the maximum, replace the connecting rod sub-assembly.

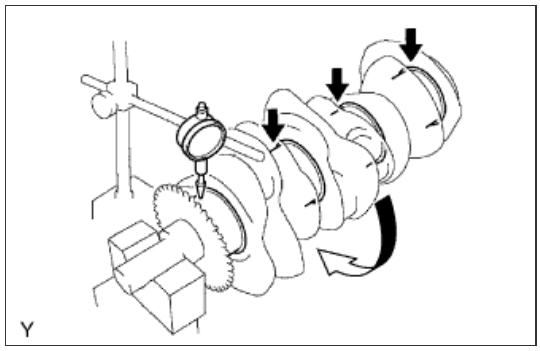


26. INSPECT CRANKSHAFT

a. Using a dial indicator and V-blocks, measure the runout as shown in the illustration.

Maximum circle runout:
0.06 mm (0.00236 in.)

If the circle runout is more than the maximum, replace the crankshaft.



b. Using a micrometer, measure the diameter of each main journal.

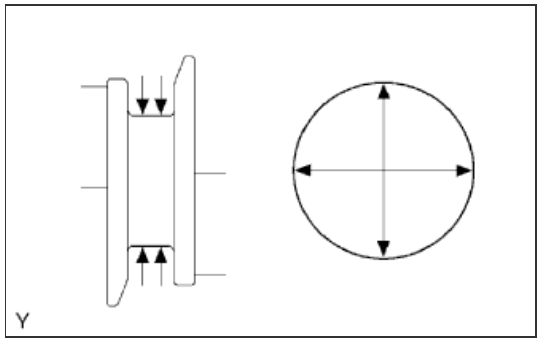
Standard diameter:
71.988 to 72.000 mm (2.8342 to 2.8346 in.)

If the diameter is not as specified, check the oil clearance. If necessary, replace the crankshaft.

c. Check each main journal for taper and out-of-round as shown in the illustration.

Maximum taper and out-of-round:
0.02 mm (0.000787 in.)

If the taper and out-of-round is more than the maximum, replace the crankshaft.



d. Using a micrometer, measure the diameter of each crank pin.

Standard diameter:
55.992 to 56.000 mm (2.2044 to 2.2047 in.)

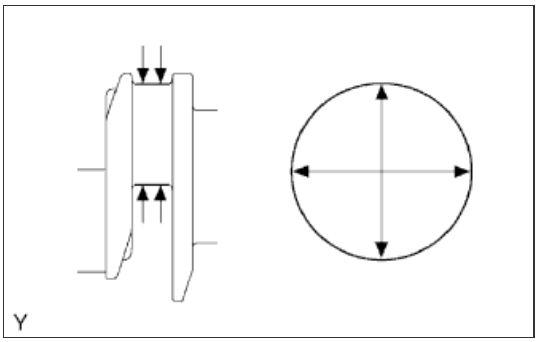
If the diameter is not as specified, check the oil clearance. If necessary, replace the crankshaft.

e. Check each crank pin for taper and out-of-round as shown in the illustration.

Maximum taper and out-of-round:

0.02 mm (0.000787 in.)

If the taper and out-of-round is more than the maximum, replace the crankshaft.



27. INSPECT CRAN SHAFT THRUST CLEARANCE

a. Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

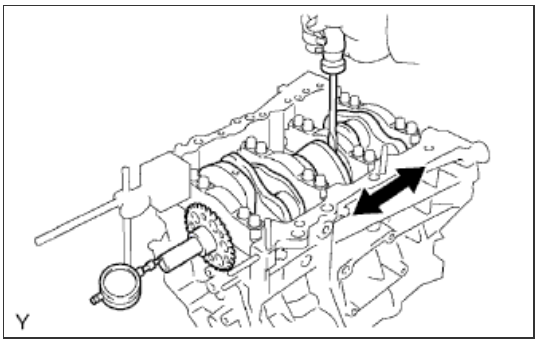
Standard thrust clearance:
0.04 to 0.24 mm (0.00157 to 0.00945 in.)

Maximum thrust clearance:
0.30 mm (0.0118 in.)

If the thrust clearance is more than the maximum, replace the thrust washers as a set.

Standard thrust washer thickness:
1.93 to 1.98 mm (0.0760 to 0.0780 in.)

If necessary, replace the crankshaft.

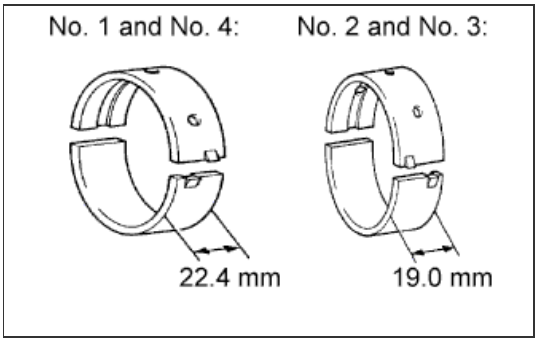


28. INSPECT CRANKSHAFT OIL CLEARANCE

HINT:

Main bearings come in widths of 19.0 mm (0.748 in.) and 22.4 mm (0.882 in.). Install the 22.4 mm (0.882 in.) bearings in the No. 1 and No. 4 cylinder block journal positions with the main bearing caps. Install the 19.0 mm (0.748 in.) bearings in the No. 2 and No. 3 positions.

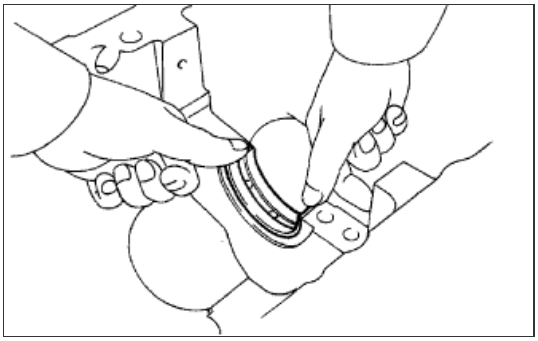
a. Clean each main journal and bearing.



b. Align the bearing claw with the claw groove of the cylinder block, and push in the 4 upper bearings.

NOTICE:

- **Do not apply engine oil to the bearings and contact surfaces.**
- **Do not allow coolant to come into contact with the bearing inner surface.**
- **If any coolant comes into contact with the bearing inner surface, replace the bearing with a new one.**



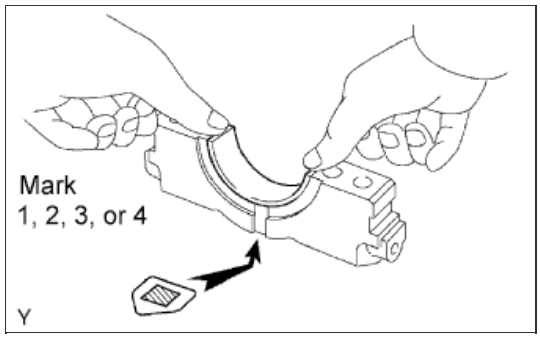
c. Align the bearing claw with the claw groove of the main bearing cap, and push in the 4 lower bearings.

NOTICE:

- **Do not apply engine oil to the bearings and contact surfaces.**
- **Do not allow coolant to come into contact with the bearing inner surface.**
- **If any coolant comes into contact with the bearing inner surface, replace the bearing with a new one.**

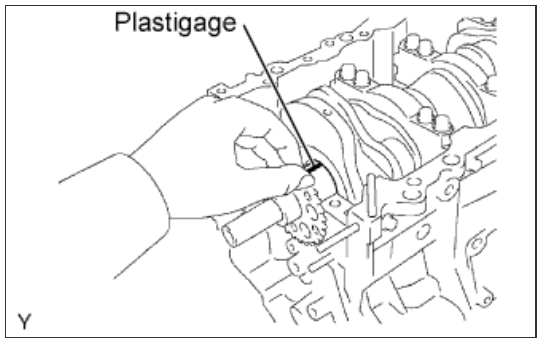
HINT:

A number marked on each main bearing cap indicates the installation position.



d. Place the crankshaft on the cylinder block.

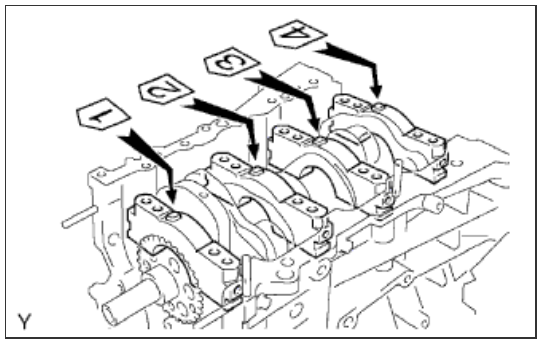
e. Lay a strip of Plastigage across each journal.



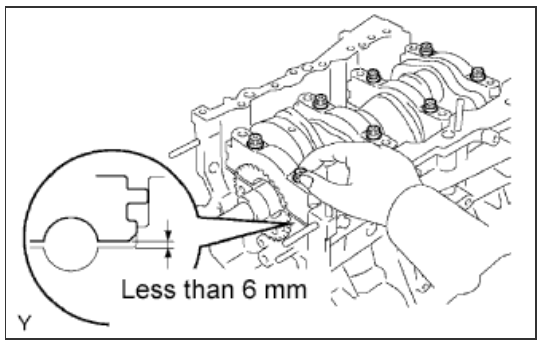
f. Examine the front marks and numbers and set the crankshaft bearing caps on the cylinder block.

g. Apply a light coat of engine oil to the threads of the crankshaft bearing cap bolts.

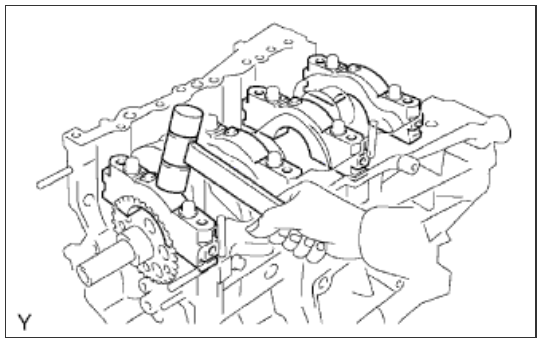
h. Temporarily install the 8 crankshaft bearing cap bolts to the inside positions.



i. Tighten the 2 bolts for each bearing cap until the clearance between the crankshaft bearing cap and the cylinder block becomes less than 6 mm (0.236 in.).

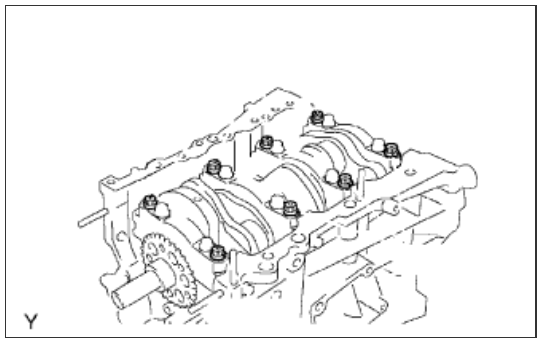


j. Using a plastic-faced hammer, lightly tap the crankshaft bearing cap to ensure a proper fit.



k. Apply a light coat of engine oil to the threads of the crankshaft bearing bolts and

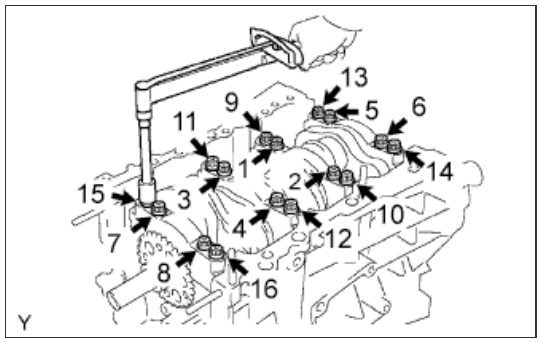
temporarily install the 8 crankshaft bearing cap bolts to the outside positions.



l. Step 1:

i. Uniformly tighten the 16 bolts in several steps in the order shown in the illustration.

Tor ue:
1 N*m{ 622 kgf*cm , 45 ft.*lbf }



m. Step 2:

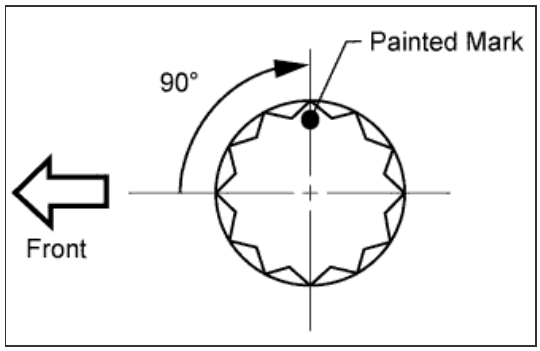
i. Mark the front side of the crankshaft bearing cap bolts with paint.

ii. Tighten the bearing cap bolts 90° in the order shown in step 1.

n. Check that the painted marks are now at a 90° angle to the front.

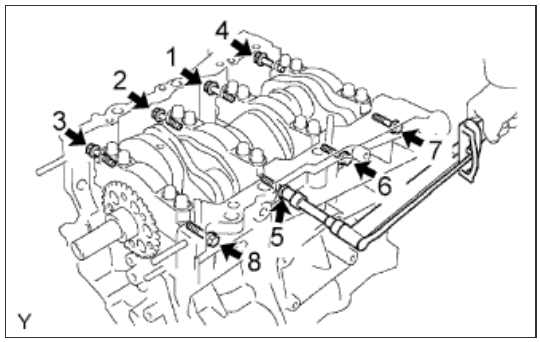
NOTICE:

Do not turn the crankshaft.



o. Install and uniformly tighten the 8 crankshaft bearing cap bolts in several steps in the sequence shown in the illustration.

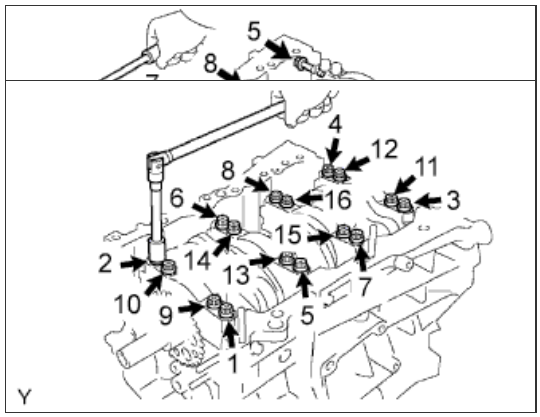
Torque:
26 N*m{ 262 kgf*cm , 19 ft.*lbf }



p. Remove the crankshaft bearing caps.

i. Step 1:
Uniformly loosen and remove the 8 bearing cap bolts in the sequence shown in the illustration.

ii. Step 2:
Uniformly loosen and remove the 16 bearing cap bolts in the sequence shown in the illustration.

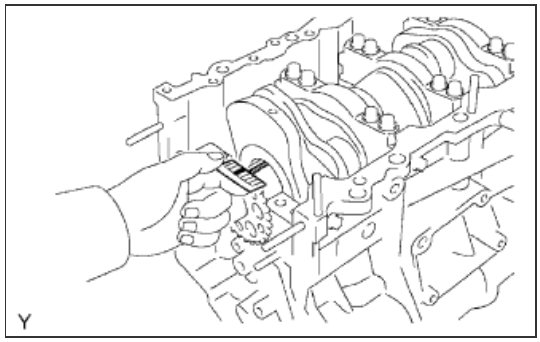


. Measure the Plastigage at its widest point.

Standard oil clearance:
0.018 to 0.030 mm (0.000709 to 0.00118 in.)

Maximum clearance:
0.046 mm (0.00181 in.)

If the oil clearance is more than the maximum, replace the bearings. If necessary, replace the crankshaft.



NOTICE:

Completely remove the Plastigage.

r. If replacing a bearing, replace it with one that has the same number. If the number of the bearing cannot be determined, select the correct bearing by adding together the numbers imprinted on the cylinder block and crankshaft, then refer to the table below for the appropriate bearing number. There are 5 sizes of standard bearings, marked "1", "2", "3", "4" and "5" accordingly.

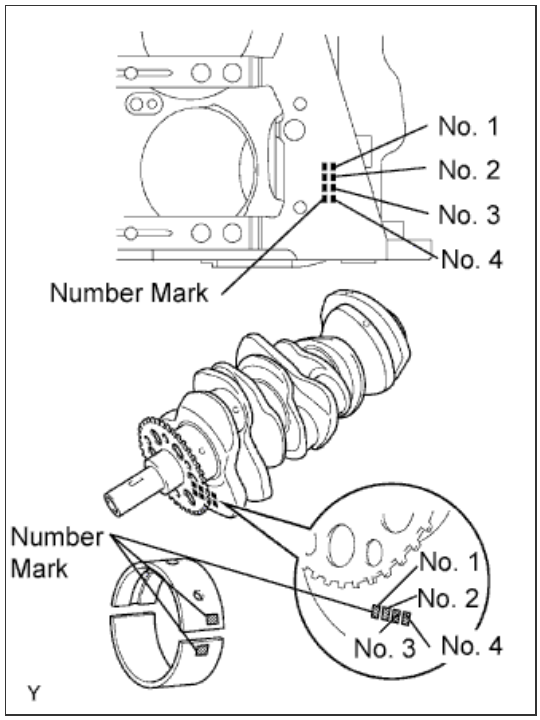
Journal Bearings:

Cylinder block (A) + Crankshaft (B)	Use Bearing
0 - 5	"1"
6 - 11	"2"
12 - 17	"3"
18 - 23	"4"
24 - 28	"5"

HINT:

Example:

Cylinder block "11" (A) + Crankshaft "06" (B) = Total number 17 (Use bearing "3")



Standard Journal Diameter:

Item	Mark	Specified Condition
Cylinder block main journal bore	"00"	77.000 mm (3.03149 in.)
	"01"	77.001 mm (3.03152 in.)
	"02"	77.002 mm (3.03156 in.)
	"03"	77.003 mm (3.03160 in.)
	"04"	77.004 mm (3.03164 in.)
	"05"	77.005 mm (3.03168 in.)
	"06"	77.006 mm (3.03172 in.)
	"07"	77.007 mm (3.03176 in.)

diameter (A)	"08"	77.008 mm (3.03180 in.)
	"09"	77.009 mm (3.03184 in.)
	"10"	77.010 mm (3.03188 in.)
	"11"	77.011 mm (3.03192 in.)
	"12"	77.012 mm (3.0396 in.)
	"13"	77.013 mm (3.03200 in.)
	"14"	77.014 mm (3.03204 in.)
	"15"	77.015 mm (3.03208 in.)
	"16"	77.016 mm (3.03211 in.)
Crankshaft main journal diameter (B)	"00"	71.999 to 72.000 mm (2.83460 to 2.83464 in.)
	"01"	71.998 to 71.999 mm (2.83456 to 2.83460 in.)
	"02"	71.997 to 71.998 mm (2.83452 to 2.83456 in.)
	"03"	71.996 to 71.997 mm (2.83448 to 2.83452 in.)
	"04"	71.995 to 71.996 mm (2.83440 to 2.83448 in.)
	"05"	71.994 to 71.995 mm (2.83440 to 2.83444 in.)
	"06"	71.993 to 71.994 mm (2.83436 to 2.83440 in.)
	"07"	71.992 to 71.993 mm (2.83432 to 2.83436 in.)
	"08"	71.991 to 71.992 mm (2.83428 to 2.83432 in.)
	"09"	71.990 to 71.991 mm (2.83424 to 2.83428 in.)
	"10"	71.989 to 71.990 mm (2.83420 to 2.83424 in.)
	"11"	71.988 to 71.989 mm (2.83416 to 2.83420 in.)

Standard Bearing Center Wall Thickness:

Mark	Specified Condition
"1"	2.488 to 2.491 mm (0.0980 to 0.0981 in.)
"2"	2.491 to 2.494 mm (0.0981 to 0.0982 in.)
"3"	2.494 to 2.497 mm (0.0982 to 0.0983 in.)
"4"	2.497 to 2.500 mm (0.0983 to 0.0984 in.)
"5"	2.500 to 2.503 mm (0.0984 to 0.0985 in.)

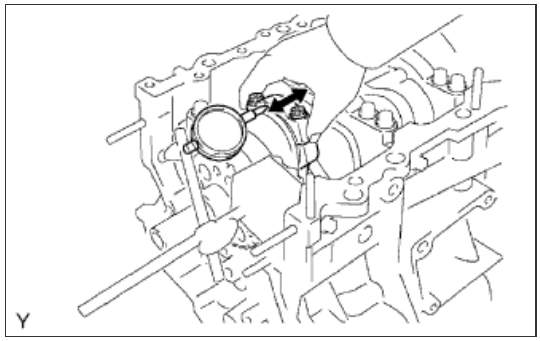
29. INSPECT CONNECTING ROD THRUST CLEARANCE

a. Using a dial indicator, measure the thrust clearance while moving the connecting rod back and forth.

Standard thrust clearance:
0.15 to 0.30 mm (0.00591 to 0.0118 in.)

Maximum thrust clearance:
0.35 mm (0.0138 in.)

If the thrust clearance is more than the maximum, replace one or more connecting rods as necessary.
If necessary, replace the crankshaft.

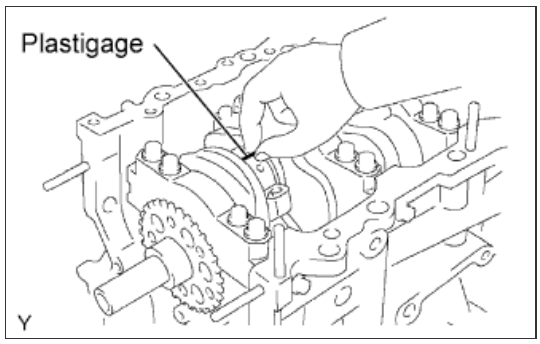


30. INSPECT CONNECTING ROD OIL CLEARANCE

a. Install the crankshaft bearing (Click here).

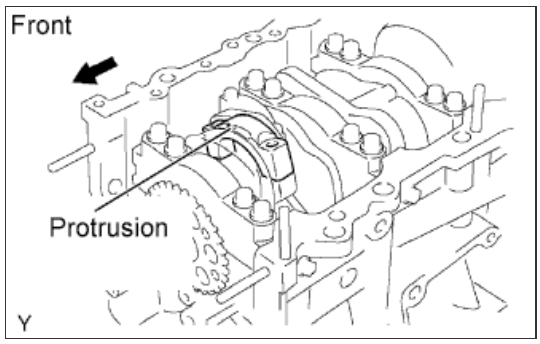
b. Install the crankshaft (Click here).

c. Lay a strip of Plastigage across the crank pin.



d. Set the connecting rod cap so that the protrusion is facing the correct direction.

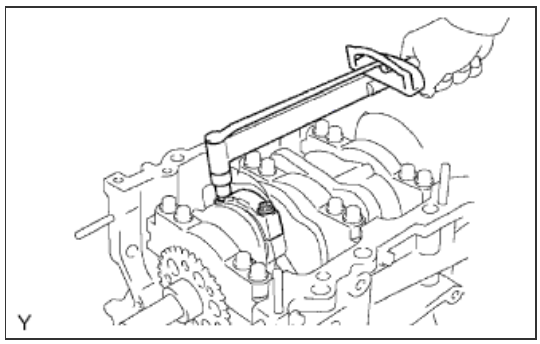
e. Apply a light coat of engine oil to the threads of the connecting rod cap bolts.



f. Step 1:

i. Install and alternately tighten the bolts of the connecting rod cap in several steps.

Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }

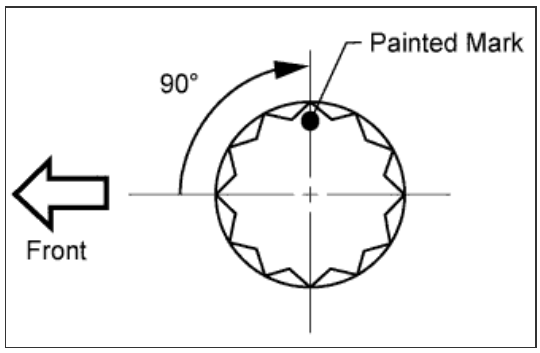


g. Step 2:

i. Mark the front side of each connecting rod cap bolt with paint.

ii. Tighten the bearing cap bolts in step 1 90°.

h. Remove the 2 bolts, connecting rod cap and lower bearing.



i. Measure the Plastigage at its widest point.

Standard oil clearance:
0.026 to 0.046 mm (0.00102 to 0.00181 in.)

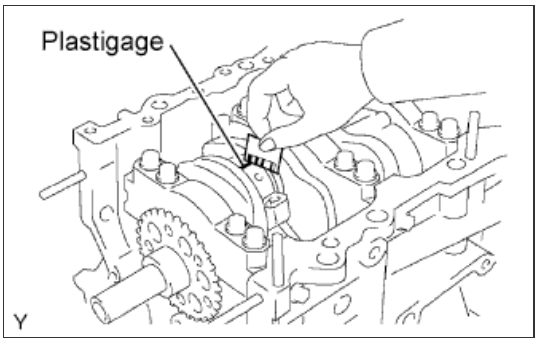
Maximum oil clearance:
0.066 mm (0.00260 in.)

If the oil clearance is more than the maximum, replace the bearings. If

necessary, replace the crankshaft.

NOTICE:

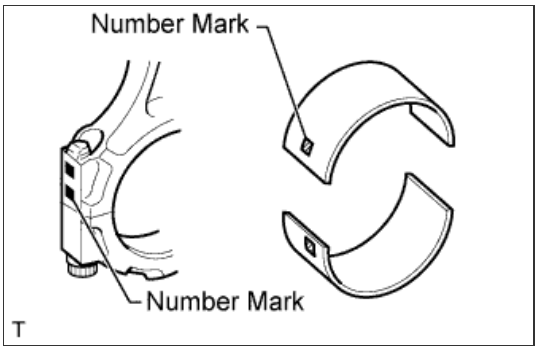
Completely remove the Plastigage.



. If replacing a bearing, replace it with one that has the same number marked on the connecting rod. There are 4 sizes of standard bearings, marked "1 ", "2", "3" and "4" accordingly.

Standard Bearing Center Wall Thickness:

Mark	Specified Condition
1	1.484 to 1.487 mm (0.05843 to 0.05854 in.)
2	1.487 to 1.490 mm (0.05854 to 0.05866 in.)
3	1.490 to 1.493 mm (0.05866 to 0.05878 in.)
4	1.493 to 1.496 mm (0.05878 to 0.05900 in.)



k. Remove the crankshaft (Click here).

l. Remove the crankshaft bearing.

31. INSPECT NO. 1 CHAIN SUB-ASSEMBLY

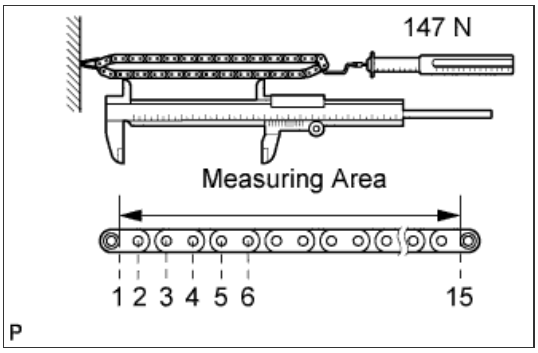
a. Using a spring scale, pull the No. 1 chain with a force of 147 N (15 kgf, 33.1 lbf) and measure the length of the No. 1 chain by using a vernier caliper.

Maximum chain elongation:
146.8 mm (5.78 in.)

HINT:

Perform the measurement at 3 random places.

If a measurement is more than the maximum, replace the No. 1 chain.



32. INSPECT NO. 2 CHAIN SUB-ASSEMBLY

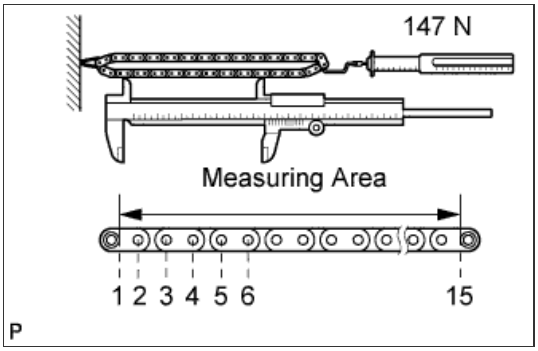
a. Using a spring scale, pull the No. 2 chain with a force of 147 N (15 kgf, 33.1 lbf) and measure the length of the No. 2 chain by using a vernier caliper.

Maximum chain elongation:
146.8 mm (5.78 in.)

HINT:

Perform the measurement at 3 random places.

If a measurement is more than the maximum, replace the No. 2 chain.



33. INSPECT CAMSHAFT TIMING GEAR ASSEMBLY

a. Wrap the No. 1 chain around the gear place for the No. 1 chain.

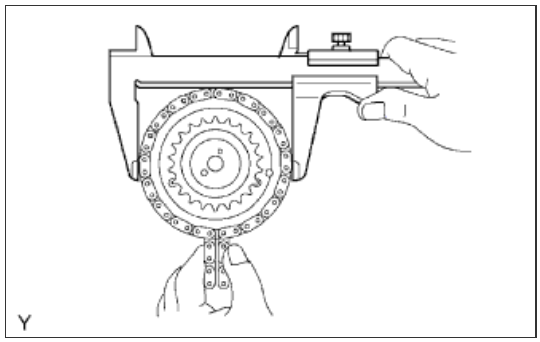
b. Using a vernier caliper, measure the timing gear with the No. 1 chain.

Minimum gear diameter (ith chain):
115.5 mm (4.55 in.)

HINT:

The vernier caliper must contact the chain rollers for the measurement.

If the diameter is less than the minimum, replace the No. 1 chain and camshaft timing gear assembly.



c. Wrap the No. 2 chain around the gear place for the No. 2 chain.

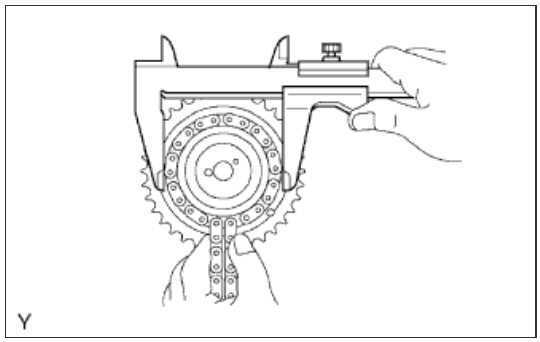
d. Using a vernier caliper, measure the timing gear with the No. 2 chain.

Minimum gear diameter (with chain):
73.1 mm (2.88 in.)

HINT:

The vernier caliper must contact the chain rollers for the measurement.

If the diameter is less than the minimum, replace the No. 2 chain and camshaft timing gear assembly.



34. INSPECT CAMSHAFT TIMING SPROCKET

a. Wrap the No. 2 chain around the sprocket.

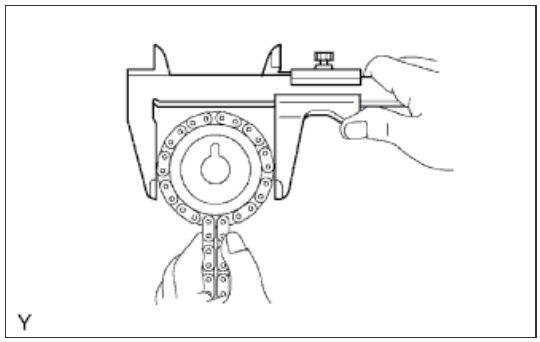
b. Using a vernier caliper, measure the camshaft timing sprocket diameter with the No. 2 chain.

Minimum gear diameter (with chain):
73.1 mm (2.88 in.)

HINT:

The vernier caliper must contact the chain rollers for the measurement.

If the diameter is less than the minimum, replace the No. 2 chain and camshaft timing sprocket.



35. INSPECT CRANKSHAFT TIMING SPROCKET

a. Wrap the No. 1 chain around the sprocket.

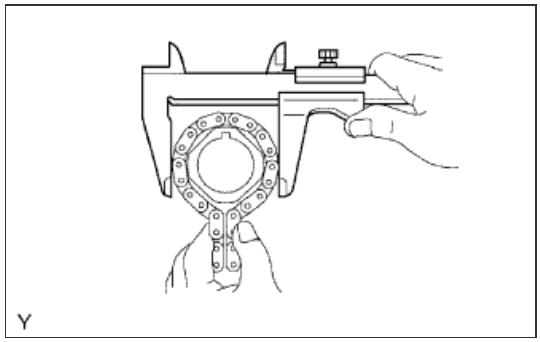
b. Using a vernier caliper, measure the crankshaft timing sprocket diameter with the No. 1 chain.

Minimum gear diameter (with chain):
61.0 mm (2.40 in.)

HINT:

The vernier caliper must contact the chain rollers for the measurement.

If the diameter is less than the minimum, replace the No. 1 chain and crankshaft timing sprocket.



3 . INSPECT NO. 1 IDLE GEAR

a. Wrap the No. 1 chain around the gear.

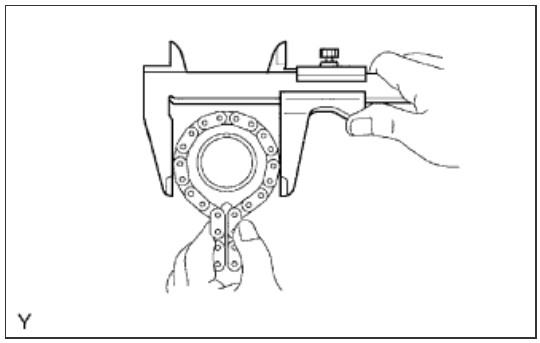
b. Using a vernier caliper, measure the No. 1 idle gear with the No. 1 chain.

Minimum gear diameter (with chain):
61.0 mm (2.40 in.)

HINT:

The vernier caliper must contact the chain rollers for the measurement.

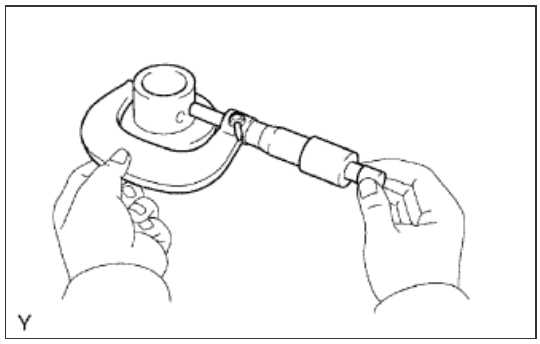
If the diameter is less than the minimum, replace the No. 1 chain and No. 1 idle gear.



37. INSPECT NO. 1 IDLE GEAR SHAFT OIL CLEARANCE

a. Using a micrometer, measure the No. 1 idle gear shaft diameter.

Standard idle gear shaft diameter:
22.987 to 23.000 mm (0.905 to 0.906 in.)



b. Using a caliper gauge, measure the inside diameter of the idle gear.

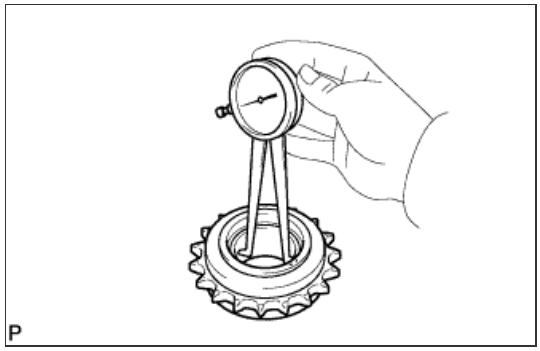
Standard idle gear inside diameter:
23.02 to 23.03 mm (0.906 to 0.907 in.)

c. Subtract the idle gear shaft diameter measurement from the idle gear inside diameter measurement.

Standard oil clearance:
0.020 to 0.043 mm (0.000787 to 0.00169 in.)

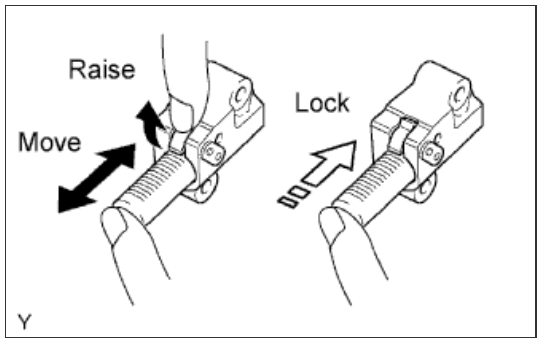
Maximum oil clearance:
0.093 mm (0.00366 in.)

If the thrust oil clearance is more than the maximum, replace the idle gear shaft and idle gear.



38. INSPECT NO. 1 CHAIN TENSIONER ASSEMBLY

a. Move the stopper plate upward to release the lock. Push the plunger and check that it moves smoothly.
If necessary, replace the chain tensioner assembly.



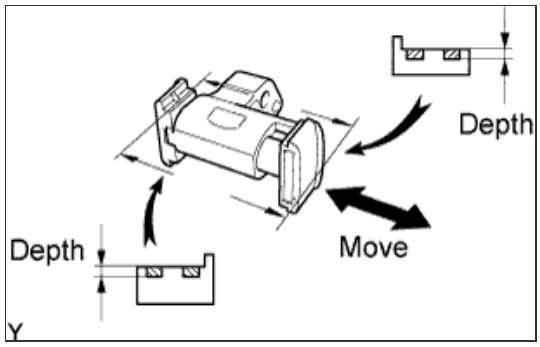
39. INSPECT NO. 2 CHAIN TENSIONER ASSEMBLY

a. Check that the plunger moves smoothly.

b. Measure the worn depth of the chain tensioner.

Maximum depth:
1.0 mm (0.0394 in.)

If the depth is more than the maximum, replace the No. 2 chain tensioner assembly.



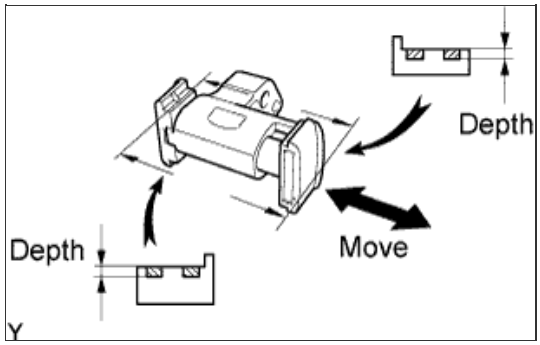
40. INSPECT NO. 3 CHAIN TENSIONER ASSEMBLY

a. Check that the plunger moves smoothly.

b. Measure the worn depth of the chain tensioner.

Maximum depth:
1.0 mm (0.0394 in.)

If the depth is more than the maximum, replace the No. 3 chain tensioner assembly.

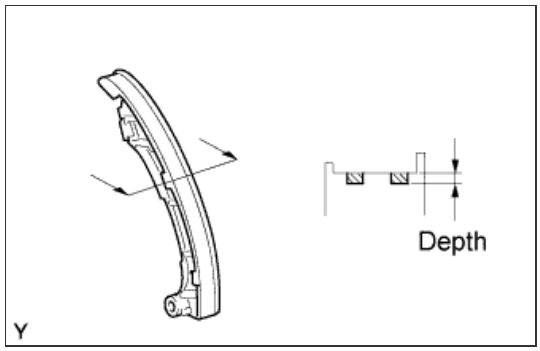


41. INSPECT CHAIN TENSIONER SLIPPER

a. Measure the worn depth of the chain tensioner slipper.

Maximum depth:
1.0 mm (0.0394 in.)

If the depth is more than the maximum, replace the chain tensioner slipper.

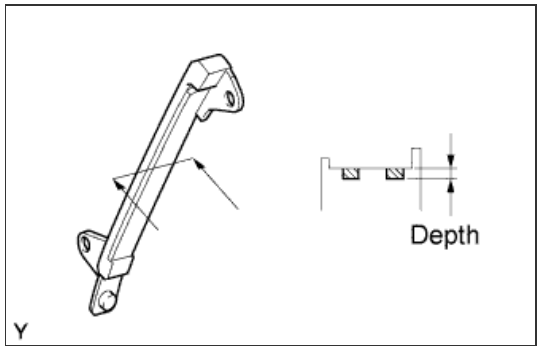


42. INSPECT NO. 1 CHAIN VIBRATION DAMPER

a. Measure the worn depth of the No. 1 chain vibration damper.

Maximum depth:
1.0 mm (0.0394 in.)

If the depth is more than the maximum, replace the No. 1 chain vibration damper.

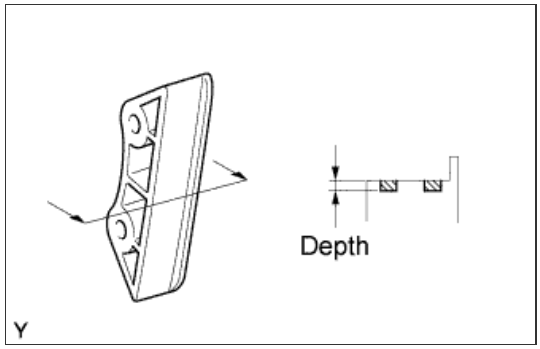


43. INSPECT NO. 2 CHAIN VIBRATION DAMPER

a. Measure the worn depth of the No. 2 chain vibration damper.

Maximum depth:
1.0 mm (0.0394 in.)

If the depth is more than the maximum, replace the No. 2 chain vibration damper.

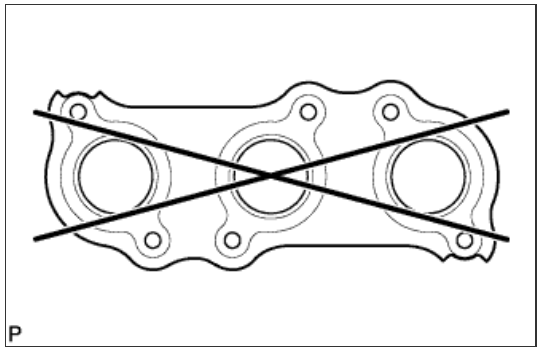


44. INSPECT EXHAUST MANIFOLD FOR FLATNESS

a. Using a precision straightedge and feeler gauge, measure the warpage of the contact surface of the cylinder head.

Maximum warpage:
0.70 mm (0.0276 in.)

If warpage is more than the maximum, replace the exhaust manifold.



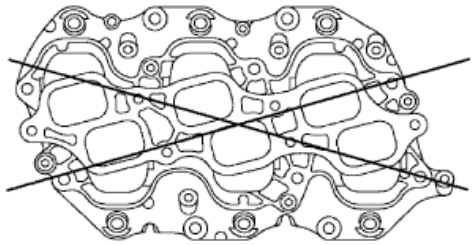
45. INSPECT INTAKE MANIFOLD FOR FLATNESS

a. Using a precision straightedge and feeler gauge, measure the warpage of the contact surface of the cylinder head and intake air surge tank.

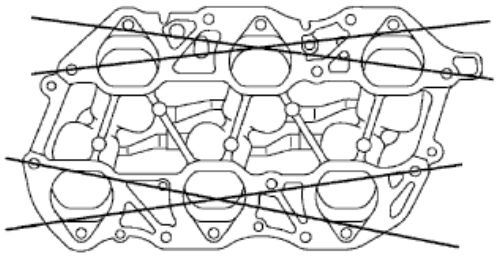
Maximum warpage:
for intake air surge tank side:
0.80 mm (0.0315 in.)
for cylinder head side:
0.20 mm (0.00787 in.)

If warpage is more than the maximum, replace the intake manifold.

Intake Air Surge Tank Side:



Cylinder Head Side:



Y

for Preparation Click here

HINT:

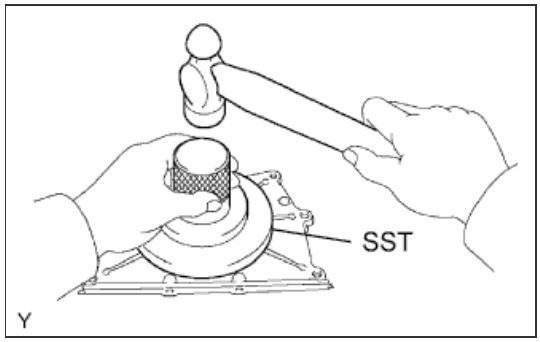
- **Thoroughly clean all parts to be assembled.**
- **Before installing the parts, apply new engine oil to all sliding and rotating surfaces.**
- **Replace all gaskets, O-rings and oil seals with new ones.**

1. INSTALL REAR CRANKSHAFT OIL SEAL

a. Using SST and a hammer, tap in a new oil seal until its surface is flush with the rear oil seal retainer edge.

SST
09223-78010

b. Apply MP grease to the lip of the oil seal.



2. INSTALL ENGINE REAR OIL SEAL RETAINER

a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the oil seal retainer and cylinder block.

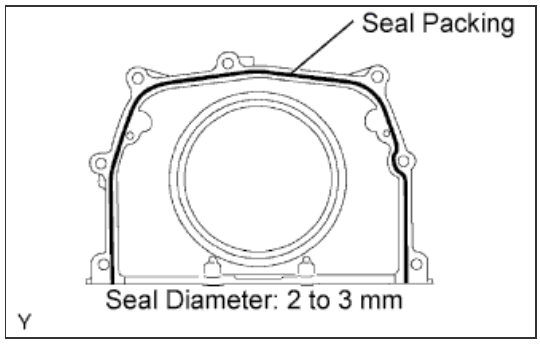
b. Apply seal packing in a continuous line as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

Parts must be assembled within 3 minutes of application. Otherwise the seal packing must be removed and reapplied.

Standard seal diameter:
2 to 3 mm 0.00315 to 0.00472 in.)



c. Install the oil seal retainer with the olts and 2 nuts.

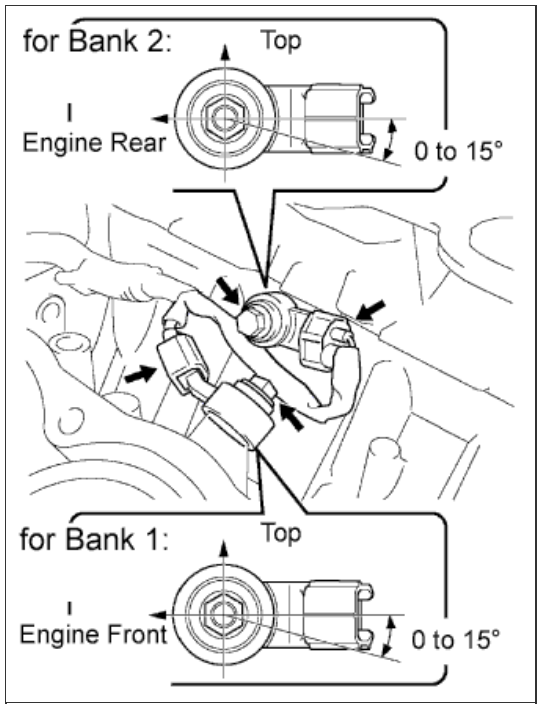
Torque:
for nut:
9.0 N m 92 kgf cm , 80 in. lbf
for bolt:
10 N m 102 kgf cm , 7 ft. lbf

3. INSTALL KNOCK SENSOR

a. Install the knock sensors with the olts as shown in the illustration.

Torque:
20 N m 204 kgf cm , 15 ft. lbf

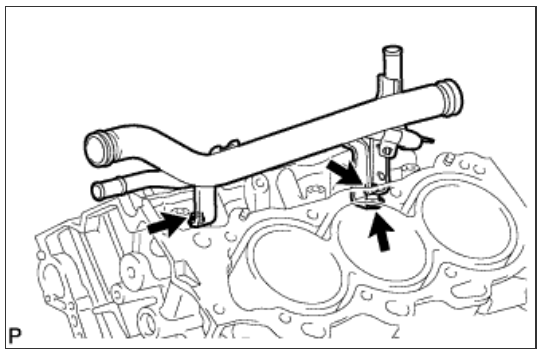
b. onnect the knock sensor connectors.



4. INSTALL NO. 1 ATER OUTLET PIPE

a. Install the water outlet pipe with the olts.

Torque:
10 N m 102 kgf cm , 7 ft. lbf



5. INSTALL CYLIN ER HEA GASKET for Bank 1)

a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the cylinder head and cylinder block.

b. Apply seal packing to a new cylinder head gasket as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

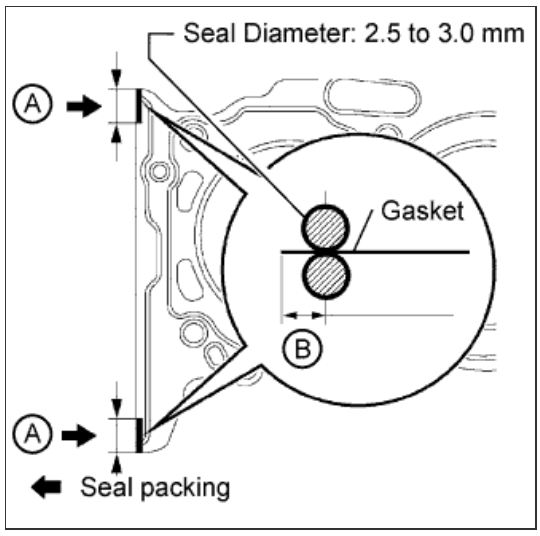
Standard seal diameter:
2.5 to 3.0 mm 0.0984 to 0.118 in.)

Seal Packing Application Range

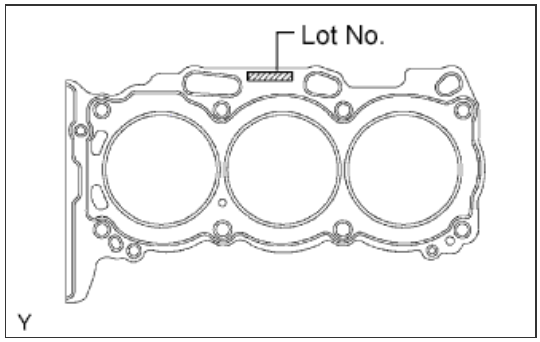
Item	Specified ondition
A	10 to 15 mm (0.3 to 0.5 in.)
B	1.25 to 1.5 mm (0.04 to 0.05 in.)

HINT:

- **Remove any oil from the contact surface.**
- **Install the cylinder head gasket within 3 minutes after applying the seal packing.**
- **not add engine oil within 2 hours of installation.**



c. Place the cylinder head gasket on the cylinder block surface with the front face of the ot No. stamp upward.



NOTICE:

Be careful of the installation direction.

. INSTALL CYLIN ER HEA SUB-ASSEMBLY RH for Bank 1)

a. Place the cylinder head on the cylinder head gasket.

NOTICE:

- **Ensure that no oil is on the mounting surface of the cylinder head.**
- **Gently place the cylinder head in order not to damage the gasket with the bottom part of the cylinder head.**

b. Install the cylinder head bolts and plate washers.

HINT:

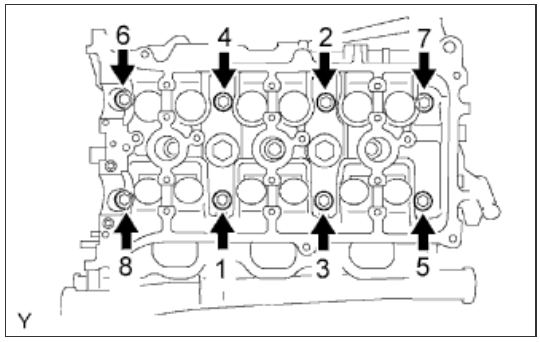
- **The cylinder head bolts are tightened in 3 progressive steps.**
- **If any cylinder head bolt is broken or deformed, replace it.**

i. Apply a light coat of engine oil to the threads and under the heads of the cylinder head bolts.

ii. Install the plate washers to the cylinder head bolts.

c. Step 1:

i. Using a 10 mm bi-he agon wrench, install and uniformly tighten the cylinder head bolts with plate washers in several steps in the se uence shown in the illustration.



Torque:
3 N m 3 7 kgf cm , 27 ft. lbf

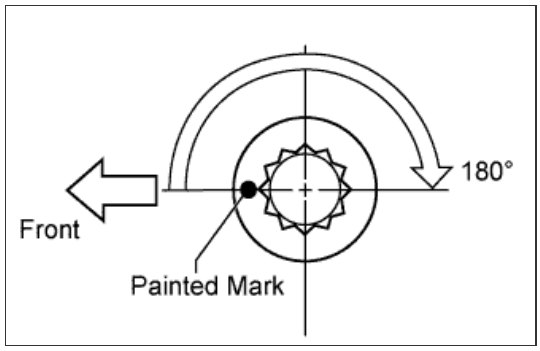
If any one of the cylinder head bolts does not meet the torque specification, replace the cylinder head bolt.

d. Step 2:

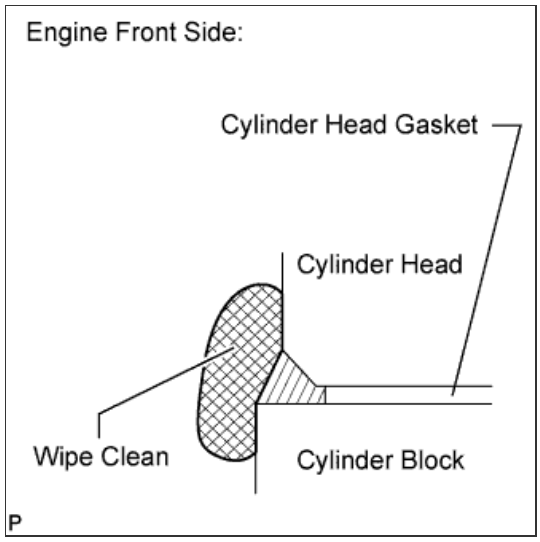
i. Mark the cylinder head bolt heads with paint as shown in the illustration.

ii. Tighten the cylinder head bolts 180° in the se uence shown in step 1.

e. heck that the painted marks are now facing rearward.



f. Seal packing will seep out from the front side of engine. Thoroughly wipe off the seal packing that seeps out.



7. INSTALL NO. 2 CYLIN ER HEA GASKET for Bank 2)

a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the cylinder head and cylinder block.

b. Apply seal packing to a new cylinder head gasket as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

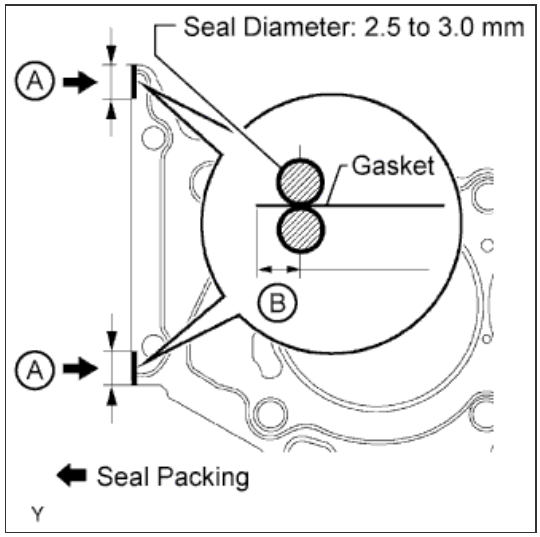
Standard seal diameter:
2.5 to 3.0 mm 0.0984 to 0.118 in.)

Seal Packing Application Range

Item	Specified ondition
A	10 to 15 mm (0.3 to 0.5 in.)
B	1.25 to 1.5 mm (0.04 to 0.05 in.)

HINT:

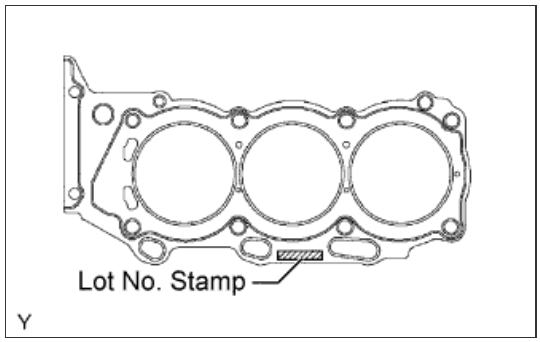
- **Remove any oil from the contact surface.**
- **Install the cylinder head gasket within 3 minutes after applying the seal packing.**
- **ot add engine oil within 2 hours of installation.**



c. Place the cylinder head gasket on the cylinder block surface with the front face of the ot No. stamp upward.

NOTICE:

Be careful of the installation direction.



8. INSTALL CYLIN ER HEA SUB-ASSEMBLY LH for Bank 2)

a. Place the cylinder head on the cylinder head gasket.

NOTICE:

- **Ensure that no oil is on the mounting surface of the cylinder head.**
- **Gently place the cylinder head in order not to damage the gasket with the bottom part of the cylinder head.**

b. Install the cylinder head bolts and plate washers.

HINT:

- **The cylinder head bolts are tightened in 3 progressive steps.**
- **If any cylinder head bolt is broken or deformed, replace it.**

i. Apply a light coat of engine oil to the threads and under the heads of the cylinder head bolts.

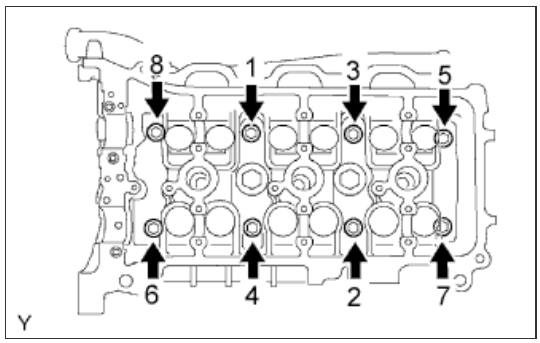
ii. Install the plate washers to the cylinder head bolts.

c. Step 1:

i. Using a 10 mm bi-he agon wrench, install and uniformly tighten the cylinder head bolts with plate washers in several steps in the se uence shown in the illustration.

Torque:
3 N m 3 7 kgf cm , 27 ft. lbf

If any one of the cylinder head bolts does not meet the torque specification, replace the cylinder head bolt.

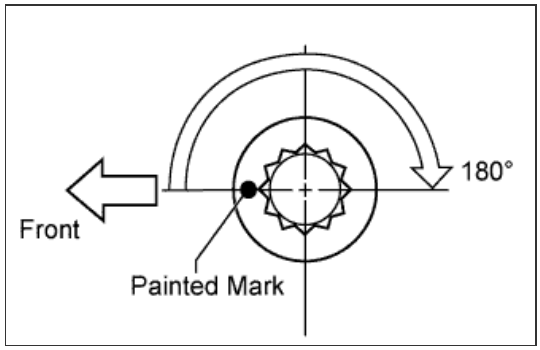


d. Step 2:

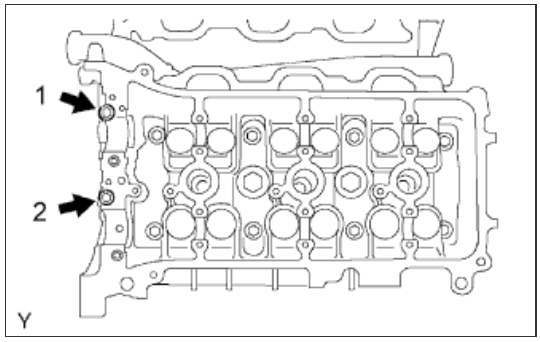
i. Mark the cylinder head bolt heads with paint as shown in the illustration.

ii. Tighten the cylinder head bolts 180° in the se uence shown in step 1.

e. heck that the painted marks are now facing rearward.



f. Install the olts in the order shown in the illustration.

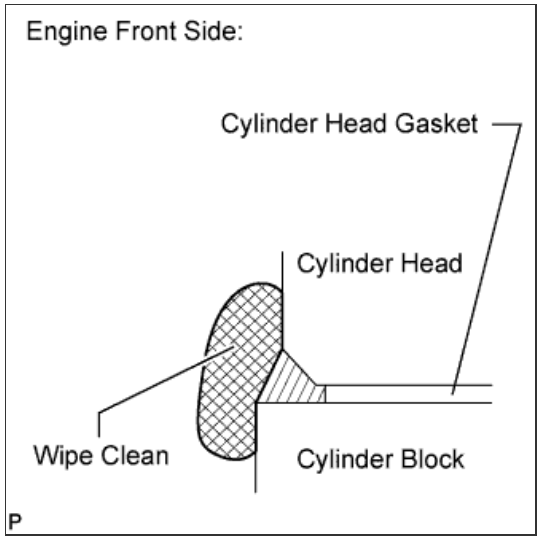


i. Apply a light coat of engine oil to the threads of the cylinder head bolts.

ii. Install the cylinder head bolts. Using several steps, tighten the olts uniformly in the se uence shown in the illustration.

Torque:
30 N m 30 kgf cm , 22 ft. lbf

g. Seal packing will seep out from the front side of the engine. Thoroughly wipe off seal packing that seeps out.

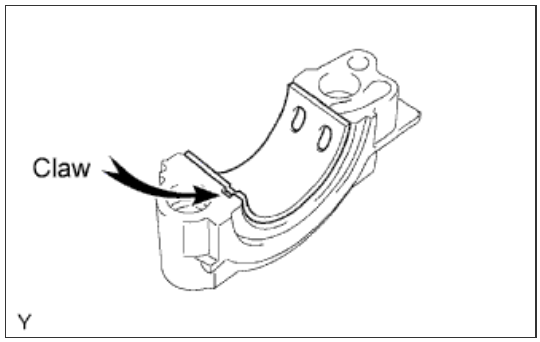


9. INSTALL NO. 1 CAMSHAFT BEARING

a. Align the aring claw with the claw groove of the aring cap, and push in the o. 1 camshaft bearing.

NOTICE:

- **Install the bearing while aligning it with the oil hole in the bearing cap.**
- **Clean the backside of the bearing and the contact surface of the bearing cap and prevent oil from adhering to them.**

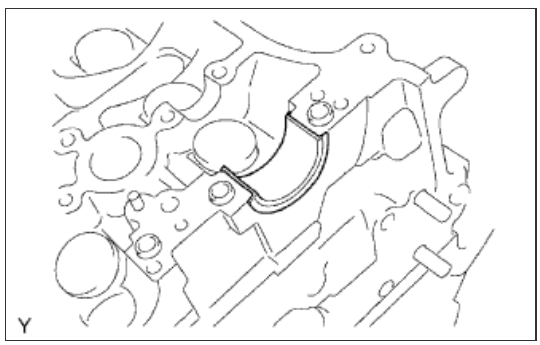


10. INSTALL NO. 2 CAMSHAFT BEARING

a. Install the o. 2 camshaft bearing to the cylinder head.

NOTICE:

lean the ackside of the aring and the contact surface of the cylinder head and prevent oil from adhering to them.



11. INSTALL NO. 1 CAMSHAFT AN NO. 2 CAMSHAFT

NOTICE:

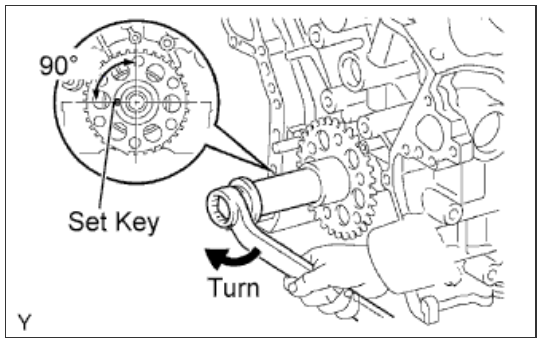
As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

a. Set the crankshaft position.

i. Using the crankshaft pulley set bolt, turn the crankshaft, and set the crankshaft set key into the left horizontal position.

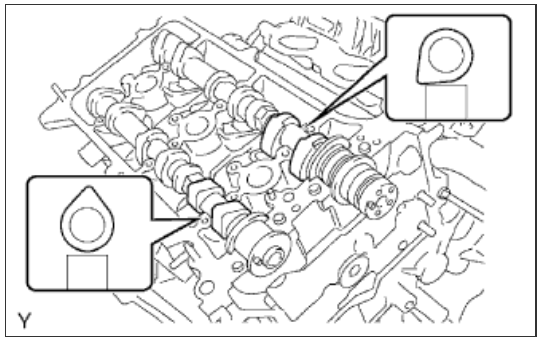
NOTICE:

Having the crankshaft at the wrong angle can cause the piston head and valve head to come into contact with each other when the camshaft is installed, causing damage. Always set the crankshaft to the correct angle.



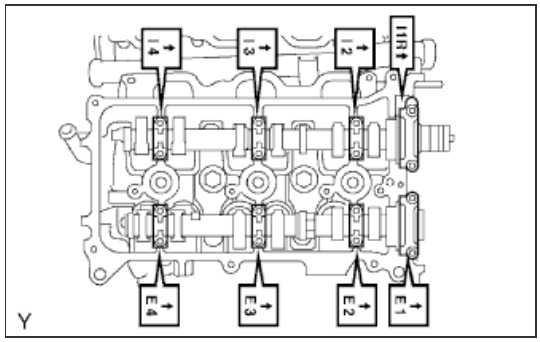
b. Apply new engine oil to the thrust portion and journals of the camshafts.

c. Place the camshafts onto the cylinder head with the cam lobes of the o. 1 cylinder facing each direction as shown in the illustration.



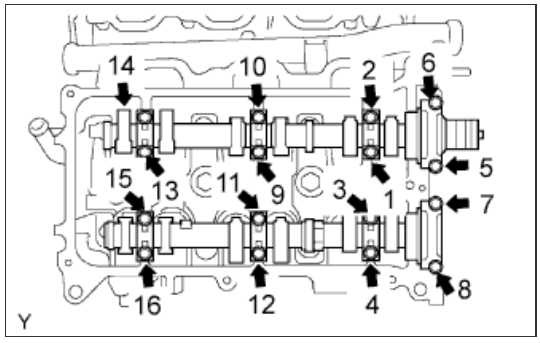
d. Set the aring caps in their proper locations.

e. Apply a light coat of engine oil to the threads and under the heads of the aring cap bolts.

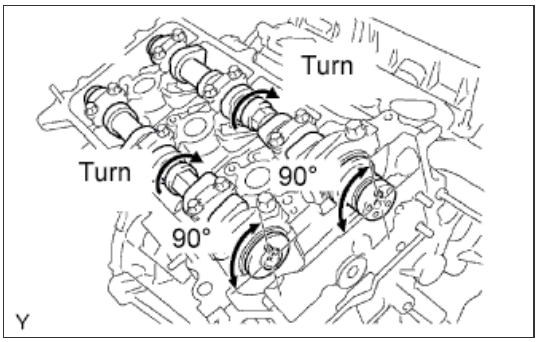


f. Uniformly install the olts in several steps in the order shown in the illustration.

Torque:
for 10 mm head bolt:
9.0 N m 92 kgf cm , 80 in. lbf
for 12 mm head bolt:
24 N m 245 kgf cm , 18 ft. lbf



g. Using a wrench, turn the camshafts clockwise until the camshaft knock pin is at a position to the cylinder head.

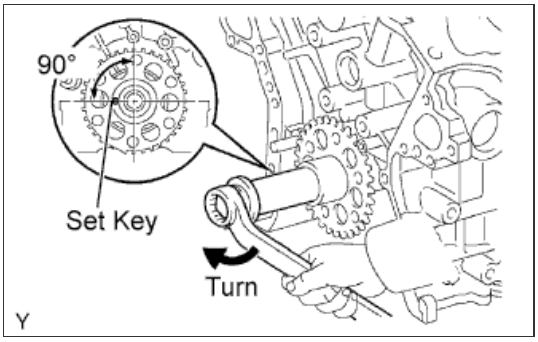


12. INSTALL NO. 3 CAMSHAFT AN NO. 4 CAMSHAFT

NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

a. Set the crankshaft position.



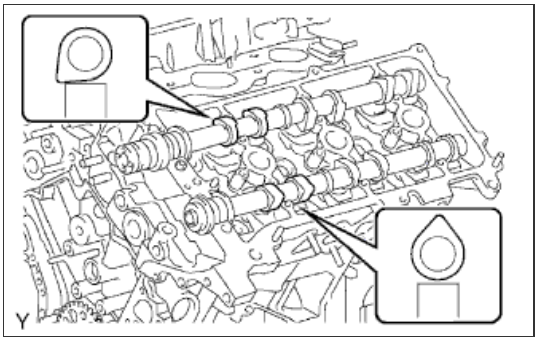
i. Using the crankshaft pulley set bolt, turn the crankshaft, and set the crankshaft set key into the left horizontal position.

NOTICE:

Having the crankshaft at the wrong angle can cause the piston head and valve head to come into contact with each other when the camshaft is installed, causing damage. Always set the crankshaft to the correct angle.

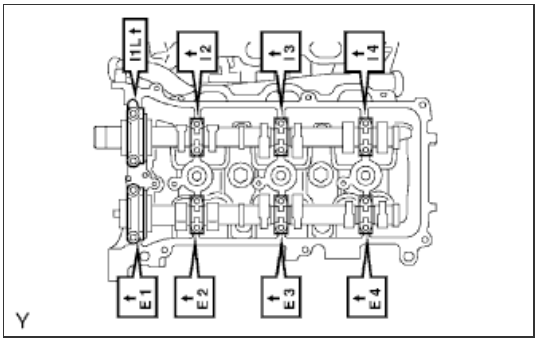
b. Apply new engine oil to the thrust portion and journals of the camshafts.

c. Place the camshafts onto the cylinder head with the cam lobes of the o. 2 cylinder facing as shown in the illustration.



d. Set the aring caps in their proper locations.

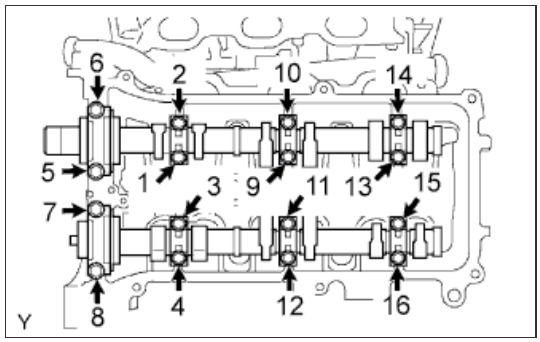
e. Apply a light coat of engine oil to the threads and under the heads of the aring cap bolts.



f. Uniformly install the olts in several steps in the order shown in the illustration.

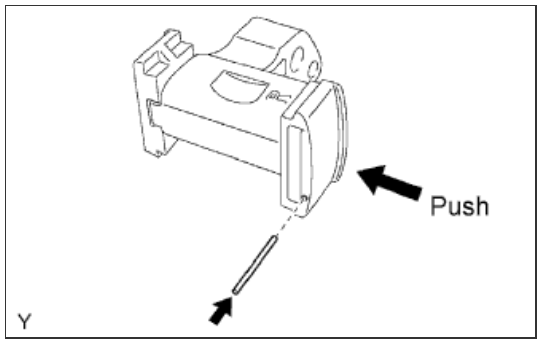
Torque:
for 10 mm head bolt:

9.0 N m 92 kgf cm , 80 in. lbf
for 12 mm head bolt:
24 N m 245 kgf cm , 18 ft. lbf



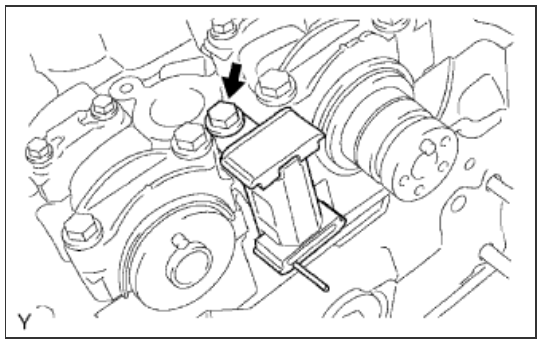
13. INSTALL NO. 2 CHAIN TENSIONER ASSEMBLY for Bank 1)

a. While pushing in the tensioner, insert a pin of φ1.0 mm (0.03 in.) into the hole to fix the tensioner in place.



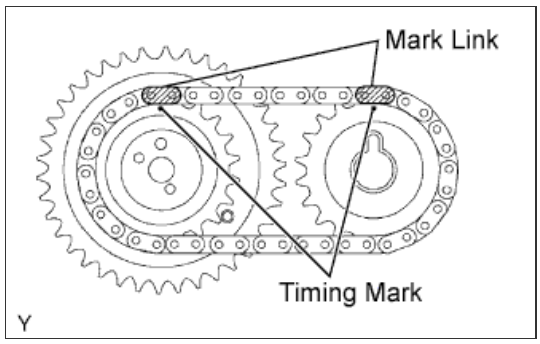
b. Install the o. 2 chain tensioner with the olt.

Torque:
21 N m 214 kgf cm , 15 ft. lbf



14. INSTALL CAMSHAFT TIMING GEARS AN NO. 2 CHAIN for Bank 1)

a. Align the mark links (yellow) of the o. 2 chain with the timing marks (1-dot mark) of the camshaft timing gear and sprocket as shown in the illustration.

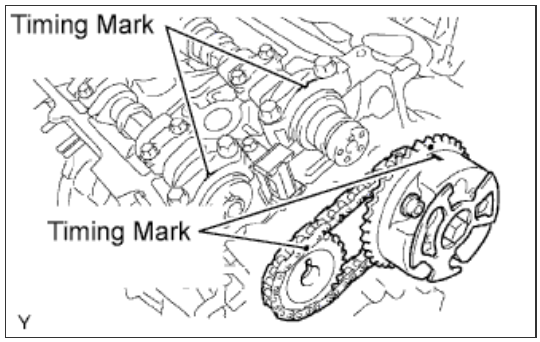


b. Align the timing marks on the camshaft timing gear and sprocket with the timing marks on the aring caps, and install the camshaft timing gear and sprocket with the o. 2 chain to the camshafts.

c. Temporarily install the camshaft timing gear set bolt and camshaft timing sprocket set bolt.

NOTICE:

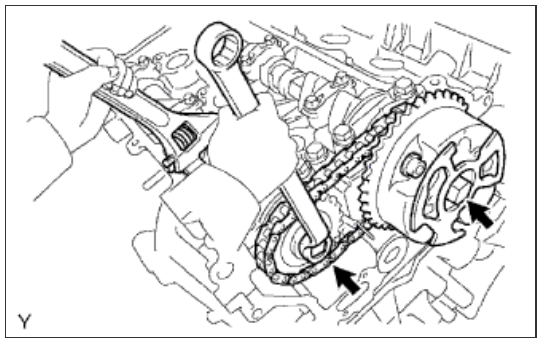
Do not push the camshaft timing gear assembly to the camshaft forcibly when installing it.



d. Hold the he agonal portion of the camshaft with a wrench, and tighten the olts.

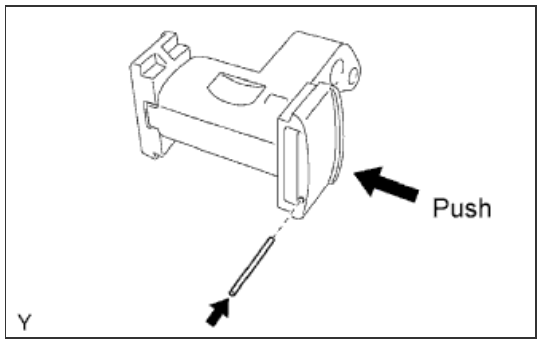
Torque:
100 N m 1020 kgf cm , 74 ft. lbf

e. Remove the pin from the o. 2 chain tensioner.



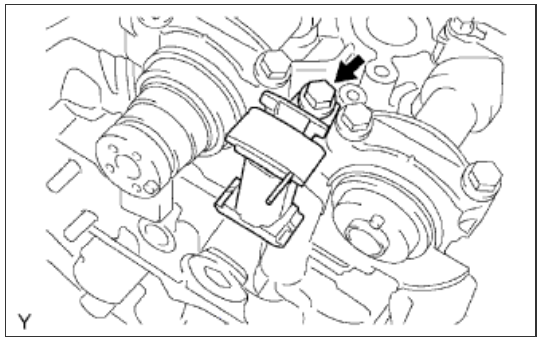
15. INSTALL NO. 3 CHAIN TENSIONER ASSEMBLY for Bank 2)

a. While pushing in the tensioner, insert a pin of φ1.0 mm (0.03 in.) into the hole to fix the tensioner in place.



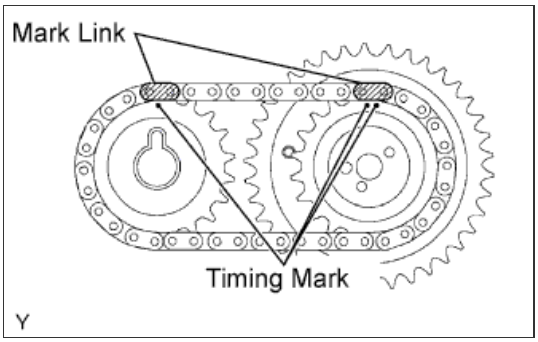
b. Install the o. 3 chain tensioner with the olt.

Torque:
21 N m 214 kgf cm , 15 ft. lbf



1 . INSTALL CAMSHAFT TIMING GEARS AN NO. 2 CHAIN for Bank 2)

a. Align the mark links (yellow) of the o. 2 chain with the timing marks (1-dot mark and 2-dot mark) of the camshaft timing gear and sprocket as shown in the illustration.

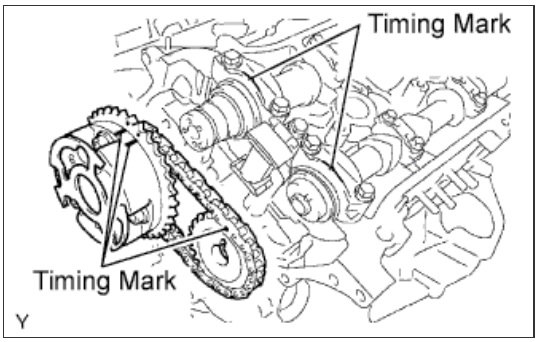


b. Align the timing marks on the camshaft timing gear and sprocket with the timing marks on the aring caps, and install the camshaft timing gear and sprocket with the o. 2 chain to the camshafts.

c. Temporarily install the camshaft timing gear set bolt and camshaft timing sprocket set bolt.

NOTICE:

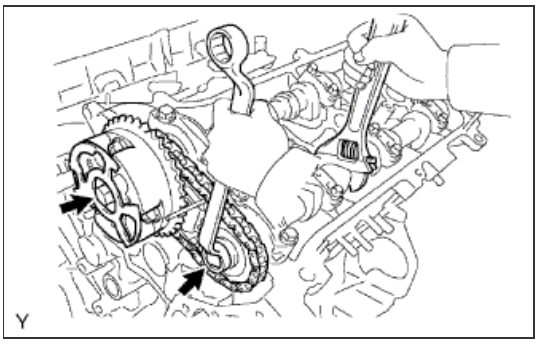
Do not push the camshaft timing gear assembly to the camshaft forcibly when installing it.



d. Hold the he agonal portion of the camshaft with a wrench, and tighten the olts.

Torque:
100 N m 1020 kgf cm , 74 ft. lbf

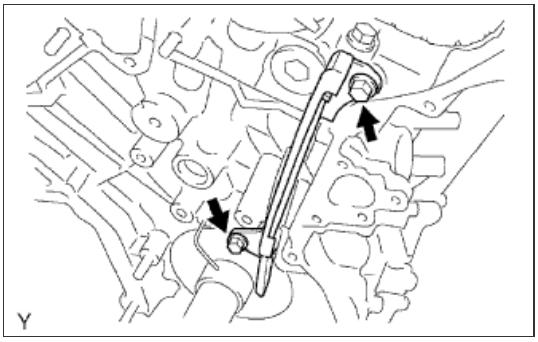
e. Remove the pin from the o. 3 chain tensioner.



17. INSTALL NO. 1 CHAIN VIBRATION AMPER

a. Install the o. 1 chain vibration damper with the olts.

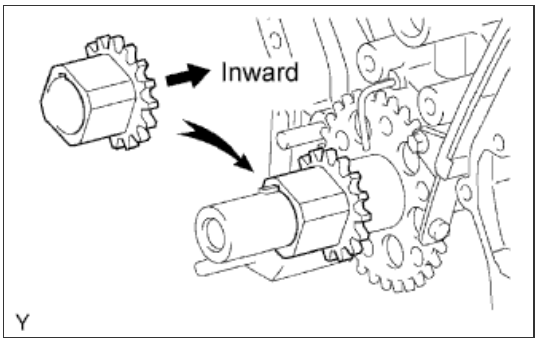
Torque:
19 N m 194 kgf cm , 14 ft. lbf



18. INSTALL CRANKSHAFT TIMING GEAR

a. Align the timing gear set key with the key groove of the timing gear.

b. Install the timing gear onto the crankshaft with the gear facing inward as shown in the illustration.



19. INSTALL CHAIN TENSIONER SLIPPER

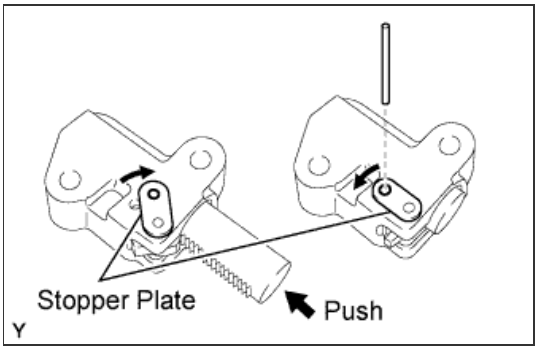
20. INSTALL NO. 1 CHAIN TENSIONER ASSEMBLY

a. While turning the stopper plate of the tensioner clockwise, push in the plunger of the tensioner as shown in the illustration.

b. While turning the stopper plate of the tensioner counterclockwise, insert a bar of φ3.5 mm (0.138 in.) into the holes on the stopper plate and tensioner to fix the stopper plate in place.

c. Install the chain tensioner with the olts.

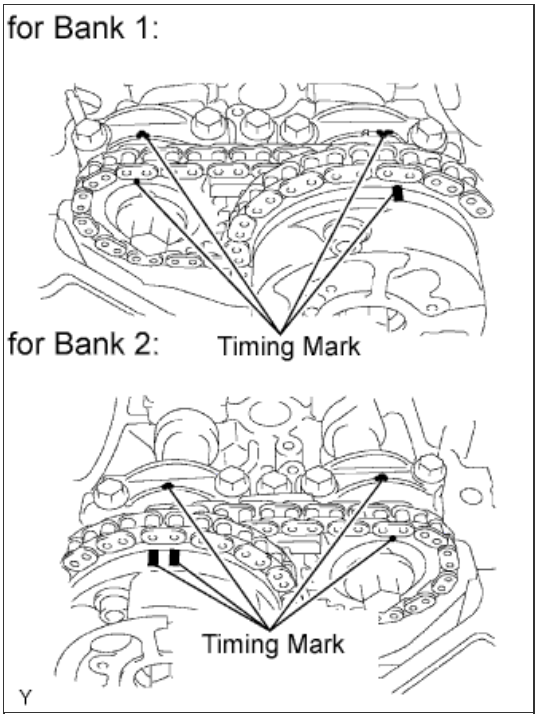
Torque:
10 N m 102 kgf cm , 7 ft. lbf



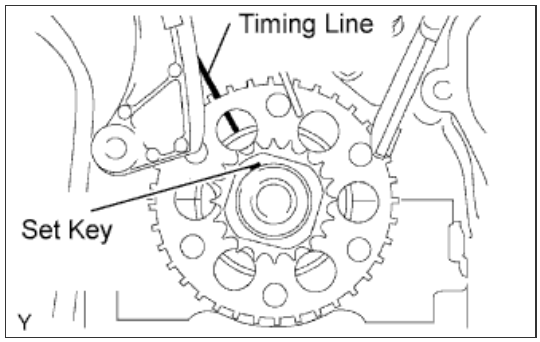
21. INSTALL NO. 1 CHAIN SUB-ASSEMBLY

a. Set the o. 1 cylinder to TD compression.

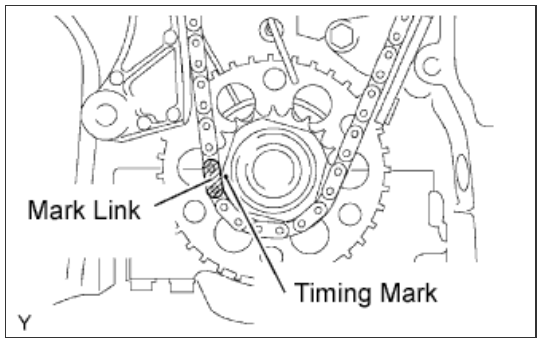
i. Align the timing marks of the camshaft timing gears and sprockets with the timing marks of the aring caps.



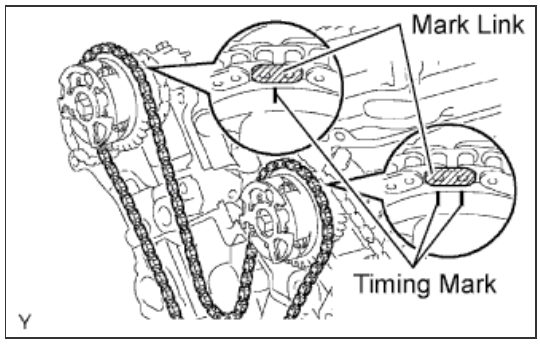
ii. Install the crankshaft pulley set bolt, and turn the crankshaft to align the crankshaft set key with the timing line of the cylinder block.



b. Align the mark link (yellow) with the timing mark of the crankshaft timing gear.

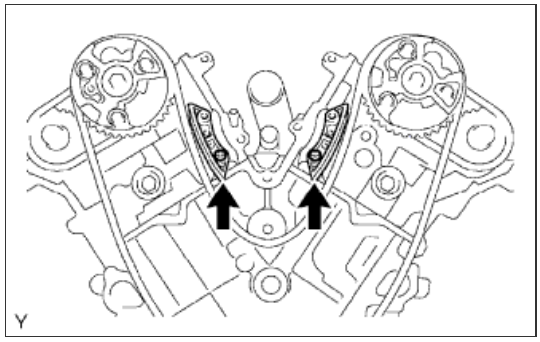


c. Align the mark links (orange) with the timing marks of the camshaft timing gears, and install the o. 1 chain.



22. INSTALL NO. 2 CHAIN VIBRATION AMPER

a. Install the o. 2 chain vibration dampers.



23. INSTALL NO. 1 I LE GEAR SHAFT

a. Apply a light coat of engine oil to the rotating surface of the o. 1 idle gear shaft.

b. Temporarily install the o. 1 idle gear shaft and No. 1 idle gear with the o. 2 idle gear shaft while aligning the knock pin of the o. 1 idle gear shaft with the knock pin groove of the cylinder block.

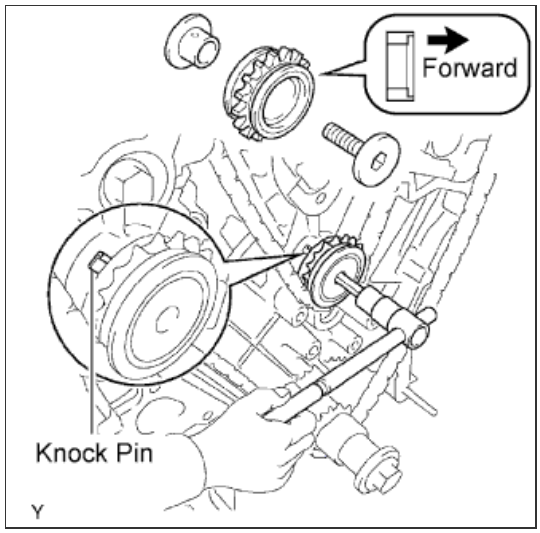
NOTICE:

Be careful of the idle gear direction.

c. Using a 10 mm he agon wrench, tighten the o. 2 idle gear shaft.

Torque:
0 N m 12 kgf cm , 44 ft. lbf

d. Remove the ar from the chain tensioner.



24. INSTALL FRONT CRANKSHAFT OIL SEAL

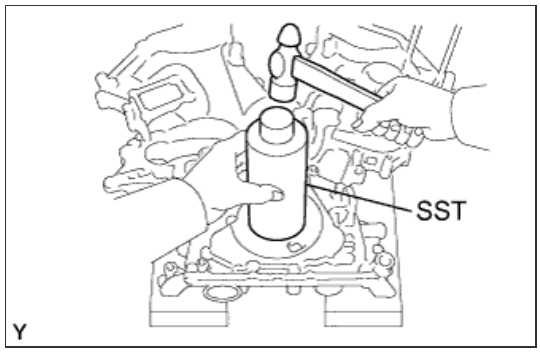
a. Using SST and a hammer, tap in a new oil seal until its surface is flush with the timing chain cover edge.

SST
0922 -10010

NOTICE:

- **Keep the lip free from foreign matter.**
- **not tap the oil seal at an angle.**

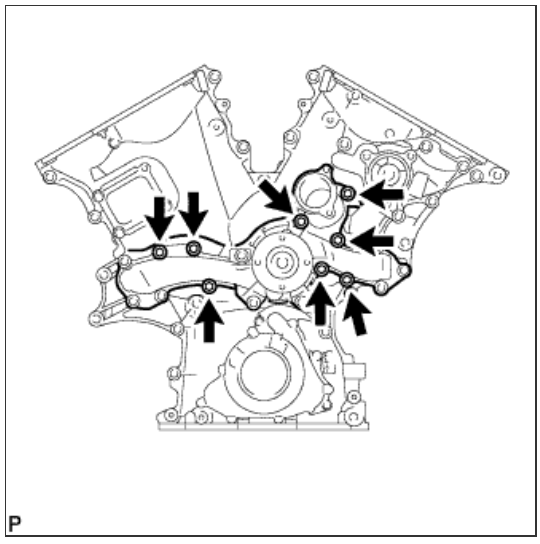
b. Apply MP grease to the lip of the oil seal.



25. INSTALL ATER PUMP ASSEMBLY

a. Install a new gasket and the water pump with the olts.

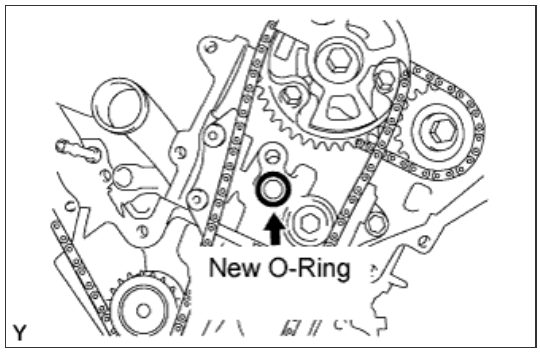
Torque:
9.0 N m 92 kgf cm , 80 in. lbf



2 . INSTALL TIMING CHAIN COVER SUB-ASSEMBLY

a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the timing chain cover, cylinder head and cylinder block.

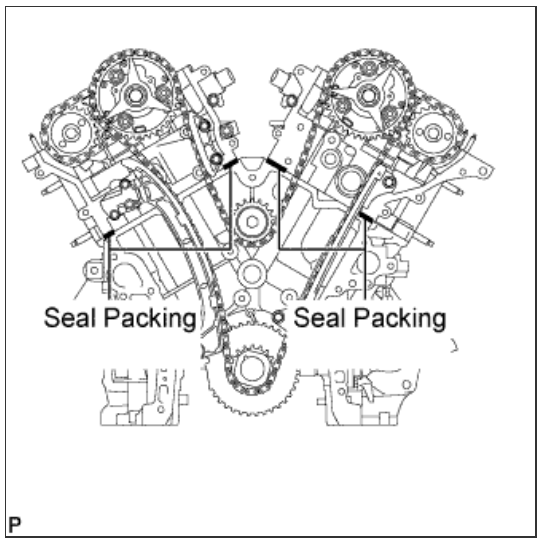
b. Install a new O-ring to the cylinder head for bank 2 as shown in the illustration.



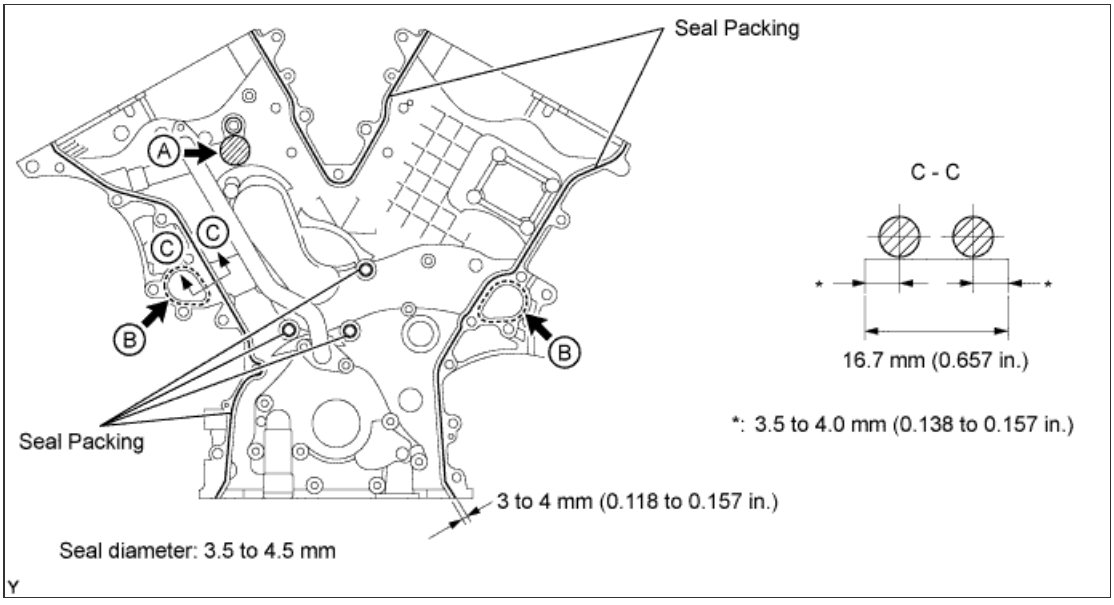
c. Apply seal packing as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
3.0 to 4.0 mm 0.118 to 0.157 in.)



d. Apply seal packing in a continuous line to the timing chain cover as shown in the illustration.



Seal packing:
for water related part:
Toyota Genuine Seal Packing 1282B, Three Bond 1282B or equivalent
for oil related part:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
3.5 to 4.5 mm 0.138 to 0.177 in.)

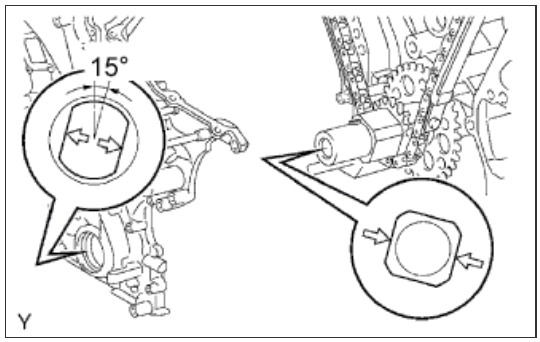
HINT:

Water related parts are labeled "B" in the illustration.

NOTICE:

- **Install the timing chain cover within 3 minutes after applying seal packing. After installing it, the timing chain cover bolts and nuts must be tightened within 15 minutes. Otherwise the seal packing must be removed and reapplied.**
- **ɑnot apply seal packing to A shown in the illustration.**

e. Align the keyway of the oil pump drive rotor with the rectangular portion of the crankshaft timing gear, and slide the timing chain cover into place.



f. Install the timing chain cover with the olts labeled A and B, and the nuts. Tighten the olts and nuts uniformly in several steps.

Torque:
23 N m 235 kgf cm , 17 ft. lbf

NOTICE:

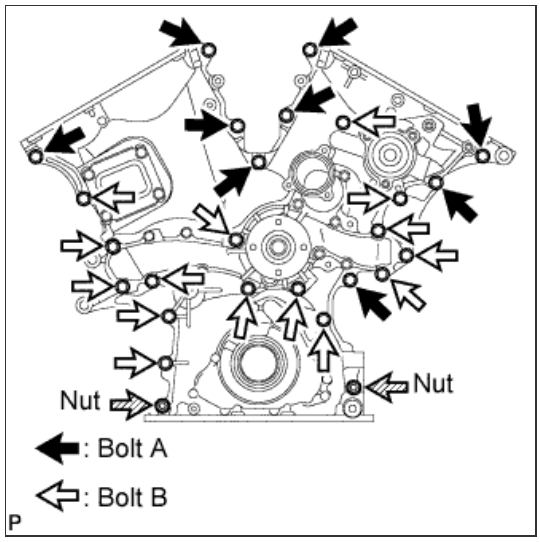
- **Make sure not to wrap the No. 1 chain and slipper over the timing chain cover seal line.**
- **Install the timing chain cover 15 minutes or more after installing the water pump.**

Standard Bolt:

Item	uantity	Length
Bolt A		mm (0. in.)
Bolt B	15	55 mm (2.17 in.)

NOTICE:

Make sure that there is no oil on the olt threads.



27. INSTALL OIL PAN SUB-ASSEMBLY

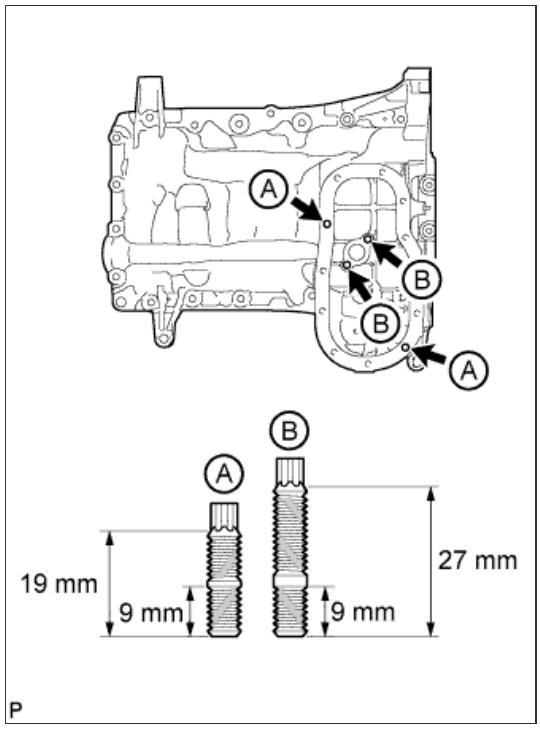
a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the cylinder block, rear oil seal retainer and oil pan.

b. Using an TORX" wrench, install the stud bolts.

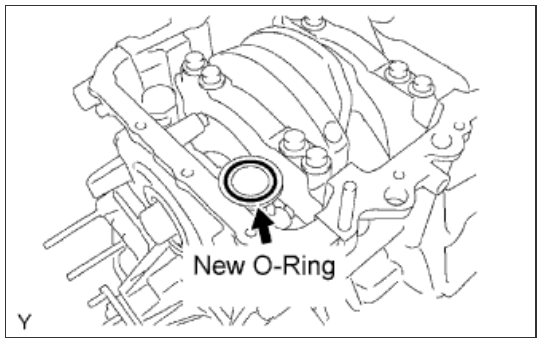
Torque:
4.0 N m 41 kgf cm , 35 in. lbf

Standard Bolt:

Item	Length
A	1 mm (0.748 in.)
	mm (0.354 in.)
B	27 mm (1.06 in.)
	mm (0.354 in.)



c. Install a new O-ring to the timing chain cover.



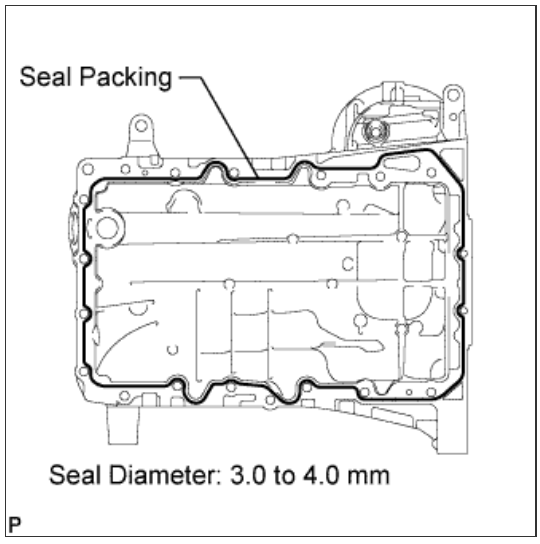
d. Apply seal packing in a continuous line as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
3 to 4 mm 0.118 to 0.157 in.)

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the oil pan within 3 minutes after applying seal packing.**
- **ot start the engine for at least 2 hours after installing.**



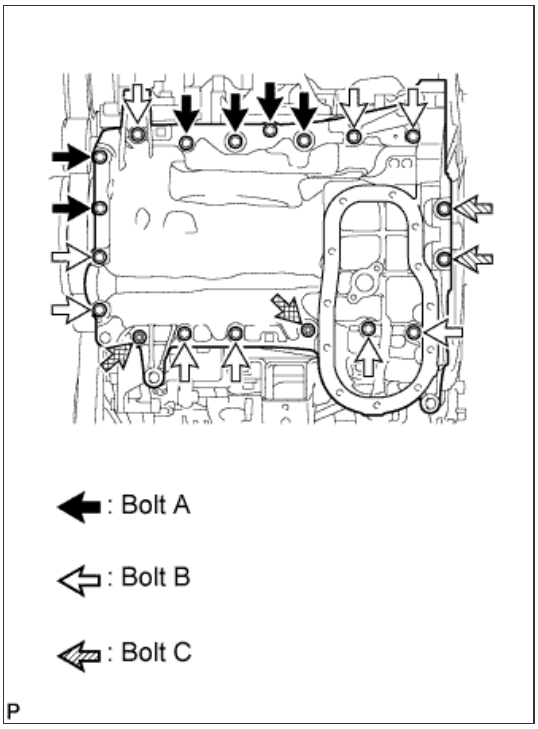
e. Install the oil pan with the olts and 2 nuts. Tighten the olts and nuts uniformly in several steps.

Torque:
for bolt A, B and nut:
21 N m 214 kgf cm , 15 ft. lbf
for bolt C:
10 N m 102 kgf cm , 7 ft. lbf

Standard Bolt:

Item	uantity	Length

A	6	25 mm (0. in.)
B		mm (1.77 in.)
		mm (0.551 in.)



28. INSTALL OIL STRAINER SUB-ASSEMBLY

a. Install a new gasket to the oil strainer.

Te tn Illustration

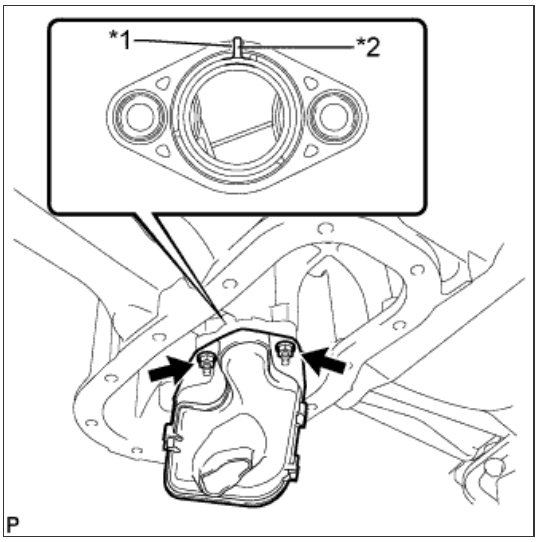
1	Groove
	Protrusion

HINT:

Align the protrusion of the gasket with the groove of the oil strainer.

b. Install the oil strainer with the nuts.

Torque:
9.0 N m 92 kgf cm , 80 in. lbf



29. INSTALL NO. 2 OIL PAN SUB-ASSEMBLY

a. Apply seal packing in a continuous line as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
3 to 4 mm 0.118 to 0.157 in.)

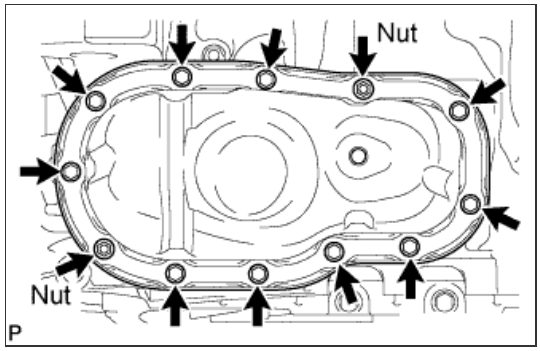
NOTICE:

- **Remove any oil from the contact surface.**
- **Install the No. 2 oil pan within 3 minutes after applying seal packing.**
- **not start the engine for at least 2 hours after the installation.**



b. Install the o. 2 oil pan with the olts and 2 nuts. Tighten the olts and nuts uniformly in several steps.

Torque:
for bolt:
9.0 N m 92 kgf cm , 81 in. lbf
for nut:
10 N m 102 kgf cm , 7 ft. lbf



30. INSTALL OIL PAN RAIN PLUG

a. Install the drain plug and a new gasket.

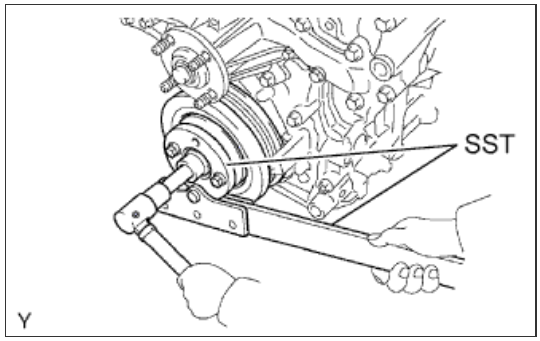
Torque:
40 N m 408 kgf cm , 30 ft. lbf

31. INSTALL CRANKSHAFT PULLEY

a. Using SST, install the crankshaft pulley with the pulley set bolt.

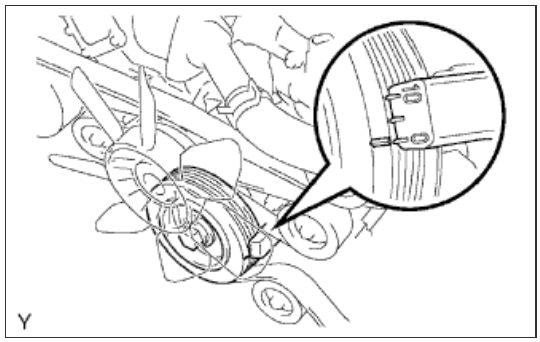
SST
09213-54015 91 51- 0855)
09330-00021

Torque:
250 N m 2549 kgf cm , 184 ft. lbf

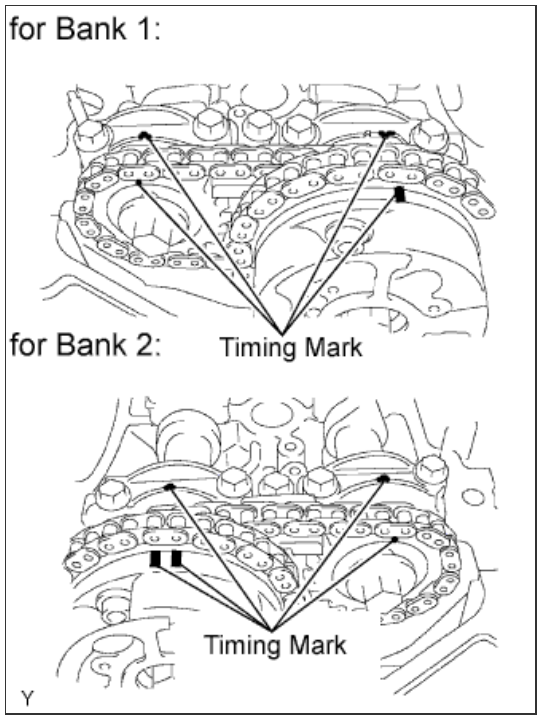


32. SET NO. 1 CYLIN ER TO T C COMPRESSION

a. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.



b. heck that the timing marks of the camshaft timing gears and sprockets are aligned with the timing marks of the aring caps as shown in the illustration. If not, turn the crankshaft 1 complete revolution (360°) and align the timing marks as above.



33. INSPECT VALVE CLEARANCE

a. heck the valves indicated in the illustration.

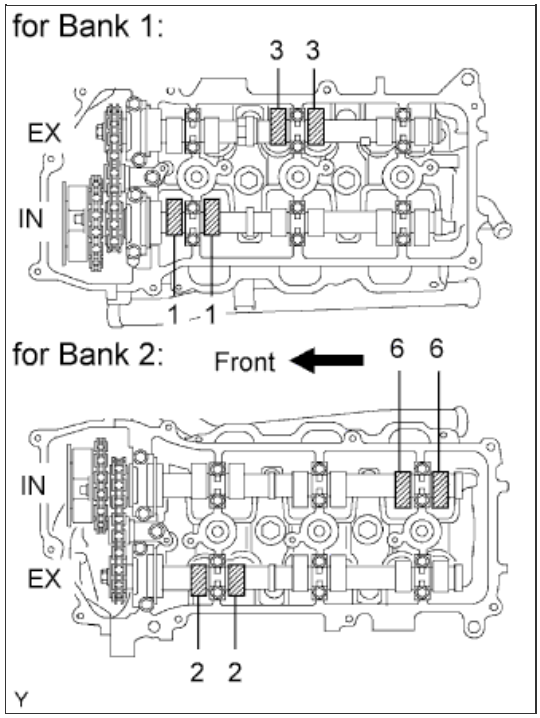
i. Using a feeler gauge, measure the clearance tween the valve lifter and camshaft.

Standard Valve Clearance Cold):

Item	Specified ondition
Intake	.15 to 0.25 mm (0.005 to 0.00 in.)
haust	0.2 to 0.3 mm (0.0114 to 0.0154 in.)

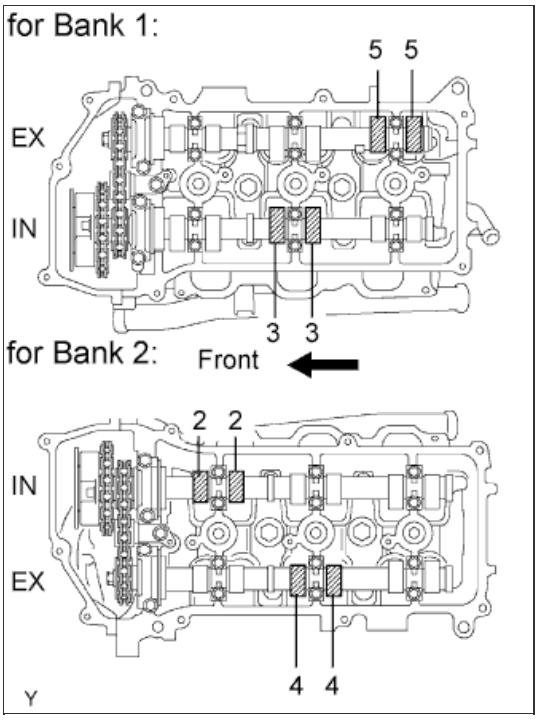
ii. Record the out-of-specification valve clearance measurements. They will be used later to determine the re ired replacement valve lifter.

b. Turn the crankshaft 2/3 of a revolution (240°).



c. heck the valves indicated in the illustration.

c. heck the valves indicated in the illustration.



i. Using a feeler gauge, measure the clearance tween the valve lifter and camshaft.

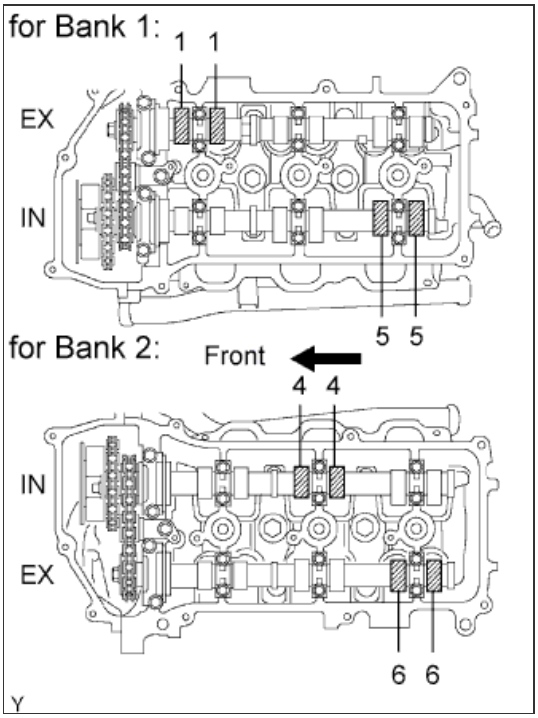
Standard Valve Clearance Cold):

Item	Specified ondition
Intake	.15 to 0.25 mm (0.005 to 0.00 in.)
haust	0.2 to 0.3 mm (0.0114 to 0.0154 in.)

ii. Record the out-of-specification valve clearance measurements. They will be used later to determine the re ired replacement valve lifter.

d. Turn the crankshaft 2/3 of a revolution (240°).

e. heck the valves indicated in the illustration.



i. Using a feeler gauge, measure the clearance tween the valve lifter and camshaft.

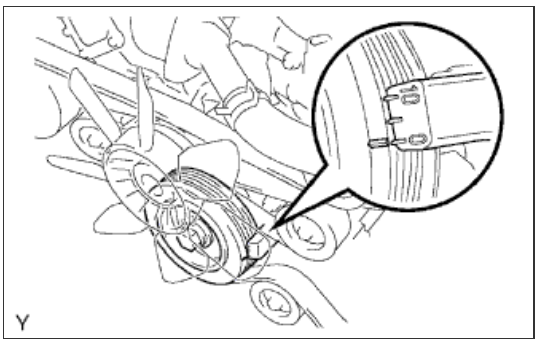
Standard Valve Clearance Cold):

Item	Specified ondition
Intake	.15 to 0.25 mm (0.005 to 0.00 in.)
haust	0.2 to 0.3 mm (0.0114 to 0.0154 in.)

ii. Record the out-of-specification valve clearance measurements. They will be used later to determine the re ired replacement valve lifter.

34. A UST VALVE CLEARANCE

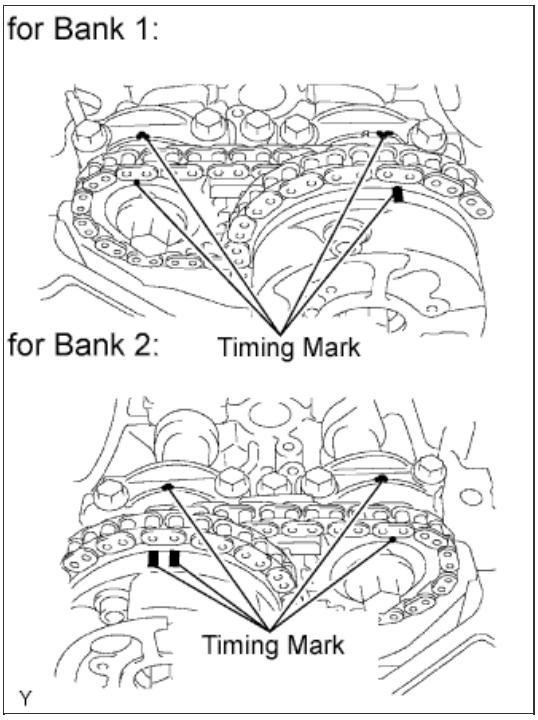
a. Set the o. 1 cylinder to TD compression.



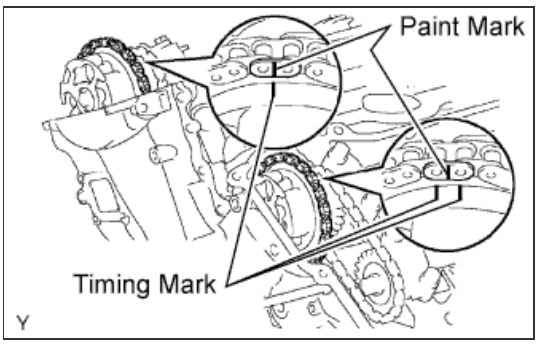
i. Turn the crankshaft pulley, and align the notch with the timing mark "0" of the timing chain cover.

ii. heck that the timing marks of the camshaft timing gears and

ii. Check that the timing marks of the camshaft timing gears and sprockets are aligned with the timing marks of the bearing caps as shown in the illustration.
If not, turn the crankshaft 1 complete revolution (360°) and align the timing marks as above.



iii. Place paint marks on the chain links that correspond with the timing marks of the camshaft timing gears.

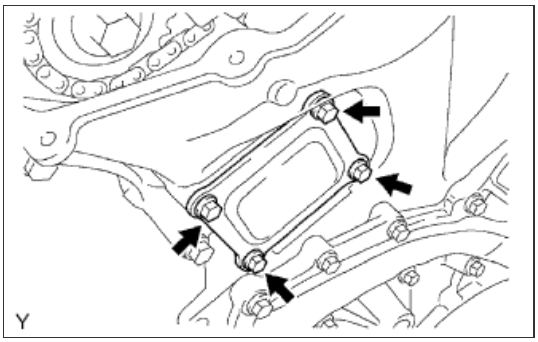


b. Remove the No. 1 chain tensioner.

NOTICE:

- **Never rotate the crankshaft with the No. 1 chain tensioner removed.**
- **When rotating the camshaft with the No. 1 chain removed, turn the crankshaft counterclockwise 40° from TDC first.**

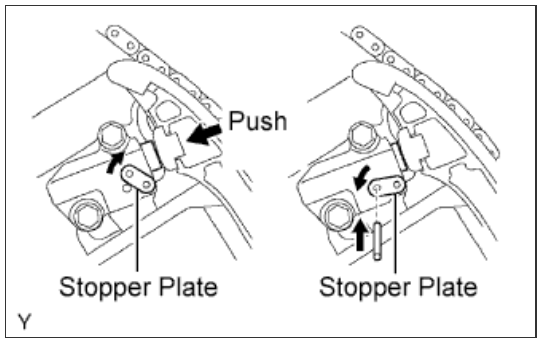
i. Remove the bolts, timing chain cover plate and gasket.



ii. While rotating the stopper plate of the No. 1 chain tensioner clockwise, push in the plunger of the No. 1 chain tensioner as shown in the illustration.

iii. While rotating the stopper plate of the tensioner counterclockwise downward, insert a bar of φ3.5 mm (0.138 in.) into the holes in the stopper plate and tensioner to fix the stopper plate in place.

iv. Remove the olts and No. 1 chain tensioner.

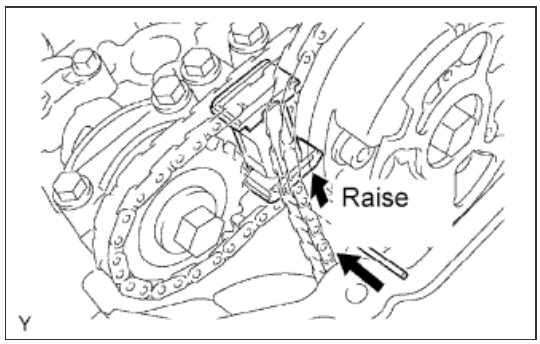


c. Remove the o. 2 camshaft.

NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

i. While raising the o. 2 chain tensioner, insert a pin of φ1.0 mm (0.03 in.) into the hole to fix the tensioner in place.

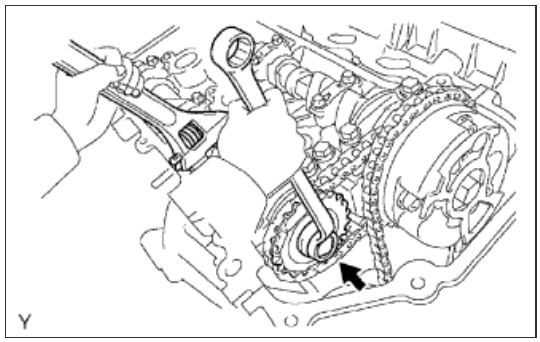


ii. Hold the he agonal portion of the o. 2 camshaft with a wrench, and remove the camshaft timing sprocket set bolt.

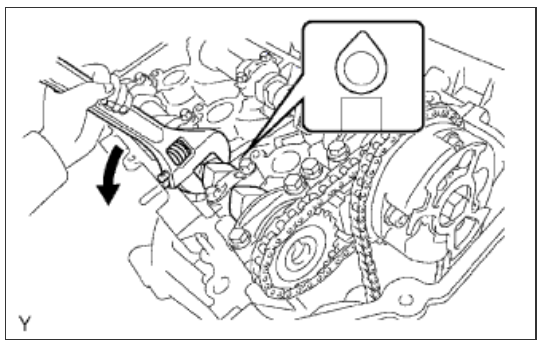
NOTICE:

Be careful not to damage the cylinder head and valve lifter with the wrench.

iii. Separate the camshaft timing sprocket from the o. 2 camshaft.

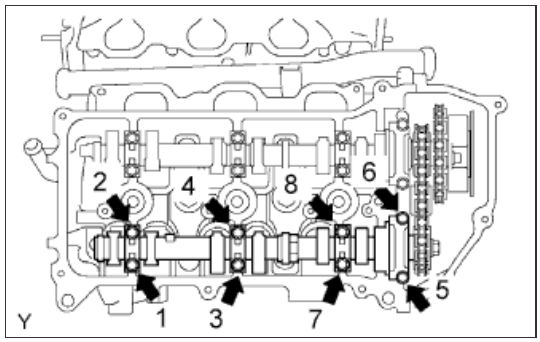


iv. Rotate the camshaft counterclockwise using the wrench so that the cam lobes of the o. 1 cylinder face upward as shown in the illustration.



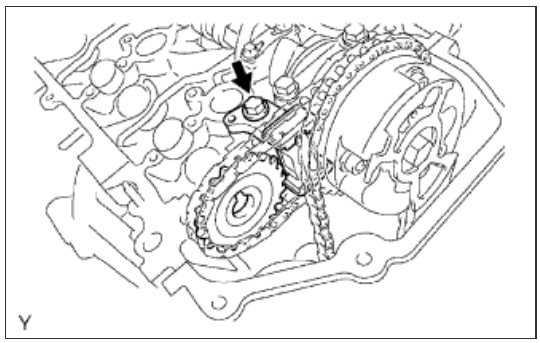
v. Uniformly loosen and remove the aring cap bolts in the se uence shown in the illustration.

vi. Remove the aring caps and No. 2 camshaft.



d. Remove the o. 2 chain tensioner.

i. Remove the o. 2 chain tensioner bolt, No. 2 chain tensioner and camshaft timing sprocket.



e. Remove the o. 1 camshaft.

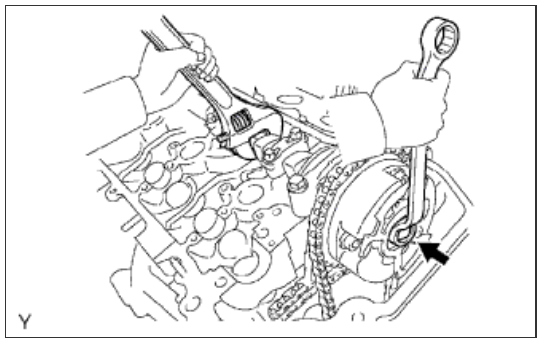
NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

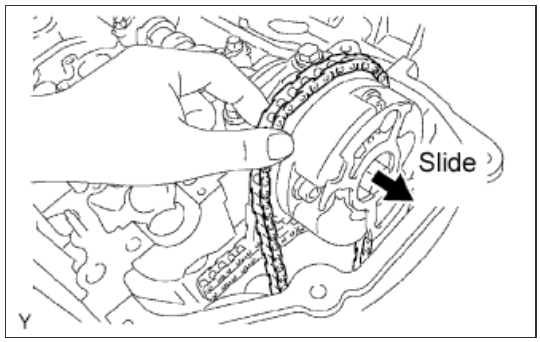
i. Hold the he agonal portion of the o. 1 camshaft with a wrench, and loosen the camshaft timing gear set bolt.

NOTICE:

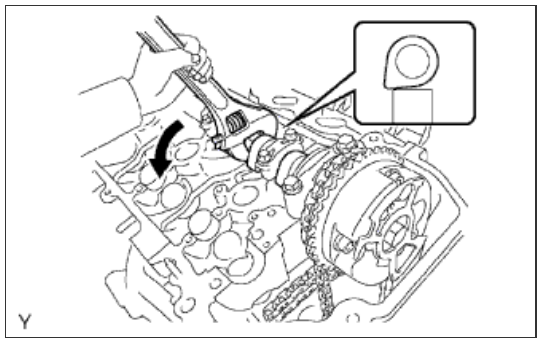
- **Be careful not to damage the cylinder head and valve lifter with the wrench.**
- **not disassemble the camshaft timing gear.**



ii. Slide the camshaft timing gear and separate the o. 1 chain from the camshaft timing gear.

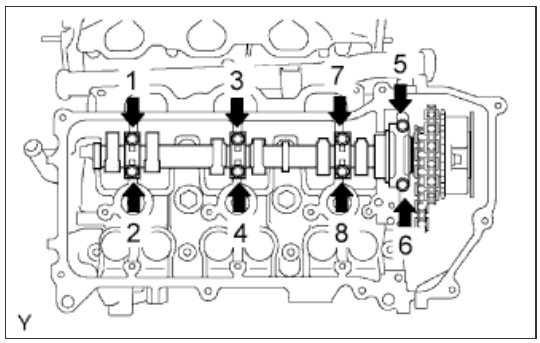


iii. Rotate the o. 1 camshaft counterclockwise using a wrench so that the cam lobes of the o. 1 cylinder face downward as shown in the illustration.

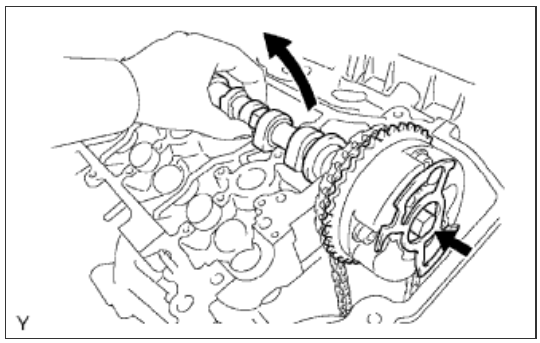


iv. Uniformly loosen and remove the bearing cap bolts in the sequence shown in the illustration.

v. Remove the bearing caps.



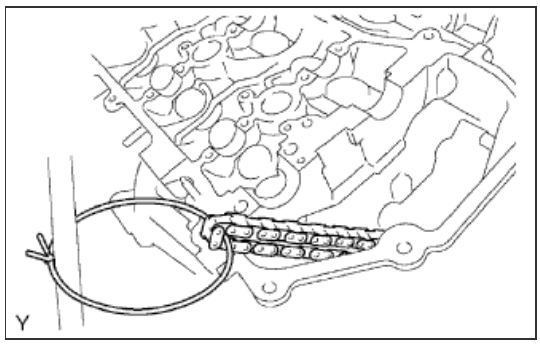
vi. Remove the camshaft timing gear set bolt with the No. 1 camshaft lifted up, and then remove the No. 1 camshaft and camshaft timing gear with the No. 2 chain.



vii. Tie the No. 1 chain with a string as shown in the illustration.

NOTICE:

Be careful not to drop anything inside the timing chain cover.

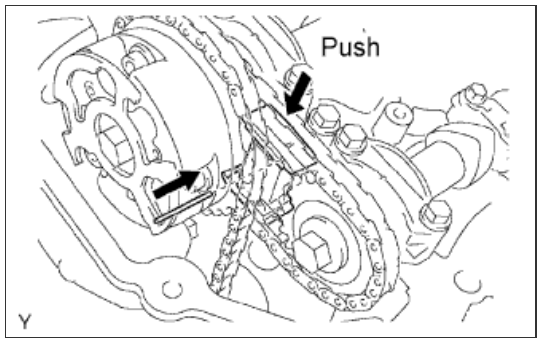


f. Remove the No. 4 camshaft.

NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

i. While pushing down the No. 3 chain tensioner, insert a pin of φ1.0 mm (0.03 in.) into the hole to fix the tensioner in place.

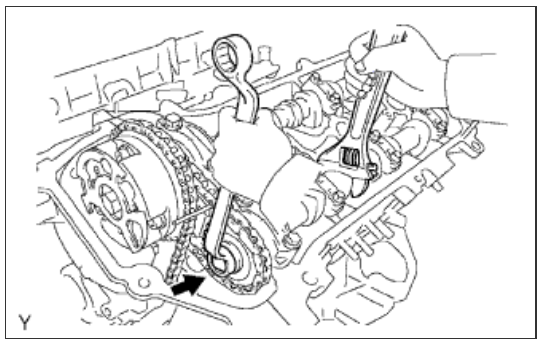


ii. Hold the he agonal portion of the o. 4 camshaft with a wrench, and remove the camshaft timing sprocket set bolt.

NOTICE:

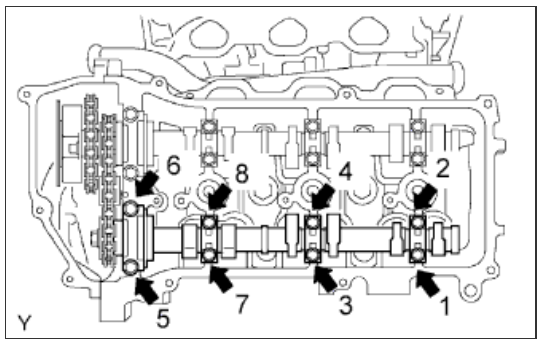
Be careful not to damage the cylinder head and valve lifter with the wrench.

iii. Separate the camshaft timing sprocket from the o. 4 camshaft.



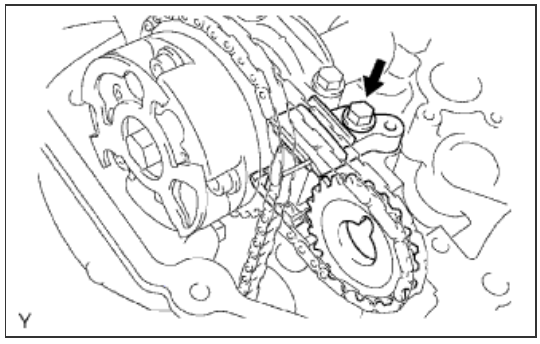
iv. Uniformly loosen and remove the aring cap bolts in the se uence shown in the illustration.

v. Remove the aring caps and No. 4 camshaft.



g. Remove the o. 3 chain tensioner.

i. Remove the o. 3 chain tensioner bolt, No. 3 chain tensioner and camshaft timing sprocket.



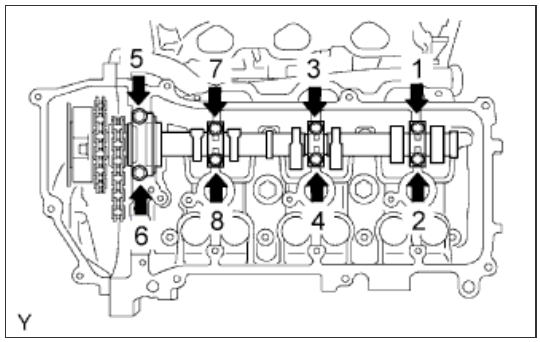
h. Remove the o. 3 camshaft.

NOTICE:

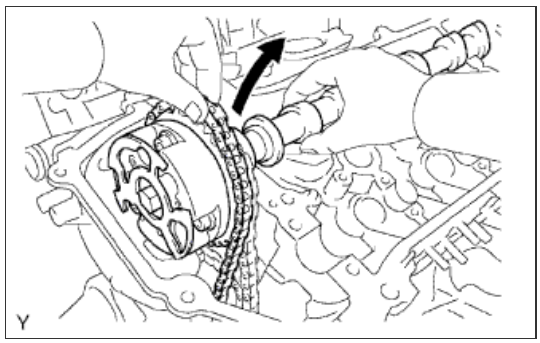
As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

i. Using several steps, loosen and remove the aring cap bolts uniformly in the se uence shown in the illustration.

ii. Remove the aring caps.



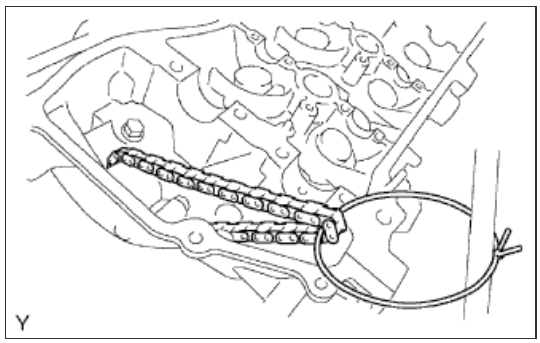
iii. Hold the o. 1 chain, and remove the o. 3 camshaft with camshaft timing gear and No. 2 chain.



iv. Tie the o. 1 chain with a string as shown in the illustration.

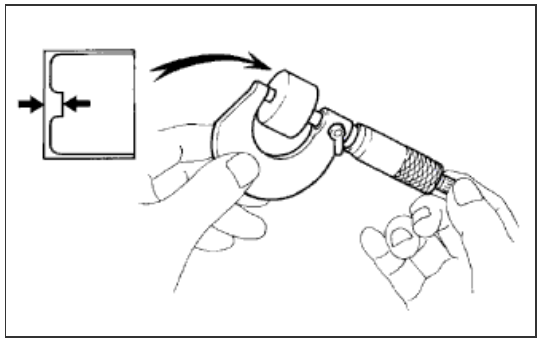
NOTICE:

Be careful not to drop anything inside the timing chain cover.



i. Remove the valve lifters from the cylinder head LH and RH.

. Determine the size of the valve lifter to be installed according to the following formulas or charts.



i. Using a micrometer, measure the thickness of the removed lifter.

ii. alculate the thickness of a new lifter so that the valve clearance comes within the specified value.

T:
Thickness of removed lifter

A:
Measured valve clearance

N:
Thickness of new lifter

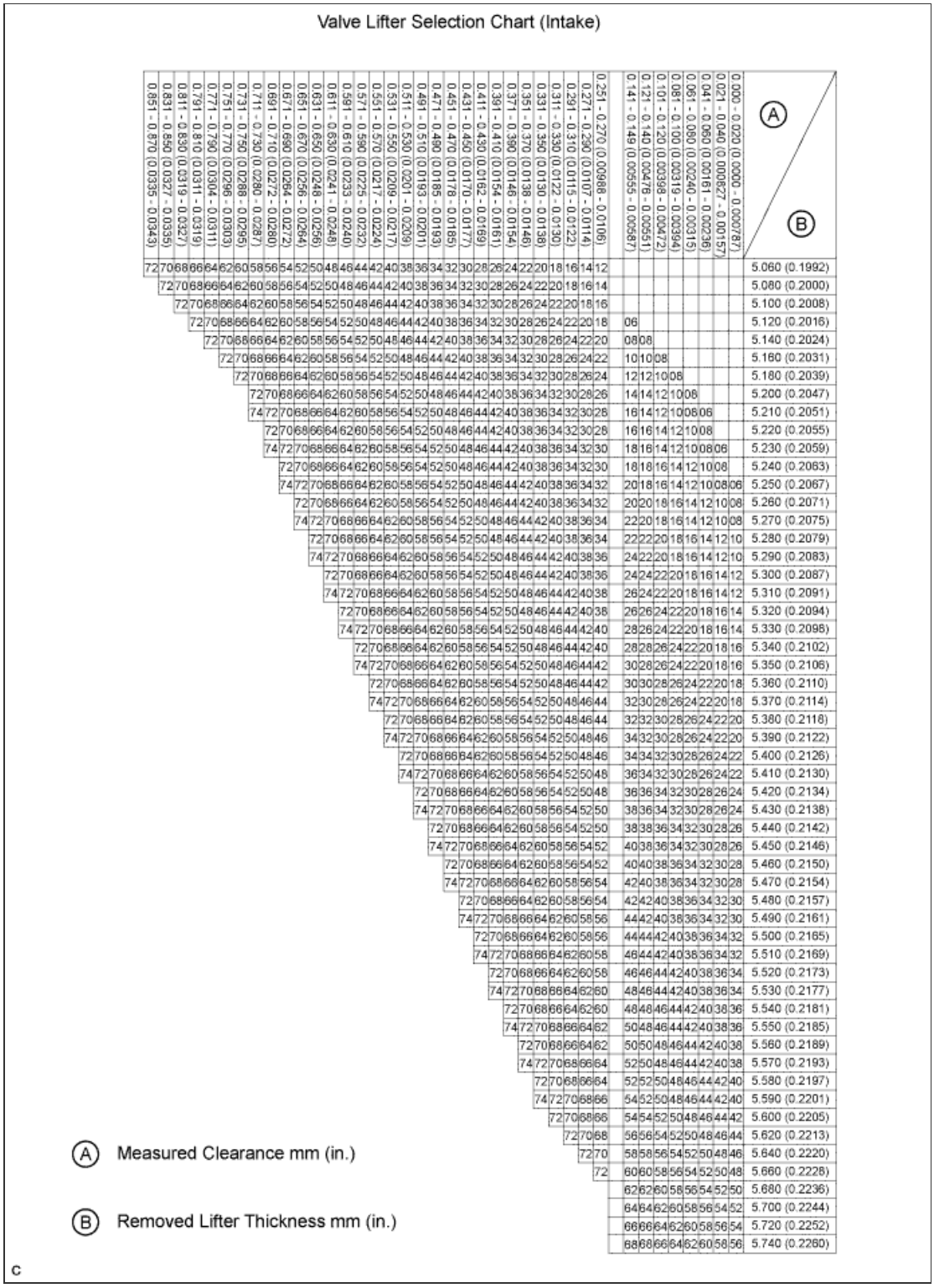
Intake:
N T A - 0.20 mm 0.00787 in.))

E haust:
N T A - 0.34 mm 0.0131 in.))

iii. Select a new lifter with a thickness as close as possible to the calculated value.

HINT:

Lifters are available in 35 sizes in increments of 0.020 mm (0.000787 in.), from 5.060 mm (0.1 in.) to 5.740 mm (0.2260 in.).

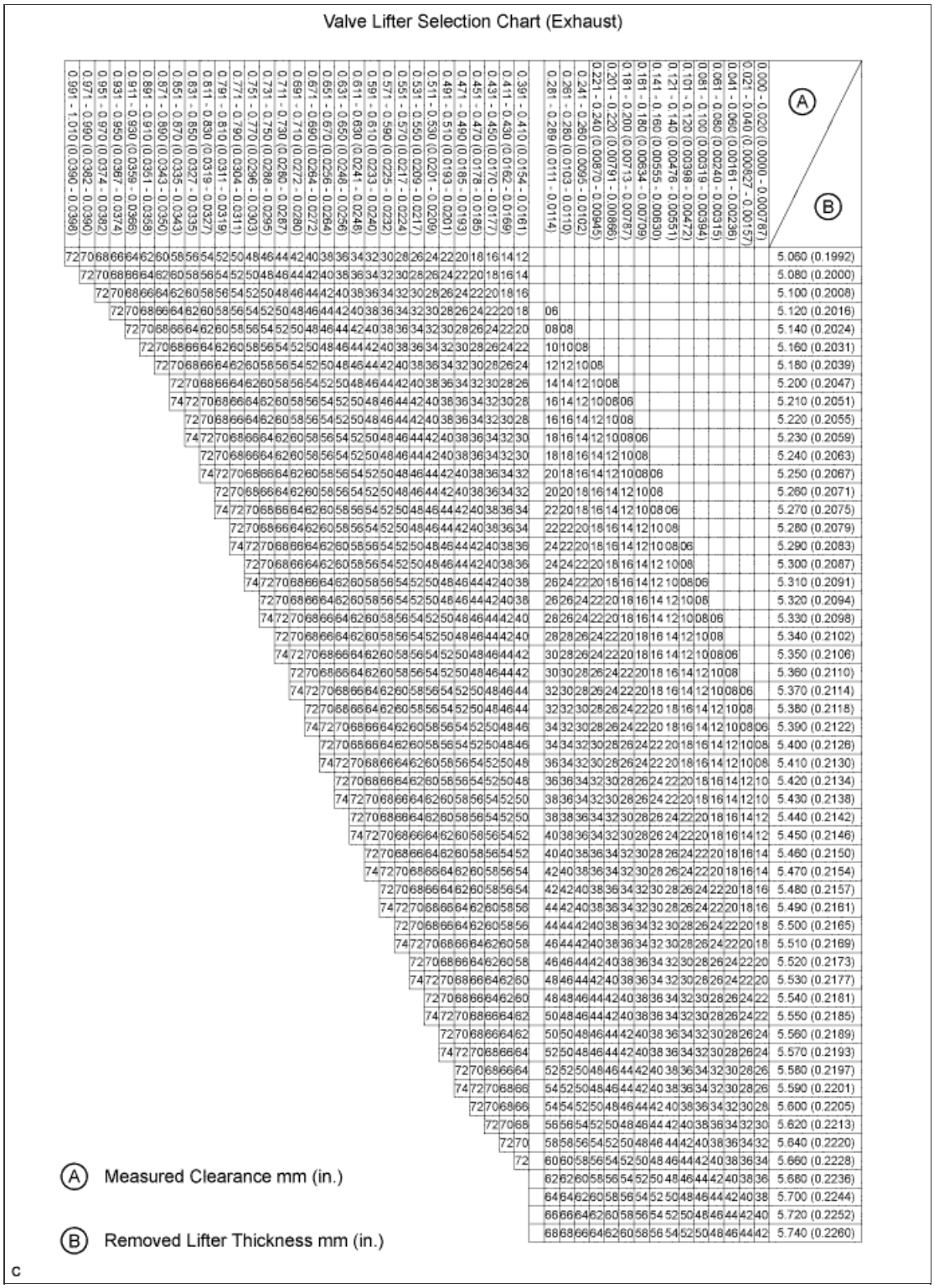


Intake valve clearance Cold):
0.15 to 0.25 mm 0.00591 to 0.00984 in.)
E AMPLE:
The 5.250 mm 0.20 7in.) lifter is installed, and the measured clearance is 0.400 mm 0.0157 in.). Replace the 5.250 mm 0.20 7in.) lifter with a No. 4 lifter.

New Lifter Thickness:

Lifter No.	Thickness	Lifter No.	Thickness	Lifter No.	Thickness
06	5.060 mm (0.1 in.)	30	5.300 mm (0.2087 in.)	54	5.540 mm (0.2181 in.)
08	5.080 mm (0.2000 in.)	32	5.320 mm (0.20 in.)	56	5.560 mm (0.218 in.)
10	5.100 mm (0.2008 in.)	34	5.340 mm (0.2102 in.)	58	5.580 mm (0.21 in.)

12	5.120 mm (0.2016 in.)	36	5.360 mm (0.2110 in.)	60	5.600 mm (0.2205 in.)
14	5.140 mm (0.2024 in.)	38	5.380 mm (0.2118 in.)	62	5.620 mm (0.2213 in.)
16	5.160 mm (0.2031 in.)	40	5.400 mm (0.2126 in.)	64	5.640 mm (0.2220 in.)
18	5.180 mm (0.203 in.)	42	5.420 mm (0.2134 in.)	66	5.660 mm (0.2228 in.)
20	5.200 mm (0.2047 in.)	44	5.440 mm (0.2142 in.)	68	5.680 mm (0.2236 in.)
22	5.220 mm (0.2055 in.)	46	5.460 mm (0.2150 in.)	70	5.700 mm (0.2244 in.)
24	5.240 mm (0.2063 in.)	48	5.480 mm (0.2157 in.)	72	5.720 mm (0.2252 in.)
26	5.260 mm (0.2071 in.)	50	5.500 mm (0.2165 in.)	74	5.740 mm (0.2260 in.)
28	5.280 mm (0.207 in.)	52	5.520 mm (0.2173 in.)	-	-



E haust valve clearance Cold):
0.29 to 0.39 mm 0.0114 to 0.0154 in.)
E AMPLE:
The 5.340 mm 0.210 in.) lifter is installed, and the measured clearance is 0.480 mm 0.0189 in.). Replace the 5.340 mm 0.210 in.) lifter with a No. 48 lifter.

New Lifter Thickness:

Lifter No.	Thickness	Lifter No.	Thickness	Lifter No.	Thickness
06	5.060 mm (0.1 in.)	30	5.300 mm (0.2087 in.)	54	5.540 mm (0.2181 in.)
08	5.080 mm (0.2000 in.)	32	5.320 mm (0.20 in.)	56	5.560 mm (0.218 in.)
10	5.100 mm (0.2008 in.)	34	5.340 mm (0.2102 in.)	58	5.580 mm (0.21 in.)
	5.120 mm		5.360 mm		5.600 mm

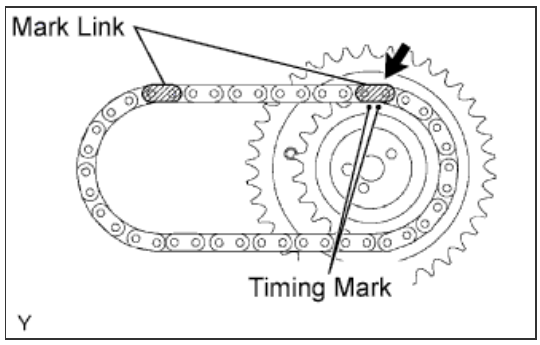
12	(0.2016 in.)	36	(0.2110 in.)	60	(0.2205 in.)
14	5.140 mm (0.2024 in.)	38	5.380 mm (0.2118 in.)	62	5.620 mm (0.2213 in.)
16	5.160 mm (0.2031 in.)	40	5.400 mm (0.2126 in.)	64	5.640 mm (0.2220 in.)
18	5.180 mm (0.203 in.)	42	5.420 mm (0.2134 in.)	66	5.660 mm (0.2228 in.)
20	5.200 mm (0.2047 in.)	44	5.440 mm (0.2142 in.)	68	5.680 mm (0.2236 in.)
22	5.220 mm (0.2051 in.)	46	5.460 mm (0.2150 in.)	70	5.700 mm (0.2244 in.)
24	5.240 mm (0.2063 in.)	48	5.480 mm (0.2157 in.)	72	5.720 mm (0.2252 in.)
26	5.260 mm (0.2071 in.)	50	5.500 mm (0.2165 in.)	74	5.740 mm (0.2260 in.)
28	5.280 mm (0.207 in.)	52	5.520 mm (0.2173 in.)	-	-

k. Install the o. 3 camshaft.

NOTICE:

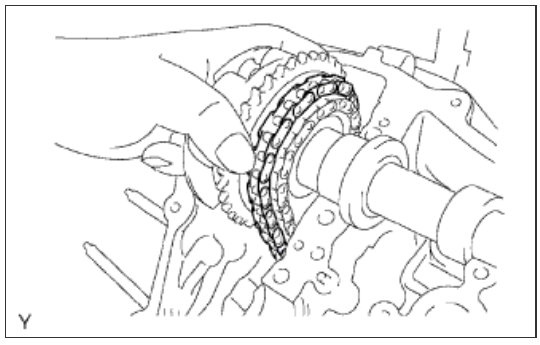
As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

i. Align the mark link (yellow) with the timing mark (2-dot mark) of the camshaft timing gear shown in the illustration.



ii. Apply a light coat of engine oil to the thrust portions and journals of the o. 3 camshaft.

iii. Temporarily put the o. 1 chain on the o. 2 chain of the camshaft timing gear.

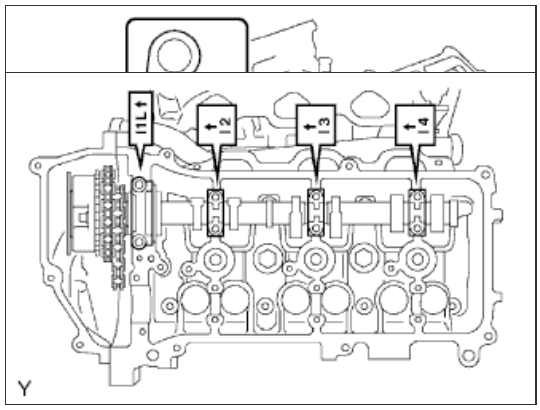


iv. Set the o. 3 camshaft onto the cylinder head LH with the cam lobes of the o. 2 cylinder facing downward as shown in the illustration.

v. Apply a light coat of engine oil to the aring caps.

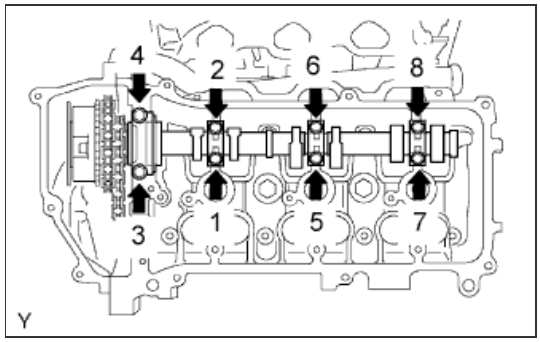
vi. Set the aring caps in their proper locations.

vii. Apply a light coat of engine oil to the threads of the aring cap bolts.

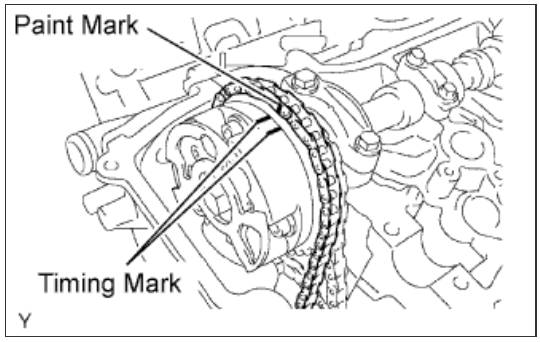


viii. Uniformly install the aring cap bolts in several steps in the order shown in the illustration.

Torque:
for 10 mm head bolt:
9.0 N m 92 kgf cm , 80 in. lbf
for 12 mm head bolt:
24 N m 245 kgf cm , 18 ft. lbf

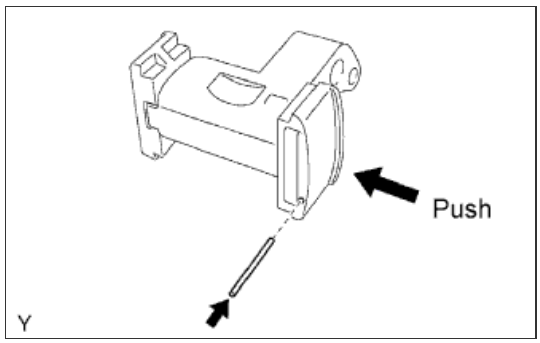


i . Set the paint mark of the o. 1 chain between the timing marks of the camshaft timing gear.



l. Install the o. 3 chain tensioner.

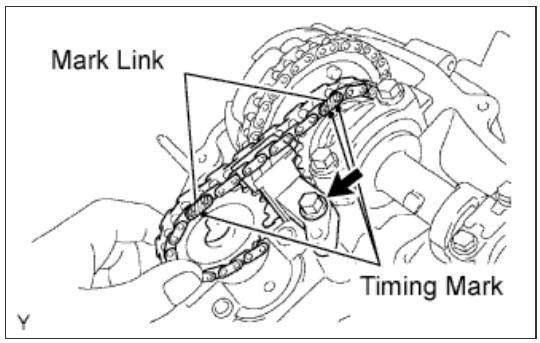
i. While pushing in the tensioner, insert a pin of φ1.0 mm (0.03 in.) into the hole to fix the tensioner in place.



ii. Temporarily install the camshaft timing sprocket and No. 3 chain tensioner with the olt and align the mark links (yellow) with the timing marks (1-dot mark and 2-dot mark) of the camshaft timing gear and sprocket.

iii. Tighten the o. 3 chain tensioner bolt.

Torque:
21 N m 214 kgf cm , 15 ft. lbf



m. Install the o. 4 camshaft.

NOTICE:

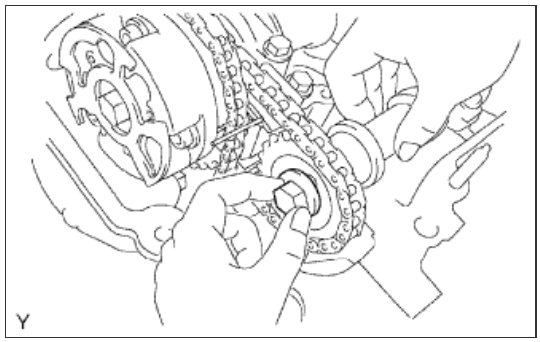
As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

i. Apply a light coat of engine oil to the thrust portions and journals of the o. 4 camshaft.

ii. Apply a light coat of engine oil to the threads and under the head of the camshaft timing sprocket set bolt.

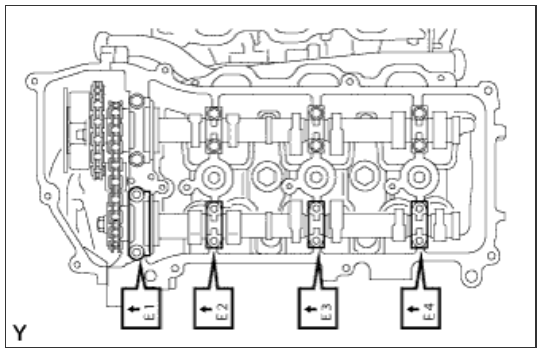
iii. Align the knock pin hole on the camshaft timing sprocket with the knock pin of the o. 4 camshaft, and insert the o. 4 camshaft into the camshaft timing sprocket.

iv. Temporarily install the camshaft timing sprocket set bolt.



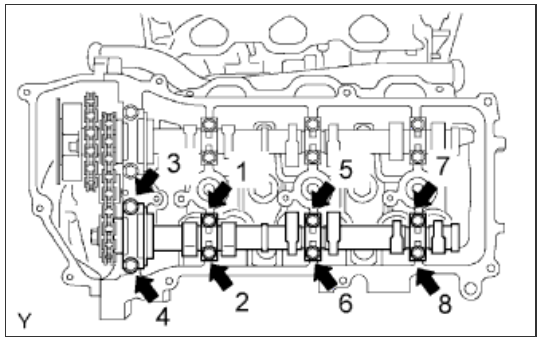
v. Set the aring caps in their proper locations.

vi. Apply a light coat of engine oil to the threads and under the heads of the aring cap bolts.



vii. Uniformly install the aring cap bolts in several steps in the order shown in the illustration.

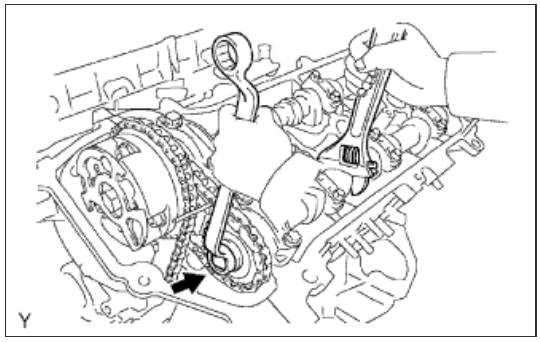
Torque:
for 10 mm head bolt:
9.0 N m 92 kgf cm , 80 in. lbf
for 12 mm head bolt:
24 N m 245 kgf cm , 18 ft. lbf



viii. Hold the he agonal portion of the o. 4 camshaft with a wrench, and tighten the camshaft timing sprocket set bolt.

Torque:
100 N m 1020 kgf cm , 74 ft. lbf

i . Remove the pin from the o. 3 chain tensioner.



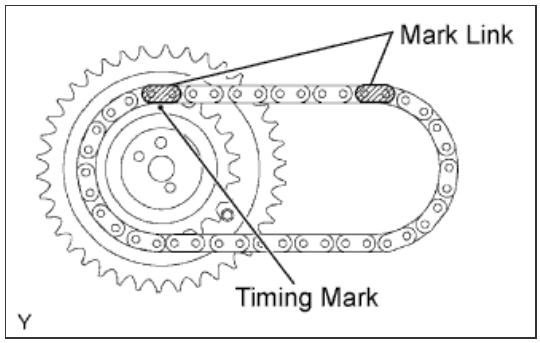
n. Install the o. 1 camshaft.

NOTICE:

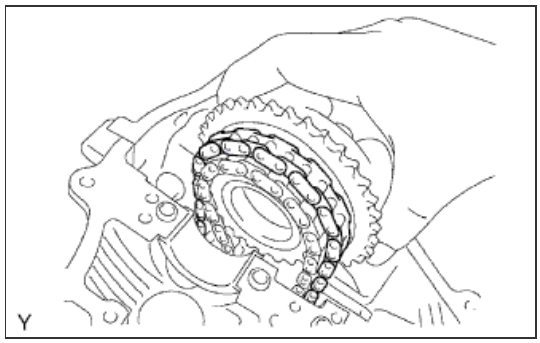
As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

i. Align the mark link (yellow) with the timing mark (1-dot mark) of the camshaft timing gear as shown in the illustration.

ii. Apply a light amount of engine oil to the thrust portions and journals of the camshaft.



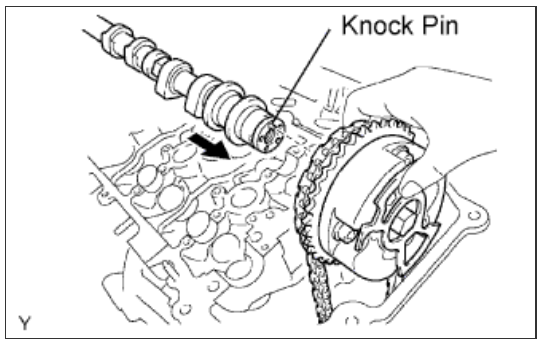
iii. Temporarily put the o. 1 chain on the o. 2 chain of the camshaft timing gear.



iv. Align the knock pin hole of the camshaft timing gear with the knock pin of the o. 1 camshaft, and insert the o. 1 camshaft into the camshaft timing gear.

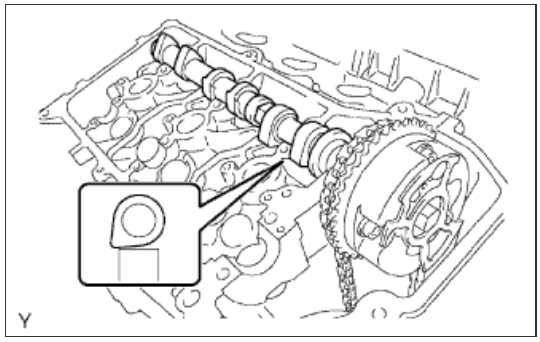
v. Apply a light coat of engine oil to the threads and under the head of the camshaft timing gear set bolt.

vi. Temporarily install the camshaft timing gear set bolt.



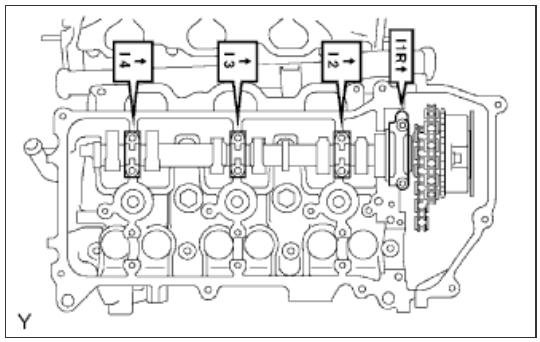
vii. Set the o. 1 camshaft onto the cylinder head RH with the cam lobes of the o. 1 cylinder facing downward as shown in the illustration.

viii. Apply a light coat of engine oil to the aring caps.



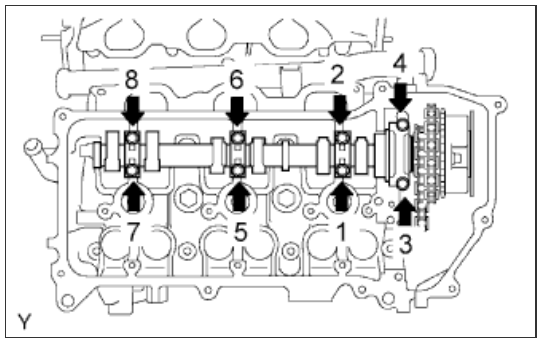
i . Set the aring caps in their proper locations.

. Apply a light coat of engine oil to the threads and under the heads of the aring cap bolts.

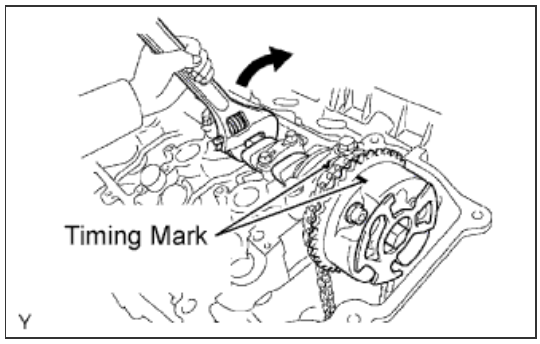


i. Uniformly install the aring cap bolts in several steps in the order shown in the illustration.

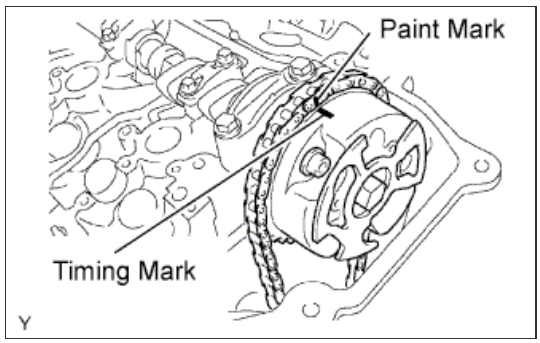
Torque:
for 10 mm head bolt:
9.0 N m 92 kgf cm , 80 in. lbf
for 12 mm head bolt:
24 N m 245 kgf cm , 18 ft. lbf



ii. Rotate the o. 1 camshaft clockwise using the he agonal portion of the o. 1 camshaft so that the timing mark of the camshaft timing gear is aligned with the timing mark of the camshaft bearing cap.

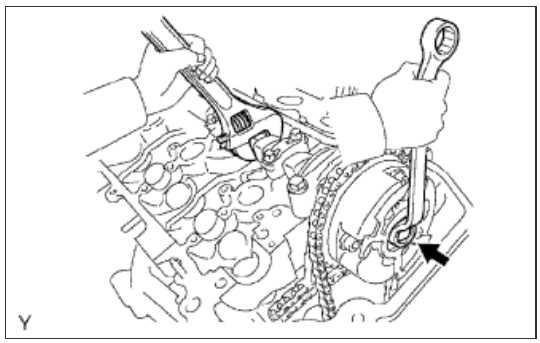


iii. Align the paint mark of the o. 1 chain with the timing mark of the camshaft timing gear.



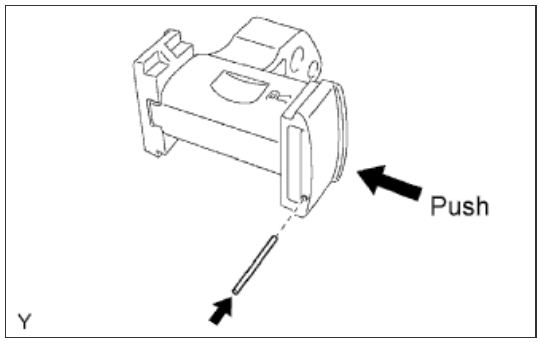
iv. Hold the he agonal portion of the o. 1 camshaft with a wrench, and tighten the camshaft timing gear set bolt.

Torque:
100 N m 1020 kgf cm , 74 ft. lbf



o. Install the o. 2 chain tensioner.

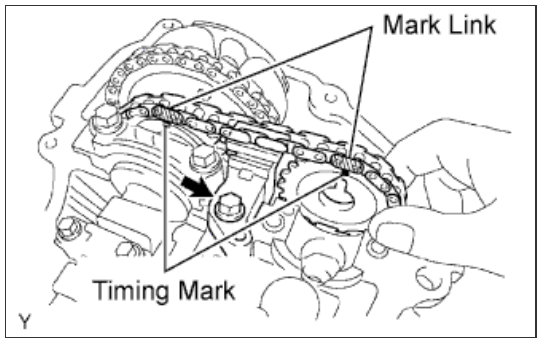
i. While pushing in the tensioner, insert a pin of φ1.0 mm (0.03 in.) into the hole to fix the tensioner in place.



ii. Temporarily install the camshaft timing sprocket and No. 2 chain tensioner with the olt and align the mark links (yellow) with the timing marks (1-dot mark and 2-dot mark) of the camshaft timing gear and sprocket.

iii. Tighten the o. 2 chain tensioner bolt.

Torque:
21 N m 214 kgf cm , 15 ft. lbf



p. Install the o. 2 camshaft.

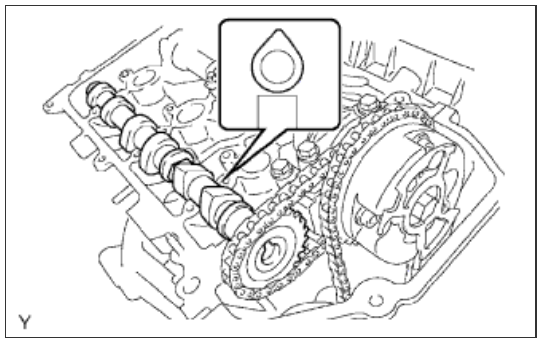
NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

i. Apply a light coat of engine oil to the thrust portions and journals of the o. 2 camshaft.

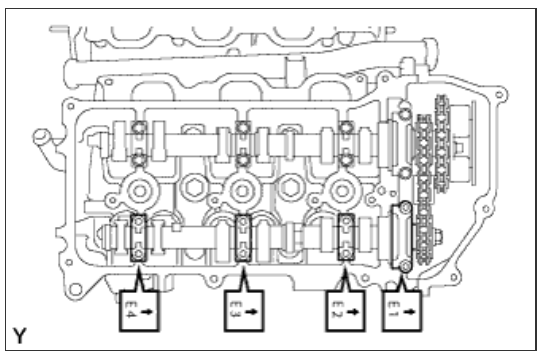
ii. Set the o. 2 camshaft onto the cylinder head RH with the cam lobes of the o. 1 cylinder facing upward as shown in the illustration.

iii. Apply a light coat of engine oil to the aring caps.



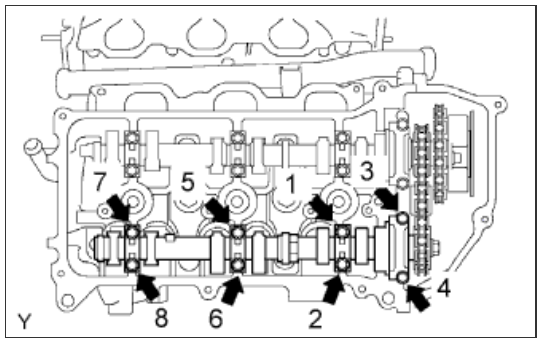
iv. Set the aring caps in their proper locations.

v. Apply a light coat of engine oil to the threads and under the heads of the aring cap bolts.



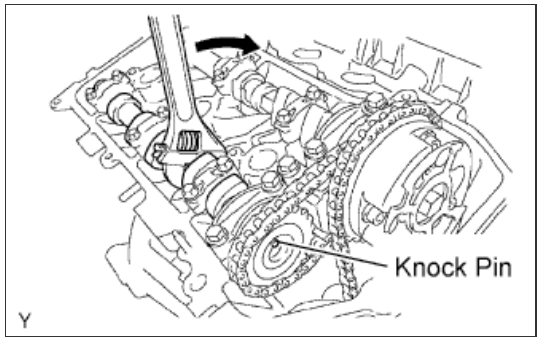
vi. Uniformly install the aring cap bolts in several steps in the order shown in the illustration.

Torque:
for 10 mm head bolt:
9.0 N m 92 kgf cm , 80 in. lbf
for 12 mm head bolt:
24 N m 245 kgf cm , 18 ft. lbf



vii. Rotate the o. 2 camshaft clockwise using a wrench so that the knock pin of the o. 2 camshaft is aligned with the knock pin hole of the camshaft timing sprocket.

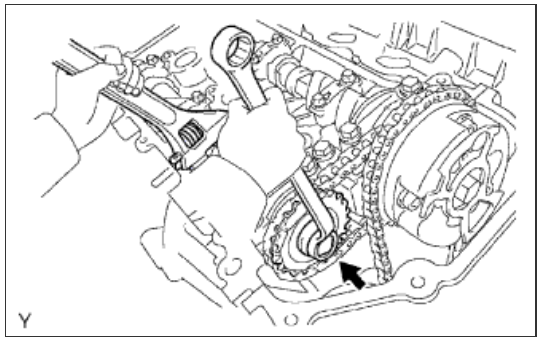
viii. Apply a light coat of engine oil to the threads and under the head of the camshaft timing sprocket set bolt.



i . Hold the he agonal portion of the o. 2 camshaft with a wrench, and install the camshaft timing sprocket set bolt.

Torque:
100 N m 1020 kgf cm , 74 ft. lbf

. Remove the pin from the o. 2 chain tensioner.



q. Install the o. 1 chain tensioner.

i. While turning the stopper plate of the tensioner clockwise, push in the plunger of the tensioner as shown in the illustration.

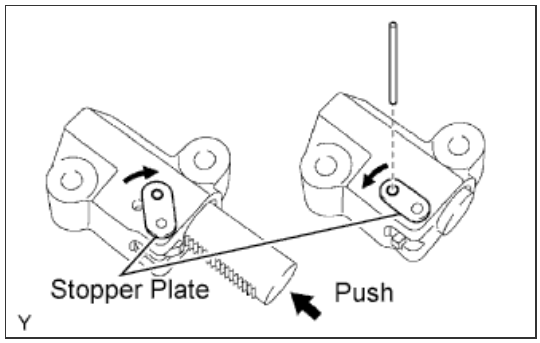
ii. While turning the stopper plate of the tensioner counterclockwise, insert a bar of φ3.5 mm (0.138 in.) into the holes on the stopper plate and tensioner to fix the stopper plate in place.

iii. Apply a light coat of engine oil to the threads and under the heads of the o. 1 chain tensioner bolts.

iv. Install the o. 1 chain tensioner with the olts.

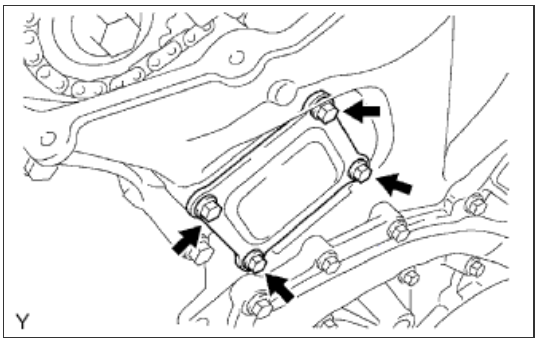
Torque:
10 N m 102 kgf cm , 7 ft. lbf

v. Remove the ar from the chain tensioner.

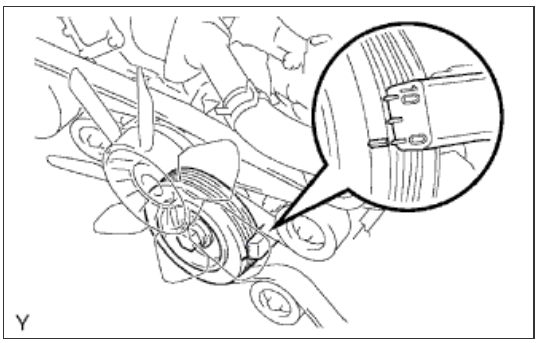


vi. Install a new gasket and the timing chain cover plate with the olts.

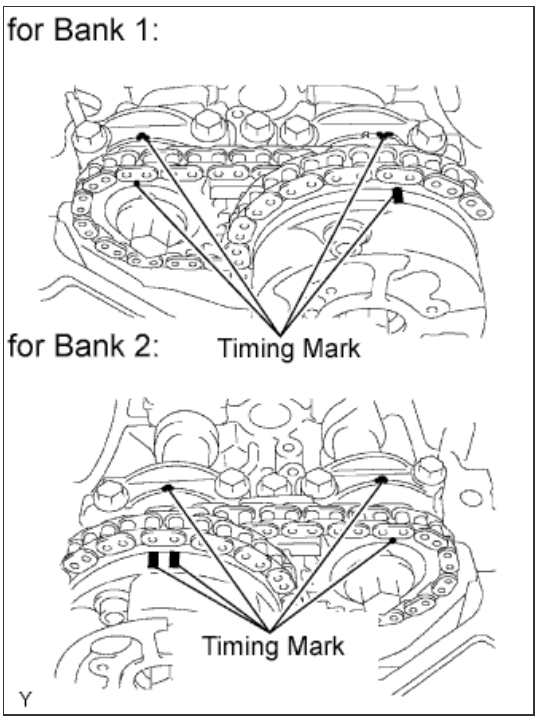
Torque:
9.0 N m 92 kgf cm , 80 in. lbf



vii. Turn the crankshaft pulley complete revolutions slowly, and align the notch with the timing mark "0" of the timing chain cover.



viii. heck that the timing marks of the camshaft timing gears and sprockets are aligned with the timing marks of the aring caps as shown in the illustration.



35. INSTALL CYLIN ER HEA COVER SUB-ASSEMBLY RH

a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the cylinder head, timing chain cover and cylinder head cover.

b. Apply seal packing as shown in the illustration.

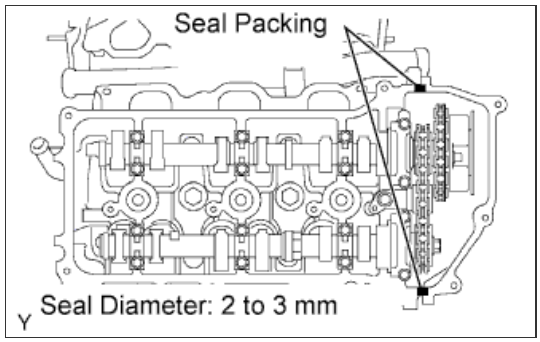
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
2 to 3 mm 0.0787 to 0.118 in.)

NOTICE:

- **Remove any oil from the contact surface.**

- **Install the head cover within 3 minutes after applying seal packing.**
- **not start the engine for at least 2 hours after the installation.**

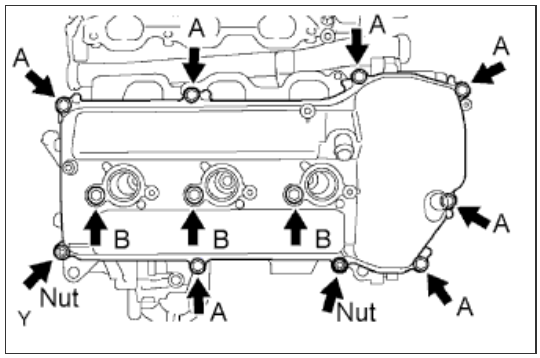


c. Install a new gasket to the cylinder head cover.

d. Install the seal washers to the olts.

e. Temporarily install the cylinder head cover with the olts and 2 nuts. Tighten the olts and nuts uniformly in several steps.

Torque:
for bolt A:
10 N m 102 kgf cm , 7 ft. lbf
for bolt B and nut:
9.0 N m 92 kgf cm , 80 in. lbf



3 . INSTALL CYLIN ER HEA COVER SUB-ASSEMBLY LH

a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the cylinder head, timing chain cover and cylinder head cover.

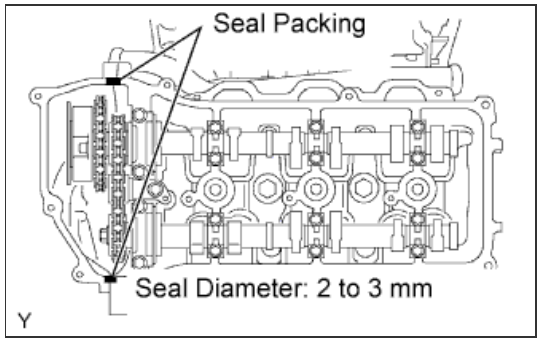
b. Apply seal packing as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
2 to 3 mm 0.0787 to 0.118 in.)

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the head cover within 3 minutes after applying seal packing.**
- **not start the engine for at least 2 hours after the installation.**

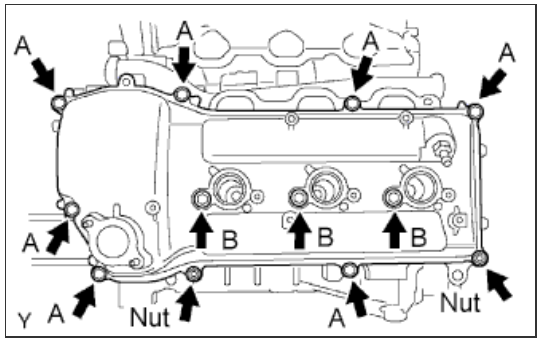


c. Install a new gasket to the cylinder head cover.

d. Install the seal washers to the olts.

e. Temporarily install the cylinder head cover with the olts and 2 nuts. Tighten the olts and nuts uniformly in several steps.

Torque:
for bolt A:
10 N m 102 kgf cm , 7 ft. lbf
for bolt B and nut:
9.0 N m 92 kgf cm , 80 in. lbf



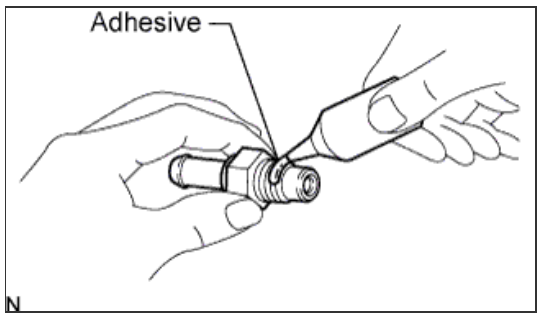
37. INSTALL VENTILATION VALVE SUB-ASSEMBLY

a. Apply adhesive to the threads of the ventilation valve.

Adhesive:
Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent

b. Install the ventilation valve to the cylinder head cover.

Torque:
27 N m 275 kgf cm , 20 ft. lbf



38. INSTALL SPARK PLUG

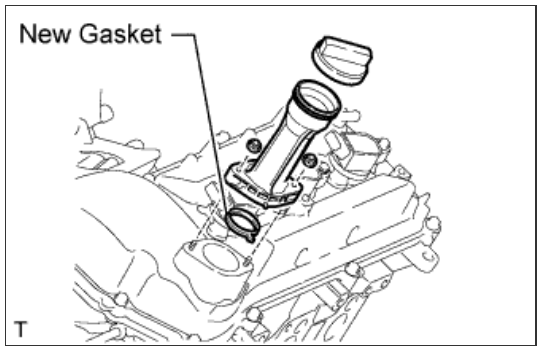
a. Install the spark plugs.

Torque:
20 N m 204 kgf cm , 15 ft. lbf

39. INSTALL OIL FILLER CAP HOUSING

a. Install a new gasket and the oil filler cap housing with the nuts.

Torque:
9.0 N m 92 kgf cm , 80 in. lbf



0. INSTALL OIL FILLER CAP SUB-ASSEMBLY

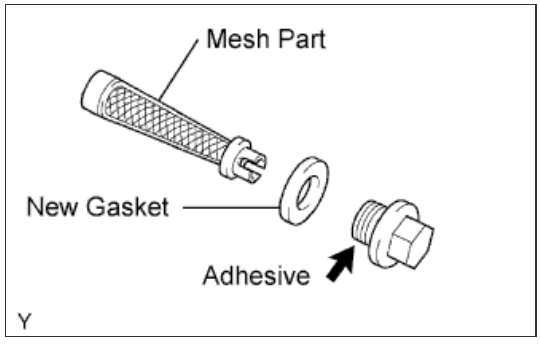
41. INSTALL OIL CONTROL VALVE FILTER

a. Install 2 new gaskets to 2 new unions.

b. Insert new filters to the unions.

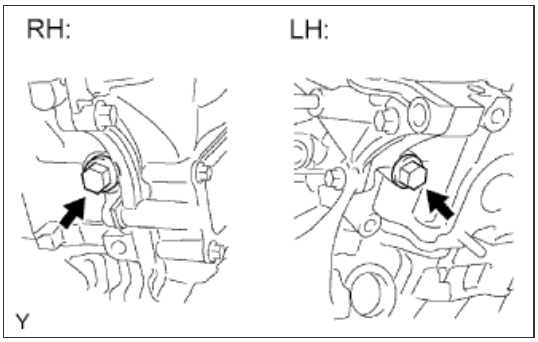
c. Apply adhesive to 2 or 3 threads of the unions.

Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent



d. Install the unions to the cylinder head LH and RH.

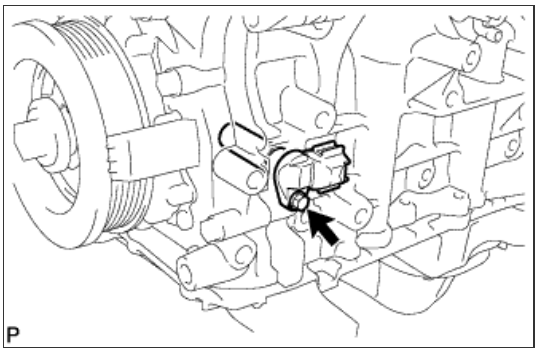
Torque:
2 N m 32 kgf cm , 4 ft. lbf



42. INSTALL CRANKSHAFT POSITION SENSOR

a. Install the sensor with the olt.

Torque:
10 N m 102 kgf cm , 7 ft. lbf

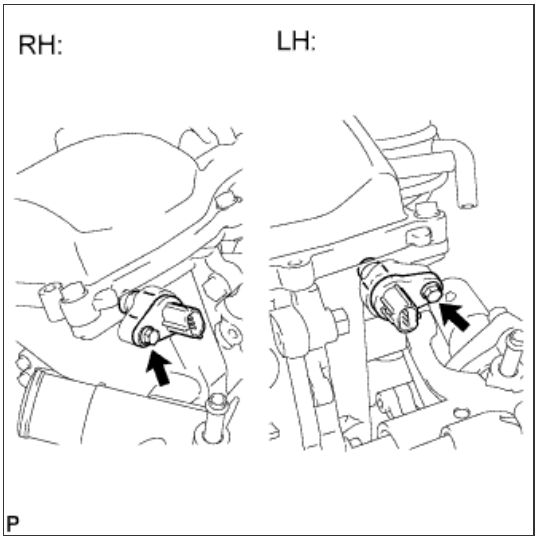


3. INSTALL VVT SENSOR

a. Apply a light coat of engine oil to the ring of each T sensor.

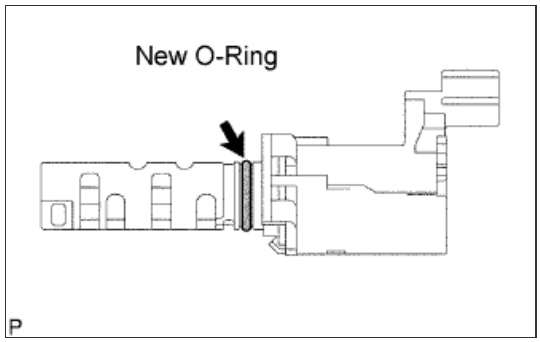
b. Install the T sensors with the olts.

Torque:
8.0 N m 82 kgf cm , 71 in. lbf



. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY LH

a. Apply a light coat of engine oil to a new O-ring and install it to the camshaft timing oil control valve.

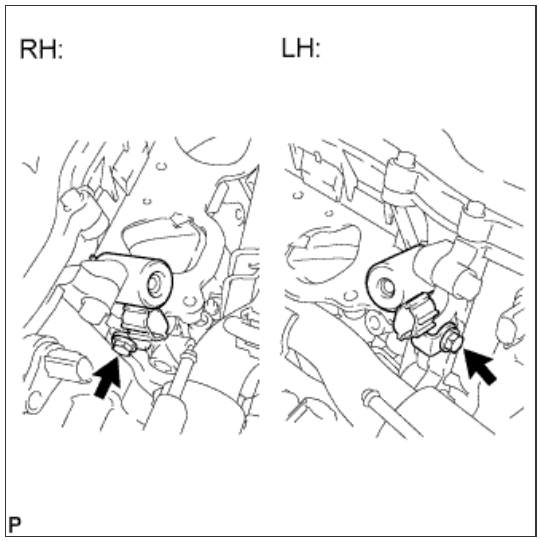


b. Install the camshaft timing oil control valve with the olt.

Torque:
10 N m 102 kgf cm , 7 ft. lbf

NOTICE:

Be careful that the ring is not cracked when installing the camshaft timing oil control valve.



45. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY RH

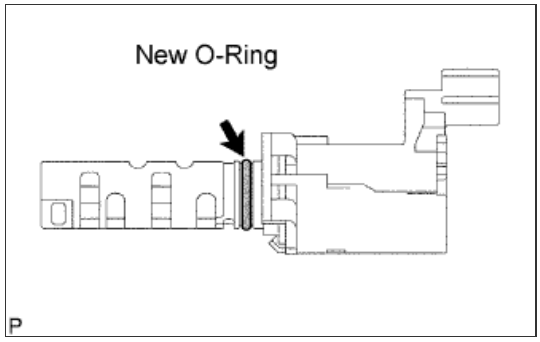
a. Apply a light coat of engine oil to a new O-ring and install it to the camshaft timing oil control valve.

b. Install the camshaft timing oil control valve with the olt.

Torque:
10 N m 102 kgf cm , 7 ft. lbf

NOTICE:

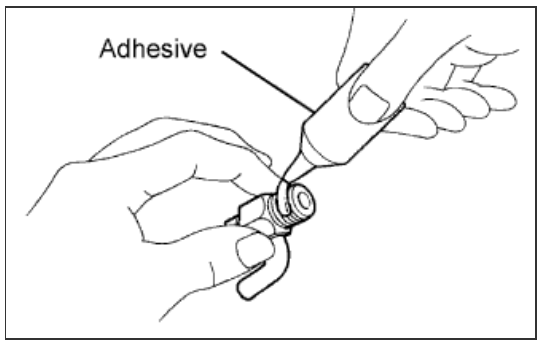
Be careful that the ring is not cracked when installing the camshaft timing oil control valve.



4 . INSTALL CYLIN ER BLOCK ATER RAIN COCK SUB-ASSEMBLY

a. Apply adhesive to 2 or 3 threads of the drain cock end.

Adhesive:
Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent



b. Install the drain cock.

Torque:
25 N m 255 kgf cm , 18 ft. lbf

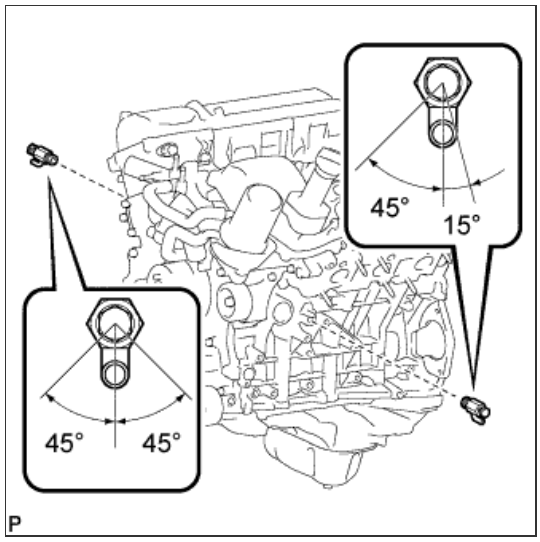
NOTICE:

- **Install the drain cock within 3 minutes after applying adhesive.**
- **ɑnot e pose the drain cock to coolant within 1 hour after installing.**

c. Rotate the drain cock clockwise as shown in the illustration.

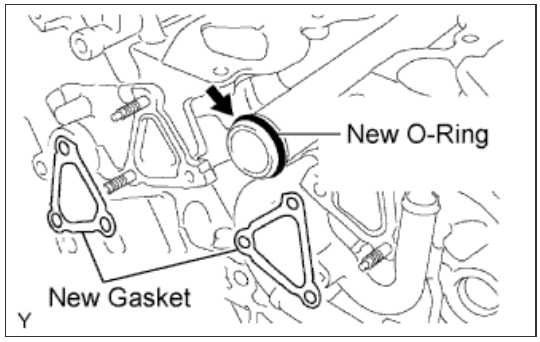
NOTICE:

- **ɑnot rotate the drain cock by more than 1 revolution 3 0 after tightening the drain cock to the specified torque.**
- **ɑnot loosen the drain cock after setting it correctly.**



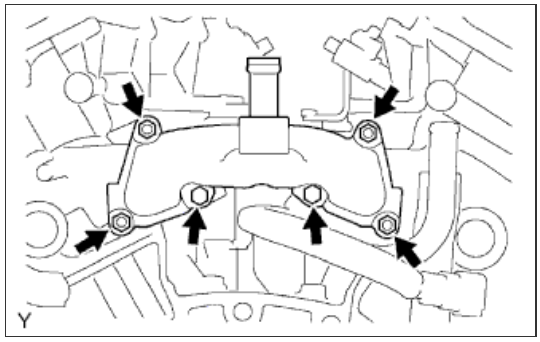
47. INSTALL REAR ATER BY-PASS OINT

a. Apply soapy water to a new O-ring, and install it to the water outlet pipe. Then set 2 new gaskets to the water ports LH and RH.



b. Install the rear water by-pass joint with the olts and 4 nuts.

Torque:
for bolt:
10 N m 102 kgf cm , 7 ft. lbf
for nut:
9.0 N m 92 kgf cm , 80 in. lbf

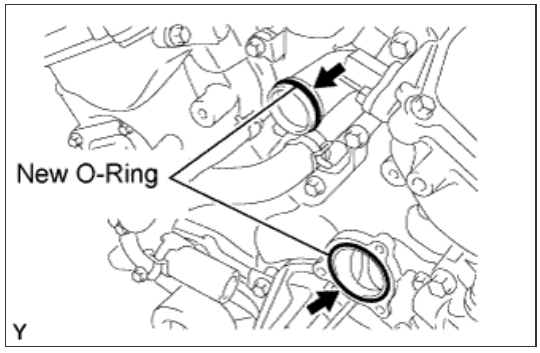


8. INSTALL ATER INLET HOUSING

a. Apply soapy water to a new O-ring, install it to the water outlet pipe.

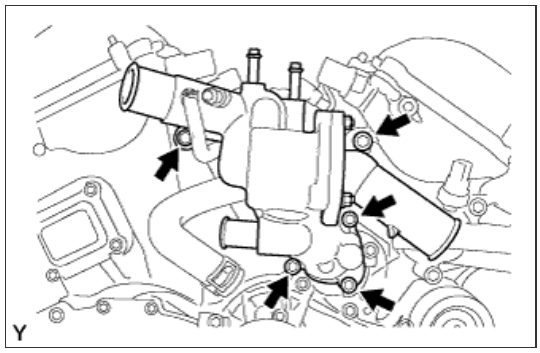
b. Install a new O-ring to the water pump.

c. Install a new gasket to the water pump.



d. Install the water inlet with the olts.

Torque:
9.0 N m 92 kgf cm , 80 in. lbf



9. CONNECT NO. 3 ATER BY-PASS HOSE

50. CONNECT NO. 2 ATER BY-PASS HOSE

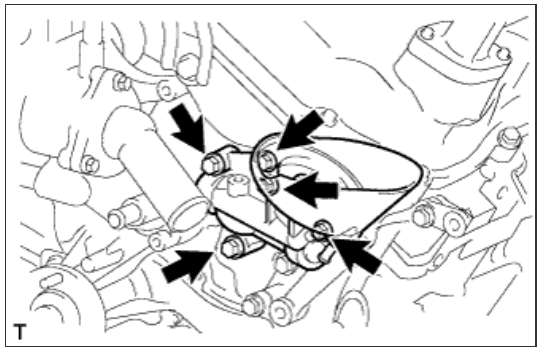
51. CONNECT NO. 1 ATER BY-PASS HOSE

52. INSTALL OIL FILTER BRACKET SUB-ASSEMBLY

a. Set a new O-ring to the timing chain cover.

b. Install the oil filter bracket with the olts and 2 nuts.

Torque:
19 N m 194 kgf cm , 14 ft. lbf



53. INSTALL OIL COOLER ASSEMBLY

a. lean the oil cooler contact surface on the cooler mounting.

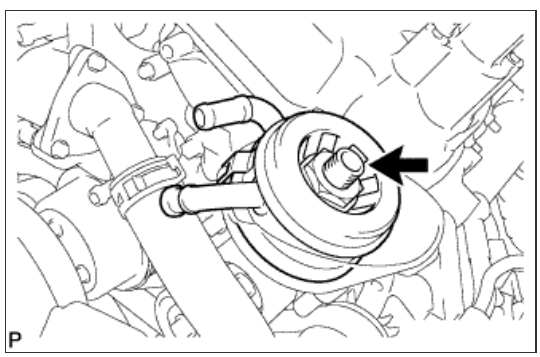
b. Apply a light coat of engine oil to a new O-ring, and install it into the oil cooler.

c. Apply a light coat of engine oil to the threads of the oil cooler union bolt.

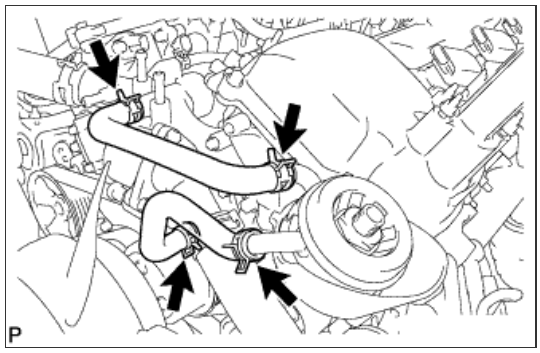
d. Align the protrusion of the oil filter bracket with the cutout of the oil cooler.

e. Install the oil cooler with the plate washer and oil cooler union bolt.

Torque:
8 N m 93 kgf cm , 50 ft. lbf



f. Install the oil cooler hose and No. 2 oil cooler hose.



54. INSTALL OIL FILTER SUB-ASSEMBLY

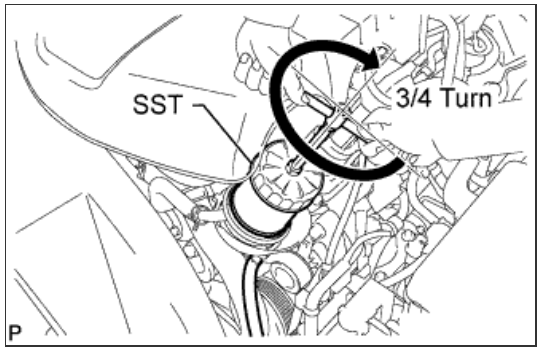
a. heck and clean the oil filter installation surface.

b. Apply clean engine oil to the gasket of a new oil filter.

c. Lightly screw the oil filter into place hand. Tighten it until the gasket contacts the seat.

d. Using SST, tighten the oil filter. Depending on the work space available, choose from the following.

SST
09228-07501



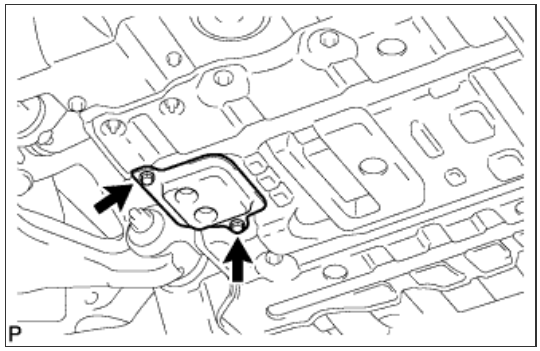
i. If enough space is available, use a torque wrench to tighten the oil filter.

Torque:
17 N m 173 kgf cm , 13 ft. lbf

ii. If enough space is not available to use a torque wrench, tighten the oil filter a 3/4 turn by hand or with a common wrench.

e. Install the service hole cover to the o. 2 engine under cover with the olts.

Torque:
10 N m 102 kgf cm , 7 ft. lbf



for Preparation Click here

1. INSTALL FLYWHEEL RING GEAR (for Manual Transmission)

a. Using a torch, heat the ring gear evenly to approximately 200°C (392°F).

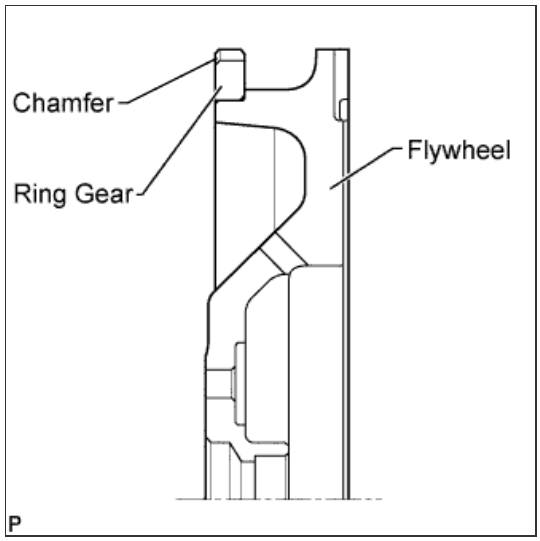
NOTICE:

Be careful not to overheat the ring gear.

b. Using a brass bar, tap the ring gear onto the flywheel with its chamfered gear teeth facing the block.

NOTICE:

After installing, allow the ring gear to cool before handling.



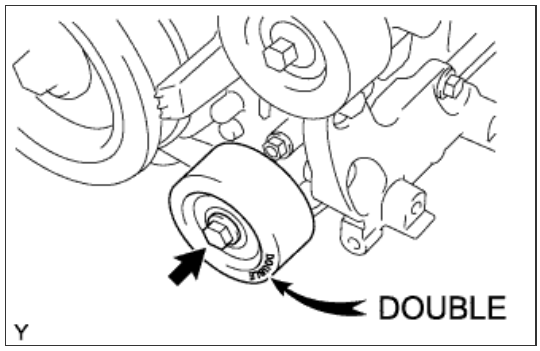
2. INSTALL NO. 1 IDLER PULLEY SUB-ASSEMBLY

a. Install the No. 1 idler pulley with the bolt.

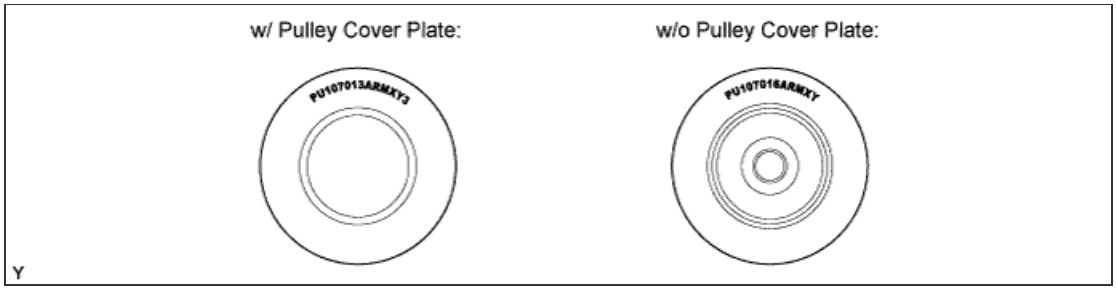
Torque:
54 N*m{ 551 kgf*cm , 40 ft.*lbf }

HINT:

"DOUBLE" is marked on the No. 1 idler pulley to distinguish it from the No. 2 idler pulley.



3. INSTALL NO. 2 IDLER PULLEY SUB-ASSEMBLY



a. w/ Pulley Cover Plate:

i. Install the idler pulley cover plate, idler pulley and No. 2 idler pulley cover plate with the bolt.

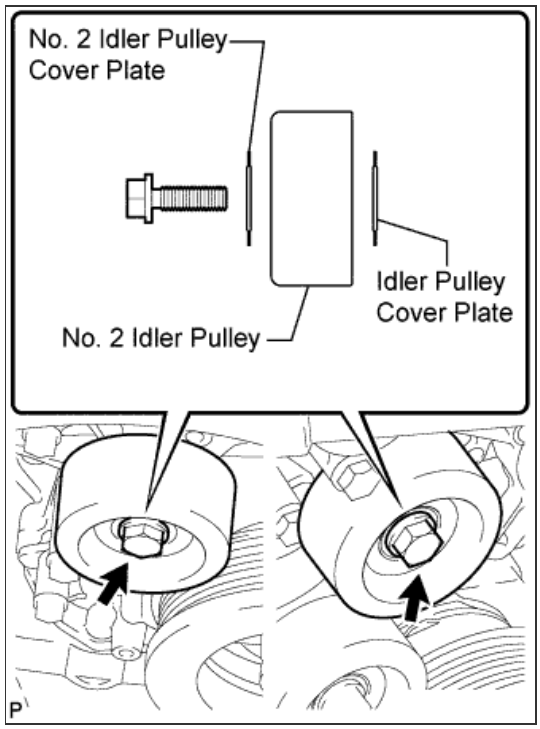
Torque:
54 N*m{ 551 kgf*cm , 40 ft.*lbf }

NOTICE:

If it is necessary to replace the pulley or either plate, replace the No. 2 idler pulley cover plate, No. 2 idler pulley and idler pulley cover plate as a set with new parts.

b. w/o Pulley Cover Plate:
Install the 2 No. 2 idler pulleys with the 2 bolts.

Torque:
54 N*m{ 551 kgf*cm , 40 ft.*lbf }



4. INSTALL FRONT NO. 1 ENGINE MOUNTING BRACKET LH

a. Install the engine mounting bracket with the 3 bolts.

Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }

5. INSTALL FRONT NO. 1 ENGINE MOUNTING BRACKET RH

a. Install the engine mounting RH with the 4 bolts.

Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }

6. INSTALL ENGINE OIL LEVEL DIPSTICK GUIDE

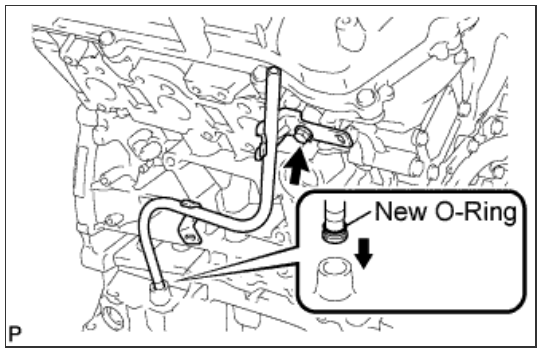
a. Install a new O-ring to the dipstick guide.

b. Apply a light coat of engine oil to the O-ring.

c. Push the dipstick guide end into the guide hole.

d. Install the dipstick guide with the bolt.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



7. INSTALL V-RIBBED BELT TENSIONER ASSEMBLY

a. Temporarily install the V-ribbed belt tensioner with the 5 bolts.

b. Tighten bolt 1 and 2 in numerical order.

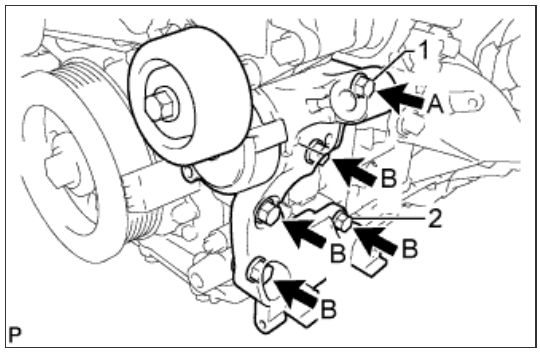
Torque:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }

c. Tighten the other bolts.

Torque:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }

Standard Bolt:

Item	Length
A	70 mm (2.76 in.)
B	33 mm (1.30 in.)



8. INSTALL IGNITION COIL ASSEMBLY

a. Install the 6 ignition coils with the 6 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

9. INSTALL ENGINE WIRE

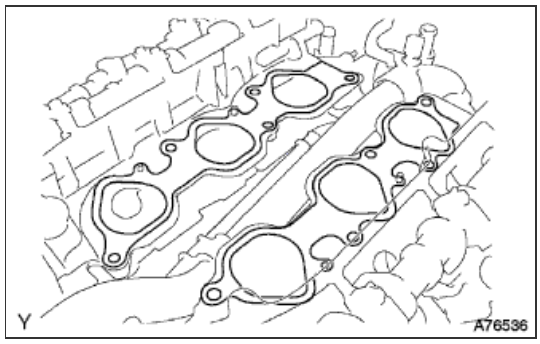
10. INSTALL INTAKE MANIFOLD

a. Set a new gasket on each cylinder head.

NOTICE:

- **Align the port holes of the gasket and cylinder head.**
- **Be careful of the installation direction.**

b. Set the intake manifold on the cylinder heads.

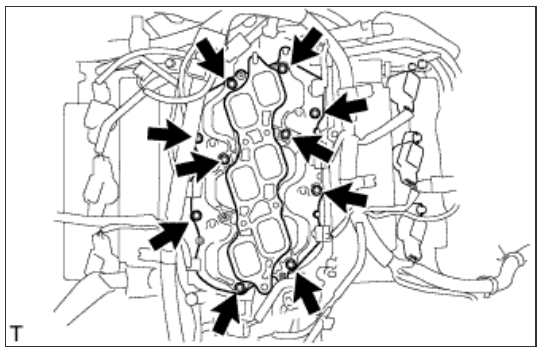


c. Install and uniformly tighten the 10 bolts in several passes.

Torque:
26 N*m{ 265 kgf*cm , 19 ft.*lbf }

HINT:

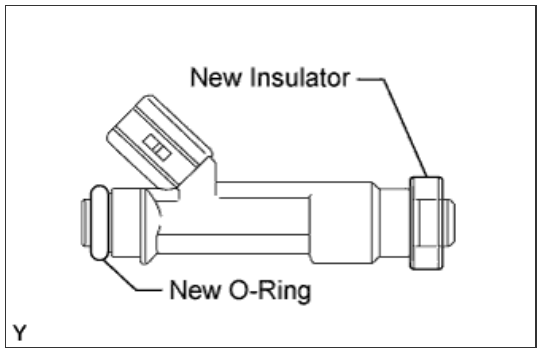
Tighten the inner installation bolts of the intake manifold before tightening the outer bolts.



11. INSTALL FUEL INJECTOR

a. Install a new insulator onto each fuel injector.

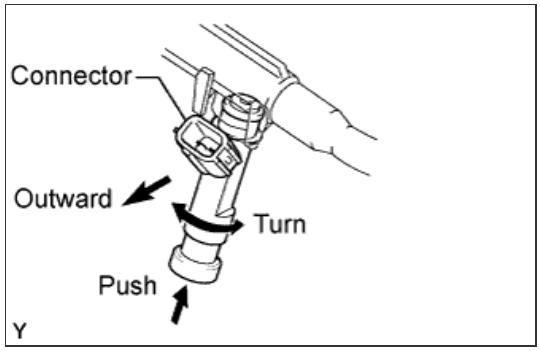
b. Apply a light coat of spindle oil or gasoline to each new O-ring and install one onto each fuel injector.



c. Install the 6 injectors.

i. While turning each fuel injector left and right, install it onto the fuel delivery pipe.

ii. Position the fuel injector connectors facing outward.



12. INSTALL FUEL DELIVERY PIPE SUB-ASSEMBLY

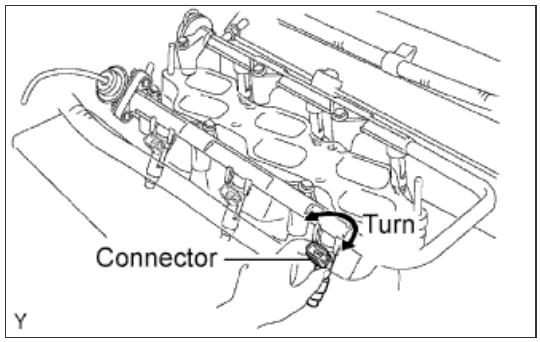
a. Place the fuel delivery pipe together with the 6 fuel injectors on the intake manifold.

b. Temporarily install the 6 bolts, which are used to hold the fuel delivery pipe, to the intake manifold.

c. Check that the fuel injectors rotate smoothly.

HINT:

If the fuel injectors do not rotate smoothly, replace the O-ring of any injector that does not rotate smoothly.



d. Position the fuel injector connectors facing outward.

e. Tighten the 6 bolts, which are used to hold the fuel delivery pipe, to the intake manifold.

Torque:
15 N*m{ 153 kgf*cm , 11 ft.*lbf }

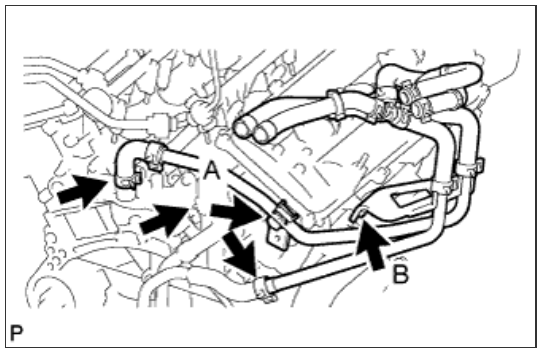
f. Connect the 6 fuel injector connectors.

13. CONNECT WATER HOSE SUB-ASSEMBLY (for Automatic Transmission)

a. Connect the heater water by-pass pipe hose to the rear water by-pass joint.

b. Temporarily install the heater water pipe, and then tighten the 2 bolts in the order shown in the illustration.

Torque:
for bolt A:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }
for bolt B:
13 N*m{ 138 kgf*cm , 10 ft.*lbf }

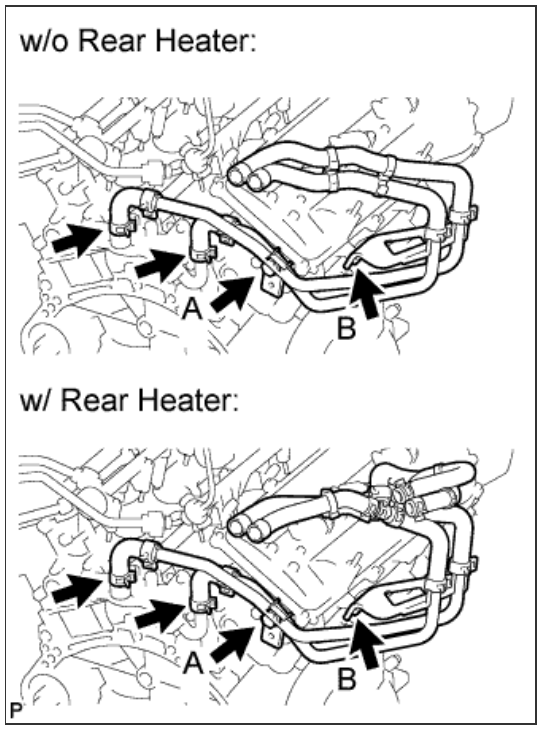


14. CONNECT WATER HOSE SUB-ASSEMBLY (for Manual Transmission)

a. Connect the heater water by-pass pipe hose to the rear water by-pass joint.

b. Temporarily install the heater water pipe, and then tighten the 2 bolts in the order shown in the illustration.

Torque:
for bolt A:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }
for bolt B:
13 N*m{ 138 kgf*cm , 10 ft.*lbf }



15. CONNECT NO. 1 WATER BY-PASS PIPE (for Automatic Transmission)

a. Connect the water by-pass pipe hoses to the water by-pass pipe and No. 1 water outlet pipe.

16. INSTALL ENGINE COOLANT TEMPERATURE SENSOR

a. Install a new gasket and the engine coolant temperature sensor.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

17. INSTALL OIL PRESSURE SENSOR

a. Apply adhesive to 2 or 3 threads of the oil pressure sensor.

Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent

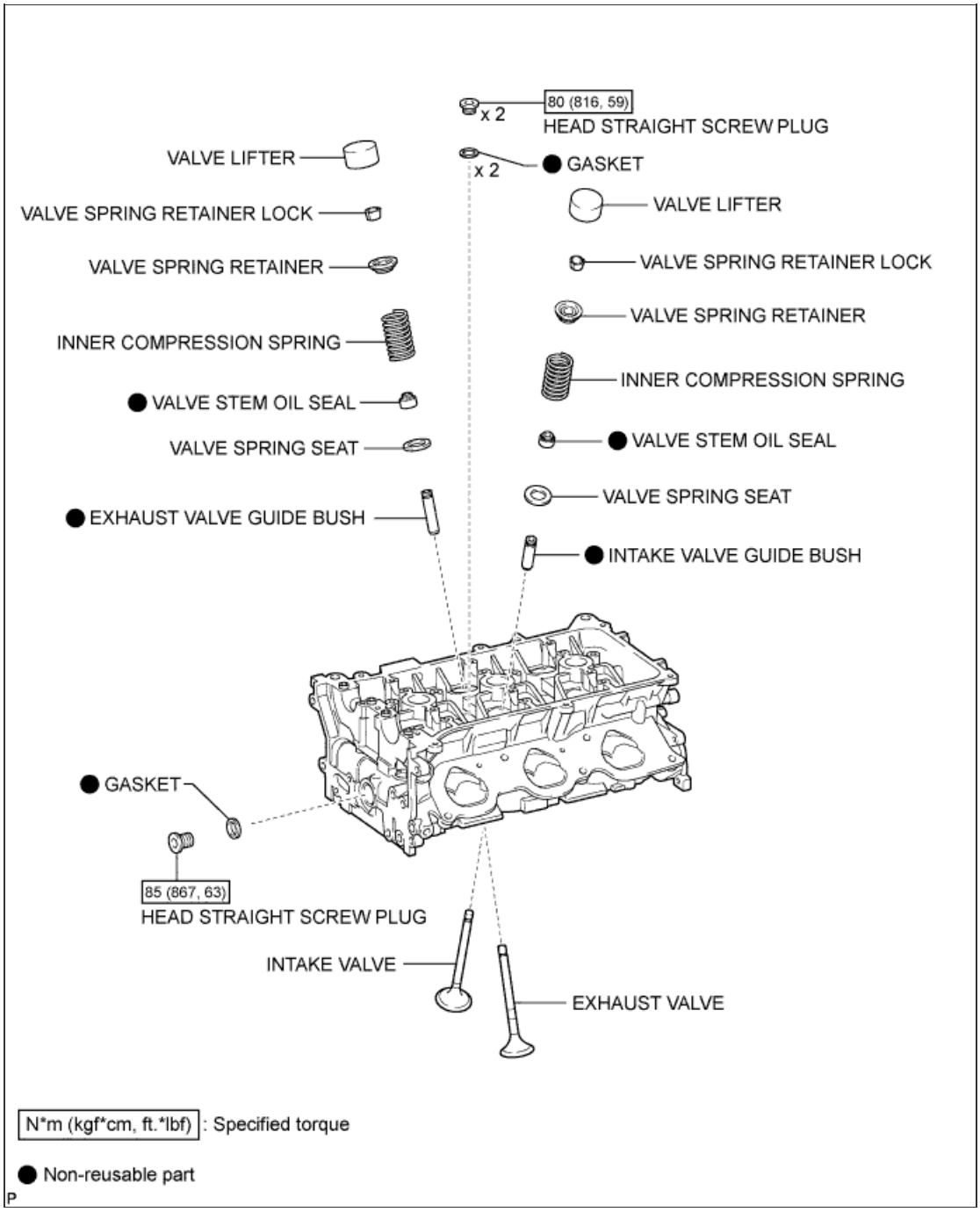
b. Using a 24 mm deep socket wrench, install the oil pressure sensor.

Torque:
15 N*m{ 150 kgf*cm , 11 ft.*lbf }

NOTICE:

Do not start the engine within 1 hour of installation.

for Preparation Click here



for Preparation Click here

1. REMO E ALE LIF ER

HIN

Arrange the valve lifters in the correct order.

REMO E ALE

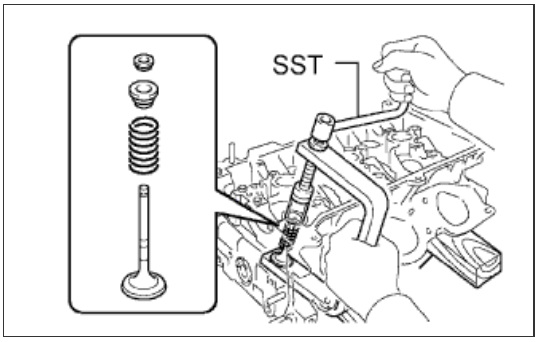
HIN

Arrange the valves, inner compression springs, valve spring retainers and valve spring retainer locks in the correct order.

a lace the cylinder head on wooden blocks.

Using SST, compress the inner compression spring and remove the valve spring retainer lock.

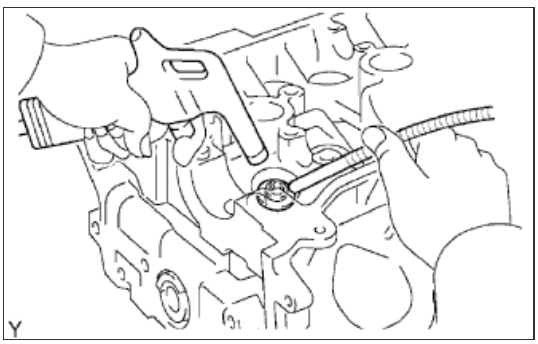
SST



c Remove the valve, inner compression spring and valve spring retainer.

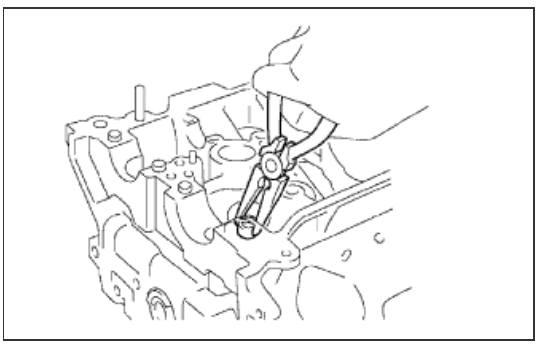
REMO E ALE SPRING SEA

a Using compressed air and a magnetic finger, remove the valve spring seat by blowing air.



REMO E ALE S EM OIL SEAL

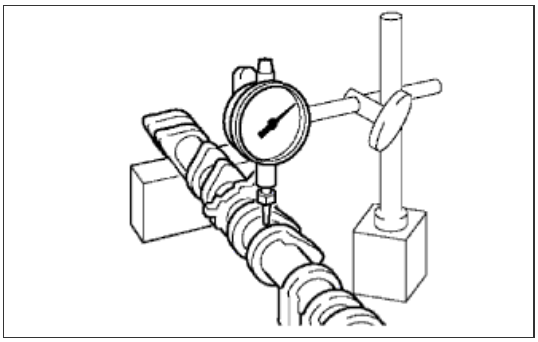
a. Using needle-nose pliers, remove the valve stem oil seal.



for Preparation Click here

1. INSPECT CAMSHAFTS

a. Inspect the camshaft runout.



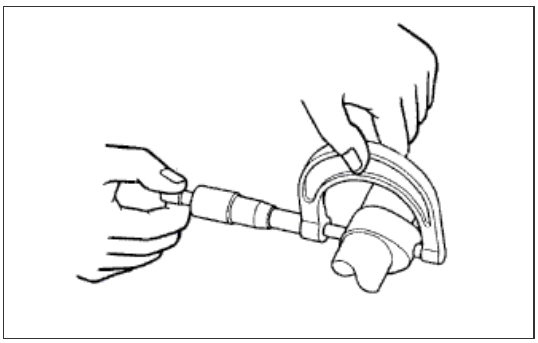
i. Place the camshaft on V-blocks.

ii. Using a dial indicator, measure the runout at the center journal.

Maximum runout:
0.06 mm (0.00236 in.)

If the runout is more than the maximum, replace the camshaft.

b. Inspect the cam lobes.



i. Using a micrometer, measure the cam lobe height.

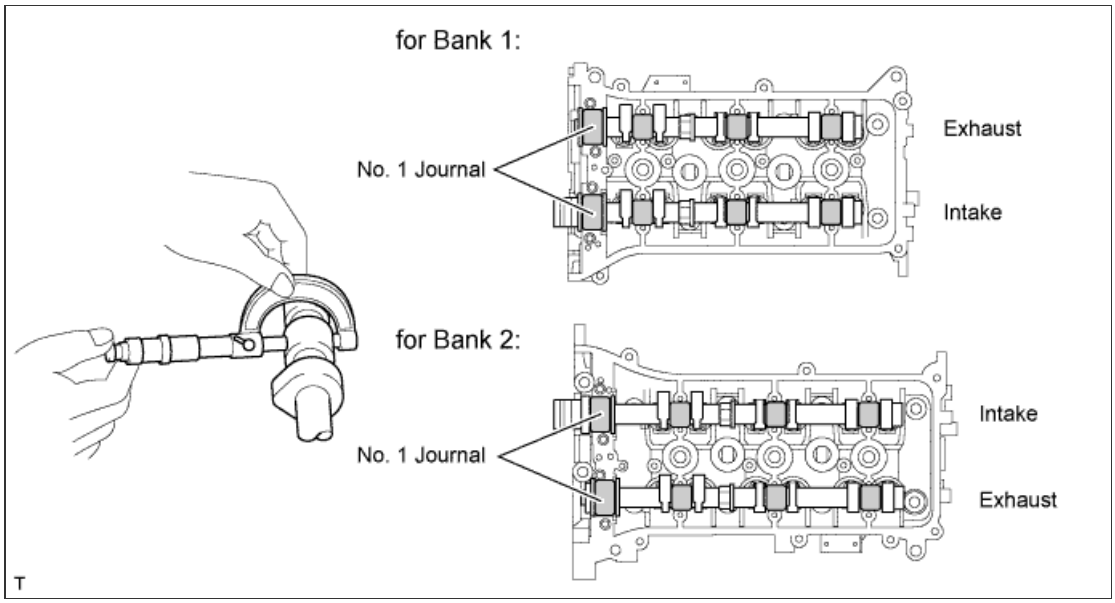
Standard Cam Lobe Height:

Item	Specified Condition
Intake	44.168 to 44.268 mm (1.739 to 1.742 in.)
Exhaust	44.580 to 44.680 mm (1.755 to 1.759 in.

Minimum Cam Lobe Height:

Item	Specified Condition
Intake	44.018 mm (1.73 in.)
Exhaust	44.430 mm (1.75 in.)

If the cam lobe height is less than the minimum, replace the camshaft.



c. Inspect the camshaft journals.

i. Using a micrometer, measure the journal diameter.

Standard Journal Diameter:

Item	Specified Condition
No. 1	35.971 to 35.985 mm (1.416 to 1.417 in.)
Other	22.959 to 22.975 mm (0.904 to 0.905 in.)

If the journal diameter is not as specified, check the oil clearance.

2. INSPECT CAMSHAFT OIL CLEARANCE

a. Clean the camshaft bearing caps, camshaft bearings and camshaft journals.

b. Install the camshaft bearing (Click here).

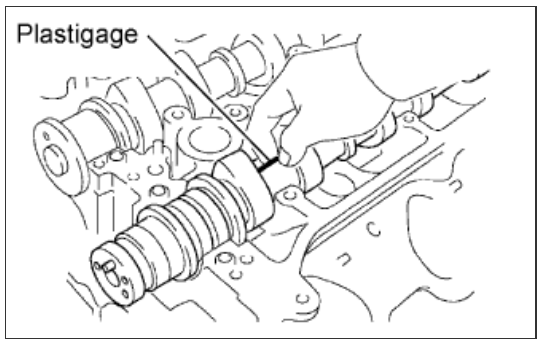
c. Place the camshafts on the cylinder head.

d. Lay a strip of Plastigage across each of the camshaft journals.

e. Install the camshaft bearing caps (Click here).

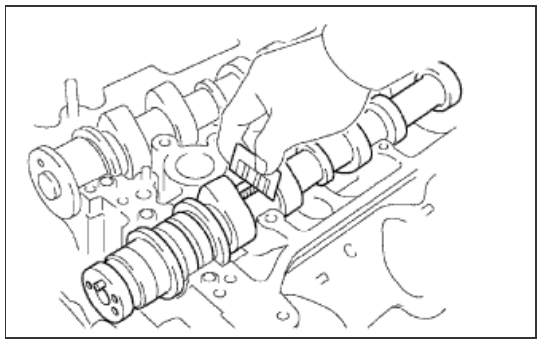
NOTICE:

Do not turn the camshafts.



f. Remove the camshaft bearing caps (Click here).

g. Measure the Plastigage at its widest point.



Standard Oil Clearance (for Cylinder Head RH):

Item	Specified Condition
No. 1 (Intake)	0.008 to 0.038 mm (0.000315 to 0.00150 in.)
No. 1 (Exhaust)	0.040 to 0.079 mm (0.00157 to 0.00311 in.)
Others	0.025 to 0.062 mm (0.000984 to 0.00244 in.)

Standard Oil Clearance (for Cylinder Head LH):

Item	Specified Condition
No. 1	0.040 to 0.079 mm (0.00157 to 0.00311 in.)
Others	0.025 to 0.062 mm (0.000984 to 0.00244 in.)

Maximum Oil Clearance (for Cylinder Head RH):

Item	Specified Condition
No. 1 (Intake)	0.07 mm (0.00276 in.)
Others	0.10 mm (0.00394 in.)

Maximum Oil Clearance (for Cylinder Head LH):

Item	Specified Condition
-	0.10 mm (0.00394 in.)

If the oil clearance is more than the maximum, replace the camshaft bearings and/or camshaft.
If necessary, replace the camshaft bearing caps and cylinder head together.

Reference:

Item	Specified Condition
Cylinder head journal bore diameter	40.009 to 40.017 mm (1.5752 to 1.5755 in.)
Camshaft bearing center wall thickness (Mark "2")	2.004 to 2.008 mm (0.0789 to 0.0791 in.)
Camshaft journal diameter	35.971 to 35.985 mm (1.4162 to 1.4167 in.)

h. Remove the Plastigage completely.

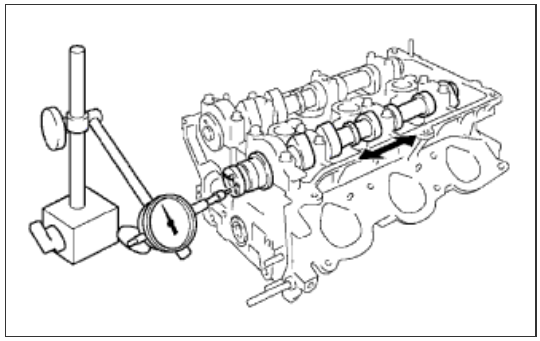
i. Remove the camshafts.

j. Remove the camshaft bearing.

3. INSPECT CAMSHAFT THRUST CLEARANCE

a. Install the camshafts (Click here).

b. Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.



Standard thrust clearance:
0.04 to 0.09 mm (0.00157 to 0.00354 in.)

Maximum thrust clearance:
0.11 mm (0.00433 in.)

If the thrust clearance is more than the maximum, replace the camshafts.
If necessary, replace the camshaft bearing caps and cylinder head as a set.

4. INSPECT CAMSHAFT TIMING GEAR ASSEMBLY

a. Fix the intake camshaft with a vise.

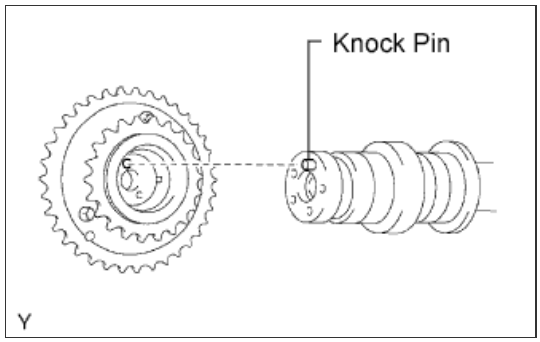
NOTICE:

Be careful not to damage the camshaft.

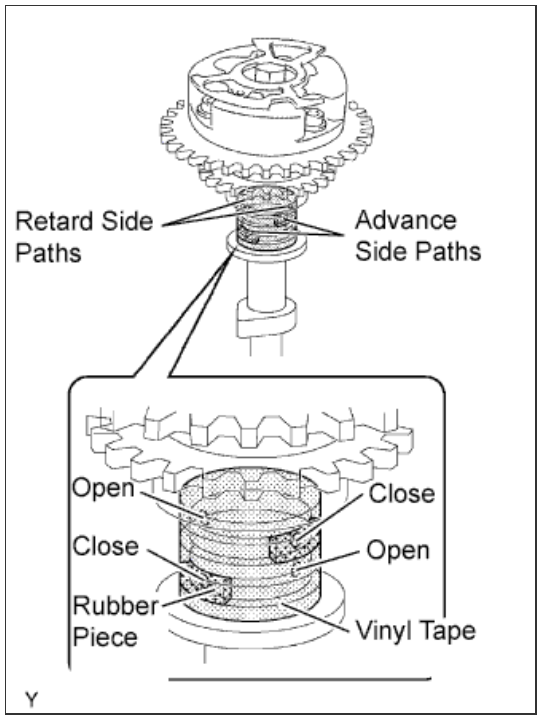
b. Align the knock pin hole in the camshaft timing gear with the knock pin of the camshaft, and install the camshaft timing gear with the bolt.

Torque:
100 N*m{ 1020 kgf*cm , 74 ft.*lbf }

c. Confirm the camshaft timing gear is locked.



d. Release the lock pin.

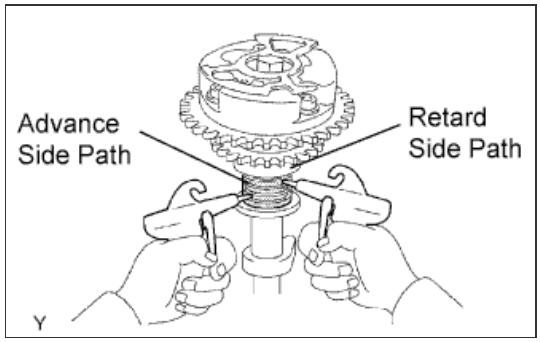


i. Cover the 4 oil paths of the cam journal with vinyl tape as shown in the illustration.

HINT:

One of the 2 grooves on the cam journal is for retard side paths (upper) and the other is for advance side paths (lower). Each groove has 2 oil paths. Plug one of the oil paths for each groove with rubber pieces as shown in the illustration before wrapping the cam journal with tape.

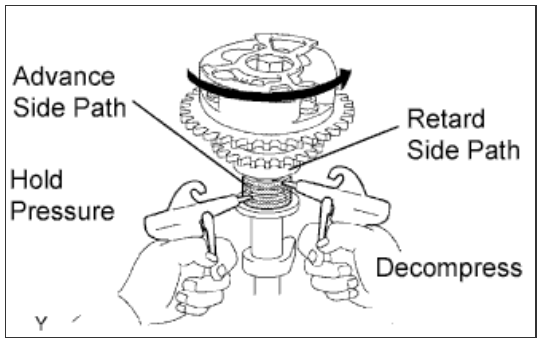
ii. Prink a hole in the tape at the 2 oil holes not plugged with rubber pieces.



iii. Apply about 200 kPa (2.0 kgf/cm^2, 28 psi) of air pressure to the two broken paths (the advance side path and the retard side path).

NOTICE:

Cover the paths with a cloth to avoid oil splashing.



iv. Confirm that the camshaft timing gear rotates in the advance direction when reducing the air pressure applied to the retard path.

HINT:

When the lock pin is released, the camshaft timing gear rotates in the advance direction.

v. When the camshaft timing gear comes to the most advanced position, release the air pressure from the retard side path, and then release the air pressure from the advance side path.

NOTICE:

The camshaft timing gear occasionally shifts to the retard side abruptly if air compression of the advanced side path is released first. This often results in the breakage of the lock pin.

e. Check for smooth rotation.

i. Except the position where the lock pin meets at the most retarded angle, turn the camshaft timing gear back and forth and check the movable range and that there is no disturbance.

Standard:
Movable smoothly in the range of about 31 °

NOTICE:

Be sure to perform this check by hand, instead of with air pressure.

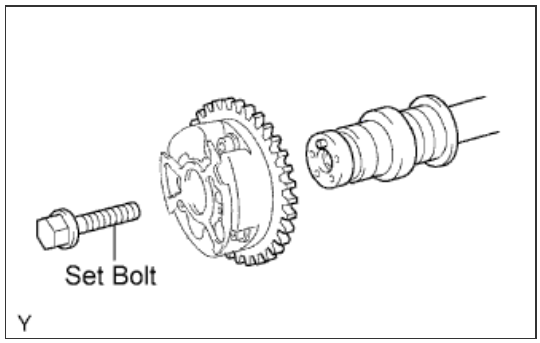
f. Check the lock in the most retarded position.

i. Confirm that the camshaft timing gear is locked at the most retarded position.

g. Remove the set bolt and camshaft timing gear.

NOTICE:

Be sure not to remove the other 3 bolts.



5. INSPECT CAMSHAFT TIMING GEAR ASSEMBLY

a. Wrap the No. 1 chain around the gear place for the No. 1 chain.

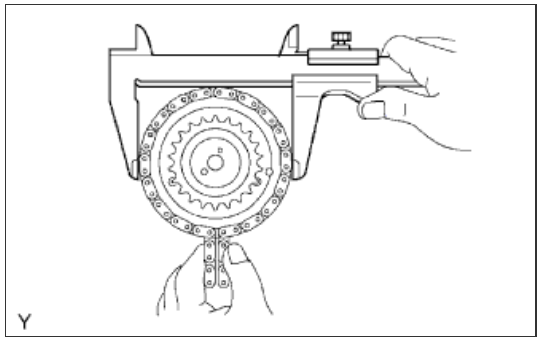
b. Using a vernier caliper, measure the timing gear with the No. 1 chain.

Minimum gear diameter (with chain):
115.5 mm (4.55 in.)

HINT:

The vernier caliper must contact the chain rollers for the measurement.

If the diameter is less than the minimum, replace the No. 1 chain and camshaft timing gear assembly.



c. Wrap the No. 2 chain around the gear place for the No. 2 chain.

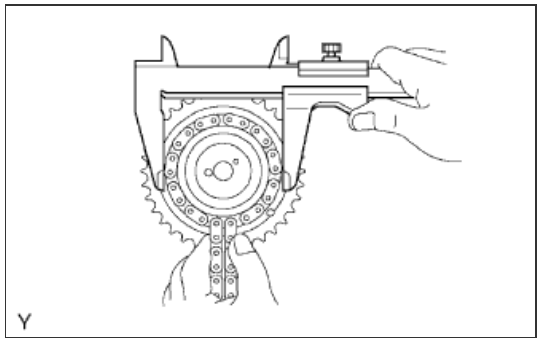
d. Using a vernier caliper, measure the timing gear with the No. 2 chain.

Minimum gear diameter (with chain):
73.1 mm (2.88 in.)

HINT:

The vernier caliper must contact the chain rollers for the measurement.

If the diameter is less than the minimum, replace the No. 2 chain and camshaft timing gear assembly.



6. INSPECT CAMSHAFT TIMING SPROCKET

a. Wrap the No. 1 chain around the sprocket.

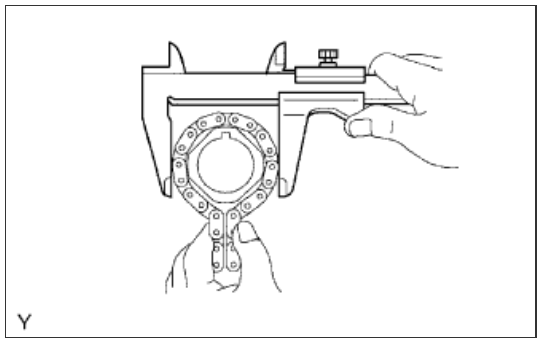
b. Using a vernier caliper, measure the crankshaft timing sprocket diameter with the No. 1 chain.

Minimum gear diameter (with chain):
61.0 mm (2.40 in.)

HINT:

The vernier caliper must contact the chain rollers for the measurement.

If the diameter is less than the minimum, replace the No. 1 chain and crankshaft timing sprocket.

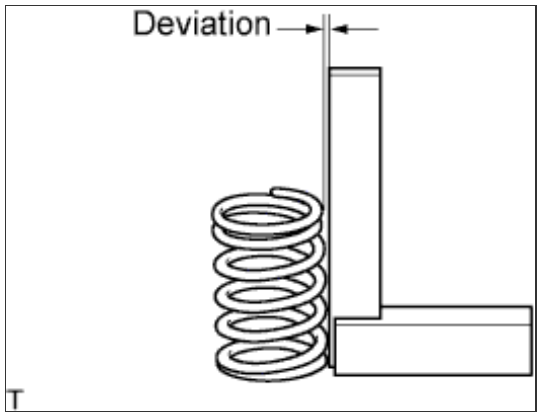


7. INSPECT INNER COMPRESSION SPRING

a. Using a steel square, measure the deviation of the inner compression spring.

Maximum deviation:
2.0 mm (0.0787 in.)

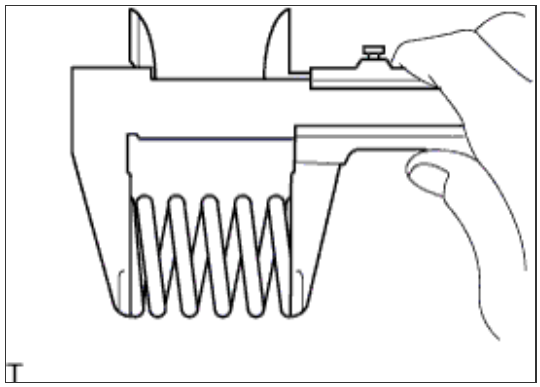
If the deviation is more than the maximum, replace the inner compression spring.



b. Using a vernier caliper, measure the free length of the inner compression spring.

Standard free length:
47.80 mm (1.88 in.)

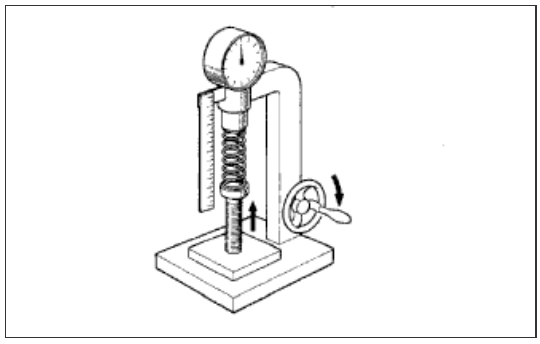
If the free length is not as specified, replace the inner compression spring.



c. Using a spring tester, measure the tension of the inner compression spring at the standard installed length.

Standard installed tension:
186 to 206 N (19 to 21 kgf, 42 to 46 lbf) at 33.3 mm (1.31 in.)

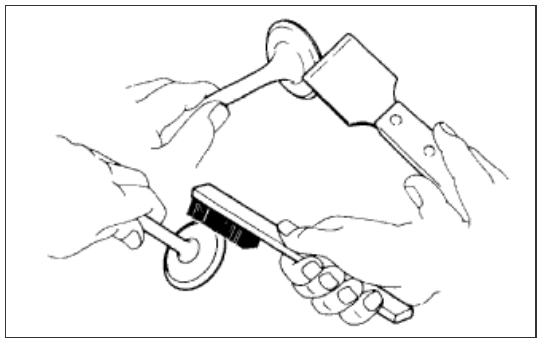
If the installed tension is not as specified, replace the inner compression spring.



8. CLEAN VALVE

a. Using a gasket scraper, chip off any carbon from the valve head.

b. Using a wire brush, thoroughly clean the valve.

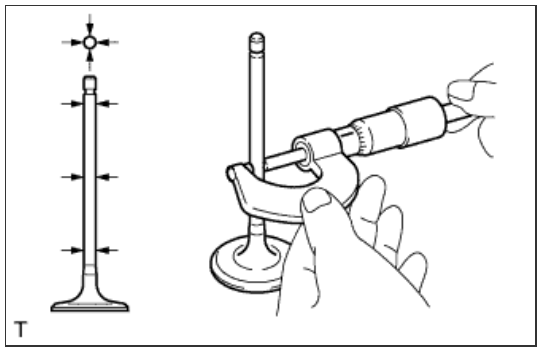


9. INSPECT AL E

a. Using a micrometer, measure the diameter of the valve stem.

Standard al Stem Diameter:

Item	Specified Condition
Intake	5.470 to 5.485 mm (0.2154 to 0.2159 in.)
Exhaust	5.465 to 5.480 mm (0.2152 to 0.2156 in.)

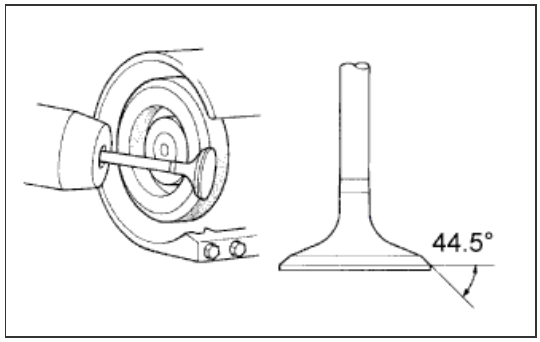


b. Inspect the valve face angle.

i. Grind the valve enough to remove pits and carbon.

ii. Check that the valve is ground to the correct valve face angle.

Standard valve face angle:
44.5



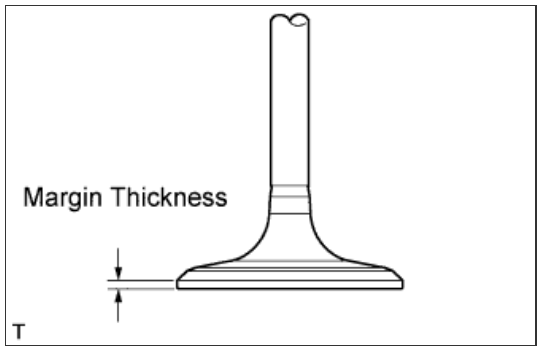
c. Using a vernier caliper, measure the valve head margin thickness.

i. Using a vernier caliper, check the valve head margin thickness.

Standard margin thickness:
1.0 mm (0.0394 in.)

Minimum margin thickness:
0.5 mm (0.0197 in.)

If the margin thickness is less than the minimum, replace the valve.



d. Using a vernier caliper, measure the overall length of the valve.

i. Using a vernier caliper, check the overall length.

Standard Overall Length:

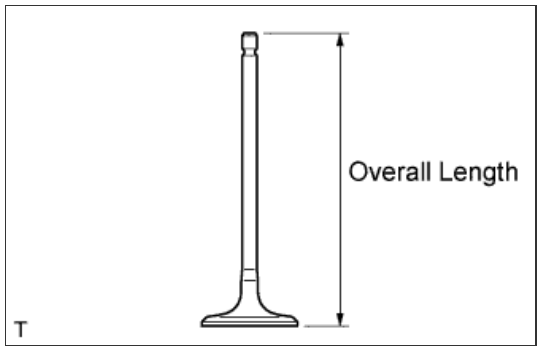
Item	Specified Condition
Intake	106.95 mm (4.21 in.)
Exhaust	105.80 mm (4.15 in.)

Minimum Overall Length:

Item	Specified Condition

Intake	106.40 mm (4.19 in.)
Exhaust	105.30 mm (4.15 in.)

If the overall length is less than the minimum, replace the valve.



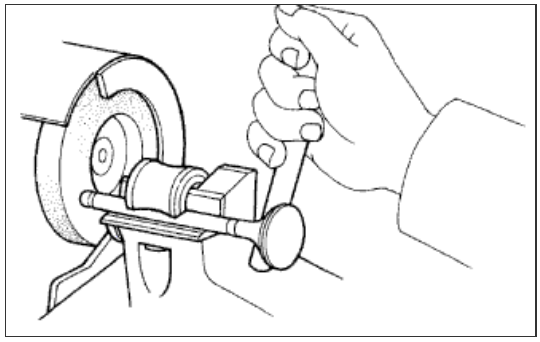
e. Inspect the valve stem tip.

i. Check the surface of the valve stem tip for wear.

NOTICE:

Do not grind the valve so it becomes shorter than the minimum overall length.

If the valve stem tip is worn, resurface the tip with a grinder or replace the valve.



10. INSPECT VALVE GUIDE BUSH OIL CLEARANCE

a. Using a caliper gauge, measure the inside diameter of the guide bush.

Standard bush inside diameter:
5.51 to 5.53 mm (0.217 to 0.218 in.)

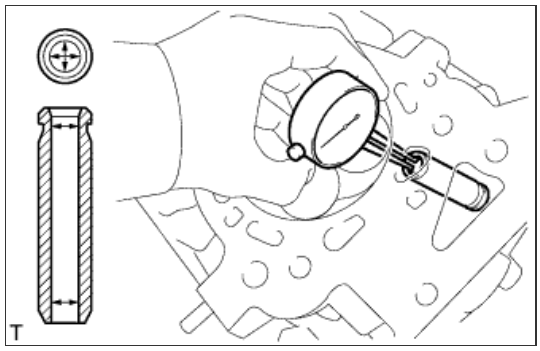
b. Subtract the valve stem diameter measurement from the guide bush inside diameter measurement.

Standard Oil Clearance:

Item	Specified Condition
Intake	0.025 to 0.060 mm (0.000984 to 0.00236 in.)
Exhaust	0.030 to 0.065 mm (0.00118 to 0.00256 in.)

Maximum Oil Clearance:

Item	Specified Condition
Intake	0.08 mm (0.00315 in.)
Exhaust	0.10 mm (0.00394 in.)



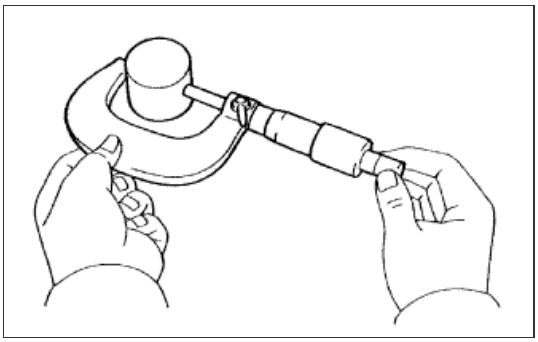
If the oil clearance is more than the maximum, replace the valve and valve guide bush.

11. INSPECT VALVE LIFTER

a. Using a micrometer, measure the valve lifter diameter.

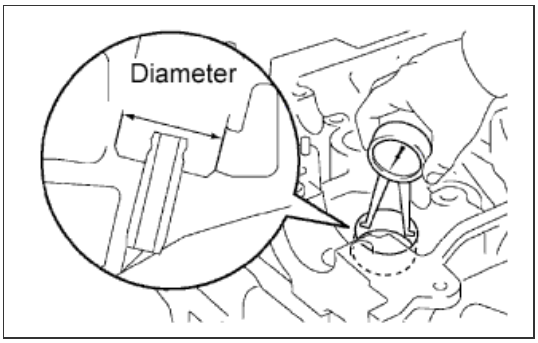
Standard valve lifter diameter:
30.966 to 30.976 mm (1.219 to 1.220 in.)

If the result is not as specified, replace the valve lifter.



12. INSPECT AL E LIFTER OIL CLEARANCE

a. Using a caliper gauge, measure the lifter bore diameter of the cylinder head.



Standard lifter bore diameter:
31.009 to 31.025 mm (1.220 to 1.221 in.)

b. Subtract the valve lifter diameter measurement (see "Inspect Valve Lifter" procedure) from the lifter bore diameter measurement.

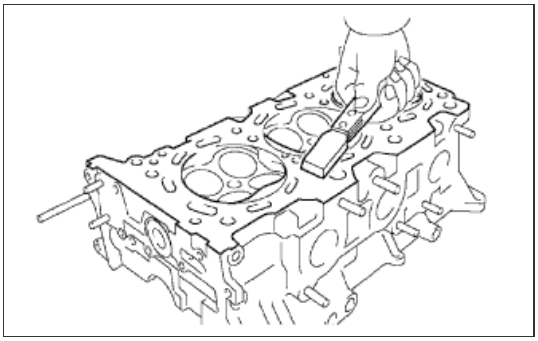
Standard oil clearance:
0.033 to 0.059 mm (0.00130 to 0.00232 in.)

Maximum oil clearance:
0.08 mm (0.00315 in.)

If the oil clearance is more than the maximum, replace the valve lifter.
If necessary, replace the cylinder head.

13. CLEAN CYLINDER HEAD SUB-ASSEMBLY

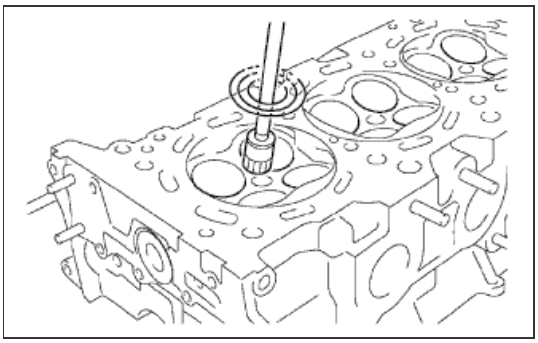
a. Using a gasket scraper, remove all the gasket material from the cylinder block contact surface.



NOTICE:

Be careful not to scratch the cylinder block contact surface.

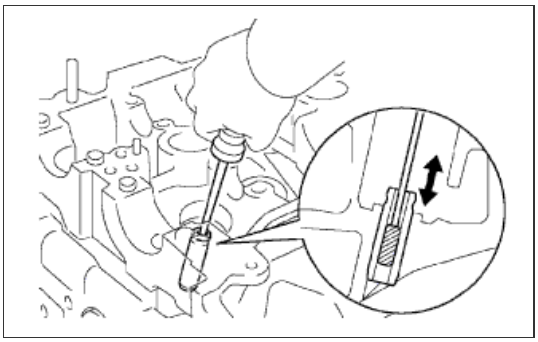
b. Using a wire brush, remove all the carbon from the combustion chambers.



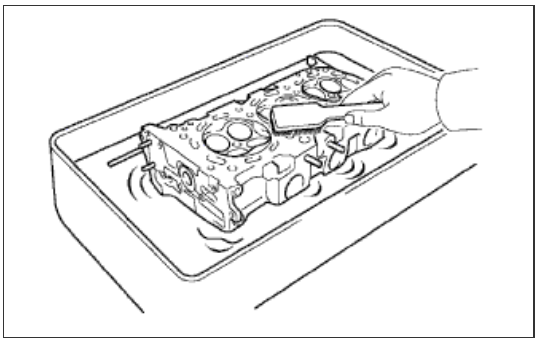
NOTICE:

Be careful not to scratch the combustion chambers.

c. Using a valve guide bushing brush and solvent, clean all the valve guide bushes.



d. Using a soft brush and solvent, thoroughly clean the cylinder head.



14. INSPECT CYLINDER HEAD SUB ASSEMBLY

a. Using a precision straightedge and feeler gauge, measure the warpage of the contact surfaces of the cylinder block and manifolds.

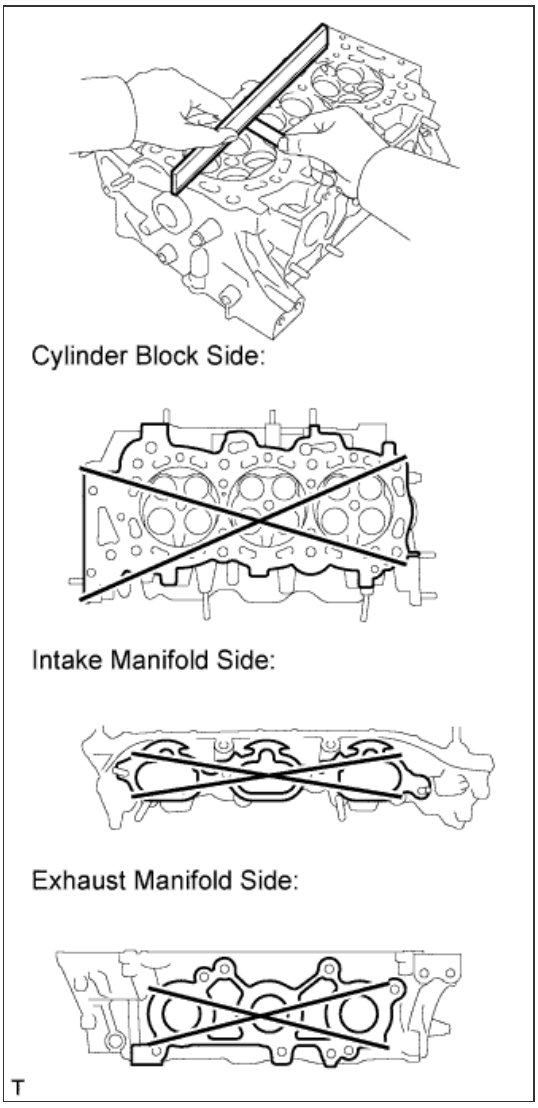
Standard warpage:

Item	Specified Condition
Cylinder block side	0.05 mm (0.00197 in.)
Intake manifold side	0.08 mm (0.00315 in.)
Exhaust manifold side	0.08 mm (0.00315 in.)

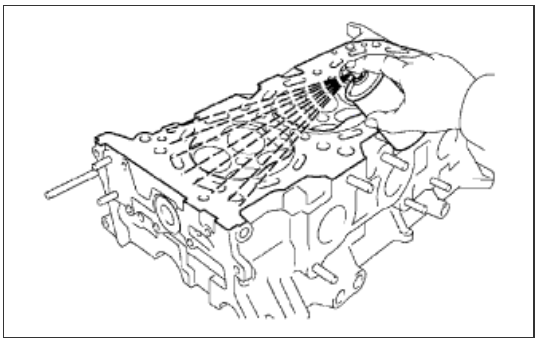
Maximum warpage:

Item	Specified Condition
Cylinder block side	0.10 mm (0.00394 in.)
Intake manifold side	0.10 mm (0.00394 in.)
Exhaust manifold side	0.10 mm (0.00394 in.)

If the warpage is more than the maximum, replace the cylinder head sub-assembly.



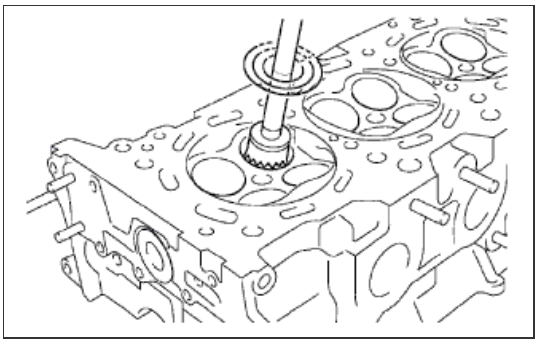
b. Using a dye penetrant, check the intake ports, exhaust ports and cylinder surface for cracks.
If there are cracks, replace the cylinder head sub-assembly.



15. CLEAN AL E SEAT

a. Using a 45° carbide cutter, resurface the valve seats.

b. Clean the valve seats.



16. INSPECT VALVE SEAT

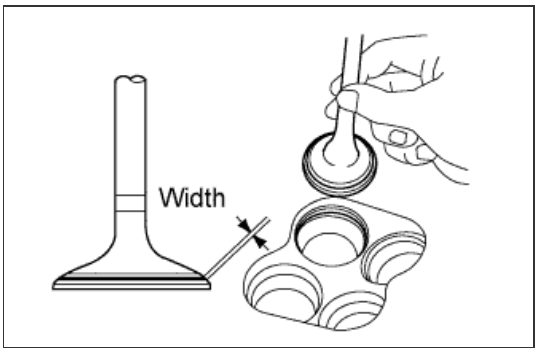
a. Apply a light coat of Prussian blue to the valve face.

b. Lightly press the valve face against the valve seat.

NOTICE:

Do not rotate the valve.

c. Check the valve face and valve seat by using the following procedure.



i. If Prussian blue appears around the entire valve face, the valve face is concentric. If not, replace the valve.

ii. If Prussian blue appears around the entire valve seat, the guide and valve face are concentric. If not, resurface the valve seat.

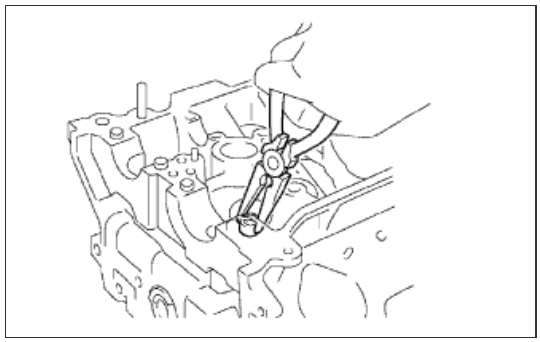
iii. Check that the seat contacts the middle of the valve face with the width below.

Standard width:
1.0 to 1.4 mm (0.0394 to 0.0551 in.)

for Preparation Click here

1. REPLACE VALVE STEM OIL SEAL

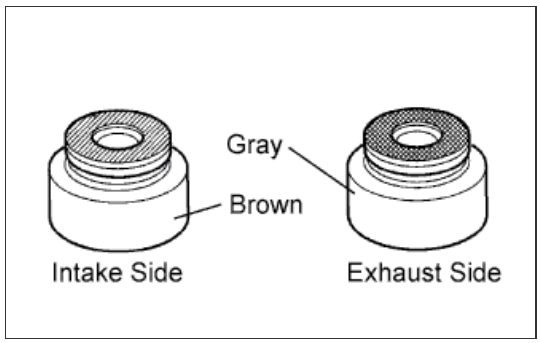
a. Using needle-nose pliers, remove the valve stem oil seal.



b. Apply a light coat of engine oil to the valve stem oil seal.

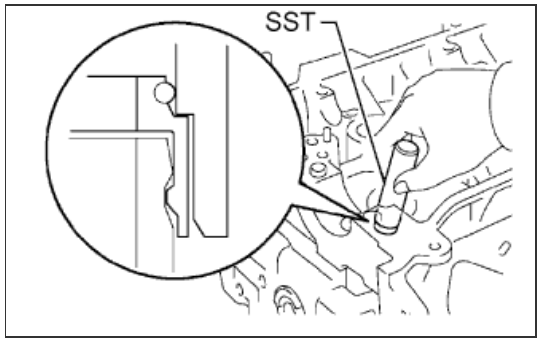
HINT:

The intake valve stem oil seal is light brown and the exhaust valve stem oil seal is gray.



c. Using SST and a hammer, push in a new valve stem oil seal.

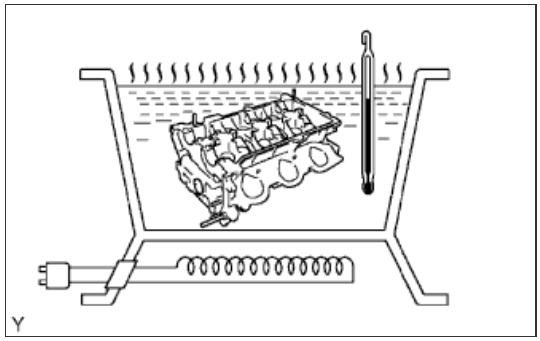
SST
09201-41020



2. REPLACE VALVE GUIDE BUSH

a. Gradually heat the cylinder head to 80 to 90°C (176 to 212°F).

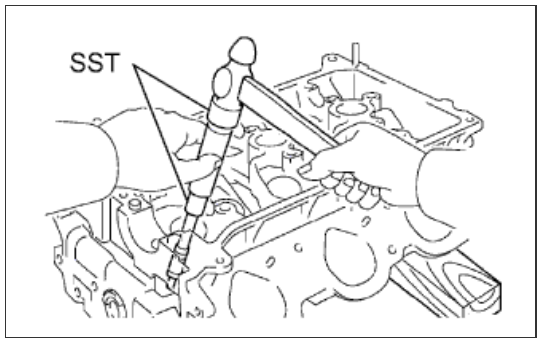
b. Place the cylinder head on wooden blocks.



c. Using SST and hammer, tap out the valve guide bush.

c. Using SST and hammer, tap out the valve guide bush.

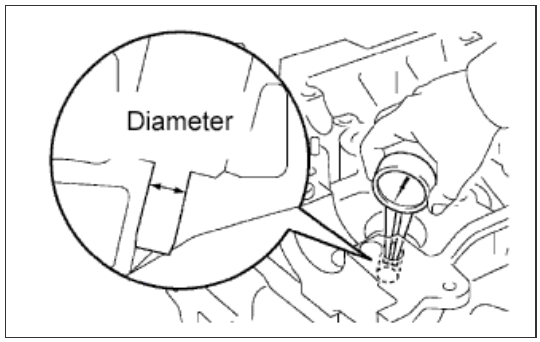
SST
09201-10000
09201-01055
09950-70010 (09951-07100)



d. Using a caliper gauge, measure the bush bore diameter of the cylinder head.

Standard bush bore diameter:
10.295 to 10.315 mm (0.405 to 0.406 in.)

If the bush bore diameter of the cylinder head is more than 10.315 mm (0.406 in.), machine the bush bore to a diameter of 10.345 to 10.365 mm (0.407 to 0.408 in.).



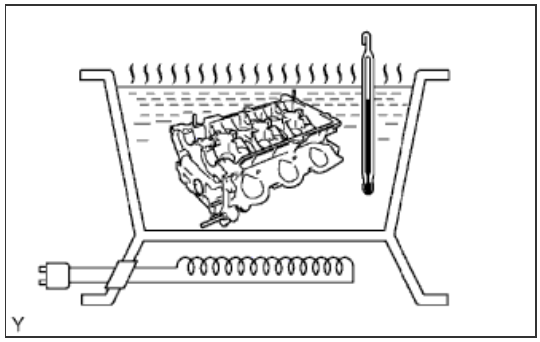
Standard Valve Guide Bush Diameter:

Item	Specified Condition
STD	10.333 to 10.344 mm (0.4068 to 0.4072 in.)
O/S 0.05	10.383 to 10.394 mm (0.4088 to 0.4092 in.)

If the bush bore diameter of the cylinder head is more than 10.365 mm (0.4081 in.), replace the cylinder head.

e. Gradually heat the cylinder head to 80 to 100°C (176 to 212°F).

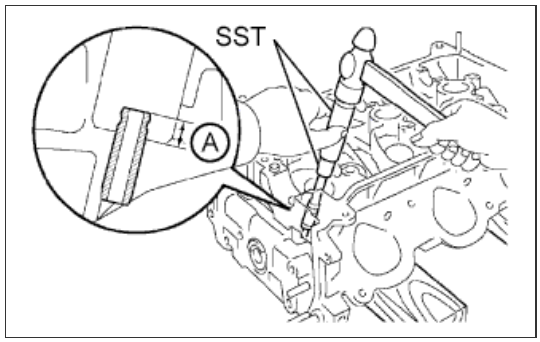
f. Place the cylinder head on wooden blocks.



g. Using SST, tap in a new valve guide bush to the standard protrusion height labeled A shown in the illustration.

SST
09201-10000
09201-01055
09950-70010 (09951-07100)

Standard protrusion height:
9.3 to 9.7 mm (0.366 to 0.382 in.)



h. Using a sharp 5.5 mm reamer, ream the valve guide bush to obtain the standard specified clearance between the valve guide bush and valve stem.

Standard Overall Length:

Item	Specified Condition
Intake	0.025 to 0.060 mm (0.00984 to 0.00236 in.)
Exhaust	0.030 to 0.065 mm (0.00118 to 0.00256 in.)

3. REPLACE UNION

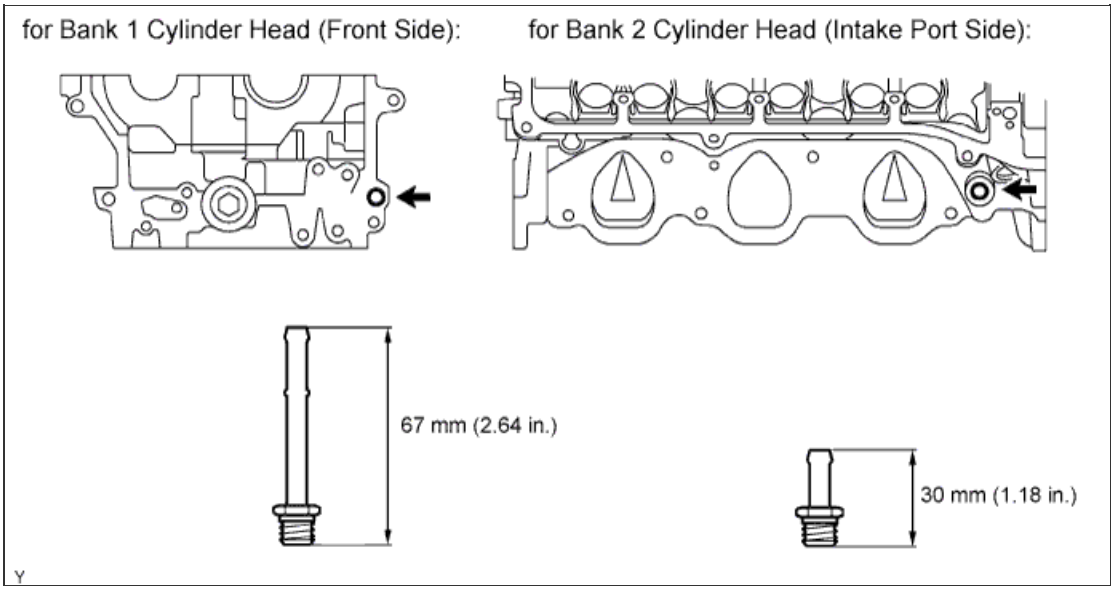
a. Remove the union from the bank 1 cylinder head (front side) and bank 2 cylinder head (intake port side).

b. Apply adhesive to 2 or 3 threads of the bolt ends of new unions.

Adhesive:
Toyota Genuine Seal Adhesive 1324, Three Bond 1324 or equivalent

c. Using a 12 mm deep socket wrench, install the 2 unions.

Torque:
15 N m 150 kgf cm , 11 ft. lbf



4. REPLACE TIGHT PLUG

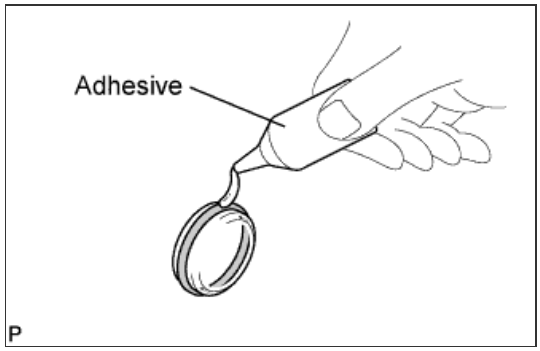
NOTICE:

If water leaks from the tight plug or the plug corrodes, replace it.

a. Remove the tight plugs.

b. Apply adhesive around new tight plugs.

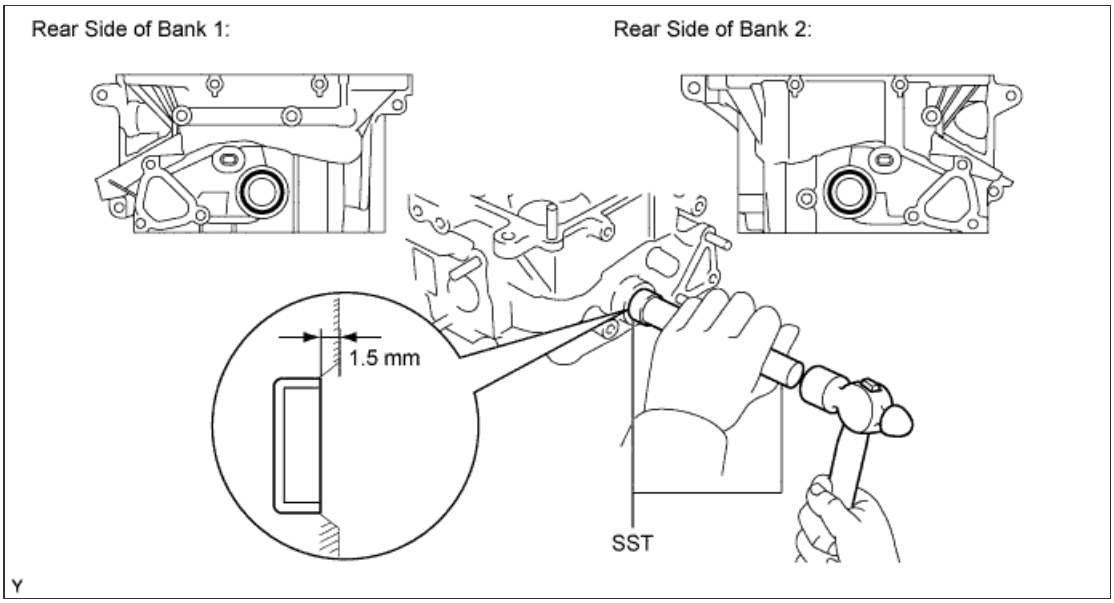
Adhesive:
Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent



c. Using SST and a hammer, tap in the tight plugs to the standard depth.

SST
09950-60010 (09951-00250)
09950-70010 (09951-07150)

Standard depth:
1.5 mm (0.0591 in.)

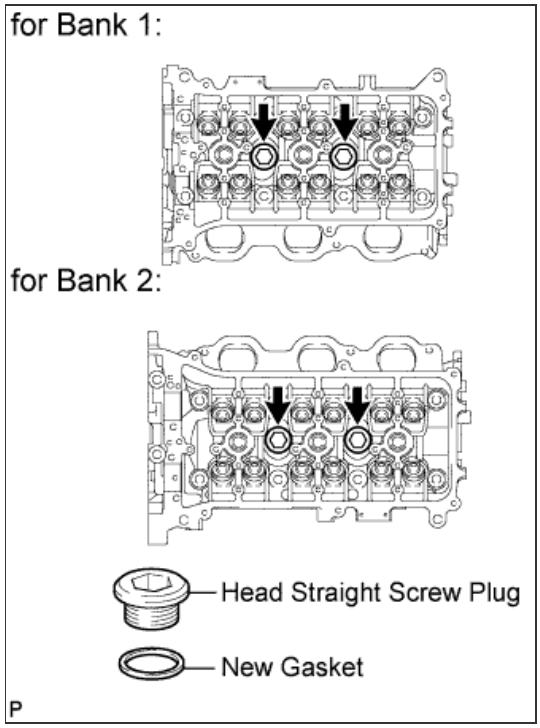


5. REPLACE HEAD STRAIGHT SCRE PLUG

a. Using a 14 mm hexagon wrench, remove the straight screw plug and gasket.

b. Using a 14 mm hexagon wrench, install a new gasket and straight screw plug.

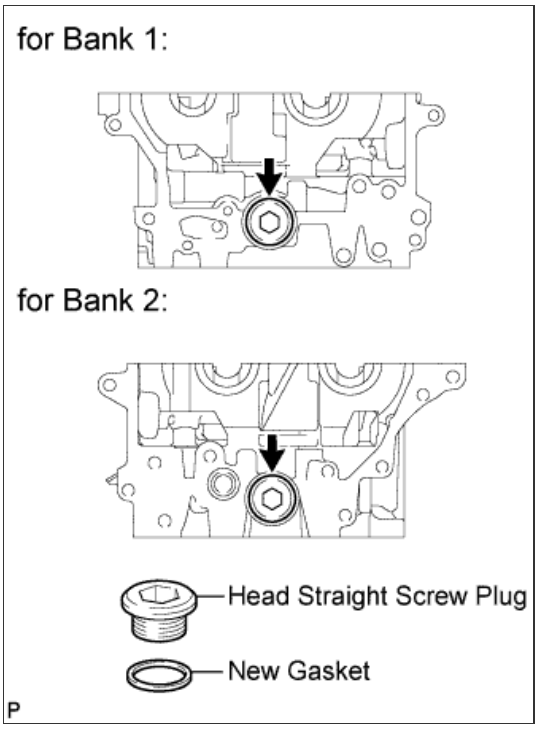
Torque:
80 N m 816 kgf cm , 59 ft. lbf



c. Using a 14 mm hexagon wrench, remove the straight screw plug and gasket.

d. Using a 14 mm hexagon wrench, install a new gasket and straight screw plug.

Torque:
85 N m 867 kgf cm , 63 ft. lbf



6. REPLACE RING PIN

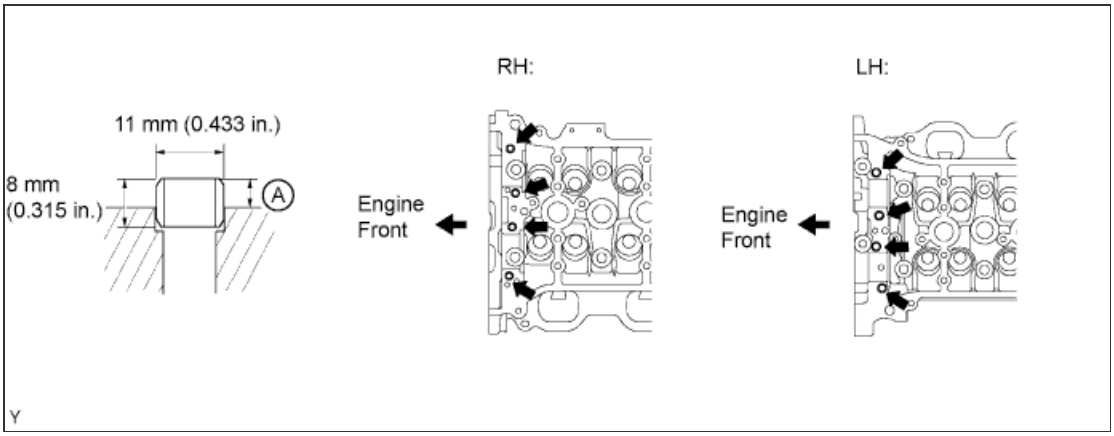
NOTICE:

It is not necessary to remove the ring pin unless it is being replaced.

a. Remove the ring pins.

b. Using a plastic-faced hammer, tap in new ring pins until they reach the standard protrusion height labeled A shown in the illustration.

Standard protrusion height:
2.7 to 3.3 mm (0.106 to 0.0969 in.)



7. REPLACE STRAIGHT PIN

NOTICE:

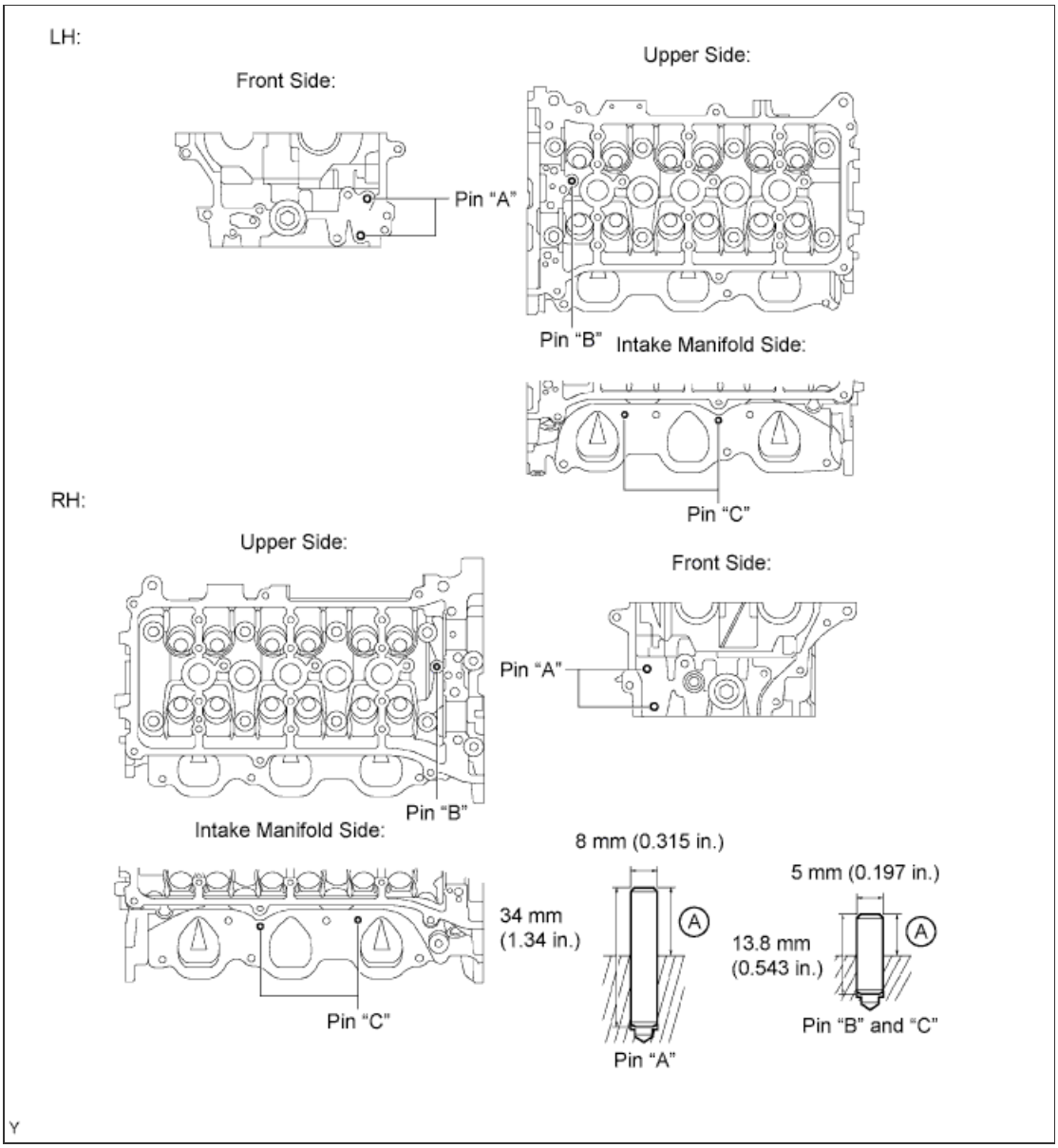
It is not necessary to remove the straight pin unless it is being replaced.

a. Remove the straight pins.

b. Using a plastic-faced hammer, tap in new straight pins until they reach the standard protrusion height labeled A shown in the illustration below.

Standard Protrusion Height:

Item	Specified Condition
Pin "A"	17.5 to 19.5 mm (0.689 to 0.768 in.)
Pin "B"	7.5 to 8.5 mm (0.295 to 0.335 in.)
Pin "C"	7.0 to 9.0 mm (0.276 to 0.354 in.)



8. REPLACE STUD BOLT

NOTICE:

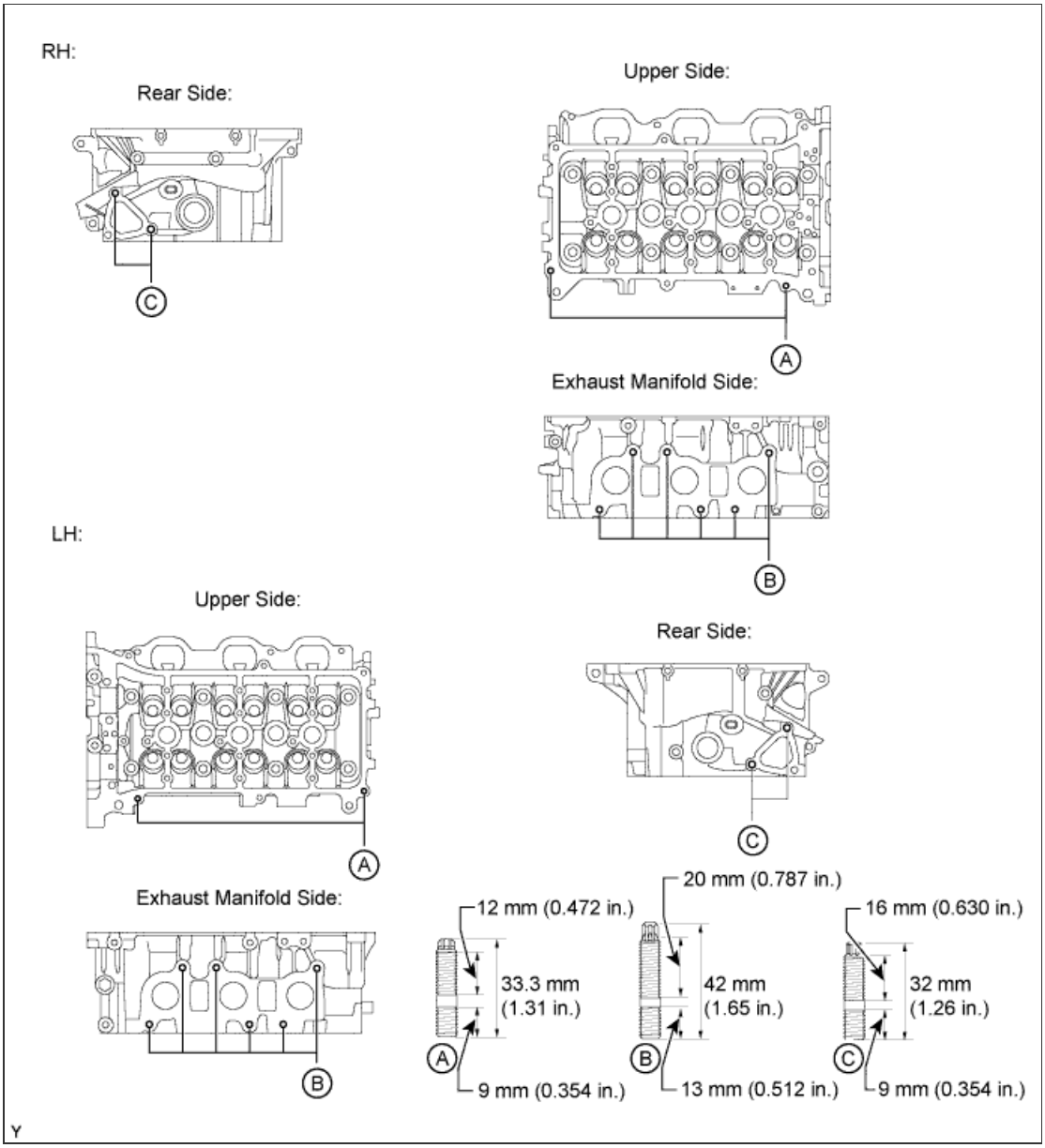
If a stud bolt is deformed or its threads are damaged, replace it.

a. Using an E5 and E7 "TORX" socket wrench, remove the stud bolts.

b. Using an E5 and E7 "TORX" socket wrench, install new stud bolts.

Torque:

for stud bolt A:
4.0 N m 41 kgf cm , 35 in. lbf
for stud bolt B:
9.5 N m 97 kgf cm , 84 in. lbf
for stud bolt C:
4.0 N m 41 kgf cm , 35 in. lbf



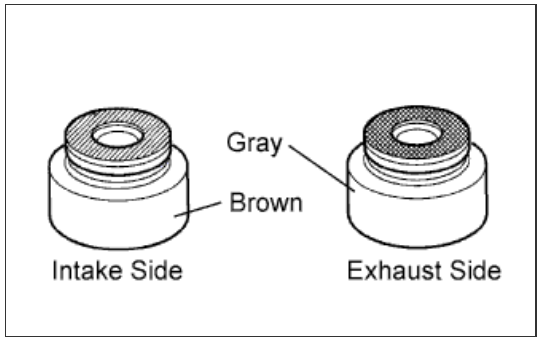
for Preparation Click here

1. INS ALL AE S EM OIL SEAL

HIN

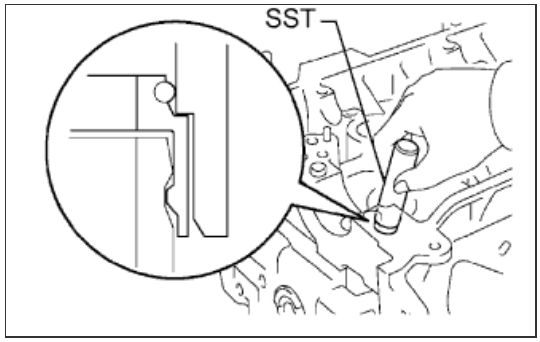
The intake valve stem oil seal is light brown and the exhaust valve stem oil seal is gray.

a Apply a light coat of engine oil to the valve stem oil seal.



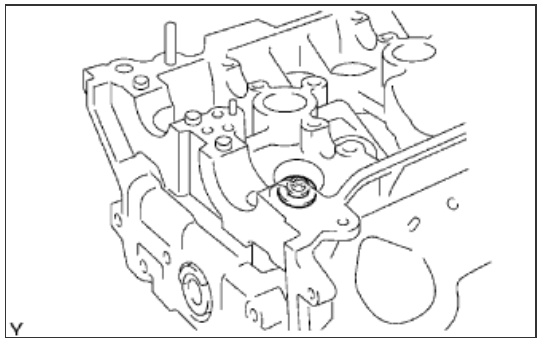
Using SST, push in a new valve stem oil seal.

SST



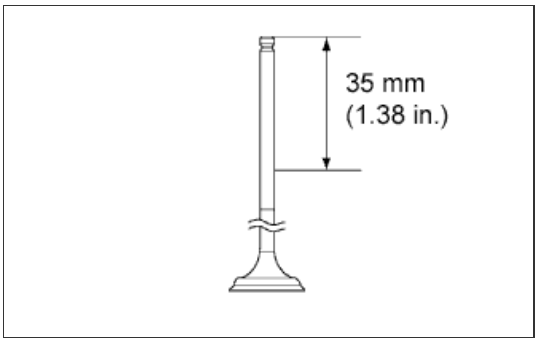
N$ ALL AE SPRING SEA

a Install the valve spring seat.



N$ ALL AE

a. Apply plenty of engine oil to the tip area of the exhaust valve shown in the illustration.



b. Place the cylinder head on wooden blocks.

c. Install the valve, inner compression spring and valve spring retainer to the cylinder head.

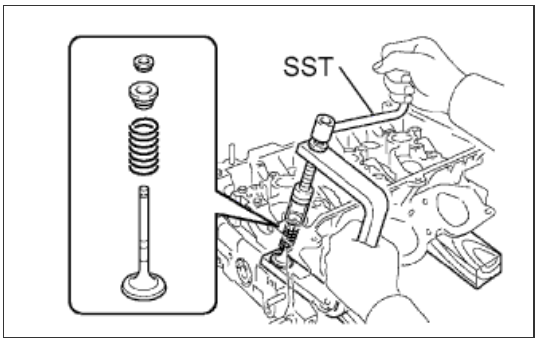
NOTICE:

Install the same parts in the same combination to their original locations.

d. Using SST, compress the inner compression spring and place the valve spring retainer lock around the valve stem.

SST

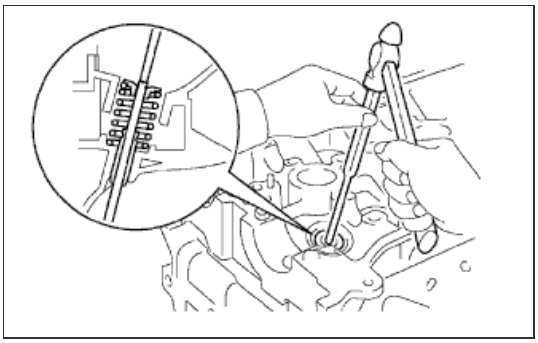
09202-0020 (09202-00010)



e. Using a pin punch 5 and hummer, lightly tap the valve stem tip to ensure a proper fit.

NOTICE:

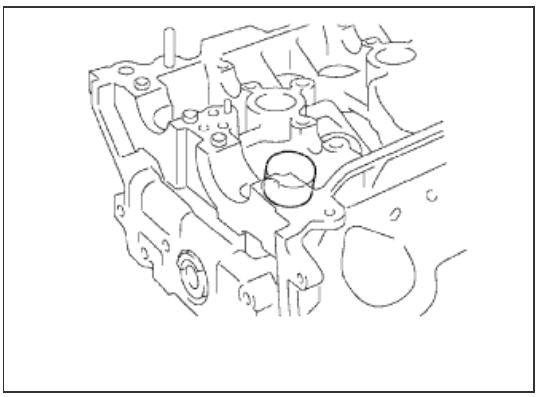
Be careful not to damage the valve stem tip.



4. INSTALL VALVE LIFTER

a. Apply engine oil to the valve stem end and valve lifter, and install the valve lifter to the valve stem.

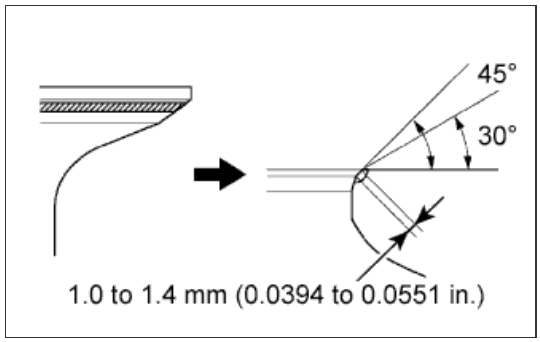
b. Check that the valve lifter rotates smoothly by hand.



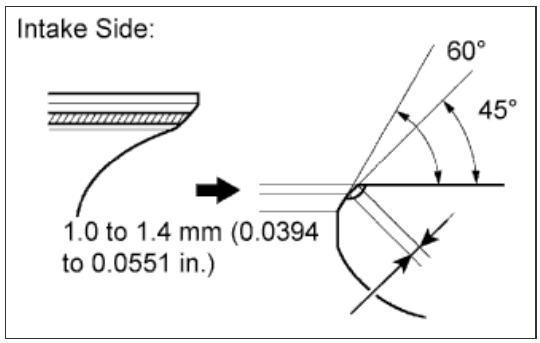
for Preparation Click here

1. REPAIR VALVE SPRIN EA

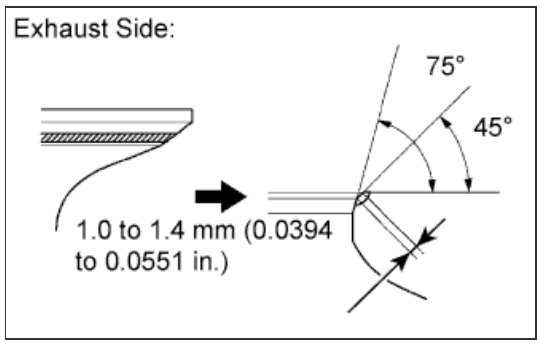
a. If the seating is too high to the valve face, use 30° and 45° cutters to correct the seat.



b. Intake Side:
If the seating is too low to the valve face, use 60° and 45° cutters to correct the seat.

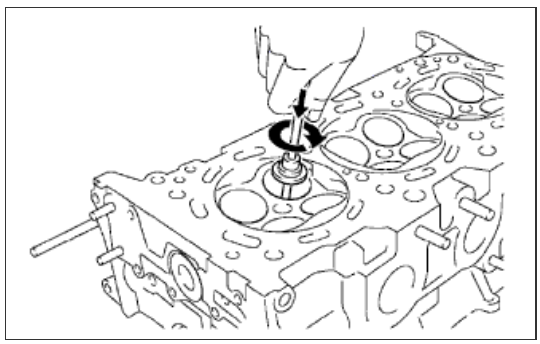


c. Exhaust Side:
If the seating is too low to the valve face, use 75° and 45° cutters to correct the seat.

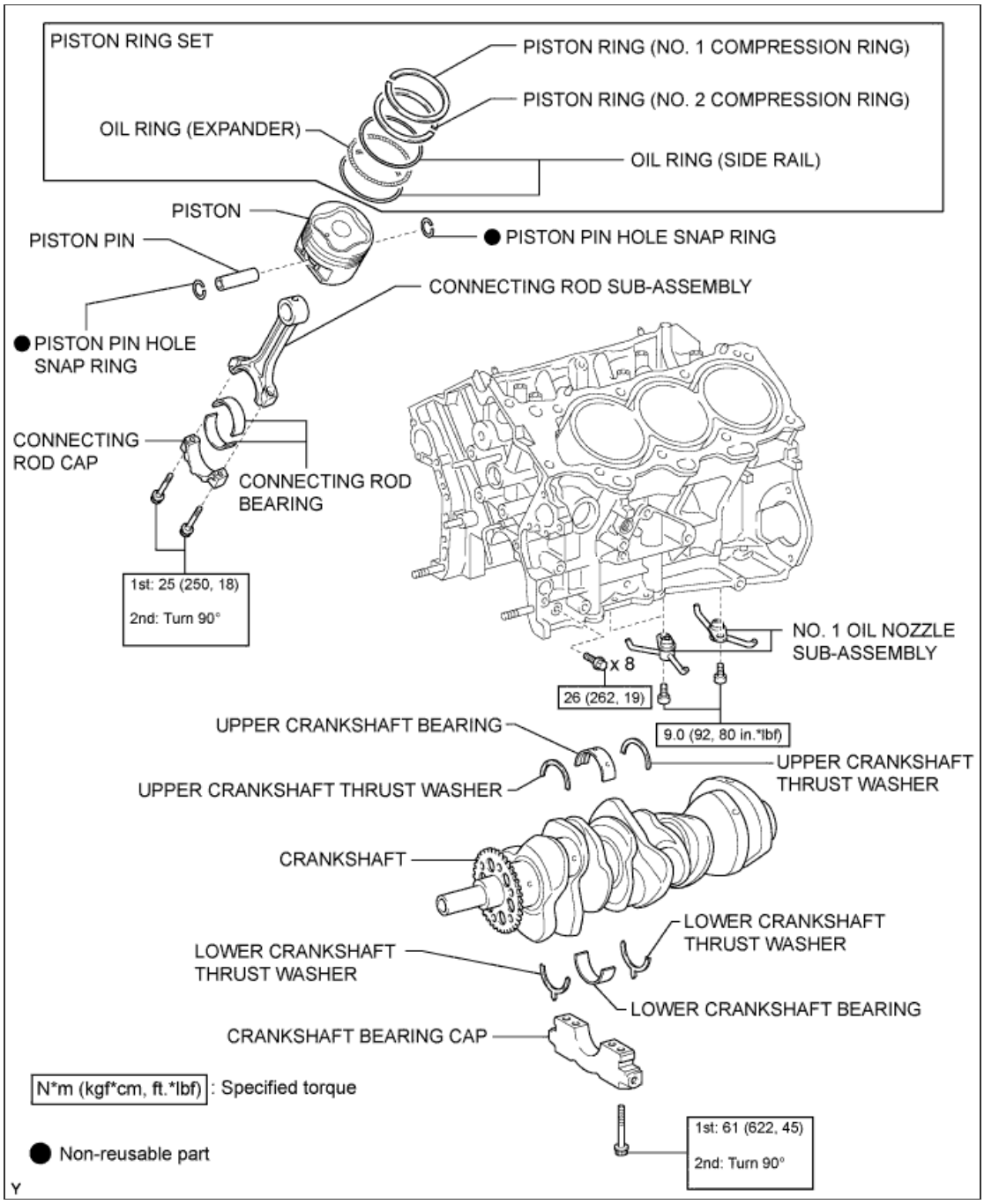


d. Hand-lap the valve and valve seat with an abrasive compound.

e. After lapping the valve by hand, clean the valve and valve seat.



for Preparation Click here



for Preparation Click here

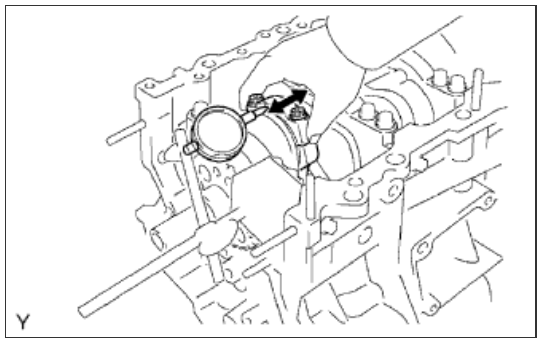
1. INSPECT CONNECTING ROD THRUST CLEARANCE

a. Using a dial indicator, measure the thrust clearance while moving the connecting rod back and forth.

Standard thrust clearance:
0.15 to 0.30 mm (0.00591 to 0.0118 in.)

Maximum thrust clearance:
0.35 mm (0.0138 in.)

If the thrust clearance is more than the maximum, replace one or more connecting rods as necessary.
If necessary, replace the crankshaft.



2. REMOVE PISTON SUB-ASSEMBLY WITH CONNECTING ROD

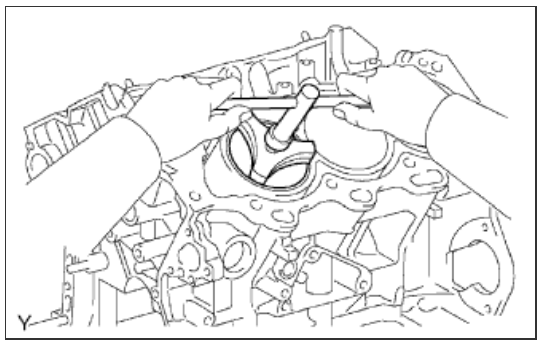
a. Using a ridge reamer, remove all the carbon from the top of the cylinder.

b. Uniformly loosen the connecting rod bolts, and remove the connecting rod cap with bearing.

c. Push out the piston with connecting rod and upper bearing through the top of the cylinder block.

HINT:

- **Keep the bearings, connecting rod and cap together.**
- **Arrange the piston and connecting rod assemblies in the correct order.**

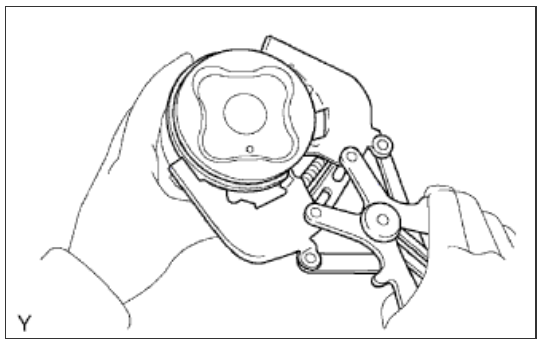


3. REMOVE CONNECTING ROD BEARING

4. REMOVE PISTON RING SET

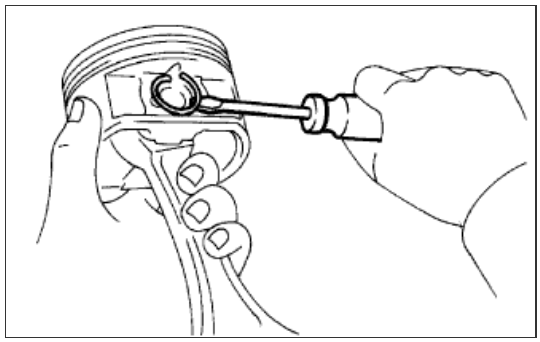
a. Using a piston ring expander, remove the 2 compression rings.

b. Remove the 2 side rails and oil ring (expander) by hand.



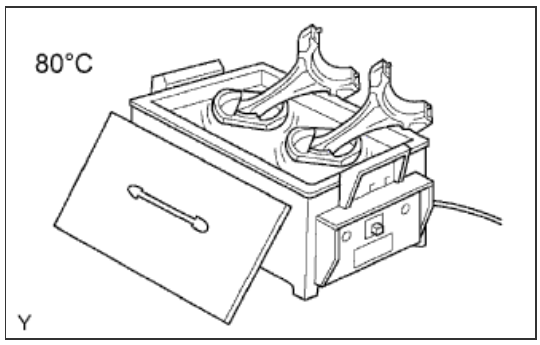
5. REMOVE PISTON PIN HOLE SNAP RING

a. Using a screwdriver, pry out the 2 snap rings.



6. REMOVE PISTON WITH PIN SUB-ASSEMBLY

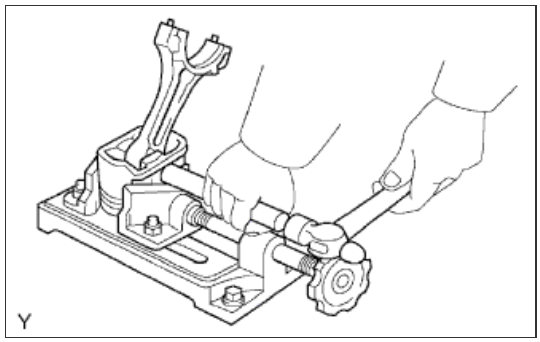
a. Gradually heat the piston to approximately 80°C (176°F).



b. Using a plastic-faced hammer and brass bar, lightly tap out the piston pin and remove the connecting rod.

HINT:

- **The piston and pin are a matched set.**
- **Arrange the pistons, pins, rings, connecting rods and bearings in the correct order.**



7. INSPECT CRANKSHAFT THRUST CLEARANCE

a. Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

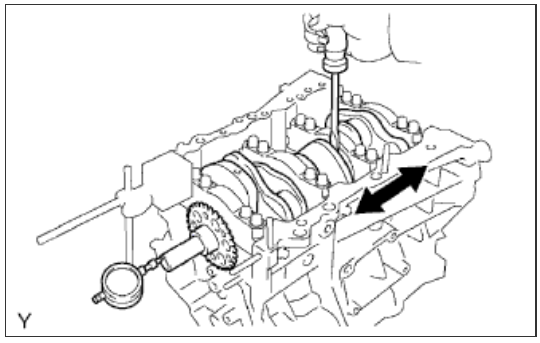
Standard thrust clearance:
0.04 to 0.24 mm (0.00157 to 0.00945 in.)

Maximum thrust clearance:
0.30 mm (0.0118 in.)

If the thrust clearance is more than the maximum, replace the thrust washers as a set.

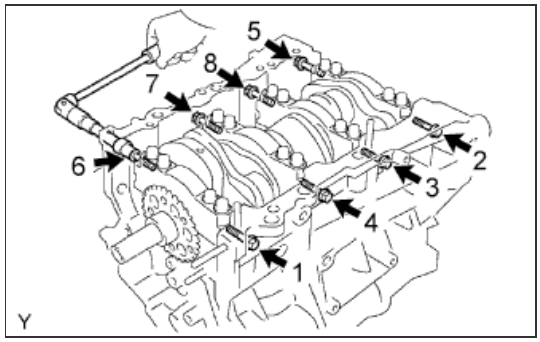
Standard thrust washer thickness:
1.93 to 1.98 mm (0.0760 to 0.0780 in.)

If necessary, replace the crankshaft.

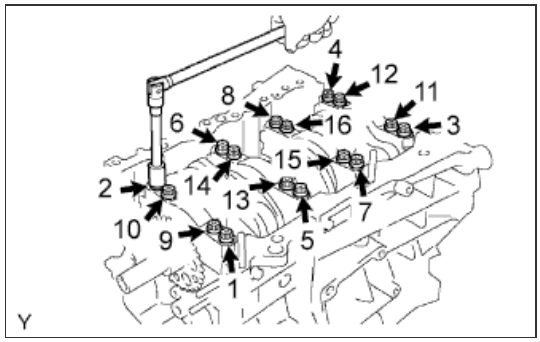


8. REMOVE CRANKSHAFT

a. Using several steps, loosen and remove the 8 bearing cap bolts and seal washers uniformly in the sequence shown in the illustration.



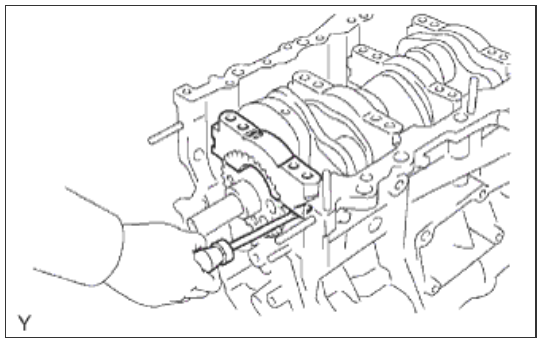
b. Using several steps, loosen and remove the 16 bearing cap bolts uniformly in the sequence shown in the illustration.



c. Using a screwdriver, pry out the bearing caps. Remove the 4 bearing caps and lower bearings.

NOTICE:

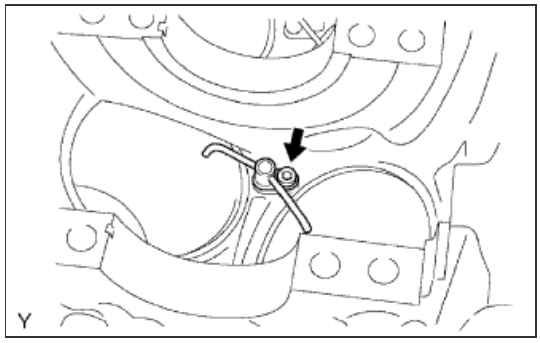
- **Push up on the cap little by little, alternating from the right and left side until the cap can be removed.**
- **Be careful not to damage the joint surfaces of the cylinder block and bearing cap.**



9. REMOVE CRANKSHAFT BEARING

10. REMOVE NO. 1 OIL NOZZLE SUB-ASSEMBLY

a. Using a 5 mm hexagon socket wrench, remove the 3 bolts and 3 oil nozzles.



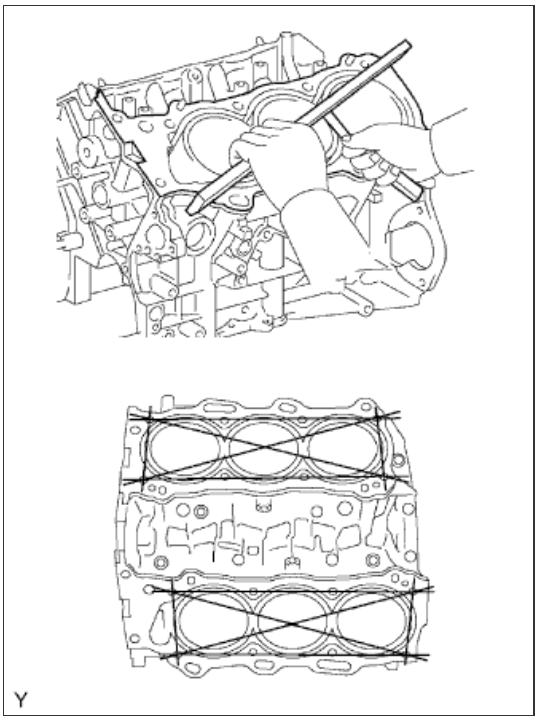
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1. INSPECT CYLINDER BLOCK FOR FLATNESS

a. Using a precision straightedge and feeler gauge, measure the warpage of the contact surface of the cylinder head gasket.

Maximum warpage:
0.05 mm (0.00197 in.)

If the warpage is more than the maximum, replace the cylinder block.



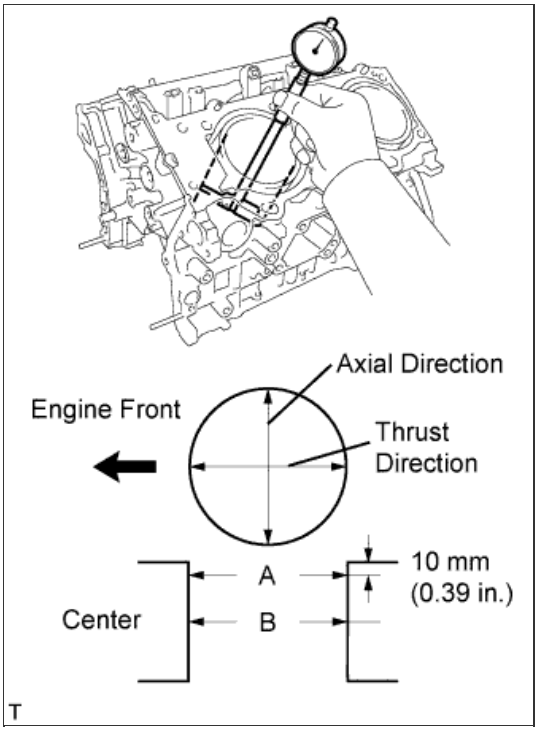
2. INSPECT CYLINDER BORE

a. Using a cylinder gauge, measure the cylinder bore diameter at positions A and B in the thrust and axial directions.

Standard diameter:
94.000 to 94.012 mm (3.7008 to 3.7013 in.)

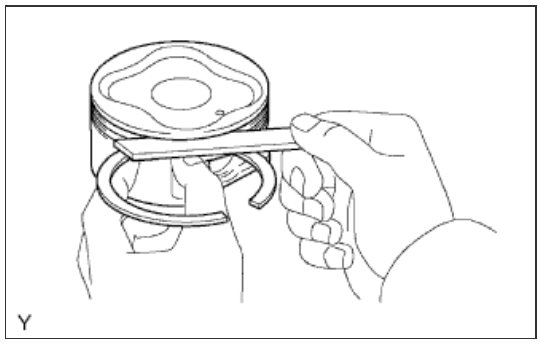
Maximum diameter:
94.132 mm (3.7060 in.)

If the diameter is more than the maximum, replace the cylinder block.



3. INSPECT RING GROOVE CLEARANCE

a. Using a feeler gauge, measure the clearance between a new piston ring and the wall of the ring groove.



Standard Ring Groove Clearance:

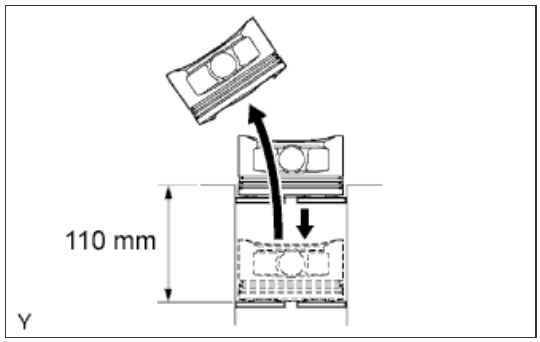
Item	Specified Condition
No. 1 Compression Ring	0.02 to 0.07 mm (0.0007 to 0.00276 in.)
No. 2 Compression Ring	0.02 to 0.06 mm (0.0007 to 0.00236 in.)
Oil Ring	0.07 to 0.15 mm (0.00276 to 0.00590 in.)

If the clearance is not as specified, replace the piston with pin sub-assembly.

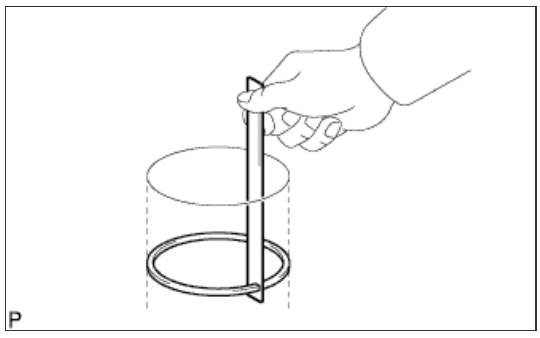
4. INSPECT PISTON RING END GAP

a. Insert the piston ring into the cylinder bore.

b. Using a piston, push the piston ring a little beyond the bottom of the ring travel, 110 mm (4.33 in.) from the top of the cylinder block.



c. Using a feeler gauge, measure the end gap.



Standard End Gap:

Item	Specified Condition
No. 1 Compression Ring	0.30 to 0.40 mm (0.011 to 0.0157 in.)
No. 2 Compression Ring	0.40 to 0.50 mm (0.0157 to 0.0197 in.)
Oil Ring (side rail)	0.10 to 0.40 mm (0.00394 to 0.0157 in.)

Maximum End Gap:

Item	Specified Condition
No. 1 Compression Ring	1.0 mm (0.0394 in.)
No. 2 Compression Ring	1.1 mm (0.0433 in.)
Oil Ring (side rail)	1.0 mm (0.0394 in.)

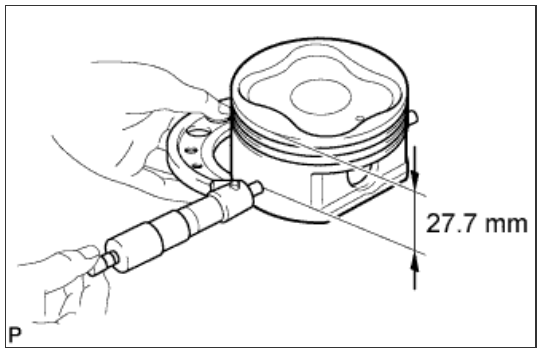
If the end gap is more than the maximum, replace the piston ring. If the end gap is more than the maximum even with a new piston ring, rebore all 6 cylinders or replace the cylinder block sub-assembly.

5. INSPECT PISTON WITH PIN SUB-ASSEMBLY

a. Using a micrometer, measure the piston diameter at a right angle to the piston pin center line, 27.7 mm (1.091 in.) from the piston head.

Piston diameter:

93.910 to 93.920 mm (3.6972 to 3.6976 in.)



6. INSPECT PISTON OIL CLEARANCE

a. Subtract the piston diameter measurement from the cylinder bore diameter measurement.

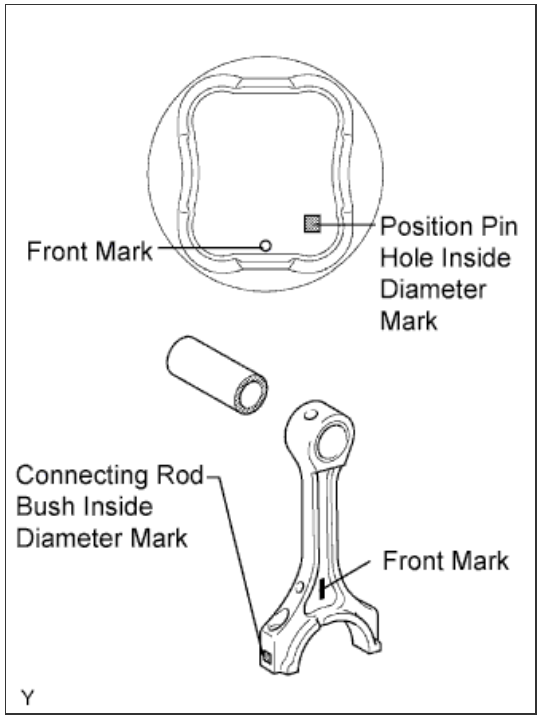
Standard oil clearance:
0.080 to 0.102 mm (0.00315 to 0.00401 in.)

Maximum oil clearance:
0.13 mm (0.00512 in.)

If the oil clearance is more than the maximum, replace all 6 pistons. If necessary, replace the cylinder block.

7. INSPECT PISTON PIN OIL CLEARANCE

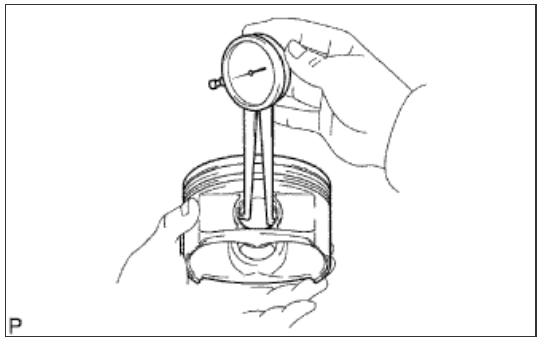
a. Check each mark on the piston and connecting rod.



b. Using a caliper gauge, measure the inside diameter of the piston pin hole.

Standard Piston Pin Hole Inside Diameter:

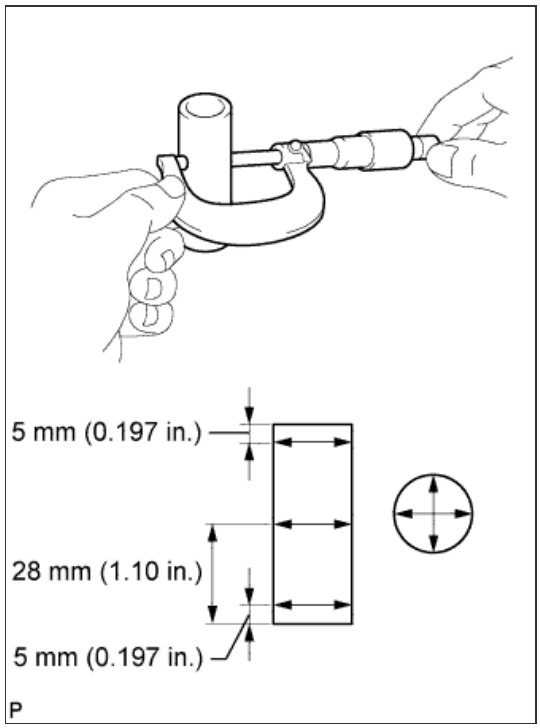
Mark	Specified Condition
A	22.001 to 22.004 mm (0. 1 to 0. 0 in.)
B	22.005 to 22.007 mm (0. to 0. in.)
C	22.00 to 22.010 mm (0. to 0. in.)



c. Using a micrometer, measure the piston pin diameter.

Standard Piston Pin Diameter:

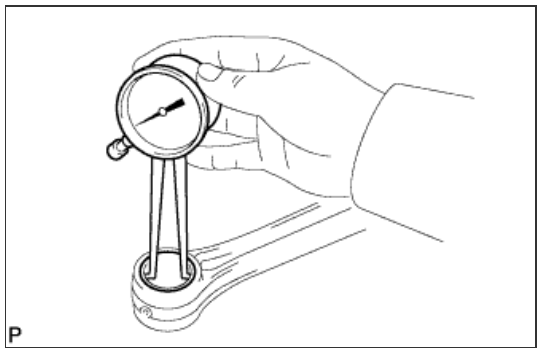
Mark	Specified Condition
A	21.997 to 22.000 mm (0. 02 to 0. 14 in.)
B	22.001 to 22.003 mm (0. 1 to 0. in.)
C	22.004 to 22.006 mm (0. 0 to 0. in.)



d. Using a caliper gauge, measure the inside diameter of the connecting rod bush.

Standard Bush Inside Diameter:

Mark	Specified Condition
A	22.005 to 22.00 mm (0. to 0. in.)
B	22.009 to 22.011 mm (0. to 0. in.)
C	22.012 to 22.014 mm (0. 1 to 0. in.)



e. Subtract the piston pin diameter measurement from the piston pin hole diameter measurement.

Standard oil clearance:
0.001 to 0.007 mm (0.0000394 to 0.000276 in.)

Maximum oil clearance:
0.040 mm (0.00157 in.)

If the oil clearance is more than the maximum, replace the piston and piston pin as a set.

f. Subtract the piston pin diameter measurement from the bush inside diameter measurement.

Standard oil clearance:
0.005 to 0.011 mm (0.000197 to 0.000433 in.)

Maximum oil clearance:
0.050 mm (0.00197 in.)

If the oil clearance is more than the maximum, replace the bush (Click here). If necessary, replace the connecting rod and piston pin as a set.

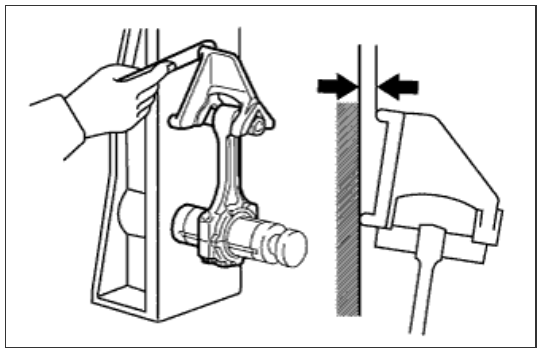
8. INSPECT CONNECTING ROD SUB-ASSEMBLY

a. Using a rod aligner and feeler gauge, check the connecting rod alignment.

i. Check for bend.

Maximum bend:
0.05 mm (0.00197 in.) per 100 mm (3.94 in.)

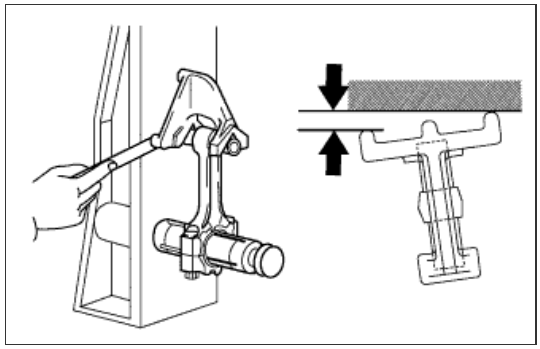
If the bend is more than the maximum, replace the connecting rod sub-assembly.



ii. Check for twist.

Maximum twist:
0.15 mm (0.00591 in.) per 100 mm (3.94 in.)

If the twist is more than the maximum, replace the connecting rod sub-assembly.

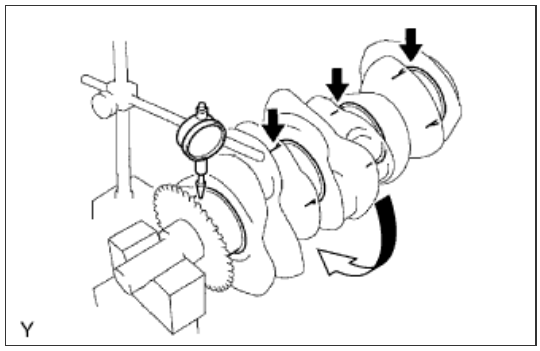


9. INSPECT CRANKSHAFT

a. Using a dial indicator and V-blocks, measure the runout as shown in the illustration.

Maximum circle runout:
0.06 mm (0.00236 in.)

If the circle runout is more than the maximum, replace the crankshaft.



b. Using a micrometer, measure the diameter of each main journal.

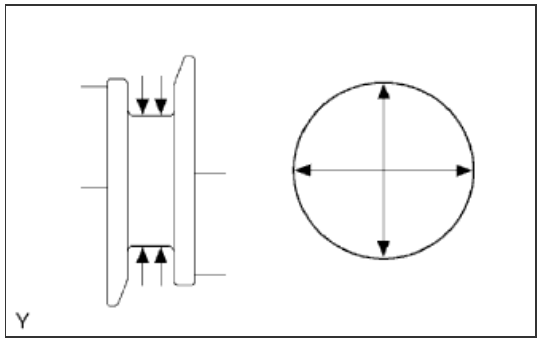
Standard diameter:
71.988 to 72.000 mm (2.8342 to 2.8346 in.)

If the diameter is not as specified, check the oil clearance. If necessary, replace the crankshaft.

c. Check each main journal for taper and out-of-round as shown in the illustration.

Maximum taper and out-of-round:
0.02 mm (0.000787 in.)

If the taper and out-of-round is more than the maximum, replace the crankshaft.



d. Using a micrometer, measure the diameter of each crank pin.

Standard diameter:
55.992 to 56.000 mm (2.2044 to 2.2047 in.)

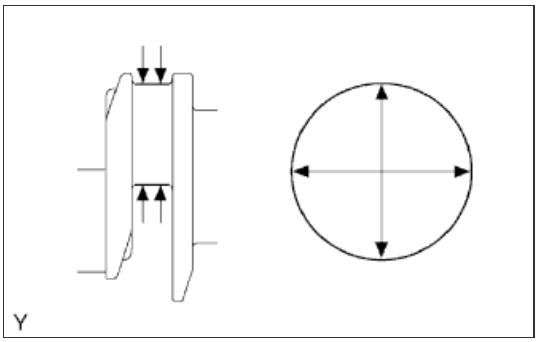
If the diameter is not as specified, check the oil clearance. If necessary, replace the crankshaft.

e. Check each crank pin for taper and out-of-round as shown in the illustration.

Maximum taper and out-of-round:

0.02 mm (0.000787 in.)

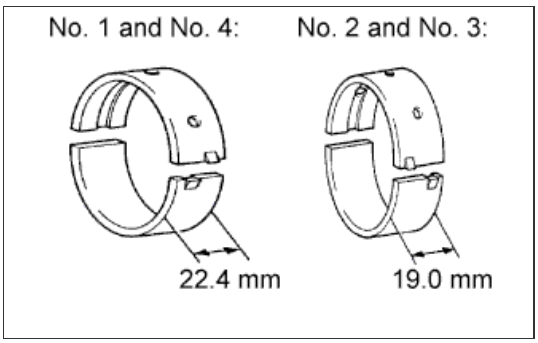
If the taper and out-of-round is more than the maximum, replace the crankshaft.



10. INSPECT CRANKSHAFT OIL CLEARANCE

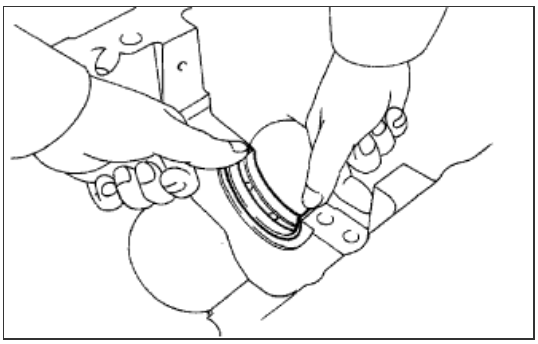
HINT:

Main bearings come in widths of 19.0 mm (0.74 in.) and 22.4 mm (0. in.). Install the 22.4 mm (0. in.) bearings in the No. 1 and No. 4 cylinder block journal positions with the main bearing caps. Install the 19.0 mm (0.74 in.) bearings in the No. 2 and No. 3 positions.



a. Clean each main journal and bearing.

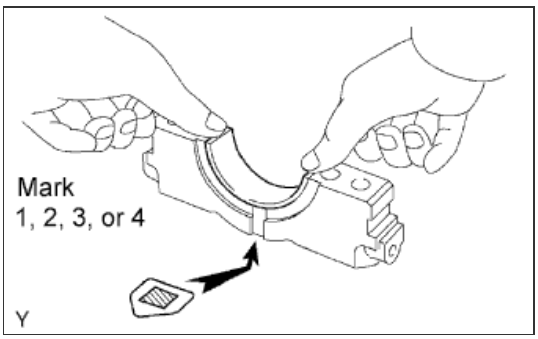
b. Align the bearing claw with the claw groove of the cylinder block, and push in the 4 upper bearings.



NOTICE:

- **Do not apply engine oil to the bearings and contact surfaces.**
- **Do not allow coolant to come into contact with the bearing inner surface.**
- **If any coolant comes into contact with the bearing inner surface, replace the bearing with a new one.**

c. Align the bearing claw with the claw groove of the main bearing cap, and push in the 4 lower bearings.



NOTICE:

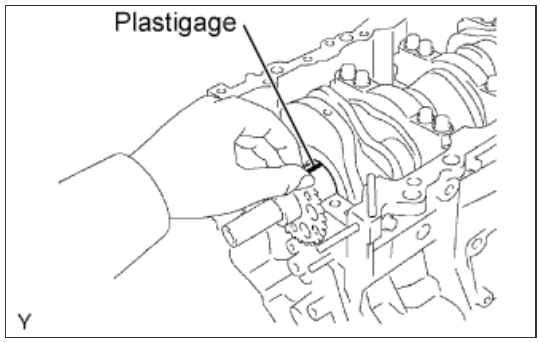
- **Do not apply engine oil to the bearings and contact surfaces.**
- **Do not allow coolant to come into contact with the bearing inner surface.**
- **If any coolant comes into contact with the bearing inner surface, replace the bearing with a new one.**

HINT:

A number marked on each main bearing cap indicates the installation position.

d. Place the crankshaft on the cylinder block.

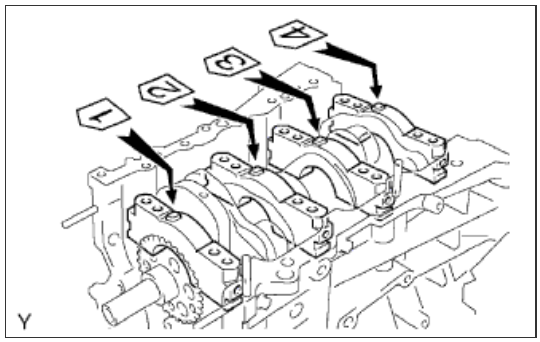
e. Lay a strip of Plastigage across each journal.



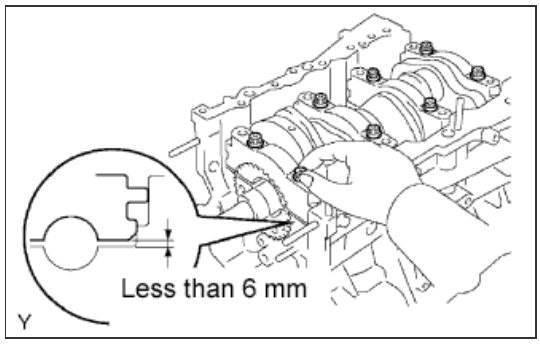
f. xamine the front marks and numbers and set the crankshaft bearing caps on the cylinder block.

g. Apply a light coat of engine oil to the threads of the crankshaft bearing cap bolts.

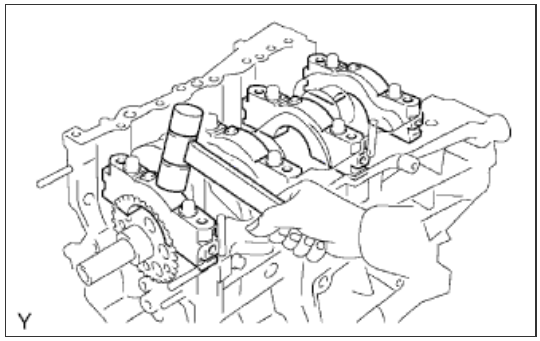
h. emporarily install the crankshaft bearing cap bolts to the inside positions.



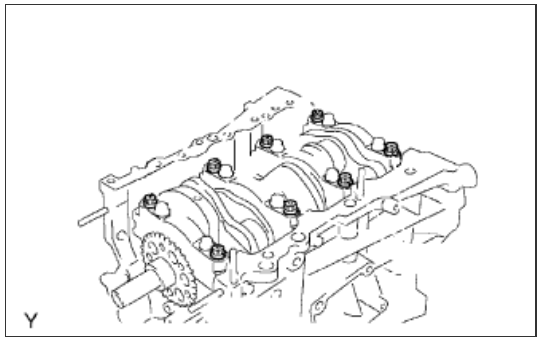
i. ghten the 2 bolts for each bearing cap until the clearance between the crankshaft bearing cap and the cylinder block becomes less than 6 mm (0.236 in.).



j. Using a plastic-faced hammer, lightly tap the crankshaft bearing cap to ensure a proper fit.



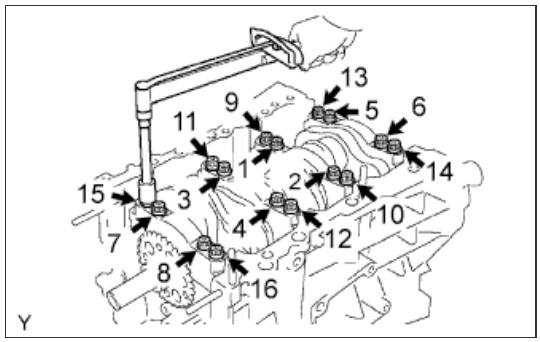
k. Apply a light coat of engine oil to the threads of the crankshaft bearing bolts and temporarily install the crankshaft bearing cap bolts to the outside positions.



l. Step 1:

i. Uniformly tighten the 16 bolts in several steps in the order shown in the illustration.

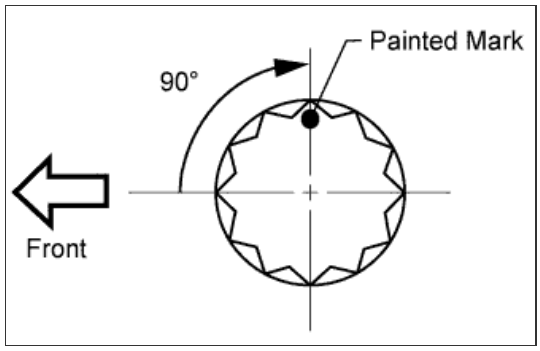
Torque:
61 N*m{ 622 kgf*cm , 45 ft.*lbf }



m. Step 2:

i. Mark the front side of the crankshaft bearing cap bolts with paint.

ii. ghten the bearing cap bolts 90° in the order shown in step 1.



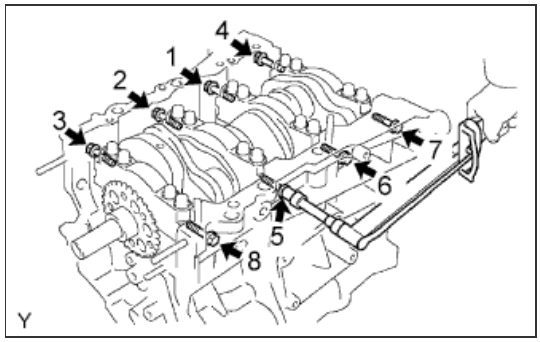
n. Check that the painted marks are now at a 90° angle to the front.

NOTICE:

Do not turn the crankshaft.

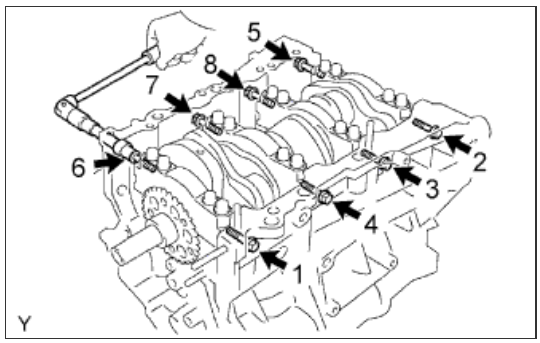
o. Install and uniformly tighten the crankshaft bearing cap bolts in several steps in the sequence shown in the illustration.

Torque:
26 N*m{ 262 kgf*cm , 19 ft.*lbf }



p. Remove the crankshaft bearing caps.

i. Step 1:
Uniformly loosen and remove the bearing cap bolts in the sequence shown in the illustration.



ii. Step 2:
Uniformly loosen and remove the 16 bearing cap bolts in the sequence shown in the illustration.

q. Measure the Plastigage at its widest point.

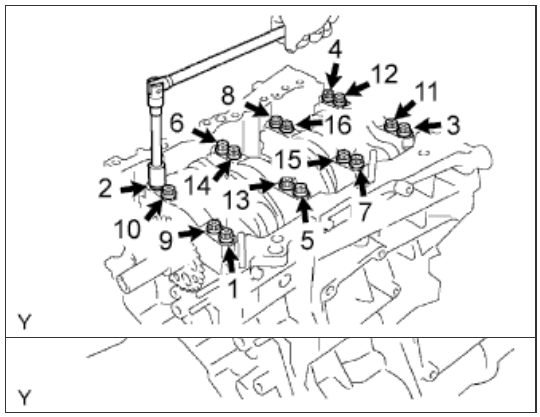
Standard oil clearance:
0.018 to 0.030 mm (0.000709 to 0.00118 in.)

Maximum clearance:
0.046 mm (0.00181 in.)

If the oil clearance is more than the maximum, replace the bearings. If necessary, replace the crankshaft.

NOTICE:

Completely remove the Plastigage.



r. If replacing a bearing, replace it with one that has the same number. If the number of the bearing cannot be determined, select the correct bearing by adding together the numbers imprinted on the cylinder block and crankshaft, then refer to the table below for the appropriate bearing number. here are 5 sizes of standard bearings, marked "1", "2", "3", "4" and "5" accordingly.

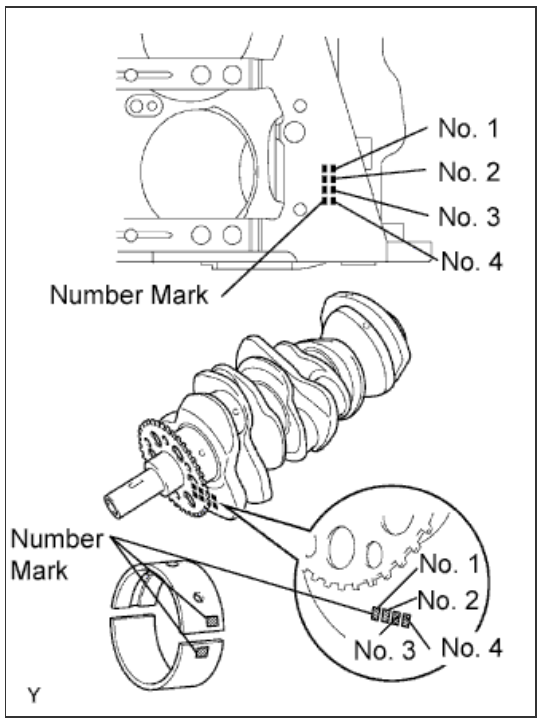
Journal Bearings:

Cylinder block (A) Crankshaft (B)	Use Bearing
0 - 5	"1"
6 - 11	"2"
12 - 17	"3"
1	

HINT:

xample:

Cylinder block "11" (A) Crankshaft "06" (B) otal number 17 (Use bearing "3")



Standard Journal Diameter:

Item	Mark	Specified Condition
Cylinder block main journal bore diameter (A)	"00"	77.000 mm (3.03149 in.)
	"01"	77.001 mm (3.03152 in.)
	"02"	77.002 mm (3.03156 in.)
	"03"	77.003 mm (3.03160 in.)
	"04"	77.004 mm (3.03164 in.)
	"05"	77.005 mm (3.0316 in.)
	"06"	77.006 mm (3.03172 in.)
	"07"	77.007 mm (3.03176 in.)
	"0	.00 mm (3.031 0 in.)
	"09"	77.009 mm (3.031 in.)
	"10"	77.010 mm (3.031 in.)
	"11"	77.011 mm (3.03192 in.)
	"12"	77.012 mm (3.0396 in.)
	"13"	77.013 mm (3.03200 in.)
	"14"	77.014 mm (3.03204 in.)
	"15"	77.015 mm (3.0320 in.)
	"16"	77.016 mm (3.03211 in.)
	"00"	71.999 to 72.000 mm (2. 0 to 2. in.)

Crankshaft main journal diameter (B)	"01"	71.99 to 71.999 mm (2. to 2. 0 in.)
	"02"	71.997 to 71.99 mm (2. to 2. in.)
	"03"	71.996 to 71.997 mm (2. to 2. in.)
	"04"	71.995 to 71.996 mm (2. 0 to 2. in.)
	"05"	71.994 to 71.995 mm (2. 0 to 2. in.)
	"06"	71.993 to 71.994 mm (2. to 2. 0 in.)
	"07"	71.992 to 71.993 mm (2. to 2. in.)
	"0	1.991 to 71.992 mm (2. to 2. in.)
	"09"	71.990 to 71.991 mm (2. to 2. in.)
	"10"	71.9 to 71.990 mm (2. 0 to 2. in.)
	"11"	71.9 to 71.9 mm (2. 16 to 2. 0 in.)

Standard Bearing Center Wall Thickness:

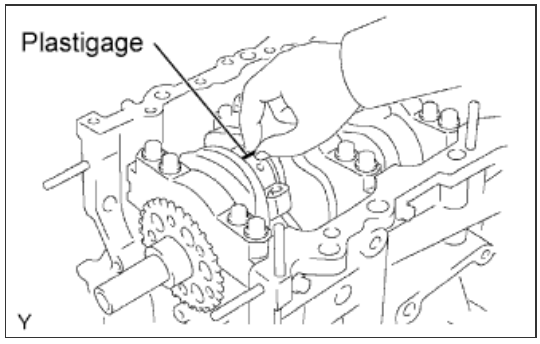
Mark	Specified Condition
"1"	2.4 to 2.491 mm (0.09 0 to 0.09 1 in.)
"2"	2.491 to 2.494 mm (0.09 1 to 0.09 in.)
"3"	2.494 to 2.497 mm (0.09 to 0.09 in.)
"4"	2.497 to 2.500 mm (0.09 to 0.09 in.)
"5"	2.500 to 2.503 mm (0.09 to 0.09 in.)

11. INSPECT CONNECTING ROD OIL CLEARANCE

a. Install the crankshaft bearing (Click here).

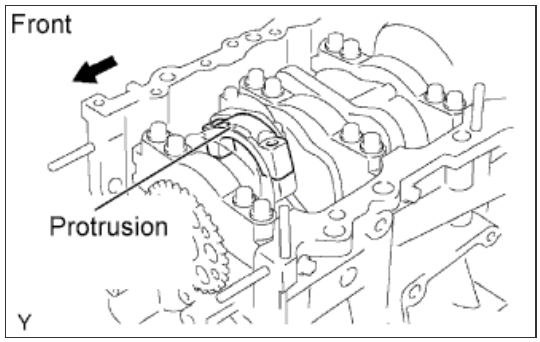
b. Install the crankshaft (Click here).

c. Lay a strip of Plastigage across the crank pin.



d. Set the connecting rod cap so that the protrusion is facing the correct direction.

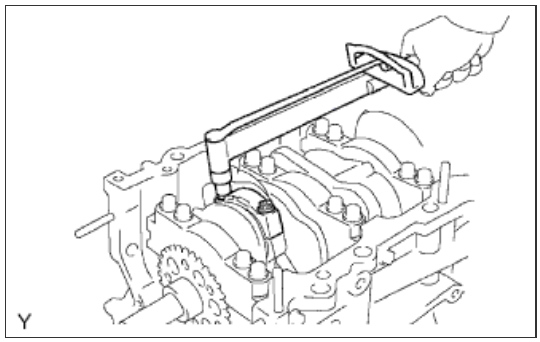
e. Apply a light coat of engine oil to the threads of the connecting rod cap bolts.



f. Step 1:

i. Install and alternately tighten the bolts of the connecting rod cap in several steps.

Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }

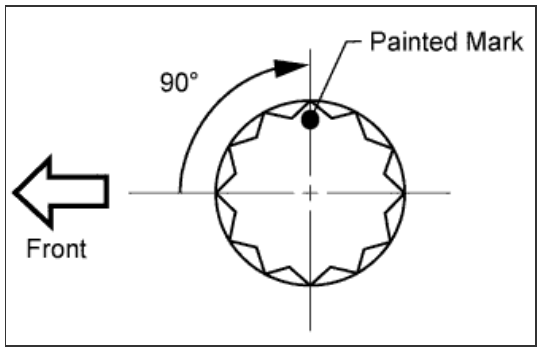


g. Step 2:

i. Mark the front side of each connecting rod cap bolt with paint.

ii. ghten the bearing cap bolts in step 1 90°.

h. Remove the 2 bolts, connecting rod cap and lower bearing.



i. Measure the Plastigage at its widest point.

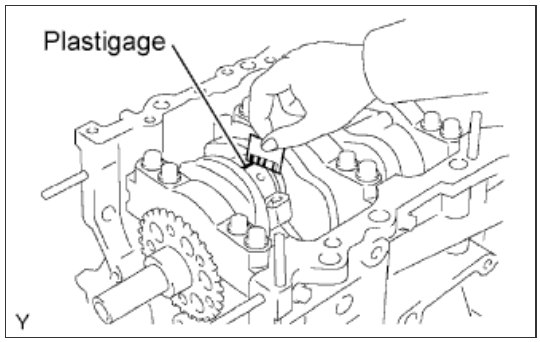
Standard oil clearance:
0.026 to 0.046 mm (0.00102 to 0.00181 in.)

Maximum oil clearance:
0.066 mm (0.00260 in.)

If the oil clearance is more than the maximum, replace the bearings. If necessary, replace the crankshaft.

NOTICE:

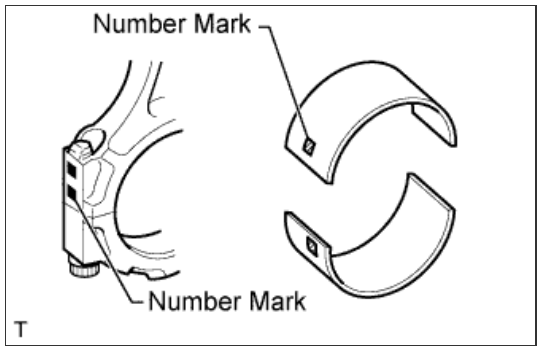
Completely remove the Plastigage.



j. If replacing a bearing, replace it with one that has the same number marked on the connecting rod. here are 4 sizes of standard bearings, marked "1 ", "2", "3" and "4" accordingly.

Standard Bearing Center Wall Thickness:

Mark	Specified Condition
1	1.4 to 1.4 mm (0.05 to 0.05 in.)
2	1.4 to 1.490 mm (0.05 to 0.05 in.)
3	1.490 to 1.493 mm (0.05 to 0.05 in.)
4	1.493 to 1.496 mm (0.05 to 0.05900 in.)



k. Remove the crankshaft (Click here).

l. Remove the crankshaft bearing.

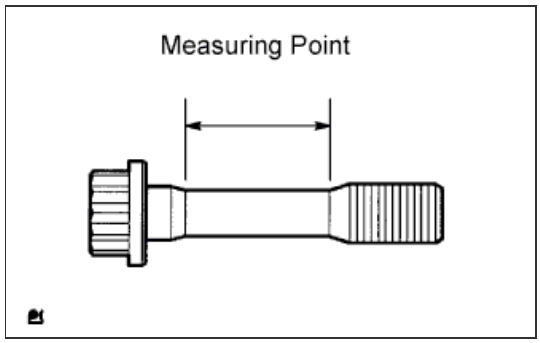
12. INSPECT CONNECTING ROD BOLT

a. Using a vernier caliper, measure the tension portion diameter of the bolt.

Standard diameter:
7.2 to 7.3 mm (0.283 to 0.287 in.)

Minimum diameter:
7.0 mm (0.276 in.)

If the diameter is less than the minimum, replace the connecting rod bolt.

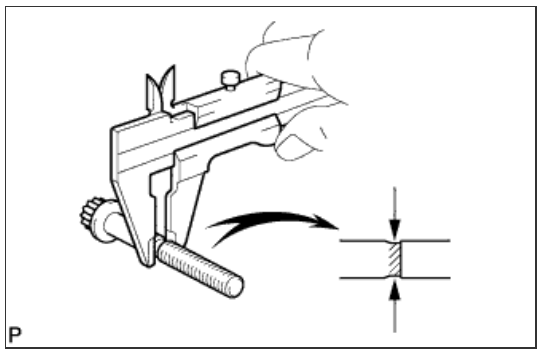


13. INSPECT CRANKSHAFT BEARING CAP SET BOLT

a. Using a vernier caliper, measure the tension portion diameter of the bolt.

Standard diameter:
10.0 to 10.2 mm (0.394 to 0.402 in.)

If the diameter is less than the minimum, replace the crankshaft bearing cap set bolt.



for Preparation Click here

1. REPLACE STUD BOLT

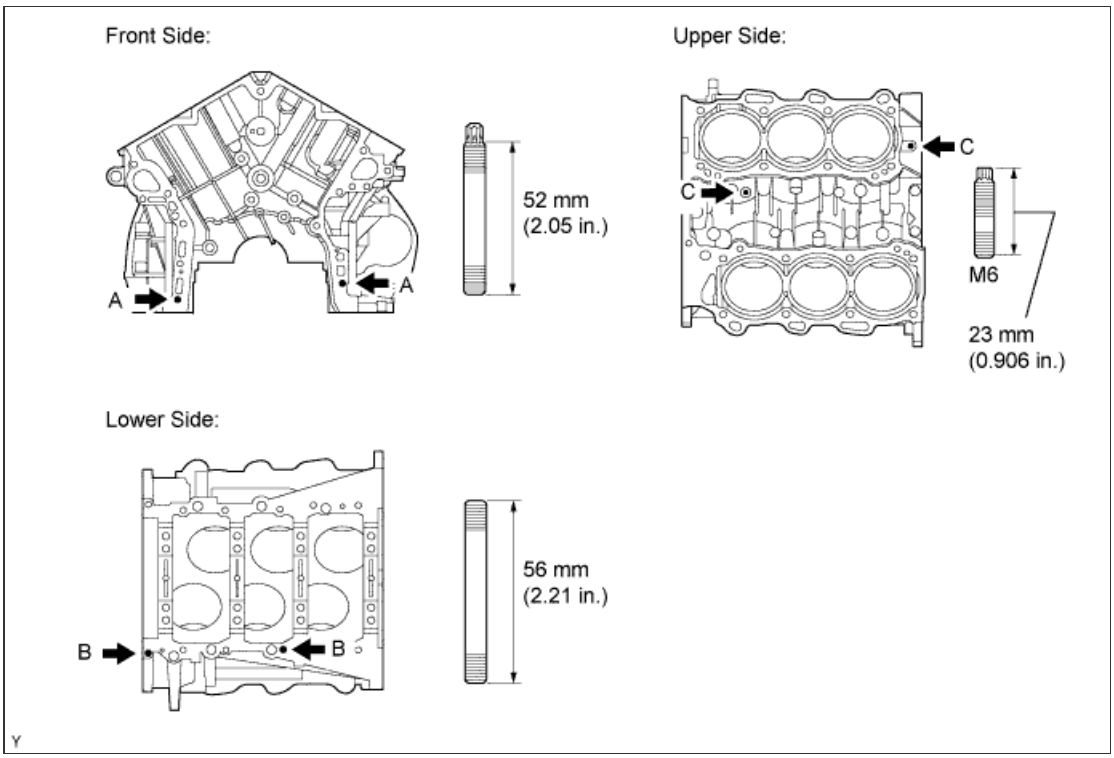
NOTICE:

If a stud bolt is deformed or its threads are damaged, replace it.

a. Remove the stud bolts.

b. Install new stud bolts.

Torque:
for stud bolt A and B:
11 N*m{ 112 kgf*cm , 8 ft.*lbf }
for stud bolt C:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }



2. REPLACE STRAIGHT PIN

NOTICE:

It is not necessary to remove the straight pin unless it is being replaced.

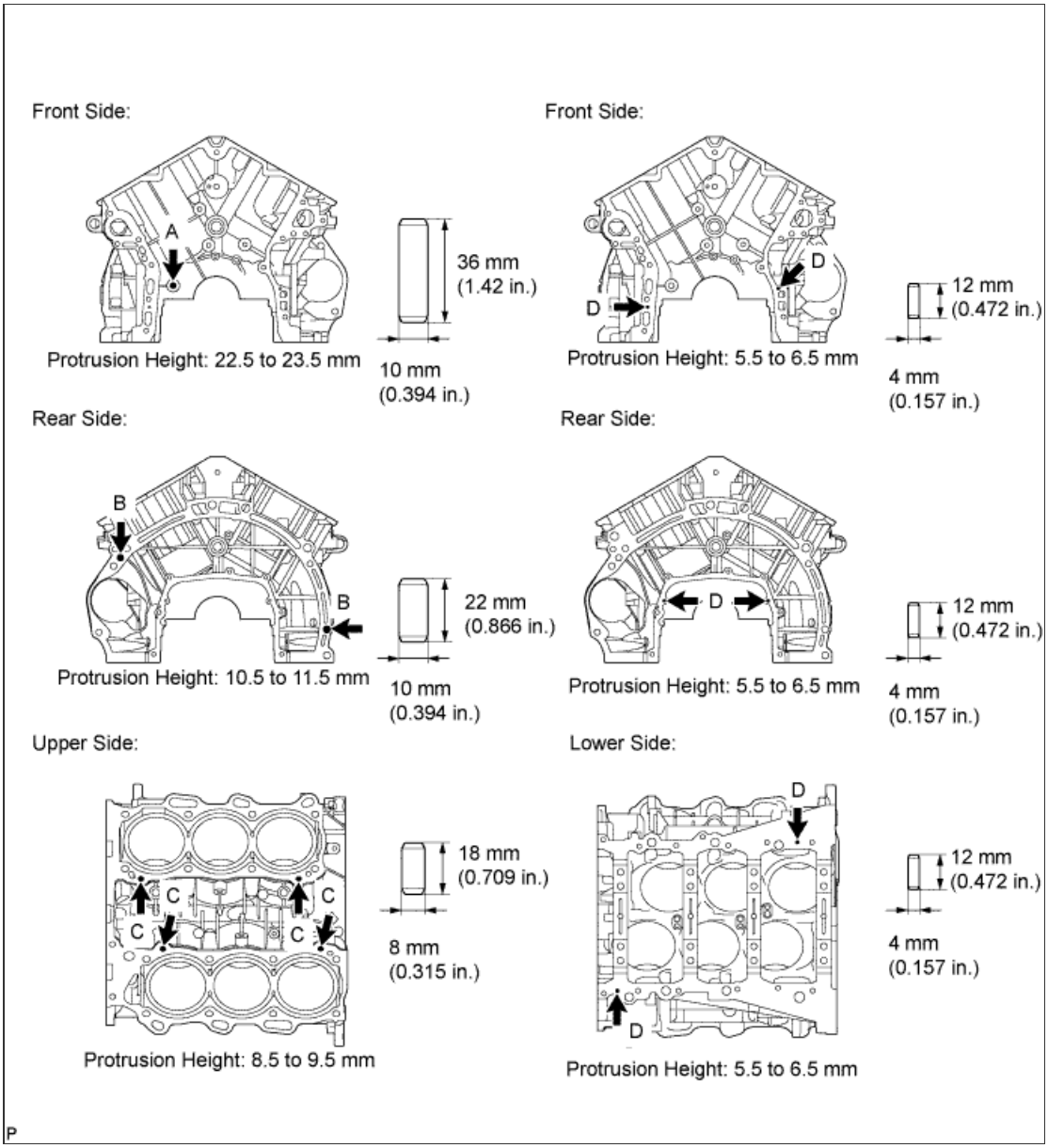
a. Remove the straight pins.

b. Using a plastic-faced hammer, tap in new straight pins to the cylinder block.

Standard Protrusion Height:

Item	Specified Condition
Pin "A"	22.5 to 23.5 mm (0.889 to

	0.925 in.)
Pin "B"	10.5 to 11.5 mm (0.413 to 0.453 in.)
Pin "C"	8.5 to 9.5 mm (0.335 to 0.374 in.)
Pin "D"	5.5 to 6.5 mm (0.217 to 0.256 in.)



3. REPLACE CYLINDER BLOCK TIGHT PLUG

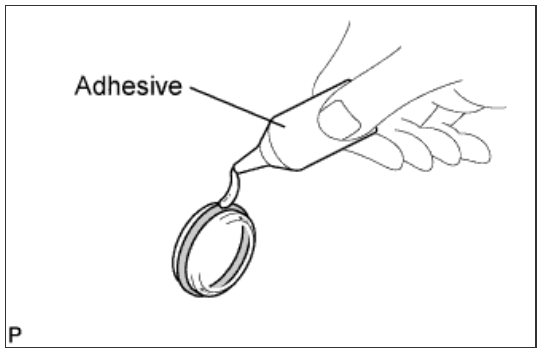
NOTICE:

If water leaks from the tight plug or the plug corrodes, replace it.

a. Remove the tight plugs.

b. Apply adhesive around new tight plugs.

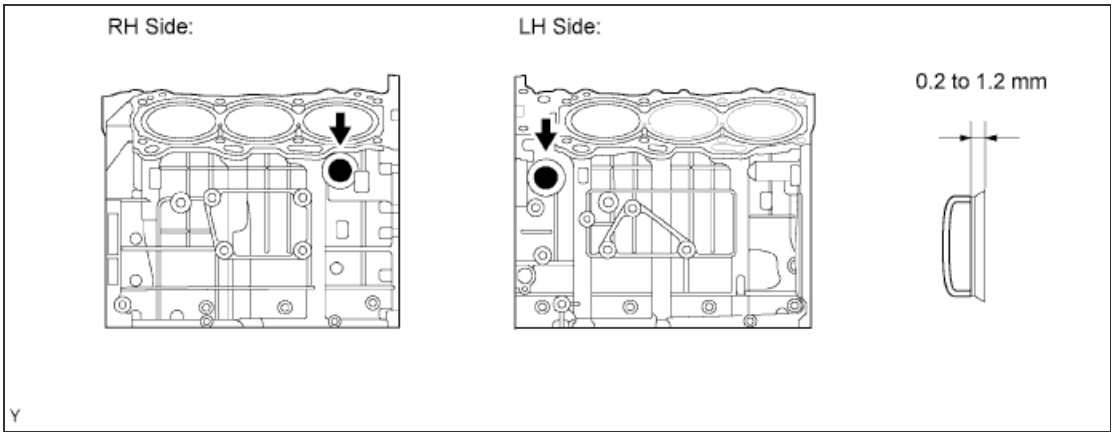
Adhesive:
To ota Genuine Adhesive 1324, Three Bond 1324 or equivalent



c. Using SST and a hammer, tap in the tight plugs to the standard depth.

SST
09950- 0010 09951-00350
09950-70010 09951-07150

Standard depth:
0.2 to 1.2 mm 0.00787 to 0.0472 in.



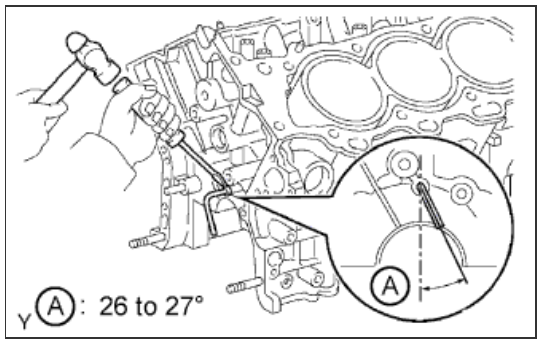
4. REPLACE OIL JET

NOTICE:

It is not necessary to remove the oil jet unless it is being replaced.

a. Using a screwdriver and hammer, tap out the oil jet.

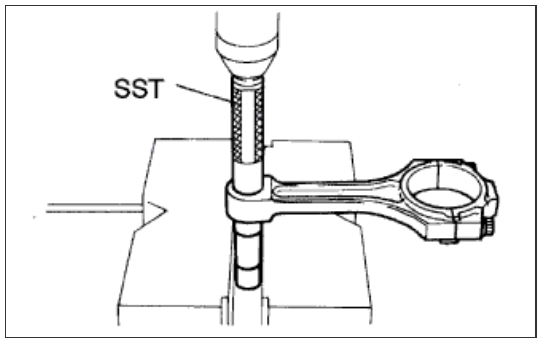
b. Using a screwdriver and hammer, tap in a new oil jet as shown in the illustration.



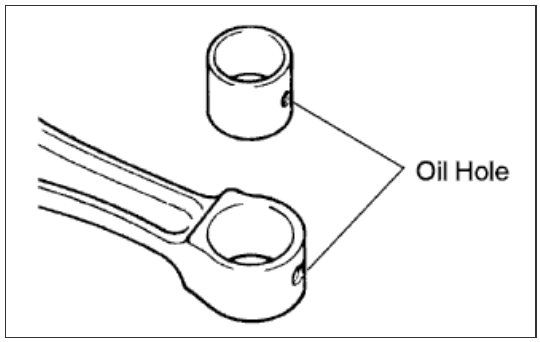
5. REPLACE CONNECTING ROD SMALL END BUSH

a. Using SST and a press, press out the bush.

SST
09222-30010

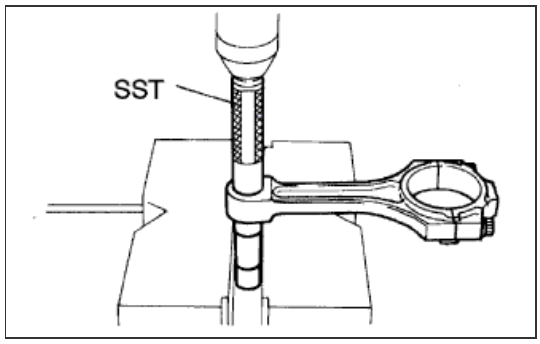


b. Align the oil holes of a new bush and the connecting rod.



c. Using SST and a press, press in the bush.

SST
09222-30010

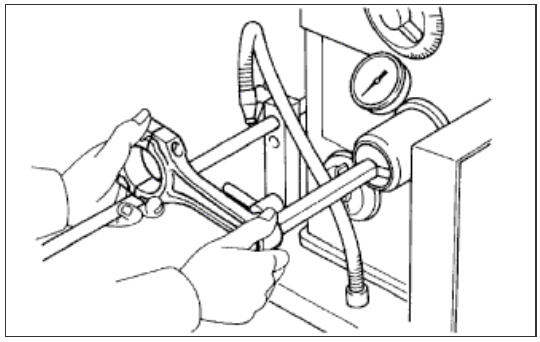


d. Using a pin hole grinder, hone the bush to obtain the standard oil clearance between the bush and piston pin.

Standard oil clearance:
0.005 to 0.011 mm 0.000197 to 0.000433 in.

HINT:

Check that the piston pin fits at a normal room temperature. Coat the piston pin with engine oil, and push it into the connecting rod with a thumb.

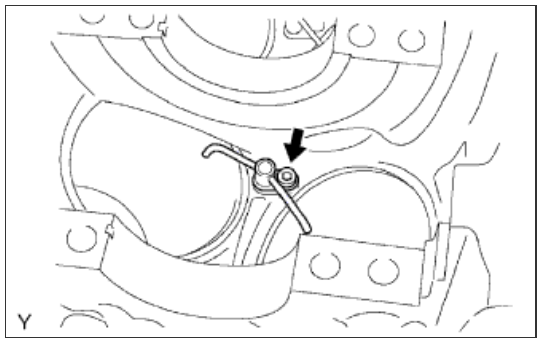


for Preparation Click here

1. INSTALL NO. 1 OIL NOZZLE SUB-ASSEMBLY

a. Using a 5 mm hexagon socket wrench, install the 3 oil nozzles with the 3 bolts.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }

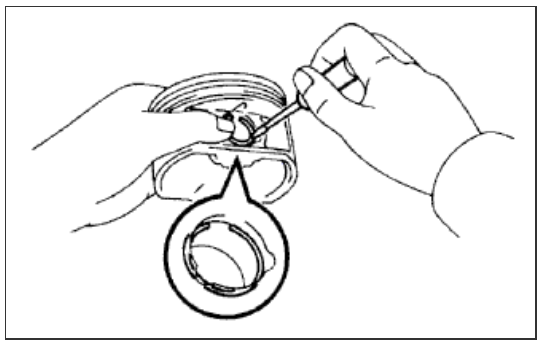


2. INSTALL PISTON PIN HOLE SNAP RING

a. Using a screwdriver, install a new snap ring on one side of the piston pin hole.

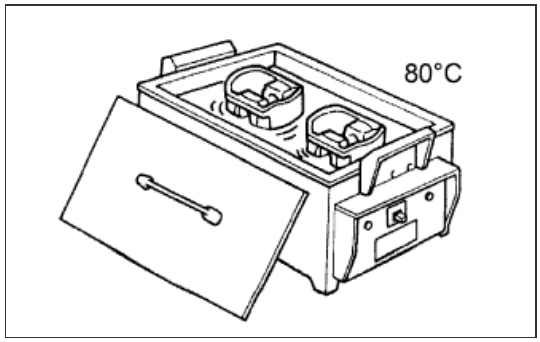
HINT:

Be sure that the end gap of the snap ring is not aligned with the pin hole cutout portion of the piston.



3. INSTALL WITH PIN PISTON SUB-ASSEMBLY

a. Gradually heat the piston to approximately 80°C (176°F).

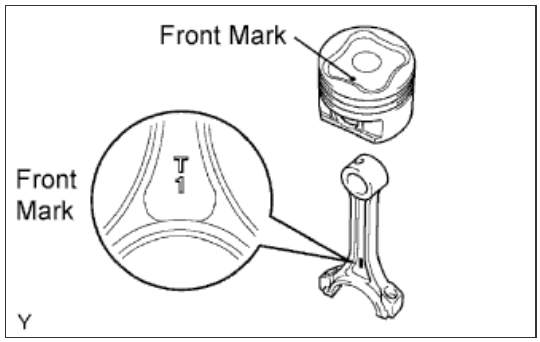


b. Coat the piston pin with engine oil.

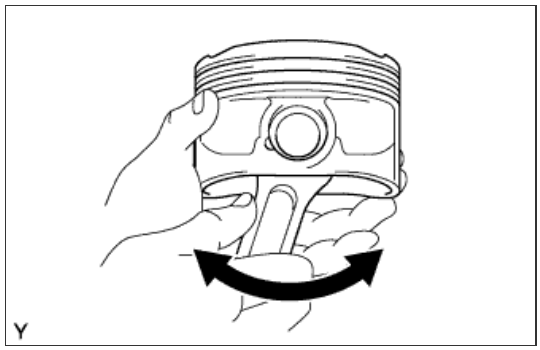
c. Align the front marks of the piston and connecting rod, and push in the piston pin with your thumb.

HINT:

The piston and pin are a matched set.



d. Check the fitting condition between the piston and piston pin by trying to move the piston back and forth on the piston pin.

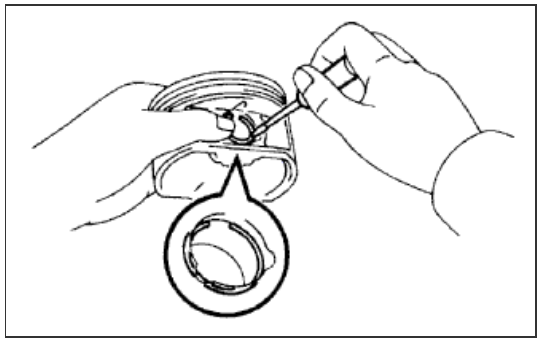


4. INSTALL PISTON PIN HOLE SNAP RING

a. Using a screwdriver, install a new snap ring at the other end of the piston pin hole.

HINT:

Be sure that the end gap of the snap ring is not aligned with the pin hole cutout portion of the piston.



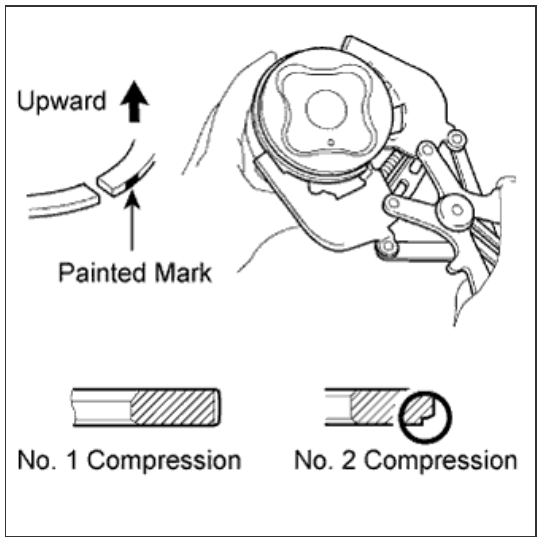
5. INSTALL PISTON RING SET

a. Install the oil ring (expander) and 2 side rails by hand.

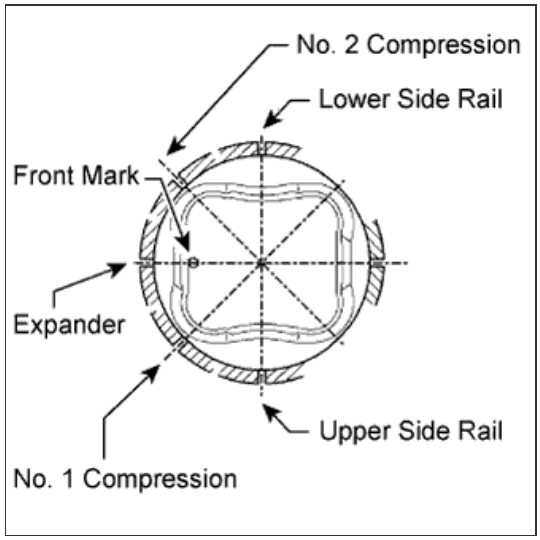
b. Using a piston ring expander, install the 2 compression rings.

NOTICE:

Install the No. 2 compression ring with the painted mark on the right side.



c. Position the piston rings so that the ring ends are as shown in the illustration.



6. INSTALL CONNECTING ROD BEARING

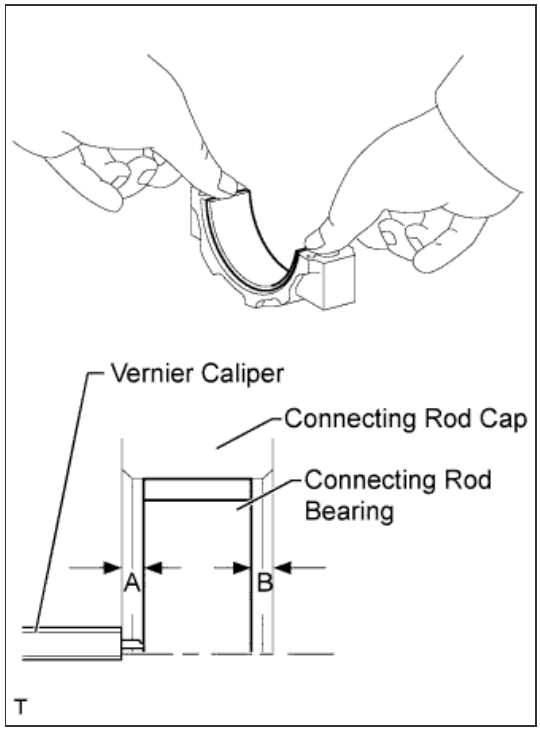
a. Install the bearing to the connecting rod cap.

b. Using a vernier caliper, measure the distance between the connecting rod cap edge and connecting rod bearing edge.

Dimension A - B or B - A:
0 to 0.7 mm (0 to 0.0276 in.)

NOTICE:

- **Clean the contact surface of the bearing and connecting rod cap.**
- **Do not apply engine oil to the bearing and its contact surface.**



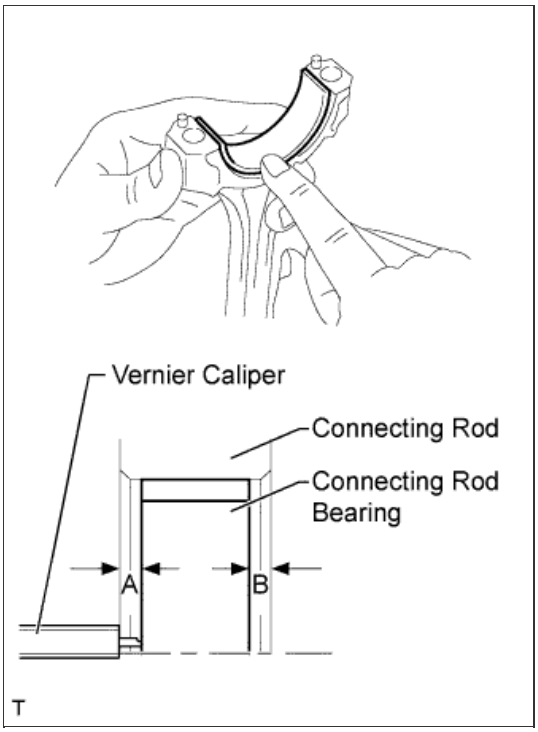
c. Install the bearing to the connecting rod.

d. Using a vernier caliper, measure the distance between the connecting rod edge and connecting rod bearing edge.

Dimension A - B or B - A:
0 to 0.7 mm (0 to 0.0276 in.)

NOTICE:

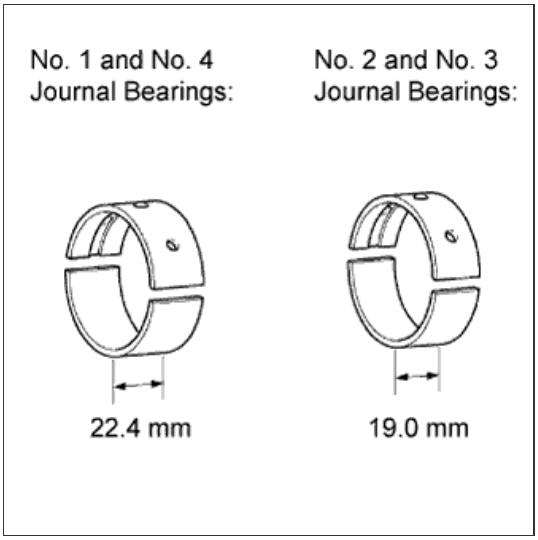
- **Clean the contact surface of the bearing and connecting rod.**
- **Do not apply engine oil to the bearing and its contact surface.**



7. INSTALL CRANKSHAFT BEARING

HINT:

Main bearings come in widths of 19.0 mm (0.748 in.) and 22.4 mm (0.882 in.). Install the 22.4 mm (0.882 in.) bearings in the No. 1 and No. 4 cylinder block journal positions with the bearing caps. Install the 19.0 mm (0.748 in.) bearings in the No. 2 and No. 3 positions.



a. Clean each main journal and bearing.

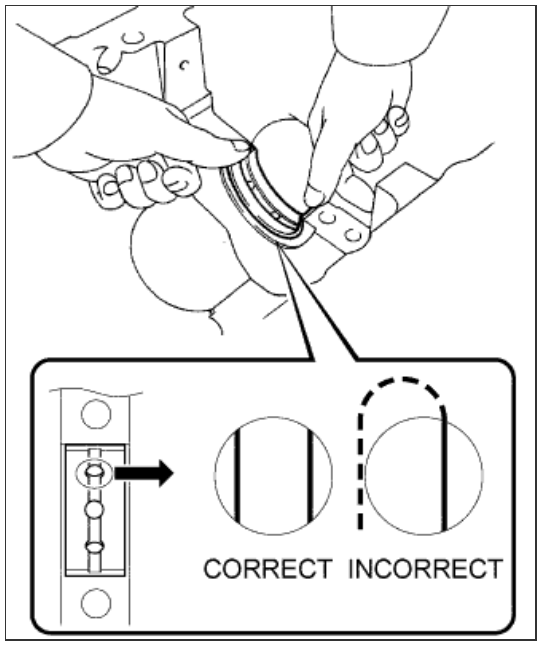
b. Install the upper bearing.

i. Install the upper bearing to the cylinder block as shown in the illustration.

NOTICE:

- **Do not apply engine oil to the bearings and the contact surface.**
- **Both sides of the oil groove in the cylinder block should be visible through the oil feed holes in the bearing. The amount visible on each side of the holes should be equal.**
- **Do not allow coolant to come into contact with the bearing inner surface.**
- **If any coolant comes into contact with the bearing**

inner surface, replace the bearing ith a ne one.



c. Install the lower bearing.

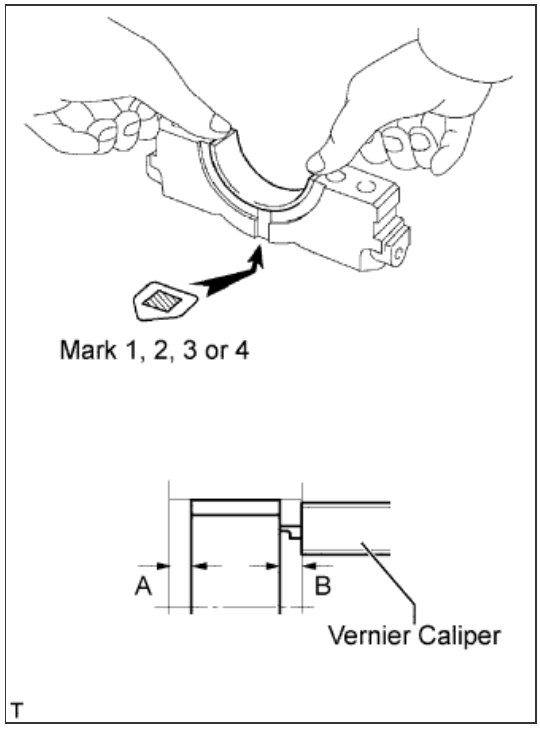
i. Install the lower bearings to the crankshaft bearing caps.

ii. Using a vernier caliper, measure the distance between the edge of the crankshaft bearing cap and the edge of the lower bearing.

Dimension A - B or B - A:
0 to 0.7 mm (0 to 0.0276 in.)

NOTICE:

- **Do not apply engine oil to the bearings and the contact surfaces.**
- **Do not allo coolant to come into contact ith the bearing inner surface.**
- **If any coolant comes into contact ith the bearing inner surface, replace the bearing ith a ne one.**



8. INSTALL CRANKSHAFT

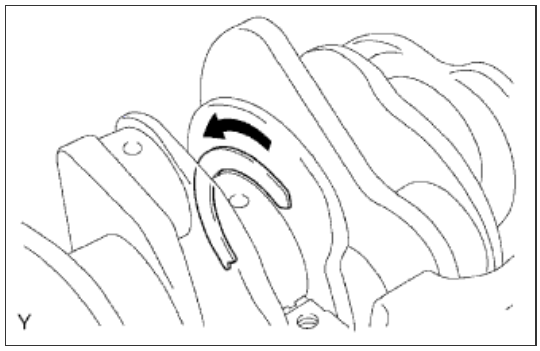
NOTICE:

Clean the contact surface of each main journal and crank pin.

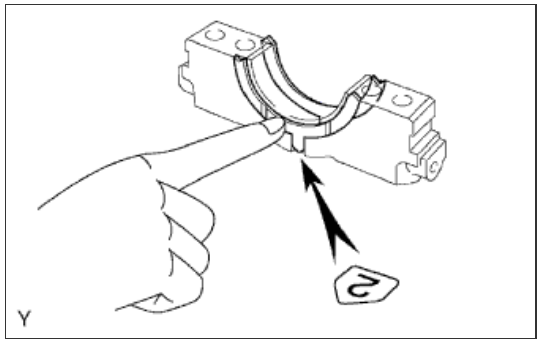
a. Apply new engine oil to the upper bearing and install the crankshaft to the cylinder block.

b. Push the crankshaft in the rear thrust direction to create clearance, and install a thrust washer to the No. 2 journal position with the oil groove facing the front of the engine.

c. Push the crankshaft in the forward thrust direction to create clearance, and install a thrust washer to the No. 2 journal position with the oil groove facing the rear of the engine.



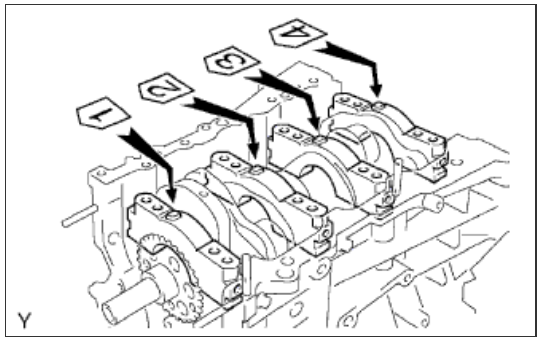
d. Install the 2 lower thrust washers on the No. 2 bearing cap with the grooves facing outward.



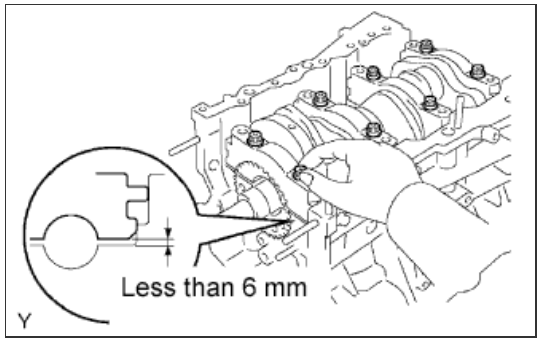
e. Examine the front marks and numbers and set the crankshaft bearing caps on the cylinder block.

f. Apply a light coat of engine oil to the threads of the crankshaft bearing cap bolts.

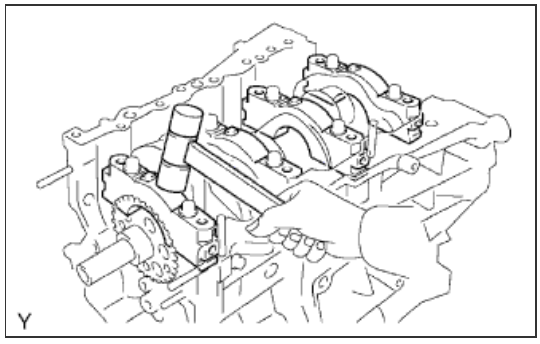
g. Temporarily install the 8 crankshaft bearing cap bolts to the inside positions.



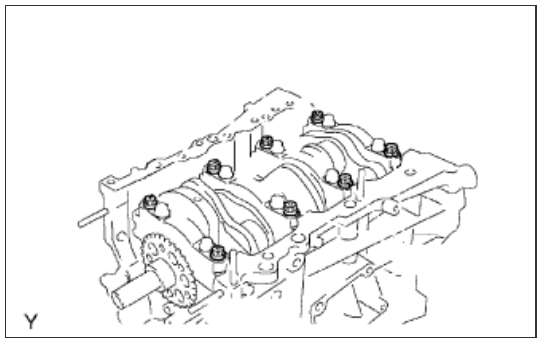
h. Tighten the 2 bolts for each bearing cap until the clearance between the crankshaft bearing cap and the cylinder block becomes less than 6 mm (0.236 in.).



i. Using a plastic-faced hammer, lightly tap the crankshaft bearing cap to ensure a proper fit.



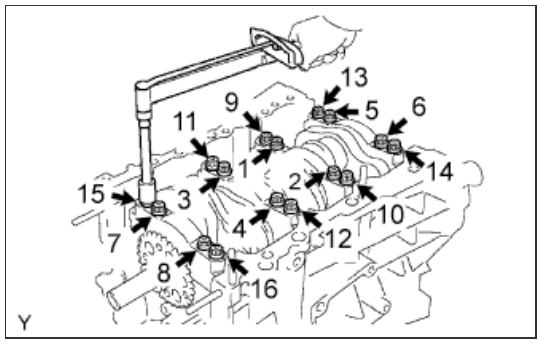
j. Apply a light coat of engine oil to the threads of the crankshaft bearing cap bolts and temporarily install the 8 crankshaft bearing bolts to the outside pistons.



k. Step 1:

i. Uniformly tighten the 16 bolts in the several steps in order shown in the illustration.

Torque:
61 N*m{ 622 kgf*cm , 45 ft.*lbf }



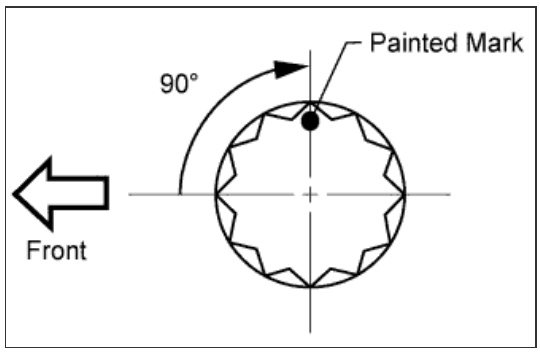
l. Step 2:

i. Mark the front side of the crankshaft bearing cap bolts with paint.

ii. Tighten the bearing cap bolts 90° in the order shown in step 1.

m. Check that the painted marks are now at a 90° angle to the front.

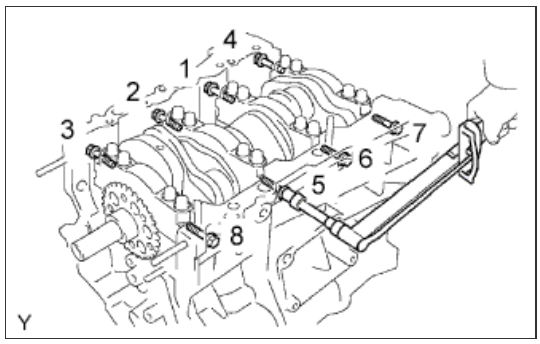
n. Check that the crankshaft turns smoothly.



o. Using several steps, install the 8 crankshaft bearing cap bolts uniformly in the sequence shown in the illustration.

Torque:
26 N*m{ 262 kgf*cm , 19 ft.*lbf }

p. Check that the crankshaft turns smoothly.



9. INSPECT CRANKSHAFT THRUST CLEARANCE

a. Using a dial indicator, measure the thrust clearance while prying the crankshaft

back and forth with a screwdriver.

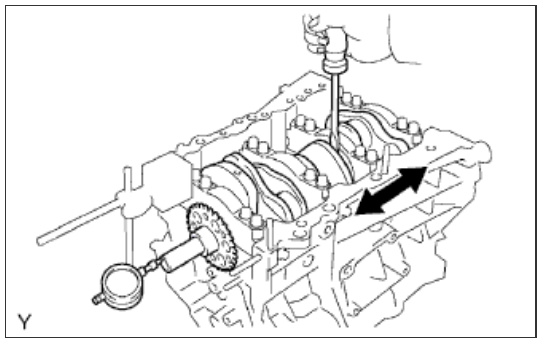
Standard thrust clearance:
0.04 to 0.24 mm (0.00157 to 0.00945 in.)

Maximum thrust clearance:
0.30 mm (0.0118 in.)

If the thrust clearance is more than the maximum, replace the thrust washers as a set.

Standard thrust washer thickness:
1.93 to 1.98 mm (0.0760 to 0.0780 in.)

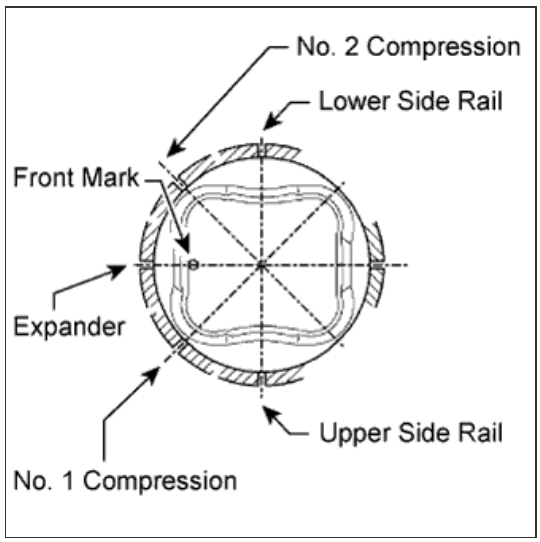
If necessary, replace the crankshaft.



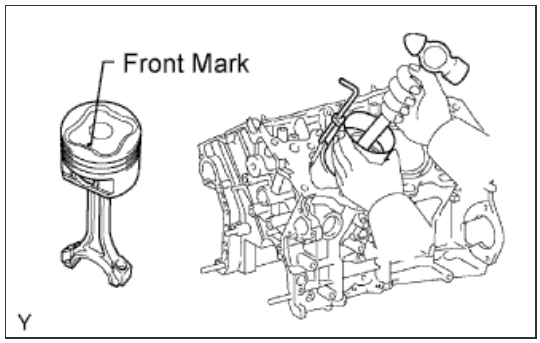
10. INSTALL PISTON SUB-ASSEMBLY WITH CONNECTING ROD

a. Apply engine oil to the cylinder walls, pistons, and surfaces of the connecting rod bearings.

b. Check the positions of the piston ring ends.



c. Using a hammer handle and piston ring compressor, press a piston and connecting rod assembly into each cylinder with the front mark of the piston facing forward.

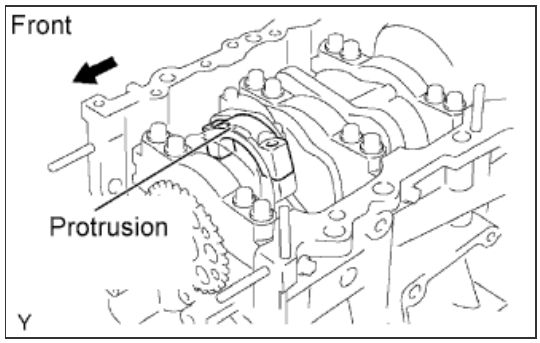


d. Set the connecting rod cap so that the protrusion is facing the correct direction.

NOTICE:

Match the numbered connecting rod cap with the connecting rod.

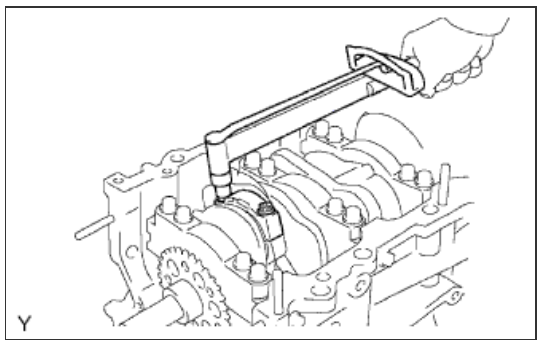
e. Apply a light coat of engine oil to the threads of the connecting rod cap bolts.



f. Step 1:

i. Install and alternately tighten the bolts of the connecting rod cap in several steps.

Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }



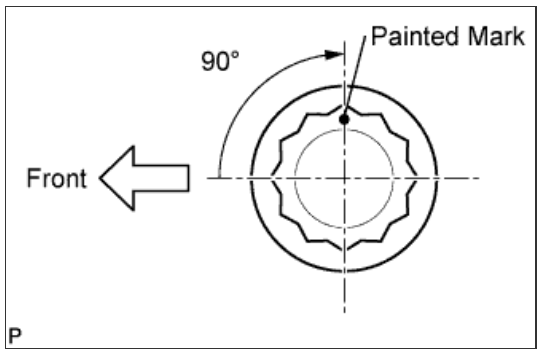
g. Step 2:

i. Mark the front side of each connecting rod cap bolt with paint.

ii. Tighten the cap bolts in step 1 90°.

h. Check that the painted marks are now at a 90° angle to the front.

i. Check that the crankshaft turns smoothly.



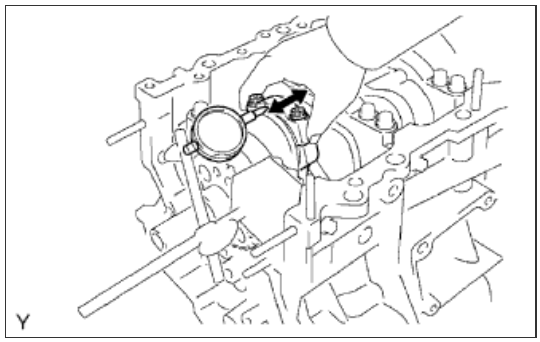
11. INSPECT CONNECTING ROD THRUST CLEARANCE

a. Using a dial indicator, measure the thrust clearance while moving the connecting rod back and forth.

Standard thrust clearance:
0.15 to 0.30 mm (0.00591 to 0.0118 in.)

Maximum thrust clearance:
0.35 mm (0.0138 in.)

If the thrust clearance is more than the maximum, replace one or more connecting rods as necessary.
If necessary, replace the crankshaft.



for Preparation Click here

1. INSPECT IGNITION TIMING

a. Warm up and stop the engine.

i. Allow the engine to warm up to a normal operating temperature.

b. When using the intelligent tester:

i. Connect the intelligent tester to the DLC3.

ii. Start the engine and idle it.

iii. Turn the intelligent tester on.

iv. Enter the following menus: Powertrain / Engine and ECT / Data List / Primary / IGN Advance.

HINT:

Refer to the intelligent tester operator's manual for further details.

Standard ignition timing:
8 to 12° BTDC @ idling (transmission in neutral and A/C switch off)

v. Disconnect the intelligent tester from the DLC3.

c. When not using the intelligent tester:

i. Connect the tester probe of a timing light to the wire of the ignition coil connector for the No. 1 cylinder.

NOTICE:

Use a timing light that detects primary signals.

ii. Using SST, connect terminals 13 (TC) and 4 (CG) of the DLC3.

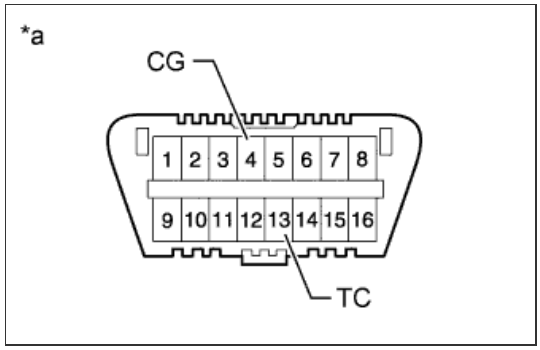
SST
09843-18040

Text in Illustration

*a	Front view of DLC3

NOTICE:

- **Confirm the terminal numbers before connecting them. Connecting the wrong terminals can damage the engine.**
- **Switch off all accessories and the A/C before connecting the terminals.**



iii. Using the timing light, check the ignition timing.

Standard ignition timing:
8 to 12° BTDC @ idling (transmission in neutral and A/C switch off)

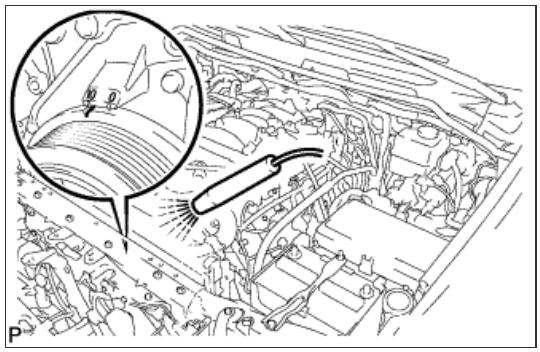
iv. Remove SST from the DLC3.

v. Check the ignition timing.

Standard ignition timing:
7 to 24° BTDC @ idling (transmission in neutral and A/C switch

off)

vi. Disconnect the timing light from the engine.



2. INSPECT ENGINE IDLE SPEED

a. Warm up and stop the engine.

i. Allow the engine to warm up to a normal operating temperature.

b. When using the intelligent tester:

i. Connect the intelligent tester to the DLC3.

NOTICE:

Switch off all accessories and the A/C before connecting the intelligent tester.

ii. Race the engine at 2500 rpm for approximately 90 seconds.

iii. Turn the intelligent tester on.

iv. Enter the following menus: Powertrain / Engine and ECT / Data List / Primary / Engine Speed.

Standard idle speed:
650 to 750 rpm (transmission in neutral and A/C switch off)

HINT:

Refer to the intelligent tester operator's manual for further details.

If the idle speed is not as specified, check the air intake system.

v. Disconnect the intelligent tester from the DLC3.

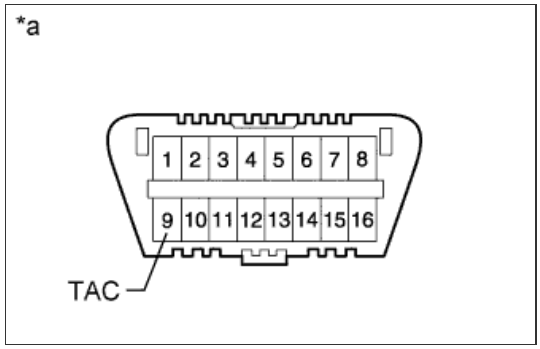
c. When not using the intelligent tester:

i. Using SST, connect the tachometer probe to terminal 9 (TAC) of the DLC3.

SST
09843-18030

Text in Illustration

*a	Front view of DLC3



NOTICE:

- **Confirm the terminal number before connecting the probe. Connecting the probe to the wrong terminal can damage the engine.**
- **Switch off all accessories and the A/C before connecting the probe.**

ii. Race the engine at 2500 rpm for approximately 90 seconds.

iii. Check the idle speed.

Standard idle speed:
650 to 750 rpm (transmission in neutral and A/C switch off)

If the idle speed is not as specified, check the air intake system.

iv. Disconnect the tachometer probe from the DLC3.

3. INSPECT COMPRESSION

a. Warm up and stop the engine.

i. Allow the engine to warm up to a normal operating temperature.

b. Remove the V-bank cover.

c. Remove the air cleaner hose assembly (Click here).

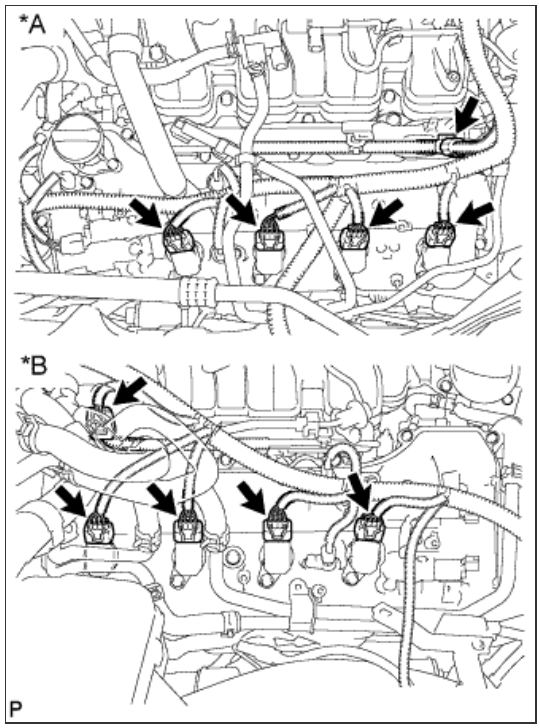
d. Remove the air cleaner assembly (Click here).

e. Disconnect the water by-pass pipe assembly (Click here).

f. Disconnect the 2 injector connectors and 8 ignition coil connectors.

Text in Illustration

*A	for Bank 1
*B	for Bank 2



g. Remove the 8 bolts and 8 ignition coils (Click here).

h. Remove the 8 spark plugs (Click here).

i. Check the cylinder compression pressure.

NOTICE:

Check the compression pressure of each cylinder in the same way.

i. Insert a compression gauge into the spark plug hole.

ii. Fully open the throttle.

iii. While cranking the engine, measure the compression pressure.

Standard compression pressure:
1300 kPa (13.3 kgf/cm^2, 189 psi) or higher

Minimum pressure:
1000 kPa (10.2 kgf/cm^2, 145 psi)

Difference between each cylinder:
100 kPa (1.0 kgf/cm^2, 15 psi) or less

NOTICE:

- **Always use a fully charged battery to obtain an engine speed of 250 rpm or more.**
- **This measurement must be done as quickly as possible.**

iv. If the cylinder compression is low in one or more cylinders, pour a small amount of engine oil into the cylinder with low compression through its spark plug hole. Then inspect the cylinder compression pressure again.

HINT:

- **If adding oil helps boost the compression, it is likely that the piston rings and/or cylinder bore are worn or damaged.**
- **If pressure stays low, a valve may be stuck or seated improperly, or there may be leakage in the gasket.**

j. Install the 8 spark plugs (Click here).

k. Install the 8 ignition coils with the 8 bolts (Click here).

l. Connect the 2 injector connectors and 8 ignition coil connectors.

m. Connect the water by-pass pipe assembly (Click here).

n. Install the air cleaner assembly (Click here).

o. Install the air cleaner hose assembly (Click here).

p. Install the V-bank cover.

4. INSPECT CO/HC

HINT:

This check is used only to determine whether or not the idle CO/HC complies with regulations.

a. Start the engine.

b. Keep the engine speed at 2500 rpm for approximately 180 seconds.

c. Insert the CO/HC meter testing probe at least 40 cm (1.31 ft.) into the tailpipe during idling.

d. Immediately check CO/HC concentration at idle and/or 2500 rpm.

HINT:

When performing the 2 mode (2500 rpm and idle) test, follow the measurement order prescribed by the applicable local regulations.

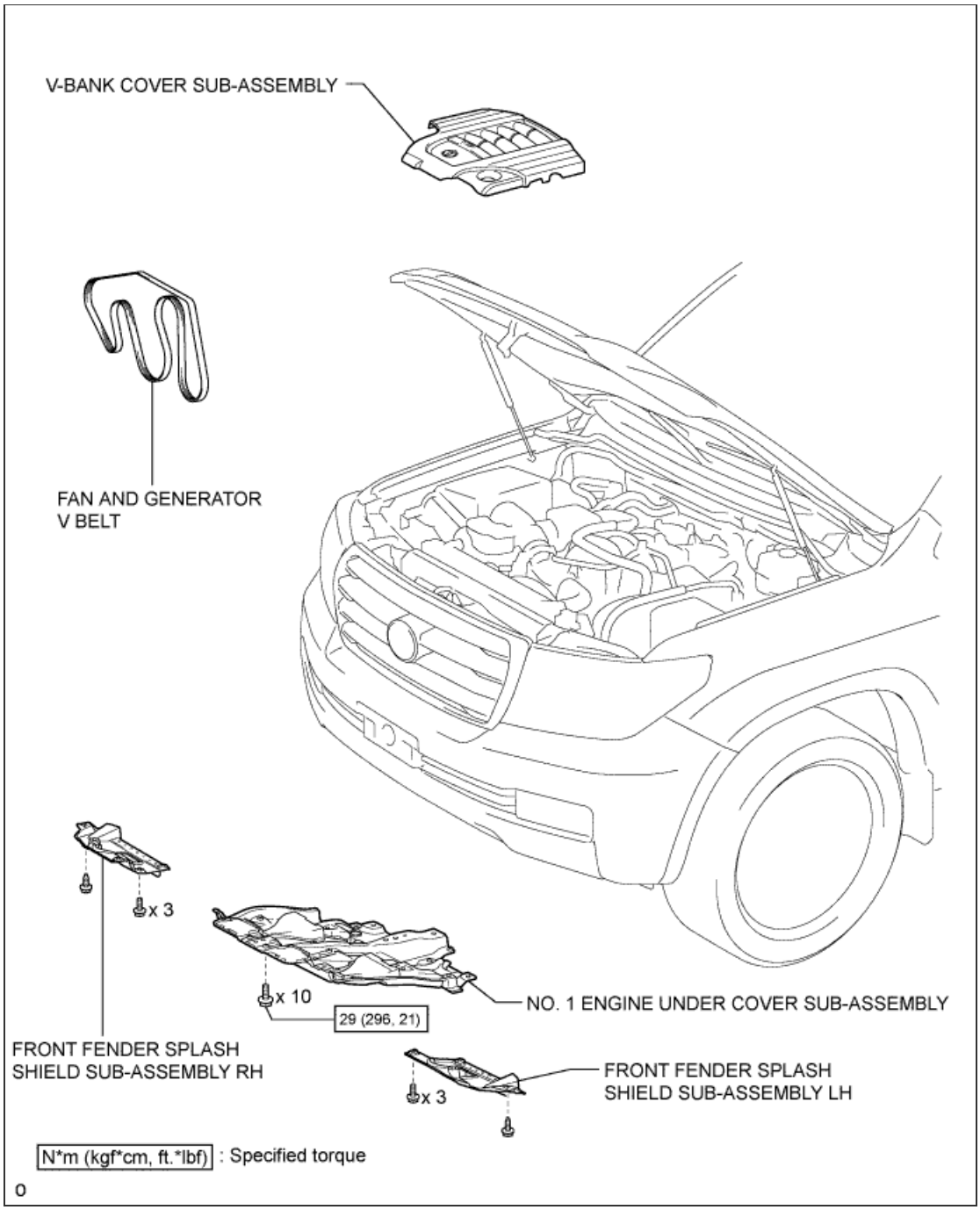
e. If the CO/HC concentration does not comply with the regulations, troubleshoot in the order given below.

i. Check the A/F sensor (Click here) and heated oxygen sensor (Click here) operation.

ii. See the table below for possible causes, and then inspect and correct the applicable causes if necessary.

CO	HC	Symptom	Cause
Normal	High	Rough idle	1. Faulty ignitions: • Incorrect timing • Plugs (contaminated, shorted or gaps are defective) 2. Incorrect valve clearance 3. Leaky intake and exhaust valves 4. Leaky cylinder
Low	High	Rough idle (Fluctuating HC reading)	1. Vacuum leaks: • PCV hose • Intake manifold • Throttle body 2. Lean mixture causing misfire
High	High	Rough idle (Black smoke from exhaust)	1. Restricted air filter 2. Faulty SFI system: • Faulty pressure regulator • Defective engine coolant temperature sensor • Faulty ECM • Faulty injectors • Faulty throttle position sensor • Faulty mass air flow meter

for Preparation Click here

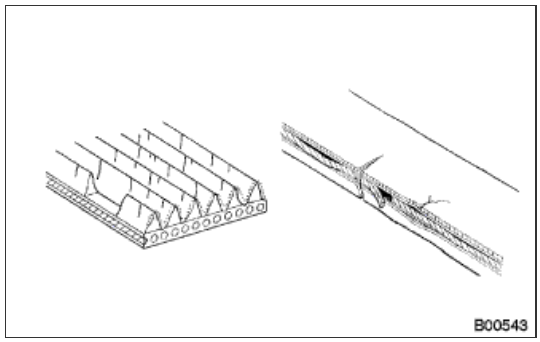


for Preparation Click here

1. INSPECT FAN & GENERATOR V BELT

a. Check the belt for wear, cracks or other signs of damage.
If any of the following defects is found, replace the fan and generator belt.

- The belt is cracked.
- The belt is worn out to the extent that the cords are exposed.
- The belt has chunks missing from the ribs.



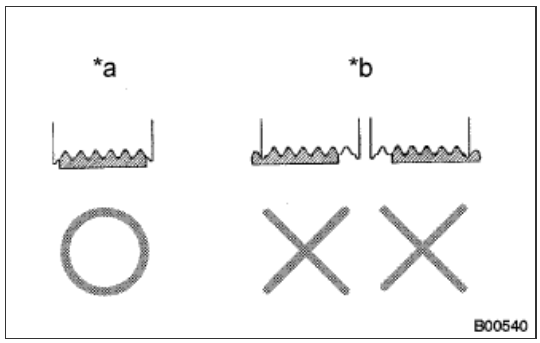
b. Check that the belt fits properly in the ribbed grooves.

Text in Illustration

a	CORRECT
b	INCORRECT

HINT:

Check with your hand to confirm that the belt has not slipped out of the grooves on the bottom of the pulley. If it has slipped out, replace the fan and generator belt. Install a new fan and generator belt correctly.



2. INSPECT V-RIBBED BELT TENSIONER ASSEMBLY

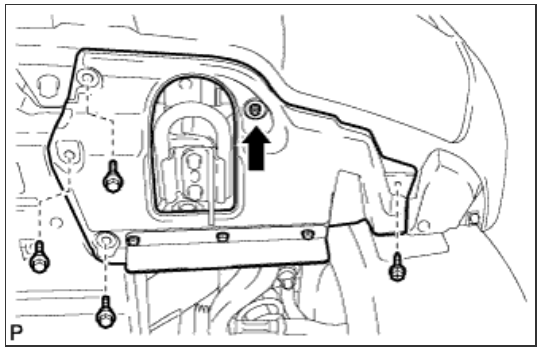
a. Check that nothing gets caught in the tensioner by turning it clockwise and counterclockwise. If a malfunction exists, replace the tensioner.

for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



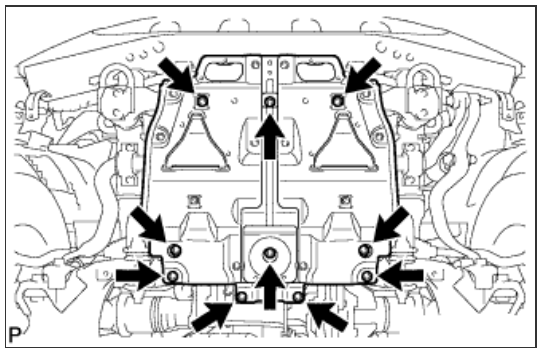
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and No. 1 engine under cover.

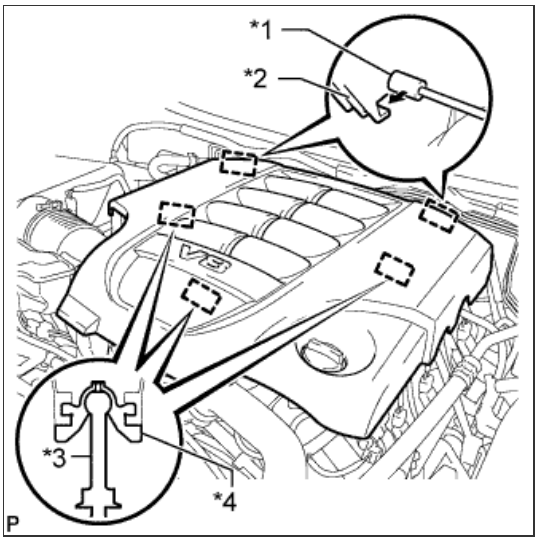


4. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Raise the front of the V-bank cover to detach the 3 pins. Then remove the 2 V-bank cover hooks from the bracket, and remove the V-bank cover.

Text in Illustration

1	Bracket
2	Hook
3	Pin
	rommet



. REMOVE FAN GENERATOR V BELT

a. While turning the belt tensioner counterclockwise, align the service hole for the belt tensioner and the belt tensioner fixing position, and then insert a bar of 5 mm (0.197 in.) into the service hole to fix the belt tensioner in place.

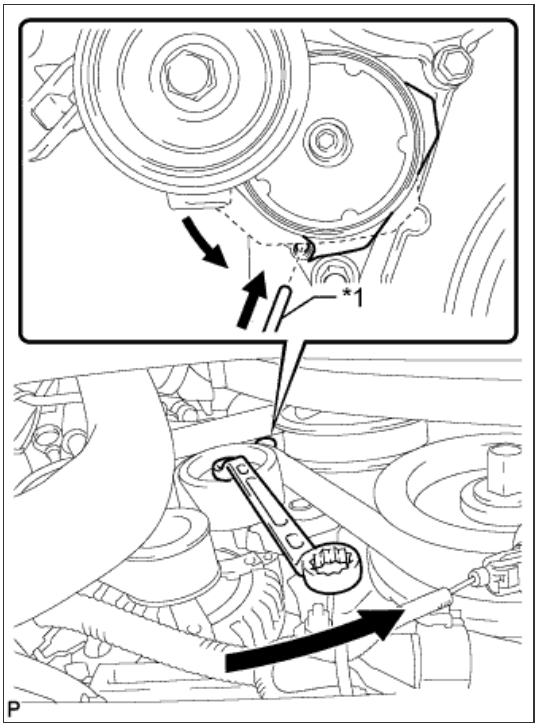
Text in Illustration

1	Bar

HINT:

The pulley bolt for the belt tensioner has a left-hand thread.

b. Remove the V belt.

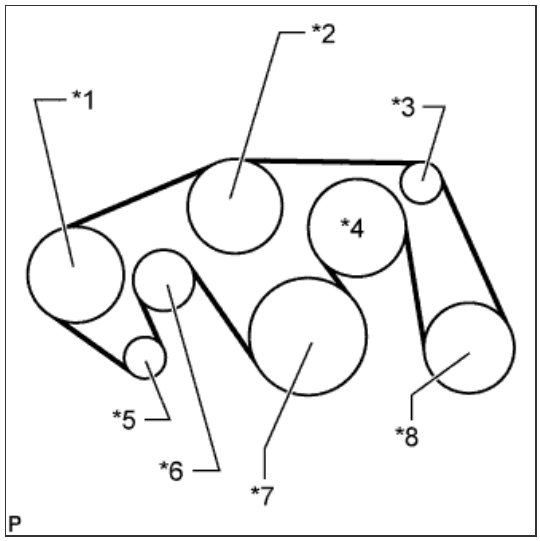


for Preparation Click here

1. INSTALL FAN & GENERATOR V BELT

a. Set the V belt onto every part.

b. While turning the belt tensioner counterclockwise, remove the bar.



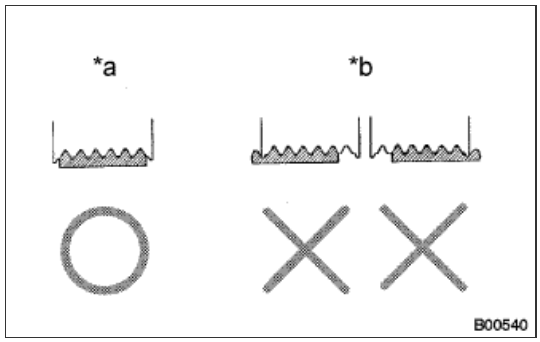
Text in Illustration

*1	Vane Pump
*2	Water Pump
*3	No. 1 Idler
*4	Fan
*5	Generator
*6	Belt Tensioner
*7	Crankshaft
*8	Cooler Compressor

NOTICE:

Make sure that the V belt is properly set to each pulley.

c. After installing the belt, check that it fits properly in the ribbed grooves.



Text in Illustration

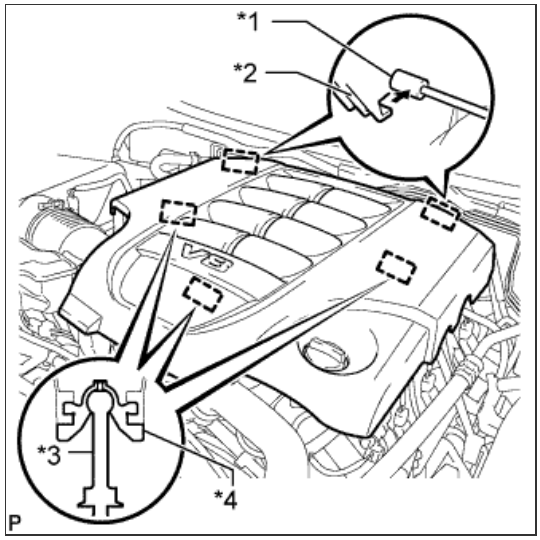
*a	CORRECT
*b	INCORRECT

HINT:

Make sure to check by hand that the belt has not slipped out of the grooves on the bottom of the pulley.

2. INSTALL V-BANK COVER SUB-ASSE BL

a. Attach the 2 V-bank cover hooks to the bracket. Then align the 3 V-bank cover grommets with the 3 pins, and press down on the V-bank cover to attach the pins.



Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet

.NSTALL NO. 1 ENGINE UNDER COVER SUB-ASSE BL

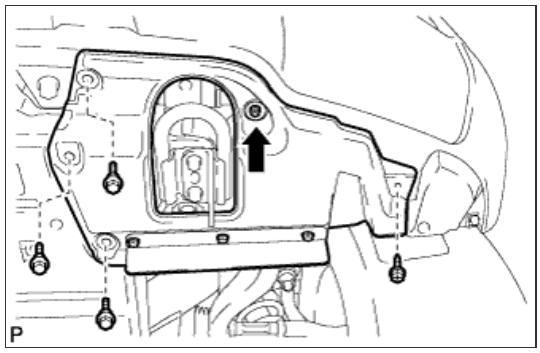
a. Install the No. 1 engine under cover with the 10 bolts.

Tor e:
2 N 2 k c 21 ft. lbf

.NSTALL FRONT FENDER SPLASH SHIELD SUB-ASSE BL HL

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.

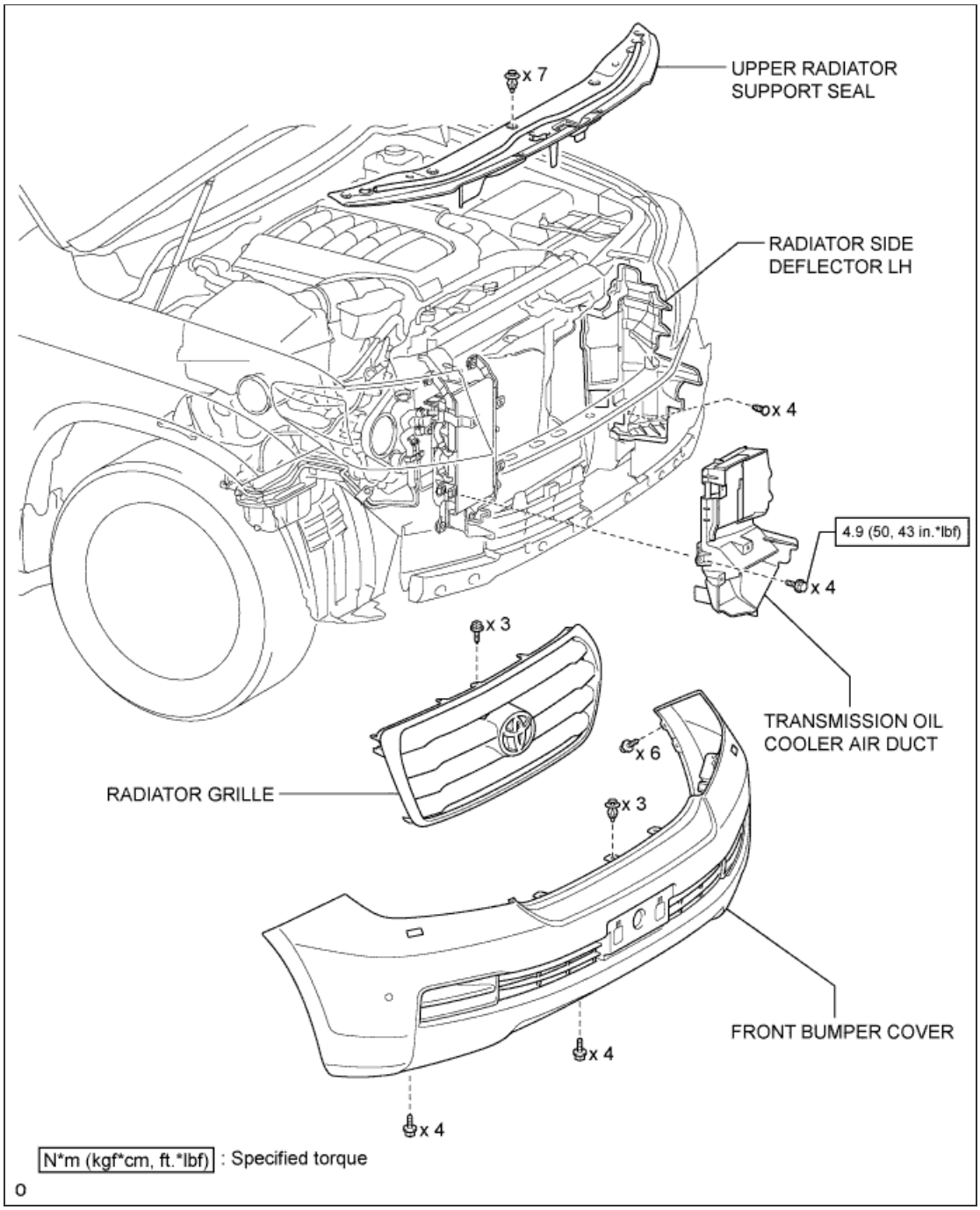


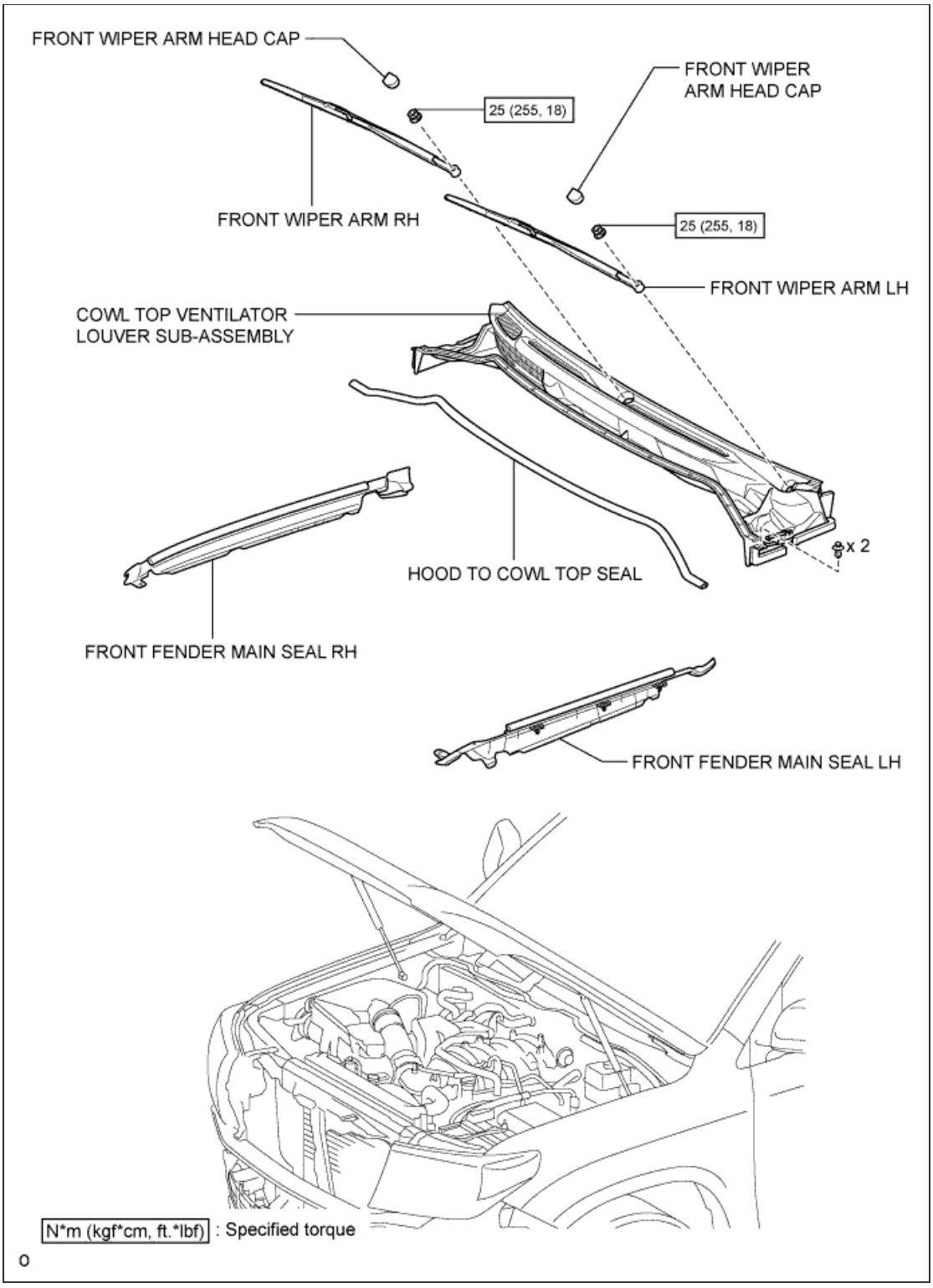
5. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSE BL HR

HINT:

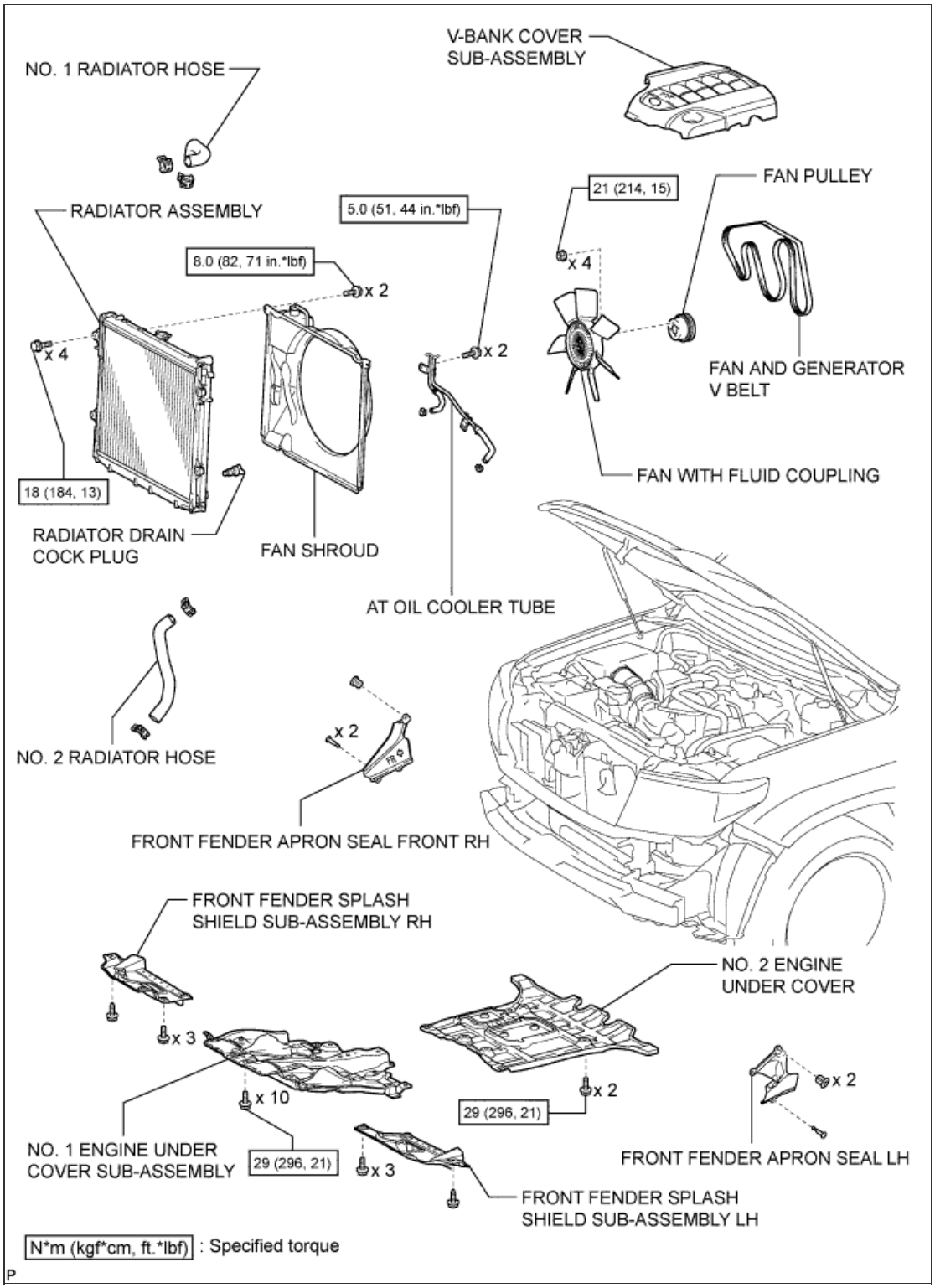
Use the same procedures described for the LH side.

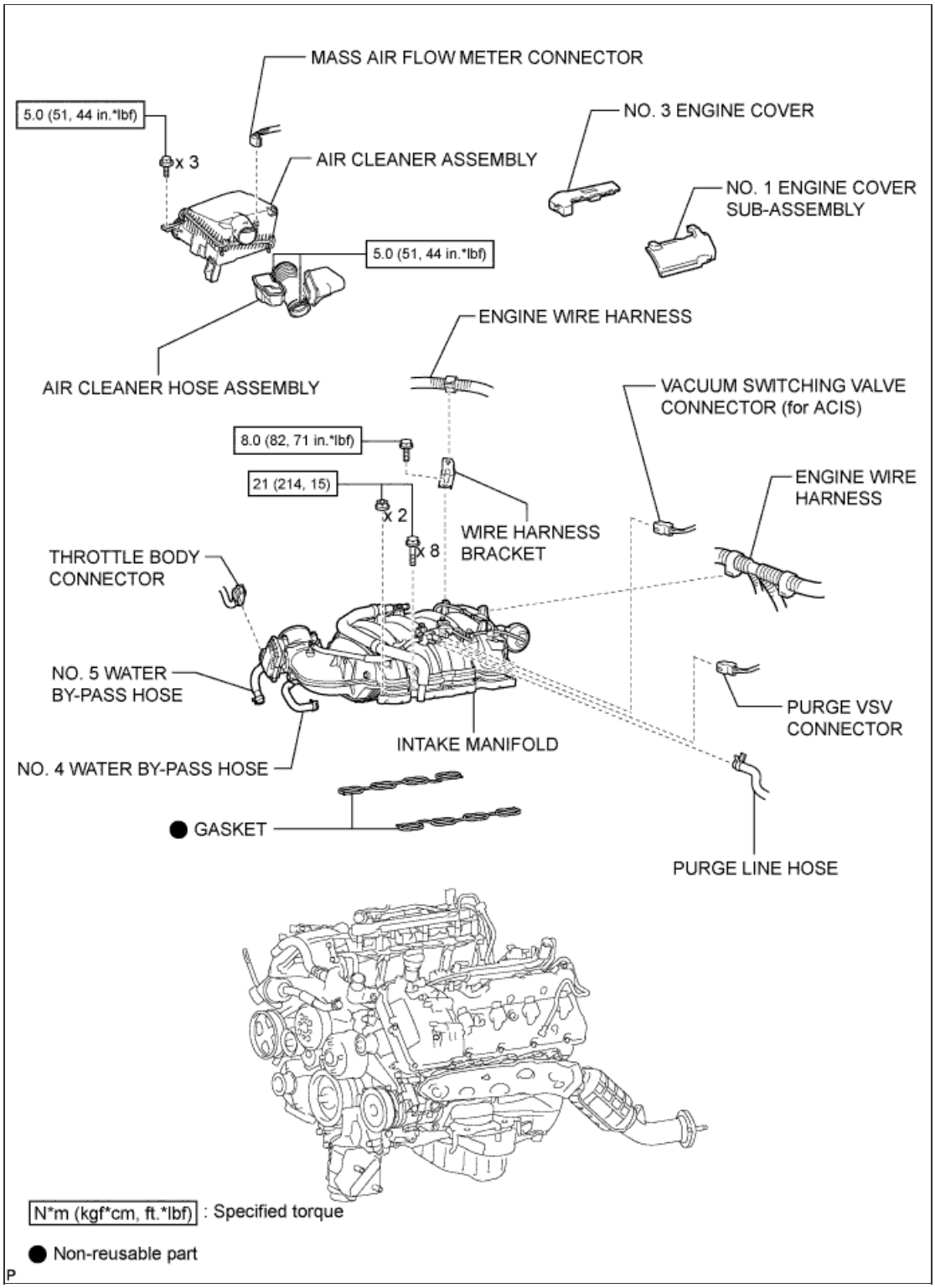
for Preparation Click here

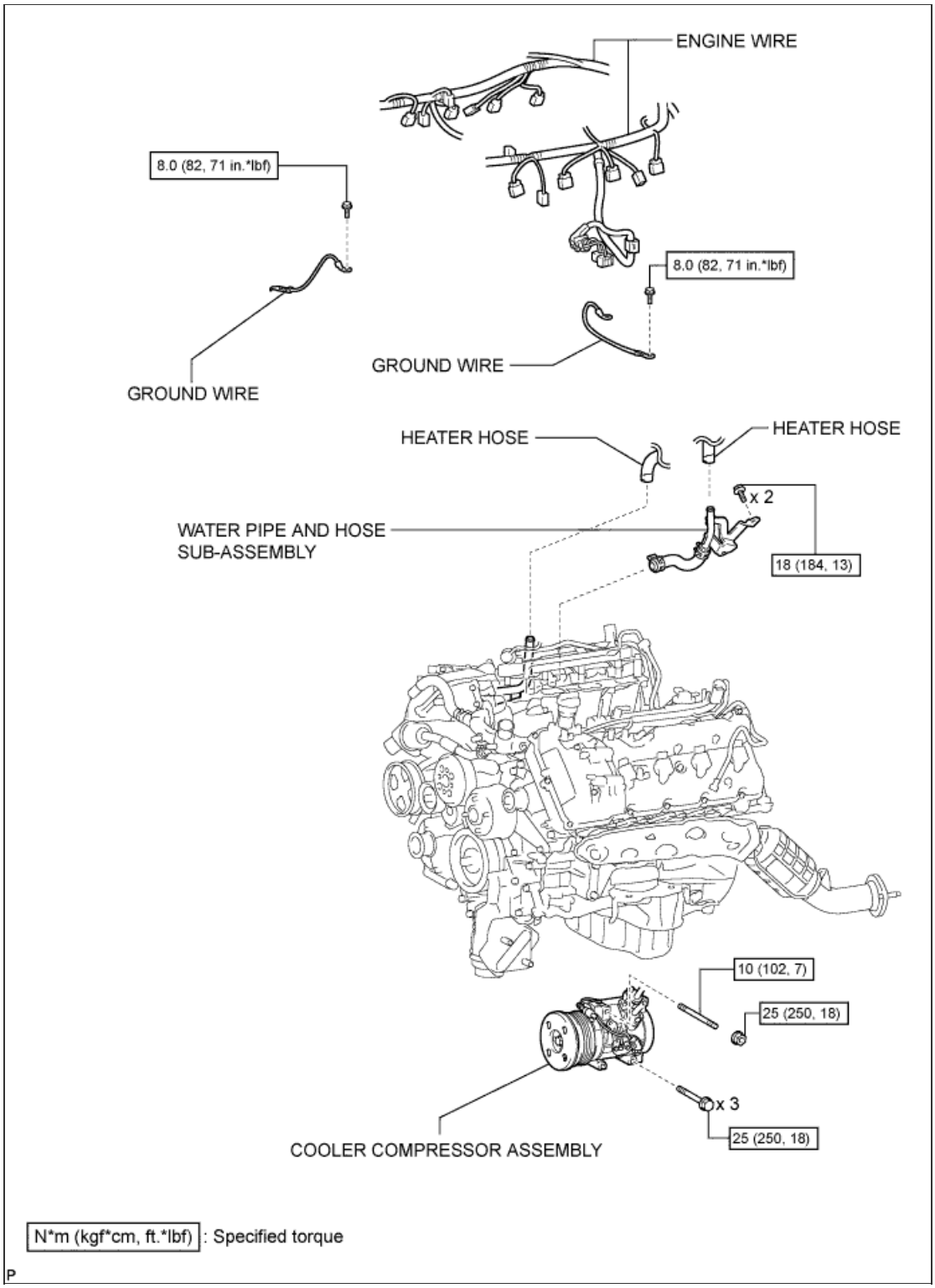



FRONT WIPER ARM HEAD CAP
FRONT WIPER ARM HEAD CAP
25 (255, 18)
FRONT WIPER ARM RH
25 (255, 18)
FRONT WIPER ARM LH
COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY
x 2
HOOD TO COWL TOP SEAL
FRONT FENDER MAIN SEAL RH
FRONT FENDER MAIN SEAL LH
N*m (kgf*cm, ft.*lbf) : Specified torque

o

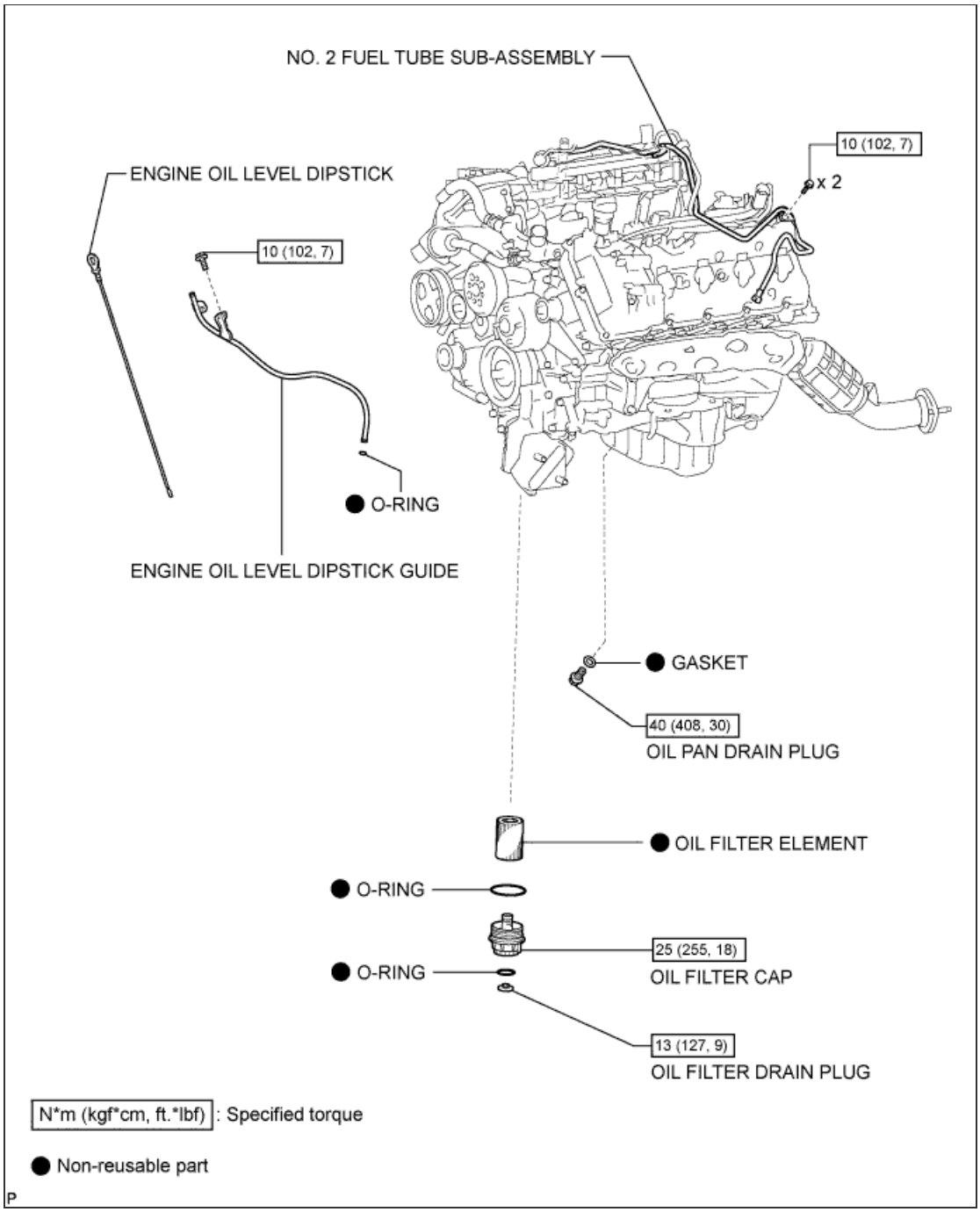

NO. 1 RADIATOR HOSE
V-BANK COVER SUB-ASSEMBLY
RADIATOR ASSEMBLY
5.0 (51, 44 in.*lbf)
21 (214, 15)
FAN PULLEY
8.0 (82, 71 in.*lbf)
x 2
x 4
x 4
x 2
FAN AND GENERATOR V BELT
18 (184, 13)
FAN WITH FLUID COUPLING
RADIATOR DRAIN COCK PLUG
FAN SHROUD
AT OIL COOLER TUBE
NO. 2 RADIATOR HOSE
x 2
FRONT FENDER APRON SEAL FRONT RH
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH
NO. 2 ENGINE UNDER COVER
x 3
x 10
x 2
29 (296, 21)
x 2
NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY
29 (296, 21)
x 3
FRONT FENDER APRON SEAL LH
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH
N*m (kgf*cm, ft.*lbf) : Specified torque
P

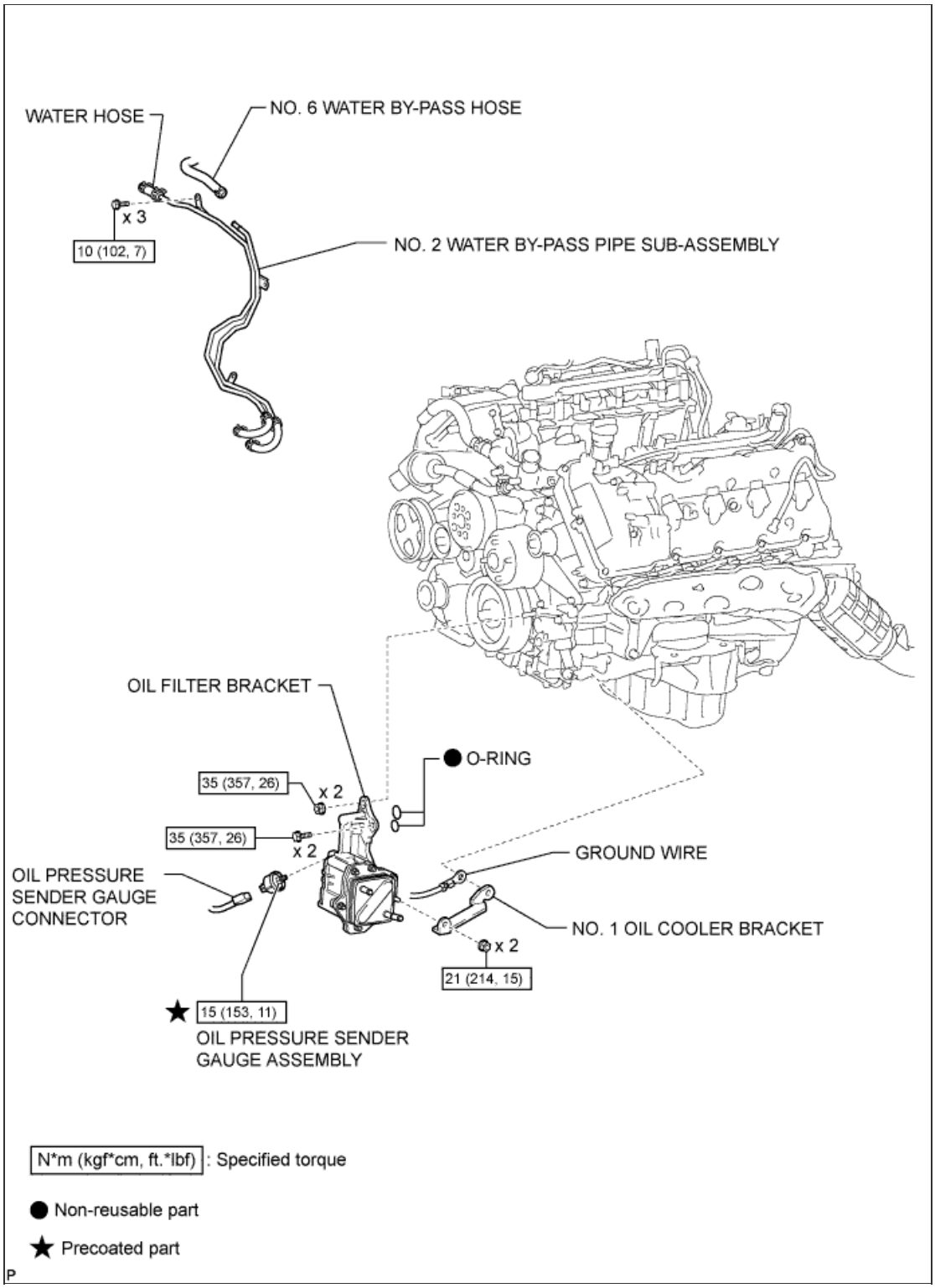

MASS AIR FLOW METER CONNECTOR
5.0 (51, 44 in.*lbf)
x 3
AIR CLEANER ASSEMBLY
NO. 3 ENGINE COVER
NO. 1 ENGINE COVER SUB-ASSEMBLY
5.0 (51, 44 in.*lbf)
ENGINE WIRE HARNESS
AIR CLEANER HOSE ASSEMBLY
VACUUM SWITCHING VALVE CONNECTOR (for ACIS)
8.0 (82, 71 in.*lbf)
21 (214, 15)
x 2
x 8
WIRE HARNESS BRACKET
ENGINE WIRE HARNESS
THROTTLE BODY CONNECTOR
NO. 5 WATER BY-PASS HOSE
PURGE VSV CONNECTOR
INTAKE MANIFOLD
NO. 4 WATER BY-PASS HOSE
● GASKET
PURGE LINE HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
P

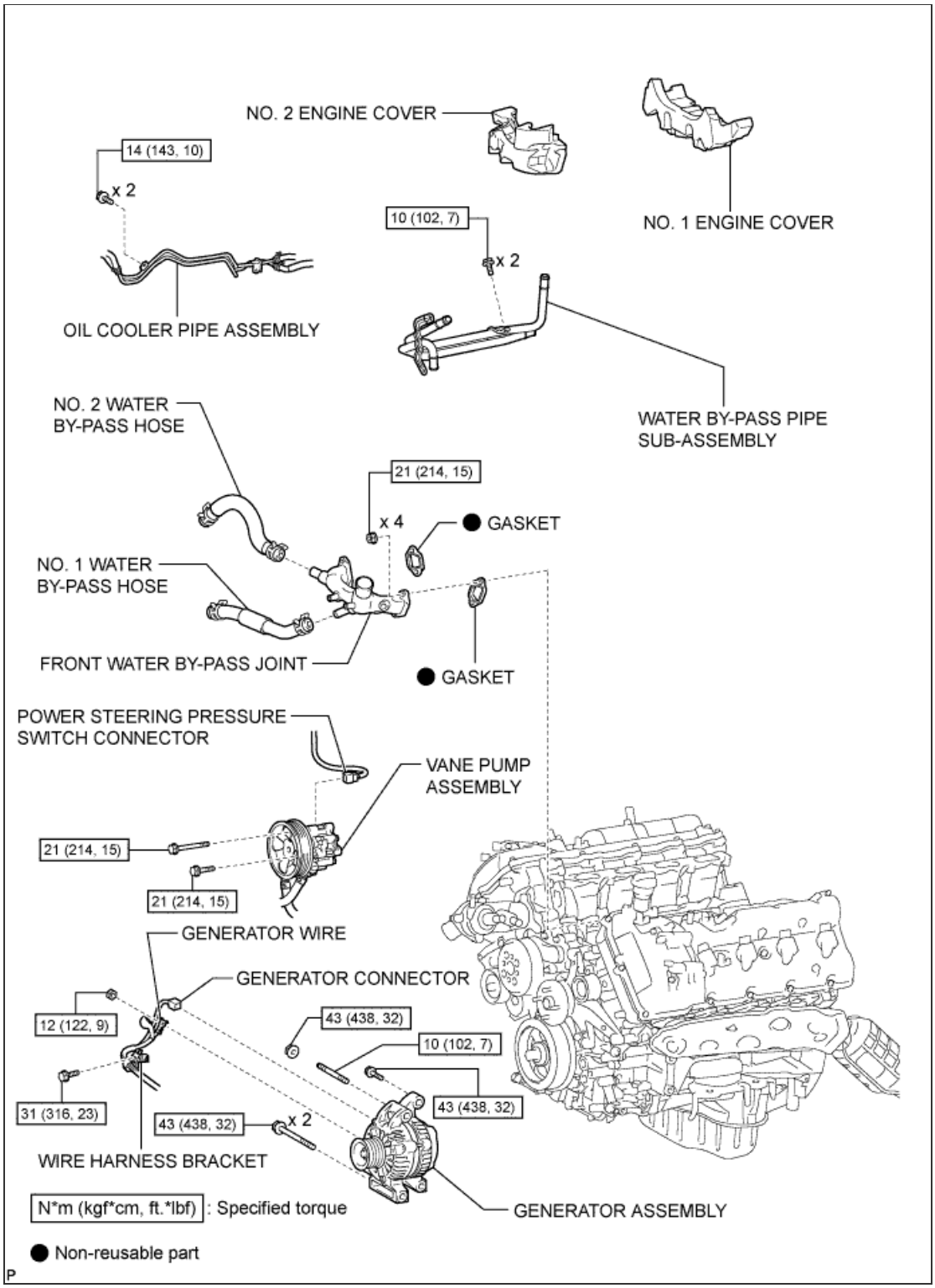


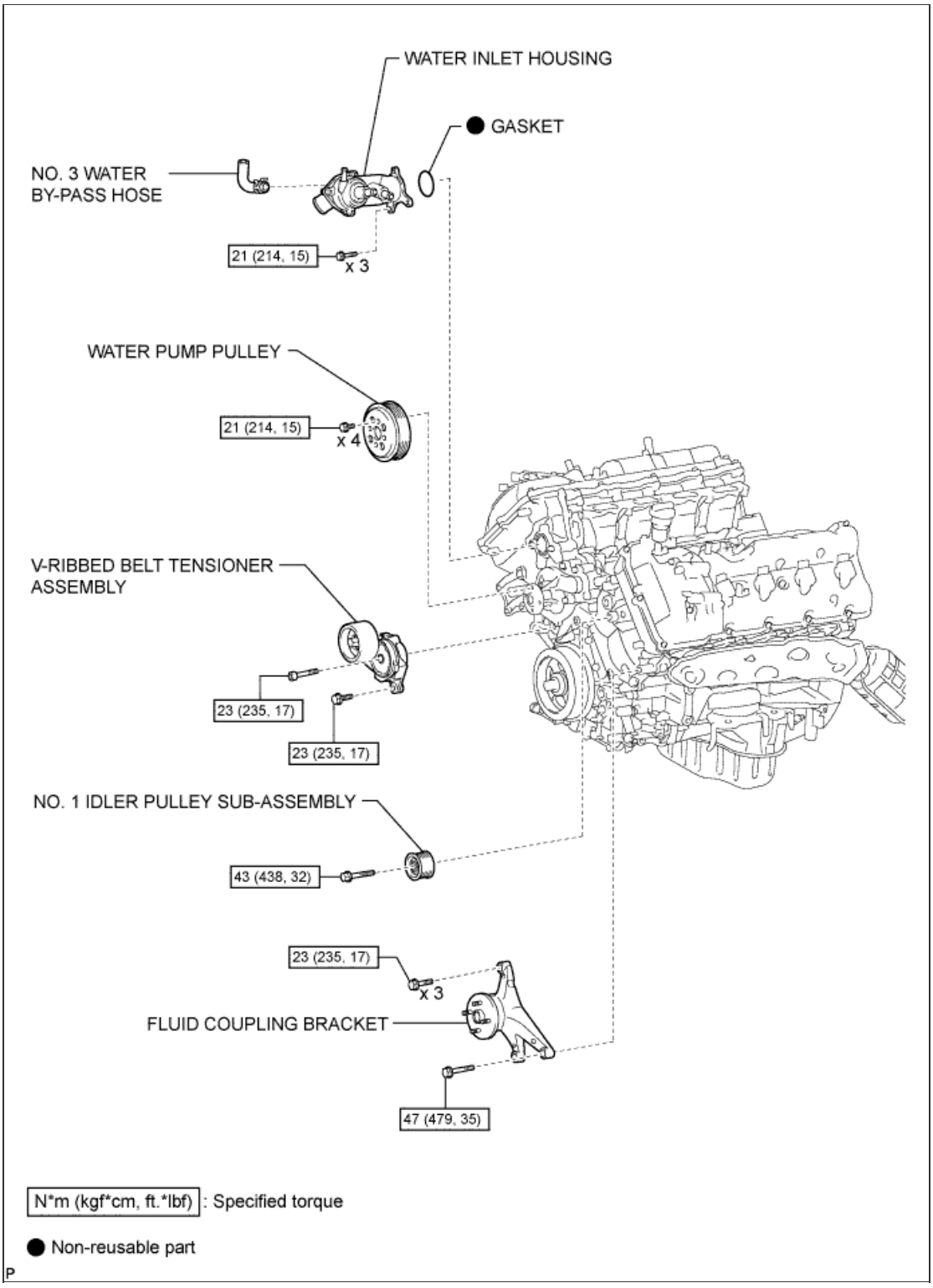
N*m (kgf*cm, ft.*lbf) : Specified torque

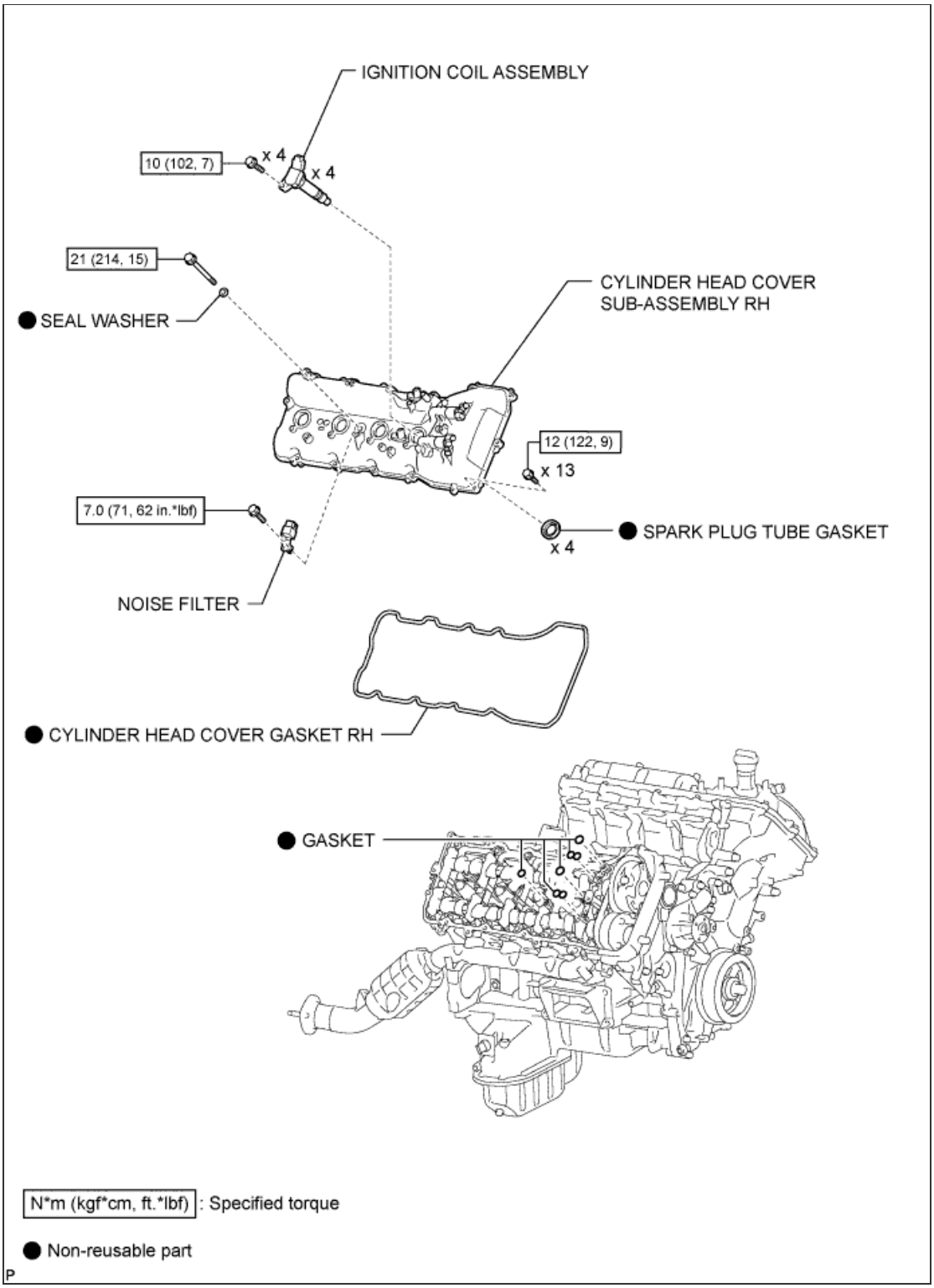
P


NO. 2 FUEL TUBE SUB-ASSEMBLY
10 (102, 7)
x 2
ENGINE OIL LEVEL DIPSTICK
10 (102, 7)
O-RING
ENGINE OIL LEVEL DIPSTICK GUIDE
GASKET
40 (408, 30)
OIL PAN DRAIN PLUG
OIL FILTER ELEMENT
O-RING
25 (255, 18)
O-RING
OIL FILTER CAP
13 (127, 9)
OIL FILTER DRAIN PLUG
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

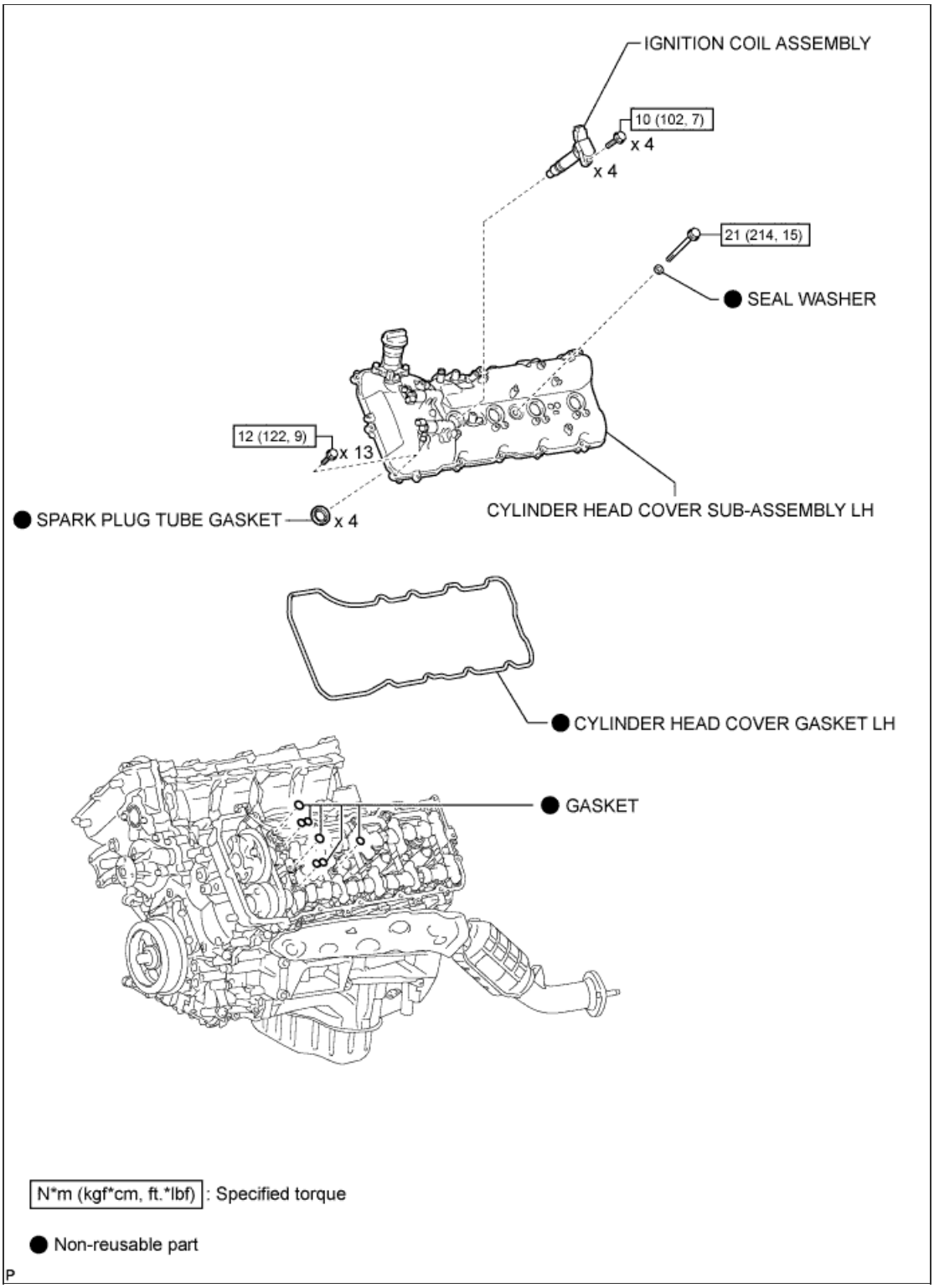

WATER HOSE
NO. 6 WATER BY-PASS HOSE
x 3
10 (102, 7)
NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY
OIL FILTER BRACKET
O-RING
35 (357, 26)
x 2
35 (357, 26)
x 2
GROUND WIRE
OIL PRESSURE SENDER GAUGE CONNECTOR
NO. 1 OIL COOLER BRACKET
x 2
21 (214, 15)
15 (153, 11)
OIL PRESSURE SENDER GAUGE ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
Precoated part
P


NO. 2 ENGINE COVER
NO. 1 ENGINE COVER
14 (143, 10)
x 2
OIL COOLER PIPE ASSEMBLY
10 (102, 7)
x 2
WATER BY-PASS PIPE SUB-ASSEMBLY
NO. 2 WATER BY-PASS HOSE
21 (214, 15)
x 4
GASKET
NO. 1 WATER BY-PASS HOSE
FRONT WATER BY-PASS JOINT
GASKET
POWER STEERING PRESSURE SWITCH CONNECTOR
VANE PUMP ASSEMBLY
21 (214, 15)
21 (214, 15)
GENERATOR WIRE
GENERATOR CONNECTOR
12 (122, 9)
43 (438, 32)
10 (102, 7)
43 (438, 32)
31 (316, 23)
43 (438, 32)
x 2
WIRE HARNESS BRACKET
GENERATOR ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

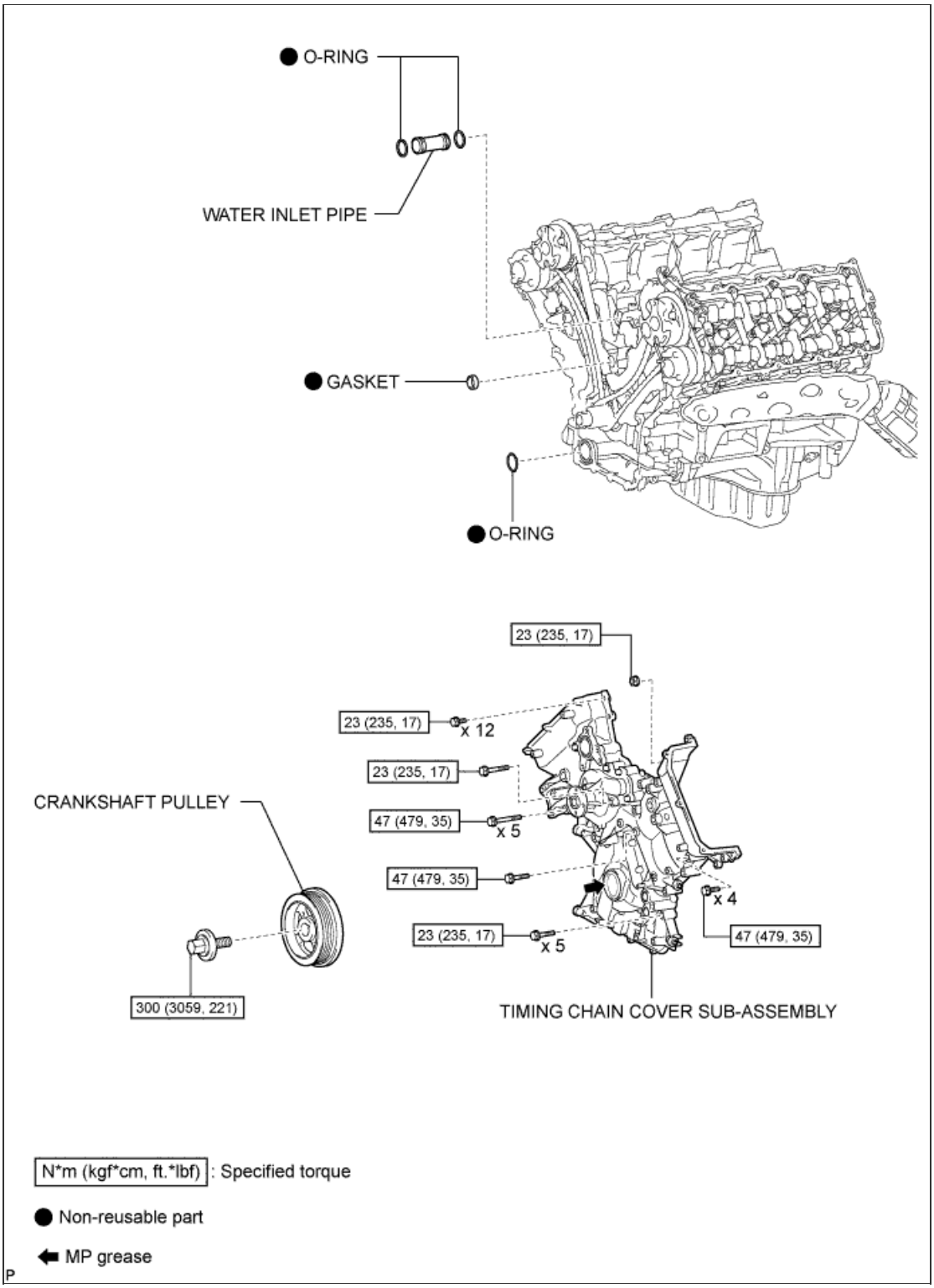

WATER INLET HOUSING
GASKET
NO. 3 WATER BY-PASS HOSE
21 (214, 15)
x 3
WATER PUMP PULLEY
21 (214, 15)
x 4
V-RIBBED BELT TENSIONER ASSEMBLY
23 (235, 17)
23 (235, 17)
NO. 1 IDLER PULLEY SUB-ASSEMBLY
43 (438, 32)
23 (235, 17)
x 3
FLUID COUPLING BRACKET
47 (479, 35)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

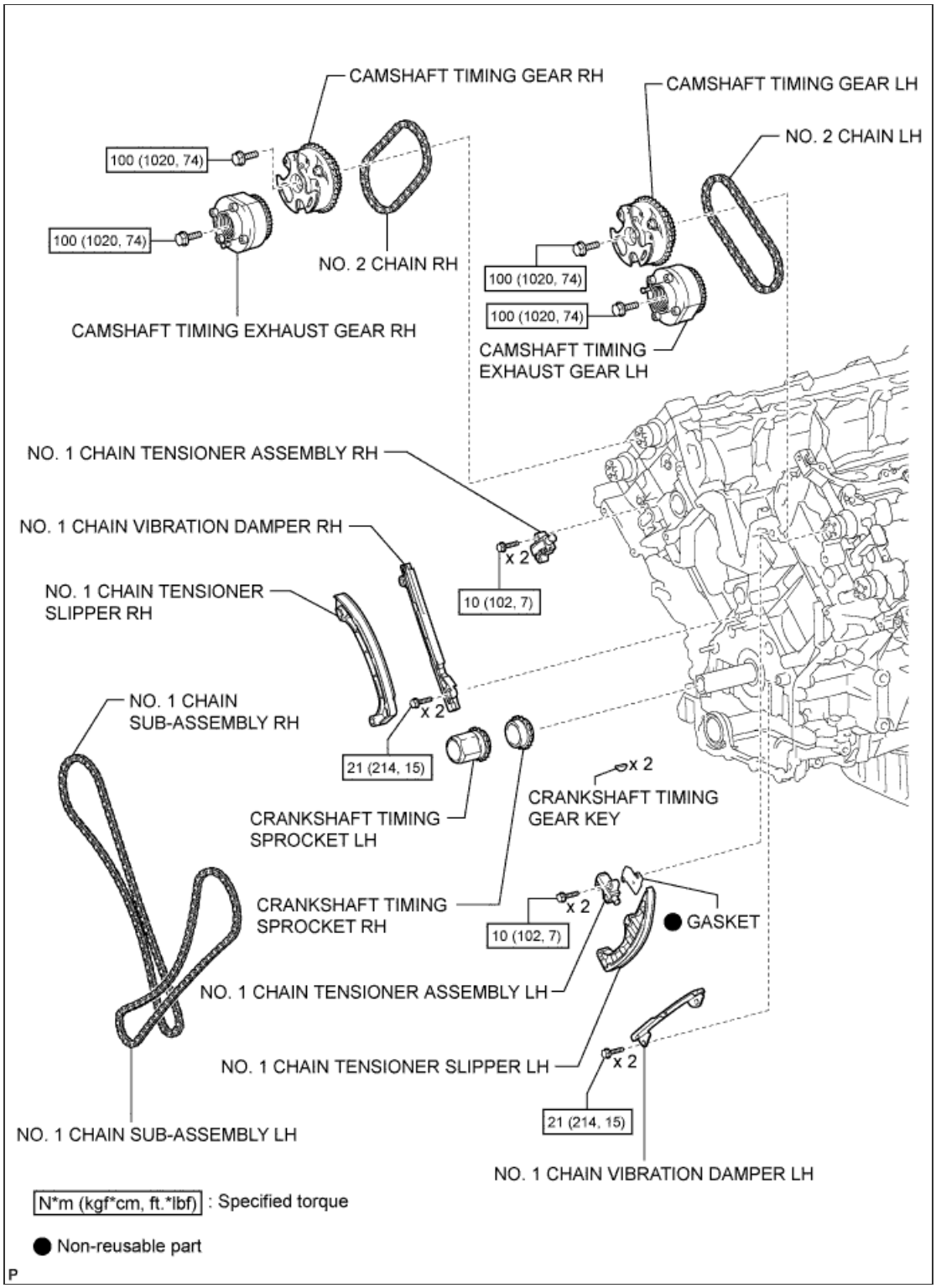

IGNITION COIL ASSEMBLY
10 (102, 7)
x 4
x 4
21 (214, 15)
SEAL WASHER
CYLINDER HEAD COVER SUB-ASSEMBLY RH
12 (122, 9)
x 13
7.0 (71, 62 in.*lbf)
SPARK PLUG TUBE GASKET
x 4
NOISE FILTER
CYLINDER HEAD COVER GASKET RH
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

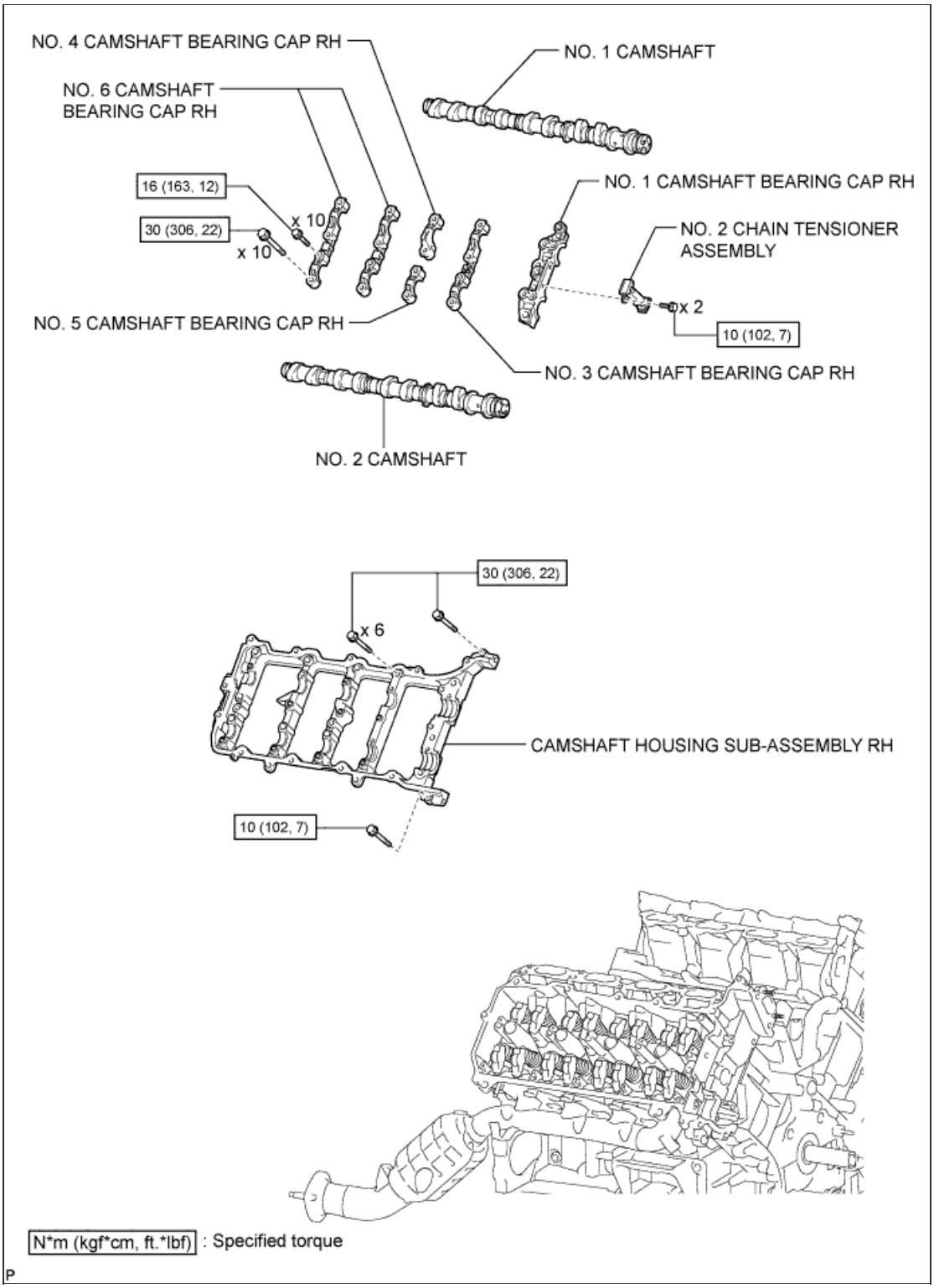
P


IGNITION COIL ASSEMBLY
10 (102, 7)
x 4
x 4
21 (214, 15)
SEAL WASHER
12 (122, 9)
x 13
SPARK PLUG TUBE GASKET
x 4
CYLINDER HEAD COVER SUB-ASSEMBLY LH
CYLINDER HEAD COVER GASKET LH
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

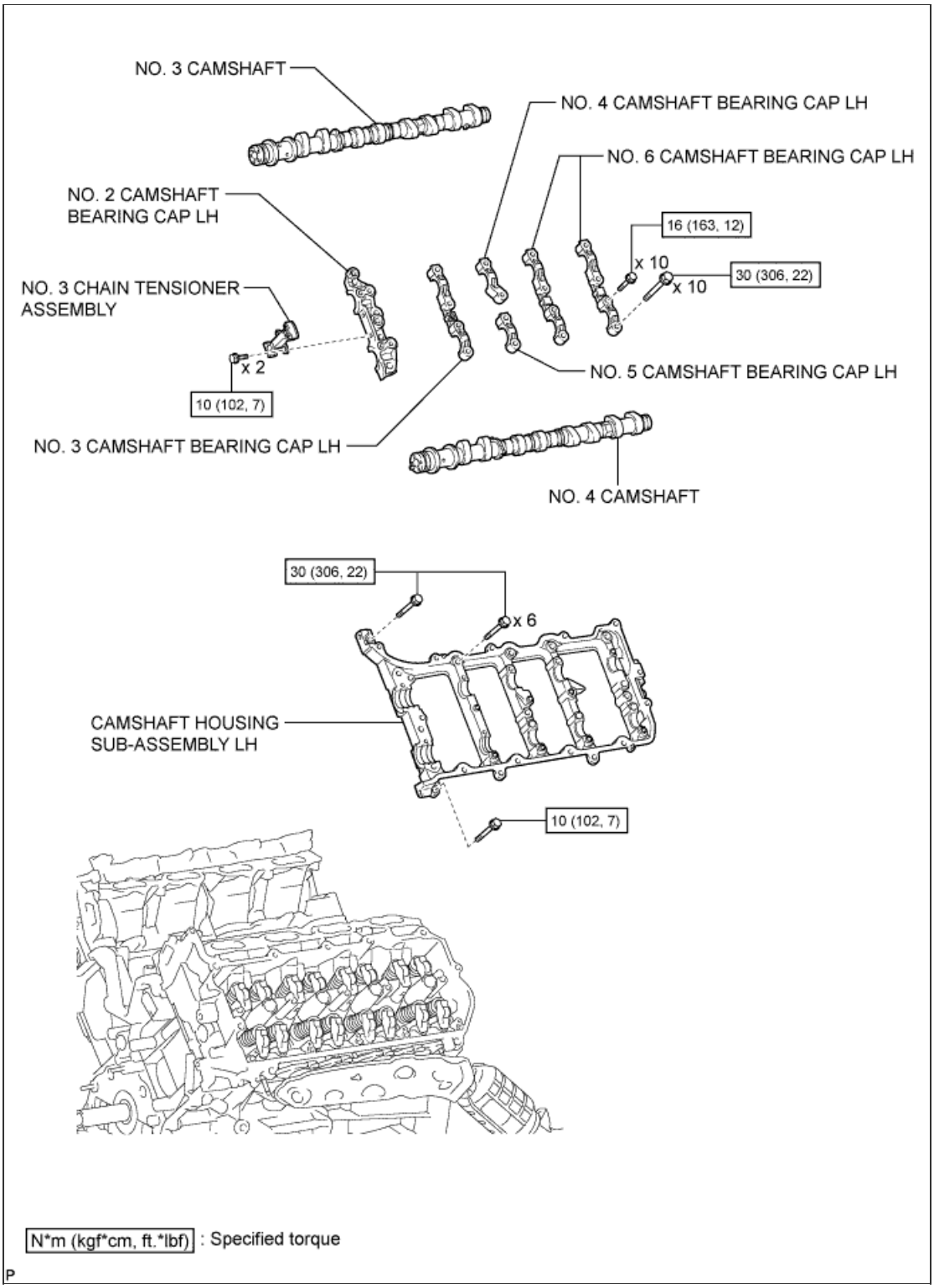
P


O-RING
WATER INLET PIPE
GASKET
O-RING
23 (235, 17)
23 (235, 17)
x 12
23 (235, 17)
47 (479, 35)
x 5
47 (479, 35)
23 (235, 17)
x 5
x 4
47 (479, 35)
CRANKSHAFT PULLEY
300 (3059, 221)
TIMING CHAIN COVER SUB-ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
MP grease
P


CAMSHAFT TIMING GEAR RH
CAMSHAFT TIMING GEAR LH
NO. 2 CHAIN LH
100 (1020, 74)
100 (1020, 74)
NO. 2 CHAIN RH
100 (1020, 74)
100 (1020, 74)
CAMSHAFT TIMING EXHAUST GEAR RH
CAMSHAFT TIMING EXHAUST GEAR LH
NO. 1 CHAIN TENSIONER ASSEMBLY RH
NO. 1 CHAIN VIBRATION DAMPER RH
x 2
10 (102, 7)
NO. 1 CHAIN TENSIONER SLIPPER RH
NO. 1 CHAIN SUB-ASSEMBLY RH
x 2
21 (214, 15)
x 2
CRANKSHAFT TIMING GEAR KEY
CRANKSHAFT TIMING SPROCKET LH
CRANKSHAFT TIMING SPROCKET RH
x 2
10 (102, 7)
GASKET
NO. 1 CHAIN TENSIONER ASSEMBLY LH
NO. 1 CHAIN TENSIONER SLIPPER LH
x 2
21 (214, 15)
NO. 1 CHAIN SUB-ASSEMBLY LH
NO. 1 CHAIN VIBRATION DAMPER LH
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P


NO. 4 CAMSHAFT BEARING CAP RH
NO. 1 CAMSHAFT
NO. 6 CAMSHAFT BEARING CAP RH
16 (163, 12)
30 (306, 22)
x 10
x 10
NO. 1 CAMSHAFT BEARING CAP RH
NO. 2 CHAIN TENSIONER ASSEMBLY
x 2
10 (102, 7)
NO. 5 CAMSHAFT BEARING CAP RH
NO. 3 CAMSHAFT BEARING CAP RH
NO. 2 CAMSHAFT
30 (306, 22)
x 6
CAMSHAFT HOUSING SUB-ASSEMBLY RH
10 (102, 7)
N*m (kgf*cm, ft.*lbf) : Specified torque

P



N*m (kgf*cm, ft.*lbf) : Specified torque

P

for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

(Click here)

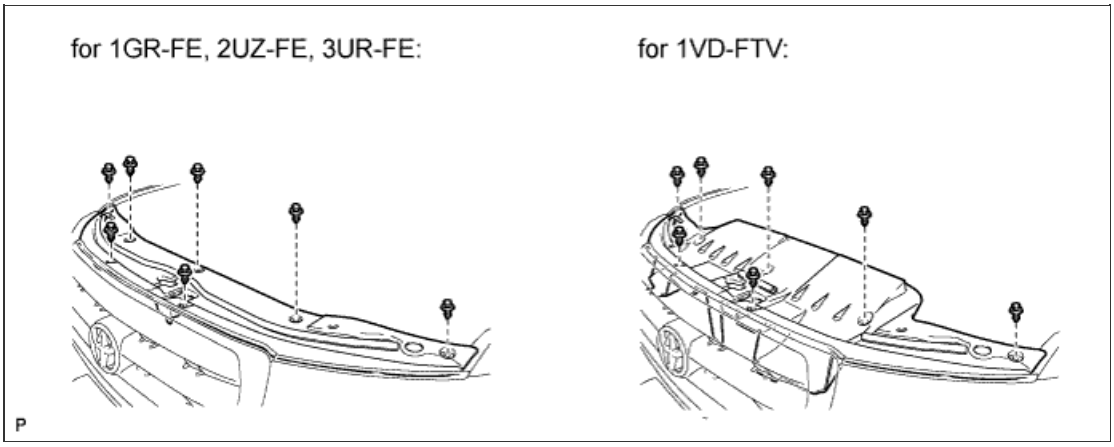
2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and radiator support seal.

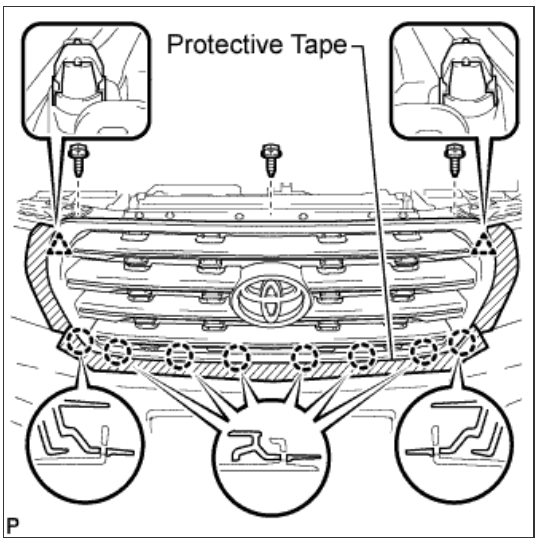


4. REMOVE RADIATOR GRILLE

a. Put protective tape around the radiator grille.

b. Remove the 3 screws.

c. Detach the 2 clips and 8 claws, and remove the radiator grille.

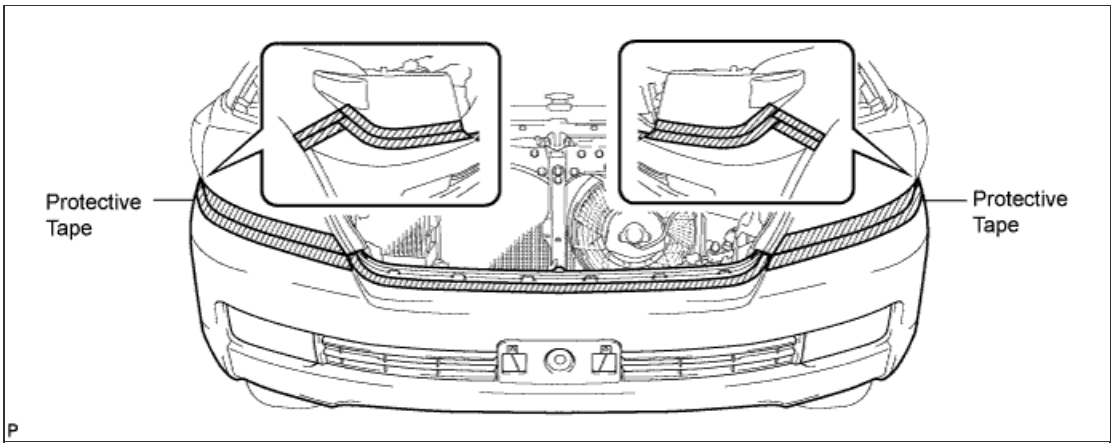


5. REMOVE FRONT BUMPER COVER

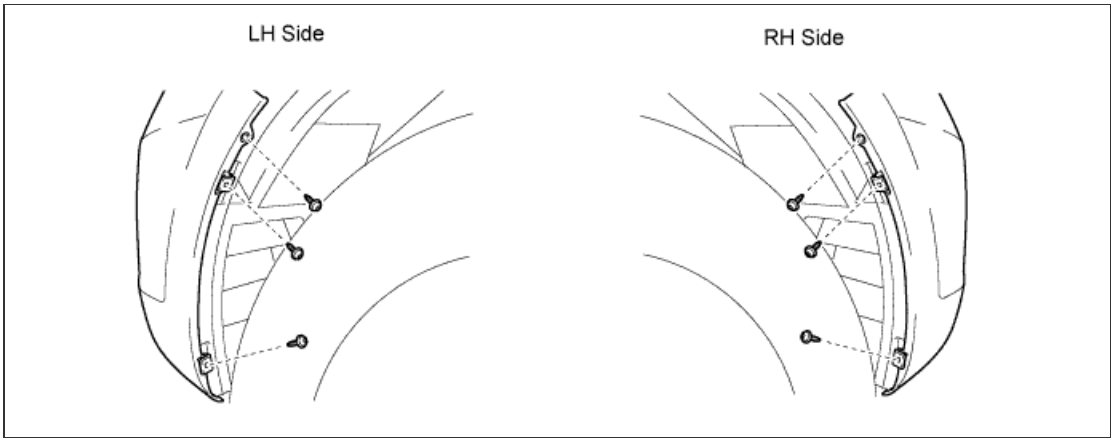
HINT:

For the front bumper cover with garnish, use the procedures described below.

a. Put protective tape around the bumper cover.



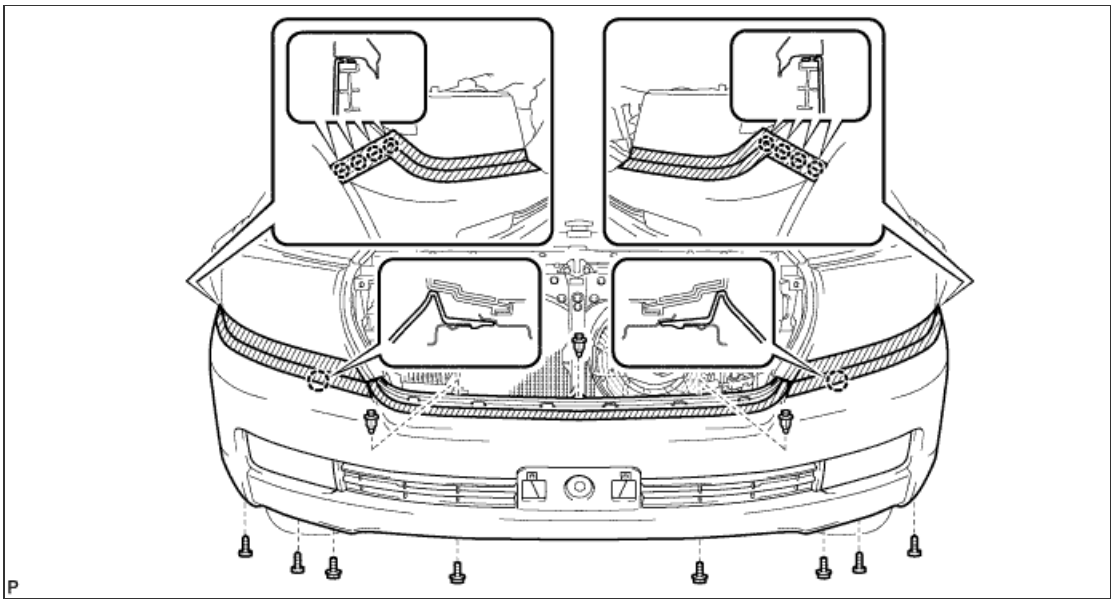
b. Using a T30 "TORX" socket, remove the 6 screws.



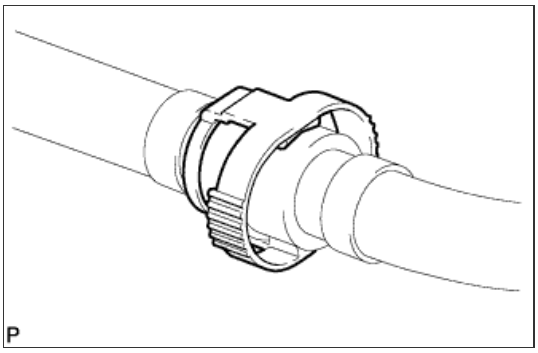
c. Remove the 3 clips, 4 screws and 4 bolts.

d. w/o TOYOTA Parking Assist-sensor System, w/o Fog Light:
Detach the 10 claws and remove the bumper cover.

e. w/ TOYOTA Parking Assist-sensor System or w/ Fog Light:
Detach the 10 claws, disconnect the No. 4 engine room wire connector and remove the bumper cover.

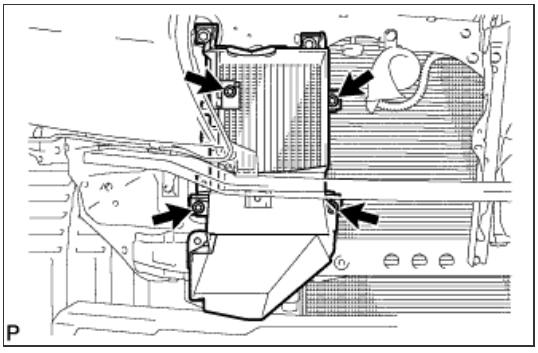


f. w/ Headlight Cleaner System:
Disconnect the headlight cleaner hose and remove the bumper cover.



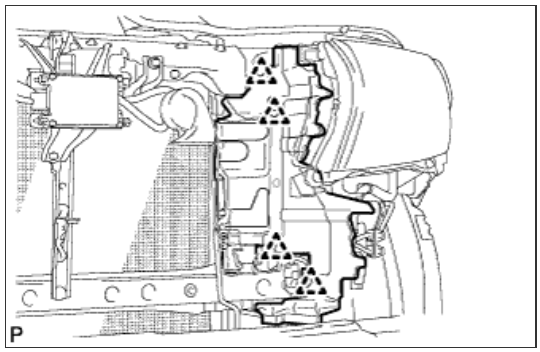
6. REMOVE TRANSMISSION OIL COOLER AIR DUCT

a. Remove the 4 bolts and oil cooler air duct.



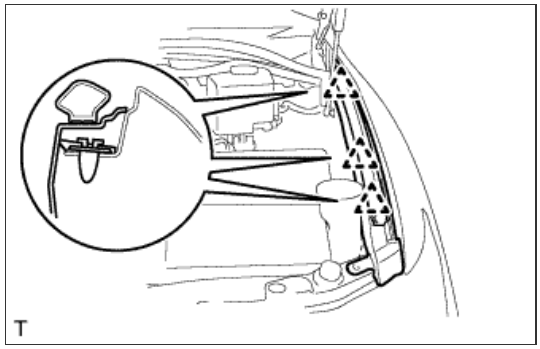
7. DISCONNECT RADIATOR SIDE DEFLECTOR LH

a. Using a clip remover, remove the 4 clips and disconnect the side deflector.



8. REMOVE FRONT FENDER MAIN SEAL LH

a. Using a clip remover, detach the 3 clips and remove the fender main seal.



9. REMOVE FRONT FENDER MAIN SEAL RH

HINT:

Use the same procedures described for the LH side.

10. REMOVE FRONT WIPER ARM LH

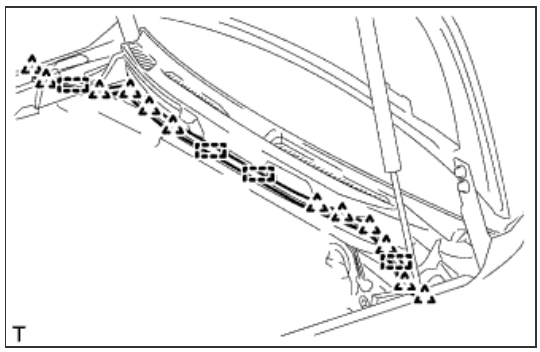
a. Remove the nut, wiper arm and blade.

11. REMOVE FRONT WIPER ARM RH

a. Remove the nut, wiper arm and blade.

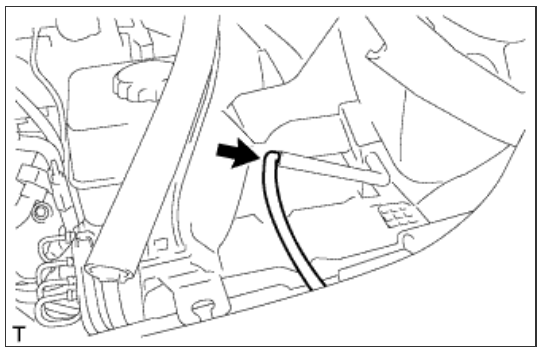
12. REMOVE HOOD TO COWL TOP SEAL

a. Using a clip remover, detach the 12 clips, 4 clamps and remove the hood to cowl top seal.



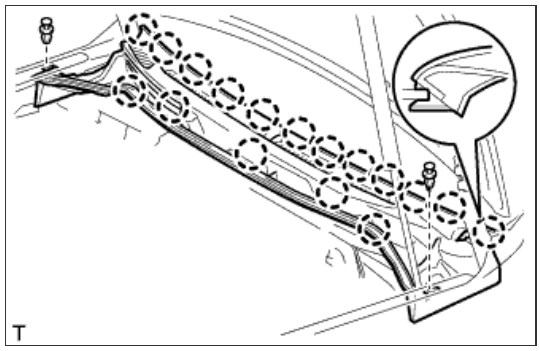
13. REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Remove the washer hose.



b. Remove the 2 clips.

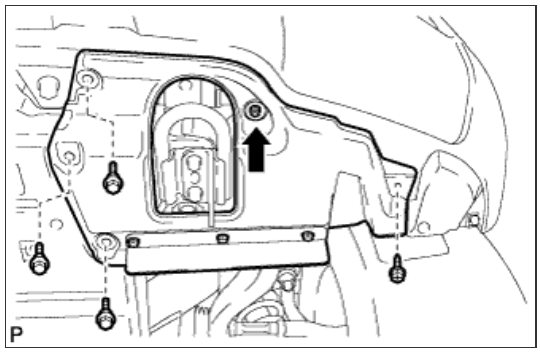
c. Detach the 17 claws and remove the cowl top ventilator louver sub-assembly.



14. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



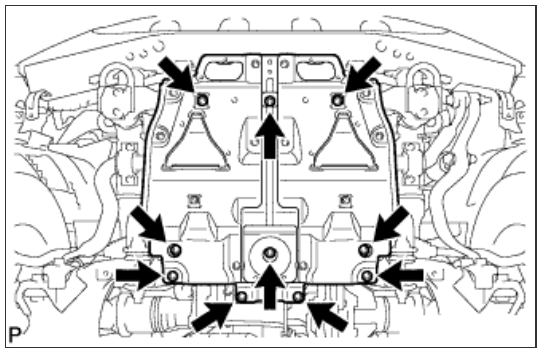
15. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

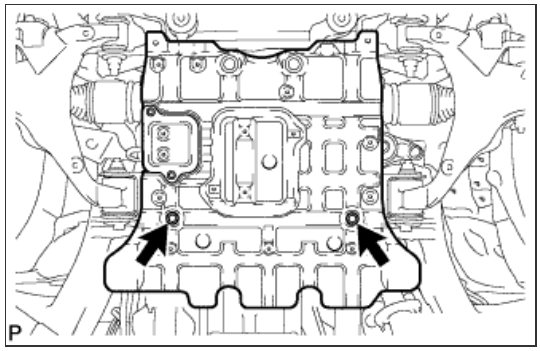
16. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and No. 1 engine under cover.



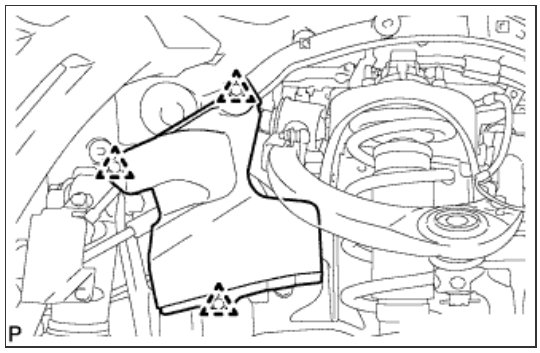
17. REMOVE NO. 2 ENGINE UNDER COVER

a. Remove the 2 bolts and No. 2 engine under cover.



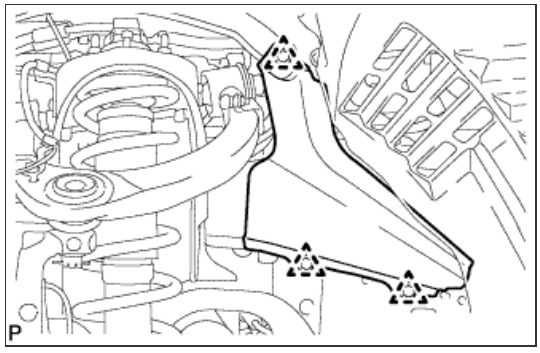
18. REMOVE FRONT FENDER APRON SEAL LH

a. Using a clip remover, remove the 3 clips and fender apron seal.



19. REMOVE FRONT FENDER APRON SEAL FRONT RH

a. Using a clip remover, remove the 3 clips and fender apron seal.



20. DRAIN ENGINE OIL

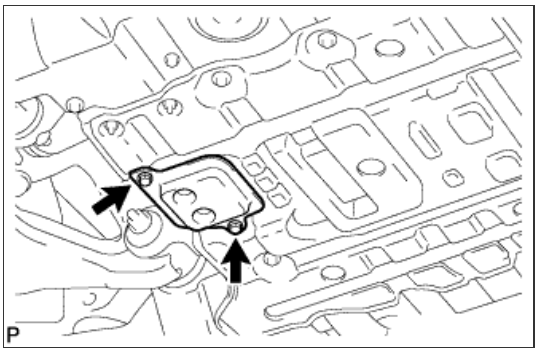
a. Remove the oil filler cap.

b. Remove the 2 bolts and No. 2 engine under cover seal.

c. Remove the oil pan drain plug and gasket, and drain the engine oil into a container.

d. Install a new gasket and the oil pan drain plug.

Tor e:
40 N*m 408 k f*cm , 30 ft.*lbf }



21. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug.

HINT:

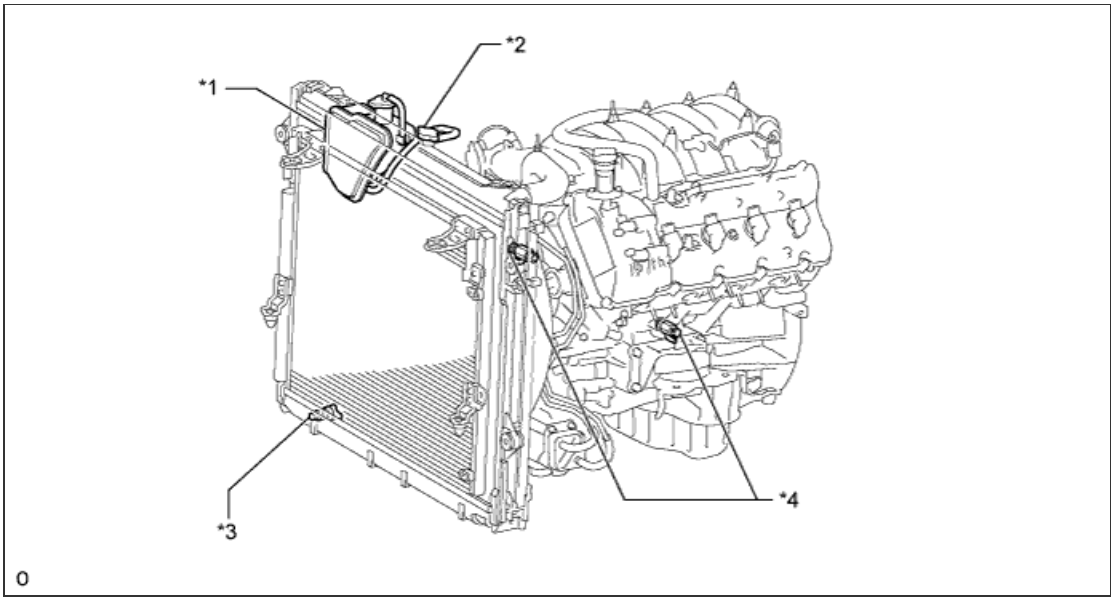
Collect the coolant in a container and dispose of it according to the regulations in your area.

b. Remove the radiator cap. Then drain the coolant from the radiator.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

d. Tighten the 2 cylinder block drain cock plugs.

Tor e:
13 N*m 133 k f*cm , 10 ft.*lbf }



Text in Illustration

*1	Radiator Reservoir	*2	Radiator Cap
*3	Radiator Drain Cock Plug	*4	Cylinder Block Drain Cock Plug

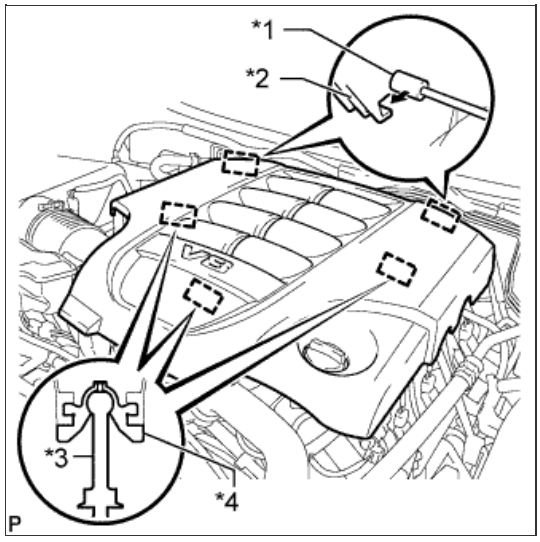
e. Tighten the radiator drain cock plug by hand.

22. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Raise the front of the V-bank cover to detach the 3 pins. Then remove the 2 V-bank cover hooks from the bracket, and remove the V-bank cover.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet

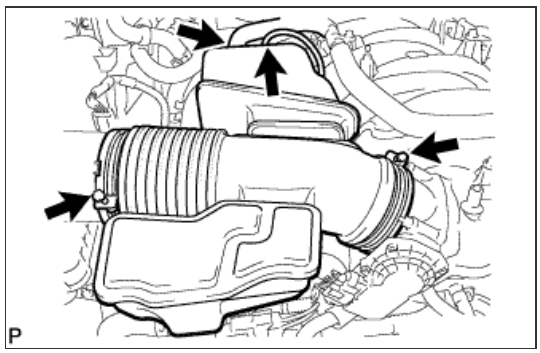


23. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum hose and No. 2 ventilation hose.

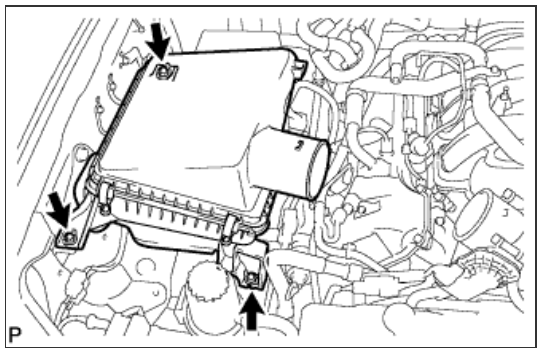
b. Loosen the 2 hose clamps.

c. Remove the air cleaner hose.



24. REMOVE AIR CLEANER ASSEMBLY

a. Remove the 3 bolts and air cleaner.



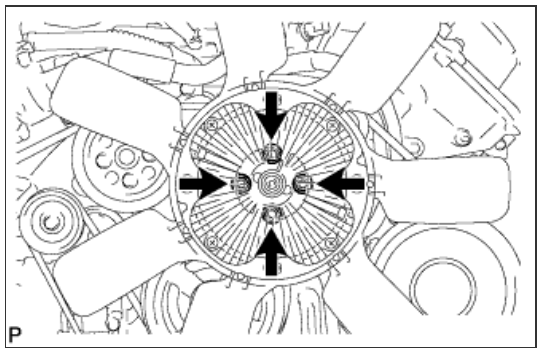
25. REMOVE NO. 1 RADIATOR HOSE

26. REMOVE NO. 2 RADIATOR HOSE

27. REMOVE FAN SHROUD

a. Loosen the 4 nuts holding the fluid coupling fan.

b. Remove the fan and generator V-belt (Click here).



c. Disconnect the reservoir hose from the upper radiator tank.

d. Detach the claw to open the flexible hose clamp.

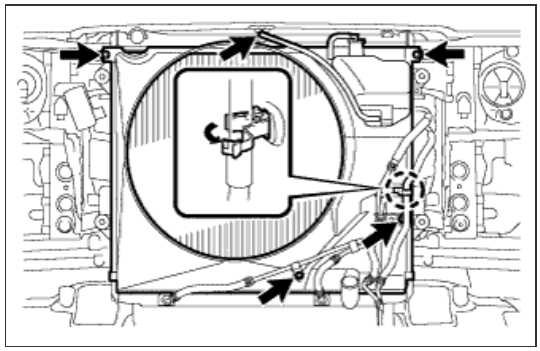
e. Remove the 2 bolts and disconnect the oil cooler tube from the fan shroud.

f. Remove the 2 bolts holding the fan shroud.

.Remove the 4 nuts of the fluid coupling fan, and then remove the shroud together with the coupling fan.

NOTICE:

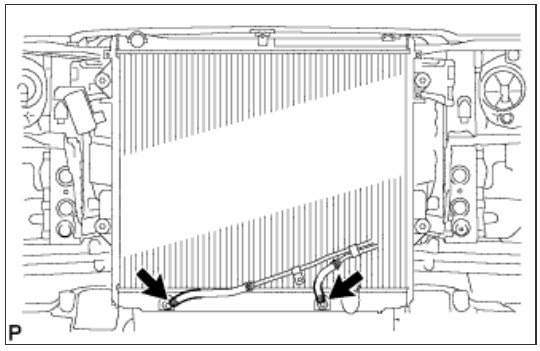
Be careful not to damage the radiator core.



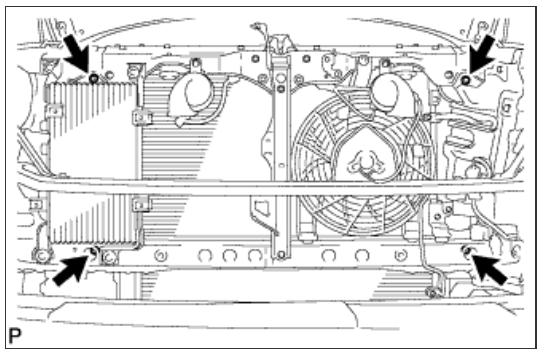
h. Remove the fan pulley.

28. REMOVE RADIATOR ASSEMBLY

a. Disconnect the 2 oil cooler hoses.



b. Remove the 4 bolts and radiator.



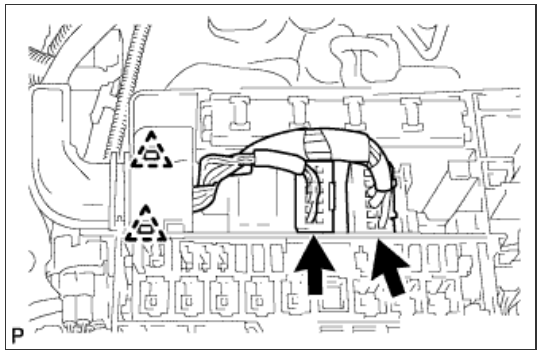
29. DISCONNECT ENGINE WIRE

a. Engine Room L H Side:

a. Engine Room LH Side:

i. Remove the engine room relay block cover.

ii. Disconnect the 2 connectors and 2 clips from the engine room junction block.



iii. Disconnect the injector connector.

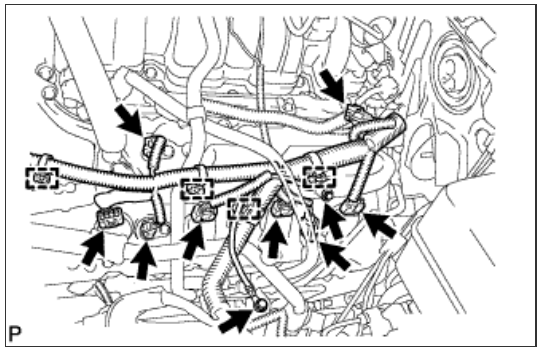
iv. Disconnect the 4 ignition coil connectors.

v. Disconnect the 2 VVT sensor connectors.

vi. Disconnect the 4 clamps.

vii. Remove the 2 bolts and ground wire.

viii. Disconnect the noise filter connector.



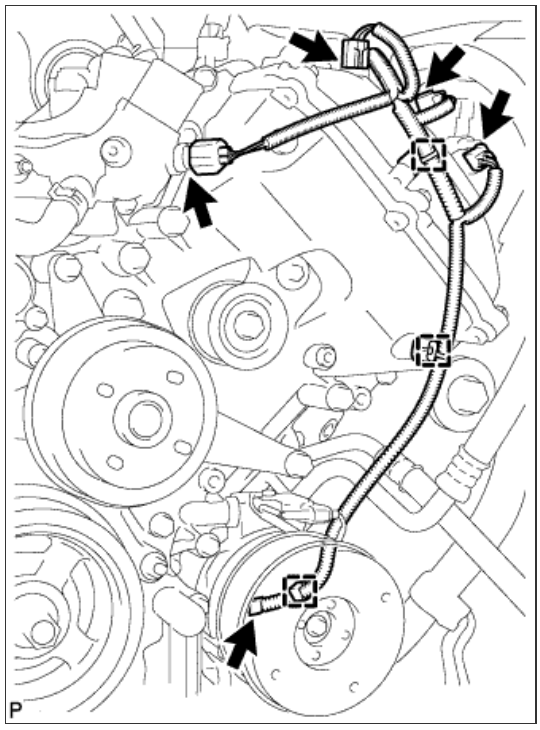
ix. Disconnect the engine coolant temperature sensor connector.

x. Disconnect the 2 camshaft timing oil control valve connectors.

xi. Disconnect the camshaft position sensor connector.

xii. Disconnect the 3 clamps.

xiii. Disconnect the cooler compressor connector.



b. Engine Room RH Side:

i. Disconnect the 2 camshaft timing oil control valve connectors.

ii. Disconnect the 4 ignition coil connectors.

iii. Disconnect the injector connector.

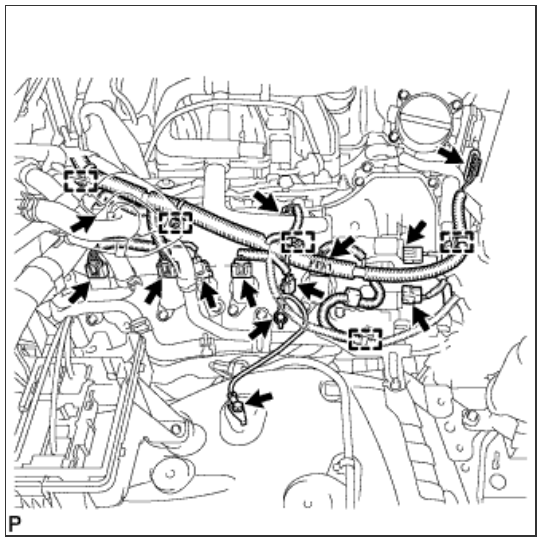
iv. Disconnect the 2 VVT sensor connectors.

v. Disconnect the noise filter connector.

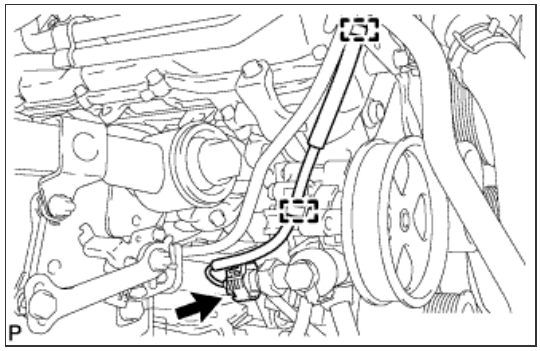
vi. Remove the 2 bolts and ground wire.

vii. Disconnect the throttle position sensor and throttle control motor connector.

viii. Disconnect the 5 clamps.



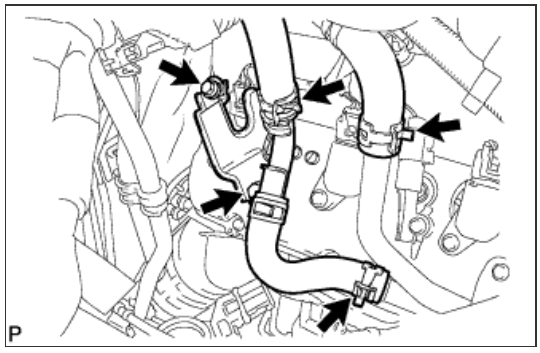
c. Disconnect the 2 clamps and power steering oil pressure switch connector.



30. DISCONNECT WATER PIPE AND HOSE SUB-ASSEMBLY

a. Disconnect the 3 hoses.

b. Remove the 2 bolts and disconnect the water pipe and hose from the cylinder head cover.

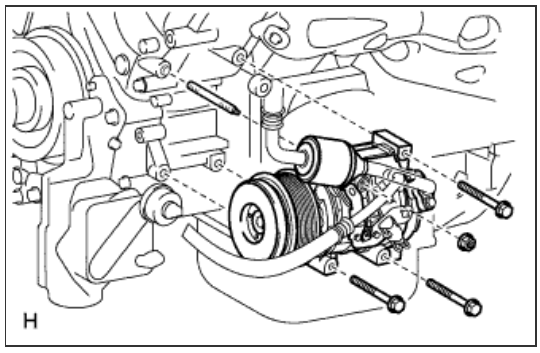


31. DISCONNECT COOLER COMPRESSOR ASSEMBLY

a. Remove the 3 bolts, nut and stud bolt, and disconnect the cooler compressor.

HINT:

It is not necessary to completely remove the compressor. With the hoses connected to the compressor, hang the compressor on the vehicle body with a rope.

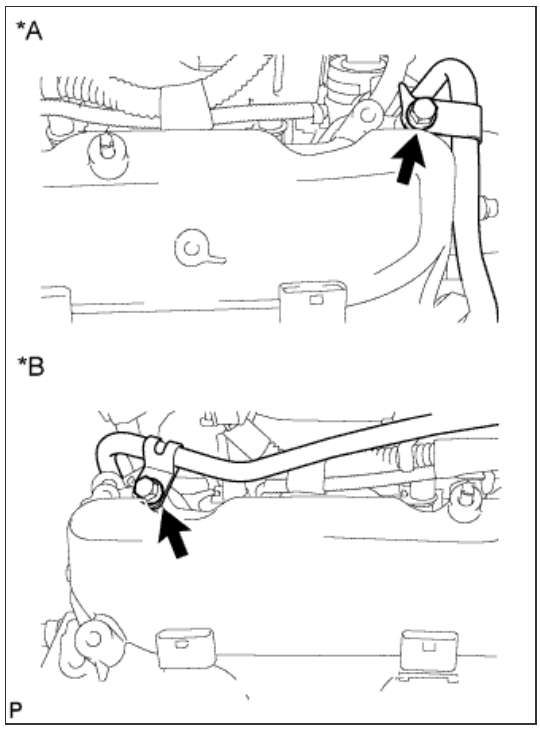


32. DISCONNECT NO. 2 FUEL TUBE SUB-ASSEMBLY

a. Remove the 2 bolts and disconnect the fuel tube.

Text in Illustration

*A	LH Side
*B	RH Side

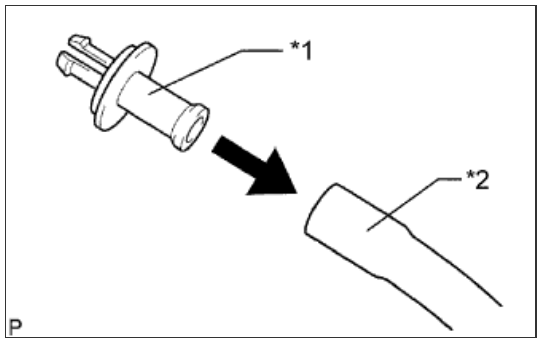


33. REMOVE OIL FILTER ELEMENT

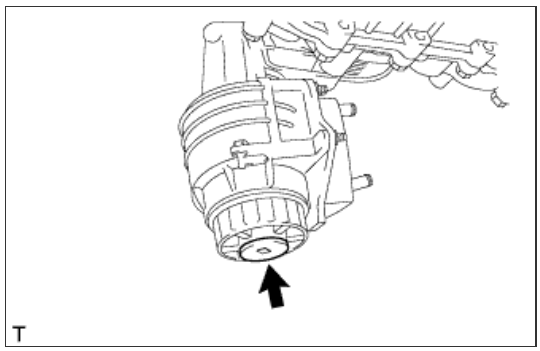
a. Connect a hose with an inside diameter of 15 mm (0.591 in.) to the pipe.

Text in Illustration

*1	Pipe
*2	Hose



b. Remove the oil filter drain plug.



c. Install the pipe to the oil filter cap.

Text in Illustration

*1	Cap
*2	Valve
*3	Pipe
*4	O-Ring

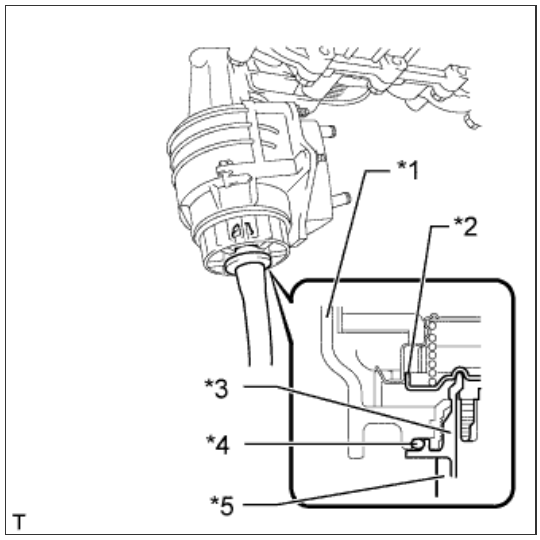
*5	Hose

NOTICE:

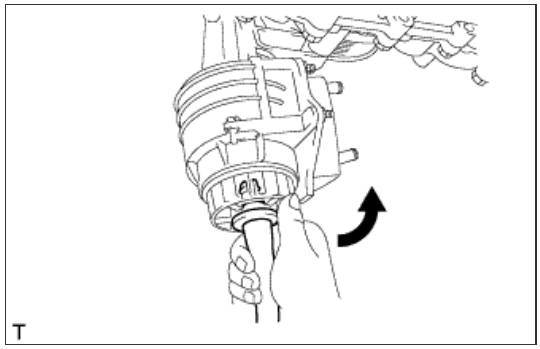
If the O-ring is removed with the drain plug, install the O-ring together with the pipe.

HINT:

Use a container to catch the draining oil.



d. Check that oil is drained from the oil filter. Then disconnect the pipe and remove the O-ring as shown in the illustration.



e. Using SST, remove the oil filter cap.

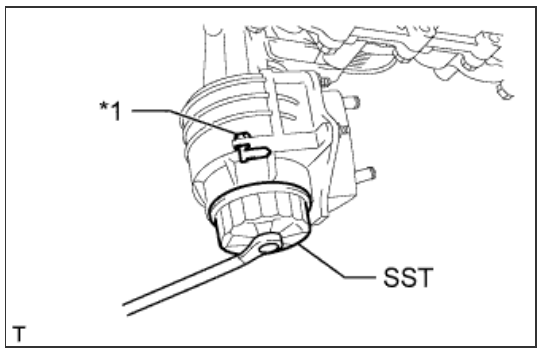
SST
09228-06501

Text in Illustration

*1	Oil Filter Bracket Clip

NOTICE:

Do not remove the oil filter bracket clip.



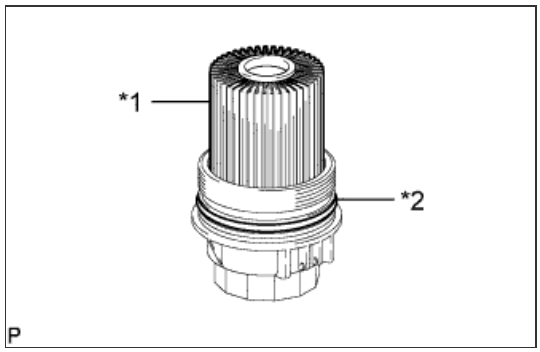
f. Remove the oil filter element and O-ring from the oil filter cap.

Text in Illustration

*1	Oil Filter Element
*2	O-Ring

NOTICE:

Be sure to remove the cap O-ring by hand, without using any tools, to prevent damage to the cap O-ring groove.



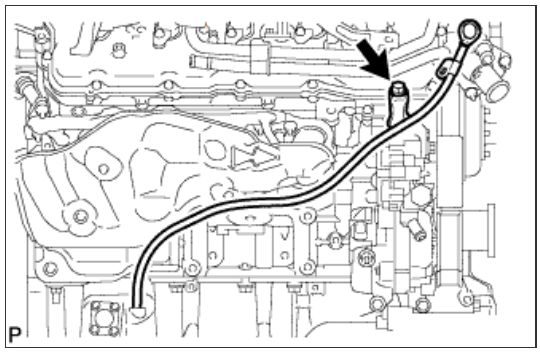
34. REMOVE ENGINE OIL LEVEL DIPSTICK GUIDE

a. Disconnect the wire harness clamp.

b. Remove the dipstick.

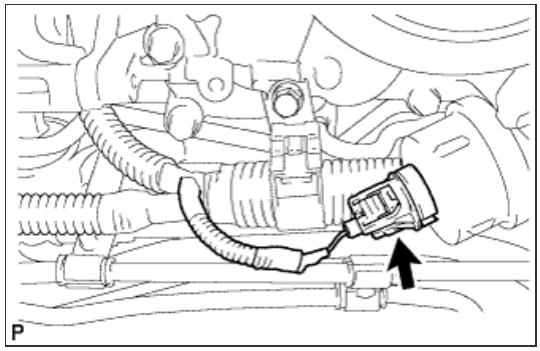
c. Remove the bolt and dipstick guide.

d. Remove the O-ring from the dipstick guide.

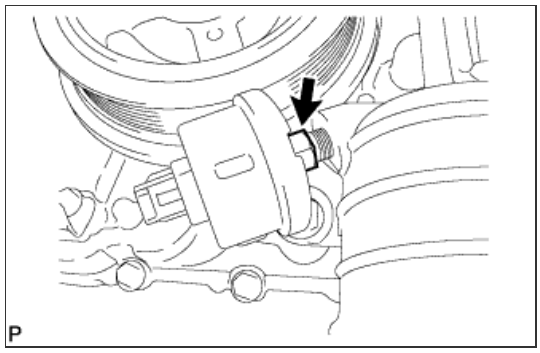


35. REMOVE OIL PRESSURE SENDER GAUGE ASSEMBLY

a. Disconnect the sender gauge connector.



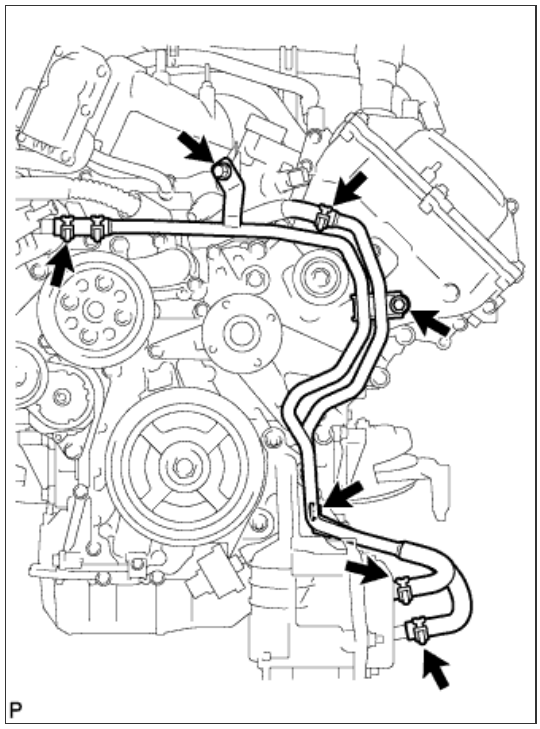
b. Remove the oil pressure sender gauge.



36. REMOVE NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY

a. Remove the 3 bolts.

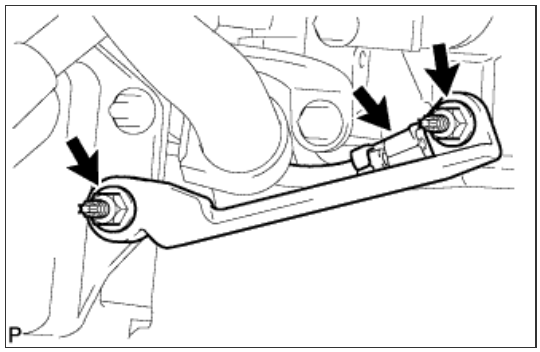
b. Disconnect the 4 hoses and remove the water by-pass pipe.



37. REMOVE NO. 1 OIL COOLER BRACKET

a. Remove the 2 nuts and bracket.

b. Disconnect the ground wire from the cylinder block.

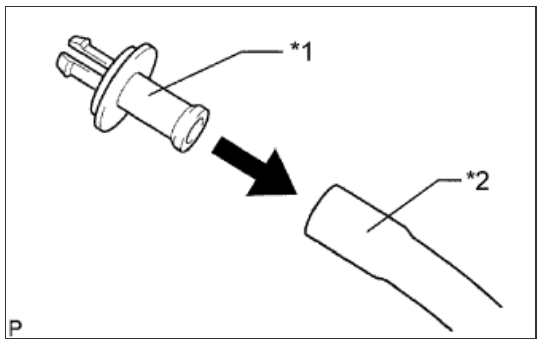


38. REMOVE OIL FILTER BRACKET

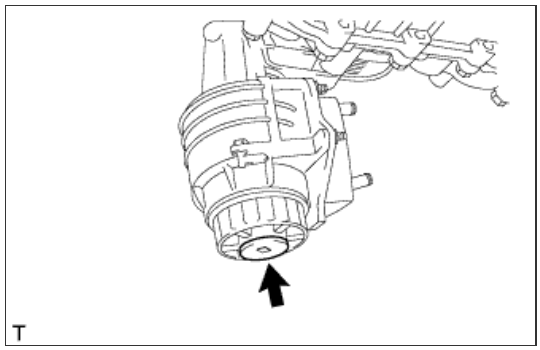
a. Connect a hose with an inside diameter of 15 mm (0.591 in.) to the pipe.

Text in Illusration

*1	Pipe
*2	Hose



b. Remove the oil filter drain plug.



c. Install the pipe to the oil filter cap.

Text in Illustration

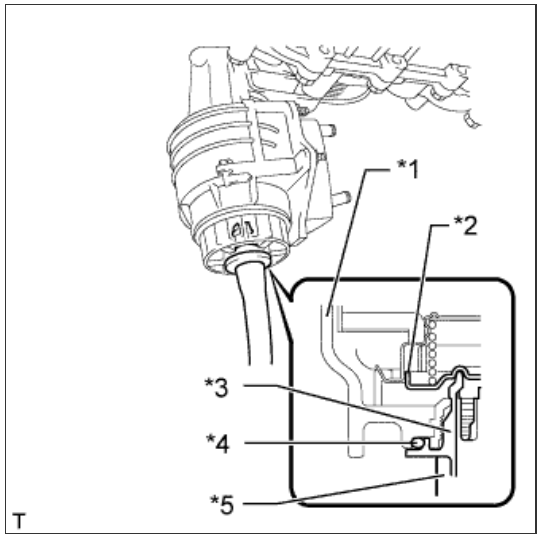
*1	Cap
*2	Valve
*3	Pipe
*4	O-Ring
*5	Hose

NOTICE:

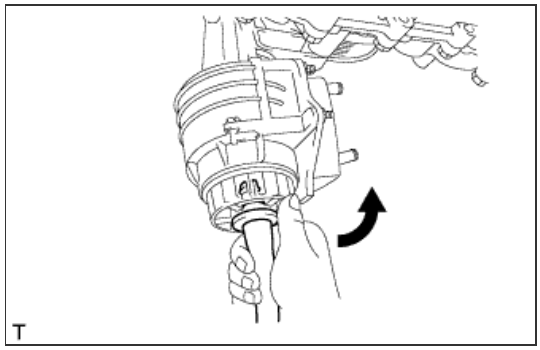
If the O-ring is removed with the drain plug, install the O-ring together with the pipe.

HINT:

Use a container to catch the draining oil.



d. Check that oil is drained from the oil filter. Then disconnect the pipe and remove the O-ring as shown in the illustration.



e. Using SST, remove the oil filter cap.

SST

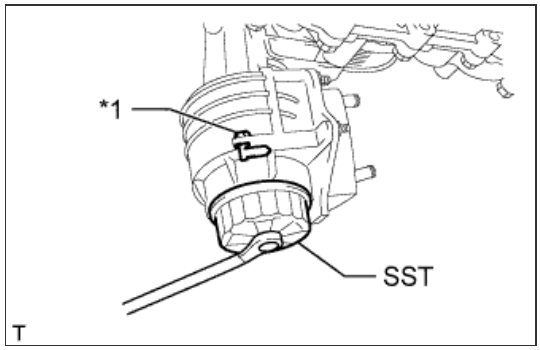
09228-06501

Text in Illustration

*1	Oil Filter Bracket Clip

NOTICE:

Do not remove the oil filter bracket clip.



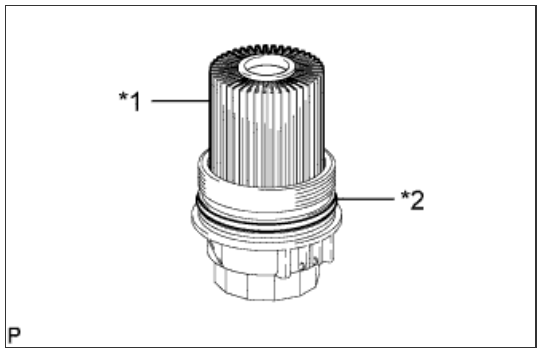
f. Remove the oil filter element and O-ring from the oil filter cap.

Text in Illustration

*1	Oil Filter Element
*2	O-Ring

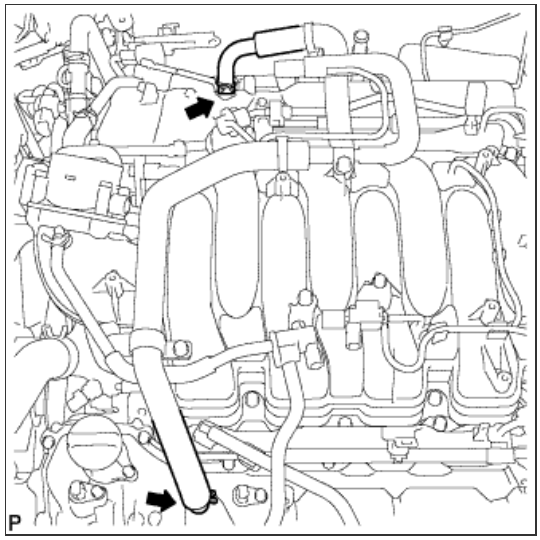
NOTICE:

Be sure to remove the cap O-ring by hand, without using any tools, to prevent damage to the cap O-ring groove.



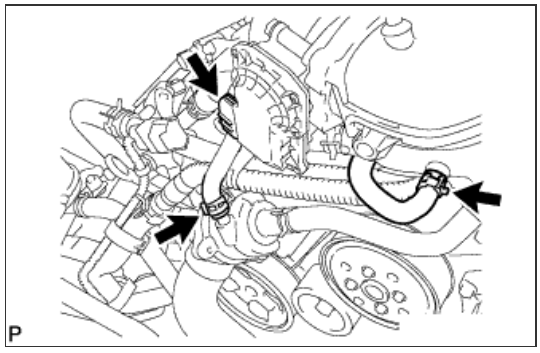
39. REMOVE INTAKE MANIFOLD

a. Disconnect the ventilation hose from the ventilation pipe of the cylinder head cover LH and RH.

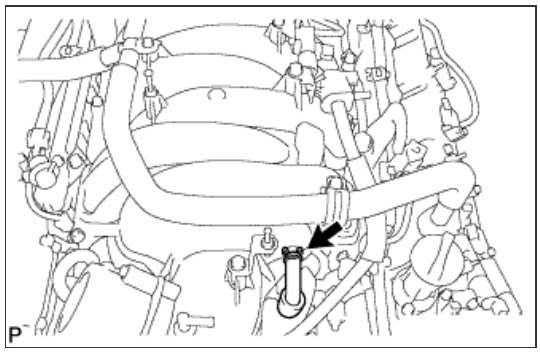


b. Disconnect the 2 water by-pass hoses.

c. Disconnect the throttle body connector.



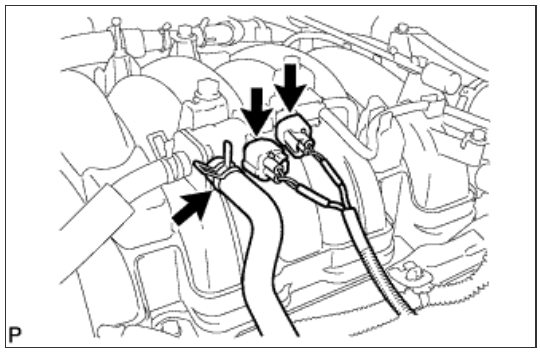
d. Disconnect the No. 1 ventilation hose.



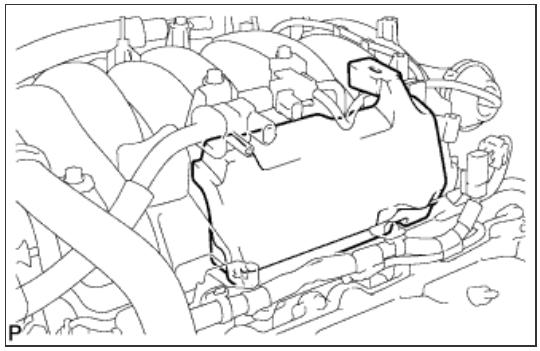
e. Disconnect the purge VSV connector.

f. Disconnect the purge line hose from the purge VSV.

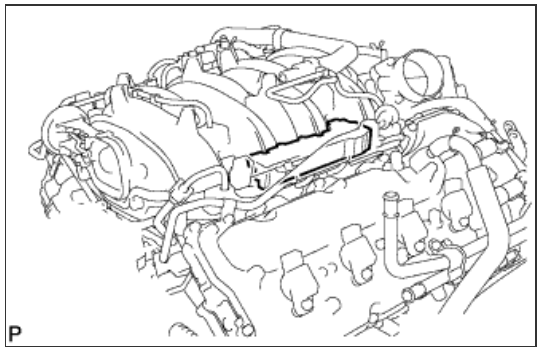
.Disconnect the vacuum switching valve connector (for ACIS).



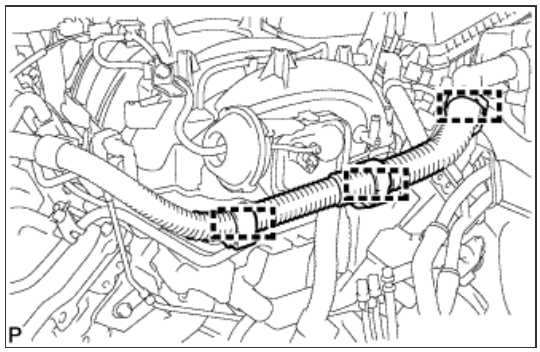
h. Remove the No. 1 engine cover sub-assembly.



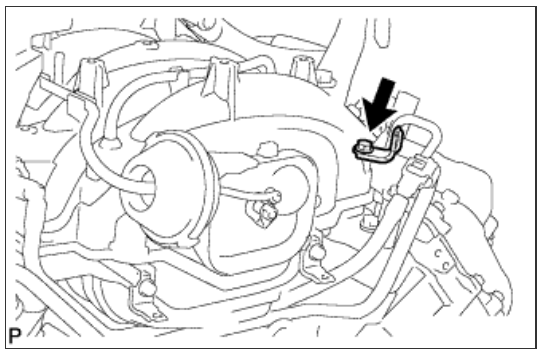
i. Remove the No. 3 engine cover.



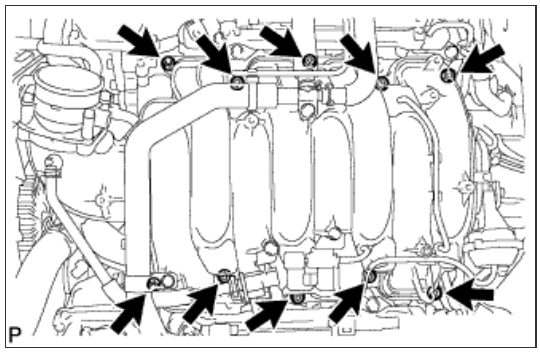
.Disconnect the 3 wire clamps from the 3 wire brackets.



k. Remove the bolt and wire bracket from the intake manifold.

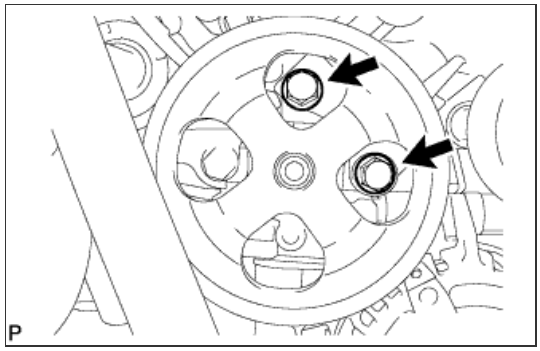


l. Remove the 2 nuts, 8 bolts, intake manifold and 2 gaskets.



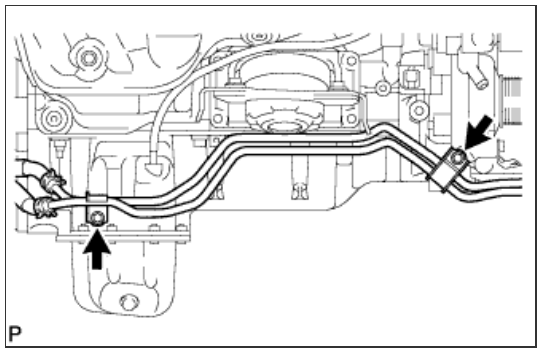
40. DISCONNECT VANE PUMP ASSEMBLY

a. Remove the 2 bolts and disconnect the vane pump.



41. DISCONNECT OIL COOLER PIPE ASSEMBLY

a. Remove the 2 bolts and disconnect the oil cooler pipe.

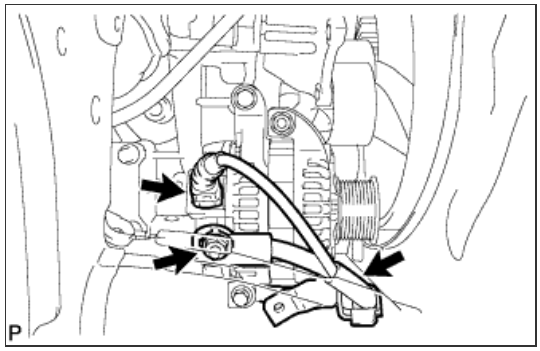


42. REMOVE GENERATOR ASSEMBLY

a. Disconnect the generator connector.

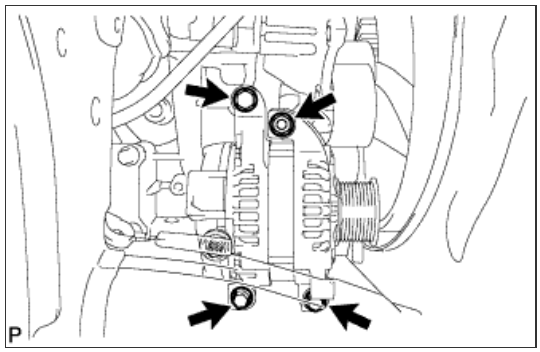
b. Remove the terminal cap and nut, and disconnect the generator wire.

c. Remove the bolt and wire harness bracket from the generator.



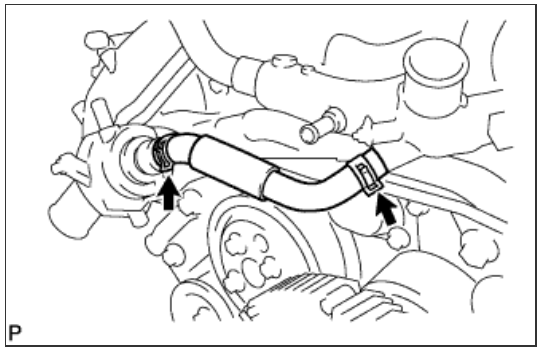
d. Remove the 3 bolts, nut and generator.

e. Remove the stud bolt.



43. REMOVE NO. 1 WATER BY-PASS HOSE

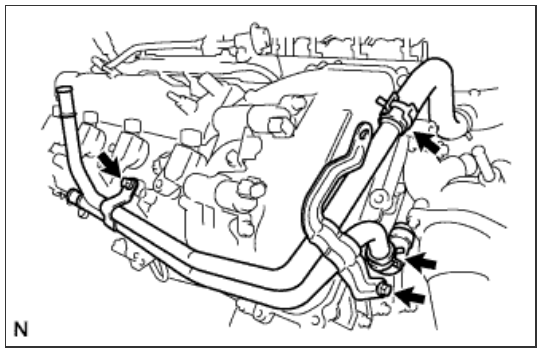
a. Remove the No. 1 water by-pass hose by disconnecting the hose from the water inlet housing and front water by-pass joint.



44. REMOVE WATER BY-PASS PIPE SUB-ASSEMBLY

a. Disconnect the 2 hoses.

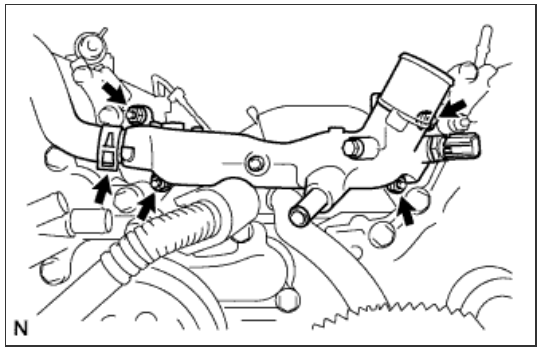
b. Remove the 2 bolts and water by-pass pipe.



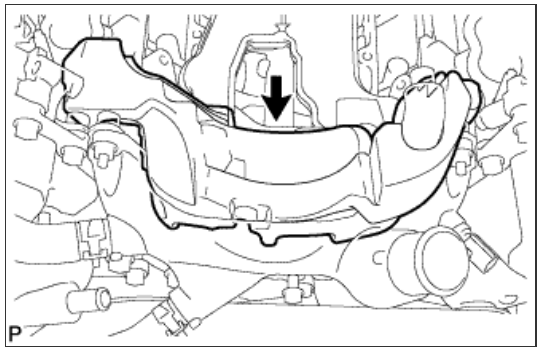
45. REMOVE FRONT WATER BY-PASS OINT

a. Disconnect the No. 2 water by-pass hose from the water by-pass joint.

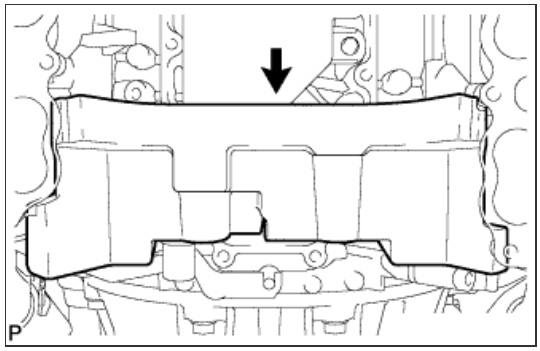
b. Remove the 4 nuts, water by-pass joint and 2 gaskets.



46. REMOVE NO. 2 ENGINE COVER

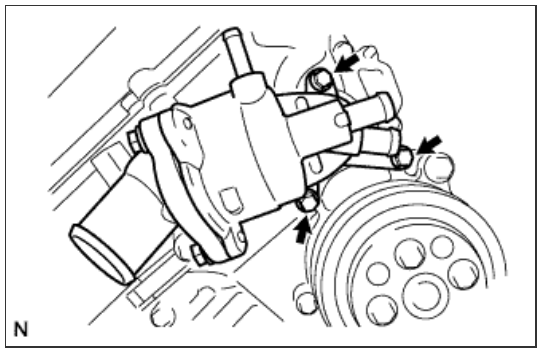


47. REMOVE NO. 1 ENGINE COVER



48. REMOVE WATER INLET HOUSING

a. Remove the 3 bolts, water inlet housing and gasket.

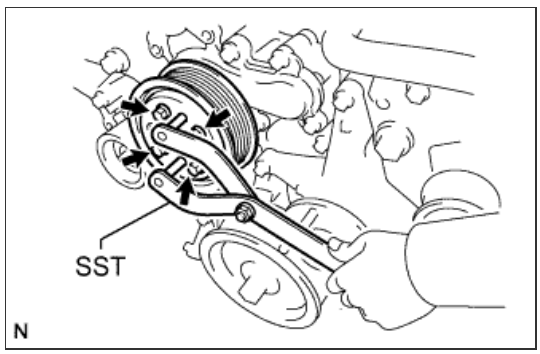


49. REMOVE WATER PUMP PULLEY

a. Using SST, hold the water pump pulley.

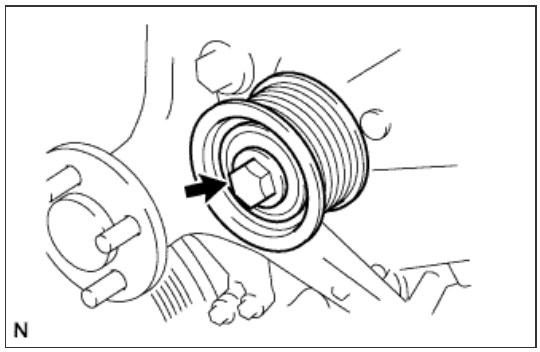
SST
09960-10010 09962-01000, 09963-01000

b. Remove the 4 bolts and water pump pulley.



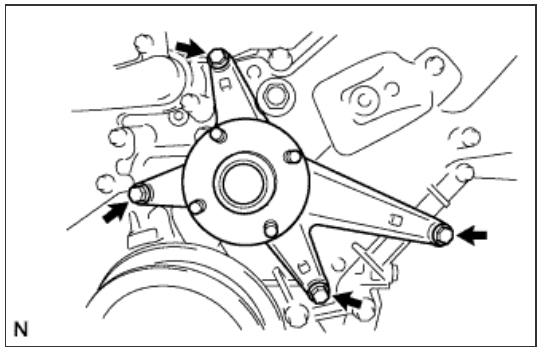
50. REMOVE NO. 1 IDLER PULLEY SUB-ASSEMBLY

a. Remove the bolt and idler pulley.



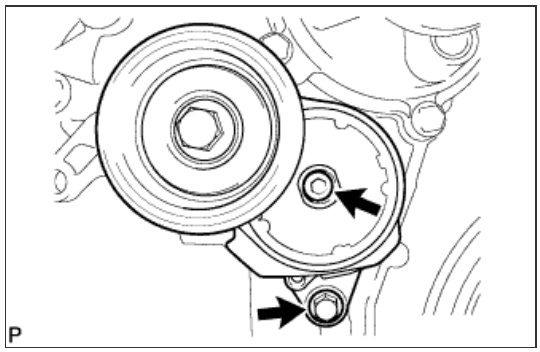
51. REMOVE FLUID COUPLING BRACKET

a. Remove the 4 bolts and fluid coupling bracket.



52. REMOVE V-RIBBED BELT TENSIONER ASSEMBLY

a. Remove the standard bolt, 6 mm hexagon wrench bolt and belt tensioner.



53. REMOVE IGNITION COIL ASSEMBLY

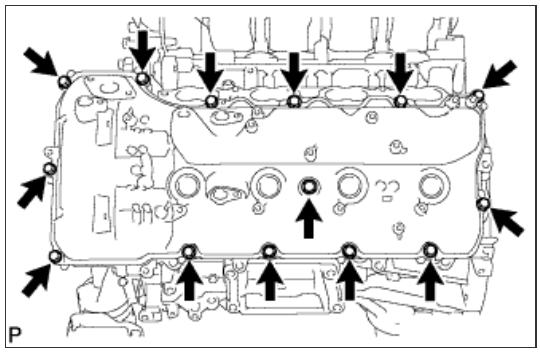
a. Remove the 8 bolts and 8 ignition coils.

54. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY LH

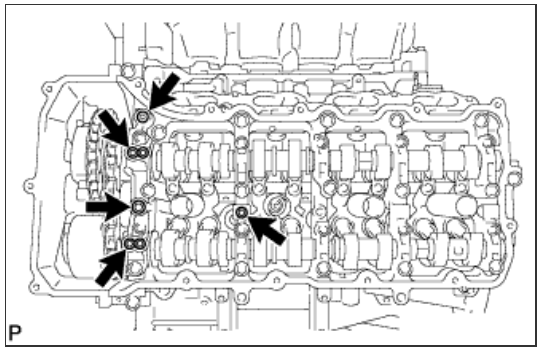
a. Remove the 14 bolts, seal washer, cylinder head cover and gasket.

HINT:

Make sure the removed parts are returned to the same places they were removed from.

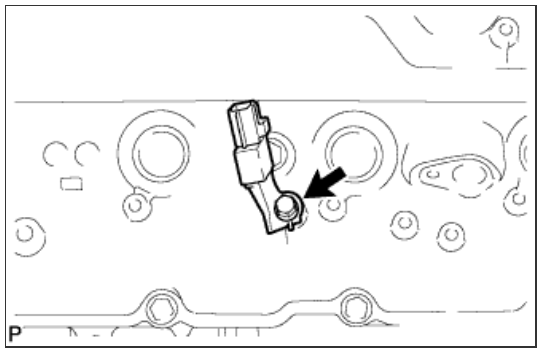


b. Remove the 5 gaskets from the camshaft bearing caps (No. 2, No. 3).



55. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY RH

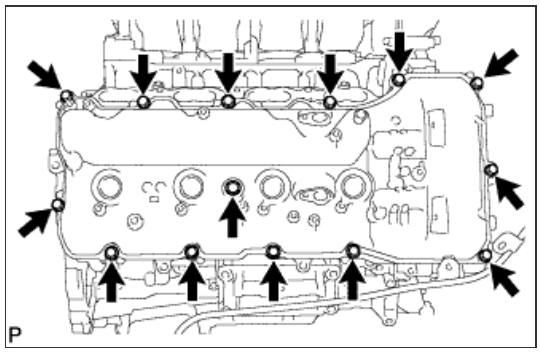
a. Remove the bolt and noise filter.



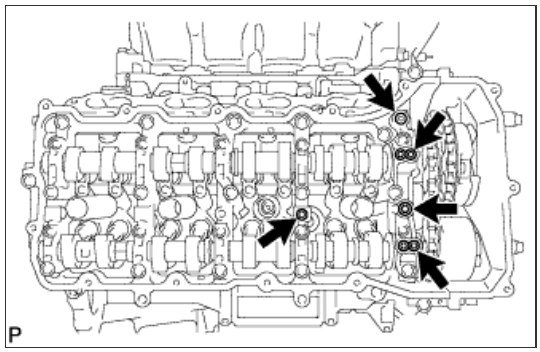
b. Remove the 14 bolts, seal washer, cylinder head cover and gasket.

HINT:

Make sure the removed parts are returned to the same places they were removed from.



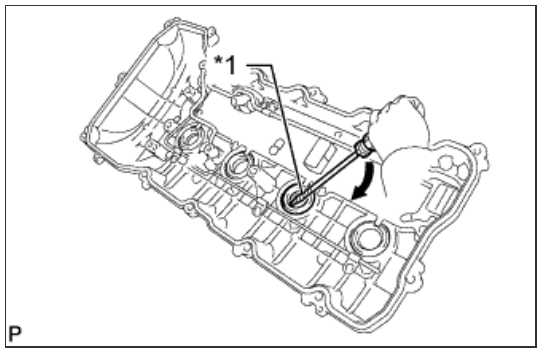
c. Remove the 5 gaskets from the camshaft bearing caps (No. 1, No. 3).



56. REMOVE SPARK PLUG TUBE GASKET

a. Bend the 4 ventilation baffle plate claws on the cylinder head cover to an angle of 90° or more.

b. Using a screwdriver, pry out the gaskets.



Text in Illustration

*1	Tape
➡	Pry

NOTICE:

- **Be careful not to damage the cylinder head cover.**
- **Be careful not to damage the gasket when removing it, as the removed gasket needs to be used when installing a new one.**

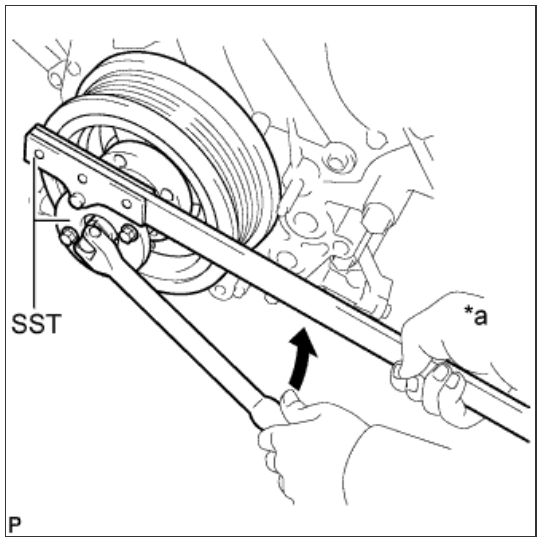
HINT:

Tape the screwdriver tip before use.

57. REMOVE CRANKSHAFT PULLEY

a. Using SST, loosen the crankshaft pulley set bolt until 2 or 3 threads are engaged.

SST
09213-70011
09330-00021



Text in Illustration

*a	Hold
➡	Turn

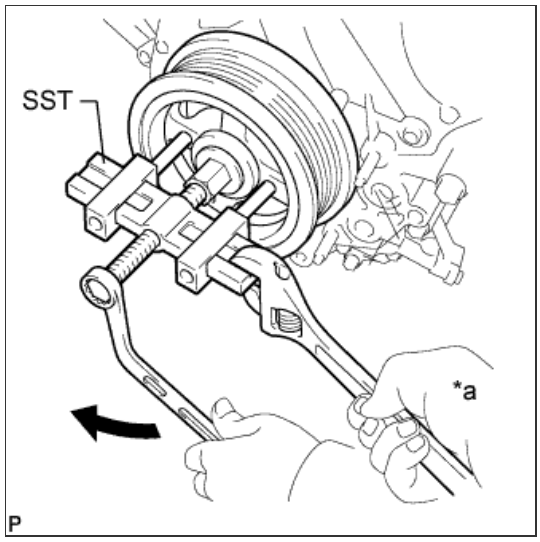
b. Using the pulley set bolt and SST, remove the crankshaft pulley.

SST
09950-50013 09951-05010, 09952-05010, 09953-05010, 09954-05011

Text in Illustration

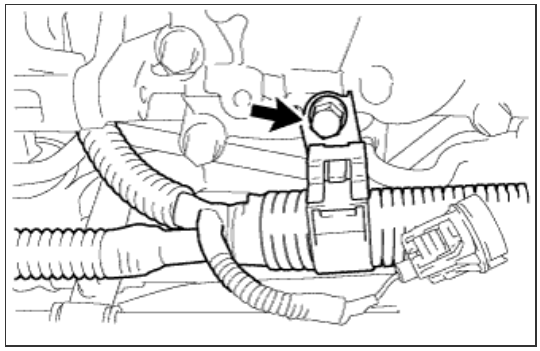
*a	Hold

➡	Turn



58. DISCONNECT WIRE HARNESS CLAMP BRACKET

a. Remove the bolt and disconnect the bracket.

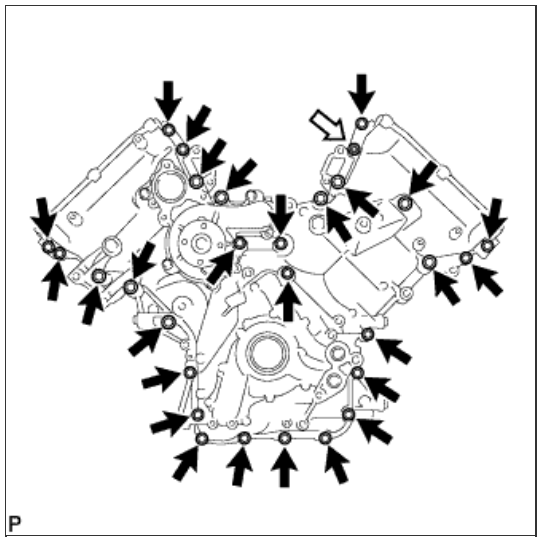


59. REMOVE TIMING CHAIN COVER SUB-ASSEMBLY

a. Remove the 28 bolts and nut shown in the illustration.

Text in Illustration

➡	Bolt
⇨	Nut



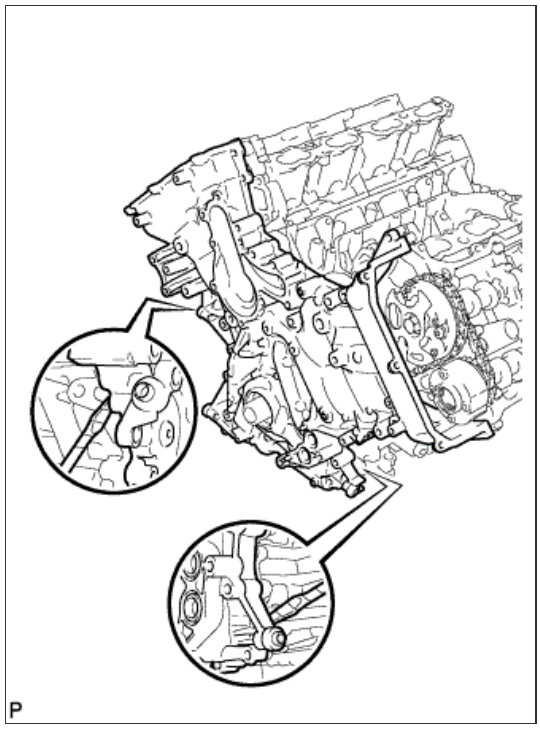
b. Remove the timing chain cover by prying between the timing chain cover and cylinder head or cylinder block with a screwdriver as shown in the illustration.

NOTICE:

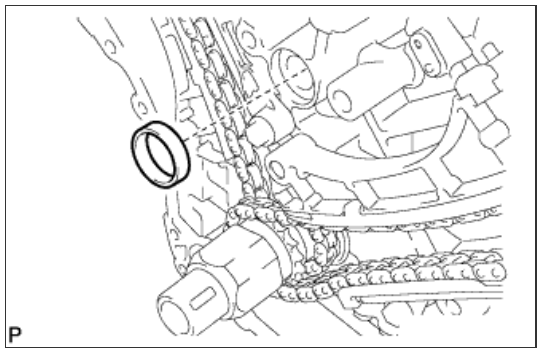
Be careful not to damage the contact surfaces of the cylinder head, cylinder block and chain cover.

HINT:

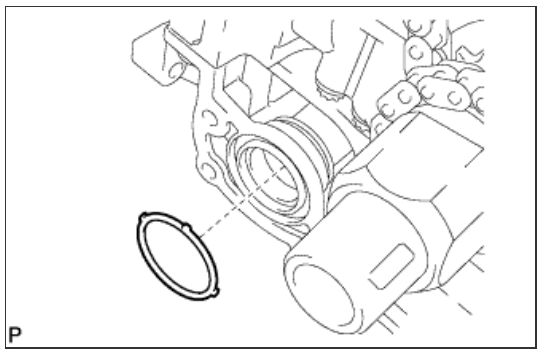
Tape the screwdriver tip before use.



c. Remove the oil pump gasket from the cylinder block.



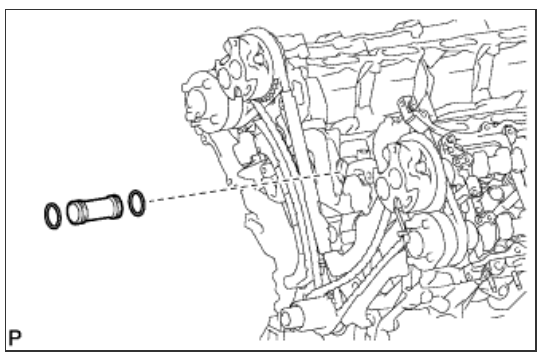
d. Remove the O-ring from the oil pan.



60. REMOVE WATER INLET PIPE

a. Remove the water inlet pipe.

b. Remove the 2 O-rings from the water inlet pipe.



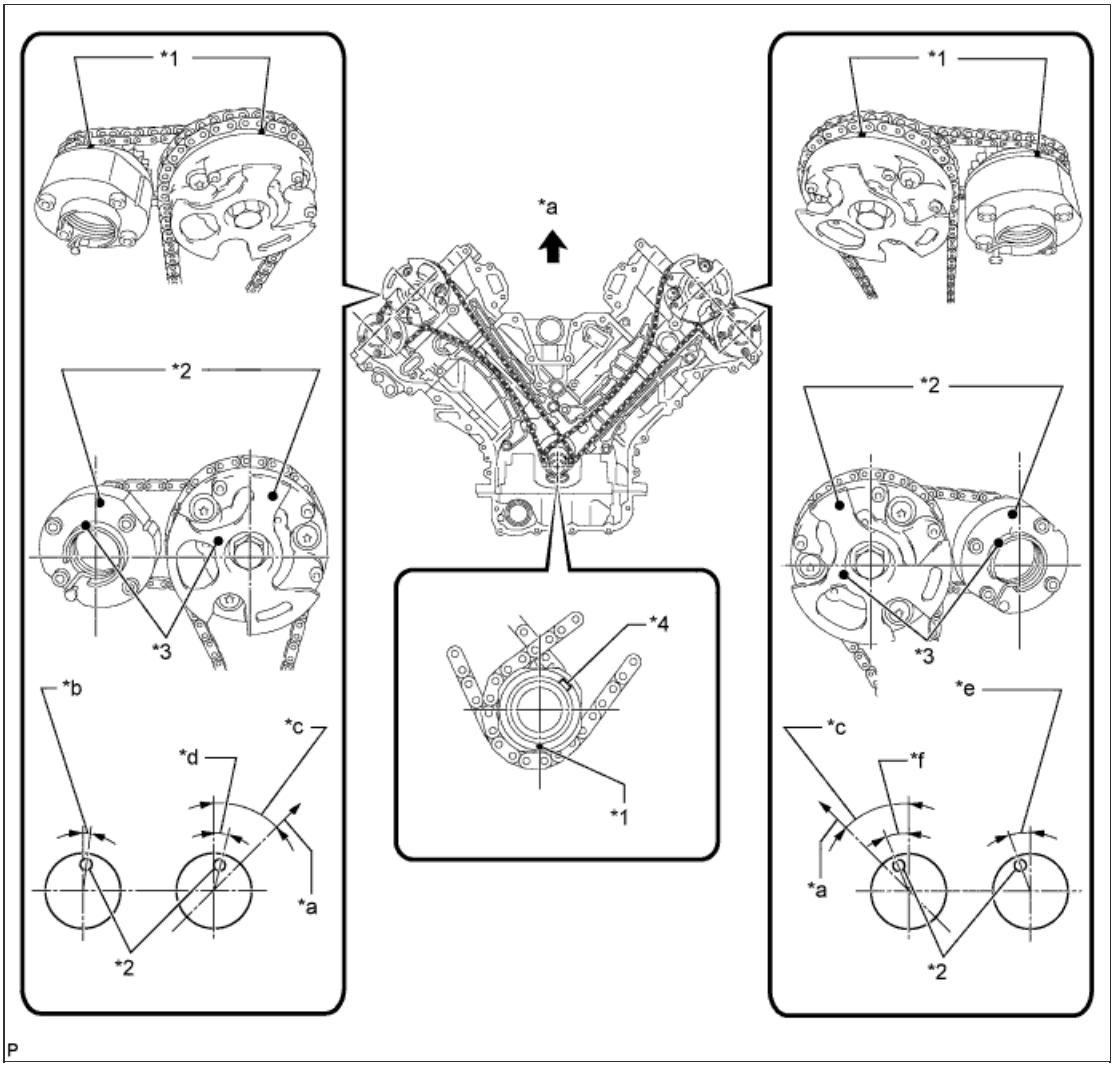
61. SET NO. 1 CYLINDER TO TDC COMPRESSION

a. Temporarily install the crankshaft pulley bolt.

b. Rotate the crankshaft clockwise so that the timing marks on the crankshaft timing sprocket and camshaft timing gears are as shown in the illustration.

HINT:

If the timing marks do not align, rotate the crankshaft clockwise again and align the timing marks.



Text in Illustration

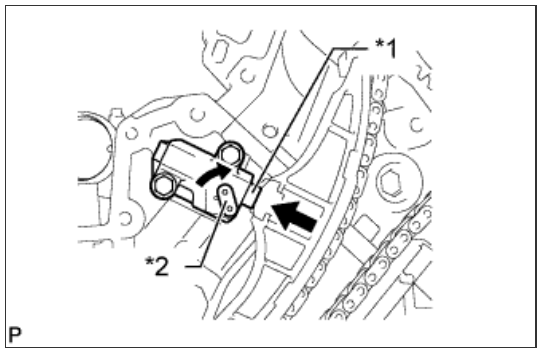
*1	Timing Mark	*2	Timing Mark Position
*3	Knock Pin Position	*4	Key
*a	Toward Ceiling	*b	Approximately 2°
*c	Approximately 45°	*d	Approximately 16°
*e	Approximately 18°	*f	Approximately 32°

62. REMOVE NO. 1 CHAIN TENSIONER ASSEMBLY LH

a. Move the stopper plate clockwise to release the lock, and push the plunger deep into the tensioner.

Text in Illustration

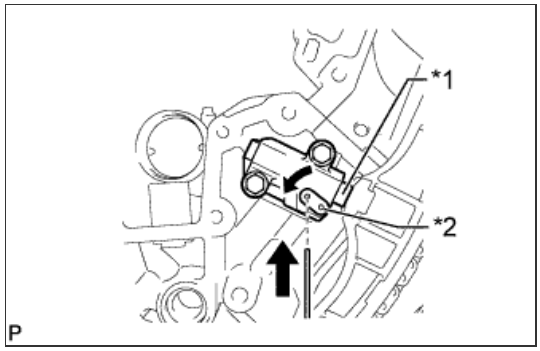
*1	Plunger
*2	Stopper Plate



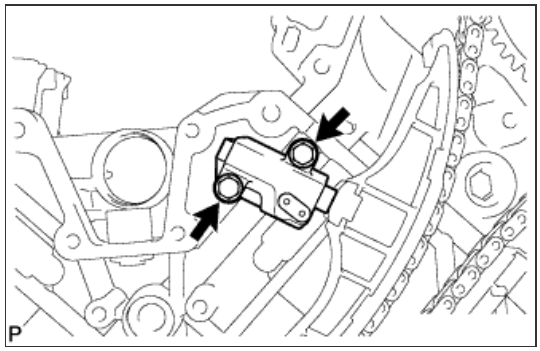
b. Move the stopper plate counterclockwise to set the lock, and insert a hexagon wrench into the stopper plate hole.

Text in Illustration

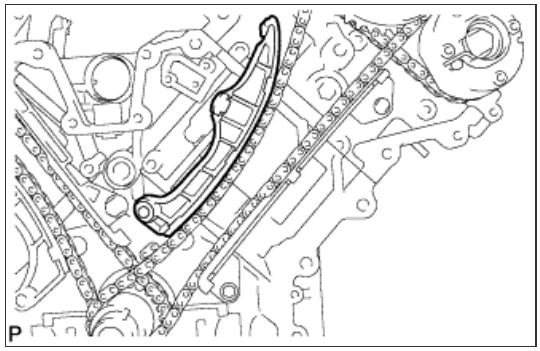
*1	Plunger
*2	Stopper Plate



c. Remove the 2 bolts, chain tensioner and gasket.

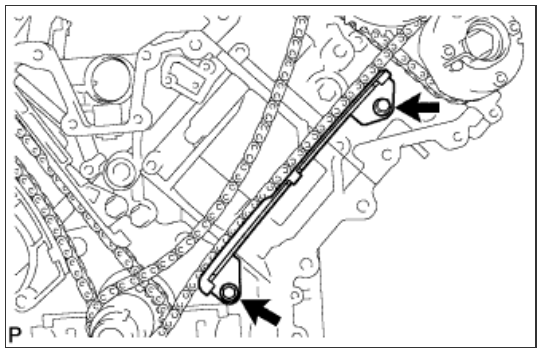


63. REMOVE NO. 1 CHAIN TENSIONER SLIPPER LH



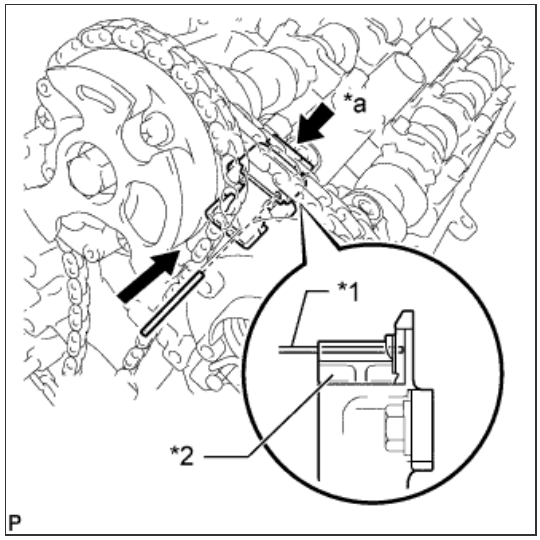
64. REMOVE NO. 1 CHAIN VIBRATION DAMPER LH

a. Remove the 2 bolts and chain vibration damper.



65. REMOVE NO. 1 CHAIN SUB-ASSEMBLY LH

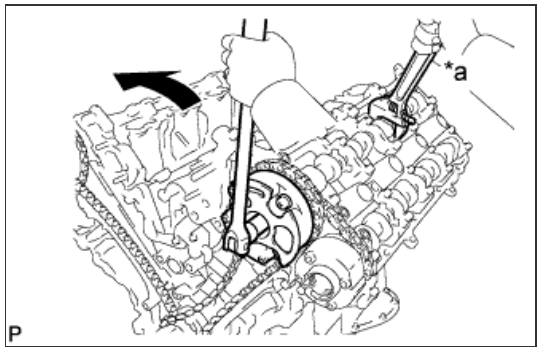
a. While pushing down the No. 3 chain tensioner, insert a pin of 1.0 mm (0.0394 in.) into the hole to fix it in place.



Text in Illustration

*1	Pin
*2	Plunger
*a	Push

b. Hold the hexagonal portion of the camshaft with a wrench and loosen the bolt.



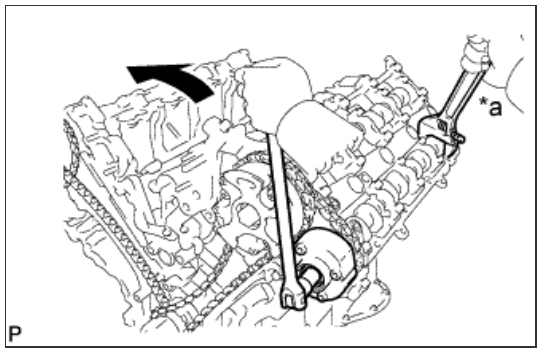
Text in Illustration

*a	Hold
➡	Turn

NOTICE:

- **Be careful not to dama the c lider head with the wrench.**
- **Do not disassemble the camshaft timin er.**

c. Hold the hexagonal portion of the camshaft with a wrench and loosen the bolt.



Text in Illustration

*a	Hold
➡	Turn

NOTICE:

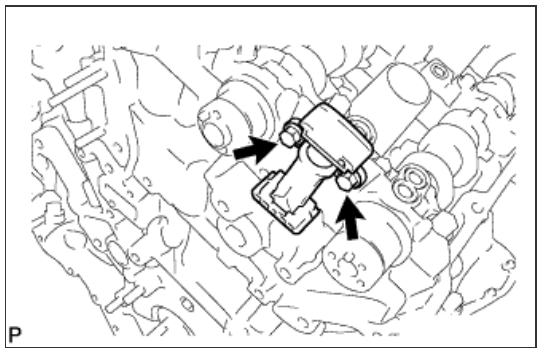
Be careful not to damage the cylinder head with the wrench.

d. Remove the 2 bolts. Then with the No. 1 and No. 2 chains still connected to the gears, remove the camshaft timing gear, camshaft timing exhaust gear and crankshaft timing sprocket LH.

e. Remove the No. 1 and No. 2 chains from the gears.

66. REMOVE NO. 3 CHAIN TENSIONER ASSEMBLY

a. Remove the 2 bolts and chain tensioner.

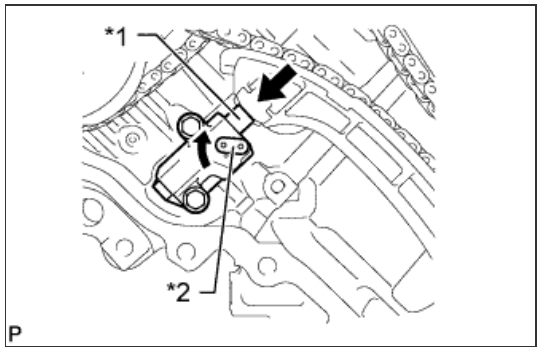


67. REMOVE NO. 1 CHAIN TENSIONER ASSEMBLY RH

a. Move the stopper plate clockwise to release the lock, and push the plunger deep into the tensioner.

Text in Illustration

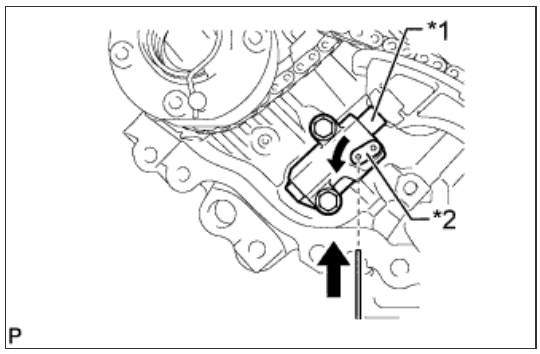
*1	Plunger
*2	Stopper Plate



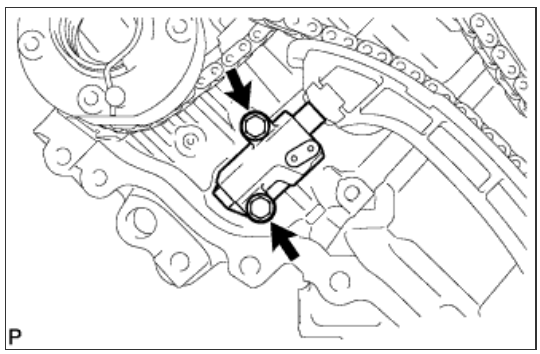
b. Move the stopper plate counterclockwise to set the lock, and insert a hexagon wrench into the stopper plate hole.

Text in Illustration

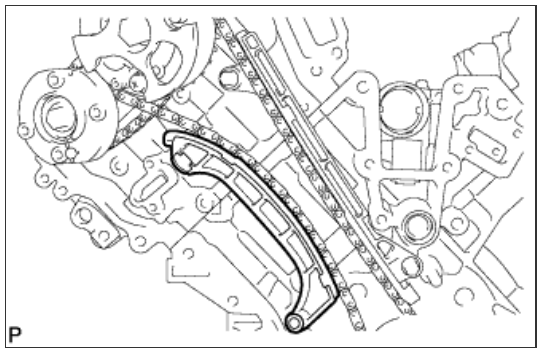
*1	Plunger
*2	Stopper Plate



c. Remove the 2 bolts and chain tensioner.

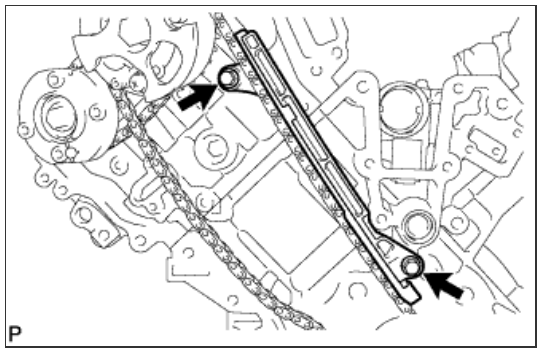


68. REMOVE NO. 1 CHAIN TENSIONER SLIPPER RH



69. REMOVE NO. 1 CHAIN VIBRATION DAMPER RH

a. Remove the 2 bolts and vibration damper.

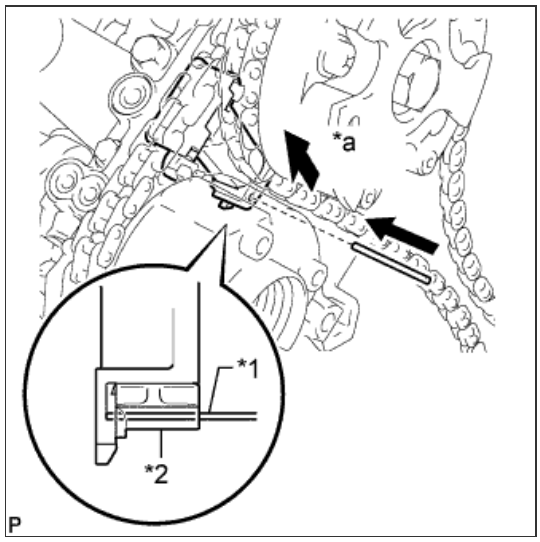


70. REMOVE NO. 1 CHAIN SUB-ASSEMBLY RH

a. While raising up the No. 2 chain tensioner, insert a pin of 1.0 mm (0.0394 in.) into the hole to fix it in place.

Text in Illustration

*1	Pin
*2	Plunger
*a	Push



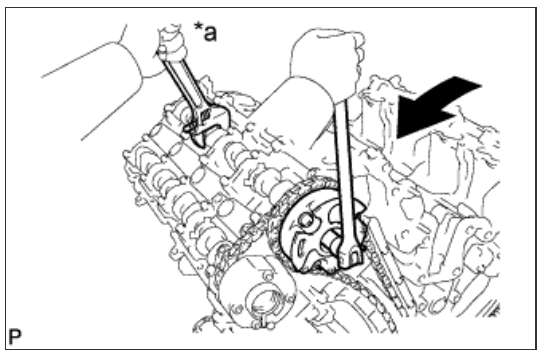
b. Hold the hexagonal portion of the camshaft with a wrench and loosen the bolt.

Text in Illustration

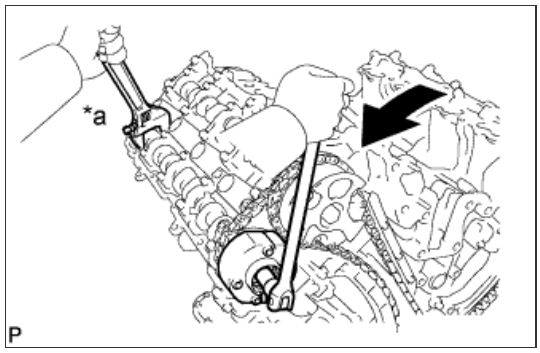
*a	Hold
➡	Turn

NOTICE:

- **Be careful not to dama the c lider head with the wrench.**
- **Do not disassemble the camshaft timin er.**



c. Hold the hexagonal portion of the camshaft with a wrench and loosen the bolt.



Text in Illustration

*a	Hold
➡	Turn

NOTICE:

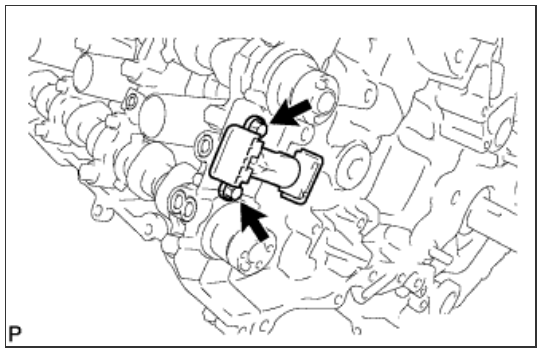
Be careful not to damage the cylinder head with the wrench.

d. Remove the 2 bolts. Then with the No. 1 and No. 2 chains still connected to the gears, remove the camshaft timing gear, camshaft timing exhaust gear and crankshaft timing sprocket RH.

e. Remove the No. 1 and No. 2 chains from the gears.

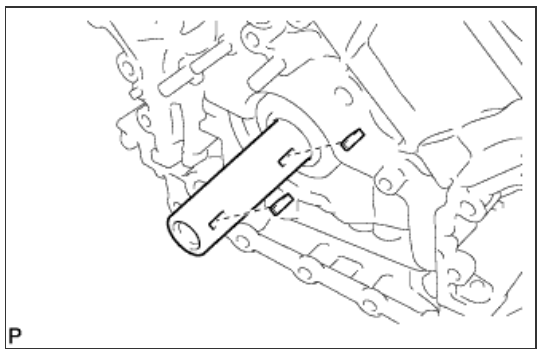
71. REMOVE NO. 2 CHAIN TENSIONER ASSEMBLY

a. Remove the 2 bolts and chain tensioner.



72. REMOVE CRANKSHAFT TIMING GEAR KEY

a. Using a screwdriver, remove the 2 timing gear keys from the crankshaft.

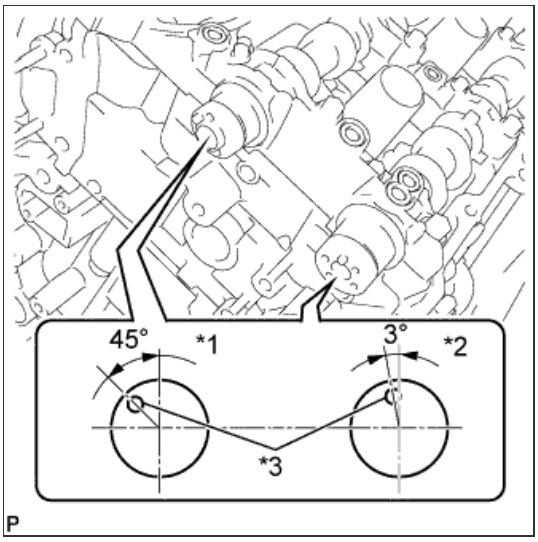


73. REMOVE CAMSHAFT BEARING CAP LH

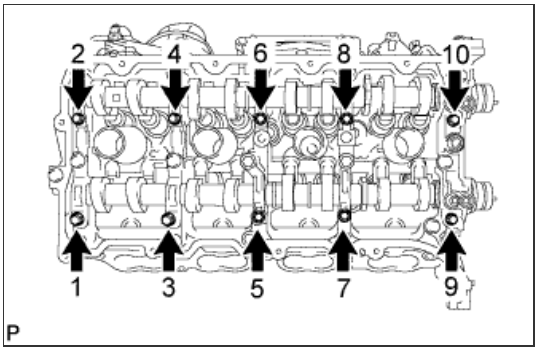
a. Make sure that the knock pin of the camshaft is positioned as shown in the illustration.

Text in Illustration

*1	IN
*2	EX
*3	Knock Pin



b. Uniformly loosen and remove the 10 bearing cap bolts in the sequence shown in the illustration.



c. Uniformly loosen and remove the 18 bearing cap bolts in the sequence shown in the illustration.

NOTICE:

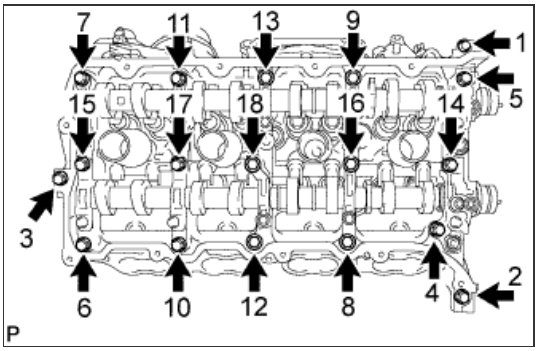
Uniformly loosen the bolts while keeping the camshaft level.

d. Remove the 6 bearing caps.

HINT:

Arrange the removed parts in the correct order.

e. Remove the No. 3 and No. 4 camshafts.



74. REMOVE CAMSHAFT HOUSING SUB-ASSEMBLY LH

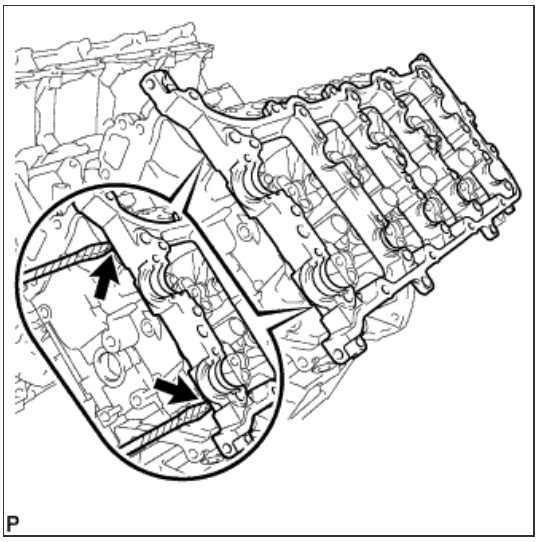
a. Remove the camshaft housing by prying between the cylinder head and camshaft housing with a screwdriver.

NOTICE:

Be careful not to damage the contact surfaces of the cylinder head and camshaft housing.

HINT:

Tape the screwdriver tip before use.

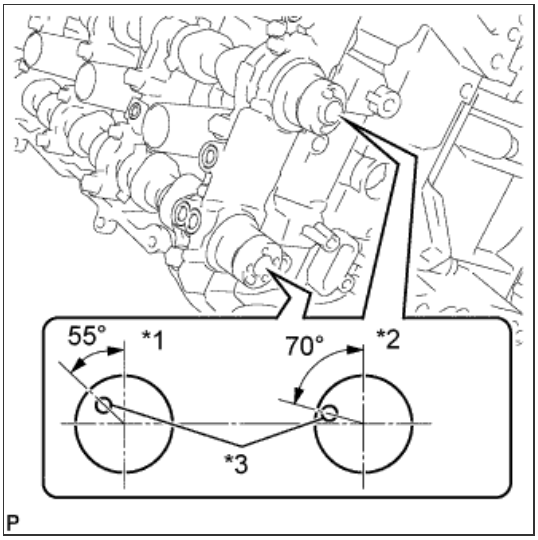


75. REMOVE CAMSHAFT BEARING CAP RH

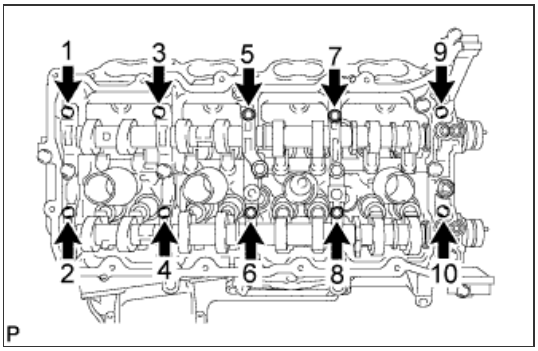
a. Make sure that the knock pin of the camshaft is positioned as shown in the illustration.

Text in Illustration

*1	EX
*2	IN
*3	Knock Pin



b. Uniformly loosen and remove the 10 bearing cap bolts in the sequence shown in the illustration.



c. Uniformly loosen and remove the 18 bearing cap bolts in the sequence shown in the illustration.

NOTICE:

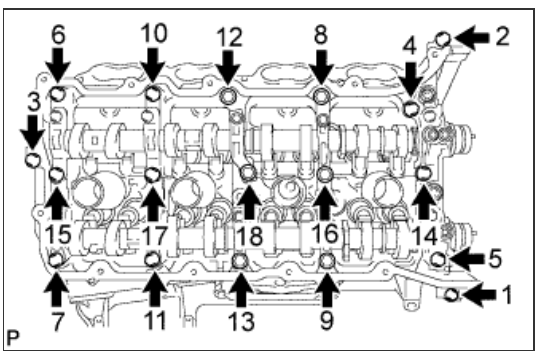
Uniformly loosen the bolts while keeping the camshaft level.

d. Remove the 6 bearing caps.

HINT:

Arrange the removed parts in the correct order.

e. Remove the No. 1 and No. 2 camshafts.



76. REMOVE CAMSHAFT HOUSING SUB-ASSEMBLY RH

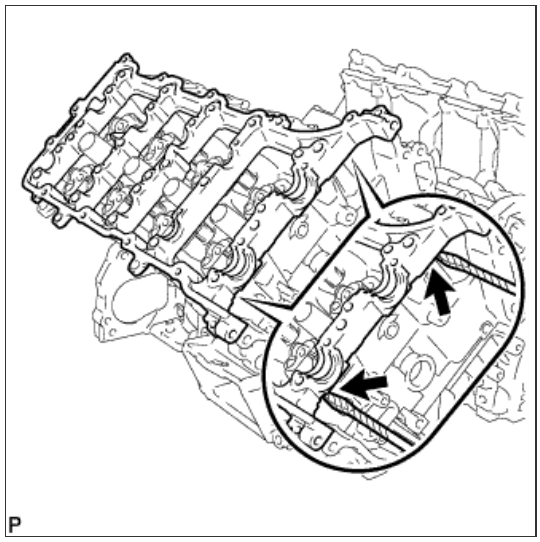
a. Remove the camshaft housing by prying between the cylinder head and camshaft housing with a screwdriver.

NOTICE:

Be careful not to damage the contact surfaces of the cylinder head and camshaft housing.

HINT:

Tape the screwdriver tip before use.



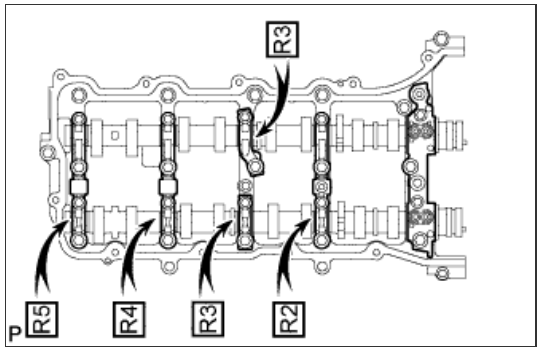
for Preparation Click here

1. INSTALL CAMSHAFT BEARING CAP RH

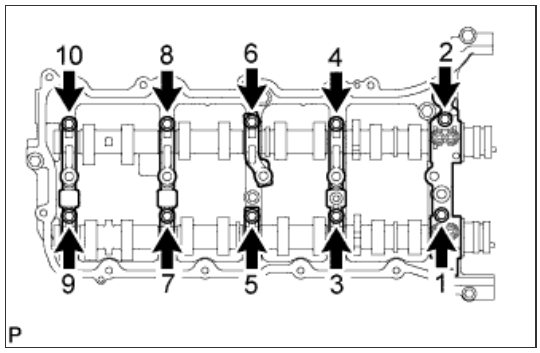
a. Apply a light coat of engine oil to the camshaft journals, camshaft housings and bearing caps.

b. Install the No. 1 and No. 2 camshafts to the camshaft housing.

c. Confirm the marks and numbers on the camshaft bearing caps and place them in their proper positions and directions.



d. Temporarily install the 10 bolts in the order shown in the illustration.

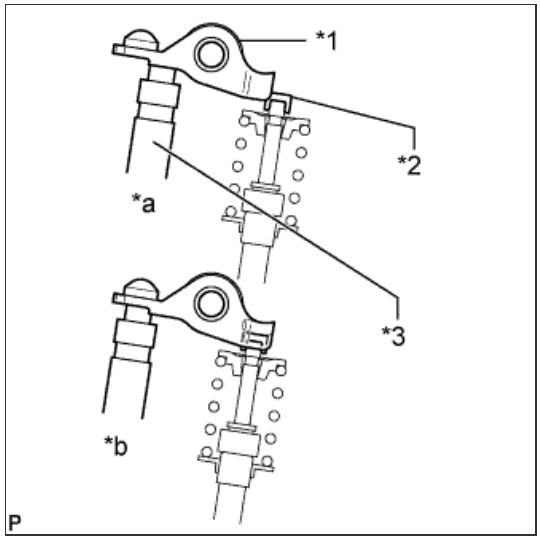


2. INSTALL CAMSHAFT HOUSING SUB-ASSEMBLY RH

a. Make sure that the valve rocker arms are installed as shown in the illustration.

Text in Illustration

*1	Valve Rocker Arm
*2	Valve Stem Cap
*3	Valve Lash Adjuster
*a	INCORRECT
*b	CORRECT



b. Apply seal packing in a continuous line as shown in the illustration.

Seal packing:

Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

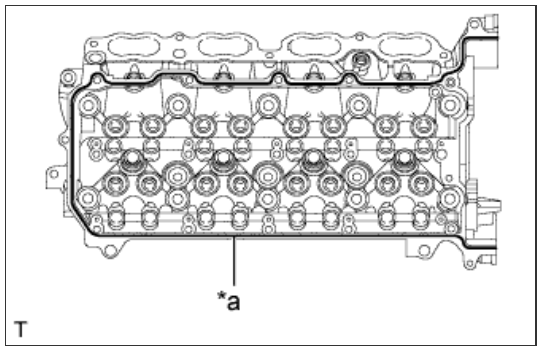
Standard seal diameter:
3.5 to 4.0 mm (0.138 to 0.157 in.)

Text in Illustration

*a	3.5 to 4.0 mm

NOTICE:

- Remove any oil from the contact surface.
- Install the camshaft housing within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.



c. Install the camshaft housing, and install the 18 bolts in the order shown in the illustration.

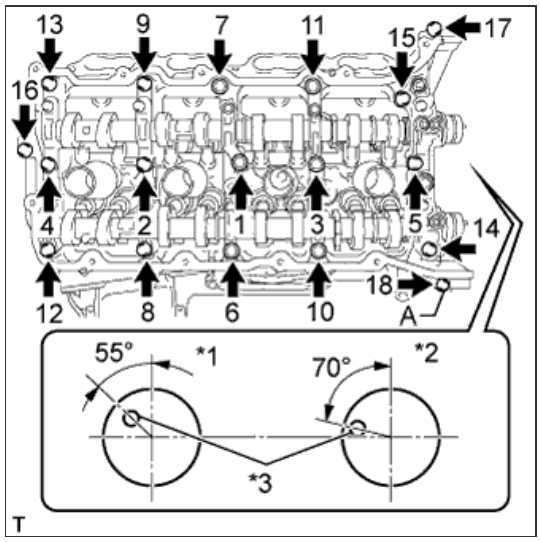
Torque:
for bolt A:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }
except bolt A:
30 N*m{ 306 kgf*cm , 22 ft.*lbf }

Text in Illustration

*1	EX
*2	IN
*3	Knock Pin

NOTICE:

- Do not start the engine for at least 2 hours after the installation.
- Make sure that the knock pin of the camshaft is positioned as shown in the illustration before installing the camshaft housing.

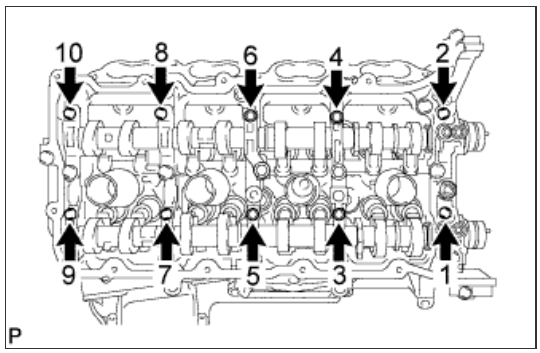


d. Tighten the 10 bolts in the order shown in the illustration.

Torque:
16 N*m{ 163 kgf*cm , 12 ft.*lbf }

NOTICE:

Thoroughly wipe clean any seal packing.

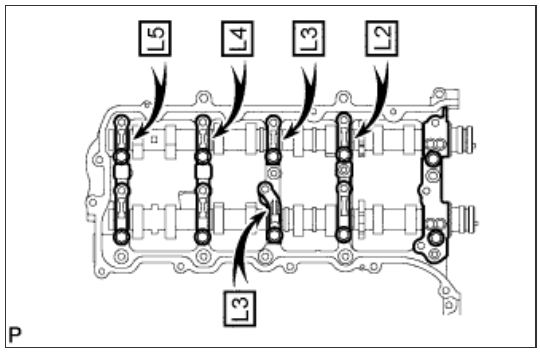


3. INSTALL CAMSHAFT BEARING CAP LH

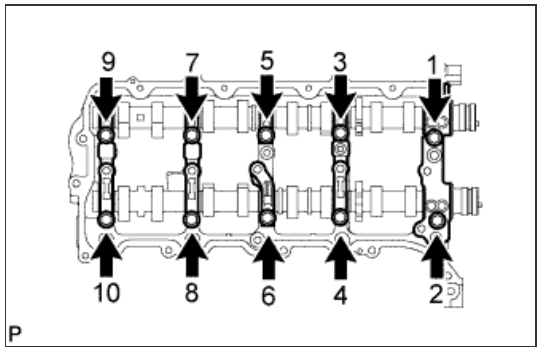
a. Apply a light coat of engine oil to the camshaft journals, camshaft housings and bearing caps.

b. Install the No. 3 and No. 4 camshafts to the camshaft housing.

c. Confirm the marks and numbers on the camshaft bearing caps and place them in their proper positions and directions.

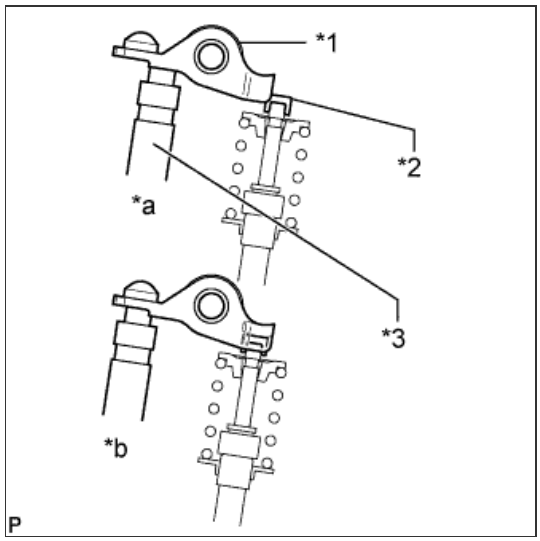


d. Temporarily install the 10 bolts in the order shown in the illustration.



4. INSTALL CAMSHAFT HOUSING SUB-ASSEMBLY LH

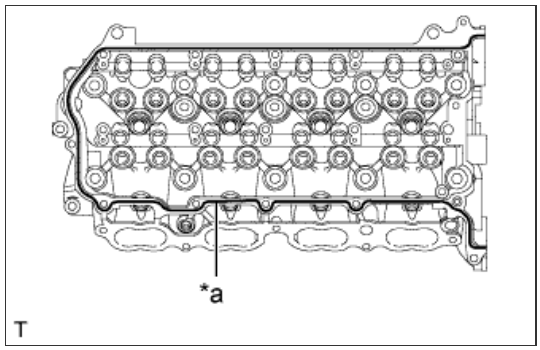
a. Make sure that the valve rocker arms are installed as shown in the illustration.



Text in Illustration

*1	Valve Rocker Arm
*2	Valve Stem Cap
*3	Valve Lash Adjuster
*a	INCORRECT
*b	CORRECT

b. Apply seal packing in a continuous line as shown in the illustration.



Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
3.5 to 4.0 mm (0.138 to 0.157 in.)

Text in Illustration

*a	3.5 to 4.0 mm

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the camshaft housing within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**

c. Install the camshaft housing, and install the 18 bolts in the order shown in the illustration.

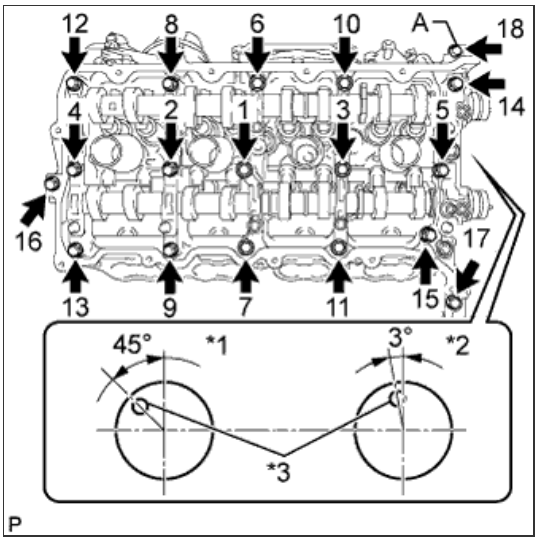
Torque:
for bolt A:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }
except bolt A:
30 N*m{ 306 kgf*cm , 22 ft.*lbf }

Text in Illustration

*1	IN
*2	EX
*3	Knock Pin

NOTICE:

- **Do not start the engine for at least 2 hours after the installation.**
- **Make sure that the knock pin of the camshaft is positioned as shown in the illustration before installing the camshaft housing.**

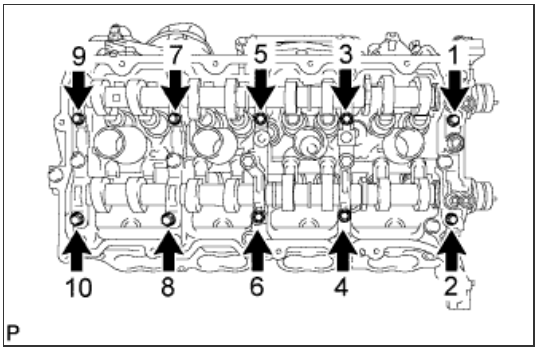


d. Tighten the 10 bolts in the order shown in the illustration.

Torque:
16 N*m{ 163 kgf*cm , 12 ft.*lbf }

NOTICE:

Thoroughly wipe clean any seal packing.

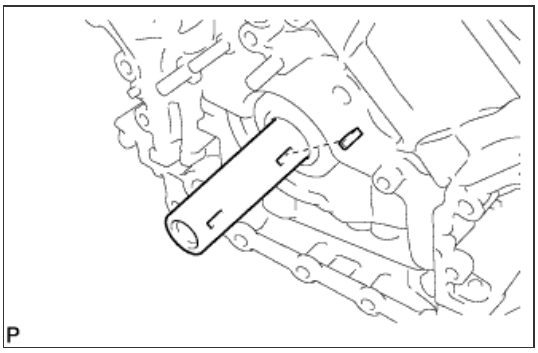


5. INSTALL CRANKSHAFT TIMING GEAR KEY

a. Install the timing gear key.

HINT:

The other timing gear key will be installed at a later step.



6. SET NO. 1 CYLINDER TO TDC/COMPRESSION

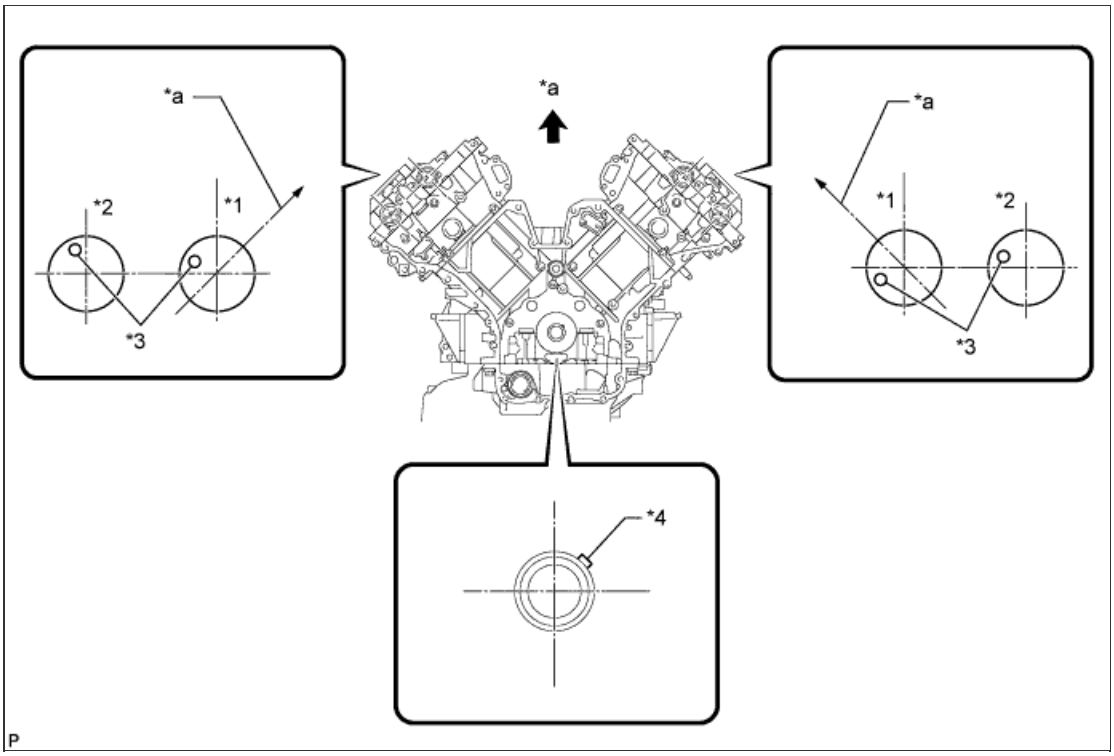
a. Temporarily install the crankshaft pulley bolt.

b. Rotate the crankshaft so that the timing gear key is as shown in the illustration. Then using a wrench, rotate each camshaft so that the timing marks are as shown in the illustration.

NOTICE:

When the crankshaft or a camshaft is rotated excessively, the valves and pistons may interfere with each other.

c. Remove the crankshaft pulley bolt.



Text in Illustration

*1	IN	*2	EX
*3	Knock Pin	*4	Key
*a	Toward Ceiling	-	-

7. INSTALL NO. 2 CHAIN TENSIONER ASSEMBLY

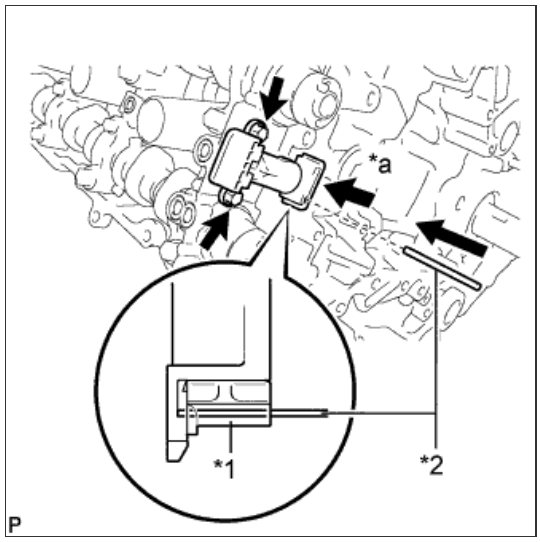
a. Install the chain tensioner with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

Text in Illustration

*1	Plunger
*2	Pin
*a	Push

b. While raising up the No. 2 chain tensioner, insert a pin of 1.0 mm (0.0394 in.) into the hole to fix it in place.

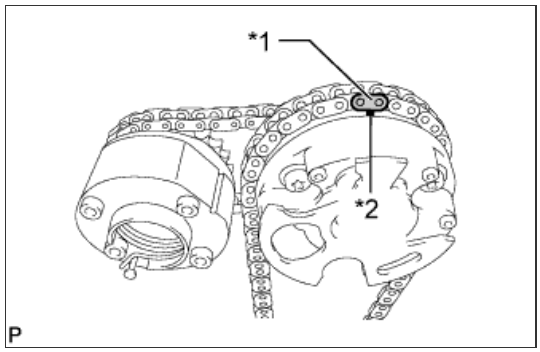


8. INSTALL NO. 1 CHAIN SUB-ASSEMBLY RH

a. Align the No. 1 chain orange mark plate with the camshaft timing gear timing mark, and attach the chain to the gear as shown in the illustration.

Text in Illustration

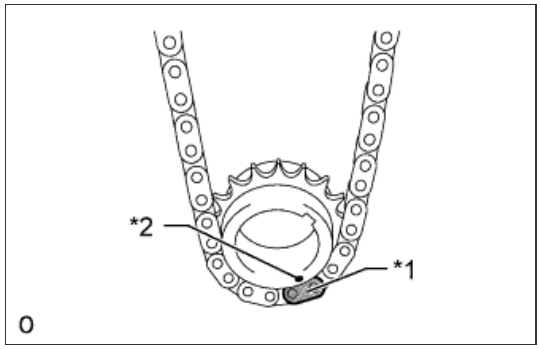
*1	Mark Plate
*2	Timing Mark



b. Align the No. 1 chain orange mark plate with the crankshaft timing sprocket timing mark, and attach the chain to the gear as shown in the illustration.

Text in Illustration

*1	Mark Plate
*2	Timing Mark



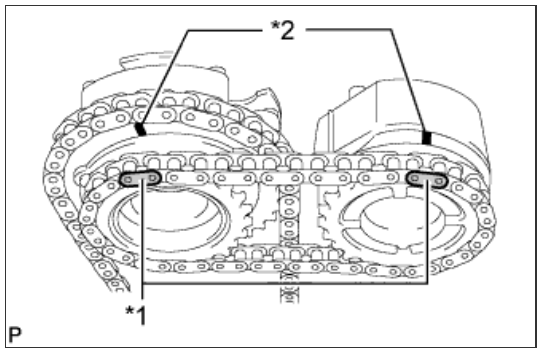
c. Align the No. 2 chain yellow mark plates with the timing marks of the camshaft timing gear assembly and camshaft timing exhaust gear assembly, and attach the No. 2 chain to the gears as shown in the illustration.

Text in Illustration

*1	Mark Plate
*2	Timing Mark

HINT:

The crankshaft timing sprocket RH and camshaft timing exhaust gear will be installed with the No. 1 and No. 2 chains connected to the gears.



d. Install the crankshaft timing sprocket RH to the crankshaft.

e. Align and attach the knock pin of the No. 1 camshaft with the pin hole of the camshaft timing gear.

f. Using the hexagonal portion of the No. 2 camshaft, align and attach the knock pin of the No. 2 camshaft with the pin hole of the camshaft timing exhaust gear.

g. Remove the pin from the No. 2 chain tensioner.

h. Using a wrench to hold the hexagonal portion of the No. 1 camshaft, temporarily install the bolt.

i. Using a wrench to hold the hexagonal portion of the No. 2 camshaft, temporarily install the bolt.

9. INSTALL NO. 1 CHAIN VIBRATION DAMPER RH

a. Install the vibration damper with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

10. INSTALL NO. 1 CHAIN TENSIONER SLIPPER RH

HINT:

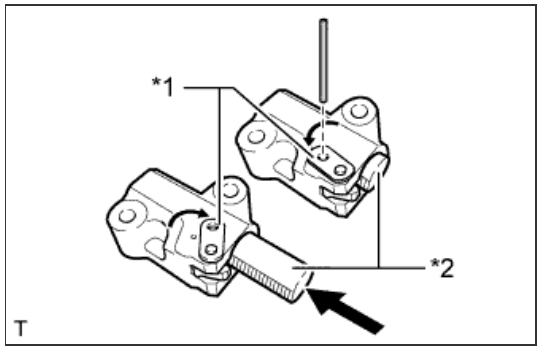
If you cannot install the chain tensioner slipper due to the tension of the chain, use the hexagonal portion of the camshaft to loosen the chain, and then install the chain tensioner slipper.

11. INSTALL NO. 1 CHAIN TENSIONER ASSEMBLY RH

a. Move the stopper plate clockwise to release the lock, and push the plunger deep into the tensioner.

Text in Illustration

*1	Stopper Plate
*2	Plunger



b. Move the stopper plate counterclockwise to set the lock, and insert a hexagon wrench into the hole of the stopper plate.

c. Install the chain tensioner with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

d. Remove the hexagon wrench from the chain tensioner.

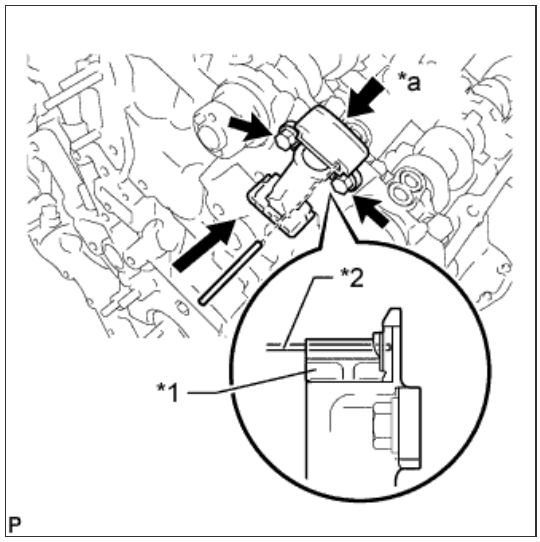
12. INSTALL NO. 3 CHAIN TENSIONER ASSEMBLY

a. Install the chain tensioner with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

Text in Illustration

*1	Plunger
*2	Pin
*a	Push



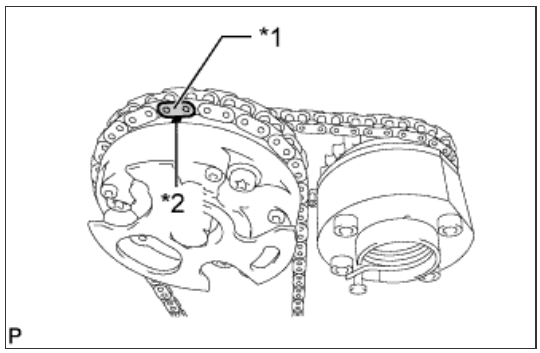
b. While pushing down the No. 2 chain tensioner, insert a pin of 1.0 mm (0.0394 in.) into the hole to fix it in place.

13. INSTALL NO. 1 CHAIN SUB-ASSEMBLY LH

a. Align the No. 1 chain orange mark plate with the camshaft timing gear timing mark, and attach the chain to the gear as shown in the illustration.

Text in Illustration

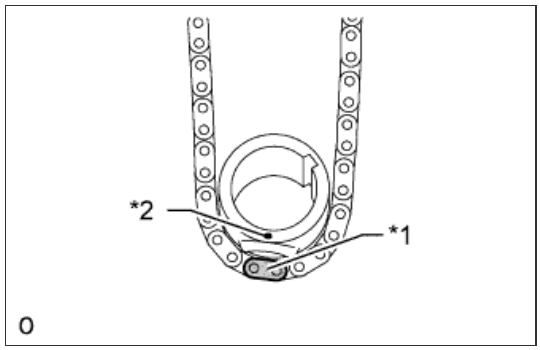
*1	Mark Plate
*2	Timing Mark



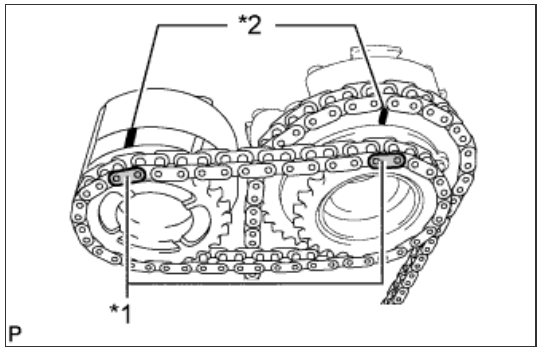
b. Align the No. 1 chain orange mark plate with the crankshaft timing sprocket timing mark, and attach the chain to the gear as shown in the illustration.

Text in Illustration

*1	Mark Plate
*2	Timing Mark



c. Align the No. 2 chain yellow mark plates with the timing marks of the camshaft timing gear assembly and camshaft timing exhaust gear assembly, and attach the No. 2 chain to the gears as shown in the illustration.



Text in Illustration

*1	Mark Plate
*2	Timing Mark

HINT:

The crankshaft timing sprocket LH and camshaft timing exhaust gear will be installed with the No. 1 and No. 2 chains connected to the gears.

d. Install the crankshaft timing sprocket LH to the crankshaft.

e. Align and attach the knock pin of the No. 3 camshaft with the pin hole of the camshaft timing gear.

f. Using the hexagonal portion of the No. 4 camshaft, align and attach the knock pin of the No. 4 camshaft with the pin hole of the camshaft timing exhaust gear.

NOTICE:

Because the timing mark positions of the gears may shift due to looseness of the No. 1 chain, use the hexagonal portion of the camshaft to hold the No. 3 camshaft in place until the No. 1 chain tensioner is installed.

g. Remove the pin from the No. 3 chain tensioner.

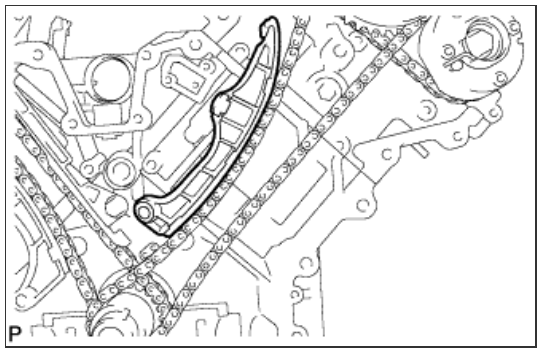
h. Using a wrench to hold the hexagonal portion of the No. 3 camshaft, temporarily install the bolt.

i. Using a wrench to hold the hexagonal portion of the No. 4 camshaft, temporarily install the bolt.

14. INSTALL NO. 1 CHAIN TENSIONER SLIPPER LH

HINT:

If you cannot install the chain tensioner slipper due to the tension of the chain, use the hexagonal portion of the camshaft to loosen the chain, and install the chain tensioner slipper.



15. INSTALL NO. 1 CHAIN TENSIONER ASSEMBLY LH

a. Move the stopper plate clockwise to release the lock, and push the plunger deep into the tensioner.

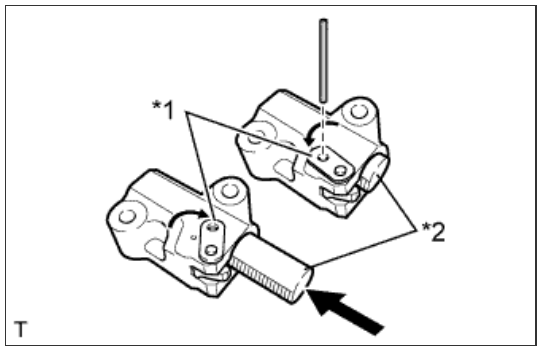
Text in Illustration

*1	Stopper Plate
*2	Plunger

b. Move the stopper plate counterclockwise to set the lock, and insert a hexagon wrench into the hole of the stopper plate.

c. Install a new gasket and the chain tensioner with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

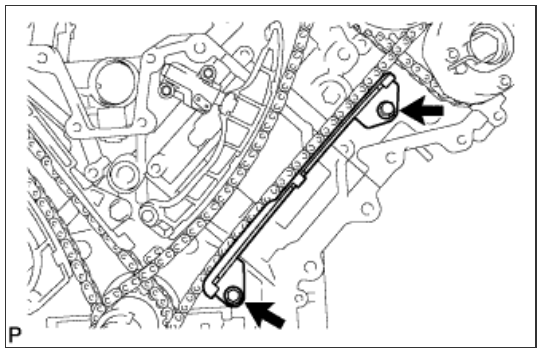


16. INSTALL NO. 1 CHAIN VIBRATION DAMPER LH

a. Install the vibration damper with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

b. Remove the hexagon wrench from the No. 1 chain tensioner.



17. TIGHTEN CAMSHAFT TIMING GEAR ASSEMBLY

a. for Bank 1:

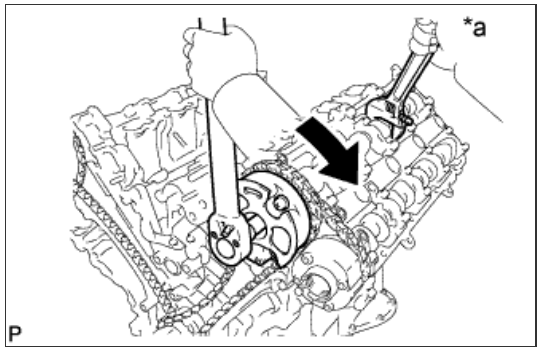
i. Using a wrench, hold the hexagonal portion of the No. 3 camshaft.

Text in Illustration

*a	Hold
➡	Turn

ii. Tighten the bolt of the camshaft timing gear.

Torque:
100 N*m{ 1020 kgf*cm , 74 ft.*lbf }

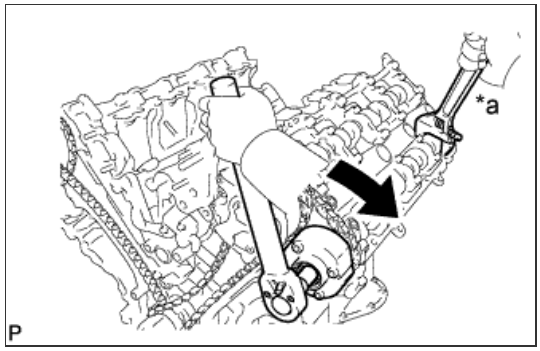


iii. Using a wrench to hold the hexagonal portion of the No. 4 camshaft, tighten the bolt of the camshaft timing exhaust gear.

Torque:
100 N*m{ 1020 kgf*cm , 74 ft.*lbf }

Text in Illustration

*a	Hold
➡	Turn

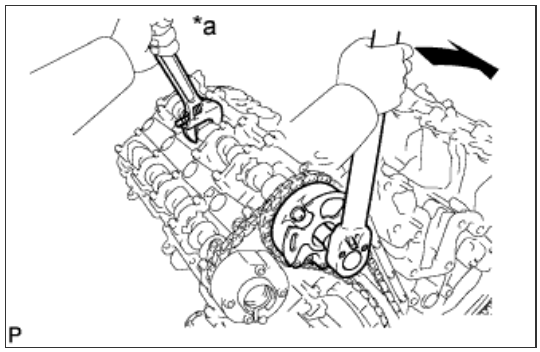


b. for Bank 2:

i. Using a wrench, hold the hexagonal portion of the No. 1 camshaft.

Text in Illustration

*a	Hold
➡	Turn



ii. Tighten the bolt of the camshaft timing gear.

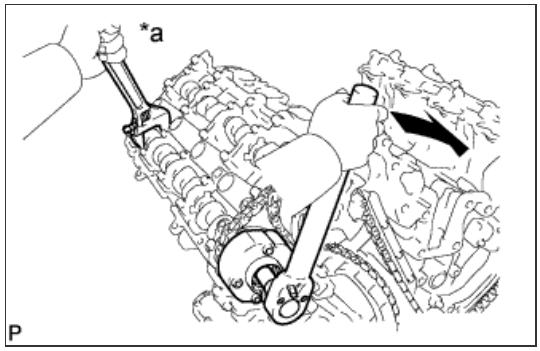
Torque:
100 N*m{ 1020 kgf*cm , 74 ft.*lbf }

iii. Using a wrench to hold the hexagonal portion of the No. 2 camshaft, tighten the bolt of the camshaft timing exhaust gear.

Torque:
100 N*m{ 1020 kgf*cm , 74 ft.*lbf }

Text in Illustration

*a	Hold
➡	Turn

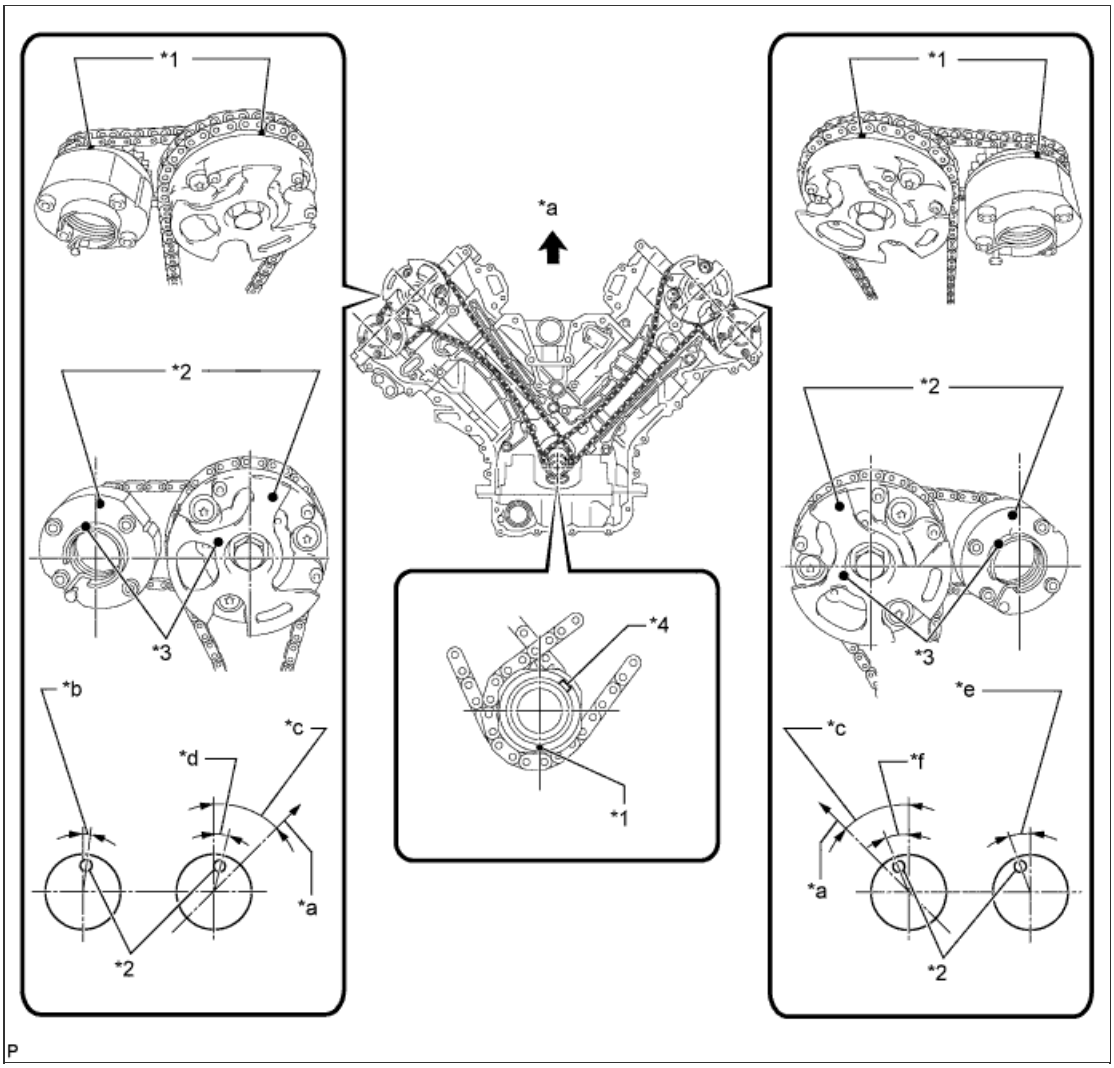


18. CHECK NO. 1 CYLINDER TO TDC/COMPRESSION

a. Temporarily install the crankshaft pulley bolt.

b. Rotate the crankshaft clockwise, and check that the timing marks on the crankshaft timing sprocket and camshaft timing gears are as shown in the illustration.

c. Remove the crankshaft pulley bolt.



Text in Illustration

*1	Timing Mark	*2	Timing Mark Position
*3	Knock Pin Position	*4	Key
*a	Toward Ceiling	*b	Approximately 2°
*c	Approximately 45°	*d	Approximately 16°
*e	Approximately 18°	*f	Approximately 32°

19. INSTALL WATER INLET PIPE

a. Apply soapy water to 2 new O-rings and install them to the inlet pipe.

b. Install the inlet pipe to the No. 1 heat exchanger cover.

20. INSTALL TIMING CHAIN COVER SUB-ASSEMBLY

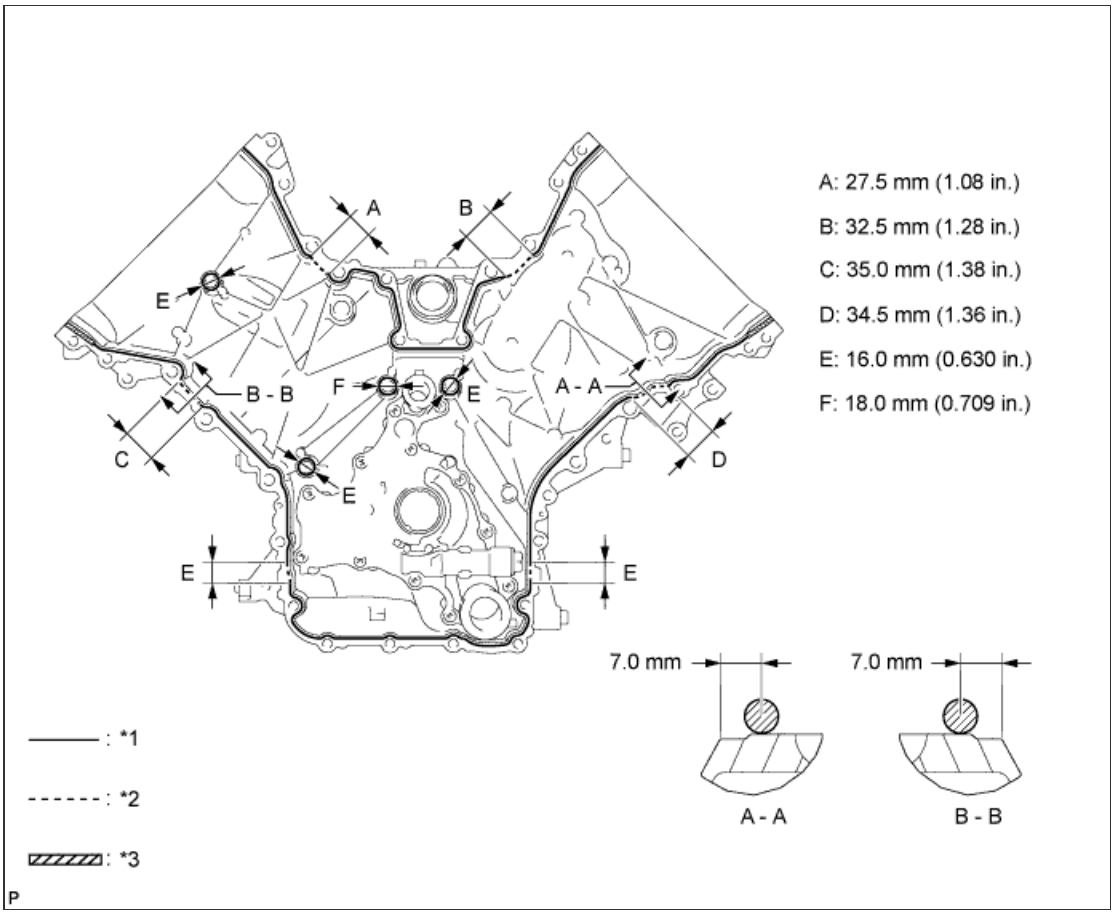
a. Apply a light coat of engine oil to a new oil pump gasket.

b. Install the oil pump gasket.

c. Apply a light coat of engine oil to a new O-ring.

d. Install the O-ring.

e. Apply seal packing in a continuous line to the timing chain cover as shown in the following illustration.



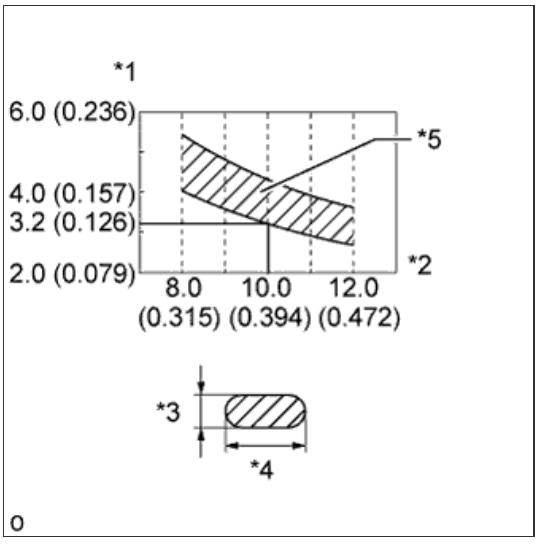
Text in Illustration

*1	Continuous line area	*2	Dashed line area
*3	Diagonal line area	-	-

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Apply Seal Packing as Follows:

Area	Seal Packing Diameter	Application Position from Inside Edge of Cover
Continuous Line Area	3.0 to 4.0 mm (0.118 to 0.157 in.)	2.5 mm (0.0984 in.)
Dashed Line Area	6.4 mm (0.252 in.) or more, or within OK area shown in illustration	7.0 mm (0.276 in.)
Diagonal Line Area	3.0 to 4.0 mm (0.118 to 0.157 in.)	5.5 mm (0.217 in.)



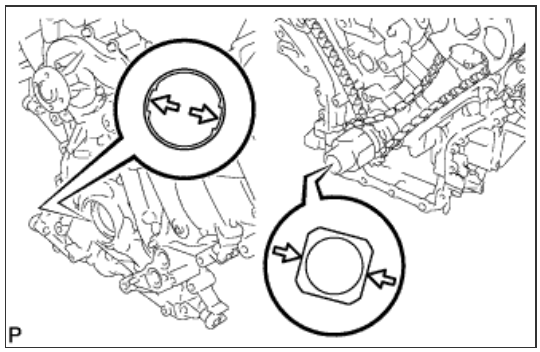
Text in Illustration

*1	Seal Packing Thickness mm (in.)
*2	Seal Packing Width mm (in.)
*3	Seal Packing Thickness
*4	Seal Packing Width
*5	OK Area

NOTICE:

- **When the contact surfaces are wet, wipe them with an oil-free cloth before applying seal packing.**
- **Install the chain cover within 3 minutes and tighten the bolts within 10 minutes after applying seal packing.**

f. Align the oil pump drive rotor spline and crankshaft as shown in the illustration. Install the spline and chain cover to the crankshaft.



g. Temporarily install the timing chain cover with the 28 bolts and nut.

Standard Bolt:

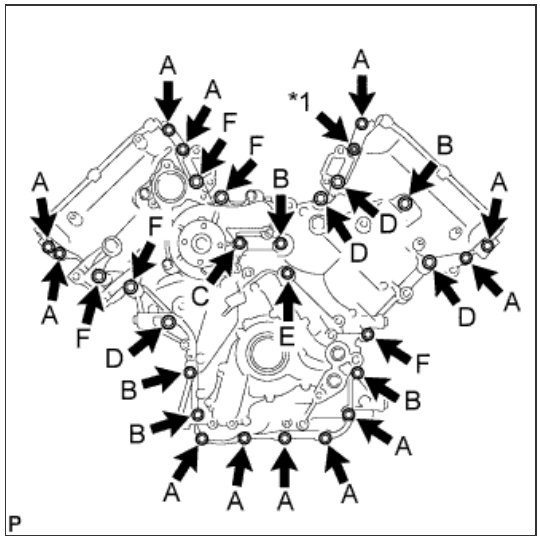
Item	Length	Thread Diameter
Bolt A	25 mm (0.984 in.)	8 mm (0.315 in.)
Bolt B	55 mm (2.17 in.)	8 mm (0.315 in.)
Bolt C	70 mm (2.76 in.)	8 mm (0.315 in.)
Bolt D	35 mm (1.38 in.)	10 mm (0.394 in.)
Bolt E	55 mm (2.17 in.)	10 mm (0.394 in.)
Bolt F	80 mm (3.15 in.)	10 mm (0.394 in.)

Text in Illustration

*1	Nut

NOTICE:

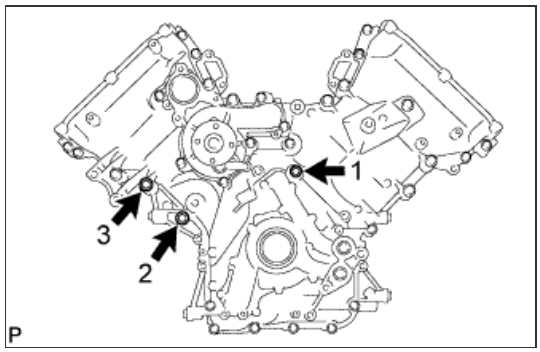
Make sure that there is no oil on the bolt threads.



h. Tighten the 3 bolts in several steps in the sequence shown in the illustration.

Torque:

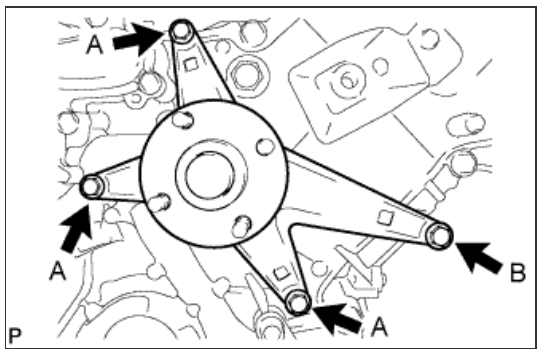
47 N*m{ 479 kgf*cm , 35 ft.*lbf }



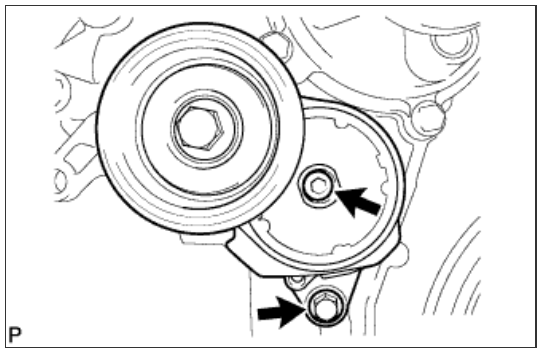
i. Temporarily install the fluid coupling bracket with the 4 bolts.

Standard Bolt:

Item	Length	Thread Diameter
Bolt A	70 mm (2.76 in.)	8 mm (0.315 in.)
Bolt B	80 mm (3.15 in.)	10 mm (0.394 in.)

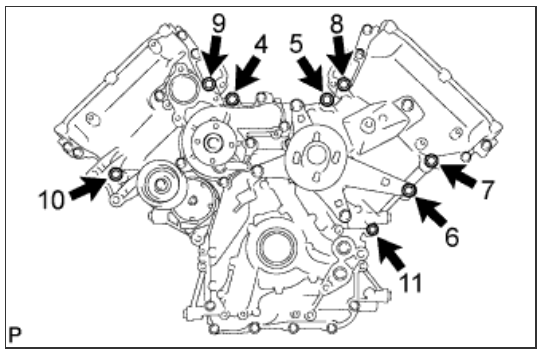


j. Temporarily install the belt tensioner with the standard bolt and 6 mm hexagon wrench bolt.



k. Tighten the 8 bolts labeled 4 to 11 in several steps in the sequence shown in the illustration.

Torque:
47 N*m{ 479 kgf*cm , 35 ft.*lbf }

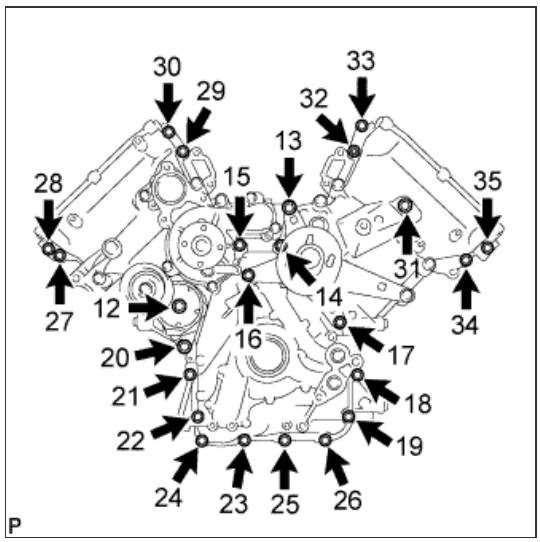


l. Tighten the 23 bolts and nut labeled 12 to 35 in several steps in the sequence shown in the illustration.

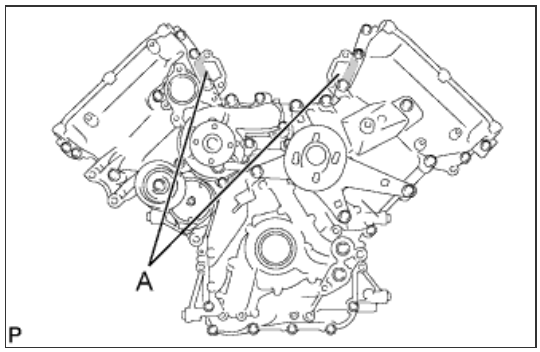
Torque:
23 N*m{ 235 kgf*cm , 17 ft.*lbf }

NOTICE:

- **Do not start the engine for at least 2 hours after installing.**



- **After the installation, if the seal packing has seeped out at the areas labeled A shown in the illustration, wipe it off.**

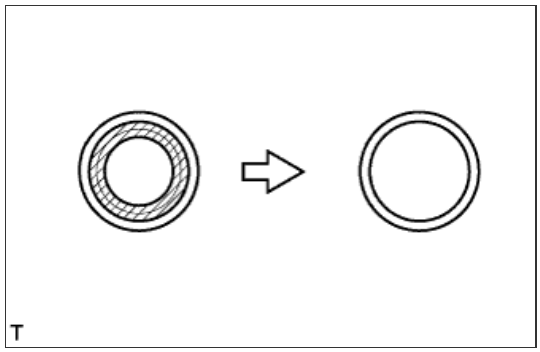


21. INSTALL SPARK PLUG TUBE GASKET

a. Using a cutter knife, cut off the seal part of the removed gasket.

Text in Illustration

	Area to cut off



b. Using the removed gasket and a hammer, tap in a new gasket until it stops.

Text in Illustration

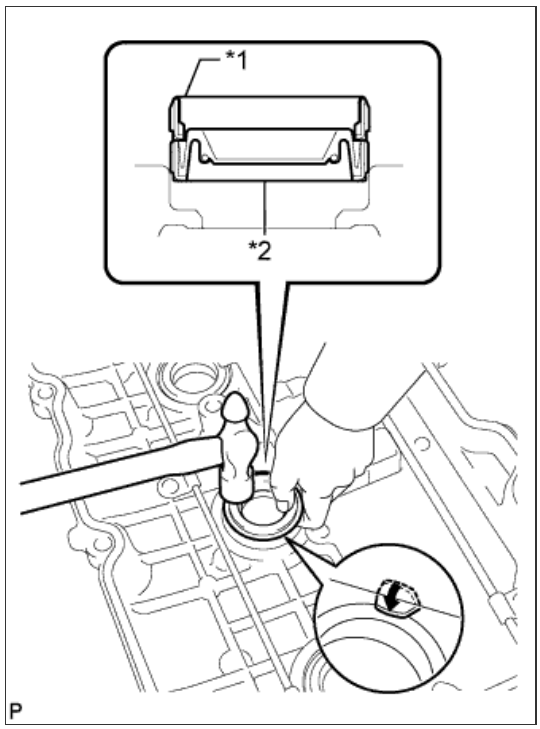
*1	Removed Gasket
*2	New Gasket

HINT:

If the removed gasket does not fit on the new one, correct the removed one with pliers.

c. Apply a light coat of MP grease to the lip of the gasket.

d. Return the 4 ventilation baffle plate claws to the original positions.



22. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY LH

a. Install 5 new gaskets to the camshaft bearing caps (No. 2, No. 3).

b. Install a new gasket to the cylinder head cover.

NOTICE:

Remove any oil from the contact surface.

c. Apply seal packing as shown in the illustration.

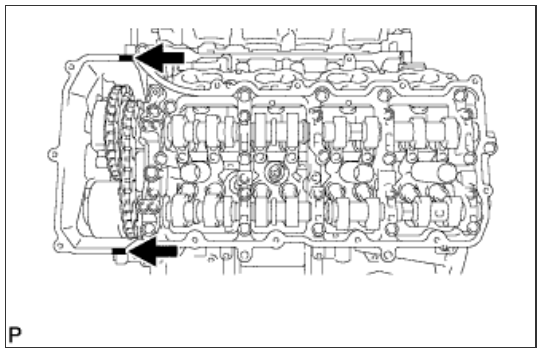
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Text in Illustration

	Seal Packing

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the cylinder head cover within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**

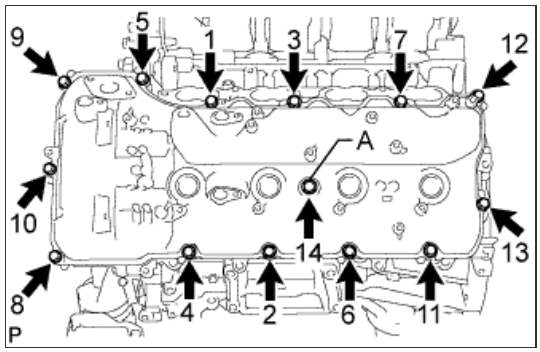


d. Install the cylinder head cover and a new seal washer with the 14 bolts in the order shown in the illustration.

Torque:
for bolt A:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
except bolt A:
12 N*m{ 122 kgf*cm , 9 ft.*lbf }

NOTICE:

Do not start the engine for at least 2 hours after the installation.



23. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY RH

a. Install 5 new gaskets to the camshaft bearing caps. (No. 1, No. 3).

b. Install a new gasket to the cylinder head cover.

NOTICE:

Remove any oil from the contact surface.

c. Apply seal packing as shown in the illustration.

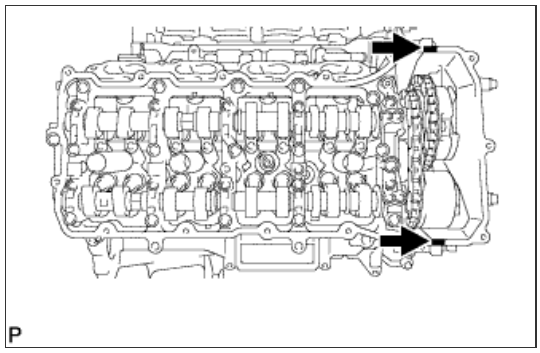
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Text in Illustration

➡	Seal Packing

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the cylinder head cover within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**

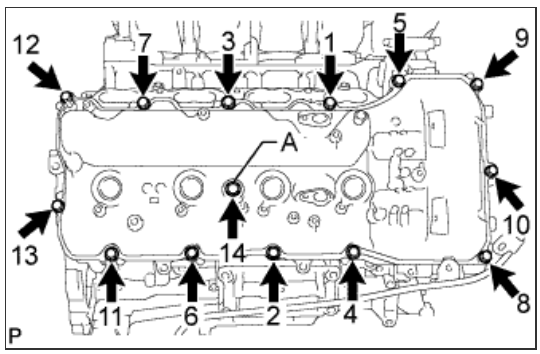


d. Install the cylinder head cover and a new seal washer with the 14 bolts in the order shown in the illustration.

Torque:
for bolt A:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
except bolt A:
12 N*m{ 122 kgf*cm , 9 ft.*lbf }

NOTICE:

Do not start the engine for at least 2 hours after the installation.



e. Install the noise filter to the cylinder head cover with the bolt.

Torque:
7.0 N*m{ 71 kgf*cm , 62 in.*lbf }

24. INSTALL IGNITION COIL ASSEMBLY

a. Install the 8 ignition coils with the 8 bolts.

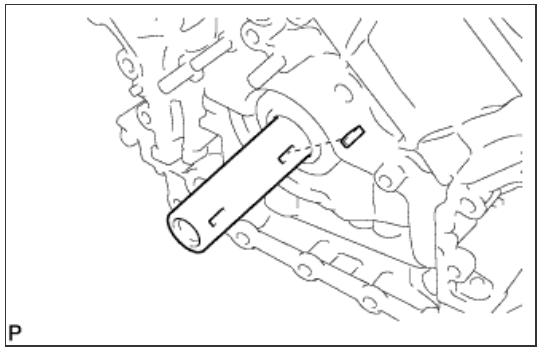
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

25. INSTALL CRANKSHAFT TIMING GEAR KEY

a. Install the timing gear key.

HINT:

The other timing gear key will be installed at a later step.



26. INSTALL CRANKSHAFT PULLEY

a. Align the pulley set key with the key groove of the pulley, and slide on the pulley.

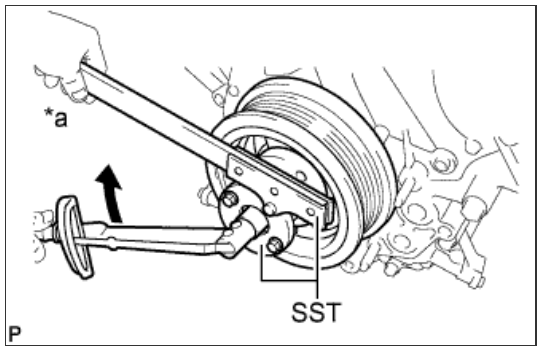
b. Using SST, install the pulley set bolt.

SST
09213-70011
09330-00021

Torque:
300 N*m{ 3059 kgf*cm , 221 ft.*lbf }

Text in Illustration

*a	Hold
➡	Turn



27. CONNECT WIRE HARNESS CLAMP BRACKET

a. Connect the bracket to the timing chain cover with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

28. INSTALL NO. 1 IDLER PULLEY SUB-ASSEMBLY

a. Install the idler pulley with the bolt.

Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }

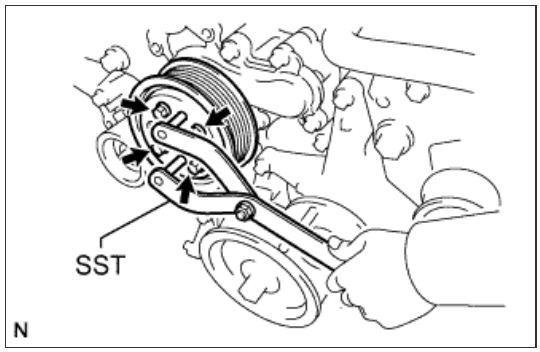
29. INSTALL WATER PUMP PULLEY

a. Temporarily install the pulley with the 4 bolts.

b. Using SST, hold the pulley and tighten the 4 bolts.

SST
09960-10010 (09962-01000, 09963-01000)

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

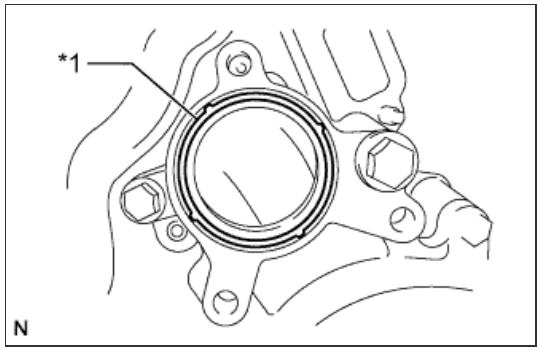


30. INSTALL WATER INLET HOUSING

a. Install a new gasket to the timing chain cover.

b. Install the water inlet with the 3 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



Text in Illustration

*1	Gasket

31. INSTALL NO. 1 ENGINE COVER

32. INSTALL NO. 2 ENGINE COVER

33. INSTALL FRONT WATER BY-PASS JOINT

a. Install 2 new gaskets and the water by-pass joint with the 4 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

b. Connect the No. 2 water by-pass hose to the water by-pass joint.

34. INSTALL WATER BY-PASS PIPE SUB-ASSEMBLY

a. Connect the 2 hoses.

b. Install the water by-pass pipe with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

35. INSTALL NO. 1 WATER BY-PASS HOSE

a. Install the No. 1 water by-pass hose by connecting the hose to the water inlet housing and front water by-pass joint.

36. INSTALL GENERATOR ASSEMBLY

a. Install the stud bolt.

Torque:

10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Install the generator with the 3 bolts and nut.

Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }

c. Connect the generator connector.

d. Connect the generator wire with the nut.

Torque:
12 N*m{ 122 kgf*cm , 9 ft.*lbf }

e. Install the terminal cap.

f. Install the harness bracket to the generator with the bolt.

Torque:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

37. CONNECT OIL COOLER PIPE ASSEMBLY

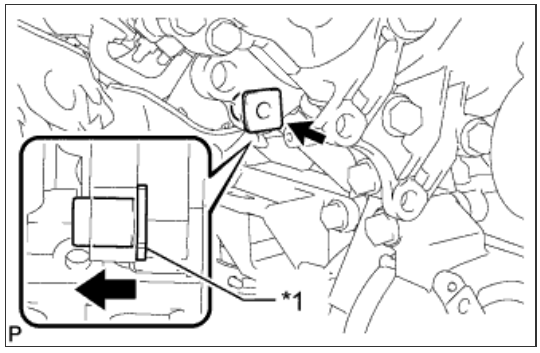
a. Connect the oil cooler pipe with the 2 bolts.

Torque:
14 N*m{ 143 kgf*cm , 10 ft.*lbf }

38. CONNECT VANE PUMP ASSEMBLY

HINT:

Before performing the following procedures, move the spacer until the vane pump can be installed.



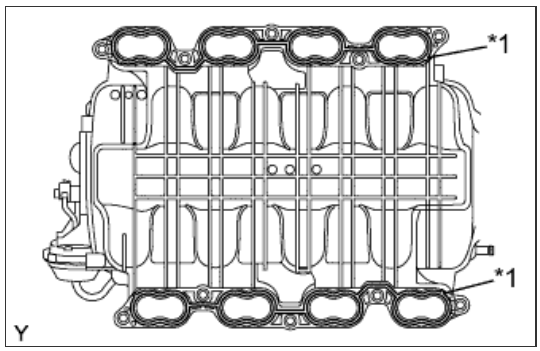
Text in Illustration

*1	Spacer

a. Connect the vane pump to the timing chain cover with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

39. INSTALL INTAKE MANIFOLD



a. Place 2 new gaskets on the intake manifold.

Text in Illustration

*1	Gasket

b. Place the intake manifold on the cylinder head.

c. Install and uniformly tighten the 8 bolts and 2 nuts in several steps.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

d. Install the wire bracket to the intake manifold with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

e. Connect the 3 wire clamps to the 3 wire brackets.

f. Install the No. 3 engine cover.

g. Install the No. 1 engine cover sub-assembly.

h. Connect the purge VSV connector.

i. Connect the purge line hose to the purge VSV.

j. Connect the vacuum switching valve connector (for ACIS).

k. Connect the No. 1 ventilation hose.

l. Connect the 2 water by-pass hoses.

m. Connect the throttle body connector.

n. Connect the ventilation hose to the ventilation pipe of the cylinder head cover LH and RH.

40. INSTALL OIL FILTER BRACKET

a. Apply a light coat of engine oil to 2 new O-rings.

b. Install the 2 O-rings to the timing chain cover.

c. Install the oil filter bracket with the 2 nuts and 2 bolts.

Torque:
35 N*m{ 357 kgf*cm , 26 ft.*lbf }

41. INSTALL NO. 1 OIL COOLER BRACKET

a. Connect the ground wire to the cylinder block.

b. Install the oil cooler bracket with the 2 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

42. INSTALL NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY

a. Connect the 4 hoses.

b. Install the water by-pass pipe with the 3 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

43. INSTALL OIL PRESSURE SENDER GAUGE ASSEMBLY

a. Apply adhesive to 2 or 3 threads of the oil pressure sender gauge.

Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent

NOTICE:

Do not allow adhesive to contact the oil hole.

Text in Illustration

*1	Oil Hole

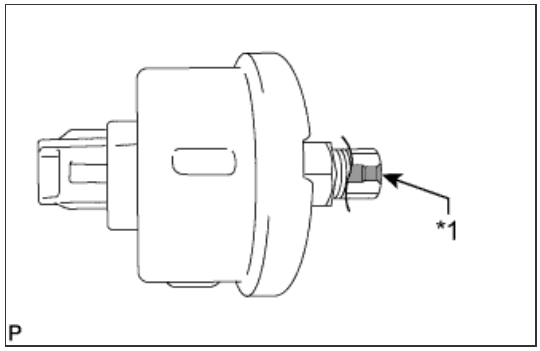
b. Install the oil pressure sender gauge.

Torque:
15 N*m{ 153 kgf*cm , 11 ft.*lbf }

NOTICE:

Do not start the engine within 1 hour after installation.

c. Connect the sender gauge connector.



44. INSTALL ENGINE OIL LEVEL DIPSTICK GUIDE

a. Apply a light coat of engine oil to a new O-ring.

b. Install the O-ring to the guide.

c. Install the dipstick guide with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

d. Install the dipstick.

e. Connect the wire harness clamp.

45. INSTALL OIL FILTER ELEMENT

a. Clean the inside of the oil filter cap, its threads and its O-ring groove.

b. Apply a small amount of engine oil to a new O-ring and install it to the oil filter cap.

c. Set a new oil filter element to the oil filter cap.

d. Remove any dirt or foreign matter from the installation surface of the engine.

e. Apply a small amount of engine oil to the O-ring again and temporarily install the oil filter cap.

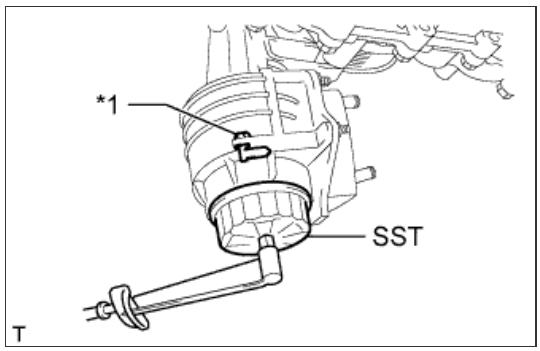
NOTICE:

Do not remove the oil filter bracket clip.

f. Using SST, tighten the oil filter cap.

SST
09228-06501

Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }



Text in Illustration

*1	Oil Filter Bracket Clip

NOTICE:

- **When tightening the oil filter cap, do not remove the oil filter bracket clip.**
- **Make sure that the oil filter is installed securely as shown in the illustration.**
- **Be careful that the O-ring does not get caught between any surrounding parts.**

g. Apply a small amount of engine oil to a new drain plug O-ring, and install it to the oil filter cap.

Text in Illustration

*1	O-Ring

NOTICE:

Before installing the O-ring, remove any dirt or foreign matter from the installation surface of the oil filter cap.

h. Install the oil filter drain plug.

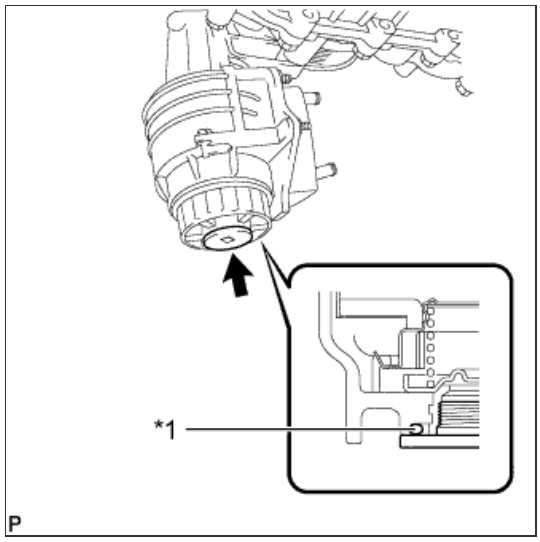
Torque:
13 N*m{ 127 kgf*cm , 9 ft.*lbf }

NOTICE:

Be careful that the O-ring does not get caught between any surrounding parts.

i. Install the No. 2 engine under cover seal with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



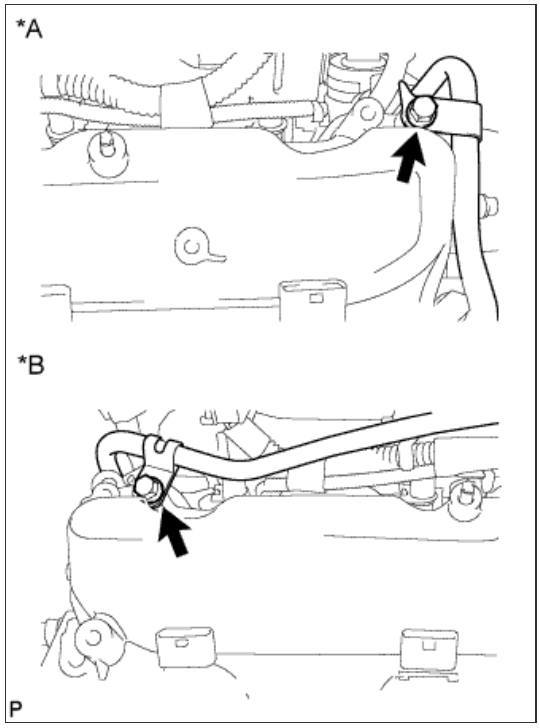
46. CONNECT NO. 2 FUEL TUBE SUB-ASSEMBLY

a. Connect the fuel tube with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

Text in Illustration

*A	LH Side
*B	RH Side



47. CONNECT COOLER COMPRESSOR ASSEMBLY

a. Install the cooler compressor with the stud bolt.

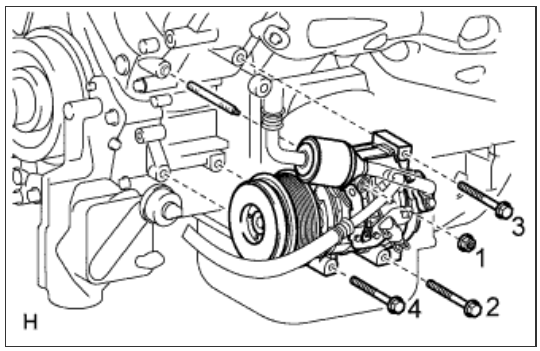
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Install the 3 bolts and nut.

Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }

NOTICE:

Tighten the bolts and nut in the order shown in the illustration to install the cooler compressor.



48. CONNECT WATER PIPE AND HOSE SUB-ASSEMBLY

a. Connect the water pipe and hose to the cylinder head cover with the 2 bolts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

b. Connect the 3 hoses.

49. CONNECT ENGINE WIRE

a. Connect the 2 clamps and power steering oil pressure switch connector.

b. Engine Room RH Side:

i. Connect the 5 clamps.

ii. Connect the throttle position sensor and throttle control motor connector.

iii. Install the ground wire with the 2 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

iv. Connect the noise filter connector.

v. Connect the 2 VVT sensor connectors.

vi. Connect the injector connector.

vii. Connect the 4 ignition coil connectors.

viii. Connect the 2 camshaft timing oil control valve connectors.

c. Engine Room LH Side:

i. Connect the cooler compressor connector.

ii. Connect the 3 clamps.

iii. Connect the camshaft position sensor connector.

iv. Connect the 2 camshaft timing oil control valve connectors.

v. Connect the engine coolant temperature sensor connector.

vi. Connect the 4 clamps.

vii. Install the ground wire with the 2 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

viii. Connect the noise filter connector.

ix. Connect the 2 VVT sensor connectors.

x. Connect the 4 ignition coil connectors.

xi. Connect the injector connector.

xii. Connect the 2 connectors and 2 clips to the engine room junction block.

xiii. Install the engine room relay block cover.

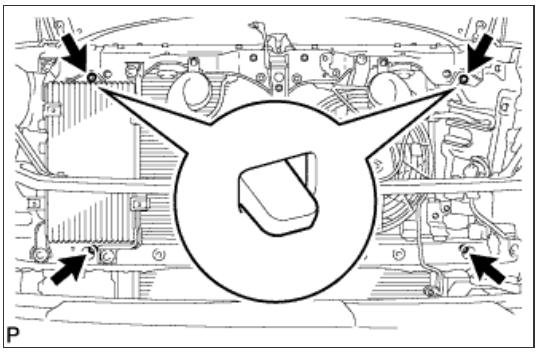
50. INSTALL RADIATOR ASSEMBLY

a. Set the radiator bracket hooks to the radiator support holes.

b. Install the radiator with the 4 bolts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

c. Connect the 2 oil cooler hoses.



51. INSTALL FAN SHROUD

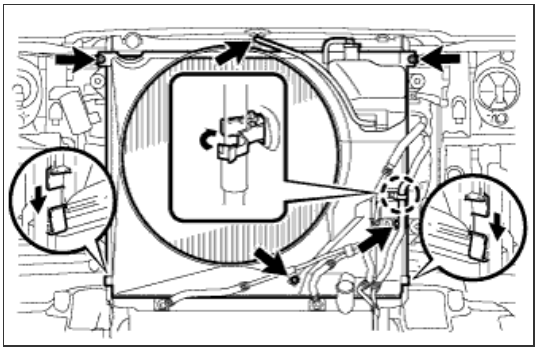
a. Install the fan pulley.

b. Place the shroud together with the coupling fan between the radiator and engine.

NOTICE:

Be careful not to damage the radiator core.

c. Temporarily install the fluid coupling fan to the fluid coupling bracket with the 4 nuts. Tighten the nuts as much as possible by hand.



d. Attach the claws of the shroud to the radiator as shown in the illustration.

e. Install the shroud with the 2 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

f. Connect the oil cooler tube to the fan shroud with the 2 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

g. Pass the hose through the flexible hose clamp and close the clamp as shown in the illustration.

h. Connect the reservoir hose to the upper radiator tank.

i. Install the fan and generator V-belt (Click here).

j. Tighten the 4 nuts of the fluid coupling fan.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

52. INSTALL NO. 2 RADIATOR HOSE

53. INSTALL NO. 1 RADIATOR HOSE

54. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner with the 3 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

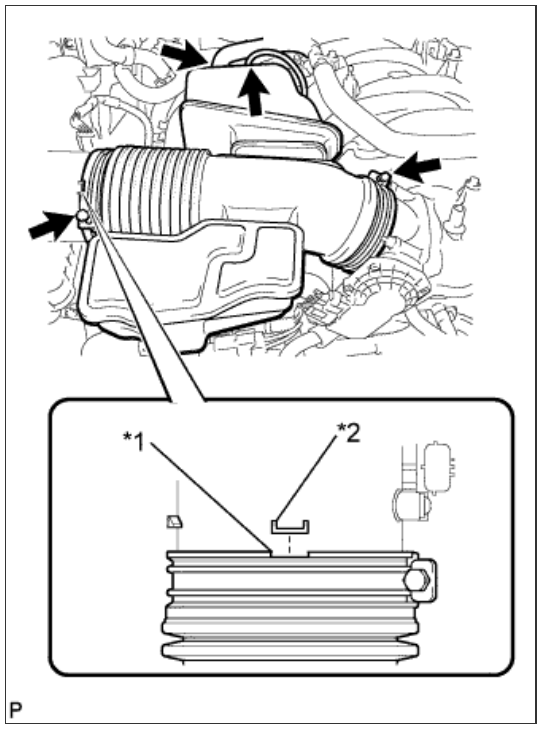
55. INSTALL AIR CLEANER HOSE ASSEMBLY

a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns

with the groove of the hose as shown in the illustration.

Text in Illustration

*1	Groove
*2	Protrusion



b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum hose.

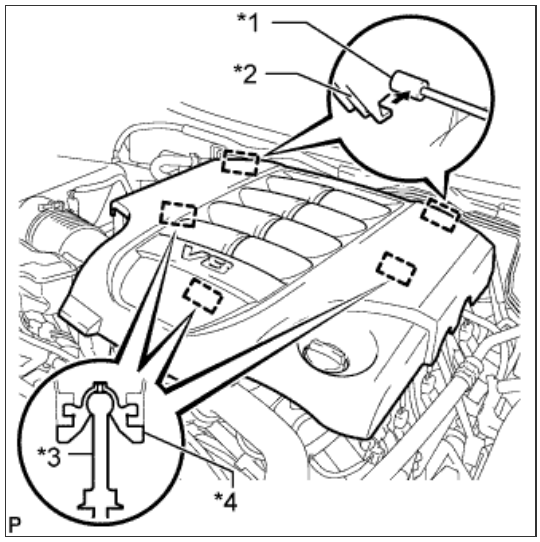
d. Connect the No. 2 ventilation hose.

56. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket. Then align the 3 V-bank cover grommets with the 3 pins, and press down on the V-bank cover to attach the pins.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet



57. ADD ENGINE OIL

a. Add fresh oil and install the oil filler cap.

Standard Oil Grade:

Oil Grade	Oil Viscosity (SAE)
API grade SL "energy-conserving", API grade SM "energy-conserving" or ILSAC multigrade engine oil	5W-30 10W-30
API grade SL and SM multigrade engine oil	15W-40 20W-50

Standard Oil Capacity:

Item	Specified Condition
Drain and refill without oil filter change	7.1 liters (7.5 US qts, 6.2 Imp. qts)
Drain and refill with oil filter change	7.5 liters (7.9 US qts, 6.6 Imp. qts)

Dry fill	9.3 liters (9.8 US qts, 8.2 Imp. qts)

58. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item	Specified Condition
with rear heater	16.2 liters (17.1 US qts, 14.3 Imp. qts)
without rear heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the radiator inlet hose by hand, and checking when the engine coolant starts to flow inside the hose.

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

h. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the fan.**

i. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

j. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.

59. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

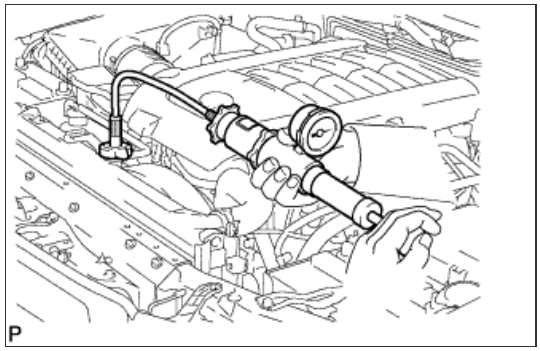
60. INSPECT FOR OIL LEAK

a. Start the engine. Make sure that there are no oil leaks from the area that was worked on.

61. INSPECT FOR COOLANT LEAK

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.



a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.

62. INSPECT ENGINE OIL LEVEL

a. Warm up the engine, stop the engine and wait 5 minutes. The oil level should be between the dipstick low level mark and full level mark. If low, check for leakage and add oil up to the full level mark.

NOTICE:

Do not fill engine oil above the full level mark.

63. INSPECT IGNITION TIMING

a. Warm up and stop the engine.

i. Allow the engine to warm up to a normal operating temperature.

b. When using the intelligent tester:

i. Connect the intelligent tester to the DLC3.

ii. Start the engine and idle it.

iii. Turn the intelligent tester on.

iv. Enter the following menus: Powertrain / Engine and ECT / Data List / Primary / IGN Advance.

HINT:

Refer to the intelligent tester operator's manual for further details.

Standard ignition timing:
8 to 12° BTDC @ idling (transmission in neutral and A/C switch off)

v. Disconnect the intelligent tester from the DLC3.

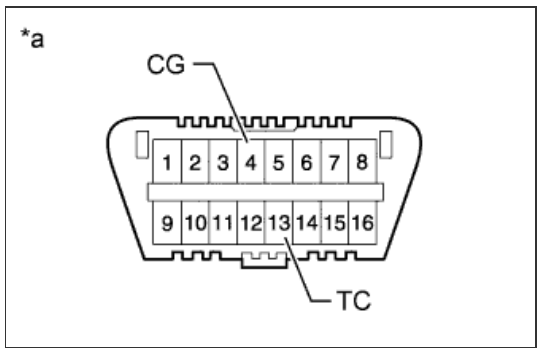
c. When not using the intelligent tester:

i. Connect the tester probe of a timing light to the wire of the ignition coil connector for the No. 1 cylinder.

NOTICE:

Use a timing light that detects primary signals.

ii. Using SST, connect terminals 13 (TC) and 4 (CG) of the DLC3.



SST
09843-18040

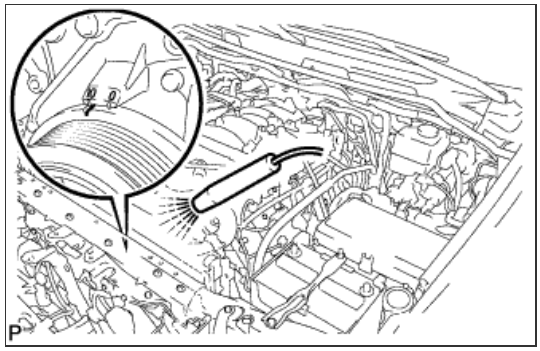
Text in Illustration

*a	Front view of DLC3

NOTICE:

- **Confirm the terminal numbers before connecting them. Connecting the wrong terminals can damage the engine.**
- **Switch off all accessories and the A/C before connecting the terminals.**

iii. Using the timing light, check the ignition timing.



Standard ignition timing:
8 to 12° BTDC @ idling (transmission in neutral and A/C switch off)

iv. Remove SST from the DLC3.

v. Check the ignition timing.

Standard ignition timing:
7 to 24° BTDC @ idling (transmission in neutral and A/C switch off)

vi. Disconnect the timing light from the engine.

64. INSPECT ENGINE IDLE SPEED

a. Warm up and stop the engine.

i. Allow the engine to warm up to a normal operating temperature.

b. When using the intelligent tester:

i. Connect the intelligent tester to the DLC3.

NOTICE:

Switch off all accessories and the A/C before connecting the intelligent tester.

ii. Race the engine at 2500 rpm for approximately 90 seconds.

iii. Turn the intelligent tester on.

iv. Enter the following menus: Powertrain / Engine and ECT / Data List / Primary / Engine Speed.

Standard idle speed:
650 to 750 rpm (transmission in neutral and A/C switch off)

HINT:

Refer to the intelligent tester operator's manual for further details.

If the idle speed is not as specified, check the air intake system.

v. Disconnect the intelligent tester from the DLC3.

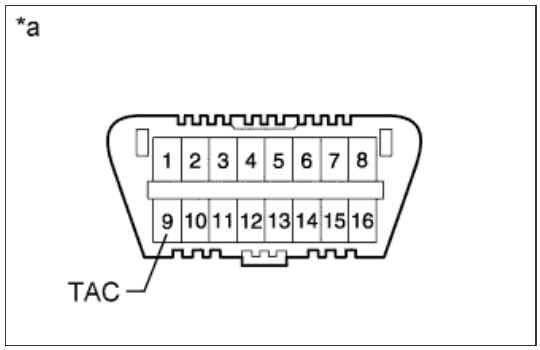
c. When not using the intelligent tester:

i. Using SST, connect the tachometer probe to terminal 9 (TAC) of the DLC3.

SST
09843-18030

Text in Illustration

*a	Front view of DLC3



NOTICE:

- **Confirm the terminal number before connecting the probe. Connecting the probe to the wrong terminal can damage the engine.**
- **Switch off all accessories and the A/C before connecting the probe.**

ii. Race the engine at 2500 rpm for approximately 90 seconds.

iii. Check the idle speed.

Standard idle speed:
650 to 750 rpm (transmission in neutral and A/C switch off)

If the idle speed is not as specified, check the air intake system.

iv. Disconnect the tachometer probe from the DLC3.

65. INSTALL FRONT FENDER APRON SEAL FRONT RH

a. Install the fender apron seal with the 3 clips.

66. INSTALL FRONT FENDER APRON SEAL LH

a. Install the fender apron seal with the 3 clips.

67. INSTALL NO. 2 ENGINE UNDER COVER

a. Install the No. 2 engine under cover with the 2 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

68. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

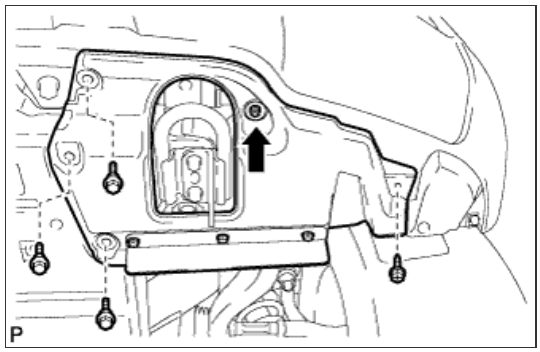
a. Install the No. 1 engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

69. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



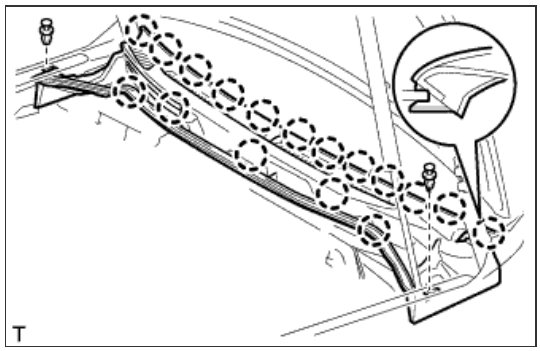
70. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

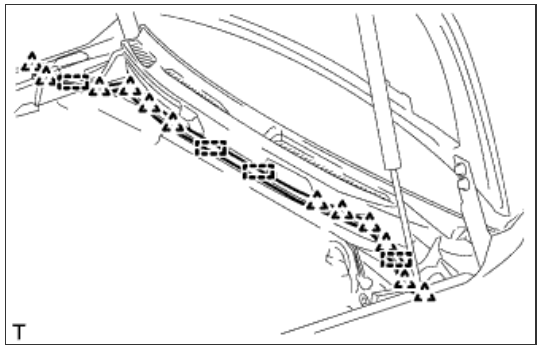
71. INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Push the ventilator louver in the direction indicated by the arrow in the illustration to attach the 17 claws and 2 clips and install the ventilator louver.

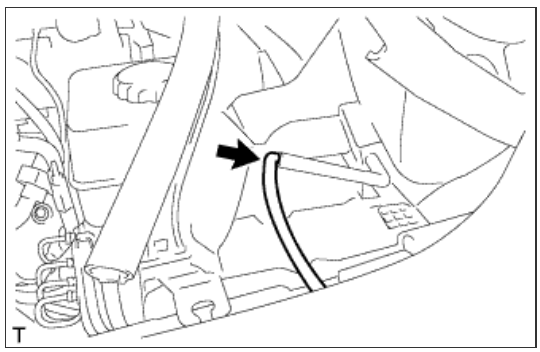


72. INSTALL HOOD TO COWL TOP SEAL

a. Attach the 12 clips and 4 clamps to install the hood to cowl top seal.

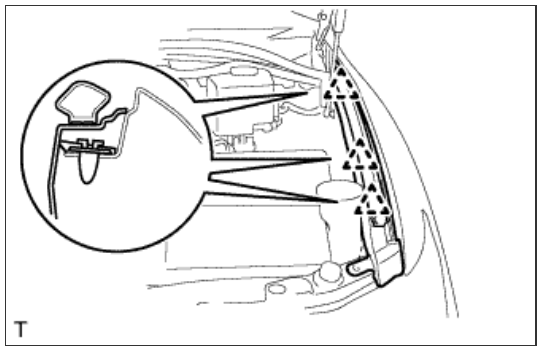


b. Install the washer hose.



73. INSTALL FRONT FENDER MAIN SEAL LH

a. Attach the 3 clips to install the fender main seal.



74. INSTALL FRONT FENDER MAIN SEAL RH

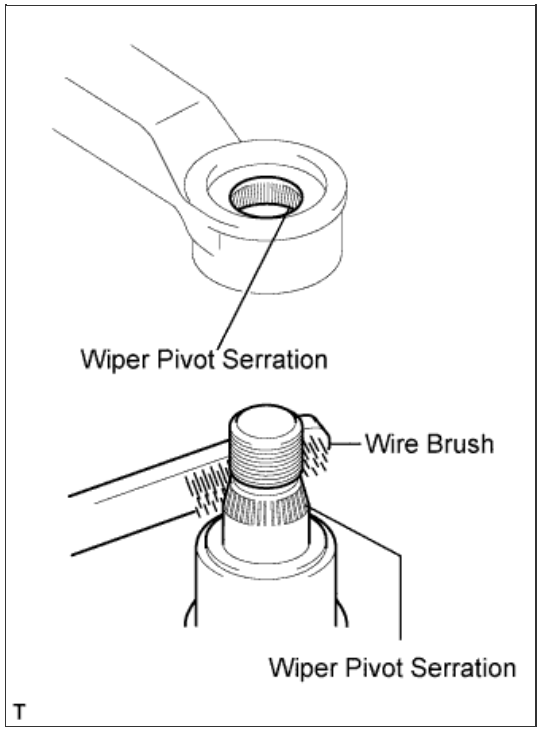
HINT:

Use the same procedures described for the LH side.

75. INSTALL FRONT WIPER ARM LH

a. Stop the wiper motor at the automatic stop position.

b. Clean the wiper pivot serration with a wire brush.



c. Install the wiper arm and blade with the nut. Make sure that the wiper arm and blade comes to the position shown in the illustration.

Standard Measurement:

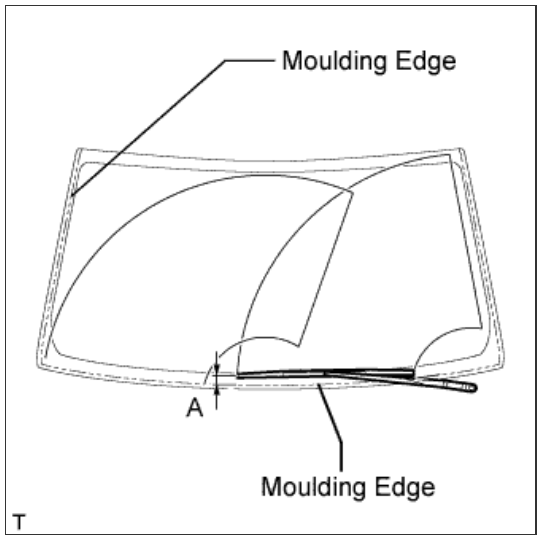
Position	Specified Condition
A	16.8 to 36.8 mm (0.661 to 1.45 in.)

Torque:

25 N*m{ 255 kgf*cm , 18 ft.*lbf }

HINT:

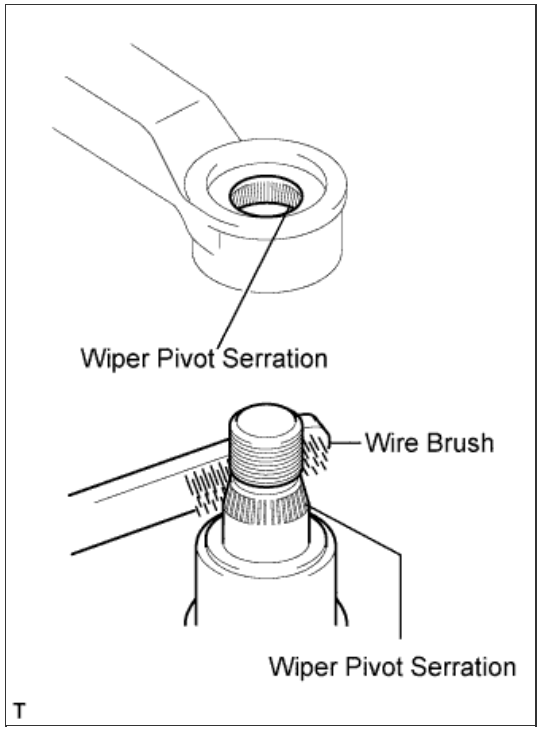
Hold down the wiper arm hinge with your hand while tightening the nut.



76. INSTALL FRONT WIPER ARM RH

a. Stop the wiper motor at the automatic stop position.

b. Clean the wiper pivot serration with a wire brush.



c. Install the wiper arm and blade with the nut. Make sure that the wiper arm and blade comes to the position shown in the illustration.

Standard Measurement:

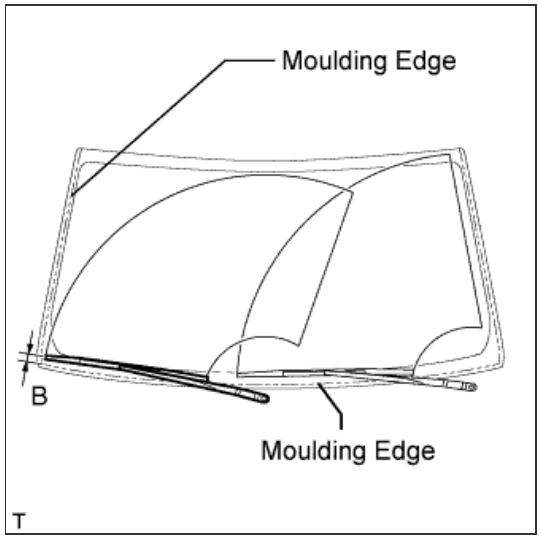
Position	Specified Condition
B	20.0 to 40.0 mm (0.787 to 1.57 in.)

Torque:

25 N*m{ 255 kgf*cm , 18 ft.*lbf }

HINT:

Hold down the wiper arm hinge with your hand while tightening the nut.



d. Operate the front wipers while spraying washer fluid on the windshield glass. Make sure that the front wipers function properly and there is no interference with the vehicle body.

77. CONNECT RADIATOR SIDE DEFLECTOR LH

a. Connect the deflector with the 4 clips.

78. INSTALL TRANSMISSION OIL COOLER AIR DUCT

a. Install the oil cooler air duct with the 4 bolts.

Torque:
4.9 N*m{ 50 kgf*cm , 43 in.*lbf }

79. INSTALL FRONT BUMPER COVER

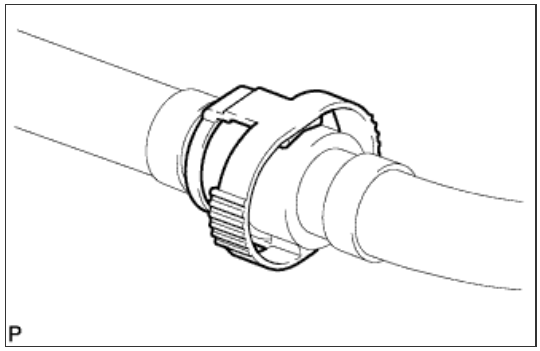
HINT:

For the front bumper cover with garnish, use the procedures described below.

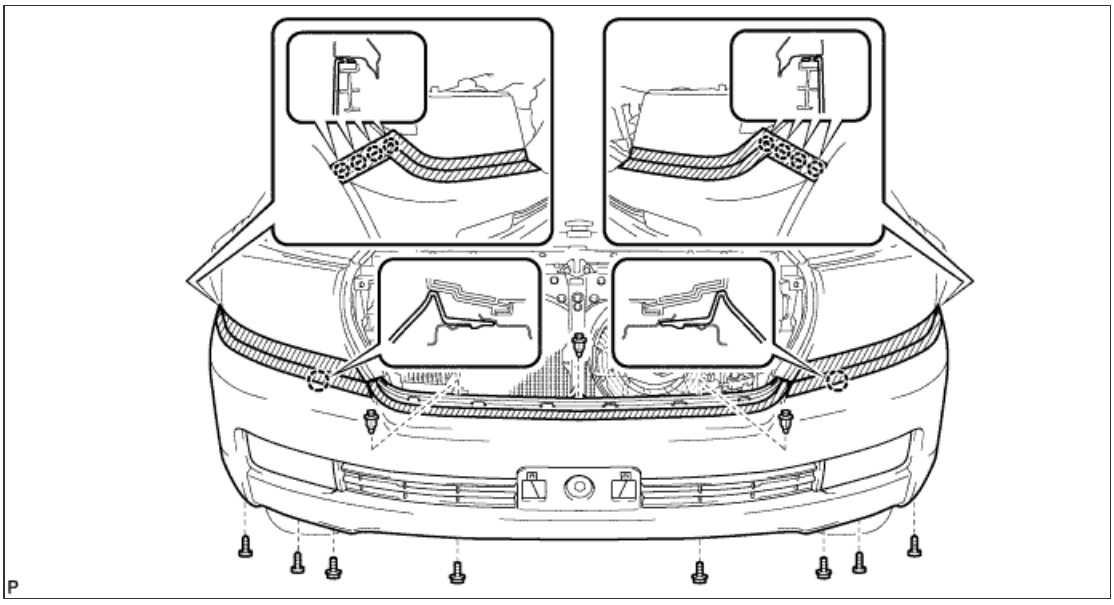
a. w/ Headlight Cleaner System:
Connect the headlight cleaner hose.

b. w/o TOYOTA Parking Assist-sensor System, w/o Fog Light:
Attach the 10 claws to install the bumper cover.

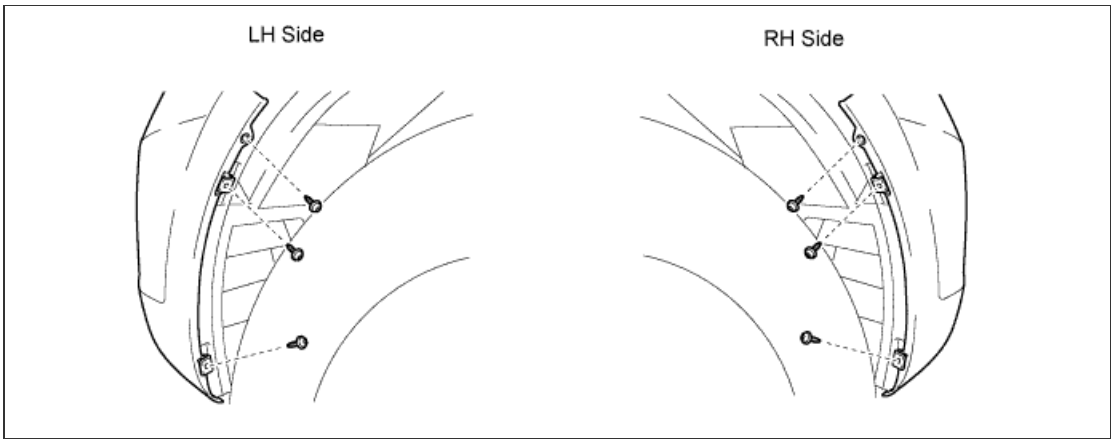
c. w/ TOYOTA Parking Assist-sensor System or w/ Fog Light:
Connect the No. 4 engine room wire connector and attach the 10 claws to install the bumper cover.



d. Install the 3 clips, 4 screws and 4 bolts.



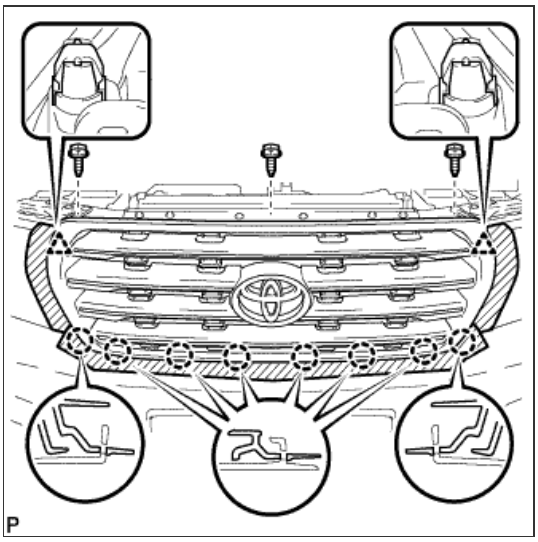
e. Using a T30 "TORX" socket, install the 6 screws.



80. INSTALL RADIATOR GRILLE

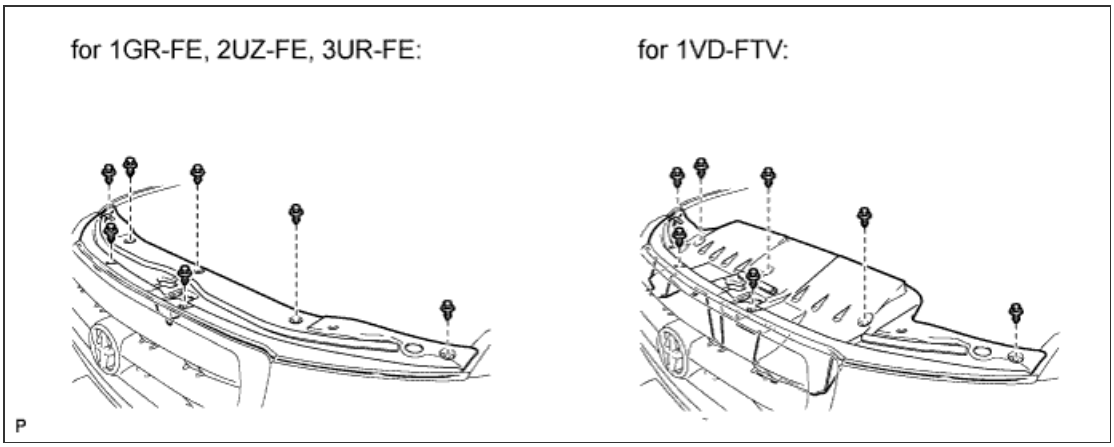
a. Attach the 2 clips and 8 claws to install the radiator grille.

b. Install the 3 screws.

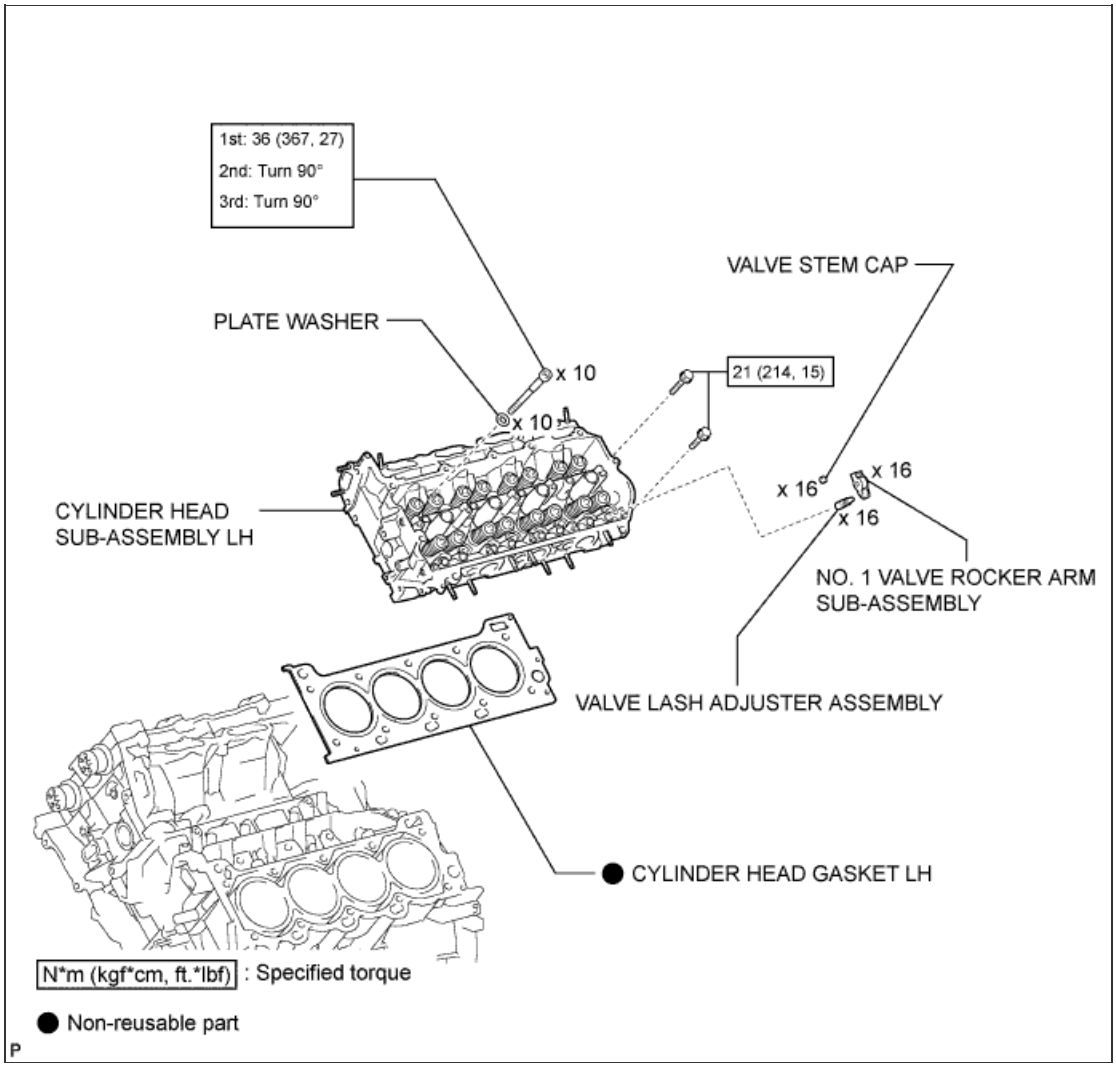


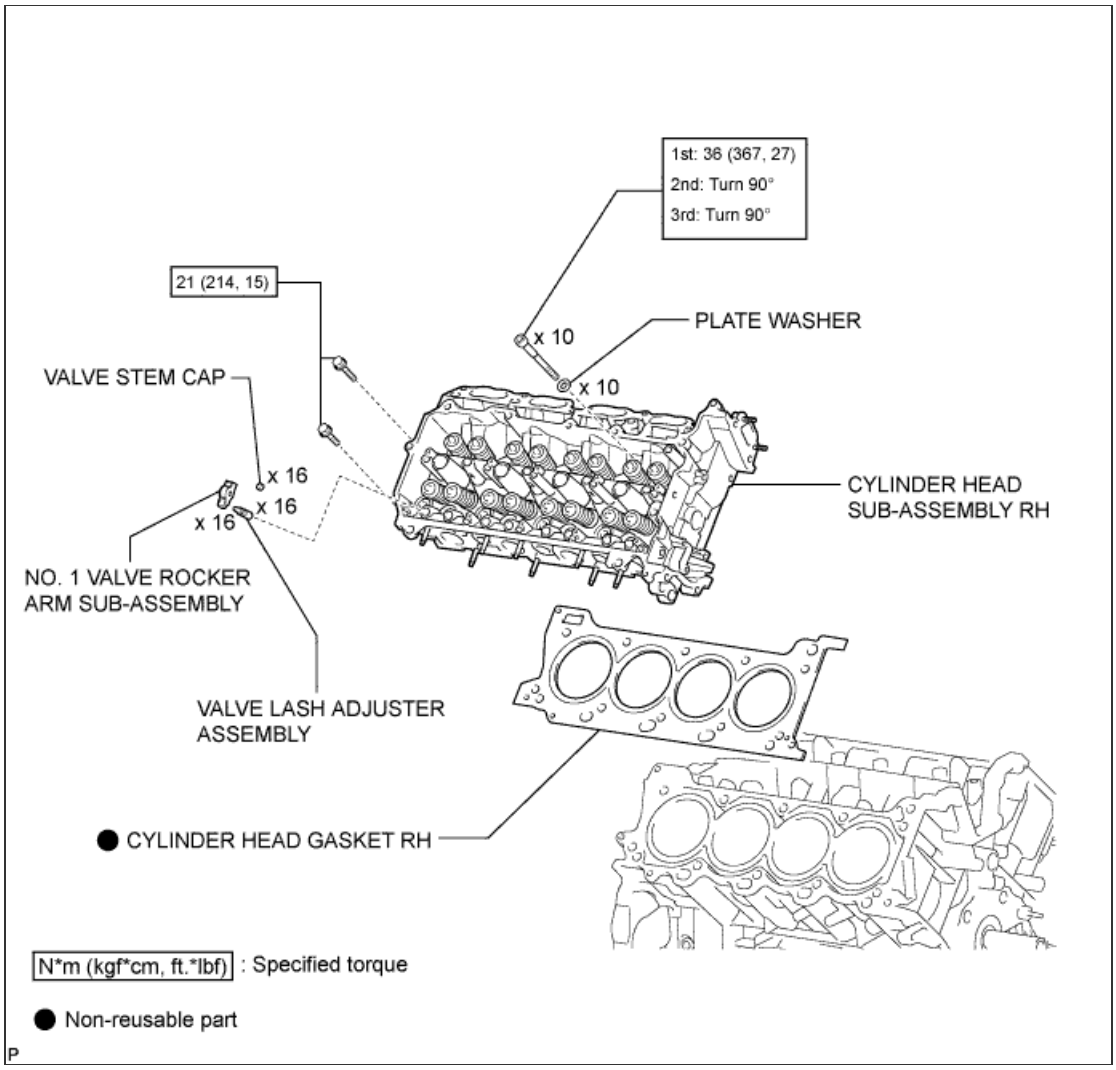
81. INSTALL UPPER RADIATOR SUPPORT SEAL

a. Install the radiator support seal with the 7 clips.



for Preparation Click here




1st: 36 (367, 27)
2nd: Turn 90°
3rd: Turn 90°
21 (214, 15)
x 10
PLATE WASHER
x 10
VALVE STEM CAP
x 16
x 16
x 16
CYLINDER HEAD
SUB-ASSEMBLY RH
NO. 1 VALVE ROCKER
ARM SUB-ASSEMBLY
VALVE LASH ADJUSTER
ASSEMBLY
CYLINDER HEAD GASKET RH
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

for Preparation Click here

1. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY

(Click here)

2. REMOVE CAMSHAFT

(Click here)

3. REMOVE NO. 1 VALVE ROCKER ARM SUB-ASSEMBLY

a. Remove the 32 valve rocker arms from the cylinder heads.

HINT:

Arrange the removed parts in the correct order.

4. REMOVE VALVE LASH ADJUSTER ASSEMBLY

a. Remove the 32 valve lash adjusters from the cylinder heads.

HINT:

Arrange the removed parts in the correct order.

5. REMOVE VALVE STEM CAP

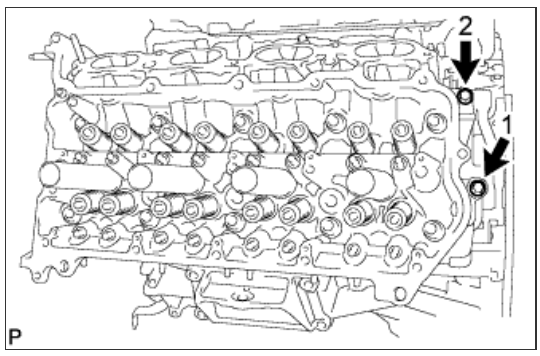
a. Remove the 32 valve stem caps from the cylinder heads.

HINT:

Arrange the removed parts in the correct order.

6. REMOVE CYLINDER HEAD SUB-ASSEMBLY LH

a. Uniformly loosen and remove the 2 bolts in the sequence shown in the illustration.



b. Using a 10 mm bi-hexagon wrench, uniformly loosen the 10 cylinder head bolts in the sequence shown in the illustration. Remove the 10 cylinder head bolts and plate washers.

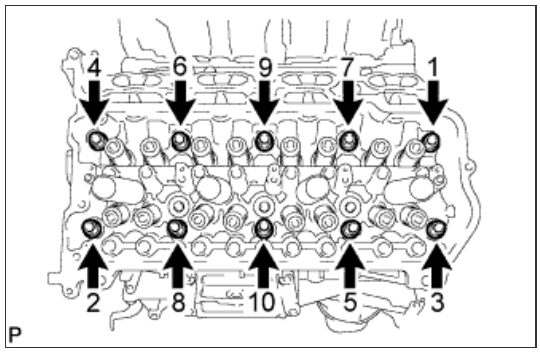
NOTICE:

- **Be careful not to drop washers into the cylinder head.**
- **Head warpage or cracking could result from removing bolts in an incorrect order.**

HINT:

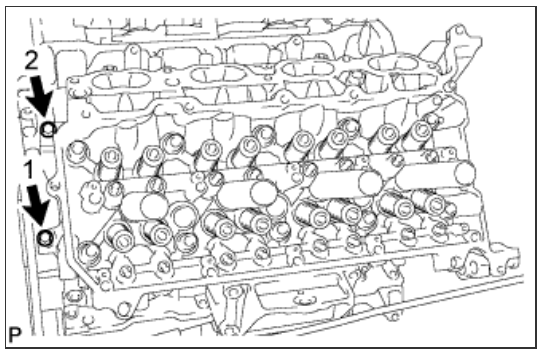
Be sure to arrange the removed parts for each installation position separately.

c. Remove the cylinder head and gasket.



7. REMOVE CYLINDER HEAD SUB-ASSEMBLY RH

a. Uniformly loosen and remove the 2 bolts in the sequence shown in the illustration.



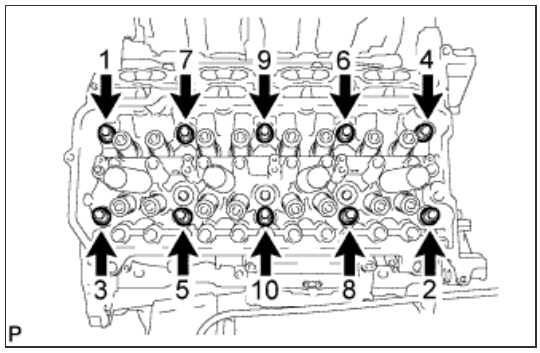
b. Using a 10 mm bi-hexagon wrench, uniformly loosen the 10 cylinder head bolts in the sequence shown in the illustration. Remove the 10 cylinder head bolts and plate washers.

NOTICE:

- **Be careful not to drop washers into the cylinder head.**
- **Head warpage or cracking could result from removing bolts in an incorrect order.**

HINT:

Be sure to arrange the removed parts for each installation position separately.

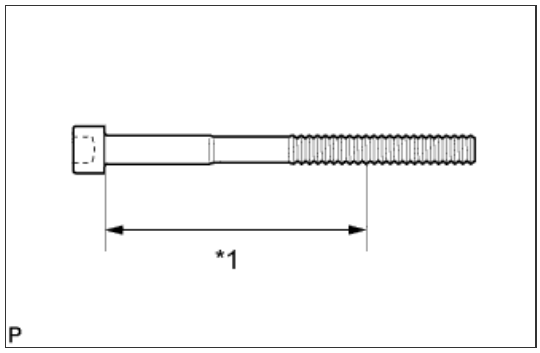


c. Remove the cylinder head and gasket.

for Preparation Click here

1. INSPECT CYLINDER HEAD SET BOLT

a. Using a vernier caliper, measure the diameter of the elongated thread at the measuring point.



Measuring point:
94 mm (3.7 in.) for intake side bolt
89 mm (3.5 in.) for exhaust side bolt

Standard diameter:
1 . to 11. mm (4 to 433 in.)

Minimum diameter:
1 . mm (417 in.)

Text in Illustration

*1	Measuring Point

If the diameter is less than the minimum, replace the cylinder head bolt.

HINT:

If a visual check reveals no excessively thin areas, check the center of the bolt (see illustration) and find the area that has the smallest diameter.

INSPECT CYLINDER HEAD SUB-ASSEMBLY

a. Using a precision straightedge and feeler gauge, measure the warpage of the surfaces where the cylinder head contacts the cylinder block and manifold.

Standard Warpage:

Item	Specified Condition
Cylinder head lower side	0.05 mm (0.00197 in.)
Intake side	0.08 mm (0.00315 in.)
Exhaust side	0.05 mm (0.00197 in.)

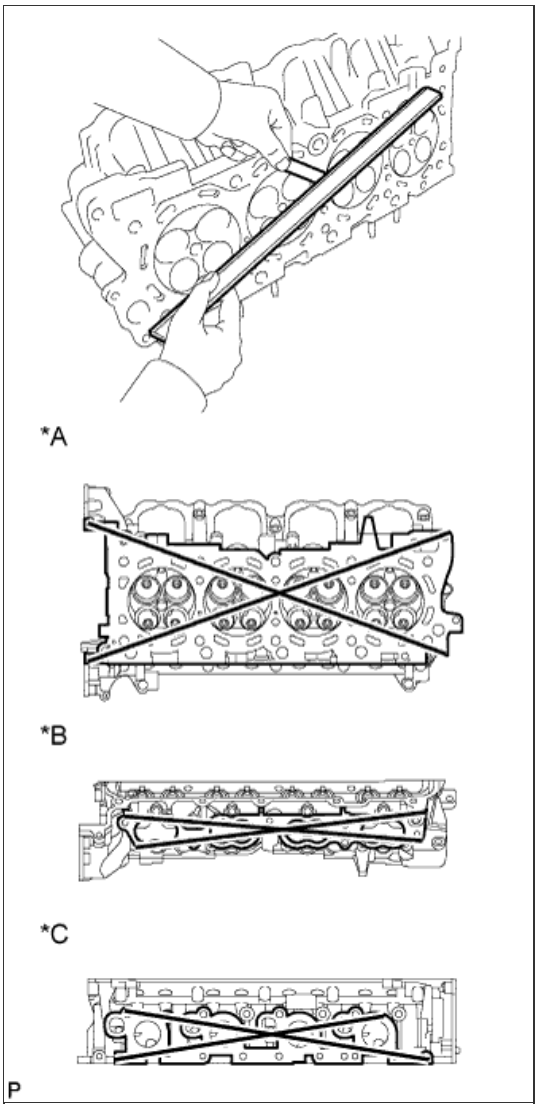
Maximum warpage:
1 mm (. 394 in.)

Text in Illustration

*A	Cylinder Head Lower Side
*B	Intake Side
*C	Exhaust Side

If the warpage is more than the maximum, replace the cylinder head.

b. Using a dye penetrant, check the intake ports, exhaust ports and cylinder surface for cracks.
If cracked, replace the cylinder head.

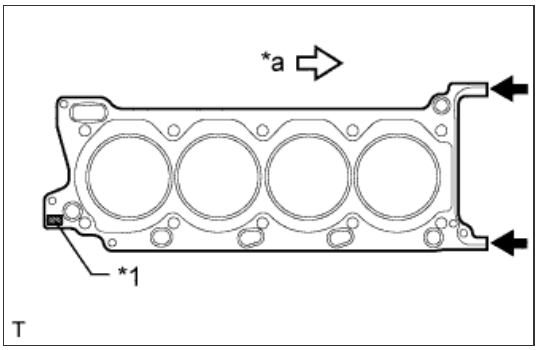


3. INSTALL CYLINDER HEAD SUB-ASSEMBLY RH

a. Clean the cylinder block with solvent.

b. Set the piston of the No. 1 cylinder to slightly ATDC.

c. Place the cylinder head gasket on the cylinder block surface with the front face of the Lot No. stamp upward.



Text in Illustration

*1	Lot No.
*a	Front

NOTICE:

- **Be careful of the installation direction.**
- **Make sure that no oil is on the front end (indicated by the arrows) of the cylinder head gasket.**

d. Place the cylinder head on the cylinder block.

NOTICE:

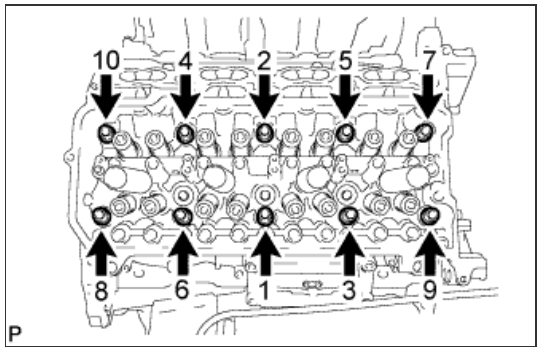
- **Ensure that no oil is on the mounting surface of the cylinder head.**
- **Gently place the cylinder head in order not to damage the gasket with the bottom part of the head.**

HINT:

The cylinder head bolts are tightened in 3 progressive steps.

e. Apply a light coat of engine oil to the threads and under the heads of the cylinder head bolts.

f. Step 1:



i. Using a 10 mm bi-hexagon wrench, install and uniformly tighten the 10 cylinder head bolts with the plate washers in several steps in the sequence shown in the illustration.

Torque:
3 N*m 3 kgf*cm , ft.*lbf

g. Step 2:

i. Mark the front side of each cylinder head bolt head with paint.

ii. Tighten the cylinder head bolts another 90°.

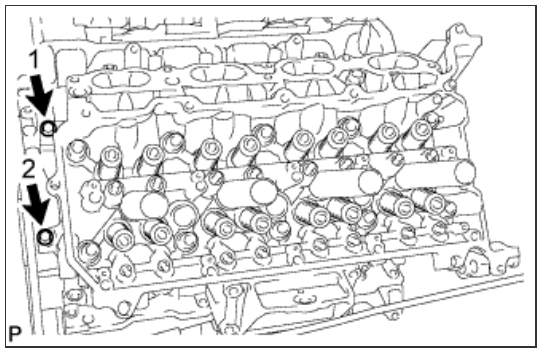
h. Step 3:

i. Tighten the cylinder head bolts an additional 90°.

ii. Check that the paint marks are now at a 180° angle to the front.

i. Install and uniformly tighten the 2 bolts in the sequence shown in the illustration.

Torque:
1 N*m 14 kgf*cm , 15 ft.*lbf



4. INSTALL CYLINDER HEAD SUB-ASSEMBLY LH

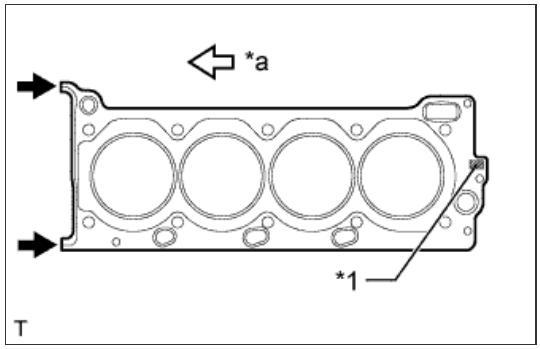
a. Clean the cylinder block with solvent.

b. Set the piston of the No. 1 cylinder to slightly ATDC.

c. Place the cylinder head gasket on the cylinder block surface with the front face of the Lot No. stamp upward.

Text in Illustration

*1	Lot No.
*a	Front



NOTICE:

- **Be careful of the installation direction.**
- **Make sure that no oil is on the front end (indicated by the arrows) of the cylinder head gasket.**

d. Place the cylinder head on the cylinder block.

NOTICE:

- **Ensure that no oil is on the mounting surface of the cylinder head.**
- **Gently place the cylinder head in order not to damage the gasket with the bottom part of the head.**

HINT:

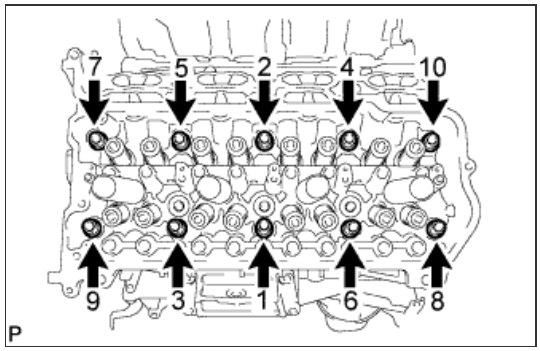
The cylinder head bolts are tightened in 3 progressive steps.

e. Apply a light coat of engine oil to the threads and under the heads of the cylinder head bolts.

f. Step 1:

HINT:

The cylinder head bolts are tightened in 3 progressive steps.



i. Using a 10 mm bi-hexagon wrench, install and uniformly tighten the 10 cylinder head bolts with the plate washers in several steps in the sequence shown in the illustration.

Torque:
3 N*m 3 kgf*cm , ft.*lbf

g. Step 2:

i. Mark the front side of each cylinder head bolt head with paint.

ii. Tighten the cylinder head bolts another 90°.

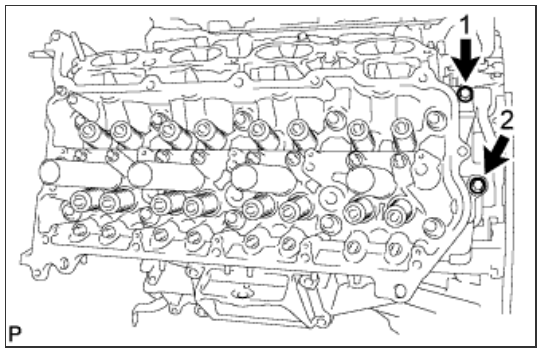
h. Step 3:

i. Tighten the cylinder head bolts an additional 90°.

ii. Check that the paint marks are now at a 180° angle to the front.

i. Install and uniformly tighten the 2 bolts in the sequence shown in the illustration.

Torque:
1 N*m 14 kgf*cm , 15 ft.*lbf



5. INSTALL VALVE STEM CAP

a. Apply a light coat of engine oil to the valve stem caps.

b. Install the 32 valve stem caps to the cylinder heads.

INSTALL VALVE LASH AD USTER ASSEMBLY

a. Inspect the valve lash adjuster before installing it (Click here).

b. Install the 32 valve lash adjusters to the cylinder heads.

NOTICE:

Install the lash adjuster to the same place it was removed from.

7. INSTALL NO. 1 VALVE ROCKER ARM SUB-ASSEMBLY

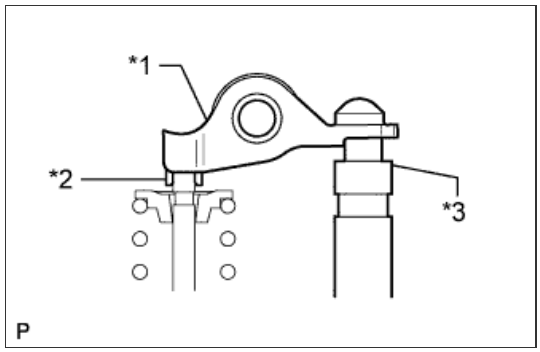
a. Apply engine oil to the lash adjuster tips and valve stem cap ends.

b. Install the 32 valve rocker arms as shown in the illustration.

Text in Illustration

*1	Valve Rocker Arm

*2	Valve Stem Cap
*3	Valve Lash Adjuster



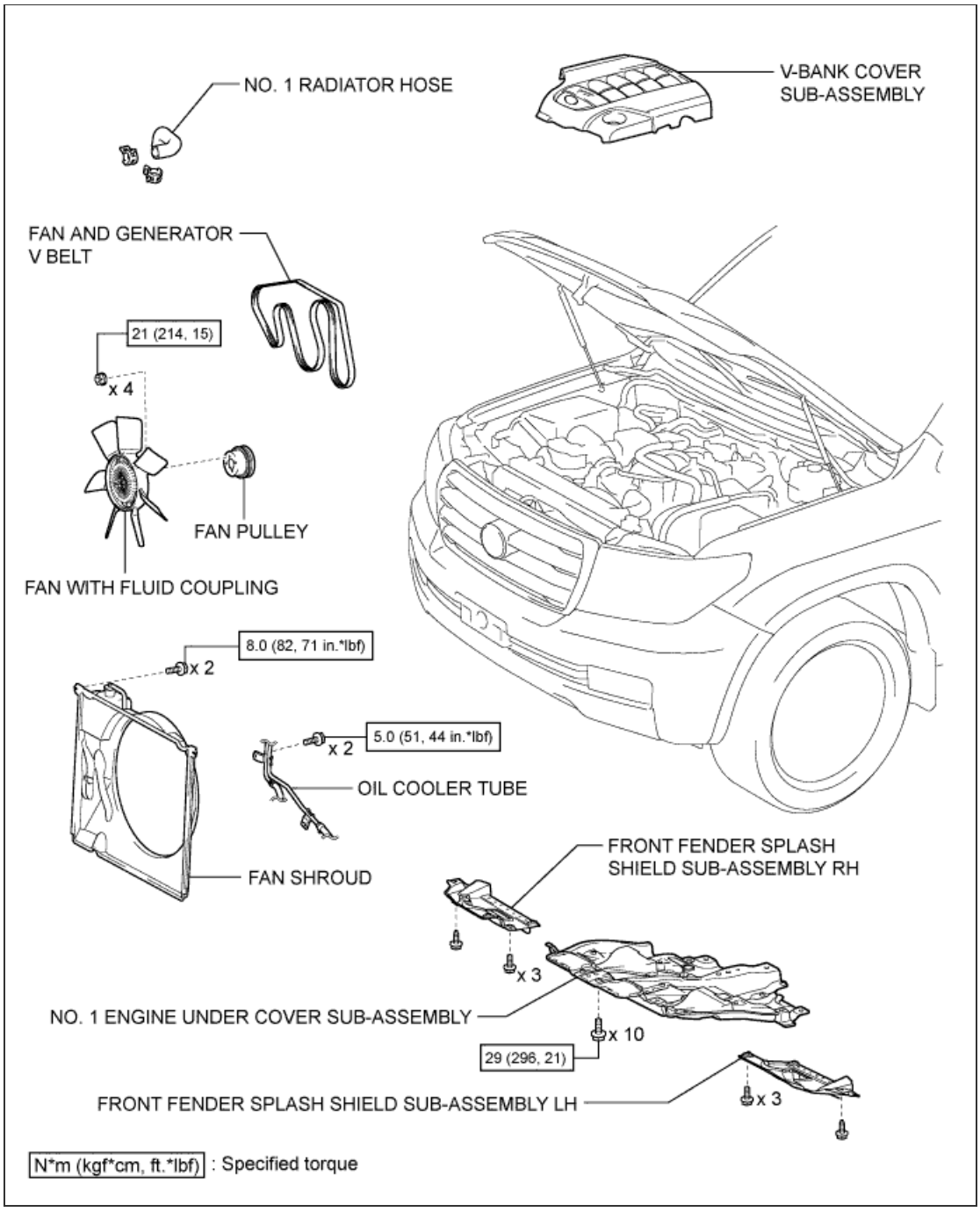
8. INSTALL CAMSHAFT

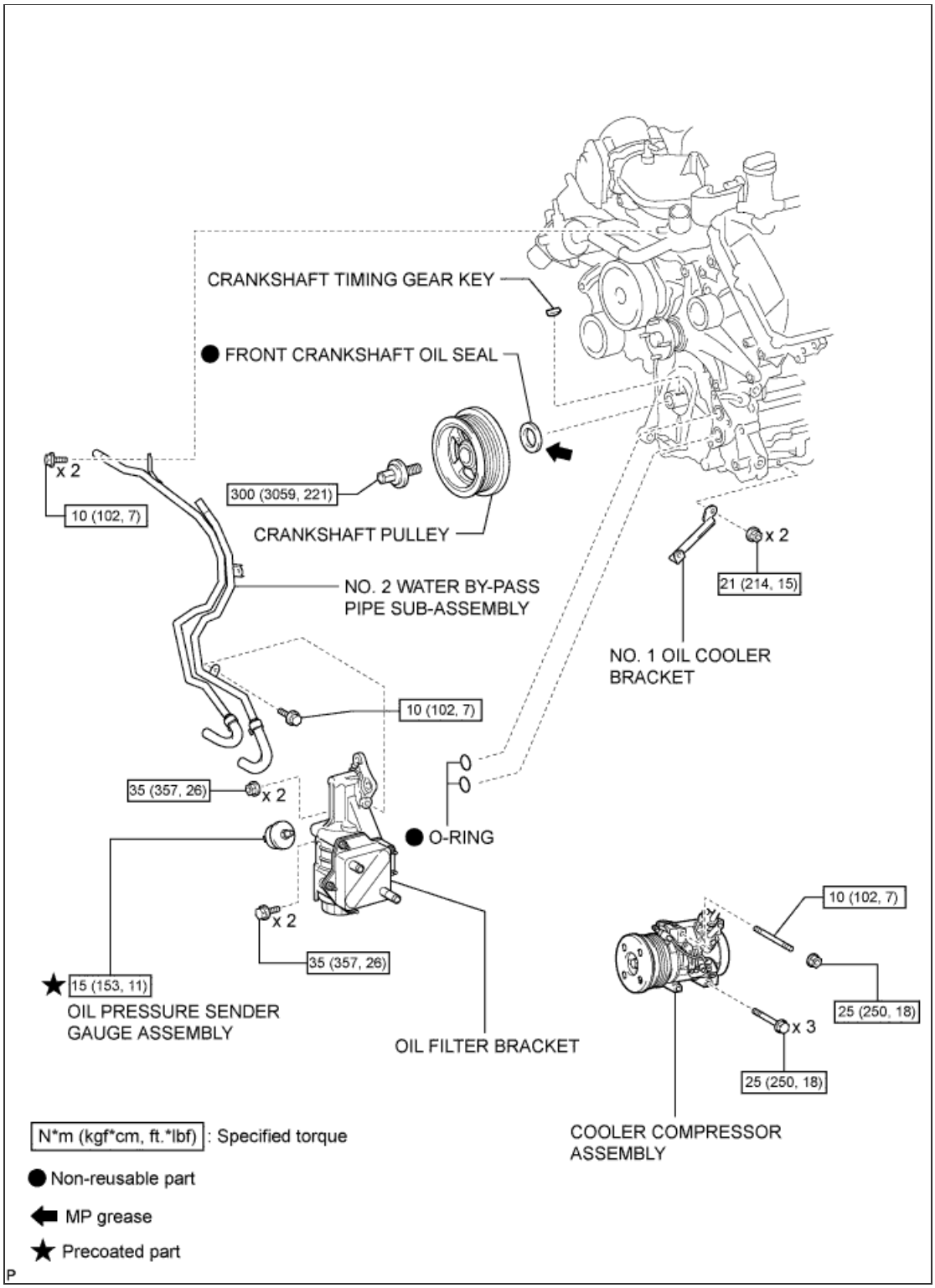
(Click here)

9. INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY

(Click here)

for Preparation Click here



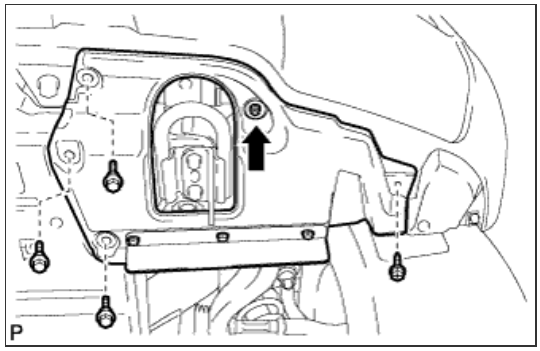

CRANKSHAFT TIMING GEAR KEY
FRONT CRANKSHAFT OIL SEAL
x 2
10 (102, 7)
300 (3059, 221)
CRANKSHAFT PULLEY
NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY
x 2
21 (214, 15)
NO. 1 OIL COOLER BRACKET
10 (102, 7)
35 (357, 26)
x 2
O-RING
x 2
35 (357, 26)
15 (153, 11)
OIL PRESSURE SENDER GAUGE ASSEMBLY
OIL FILTER BRACKET
10 (102, 7)
25 (250, 18)
x 3
25 (250, 18)
COOLER COMPRESSOR ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
MP grease
Precoated part
P

for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



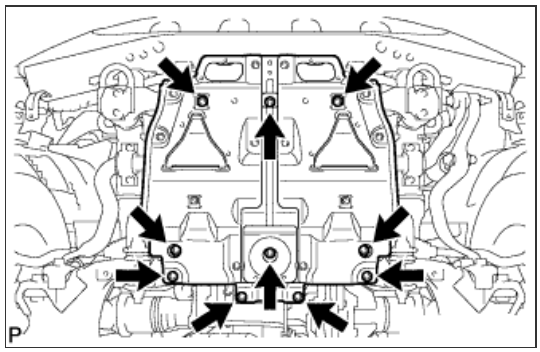
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and No. 1 engine under cover.



4. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

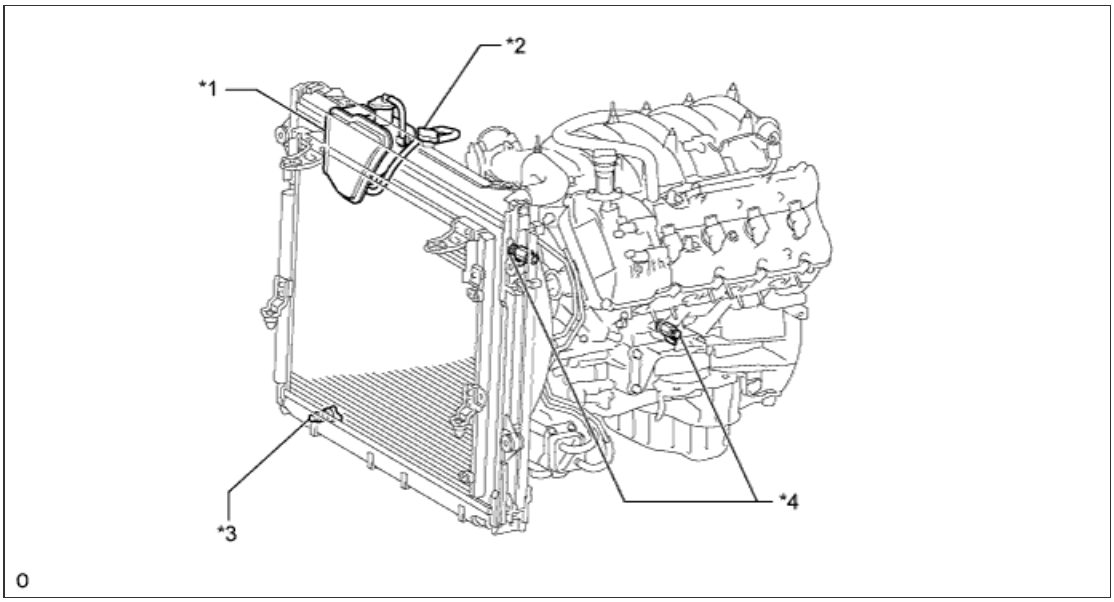
b. Remove the radiator cap. Then drain the coolant from the radiator.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

d. Tighten the 2 cylinder block drain cock plugs.

Torque:

13 N*m{ 133 kgf*cm , 10 ft.*lbf }



Text in Illu tration

*1	Radiator Reservoir	*2	Radiator Cap
*3	Radiator Drain Cock Plug	*4	Cylinder Block Drain Cock Plug

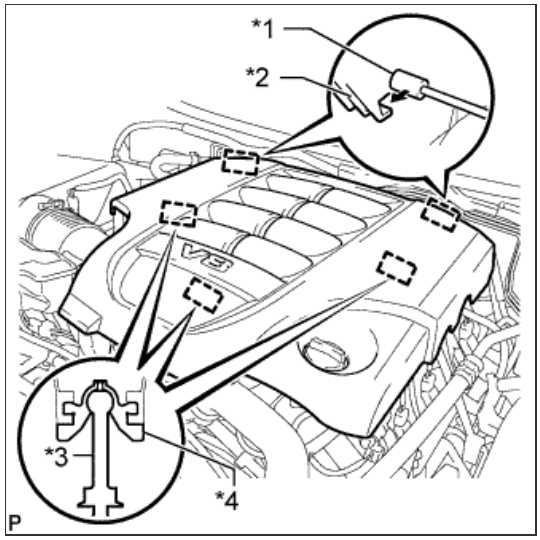
e. Tighten the radiator drain cock plug by hand.

5. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Raise the front of the V bank cover to detach the 3 pins. Then remove the 2 V bank cover hooks from the bracket, and remove the V bank cover.

Text in Illu tration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet

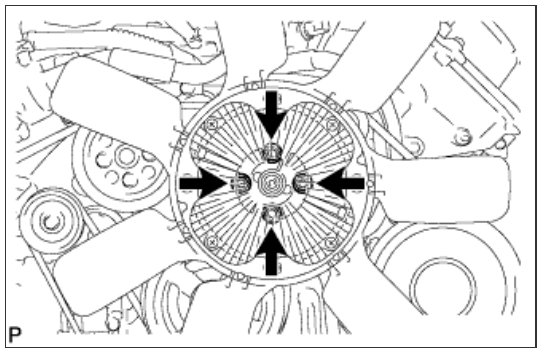


6. REMOVE NO. 1 RADIATOR HOSE

7. REMOVE FAN SHROUD

a. Loosen the 4 nuts holding the fluid coupling fan.

b. Remove the fan and generator V belt (Click here).



c. Disconnect the reservoir hose from the upper radiator tank.

d. Detach the claw to open the flexible hose clamp.

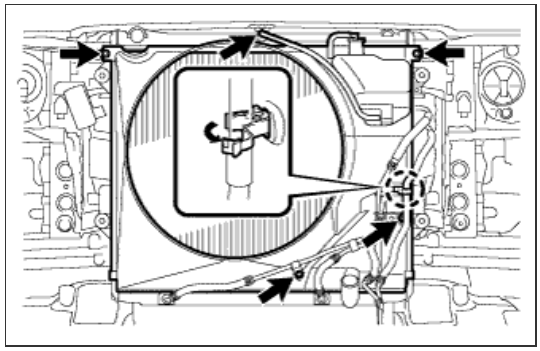
e. Remove the 2 bolts and disconnect the oil cooler tube from the fan shroud.

f. Remove the 2 bolts holding the fan shroud.

g. Remove the 4 nuts of the fluid coupling fan, and then remove the shroud together with the coupling fan.

NOTICE:

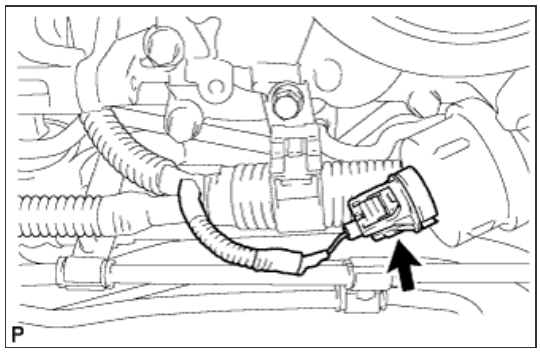
Be careful not to damage the radiator core.



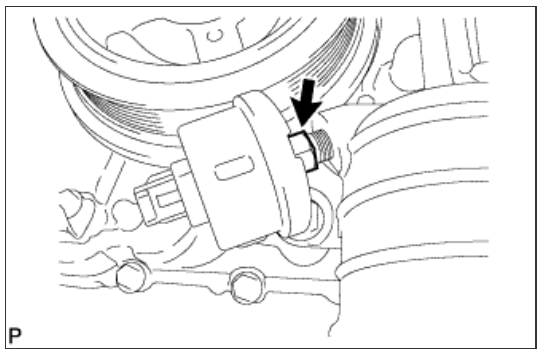
h. Remove the fan pulley.

8. REMOVE OIL PRESSURE SENDER GAUGE ASSEMBLY

a. Disconnect the sender gauge connector.



b. Remove the oil pressure sender gauge.

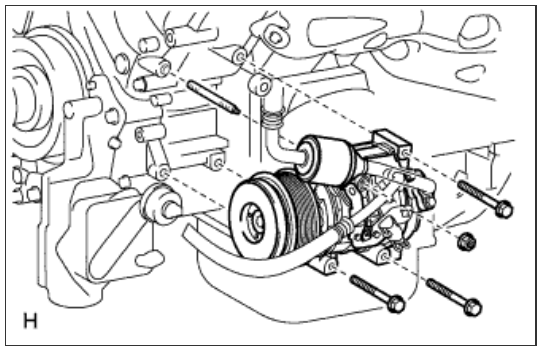


9. DISCONNECT COOLER COMPRESSOR ASSEMBLY

a. Remove the 3 bolts, nut and stud bolt, and disconnect the cooler compressor.

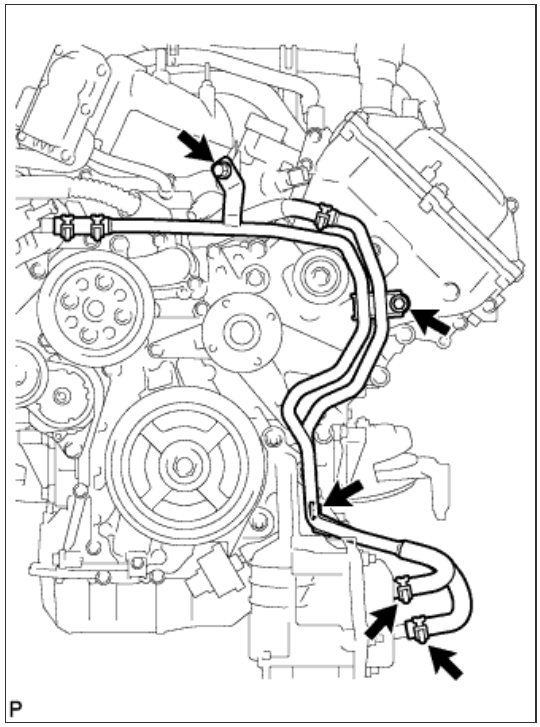
HINT:

It is not necessary to completely remove the compressor. With the hoses connected to the compressor, hang the compressor on the vehicle body with a rope.



10. DISCONNECT NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY

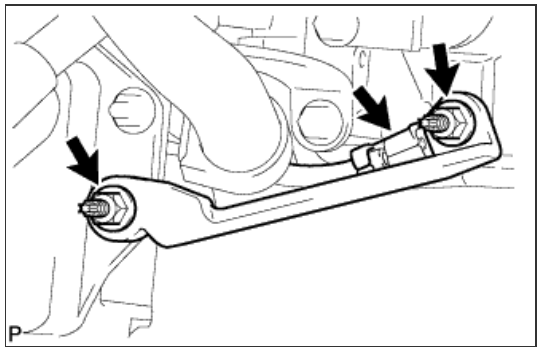
a. Remove the 3 bolts and disconnect the 2 water by pass hoses from the oil cooler.



11. REMOVE NO. 1 OIL COOLER BRACKET

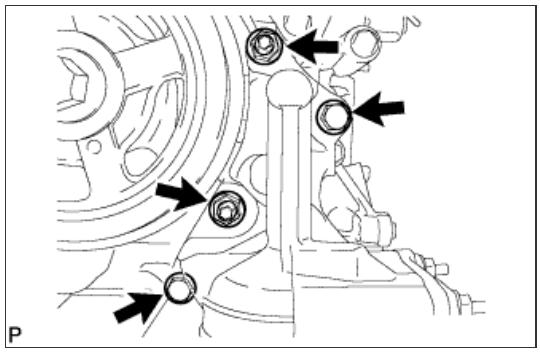
a. Remove the 2 nuts and bracket.

b. Disconnect the ground wire from the cylinder block.

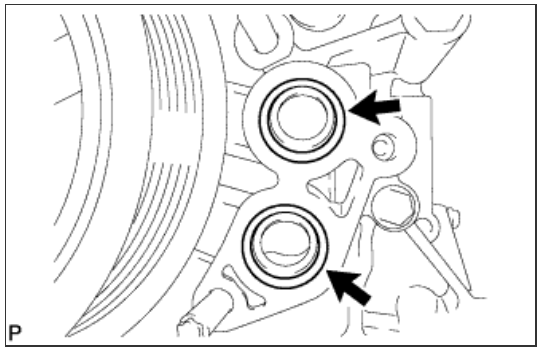


12. REMOVE OIL FILTER BRACKET

a. Remove the 2 bolts, 2 nuts and filter bracket.



b. Remove the 2 O rings.



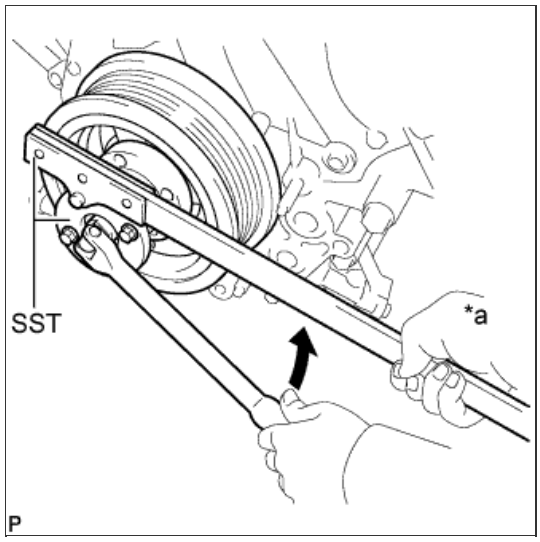
13. REMOVE CRANKSHAFT PULLEY

a. Using SST, loosen the crankshaft pulley set bolt until 2 or 3 threads are engaged.

SST
09213-70011
09330-00021

Text in Illu tration

*a	Hold
➡	Turn

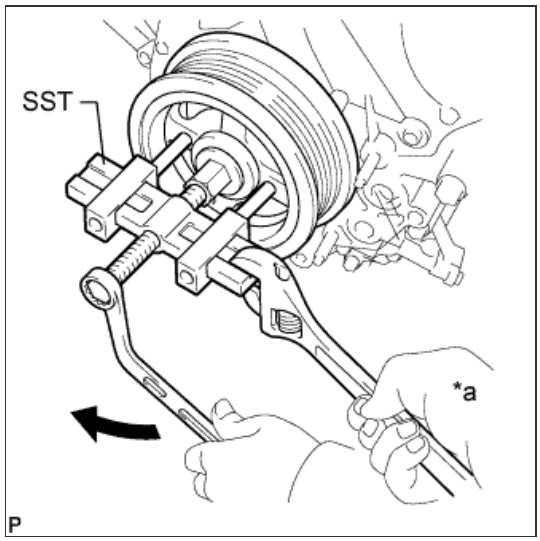


b. Using the pulley set bolt and SST, remove the crankshaft pulley.

SST
09950-50013 (09951-05010, 09952-05010, 09953-05010, 09954-05011)

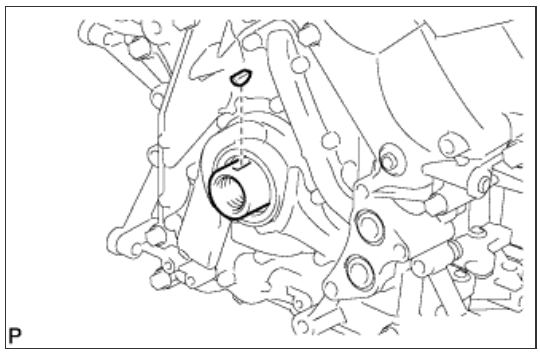
Text in Illu tration

*a	Hold
➡	Turn



14. REMOVE CRANKSHAFT TIMING GEAR KEY

a. Remove the crankshaft timing gear key from the crankshaft.



15. REMOVE FRONT CRANKSHAFT OIL SEAL

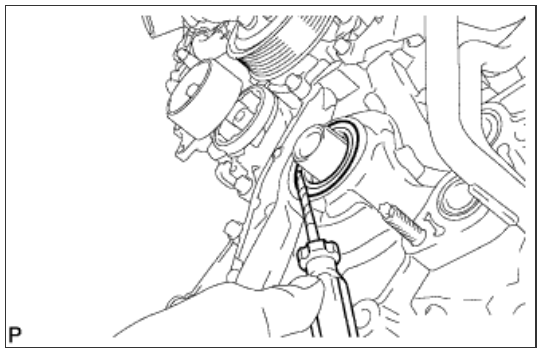
a. Using a screwdriver, pry out the oil seal.

NOTICE:

Do not damage the surface of the oil seal press fit hole and crankshaft.

HINT:

Tape the screwdriver tip before use.



for Preparation Click here

1. INSTALL FRONT CRANKSHAFT OIL SEAL

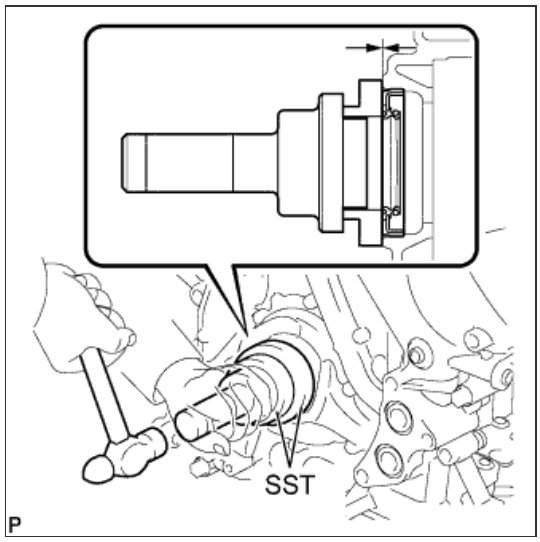
a. Apply MP grease to the lip of a new oil seal.

b. Using SST and a hammer, tap in the oil seal to a depth between 0 and 1.0 mm (0 and 0.0394 in.) from the timing chain cover edge.

SST
09223-22010
09506-35010

NOTICE:

- **Keep the lip free from foreign matter.**
- **Do not tap the oil seal at an angle.**



2. INSTALL CRANKSHAFT TIMING GEAR KEY

a. Install the crankshaft timing gear key.

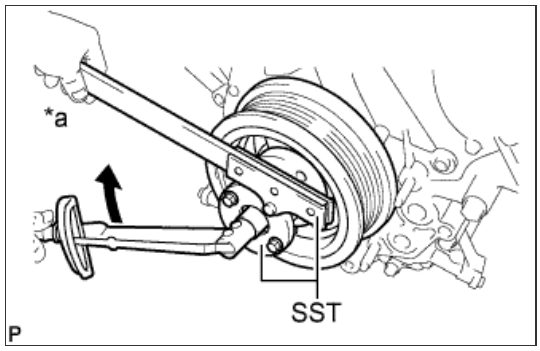
3. INSTALL CRANKSHAFT PULLEY

a. Align the pulley set key with the key groove of the pulley, and slide on the pulley.

b. Using SST, install the pulley set bolt.

SST
09213-70011
09330-00021

Torque:
300 N*m 3059 kgf*cm , 221 ft.*lbf }



Text in Illustration

*a	Hold
➡	Turn

4. INSTALL OIL FILTER BRACKET

a. Apply a light coat of engine oil to 2 new O-rings.

b. Install the 2 O-rings to the timing chain cover.

c. Install the oil filter bracket with the 2 nuts and 2 bolts.

Torque:

35 N*m 357 kgf*cm , 26 ft.*lbf }

5. INSTALL NO. 1 OIL COOLER BRACKET

a. Connect the ground wire to the cylinder block.

b. Install the oil cooler bracket with the 2 nuts.

Torque:
21 N*m 24 kgf*cm , 15 ft.*lbf }

6. CONNECT NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY

a. Connect the 2 water by-pass hoses to the oil cooler.

b. Install the 3 by-pass pipe bolts.

Torque:
10 N*m 102 kgf*cm , 7 ft.*lbf }

7. CONNECT COOLER COMPRESSOR ASSEMBLY

a. Install the cooler compressor with the stud bolt.

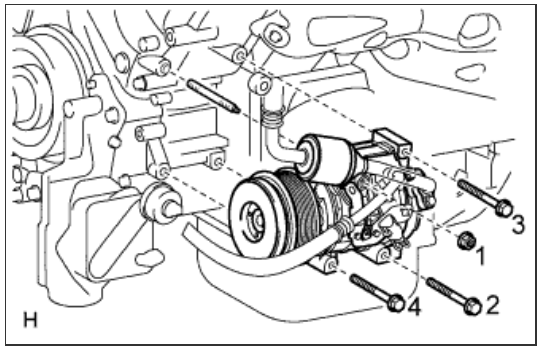
Torque:
10 N*m 102 kgf*cm , 7 ft.*lbf }

b. Install the 3 bolts and nut.

Torque:
25 N*m 30 kgf*cm , 18 ft.*lbf }

NOTICE:

Tighten the bolts and nut in the order shown in the illustration to install the cooler compressor.



8. INSTALL OIL PRESSURE SENDER GAUGE ASSEMBLY

a. Apply adhesive to 2 or 3 threads of the oil pressure sender gauge.

Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent

NOTICE:

Do not allow adhesive to contact the oil hole.

Text in Illustration

*1	Oil Hole

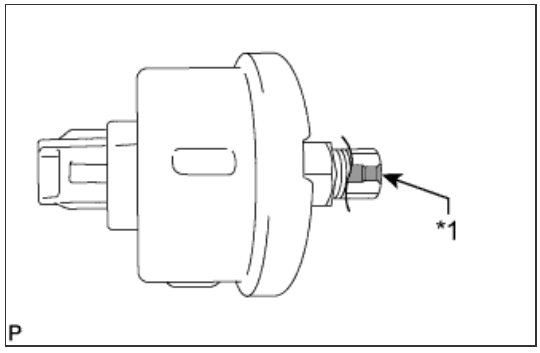
b. Install the oil pressure sender gauge.

Torque:
15 N*m 153 kgf*cm , 11 ft.*lbf }

NOTICE:

Do not start the engine within 1 hour after installation.

c. Connect the sender gauge connector.



9. INSTALL FAN SHROUD

a. Install the fan pulley.

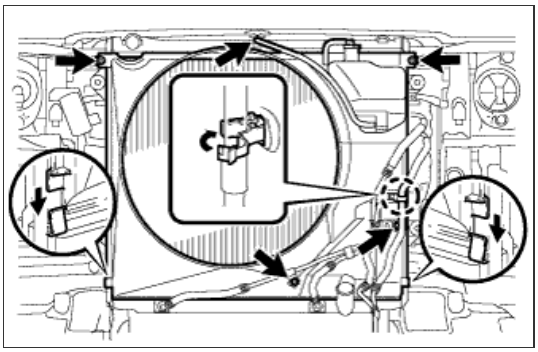
b. Place the shroud together with the coupling fan between the radiator and engine.

NOTICE:

Be careful not to damage the radiator core.

c. Temporarily install the fluid coupling fan to the fluid coupling bracket with the 4 nuts. Tighten the nuts as much as possible by hand.

d. Attach the claws of the shroud to the radiator as shown in the illustration.



e. Install the shroud with the 2 bolts.

Torque:
8.0 N*m 82 kgf*cm , 71 in.*lbf }

f. Connect the oil cooler tube to the fan shroud with the 2 bolts.

Torque:
5.0 N*m 51 kgf*cm , 44 in.*lbf }

g. Pass the hose through the flexible hose clamp and close the clamp as shown in the illustration.

h. Connect the reservoir hose to the upper radiator tank.

i. Install the fan and generator V-belt (Click here).

. Tighten the 4 nuts of the fluid coupling fan.

Torque:
21 N*m 214 kgf*cm , 15 ft.*lbf }

10. INSTALL NO. 1 RADIATOR HOSE

11. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item	Specified Condition
with rear heater	16.2 liters (17.1 US qts, 14.3 Imp. qts)
without rear heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the radiator inlet hose by hand, and checking when the engine coolant starts to flow inside the hose.

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the ater temperature meter. Make sure that the needle does not sho an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the follo ing: 1) stop the engine, 2) ait until the coolant has cooled do n, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

h. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands a ay from the fan.**

i. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.

12. INSPECT FOR COOLANT LEAK

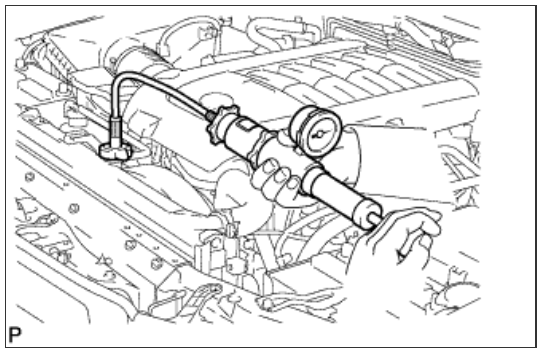
CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



13. INSPECT FOR OIL LEAK

a. Start the engine. Make sure that there are no oil leaks from the area that was worked on.

14. INSPECT ENGINE OIL LE EL

a. Warm up the engine, stop the engine and wait 5 minutes. The oil level should be between the dipstick low level mark and full level mark.
If low, check for leakage and add oil up to the full level mark.

NOTICE:

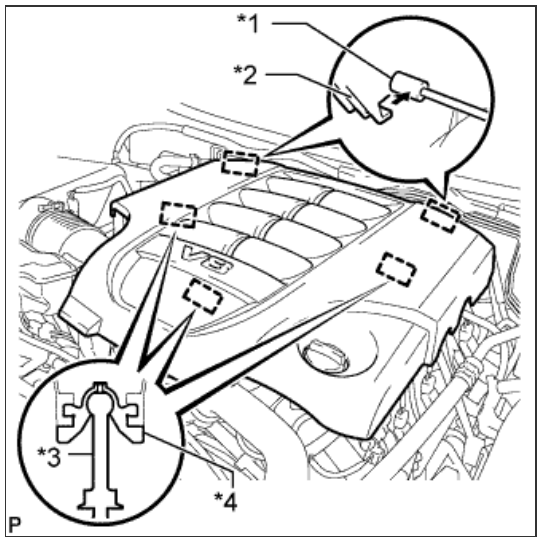
Do not fill engine oil above the full level mark.

15. INSTALL -BANK CO ER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket. Then align the 3 V-bank cover grommets with the 3 pins, and press down on the V-bank cover to attach the pins.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet



16. INSTALL NO. 1 ENGINE UNDER CO ER SUB-ASSEMBLY

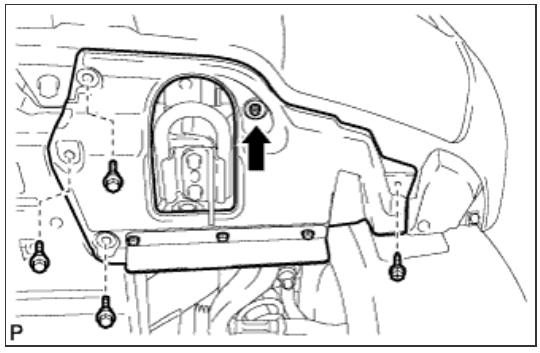
a. Install the No. 1 engine under cover with the 10 bolts.

Torque:
29 N*m 296 kgf*cm , 21 ft.*lbf }

17. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.

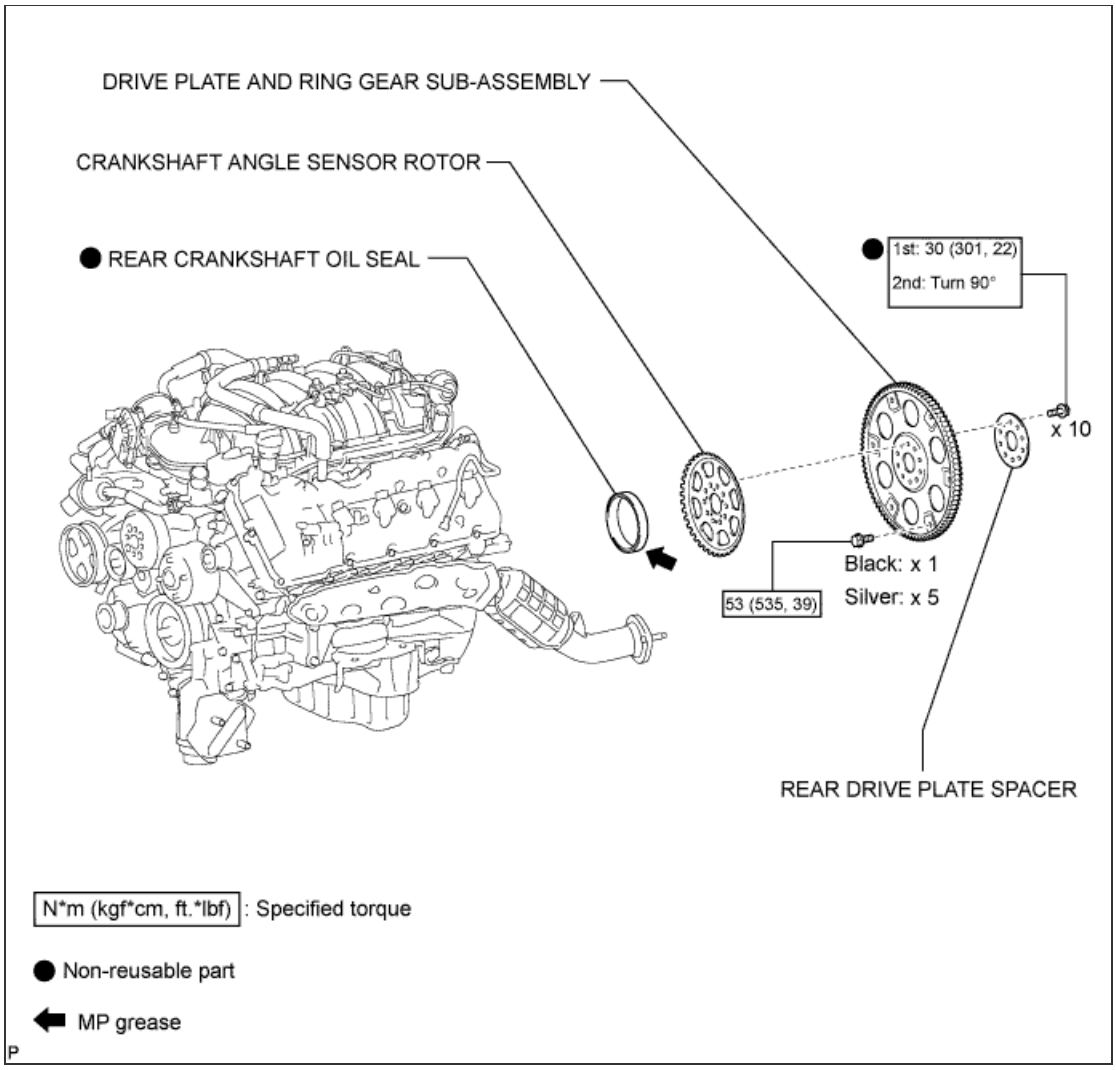


18. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

for Preparation Click here



for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

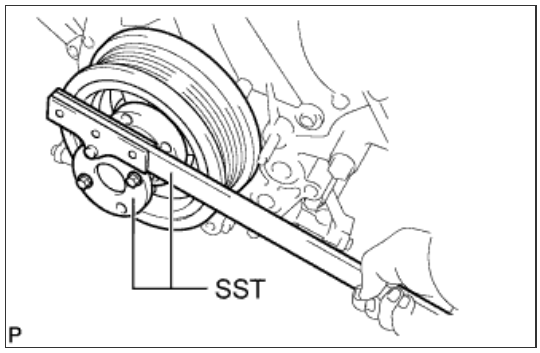
2. REMOVE AUTOMATIC TRANSMISSION ASSEMBLY

(Click here)

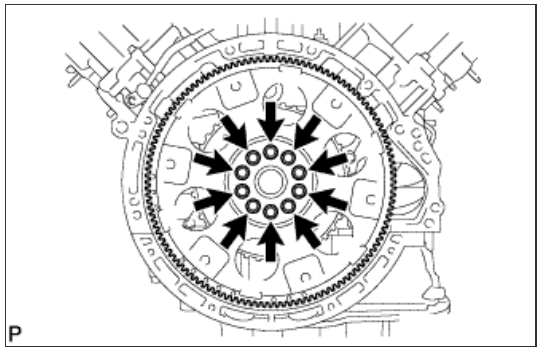
3. REMOVE DRIVE PLATE AND RING GEAR SUB ASSEMBLY

a. Using SST, hold the crankshaft.

SST
09213
09330



b. Remove the 10 bolts, rear drive plate spacer, drive plate and crankshaft angle sensor rotor.



4. REMOVE REAR CRANKSHAFT OIL SEAL

a. Using a knife, cut off the lip of the oil seal.

b. Using a scre driver, pry out the oil seal.

Text in Ill tration

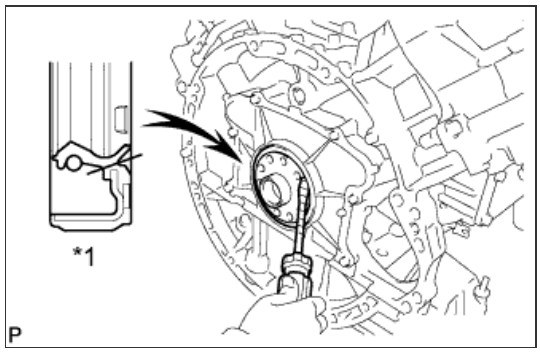
	t Position

HINT:

Tape the scre driver tip before use.

NOTICE:

Do not damage the surface of the oil seal press fit hole and crankshaft.



for Preparation Click here

1. INSTALL REAR CRANKSHAFT OIL SEAL

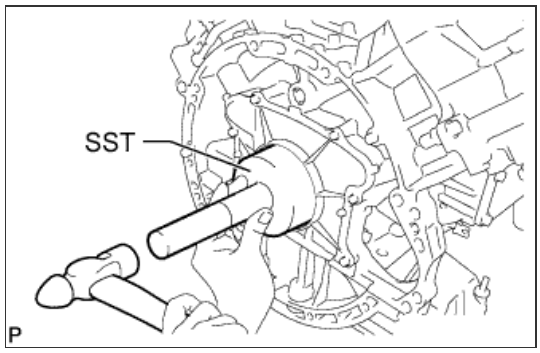
a. Apply MP grease to the lip of a new oil seal.

b. Using SST and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.

SST
09223-56010

NOTICE:

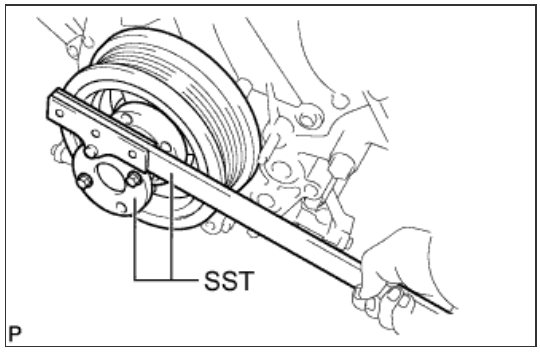
- **Keep the lip free from foreign matter.**
- **Do not tap on the oil seal at an angle.**



2. INSTALL DRIVE PLATE AND RING GEAR SUB-ASSEMBL

a. Using SST, hold the crankshaft.

SST
09213-70011
09330-00021



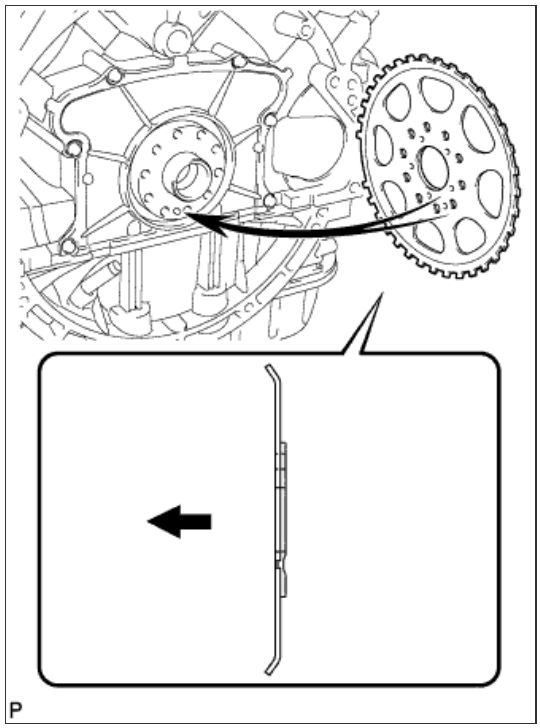
b. Install the crankshaft angle sensor rotor.

Text in Illustration

➡	Engine Side

HINT:

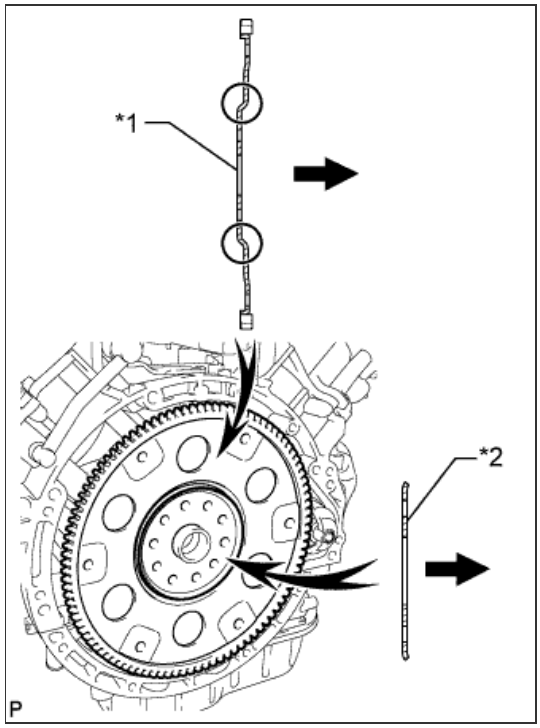
- **Align the pin hole of the crankshaft angle sensor rotor with the pin of the crankshaft.**
- **As the crankshaft angle sensor rotor is not reversible, be sure to install it so that it is facing in the direction shown in the illustration.**



c. Install the drive plate and rear drive plate spacer onto the crankshaft.

Text in Illustration

	rive Plate
	ear Drive Plate Spacer
➡	Automatic Transmission Side



HINT:

As the rear drive plate spacer and the drive plate are not reversible, be sure to install them so that they are facing in the direction shown in the illustration.

d. Install the drive plate and ring gear and bolts.

HINT:

The bolts are tightened in 2 progressive steps.

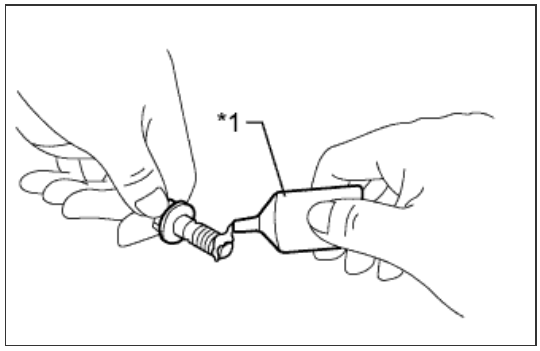
i. Clean the bolts and bolt holes.

ii. Apply adhesive to 2 or 3 threads at the end of each of the 10 bolts.

Adhesive:
To ota Genuine Adhesive 1324, Three Bond 1324 or equivalent

Text in Illustration

	dAesive

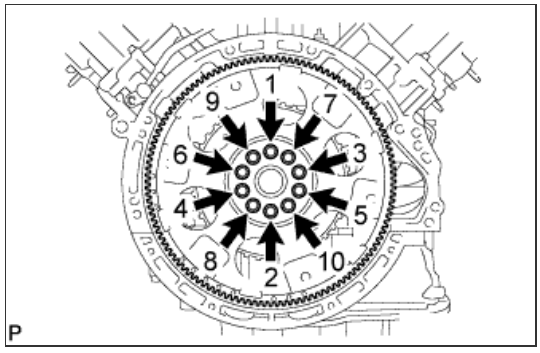


iii. Step 1:
Install and uniformly tighten 10 new bolts in the sequence shown in the illustration.

Torque:
30 N*m 301 kgf*cm , 22 ft.*lbf

NOTICE:

- **Do not reuse the drive plate installation bolts.**
- **Do not strike or damage the drive plate installation bolts. Be sure to handle them carefull .**



iv. Mark the upside of each drive plate installation bolt with paint.

v. Step 2:
Tighten the cylinder head bolts another .

vi. Check that the painted marks are now at a angle to the upside.

NOTICE:

Do not start the engine for at least an hour after installing the drive plate.

3. INSTALL AUTOMATIC TRANSMISSION ASSEMBL

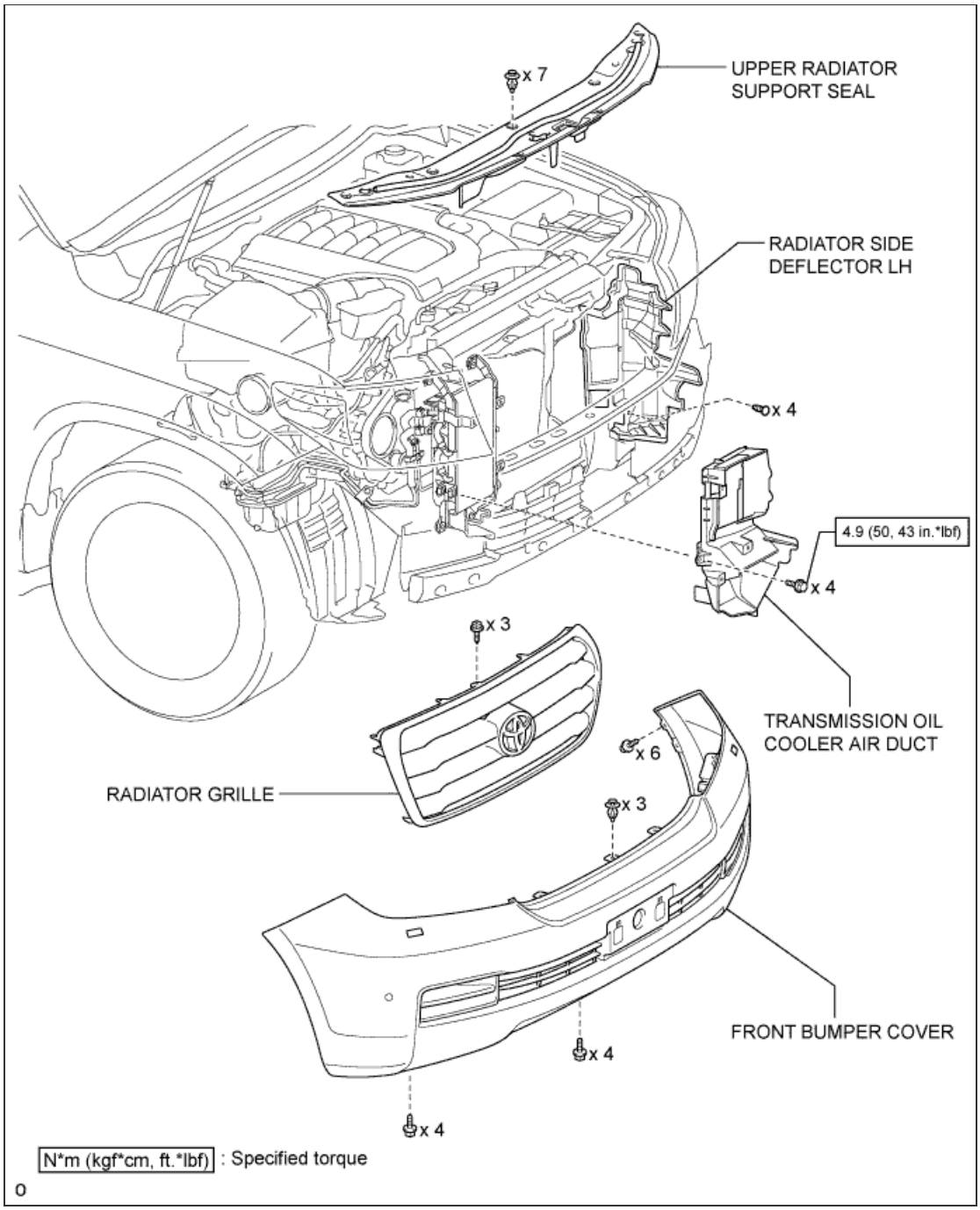
(Click here)

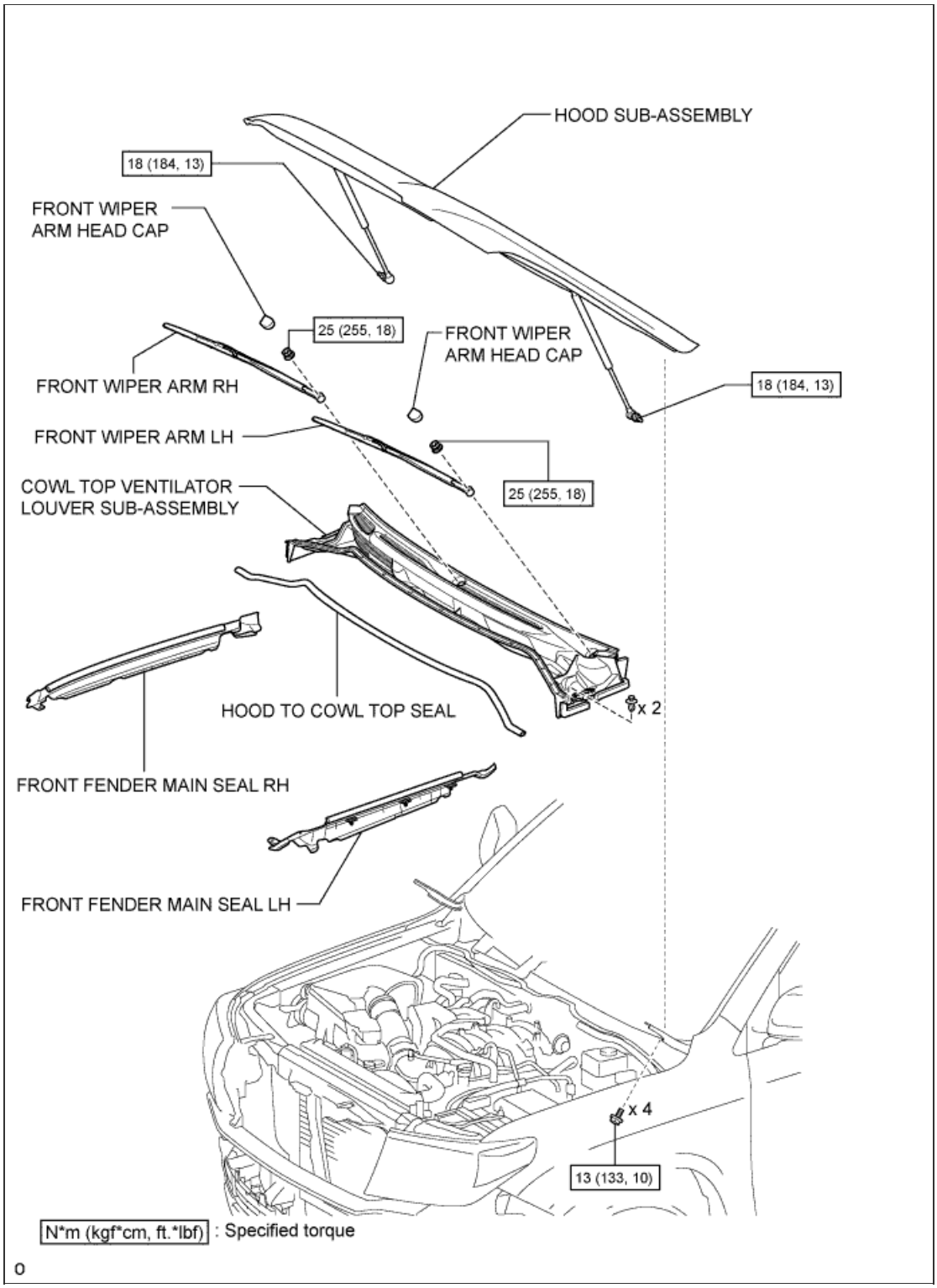
CONNECT CABLE TO NEGATIVE BATTER TERMINAL

NOTICE:

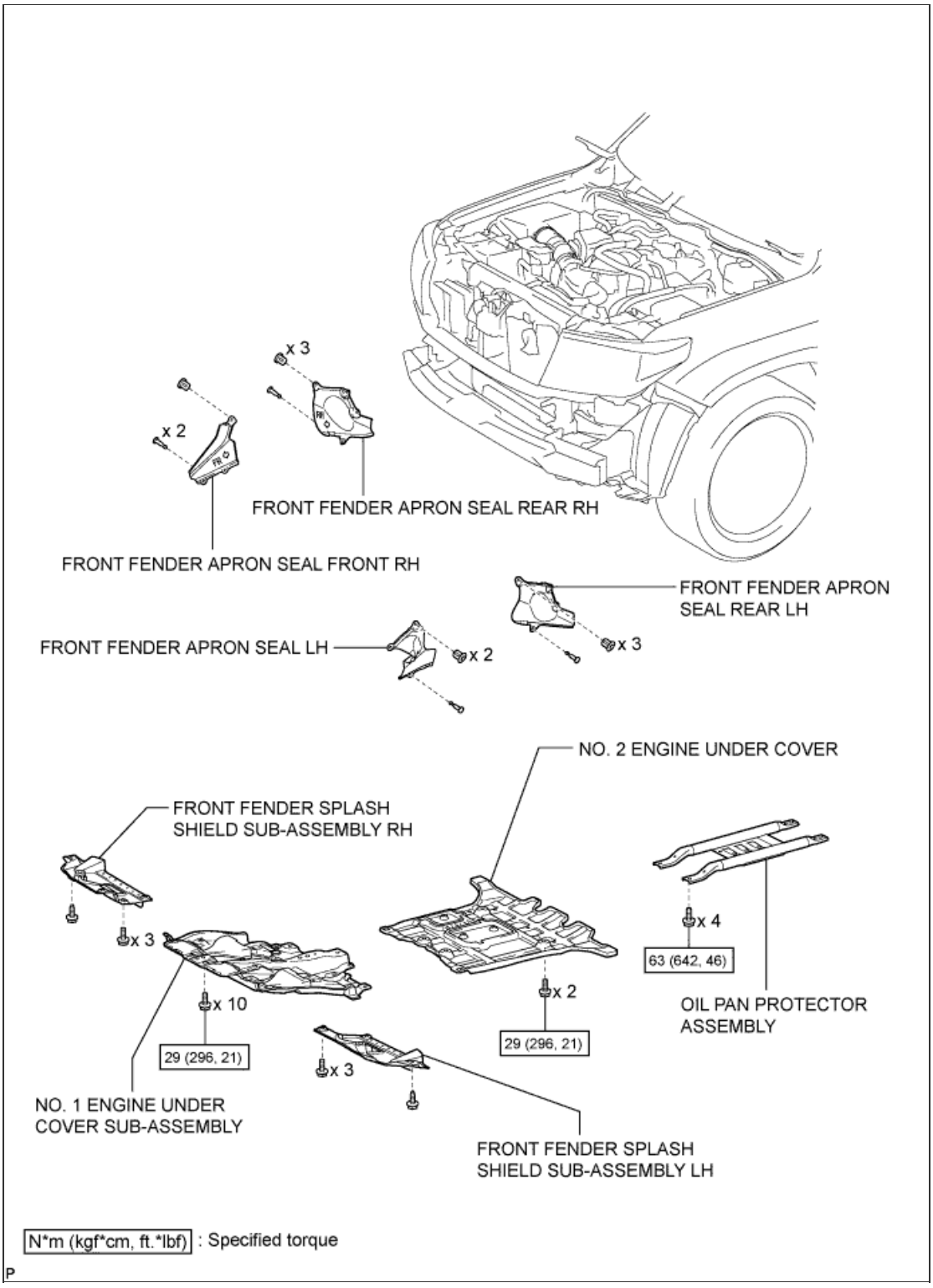
When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

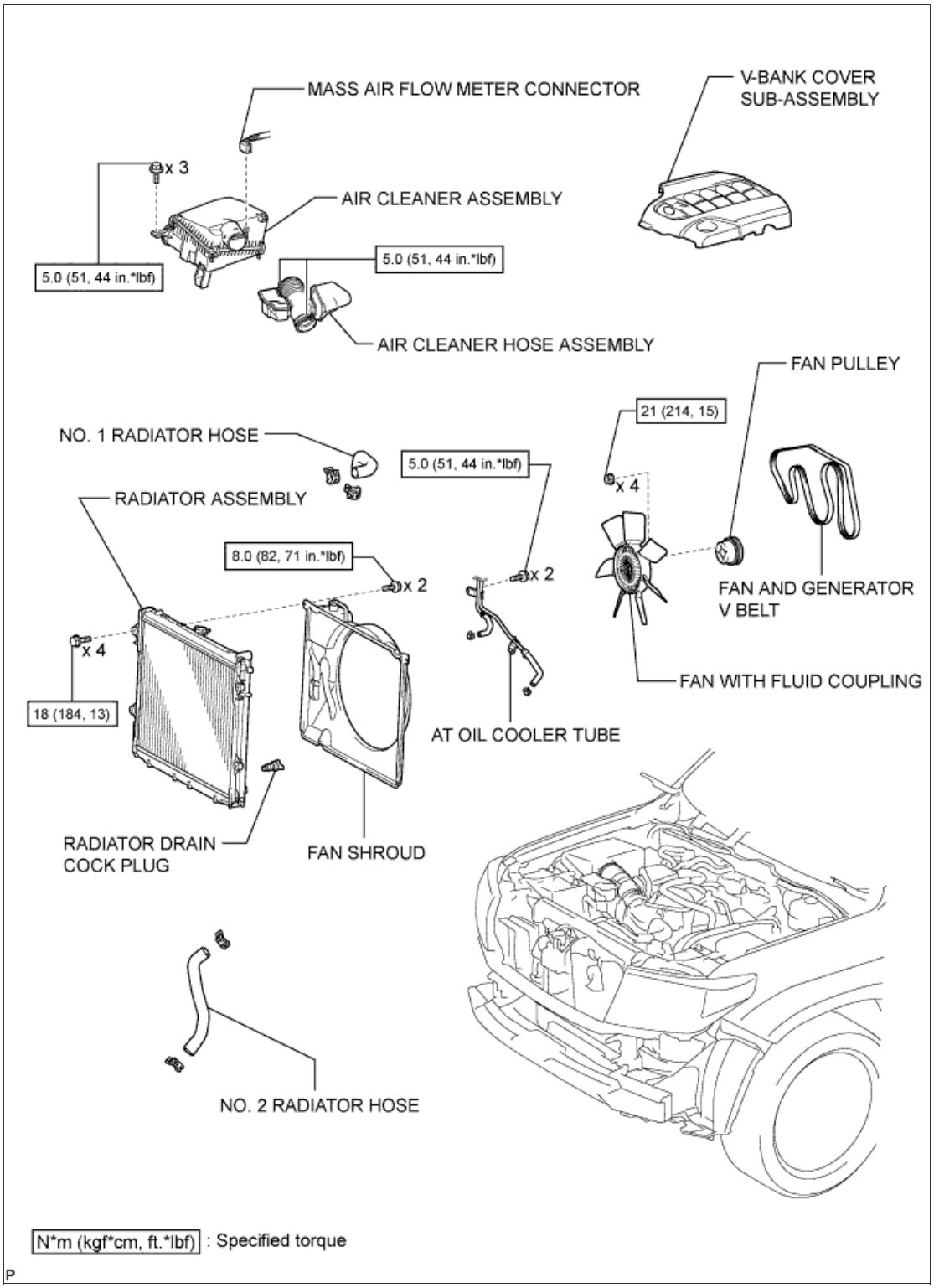
for Preparation Click here



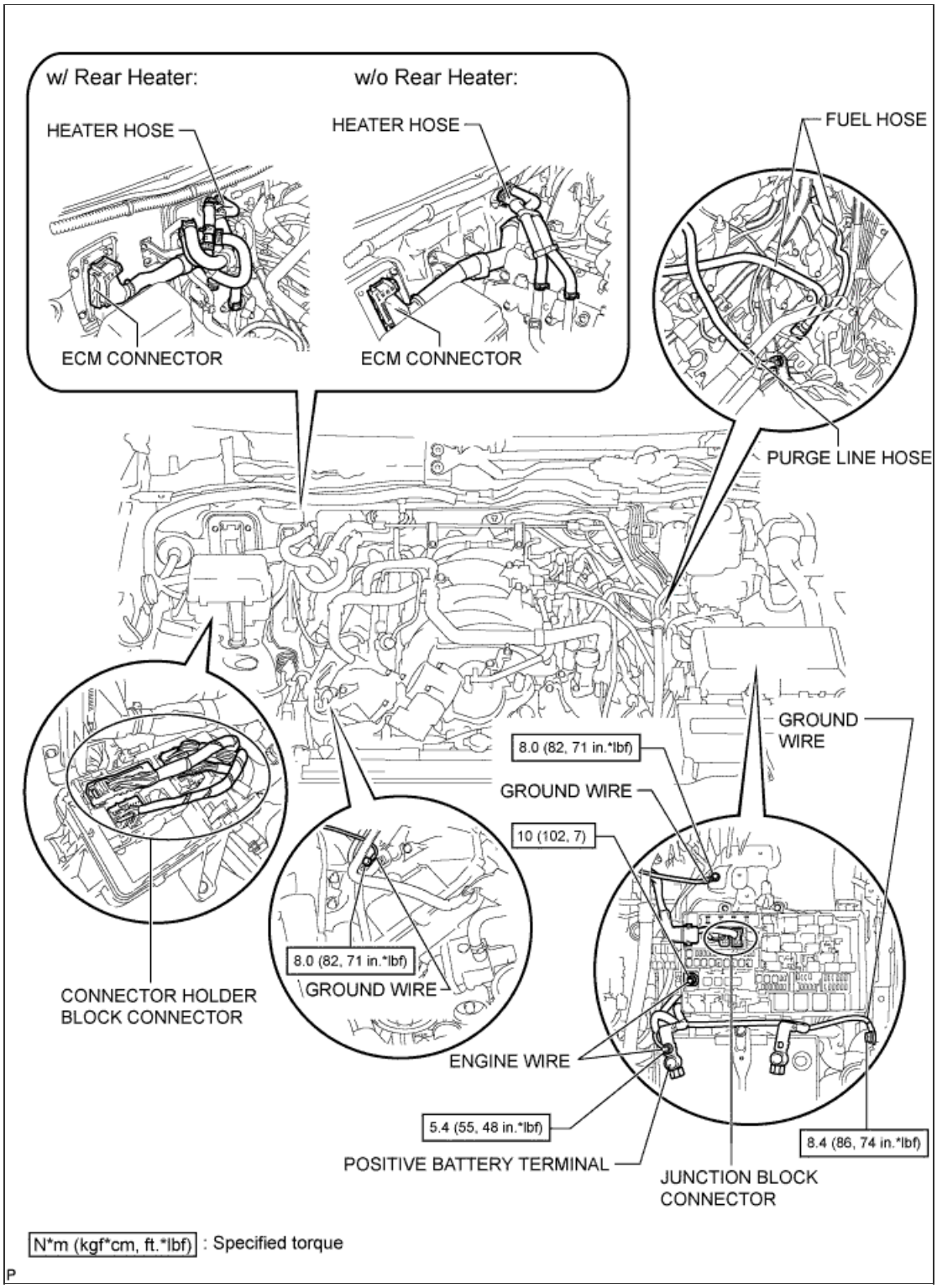

HOOD SUB-ASSEMBLY
18 (184, 13)
FRONT WIPER
ARM HEAD CAP
25 (255, 18)
FRONT WIPER
ARM HEAD CAP
18 (184, 13)
FRONT WIPER ARM RH
FRONT WIPER ARM LH
25 (255, 18)
COWL TOP VENTILATOR
LOUVER SUB-ASSEMBLY
x 2
HOOD TO COWL TOP SEAL
FRONT FENDER MAIN SEAL RH
FRONT FENDER MAIN SEAL LH
x 4
13 (133, 10)
N*m (kgf*cm, ft.*lbf) : Specified torque

o

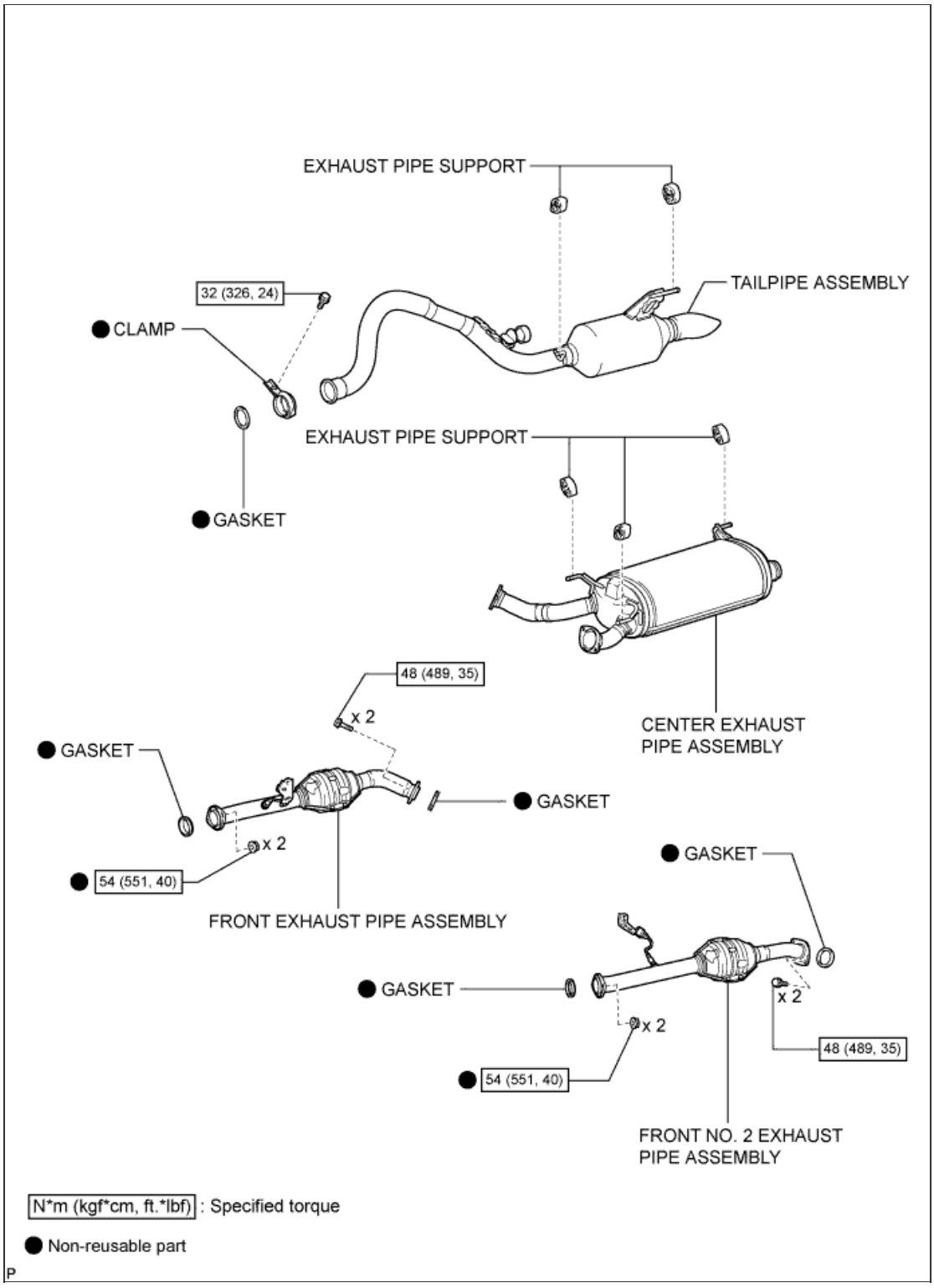

x 3
x 2
FRONT FENDER APRON SEAL REAR RH
FRONT FENDER APRON SEAL FRONT RH
FRONT FENDER APRON SEAL REAR LH
x 3
FRONT FENDER APRON SEAL LH
x 2
NO. 2 ENGINE UNDER COVER
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH
x 4
63 (642, 46)
x 3
x 10
29 (296, 21)
x 2
29 (296, 21)
OIL PAN PROTECTOR ASSEMBLY
x 3
NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH
N*m (kgf*cm, ft.*lbf) : Specified torque
P


MASS AIR FLOW METER CONNECTOR
V-BANK COVER SUB-ASSEMBLY
x 3
AIR CLEANER ASSEMBLY
5.0 (51, 44 in.*lbf)
5.0 (51, 44 in.*lbf)
AIR CLEANER HOSE ASSEMBLY
FAN PULLEY
21 (214, 15)
NO. 1 RADIATOR HOSE
5.0 (51, 44 in.*lbf)
x 4
RADIATOR ASSEMBLY
8.0 (82, 71 in.*lbf)
x 2
x 2
FAN AND GENERATOR V BELT
x 4
18 (184, 13)
FAN WITH FLUID COUPLING
AT OIL COOLER TUBE
RADIATOR DRAIN COCK PLUG
FAN SHROUD
NO. 2 RADIATOR HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque

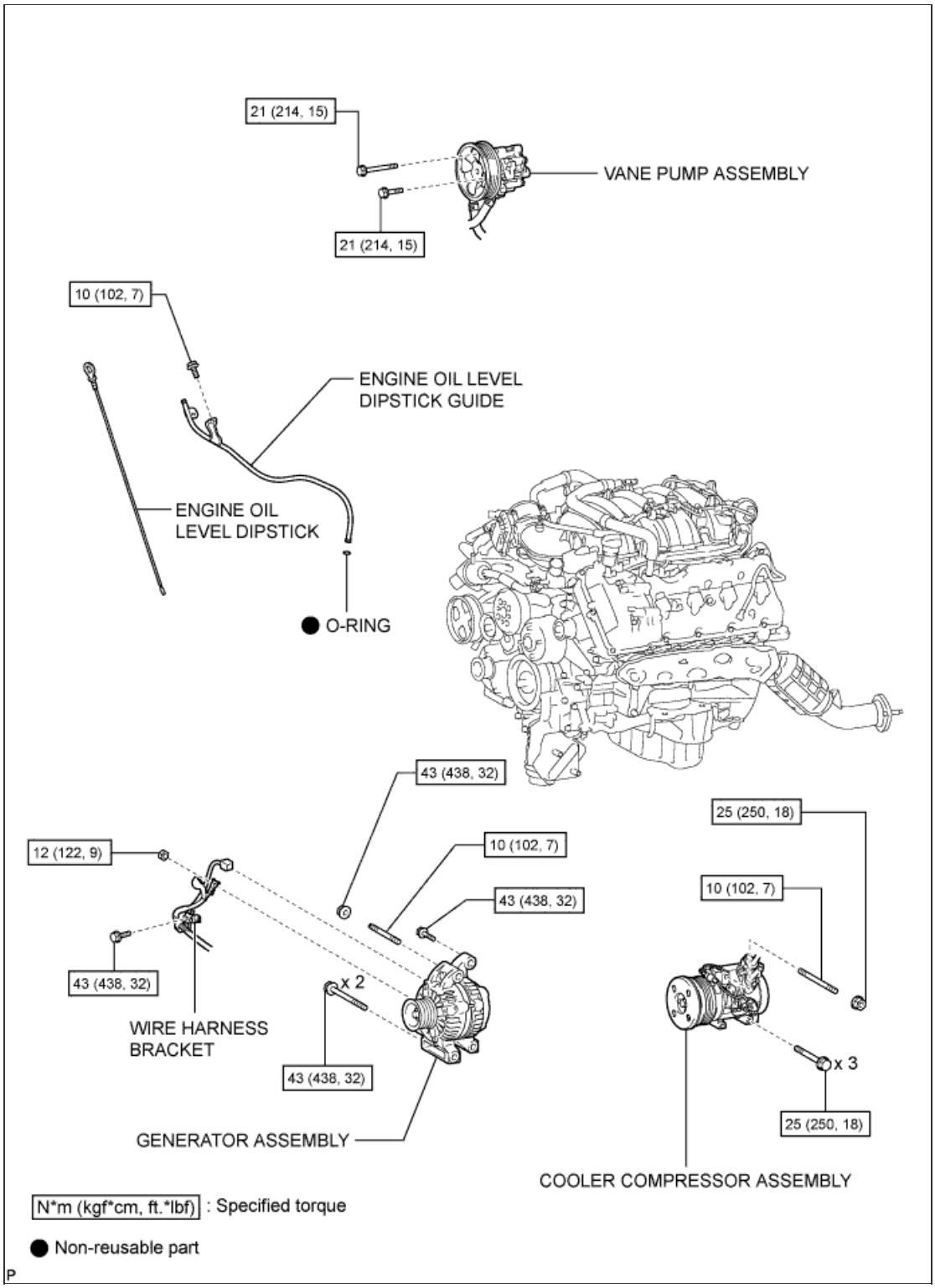
P

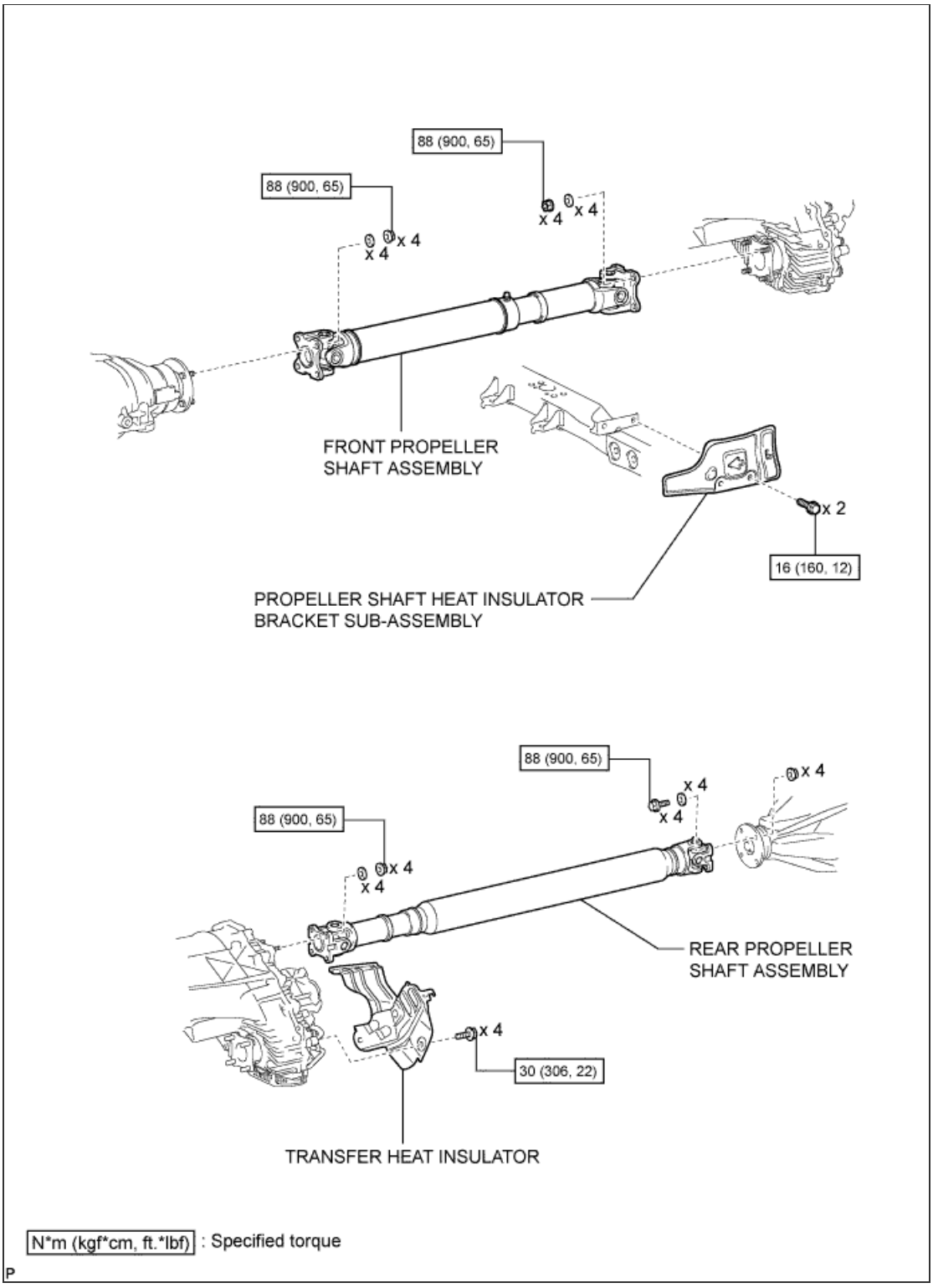

w/ Rear Heater:
w/o Rear Heater:
HEATER HOSE
HEATER HOSE
ECM CONNECTOR
ECM CONNECTOR
FUEL HOSE
PURGE LINE HOSE
GROUND WIRE
8.0 (82, 71 in.*lbf)
GROUND WIRE
10 (102, 7)
8.0 (82, 71 in.*lbf)
GROUND WIRE
CONNECTOR HOLDER
BLOCK CONNECTOR
ENGINE WIRE
5.4 (55, 48 in.*lbf)
POSITIVE BATTERY TERMINAL
8.4 (86, 74 in.*lbf)
JUNCTION BLOCK
CONNECTOR
N*m (kgf*cm, ft.*lbf) : Specified torque

P


EXHAUST PIPE SUPPORT
TAILPIPE ASSEMBLY
32 (326, 24)
CLAMP
EXHAUST PIPE SUPPORT
GASKET
48 (489, 35)
x 2
CENTER EXHAUST PIPE ASSEMBLY
GASKET
GASKET
x 2
54 (551, 40)
FRONT EXHAUST PIPE ASSEMBLY
GASKET
GASKET
x 2
x 2
48 (489, 35)
54 (551, 40)
FRONT NO. 2 EXHAUST PIPE ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

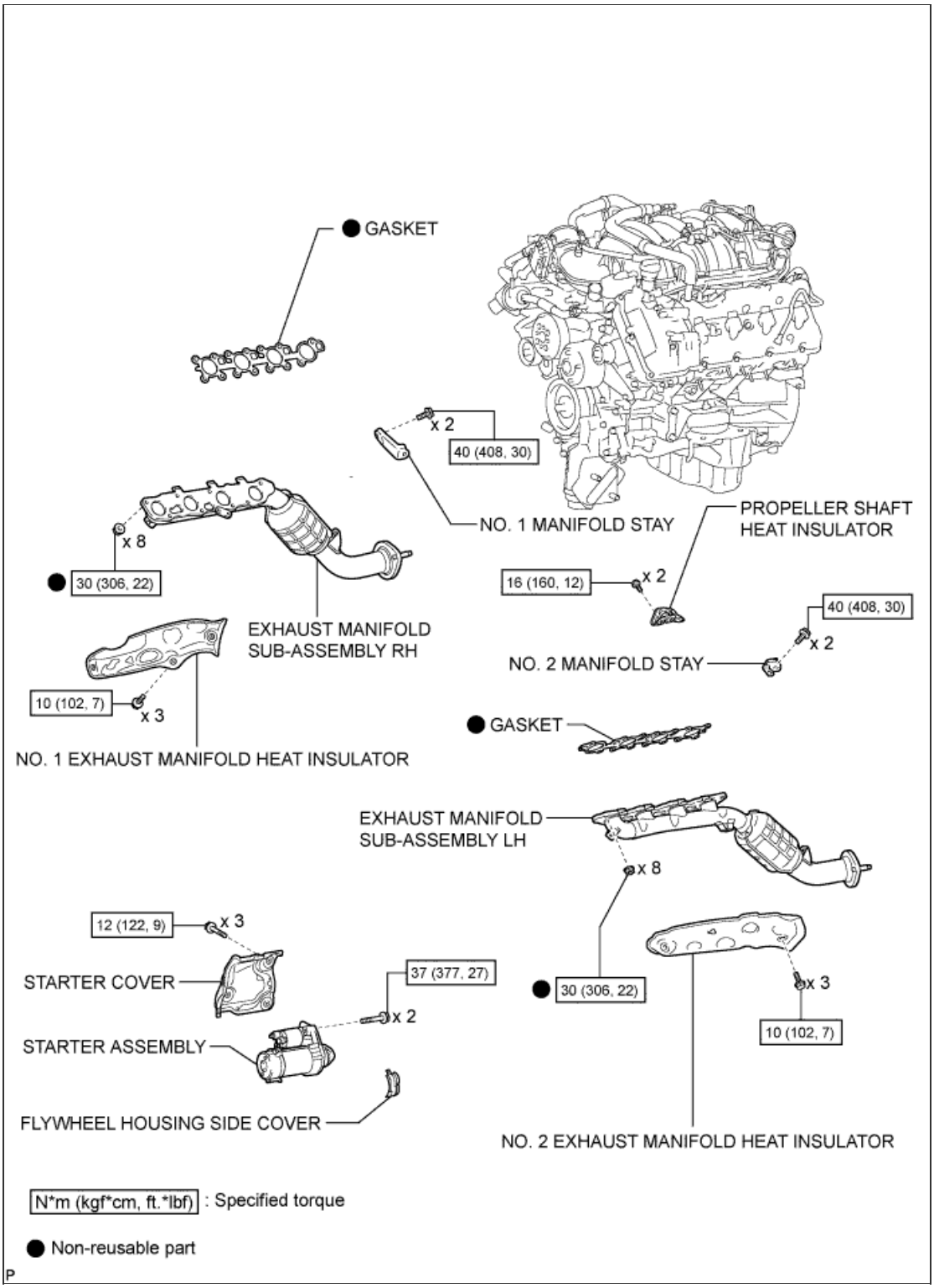
P


21 (214, 15)
VANE PUMP ASSEMBLY
21 (214, 15)
10 (102, 7)
ENGINE OIL LEVEL
DIPSTICK GUIDE
ENGINE OIL
LEVEL DIPSTICK
● O-RING
43 (438, 32)
25 (250, 18)
12 (122, 9)
10 (102, 7)
43 (438, 32)
10 (102, 7)
43 (438, 32)
x 2
WIRE HARNESS
BRACKET
43 (438, 32)
x 3
25 (250, 18)
GENERATOR ASSEMBLY
COOLER COMPRESSOR ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
P

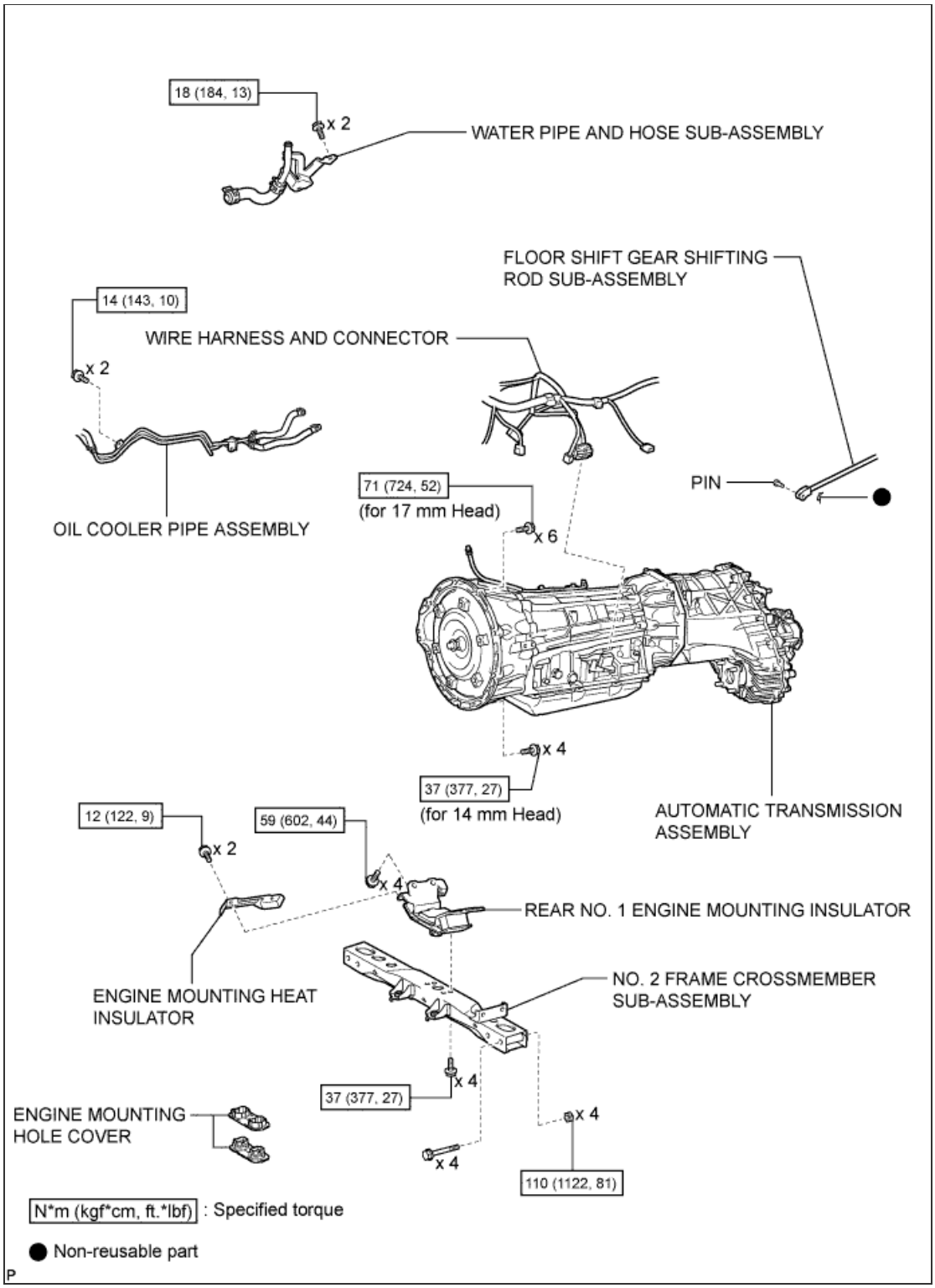


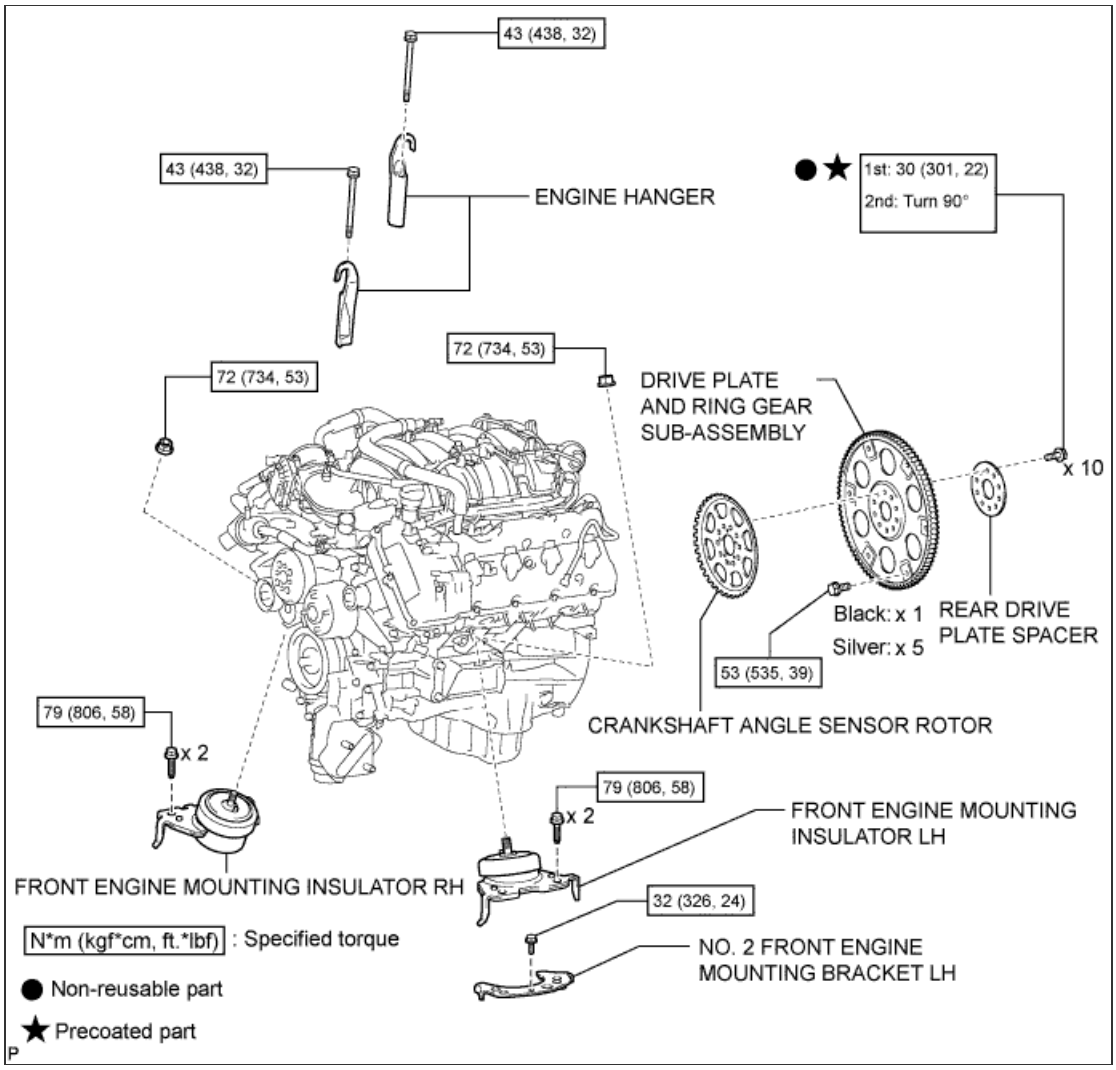
N*m (kgf*cm, ft.*lbf) : Specified torque

P


GASKET
x 2
40 (408, 30)
NO. 1 MANIFOLD STAY
PROPELLER SHAFT
HEAT INSULATOR
x 8
30 (306, 22)
16 (160, 12)
x 2
EXHAUST MANIFOLD
SUB-ASSEMBLY RH
40 (408, 30)
x 2
NO. 2 MANIFOLD STAY
10 (102, 7)
x 3
GASKET
NO. 1 EXHAUST MANIFOLD HEAT INSULATOR
EXHAUST MANIFOLD
SUB-ASSEMBLY LH
x 8
12 (122, 9)
x 3
STARTER COVER
37 (377, 27)
x 2
STARTER ASSEMBLY
30 (306, 22)
x 3
10 (102, 7)
FLYWHEEL HOUSING SIDE COVER
NO. 2 EXHAUST MANIFOLD HEAT INSULATOR
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P


18 (184, 13)
x 2
WATER PIPE AND HOSE SUB-ASSEMBLY
FLOOR SHIFT GEAR SHIFTING ROD SUB-ASSEMBLY
14 (143, 10)
WIRE HARNESS AND CONNECTOR
x 2
OIL COOLER PIPE ASSEMBLY
71 (724, 52)
(for 17 mm Head)
x 6
PIN
x 4
37 (377, 27)
(for 14 mm Head)
AUTOMATIC TRANSMISSION ASSEMBLY
12 (122, 9)
x 2
59 (602, 44)
x 4
REAR NO. 1 ENGINE MOUNTING INSULATOR
ENGINE MOUNTING HEAT INSULATOR
NO. 2 FRAME CROSSMEMBER SUB-ASSEMBLY
x 4
37 (377, 27)
ENGINE MOUNTING HOLE COVER
x 4
x 4
110 (1122, 81)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P


43 (438, 32)
43 (438, 32)
ENGINE HANGER
●★ 1st: 30 (301, 22)
2nd: Turn 90°
72 (734, 53)
72 (734, 53)
DRIVE PLATE
AND RING GEAR
SUB-ASSEMBLY
x 10
Black: x 1
Silver: x 5
REAR DRIVE
PLATE SPACER
53 (535, 39)
CRANKSHAFT ANGLE SENSOR ROTOR
79 (806, 58)
x 2
79 (806, 58)
x 2
FRONT ENGINE MOUNTING
INSULATOR LH
FRONT ENGINE MOUNTING INSULATOR RH
32 (326, 24)
NO. 2 FRONT ENGINE
MOUNTING BRACKET LH
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
★ Precoated part
P

for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

(Click here)

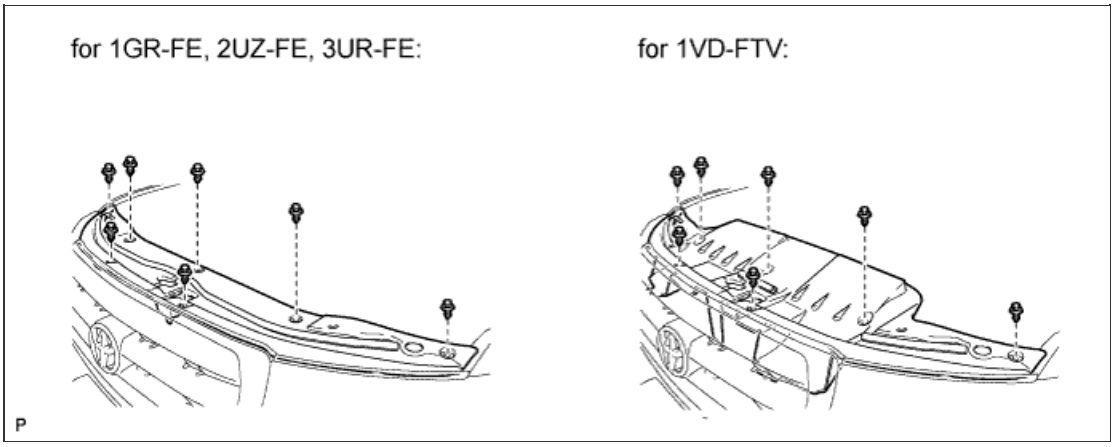
2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and radiator support seal.

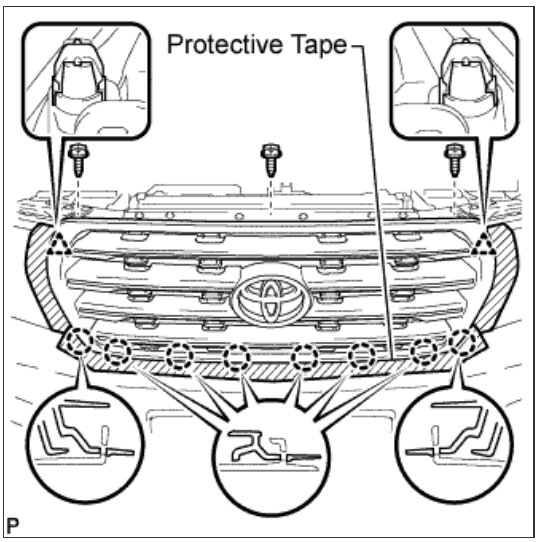


4. REMOVE RADIATOR GRILLE

a. Put protective tape around the radiator grille.

b. Remove the 3 screws.

c. Detach the 2 clips and 8 claws, and remove the radiator grille.

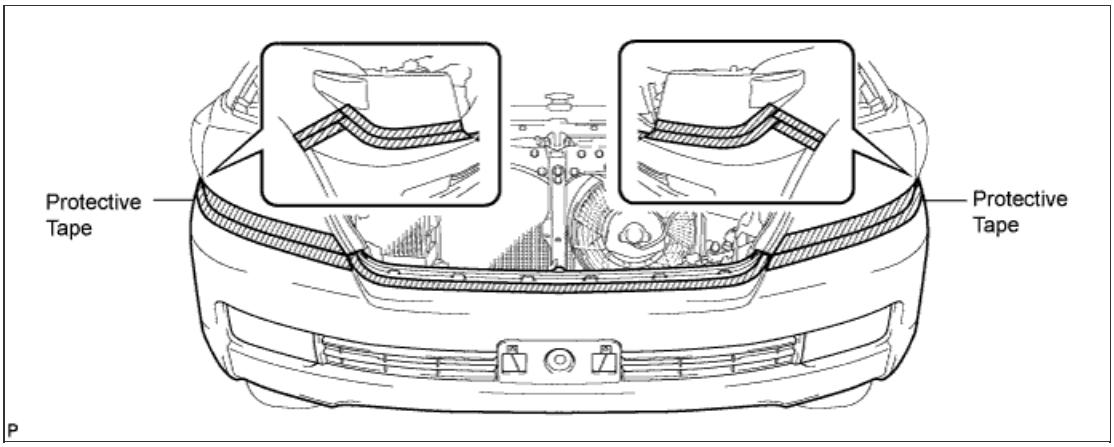


5. REMOVE FRONT BUMPER COVER

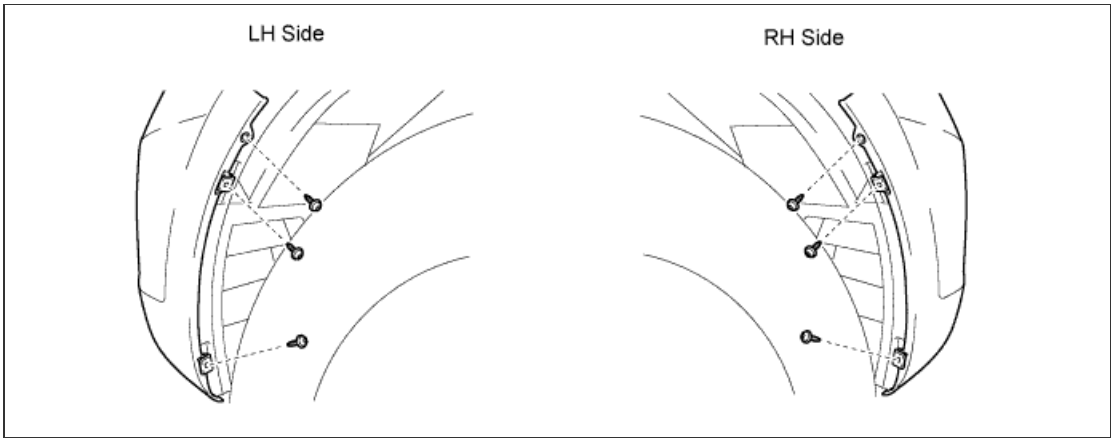
HINT:

For the front bumper cover with garnish, use the procedures described below.

a. Put protective tape around the bumper cover.



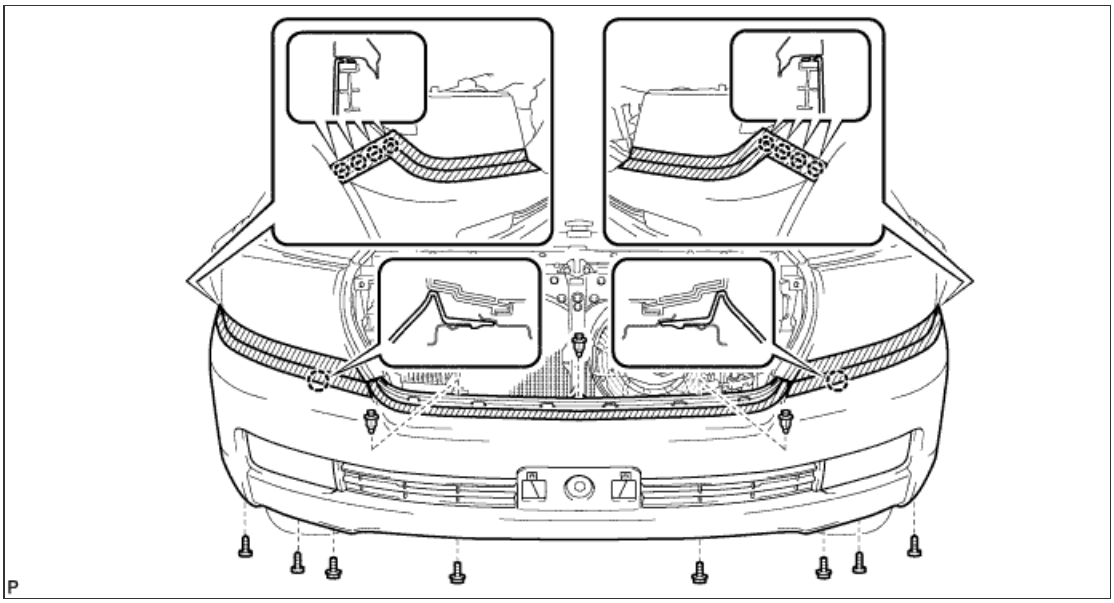
b. Using a T30 "TORX" socket, remove the 6 screws.



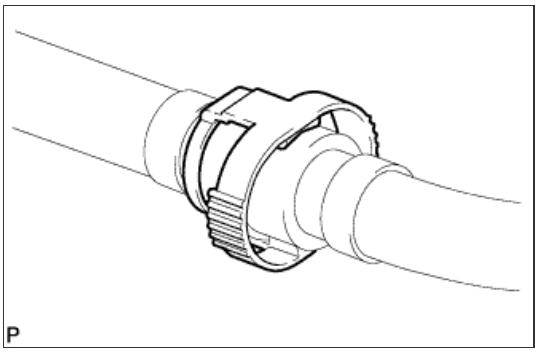
c. Remove the 3 clips, 4 screws and 4 bolts.

d. w/o TOYOTA Parking Assist-sensor System, w/o Fog Light:
Detach the 10 claws and remove the bumper cover.

e. w/ TOYOTA Parking Assist-sensor System or w/ Fog Light:
Detach the 10 claws, disconnect the No. 4 engine room wire connector and remove the bumper cover.

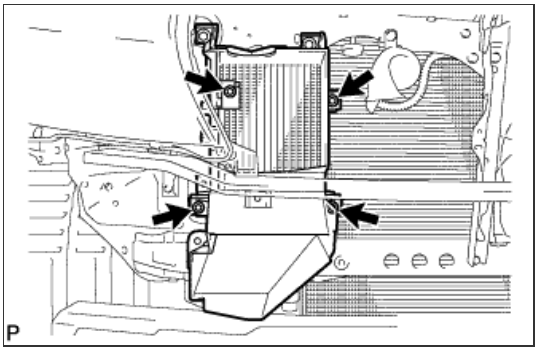


f. w/ Headlight Cleaner System:
Disconnect the headlight cleaner hose and remove the bumper cover.



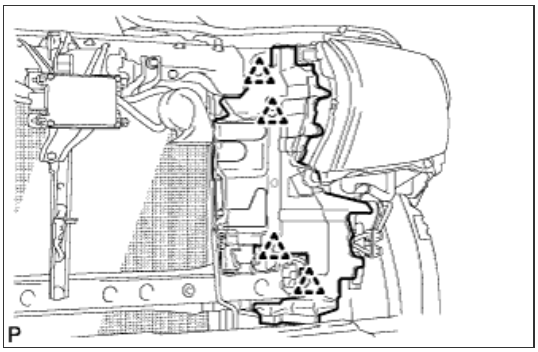
6. REMOVE TRANSMISSION OIL COOLER AIR DUCT

a. Remove the 4 bolts and oil cooler air duct.



7. DISCONNECT RADIATOR SIDE DEFLECTOR LH

a. Using a clip remover, remove the 4 clips and disconnect the side deflector.



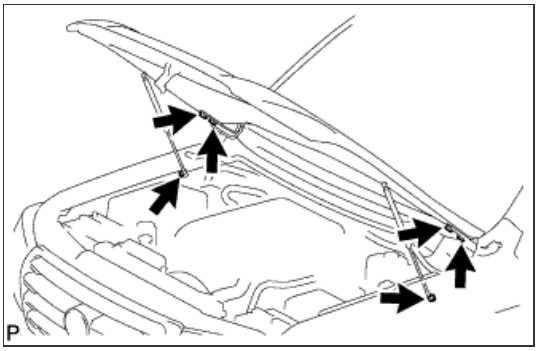
8. REMOVE HOOD SUB-ASSEMBLY

a. Remove the 2 hood support bolts and disconnect the hood supports.

CAUTION:

Remove the hood support assembly while supporting the hood by hand.

b. Remove the 4 bolts and hood.

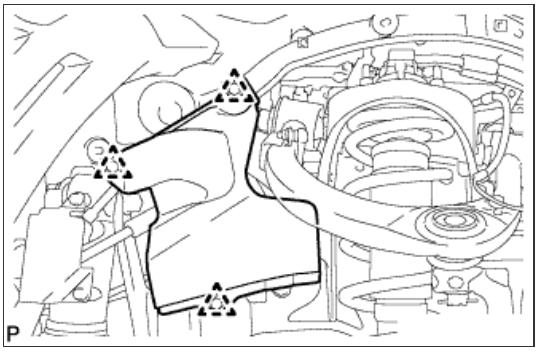


9. REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

(Click here)

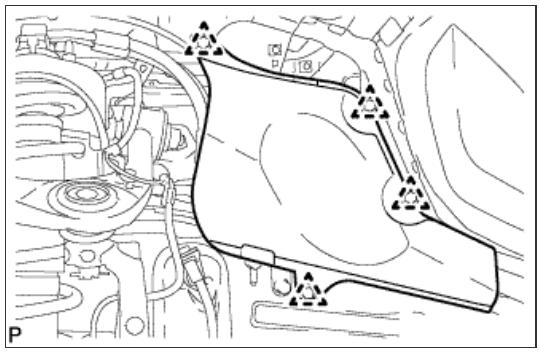
10. REMOVE FRONT FENDER APRON SEAL LH

a. Using a clip remover, remove the 3 clips and fender apron seal.



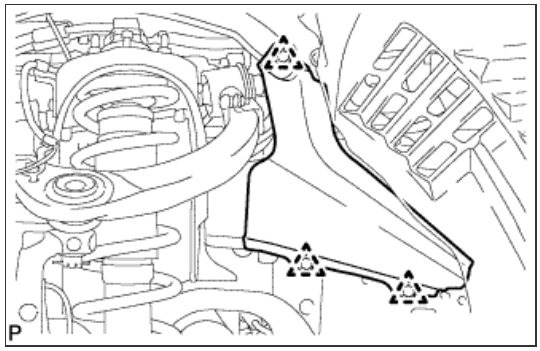
11. REMOVE FRONT FENDER APRON SEAL REAR LH

a. Using a clip remover, remove the 4 clips and fender apron seal.



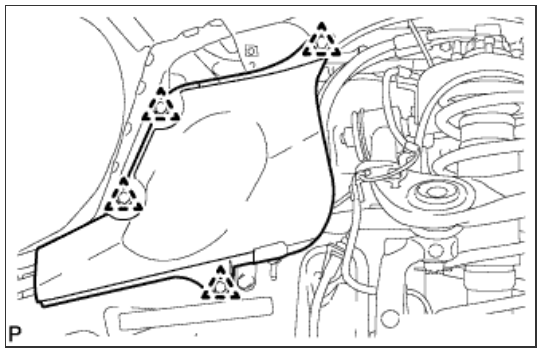
12. REMOVE FRONT FENDER APRON SEAL FRONT RH

a. Using a clip remover, remove the 3 clips and fender apron seal.



13. REMOVE FRONT FENDER APRON SEAL REAR RH

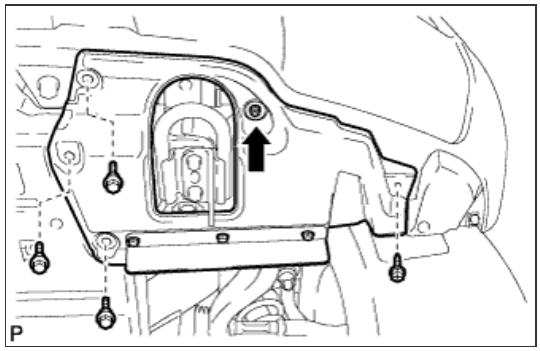
a. Using a clip remover, remove the 4 clips and fender apron seal.



14. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



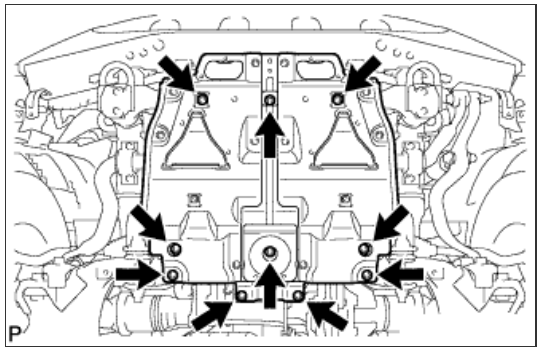
15. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

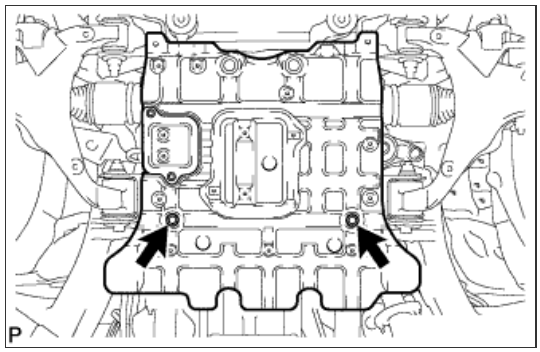
16. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and No. 1 engine under cover.



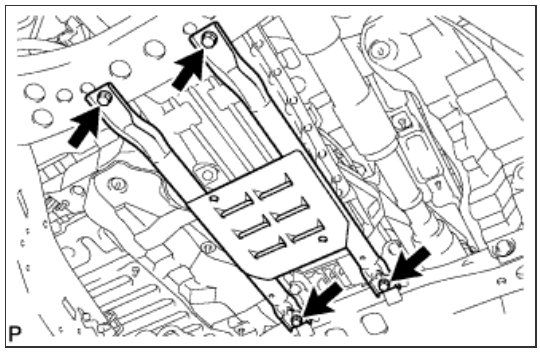
17. REMOVE NO. 2 ENGINE UNDER COVER

a. Remove the 2 bolts and No. 2 engine under cover.



18. REMOVE OIL PAN PROTECTOR ASSEMBLY

a. Remove the 4 bolts and oil pan protector assembly.



19. DRAIN ENGINE OIL

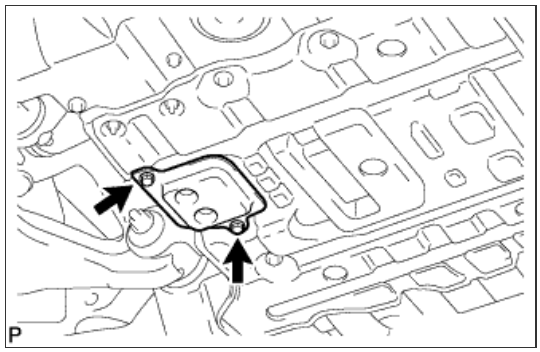
a. Remove the oil filler cap.

b. Remove the 2 bolts and No. 2 engine under cover seal.

c. Remove the oil pan drain plug and gasket, and drain the engine oil into a container.

d. Install a new gasket and the oil pan drain plug.

Tor e:
40 N*m 408 k f*cm , 30 ft.*lbf }



20. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug.

HINT:

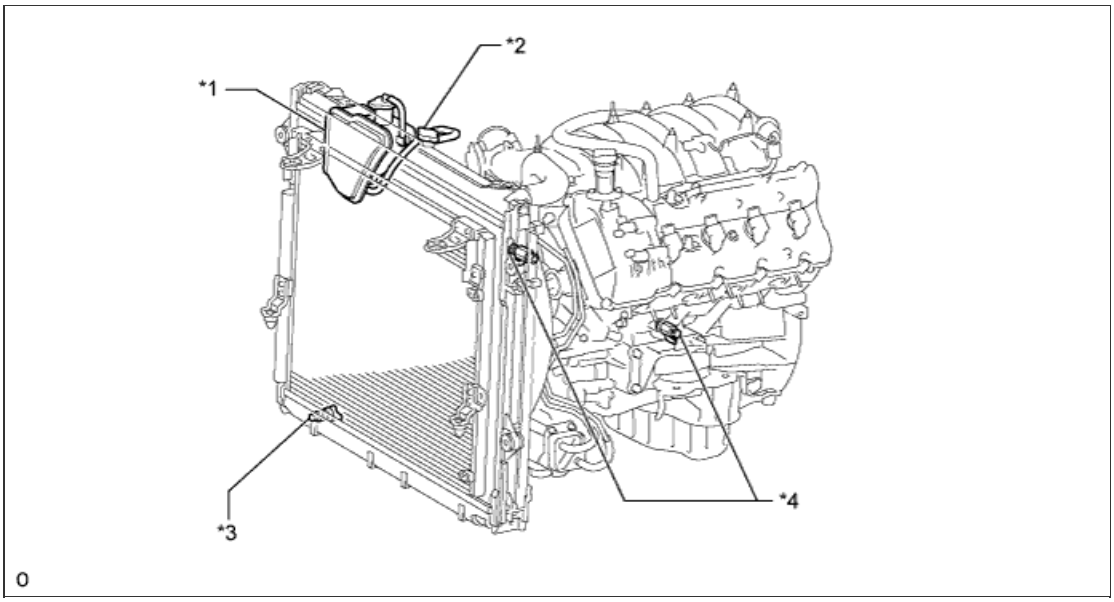
Collect the coolant in a container and dispose of it according to the regulations in your area.

b. Remove the radiator cap. Then drain the coolant from the radiator.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

d. Tighten the 2 cylinder block drain cock plugs.

Tor e:
13 N*m 133 k f*cm , 10 ft.*lbf }



Text in Illustration

*1	Radiator Reservoir	*2	Radiator Cap
*3	Radiator Drain Cock Plug	*4	Cylinder Block Drain Cock Plug

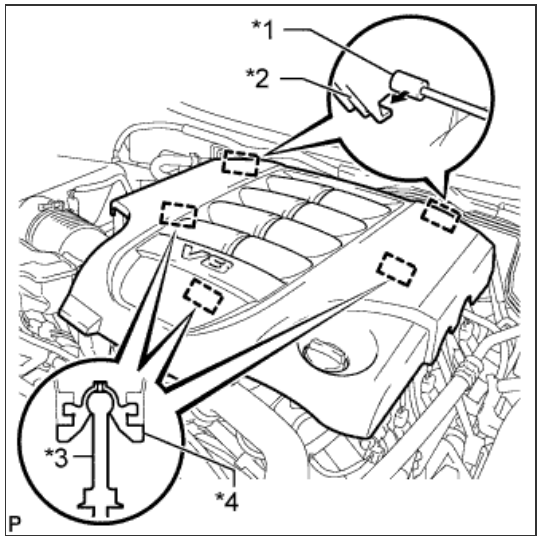
e. Tighten the radiator drain cock plug by hand.

21. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Raise the front of the V-bank cover to detach the 3 pins. Then remove the 2 V-bank cover hooks from the bracket, and remove the V-bank cover.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet

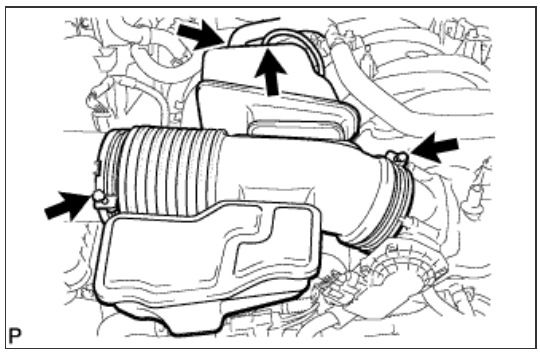


22. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum hose and No. 2 ventilation hose.

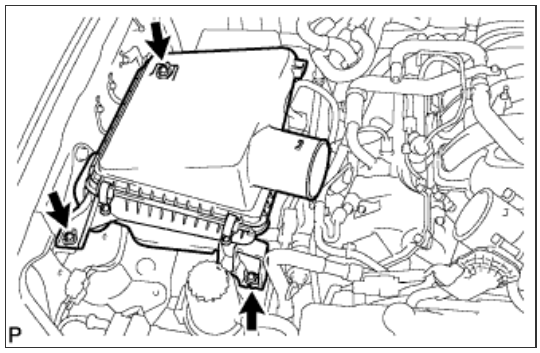
b. Loosen the 2 hose clamps.

c. Remove the air cleaner hose.



23. REMOVE AIR CLEANER ASSEMBLY

a. Remove the 3 bolts and air cleaner.



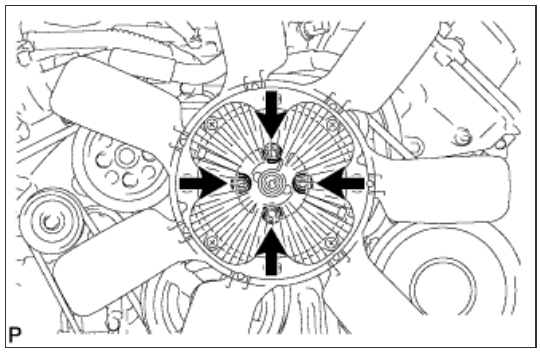
24. REMOVE NO. 1 RADIATOR HOSE

25. REMOVE NO. 2 RADIATOR HOSE

26. REMOVE FAN SHROUD

a. Loosen the 4 nuts holding the fluid coupling fan.

b. Remove the fan and generator V-belt (Click here).



c. Disconnect the reservoir hose from the upper radiator tank.

d. Detach the claw to open the flexible hose clamp.

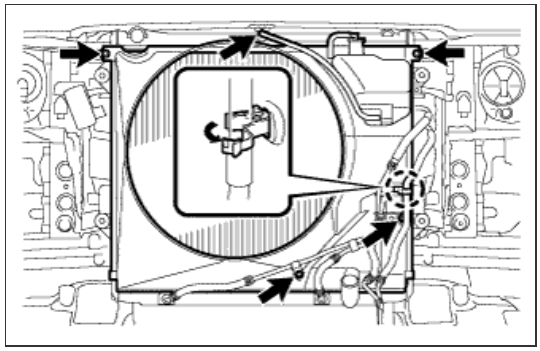
e. Remove the 2 bolts and disconnect the oil cooler tube from the fan shroud.

f. Remove the 2 bolts holding the fan shroud.

.Remove the 4 nuts of the fluid coupling fan, and then remove the shroud together with the coupling fan.

NOTICE:

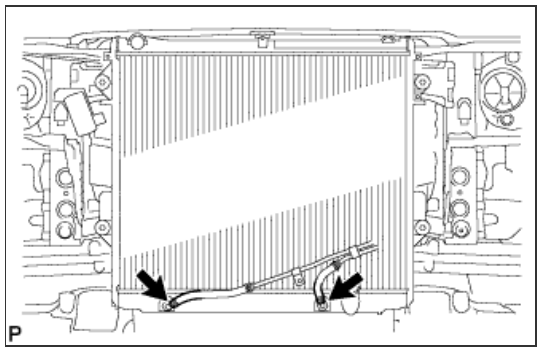
Be careful not to damage the radiator core.



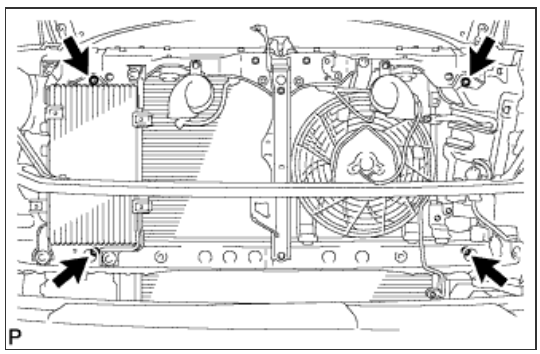
h. Remove the fan pulley.

27. REMOVE RADIATOR ASSEMBLY

a. Disconnect the 2 oil cooler hoses.



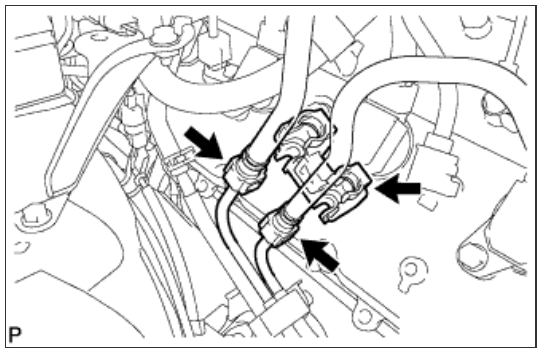
b. Remove the 4 bolts and radiator.



28. DISCONNECT FUEL MAIN AND RETURN HOSE

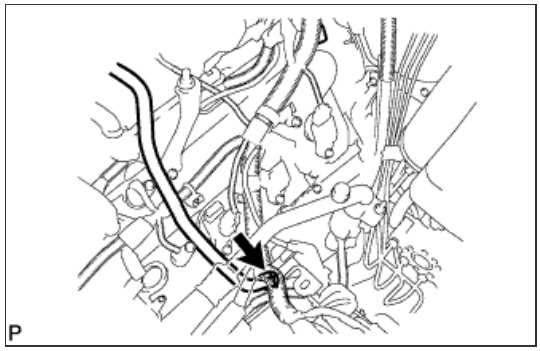
a. Remove the fuel pipe clamp.

b. Disconnect the fuel main and return hoses (Click here).



29. DISCONNECT WIRE HARNESS AND HOSE

a. Disconnect the purge line hose.



b. Remove the heater hose.

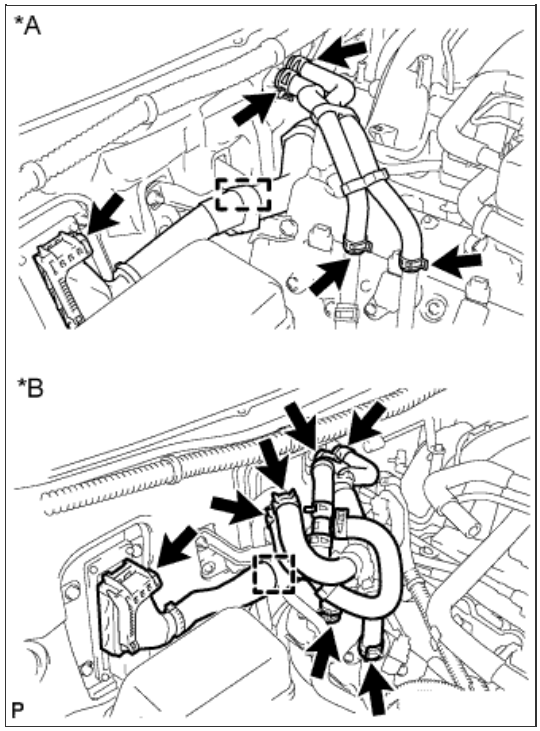
c. Disconnect the clamp and EC connector.

Text in Illustration

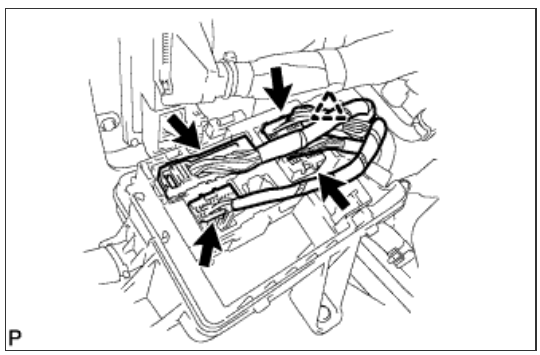
*A	w/o Rear Heater
*B	w/ Rear Heater

HINT:

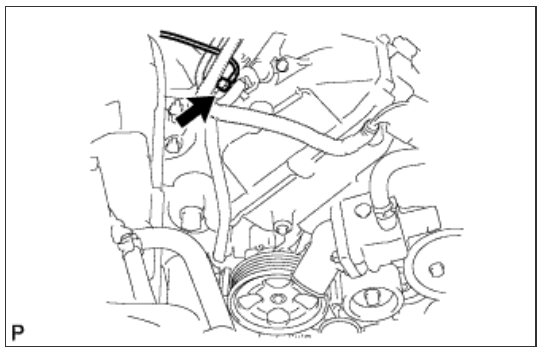
Refer to the following procedures to disconnect the EC connector (Click here).



d. Disconnect the 4 connectors and clamp from the connector holder block.



e. Remove the bolt and disconnect the ground wire.



f. Remove the nut and disconnect the wire from the positive ( ) battery cable.

.Disconnect the cable from the positive ( ) battery terminal.

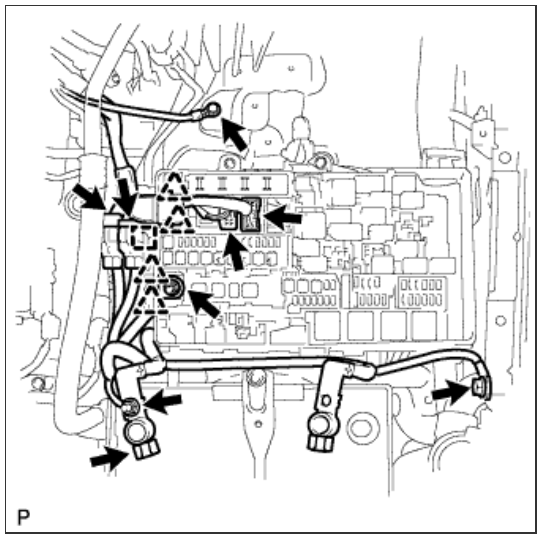
h. Remove the bolt and disconnect the ground wire from the body.

i. Remove the bolt and disconnect the ground wire from the bracket.

j. Remove the nut and disconnect the wire and 2 clips from the engine room unction block.

k. Disconnect the 2 connectors and 2 clips from the engine room unction block.

l. Disconnect the 2 connectors and clamp.

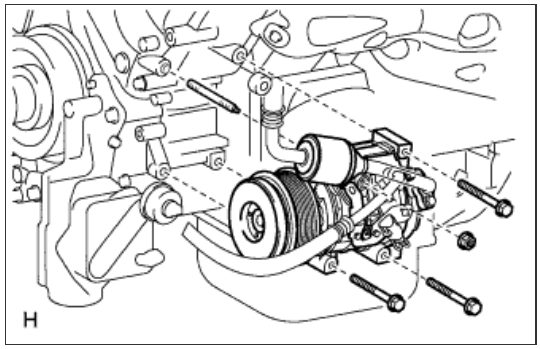


30. DISCONNECT COOLER COMPRESSOR ASSEMBLY

a. Remove the 3 bolts, nut and stud bolt, and disconnect the cooler compressor.

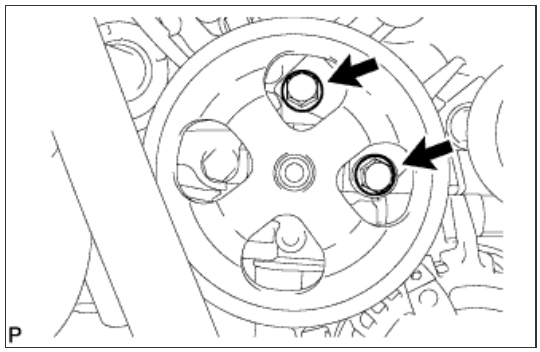
HINT:

It is not necessary to completely remove the compressor. With the hoses connected to the compressor, hang the compressor on the vehicle body with a rope.



31. DISCONNECT VANE PUMP ASSEMBLY

a. Remove the 2 bolts and disconnect the vane pump.

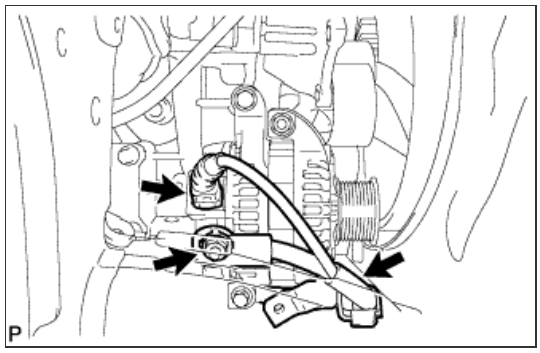


32. REMOVE GENERATOR ASSEMBLY

a. Disconnect the generator connector.

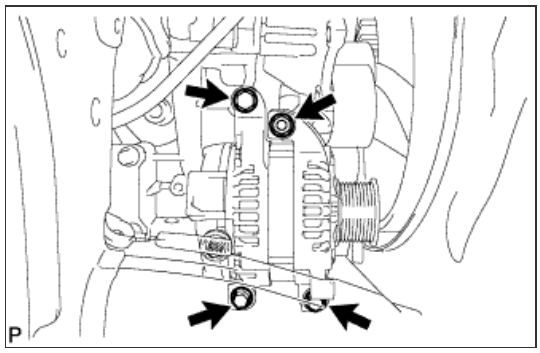
b. Remove the terminal cap and nut, and disconnect the generator wire.

c. Remove the bolt and wire harness bracket from the generator.



d. Remove the 3 bolts, nut and generator.

e. Remove the stud bolt.



33. REMOVE TAILPIPE ASSEMBLY

a. Remove the bolt, clamp and gasket.

b. Remove the tailpipe from the 2 exhaust pipe supports.

c. Remove the bolt and clamp, and then disconnect the tailpipe from the center exhaust pipe.

34. REMOVE CENTER EXHAUST PIPE ASSEMBLY

a. Remove the 4 bolts.

b. Remove the center exhaust pipe from the 3 exhaust pipe supports.

c. Remove the 2 gaskets from the front exhaust pipe and front No. 2 exhaust pipe.

35. REMOVE FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Disconnect the heated oxygen sensor connector.

b. Remove the bolt and disconnect the wire harness clamp bracket of the oxygen sensor from the transmission.

c. Remove the 2 nuts, front No. 2 exhaust pipe and gasket from the exhaust manifold LH.

36. REMOVE FRONT EXHAUST PIPE ASSEMBLY

a. Disconnect the heated oxygen sensor connector.

b. Remove the bolt and disconnect the wire harness clamp bracket of the oxygen sensor from the transmission.

c. Remove the 2 nuts, front exhaust pipe and gasket from the exhaust manifold RH.

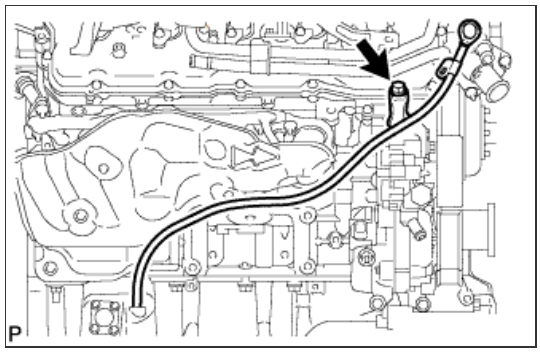
37. REMOVE ENGINE OIL LEVEL DIPSTICK GUIDE

a. Disconnect the wire harness clamp.

b. Remove the dipstick.

c. Remove the bolt and dipstick guide.

d. Remove the O-ring from the dipstick guide.



38. REMOVE FRONT PROPELLER SHAFT ASSEMBLY

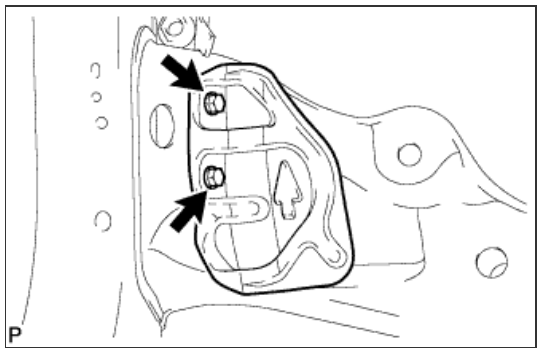
(Click here)

39. REMOVE REAR PROPELLER SHAFT ASSEMBLY

(Click here)

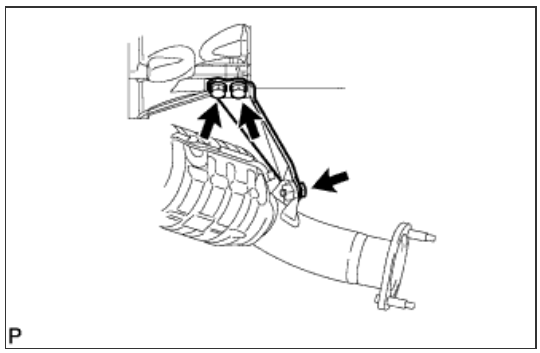
40. REMOVE PROPELLER SHAFT HEAT INSULATOR

a. Remove the 2 bolts and heat insulator.



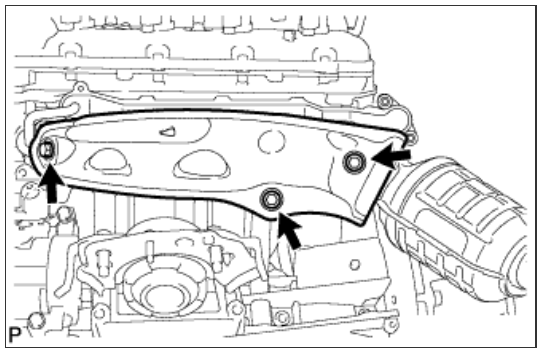
41. REMOVE NO. 2 MANIFOLD STAY

a. Remove the 3 bolts and manifold stay.



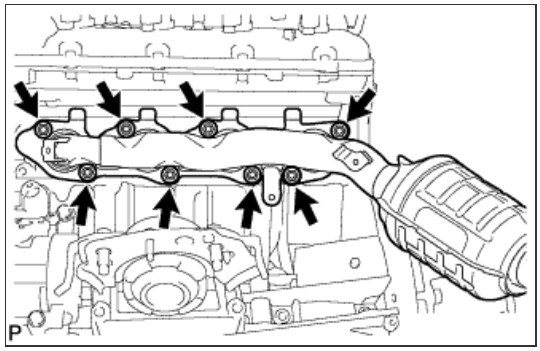
42. REMOVE NO. 2 EXHAUST MANIFOLD HEAT INSULATOR

a. Remove the 3 bolts and heat insulator.



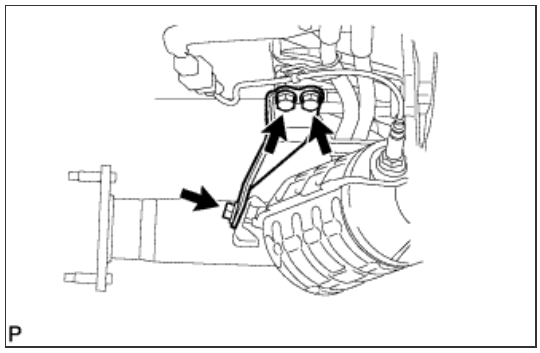
43. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY LH

a. Remove the 8 nuts, exhaust manifold and gasket.



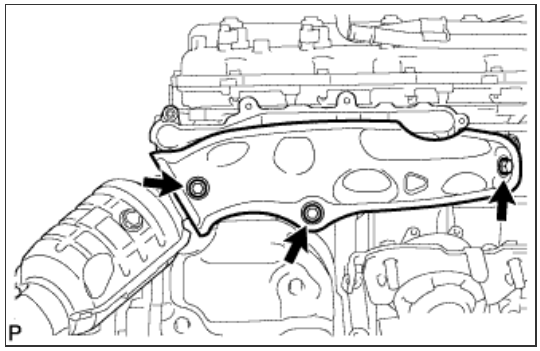
44. REMOVE NO. 1 MANIFOLD STAY

a. Remove the 3 bolts and manifold stay.



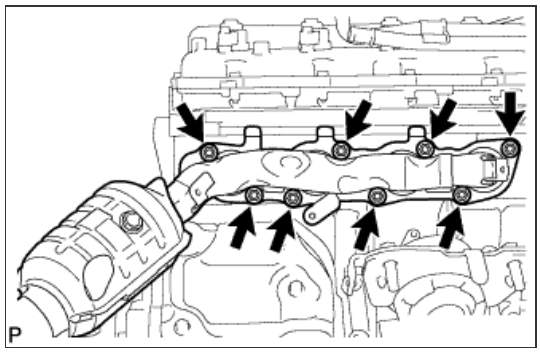
45. REMOVE NO. 1 EXHAUST MANIFOLD HEAT INSULATOR

a. Remove the 3 bolts and heat insulator.



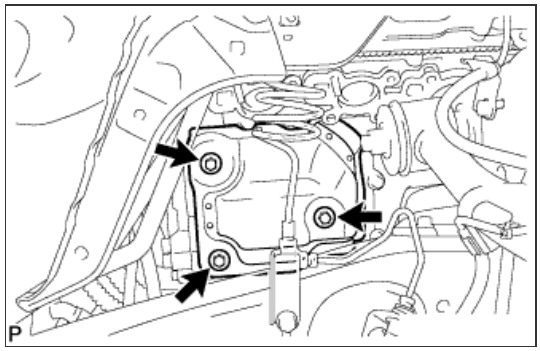
46. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY RH

a. Remove the 8 nuts, exhaust manifold and gasket.



47. REMOVE STARTER COVER

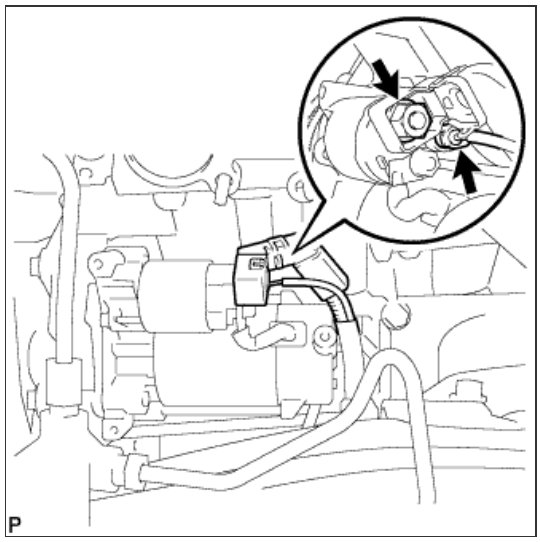
a. Remove the 3 bolts and starter cover.



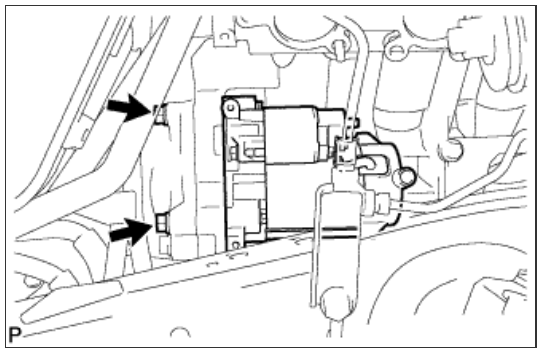
48. REMOVE STARTER ASSEMBLY

a. Disconnect the starter connector.

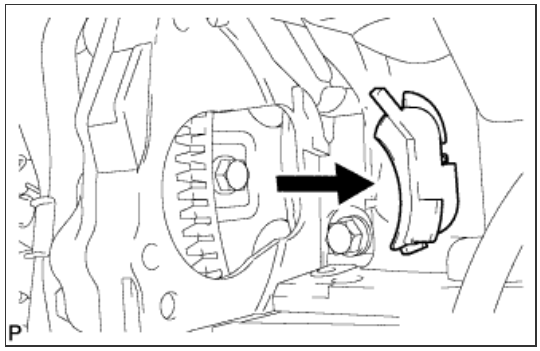
b. Remove the nut and disconnect the starter wire.



c. Remove the 2 bolts and starter.



d. Remove the flywheel housing side cover.



49. REMOVE AUTOMATIC TRANSMISSION ASSEMBLY

(Click here)

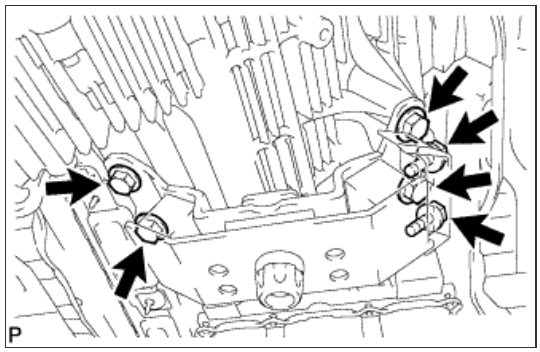
50. REMOVE REAR NO. 1 ENGINE MOUNTING INSULATOR

HINT:

Only perform this procedure when replacement of the engine mounting insulator is necessary.

a. Remove the 2 bolts and front engine mounting insulator RH.

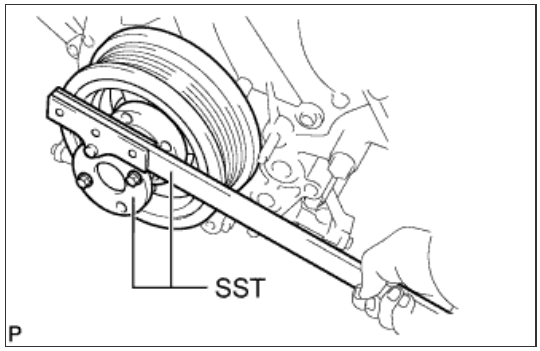
b. Remove the 4 bolts and rear engine mounting insulator from the transmission.



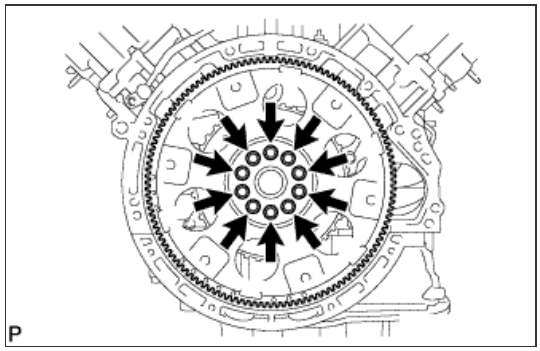
51. REMOVE DRIVE PLATE AND RING GEAR SUB-ASSEMBLY

a. Using SST, hold the crankshaft.

SST
09213-70011
09330-00021

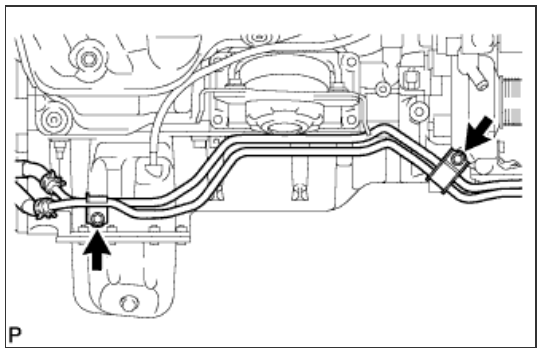


b. Remove the 10 bolts, rear drive plate spacer, drive plate and crankshaft angle sensor rotor.



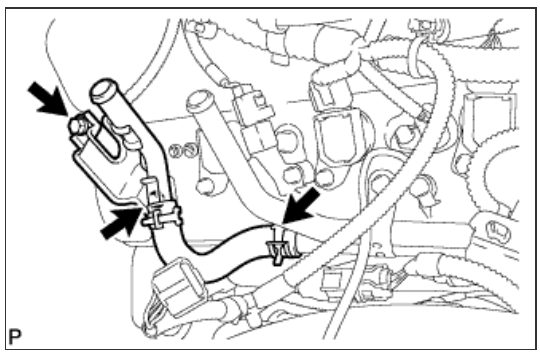
52. DISCONNECT OIL COOLER PIPE ASSEMBLY

a. Remove the 2 bolts and disconnect the oil cooler pipe.



53. REMOVE WATER PIPE AND HOSE SUB-ASSEMBLY

a. Remove the 2 bolts and disconnect the hose. Then remove the water pipe and hose.



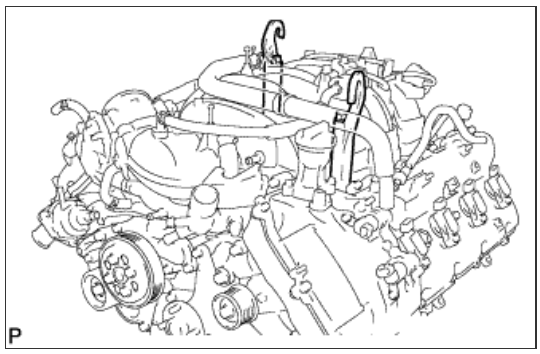
54. REMOVE ENGINE ASSEMBLY

a. Install 2 engine hangers with 2 bolts as shown in the illustration.

Tor e:
43 N*m 438 k f*cm , 32 ft.*lbf }

HINT:

Engine hanger	12281-381 0
Bolt	011 -14120

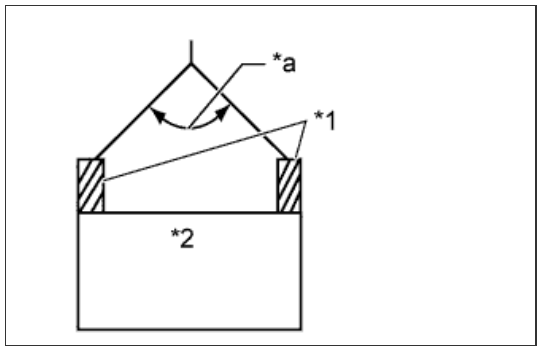


b. Attach an engine sling device and hang the engine with a chain block.

b. Attach an engine sling device and hang the engine with a chain block.

Text in Illustration

*1	Engine Hanger
*2	ENGINE
*a	0 or less



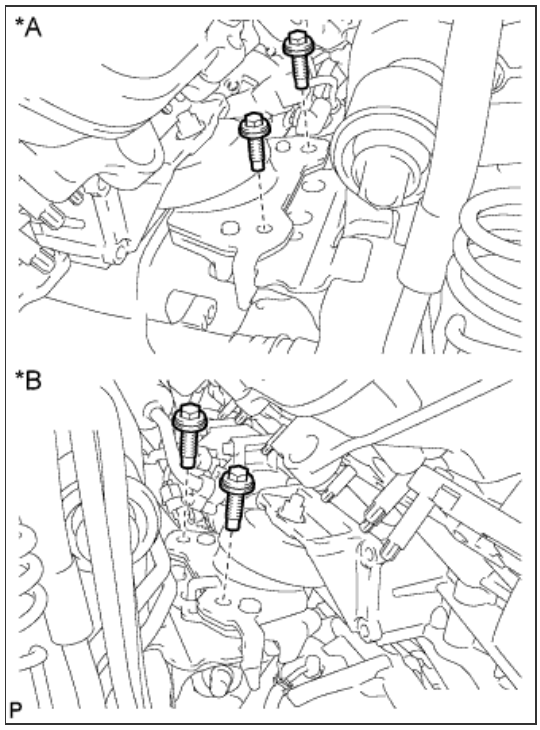
NOTICE:

When hanging the engine, make sure to hang the engine with the sling device s hanging angle at 0 or less. If not, the engine or engine hangers may be damaged.

c. Remove the 4 engine mounting insulator bolts.

Text in Illustration

*A	RH
*B	LH



d. Lift the engine out from the vehicle slowly and carefully.

NOTICE:

- **Make sure the en ine is clear of all irin hoses and cables.**
- **With the exception of installin the en ine assembly to an en ine stand or remo in the en ine assembly from an en ine stand, do not perform any dk on the en ine hile it is suspended, as doin so is dan erous.**
- **Pay attention to the an le of the slin de ice as the en ine assembly or en ine han ers may be dama ed or deformed if the an le is incorrect.**

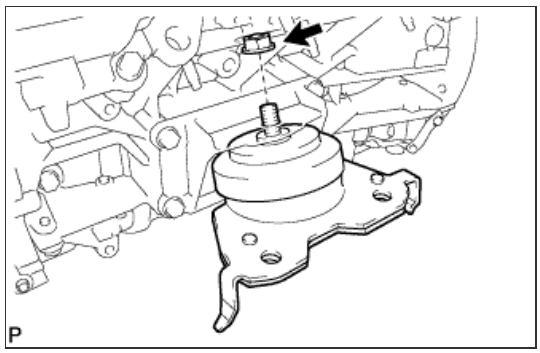
55. INSTALL ENGINE ON ENGINE STAND

a. Install the engine onto an engine stand with bolts.

b. Remove the 2 bolts and 2 engine hangers.

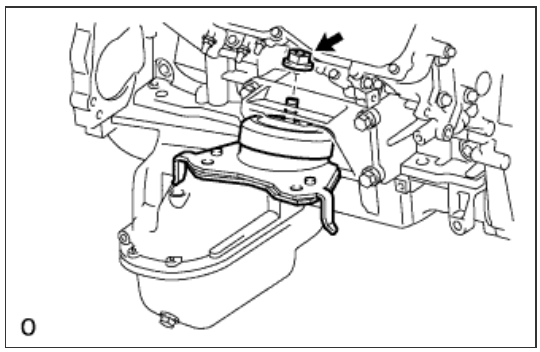
56. REMOVE FRONT ENGINE MOUNTING INSULATOR LH

a. Remove the nut and mounting insulator.



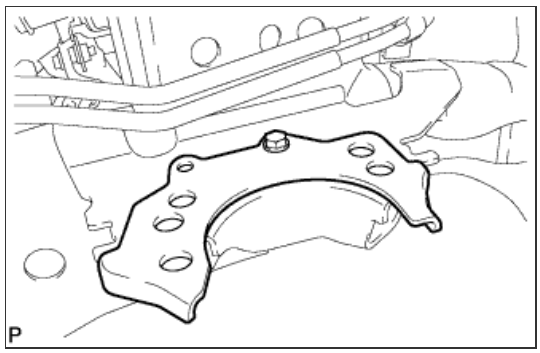
57. REMOVE FRONT ENGINE MOUNTING INSULATOR RH

a. Remove the nut and mounting insulator.



58. REMOVE NO. 2 FRONT ENGINE MOUNTING BRACKET LH

a. Remove the bolt and No. 2 front engine mounting bracket LH.



for Preparation Click here

1. INSTALL NO. 2 FRONT ENGINE MOUNTING BRACKET LH

a. Install the No. 2 front engine mounting bracket with the bolt.

Torque:
32 N*m{ 326 kgf*cm , 24 ft.*lbf }

2. INSTALL FRONT ENGINE MOUNTING INSULATOR RH

a. Install the mounting insulator with the nut.

Torque:
72 N*m{ 734 kgf*cm , 53 ft.*lbf }

3. INSTALL FRONT ENGINE MOUNTING INSULATOR LH

a. Install the mounting insulator with the nut.

Torque:
72 N*m{ 734 kgf*cm , 53 ft.*lbf }

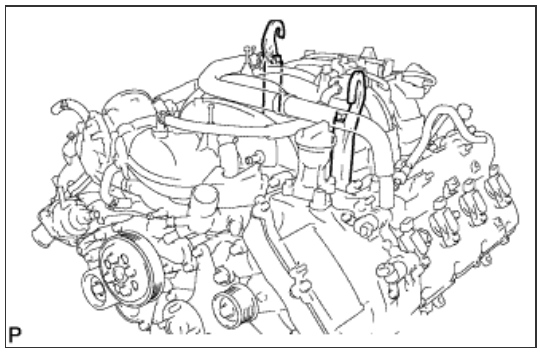
4. REMOVE ENGINE STAND

a. Install 2 engine hangers with 2 bolts as shown in the illustration.

Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }

HINT:

ngine hanger	12281-38150
Bolt	



b. ttach an engine sling device and hang the engine with a chain block.

c. e o the bolts and engine assembly from the engine stand.

NOTICE:

- **With the exception of installing the engine assembly to an engine stand or removing the engine assembly from an engine stand, do not perform any work on the engine while it is suspended, as doing so is dangerous.**
- **Pay attention to the angle of the sling device as the engine assembly or engine hangers may be damaged or deformed if the angle is incorrect.**

5. INSTALL ENGINE ASSEMBLY

a. lowly lower the engine assembly into the engine compartment.

NOTICE:

ake sure that the engine is clear of all wiring and hoses.

b. ttach the engine mounting insulators to the vehicle.

c. Install the 4 engine mounting insulator bolts.

Torque:
79 N*m{ 806 kgf*cm , 58 ft.*lbf }

d. Remove the 2 bolts and 2 engine hangers.

6. INSTALL WATER PIPE AND HOSE SUB-ASSEMBLY

a. onect the hose and install the water pipe and hose with the 2 bolts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

7. CONNECT OIL COOLER PIPE ASSEMBLY

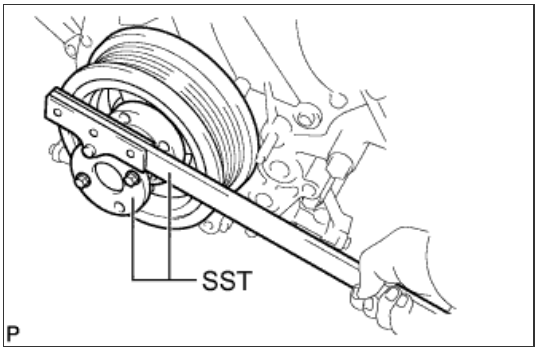
a. onect the oil cooler pipe with the 2 bolts.

Torque:
14 N*m{ 143 kgf*cm , 10 ft.*lbf }

8. INSTALL DRIVE PLATE AND RING GEAR SUB-ASSEMBLY

a. sing SST, hold the crankshaft.

SST
09213-70011
09330-00021



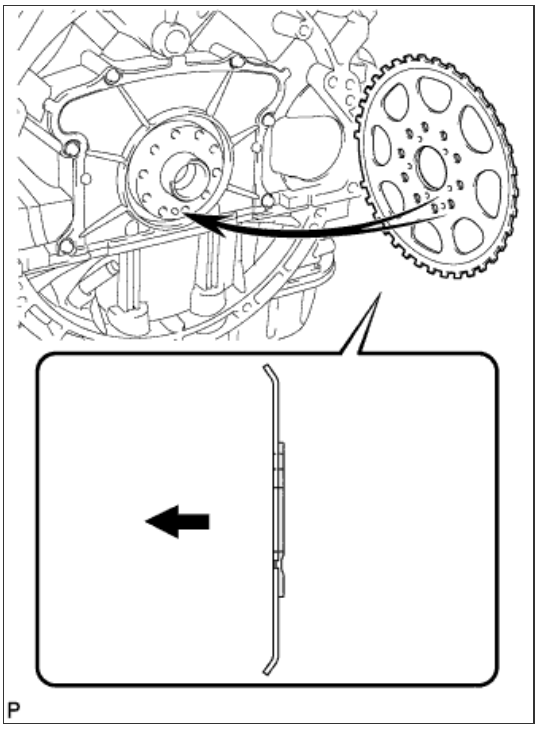
b. Install the crankshaft angle sensor rotor.

Text in Illustration

➡	ngine Side

HINT:

- **Align the pin hole of the crankshaft angle sensor rotor with the pin of the crankshaft.**
- **As the crankshaft angle sensor rotor is not reversible, be sure to install it so that it is facing in the direction shown in the illustration.**



c. Install the drive plate and rear drive plate spacer onto the crankshaft.

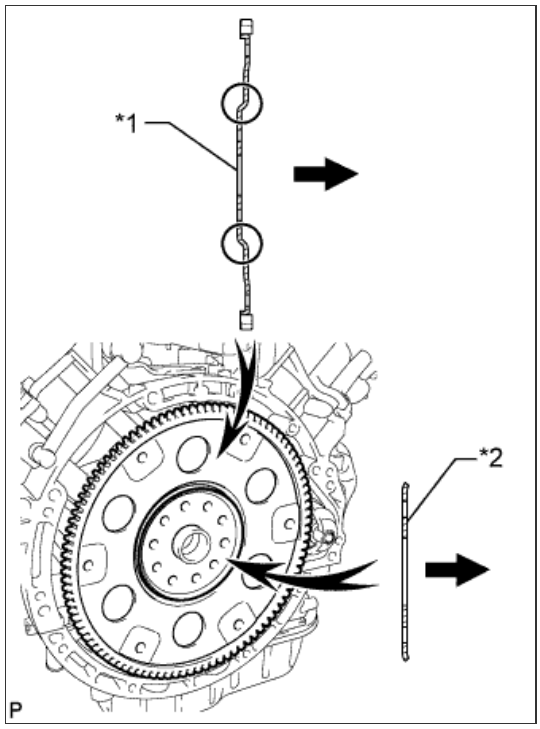
Text in Illustration

	Plate e

	ar Drive Plate Spacer
→	Automatic Transmission Side

HINT:

As the rear drive plate spacer and the drive plate are not reversible, be sure to install them so that they are facing in the direction shown in the illustration.



d. Install the drive plate and ring gear and bolts.

HINT:

he bolts are tightened in 2 progressive steps.

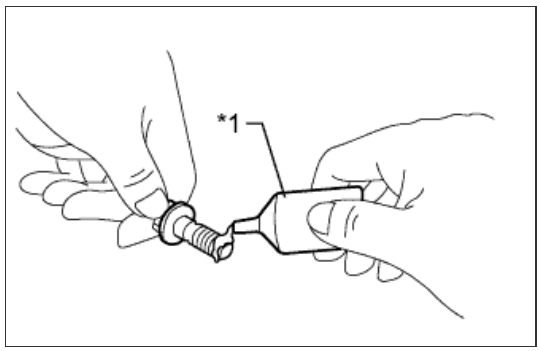
i. lean the bolts and bolt holes.

ii. Apply adhesive to 2 or 3 threads at the end of each of the 10 bolts.

Adhesive:
Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent

Text in Illustration

1	Adhesive

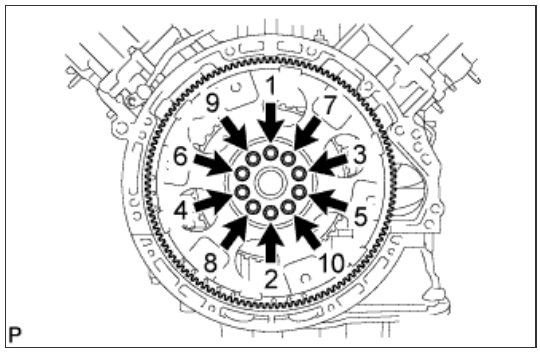


iii. Step 1:
Install and uniformly tighten 10 new bolts in the sequence shown in the illustration.

Torque:
30 N*m{ 301 kgf*cm , 22 ft.*lbf }

NOTICE:

- **Do not reuse the drive plate installation bolts.**
- **Do not strike or damage the drive plate installation bolts. Be sure to handle them carefully.**



iv. Mark the upside of each drive plate installation bolt with paint.

v. Step 2:
Tighten the cylinder head bolts another 90°.

vi. Check that the painted marks are now at a 90° angle to the upside.

NOTICE:

Do not start the engine for at least an hour after installing the drive plate.

9. INSTALL REAR NO. 1 ENGINE MOUNTING INSULATOR

HINT:

Only perform this procedure when replacement of the engine mounting insulator is necessary.

a. Install the rear engine mounting insulator to the transmission with the 4 bolts.

Torque:
59 N*m{ 602 kgf*cm , 44 ft.*lbf }

b. Install the front engine mounting insulator RH with the 2 bolts.

Torque:
12 N*m{ 122 kgf*cm , 9 ft.*lbf }

10. INSTALL AUTOMATIC TRANSMISSION ASSEMBLY

(Click here)

11. INSTALL STARTER ASSEMBLY

a. Install the flywheel housing side cover.

b. Install the starter with the 2 bolts.

Torque:
37 N*m{ 377 kgf*cm , 27 ft.*lbf }

c. Install the starter wire with the nut.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }

d. Connect the starter connector.

12. INSTALL STARTER COVER

a. Install the starter cover with the 3 bolts.

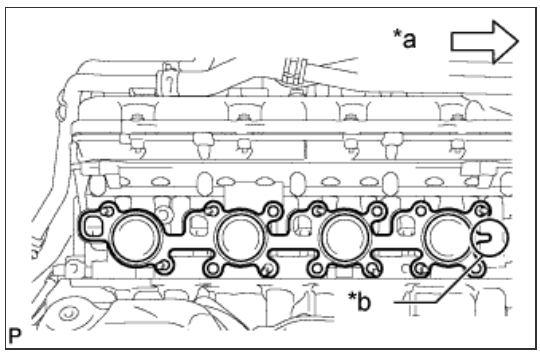
Torque:
12 N*m{ 122 kgf*cm , 9 ft.*lbf }

13. INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY RH

a. Install a new gasket to the cylinder head.

HINT:

Install the exhaust manifold gasket with the gasket tab facing toward the front of the engine.



Text in Illustration

*a	Front
*b	Tab

b. Install the exhaust manifold with 8 new nuts.

Torque:
30 N*m{ 306 kgf*cm , 22 ft.*lbf }

14. INSTALL NO. 1 EXHAUST MANIFOLD HEAT INSULATOR

a. Install the heat insulator with the 3 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

15. INSTALL NO. 1 MANIFOLD STAY

a. Install the manifold stay with the 3 bolts.

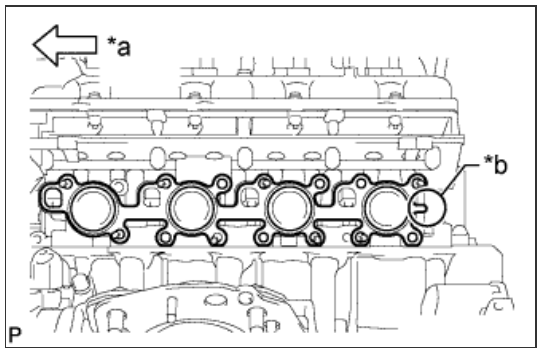
Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

16. INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY LH

a. Install a new gasket to the cylinder head.

HINT:

Install the exhaust manifold gasket with the gasket tab facing toward the rear of the engine.



Text in Illustration

*a	Front
*b	Tab

b. Install the exhaust manifold with 8 new nuts.

Torque:
30 N*m{ 306 kgf*cm , 22 ft.*lbf }

17. INSTALL NO. 2 EXHAUST MANIFOLD HEAT INSULATOR

a. Install the heat insulator with the 3 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

18. INSTALL NO. 2 MANIFOLD STAY

a. Install the manifold stay with the 3 bolts.

Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

19. INSTALL PROPELLER SHAFT HEAT INSULATOR

a. Install the heat insulator with the 2 bolts.

Torque:
16 N*m{ 160 kgf*cm , 12 ft.*lbf }

20. INSTALL REAR PROPELLER SHAFT ASSEMBLY

(Click here)

21. INSTALL FRONT PROPELLER SHAFT ASSEMBLY

(Click here)

22. INSTALL ENGINE OIL LEVEL DIPSTICK GUIDE

a. Apply a light coat of engine oil to a new O-ring.

b. Install the O-ring to the guide.

c. Install the dipstick guide with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

d. Install the dipstick.

e. Connect the wire harness clamp.

23. INSTALL FRONT EXHAUST PIPE ASSEMBLY

a. Install a new gasket and the front exhaust pipe to the exhaust manifold RH with 2 new nuts.

Torque:
54 N*m{ 551 kgf*cm , 40 ft.*lbf }

b. Install the wire harness clamp bracket of the oxygen sensor to the transmission with the bolt.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

c. Connect the heated oxygen sensor connector.

24. INSTALL FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Install a new gasket and the front No. 2 exhaust pipe to the exhaust manifold LH with 2 new nuts.

Torque:
54 N*m{ 551 kgf*cm , 40 ft.*lbf }

b. Install the wire harness clamp bracket of the oxygen sensor to the transmission with the bolt.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

c. Connect the heated oxygen sensor connector.

25. INSTALL CENTER EXHAUST PIPE ASSEMBLY

a. Install 2 new gaskets to the front exhaust pipe and front No. 2 exhaust pipe.

b. Install the center exhaust pipe to the 3 exhaust pipe supports, and then install the 4 bolts.

Torque:
48 N*m{ 489 kgf*cm , 35 ft.*lbf }

26. INSTALL TAILPIPE ASSEMBLY

a. Install the tailpipe to the 2 exhaust pipe supports.

b. Install a new gasket to the center exhaust pipe.

c. Connect the tailpipe to the center exhaust pipe.

d. Attach a new clamp to the tailpipe and center exhaust pipe. Then install the bolt to the clamp.

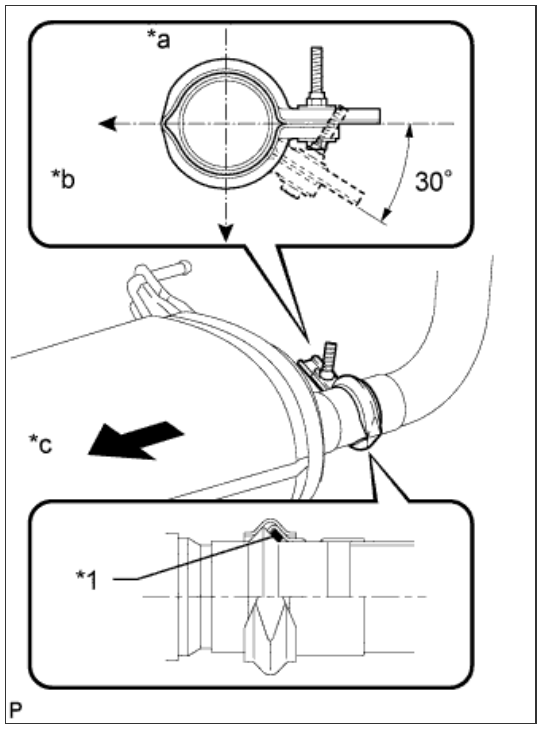
Torque:
32 N*m{ 326 kgf*cm , 24 ft.*lbf }

Text in Illustration

*1	Gasket
*a	Top
*b	LH Side
*c	Front

HINT:

Install the clamp within the angle range shown in the illustration.



27. INSTALL GENERATOR ASSEMBLY

a. Install the stud bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Install the generator with the 3 bolts and nut.

Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }

c. Connect the generator connector.

d. Connect the generator wire with the nut.

Torque:
12 N*m{ 122 kgf*cm , 9 ft.*lbf }

e. Install the terminal cap.

f. Install the harness bracket to the generator with the bolt.

Torque:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

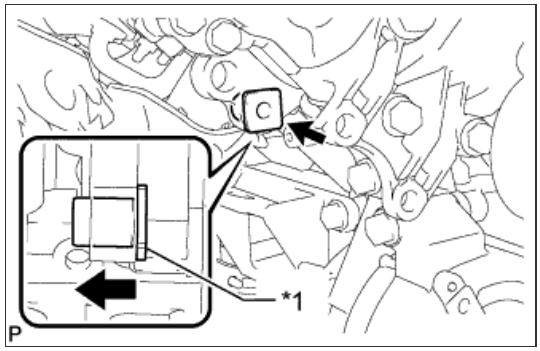
28. CONNECT VANE PUMP ASSEMBLY

HINT:

Before performing the following procedures, move the spacer until the vane pump can be installed.

Text in Illustration

*1	Spacer



a. Connect the vane pump to the timing chain cover with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

29. CONNECT COOLER COMPRESSOR ASSEMBLY

a. Install the cooler compressor with the stud bolt.

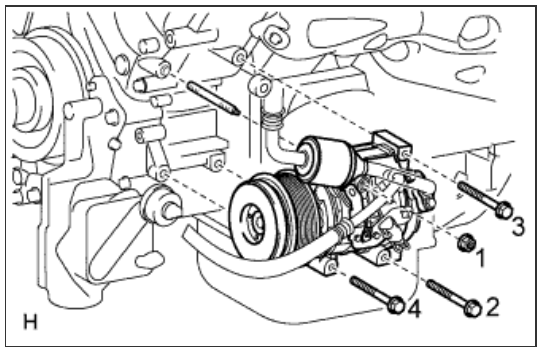
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Install the 3 bolts and nut.

Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }

NOTICE:

Tighten the bolts and nut in the order shown in the illustration to install the cooler compressor.



30. CONNECT WIRE HARNESS AND HOSE

a. Connect the clamp and 2 connectors.

b. Connect the 2 connectors and 2 clips to the engine room junction block.

c. Install the engine wire to the engine room junction block with the nut. Then connect the 2 clips.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

d. Install the ground wire to the bracket with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

e. Install the ground wire to the body with the bolt.

Torque:
8.4 N*m{ 86 kgf*cm , 74 in.*lbf }

f. Connect the cable to the positive (+) battery terminal.

g. Install the wire to the positive (+) battery cable with the nut.

Torque:
5.4 N*m{ 55 kgf*cm , 48 in.*lbf }

h. Install the ground wire with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

i. Connect the clamp and 4 connectors to the connector holder block.

j. Install the heater hose.

k. Connect the ECM connector and clamp.

HINT:

Refer to the following procedures to connect the ECM connector (Click here).

l. Connect the purge line hose.

31. CONNECT FUEL MAIN AND RETURN HOSE

a. Connect the fuel main and return hoses (Click here).

b. Install the fuel pipe clamp.

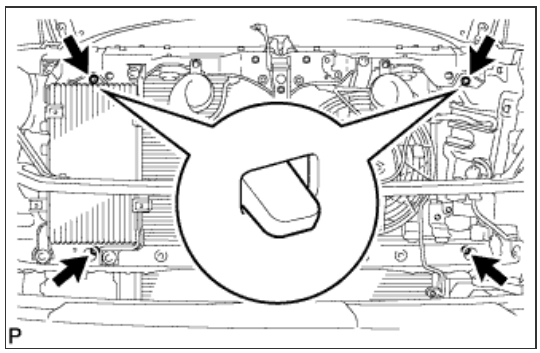
32. INSTALL RADIATOR ASSEMBLY

a. Set the radiator bracket hooks to the radiator support holes.

b. Install the radiator with the 4 bolts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

c. Connect the 2 oil cooler hoses.



33. INSTALL FAN SHROUD

a. Install the fan pulley.

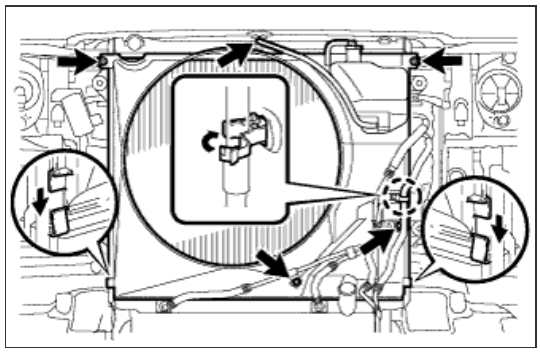
b. Place the shroud together with the coupling fan between the radiator and engine.

NOTICE:

Be careful not to damage the radiator core.

c. Temporarily install the fluid coupling fan to the fluid coupling bracket with the 4 nuts. Tighten the nuts as much as possible by hand.

d. Attach the claws of the shroud to the radiator as shown in the illustration.



e. Install the shroud with the 2 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

f. Connect the oil cooler tube to the fan shroud with the 2 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

g. Pass the hose through the flexible hose clamp and close the clamp as shown in the illustration.

h. Connect the reservoir hose to the upper radiator tank.

i. Install the fan and generator V-belt (Click here).

j. Tighten the 4 nuts of the fluid coupling fan.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

34. INSTALL NO. 2 RADIATOR HOSE

35. INSTALL NO. 1 RADIATOR HOSE

36. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner with the 3 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

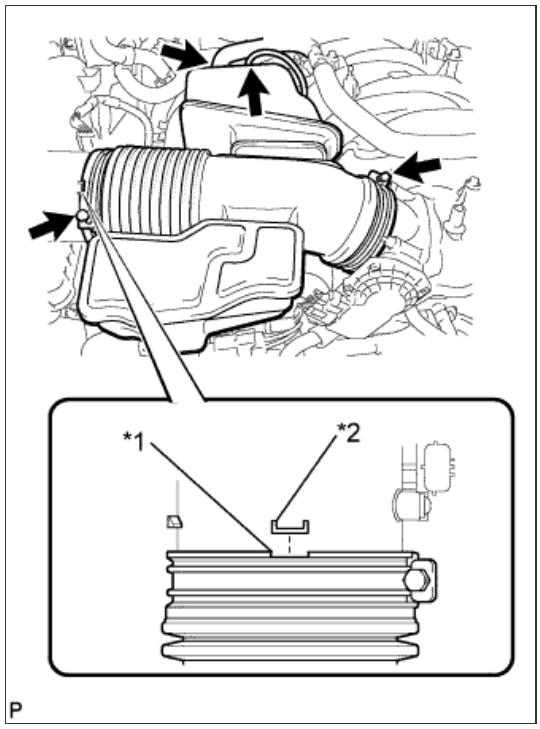
37. INSTALL AIR CLEANER HOSE ASSEMBLY

a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns

with the groove of the hose as shown in the illustration.

Text in Illustration

*1	Groove
*2	Protrusion



b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum hose.

d. Connect the No. 2 ventilation hose.

38. ADD ENGINE OIL

a. Add fresh oil and install the oil filler cap.

Standard Oil Grade:

Oil Grade	Oil Viscosity (SAE)
API grade SL "energy-conserving", API grade SM "energy-conserving" or ILSAC multigrade engine oil	5W-30 10W-30
API grade SL and SM multigrade engine oil	15W-40 20W-50

Standard Oil Capacity:

Item	Specified Condition
Drain and refill without oil filter change	7.1 liters (7.5 US qts, 6.2 Imp. qts)
Drain and refill with oil filter change	7.5 liters (7.9 US qts, 6.6 Imp. qts)
Dry fill	9.3 liters (9.8 US qts, 8.2 Imp. qts)

39. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item	Specified Condition
with rear heater	16.2 liters (17.1 US qts, 14.3 Imp. qts)
without rear heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the radiator inlet hose by hand, and checking when the engine coolant starts to flow inside the hose.

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

h. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the fan.**

i. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

j. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.

40. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

41. INSPECT FOR OIL LEAK

a. Start the engine. Make sure that there are no oil leaks from the area that was worked on.

42. INSPECT FOR COOLANT LEAK

CAUTION:

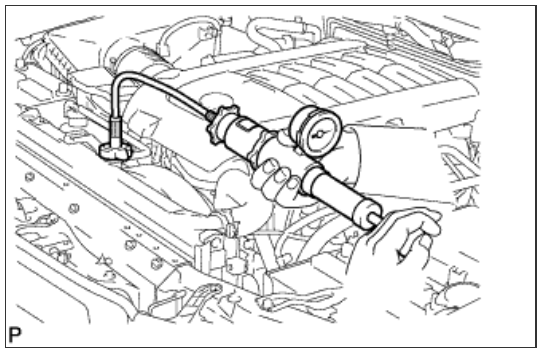
Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no

external leaks are found, check the heater core, cylinder block and head.



43. INSPECT FOR EXHAUST GAS LEAK

If gas is leaking, tighten the areas necessary to stop the leak. Replace damaged parts as necessary.

44. INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and intelligent tester main switch on.

NOTICE:

Do not start the engine.

c. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Fuel Pump / Speed.

d. Check that there are no fuel leaks after doing maintenance anywhere on the fuel system.

45. INSPECT SHIFT LEVER POSITION

a. When moving the shift lever from P to R with the ignition switch ON and the brake pedal depressed, make sure that it moves smoothly and correctly into position.

b. Check that the shift lever does not stop when moving the shift lever from R to P, and check that the shift lever does not stick when moving the shift lever from D to S.

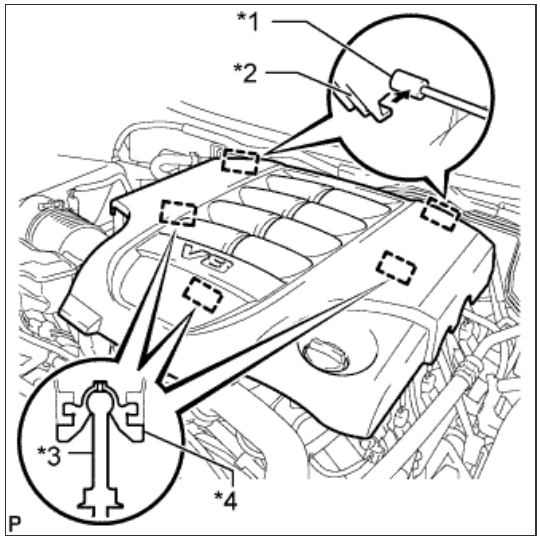
c. Start the engine and make sure that the vehicle moves forward after moving the shift lever from N to D and moves rearward after moving the shift lever to R.
If the operation cannot be performed as specified, inspect the park/neutral position switch assembly and check the shift lever assembly installation condition.

46. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket. Then align the 3 V-bank cover grommets with the 3 pins, and press down on the V-bank cover to attach the pins.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet



47. INSTALL OIL PAN PROTECTOR ASSEMBLY

a. Install the oil pan protector with the 4 bolts.

Torque:
63 N*m{ 642 kgf*cm , 46 ft.*lbf }

48. INSTALL NO. 2 ENGINE UNDER COVER

a. Install the No. 2 engine under cover with the 2 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

49. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

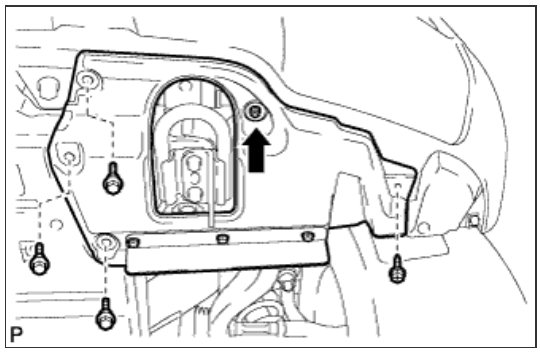
a. Install the No. 1 engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

50. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



51. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

52. INSTALL FRONT FENDER APRON SEAL REAR RH

a. Install the fender apron seal with the 4 clips.

53. INSTALL FRONT FENDER APRON SEAL FRONT RH

a. Install the fender apron seal with the 3 clips.

54. INSTALL FRONT FENDER APRON SEAL REAR LH

a. Install the fender apron seal with the 4 clips.

55. INSTALL FRONT FENDER APRON SEAL LH

a. Install the fender apron seal with the 3 clips.

56. INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

(Click here)

57. INSTALL HOOD SUB-ASSEMBLY

a. Install the hood with the 4 bolts.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }

b. Connect the 2 hood supports with the 2 hood support bolts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

CAUTION:

Install the hood support while supporting the hood by hand.

NOTICE:

Check that the hood support is engaged in the ball joint and that it cannot be pulled out.

58. ADJUST HOOD SUB-ASSEMBLY

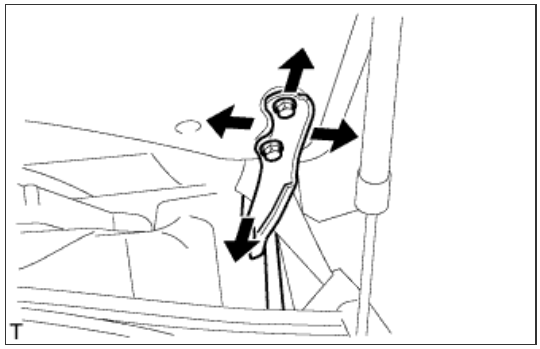
a. Adjust the hood position.

i. Loosen the 4 hinge bolts of the hood.

ii. Move the hood and adjust the clearance between the hood and front fender.

iii. Tighten the 4 hinge bolts of the hood after the adjustment.

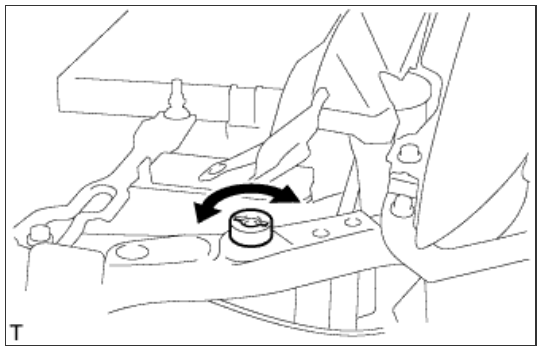
Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



iv. Adjust the cushion rubber so that the height of the hood and fender are aligned.

HINT:

Raise or lower the hood front end by turning the cushion rubber.

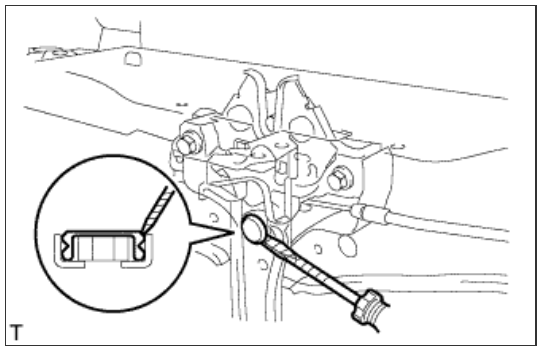


b. Adjust the hood lock.

i. Using a screwdriver, remove the hood lock nut cap as shown in the illustration.

HINT:

Tape the screwdriver tip before use.



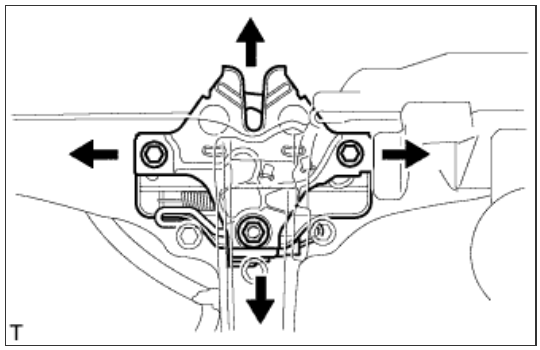
ii. Loosen the 2 bolts and hood lock nut.

iii. Adjust the hood lock position so that the striker can enter it smoothly.

iv. Tighten the bolts and nut after the adjustment.

Torque:
5.5 N*m{ 56 kgf*cm , 49 in.*lbf }

v. Install a new cap.



59. CONNECT RADIATOR SIDE DEFLECTOR LH

a. Connect the deflector with the 4 clips.

60. INSTALL TRANSMISSION OIL COOLER AIR DUCT

a. Install the oil cooler air duct with the 4 bolts.

Torque:
4.9 N*m{ 50 kgf*cm , 43 in.*lbf }

61. INSTALL FRONT BUMPER COVER

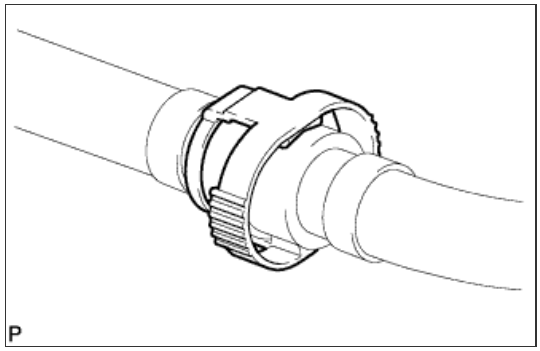
HINT:

For the front bumper cover with garnish, use the procedures described below.

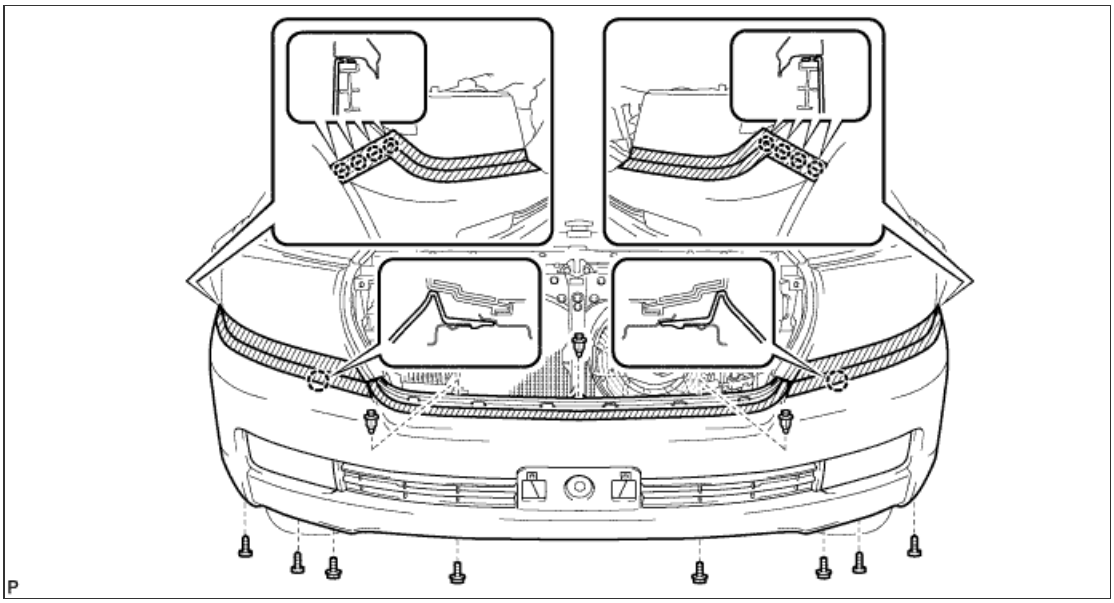
a. w/ Headlight Cleaner System:
Connect the headlight cleaner hose.

b. w/o TOYOTA Parking Assist-sensor System, w/o Fog Light:
Attach the 10 claws to install the bumper cover.

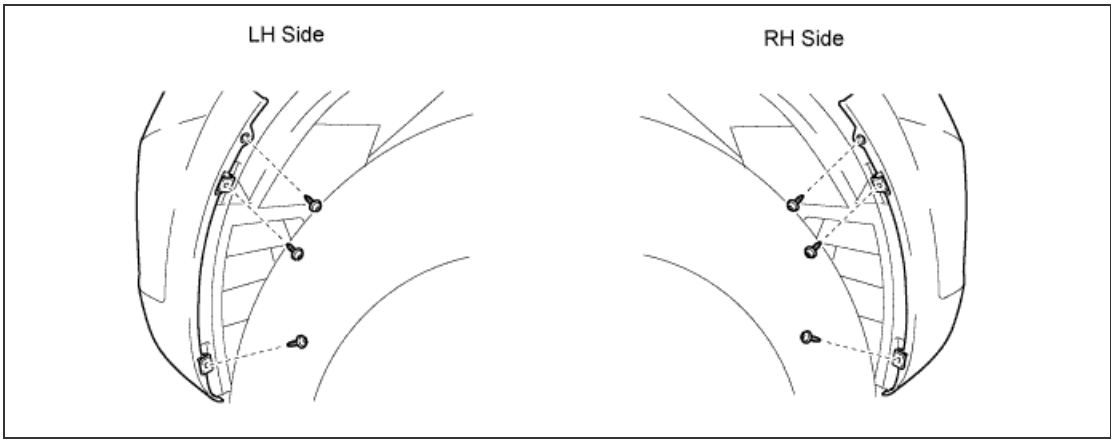
c. w/ TOYOTA Parking Assist-sensor System or w/ Fog Light:
Connect the No. 4 engine room wire connector and attach the 10 claws to install the bumper cover.



d. Install the 3 clips, 4 screws and 4 bolts.



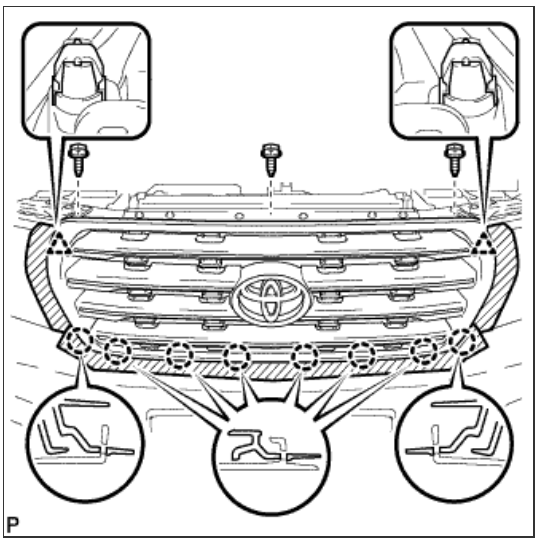
e. Using a T30 "TORX" socket, install the 6 screws.



62. INSTALL RADIATOR GRILLE

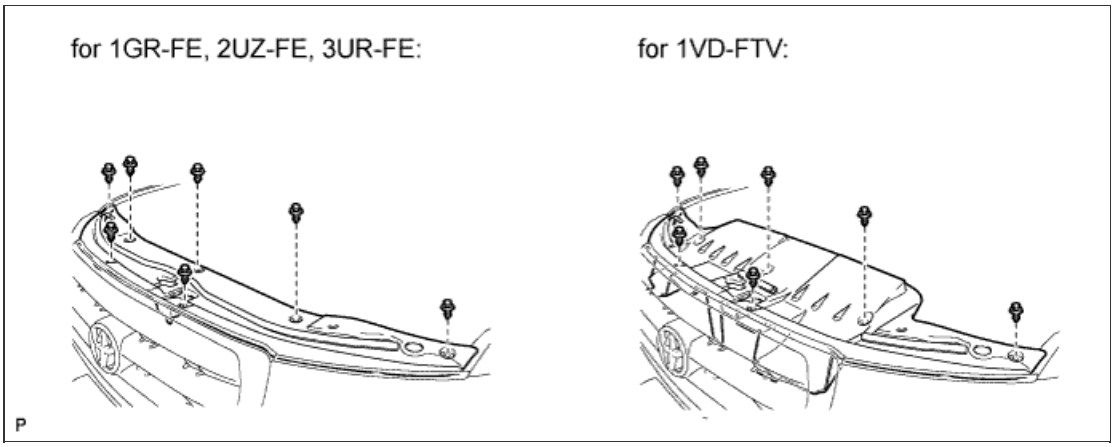
a. Attach the 2 clips and 8 claws to install the radiator grille.

b. Install the 3 screws.



63. INSTALL UPPER RADIATOR SUPPORT SEAL

a. Install the radiator support seal with the 7 clips.



64. INSPECT IGNITION TIMING

a. Warm up and stop the engine.

i. Allow the engine to warm up to a normal operating temperature.

b. When using the intelligent tester:

i. Connect the intelligent tester to the DLC3.

ii. Start the engine and idle it.

iii. Turn the intelligent tester on.

iv. Enter the following menus: Powertrain / Engine and ECT / Data List / Primary / IGN Advance.

HINT:

Refer to the intelligent tester operator's manual for further details.

Standard ignition timing:
8 to 12° BTDC @ idling (transmission in neutral and A/C switch off)

v. Disconnect the intelligent tester from the DLC3.

c. When not using the intelligent tester:

i. Connect the tester probe of a timing light to the wire of the ignition coil connector for the No. 1 cylinder.

NOTICE:

Use a timing light that detects primary signals.

ii. Using SST, connect terminals 13 (TC) and 4 (CG) of the DLC3.

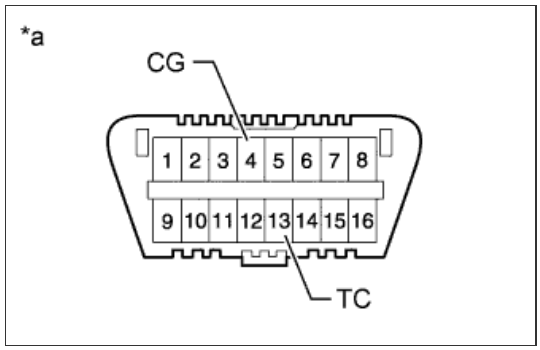
SST
09843-18040

Text in Illustration

*a	Front view of DLC3

NOTICE:

- **Confirm the terminal numbers before connecting them. Connecting the wrong terminals can damage the engine.**
- **Switch off all accessories and the A/C before connecting the terminals.**



iii. Using the timing light, check the ignition timing.

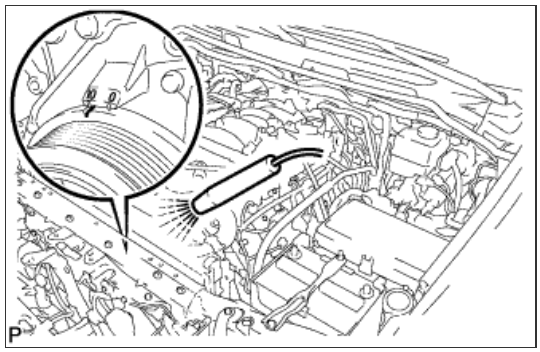
Standard ignition timing:
8 to 12° BTDC @ idling (transmission in neutral and A/C switch off)

iv. Remove SST from the DLC3.

v. Check the ignition timing.

Standard ignition timing:
7 to 24° BTDC @ idling (transmission in neutral and A/C switch off)

vi. Disconnect the timing light from the engine.



65. INSPECT ENGINE IDLE SPEED

a. Warm up and stop the engine.

i. Allow the engine to warm up to a normal operating temperature.

b. When using the intelligent tester:

i. Connect the intelligent tester to the DLC3.

NOTICE:

Switch off all accessories and the A/C before connecting the intelligent tester.

ii. Race the engine at 2500 rpm for approximately 90 seconds.

iii. Turn the intelligent tester on.

iv. Enter the following menus: Powertrain / Engine and ECT / Data List / Primary / Engine Speed.

Standard idle speed:
650 to 750 rpm (transmission in neutral and A/C switch off)

HINT:

Refer to the intelligent tester operator's manual for further details.

If the idle speed is not as specified, check the air intake system.

v. Disconnect the intelligent tester from the DLC3.

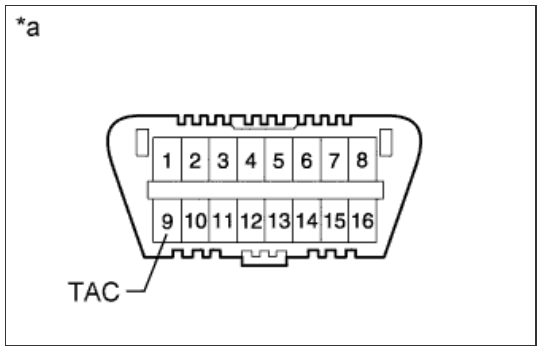
c. When not using the intelligent tester:

i. Using SST, connect the tachometer probe to terminal 9 (TAC) of the DLC3.

SST
09843-18030

Text in Illustration

*a Front view of DLC3



NOTICE:

- **Confirm the terminal number before connecting the probe. Connecting the probe to the wrong terminal can damage the engine.**
- **Switch off all accessories and the A/C before connecting the probe.**

ii. Race the engine at 2500 rpm for approximately 90 seconds.

iii. Check the idle speed.

Standard idle speed:
650 to 750 rpm (transmission in neutral and A/C switch off)

If the idle speed is not as specified, check the air intake system.

iv. Disconnect the tachometer probe from the DLC3.

66. INSPECT CO/HC

HINT:

This check is used only to determine whether or not the idle CO/HC complies with regulations.

a. Start the engine.

b. Keep the engine speed at 2500 rpm for approximately 180 seconds.

c. Insert the CO/HC meter testing probe at least 40 cm (1.31 ft.) into the tailpipe during idling.

d. Immediately check CO/HC concentration at idle and/or 2500 rpm.

HINT:

When performing the 2 mode (2500 rpm and idle) test, follow the measurement order prescribed by the applicable local regulations.

e. If the CO/HC concentration does not comply with the regulations, troubleshoot in the order given below.

i. Check the A/F sensor (Click here) and heated oxygen sensor (Click here) operation.

ii. See the table below for possible causes, and then inspect and correct the applicable causes if necessary.

CO	HC	Symptom	Cause
Normal	High	Rough idle	1. Faulty ignitions: • Incorrect timing • Plugs (contaminated, shorted or gaps are defective) 2. Incorrect valve clearance 3. Leaky intake and exhaust valves 4. Leaky cylinder
Low	High	Rough idle (Fluctuating HC reading)	1. Vacuum leaks: • PCV hose • Intake manifold • Throttle body 2. Lean mixture causing misfire
High	High	Rough idle (Black smoke from exhaust)	1. Restricted air filter 2. Faulty SFI system: • Faulty pressure regulator • Defective engine coolant temperature sensor • Faulty ECM • Faulty injectors • Faulty throttle position sensor • Faulty mass air flow meter

67. INSPECT ENGINE OIL LEVEL

a. Warm up the engine, stop the engine and wait 5 minutes. The oil level should be between the dipstick low level mark and full level mark.

If low, check for leakage and add oil up to the full level mark.

NOTICE:

Do not fill engine oil above the full level mark.

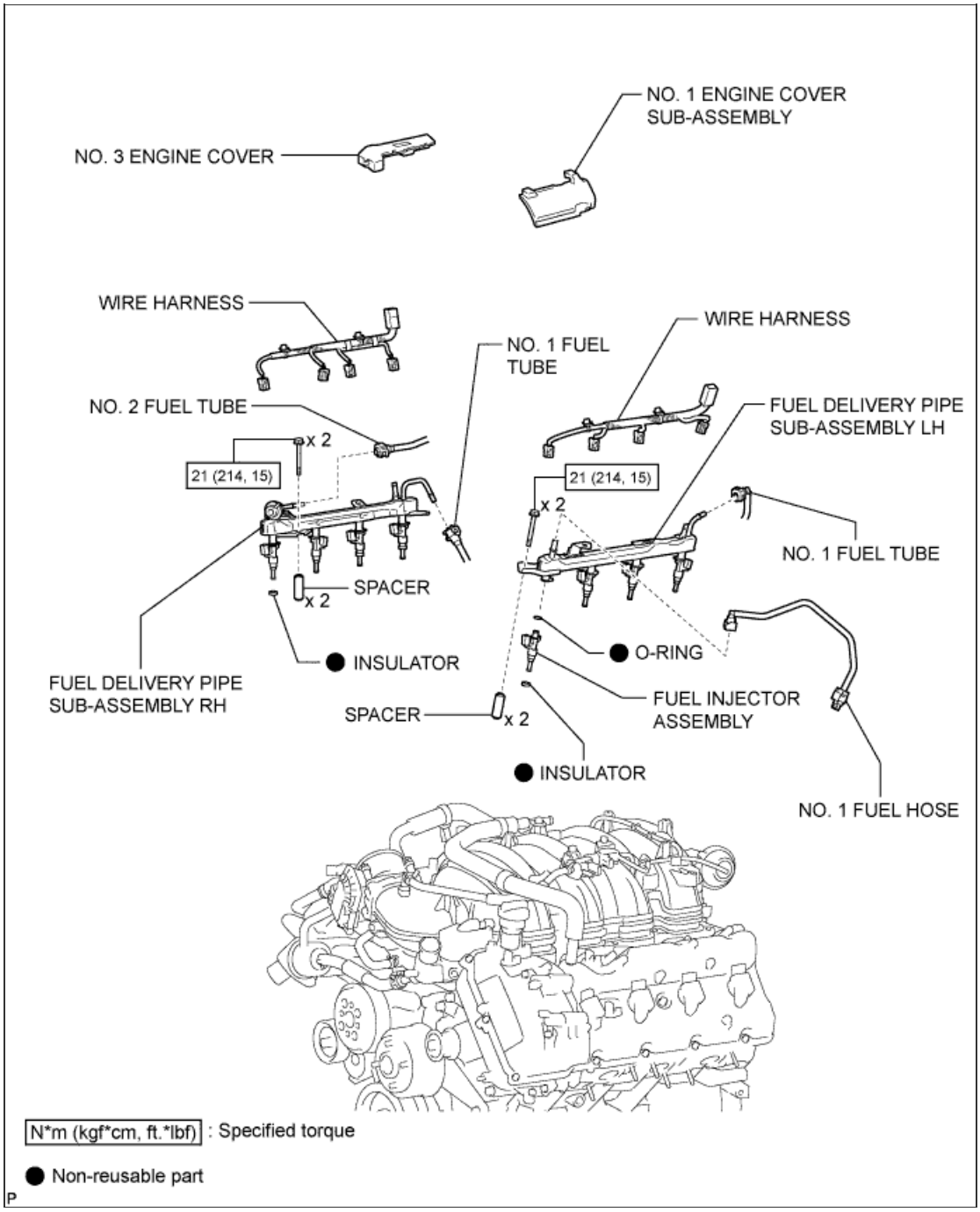
68. INSPECT ENGINE COOLANT LEVEL

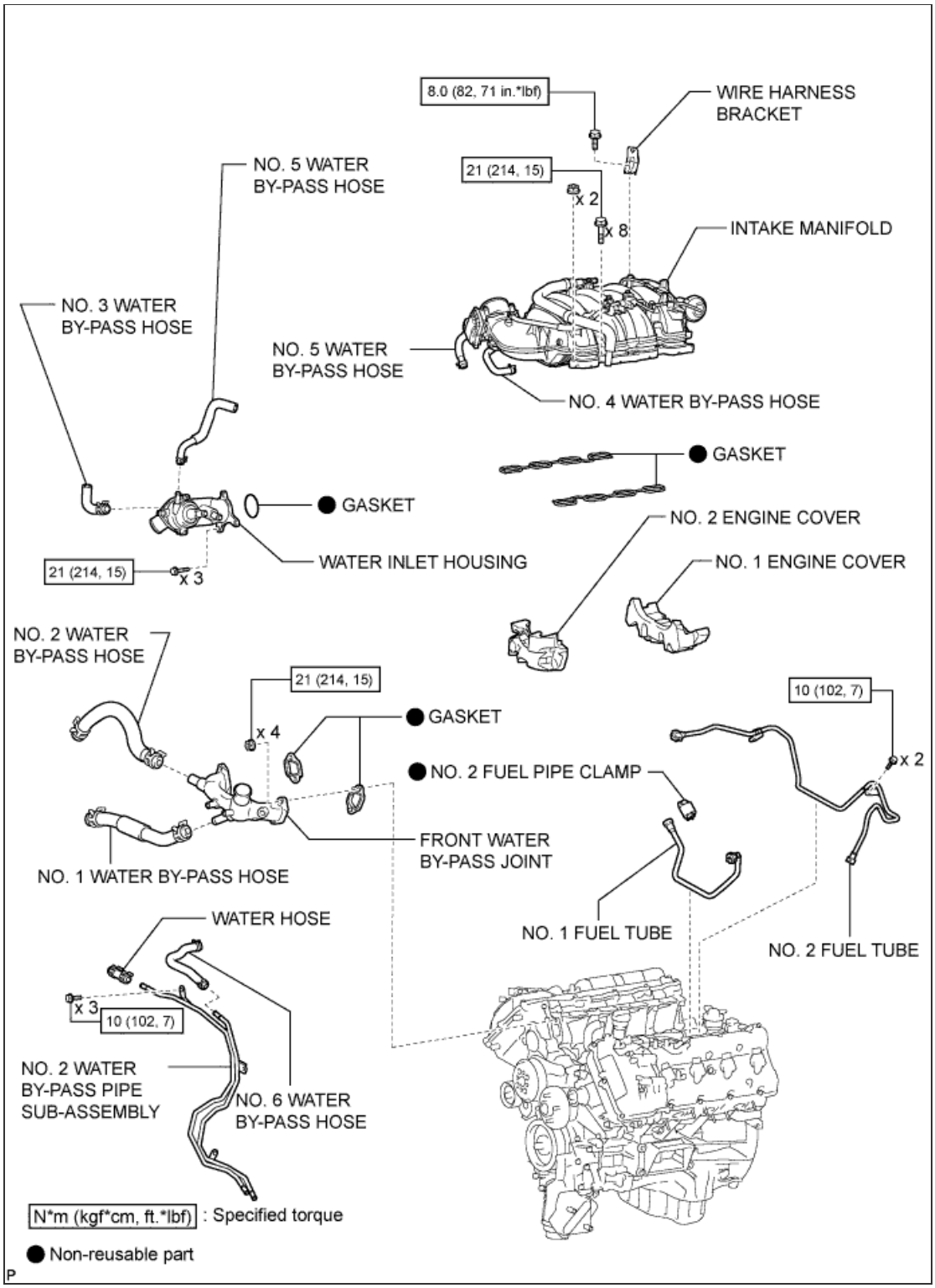
a. Check that the engine coolant level is between the L and F lines when the engine is cold.
If the engine coolant is below the L line, check for leaks and add "TOYOTA Super Long Life Coolant" or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite and non-borate coolant with long-life hybrid organic acid technology to the F line.

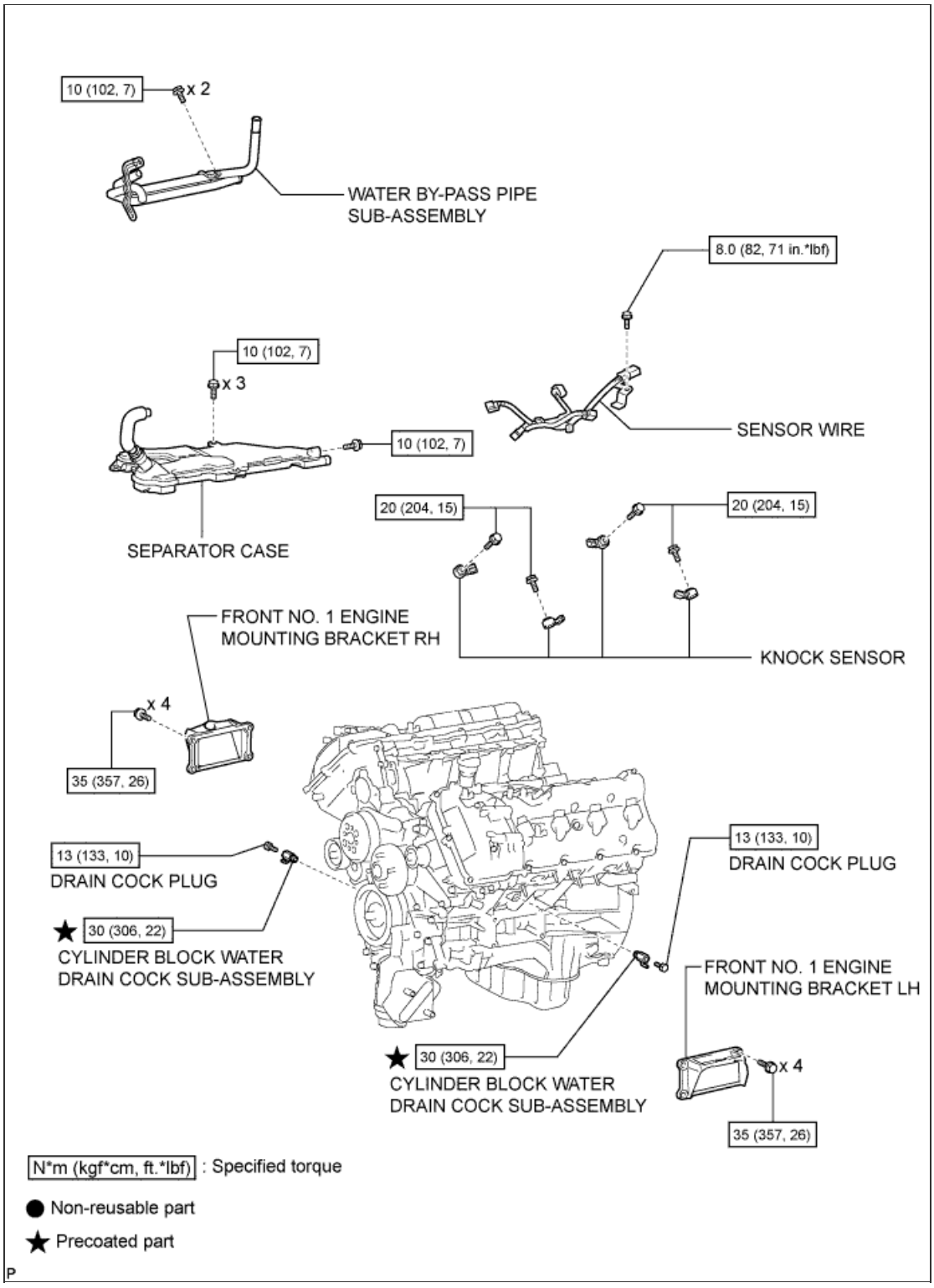
NOTICE:

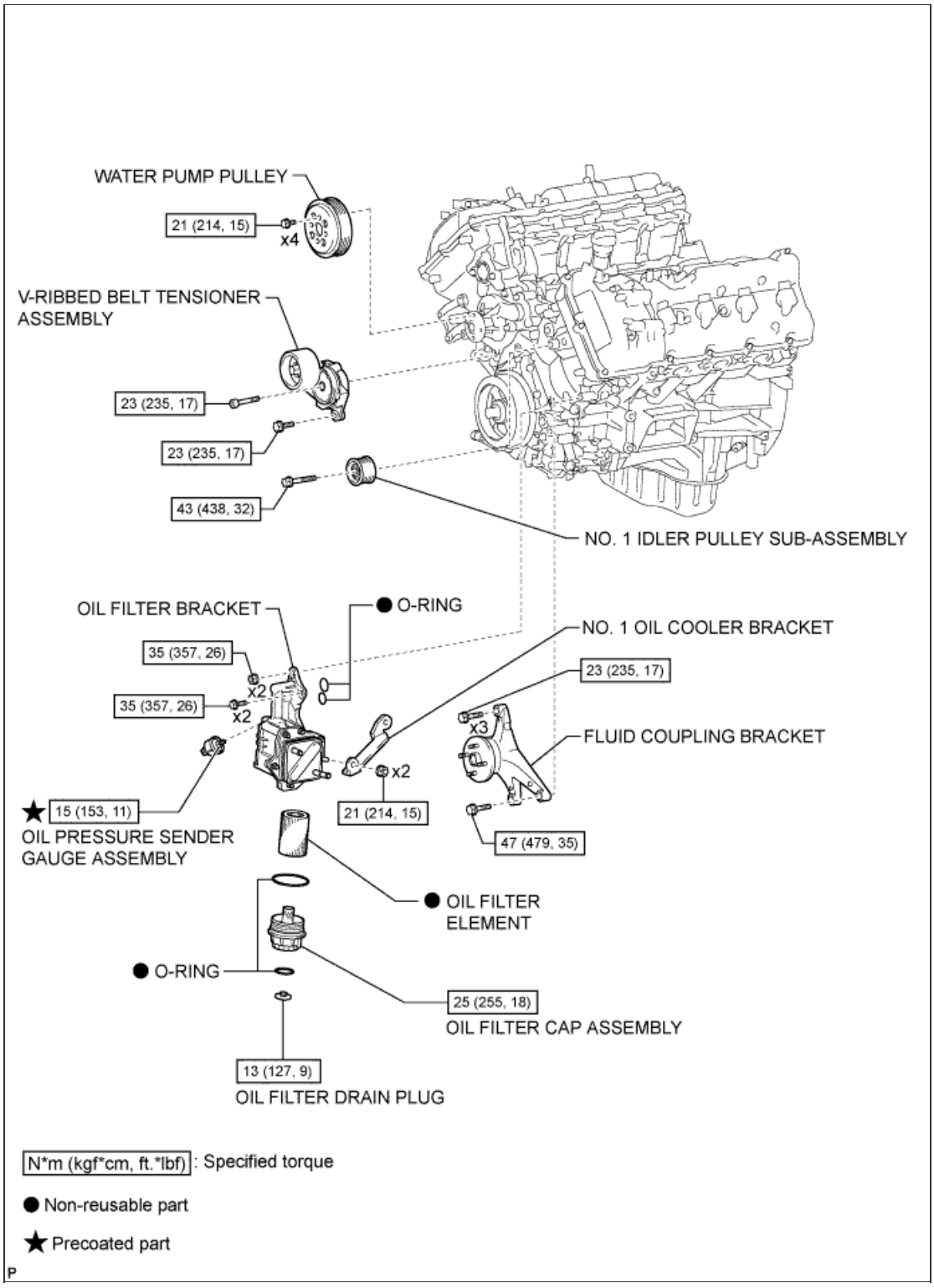
Do not substitute plain water for engine coolant.

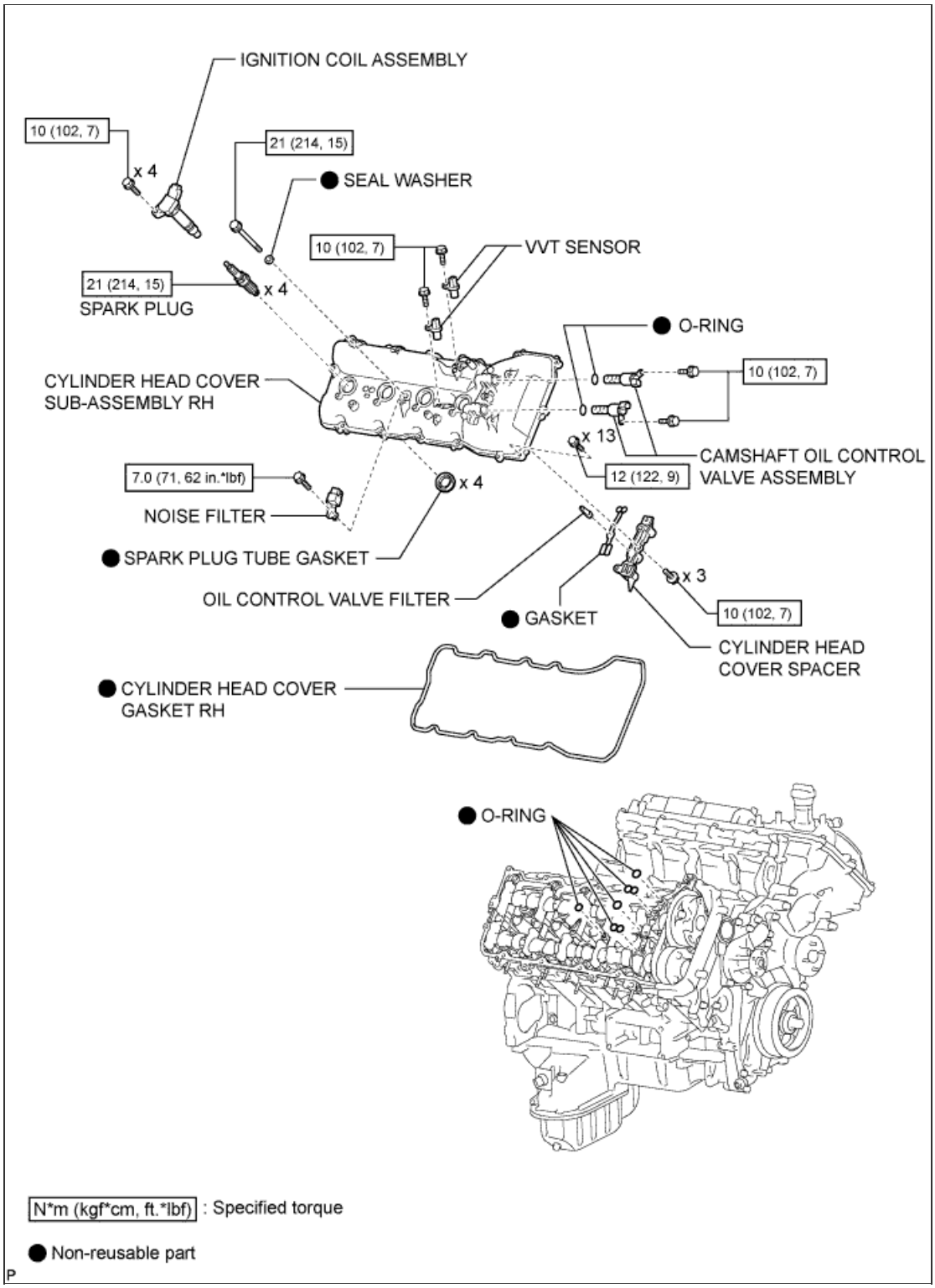
for Preparation Click here



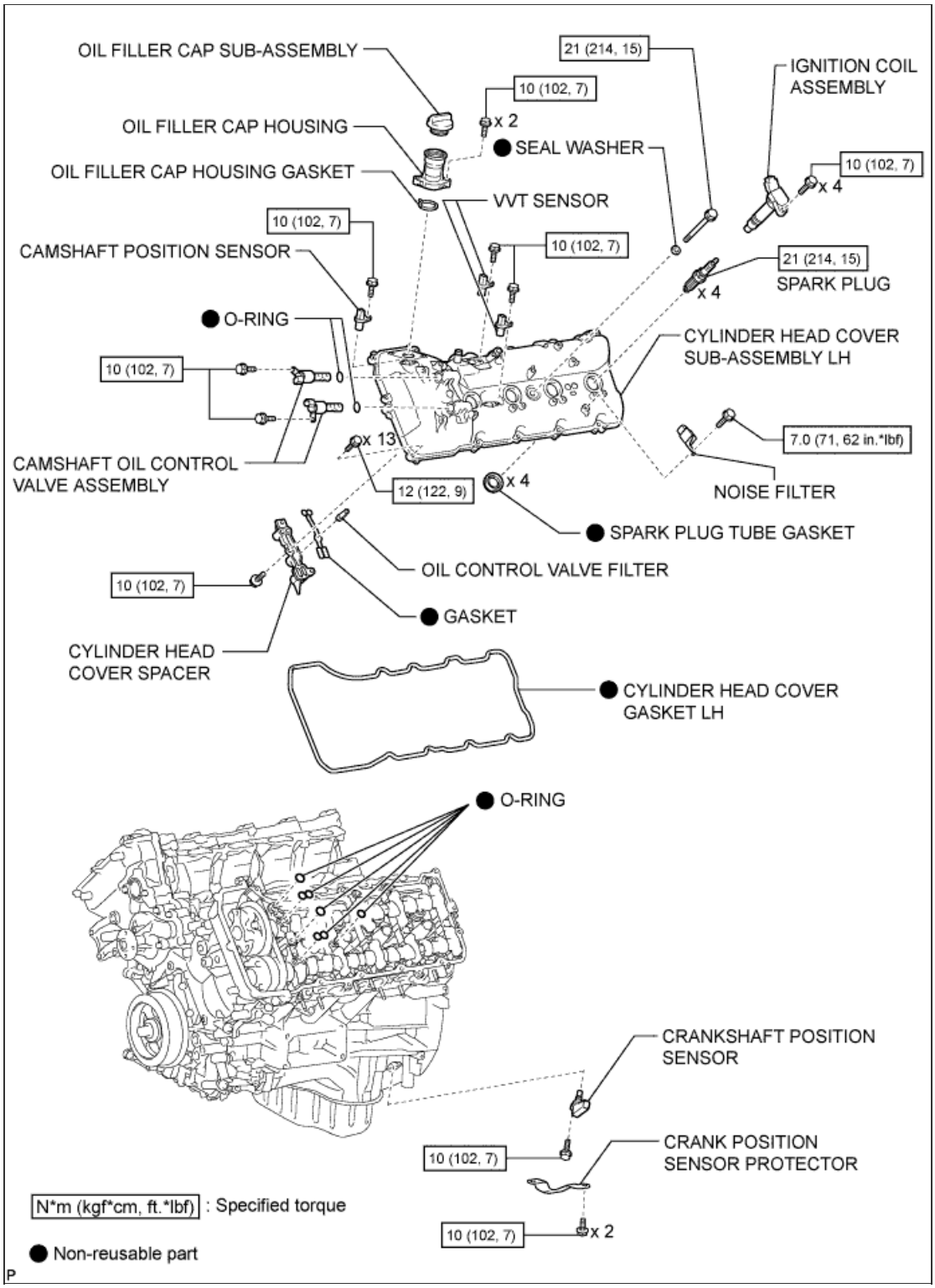

8.0 (82, 71 in.*lbf)
WIRE HARNESS BRACKET
NO. 5 WATER BY-PASS HOSE
21 (214, 15)
x 2
x 8
INTAKE MANIFOLD
NO. 3 WATER BY-PASS HOSE
NO. 5 WATER BY-PASS HOSE
NO. 4 WATER BY-PASS HOSE
GASKET
GASKET
NO. 2 ENGINE COVER
NO. 1 ENGINE COVER
WATER INLET HOUSING
21 (214, 15)
x 3
NO. 2 WATER BY-PASS HOSE
21 (214, 15)
x 4
GASKET
NO. 2 FUEL PIPE CLAMP
10 (102, 7)
x 2
FRONT WATER BY-PASS JOINT
NO. 1 WATER BY-PASS HOSE
NO. 1 FUEL TUBE
NO. 2 FUEL TUBE
WATER HOSE
x 3
10 (102, 7)
NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY
NO. 6 WATER BY-PASS HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

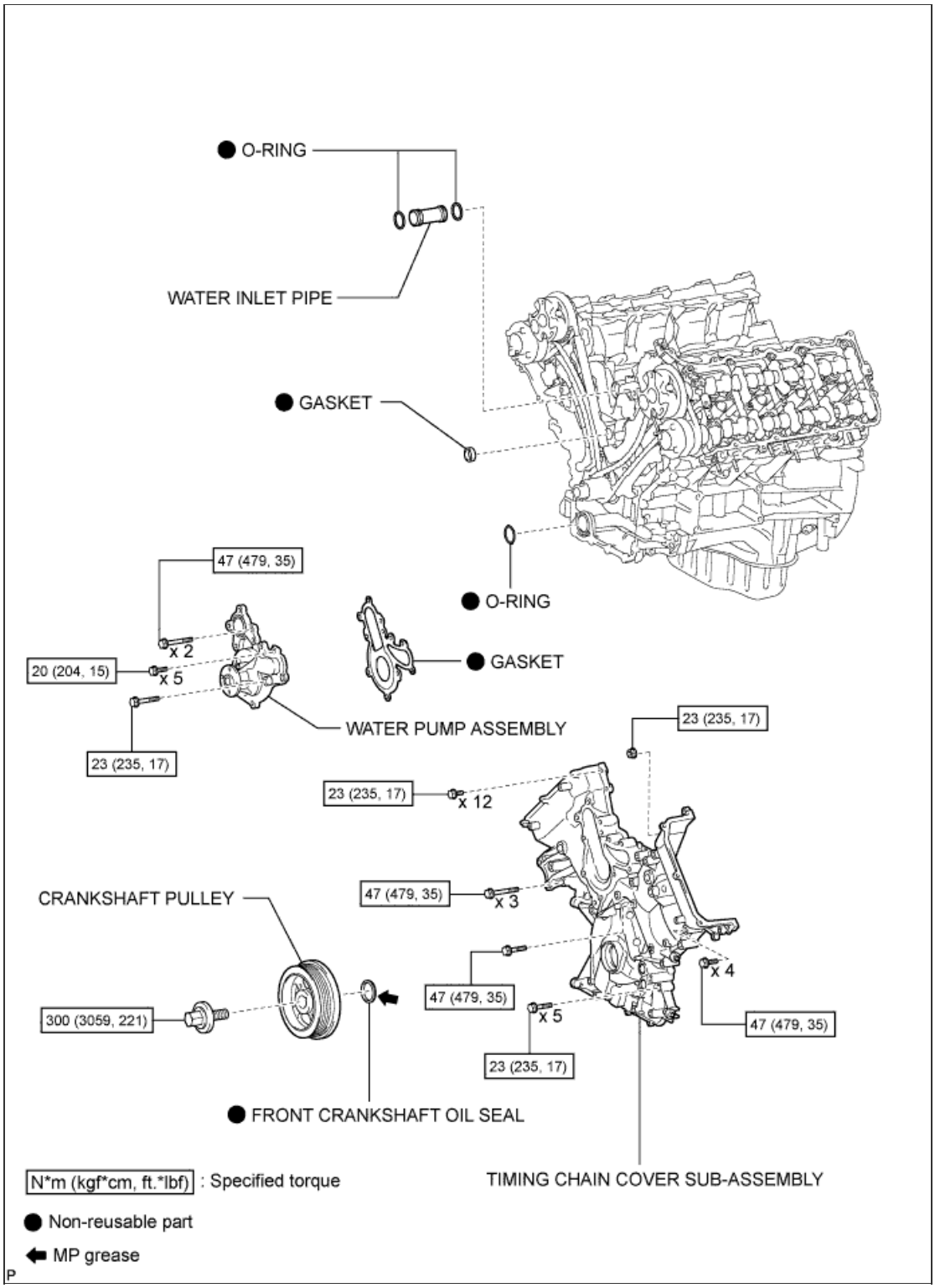

10 (102, 7)
x 2
WATER BY-PASS PIPE SUB-ASSEMBLY
8.0 (82, 71 in.*lbf)
10 (102, 7)
x 3
10 (102, 7)
SENSOR WIRE
SEPARATOR CASE
20 (204, 15)
20 (204, 15)
FRONT NO. 1 ENGINE MOUNTING BRACKET RH
KNOCK SENSOR
x 4
35 (357, 26)
13 (133, 10)
DRAIN COCK PLUG
30 (306, 22)
CYLINDER BLOCK WATER DRAIN COCK SUB-ASSEMBLY
13 (133, 10)
DRAIN COCK PLUG
FRONT NO. 1 ENGINE MOUNTING BRACKET LH
30 (306, 22)
CYLINDER BLOCK WATER DRAIN COCK SUB-ASSEMBLY
x 4
35 (357, 26)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
Precoated part
P

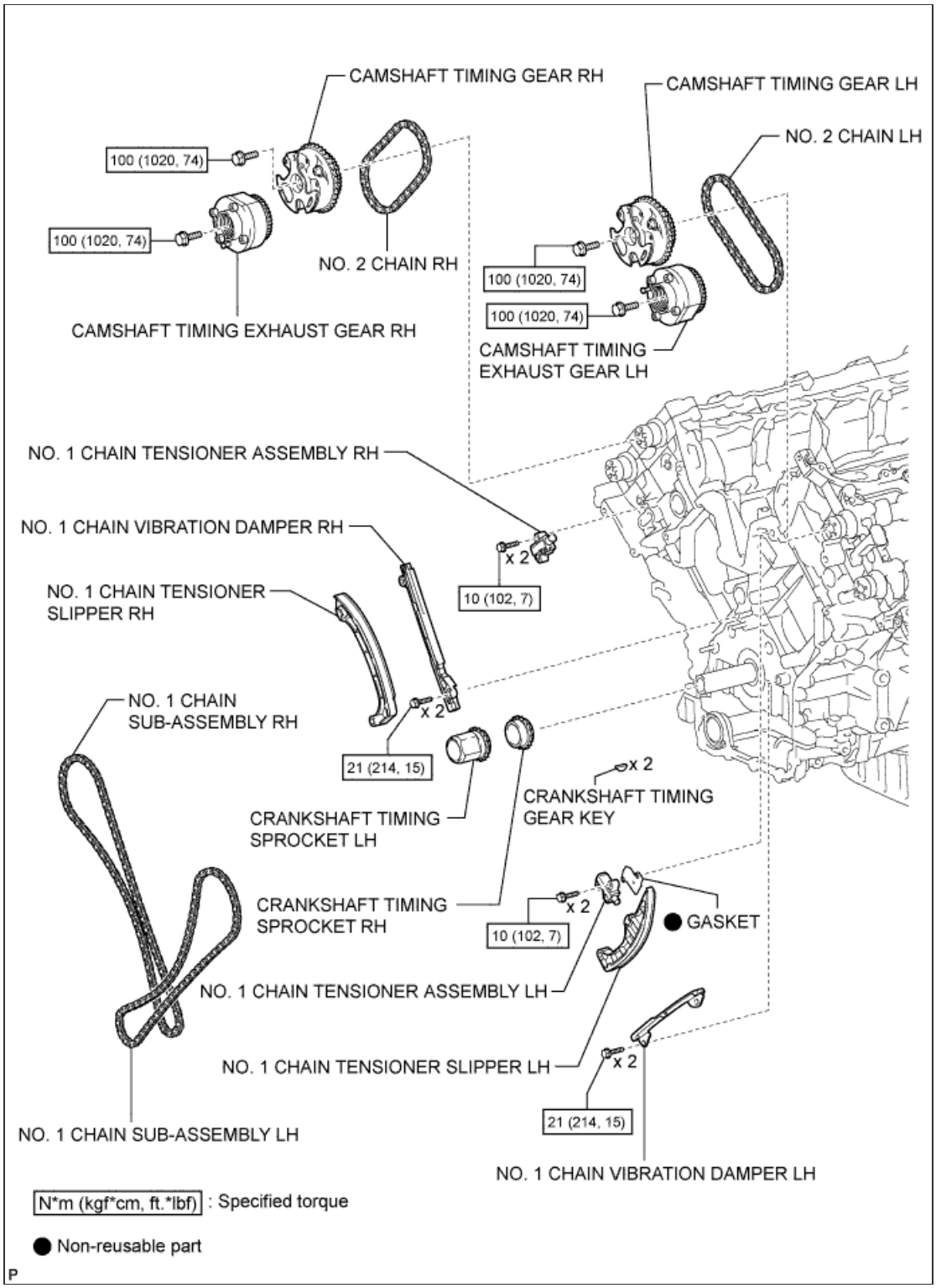

WATER PUMP PULLEY
21 (214, 15)
x4
V-RIBBED BELT TENSIONER ASSEMBLY
23 (235, 17)
23 (235, 17)
43 (438, 32)
NO. 1 IDLER PULLEY SUB-ASSEMBLY
OIL FILTER BRACKET
O-RING
35 (357, 26)
x2
35 (357, 26)
x2
NO. 1 OIL COOLER BRACKET
23 (235, 17)
x3
FLUID COUPLING BRACKET
x2
21 (214, 15)
15 (153, 11)
OIL PRESSURE SENDER GAUGE ASSEMBLY
47 (479, 35)
OIL FILTER ELEMENT
O-RING
25 (255, 18)
OIL FILTER CAP ASSEMBLY
13 (127, 9)
OIL FILTER DRAIN PLUG
N*m (kgf*cm, ft.*lbf): Specified torque
Non-reusable part
Precoated part
P

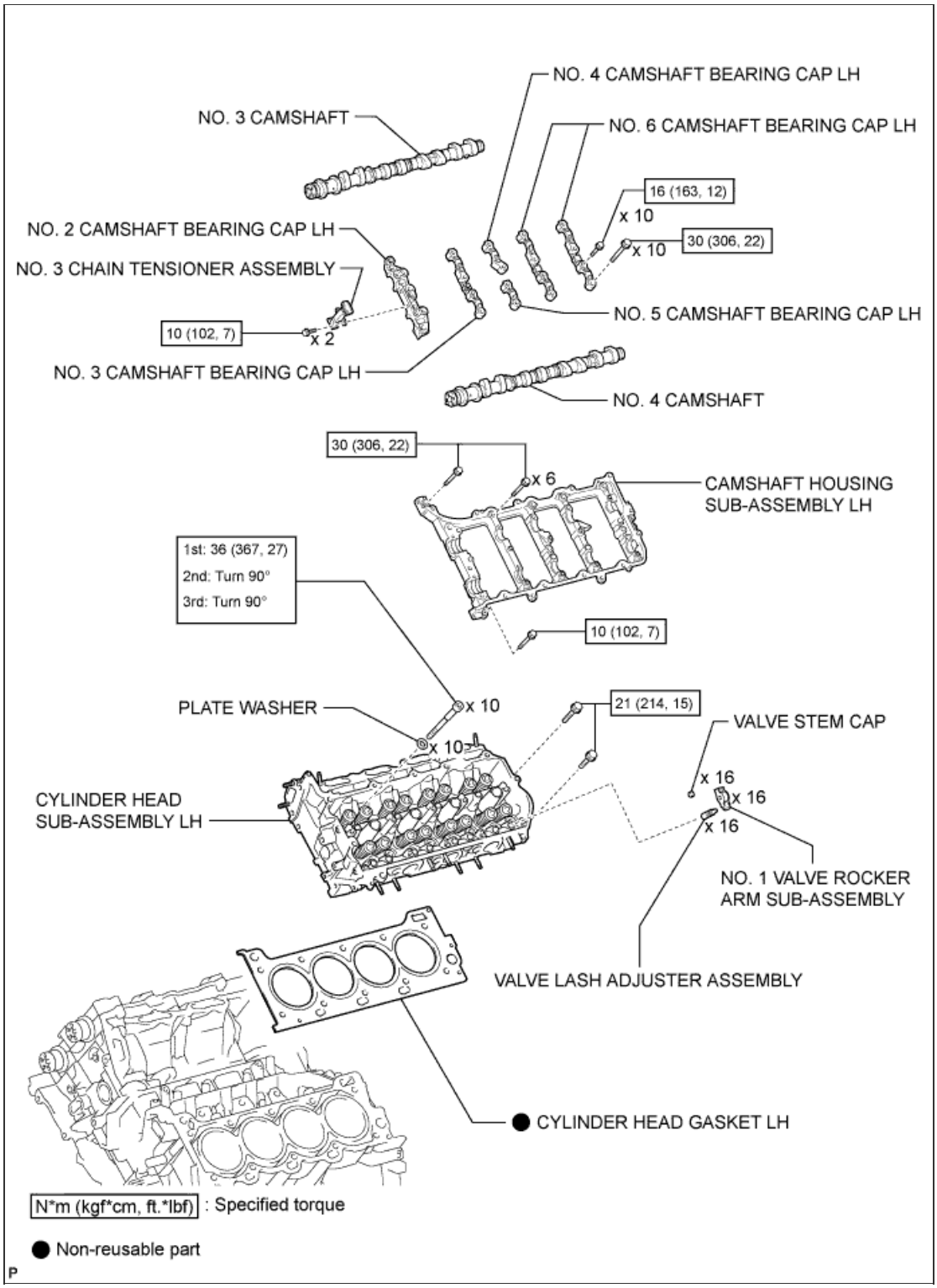

IGNITION COIL ASSEMBLY
10 (102, 7)
x 4
21 (214, 15)
SEAL WASHER
10 (102, 7)
VVT SENSOR
21 (214, 15)
x 4
SPARK PLUG
O-RING
CYLINDER HEAD COVER
SUB-ASSEMBLY RH
10 (102, 7)
x 13
CAMSHAFT OIL CONTROL
VALVE ASSEMBLY
12 (122, 9)
7.0 (71, 62 in.*lbf)
x 4
NOISE FILTER
SPARK PLUG TUBE GASKET
OIL CONTROL VALVE FILTER
GASKET
x 3
10 (102, 7)
CYLINDER HEAD
COVER SPACER
CYLINDER HEAD COVER
GASKET RH
O-RING
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

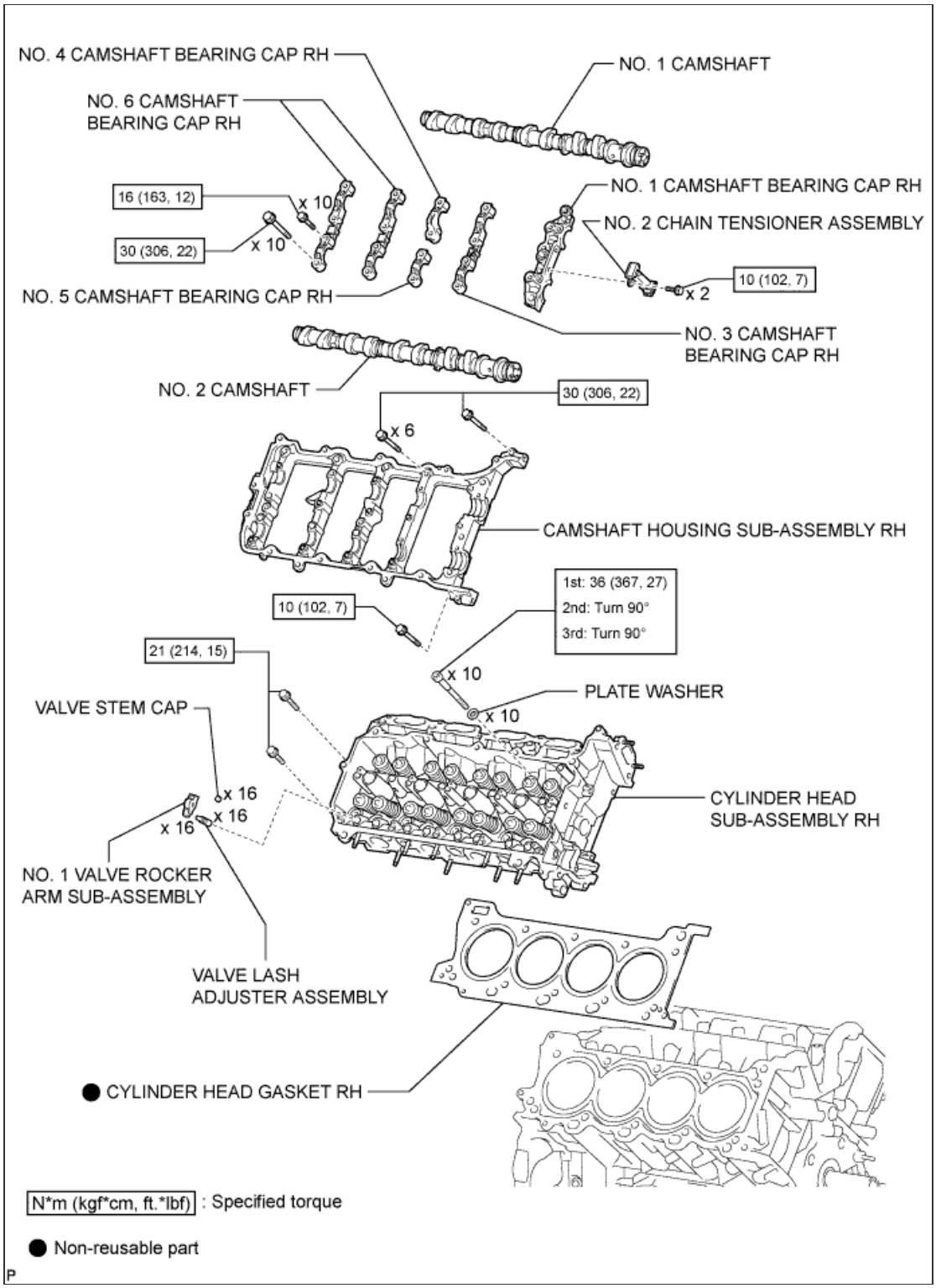
P

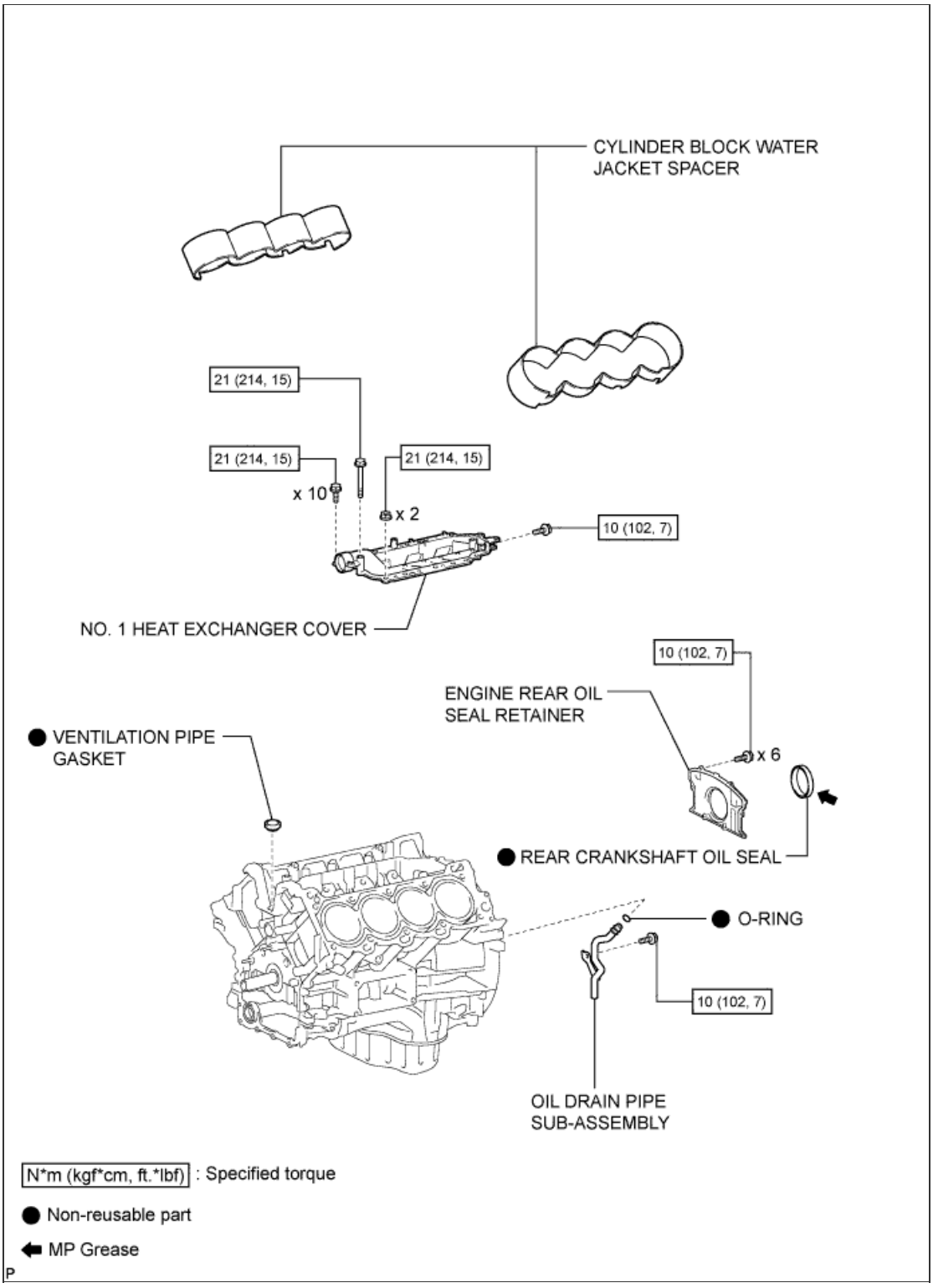

OIL FILLER CAP SUB-ASSEMBLY
21 (214, 15)
IGNITION COIL ASSEMBLY
10 (102, 7)
x 2
OIL FILLER CAP HOUSING
SEAL WASHER
OIL FILLER CAP HOUSING GASKET
10 (102, 7)
x 4
VVT SENSOR
10 (102, 7)
CAMSHAFT POSITION SENSOR
10 (102, 7)
21 (214, 15)
SPARK PLUG
x 4
O-RING
CYLINDER HEAD COVER SUB-ASSEMBLY LH
10 (102, 7)
x 13
7.0 (71, 62 in.*lbf)
CAMSHAFT OIL CONTROL VALVE ASSEMBLY
12 (122, 9)
x 4
NOISE FILTER
SPARK PLUG TUBE GASKET
OIL CONTROL VALVE FILTER
10 (102, 7)
GASKET
CYLINDER HEAD COVER SPACER
CYLINDER HEAD COVER GASKET LH
O-RING
CRANKSHAFT POSITION SENSOR
10 (102, 7)
CRANK POSITION SENSOR PROTECTOR
10 (102, 7)
x 2
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

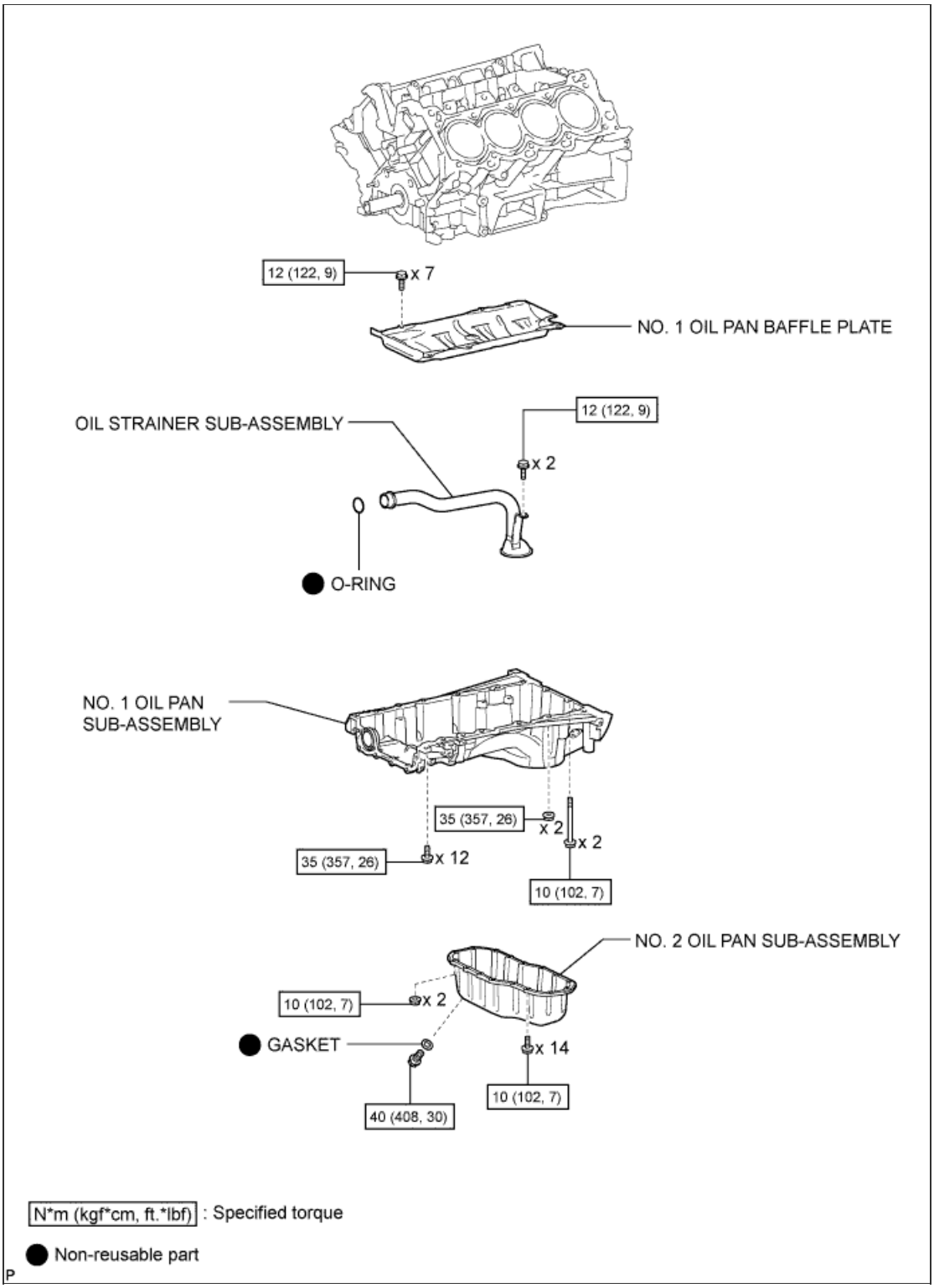

O-RING
WATER INLET PIPE
GASKET
O-RING
47 (479, 35)
x 2
20 (204, 15)
x 5
23 (235, 17)
GASKET
WATER PUMP ASSEMBLY
23 (235, 17)
23 (235, 17)
x 12
CRANKSHAFT PULLEY
47 (479, 35)
x 3
47 (479, 35)
x 5
x 4
47 (479, 35)
300 (3059, 221)
23 (235, 17)
FRONT CRANKSHAFT OIL SEAL
TIMING CHAIN COVER SUB-ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
MP grease
P


CAMSHAFT TIMING GEAR RH
CAMSHAFT TIMING GEAR LH
NO. 2 CHAIN LH
100 (1020, 74)
100 (1020, 74)
NO. 2 CHAIN RH
100 (1020, 74)
100 (1020, 74)
CAMSHAFT TIMING EXHAUST GEAR RH
CAMSHAFT TIMING EXHAUST GEAR LH
NO. 1 CHAIN TENSIONER ASSEMBLY RH
NO. 1 CHAIN VIBRATION DAMPER RH
x 2
10 (102, 7)
NO. 1 CHAIN TENSIONER SLIPPER RH
NO. 1 CHAIN SUB-ASSEMBLY RH
x 2
21 (214, 15)
x 2
CRANKSHAFT TIMING GEAR KEY
CRANKSHAFT TIMING SPROCKET LH
CRANKSHAFT TIMING SPROCKET RH
x 2
10 (102, 7)
GASKET
NO. 1 CHAIN TENSIONER ASSEMBLY LH
NO. 1 CHAIN TENSIONER SLIPPER LH
x 2
21 (214, 15)
NO. 1 CHAIN SUB-ASSEMBLY LH
NO. 1 CHAIN VIBRATION DAMPER LH
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P


NO. 4 CAMSHAFT BEARING CAP LH
NO. 3 CAMSHAFT
NO. 6 CAMSHAFT BEARING CAP LH
16 (163, 12)
x 10
30 (306, 22)
x 10
NO. 2 CAMSHAFT BEARING CAP LH
NO. 3 CHAIN TENSIONER ASSEMBLY
NO. 5 CAMSHAFT BEARING CAP LH
10 (102, 7)
x 2
NO. 3 CAMSHAFT BEARING CAP LH
NO. 4 CAMSHAFT
30 (306, 22)
x 6
CAMSHAFT HOUSING SUB-ASSEMBLY LH
1st: 36 (367, 27)
2nd: Turn 90°
3rd: Turn 90°
10 (102, 7)
PLATE WASHER
x 10
x 10
21 (214, 15)
VALVE STEM CAP
x 16
x 16
x 16
CYLINDER HEAD SUB-ASSEMBLY LH
NO. 1 VALVE ROCKER ARM SUB-ASSEMBLY
VALVE LASH ADJUSTER ASSEMBLY
● CYLINDER HEAD GASKET LH
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
P


NO. 4 CAMSHAFT BEARING CAP RH
NO. 1 CAMSHAFT
NO. 6 CAMSHAFT BEARING CAP RH
16 (163, 12)
x 10
30 (306, 22)
x 10
NO. 1 CAMSHAFT BEARING CAP RH
NO. 2 CHAIN TENSIONER ASSEMBLY
10 (102, 7)
x 2
NO. 5 CAMSHAFT BEARING CAP RH
NO. 3 CAMSHAFT BEARING CAP RH
NO. 2 CAMSHAFT
30 (306, 22)
x 6
CAMSHAFT HOUSING SUB-ASSEMBLY RH
10 (102, 7)
1st: 36 (367, 27)
2nd: Turn 90°
3rd: Turn 90°
21 (214, 15)
x 10
PLATE WASHER
x 10
VALVE STEM CAP
x 16
x 16
x 16
CYLINDER HEAD SUB-ASSEMBLY RH
NO. 1 VALVE ROCKER ARM SUB-ASSEMBLY
VALVE LASH ADJUSTER ASSEMBLY
● CYLINDER HEAD GASKET RH
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
P


CYLINDER BLOCK WATER JACKET SPACER
21 (214, 15)
21 (214, 15)
21 (214, 15)
x 10
x 2
10 (102, 7)
NO. 1 HEAT EXCHANGER COVER
10 (102, 7)
ENGINE REAR OIL SEAL RETAINER
x 6
VENTILATION PIPE GASKET
REAR CRANKSHAFT OIL SEAL
O-RING
10 (102, 7)
OIL DRAIN PIPE SUB-ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
MP Grease
P


12 (122, 9)
x 7
NO. 1 OIL PAN BAFFLE PLATE
OIL STRAINER SUB-ASSEMBLY
12 (122, 9)
x 2
O-RING
NO. 1 OIL PAN
SUB-ASSEMBLY
35 (357, 26)
x 2
x 2
35 (357, 26)
x 12
10 (102, 7)
NO. 2 OIL PAN SUB-ASSEMBLY
10 (102, 7)
x 2
GASKET
x 14
10 (102, 7)
40 (408, 30)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P

for Preparation Click here

1. REMOVE ENGINE WIRE

a. Engine LH Side:

i. Disconnect the 2 camshaft timing control valve connectors.

ii. Disconnect the 4 ignition coil connectors.

iii. Disconnect the 2 VVT sensor connectors.

iv. Disconnect the camshaft position sensor connector.

v. Disconnect the vacuum switching valve connector (for ACIS).

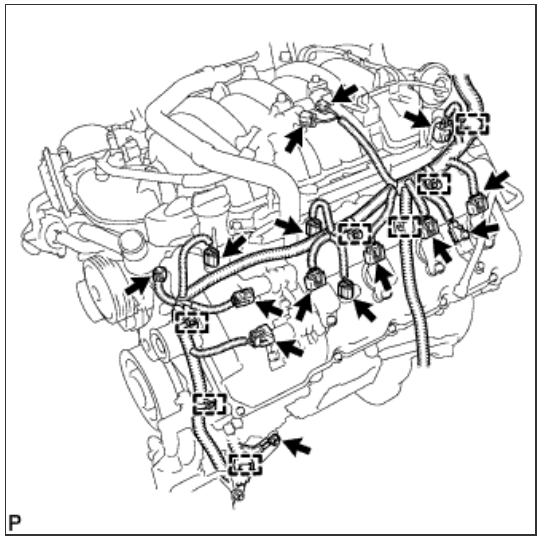
vi. Disconnect the purge VSV connector.

vii. Disconnect the engine coolant temperature sensor connector.

viii. Disconnect the fuel injector connector.

ix. Disconnect the noise filter connector.

x. Remove the bolt and disconnect the 7 clamps.



b. Engine RH Side:

i. Disconnect the 2 camshaft timing control valve connectors.

ii. Disconnect the 4 ignition coil connectors.

iii. Disconnect the 2 VVT sensor connectors.

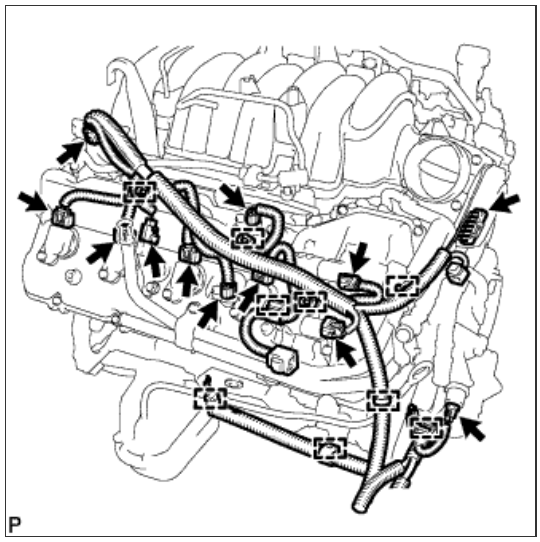
iv. Disconnect the fuel injector connector.

v. Disconnect the noise filter connector.

vi. Disconnect the throttle sensor connector.

vii. Disconnect the oil pressure sender gauge connector.

viii. Disconnect the 9 clamps.



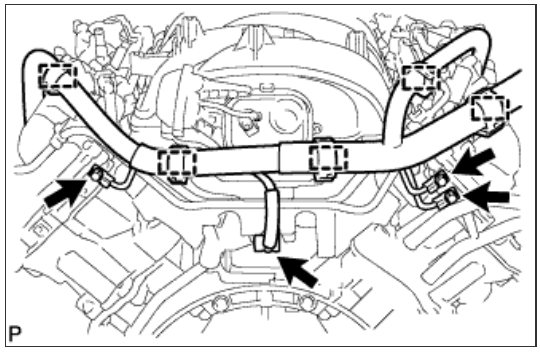
c. Engine Rear Side:

i. Disconnect the sensor wire connector.

ii. Disconnect the 5 clamps.

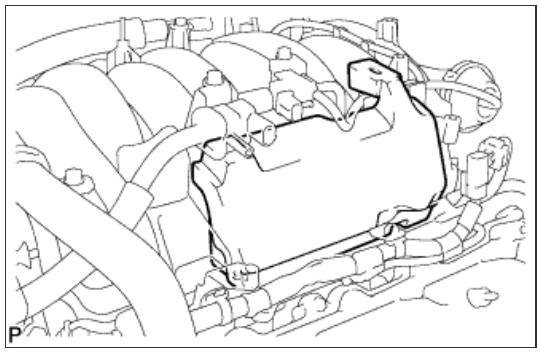
iii. Remove the 3 bolts.

d. Remove the engine wire.



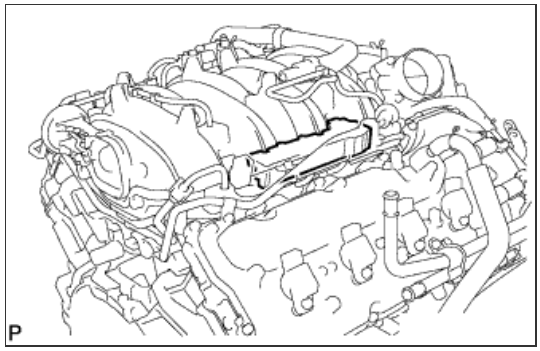
2. REMOVE NO. 1 ENGINE COVER SUB-ASSEMBLY

a. Remove the No. 1 engine cover sub-assembly.



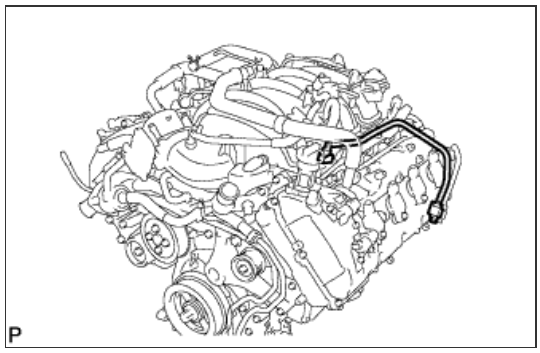
3. REMOVE NO. 3 ENGINE COVER

a. Remove the No. 3 engine cover.



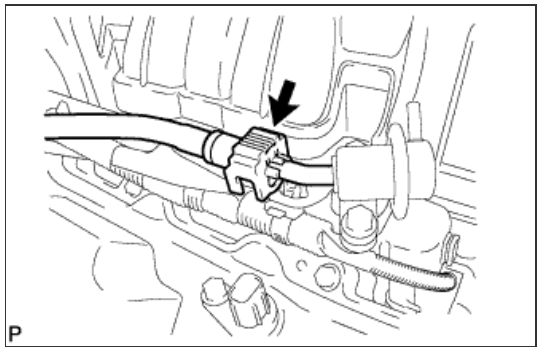
4. REMOVE NO. 1 FUEL HOSE

a. Remove the fuel hose (Click here).



5. DISCONNECT NO. 2 FUEL TUBE

a. Disconnect the No. 2 fuel tube from the fuel pressure regulator (Click here).



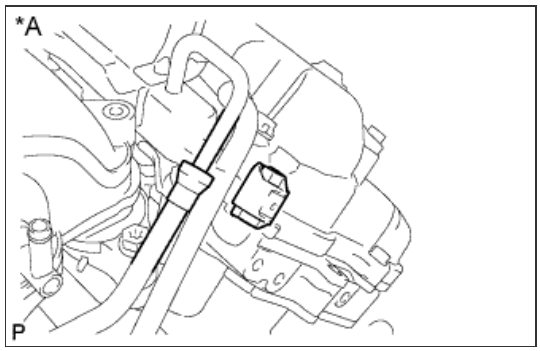
6. DISCONNECT NO. 1 FUEL TUBE

a. Disconnect the No. 1 fuel tube from the fuel delivery pipe RH (for metallic type) (Click here).

SST
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Text in Illustration

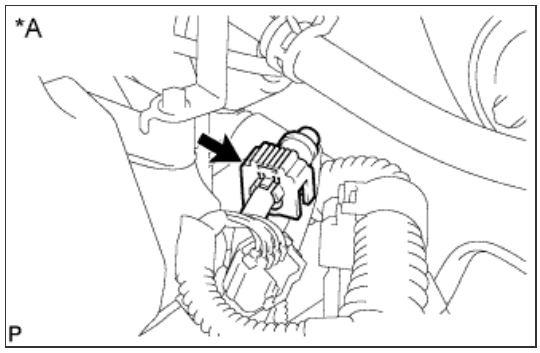
*A	RH Side



b. LH Side:
Disconnect the No. 1 fuel tube from the fuel delivery pipe LH (Click here).

Text in Illustration

*A	LH Side



7. REMOVE FUEL DELIVERY PIPE SUB-ASSEMBLY LH

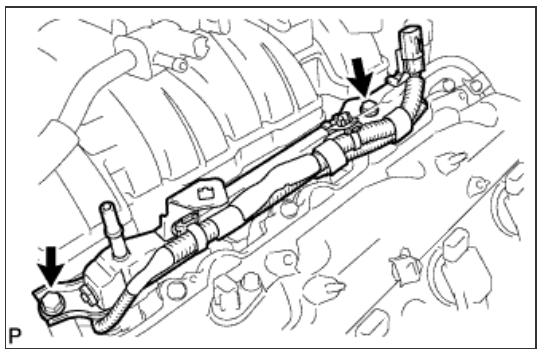
a. Disconnect the No. 7 wire harness connector.

b. Remove the 2 bolts and fuel delivery pipe LH.

NOTICE

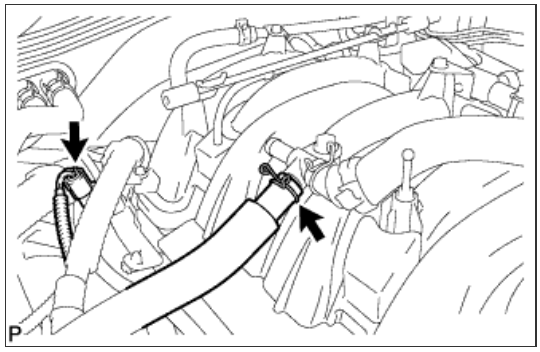
When removing the delivery pipe, hold the pipe by both ends and pull it straight upward.

c. Remove the 2 delivery pipe spacers and 4 insulators from the cylinder head LH.



8. REMOVE FUEL DELIVERY PIPE SUB-ASSEMBLY RH

a. Disconnect the ventilation hose and No. 6 wire harness connector.

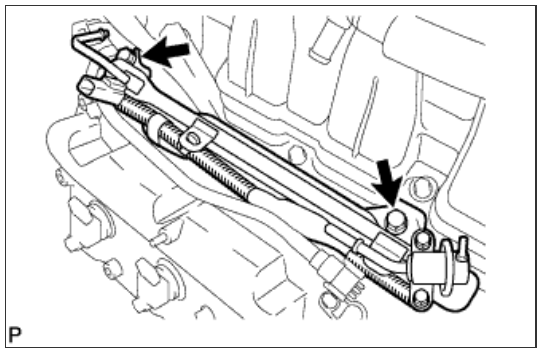


b. Remove the 2 bolts and fuel delivery pipe RH.

NOTICE

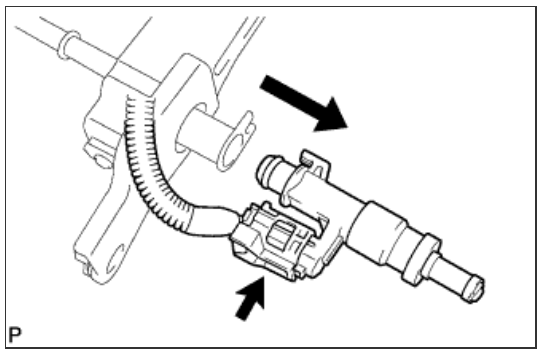
When removing the delivery pipe, hold the pipe by both ends and pull it straight upward.

c. Remove the 2 delivery pipe spacers and 4 insulators from the cylinder head RH.



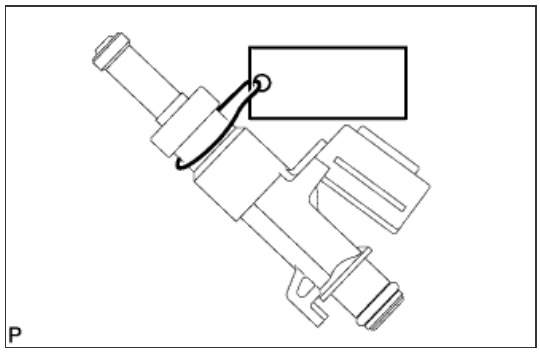
9. REMOVE FUEL INJECTOR ASSEMBLY

a. Remove the fuel injector from the fuel delivery pipe, and then disconnect the injector connector.



NOTICE

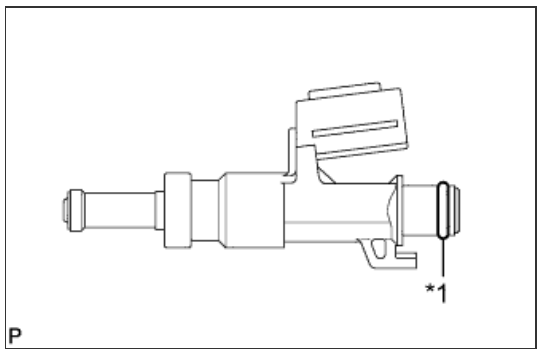
For reinstallation, attach a tag or label to the injector shaft.



b. Remove the O-ring from the fuel injector.

Text in Illustration

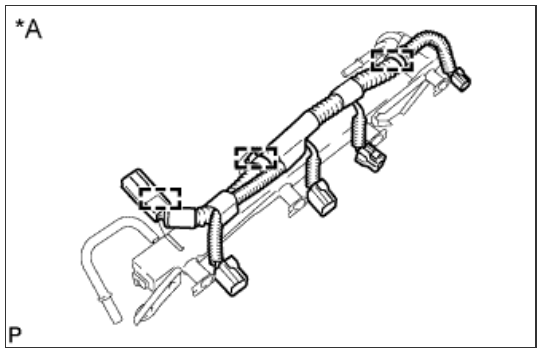
*1	O-Ring



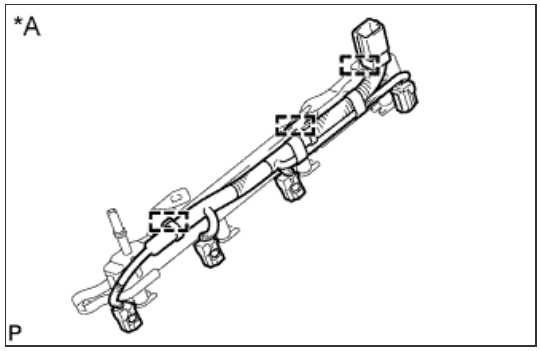
c. Detach the 3 clamps and then remove the No. 6 wire harness from the delivery pipe RH.

Text in Illustration

*A	Fuel Delivery Pipe RH



d. Detach the 3 clamps and then remove the No. 7 wire harness from the delivery pipe LH.

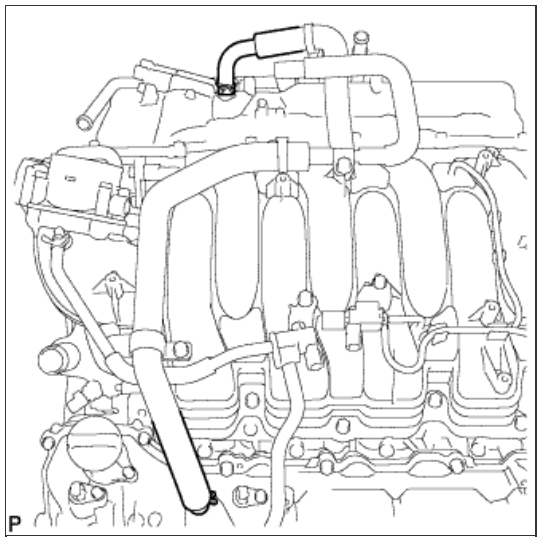


Text in Illustration

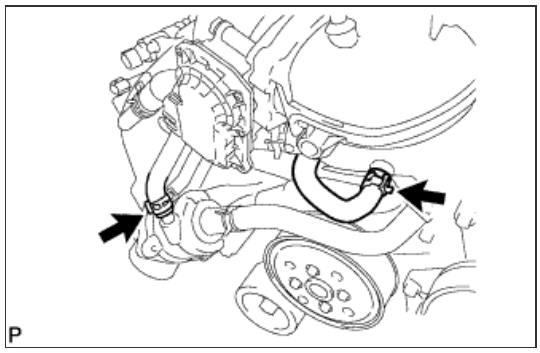
*A	Fuel Delivery Pipe LH

10. REMOVE INTAKE MANIFOLD

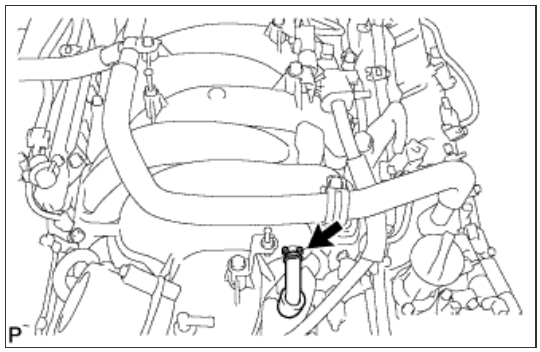
a. Disconnect the ventilation hose from the ventilation pipe of the cylinder head cover LH and RH.



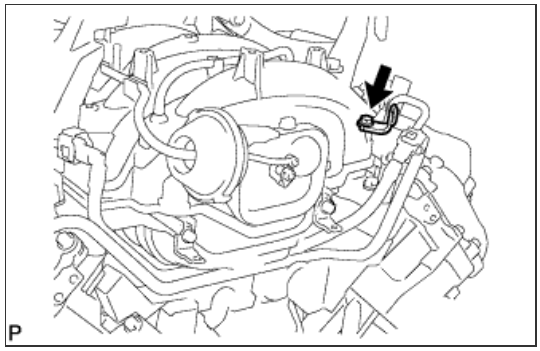
b. Disconnect the 2 water by-pass hoses.



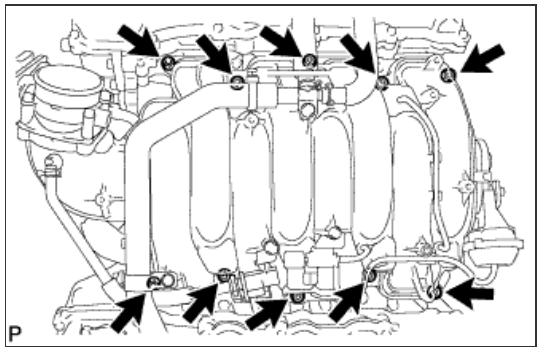
c. Disconnect the No. 1 ventilation hose.



d. Remove the bolt and wire bracket from the intake manifold.

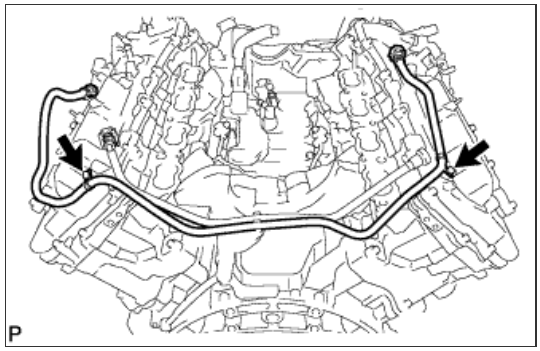


e. Remove the 2 nuts, 8 bolts, intake manifold and 2 gaskets.

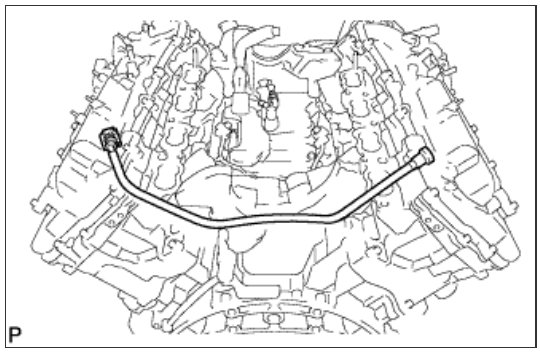


11. REMOVE NO. 2 FUEL TUBE

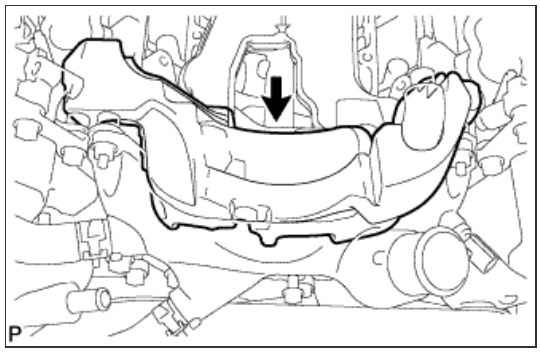
a. Remove the 2 bolts and No. 2 fuel tube.



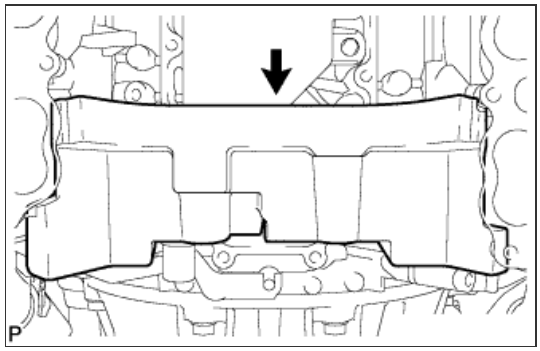
12. REMOVE NO. 1 FUEL TUBE



13. REMOVE NO. 2 ENGINE COVER



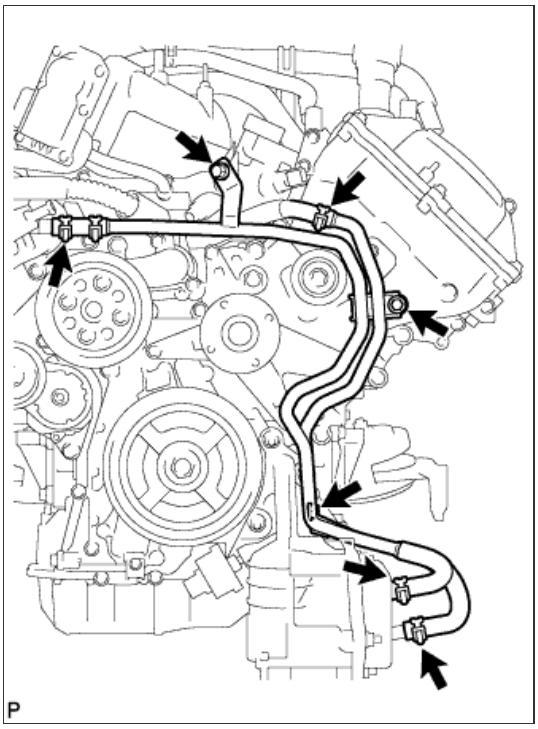
14. REMOVE NO. 1 ENGINE COVER



15. REMOVE NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY

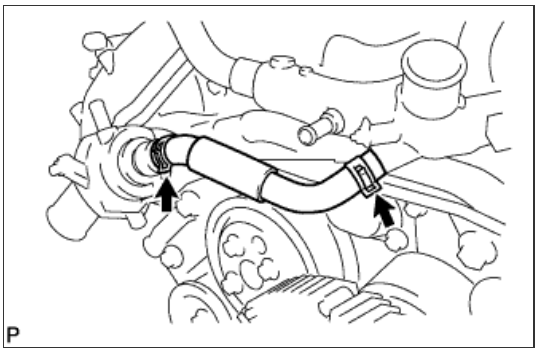
a. Remove the 3 bolts.

b. Disconnect the 4 hoses and remove the water by-pass pipe.



16. REMOVE NO. 1 WATER BY-PASS HOSE

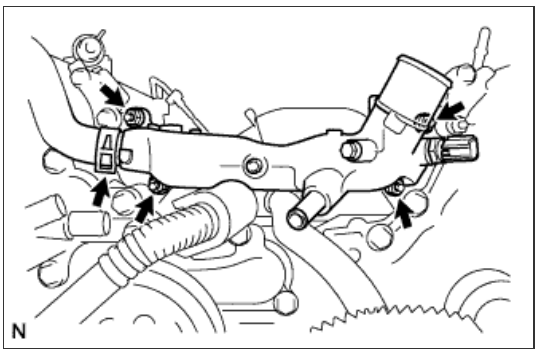
a. Remove the No. 1 water by-pass hose by disconnecting the hose from the water inlet housing and front water by-pass joint.



17. REMOVE FRONT WATER BY-PASS JOINT

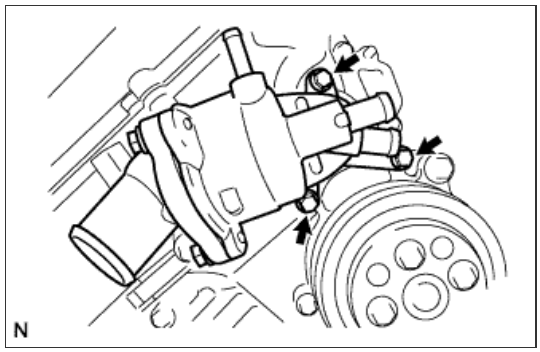
a. Disconnect the No. 2 water by-pass hose from the water by-pass joint.

b. Remove the 4 nuts, water by-pass joint and 2 gaskets.



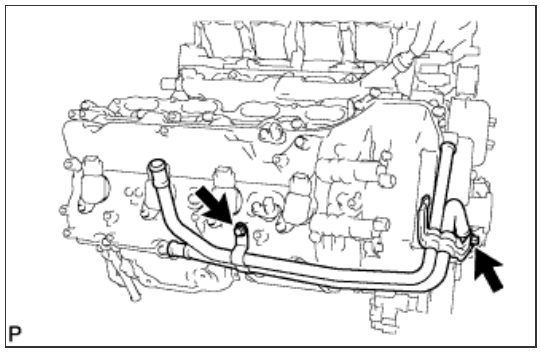
18. REMOVE WATER INLET HOUSING

a. Remove the 3 bolts, water inlet housing and gasket.



19. REMOVE WATER BY-PASS PIPE SUB-ASSEMBLY

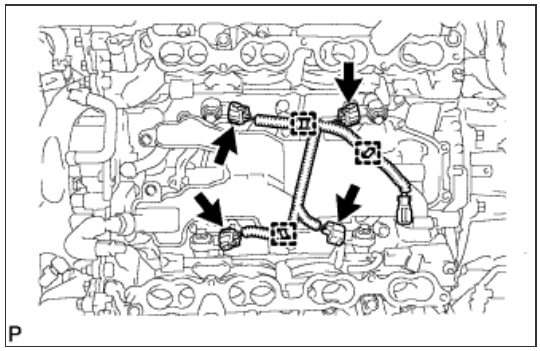
a. Remove the 2 bolts and water by-pass pipe.



20. REMOVE SENSOR WIRE

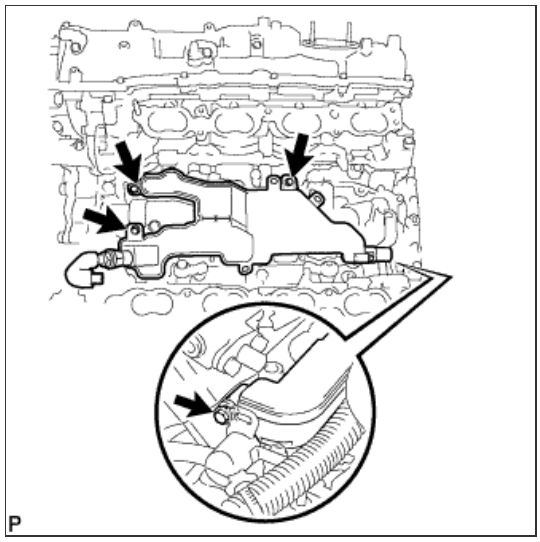
a. Disconnect the 4 knock sensor connectors.

b. Disconnect the 3 clamps. Then remove the sensor wire.



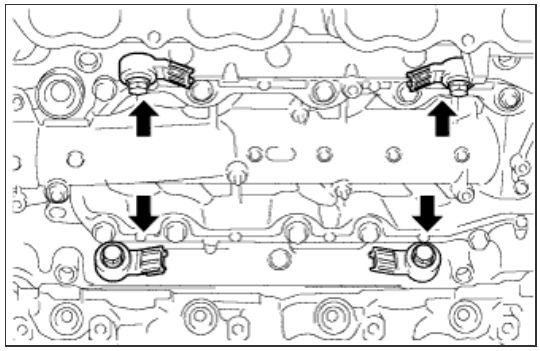
21. REMOVE SEPARATOR CASE

a. Remove the 4 bolts and separator case.



22. REMOVE KNOCK SENSOR

a. Remove the 4 bolts and 4 knock sensors.



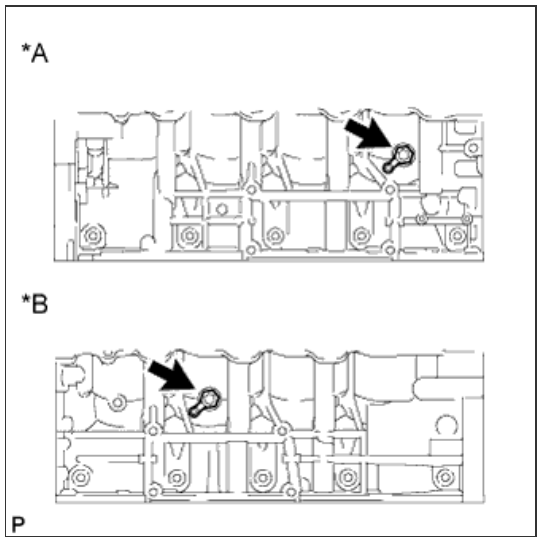
23. REMOVE CYLINDER BLOCK WATER DRAIN COCK SUB-ASSEMBLY

a. Remove the 2 water drain cock plugs from the water drain cocks.

b. Remove the 2 water drain cocks from the cylinder block.

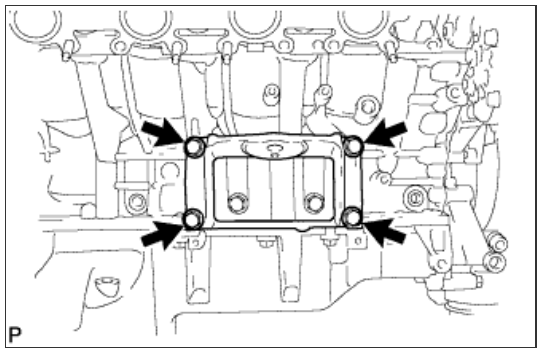
Text in Illustration

*A	RH
*B	LH



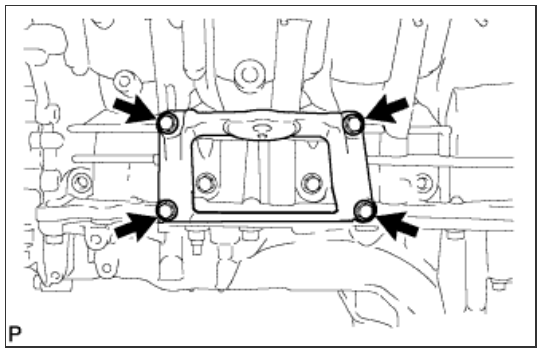
24. REMOVE FRONT NO. 1 ENGINE MOUNTING BRACKET RH

a. Remove the 4 bolts and mounting bracket.



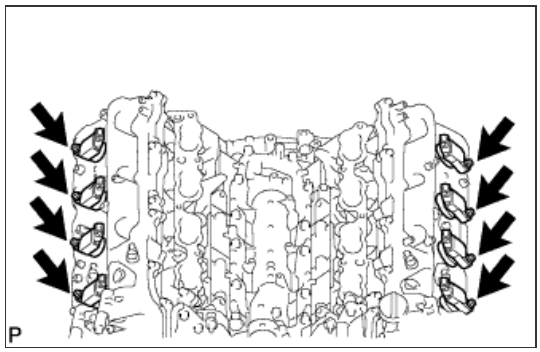
25. REMOVE FRONT NO. 1 ENGINE MOUNTING BRACKET LH

a. Remove the 4 bolts and mounting bracket.



26. REMOVE IGNITION COIL ASSEMBLY

a. Remove the 8 bolts and 8 ignition coils.



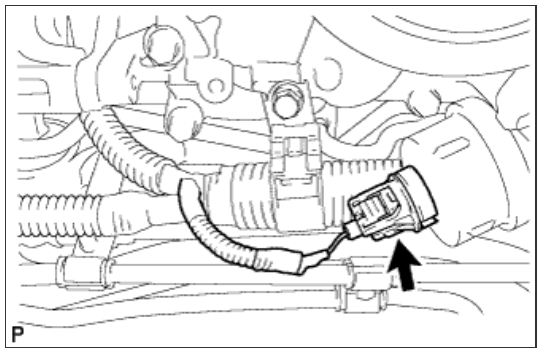
27. REMOVE NOISE FILTER

a. Remove the 2 bolts and 2 noise filters from the cylinder head cover.

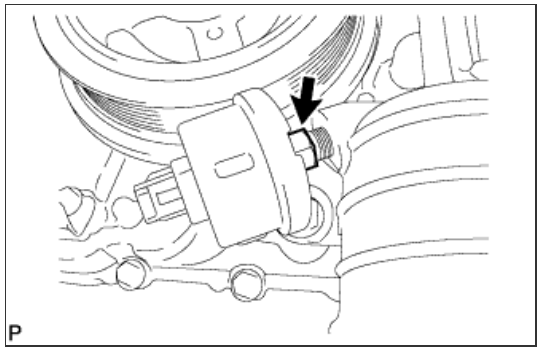
for Preparation Click here

1. REMOVE OIL PRESSURE SENDER GAUGE ASSEMBLY

a. Disconnect the sender gauge connector.



b. Remove the oil pressure sender gauge.

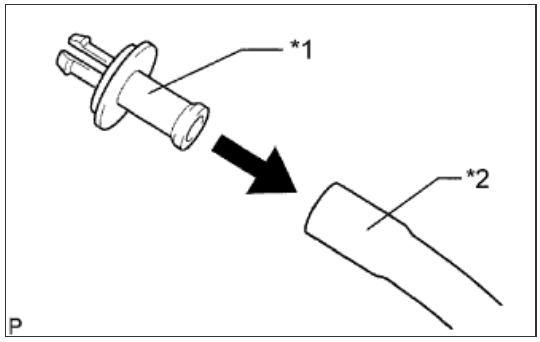


2. REMOVE OIL FILTER ELEMENT

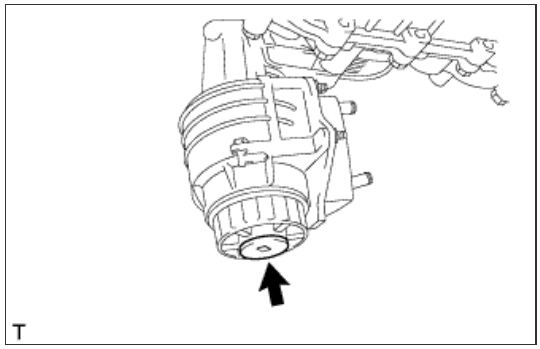
a. Connect a hose with an inside diameter of 15 mm (0.591 in.) to the pipe.

Text in Illustration

*1	Pipe
*2	Hose



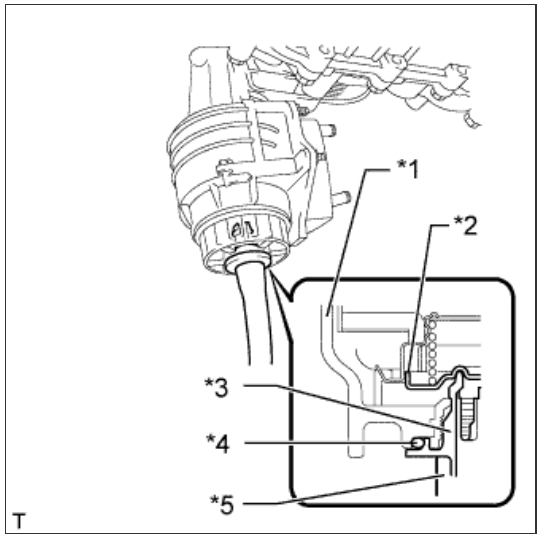
b. Remove the oil filter drain plug.



c. Install the pipe to the oil filter cap.

Text in Illustration

*1	Cap
*2	Valve
*3	Pipe
*4	O-Ring
*5	Hose



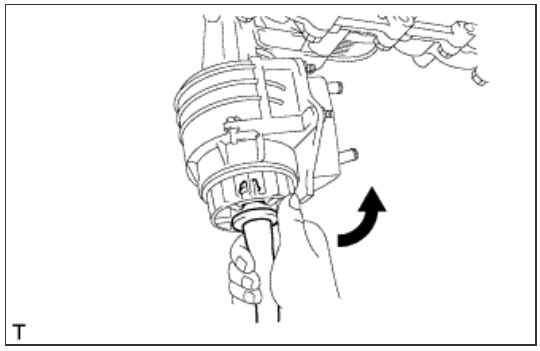
NOTICE:

If the O-ring is removed with the drain plug, install the O-ring together with the pipe.

HINT:

Use a container to catch the draining oil.

d. Check that oil is drained from the oil filter. Then disconnect the pipe and remove the O-ring as shown in the illustration.

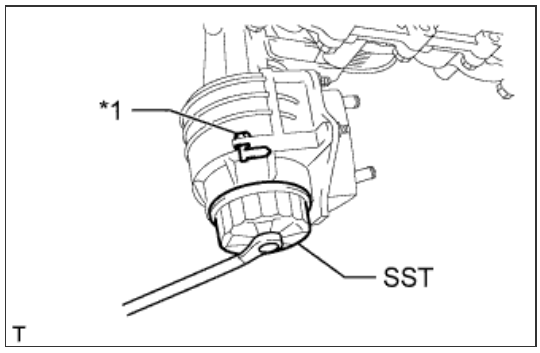


e. Using SST, remove the oil filter cap.

SST
09228-06501

Text in Illustration

*1	Oil Filter Bracket Clip



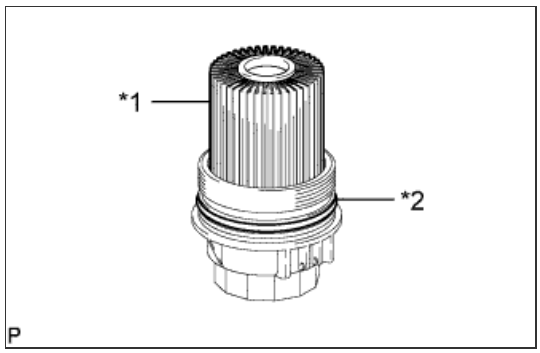
NOTICE:

Do not remove the oil filter bracket clip.

f. Remove the oil filter element and O-ring from the oil filter cap.

Text in Illustration

*1	Oil Filter Element
*2	O-Ring



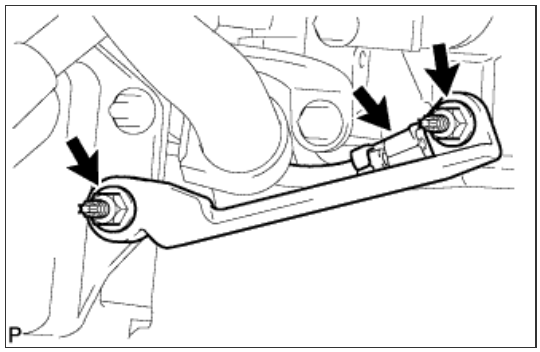
NOTICE:

Be sure to remove the cap O-ring by hand, without using any tools, to prevent damage to the cap O-ring groove.

3. REMOVE NO. 1 OIL COOLER BRACKET

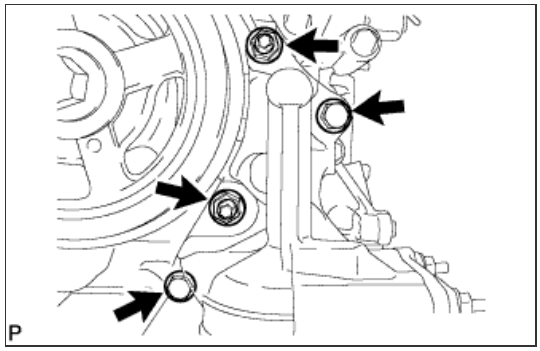
a. Remove the 2 nuts and bracket.

b. Disconnect the ground wire from the cylinder block.

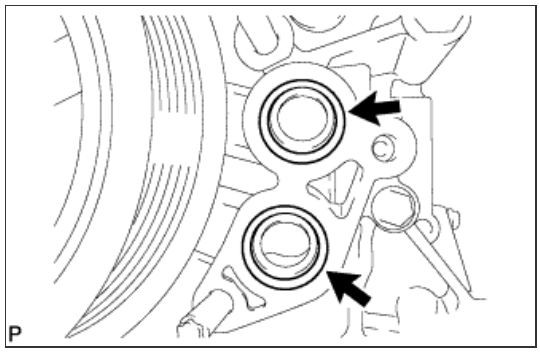


4. REMOVE OIL FILTER BRACKET

a. Remove the 2 bolts, 2 nuts and filter bracket.



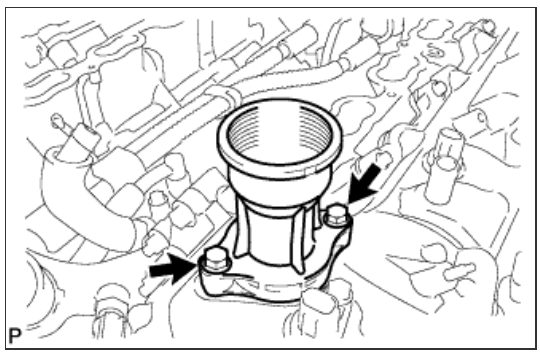
b. Remove the 2 O-rings.



5. REMOVE OIL FILLER CAP SUB-ASSEMBLY

6. REMOVE OIL FILLER CAP HOUSING

a. Remove the 2 bolts, filler cap housing and gasket.

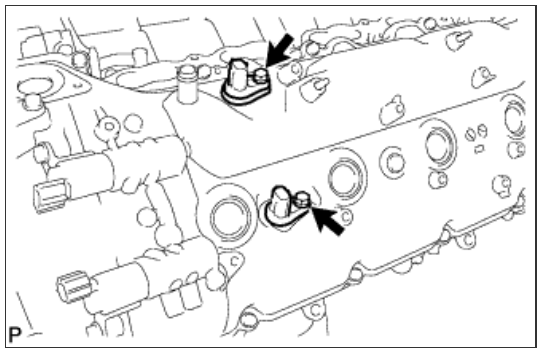


7. REMOVE SPARK PLUG

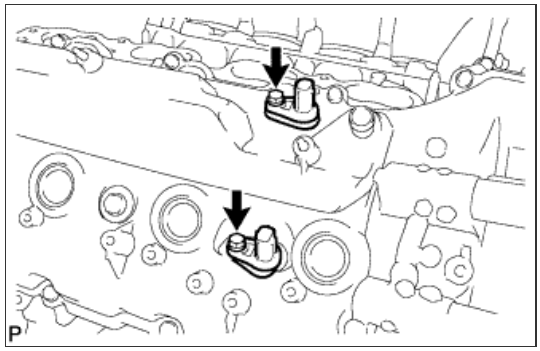
a. Using a 16 mm plug wrench, remove the 8 spark plugs.

8. REMOVE VVT SENSOR

a. LH:
Remove the 2 bolts and 2 VVT sensors.

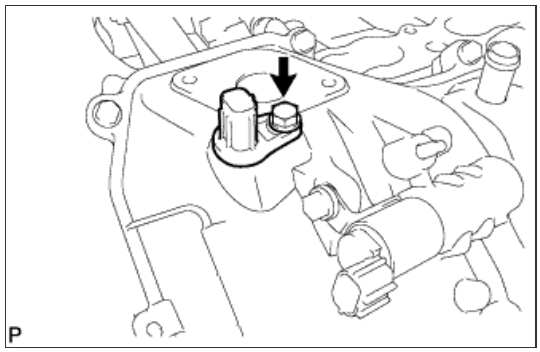


b. RH:
Remove the 2 bolts and 2 VVT sensors.



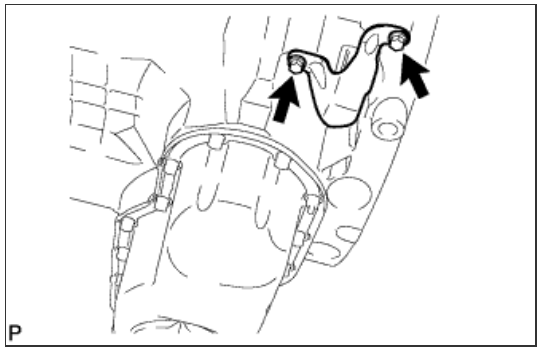
9. REMOVE CAMSHAFT POSITION SENSOR

a. Remove the bolt and camshaft position sensor.



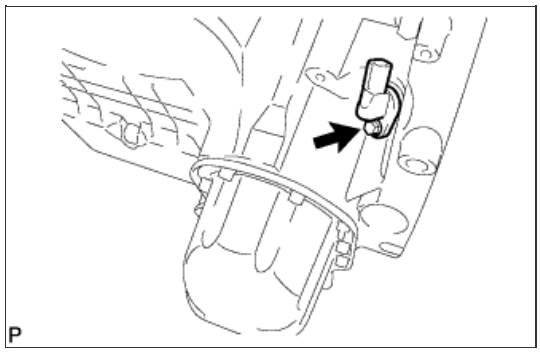
10. REMOVE CRANK POSITION SENSOR PROTECTOR

a. Remove the 2 bolts and sensor protector.



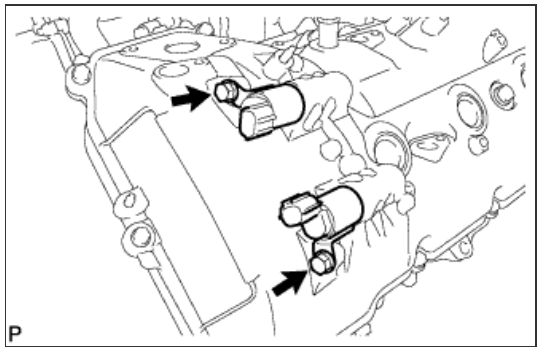
11. REMOVE CRANKSHAFT POSITION SENSOR

a. Remove the bolt and crankshaft position sensor.

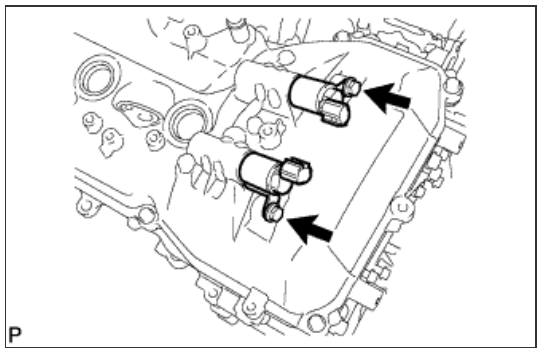


12. REMOVE CAMSHAFT OIL CONTROL VALVE ASSEMBLY

a. LH:
Remove the 2 bolts and 2 oil control valves.



b. RH:
Remove the 2 bolts and 2 oil control valves.

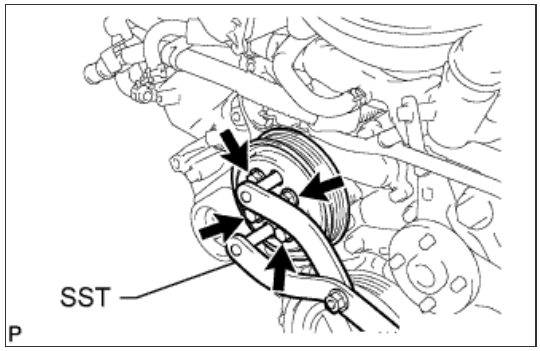


13. REMOVE WATER PUMP PULLEY

a. Using SST, hold the water pump pulley.

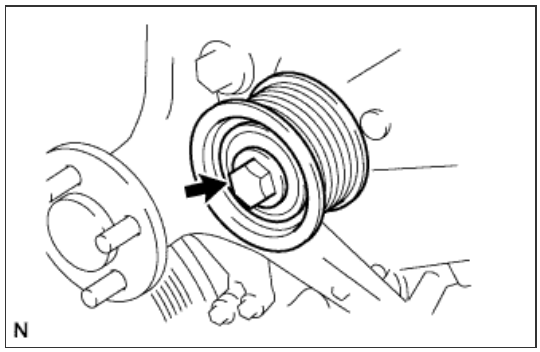
SST
09960-10010 (09962-01000, 09963-01000)

b. Remove the 4 bolts and water pump pulley.



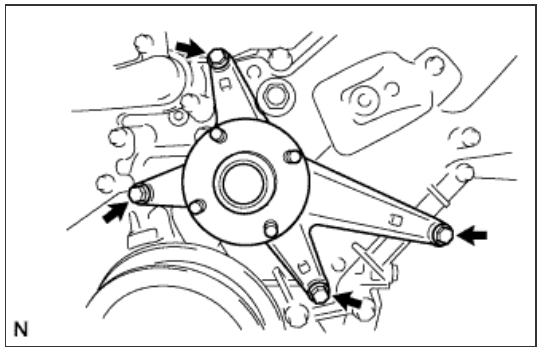
14. REMOVE NO. 1 IDLER PULLEY SUB-ASSEMBLY

a. Remove the bolt and idler pulley.



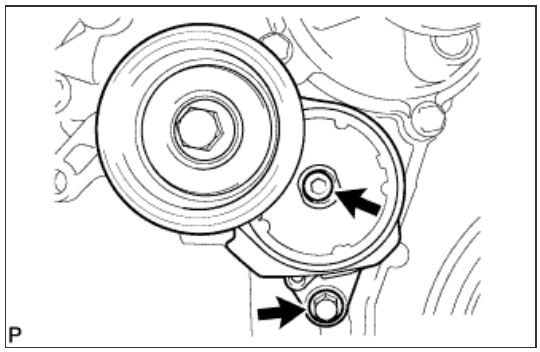
15. REMOVE FLUID COUPLING BRACKET

a. Remove the 4 bolts and fluid coupling bracket.



16. REMOVE V-RIBBED BELT TENSIONER ASSEMBLY

a. Remove the standard bolt, 6 mm hexagon wrench bolt and belt tensioner.

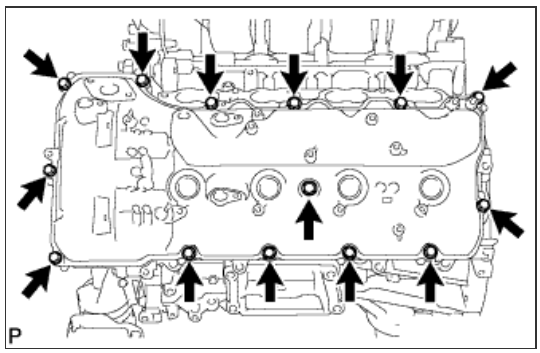


17. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY LH

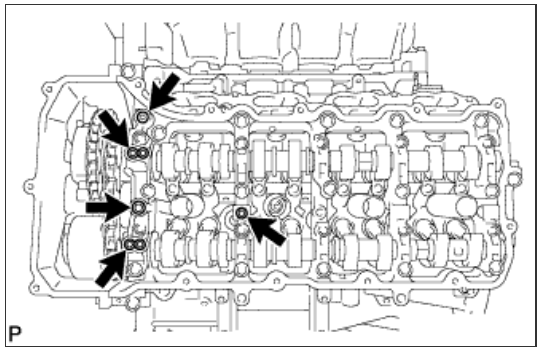
a. Remove the 14 bolts, seal washer, cylinder head cover and gasket.

HINT:

Make sure the removed parts are returned to the same places they were removed from.

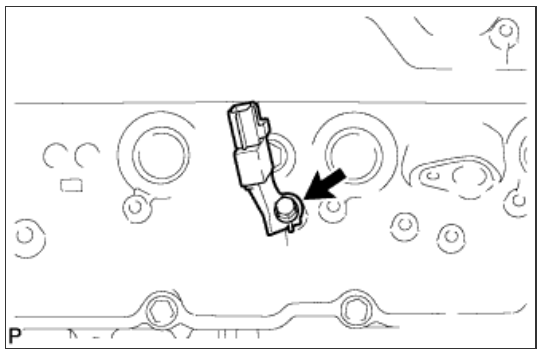


b. Remove the 5 gaskets from the camshaft bearing caps (No. 2, No. 3).



18. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY RH

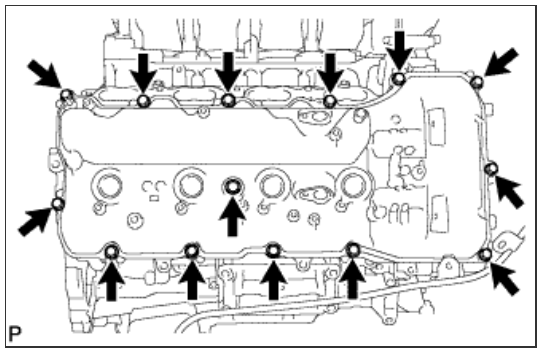
a. Remove the bolt and noise filter.



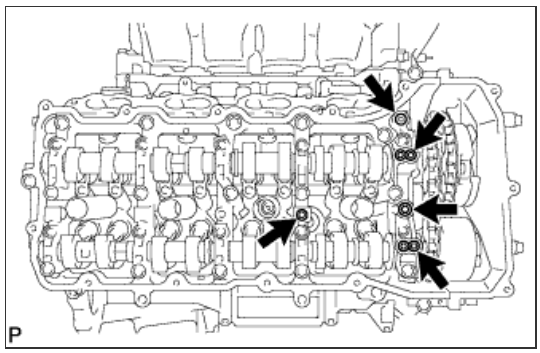
b. Remove the 14 bolts, seal washer, cylinder head cover and gasket.

HINT:

Make sure the removed parts are returned to the same places they were removed from.



c. Remove the 5 gaskets from the camshaft bearing caps (No. 1, No. 3).



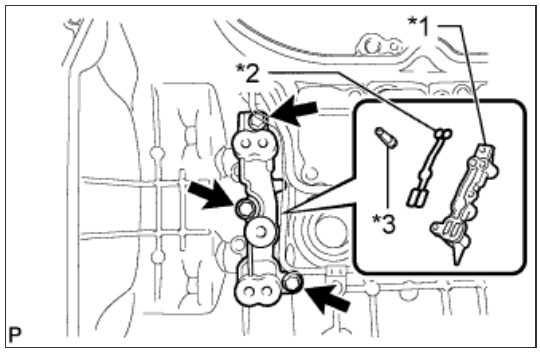
19. REMOVE OIL CONTROL VALVE FILTER

a. LH:
Remove the 3 bolts, cylinder head cover spacer, gasket and filter.

Text in Illustration

*1	Cylinder Head Cover Spacer
*2	Gasket

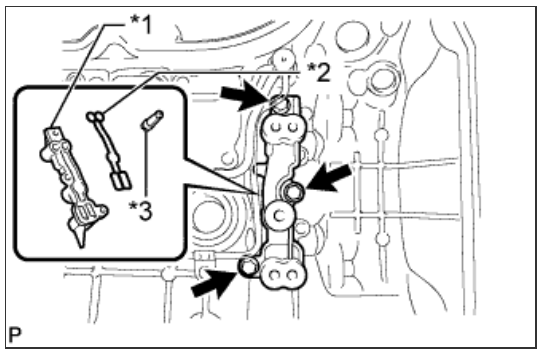
*3	Filter



b. RH:
Remove the 3 bolts, cylinder head cover spacer, gasket and filter.

Text in Illustration

*1	Cylinder Head Cover Spacer
*2	Gasket
*3	Filter



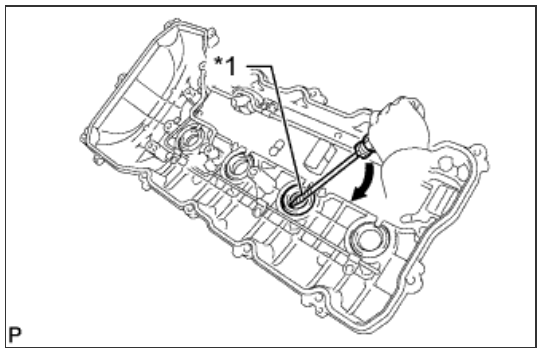
20. REMOVE SPARK PLUG TUBE GASKET

a. Bend the 4 ventilation baffle plate claws on the cylinder head cover to an angle of 90° or more.

b. Using a screwdriver, pry out the gaskets.

Text in Illustration

*1	Tape
➡	Pry



NOTICE:

- **Be careful not to damage the cylinder head cover.**
- **Be careful not to damage the gasket when removing it, as the removed gasket needs to be used when installing a new one.**

HINT:

Tape the screwdriver tip before use.

21. REMOVE CRANKSHAFT PULLEY

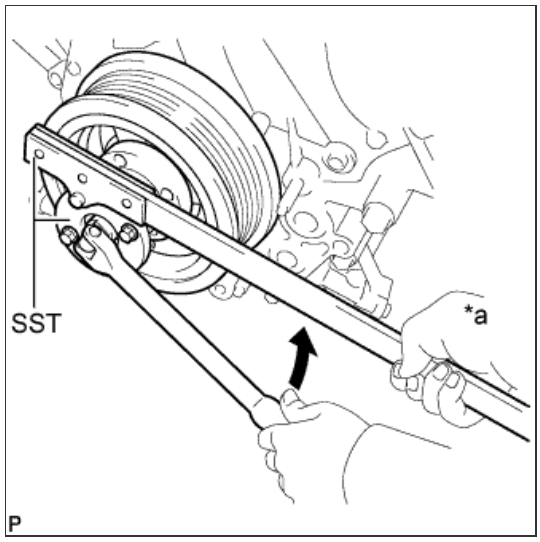
a. Using SST, loosen the crankshaft pulley set bolt until 2 or 3 threads are engaged.

SST

09213-70011
09330-00021

Text in Illustration

*a	Hold
➡	Turn



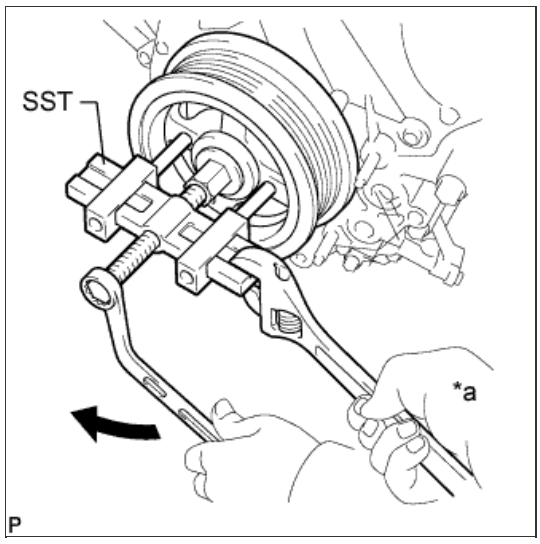
b. Using the pulley set bolt and SST, remove the crankshaft pulley.

SST

09950-50013 (09951-05010, 09952-05010, 09953-05010, 09954-05011)

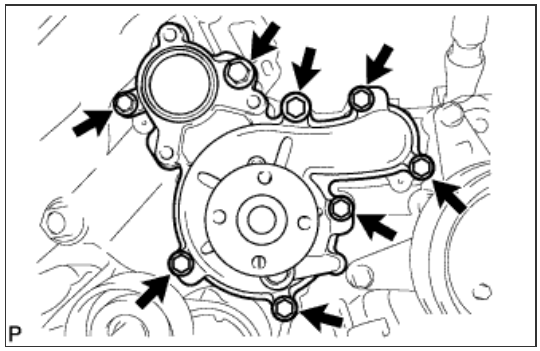
Text in Illustration

*a	Hold
➡	Turn



22. REMOVE WATER PUMP ASSEMBLY

a. Remove the 8 bolts, water pump and gasket.



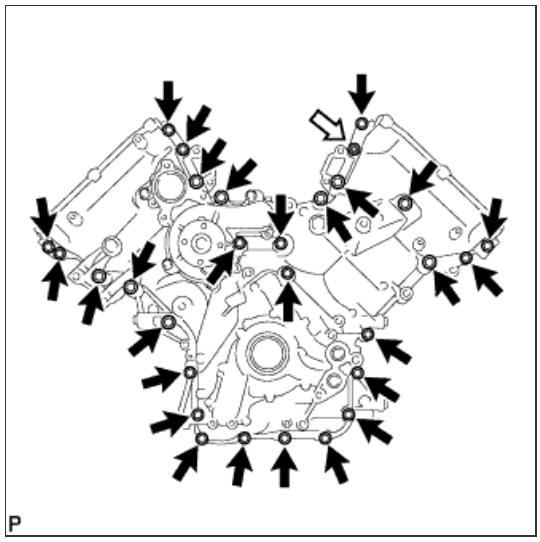
23. REMOVE TIMING CHAIN COVER SUB-ASSEMBLY

a. Remove the 28 bolts and nut shown in the illustration.

Text in Illustration

➡	Bolt

⇨	Nut



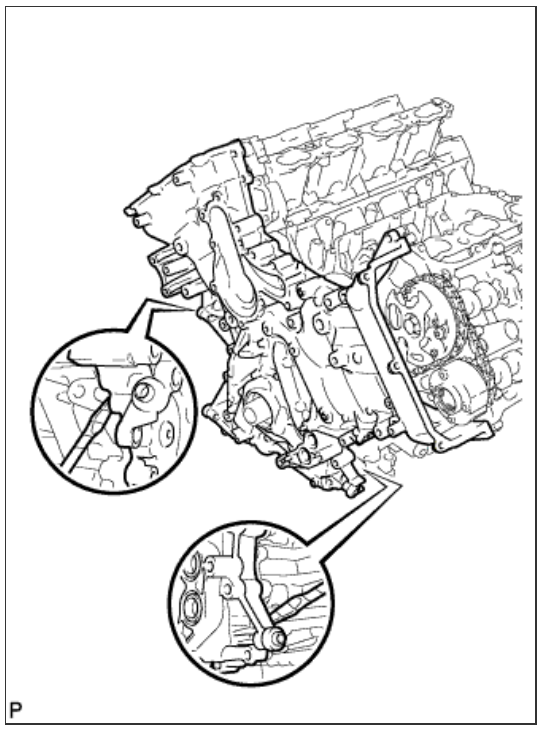
b. Remove the timing chain cover by prying between the timing chain cover and cylinder head or cylinder block with a screwdriver as shown in the illustration.

NOTICE:

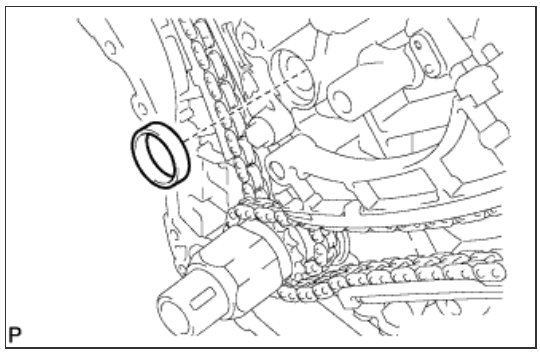
Be careful not to damage the contact surfaces of the cylinder head, cylinder block and chain cover.

HINT:

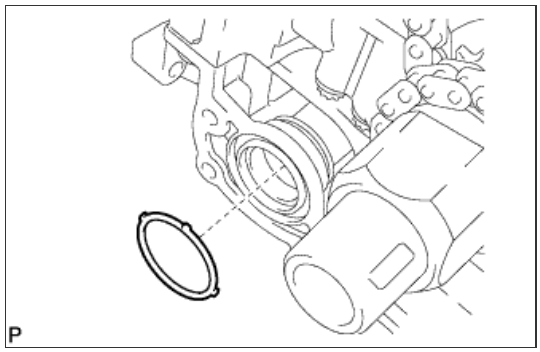
Tape the screwdriver tip before use.



c. Remove the oil pump gasket from the cylinder block.



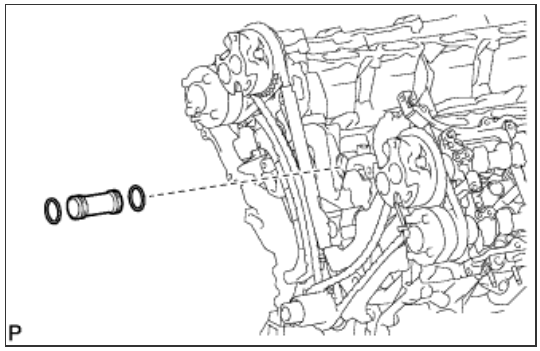
d. Remove the O-ring from the oil pan.



24. REMOVE WATER INLET PIPE

a. Remove the water inlet pipe.

b. Remove the 2 O-rings from the water inlet pipe.



25. REMOVE FRONT CRANKSHAFT OIL SEAL

a. Place the timing chain cover on wooden blocks.

b. Using a screwdriver and wooden block, pry out the oil seal.

Text in Illustration

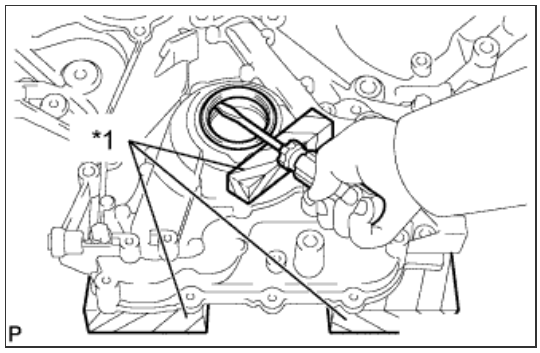
*1	Wooden Block

NOTICE:

Do not damage the surface of the oil seal press fit hole.

HINT:

Tape the screwdriver tip before use.



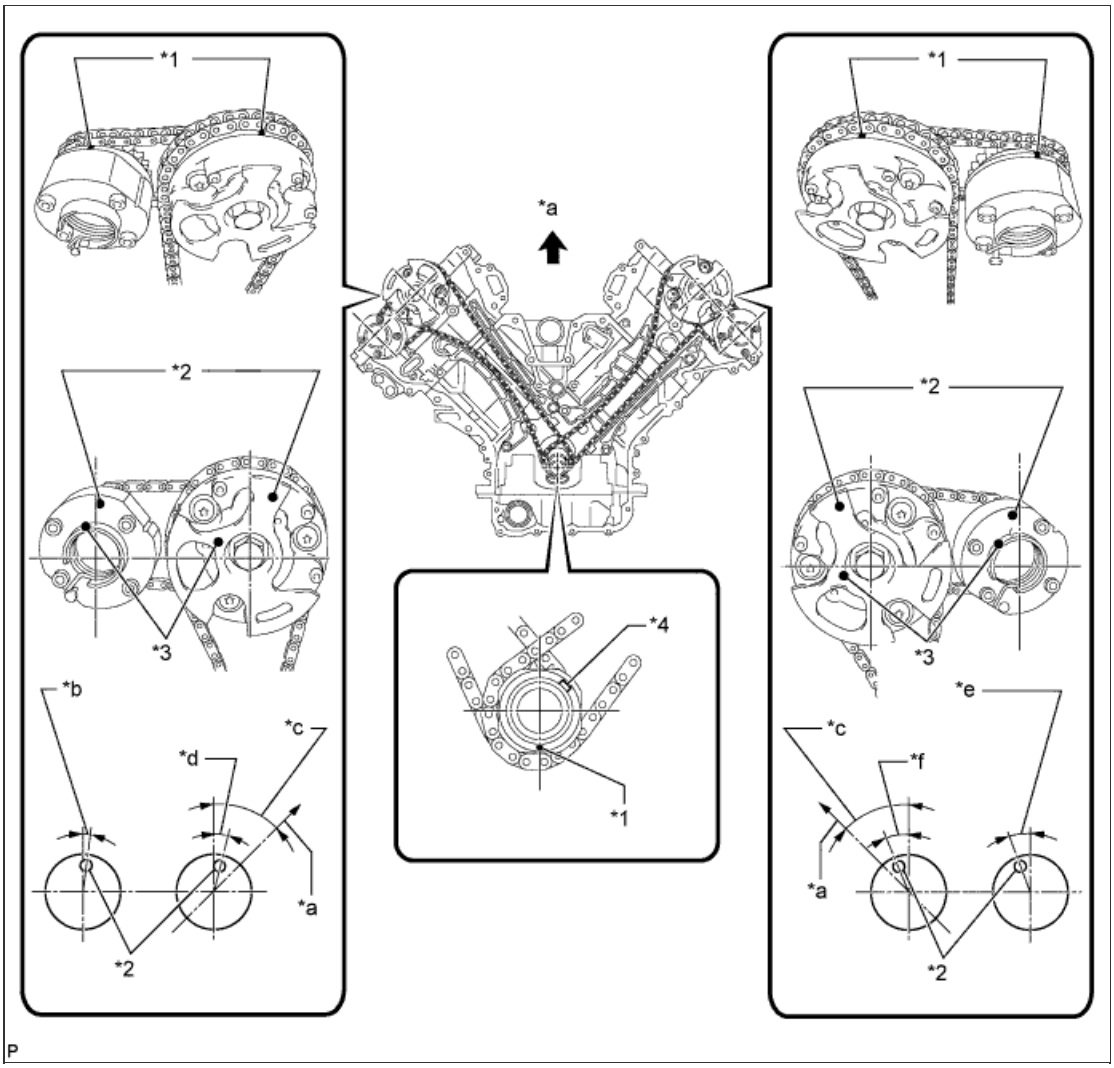
26. SET NO. 1 CYLINDER TO TDC/COMPRESSION

a. Temporarily install the crankshaft pulley bolt.

b. Rotate the crankshaft clockwise so that the timing marks on the crankshaft timing sprocket and camshaft timing gears are as shown in the illustration.

HINT:

If the timing marks do not align, rotate the crankshaft clockwise again and align the timing marks.



Text in Illustration

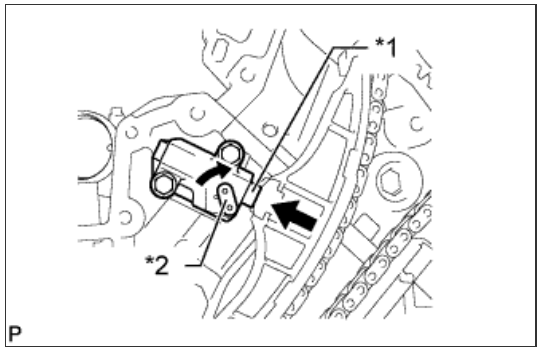
*1	Timing Mark	*2	Timing Mark Position
*3	Knock Pin Position	*4	Key
*a	Toward Ceiling	*b	Approximately 2°
*c	Approximately 45°	*d	Approximately 16°
*e	Approximately 18°	*f	Approximately 32°

27. REMOVE NO. 1 CHAIN TENSIONER ASSEMBLY LH

a. Move the stopper plate clockwise to release the lock, and push the plunger deep into the tensioner.

Text in Illustration

*1	Plunger
*2	Stopper Plate

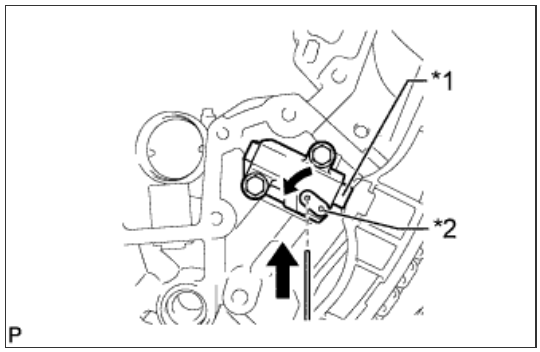


b. Move the stopper plate counterclockwise to set the lock, and insert a hexagon wrench into the stopper plate hole.

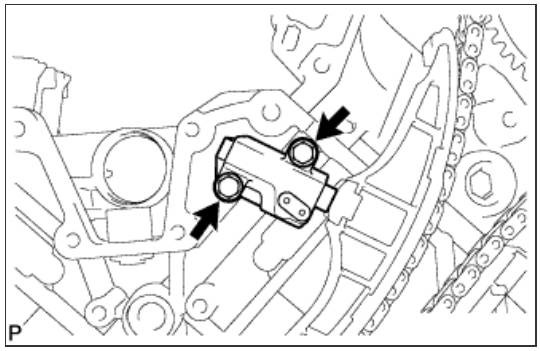
Text in Illustration

*1	Plunger

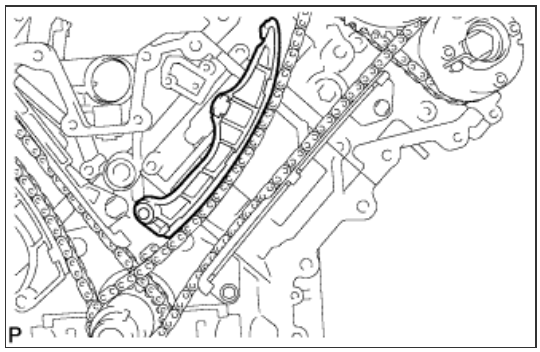
*2	Stopper Plate



c. Remove the 2 bolts, chain tensioner and gasket.

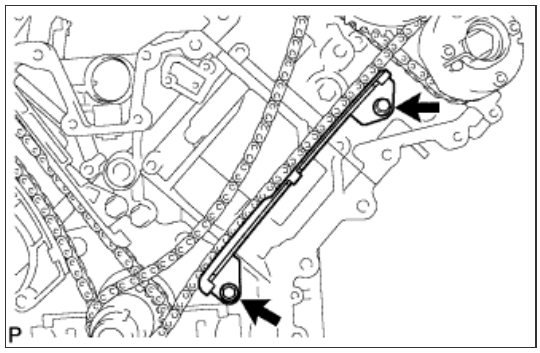


28. REMOVE NO. 1 CHAIN TENSIONER SLIPPER LH



29. REMOVE NO. 1 CHAIN VIBRATION DAMPER LH

a. Remove the 2 bolts and chain vibration damper.

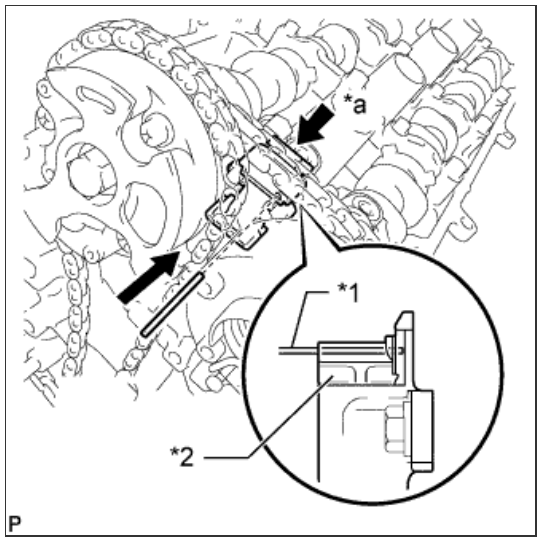


30. REMOVE NO. 1 CHAIN SUB-ASSEMBLY LH

a. While pushing down the No. 3 chain tensioner, insert a pin of 1.0 mm (0.0394 in.) into the hole to fix it in place.

Text in Illustration

*1	Pin
*2	Plunger
*a	Push



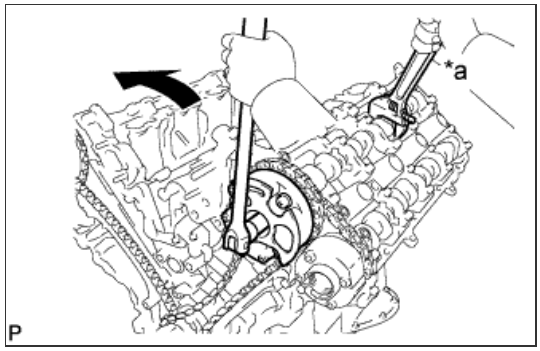
b. Hold the hexagonal portion of the camshaft with a wrench and loosen the bolt.

Text in Illustration

*a	Hold
➡	Turn

NOTICE:

- **Be careful not to damage the cylinder head with the wrench.**
- **Do not disassemble the camshaft timing gear.**



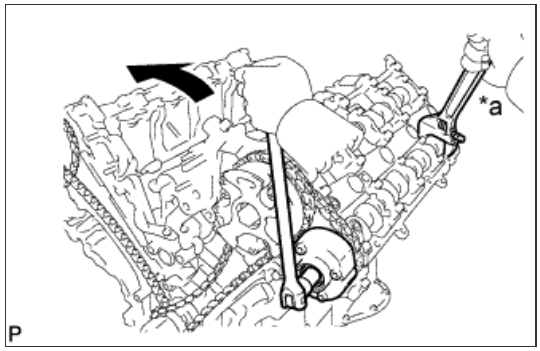
c. Hold the hexagonal portion of the camshaft with a wrench and loosen the bolt.

Text in Illustration

*a	Hold
➡	Turn

NOTICE:

Be careful not to damage the cylinder head with the wrench.

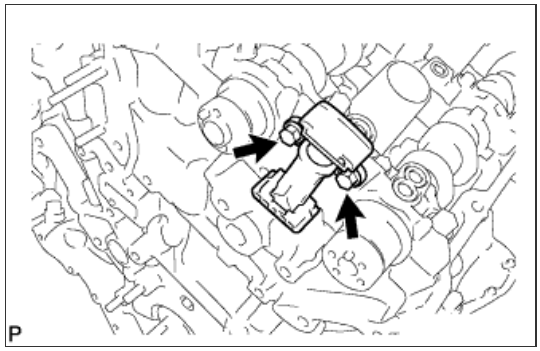


d. Remove the 2 bolts. Then with the No. 1 and No. 2 chains still connected to the gears, remove the camshaft timing gear, camshaft timing exhaust gear and crankshaft timing sprocket LH.

e. Remove the No. 1 and No. 2 chains from the gears.

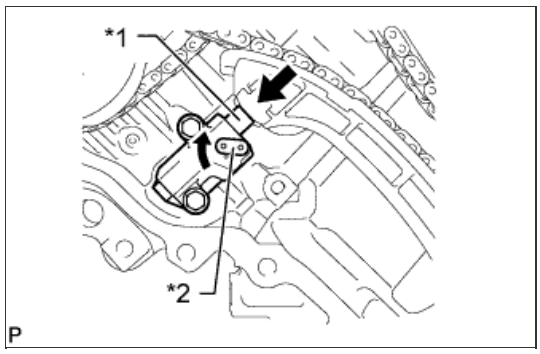
31. REMOVE NO. 3 CHAIN TENSIONER ASSEMBLY

a. Remove the 2 bolts and chain tensioner.



32. REMOVE NO. 1 CHAIN TENSIONER ASSEMBLY RH

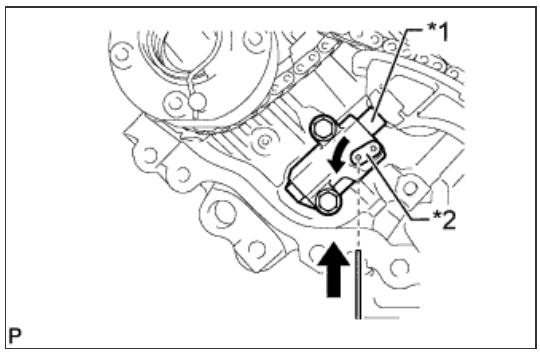
a. Move the stopper plate clockwise to release the lock, and push the plunger deep into the tensioner.



Text in Illustration

*1	Plunger
*2	Stopper Plate

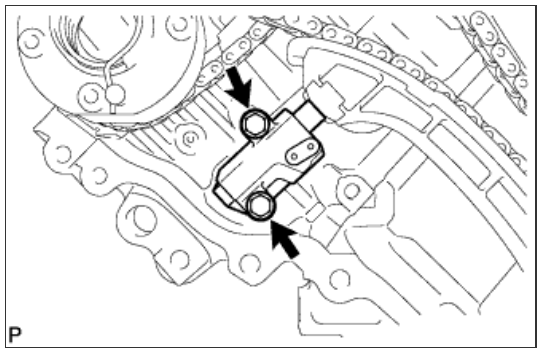
b. Move the stopper plate counterclockwise to set the lock, and insert a hexagon wrench into the stopper plate hole.



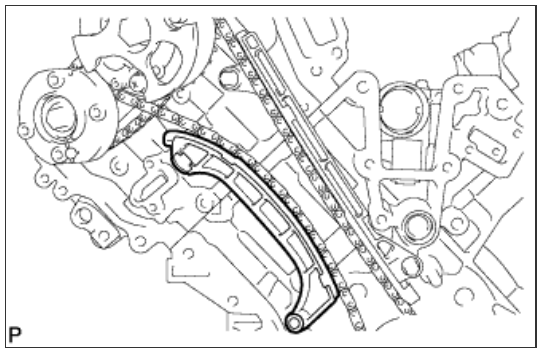
Text in Illustration

*1	Plunger
*2	Stopper Plate

c. Remove the 2 bolts and chain tensioner.

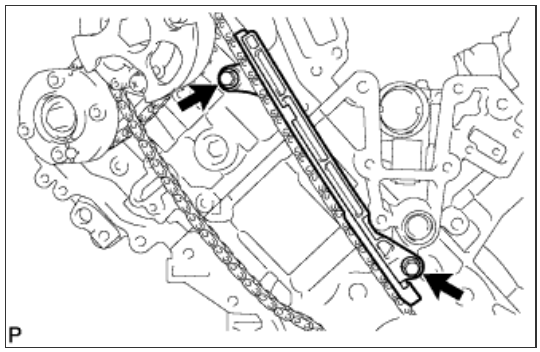


33. REMOVE NO. 1 CHAIN TENSIONER SLIPPER RH



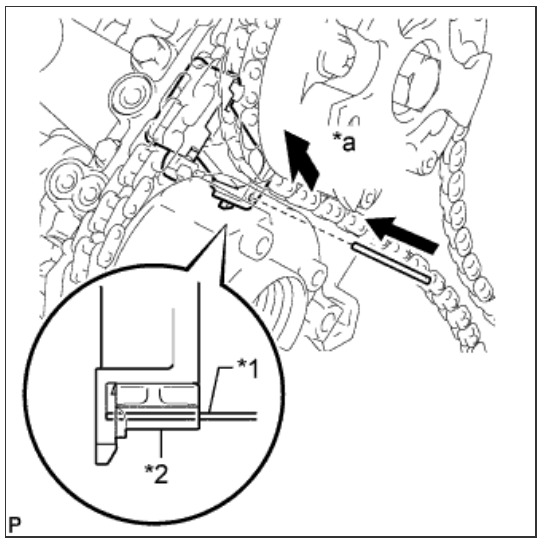
34. REMOVE NO. 1 CHAIN VIBRATION DAMPER RH

a. Remove the 2 bolts and vibration damper.



35. REMOVE NO. 1 CHAIN SUB-ASSEMBLY RH

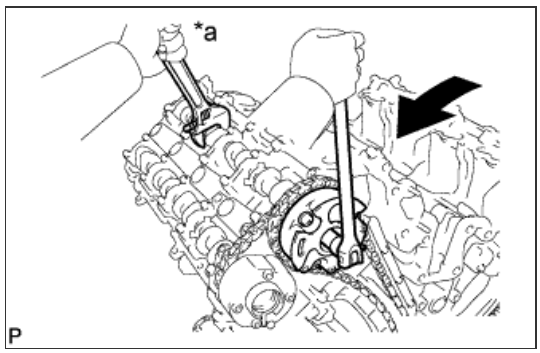
a. While raising up the No. 2 chain tensioner, insert a pin of 1.0 mm (0.0394 in.) into the hole to fix it in place.



Text in Illustration

*1	Pin
*2	Plunger
*a	Push

b. Hold the hexagonal portion of the camshaft with a wrench and loosen the bolt.



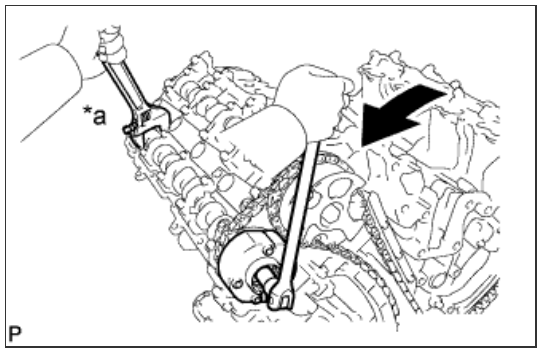
Text in Illustration

*a	Hold
➡	Turn

NOTICE:

- **Be careful not to damage the cylinder head with the wrench.**
- **Do not disassemble the camshaft timing gear.**

c. Hold the hexagonal portion of the camshaft with a wrench and loosen the bolt.



Text in Illustration

*a	Hold
➡	Turn

NOTICE:

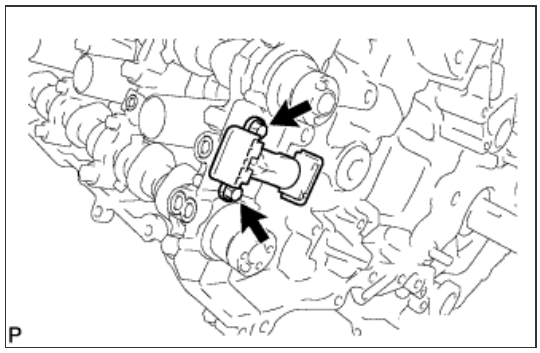
Be careful not to damage the cylinder head with the wrench.

d. Remove the 2 bolts. Then with the No. 1 and No. 2 chains still connected to the gears, remove the camshaft timing gear, camshaft timing exhaust gear and crankshaft timing sprocket RH.

e. Remove the No. 1 and No. 2 chains from the gears.

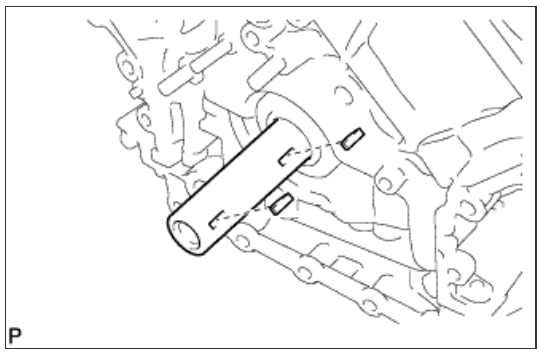
36. REMOVE NO. 2 CHAIN TENSIONER ASSEMBLY

a. Remove the 2 bolts and chain tensioner.



37. REMOVE CRANKSHAFT TIMING GEAR KEY

a. Using a screwdriver, remove the 2 timing gear keys from the crankshaft.

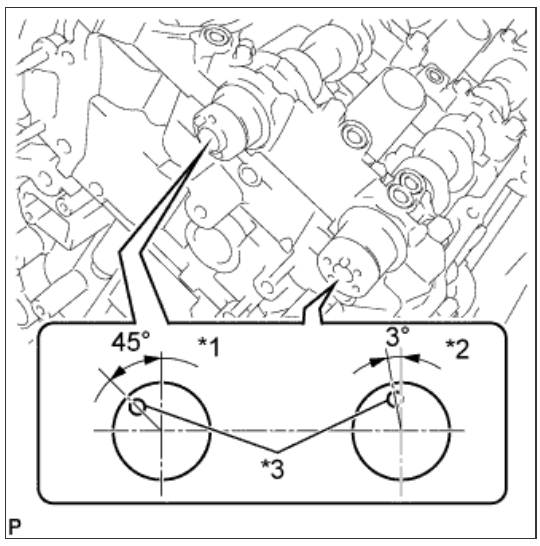


38. REMOVE CAMSHAFT BEARING CAP LH

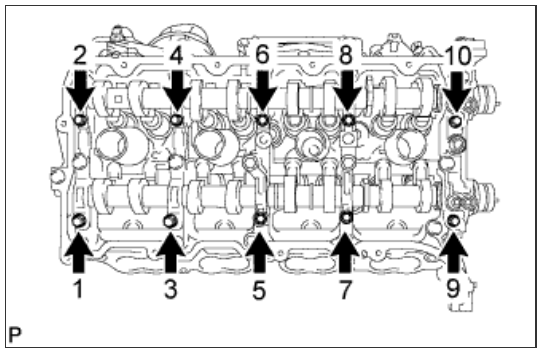
a. Make sure that the knock pin of the camshaft is positioned as shown in the illustration.

Text in Illustration

*1	IN
*2	EX
*3	Knock Pin



b. Uniformly loosen and remove the 10 bearing cap bolts in the sequence shown in the illustration.



c. Uniformly loosen and remove the 18 bearing cap bolts in the sequence shown in the illustration.

NOTICE:

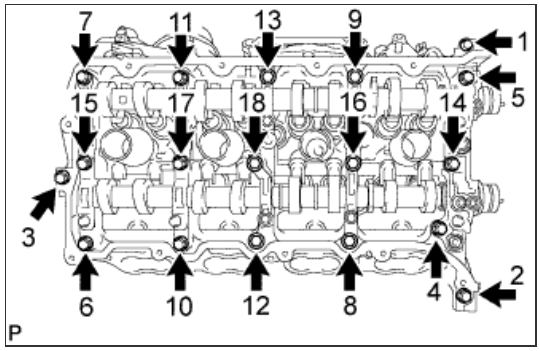
Uniformly loosen the bolts while keeping the camshaft level.

d. Remove the 6 bearing caps.

HINT:

Arrange the removed parts in the correct order.

e. Remove the No. 3 and No. 4 camshafts.



39. REMOVE CAMSHAFT HOUSING SUB-ASSEMBLY LH

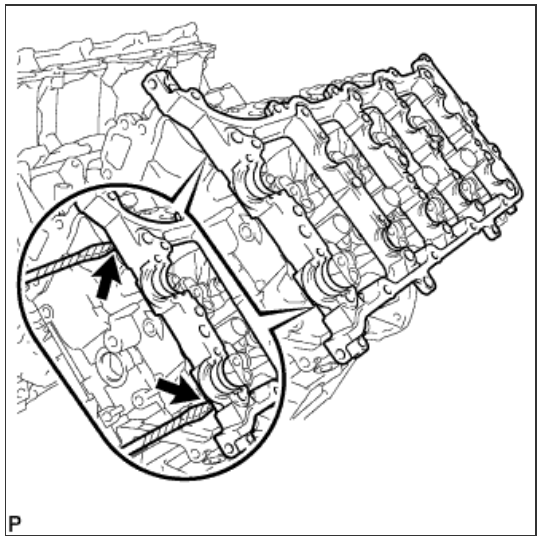
a. Remove the camshaft housing by prying between the cylinder head and camshaft housing with a screwdriver.

NOTICE:

Be careful not to damage the contact surfaces of the cylinder head and camshaft housing.

HINT:

Tape the screwdriver tip before use.

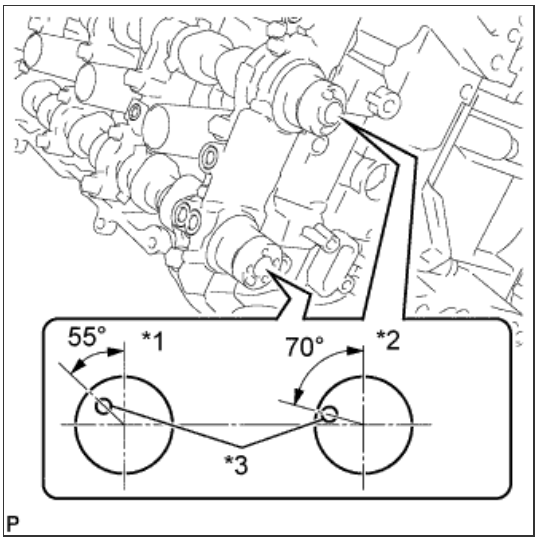


40. REMOVE CAMSHAFT BEARING CAP RH

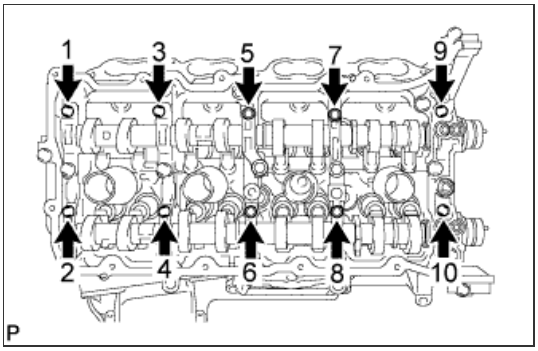
a. Make sure that the knock pin of the camshaft is positioned as shown in the illustration.

Text in Illustration

*1	EX
*2	IN
*3	Knock Pin



b. Uniformly loosen and remove the 10 bearing cap bolts in the sequence shown in the illustration.



c. Uniformly loosen and remove the 18 bearing cap bolts in the sequence shown in the illustration.

NOTICE:

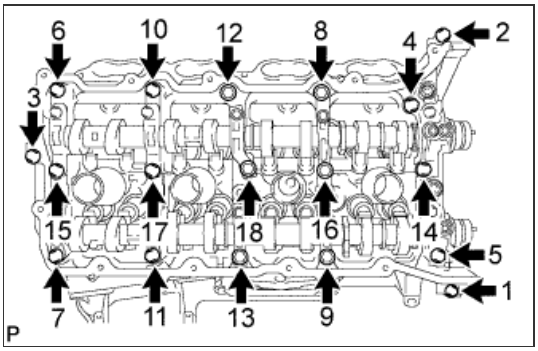
Uniformly loosen the bolts while keeping the camshaft level.

d. Remove the 6 bearing caps.

HINT:

Arrange the removed parts in the correct order.

e. Remove the No. 1 and No. 2 camshafts.



41. REMOVE CAMSHAFT HOUSING SUB-ASSEMBLY RH

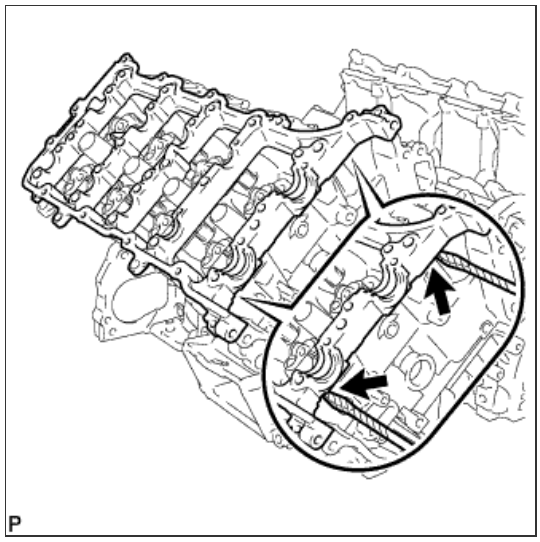
a. Remove the camshaft housing by prying between the cylinder head and camshaft housing with a screwdriver.

NOTICE:

Be careful not to damage the contact surfaces of the cylinder head and camshaft housing.

HINT:

Tape the screwdriver tip before use.



42. REMOVE NO. 1 VALVE ROCKER ARM SUB-ASSEMBLY

a. Remove the 32 valve rocker arms from the cylinder heads.

HINT:

Arrange the removed parts in the correct order.

43. REMOVE VALVE LASH ADJUSTER ASSEMBLY

a. Remove the 32 valve lash adjusters from the cylinder heads.

HINT:

Arrange the removed parts in the correct order.

44. REMOVE VALVE STEM CAP

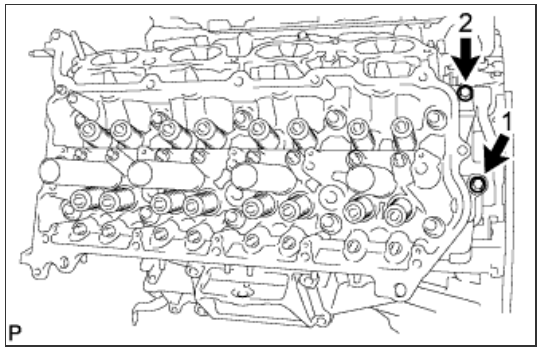
a. Remove the 32 valve stem caps from the cylinder heads.

HINT:

Arrange the removed parts in the correct order.

45. REMOVE CYLINDER HEAD SUB-ASSEMBLY LH

a. Uniformly loosen and remove the 2 bolts in the sequence shown in the illustration.



b. Using a 10 mm bi-hexagon wrench, uniformly loosen the 10 cylinder head bolts in the sequence shown in the illustration. Remove the 10 cylinder head bolts and plate washers.

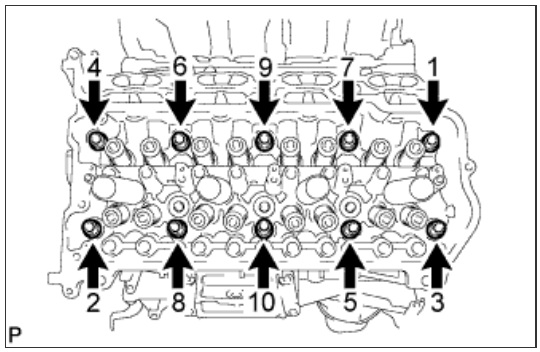
NOTICE:

- **Be careful not to drop washers into the cylinder head.**
- **Head warpage or cracking could result from removing bolts in an incorrect order.**

HINT:

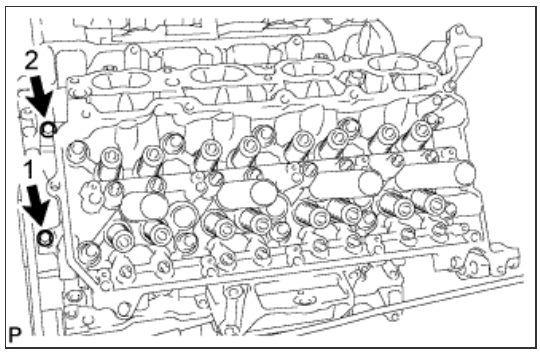
Be sure to arrange the removed parts for each installation position separately.

c. Remove the cylinder head and gasket.



46. REMOVE CYLINDER HEAD SUB-ASSEMBLY RH

a. Uniformly loosen and remove the 2 bolts in the sequence shown in the illustration.



b. Using a 10 mm bi-hexagon wrench, uniformly loosen the 10 cylinder head bolts in the sequence shown in the illustration. Remove the 10 cylinder head bolts and plate washers.

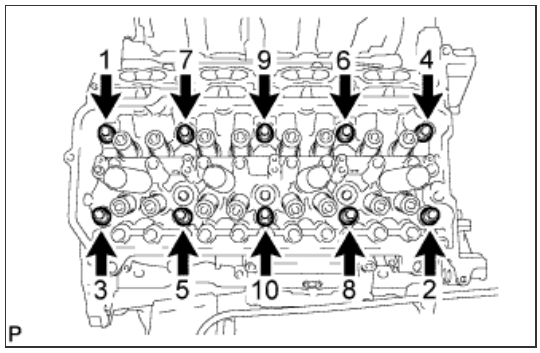
NOTICE:

- **Be careful not to drop washers into the cylinder head.**
- **Head warpage or cracking could result from removing bolts in an incorrect order.**

HINT:

Be sure to arrange the removed parts for each installation position separately.

c. Remove the cylinder head and gasket.

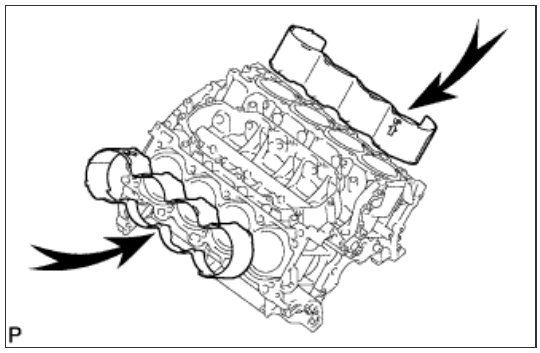


47. REMOVE CYLINDER BLOCK WATER JACKET SPACER

a. Remove the 2 water jacket spacers from the cylinder block.

NOTICE:

Be sure to remove the water jacket spacers. If not, they may fall and become damaged when the cylinder block is inverted.



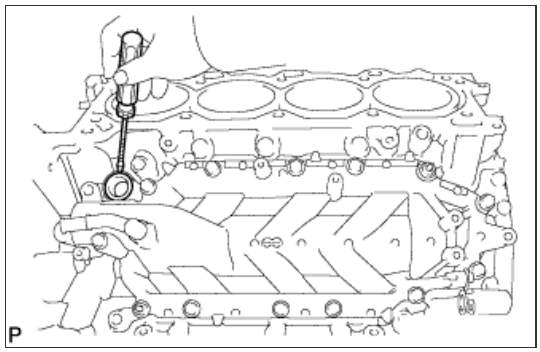
48. REMOVE VENTILATION PIPE GASKET

a. Using a screwdriver, pry out the ventilation pipe gasket.

a. Using a screwdriver, pry out the ventilation pipe gasket.

HINT:

Tape the screwdriver tip before use.

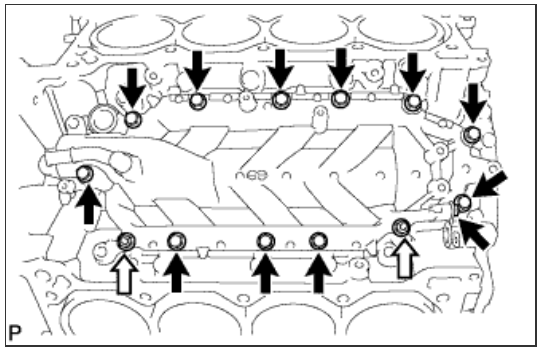


49. REMOVE NO. 1 HEAT EXCHANGER COVER

a. Remove the 12 bolts and 2 nuts.

Text in Illustration

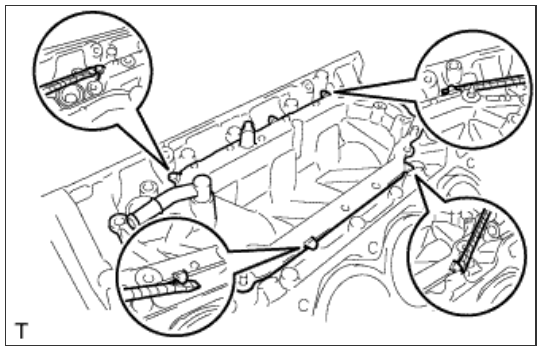
➡	Bolt
⇨	Nut



b. Remove the heat exchanger by prying between the heat exchanger and cylinder block with a screwdriver.

HINT:

Tape the screwdriver tip before use.

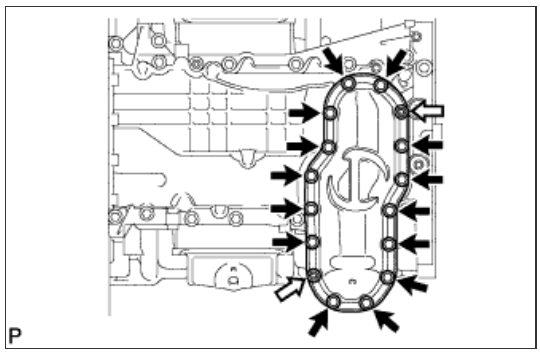


50. REMOVE NO. 2 OIL PAN SUB-ASSEMBLY

a. Remove the 14 bolts and 2 nuts.

Text in Illustration

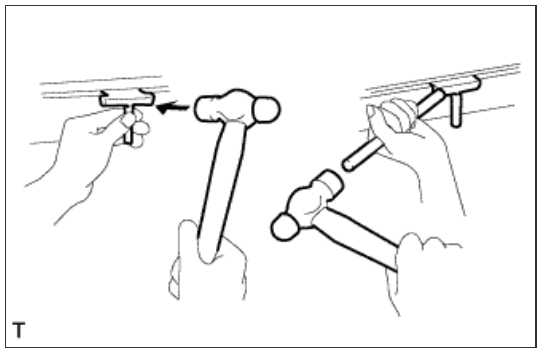
➡	Bolt
⇨	Nut



b. Insert the blade of an oil pan seal cutter between the oil pans. Cut through the applied sealer and remove the No. 2 oil pan.

NOTICE:

Be careful not to damage the contact surfaces of the oil pans.

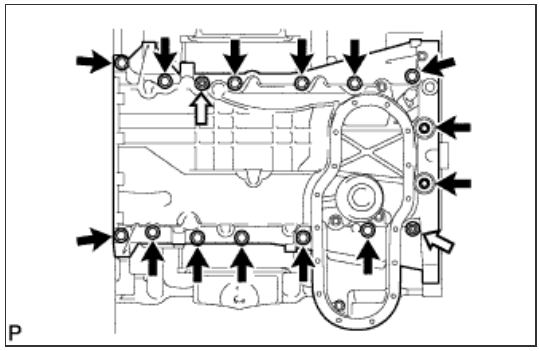


51. REMOVE NO. 1 OIL PAN SUB-ASSEMBLY

a. Remove the 14 bolts and 2 nuts.

Text in Illustration

➡	Bolt
⇨	Nut



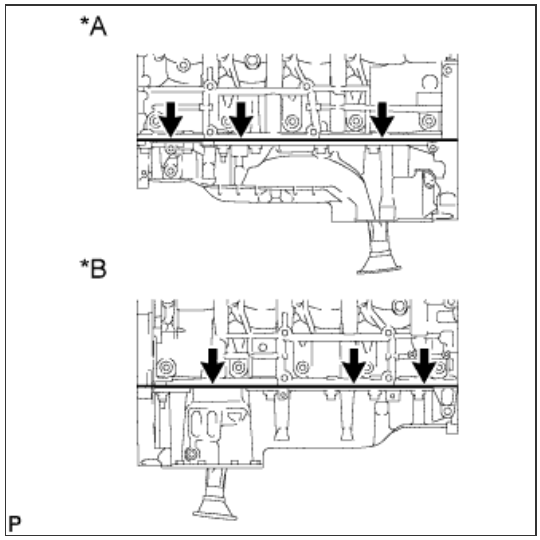
HINT:

Be sure to clean the bolts and stud bolts, and check the threads for cracks or other damage.

b. Remove the oil pan by prying between the oil pan and cylinder block with a screwdriver.

Text in Illustration

*A	LH Side
*B	RH Side



NOTICE:

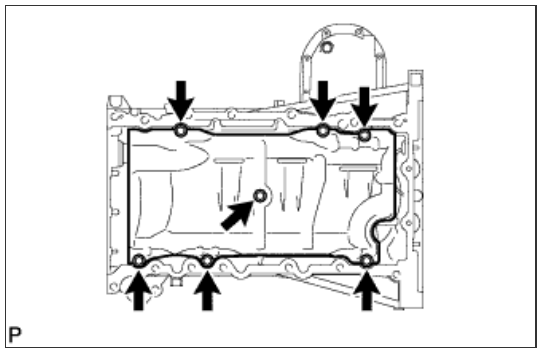
Be careful not to damage the contact surfaces of the cylinder block and oil pan.

HINT:

Tape the screwdriver tip before use.

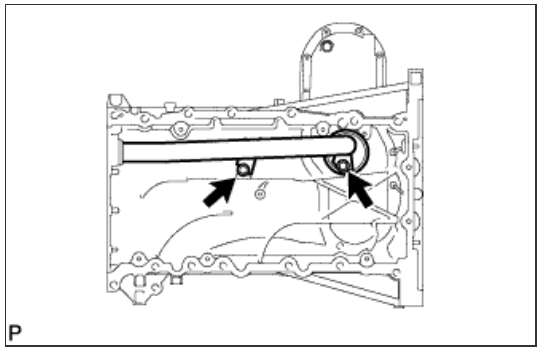
52. REMOVE NO. 1 OIL PAN BAFFLE PLATE

a. Remove the 7 bolts and baffle plate.



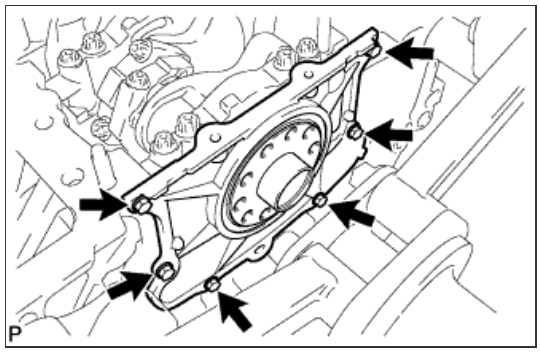
53. REMOVE OIL STRAINER SUB-ASSEMBLY

a. Remove the 2 bolts, oil strainer and O-ring.



54. REMOVE ENGINE REAR OIL SEAL RETAINER

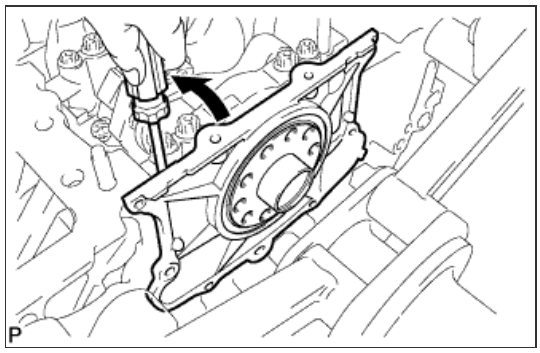
a. Remove the 6 bolts and oil seal retainer.



b. Using a screwdriver, pry out the oil seal retainer.

HINT:

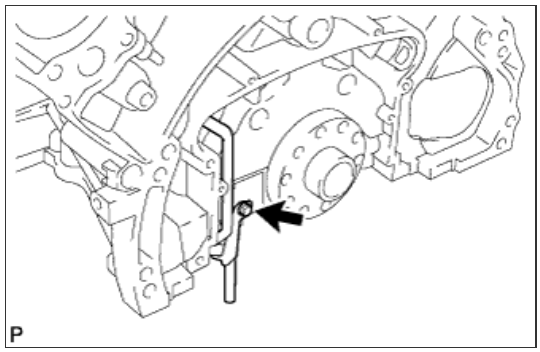
Tape the screwdriver tip before use.



55. REMOVE OIL DRAIN PIPE SUB-ASSEMBLY

a. Remove the bolt and oil drain pipe.

b. Remove the O-ring.



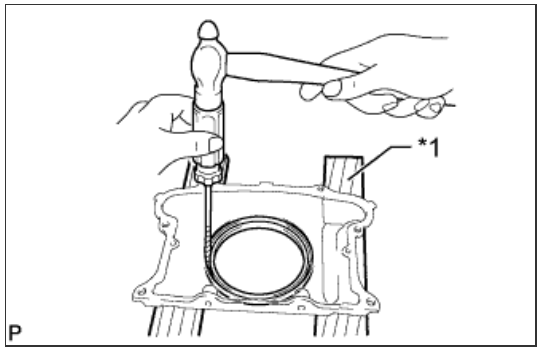
56. REMOVE REAR CRANKSHAFT OIL SEAL

a. Place the oil seal retainer on wooden blocks.

Text in Illustration

*1	Wooden Block

b. Using a screwdriver and hammer, tap out the oil seal.



57. REMOVE RING PIN

NOTICE:

It is not necessary to remove the ring pin unless it is being replaced.

58. REMOVE STUD BOLT

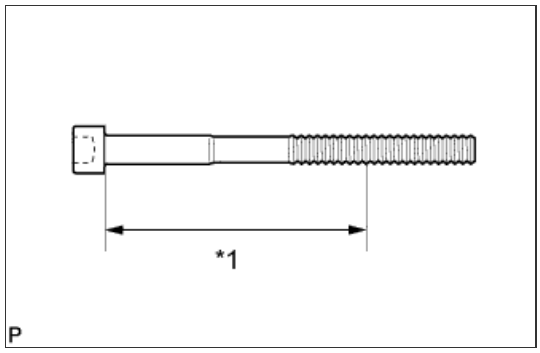
NOTICE:

If the stud bolt is deformed or its threads are damaged, replace it.

for Preparation Click here

1. INSPECT CYLINDER HEAD SET BOLT

a. Using a vernier caliper, measure the diameter of the elongated thread at the measuring point.



Measuring point:
94 mm (3.7 in.) for intake side bolt
89 mm (3.5 in.) for exhaust side bolt

Standard diameter:
1 .85 to 11. mm (.4 to .433 in.)

Minimum diameter:
1 . mm (.417 in.)

Text in Illustration

*1	Measuring Point

If the diameter is less than the minimum, replace the cylinder head bolt.

HINT:

If a visual check reveals no excessively thin areas, check the center of the bolt (see illustration) and find the area that has the smallest diameter.

. INSPECT NO. 1 VALVE ROCKER ARM SUB-ASSEMBLY

a. Turn the roller by hand to check that it turns smoothly.
If the roller does not turn smoothly, replace the valve rocker arm.

3. INSPECT VALVE LASH AD USTER ASSEMBLY

NOTICE:

- **Keep the adjuster free from dirt and foreign objects.**
- **Use only clean engine oil.**

a. Place the lash adjuster into a container full of new engine oil.

b. Insert the tip of SST into the lash adjuster plunger and use the tip to press down on the check ball inside the plunger.

SST
9 1

c. Squeeze SST and the lash adjuster together to move the plunger up and down 5 to 6 times.

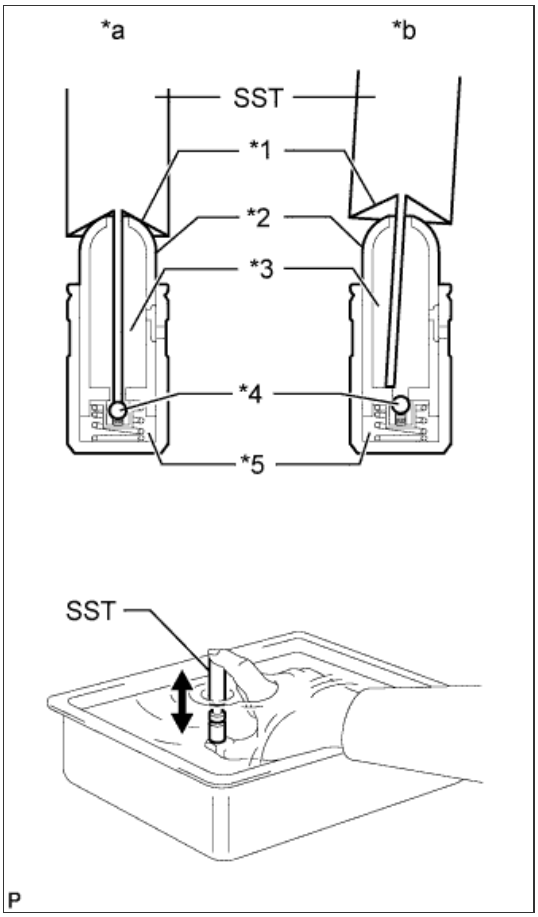
d. Check the movement of the plunger and bleed air.

OK:
Plunger moves up and down.

Text in Illustration

*1	Taper Part
*2	Plunger
*3	Low Pressure Chamber
*4	Check Ball
*5	High Pressure Chamber

*a	CORRECT
*b	INCORRECT



NOTICE:

When bleeding high-pressure air from the compression chamber, make sure that the tip of SST is actually pressing the check ball as shown in the illustration. If the check ball is not pressed, air will not bleed.

e. After bleeding the air, remove SST. Then try to quickly and firmly press the plunger with your fingers.

OK:
Plunger can be pressed 3 times.

If the plunger can still be compressed after pressing it 3 times, replace the valve lash adjuster with a new one.

4. INSPECT CAMSHA T SUB-ASSEMBLY

a. Inspect the camshaft for runout.

i. Place the camshaft on V-blocks.

ii. Using a dial indicator, measure the circle runout at the center journal.

Maximum circle runout:
. 4 mm (. 157 in.)

If the circle runout is more than the maximum, replace the camshaft sub-assembly.

HINT:

Check the oil clearance after replacing the camshaft.

b. Using a micrometer, measure the cam lobe height.

Standard Cam Lobe Height:

Item	Specified Condition
Intake	44.291 to 44.441 mm (1.744 to 1.750 in.)
Exhaust	44.196 to 44.346 mm (1.740 to 1.746 in.)

Minimum Cam Lobe Height:

Item	Specified Condition
Intake	44.241 mm (1.742 in.)
Exhaust	44.146 mm (1.738 in.)

If the cam lobe height is less than the minimum, replace the camshaft sub-assembly.

c. Using a micrometer, measure the journal diameter.

Standard ournal Diameter:

Item	Specified Condition
No. 1 journal	29.956 to 29.970 mm (1.179 to 1.180 in.)

Other journals	25.959 to 25.975 mm (1.022 to 1.023 in.)

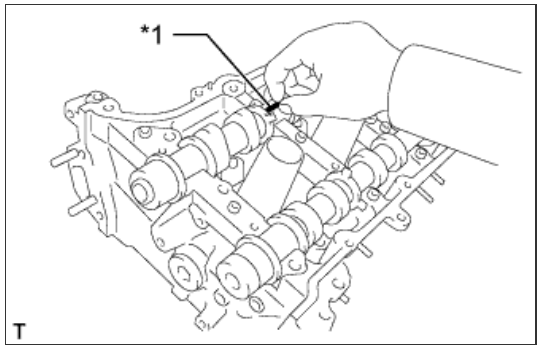
If the journal diameter is not as specified, check the oil clearance.

5. INSPECT CAMSHA T OIL CLEARANCE

a. Clean the bearing caps, camshaft housing and camshaft journals.

b. Place the camshafts on the camshaft housing.

c. Lay a strip of Plastigage across each of the camshaft journals.



Text in Illustration

*1	Plastigage

d. Install the camshaft bearing caps (Click here).

NOTICE:

Do not turn the camshaft.

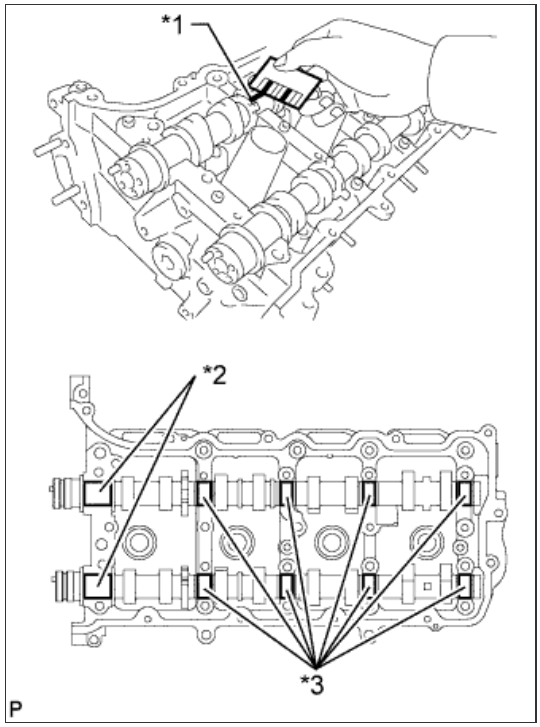
e. Install the camshaft housing (Click here).

NOTICE:

Do not turn the camshaft.

f. Remove the camshaft bearing caps (Click here).

g. Measure the Plastigage at its widest point.



Standard Oil Clearance:

Item	Specified Condition
No. 1 journal	0.030 to 0.065 mm (0.00118 to 0.00256 in.)
Other journals	0.025 to 0.062 mm (0.000984 to 0.00244 in.)

Maximum Oil Clearance:

Item	Specified Condition
No. 1 journal	0.10 mm (0.00394 in.)
Other journals	0.09 mm (0.00354 in.)

Text in Illustration

*1	Plastigage
*2	No. 1 Journal
*3	Other Journals

If the oil clearance is more than the maximum, replace the camshaft. If necessary, replace the camshaft housing.

. INSPECT CAMSHA T TIMING GEAR

a. Install the camshaft bearing caps (Click here).

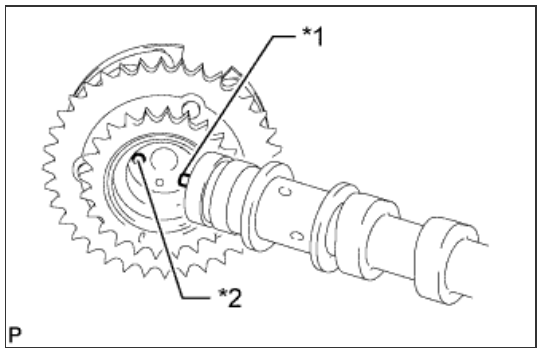
HINT:

Only install the intake camshaft.

b. Install the camshaft housing (Click here).

c. Apply a light coat of engine oil to the camshaft and camshaft timing gear.

d. Using the hexagonal portion of the camshaft, align and attach the knock pin of the camshaft with the pin hole of the camshaft timing gear.

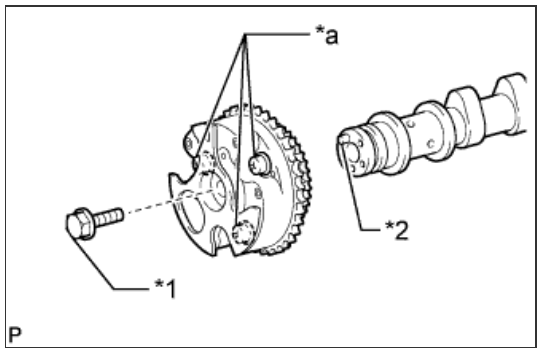


Text in Illustration

*1	Knock Pin
*2	Key Groove

NOTICE:

- **Do not forcefully push on the camshaft timing gear. This may cause the camshaft knock pin tip to damage the installation surface of the camshaft timing gear.**
- **Do not loosen or remove the 3 bolts shown in the illustration. If any of them are loosened or removed the backlash of the gear in the timing tube will go out of adjustment. In this case replace the camshaft timing gear assembly with a new one.**

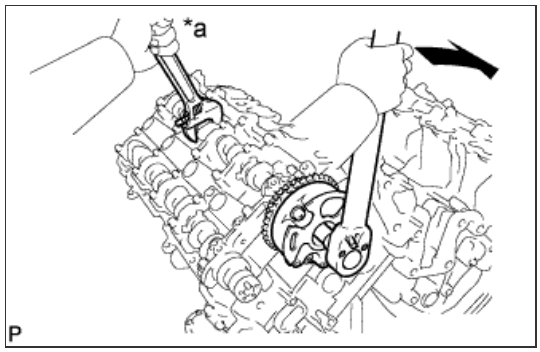


Text in Illustration

*1	lange Bolt
*2	Knock Pin
*a	Do not remove

e. pply a light coat of engine oil to the threads and under the head of the bolt.

f. Using a wrench to hold the hexagonal portion of the camshaft, install the camshaft timing gear with the bolt.



Torque:
1 N*m{ 1 kgf*cm 74 ft.*lbf }

Text in Illustration

*a	Hold
	Turn

g. Remove the camshaft bearing caps (Click here).

h. Check the lock of the camshaft timing gear.

i. Make sure that the camshaft timing gear is locked.

NOTICE:

Be careful not to damage the camshaft.

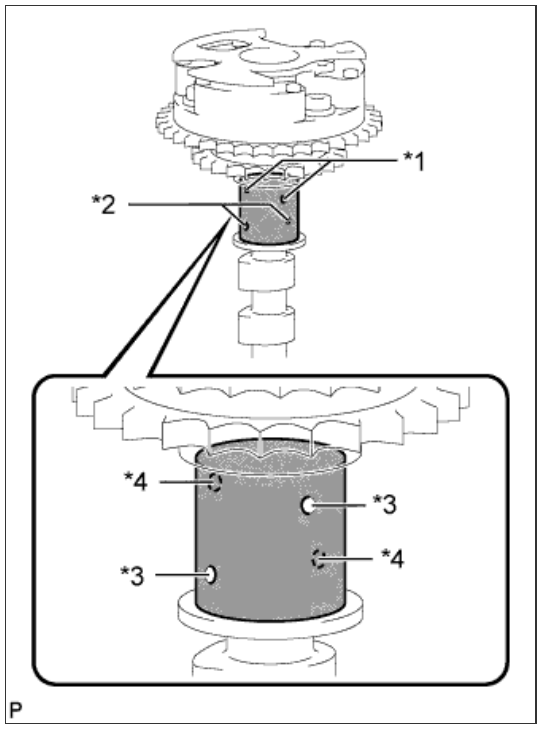
i. Release the lock pin.

i. Cover the 4 oil paths of the cam journal with vinyl tape as shown in the illustration.

ii. Break through the tape of the advance side path and retard side path as shown in the illustration.

Text in Illustration

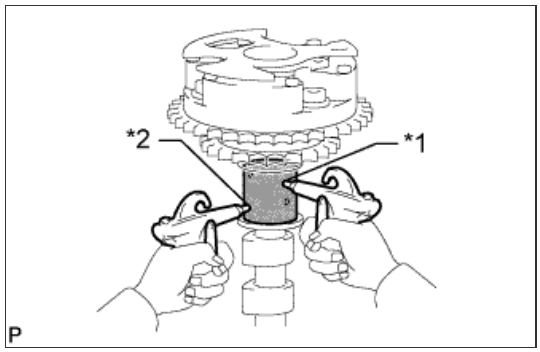
*1	Advance Side Path
*2	Retard Side Path
*3	Open
*4	Close
	Vinyl Tape



iii. pply approximately 200 kPa (2.0 kgf m^2, 29 psi) of air pressure to the two broken paths.

Text in Illustration

*1	dvance Side Path
*2	Retard Side Path



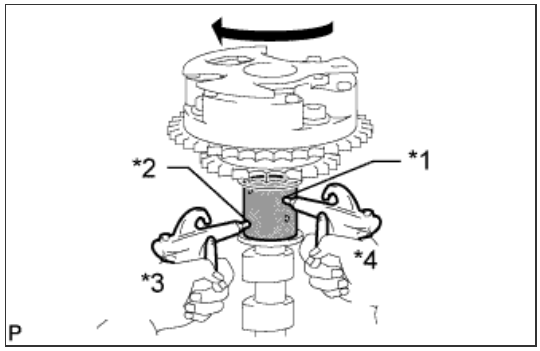
NOTICE:

Cover the paths with a piece of cloth when applying pressure to keep oil from splashing.

iv. Check that the camshaft timing gear revolves in the advance direction when reducing the air pressure applied to the retard side path.

Text in Illustration

*1	Advance Side Path
*2	Retard Side Path
*3	Decompress
*4	Hold Pressure



HINT:

This operation releases the lock pin for the most retarded position.

v. When the camshaft timing gear reaches the most advanced position, release the air pressure from the retard side path and advance side path, in that order.

NOTICE:

Do not release the air pressure from the advance side path first. The gear may abruptly shift in the retard direction and break the lock pin.

j. Check for smooth rotation.

i. Turn the camshaft timing gear within its movable range (21°) 2 or 3 times, but do not turn it to the most retarded position. Make sure that the gear turns smoothly.

NOTICE:

Do not use air pressure to perform the smooth rotation check.

k. Check the lock in the most retarded position.

i. Confirm that the camshaft timing gear is locked at the most retarded position.

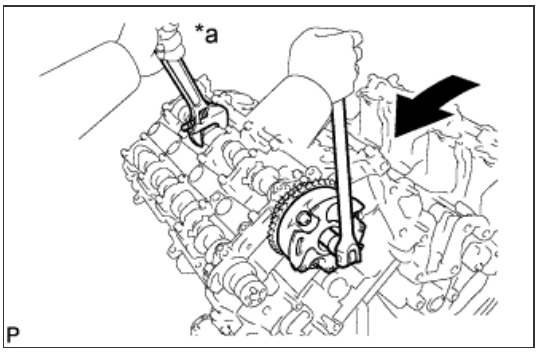
l. Install the camshaft bearing caps (Click here).

HINT:

Only install the intake camshaft.

m. Install the camshaft housing (Click here).

n. Hold the hexagonal portion of the camshaft with a wrench and loosen the bolt.

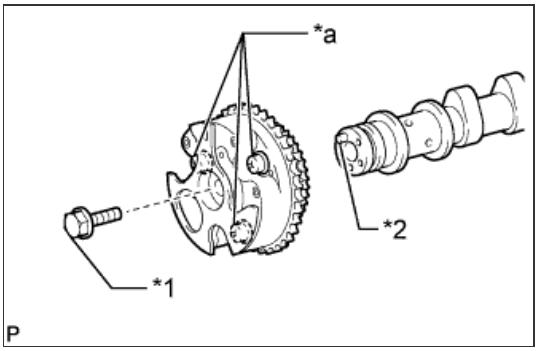


Text in Illustration

*a	Hold
➡	Turn

o. Remove the camshaft bearing caps (Click here).

p. Remove the flange bolt and camshaft timing gear.



Text in Illustration

*1	Flange Bolt
*2	Knock Pin
*a	Do not remove

7. INSPECT CAMSHA T TIMING E HAUST GEAR

a. Install the camshaft bearing caps (Click here).

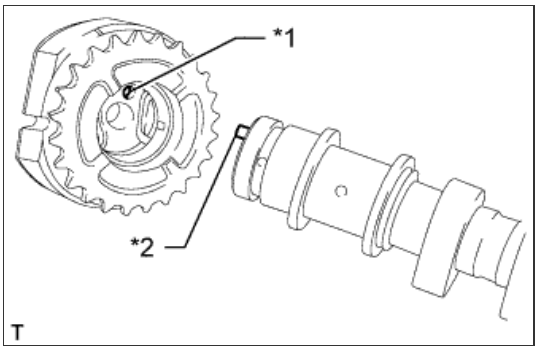
HINT:

Only install the exhaust camshaft.

b. Install the camshaft housing (Click here).

c. Apply a light coat of engine oil to the camshaft and camshaft timing exhaust gear.

d. Using the hexagonal portion of the camshaft, align and attach the knock pin of the camshaft with the pin hole of the camshaft timing exhaust gear.



Text in Illustration

*1	Key Groove
*2	Knock Pin

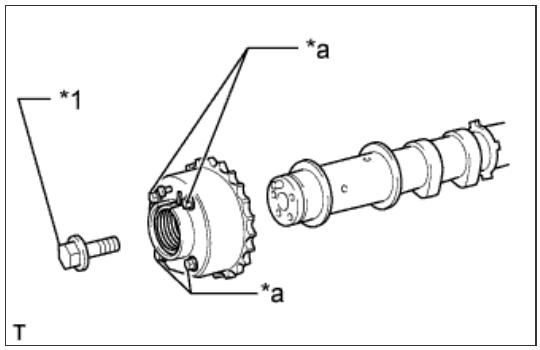
NOTICE:

- **Do not forcefully push on the camshaft timing exhaust gear. This may cause the camshaft knock pin tip to damage the installation surface of the camshaft timing exhaust gear.**
- **Do not loosen or remove the 4 bolts shown in the illustration. If any of them are loosened or removed the backlash of the gear in the timing tube will go out of adjustment. In this case replace the camshaft timing exhaust gear assembly with a new one.**

Text in Illustration

*1	lange Bolt
*a	Do not remove

e. pply a light coat of engine oil to the threads and under the head of the bolt.

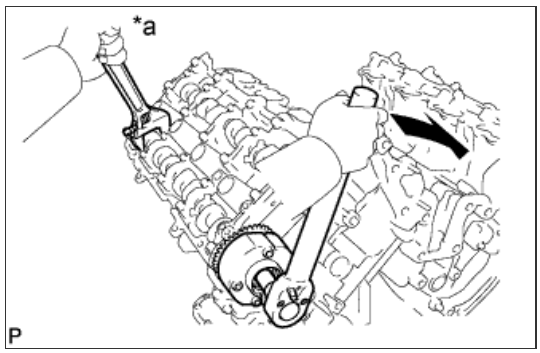


f. Using a wrench to hold the hexagonal portion of the camshaft, install the camshaft timing exhaust gear with the bolt.

Torque:
1 N*m{ 1 kgf*cm 74 ft.*lbf }

Text in Illustration

*a	Hold
➡	Turn



g. Remove the camshaft bearing caps (Click here).

h. Check the camshaft timing exhaust gear lock.

i. Make sure that the camshaft timing exhaust gear is locked.

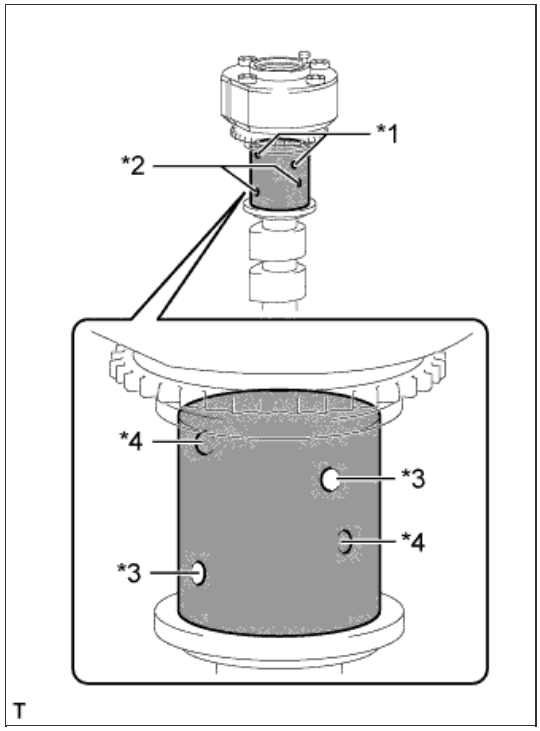
i. Release the lock pin.

i. Cover the 4 oil paths of the cam journal with vinyl tape as shown in the illustration.

ii. Break through the tape of the advance side path and retard side path as shown in the illustration.

Text in Illustration

*1	Advance Side Path
*2	Retard Side Path
*3	Open
*4	Close
■	Vinyl Tape



iii. Apply approximately 200 kPa (2.0 kgf/cm^2, 29 psi) of air pressure to the two broken paths (the advance side path and the retard side path).

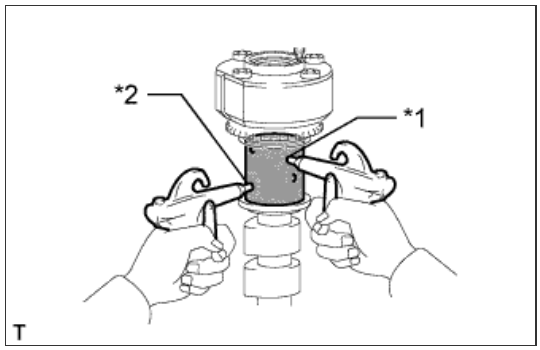
Text in Illustration

*1	Advance Side Path
*2	Retard Side Path

NOTICE:

Cover the paths with a piece of cloth when applying pressure to

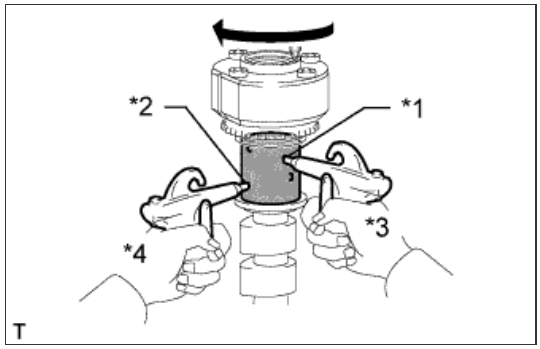
keep oil from splashing.



iv. Check that the camshaft timing exhaust gear turns in the retard direction when reducing the air pressure applied to the advance side path.

Text in Illustration

*1	Advance Side Path
*2	Retard Side Path
*3	Decompress
*4	Hold Pressure



HINT:

The lock pin is released and the camshaft timing exhaust gear turns in the retard direction.

v. When the camshaft timing exhaust gear moves to the most retarded position, release the air pressure from the advance side path, and then release the air pressure from the retard side path.

NOTICE:

Be sure to release the air pressure from the advance side path first. If the air pressure of the retard side path is released first, the camshaft timing exhaust gear may abruptly shift in the advance direction and break the lock pin or other parts.

j. Check for smooth rotation.

i. Turn the camshaft timing exhaust gear within its movable range (18.5°) 2 or 3 times, but do not turn it to the most advanced position. Make sure that the gear turns smoothly.

NOTICE:

When the air pressure is released from the advance side path and then from the retard side path, the gear automatically returns to the most advanced position due to the advance assist spring operation, and locks. Gradually release the air pressure from the retard side path before performing the smooth rotation check.

k. Check the lock at the most advanced position.

i. Make sure that the camshaft timing exhaust gear is locked at the most advanced position.

l. Install the camshaft bearing caps (Click here).

HINT:

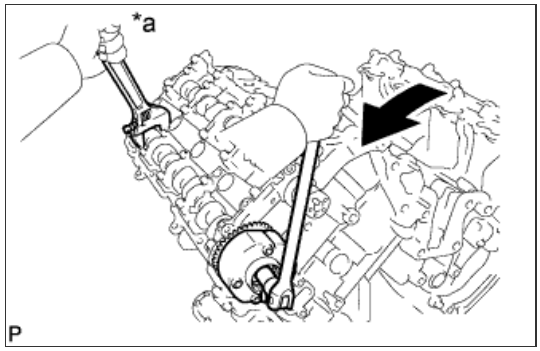
Only install the exhaust camshaft.

m. Install the camshaft housing (Click here).

n. Hold the hexagonal portion of the camshaft with a wrench and loosen the bolt.

Text in Illustration

*a	Hold
➡	Turn

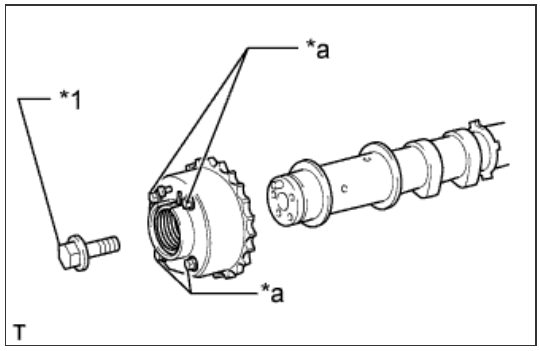


o. Remove the camshaft bearing caps (Click here).

p. Remove the flange bolt and camshaft timing exhaust gear.

Text in Illustration

*1	lange Bolt
*a	Do not remove

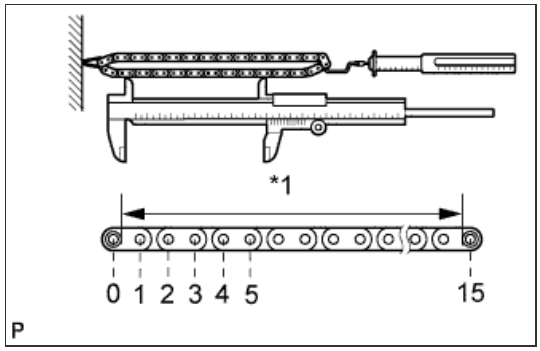


8. INSPECT NO. 1 CHAIN SUB-ASSEMBLY

a. Using a spring scale, pull the chain with a force of 147 N (15 kgf, 33.0 lbf) as shown in the illustration.

b. Using a vernier caliper, measure the length of 15 pins.

Maximum chain elongation:
13 .9 mm (5.39 in.)



Text in Illustration

*1	Measuring rea

HINT:

Perform the measurement at 3 random places.

If the elongation is more than the maximum, replace the No. 1 chain.

9. INSPECT NO. CHAIN SUB-ASSEMBLY

a. Using a spring scale, pull the chain with a force of 147 N (15 kgf, 33.0 lbf) as shown in the illustration.

b. Using a vernier caliper, measure the length of 15 pins.

Maximum chain elongation:
137. mm (5.4 in.)

HINT:

Perform the measurement at 3 random places.

If the elongation is more than the maximum, replace the No. 2 chain.

1 . INSPECT CRANKSHA T TIMING SPROCKET RH

a. Wrap the chain around the sprocket.

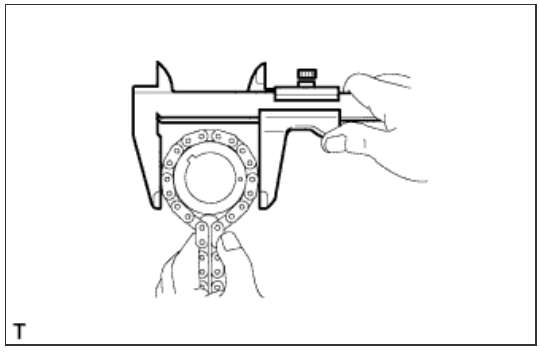
b. Using a vernier caliper, measure the sprocket diameter with the chain.

Minimum sprocket diameter (with chain):
1.4 mm (.4 in.)

If the diameter is less than the minimum, replace the chain and crankshaft timing sprocket RH.

HINT:

The vernier caliper must contact the chain rollers for the measurement.



11. INSPECT CRANKSHA T TIMING SPROCKET LH

a. Wrap the chain around the sprocket.

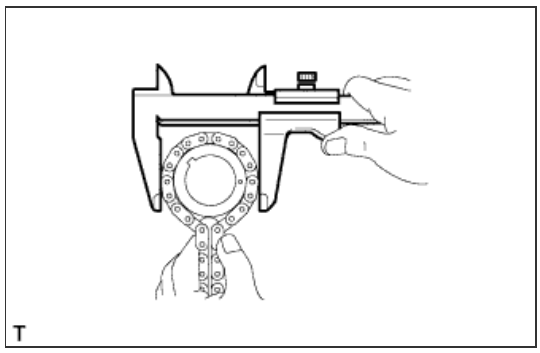
b. Using a vernier caliper, measure the sprocket diameter with the chain.

Minimum sprocket diameter (with chain):
1.4 mm (.4 in.)

If the diameter is less than the minimum, replace the chain and crankshaft timing sprocket LH.

HINT:

The vernier caliper must contact the chain rollers for the measurement.



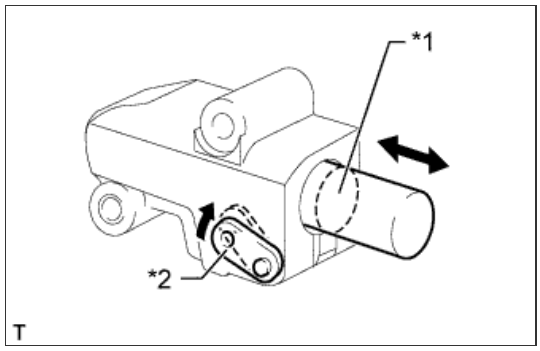
1 . INSPECT NO. 1 CHAIN TENSIONER ASSEMBLY

a. Move the stopper plate clockwise to release the lock. Push the plunger and check that it moves smoothly.

Text in Illustration

*1	Plunger
*2	Stopper Plate

If necessary, replace the No. 1 chain tensioner.



13. INSPECT NO. CHAIN TENSIONER ASSEMBLY

a. Check that the plunger moves smoothly.

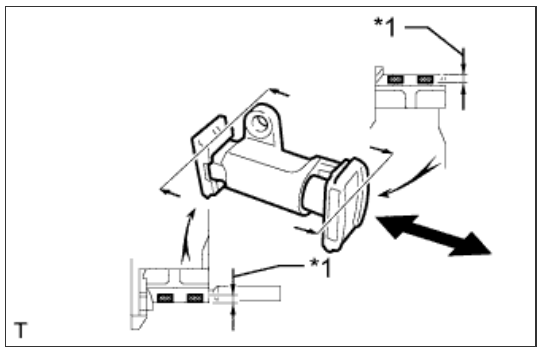
b. Measure the worn depth of the chain tensioner.

Maximum depth:
.9 mm (. 354 in.)

Text in Illustration

*1	Depth

If the depth is more than the maximum, replace the No. 2 chain tensioner.



14. INSPECT NO. 3 CHAIN TENSIONER ASSEMBLY

a. Check that the plunger moves smoothly.

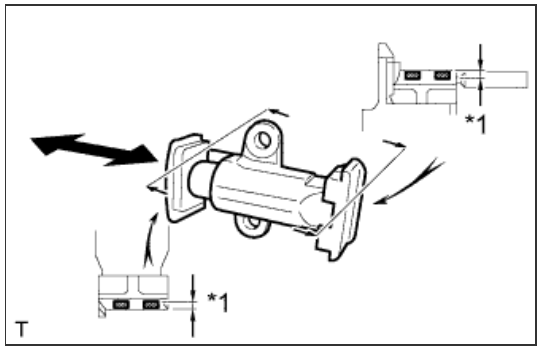
b. Measure the worn depth of the chain tensioner.

Maximum depth:
.9 mm (. 354 in.)

Text in Illustration

*1	Depth

If the depth is more than the maximum, replace the No. 3 chain tensioner.



15. INSPECT NO. 1 CHAIN TENSIONER SLIPPER

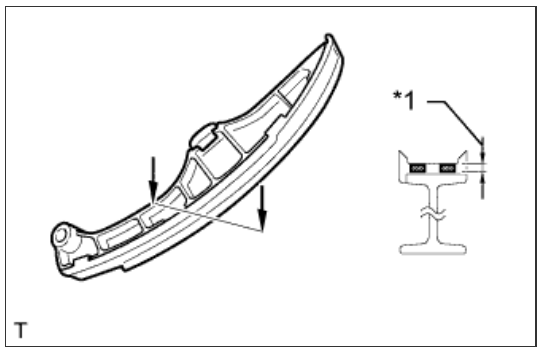
a. for LH
Measure the worn depth of the chain tensioner slipper.

Maximum depth:
1. mm (. 394 in.)

Text in Illustration

*1	Depth

If the depth is more than the maximum, replace the No. 1 chain tensioner slipper.



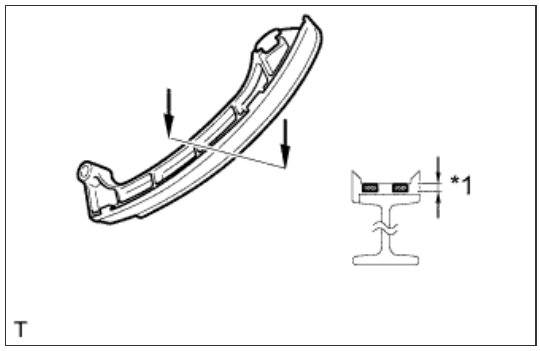
b. for RH
Measure the worn depth of the chain tensioner slipper.

Maximum depth:
1. mm (. 394 in.)

Text in Illustration

*1	Depth

If the depth is more than the maximum, replace the No. 1 chain tensioner slipper.



1 . INSPECT NO. 1 CHAIN VIBRATION DAMPER

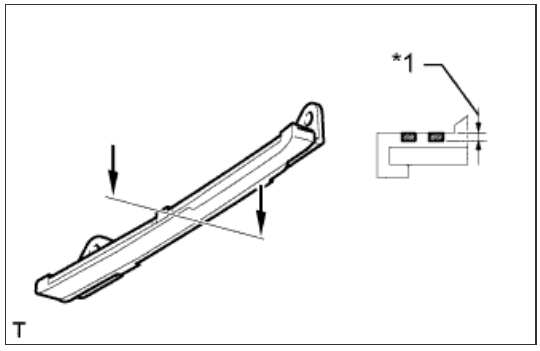
a. for LH
Measure the worn depth of the chain vibration damper.

Maximum depth:
1. mm (. 394 in.)

Text in Illustration

*1	Depth

If the depth is more than the maximum, replace the No. 1 chain vibration damper.



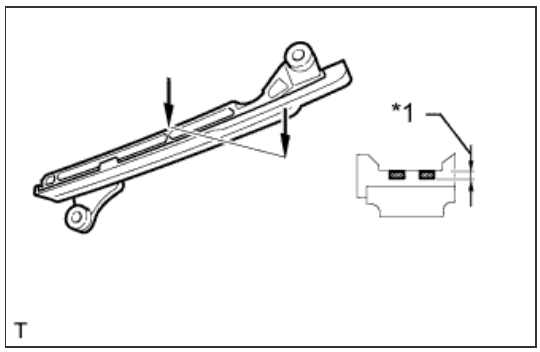
b. for RH
Measure the worn depth of the chain vibration damper.

Maximum depth:
1. mm (. 394 in.)

Text in Illustration

*1	Depth

If the depth is more than the maximum, replace the No. 1 chain vibration damper.

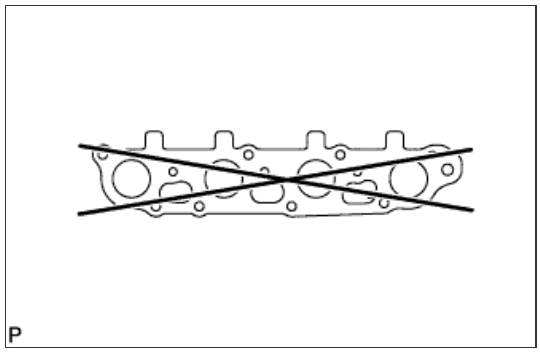


17. INSPECT E HAUST MANI OLD SUB-ASSEMBLY LH

a. Using a precision straightedge and feeler gauge, measure the warpage of the surface where the exhaust manifold LH contacts the cylinder head.

Maximum warpage:
.7 mm (. in.)

If the warpage is more than the maximum, replace the exhaust manifold LH.

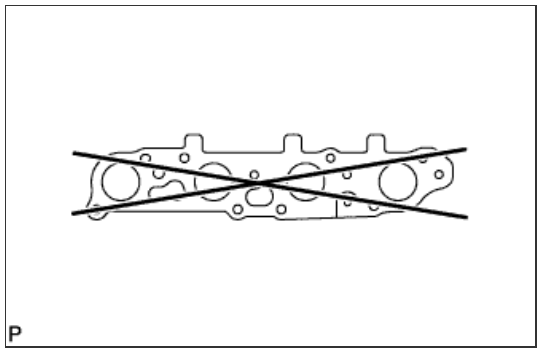


18. INSPECT E HAUST MANI OLD SUB-ASSEMBLY RH

a. Using a precision straightedge and feeler gauge, measure the warpage of the surface where the exhaust manifold RH contacts the cylinder head.

Maximum warpage:
.7 mm (. in.)

If the warpage is more than the maximum, replace the exhaust manifold RH.



for Preparation Click here

1. INSTALL STUD BOLT

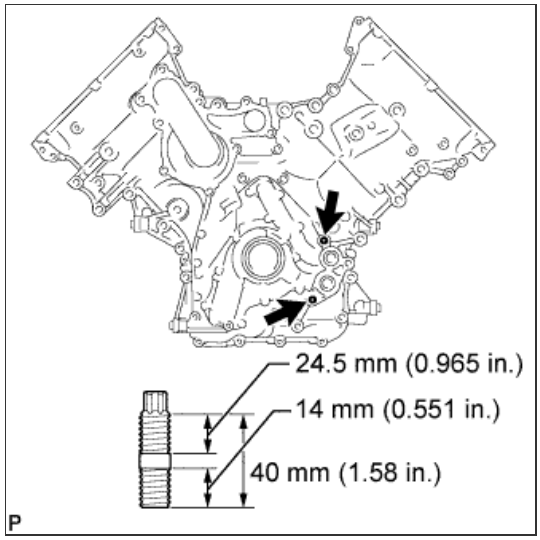
NOTICE:

If the stud bolt is deformed or its threads are damaged, replace it.

a. Install the timing chain cover stud bolt.

i. Using an E10 "TORX" socket wrench, install the 2 stud bolts as shown in the illustration.

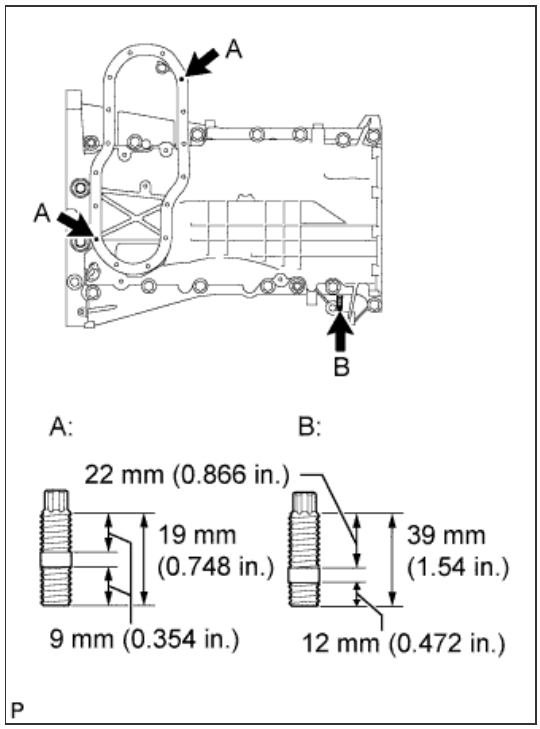
Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }



b. Install the oil pan stud bolt.

i. Using an E6 and E7 "TORX" socket wrench, install the 3 stud bolts as shown in the illustration.

Torque:
for stud bolt A:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }
for stud bolt B:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



2. INSTALL RING PIN

NOTICE:

It is not necessary to remove the ring pin unless it is being replaced.

a. Using a plastic-faced hammer, tap in new ring pins to the timing chain cover.

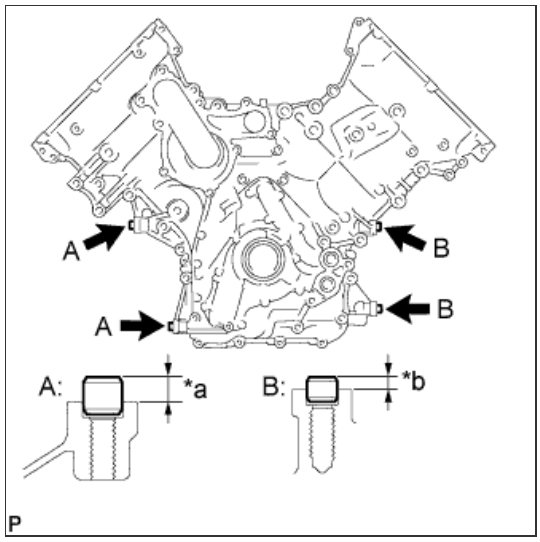
Standard Protrusion:

Item	Ring Pin Diameter	Specified Condition

Ring pin A	13 mm (0.512 in.)	7.5 to 8.5 mm (0.295 to 0.335 in.)
Ring pin B	11 mm (0.433 in.)	3.6 to 4.6 mm (0.142 to 0.181 in.)

Text in Illustration

*a	7.5 to 8.5 mm
*b	3.6 to 4.6 mm



3. INSTALL REAR CRANKS AFT OIL SEAL

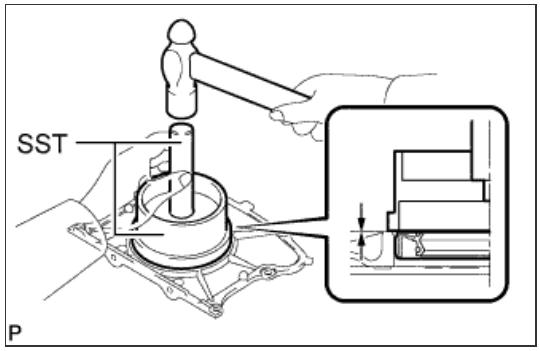
a. Using SST, tap in a new oil seal until its surface is flush with the oil seal retainer edge.

SST
09223-15030
09950-70010 09951-07100

Standard depth:
0 to 1.0 mm 0 to 0.0394 in.

NOTICE:

- **Keep the lip free from foreign matter.**
- **Do not tap on the oil seal at an angle.**



4. INSTALL OIL DRAIN PIPE SUB-ASSEMBLY

a. Apply a light coat of engine oil to a new O-ring.

b. Install the O-ring to the drain pipe.

c. Install the oil drain pipe with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

5. INSTALL ENGINE REAR OIL SEAL RETAINER

a. Apply seal packing in a continuous line as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

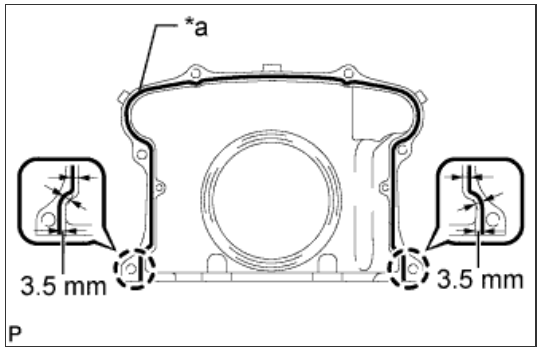
Standard Seal diameter:
2.0 to 3.0 mm 0.0787 to 0.118 in.

Application position from inside edge of retainer:
3.5 mm 0.138 in.

Text in Illustration

*a	2.0 to 3.0 mm

NOTICE:



- Remove any oil from the contact surface.
- Install the oil seal retainer within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.

b. Install the oil seal retainer with the 6 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

NOTICE:

- Do not start the engine for at least 2 hours after installing.
- hen installing the oil seal retainer, make sure the lip of the oil seal is not damaged.
- hen installing the oil seal retainer, make sure the lip of the oil seal is not folded incorrectly.

6. INSTALL OIL STRAINER SUB-ASSEMBLY

a. Apply a light coat of engine oil to a new O-ring.

b. Install the O-ring to the oil strainer.

c. Install the oil strainer with the 2 bolts.

Torque:
12 N*m{ 122 kgf*cm , 9 ft.*lbf }

NOTICE:

Make sure the O-ring is not twisted or damaged.

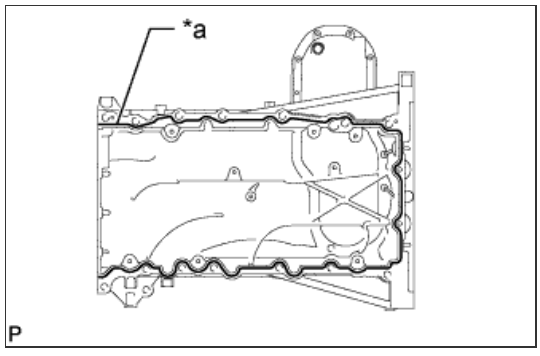
7. INSTALL NO. 1 OIL PAN BAFFLE PLATE

a. Install the baffle plate with the 7 bolts.

Torque:
12 N*m{ 122 kgf*cm , 9 ft.*lbf }

8. INSTALL NO. 1 OIL PAN SUB-ASSEMBLY

a. Apply seal packing in a continuous line as shown in the illustration.



Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
3.0 to 4.0 mm 0.118 to 0.157 in.

Text in Illustration

*a	3.0 to 4.0 mm

NOTICE:

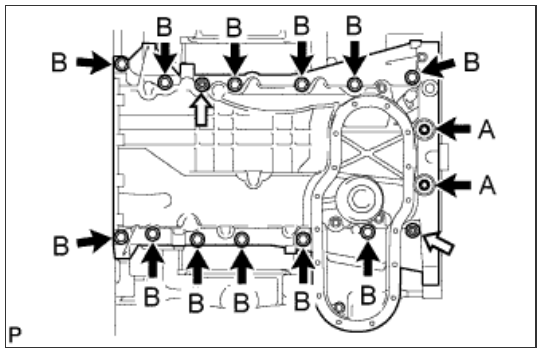
- Remove any oil from the contact surface.
- Install the oil pan within 3 minutes and tighten the bolts and nuts within 15 minutes after applying seal packing.

b. Install the oil pan with the 14 bolts and 2 nuts.

Torque:
for bolt A:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }
for bolt B:
35 N*m{ 357 kgf*cm , 26 ft.*lbf }
for nut:
35 N*m{ 357 kgf*cm , 26 ft.*lbf }

Text in Illustration

➡	Bolt
⇨	Nut



NOTICE:

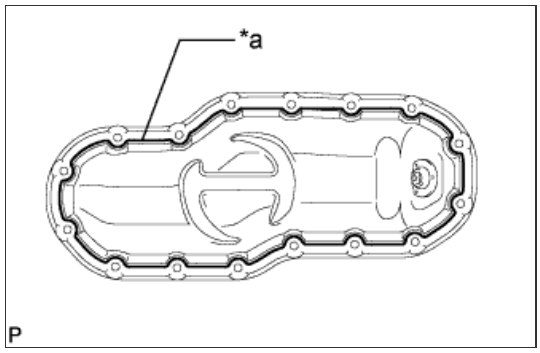
Do not start the engine for at least 2 hours after installing.

Standard Bolt:

Item	Length	Thread Diameter
Bolt A	92 mm (3.62 in.)	6 mm (0.236 in.)
Bolt B	30 mm (1.18 in.)	10 mm (0.394 in.)

9. INSTALL NO. 2 OIL PAN SUB-ASSEMBLY

a. Apply seal packing in a continuous line as shown in the illustration.



Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
3.0 to 4.0 mm 0.118 to 0.157 in.

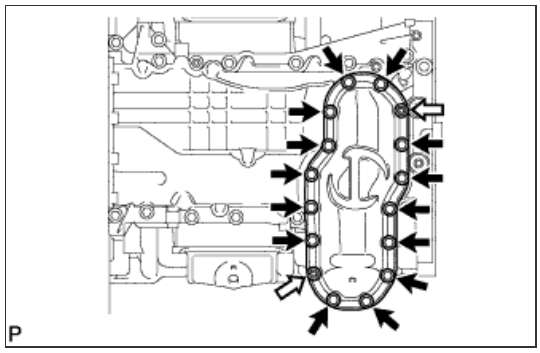
Text in Illustration

*a	3.0 to 4.0 mm

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the oil pan within 3 minutes and tighten the bolts and nuts within 15 minutes after applying seal packing.**

b. Install the oil pan with the 14 bolts and 2 nuts.



Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

Text in Illustration

➡	Bolt
⇨	Nut

NOTICE:

Do not start the engine for at least 2 hours after installing.

10. INSTALL NO. 1 EAT EXC ANGER CO ER

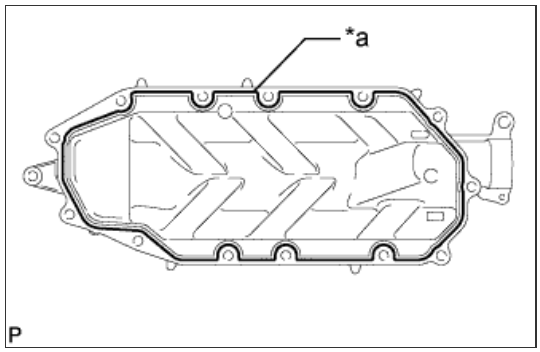
a. Apply seal packing in a continuous line as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing 1282B, Three Bond 1282B or equivalent

Standard seal diameter:
3.0 to 4.0 mm 0.118 to 0.157 in.

Text in Illustration

*a	3.0 to 4.0 mm

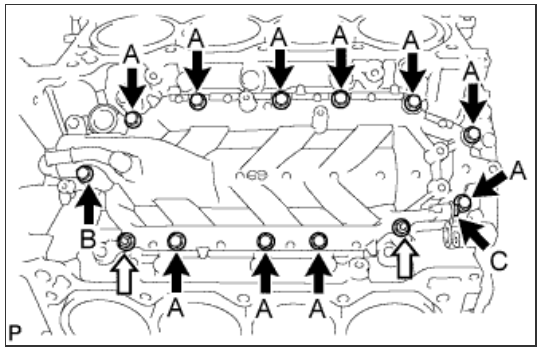


NOTICE:

- Remove any oil from the contact surface.
- Install the heat exchanger cover within 3 minutes and tighten the bolts and nuts within 15 minutes after applying seal packing.

b. Install the heat exchanger cover with the 12 bolts and 2 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



Text in Illustration

➡	Bolt
⇨	Nut

NOTICE:

Do not start the engine for at least 2 hours after installing.

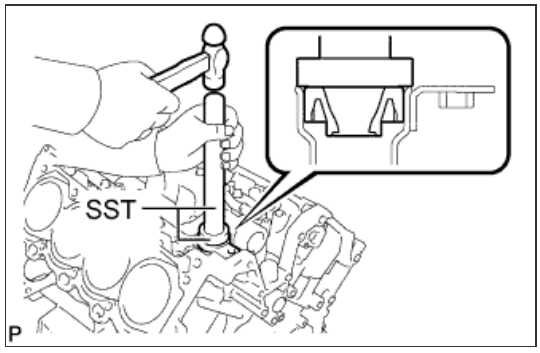
Standard Bolt:

Item	Length	Thread Diameter
Bolt A	20 mm (0.787 in.)	8 mm (0.315 in.)
Bolt B	70 mm (2.76 in.)	8 mm (0.315 in.)
Bolt C	16 mm (0.630 in.)	6 mm (0.236 in.)

11. INSTALL ENTILATION PIPE GASKET

a. Using SST, evenly tap in a new ventilation pipe gasket until its surface is flush with the lip of the ventilation pipe.

SST
09950-60010 09951-00360
09950-70010 09951-07100



NOTICE:

- Do not tap the gasket at an angle.
- Do not tap the gasket excessively.

12. INSTALL CYLINDER BLOCK ATER JACKET SPACER

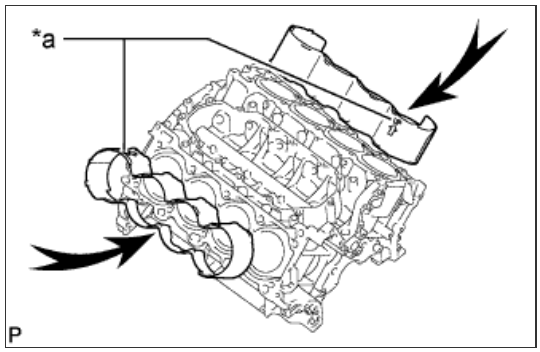
a. Install the 2 water jacket spacers as shown in the illustration.

Text in Illustration

*a	UP Mark

INT:

- Face the cutouts indicated b the arrows in illustration away from the engine.
- Face the UP mark as shown in the illustration.

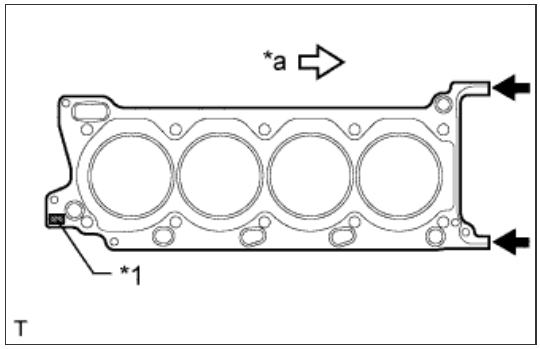


13. INSTALL CYLINDER EAD SUB-ASSEMBLY R

a. Clean the cylinder block with solvent.

b. Set the piston of the No. 1 cylinder to slightly ATDC.

c. Place the cylinder head gasket on the cylinder block surface with the front face of the Lot No. stamp upward.



Text in Illustration

*1	Lot No.
*a	Front

NOTICE:

- **Be careful of the installation direction.**
- **Make sure that no oil is on the front end indicated b the arrows of the cylinder head gasket.**

d. Place the cylinder head on the cylinder block.

NOTICE:

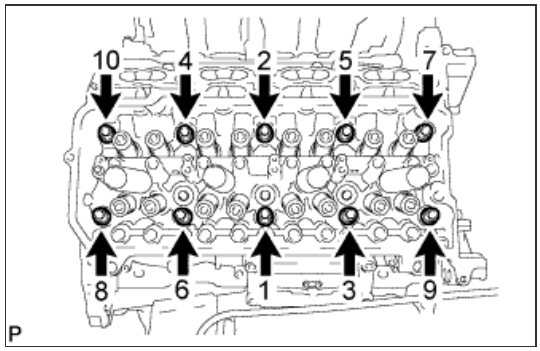
- **Ensure that no oil is on the mounting surface of the cylinder head.**
- **Gently place the cylinder head in order not to damage the gasket with the bottom part of the head.**

INT:

The cylinder head bolts are tightened in 3 progressive steps.

e. Apply a light coat of engine oil to the threads and under the heads of the cylinder head bolts.

f. Step 1:



i. Using a 10 mm bi-hexagon wrench, install and uniformly tighten the 10 cylinder head bolts with the plate washers in several steps in the sequence shown in the illustration.

Torque:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }

g. Step 2:

i. Mark the front side of each cylinder head bolt head with paint.

ii. Tighten the cylinder head bolts another 90°.

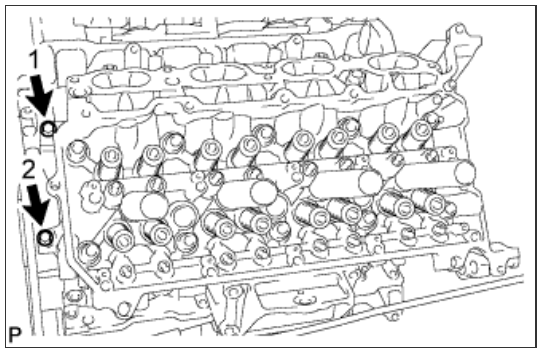
h. Step 3:

i. Tighten the cylinder head bolts an additional 90°.

ii. Check that the paint marks are now at a 180° angle to the front.

i. Install and uniformly tighten the 2 bolts in the sequence shown in the illustration.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

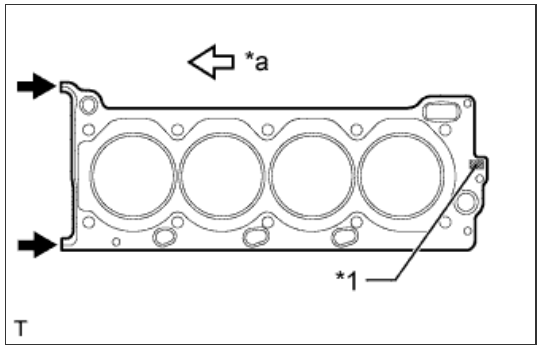


14. INSTALL CYLINDER EAD SUB-ASSEMBLY L

a. Clean the cylinder block with solvent.

b. Set the piston of the No. 1 cylinder to slightly ATDC.

c. Place the cylinder head gasket on the cylinder block surface with the front face of the Lot No. stamp upward.



Text in Illustration

*1	Lot No.
*a	Front

NOTICE:

- **Be careful of the installation direction.**
- **Make sure that no oil is on the front end indicated b the arrows of the cylinder head gasket.**

d. Place the cylinder head on the cylinder block.

NOTICE:

- **Ensure that no oil is on the mounting surface of the cylinder head.**
- **Gently place the cylinder head in order not to damage the gasket with the bottom part of the head.**

INT:

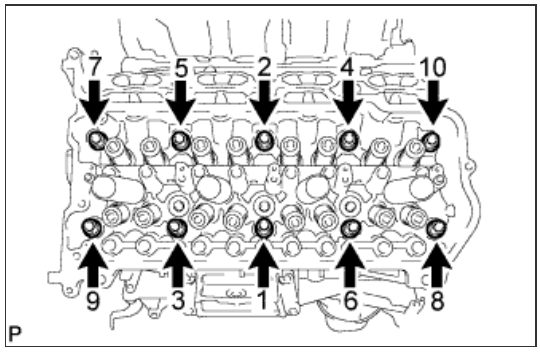
The cylinder head bolts are tightened in 3 progressive steps.

e. Apply a light coat of engine oil to the threads and under the heads of the cylinder head bolts.

f. Step 1:

INT:

The cylinder head bolts are tightened in 3 progressive steps.



i. Using a 10 mm bi-hexagon wrench, install and uniformly tighten the 10 cylinder head bolts with the plate washers in several steps in the sequence shown in the illustration.

Torque:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }

g. Step 2:

i. Mark the front side of each cylinder head bolt head with paint.

ii. Tighten the cylinder head bolts another 90°.

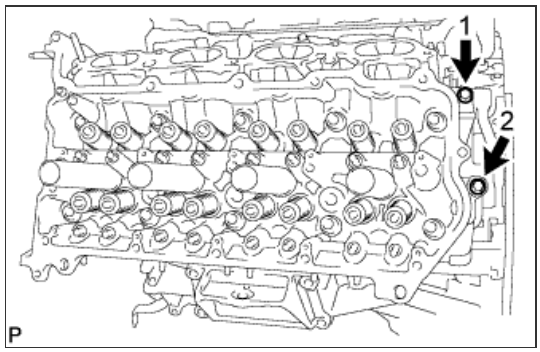
h. Step 3:

i. Tighten the cylinder head bolts an additional 90°.

ii. Check that the paint marks are now at a 180° angle to the front.

i. Install and uniformly tighten the 2 bolts in the sequence shown in the illustration.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



15. INSTALL AL E STEM CAP

a. Apply a light coat of engine oil to the valve stem caps.

b. Install the 32 valve stem caps to the cylinder heads.

16. INSTALL AL E LAS ADJUSTER ASSEMBLY

a. Inspect the valve lash adjuster before installing it (Click here).

b. Install the 32 valve lash adjusters to the cylinder heads.

NOTICE:

Install the lash adjuster to the same place it was removed from.

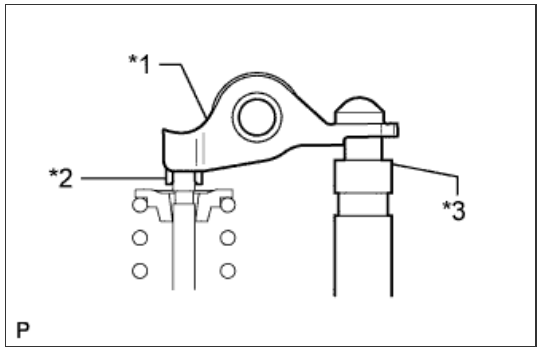
17. INSTALL NO. 1 AL E ROCKER ARM SUB-ASSEMBLY

a. Apply engine oil to the lash adjuster tips and valve stem cap ends.

b. Install the 32 valve rocker arms as shown in the illustration.

Text in Illustration

*1	Valve Rocker Arm
*2	Valve Stem Cap
*3	Valve Lash Adjuster

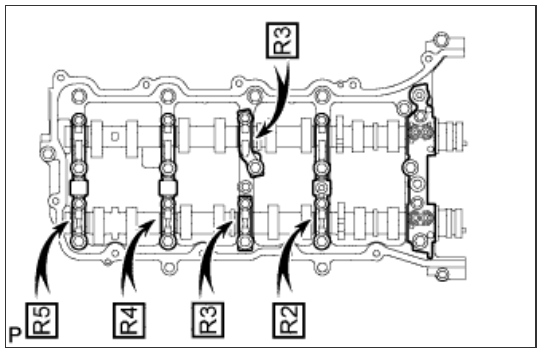


18. INSTALL CAMS AFT BEARING CAP R

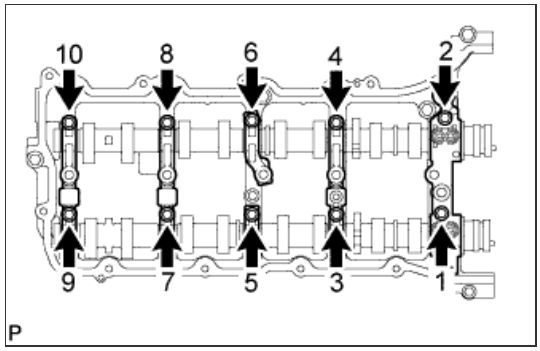
a. Apply a light coat of engine oil to the camshaft journals, camshaft housings and bearing caps.

b. Install the No. 1 and No. 2 camshafts to the camshaft housing.

c. Confirm the marks and numbers on the camshaft bearing caps and place them in their proper positions and directions.

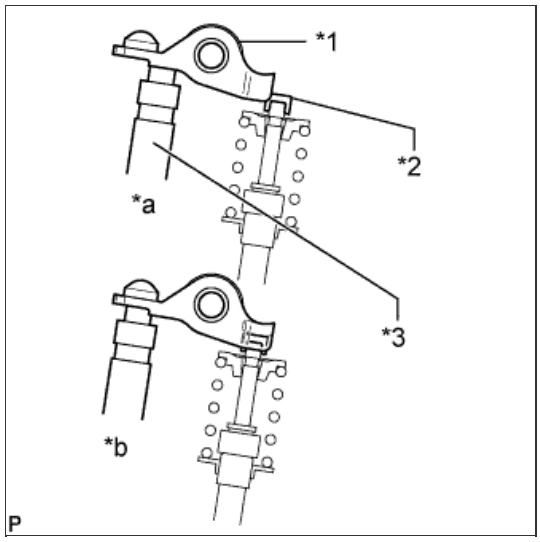


d. Temporarily install the 10 bolts in the order shown in the illustration.



19. INSTALL CAMS AFT OUSING SUB-ASSEMBLY R

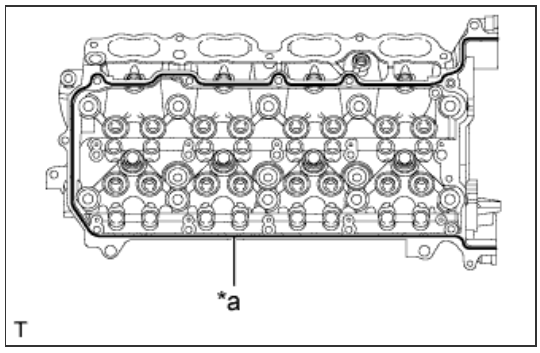
a. Make sure that the valve rocker arms are installed as shown in the illustration.



Text in Illustration

*1	Valve Rocker Arm
*2	Valve Stem Cap
*3	Valve Lash Adjuster
*a	INCORRECT
*b	CORRECT

b. Apply seal packing in a continuous line as shown in the illustration.



Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
3.5 to 4.0 mm 0.138 to 0.157 in.

Text in Illustration

*a	3.5 to 4.0 mm

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the camshaft housing within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**

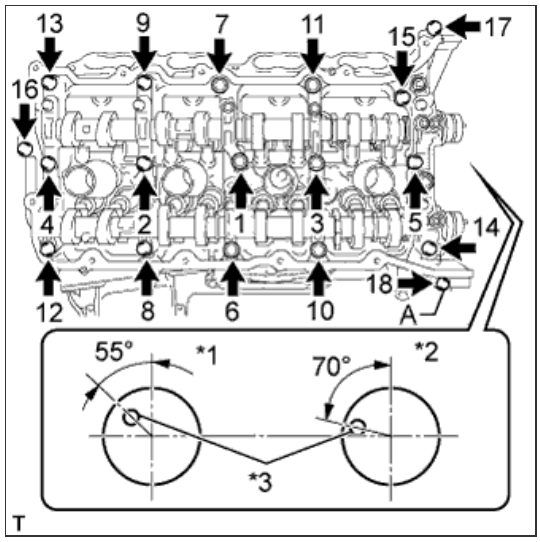
c. Install the camshaft housing, and install the 18 bolts in the order shown in the

illustration.

Torque:
for bolt A:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }
except bolt A:
30 N*m{ 306 kgf*cm , 22 ft.*lbf }

Text in Illustration

*1	EX
*2	IN
*3	Knock Pin



NOTICE:

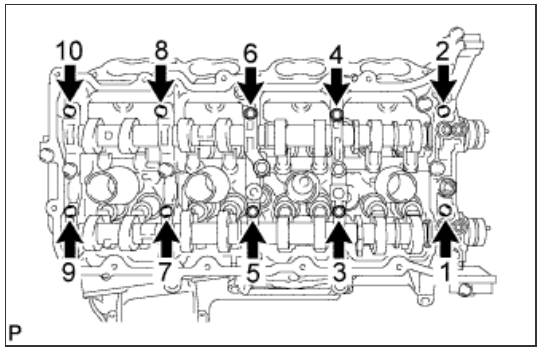
- **Do not start the engine for at least 2 hours after the installation.**
- **Make sure that the knock pin of the camshaft is positioned as shown in the illustration before installing the camshaft housing.**

d. Tighten the 10 bolts in the order shown in the illustration.

Torque:
16 N*m{ 163 kgf*cm , 12 ft.*lbf }

NOTICE:

Thoroughly wipe clean any seal packing.

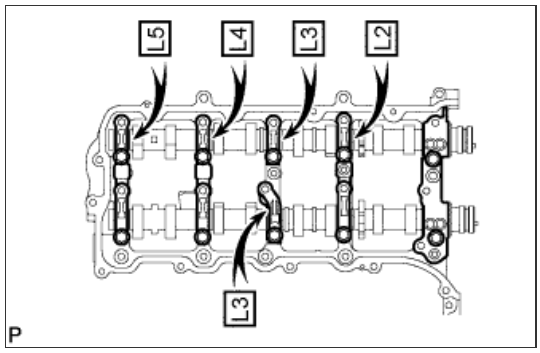


20. INSTALL CAMS AFT BEARING CAP L

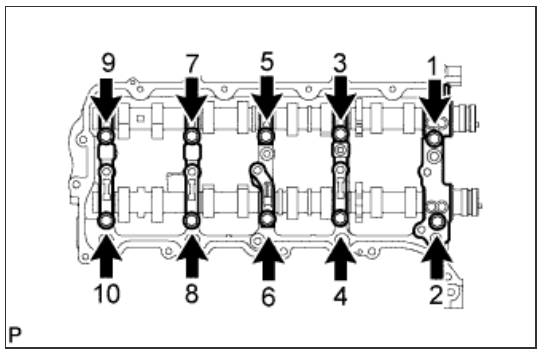
a. Apply a light coat of engine oil to the camshaft journals, camshaft housings and bearing caps.

b. Install the No. 3 and No. 4 camshafts to the camshaft housing.

c. Confirm the marks and numbers on the camshaft bearing caps and place them in their proper positions and directions.

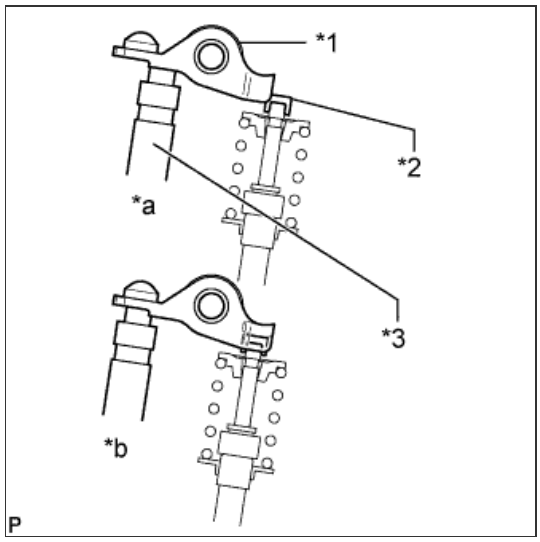


d. Temporarily install the 10 bolts in the order shown in the illustration.



21. INSTALL CAMS AFT OUSING SUB-ASSEMBLY L

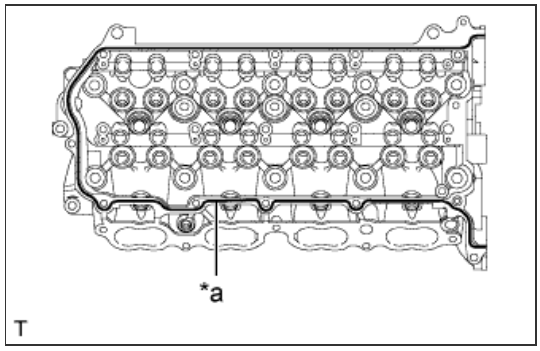
a. Make sure that the valve rocker arms are installed as shown in the illustration.



Text in Illustration

*1	Valve Rocker Arm
*2	Valve Stem Cap
*3	Valve Lash Adjuster
*a	INCORRECT
*b	CORRECT

b. Apply seal packing in a continuous line as shown in the illustration.



Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
3.5 to 4.0 mm 0.138 to 0.157 in.

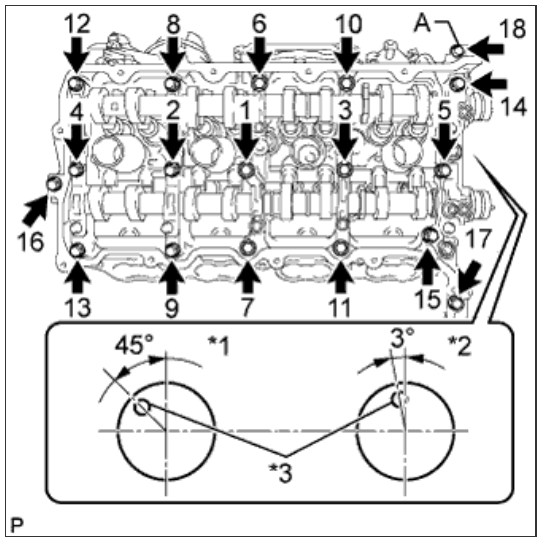
Text in Illustration

*a	3.5 to 4.0 mm

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the camshaft housing within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**

c. Install the camshaft housing, and install the 18 bolts in the order shown in the illustration.



Torque:
for bolt A:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }
except bolt A:
30 N*m{ 306 kgf*cm , 22 ft.*lbf }

Text in Illustration

*1	IN
*2	EX
*3	Knock Pin

NOTICE:

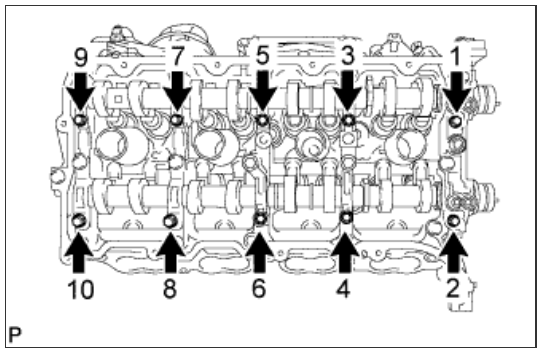
- **Do not start the engine for at least 2 hours after the installation.**
- **Make sure that the knock pin of the camshaft is positioned as shown in the illustration before installing the camshaft housing.**

d. Tighten the 10 bolts in the order shown in the illustration.

Torque:
16 N*m{ 163 kgf*cm , 12 ft.*lbf }

NOTICE:

Thoroughly wipe clean any seal packing.

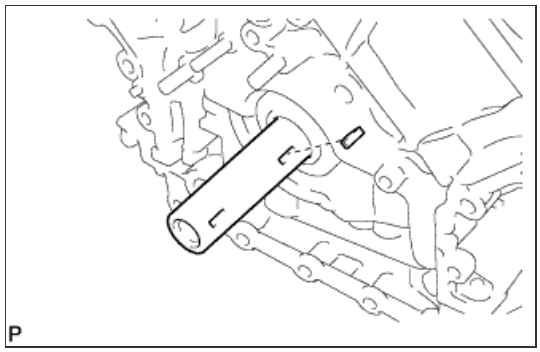


22. INSTALL CRANKS AFT TIMING GEAR KEY

a. Install the timing gear key.

INT:

The other timing gear key will be installed at a later step.



23. SET NO. 1 CYLINDER TO TDC COMPRESSION

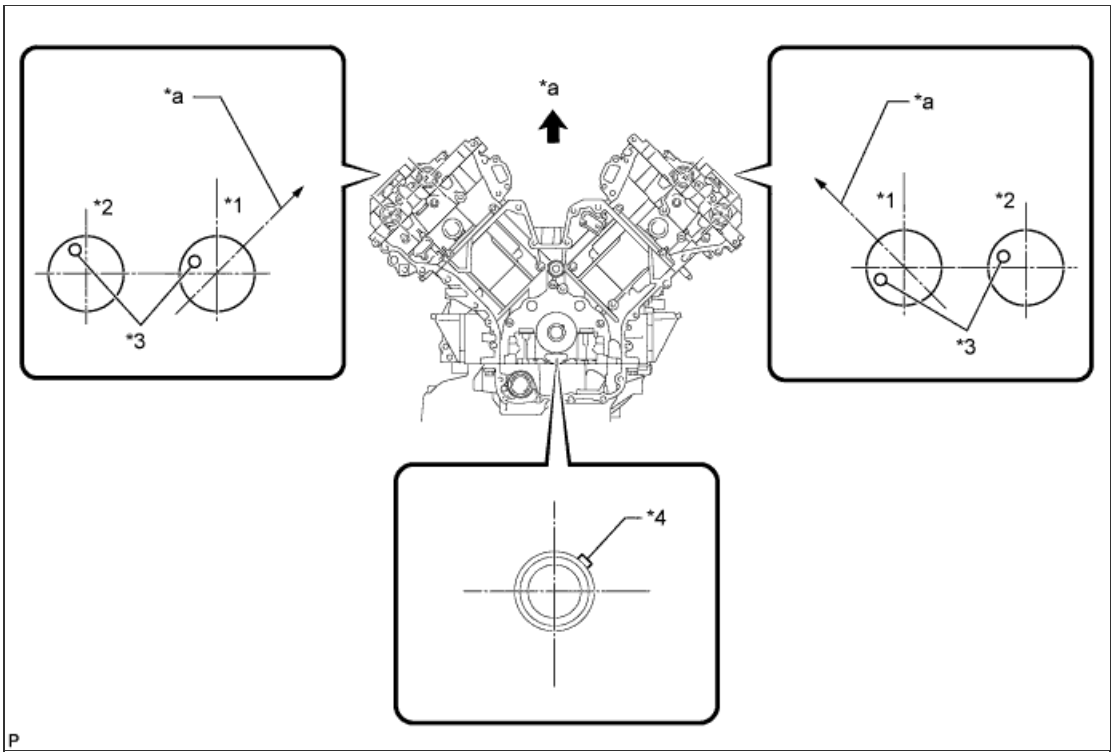
a. Temporarily install the crankshaft pulley bolt.

b. Rotate the crankshaft so that the timing gear key is as shown in the illustration. Then using a wrench, rotate each camshaft so that the timing marks are as shown in the illustration.

NOTICE:

When the crankshaft or a camshaft is rotated excessively, the valves and pistons may interfere with each other.

c. Remove the crankshaft pulley bolt.



Text in Illustration

*1	IN	*2	EX
*3	Knock Pin	*4	Key
*a	Toward Ceiling	-	-

24. INSTALL NO. 2 C AIN TENSIONER ASSEMBLY

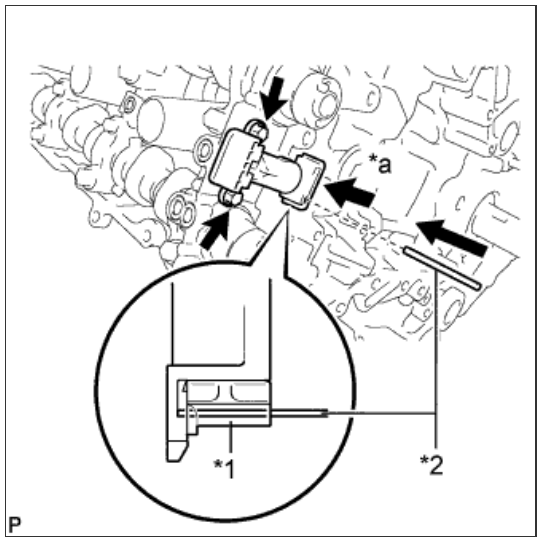
a. Install the chain tensioner with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

Text in Illustration

*1	Plunger
*2	Pin
*a	Push

b. While raising up the No. 2 chain tensioner, insert a pin of 1.0 mm (0.0394 in.) into the hole to fix it in place.

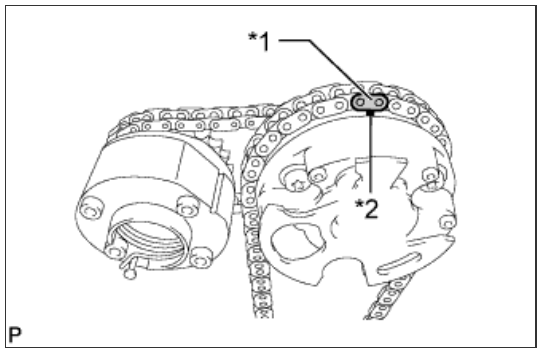


25. INSTALL NO. 1 C AIN SUB-ASSEMBLY R

a. Align the No. 1 chain orange mark plate with the camshaft timing gear timing mark, and attach the chain to the gear as shown in the illustration.

Text in Illustration

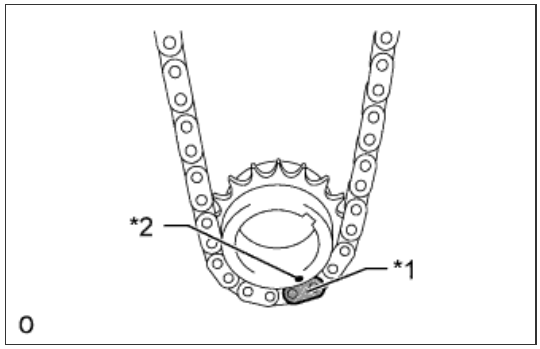
*1	Mark Plate
*2	Timing Mark



b. Align the No. 1 chain orange mark plate with the crankshaft timing sprocket timing mark, and attach the chain to the gear as shown in the illustration.

Text in Illustration

*1	Mark Plate
*2	Timing Mark



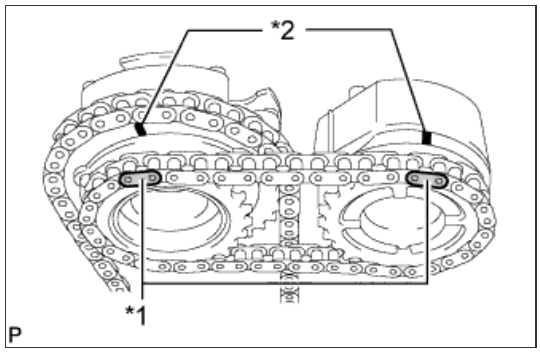
c. Align the No. 2 chain yellow mark plates with the timing marks of the camshaft timing gear assembly and camshaft timing exhaust gear assembly, and attach the No. 2 chain to the gears as shown in the illustration.

Text in Illustration

*1	Mark Plate
*2	Timing Mark

INT:

The crankshaft timing sprocket RH and camshaft timing exhaust gear will be installed with the No. 1 and No. 2 chains connected to the gears.



d. Install the crankshaft timing sprocket RH to the crankshaft.

e. Align and attach the knock pin of the No. 1 camshaft with the pin hole of the camshaft timing gear.

f. Using the hexagonal portion of the No. 2 camshaft, align and attach the knock pin of the No. 2 camshaft with the pin hole of the camshaft timing exhaust gear.

g. Remove the pin from the No. 2 chain tensioner.

h. Using a wrench to hold the hexagonal portion of the No. 1 camshaft, temporarily install the bolt.

i. Using a wrench to hold the hexagonal portion of the No. 2 camshaft, temporarily install the bolt.

26. INSTALL NO. 1 C AIN IBRATION DAMPER R

a. Install the vibration damper with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

27. INSTALL NO. 1 C AIN TENSIONER SLIPPER R

INT:

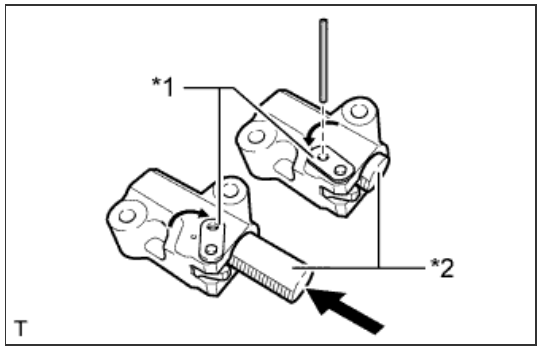
If you cannot install the chain tensioner slipper due to the tension of the chain, use the hexagonal portion of the camshaft to loosen the chain, and then install the chain tensioner slipper.

28. INSTALL NO. 1 C AIN TENSIONER ASSEMBLY R

a. Move the stopper plate clockwise to release the lock, and push the plunger deep into the tensioner.

Text in Illustration

*1	Stopper Plate
*2	Plunger



b. Move the stopper plate counterclockwise to set the lock, and insert a hexagon wrench into the hole of the stopper plate.

c. Install the chain tensioner with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

d. Remove the hexagon wrench from the chain tensioner.

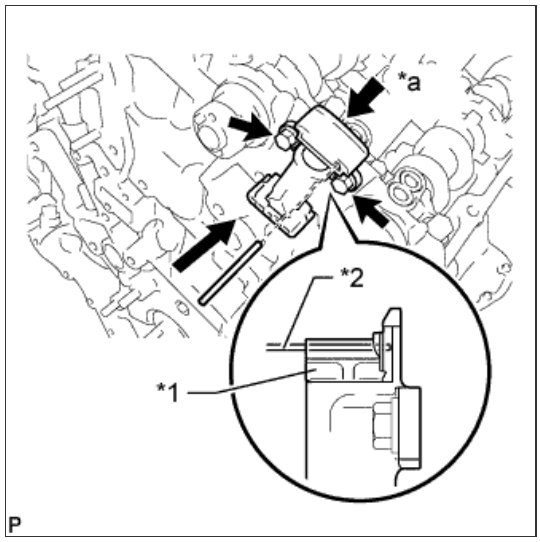
29. INSTALL NO. 3 C AIN TENSIONER ASSEMBLY

a. Install the chain tensioner with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

Text in Illustration

*1	Plunger
*2	Pin
*a	Push



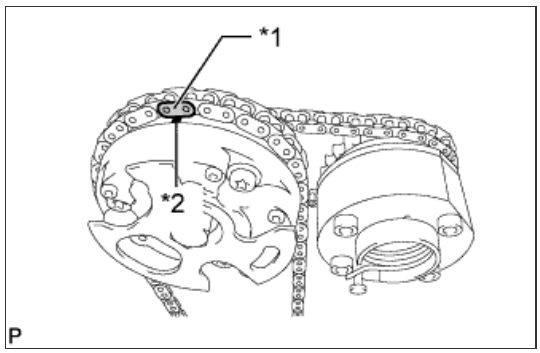
b. While pushing down the No. 2 chain tensioner, insert a pin of 1.0 mm (0.0394 in.) into the hole to fix it in place.

30. INSTALL NO. 1 C AIN SUB-ASSEMBLY L

a. Align the No. 1 chain orange mark plate with the camshaft timing gear timing mark, and attach the chain to the gear as shown in the illustration.

Text in Illustration

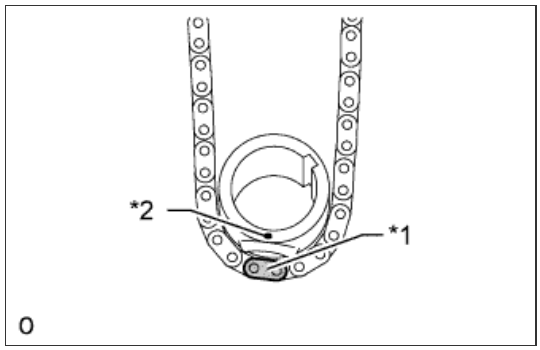
*1	Mark Plate
*2	Timing Mark



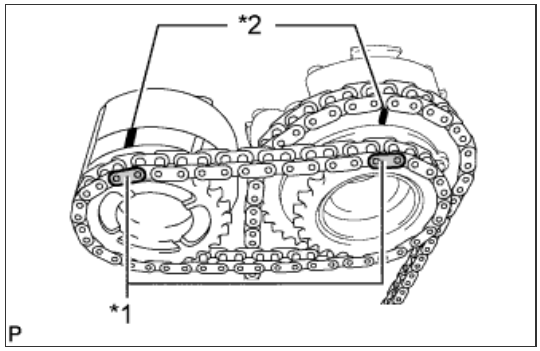
b. Align the No. 1 chain orange mark plate with the crankshaft timing sprocket timing mark, and attach the chain to the gear as shown in the illustration.

Text in Illustration

*1	Mark Plate
*2	Timing Mark



c. Align the No. 2 chain yellow mark plates with the timing marks of the camshaft timing gear assembly and camshaft timing exhaust gear assembly, and attach the No. 2 chain to the gears as shown in the illustration.



Text in Illustration

*1	Mark Plate
*2	Timing Mark

INT:

The crankshaft timing sprocket LH and camshaft timing exhaust gear will be installed with the No. 1 and No. 2 chains connected to the gears.

d. Install the crankshaft timing sprocket LH to the crankshaft.

e. Align and attach the knock pin of the No. 3 camshaft with the pin hole of the camshaft timing gear.

f. Using the hexagonal portion of the No. 4 camshaft, align and attach the knock pin of the No. 4 camshaft with the pin hole of the camshaft timing exhaust gear.

NOTICE:

Because the timing mark positions of the gears may shift due to looseness of the No. 1 chain, use the hexagonal portion of the camshaft to hold the No. 3 camshaft in place until the No. 1 chain tensioner is installed.

g. Remove the pin from the No. 3 chain tensioner.

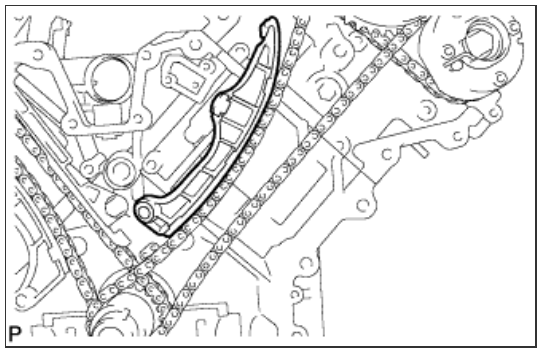
h. Using a wrench to hold the hexagonal portion of the No. 3 camshaft, temporarily install the bolt.

i. Using a wrench to hold the hexagonal portion of the No. 4 camshaft, temporarily install the bolt.

31. INSTALL NO. 1 C AIN TENSIONER SLIPPER L

INT:

If you cannot install the chain tensioner slipper due to the tension of the chain, use the hexagonal portion of the camshaft to loosen the chain, and install the chain tensioner slipper.



32. INSTALL NO. 1 C AIN TENSIONER ASSEMBLY L

a. Move the stopper plate clockwise to release the lock, and push the plunger deep into the tensioner.

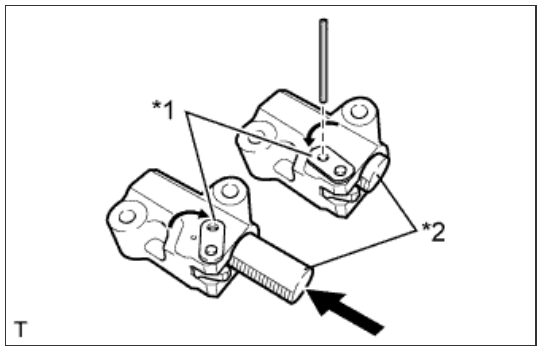
Text in Illustration

*1	Stopper Plate
*2	Plunger

b. Move the stopper plate counterclockwise to set the lock, and insert a hexagon wrench into the hole of the stopper plate.

c. Install a new gasket and the chain tensioner with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

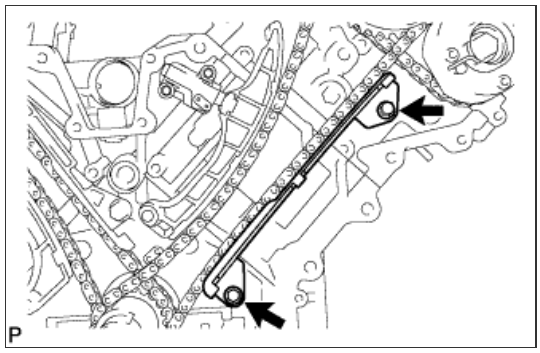


33. INSTALL NO. 1 C AIN IBRATION DAMPER L

a. Install the vibration damper with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

b. Remove the hexagon wrench from the No. 1 chain tensioner.



34. TIG TEN CAMS AFT TIMING GEAR

a. for Bank 1:

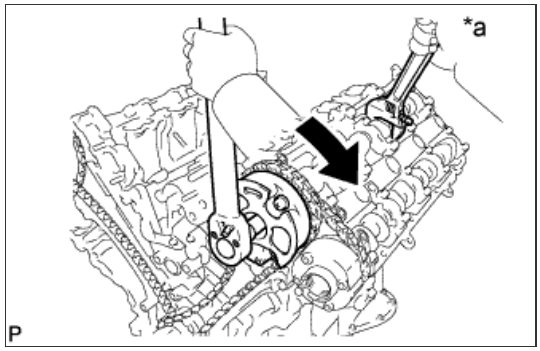
i. Using a wrench, hold the hexagonal portion of the No. 3 camshaft.

Text in Illustration

*a	Hold
➡	Turn

ii. Tighten the bolt of the camshaft timing gear.

Torque:
100 N*m{ 1020 kgf*cm , 74 ft.*lbf }

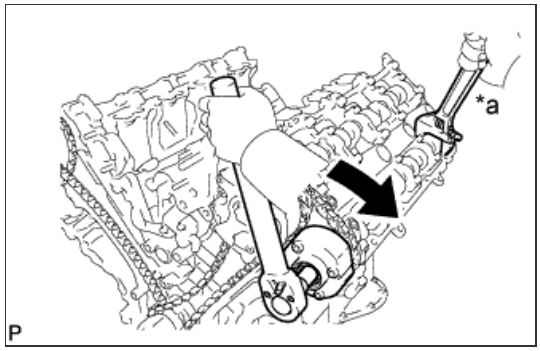


iii. Using a wrench to hold the hexagonal portion of the No. 4 camshaft, tighten the bolt of the camshaft timing exhaust gear.

Torque:
100 N*m{ 1020 kgf*cm , 74 ft.*lbf }

Text in Illustration

*a	Hold
➡	Turn

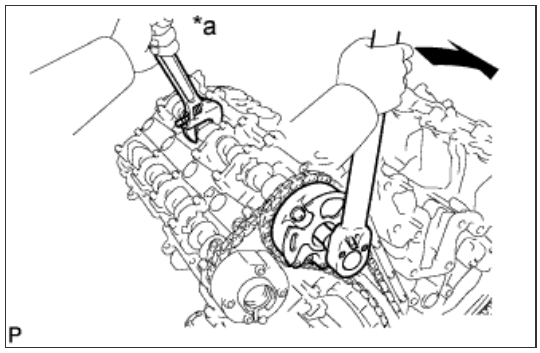


b. for Bank 2:

i. Using a wrench, hold the hexagonal portion of the No. 1 camshaft.

Text in Illustration

*a	Hold
➡	Turn



ii. Tighten the bolt of the camshaft timing gear.

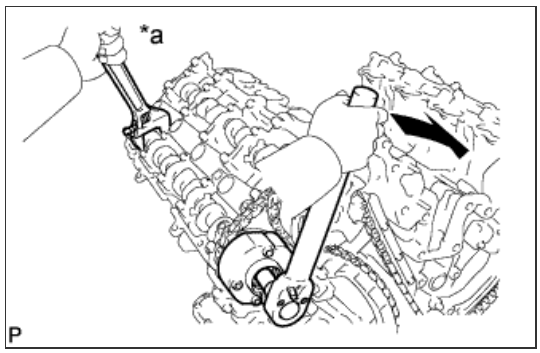
Torque:
100 N*m{ 1020 kgf*cm , 74 ft.*lbf }

iii. Using a wrench to hold the hexagonal portion of the No. 2 camshaft, tighten the bolt of the camshaft timing exhaust gear.

Torque:
100 N*m{ 1020 kgf*cm , 74 ft.*lbf }

Text in Illustration

*a	Hold
➡	Turn

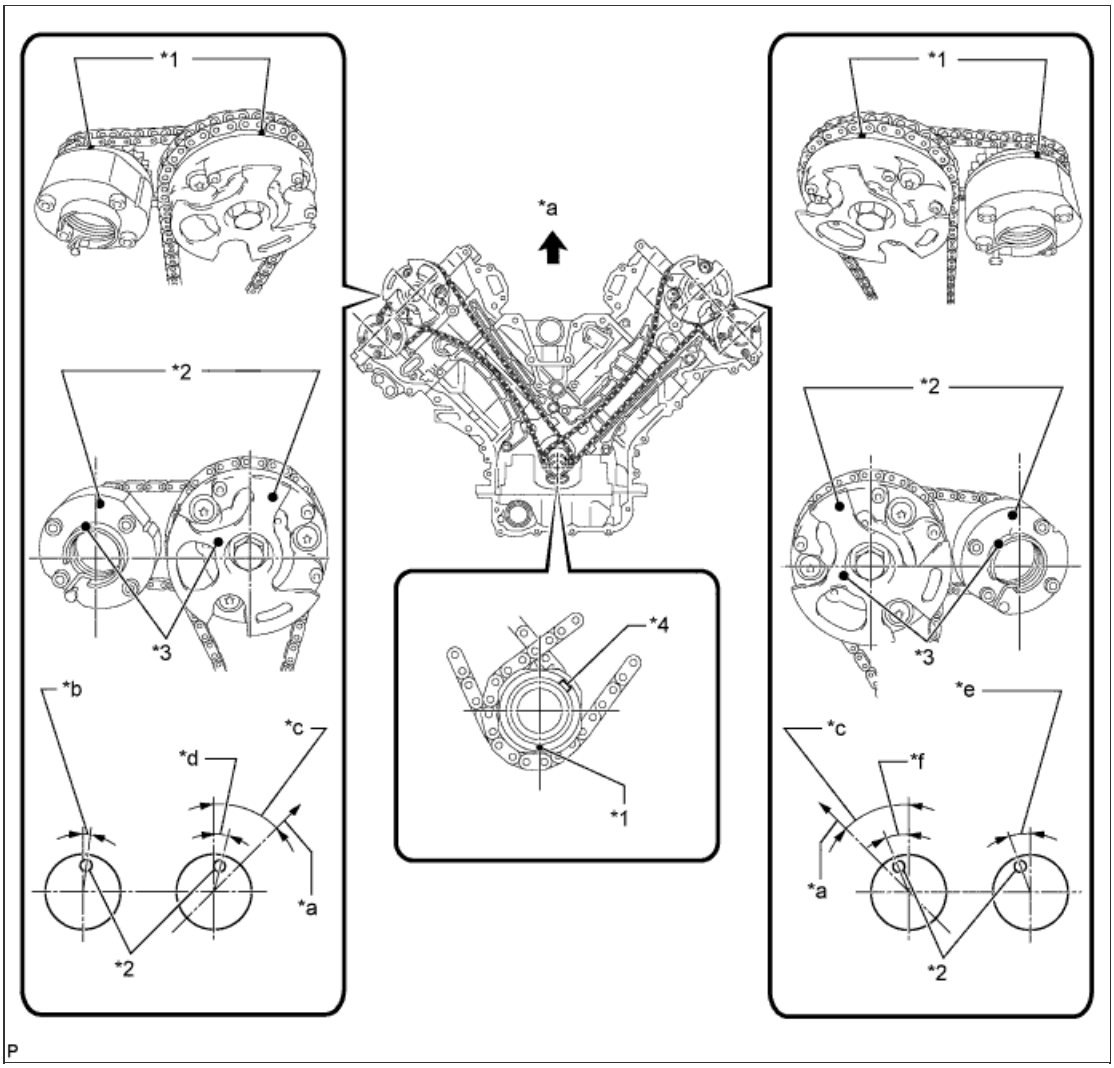


35. C ECK NO. 1 CYLINDER TO TDC COMPRESSION

a. Temporarily install the crankshaft pulley bolt.

b. Rotate the crankshaft clockwise, and check that the timing marks on the crankshaft timing sprocket and camshaft timing gears are as shown in the illustration.

c. Remove the crankshaft pulley bolt.



Text in Illustration

*1	Timing Mark	*2	Timing Mark Position
*3	Knock Pin Position	*4	Key
*a	Toward Ceiling	*b	Approximately 2°
*c	Approximately 45°	*d	Approximately 16°
*e	Approximately 18°	*f	Approximately 32°

36. INSTALL ATER INLET PIPE

a. Apply soapy water to 2 new O-rings and install them to the inlet pipe.

b. Install the inlet pipe to the No. 1 heat exchanger cover.

37. INSTALL TIMING C AIN CO ER SUB-ASSEMBLY

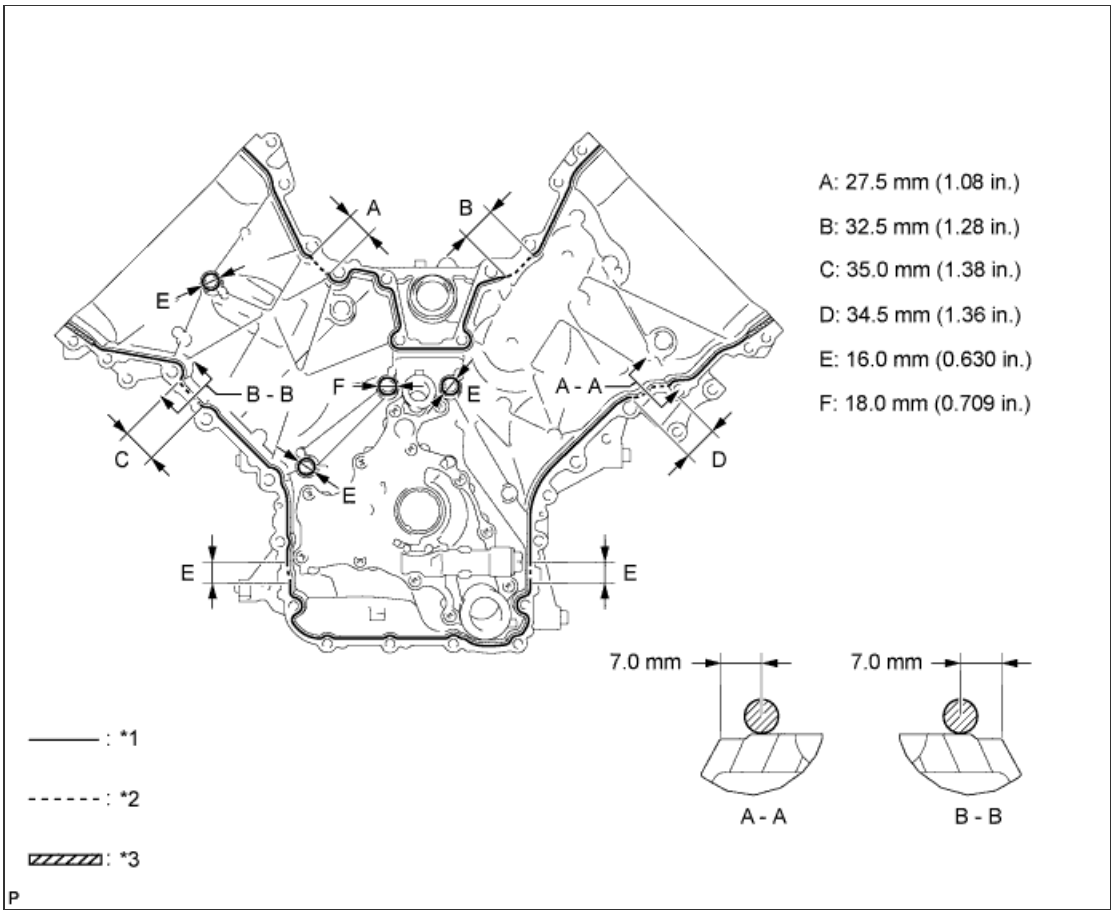
a. Apply a light coat of engine oil to a new oil pump gasket.

b. Install the oil pump gasket.

c. Apply a light coat of engine oil to a new O-ring.

d. Install the O-ring.

e. Apply seal packing in a continuous line to the timing chain cover as shown in the following illustration.



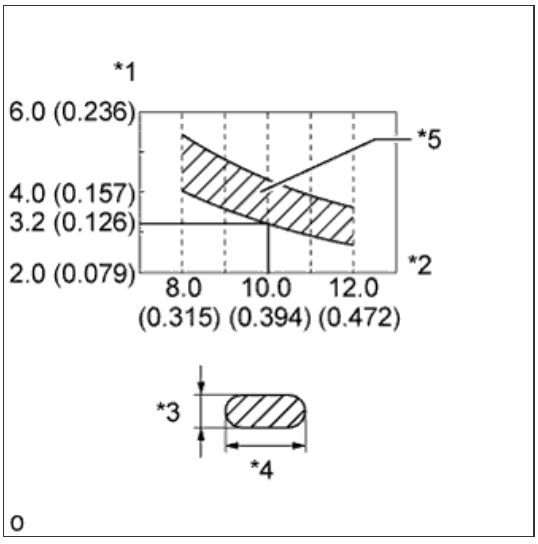
Text in Illustration

*1	Continuous line area	*2	Dashed line area
*3	Diagonal line area	-	-

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Apply Seal Packing as Follows:

Area	Seal Packing Diameter	Application Position from Inside Edge of Cover
Continuous Line Area	3.0 to 4.0 mm (0.118 to 0.157 in.)	2.5 mm (0.0984 in.)
Dashed Line Area	6.4 mm (0.252 in.) or more, or within OK area shown in illustration	7.0 mm (0.276 in.)
Diagonal Line Area	3.0 to 4.0 mm (0.118 to 0.157 in.)	5.5 mm (0.217 in.)



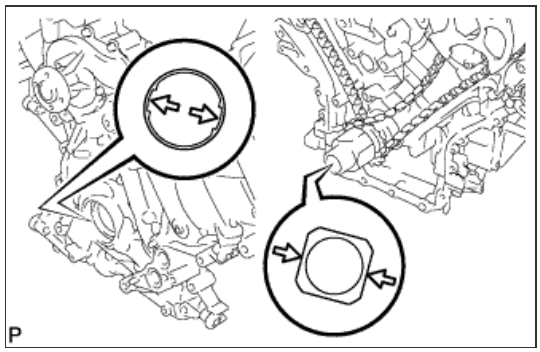
Text in Illustration

*1	Seal Packing Thickness mm (in.)
*2	Seal Packing Width mm (in.)
*3	Seal Packing Thickness
*4	Seal Packing Width
*5	OK Area

NOTICE:

- **hen the contact surfaces are wet, wipe them with an oil-free cloth before applying seal packing.**
- **Install the chain cover within 3 minutes and tighten the bolts within 10 minutes after applying seal packing.**

f. Align the oil pump drive rotor spline and crankshaft as shown in the illustration. Install the spline and chain cover to the crankshaft.



g. Temporarily install the timing chain cover with the 28 bolts and nut.

Standard Bolt:

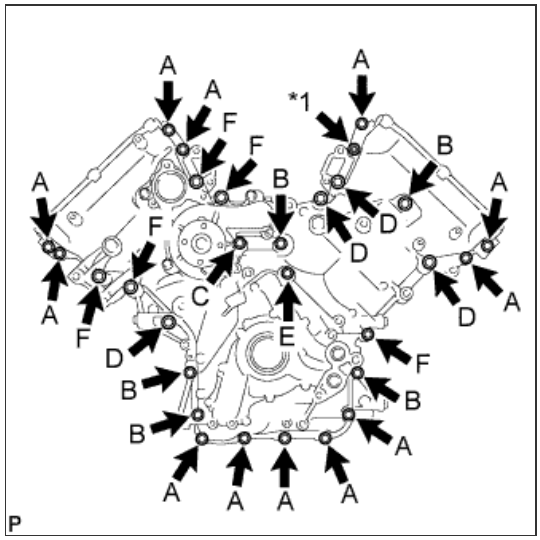
Item	Length	Thread Diameter
Bolt A	25 mm (0.984 in.)	8 mm (0.315 in.)
Bolt B	55 mm (2.17 in.)	8 mm (0.315 in.)
Bolt C	70 mm (2.76 in.)	8 mm (0.315 in.)
Bolt D	35 mm (1.38 in.)	10 mm (0.394 in.)
Bolt E	55 mm (2.17 in.)	10 mm (0.394 in.)
Bolt F	80 mm (3.15 in.)	10 mm (0.394 in.)

Text in Illustration

*1	Nut

NOTICE:

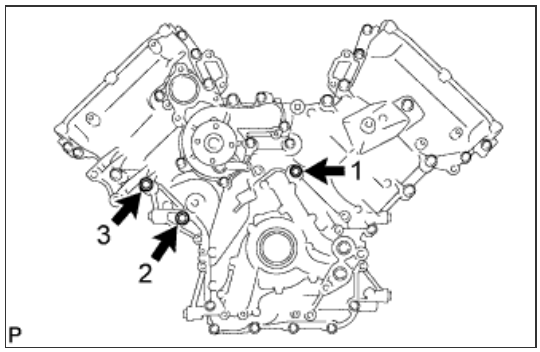
Make sure that there is no oil on the bolt threads.



h. Tighten the 3 bolts in several steps in the sequence shown in the illustration.

Torque:

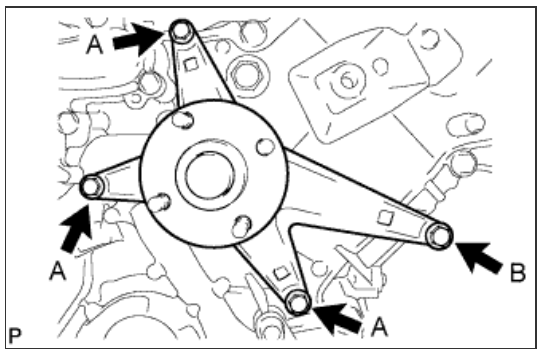
47 N*m{ 479 kgf*cm , 35 ft.*lbf }



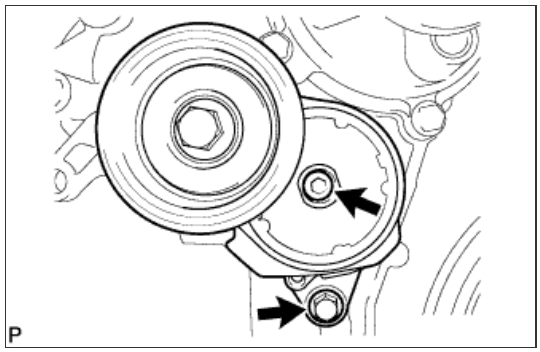
i. Temporarily install the fluid coupling bracket with the 4 bolts.

Standard Bolt:

Item	Length	Thread Diameter
Bolt A	70 mm (2.76 in.)	8 mm (0.315 in.)
Bolt B	80 mm (3.15 in.)	10 mm (0.394 in.)

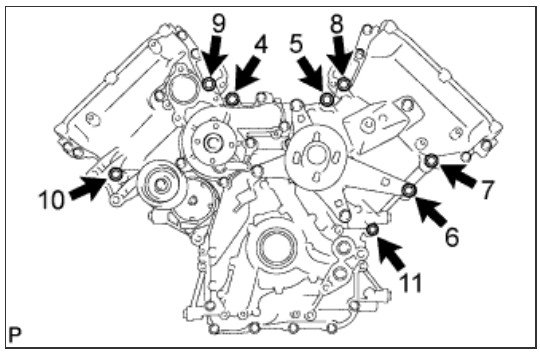


.Temporarily install the belt tensioner with the standard bolt and 6 mm hexagon wrench bolt.



k. Tighten the 8 bolts labeled 4 to 11 in several steps in the sequence shown in the illustration.

Torque:
47 N*m{ 479 kgf*cm , 35 ft.*lbf }

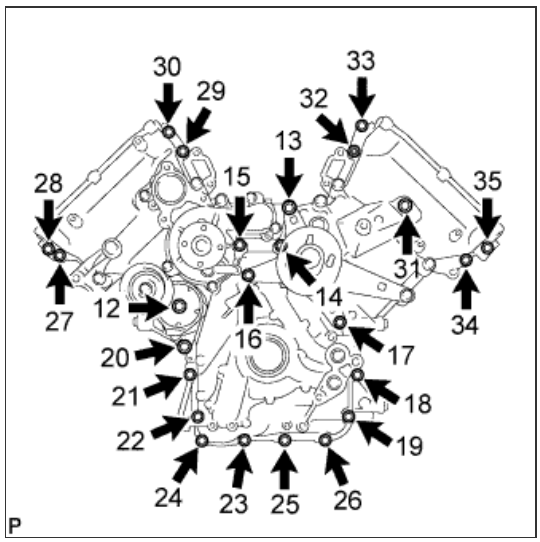


l. Tighten the 23 bolts and nut labeled 12 to 35 in several steps in the sequence shown in the illustration.

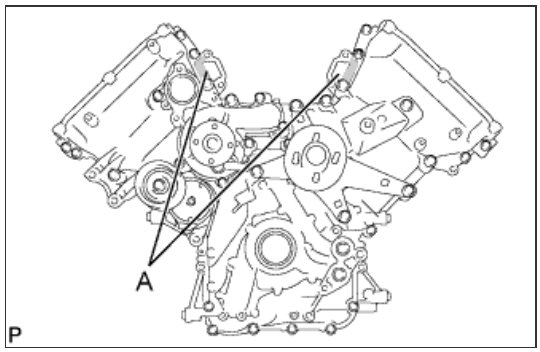
Torque:
23 N*m{ 235 kgf*cm , 17 ft.*lbf }

NOTICE:

- **Do not start the engine for at least 2 hours after installing.**



- **After the installation, if the seal packing has seeped out at the areas labeled A shown in the illustration, wipe it off.**



38. INSTALL ATER PUMP ASSEMBLY

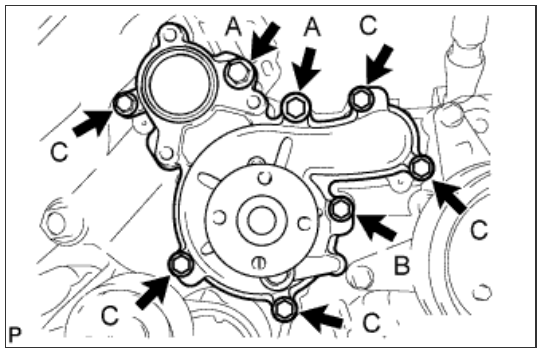
a. Install a new gasket and the water pump with the 8 bolts shown in the illustration.

Torque:
for bolt A:
47 N*m{ 479 kgf*cm , 35 ft.*lbf }

for bolt B:
23 N*m{ 235 kgf*cm , 17 ft.*lbf }
for bolt C:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

Standard Bolt:

Item	Length	Thread Diameter
Bolt A	80 mm (3.15 in.)	10 mm (0.394 in.)
Bolt B	70 mm (2.76 in.)	8 mm (0.315 in.)
Bolt C	25 mm (0.984 in.)	8 mm (0.315 in.)

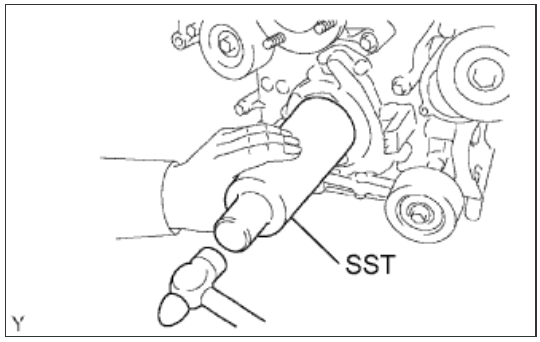


39. INSTALL FRONT CRANKS AFT OIL SEAL

a. Apply MP grease to the lip of a new oil seal.

b. Using SST and a hammer, tap in the oil seal until its surface is flush with the timing chain cover edge.

SST
09226-10010



40. INSTALL CRANKS AFT TIMING GEAR KEY

a. Install the crankshaft timing gear key.

41. INSTALL CRANKS AFT PULLEY

a. Align the pulley set key with the key groove of the pulley, and slide on the pulley.

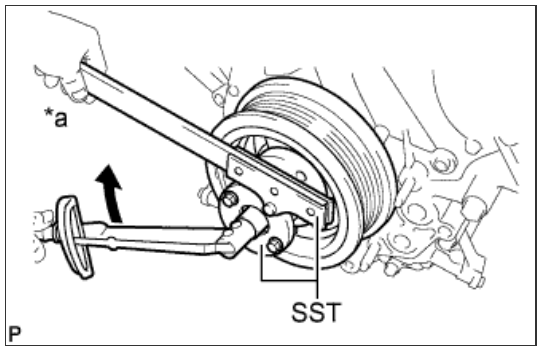
b. Using SST, install the pulley set bolt.

SST
09213-70011
09330-00021

Torque:
300 N*m{ 3059 kgf*cm , 221 ft.*lbf }

Text in Illustration

*a	Hold
➡	Turn

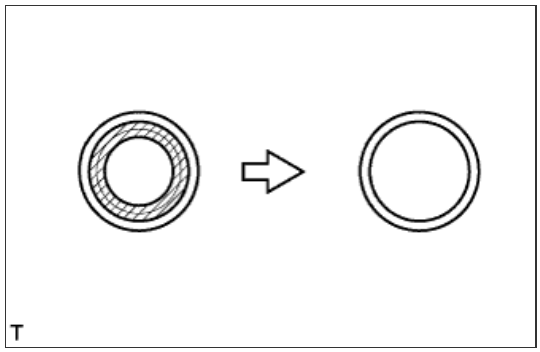


42. INSTALL SPARK PLUG TUBE GASKET

a. Using a cutter knife, cut off the seal part of the removed gasket.

Text in Illustration

	Area to cut off



b. Using the removed gasket and a hammer, tap in a new gasket until it stops.

Text in Illustration

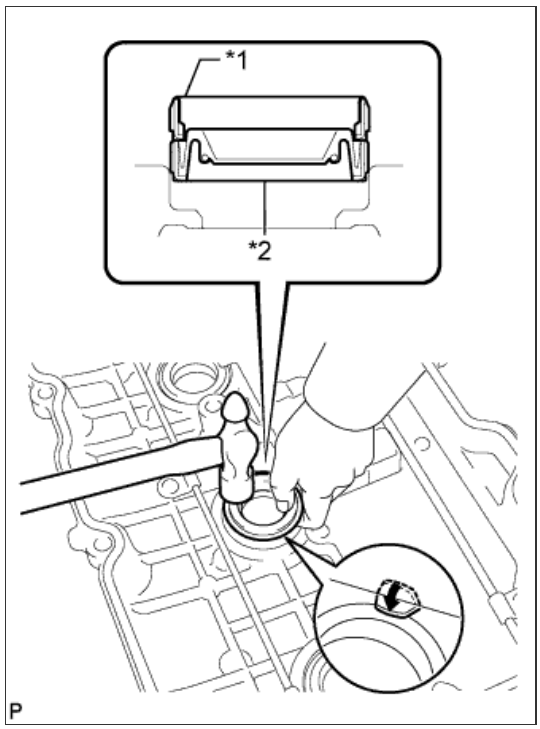
*1	Removed Gasket
*2	New Gasket

INT:

If the removed gasket does not fit on the new one, correct the removed one with pliers.

c. Apply a light coat of MP grease to the lip of the gasket.

d. Return the 4 ventilation baffle plate claws to the original positions.



43. INSTALL OIL CONTROL AL E FILTER

a. LH:

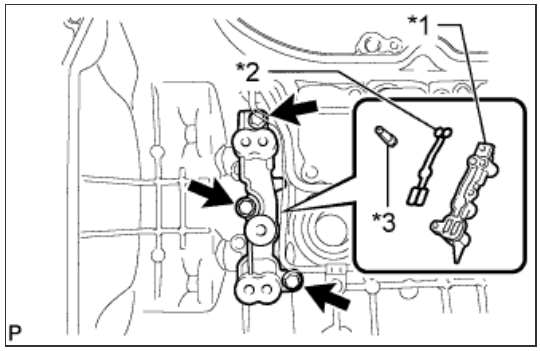
i. Install the filter in the cylinder head.

Text in Illustration

*1	Cylinder Head Cover Spacer
*2	Gasket
*3	Filter

ii. Install a new gasket and the cylinder head cover spacer with the 3 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



b. RH:

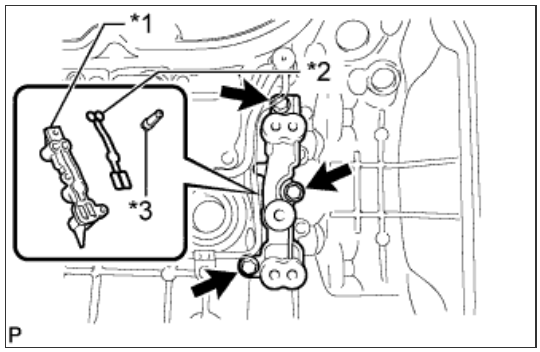
i. Install the filter in the cylinder head.

Text in Illustration

*1	Cylinder Head Cover Spacer
*2	Gasket
*3	Filter

ii. Install a new gasket and the cylinder head cover spacer with the 3 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



44. INSTALL CYLINDER EAD CO ER SUB-ASSEMBLY R

a. Install 5 new gaskets to the camshaft bearing caps. (No. 1, No. 3).

b. Install a new gasket to the cylinder head cover.

NOTICE:

Remove any oil from the contact surface.

c. Apply seal packing as shown in the illustration.

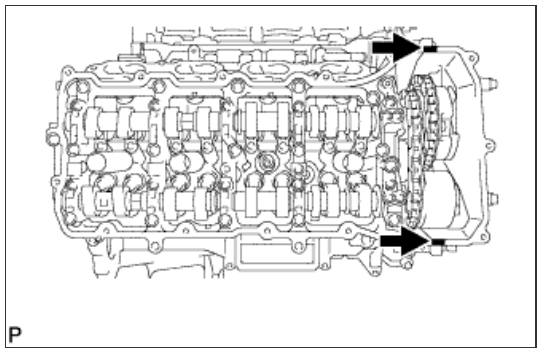
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Text in Illustration

➡	Seal Packing

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the cylinder head cover within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**



d. Install the cylinder head cover and a new seal washer with the 14 bolts in the order shown in the illustration.

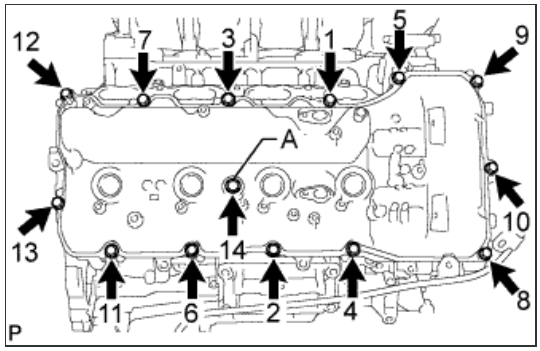
Torque:
for bolt A:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
except bolt A:
12 N*m{ 122 kgf*cm , 9 ft.*lbf }

NOTICE:

Do not start the engine for at least 2 hours after the installation.

e. Install the noise filter to the cylinder head cover with the bolt.

Torque:
7.0 N*m{ 71 kgf*cm , 62 in.*lbf }



45. INSTALL CYLINDER EAD CO ER SUB-ASSEMBLY L

a. Install 5 new gaskets to the camshaft bearing caps (No. 2, No. 3).

b. Install a new gasket to the cylinder head cover.

NOTICE:

Remove any oil from the contact surface.

c. Apply seal packing as shown in the illustration.

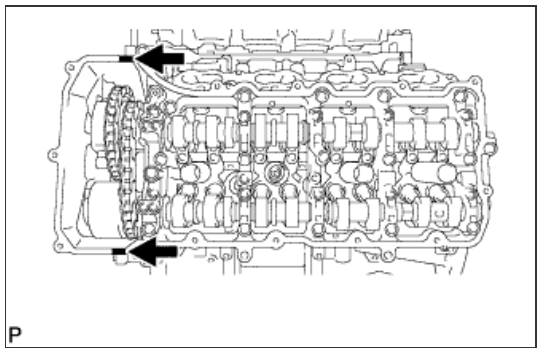
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Text in Illustration

➡	Seal Packing

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the cylinder head cover within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**

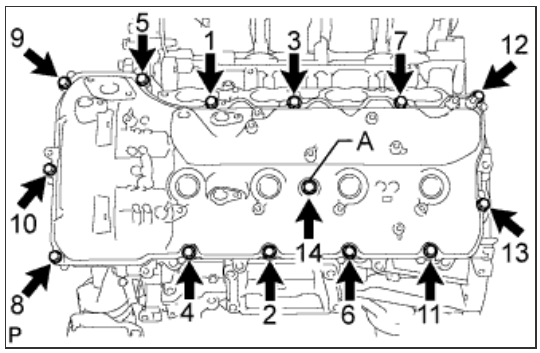


d. Install the cylinder head cover and a new seal washer with the 14 bolts in the order shown in the illustration.

Torque:
for bolt A:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
except bolt A:
12 N*m{ 122 kgf*cm , 9 ft.*lbf }

NOTICE:

Do not start the engine for at least 2 hours after the installation.



46. INSTALL NO. 1 IDLER PULLEY SUB-ASSEMBLY

a. Install the idler pulley with the bolt.

Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }

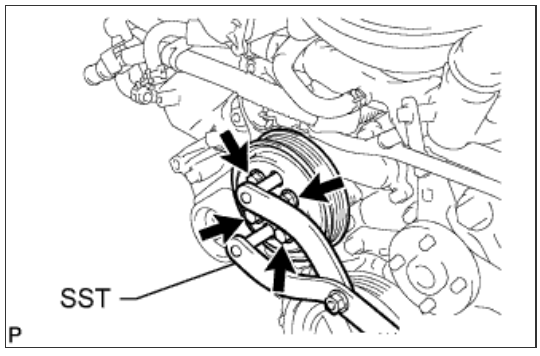
47. INSTALL ATER PUMP PULLEY

a. Temporarily install the pulley with the 4 bolts.

b. Using SST, hold the pulley and tighten the 4 bolts.

SST
09960-10010 09962-01000, 09963-01000

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



48. INSTALL CAMS AFT OIL CONTROL AL E ASSEMBLY

a. for Bank 1:

i. Apply a light coat of engine oil to 2 new O-rings.

ii. Install the 2 O-rings to the 2 oil control valves.

iii. Install the 2 oil control valves with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. for Bank 2:

i. Apply a light coat of engine oil to 2 new O-rings.

ii. Install the 2 O-rings to the 2 oil control valves.

iii. Install the 2 oil control valves with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

49. INSTALL CRANKS AFT POSITION SENSOR

a. Install the crankshaft position sensor with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

50. INSTALL CRANK POSITION SENSOR PROTECTOR

a. Install the sensor protector with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

51. INSTALL CAMS AFT POSITION SENSOR

a. Install the camshaft position sensor with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

52. INSTALL T SENSOR

a. for Bank 1:

i. Install the 2 VVT sensors with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. for Bank 2:

i. Install the 2 VVT sensors with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

53. INSTALL SPARK PLUG

a. Using a 16 mm plug wrench, install the 8 spark plugs.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

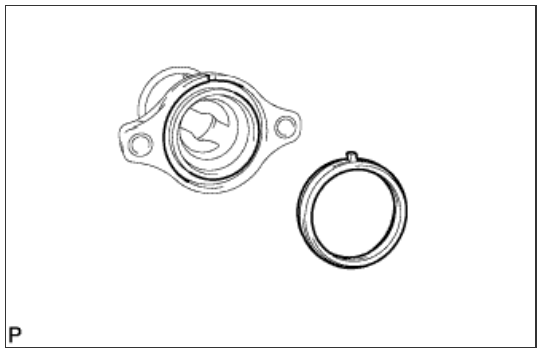
54. INSTALL OIL FILLER CAP OUSING

a. Align the protrusion of a new gasket with the cutout of the oil filler cap housing,

and install the gasket to the housing.

b. Install the cap housing with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



55. INSTALL OIL FILLER CAP SUB-ASSEMBLY

56. INSTALL OIL FILTER BRACKET

a. Apply a light coat of engine oil to 2 new O-rings.

b. Install the 2 O-rings to the timing chain cover.

c. Install the oil filter bracket with the 2 nuts and 2 bolts.

Torque:
35 N*m{ 357 kgf*cm , 26 ft.*lbf }

57. INSTALL NO. 1 OIL COOLER BRACKET

a. Connect the ground wire to the cylinder block.

b. Install the oil cooler bracket with the 2 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

58. INSTALL OIL FILTER ELEMENT

a. Clean the inside of the oil filter cap, its threads and its O-ring groove.

b. Apply a small amount of engine oil to a new O-ring and install it to the oil filter cap.

c. Set a new oil filter element to the oil filter cap.

d. Remove any dirt or foreign matter from the installation surface of the engine.

e. Apply a small amount of engine oil to the O-ring again and temporarily install the oil filter cap.

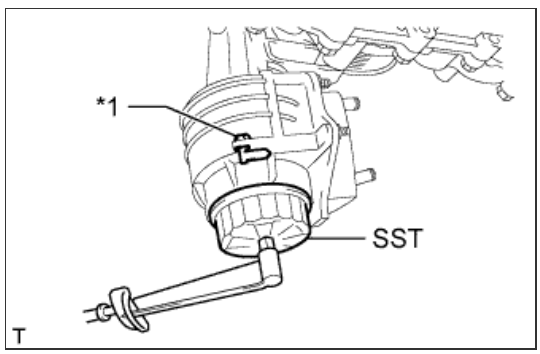
NOTICE:

Do not remove the oil filter bracket clip.

f. Using SST, tighten the oil filter cap.

SST
09228-06501

Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }



Text in Illustration

*1	Oil Filter Bracket Clip

NOTICE:

- **hen tightening the oil filter cap, do not remove the oil filter bracket clip.**
- **Make sure that the oil filter is installed securely as shown in the illustration.**

- **Be careful that the O-ring does not get caught between any surrounding parts.**

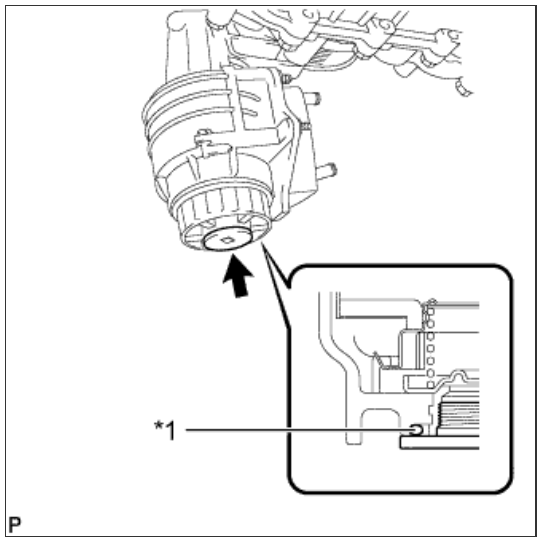
g. Apply a small amount of engine oil to a new drain plug O-ring, and install it to the oil filter cap.

Text in Illustration

*1	O-Ring

NOTICE:

Before installing the O-ring, remove any dirt or foreign matter from the installation surface of the oil filter cap.



h. Install the oil filter drain plug.

Torque:
13 N*m{ 127 kgf*cm , 9 ft.*lbf }

NOTICE:

Be careful that the O-ring does not get caught between any surrounding parts.

i. Install the No. 2 engine under cover seal with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

59. INSTALL OIL PRESSURE SENDER GAUGE ASSEMBLY

a. Apply adhesive to 2 or 3 threads of the oil pressure sender gauge.

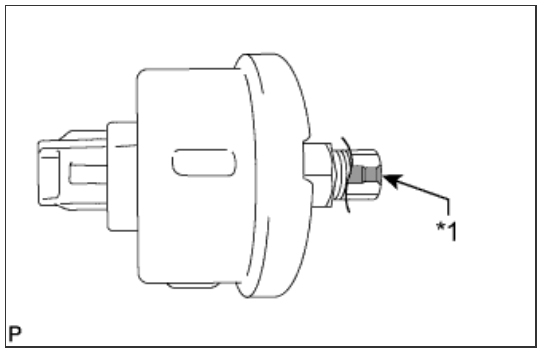
Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent

NOTICE:

Do not allow adhesive to contact the oil hole.

Text in Illustration

*1	Oil Hole



b. Install the oil pressure sender gauge.

Torque:
15 N*m{ 153 kgf*cm , 11 ft.*lbf }

NOTICE:

Do not start the engine within 1 hour after installation.

c. Connect the sender gauge connector.

for Preparation Click here

1. INSTALL NOISE FILTER

a. Install the 2 noise filters to the cylinder head cover with the 2 bolts.

Torque:
7.0 N*m{ 71 kgf*cm , 62 in.*lbf }

2. INSTALL IGNITION COIL ASSE L

a. Install the 8 ignition coils with the 8 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

3. INSTALL FRONT NO. 1 ENGINE OUNTING BRACKET LH

a. Install the mounting bracket with the 4 bolts.

Torque:
35 N*m{ 357 kgf*cm , 26 ft.*lbf }

4. INSTALL FRONT NO. 1 ENGINE OUNTING BRACKET RH

a. Install the mounting bracket with the 4 bolts.

Torque:
35 N*m{ 357 kgf*cm , 26 ft.*lbf }

5. INSTALL C LINDER BLOCK WATER DRAIN COCK SUB-ASSE L

a. Apply adhesive to 2 or 3 threads of the drain cocks.

Adhe i e:
Toyota Genuine Adhe i e 1344, Three Bond 1344 or equi alent

b. Install the water drain cocks as shown in the illustration.

Torque:
30 N*m{ 306 kgf*cm , 22 ft.*lbf }

Text in Illu tration

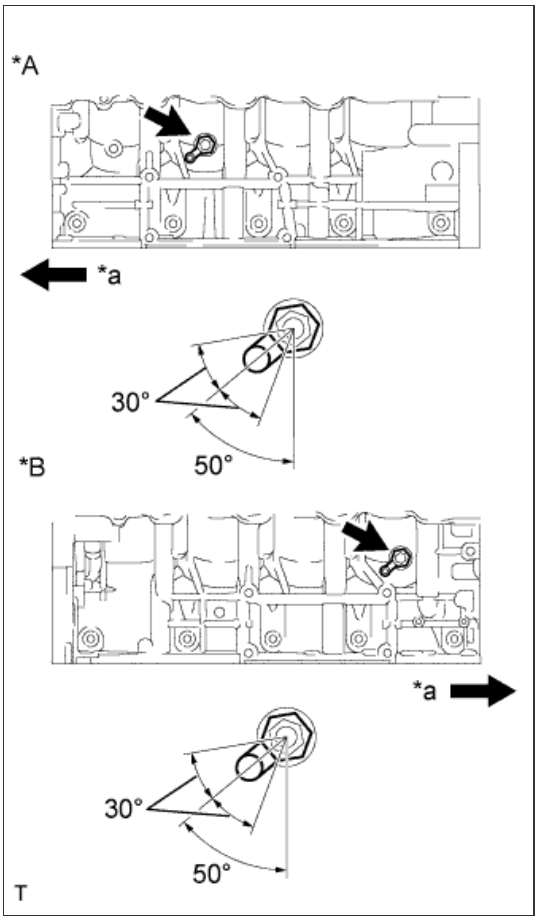
*A	LH
*B	RH
*a	Front

NOTICE:

- **Do not rotate the drain cock more than 1 re olution 360 after tightening the drain cock to the pecified torque.**
- **Do not loo en the drain cock to ad u t them. If an ad u tment i nece ary, remo e the drain cock and rein tall them.**

c. Install the water drain cock plugs to the water drain cocks.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



6. INSTALL KNOCK SENSOR

a. Install the 4 sensors with the 4 bolts so that the sensors are angled as shown in the illustration.

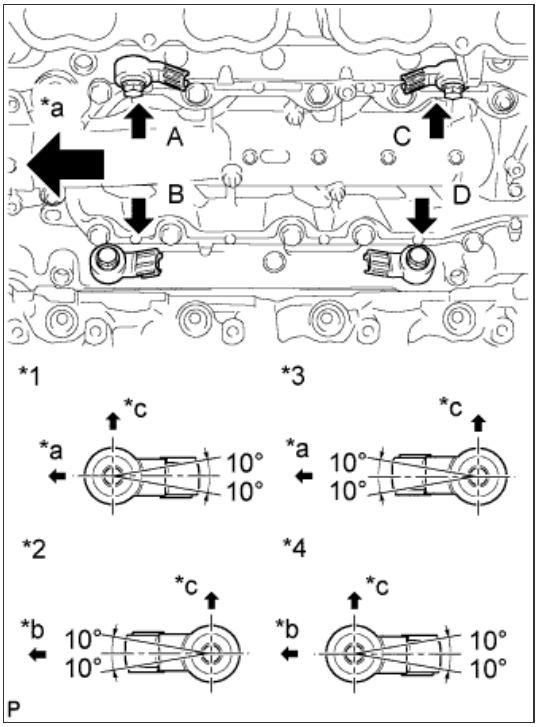
Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

Text in Illu tration

*1	Bank 2 Sensor 1
*2	Bank 1 Sensor 1
*3	Bank 2 Sensor 2
*4	Bank 1 Sensor 2
*a	Front
*b	Rear
*c	Top

NOTICE:

The acceptable installation angle of the sensor is between 10° upward and downward from the horizontal position.



7. INSTALL SEPARATOR CASE

a. After inserting the pipe on the rear of the separator case into the oil return pipe and the pipe on the front into the ventilation pipe, temporarily install bolt A.

b. Temporarily install bolt B and tighten bolt A.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

c. Install the bolts labeled C.

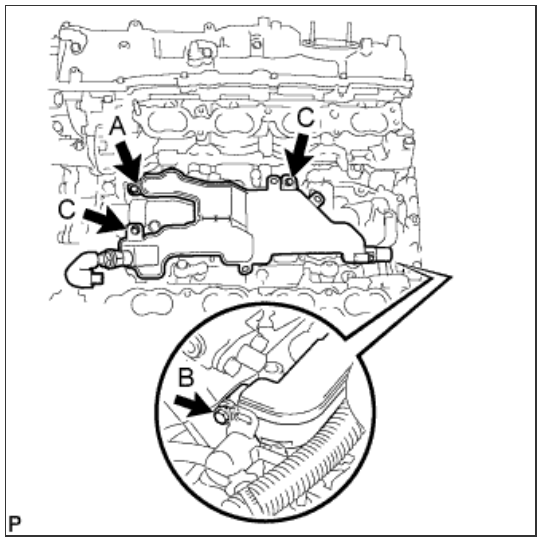
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

d. Tighten bolt B.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

Standard Bolt:

Item	Length	Thread Diameter
Bolt A	25 mm (0.984 in.)	6 mm (0.236 in.)
Bolt B and C	16 mm (0.630 in.)	6 mm (0.236 in.)



8. INSTALL SENSOR WIRE

a. Connect the 3 clamps and 4 knock sensor connectors.

INSTALL WATER B PASS PIPE SUB-ASSE L

a. Install the water by-pass pipe with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

10. INSTALL WATER INLET HOUSING

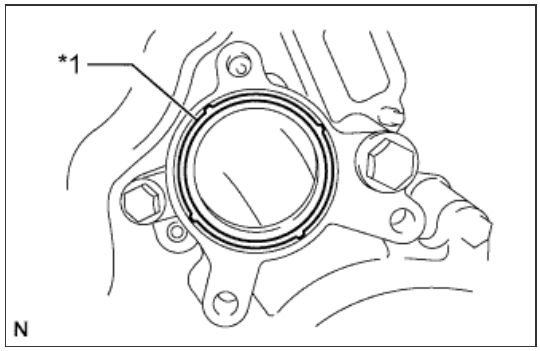
a. Install a new gasket to the timing chain cover.

b. Install the water inlet with the 3 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

Text in Illustration

*1	Gasket



11. INSTALL FRONT WATER B PASS OINT

a. Install 2 new gaskets and the water by-pass joint with the 4 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

b. Connect the No. 2 water by-pass hose to the water by-pass joint.

12. INSTALL NO. 1 WATER B PASS HOSE

a. Install the No. 1 water by-pass hose by connecting the hose to the water inlet housing and front water by-pass joint.

13. INSTALL NO. 2 WATER B PASS PIPE SUB-ASSE L

a. Connect the 4 hoses.

b. Install the water by-pass pipe with the 3 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

14. INSTALL NO. 1 ENGINE CO ER

15. INSTALL NO. 2 ENGINE CO ER

16. INSTALL NO. 1 FUEL TUBE

17. INSTALL NO. 2 FUEL TUBE

a. Install the No. 2 fuel tube with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

18. INSTALL INTAKE AIFOLD

a. Place 2 new gaskets on the intake manifold.

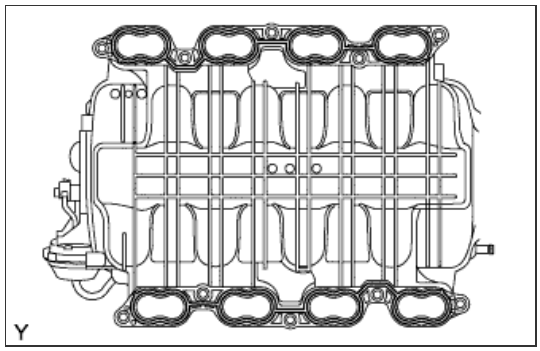
b. Place the intake manifold on the cylinder head.

c. Install and uniformly tighten the 8 bolts and 2 nuts in several steps.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

d. Install the wire bracket to the intake manifold with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }



e. Connect the No. 1 ventilation hose.

f. Connect the 2 water by-pass hoses.

g. Connect the ventilation pipe to the ventilation pipe of the cylinder head cover LH and RH.

19. INSTALL FUEL IN ECTOR ASSE L

a. Attach the 3 clamps to install the No. 6 wire harness to the delivery pipe RH.

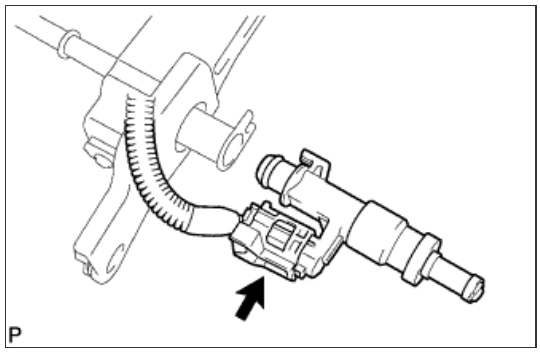
b. Attach the 3 clamps to install the No. 7 wire harness to the delivery pipe LH.

c. Apply gasoline or spindle oil to a new O-ring and install it to the injector.

NOTICE:

Make sure that there is no damage or foreign material in the groove of the injector when installing the O-ring.

d. Connect the injector connector.



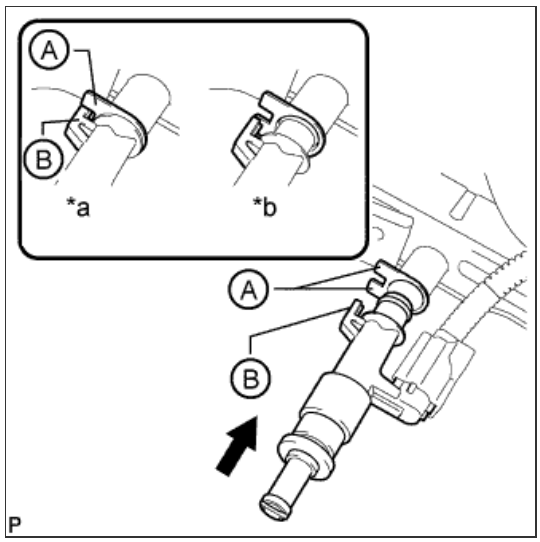
e. Install the injector to the delivery pipe as shown in the illustration.

Text in Illustration

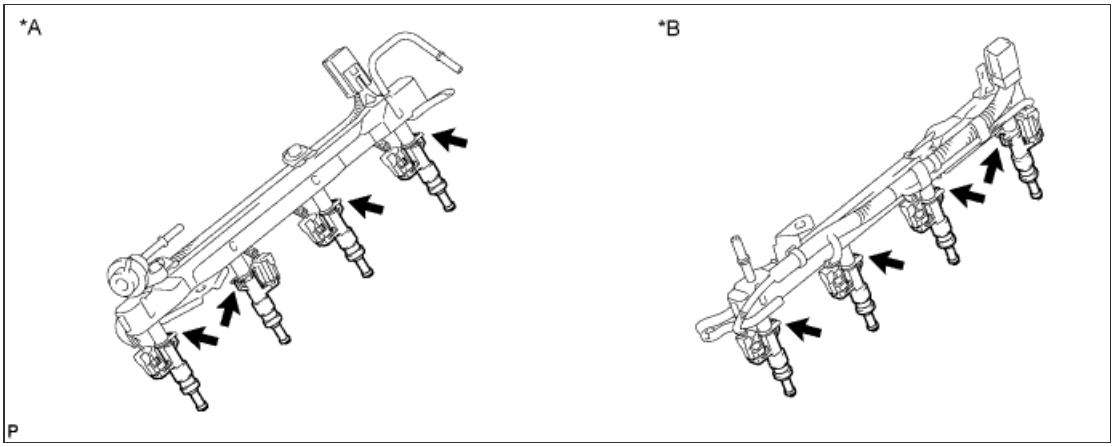
*a	CORRECT
*b	INCORRECT

NOTICE:

- ake sure that there are no scratches or foreign matter in or around the insertion hole of the deli ery pipe.
- When inserting the injector, be careful not to damage the O-ring.
- Attach the part of the injector labeled B bet een the parts of the deli ery pipe labeled A.



f. Check that each injector is installed to the delivery pipe facing the direction shown in the illustration.



Text in Illustration

*A	Fuel Delivery Pipe RH	*B	Fuel Delivery Pipe LH

20. INSTALL FUEL DELI ER PIPE SUB-ASSE L RH

a. Install the 2 delivery pipe spacers and 4 insulators to the cylinder head RH.

b. Install the delivery pipe (with injectors) to the cylinder head RH.

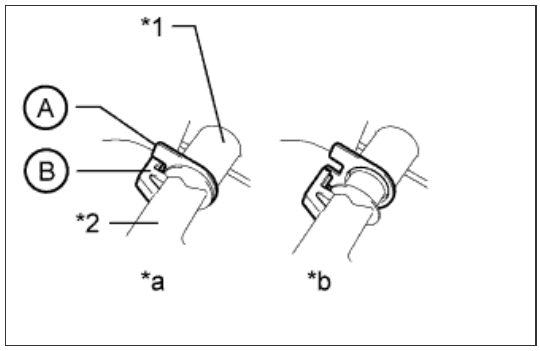
c. Install the 2 bolts.

Torque:

21 N*m{ 214 kgf*cm , 15 ft.*lbf }

NOTICE:

Make sure that the part of the injector labeled B is between the parts of the delivery pipe labeled A.



Text in Illustration

*1	Delivery Pipe
*2	Injector
*a	CORRECT
*b	INCORRECT

d. Connect the No. 6 wire harness connector.

e. Connect the ventilation hose.

21. INSTALL FUEL DELI ER PIPE SUB-ASSE L LH

a. Install the 2 delivery pipe spacers and 4 insulators to the cylinder head LH.

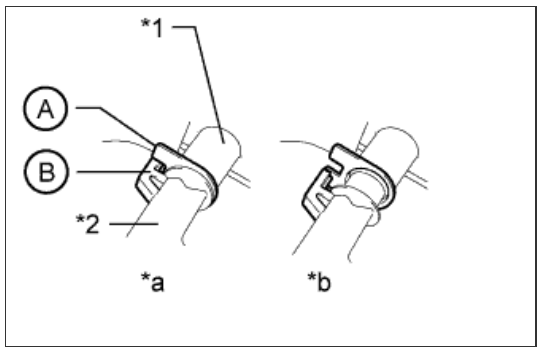
b. Install the delivery pipe (with injectors) to the cylinder head LH.

c. Install the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

NOTICE:

Make sure that the part of the injector labeled B is between the parts of the delivery pipe labeled A.



Text in Illustration

*1	Delivery Pipe
*2	Injector
*a	CORRECT
*b	INCORRECT

d. Connect the No. 7 wire harness connector.

22. CONNECT NO. 1 FUEL TUBE

a. LH Side:
Connect the No. 1 fuel tube to the delivery pipe LH (Click here).

b. Connect the No. 1 fuel tube to the delivery pipe RH (for metallic type) (Click here).

23. CONNECT NO. 2 FUEL TUBE

a. Connect the No. 2 fuel tube to the fuel pressure regulator (Click here).

24. INSTALL NO. 1 FUEL HOSE

a. Install the fuel hose (Click here).

25. INSTALL NO. 3 ENGINE CO ER

26. INSTALL NO. 1 ENGINE CO ER SUB-ASSE L

27. INSTALL ENGINE WIRE

a. Install the engine wire.

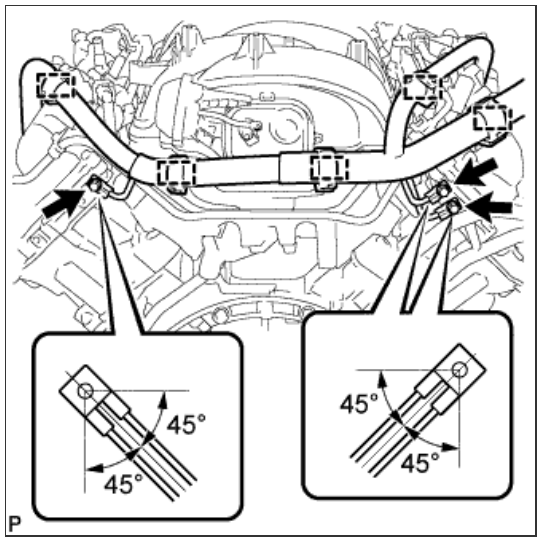
b. Engine Rear Side:

i. Install the 3 bolts as shown in the illustration.

Torque:
8.5 N*m{ 87 kgf*cm , 75 in.*lbf }

ii. Connect the 5 clamps.

iii. Connect the sensor wire connector.



c. Engine RH Side:

i. Connect the 9 clamps.

ii. Connect the oil pressure sender gauge connector.

iii. Connect the throttle sensor connector.

i .Connect the noise filter connector.

.Connect the fuel injector connector.

i. Connect the 2 VVT sensor connectors.

HINT:

The wire harnesses on the exhaust side are wrapped with white tape.

ii. Connect the 4 ignition coil connectors.

iii. Connect the 2 camshaft timing control valve connectors.

HINT:

The wire harnesses on the exhaust side are wrapped with white tape.

d. Engine LH Side:

i. Connect the 7 clamps and install the engine wire with the bolt.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

ii. Connect the noise filter connector.

iii. Connect the fuel injector connector.

i .Connect the engine coolant temperature sensor connector.

.Connect the purge VSV connector.

i. Connect the vacuum switching valve connector (for ACIS).

ii. Connect the camshaft position sensor connector.

iii. Connect the 2 VVT sensor connectors.

HINT:

The wire harnesses on the exhaust side are wrapped with white tape.

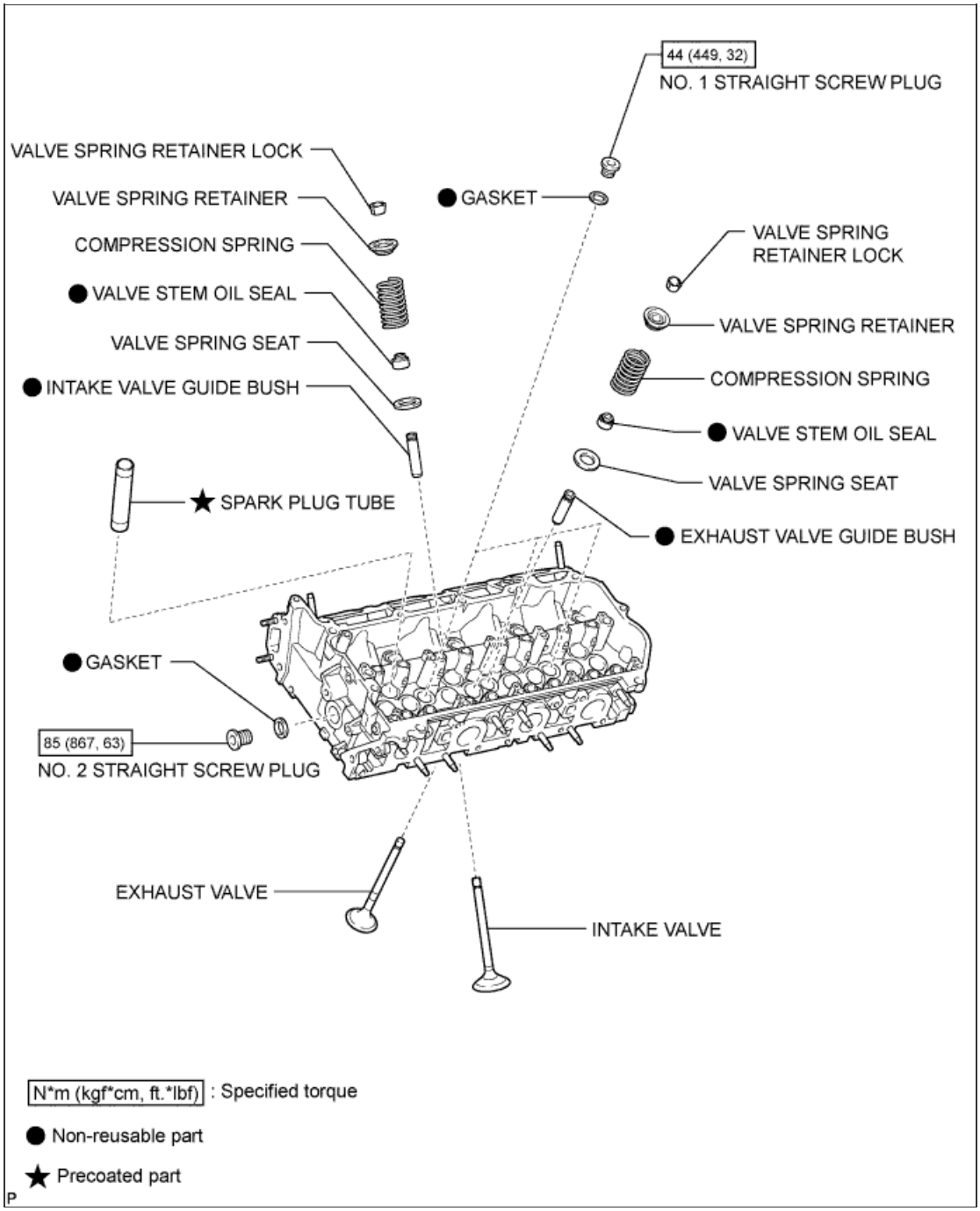
ix. Connect the 4 ignition coil connectors.

x. Connect the 2 camshaft timing control valve connectors.

HINT:

The wire harnesses on the exhaust side are wrapped with white tape.

for Preparation Click here



for Preparation Click here

1. REMOVE INTAKE VALVE

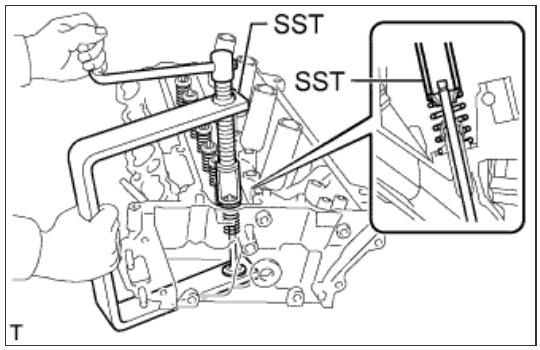
a. Using SST and wooden blocks, compress the compression spring and remove the valve spring retainer locks.

SST
09202-70020 (09202-00010)

b. Remove the retainer, compression spring and valve.

HINT:

Arrange the removed parts in the correct order.



2. REMOVE EXHAUST VALVE

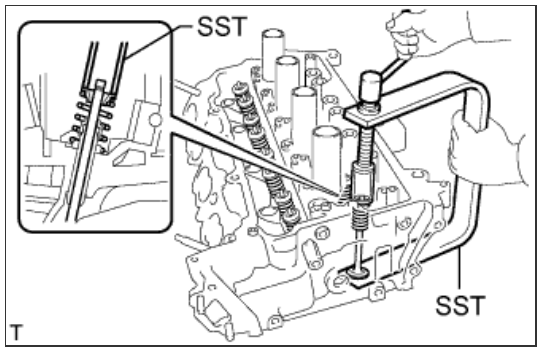
a. Using SST and wooden blocks, compress the compression spring and remove the valve spring retainer locks.

SST
09202-70020 (09202-00010)

b. Remove the retainer, compression spring and valve.

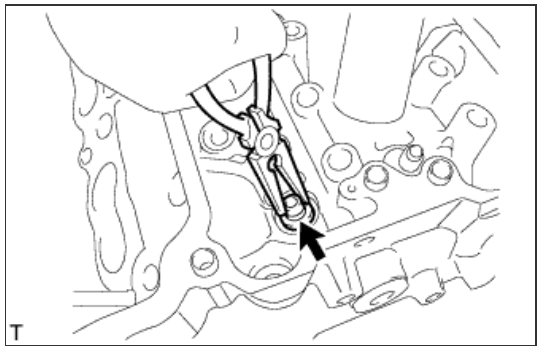
HINT:

Arrange the removed parts in the correct order.



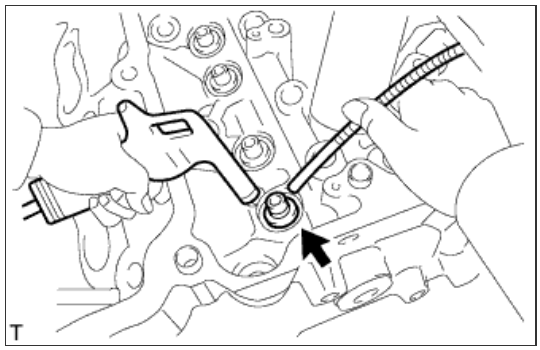
3. REMOVE VALVE STEM OIL SEAL

a. Using needle-nose pliers, remove the oil seals.



4. REMOVE VALVE SPRING SEAT

a. Using compressed air and a magnet hand, remove the valve spring seat by blowing air onto it.



5. REMOVE NO. 1 STRAIGHT SCREW PLUG

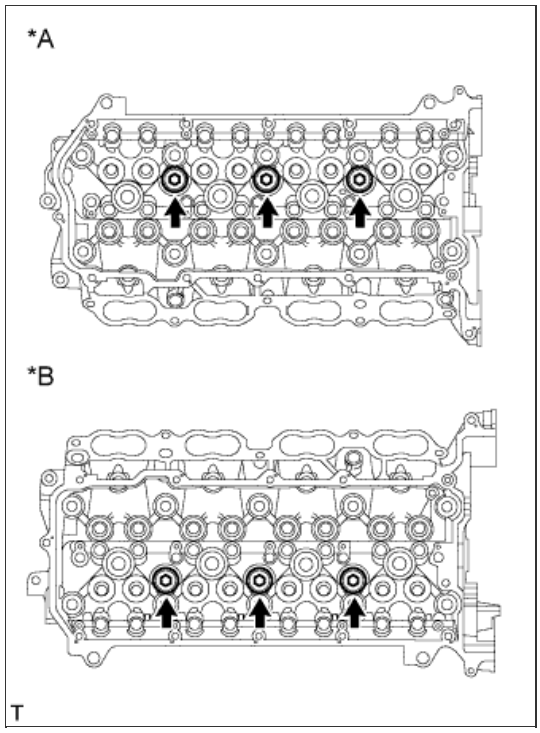
NOTICE:

If water leaks from the No. 1 straight screw plug or the plug is corroded, replace it.

a. Using a 10 mm hexagon wrench, remove the 6 screw plugs and 6 gaskets.

Text in Illustration

*A	LH
*B	RH



6. REMOVE NO. 2 STRAIGHT SCREW PLUG

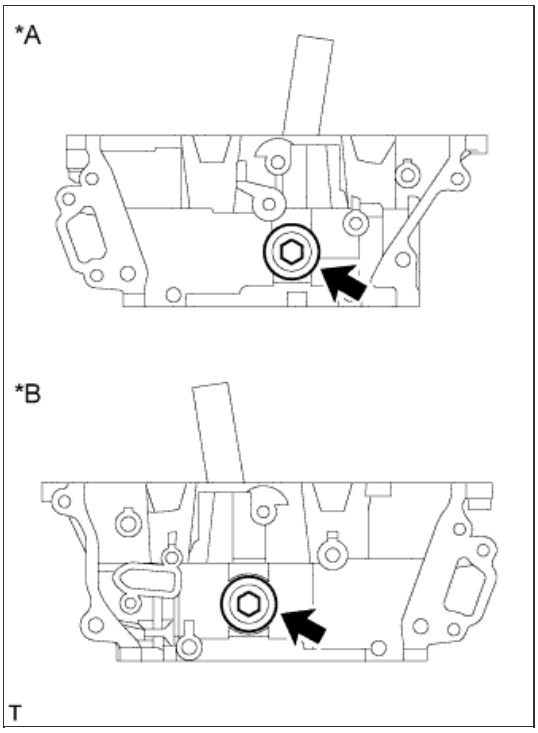
NOTICE:

If water leaks from the No. 2 straight screw plug or the plug is corroded, replace it.

a. Using a 14 mm hexagon wrench, remove the 2 screw plugs and 2 gaskets.

Text in Illustration

*A	LH
*B	RH



7. REMOVE STUD BOLT

NOTICE:

If the stud bolt is deformed or its threads are damaged, replace it.

for Preparation Click here

1. INSPECT CYLINDER HEAD SUB-ASSEMBLY

a. Using a precision straightedge and feeler gauge, measure the warpage of the surfaces where the cylinder head contacts the cylinder block and manifold.

Standard Warpage:

Item	Specified Condition
Cylinder head lower side	0.05 mm (0.00197 in.)
Intake side	0.08 mm (0.00315 in.)
Exhaust side	0.05 mm (0.00197 in.)

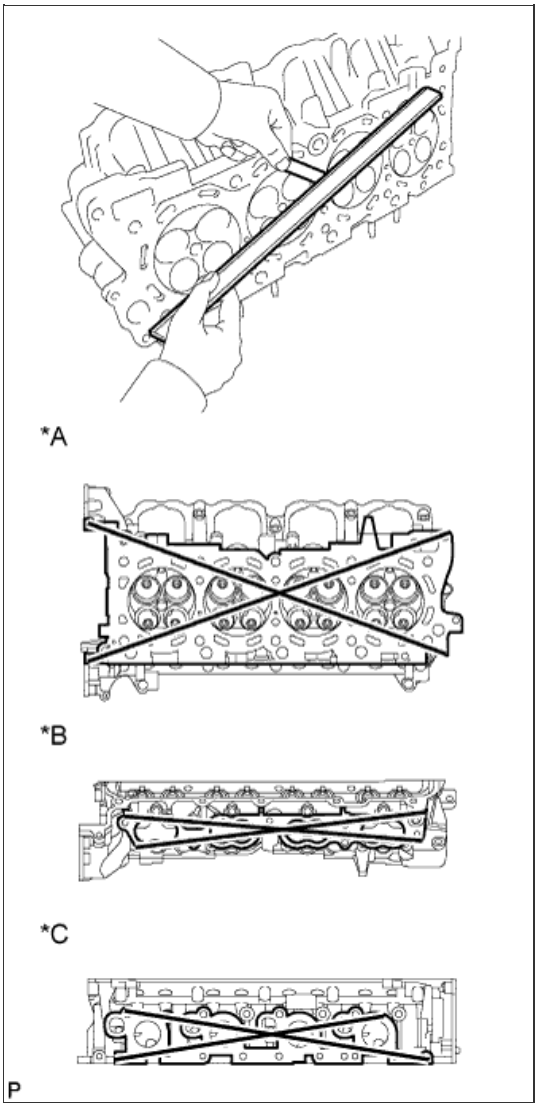
Maximum warpage:
0.10 mm (0.003 in.)

Text in Illustration

*A	Cylinder Head Lower Side
*B	Intake Side
*C	Exhaust Side

If the warpage is more than the maximum, replace the cylinder head.

b. Using a dye penetrant, check the intake ports, exhaust ports and cylinder surface for cracks.
If cracked, replace the cylinder head.



2. INSPECT INTAKE VALVE

a. Using a micrometer, measure the diameter of the valve stem.

Standard valve stem diameter:
5.470 to 5.485 mm (0.215 to 0.216 in.)

If the diameter is not as specified, replace the valve and guide bush.

b. Using a vernier caliper, measure the valve head margin thickness.

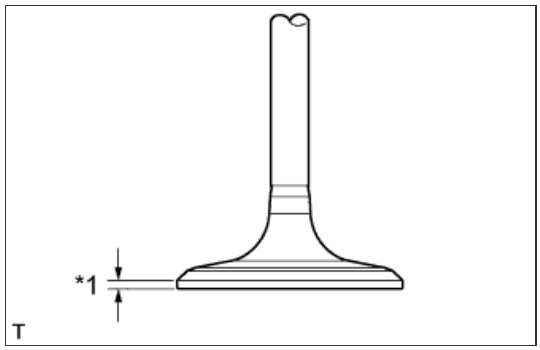
Standard margin thickness:
1.25 mm (0.04 in.)

Minimum margin thickness:
0.50 mm (0.01 in.)

Text in Illustration

*1	Margin Thickness

If the margin thickness is less than the minimum, replace the intake valve.



c. Using a vernier caliper, measure the valve overall length.

Standard overall length:
105.85 mm (4.17 in.)

Minimum overall length:
105.35 mm (4.15 in.)

If the overall length is less than the minimum, replace the intake valve.

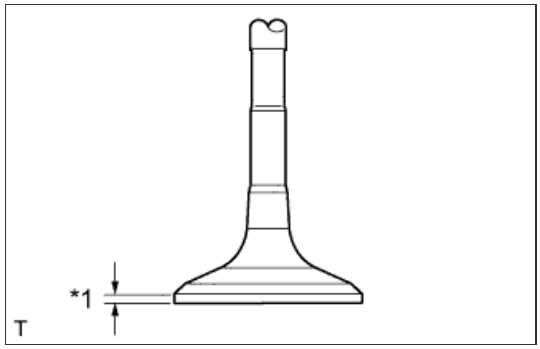
3. INSPECT EXHAUST VALVE

a. Using a micrometer, measure the diameter of the valve stem.

Standard valve stem diameter:
5.465 to 5.480 mm (0.215 to 0.216 in.)

If the diameter is not as specified, replace the valve and guide bush.

b. Using a vernier caliper, measure the valve head margin thickness.



Standard margin thickness:
1.4 mm (0.0551 in.)

Minimum margin thickness:
0.50 mm (0.01 in.)

Text in Illustration

*1	Margin Thickness

If the margin thickness is less than the minimum, replace the exhaust valve.

c. Using a vernier caliper, measure the valve overall length.

Standard overall length:
110.40 mm (4.35 in.)

Minimum overall length:
10 .0 mm (4.33 in.)

If the overall length is less than the minimum, replace the exhaust valve.

4. INSPECT INTAKE VALVE SEAT

a. Apply a light coat of Prussian blue to the valve face.

b. Lightly press the valve face against the valve seat.

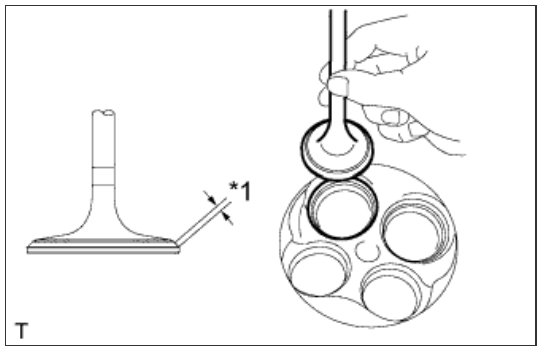
HINT:

Do not rotate the valve while pressing the valve.

c. Check the valve face and valve seat.

Text in Illustration

*1	Width



i. Check that the contact surfaces of the valve seat and valve face are in the middle area of their respective surfaces, with the width between 1.1 and 1.5 mm (0.0433 and 0.0591 in.).
If not, correct the valve seat.

ii. Check that the contact surfaces of the valve seat and valve face are even around the entire valve seat.
If not, correct the valve seat.

5. INSPECT EXHAUST VALVE SEAT

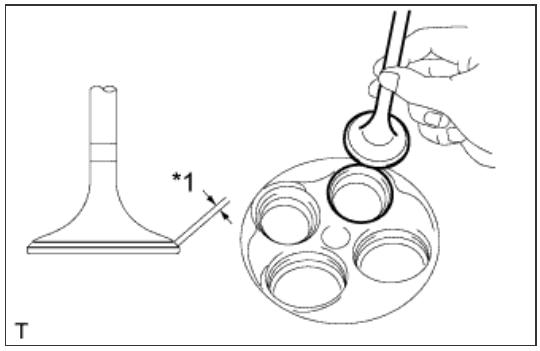
a. Apply a light coat of Prussian blue to the valve face.

b. Lightly press the valve face against the valve seat.

HINT:

Do not rotate the valve while pressing the valve.

c. Check the valve face and valve seat.



Text in Illustration

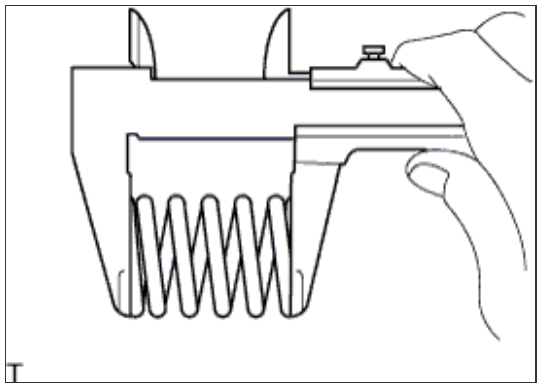
*1	Width

i. Check that the contact surfaces of the valve seat and valve face are in the middle area of their respective surfaces, with the width between 1.1 and 1.5 mm (0.0433 and 0.0591 in.).
If not, correct the valve seat.

ii. Check that the contact surfaces of the valve seat and valve face are even around the entire valve seat.
If not, correct the valve seat.

6. INSPECT COMPRESSION SPRING

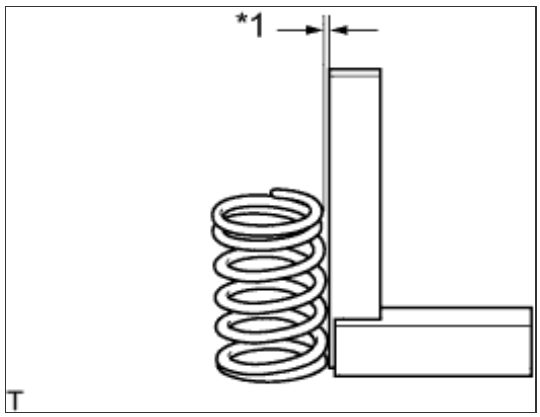
a. Using a vernier caliper, measure the free length of the inner compression spring.



Standard free length:
4 . mm (1. in.)

If the free length is not as specified, replace the spring.

b. Using a steel square, measure the deviation of the inner compression spring.



Maximum deviation:
1.0 mm (0.03 in.)

Maximum angle (reference):
2

Text in Illustration

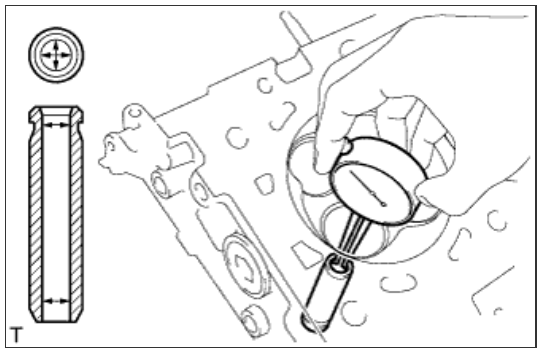
*1	Deviation

If the deviation is more than the maximum, replace the spring.

7. INSPECT VALVE GUIDE BUSH OIL CLEARANCE

a. Using a caliper gauge, measure the inside diameter of the guide bush.

Standard bush inside diameter:
5.51 to 5.53 mm (0.217 to 0.218 in.)



b. Subtract the valve stem diameter measurement from the guide bush inside diameter measurement.

Standard Oil Clearance:

Item	Specified Condition
Intake	0.025 to 0.060 mm (0.000984 to 0.00236 in.)
Exhaust	0.030 to 0.065 mm (0.00118 to 0.00256 in.)

Maximum Oil Clearance:

Item	Specified Condition
Intake	0.08 mm (0.00315 in.)
Exhaust	0.10 mm (0.00394 in.)

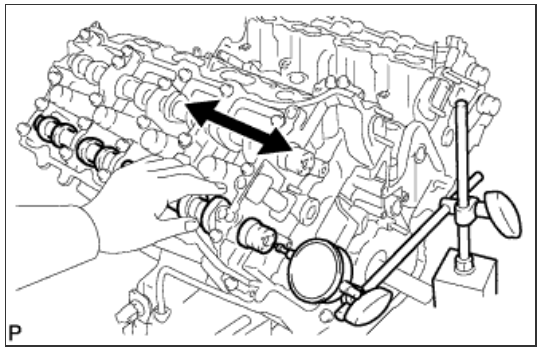
If the oil clearance is more than the maximum, replace the valve and guide bush.

8. INSPECT CAMSHA T THRUST CLEARANCE

a. Inspect the bank 1 camshafts.

i. Install the bank 1 camshafts.

ii. Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.



Standard thrust clearance:
0.08 to 0.135 mm (0.00315 to 0.00531 in.)

Maximum thrust clearance:
0.15 mm (0.005 1 in.)

If the thrust clearance is more than the maximum, replace the camshaft housing. If the thrust surface is damaged, replace the camshaft.

b. Inspect the bank 2 camshafts.

i. Install the bank 2 camshafts.

ii. Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.

Standard thrust clearance:
0.08 to 0.135 mm (0.00315 to 0.00531 in.)

Maximum thrust clearance:
0.15 mm (0.005 1 in.)

If the thrust clearance is more than the maximum, replace the camshaft housing. If the thrust surface is damaged, replace the camshaft.

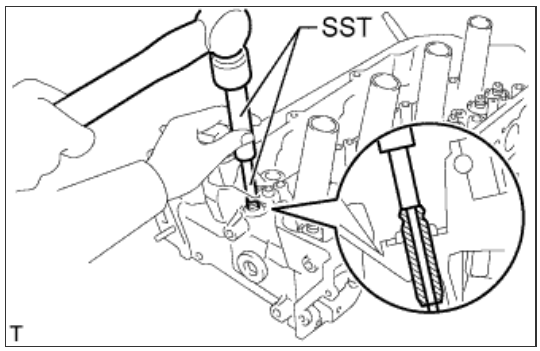
for Preparation Click here

1. REPLACE INTAKE VALVE GUIDE BUSH

a. Heat the cylinder head to approximately 80 to 100°C (176 to 212°F).

b. Place the cylinder head on wooden blocks.

c. Using SST and a hammer, tap out the valve guide bush.



SST
09201-10000 (09201-01050)
09950-70010 (09951-07100)

d. Using a caliper gauge, measure the bush bore diameter of the cylinder head side.

Standard bush bore diameter:
10.285 to 10.306 mm (0.405 to 0.406 in.)

If the bush bore diameter of the cylinder head is between 10.285 and 10.306 mm (0.405 and 0.406 in.), proceed to the next step.
If the bush bore diameter of the cylinder head is 10.356 mm (0.408 in.) or more, replace the cylinder head.

e. Select a new guide bush (STD or O/S 0.05), and measure its diameter.

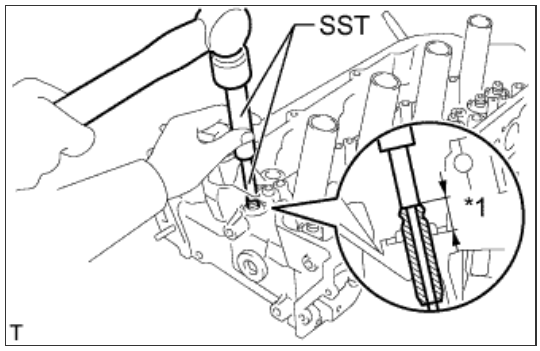
f. Machine the bush bore diameter of the cylinder head side to the diameter of the selected guide bush.

Bush Bore Diameter:

Bush Size	Specified Condition
STD	10.333 to 10.344 mm (0.4068 to 0.4072 in.)
O/S 0.05	10.383 to 10.394 mm (0.4088 to 0.4092 in.)

Standard bush length:
41.3 to 41.7 mm (1.63 to 1.64 in.)

g. Using SST and a hammer, tap in a new guide bush to the standard protrusion height.



SST
09201-10000 (09201-01050)
09950-70010 (09951-07100)

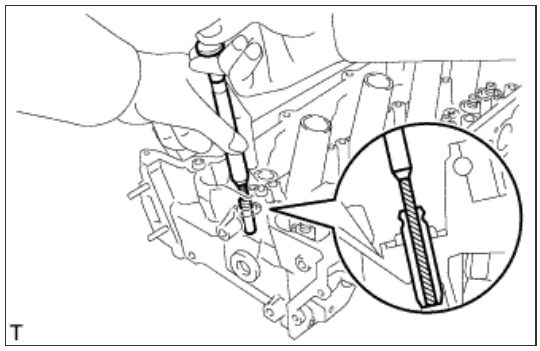
Standard protrusion height:
14.3 to 14.7 mm (0.563 to 0.579 in.)

Text in Illustration

*1	Height

h. Using a sharp 5.5 mm reamer, ream the guide bush to obtain the standard oil clearance between the guide bush and valve stem.

Standard oil clearance:
0.025 to 0.060 mm (0.000984 to 0.00236 in.)



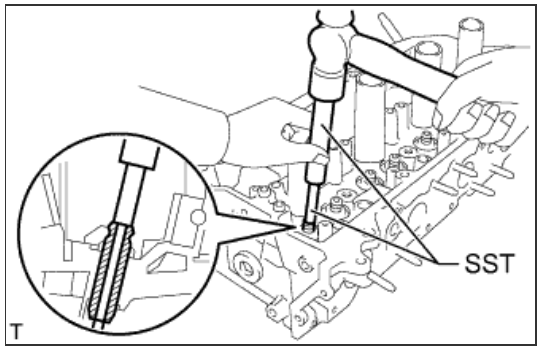
2. REPLACE EXHAUST VALVE GUIDE BUSH

a. Heat the cylinder head to approximately 80 to 100°C (176 to 212°F).

b. Place the cylinder head on wooden blocks.

c. Using SST and a hammer, tap out the valve guide bush.

SST
09201-10000 (09201-01050)
09950-70010 (09951-07100)



d. Using a caliper gauge, measure the bush bore diameter of the cylinder head.

Standard bush bore diameter:
10.285 to 10.306 mm (0.405 to 0.406 in.)

If the bush bore diameter of the cylinder head is between 10.285 and 10.306 mm (0.405 and 0.406 in.), proceed to the next step.
If the bush bore diameter of the cylinder head is 10.356 mm (0.408 in.) or more, replace the cylinder head.

e. Select a new guide bush (STD or O/S 0.05), and measure its diameter.

f. Machine the bush bore diameter of the cylinder head side to the diameter of the selected guide bush.

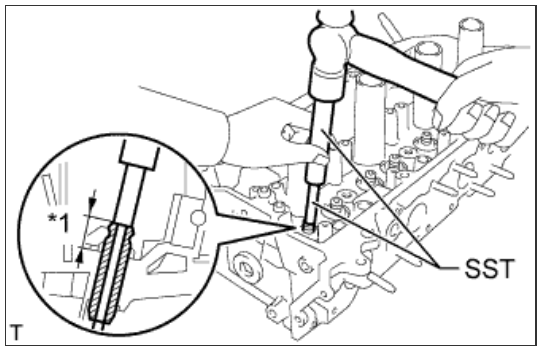
Bush Bore Diameter:

Bush Size	Specified Condition
STD	10.333 to 10.344 mm (0.4068 to 0.4072 in.)
O/S 0.05	10.383 to 10.394 mm (0.4088 to 0.4092 in.)

Standard bush length:
46.8 to 47.2 mm (1.84 to 1.86 in.)

g. Using SST and a hammer, tap in a new guide bush to the standard protrusion height.

SST
09201-10000 (09201-01050)
09950-70010 (09951-07100)



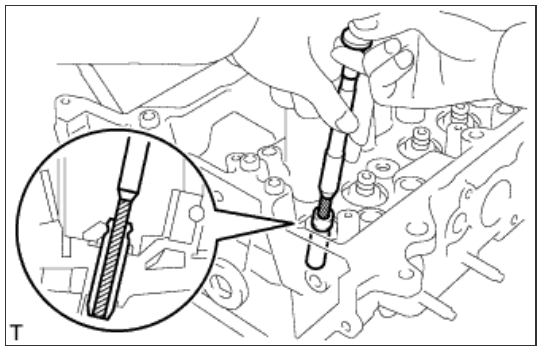
Standard protrusion height:
14.3 to 14.7 mm (0.563 to 0.579 in.)

Text in Illustration

*1	Height

h. Using a sharp 5.5 mm reamer, ream the guide bush to obtain the standard oil clearance between the guide bush and valve stem.

Standard oil clearance:
0.030 to 0.065 mm (0.00118 to 0.00256 in.)



3. REPLACE SPARK PLUG TUBE

HINT:

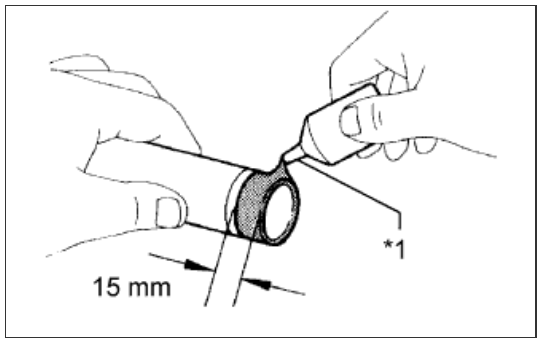
When using a new cylinder head, the spark plug tubes must be replaced.

a. Remove the spark plug tube.

b. Apply adhesive to the end of a new spark plug tube.

Adhesive:
Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent.

Standard seal diameter:
15 mm (0.591 in.)



Text in Illustration

*1	Adhesive

NOTICE:

- **Install the spark plug tube within 3 minutes after applying adhesive.**
- **Be careful not to deform the spark plug tube.**
- **Be careful not to expose the seal to coolant for at least 1 hour after installing it.**

c. Using a wooden block and hammer, tap in the spark plug tube to the specified protrusion height.

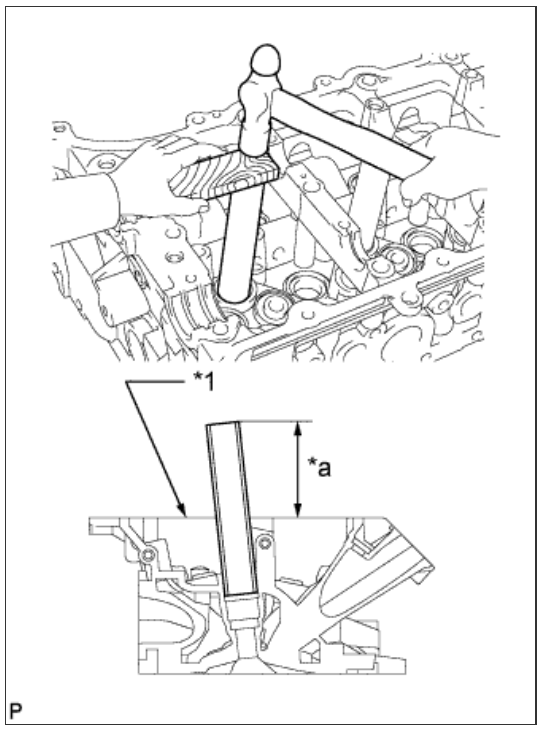
Standard protrusion height:
75.1 to 76.1 mm (2.96 to 3.00 in.)

Text in Illustration

*1	Cylinder Head Top Surface
*a	75.1 to 76.1 mm

NOTICE:

To avoid tapping in the spark plug tube too far, measure the protrusion height while tapping it.



4. REPLACE RING PIN

N TICE:

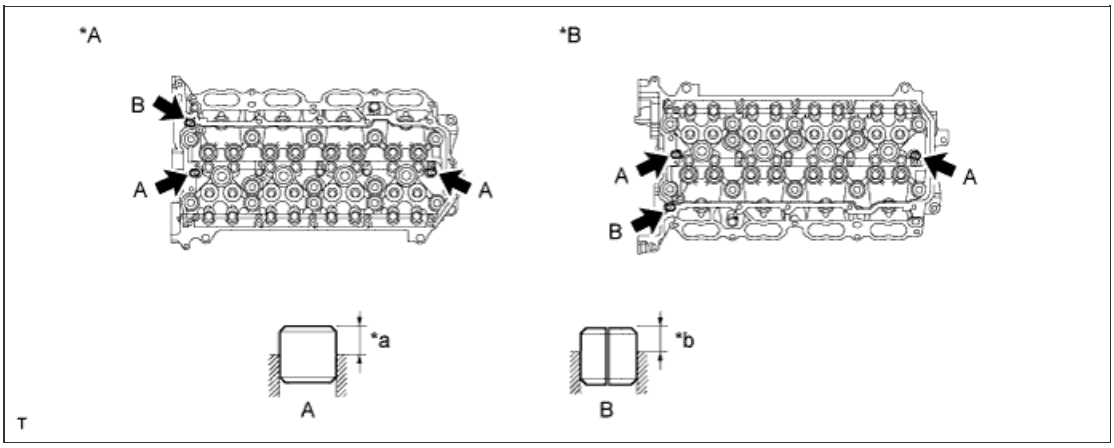
It is not necessary to remove the ring pin unless it is being replaced.

a. Remove the ring pins.

b. Using a plastic-faced hammer, tap in new ring pins to the cylinder head.

Standard Protrusion:

Item	Specified Condition
Ring pin A	5.5 to 6.5 mm (0.217 to 0.256 in.)
Ring pin B	3.5 to 6.5 mm (0.138 to 0.256 in.)



Text in Illustration

*A	for Bank 1	*B	for Bank 2
*a	5.5 to 6.5 mm	*b	3.5 to 6.5 mm

for Preparation Click here

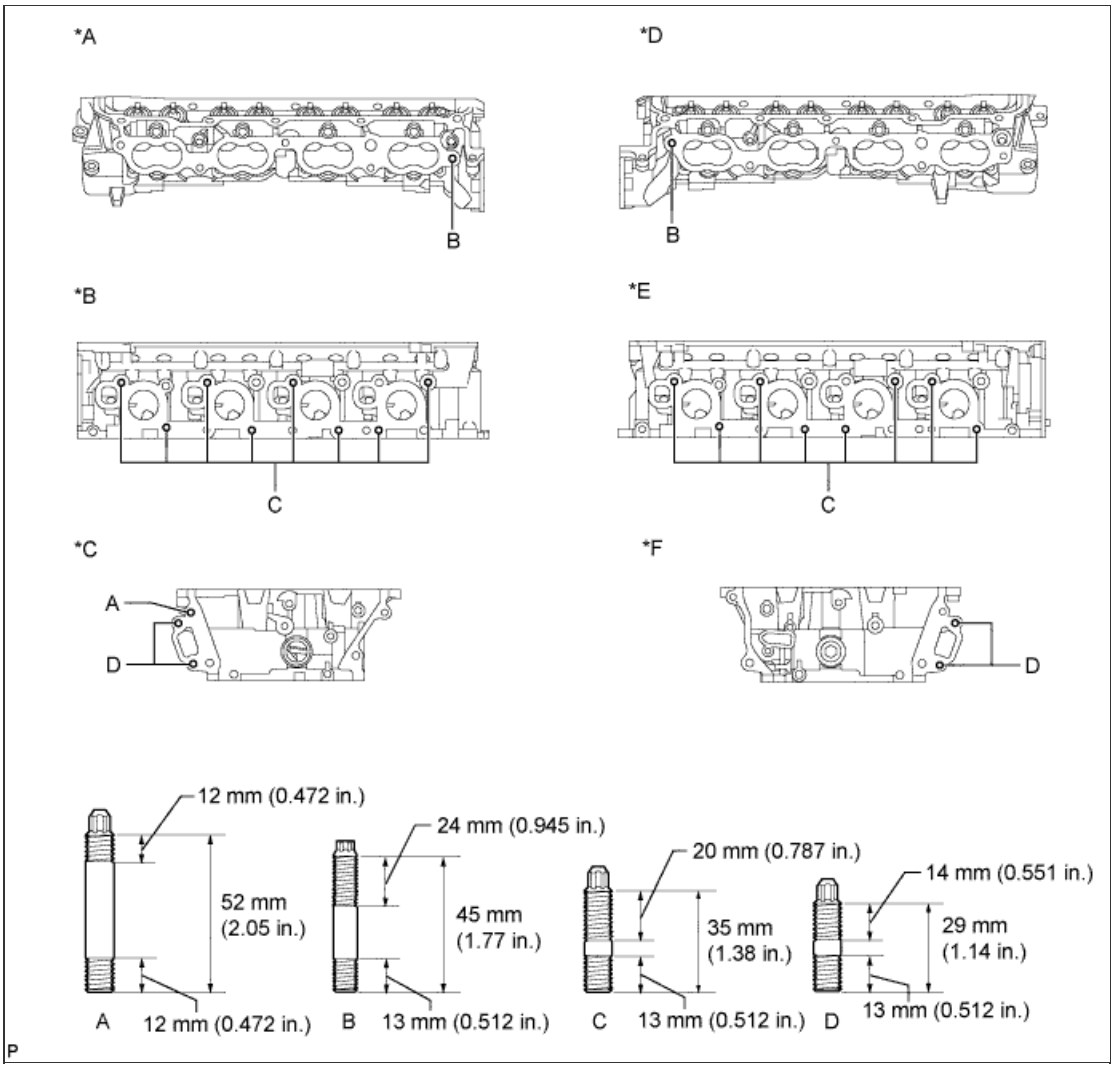
1. INSTALL STUD BOLT

NOTICE:

If the stud bolt is deformed or its threads are damaged, replace it.

a. Using E7 and E8 "TORX" socket wrenches, install the stud bolts.

Torque:
for stud bolts A, B, C and D:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



Text in Illustration

*A	LH for Intake Side	*B	LH for Exhaust Side
*C	LH for Front Side	*D	RH for Intake Side
*E	RH for Exhaust Side	*F	RH for Front Side

2. INSTALL NO. 2 STRAIGHT SCREW PLUG

NOTICE:

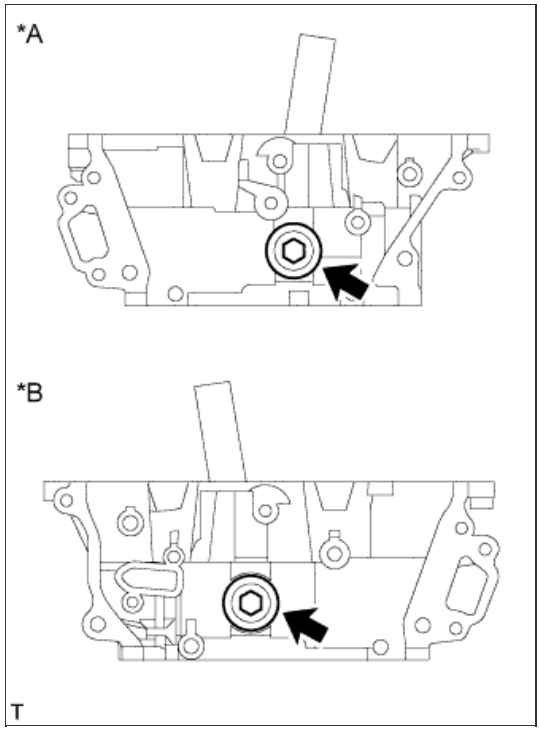
If water leaks from the No. 2 straight screw plug or the plug is corroded, replace it.

a. Using a 14 mm hexagon wrench, install 2 new gaskets and the 2 straight screw plugs.

Torque:
85 N* 867 kgf*c , 63 ft.*lbf }

Text in Illustration

*A	LH
*B	RH



3. INSTALL NO. 1 STRAIGHT SCREW PLUG

NOTICE:

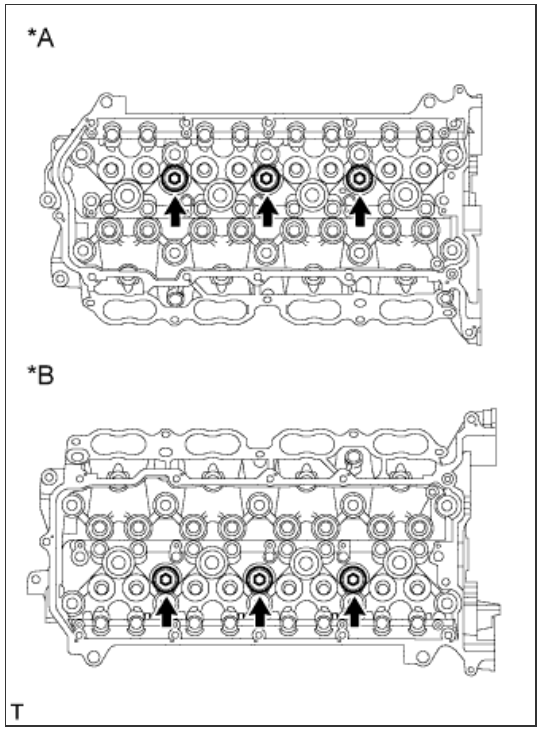
If water leaks from the No. 1 straight screw plug or the plug is corroded, replace it.

a. Using a 10 mm hexagon wrench, install 6 new gaskets and the 6 straight screw plugs.

Torque:
44 N* 449 kgf*cm , 32 ft.*lbf }

Text in Illustration

*A	LH
*B	RH



4. INSTALL VALVE SPRING SEAT

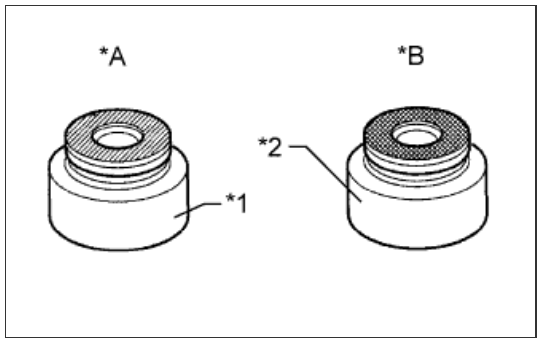
a. Install the valve spring seats to the cylinder head.

5. INSTALL VALVE STEM OIL SEAL

a. Apply a light coat of engine oil to new oil seals.

Text in Illustration

*A	Intake Side
*B	Exhaust Side
*1	Brown
*2	Gray



NOTICE:

Pay attention when installing the intake and exhaust oil seals. For example, installing the intake oil seal into the exhaust side or installing the exhaust oil seal into the intake side can cause installation problems later.

HINT:

The intake valve oil seals are brown and the exhaust valve oil seals are gray.

b. Using SST, push in the oil seals.

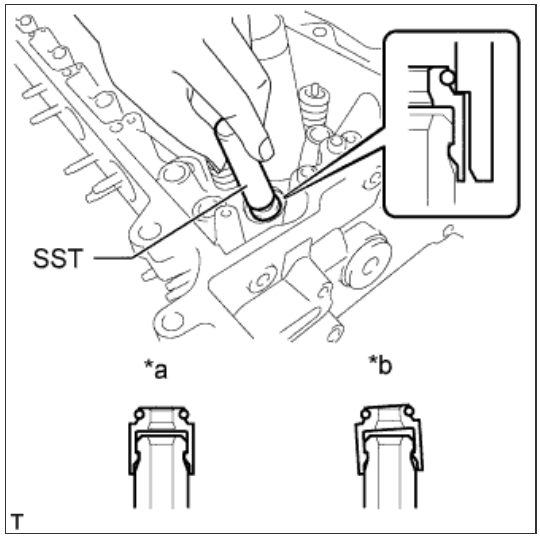
SST
09201-41020

Text in Illustration

*a	CORRECT
*b	INCORRECT

NOTICE:

Failure to use SST will cause the seal to be damaged or improperly seated.



6. INSTALL INTAKE VALVE

a. Apply plenty of engine oil to the tip area of the intake valve shown in the illustration.

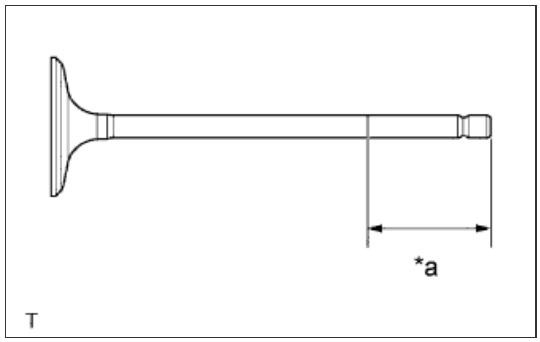
b. Install the valve, compression spring and spring retainer to the cylinder head.

Text in Illustration

*a	40 mm (1.57 in.) or more

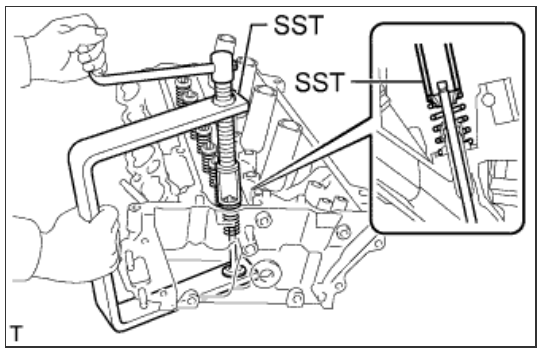
NOTICE:

Install the same parts in the same combination to their original locations.



c. Using SST and wooden blocks, compress the spring and install the retainer locks.

SST
09202-70020 (09202-00010)

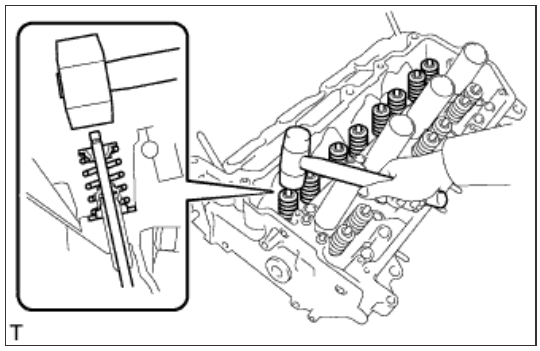


d. Using a plastic-faced hammer, lightly tap the valve stem tip to ensure a proper

fit.

NOTICE:

Be careful not to damage the retainer.



7. INSTALL E HAUST VALVE

a. Apply plenty of engine oil to the tip area of the exhaust valve shown in the illustration.

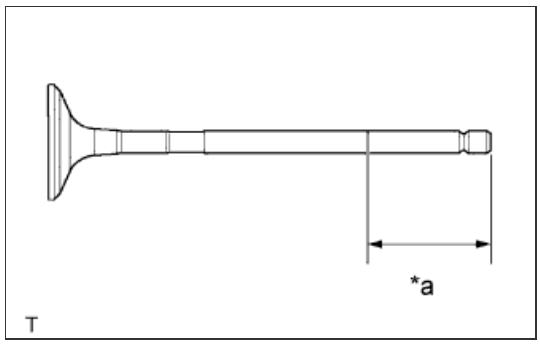
b. Install the valve, compression spring and spring retainer to the cylinder head.

Text in Illustration

*a	40 mm (1.57 in.) or more

NOTICE:

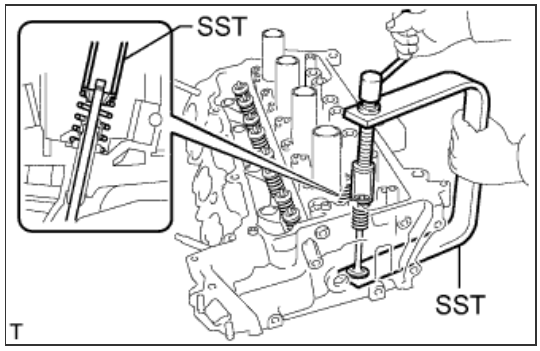
Install the same parts in the same combination to their original locations.



c. Using SST and wooden blocks, compress the spring and install the retainer locks.

SST

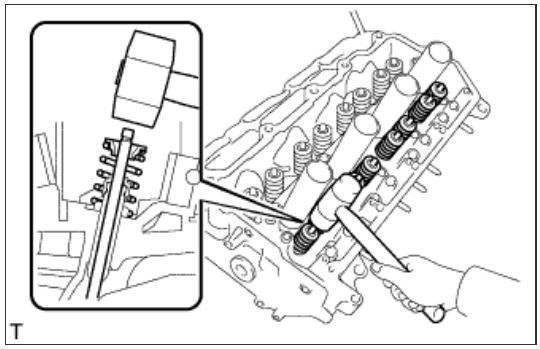
09202-70020 (09202-00010)



d. Using a plastic-faced hammer, lightly tap the valve stem tip to ensure a proper fit.

NOTICE:

Be careful not to damage the retainer.



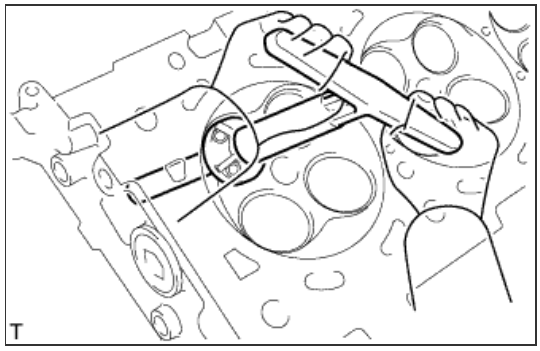
for Preparation Click here

1. REPAIR INTAKE VALVE SEAT

NOTICE:

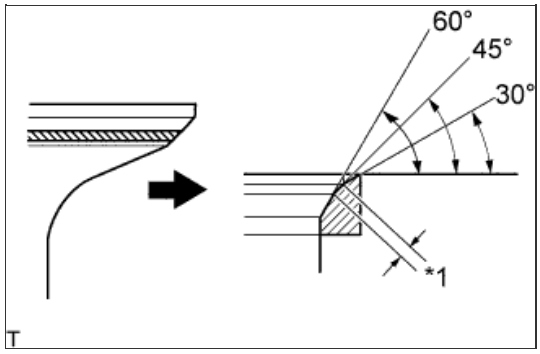
- **Repair the seat while checking the seating position.**
- **Keep the lip free of foreign matter.**
- **Take off the cutter gradually to make the intake valve seat smooth.**

a. Using a 45° cutter, resurface the valve seat so that the valve seat width is more than the specification.



b. Using 30° and 60° cutters, correct the valve seat so that the valve contacts the entire circumference of the seat. The contact should be in the center of the valve seat, and the valve seat width should be maintained within the specified range around the entire circumference of the seat.

Standard width:
1.1 to 1.5 mm (. to . 1 in.)



Text in Illustration

*1	Width

c. Hand-lap the valve and valve seat with an abrasive compound.

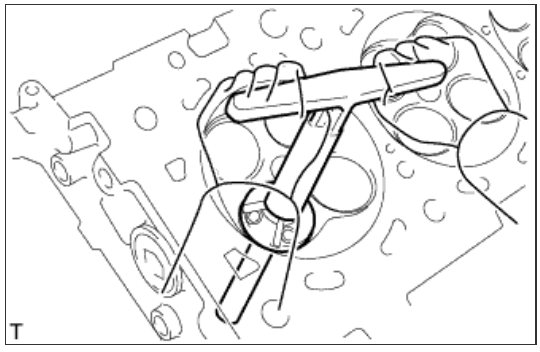
d. Check the valve seating position.

. REPAIR E HA ST VALVE SEAT

NOTICE:

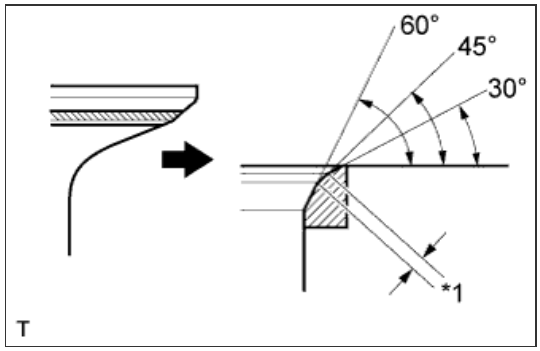
- **Repair the seat while checking the seating position.**
- **Keep the lip free of foreign matter.**
- **Take off the cutter gradually to make the exhaust valve seat smooth.**

a. Using a 45° cutter, resurface the valve seat so that the valve seat width is more than the specification.



b. Using 30° and 60° cutters, correct the valve seat so that the valve contacts the entire circumference of the seat. The contact should be in the center of the valve seat, and the valve seat width should be maintained within the specified range around the entire circumference of the seat.

Standard width:
1.1 to 1.5 mm (. to . 1 in.)



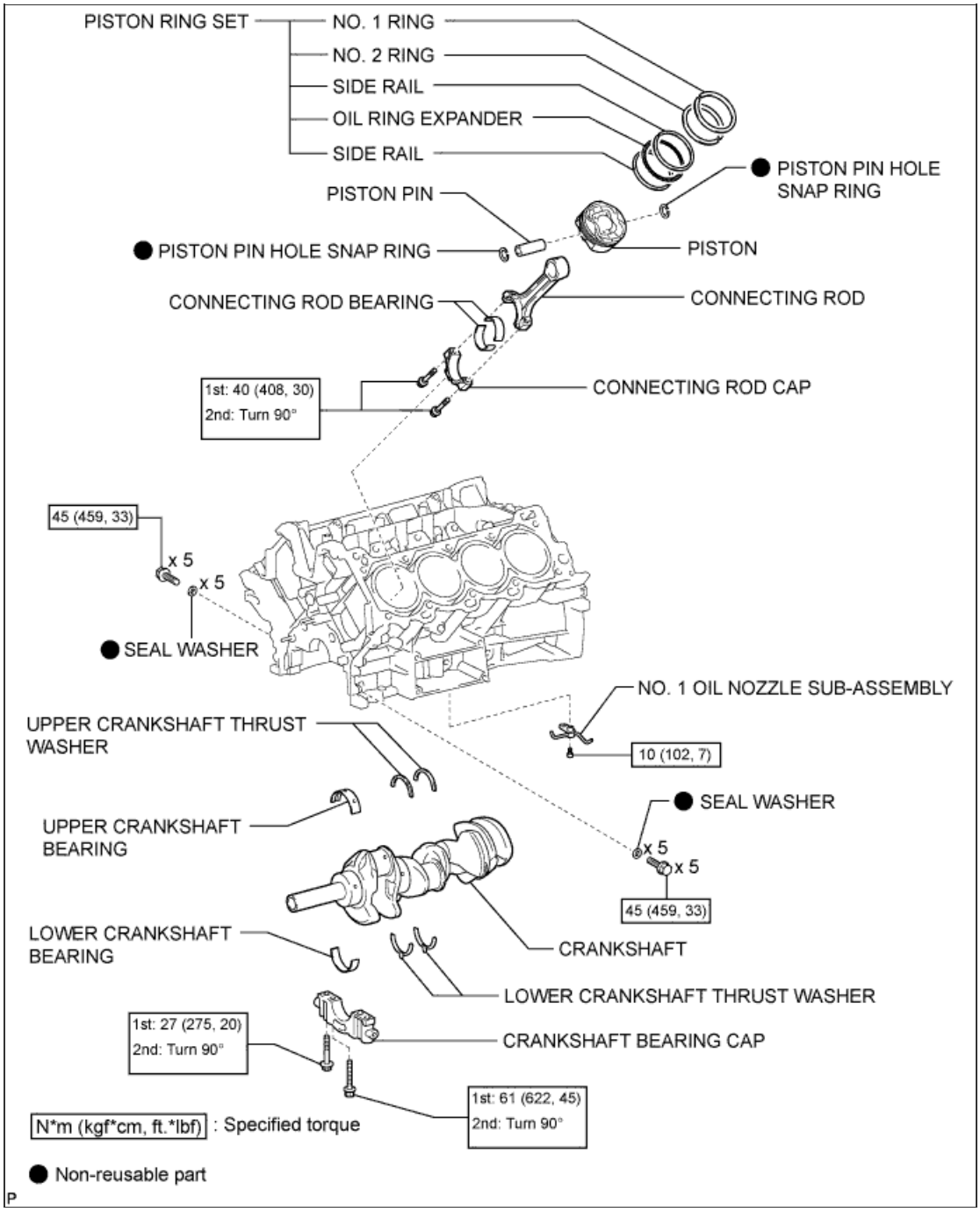
Text in Illustration

*1	Width

c. Hand-lap the valve and valve seat with an abrasive compound.

d. Check the valve seating position.

for Preparation Click here



for Preparation Click here

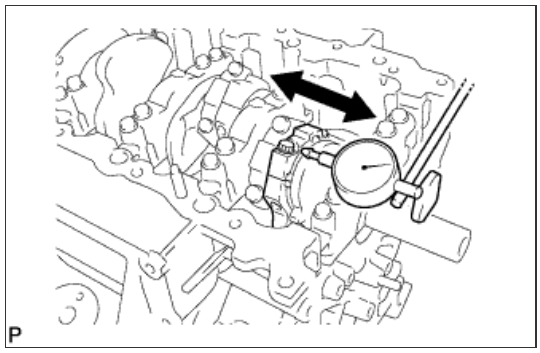
1. INSPECT CONNECTING ROD THRUST CLEARANCE

a. Using a dial indicator, measure the thrust clearance while moving the connecting rod back and forth.

Standard thrust clearance:
0.15 to 0.55 mm (0.005 1 to 0.0217 in.)

Maximum thrust clearance:
0.70 mm (0.0276 in.)

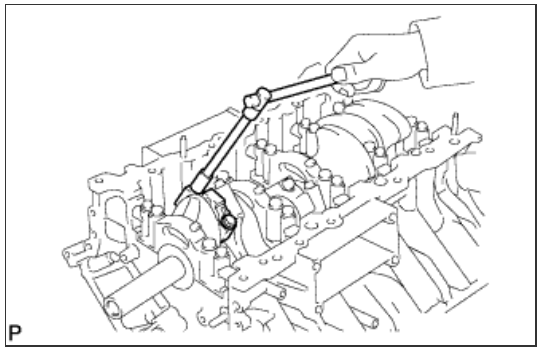
If the thrust clearance is more than the maximum, replace one or more connecting rods as necessary.
If necessary, replace the crankshaft.



2. INSPECT CONNECTING ROD OIL CLEARANCE

a. Check that the front mark on the connecting rod and cap are aligned to ensure correct reassembly.

b. Remove the 2 connecting rod cap bolts.



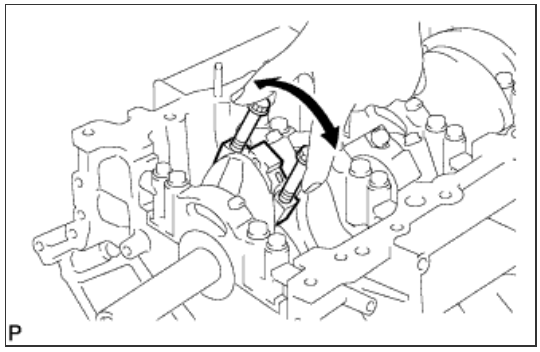
c. Using the 2 removed connecting rod cap bolts, remove the connecting rod cap and lower bearing by wiggling the connecting rod cap right and left.

HINT:

Keep the lower bearing inserted to the connecting rod cap.

d. Check the crank pin and bearing for pitting and scratches.
If the crank pin or bearing is damaged, replace the bearings. If necessary, replace the crankshaft.

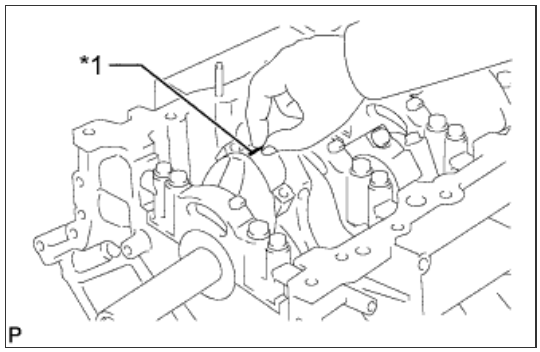
e. Clean the crank pin and bearing.



f. Lay a strip of Plastigage on the crank pin.

Text in Illustration

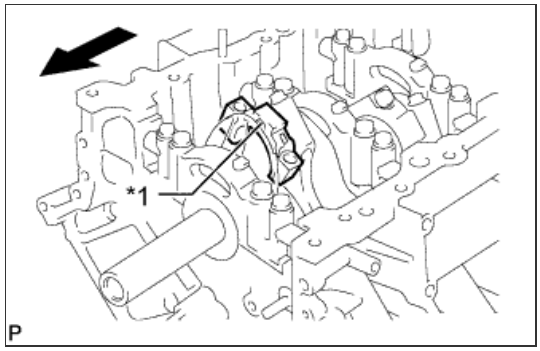
*1	Plastigage



g. Place the connecting rod cap on the connecting rod with the front mark facing forward.

Text in Illustration

*1	Front Mark
➡	Front



h. Install and alternately tighten the bolts of the connecting rod cap in several steps.

Tor ue:
40 N m 408 kgf cm , 30 ft. lbf

NOTICE:

Do not turn the crankshaft.

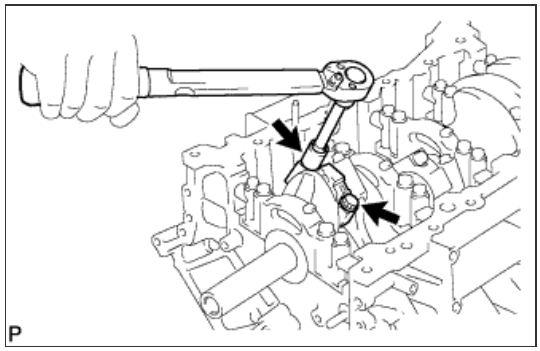
i. Mark the front side of each connecting rod cap bolt with paint.

j. Tighten the cap bolts 90° as shown in the illustration.

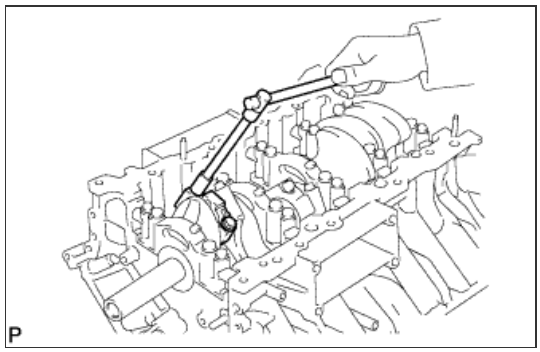
k. Check that the painted marks are now at a 90° angle to the front.

NOTICE:

Do not turn the crankshaft.



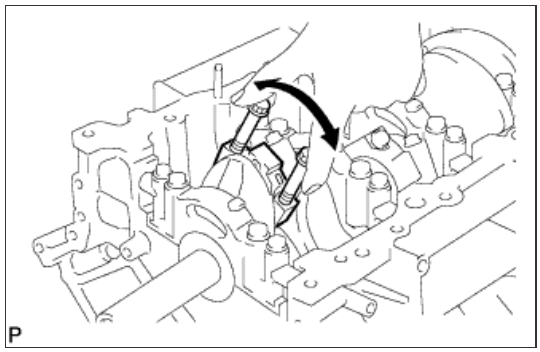
l. Remove the 2 connecting rod cap bolts.



m. Using the 2 removed connecting rod cap bolts, remove the connecting rod cap and lower bearing by wiggling the connecting rod cap right and left.

HINT:

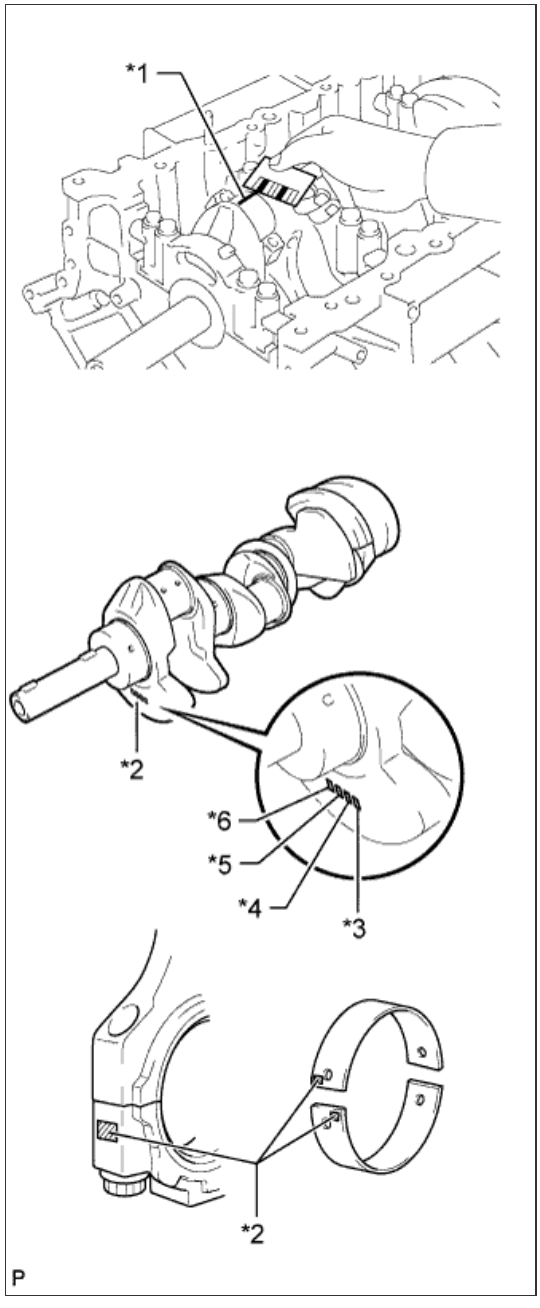
Keep the lower bearing inserted to the connecting rod cap.



n. Measure the Plastigage at its widest point.

Standard oil clearance:
0.025 to 0.050 mm (0.000 to 0.001 in.)

Maximum oil clearance:
0.070 mm (0.00276 in.)



Text in Illustration

*1	Plastigage
*2	Number Mark
*3	No. 1
*4	No. 2
*5	No. 3
*6	No. 4

If the oil clearance is more than the maximum, replace the bearings. If necessary, replace the crankshaft.

HINT:

- **If replacing a bearing, replace it with one that has the same number as its respective connecting rod cap. The standard thickness of each bearing is indicated by a 1, 2, 3 or 4 mark on its surface.**
- **Select the correct bearing by adding together the number marks imprinted on the connecting rod big end and crank pin.**

Example:

Connecting rod "1" + Crank pin "2" = 3 (Use bearing "3")

Reference:

Standard Sized Bearing Center Wall Thickness:

Mark	Thickness
2	1.489 to 1.492 mm (0.0586 to 0.0587 in.)
3	1.492 to 1.495 mm (0.0587 to 0.0589 in.)
4	1.495 to 1.498 mm (0.0589 to 0.0590 in.)
5	1.498 to 1.501 mm (0.0590 to 0.0591 in.)
6	1.501 to 1.504 mm (0.0591 to 0.0592 in.)
7	1.504 to 1.507 mm (0.0592 to 0.0593 in.)

Connecting Rod Big End Inside Diameter:

Mark	Thickness
1	59.000 to 59.006 mm (2.32283 to 2.32307 in.)
2	59.006 to 59.012 mm (2.32307 to 2.32330 in.)
3	59.012 to 59.018 mm (2.32330 to 2.32354 in.)
	59.018 to 59.024 mm

4	(2.32354 to 2.32377 in.)

Crankshaft Pin Diameter:

Mark	Thickness
1	55.994 to 56.000 mm (2.20448 to 2.20472 in.)
2	55.988 to 55.994 mm (2.20425 to 2.20448 in.)
3	55.982 to 55.988 mm (2.20401 to 2.20425 in.)

o. Completely remove the Plastigage.

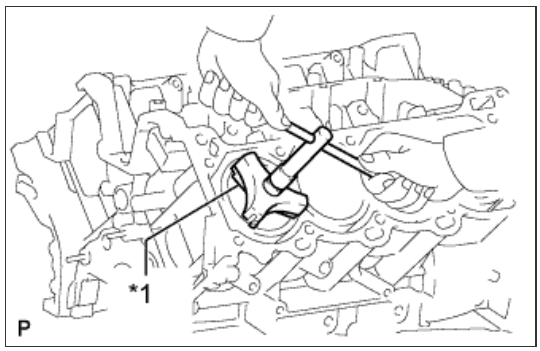
p. Perform the inspection above for each cylinder.

3. REMOVE PISTON AND CONNECTING ROD

a. Using a ridge reamer, remove all the carbon from the top of the cylinder.

Text in Illustration

*1	Ridge Reamer



b. Remove the 16 cap bolts, 8 connecting rod caps and 8 lower bearings.

c. Push the 8 pistons and 8 connecting rods through the top of the cylinder block.

HINT:

- **Keep the bearing, connecting rod and cap together.**
- **Arrange the piston and connecting rods in the correct order.**

4. REMOVE CONNECTING ROD BEARING

a. Remove the connecting rod bearings from the connecting rods and connecting rod caps.

HINT:

Arrange the removed parts in the correct order.

5. INSPECT CRANKSHA T THRUST CLEARANCE

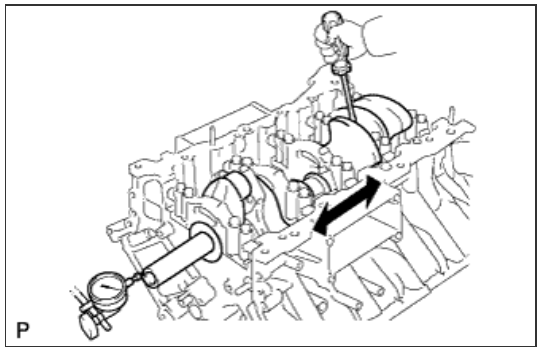
a. Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

Standard thrust clearance:
0.020 to 0.220 mm (0.000787 to 0.00866 in.)

Maximum thrust clearance:
0.30 mm (0.0118 in.)

If the thrust clearance is more than the maximum, replace the thrust washers as a set. If necessary, replace the crankshaft.

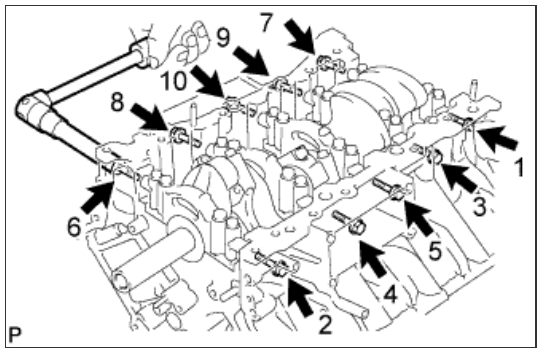
Standard thrust washer thickness:
2.44 to 2.4 mm (0.0 1 to 0.0 0 in.)



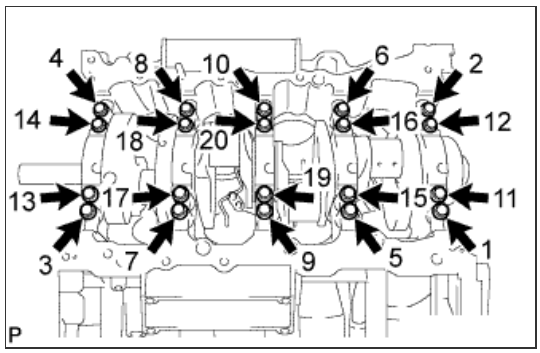
6. REMOVE CRANKSHA T

a. Uniformly loosen and remove the 10 bearing cap bolts and 10 seal washers in

several steps in the sequence shown in the illustration.



b. Uniformly loosen and remove the 20 bearing cap bolts in several steps in the sequence shown in the illustration.



c. Using a screwdriver, slightly pry up the 5 main bearing caps.

Text in Illustration

*1	Protective Tape
*2	Cylinder Block
*3	Joint Surface
*4	Bearing Cap

NOTICE:

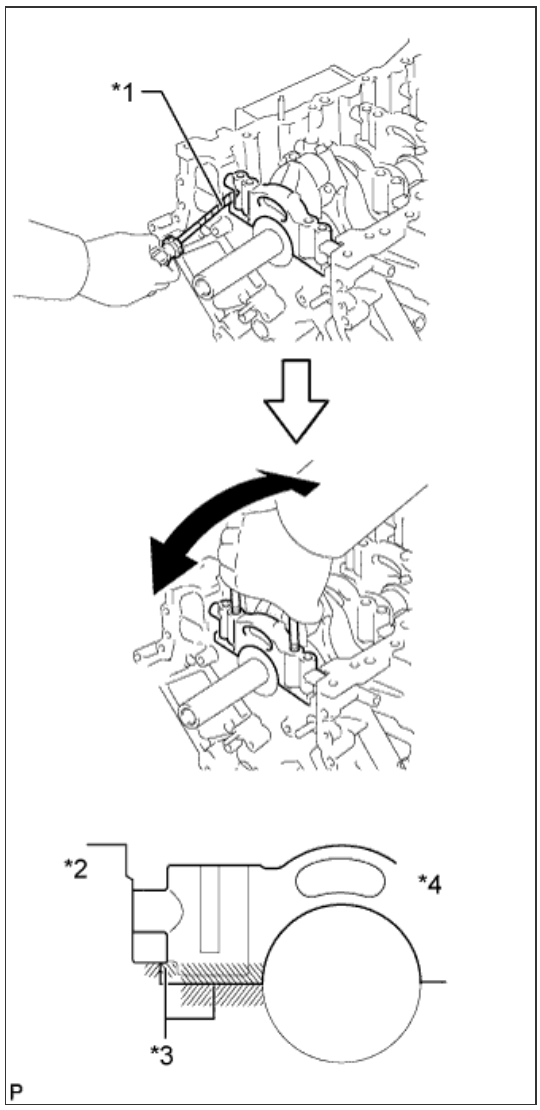
- **Be careful not to damage the joint surface of the cylinder block and main bearing caps.**
- **Pry up the left and right side of the cap little by little.**

HINT:

Tape the screwdriver tip before use.

d. Using the 2 inside position crankshaft bearing cap bolts, loosen each crankshaft bearing cap by moving it forward and backward, and remove each crankshaft bearing cap.

e. Remove the crankshaft.



7. REMOVE CRANKSHA T BEARING

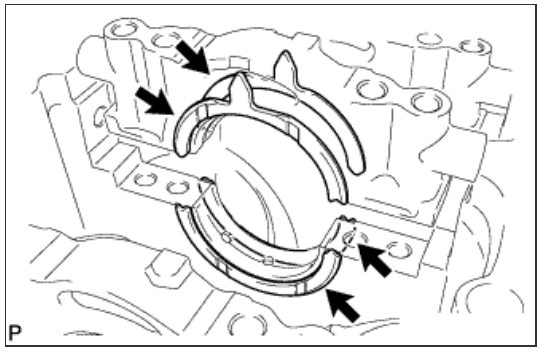
a. Remove the crankshaft bearings from the bearing caps and cylinder block.

HINT:

Arrange the removed parts in the correct order.

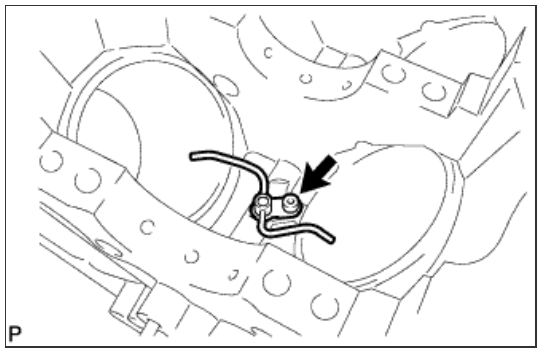
8. REMOVE CRANKSHA T THRUST WASHER SET

a. Remove the thrust washer set from the cylinder block and No. 3 bearing cap.



REMOVE NO. 1 OIL NO LSUB-ASSEMBLY

a. Using a 5 mm hexagon wrench, remove the 4 bolts and 4 oil nozzles.



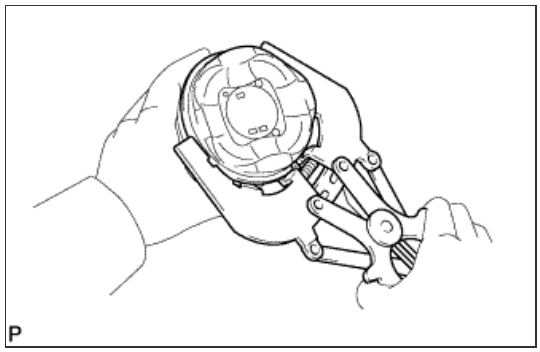
10. REMOVE PISTON RING SET

HINT:

Arrange the piston rings in the correct order.

a. Using a piston ring expander, remove the 2 compression rings.

b. Remove the 2 side rails and oil ring expander by hand.

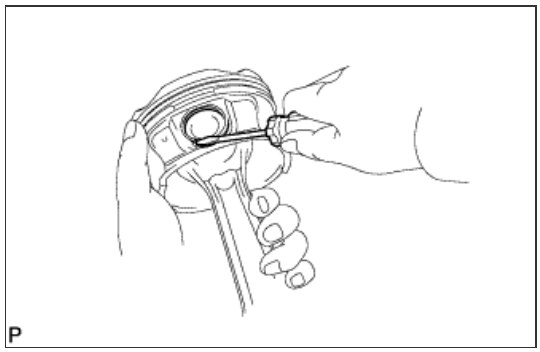


11. REMOVE PISTON WITH PIN SUB-ASSEMBLY

a. Disconnect the connecting rod from the piston.

i. Using a small screwdriver, pry off the 2 snap rings from the piston.

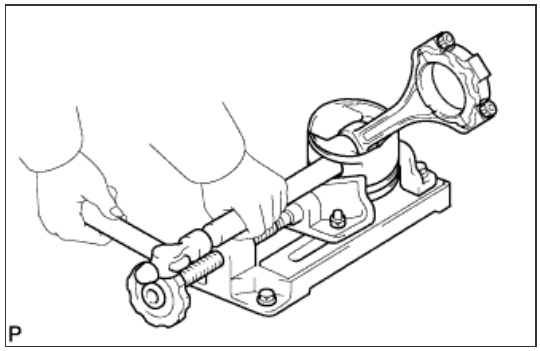
ii. Gradually heat the piston to approximately 80°C (176°F).



iii. Using a brass bar and plastic faced hammer, lightly tap out the piston pin. Then remove the connecting rod.

HINT:

- **The piston and pin are a matched set.**
- **Arrange the pistons, pins, rings, connecting rods and bearings in the correct order.**



b. Clean the piston.

i. Using a gasket scraper, remove the carbon from the piston top.

ii. Using a groove cleaning tool or broken ring, clean the piston ring grooves.

iii. Using solvent and a brush, thoroughly clean the piston.

NOTICE:

Do not use a wire brush.

12. REMOVE STUD BOLT

NOTICE:

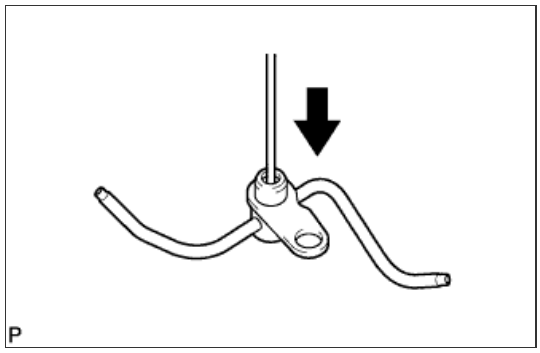
If the stud bolt is deformed or its threads are damaged, replace it.

for Preparation Click here

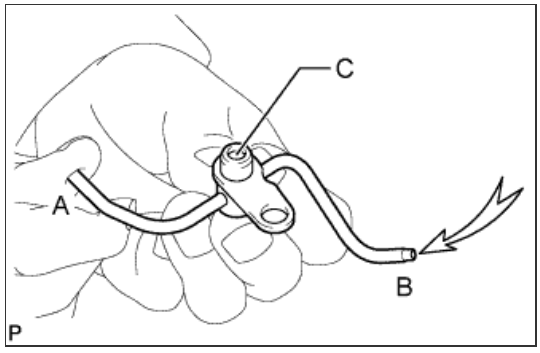
1. INSPECT NO. 1 OIL NOZZLE SUB-ASSEMBLY

a. Push the check valve with a pin to check if it is stuck.
If stuck, replace the No. 1 oil nozzle sub-assembly.

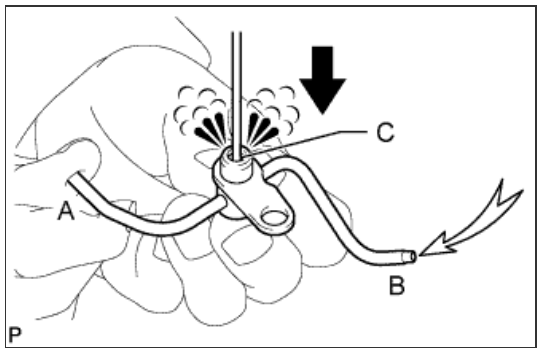
b. Push the check valve with a pin to check if it moves smoothly.
If it does not move smoothly, clean or replace the No. 1 oil nozzle sub-assembly.



c. While covering A, apply air into B. Check that air does not leak through C.
Perform the check again while covering B and applying air into A.
If air leaks, clean or replace the No. 1 oil nozzle sub-assembly.



d. Push the check valve while covering A, and apply air into B. Check that air passes through C. Perform the check again while covering B, pushing the check valve and applying air into A.
If air does not pass through C, clean or replace the No. 1 oil nozzle sub-assembly.



2. CHECK CYLINDER BLOCK SUB-ASSEMBLY

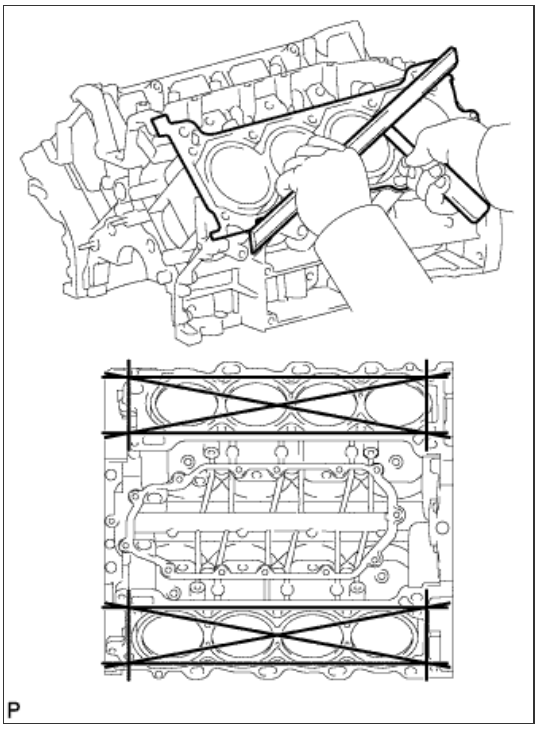
a. Visually check the cylinder for vertical scratches.
If necessary, replace the cylinder block.

3. INSPECT CYLINDER BLOCK FOR WARPAGE

a. Using a precision straightedge and feeler gauge, measure the warpage of the surfaces where the cylinder head gaskets contact the cylinder block.

Maximum warpage:
0.07 mm (0.00276 in.)

If the warpage is more than the maximum, replace the cylinder block.



4. INSPECT CYLINDER BORE

a. Using a cylinder gauge, measure the cylinder bore diameter at positions A and B in the thrust and axial directions.

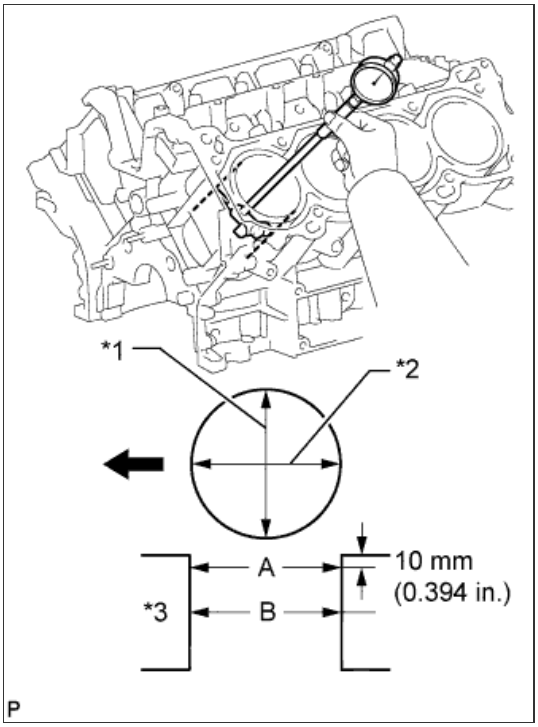
Standard diameter:
94.000 to 94.012 mm (3.7008 to 3.7013 in.)

Maximum diameter:
94.200 mm (3.7087 in.)

Text in Illustration

*1	Thrust Direction
*2	Axial Direction
*3	Center
➡	Front

If the diameter is more than the maximum, replace the cylinder block.



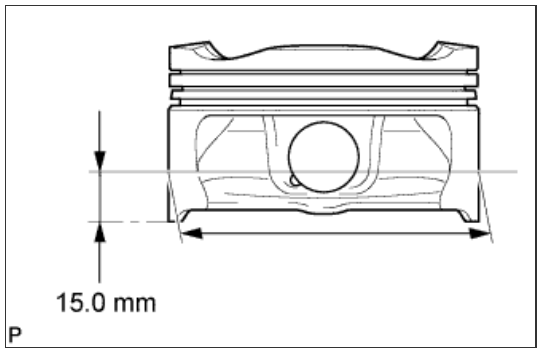
5. INSPECT PISTON SUB-ASSEMBLY WITH PIN

a. Using a micrometer, measure the piston diameter at a position that is 15.0 mm (0.591 in.) from the bottom of the piston (refer to the illustration).

Standard diameter:
93.950 to 93.960 mm (3.6988 to 3.6992 in.)

Minimum diameter:
93.815 mm (3.6935 in.)

If the diameter is less than the minimum, replace the piston.



6. INSPECT PISTON OIL CLEARANCE

a. Measure the cylinder bore diameter in the thrust direction.

b. Subtract the piston diameter measurement from the cylinder bore diameter measurement.

Standard oil clearance:
0.020 to 0.072 mm (0.000787 to 0.00283 in.)

Maximum oil clearance:
0.385 mm (0.0152 in.)

If the oil clearance is more than the maximum, replace all the pistons. If necessary, replace the cylinder block.

7. INSPECT RING GROOVE CLEARANCE

a. Using a feeler gauge, measure the clearance between a new piston ring and the wall of the ring groove.

Standard Ring Groove Clearance:

Item	Specified Condition
No. 1 ring	0.020 to 0.070 mm (0.000787 to 0.00276 in.)
No. 2 ring	0.020 to 0.060 mm (0.000787 to 0.00236 in.)
Oil ring expander	0.070 to 0.145 mm (0.00276 to 0.00571 in.)

If the clearance is not as specified, replace the piston.

8. INSPECT PISTON RING END GAP

a. Insert the piston ring into the cylinder bore.

b. Using a piston, push the piston ring a little beyond the bottom of the ring travel, 60 mm (2.36 in.) from the top of the cylinder block.

c. Using a feeler gauge, measure the end gap.

Standard End Gap:

Item	Specified Condition
No. 1 ring	0.23 to 0.33 mm (0.00906 to 0.0130 in.)
No. 2 ring	0.40 to 0.50 mm (0.0157 to 0.0197 in.)
Oil ring expander	0.10 to 0.40 mm (0.00394 to 0.0157 in.)

Maximum End Gap:

Item	Specified Condition
No. 1 ring	0.42 mm (0.0165 in.)
No. 2 ring	0.55 mm (0.0217 in.)
Oil ring expander	0.45 mm (0.0177 in.)

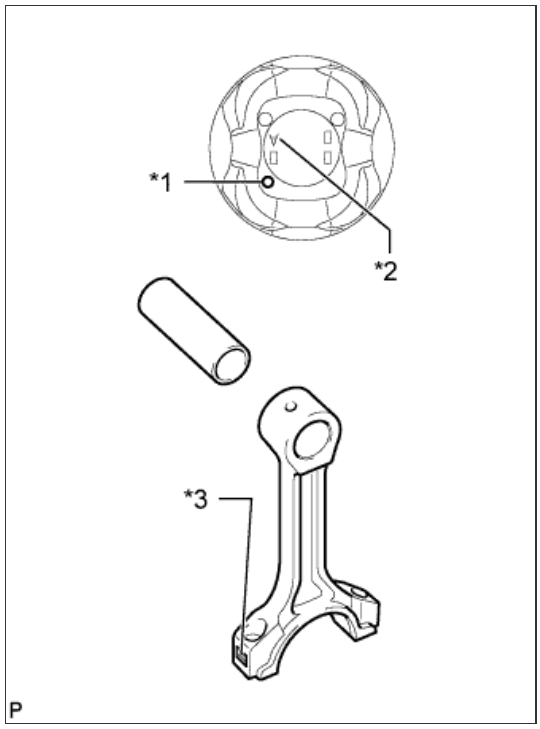
If the end gap is more than the maximum, replace the piston ring. If the end gap is more than the maximum even with a new piston ring, replace the cylinder block.

9. INSPECT PISTON PIN OIL CLEARANCE

a. Check each mark on the piston, piston pin and connecting rod.

Text in Illustration

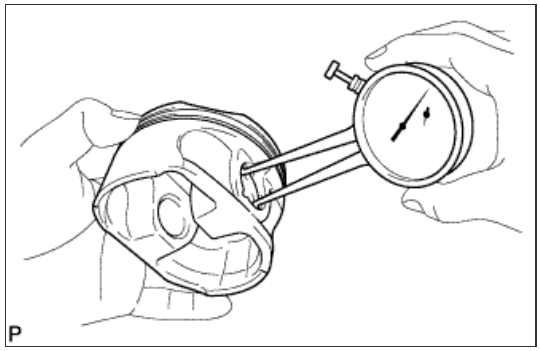
*1	Front Mark
*2	Position Pin Hole Inside Diameter Mark
*3	Connecting Rod Bush Inside Diameter Mark



b. Using a caliper gauge, measure the inside diameter of the piston pin hole.

Standard Piston Pin Hole Inside Diameter:

Mark	Specified Condition
A	21.998 to 22.001 mm (0.86606 to 0.86618 in.)
B	22.001 to 22.004 mm (0.86618 to 0.86630 in.)
C	22.004 to 22.007 mm (0.86630 to 0.86642 in.)



c. Using a micrometer, measure the piston pin diameter.

Standard Piston Pin Diameter:

Mark	Specified Condition
A	21.997 to 22.000 mm (0.86602 to 0.86614 in.)
B	22.000 to 22.003 mm (0.86614 to 0.86626 in.)
C	22.003 to 22.006 mm (0.86626 to 0.86638 in.)

d. Subtract the piston pin diameter measurement from the piston pin hole diameter measurement.

Standard oil clearance:
-0.002 to 0.004 mm (-0.0000787 to 0.000157 in.)

Maximum oil clearance:
0.015 mm (0.000591 in.)

If the oil clearance is more than the maximum, replace the piston and piston pin as a set.

e. Using a caliper gauge, measure the inside diameter of the connecting rod bush.

Standard Bush Inside Diameter:

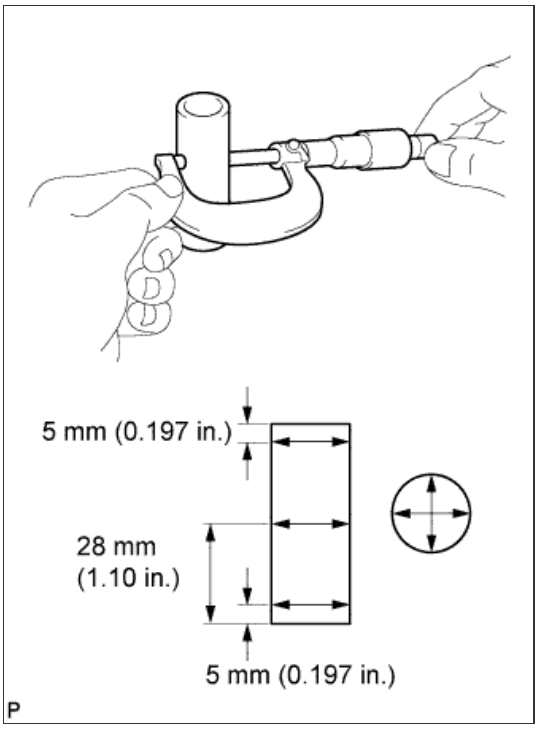
Mark	Specified Condition
A	22.005 to 22.008 mm (0.86634 to 0.86645 in.)
B	22.008 to 22.011 mm (0.86645 to 0.86657 in.)
C	22.011 to 22.014 mm (0.86657 to 0.86669 in.)

f. Subtract the piston pin diameter measurement from the bush inside diameter measurement.

Standard oil clearance:
0.005 to 0.011 mm (0.000197 to 0.000433 in.)

Maximum oil clearance:
0.03 mm (0.00118 in.)

If the oil clearance is more than the maximum, replace the connecting rod, and replace the piston and pin as a set.



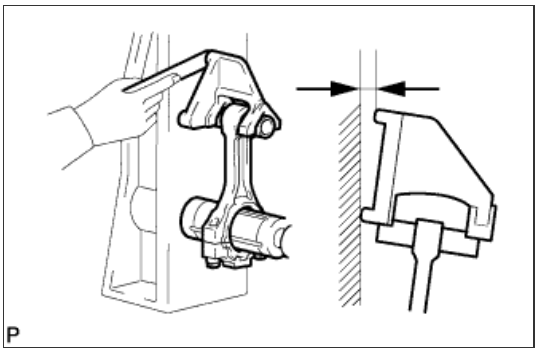
10. INSPECT CONNECTING ROD SUB-ASSEMBLY

a. Using a rod aligner and feeler gauge, check the connecting rod alignment.

i. Check for bend.

Maximum bend:
0.05 mm (0.00197 in.) per 100 mm (3.94 in.)

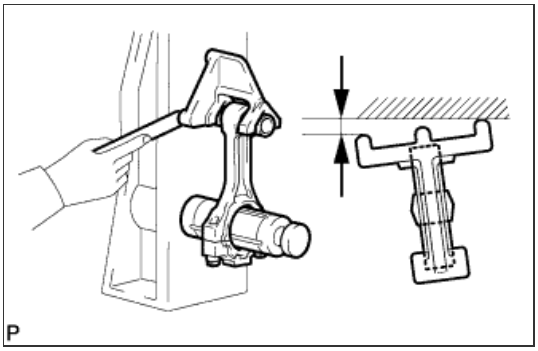
If the bend is more than the maximum, replace the connecting rod.



ii. Check for twist.

Maximum twist:
0.15 mm (0.00591 in.) per 100 mm (3.94 in.)

If the twist is more than the maximum, replace the connecting rod.



11. INSPECT CONNECTING ROD BOLT

a. Using a vernier caliper, measure the tension portion diameter of the bolt.

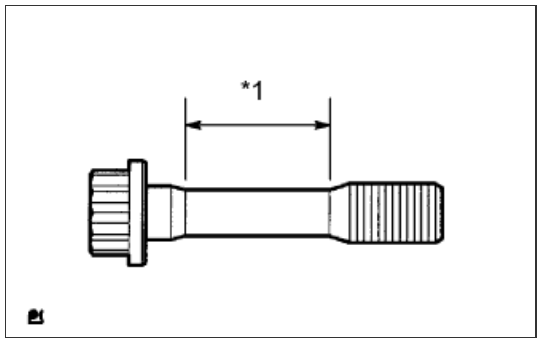
Standard diameter:
8.5 to 8.6 mm (0.335 to 0.339 in.)

Minimum diameter:
8.3 mm (0.327 in.)

Text in Illustration

*1	Measuring Point

If the diameter is less than the minimum, replace the bolt.



12. INSPECT CRANKSHAFT

a. Inspect circle runout.

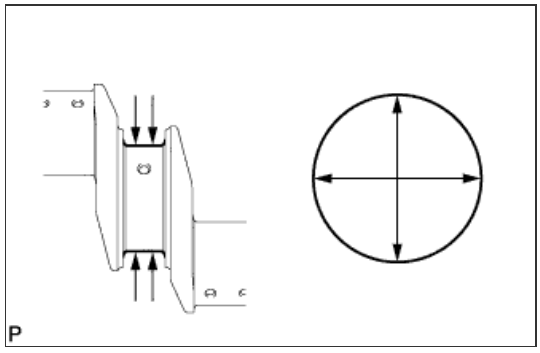
i. Place the crankshaft on V-blocks.

ii. Using a dial indicator, measure the circle runout at the center journal.

Maximum circle runout:
0.06 mm (0.00236 in.)

If the circle runout is more than the maximum, replace the crankshaft.

b. Inspect the main journals.



i. Using a micrometer, measure the diameter of each main journal.

Standard journal diameter:
66.988 to 67.000 mm (2.6373 to 2.6378 in.)

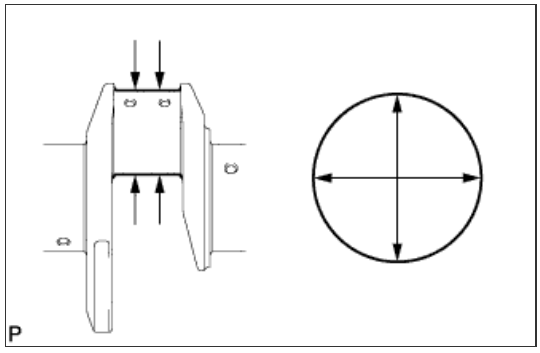
If the diameter is not as specified, check the oil clearance. If necessary, replace the crankshaft.

ii. Check each main journal for taper and out-of-round as shown in the illustration.

Maximum taper and out-of-round:
0.02 mm (0.000787 in.)

If the taper and out-of-round is more than the maximum, replace the crankshaft.

c. Inspect the crank pins.



i. Using a micrometer, measure the diameter of each crank pin.

Standard crank pin diameter:
55.982 to 56.000 mm (2.2040 to 2.2047 in.)

If the diameter is not as specified, check the oil clearance. If necessary, replace the crankshaft.

ii. Check each crank pin for taper and out-of-round as shown in the illustration.

Maximum taper and out-of-round:
0.02 mm (0.000787 in.)

If the taper and out-of-round is more than the maximum, replace the crankshaft.

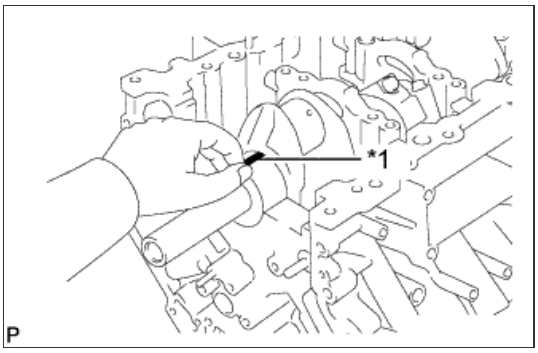
13. INSPECT CRANKSHAFT OIL CLEARANCE

a. Clean each main journal and bearing.

b. Check each main journal and bearing for pitting and scratches.
If the journal or bearing is damaged, replace the bearing.

c. Place the crankshaft on the cylinder block.

d. Lay a strip of Plastigage across each journal.



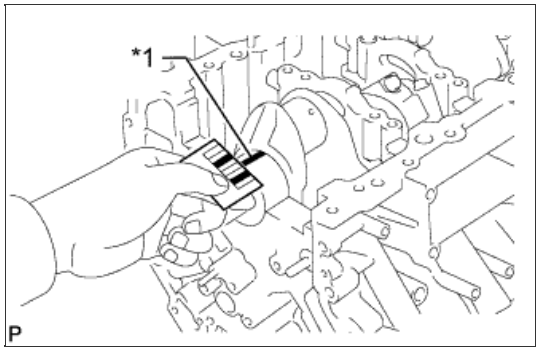
Text in Illustration

*1	Plastigage

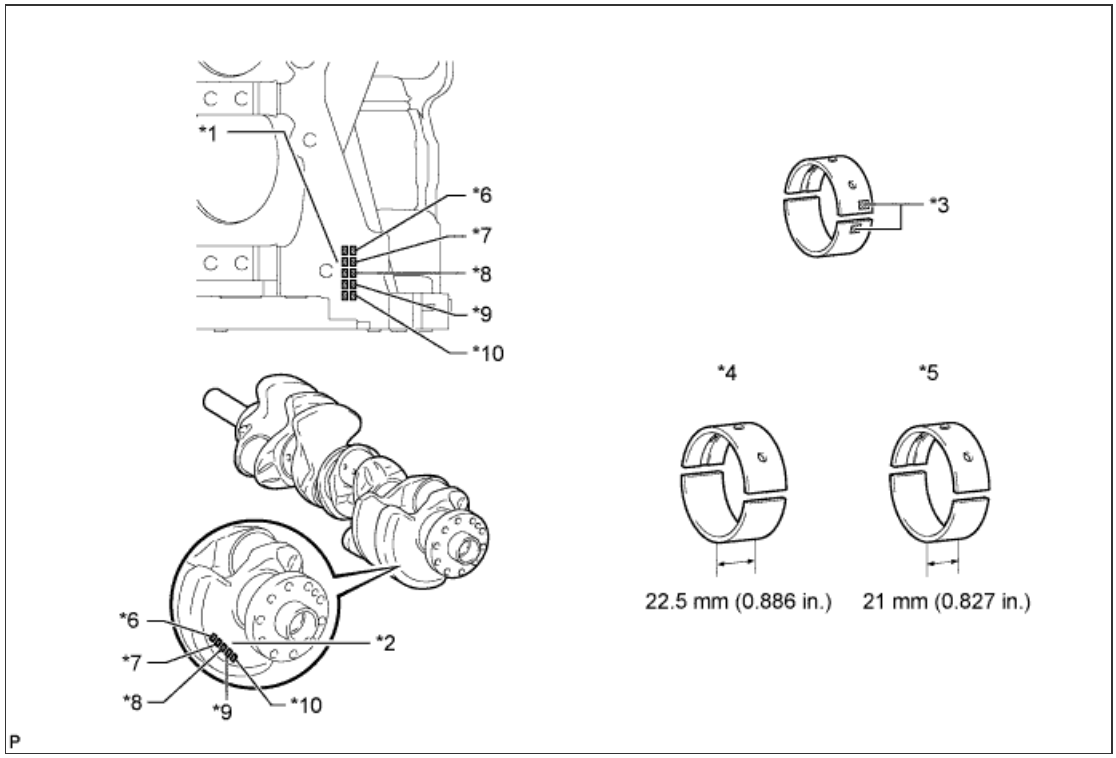
e. Install the crankshaft bearing caps (Click here).

f. Remove the 30 bolts and bearing caps.

g. Measure the Plastigage at its widest point.



Standard Oil Clearance:



Number Mark	Specified Condition
No. 1 and No. 5 journals	0.017 to 0.030 mm (0.000669 to 0.00118 in.)
Other journals	0.024 to 0.037 mm (0.000945 to 0.00146 in.)

Maximum Oil Clearance:

Number Mark	Specified Condition
No. 1 and No. 5 journals	0.050 mm (0.00197 in.)
Other journals	0.060 mm (0.00236 in.)

Text in Illustration

*1	Plastigage

If the oil clearance is more than the maximum, replace the bearings. If necessary, replace the crankshaft.

HINT:

If replacing a bearing, replace it with one that has the same number. If the number of the bearing cannot be determined, select the correct bearing by adding together the numbers imprinted on the cylinder block and crankshaft. Refer to the table below for the appropriate bearing number. There are 6 sizes of standard bearings. For the No. 1 and No. 5 position bearings, use bearings marked 4, 5, 6, 7, 8 or 9. For other bearings, use bearings marked 3, 4, 5, 6, 7 or 8.

Text in Illustration

*1	Cylinder Block Number Mark	*2	Crankshaft Number Mark
*3	Number Mark	*4	No. 1 and No. 5 Journal Bearings
*5	No. 2, No. 3 and No. 4 Journal Bearings	*6	No. 1
*7	No. 2	*8	No. 3
*9	No. 4	*10	No. 5

Example:
Cylinder block "07" + Crankshaft "06" = Total number 13 (Use upper bearing "6" and lower bearing "7")

HINT:

A = Cylinder block number mark

B = Crankshaft number mark

Standard Bearing Center Wall Thickness:

No. 1 and No. 5 Journals

(A) + (B)	Upper Bearing		Lower Bearing	
	Number Mark	Specified Condition	Number Mark	Specified Condition
00 to 02	4	2.501 to 2.504 (0.0985 to 0.0986 in.)	5	2.488 to 2.491 (0.0980 to 0.0981 in.)
03 to 05	5	2.504 to 2.507 (0.0986 to 0.0987 in.)	5	2.488 to 2.491 (0.0980 to 0.0981 in.)
06 to 08	5	2.504 to 2.507 (0.0986 to 0.0987 in.)	6	2.491 to 2.494 (0.0981 to 0.0982 in.)
09 to 11	6	2.507 to 2.510 (0.0987 to 0.0988 in.)	6	2.491 to 2.494 (0.0981 to 0.0982 in.)
12 to 14	6	2.507 to 2.510 (0.0987 to 0.0988 in.)	7	2.494 to 2.497 (0.0982 to 0.0983 in.)
15 to 17	7	2.510 to 2.513 (0.0988 to 0.0989 in.)	7	2.494 to 2.497 (0.0982 to 0.0983 in.)
18 to 20	7	2.510 to 2.513 (0.0988 to 0.0989 in.)	8	2.497 to 2.500 (0.0983 to 0.0984 in.)
21 to 23	8	2.513 to 2.516 (0.0989 to 0.0991 in.)	8	2.497 to 2.500 (0.0983 to 0.0984 in.)
24 to 26	8	2.513 to 2.516 (0.0989 to 0.0991 in.)	9	2.500 to 2.503 (0.0984 to 0.0985 in.)
27 to 28	9	2.516 to 2.519 (0.0991 to 0.0992 in.)	9	2.500 to 2.503 (0.0984 to 0.0985 in.)

Other Journals:

(A) + (B)	Upper Bearing		Lower Bearing	
	Number Mark	Specified Condition	Number Mark	Specified Condition
00 to 02	3	2.482 to 2.485 (0.0977 to 0.0978 in.)	4	2.501 to 2.504 (0.0985 to 0.0986 in.)
03 to 05	4	2.485 to 2.488 (0.0978 to 0.0980 in.)	4	2.501 to 2.504 (0.0985 to 0.0986 in.)
06 to 08	4	2.485 to 2.488 (0.0978 to 0.0980 in.)	5	2.504 to 2.507 (0.0986 to 0.0987 in.)
09 to 11	5	2.488 to 2.491 (0.0980 to 0.0981 in.)	5	2.504 to 2.507 (0.0986 to 0.0987 in.)

12 to 14	5	2.488 to 2.491 (0.0980 to 0.0981 in.)	6	2.507 to 2.510 (0.0987 to 0.0988 in.)
15 to 17	6	2.491 to 2.494 (0.0981 to 0.0982 in.)	6	2.507 to 2.510 (0.0987 to 0.0988 in.)
18 to 20	6	2.491 to 2.494 (0.0981 to 0.0982 in.)	7	2.510 to 2.513 (0.0988 to 0.0989 in.)
21 to 23	7	2.494 to 2.497 (0.0982 to 0.0983 in.)	7	2.510 to 2.513 (0.0988 to 0.0989 in.)
24 to 26	7	2.494 to 2.497 (0.0982 to 0.0983 in.)	8	2.513 to 2.516 (0.0989 to 0.0991 in.)
27 to 28	8	2.497 to 2.500 (0.0983 to 0.0984 in.)	8	2.513 to 2.516 (0.0989 to 0.0991 in.)

h. Completely remove the Plastigage.

14. INSPECT CRANKSHAFT BEARING CAP SET BOLT

a. Using a vernier caliper, measure the minimum diameter of the elongated thread at the measuring point.

Measuring point:
54.5 mm (2.15 in.)

Standard Diameter:

Item	Specified Condition
Bolt A	10.5 to 11.0 mm (0.413 to 0.433 in.)
Bolt B	9.5 to 10.0 mm (0.374 to 0.394 in.)

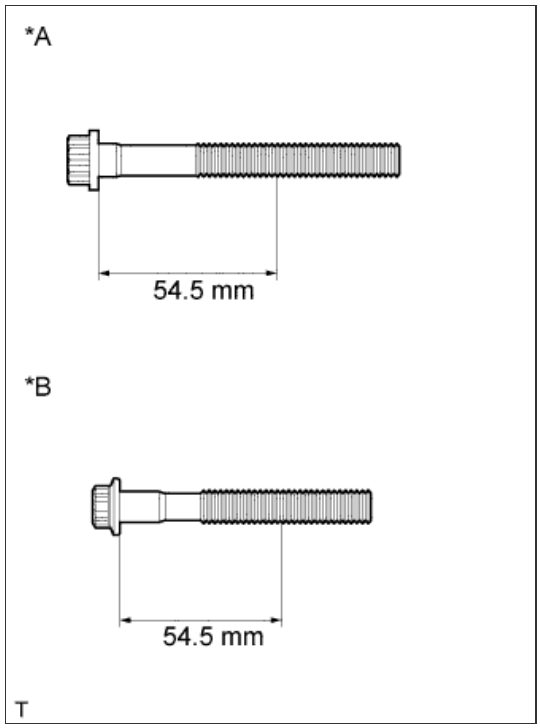
Minimum Diameter:

Item	Specified Condition
Bolt A	10.4 mm (0.409 in.)
Bolt B	9.4 mm (0.370 in.)

Text in Illustration

*A	Bolt A
*B	Bolt B

If the diameter is less than the minimum, replace the bolt.



for Preparation Click here

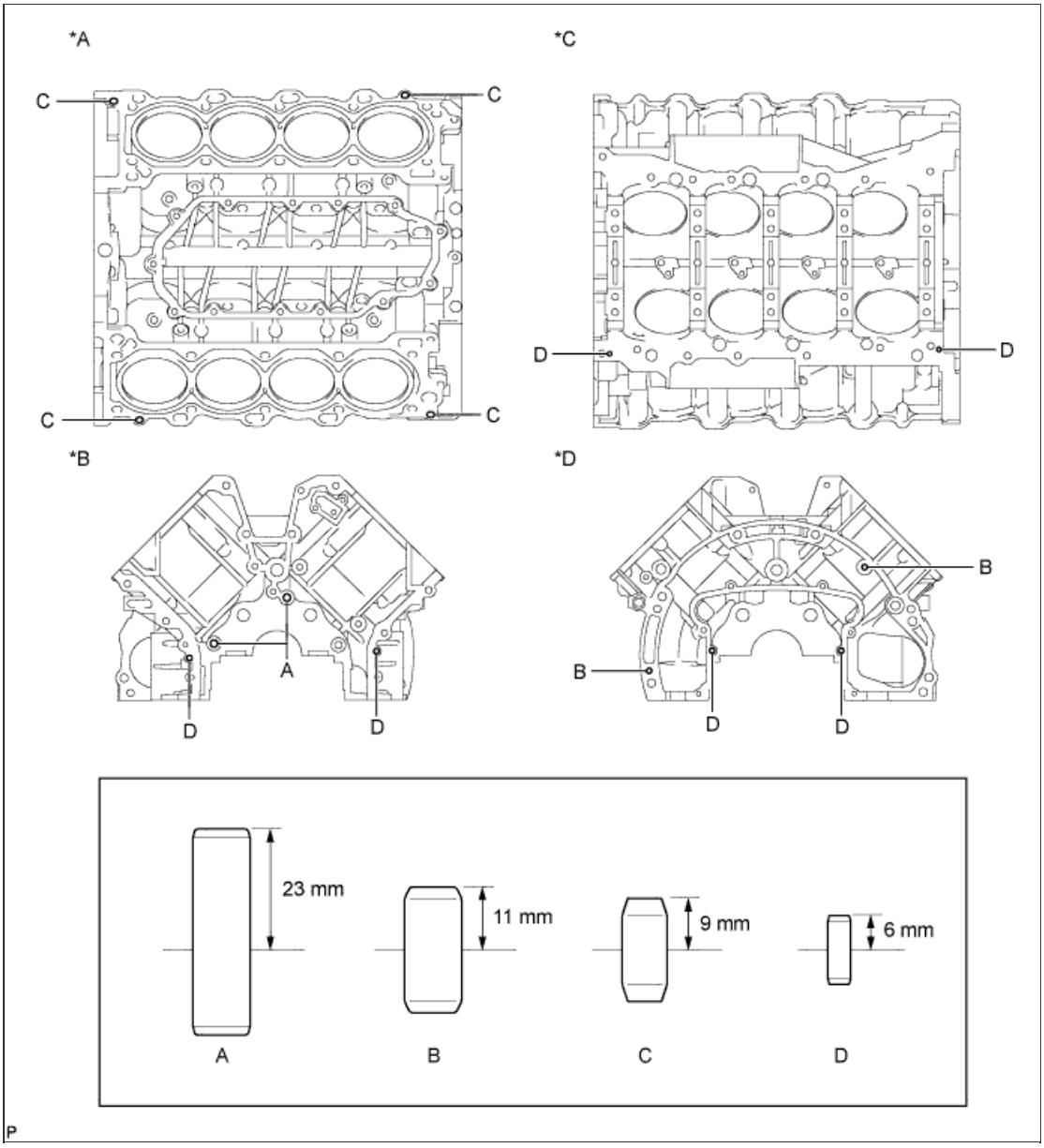
1. REPLACE STRAIGHT PIN

NOTICE:

It is not necessary to remove the straight pin unless it is being replaced.

a. Remove the straight pins.

b. Using a plastic-faced hammer, tap in new straight pins to the cylinder block.



Text in Illustration

*A	Upper Side	*B	Front Side
*C	Lower Side	*D	Rear Side

Standard Protrusion:

Item	Pin Diameter	Specified Condition

Pin A	10 mm (0.394 in.)	23 mm (0.906 in.)
Pin B	10 mm (0.394 in.)	11 mm (0.433 in.)
Pin C	8 mm (0.315 in.)	9 mm (0.354 in.)
Pin D	4 mm (0.157 in.)	6 mm (0.236 in.)

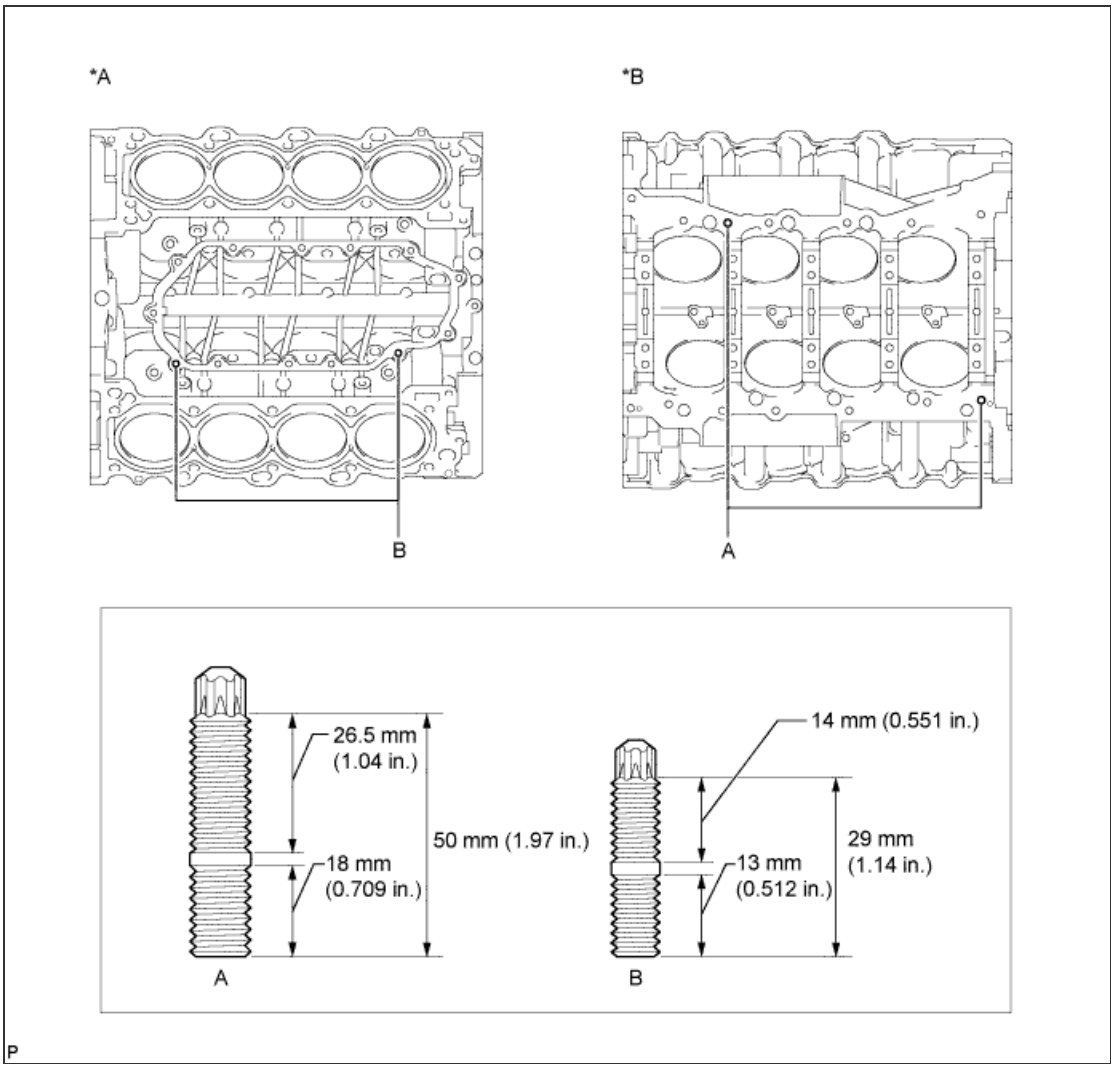
for Preparation Click here

1. INSTALL STUD BOLT

NOTICE:

If the stud bolt is deformed or its threads are damaged, replace it.

a. Using an E8 "TORX" socket wrench, install the stud bolts.



Text in Illustration

*A	Upper Side	*B	Lower Side

Torque:

for stud bolt A:

20 N* 204 kgf*c , 15 ft.*lbf }

for stud bolt B:

9.0 N* 92 kgf*c , 80 in.*lbf }

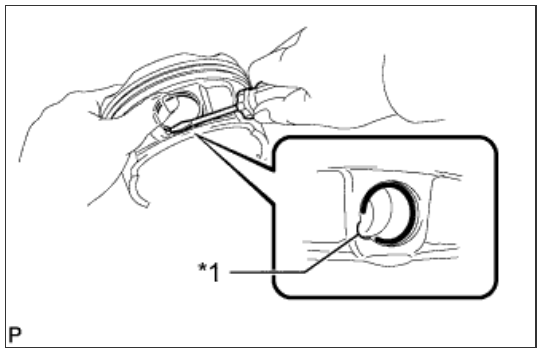
2. INSTALL NO. 1 OIL NO LE SUB-ASSEMBLY

a. Using a 5 mm hexagon wrench, install the 4 oil nozzles with the 4 bolts.

Torque:
10 N* 102 kgf*c , 7 ft.*lbf }

3. INSTALL PISTON IT PIN SUB-ASSEMBLY

a. Using a small screwdriver, install a new snap ring at one end of the piston pin hole.



Text in Illustration

*1	Service Hole

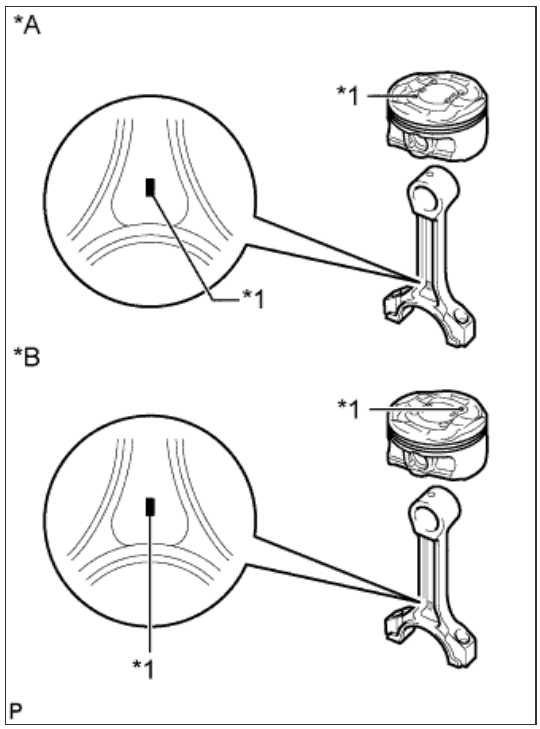
INT:

Be sure that the end gap of the snap ring is not aligned with the service hole of the piston.

b. Gradually heat the piston to approximately 80°C (176°F).

c. Coat the piston pin and connecting rod with engine oil.

d. Align the front marks of the piston and connecting rod as shown in the illustration. Then push in the piston pin with your thumb until the piston pin contacts the snap ring.



Text in Illustration

*A	LH
*B	RH
*1	Front Mark

NOTICE:

For the LH side, perform the assembly so that the front marks of the piston and connecting rod are on the same side. For the RH side, perform the assembly so that the front marks of the piston and connecting rod are on opposite sides.

INT:

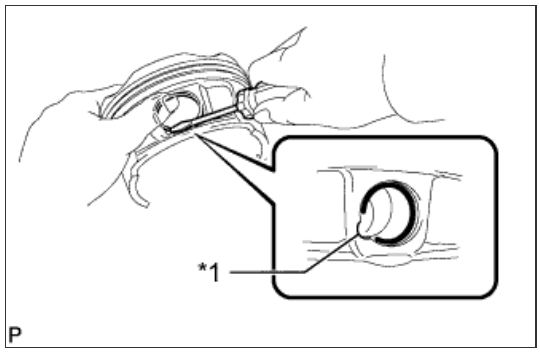
The piston and pin are a matched set.

e. Check the fitting condition between the piston and piston pin.

i. Move the connecting rod back and forth on the piston pin. Check the fitting condition.
If abnormal movement is felt, replace the piston and pin as a set.

ii. Rotate the piston back and forth on the piston pin. Check the fitting condition.
If abnormal movement is felt, replace the piston and pin as a set.

f. Using a small screwdriver, install a new snap ring at the other end of the piston pin hole.



Text in Illustration

*1	Service Hole

INT:

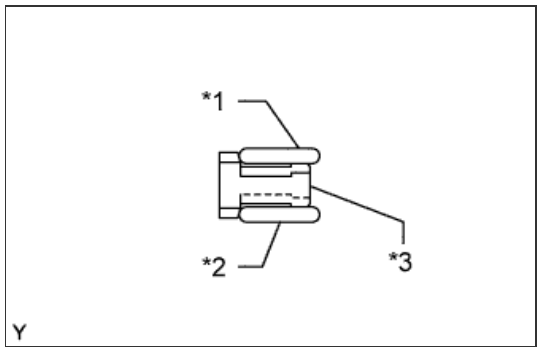
Be sure that the end gap of the snap ring is not aligned with the service hole of the piston.

4. INSTALL PISTON RIN SET

a. Install the oil ring expander and 2 side rails by hand.

Text in Illustration

*1	Side Rail Upper
*2	Side Rail Lower
*3	Oil Ring Expander



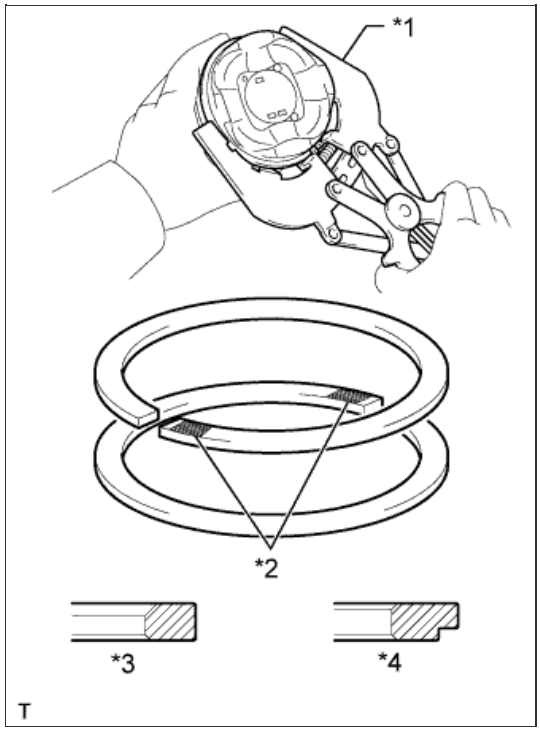
b. Using a piston ring expander, install the 2 compression rings so that the paint marks are positioned as shown in the illustration.

Paint Mark:

Piston Ring	Paint Mark
No. 1	Blue
No. 2	Orange

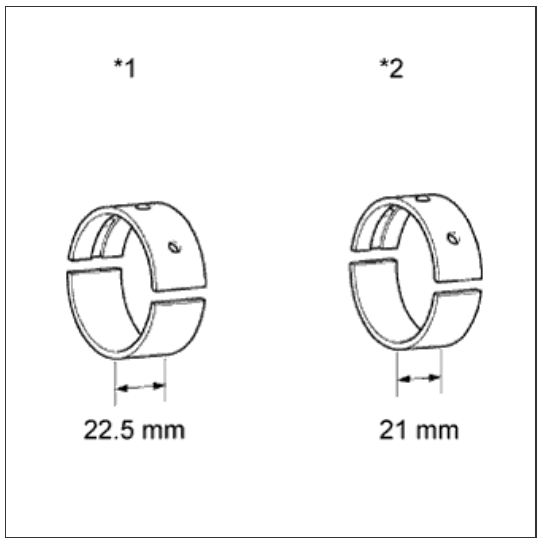
Text in Illustration

*1	Piston Ring Expander
*2	Paint Mark
*3	No. 1 Ring
*4	No. 2 Ring



5. INSTALL CRANKS AFT BEARIN

a. Clean the main journal and both surfaces of the bearing.



b. Install the upper bearing.

Text in Illustration

*1	No. 1 and No. 5 Journal Bearings
*2	No. 2, No. 3 and No. 4 Journal Bearings

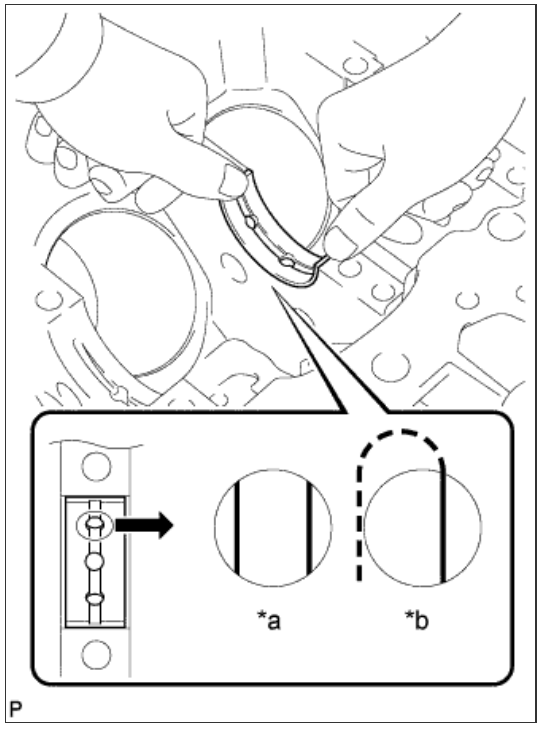
NOTICE:

Main bearings come in widths of 21 mm (0.827 in.) and 22.5 mm (0.886 in.). Install the 22.5 mm (0.886 in.) bearings in the No. 1 and No. 5 cylinder block journal positions with the main bearing caps. Install the 21 mm (0.827 in.) bearings in the No. 2, No. 3 and No. 4 positions.

i. Install the upper bearing to the cylinder block as shown in the illustration.

Text in Illustration

*a	CORRECT
*b	INCORRECT



NOTICE:

- **Do not apply engine oil to the bearings and the contact surfaces.**
- **Both sides of the oil groove in the cylinder block should be visible through the oil feed holes in the bearing. The amount visible on each side of the holes should be equal.**
- **Do not allow coolant to come into contact with the bearing inner surface.**
- **If any coolant comes into contact with the bearing inner surface, replace the bearing with a new one.**

c. Install the lower bearing.

NOTICE:

- **Be sure to install the selected bearing.**
- **Main bearings come in widths of 21 mm (0.827 in.) and 22.5 mm (0.886 in.). Install the 22.5 mm (0.886 in.) bearings in the No. 1 and No. 5 cylinder block journal positions with the main bearing caps. Install the 21 mm (0.827 in.) bearings in the No. 2, No. 3 and No. 4 positions.**

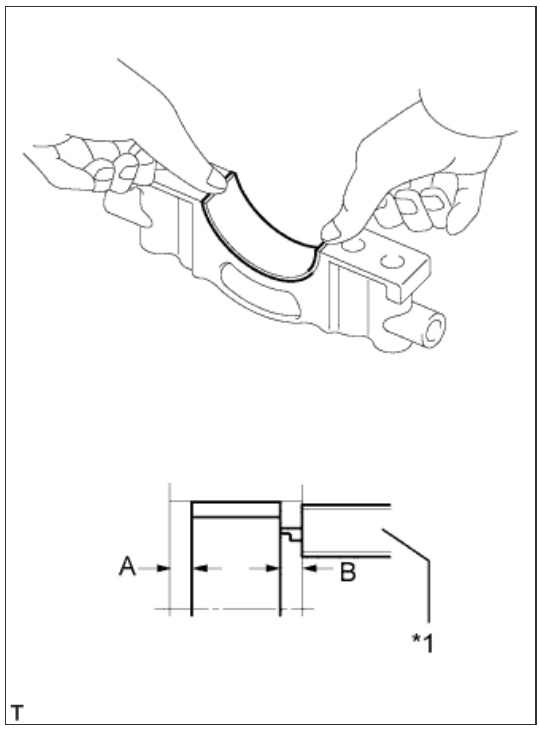
i. Install the lower bearings to the crankshaft bearing caps.

ii. Using a vernier caliper, measure the distance between the crankshaft bearing cap edge and the lower bearing edge.

Dimension A - B or B - A:
0 to 0.7 mm (0 to 0.0276 in.)

Text in Illustration

*1	Vernier Caliper



NOTICE:

- **Do not apply engine oil to the bearings and the contact surfaces.**
- **Do not allow coolant to come into contact with the bearing inner surface.**
- **If any coolant comes into contact with the bearing inner surface, replace the bearing with a new one.**

6. INSTALL CRANKSHAFT THRUST WASHER SET

a. Apply engine oil to the thrust washer set.

b. Install the 4 thrust washers to the No. 3 journal position of the cylinder block and crankshaft bearing cap with the oil grooves facing outward.

7. INSTALL CRANKSHAFT

a. Apply engine oil to the upper bearing and lower bearing, then place the crankshaft on the cylinder block.

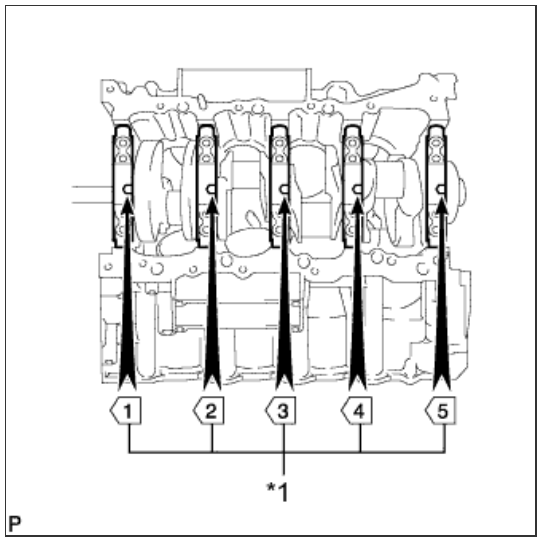
b. Confirm the front marks and numbers of the crankshaft bearing caps, and install the crankshaft bearing caps on the cylinder block.

Text in Illustration

*1	Number Mark

HINT:

A number is marked on each main bearing cap to indicate the installation position.



c. Apply a light coat of engine oil to the threads and under the heads of the bearing cap bolts.

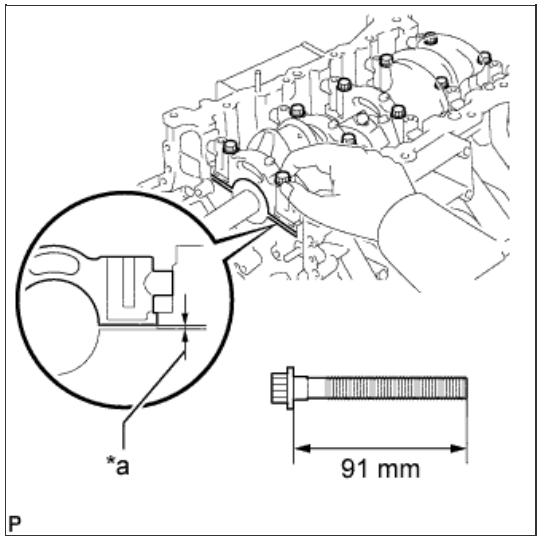
d. Temporarily install the 10 crankshaft bearing cap bolts to the inside positions.

e. Push the crankshaft bearing cap by hand until the clearance between the crankshaft bearing cap and cylinder block is less than 6 mm (0.236 in.).

Bolt length:
91 mm (3.58 in.)

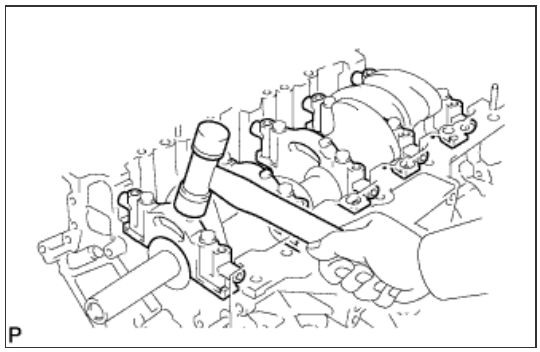
Text in Illustration

*a	Less than 6 mm



f. Using a plastic-faced hammer, lightly tap the crankshaft bearing cap to ensure a proper fit.

g. Apply a light coat of engine oil to the threads and under the heads of the 10 crankshaft bearing cap bolts.

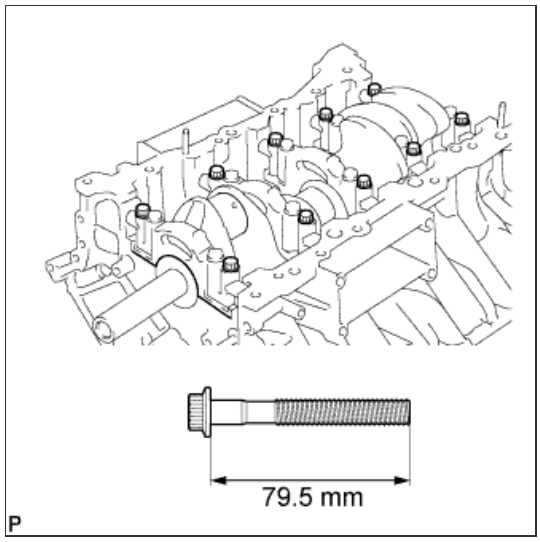


h. Temporarily install the 10 crankshaft bearing cap bolts to the outside positions.

Bolt length:
79.5 mm (3.13 in.)

HINT:

The main bearing cap bolts are tightened in 2 progressive steps.

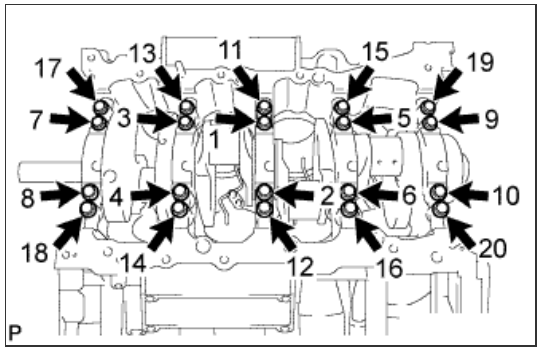


i. Step 1:

i. Uniformly tighten the 20 crankshaft bearing cap bolts in the sequence shown in the illustration.

Torque:
for inside position:
61 N*m{ 22 kgf*cm , 45 ft.*lbf }
for outside position:
27 N*m{ 275 kgf*cm , 20 ft.*lbf }

If any of the main bearing cap bolts does not meet the specified torque, replace it.



j. Step 2:

i. Mark the front of the bearing cap bolts with paint.

ii. Tighten the bearing cap bolts 90° in the order shown in step 1.

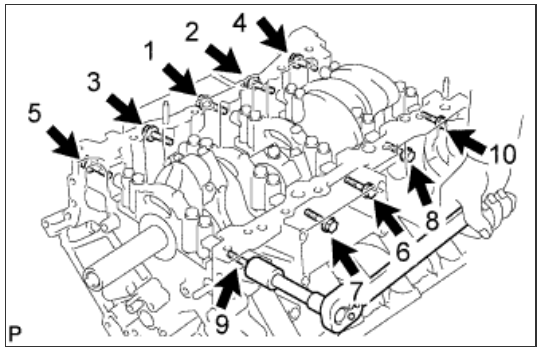
iii. Check that the painted marks are now at a 90° angle to the front.

k. Check that the crankshaft turns smoothly.

l. Install and uniformly tighten the 10 crankshaft bearing cap bolts and 10 new seal washers in several steps in the sequence shown in the illustration.

Torque:
45 N*m{ 459 kgf*cm , 33 ft.*lbf }

m. Check that the crankshaft turns smoothly.



8. INSTALL CONNECTING ROD BEARING

a. Install the connecting rod bearings to the connecting rods and bearing caps.

b. Using a vernier caliper, measure the distance between the connecting rod and bearing cap edges, and each connecting rod bearing edge.

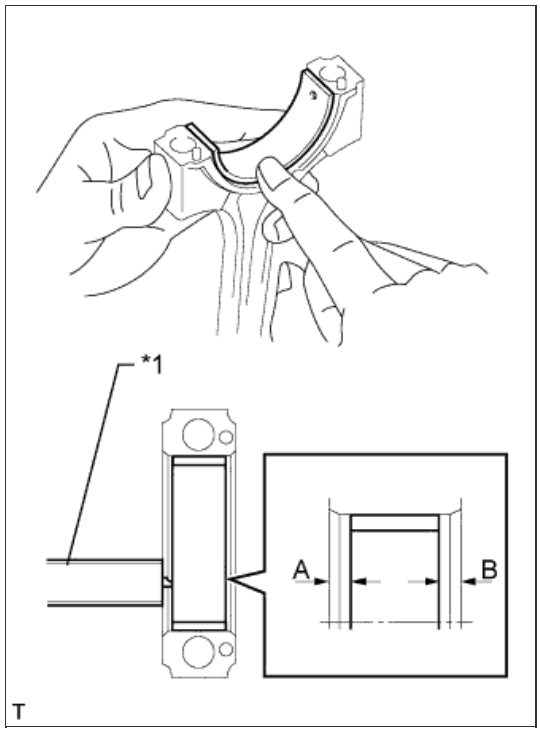
Dimension A - B or B - A:
0 to 0.7 mm (0 to 0.0276 in.)

Text in Illustration

*1	Vernier Caliper

NOTICE:

- **Do not apply engine oil to the bearings and the contact surfaces.**
- **Do not allow coolant to come into contact with the bearing inner surface.**
- **If any coolant comes into contact with the bearing inner surface, replace the bearing with a new one.**



9. INSTALL PISTON AND CONNECTING ROD

a. Apply engine oil to the cylinder walls, the pistons, and the surfaces of the connecting rod bearings.

b. Position the piston rings so that the ring ends are as shown in the illustration.

Text in Illustration

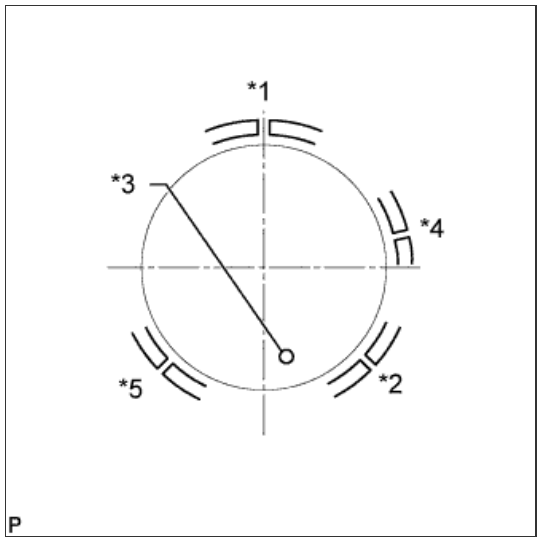
*1	Side Rail Upper
*2	Side Rail Lower
*3	Front Mark
*4	No. 1 Ring
*5	No. 2 Ring

NOTICE:

Do not align the ring ends.

HINT:

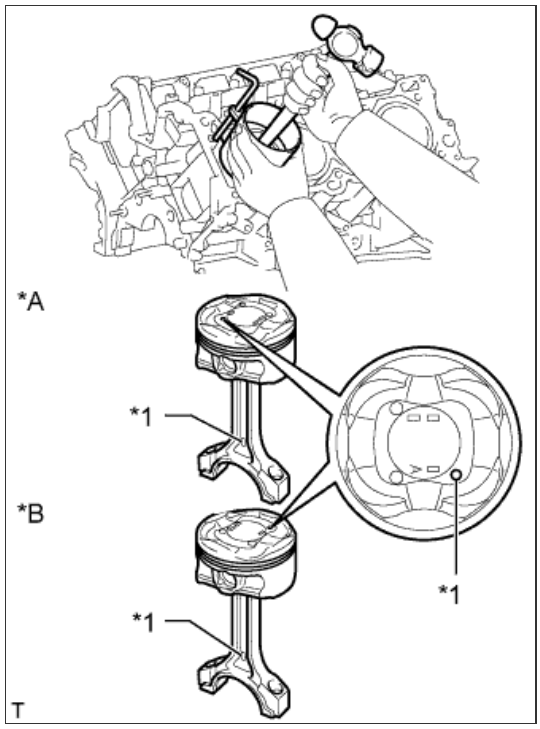
The expander ends can be placed anywhere.



c. Using a hammer handle and piston ring compressor, push the correctly numbered piston and connecting rod into the cylinder with the front mark of the piston facing forward.

Text in Illustration

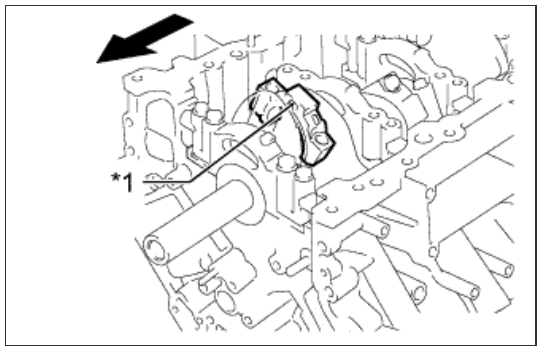
*A	LH
*B	RH
*1	Front Mark



d. Place the connecting rod cap on the connecting rod.

i. Match the numbered connecting rod cap with the connecting rod.

ii. Place the connecting rod cap on the connecting rod, and check that the front mark of the connecting rod cap is facing the direction indicated in the chart below.



Front Mark:

Item	Front Mark
Bank 1	Front side
Bank 2	Rear side

Text in Illustration

*1	Front Mark
➡	Front

e. Apply a light coat of engine oil to the threads and under the heads of the connecting rod cap bolts.

f. Temporarily install the connecting rod cap bolts.

HINT:

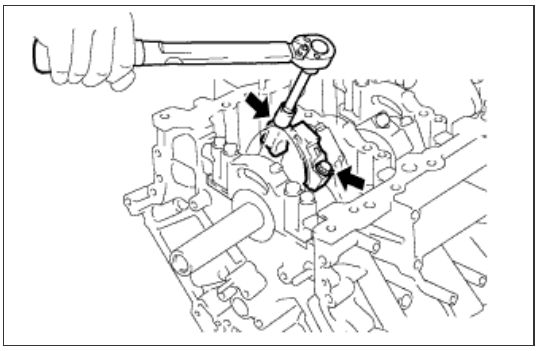
The connecting rod cap bolts are tightened in 2 progressive steps.

g. Step 1:

i. Install and alternately tighten the bolts of the connecting rod cap in several steps.

Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

h. Step 2:



i. Mark the front side of each connecting rod cap bolt with paint.

ii. Tighten the cap bolts 90° as shown in the illustration in the order in step 1.

iii. Check that the painted marks are now at a 90° angle to the front.

i. Check that the crankshaft turns smoothly.

for Preparation Click here

1. INSPECT IGNITION TIMING

a. Warm up and stop the engine.

i. Allow the engine to warm up to a normal operating temperature.

b. When using the intelligent tester:

i. Connect the intelligent tester to the DLC3.

NOTICE:

Switch off all accessories and the A/C before connecting the intelligent tester.

ii. Start the engine and idle it.

iii. Push the intelligent tester main switch ON.

iv. Enter the following menus: Powertrain / Engine and ECT / Data List / Primary / IGN Advance.

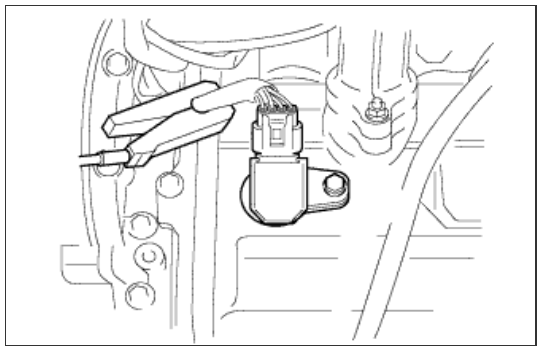
HINT:

Refer to the intelligent tester operator's manual for further details.

Standard ignition timing:
5 to 15° BTDC @ idling (transmission in neutral and A/C switch off)

v. Disconnect the intelligent tester from the DLC3.

c. When not using the intelligent tester:



i. Remove the 2 nuts and V-bank cover.

ii. Connect the tester probe of a timing light to the wire of the ignition coil connector for the No. 1 cylinder.

NOTICE:

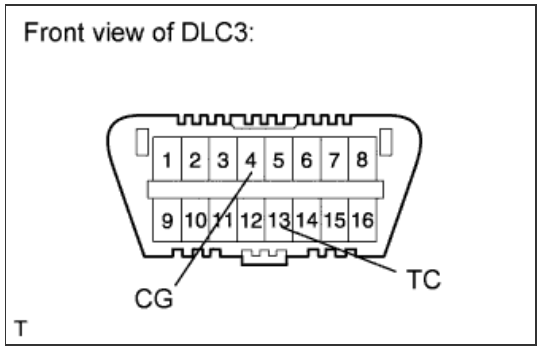
Use a timing light that detects primary signals.

iii. Using SST, connect terminals 13 (TC) and 4 (CG) of the DLC3.

SST
09843-18040

NOTICE:

- **Confirm the terminal numbers before connecting them. Connecting the wrong terminals can damage the engine.**
- **Switch off all accessories and the A/C.**



iv. Using the timing light, check the ignition timing.

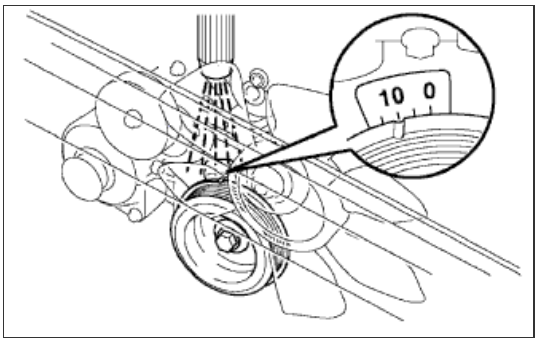
Ignition timing:
5 to 15° BTDC @ idling (transmission in neutral and A/C switch off)

v. Remove SST from the DLC3.

vi. Disconnect the timing light from the engine.

vii. Install the V-bank cover with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



2. INSPECT ENGINE IDLE SPEED

a. Warm up and stop the engine.

i. Allow the engine to warm up to a normal operating temperature.

b. When using the intelligent tester:

i. Connect the intelligent tester to the DLC3.

NOTICE:

Switch off all accessories and the A/C before connecting the intelligent tester.

ii. Race the engine at 2500 rpm for approximately 90 seconds.

iii. Push the intelligent tester main switch ON.

iv. Enter the following menus: Powertrain / Engine and ECT / Data List / Primary / Engine Speed.

Standard idle speed:
650 to 750 rpm (transmission in neutral and A/C switch off)

HINT:

Refer to the intelligent tester operator's manual for further details.

If the idle speed is not as specified, check the air intake system.

v. Disconnect the intelligent tester from the DLC3.

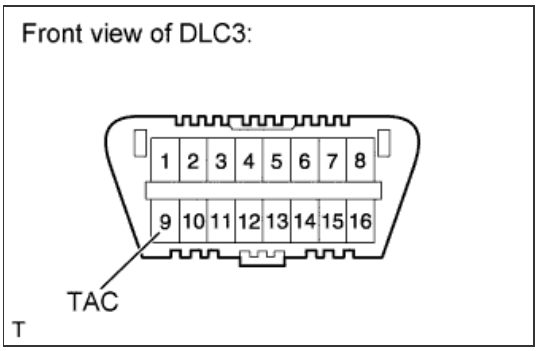
c. When not using the intelligent tester:

i. Using SST, connect a tachometer probe to terminal 9 (TAC) of the DLC3.

SST
09843-18030

NOTICE:

- **Confirm the terminal number before connecting the probe. Connecting the probe to the wrong terminal can damage the engine.**
- **Switch off all accessories and the A/C.**



ii. Race the engine at 2500 rpm for approximately 90 seconds.

iii. Check the idle speed.

Standard idle speed:
650 to 750 rpm (transmission in neutral and A/C switch off)

If the idle speed is not as specified, check the air intake system.

iv. Disconnect the tachometer from the DLC3.

3. INSPECT COMPRESSION

a. Warm up and stop the engine.

   i. Allow the engine to warm up to a normal operating temperature.

b. Check for DTCs (Click here).

c. Remove the 2 nuts and V-bank cover.

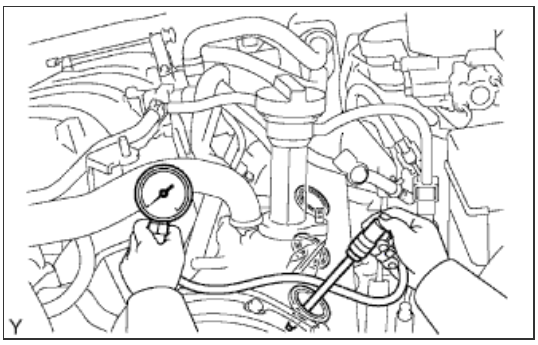
d. Remove the air cleaner hose assembly.

e. Disconnect the 8 injector connectors and 8 ignition coil connectors.

f. Remove the 8 bolts and 8 ignition coils.

g. Remove the 8 spark plugs.

h. Check the cylinder compression pressure.



NOTICE:

Check the compression pressure of each cylinder in the same way.

   i. Insert a compression gauge into the spark plug hole.

   ii. Fully open the throttle.

   iii. While cranking the engine, measure the compression pressure.

Standard compression pressure:
1373 kPa (14.0 kgf/cm^2, 199 psi) or more

Minimum pressure:
1030 kPa (10.5 kgf/cm^2, 149 psi)

Difference between each cylinder:
98 kPa (1.0 kgf/cm^2, 14.2 psi) or less

NOTICE:

- **Always use a fully charged battery to obtain an engine speed of 250 rpm or more.**
- **This measurement must be done as quickly as possible.**

   iv. If the cylinder compression is low in one or more cylinders, pour a small amount of engine oil into the cylinder with low compression through its spark plug hole. Then inspect the cylinder compression pressure again.

HINT:

- **If adding oil helps boost the compression, it is likely that the piston rings and/or cylinder bore are worn or damaged.**
- **If pressure stays low, a valve may be stuck or seated improperly, or there may be leakage in the gasket.**

i. Install the 8 spark plugs.

Torque:
18 N*m{ 178 kgf*cm , 13 ft.*lbf }

j. Install the 8 ignition coils with the 8 bolts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

k. Connect the 8 injector connectors and 8 ignition coil connectors.

l. Install the air cleaner hose assembly.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

m. Install the V-bank cover with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

n. Clear the DTCs (Click here).

4. INSPECT CO/HC

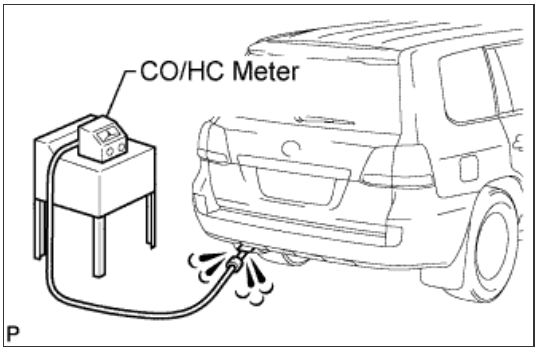
HINT:

This check is used only to determine whether or not the idle CO/HC complies with regulations.

a. Warm up the engine.

b. Keep the engine speed at 2500 rpm for approximately 180 seconds.

c. Insert the CO/HC meter testing probe at least 40 cm (1.31 ft.) into the tailpipe during idling.



d. Immediately check CO/HC concentration at idle and/or 2500 rpm.

HINT:

When performing the 2 mode (2500 rpm and idle) test, follow the measurement order prescribed by the applicable local regulations.

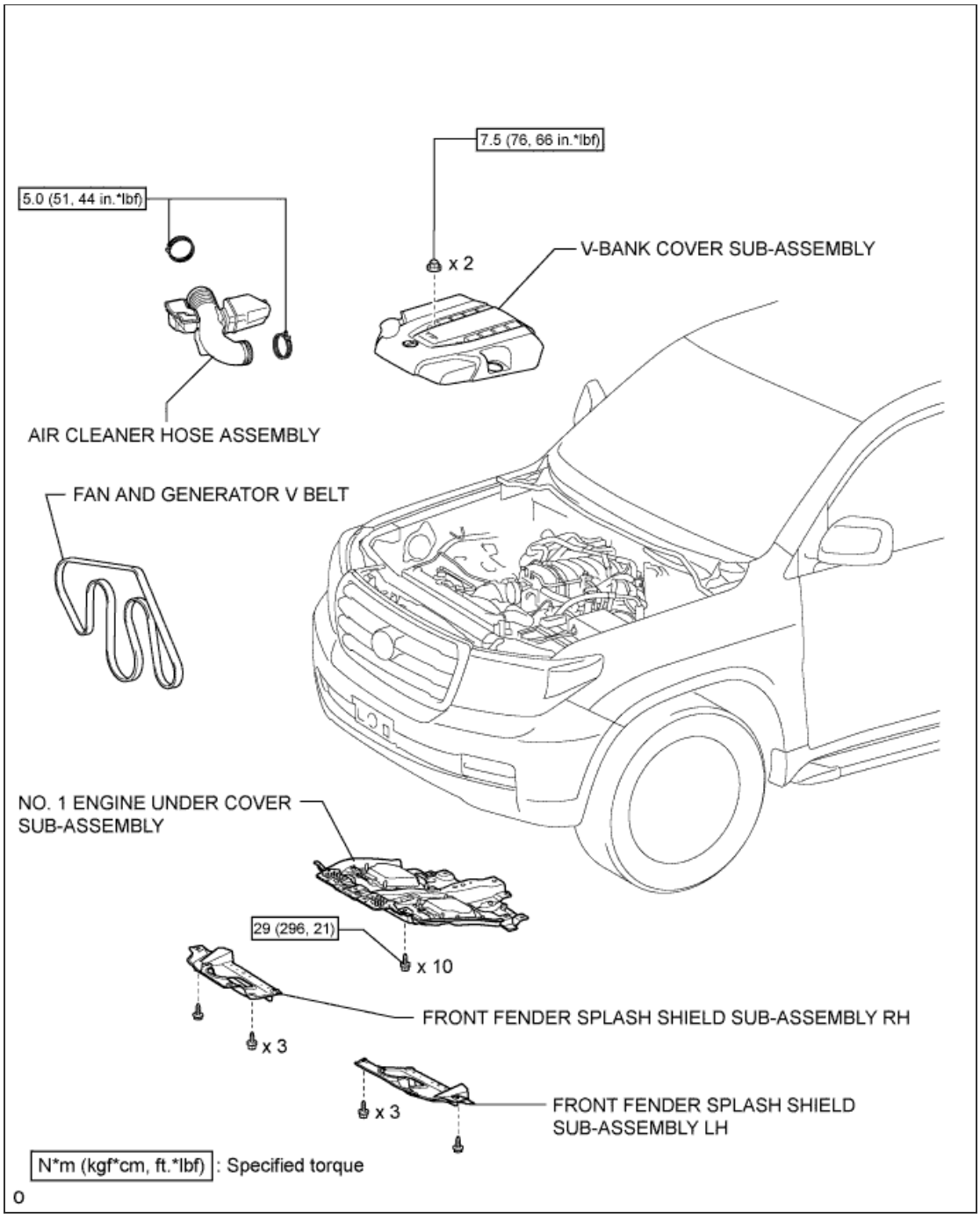
e. If the CO/HC concentration does not comply with regulations, troubleshoot in the order given below.

i. Check the A/F sensor (Click here) and heated oxygen sensor (Click here) operation.

ii. See the table below for possible causes, and then inspect and correct the applicable causes if necessary.

CO	HC	Symptom	Cause
Normal	High	Rough idle	1. Faulty ignitions: • Incorrect timing • Plugs (contaminated, shorted or gaps are defective) 2. Incorrect valve clearance 3. Leaky intake and exhaust valves 4. Leaky cylinder
Low	High	Rough idle (Fluctuating HC reading)	1. Vacuum leaks: • PCV hose • Intake manifold • Throttle body 2. Lean mixture causing misfire
High	High	Rough idle (Black smoke from exhaust)	1. Restricted air filter 2. Faulty SFI system: • Faulty pressure regulator • Defective ECT sensor • Faulty ECM • Faulty injectors • Faulty throttle position sensor • Faulty MAF meter

for Preparation [Click here]

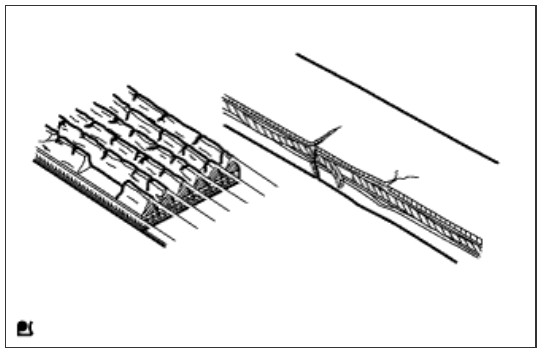


for Preparation Click here

1. INSPECT FAN & GENERATOR V BELT

a. Check the belt for wear, cracks or other signs of damage.
If any of the following defects is found, replace the fan and generator V belt.

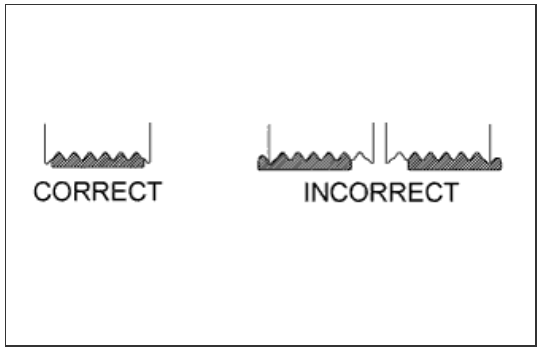
- The belt is cracked.
- The belt is worn out to the extent that the cords are exposed.
- The belt has chunks missing from the ribs.



b. Check that the belt fits properly in the ribbed grooves.

HINT:

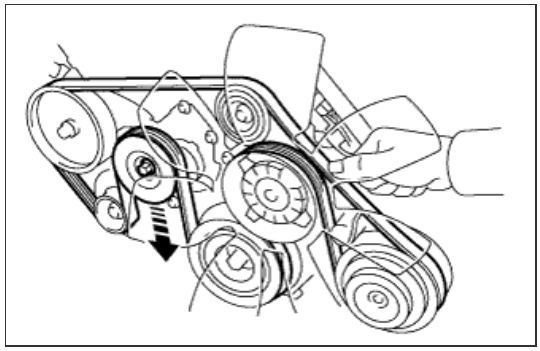
Check with your hand to confirm that the belt has not slipped out of the groove on the bottom to the pulley. If it has slipped out, replace the fan and generator V belt. Install a new fan and generator V belt correctly.



2. INSPECT V-RIBBED BELT TENSIONER ASSEMBLY

a. Check that the belt tensioner moves downward when the belt is pressed down at the point indicated in the illustration with approximately 98 N (10 kgf, 22.0 lbf) of force.

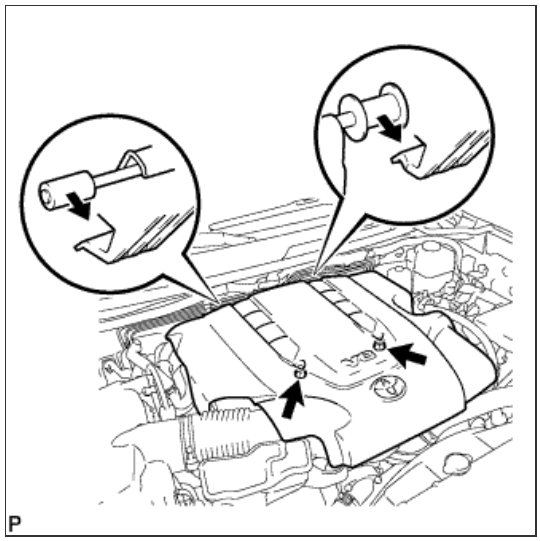
b. Check that nothing gets caught in the tensioner by turning it clockwise and counterclockwise.
If a malfunction exists, replace the tensioner.



for Preparation Click here

1. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Remove the 2 nuts and V-bank cover.

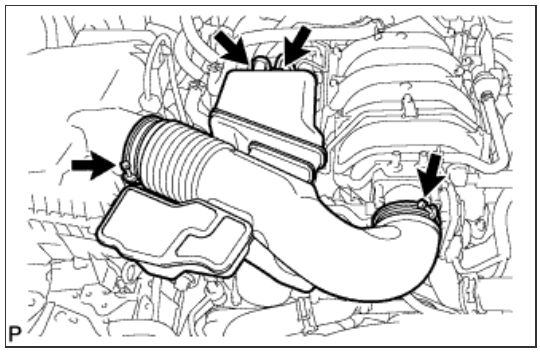


2. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum transmitting hose and No. 2 venti ation hose.

b. Loosen the 2 hose c amps.

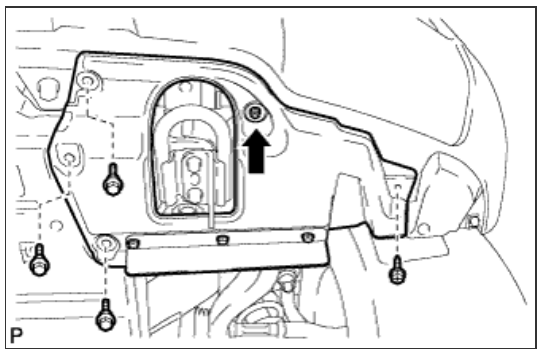
c. Remove the air c aner hose.



3. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bo ts and screw.

b. Turn the c ip indicated by the arrow in the i stration to remove the fender sp ash shie d.



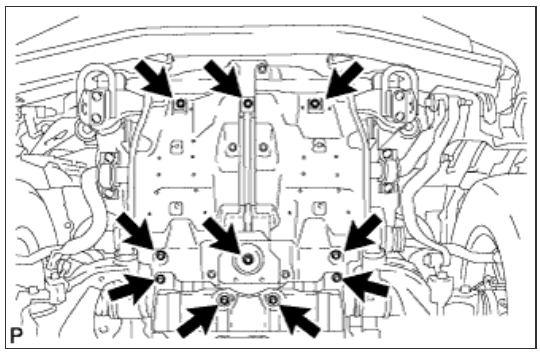
4. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

5. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and No. 1 engine under cover.

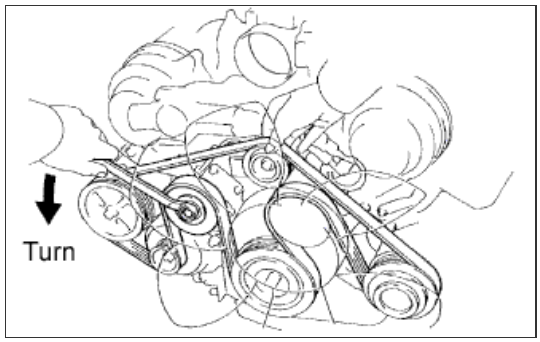


6. REMOVE FAN & GENERATOR V BELT

a. Loosen the belt tension by turning the belt tensioner counterclockwise, and then remove the fan and generator V belt.

HINT:

The pulley bolt for the belt tensioner has left-hand thread.



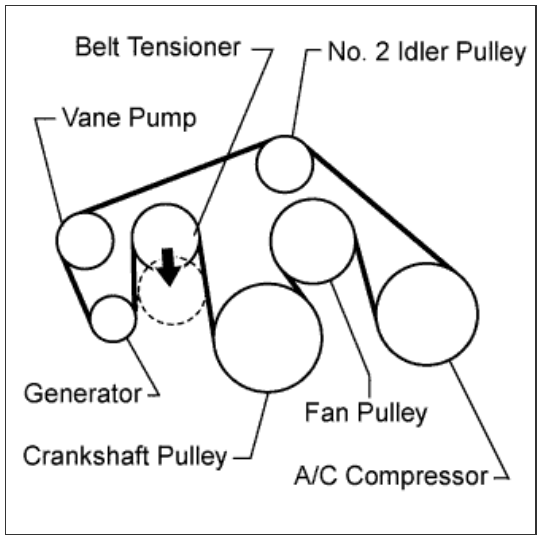
for Preparation Click here

1. INSTALL FAN & GENERATOR V BELT

a. Set the V belt onto every part except the belt tensioner, as shown in the illustration.

b. Loosen the V belt by turning the belt tensioner counterclockwise.

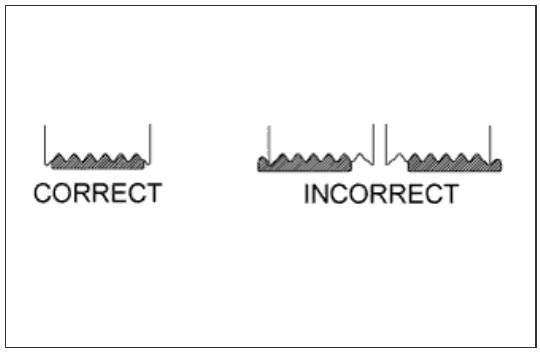
c. Set the V belt to the belt tensioner.



d. Check that the belt fits properly in the ribbed grooves.

HINT:

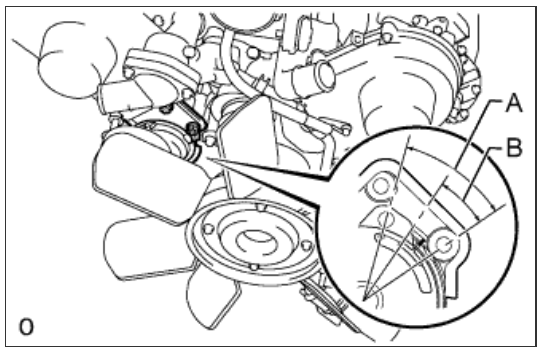
Make sure to check by hand that the belt has not slipped out of the grooves on the bottom of the pulley.



e. Check that the arrow on the belt tensioner is within area "A".
If the arrow is outside area "A", replace the fan and generator V belt.

HINT:

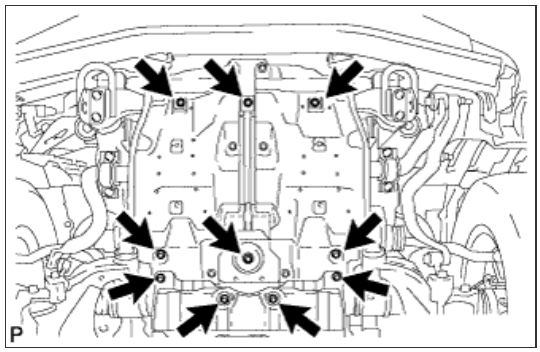
When a new belt is installed, the arrow should be within area "B". If not, the fan and generator V belt is not installed correctly.



2. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the No. 1 engine under cover with the 10 bolts.

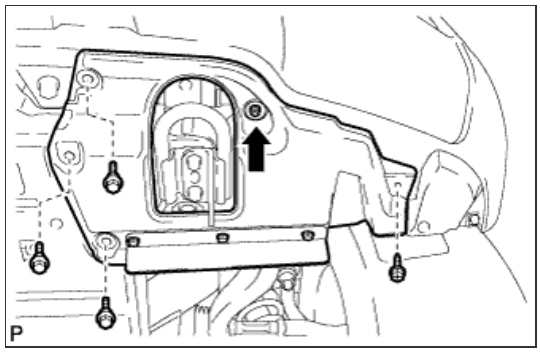
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



4. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

5. INSTALL AIR CLEANER HOSE ASSEMBLY

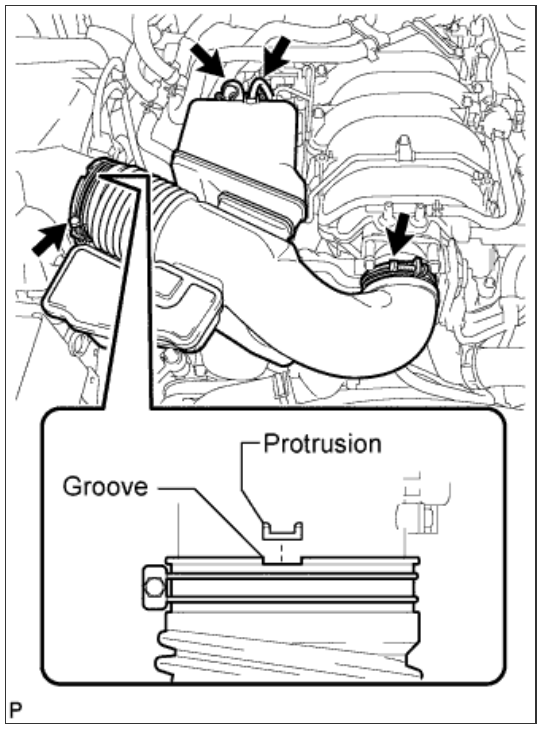
a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum transmitting hose.

d. Connect the No. 2 ventilation hose.

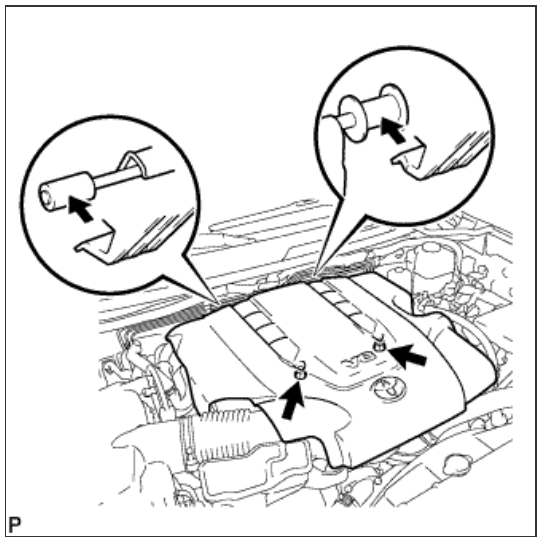


6. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket.

b. Install the V-bank cover with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

a. Discharge the fuel system pressure (Click here).

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

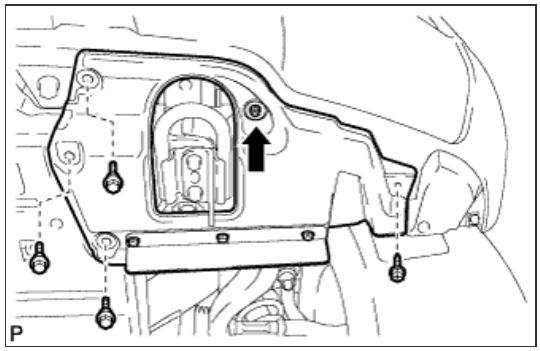
HINT:

Use the same procedures described for the LH side.

4. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

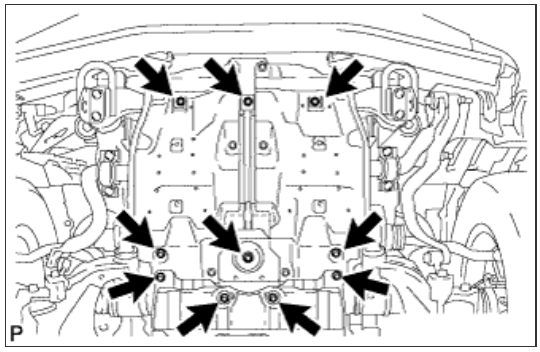
a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



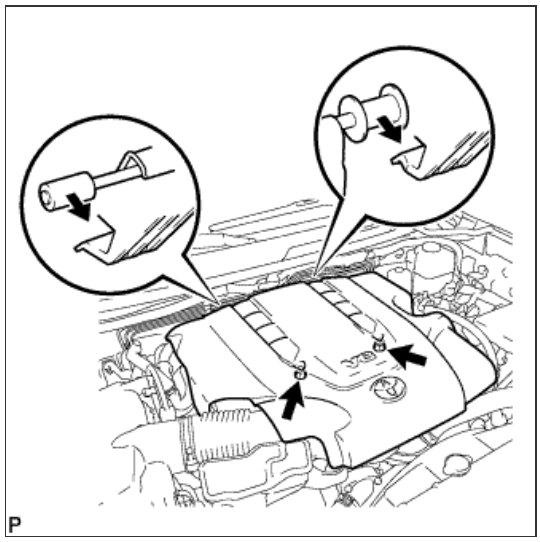
5. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and No. 1 engine under cover.



6. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Remove the 2 nuts and V-bank cover.

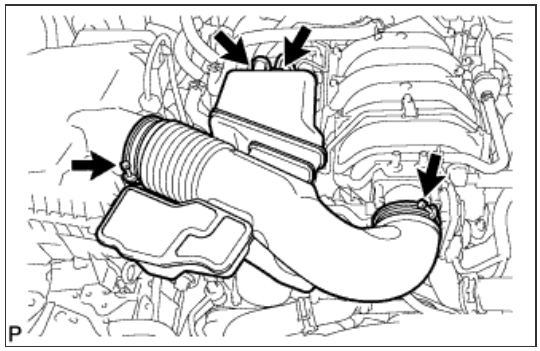


7. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum transmitting hose and No. 2 ventilation hose.

b. Loosen the 2 hose clamps.

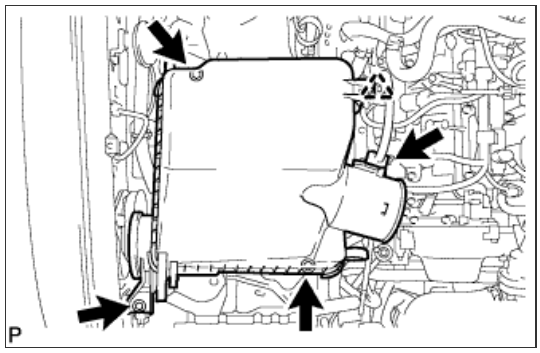
c. Remove the air cleaner hose.



8. REMOVE AIR CLEANER ASSEMBLY

a. Disconnect the clamp and MAF connector.

b. Remove the 3 bolts and air cleaner.

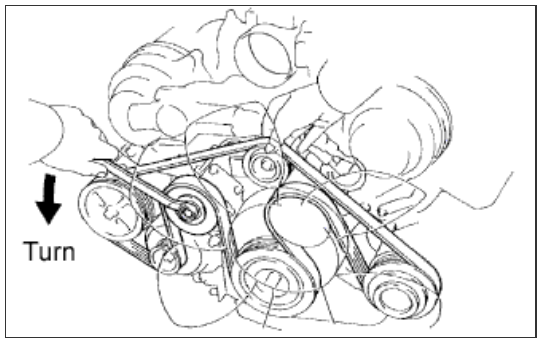


9. REMOVE FAN & GENERATOR V BELT

a. Loosen the belt tension by turning the belt tensioner counterclockwise, and then remove the fan and generator V belt.

HINT:

The pulley bolt for the belt tensioner has left-hand thread.



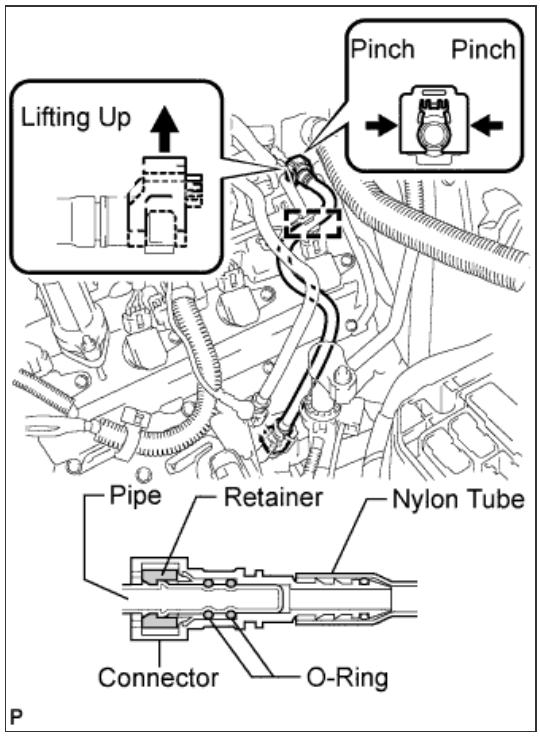
1 . REMOVE NO. 2 FUEL HOSE

a. for engine side:

i. Detach the fuel hose clamp.

ii. Detach the lock claw by lifting up the cover, as shown in the illustration.

iii. Pinch and pull the No. 2 fuel hose connector to disconnect the connector from the No. 3 fuel pipe.



NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**

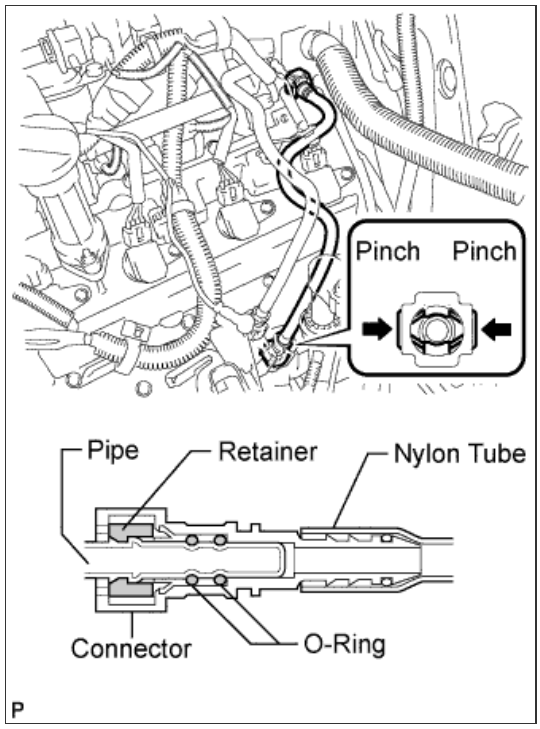
b. for body side:

i. Pinch and pull the No. 2 fuel hose connector to disconnect the connector from the fuel pipe.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**

- If the pipe and connector are t dto ether, pinch the connector between your fingers and turn it carefully to disconnect it.



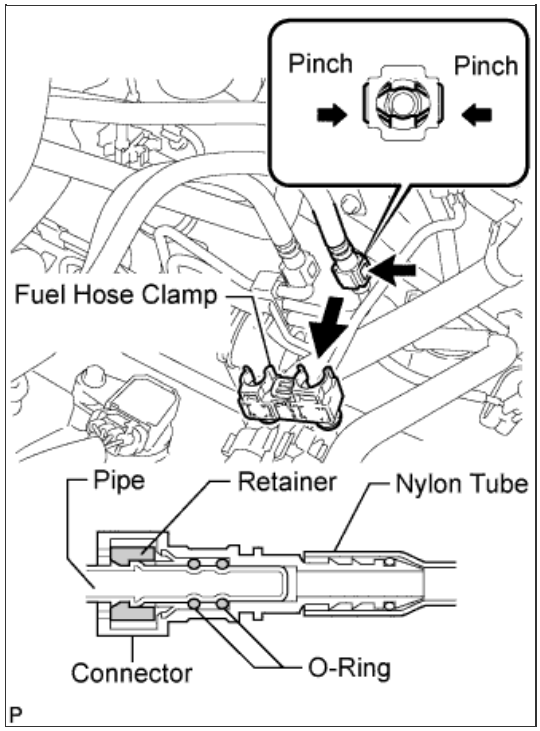
11. DISCONNECT FUEL HOSE

a. Remove the fuel hose clamp.

b. Pinch and pull the fuel hose connector to disconnect the connector from the fuel pipe.

NOTICE:

- Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.
- Do not use any tools to separate the pipe and connector.
- Do not forcefully bend or twist the nylon tube.
- Check for foreign matter on the pipe seal surface. Clean if necessary.
- Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.
- If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.



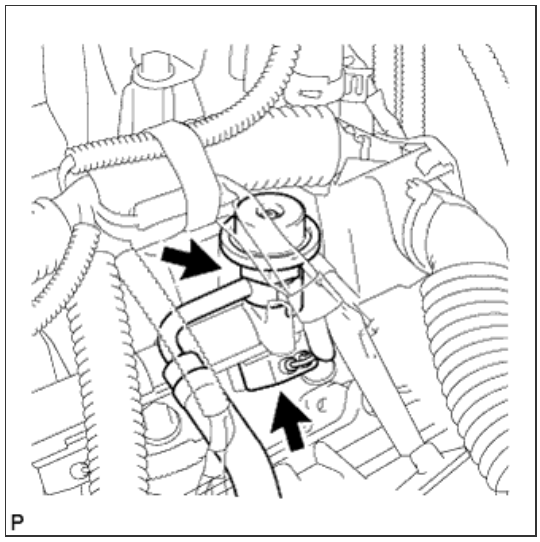
12. REMOVE FUEL PRESSURE PULSATION DAMPER ASSEMBLY

a. Disconnect the fuel injector connector.

b. Remove the pulsation damper, upper gasket, fuel hose and lower gasket.

NOTICE:

- Put a cloth or equivalent under the delivery pipe.
- Slowly loosen the pulsation damper.

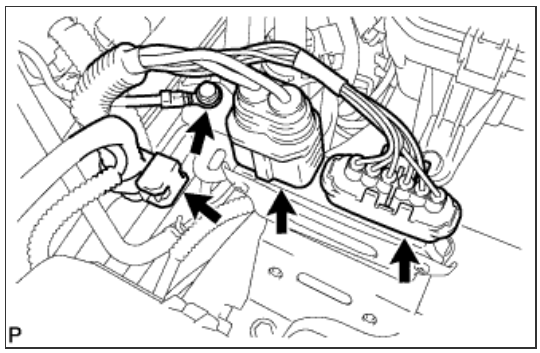


13. DISCONNECT WIRE HARNESS

a. Disconnect the 2 air injection control driver connectors.

b. Remove the bolt and disconnect the ground wire.

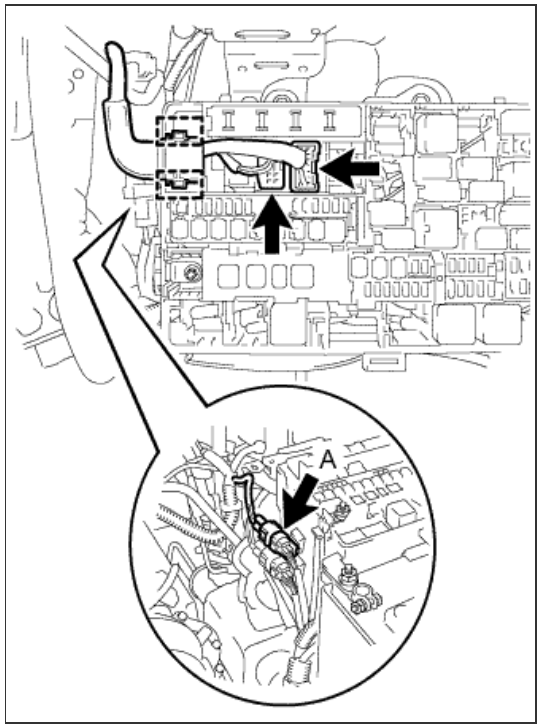
c. Disconnect the wire harness clamp.



d. Disconnect the 2 clamps and 2 connectors from the engine room relay block.

e. Disconnect connector A from the engine room relay block.

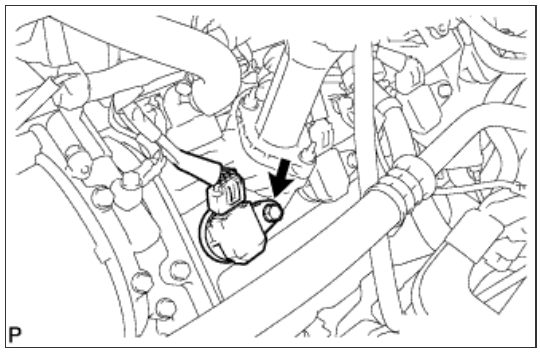
f. Disconnect the wire harness clamp from the cylinder head cover LH.



14. REMOVE IGNITION COIL ASSEMBLY

a. Disconnect the 8 ignition coil connectors.

b. Remove the 8 bolts and pull out the 8 ignition coils.

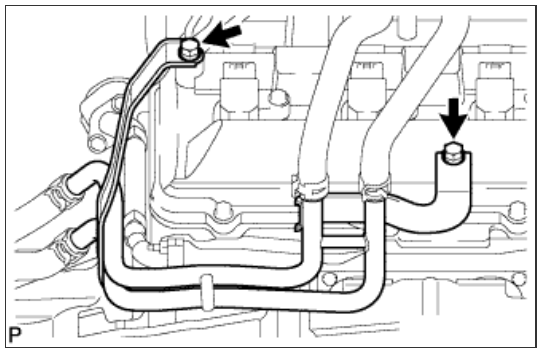


15. REMOVE SPARK PLUG

a. Remove the 8 spark plugs.

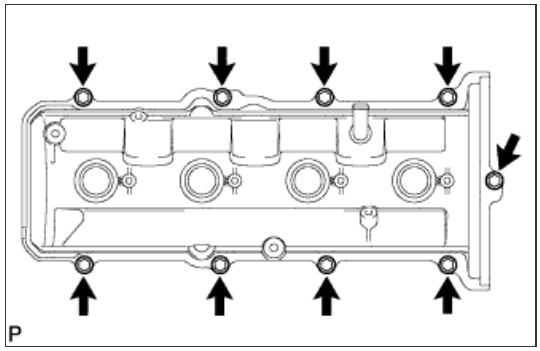
16. DISCONNECT NO. 1 WATER BY-PASS PIPE (w/ Air Cooled Transmission Oil Cooler)

a. Remove the 2 bolts and disconnect the water by-pass pipe from the cylinder head cover RH.



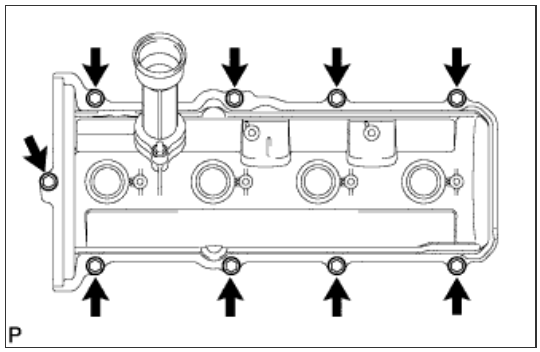
17. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY

a. Remove the 9 bolts, cylinder head cover and gasket.



18. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY LH

a. Remove the 9 bolts, cylinder head cover and gasket.



1 . REMOVE SPARK PLUG TUBE GASKET

a. Bend the 8 ventilation case claws of the cylinder head cover to an angle of 90° or more.

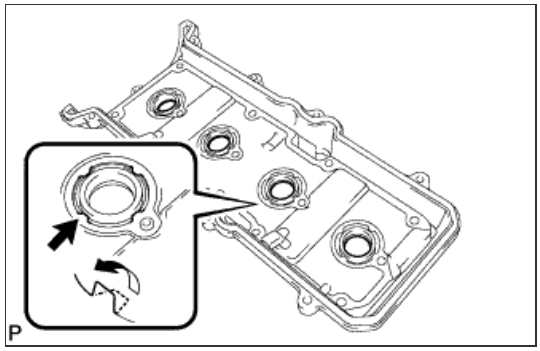
b. Using a screwdriver, pry out the gaskets.

NOTICE:

- **Be careful not to damage the cylinder head cover.**
- **Be careful not to damage the gasket when removing it, as the removed gasket needs to be reused when installing a new one.**

HINT:

Tape the screwdriver tip before use.

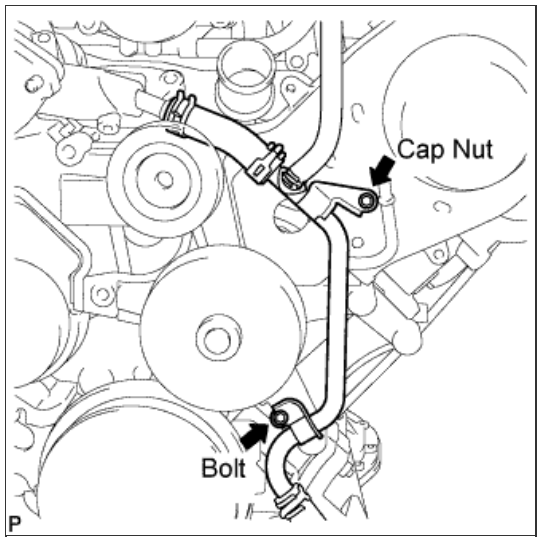


20. REMOVE SEMICIRCULAR PLUG

a. Remove the 4 semicircular plugs from the cylinder heads.

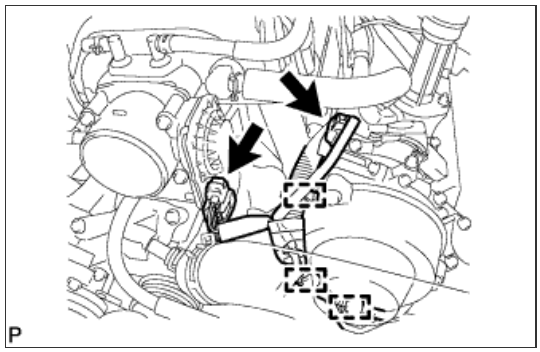
21. DISCONNECT OIL COOLER PIPE

a. Remove the cap nut and bolt. Then disconnect the oil cooler pipe.



22. REMOVE NO. 3 TIMING BELT COVER SUB-ASSEMBLY LH

a. Detach the 3 wire clamps and disconnect the camshaft timing oil control valve connector and control motor connector.



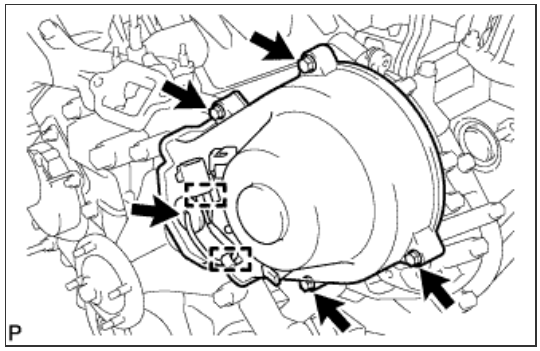
b. Disconnect the camshaft position sensor connector.

c. Disconnect the camshaft position sensor wire from the 2 wire clamps on the timing belt cover.

d. Remove the wire grommet from the timing belt cover.

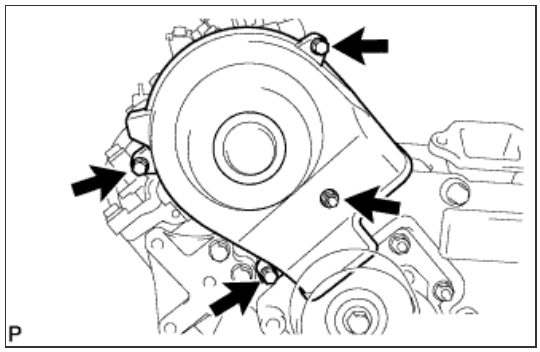
e. Remove the 4 bolts.

f. Pull the cover outward, pull the camshaft position sensor wire out of the cover, and remove the cover.



23. REMOVE NO. 3 TIMING BELT COVER SUB-ASSEMBLY RH

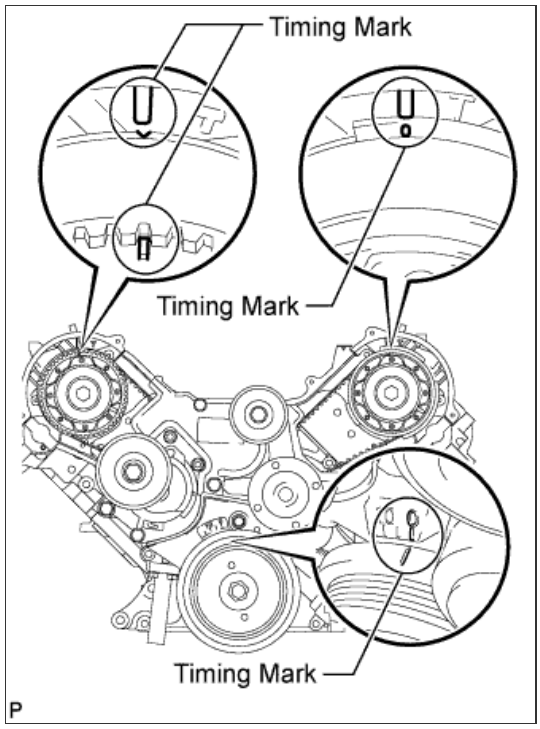
a. Remove the 3 bolts, nut and timing belt cover.



24. SET NO. 1 CYLINDER TO TDC/COMPRESSION

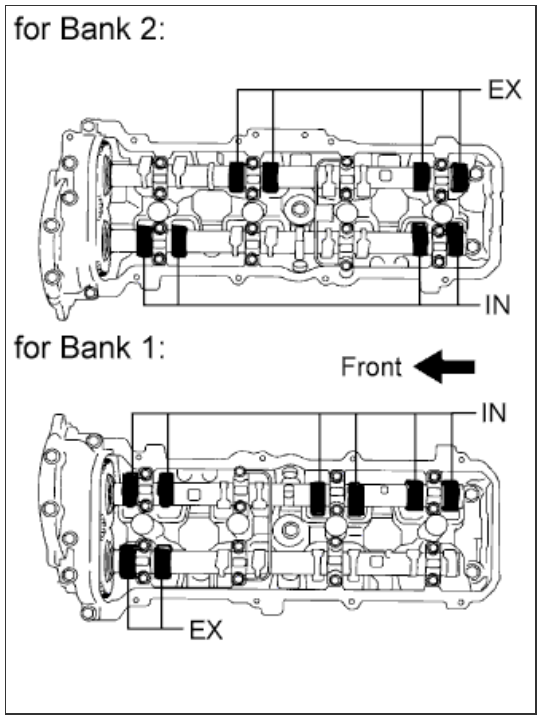
a. Turn the crankshaft damper to align its notch with timing mark 0 of the No. 1 timing belt cover.

b. Check that the timing marks of the camshaft timing pulleys and timing belt rear plates are aligned.
If not, turn the crankshaft 1 complete revolution (360) and align the marks as above.



25. INSPECT VALVE CLEARANCE

a. Check only the valves indicated.



i. Using a feeler gauge, measure the clearance between the valve lifter and camshaft.

Standard Val e Clearance Cold):

Item	Specified Condition
Intake	0.15 to 0.25 mm (0.00591 to 0.00984 in.)
Exhaust	0.25 to 0.35 mm (0.00984 to 0.0138 in.)

ii. Record the out-of-specification valve clearance measurements. They will be used later to determine the required replacement adjusting shim.

b. Turn the crankshaft 1 complete revolution (360°) and align the camshaft timing marks.

c. Check only the valves indicated in the illustration.

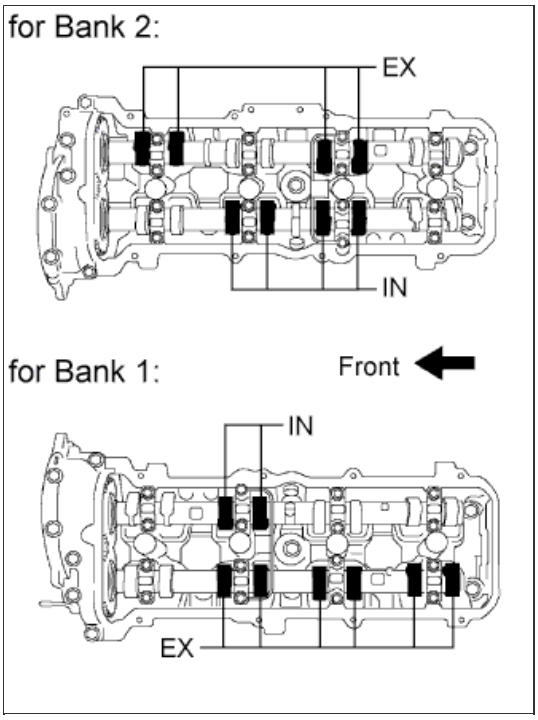
i. Using a feeler gauge, measure the clearance between the valve lifter and camshaft.

Standard Valve Clearance (Cold):

Item	Specified Condition
Intake	0.15 to 0.25 mm (0.00591 to 0.00984 in.)
Exhaust	0.25 to 0.35 mm

	(0.00984 to 0.0138 in.)

ii. Record the out-of-specification valve clearance measurements. They will be used later to determine the required replacement adjusting shim.



26. ADJUST VALVE CLEARANCE

a. Remove the timing belt (Click here).

b. Remove the camshaft (Click here).

c. Remove the valve lifter and adjusting shim.

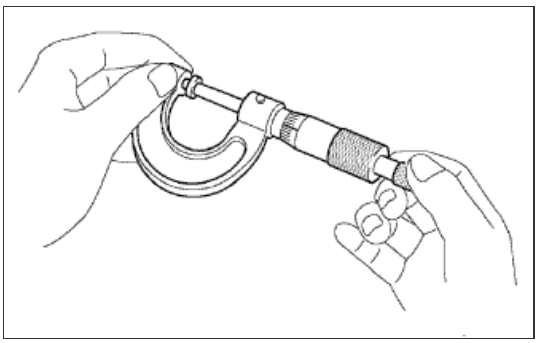
NOTICE:

Be careful not to drop the adjusting shim into the cylinder head.

HINT:

Arrange the removed parts in the correct order.

d. Using a micrometer, measure the thickness of the removed shim.



e. Determine the replacement adjusting shim size according to the formula or charts below.

i. Calculate the thickness of a new shim so that the valve clearance comes within the specified value.

T:
Thickness of removed shim

A:
Measured valve clearance

N:
Thickness of new shim

Intake:
N = T + (A - 0.20 mm (0.00787 in.))

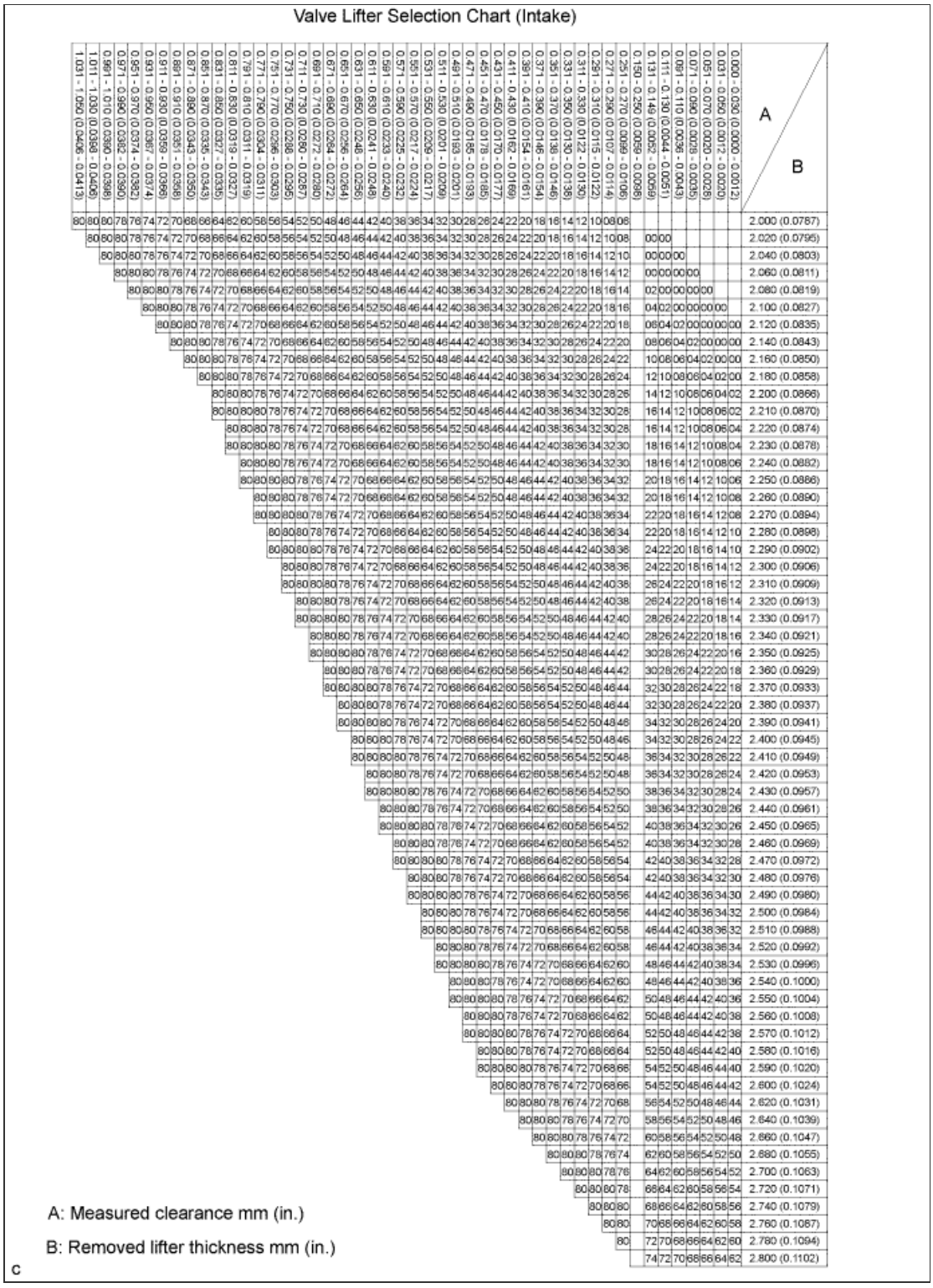
Exhaust:
N = T + (A - 0.30 mm (0.0118 in.))

ii. Select a new shim with a thickness as close as possible to the calculated value.

HINT:

- **Shims are available in 41 increments of 0.020 mm (0.000787 in.), from 2.00 mm (0.0787 in.) to 2.80 mm (0.1102 in.) and 33 increments of 0.025 mm (0.000984 in.), from 2.50 mm (0.0984 in.) to 3.30 mm (0.1299 in.).**

- **Refer to the Ad in t Shim Selection Chart.**

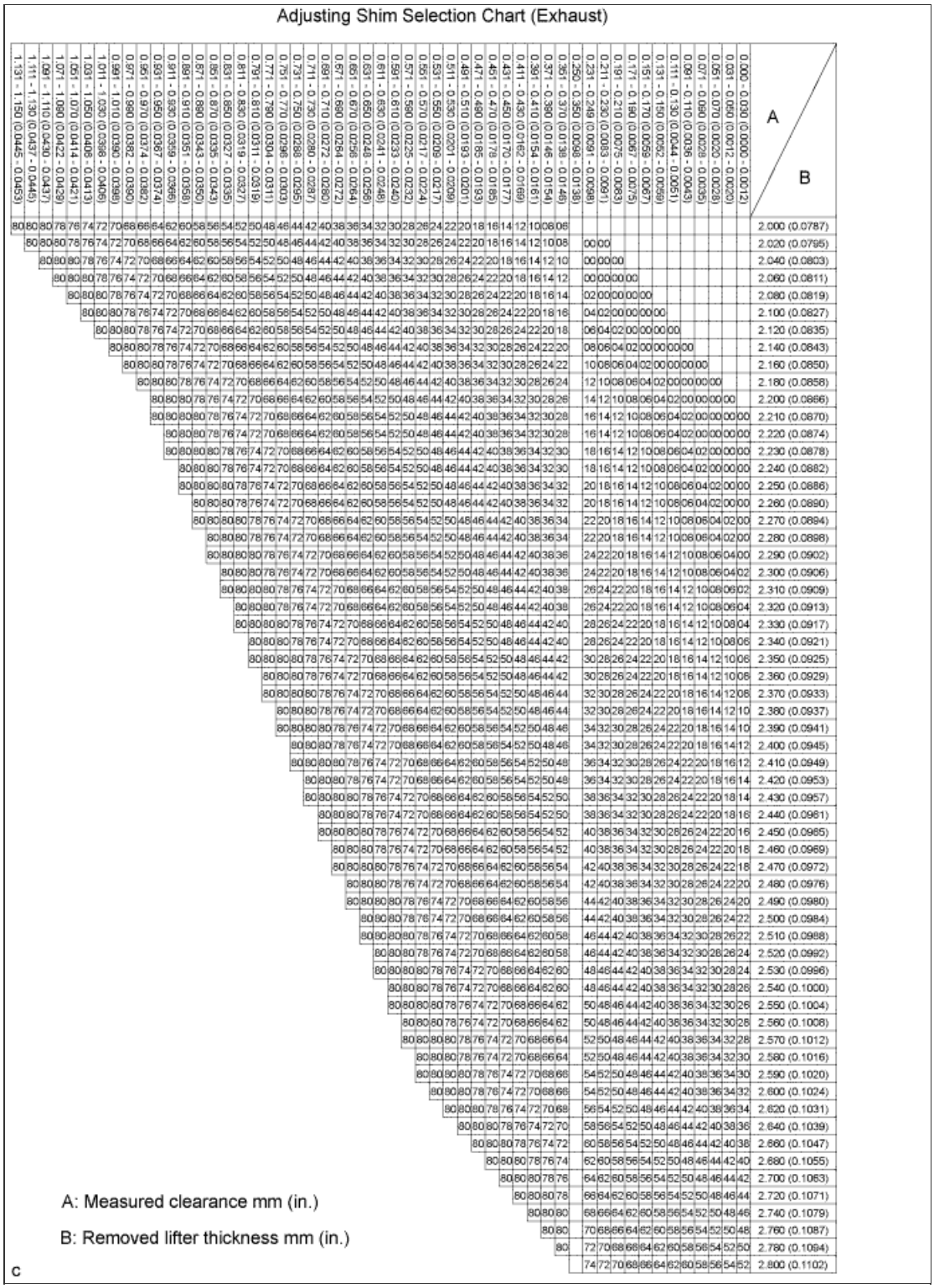


Intake la e clearance Cold):
.15 to .25 mm . 5 1 to . 4 in.)
E AMPLE:
The 2.3 mm . in) him i in tled, and the mea ed clearance i .44 mm . 173 in.). Replace the 2.3 mm . in) him ith a No. 54 him.

Ne Shim Thickne :

Shim No.	Thickness	Shim No.	Thickness	Shim No.	Thickness
00	2.000 mm (0.0787 in.)	28	2.280 mm (0.0898 in.)	56	2.560 mm (0.1008 in.)
02	2.020 mm (0.0795 in.)	30	2.300 mm (0.0906 in.)	58	2.580 mm (0.1016 in.)

04	2.040 mm (0.0803 in.)	32	2.320 mm (0.0913 in.)	60	2.600 mm (0.1024 in.)
06	2.060 mm (0.0811 in.)	34	2.340 mm (0.0921 in.)	62	2.620 mm (0.1031 in.)
08	2.080 mm (0.0819 in.)	36	2.360 mm (0.0929 in.)	64	2.640 mm (0.1039 in.)
10	2.100 mm (0.0827 in.)	38	2.380 mm (0.0937 in.)	66	2.660 mm (0.1047 in.)
12	2.120 mm (0.0835 in.)	40	2.400 mm (0.0945 in.)	68	2.680 mm (0.1055 in.)
14	2.140 mm (0.0843 in.)	42	2.420 mm (0.0953 in.)	70	2.700 mm (0.1063 in.)
16	2.160 mm (0.0850 in.)	44	2.440 mm (0.0961 in.)	72	2.720 mm (0.1071 in.)
18	2.180 mm (0.0858 in.)	46	2.460 mm (0.0969 in.)	74	2.740 mm (0.1079 in.)
20	2.200 mm (0.0866 in.)	48	2.480 mm (0.0976 in.)	76	2.760 mm (0.1087 in.)
22	2.220 mm (0.0874 in.)	50	2.500 mm (0.0984 in.)	78	2.780 mm (0.1094 in.)
24	2.240 mm (0.0882 in.)	52	2.520 mm (0.0992 in.)	80	2.800 mm (0.1102 in.)
26	2.260 mm (0.0890 in.)	54	2.540 mm (0.1000 in.)	-	-



E ha t a e clearance Cold):
.25 to .35 mm . 4 to . 13 in.)
E AMPLE:
The 2.3 mm . in6 him i in tlled, and the mea ed clearance i .44 mm . 173 in.). Replace the 2.3 mm . in6 him ith a No. 44 him.

Ne Shim Thickne :

Shim No.	Thickness	Shim No.	Thickness	Shim No.	Thickness
00	2.000 mm (0.0787 in.)	28	2.280 mm (0.0898 in.)	56	2.560 mm (0.1008 in.)
02	2.020 mm (0.0795 in.)	30	2.300 mm (0.0906 in.)	58	2.580 mm (0.1016 in.)
04	2.040 mm (0.0803 in.)	32	2.320 mm (0.0913 in.)	60	2.600 mm (0.1024 in.)
	2.060 mm		2.340 mm		2.620 mm

06	(0.0811 in.)	34	(0.0921 in.)	62	(0.1031 in.)
08	2.080 mm (0.0819 in.)	36	2.360 mm (0.0929 in.)	64	2.640 mm (0.1039 in.)
10	2.100 mm (0.0827 in.)	38	2.380 mm (0.0937 in.)	66	2.660 mm (0.1047 in.)
12	2.120 mm (0.0835 in.)	40	2.400 mm (0.0945 in.)	68	2.680 mm (0.1055 in.)
14	2.140 mm (0.0843 in.)	42	2.420 mm (0.0953 in.)	70	2.700 mm (0.1063 in.)
16	2.160 mm (0.0850 in.)	44	2.440 mm (0.0961 in.)	72	2.720 mm (0.1071 in.)
18	2.180 mm (0.0858 in.)	46	2.460 mm (0.0969 in.)	74	2.740 mm (0.1079 in.)
20	2.200 mm (0.0866 in.)	48	2.480 mm (0.0976 in.)	76	2.760 mm (0.1087 in.)
22	2.220 mm (0.0874 in.)	50	2.500 mm (0.0984 in.)	78	2.780 mm (0.1094 in.)
24	2.240 mm (0.0882 in.)	52	2.520 mm (0.0992 in.)	80	2.800 mm (0.1102 in.)
26	2.260 mm (0.0890 in.)	54	2.540 mm (0.1000 in.)	-	-

f. Apply a light coat of engine oil to the valve lifters, adjusting shims and valve stem tip.

. Place a new adjusting shim on the valve stem.

NOTICE:

Be careful not to drop the adjusting shim into the cylinder head.

h. Place the valve lifter.

i. Install the camshaft (Click here).

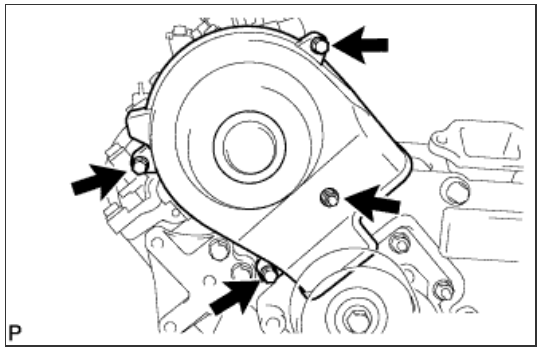
j. Install the timing belt (Click here).

k. Check the valve clearance.
If the result is not as specified, adjust the valve clearance.

27. INSTALL NO. 3 TIMING BELT COVER SUB-ASSEMBLY RH

a. Install the timing belt cover with the 3 bolts and nut.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



28. INSTALL NO. 3 TIMING BELT COVER SUB-ASSEMBLY LH

a. Pass the camshaft position sensor wire through the cover hole.

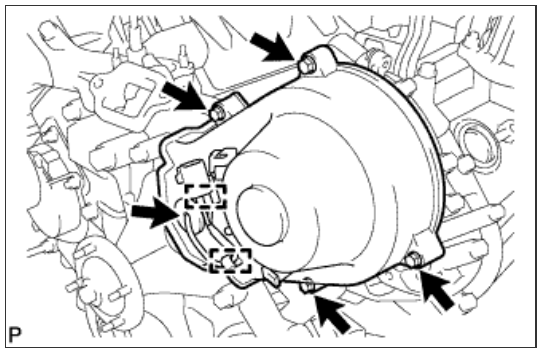
b. Install the timing belt cover with the 4 bolts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

c. Install the wire grommet to the timing belt cover.

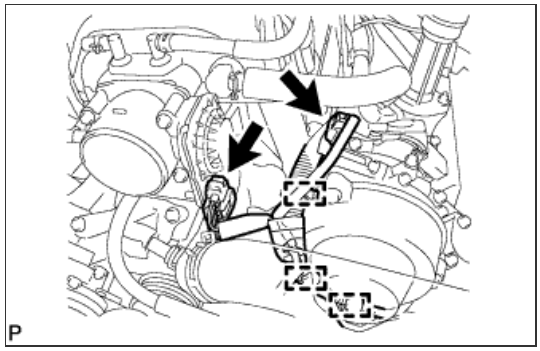
d. Connect the sensor connector.

e. Install the sensor wire to the 2 wire clamps on the cover.



f. Connect the engine wire to the 3 wire clamps.

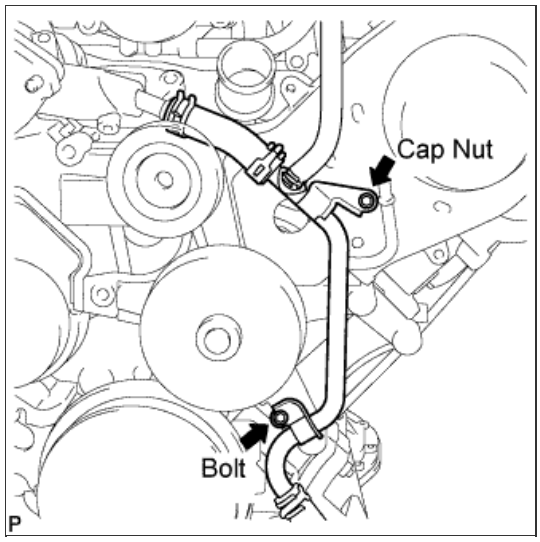
. Connect the camshaft timing oil control valve connector and control motor connector.



2 . CONNECT OIL COOLER PIPE

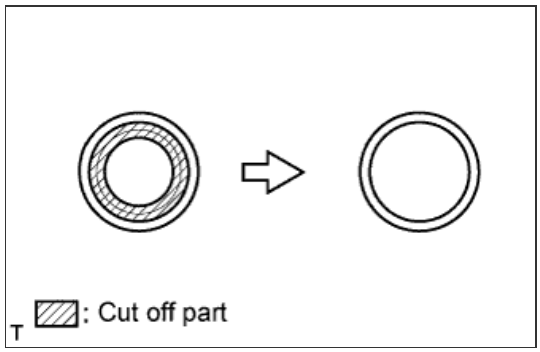
a. Install the oil cooler pipe with the cap nut and bolt.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



30. INSTALL SPARK PLUG TUBE GASKET

a. Using a cutter knife, cut off the seal part of the removed gasket.



b. Using the removed gasket and a hammer, tap in a new gasket until it stops.

NOTICE:

Do not tap on the oil seal at an angle.

HINT:

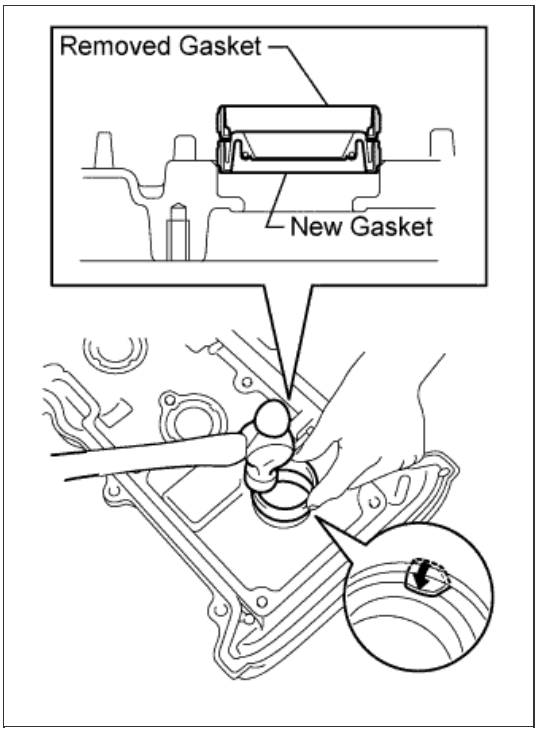
If the removed gasket does not fit on the new one, correct the removed one with pliers.

c. Apply a light coat of MP grease to the lip of the gasket.

NOTICE:

eep the lip free from foreign matter.

d. Return the 8 ventilation case claws to the original positions.



31. INSTALL SEMICIRCULAR PLUG

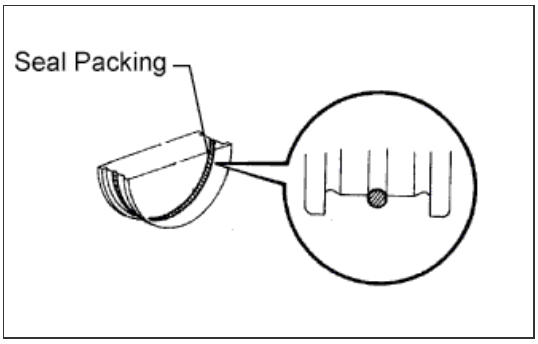
a. Apply seal packing to the semicircular plug grooves.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

b. Install the 4 semicircular plugs to the cylinder heads.

NOTICE:

Install the cylinder head cover within 3 minutes after applying seal packing.



32. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY LH

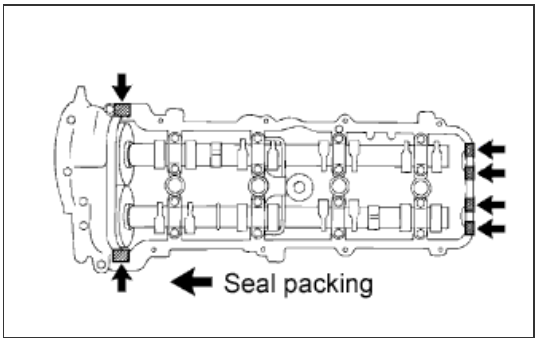
a. Install a new gasket to the cylinder head cover.

b. Apply seal packing to the cylinder head as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

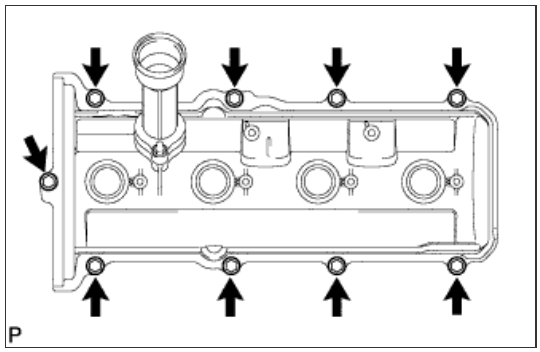
NOTICE:

- **Remove any oil from the contact surface.**
- **Install the cylinder head cover within 3 minutes after applying seal packing.**



c. Install the cylinder head cover with the 9 bolts. Uniformly tighten the bolts in several steps.

Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }



33. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY

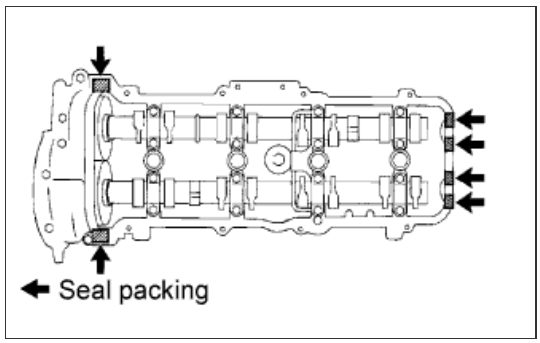
a. Install a new gasket to the cylinder head cover.

b. Apply seal packing to the cylinder head as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

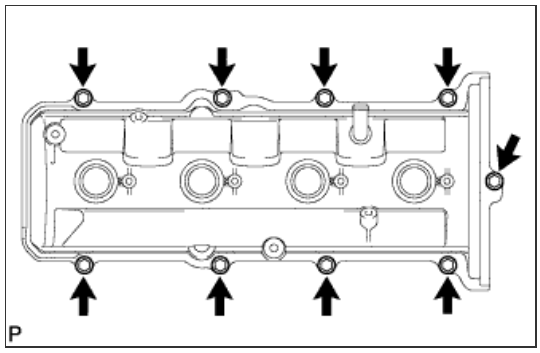
NOTICE:

- **Remove any oil from the contact surface.**
- **Install the cylinder head cover within 3 minutes after applying seal packing.**



c. Install the cylinder head cover with the 9 bolts. Uniformly tighten the bolts in several steps.

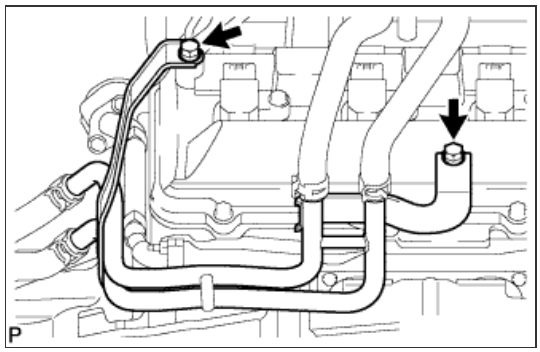
Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }



34. CONNECT NO. 1 WATER BY-PASS PIPE (w/ Air Cooled Transmission Oil Cooler)

a. Connect the water by-pass pipe to the cylinder head cover RH with the 2 bolts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }



35. INSTALL SPARK PLUG

a. Install the 8 spark plugs.

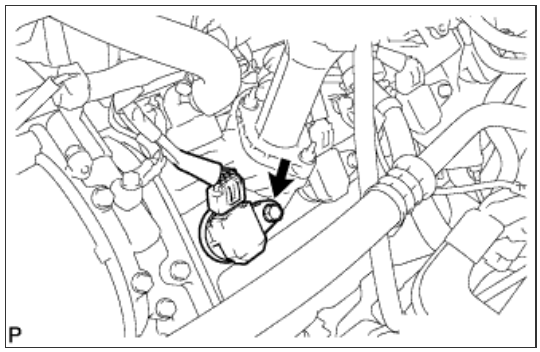
Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

36. INSTALL IGNITION COIL ASSEMBLY

a. Install the 8 ignition coils with the 8 bolts.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }

b. Connect the 8 ignition coil connectors.

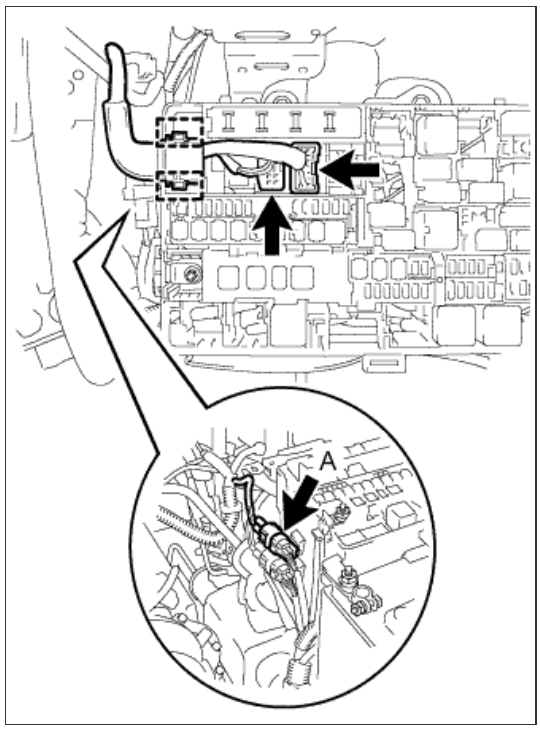


37. CONNECT WIRE HARNESS

a. Connect connector A to the engine room relay block.

b. Connect the 2 connectors and 2 clamps to the engine room relay block.

c. Connect the wire harness clamp to the cylinder head cover LH.

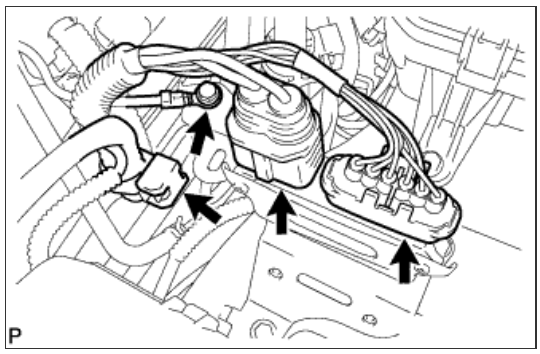


d. Connect the wire harness clamp.

e. Connect the ground wire with the bolt.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

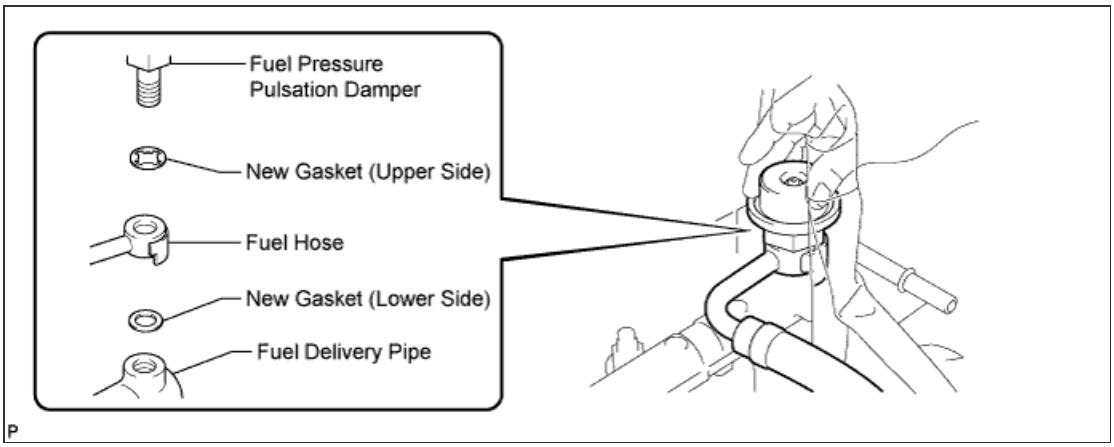
f. Connect the 2 air injection control driver connectors.



38. INSTALL FUEL PRESSURE PULSATION DAMPER ASSEMBLY

a. Install 2 new gaskets and the fuel hose with the fuel pressure pulsation damper

a. Install 2 new gaskets and the fuel hose with the fuel pressure pulsation damper.



NOTICE:

Make sure to install the gaskets in the order shown in the illustration, as the shape of the upper side and lower side gaskets is different.

b. Tighten the fuel pressure pulsation damper by hand.

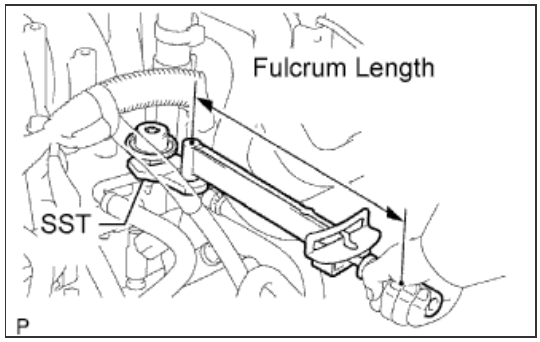
c. Using SST, tighten the union bolt.

SST
09612-24014 (09617-24011)

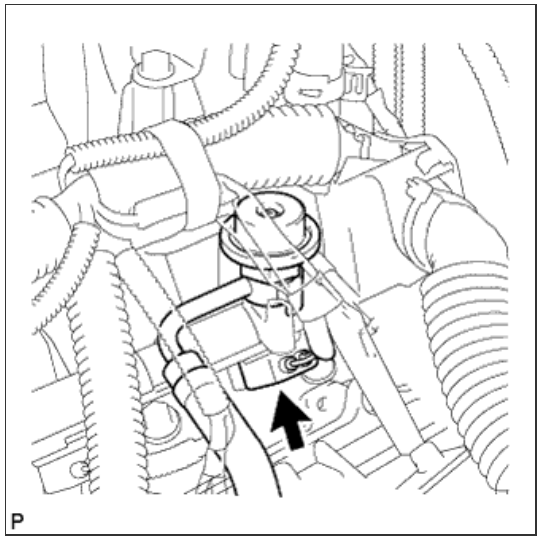
Torque:
with SST:
33 N*m{ 340 kgf*cm , 24 ft.*lbf }
without SST:
39 N*m{ 398 kgf*cm , 29 ft.*lbf }

HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure SST and the wrench are connected in a straight line.**



d. Connect the fuel injector connector.



39. CONNECT FUEL HOSE

a. Connect the fuel hose.

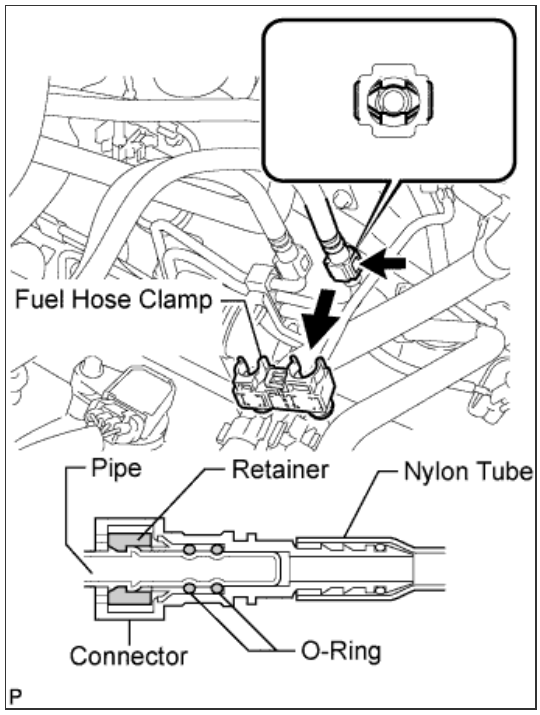
HINT:

Push the parts together firmly until a click sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Install the fuel hose clamp.



40. INSTALL NO. 2 FUEL HOSE

a. for engine side:

i. Connect the fuel hose to the No. 3 fuel pipe.

HINT:

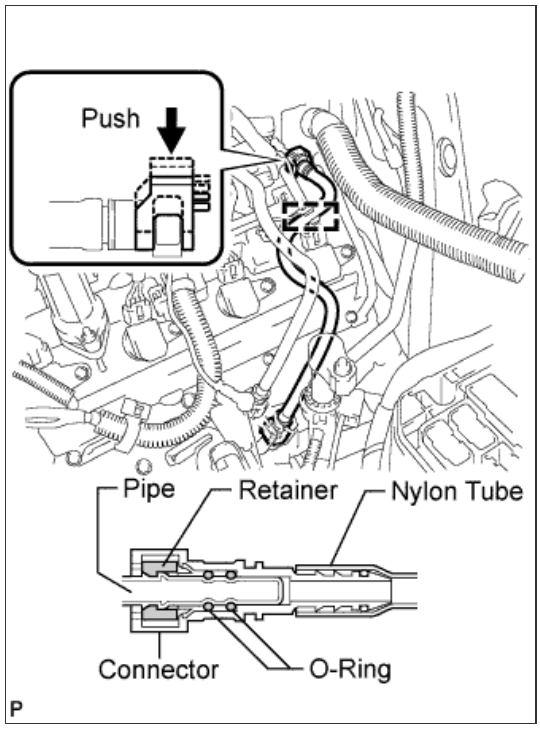
Push the parts together firmly until a click sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

ii. Attach the lock claws to the connector by pushing down on the cover, as shown in the illustration.

iii. Attach the fuel hose clamp.



b. for body side:

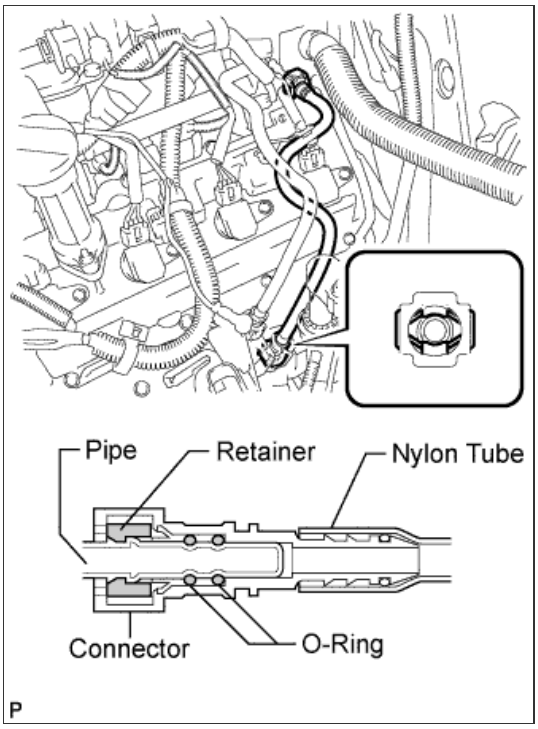
i. Connect the fuel hose to the fuel pipe.

HINT:

Push the parts together firmly until a click sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

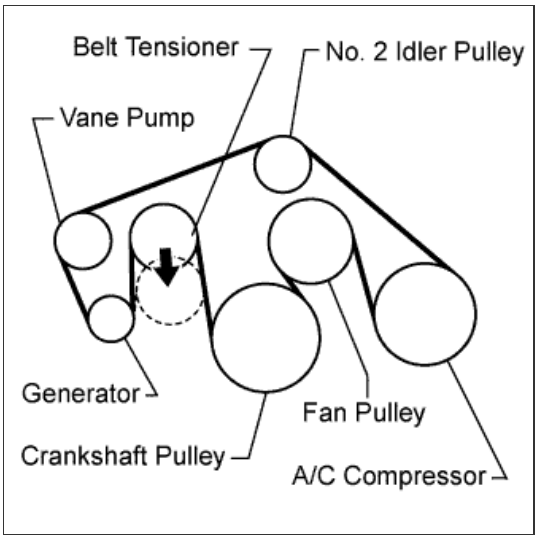


41. INSTALL FAN & GENERATOR V BELT

a. Set the V belt onto every part except the belt tensioner, as shown in the illustration.

b. Loosen the V belt by turning the belt tensioner counterclockwise.

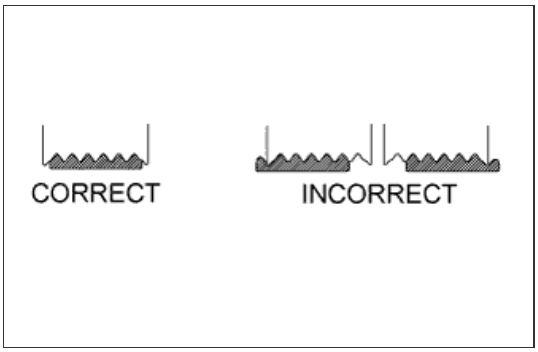
c. Set the V belt to the belt tensioner.



d. Check that the belt fits properly in the ribbed grooves.

HINT:

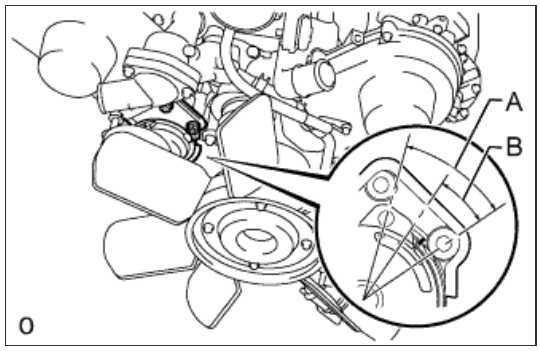
Make sure to check by hand that the belt has not slipped out of the grooves on the bottom of the pulley.



e. Check that the arrow on the belt tensioner is within area A .
f the arrow is outside area A, replace the fan and generator V belt.

HINT:

When a new belt is installed, the arrow should be within area If not, the fan and generator V belt is not installed correctly.

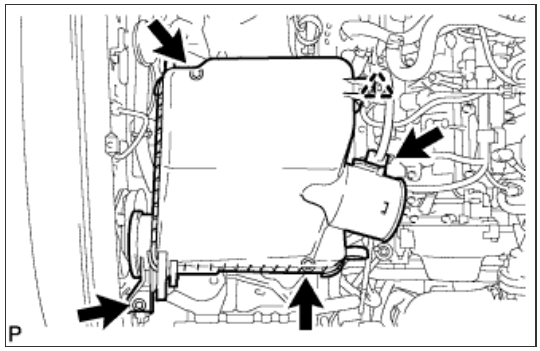


42. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner with the 3 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

b. Connect the clamp and MAF connector.



43. INSTALL AIR CLEANER HOSE ASSEMBLY

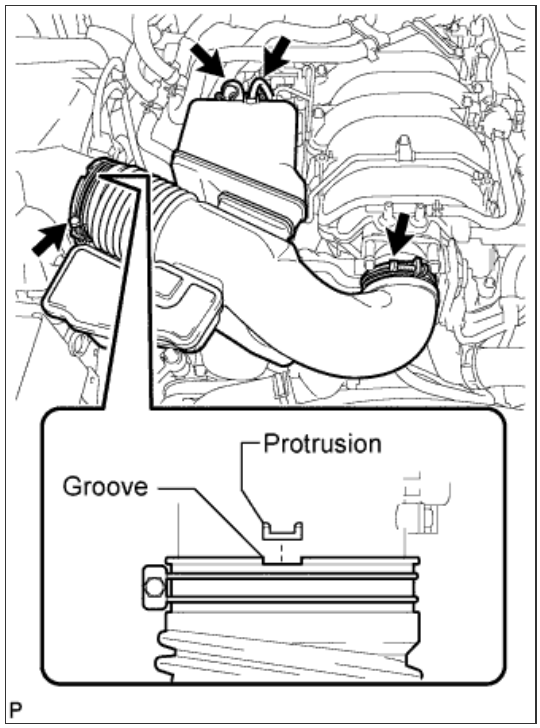
a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum transmitting hose.

d. Connect the No. 2 ventilation hose.

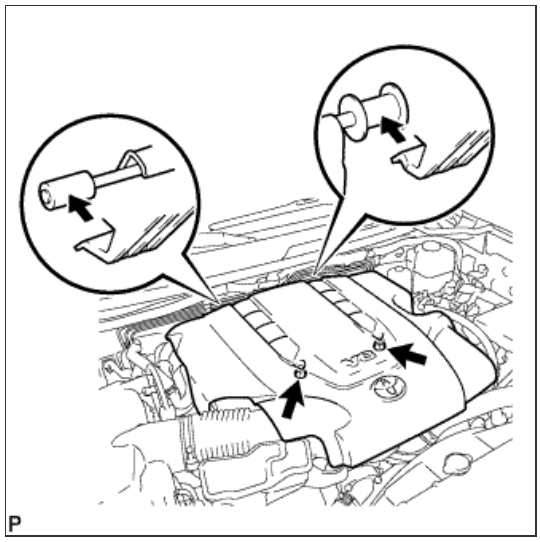


44. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket.

b. Install the V-bank cover with the 2 nuts.

Tor e:
7.5 N 76 k f c, 66 in. lbf }



45. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

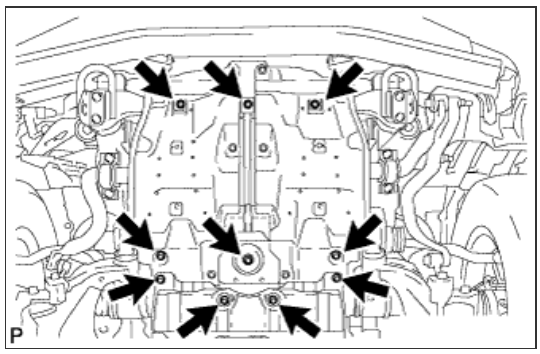
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

46. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the No. 1 engine under cover with the 10 bolts.

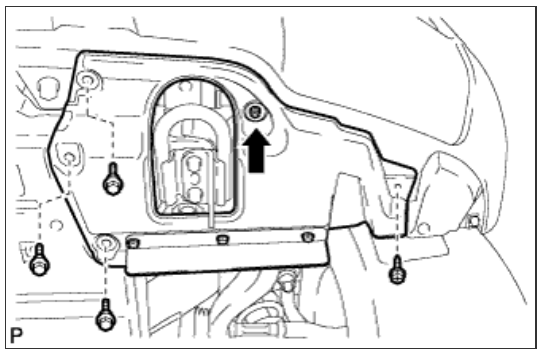
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



47. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.

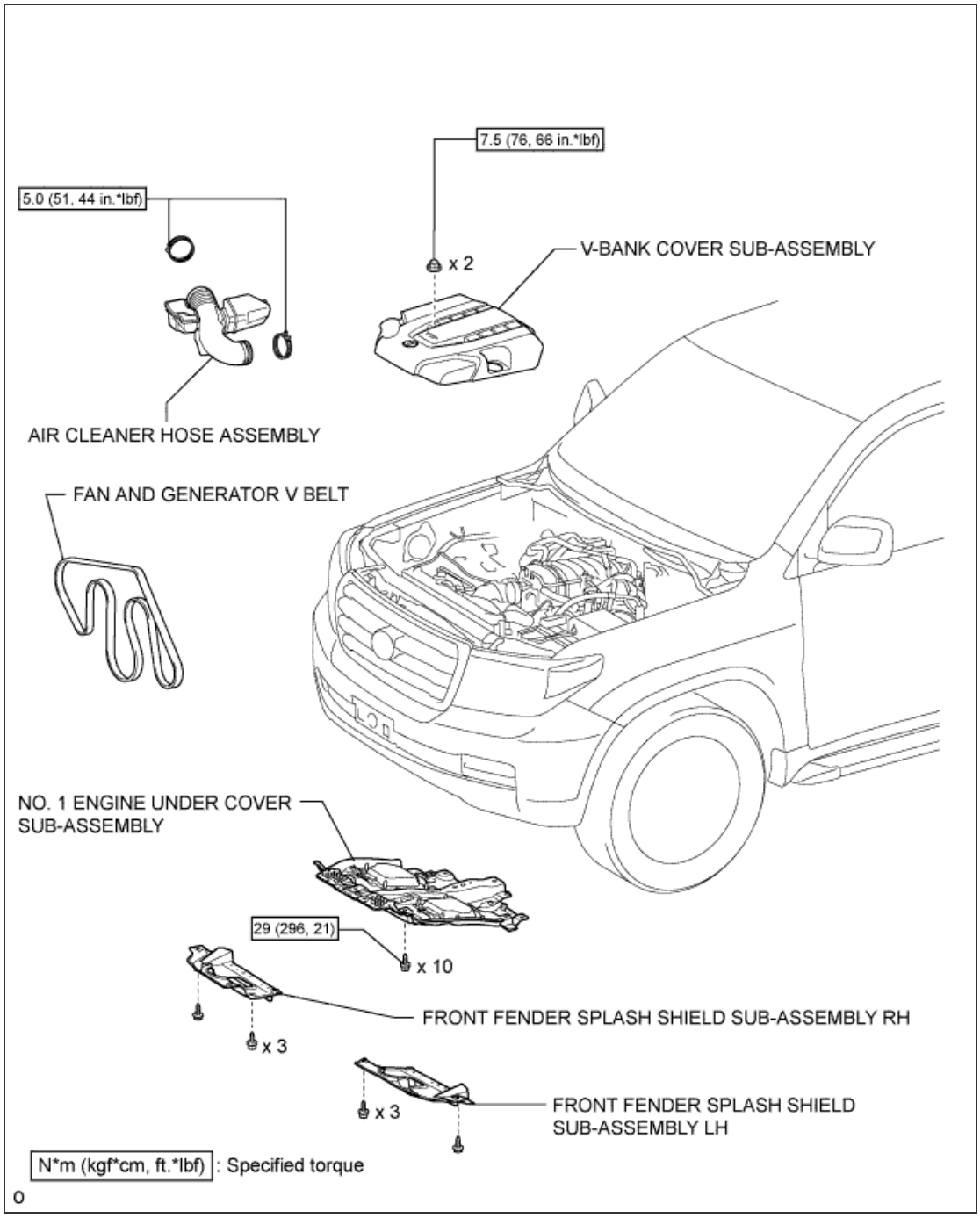


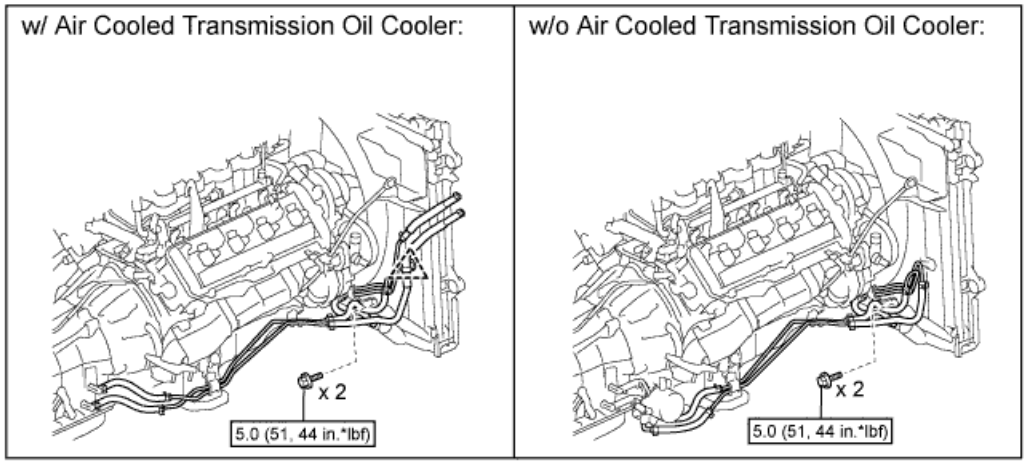
48. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

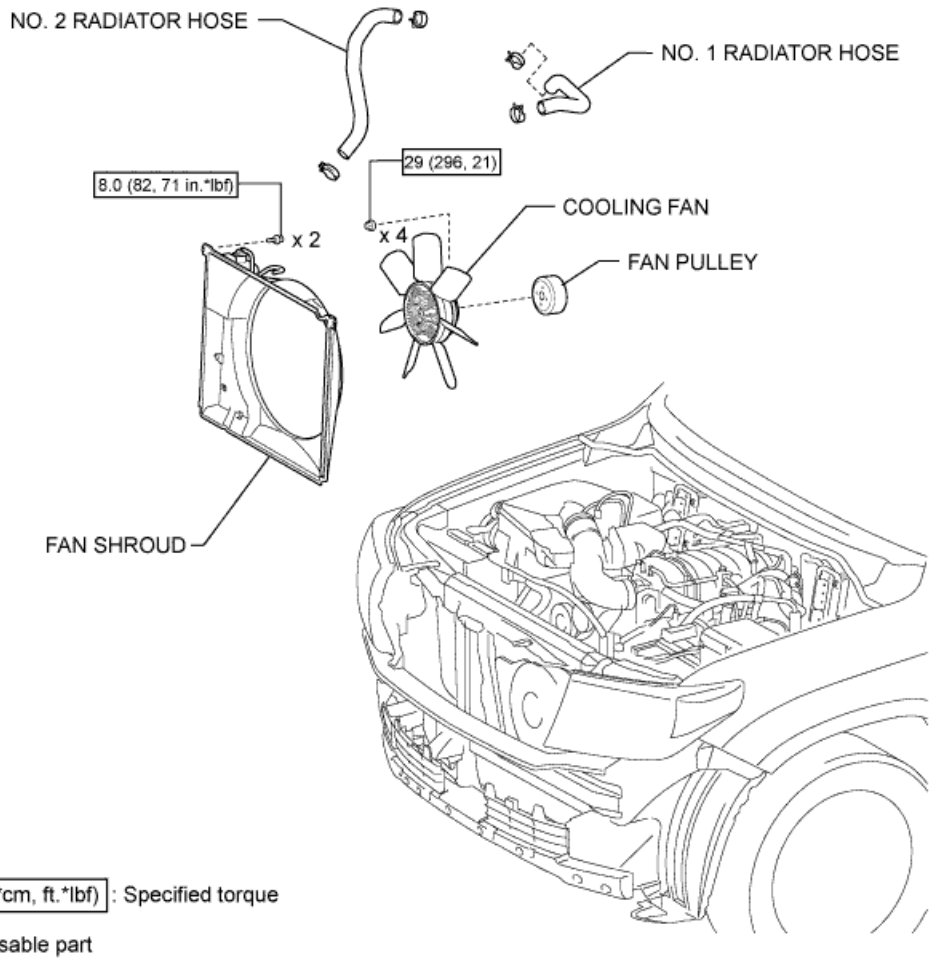
HINT:

Use the same procedures described for the LH side.

for Preparation Click here



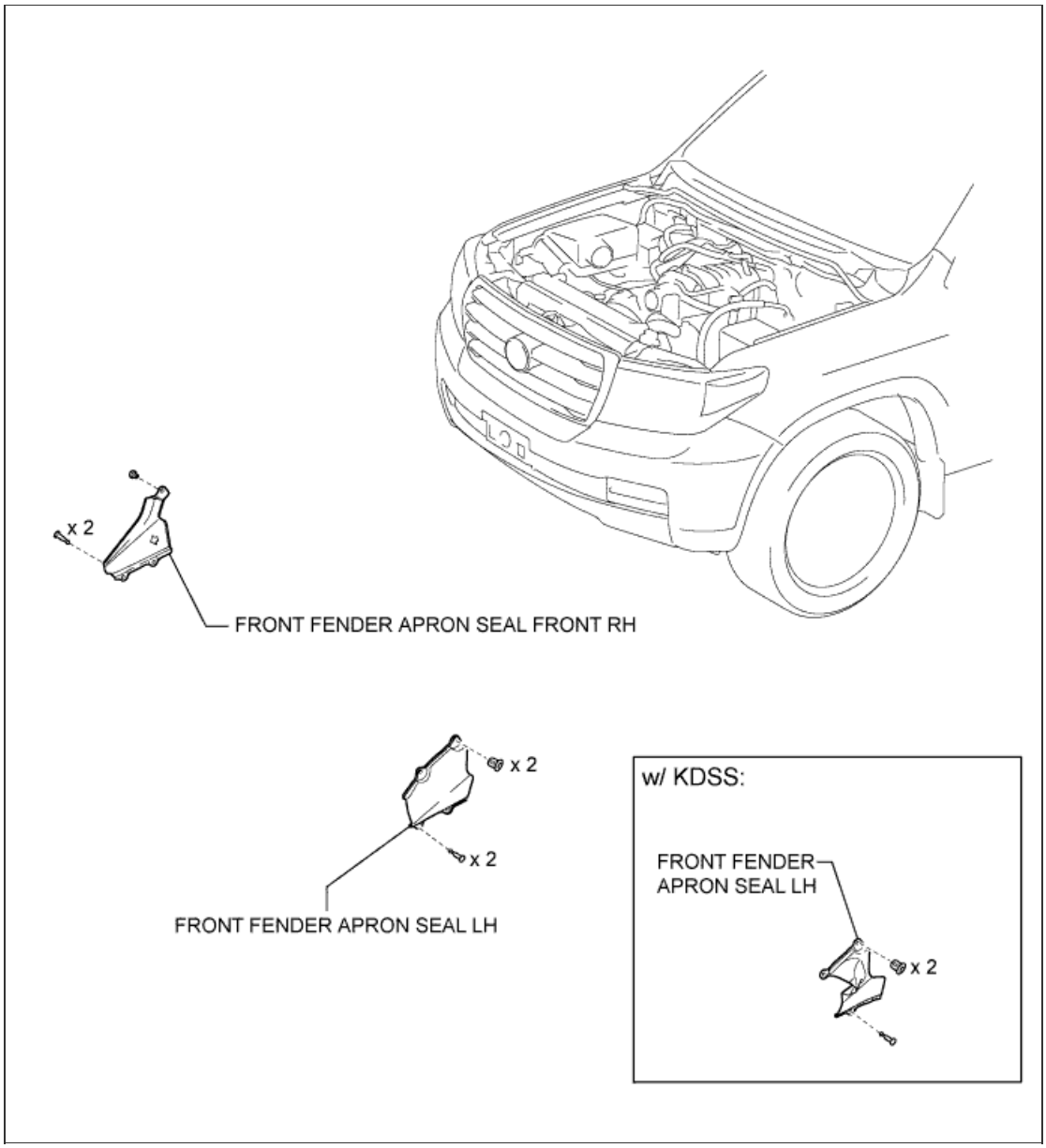


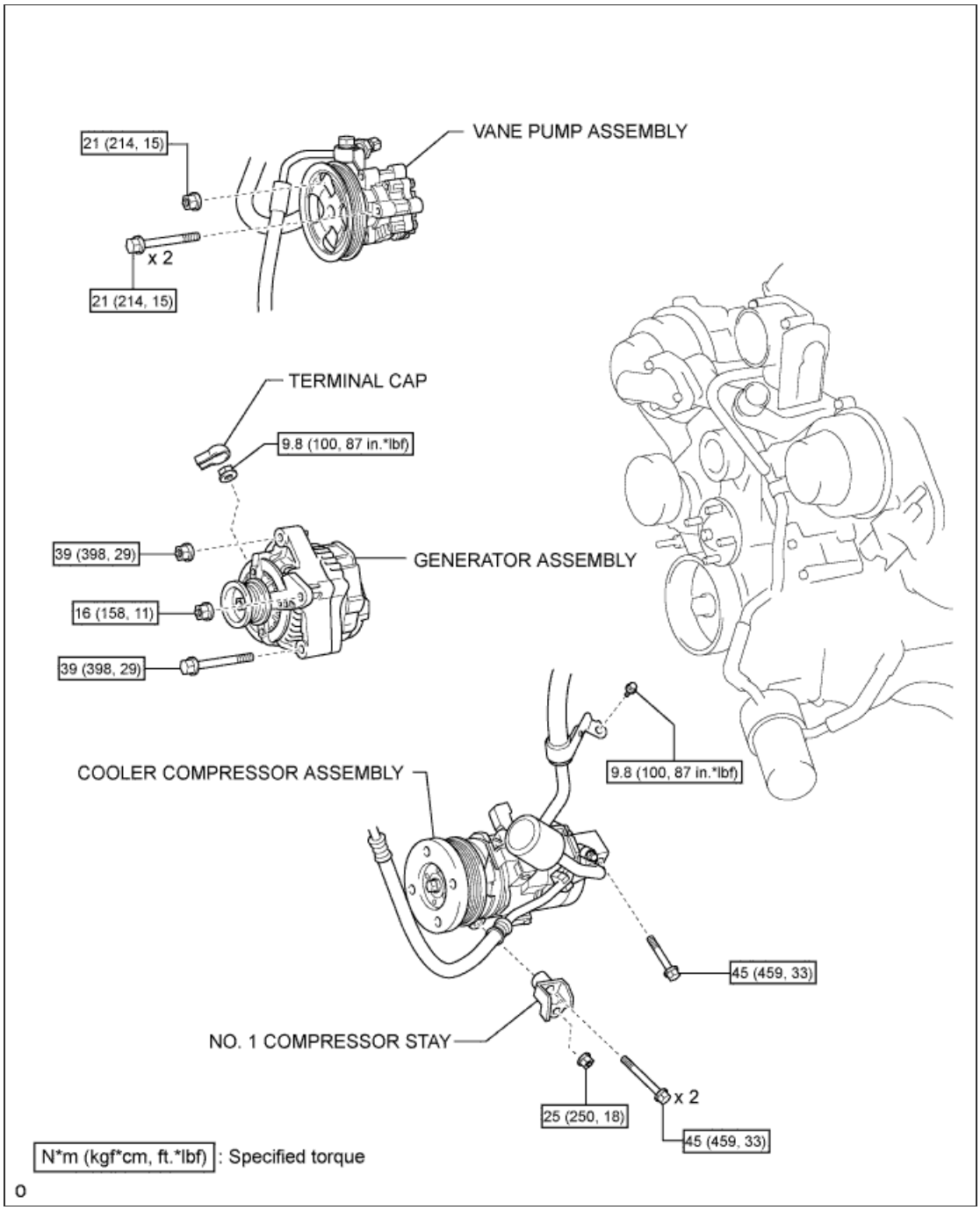


N*m (kgf*cm, ft.*lbf) : Specified torque

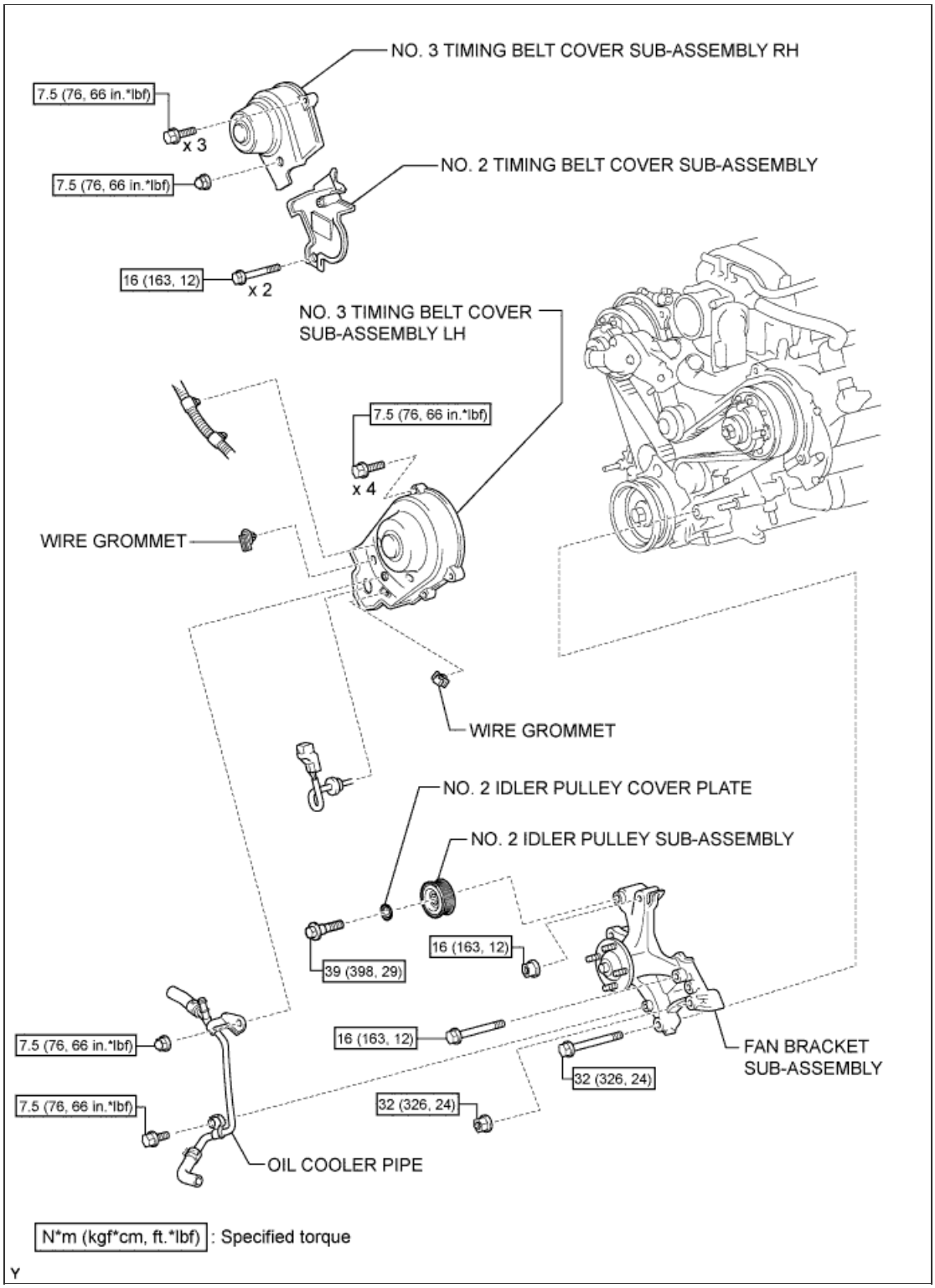
● Non-reusable part

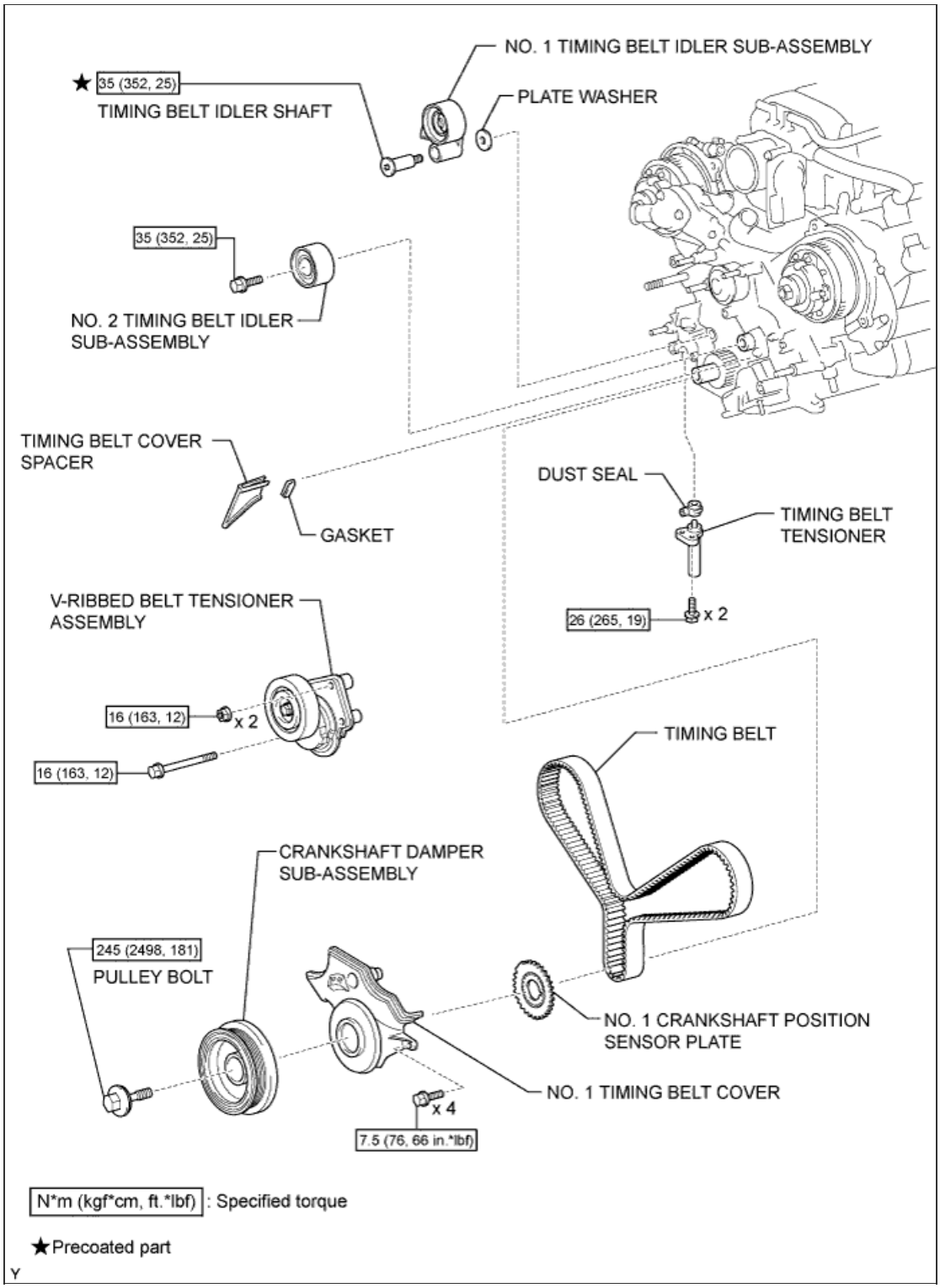
o


x 2
FRONT FENDER APRON SEAL FRONT RH
x 2
x 2
FRONT FENDER APRON SEAL LH
w/ KDSS:
FRONT FENDER APRON SEAL LH
x 2


21 (214, 15)
VANE PUMP ASSEMBLY
x 2
21 (214, 15)
TERMINAL CAP
9.8 (100, 87 in.*lbf)
39 (398, 29)
GENERATOR ASSEMBLY
16 (158, 11)
39 (398, 29)
COOLER COMPRESSOR ASSEMBLY
9.8 (100, 87 in.*lbf)
45 (459, 33)
NO. 1 COMPRESSOR STAY
25 (250, 18)
x 2
45 (459, 33)
N*m (kgf*cm, ft.*lbf) : Specified torque

o


NO. 3 TIMING BELT COVER SUB-ASSEMBLY RH
7.5 (76, 66 in.*lbf)
x 3
NO. 2 TIMING BELT COVER SUB-ASSEMBLY
7.5 (76, 66 in.*lbf)
16 (163, 12)
x 2
NO. 3 TIMING BELT COVER SUB-ASSEMBLY LH
7.5 (76, 66 in.*lbf)
x 4
WIRE GROMMET
WIRE GROMMET
NO. 2 IDLER PULLEY COVER PLATE
NO. 2 IDLER PULLEY SUB-ASSEMBLY
39 (398, 29)
16 (163, 12)
7.5 (76, 66 in.*lbf)
16 (163, 12)
32 (326, 24)
FAN BRACKET SUB-ASSEMBLY
7.5 (76, 66 in.*lbf)
32 (326, 24)
OIL COOLER PIPE
N*m (kgf*cm, ft.*lbf) : Specified torque
Y


NO. 1 TIMING BELT IDLER SUB-ASSEMBLY
★ 35 (352, 25)
TIMING BELT IDLER SHAFT
PLATE WASHER
35 (352, 25)
NO. 2 TIMING BELT IDLER SUB-ASSEMBLY
TIMING BELT COVER SPACER
GASKET
DUST SEAL
TIMING BELT TENSIONER
26 (265, 19) x 2
V-RIBBED BELT TENSIONER ASSEMBLY
16 (163, 12) x 2
16 (163, 12)
TIMING BELT
CRANKSHAFT DAMPER SUB-ASSEMBLY
245 (2498, 181)
PULLEY BOLT
NO. 1 CRANKSHAFT POSITION SENSOR PLATE
NO. 1 TIMING BELT COVER
x 4
7.5 (76, 66 in.*lbf)
N*m (kgf*cm, ft.*lbf) : Specified torque
★Precoated part
Y

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

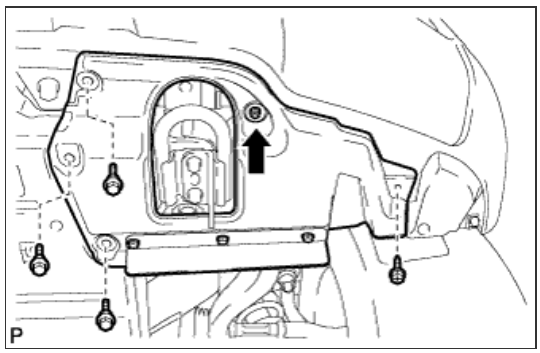
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



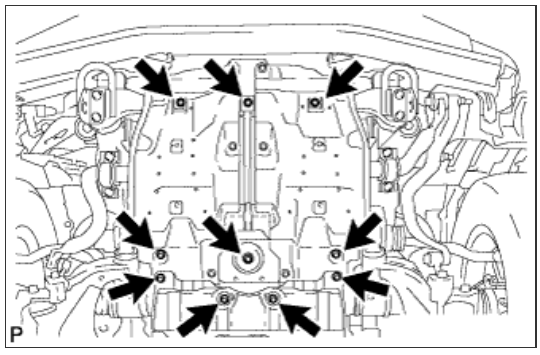
3. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

4. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

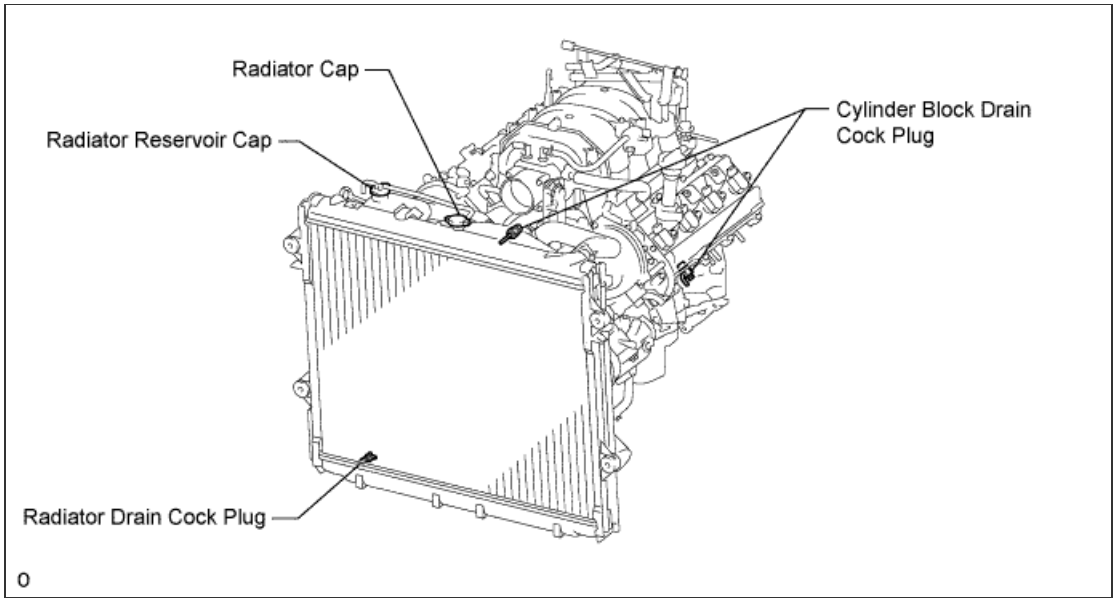
a. Remove the 10 bolts and No. 1 engine under cover.



5. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.



a. Loosen the radiator drain cock plug.

b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

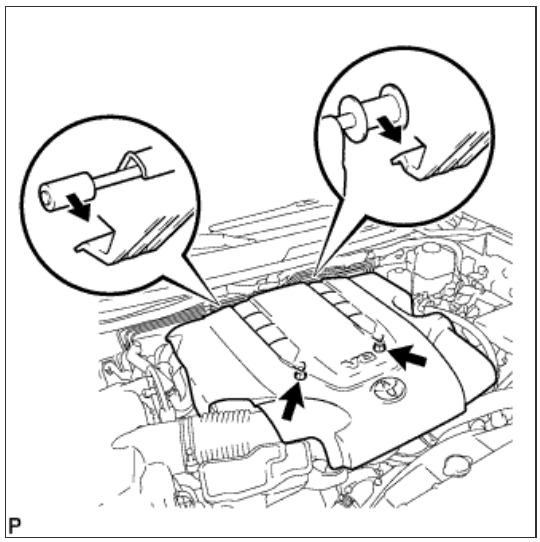
d. Tighten the 2 cylinder block drain cock plugs.

Torque:
13 N*m{ 130 kgf*cm , 9 ft.*lbf }

e. Tighten the radiator drain cock plug by hand.

6. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Remove the 2 nuts and V-bank cover.

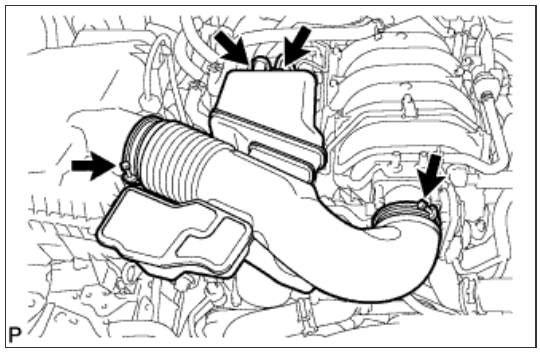


7. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum transmitting hose and No. 2 ventilation hose.

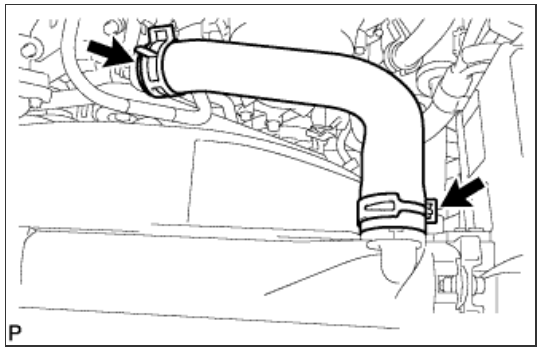
b. Loosen the 2 hose clamps.

c. Remove the air cleaner hose.



8. REMOVE NO. 1 RADIATOR HOSE

a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to remove the radiator hose.

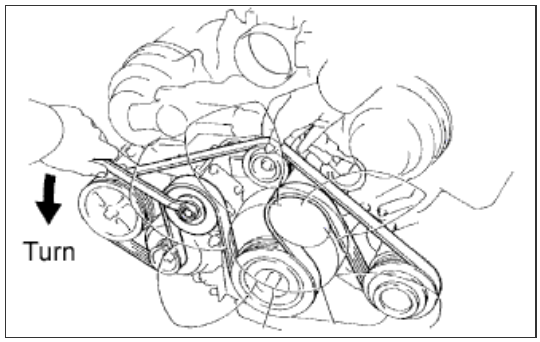


9. REMOVE FAN & GENERATOR V BELT

a. Loosen the belt tension by turning the belt tensioner counterclockwise, and then remove the fan and generator V belt.

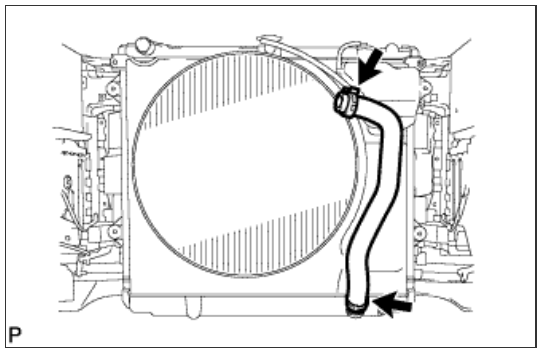
HINT:

The pulley bolt for the belt tensioner has left-hand thread.



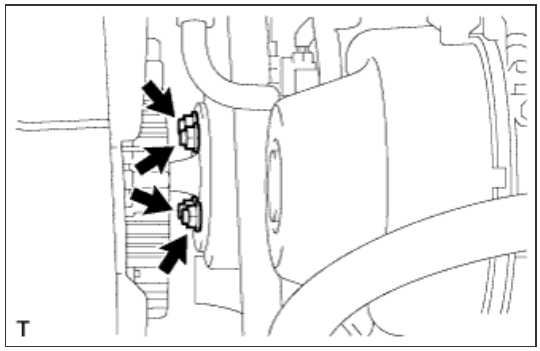
10. REMOVE NO. 2 RADIATOR HOSE

a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to remove the radiator hose.



11. REMOVE FAN SHROUD

a. Loosen the 4 nuts holding the cooling fan.



b. Disconnect the reservoir hose from the upper side of the radiator tank.

c. w/ Air Cooled Transmission Oil Cooler:
Detach the claw to open the flexible hose clamp.

d. Remove the 2 bolts and disconnect the oil cooler tube from the fan shroud.

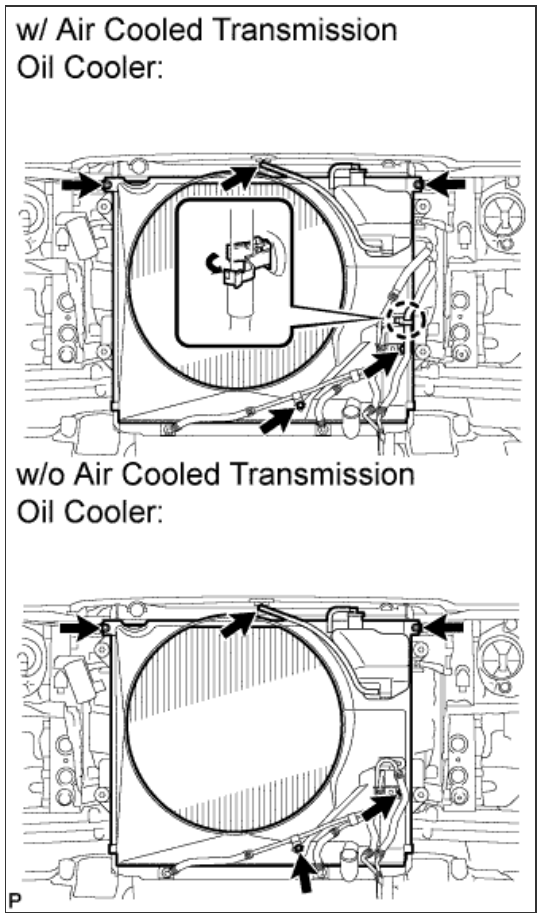
e. Remove the 2 bolts holding the fan shroud.

f. Remove the 4 nuts of the cooling fan, and then remove the shroud together with the cooling fan.

NOTICE:

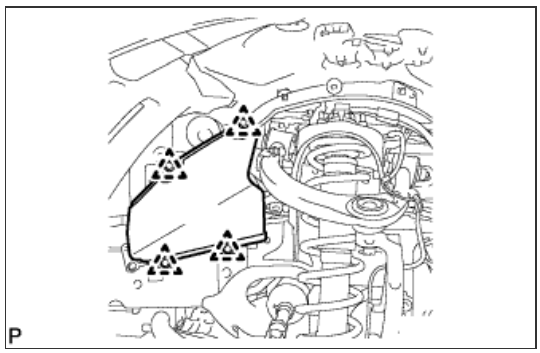
Be careful not to damage the radiator core.

g. Remove the fan pulley from the water pump.



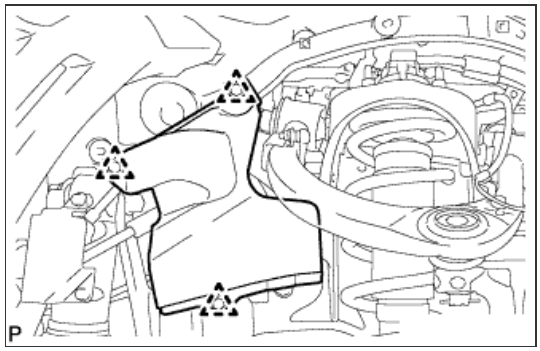
12. REMOVE FRONT FENDER APRON SEAL LH

a. Using a clip remover, remove the 4 clips and fender apron seal.



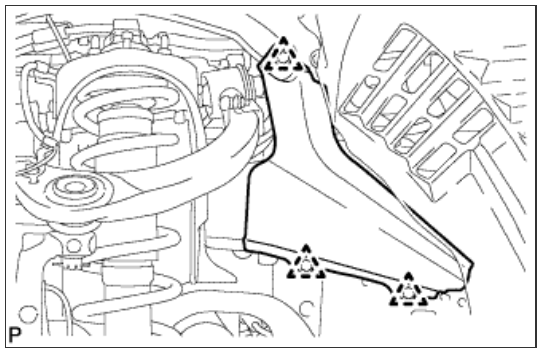
13. REMOVE FRONT FENDER APRON SEAL LH (w/ KDSS)

a. Using a clip remover, remove the 3 clips and fender apron seal.



14. REMOVE FRONT FENDER APRON SEAL FRONT RH

a. Using a clip remover, remove the 3 clips and fender apron seal.

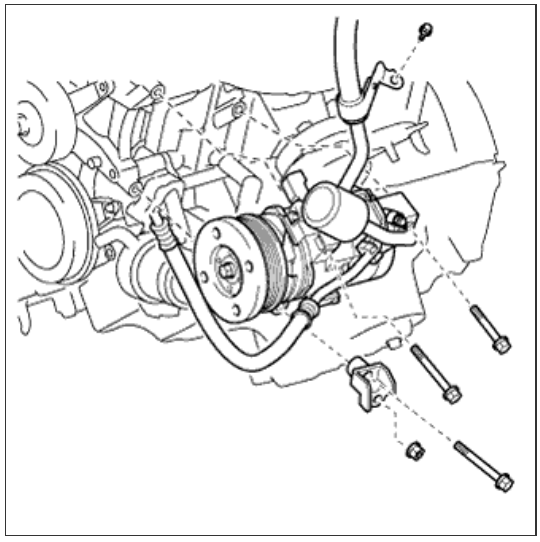


15. DISCONNECT COOLER COMPRESSOR ASSEMBLY

a. Disconnect the connector.

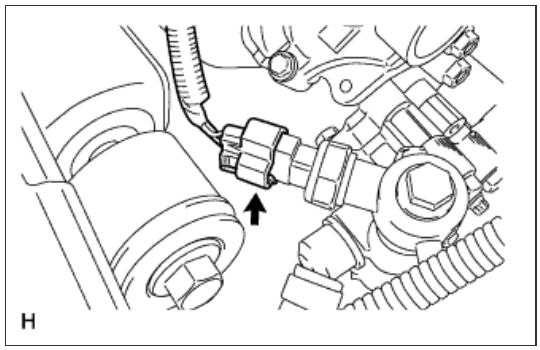
b. Remove the bolt. Then disconnect the cooler refrigerant suction hose from the cylinder head cover.

c. Remove the 3 bolts, nut and No. 1 compressor stay and disconnect the cooler compressor.

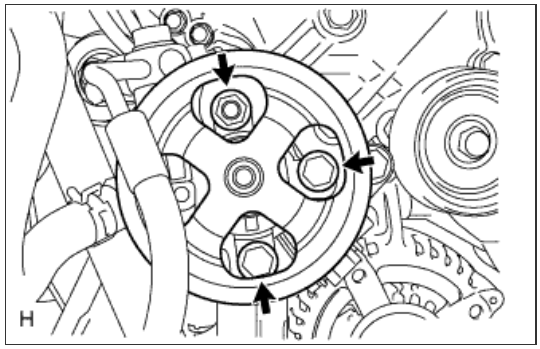


16. DISCONNECT VANE PUMP ASSEMBLY

a. Disconnect the connector.



b. Remove the 2 bolts and nut. Then disconnect the vane pump.

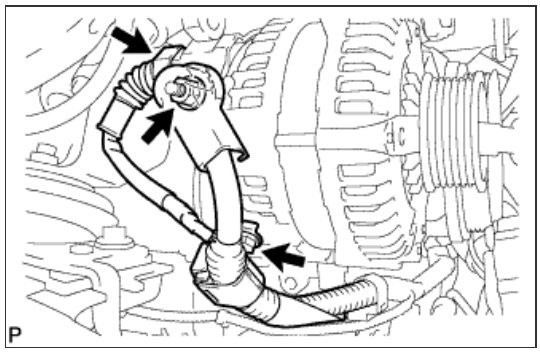


17. REMOVE GENERATOR ASSEMBLY

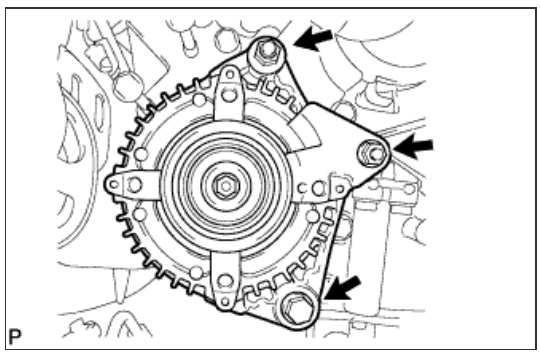
a. Disconnect the generator connector.

b. Remove the terminal cap and nut, and disconnect the generator wire.

c. Remove the bolt and disconnect the wire harness bracket from the generator.



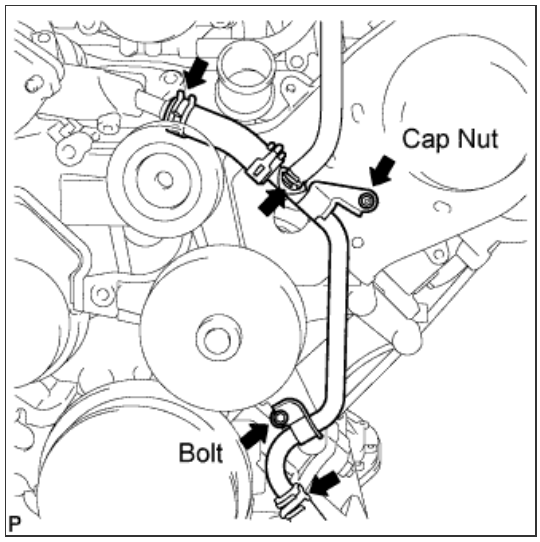
d. Remove the bolt, 2 nuts and generator.



18. REMOVE OIL COOLER PIPE

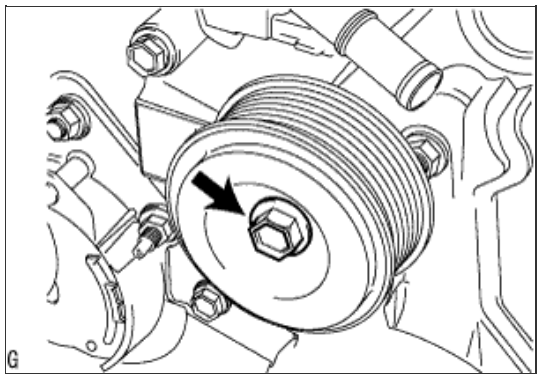
a. Remove the cap nut and bolt.

b. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to disconnect the 3 water by-pass hoses and remove the oil cooler pipe.



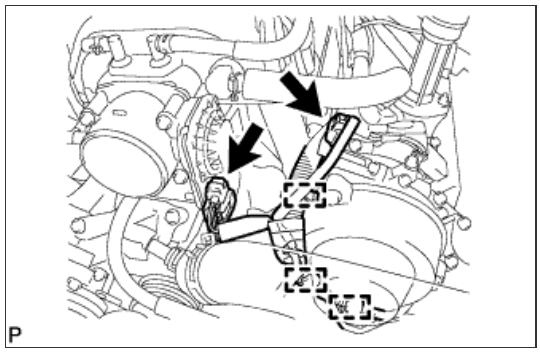
1 . REMOVE NO. 2 IDLER PULLEY SUB-ASSEMBLY

a. Remove the pulley bolt, cover plate and idler pulley.



20. REMOVE NO. 3 TIMING BELT COVER SUB-ASSEMBLY LH

a. Detach the 3 wire clamps and disconnect the camshaft timing oil control valve connector and control motor connector.



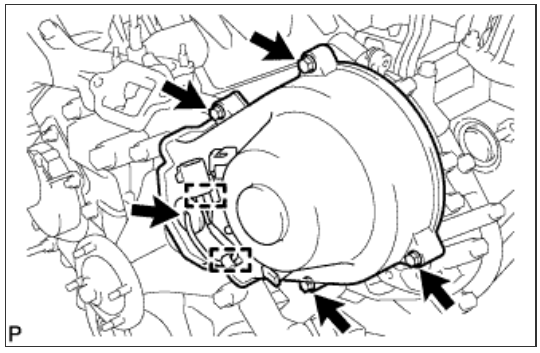
b. Disconnect the camshaft position sensor connector.

c. Disconnect the camshaft position sensor wire from the 2 wire clamps on the timing belt cover.

d. Remove the wire grommet from the timing belt cover.

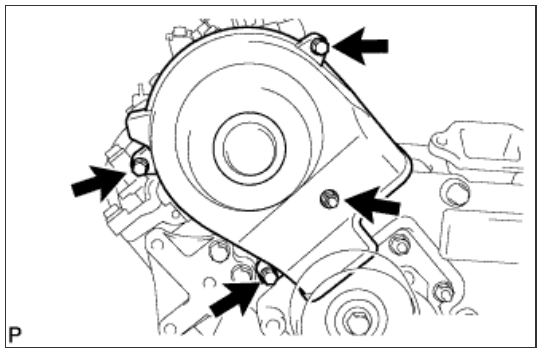
e. Remove the 4 bolts.

f. Pull the cover outward, pull the camshaft position sensor wire out of the cover, and remove the cover.



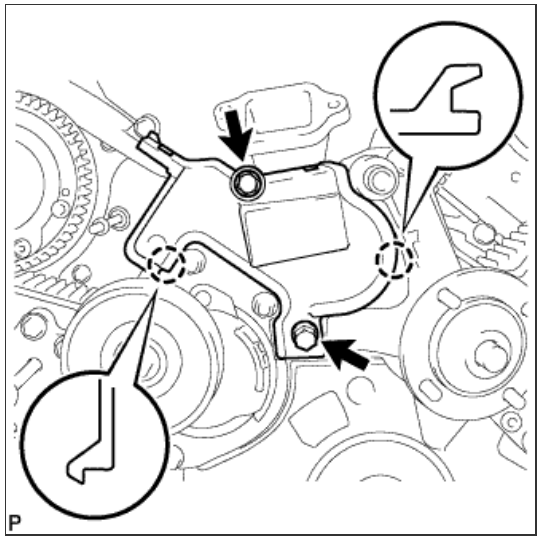
21. REMOVE NO. 3 TIMING BELT COVER SUB-ASSEMBLY RH

a. Remove the 3 bolts, nut and timing belt cover.



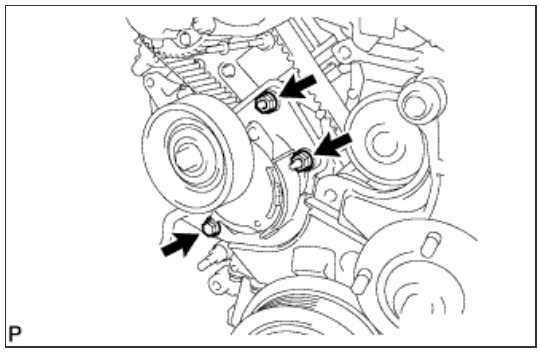
22. REMOVE NO. 2 TIMING BELT COVER SUB-ASSEMBLY

a. Remove the 2 bolts and detach the 2 claws, and then remove the No. 2 timing belt cover.



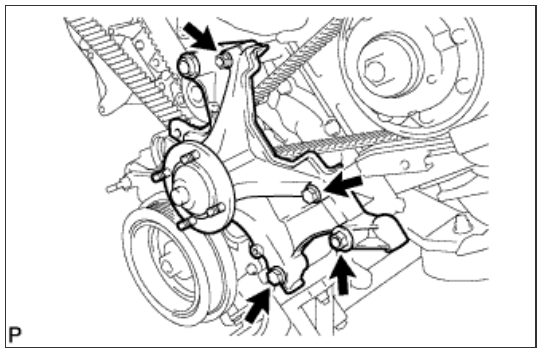
23. REMOVE V-RIBBED BELT TENSIONER ASSEMBLY

a. Remove the bolt, 2 nuts and V-ribbed belt tensioner.



24. REMOVE FAN BRACKET SUB-ASSEMBLY

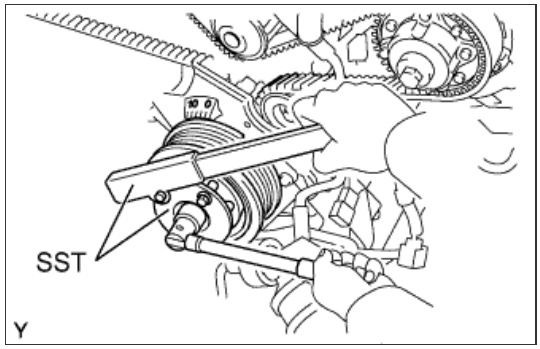
a. Remove the 2 nuts, 2 bolts and fan bracket.



25. REMOVE CRANKSHAFT DAMPER SUB-ASSEMBLY

a. Using SST, hold the crankshaft damper and loosen the pulley bolt. Further loosen the bolt until 2 or 3 threads are screwed into the crankshaft.

SST
09213-70011 (09213-70020)
09330-00021 (09330-00030)

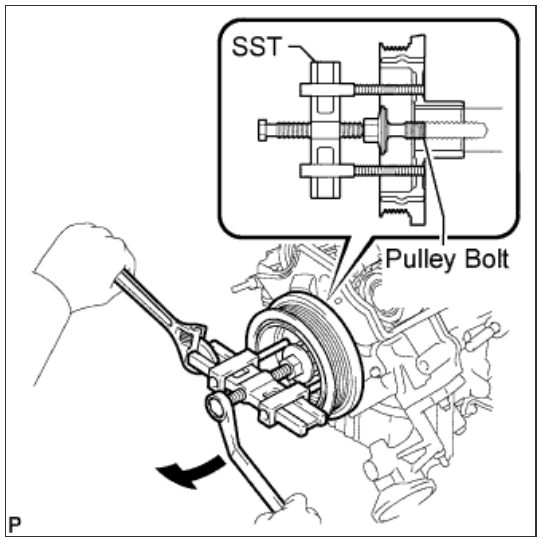


b. Using SST and the pulley bolt, remove the crankshaft damper.

SST
09950-50013 (09951-05010, 09952-05010, 09953-05020, 09954-05031)

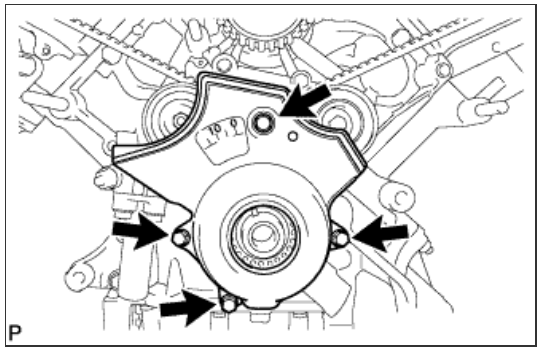
HINT:

Apply a lubricant to the threads and end of SST.



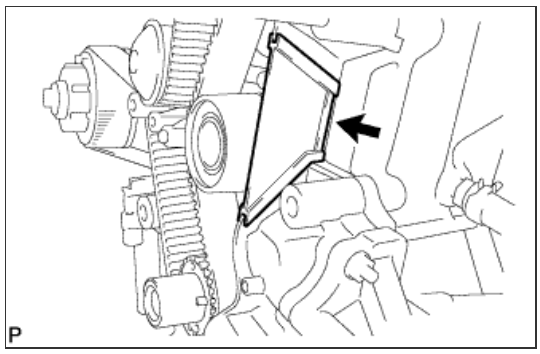
26. REMOVE NO. 1 TIMING BELT COVER

a. Remove the 4 bolts and timing belt cover.



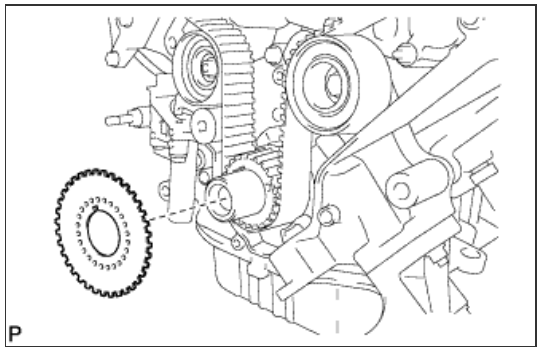
27. REMOVE TIMING BELT COVER SPACER

a. Remove the cover spacer and gasket.



28. REMOVE NO. 1 CRANKSHAFT POSITION SENSOR PLATE

a. Remove the position sensor plate from the crankshaft.



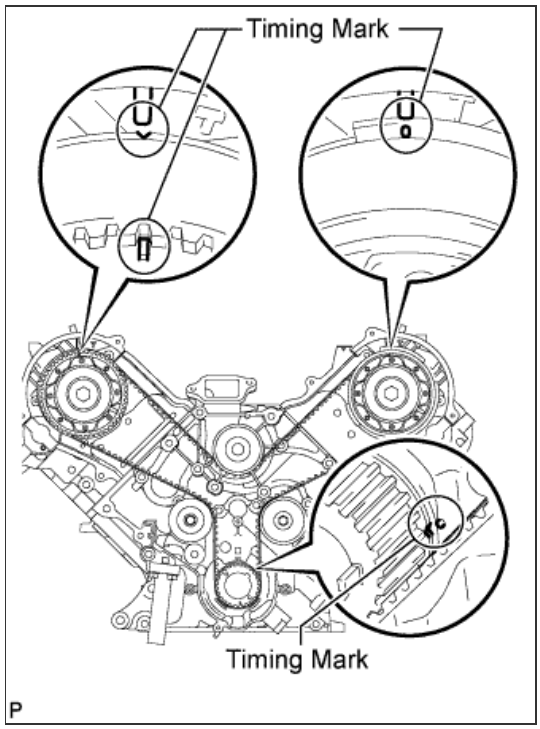
29. SET NO. 1 CYLINDER TO TDC/COMPRESSION

a. Temporarily install the pulley bolt.

b. Rotate the crankshaft clockwise so that the timing marks on the crankshaft timing pulley and camshaft timing pulleys are as shown in the illustration.

HINT:

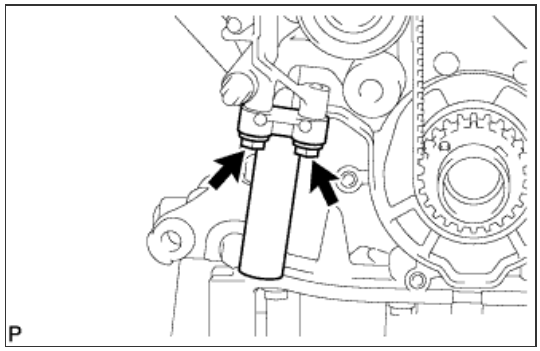
- **If the timing marks do not align, rotate the crankshaft clockwise again and align the timing marks.**
- **When reusing the timing belt, put a timing mark on the belt where the timing marks on the belt and timing pulley are aligned after rotating the crankshaft.**



30. REMOVE TIMING BELT

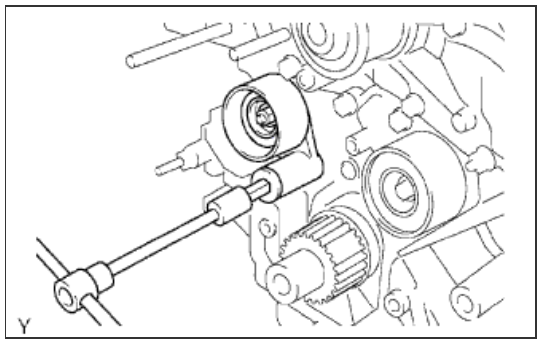
a. Alternately loosen the 2 bolts, then remove the bolts, timing belt tensioner and dust seal.

b. Remove the timing belt.



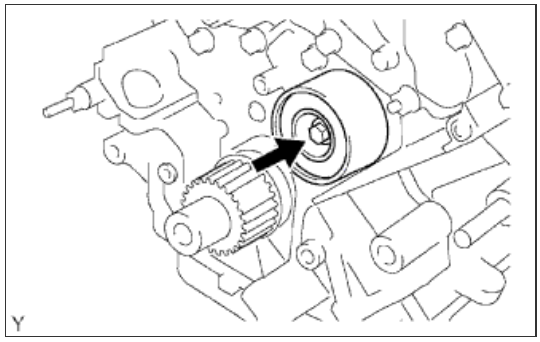
31. REMOVE NO. 1 TIMING BELT IDLER SUB-ASSEMBLY

a. Using a 10 mm hexagon wrench, remove the idler shaft, timing belt idler and plate washer.



32. REMOVE NO. 2 TIMING BELT IDLER SUB-ASSEMBLY

a. Remove the bolt and timing belt idler.



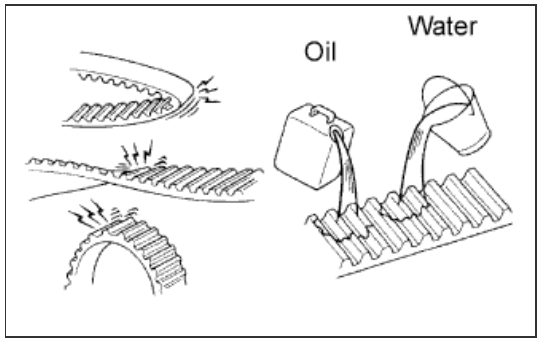
for Preparation Click here

1. INSPECT TIMING BELT

a. Visually check the timing belt for excessive wear, frayed cords, etc.
If necessary, replace the timing belt.

NOTICE:

- **Do not bend or twist the timing belt or turn it inside out.**
- **Do not allow the timing belt to come into contact with oil, water or steam.**

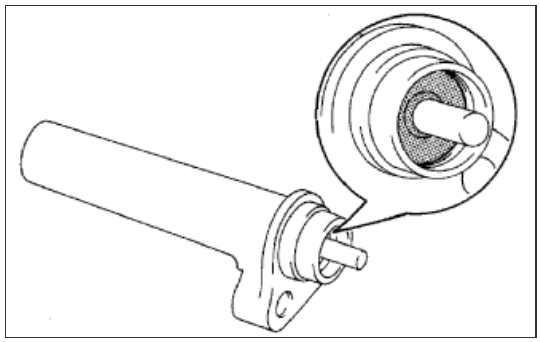


2. INSPECT TIMING BELT TENSIONER ASSEMBLY

a. Visually check the seal portion of the tensioner for oil leakage.
If leakage is found, replace the timing belt tensioner assembly.

HINT:

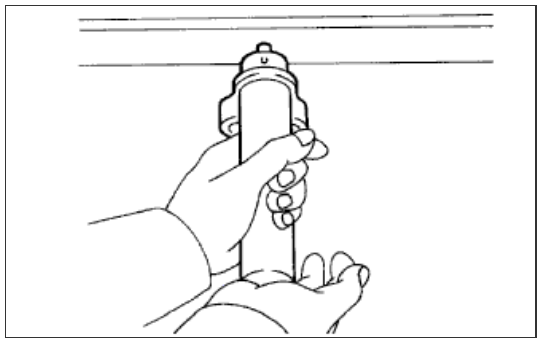
If there is only a faint trace of oil on the push rod, the tensioner does not need to be replaced.



b. Hold the tensioner with both hands and push the push rod strongly as shown to check that it does not move.
If the push rod moves, replace the timing belt tensioner assembly.

NOTICE:

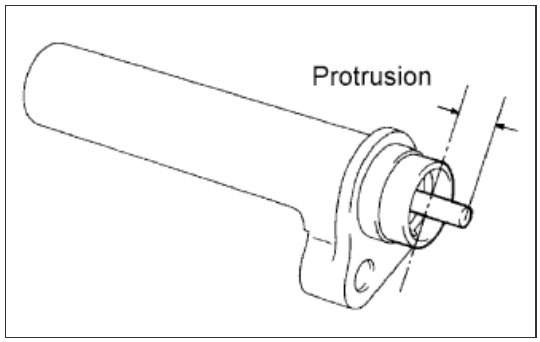
Never face the tensioner push rod downward.



c. Measure the protrusion of the push rod from the housing end.

Standard protrusion:
9.5 to 10.5 mm (0.374 to 0.413 in.)

If the protrusion is not as specified, replace the timing belt tensioner assembly.

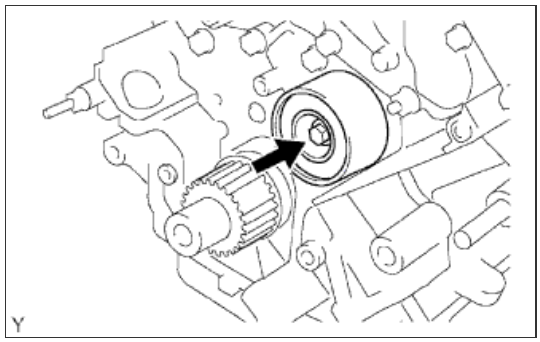

Protrusion

for Preparation Click here

1. INSTALL NO. 2 TIMING BELT IDLER SUB-ASSEMBLY

a. Install the timing belt idler with the bolt.

Torque:
35 N*m{ 352 kgf*cm , 25 ft.*lbf }



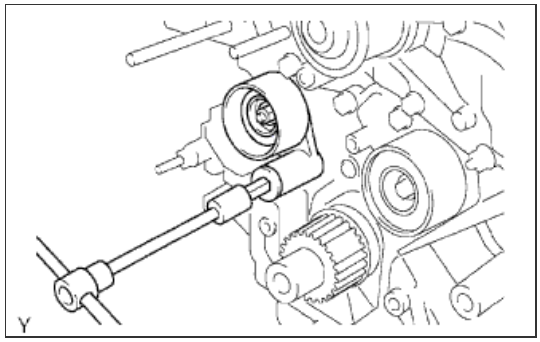
2. INSTALL NO. 1 TIMING BELT IDLER SUB-ASSEMBLY

a. When reusing the timing belt idler shaft, apply adhesive to 2 or 3 of the threads.

Adhesive:
Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent

b. Using a 10 mm hexagon wrench, install the plate washer and timing belt idler with the idler shaft.

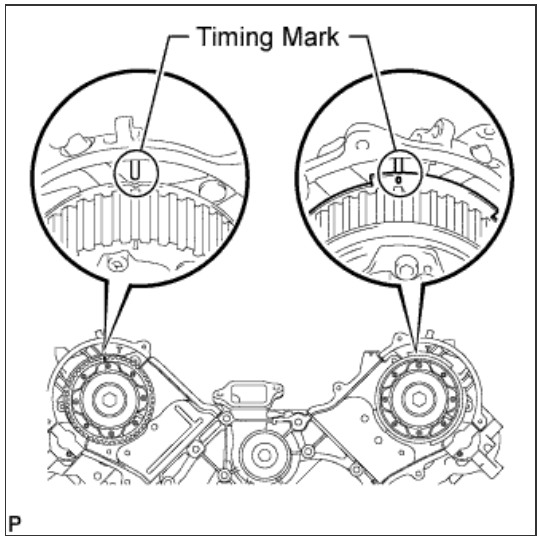
Torque:
35 N*m{ 352 kgf*cm , 25 ft.*lbf }



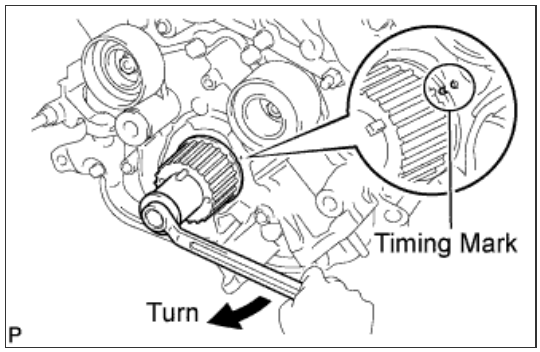
3. INSTALL TIMING BELT

a. Set the No. 1 cylinder to TDC/compression.

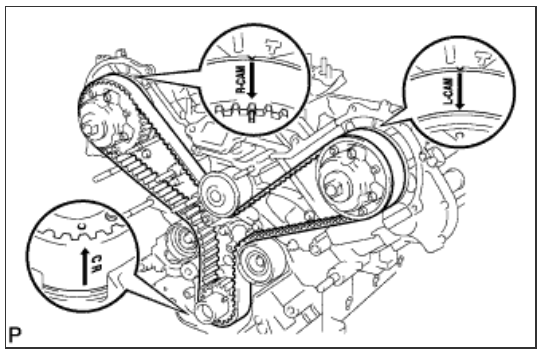
i. Turn the hexagonal portion of the camshaft to align the timing marks of the camshaft timing pulleys and timing belt plates.



ii. Using the pulley bolt, turn the crankshaft to align the timing marks of the crankshaft timing pulley and oil pump body.



b. Install the timing belt.



i. Remove any oil or water from each pulley, and keep them clean.

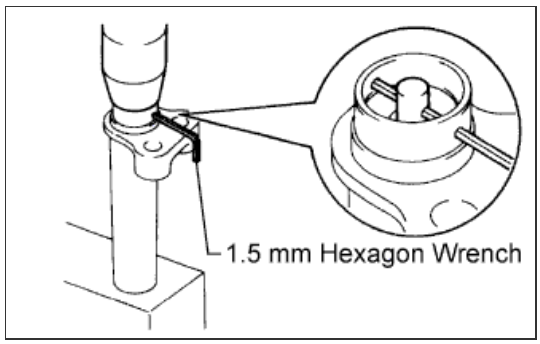
NOTICE:

Only wipe the pulleys. Do not use any cleansing agent on the pulleys.

ii. Face the front mark (arrow) on the timing belt forward.

iii. Align the timing marks on the timing belt and crankshaft timing pulley, and the timing belt and camshaft timing pulleys, and install the timing belt.

c. Install the belt tensioner.



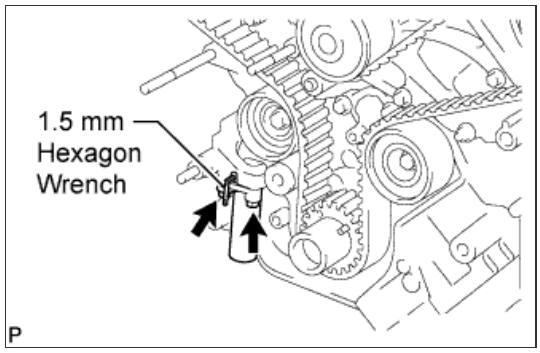
i. Remove the dust seal from the belt tensioner.

ii. Using a press, slowly press in the push rod using a force of 981 to 9807 N (100 to 1000 kgf, 220.5 to 2204.7 lbf).

iii. Align the holes of the push rod and housing, and pass a 1.5 mm hexagon wrench through the holes to keep the setting position of the push rod.

iv. Release the press.

v. Install the dust seal to the belt tensioner.



vi. Temporarily install the belt tensioner with the 2 bolts.

vii. Tighten the 2 bolts.

Torque:
26 N*m{ 265 kgf*cm , 19 ft.*lbf }

viii. Using pliers, remove the 1.5 mm hexagon wrench from the timing belt tensioner.

4. CHECK NO. 1 CYLINDER TO TDC/COMPRESSION

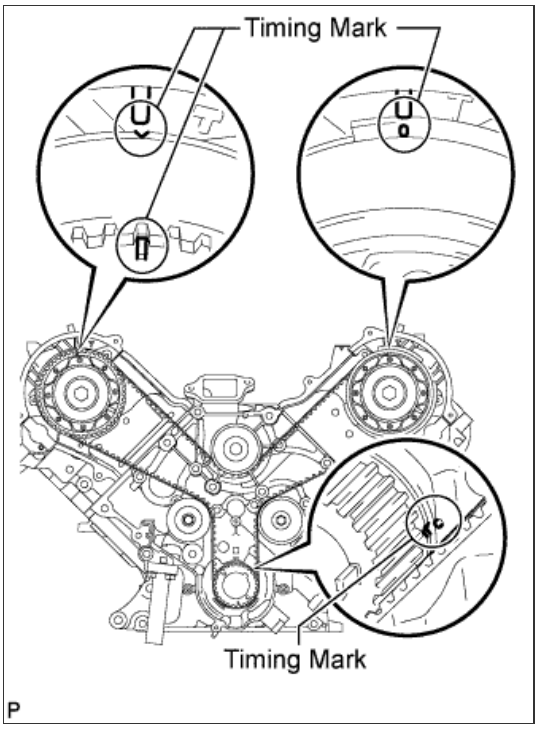
a. Using the pulley bolt, slowly turn the crankshaft timing pulley 2 revolutions from the TDC to TDC.

NOTICE:

Always turn the crankshaft timing pulley clockwise.

b. Check that each pulley is aligned with each timing mark as shown in the illustration.
If the timing marks are not aligned, remove the timing belt and reinstall it.

c. Remove the pulley bolt.

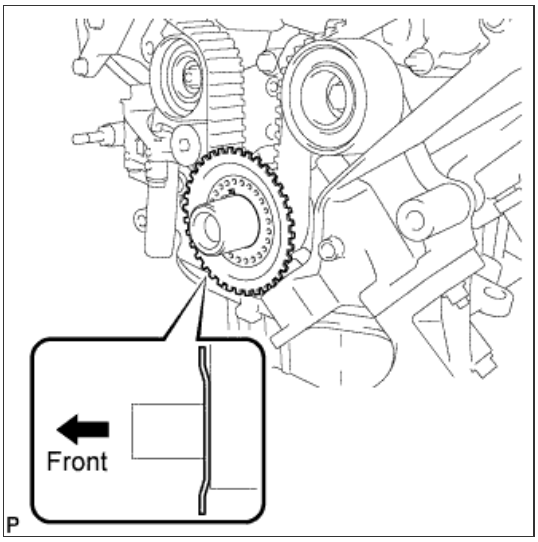


5. INSTALL NO. 1 CRANKSHAFT POSITION SENSOR PLATE

a. Install the sensor plate as shown in the illustration.

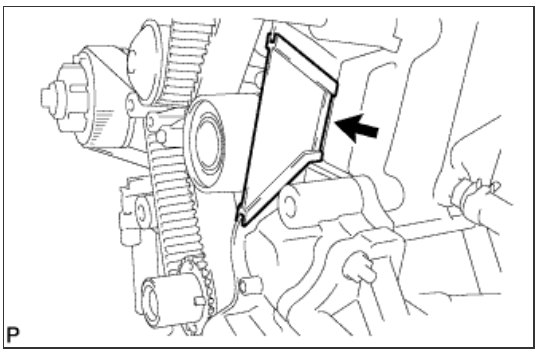
NOTICE:

Take care not to install the sensor plate in a wrong direction.



6. INSTALL TIMING BELT COVER SPACER

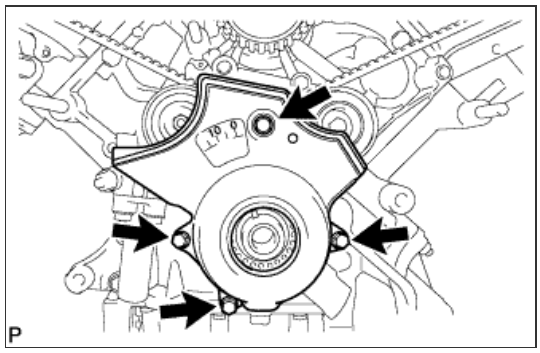
a. Install the cover spacer and gasket.



7. INSTALL NO. 1 TIMING BELT COVER

a. Install the timing belt cover with the 4 bolts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



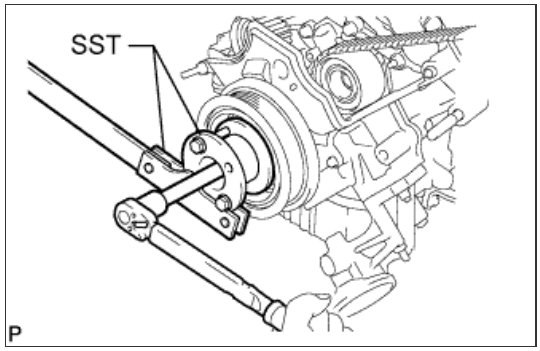
8. INSTALL CRANKSHAFT DAMPER SUB-ASSEMBLY

a. Align the pulley set key with the key groove of the crankshaft damper.

b. Using SST, hold the crankshaft pulley and install the pulley bolt.

SST
09213-70011 (09213-70020)
09330-00021 (09330-00030)

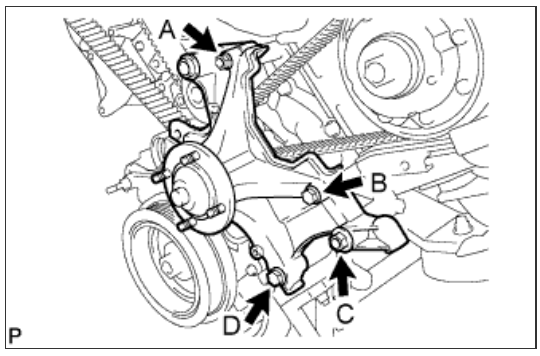
Torque:
245 N*m{ 2498 kgf*cm , 181 ft.*lbf }



9. INSTALL FAN BRACKET SUB-ASSEMBLY

a. Install the fan bracket with the 2 bolts and 2 nuts.

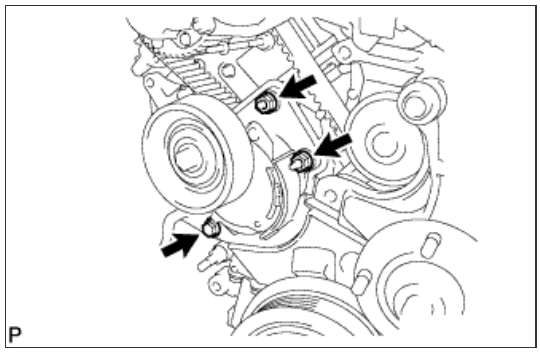
Torque:
for nut A, bolt B:
16 N*m{ 163 kgf*cm , 12 ft.*lbf }
for nut C, bolt D:
32 N*m{ 326 kgf*cm , 24 ft.*lbf }



10. INSTALL V-RIBBED BELT TENSIONER ASSEMBLY

a. Install the belt tensioner with the bolt and 2 nuts.

Torque:
16 N*m{ 163 kgf*cm , 12 ft.*lbf }

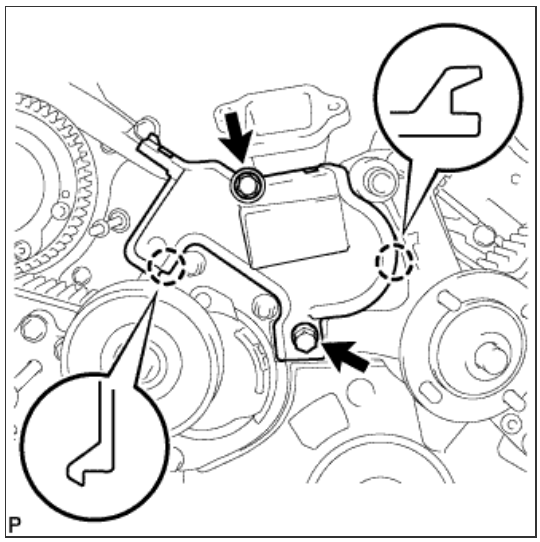


11. INSTALL NO. 2 TIMING BELT COVER SUB-ASSEMBLY

a. Install the timing belt cover and fit the 2 claws into each part.

b. Install the 2 bolts.

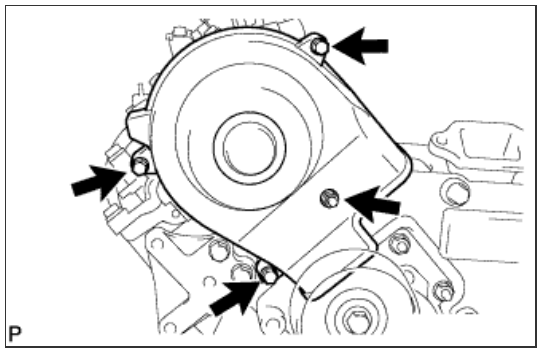
Torque:
16 N*m{ 163 kgf*cm , 12 ft.*lbf }



12. INSTALL NO. 3 TIMING BELT COVER SUB-ASSEMBLY RH

a. Install the timing belt cover with the 3 bolts and nut.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



13. INSTALL NO. 3 TIMING BELT COVER SUB-ASSEMBLY LH

a. Pass the camshaft position sensor wire through the cover hole.

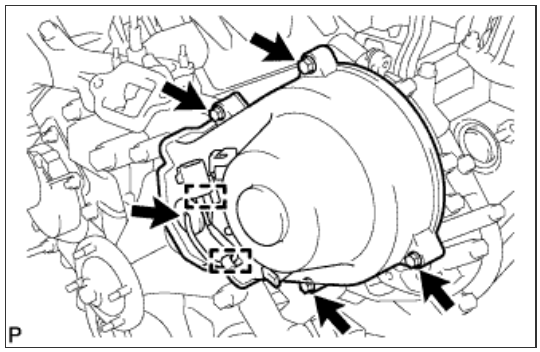
b. Install the timing belt cover with the 4 bolts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

c. Install the wire grommet to the timing belt cover.

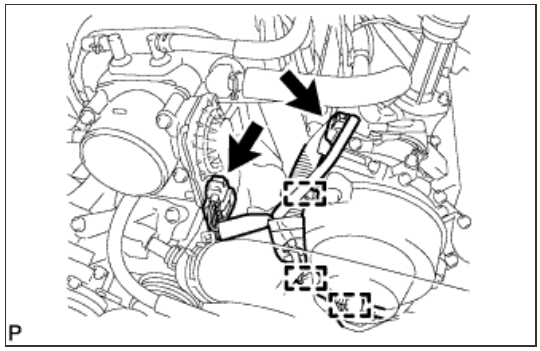
d. Connect the sensor connector.

e. Install the sensor wire to the 2 wire clamps on the cover.



f. Connect the engine wire to the 3 wire clamps.

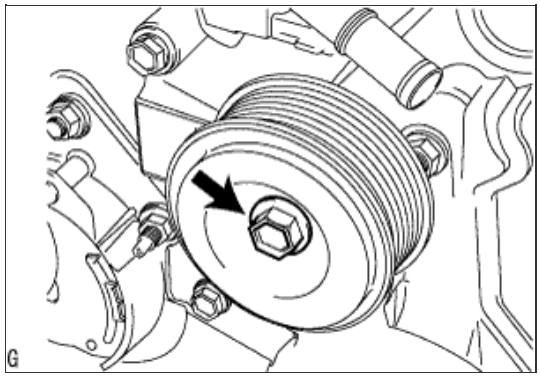
g. Connect the camshaft timing oil control valve connector and control motor connector.



14. INSTALL NO. 2 IDLER PULLEY SUB-ASSEMBLY

a. Install the idler pulley and cover plate with the bolt.

Torque:
39 N*m{ 398 kgf*cm , 29 ft.*lbf }

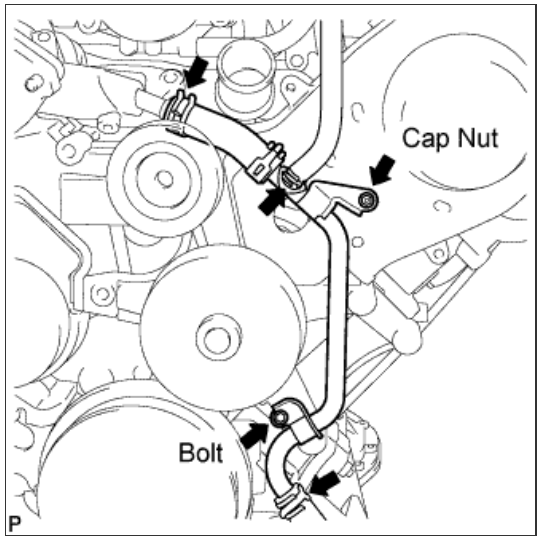


15. INSTALL OIL COOLER PIPE

a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to connect the 3 water by-pass hoses.

b. Install the oil cooler pipe with the cap nut and bolt.

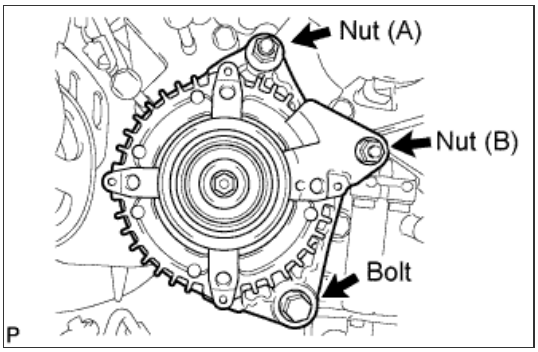
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



16. INSTALL GENERATOR ASSEMBLY

a. Install the generator with the bolt and 2 nuts.

Torque:
for bolt and nut (A):
39 N*m{ 398 kgf*cm , 29 ft.*lbf }
for nut (B):
16 N*m{ 158 kgf*cm , 11 ft.*lbf }



b. Connect the generator connector.

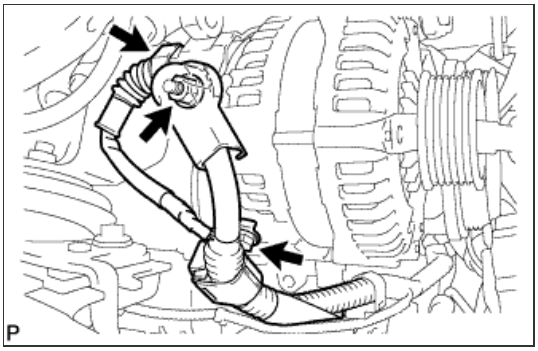
c. Connect the generator wire with the nut.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }

d. Install the terminal cap.

e. Connect the harness bracket to the generator with the bolt.

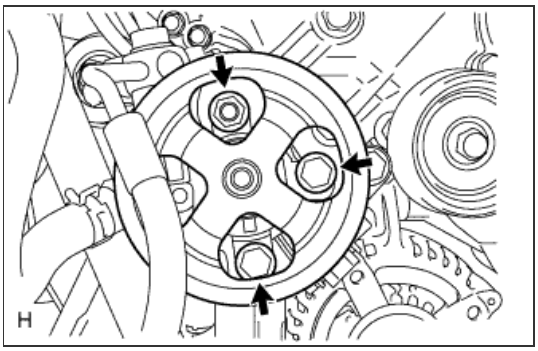
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }



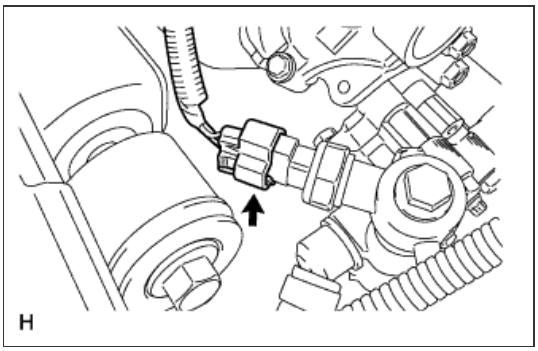
17. CONNECT VANE PUMP ASSEMBLY

a. Connect the vane pump with the 2 bolts and nut.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



b. Connect the connector.



18. CONNECT COOLER COMPRESSOR ASSEMBLY

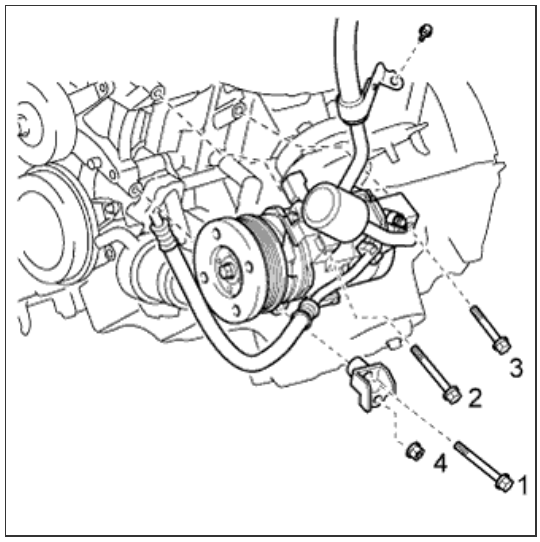
a. Connect the compressor. Then install it and the No. 1 compressor stay with the

nut and 3 bolts.

Torque:
for bolt:
45 N*m{ 459 kgf*cm , 33 ft.*lbf }
for nut:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }

HINT:

Tighten the bolts in the order shown in the illustration to install the cooler compressor.



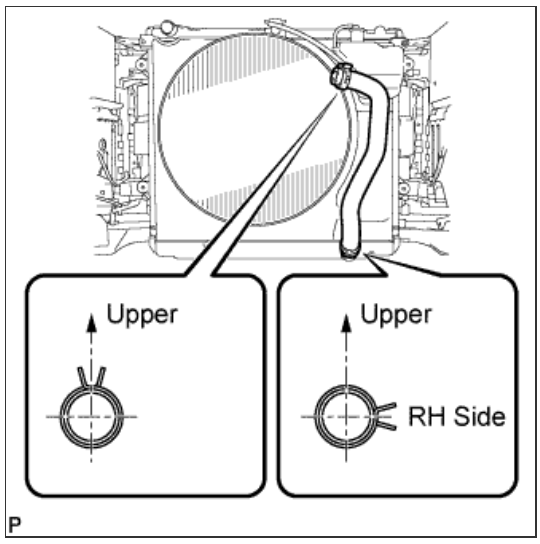
b. Install the cooler refrigerant suction hose with the bolt.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }

c. Connect the connector.

19. INSTALL NO. 2 RADIATOR HOSE

a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to install the radiator hose.



20. INSTALL FAN SHROUD

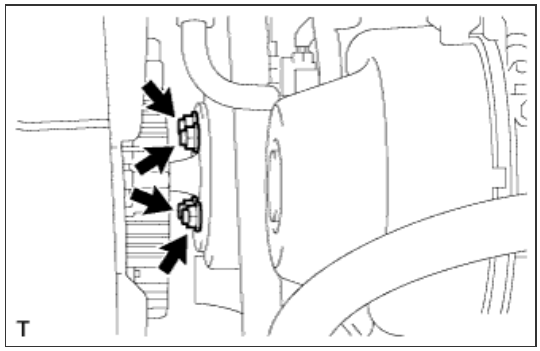
a. Install the fan pulley to the water pump.

b. Place the shroud together with the cooling fan between the radiator and engine.

NOTICE:

Be careful not to damage the radiator core.

c. Temporarily install the cooling fan to the water pump with the 4 nuts. Tighten the nuts as much as possible by hand.



d. Attach the claws of the shroud to the radiator as shown in the illustration.

e. Install the shroud with the 2 bolts.

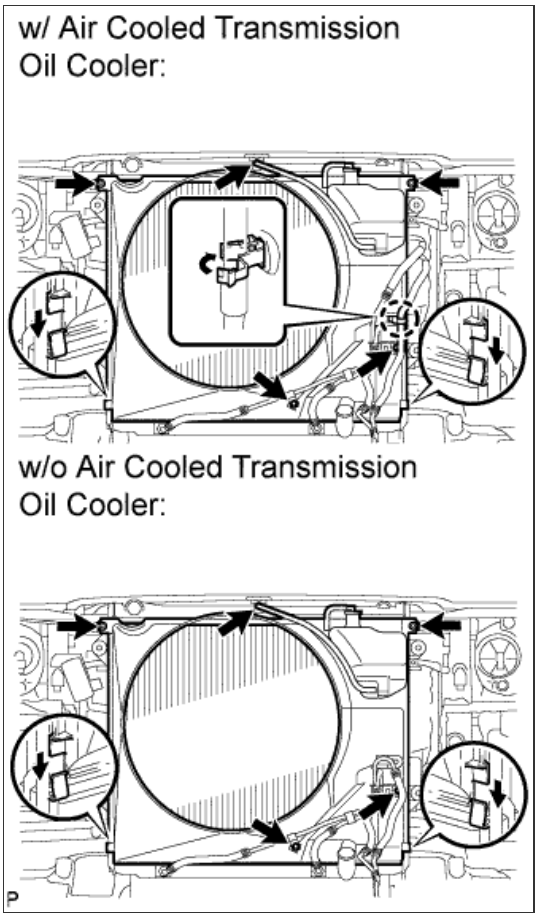
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

f. Connect the oil cooler tube to the fan shroud with the 2 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

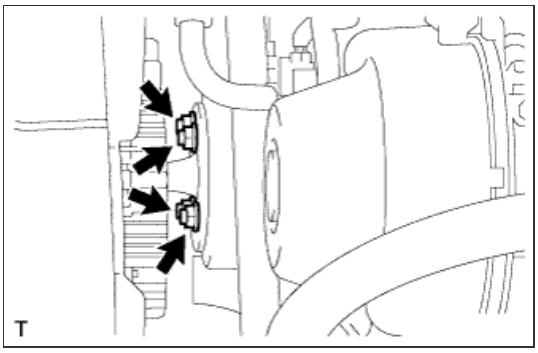
g. w/ Air Cooled Transmission Oil Cooler:
Pass the hose through the flexible hose clamp and close the clamp as shown in the illustration.

h. Connect the reservoir hose to the upper side of the radiator tank.



i. Tighten the 4 nuts of the cooling fan.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

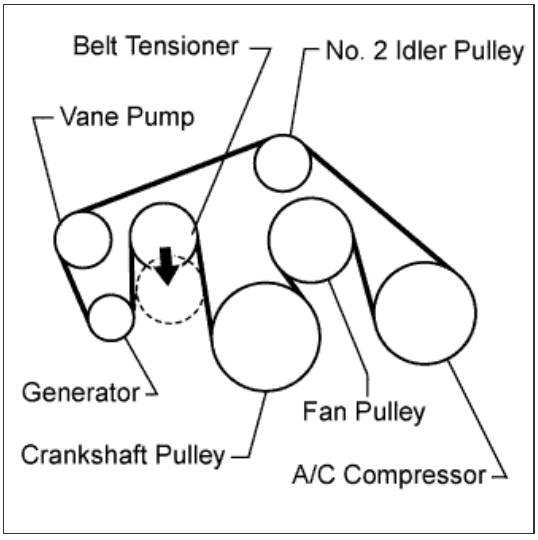


21. INSTALL FAN & GENERATOR V BELT

a. Set the V belt onto every part except the belt tensioner, as shown in the illustration.

b. Loosen the V belt by turning the belt tensioner counterclockwise.

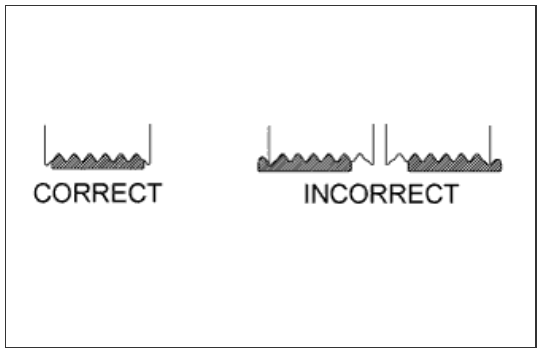
c. Set the V belt to the belt tensioner.



d. Check that the belt fits properly in the ribbed grooves.

HINT:

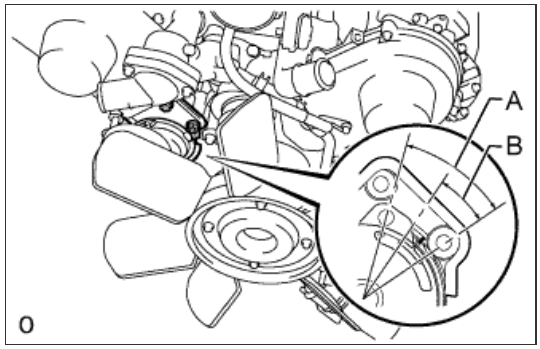
Make sure to check by hand that the belt has not slipped out of the grooves on the bottom of the pulley.



e. Check that the arrow on the belt tensioner is within area "A".
If the arrow is outside area "A", replace the fan and generator V belt.

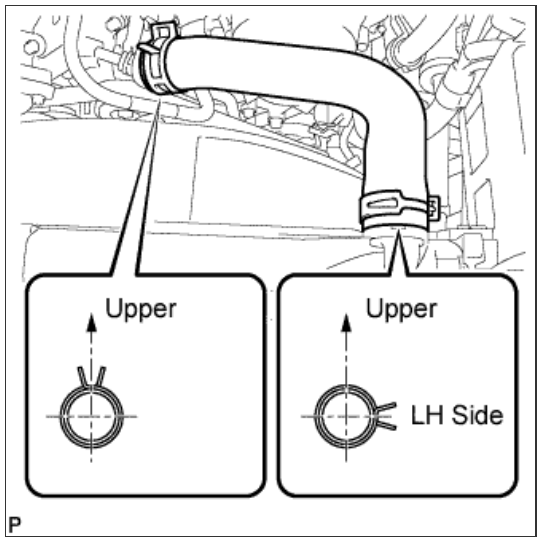
HINT:

When a new belt is installed, the arrow should be within area "B". If not, the fan and generator V belt is not installed correctly.



22. INSTALL NO. 1 RADIATOR HOSE

a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to install the radiator hose.



23. INSTALL AIR CLEANER HOSE ASSEMBLY

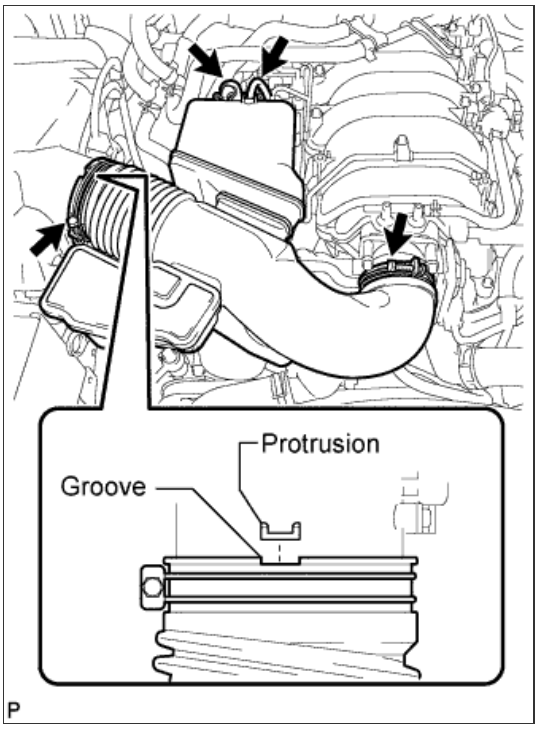
a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum transmitting hose.

d. Connect the No. 2 ventilation hose.



24. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

25. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item		Specified Condition
w/o Transmission oil cooler	w/o Rear Heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)
	w/ Rear Heater	16.3 liters (17.2 US qts, 14.3 Imp. qts)
w/ Transmission oil cooler	w/o Rear Heater	14.1 liters (14.9 US qts, 12.4 Imp. qts)
	w/ Rear Heater	16.9 liters (17.9 US qts, 14.9 Imp. qts)

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the radiator reservoir cap.

d. Press the inlet and outlet radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.

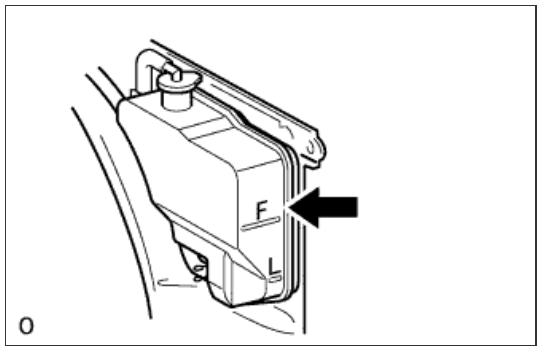
NOTICE:

Switch off the A/C.

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**



h. Press the inlet and outlet radiator hoses several times by hand to bleed air.

CAUTION:

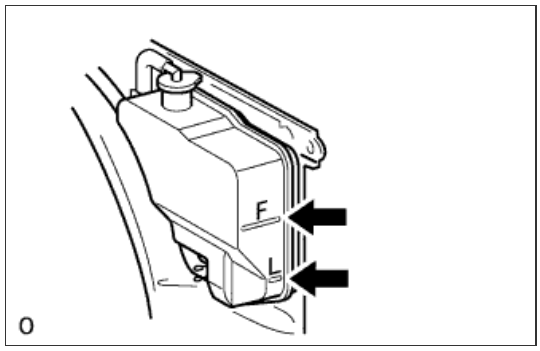
- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the cooling fan.**

i. Stop the engine, and wait until the engine coolant cools down to the ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

j. Check that the coolant level is between the F and L lines. If the coolant level is below the L line, repeat all of the procedures above. If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.

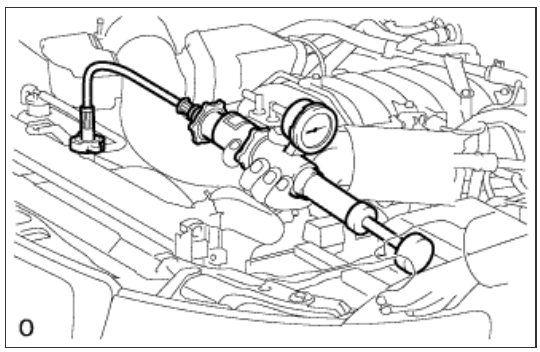


26. INSPECT FOR COOLANT LEAK

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



27. INSPECT IGNITION TIMING

a. Warm up and stop the engine.

i. Allow the engine to warm up to a normal operating temperature.

b. When using the intelligent tester:

i. Connect the intelligent tester to the DLC3.

NOTICE:

Switch off all accessories and the A/C before connecting the intelligent tester.

ii. Start the engine and idle it.

iii. Push the intelligent tester main switch ON.

iv. Enter the following menus: Powertrain / Engine and ECT / Data List / Primary / IGN Advance.

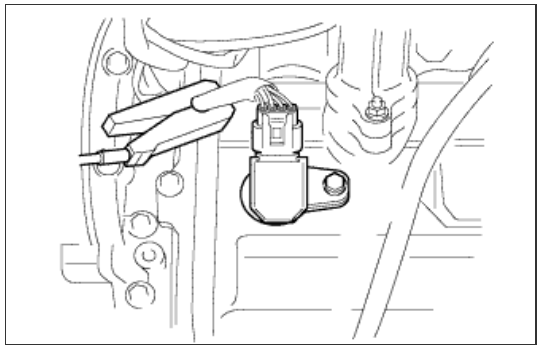
HINT:

Refer to the intelligent tester operator's manual for further details.

Standard ignition timing:
5 to 15° BTDC @ idling (transmission in neutral and A/C switch off)

v. Disconnect the intelligent tester from the DLC3.

c. When not using the intelligent tester:



i. Remove the 2 nuts and V-bank cover.

ii. Connect the tester probe of a timing light to the wire of the ignition coil connector for the No. 1 cylinder.

NOTICE:

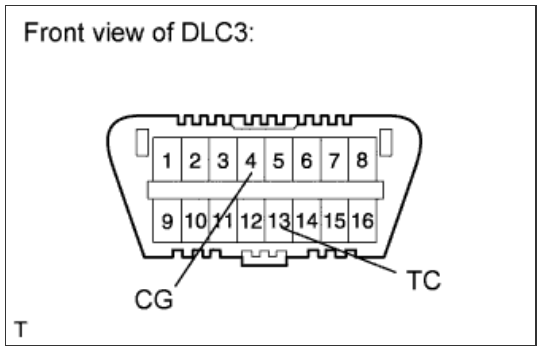
Use a timing light that detects primary signals.

iii. Using SST, connect terminals 13 (TC) and 4 (CG) of the DLC3.

SST
09843-18040

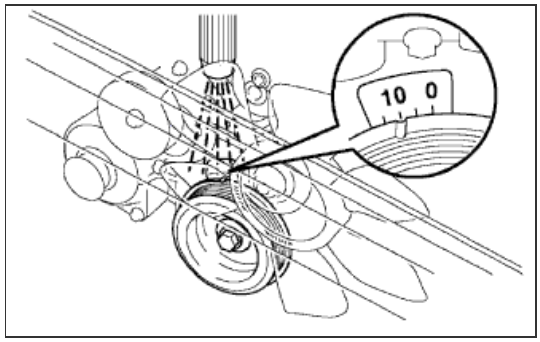
NOTICE:

- **Confirm the terminal numbers before connecting them. Connecting the wrong terminals can damage the engine.**
- **Switch off all accessories and the A/C.**



iv. Using the timing light, check the ignition timing.

Ignition timing:
5 to 15° BTDC @ idling (transmission in neutral and A/C switch off)



v. Remove SST from the DLC3.

vi. Disconnect the timing light from the engine.

vii. Install the V-bank cover with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

28. INSPECT ENGINE IDLE SPEED

a. Warm up and stop the engine.

i. Allow the engine to warm up to a normal operating temperature.

b. When using the intelligent tester:

i. Connect the intelligent tester to the DLC3.

NOTICE:

Switch off all accessories and the A/C before connecting the intelligent tester.

ii. Race the engine at 2500 rpm for approximately 90 seconds.

iii. Push the intelligent tester main switch ON.

iv. Enter the following menus: Powertrain / Engine and ECT / Data List / Primary / Engine Speed.

Standard idle speed:
650 to 750 rpm (transmission in neutral and A/C switch off)

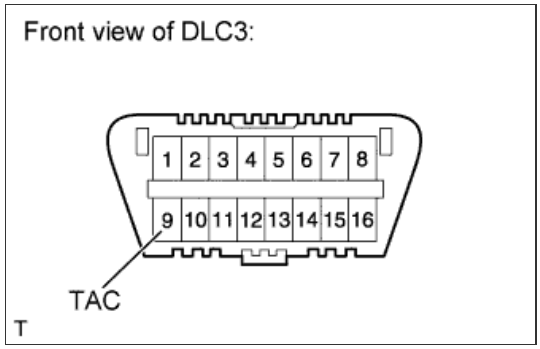
HINT:

Refer to the intelligent tester operator's manual for further details.

If the idle speed is not as specified, check the air intake system.

v. Disconnect the intelligent tester from the DLC3.

c. When not using the intelligent tester:



i. Using SST, connect a tachometer probe to terminal 9 (TAC) of the DLC3.

SST
09843-18030

NOTICE:

- **Confirm the terminal number before connecting the probe. Connecting the probe to the wrong terminal can damage the engine.**
- **Switch off all accessories and the A/C.**

ii. Race the engine at 2500 rpm for approximately 90 seconds.

iii. Check the idle speed.

Standard idle speed:
650 to 750 rpm (transmission in neutral and A/C switch off)

If the idle speed is not as specified, check the air intake system.

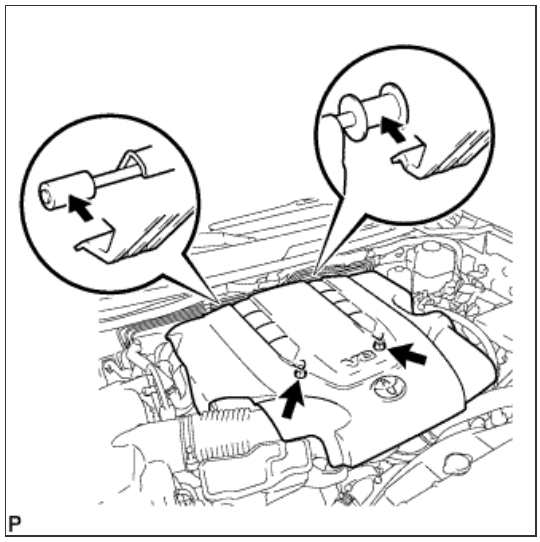
iv. Disconnect the tachometer from the DLC3.

29. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket.

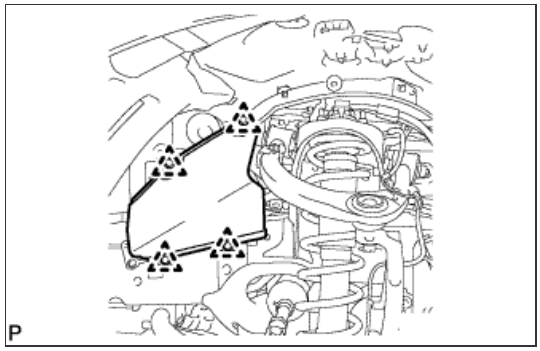
b. Install the V-bank cover with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



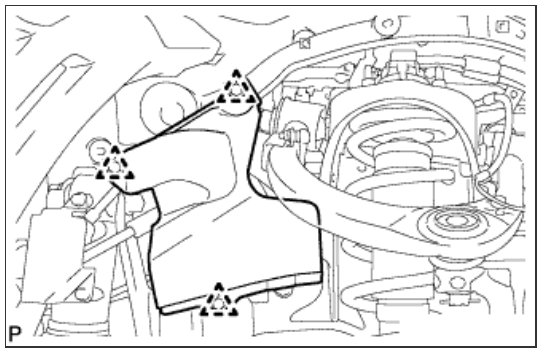
30. INSTALL FRONT FENDER APRON SEAL LH

a. Install the fender apron seal with the 4 clips.



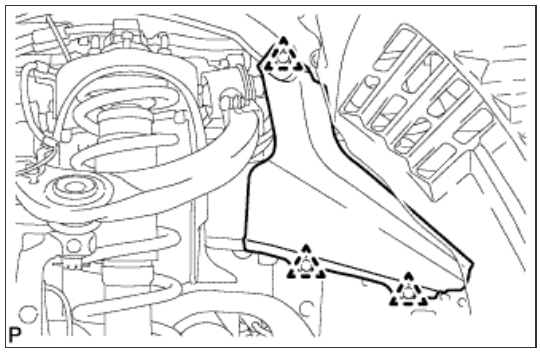
31. INSTALL FRONT FENDER APRON SEAL LH (w/ KDSS)

a. Install the fender apron seal with the 3 clips.



32. INSTALL FRONT FENDER APRON SEAL FRONT RH

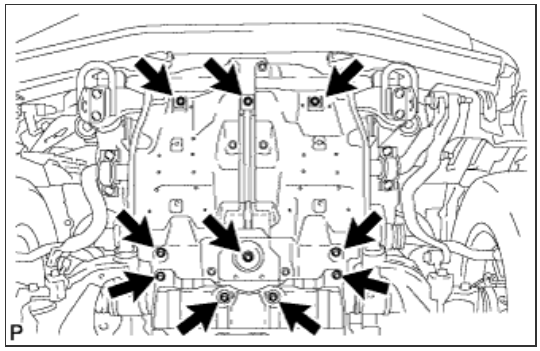
a. Install the fender apron seal with the 3 clips.



33. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the No. 1 engine under cover with the 10 bolts.

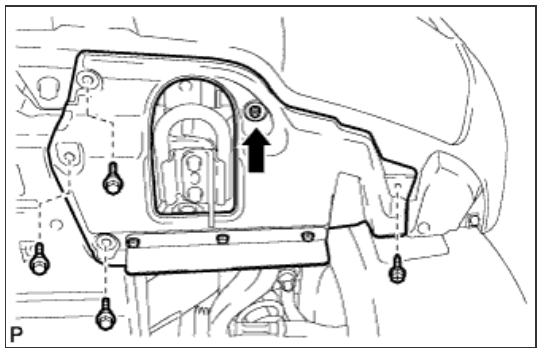
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



34. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



35. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

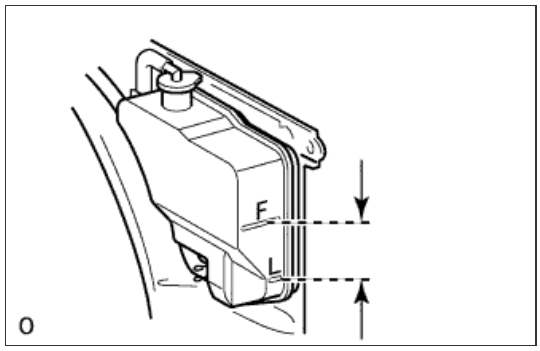
36. INSPECT ENGINE COOLANT LEVEL

a. Check that the engine coolant level is between the L and F lines when the engine is cold.
If the engine coolant is low, check for leaks and add "TOYOTA Super Long Life Coolant" or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite and non-borate coolant with long-life hybrid organic acid technology to the F line.

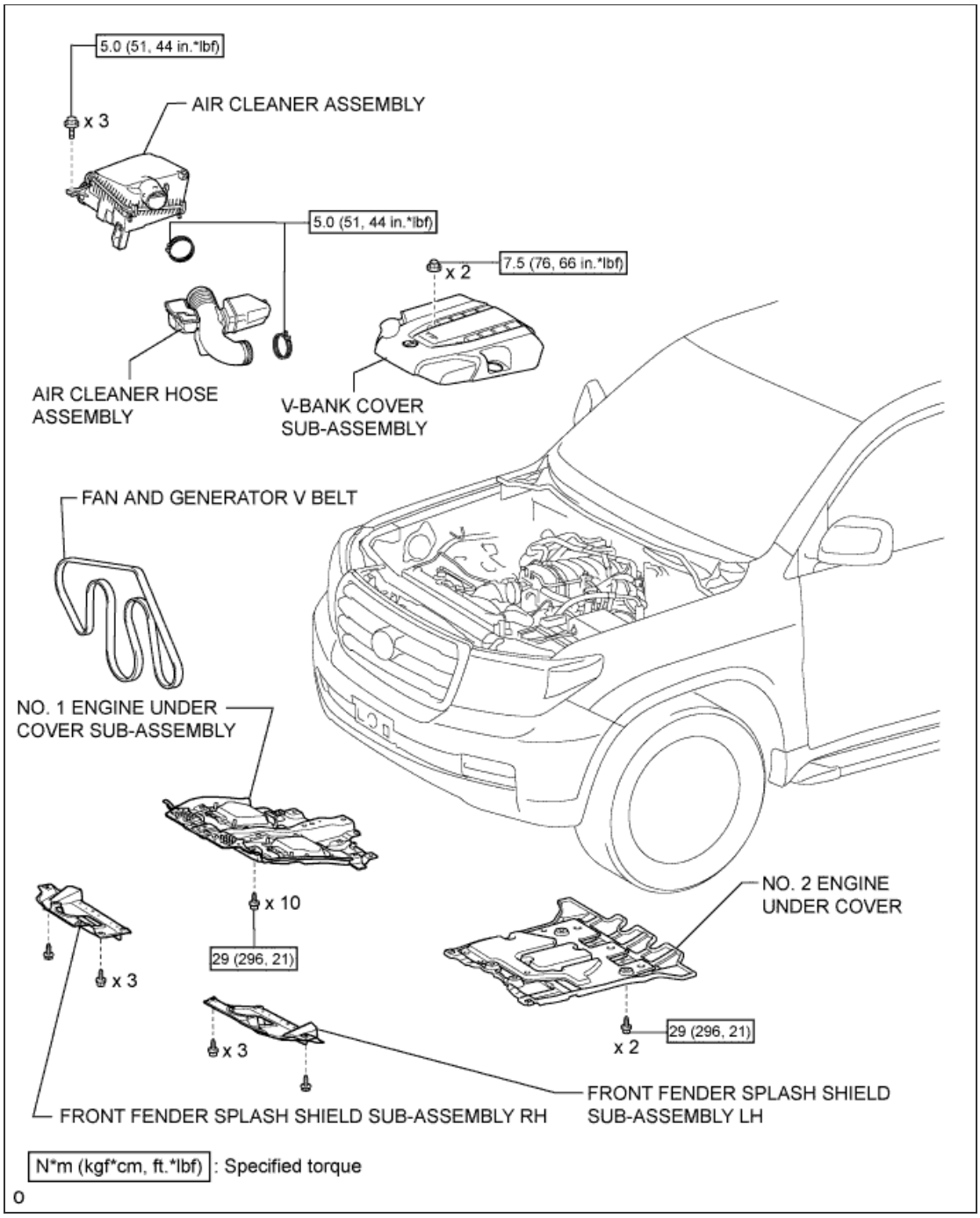
NOTICE:

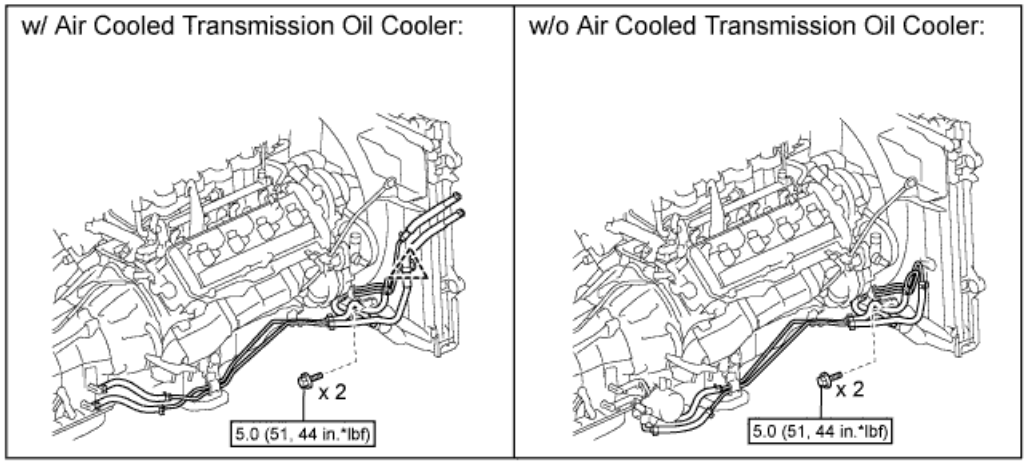
Do not substitute plain water for engine coolant.

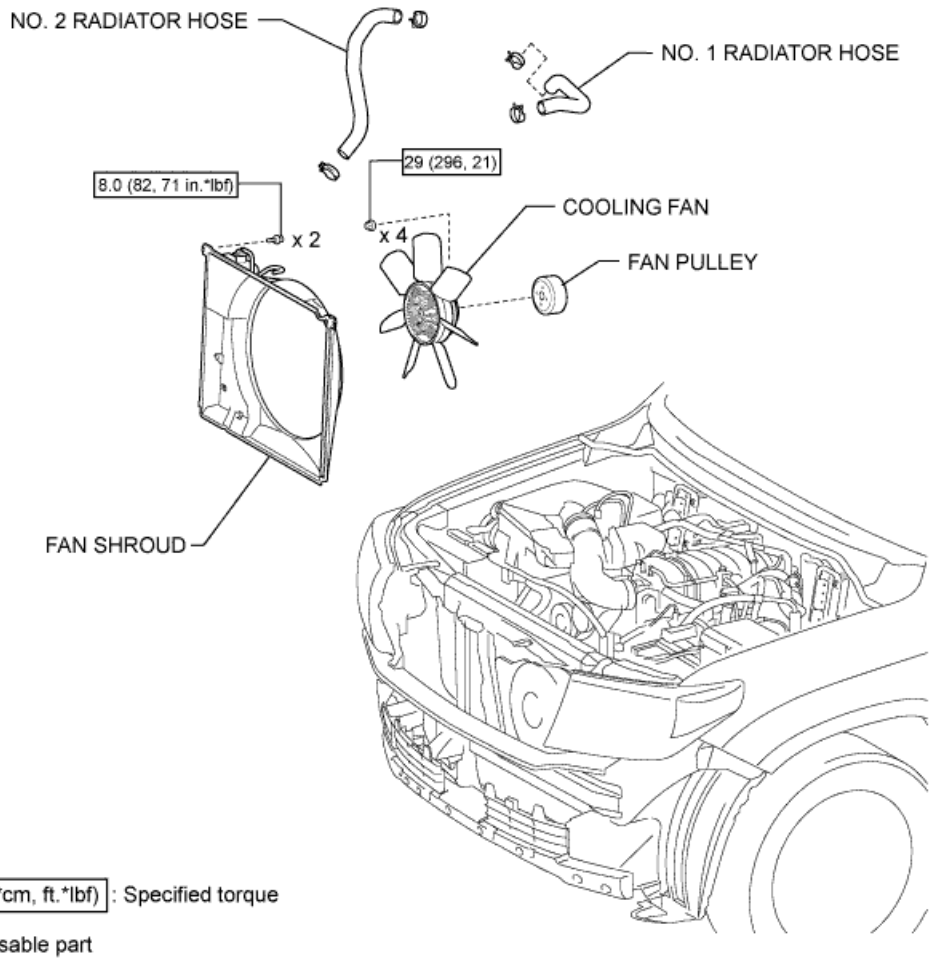
b. Remove the radiator cap, and check that the coolant level is up to the radiator filler hole.



for Preparation [Click here]



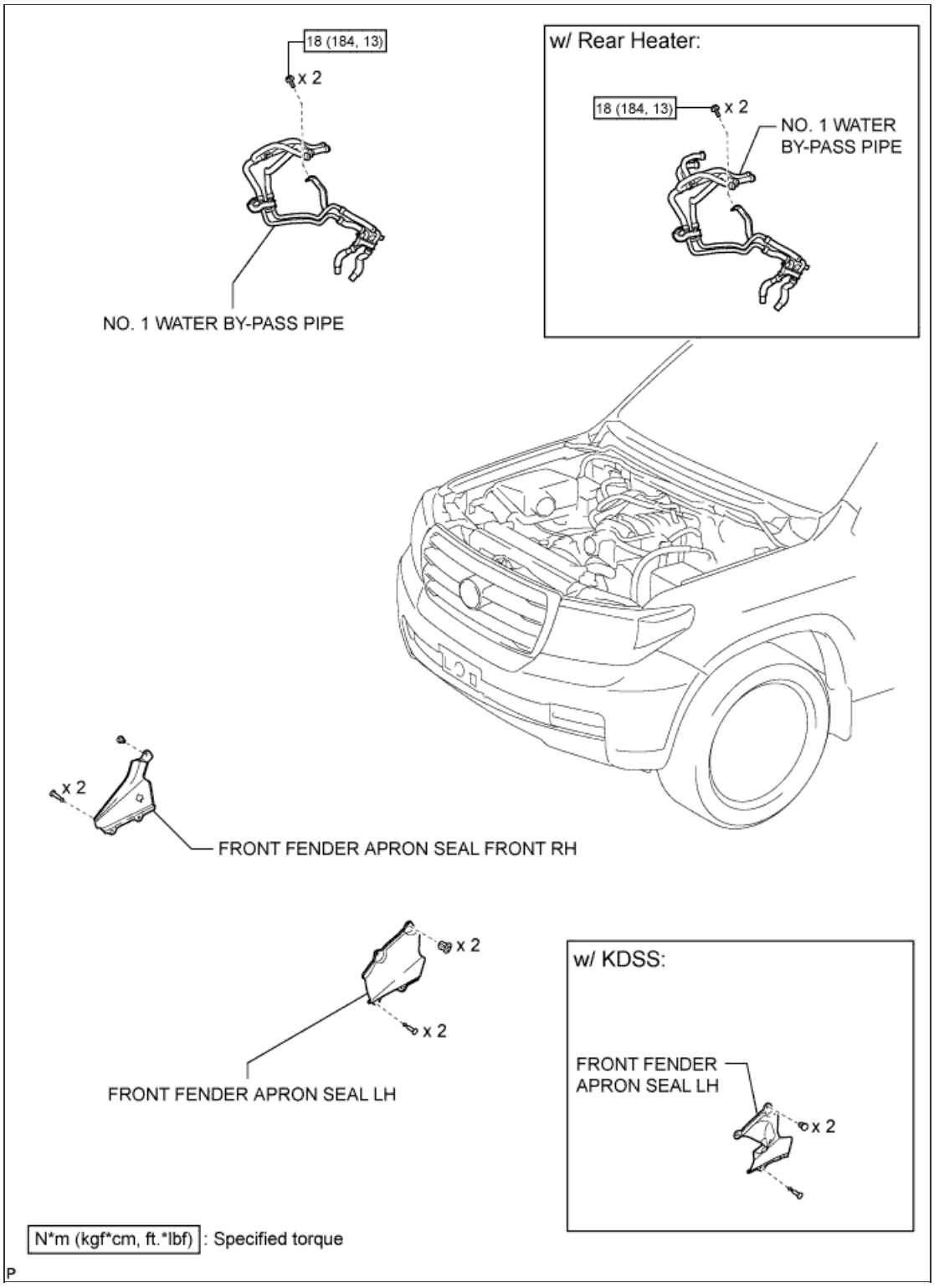


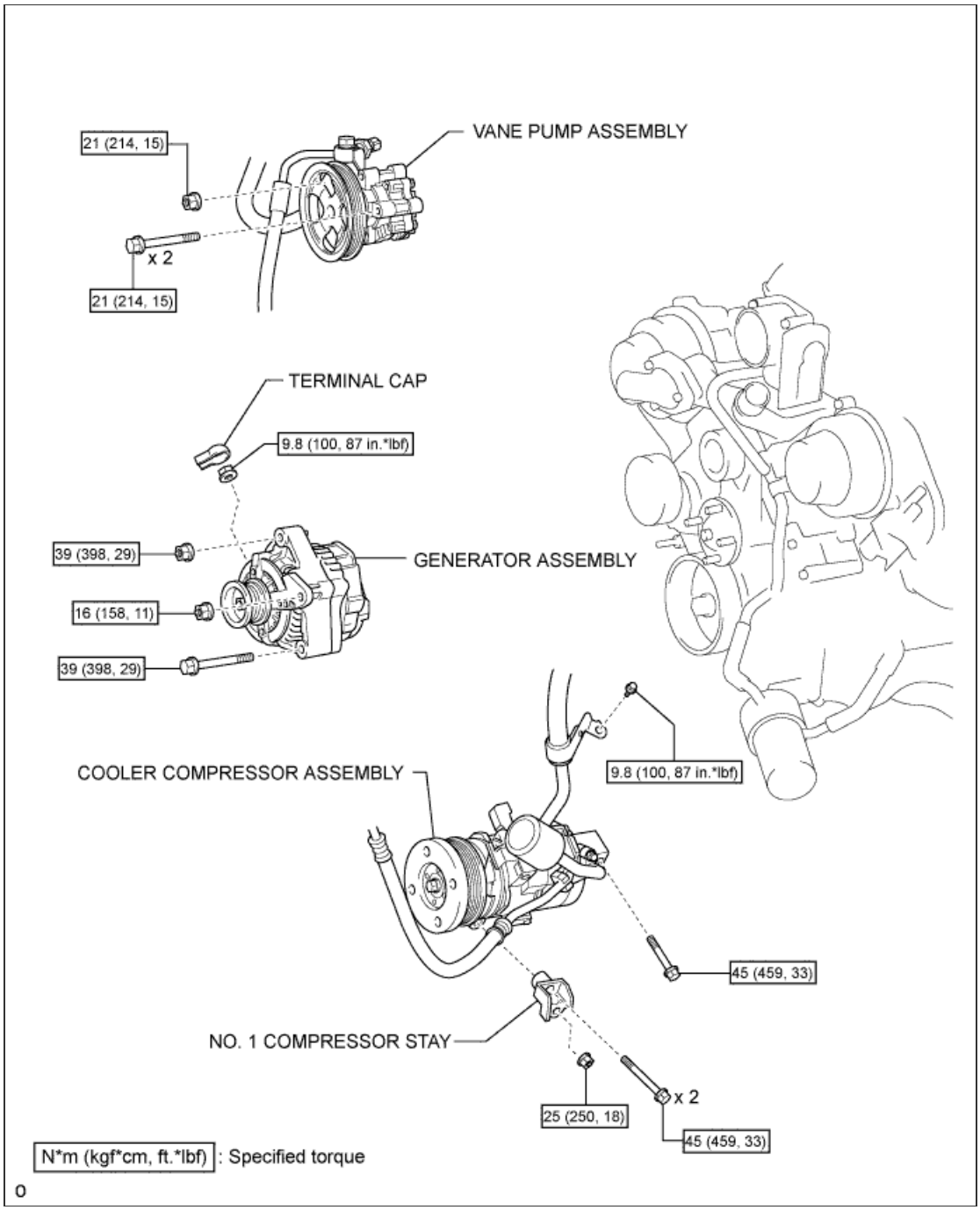


N*m (kgf*cm, ft.*lbf) : Specified torque

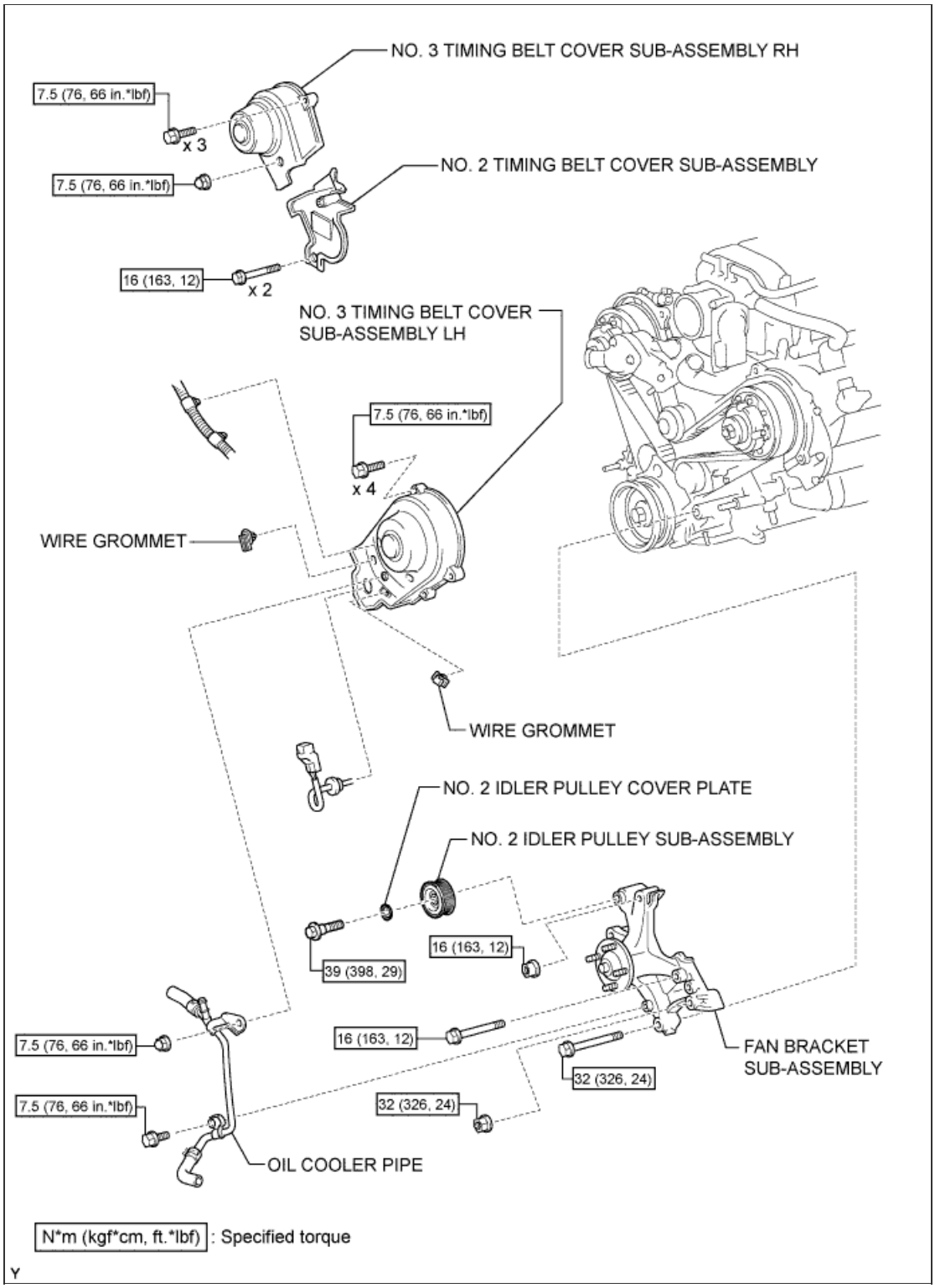
● Non-reusable part

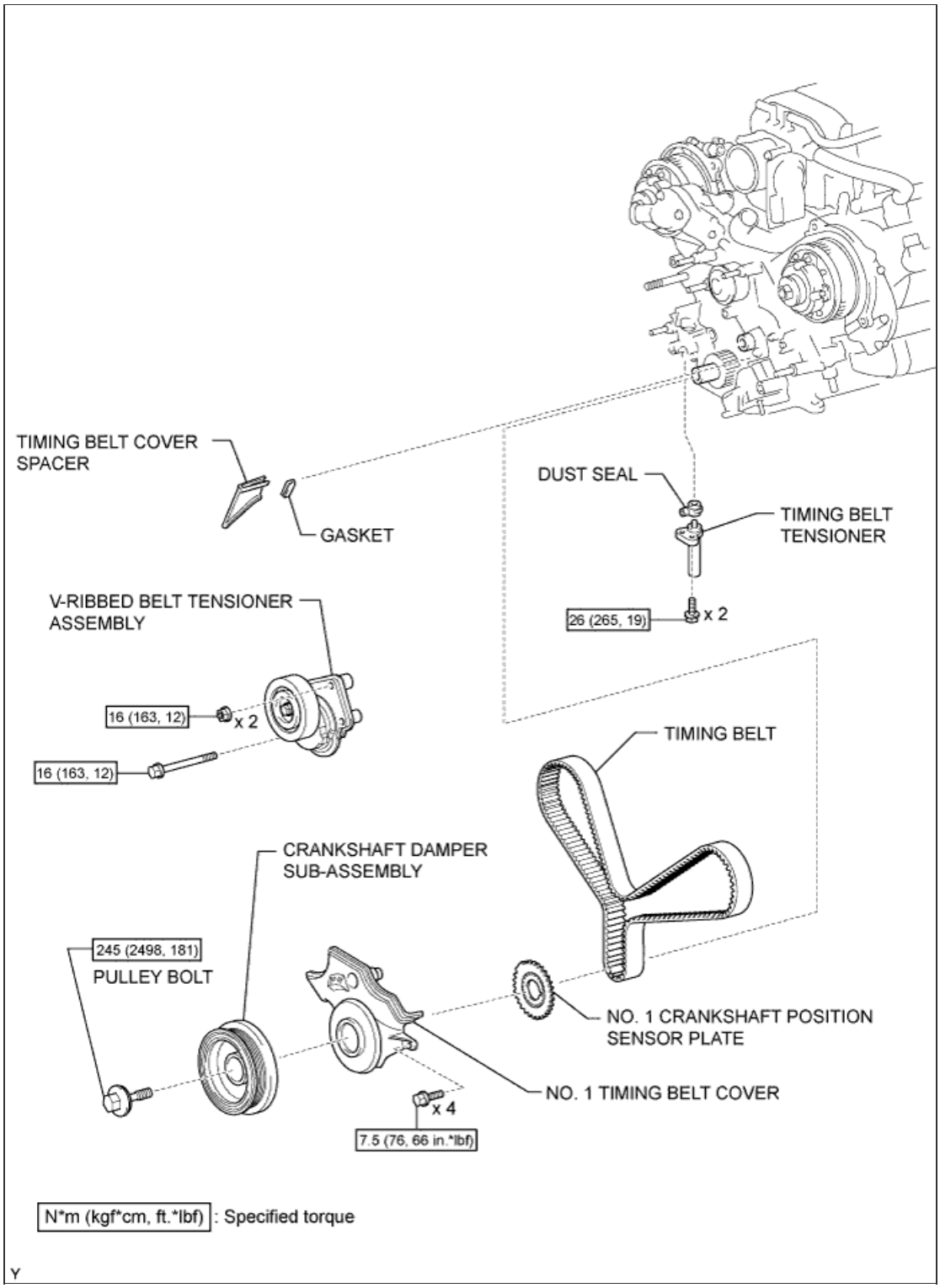
o


18 (184, 13)
x 2
NO. 1 WATER BY-PASS PIPE
w/ Rear Heater:
18 (184, 13)
x 2
NO. 1 WATER BY-PASS PIPE
x 2
FRONT FENDER APRON SEAL FRONT RH
x 2
x 2
FRONT FENDER APRON SEAL LH
w/ KDSS:
FRONT FENDER APRON SEAL LH
x 2
N*m (kgf*cm, ft.*lbf) : Specified torque
P

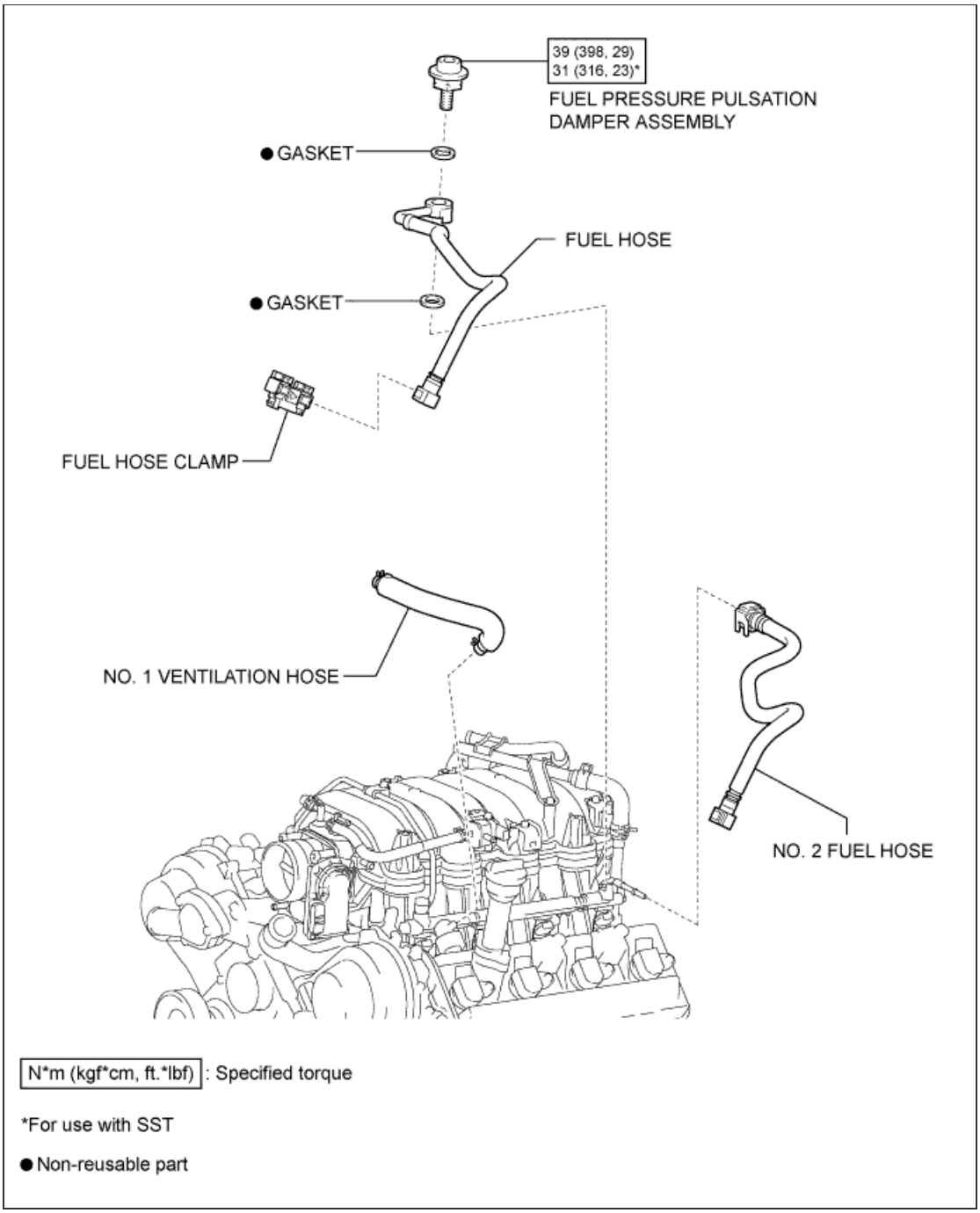

21 (214, 15)
VANE PUMP ASSEMBLY
x 2
21 (214, 15)
TERMINAL CAP
9.8 (100, 87 in.*lbf)
39 (398, 29)
GENERATOR ASSEMBLY
16 (158, 11)
39 (398, 29)
9.8 (100, 87 in.*lbf)
COOLER COMPRESSOR ASSEMBLY
45 (459, 33)
NO. 1 COMPRESSOR STAY
x 2
25 (250, 18)
45 (459, 33)
N*m (kgf*cm, ft.*lbf) : Specified torque

o


NO. 3 TIMING BELT COVER SUB-ASSEMBLY RH
7.5 (76, 66 in.*lbf)
x 3
NO. 2 TIMING BELT COVER SUB-ASSEMBLY
7.5 (76, 66 in.*lbf)
16 (163, 12)
x 2
NO. 3 TIMING BELT COVER SUB-ASSEMBLY LH
7.5 (76, 66 in.*lbf)
x 4
WIRE GROMMET
WIRE GROMMET
NO. 2 IDLER PULLEY COVER PLATE
NO. 2 IDLER PULLEY SUB-ASSEMBLY
39 (398, 29)
16 (163, 12)
7.5 (76, 66 in.*lbf)
16 (163, 12)
32 (326, 24)
FAN BRACKET SUB-ASSEMBLY
7.5 (76, 66 in.*lbf)
32 (326, 24)
OIL COOLER PIPE
N*m (kgf*cm, ft.*lbf) : Specified torque
Y


TIMING BELT COVER SPACER
GASKET
DUST SEAL
TIMING BELT TENSIONER
26 (265, 19)
x 2
V-RIBBED BELT TENSIONER ASSEMBLY
16 (163, 12)
x 2
16 (163, 12)
TIMING BELT
CRANKSHAFT DAMPER SUB-ASSEMBLY
245 (2498, 181)
PULLEY BOLT
NO. 1 CRANKSHAFT POSITION SENSOR PLATE
NO. 1 TIMING BELT COVER
x 4
7.5 (76, 66 in.*lbf)
N*m (kgf*cm, ft.*lbf) : Specified torque

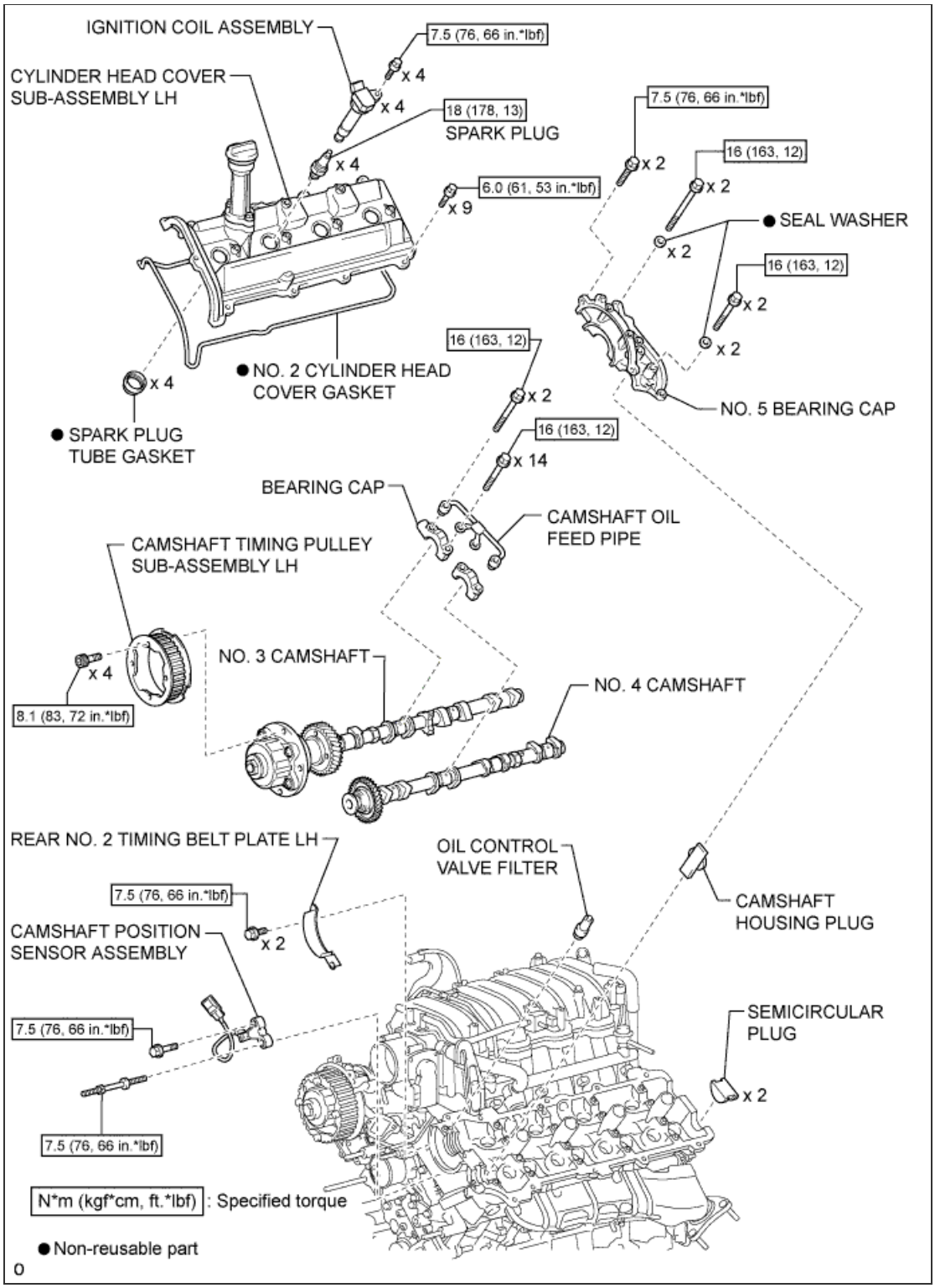
Y

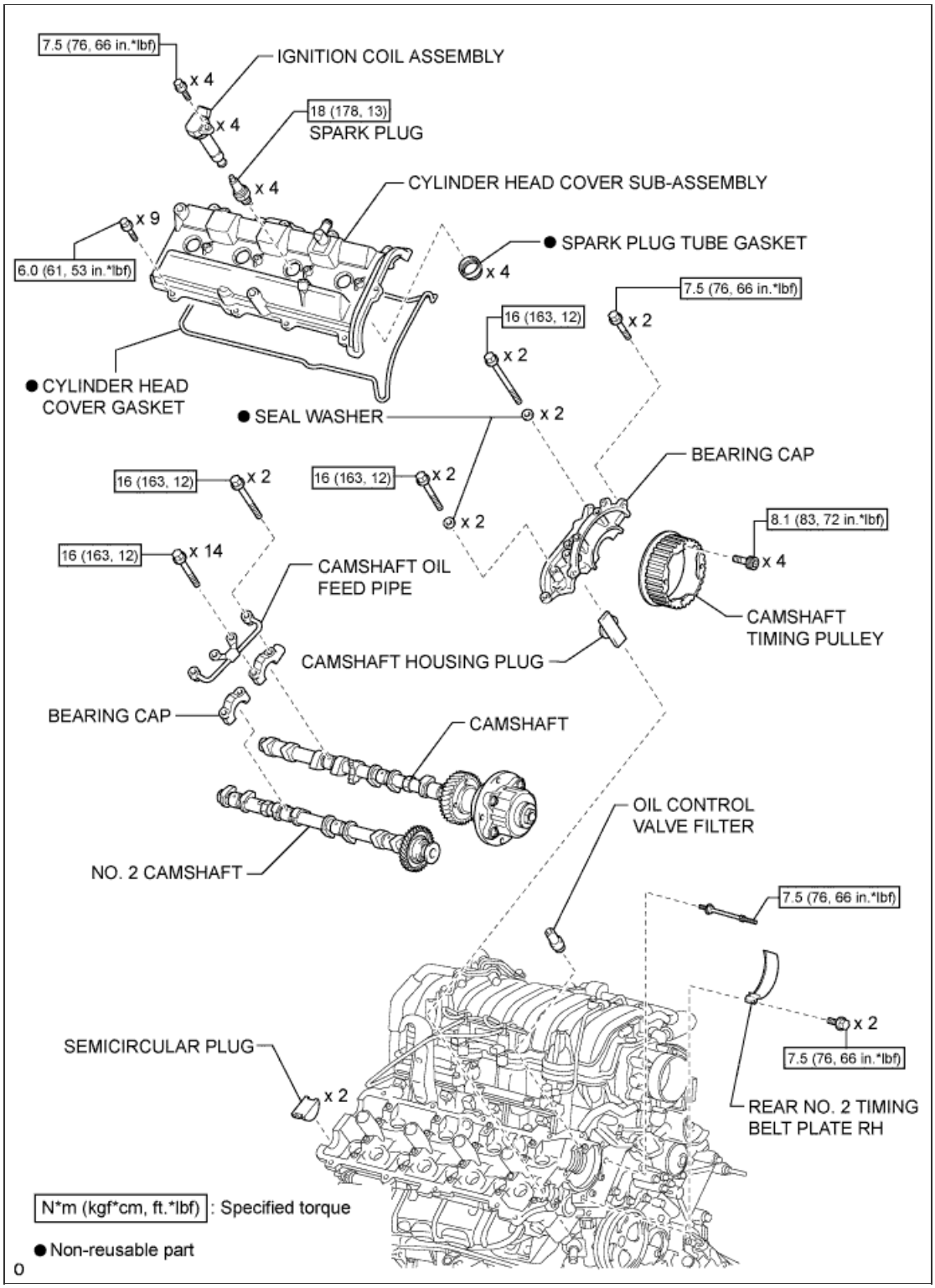


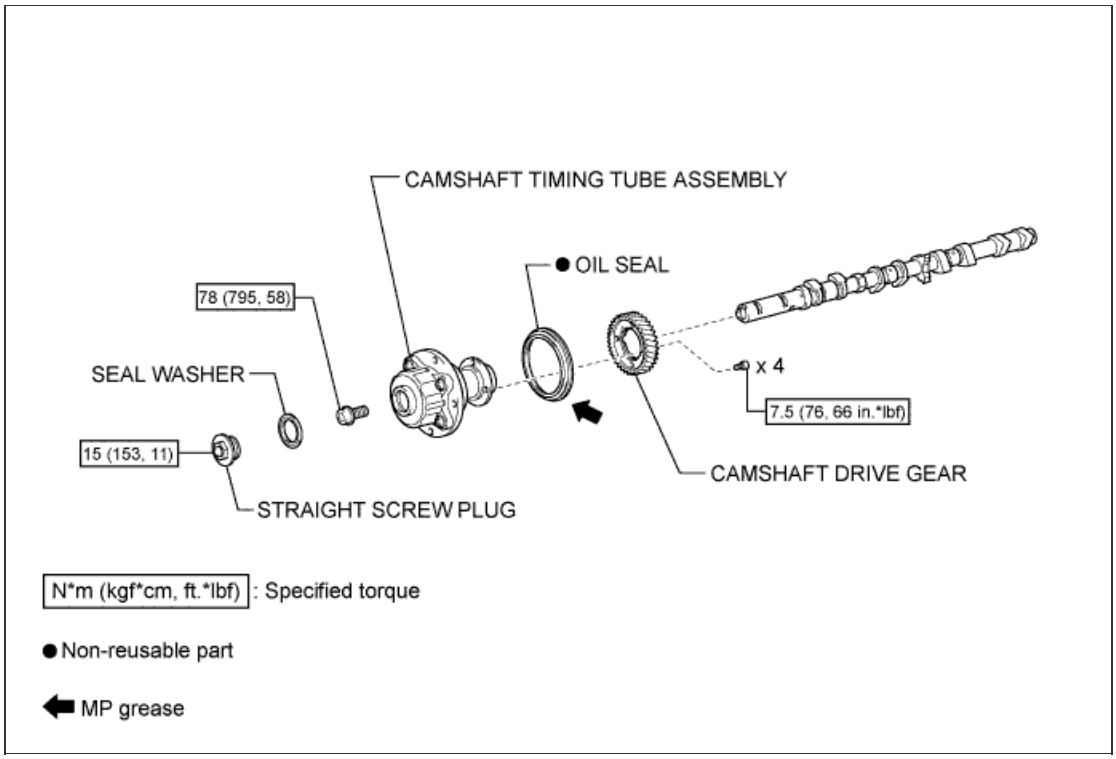
N*m (kgf*cm, ft.*lbf) : Specified torque

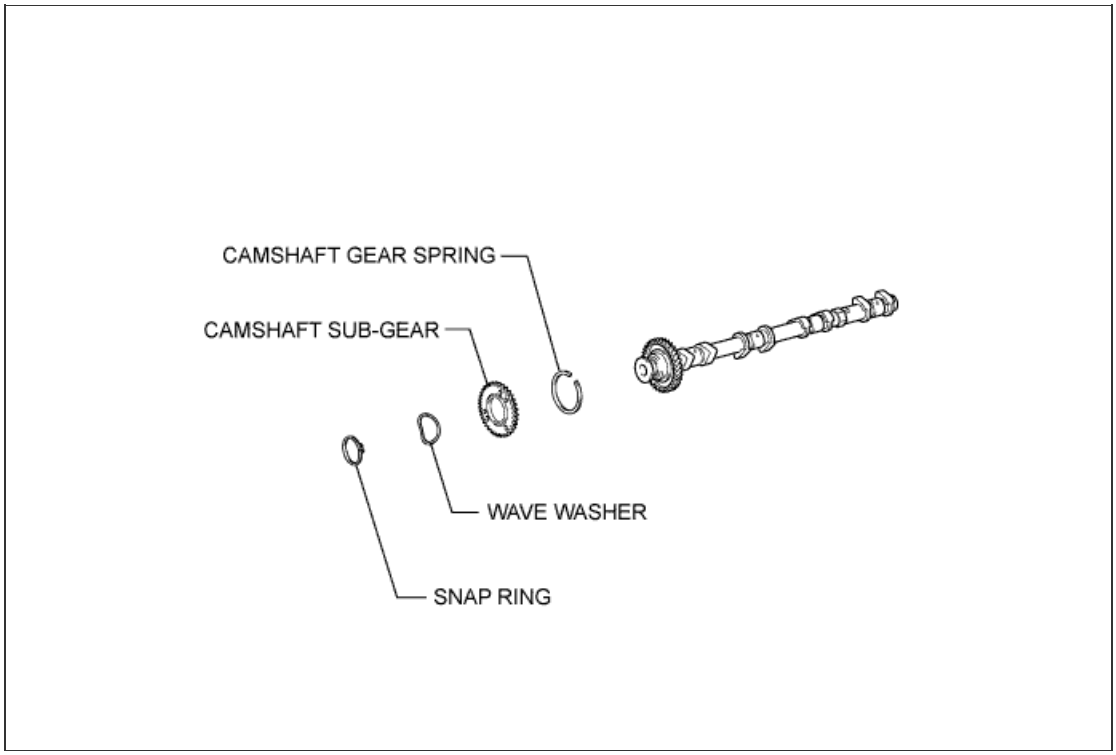
*For use with SST

● Non-reusable part


IGNITION COIL ASSEMBLY
7.5 (76, 66 in.*lbf)
x 4
CYLINDER HEAD COVER SUB-ASSEMBLY LH
x 4
18 (178, 13)
SPARK PLUG
x 4
7.5 (76, 66 in.*lbf)
x 2
16 (163, 12)
x 2
6.0 (61, 53 in.*lbf)
x 9
SEAL WASHER
x 2
16 (163, 12)
x 2
x 2
x 4
NO. 2 CYLINDER HEAD COVER GASKET
16 (163, 12)
x 2
NO. 5 BEARING CAP
SPARK PLUG TUBE GASKET
16 (163, 12)
x 14
BEARING CAP
CAMSHAFT OIL FEED PIPE
CAMSHAFT TIMING PULLEY SUB-ASSEMBLY LH
x 4
NO. 3 CAMSHAFT
NO. 4 CAMSHAFT
8.1 (83, 72 in.*lbf)
REAR NO. 2 TIMING BELT PLATE LH
OIL CONTROL VALVE FILTER
7.5 (76, 66 in.*lbf)
x 2
CAMSHAFT HOUSING PLUG
CAMSHAFT POSITION SENSOR ASSEMBLY
SEMICIRCULAR PLUG
7.5 (76, 66 in.*lbf)
x 2
7.5 (76, 66 in.*lbf)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part


7.5 (76, 66 in.*lbf)
x 4
IGNITION COIL ASSEMBLY
x 4
18 (178, 13)
SPARK PLUG
x 4
CYLINDER HEAD COVER SUB-ASSEMBLY
x 9
6.0 (61, 53 in.*lbf)
● SPARK PLUG TUBE GASKET
x 4
7.5 (76, 66 in.*lbf)
x 2
16 (163, 12)
x 2
● CYLINDER HEAD COVER GASKET
● SEAL WASHER
x 2
BEARING CAP
16 (163, 12)
x 2
16 (163, 12)
x 2
x 2
8.1 (83, 72 in.*lbf)
16 (163, 12)
x 14
x 4
CAMSHAFT OIL FEED PIPE
CAMSHAFT TIMING PULLEY
CAMSHAFT HOUSING PLUG
BEARING CAP
CAMSHAFT
OIL CONTROL VALVE FILTER
NO. 2 CAMSHAFT
7.5 (76, 66 in.*lbf)
x 2
7.5 (76, 66 in.*lbf)
SEMICIRCULAR PLUG
x 2
REAR NO. 2 TIMING BELT PLATE RH
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part


CAMSHAFT TIMING TUBE ASSEMBLY
● OIL SEAL
78 (795, 58)
SEAL WASHER
x 4
7.5 (76, 66 in.*lbf)
15 (153, 11)
CAMSHAFT DRIVE GEAR
STRAIGHT SCREW PLUG
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
MP grease


CAMSHAFT GEAR SPRING
CAMSHAFT SUB-GEAR
WAVE WASHER
SNAP RING

for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

a. Discharge the fuel system pressure (Click here).

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

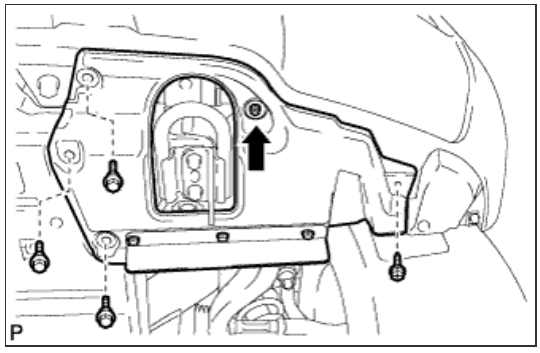
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



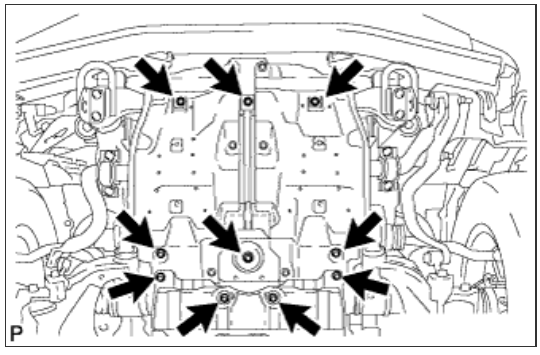
4. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

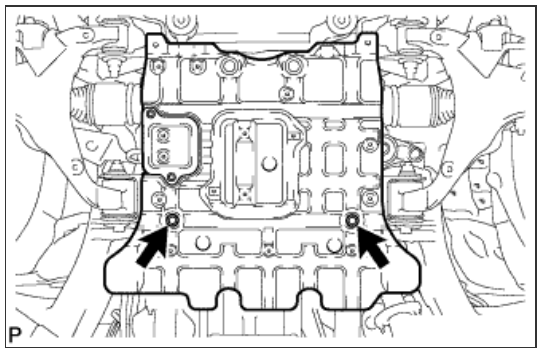
5. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and No. 1 engine under cover.



6. REMOVE NO. 2 ENGINE UNDER COVER

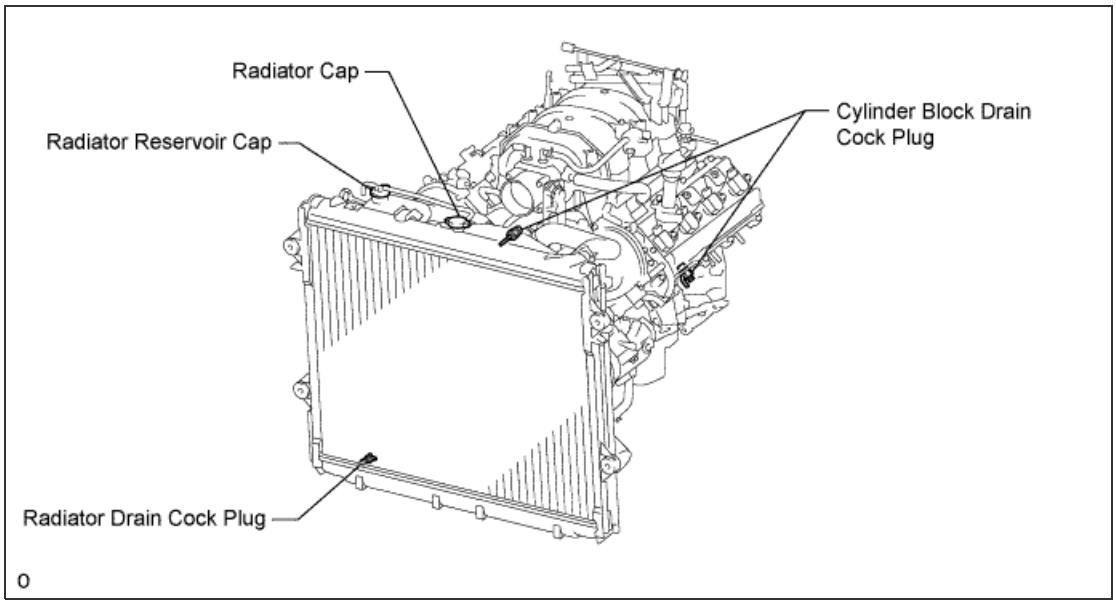
a. Remove the 2 bolts and No. 2 engine under cover.



7. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.



a. Loosen the radiator drain cock plug.

b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

d. Tighten the 2 cylinder block drain cock plugs.

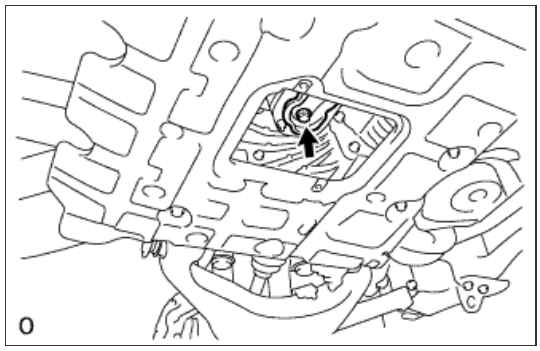
Torque:
13 N*m{ 130 kgf*cm , 9 ft.*lbf }

e. Tighten the radiator drain cock plug by hand.

8. DRAIN ENGINE OIL

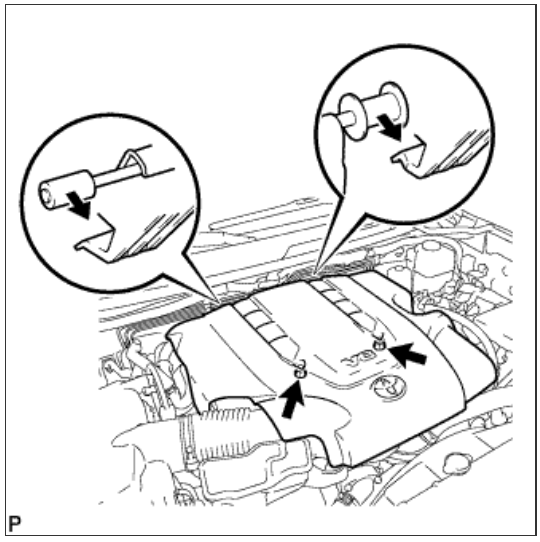
a. Remove the oil drain plug and gasket, and drain the engine oil into a container.

b. Remove the oil drain plug and gasket, and drain the engine oil into a container.



9. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Remove the 2 nuts and V-bank cover.

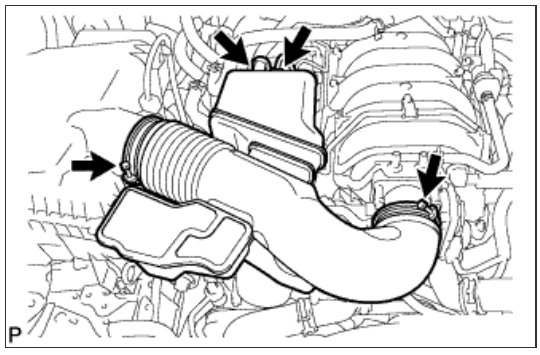


10. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum transmitting hose and No. 2 ventilation hose.

b. Loosen the 2 hose clamps.

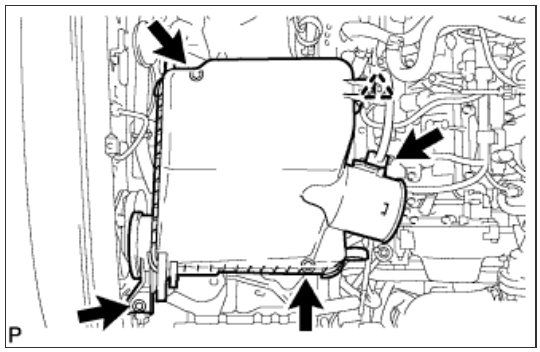
c. Remove the air cleaner hose.



11. REMOVE AIR CLEANER ASSEMBLY

a. Disconnect the clamp and connector.

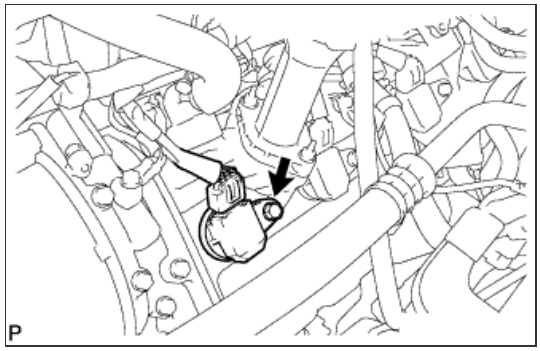
b. Remove the 3 bolts and air cleaner.



12. REMOVE IGNITION COIL ASSEMBLY

a. Disconnect the 8 ignition coil connectors.

b. Remove the 8 bolts and pull out the 8 ignition coils.

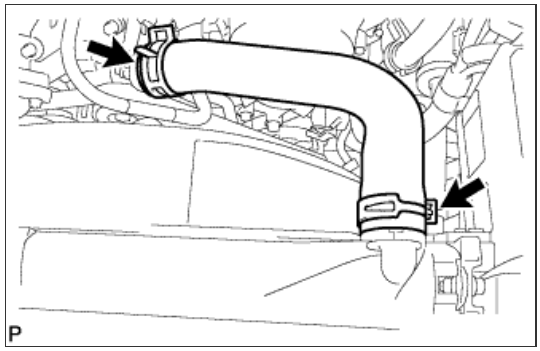


13. REMOVE SPARK PLUG

a. Remove the 8 spark plugs.

14. REMOVE NO. 1 RADIATOR HOSE

a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to remove the radiator hose.

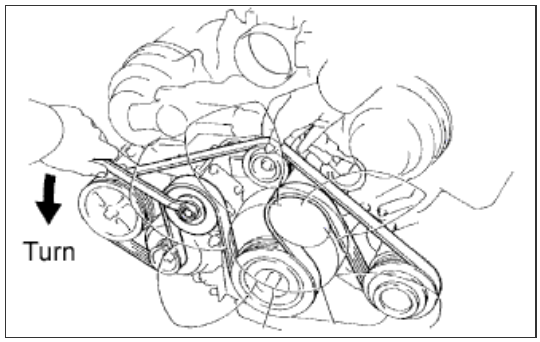


15. REMOVE FAN & GENERATOR V BELT

a. Loosen the belt tension by turning the belt tensioner counterclockwise, and then remove the fan and generator V belt.

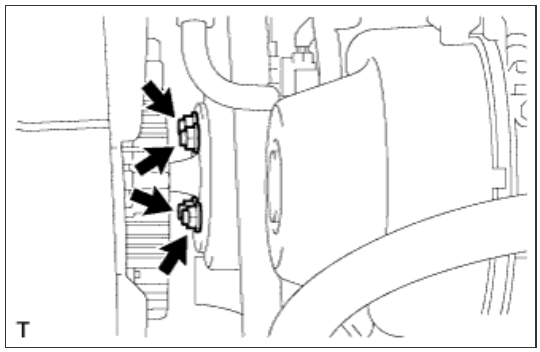
HINT:

The pulley bolt for the belt tensioner has left-hand thread.



16. REMOVE FAN SHROUD

a. Loosen the 4 nuts holding the cooling fan.



b. Disconnect the reservoir hose from the upper side of the radiator tank.

c. w/ Air Cooled Transmission Oil Cooler:
Detach the claw to open the flexible hose clamp.

d. Remove the 2 bolts and disconnect the oil cooler tube from the fan shroud.

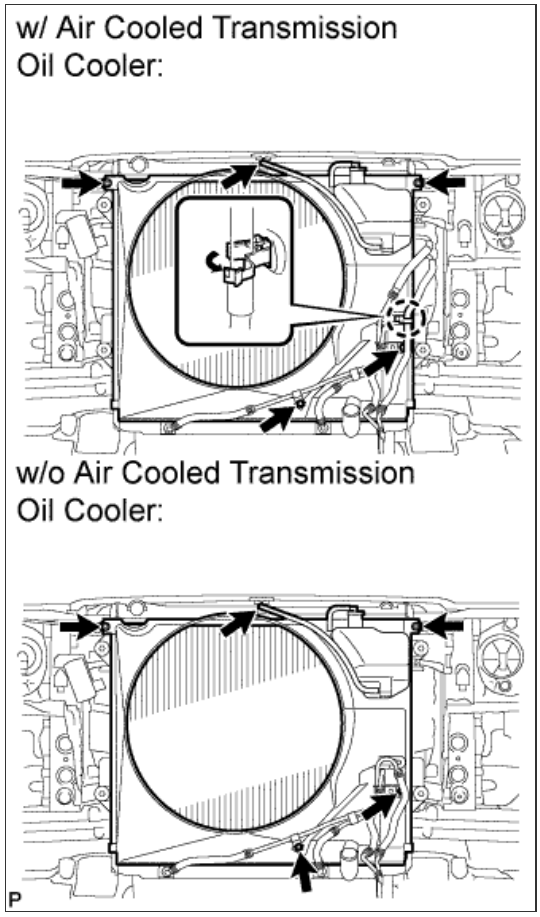
e. Remove the 2 bolts holding the fan shroud.

f. Remove the 4 nuts of the cooling fan, and then remove the shroud together with the cooling fan.

NOTICE:

Be careful not to damage the radiator core.

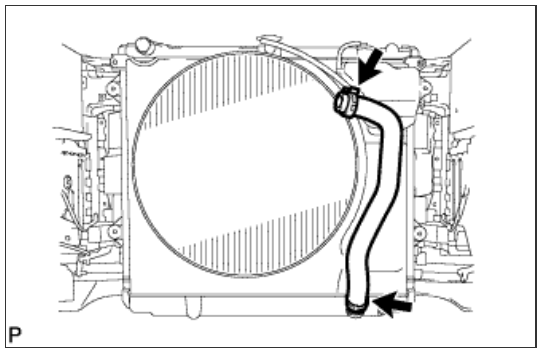
g. Remove the fan pulley from the water pump.



17. REMOVE NO. 2 RADIATOR HOSE

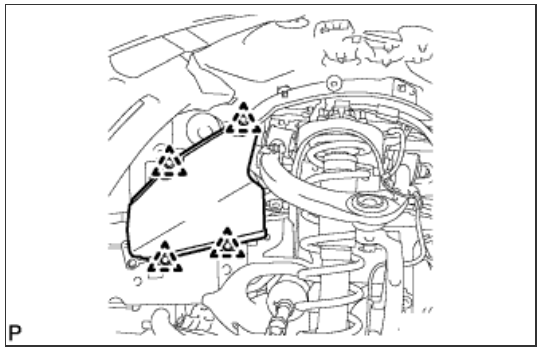
a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to

remove the radiator hose.



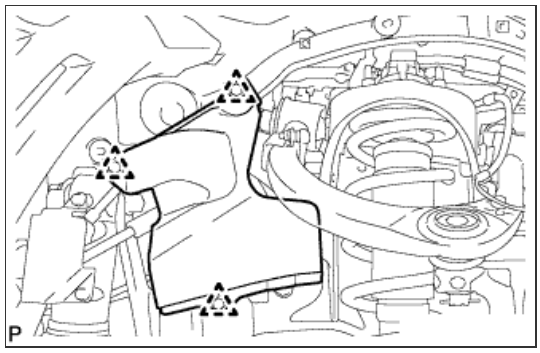
18. REMOVE FRONT FENDER APRON SEAL LH

a. Using a clip remover, remove the 4 clips and fender apron seal.



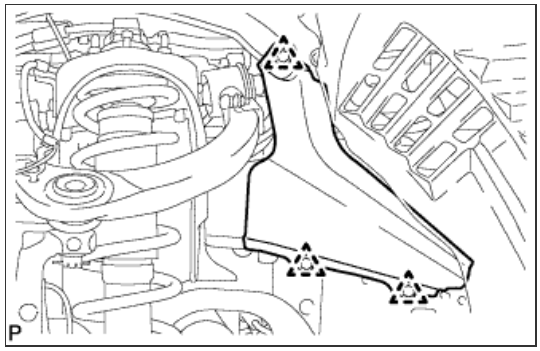
19. REMOVE FRONT FENDER APRON SEAL LH (w/ KDSS)

a. Using a clip remover, remove the 3 clips and fender apron seal.



20. REMOVE FRONT FENDER APRON SEAL FRONT RH

a. Using a clip remover, remove the 3 clips and fender apron seal.

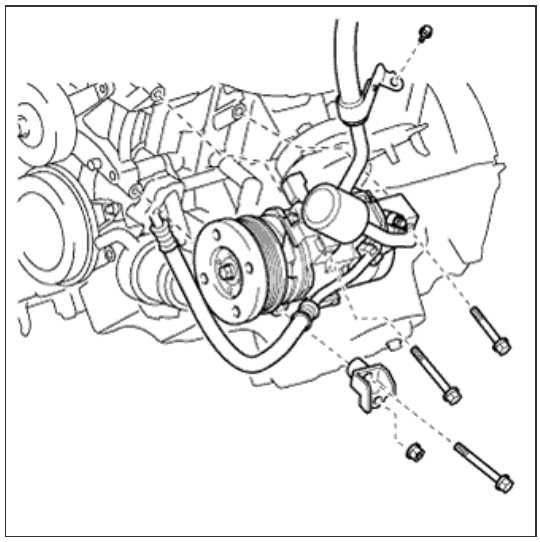


21. DISCONNECT COOLER COMPRESSOR ASSEMBLY

a. Disconnect the connector.

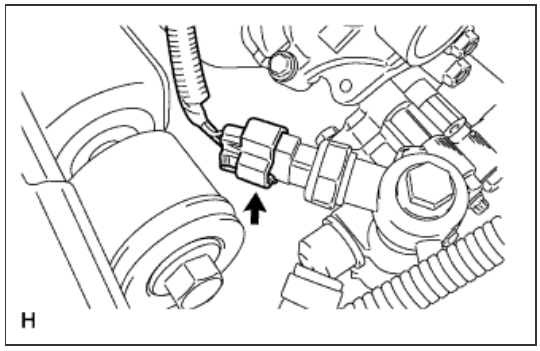
b. Remove the bolt. Then disconnect the cooler refrigerant suction hose from the cylinder head cover.

c. Remove the 3 bolts, nut and No. 1 compressor stay and disconnect the cooler compressor.

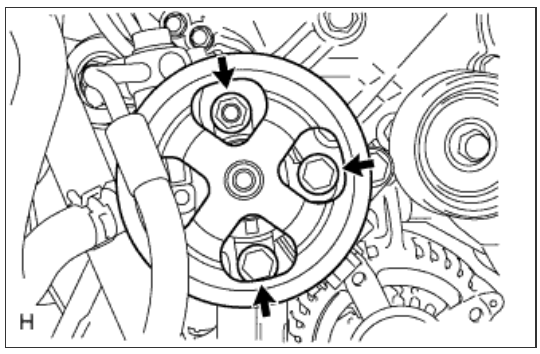


22. DISCONNECT VANE PUMP ASSEMBLY

a. Disconnect the connector.



b. Remove the 2 bolts and nut. Then disconnect the vane pump.

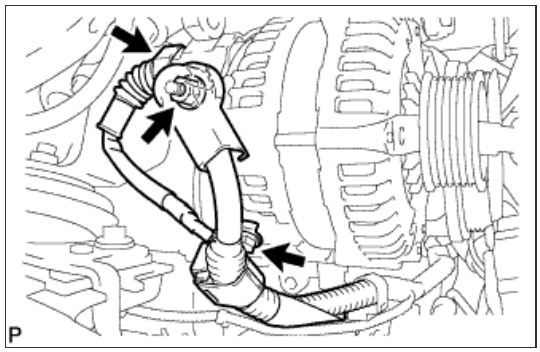


23. REMOVE GENERATOR ASSEMBLY

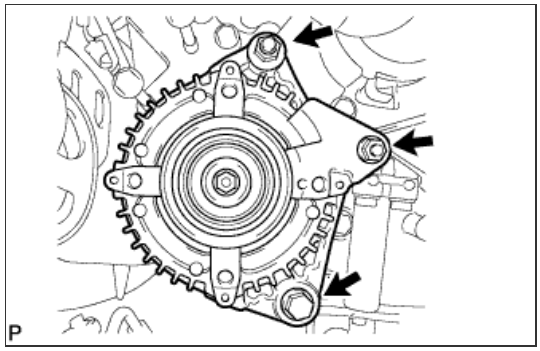
a. Disconnect the generator connector.

b. Remove the terminal cap and nut, and disconnect the generator wire.

c. Remove the bolt and disconnect the wire harness bracket from the generator.



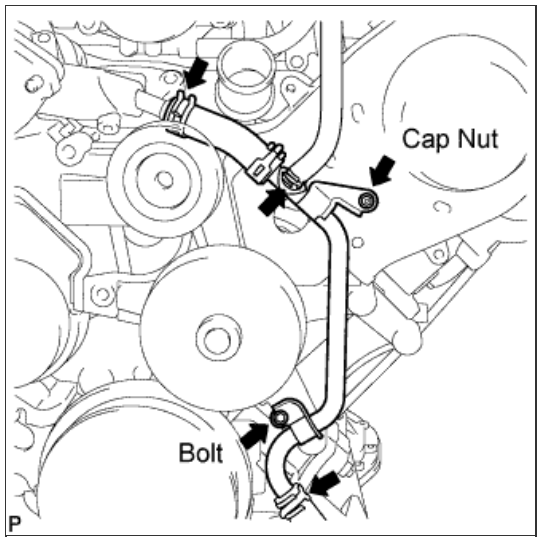
d. Remove the bolt, 2 nuts and generator.



24. REMOVE OIL COOLER PIPE

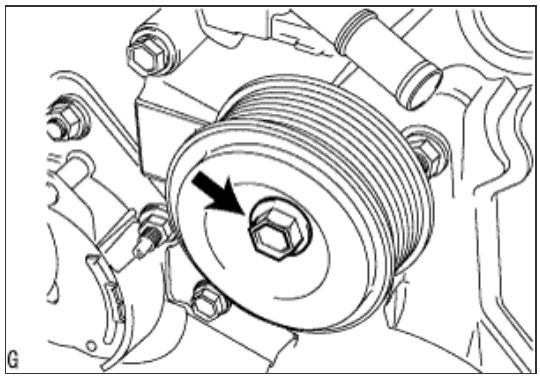
a. Remove the cap nut and bolt.

b. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to disconnect the 3 water by-pass hoses and remove the oil cooler pipe.



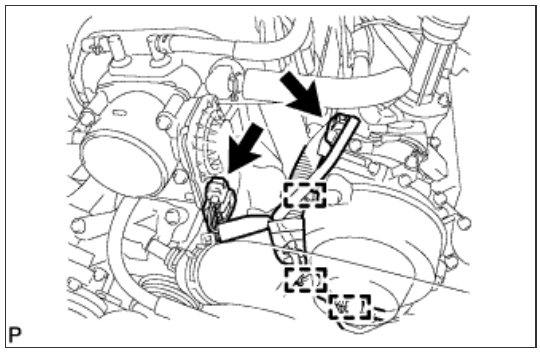
25. REMOVE NO. 2 IDLER PULLEY SUB-ASSEMBLY

a. Remove the pulley bolt, cover plate and idler pulley.



26. REMOVE NO. 3 TIMING BELT COVER SUB-ASSEMBLY LH

a. Detach the 3 wire clamps and disconnect the camshaft timing oil control valve connector and control motor connector.



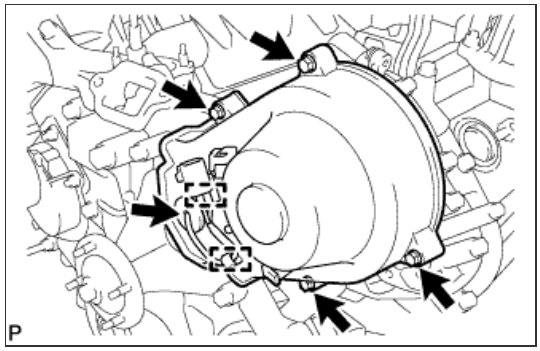
b. Disconnect the camshaft position sensor connector.

c. Disconnect the camshaft position sensor wire from the 2 wire clamps on the timing belt cover.

d. Remove the wire grommet from the timing belt cover.

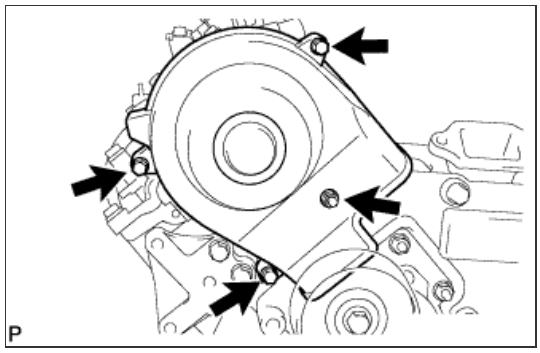
e. Remove the 4 bolts.

f. Pull the cover outward, pull the camshaft position sensor wire out of the cover, and remove the cover.



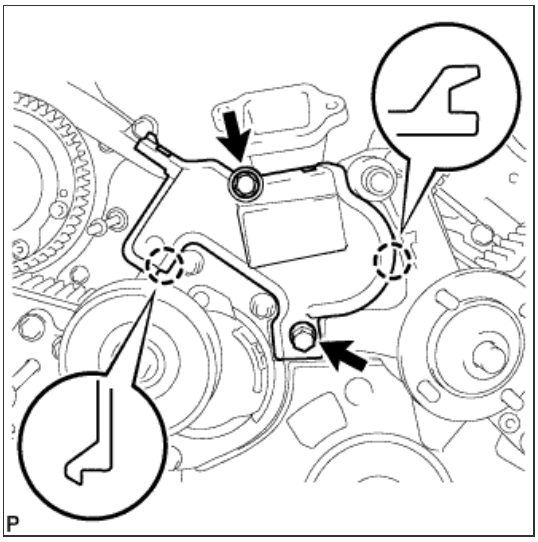
27. REMOVE NO. 3 TIMING BELT COVER SUB-ASSEMBLY RH

a. Remove the 3 bolts, nut and timing belt cover.



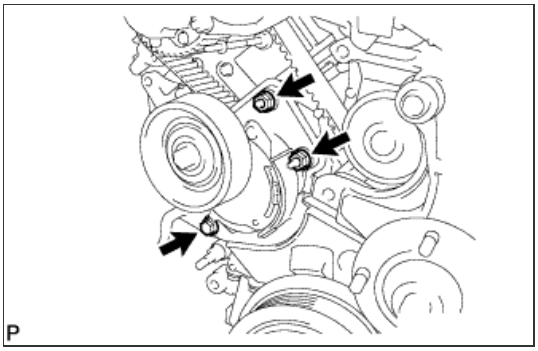
28. REMOVE NO. 2 TIMING BELT COVER SUB-ASSEMBLY

a. Remove the 2 bolts and detach the 2 claws, and then remove the No. 2 timing belt cover.



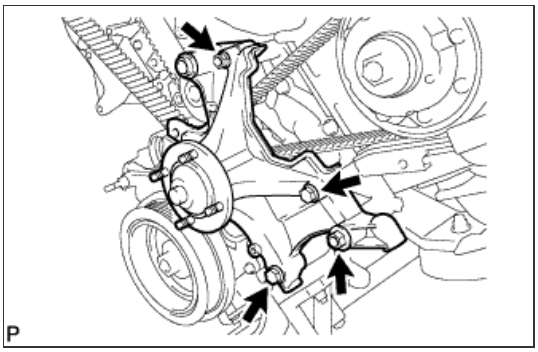
29. REMOVE V-RIBBED BELT TENSIONER ASSEMBLY

a. Remove the bolt, 2 nuts and V-ribbed belt tensioner.



30. REMOVE FAN BRACKET SUB-ASSEMBLY

a. Remove the 2 nuts, 2 bolts and fan bracket.

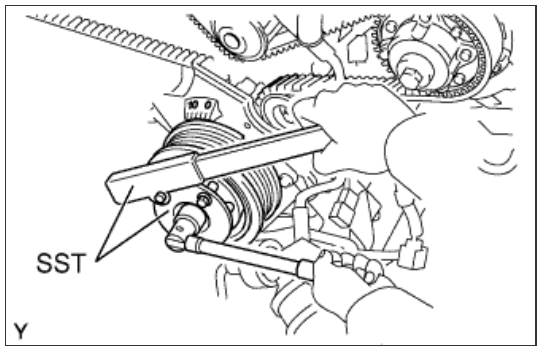


31. REMOVE CRANKSHAFT DAMPER SUB-ASSEMBLY

a. Using SST, hold the crankshaft damper and loosen the pulley bolt. Further loosen the bolt until 2 or 3 threads are screwed into the crankshaft.

SST

09213-70011 (09213-70020)
09330-00021 (09330-00030)



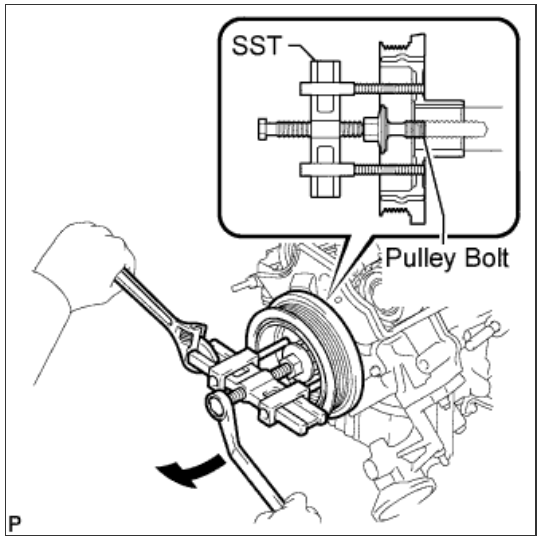
b. Using SST and the pulley bolt, remove the crankshaft damper.

SST

09950-50013 (09951-05010, 09952-05010, 09953-05020, 09954-05031)

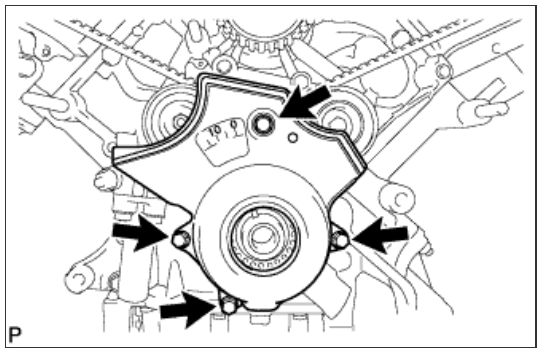
HINT:

Apply a lubricant to the threads and end of SST.



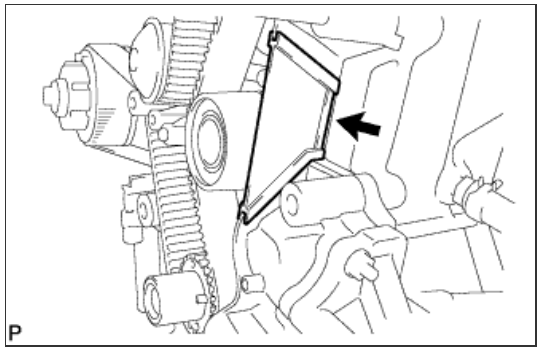
32. REMOVE NO. 1 TIMING BELT COVER

a. Remove the 4 bolts and timing belt cover.



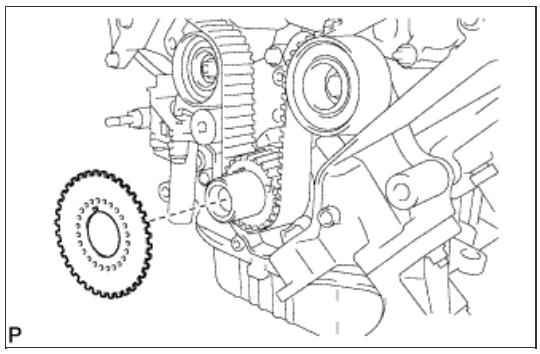
33. REMOVE TIMING BELT COVER SPACER

a. Remove the cover spacer and gasket.



34. REMOVE NO. 1 CRANKSHAFT POSITION SENSOR PLATE

a. Remove the position sensor plate from the crankshaft.



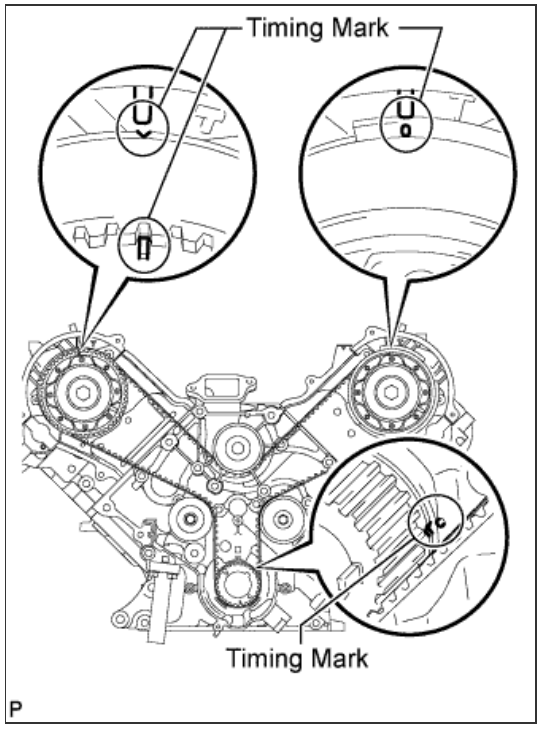
35. SET NO. 1 CYLINDER TO TDC/COMPRESSION

a. Temporarily install the pulley bolt.

b. Rotate the crankshaft clockwise so that the timing marks on the crankshaft timing pulley and camshaft timing pulleys are as shown in the illustration.

HINT:

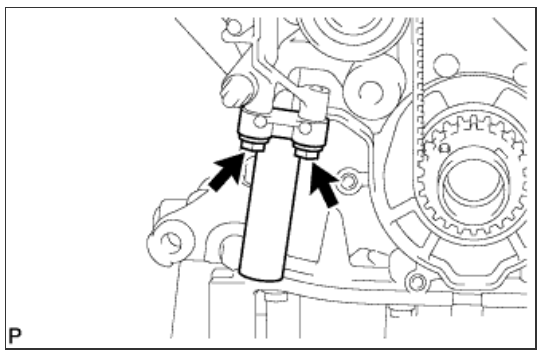
- **If the timing marks do not align, rotate the crankshaft clockwise again and align the timing marks.**
- **When reusing the timing belt, put a timing mark on the belt where the timing marks on the belt and timing pulley are aligned after rotating the crankshaft.**



36. REMOVE TIMING BELT

a. Alternately loosen the 2 bolts, then remove the bolts, timing belt tensioner and dust seal.

b. Remove the timing belt.

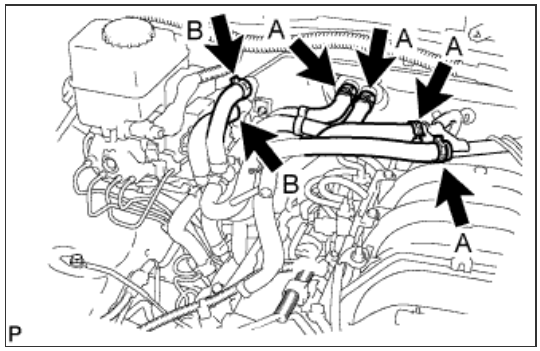


37. DISCONNECT WATER HOSE SUB-ASSEMBLY

a. Disconnect the water by-pass hose.

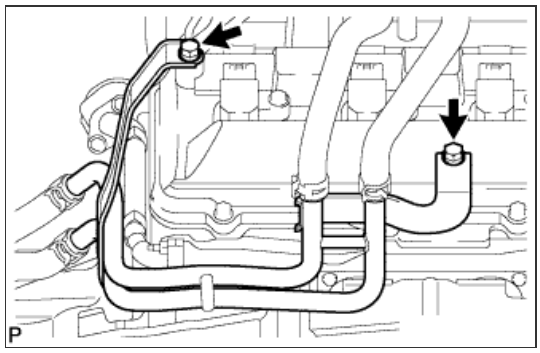
i. w/ Rear Heater:
Disconnect the water hoses labeled A and B.

ii. w/o Rear Heater:
Disconnect the water hoses labeled A.



38. DISCONNECT NO. 1 WATER BY-PASS PIPE (w/ Air Cooled Transmission Oil Cooler)

a. Remove the 2 bolts. Then disconnect the water by-pass pipe from the cylinder head cover RH.



39. REMOVE NO. 2 FUEL HOSE

a. for engine side:

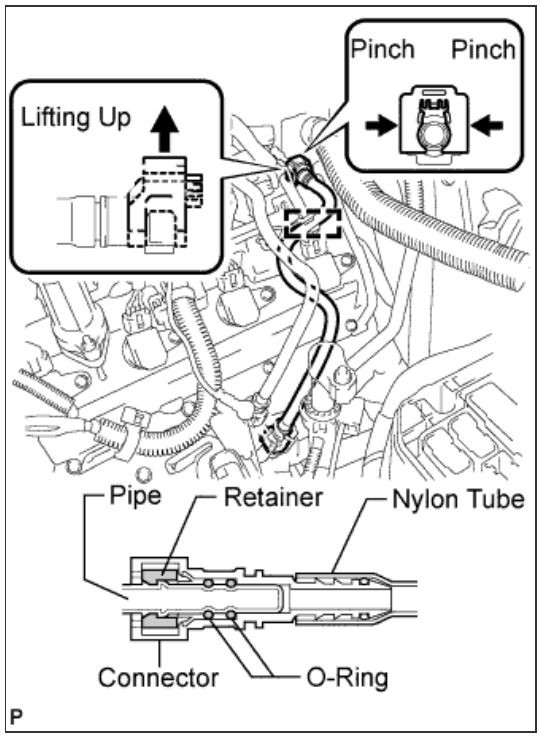
i. Detach the fuel hose clamp.

ii. Detach the lock claw by lifting up the cover, as shown in the illustration.

iii. Pinch and pull the No. 2 fuel hose connector to disconnect the connector from the No. 3 fuel pipe.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



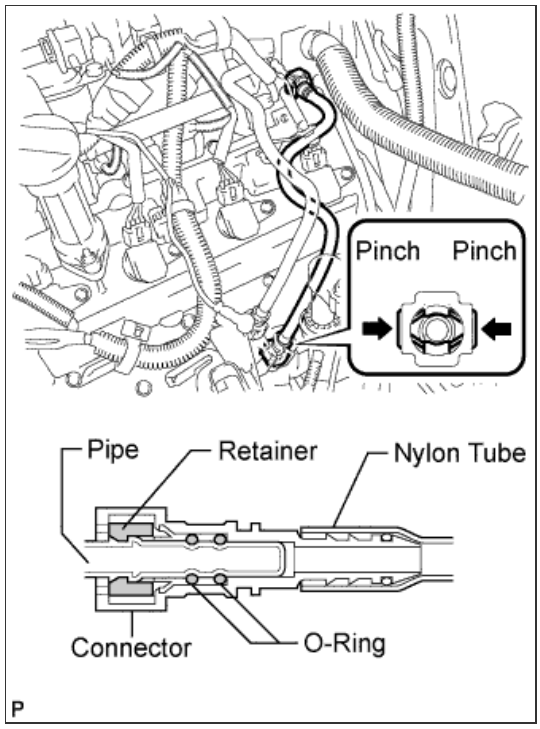
b. for body side:

b. for body side:

i. Pinch and pull the No. 2 fuel hose connector to disconnect the connector from the fuel pipe.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



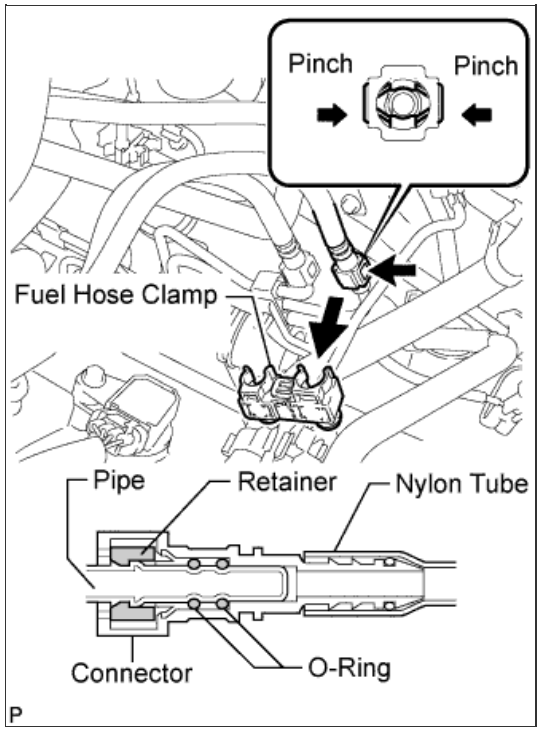
40. DISCONNECT FUEL HOSE

a. Remove the fuel hose clamp.

b. Pinch and pull the fuel hose connector to disconnect the connector from the fuel pipe.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



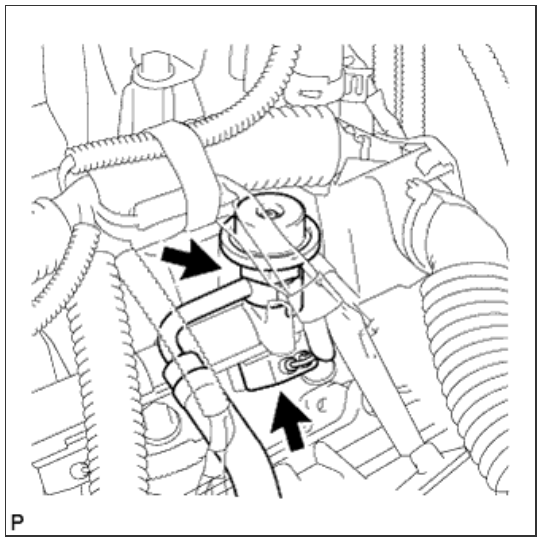
41. REMOVE FUEL PRESSURE PULSATION DAMPER ASSEMBLY

a. Disconnect the fuel injector connector.

b. Remove the pulsation damper, upper gasket, fuel hose and lower gasket.

NOTICE:

- **Put a cloth or equivalent under the delivery pipe.**
- **Slowly loosen the pulsation damper.**

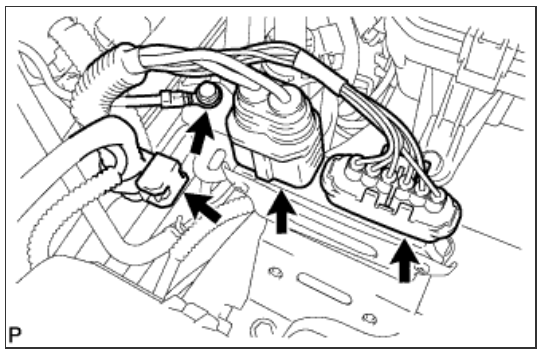


42. SEPARATE WIRE HARNESS

a. Disconnect the 2 air injection control driver connectors.

b. Remove the bolt and disconnect the ground wire.

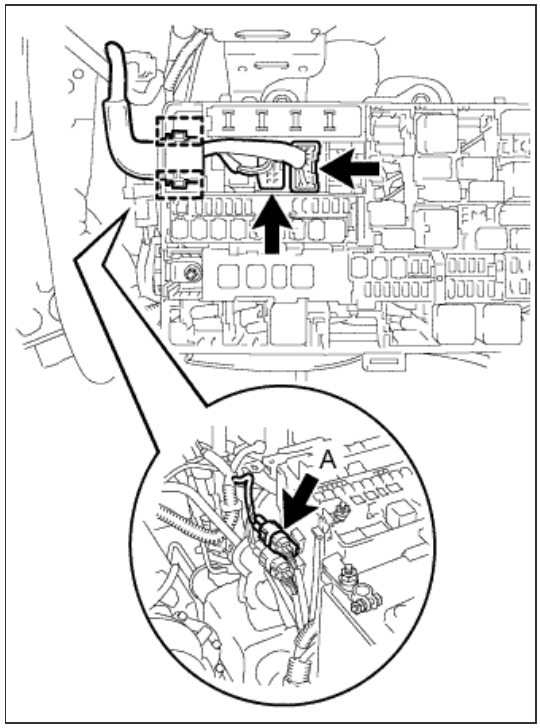
c. Disconnect the wire harness clamp.



d. Disconnect the 2 clamps and 2 connectors from the engine room relay block.

e. Disconnect connector A from the engine room relay block.

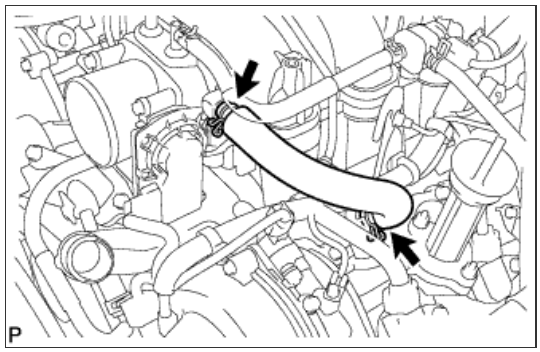
f. Disconnect the wire harness clamp from the cylinder head cover LH.



43. REMOVE NO. 1 VENTILATION HOSE

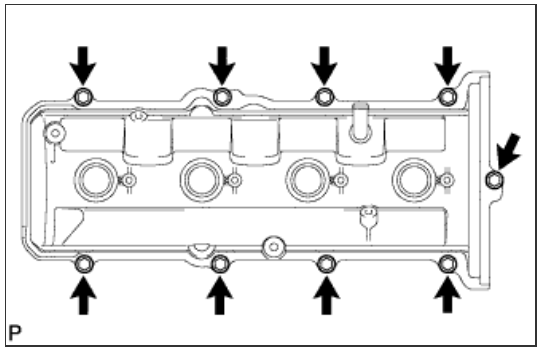
a. Remove the No. 1 ventilation hose from the intake manifold and ventilation

valve.



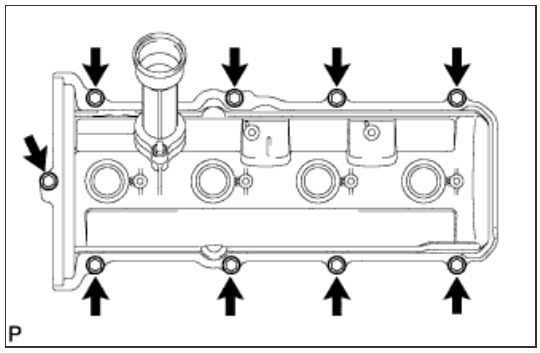
44. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY

a. Remove the 9 bolts, cylinder head cover and gasket.



45. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY LH

a. Remove the 9 bolts, cylinder head cover and gasket.



46. REMOVE SPARK PLUG TUBE GASKET

a. Bend the 8 ventilation case claws of the cylinder head cover to an angle of 90° or more.

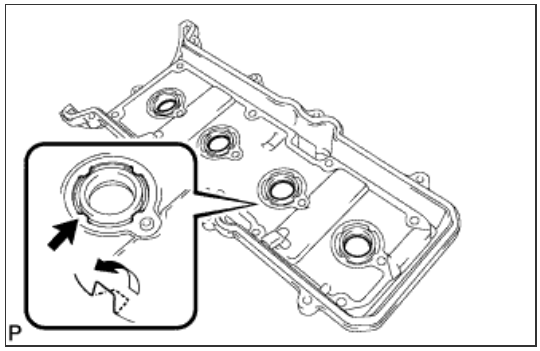
b. Using a screwdriver, pry out the gaskets.

NOTICE:

- **Be careful not to damage the cylinder head cover.**
- **Be careful not to damage the gasket when removing it, as the removed gasket needs to be reused when installing a new one.**

HINT:

Tape the screwdriver tip before use.

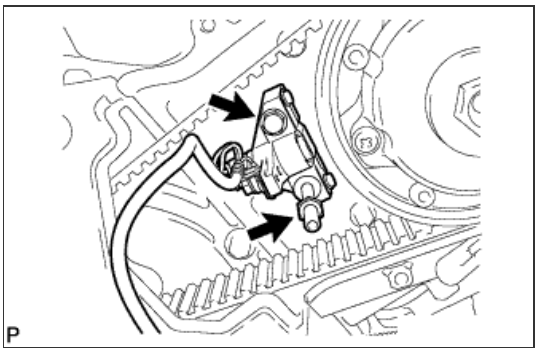


47. REMOVE SEMICIRCULAR PLUG

a. Remove the 4 semicircular plugs from the cylinder heads.

48. REMOVE CAMSHAFT POSITION SENSOR ASSEMBLY

a. Remove the bolt, stud bolt and camshaft position sensor.

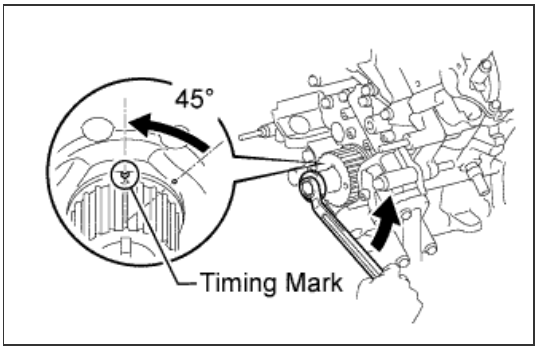


49. REMOVE CAMSHAFT TIMING PULLEY

a. Using the pulley set bolt, turn the crankshaft counterclockwise by approximately 45°.

NOTICE:

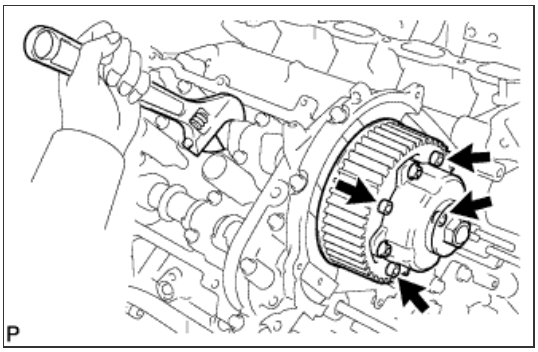
f the timing belt is disengaged, having the crankshaft pulley at a wrong angle can cause the piston head and valve head to come into contact with each other when removing the camshaft timing pulley and camshaft, causing damage. So always set the crankshaft pulley at the correct angle.



b. Hold the hexagonal portion of the camshaft with a wrench and remove the 4 bolts indicated by the arrows in the illustration and timing pulley.

NOTICE:

- **Do not loosen or remove the 4 bolts that are not indicated by the arrows in the illustration. If any of them are loosened or removed, the backlash of the gear in the timing tube will go out of adjustment. In this case, replace the timing tube assembly with a new one.**
- **Be careful not to damage the cylinder head with the wrench.**

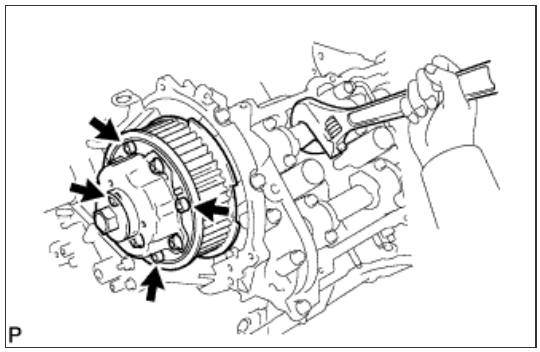


50. REMOVE CAMSHAFT TIMING PULLEY SUB-ASSEMBLY LH

a. Hold the hexagonal portion of the camshaft with a wrench and remove the 4 bolts indicated by the arrows in the illustration and timing pulley.

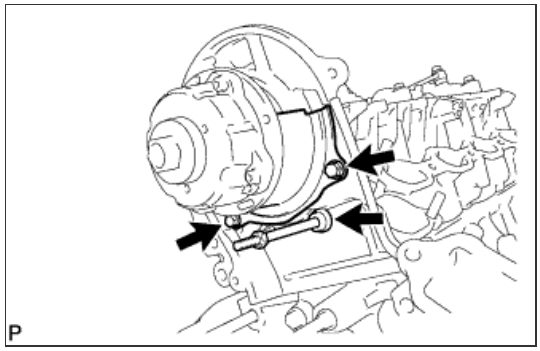
NOTICE:

- **Do not loosen or remove the 4 bolts that are not indicated by the arrows in the illustration. If any of them are loosened or removed, the backlash of the gear in the timing tube will go out of adjustment. In this case, replace the timing tube assembly with a new one.**
- **Be careful not to damage the cylinder head with the wrench.**



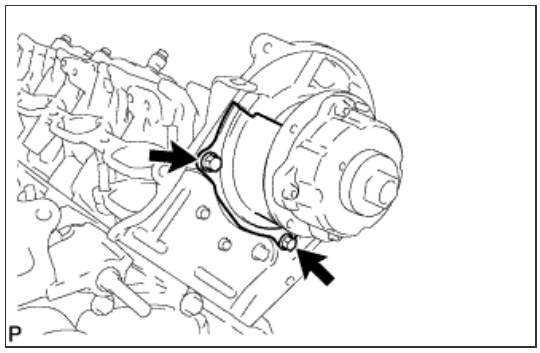
51. REMOVE REAR NO. 2 TIMING BELT PLATE RH

a. Remove the 2 bolts, stud bolt and timing belt plate.



52. REMOVE REAR NO. 2 TIMING BELT PLATE LH

a. Remove the 2 bolts and timing belt plate.



53. REMOVE CAMSHAFT (for Bank 1)

a. Bring the service bolt hole of the sub-gear upward by turning the hexagonal portion of the exhaust camshaft with a wrench.

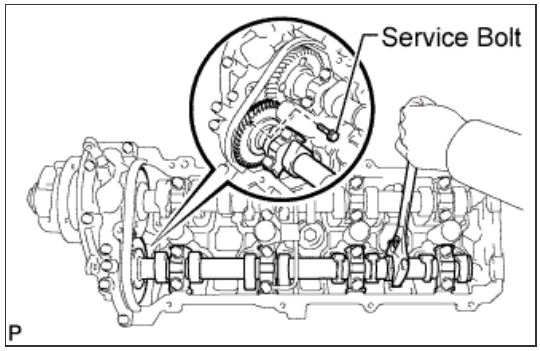
b. Secure the sub-gear to the driven gear with a service bolt.

Recommended Service Bolt:

Thread Diameter	Thread Pitch	Bolt Length
6.0 mm	1.0 mm	16 to 20 mm (0.630 to 0.787 in.)

HINT:

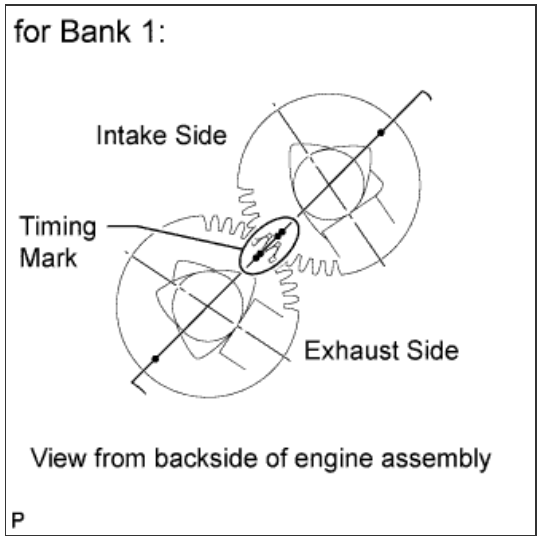
When removing the camshafts, make sure that the torsional spring force of the sub-gear has been eliminated by the above operation.



c. Using a wrench, turn the camshaft so that the timing marks (2 dot marks each) on the camshaft drive and driven gears are aligned, as shown in the illustration.

HINT:

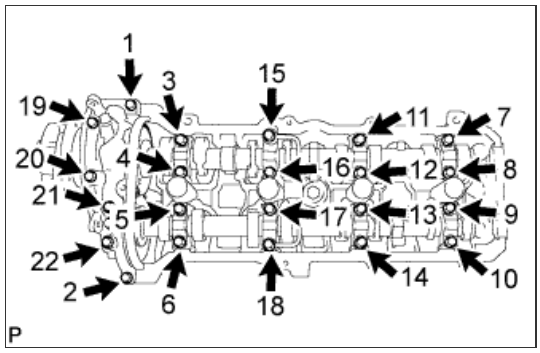
The position shown in the illustration is the most stable position for the exhaust camshaft.



d. Uniformly loosen and remove the 22 bearing cap bolts in several steps, in the order shown in the illustration.

NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. f the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged. To avoid this, the following steps should be carried out.



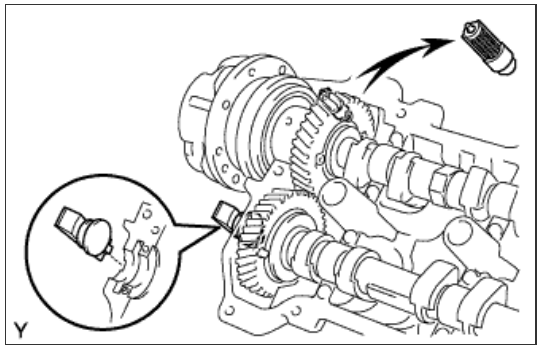
e. Remove the cap bolts, 4 seal washers, oil feed pipe, 9 bearing caps, camshaft housing plug, oil control valve filter and camshafts.

NOTICE:

- **Do not forcibly pry the camshaft with a tool.**
- **Do not damage the reception part of the thrust on the cylinder head side.**

HINT:

Arrange the bearing caps in the correct order.



54. REMOVE CAMSHAFT (for Bank 2)

a. Bring the service bolt hole of the sub-gear upward by turning the hexagonal portion of the exhaust camshaft with a wrench.

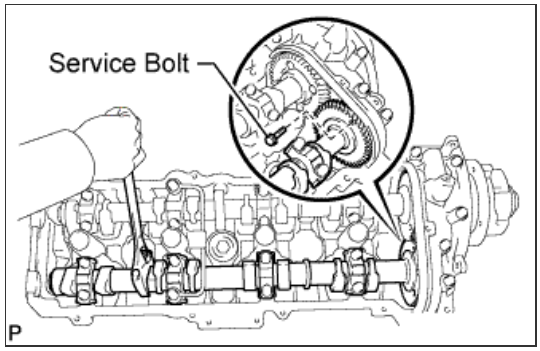
b. Secure the sub-gear to the driven gear with a service bolt.

Recommended Service Bolt:

Thread Diameter	Thread Pitch	Bolt Length
6.0 mm	1.0 mm	16 to 20 mm (0.630 to 0.787 in.)

HINT:

When removing the camshafts, make sure that the torsional spring force of the sub-gear has been eliminated by the above operation.

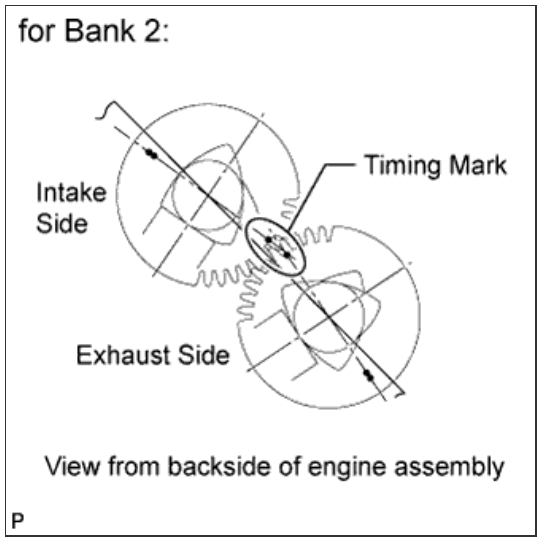


c. Using a wrench, turn the camshaft so that the timing marks (1 dot mark each) on

the camshaft drive and driven gears are aligned, as shown in the illustration.

HINT:

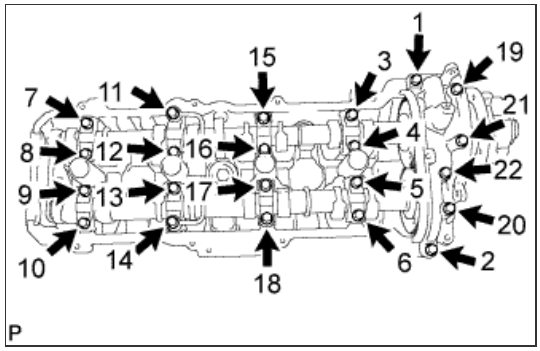
The position shown in the illustration is the most stable position for the exhaust camshaft.



d. Uniformly loosen and remove the 22 bearing cap bolts in several steps, in the order shown in the illustration.

NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. f the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged. To avoid this, the following steps should be carried out.



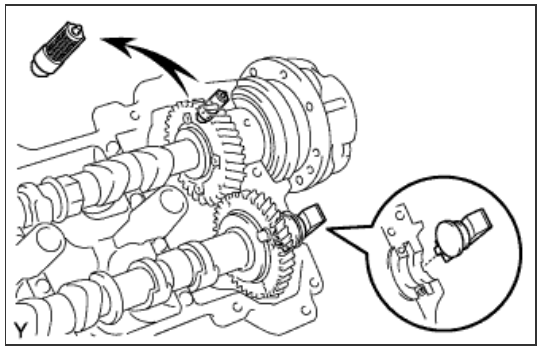
e. Remove the cap bolts, 4 seal washers, oil feed pipe, 9 bearing caps, camshaft housing plug, oil control valve filter and camshafts.

NOTICE:

- **Do not forcibly pry the camshaft with a tool.**
- **Do not damage the reception part of the thrust on the cylinder head side.**

HINT:

Arrange the bearing caps in the correct order.



55. INSPECT CAMSHAFT TIMING TUBE ASSEMBLY

a. Using a micrometer, measure the journal diameter.

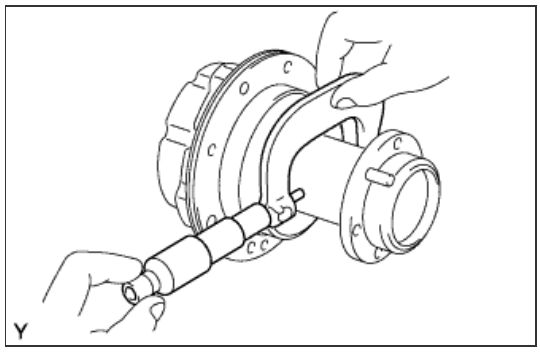
Standard journal diameter:
39.955 to 39.964 mm (1.5730 to 1.5734 in.)

f the journal diameter is not as specified, check the oil clearance. f necessary, replace the camshaft and cylinder head.

b. nstall the camshaft timing tube to the camshaft (Click here).

c. Check the lock of the camshaft timing tube.

i. Check that the camshaft timing tube is locked.

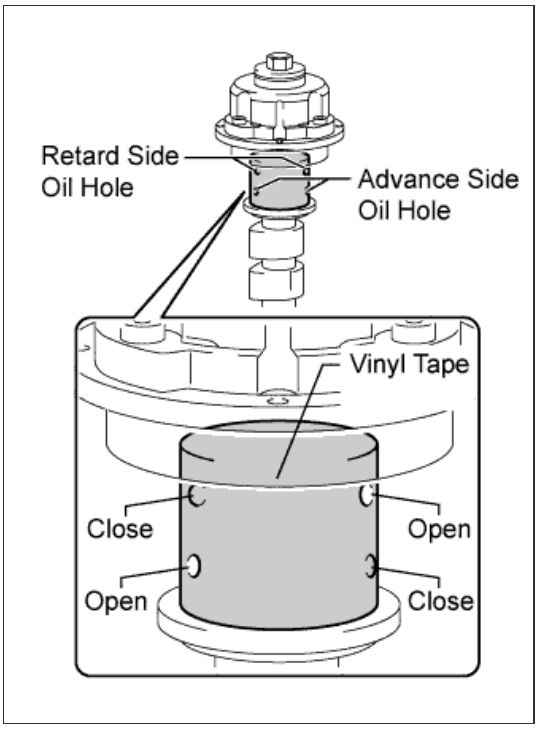


d. Release the lock pin.

i. Clean the camshaft timing tube journal with non-residue solvent.

ii. Wrap tape around the entire journal to block the 4 oil holes as shown in the illustration.

iii. Open a hole in the tape at 2 places, one in the retard side oil hole and one in the advance side oil hole as shown in the illustration.



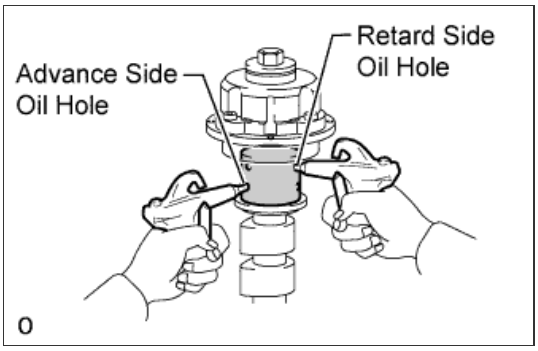
iv. Apply approximately 200 kPa (2.0 kgf/cm^2, 29 psi) of air pressure to the 2 open oil holes (the advance side oil hole and the retard side oil hole).

NOTICE:

Cover the oil holes with a piece of cloth when applying pressure to keep oil from splashing.

HINT:

The lock pin will be released when air pressure is applied.

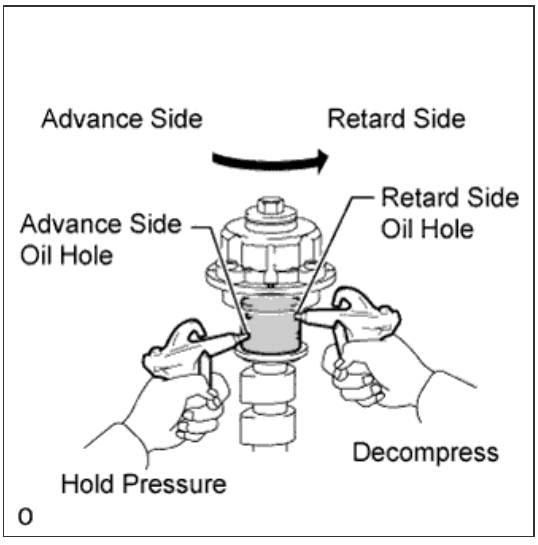


v. Check that the camshaft timing tube revolves in the advance direction when reducing the air pressure applied to the retard side oil hole.

vi. When the camshaft timing tube reaches the most advanced position, release the air pressure from the retard side oil hole and advance side oil hole, in that order.

NOTICE:

- **Do not release the air pressure from the advance side oil hole first. The tube may abruptly shift in the retard direction and break the lock pin.**
- **When releasing the air pressure from the retard side oil hole, do not release the air pressure too quickly to prevent damage.**



e. Check for smooth rotation.

i. Apply 60 kPa (0.6 kgf/cm^2, 8.7 psi) of air pressure to the retard side oil hole to release the lock pin.

ii. Turn the camshaft timing tube within its movable range (21°) 2 or 3 times, but do not turn it to the most retarded position. ake sure that the camshaft timing tube turns smoothly.

NOTICE:

Do not use air pressure to perform the smooth rotation check. Always perform the check by hand.

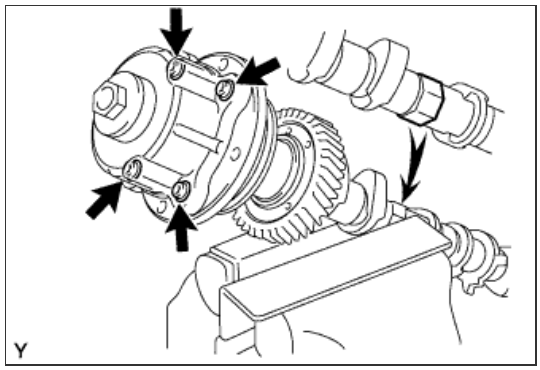
f. Check the lock in the most retarded position.

i. Confirm that the camshaft timing tube is locked at the most retarded position.

g. Remove the camshaft timing tube (Click here).

56. REMOVE CAMSHAFT TIMING TUBE ASSEMBLY

a. ount the hexagonal portion of the camshaft in a vise.

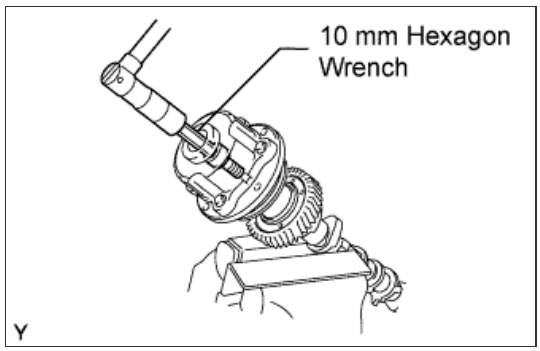


NOTICE:

- **Be careful not to damage the camshaft.**
- **Do not loosen or remove the 4 bolts shown in the illustration. If any of them are loosened or removed, the backlash of the gear in the timing tube will go out of adjustment. In this case, replace the timing tube assembly with a new one.**

b. Remove the screw plug and seal washer.

c. Using a 10 mm hexagon wrench, remove the bolt and timing tube.



57. REMOVE CAMSHAFT DRIVE GEAR

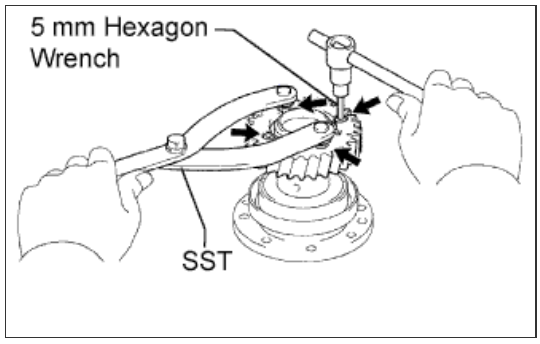
a. Using SST and a 5 mm hexagon wrench, remove the 4 bolts, drive gear and oil seal.

SST

09960-10010 (09962-01000, 09963-00500)

NOTICE:

Be careful not to damage the timing tube.

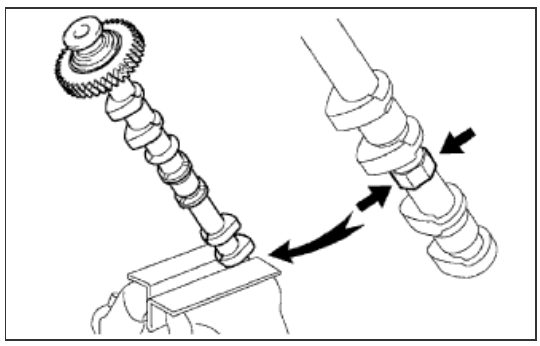


58. REMOVE CAMSHAFT SUB-GEAR

a. ount the hexagonal portion of the camshaft in a vise.

NOTICE:

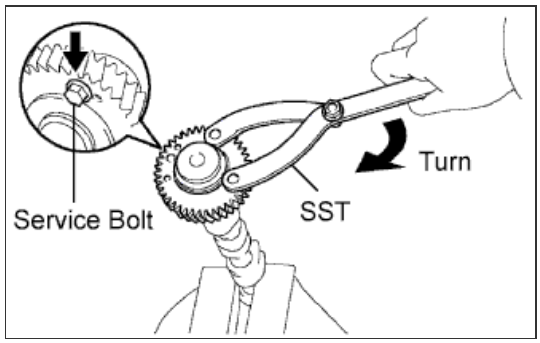
Be careful not to damage the camshaft.



b. Using SST, turn the sub-gear clockwise, and remove the service bolt.

SST

09960-10010 (09962-01000, 09963-00500)

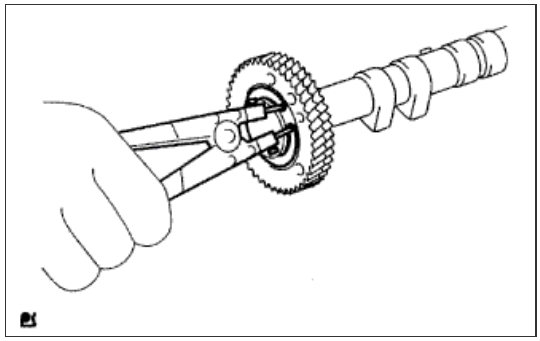


c. Using snap ring pliers, remove the snap ring.

d. Remove the wave washer, sub-gear and gear spring.

HINT:

Arrange the camshaft sub-gears and gear spring (LH and RH).



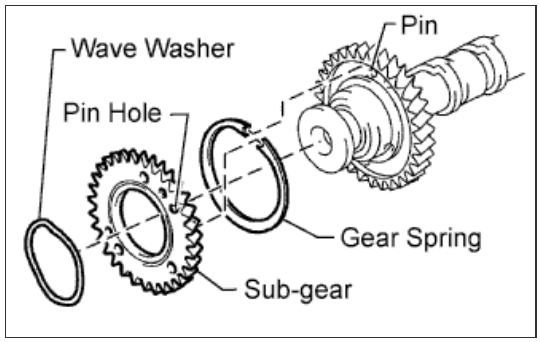
for Preparation Click here

1. INSTALL CAMSHAFT SUB-GEAR

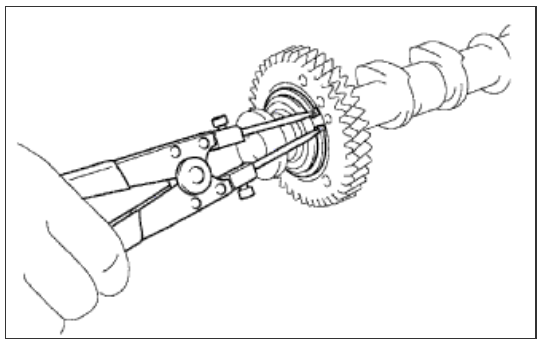
a. Install the gear spring, sub-gear and wave washer.

HINT:

Attach the pins on the gears to the gear spring ends.



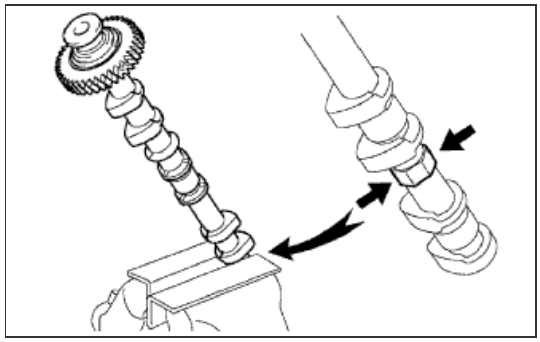
b. Using snap ring pliers, install the snap ring.



c. Mount the hexagonal portion of the camshaft in a vise.

NOTICE:

Be careful not to damage the camshaft.



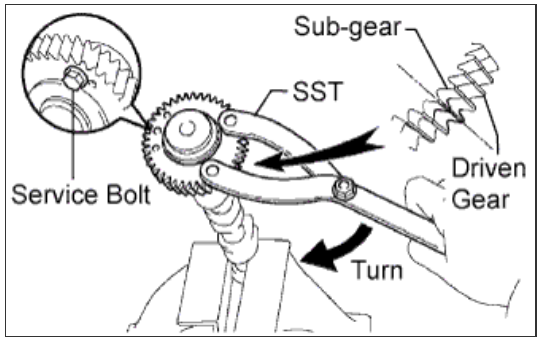
d. Using SST, align the holes of the driven gear and sub-gear by turning the sub-gear clockwise, and temporarily install a service bolt.

SST

09960-10010 (09962-01000, 09963-00500)

Recommended Service Bolt:

Thread Diameter	Thread Pitch	Bolt Length
6 mm	1.0 mm	16 to 20 mm (0.630 to 0.787 in.)



e. Align the gear teeth of the driven gear and sub-gear, and tighten the service bolt.

2. INSTALL CAMSHAFT DRIVE GEAR

a. Align the timing tube knock pin with the knock pin groove of the drive gear, and temporarily install the drive gear with the 4 bolts.

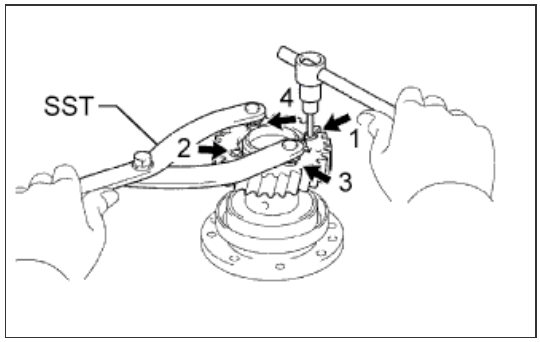
b. Using SST and a 5 mm hexagon wrench, uniformly tighten the 4 bolts in several steps, in the sequence shown in the illustration.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

SST
09960-10010 (09962-01000, 09963-00500)

NOTICE:

Be careful not to damage the timing tube.



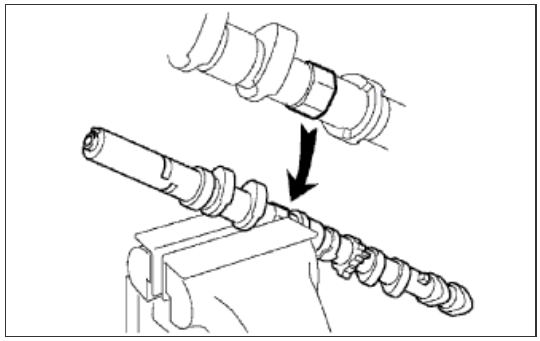
3. INSTALL CAMSHAFT TIMING TUBE ASSEMBLY

a. Mount the hexagonal portion of the camshaft in a vise.

NOTICE:

Be careful not to damage the camshaft.

b. Apply a light coat of engine oil to the camshaft and camshaft timing tube.



c. Align the camshaft knock pin with the knock pin hole of the timing tube, and push the timing tube by hand until the camshaft knock pin touches the bottom of the timing tube knock pin hole.

NOTICE:

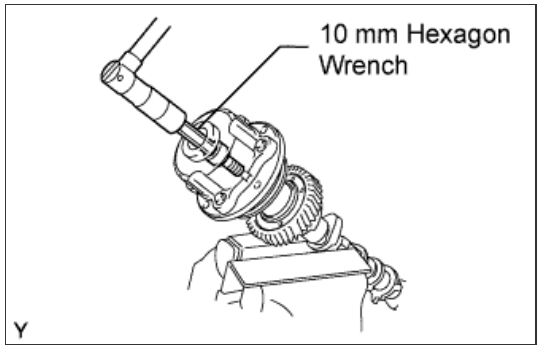
Do not forcefully push on the camshaft timing tube. This may cause the camshaft knock pin tip to damage the installation surface of the camshaft timing tube.

d. Using a 10 mm socket hexagon wrench, install the bolt.

Torque:
78 N*m{ 795 kgf*cm , 58 ft.*lbf }

e. Install the seal washer and screw plug.

Torque:
15 N*m{ 153 kgf*cm , 11 ft.*lbf }



4. INSTALL CAMSHAFT (for Bank 1)

NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged. To avoid this, the following steps should be carried out.

HINT:

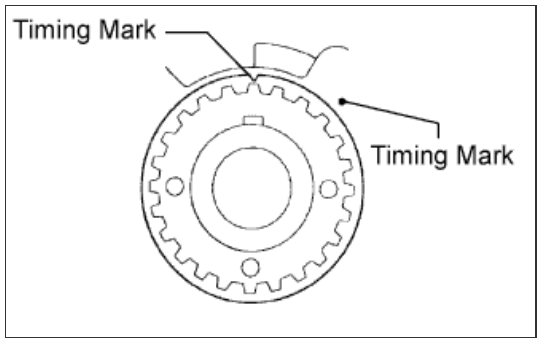
When performing this procedure to adjust the valve clearance, it is not necessary to apply seal packing to the No. 5 bearing cap and camshaft housing plug.

a. heck that the timing mark of the crankshaft timing pulley is in the position

shown in the illustration, and that the piston is below the TD of compression.

NOTICE:

Having the crankshaft pulley at a wrong angle can cause the piston head and valve head to come into contact with each other when removing the camshaft. Always set the crankshaft pulley at the correct angle as shown in the illustration.

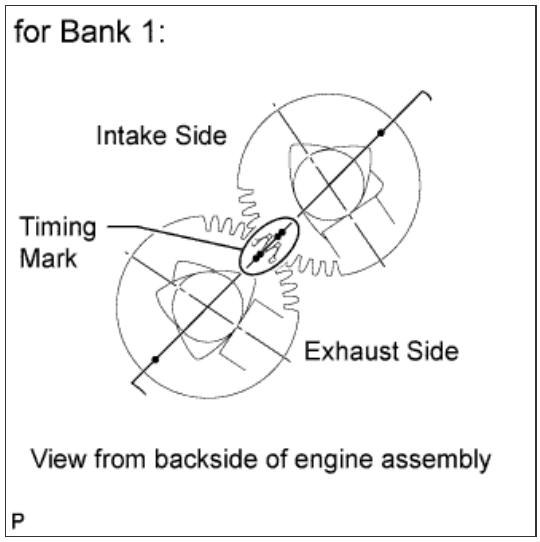


b. Apply a light coat of engine oil to the cam lobe and gear of the camshaft and the journal of the cylinder head.

c. Using a wrench, align the timing marks (2 dot marks each) of the camshaft drive and driven gears, and set the No. 3 and No. 4 camshafts in place.

HINT:

The position shown in the illustration is the most stable position for the exhaust camshaft.



d. Apply seal packing to the camshaft housing plug groove.

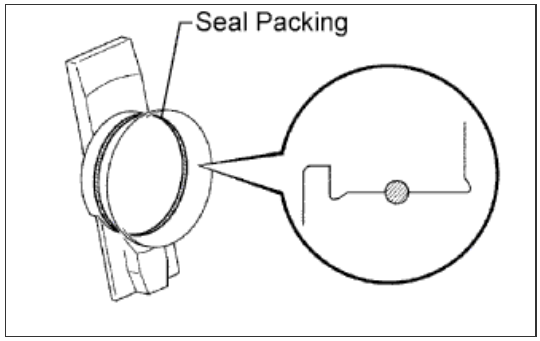
HINT:

Remove any old packing (FIPG) material before applying new seal packing.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

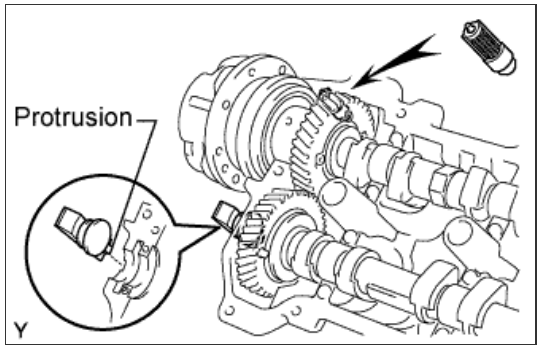
- **Be careful of the installation direction.**
- **Remove any oil from the contact surface.**



e. Install the camshaft housing plug and oil control valve filter to the cylinder head as shown in the illustration.

HINT:

Align the protrusion on the camshaft housing plug with the groove of the cylinder head and install the plug.



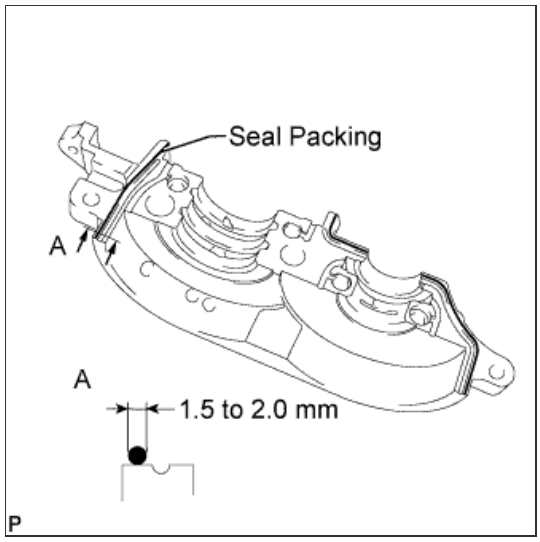
f. Apply seal packing to the No. 5 bearing cap as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
1.5 to 2.0 mm (0.0591 to 0.0787 in.)

NOTICE:

Install the No. 5 bearing cap and housing plug within 3 minutes.



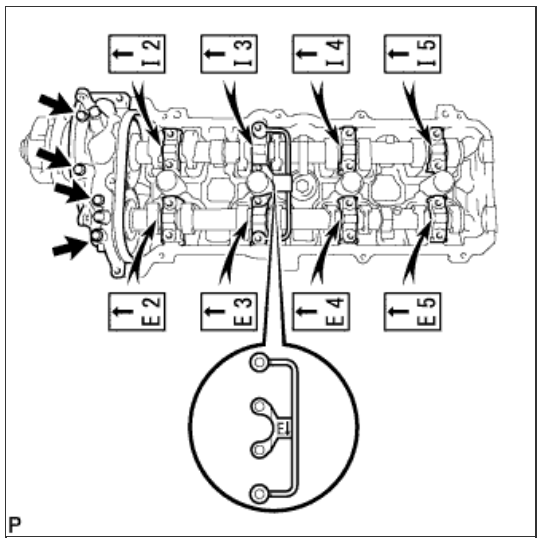
g. Install a new seal washer to each bearing cap bolt indicated by an arrow in the illustration, and apply engine oil to the threads of the bolts. Then temporarily install them.

h. Apply engine oil to the threads and washer part of the bearing cap bolts not indicated in the illustration.

i. Temporarily install the oil feed pipe and bearing caps with the 18 bearing cap bolts, as shown in the illustration.

Bolt Length:

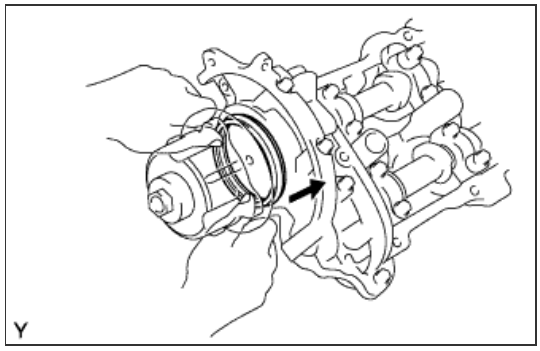
Item	Length
Bolt A with seal washer	94 mm (3.70 in.)
Bolt B with seal washer	72 mm (2.84 in.)
Bolt	25 mm (0.984 in.)
Bolt D	55 mm (2.17 in.)
Bolt	40 mm (1.58 in.)



HINT:

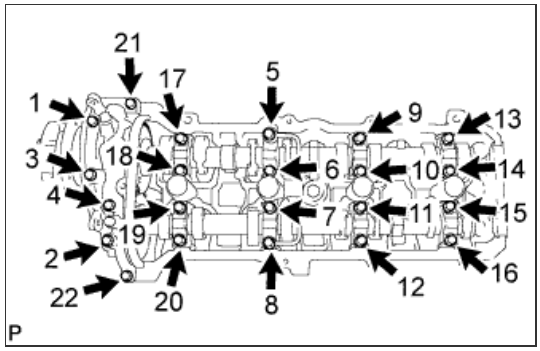
Face the arrow imprinted on the oil feed pipe to the exhaust side.

j. Push in the camshaft setting oil seal.



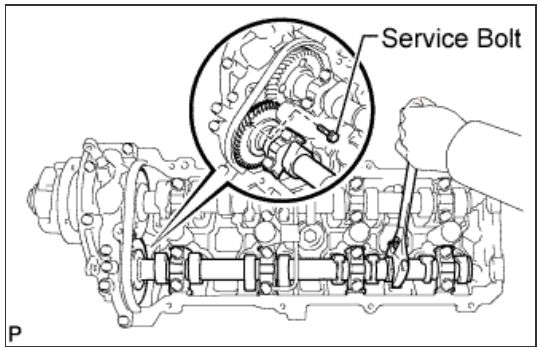
k. Uniformly tighten the 22 bearing cap bolts in several steps, in the sequence shown in the illustration.

Torque:
for bolt 21, 22:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }
for other bolt:
16 N*m{ 163 kgf*cm , 12 ft.*lbf }



l. Bring the service bolt installed in the driven sub-gear upward by turning the hexagonal portion of the camshaft with a wrench.

m. Remove the service bolt.



5. INSTALL CAMSHAFT (for Bank 2)

NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged. To avoid this, the following steps should be carried out.

HINT:

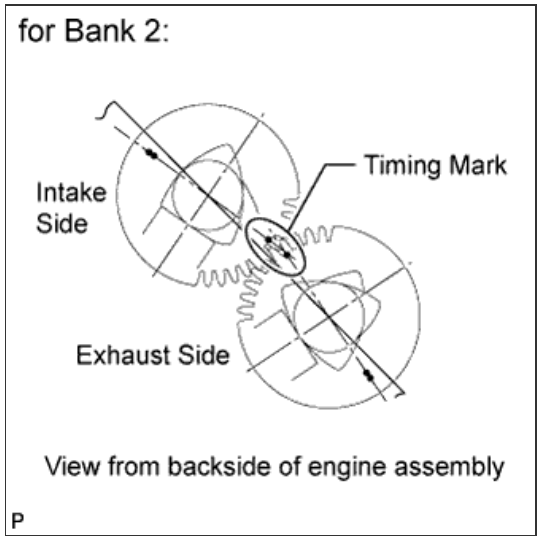
When performing this procedure to adjust the valve clearance, it is not necessary to apply seal packing to the No. 1 bearing cap and camshaft housing plug.

a. Apply a light coat of engine oil to the cam lobe and gear of the camshaft and the journal of the cylinder head.

b. Using a wrench, align the timing marks (1 dot mark each) of the camshaft drive and driven gears, and set the camshaft and No. 2 camshaft in place.

HINT:

The position shown in the illustration is the most stable position for the exhaust camshaft.



c. Apply seal packing to the camshaft housing plug groove.

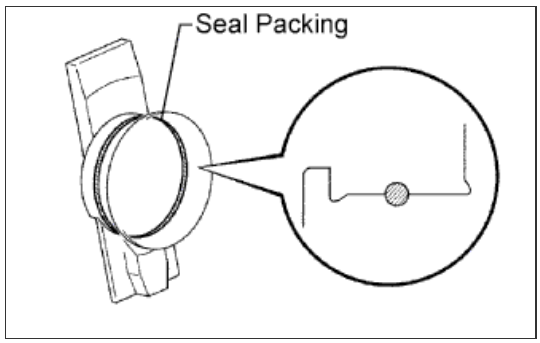
HINT:

Remove any old packing (FIPG) material before applying new seal packing.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

- **Be careful of the installation direction.**
- **Remove any oil from the contact surface.**

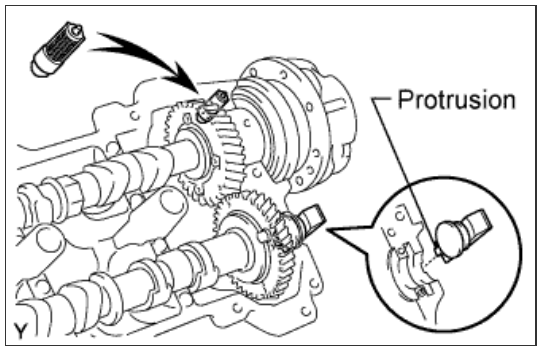


d. Install the camshaft housing plug and oil control valve filter to the cylinder head as shown in the illustration.

HINT:

Align the protrusion on the camshaft housing plug with the groove of the

cylinder head and install the plug.



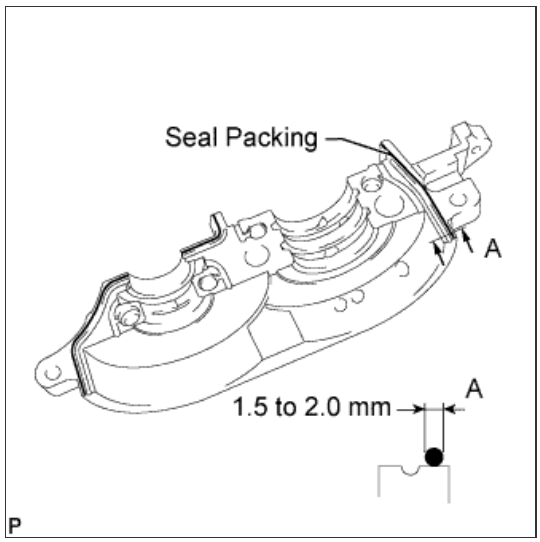
e. Apply seal packing to the No. 1 bearing cap as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
1.5 to 2.0 mm (0.0591 to 0.0787 in.)

NOTICE:

Install the No. 1 bearing cap and housing plug within 3 minutes.



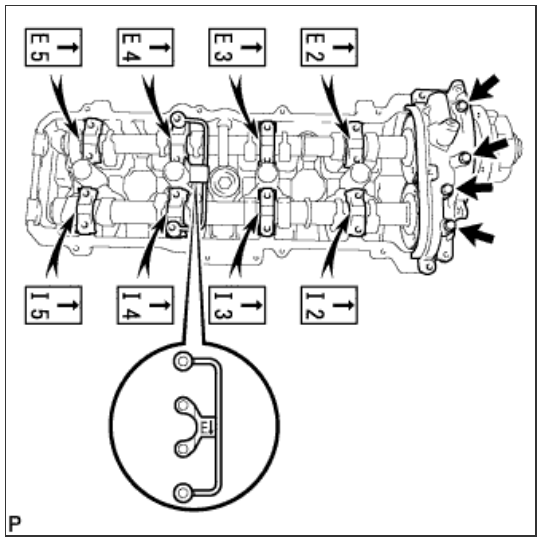
f. Install a new seal washer to each bearing cap bolt indicated by an arrow in the illustration, and apply engine oil to the threads of the bolts. Then temporarily install them.

g. Apply engine oil to the threads and washer part of the bearing cap bolts not indicated in the illustration.

h. Temporarily install the oil feed pipe and bearing caps with the 18 bearing cap bolts, as shown in the illustration.

Bolt Length:

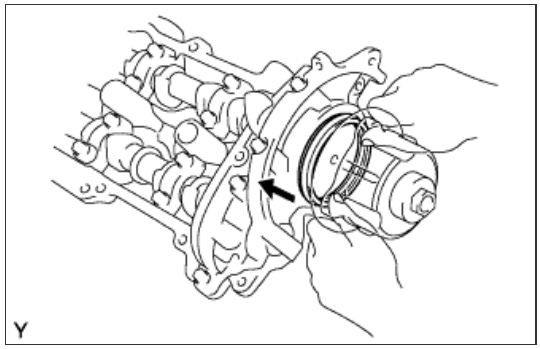
Item	Length
Bolt A with seal washer	94 mm (3.70 in.)
Bolt B with seal washer	72 mm (2.84 in.)
Bolt	25 mm (0.984 in.)
Bolt D	55 mm (2.17 in.)
Bolt	40 mm (1.58 in.)



HINT:

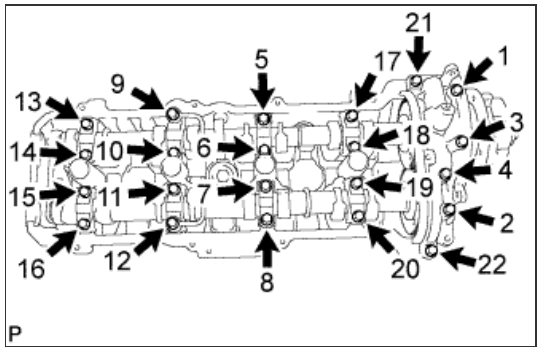
Face the arrow imprinted on the oil feed pipe to the exhaust side.

i. Push in the camshaft setting oil seal.



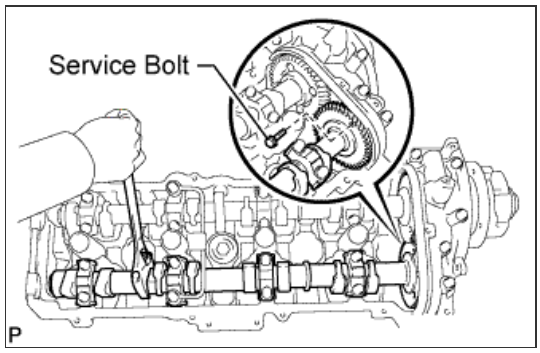
j. Uniformly tighten the 22 bearing cap bolts in several steps, in the sequence shown in the illustration.

Torque:
for bolt 21, 22:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }
for other bolt:
16 N*m{ 163 kgf*cm , 12 ft.*lbf }



k. Bring the service bolt installed in the driven sub-gear upward by turning the hexagonal portion of the camshaft with a wrench.

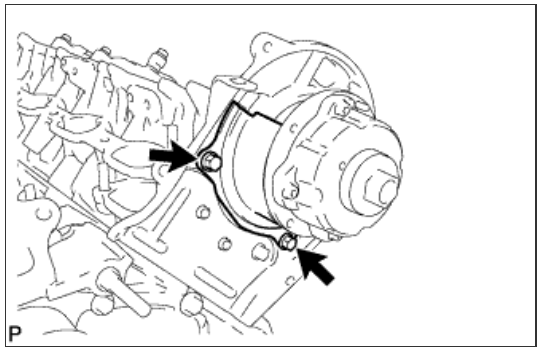
l. Remove the service bolt.



6. INSTALL REAR NO. 2 TIMING BELT PLATE LH

a. Install the timing plate with the 2 bolts.

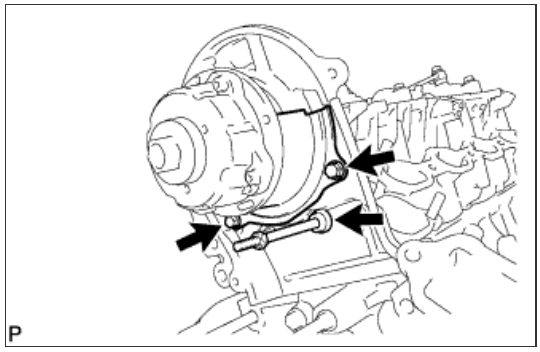
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



7. INSTALL REAR NO. 2 TIMING BELT PLATE RH

a. Install the timing plate with the 2 bolts and stud bolt.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



8. INSTALL CAMSHAFT TIMING PULLEY SUB-ASSEMBLY LH

a. Align the camshaft timing tube knock pin with the knock pin groove of the timing

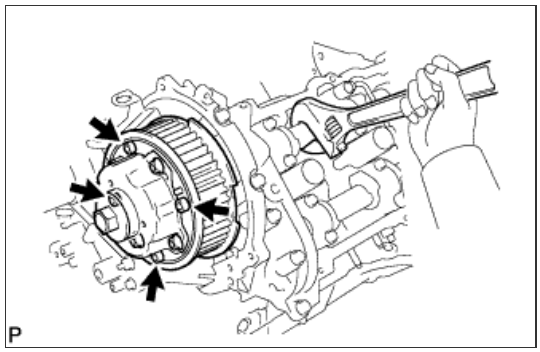
a. Align the camshaft timing tube knock pin with the knock pin groove of the timing pulley.

b. Temporarily install the 4 bolts of the camshaft timing pulley.

c. Hold the hexagonal portion of the camshaft with a wrench.

d. Using a 5 mm hexagon wrench, tighten the 4 bolts.

Torque:
8.1 N*m{ 83 kgf*cm , 72 in.*lbf }



9. INSTALL CAMSHAFT TIMING PULLEY

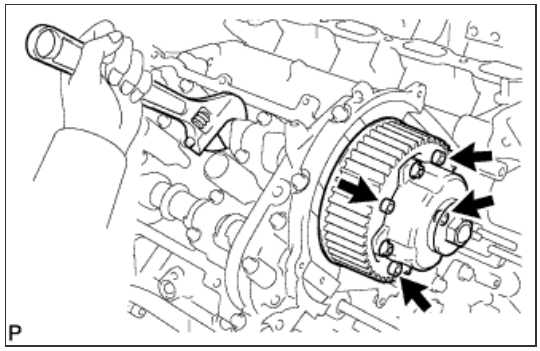
a. Align the camshaft timing tube knock pin with the knock pin groove of the timing pulley.

b. Temporarily install the 4 bolts of the camshaft timing pulley.

c. Hold the hexagonal portion of the camshaft with a wrench.

d. Using a 5 mm hexagon wrench, tighten the 4 bolts.

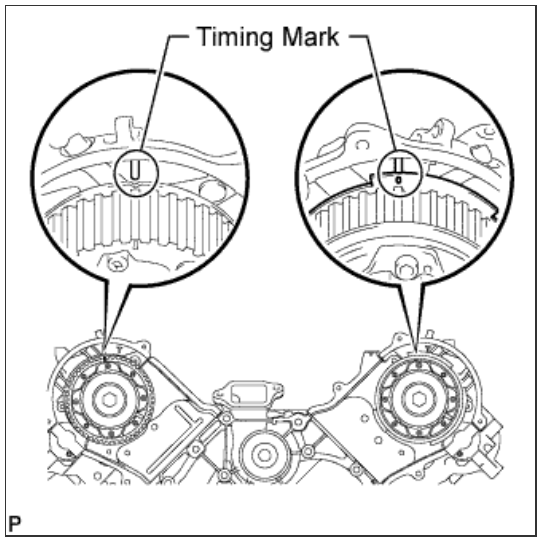
Torque:
8.1 N*m{ 83 kgf*cm , 72 in.*lbf }



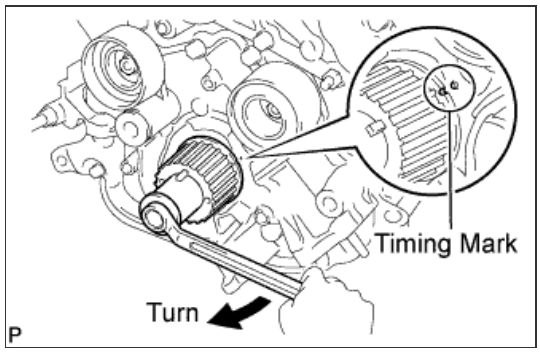
10. INSTALL TIMING BELT

a. Set the No. 1 cylinder to TD compression.

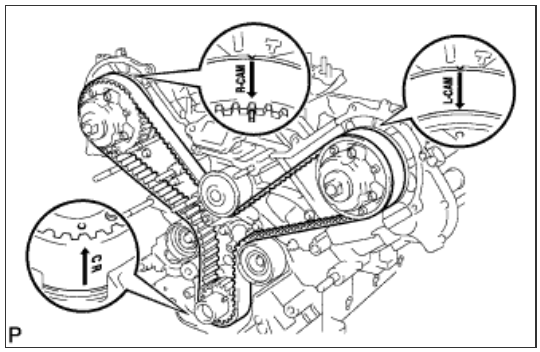
i. Turn the hexagonal portion of the camshaft to align the timing marks of the camshaft timing pulleys and timing belt plates.



ii. Using the pulley bolt, turn the crankshaft to align the timing marks of the crankshaft timing pulley and oil pump body.



b. Install the timing belt.



i. Remove any oil or water from each pulley, and keep them clean.

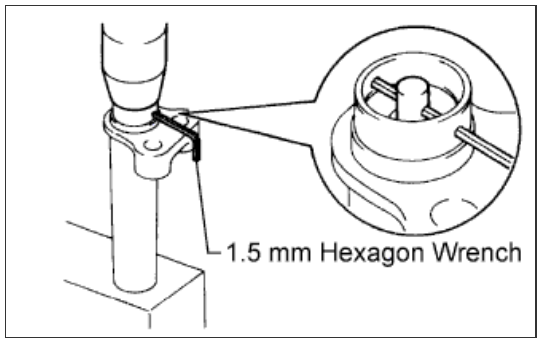
NOTICE:

nly wipe the pulleys. Do not use any cleansing agent on the pulleys.

ii. Face the front mark (arrow) on the timing belt forward.

iii. Align the timing marks on the timing belt and crankshaft timing pulley, and the timing belt and camshaft timing pulleys, and install the timing belt.

c. Install the belt tensioner.



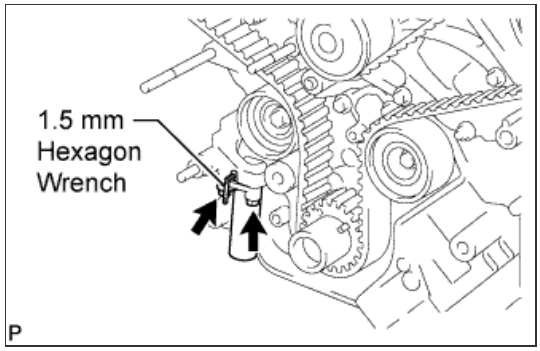
i. Remove the dust seal from the belt tensioner.

ii. Using a press, slowly press in the push rod using a force of 981 to 9807 N (100 to 1000 kgf, 220.5 to 2204.7 lbf).

iii. Align the holes of the push rod and housing, and pass a 1.5 mm hexagon wrench through the holes to keep the setting position of the push rod.

iv. Release the press.

v. Install the dust seal to the belt tensioner.



vi. Temporarily install the belt tensioner with the 2 bolts.

vii. Tighten the 2 bolts.

Torque:
26 N*m{ 265 kgf*cm , 19 ft.*lbf }

viii. Using pliers, remove the 1.5 mm hexagon wrench from the timing belt tensioner.

11. CHECK NO. 1 CYLINDER TO TDC/COMPRESSION

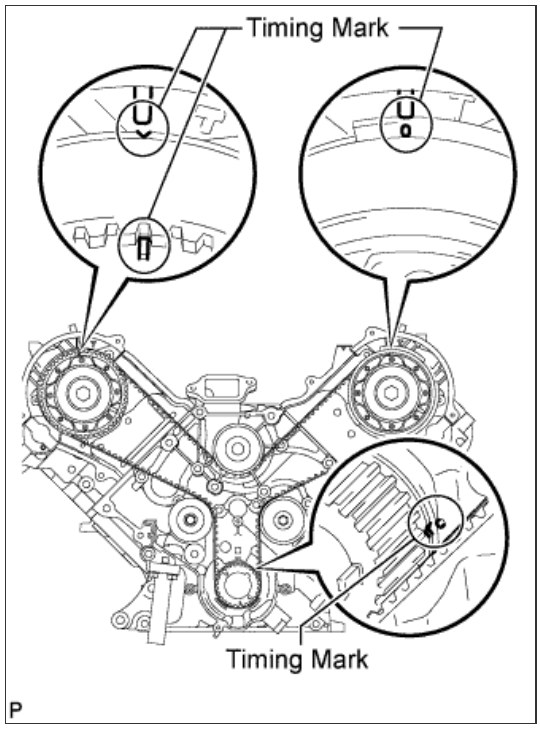
a. Using the pulley bolt, slowly turn the crankshaft timing pulley 2 revolutions from the TD to TD .

NOTICE:

Always turn the crankshaft timing pulley clockwise.

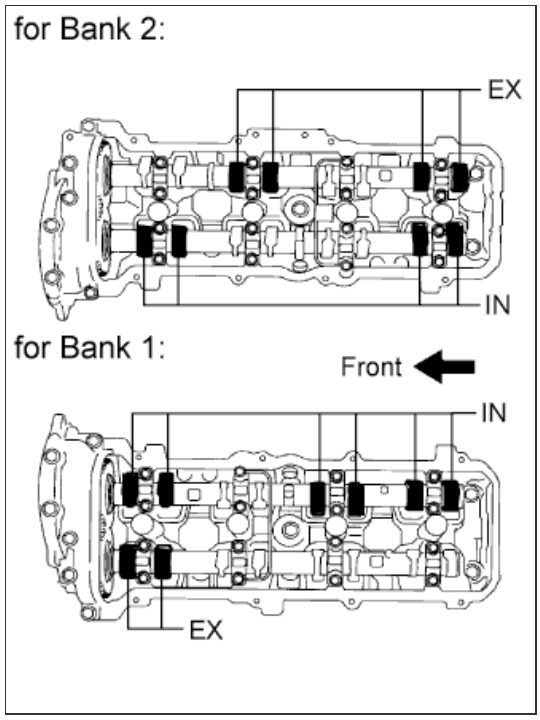
b. heck that each pulley is aligned with each timing mark as shown in the illustration.
If the timing marks are not aligned, remove the timing belt and reinstall it.

c. Remove the pulley bolt.



12. INSPECT VALVE CLEARANCE

a. heck only the valves indicated.



i. Using a feeler gauge, measure the clearance between the valve lifter and camshaft.

Standard Valve Clearance (Cold):

Item	Specified ondition
Intake	0.15 to 0.25 mm (0.00591 to 0.00984 in.)
xhaust	0.25 to 0.35 mm (0.00984 to 0.0138 in.)

ii. Record the out-of-specification valve clearance measurements. They will be used later to determine the required replacement adjusting shim.

b. Turn the crankshaft 1 complete revolution (360°) and align the camshaft timing marks.

c. heck only the valves indicated in the illustration.

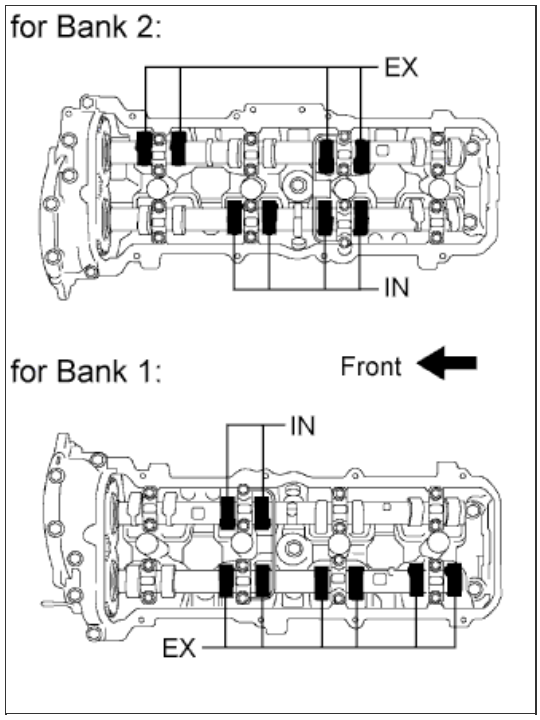
i. Using a feeler gauge, measure the clearance between the valve lifter and camshaft.

Standard Valve Clearance (Cold):

Item	Specified ondition
Intake	0.15 to 0.25 mm (0.00591 to 0.00984 in.)
xhaust	0.25 to 0.35 mm

	(0.00984 to 0.0138 in.)

ii. Record the out-of-specification valve clearance measurements. They will be used later to determine the required replacement adjusting shim.



13. ADJUST VALVE CLEARANCE

a. Remove the timing belt (lick here).

b. Remove the camshaft (lick here).

c. Remove the valve lifter and adjusting shim.

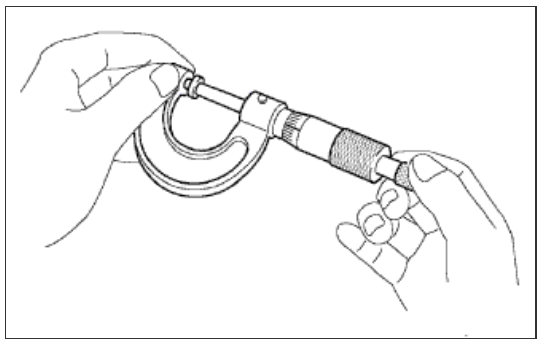
NOTICE:

Be careful not to drop the adjusting shim into the cylinder head.

HINT:

Arrange the removed parts in the correct order.

d. Using a micrometer, measure the thickness of the removed shim.



e. Determine the replacement adjusting shim size according to the formula or charts below.

i. alculate the thickness of a new shim so that the valve clearance comes within the specified value.

T:
Thickness of removed shim

A:
Measured valve clearance

N:
Thickness of new shim

Intake:
N = T + (A - 0.20 mm (0.00787 in.))

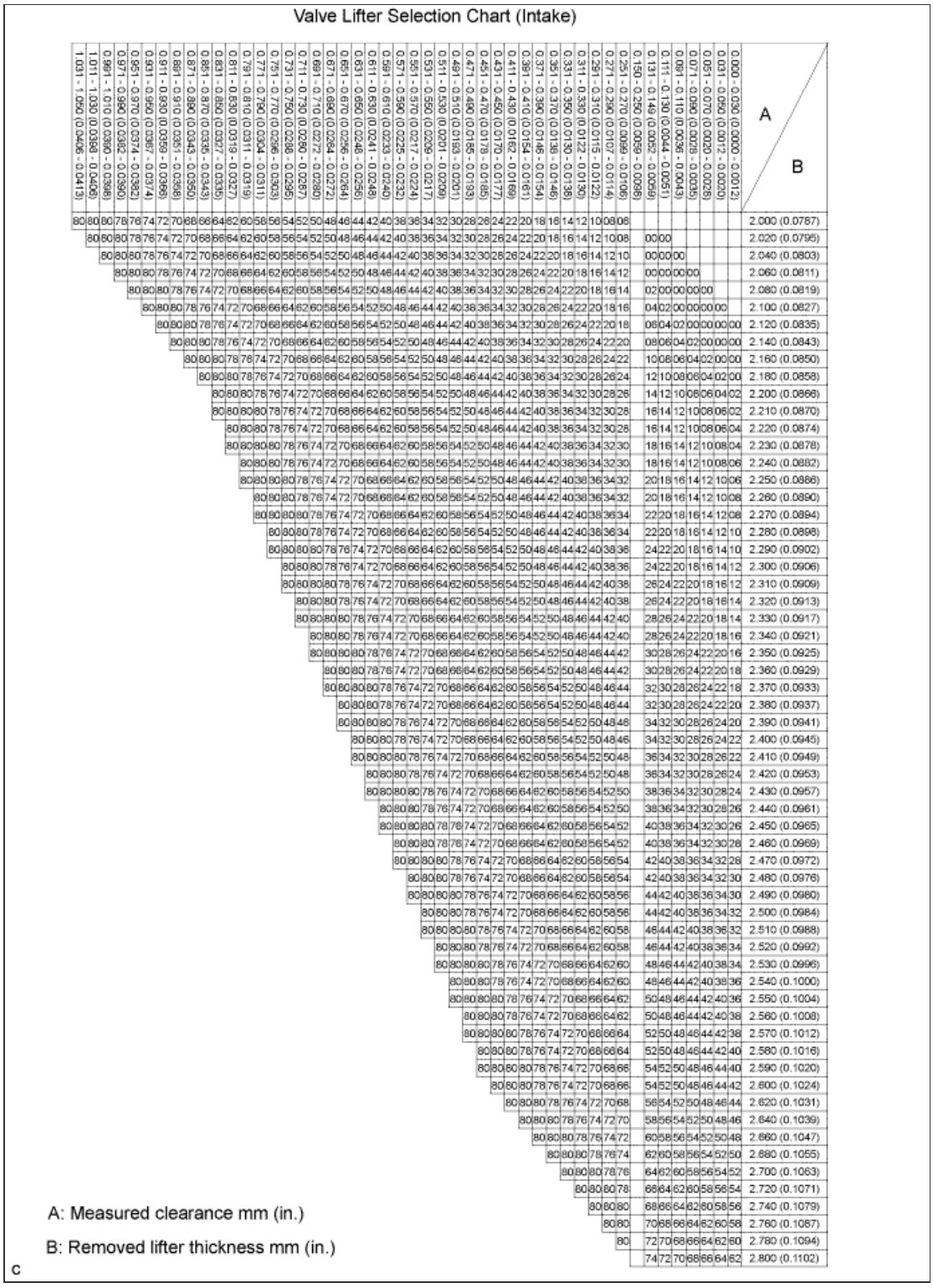
Exhaust:
N = T + (A - 0.30 mm (0.0118 in.))

ii. Select a new shim with a thickness as close as possible to the calculated value.

HINT:

- **Shims are available in 41 increments of 0.020 mm (0.000787 in.), from 2.00 mm (0.0787 in.) to 2.80 mm (0.1102 in.) and 33 increments of 0.025 mm (0.000984 in.), from 2.50 mm (0.0984 in.) to 3.30 mm (0.1299 in.).**

- **Refer to the Adjusting Shim Selection Chart.**

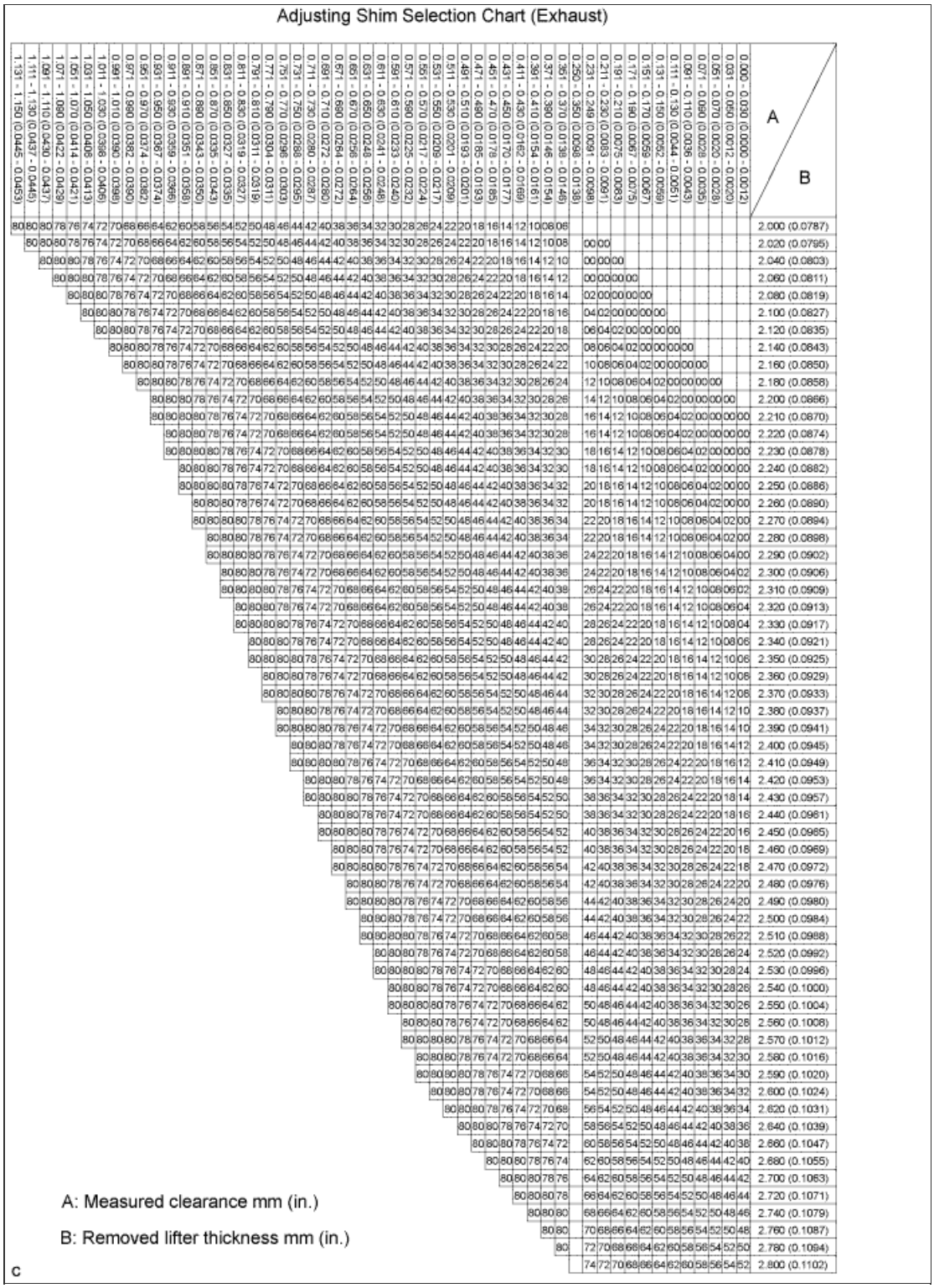


Intake valve clearance (Cold):
0.15 to 0.25 mm (0.00591 to 0.00984 in.)
EXAMPLE:
The 2.300 mm (0.0906 in.) shim is installed, and the measured clearance is 0.440 mm (0.0173 in.). Replace the 2.300 mm (0.0906 in.) shim with a No. 54 shim.

New Shim Thickness:

Shim No.	Thickness	Shim No.	Thickness	Shim No.	Thickness
00	2.000 mm (0.0787 in.)	28	2.280 mm (0.0898 in.)	56	2.560 mm (0.1008 in.)
02	2.020 mm (0.0795 in.)	30	2.300 mm (0.0906 in.)	58	2.580 mm (0.1016 in.)

04	2.040 mm (0.0803 in.)	32	2.320 mm (0.0913 in.)	60	2.600 mm (0.1024 in.)
06	2.060 mm (0.0811 in.)	34	2.340 mm (0.0921 in.)	62	2.620 mm (0.1031 in.)
08	2.080 mm (0.0819 in.)	36	2.360 mm (0.0929 in.)	64	2.640 mm (0.1039 in.)
10	2.100 mm (0.0827 in.)	38	2.380 mm (0.0937 in.)	66	2.660 mm (0.1047 in.)
12	2.120 mm (0.0835 in.)	40	2.400 mm (0.0945 in.)	68	2.680 mm (0.1055 in.)
14	2.140 mm (0.0843 in.)	42	2.420 mm (0.0953 in.)	70	2.700 mm (0.1063 in.)
16	2.160 mm (0.0850 in.)	44	2.440 mm (0.0961 in.)	72	2.720 mm (0.1071 in.)
18	2.180 mm (0.0858 in.)	46	2.460 mm (0.0969 in.)	74	2.740 mm (0.1079 in.)
20	2.200 mm (0.0866 in.)	48	2.480 mm (0.0976 in.)	76	2.760 mm (0.1087 in.)
22	2.220 mm (0.0874 in.)	50	2.500 mm (0.0984 in.)	78	2.780 mm (0.1094 in.)
24	2.240 mm (0.0882 in.)	52	2.520 mm (0.0992 in.)	80	2.800 mm (0.1102 in.)
26	2.260 mm (0.0890 in.)	54	2.540 mm (0.1000 in.)	-	-



Exhaust valve clearance (Cold):
0.25 to 0.35 mm (0.00984 to 0.0138 in.)
EXAMPLE:
The 2.300 mm (0.0906 in.) shim is installed, and the measured clearance is 0.440 mm (0.0173 in.). Replace the 2.300 mm (0.0906 in.) shim with a No. 44 shim.

New Shim Thickness:

Shim No.	Thickness	Shim No.	Thickness	Shim No.	Thickness
00	2.000 mm (0.0787 in.)	28	2.280 mm (0.0898 in.)	56	2.560 mm (0.1008 in.)
02	2.020 mm (0.0795 in.)	30	2.300 mm (0.0906 in.)	58	2.580 mm (0.1016 in.)
04	2.040 mm (0.0803 in.)	32	2.320 mm (0.0913 in.)	60	2.600 mm (0.1024 in.)
	2.060 mm		2.340 mm		2.620 mm

06	(0.0811 in.)	34	(0.0921 in.)	62	(0.1031 in.)
08	2.080 mm (0.0819 in.)	36	2.360 mm (0.0929 in.)	64	2.640 mm (0.1039 in.)
10	2.100 mm (0.0827 in.)	38	2.380 mm (0.0937 in.)	66	2.660 mm (0.1047 in.)
12	2.120 mm (0.0835 in.)	40	2.400 mm (0.0945 in.)	68	2.680 mm (0.1055 in.)
14	2.140 mm (0.0843 in.)	42	2.420 mm (0.0953 in.)	70	2.700 mm (0.1063 in.)
16	2.160 mm (0.0850 in.)	44	2.440 mm (0.0961 in.)	72	2.720 mm (0.1071 in.)
18	2.180 mm (0.0858 in.)	46	2.460 mm (0.0969 in.)	74	2.740 mm (0.1079 in.)
20	2.200 mm (0.0866 in.)	48	2.480 mm (0.0976 in.)	76	2.760 mm (0.1087 in.)
22	2.220 mm (0.0874 in.)	50	2.500 mm (0.0984 in.)	78	2.780 mm (0.1094 in.)
24	2.240 mm (0.0882 in.)	52	2.520 mm (0.0992 in.)	80	2.800 mm (0.1102 in.)
26	2.260 mm (0.0890 in.)	54	2.540 mm (0.1000 in.)	-	-

f. Apply a light coat of engine oil to the valve lifters, adjusting shims and valve stem tip.

g. Place a new adjusting shim on the valve stem.

NOTICE:

Be careful not to drop the adjusting shim into the cylinder head.

h. Place the valve lifter.

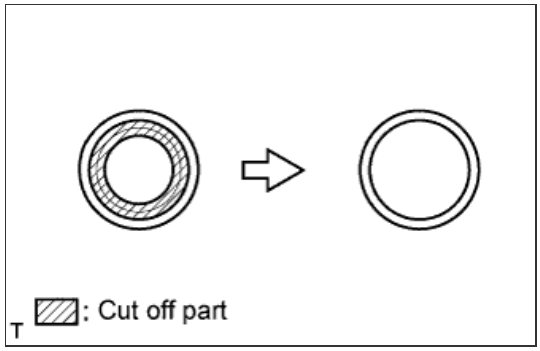
i. Install the camshaft (lick here).

j. Install the timing belt (lick here).

k. heck the valve clearance.
If the result is not as specified, adjust the valve clearance.

14. INSTALL SPARK PLUG TUBE GASKET

a. Using a cutter knife, cut off the seal part of the removed gasket.



b. Using the removed gasket and a hammer, tap in a new gasket until it stops.

NOTICE:

Do not tap on the oil seal at an angle.

HINT:

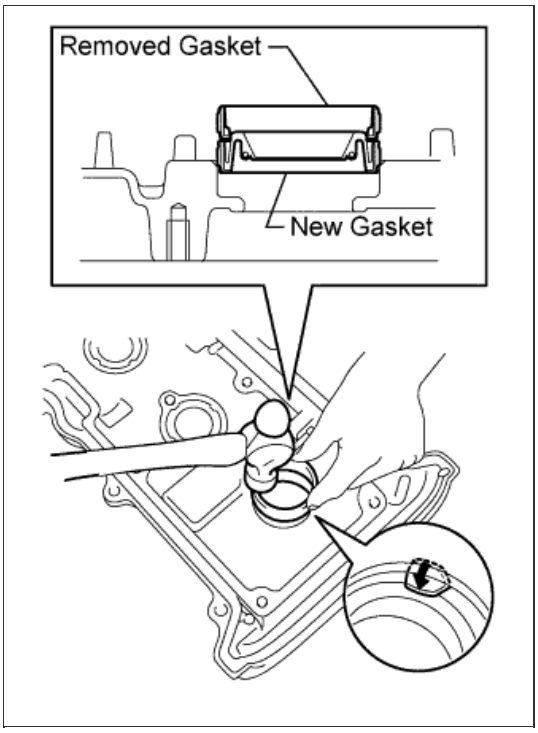
If the removed gasket does not fit on the new one, correct the removed one with pliers.

c. Apply a light coat of MP grease to the lip of the gasket.

NOTICE:

eep the lip free from foreign matter.

d. Return the 8 ventilation case claws to the original positions.



15. INSTALL SEMICIRCULAR PLUG

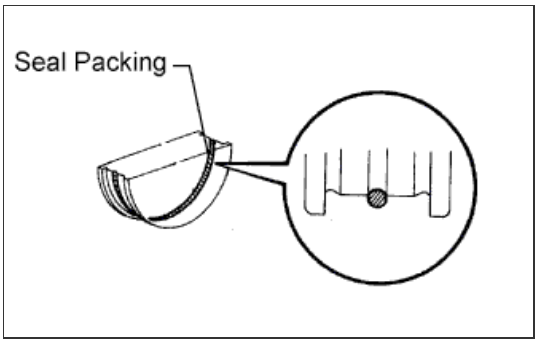
a. Apply seal packing to the semicircular plug grooves.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

b. Install the 4 semicircular plugs to the cylinder heads.

NOTICE:

Install the cylinder head cover within 3 minutes after applying seal packing.



16. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY LH

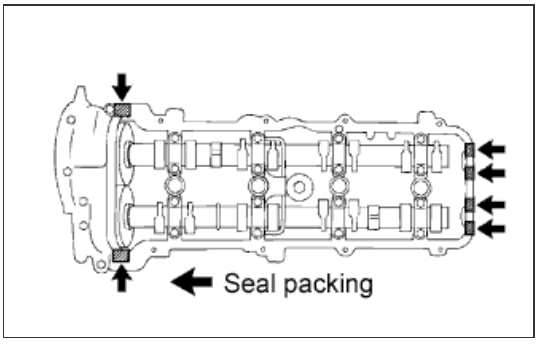
a. Install a new gasket to the cylinder head cover.

b. Apply seal packing to the cylinder head as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

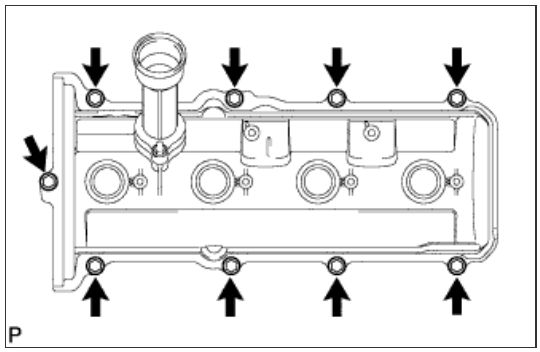
NOTICE:

- **Remove any oil from the contact surface.**
- **Install the cylinder head cover within 3 minutes after applying seal packing.**



c. Install the cylinder head cover with the 9 bolts. Uniformly tighten the bolts in several steps.

Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }



17. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY

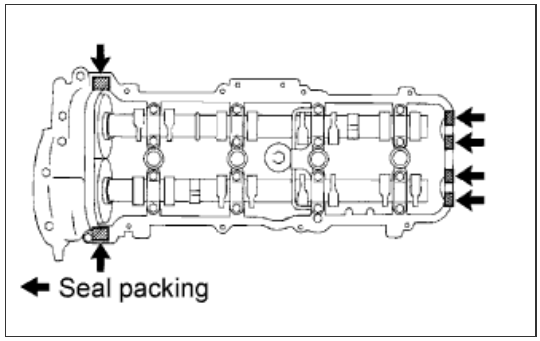
a. Install a new gasket to the cylinder head cover.

b. Apply seal packing to the cylinder head as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

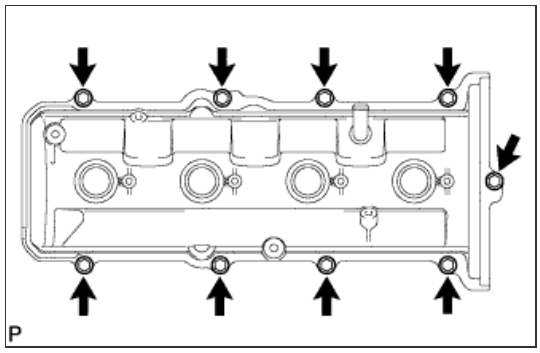
NOTICE:

- **Remove any oil from the contact surface.**
- **Install the cylinder head cover within 3 minutes after applying seal packing.**



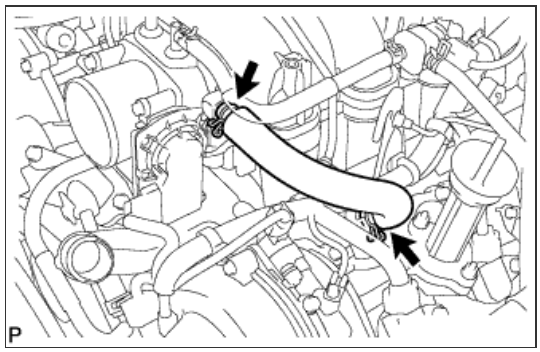
c. Install the cylinder head cover with the 9 bolts. Uniformly tighten the bolts in several steps.

Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }



18. INSTALL NO. 1 VENTILATION HOSE

a. Install the No. 1 ventilation hose to the intake manifold and ventilation valve.



19. INSTALL SPARK PLUG

a. Install the 8 spark plugs.

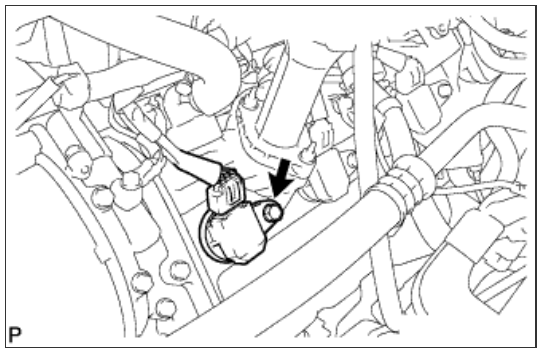
Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

20. INSTALL IGNITION COIL ASSEMBLY

a. Install the 8 ignition coils with the 8 bolts.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }

b. onnect the 8 ignition coil connectors.



21. INSTALL NO. 2 FUEL HOSE

a. for engine side:

i. onnect the fuel hose to the No. 3 fuel pipe.

HINT:

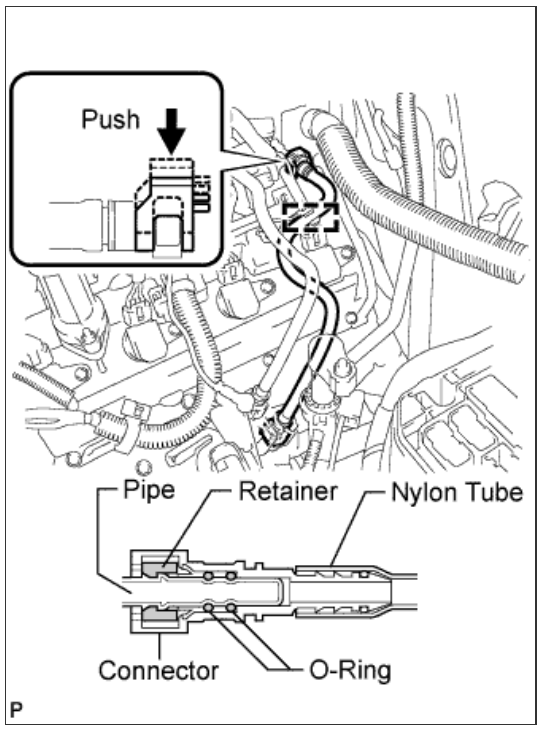
Push the parts together firmly until a click sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

ii. Attach the lock claws to the connector by pushing down on the cover, as shown in the illustration.

iii. Attach the fuel hose clamp.



b. for body side:

i. onnect the fuel hose to the fuel pipe.

HINT:

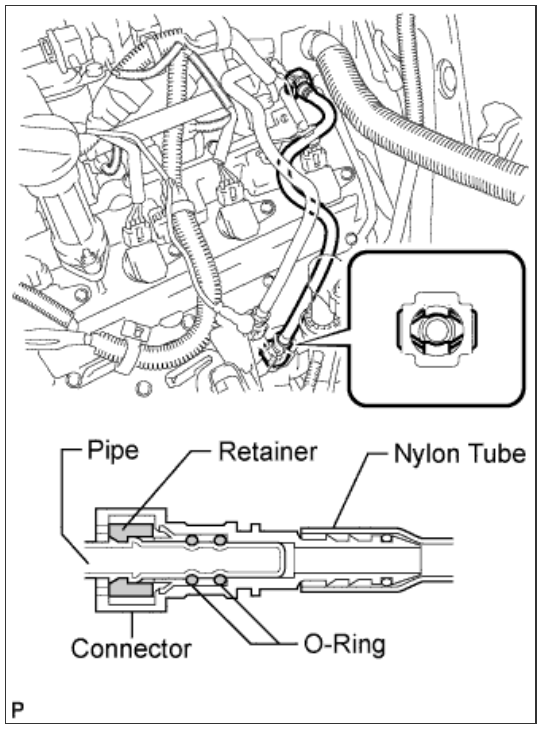
Push the parts together firmly until a click sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes,**

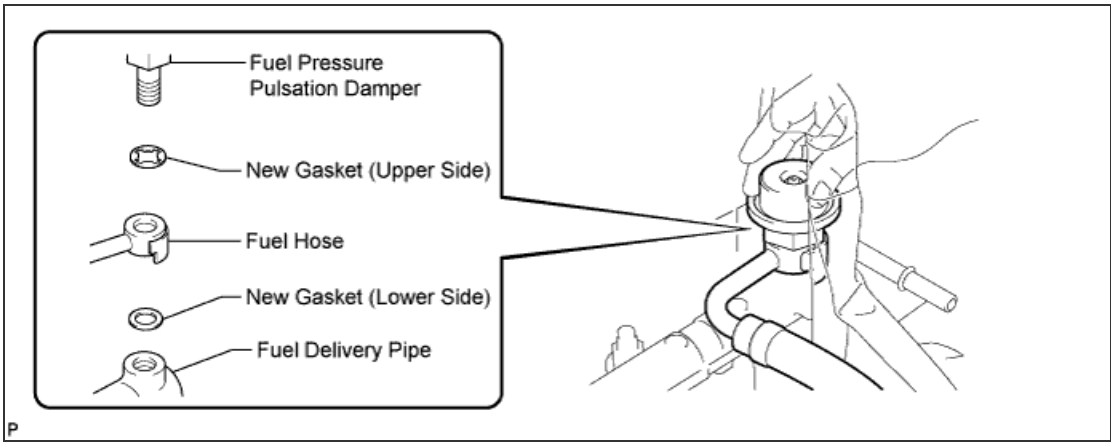
check if there is any damage or foreign matter in the connectors.

- After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.



22. INSTALL FUEL PRESSURE PULSATION DAMPER ASSEMBLY

a. Install 2 new gaskets and the fuel hose with the fuel pressure pulsation damper.



NOTICE:

Make sure to install the gaskets in the order shown in the illustration, as the shape of the upper side and lower side gaskets is different.

b. Tighten the fuel pressure pulsation damper by hand.

c. Using SST, tighten the union bolt.

SST

09612-24014 (09617-24011)

Torque:

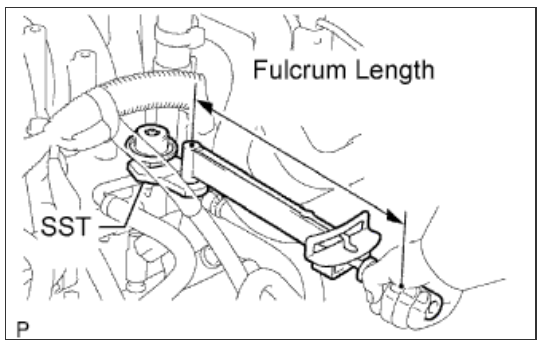
with SST:

33 N*m{ 340 kgf*cm , 24 ft.*lbf }

without SST:

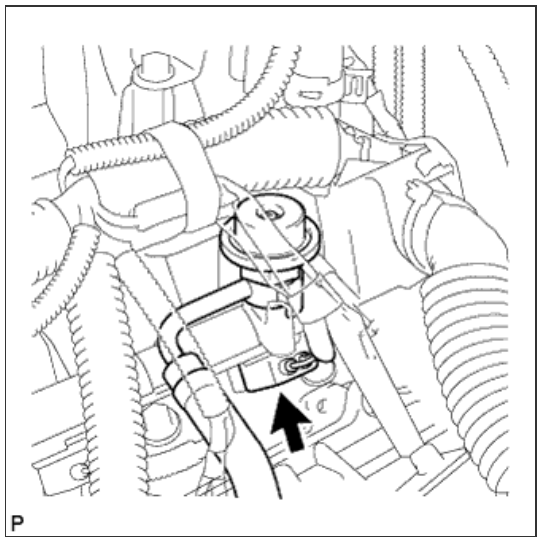
39 N*m{ 398 kgf*cm , 29 ft.*lbf }

HINT:



- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure SST and the wrench are connected in a straight line.**

d. onnect the fuel injector connector.



23. CONNECT FUEL HOSE

a. onnect the fuel hose.

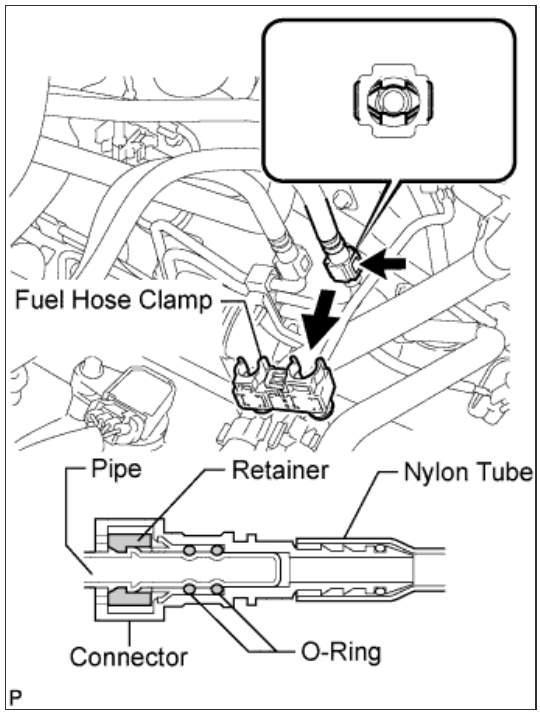
HINT:

Push the parts together firmly until a click sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Install the fuel hose clamp.

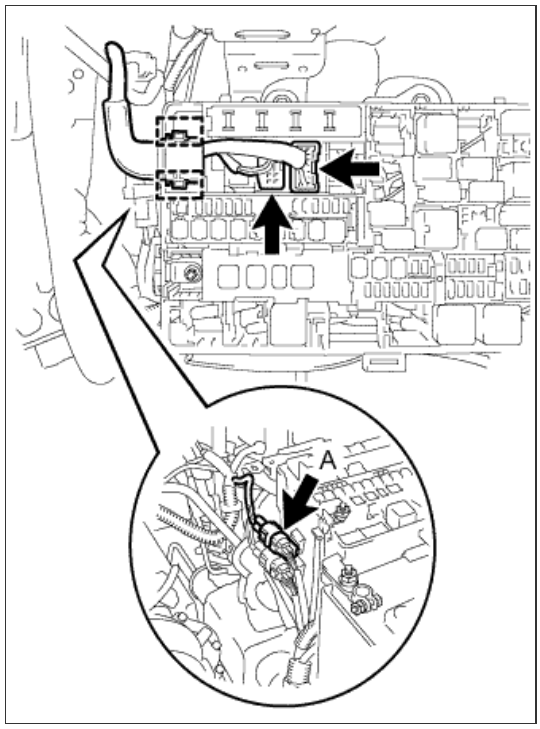


24. CONNECT WIRE HARNESS

a. onnect connector A to the engine room relay block.

b. onnect the 2 connectors and 2 clamps to the engine room relay block.

c. onnect the wire harness clamp to the cylinder head cover LH.

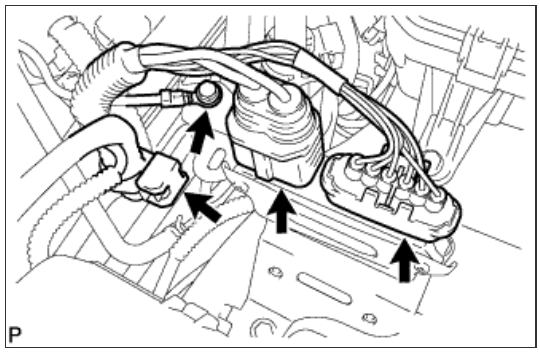


d. onnect the wire harness clamp.

e. onnect the ground wire with the bolt.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

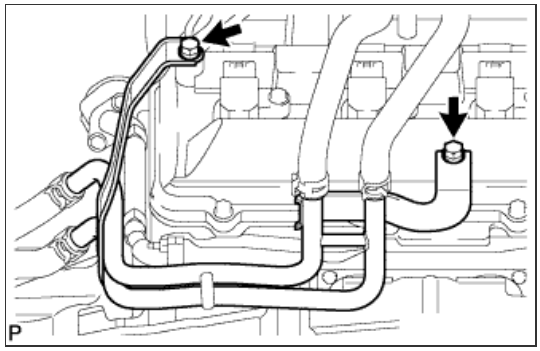
f. onnect the 2 air injection control driver connectors.



25. INSTALL NO. 1 WATER BY-PASS PIPE (w/ Air Cooled Transmission Oil Cooler)

a. Install the water by-pass pipe with the 2 bolts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

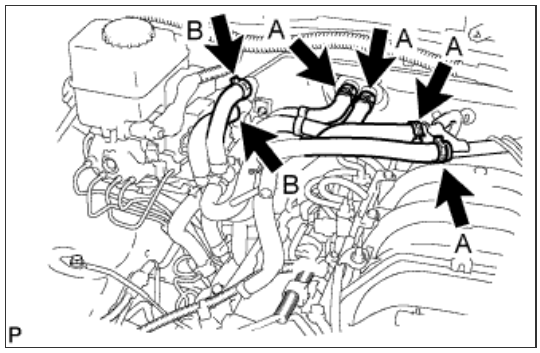


26. CONNECT WATER HOSE SUB-ASSEMBLY

a. onnect the water by-pass hose.

i. w/ Rear Heater:
onnect the water hoses labeled A and B.

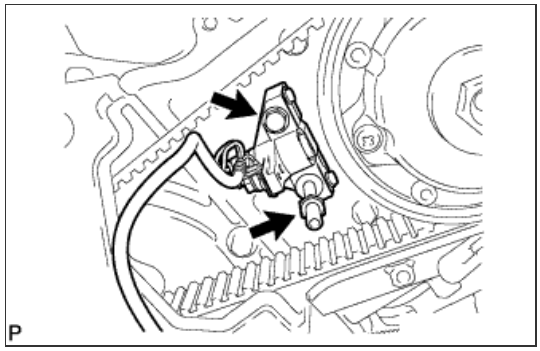
ii. w/o Rear Heater:
onnect the water hoses labeled A.



27. INSTALL CAMSHAFT POSITION SENSOR ASSEMBLY

a. Install the camshaft position sensor with the bolt and stud bolt.

Torque:
7.5 N*m{ 80 kgf*cm , 66 in.*lbf }

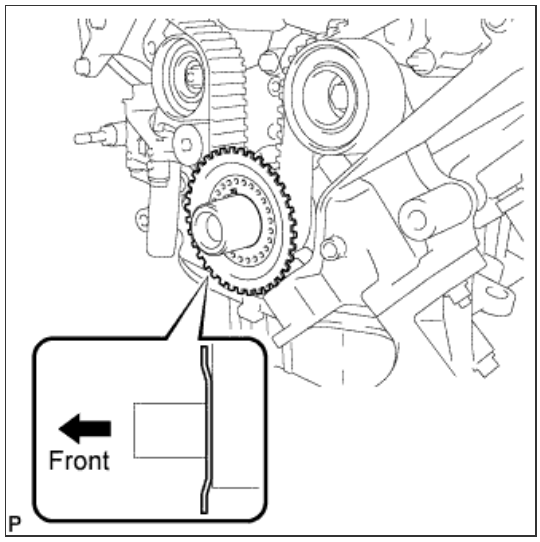


28. INSTALL NO. 1 CRANKSHAFT POSITION SENSOR PLATE

a. Install the sensor plate as shown in the illustration.

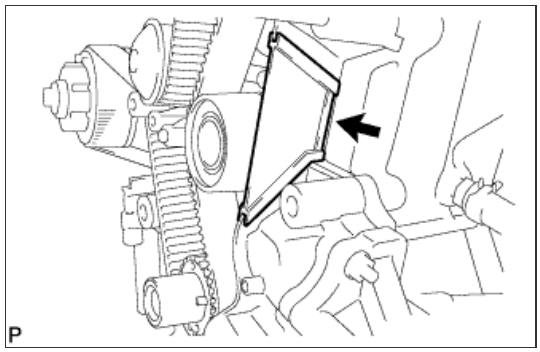
NOTICE:

Take care not to install the sensor plate in a wrong direction.



29. INSTALL TIMING BELT COVER SPACER

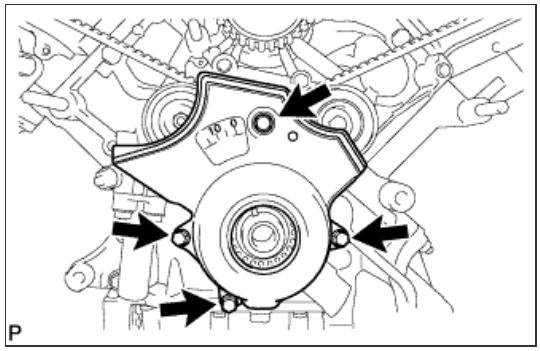
a. Install the cover spacer and gasket.



30. INSTALL NO. 1 TIMING BELT COVER

a. Install the timing belt cover with the 4 bolts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



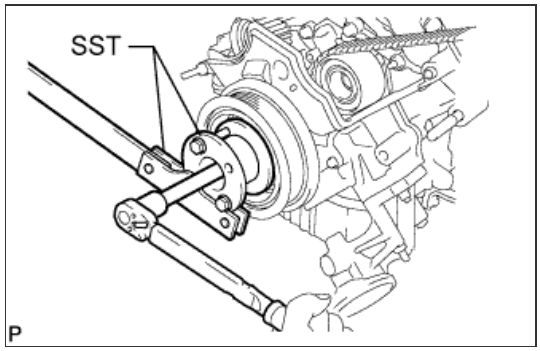
31. INSTALL CRANKSHAFT DAMPER SUB-ASSEMBLY

a. Align the pulley set key with the key groove of the crankshaft damper.

b. Using SST, hold the crankshaft pulley and install the pulley bolt.

SST
09213-70011 (09213-70020)
09330-00021 (09330-00030)

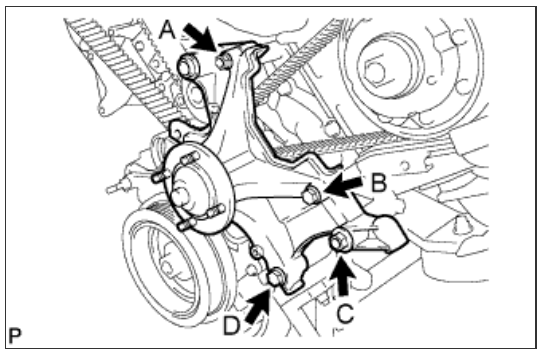
Torque:
245 N*m{ 2498 kgf*cm , 181 ft.*lbf }



32. INSTALL FAN BRACKET SUB-ASSEMBLY

a. Install the fan bracket with the 2 bolts and 2 nuts.

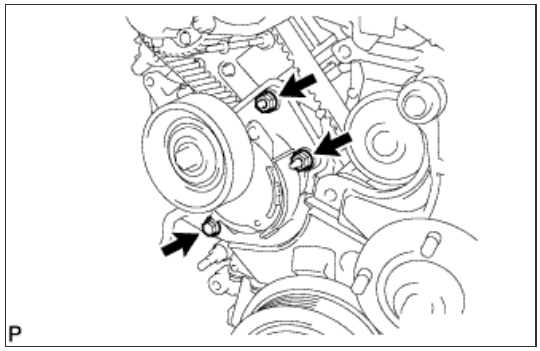
Torque:
for nut A, bolt B:
16 N*m{ 163 kgf*cm , 12 ft.*lbf }
for nut C, bolt D:
32 N*m{ 326 kgf*cm , 24 ft.*lbf }



33. INSTALL V-RIBBED BELT TENSIONER ASSEMBLY

a. Install the belt tensioner with the bolt and 2 nuts.

Torque:
16 N*m{ 163 kgf*cm , 12 ft.*lbf }

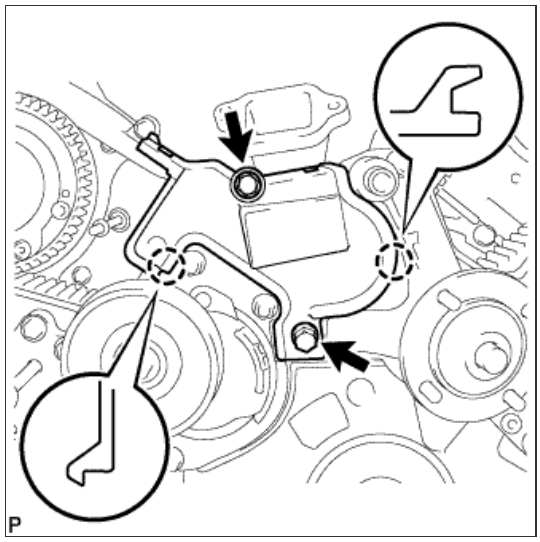


34. INSTALL NO. 2 TIMING BELT COVER SUB-ASSEMBLY

a. Install the timing belt cover and fit the 2 claws into each part.

b. Install the 2 bolts.

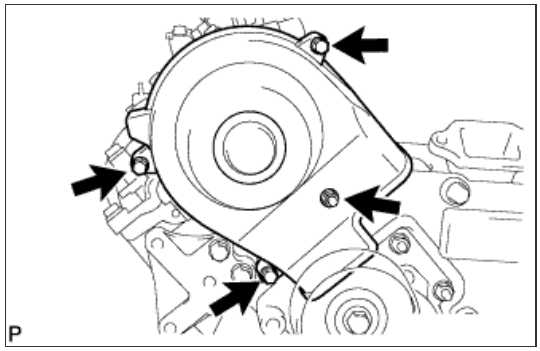
Torque:
16 N*m{ 163 kgf*cm , 12 ft.*lbf }



35. INSTALL NO. 3 TIMING BELT COVER SUB-ASSEMBLY RH

a. Install the timing belt cover with the 3 bolts and nut.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



36. INSTALL NO. 3 TIMING BELT COVER SUB-ASSEMBLY LH

a. Pass the camshaft position sensor wire through the cover hole.

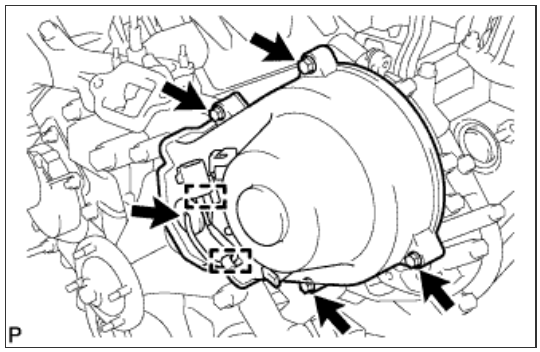
b. Install the timing belt cover with the 4 bolts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

c. Install the wire grommet to the timing belt cover.

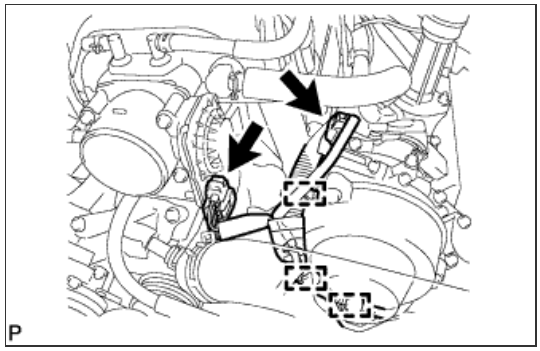
d. onnect the sensor connector.

e. Install the sensor wire to the 2 wire clamps on the cover.



f. onnect the engine wire to the 3 wire clamps.

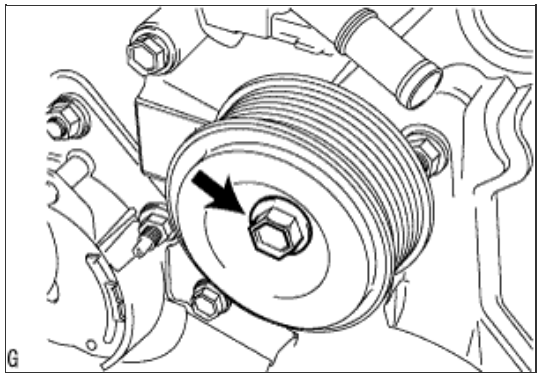
g. onnect the camshaft timing oil control valve connector and control motor connector.



37. INSTALL NO. 2 IDLER PULLEY SUB-ASSEMBLY

a. Install the idler pulley and cover plate with the bolt.

Torque:
39 N*m{ 398 kgf*cm , 29 ft.*lbf }

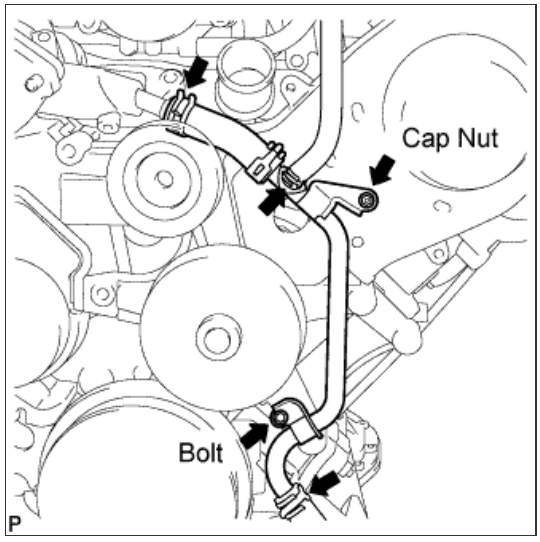


38. INSTALL OIL COOLER PIPE

a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to connect the 3 water by-pass hoses.

b. Install the oil cooler pipe with the cap nut and bolt.

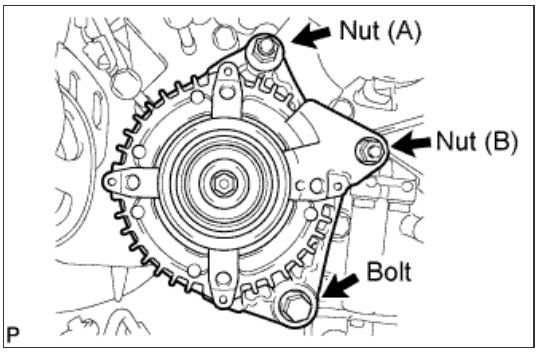
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



39. INSTALL GENERATOR ASSEMBLY

a. Install the generator with the bolt and 2 nuts.

Torque:
for bolt and nut (A):
39 N*m{ 398 kgf*cm , 29 ft.*lbf }
for nut (B):
16 N*m{ 158 kgf*cm , 11 ft.*lbf }



b. onnect the generator connector.

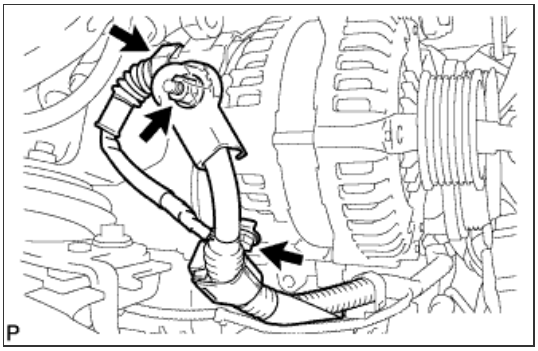
c. onnect the generator wire with the nut.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }

d. Install the terminal cap.

e. onnect the harness bracket to the generator with the bolt.

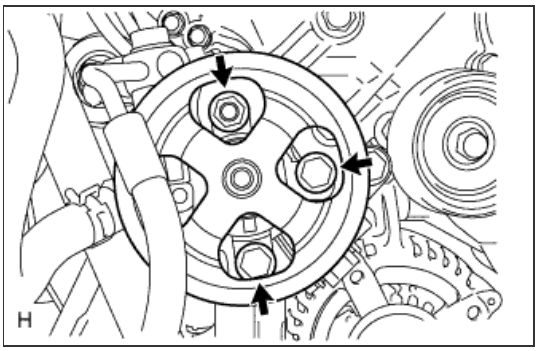
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }



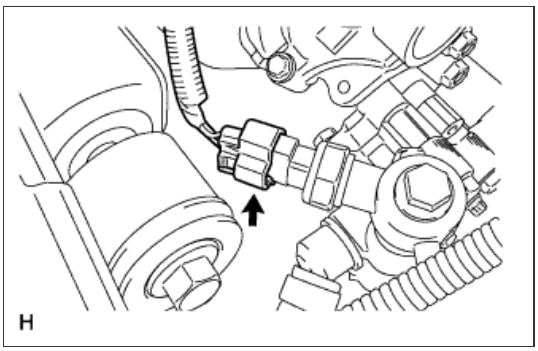
40. CONNECT VANE PUMP ASSEMBLY

a. onnect the vane pump with the 2 bolts and nut.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



b. onnect the connector.



41. CONNECT COOLER COMPRESSOR ASSEMBLY

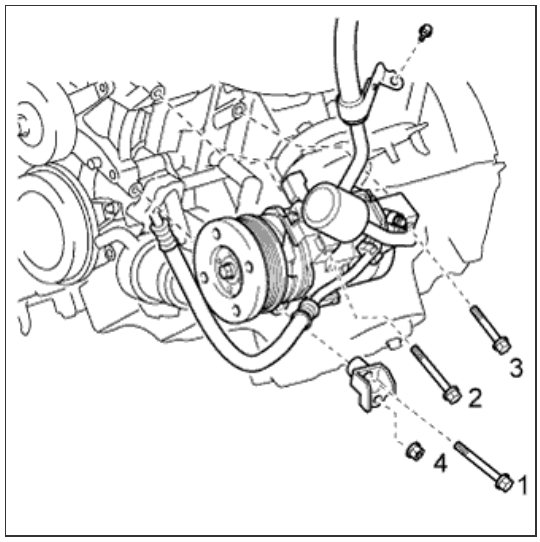
a. onnect the compressor. Then install it and the No. 1 compressor stay with the

nut and 3 bolts.

Torque:
for bolt:
45 N*m{ 459 kgf*cm , 33 ft.*lbf }
for nut:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }

HINT:

Tighten the bolts in the order shown in the illustration to install the cooler compressor.



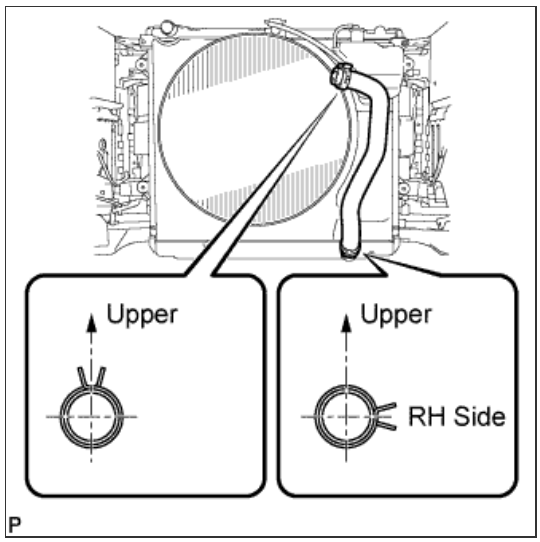
b. Install the cooler refrigerant suction hose with the bolt.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }

c. onnect the connector.

42. INSTALL NO. 2 RADIATOR HOSE

a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to install the radiator hose.



43. INSTALL FAN SHROUD

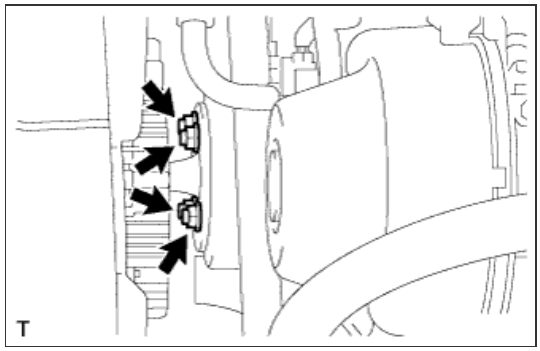
a. Install the fan pulley to the water pump.

b. Place the shroud together with the cooling fan between the radiator and engine.

NOTICE:

Be careful not to damage the radiator core.

c. Temporarily install the cooling fan to the water pump with the 4 nuts. Tighten the nuts as much as possible by hand.



d. Attach the claws of the shroud to the radiator as shown in the illustration.

e. Install the shroud with the 2 bolts.

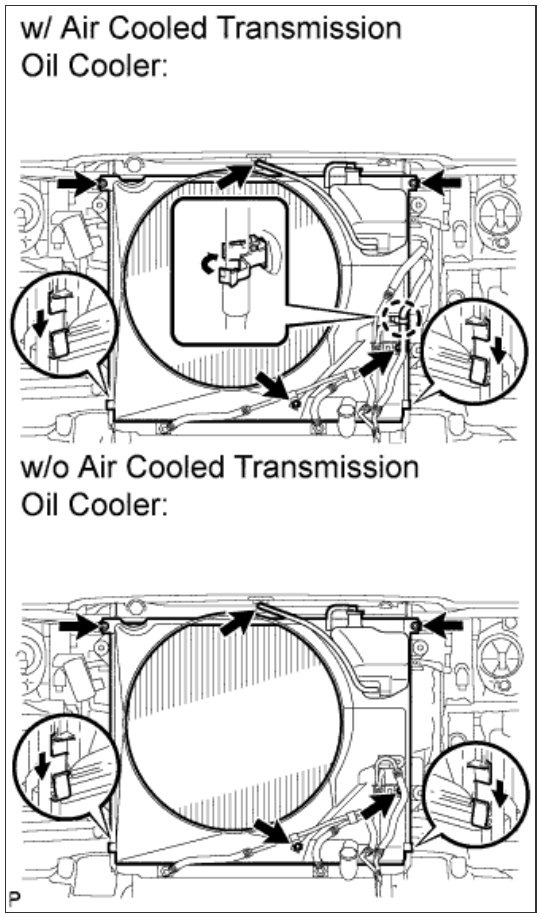
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

f. onnect the oil cooler tube to the fan shroud with the 2 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

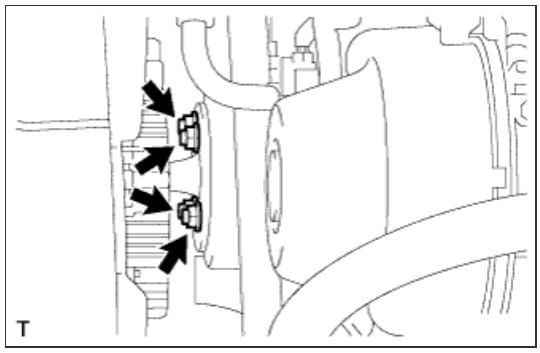
g. w/ Air ooled Transmission il ooler:
Pass the hose through the flexible hose clamp and close the clamp as shown in the illustration.

h. onnect the reservoir hose to the upper side of the radiator tank.



i. Tighten the 4 nuts of the cooling fan.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

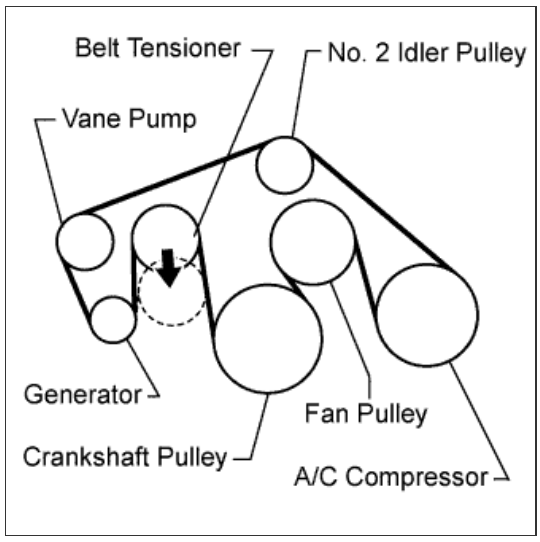


44. INSTALL FAN & GENERATOR V BELT

a. Set the belt onto every part except the belt tensioner, as shown in the illustration.

b. Loosen the belt by turning the belt tensioner counterclockwise.

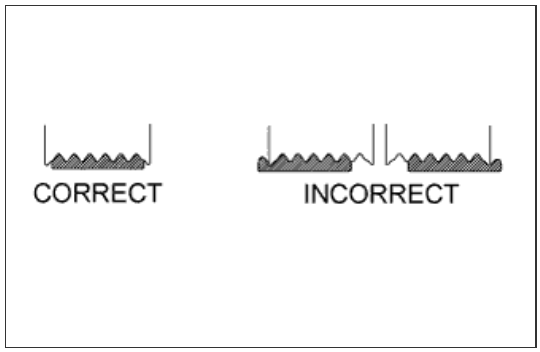
c. Set the belt to the belt tensioner.



d. heck that the belt fits properly in the ribbed grooves.

HINT:

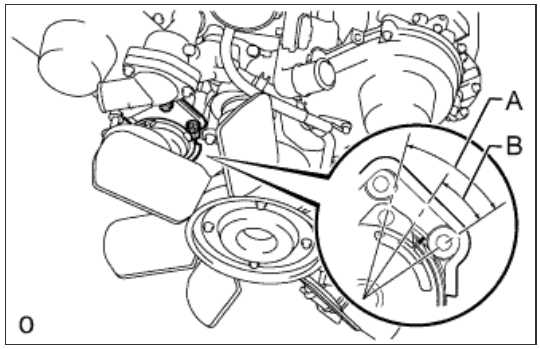
Make sure to check by hand that the belt has not slipped out of the grooves on the bottom of the pulley.



e. heck that the arrow on the belt tensioner is within area A .
If the arrow is outside area A , replace the fan and generator belt.

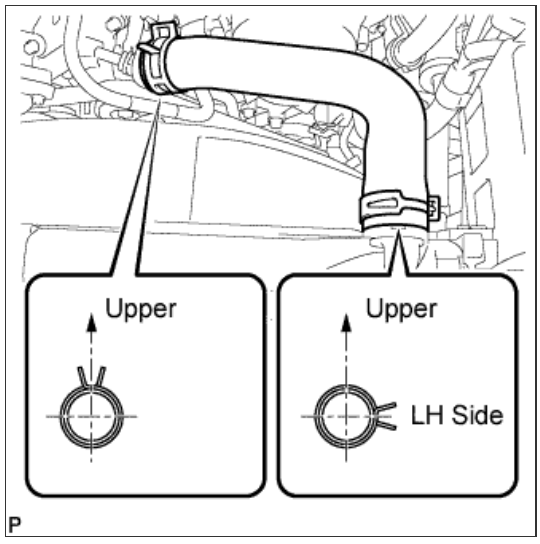
HINT:

When a new belt is installed, the arrow should be within area B . If not, the fan and generator belt is not installed correctly.



45. INSTALL NO. 1 RADIATOR HOSE

a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to install the radiator hose.

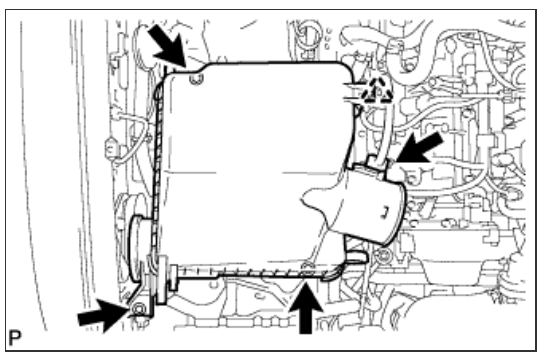


46. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner with the 3 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

b. onnect the clamp and MAF connector.



47. INSTALL AIR CLEANER HOSE ASSEMBLY

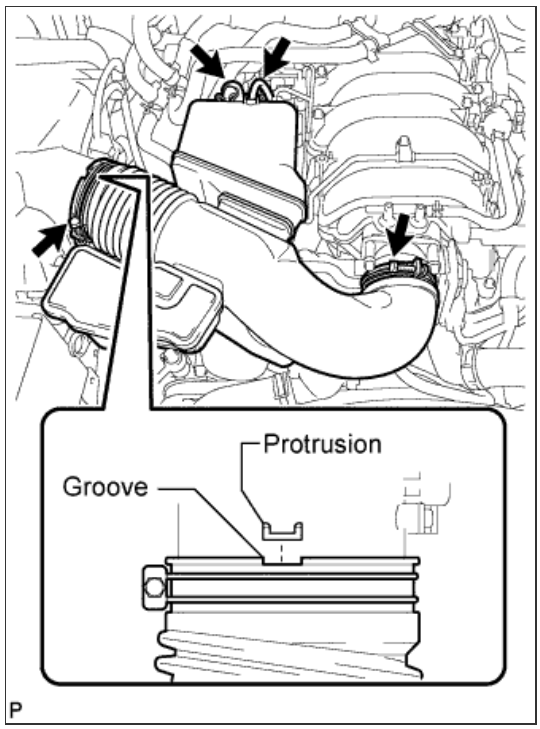
a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. onnect the vacuum transmitting hose.

d. onnect the No. 2 ventilation hose.



48. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (lick here).

49. ADD ENGINE OIL

a. Install a new gasket and the drain plug.

Torque:
39 N*m{ 398 kgf*cm , 29 ft.*lbf }

b. Add new engine oil.

Standard Engine Oil:

il Grade	il iscosity (SA)
API grade SL nergy-onserving , SM nergy-onserving or ILSA multigrade engine oil	10W-30 (10W-30 is best choice for fuel economy and good starting in cold weather).
API grade SL or SM multigrade engine oil	10W-30

Standard Oil Capacity:

Item	Specified ondition
Drain and refill with oil filter change	6.2 liters (6.6 US qts, 5.5 Imp. qts)
Drain and refill without oil filter change	5.7 liters (6.0 US qts, 5.0 Imp. qts)
Dry fill	7.1 liters (7.5 US qts, 6.2 Imp. qts)

50. ADD ENGINE COOLANT

a. Add engine coolant.

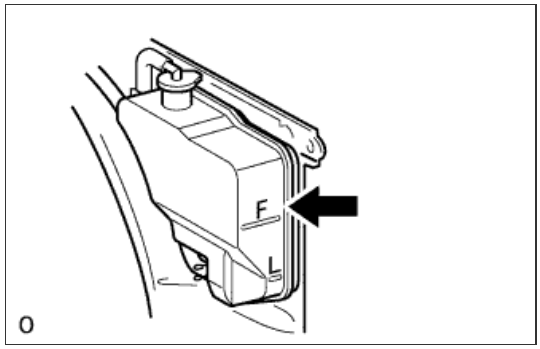
Standard Capacity:

Item		Specified ondition
w/o Transmission oil cooler	w/o Rear Heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)
	w/ Rear Heater	16.3 liters (17.2 US qts, 14.3 Imp. qts)
w/ Transmission oil cooler	w/o Rear Heater	14.1 liters (14.9 US qts, 12.4 Imp. qts)
	w/ Rear Heater	16.9 liters (17.9 US qts, 14.9 Imp. qts)

HINT:

T TA vehicles are filled with T TA SLL at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use T TA SLL or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.



c. Install the radiator reservoir cap.

d. Press the inlet and outlet radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.

NOTICE:

Switch off the A/ .

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

h. Press the inlet and outlet radiator hoses several times by hand to bleed air.

CAUTION:

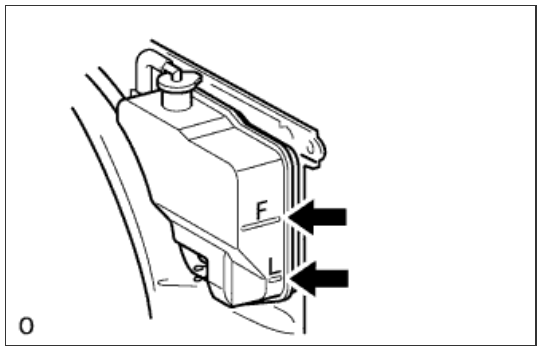
- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the cooling fan.**

i. Stop the engine, and wait until the engine coolant cools down to the ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

j. heck that the coolant level is between the F and L lines. If the coolant level is below the L line, repeat all of the procedures above. If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.



51. INSPECT FOR FUEL LEAK

a. onnect the intelligent tester to the DL 3

b. Turn the engine switch on (IG) and intelligent tester .

NOTICE:

Do not start the engine.

c. nter the following menus: Powertrain / ngine and T / Active Test / Activate the Fuel Pump Speed ontrol.

d. heck that there are no fuel leaks after doing maintenance anywhere on the fuel system.

52. INSPECT FOR OIL LEAK

a. Start the engine. Make sure that there are no oil leaks from the area that was worked on.

53. INSPECT ENGINE OIL LEVEL

a. Warm up the engine, then stop the engine and wait for 5 minutes.

b. heck that the engine oil level is between the low level and full level marks on the dipstick.
If low, check for leakage and add oil up to the full level mark.

NOTICE:

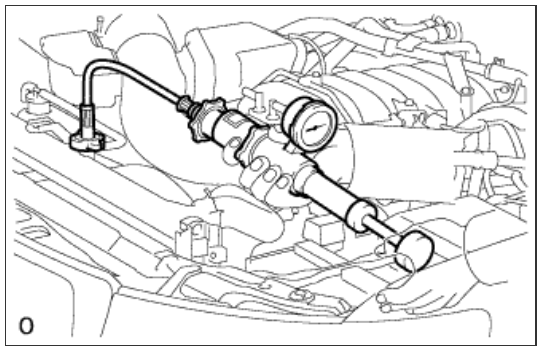
Do not fill engine oil above the full level mark.

54. INSPECT FOR COOLANT LEAK

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



55. INSPECT IGNITION TIMING

a. Warm up and stop the engine.

i. Allow the engine to warm up to a normal operating temperature.

b. When using the intelligent tester:

i. onnect the intelligent tester to the DL 3

NOTICE:

Switch off all accessories and the A/ before connecting the intelligent tester.

ii. Start the engine and idle it.

iii. Push the intelligent tester main switch .

iv. nter the following menus: Powertrain / ngine and T / Data List / Primary / IGN Advance.

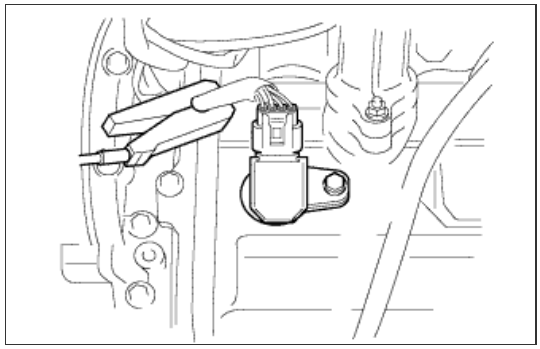
HINT:

Refer to the intelligent tester operator s manual for further details.

Standard ignition timing:
5 to 15° BTDC @ idling (transmission in neutral and A/C switch off)

v. Disconnect the intelligent tester from the DL 3

c. When not using the intelligent tester:



i. Remove the 2 nuts and -bank cover.

ii. onnect the tester probe of a timing light to the wire of the ignition coil connector for the No. 1 cylinder.

NOTICE:

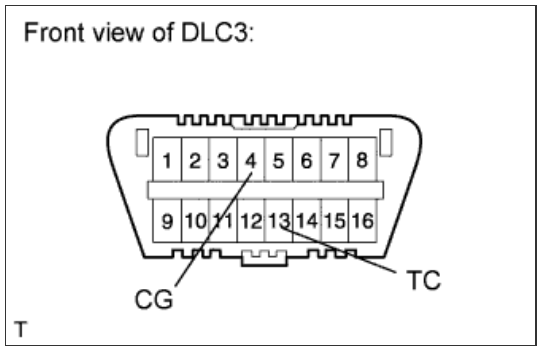
Use a timing light that detects primary signals.

iii. Using SST, connect terminals 13 (T and 4 (of the DL 3

SST
09843-18040

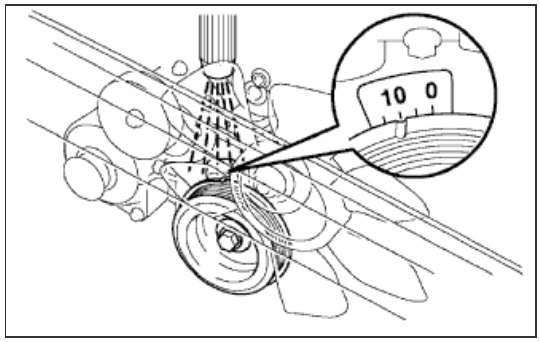
NOTICE:

- **Confirm the terminal numbers before connecting them. Connecting the wrong terminals can damage the engine.**
- **Switch off all accessories and the A/C.**



iv. Using the timing light, check the ignition timing.

Ignition timing:
5 to 15° BTDC @ idling (transmission in neutral and A/C switch off)



v. Remove SST from the DL 3

vi. Disconnect the timing light from the engine.

vii. Install the -bank cover with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

56. INSPECT ENGINE IDLE SPEED

a. Warm up and stop the engine.

i. Allow the engine to warm up to a normal operating temperature.

b. When using the intelligent tester:

i. onnect the intelligent tester to the DL 3

NOTICE:

Switch off all accessories and the A/ before connecting the intelligent tester.

ii. Race the engine at 2500 rpm for approximately 90 seconds.

iii. Push the intelligent tester main switch .

iv. nter the following menus: Powertrain / ngine and T / Data List / Primary / ngine Speed.

Standard idle speed:
650 to 750 rpm (transmission in neutral and A/C switch off)

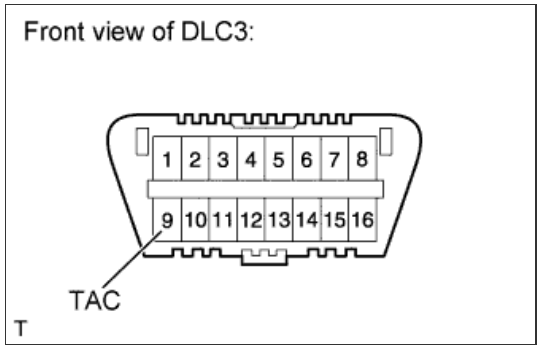
HINT:

Refer to the intelligent tester operator s manual for further details.

If the idle speed is not as specified, check the air intake system.

v. Disconnect the intelligent tester from the DL 3

c. When not using the intelligent tester:



i. Using SST, connect a tachometer probe to terminal 9 (TA)f the DL 3

SST
09843-18030

NOTICE:

- **Confirm the terminal number before connecting the probe. Connecting the probe to the wrong terminal can damage the engine.**
- **Switch off all accessories and the A/C.**

ii. Race the engine at 2500 rpm for approximately 90 seconds.

iii. heck the idle speed.

Standard idle speed:
650 to 750 rpm (transmission in neutral and A/C switch off)

If the idle speed is not as specified, check the air intake system.

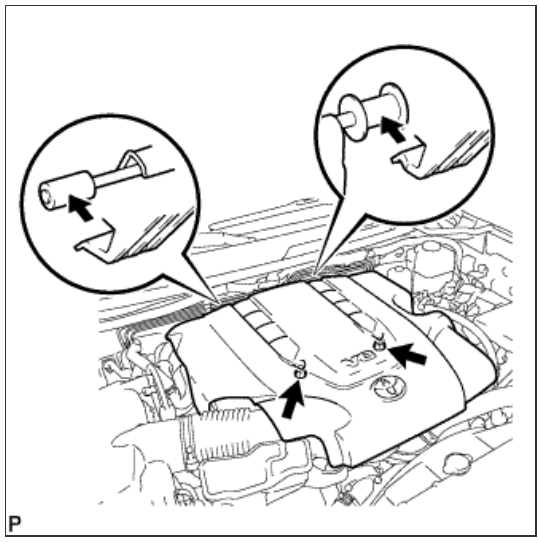
iv. Disconnect the tachometer from the DL 3

57. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 -bank cover hooks to the bracket.

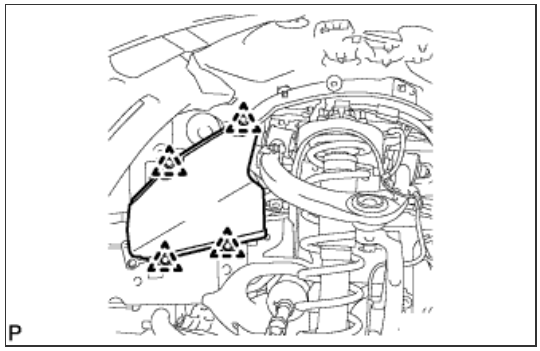
b. Install the -bank cover with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



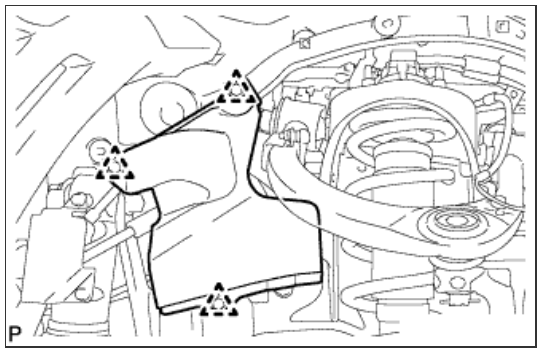
58. INSTALL FRONT FENDER APRON SEAL LH

a. Install the fender apron seal with the 4 clips.



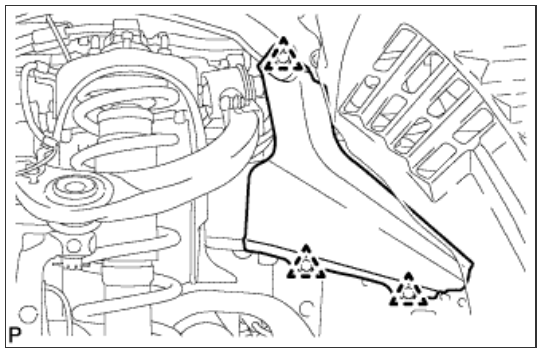
59. INSTALL FRONT FENDER APRON SEAL LH (w/ KDSS)

a. Install the fender apron seal with the 3 clips.



60. INSTALL FRONT FENDER APRON SEAL FRONT RH

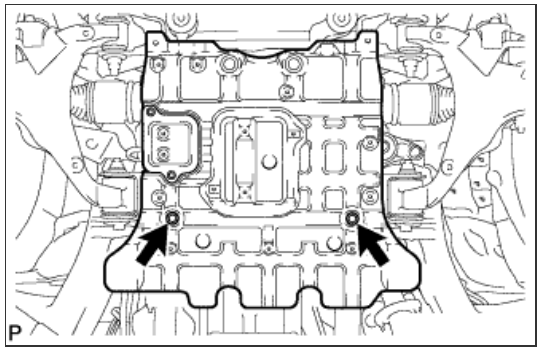
a. Install the fender apron seal with the 3 clips.



61. INSTALL NO. 2 ENGINE UNDER COVER

a. Install the No. 2 engine under cover with the 2 bolts.

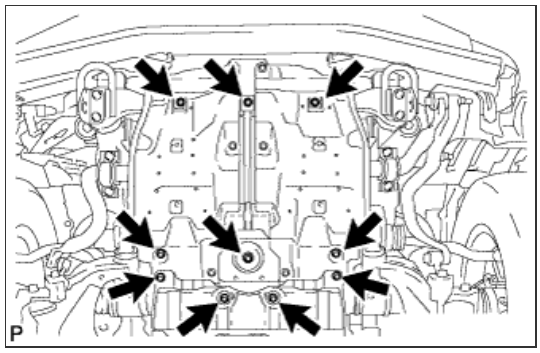
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



62. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the No. 1 engine under cover with the 10 bolts.

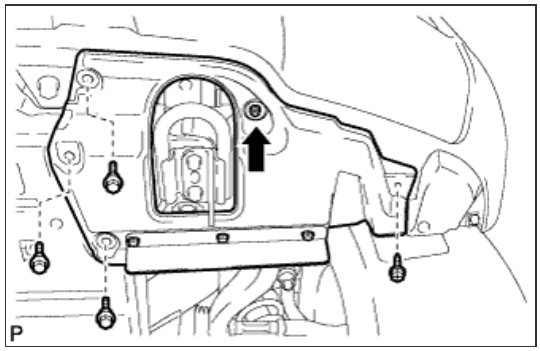
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



63. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



64. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

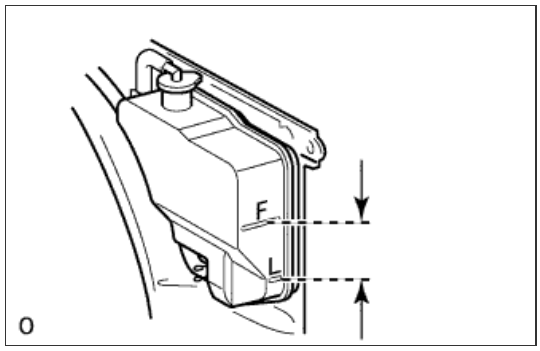
65. INSPECT ENGINE COOLANT LEVEL

a. heck that the engine coolant level is between the L and F lines when the engine is cold.
If the engine coolant is low, check for leaks and add T TA Super Long Life oolant or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite and non-borate coolant with long-life hybrid organic acid technology to the F line.

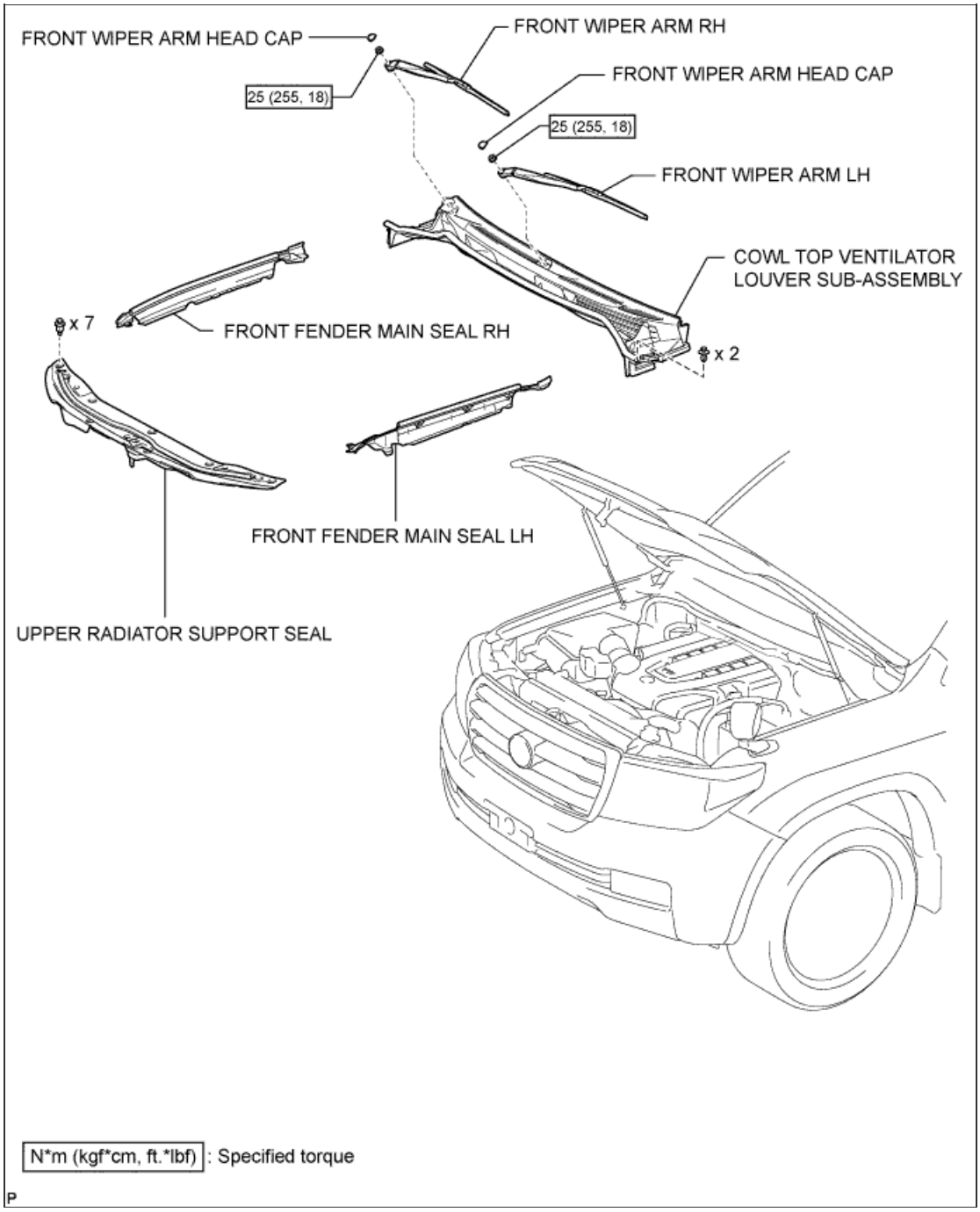
NOTICE:

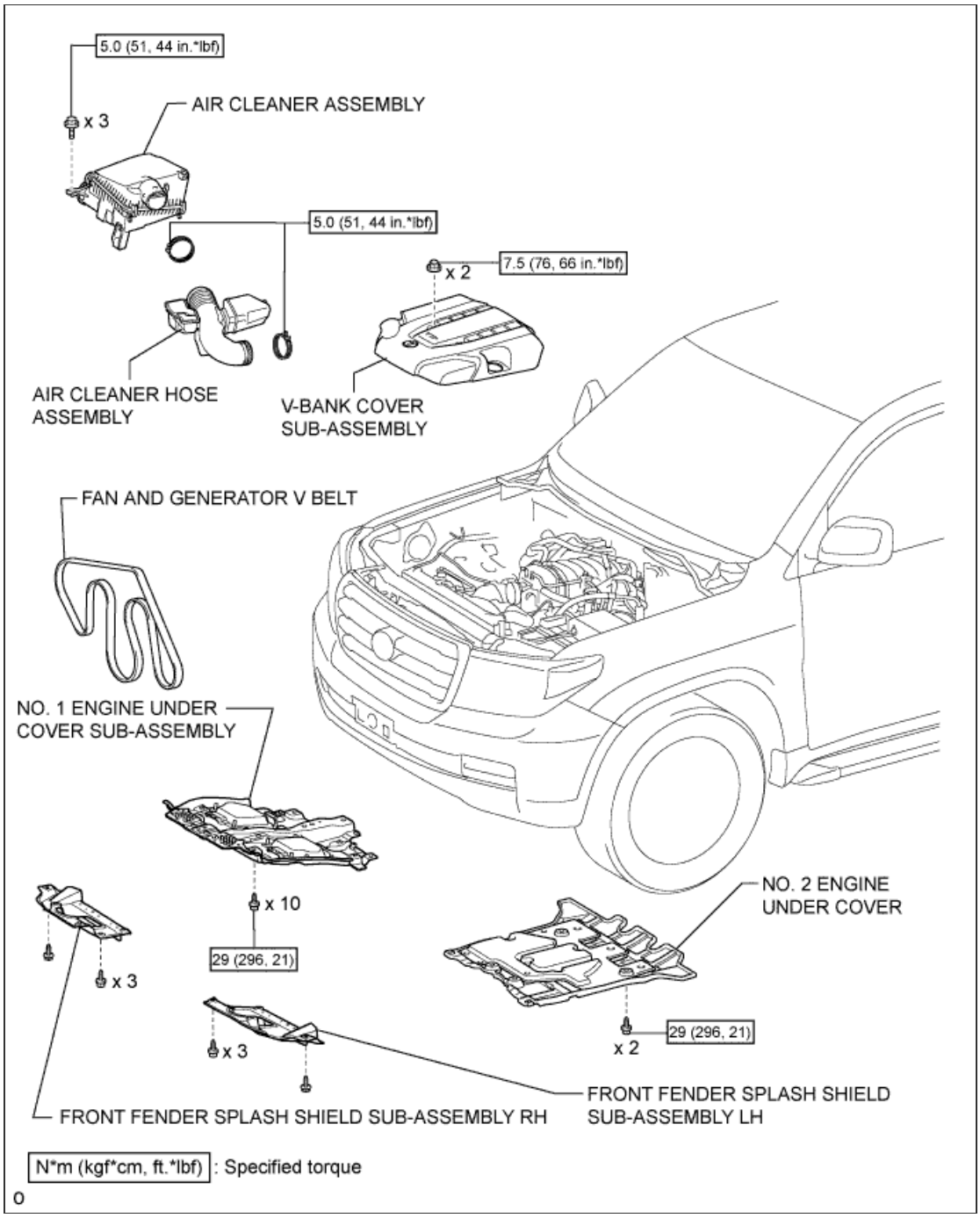
Do not substitute plain water for engine coolant.

b. Remove the radiator cap, and check that the coolant level is up to the radiator filler hole.

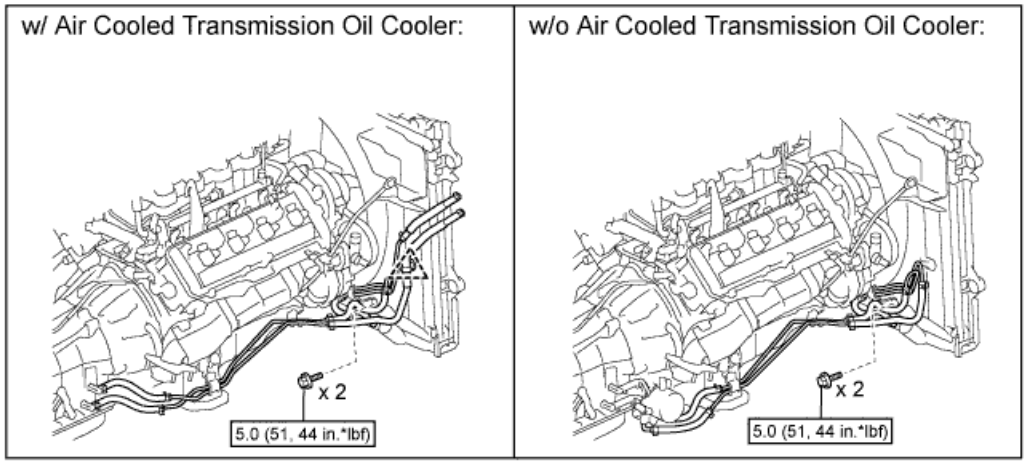


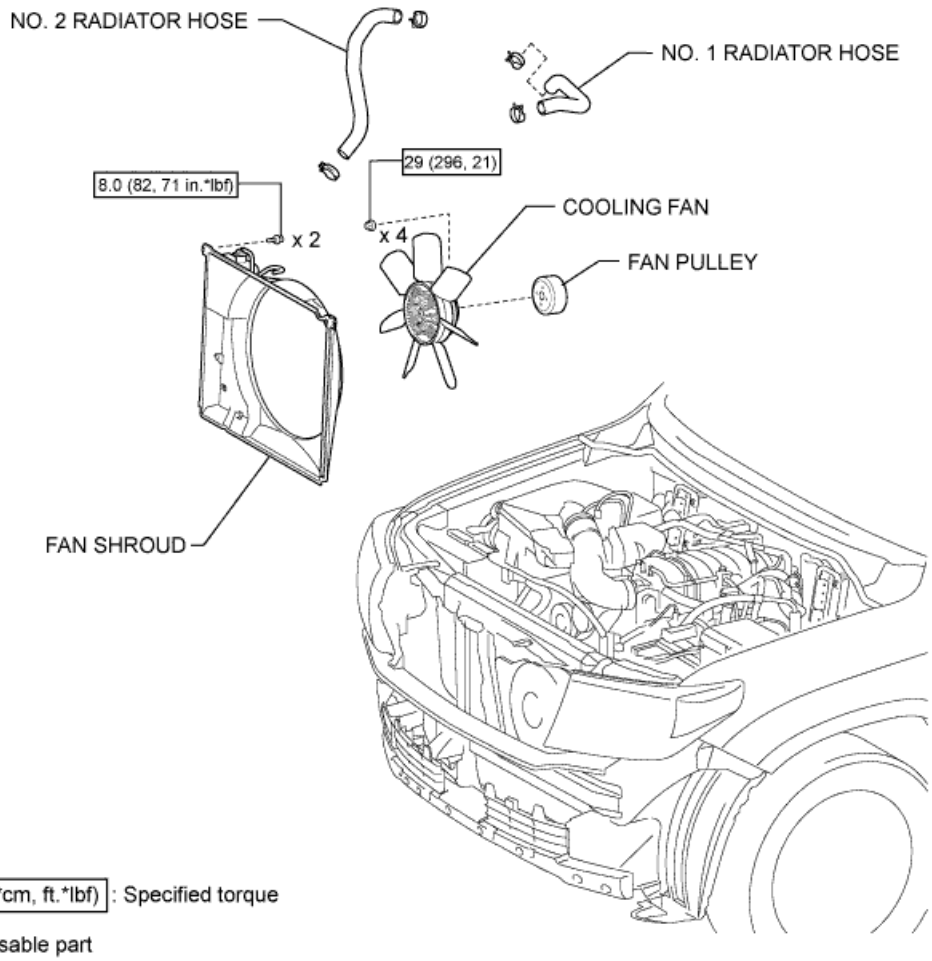
for Preparation Click here




5.0 (51, 44 in.*lbf)
x 3
AIR CLEANER ASSEMBLY
5.0 (51, 44 in.*lbf)
x 2
7.5 (76, 66 in.*lbf)
AIR CLEANER HOSE ASSEMBLY
V-BANK COVER SUB-ASSEMBLY
FAN AND GENERATOR V BELT
NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY
x 10
29 (296, 21)
x 3
NO. 2 ENGINE UNDER COVER
29 (296, 21)
x 2
x 3
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH
N*m (kgf*cm, ft.*lbf) : Specified torque

o

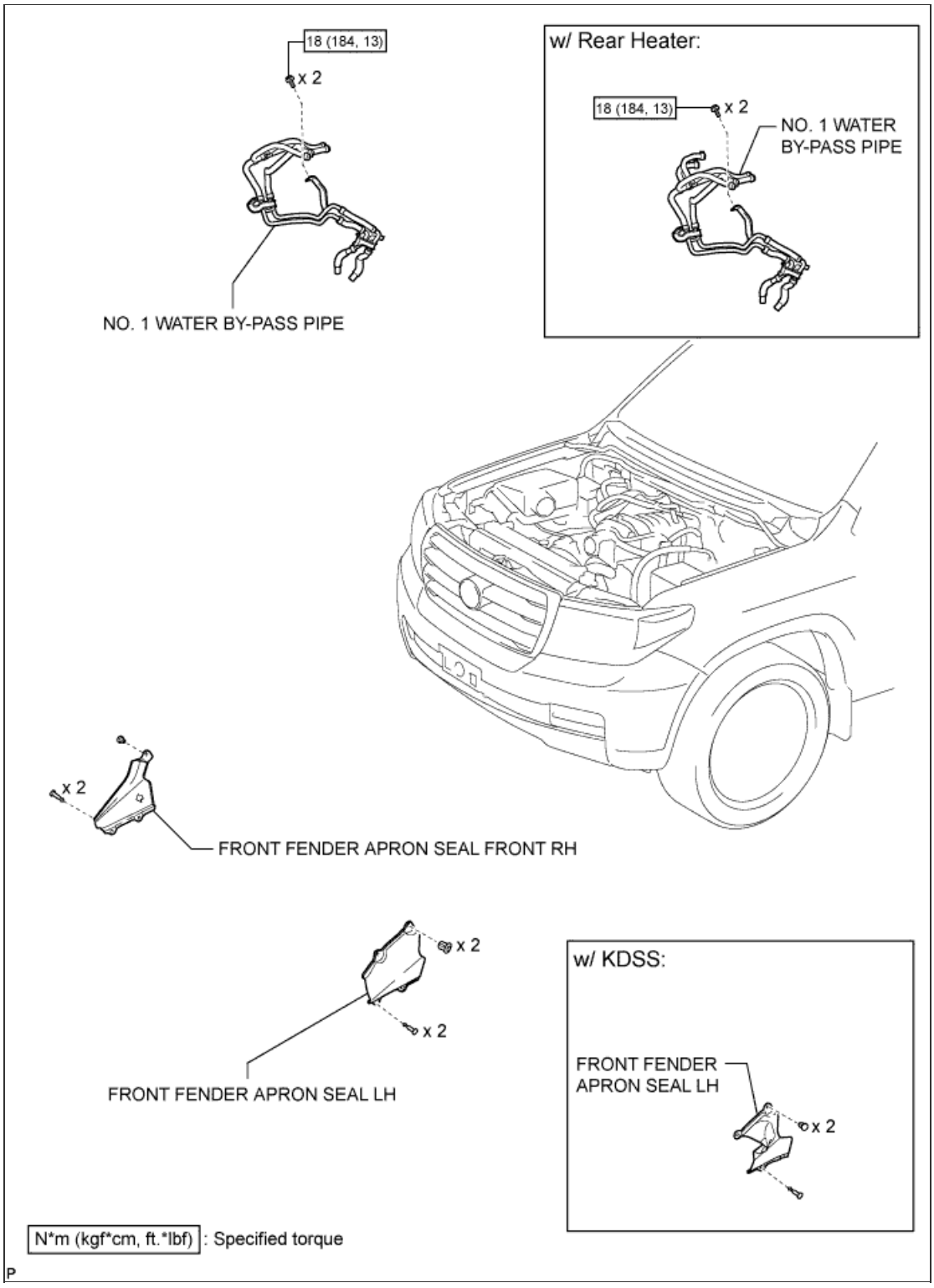


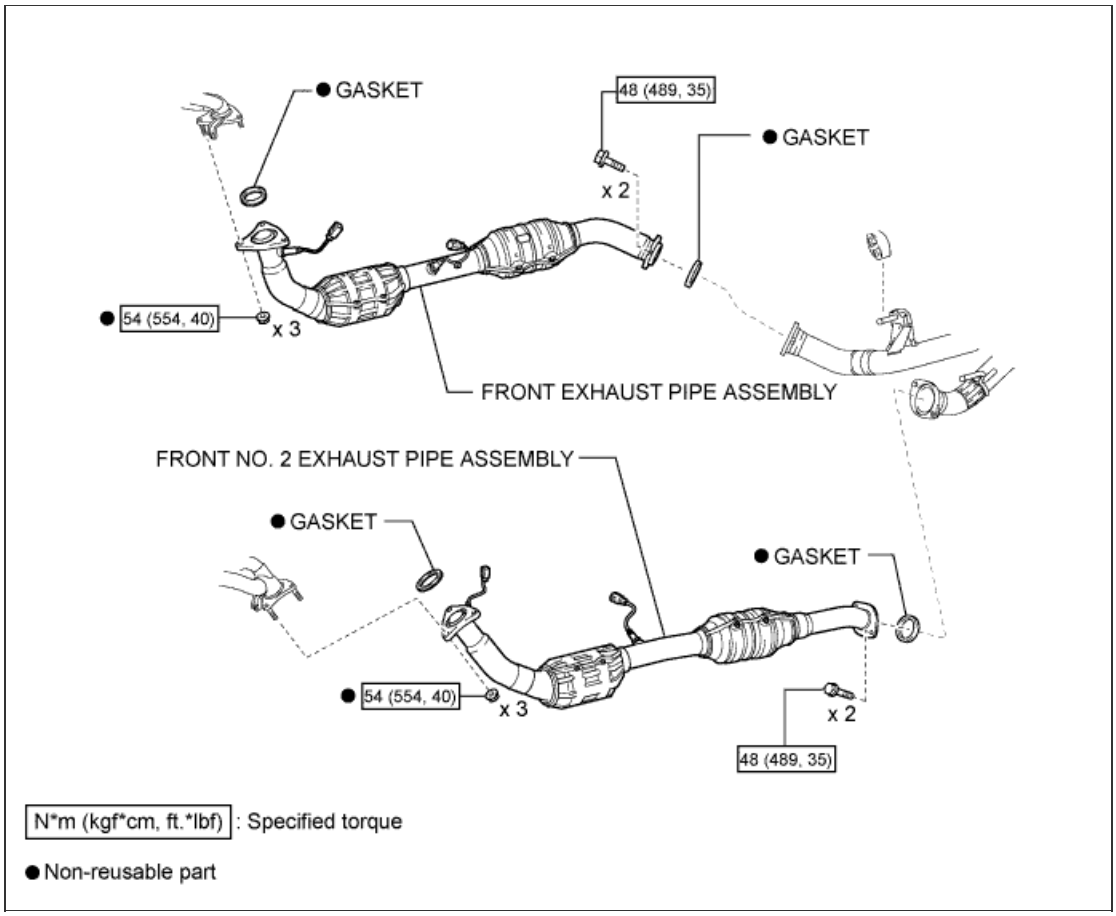


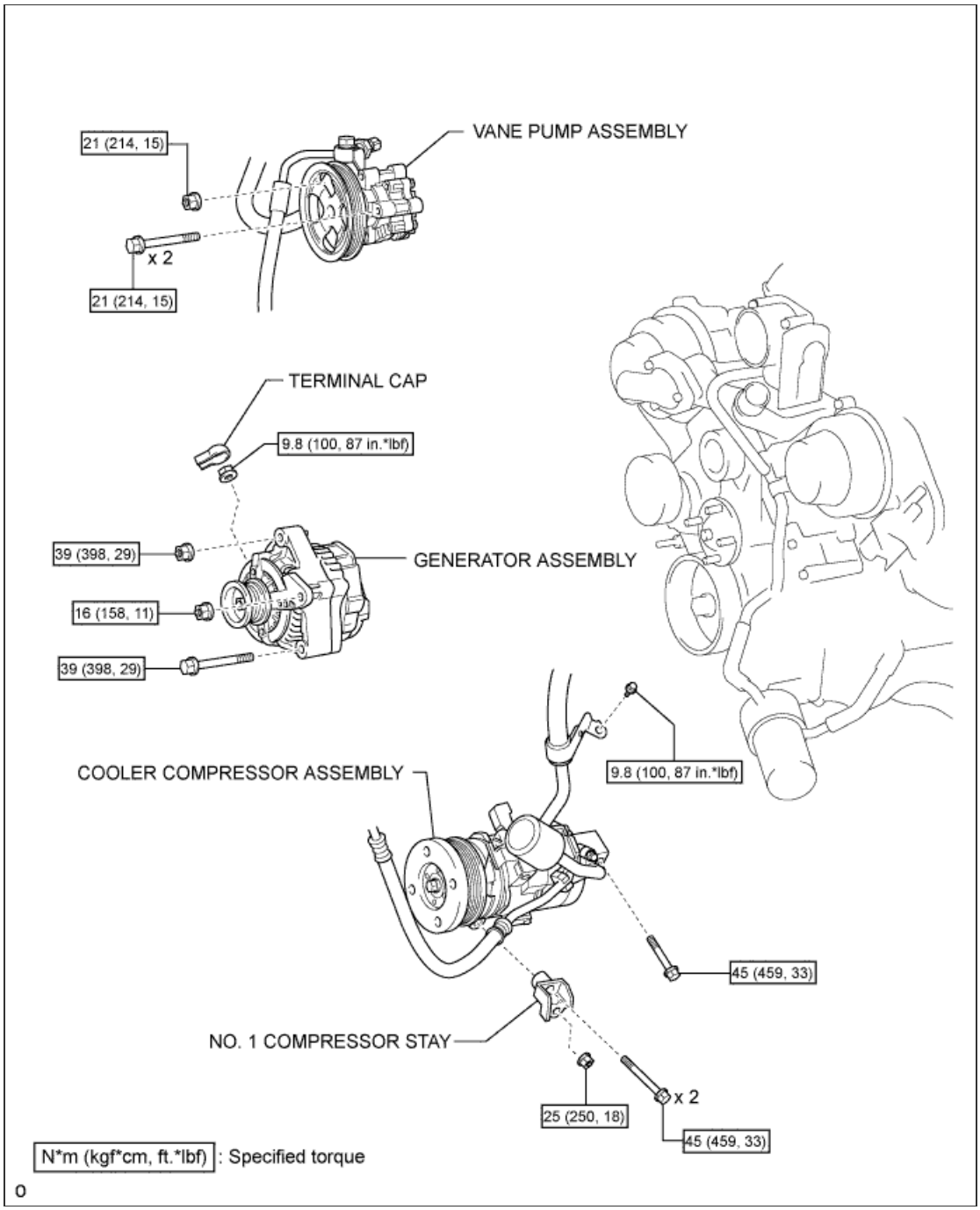
N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

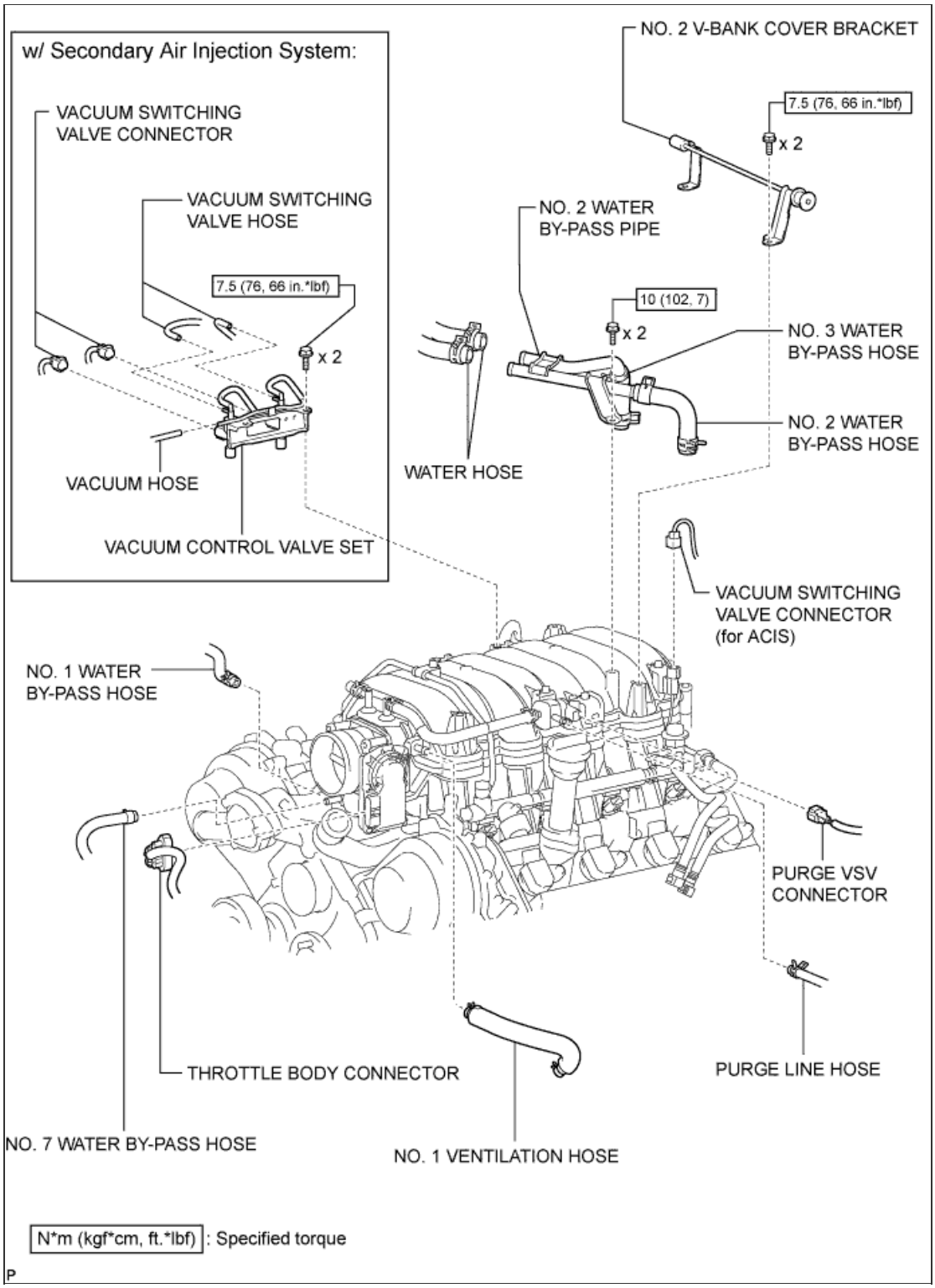
o

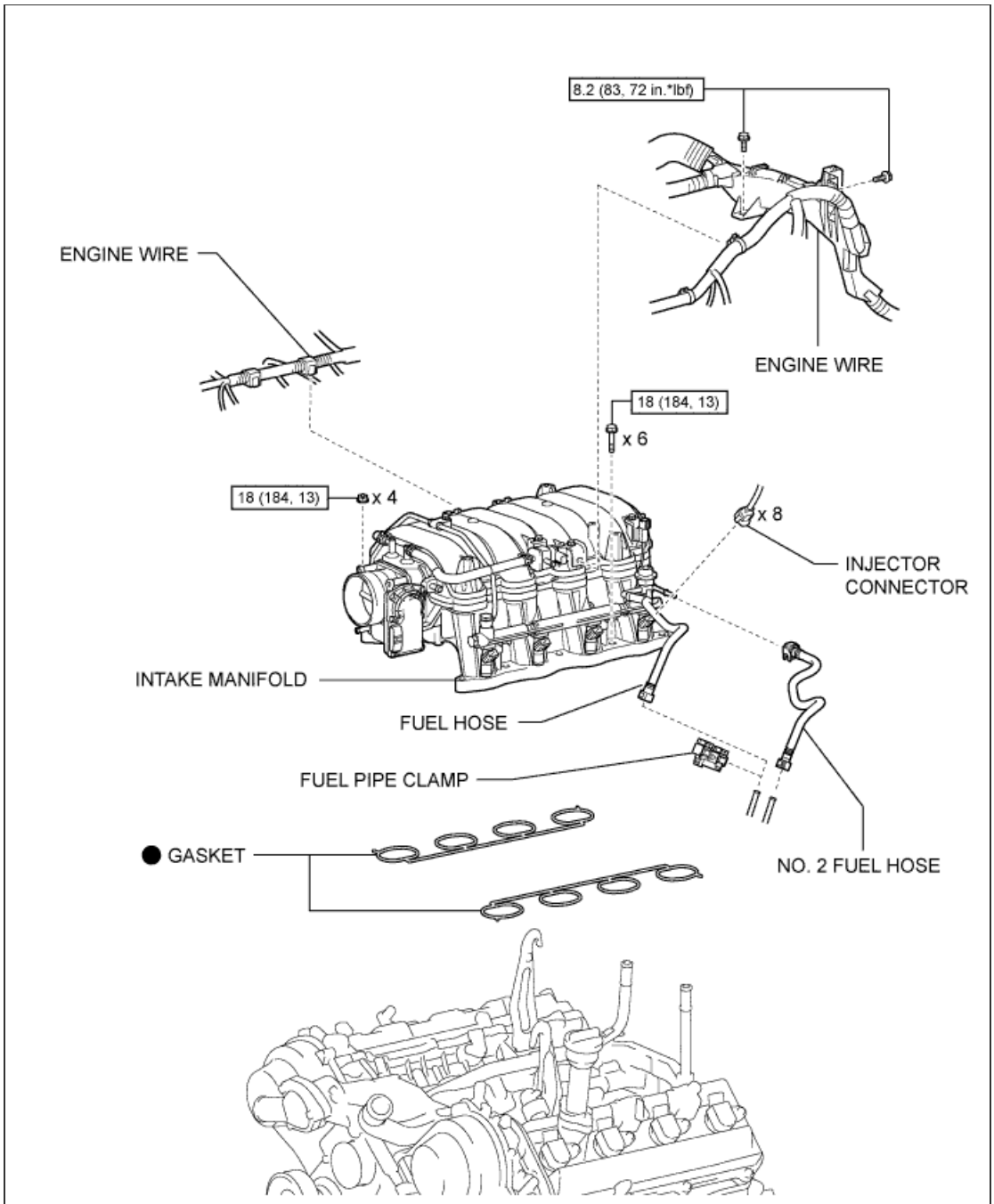

18 (184, 13)
x 2
NO. 1 WATER BY-PASS PIPE
w/ Rear Heater:
18 (184, 13)
x 2
NO. 1 WATER BY-PASS PIPE
x 2
FRONT FENDER APRON SEAL FRONT RH
x 2
x 2
FRONT FENDER APRON SEAL LH
w/ KDSS:
FRONT FENDER APRON SEAL LH
x 2
N*m (kgf*cm, ft.*lbf) : Specified torque
P


● GASKET
48 (489, 35)
x 2
● GASKET
● 54 (554, 40)
x 3
FRONT EXHAUST PIPE ASSEMBLY
FRONT NO. 2 EXHAUST PIPE ASSEMBLY
● GASKET
● GASKET
● 54 (554, 40)
x 3
x 2
48 (489, 35)
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part


21 (214, 15)
VANE PUMP ASSEMBLY
x 2
21 (214, 15)
TERMINAL CAP
9.8 (100, 87 in.*lbf)
39 (398, 29)
GENERATOR ASSEMBLY
16 (158, 11)
39 (398, 29)
9.8 (100, 87 in.*lbf)
COOLER COMPRESSOR ASSEMBLY
45 (459, 33)
NO. 1 COMPRESSOR STAY
x 2
25 (250, 18)
45 (459, 33)
N*m (kgf*cm, ft.*lbf) : Specified torque

o


w/ Secondary Air Injection System:
VACUUM SWITCHING VALVE CONNECTOR
VACUUM SWITCHING VALVE HOSE
7.5 (76, 66 in.*lbf)
x 2
VACUUM HOSE
VACUUM CONTROL VALVE SET
NO. 2 V-BANK COVER BRACKET
7.5 (76, 66 in.*lbf)
x 2
NO. 2 WATER BY-PASS PIPE
10 (102, 7)
x 2
NO. 3 WATER BY-PASS HOSE
NO. 2 WATER BY-PASS HOSE
WATER HOSE
VACUUM SWITCHING VALVE CONNECTOR (for ACIS)
NO. 1 WATER BY-PASS HOSE
PURGE VSV CONNECTOR
PURGE LINE HOSE
THROTTLE BODY CONNECTOR
NO. 7 WATER BY-PASS HOSE
NO. 1 VENTILATION HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
P

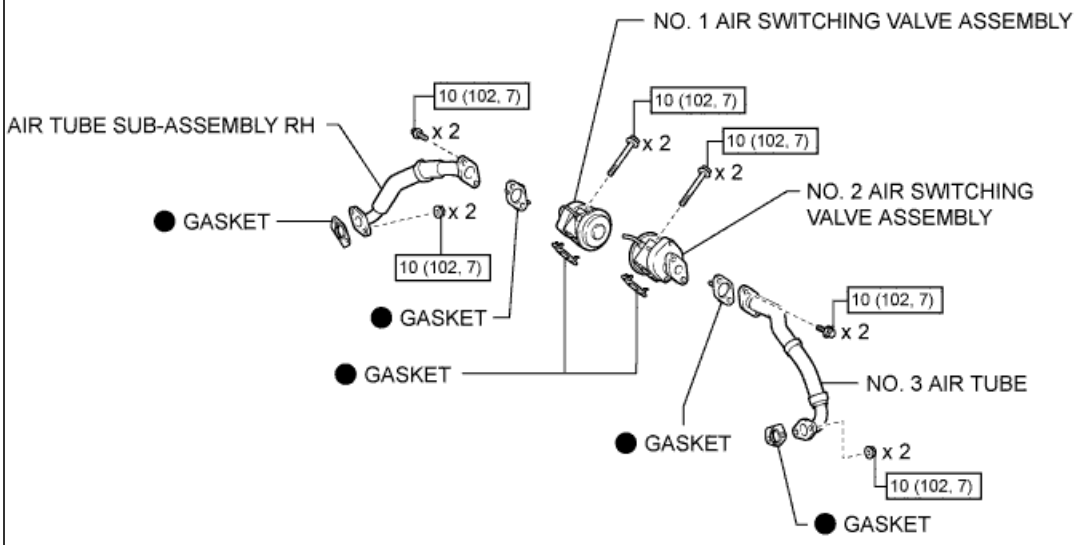


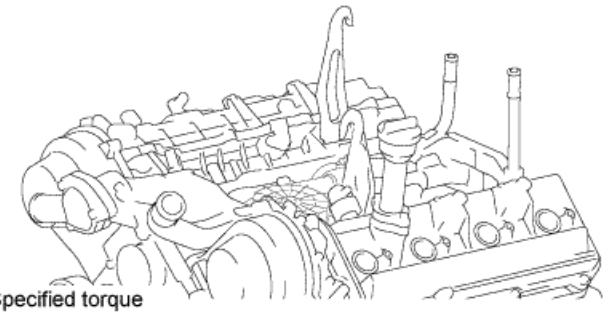
N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P

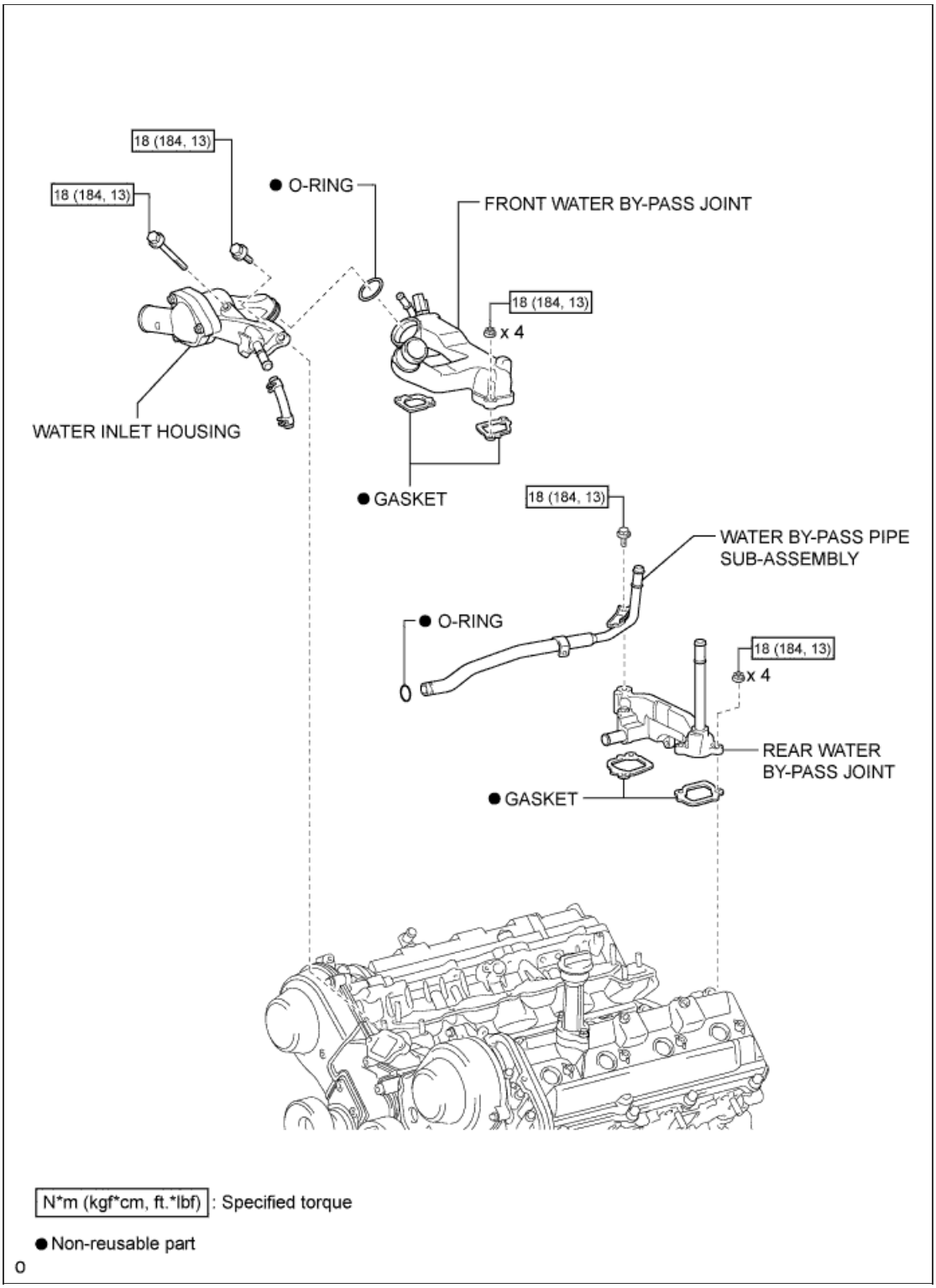
w/ Secondary Air Injection System:

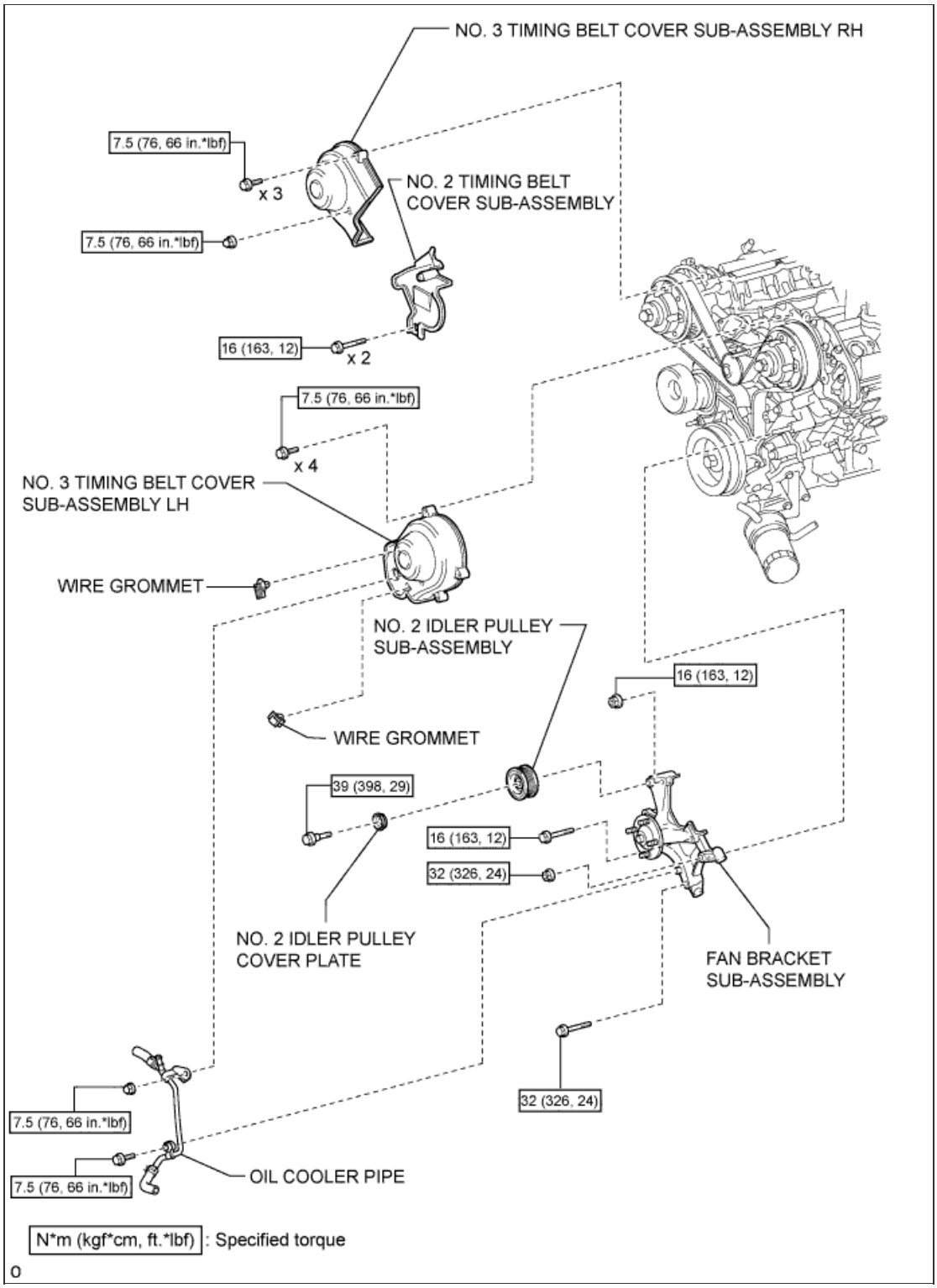


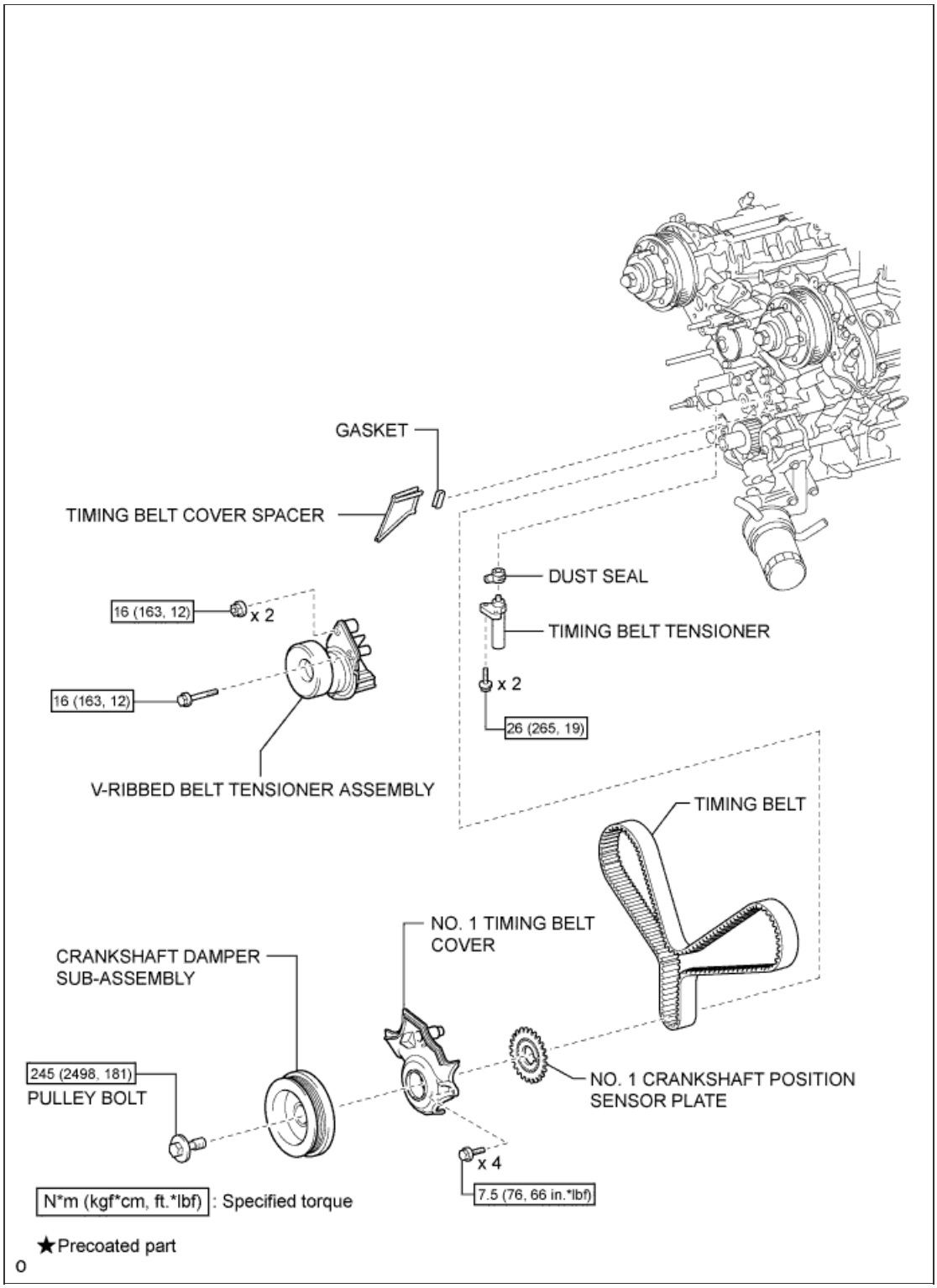


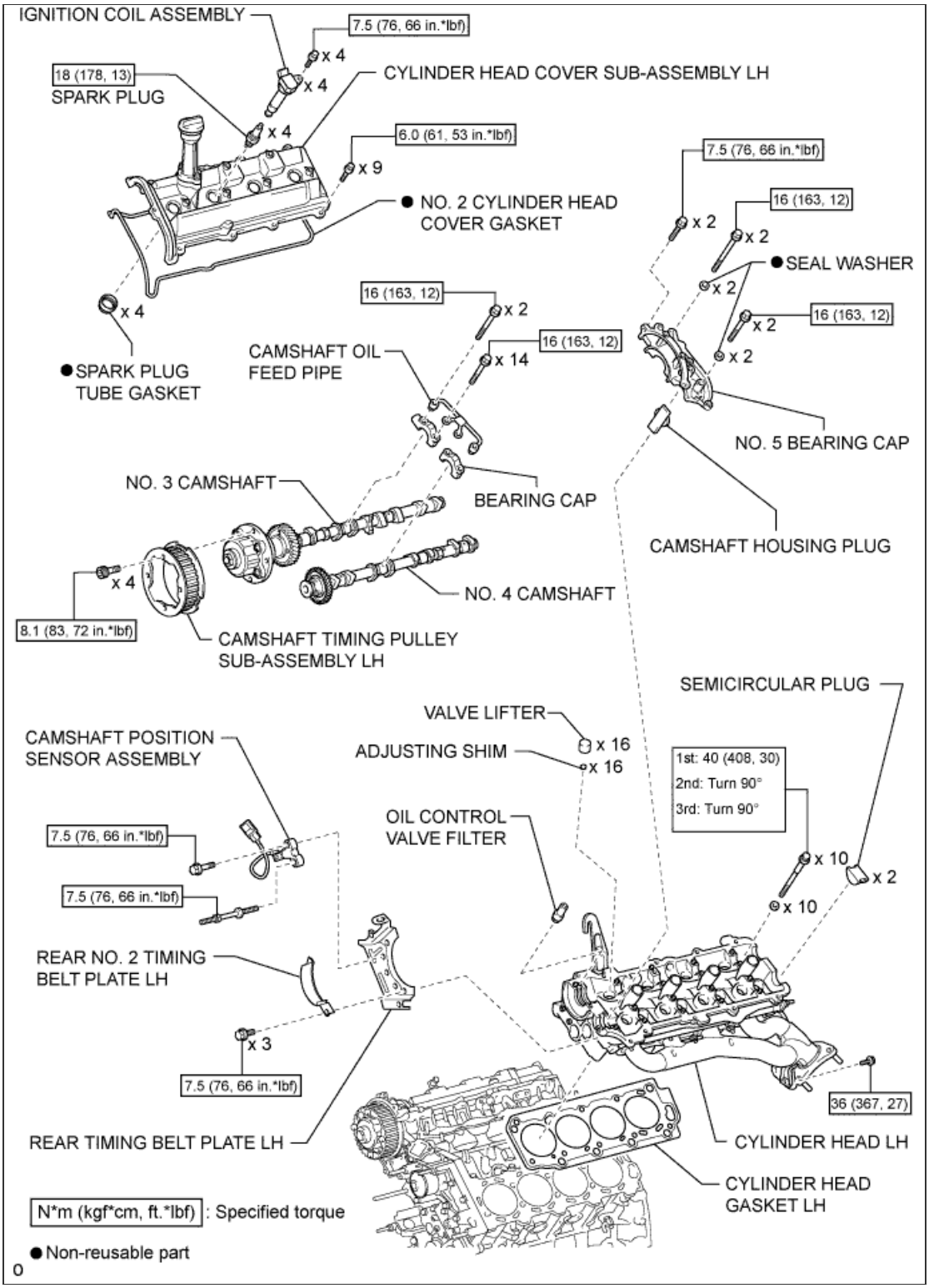
N*m (kgf*cm, ft.*lbf) : Specified torque

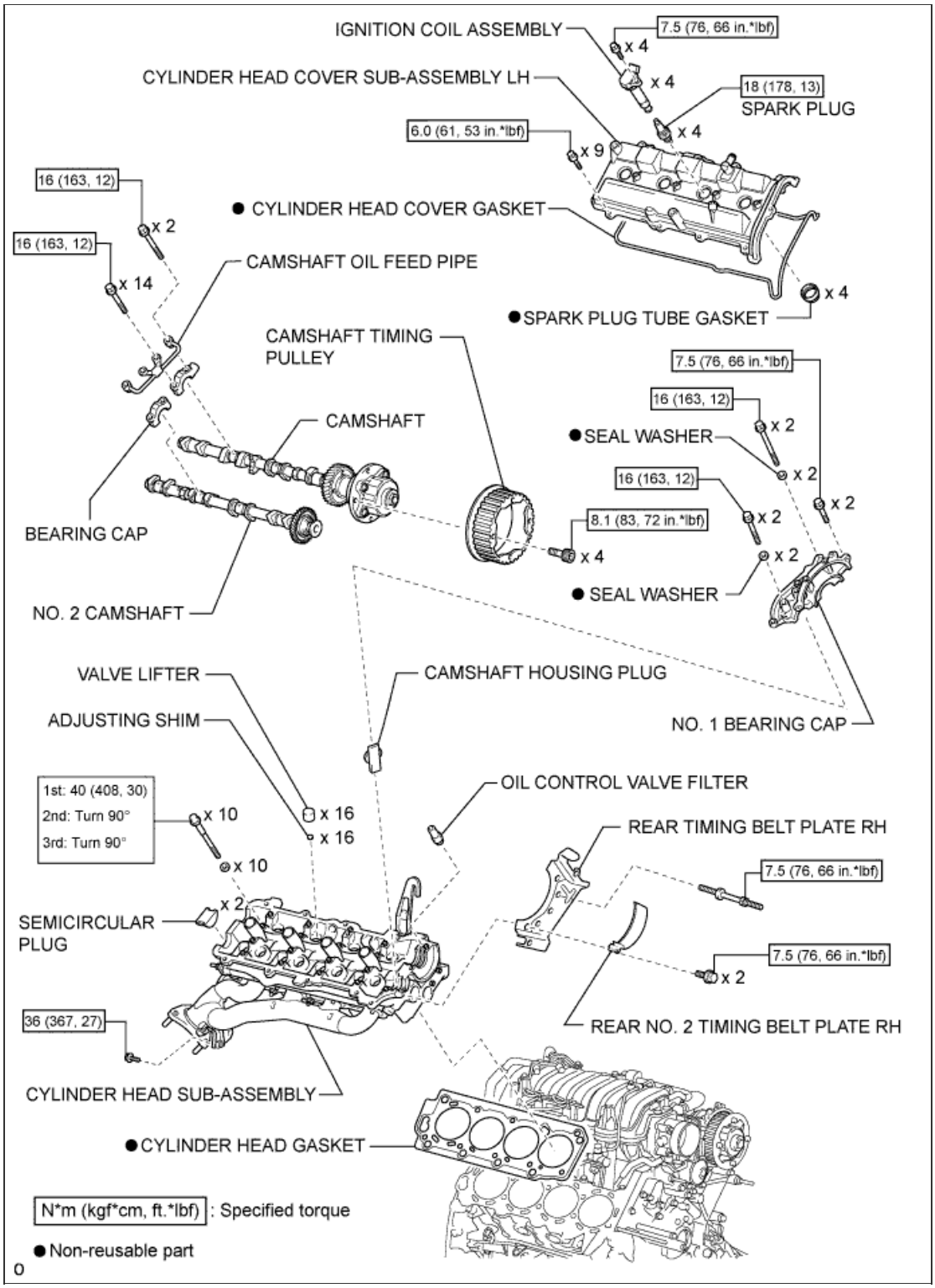
● Non-reusable part

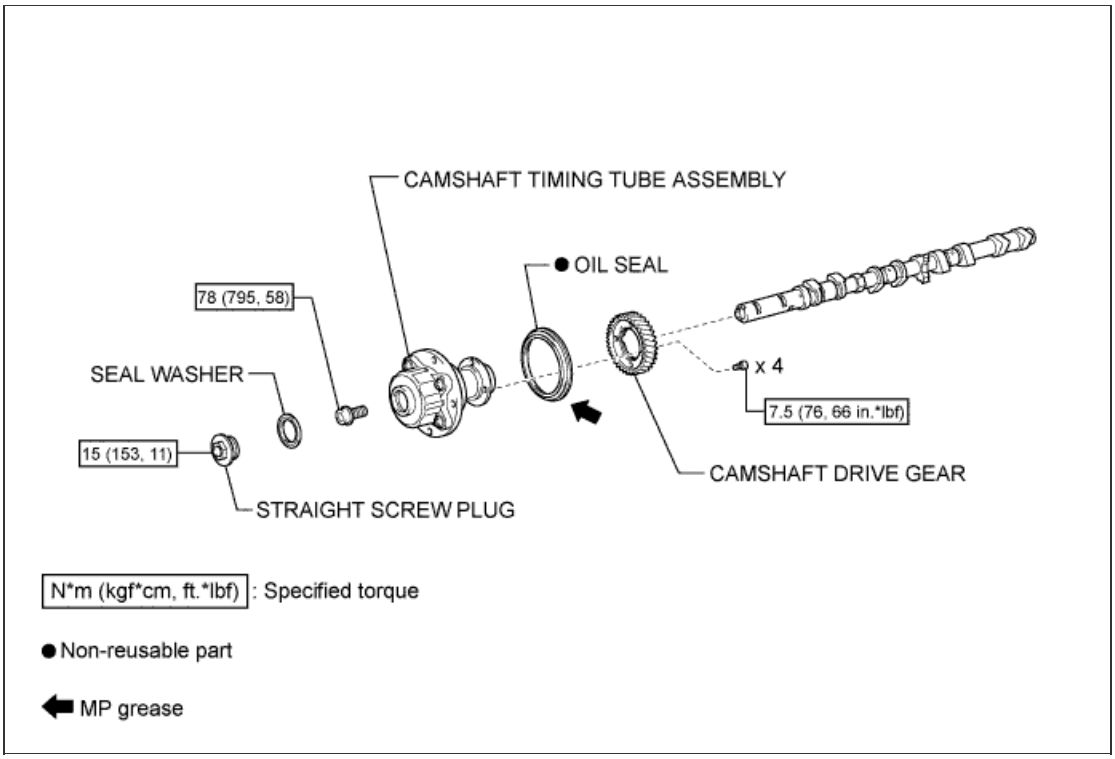

18 (184, 13)
18 (184, 13)
● O-RING
FRONT WATER BY-PASS JOINT
18 (184, 13)
x 4
WATER INLET HOUSING
● GASKET
18 (184, 13)
WATER BY-PASS PIPE
SUB-ASSEMBLY
● O-RING
18 (184, 13)
x 4
REAR WATER
BY-PASS JOINT
● GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
o


NO. 3 TIMING BELT COVER SUB-ASSEMBLY RH
7.5 (76, 66 in.*lbf)
x 3
NO. 2 TIMING BELT COVER SUB-ASSEMBLY
7.5 (76, 66 in.*lbf)
16 (163, 12)
x 2
7.5 (76, 66 in.*lbf)
x 4
NO. 3 TIMING BELT COVER SUB-ASSEMBLY LH
WIRE GROMMET
NO. 2 IDLER PULLEY SUB-ASSEMBLY
16 (163, 12)
WIRE GROMMET
39 (398, 29)
16 (163, 12)
32 (326, 24)
NO. 2 IDLER PULLEY COVER PLATE
FAN BRACKET SUB-ASSEMBLY
32 (326, 24)
7.5 (76, 66 in.*lbf)
7.5 (76, 66 in.*lbf)
OIL COOLER PIPE
N*m (kgf*cm, ft.*lbf) : Specified torque


GASKET
TIMING BELT COVER SPACER
DUST SEAL
TIMING BELT TENSIONER
16 (163, 12)
x 2
16 (163, 12)
x 2
26 (265, 19)
V-RIBBED BELT TENSIONER ASSEMBLY
TIMING BELT
NO. 1 TIMING BELT COVER
CRANKSHAFT DAMPER SUB-ASSEMBLY
245 (2498, 181)
PULLEY BOLT
NO. 1 CRANKSHAFT POSITION SENSOR PLATE
x 4
7.5 (76, 66 in.*lbf)
N*m (kgf*cm, ft.*lbf) : Specified torque
★Precoated part


IGNITION COIL ASSEMBLY
7.5 (76, 66 in.*lbf)
x 4
x 4
18 (178, 13)
SPARK PLUG
CYLINDER HEAD COVER SUB-ASSEMBLY LH
x 4
6.0 (61, 53 in.*lbf)
x 9
● NO. 2 CYLINDER HEAD COVER GASKET
7.5 (76, 66 in.*lbf)
x 2
16 (163, 12)
x 2
● SEAL WASHER
x 2
16 (163, 12)
x 2
x 2
x 4
● SPARK PLUG TUBE GASKET
16 (163, 12)
x 2
CAMSHAFT OIL FEED PIPE
16 (163, 12)
x 14
NO. 5 BEARING CAP
NO. 3 CAMSHAFT
BEARING CAP
CAMSHAFT HOUSING PLUG
x 4
NO. 4 CAMSHAFT
8.1 (83, 72 in.*lbf)
CAMSHAFT TIMING PULLEY SUB-ASSEMBLY LH
SEMICIRCULAR PLUG
VALVE LIFTER
x 16
CAMSHAFT POSITION SENSOR ASSEMBLY
ADJUSTING SHIM
x 16
1st: 40 (408, 30)
2nd: Turn 90°
3rd: Turn 90°
OIL CONTROL VALVE FILTER
7.5 (76, 66 in.*lbf)
x 10
x 2
7.5 (76, 66 in.*lbf)
x 10
REAR NO. 2 TIMING BELT PLATE LH
x 3
7.5 (76, 66 in.*lbf)
36 (367, 27)
REAR TIMING BELT PLATE LH
CYLINDER HEAD LH
CYLINDER HEAD GASKET LH
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part


IGNITION COIL ASSEMBLY
7.5 (76, 66 in.*lbf)
x 4
CYLINDER HEAD COVER SUB-ASSEMBLY LH
x 4
18 (178, 13)
SPARK PLUG
6.0 (61, 53 in.*lbf)
x 4
x 9
16 (163, 12)
x 2
● CYLINDER HEAD COVER GASKET
16 (163, 12)
x 14
CAMSHAFT OIL FEED PIPE
x 4
● SPARK PLUG TUBE GASKET
CAMSHAFT TIMING PULLEY
7.5 (76, 66 in.*lbf)
16 (163, 12)
x 2
CAMSHAFT
● SEAL WASHER
x 2
16 (163, 12)
x 2
x 2
8.1 (83, 72 in.*lbf)
x 2
BEARING CAP
x 4
x 2
● SEAL WASHER
NO. 2 CAMSHAFT
VALVE LIFTER
CAMSHAFT HOUSING PLUG
ADJUSTING SHIM
NO. 1 BEARING CAP
1st: 40 (408, 30)
2nd: Turn 90°
3rd: Turn 90°
x 10
x 16
OIL CONTROL VALVE FILTER
x 16
x 10
REAR TIMING BELT PLATE RH
7.5 (76, 66 in.*lbf)
x 2
SEMICIRCULAR PLUG
7.5 (76, 66 in.*lbf)
x 2
36 (367, 27)
REAR NO. 2 TIMING BELT PLATE RH
CYLINDER HEAD SUB-ASSEMBLY
● CYLINDER HEAD GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part


CAMSHAFT TIMING TUBE ASSEMBLY
● OIL SEAL
78 (795, 58)
SEAL WASHER
15 (153, 11)
STRAIGHT SCREW PLUG
x 4
7.5 (76, 66 in.*lbf)
CAMSHAFT DRIVE GEAR
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
MP grease

for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

a. Discharge the fuel system pressure (Click here).

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

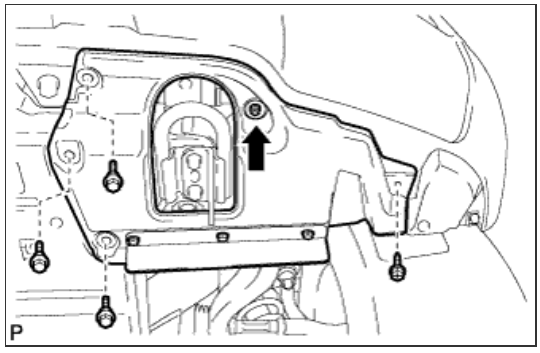
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



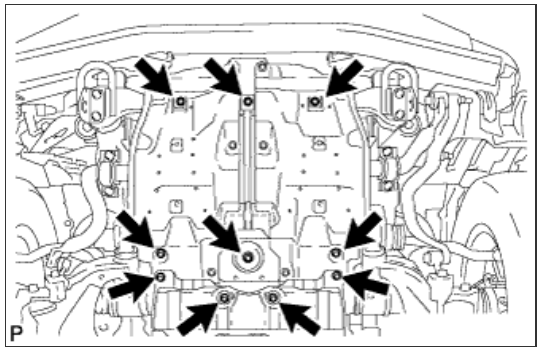
4. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

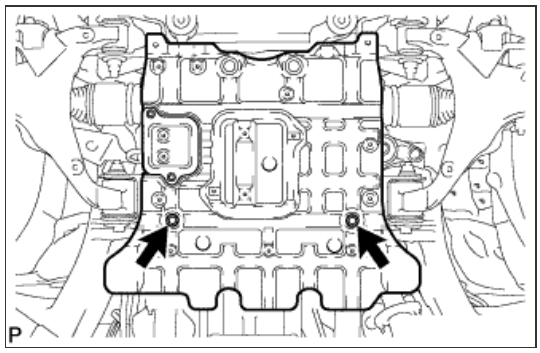
5. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and No. 1 engine under cover.



6. REMOVE NO. 2 ENGINE UNDER COVER

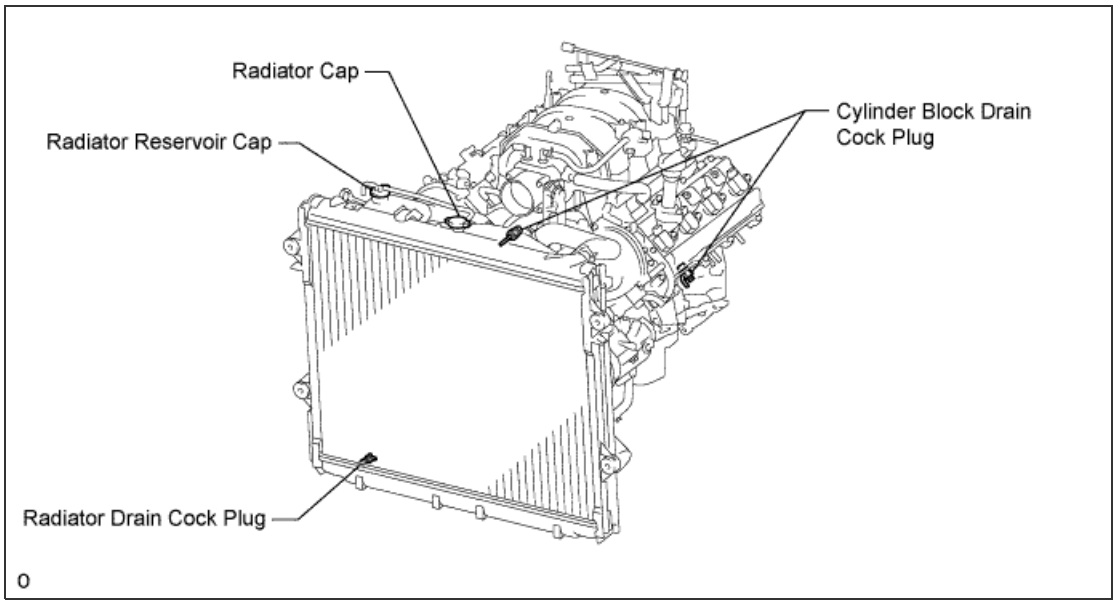
a. Remove the 2 bolts and No. 2 engine under cover.



7. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.



a. Loosen the radiator drain cock plug.

b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

. Tighten the 2 cylinder block drain cock plugs.

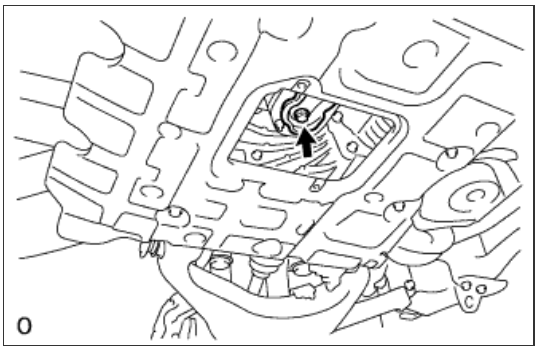
Torq e:
13 N 13 k f c 9 ft. lbf }

e. Tighten the radiator drain cock plug by hand.

. DRAIN ENGINE OIL

a. Remove the oil drain plug and gasket, and drain the engine oil into a container.

b. Remove the oil drain plug and gasket, and drain the engine oil into a container.



9. DISCONNECT FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Disconnect the air fuel ratio sensor connector.

b. Disconnect the heated oxygen sensor connector.

c. Remove the 3 nuts and 2 bolts, disconnect the front No. 2 exhaust pipe from the exhaust manifold LH and center exhaust pipe, and then remove the 2 gaskets.

HINT:

It is not necessary to remove the front No. 2 exhaust pipe from the vehicle.

. Remove the bolt and disconnect the exhaust manifold LH from the No. 2 manifold stay.

1 . DISCONNECT FRONT EXHAUST PIPE ASSEMBLY

a. Disconnect the air fuel ratio sensor connector.

b. Disconnect the heated oxygen sensor connector.

c. Detach the heated oxygen sensor wire clamp.

. Remove the 3 nuts and 2 bolts, disconnect the front exhaust pipe from the exhaust manifold RH and center exhaust pipe, and then remove the 2 gaskets.

HINT:

It is not necessary to remove the front exhaust pipe from the vehicle.

e. Remove the bolt and disconnect the exhaust manifold RH from the manifold stay RH.

11. REMOVE CO L TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Remove the cowl top ventilator louver (Click here).

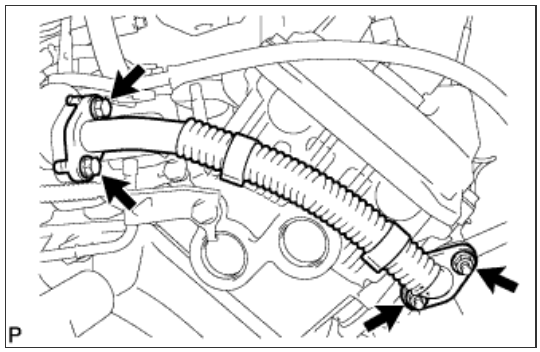
12. REMOVE INTAKE MANIFOLD

a. Remove the intake manifold (Click here).

13. REMOVE AIR TUBE SUB-ASSEMBLY RH Secon ar Air In ection S te

a. Remove the 2 bolts, 2 nuts and air tube sub-assembly.

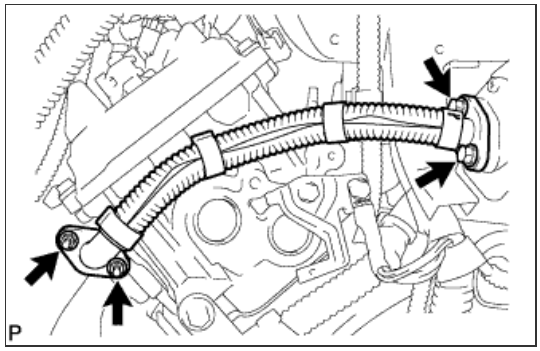
b. Remove the 2 gaskets.



14. REMOVE NO. 3 AIR TUBE Secon ar Air In ection S te

a. Remove the 2 bolts, 2 nuts and No. 3 air tube.

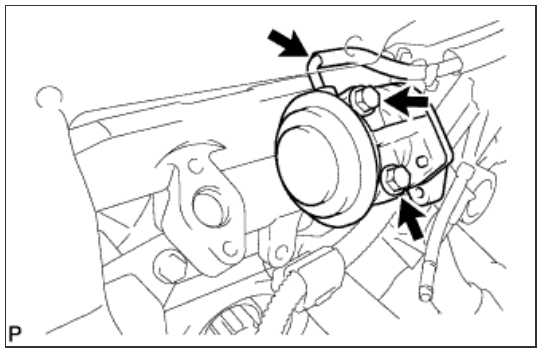
b. Remove the 2 gaskets.



15. REMOVE NO. 1 AIR S ITCHING VALVE ASSEMBLY Secon ar Air In ection S te

a. Remove the vacuum switching valve hose from the No. 1 air switching valve.

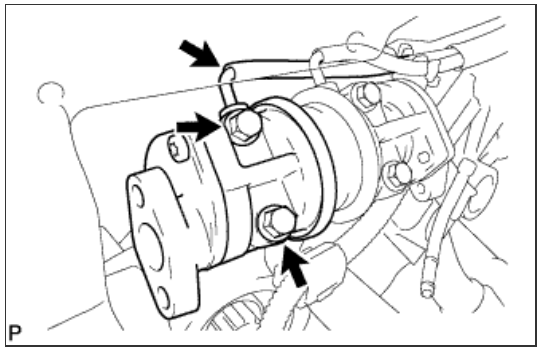
b. Remove the 2 bolts, gasket and No. 1 air switching valve from the rear water by-pass joint.



16. REMOVE NO. 2 AIR S ITCHING VALVE ASSEMBLY Secon ar Air In ection S te

a. Remove the vacuum switching valve hose from the No. 2 air switching valve.

b. Remove the 2 bolts, gasket and No. 2 air switching valve from the rear water by-pass joint.

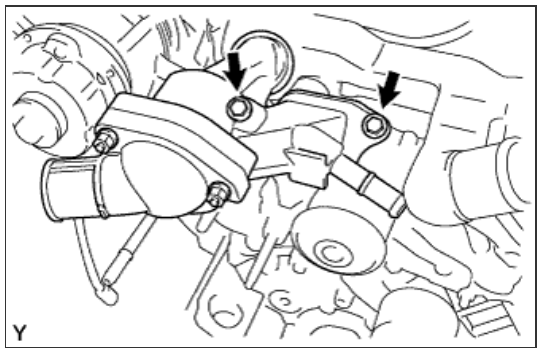


17. REMOVE ATER INLET HOUSING

a. Remove the 2 bolts holding the water inlet housing to the water pump.

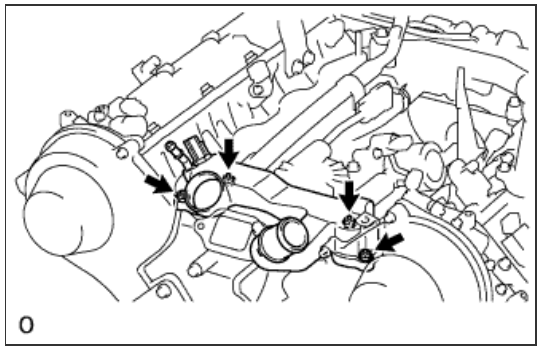
b. Disconnect the water inlet housing from the front water by-pass joint and water pump. Then remove the water inlet and inlet housing assembly.

c. Remove the O-ring from the water inlet housing.



1 . REMOVE FRONT ATER BY-PASS OINT

a. Remove the 4 nuts, front water by-pass joint and 2 gaskets.



19. REMOVE ATER BY-PASS PIPE SUB-ASSEMBLY

a. Disconnect the connector.

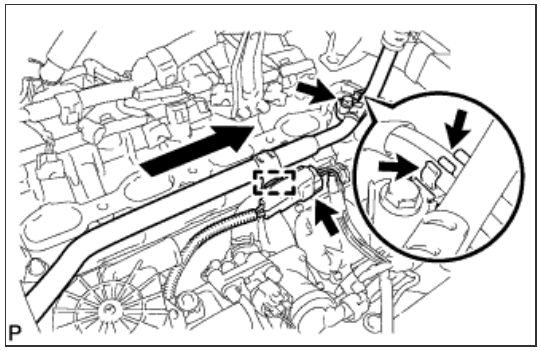
b. Disconnect the wire harness clamp from the water by-pass pipe.

c. Disconnect the 2 vacuum switching valve hoses from the water by-pass pipe clamp.

. Remove the bolt.

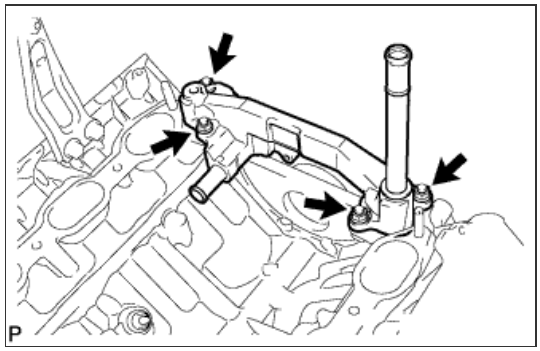
e. Pull out the water by-pass pipe.

f. Remove the O-ring from the water by-pass pipe.



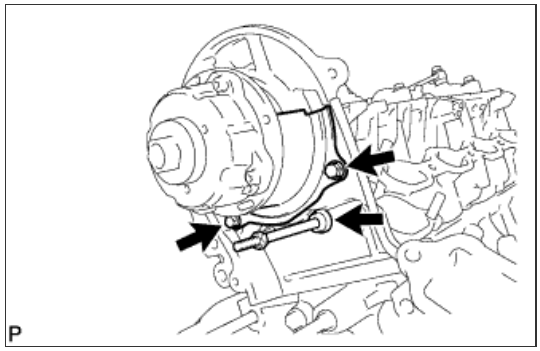
2 . REMOVE REAR ATER BY-PASS OINT

a. Remove the 4 nuts, water by-pass joint and 2 gaskets.



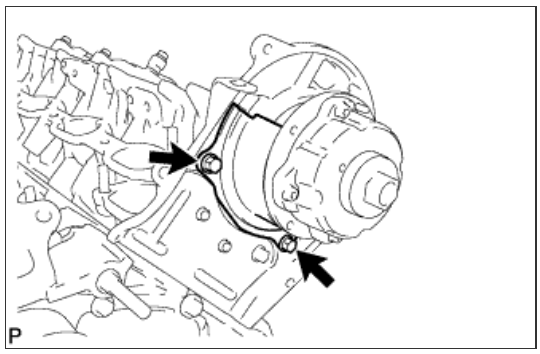
21. REMOVE REAR NO. 2 TIMING BELT PLATE RH

a. Remove the 2 bolts, stud bolt and timing belt plate.



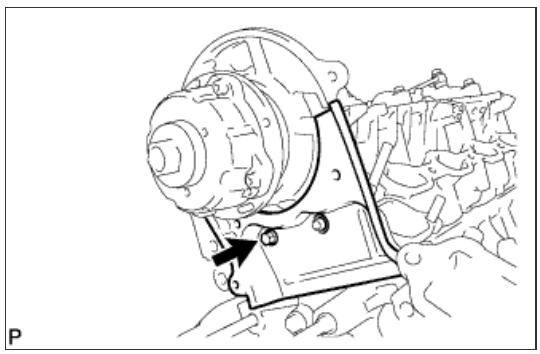
22. REMOVE REAR NO. 2 TIMING BELT PLATE LH

a. Remove the 2 bolts and timing belt plate.



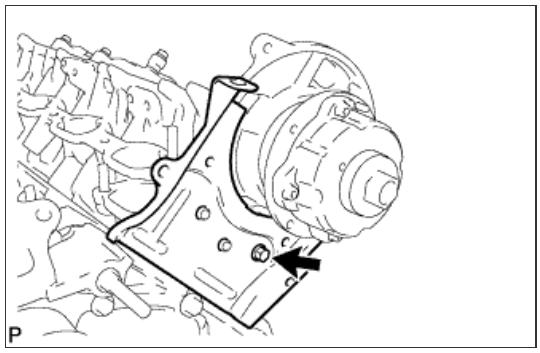
23. REMOVE REAR TIMING BELT PLATE RH

a. Remove the bolt and rear timing belt plate.



24. REMOVE REAR TIMING BELT PLATE LH

a. Remove the bolt and rear timing belt plate.

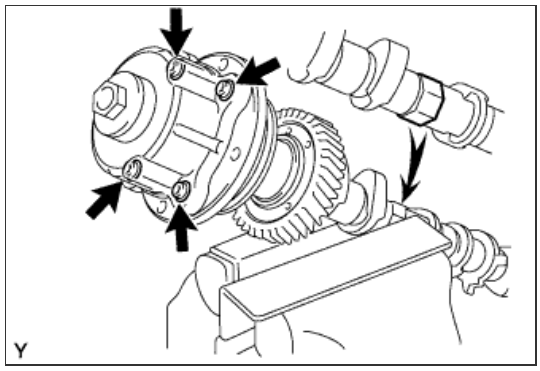


25. REMOVE CAMSHAFT

a. Remove the camshaft (Click here).

26. REMOVE CAMSHAFT TIMING TUBE ASSEMBLY

a. ount the hexagonal portion of the camshaft in a vise.

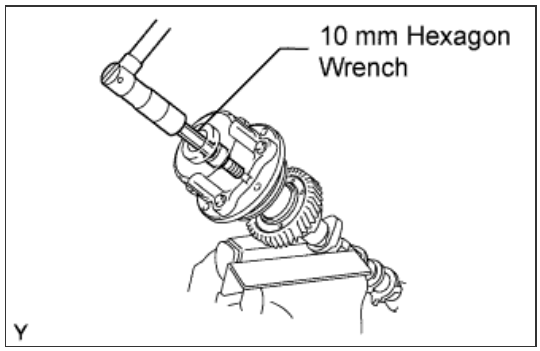


NOTICE:

- **Be caref l not to a a e the ca haft.**
- **Do not loosen or re oe the 4 bolts shown in the ill tration. If an of the are loosene or re oe the backlash of the ear in the ti in t be will œ t of a t ent. In this case replace the ti in t be asse bl with a new one.**

b. Remove the screw plug and seal washer.

c. Using a 10 mm hexagon wrench, remove the bolt and timing tube.



27. REMOVE CAMSHAFT DRIVE GEAR

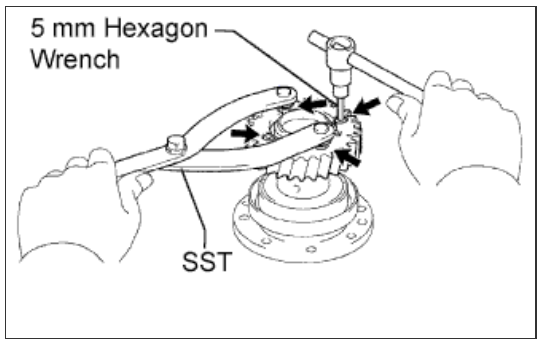
a. Using SST and a 5 mm hexagon wrench, remove the 4 bolts, drive gear and oil seal.

SST

-16 1 2- 16 3- 6 5

NOTICE:

Be careful not to damage the timing tube.

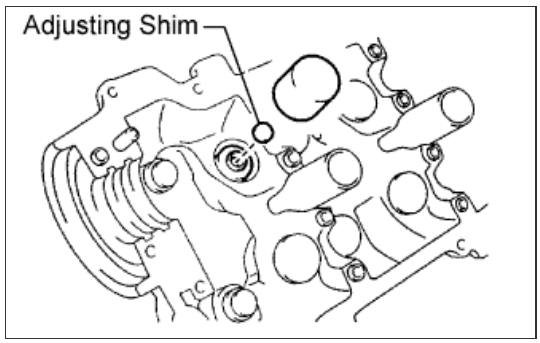


2 . REMOVE VALVE LIFTER

a. Remove the valve lifters and adjusting shims from the cylinder head.

HINT:

rrange the removed parts in the correct order.



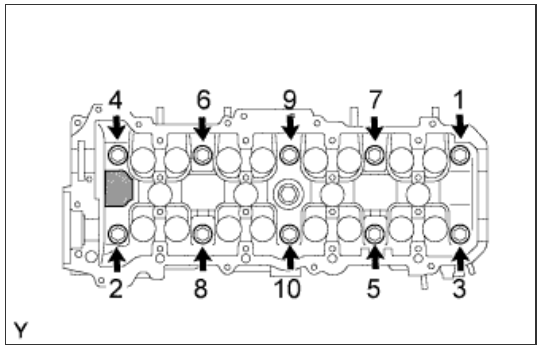
29. REMOVE CYLINDER HEAD SUB-ASSEMBLY

a. Uniformly loosen the 10 cylinder head bolts on the cylinder head in several passes, in the se uence shown in the illustration.

b. Remove the bolts and plate washers.

NOTICE:

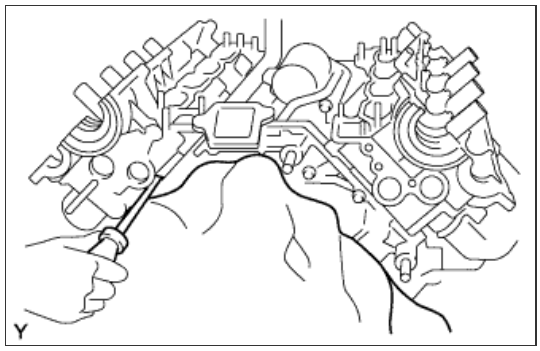
- C lin er hea warpa e or crackin co l res lt fro re oin bolts in the incorrect or er.
- Do not rop the plate washer for the c lin er hea bolt of the c lin er hea .



c. Remove the cylinder head by prying between the cylinder block and cylinder head with a screwdriver.

NOTICE:

- Be caref l not to a a e the contact s rfaces of the c lin er hea an c lin er block.
- The c lin er hea sho l not be tilte so as to sec re the al e lifter. If the c lin er hea is tilte re oe the al e lifter an check that the a tin shi is set correctl .



3 . REMOVE CYLINDER HEAD GASKET

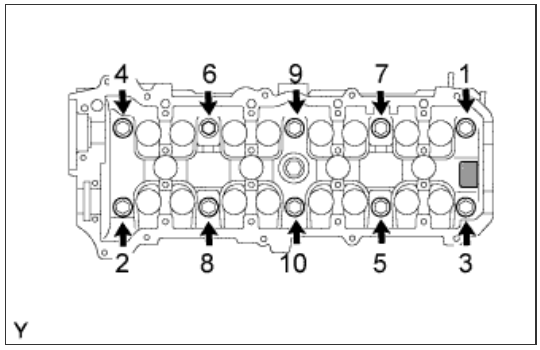
31. REMOVE CYLINDER HEAD LH

a. Uniformly loosen the 10 cylinder head bolts on the cylinder head in several passes, in the se uence shown in the illustration.

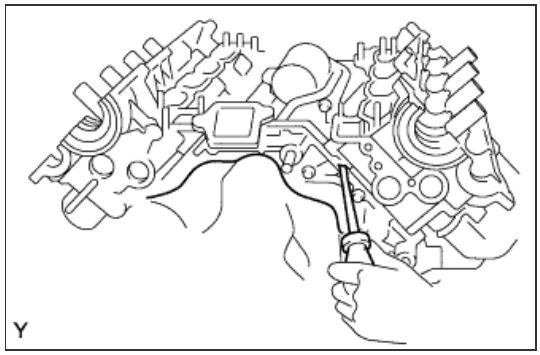
b. Remove the bolts and plate washers.

NOTICE:

- C lin er hea warpa e or crackin co l res lt fro re oin bolts in the incorrect or er.
- Do not rop the plate washer for the c lin er hea bolt of the c lin er hea .



c. Remove the cylinder head by prying between the cylinder block and cylinder head with a screwdriver.



NOTICE:

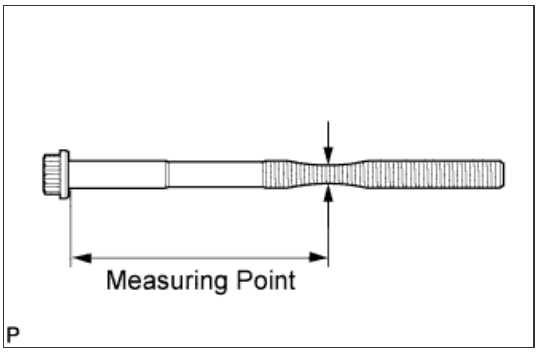
- **Be caref l not to a a e the contact s rfaces of the c lin er hea an c lin er block.**
- **The c lin er hea sho l not be tilte so as to sec re the al e lifter. If the c lin er hea is tilte re oe the al e lifter an check that the a tin shi is set correctl .**

32. REMOVE CYLINDER HEAD GASKET LH

for Preparation Click here

1. INSPECT CYLINDER HEAD SET BOLT

a. Using a vernier caliper, measure the thread outside diameter of the bolt.



Measuring Point:

Item	Specified Condition
Intake side	82 mm (3.23 in.)
Exhaust side	86 mm (3.39 in.)

Standard outside diameter:
9.810 to 9.960 mm (0.386 to 0.392 in.)

Minimum outside diameter:
9.700 mm (0.382 in.)

If the outside diameter is less than the minimum, replace the cylinder head set bolt.

HINT:

If a visual check reveals no excessively thin areas, check the center of the bolt (see illustration) and find the area that has the minimum diameter.

2. INSPECT CYLINDER HEAD SUB-ASSEMBLY

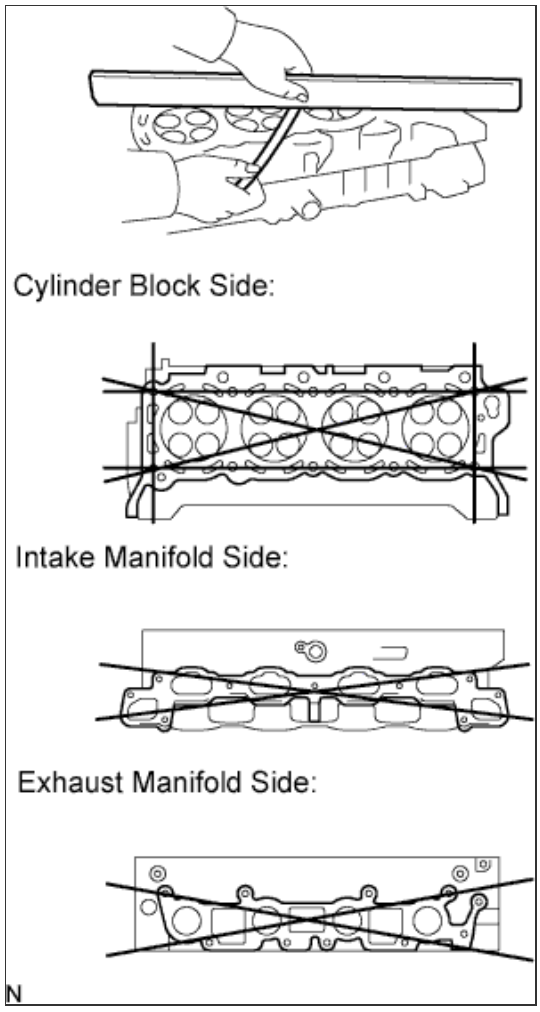
a. Using a precision straightedge and feeler gauge, measure the surfaces contacting the cylinder block and manifolds for warpage.

Standard Warpage:

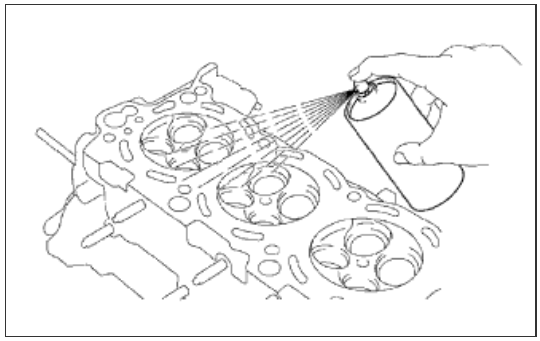
Item	Specified Condition
Cylinder block side	0 to 0.05 mm (0 to 0.00197 in.)
Intake manifold side	0 to 0.08 mm (0 to 0.00315 in.)
Exhaust manifold side	0 to 0.08 mm (0 to 0.00315 in.)

Maximum warpage:
0.10 mm (0.00394 in.)

If the warpage is more than the maximum, replace the cylinder head sub-assembly.



b. Using a dye penetrant, check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks.
If the cylinder head is cracked, replace it.



3. INSTALL CYLINDER HEAD GASKET LH

a. Clean the cylinder block and cylinder head with solvent.

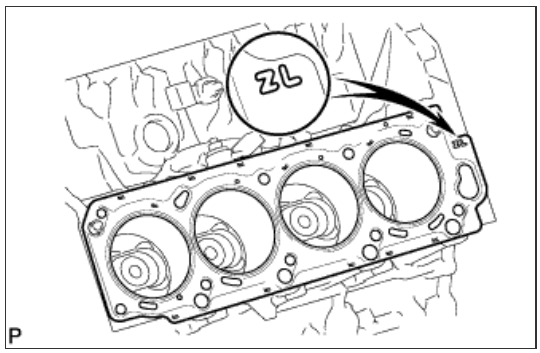
b. Place a new cylinder head gasket in position on the cylinder block.

HINT:

A mark is placed on the rear side of the cylinder head gasket to distinguish the LH and RH sides, a "2R" mark for the RH side and a "2L" mark for the LH side.

NOTICE:

Be careful of the installation direction.

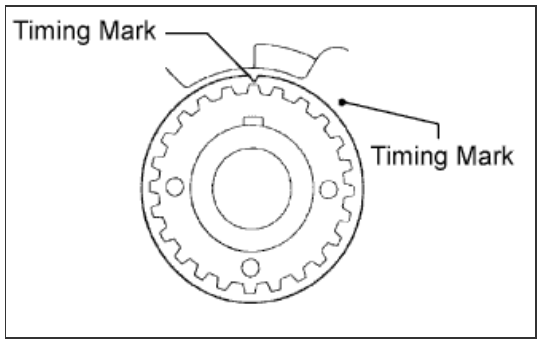


4. INSTALL CYLINDER HEAD LH

HINT:

The cylinder head bolts are tightened in 3 progressive steps.

a. Check that the timing mark of the crankshaft timing pulley is in the position shown in the illustration, and that the piston is below the TDC of compression.



b. Install the cylinder head with the exhaust manifold to the cylinder block.

NOTICE:

Ensure that no oil is on the mounting surface of the cylinder head.

c. Apply a light coat of engine oil to the threads and under the heads of the cylinder head bolts.

d. Step 1:

i. Set the plate washer to the cylinder head bolt.

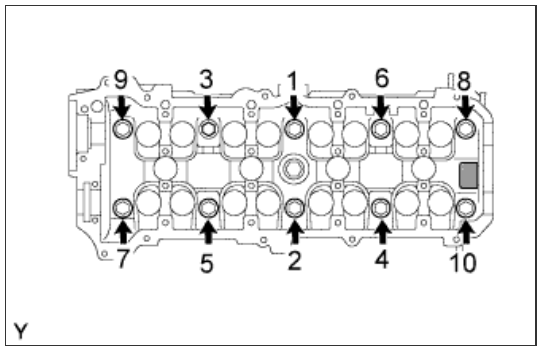
ii. Install and uniformly tighten the 10 cylinder head bolts and plate washers in the sequence shown in the illustration.

Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

If any one of the cylinder head bolts does not meet the torque specification, replace the cylinder head bolt.

NOTICE:

Do not drop the plate washer for the cylinder head bolt of the cylinder head.



e. Step 2:

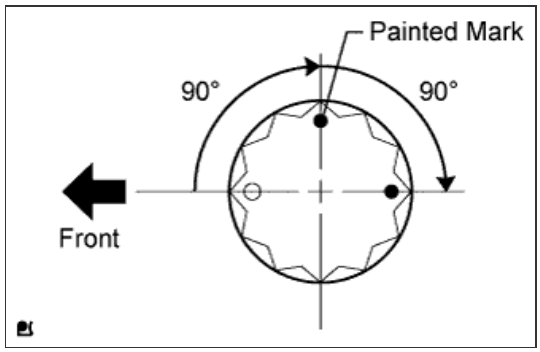
i. Mark the cylinder head bolt head with paint as shown in the illustration.

ii. Tighten the cylinder head bolts 90° in the sequence shown in step 1.

f. Step 3:

i. Tighten the cylinder head bolts another 90° in the sequence shown in step 1.

ii. Check that the painted marks are now facing rearward.



5. INSTALL CYLINDER HEAD GASKET

a. Clean the cylinder block and cylinder head with solvent.

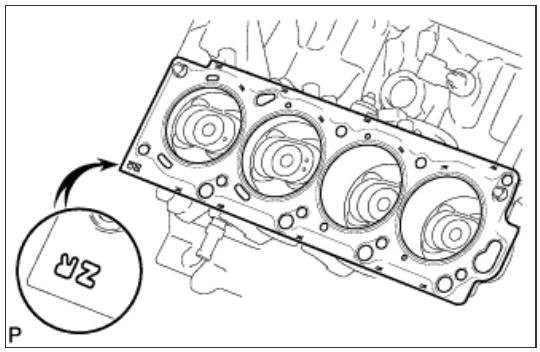
b. Place a new cylinder head gasket in position on the cylinder block.

HINT:

A mark is placed on the rear side of the cylinder head gasket to distinguish the LH and RH sides, a "2R" mark for the RH side and a "2L" mark for the LH side.

NOTICE:

Be careful of the installation direction.



6. INSTALL CYLINDER HEAD SUB-ASSEMBLY

HINT:

The cylinder head bolts are tightened in 3 progressive steps.

a. Install the cylinder head with the exhaust manifold to the cylinder block.

NOTICE:

Ensure that no oil is on the mounting surface of the cylinder head.

b. Apply a light coat of engine oil to the threads and under the heads of the cylinder head bolts.

c. Step 1:

i. Set the plate washer to the cylinder head bolt.

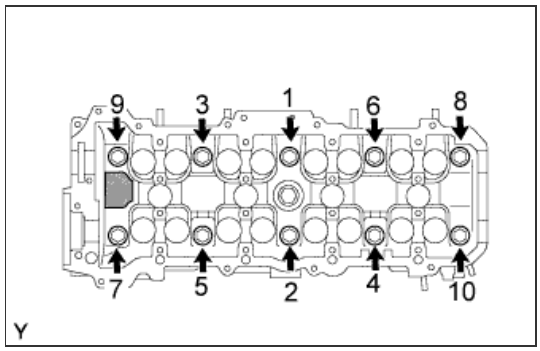
ii. Install and uniformly tighten the 10 cylinder head bolts and plate washers in the sequence shown in the illustration.

Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

If any one of the cylinder head bolts does not meet the torque specification, replace the cylinder head bolt.

NOTICE:

Do not drop the plate washer for the cylinder head bolt of the cylinder head.



d. Step 2:

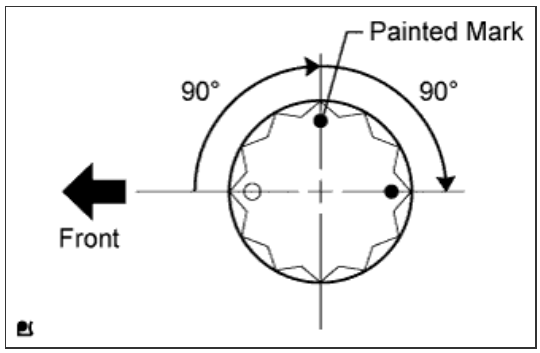
i. Mark the cylinder head bolt head with paint as shown in the illustration.

ii. Tighten the cylinder head bolts 90° in the sequence shown in step 1.

e. Step 3:

i. Tighten the cylinder head bolts another 90° in the sequence shown in step 1.

ii. Check that the painted marks are now facing rearward.

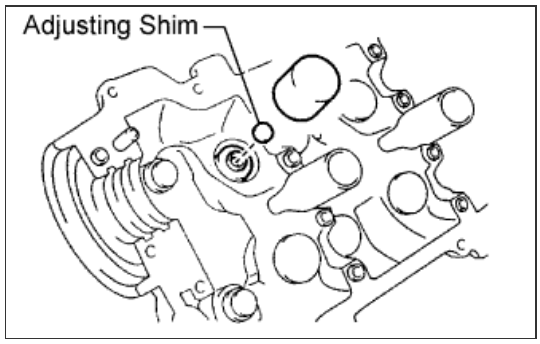


7. INSTALL VALVE LIFTER

a. Apply a light coat of engine oil to the valve lifters and adjusting shims.

b. Install the valve lifters and shims to the cylinder head.

c. Check that the valve lifter rotates smoothly by hand.



8. INSTALL CAMSHAFT SETTING OIL SEAL

a. Apply MP grease to the lip of a new oil seal.

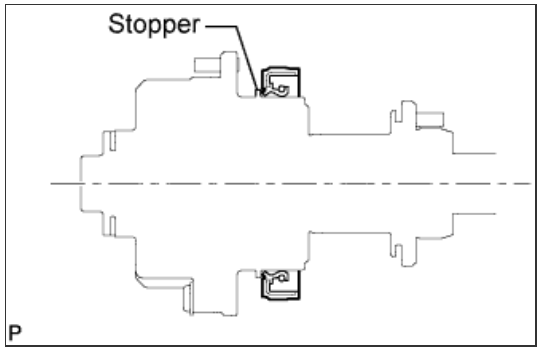
NOTICE:

- **Do not allow foreign matter to contact the lip of the oil seal.**
- **Do not allow MP grease to contact the dust seal.**

b. Insert the oil seal into the camshaft timing tube until it reaches the stopper.

NOTICE:

- **Be careful of the installation direction.**
- **Do not turn over the lip of the oil seal.**



9. INSTALL CAMSHAFT DRIVE GEAR

a. Align the timing tube knock pin with the knock pin groove of the drive gear, and temporarily install the drive gear with the 4 bolts.

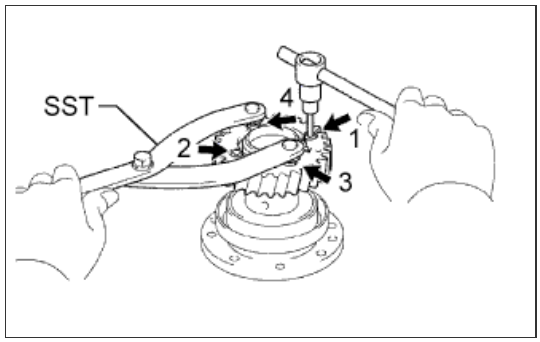
b. Using SST and a 5 mm hexagon wrench, uniformly tighten the 4 bolts in several steps, in the sequence shown in the illustration.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

SST
09960-10010 (09962-01000, 09963-00500)

NOTICE:

Be careful not to damage the timing tube.



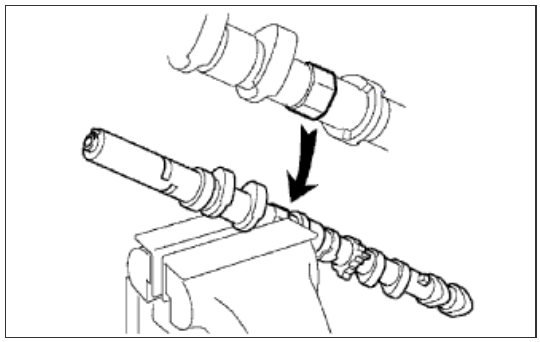
10. INSTALL CAMSHAFT TIMING TUBE ASSEMBLY

a. Mount the hexagonal portion of the camshaft in a vise.

NOTICE:

Be careful not to damage the camshaft.

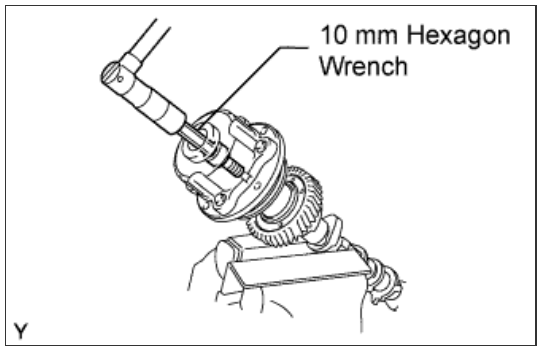
b. Apply a light coat of engine oil to the camshaft and camshaft timing tube.



c. Align the camshaft knock pin with the knock pin hole of the timing tube, and push the timing tube by hand until the camshaft knock pin touches the bottom of the timing tube knock pin hole.

NOTICE:

Do not forcefully push on the camshaft timing tube. This may cause the camshaft knock pin tip to damage the installation surface of the camshaft timing tube.



d. Using a 10 mm socket hexagon wrench, install the bolt.

Torque:
78 N*m{ 795 kgf*cm , 58 ft.*lbf }

e. Install the seal washer and screw plug.

Torque:
15 N*m{ 153 kgf*cm , 11 ft.*lbf }

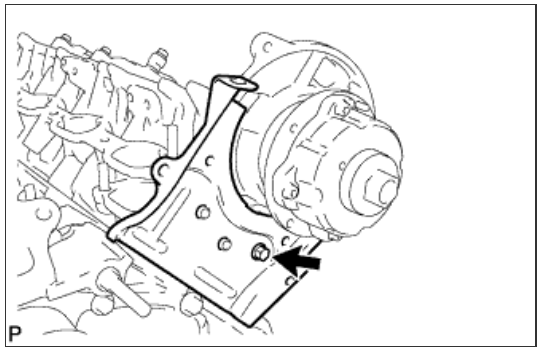
11. INSTALL CAMSHAFT

a. Install the camshaft (Click here).

12. INSTALL REAR TIMING BELT PLATE LH

a. Install the timing belt plate with the bolt.

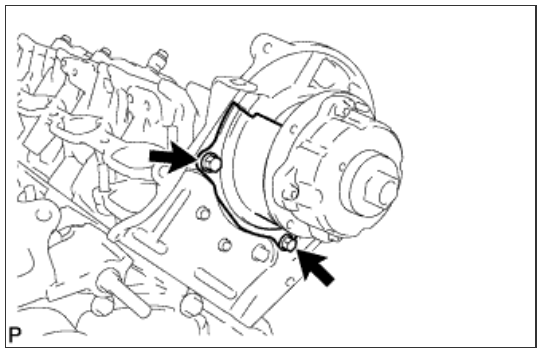
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



13. INSTALL REAR NO. 2 TIMING BELT PLATE LH

a. Install the timing plate with the 2 bolts.

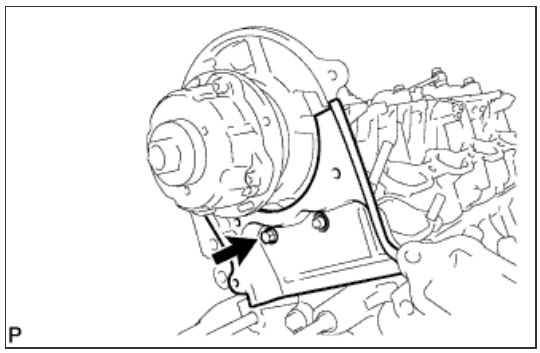
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



14. INSTALL REAR TIMING BELT PLATE RH

a. Install the timing belt plate with the bolt.

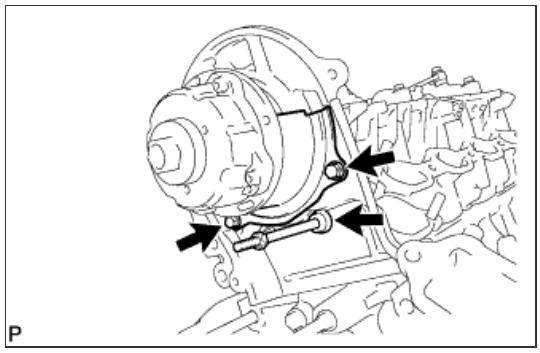
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



15. INSTALL REAR NO. 2 TIMING BELT PLATE RH

a. Install the timing plate with the 2 bolts and stud bolt.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



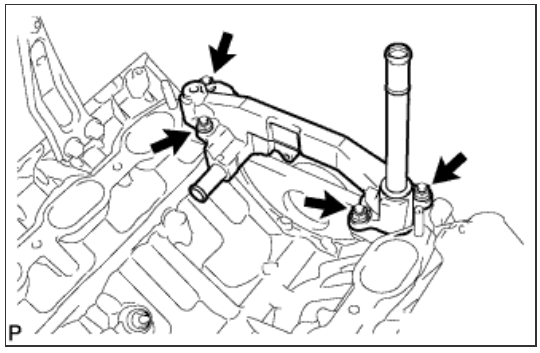
16. INSTALL REAR WATER BY-PASS JOINT

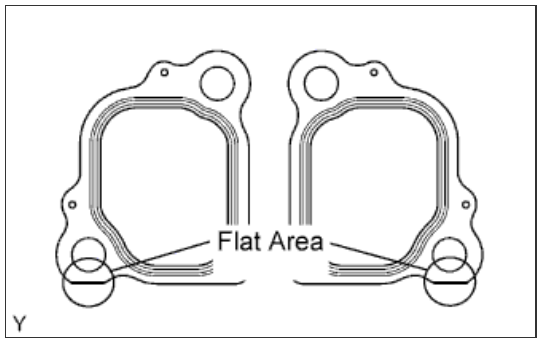
a. Install 2 new gaskets and the water by-pass joint with the 4 nuts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

HINT:

With the flat-bottom of each new gasket facing downward as shown in the illustration, install the 2 gaskets to the engine rear side.





17. INSTALL WATER BY-PASS PIPE SUB-ASSEMBLY

a. Apply soapy water to the O-ring.

b. Install a new O-ring to the water by-pass pipe.

c. Push in the water by-pass pipe.

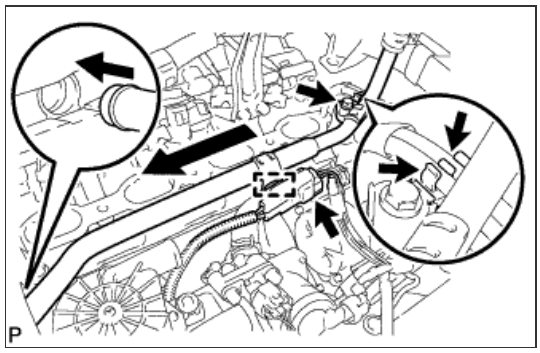
d. Install the water by-pass pipe with the bolt.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

e. Connect the 2 vacuum switching valve hoses to the water by-pass pipe clamp.

f. Connect the wire harness clamp.

g. Connect the connector.



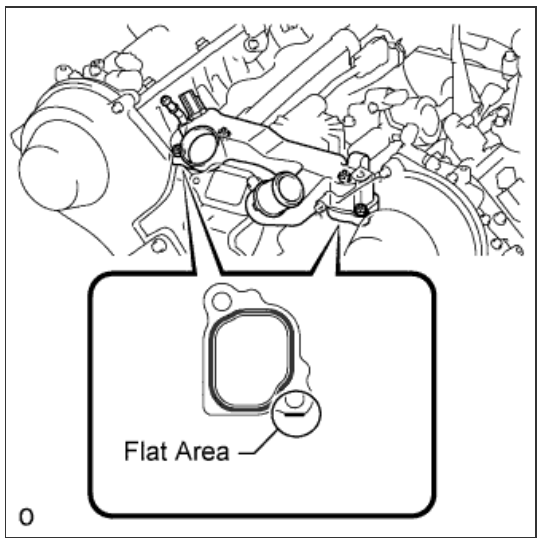
18. INSTALL FRONT WATER BY-PASS JOINT

a. Install 2 new gaskets and the water by-pass joint with the 4 nuts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

HINT:

With the flat-bottom of each new gasket facing downward as shown in the illustration, install the 2 gaskets to the engine front side.



19. INSTALL WATER INLET HOUSING

a. Apply soapy water to a new O-ring and install it to the water inlet housing.

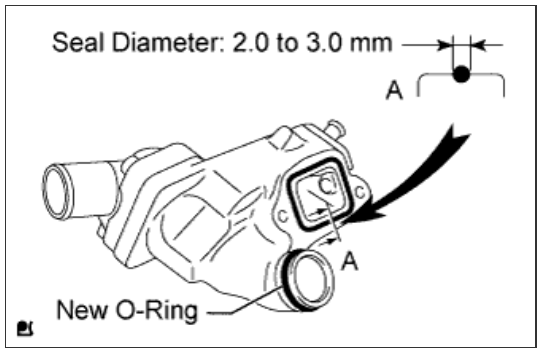
b. Apply seal packing in a continuous line to the places shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing 1282B, Three Bond 1282B or equivalent

Standard seal diameter:
2.0 to 3.0 mm (0.0787 to 0.118 in.)

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the water inlet housing within 3 minutes after applying seal packing.**

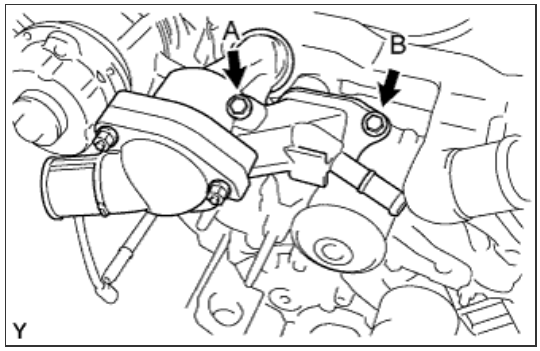


c. Temporarily install the water inlet housing with the 2 bolts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

Bolt Length:

Item	Length
Bolt A	77 mm (3.03 in.)
Bolt B	22 mm (0.866 in.)

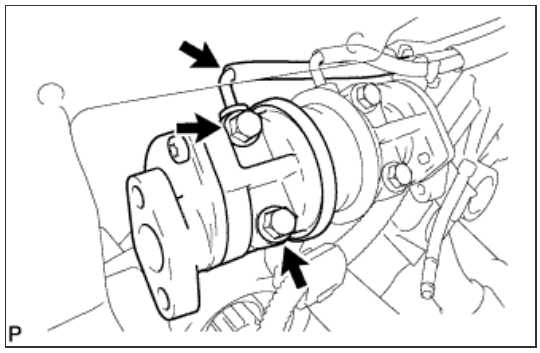


20. INSTALL NO. 2 AIR SWITCHING VALVE ASSEMBLY (w/ Secondary Air Injection System)

a. Install a new gasket and the No. 2 air switching valve to the rear water by-pass joint with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Connect the vacuum switching valve hose to the No. 2 air switching valve.

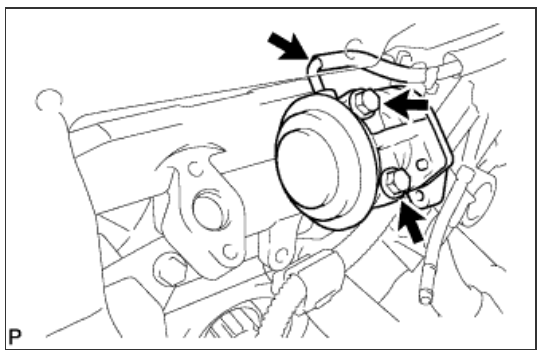


21. INSTALL NO. 1 AIR SWITCHING VALVE ASSEMBLY (w/ Secondary Air Injection System)

a. Install a new gasket and the No. 1 air switching valve to the rear water by-pass joint with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Connect the vacuum switching valve hose to the No. 1 air switching valve.



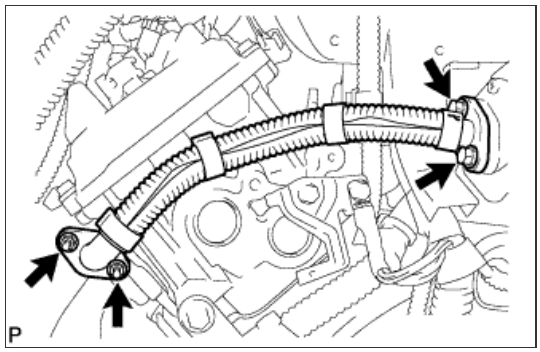
22. INSTALL NO. 3 AIR TUBE (w/ Secondary Air Injection System)

a. Install a new gasket and connect the No. 3 air tube to the exhaust manifold with the 2 nuts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Install a new gasket and connect the No. 3 air tube to the No. 2 air switching valve with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



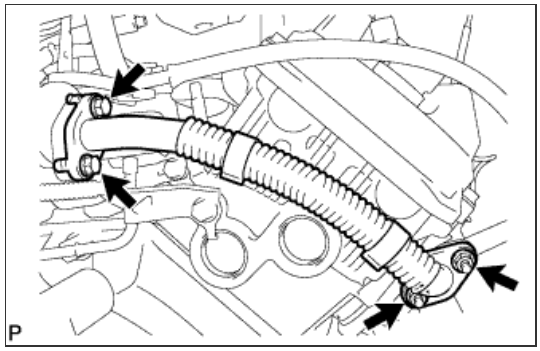
23. INSTALL AIR TUBE SUB-ASSEMBLY RH (w/ Secondary Air Injection System)

a. Install a new gasket and connect the air tube to the exhaust manifold with the 2 nuts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Install a new gasket and connect the air tube to the No. 1 air switching valve with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



24. INSTALL INTAKE MANIFOLD

a. Install the intake manifold (Click here).

25. CONNECT FRONT EXHAUST PIPE ASSEMBLY

a. Install the exhaust manifold RH with the bolt.

Torque:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }

b. Install the 2 gaskets to the front exhaust pipe and connect the front exhaust pipe to the exhaust manifold RH and center exhaust pipe. Then install the 3 nuts and 2 bolts.

Torque:
for bolt:
48 N*m{ 489 kgf*cm , 35 ft.*lbf }
for nut:
54 N*m{ 554 kgf*cm , 40 ft.*lbf }

c. Connect the air fuel ratio sensor connector.

d. Connect the heated oxygen sensor connector.

e. Attach the heated oxygen sensor wire clamp.

26. CONNECT FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Install the exhaust manifold LH with the bolt.

Torque:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }

b. Install the 2 gaskets to the front No. 2 exhaust pipe and connect the front No. 2 exhaust pipe to the exhaust manifold LH and center exhaust pipe. Then install the 3 nuts and 2 bolts.

Torque:
for bolt:
48 N*m{ 489 kgf*cm , 35 ft.*lbf }

for nut:
54 N*m{ 554 kgf*cm , 40 ft.*lbf }

c. Connect the air fuel ratio sensor connector.

d. Connect the heated oxygen sensor connector.

27. ADD ENGINE OIL

a. Install a new gasket and the drain plug.

Torque:
39 N*m{ 398 kgf*cm , 29 ft.*lbf }

b. Add new engine oil.

Standard Engine Oil:

Oil Grade	Oil Viscosity (SAE)
API grade SL "Energy-Conserving", SM "Energy-Conserving" or ILSAC multigrade engine oil	10W-30 (10W-30 is best choice for fuel economy and good starting in cold weather).
API grade SL or SM multigrade engine oil	10W-30

Standard Oil Capacity:

Item	Specified Condition
Drain and refill with oil filter change	6.2 liters (6.6 US qts, 5.5 Imp. qts)
Drain and refill without oil filter change	5.7 liters (6.0 US qts, 5.0 Imp. qts)
Dry fill	7.1 liters (7.5 US qts, 6.2 Imp. qts)

28. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item		Specified Condition
w/o Transmission oil cooler	w/o Rear Heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)
	w/ Rear Heater	16.3 liters (17.2 US qts, 14.3 Imp. qts)
w/ Transmission oil cooler	w/o Rear Heater	14.1 liters (14.9 US qts, 12.4 Imp. qts)
	w/ Rear Heater	16.9 liters (17.9 US qts, 14.9 Imp. qts)

HINT:

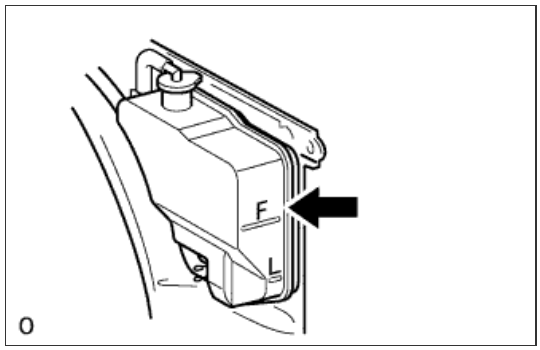
TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the radiator reservoir cap.

d. Press the inlet and outlet radiator hoses several times by hand, and then check

the coolant level. If the coolant level is low, add coolant.



e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.

NOTICE:

Switch off the A/C.

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

h. Press the inlet and outlet radiator hoses several times by hand to bleed air.

CAUTION:

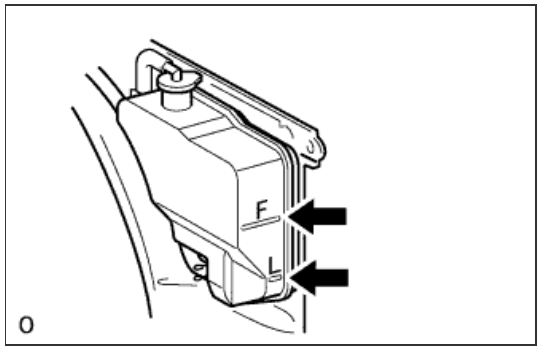
- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the cooling fan.**

i. Stop the engine, and wait until the engine coolant cools down to the ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

j. Check that the coolant level is between the F and L lines. If the coolant level is below the L line, repeat all of the procedures above. If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.



29. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

30. INSPECT FOR OIL LEAK

a. Start the engine. Make sure that there are no oil leaks from the area that was worked on.

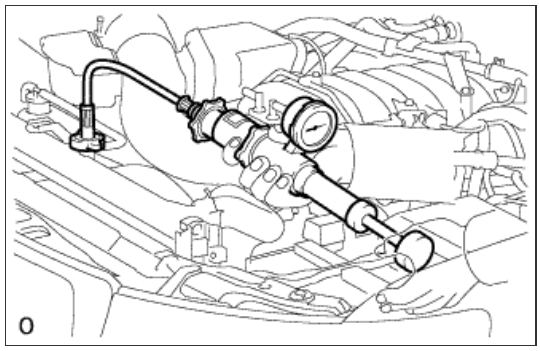
31. INSPECT FOR COOLANT LEAK

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123

kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



32. INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and intelligent tester ON.

NOTICE:

Do not start the engine.

c. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the Fuel Pump Speed Control.

d. Check that there are no fuel leaks after doing maintenance anywhere on the fuel system.

33. INSPECT FOR EXHAUST GAS LEAK

If gas is leaking, tighten the areas necessary to stop the leak. Replace damaged parts as necessary.

34. CHECK ENGINE OIL LEVEL

a. Warm up the engine, then stop the engine and wait for 5 minutes.

b. Check that the engine oil level is between the low level and full level marks on the dipstick.
If low, check for leakage and add oil up to the full level mark.

NOTICE:

Do not fill engine oil above the full level mark.

35. INSPECT IGNITION TIMING

a. Warm up and stop the engine.

i. Allow the engine to warm up to a normal operating temperature.

b. When using the intelligent tester:

i. Connect the intelligent tester to the DLC3.

NOTICE:

Switch off all accessories and the A/C before connecting the intelligent tester.

ii. Start the engine and idle it.

iii. Push the intelligent tester main switch ON.

iv. Enter the following menus: Powertrain / Engine and ECT / Data List / Primary / IGN Advance.

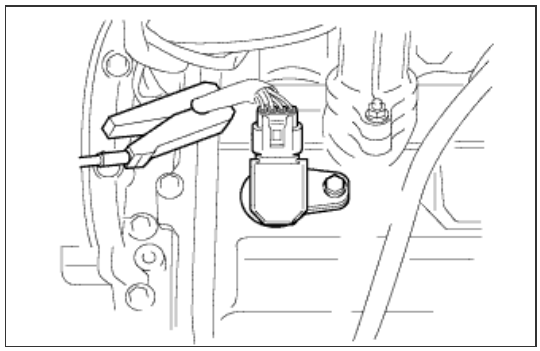
HINT:

Refer to the intelligent tester operator's manual for further details.

Standard ignition timing:
5 to 15° BTDC @ idling (transmission in neutral and A/C switch off)

v. Disconnect the intelligent tester from the DLC3.

c. When not using the intelligent tester:



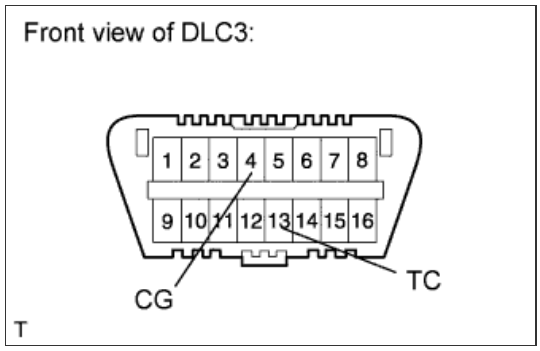
i. Remove the 2 nuts and V-bank cover.

ii. Connect the tester probe of a timing light to the wire of the ignition coil connector for the No. 1 cylinder.

NOTICE:

Use a timing light that detects primary signals.

iii. Using SST, connect terminals 13 (TC) and 4 (CG) of the DLC3.

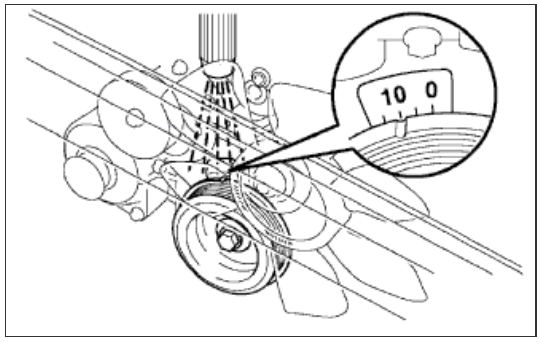


SST
09843-18040

NOTICE:

- **Confirm the terminal numbers before connecting them. Connecting the wrong terminals can damage the engine.**
- **Switch off all accessories and the A/C.**

iv. Using the timing light, check the ignition timing.



Ignition timing:
5 to 15° BTDC @ idling (transmission in neutral and A/C switch off)

v. Remove SST from the DLC3.

vi. Disconnect the timing light from the engine.

vii. Install the V-bank cover with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

36. INSPECT ENGINE IDLE SPEED

a. Warm up and stop the engine.

i. Allow the engine to warm up to a normal operating temperature.

b. When using the intelligent tester:

i. Connect the intelligent tester to the DLC3.

NOTICE:

Switch off all accessories and the A/C before connecting the intelligent tester.

ii. Race the engine at 2500 rpm for approximately 90 seconds.

iii. Push the intelligent tester main switch ON.

iv. Enter the following menus: Powertrain / Engine and ECT / Data List / Primary / Engine Speed.

Standard idle speed:
650 to 750 rpm (transmission in neutral and A/C switch off)

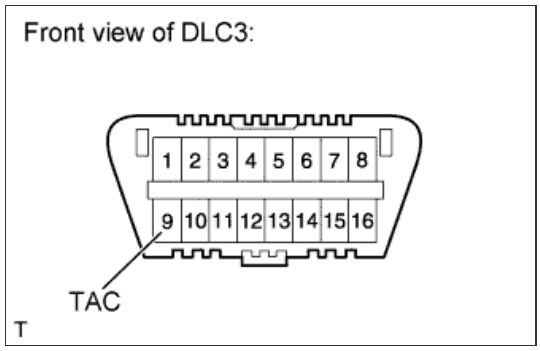
HINT:

Refer to the intelligent tester operator's manual for further details.

If the idle speed is not as specified, check the air intake system.

. Disconnect the intelligent tester from the DLC3.

c. When not using the intelligent tester:



i. Using SST, connect a tachometer probe to terminal 9 (TAC) of the DLC3.

SST
09843-18030

NOTICE:

- **Confirm the terminal number before connecting the probe. Connecting the probe to the wrong terminal can damage the engine.**
- **Switch off all accessories and the A/C.**

ii. Race the engine at 2500 rpm for approximately 90 seconds.

iii. Check the idle speed.

Standard idle speed:
650 to 750 rpm (transmission in neutral and A/C switch off)

If the idle speed is not as specified, check the air intake system.

iv. Disconnect the tachometer from the DLC3.

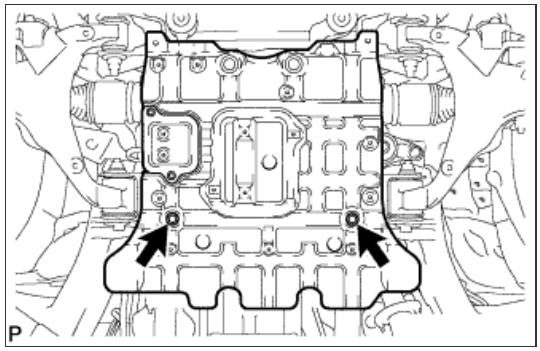
37. INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Install the cowl top ventilator louver (Click here).

38. INSTALL NO. 2 ENGINE UNDER COVER

a. Install the No. 2 engine under cover with the 2 bolts.

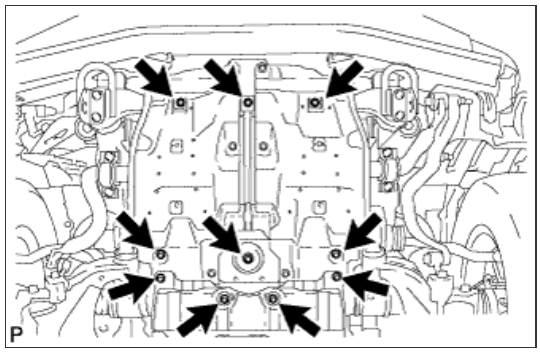
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



39. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the No. 1 engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



40. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

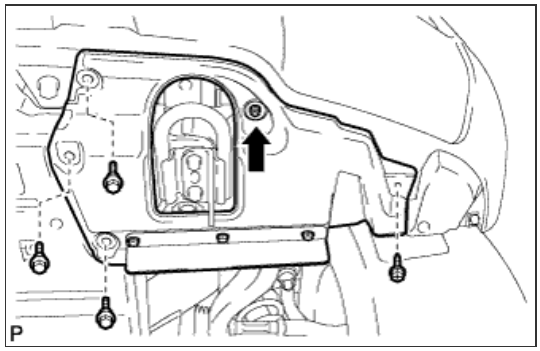
HINT:

Use the same procedures described for the LH side.

41. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



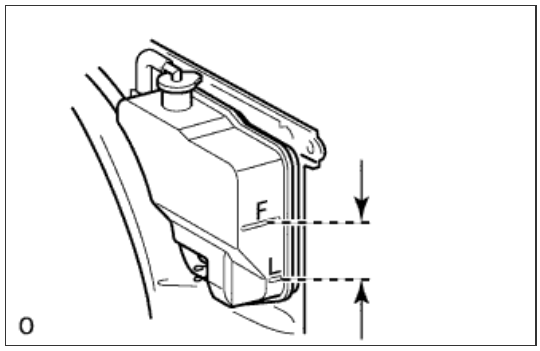
42. INSPECT ENGINE COOLANT LEVEL

a. Check that the engine coolant level is between the L and F lines when the engine is cold.
If the engine coolant is low, check for leaks and add "TOYOTA Super Long Life Coolant" or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite and non-borate coolant with long-life hybrid organic acid technology to the F line.

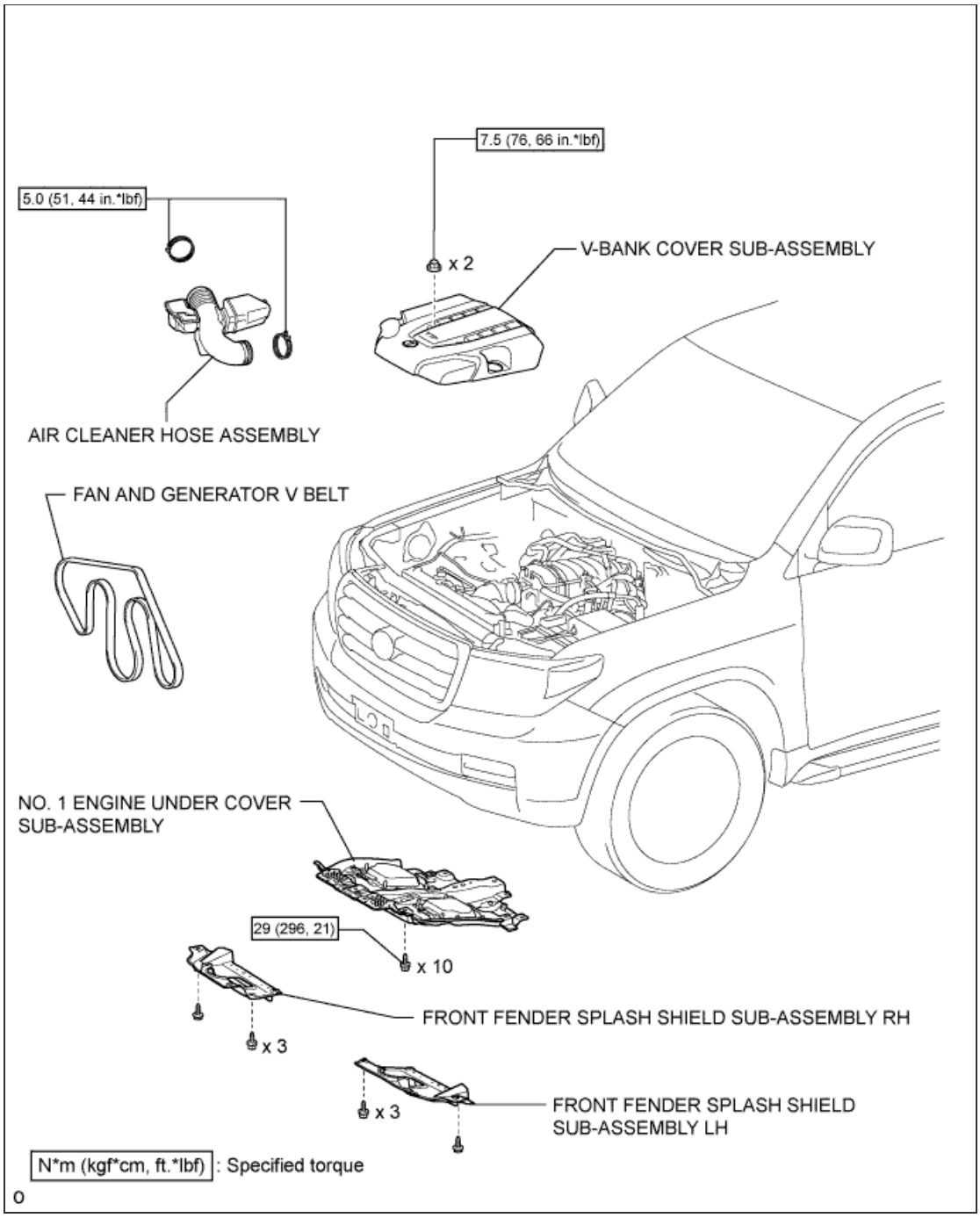
NOTICE:

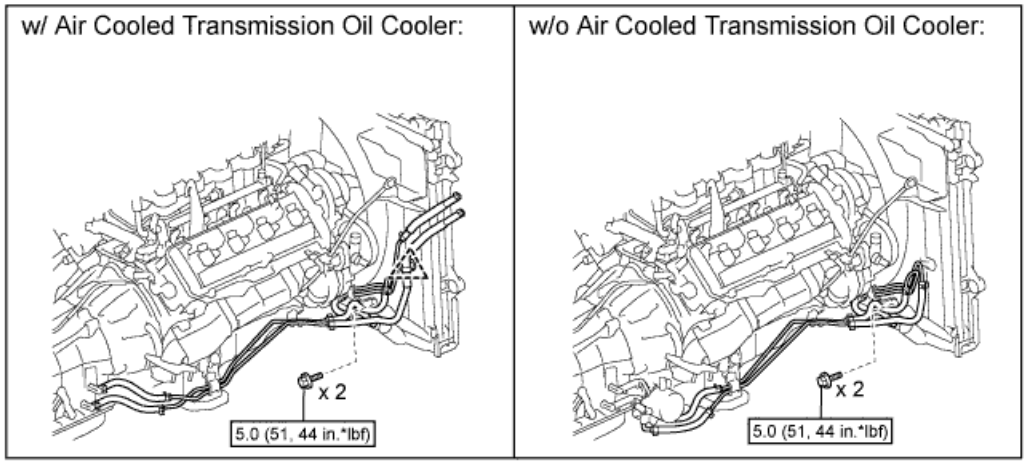
Do not substitute plain water for engine coolant.

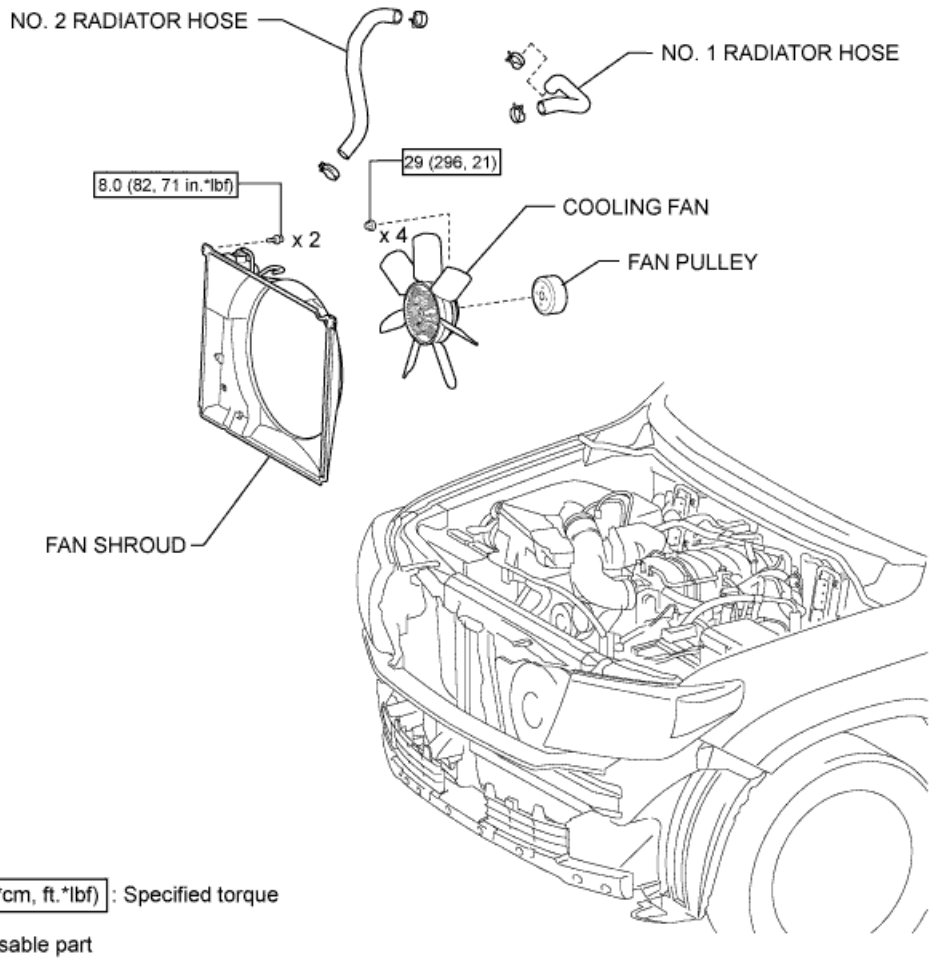
b. Remove the radiator cap, and check that the coolant level is up to the radiator filler hole.



for Preparation Click here



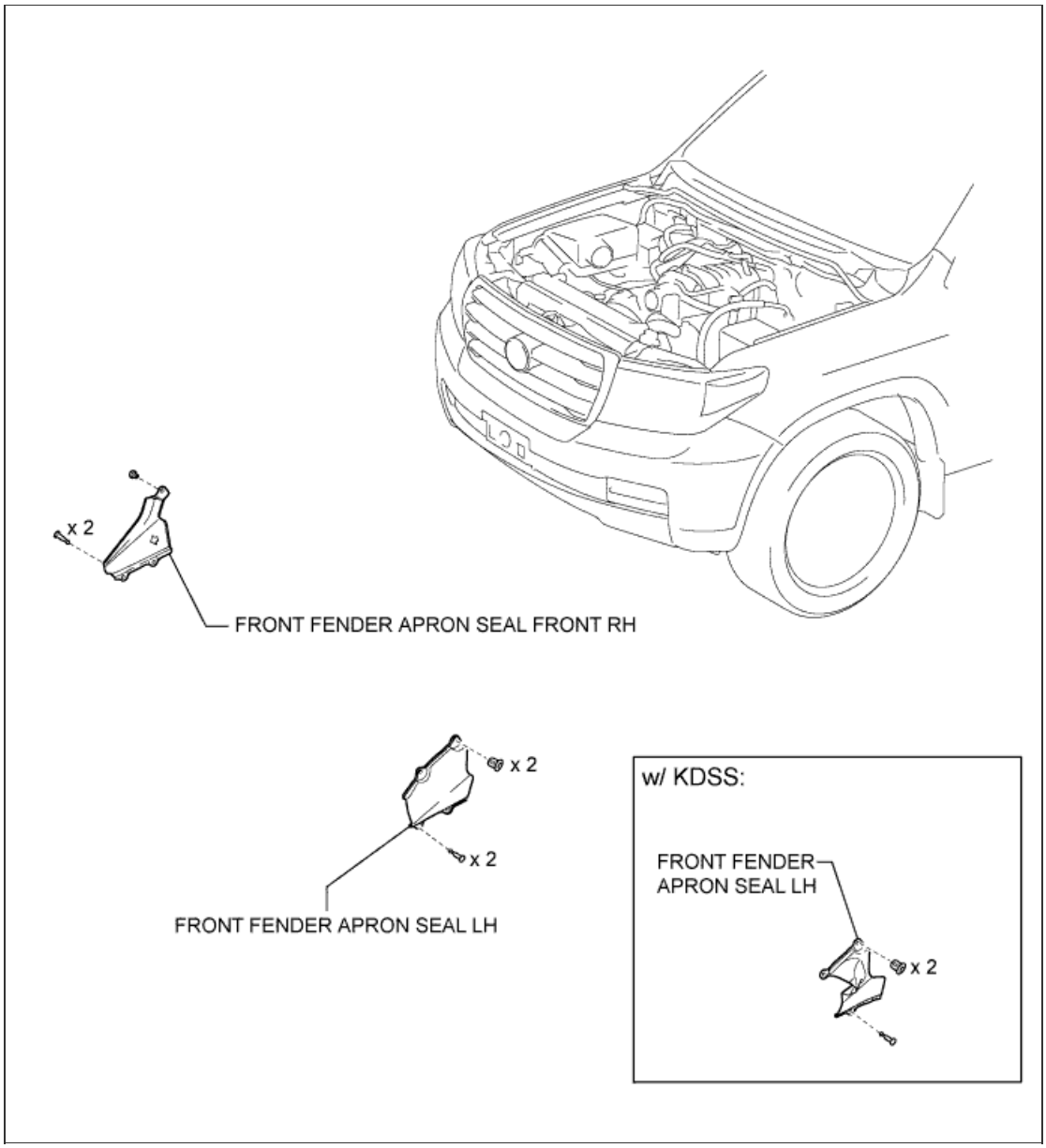


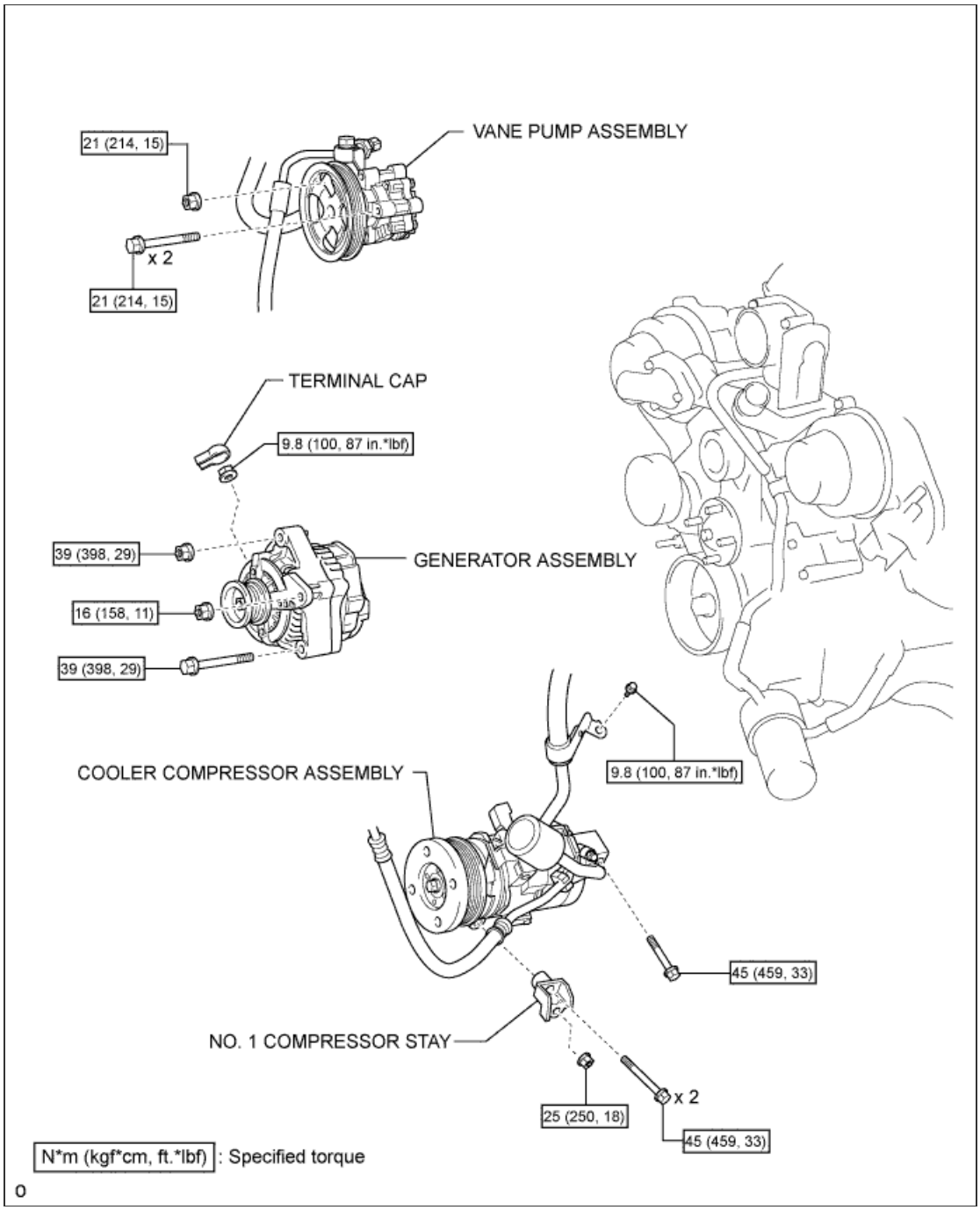


N*m (kgf*cm, ft.*lbf) : Specified torque

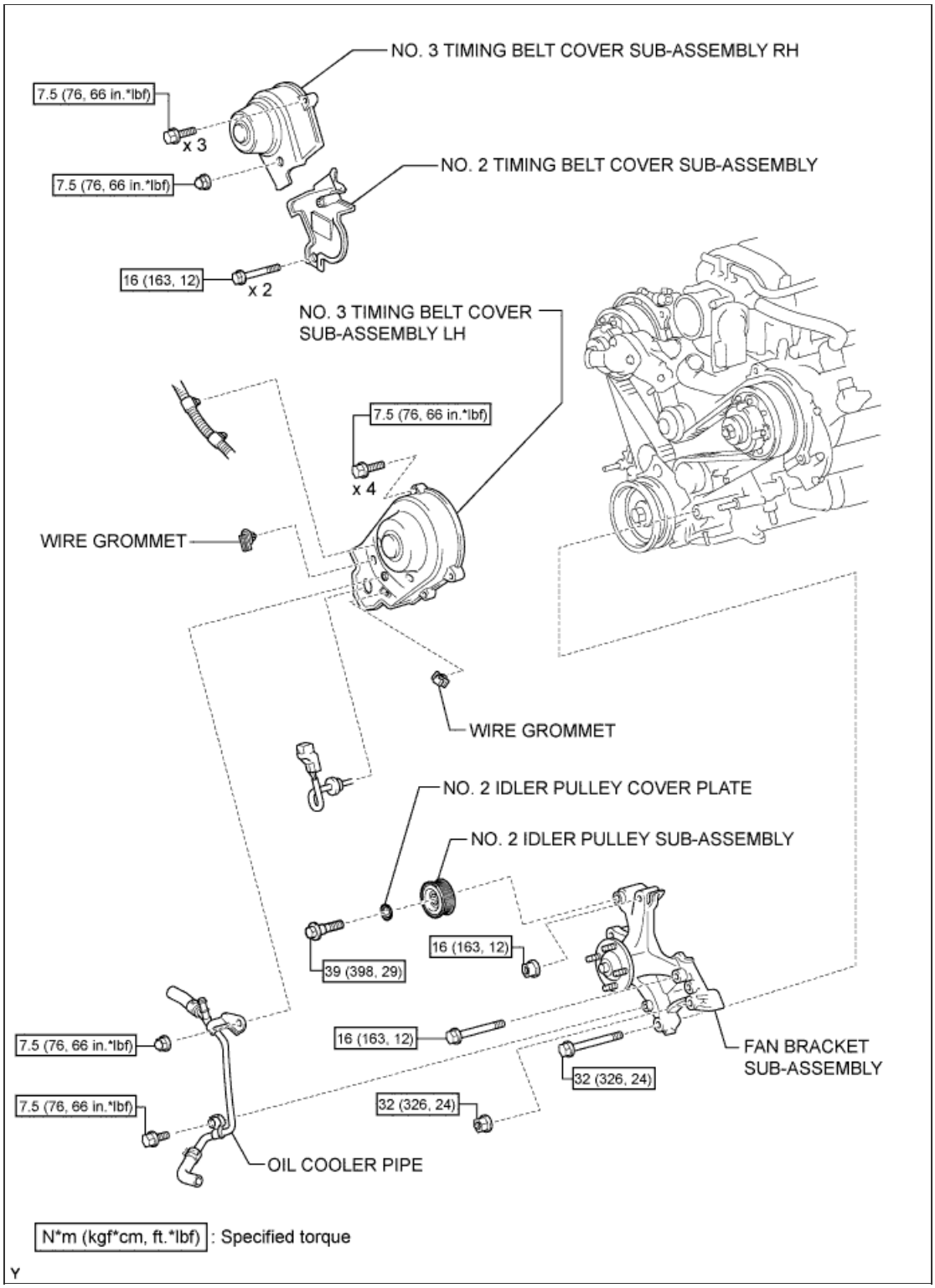
● Non-reusable part

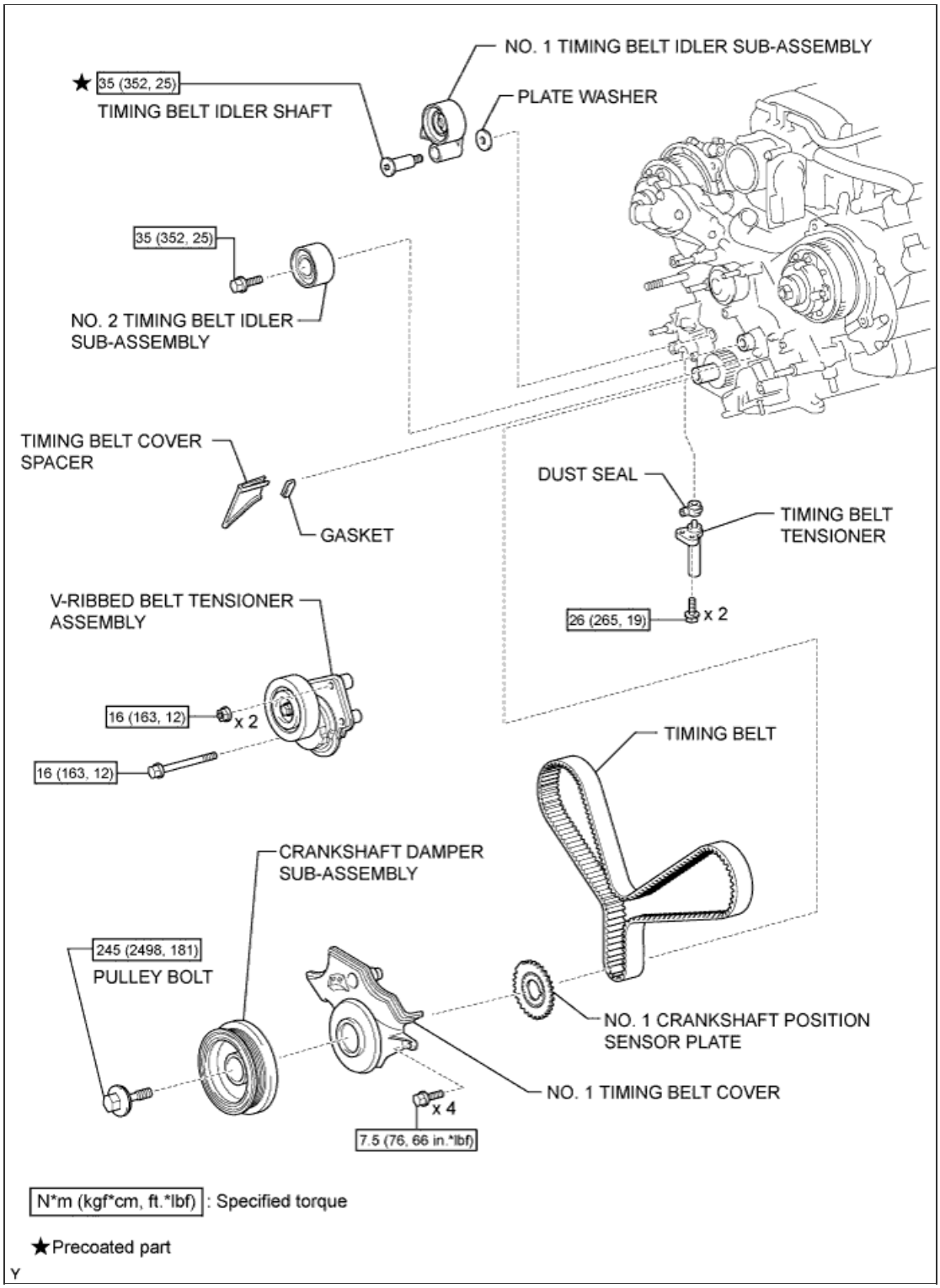
o

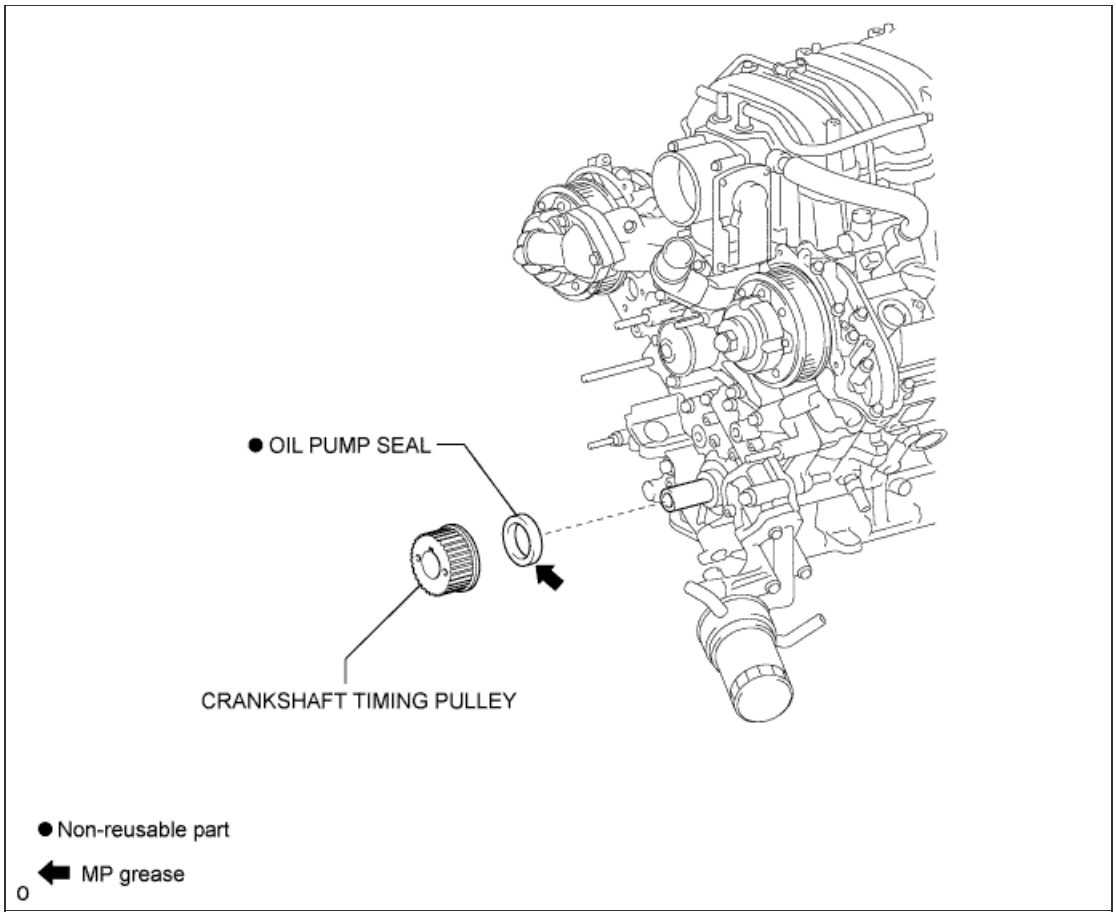

x 2
FRONT FENDER APRON SEAL FRONT RH
x 2
x 2
FRONT FENDER APRON SEAL LH
w/ KDSS:
FRONT FENDER APRON SEAL LH
x 2


21 (214, 15)
VANE PUMP ASSEMBLY
x 2
21 (214, 15)
TERMINAL CAP
9.8 (100, 87 in.*lbf)
39 (398, 29)
GENERATOR ASSEMBLY
16 (158, 11)
39 (398, 29)
COOLER COMPRESSOR ASSEMBLY
9.8 (100, 87 in.*lbf)
45 (459, 33)
NO. 1 COMPRESSOR STAY
25 (250, 18)
x 2
45 (459, 33)
N*m (kgf*cm, ft.*lbf) : Specified torque

o


NO. 3 TIMING BELT COVER SUB-ASSEMBLY RH
7.5 (76, 66 in.*lbf)
x 3
NO. 2 TIMING BELT COVER SUB-ASSEMBLY
7.5 (76, 66 in.*lbf)
16 (163, 12)
x 2
NO. 3 TIMING BELT COVER SUB-ASSEMBLY LH
7.5 (76, 66 in.*lbf)
x 4
WIRE GROMMET
WIRE GROMMET
NO. 2 IDLER PULLEY COVER PLATE
NO. 2 IDLER PULLEY SUB-ASSEMBLY
39 (398, 29)
16 (163, 12)
7.5 (76, 66 in.*lbf)
16 (163, 12)
32 (326, 24)
FAN BRACKET SUB-ASSEMBLY
7.5 (76, 66 in.*lbf)
32 (326, 24)
OIL COOLER PIPE
N*m (kgf*cm, ft.*lbf) : Specified torque
Y


NO. 1 TIMING BELT IDLER SUB-ASSEMBLY
★ 35 (352, 25)
TIMING BELT IDLER SHAFT
PLATE WASHER
35 (352, 25)
NO. 2 TIMING BELT IDLER SUB-ASSEMBLY
TIMING BELT COVER SPACER
GASKET
DUST SEAL
TIMING BELT TENSIONER
26 (265, 19) x 2
V-RIBBED BELT TENSIONER ASSEMBLY
16 (163, 12) x 2
16 (163, 12)
TIMING BELT
CRANKSHAFT DAMPER SUB-ASSEMBLY
245 (2498, 181)
PULLEY BOLT
NO. 1 CRANKSHAFT POSITION SENSOR PLATE
NO. 1 TIMING BELT COVER
x 4
7.5 (76, 66 in.*lbf)
N*m (kgf*cm, ft.*lbf) : Specified torque
★Precoated part
Y


● OIL PUMP SEAL
CRANKSHAFT TIMING PULLEY
● Non-reusable part
MP grease

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

2. REMOVE TIMING BELT

a. Remove the timing belt (Click here).

3. REMOVE CRANKSHAFT TIMING PULLEY

a. Using SST, remove the timing pulley.

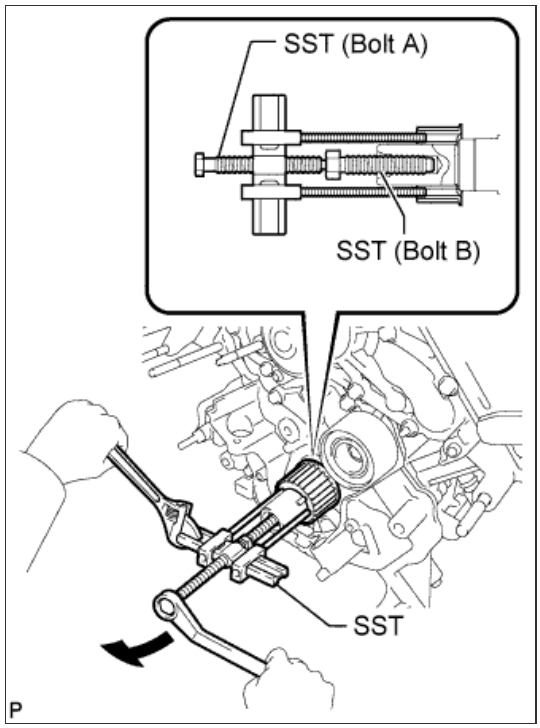
SST
0

HINT:

Apply a lubricant to the threads and end of SST.

Parts Nu er:

Item	Parts number
SST (Bolt A)	09953-05020
SST (Bolt B)	09953-05010



4. REMOVE OIL PUMP SEAL

a. Using a knife, cut off the lip of the oil seal.

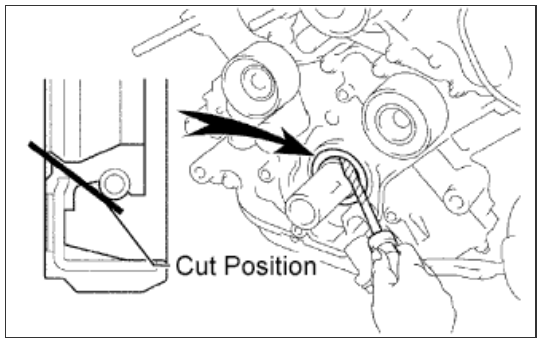
b. Using a screwdriver, pry out the oil seal.

NOTICE:

Do not damage the surface of the oil seal press fit hole and crankshaft.

HINT:

Tape the screwdriver tip before use.


Cut Position

for Preparation Click here

1. INSTALL OIL PUMP SEAL

a. Apply MP grease to the lip of a new oil seal.

NOTICE:

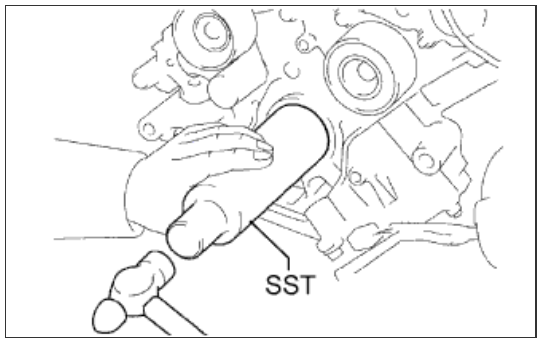
- **Do not allow foreign matter to contact the lip of the oil seal.**
- **Do not allow MP grease to contact the dust seal.**

b. Using SST and a hammer, tap in the oil seal until its surface is flush with the oil pump body edge.

SST
09316-60011 09316-00011

NOTICE:

- **Keep the lip of the oil seal free from foreign matter.**
- **Do not tap the oil seal at an angle.**

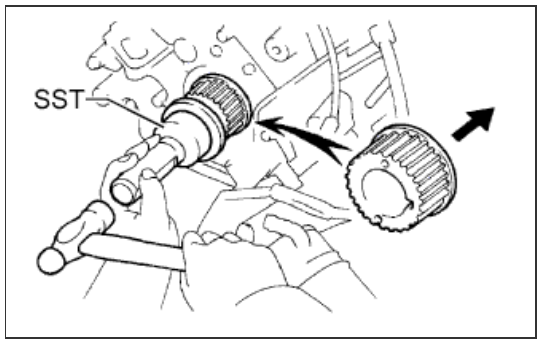


. INSTALL CRANKSHAFT TIMIN PULLEY

a. Align the timing pulley set key with the key groove of the pulley.

b. Using SST and a hammer, tap in the timing pulley with the flange side facing inward.

SST
09 3-46011



3. INSTALL TIMIN ELT

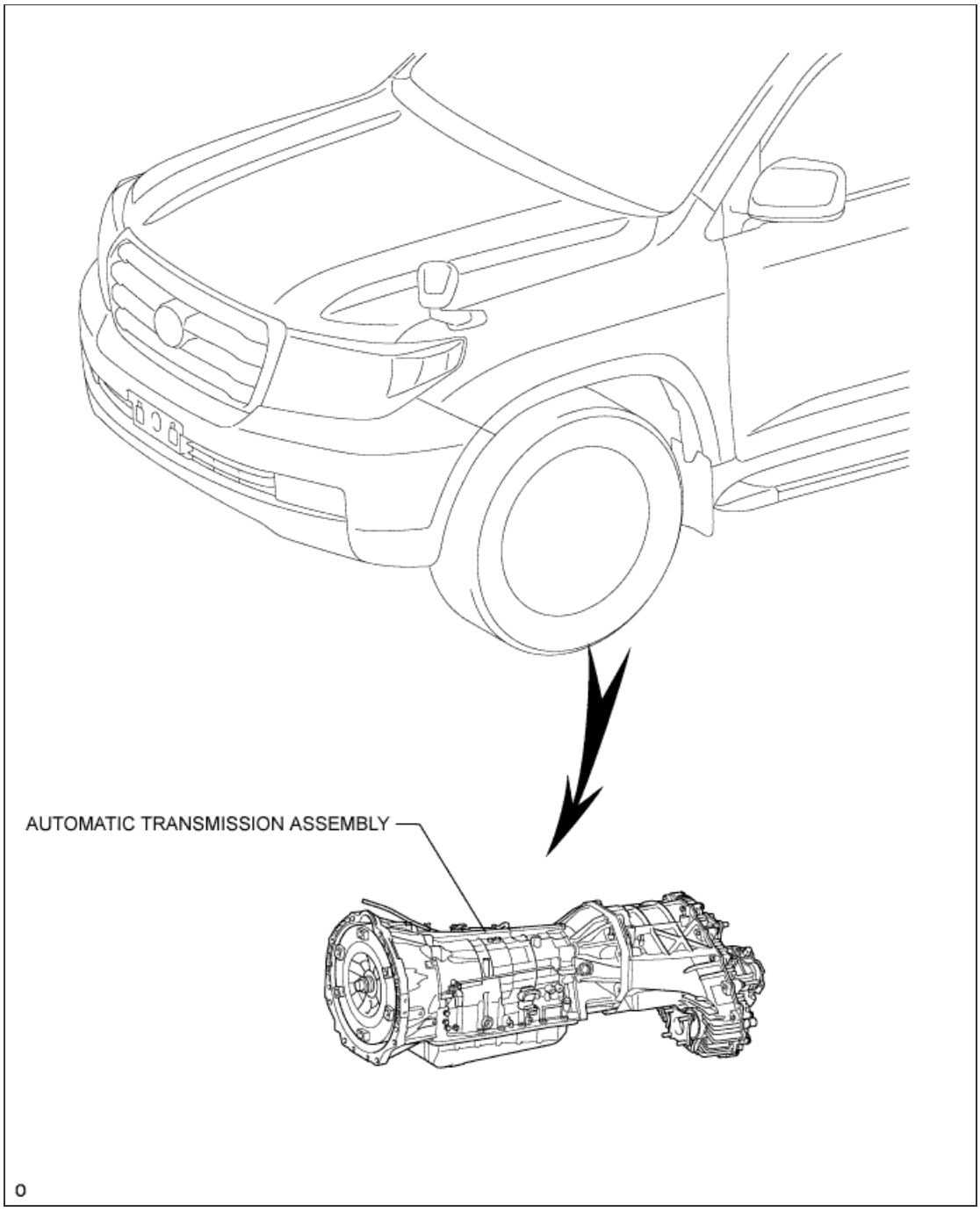
a. Install the timing belt (Click here).

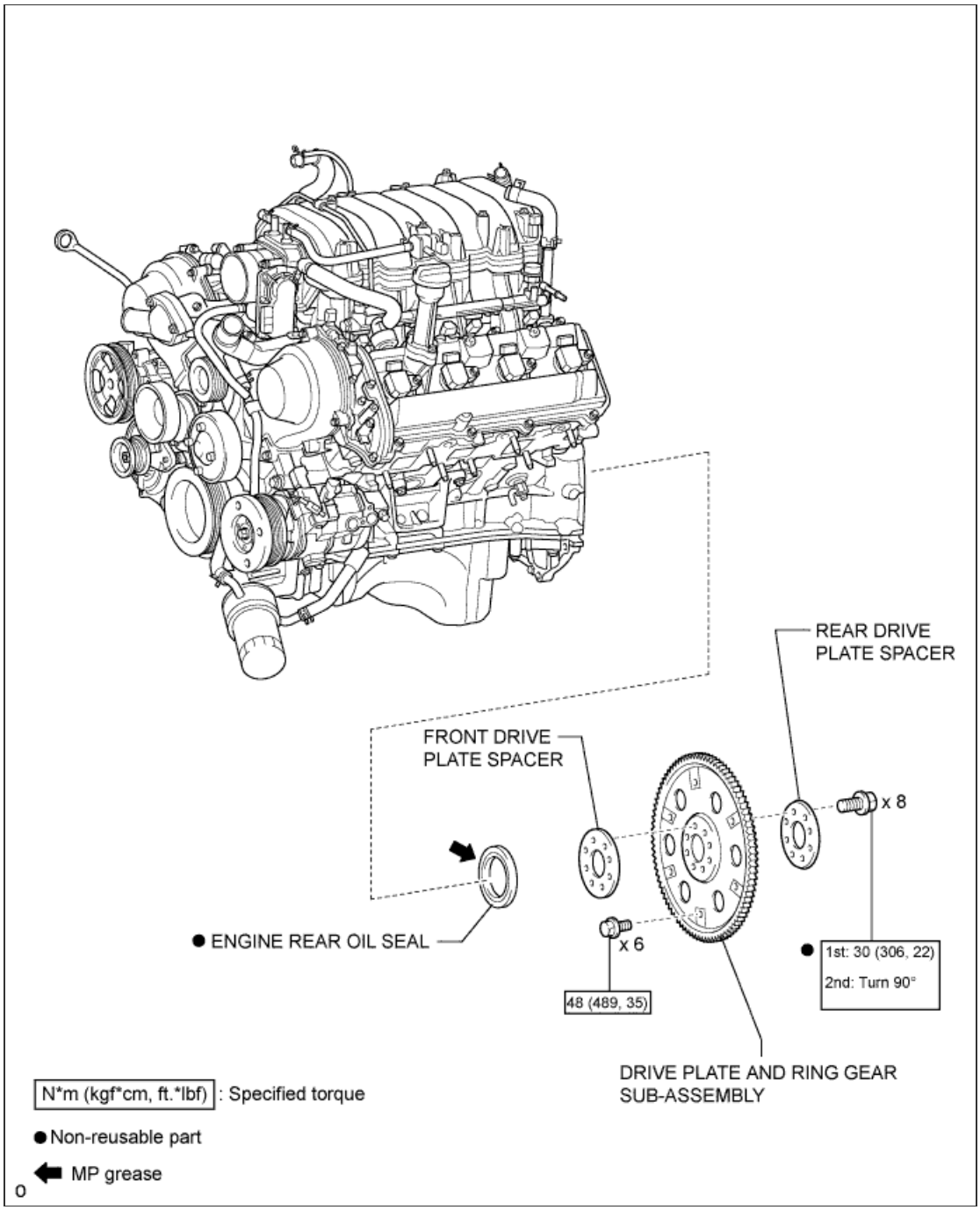
4. CONNECT CABLE TO NE ATI E BATTERY TERMINAL

NOTICE:

hen disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

for Preparation [Click here]




REAR DRIVE
PLATE SPACER
FRONT DRIVE
PLATE SPACER
x 8
● ENGINE REAR OIL SEAL
x 6
● 1st: 30 (306, 22)
2nd: Turn 90°
48 (489, 35)
DRIVE PLATE AND RING GEAR
SUB-ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
MP grease

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

2. REMOVE AUTOMATIC TRANSMISSION ASSEMBLY

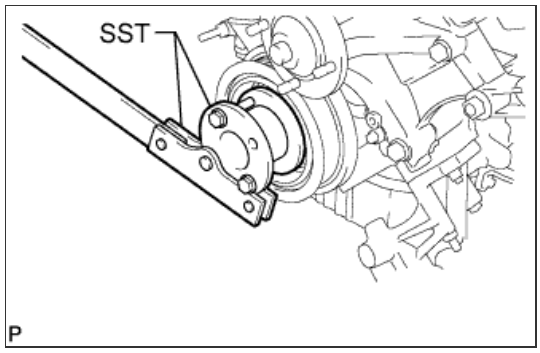
a. Remove the automatic transmission (Click here).

3. REMOVE DRIVE PLATE AND RING GEAR SUB ASSEMBLY

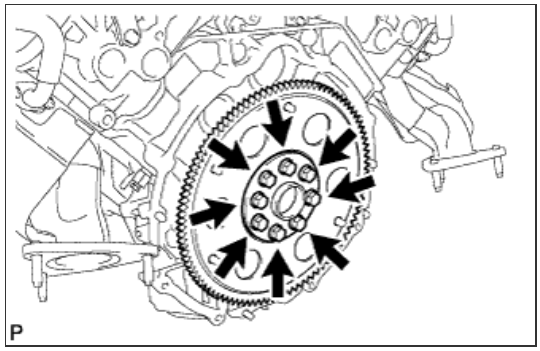
a. Using SST, hold the crankshaft damper.

SST

09213	(09213
09330	(09330



. Remove the 8 bolts, front drive plate spacer, drive plate and rear drive plate spacer.



4. REMOVE ENGINE REAR OIL SEAL

a. Using a knife, cut off the lip of the oil seal.

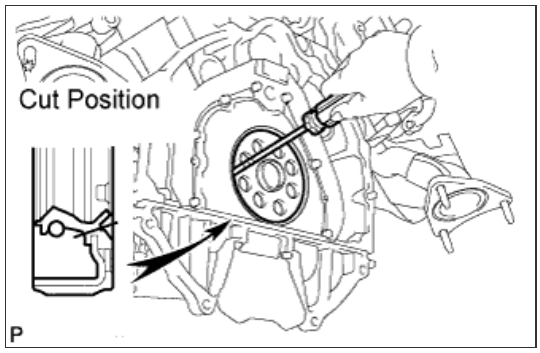
. Using a screwdriver, pry out the oil seal.

NOTICE:

Do not damage the surface of the oil seal press fit hole and crankshaft.

HINT:

Tape the screwdriver tip before use.


Cut Position
P

for Preparation Click here

1. INSTALL ENGINE REAR OIL SEAL

a. Apply MP grease to the lip of a new oil seal.

NOTICE:

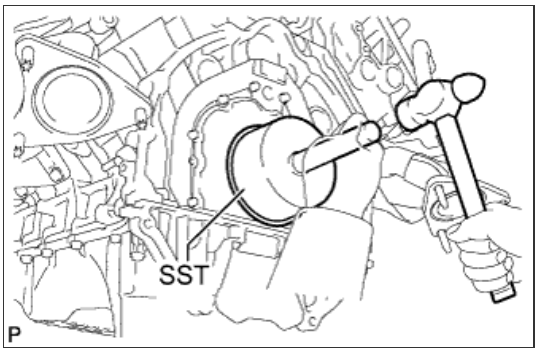
- **Do not allow foreign matter to contact the lip of the oil seal.**
- **Do not allow MP grease to contact the dust seal.**

b. Using SST and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.

SST
09223-56010

NOTICE:

- **Keep the lip of the oil seal free from foreign matter.**
- **Do not tap on the oil seal at an angle.**

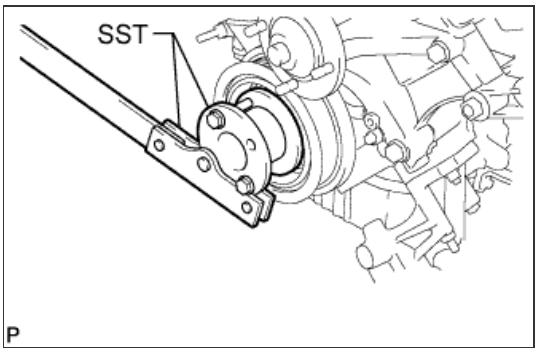


2. INSTALL DRI E PLATE AND RING GEAR SUB-ASSEMBLY

a. Using SST, hold the crankshaft.

SST
09213-70011 (09213-70020)
09330-00021 (09330-00030)

b. Install the front drive plate spacer, drive plate and rear drive plate spacer to the crankshaft.

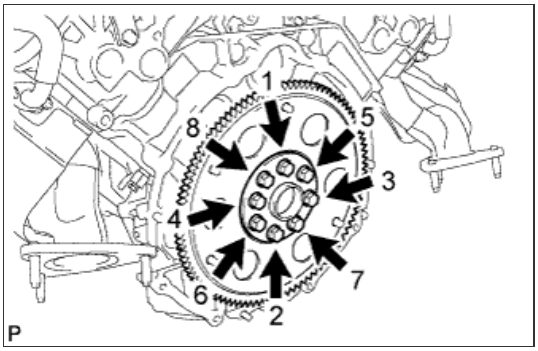


c. Install and uniformly tighten 8 new bolts in the sequence shown in the illustration.

Tor ue:
30 N m 306 kgf m 22 ft. lbf }

NOTICE:

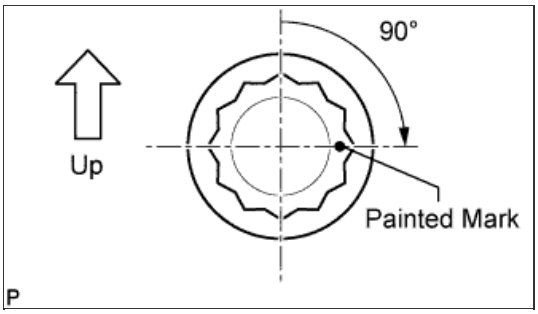
- **Do not reuse the drive plate installation bolts.**
- **Do not impact or damage the drive plate installation bolts. Be sure to handle them carefully.**



d. Mark the upside of each drive plate installation bolt with paint.

e. Tighten the drive plate installation bolts another 90° as shown.

f. Check that the painted marks are now at a 90° angle to the upside.



3. INSTALL AUTOMATIC TRANSMISSION ASSEMBLY

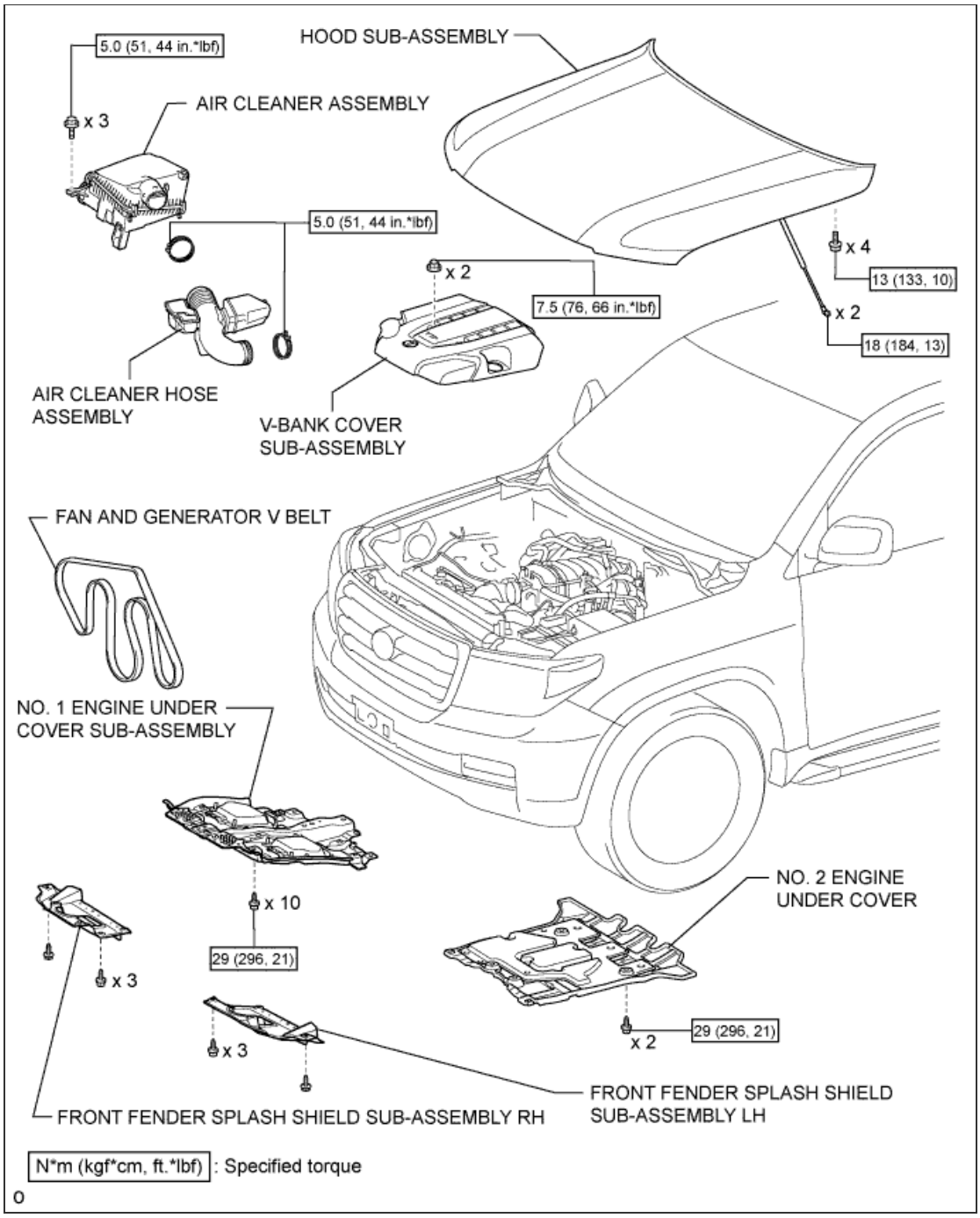
a. Install the automatic transmission (Click here).

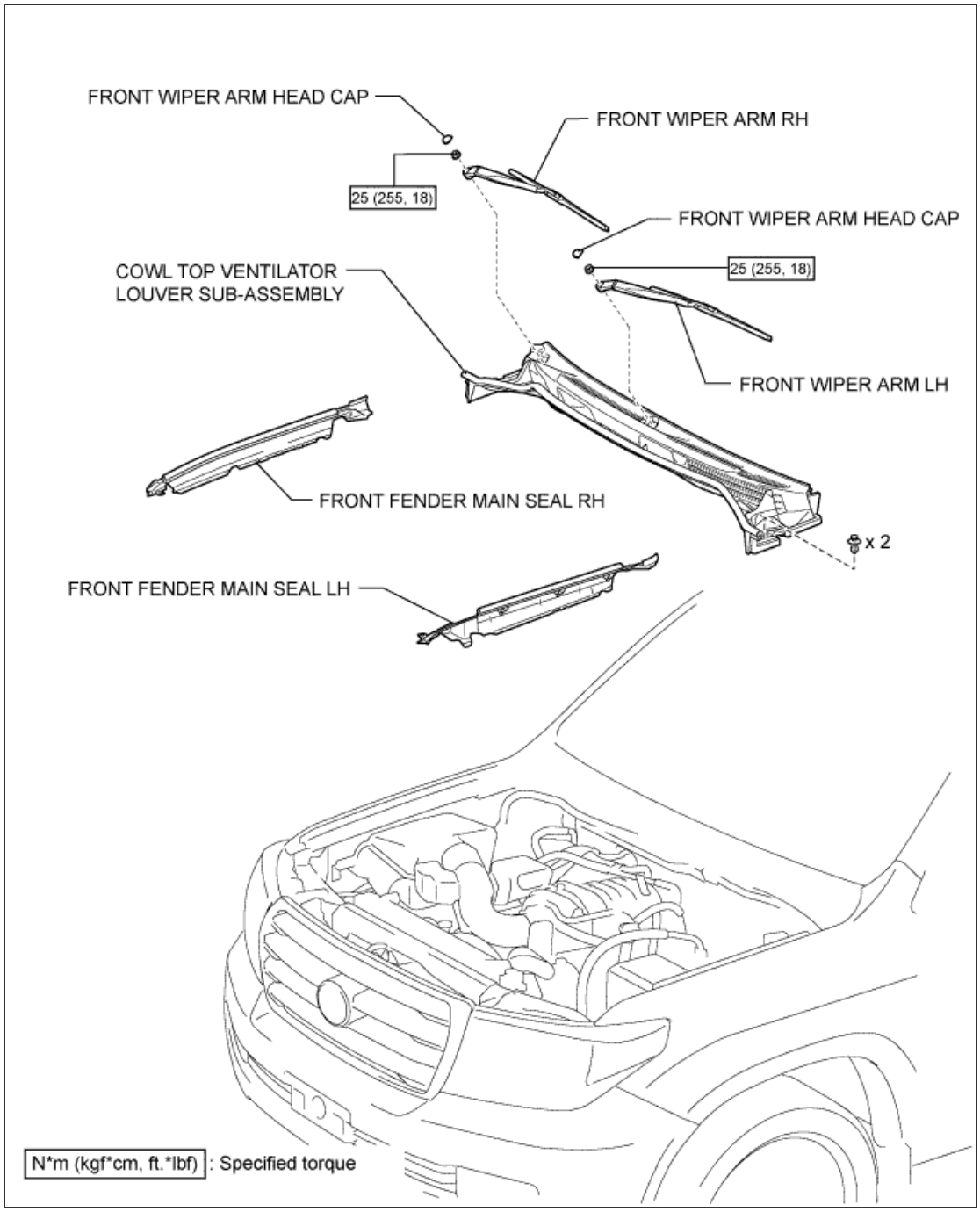
4. CONNECT CABLE TO NEGATI E BATTERY TERMINAL

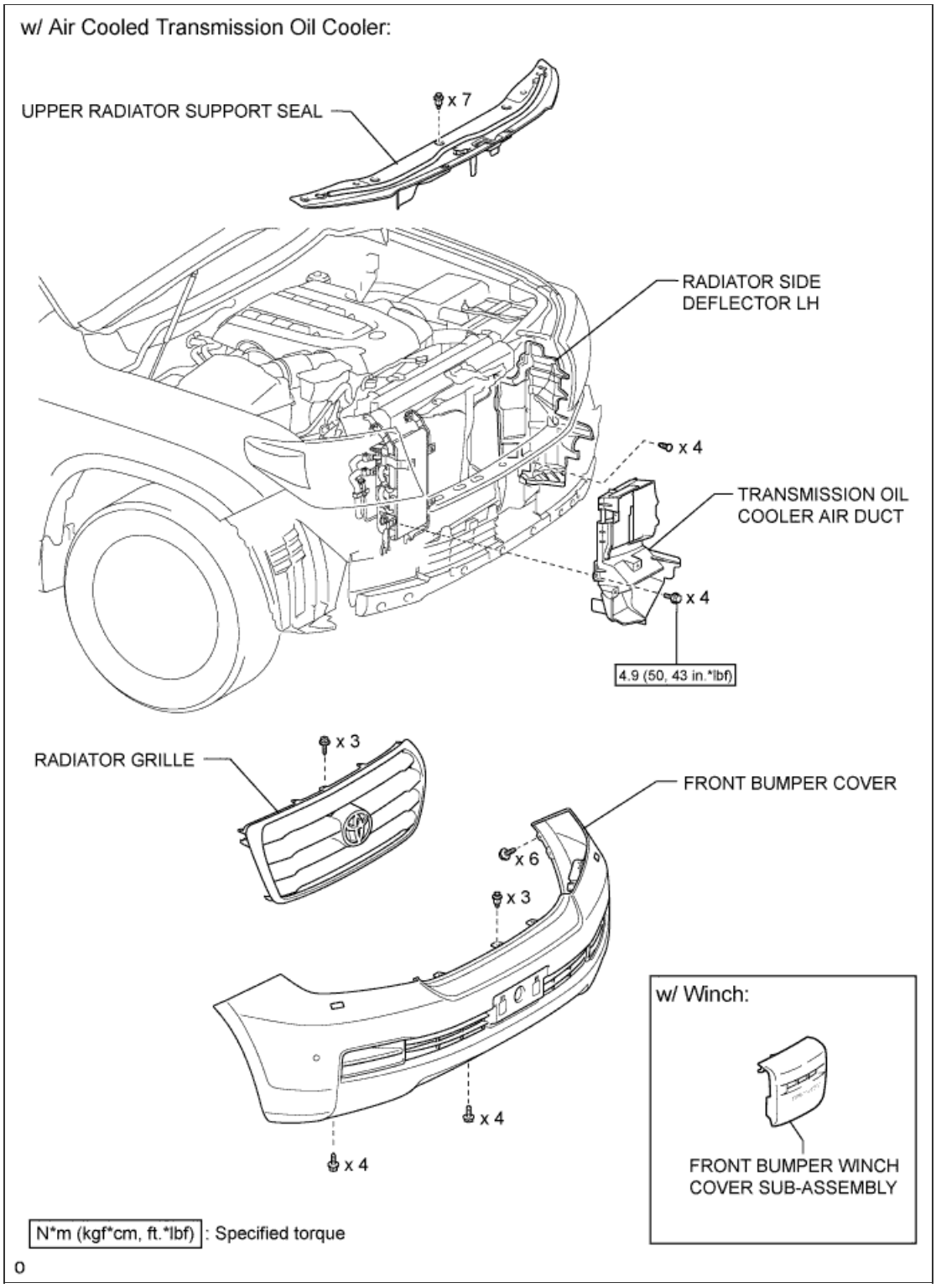
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

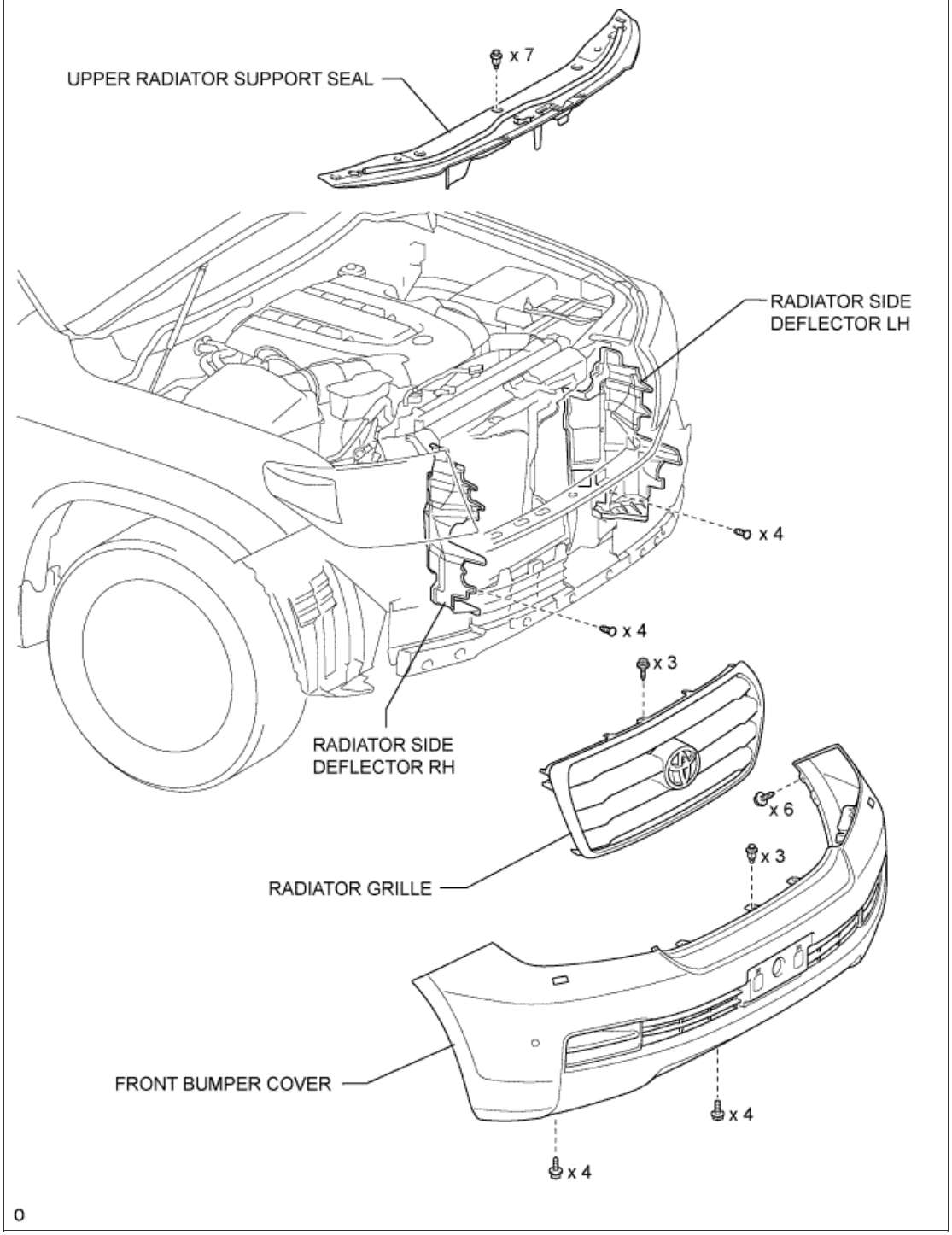
for Preparation [Click here]



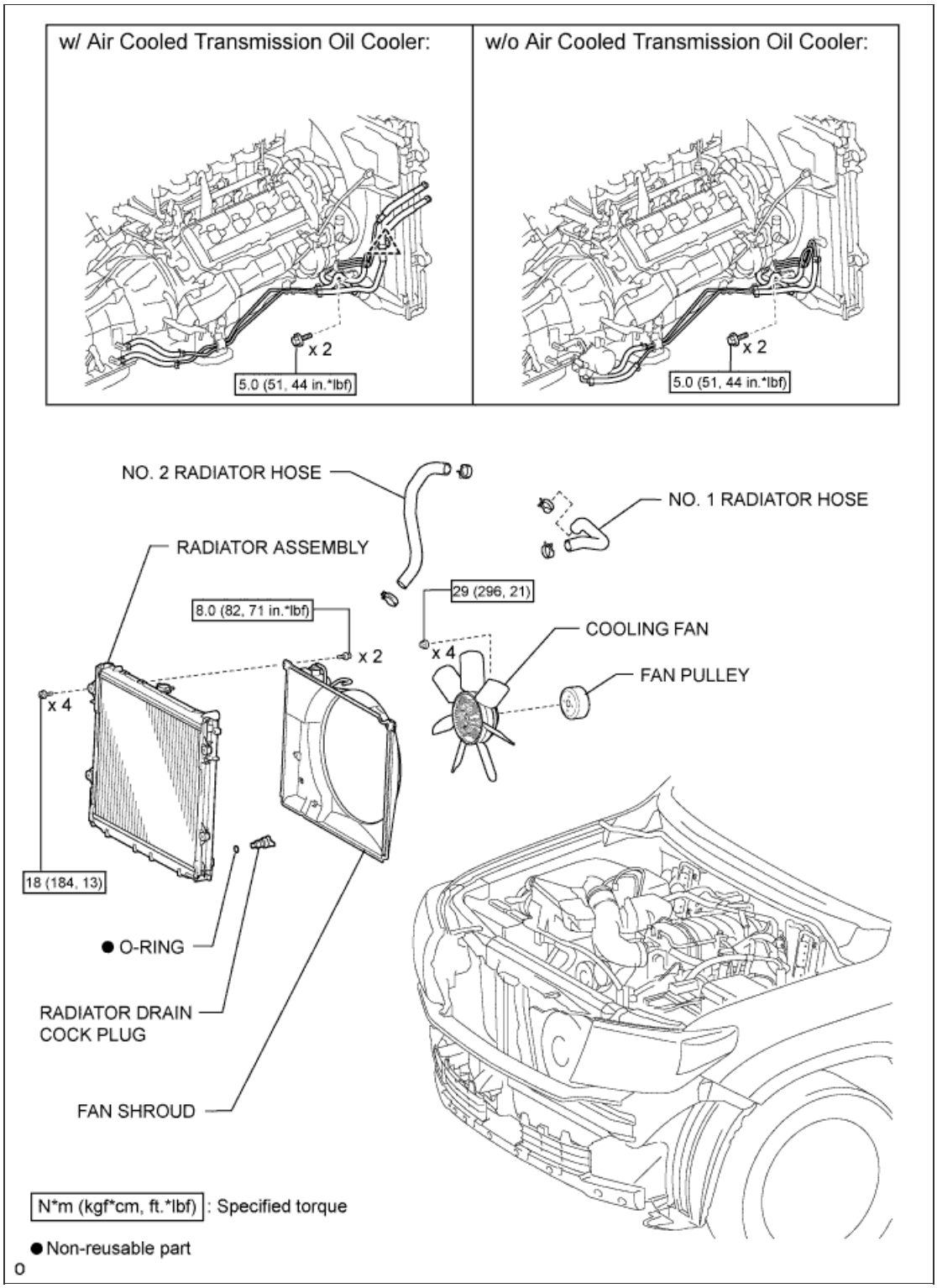

FRONT WIPER ARM HEAD CAP
FRONT WIPER ARM RH
25 (255, 18)
FRONT WIPER ARM HEAD CAP
25 (255, 18)
COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY
FRONT WIPER ARM LH
FRONT FENDER MAIN SEAL RH
x 2
FRONT FENDER MAIN SEAL LH
N*m (kgf*cm, ft.*lbf) : Specified torque

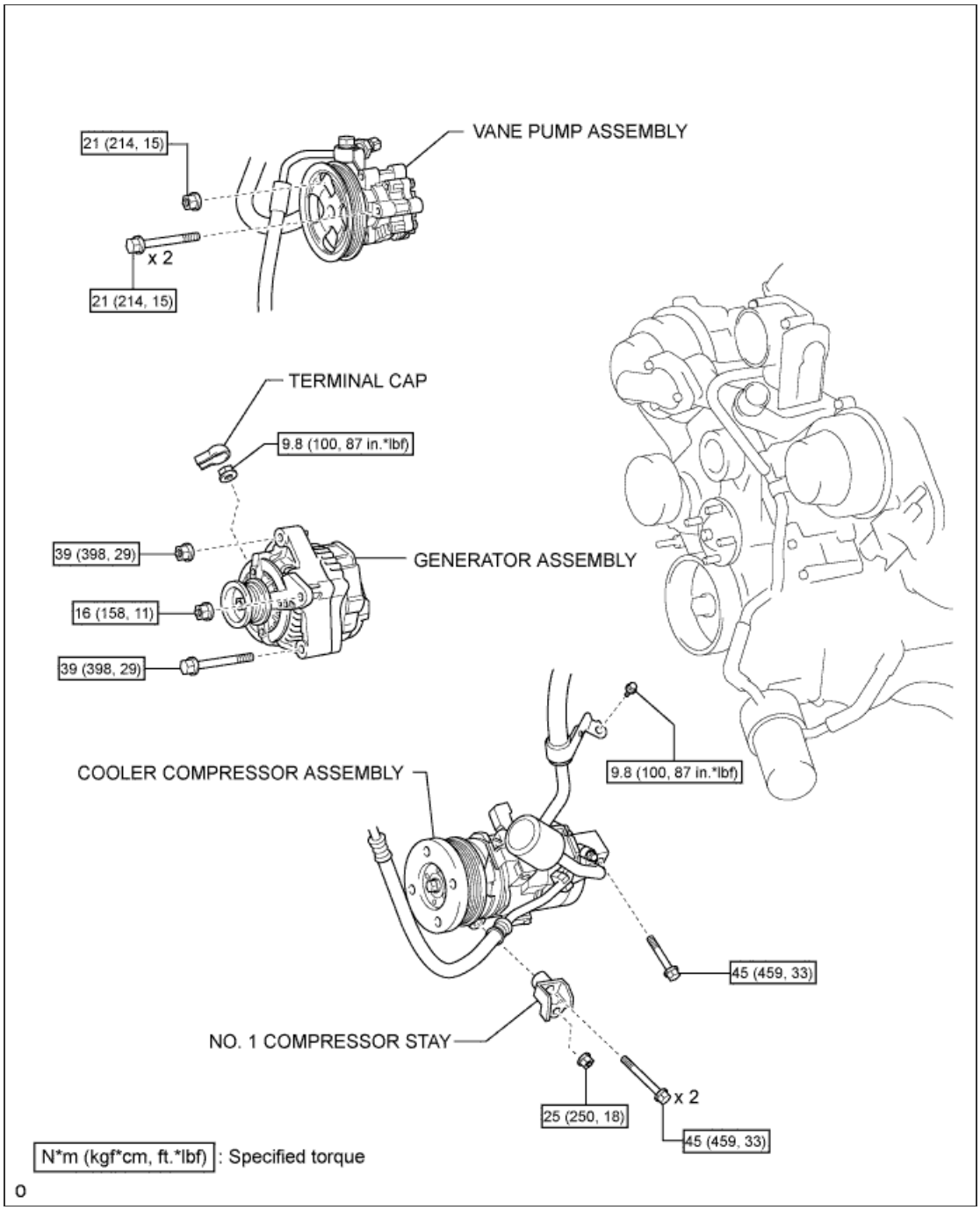

w/ Air Cooled Transmission Oil Cooler:
UPPER RADIATOR SUPPORT SEAL
x 7
RADIATOR SIDE DEFLECTOR LH
x 4
TRANSMISSION OIL COOLER AIR DUCT
x 4
4.9 (50, 43 in.*lbf)
RADIATOR GRILLE
x 3
FRONT BUMPER COVER
x 6
x 3
x 4
x 4
w/ Winch:
FRONT BUMPER WINCH COVER SUB-ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
o

w/o Air Cooled Transmission Oil Cooler:

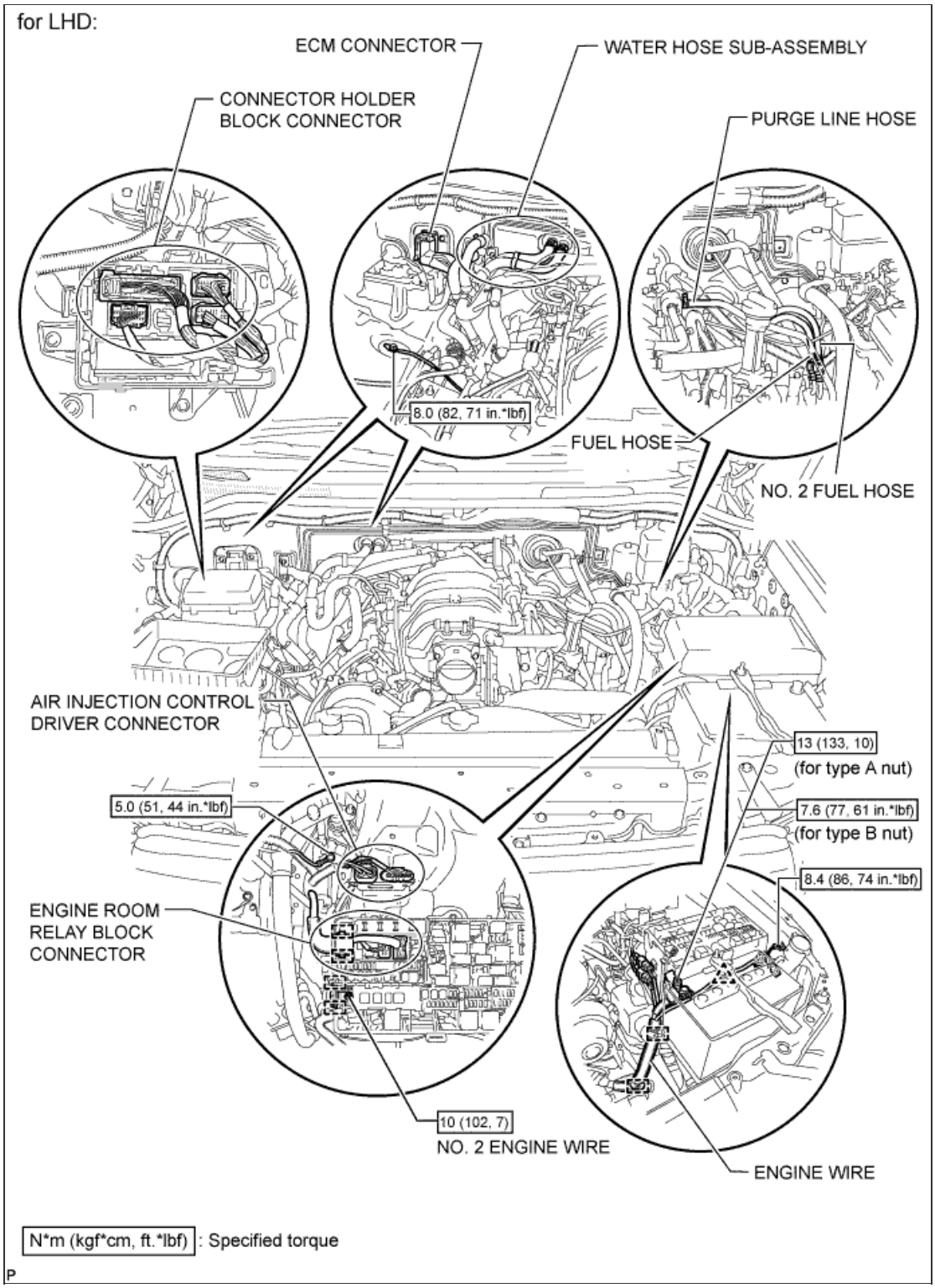


o

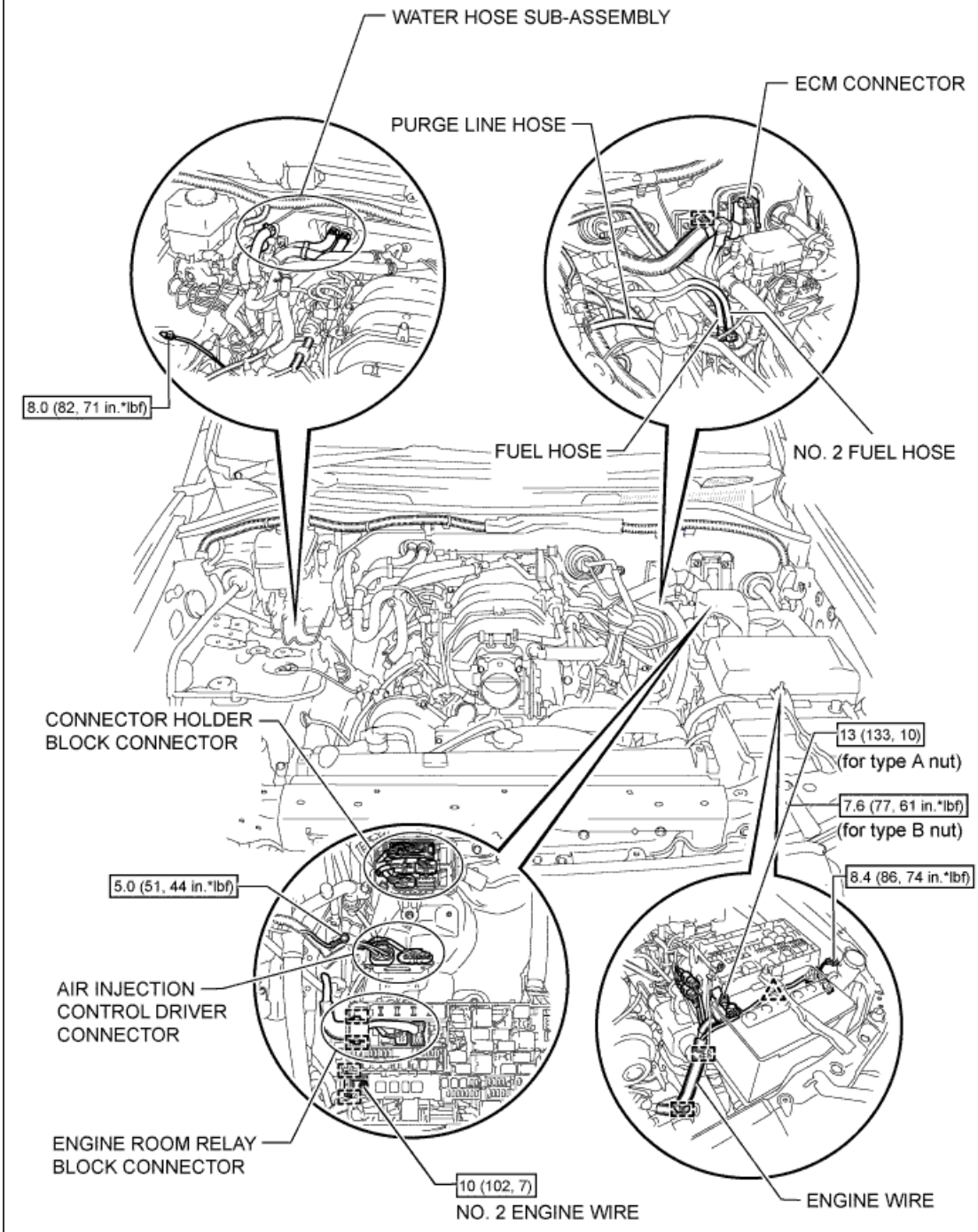

w/ Air Cooled Transmission Oil Cooler:
x 2
5.0 (51, 44 in.*lbf)
w/o Air Cooled Transmission Oil Cooler:
x 2
5.0 (51, 44 in.*lbf)
NO. 2 RADIATOR HOSE
NO. 1 RADIATOR HOSE
RADIATOR ASSEMBLY
29 (296, 21)
8.0 (82, 71 in.*lbf)
COOLING FAN
x 2
x 4
FAN PULLEY
x 4
18 (184, 13)
● O-RING
RADIATOR DRAIN COCK PLUG
FAN SHROUD
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part


21 (214, 15)
VANE PUMP ASSEMBLY
x 2
21 (214, 15)
TERMINAL CAP
9.8 (100, 87 in.*lbf)
39 (398, 29)
GENERATOR ASSEMBLY
16 (158, 11)
39 (398, 29)
COOLER COMPRESSOR ASSEMBLY
9.8 (100, 87 in.*lbf)
45 (459, 33)
NO. 1 COMPRESSOR STAY
25 (250, 18)
x 2
45 (459, 33)
N*m (kgf*cm, ft.*lbf) : Specified torque

o


for LHD:
ECM CONNECTOR
WATER HOSE SUB-ASSEMBLY
CONNECTOR HOLDER
BLOCK CONNECTOR
PURGE LINE HOSE
8.0 (82, 71 in.*lbf)
FUEL HOSE
NO. 2 FUEL HOSE
AIR INJECTION CONTROL
DRIVER CONNECTOR
13 (133, 10)
(for type A nut)
5.0 (51, 44 in.*lbf)
7.6 (77, 61 in.*lbf)
(for type B nut)
8.4 (86, 74 in.*lbf)
ENGINE ROOM
RELAY BLOCK
CONNECTOR
10 (102, 7)
NO. 2 ENGINE WIRE
ENGINE WIRE
N*m (kgf*cm, ft.*lbf) : Specified torque
P

for RHD:



N*m (kgf*cm, ft.*lbf) : Specified torque

P

w/o Air Cooled Transmission Oil Cooler:



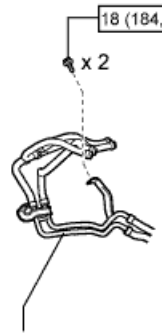
WATER HOSE SUB-ASSEMBLY

w/ Rear Heater:



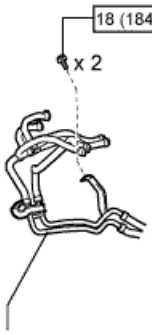
WATER HOSE SUB-ASSEMBLY

w/ Air Cooled Transmission Oil Cooler:



NO. 1 WATER BY-PASS PIPE

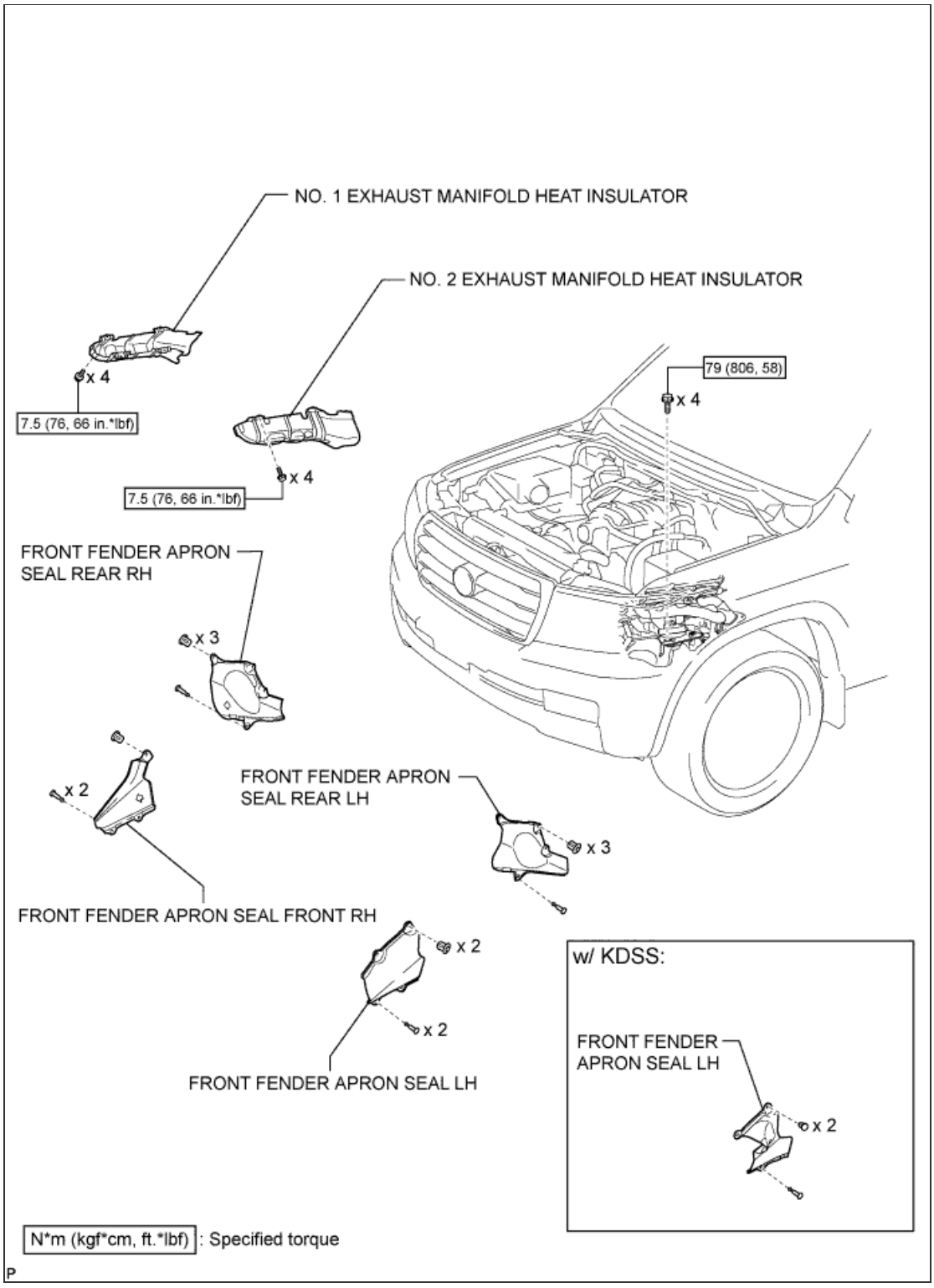
w/ Rear Heater:

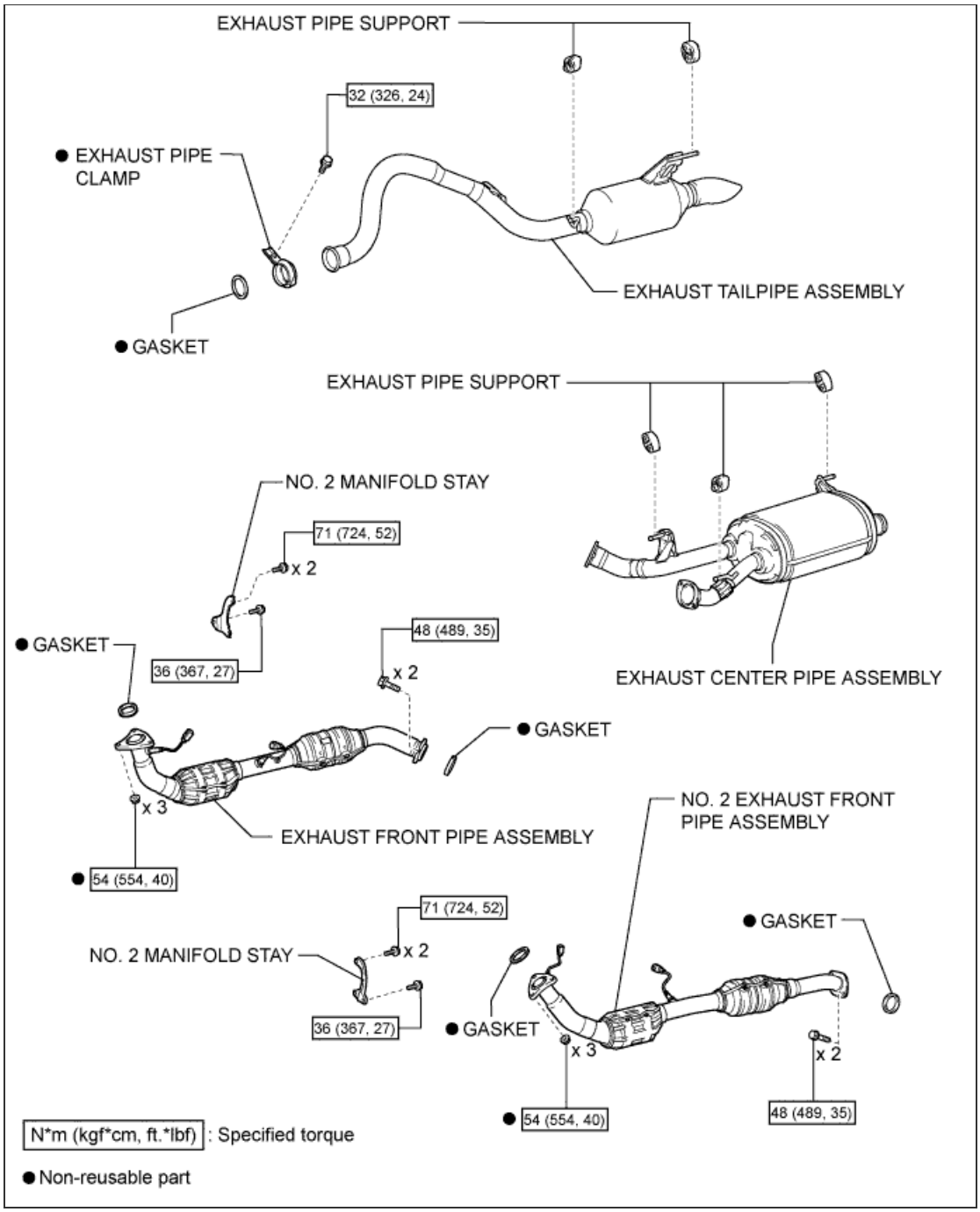


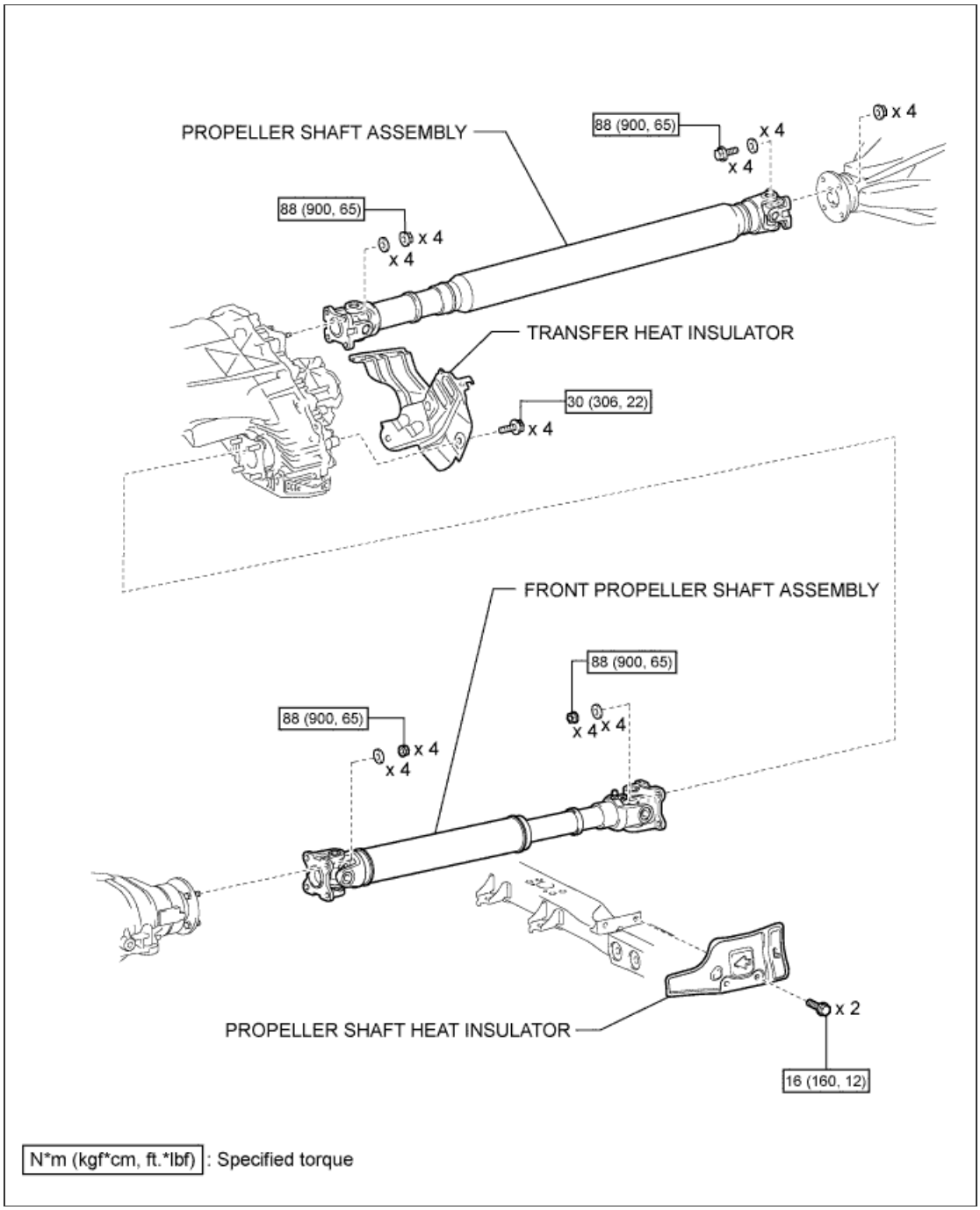
NO. 1 WATER BY-PASS PIPE

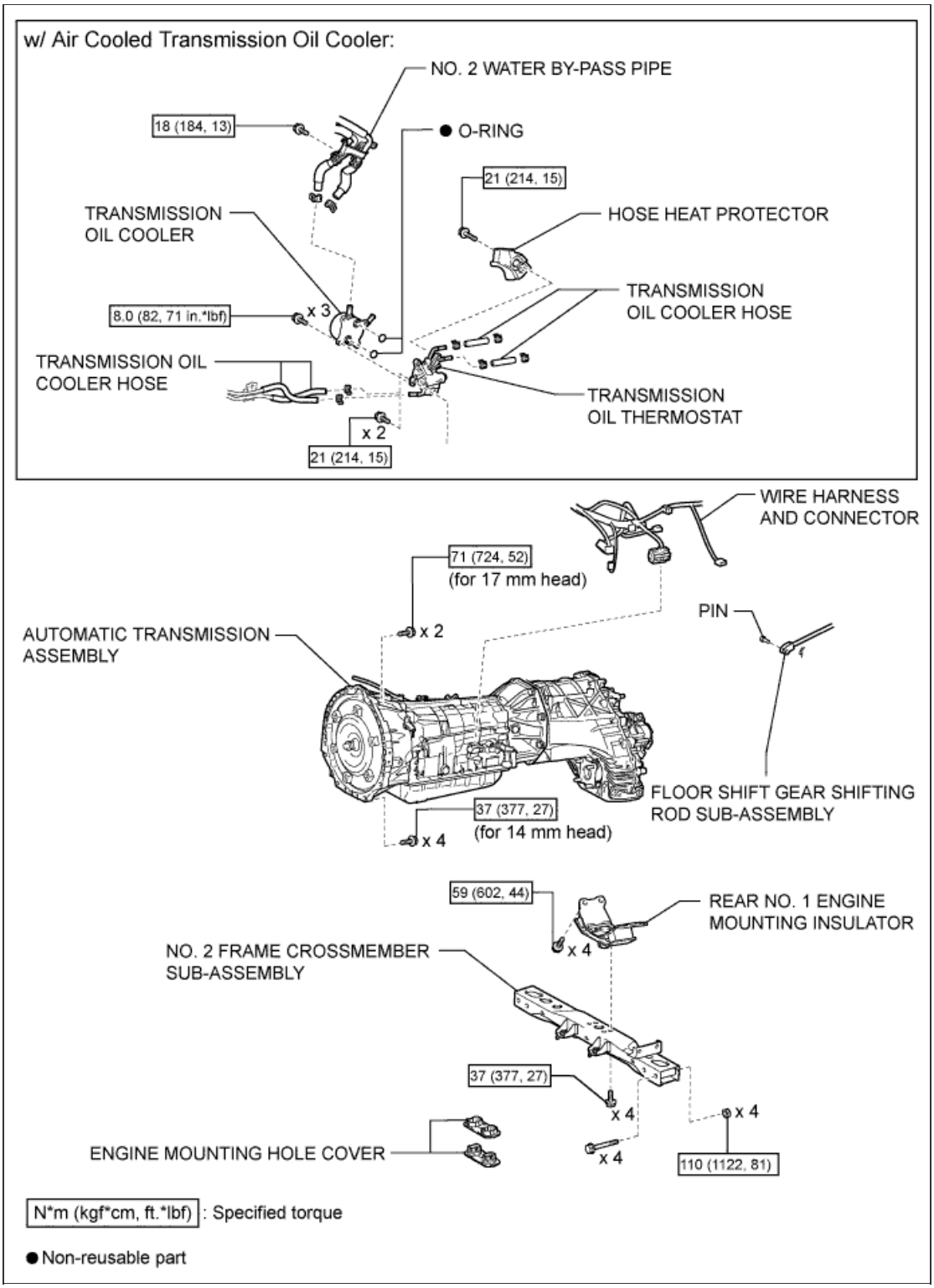
N*m (kgf*cm, ft.*lbf) : Specified torque

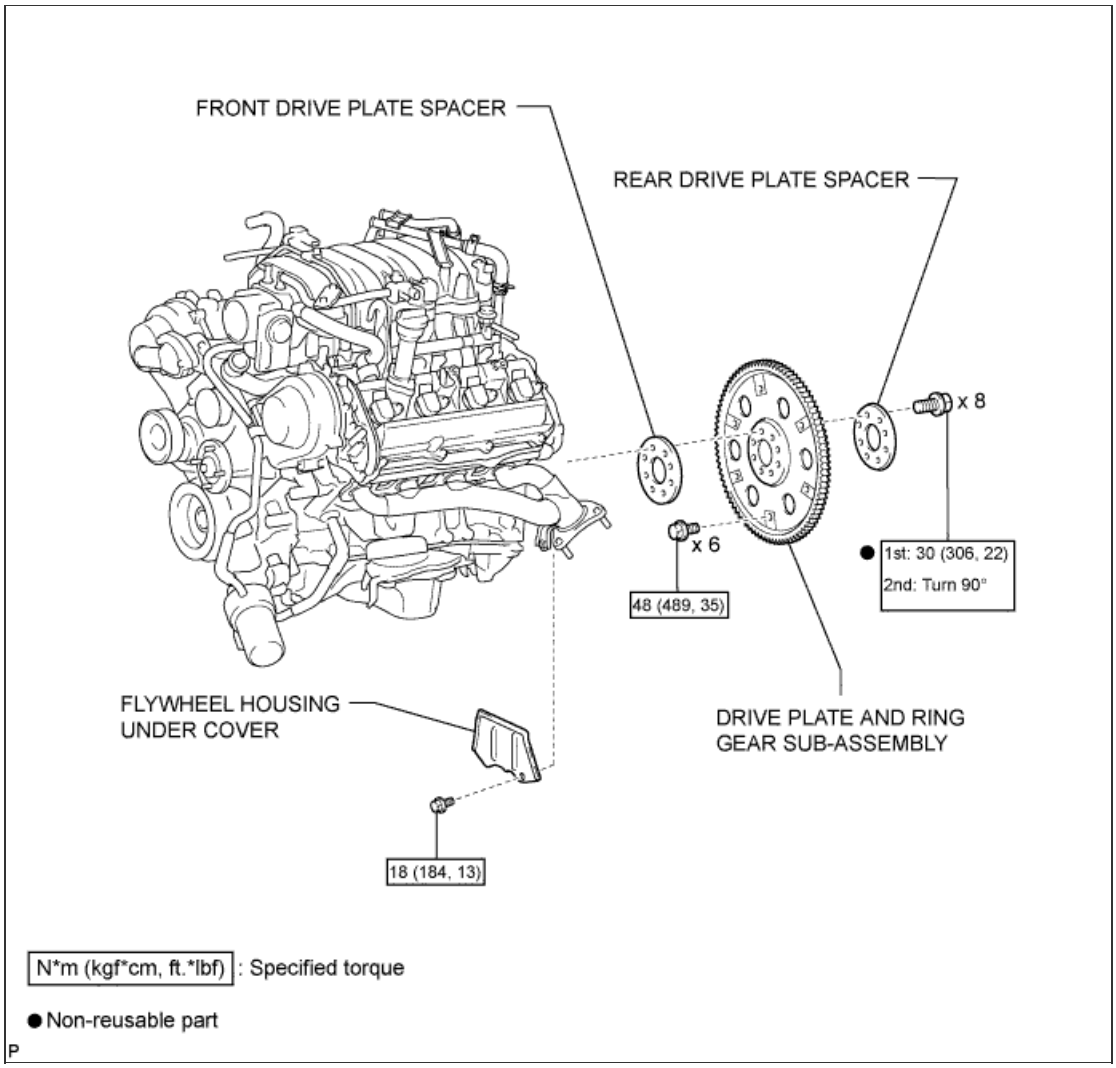
P


NO. 1 EXHAUST MANIFOLD HEAT INSULATOR
NO. 2 EXHAUST MANIFOLD HEAT INSULATOR
x 4
7.5 (76, 66 in.*lbf)
x 4
7.5 (76, 66 in.*lbf)
79 (806, 58)
x 4
FRONT FENDER APRON SEAL REAR RH
x 3
x 2
FRONT FENDER APRON SEAL FRONT RH
FRONT FENDER APRON SEAL REAR LH
x 3
x 2
x 2
FRONT FENDER APRON SEAL LH
w/ KDSS:
FRONT FENDER APRON SEAL LH
x 2
N*m (kgf*cm, ft.*lbf) : Specified torque
P


EXHAUST PIPE SUPPORT
32 (326, 24)
● EXHAUST PIPE CLAMP
EXHAUST TAILPIPE ASSEMBLY
● GASKET
EXHAUST PIPE SUPPORT
NO. 2 MANIFOLD STAY
71 (724, 52)
x 2
● GASKET
36 (367, 27)
48 (489, 35)
x 2
EXHAUST CENTER PIPE ASSEMBLY
● GASKET
x 3
EXHAUST FRONT PIPE ASSEMBLY
NO. 2 EXHAUST FRONT PIPE ASSEMBLY
● 54 (554, 40)
71 (724, 52)
NO. 2 MANIFOLD STAY
x 2
● GASKET
36 (367, 27)
● GASKET
x 3
x 2
● 54 (554, 40)
48 (489, 35)
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part


PROPELLER SHAFT ASSEMBLY
88 (900, 65)
x 4
x 4
x 4
88 (900, 65)
x 4
x 4
TRANSFER HEAT INSULATOR
30 (306, 22)
x 4
FRONT PROPELLER SHAFT ASSEMBLY
88 (900, 65)
x 4
x 4
88 (900, 65)
x 4
x 4
PROPELLER SHAFT HEAT INSULATOR
x 2
16 (160, 12)
N*m (kgf*cm, ft.*lbf) : Specified torque


w/ Air Cooled Transmission Oil Cooler:
NO. 2 WATER BY-PASS PIPE
18 (184, 13)
● O-RING
21 (214, 15)
HOSE HEAT PROTECTOR
TRANSMISSION OIL COOLER
TRANSMISSION OIL COOLER HOSE
8.0 (82, 71 in.*lbf)
x 3
TRANSMISSION OIL COOLER HOSE
TRANSMISSION OIL THERMOSTAT
x 2
21 (214, 15)
WIRE HARNESS AND CONNECTOR
71 (724, 52)
(for 17 mm head)
x 2
PIN
AUTOMATIC TRANSMISSION ASSEMBLY
FLOOR SHIFT GEAR SHIFTING ROD SUB-ASSEMBLY
37 (377, 27)
(for 14 mm head)
x 4
59 (602, 44)
REAR NO. 1 ENGINE MOUNTING INSULATOR
x 4
NO. 2 FRAME CROSSMEMBER SUB-ASSEMBLY
37 (377, 27)
x 4
x 4
x 4
ENGINE MOUNTING HOLE COVER
110 (1122, 81)
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part



N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P

for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

a. Discharge the fuel system pressure (Click here).

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

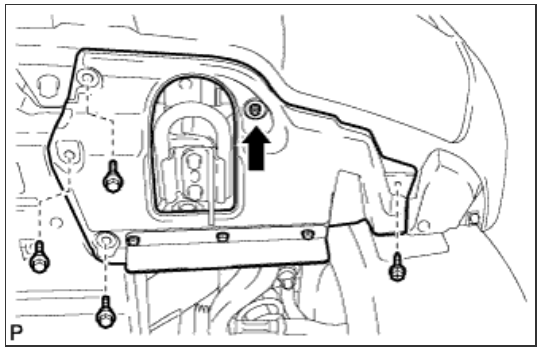
When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE FRONT TIRE

4. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



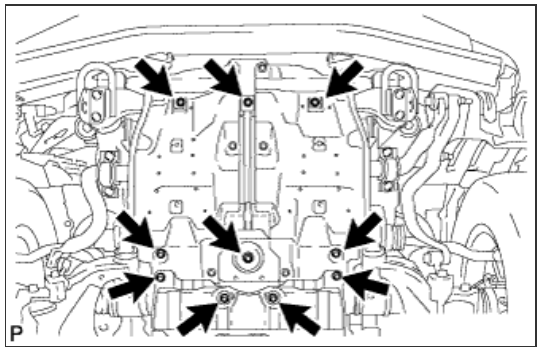
5. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

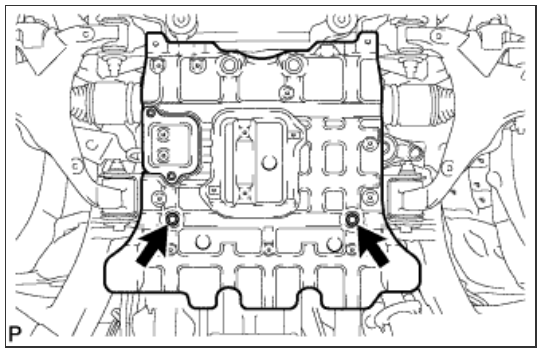
6. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 1 bolts and No. 1 engine under cover.



7. REMOVE NO. 2 ENGINE UNDER COVER

a. Remove the 2 bolts and No. 2 engine under cover.

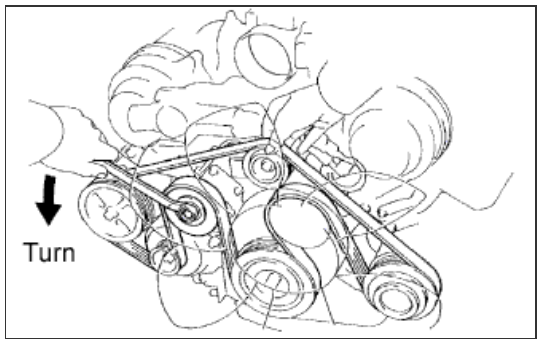


8. REMOVE FAN & GENERATOR V BELT

a. Loosen the belt tension by turning the belt tensioner counterclockwise, and then remove the fan and generator V belt.

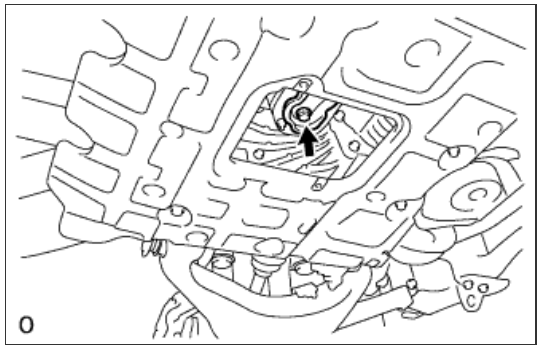
HINT:

The pulley bolt for the belt tensioner has left-hand thread.



9. DRAIN ENGINE OIL

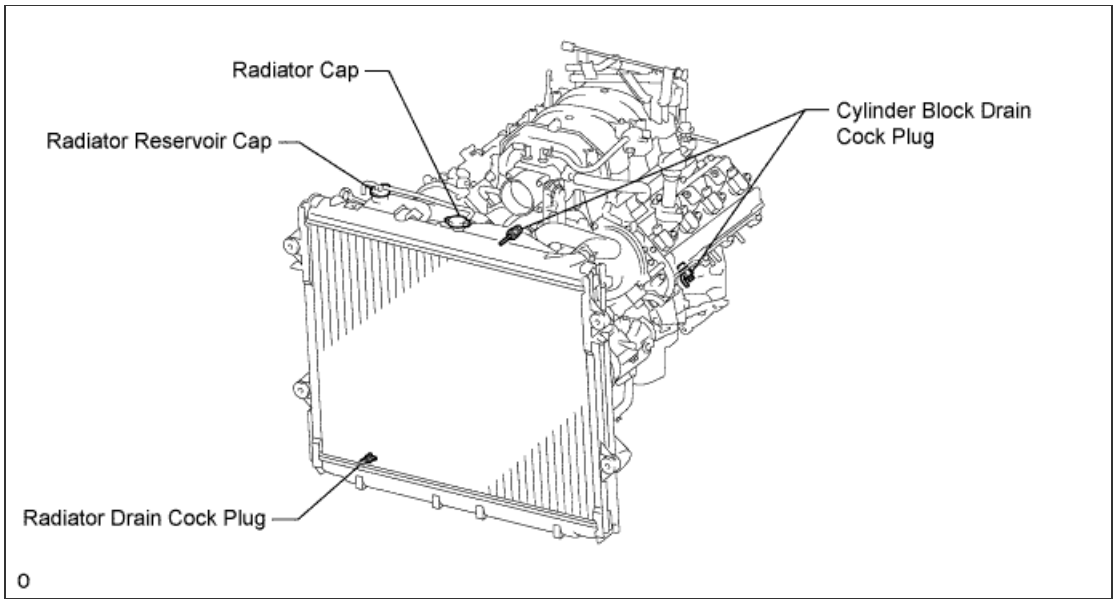
a. Remove the oil drain plug and gasket, and drain the engine oil into a container.



10. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.



a. Loosen the radiator drain cock plug.

b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

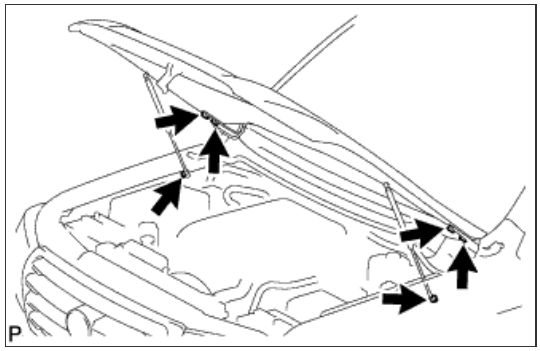
d. Tighten the 2 cylinder block drain cock plugs.

Torque:
13 N*m{ 130 kgf*cm , 9 ft.*lbf }

e. Tighten the radiator drain cock plug by hand.

11. REMOVE HOOD SUB-ASSEMBLY

a. Remove the 2 hood stay bolts. Then disconnect the 2 hood supports.



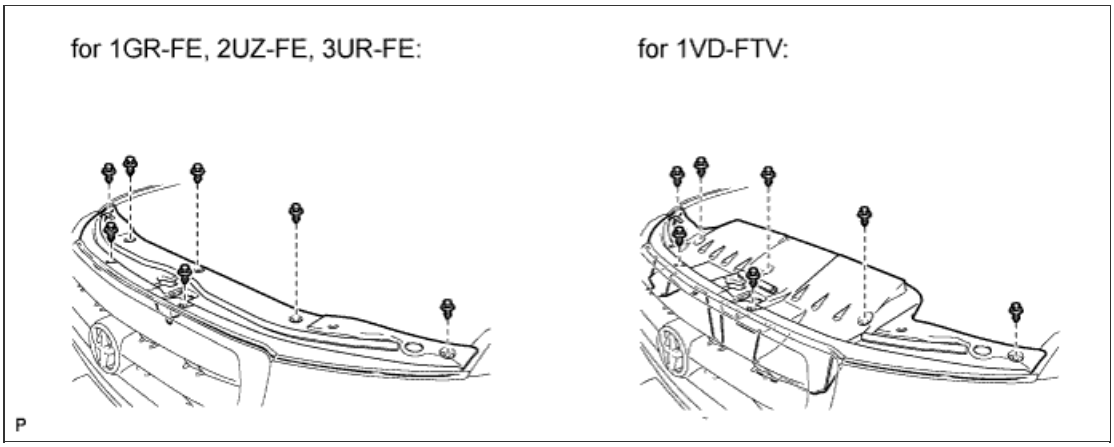
NOTICE:

- **Avoid touching the stroke portions of the rod as much as possible to prevent foreign matter from attaching to it. Be sure to hold the cylinders while servicing.**
- **Do not wear cotton gloves or other similar materials when handling the rod. Fibers may attach to the rod and result in gas leaks.**
- **Do not apply any load to the cylinders in the horizontal direction in order to prevent the rod from being deformed.**
- **Remove the hood support while supporting the hood by hand.**

b. Remove the 4 bolts and hood.

12. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and radiator support seal.



13. REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Remove the cowl top ventilator louver (Click here).

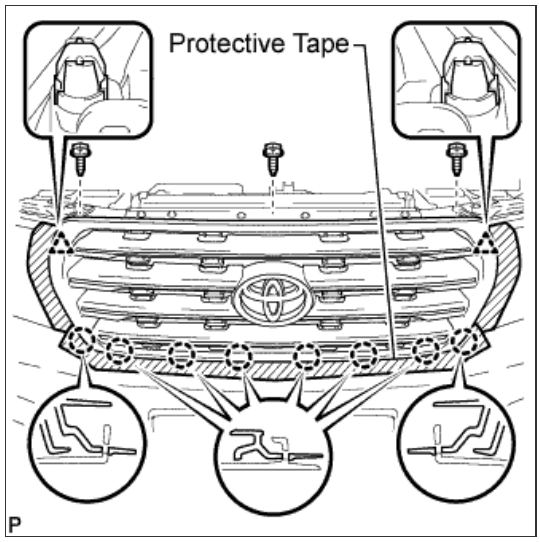
14. REMOVE FRONT BUMPER WINCH COVER SUB-ASSEMBLY (w/ Winch)

15. REMOVE RADIATOR GRILLE

a. Put protective tape around the radiator grille.

b. Remove the 3 screws.

c. Detach the 2 clips and 8 claws, and remove the radiator grille.



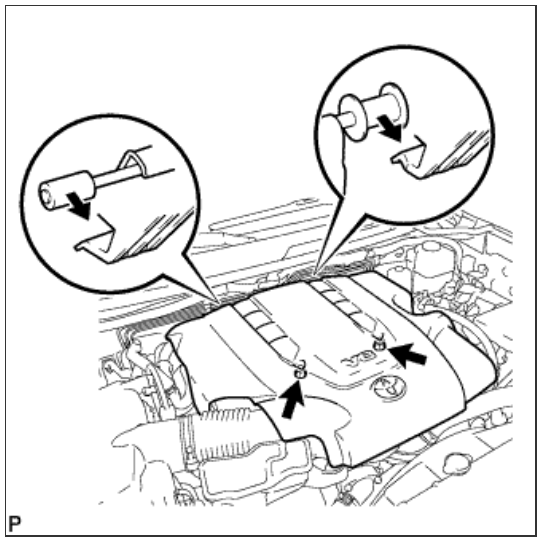
16. REMOVE FRONT BUMPER COVER

a. for Standard:
Remove the front bumper cover (Click here).

b. w/ Winch:
Remove the front bumper cover (Click here).

17. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Remove the 2 nuts and V-bank cover.

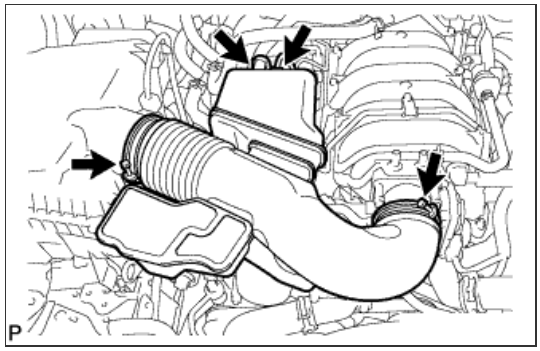


18. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum transmitting hose and No. 2 ventilation hose.

b. Loosen the 2 hose clamps.

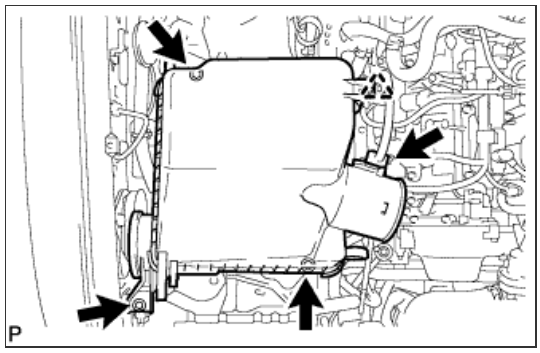
c. Remove the air cleaner hose.



19. REMOVE AIR CLEANER ASSEMBLY

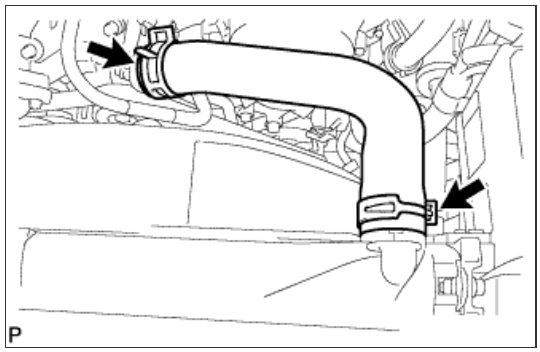
a. Disconnect the clamp and MAF connector.

b. Remove the 3 bolts and air cleaner.



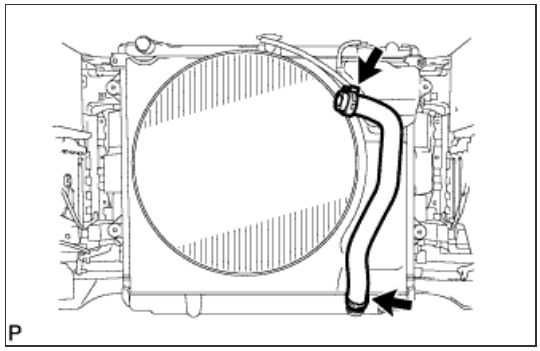
20. REMOVE NO. 1 RADIATOR HOSE

a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to remove the radiator hose.



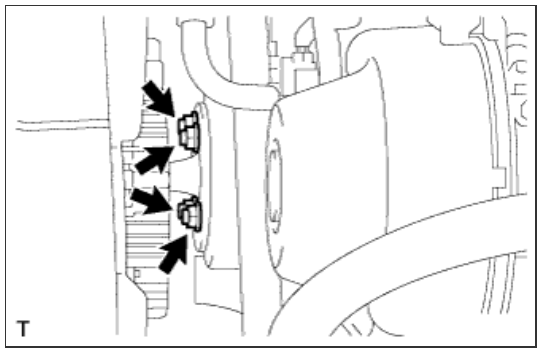
21. REMOVE NO. 2 RADIATOR HOSE

a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to remove the radiator hose.



22. REMOVE FAN SHROUD

a. Loosen the 4 nuts holding the cooling fan.



b. Disconnect the reservoir hose from the upper side of the radiator tank.

c. w/ Air Cooled Transmission Oil Cooler:
Detach the claw to open the fle ible hose clamp.

d. Remove the 2 bolts and disconnect the oil cooler tube from the fan shroud.

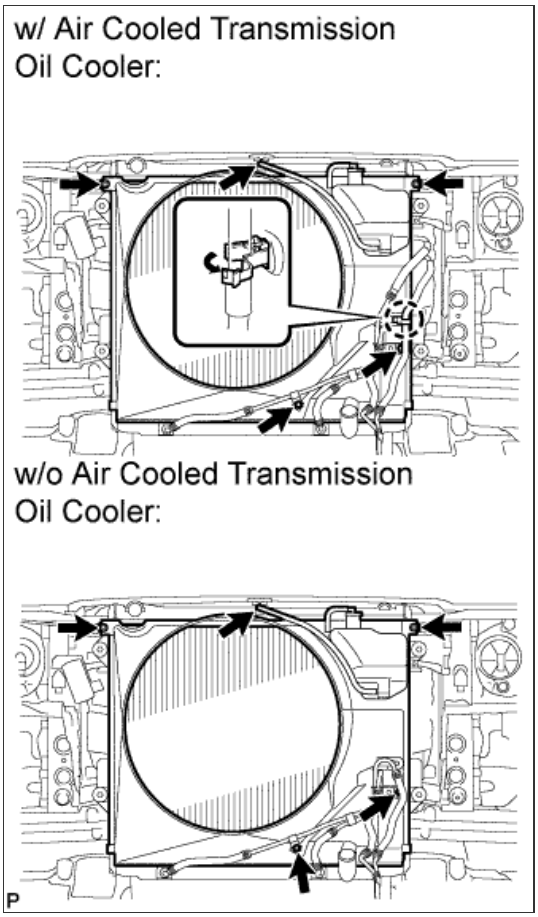
e. Remove the 2 bolts holding the fan shroud.

f. Remove the 4 nuts of the cooling fan, and then remove the shroud together with the cooling fan.

NOTICE:

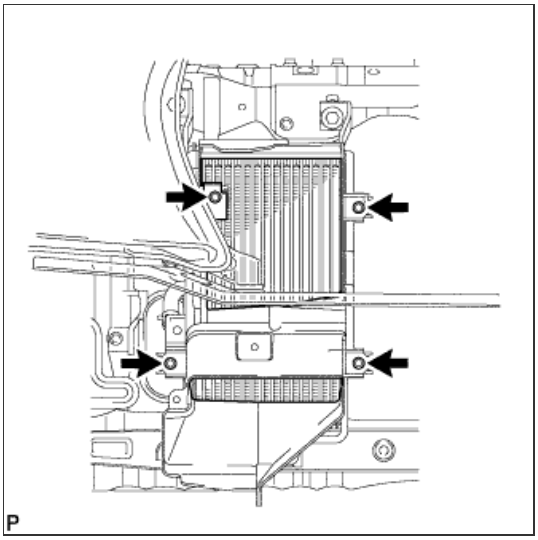
Be careful not to damage the radiator core.

g. Remove the fan pulley from the water pump.



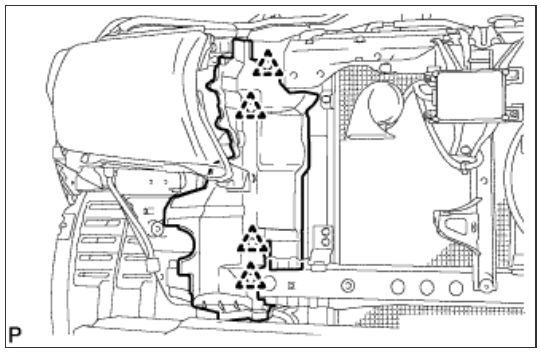
23. REMOVE TRANSMISSION OIL COOLER AIR DUCT (w/ Air Cooled Transmission Oil Cooler)

a. Remove the 4 bolts and transmission oil cooler air duct.



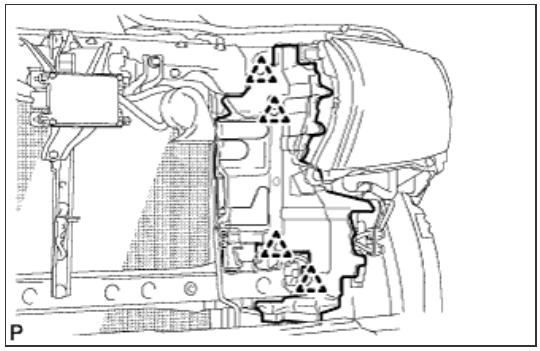
24. REMOVE RADIATOR SIDE DEFLECTOR RH (w/o Air Cooled Transmission Oil Cooler)

a. Using a clip remover, remove the 4 clips and disconnect the side deflector.



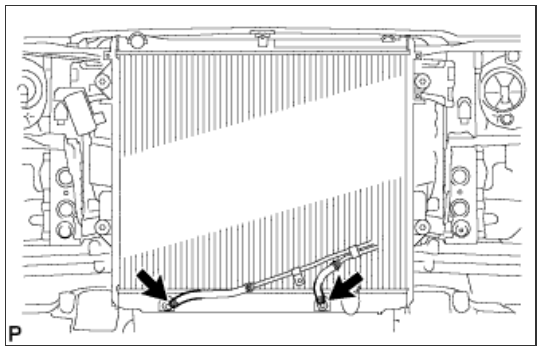
25. REMOVE RADIATOR SIDE DEFLECTOR LH

a. Using a clip remover, remove the 4 clips and disconnect the side deflector.

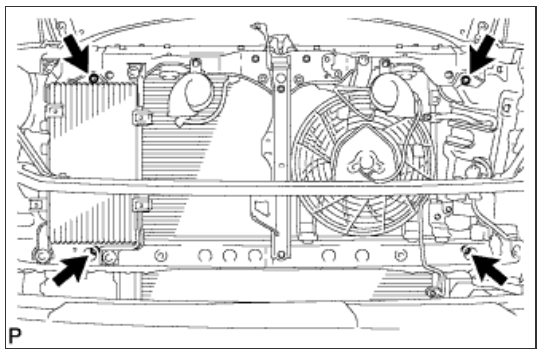


26. REMOVE RADIATOR ASSEMBLY

a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to disconnect the 2 oil cooler hoses.

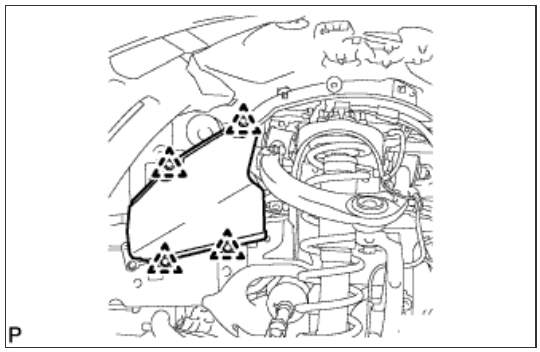


b. Remove the 4 bolts and radiator.



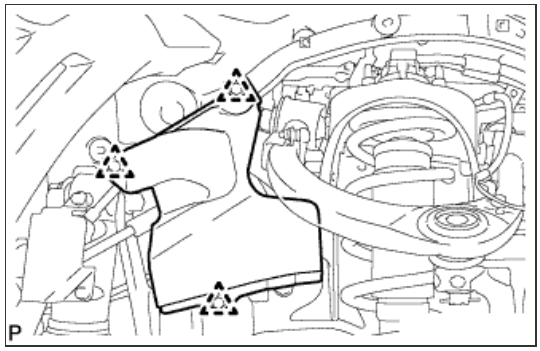
27. REMOVE FRONT FENDER APRON SEAL LH

a. Using a clip remover, remove the 4 clips and fender apron seal.



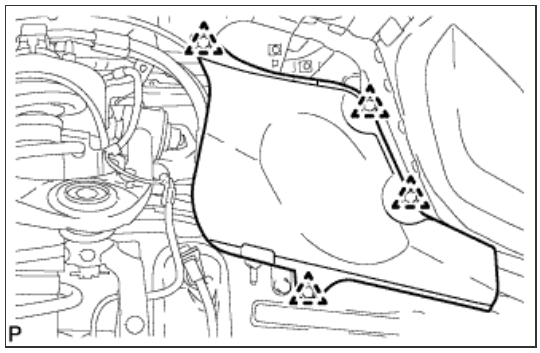
28. REMOVE FRONT FENDER APRON SEAL LH (w/ KDSS)

a. Using a clip remover, remove the 3 clips and fender apron seal.



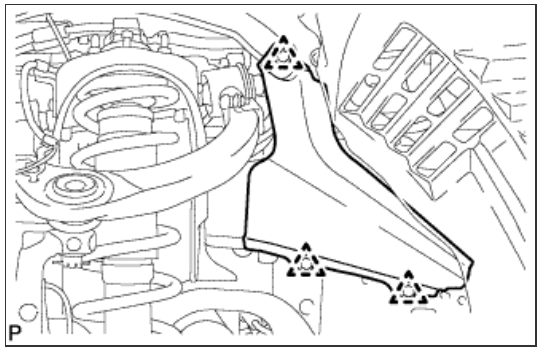
29. REMOVE FRONT FENDER APRON SEAL REAR LH

a. Using a clip remover, remove the 4 clips and fender apron seal.



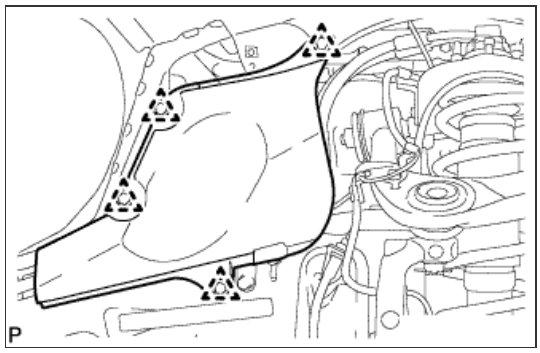
30. REMOVE FRONT FENDER APRON SEAL FRONT RH

a. Using a clip remover, remove the 3 clips and fender apron seal.



31. REMOVE FRONT FENDER APRON SEAL REAR RH

a. Using a clip remover, remove the 4 clips and fender apron seal.

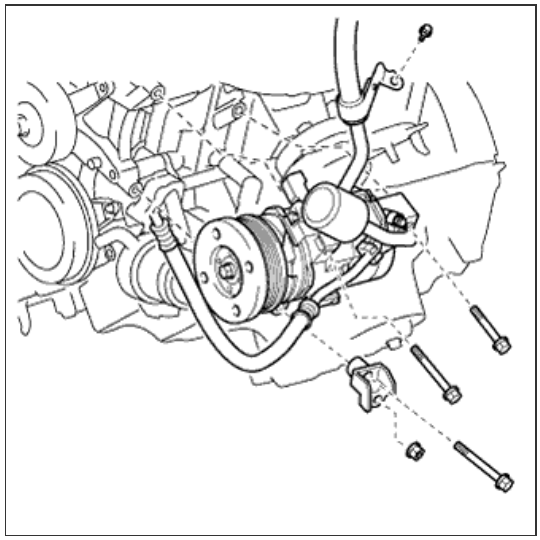


32. DISCONNECT COOLER COMPRESSOR ASSEMBLY

a. Disconnect the connector.

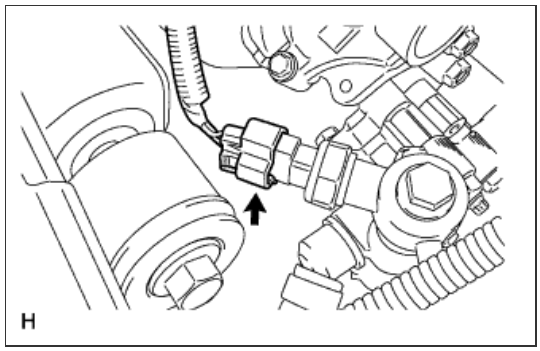
b. Remove the bolt. Then disconnect the cooler refrigerant suction hose from the cylinder head cover.

c. Remove the 3 bolts, nut and No. 1 compressor stay and disconnect the cooler compressor.

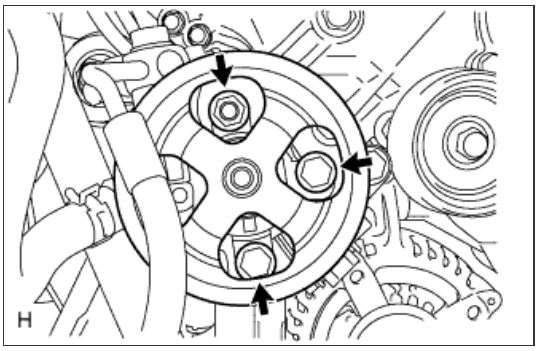


33. DISCONNECT VANE PUMP ASSEMBLY

a. Disconnect the connector.



b. Remove the 2 bolts and nut. Then disconnect the vane pump.

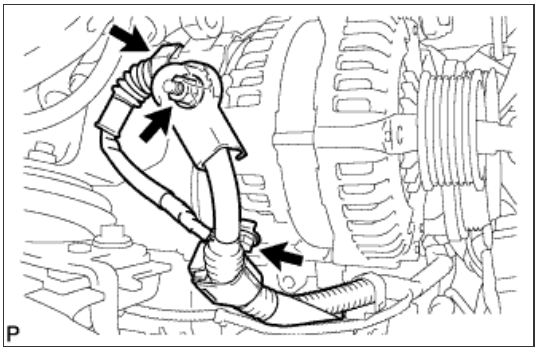


34. REMOVE GENERATOR ASSEMBLY

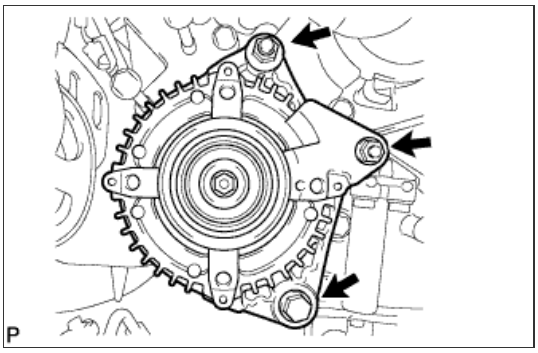
a. Disconnect the generator connector.

b. Remove the terminal cap and nut, and disconnect the generator wire.

c. Remove the bolt and disconnect the wire harness bracket from the generator.



d. Remove the bolt, 2 nuts and generator.



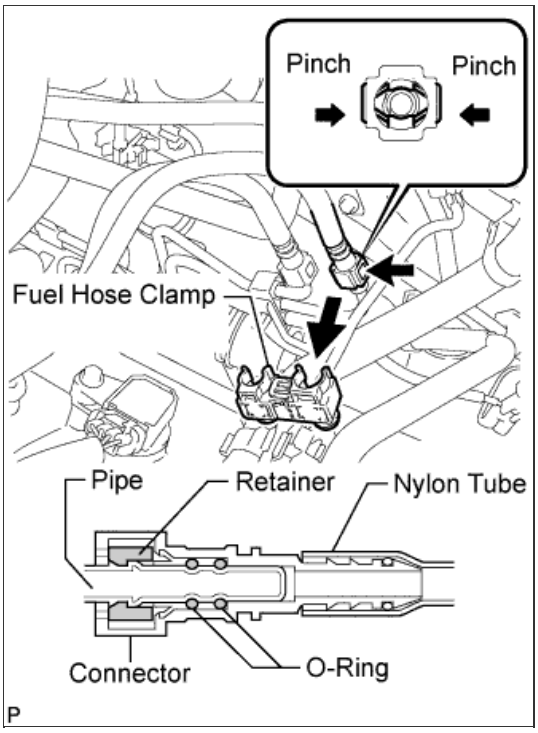
35. DISCONNECT FUEL HOSE

a. Remove the fuel hose clamp.

b. Pinch and pull the fuel hose connector to disconnect the connector from the fuel pipe.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



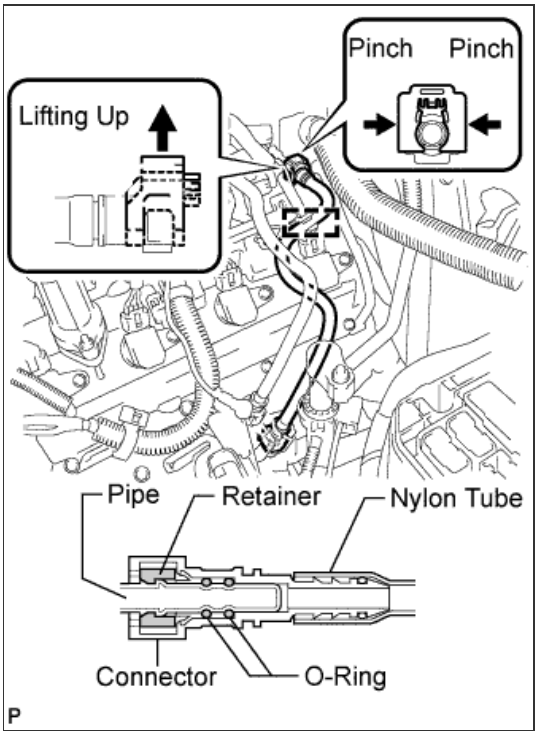
36. REMOVE NO. 2 FUEL HOSE

a. for engine side:

i. Detach the fuel hose clamp.

ii. Detach the lock claw by lifting up the cover, as shown in the illustration.

iii. Pinch and pull the No. 2 fuel hose connector to disconnect the connector from the No. 3 fuel pipe.



NOTICE:

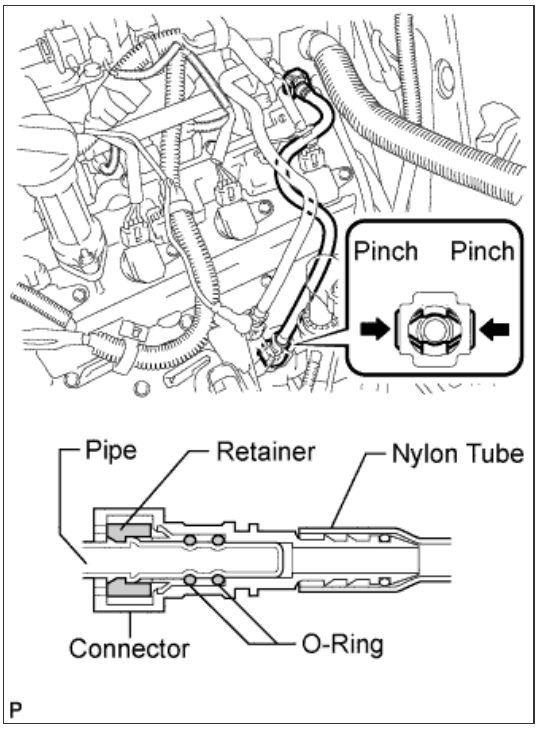
- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**

b. for body side:

i. Pinch and pull the No. 2 fuel hose connector to disconnect the connector from the fuel pipe.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**

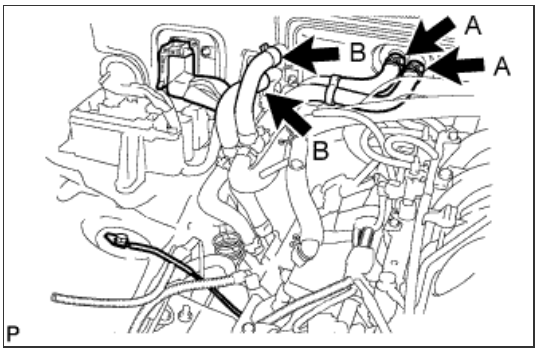


37. DISCONNECT WATER HOSE SUB-ASSEMBLY

a. Disconnect the water hose.

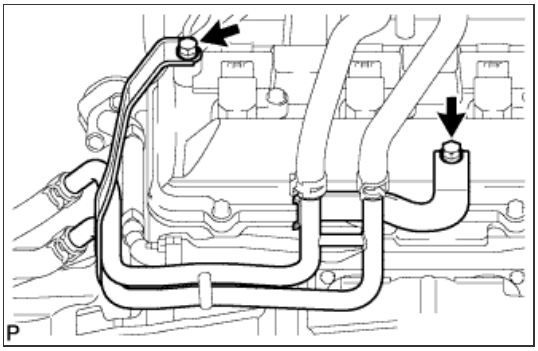
i. w/ Rear Heater:
Disconnect the water hoses labeled A and B.

ii. w/o Rear Heater:
Disconnect the water hoses labeled A.



38. DISCONNECT NO. 1 WATER BY-PASS PIPE (w/ Air Cooled Transmission Oil Cooler)

a. Remove the 2 bolts and disconnect the water by-pass pipe from the cylinder head cover RH.



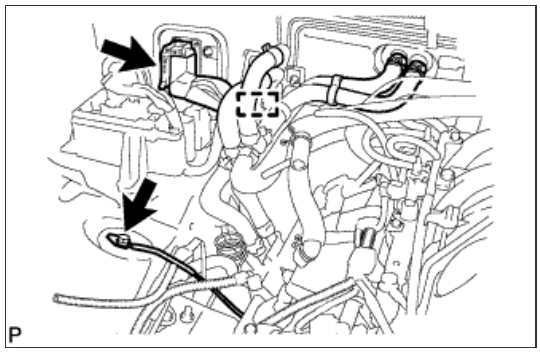
39. DISCONNECT WIRE HARNESS

a. Disconnect the clamp and CM connector.

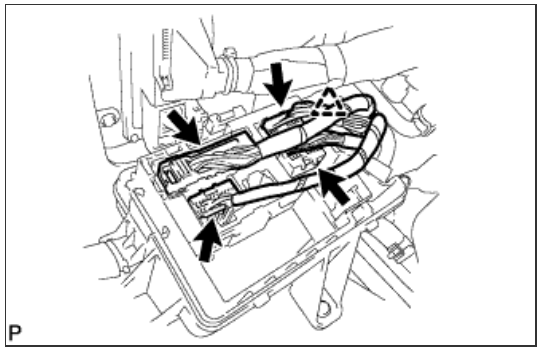
HINT:

Refer to the following procedures to disconnect the CM connector (Click here).

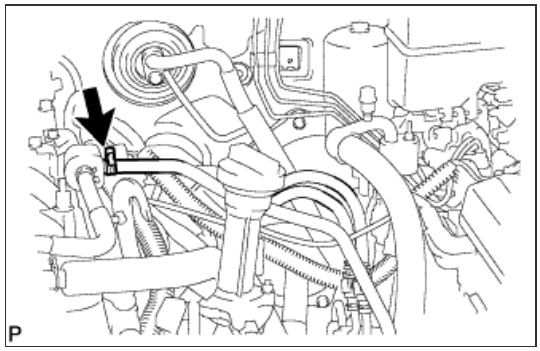
b. Remove the bolt and disconnect the ground wire.



c. Disconnect the 4 connectors and clamp from the connector holder block.



d. Disconnect the purge line hose from the purge VSV.



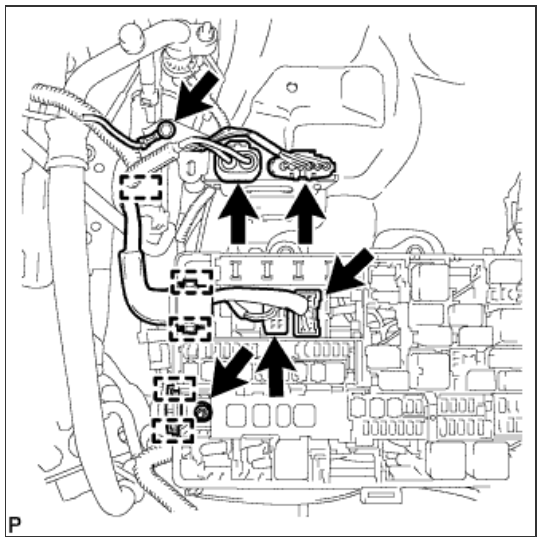
e. Disconnect the 2 air injection control driver connectors.

f. Disconnect the wire harness clamp.

g. Remove the bolt and disconnect the ground wire.

h. Disconnect the 2 clamps and 2 connectors from the engine room relay block.

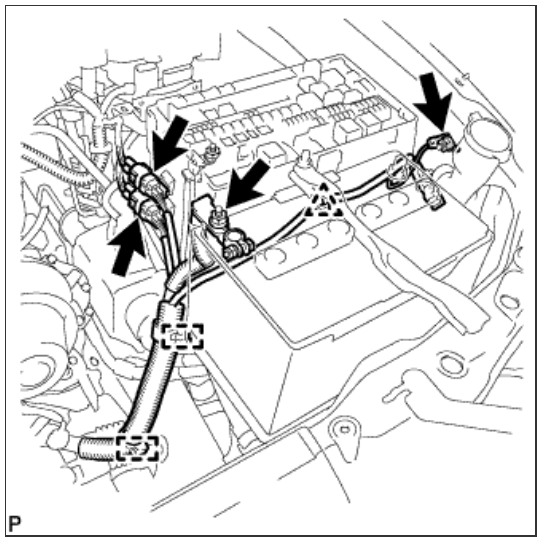
i. Remove the nut and disconnect the 2 clamps and wire harness from the engine room relay block.



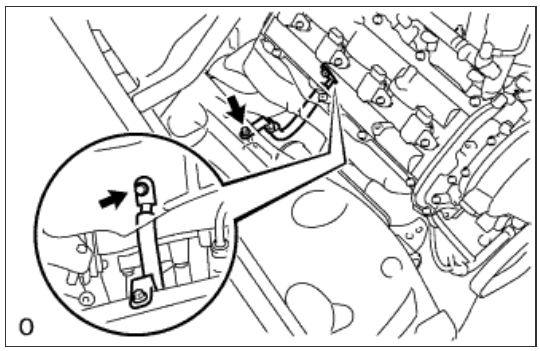
j. Remove the nut and disconnect the wire harness from the positive (+) battery terminal.

k. Disconnect the 2 connectors and 2 connector clamps from the engine room relay block.

l. Remove the bolt and disconnect the 3 clamps and ground wire.



. w/ Winch:
Remove the 2 bolts and disconnect the winch ground wire.



4 . REMOVE EXHAUST TAILPIPE ASSEMBLY

a. Remove the bolt, clamp and gasket.

b. Remove the tailpipe from the 2 e haust pipe supports.

41. REMOVE EXHAUST CENTER PIPE ASSEMBLY

a. Remove the 4 bolts.

b. Remove the center e haust pipe from the 3 e haust pipe supports.

c. Remove the 2 gaskets from the front e haust pipe and front No. 2 e haust pipe.

42. REMOVE NO. 2 EXHAUST FRONT PIPE ASSEMBLY

a. Disconnect the air fuel ratio sensor connector.

b. Disconnect the heated o ygen sensor connector.

c. Remove the 3 nuts, front No. 2 e haust pipe and gasket.

43. REMOVE EXHAUST FRONT PIPE ASSEMBLY

a. Disconnect the air fuel ratio sensor connector.

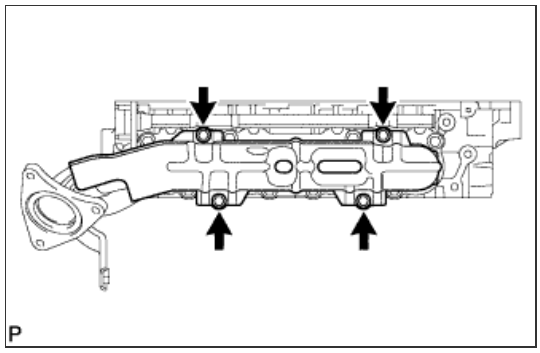
b. Disconnect the heated o ygen sensor connector.

c. Detach the heated o ygen sensor wire clamp.

d. Remove the 3 nuts, front e haust pipe and gasket.

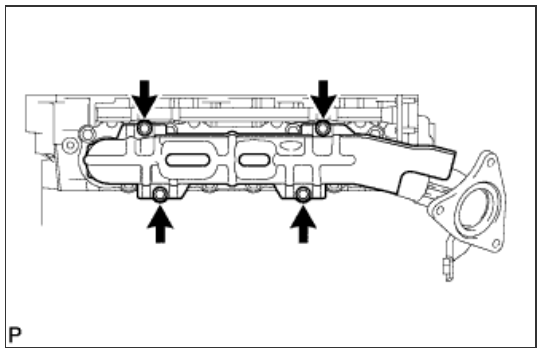
44. REMOVE NO. 1 EXHAUST MANIFOLD HEAT INSULATOR

a. Remove the 4 bolts and heat insulator.



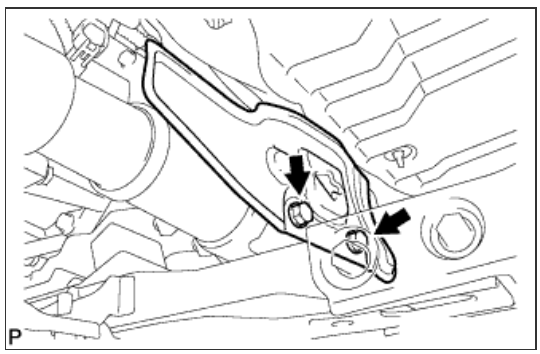
45. REMOVE NO. 2 EXHAUST MANIFOLD HEAT INSULATOR

a. Remove the 4 bolts and heat insulator.



46. REMOVE PROPELLER SHAFT HEAT INSULATOR

a. Remove the 2 bolts and insulator.

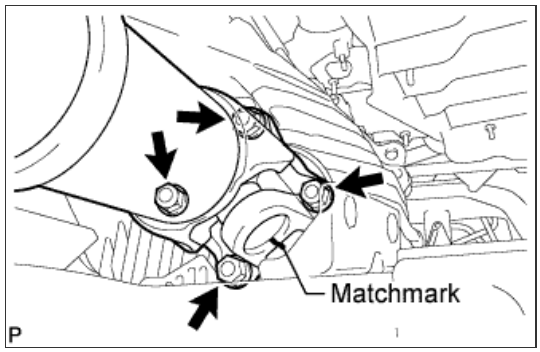


47. REMOVE FRONT PROPELLER SHAFT ASSEMBLY

a. for 1GR-F , 2U -F and Center Grease Fitting type:

i. Place matchmarks on the propeller shaft flange and transfer flange.

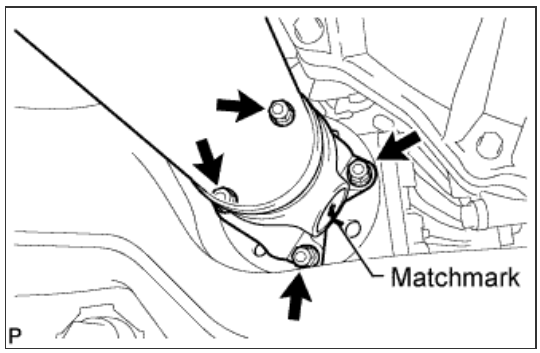
ii. Remove the 4 nuts and 4 washers.



iii. Place matchmarks on the propeller shaft flange and differential.

i . Remove the 4 nuts and 4 washers.

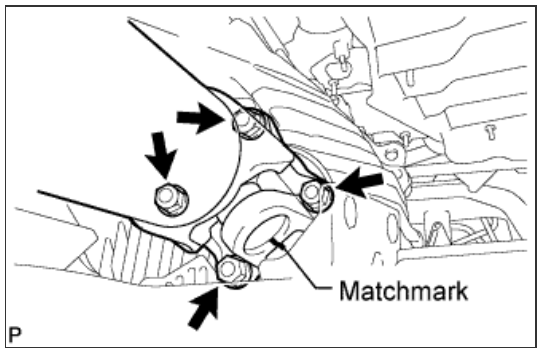
. Remove the front propeller shaft.



b. for 1VD-FTV:

i. Place matchmarks on the propeller shaft flange and transfer flange.

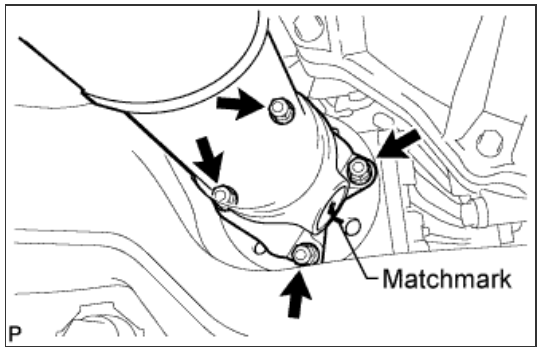
ii. Remove the 4 nuts and 4 washers.



iii. Place matchmarks on the propeller shaft flange and differential.

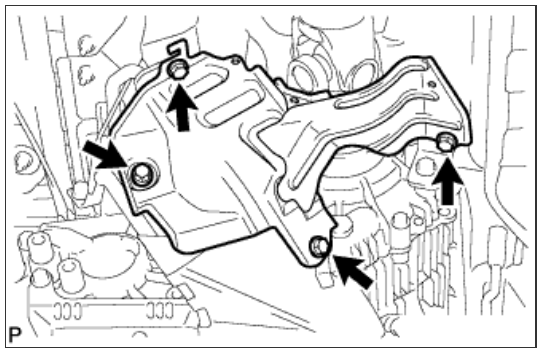
iv. Remove the 4 nuts and 4 washers.

v. Remove the front propeller shaft.



48. REMOVE TRANSFER HEAT INSULATOR

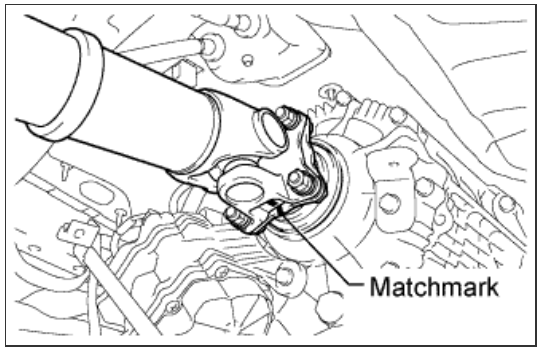
a. Remove the 4 bolts and insulator.



4 . REMOVE PROPELLER SHAFT ASSEMBLY

a. Place matchmarks on the propeller shaft flange and transfer.

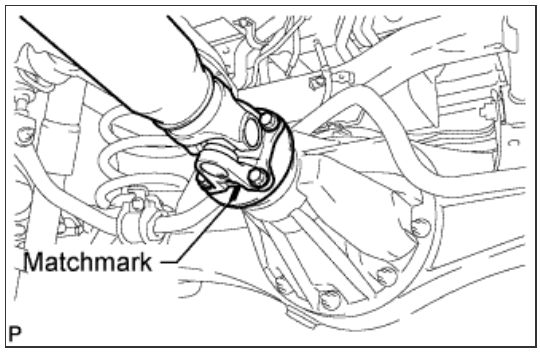
b. Remove the 4 nuts and 4 washers.



c. Place matchmarks on the propeller shaft flange and rear differential.

d. Remove the 4 nuts, 4 bolts and 4 washers.

e. Remove the rear propeller shaft.



50. REMOVE AUTOMATIC TRANSMISSION ASSEMBLY

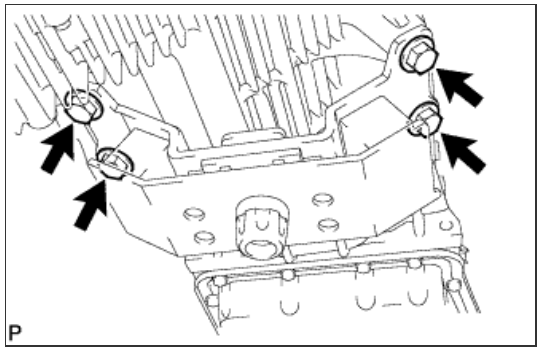
a. Remove the automatic transmission (Click here).

51. REMOVE REAR NO. 1 ENGINE MOUNTING INSULATOR

HINT:

Perform this procedure only when replacement of the engine mounting insulator is necessary.

a. Remove the 4 bolts and rear No. 1 engine mounting insulator.

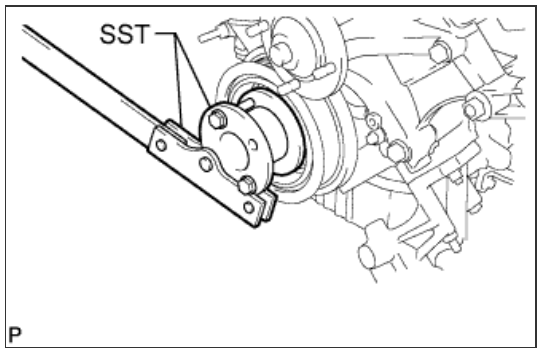


52. REMOVE DRIVE PLATE AND RING GEAR SUB-ASSEMBLY

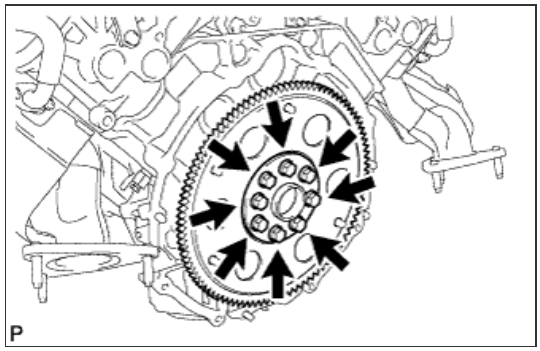
a. Using SST, hold the crankshaft damper.

SST

213-7	11	213-7	2
33	21	33	3



b. Remove the 8 bolts, front drive plate spacer, drive plate and rear drive plate spacer.



53. REMOVE ENGINE ASSEMBLY

a. Attach an engine sling device and hang the engine with a chain block.

NOTICE:

Pay attention to the angle of the sling device, as the engine assembly or engine hanger No. 1 may be damaged or deformed.

b. Remove the 4 engine mounting insulator bolts.

c. Lift the engine out from the vehicle slowly and carefully.

NOTICE:

Make sure the engine is clear of all wiring, hoses and cables.

54. INSTALL ENGINE ON ENGINE STAND

a. nstall the engine onto an engine stand with bolts.

for Preparation Click here

1. REMOVE ENGINE STAND

a. Attach an engine sling device and hang the engine with a chain block.

NOTICE:

ay attention to the angle of the sling device, as the engine assembly o ngine hange ay be damaged o e e

b. e thebolts and engine assembly f the engine stand.

2. INSTALL ENGINE ASSEMBLY

a. Slowly lowe the engine assembly into the engine compa tment.

NOTICE:

Make su hat the engine is clea all wi ing and hoses.

b. Attach the engine mounting insulato s to the vehicle.

c. Install the 4 engine mounting insulato ts. I

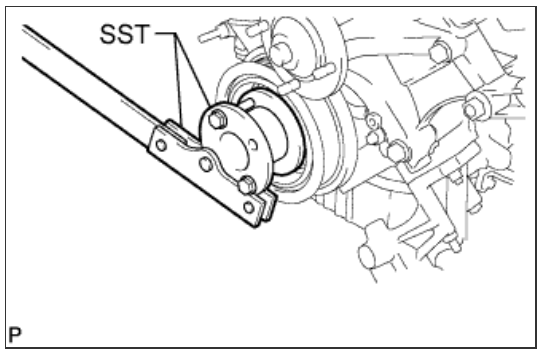
Torque:
79 N*m{ 806 kgf*cm , 58 ft.*lbf }

3. INSTALL DRIVE PLATE AND RING GEAR SUB-ASSEMBLY

a. Using SST, hold the c ankshaft.

SST
09213-70011 (09213-70020)
09330-00021 (09330-00030)

b. Install the f nt d ive plate space ive plate and a ive plate space to the c ankshaft.

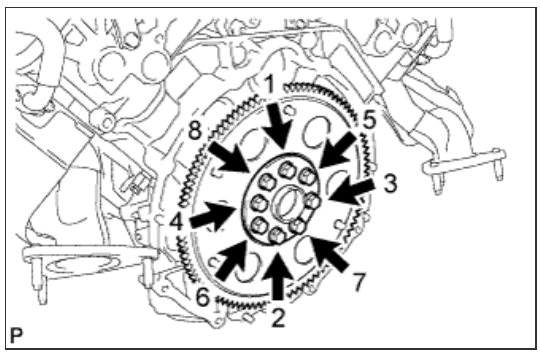


c. Install and unifo tighten 8 new bolts in the sequence shown in the illust ation.

Torque:
30 N*m{ 306 kgf*cm , 22 ft.*lbf }

NOTICE:

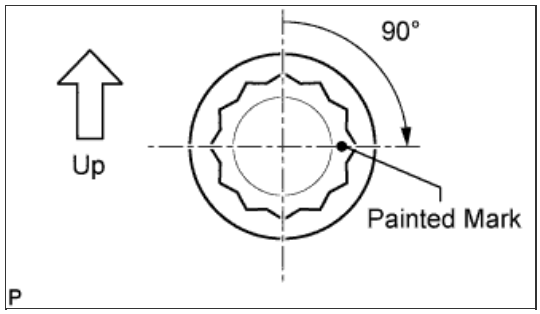
- **Do not reuse the drive plate installation bolts.**
- **Do not impact or damage the drive plate installation bolts. Be sure to handle them carefully.**



d. Ma the upside of each d ive plate installation bolt with paint.

e. Tighten the d ive plate installation bolts anothe as shown.

f. Check that the painted ma s a now at a 90° angle to the upside.



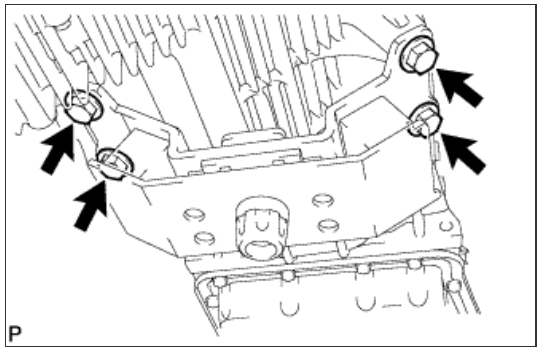
4. INSTALL REAR NO. 1 ENGINE MOUNTING INSULATOR

HINT:

e this p cedu e nly when e adement of the engine mounting insulato is necessa

a. nstall the a ngine mounting insulato ith the 4 bolts.

Torque:
59 N*m{ 602 kgf*cm , 44 ft.*lbf }



5. INSTALL AUTOMATIC TRANSMISSION ASSEMBLY

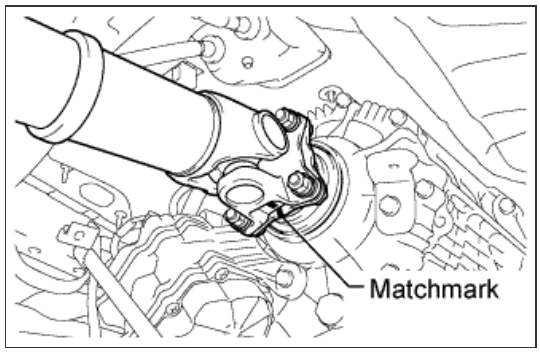
a. Install the automatic t ansmission (Click he e

6. INSTALL PROPELLER SHAFT ASSEMBLY

a. Align the matchma s on the p ell haft flange and t ansfe

b. nnect the p ell haft with the 4 washe s and 4 nuts.

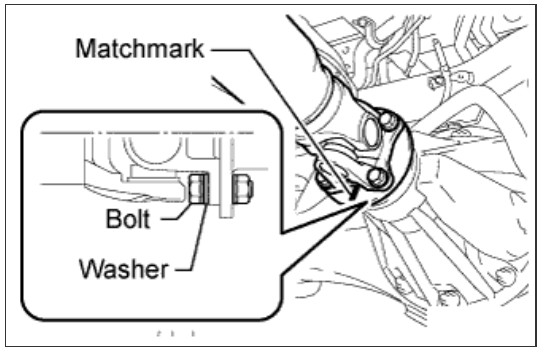
Torque:
88 N*m{ 900 kgf*cm , 65 ft.*lbf }



c. Align the matchma s on the p ell haft flange and a iffe ential.

d. Install the p ell haft with the 4 bolts, 4 washe s and 4 nuts.

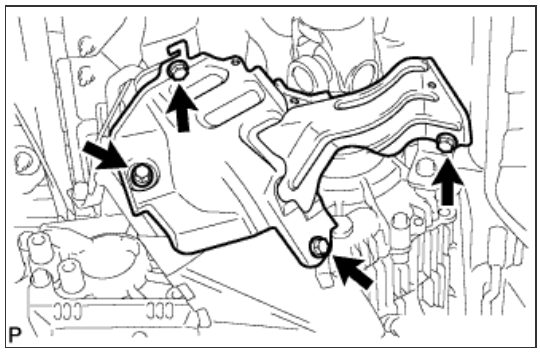
Torque:
88 N*m{ 900 kgf*cm , 65 ft.*lbf }



7. INSTALL TRANSFER HEAT INSULATOR

a. Install the insulato ith the 4 bolts.

Torque:
30 N*m{ 306 kgf*cm , 22 ft.*lbf }



8. INSTALL FRONT PROPELLER SHAFT ASSEMBLY

NOTICE:

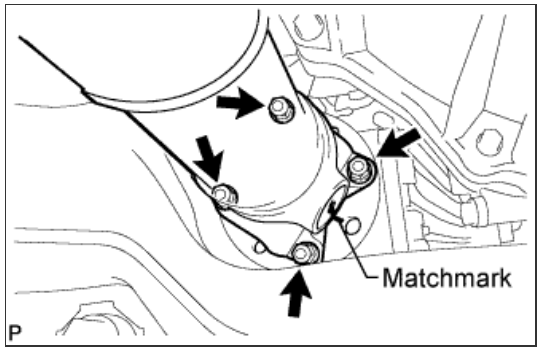
Refe to the components illust ation fo the installation di etion of the p elshaft.

a. fo

i. Align the matchma s on the p elshaft flange and diffe ential.

ii. Connect the p elshaft with the 4 washe s and 4 nuts.

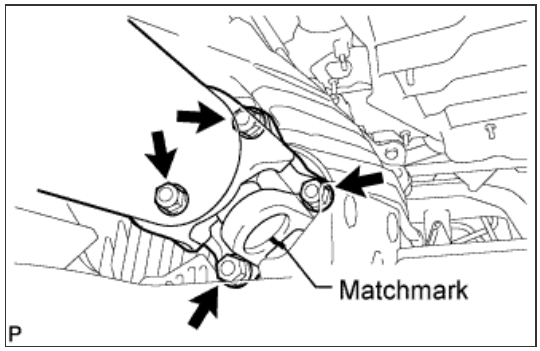
Torque:
88 N*m{ 900 kgf*cm , 65 ft.*lbf }



iii. Align the matchma s on the yoke and t ansfe ange.

iv. Install the p elshaft with the 4 washe s and 4 nuts.

Torque:
88 N*m{ 900 kgf*cm , 65 ft.*lbf }

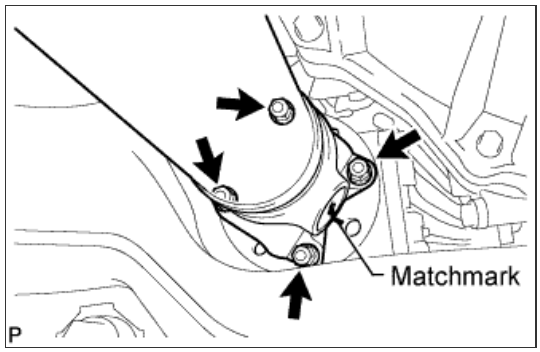


b. fo and Cente ase Fitting type:

i. Align the matchma s on the p elshaft flange and diffe ential.

ii. Connect the p elshaft with the 4 washe s and 4 nuts.

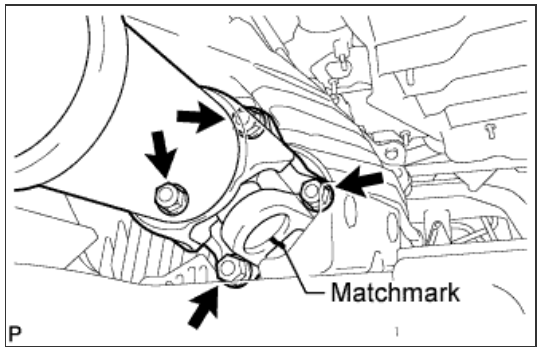
Torque:
88 N*m{ 900 kgf*cm , 65 ft.*lbf }



iii. Align the matchma s on the p eshaft flange and t ansfe dnge.

iv. Install the p eshaft with the 4 washe s and 4 nuts.

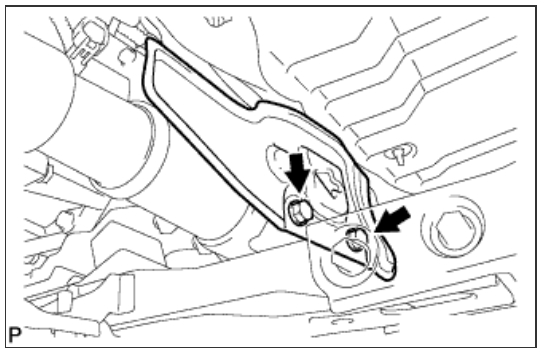
Torque:
88 N*m{ 900 kgf*cm , 65 ft.*lbf }



9. INSTALL PROPELLER SHAFT HEAT INSULATOR

a. Install the insulato ith the 2 bolts.

Torque:
16 N*m{ 160 kgf*cm , 12 ft.*lbf }

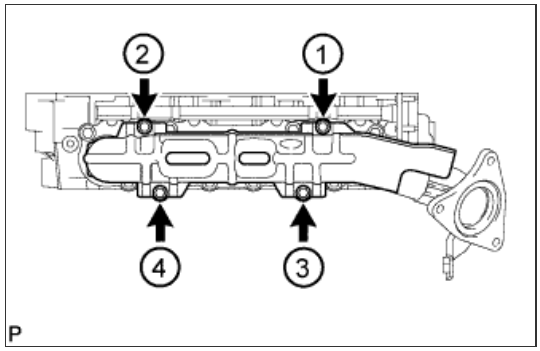


10. INSTALL NO. 2 EXHAUST MANIFOLD HEAT INSULATOR

a. Tempo a ily install the heat insulato ith the 4 bolts.

b. Unifo tighten the 4 bolts in seve al steps, in the sequence shown in the illust ation.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

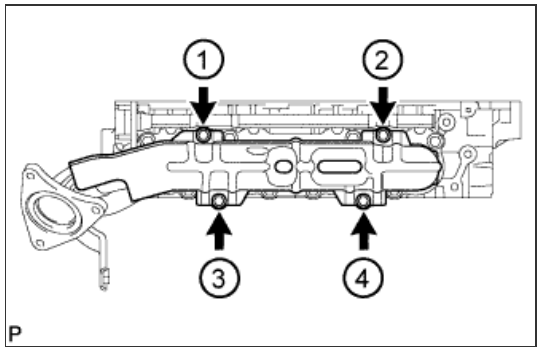


11. INSTALL NO. 1 EXHAUST MANIFOLD HEAT INSULATOR

a. Tempo a ily install the heat insulato ith the 4 bolts.

b. Unifo tighten the 4 bolts in seve al steps, in the sequence shown in the illust ation.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



12. INSTALL EXHAUST FRONT PIPE ASSEMBLY

a. Install a new gasket and the f nt exhaust pipe to the exhaust manifold with new nuts.

Torque:
54 N*m{ 554 kgf*cm , 40 ft.*lbf }

b. Connect the ai atio senso connecto

c. nnect the heated oxygen senso connecto

d. Attach the heated oxygen senso i clamp.

13. INSTALL NO. 2 EXHAUST FRONT PIPE ASSEMBLY

a. Install a new gasket and the f nt No. 2 exhaust pipe to the exhaust manifold LH with new nuts.

Torque:
54 N*m{ 554 kgf*cm , 40 ft.*lbf }

b. Connect the ai atio senso connecto

c. nnect the heated oxygen senso connecto

14. INSTALL EXHAUST CENTER PIPE ASSEMBLY

a. nstall the cente e abst pipe to the exhaust pipe supports.

b. Install 2 new gaskets to the front exhaust pipe and front No. 2 exhaust pipe.

c. Install the 4 bolts.

Torque:
48 N*m{ 489 kgf*cm , 35 ft.*lbf }

15. INSTALL EXHAUST TAILPIPE ASSEMBLY

a. Install the tailpipe to the 2 exhaust pipe supports.

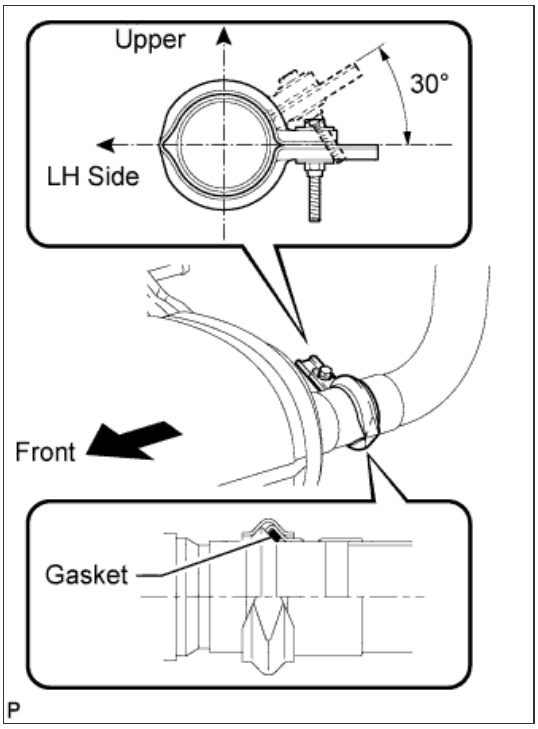
b. Install a new gasket to the center exhaust pipe.

c. Connect the tailpipe and center exhaust pipe with a new clamp.

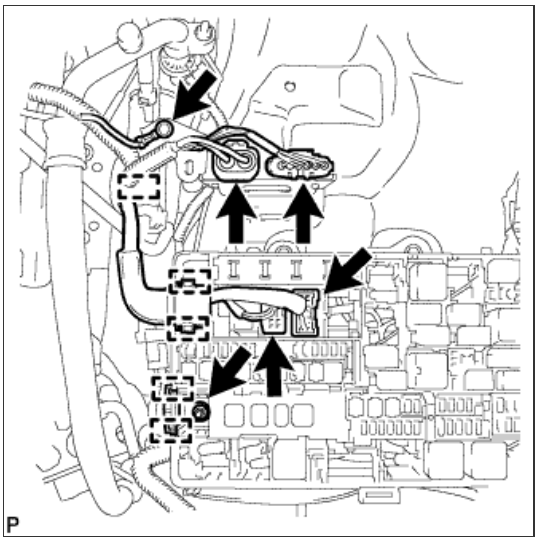
Torque:
32 N*m{ 326 kgf*cm , 24 ft.*lbf }

HINT:

Install the clamp within the angle range shown in the illustration.



16. CONNECT WIRE HARNESS



a. Connect the 2 clamps and 2 connectors to the engine room relay block.

b. Connect the wire harness and 2 clamps and install the nut.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

c. Connect the wire harness clamp to the air injection control driver bracket.

d. Connect the ground wire and install the bolt.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

e. Connect the 2 air injection control driver connectors.

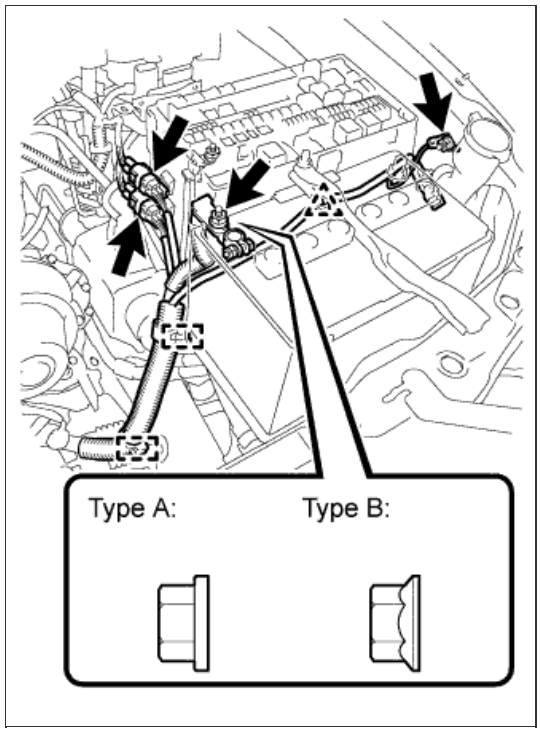
f. Connect the 3 clamps and ground wire and install the bolt.

Torque:
8.4 N*m{ 86 kgf*cm , 74 in.*lbf }

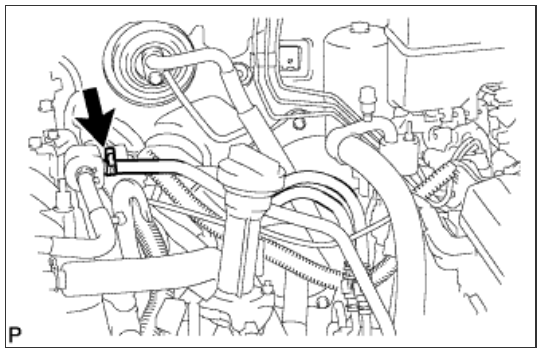
g. Connect the 2 connector clamps to the engine room relay block. Then connect the 2 connectors.

h. Install the wire harness to the positive (+) battery terminal with the nut.

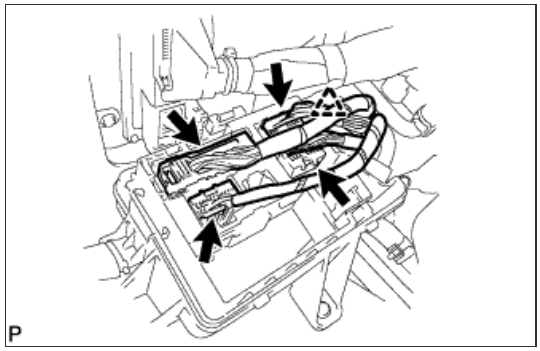
Torque:
for type A nut:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }
for type B nut:
7.6 N*m{ 77 kgf*cm , 67 in.*lbf }



i. Connect the purge line hose to the purge VSV.



j. Connect the 4 connectors and clamp to the connector holder block.



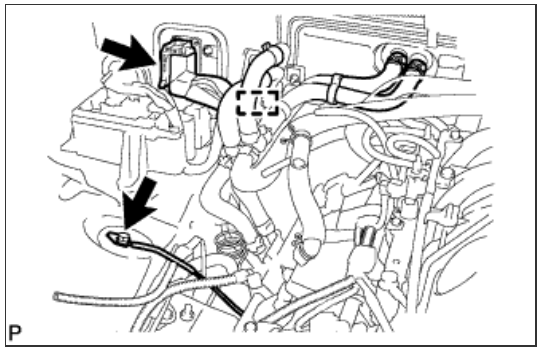
k. Install the ground wire and install the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

l. Connect the clamp and ECM connector.

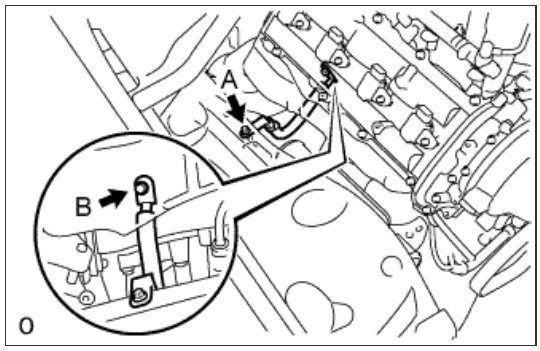
HINT:

Refer to the following procedures to connect the ECM connector (Click here).



m. w/ Winch:
Connect the winch ground wire and install the 2 bolts.

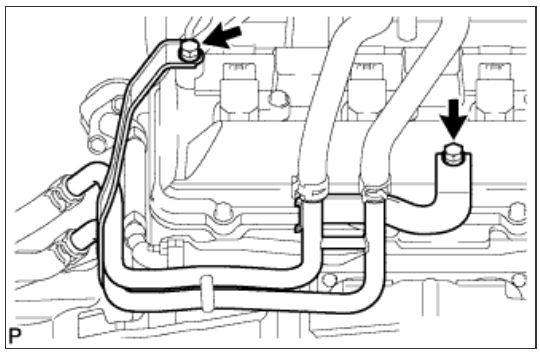
Torque:
for bolt A:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }
for bolt B:
19 N*m{ 194 kgf*cm , 14 ft.*lbf }



17. CONNECT NO. 1 WATER BY-PASS PIPE (w/ Air Cooled Transmission Oil Cooler)

a. Connect the water by-pass pipe to the cylinder head cover RH with the 2 bolts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

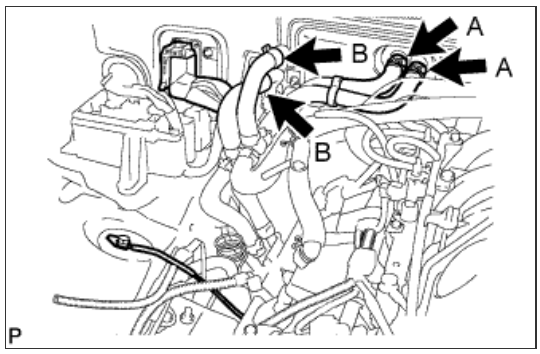


18. CONNECT WATER HOSE SUB-ASSEMBLY

a. Connect the water hose.

i. w/ Rear Heater:
Connect the water hoses labeled A and B.

ii. w/o Rear Heater:
Connect the water hoses labeled A.



19. INSTALL NO. 2 FUEL HOSE

a. for engine side:

i. Connect the fuel hose to the No. 3 fuel pipe.

HINT:

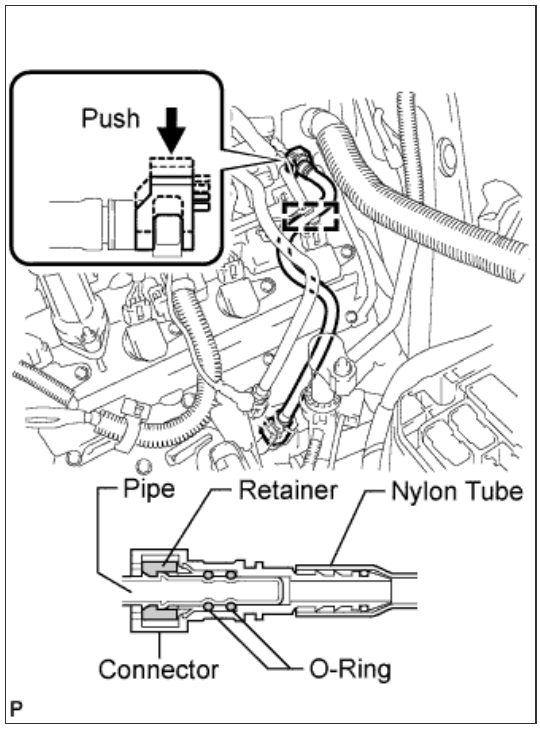
Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

ii. Attach the lock claws to the connector by pushing down on the cover, as shown in the illustration.

iii. Attach the fuel hose clamp.



b. for body side:

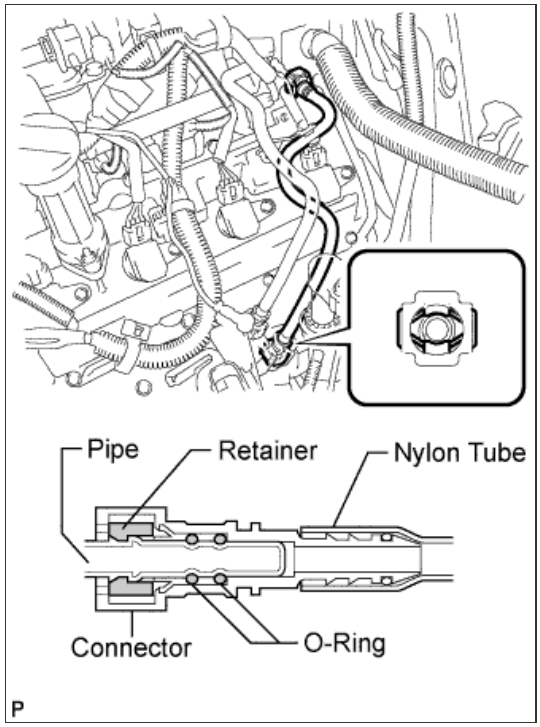
i. Connect the fuel hose to the fuel pipe.

HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**



20. CONNECT FUEL HOSE

a. Connect the fuel hose.

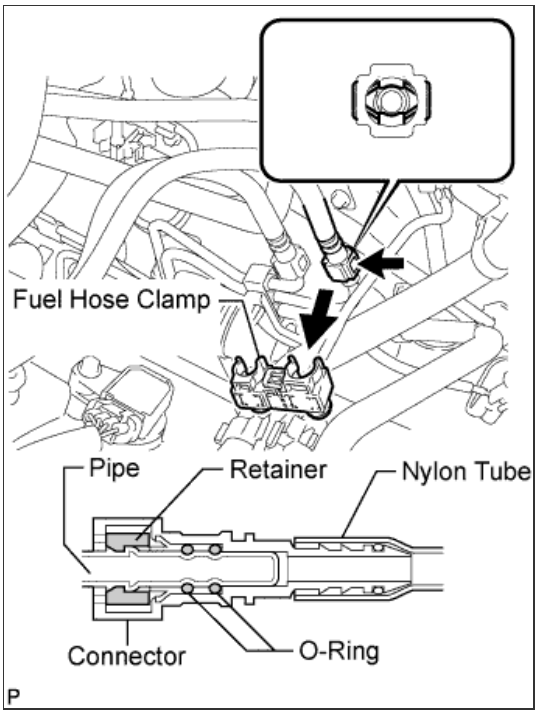
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

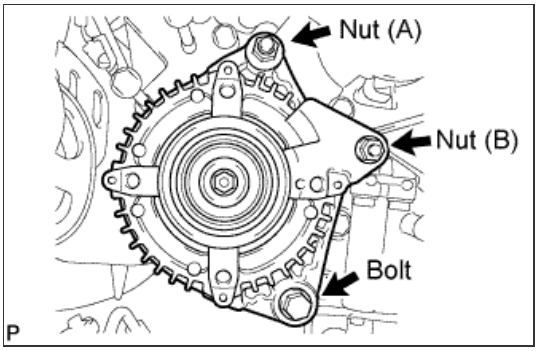
b. Install the fuel hose clamp.



21. INSTALL GENERATOR ASSEMBLY

a. Install the generator with the bolt and 2 nuts.

Torque:
for bolt and nut (A):
39 N*m{ 398 kgf*cm , 29 ft.*lbf }
for nut (B):
16 N*m{ 158 kgf*cm , 11 ft.*lbf }



b. Connect the generator connector.

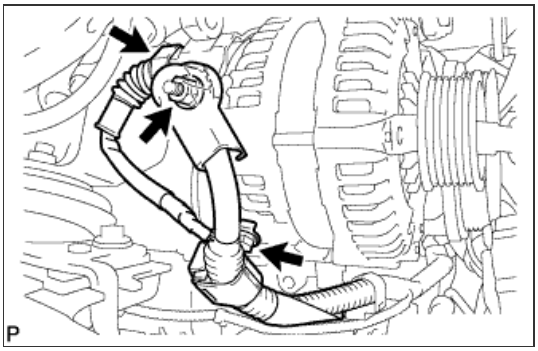
c. Connect the generator wire with the nut.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }

d. Install the terminal cap.

e. Connect the harness bracket to the generator with the bolt.

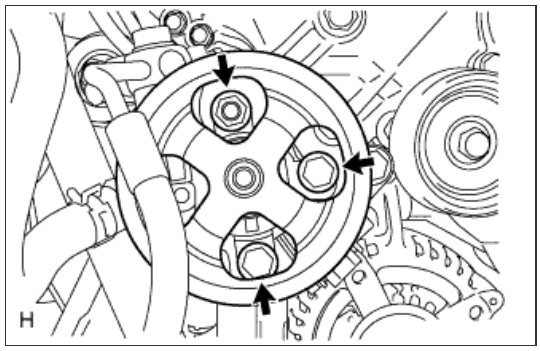
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }



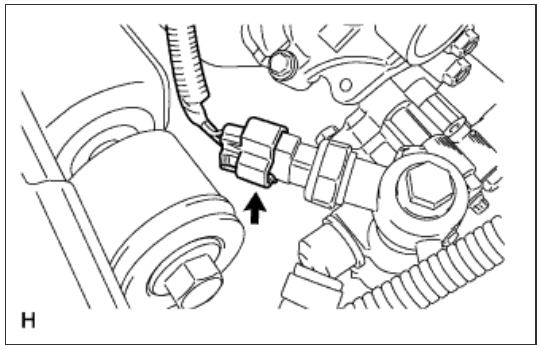
22. CONNECT VANE PUMP ASSEMBLY

a. Connect the vane pump with the 2 bolts and nut.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



b. Connect the connector.



23. CONNECT COOLER COMPRESSOR ASSEMBLY

a. Connect the compressor. Then install it and the No. 1 compressor stay with the nut and 3 bolts.

Torque:
for bolt:
45 N*m{ 459 kgf*cm , 33 ft.*lbf }
for nut:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }

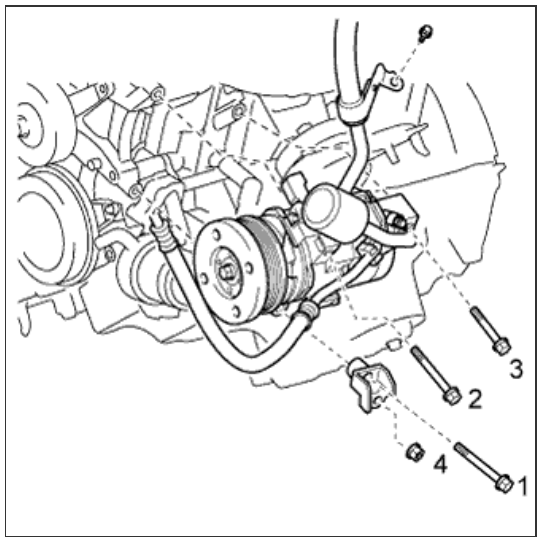
HINT:

Tighten the bolts in the order shown in the illustration to install the cooler compressor.

b. Install the cooler refrigerant suction hose with the bolt.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }

c. Connect the connector.

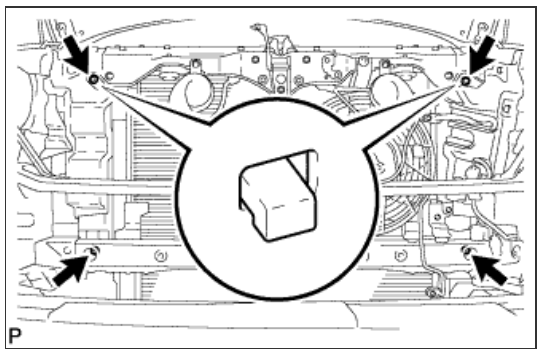


24. INSTALL RADIATOR ASSEMBLY

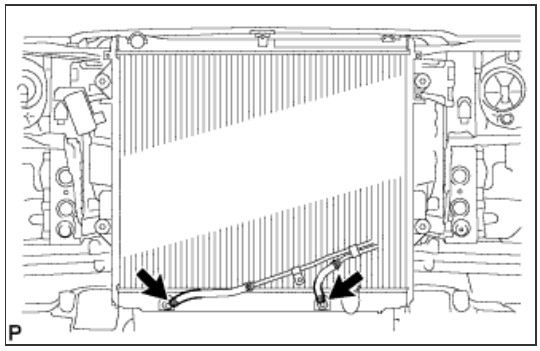
a. Set the radiator bracket hooks to the radiator support holes.

b. Install the radiator with the 4 bolts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

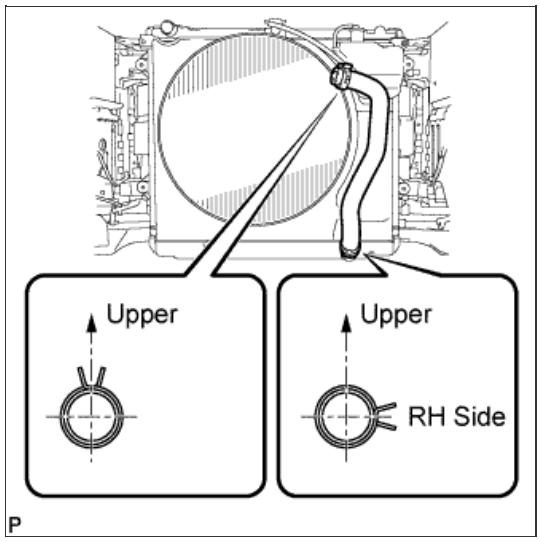


c. Connect the 2 oil cooler hoses.



25. INSTALL NO. 2 RADIATOR HOSE

a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to install the radiator hose.



26. INSTALL FAN SHROUD

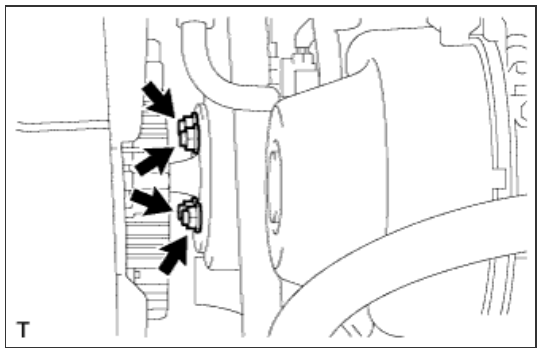
a. Install the fan pulley to the water pump.

b. Place the shroud together with the cooling fan between the radiator and engine.

NOTICE:

Be careful not to damage the radiator core.

c. Temporarily install the cooling fan to the water pump with the 4 nuts. Tighten the nuts as much as possible by hand.



d. Attach the claws of the shroud to the radiator as shown in the illustration.

e. Install the shroud with the 2 bolts.

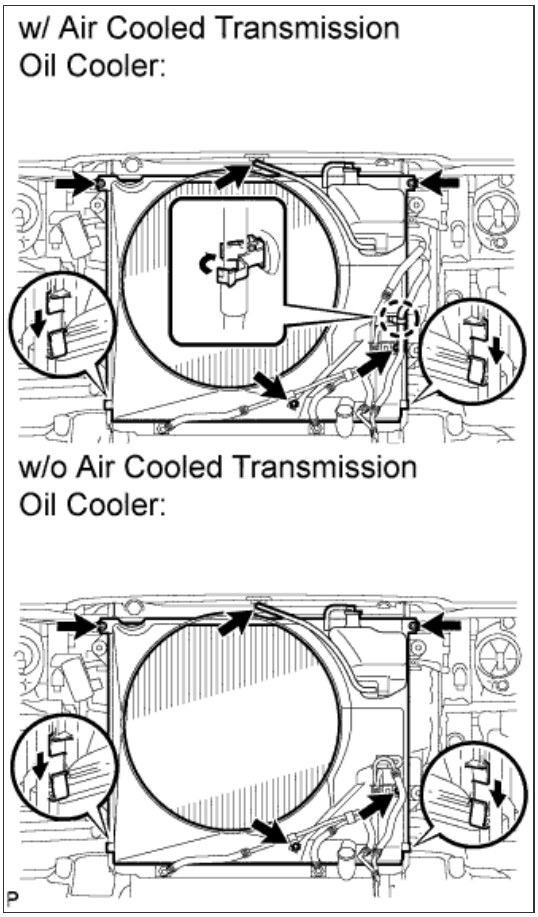
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

f. Connect the oil cooler tube to the fan shroud with the 2 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

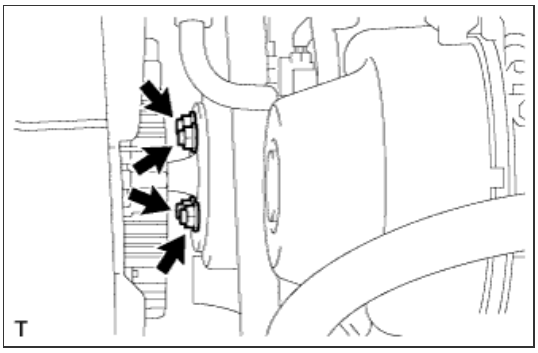
g. w/ Air Cooled Transmission Oil Cooler:
Pass the hose through the flexible hose clamp and close the clamp as shown in the illustration.

h. Connect the reservoir hose to the upper side of the radiator tank.



i. Tighten the 4 nuts of the cooling fan.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

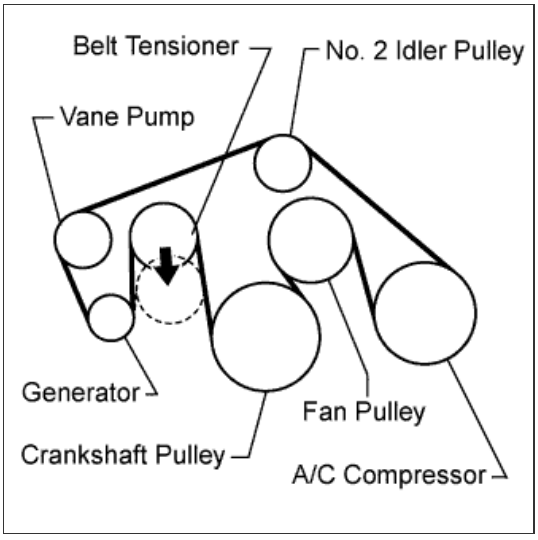


27. INSTALL FAN & GENERATOR V BELT

a. Set the V belt onto every part except the belt tensioner, as shown in the illustration.

b. Loosen the V belt by turning the belt tensioner counterclockwise.

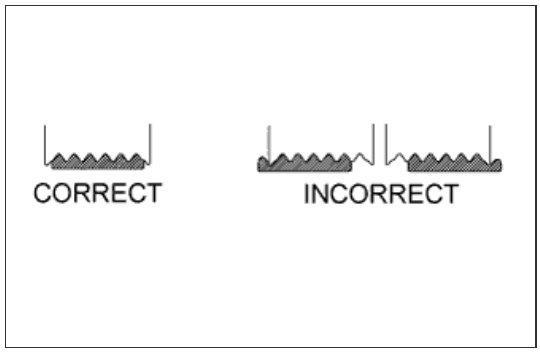
c. Set the V belt to the belt tensioner.



d. Check that the belt fits properly in the ribbed grooves.

HINT:

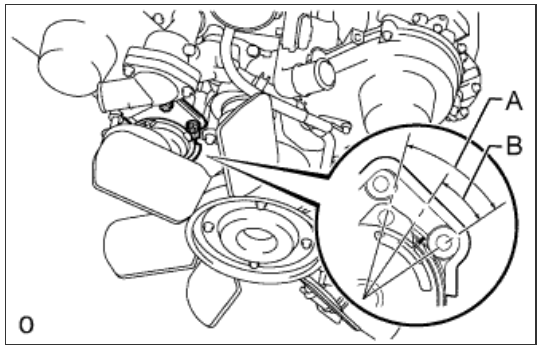
Make sure to check by hand that the belt has not slipped out of the grooves on the bottom of the pulley.



e. Check that the arrow on the belt tensioner is within area "A".
If the arrow is outside area "A", replace the fan and generator V belt.

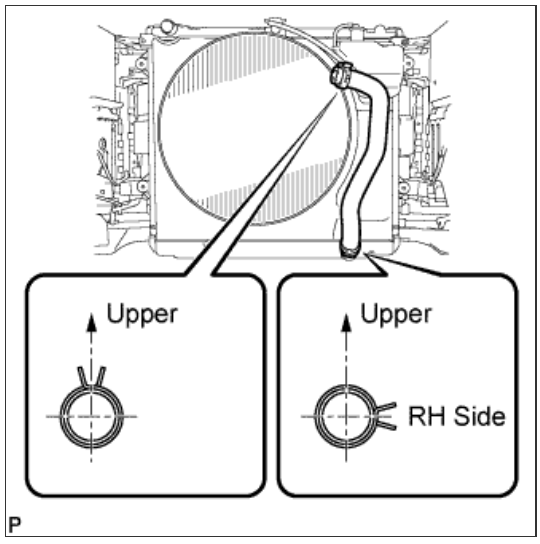
HINT:

When a new belt is installed, the arrow should be within area "B". If not, the fan and generator V belt is not installed correctly.



28. INSTALL NO. 1 RADIATOR HOSE

a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to install the radiator hose.

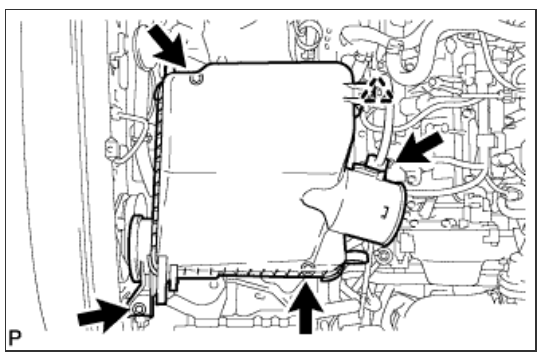


29. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner with the 3 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

b. Connect the clamp and MAF connector.



30. INSTALL AIR CLEANER HOSE ASSEMBLY

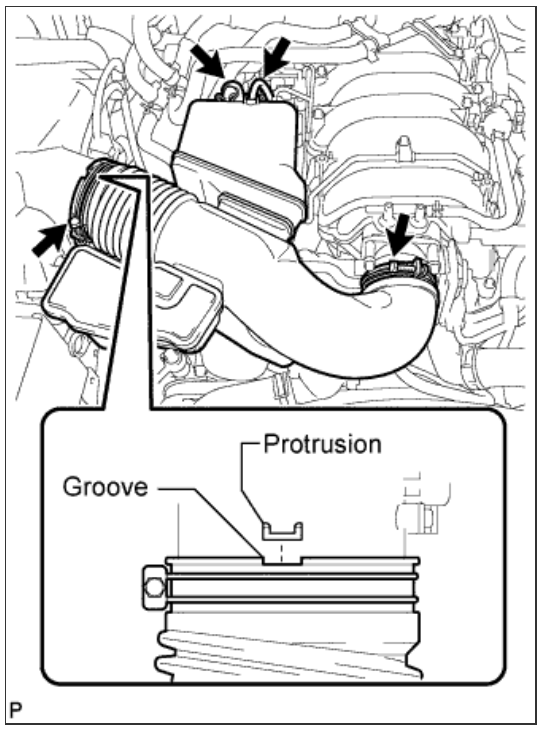
a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum transmitting hose.

d. Connect the No. 2 ventilation hose.



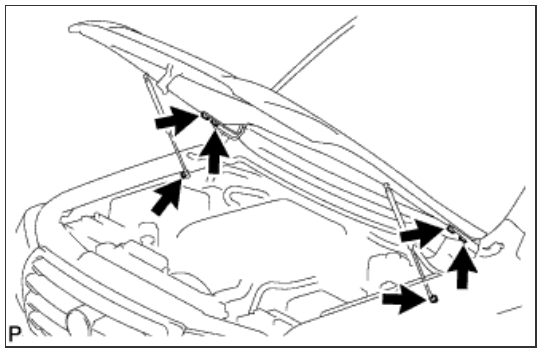
31. INSTALL HOOD SUB-ASSEMBLY

a. Install the hood with the 4 bolts.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }

b. Install the 2 hood supports with the 2 hood stay bolts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }



NOTICE:

- **Avoid touching the stroke portions of the rod as much as possible to prevent foreign matter from attaching to it. Be sure to hold the cylinders while servicing.**
- **Do not wear cotton gloves or other similar materials when handling the rod. Fibers may attach to the rod and result in gas leaks.**
- **Do not apply any load to the cylinders in the horizontal direction in order to prevent the rod from being deformed.**
- **Install the hood support while supporting the hood by hand.**

32. ADJUST HOOD SUB-ASSEMBLY

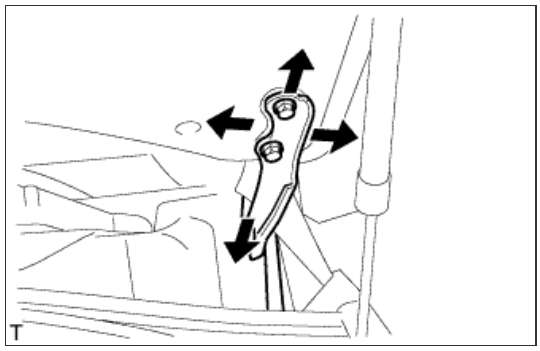
a. Adjust the hood position.

i. Loosen the 4 hinge bolts of the hood.

ii. Move the hood and adjust the clearance between the hood and front fender.

iii. Tighten the 4 hinge bolts of the hood after the adjustment.

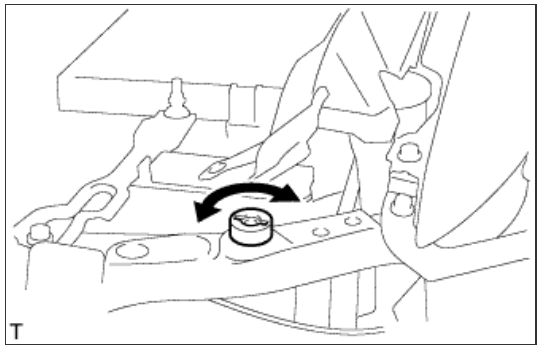
Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



iv. Adjust the cushion rubber so that the height of the hood and fender are aligned.

HINT:

Raise or lower the hood front end by turning the cushion rubber.

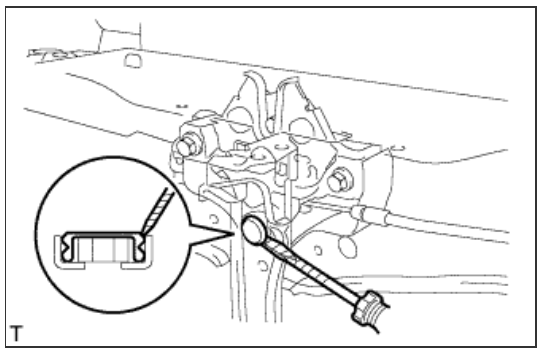


b. Adjust the hood lock.

i. Using a screwdriver, remove the hood lock nut cap as shown in the illustration.

HINT:

Tape the screwdriver tip before use.



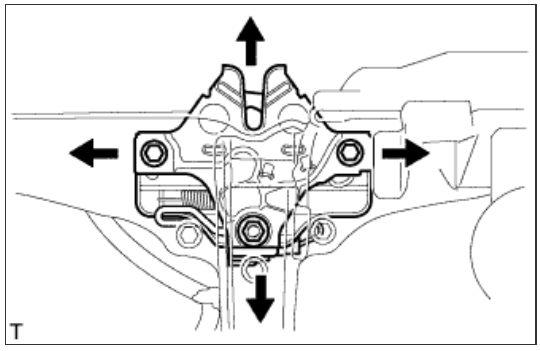
ii. Loosen the 2 bolts and hood lock nut.

iii. Adjust the hood lock position so that the striker can enter it smoothly.

iv. Tighten the bolts and nut after the adjustment.

Torque:
5.5 N*m{ 56 kgf*cm , 49 in.*lbf }

v. Install a new cap.



33. ADD ENGINE OIL

a. Install a new gasket and the drain plug.

Torque:
39 N*m{ 398 kgf*cm , 29 ft.*lbf }

b. Add new engine oil.

Standard Engine Oil:

Oil Grade	Oil Viscosity (SAE)

API grade SL "Energy-Conserving", SM "Energy-Conserving" or ILSAC multigrade engine oil	10W-30 (10W-30 is best choice for fuel economy and good starting in cold weather).
API grade SL or SM multigrade engine oil	10W-30

Standard Oil Capacity:

Item	Specified Condition
Drain and refill with oil filter change	6.2 liters (6.6 US qts, 5.5 Imp. qts)
Drain and refill without oil filter change	5.7 liters (6.0 US qts, 5.0 Imp. qts)
Dry fill	7.1 liters (7.5 US qts, 6.2 Imp. qts)

34. ADD ENGINE COOLANT

a. Add engine coolant.

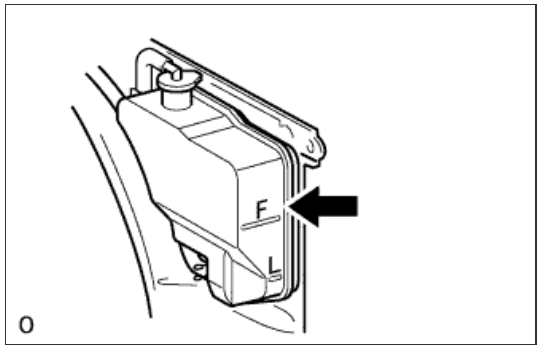
Standard Capacity:

Item		Specified Condition
w/o Transmission oil cooler	w/o Rear Heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)
	w/ Rear Heater	16.3 liters (17.2 US qts, 14.3 Imp. qts)
w/ Transmission oil cooler	w/o Rear Heater	14.1 liters (14.9 US qts, 12.4 Imp. qts)
	w/ Rear Heater	16.9 liters (17.9 US qts, 14.9 Imp. qts)

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.



c. Install the radiator reservoir cap.

d. Press the inlet and outlet radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.

NOTICE:

Switch off the A/C.

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

h. Press the inlet and outlet radiator hoses several times by hand to bleed air.

CAUTION:

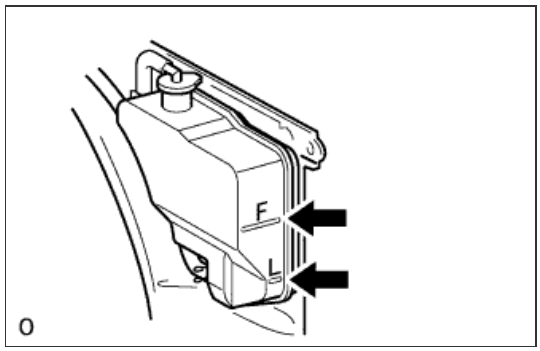
- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the cooling fan.**

i. Stop the engine, and wait until the engine coolant cools down to the ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

j. Check that the coolant level is between the F and L lines. If the coolant level is below the L line, repeat all of the procedures above. If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.



35. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

36. INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and intelligent tester ON.

NOTICE:

Do not start the engine.

c. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the Fuel Pump Speed Control.

d. Check that there are no fuel leaks after doing maintenance anywhere on the fuel system.

37. INSPECT FOR EXHAUST GAS LEAK

If gas is leaking, tighten the areas necessary to stop the leak. Replace damaged parts as necessary.

38. INSPECT FOR COOLANT LEAK

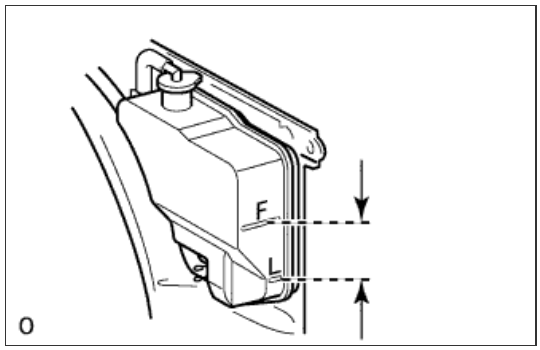
a. Check that the engine coolant level is between the L and F lines when the engine is cold.
If the engine coolant is low, check for leaks and add "TOYOTA Super Long Life Coolant" or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite and non-borate coolant with long-life hybrid organic acid technology to the F line.

NOTICE:

Do not substitute plain water for engine coolant.

b. Remove the radiator cap, and check that the coolant level is up to the radiator

filler hole.



39. INSPECT FOR OIL LEAK

a. Start the engine. Make sure that there are no oil leaks from the area that was worked on.

40. INSPECT ENGINE OIL LEVEL

a. Warm up the engine, then stop the engine and wait for 5 minutes.

b. Check that the engine oil level is between the low level and full level marks on the dipstick.
If low, check for leakage and add oil up to the full level mark.

NOTICE:

Do not fill engine oil above the full level mark.

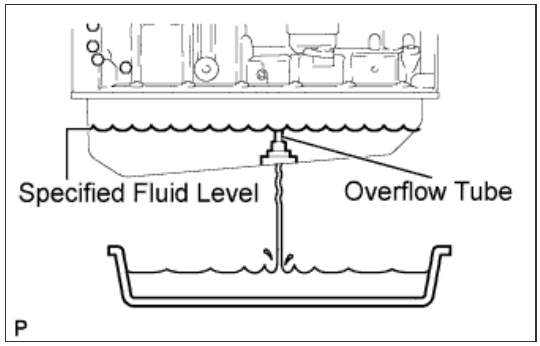
41. CHECK FLUID LEVEL

NOTICE:

The fluid temperature must be between 38 to 45°C (100 to 113°F) to accurately check the fluid level.

a. Remove the overflow plug with the engine idling.

b. Check that fluid comes out of the overflow tube.
If fluid does not come out, proceed to the "Transmission Refill" procedures.
If fluid comes out, wait until the overflow slows to a trickle and proceed to the "Complete" procedures.



42. INSPECT SHIFT LEVER POSITION

a. When moving the shift lever from P to R with the engine switch on (IG) and the brake pedal depressed, make sure that it moves smoothly and correctly into position.

b. Check that the shift lever does not stop when moving the shift lever from R to P, and check that the shift lever does not stick when moving the shift lever from D to S.

c. Start the engine and make sure that the vehicle moves forward after moving the shift lever from N to D and moves rearward after moving the shift lever to R.
If the operation cannot be performed as specified, inspect the park/neutral position switch assembly and check the shift lever assembly installation condition.

43. INSPECT IGNITION TIMING

a. Warm up and stop the engine.

i. Allow the engine to warm up to a normal operating temperature.

b. When using the intelligent tester:

i. Connect the intelligent tester to the DLC3.

NOTICE:

Switch off all accessories and the A/C before connecting the intelligent tester.

ii. Start the engine and idle it.

iii. Push the intelligent tester main switch ON.

iv. Enter the following menus: Powertrain / Engine and ECT / Data List / Primary / IGN Advance.

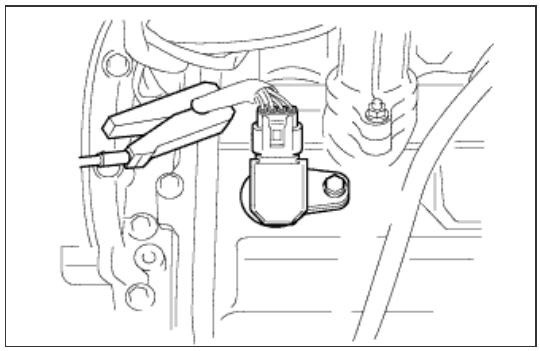
HINT:

Refer to the intelligent tester operator's manual for further details.

Standard ignition timing:
5 to 15° BTDC @ idling (transmission in neutral and A/C switch off)

v. Disconnect the intelligent tester from the DLC3.

c. When not using the intelligent tester:



i. Remove the 2 nuts and V-bank cover.

ii. Connect the tester probe of a timing light to the wire of the ignition coil connector for the No. 1 cylinder.

NOTICE:

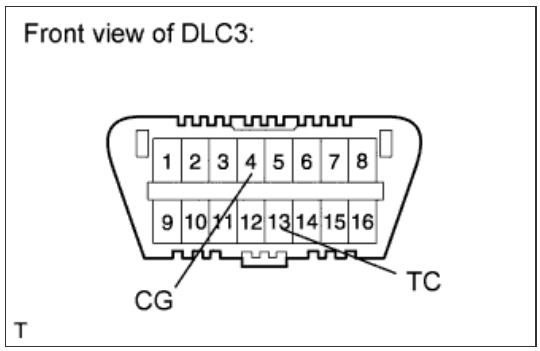
Use a timing light that detects primary signals.

iii. Using SST, connect terminals 13 (TC) and 4 (CG) of the DLC3.

SST
09843-18040

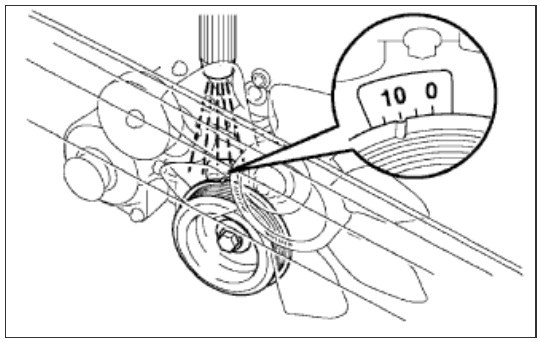
NOTICE:

- **Confirm the terminal numbers before connecting them. Connecting the wrong terminals can damage the engine.**
- **Switch off all accessories and the A/C.**



iv. Using the timing light, check the ignition timing.

Ignition timing:
5 to 15° BTDC @ idling (transmission in neutral and A/C switch off)



v. Remove SST from the DLC3.

vi. Disconnect the timing light from the engine.

vii. Install the V-bank cover with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

44. INSPECT ENGINE IDLE SPEED

a. Warm up and stop the engine.

i. Allow the engine to warm up to a normal operating temperature.

b. When using the intelligent tester:

i. Connect the intelligent tester to the DLC3.

NOTICE:

Switch off all accessories and the A/C before connecting the intelligent tester.

ii. Race the engine at 2500 rpm for approximately 90 seconds.

iii. Push the intelligent tester main switch ON.

iv. Enter the following menus: Powertrain / Engine and ECT / Data List / Primary / Engine Speed.

Standard idle speed:
650 to 750 rpm (transmission in neutral and A/C switch off)

HINT:

Refer to the intelligent tester operator's manual for further details.

If the idle speed is not as specified, check the air intake system.

v. Disconnect the intelligent tester from the DLC3.

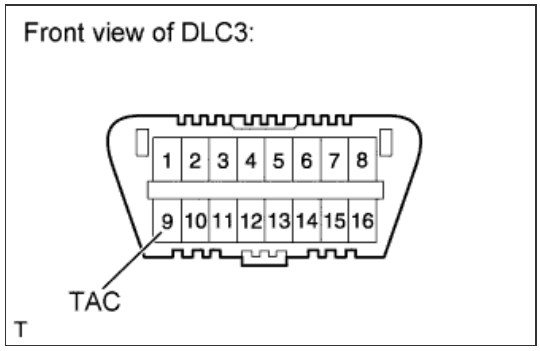
c. When not using the intelligent tester:

i. Using SST, connect a tachometer probe to terminal 9 (TAC) of the DLC3.

SST
09843-18030

NOTICE:

- **Confirm the terminal number before connecting the probe. Connecting the probe to the wrong terminal can damage the engine.**
- **Switch off all accessories and the A/C.**



ii. Race the engine at 2500 rpm for approximately 90 seconds.

iii. Check the idle speed.

Standard idle speed:
650 to 750 rpm (transmission in neutral and A/C switch off)

If the idle speed is not as specified, check the air intake system.

iv. Disconnect the tachometer from the DLC3.

45. INSPECT CO/HC

HINT:

This check is used only to determine whether or not the idle CO/HC complies with regulations.

a. Warm up the engine.

b. Keep the engine speed at 2500 rpm for approximately 180 seconds.

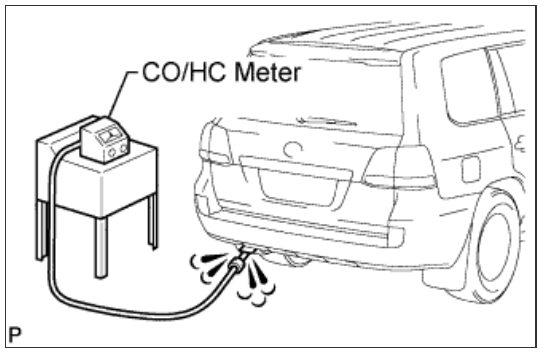
c. Insert the CO/HC meter testing probe at least 40 cm (1.31 ft.) into the tailpipe during idling.

d. Immediately check CO/HC concentration at idle and/or 2500 rpm.

HINT:

When performing the 2 mode (2500 rpm and idle) test, follow the measurement order prescribed by the applicable local regulations.

e. If the C concentration does not comply with regulations, troubleshoot in the order given below.



i. Check the A/F sensor (Click here) and heated oxygen sensor (Click here) operation.

ii. See the table below for possible causes, and then inspect and correct the applicable causes if necessary.

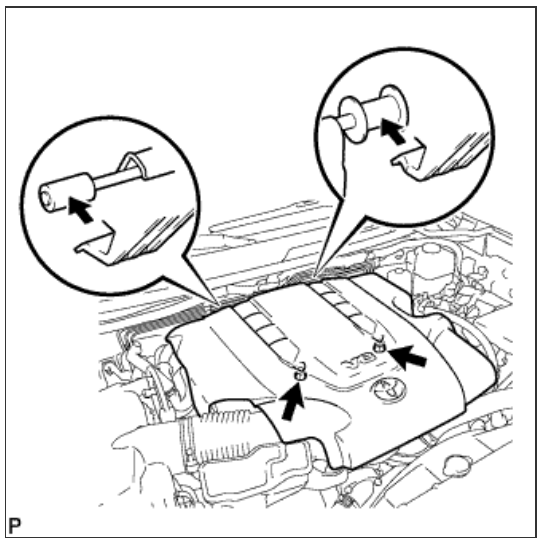
CO	HC	Symptom	Cause
Normal	High	Rough idle	1. Faulty ignitions: • Incorrect timing • Plugs (contaminated, shorted or gaps are defective) 2. Incorrect valve clearance 3. Leaky intake and exhaust valves 4. Leaky cylinder
Low	High	Rough idle (Fluctuating HC reading)	1. Vacuum leaks: • PCV hose • Intake manifold • Throttle body 2. Lean mixture causing misfire
High	High	Rough idle (Black smoke from exhaust)	1. Restricted air filter 2. Faulty SFI system: • Faulty pressure regulator • Defective ECT sensor • Faulty ECM • Faulty injectors • Faulty throttle position sensor • Faulty MAF meter

46. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket.

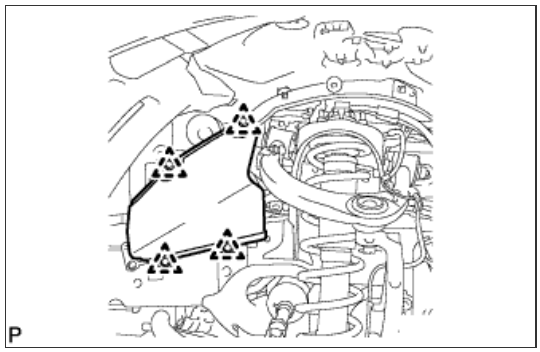
b. Install the V-bank cover with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



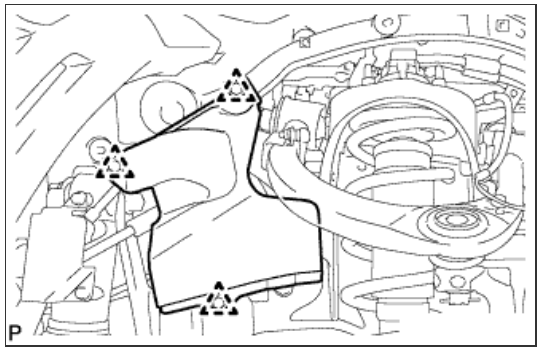
47. INSTALL FRONT FENDER APRON SEAL LH

a. Install the fender apron seal with the 4 clips.



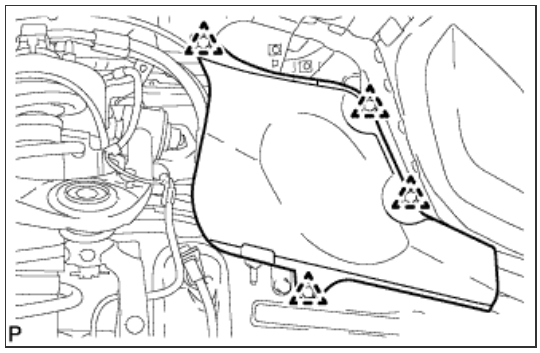
48. INSTALL FRONT FENDER APRON SEAL LH (w/ KDSS)

a. Install the fender apron seal with the 3 clips.



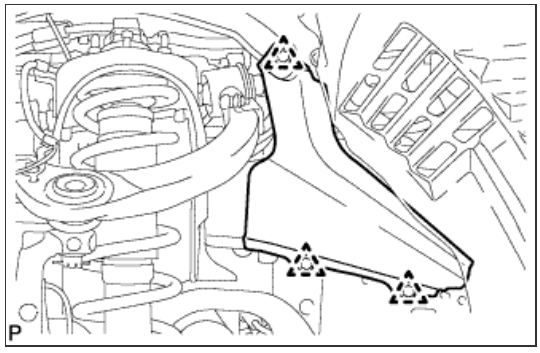
49. INSTALL FRONT FENDER APRON SEAL REAR LH

a. Install the fender apron seal with the 4 clips.



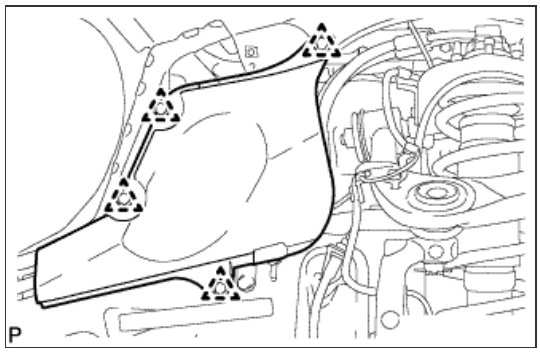
50. INSTALL FRONT FENDER APRON SEAL FRONT RH

a. Install the fender apron seal with the 3 clips.



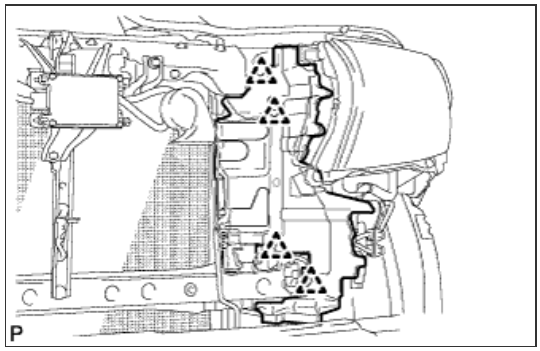
51. INSTALL FRONT FENDER APRON SEAL REAR RH

a. Install the fender apron seal with the 4 clips.



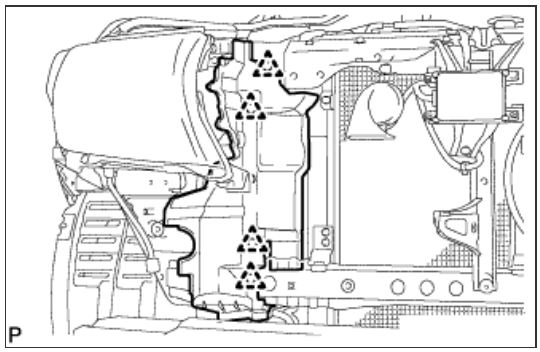
52. CONNECT RADIATOR SIDE DEFLECTOR LH

a. Connect the deflector with the 4 clips.



53. CONNECT RADIATOR SIDE DEFLECTOR RH (w/o Air Cooled Transmission Oil Cooler)

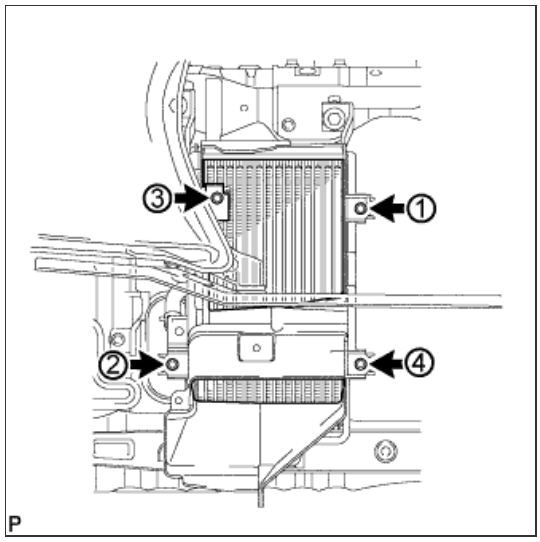
a. Connect the deflector with the 4 clips.



54. INSTALL TRANSMISSION OIL COOLER AIR DUCT (w/ Air Cooled Transmission Oil Cooler)

a. Install the oil cooler air duct with the 4 bolts in the sequence shown in the illustration.

Torque:
4.9 N*m{ 50 kgf*cm , 43 in.*lbf }



55. INSTALL FRONT BUMPER COVER

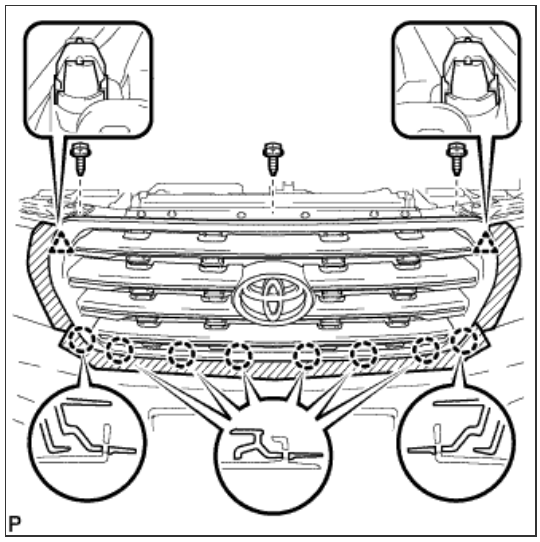
a. for Standard:
Install the front bumper (Click here).

b. w/ Winch:
Install the front bumper (Click here).

56. INSTALL RADIATOR GRILLE

a. Attach the 2 clips and 8 claws to install the radiator grille.

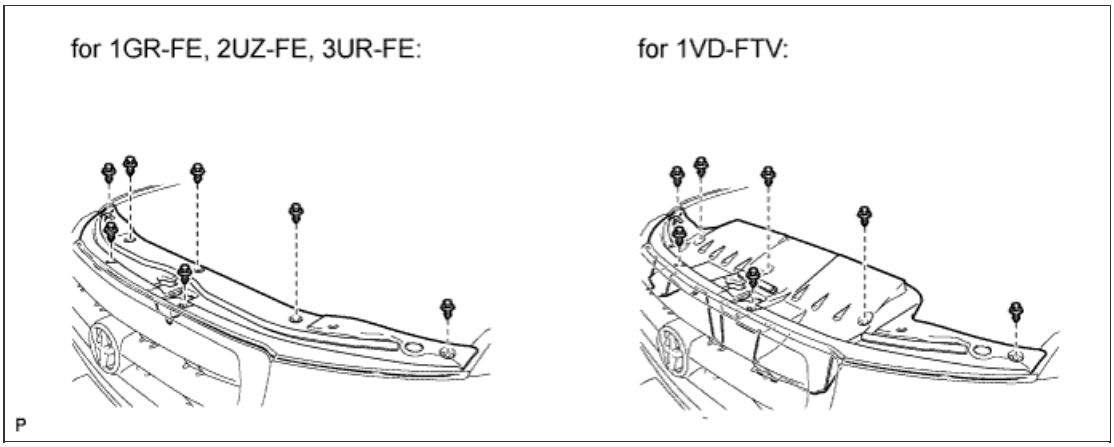
b. Install the 3 screws.



57. INSTALL FRONT BUMPER WINCH COVER SUB-ASSEMBLY (w/ Winch)

58. INSTALL UPPER RADIATOR SUPPORT SEAL

a. Install the radiator support seal with the 7 clips.



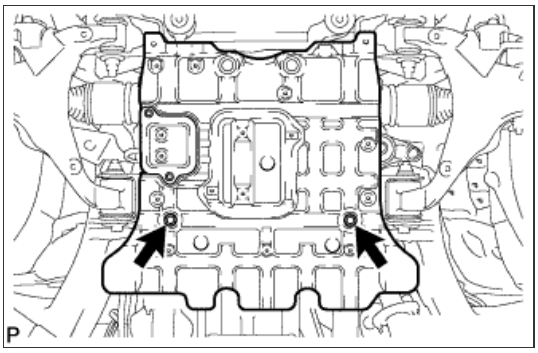
59. INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Install the cowl top ventilator (Click here).

60. INSTALL NO. 2 ENGINE UNDER COVER

a. Install the No. 2 engine under cover with the 2 bolts.

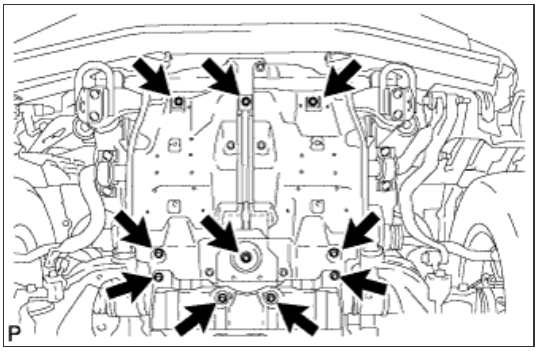
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



61. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the No. 1 engine under cover with the 10 bolts.

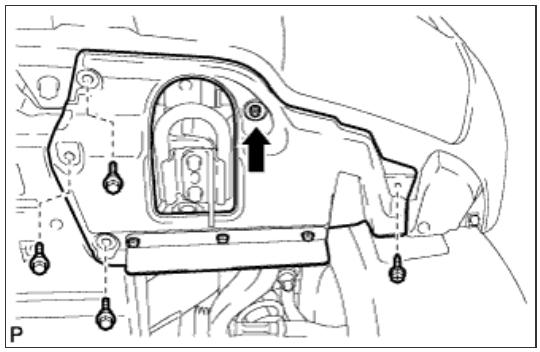
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



62. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



63. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

64. INSTALL FRONT WHEEL

Torque:
for aluminum wheel:
131 N*m{ 1336 kgf*cm , 97 ft.*lbf }
for steel wheel:
209 N*m{ 2131 kgf*cm , 154 ft.*lbf }

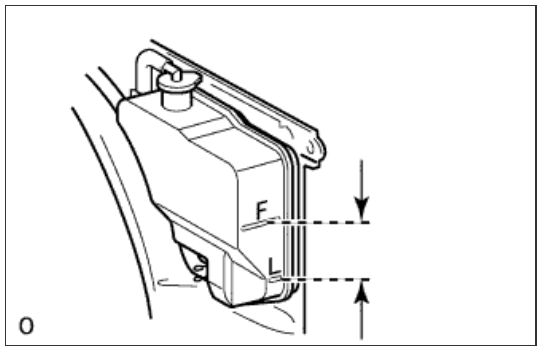
65. INSPECT ENGINE COOLANT LEVEL

a. Check that the engine coolant level is between the L and F lines when the engine is cold.
If the engine coolant is low, check for leaks and add "TOYOTA Super Long Life Coolant" or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite and non-borate coolant with long-life hybrid organic acid technology to the F line.

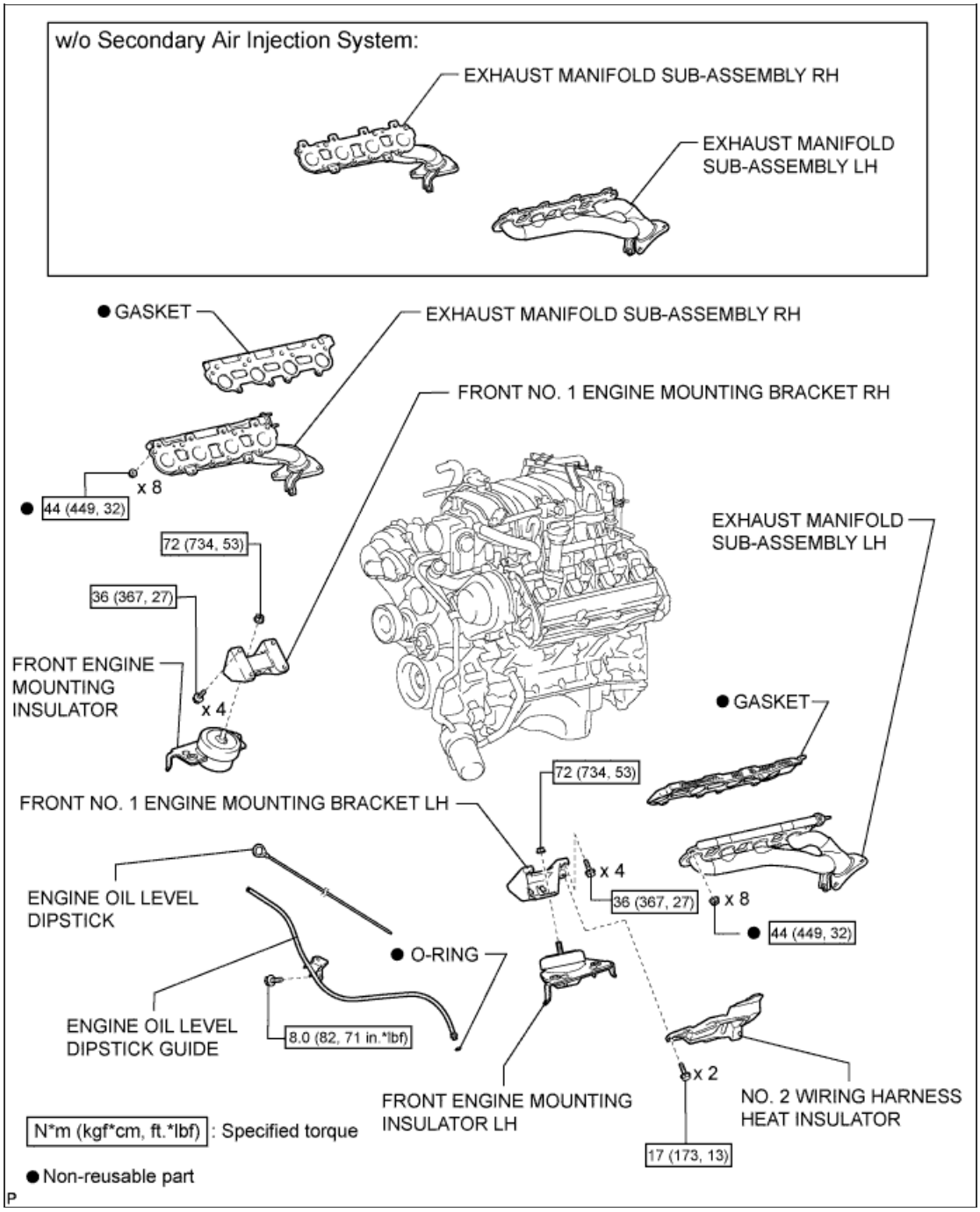
NOTICE:

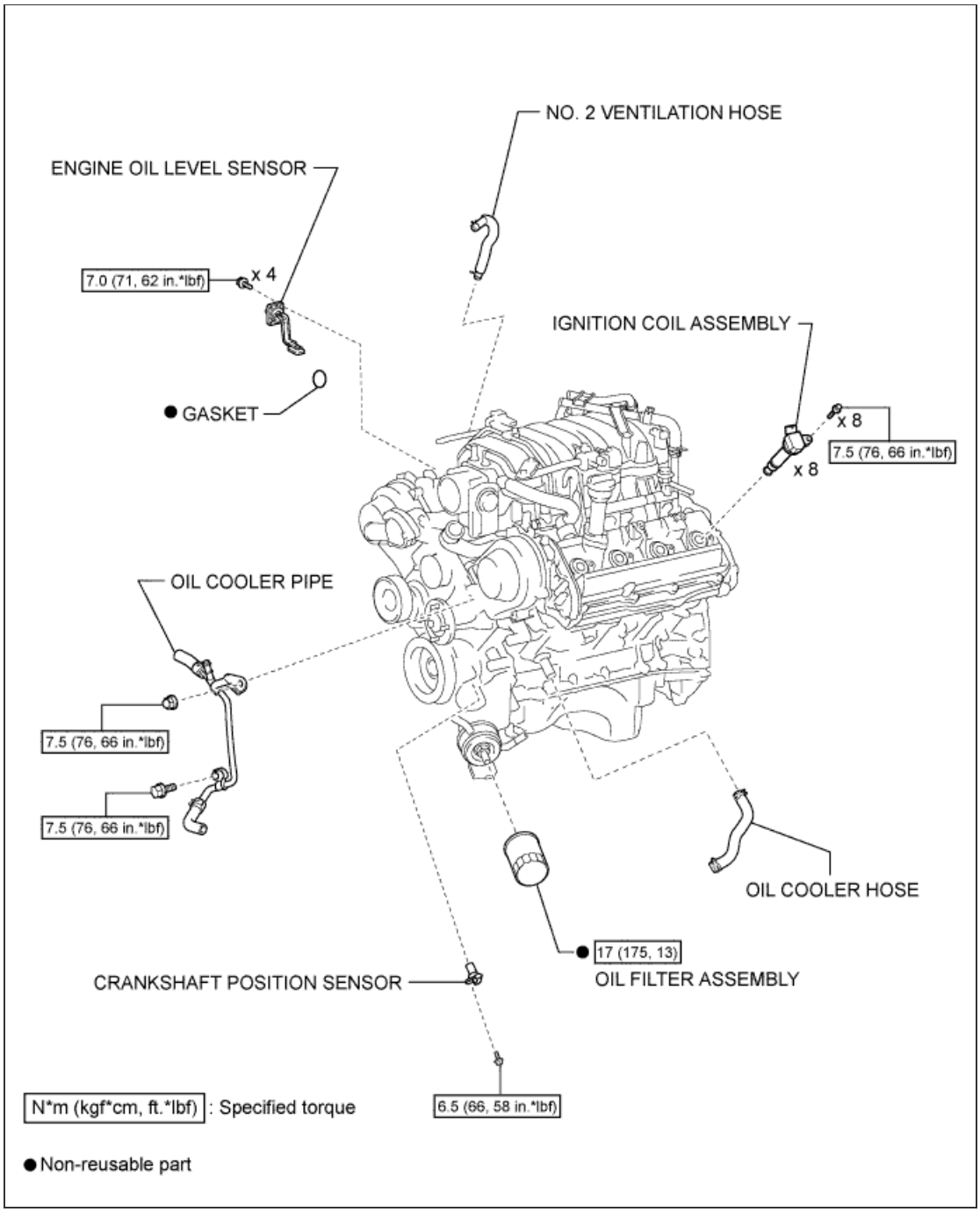
Do not substitute plain water for engine coolant.

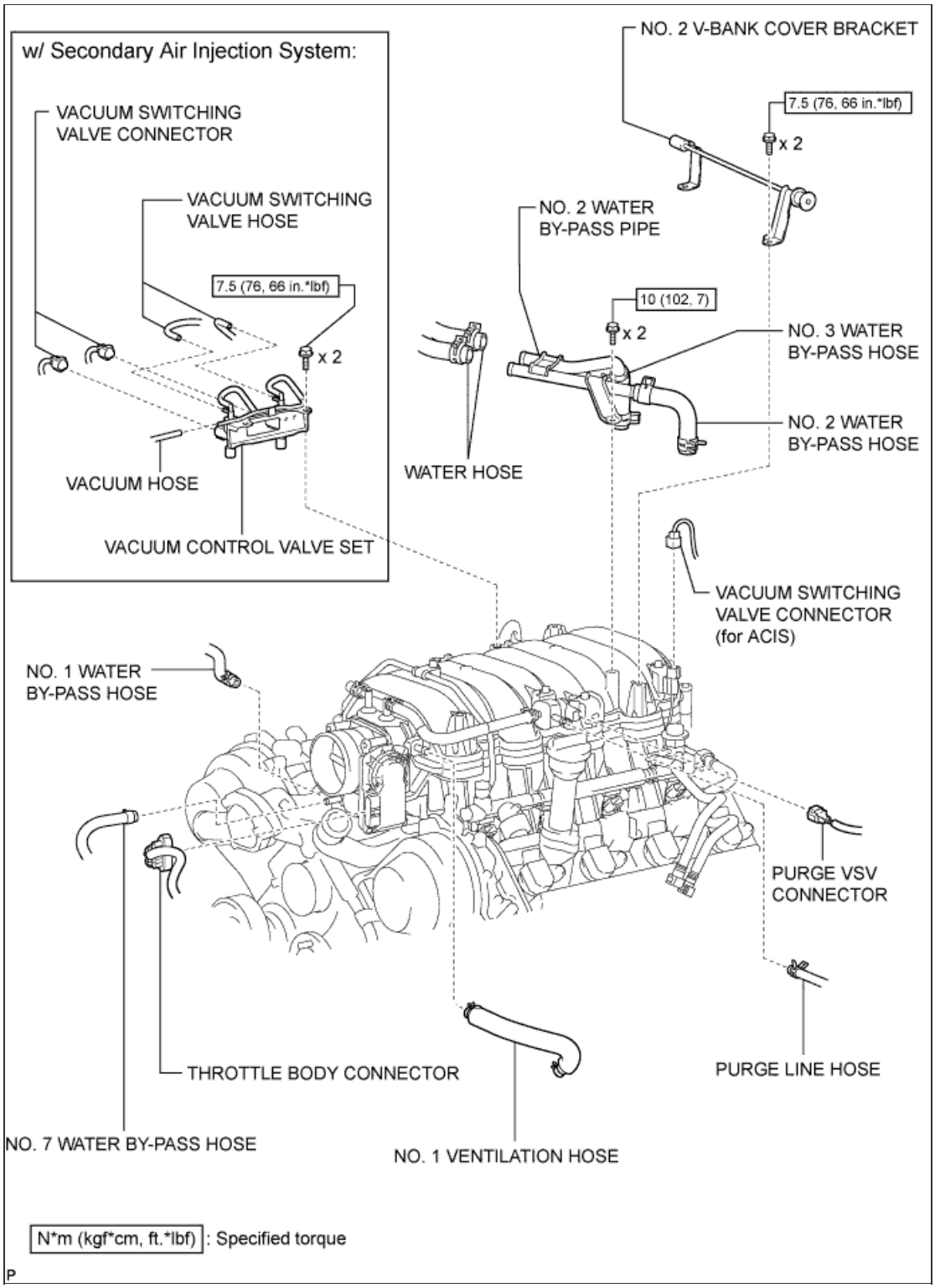
b. Remove the radiator cap, and check that the coolant level is up to the radiator filler hole.

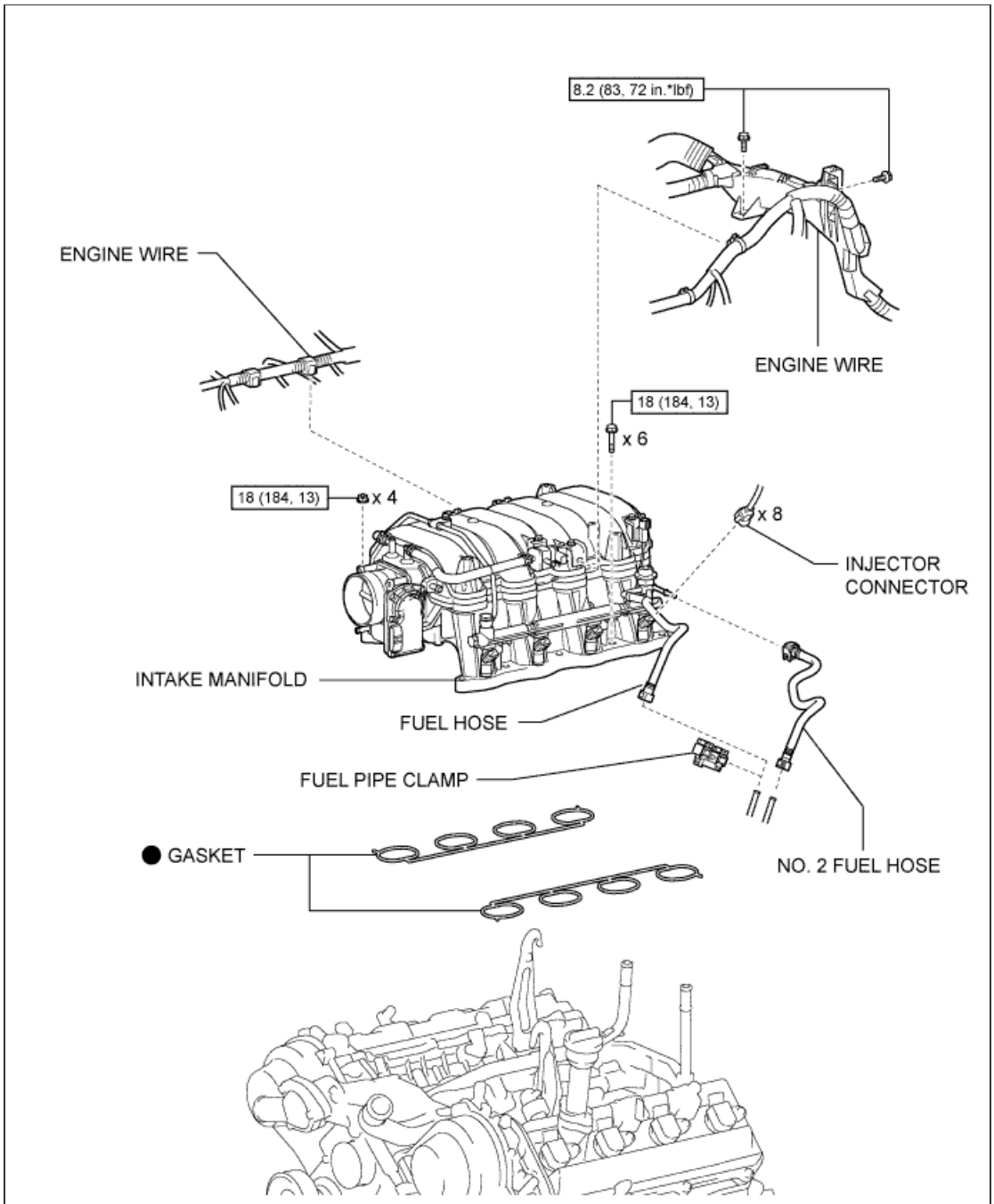


for Preparation Click here




NO. 2 VENTILATION HOSE
ENGINE OIL LEVEL SENSOR
7.0 (71, 62 in.*lbf)
x 4
IGNITION COIL ASSEMBLY
● GASKET
x 8
7.5 (76, 66 in.*lbf)
x 8
OIL COOLER PIPE
7.5 (76, 66 in.*lbf)
7.5 (76, 66 in.*lbf)
OIL COOLER HOSE
● 17 (175, 13)
OIL FILTER ASSEMBLY
CRANKSHAFT POSITION SENSOR
6.5 (66, 58 in.*lbf)
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part


w/ Secondary Air Injection System:
VACUUM SWITCHING VALVE CONNECTOR
VACUUM SWITCHING VALVE HOSE
7.5 (76, 66 in.*lbf)
x 2
VACUUM HOSE
VACUUM CONTROL VALVE SET
NO. 2 V-BANK COVER BRACKET
7.5 (76, 66 in.*lbf)
x 2
NO. 2 WATER BY-PASS PIPE
10 (102, 7)
x 2
NO. 3 WATER BY-PASS HOSE
NO. 2 WATER BY-PASS HOSE
WATER HOSE
VACUUM SWITCHING VALVE CONNECTOR (for ACIS)
NO. 1 WATER BY-PASS HOSE
PURGE VSV CONNECTOR
PURGE LINE HOSE
THROTTLE BODY CONNECTOR
NO. 7 WATER BY-PASS HOSE
NO. 1 VENTILATION HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
P

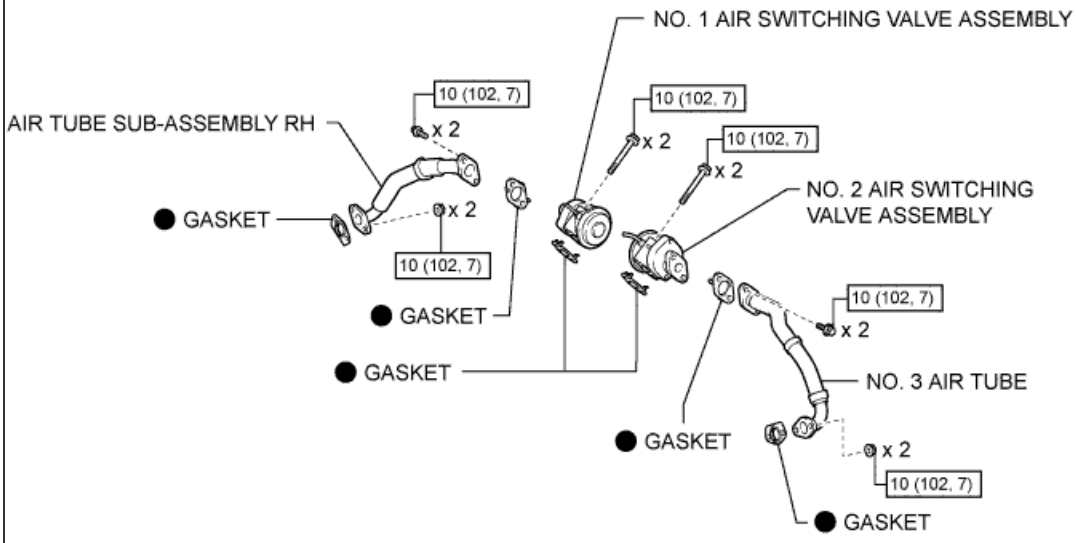


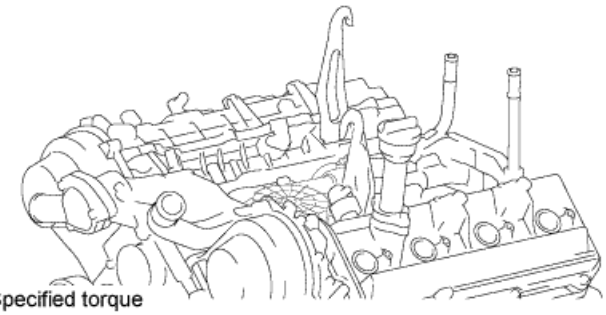
N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P

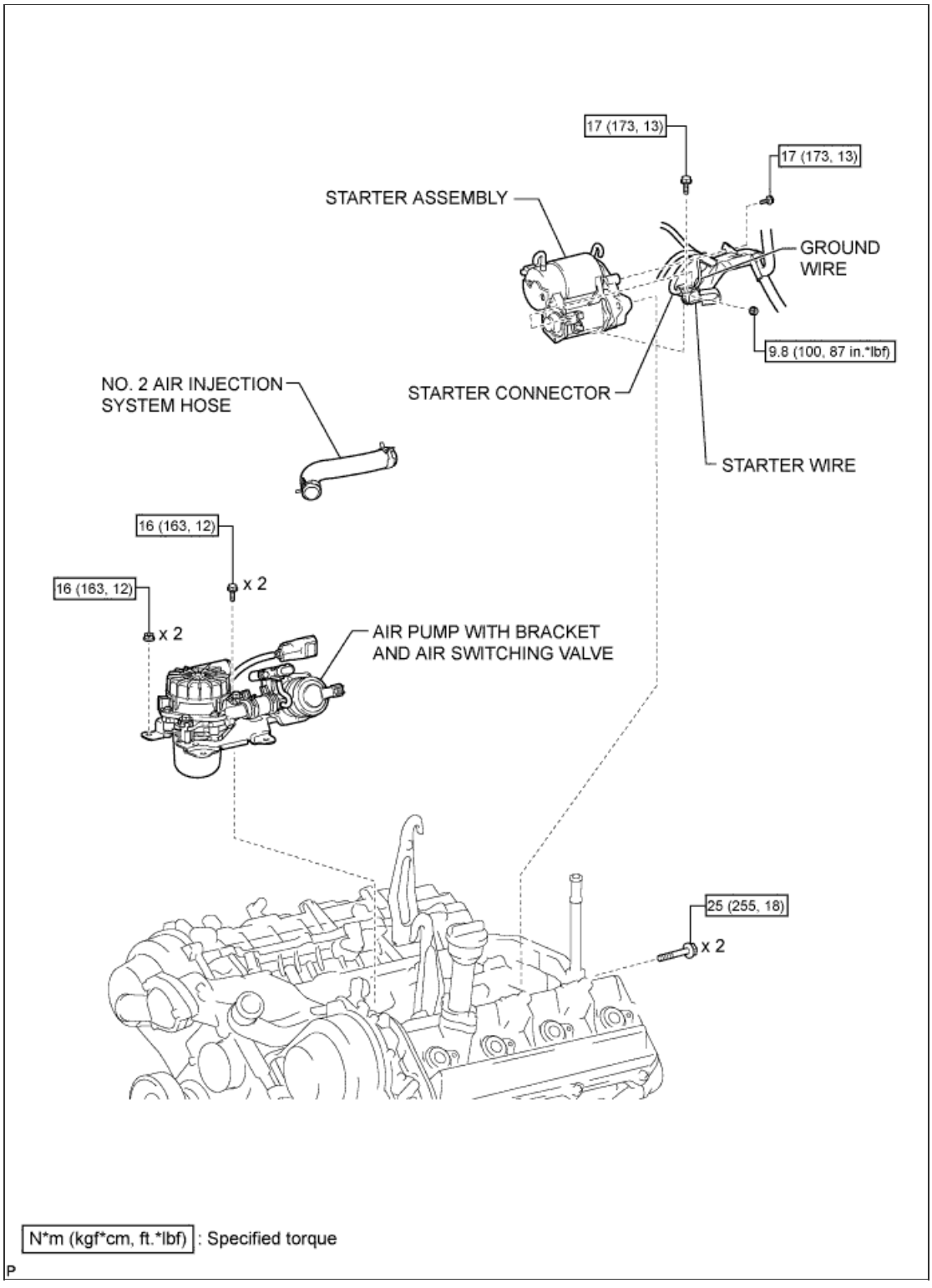
w/ Secondary Air Injection System:

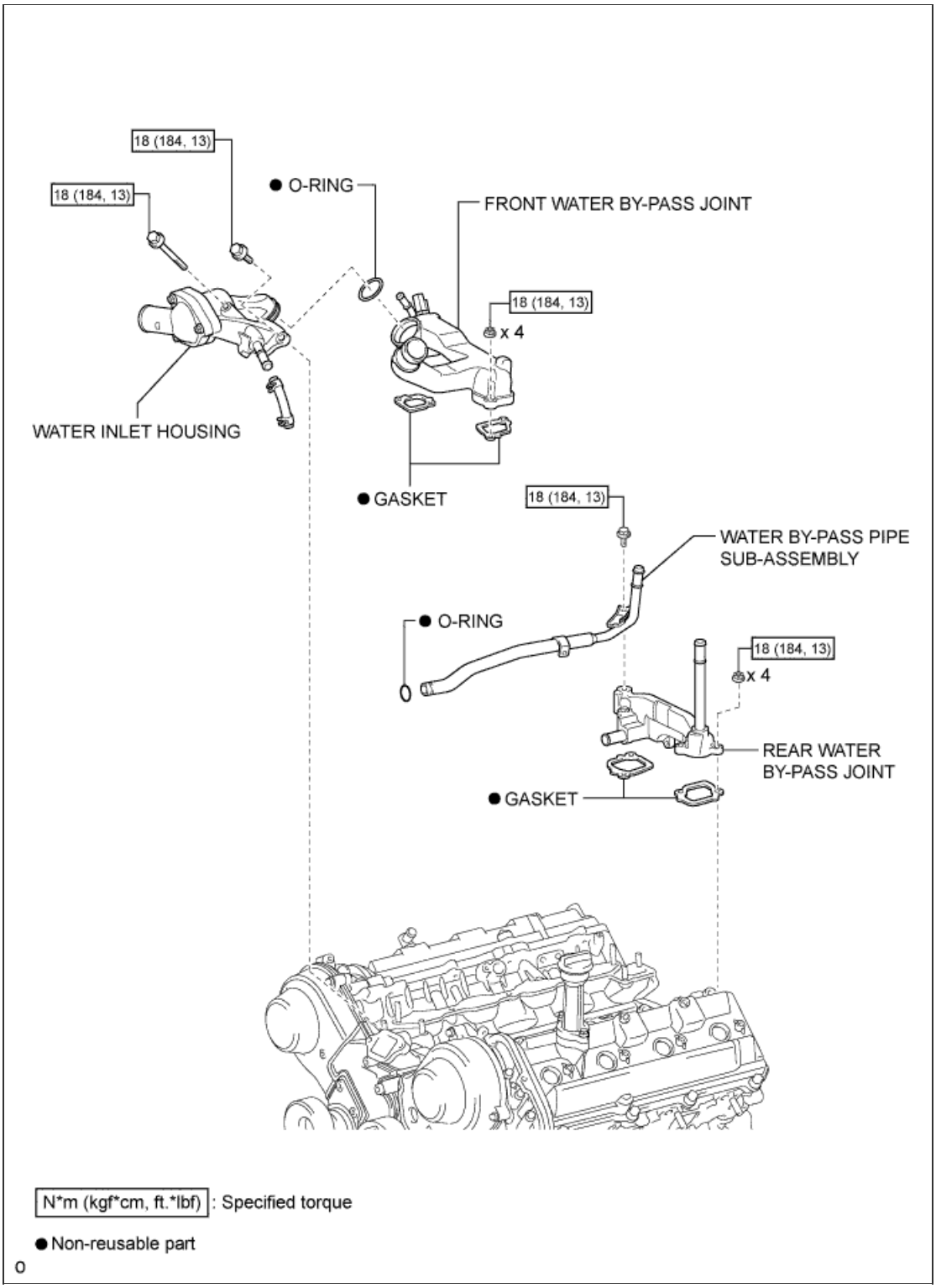


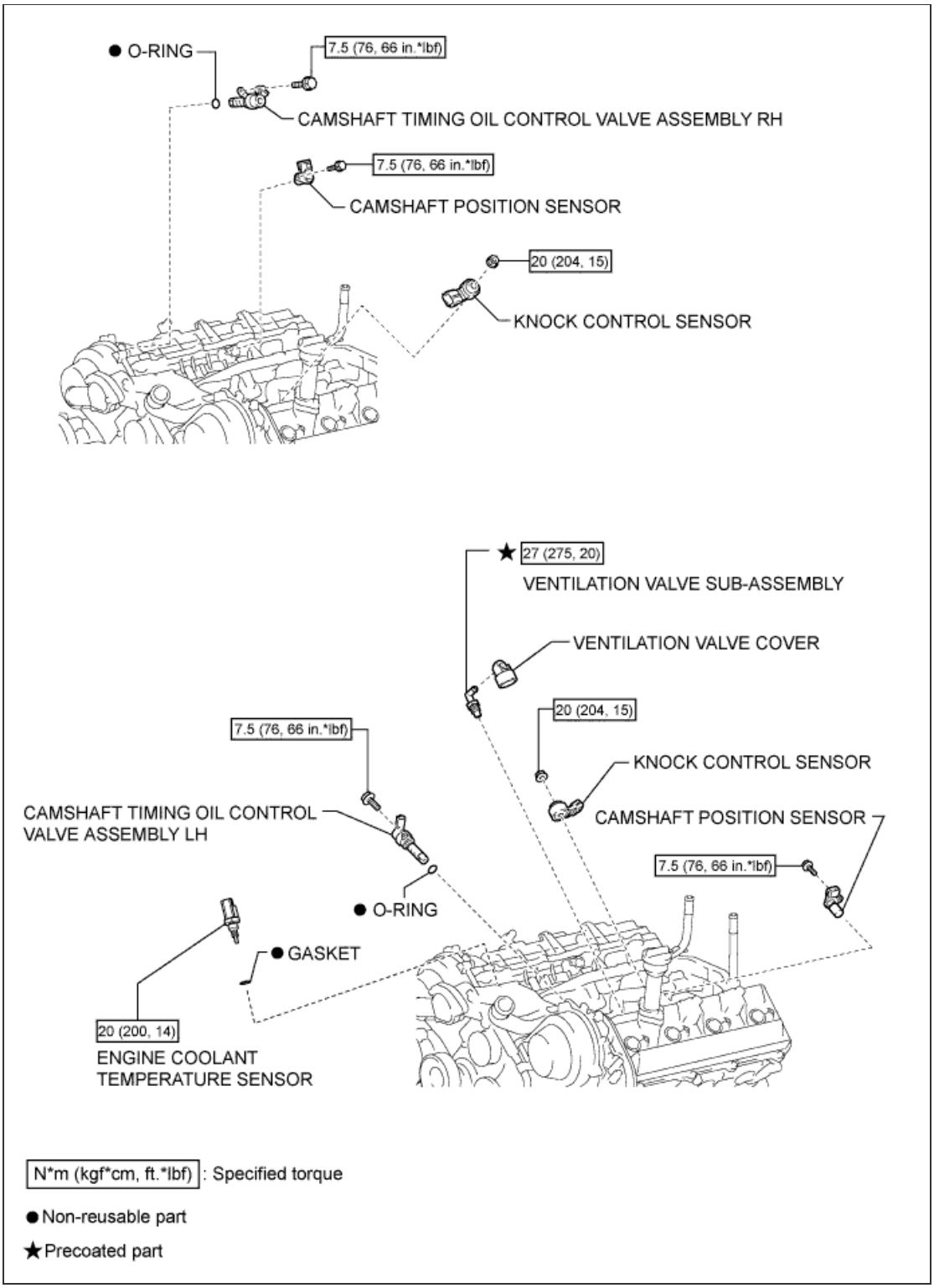


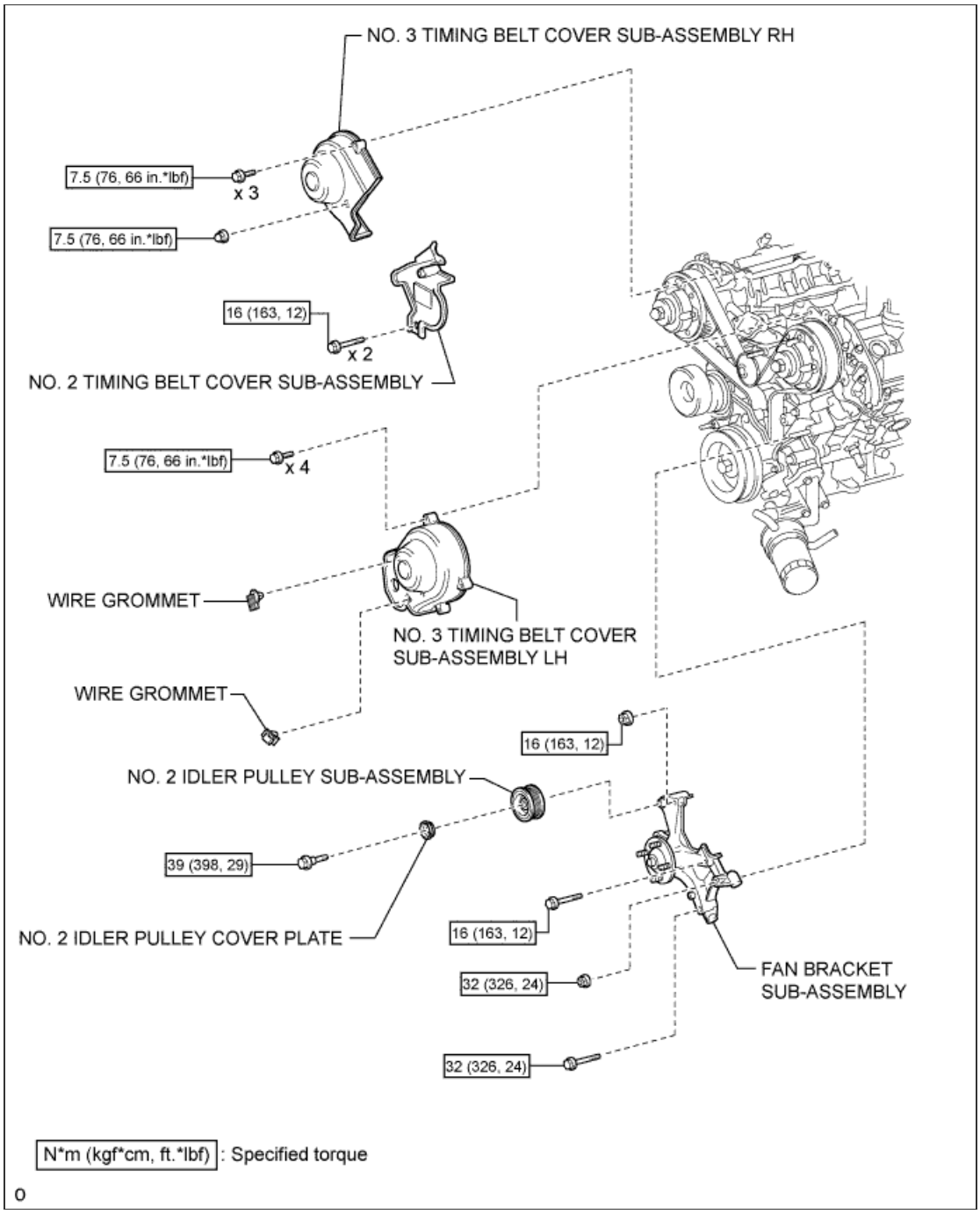
10 (102, 7) : Specified torque

● Non-reusable part

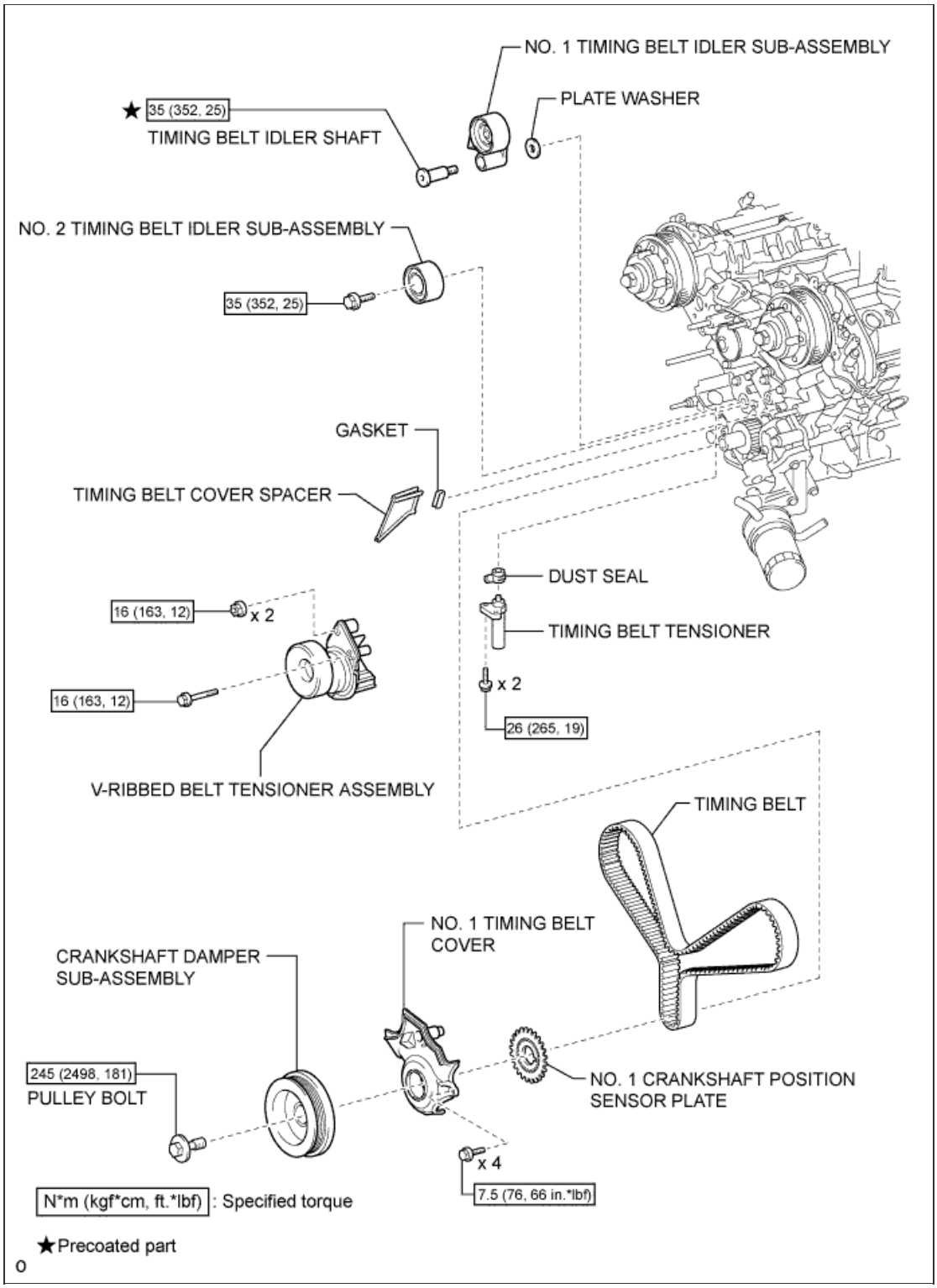

17 (173, 13)
17 (173, 13)
STARTER ASSEMBLY
GROUND WIRE
9.8 (100, 87 in.*lbf)
NO. 2 AIR INJECTION SYSTEM HOSE
STARTER CONNECTOR
STARTER WIRE
16 (163, 12)
x 2
16 (163, 12)
x 2
AIR PUMP WITH BRACKET AND AIR SWITCHING VALVE
25 (255, 18)
x 2
N*m (kgf*cm, ft.*lbf) : Specified torque
P

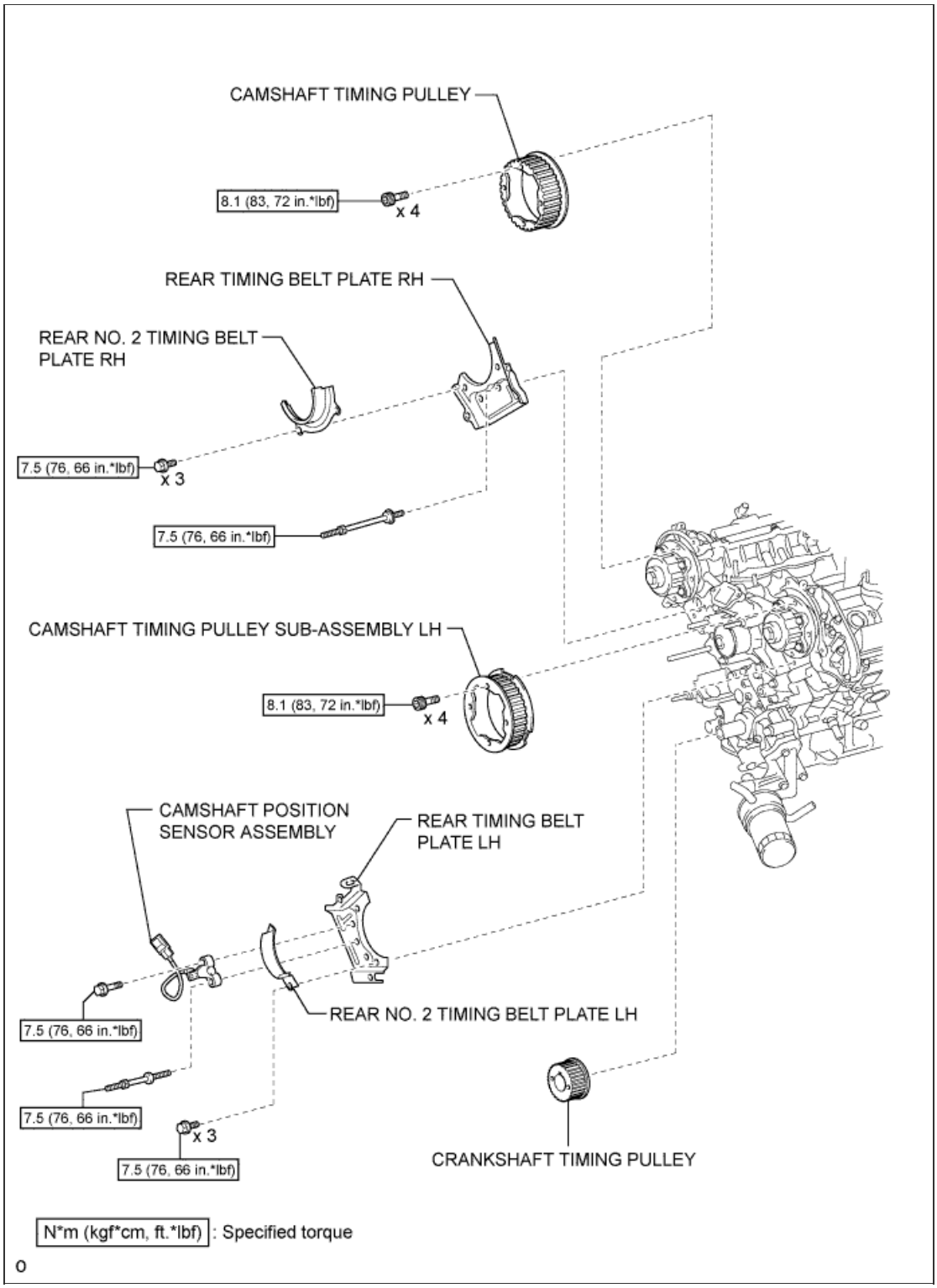

18 (184, 13)
18 (184, 13)
● O-RING
FRONT WATER BY-PASS JOINT
18 (184, 13)
x 4
WATER INLET HOUSING
● GASKET
18 (184, 13)
WATER BY-PASS PIPE
SUB-ASSEMBLY
● O-RING
18 (184, 13)
x 4
REAR WATER
BY-PASS JOINT
● GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
o

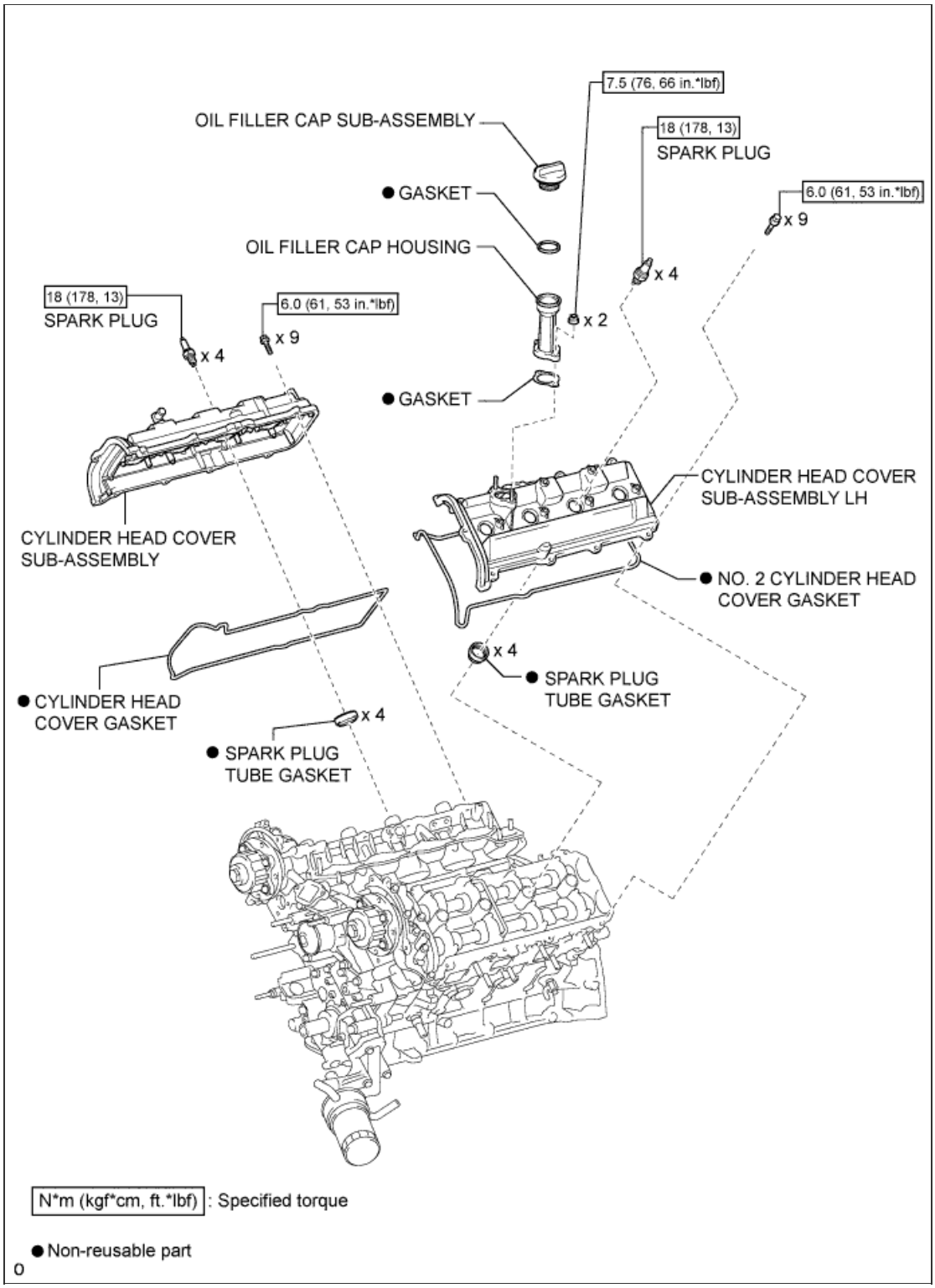

● O-RING
7.5 (76, 66 in.*lbf)
CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY RH
7.5 (76, 66 in.*lbf)
CAMSHAFT POSITION SENSOR
20 (204, 15)
KNOCK CONTROL SENSOR
★ 27 (275, 20)
VENTILATION VALVE SUB-ASSEMBLY
VENTILATION VALVE COVER
20 (204, 15)
KNOCK CONTROL SENSOR
7.5 (76, 66 in.*lbf)
CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY LH
CAMSHAFT POSITION SENSOR
7.5 (76, 66 in.*lbf)
● O-RING
● GASKET
20 (200, 14)
ENGINE COOLANT TEMPERATURE SENSOR
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
★ Precoated part

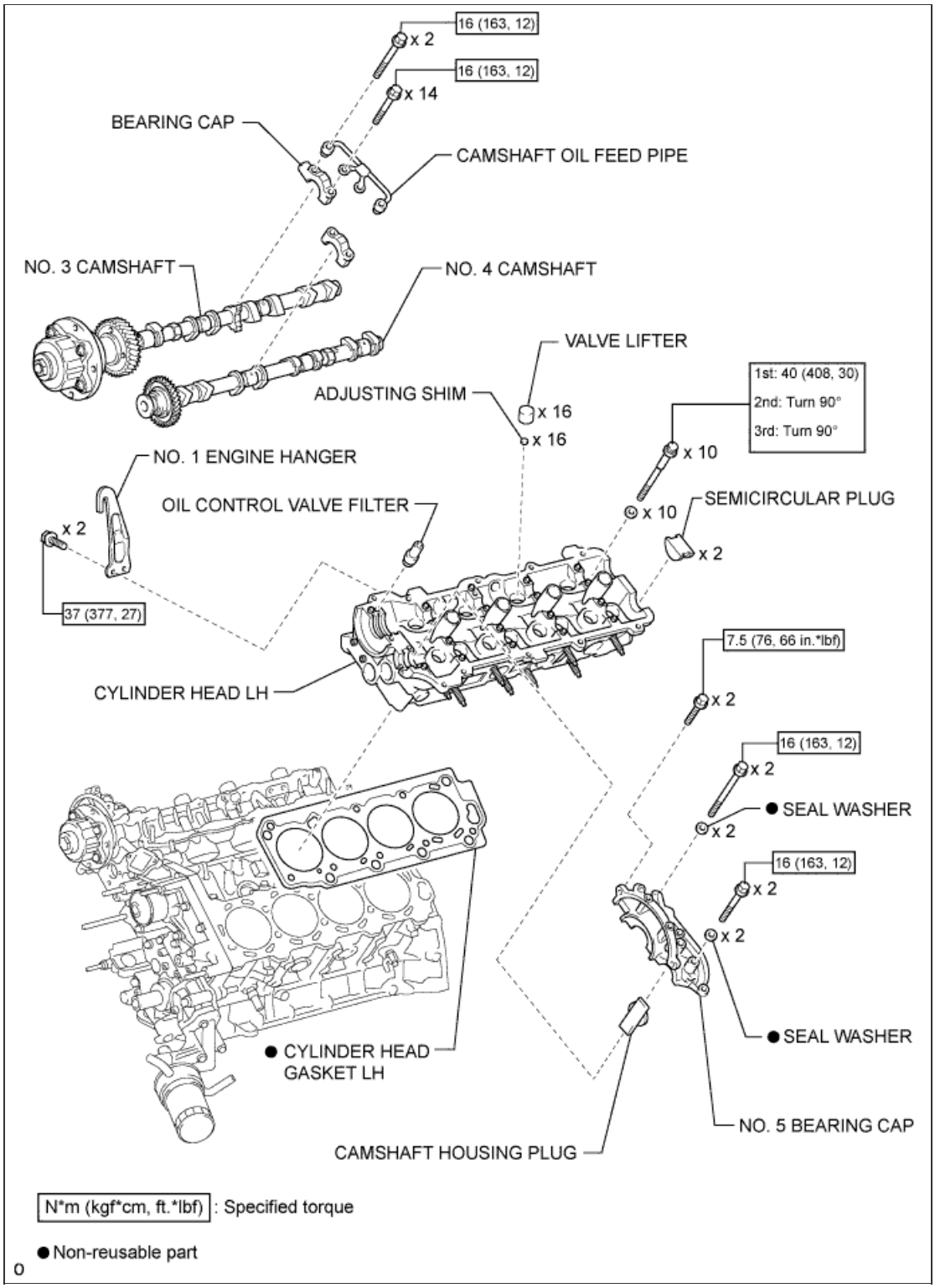

NO. 3 TIMING BELT COVER SUB-ASSEMBLY RH
7.5 (76, 66 in.*lbf)
x 3
7.5 (76, 66 in.*lbf)
16 (163, 12)
x 2
NO. 2 TIMING BELT COVER SUB-ASSEMBLY
7.5 (76, 66 in.*lbf)
x 4
WIRE GROMMET
NO. 3 TIMING BELT COVER SUB-ASSEMBLY LH
WIRE GROMMET
16 (163, 12)
NO. 2 IDLER PULLEY SUB-ASSEMBLY
39 (398, 29)
NO. 2 IDLER PULLEY COVER PLATE
16 (163, 12)
32 (326, 24)
32 (326, 24)
FAN BRACKET SUB-ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque

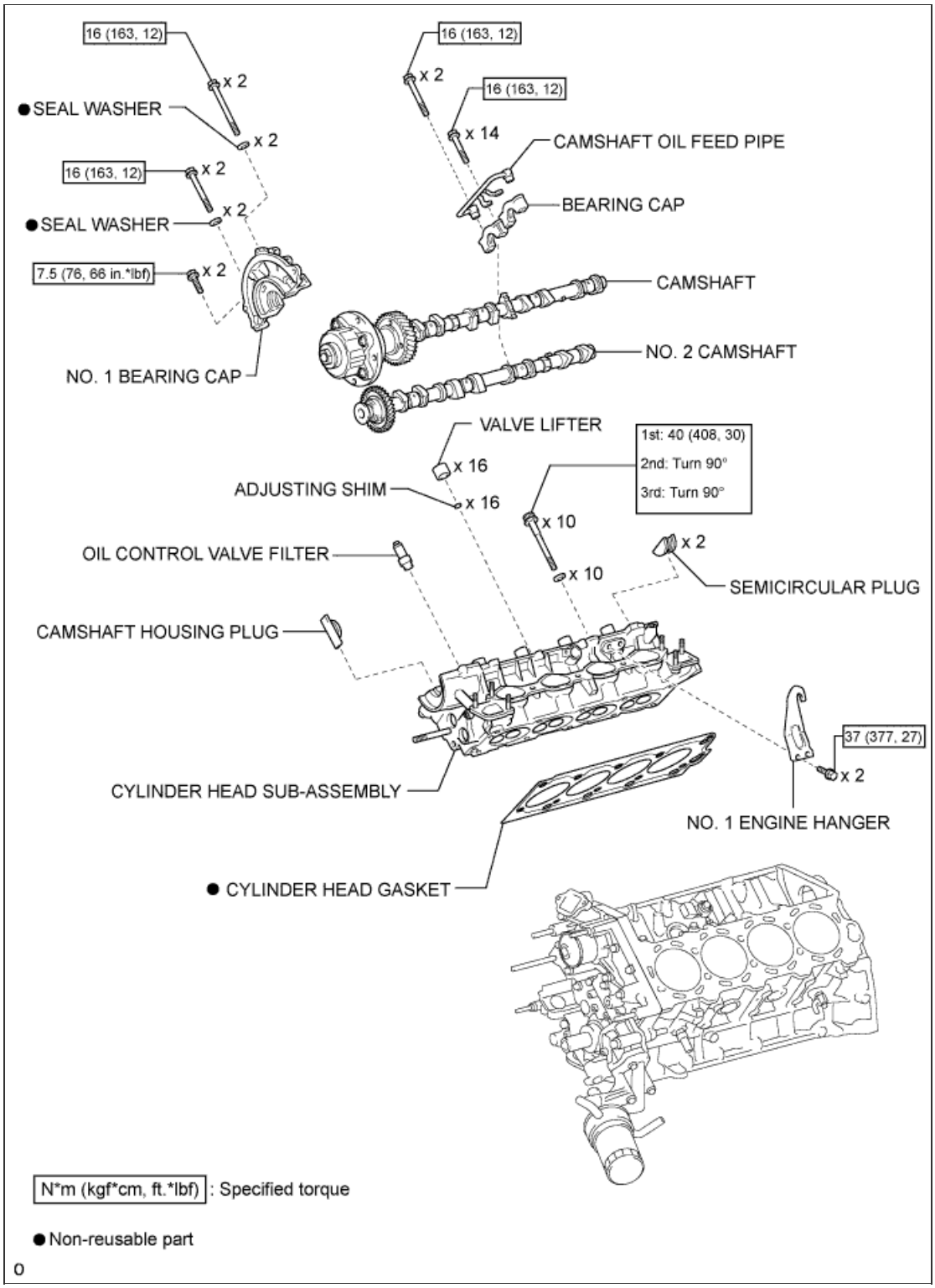
o


NO. 1 TIMING BELT IDLER SUB-ASSEMBLY
PLATE WASHER
★ 35 (352, 25)
TIMING BELT IDLER SHAFT
NO. 2 TIMING BELT IDLER SUB-ASSEMBLY
35 (352, 25)
GASKET
TIMING BELT COVER SPACER
DUST SEAL
TIMING BELT TENSIONER
x 2
26 (265, 19)
16 (163, 12)
x 2
16 (163, 12)
V-RIBBED BELT TENSIONER ASSEMBLY
TIMING BELT
NO. 1 TIMING BELT COVER
CRANKSHAFT DAMPER SUB-ASSEMBLY
245 (2498, 181)
PULLEY BOLT
NO. 1 CRANKSHAFT POSITION SENSOR PLATE
x 4
7.5 (76, 66 in.*lbf)
N*m (kgf*cm, ft.*lbf) : Specified torque
★ Precoated part

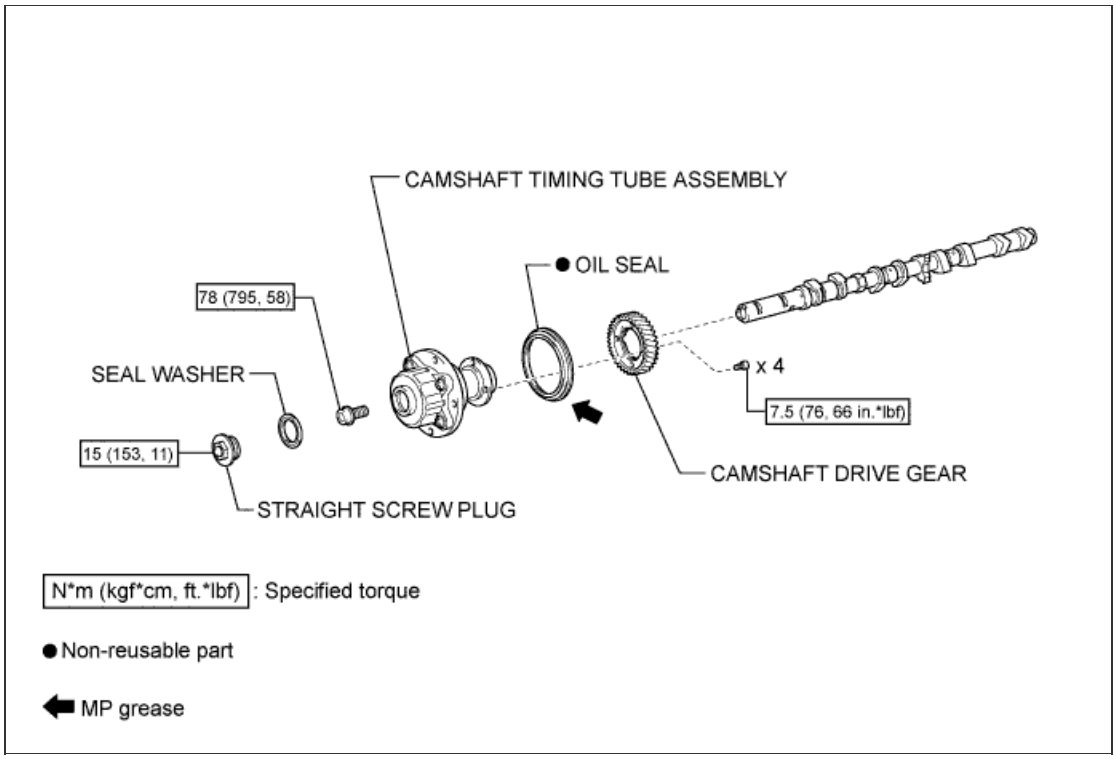

CAMSHAFT TIMING PULLEY
8.1 (83, 72 in.*lbf)
x 4
REAR TIMING BELT PLATE RH
REAR NO. 2 TIMING BELT PLATE RH
7.5 (76, 66 in.*lbf)
x 3
7.5 (76, 66 in.*lbf)
CAMSHAFT TIMING PULLEY SUB-ASSEMBLY LH
8.1 (83, 72 in.*lbf)
x 4
CAMSHAFT POSITION SENSOR ASSEMBLY
REAR TIMING BELT PLATE LH
REAR NO. 2 TIMING BELT PLATE LH
7.5 (76, 66 in.*lbf)
7.5 (76, 66 in.*lbf)
x 3
7.5 (76, 66 in.*lbf)
CRANKSHAFT TIMING PULLEY
N*m (kgf*cm, ft.*lbf) : Specified torque
o

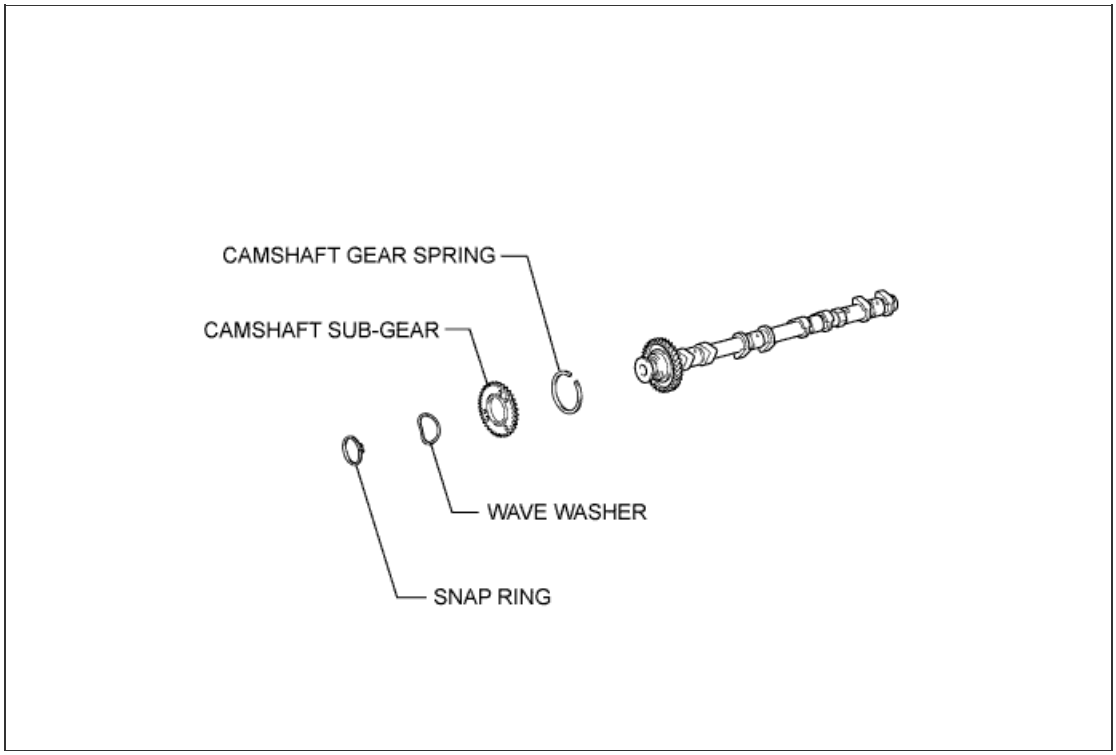

OIL FILLER CAP SUB-ASSEMBLY
7.5 (76, 66 in.*lbf)
18 (178, 13)
SPARK PLUG
● GASKET
6.0 (61, 53 in.*lbf)
x 9
OIL FILLER CAP HOUSING
x 4
18 (178, 13)
SPARK PLUG
6.0 (61, 53 in.*lbf)
x 4
x 9
x 2
● GASKET
CYLINDER HEAD COVER SUB-ASSEMBLY LH
CYLINDER HEAD COVER SUB-ASSEMBLY
● NO. 2 CYLINDER HEAD COVER GASKET
x 4
● SPARK PLUG TUBE GASKET
● CYLINDER HEAD COVER GASKET
x 4
● SPARK PLUG TUBE GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part

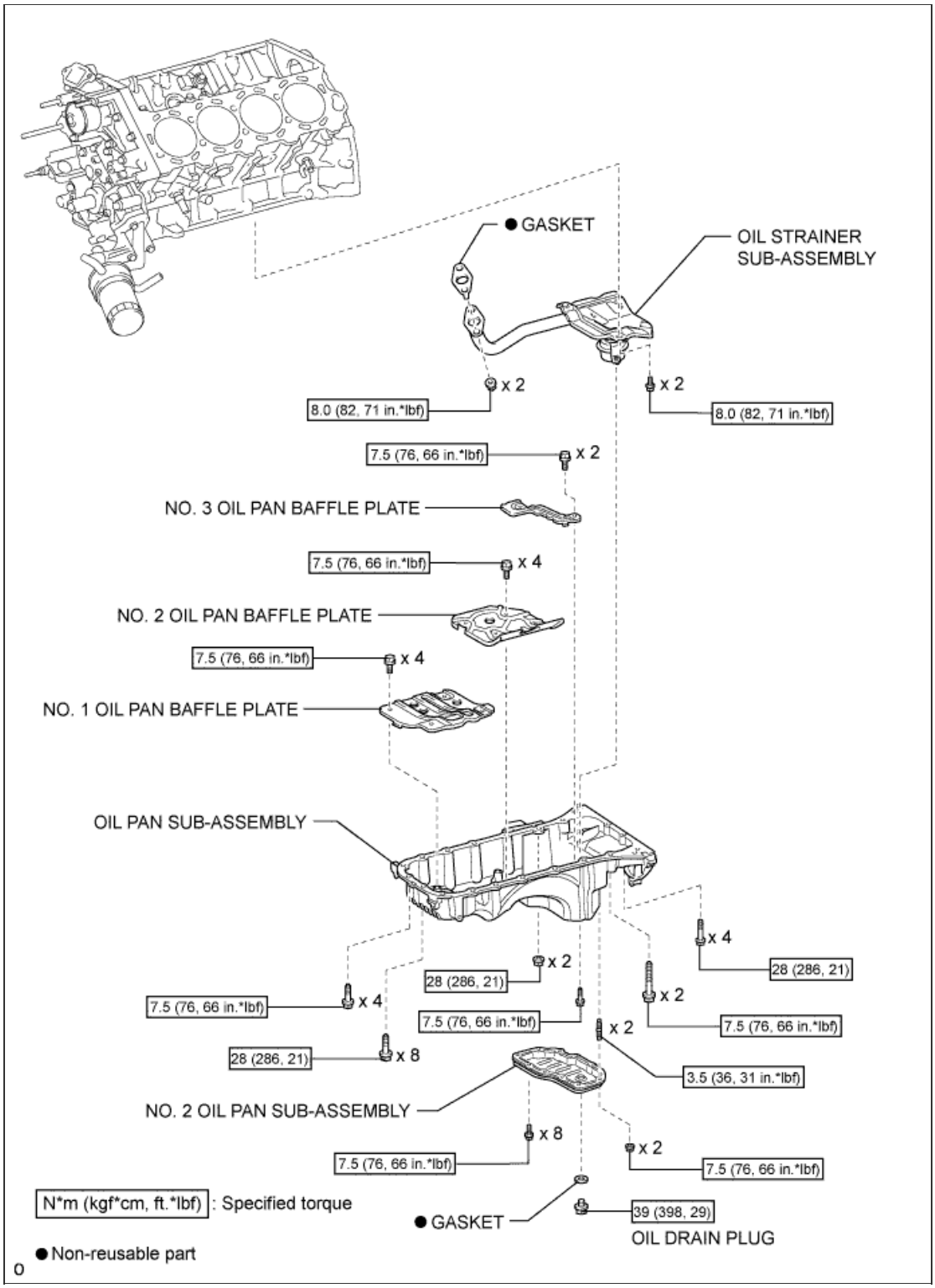

16 (163, 12)
x 2
16 (163, 12)
x 14
BEARING CAP
CAMSHAFT OIL FEED PIPE
NO. 3 CAMSHAFT
NO. 4 CAMSHAFT
VALVE LIFTER
ADJUSTING SHIM
x 16
x 16
1st: 40 (408, 30)
2nd: Turn 90°
3rd: Turn 90°
x 10
NO. 1 ENGINE HANGER
OIL CONTROL VALVE FILTER
x 10
SEMICIRCULAR PLUG
x 2
x 2
37 (377, 27)
7.5 (76, 66 in.*lbf)
CYLINDER HEAD LH
x 2
16 (163, 12)
x 2
● SEAL WASHER
x 2
16 (163, 12)
x 2
x 2
● SEAL WASHER
● CYLINDER HEAD GASKET LH
NO. 5 BEARING CAP
CAMSHAFT HOUSING PLUG
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part

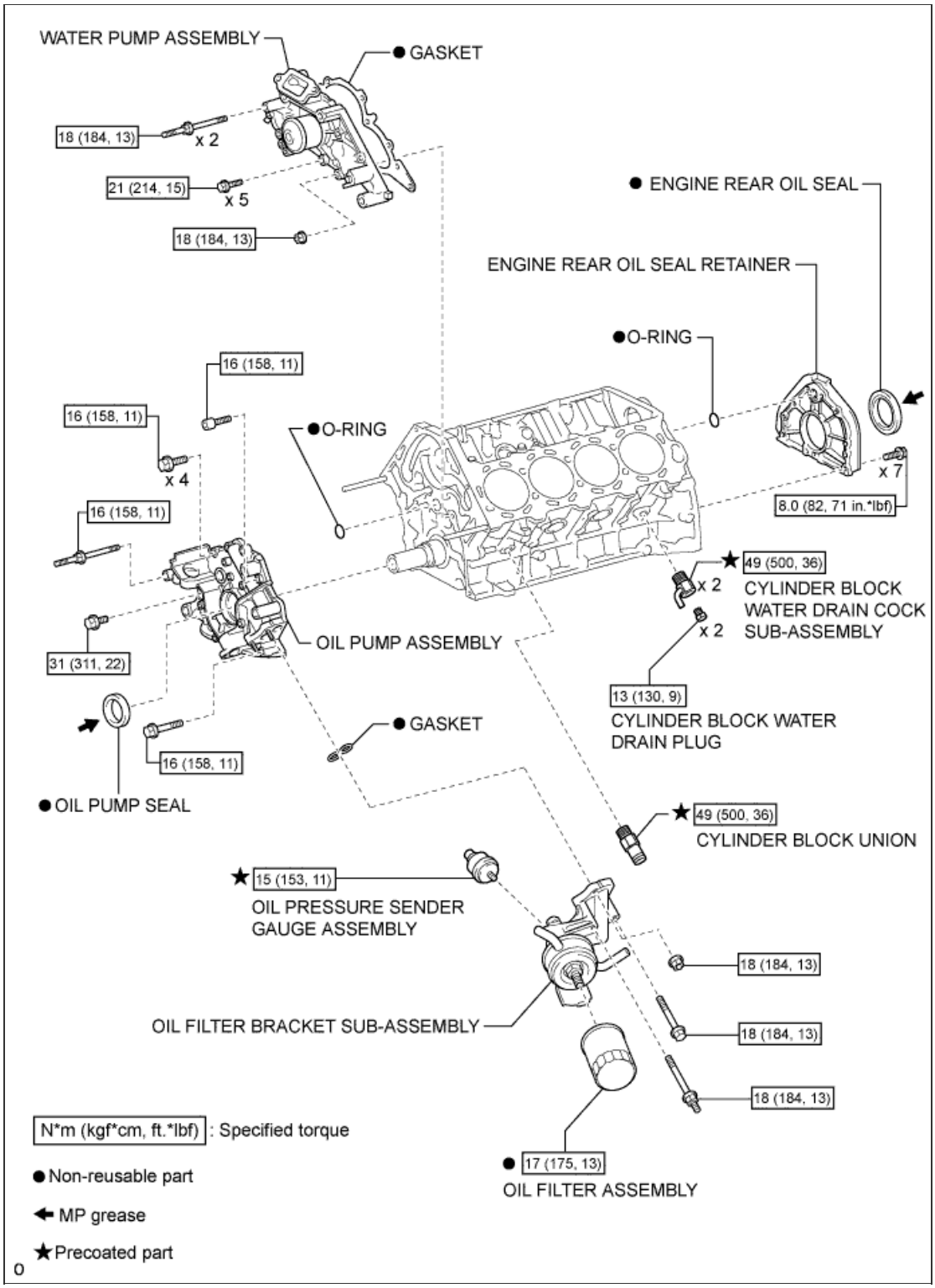

16 (163, 12)
x 2
● SEAL WASHER
x 2
16 (163, 12)
x 2
● SEAL WASHER
x 2
7.5 (76, 66 in.*lbf)
x 2
NO. 1 BEARING CAP
16 (163, 12)
x 2
16 (163, 12)
x 14
CAMSHAFT OIL FEED PIPE
BEARING CAP
CAMSHAFT
NO. 2 CAMSHAFT
VALVE LIFTER
x 16
ADJUSTING SHIM
x 16
1st: 40 (408, 30)
2nd: Turn 90°
3rd: Turn 90°
x 10
x 10
x 2
SEMICIRCULAR PLUG
OIL CONTROL VALVE FILTER
CAMSHAFT HOUSING PLUG
37 (377, 27)
x 2
NO. 1 ENGINE HANGER
CYLINDER HEAD SUB-ASSEMBLY
● CYLINDER HEAD GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part

0


CAMSHAFT TIMING TUBE ASSEMBLY
● OIL SEAL
78 (795, 58)
SEAL WASHER
x 4
7.5 (76, 66 in.*lbf)
15 (153, 11)
CAMSHAFT DRIVE GEAR
STRAIGHT SCREW PLUG
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
MP grease


CAMSHAFT GEAR SPRING
CAMSHAFT SUB-GEAR
WAVE WASHER
SNAP RING


● GASKET
OIL STRAINER SUB-ASSEMBLY
x 2
8.0 (82, 71 in.*lbf)
x 2
8.0 (82, 71 in.*lbf)
7.5 (76, 66 in.*lbf)
x 2
NO. 3 OIL PAN BAFFLE PLATE
7.5 (76, 66 in.*lbf)
x 4
NO. 2 OIL PAN BAFFLE PLATE
7.5 (76, 66 in.*lbf)
x 4
NO. 1 OIL PAN BAFFLE PLATE
OIL PAN SUB-ASSEMBLY
x 4
28 (286, 21)
x 2
28 (286, 21)
x 2
7.5 (76, 66 in.*lbf)
x 4
7.5 (76, 66 in.*lbf)
x 2
7.5 (76, 66 in.*lbf)
x 2
28 (286, 21)
x 8
3.5 (36, 31 in.*lbf)
NO. 2 OIL PAN SUB-ASSEMBLY
x 8
7.5 (76, 66 in.*lbf)
x 2
7.5 (76, 66 in.*lbf)
N*m (kgf*cm, ft.*lbf) : Specified torque
● GASKET
39 (398, 29)
OIL DRAIN PLUG
● Non-reusable part


WATER PUMP ASSEMBLY
GASKET
18 (184, 13)
x 2
21 (214, 15)
x 5
18 (184, 13)
ENGINE REAR OIL SEAL
ENGINE REAR OIL SEAL RETAINER
O-RING
16 (158, 11)
16 (158, 11)
x 4
O-RING
16 (158, 11)
x 7
8.0 (82, 71 in.*lbf)
49 (500, 36)
x 2
CYLINDER BLOCK WATER DRAIN COCK SUB-ASSEMBLY
x 2
OIL PUMP ASSEMBLY
31 (311, 22)
13 (130, 9)
CYLINDER BLOCK WATER DRAIN PLUG
GASKET
16 (158, 11)
OIL PUMP SEAL
49 (500, 36)
CYLINDER BLOCK UNION
15 (153, 11)
OIL PRESSURE SENDER GAUGE ASSEMBLY
18 (184, 13)
OIL FILTER BRACKET SUB-ASSEMBLY
18 (184, 13)
18 (184, 13)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
MP grease
Precoated part
17 (175, 13)
OIL FILTER ASSEMBLY

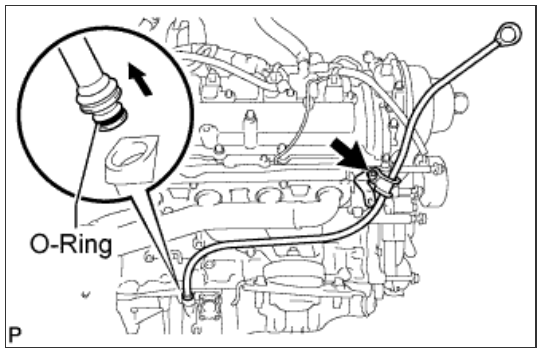
for Preparation Click here

1. REMOVE ENGINE OIL LEVEL DIPSTICK GUIDE

a. Remove the dipstick.

b. Remove the bolt and dipstick guide.

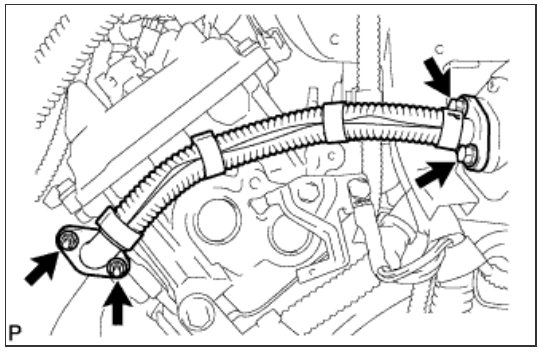
c. Remove the O-ring from the dipstick guide.



2. REMOVE NO. 3 AIR TUBE (w/ Secondary Air Injection System)

a. Remove the 2 bolts, 2 nuts and No. 3 air tube.

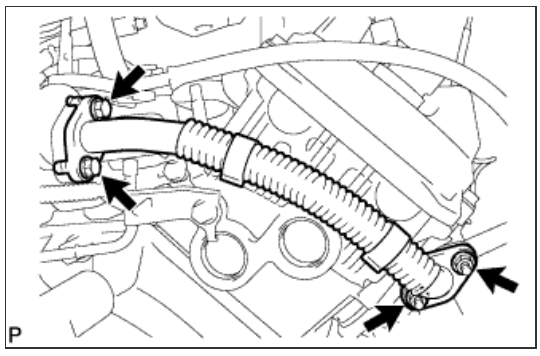
b. Remove the 2 gaskets.



3. REMOVE AIR TUBE SUB-ASSEMBLY R (w/ Secondary Air Injection System)

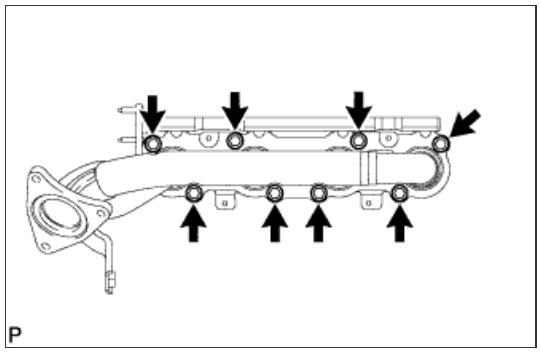
a. Remove the 2 bolts, 2 nuts and air tube sub-assembly.

b. Remove the 2 gaskets.

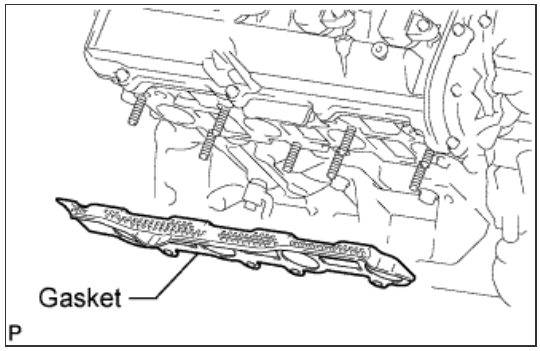


4. REMOVE E UST MANIFOLD SUB-ASSEMBLY R (w/ Secondary Air Injection System)

a. Remove the 8 nuts and exhaust manifold.

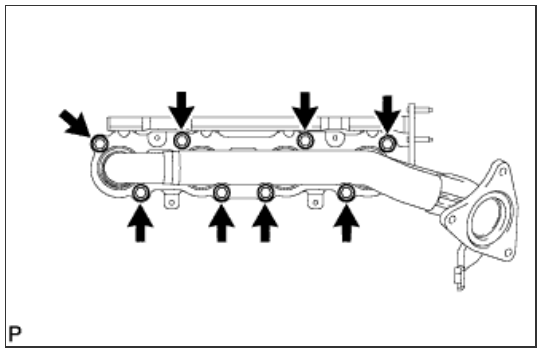


b. Remove the gasket from the cylinder head RH.

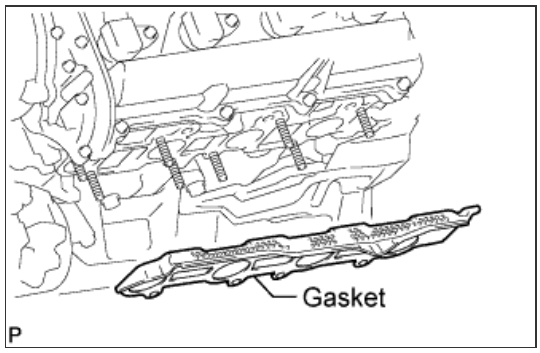


5. REMOVE E UST MANIFOLD SUB-ASSEMBLY L (w/ Secondary Air Injection System)

a. Remove the 8 nuts and exhaust manifold.

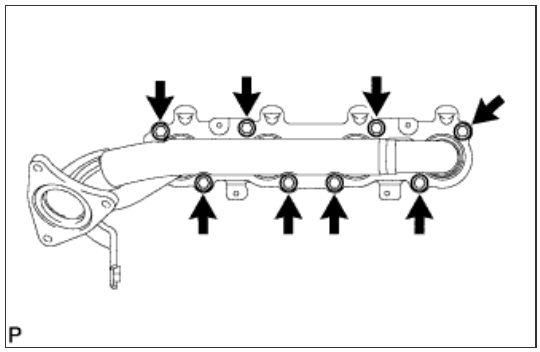


b. Remove the gasket from the cylinder head LH.

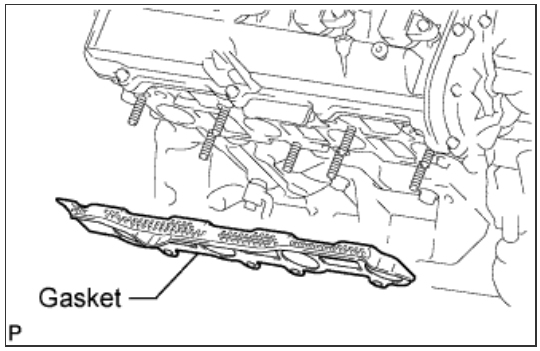


6. REMOVE E UST MANIFOLD SUB-ASSEMBLY R (w/o Secondary Air Injection System)

a. Remove the 8 nuts and exhaust manifold.

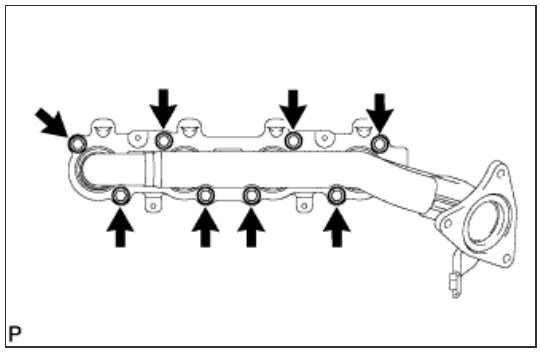


b. Remove the gasket from the cylinder head RH.

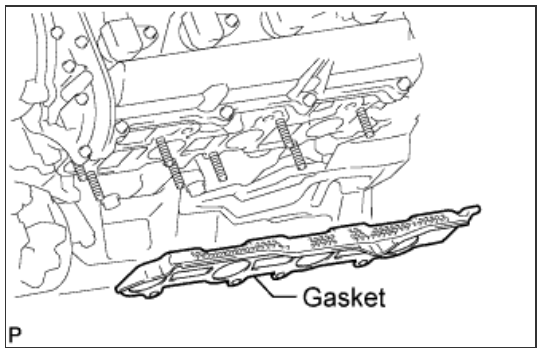


7. REMOVE E UST MANIFOLD SUB-ASSEMBLY L (w/o Secondary Air Injection System)

a. Remove the 8 nuts and exhaust manifold.

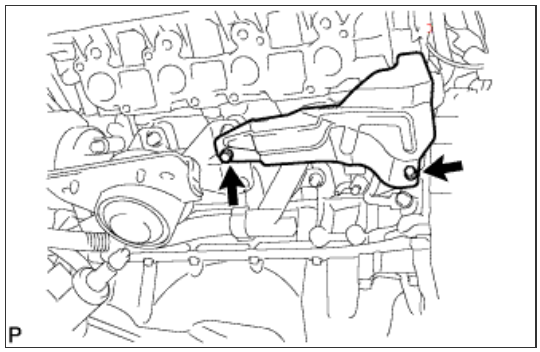


b. Remove the gasket from the cylinder head LH.



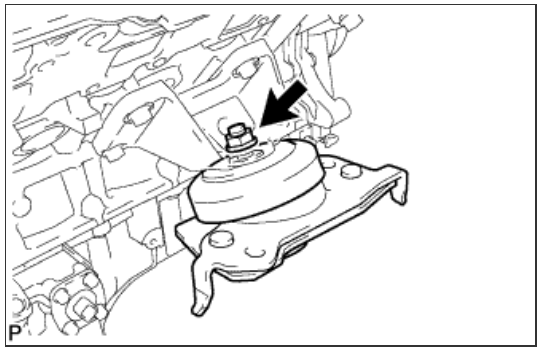
8. REMOVE NO. 2 IRING ARNESS EAT INSULATOR

a. Remove the 2 bolts and No. 2 wiring harness heat insulator.



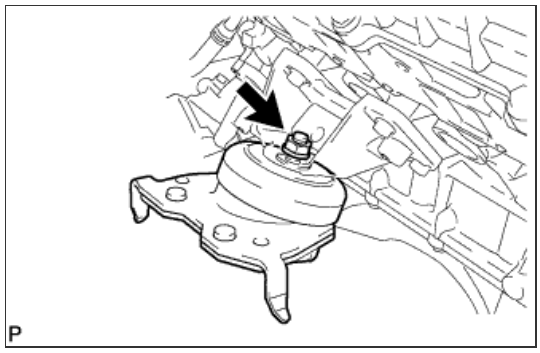
9. REMOVE FRONT ENGINE MOUNTING INSULATOR

a. Remove the nut and engine mounting insulator.



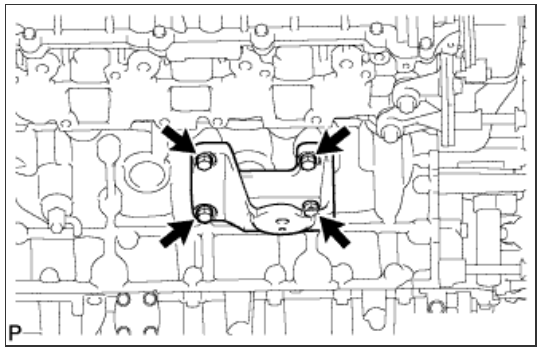
10. REMOVE FRONT ENGINE MOUNTING INSULATOR L

a. Remove the nut and engine mounting insulator LH.



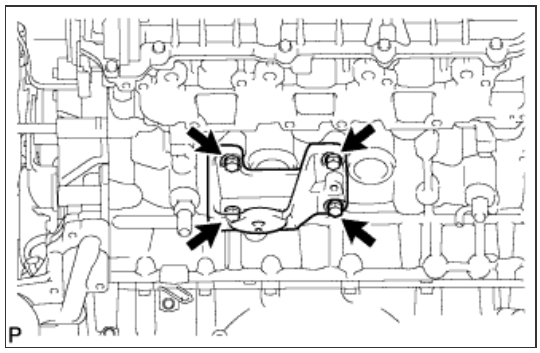
11. REMOVE FRONT NO. 1 ENGINE MOUNTING BRACKET R

a. Remove the 4 bolts and No. 1 engine mounting bracket RH.



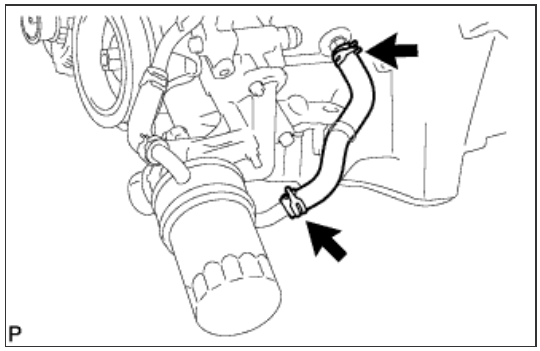
12. REMOVE FRONT NO. 1 ENGINE MOUNTING BRACKET L

a. Remove the 4 bolts and No. 1 engine mounting bracket LH.



13. REMOVE OIL COOLER OSE

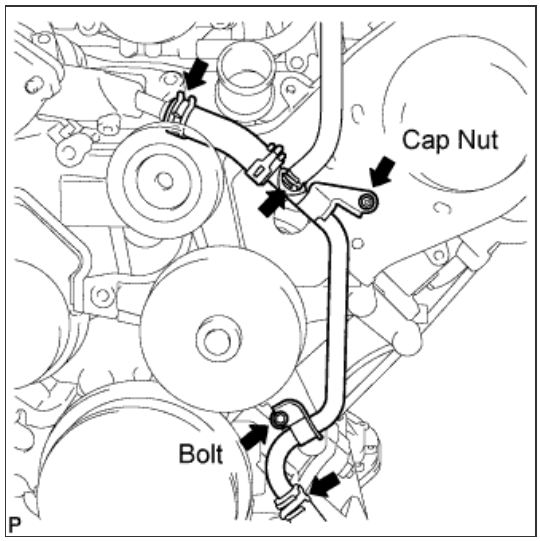
a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to remove the oil cooler hose.



14. REMOVE OIL COOLER PIPE

a. Remove the cap nut and bolt.

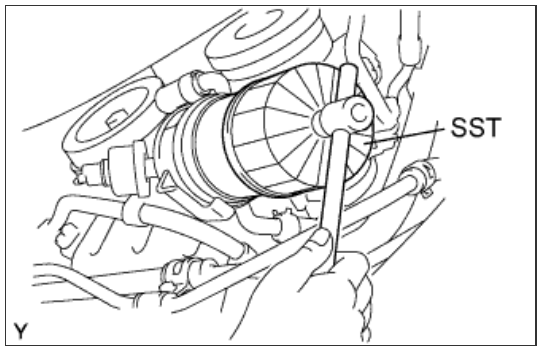
b. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to disconnect the 3 water by-pass hoses and remove the oil cooler pipe.



15. REMOVE OIL FILTER ASSEMBLY

a. Using SST, remove the oil filter.

SST
09228-07501



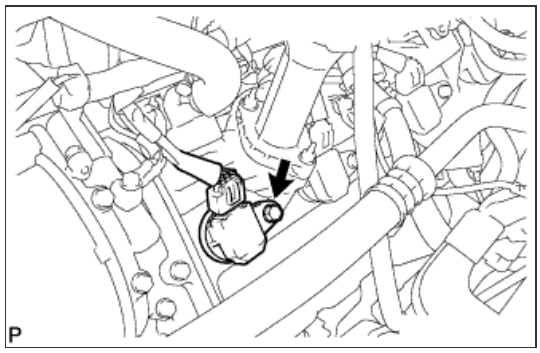
16. REMOVE INTAKE MANIFOLD

a. Remove the intake manifold (Click here).

17. REMOVE IGNITION COIL ASSEMBLY

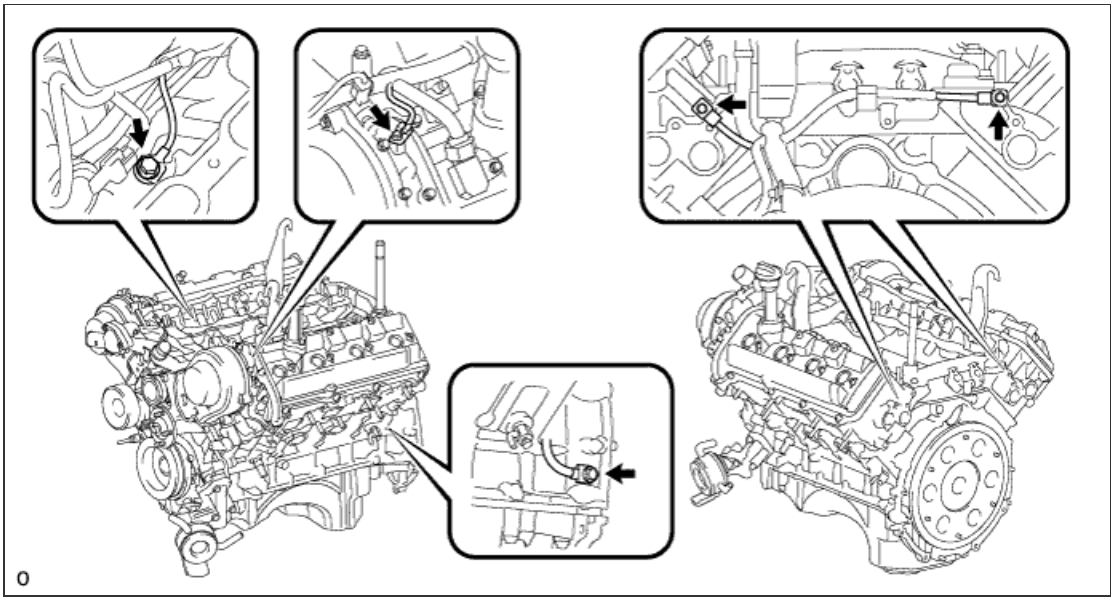
a. Disconnect the 8 ignition coil connectors.

b. Remove the 8 bolts and pull out the 8 ignition coils.



18. DISCONNECT ENGINE IRE

a. Remove the bolt and disconnect the ground wire from the No. 5 bearing cap.



b. Remove the bolt and disconnect the ground wire from the left side of the engine.

c. Remove the 2 bolts and disconnect the 2 ground wires from the cylinder head and cylinder head LH rear side.

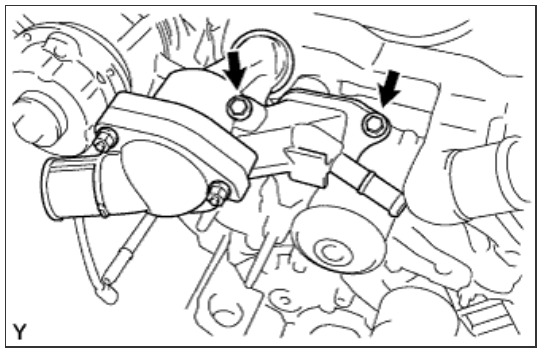
d. Remove the bolt and disconnect the ground wire from the inside left side of the V-bank.

19. REMOVE WATER INLET HOUSING

a. Remove the 2 bolts holding the water inlet housing to the water pump.

b. Disconnect the water inlet housing from the front water by-pass joint and water pump. Then remove the water inlet and inlet housing assembly.

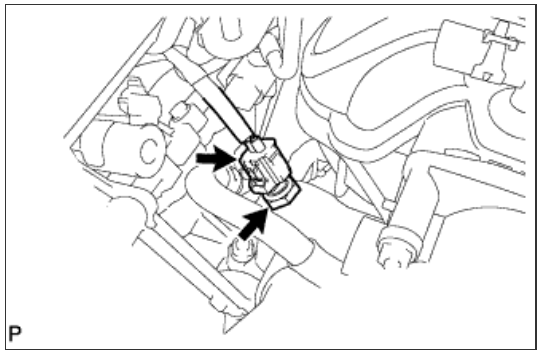
c. Remove the O-ring from the water inlet housing.



20. REMOVE ENGINE COOLANT TEMPERATURE SENSOR

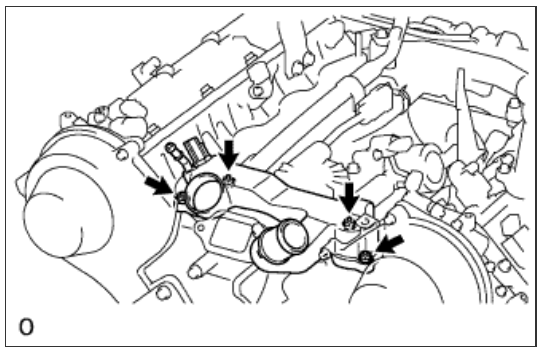
a. Disconnect the sensor connector.

b. Using a 19 mm deep socket wrench, remove the sensor and gasket.



21. REMOVE FRONT WATER BY-PASS JOINT

a. Remove the 4 nuts, front water by-pass joint and 2 gaskets.



22. REMOVE WATER BY-PASS PIPE SUB-ASSEMBLY

a. Disconnect the connector.

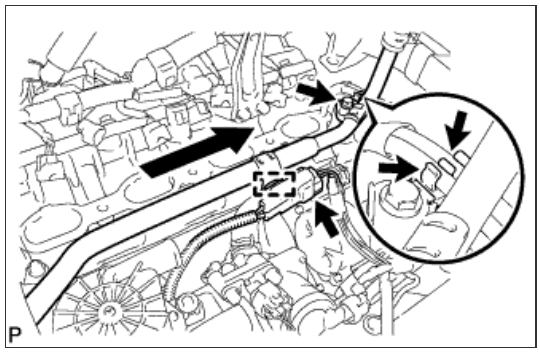
b. Disconnect the wire harness clamp from the water by-pass pipe.

c. Disconnect the 2 vacuum switching valve hoses from the water by-pass pipe clamp.

d. Remove the bolt.

e. Pull out the water by-pass pipe.

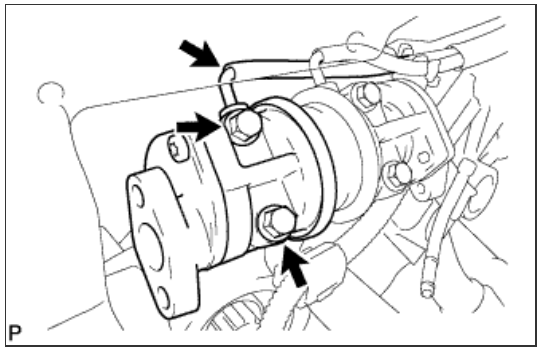
f. Remove the O-ring from the water by-pass pipe.



23. REMOVE NO. 2 AIR S ITC ING VALVE ASSEMBLY (w/ Secondary Air Injection System)

a. Remove the vacuum switching valve hose from the No. 2 air switching valve.

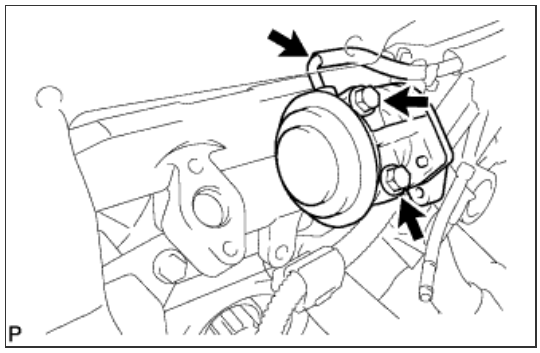
b. Remove the 2 bolts, gasket and No. 2 air switching valve from the rear water by-pass joint.



24. REMOVE NO. 1 AIR S ITC ING VALVE ASSEMBLY (w/ Secondary Air Injection System)

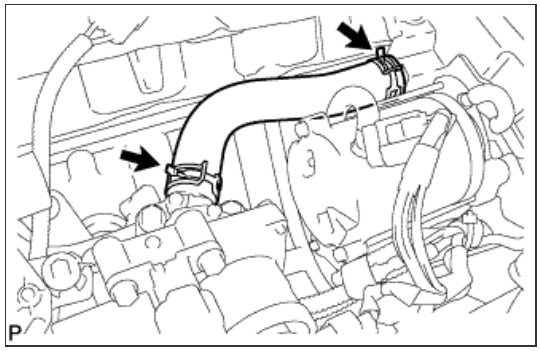
a. Remove the vacuum switching valve hose from the No. 1 air switching valve.

b. Remove the 2 bolts, gasket and No. 1 air switching valve from the rear water by-pass joint.



25. REMOVE NO. 2 AIR IN ECTION SYSTEM OSE (w/ Secondary Air Injection System)

a. Remove the No. 2 air injection system hose from the rear water by-pass joint and air switching valve.

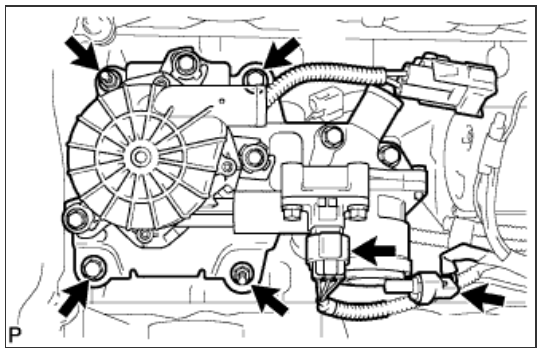


26. REMOVE AIR PUMP IT BRACKET AND AIR S ITC ING VALVE (w/ Secondary Air Injection System)

a. Disconnect the air switching valve connector.

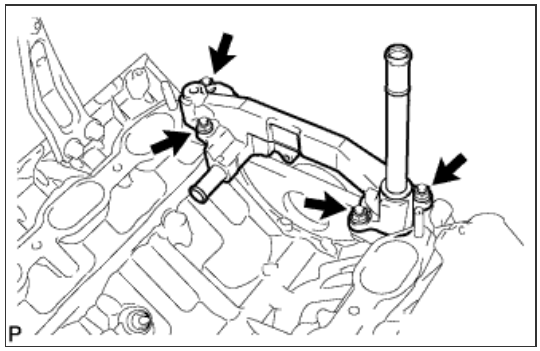
b. Disconnect the air pressure sensor connector.

c. Remove the 2 bolts, 2 nuts and air pump with bracket.



27. REMOVE REAR WATER BY-PASS JOINT

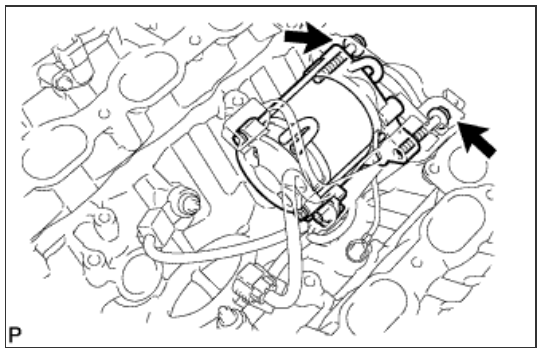
a. Remove the 4 nuts, water by-pass joint and 2 gaskets.



28. REMOVE STARTER ASSEMBLY

a. Remove the 2 bolts holding the starter to the cylinder block.

b. Disconnect the starter from the cylinder block.



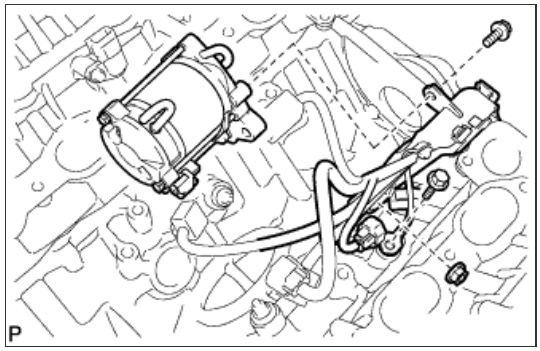
c. Remove the bolt and disconnect the engine wire protector from the starter.

d. Remove the bolt and disconnect the ground wire.

e. Disconnect the starter connector.

f. Remove the nut and disconnect the starter wire.

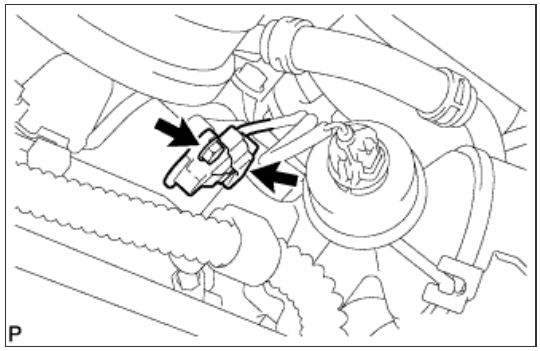
. Remove the starter.



29. REMOVE CRANKSHAFT POSITION SENSOR

a. Disconnect the sensor connector.

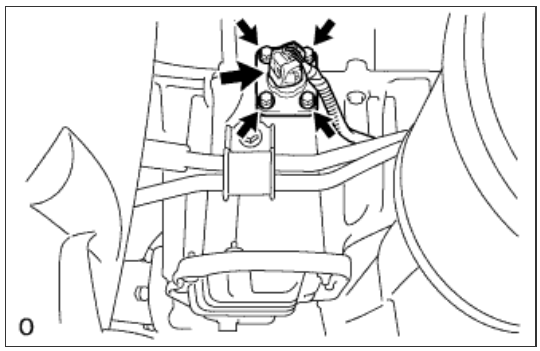
b. Remove the bolt and sensor.



30. REMOVE ENGINE OIL LEVEL SENSOR

a. Disconnect the oil level sensor connector.

b. Remove the 4 bolts and oil level sensor.

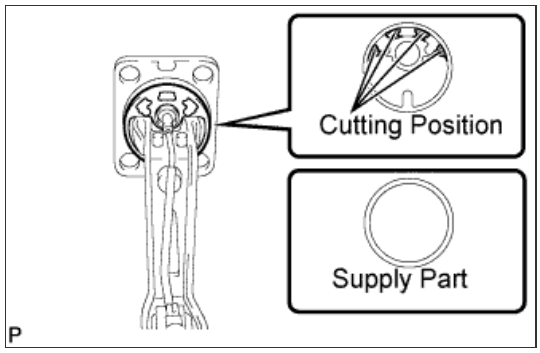


c. Cut off the gasket as shown in the illustration.

d. Remove the gasket from the oil level sensor.

INT

After cutting away the parts of the gasket shown in the illustration, remove only the outer part of the gasket.

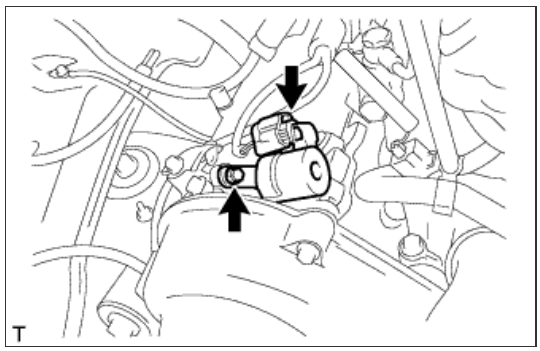


31. REMOVE CAMS AT TIMING OIL CONTROL VALVE ASSEMBLY R

a. Disconnect the oil control valve connector.

b. Remove the bolt and camshaft timing oil control valve.

c. Remove the O-ring from the camshaft timing oil control valve.

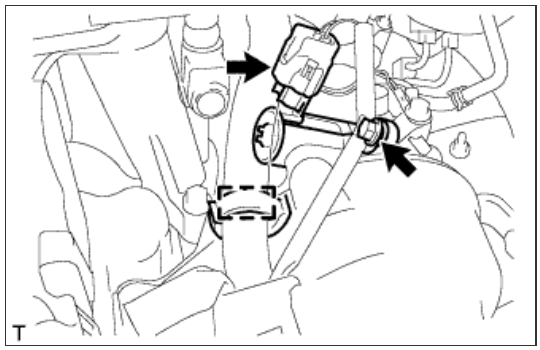


32. REMOVE CAMS AT TIMING OIL CONTROL VALVE ASSEMBLY L

a. Disconnect the oil control valve connector and wire harness clamp.

b. Remove the bolt and camshaft timing oil control valve.

c. Remove the O-ring from the camshaft timing oil control valve.

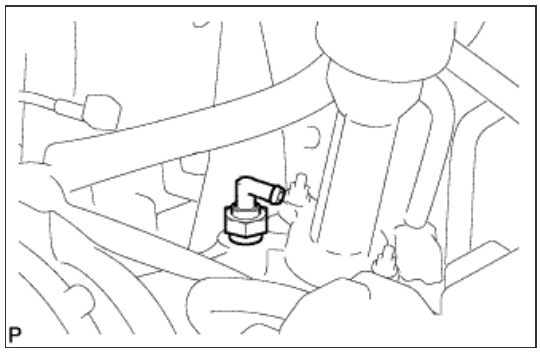


33. REMOVE VENTILATION VALVE COVER

a. Remove the ventilation valve cover from the ventilation valve.

34. REMOVE VENTILATION VALVE SUB-ASSEMBLY

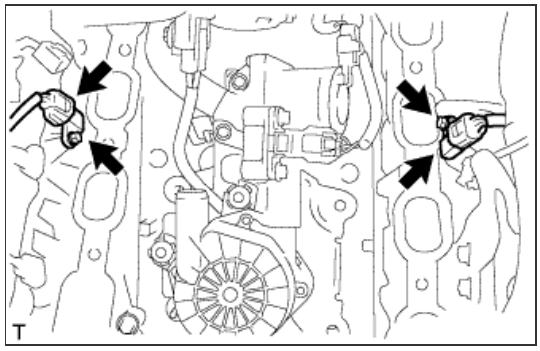
a. Remove the ventilation valve from the cylinder head cover sub-assembly LH.



35. REMOVE CAMS AT POSITION SENSOR

a. Disconnect the 2 sensor connectors.

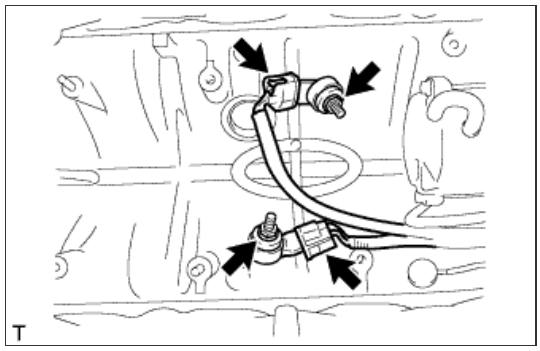
b. Remove the 2 bolts and 2 sensors.



36. REMOVE KNOCK CONTROL SENSOR

a. Disconnect the 2 sensor connectors.

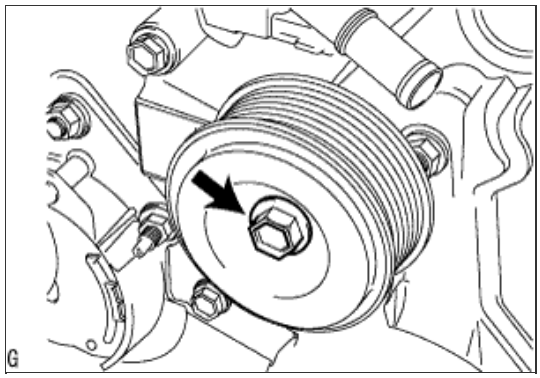
b. Remove the 2 nuts and 2 sensors.


T

for Preparation Click here

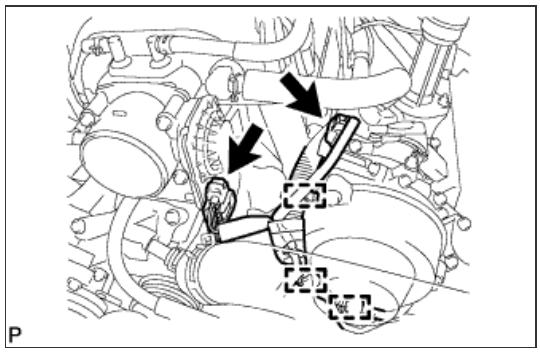
1. REMOVE NO. 2 IDLER PULLEY SUB-ASSEMBLY

a. Remove the pulley bolt, cover plate and idler pulley.



2. REMOVE NO. 3 TIMING BELT COVER SUB-ASSEMBLY LH

a. Detach the 3 wire clamps and disconnect the camshaft timing oil control valve connector and control motor connector.



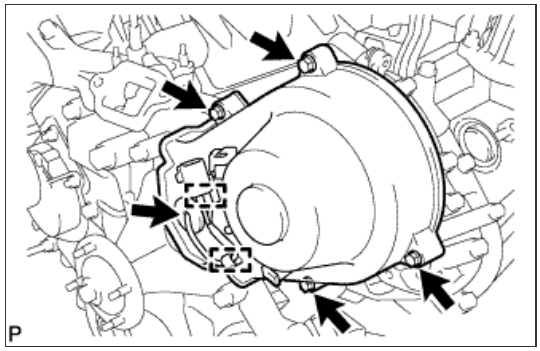
b. Disconnect the camshaft position sensor connector.

c. Disconnect the camshaft position sensor wire from the 2 wire clamps on the timing belt cover.

d. Remove the wire grommet from the timing belt cover.

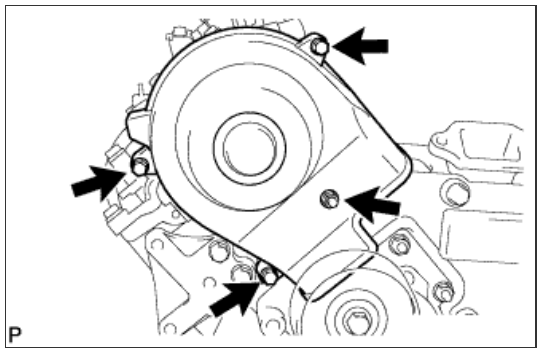
e. Remove the 4 bolts.

f. Pull the cover outward, pull the camshaft position sensor wire out of the cover, and remove the cover.



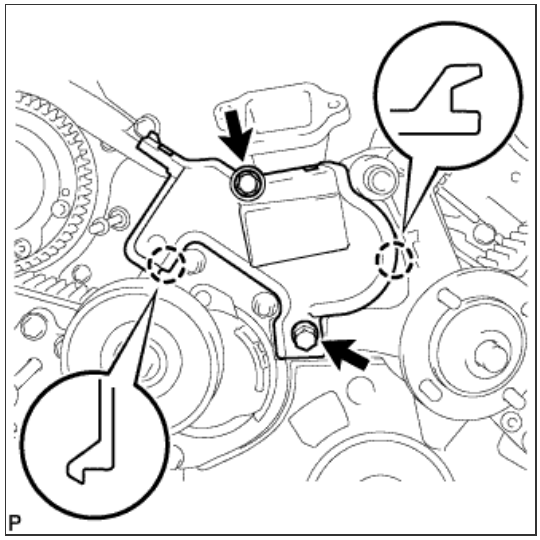
3. REMOVE NO. 3 TIMING BELT COVER SUB-ASSEMBLY RH

a. Remove the 3 bolts, nut and timing belt cover.



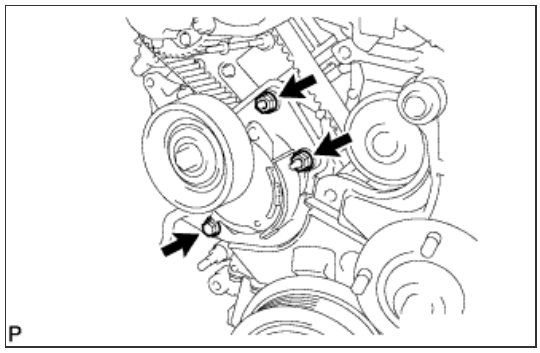
4. REMOVE NO. 2 TIMING BELT COVER SUB-ASSEMBLY

a. Remove the 2 bolts and detach the 2 claws, and then remove the No. 2 timing belt cover.



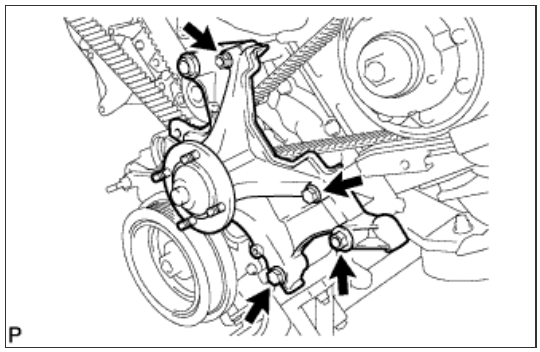
5. REMOVE V-RIBBED BELT TENSIONER ASSEMBLY

a. Remove the bolt, 2 nuts and V-ribbed belt tensioner.



6. REMOVE FAN BRACKET SUB-ASSEMBLY

a. Remove the 2 nuts, 2 bolts and fan bracket.

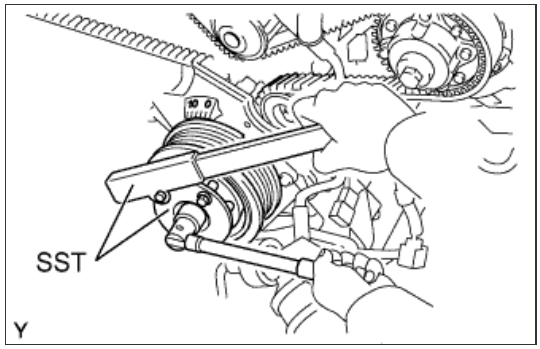


7. REMOVE CRANKSHAFT DAMPER SUB-ASSEMBLY

a. Using SST, hold the crankshaft damper and loosen the pulley bolt. Further loosen the bolt until 2 or 3 threads are screwed into the crankshaft.

SST

213-70011 (09213-70020)
09330-00021 (09330-00030)



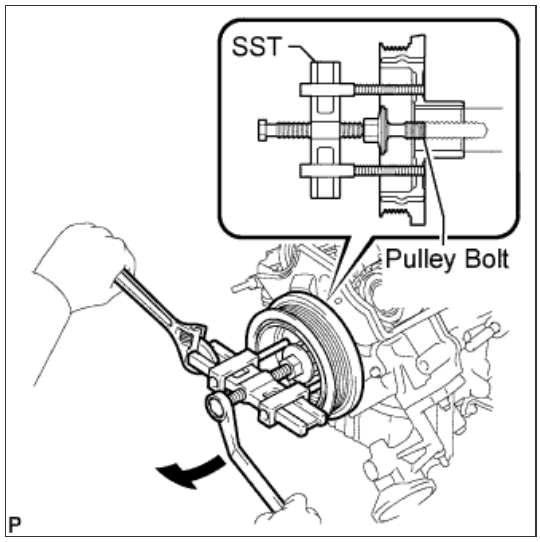
b. Using SST and the pulley bolt, remove the crankshaft damper.

SST

09950-50013 (09951-05010, 09952-05010, 09953-05020, 09954-05031)

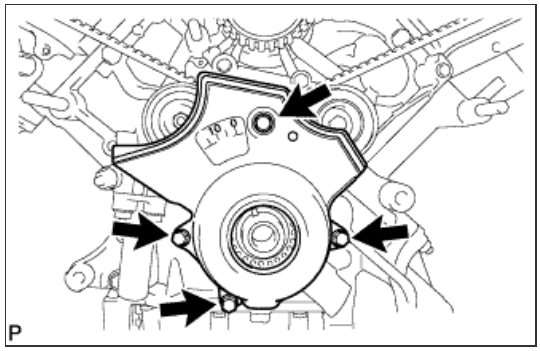
HINT:

Apply a lubricant to the threads and end of SST.



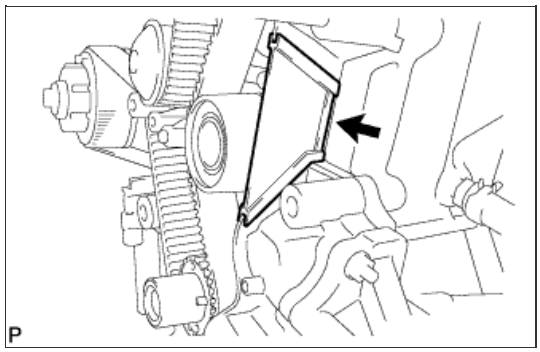
8. REMOVE NO. 1 TIMING BELT COVER

a. Remove the 4 bolts and timing belt cover.



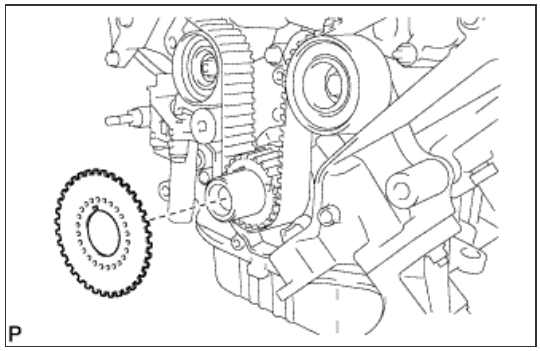
. REMOVE TIMING BELT COVER SPACER

a. Remove the cover spacer and gasket.



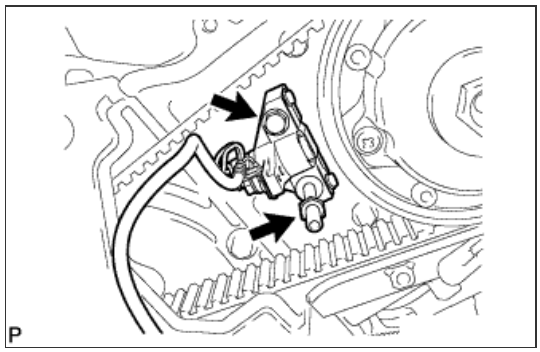
1 . REMOVE NO. 1 CRANKSHAFT POSITION SENSOR PLATE

a. Remove the position sensor plate from the crankshaft.



11. REMOVE CAMSHAFT POSITION SENSOR ASSEMBLY

a. Remove the bolt, stud bolt and camshaft position sensor.



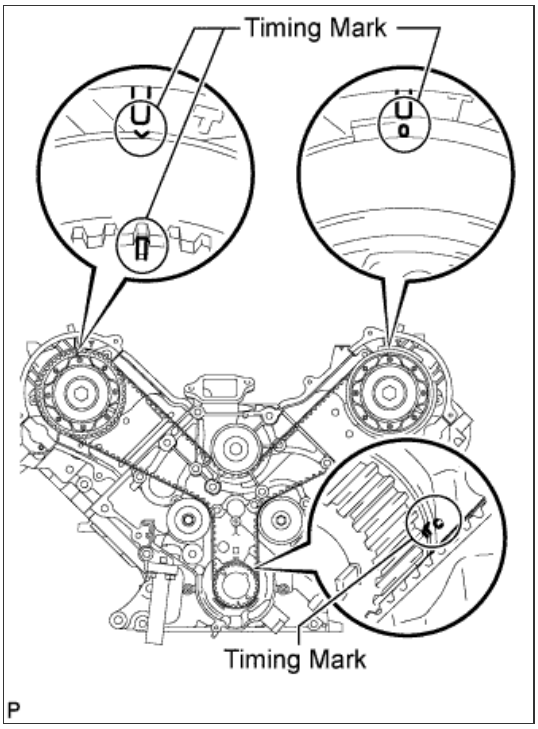
12. SET NO. 1 CYLINDER TO TDC COMPRESSION

a. Temporarily install the pulley bolt.

b. Rotate the crankshaft clockwise so that the timing marks on the crankshaft timing pulley and camshaft timing pulleys are as shown in the illustration.

HINT

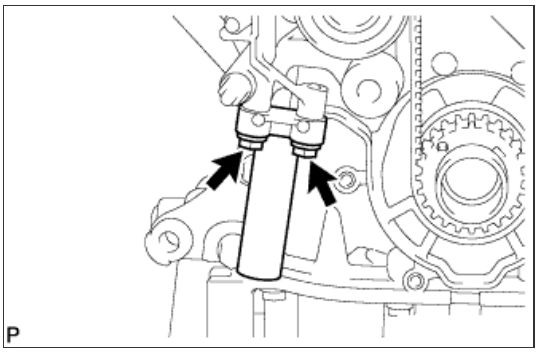
- **If the ti ing ak do not align, rotate the crank haft clock i e again and align the ti ing ak .**
- **hen re ing the ti ing belt, p ta ti ing ak on the belt here the ti ing ak on the belt and ti ing p lley are aligned after rotating the crank haft.**



13. REMOVE TIMING BELT

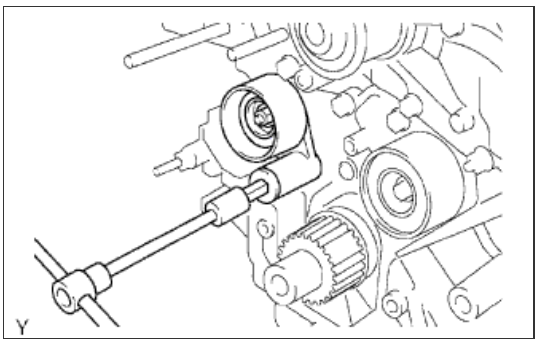
a. Alternately loosen the 2 bolts, then remove the bolts, timing belt tensioner and dust seal.

b. Remove the timing belt.



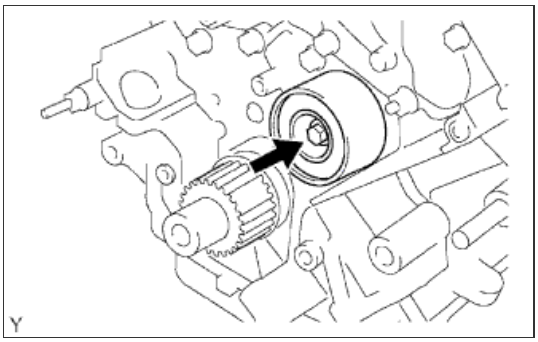
14. REMOVE NO. 1 TIMING BELT IDLER SUB-ASSEMBLY

a. Using a 10 mm hexagon wrench, remove the idler shaft, timing belt idler and plate washer.



15. REMOVE NO. 2 TIMING BELT IDLER SUB-ASSEMBLY

a. Remove the bolt and timing belt idler.



16. REMOVE CRANKSHAFT TIMING PULLEY

a. Using SST, remove the timing pulley.

SST

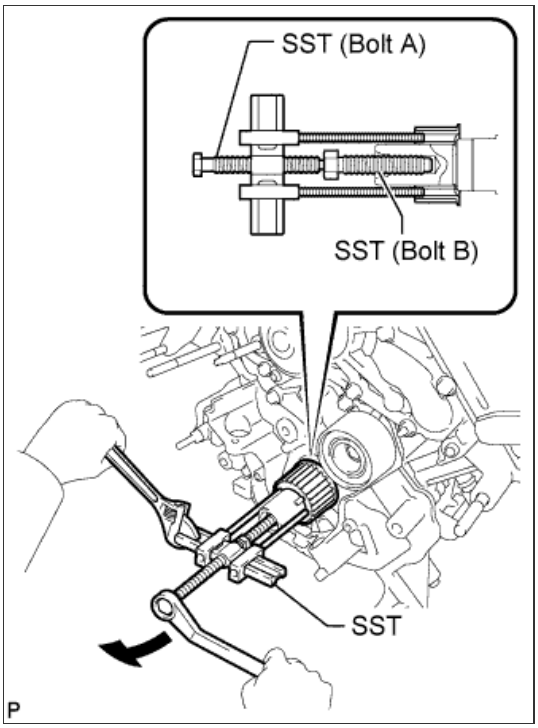
09950-50013 (09951-05010, 09952-05010, 09953-05010, 09953-05020, 09954-05011)

HINT:

Apply a lubricant to the threads and end of SST.

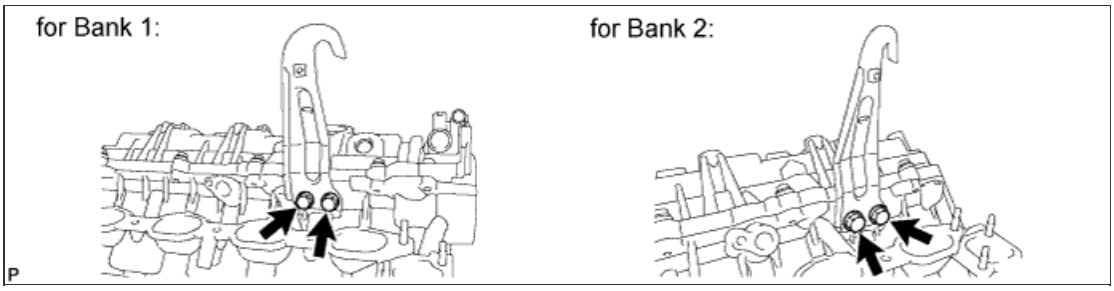
Parts Number:

Item	Parts number
SST (Bolt A)	09953-05020
SST (Bolt B)	09953-05010



17. REMOVE NO. 1 ENGINE HANGER

a. Remove the 2 bolts and engine hanger.



18. REMOVE SPARK PLUG

a. Remove the 8 spark plugs.

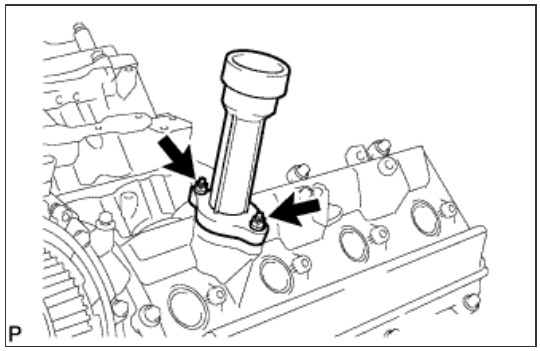
1 . REMOVE OIL FILLER CAP SUB-ASSEMBLY

a. Remove the oil filler cap.

b. Remove the gasket from the oil filler cap.

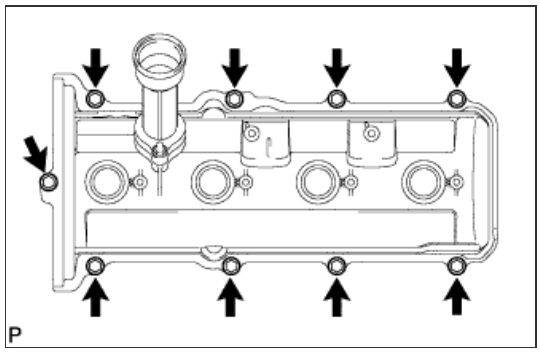
2 . REMOVE OIL FILLER CAP HOUSING

a. Remove the 2 nuts, housing and gasket.



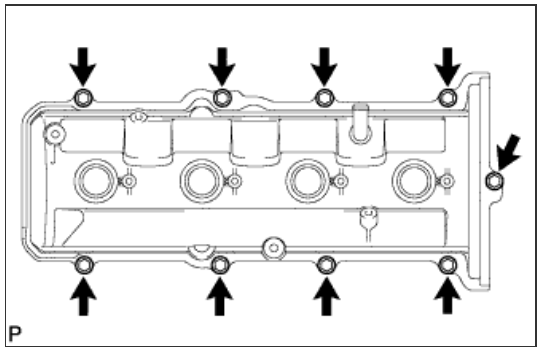
21. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY LH

a. Remove the 9 bolts, cylinder head cover and gasket.



22. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY

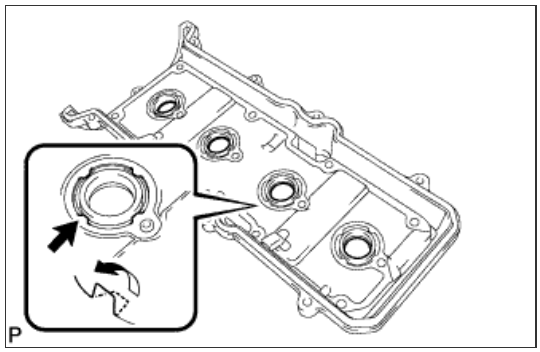
a. Remove the 9 bolts, cylinder head cover and gasket.



23. REMOVE SPARK PLUG TUBE GASKET

a. Bend the 8 ventilation case claws of the cylinder head cover to an angle of 90° or more.

b. Using a screwdriver, pry out the gaskets.



NOTICE

- **Be caref l not to da ae the cylinder head cover.**
- **Be caref l not to da ae the ga ket hen re oving it, a the re oved ga ket need to be re ed hen in tlling a ne one.**

HINT

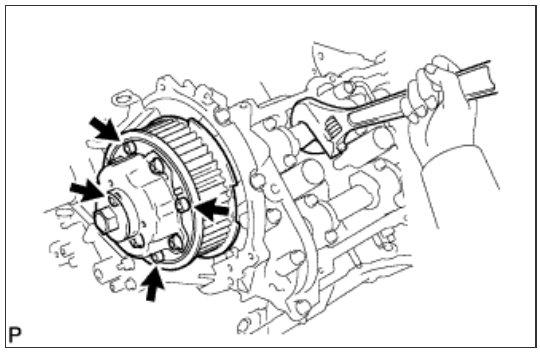
Tape the screwdriver tip before use.

24. REMOVE SEMICIRCULAR PLUG

a. Remove the 4 semicircular plugs from the cylinder heads.

25. REMOVE CAMSHAFT TIMING PULLEY SUB-ASSEMBLY LH

a. Hold the hexagonal portion of the camshaft with a wrench and remove the 4 bolts indicated by the arrows in the illustration and timing pulley.

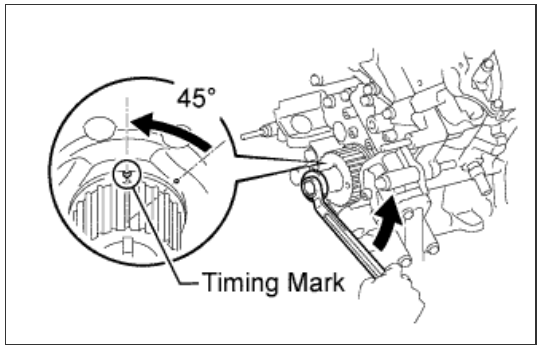


NOTICE

- **Do not loo en or re ove the 4 bolt that are not indicated by the arro in the ill tion. If any of the are loo ened or re oved, the backla h of the gear in the ti ing t be ill go o t of adj ent. In thi ca e, replace the ti ing t be a e bly ith a ne one.**
- **Be caref l not to da ae the cylinder head ith the nch.**

26. REMOVE CAMSHAFT TIMING PULLEY

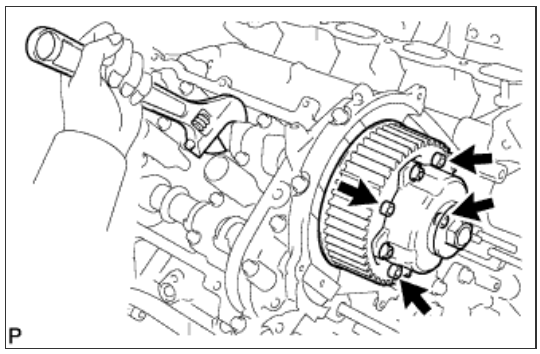
a. Using the pulley set bolt, turn the crankshaft counterclockwise by approximately 45°.



NOTICE:

If the timing belt is disengaged, having the crankshaft pulley at a wrong angle can cause the piston head and valve head to come into contact with each other when removing the camshaft timing pulley and camshaft, causing damage. So always set the crankshaft pulley at the correct angle.

b. Hold the hexagonal portion of the camshaft with a wrench and remove the 4 bolts indicated by the arrows in the illustration and timing pulley.

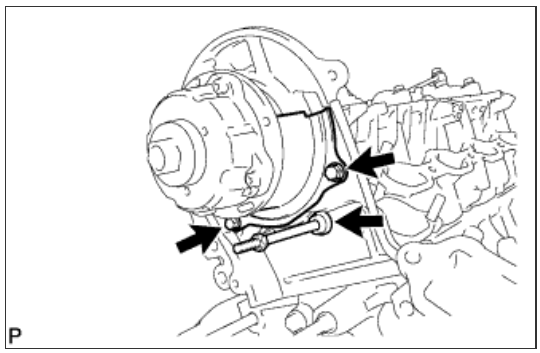


NOTICE:

- **Do not loosen or remove the 4 bolts that are not indicated by the arrows in the illustration. If any of them are loosened or removed, the backlash of the gear in the timing tube will go out of adjustment. In this case, replace the timing tube assembly with a new one.**
- **Be careful not to damage the cylinder head with the wrench.**

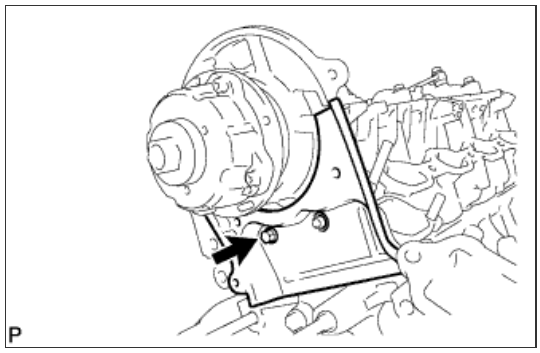
27. REMOVE REAR NO. 2 TIMING BELT PLATE RH

a. Remove the 2 bolts, stud bolt and timing belt plate.



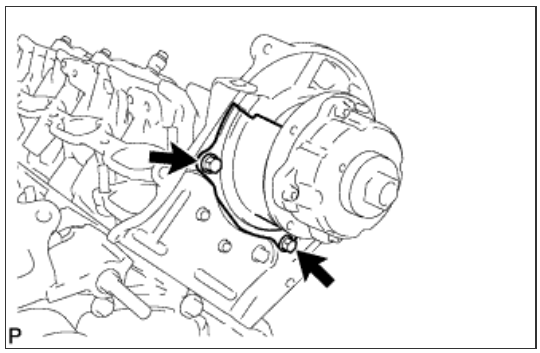
28. REMOVE REAR TIMING BELT PLATE RH

a. Remove the bolt and rear timing belt plate.



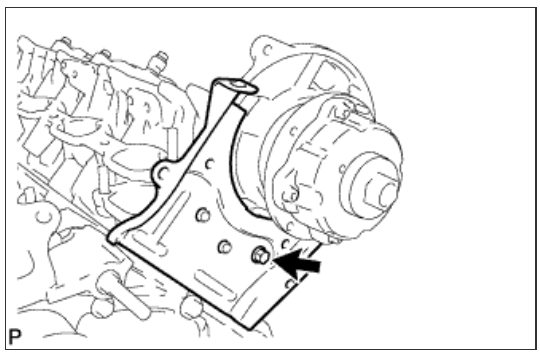
2 . REMOVE REAR NO. 2 TIMING BELT PLATE LH

a. Remove the 2 bolts and timing belt plate.



30. REMOVE REAR TIMING BELT PLATE LH

a. Remove the bolt and rear timing belt plate.



31. REMOVE CAMSHAFT (for Bank 1)

a. Bring the service bolt hole of the sub-gear upward by turning the hexagonal portion of the exhaust camshaft with a wrench.

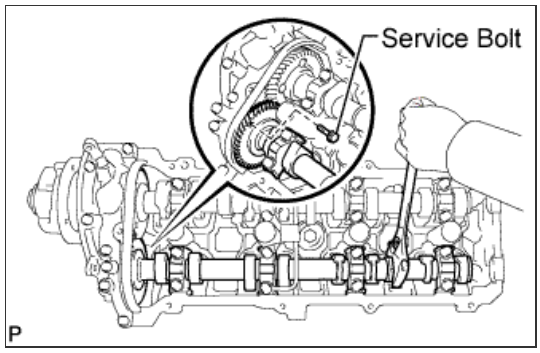
b. Secure the sub-gear to the driven gear with a service bolt.

Recommended Service Bolt:

Thread Diameter	Thread Pitch	Bolt Length
6.0 mm	1.0 mm	16 to 20 mm (0.630 to 0.787 in.)

HINT:

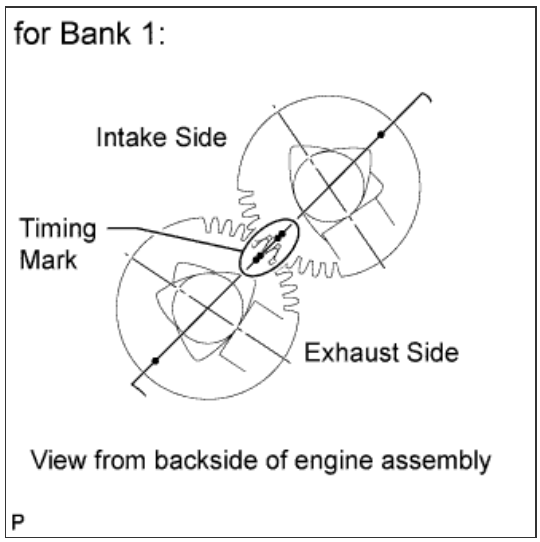
When removing the camshafts, make sure that the torsional spring force of the sub-gear has been eliminated by the above operation.



c. Using a wrench, turn the camshaft so that the timing marks (2 dot marks each) on the camshaft drive and driven gears are aligned, as shown in the illustration.

HINT:

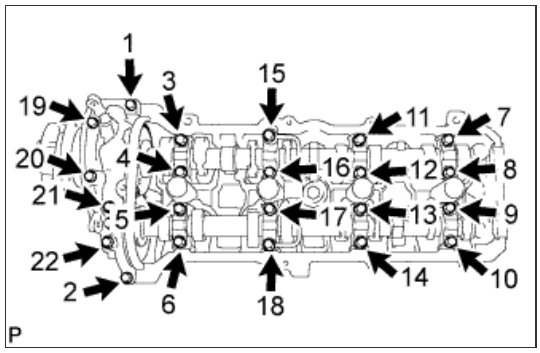
The position shown in the illustration is the most stable position for the exhaust camshaft.



d. Uniformly loosen and remove the 22 bearing cap bolts in several steps, in the order shown in the illustration.

NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged. To avoid this, the following steps should be carried out.



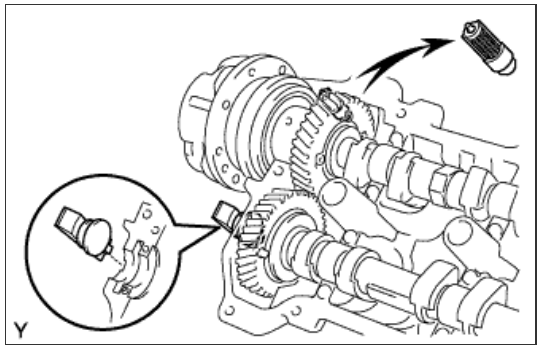
e. Remove the cap bolts, 4 seal washers, oil feed pipe, 9 bearing caps, camshaft housing plug, oil control valve filter and camshafts.

NOTICE:

- **Do not forcibly pry the camshaft with a tool.**
- **Do not damage the reception part of the thrust on the cylinder head side.**

HINT:

Arrange the bearing caps in the correct order.



32. REMOVE CAMSHAFT (for Bank 2)

a. Bring the service bolt hole of the sub-gear upward by turning the hexagonal portion of the exhaust camshaft with a wrench.

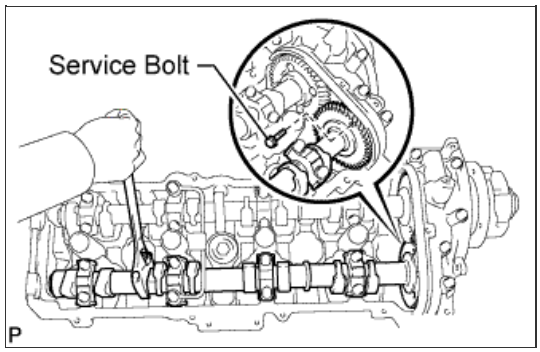
b. Secure the sub-gear to the driven gear with a service bolt.

Recommended Service Bolt:

Thread Diameter	Thread Pitch	Bolt Length
6.0 mm	1.0 mm	16 to 20 mm (0.630 to 0.787 in.)

HINT:

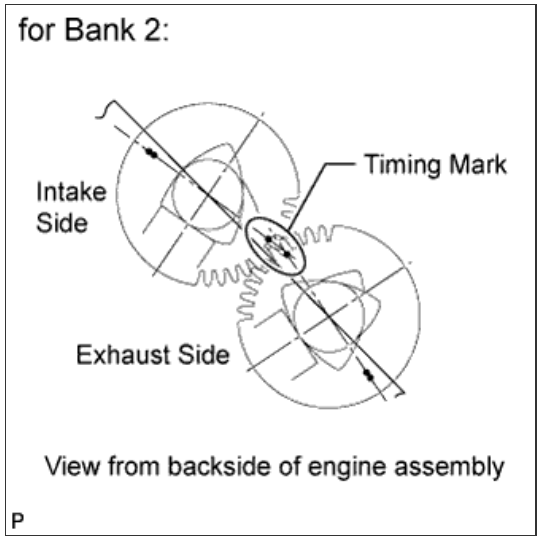
When removing the camshafts, make sure that the torsional spring force of the sub-gear has been eliminated by the above operation.



c. Using a wrench, turn the camshaft so that the timing marks (1 dot mark each) on the camshaft drive and driven gears are aligned, as shown in the illustration.

HINT:

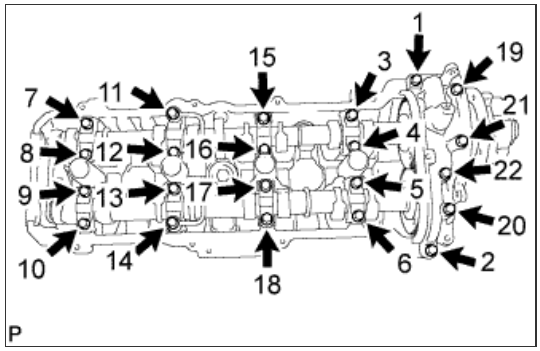
The position shown in the illustration is the most stable position for the exhaust camshaft.



d. Uniformly loosen and remove the 22 bearing cap bolts in several steps, in the order shown in the illustration.

NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged. To avoid this, the following steps should be carried out.



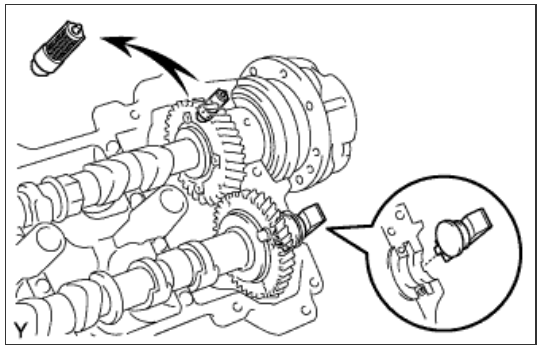
e. Remove the cap bolts, 4 seal washers, oil feed pipe, 9 bearing caps, camshaft housing plug, oil control valve filter and camshafts.

NOTICE:

- **Do not forcibly pry the camshaft with a tool.**
- **Do not damage the reception part of the thrust on the cylinder head side.**

HINT:

Arrange the bearing caps in the correct order.

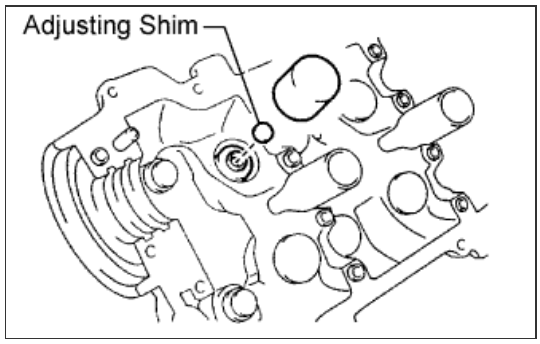


33. REMOVE VALVE LIFTER

a. Remove the valve lifters and adjusting shims from the cylinder head.

HINT

Arrange the removed parts in the correct order.



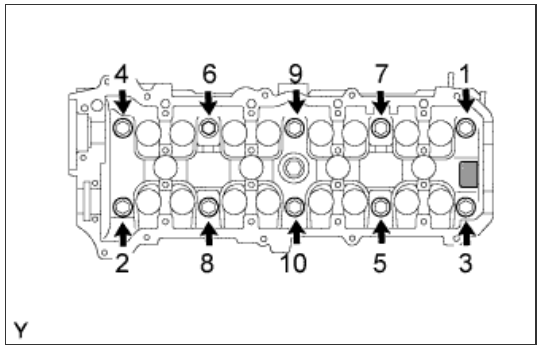
34. REMOVE CYLINDER HEAD LH

a. Uniformly loosen the 10 cylinder head bolts on the cylinder head in several passes, in the sequence shown in the illustration.

b. Remove the bolts and plate washers.

NOTICE:

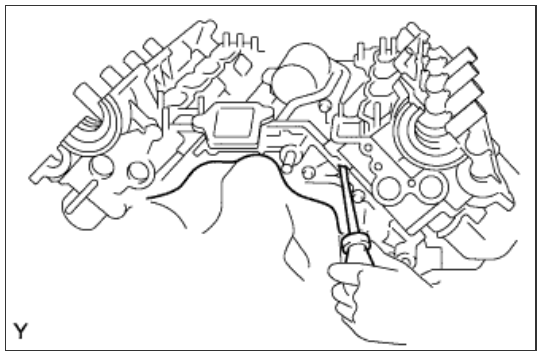
- **Cylinder head warpage or cracking could result from removing bolts in the incorrect order.**
- **Do not drop the plate washer for the cylinder head bolt of the cylinder head.**



c. Remove the cylinder head by prying between the cylinder block and cylinder head with a screwdriver.

NOTICE:

- **Be careful not to damage the contact surfaces of the cylinder head and cylinder block.**
- **The cylinder head should not be tilted so as to secure the valve lifter. If the cylinder head is tilted, remove the valve lifter and check that the adjusting shim is set correctly.**



35. REMOVE CYLINDER HEAD GASKET LH

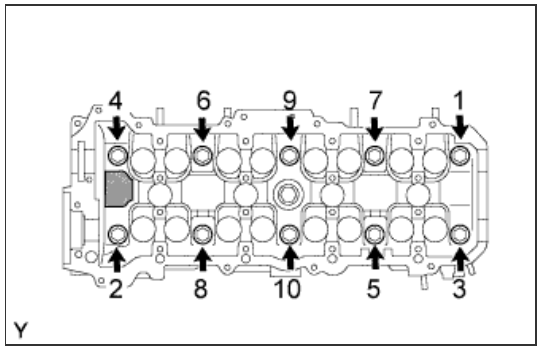
36. REMOVE CYLINDER HEAD SUB-ASSEMBLY

a. Uniformly loosen the 10 cylinder head bolts on the cylinder head in several passes, in the sequence shown in the illustration.

b. Remove the bolts and plate washers.

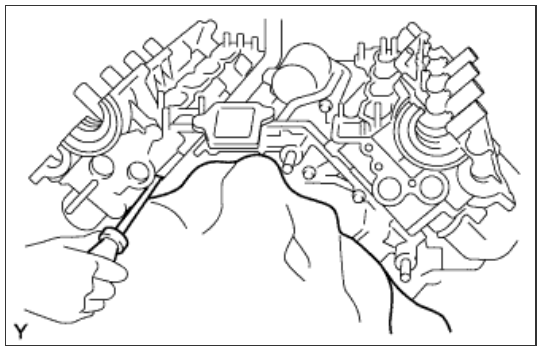
NOTICE:

- **Cylinder head warpage or cracking could result from removing bolts in the incorrect order.**
- **Do not drop the plate washer for the cylinder head bolt of the cylinder head.**



c. Remove the cylinder head by prying between the cylinder block and cylinder

c. Remove the cylinder head by prying between the cylinder block and cylinder head with a screwdriver.



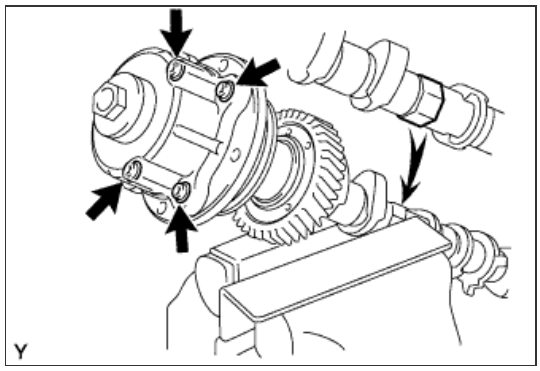
NOTICE

- **Be careful not to damage the contact surface of the cylinder head and cylinder block.**
- **The cylinder head should not be tilted or a force to exceed the valve lifter. If the cylinder head is tilted, remove the valve lifter and check that the adjusting shim is set correctly.**

37. REMOVE CYLINDER HEAD GASKET RH

38. REMOVE CAMSHAFT TIMING TUBE ASSEMBLY

a. Mount the hexagonal portion of the camshaft in a vise.

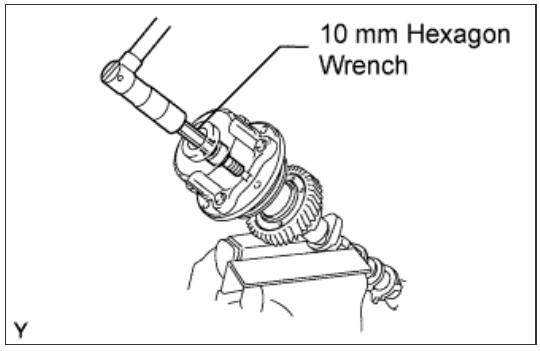


NOTICE:

- **Be careful not to damage the camshaft.**
- **Do not loosen or remove the 4 bolts shown in the illustration. If any of them are loosened or removed, the backlash of the gear in the timing tube will go out of adjustment. In this case, replace the timing tube assembly with a new one.**

b. Remove the screw plug and seal washer.

c. Using a 10 mm hexagon wrench, remove the bolt and timing tube.



39. REMOVE CAMSHAFT DRIVE GEAR

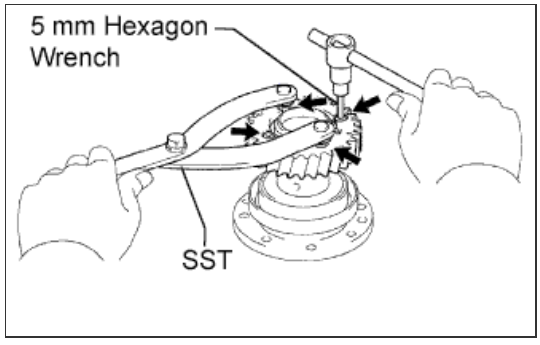
a. Using SST and a 5 mm hexagon wrench, remove the 4 bolts, drive gear and oil seal.

SST

09960-10010 (09962-01000, 09963-00500)

NOTICE:

Be careful not to damage the timing tube.

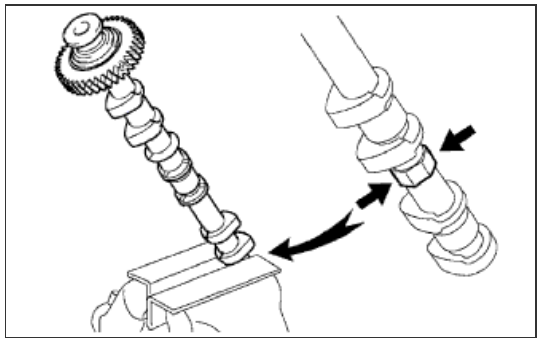


40. REMOVE CAMSHAFT SUB-GEAR

a. Mount the hexagonal portion of the camshaft in a vise.

NOTICE

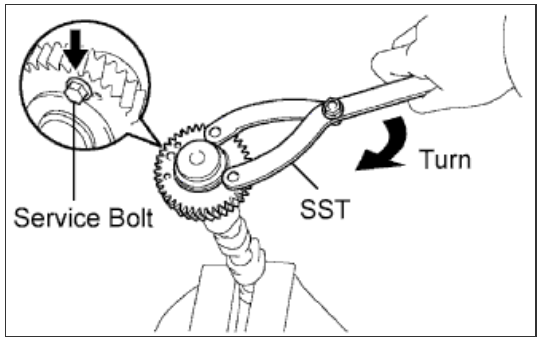
Be careful not to damage the camshaft.



b. Using SST, turn the sub-gear clockwise, and remove the service bolt.

SST

60-10010 (09962-01000, 09963-00500)

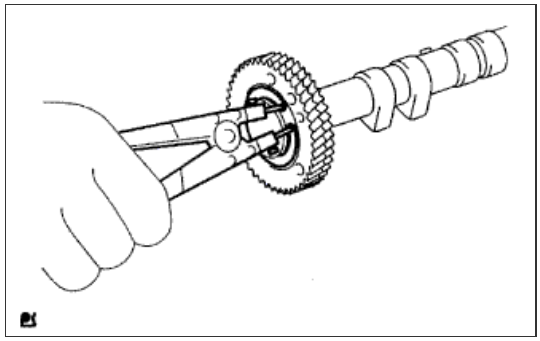


c. Using snap ring pliers, remove the snap ring.

d. Remove the wave washer, sub-gear and gear spring.

HINT:

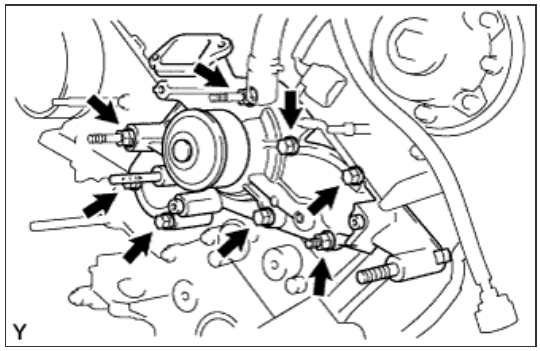
Arrange the camshaft sub-gears and gear spring (LH and RH).



41. REMOVE WATER PUMP ASSEMBLY

a. Remove the 5 bolts, 2 stud bolts, nut, water pump and gasket.

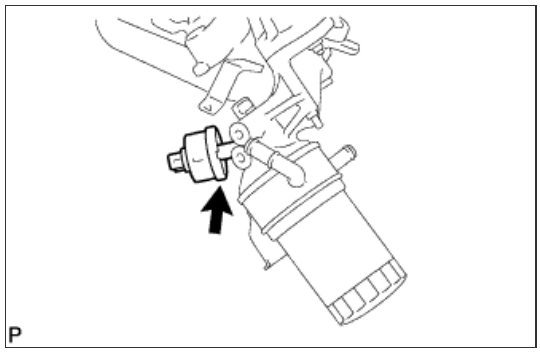
b. Remove the O-ring from the water by-pass pipe.



42. REMOVE OIL PRESSURE SENDER GAUGE ASSEMBLY

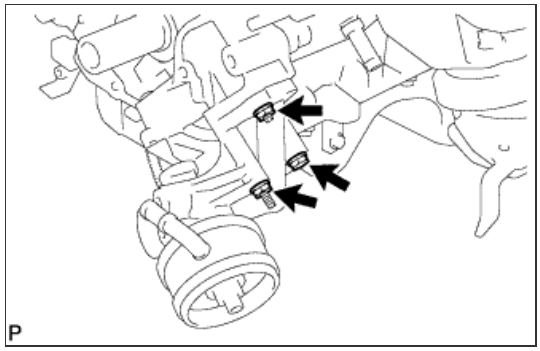
a. Disconnect the sender gauge connector.

b. Remove the sender gauge.



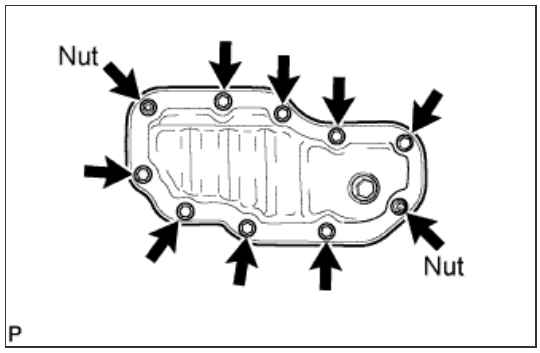
43. REMOVE OIL FILTER BRACKET SUB-ASSEMBLY

a. Remove the bolt, nut, stud bolt, oil filter bracket and gasket.



44. REMOVE NO. 2 OIL PAN SUB-ASSEMBLY

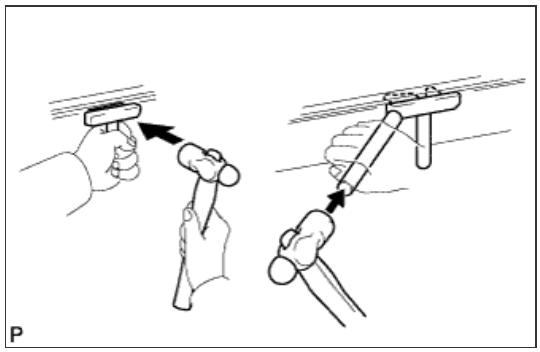
a. Remove the 8 bolts and 2 nuts.



b. Insert the blade of an oil pan seal cutter between the oil pans, cut off applied sealer and remove the No. 2 oil pan.

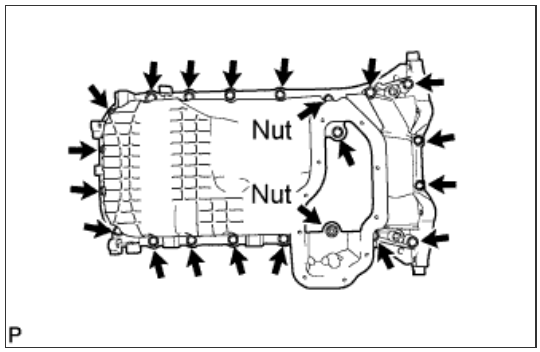
NOTICE:

- **Be careful not to damage the No. 2 oil pan contact surface of the oil pan.**
- **Be careful not to damage the No. 2 oil pan flange.**



45. REMOVE OIL PAN SUB-ASSEMBLY

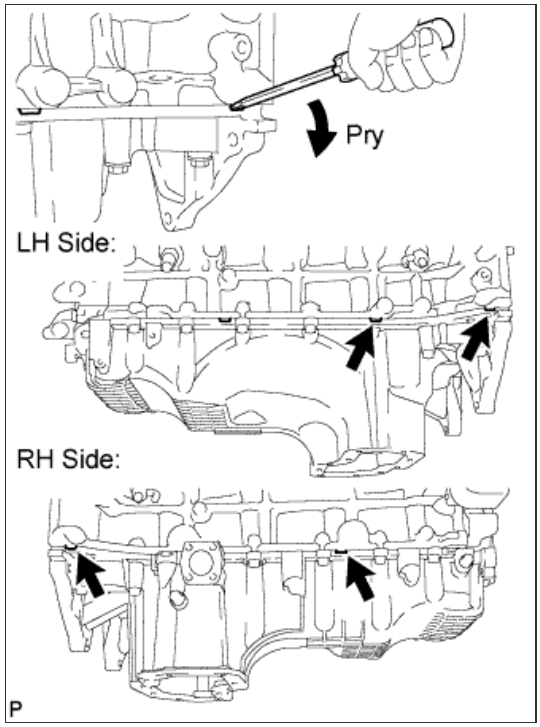
a. Remove the 19 bolts and 2 nuts.



b. Using a screwdriver, remove the oil pan by prying between the oil pan and cylinder block as shown in the illustration.

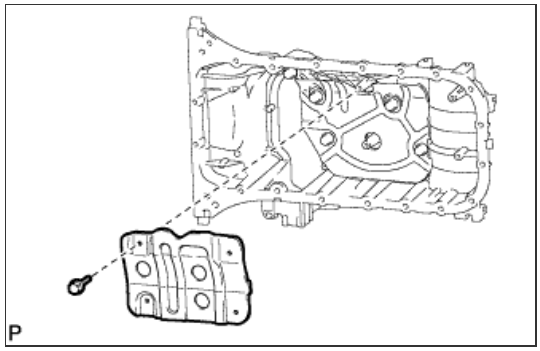
NOTICE

Be careful not to damage the contact surfaces of the cylinder block and oil pan.



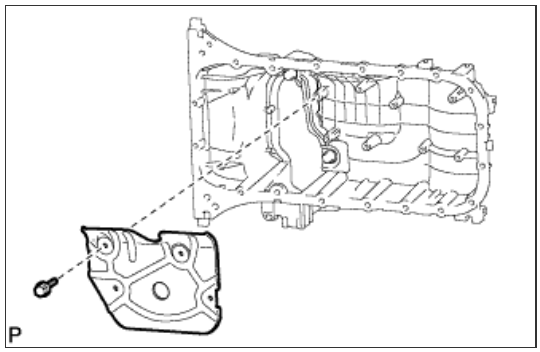
46. REMOVE NO. 1 OIL PAN BAFFLE PLATE

a. Remove the 4 bolts and baffle plate.



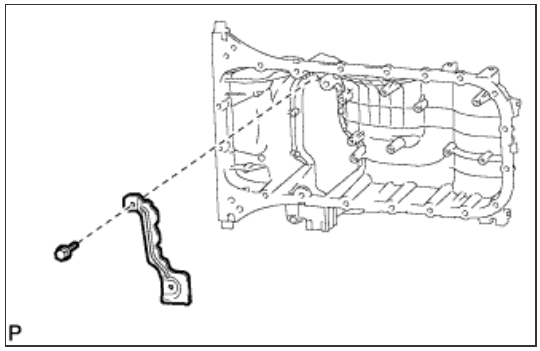
47. REMOVE NO. 2 OIL PAN BAFFLE PLATE

a. Remove the 4 bolts and baffle plate.



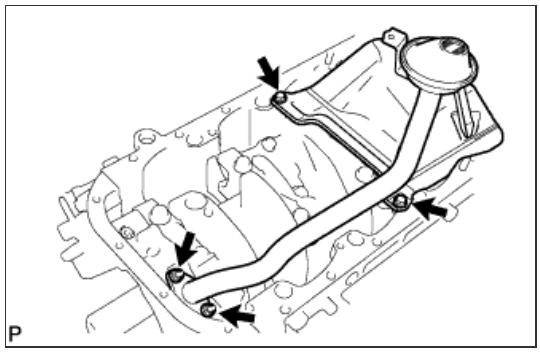
48. REMOVE NO. 3 OIL PAN BAFFLE PLATE

a. Remove the 2 bolts and baffle plate.



49. REMOVE OIL STRAINER SUB-ASSEMBLY

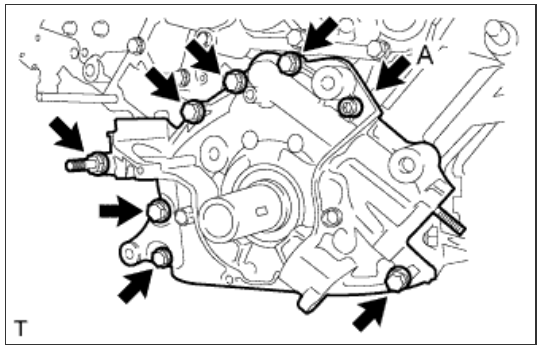
a. Remove the 2 bolts, 2 nuts, oil strainer and gasket.



50. REMOVE OIL PUMP ASSEMBLY

a. Using a 6 mm hexagon wrench, remove bolt A.

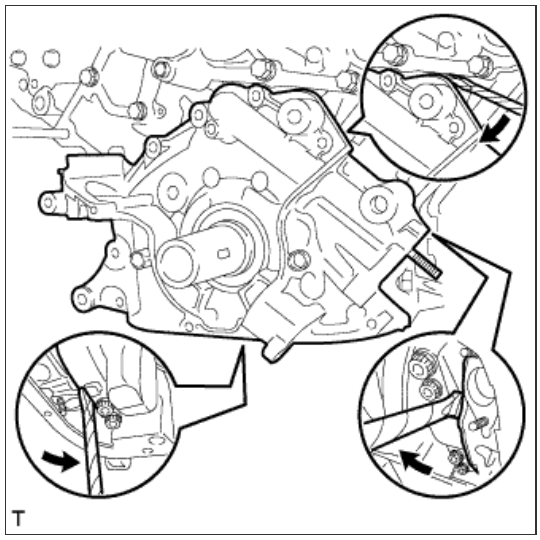
b. Remove the 6 bolts and stud bolt.



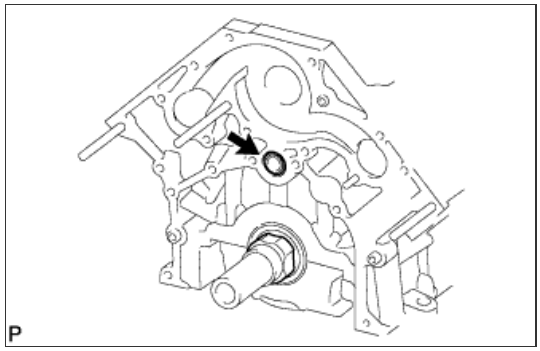
c. Using a screwdriver, remove the oil pump by prying the portions between the oil pump and cylinder block shown in the illustration.

NOTICE

Be careful not to damage the contact surfaces of the cylinder block and oil pump.



d. Remove the O-ring from the cylinder block.

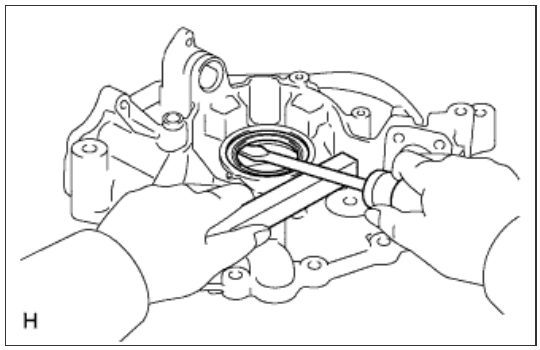


51. REMOVE OIL PUMP SEAL

a. Using a screwdriver and wooden block, pry out the oil seal.

NOTICE

Do not damage the surface of the oil seal press fit hole.

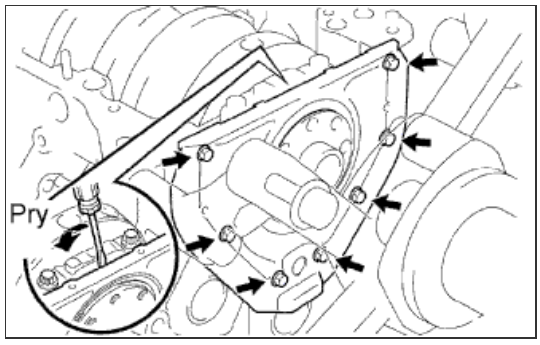


52. REMOVE ENGINE REAR OIL SEAL RETAINER

a. Remove the 7 bolts.

b. Using a screwdriver, remove the oil seal retainer by prying in between the oil seal retainer and crankshaft bearing cap.

c. Remove the O-ring.



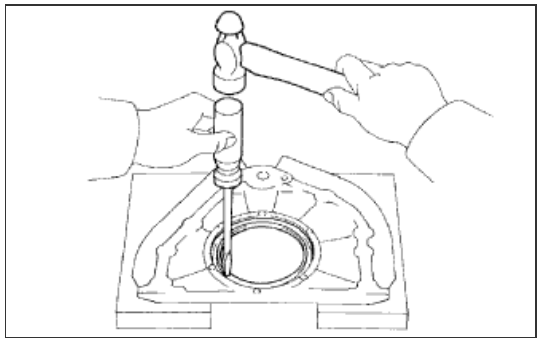
53. REMOVE ENGINE REAR OIL SEAL

a. Place the rear oil seal retainer on wooden blocks.

b. Using a screwdriver and hammer, tap out the oil seal.

NOTICE

Do not damage the surface of the oil seal press fit hole.



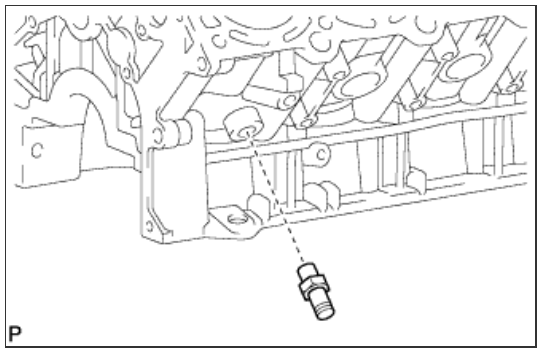
54. REMOVE CYLINDER BLOCK ATER DRAIN COCK SUB-ASSEMBLY

a. Remove the 2 drain cock plugs from the drain cock.

b. Remove the 2 drain cocks.

55. REMOVE CYLINDER BLOCK UNION

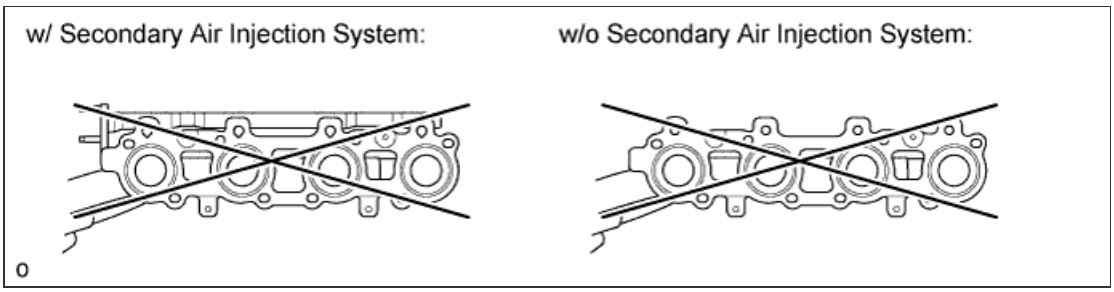
a. Remove the union from the cylinder block.



for Preparation Click here

1. INSPECT EXHAUST MANIFOLD SUB-ASSEMBLY LH

a. Using a precision straightedge and feeler gauge, measure the warpage of the contact surface between the cylinder head and exhaust manifold.

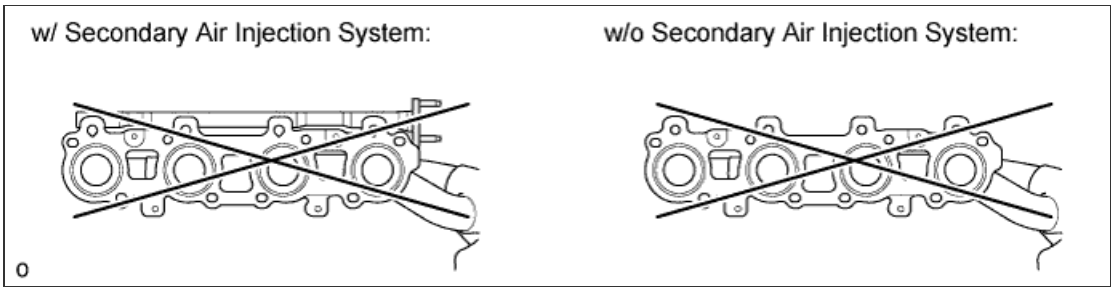


Maximum warpage:
0.50 mm (0.0197 in.)

If the warpage is more than the maximum, replace the exhaust manifold.

2. INSPECT EXHAUST MANIFOLD SUB-ASSEMBLY H

a. Using a precision straightedge and feeler gauge, measure the warpage of the contact surface between the cylinder head and exhaust manifold.



Maximum warpage:
0.50 mm (0.0197 in.)

If the warpage is more than the maximum, replace the exhaust manifold.

3. INSPECT CYLINDE HEAD SET BOLT

a. Using a vernier caliper, measure the thread outside diameter of the bolt.

Measuring Point:

Item	Specified Condition
Intake side	82 mm (3.23 in.)

Exhaust side	86 mm (3.39 in.)

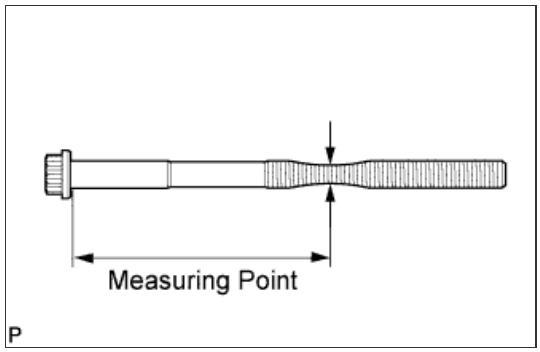
Standard outside diameter:
9.810 to 9.960 mm (0.386 to 0.392 in.)

Minimum outside diameter:
9.700 mm (0.382 in.)

If the outside diameter is less than the minimum, replace the cylinder head set bolt.

HINT:

If a visual check reveals no excessively thin areas, check the center of the bolt (see illustration) and find the area that has the minimum diameter.



4. INSPECT CAMSHAFT

a. Inspect the circle runout.

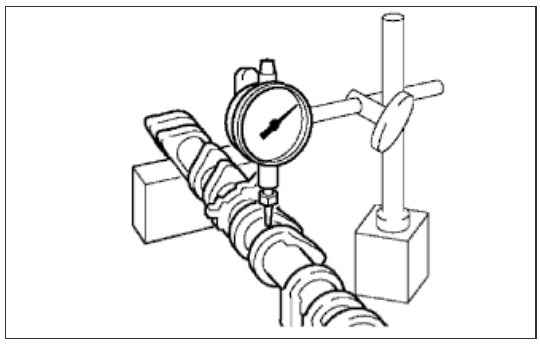
i. Place the camshaft on V-blocks.

ii. Using a dial indicator, measure the circle runout at the center journal.

Standard circle runout:
0 to 0.06 mm (0 to 0.00236 in.)

Maximum circle runout:
0.08 mm (0.00315 in.)

If the circle runout is more than the maximum, replace the camshaft.



b. Inspect the cam lobes.

i. Using a micrometer, measure the cam lobe height.

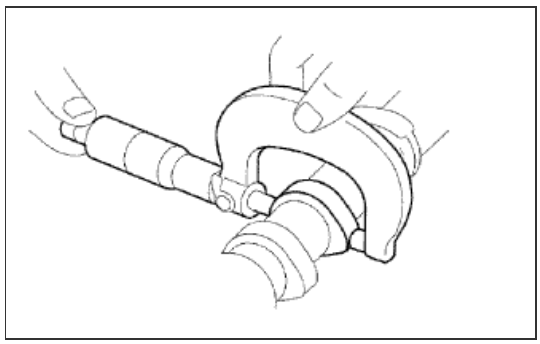
Standard Cam Lobe Height:

Item	Specified Condition
Intake	42.61 to 42.71 mm (1.6776 to 1.6815 in.)
Exhaust	42.63 to 42.73 mm (1.6783 to 1.6823 in.)

Minimum Cam Lobe Height:

Item	Specified Condition
Intake	42.46 mm (1.6717 in.)
Exhaust	42.48 mm (1.6724 in.)

If the cam lobe height is less than the minimum, replace the camshaft.

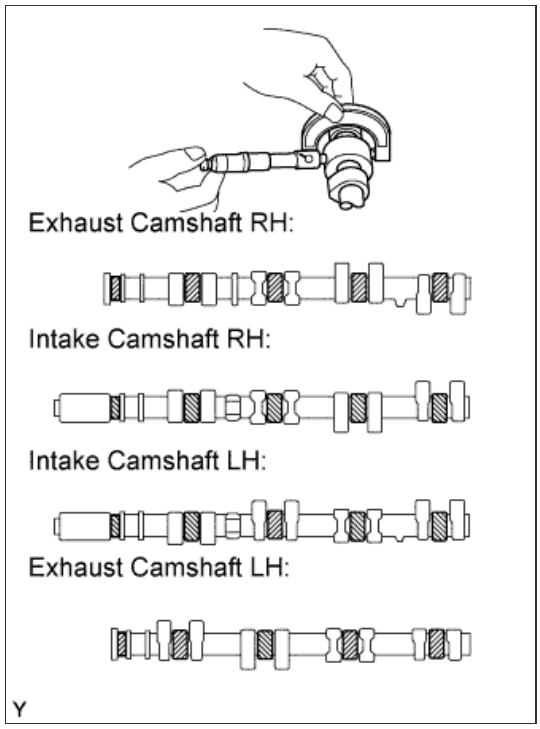


c. Inspect the camshaft journals.

i. Using a micrometer, measure the journal diameter.

Standard journal diameter:
26.954 to 26.970 mm (1.061 to 1.062 in.)

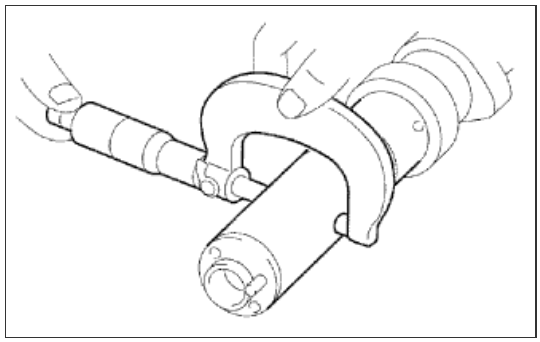
If the journal diameter is not as specified, check the oil clearance. If necessary, replace the camshaft.



ii. Using a micrometer, measure the journal diameter for the camshaft timing tube.

Standard journal diameter:
30.984 to 31.000 mm (1.2198 to 1.2204 in.)

If the journal diameter is not as specified replace the camshaft.



5. INSPECT CAMSHAFT TIMING TUBE ASSEMBLY

a. Using a micrometer, measure the journal diameter.

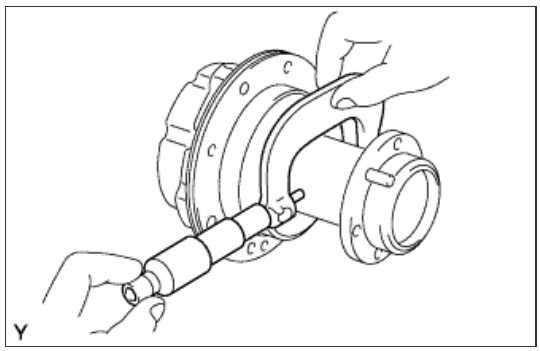
Standard journal diameter:
39.955 to 39.964 mm (1.5730 to 1.5734 in.)

If the journal diameter is not as specified, check the oil clearance. If necessary, replace the camshaft and cylinder head.

b. Install the camshaft timing tube to the camshaft (Click here).

c. Check the lock of the camshaft timing tube.

i. Check that the camshaft timing tube is locked.

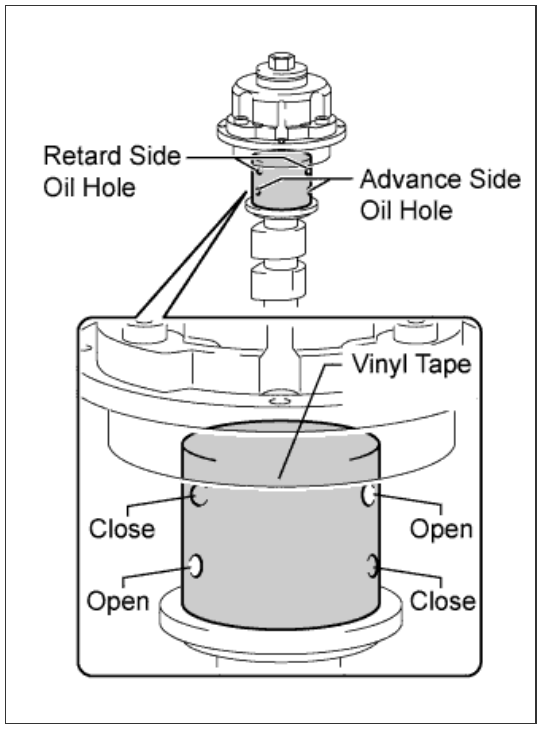


d. Release the lock pin.

i. Clean the camshaft timing tube journal with non-residue solvent.

ii. Wrap tape around the entire journal to block the 4 oil holes as shown in the illustration.

iii. Open a hole in the tape at 2 places, one in the retard side oil hole and one in the advance side oil hole as shown in the illustration.



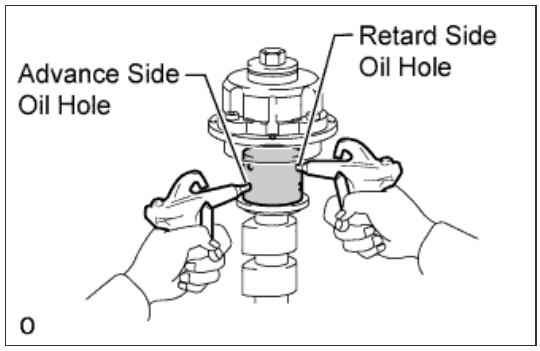
iv. Apply approximately 200 kPa (2.0 kgf/cm^2, 29 psi) of air pressure to the 2 open oil holes (the advance side oil hole and the retard side oil hole).

NOTICE:

Cover the oil holes with a piece of cloth when applying pressure to keep oil from splashing.

HINT:

he lock pin will be released when air pressure is applied.

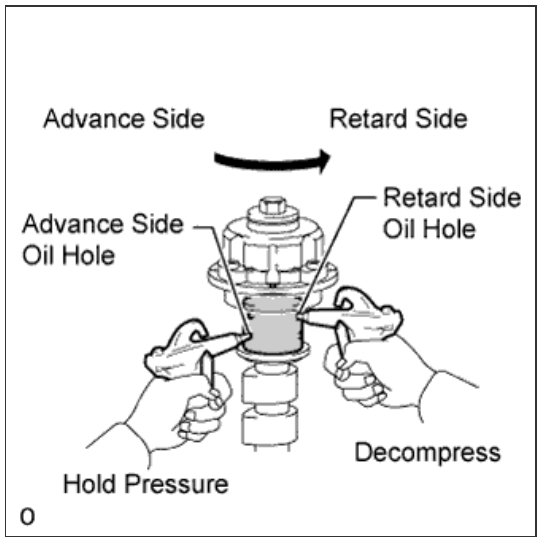


v. Check that the camshaft timing tube revolves in the advance direction when reducing the air pressure applied to the retard side oil hole.

vi. When the camshaft timing tube reaches the most advanced position, release the air pressure from the retard side oil hole and advance side oil hole, in that order.

NOTICE:

- **Do not release the air pressure from the advance side oil hole first. The tube may abruptly shift in the retard direction and break the lock pin.**
- **When releasing the air pressure from the retard side oil hole, do not release the air pressure too quickly to prevent damage.**



e. Check for smooth rotation.

i. Apply 60 kPa (0.6 kgf/cm^2, 8.7 psi) of air pressure to the retard side oil hole to release the lock pin.

ii. rn the camshaft timing tube within its movable range (21) 2 or 3 times, but do not turn it to the most retarded position. Make sure that the camshaft timing tube turns smoothly.

NOTICE:

Do not use air pressure to perform the smooth rotation check. Always perform the check by hand.

f. Check the lock in the most retarded position.

i. Confirm that the camshaft timing tube is locked at the most retarded position.

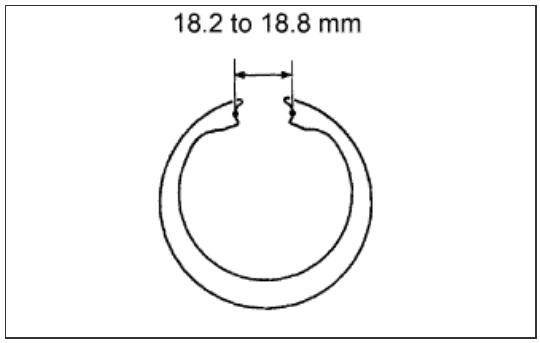
g. Remove the camshaft timing tube (Click here).

6. INSPECT CAMSHAFT GEA SP ING

a. Using a vernier caliper, measure the gap distance of the gear spring.

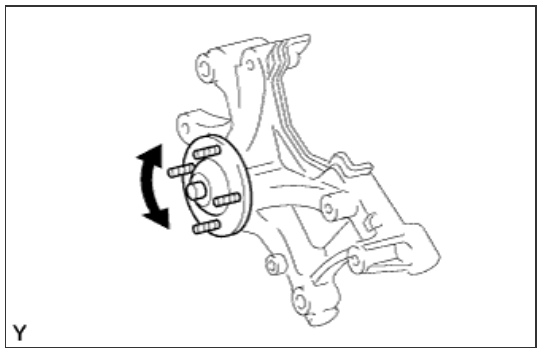
Standard gap distance:
18.2 to 18.8 mm (0.717 to 0.740 in.)

If the gap distance is not as specified, replace the camshaft gear spring.



7. INSPECT FAN B ACKET SUB-ASSEMBLY

a. Check that the fan bracket turns smoothly by turning it.
If necessary, replace the fan bracket.

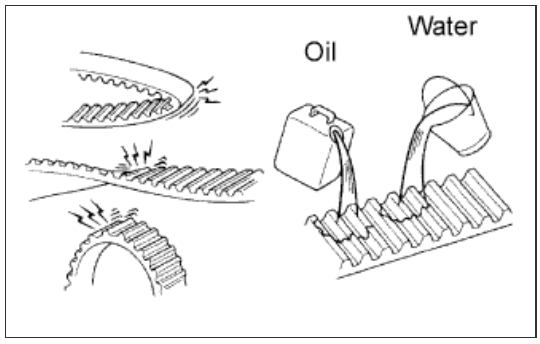


8. INSPECT TIMING BELT

a. Visually check the timing belt for excessive wear, frayed cords, etc.
If necessary, replace the timing belt.

NOTICE:

- **Do not bend or twist the timing belt or turn it inside out.**
- **Do not allow the timing belt to come into contact with oil, water or steam.**

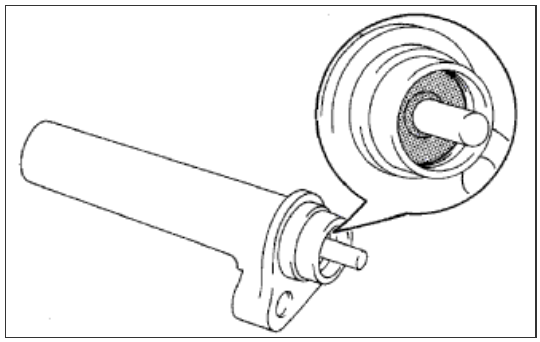


9. INSPECT TIMING BELT TENSIONE ASSEMBLY

a. Visually check the seal portion of the tensioner for oil leakage.
If leakage is found, replace the timing belt tensioner assembly.

HINT:

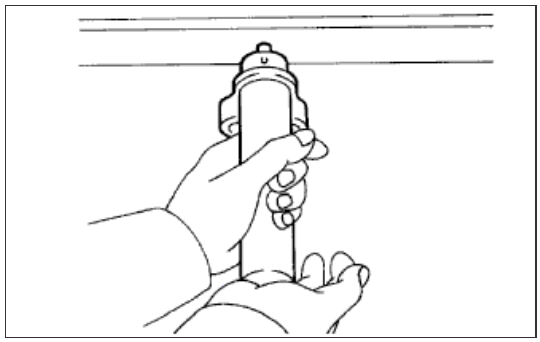
If there is only a faint trace of oil on the push rod, the tensioner does not need to be replaced.



b. Hold the tensioner with both hands and push the push rod strongly as shown to check that it does not move.
If the push rod moves, replace the timing belt tensioner assembly.

NOTICE:

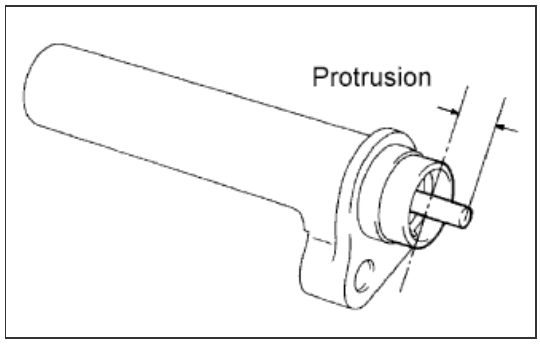
Never face the tensioner push rod downward.



c. Measure the protrusion of the push rod from the housing end.

Standard protrusion:
9.5 to 10.5 mm (0.374 to 0.413 in.)

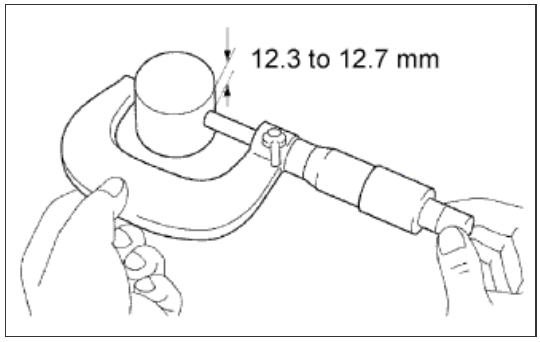
If the protrusion is not as specified, replace the timing belt tensioner assembly.



10. INSPECT VALVE LIFTE

a. Using a micrometer, measure the lifter diameter at a position 12.3 to 12.7 mm (0.484 to 0.500 in.) from the top surface.

Standard lifter diameter:
30.968 to 30.976 mm (1.2192 to 1.2195 in.)



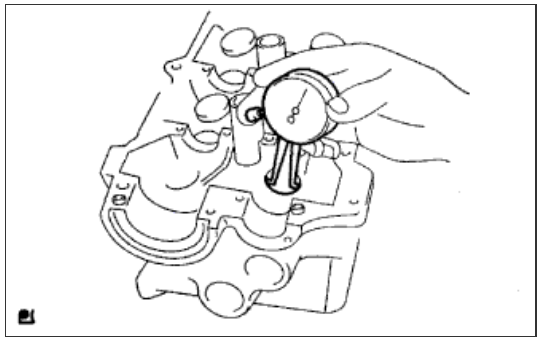
b. Using a caliper gauge, measure the lifter bore diameter of the cylinder head.

Standard lifter bore diameter:
31.000 to 31.016 mm (1.220 to 1.221 in.)

c. Subtract the lifter diameter measurement from the lifter bore diameter measurement.

Standard oil clearance:
0.024 to 0.050 mm (0.000945 to 0.00197 in.)

Maximum oil clearance:
0.07 mm (0.00276 in.)



If the oil clearance is more than the maximum, replace the lifter. If necessary, replace the cylinder head sub-assembly.

11. INSPECT CYLINDE HEAD SUB-ASSEMBLY

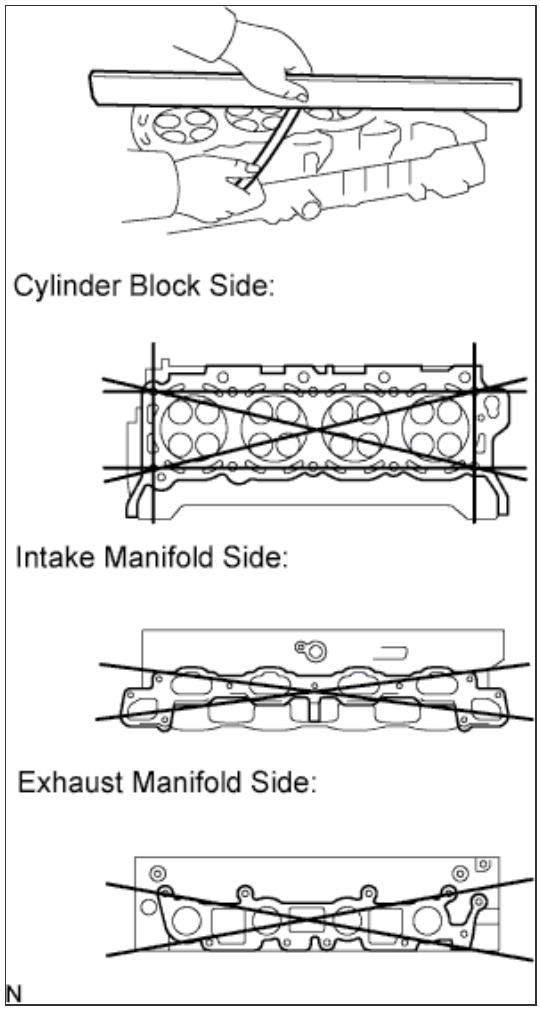
a. Using a precision straightedge and feeler gauge, measure the surfaces contacting the cylinder block and manifolds for warpage.

Standard Warpage:

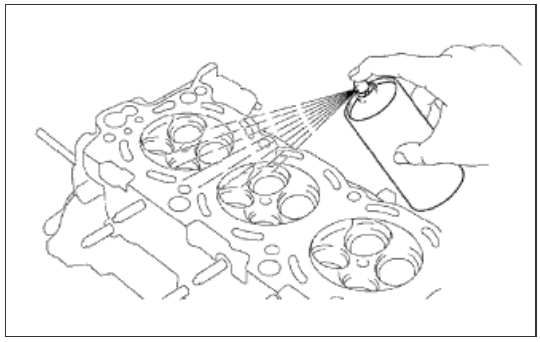
Item	Specified Condition
Cylinder block side	0 to 0.05 mm (0 to 0.00197 in.)
Intake manifold side	0 to 0.08 mm (0 to 0.00315 in.)
Exhaust manifold side	0 to 0.08 mm (0 to 0.00315 in.)

Maximum warpage:
0.10 mm (0.00394 in.)

If the warpage is more than the maximum, replace the cylinder head sub-assembly.



b. Using a dye penetrant, check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks.
If the cylinder head is cracked, replace it.



12. INSPECT CYLINDE BLOCK SUB-ASSEMBLY

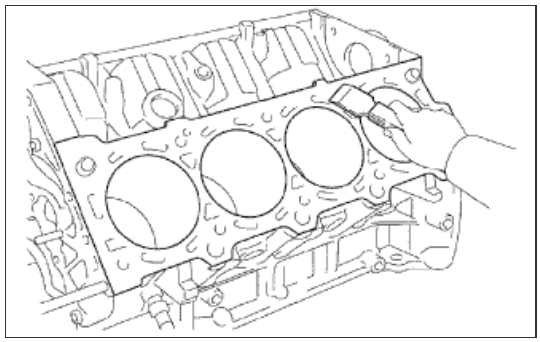
a. Clean the cylinder block.

i. Using a gasket scraper, remove all the gasket material from the top surface of the cylinder block.

ii. Using a soft brush and solvent, thoroughly clean the cylinder block.

NOTICE:

If the cylinder is washed at high temperatures, the cylinder liner sticks out beyond the cylinder block. Always wash the cylinder block at a temperature of 45 C (113) or less.

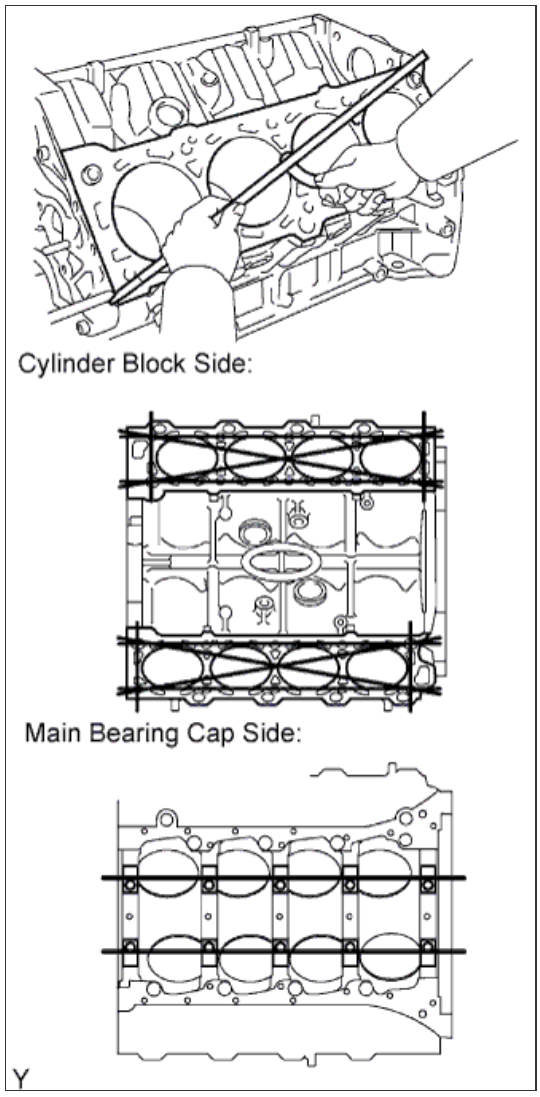


b. Using a precision straightedge and feeler gauge, measure the surfaces contacting the cylinder head and main bearing cap for warpage.

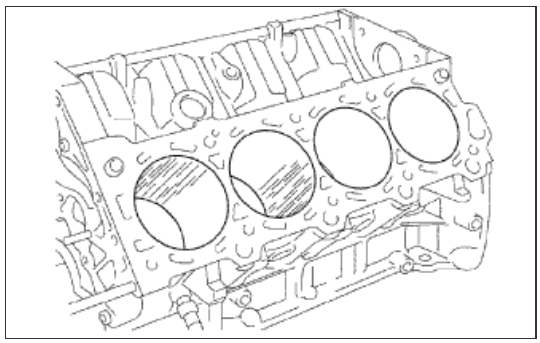
Standard warpage:
0 to 0.05 mm (0 to 0.00197 in.)

Maximum warpage:
0.07 mm (0.00276 in.)

If the warpage is more than the maximum, replace the cylinder block.



c. Visually check the cylinder for vertical scratches.
If deep scratches are present, rebore all 8 cylinders and replace all 8 pistons. If necessary, replace the cylinder block.



for Preparation Click here

1. INSTALL CYLINDER BLOCK UNION

a. Apply seal packing to 2 or 3 threads of the cylinder block union.

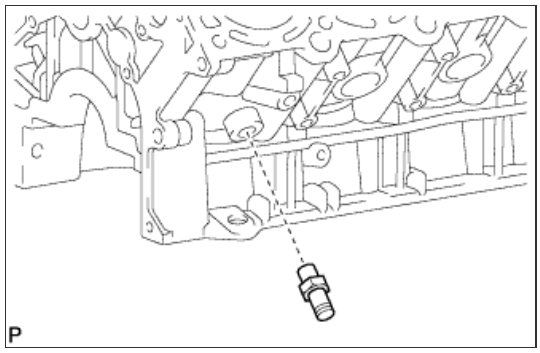
Seal packing:
Toyota Genuine Seal Packing 1282B, Three Bond 1282B or equivalent

b. Install the union to the cylinder block.

Torque:
49 N*m{ 500 kgf*cm , 36 ft.*lbf

NOTICE:

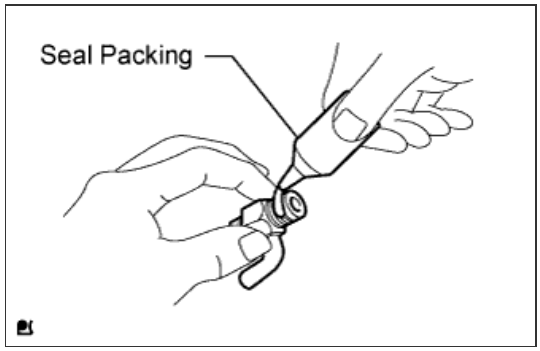
Install the cylinder block union within 3 minutes and tighten the union within 15 minutes after applying seal packing.



2. INSTALL CYLINDER BLOCK WATER DRAIN COCK SUB-ASSEMBLY

a. Apply seal packing to 2 or 3 threads of the drain cock.

Seal packing:
Toyota Genuine Seal Packing 1282B, Three Bond 1282B or equivalent



b. Install the 2 drain cocks as shown in the illustration.

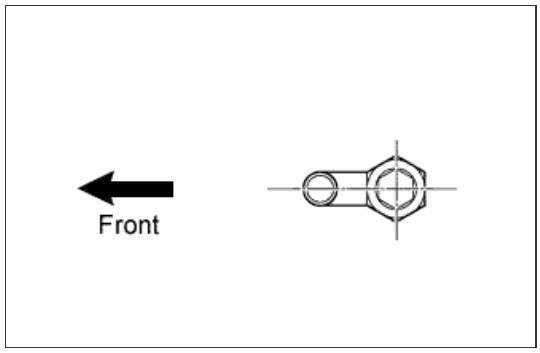
Torque:
49 N*m{ 500 kgf*cm , 36 ft.*lbf

NOTICE:

- **Do not rotate the drain cocks more than 1 revolution 60 after tightening the drain cocks to the specified torque.**
- **Do not loosen the drain cocks to adjust them. If an adjustment is necessary, remove the drain cocks and reinstall them.**

c. Install the 2 drain cock plugs to the drain cock.

Torque:
13 N*m{ 130 kgf*cm , 9 ft.*lbf



. INSTALL ENGINE REAR OIL SEAL

a. Place the oil seal retainer on wooden blocks.

b. Using SST and a hammer, tap in a new oil seal until its surface is flush with the

rear oil seal retainer edge.

SST
09223-56010

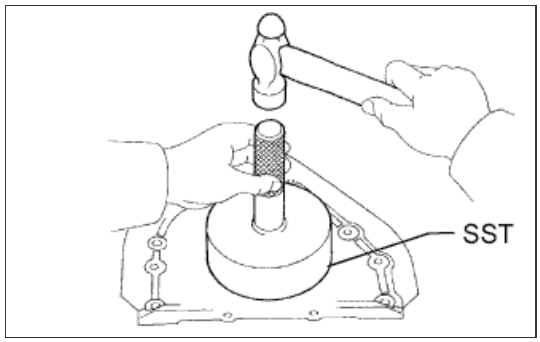
NOTICE:

Do not tap on the oil seal at an angle.

c. Apply MP grease to the lip of the oil seal.

NOTICE:

- **Do not allow foreign matter to contact the lip of the oil seal.**
- **Do not allow MP grease to contact the dust seal.**



4. INSTALL ENGINE REAR OIL SEAL RETAINER

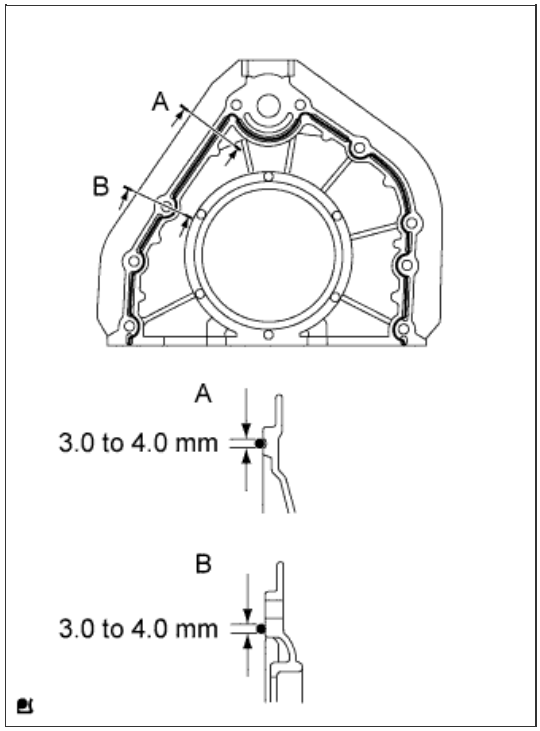
a. Apply seal packing to the oil seal retainer as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
3.0 to 4.0 mm 0.118 to 0.157 in.)

NOTICE:

- **Install the oil seal retainer within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**
- **Be careful not to drop any oil on the contact surfaces of the oil seal retainer and cylinder block.**



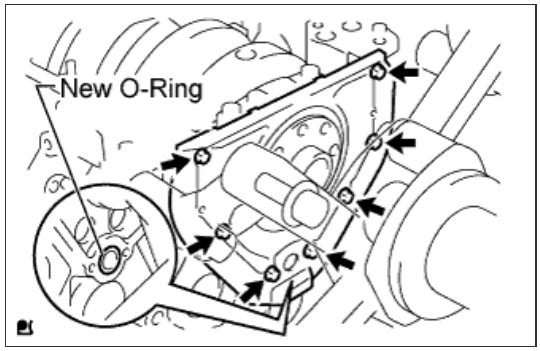
b. Install a new O-ring to the cylinder block.

c. Install the oil seal retainer with the 7 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf

NOTICE:

Do not expose the seal to engine oil for at least an hour after installing it.



5. INSTALL OIL PUMP SEAL

a. Place the oil pump on a wooden block.

b. Using SST and a hammer, tap in a new oil seal until its surface is flush with the oil pump body edge.

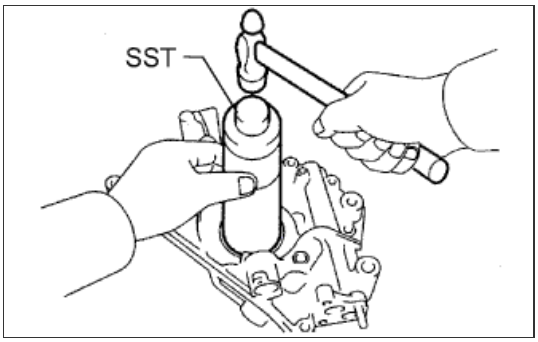
SST

09316-60011 09316-00011)

NOTICE:

Do not tap the oil seal at an angle.

c. Apply MP grease to the lip of the oil seal.

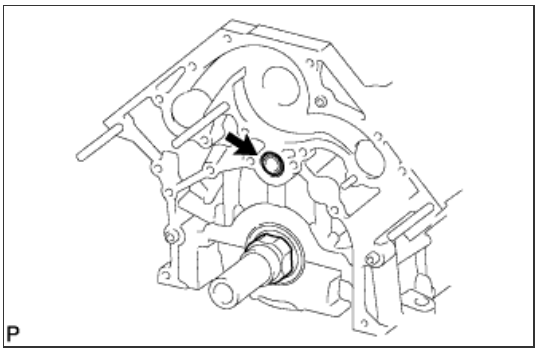


NOTICE:

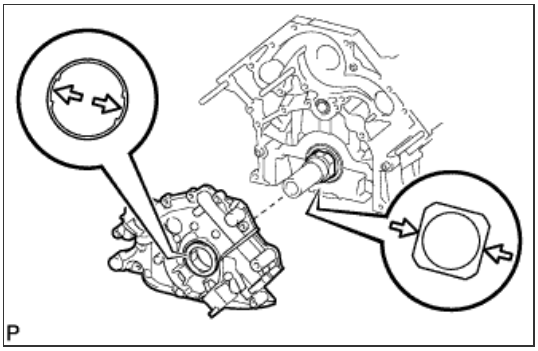
- **Do not allow foreign matter to contact the lip of the oil seal.**
- **Do not allow MP grease to contact the dust seal.**

6. INSTALL OIL PUMP ASSEMBLY

a. Apply a light coat of engine oil to a new O-ring and install it to the cylinder block.



b. Align the oil pump drive rotor spline and the crankshaft as shown in the illustration.



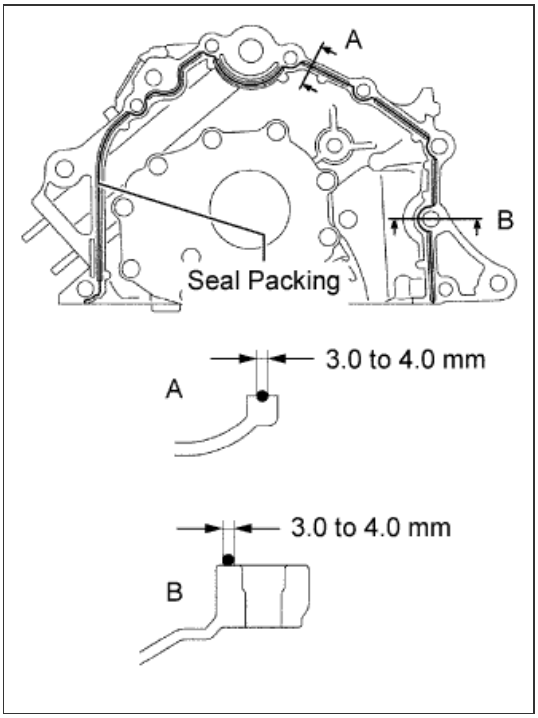
c. Apply seal packing to the oil pump as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
3.0 to 4.0 mm 0.118 to 0.157 in.)

NOTICE:

- **Install the oil pump within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**
- **Be careful not to drop any oil on the contact surfaces of the oil pump and cylinder block.**
- **Do not e pose the seal to engine oil for at least 2 hours after installing it.**

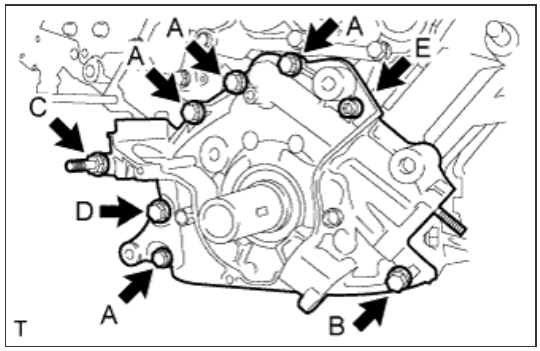


d. Install the oil pump with the stud bolt, 6 standard bolts and the 6 mm hexagon wrench bolt. Uniformly tighten the bolts in several steps.

Torque:
for bolt A, B, C, E:
16 N*m{ 163 kgf*cm , 12 ft.*lbf
for bolt D:
31 N*m{ 316 kgf*cm , 23 ft.*lbf

Bolt Length:

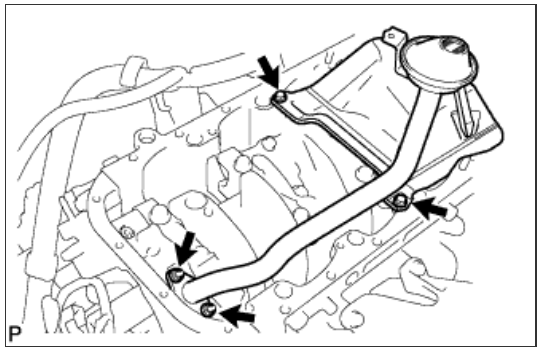
Item	Bolt Head Size	Length
Bolt A	12 mm	35 mm (1.38 in.)
Bolt B	12 mm	50 mm (1.97 in.)
Bolt C	14 mm	103 mm (4.06 in.)
Bolt D	14 mm	44 mm (1.73 in.)
Bolt E	6 mm hexagon	28 mm (1.10 in.)



7. INSTALL OIL STRAINER SUB-ASSEMBLY

a. Install a new gasket and the oil strainer with the 2 bolts and 2 nuts.

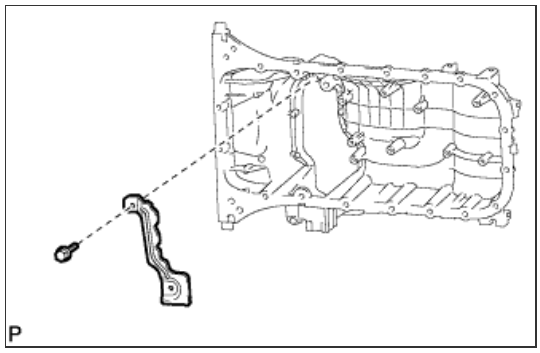
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf



8. INSTALL NO. 3 OIL PAN BA LE PLATE

a. Install the baffle plate with the 2 bolts.

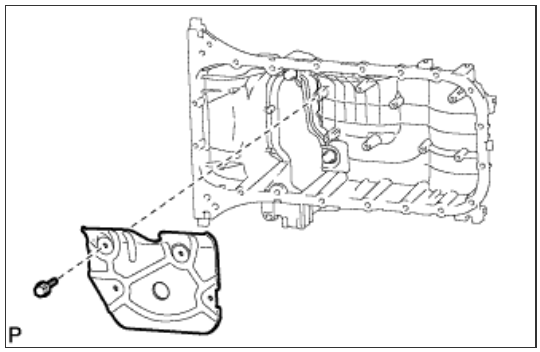
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf



9. INSTALL NO. 2 OIL PAN BA LE PLATE

a. Install the baffle plate with the 4 bolts.

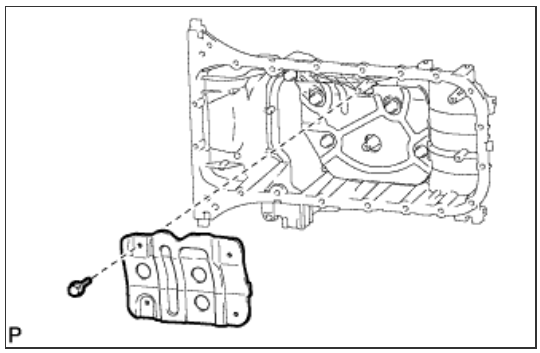
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf



10. INSTALL NO. 1 OIL PAN BA LE PLATE

a. Install the baffle plate with the bolts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf



11. INSTALL OIL PAN SUB-ASSEMBLY

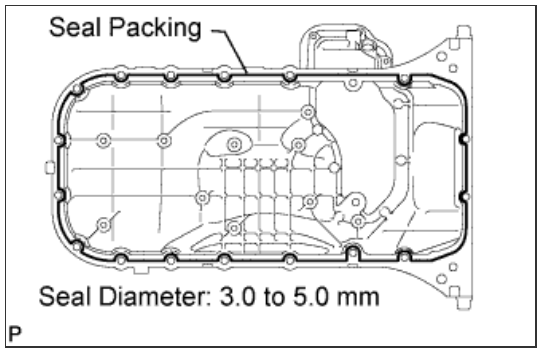
a. Apply seal packing to the oil pan as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
3.0 to 5.0 mm 0.118 to 0.197 in.)

NOTICE:

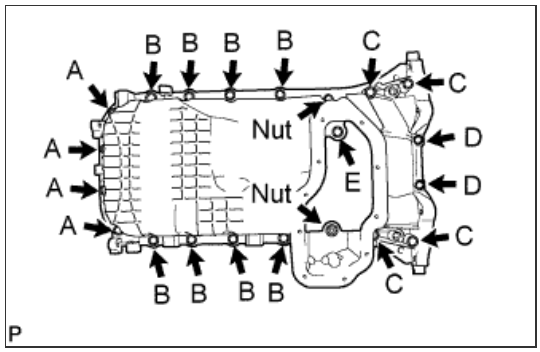
- **Install the oil pan within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**
- **Be careful not to drop any oil on the contact surfaces of the oil pan and cylinder block.**
- **Do not e pose the seal to engine oil for at least 2 hours after installing it.**



b. Temporarily install the oil pan with the 19 bolts and 2 nuts.

Bolt Length:

Item	Bolt Head Size	Length
Bolt A	10 mm	22 mm (0.866 in.)
Bolt B	12 mm	25 mm (0.98 in.)
Bolt	12 mm	60 mm (2.36 in.)
Bolt D	10 mm	35 mm (1.38 in.)
Bolt E	10 mm	22 mm (0.866 in.)



NOTICE:

Make sure the rear ends of the oil pan and cylinder block are aligned. If not, the oil pan may become damaged.

c. Uniformly tighten the bolts and nuts in several passes.

Torque:

for bolt A, D, E:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf
for bolt B, C, nut:
28 N*m{ 286 kgf*cm , 21 ft.*lbf

12. INSTALL NO. 2 OIL PAN SUB-ASSEMBLY

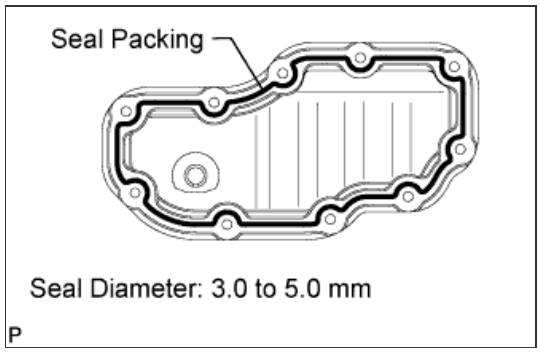
a. Apply seal packing to the No. 2 oil pan as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
3.0 to 5.0 mm 0.118 to 0.197 in.)

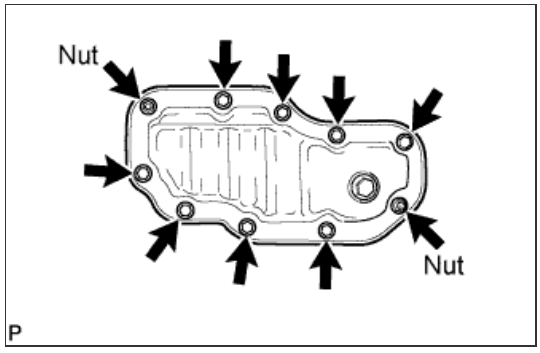
NOTICE:

- Install the oil pan within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.
- Be careful not to drop any oil on the contact surfaces of the oil pan and No. 2 oil pan.
- Do not e pose the seal to engine oil for at least 2 hours after installing it.



b. Install the No. 2 oil pan with the 8 bolts and 2 nuts. Uniformly tighten the bolts and nuts in several passes.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf

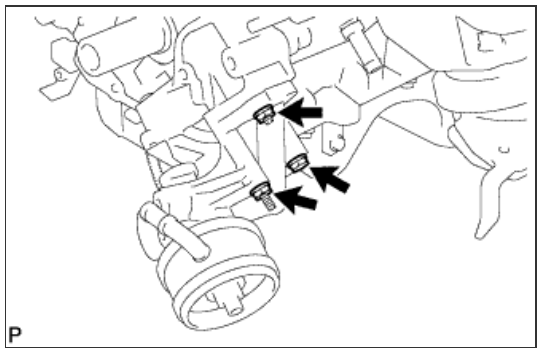


13. INSTALL OIL LTER BRACKET SUB-ASSEMBLY

a. Install a new gasket to the oil filter bracket.

b. Install the oil filter bracket with the bolt, stud bolt and nut.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf



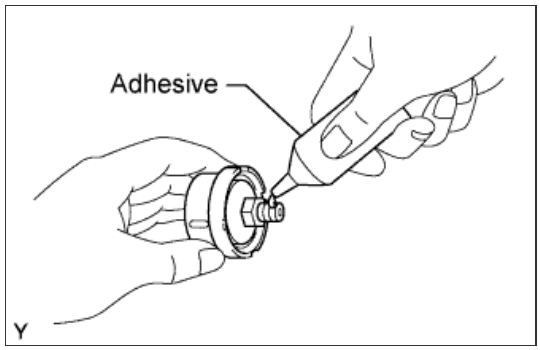
14. INSTALL OIL PRESSURE SENDER GAUGE ASSEMBLY

a. Apply adhesive to 2 or 3 threads of the sender gauge.

Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent

NOTICE:

Do not let adhesive adhere to the oil hole.



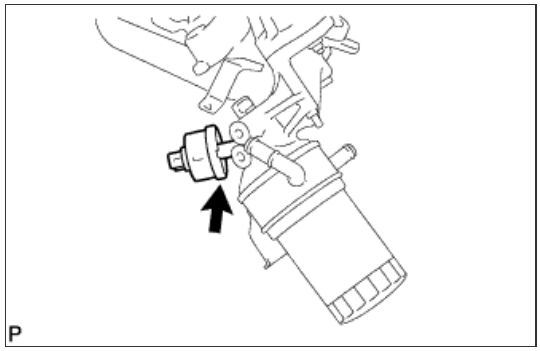
b. Install the sender gauge.

Torque:
15 N*m{ 153 kgf*cm , 11 ft.*lbf

NOTICE:

Do not start the engine within 1 hour of installation.

c. onnect the sender gauge connector.



15. INSTALL WATER PUMP ASSEMBLY

a. Apply soapy water to a new O-ring.

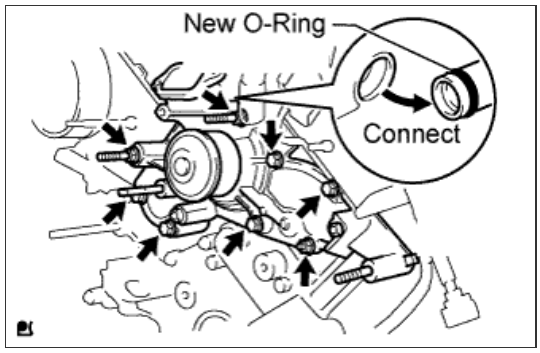
b. Install the O-ring to the water by-pass pipe end.

c. Install a new gasket to the cylinder block.

d. onnect the water pump to the water by-pass pipe end.

e. Temporarily install the water pump with the 5 bolts, 2 stud bolts and nut. Uniformly tighten the bolts, stud bolts and nut in several passes.

Torque:
for bolt:
21 N*m{ 214 kgf*cm , 15 ft.*lbf
for stud bolt, nut:
18 N*m{ 184 kgf*cm , 13 ft.*lbf



16. INSTALL CYLINDER AD GASKET L

a. lean the cylinder block and cylinder head with solvent.

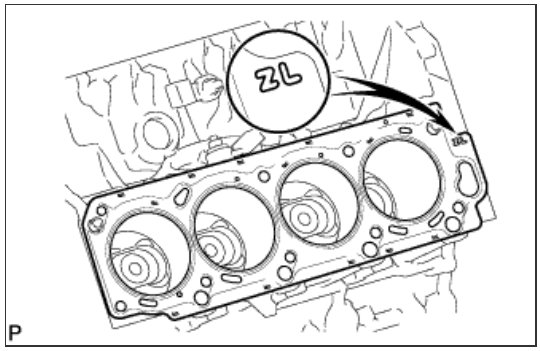
b. Place a new cylinder head gasket in position on the cylinder block.

IN:

A mark is placed on the rear side of the cylinder head gasket to distinguish the LH and RH sides, a "2 mark for the RH side and a "2L" mark for the LH side.

NOTICE:

Be careful of the installation direction.

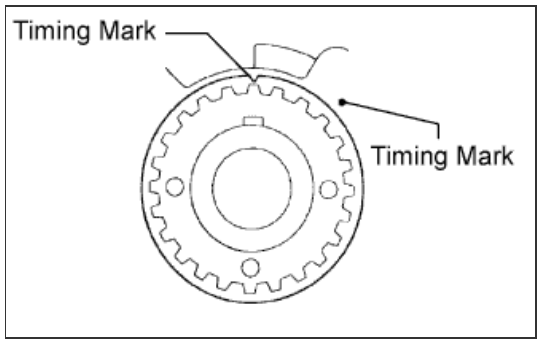


17. INSTALL CYLINDER AD L

IN:

The cylinder head bolts are tightened in 3 progressive steps.

a. Check that the timing mark of the crankshaft timing pulley is in the position shown in the illustration, and that the piston is below the TDC of compression.



b. Install the cylinder head with the exhaust manifold to the cylinder block.

NOTICE:

Ensure that no oil is on the mounting surface of the cylinder head.

c. Apply a light coat of engine oil to the threads and under the heads of the cylinder head bolts.

d. Step 1:

i. Set the plate washer to the cylinder head bolt.

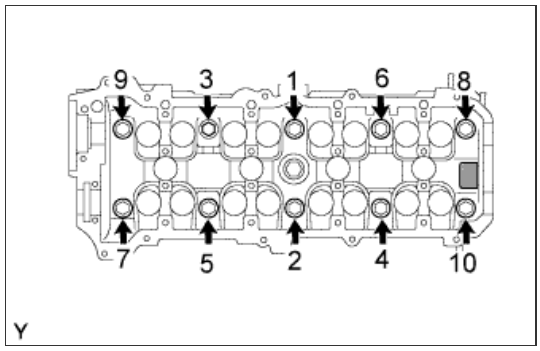
ii. Install and uniformly tighten the 10 cylinder head bolts and plate washers in the sequence shown in the illustration.

Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf

If any one of the cylinder head bolts does not meet the torque specification, replace the cylinder head bolt.

NOTICE:

Do not drop the plate washer for the cylinder head bolt of the cylinder head.



e. Step 2:

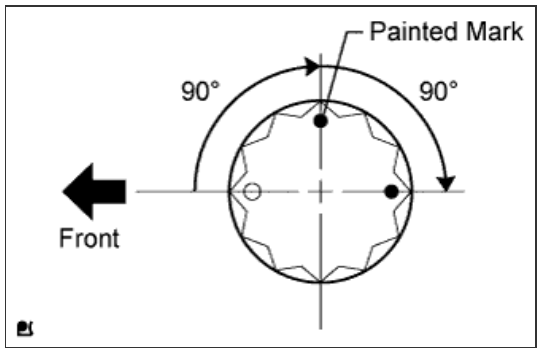
i. Mark the cylinder head bolt head with paint as shown in the illustration.

ii. Tighten the cylinder head bolts 90° in the sequence shown in step 1.

f. Step 3:

i. Tighten the cylinder head bolts another 90° in the sequence shown in step 1.

ii. Check that the painted marks are now facing rearward.



18. INSTALL CYLINDER HEAD GASKET

a. Clean the cylinder block and cylinder head with solvent.

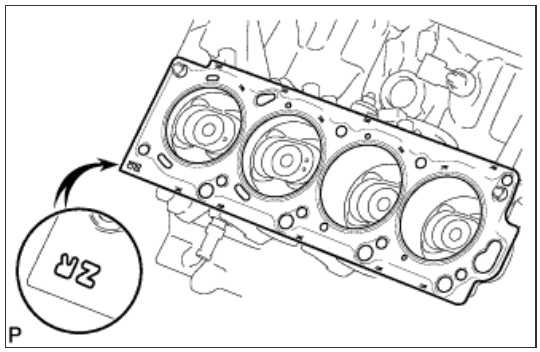
b. Place a new cylinder head gasket in position on the cylinder block.

IN:

A mark is placed on the rear side of the cylinder head gasket to distinguish the LH and RH sides, a "2 mark for the RH side and a "2L" mark for the LH side.

NOTICE:

Be careful of the installation direction.



19. INSTALL CYLINDER AD SUB-ASSEMBLY

IN:

The cylinder head bolts are tightened in 3 progressive steps.

a. Install the cylinder head with the exhaust manifold to the cylinder block.

NOTICE:

Ensure that no oil is on the mounting surface of the cylinder head.

b. Apply a light coat of engine oil to the threads and under the heads of the cylinder head bolts.

c. Step 1:

i. Set the plate washer to the cylinder head bolt.

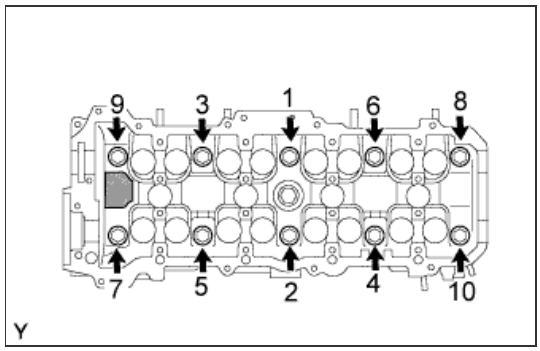
ii. Install and uniformly tighten the 10 cylinder head bolts and plate washers in the sequence shown in the illustration.

Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf

If any one of the cylinder head bolts does not meet the torque specification, replace the cylinder head bolt.

NOTICE:

Do not drop the plate washer for the cylinder head bolt of the cylinder head.



d. Step 2:

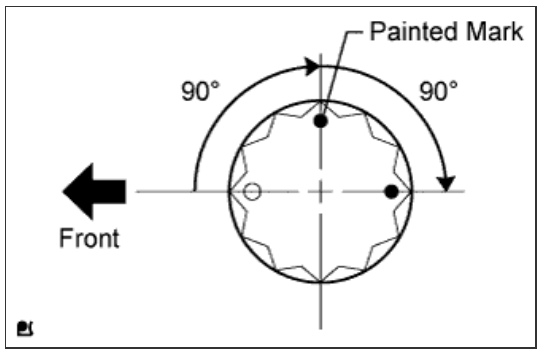
i. Mark the cylinder head bolt head with paint as shown in the illustration.

ii. Tighten the cylinder head bolts 90° in the sequence shown in step 1.

e. Step 3:

i. Tighten the cylinder head bolts another 90° in the sequence shown in step 1.

ii. Check that the painted marks are now facing rearward.



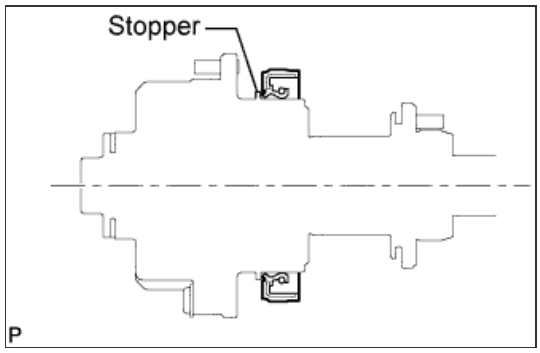
20. INSTALL CAMS A T SETTING OIL SEAL

a. Apply MP grease to the lip of a new oil seal.

NOTICE:

- **Do not allow foreign matter to contact the lip of the oil seal.**
- **Do not allow MP grease to contact the dust seal.**

b. Insert the oil seal into the camshaft timing tube until it reaches the stopper.



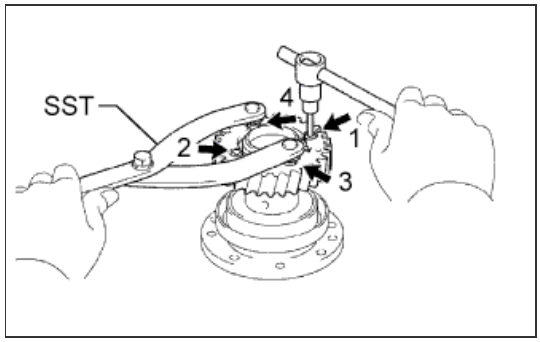
NOTICE:

- **Be careful of the installation direction.**
- **Do not turn over the lip of the oil seal.**

21. INSTALL CAMS A T DRI E GEAR

a. Align the timing tube knock pin with the knock pin groove of the drive gear, and temporarily install the drive gear with the bolts.

b. Using SST and a 5 mm hexagon wrench, uniformly tighten the bolts in several steps, in the sequence shown in the illustration.



Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf

SST
9960-10010 09962-01000, 09963-00500)

NOTICE:

Be careful not to damage the timing tube.

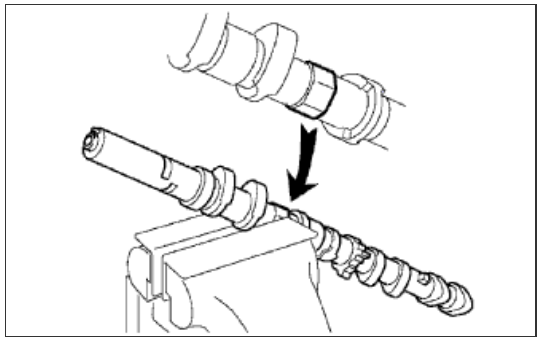
22. INSTALL CAMS A T TIMING TUBE ASSEMBLY

a. Mount the hexagonal portion of the camshaft in a vise.

NOTICE:

Be careful not to damage the camshaft.

b. Apply a light coat of engine oil to the camshaft and camshaft timing tube.



c. Align the camshaft knock pin with the knock pin hole of the timing tube, and push the timing tube by hand until the camshaft knock pin touches the bottom of the timing tube knock pin hole.

NOTICE:

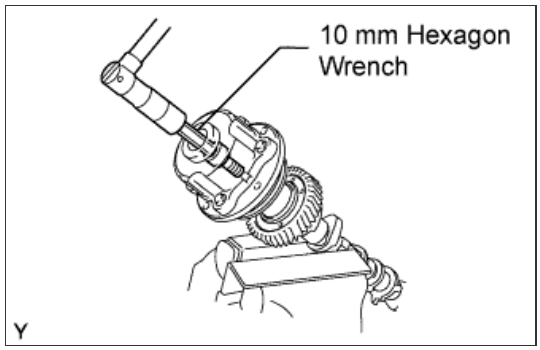
Do not forcefully push on the camshaft timing tube. This may cause the camshaft knock pin tip to damage the installation surface of the camshaft timing tube.

d. Using a 10 mm socket hexagon wrench, install the bolt.

Torque:
78 N*m{ 795 kgf*cm , 58 ft.*lbf

e. Install the seal washer and screw plug.

Torque:
15 N*m{ 153 kgf*cm , 11 ft.*lbf

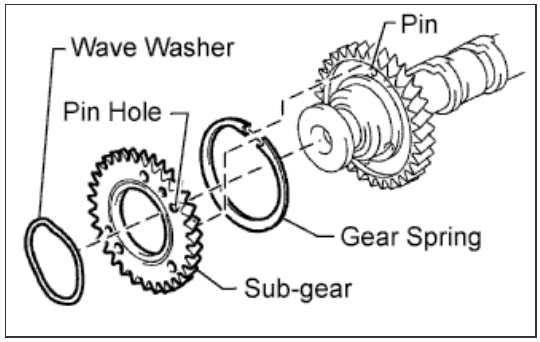


23. INSTALL CAMS A T SUB-GEAR

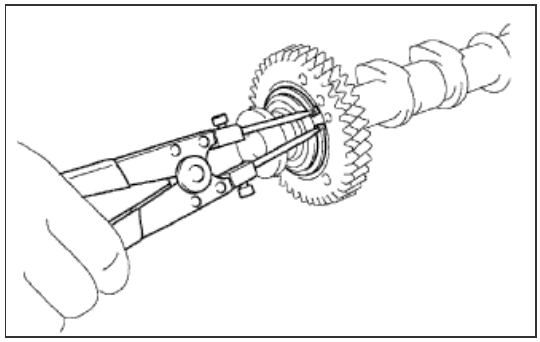
a. Install the gear spring, sub-gear and wave washer.

IN:

Attach the pins on the gears to the gear spring ends.



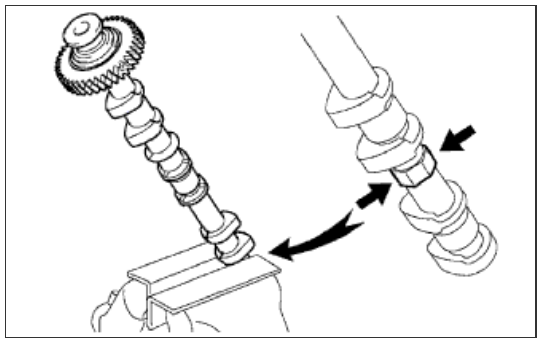
b. Using snap ring pliers, install the snap ring.



c. Mount the hexagonal portion of the camshaft in a vise.

NOTICE:

Be careful not to damage the camshaft.

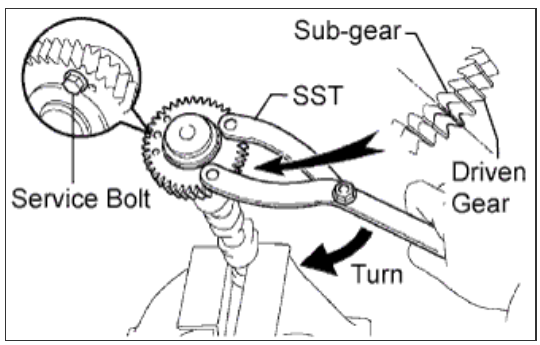


d. Using SST, align the holes of the driven gear and sub-gear by turning the sub-gear clockwise, and temporarily install a service bolt.

SST
09960-10010 09962-01000, 09963-00500)

Recommended Service Bolt:

Thread Diameter	Thread Pitch	Bolt Length
6 mm	1.0 mm	16 to 2 mm (0.630 to 0.787 in.)



e. Align the gear teeth of the driven gear and sub-gear, and tighten the service bolt.

24. INSTALL AL ELI TER

a. Apply a light coat of engine oil to the valve lifters, adjusting shims and valve stem tips.

b. Install the valve lifters and adjusting shims.

NOTICE:

Be careful not to drop the adjusting shim into the cylinder head.

25. INSTALL CAMS A T for Bank 2)

NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged. To avoid this, the following steps should be carried out.

IN:

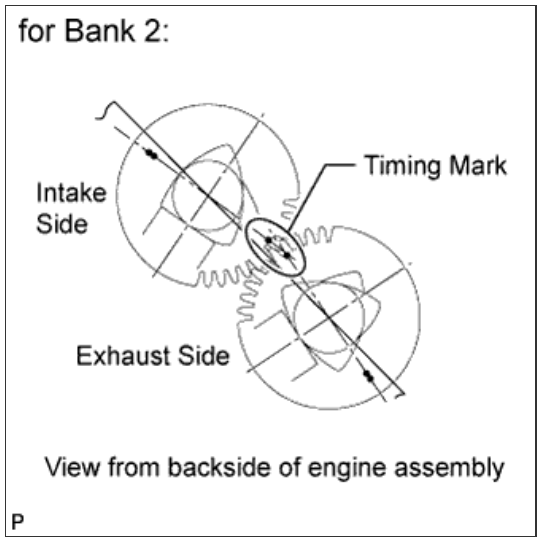
When performing this procedure to adjust the valve clearance, it is not necessary to apply seal packing to the No. 1 bearing cap and camshaft housing plug.

a. Apply a light coat of engine oil to the cam lobe and gear of the camshaft and the journal of the cylinder head.

b. Using a wrench, align the timing marks (1 dot mark each) of the camshaft drive and driven gears, and set the camshaft and No. 2 camshaft in place.

IN:

The position shown in the illustration is the most stable position for the exhaust camshaft.



c. Apply seal packing to the camshaft housing plug groove.

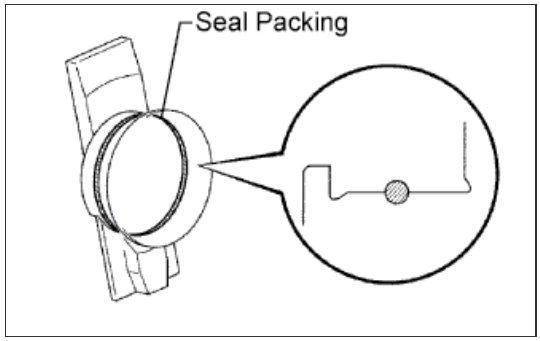
IN:

Remove any old packing (IPG) material before applying new seal packing.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

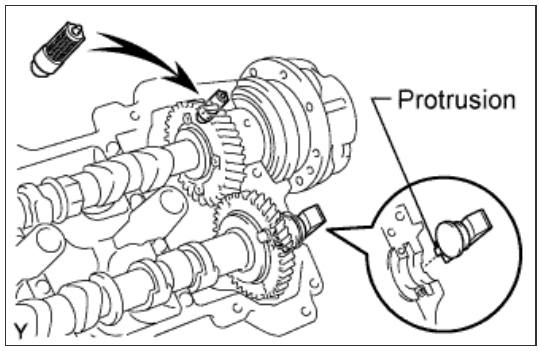
- **Be careful of the installation direction.**
- **Remove any oil from the contact surface.**



d. Install the camshaft housing plug and oil control valve filter to the cylinder head as shown in the illustration.

IN:

Align the protrusion on the camshaft housing plug with the groove of the cylinder head and install the plug.



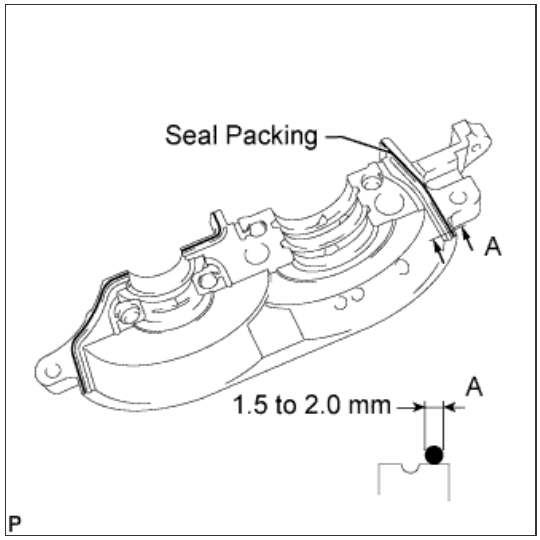
e. Apply seal packing to the No. 1 bearing cap as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
1.5 to 2.0 mm 0.0591 to 0.0787 in.)

NOTICE:

Install the No. 1 bearing cap and housing plug within 3 minutes.



f. Install a new seal washer to each bearing cap bolt indicated by an arrow in the illustration, and apply engine oil to the threads of the bolts. Then temporarily install them.

g. Apply engine oil to the threads and washer part of the bearing cap bolts not indicated in the illustration.

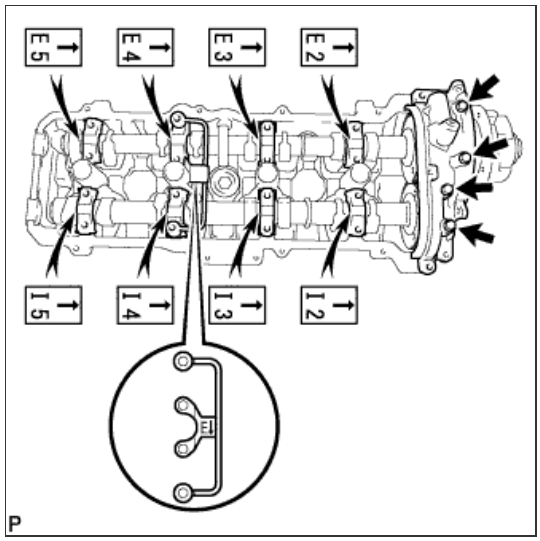
h. Temporarily install the oil feed pipe and bearing caps with the 18 bearing cap bolts, as shown in the illustration.

Bolt Length:

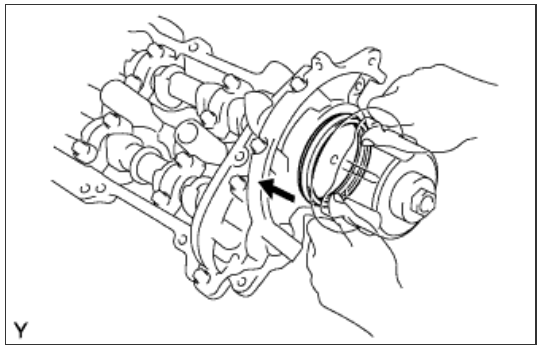
Item	Length
Bolt A with seal washer	94 mm (3.70 in.)
Bolt B with seal washer	72 mm (2.84 in.)
Bolt C	25 mm (0.984 in.)
Bolt D	55 mm (2.17 in.)
Bolt E	40 mm (1.58 in.)

IN:

Face the arrow imprinted on the oil feed pipe to the exhaust side.

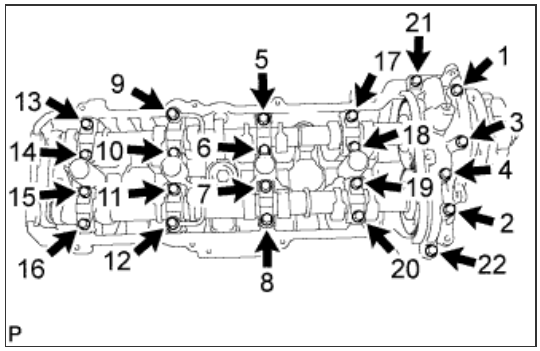


i. Push in the camshaft setting oil seal.



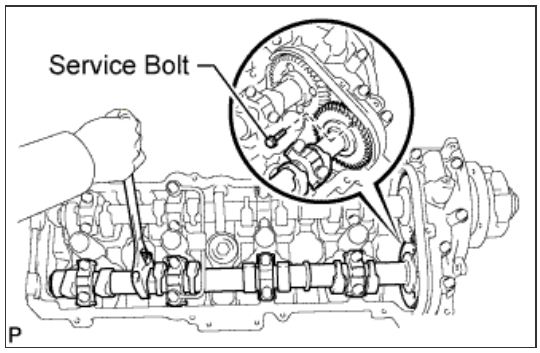
j. Uniformly tighten the 22 bearing cap bolts in several steps, in the sequence shown in the illustration.

Torque:
for bolt 21, 22:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf
for other bolt:
16 N*m{ 163 kgf*cm , 12 ft.*lbf



k. Bring the service bolt installed in the driven sub-gear upward by turning the hexagonal portion of the camshaft with a wrench.

l. Remove the service bolt.



26. INSTALL CAMS A T for Bank 1)

NOTICE:

As the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head which receives the shaft thrust may crack or be damaged. To avoid this, the following steps should be carried out.

IN:

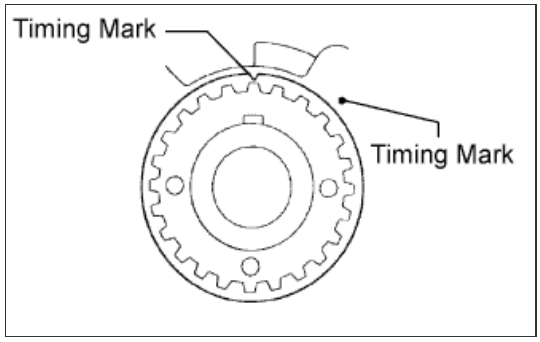
When performing this procedure to adjust the valve clearance, it is not necessary to apply seal packing to the No. 5 bearing cap and camshaft housing plug.

a. heck that the timing mark of the crankshaft timing pulley is in the position shown in the illustration, and that the piston is below the TD of compression.

NOTICE:

Having the crankshaft pulley at a wrong angle can cause the piston head and valve head to come into contact with each other when removing the camshaft. Always set the crankshaft pulley at the correct angle as shown in the illustration.

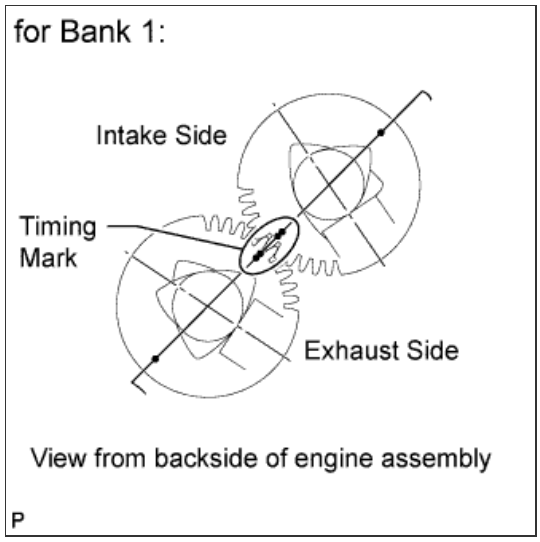
b. Apply a light coat of engine oil to the cam lobe and gear of the camshaft and the journal of the cylinder head.



c. Using a wrench, align the timing marks (2 dot marks each) of the camshaft drive and driven gears, and set the No. 3 and No. 4 camshafts in place.

IN:

The position shown in the illustration is the most stable position for the exhaust camshaft.



d. Apply seal packing to the camshaft housing plug groove.

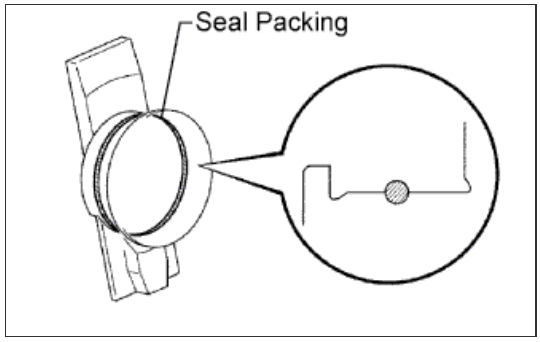
HINT:

Remove any old packing (IPG) material before applying new seal packing.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

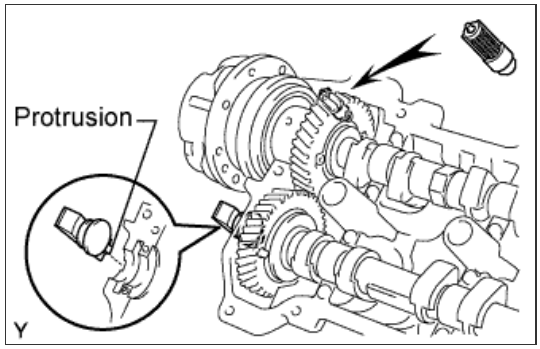
- **Be careful of the installation direction.**
- **Remove any oil from the contact surface.**



e. Install the camshaft housing plug and oil control valve filter to the cylinder head as shown in the illustration.

HINT:

Align the protrusion on the camshaft housing plug with the groove of the cylinder head and install the plug.



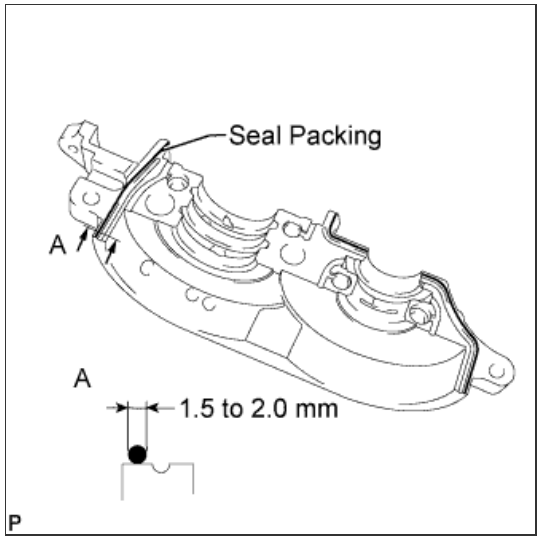
f. Apply seal packing to the No. 5 bearing cap as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
1.5 to 2.0 mm 0.0591 to 0.0787 in.)

NOTICE:

Install the No. 5 bearing cap and housing plug within 3 minutes.



g. Install a new seal washer to each bearing cap bolt indicated by an arrow in the illustration, and apply engine oil to the threads of the bolts. Then temporarily

install them.

h. Apply engine oil to the threads and washer part of the bearing cap bolts not indicated in the illustration.

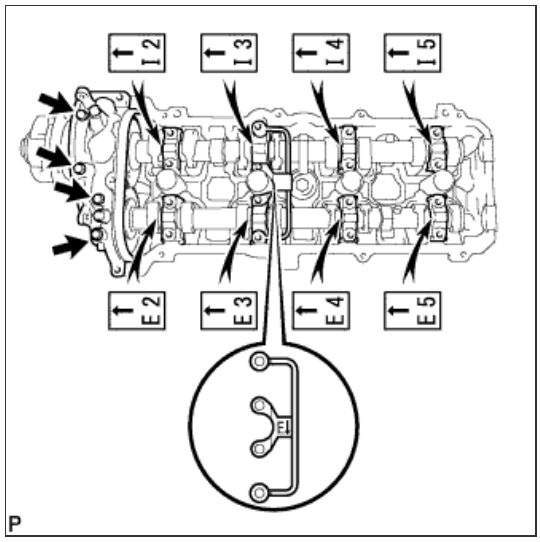
i. Temporarily install the oil feed pipe and bearing caps with the 18 bearing cap bolts, as shown in the illustration.

Bolt Length:

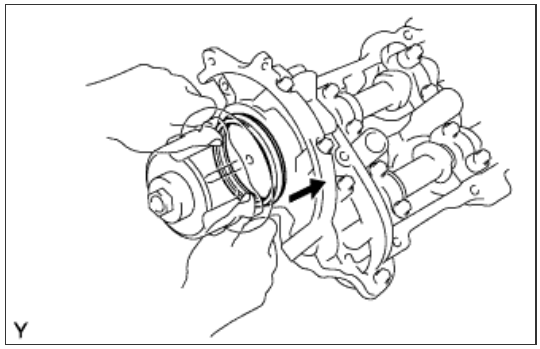
Item	Length
Bolt A with seal washer	9 mm (3.70 in.)
Bolt B with seal washer	72 mm (2.84 in.)
Bolt C	25 mm (0.984 in.)
Bolt D	55 mm (2.17 in.)
Bolt E	40 mm (1.58 in.)

HINT:

Face the arrow imprinted on the oil feed pipe to the exhaust side.

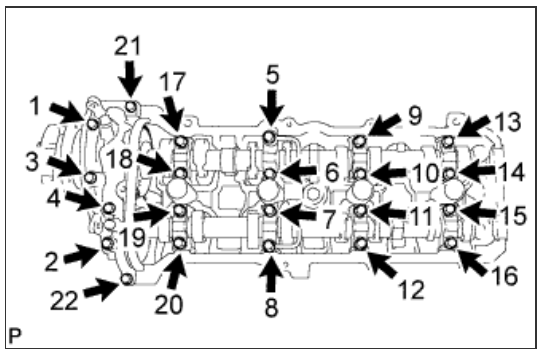


j. Push in the camshaft setting oil seal.



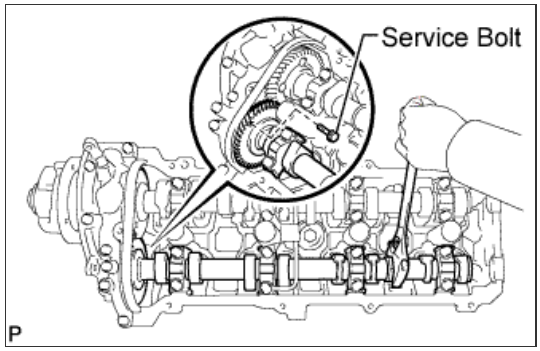
k. Uniformly tighten the 22 bearing cap bolts in several steps, in the sequence shown in the illustration.

Torque:
for bolt 21, 22:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf
for other bolt:
16 N*m{ 163 kgf*cm , 12 ft.*lbf



l. Bring the service bolt installed in the driven sub-gear upward by turning the hexagonal portion of the camshaft with a wrench.

m. Remove the service bolt.

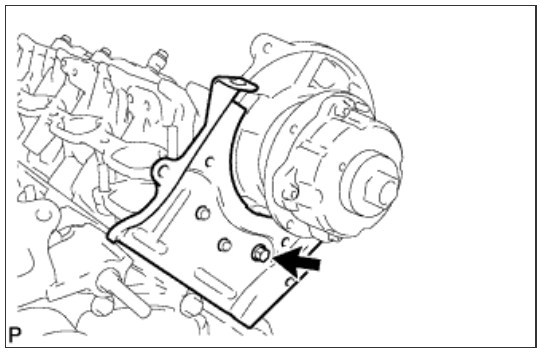


27. INSTALL REAR TIMING BELT PLATE L

a. Install the timing belt plate with the bolt.

Torque:

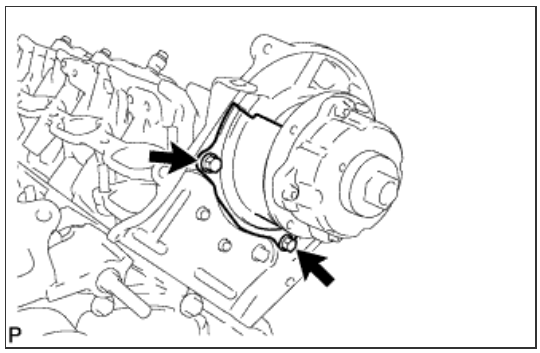
7.5 N*m{ 76 kgf*cm , 66 in.*lbf



28. INSTALL REAR NO. 2 TIMING BELT PLATE L

a. Install the timing plate with the 2 bolts.

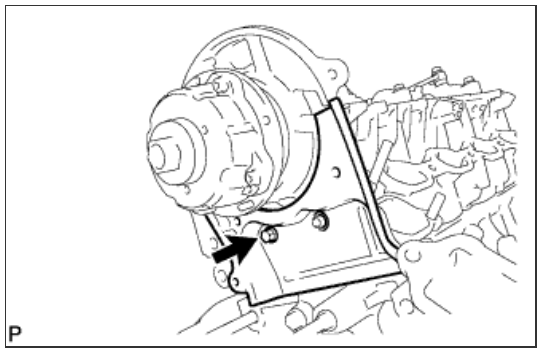
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf



29. INSTALL REAR TIMING BELT PLATE R

a. Install the timing belt plate with the bolt.

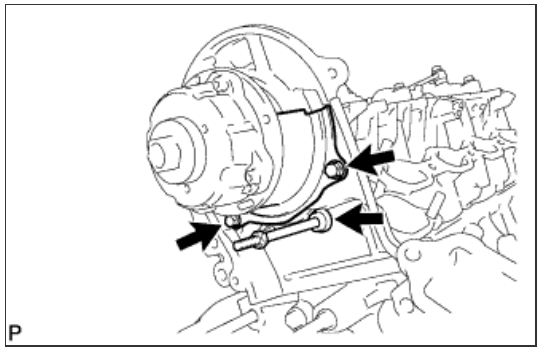
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf



. INSTALL REAR NO. 2 TIMING BELT PLATE R

a. Install the timing plate with the 2 bolts and stud bolt.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf



1. INSTALL CAMS A T TIMING PULLEY

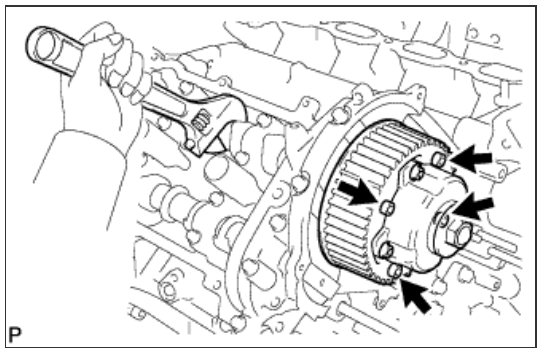
a. Align the camshaft timing tube knock pin with the knock pin groove of the timing pulley.

b. Temporarily install the bolts of the camshaft timing pulley.

c. Hold the hexagonal portion of the camshaft with a wrench.

d. Using a 5 mm hexagon wrench, tighten the bolts.

Torque:
8.1 N*m{ 83 kgf*cm , 72 in.*lbf



2. INSTALL CAMS A T TIMING PULLEY SUB-ASSEMBLY L

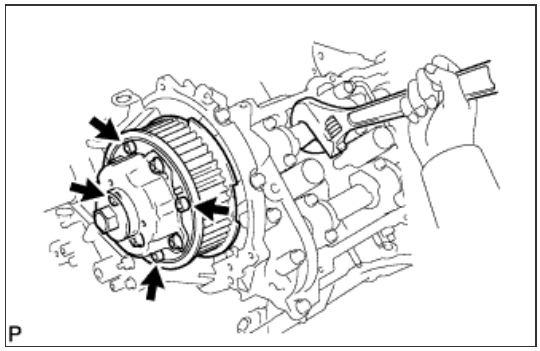
a. Align the camshaft timing tube knock pin with the knock pin groove of the timing pulley.

b. Temporarily install the bolts of the camshaft timing pulley.

c. Hold the hexagonal portion of the camshaft with a wrench.

d. Using a 5 mm hexagon wrench, tighten the bolts.

Torque:
8.1 N*m{ 83 kgf*cm , 72 in.*lbf

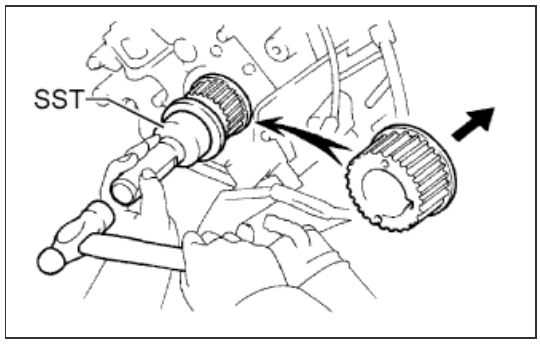


. INSTALL CRANKS A T TIMING PULLEY

a. Align the timing pulley set key with the key groove of the pulley.

b. Using SST and a hammer, tap in the timing pulley with the flange side facing inward.

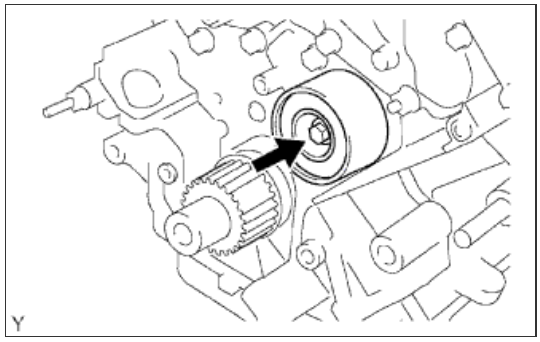
SST
09223-46011



34. INSTALL NO. 2 TIMING BELT IDLER SUB-ASSEMBLY

a. Install the timing belt idler with the bolt.

Torque:
35 N*m{ 352 kgf*cm , 25 ft.*lbf



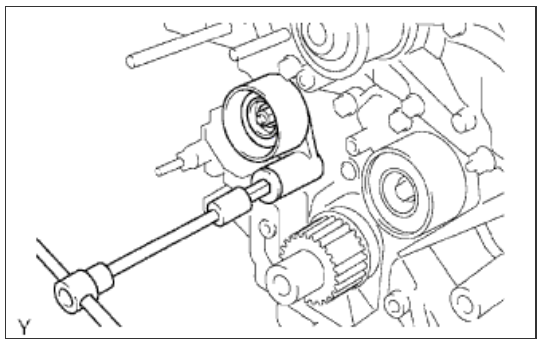
35. INSTALL NO. 1 TIMING BELT IDLER SUB-ASSEMBLY

a. When reusing the timing belt idler shaft, apply adhesive to 2 or 3 of the threads.

Adhesive:
Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent

b. Using a 10 mm hexagon wrench, install the plate washer and timing belt idler with the idler shaft.

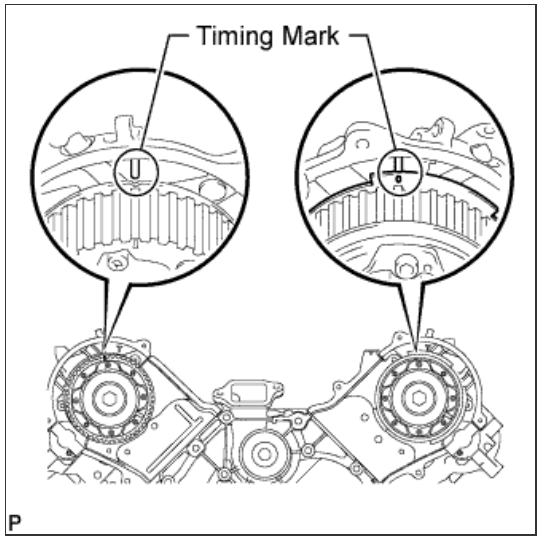
Torque:
35 N*m{ 352 kgf*cm , 25 ft.*lbf



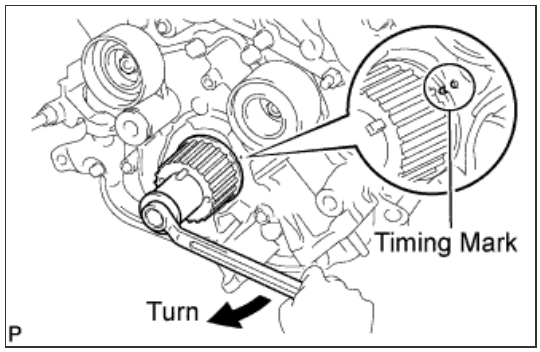
. INSTALL TIMING BELT

a. Set the No. 1 cylinder to TDC/compression.

i. Turn the hexagonal portion of the camshaft to align the timing marks of the camshaft timing pulleys and timing belt plates.



ii. Using the pulley bolt, turn the crankshaft to align the timing marks of the crankshaft timing pulley and oil pump body.



b. Install the timing belt.

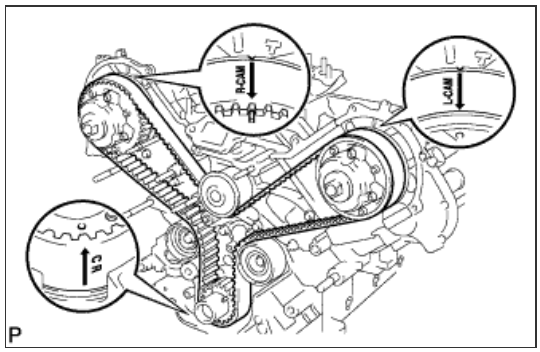
i. Remove any oil or water from each pulley, and keep them clean.

NOTICE:

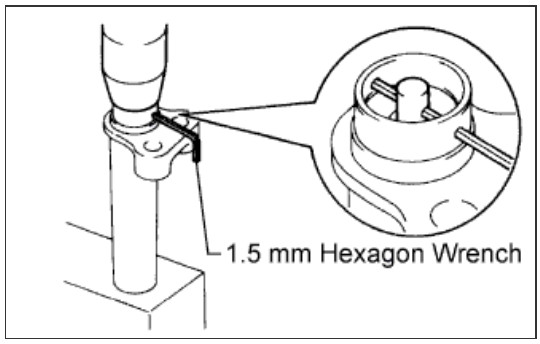
Only wipe the pulleys. Do not use any cleansing agent on the pulleys.

ii. Face the front mark (arrow) on the timing belt forward.

iii. Align the timing marks on the timing belt and crankshaft timing pulley, and the timing belt and camshaft timing pulleys, and install the timing belt.



c. Install the belt tensioner.



i. Remove the dust seal from the belt tensioner.

ii. Using a press, slowly press in the push rod using a force of 981 to 9807 N (100 to 1000 kgf, 22 .5 to 22 .7 lbf).

iii. Align the holes of the push rod and housing, and pass a 1.5 mm hexagon wrench through the holes to keep the setting position of the push rod.

iv. Release the press.

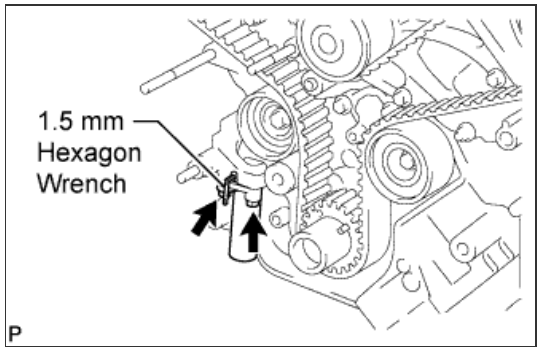
v. Install the dust seal to the belt tensioner.

vi. Temporarily install the belt tensioner with the 2 bolts.

vii. Tighten the 2 bolts.

Torque:
26 N*m{ 265 kgf*cm , 19 ft.*lbf

viii. Using pliers, remove the 1.5 mm hexagon wrench from the timing belt tensioner.



37. C EK NO. 1 CYLINDER TO TDC COMPRESSION

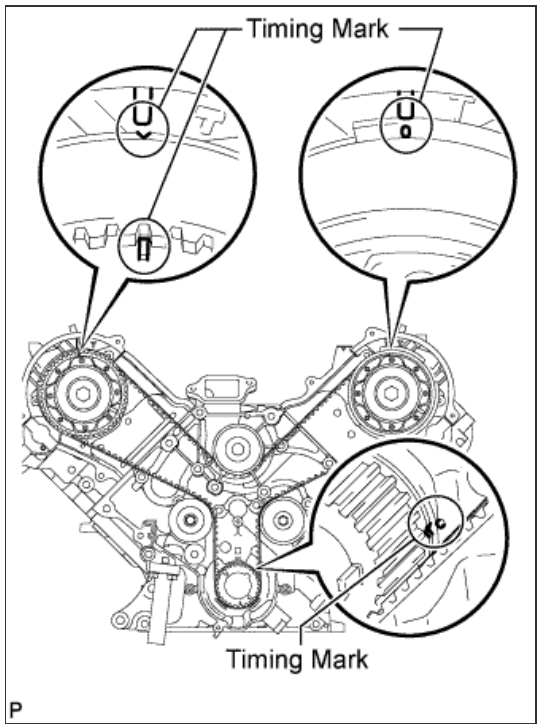
a. Using the pulley bolt, slowly turn the crankshaft timing pulley 2 revolutions from the TD to TD .

NOTICE:

Always turn the crankshaft timing pulley clockwise.

b. heck that each pulley is aligned with each timing mark as shown in the illustration.
If the timing marks are not aligned, remove the timing belt and reinstall it.

c. Remove the pulley bolt.



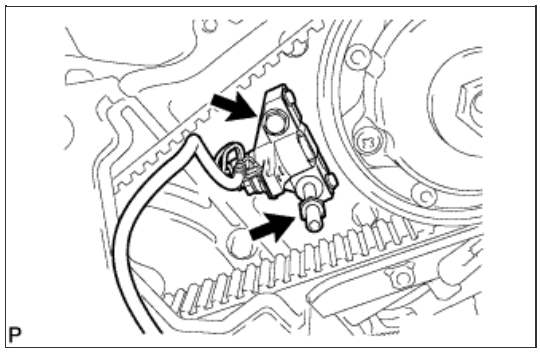
38. INSPECT AL E CLEARANCE

a. Inspect the valve clearance (lick here).
If the result is not as specified, adjust the valve clearance (lick here).

39. INSTALL CAMS A T POSITION SENSOR ASSEMBLY

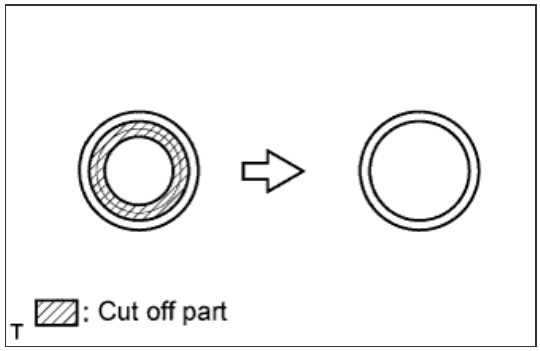
a. Install the camshaft position sensor with the bolt and stud bolt.

Torque:
7.5 N*m{ 80 kgf*cm , 66 in.*lbf



40. INSTALL SPARK PLUG TUBE GASKET

a. Using a cutter knife, cut off the seal part of the removed gasket.



b. Using the removed gasket and a hammer, tap in a new gasket until it stops.

NOTICE:

Do not tap on the oil seal at an angle.

HINT:

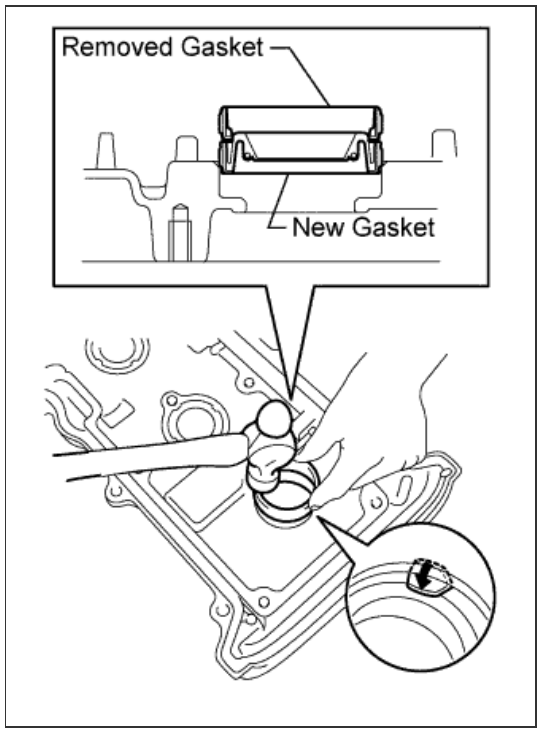
If the removed gasket does not fit on the new one, correct the removed one with pliers.

c. Apply a light coat of MP grease to the lip of the gasket.

NOTICE:

Keep the lip free from foreign matter.

d. Return the 8 ventilation case claws to the original positions.



41. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY

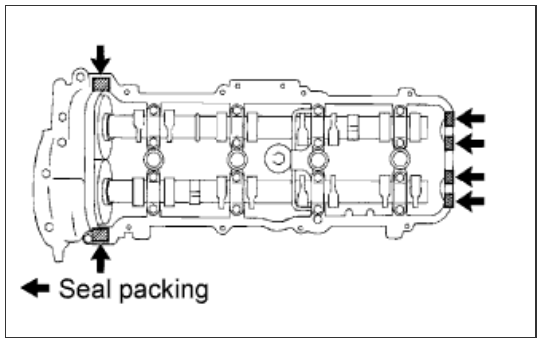
a. Install a new gasket to the cylinder head cover.

b. Apply seal packing to the cylinder head as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

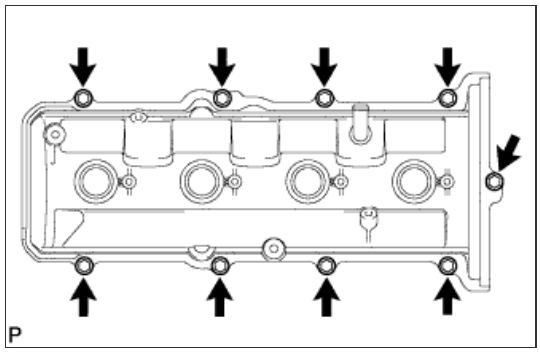
NOTICE:

- **Remove any oil from the contact surface.**
- **Install the cylinder head cover within 3 minutes after applying seal packing.**



c. Install the cylinder head cover with the 9 bolts. Uniformly tighten the bolts in several steps.

Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf



42. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY L

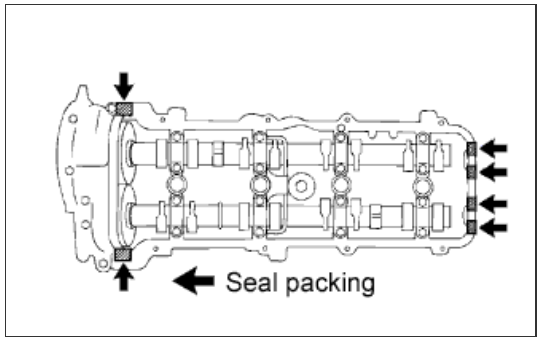
a. Install a new gasket to the cylinder head cover.

b. Apply seal packing to the cylinder head as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

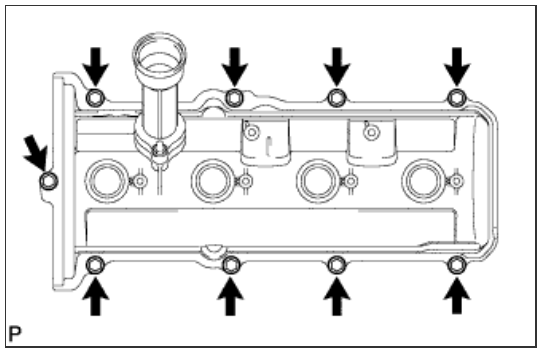
NOTICE:

- **Remove any oil from the contact surface.**
- **Install the cylinder head cover within 3 minutes after applying seal packing.**



c. Install the cylinder head cover with the 9 bolts. Uniformly tighten the bolts in several steps.

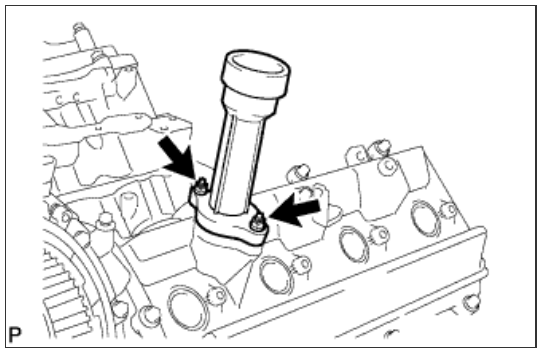
Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf



43. INSTALL OIL FILLER CAP HOUSING

a. Install a new gasket and the housing with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf



44. INSTALL OIL ILLER CAP SUB-ASSEMBLY

a. Install a new gasket to the oil filler cap.

b. Install the oil filler cap.

45. INSTALL SPARK PLUG

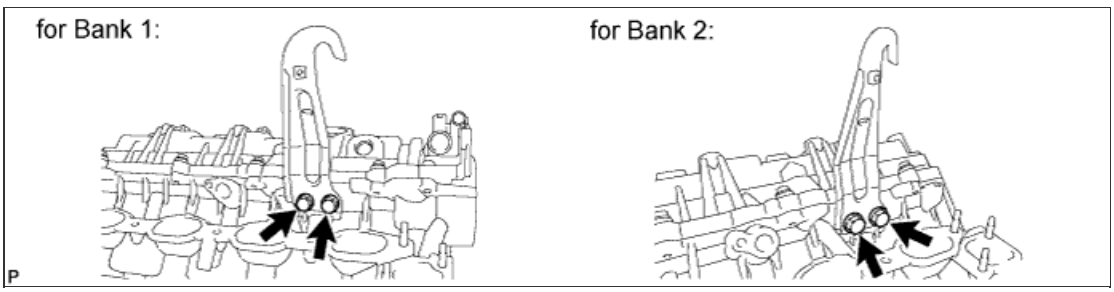
a. Install the 8 spark plugs.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf

46. INSTALL NO. 1 ENGINE ANGER

a. Install the engine hanger with the 2 bolts.

Torque:
37 N*m{ 377 kgf*cm , 27 ft.*lbf

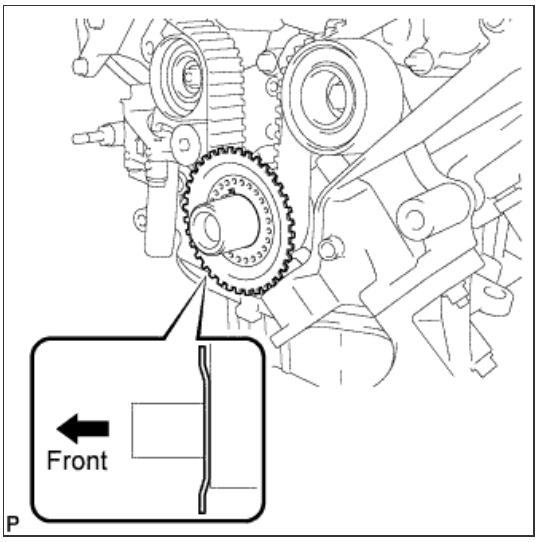


47. INSTALL NO. 1 CRANKS A T POSITION SENSOR PLATE

a. Install the sensor plate as shown in the illustration.

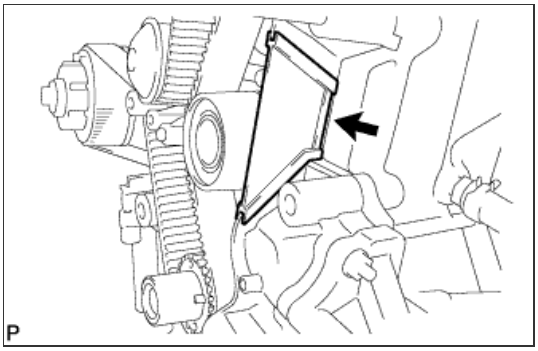
NOTICE:

Take care not to install the sensor plate in a wrong direction.



48. INSTALL TIMING BELT CO B SPACER

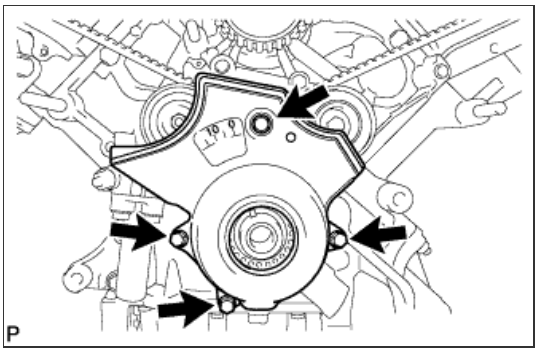
a. Install the cover spacer and gasket.



49. INSTALL NO. 1 TIMING BELT CO B

a. Install the timing belt cover with the bolts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf



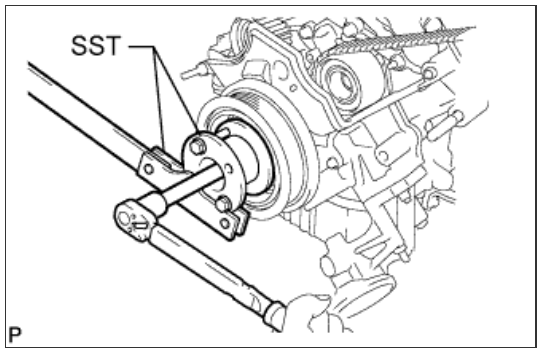
50. INSTALL CRANKS A T DAMPER SUB-ASSEMBLY

a. Align the pulley set key with the key groove of the crankshaft damper.

b. Using SST, hold the crankshaft pulley and install the pulley bolt.

SST
09213-70011 09213-70020)
09330-00021 09330-00030)

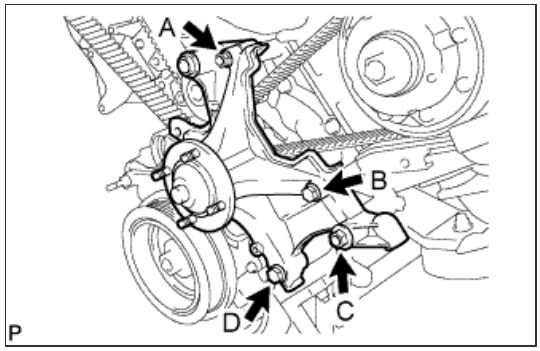
Torque:
245 N*m{ 2498 kgf*cm , 181 ft.*lbf



51. INSTALL AN BRACKET SUB-ASSEMBLY

a. Install the fan bracket with the 2 bolts and 2 nuts.

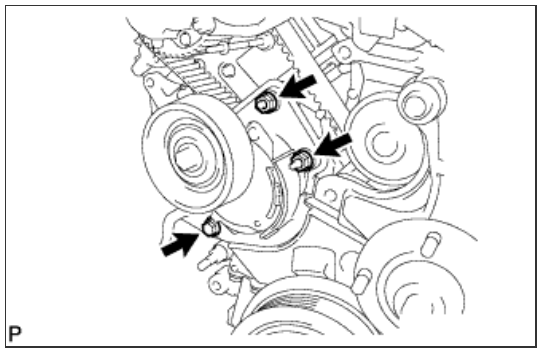
Torque:
for nut A, bolt B:
16 N*m{ 163 kgf*cm , 12 ft.*lbf
for nut C, bolt D:
32 N*m{ 326 kgf*cm , 24 ft.*lbf



52. INSTALL -RIBBED BELT TENSIONER ASSEMBLY

a. Install the belt tensioner with the bolt and 2 nuts.

Torque:
16 N*m{ 163 kgf*cm , 12 ft.*lbf

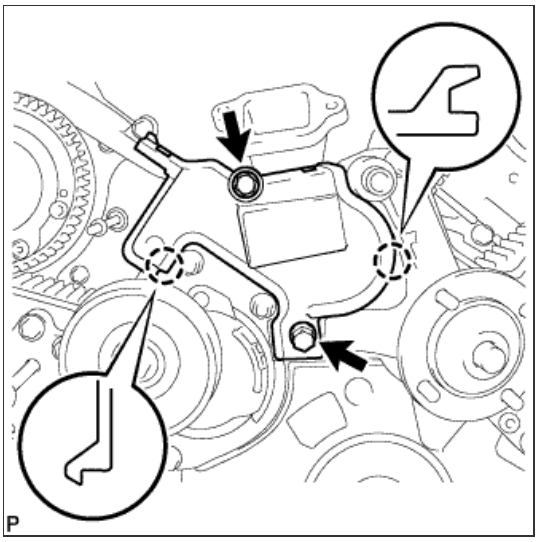


53. INSTALL NO. 2 TIMING BELT CO ER SUB-ASSEMBLY

a. Install the timing belt cover and fit the 2 claws into each part.

b. Install the 2 bolts.

Torque:
16 N*m{ 163 kgf*cm , 12 ft.*lbf



54. INSTALL NO. 3 TIMING BELT CO B SUB-ASSEMBLY L

a. Pass the camshaft position sensor wire through the cover hole.

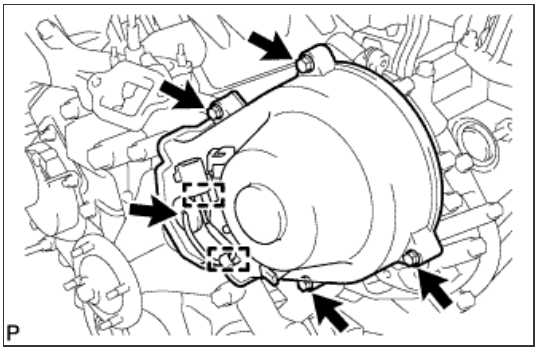
b. Install the timing belt cover with the bolts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf

c. Install the wire grommet to the timing belt cover.

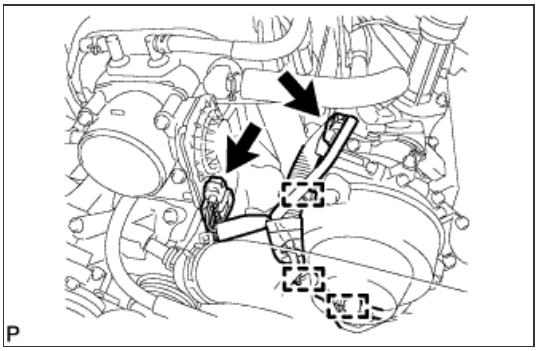
d. onnect the sensor connector.

e. Install the sensor wire to the 2 wire clamps on the cover.



f. onnect the engine wire to the 3 wire clamps.

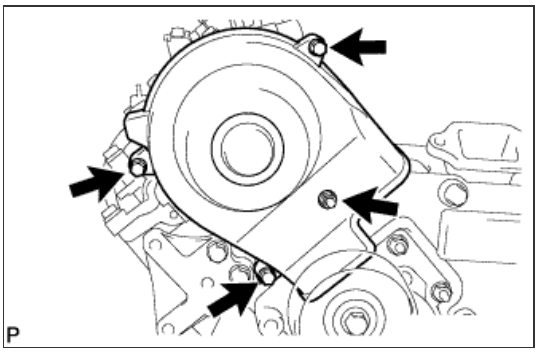
g. Connect the camshaft timing oil control valve connector and control motor connector.



55. INSTALL NO. 3 TIMING BELT CO B SUB-ASSEMBLY R

a. Install the timing belt cover with the 3 bolts and nut.

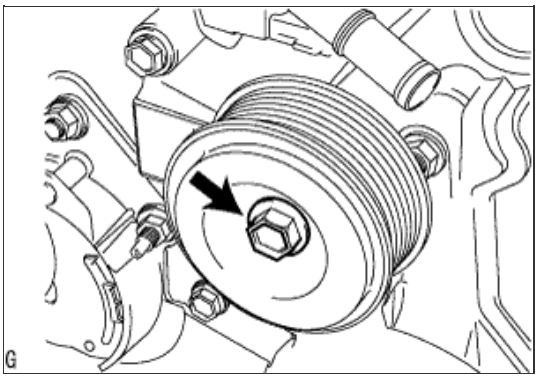
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf



56. INSTALL NO. 2 IDLER PULLEY SUB-ASSEMBLY

a. Install the idler pulley and cover plate with the bolt.

Torque:
39 N*m{ 398 kgf*cm , 29 ft.*lbf



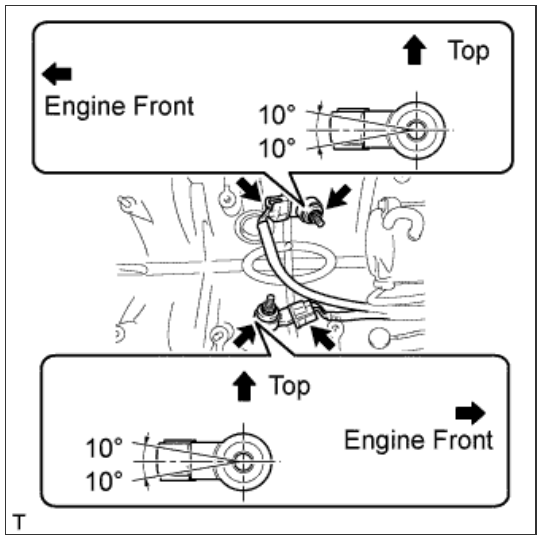
for Preparation Click here

1. INSTALL KNOCK CONTROL SENSOR

a. Install the 2 sensors with the 2 nuts as shown in the illustration.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

b. Connect the 2 sensor connectors.



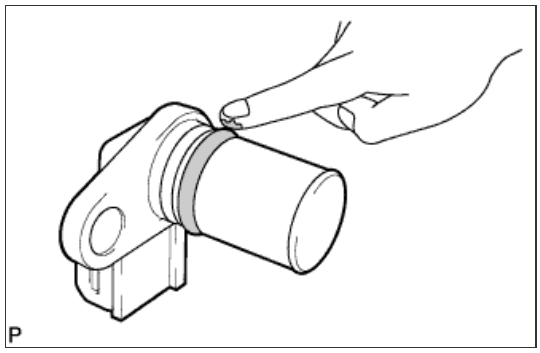
2. INSTALL CAMSHAFT POSITION SENSOR

a. Apply a light coat of engine oil to the O-ring.

NOTICE:

When reusing the sensor, inspect the O-ring.

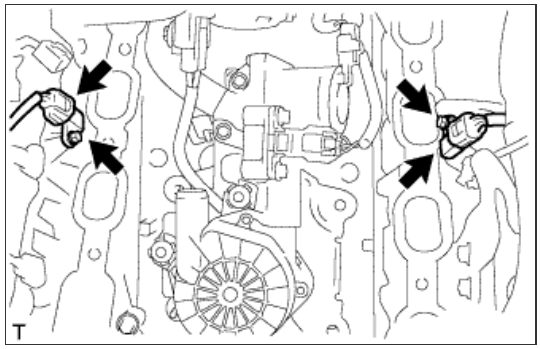
If the O-ring has scratches or cuts, replace the sensor.



b. Install the 2 sensors with the 2 bolts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

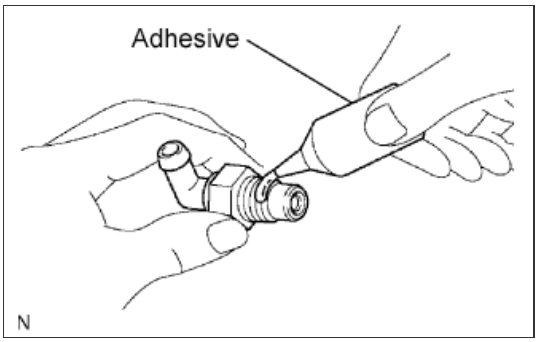
c. Connect the 2 sensor connectors.



3. INSTALL VENTILATION VALVE SUB-ASSEMBLY

a. Apply adhesive to 2 or 3 threads of the ventilation valve.

Adhesive:
Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent

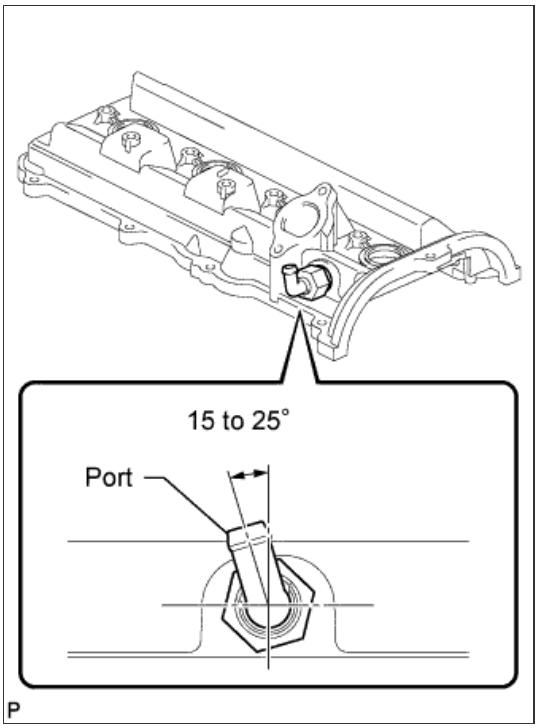


b. Install the ventilation valve to the cylinder head cover sub-assembly LH.

Torque:
27 N*m{ 275 kgf*cm , 20 ft.*lbf }

HINT:

After applying the specified torque, rotate the ventilation valve clockwise until the port facing in the direction indicated in the illustration.



4. INSTALL VENTILATION VALVE COVER

a. Install the ventilation valve cover to the ventilation valve.

5. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY LH

a. Install a new O-ring to the camshaft timing oil control valve.

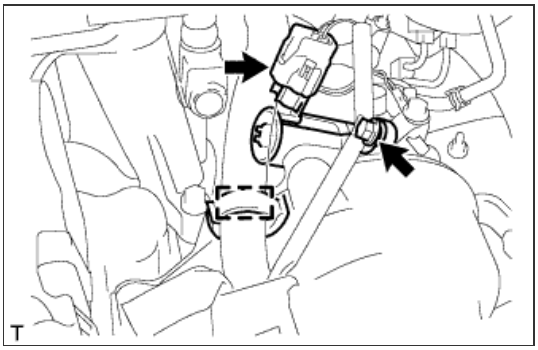
b. Apply a light coat of engine oil to the O-ring.

c. Install the camshaft timing oil control valve with the bolt.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

NOTICE:

- **o not allow foreign matter to contact the oil seal face of the oil control valve connecting surface with cylinder head cover .**
- **Be careful that the O-ring is not cracked when installing the oil control valve.**



d. Connect the camshaft timing oil control valve connector and wire harness clamp.

6. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY RH

a. Install a new O-ring to the camshaft timing oil control valve.

b. Apply a light coat of engine oil to the O-ring.

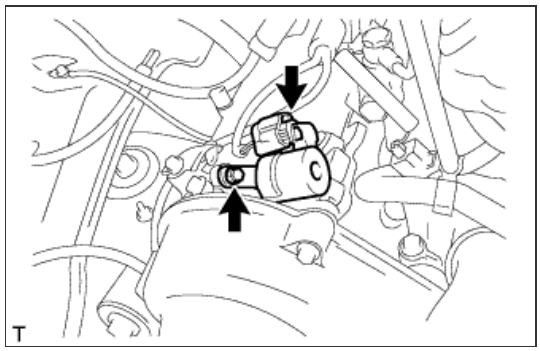
c. Install the oil control valve with the bolt.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

NOTICE:

- **o not allow foreign matter to contact the oil seal face of the oil control valve connecting surface with cylinder head cover .**
- **Be careful that the O-ring is not cracked when installing the oil control valve.**

d. Connect the camshaft timing oil control valve connector.



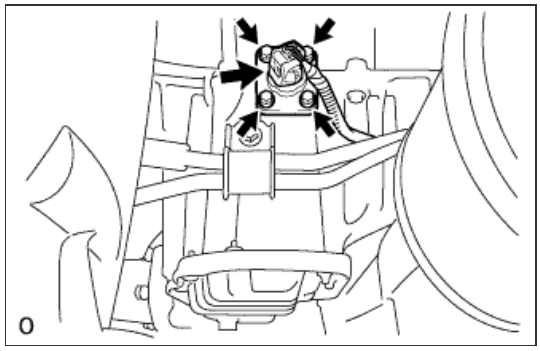
7. INSTALL ENGINE OIL LEVEL SENSOR

a. Clean the oil level sensor installation surface.

b. Install a new gasket and the oil level sensor with the 4 bolts.

Torque:
7.0 N*m{ 71 kgf*cm , 62 in.*lbf }

c. Connect the oil level sensor connector.

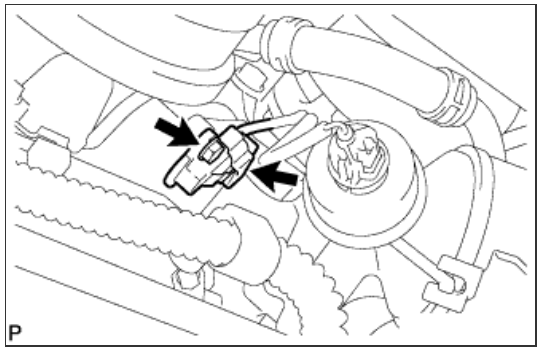


INSTALL CRANKSHAFT POSITION SENSOR

a. Install the sensor with the bolt.

Torque:
6.5 N*m{ 66 kgf*cm , 5 in.*lbf }

b. Connect the sensor connector.



9. INSTALL STARTER ASSEMBLY

a. Connect the starter wire with the nut.

Torque:
9. N*m{ 100 kgf*cm , 7 in.*lbf }

b. Connect the starter connector.

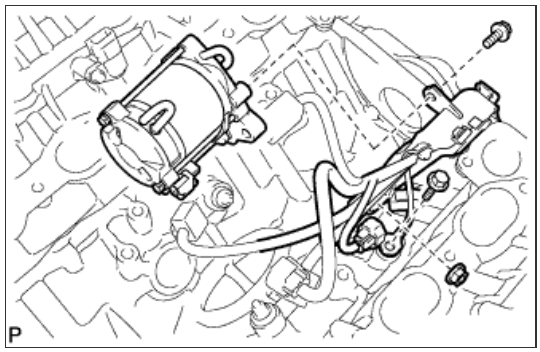
c. Connect the starter to the cylinder block.

d. Connect the ground wire with the bolt.

Torque:
17 N*m{ 173 kgf*cm , 13 ft.*lbf }

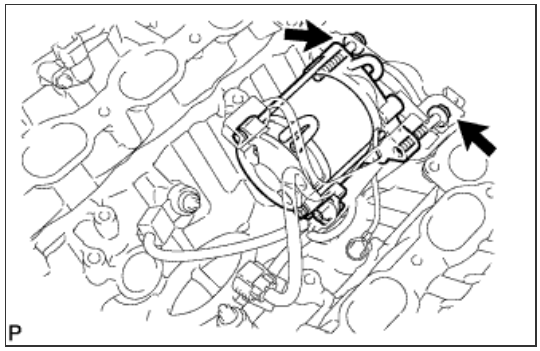
e. Connect the engine wire protector to the starter with the bolt.

Torque:
17 N*m{ 173 kgf*cm , 13 ft.*lbf }



f. Install the starter with the 2 bolts.

Torque:
25 N*m{ 255 kgf*cm , 1 ft.*lbf }



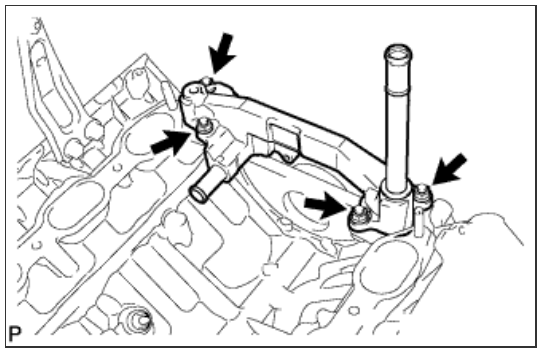
10. INSTALL REAR WATER BY-PASS JOINT

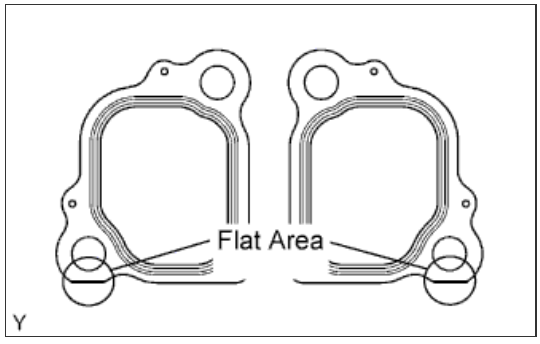
a. Install 2 new gaskets and the water by-pass joint with the 4 nuts.

Torque:
1 N*m{ 1 4 kgf*cm , 13 ft.*lbf }

HINT:

With the flat-bottom of each new gasket facing downward as shown in the illustration, install the 2 gaskets to the engine rear side.





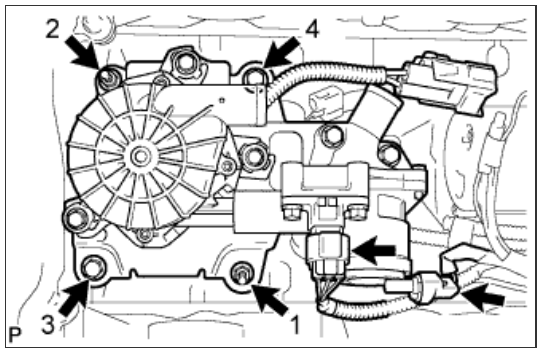
11. INSTALL AIR PUMP WITH BRACKET AN AIR SWITCHING VALVE Secondary Air Injection System

a. Install the air pump with bracket with the 2 bolts and 2 nuts in the order shown in the illustration.

Torque:
16 N*m{ 163 kgf*cm , 12 ft.*lbf }

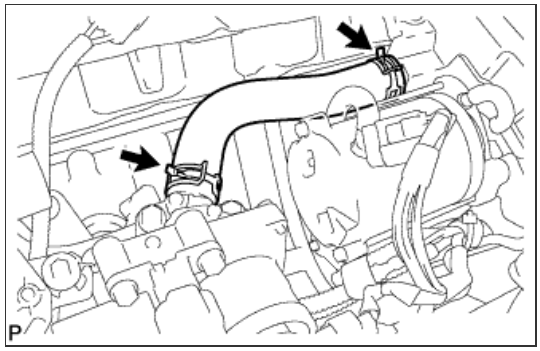
b. Connect the pressure sensor connector.

c. Connect the air switching valve connector.



12. INSTALL NO. 2 AIR INJECTION SYSTEM HOSE Secondary Air Injection System

a. Install the hose.

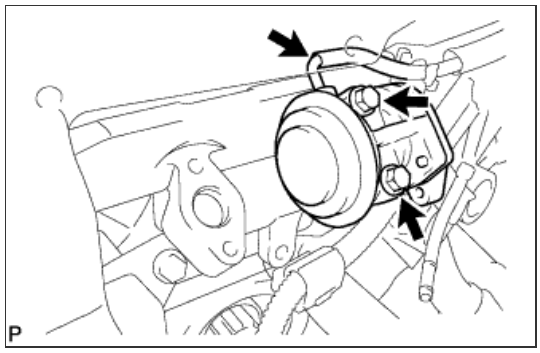


13. INSTALL NO. 1 AIR SWITCHING VALVE ASSEMBLY Secondary Air Injection System

a. Install a new gasket and the No. 1 air switching valve to the rear water by-pass joint with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Connect the vacuum switching valve hose to the No. 1 air switching valve.

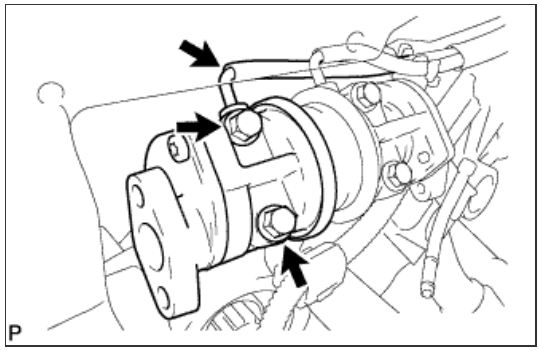


14. INSTALL NO. 2 AIR SWITCHING VALVE ASSEMBLY Secondary Air Injection System

a. Install a new gasket and the No. 2 air switching valve to the rear water by-pass joint with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Connect the vacuum switching valve hose to the No. 2 air switching valve.



15. INSTALL WATER BY-PASS PIPE SUB-ASSEMBLY

a. Apply soapy water to the O-ring.

b. Install a new O-ring to the water by-pass pipe.

c. Push in the water by-pass pipe.

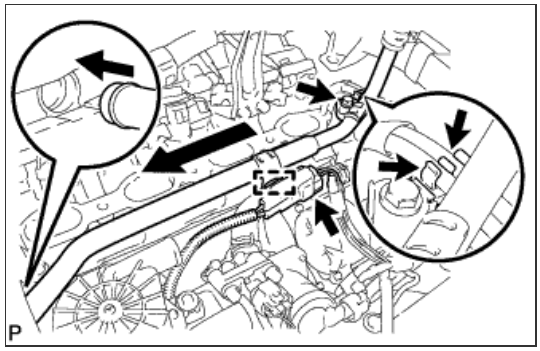
d. Install the water by-pass pipe with the bolt.

Torque:
1 N*m{ 1 4 kgf*cm , 13 ft.*lbf }

e. Connect the 2 vacuum switching valve hoses to the water by-pass pipe clamp.

f. Connect the wire harness clamp.

g. Connect the connector.



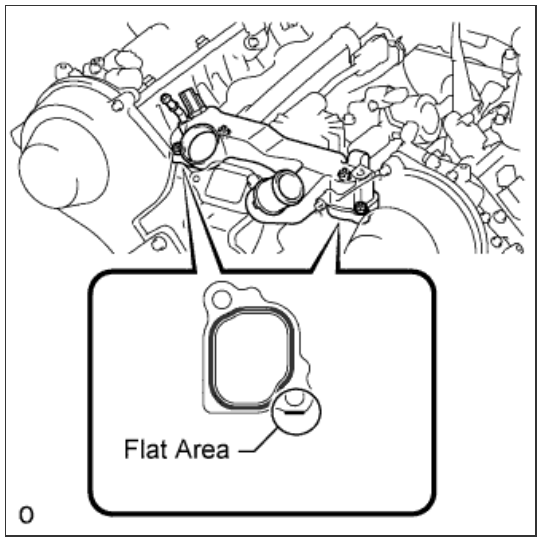
16. INSTALL FRONT WATER BY-PASS JOINT

a. Install 2 new gaskets and the water by-pass joint with the 4 nuts.

Torque:
1 N*m{ 1 4 kgf*cm , 13 ft.*lbf }

HINT:

With the flat-bottom of each new gasket facing downward as shown in the illustration, install the 2 gaskets to the engine front side.



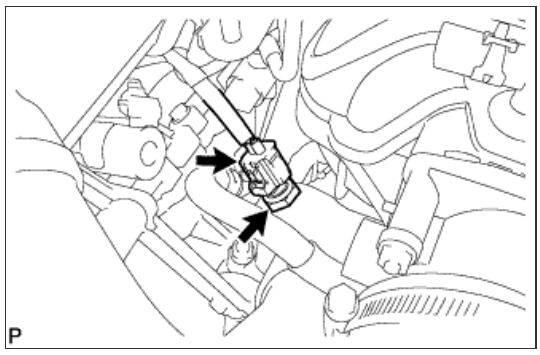
17. INSTALL ENGINE COOLANT TEMPERATURE SENSOR

a. Install a new gasket to the sensor.

b. Using a 19 mm deep socket wrench, install the sensor.

Torque:
20 N*m{ 200 kgf*cm , 14 ft.*lbf }

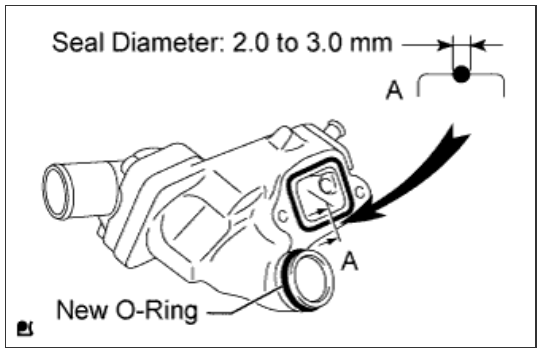
c. Connect the sensor connector.



1 INSTALL WATER INLET HOUSING

a. Apply soapy water to a new O-ring and install it to the water inlet housing.

b. Apply seal packing in a continuous line to the places shown in the illustration.



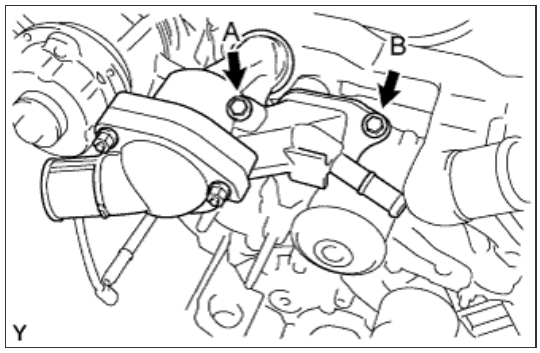
Seal packing:
Toyota Genuine Seal Packing 12 2B, Three Bond 12 2B or equivalent

Standard seal diameter:
2.0 to 3.0 mm 0.07 7 to 0.11 in.

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the water inlet housing within 3 minutes after applying seal packing.**

c. Temporarily install the water inlet housing with the 2 bolts.



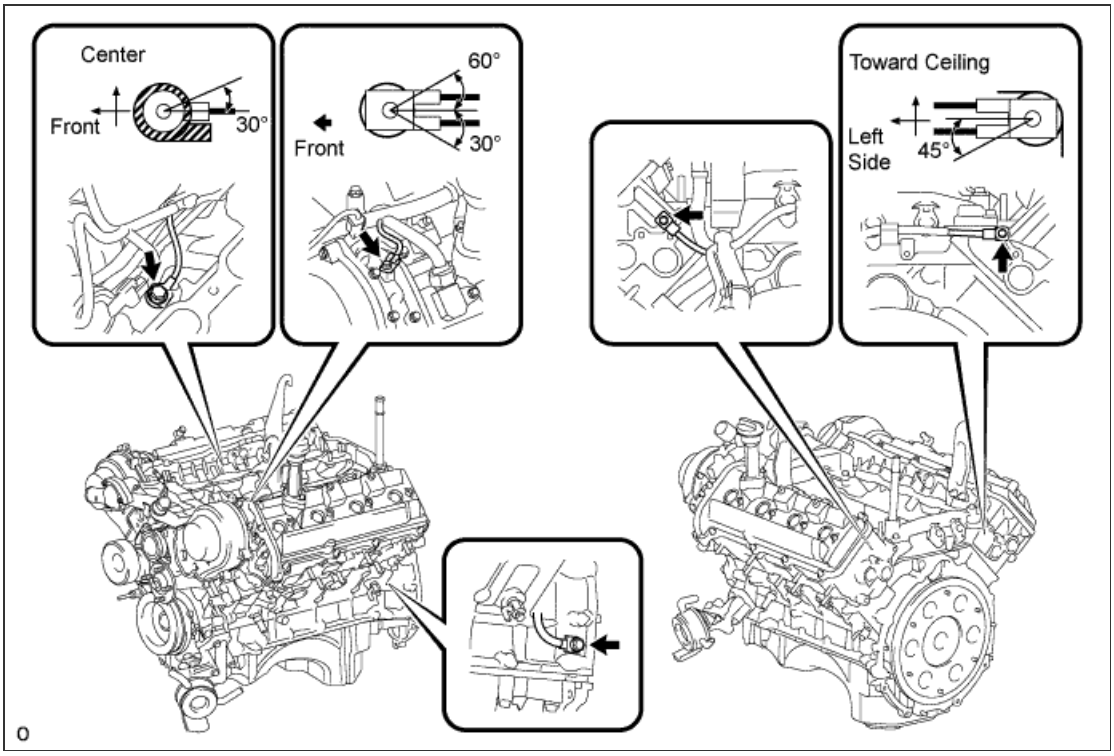
Torque:
1 N*m{ 1 4 kgf*cm , 13 ft.*lbf }

Bolt Length:

Item	Length
Bolt A	77 mm (3.03 in.)
Bolt B	22 mm (0.866 in.)

19. CONNECT ENGINE WIRE

a. Connect the ground wire to the No. 5 bearing cap and install the bolt, as shown in the illustration.



Torque:
4 N*m{ 6kgf*cm , 74 in.*lbf }

b. Connect the ground wire to the left side of the engine and install the bolt.

Torque:
17 N*m{ 173 kgf*cm , 13 ft.*lbf }

c. Connect the ground wire to the inside left side of the V-bank and install the bolt, as shown in the illustration.

Torque:
17 N*m{ 173 kgf*cm , 13 ft.*lbf }

d. Connect each ground wire to the cylinder head and cylinder head LH rear side and install the 2 bolts, as shown in the illustration.

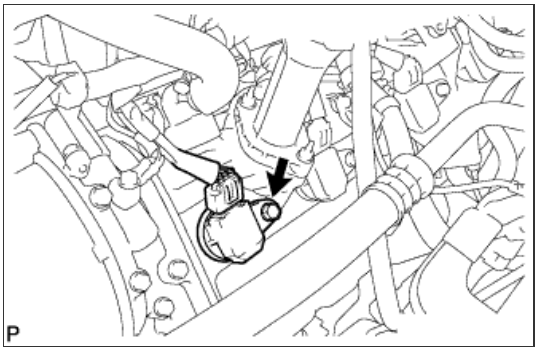
Torque:
4 N*m{ 6kgf*cm , 74 in.*lbf }

20. INSTALL IGNITION COIL ASSEMBLY

a. Install the 8 ignition coils with the 8 bolts.

Torque:
9.0 N*m{ 92 kgf*cm , 0 in.*lbf }

b. Connect the 8 ignition coil connectors.



21. INSTALL INTAKE MANIFOL

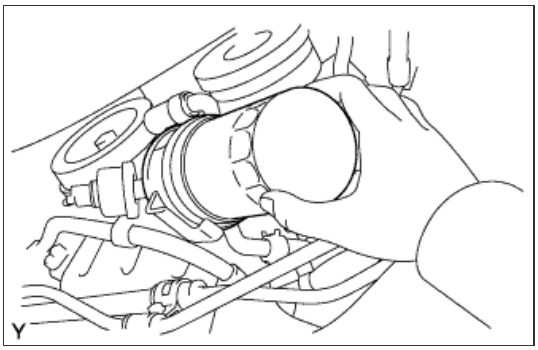
a. Install the intake manifold (Click here).

22. INSTALL OIL FILTER ASSEMBLY

a. Clean and check the oil filter installation surface.

b. Apply clean engine oil to the gasket of a new oil filter.

c. Lightly screw the oil filter into place by hand. Tighten it until the gasket contacts the seat.



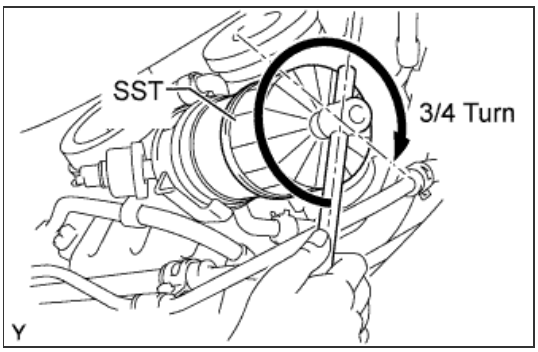
d. Using SST, tighten the oil filter. Choose from the following to tighten the oil filter.

SST
0922 -07501

i. Using a torque wrench, tighten the oil filter.

Torque:
17 N*m{ 175 kgf*cm , 13 ft.*lbf }

ii. Tighten the oil filter a 3/4 turn by hand or with a common wrench.

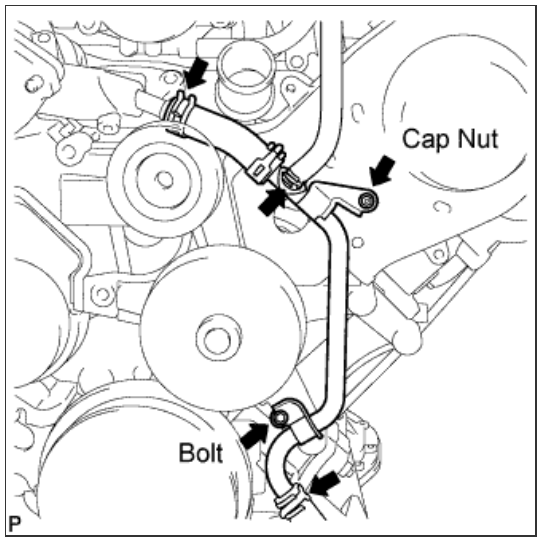


23. INSTALL OIL COOLER PIPE

a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to connect the 3 water by-pass hoses.

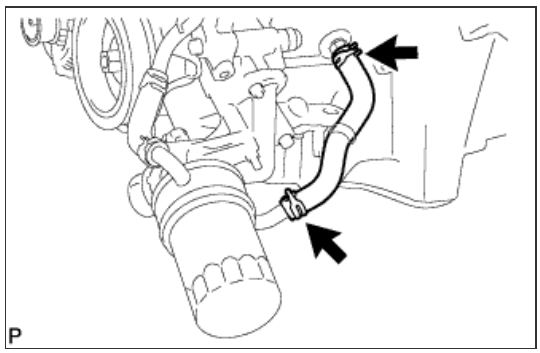
b. Install the oil cooler pipe with the cap nut and bolt.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



24. INSTALL OIL COOLER HOSE

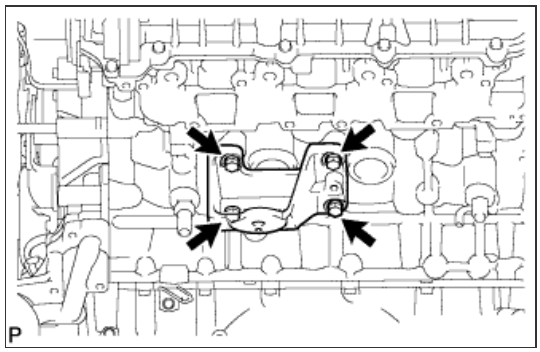
a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to connect the oil cooler hose.



25. INSTALL FRONT NO. 1 ENGINE MOUNTING BRACKET LH

a. Install the engine mounting bracket with the 4 bolts.

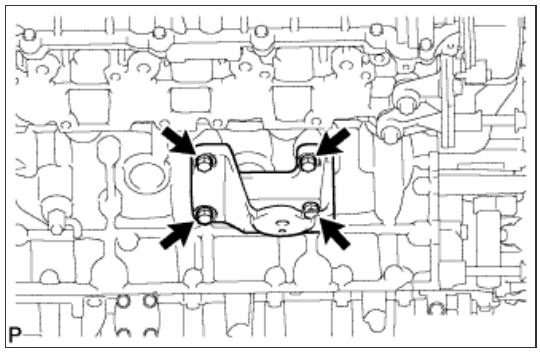
Torque:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }



26. INSTALL FRONT NO. 1 ENGINE MOUNTING BRACKET RH

a. Install the engine mounting bracket with the 4 bolts.

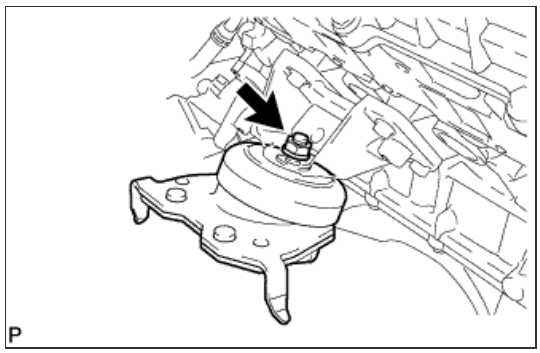
Torque:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }



27. INSTALL FRONT ENGINE MOUNTING INSULATOR LH

a. Install the engine mounting insulator with the nut.

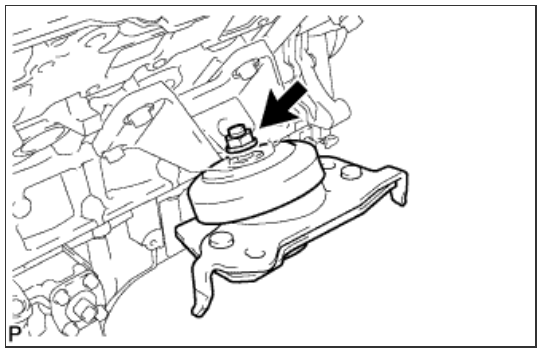
Torque:
72 N*m{ 734 kgf*cm , 53 ft.*lbf }



2 INSTALL FRONT ENGINE MOUNTING INSULATOR

a. Install the engine mounting insulator with the nut.

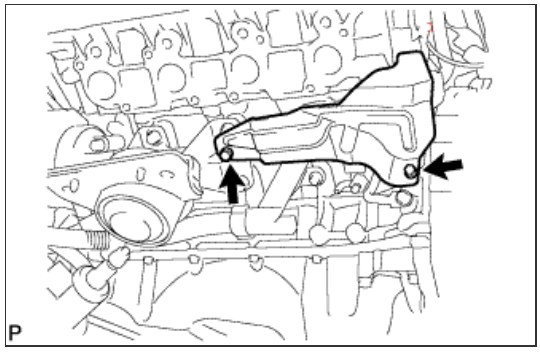
Torque:
72 N*m{ 734 kgf*cm , 53 ft.*lbf }



29. INSTALL NO. 2 WIRING HARNESS HEAT INSULATOR

a. Install the wiring harness heat insulator with the 2 bolts.

Torque:
17 N*m{ 173 kgf*cm , 13 ft.*lbf }

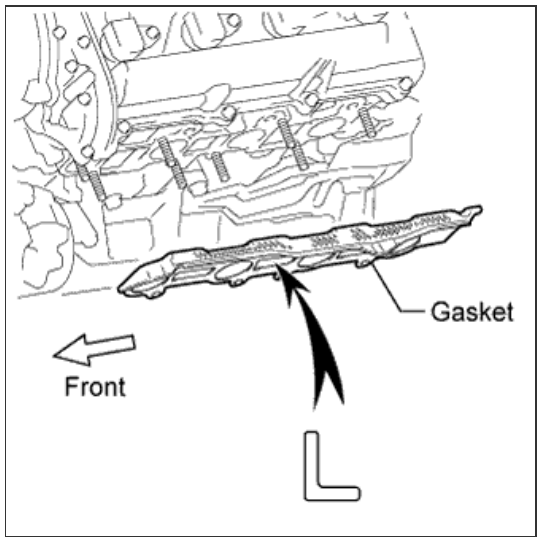


30. INSTALL EXHAUST MANIFOL SUB-ASSEMBLY LH o Secondary Air Injection System

a. Place a new gasket on the cylinder head with the "L" mark facing the manifold side.

NOTICE:

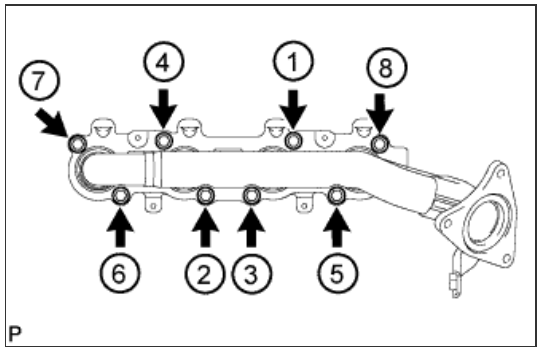
Be careful of the installation direction.



b. Temporarily install the exhaust manifold with 8 new nuts, and then uniformly tighten the nuts in several steps, in the sequence shown in the illustration.

Torque:

44 N*m{ 449 kgf*cm , 32 ft.*lbf }

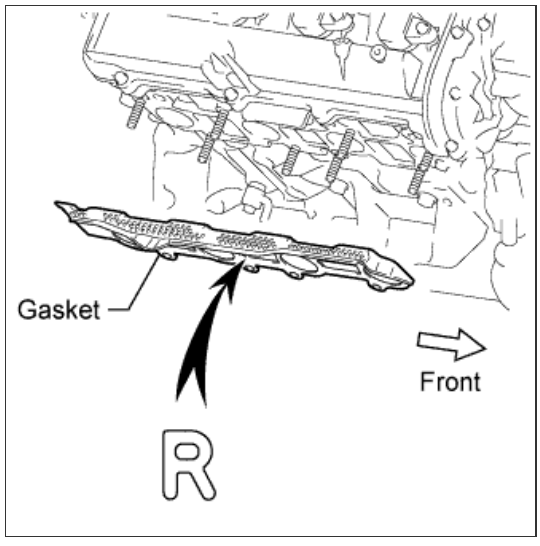


31. INSTALL EXHAUST MANIFOL SUB-ASSEMBLY RH o Secondary Air Injection System

a. Place a new gasket on the cylinder head with the "R" mark facing the manifold side.

NOTICE:

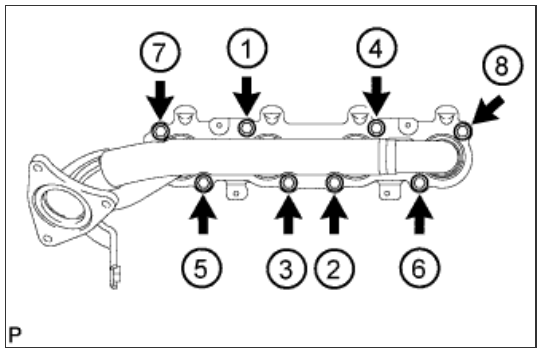
Be careful of the installation direction.



b. Temporarily install the exhaust manifold with 8 new nuts, and then uniformly tighten the nuts in several steps, in the sequence shown in the illustration.

Torque:

44 N*m{ 429 kgf*cm , 32 ft.*lbf }

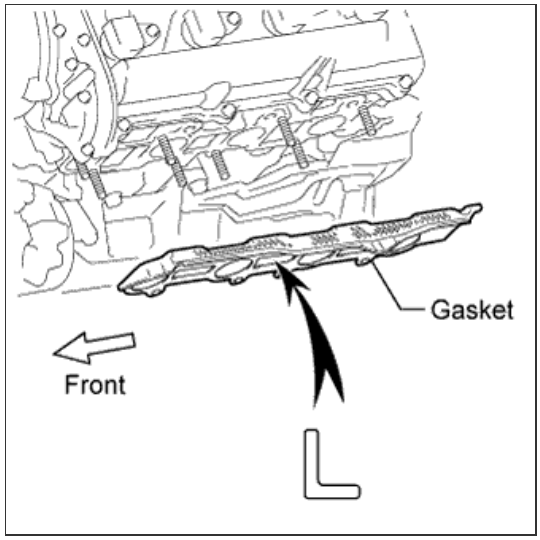


32. INSTALL EXHAUST MANIFOL SUB-ASSEMBLY LH Secondary Air Injection System

a. Place a new gasket on the cylinder head with the "L" mark facing the manifold side.

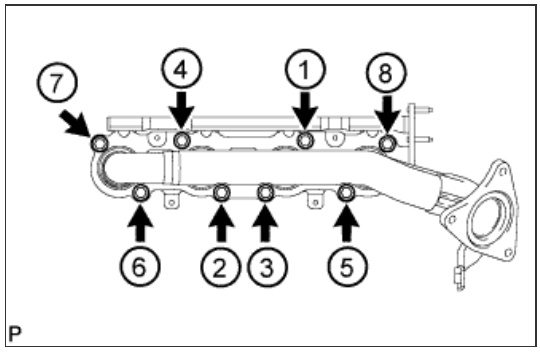
NOTICE:

Be careful of the installation direction.



b. Temporarily install the exhaust manifold with 8 new nuts, and then uniformly tighten the nuts in several steps, in the sequence shown in the illustration.

Torque:
44 N*m{ 449 kgf*cm , 32 ft.*lbf }

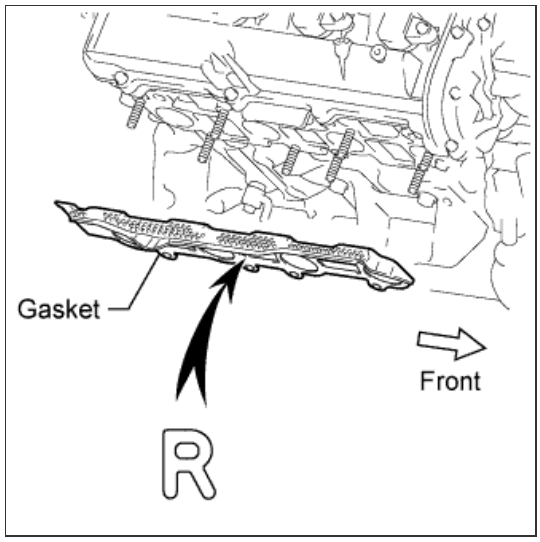


33. INSTALL EXHAUST MANIFOL SUB-ASSEMBLY RH Secondary Air Injection System

a. Place a new gasket on the cylinder head with the "R" mark facing the manifold side.

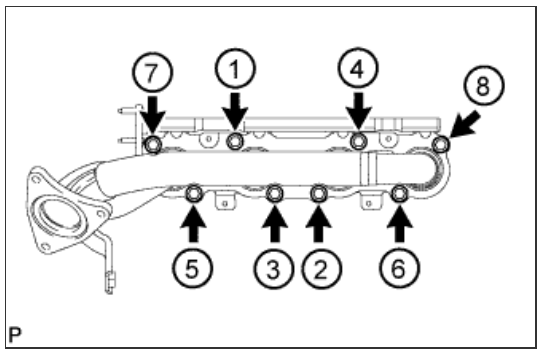
NOTICE:

Be careful of the installation direction.



b. Temporarily install the exhaust manifold with 8 new nuts, and then uniformly tighten the nuts in several steps, in the sequence shown in the illustration.

Torque:
44 N*m{ 429 kgf*cm , 32 ft.*lbf }



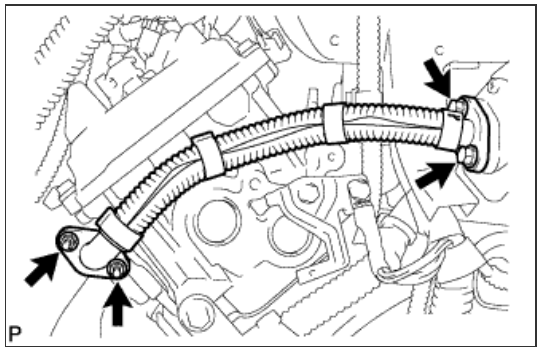
34. INSTALL NO. 3 AIR TUBE Secondary Air Injection System

a. Install a new gasket and connect the No. 3 air tube to the exhaust manifold with the 2 nuts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Install a new gasket and connect the No. 3 air tube to the No. 2 air switching valve with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



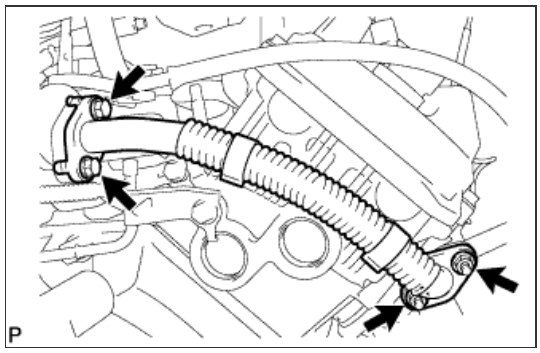
35. INSTALL AIR TUBE SUB-ASSEMBLY RH Secondary Air Injection System

a. Install a new gasket and connect the air tube to the exhaust manifold with the 2 nuts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Install a new gasket and connect the air tube to the No. 1 air switching valve with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



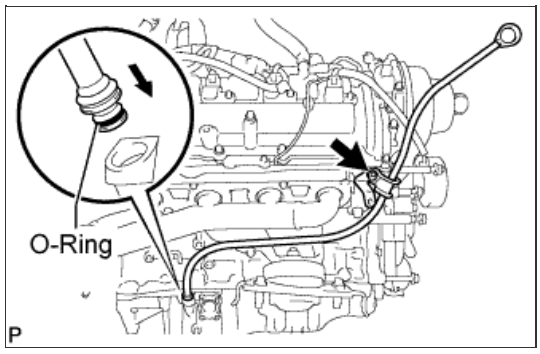
a. Apply a light coat of engine oil to a new O-ring.

b. Install a new O-ring to the guide.

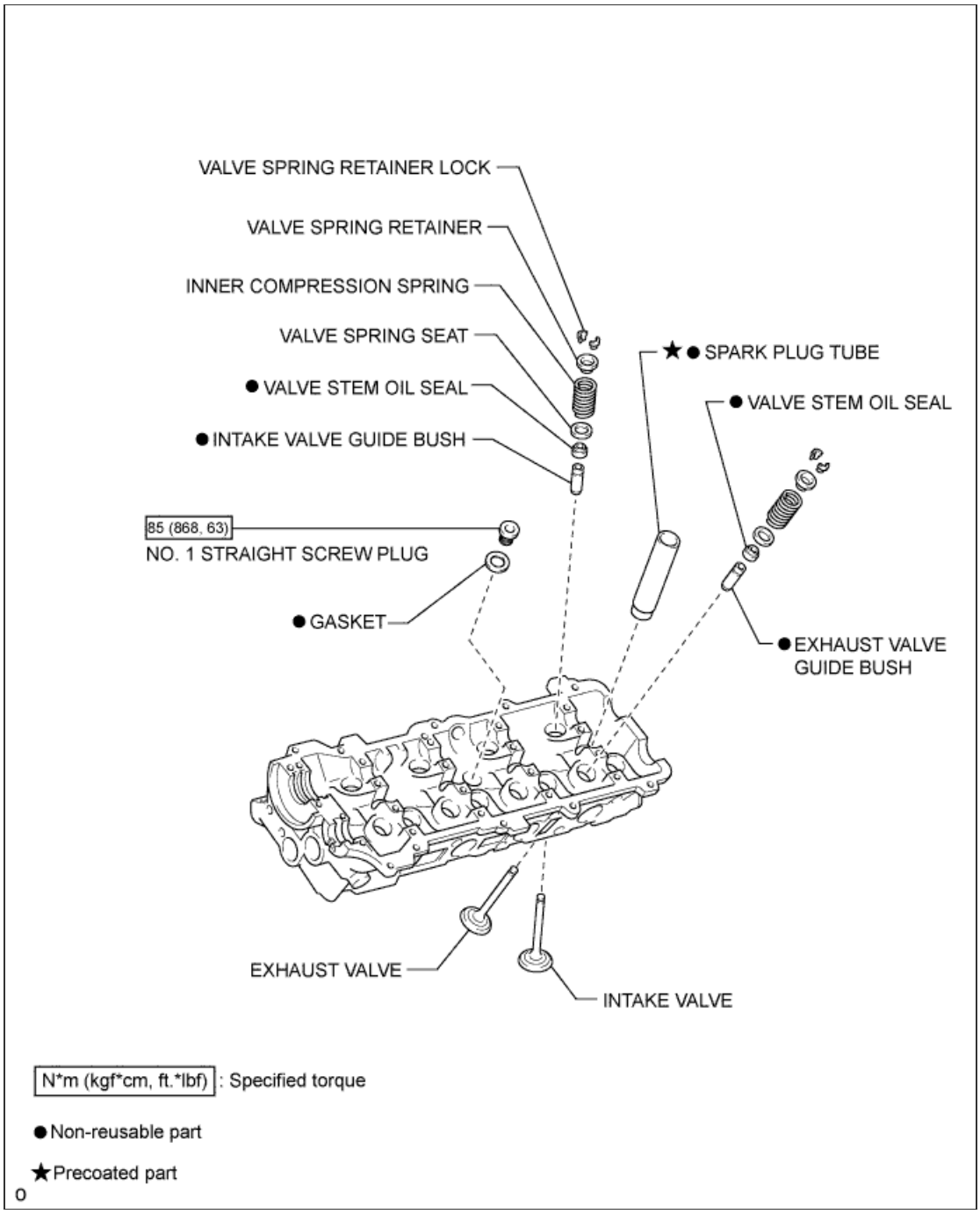
c. Install the dipstick guide with the bolt.

Torque:
0 N*m{ 2 kgf*cm , 71 in.*lbf }

d. Install the dipstick.



for Preparation Click here



for Preparation Click here

1. REMOVE INTAKE VALVE

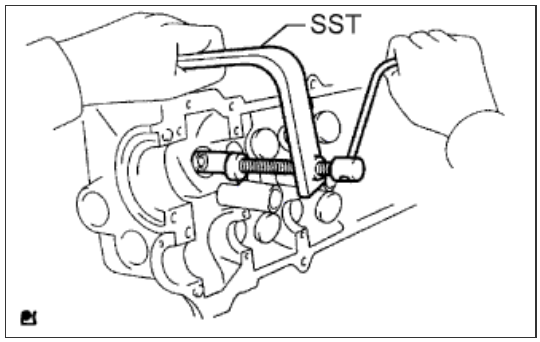
a. Using SST, compress the compression spring and remove the 2 valve spring retainer locks.

SST
09202-70020 (09202-00010, 09202-01010, 09202-01020)

b. Remove the spring retainer, inner compression spring and valve.

HINT:

Arrange the removed parts in the correct order.



2. REMOVE E HAUST VALVE

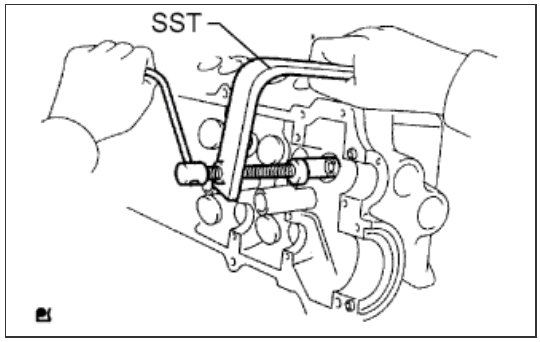
a. Using SST, compress the compression spring and remove the 2 valve spring retainer locks.

SST
09202-70020 (09202-00010, 09202-01010, 09202-01020)

b. Remove the spring retainer, inner compression spring and valve.

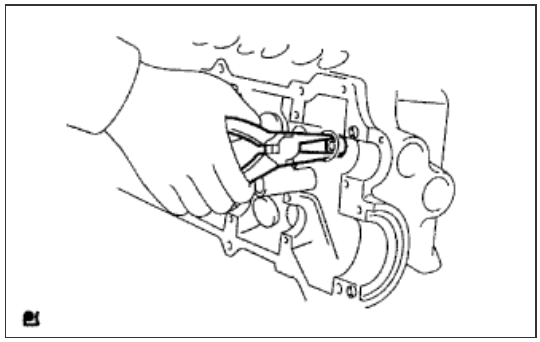
HINT:

Arrange the removed parts in the correct order.



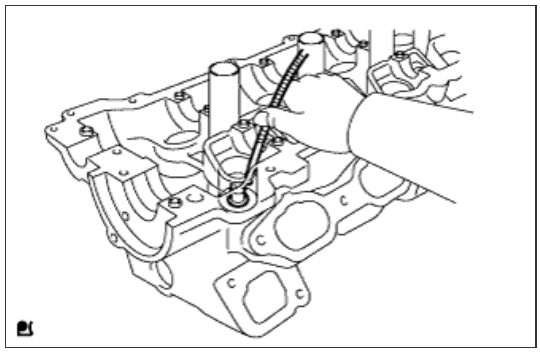
3. REMOVE VALVE STEM OIL SEAL

a. Using needle nose pliers, remove the stem oil seals.



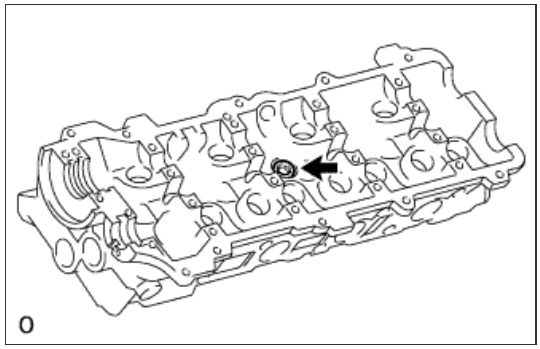
4. REMOVE VALVE SPRING SEAT

a. Using compressed air and a magnetic finger, remove the valve spring seat by blowing air onto it.



5. REMOVE NO. 1 STRAIGHT SCREW PLUG

a. Using a 14 mm hexagon wrench, remove the screw plugs and gasket.



6. REMOVE STUD BOLT

NOTICE:

If the stud bolt is deformed or its threads are damaged, replace it.

for Preparation Click here

1. CLEAN CYLINDER HEAD SUB-ASSEMBLY

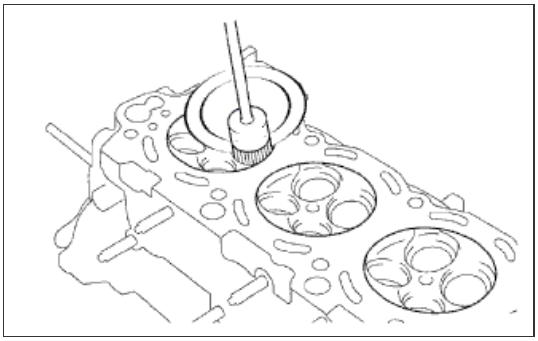
a. Using a gasket scraper, remove all the gasket material from the cylinder block contact surface.



NOTICE:

Be careful not to scratch the cylinder block contact surface.

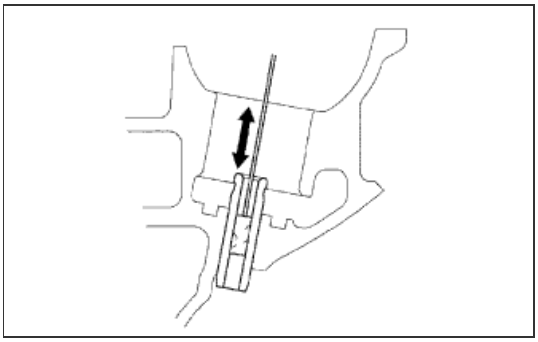
b. Using a wire brush, remove all the carbon from the combustion chambers.



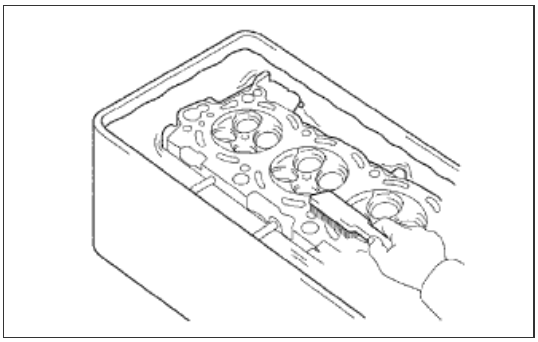
NOTICE:

Be careful not to scratch the cylinder block contact surface.

c. Using a valve guide bushing brush and solvent, clean all the guide bushes.



d. Using a soft brush and solvent, thoroughly clean the cylinder head.



2. INSPECT CYLINDER HEAD SUB-ASSEMBLY

a. Using a precision straightedge and feeler gauge, measure the surfaces

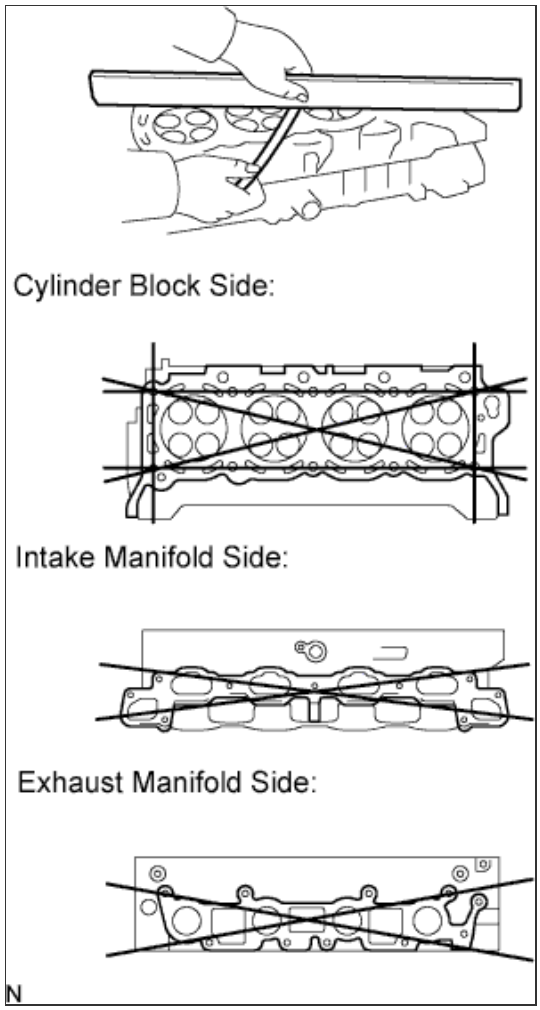
a. Using a precision straightedge and feeler gauge, measure the surfaces contacting the cylinder block and manifolds for warpage.

Standard Warpage:

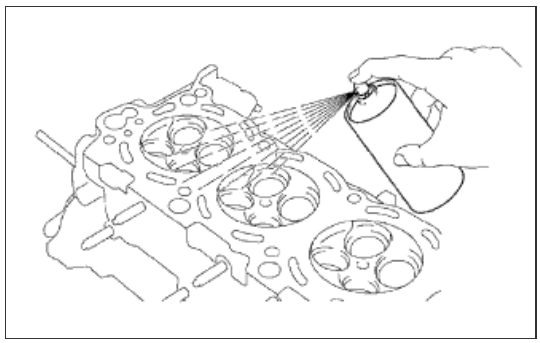
Item	Specified Condition
Cylinder block side	0 to 0.05 mm (0 to 0.00197 in.)
Intake manifold side	0 to 0.08 mm (0 to 0.00315 in.)
Exhaust manifold side	0 to 0.08 mm (0 to 0.00315 in.)

Maximum warpage:
0.10 mm (0.00394 in.)

If the warpage is more than the maximum, replace the cylinder head sub-assembly.



b. Using a dye penetrant, check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks.
If the cylinder head is cracked, replace it.



3. INSPECT INTAKE VALVE

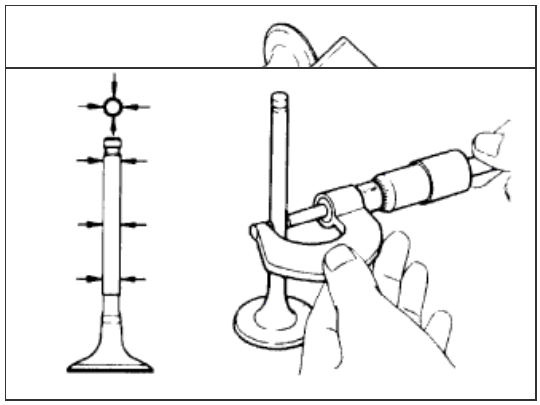
a. Clean the valves.

i. Using a gasket scraper, chip off any carbon from the valve head.

ii. Using a wire brush, thoroughly clean the valve.

b. Using a micrometer, measure the diameter of the valve stem.

Standard valve stem diameter:
5.470 to 5.485 mm (0.215 to 0.216 in.)



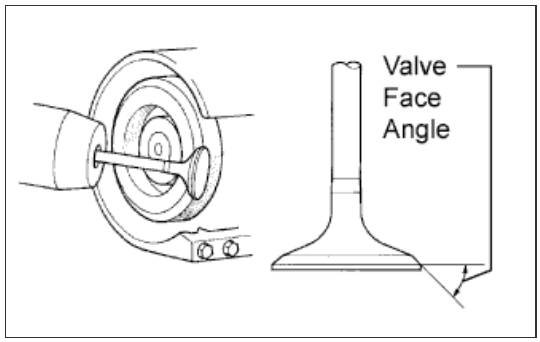
c. Check the valve face angle.

i. Grind the valve sufficiently to remove pits and carbon.

ii. Check that the valve is ground to the correct valve face angle.

Standard valve face angle:
44.5°

If the valve face is worn, replace the valve.

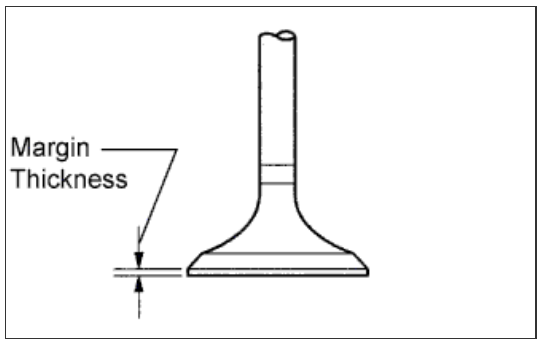


d. Check the valve head margin thickness.

Standard margin thickness:
1.0 mm (0.0394 in.)

Minimum margin thickness:
0.5 mm (0.0197 in.)

If the margin thickness is less than the minimum, replace the valve.

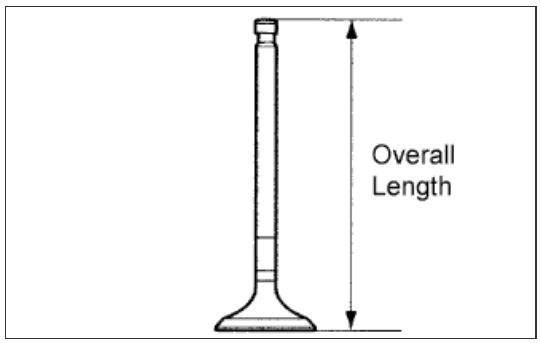


e. Check the valve overall length.

Standard overall length:
95.05 mm (3.74 in.)

Minimum overall length:
94.55 mm (3.72 in.)

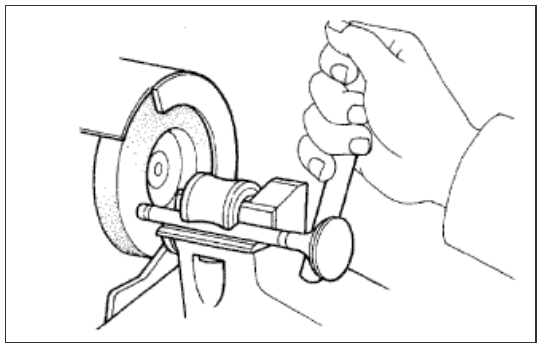
If the overall length is less than the minimum, replace the valve.



f. Check the surface of the valve stem tip for wear.
If the valve stem tip is worn, resurface the tip with a grinder or replace the valve.

NOTICE:

Be careful not to grind off more than the minimum length.

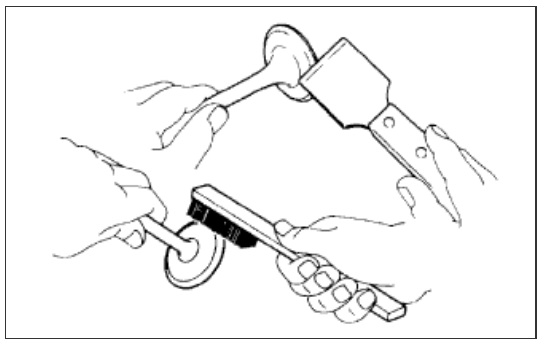


4. INSPECT EXHAUST VALVE

a. Clean the valves.

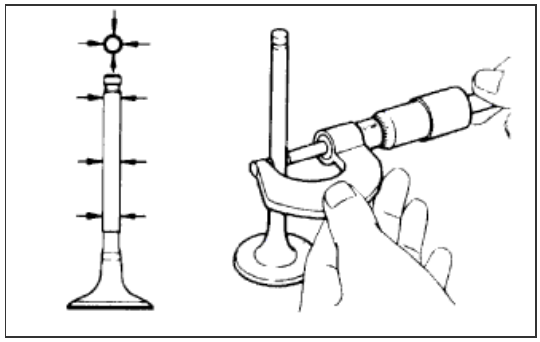
i. Using a gasket scraper, chip off any carbon from the valve head.

ii. Using a wire brush, thoroughly clean the valve.



b. Using a micrometer, measure the diameter of the valve stem.

Standard valve stem diameter:
5.465 to 5.480 mm (0.215 to 0.216 in.)



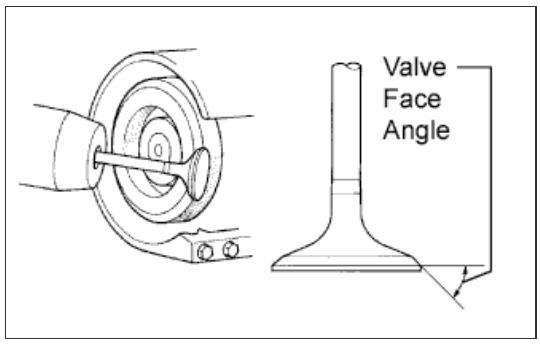
c. Check the valve face angle.

i. Grind the valve sufficiently to remove pits and carbon.

ii. Check that the valve is ground to the correct valve face angle.

Standard valve face angle:
44.5°

If the valve face is worn, replace the valve.

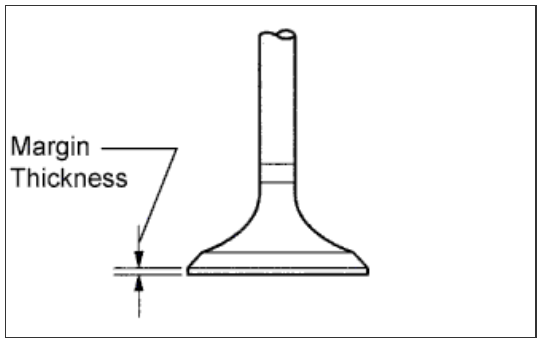


d. Check the valve head margin thickness.

Standard margin thickness:
1.0 mm (0.0394 in.)

Minimum margin thickness:
0.5 mm (0.0197 in.)

If the margin thickness is less than the minimum, replace the valve.

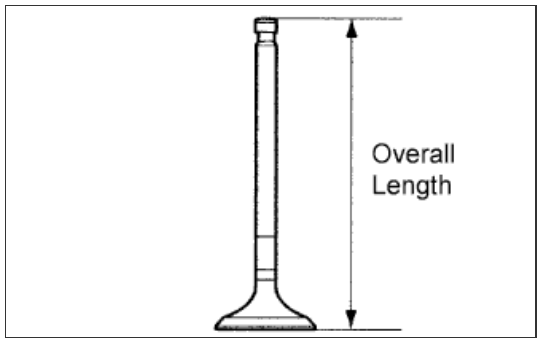


e. Check the valve overall length.

Standard overall length:
95.10 mm (3.744 in.)

Minimum overall length:
94.60 mm (3.724 in.)

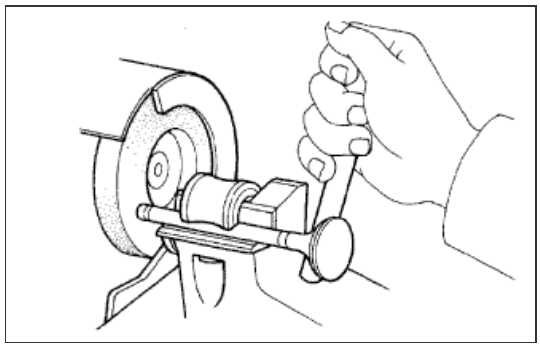
If the overall length is less than the minimum, replace the valve.



f. Check the surface of the valve stem tip for wear.
If the valve stem tip is worn, resurface the tip with a grinder or replace the valve.

NOTICE:

Be careful not to grind off more than the minimum length.



5. INSPECT INTAKE VALVE GUIDE BUSH

a. Using a caliper gauge, measure the inside diameter of the guide bush.

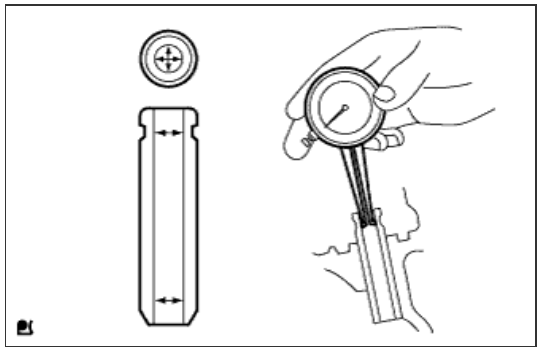
Standard bush inside diameter:
5.510 to 5.530 mm (0.217 to 0.218 in.)

b. Subtract the valve stem diameter measurement from the guide bush inside diameter measurement.

Standard oil clearance:
0.025 to 0.060 mm (0.000984 to 0.00236 in.)

Maximum oil clearance:
0.08 mm (0.00314 in.)

If the oil clearance is more than the maximum, replace the valve and guide bush.



6. INSPECT EXHAUST VALVE GUIDE BUSH

a. Using a caliper gauge, measure the inside diameter of the guide bush.

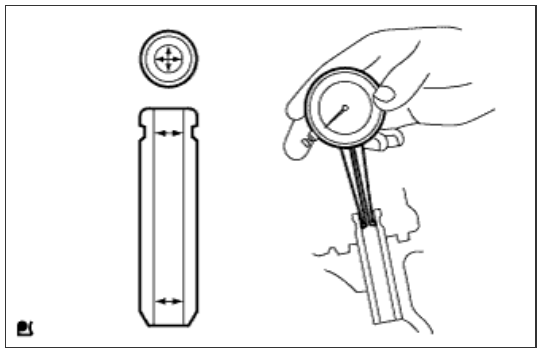
Standard bush inside diameter:
5.510 to 5.530 mm (0.217 to 0.218 in.)

b. Subtract the valve stem diameter measurement from the guide bush inside diameter measurement.

Standard oil clearance:
0.030 to 0.065 mm (0.00118 to 0.00256 in.)

Maximum oil clearance:
0.10 mm (0.00394 in.)

If the oil clearance is more than the maximum, replace the valve and guide bush.



7. INSPECT INTAKE VALVE SEAT

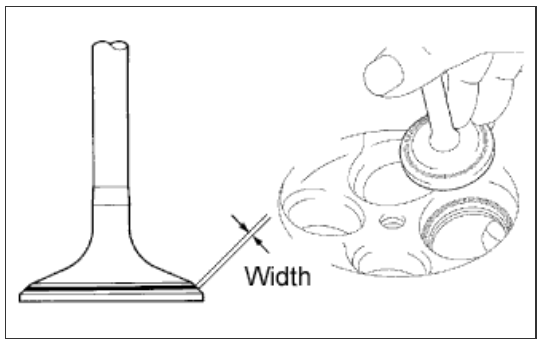
a. Apply a light coat of Prussian blue to the valve face.

b. Lightly press the valve against the seat.

HINT:

Do not rotate the valve while pressing it.

c. Check the valve face and seat.



i. Check that the contact surfaces of the valve seat and valve face are in the middle area of their respective surfaces, with the width between 1.0 to 1.4 mm (0.0394 to 0.0551 in.).
If not, correct the valve seat.

ii. Check that the contact surfaces of the valve seat and valve face are even around the entire valve seat.
If not, correct the valve seat.

8. INSPECT EXHAUST VALVE SEAT

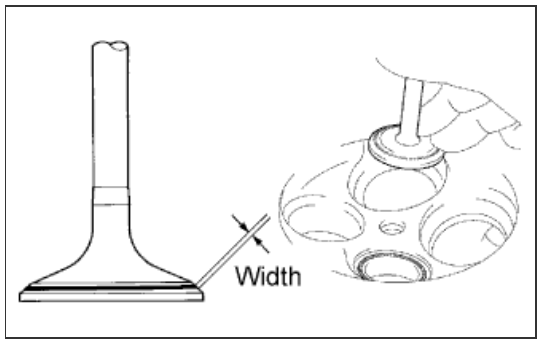
a. Apply a light coat of Prussian blue to the valve face.

b. Lightly press the valve against the seat.

HINT:

Do not rotate the valve while pressing it.

c. Check the valve face and seat.



i. Check that the contact surfaces of the valve seat and valve face are in the middle area of their respective surfaces, with the width between 1.0 to 1.4 mm (0.0394 to 0.0551 in.).
If not, correct the valve seat.

ii. Check that the contact surfaces of the valve seat and valve face are even around the entire valve seat.
If not, correct the valve seat.

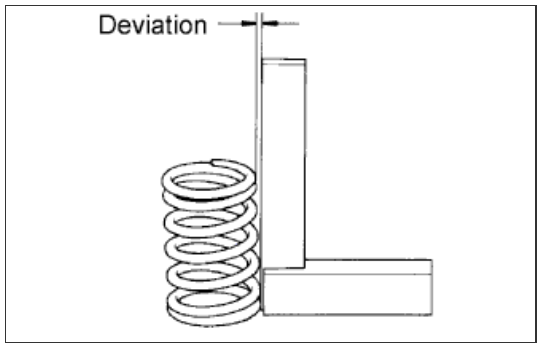
9. INSPECT INNER COMPRESSION SPRING

a. Using steel squares, measure the deviation of the spring.

Maximum deviation:
2.0 mm (0.0787 in.)

If the deviation is more than the maximum, replace the inner compression

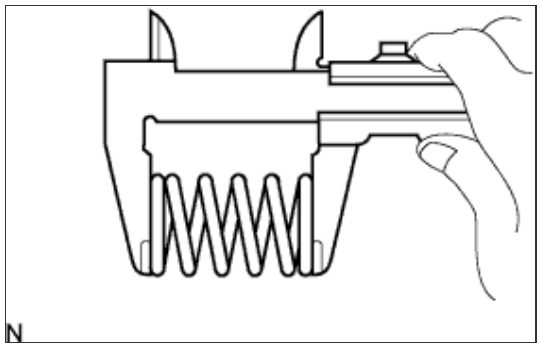
spring.



b. Using a vernier caliper, measure the free length of the spring.

Standard free length:
51.29 mm (2.02 in.)

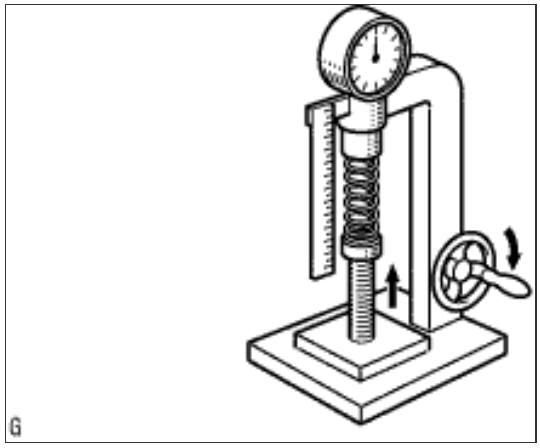
If the free length is not as specified, replace the inner compression spring.



c. Using a spring tester, measure the tension of the inner compression spring when it is compressed to the specified installation length.

Standard installed tension:
210 to 226 N (21 to 23 kgf, 47.2 to 50.7 lbf) at 33.4 mm (1.31 in.)

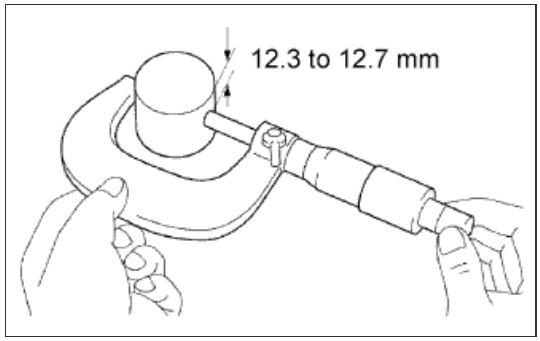
If the installed tension is not as specified, replace the inner compression spring.



10. INSPECT VALVE LI TER

a. Using a micrometer, measure the lifter diameter at a position 12.3 to 12.7 mm (0.484 to 0.500 in.) from the top surface.

Standard lifter diameter:
30.968 to 30.976 mm (1.2192 to 1.2195 in.)



b. Using a caliper gauge, measure the lifter bore diameter of the cylinder head.

Standard lifter bore diameter:
31.000 to 31.016 mm (1.220 to 1.221 in.)

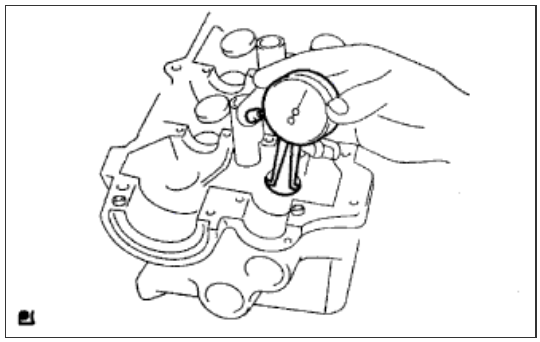
c. Subtract the lifter diameter measurement from the lifter bore diameter measurement.

Standard oil clearance:

0.024 to 0.050 mm (0.000945 to 0.00197 in.)

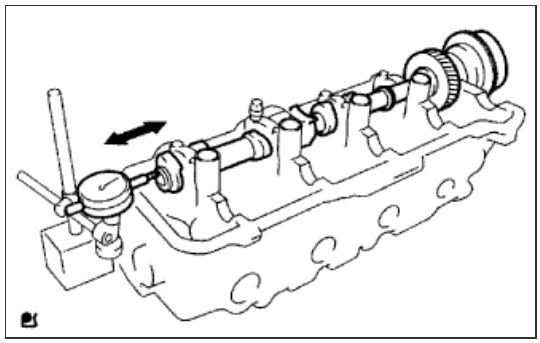
Maximum oil clearance:
0.07 mm (0.00276 in.)

If the oil clearance is more than the maximum, replace the lifter. If necessary, replace the cylinder head sub-assembly.



11. INSPECT CAMSHA T THRUST CLEARANCE

a. Inspect the clearance on the intake side.



i. Install the camshaft.

ii. Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.

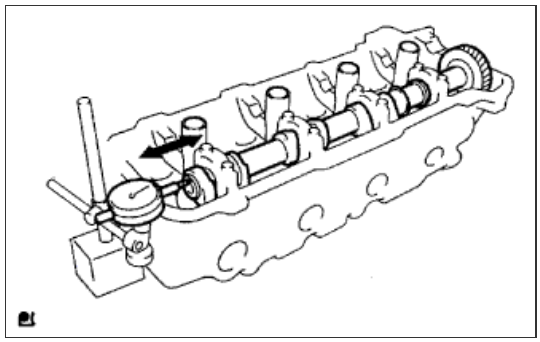
Standard thrust clearance:
0 to 0.040 mm (0 to 0.00157 in.)

Maximum thrust clearance:
0.12 mm (0.00472 in.)

If the thrust clearance is more than the maximum, replace the camshaft. If necessary, replace the cylinder head sub-assembly.

iii. Remove the camshaft.

b. Inspect the clearance on the exhaust side.



i. Install the camshaft.

ii. Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.

Standard thrust clearance:
0.030 to 0.070 mm (0.00118 to 0.00276 in.)

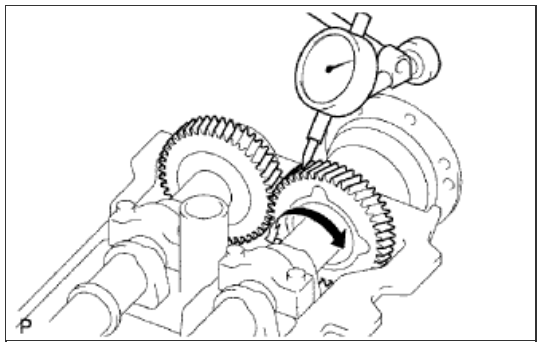
Maximum thrust clearance:
0.10 mm (0.00394 in.)

If the thrust clearance is more than the maximum, replace the camshaft. If necessary, replace the cylinder head sub-assembly.

iii. Remove the camshaft.

12. INSPECT CAMSHA T GEAR BACKLASH

a. for Bank 1:



i. Install the drive gear to the camshaft timing tube.

ii. Install the camshaft timing tube to the No. 3 camshaft.

iii. Install the No. 3 camshaft and No. 4 camshaft without installing the camshaft sub-gear and No. 5 bearing cap.

iv. Using a dial indicator, measure the backlash.

Standard backlash:
0.020 to 0.200 mm (0.000787 to 0.00787 in.)

Maximum backlash:
0.30 mm (0.0118 in.)

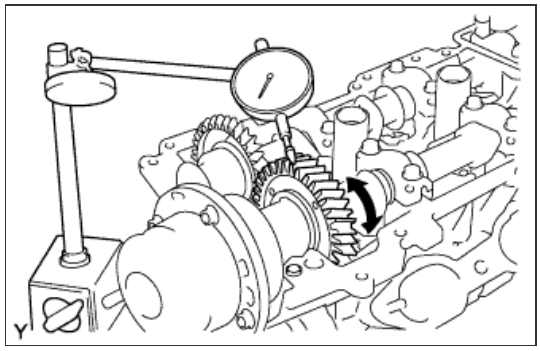
If the backlash is more than the maximum, replace the drive gear and No. 4 camshaft.

v. Remove the No. 3 camshaft and No. 4 camshaft.

vi. Remove the camshaft timing tube from the No. 3 camshaft.

vii. Remove the drive gear from the camshaft timing tube.

b. for Bank 2:



i. Install the drive gear to the camshaft timing tube.

ii. Install the camshaft timing tube to the camshaft.

iii. Install the camshaft and No. 2 camshaft without installing the camshaft sub-gear and No. 1 bearing cap.

iv. Using a dial indicator, measure the backlash.

Standard backlash:
0.020 to 0.200 mm (0.000787 to 0.00787 in.)

Maximum backlash:
0.30 mm (0.0118 in.)

If the backlash is more than the maximum, replace the drive gear and No. 2 camshaft.

v. Remove the camshaft and No. 2 camshaft.

vi. Remove the camshaft timing tube from the camshaft.

vii. Remove the drive gear from the camshaft timing tube.

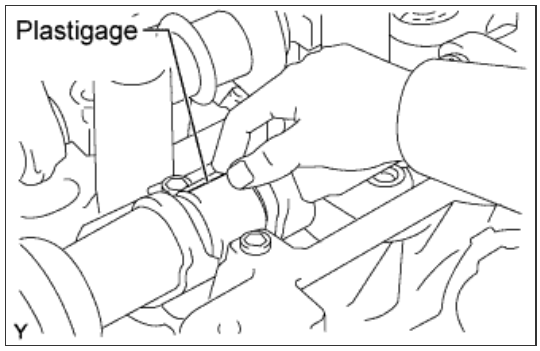
13. INSPECT CAMSHA T OIL CLEARANCE

a. Clean the bearing caps and camshaft journals.

b. Check the bearings for flaking and scoring.
If the bearings are damaged, replace the cylinder head sub-assembly.

c. Place the camshafts on the cylinder head.

d. Lay a strip of Plastigage across each of the camshaft journals.



e. Install the bearing caps.

HINT:

- **or Bank 1:**
  Refer to the following procedures (Click here).
- **or Bank 2:**
  Refer to the following procedures (Click here).

NOTICE:

Do not turn the camshaft.

f. Remove the bearing caps.

HINT:

- **or Bank 1:**
  Refer to the following procedures (Click here).
- **or Bank 2:**
  Refer to the following procedures (Click here).

g. Measure the Plastigage at its widest point.

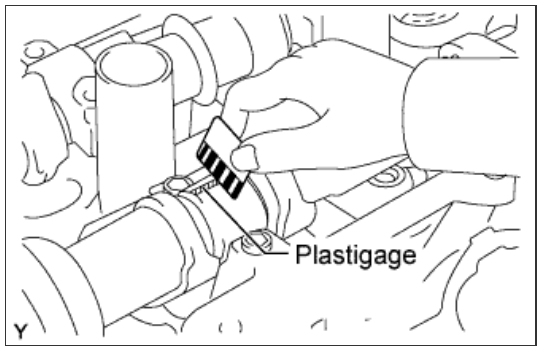
Standard oil clearance:
0.030 to 0.071 mm (0.00118 to 0.00280 in.)

Maximum oil clearance:
0.10 mm (0.00394 in.)

If the oil clearance is more than the maximum, replace the camshaft. If necessary, replace the cylinder head sub-assembly.

h. Remove the camshafts.

i. Completely remove the Plastigage.

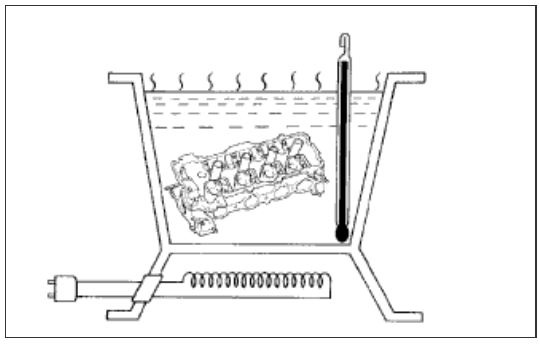


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1. REPLACE INTAKE VALVE GUIDE BUSH

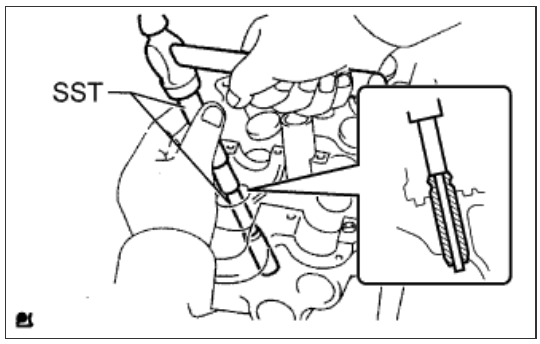
a. Gradually heat the cylinder head to approximately 80 to 100°C (176 to 212°F).

b. Place the cylinder head on wooden blocks.



c. Using SST and a hammer, tap out the guide bush.

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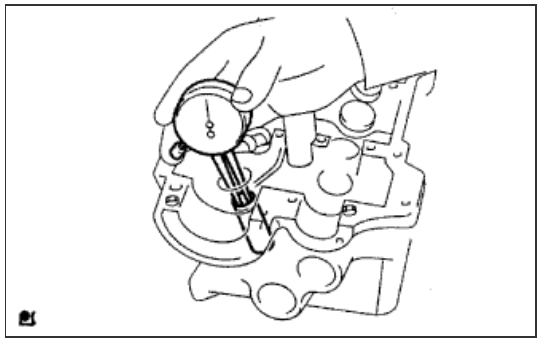


d. Using a caliper gauge, measure the bush bore diameter of the cylinder head.

Standard cylinder bore diameter:
10.285 to 10.306 mm (0.405 to 0.406 in.)

If the bush bore diameter of the cylinder head is between 10.285 to 10.356 mm (0.405 to 0.408 in.), proceed to the next step.
If the bush bore diameter of the cylinder head is more than 10.356 mm (0.408 in.), replace the cylinder head.

e. Select a new guide bush (STD or O/S 0.05), and measure its diameter.



f. Machine the bush bore diameter of the cylinder head side to the diameter of the selected guide bush.

B h Bore Diameter:

Bush Size	Specified Condition
Use STD	10.333 to 10.344 mm (0.4068 to 0.4072 in.)
Use O/S 0.05	10.383 to 10.394 mm (0.4087 to 0.4092 in.)

HINT:

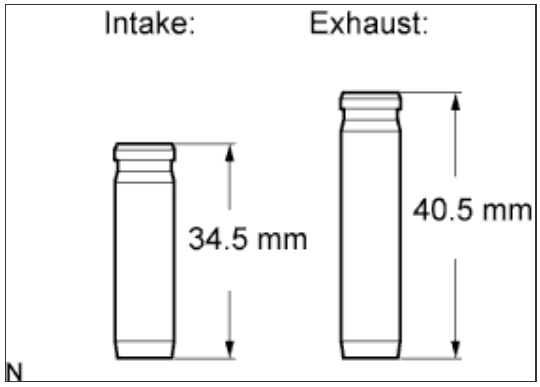
Different bushes are used for the intake and exhaust.

Standard B h Length:

Item	Specified Condition
Intake	34.5 mm (1.36 in.)

Exhaust	40.5 mm (1.59 in.)

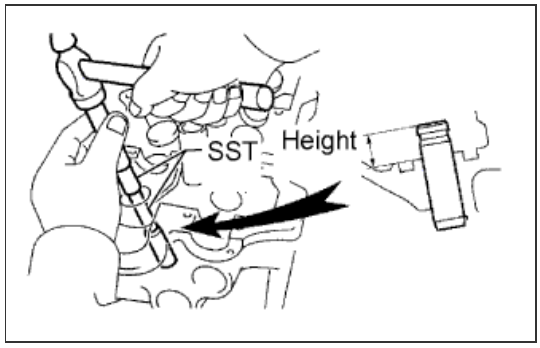
g. Gradually heat the cylinder head to approximately 80 to 100°C (176 to 212°F).



h. Using SST and a hammer, tap in a new guide bush to the specified protrusion height.

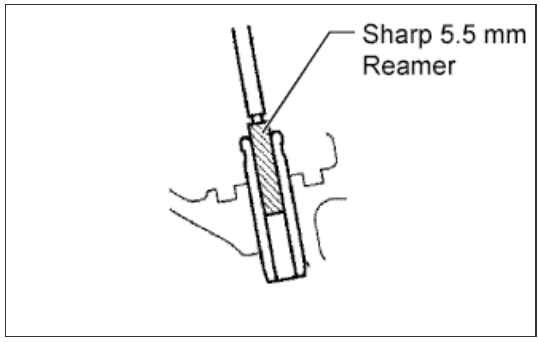
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Standard protr ion height:
9.2 to 9.8 mm (0.362 to 0.386 in.)



i. Using a sharp 5.5 mm reamer, ream the guide bush to obtain the standard clearance between the guide bush and valve stem.

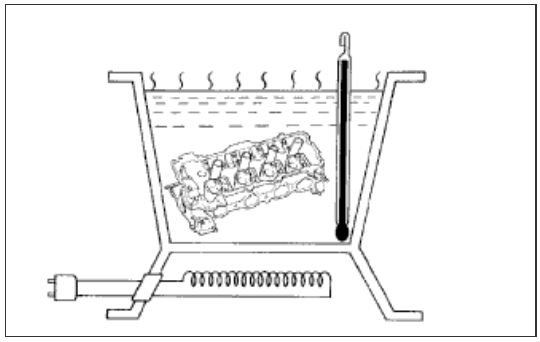
Standard oil clearance:
0.025 to 0.060 mm (0.000984 to 0.00236 in.)



2. REPLACE EXHAUST VALVE GUIDE BUSH

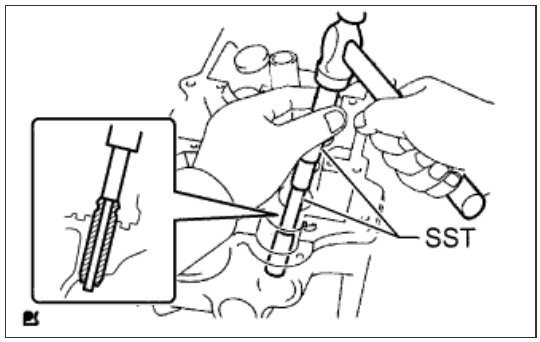
a. Gradually heat the cylinder head to approximately 80 to 100°C (176 to 212°F).

b. Place the cylinder head on wooden blocks.



c. Using SST and a hammer, tap out the guide bush.

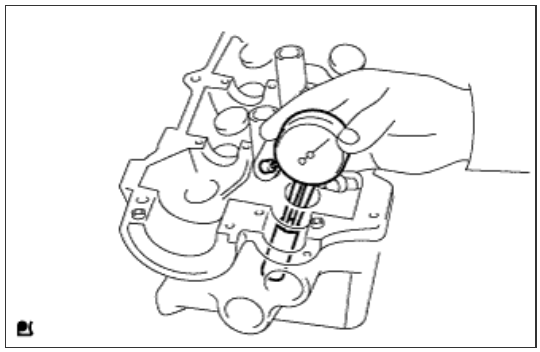
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09201-01055
09950-70010 (09951-07100)



d. Using a caliper gauge, measure the bush bore diameter of the cylinder head.

Standard cylinder bore diameter:
10.285 to 10.306 mm (0.405 to 0.406 in.)

If the bush bore diameter of the cylinder head is between 10.285 to 10.356 mm (0.405 to 0.408 in.), proceed to the next step.
If the bush bore diameter of the cylinder head is more than 10.356 mm (0.408 in.), replace the cylinder head.



e. Select a new guide bush (STD or O/S 0.05), and measure its diameter.

f. Machine the bush bore diameter of the cylinder head side to the diameter of the selected guide bush.

B h Bore Diameter:

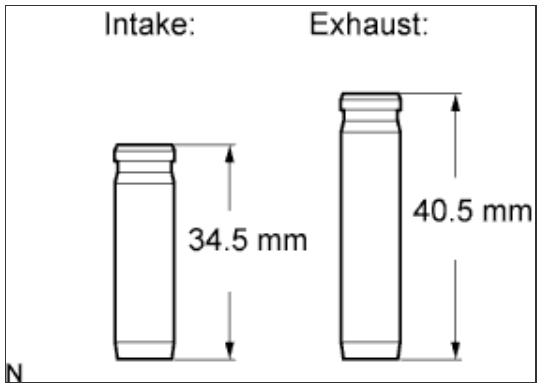
Bush Size	Specified Condition
Use STD	10.333 to 10.344 mm (0.4068 to 0.4072 in.)
Use O/S 0.05	10.383 to 10.394 mm (0.4087 to 0.4092 in.)

HINT:

Different bushes are used for the intake and exhaust.

Standard B h Length:

Item	Specified Condition
Intake	34.5 mm (1.36 in.)
Exhaust	40.5 mm (1.59 in.)

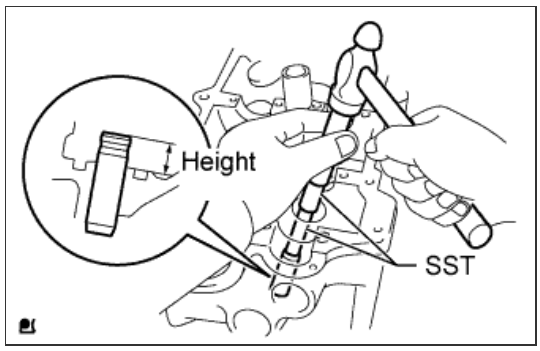


g. Gradually heat the cylinder head to approximately 80 to 100°C (176 to 212°F).

h. Using SST and a hammer, tap in a new guide bush to the specified protrusion height.

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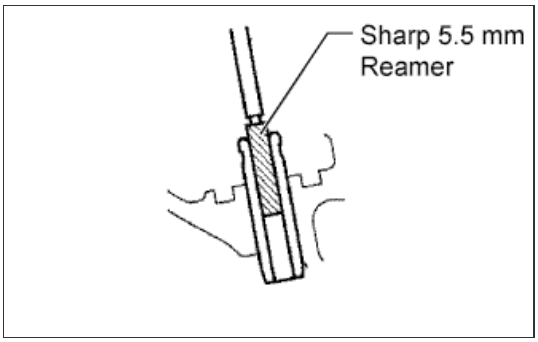
Standard protr ion height:
8.2 to 8.8 mm (0.323 to 0.346 in.)



i. Using a sharp 5.5 mm reamer, ream the guide bush to obtain the standard

clearance between the guide bush and valve stem.

Standard oil clearance:
0.030 to 0.065 mm (0.00118 to 0.00256 in.)



3. REPLACE SPARK PLUG TUBE

HINT:

When using a new cylinder head, the spark plug tubes must be replaced.

a. Remove the spark plug tubes.

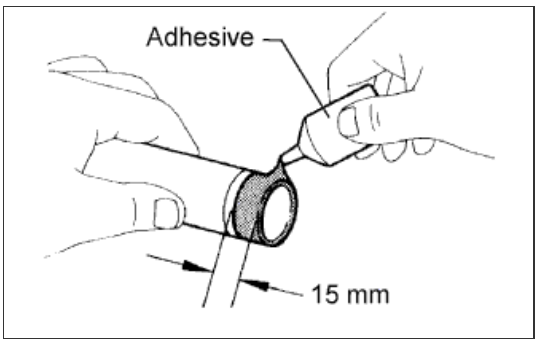
b. Apply adhesive to the end of a new spark plug tube.

Standard adhesive width:
15 mm (0.591 in.)

Adhesive:
Toyota Gen ine Adhesive 1324, Three Bond 1324 or e ivalent.

N TICE:

Install the spark plug tube within 3 minutes after applying adhesive.

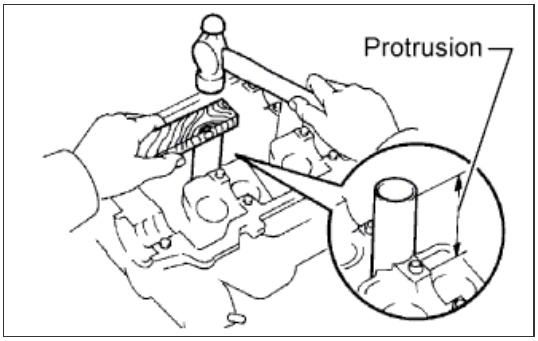


c. Using a wooden block and hammer, tap in the spark plug tube until it is protruding 40.9 to 42.1 mm (1.61 to 1.66 in.) from the camshaft bearing cap installation surface of the cylinder head.

Standard protr ion:
40.9 to 42.1 mm (1.61 to 1.66 in.)

N TICE:

- **To avoid tapping in a new spark pl t be too far, meas re the protr ion height while tapping it.**
- **Be caref l not to deform the spark pl t be.**
- **Be caref l not to expose the seal to coolant for at least 1 ho r after installing it.**



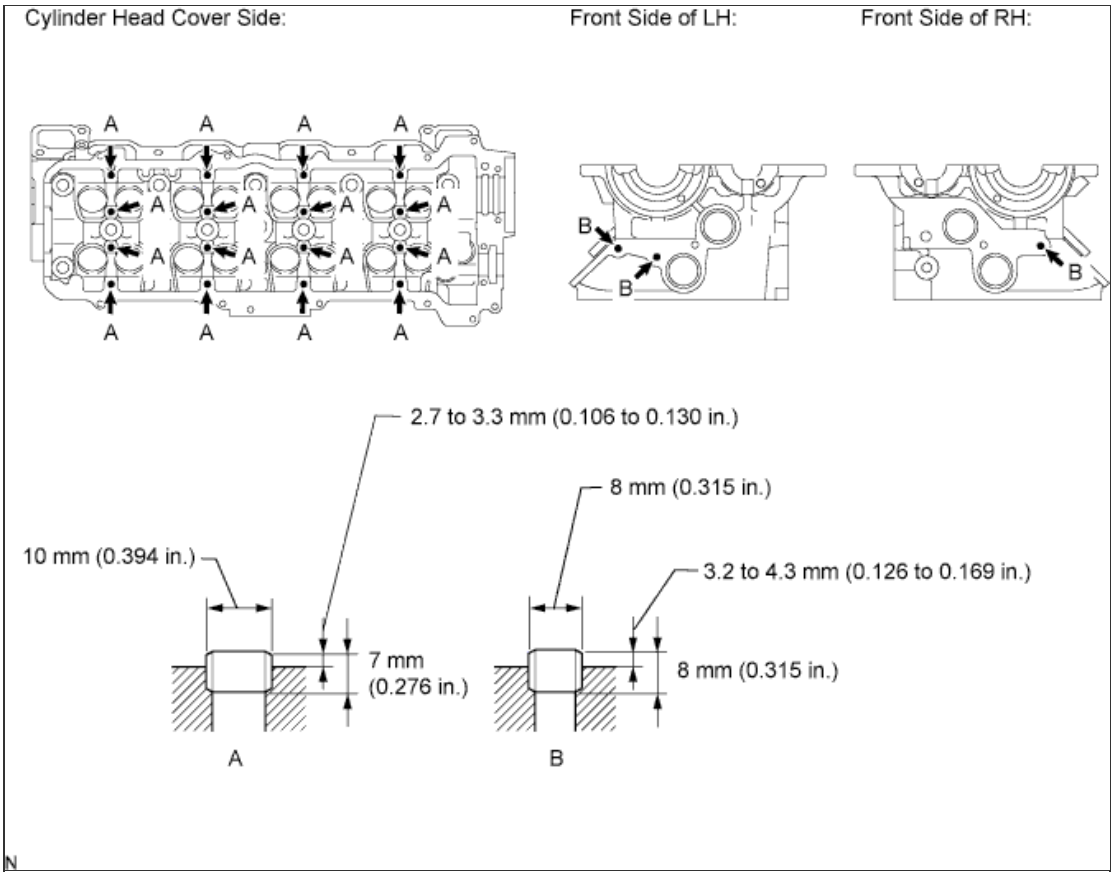
4. REPLACE RING PIN

N TICE:

It is not necessary to remove the ring pin unless it is being replaced.

a. Remove the ring pin.

b. Using a plastic-faced hammer, tap in new ring pins until they stop.



Standard Protr ion:

Item	Specified Condition
A	2.7 to 3.3 mm (0.106 to 0.130 in.)
B	3.2 to 4.3 mm (0.126 to 0.169 in.)

for Preparation Click here

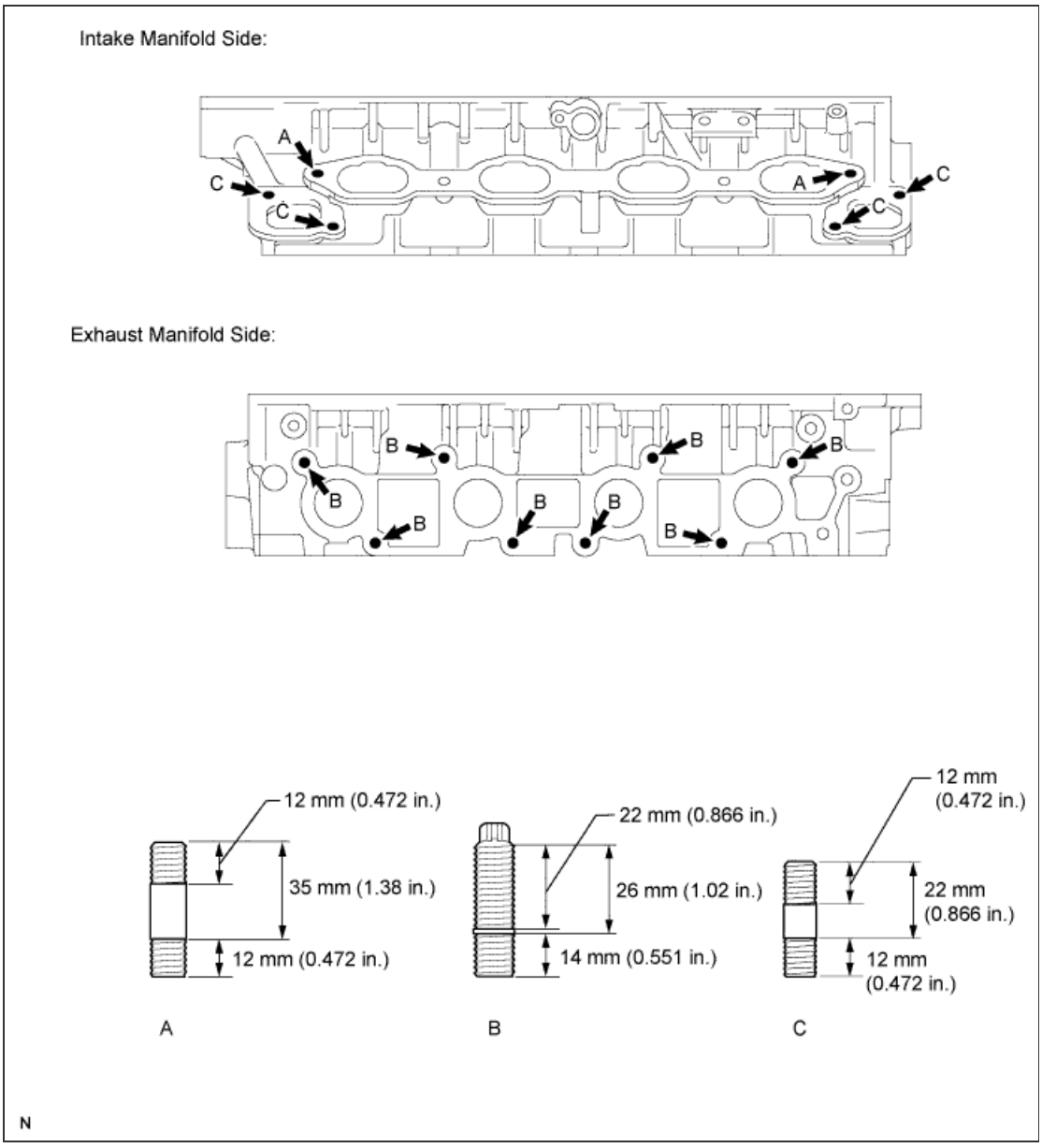
1. INSTALL STUD BOLT

NOTICE:

If a stud bolt is deformed or the threads are damaged, replace it.

a. Using an E10 "TORX" socket wrench, install the stud bolts A, B and C.

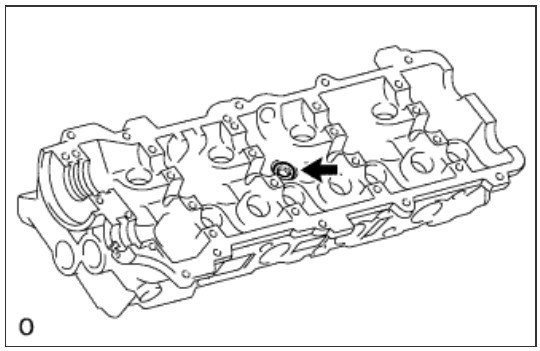
Torque:
for stud bolt A, C:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }
for stud bolt B:
15 N*m{ 153 kgf*cm , 11 ft.*lbf }



2. INSTALL NO. 1 STRAIGHT SCREW PLUG

a. Using a 14 mm hexagon wrench, install 2 new gaskets and the 2 straight screw plugs.

Torque:
85 N*m{ 868 kgf*cm , 63 ft.*lbf }



3. INSTALL VALVE SPRING SEAT

a. Install the valve spring seats to the cylinder head.

4. INSTALL VALVE STEM OIL SEAL

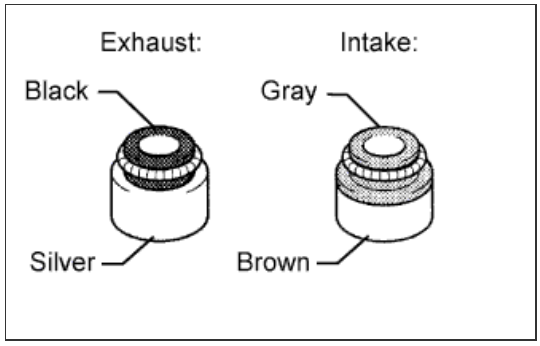
a. Apply a light coat of engine oil to a new stem oil seal.

NOTICE:

Pay close attention when installing the intake and exhaust oil seals. For example, installing the intake oil seal into the exhaust or installing the exhaust oil seal to the intake can cause installation problems later.

HINT:

The intake valve oil seal is gray/brown and the exhaust valve oil seal is black/silver.

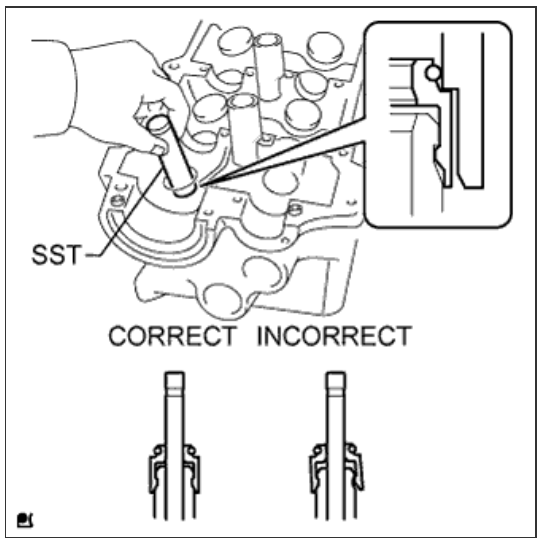


b. Using SST, push in the oil seal.

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NOTICE:

Failure to use SST will cause the seal to be damaged or improperly seated.



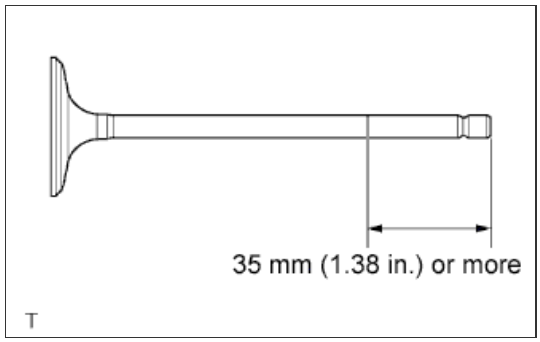
5. INSTALL INTAKE VALVE

a. Apply plenty of engine oil to the tip area of the intake valve shown in the illustration.

b. Install the valve, inner compression spring and spring retainer to the cylinder head.

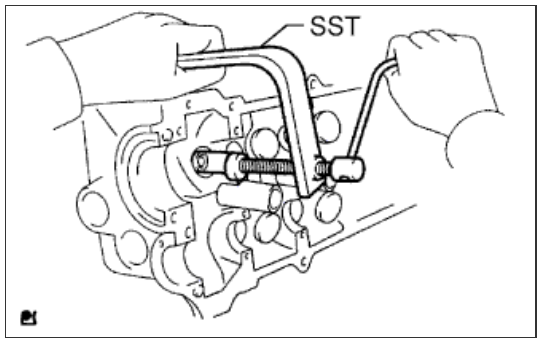
NOTICE:

Install the same parts in the same combination to their original locations.



c. Using SST, compress the compression spring and place the 2 spring retainer locks around the valve stem.

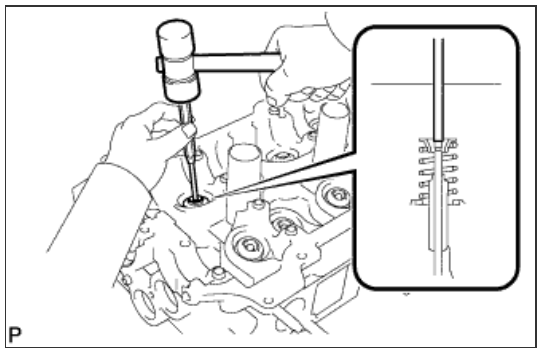
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d. Using a plastic-faced hammer and 5 mm pin punch, lightly tap the valve stem tip to ensure a proper fit.

NOTICE:

Do not damage the valve stem tip.



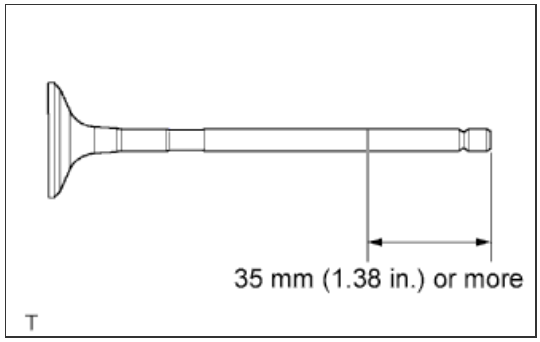
6. INSTALL EXHAUST VALVE

a. Apply plenty of engine oil to the tip area of the exhaust valve shown in the illustration.

b. Install the valve, inner compression spring and spring retainer to the cylinder head.

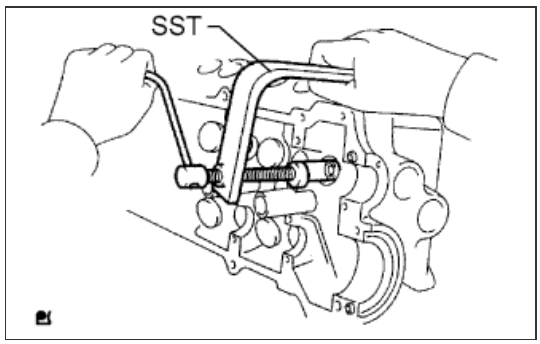
NOTICE:

Install the same parts in the same combination to their original locations.



c. Using SST, compress the compression spring and place the 2 spring retainer locks around the valve stem.

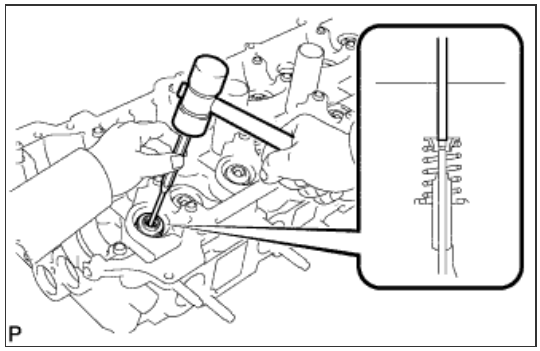
SST
09202-70020 (09202-00010, 09202-01010, 09202-01020)



d. Using a plastic-faced hammer and 5 mm pin punch, lightly tap the valve stem tip to ensure a proper fit.

NOTICE:

Do not damage the valve stem tip.



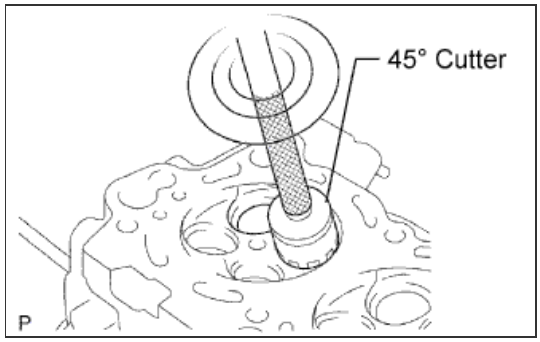
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1. REPAIR INTAKE VALVE SEAT

NOTICE:

- **Repair the seat while checking the seating position.**
- **Keep the lip free of foreign matter.**
- **Take off a cutter gradually to make the intake valve seat smooth.**

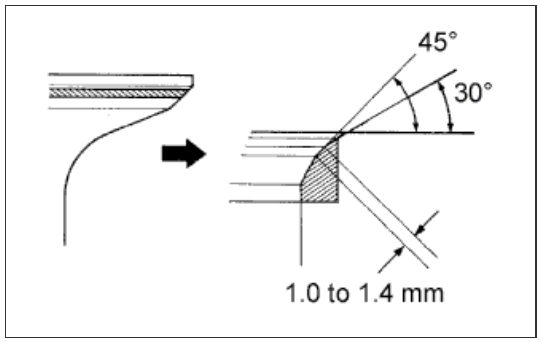
a. Using a 45° cutter, resurface the valve seats.



HINT:

Only remove the amount of metal necessary to clean the seats.

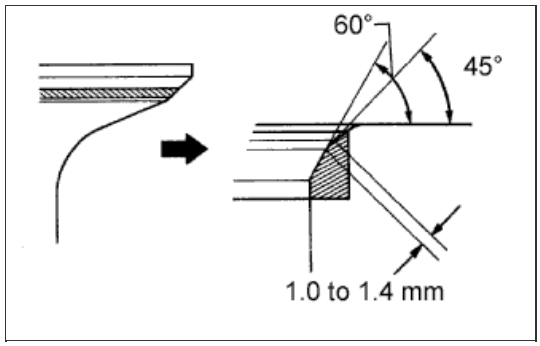
b. If the seating is too high on the valve face:
Use ° and 45° cutters to correct the seat.



c. If the seating is too low on the valve face:
Use 60° and 45° cutters to correct the seat.

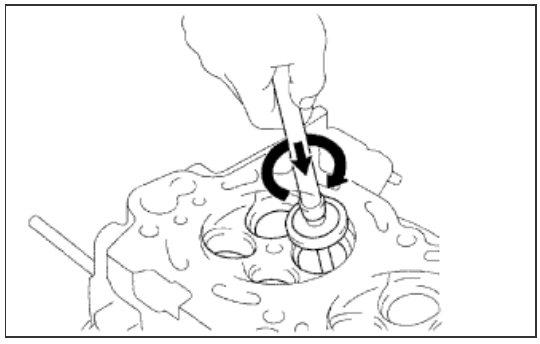
d. Check that the seat contact is in the middle of the valve face and has the following width.

Standard width:
1. to 1.4 mm (. to . 1 in.)



e. Hand-lap the valve and valve seat with an abrasive compound.

f. Clean and check the valve seating position.



2. REPAIR E HAUST VALVE SEAT

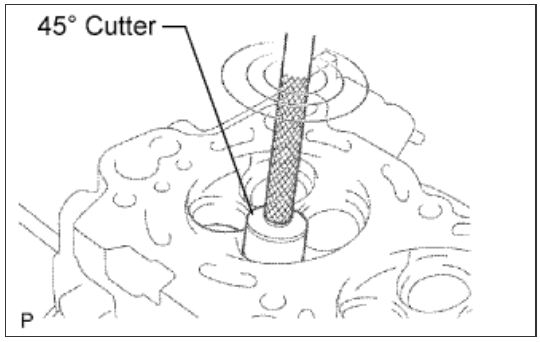
NOTICE:

- **Repair the seat while checking the seating position.**
- **Keep the lip free of foreign matter.**
- **Take off a cutter gradually to make the exhaust valve seat smooth.**

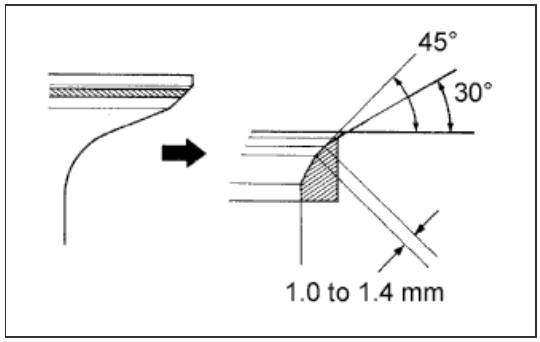
a. Using a 45° cutter, resurface the valve seats.

HINT:

Only remove the amount of metal necessary to clean the seats.



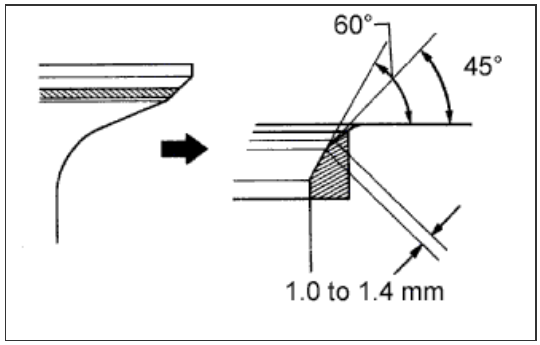
b. If the seating is too high on the valve face:
Use ° and 45° cutters to correct the seat.



c. If the seating is too low on the valve face:
Use 60° and 45° cutters to correct the seat.

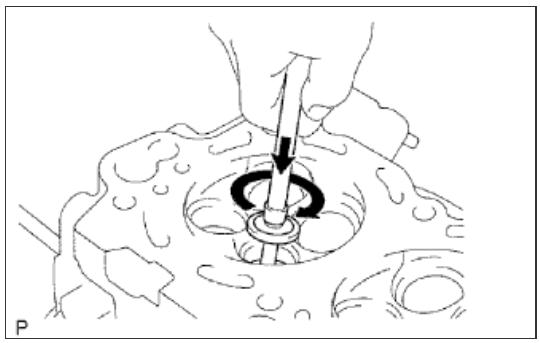
d. Check that the seat contact is in the middle of the valve face and has the following width.

Standard width:
1. to 1.4 mm (. to . 1 in.)

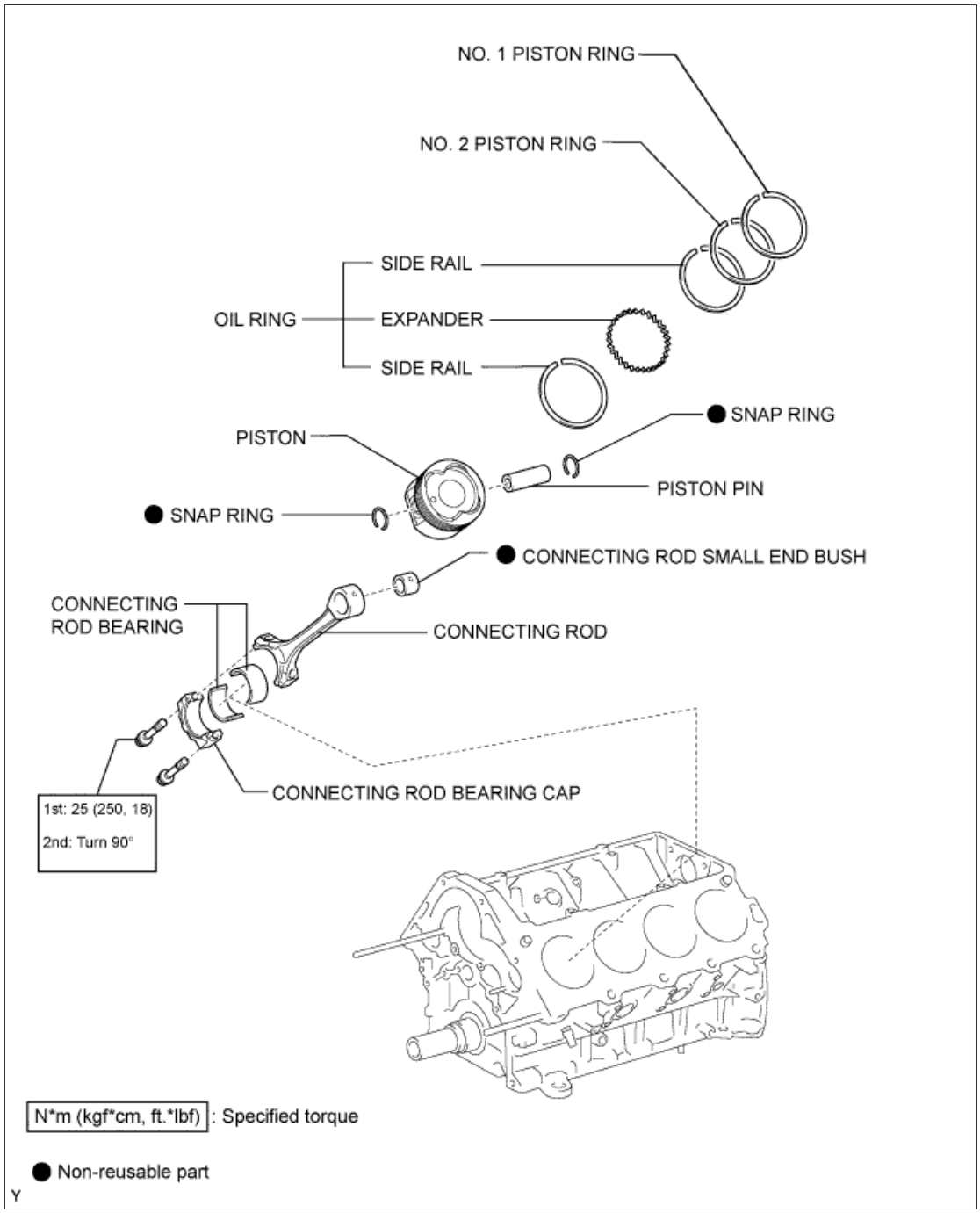


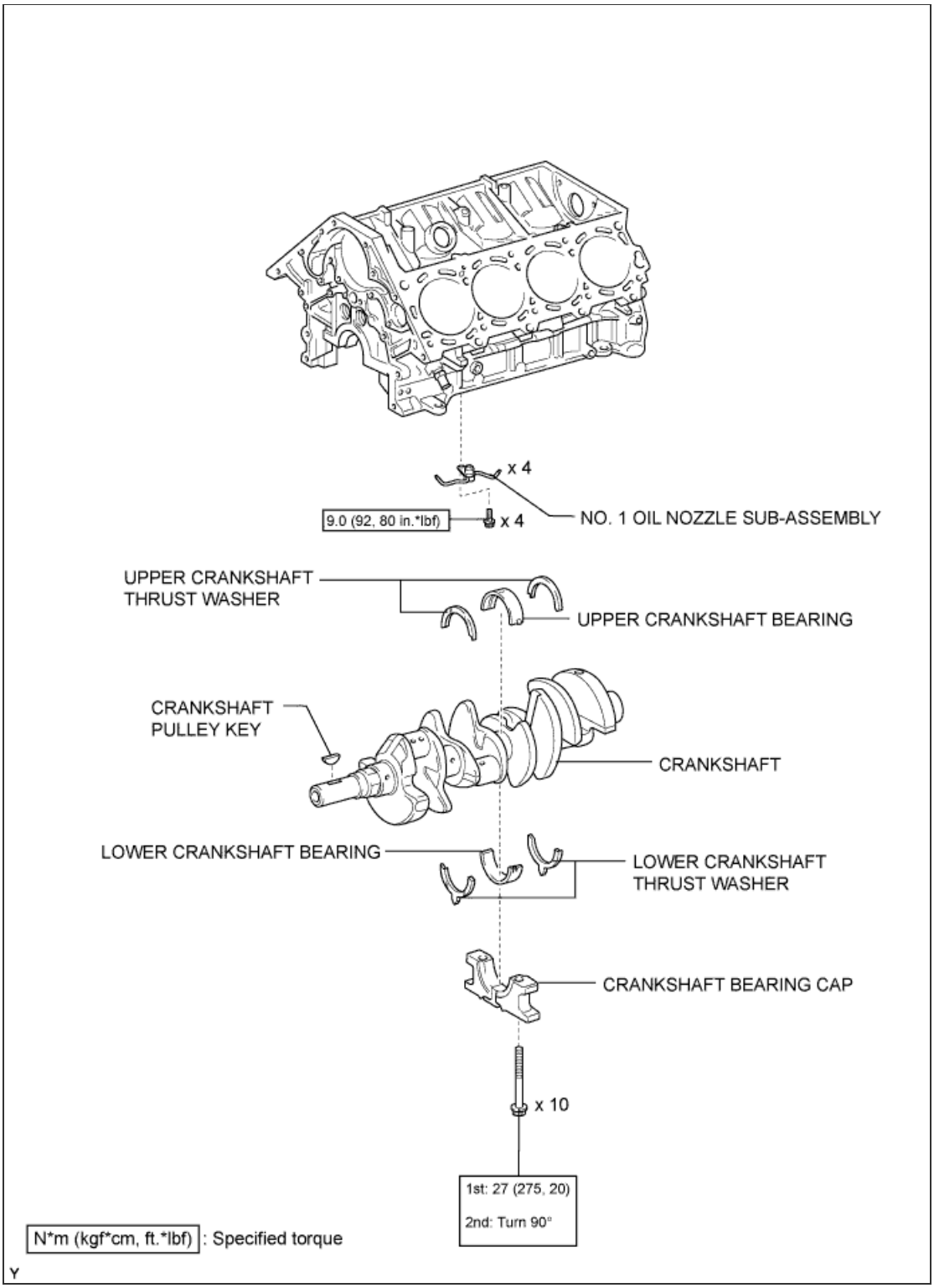
e. Hand-lap the valve and valve seat with an abrasive compound.

f. Clean and check the valve seating position.



for Preparation Click here




x 4
9.0 (92, 80 in.*lbf)
x 4
NO. 1 OIL NOZZLE SUB-ASSEMBLY
UPPER CRANKSHAFT THRUST WASHER
UPPER CRANKSHAFT BEARING
CRANKSHAFT PULLEY KEY
CRANKSHAFT
LOWER CRANKSHAFT BEARING
LOWER CRANKSHAFT THRUST WASHER
CRANKSHAFT BEARING CAP
x 10
1st: 27 (275, 20)
2nd: Turn 90°
N*m (kgf*cm, ft.*lbf) : Specified torque
Y

for Preparation Click here

1. INSPECT CONNECTING ROD THRUST CLEARANCE

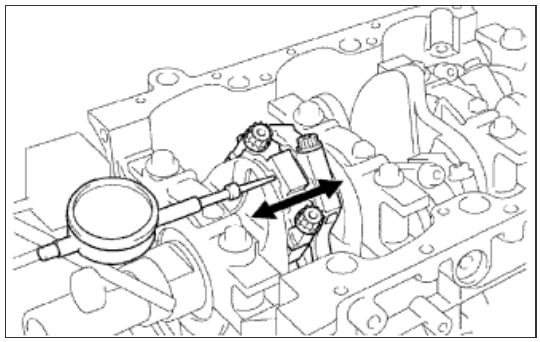
a. Using a dial indicator, measure the thrust clearance while moving the connecting rod back and forth.

Standard thrust clearance:
0.160 to 0.290 mm (0.00630 to 0.0114 in.)

Maximum thrust clearance:
0.35 mm (0.0138 in.)

If the thrust clearance is more than the maximum, replace the connecting rod assembly. If necessary, replace the crankshaft.

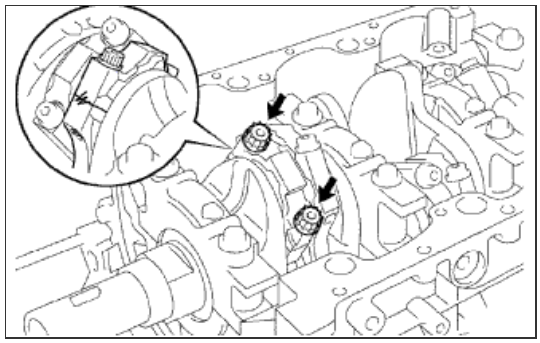
Standard connecting rod thickness:
22.880 to 22.920 mm (0.901 to 0.902 in.)



2. INSPECT CONNECTING ROD OIL CLEARANCE

a. Check the matchmarks on the connecting rod and cap to ensure correct reassembly.

b. Remove the 2 connecting rod cap bolts.



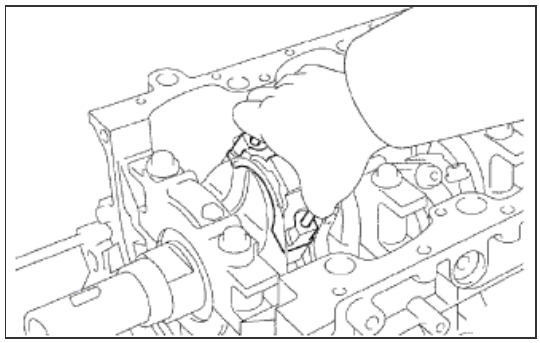
c. Using the 2 removed connecting rod cap bolts, remove the connecting rod cap and lower bearing by wiggling the connecting rod cap right and left.

HINT:

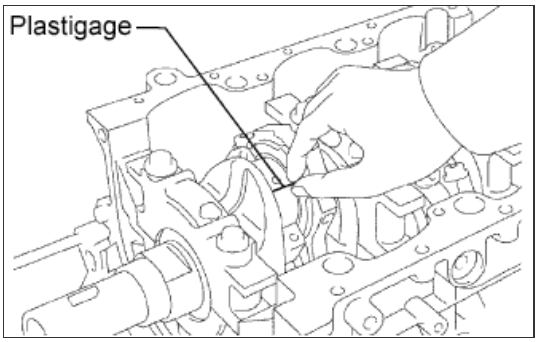
Keep the lower bearing and connecting rod cap together.

d. Clean the crank pin and bearing.

e. Check the crank pin and bearing for pitting and scratches.
If the crank pin or bearing is damaged, replace the bearings. If necessary, replace the crankshaft.



f. Lay a strip of Plastigage across the crank pin.



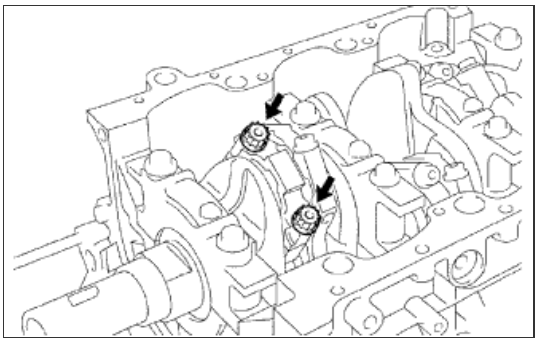
g. Install the connecting rod cap with the 2 bolts.

Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }

NOTICE:

Do not turn the crankshaft.

If any one of the connecting rod cap bolts does not meet the torque specification, replace the connecting rod cap bolts.

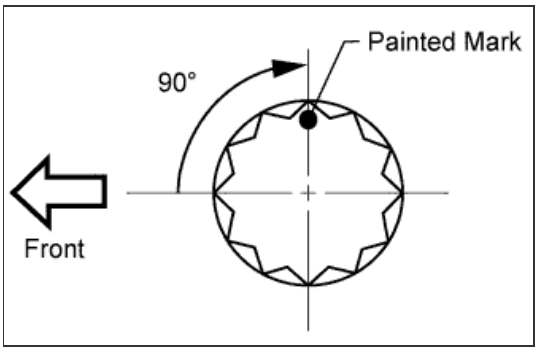


h. Mark the front side of each connecting rod cap bolt with paint.

i. Tighten the cap bolts 90° as shown.

j. Check that the painted marks are now at a 90° angle to the front.

k. Remove the 2 bolts, connecting rod cap and lower bearing.



l. Measure the Plastigage at its widest point.

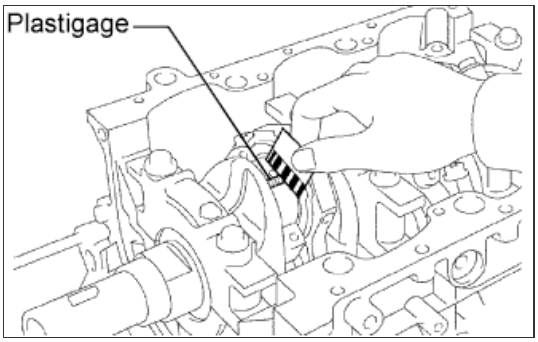
Standard oil clearance:
0.021 to 0.047 mm (0.000827 to 0.00185 in.)

Maximum oil clearance:
0.059 mm (0.00232 in.)

If the oil clearance is more than the maximum, replace the bearings. If necessary, replace the crankshaft.

HINT:

If replacing a standard bearing, replace it with one that has the same number. If the number of the bearing cannot be determined, select the correct bearing by adding together the numbers imprinted on the connecting rod cap and crankshaft. Then select the bearing with the same number as the total. There are 6 sizes of standard bearings, marked 2, 3, 4, 5, 6 and 7.

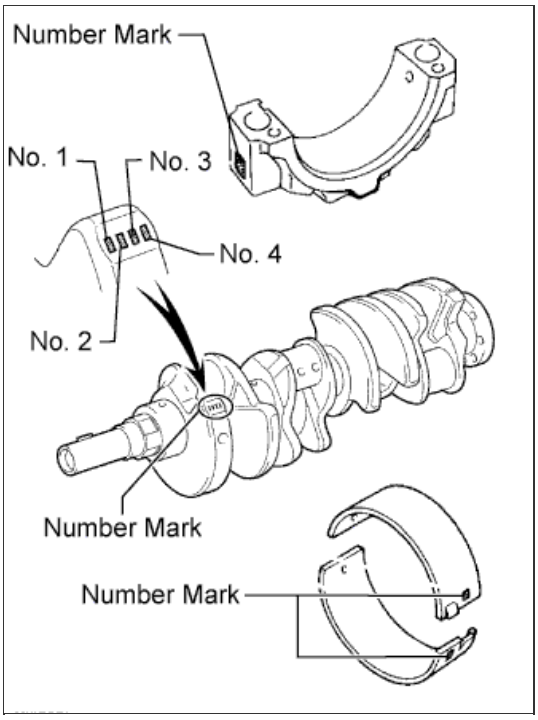


EXAMPLE:
Connecting rod cap "3" + Crankshaft "1" = "4" (Use bearing "4")

Standard Bearing Chart:

Item	Connecting Rod	Crankshaft	Use Bearing
Number Mark	1	1	2
	1	2	3
	2	1	
	1	3	4
	2	2	
	3	1	

	2	3	
	3	2	5
	4	1	
	3	3	6
	4	2	
	4	3	7



Standard Connecting Rod Big End Inside Diameter:

Number Mark	Specified Condition
Mark 1	55.000 to less than 55.006 mm (2.1654 to less than 2.1656 in.)
Mark 2	55.006 to less than 55.012 mm (2.1656 to less than 2.1658 in.)
Mark 3	55.012 to less than 55.018 mm (2.1658 to less than 2.1661 in.)
Mark 4	55.018 to less than 55.024 mm (2.1661 to less than 2.1663 in.)

Standard Crankshaft Crank Pin Diameter:

Number Mark	Specified Condition
Mark 1	51.994 to less than 52.000 mm (2.0470 to less than 2.0472 in.)
Mark 2	51.988 to less than 51.994 mm (2.0468 to less than 2.0470 in.)
Mark 3	51.982 to less than 51.988 mm (2.0465 to less than 2.0468 in.)

Standard Si ed Bearing Center all Thickness:

Number Mark	Specified Condition
Mark 2	1.487 to less than 1.490 mm (0.0585 to less than 0.0587 in.)
Mark 3	1.490 to less than 1.493 mm (0.0587 to less than 0.0588 in.)
Mark 4	1.493 to less than 1.496 mm (0.0588 to less than 0.0589 in.)
Mark 5	1.496 to less than 1.499 mm (0.0589 to less than 0.0590 in.)
Mark 6	1.499 to less than 1.502 mm (0.0590 to less than 0.0591 in.)
Mark 7	1.502 to less than 1.505 mm (0.0591 to less than 0.0593 in.)

m. Completely remove the Plastigage.

n. Perform the inspection above for each cylinder.

3. REMOVE PISTON AND CONNECTING ROD

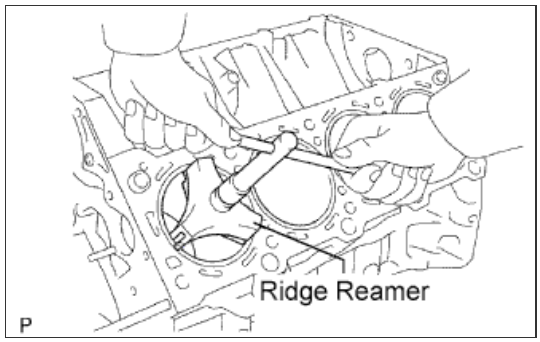
a. Using a ridge reamer, remove all the carbon from the top of the cylinder.

b. Remove the 16 cap bolts and 8 connecting rod caps.

c. Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

HINT:

- **Keep the bearings, connecting rod and cap together.**
- **Arrange the piston and connecting rod in the correct order.**
- **Be sure to arrange the remo ed piston and connecting rod assemblies in such a ay that they can be reinstalled exactly as before.**



4. REMOVE CONNECTING ROD BEARING

a. Remove the connecting rod bearings from the connecting rods and connecting rod caps.

HINT:

Arrange the removed parts in the correct order.

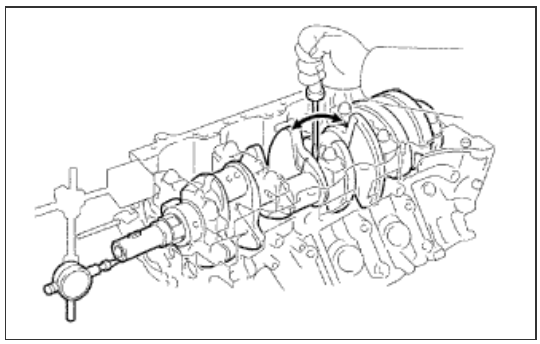
5. INSPECT CRANKSHA T THRUST CLEARANCE

a. Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

Standard thrust clearance:
0.020 to 0.220 mm (0.000787 to 0.00866 in.)

Maximum thrust clearance:
0.30 mm (0.0118 in.)

If the thrust clearance is more than the maximum, replace the thrust washers as a set. If necessary, replace the crankshaft.

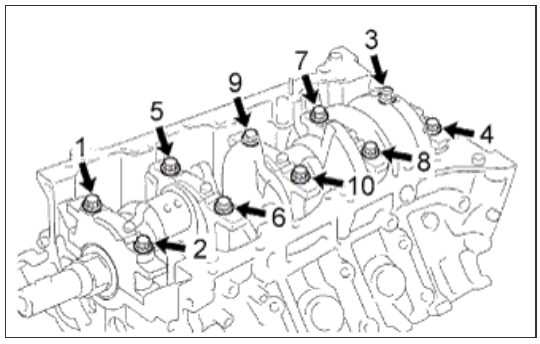


Standard Thrust asher Thickness:

Item	Specified Condition
Standard	2.440 to 2.490 mm (0.0961 to 0.0980 in.)
O/S (0.125)	2.565 to 2.615 mm (0.101 to 0.103 in.)

6. REMOVE CRANKSHA T

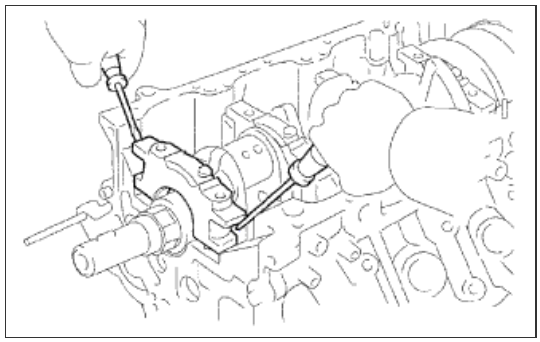
a. Uniformly loosen and remove the 10 crankshaft bearing cap bolts in the sequence shown in the illustration.



b. Using 2 screwdrivers, gradually pry up and remove the 5 crankshaft bearing caps, 5 lower bearings and 2 lower thrust washers (No. 3 crankshaft bearing cap only).

NOTICE:

Be careful not to damage the contact surface between the cylinder block and bearing cap.



HINT:

- **Keep the lo er bearing and crankshaft bearing cap together.**
- **Arrange the remo ed parts in the correct order.**
- **Be sure to arrange the bearing caps and lo er thrust ashers in such a ay that they can be reinstalled exactly as before.**

c. Lift out the crankshaft.

d. Remove the crankshaft bearings and upper thrust washers from the cylinder block.

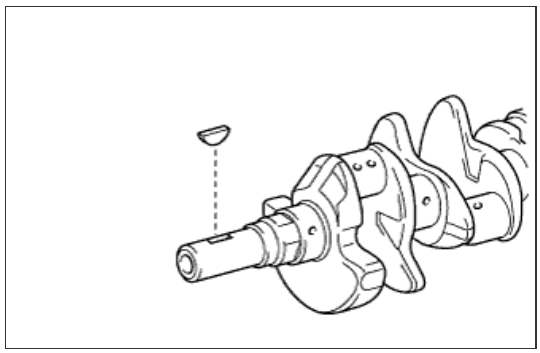
HINT:

Arrange the bearings and thrust washers in the correct order.

e. Check each crankshaft journal and bearing for pitting and scratches.
If the journal or bearing is damaged, replace the bearings. If necessary, replace the crankshaft.

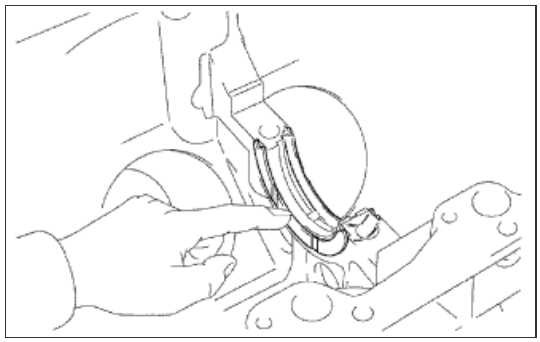
7. REMOVE CRANKSHA T PULLEY KEY

a. Using a screwdriver, remove the pulley key from the crankshaft.

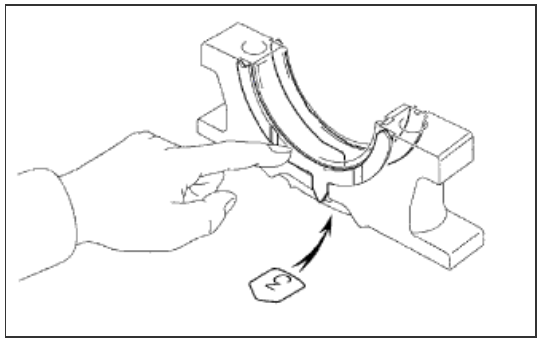


8. REMOVE CRANKSHA T THRUST ASHER SET

a. Remove the thrust washer set (upper side) from the cylinder block.



b. Remove the thrust washer set (lower side) from the No. 3 bearing cap.



9. REMOVE CRANKSHA T BEARING

a. Remove the crankshaft bearings from the cylinder block and bearing caps.

HINT:

Arrange the removed parts in the correct order.

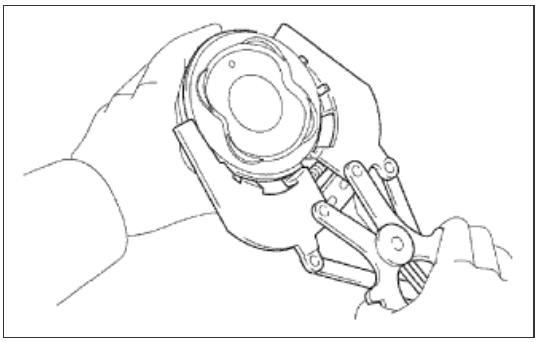
10. REMOVE PISTON RING SET

HINT:

Arrange the piston rings in the correct order.

a. Using a piston ring expander, remove the No. 1 and No. 2 piston rings.

b. Remove the oil ring (2 side rails and expander) by hand.

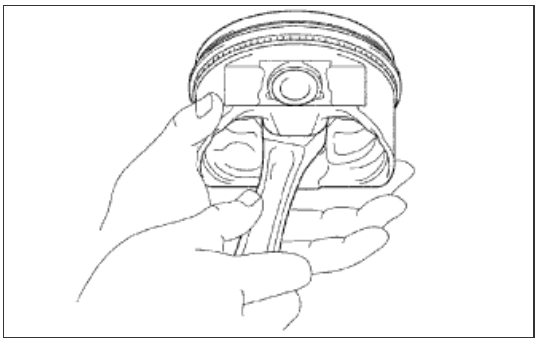


11. REMOVE PISTON SUB-ASSEMBLY ITH PIN

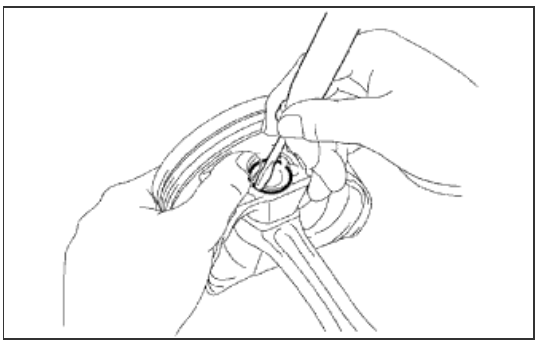
a. Check the fitting condition between the piston and piston pin.

i. Move the connecting rod back and forth on the piston pin. Check the fitting condition.
If abnormal movement is felt, replace the piston and pin as a set.

ii. Rotate the piston back and forth on the piston pin. Check the fitting condition.
If abnormal movement is felt, replace the piston and pin as a set.



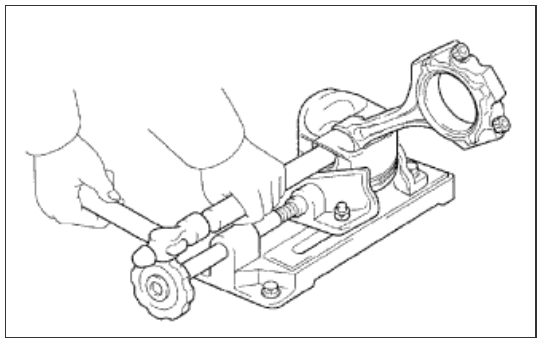
b. Using a small screwdriver, pry out the 2 snap rings.



c. Using a plastic-faced hammer and brass bar, lightly tap out the piston pin. Then remove the connecting rod.

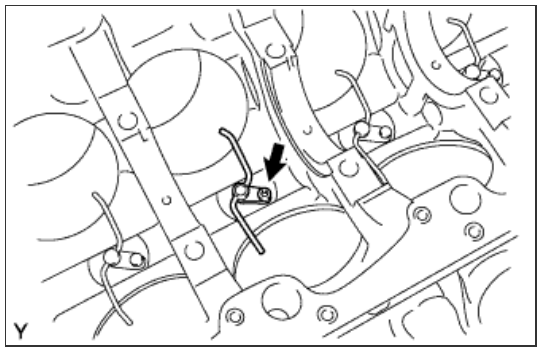
HINT:

- **The piston and pin are a matched set.**
- **Be sure to arrange the remo ed pistons, pins, rings, connecting rods and bearings in such a ay that the parts can be reinstalled exactly as before.**
- **Arrange the remo ed parts in the correct order.**



12. REMOVE NO. 1 OIL NOZZLE SUB-ASSEMBLY

a. Using a 5 mm hexagon wrench, remove the 4 bolts and 4 oil nozzles.



13. REMOVE STUD BOLT

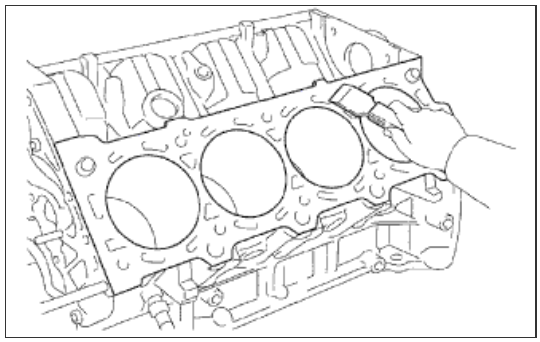
NOTICE:

If a stud bolt is deformed or the threads are damaged, replace it.

for Preparation Click here

1. INSPECT CYLINDER BLOCK SUB-ASSEMBLY

a. Clean the cylinder block.



i. Using a gasket scraper, remove all the gasket material from the top surface of the cylinder block.

ii. Using a soft brush and solvent, thoroughly clean the cylinder block.

NOTICE:

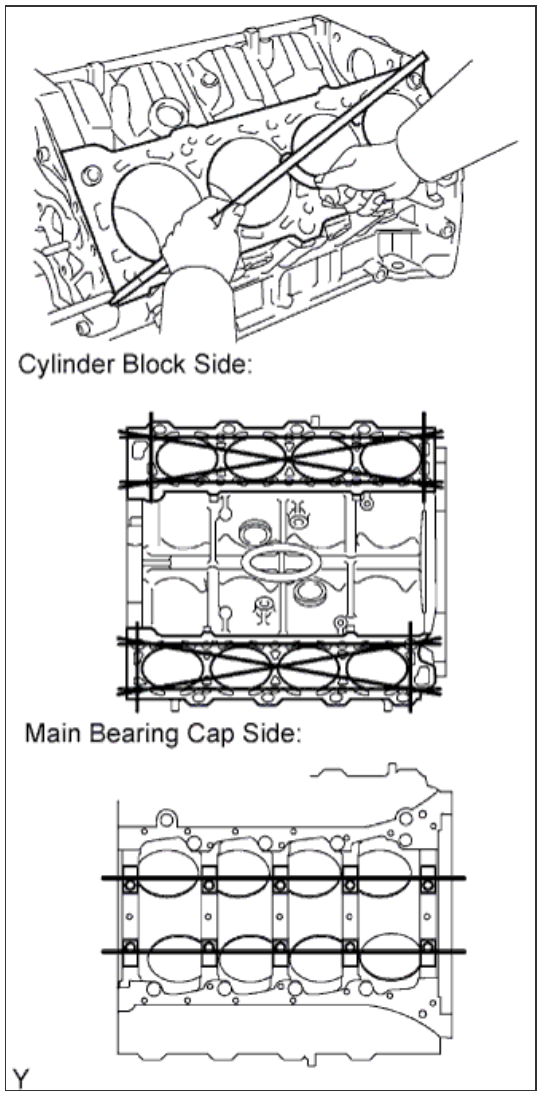
If the cylinder is washed at high temperatures, the cylinder liner sticks out beyond the cylinder block. Always wash the cylinder block at a temperature of 45°C (113°F) or less.

b. Using a precision straightedge and feeler gauge, measure the surfaces contacting the cylinder head and main bearing cap for warpage.

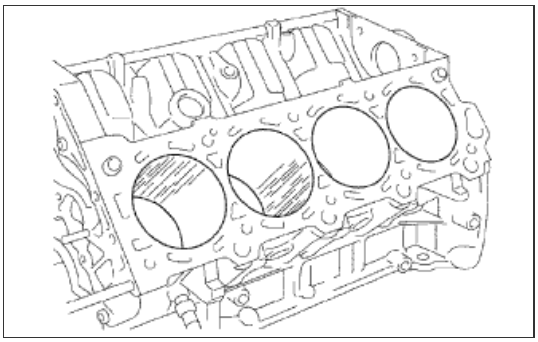
Standard warpage:
0 to 0.05 mm (0 to 0.00197 in.)

Maximum warpage:
0.07 mm (0.00276 in.)

If the warpage is more than the maximum, replace the cylinder block.



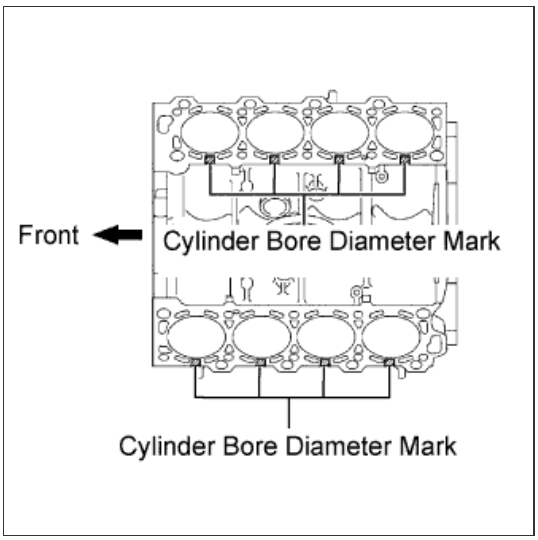
c. Visually check the cylinder for vertical scratches.
If deep scratches are present, rebore all 8 cylinders and replace all 8 pistons. If necessary, replace the cylinder block.



2. INSPECT CYLINDER BORE

INT:

There are 3 standard cylinder bore diameter sizes, marked "1", "2" and "3" accordingly. The mark is stamped on the top of the cylinder block.



a. Inspect the cylinder bore diameter.

i. Using a cylinder gauge, measure the cylinder bore diameter at positions A, B and C in the thrust and axial directions.

Measurement Cylinder Bore Position:

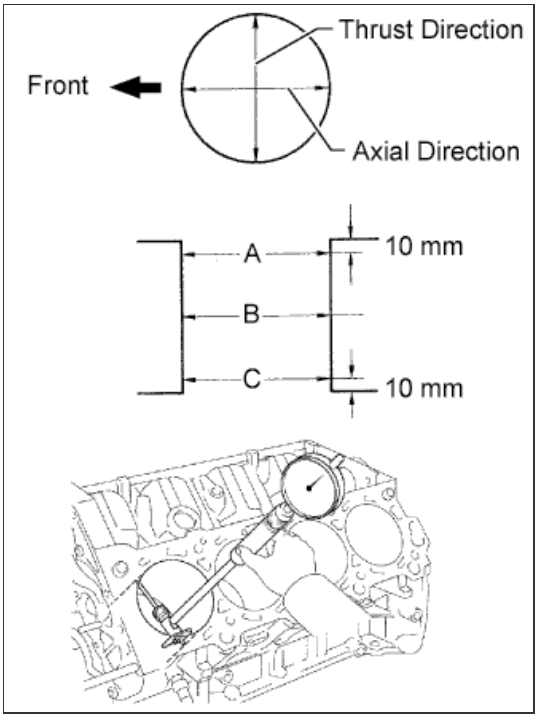
Position	Specified Condition
A	10 mm (0.394 in.) from top edge
B	Center
C	10 mm (0.394 in.) from bottom edge

Standard Diameter:

Number Mark	Specified Condition
Mark 1	94.002 to 94.010 mm (3.70087 to 3.70118 in.)
Mark 2	94.011 to 94.020 mm (3.70122 to 3.70157 in.)
Mark 3	94.021 to 94.028 mm (3.70161 to 3.70189 in.)

Maximum diameter:
94.230 mm (3.71 in.)

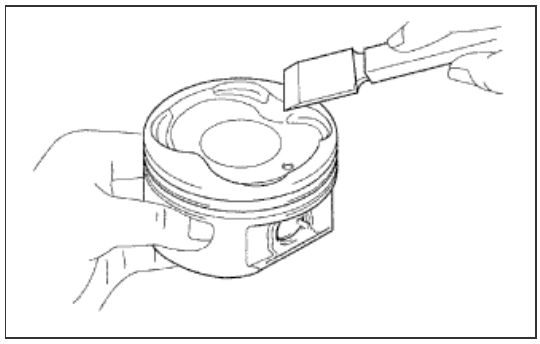
If the diameter is more than the maximum, rebore all 8 cylinders and replace all 8 pistons. If necessary, replace the cylinder block.



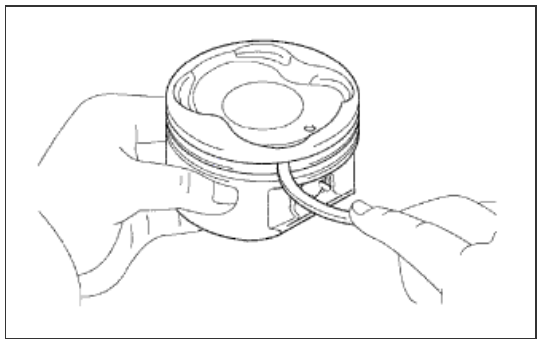
3. INSPECT PISTON SUB-ASSEMBLY WIT PIN

a. Clean the piston.

i. Using a gasket scraper, remove the carbon from the piston top.



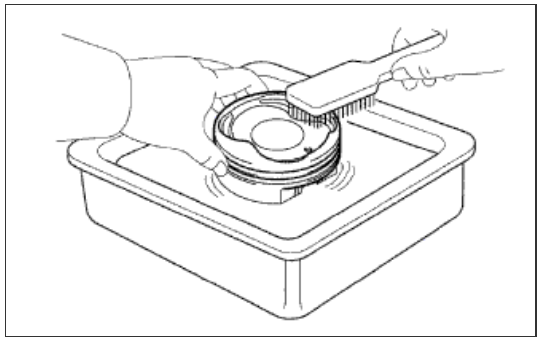
ii. Using a groove cleaning tool or broken ring, clean the piston ring grooves.



iii. Using solvent and a brush, thoroughly clean the piston.

NOTICE:

Do not use a wire brush.

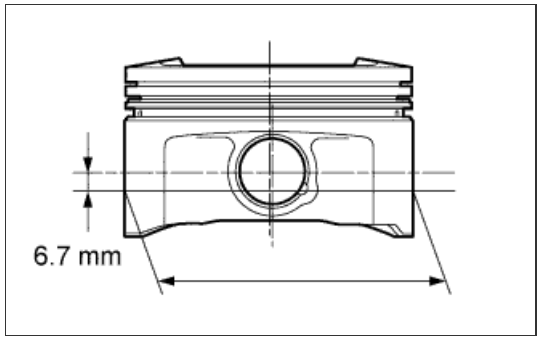


b. Inspect the piston diameter.

i. Using a micrometer, measure the piston diameter at a position that is 6.7 mm (0.264 in.) downward from the center of the piston pin hole (refer to the illustration).

Standard Piston Diameter:

Piston	Specified Condition
STD	93.968 to 93.996 mm (3.670 to 3.701 in.)
O/S (0.50)	94.468 to 94.496 mm (3.719 to 3.720 in.)

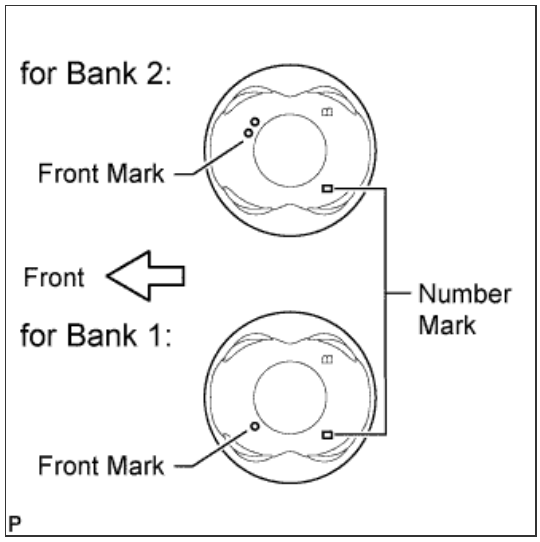


INT:

There are 3 standard diameter sizes, marked "1", "2" and "3". The mark is stamped on the piston top.

Standard Piston Diameter:

Number ark	Specified Condition
ark 1	93.942 to 93.952 mm (3.6985 to 3.6989 in.)
ark 2	93.952 to 93.960 mm (3.6989 to 3.6992 in.)
ark 3	93.960 to 93.970 mm (3.6992 to 3.6996 in.)



4. INSPECT PISTON OIL CLEARANCE

a. easure the cylinder bore diameter in the thrust directions.

b. Subtract the piston diameter measurement from the cylinder bore diameter measurement.

Standard oil clearance:
0.050 to 0.068 mm (0.00197 to 0.00268 in.)

Maximum oil clearance:
0.13 mm (0.00512 in.)

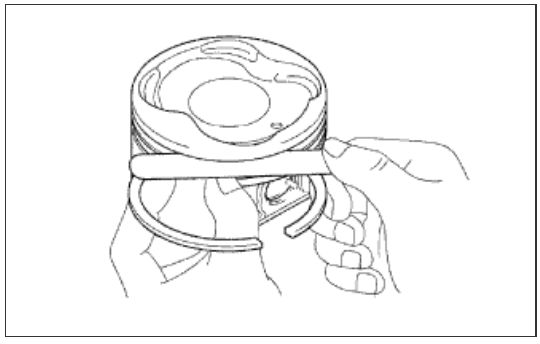
If the oil clearance is more than the maximum, replace all 8 pistons and rebore all 8 cylinders. If necessary, replace the cylinder block.

INT:

When replacing the cylinder block, use a piston with the same number mark as the cylinder diameter marked on the cylinder block.

5. INSPECT RING GROOVE CLEARANCE

a. Inspect the piston ring groove clearance.



i. Using a feeler gauge, measure the clearance between a new piston ring and the wall of the ring groove.

Standard Ring Groove Clearance:

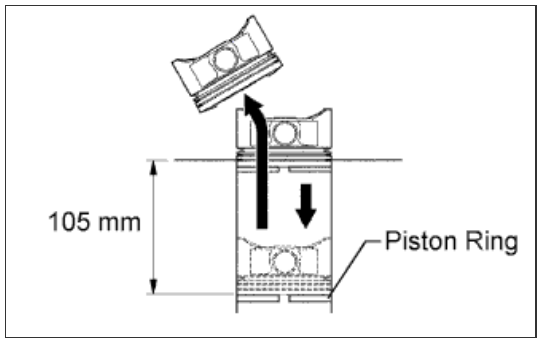
Piston Ring	Specified Condition
No. 1	0.030 to 0.080 mm (0.00118 to 0.00315 in.)
No. 2	0.020 to 0.060 mm (0.000787 to 0.00236 in.)

If the clearance is not as specified, replace the piston.

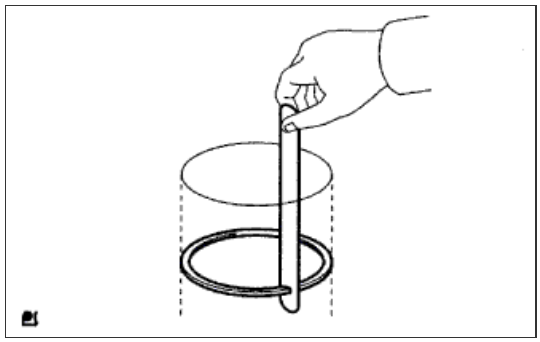
6. INSPECT PISTON RING END GAP

a. Insert the piston ring into the cylinder bore.

b. Using a piston, push the piston ring a little beyond the bottom of the ring travel, 105 mm (4.13 in.) from the top of the cylinder block.



c. Using a feeler gauge, measure the end gap.



Standard End Gap:

Piston Ring	Specified Condition
No. 1 piston ring	0.300 to 0.400 mm (0.0118 to 0.0157 in.)
No. 2 piston ring	0.400 to 0.550 mm (0.0157 to 0.0217 in.)
Oil ring (Side rail)	0.130 to 0.380 mm (0.00512 to 0.0150 in.)

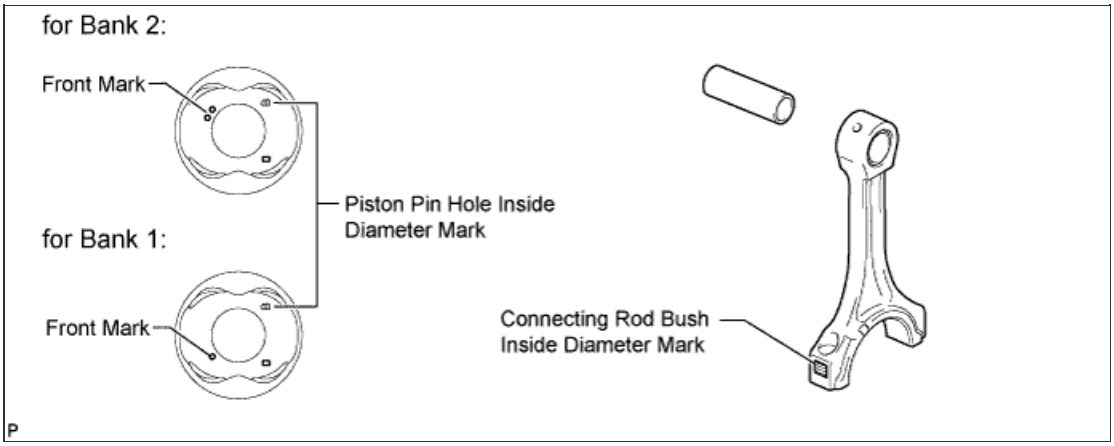
Maximum End Gap:

Piston Ring	Specified Condition
No. 1 piston ring	1.10 mm (0.0433 in.)
No. 2 piston ring	1.30 mm (0.0512 in.)
Oil ring (Side rail)	0.90 mm (0.0354 in.)

If the end gap is more than the maximum, replace the piston ring. If the end gap is more than the maximum even with a new piston ring, rebore all 8 cylinders or replace the cylinder block sub-assembly.

7. INSPECT PISTON PIN OIL CLEARANCE

a. Check each mark on the piston and connecting rod.

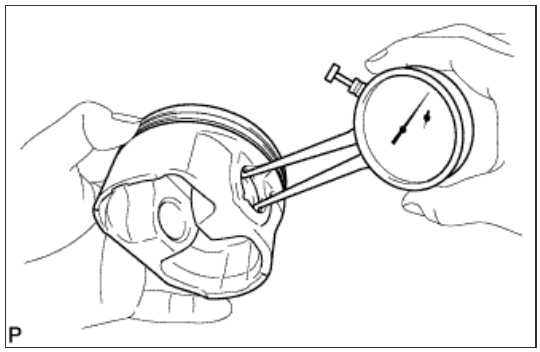


b. Using a caliper gauge, measure the inside diameter of the piston pin hole.

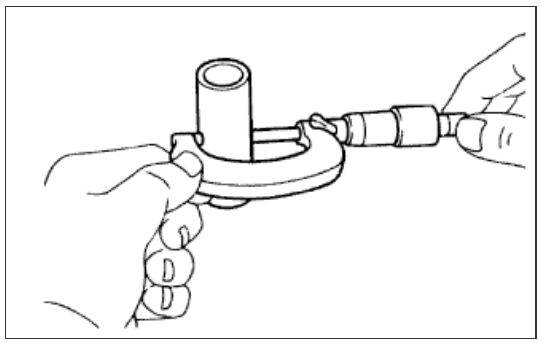
Standard Piston Pin ole Inside Diameter:

Mark	Specified Condition
A	21.998 to 22.001 mm (0.86606 to 0.86618 in.)

B	22.002 to 22.004 mm (0.86622 to 0.86630 in.)
C	22.005 to 22.007 mm (0.86634 to 0.86642 in.)



c. Using a micrometer, measure the piston pin diameter.



Standard Piston Pin Diameter:

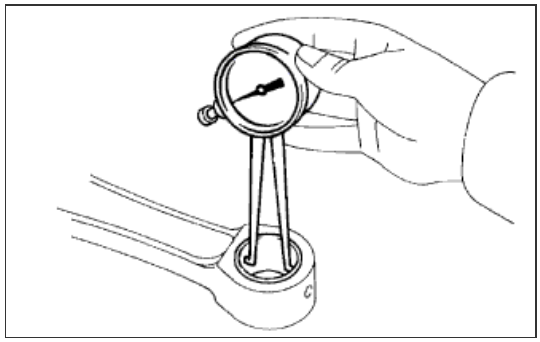
Piston Pin	Specified Condition
A	21.997 to 22.000 mm (0.86602 to 0.86614 in.)
B	22.001 to 22.003 mm (0.86618 to 0.86626 in.)
C	22.004 to 22.006 mm (0.86630 to 0.86638 in.)

d. Subtract the piston pin diameter measurement from the piston pin hole diameter measurement.

Standard oil clearance:
-0.002 to 0.004 mm (-0.0000787 to 0.000157 in.)

If the oil clearance is more than the maximum, replace the piston and piston pin as a set.

e. Using a caliper gauge, measure the inside diameter of the connecting rod bush.



Standard Bush Inside Diameter:

Bush	Specified Condition
A	22.005 to 22.008 mm (0.86633 to 0.86646 in.)
B	22.009 to 22.011 mm (0.86650 to 0.86657 in.)
C	22.012 to 22.014 mm (0.86661 to 0.86669 in.)

If the bush inside diameter is not as specified, replace the connecting rod small end bush and check the oil clearance.

f. Subtract the piston pin diameter measurement from the bush inside diameter measurement.

Standard oil clearance:
0.005 to 0.011 mm (0.000197 to 0.000433 in.)

Maximum oil clearance:
0.05 mm (0.00197 in.)

If the oil clearance is more than the maximum, replace the connecting rod small end bush. If necessary, replace the piston and piston pin with a new piston and pin set.

8. INSPECT CONNECTING ROD SUB-ASSEMBLY

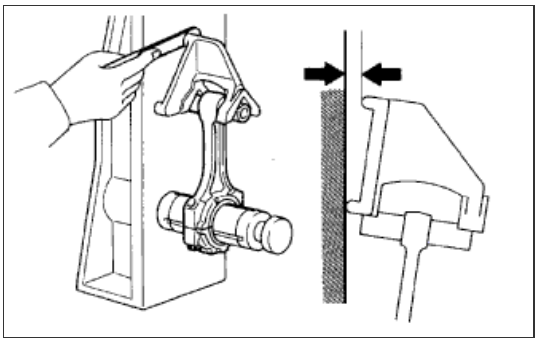
a. Using a rod aligner and feeler gauge, check the connecting rod alignment.

i. Check if the connecting rod is bent.

Maximum bend:

0.05 mm (0.00197 in.) per 100 mm (3.94 in.)

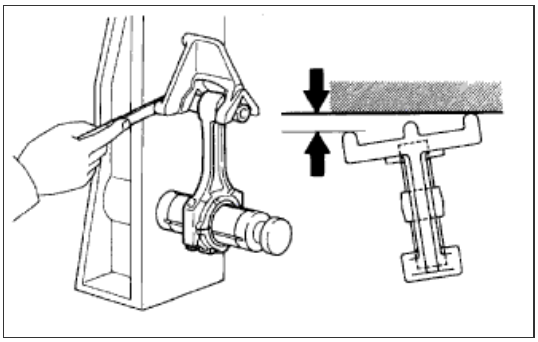
If the bend is more than the maximum, replace the connecting rod sub-assembly.



ii. Check if the connecting rod is twisted.

Maximum twist:
0.15 mm (0.00591 in.) per 100 mm (3.94 in.)

If the twist is more than the maximum, replace the connecting rod sub-assembly.



9. INSPECT CRANKS AFT

a. Inspect for circle runout.

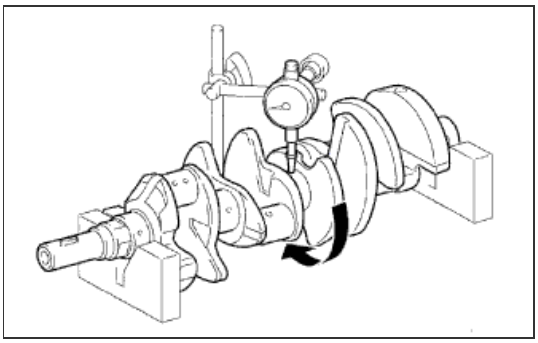
i. Place the crankshaft on V-blocks.

ii. Using a dial indicator, measure the circle runout at the center journal.

Standard circle runout:
0 to 0.06 mm (0 to 0.00236 in.)

Maximum circle runout:
0.08 mm (0.00315 in.)

If the circle runout is more than the maximum, replace the crankshaft.



b. Inspect the main journals.

i. Using a micrometer, measure the diameter of each main journal.

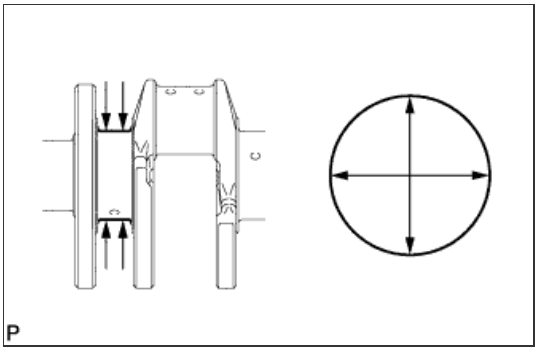
Standard diameter:
66.988 to 67.000 mm (2.6373 to 2.6378 in.)

If the diameter is not as specified, check the oil clearance. If necessary, replace the crankshaft.

ii. Check each main journal for taper and out of round as shown in the illustration.

Maximum taper and out of round:
0.02 mm (0.000787 in.)

If the taper and out of round is more than the maximum, replace the crankshaft.



c. Inspect the crank pins.

i. Using a micrometer, measure the diameter of each crank pin.

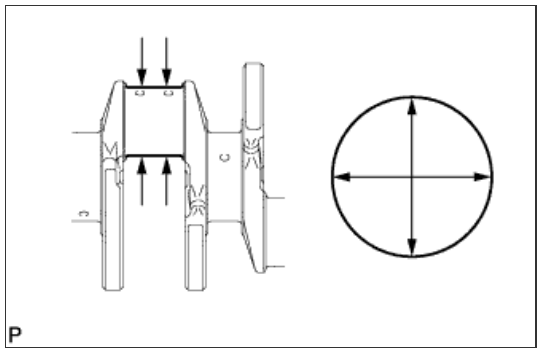
Standard diameter:
51.982 to 52.000 mm (2.0465 to 2.0472 in.)

If the diameter is not as specified, check the oil clearance. If necessary, replace the crankshaft.

ii. Check each crank pin for taper and out of round as shown in the illustration.

Maximum taper and out of round:
0.02 mm (0.000787 in.)

If the taper and out of round is more than the maximum, replace the crankshaft.



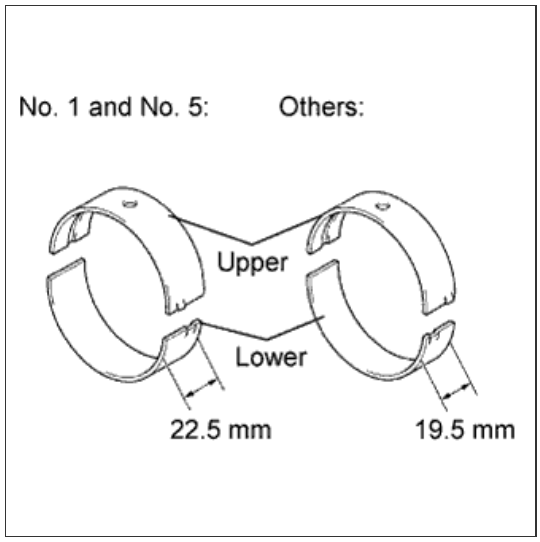
10. INSPECT CRANKS AFT OIL CLEARANCE

a. Clean each crankshaft journal and bearing.

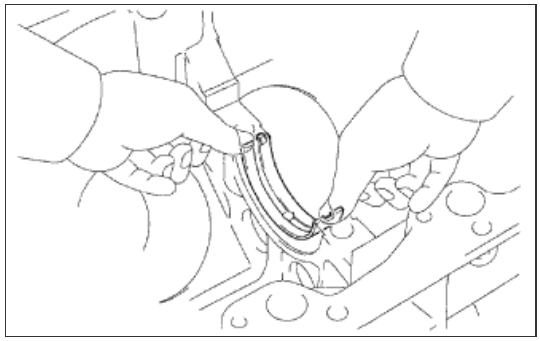
INT:

- **Main bearings come in widths of 19.5 mm (0.768 in.) and 22.5 mm (0.886 in.). Install the 22.5 mm (0.886 in.) bearings in the No. 1 and No. 5 cylinder block journal positions with the crankshaft bearing cap. Install the 19.5 mm (0.768 in.) bearings in the other positions.**
- **Upper bearings have an oil groove and oil holes lower bearings do not.**

b. Check each crankshaft journal and bearing for pitting and scratches.
If the journal or bearing is damaged, replace the bearings. If necessary, replace the crankshaft.



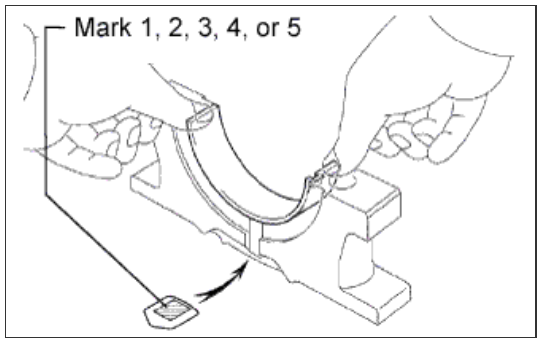
c. Align the bearing claw with the claw groove of the cylinder block, and push in the 5 upper bearings.



d. Align the bearing claw with the claw groove of the crankshaft bearing cap, and push in the 5 lower bearings.

INT:

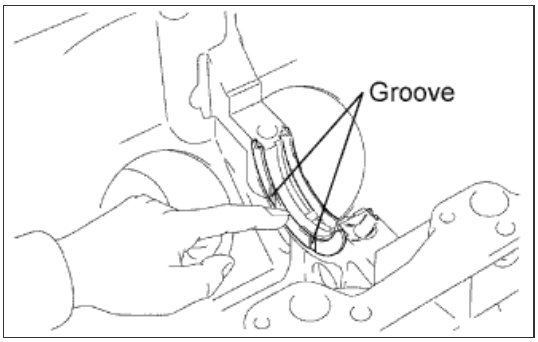
A number is marked on each bearing cap to indicate the installation position.



e. Apply engine oil to the thrust washer set.

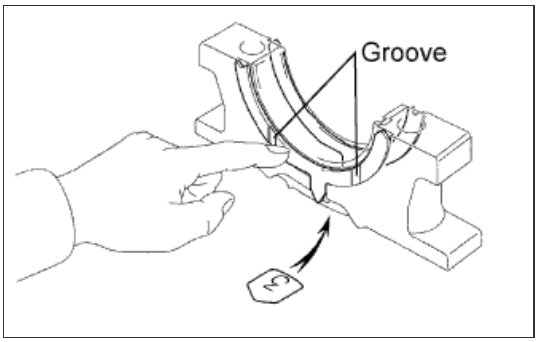
f. Install the 2 thrust washers under the No. 3 journal position of the cylinder block

with the oil grooves facing outward.

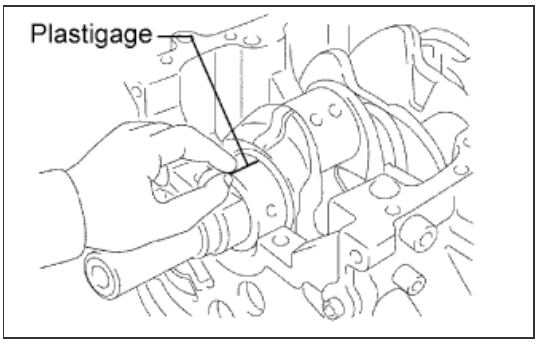


g. Install the 2 thrust washers on the No. 3 crankshaft bearing cap with the grooves facing outward.

h. Place the crankshaft on the cylinder block.



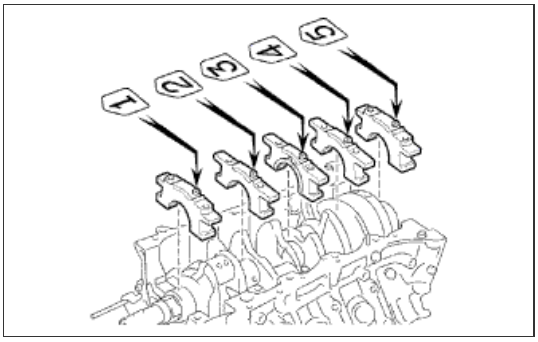
i. Lay a strip of Plastigage across each journal.



j. Examine the front mark and number, and install the 5 crankshaft bearing caps to the cylinder block.

INT:

A number is marked on each bearing cap to indicate the installation position.



k. Apply a light coat of engine oil to the threads and under the heads of the crankshaft bearing cap bolts.

l. Install the 10 crankshaft bearing cap bolts.

INT:

If any one of the main bearing cap bolts is broken or deformed, replace it.

i. Uniformly tighten the 10 crankshaft bearing cap bolts in several passes in the sequence shown in the illustration.

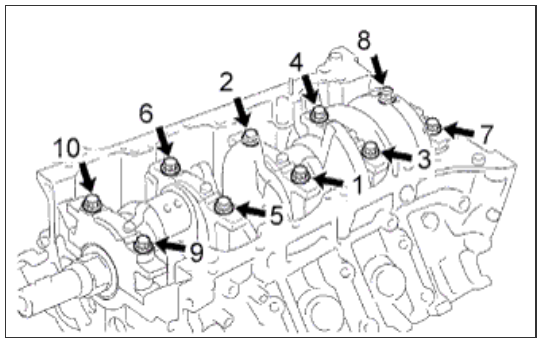
Torque:

27 N*m{ 275 kgf*cm 20 ft.*lbf

NOTICE:

Do not turn the crankshaft.

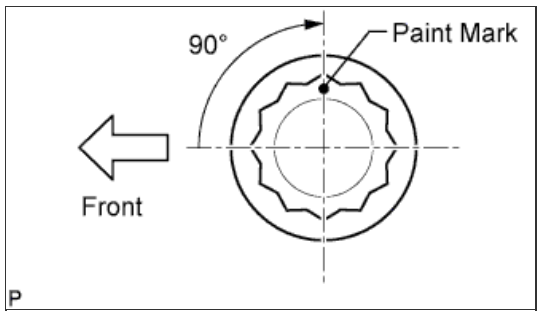
If any of the bearing cap bolts cannot meet the torque specification, replace the bearing cap bolt.



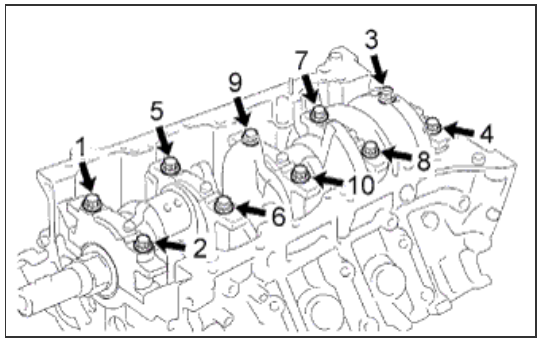
ii. ark the front of the crankshaft bearing cap bolts with paint.

iii. Tighten the crankshaft bearing cap bolts 90° as shown in the illustration.

iv. Check that the painted marks are now at a 90° angle to the front.



m. Uniformly loosen and remove the 10 crankshaft bearing cap bolts in the sequence shown in the illustration.



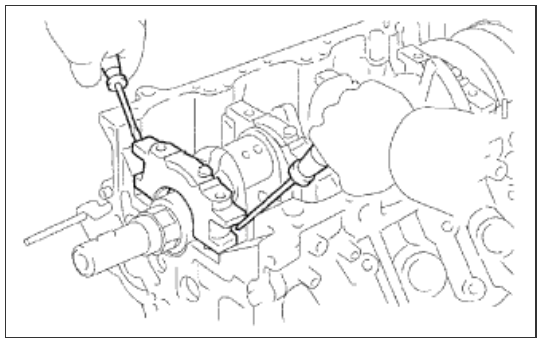
n. Using 2 screwdrivers, gradually pry up and remove the 5 crankshaft bearing caps, 5 lower bearings and 2 lower thrust washers (No. 3 crankshaft bearing cap only).

NOTICE:

Be careful not to damage the contact surfaces of the cylinder block and bearing cap.

INT:

- **Keep the lower bearing and crankshaft bearing cap together.**
- **Arrange the removed parts in the correct order.**



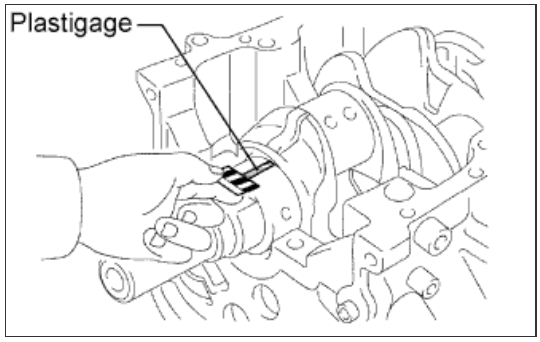
o. Measure the Plastigage at its widest point.

Standard Oil Clearance:

Number Mark	Specified Condition
No. 1 and No. 5	0.028 to 0.046 mm (0.00110 to 0.00181 in.)
Other	0.040 to 0.058 mm (0.00157 to 0.00228 in.)

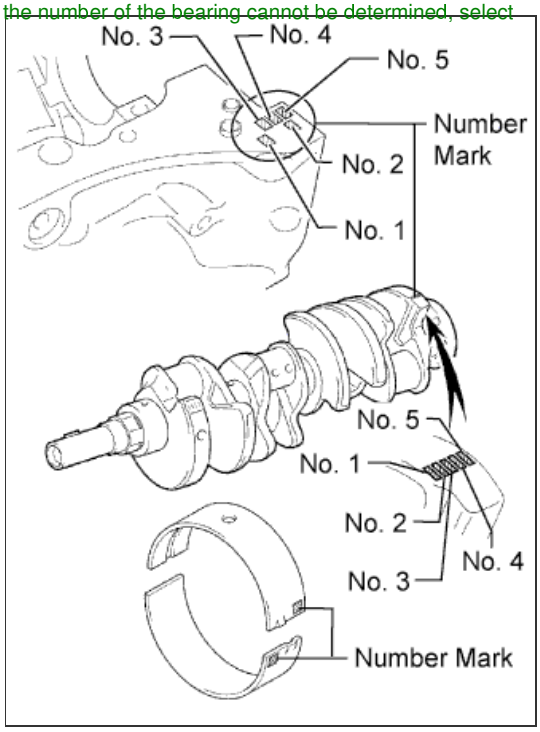
Maximum oil clearance:
0.065 mm (0.00256 in.)

If the oil clearance is more than the maximum, replace the bearings. If necessary, replace the crankshaft.



INT:

If replacing a standard bearing, replace it with one that has the same number. If the number of the bearing cannot be determined, select the correct bearing by adding together the numbers imprinted on the cylinder block and crankshaft. Then refer to the table below for the appropriate bearing number. There are 5 sizes of standard bearings. For No. 1 and No. 5 position bearings, use bearings marked 3, 4, 5, 6 and 7. For other position bearings, use bearings marked 1, 2, 3, 4 and 5.



E A PLE:
No. 1 and No. 5 journal
Cylinder block (A) "7" + Crankshaft (B) "6" = Total number 13
(Use bearing "5")
Other journal
Cylinder block (A) "7" + Crankshaft (B) "6" = Total number 13
(Use bearing "3")

A = Cylinder block number mark
B = Crankshaft number mark

INT:

(Cylinder block journal diameter - crankshaft journal diameter - 5) X 1000 = A + B

Bearing Chart:

(A) + (B)	No. 1 and No. 5 Journal	Other Journal
0 to 6	3	1
6 to 11	4	2
12 to 17	5	3
18 to 23	6	4
24 to 28	7	5

Standard Cylinder Block Crankshaft Journal Bore Diameter (A):

Number Mark	Specified Condition
Mark 00	72.000 mm (2.83465 in.)
Mark 01	72.001 mm (2.83469 in.)
Mark 02	72.002 mm (2.83472 in.)
Mark 03	72.003 mm (2.83476 in.)
Mark 04	72.004 mm (2.83480 in.)
Mark 05	72.005 mm (2.83484 in.)
Mark 06	72.006 mm (2.83488 in.)
Mark 07	72.007 mm (2.83492 in.)
Mark 08	72.008 mm (2.83496 in.)
Mark 09	72.009 mm (2.83500 in.)
Mark 10	72.010 mm (2.83504 in.)
Mark 11	72.011 mm (2.83508 in.)
Mark 12	72.012 mm (2.83512 in.)
Mark 13	72.013 mm (2.83516 in.)
Mark 14	72.014 mm (2.83520 in.)
Mark 15	72.015 mm (2.83524 in.)
Mark 16	72.016 mm (2.83528 in.)

Standard Crankshaft Journal Diameter (B):

Number Mark	Specified Condition
Mark 00	67.000 mm (2.63780 in.)
Mark 01	66.999 mm (2.63776 in.)
Mark 02	66.998 mm (2.63772 in.)
Mark 03	66.997 mm (2.63768 in.)
Mark 04	66.996 mm (2.63764 in.)
Mark 05	66.995 mm (2.63760 in.)
Mark 06	66.994 mm (2.63756 in.)
Mark 07	66.993 mm (2.63752 in.)
Mark 08	66.992 mm (2.63748 in.)
Mark 09	66.991 mm (2.63744 in.)

ark 10	66.990 mm (2.63740 in.)
ark 11	66.989 mm (2.63736 in.)
ark 12	66.988 mm (2.63732 in.)

Standard Bearing Center Wall Thickness:

Number ark	Specified Condition
ark 1	2.481 to less than 2.484 mm (0.0977 to less than 0.0978 in.)
ark 2	2.484 to less than 2.487 mm (0.0978 to less than 0.0979 in.)
ark 3	2.487 to less than 2.490 mm (0.0979 to less than 0.0980 in.)
ark 4	2.490 to less than 2.493 mm (0.0980 to less than 0.0981 in.)
ark 5	2.493 to less than 2.496 mm (0.0981 to less than 0.0983 in.)
ark 6	2.496 to less than 2.499 mm (0.0983 to less than 0.0984 in.)
ark 7	2.499 to less than 2.502 mm (0.0984 to less than 0.0985 in.)

p. Completely remove the Plastigage.

q. Perform the inspection above for each journal.

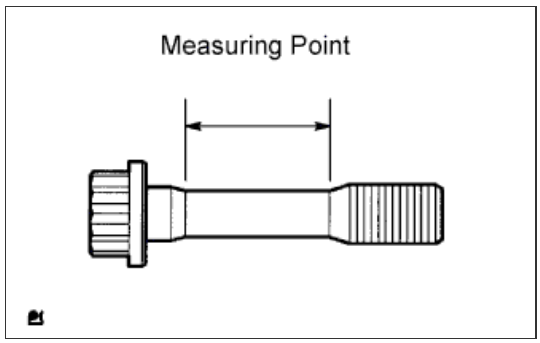
11. INSPECT CONNECTING ROD BOLT

a. Using a vernier caliper, measure the tension portion of the connecting rod bolt.

Standard diameter:
7.200 to 7.300 mm (0.283 to 0.287 in.)

Minimum diameter:
7.00 mm (0.276 in.)

If the diameter is less than the minimum, replace the connecting rod bolt.



12. INSPECT CRANKS AFT BEARING CAP BOLT

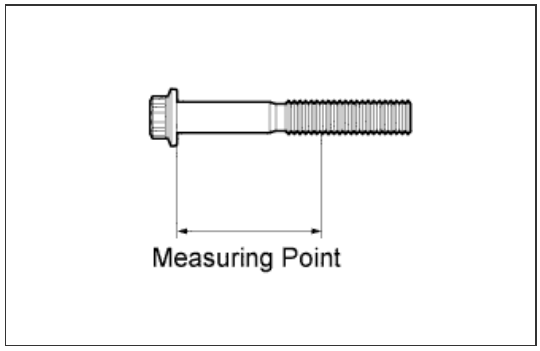
a. Using a vernier caliper, measure the thread outside diameter of the main bearing cap bolt.

Measuring point:
67.0 mm (2.64 in.)

Standard diameter:
10.760 to 10.970 mm (0.424 to 0.432 in.)

Minimum diameter:
10.40 mm (0.409 in.)

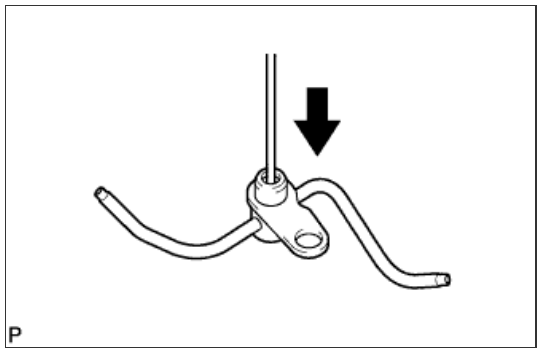
If the diameter is less than the minimum, replace the crankshaft bearing cap bolt.



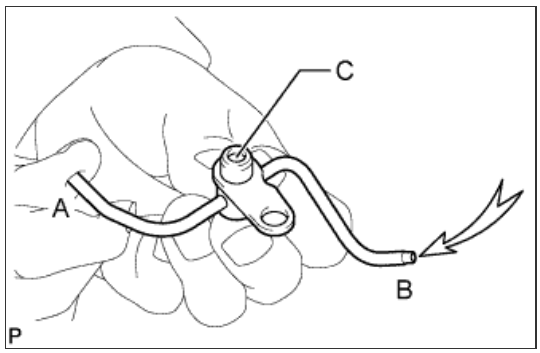
13. INSPECT NO. 1 OIL NO LE SUB-ASSEMBLY

a. Push the check valve with a pin to check if it is stuck.
If stuck, replace the oil nozzle sub-assembly.

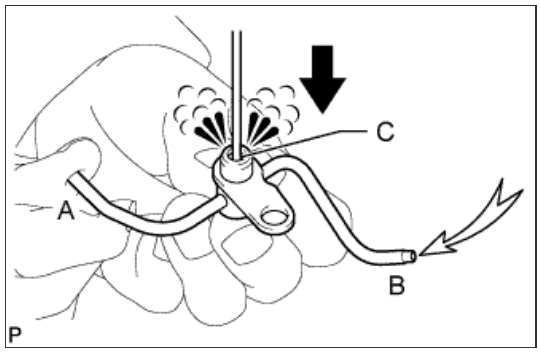
b. Push the check valve with a pin to check if it moves smoothly.
If it does not move smoothly, clean or replace the No. 1 oil nozzle sub-assembly.



c. While covering A, apply air into B. Check that air does not leak through C.
Perform the check again while covering B and applying air into A.
If air leaks, clean or replace the No. 1 oil nozzle sub-assembly.



d. Push the check valve while covering A, and apply air into B. Check that air passes through C. Perform the check again while covering B, pushing the check valve and applying air into A.
If air does not pass through C, clean or replace the No. 1 oil nozzle sub-assembly.



for Preparation Click here

1. REPLACE RING PIN

NOTICE:

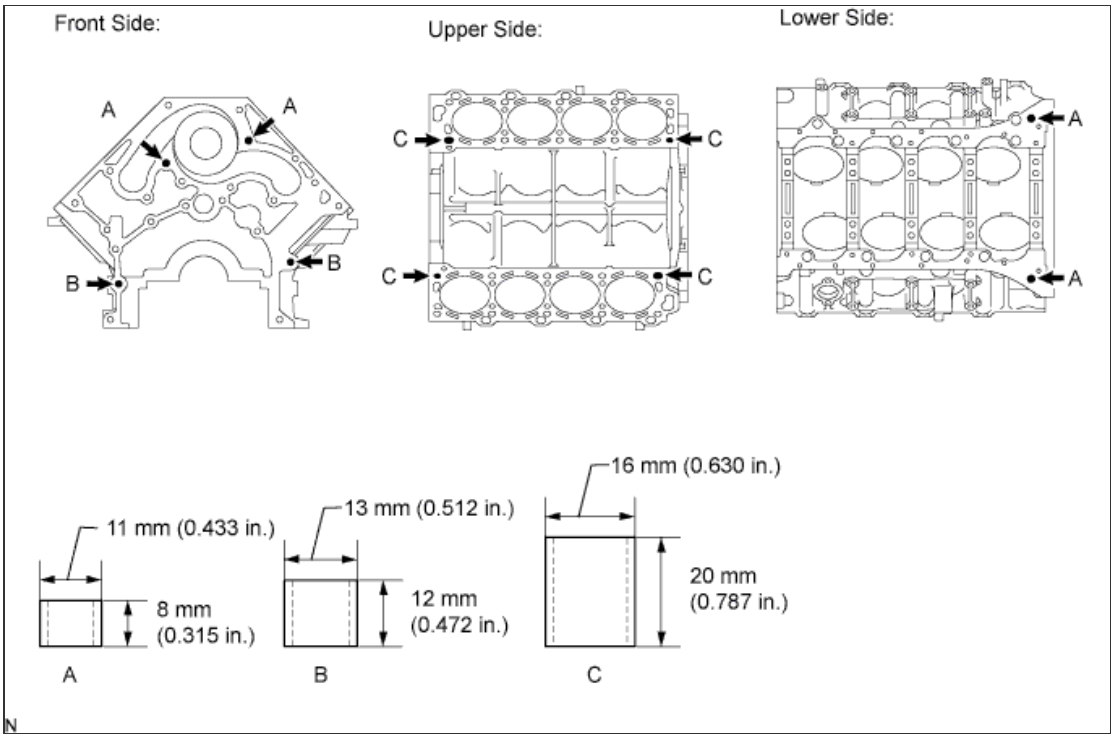
It is not necessary to remove the ring pin unless it is being replaced.

a. Remove the ring pin.

b. Using a plastic-faced hammer, tap in new ring pins until they stop.

Standard Protrusion:

Ring Pin	Specified Condition
A	3.5 to 4.5 mm (0.138 to 0.177 in.)
B	6.5 to 7.5 mm (0.256 to 0.295 in.)
C	9.0 to 10.0 mm (0.354 to 0.394 in.)



2. REPLACE STRAIGHT PIN

NOTICE:

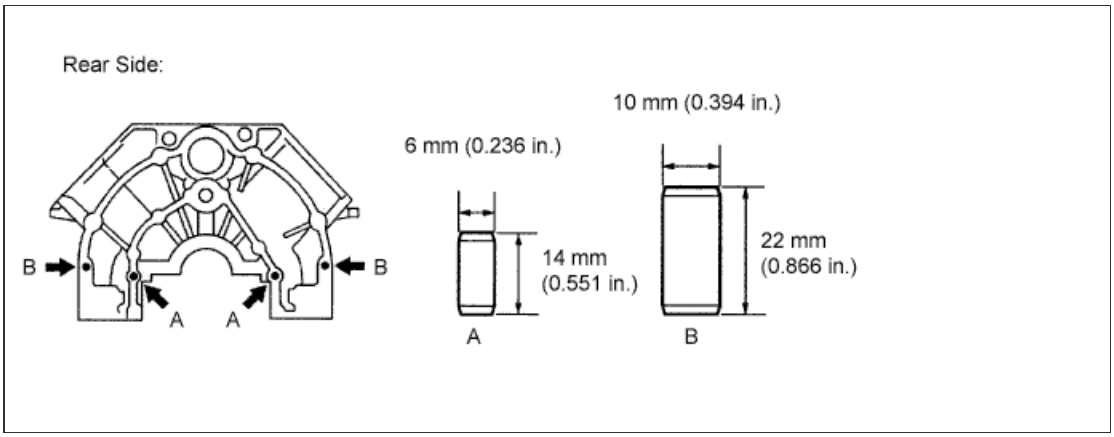
It is not necessary to remove the straight pin unless it is being replaced.

a. Remove the straight pin.

b. Using a plastic-faced hammer, tap in new straight pins until they stop.

Standard Protrusion:

Straight Pin	Specified Condition
A	5.5 to 6.5 mm (0.217 to 0.256 in.)
B	10.5 to 11.5 mm (0.413 to 0.453 in.)



3. REPLACE CYLINDER BLOCK TIGHT PLUG

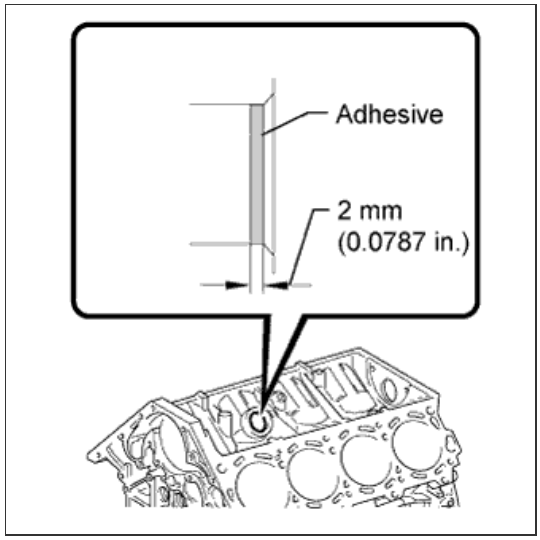
NOTICE:

If water leaks from the tight plug or the plug corrodes, replace it.

a. Remove the tight plugs.

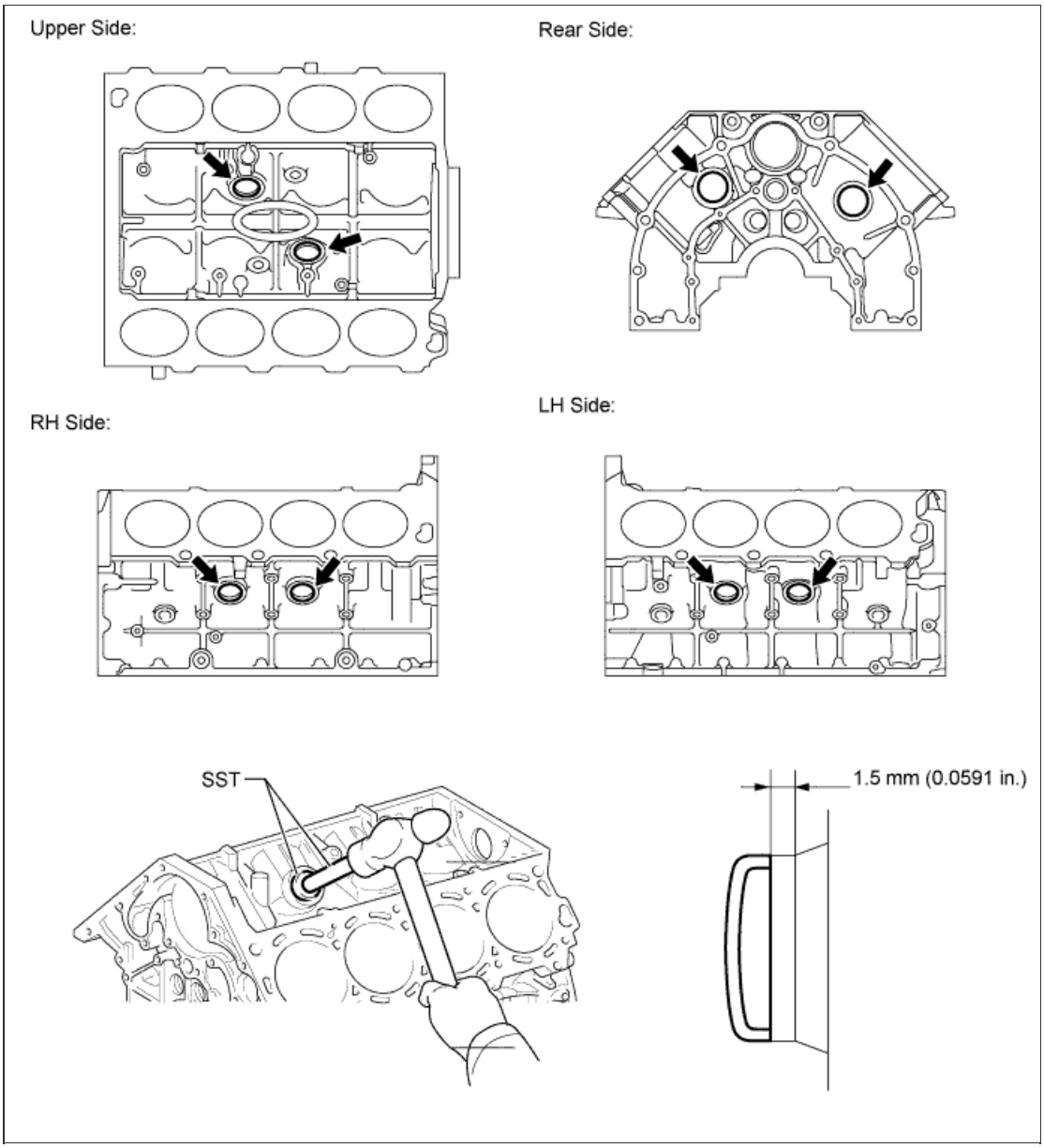
b. Apply adhesive to the inner circumference of the holes where the tight plugs contact.

Adhesive:
Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent



c. Using SST and a hammer, tap in new tight plugs as shown in the illustration.

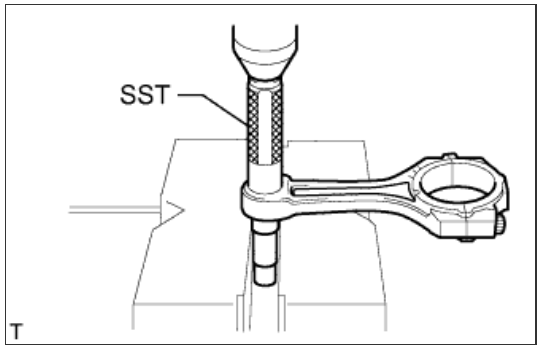
SST
09950-60010 (09951-00340)
09950-70010 (09951-07100)



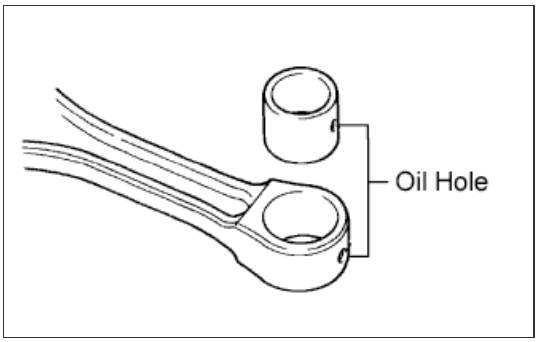
4. REPLACE CONNECTING ROD SMALL END BUSH

a. Using SST and a press, press out the bushing.

SST
09222-30010

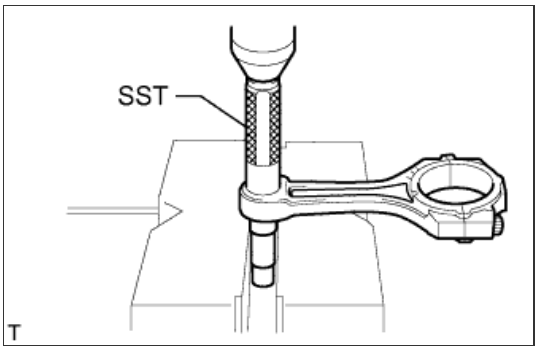


b. Align the oil holes of a new bushing and the connecting rod.



c. Using SST and a press, press in the bushing.

SST
09222-30010



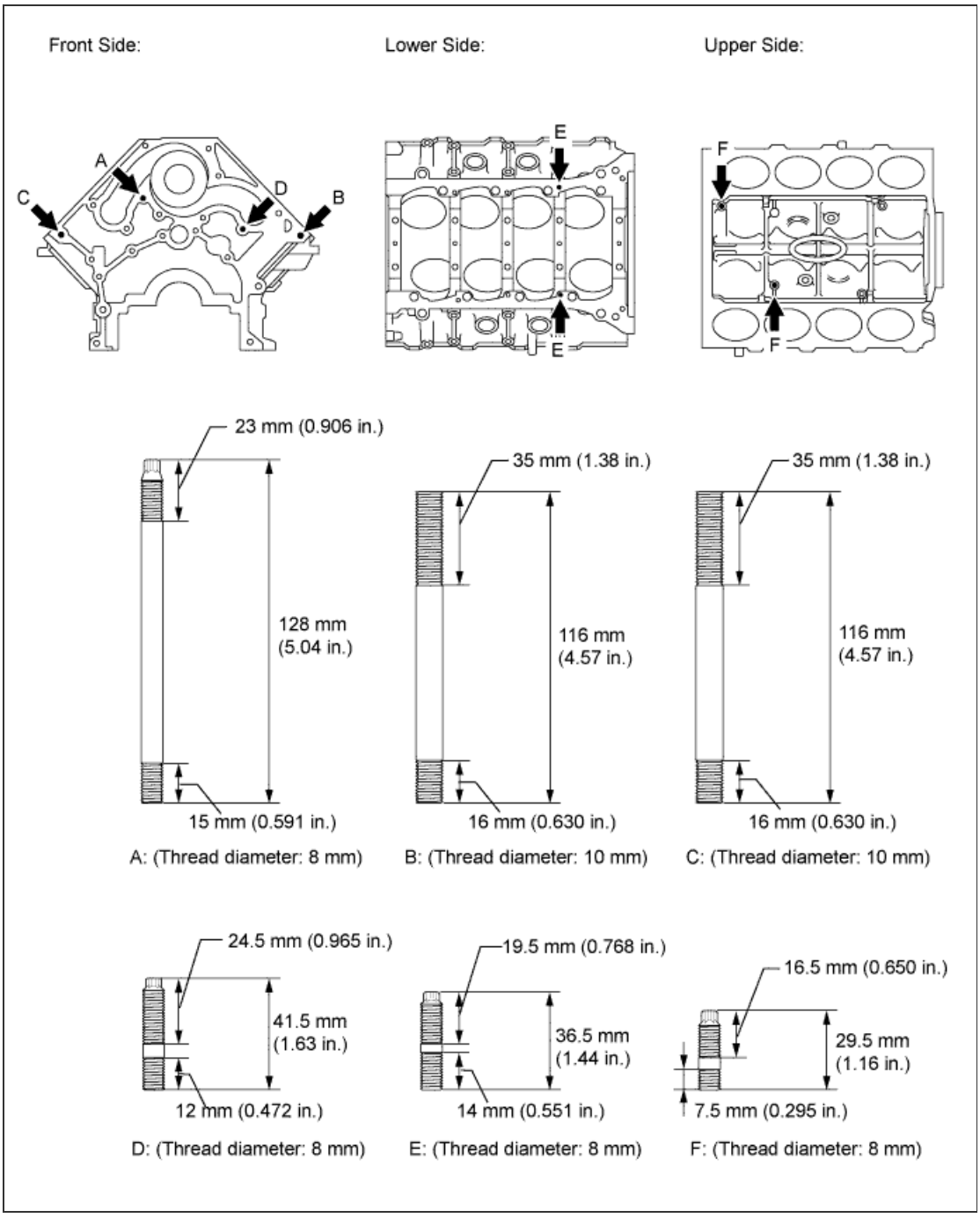
for Preparation Click here

1. INSTALL STUD BOLT

NOTICE:

If a stud bolt is deformed or the threads are damaged, replace it.

a. Using E7 and E8 "TORX" socket wrenches, install the stud bolts.



Torque:

for stud bolt A, B, F:

8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

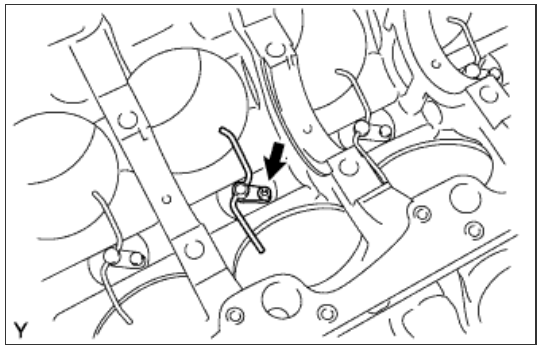
for stud bolt C:

20 N*m{ 204 kgf*cm , 15 ft.*lbf }
for stud bolt D:
12 N*m{ 122 kgf*cm , 9 ft.*lbf }
for stud bolt E:
14 N*m{ 143 kgf*cm , 10 ft.*lbf }

2. INSTALL NO. 1 OIL NO LE SUB-ASSEMBLY

a. Using a 5 mm hexagon wrench, install the 4 oil nozzles with the 4 bolts.

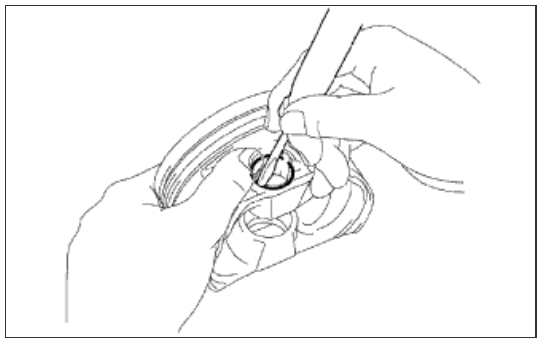
Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



3. INSTALL PISTON SUB-ASSEMBLY WITH PIN

a. Using a small screwdriver, install a new snap ring on one side of the piston pin hole.

b. Coat the piston, piston pin and connecting rod with engine oil.



c. Align the marks of the piston and connecting rod as shown in the illustration. Then push in the piston pin with your thumb until the piston pin contacts the snap ring.

Front Mark:

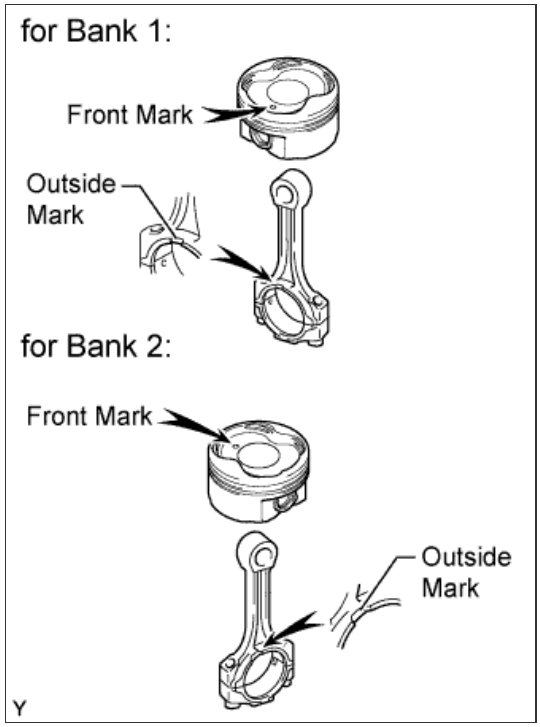
Item	Front Mark
for Bank 1	1
for Bank 2	2

NOTICE:

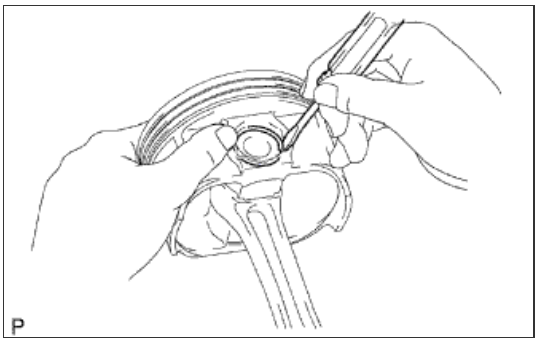
For bank 1 side, perform the assembly so that the marks of the piston and connecting rod are on the same side. For bank 2 side, perform the assembly so that the marks of the piston and connecting rod are on opposite sides.

HINT:

The piston and pin are a matched set.



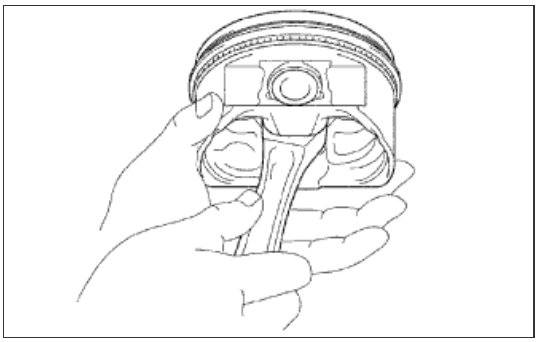
d. Using a small screwdriver, install a new snap ring on the other side of the piston pin hole.



e. Check the fitting condition between the piston and piston pin.

i. Move the connecting rod back and forth on the piston pin. Check the fitting condition.
If abnormal movement is felt, replace the piston and pin as a set.

ii. Rotate the piston back and forth on the piston pin. Check the fitting condition.
If abnormal movement is felt, replace the piston and pin as a set.



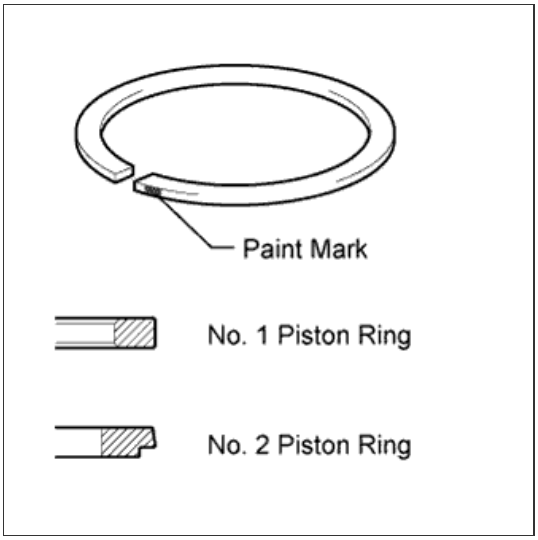
4. INSTALL PISTON RIN SET

a. Install the oil ring expander and 2 side rails by hand.

b. Using a piston ring expander, install the No. 1 and No. 2 piston rings.

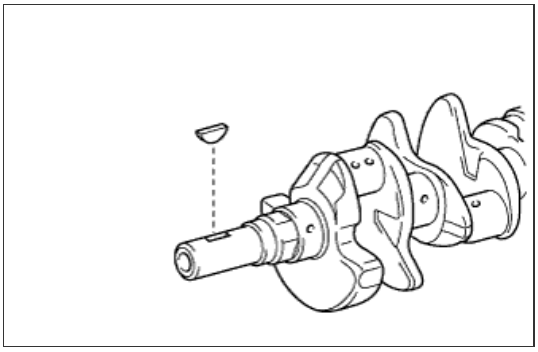
Paint Mark:

Piston Ring	Paint Mark
No. 1	Green Color
No. 2	Peach Color



5. INSTALL CRANKSHAFT PULLEY KEY

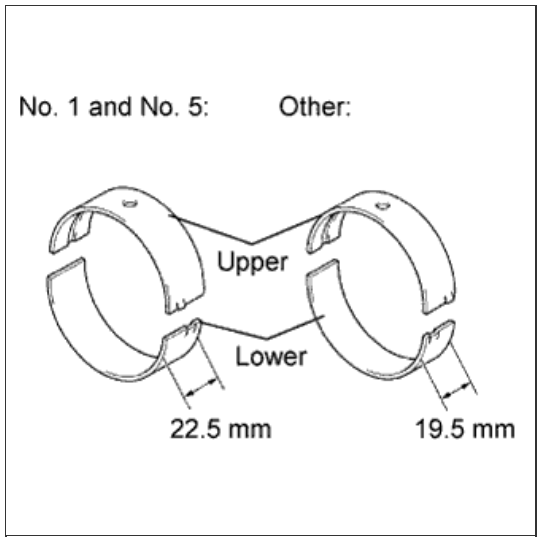
a. Install the pulley key to the crankshaft.



6. INSTALL CRANKSHAFT BEARIN

HINT:

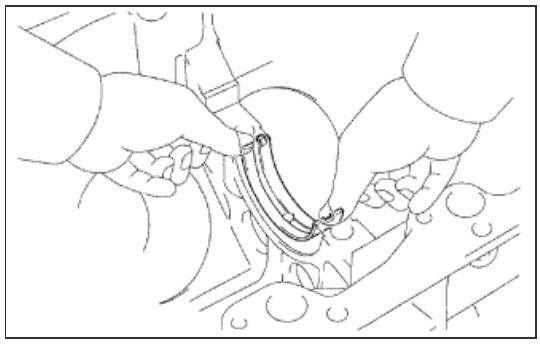
- **Main bearings come in widths of 19.5 mm (0.768 in.) and 22.5 mm (0.886 in.). Install the 22.5 mm (0.886 in.) bearings in the No. 1 and No. 5 c linder block journal positions with the crankshaft bearing cap. Install the 19.5 mm (0.768 in.) bearings in the other positions.**
- **Upper bearings ha e an oil groo e and oil holes lower bearings do not.**



a. Align the bearing claw with the claw groove of the cylinder block, and push in the 5 upper bearings.

NOTICE:

Do not apply engine oil to the bearings and the contact surfaces.



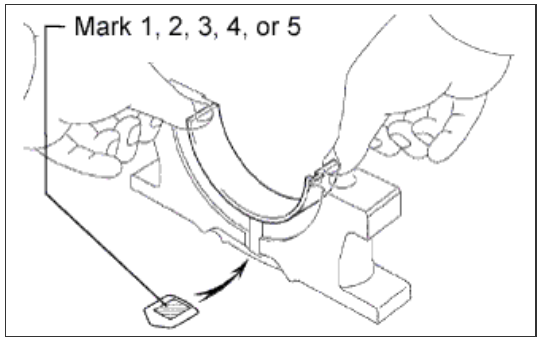
b. Align the bearing claw with the claw groove of the crankshaft bearing cap, and push in the 5 lower bearings.

NOTICE:

Do not apply engine oil to the bearings and the contact surfaces.

HINT:

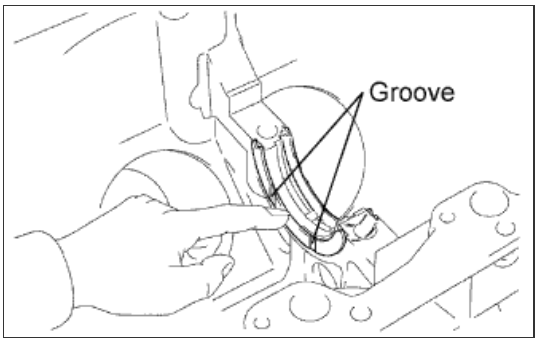
A number is marked on each bearing cap to indicate the installation position.



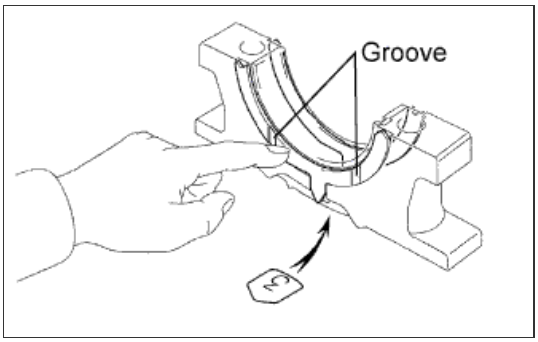
7. INSTALL CRANKSHAFT THRUST WASHER SET

a. Apply engine oil to the thrust washer set.

b. Install the 2 thrust washers under the No. 3 journal position of the cylinder block with the oil grooves facing outward.



c. Install the 2 thrust washers on the No. 3 crankshaft bearing cap with the grooves facing outward.



8. INSTALL CRANKSHAFT

a. Apply engine oil to the upper bearing and lower bearing, then place the crankshaft on the cylinder block.

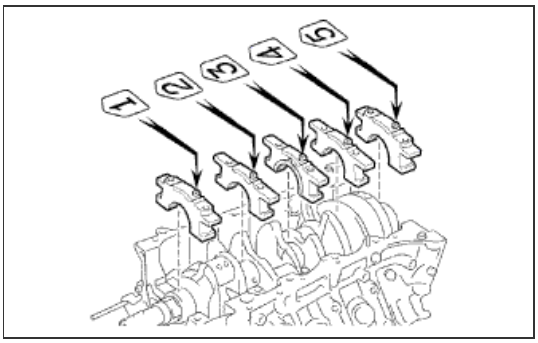
b. Install the 5 crankshaft bearing caps in their proper locations.

HINT:

Place the bearing caps on the level and let them return to their original positions by their own weight.

NOTICE:

Do not install the bearing caps by tapping them.

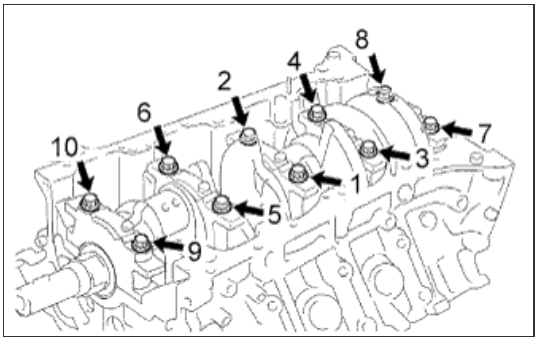


c. Apply a light coat of engine oil on the threads and under the heads of the bearing cap bolts.

d. Install the 1 crankshaft bearing cap bolts.

HINT:

If any one of the bearing cap bolts is broken or deformed, replace it.



i. Uniformly tighten the 1 crankshaft bearing cap bolts in several passes in the sequence shown in the illustration.

Torque:
27 N*m{ 275 kgf*cm , 20 ft.*lbf }

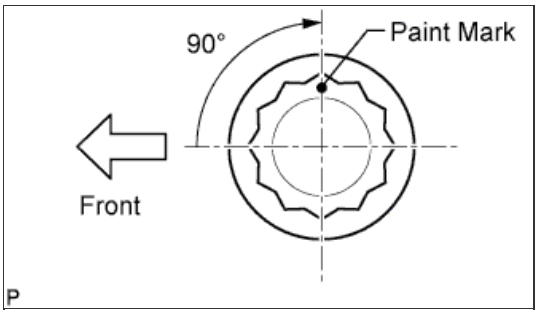
If any of the bearing cap bolts cannot meet the torque specification, replace the bearing cap bolt.

ii. Mark the front of the crankshaft bearing cap bolts with paint.

iii. Tighten the crankshaft bearing cap bolts 9 as shown in the illustration.

i . Check that the painted marks are now at a 9 angle to the front.

e. Check that the crankshaft turns smoothly.



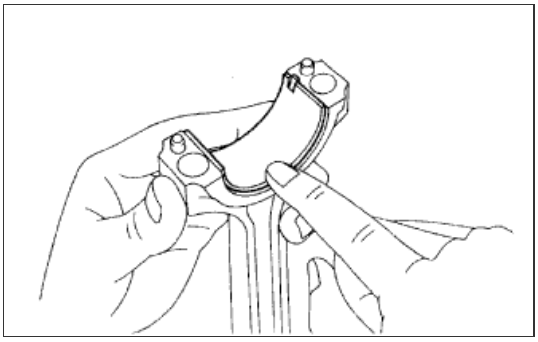
9. INSTALL CONNECTIN ROD BEARIN

a. Align the bearing claw with the groove of the connecting rod or connecting cap.

b. Install the bearings in the connecting rod and connecting rod cap.

NOTICE:

Do not apply engine oil to the bearings and the contact surfaces.



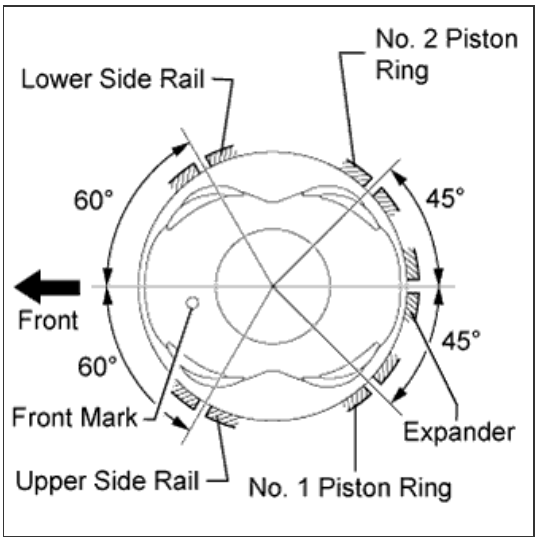
10. INSTALL PISTON AND CONNECTIN ROD

a. Apply engine oil to the cylinder walls, the pistons, and the surfaces of the connecting rod bearings.

b. Position the piston rings so that the ring ends are as shown in the illustration.

NOTICE:

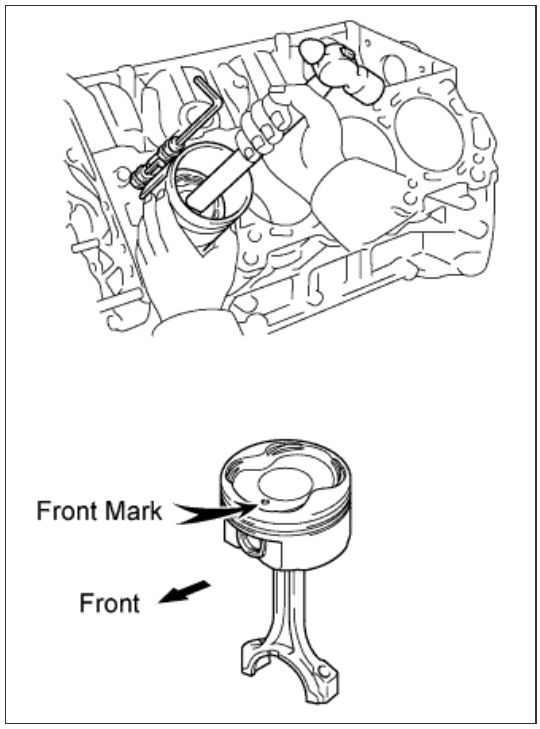
Do not align the ring ends.



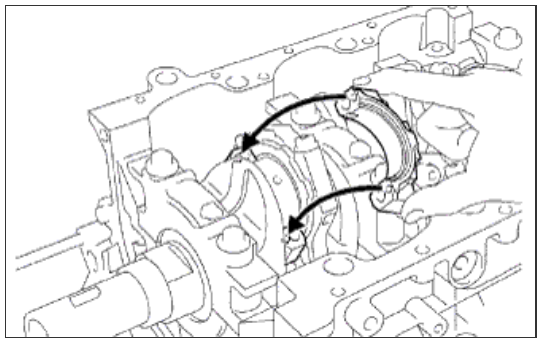
c. Using a hammer handle and piston ring compressor, press a piston and connecting rod assembly into each cylinder with the front mark of the piston facing forward.

Front Mark:

Item	Front Mark
for Bank 1	1
for Bank 2	2



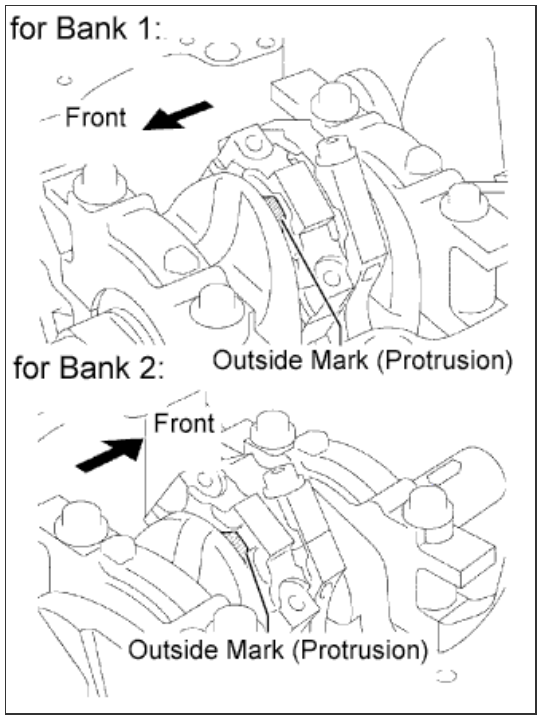
d. Place the connecting rod cap on the connecting rod.



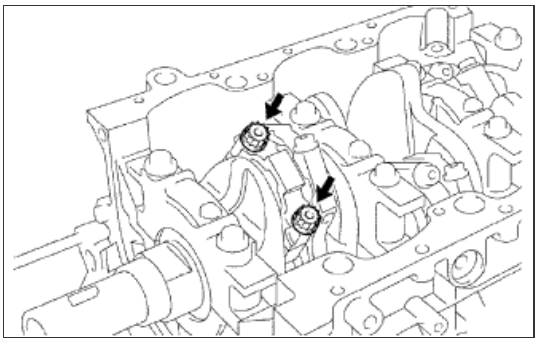
i. Match the numbered connecting rod cap with the connecting rod.

ii. Align the pin groove of the connecting rod cap with the pins of the connecting rod, and install the connecting rod cap.

iii. Check that the outside mark of the connecting rod cap is facing in the correct direction.



e. Apply a light coat of engine oil on the threads and under the heads of the connecting rod cap bolts.



f. Install the connecting rod cap bolts.

HINT:

If any one of the connecting rod cap bolts is broken or deformed, replace it.

i. Install and alternately tighten the 2 connecting rod cap bolts in several passes.

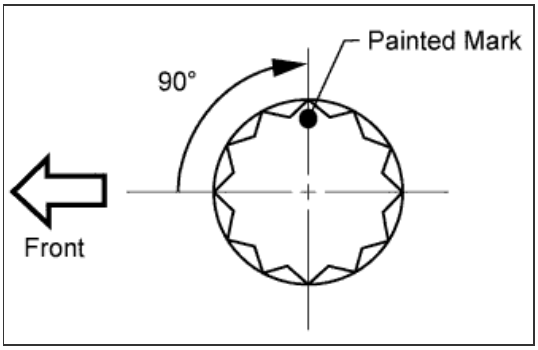
Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }

If any of the connecting rod cap bolts cannot meet the torque specification, replace the connecting rod cap bolts.

ii. Mark the front of the connecting cap bolt with paint.

iii. Tighten the cap bolts 9 as shown in the illustration.

i . Check that the painted marks are now at a 9 angle to the front.



g. Check that the crankshaft turns smoothly.

for Preparation Click here

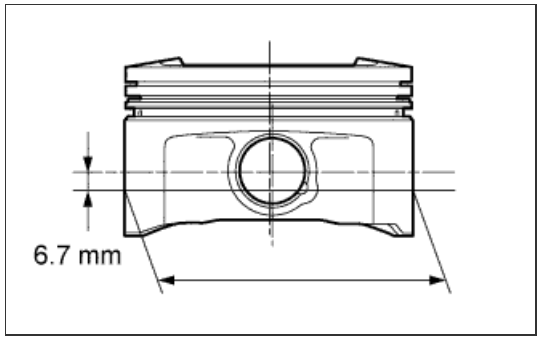
HINT:

- **Bore all 8 cylinders to fit the O/S piston outside diameter.**
- **Replace all the piston rings with ones to match the O/S pistons.**

1. BORE CYLINDER

a. Prepare 4 new O/S pistons.

b. Using a micrometer, measure the piston diameter at a position that is 6.7 mm (0.264 in.) downward from the center of the piston pin hole.



Standard piston diameter (O/S 0.50):
94.468 to 94.496 mm (3.719 to 3.720 in.)

c. Calculate the amount each cylinder is to be rebored as follows.

HINT:

Size to be rebored = P + C - H
P = Piston diameter
C = Piston oil clearance: 0.050 to 0.068 mm (0.00197 to 0.00268 in.)
H = Allowance for honing: 0.02 mm (0.000787 in.) or less

d. Bore and hone the cylinders to the calculated dimensions.

NOTICE:

Excess honing will destroy the finished roundness.

e. Using a cylinder gauge, measure the cylinder bore diameter and calculate the honing allowance.

HINT:

Honing allowance = cylinder bore diameter - (piston diameter + oil clearance)

f. Finish the cylinder bore using the calculated value.

g. Using a cylinder gauge, measure the cylinder bore diameter.

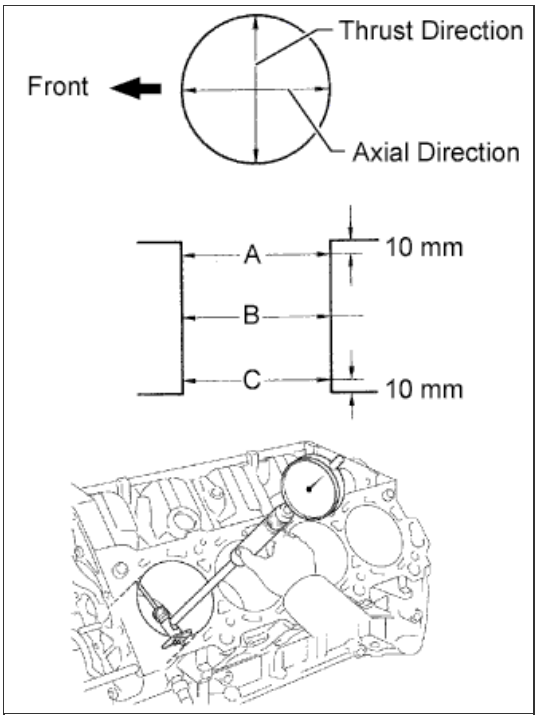
Measurement Cylinder Bore Position:

Position	Specified Condition
A	10 mm (0.394 in.) from top edge
B	Center
C	10 mm (0.394 in.) from bottom edge

Standard oil clearance:
0.050 to 0.068 mm (0.00197 to 0.00268 in.)

Maximum taper and out-of-round:
0.02 mm (0.000787 in.)

Maximum difference in diameter between each cylinder:
0.05 mm (0.00197 in.)


Thrust Direction
Front
Axial Direction
A
B
C
10 mm
10 mm

for Preparation Click here

1. INSPECT ENGINE IDLE SPEED

NOTICE:

- **Turn all the electrical systems and the A/C off.**
- **When checking the idle speed, move the shift lever to neutral.**

HINT:

- **For more information about the intelligent tester, refer to its operator's manual.**
- **If an intelligent tester is not available, use a tachometer tester probe as a substitute.**

a. When using the intelligent tester:

i. Warm up the engine.

ii. Connect the intelligent tester to the DLC3.

iii. Enter the following menus:
Powertrain / Engine / Data List / Engine Speed.

HINT:

Refer to the intelligent tester operator's manual for help selecting the Data List.

iv. Inspect the engine idle speed.

Standard Idle Speed:

Item	Specified Condition
for Automatic Transmission	550 to 650 rpm
for Manual Transmission	500 to 600 rpm

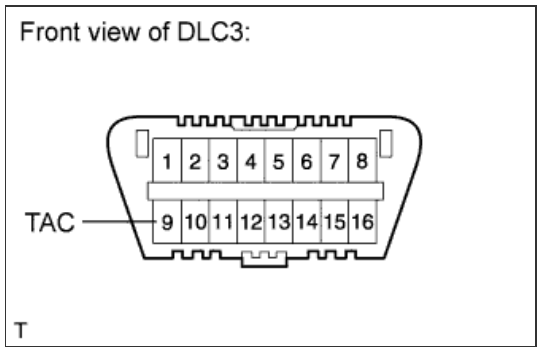
v. Disconnect the intelligent tester from the DLC3.

b. When not using the intelligent tester:

i. Warm up and stop the engine.

ii. Connect a tester probe of a tachometer to terminal 9 (TAC) of the DLC3 with SST.

SST
09843-18030



iii. Inspect the engine idle speed.

Standard Idle Speed:

Item	Specified Condition
for Automatic Transmission	550 to 650 rpm
for Manual Transmission	500 to 600 rpm

iv. Disconnect the tester probe from terminal 9 (TAC) of the DLC3.

2. INSPECT MAXIMUM ENGINE SPEED

a. Start the engine.

b. Fully depress the accelerator pedal.

c. Check the maximum engine speed.

Maximum engine speed:
4700 to 4900 rpm

3. INSPECT COMPRESSION

a. Warm up and stop the engine.

b. Remove the 8 glow plugs (Click here).

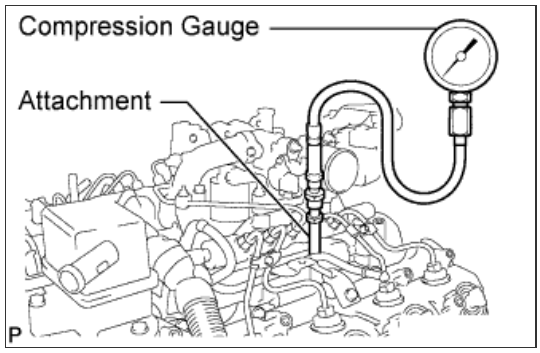
c. Disconnect all connectors from the 8 injectors.

d. Inspect the cylinder compression pressure.

i. Insert SST (attachment) into the glow plug hole.

SST
09992-00026 (09992-00410, 09992-00211)

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



ii. Connect SST (compression gauge) to SST (attachment).

iii. While cranking the engine, measure the compression pressure.

Standard compression pressure (normal condition):
2700 kPa (27.5 kgf/cm^2, 392 psi)

Minimum compression pressure:
2200 kPa (22.4 kgf/cm^2, 319 psi)

Difference between each cylinder:
500 kPa (5.1 kgf/cm^2, 73 psi) or less

NOTICE:

- **Use a fully-charged battery so the engine speed can be increased to 280 rpm or more.**
- **Inspect the other cylinders in the same way.**
- **Measure the compression as quickly as possible.**

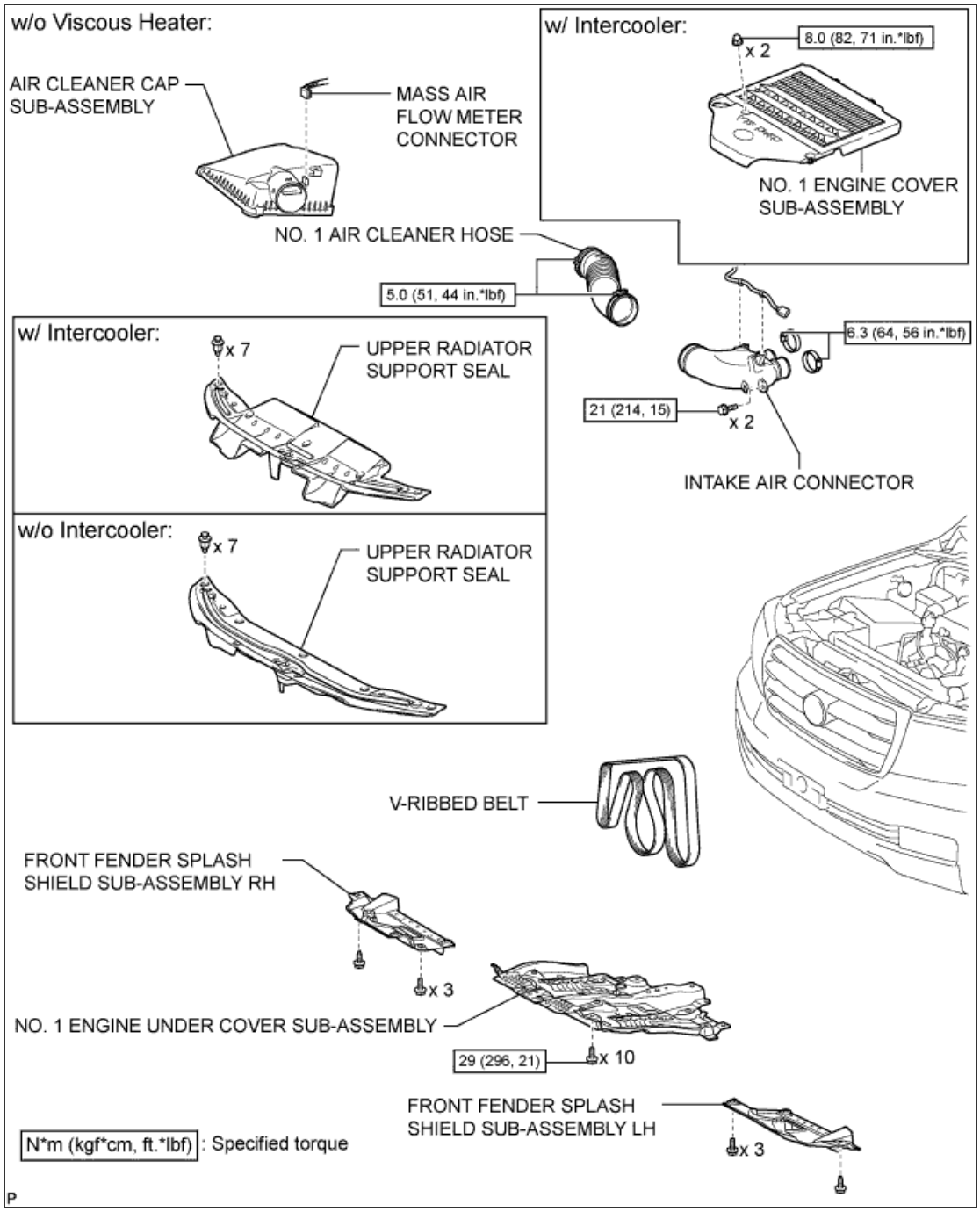
iv. If the cylinder compression is low, pour a small amount of engine oil into the cylinder through the glow plug holes. Then inspect the cylinder compression again.
If adding oil increases the compression pressure, the piston rings and/or cylinder bore may be worn or damaged.
If the pressure stays low, the valve may be stuck or seated improperly, or there may be leakage from the gasket.

v. Remove SST (attachment and compression gauge).

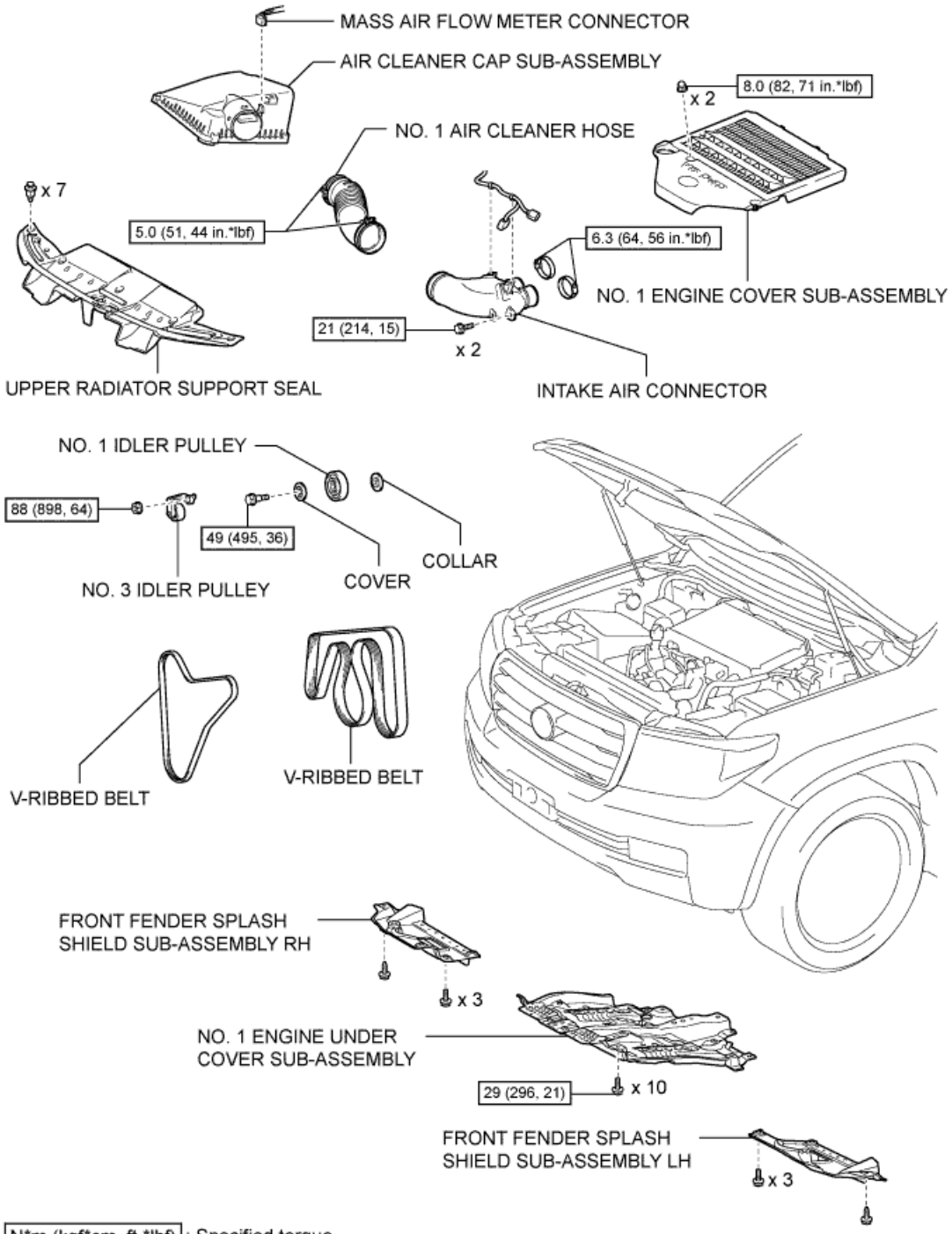
e. Connect all connectors to the 8 injectors.

f. Install the 8 glow plugs (Click here).

for Preparation [Click here]



w/ Viscous Heater:



P

for Preparation Click here

1. INSPECT V-RIBBED BELT

a. Check the belt for wear, cracks or other signs of damage.
If any of the following defects is found, replace the V-ribbed belt.

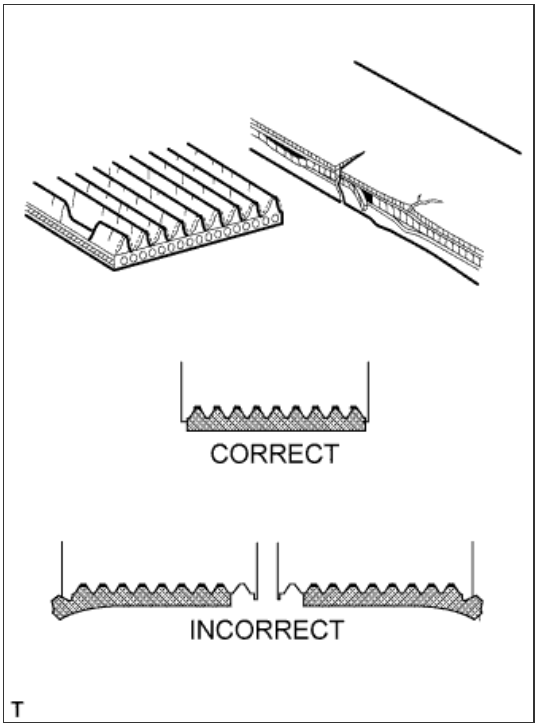
- The belt is cracked.
- The belt is worn out to the extent that the cords are exposed.
- The belt has chunks missing from the ribs.

b. Check that the belt fits properly in the ribbed grooves.

HINT:

Check with your hand to confirm that the belt has not slipped out of the groove on the bottom of the pulley.

If it has slipped out, replace the V-ribbed belt. Install a new V-ribbed belt.



2. INSPECT V-RIBBED BELT TENSION (w/ Viscous Heater)

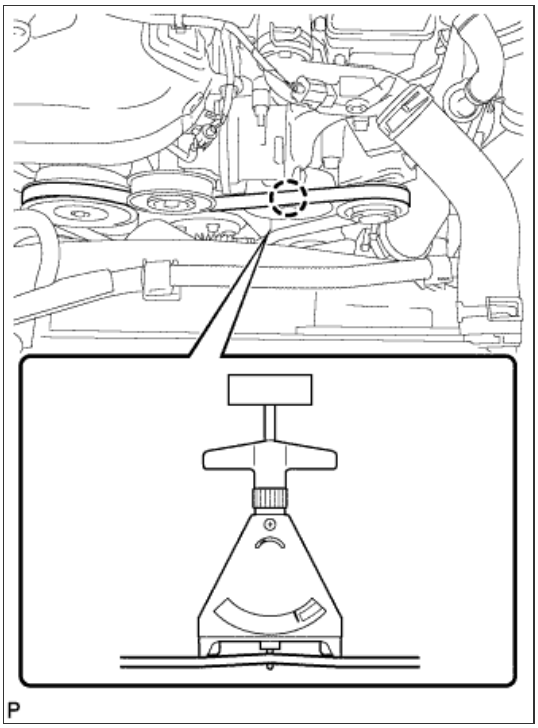
a. Using a belt tension gauge, inspect the belt tension.

Standard Belt Tension:

Item	Specified Condition
New belt	400 to 650 N (41 to 66 kgf, 89.9 to 146.1 lbf)
Used belt	300 to 500 N (31 to 51 kgf, 67.4 to 112.4 lbf)

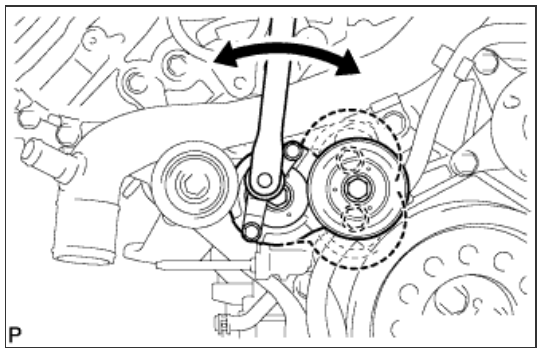
HINT:

- **A "new belt" is a belt which has been used for less than 5 minutes on a running engine.**
- **A "used belt" is a belt which has been used on a running engine for 5 minutes or more.**
- **After installing a new belt, run the engine for approximately 5 minutes and then recheck the tension.**



3. INSPECT V-RIBBED BELT TENSIONER ASSEMBLY

a. Check that nothing gets caught in the tensioner by turning it clockwise and counterclockwise.
If a malfunction exists, replace the tensioner.

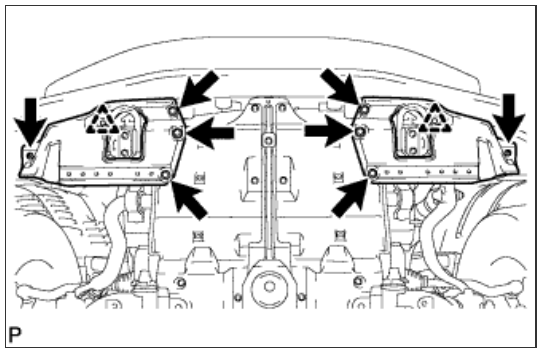


for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.



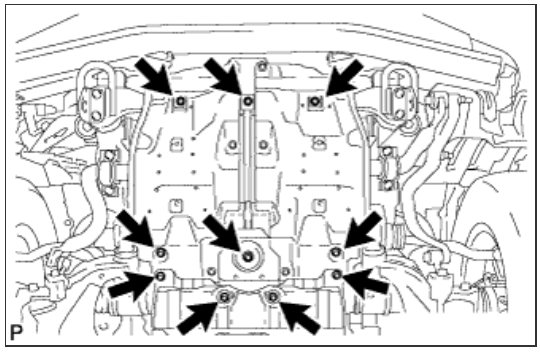
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.

3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.

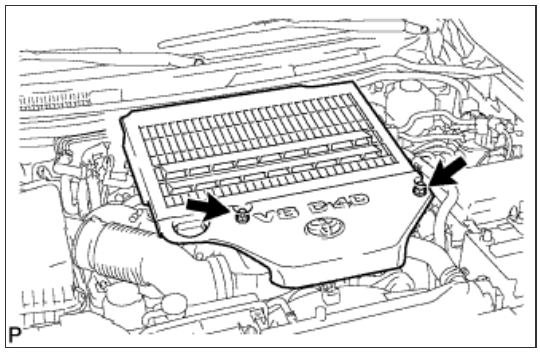


4. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the clips and upper radiator support seal.

5. REMOVE NO. 1 ENGINE COVER SUB-ASSEMBLY (w/ Intercooler)

a. Remove the 2 nuts and No. 1 engine cover.

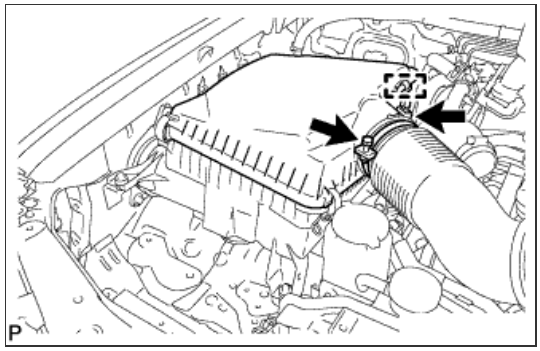


6. REMOVE AIR CLEANER CAP SUB-ASSEMBLY

a. Loosen the hose clamp.

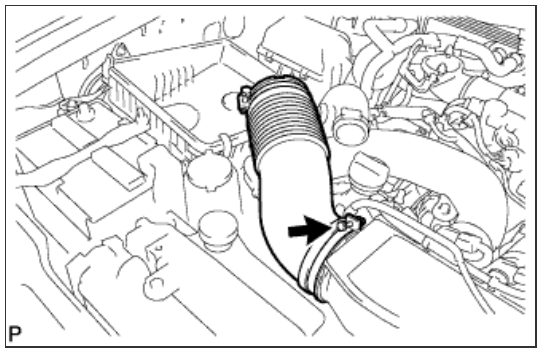
b. Disconnect the mass air flow meter connector and using a clip remover, detach the wire harness clamp from the air cleaner cap.

c. Detach the clamps and remove the air cleaner cap.



7. REMOVE NO. 1 AIR CLEANER HOSE

a. Loosen the hose clamp and remove the No. 1 air cleaner hose.



8. REMOVE INTAKE AIR CONNECTOR

a. w/o iscous Heater:

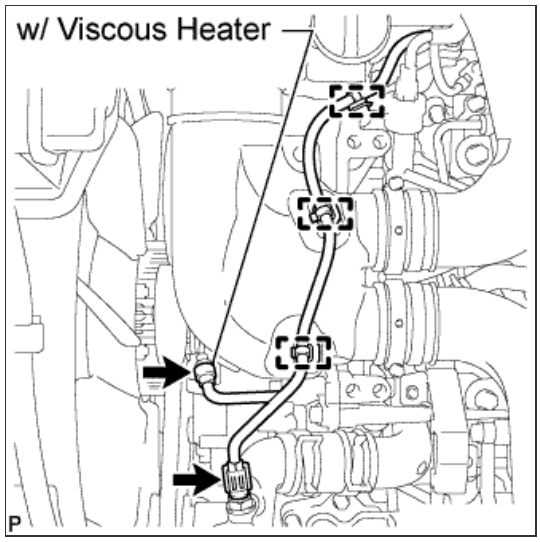
i. Disconnect the connector from the water temperature sensor.

ii. Using a clip remover, detach the 3 wire harness clamps.

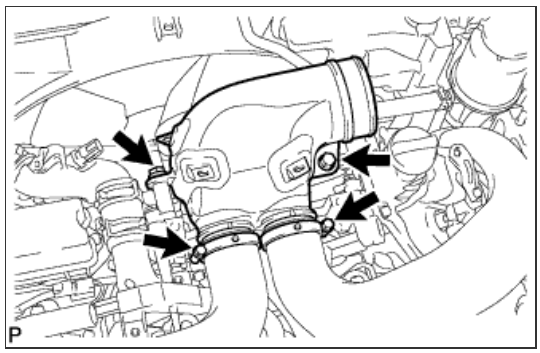
b. w/ iscous Heater:

i. Disconnect the 2 connectors from the viscous with magnet clutch heater and water temperature sensor.

ii. Using a clip remover, detach the 3 wire harness clamps.



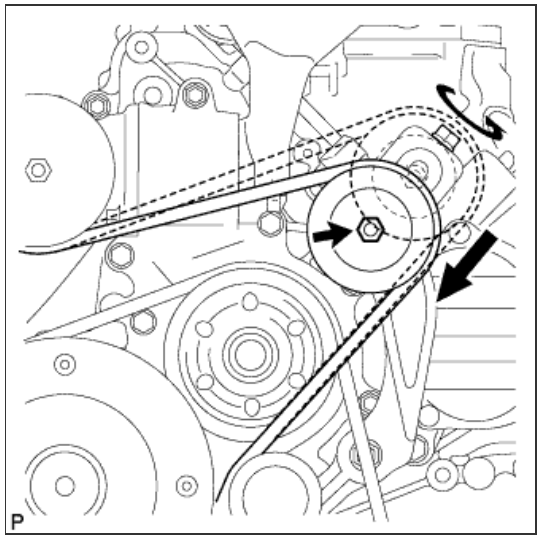
c. Loosen the 2 hose clamps and remove the 2 bolts and intake air connector.



9. REMOVE V-RIBBED BELT (w/ Visco Heater)

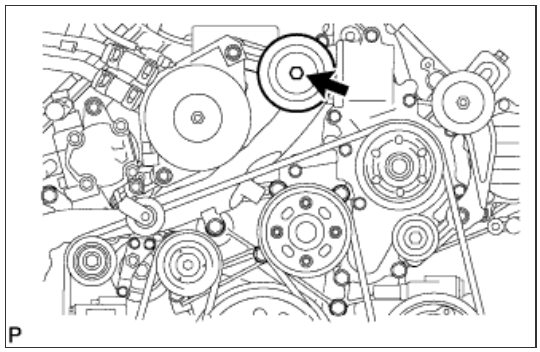
a. Loosen the lock nut and turn the bolt counterclockwise.

b. Remove the ibbed belt.



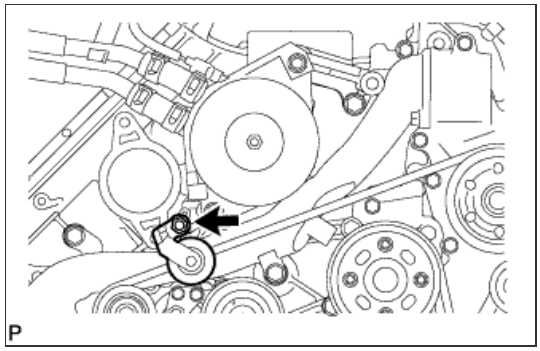
10. REMOVE NO. 1 IDLER PULLEY (w/ Visco Heater)

a. Remove the bolt, cover, No. 1 idler pulley and collar.



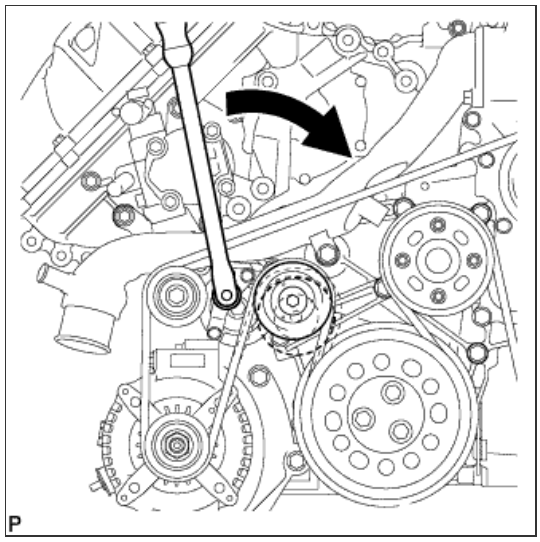
11. REMOVE NO. 3 IDLER PULLEY (w/ Visco Heater)

a. Remove the nut and No. 3 idler pulley.



12. REMOVE V-RIBBED BELT

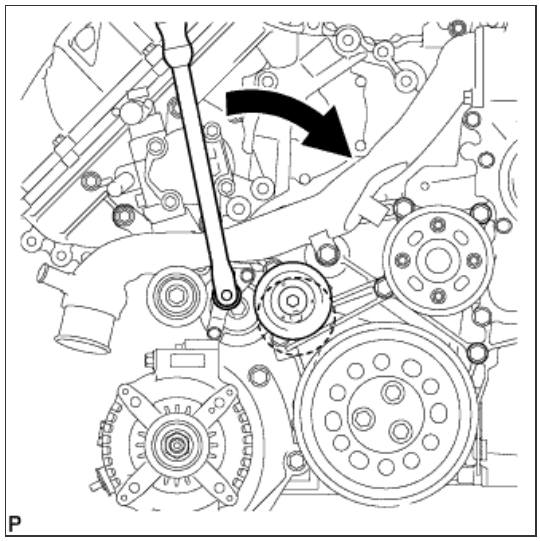
a. Using a wrench to the ibbed belt tensioner bracket, turn the wrench clockwise and remove the ibbed belt.



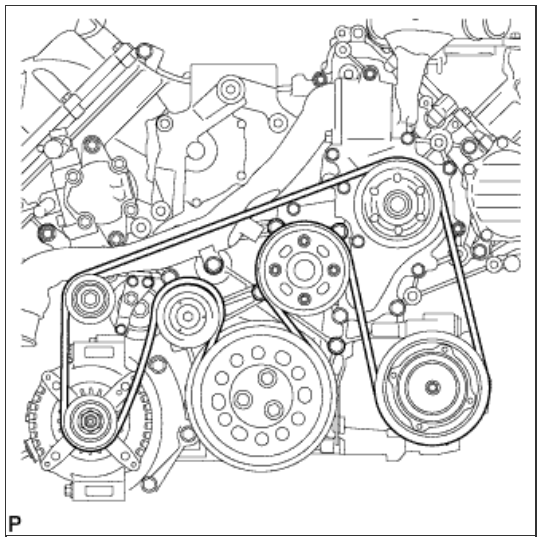
for Preparation Click here

1. INSTALL V-RIBBED BELT

a. Attach a wrench to the V-ribbed belt tensioner bracket and turn the wrench clockwise.



b. Install the V-ribbed belt as shown in the illustration.

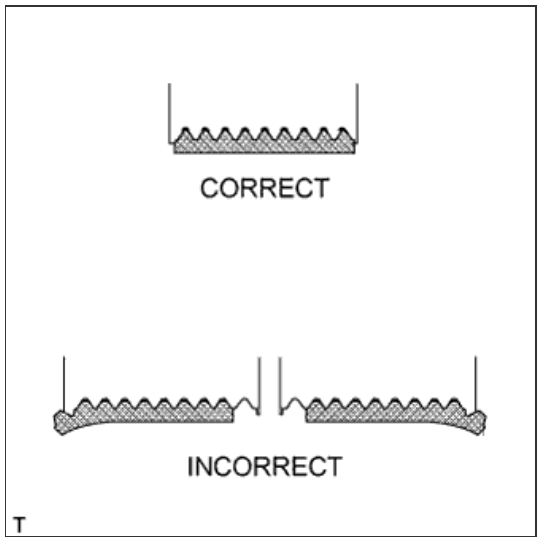


c. Check that the belt fits properly in the ribbed grooves.

HINT:

Check with your hand to confirm that the belt has not slipped out of the groove on the bottom of the pulley.

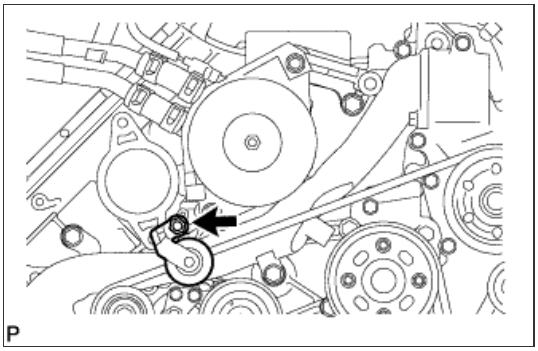
If it has slipped out, replace the V-ribbed belt. Install a new V-ribbed belt.



2. INSTALL NO. 3 IDLER PULLEY (w/ Viscous Heater)

a. Align the No. 3 idler pulley bracket knock pin and No. 1 idler pulley bracket knock pin hole and install the No. 3 idler pulley with the nut.

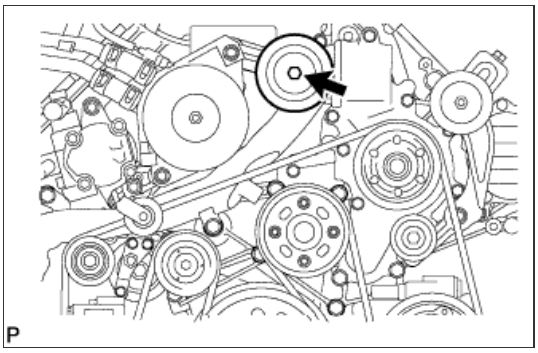
Torque:
88 N*m{ 898 kgf*cm , 64 ft.*lbf }



3. INSTALL NO. 1 IDLER PULLEY (w/ Viscous Heater)

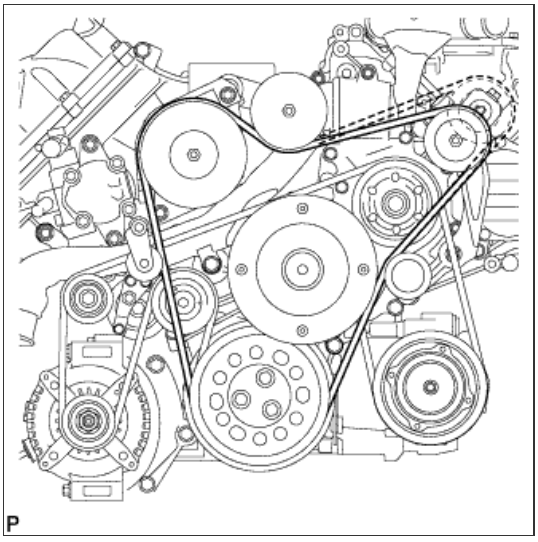
a. Install the collar, No. 1 idler pulley and cover with the bolt.

Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }

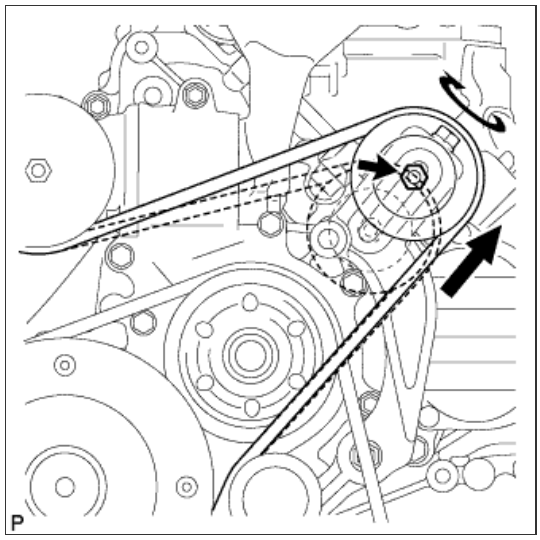


4. INSTALL V-RIBBED BELT (w/ Viscous Heater)

a. Install the V-ribbed belt as shown in the illustration.



b. Temporarily install the lock nut, and turn the bolt clockwise.



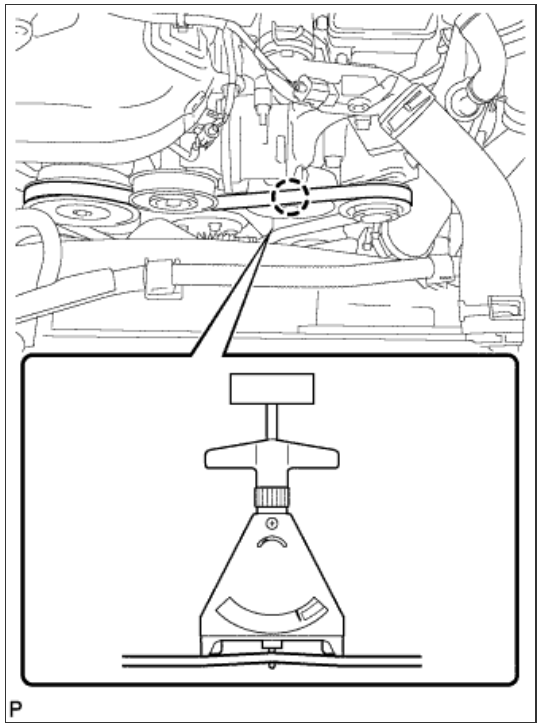
c. Using a belt tension gauge, adjust belt tension.

Standard Belt Tension:

Item	Specified Condition
New belt	400 to 650 N (41 to 66 kgf, 89.9 to 146.1 lbf)
Used belt	300 to 500 N (31 to 51 kgf, 67.4 to 112.4 lbf)

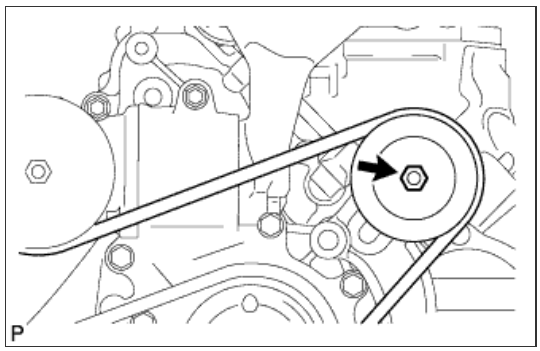
HINT:

- **A "new belt" is a belt which has been used for less than 5 minutes on a running engine.**
- **A "used belt" is a belt which has been used on a running engine for 5 minutes or more.**
- **After installing a new belt, run the engine for approximately 5 minutes and then recheck the tension.**



d. Tighten the nut.

Torque:
4 N*m{ 4 8 kgf*cm , 3 ft.*lbf }

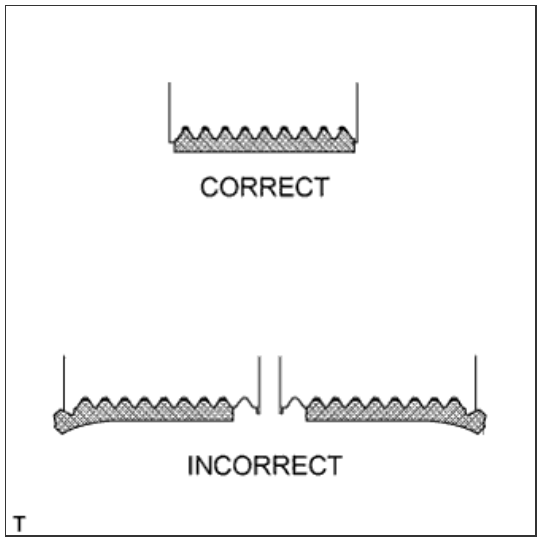


e. Check that the belt fits properly in the ribbed grooves.

HINT:

Check with your hand to confirm that the belt has not slipped out of the groove on the bottom of the pulley.

If it has slipped out, replace the V-ribbed belt. Install a new V-ribbed belt.



5. INSTALL INTA E AIR CONNECTOR

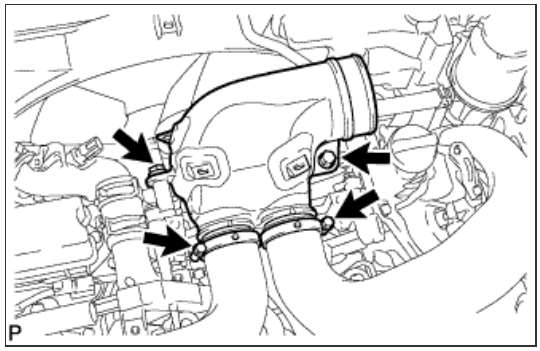
a. Connect the intake air connector to the No. 1 and No. 2 air cleaner pipes.

b. Install the connector with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Tighten the 2 hose clamps.

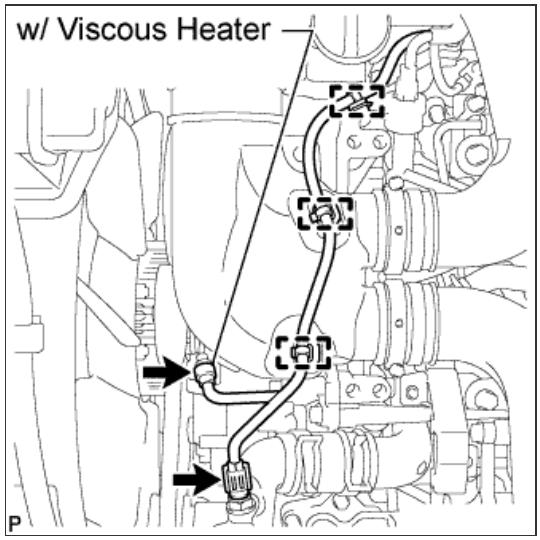
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



d. Attach the 3 wire harness clamps.

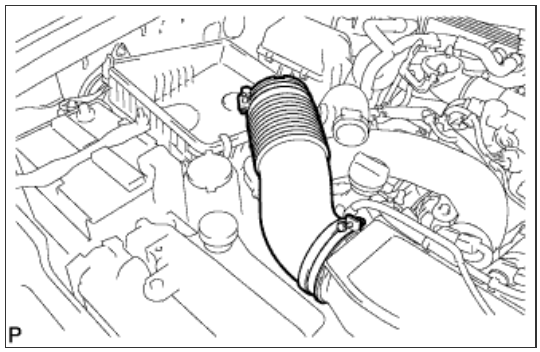
e. w/o Viscous Heater:
Connect the connector to the water temperature sensor.

f. w/ Viscous Heater:
Connect the 2 connectors to the water temperature sensor and viscous with magnet clutch heater.



6. TEMPORARILY INSTALL NO. 1 AIR CLEANER HOSE

a. Temporarily install the air cleaner hose to the intake air connector.

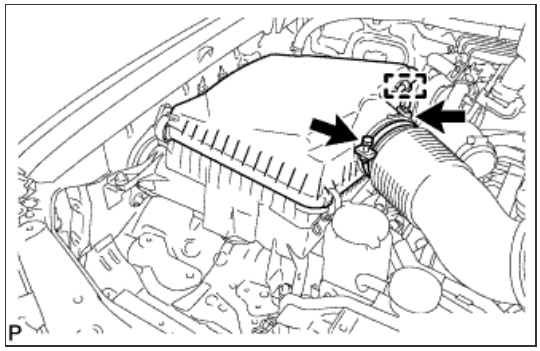


7. INSTALL AIR CLEANER CAP SUB-ASSE BLY

a. Connect the air cleaner cap to the air cleaner hose, and install the air cleaner cap with the 4 clamps.

b. Connect the mass air flow meter connector and attach the wire harness clamp to the air cleaner cap.

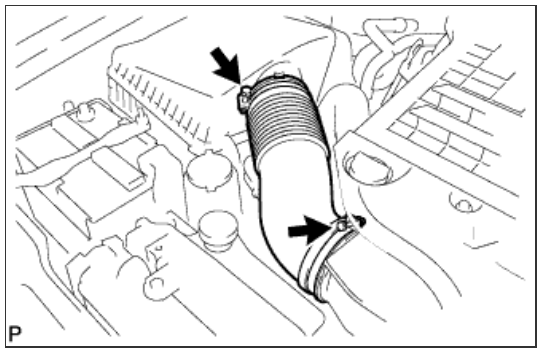
c. Attach the wire harness clamp.



d. Align the protrusion of air cleaner cap and concave portion of air cleaner hose.

e. Tighten the 2 hose clamps.

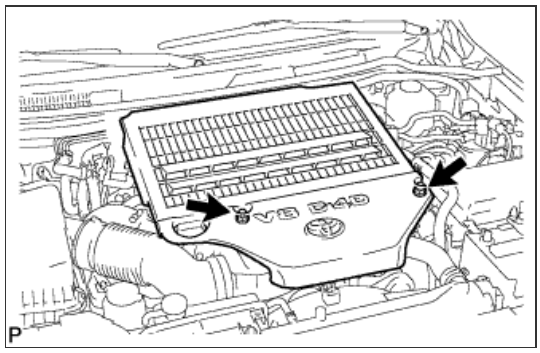
Torque:
5. N*m{ 51 kgf*cm , 44 in.*lbf }



8. INSTALL NO. 1 ENGINE COVER SUB-ASSEMBLY (w/ Intercooler)

a. Install the engine cover with the 2 nuts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }



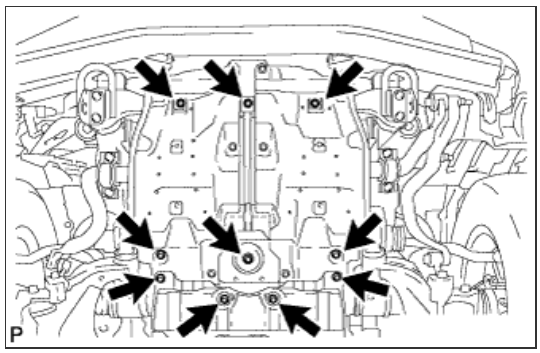
9. INSTALL UPPER RADIATOR SUPPORT SEAL

a. Install the upper radiator support seal with the 7 clips.

10. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

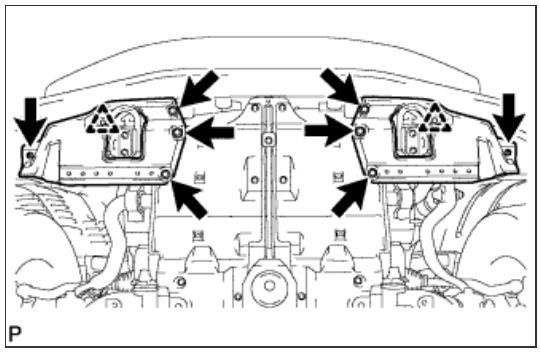
a. Install the engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



11. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

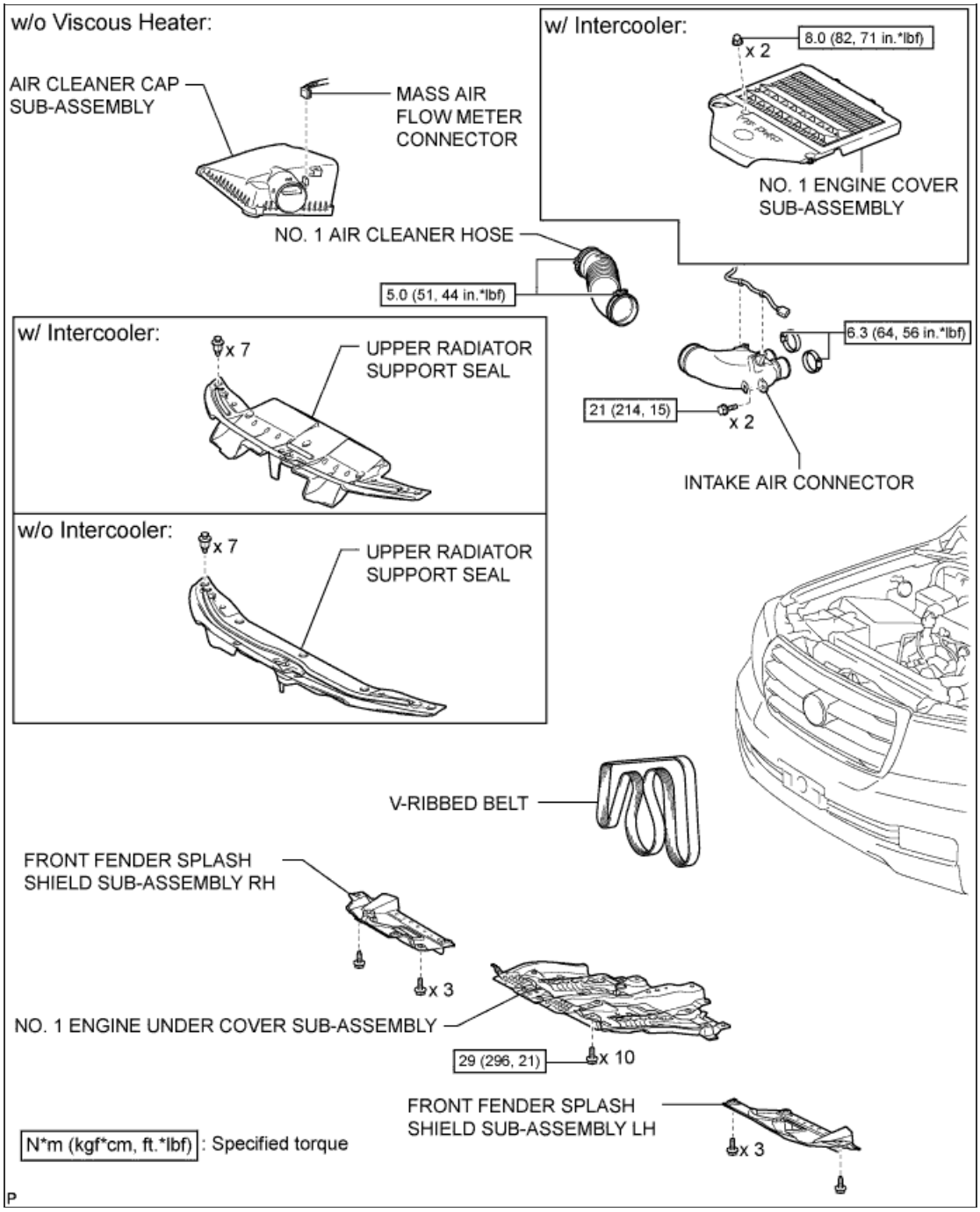
a. Install the splash shield with the clip, and then install the 3 bolts and screw.



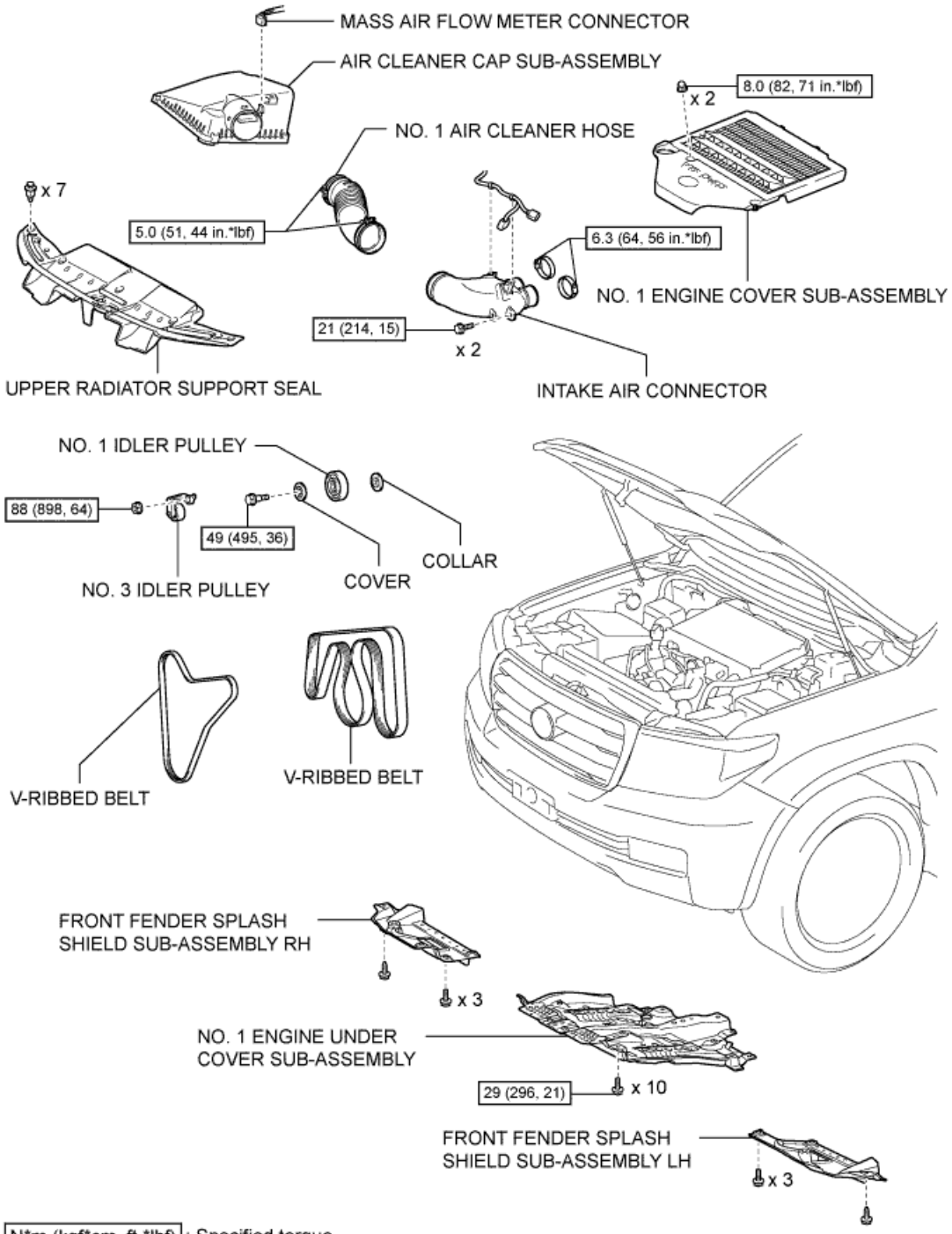
12. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Install the splash shield with the clip, and then install the 3 bolts and screw.

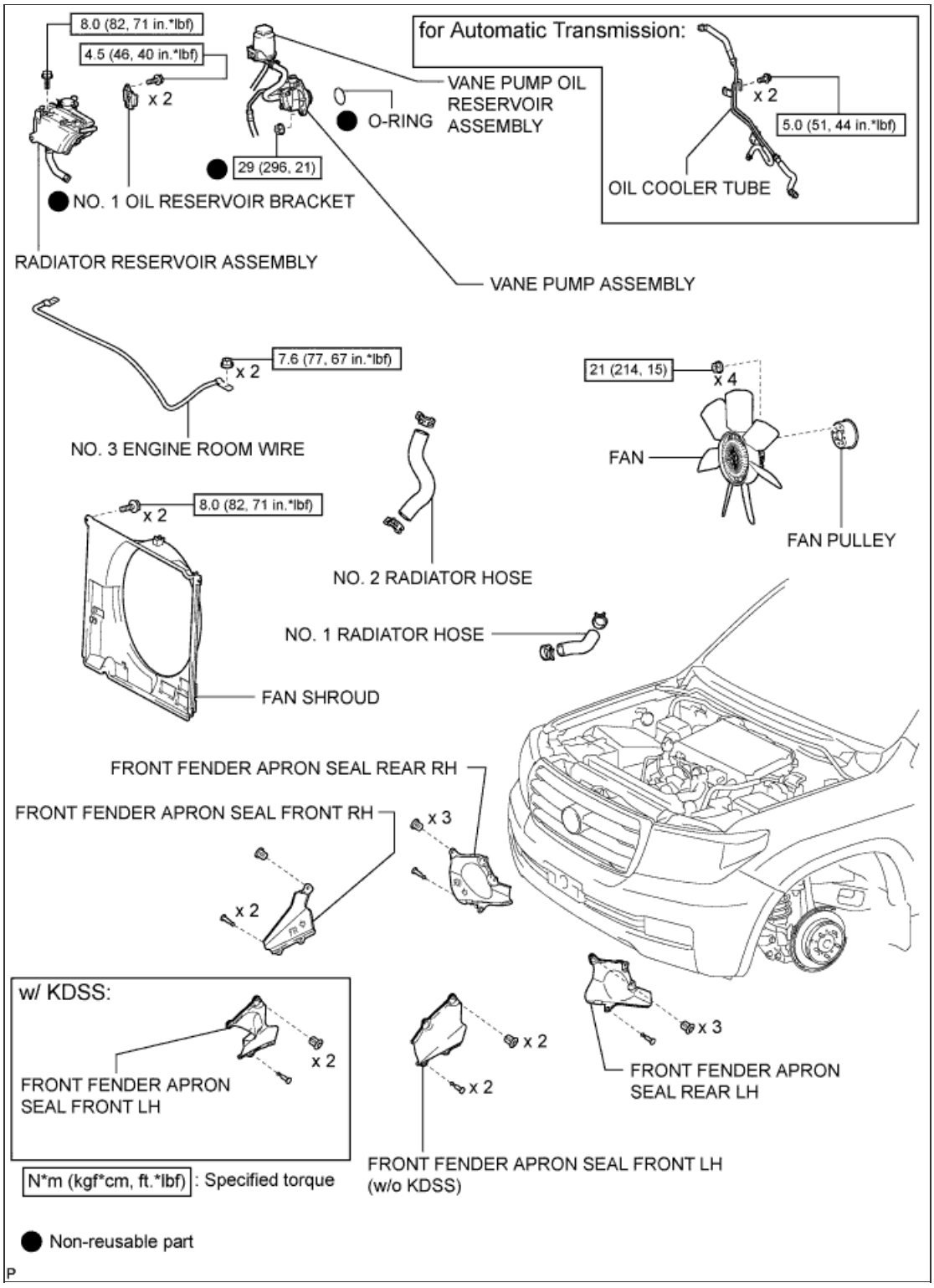
for Preparation Click here

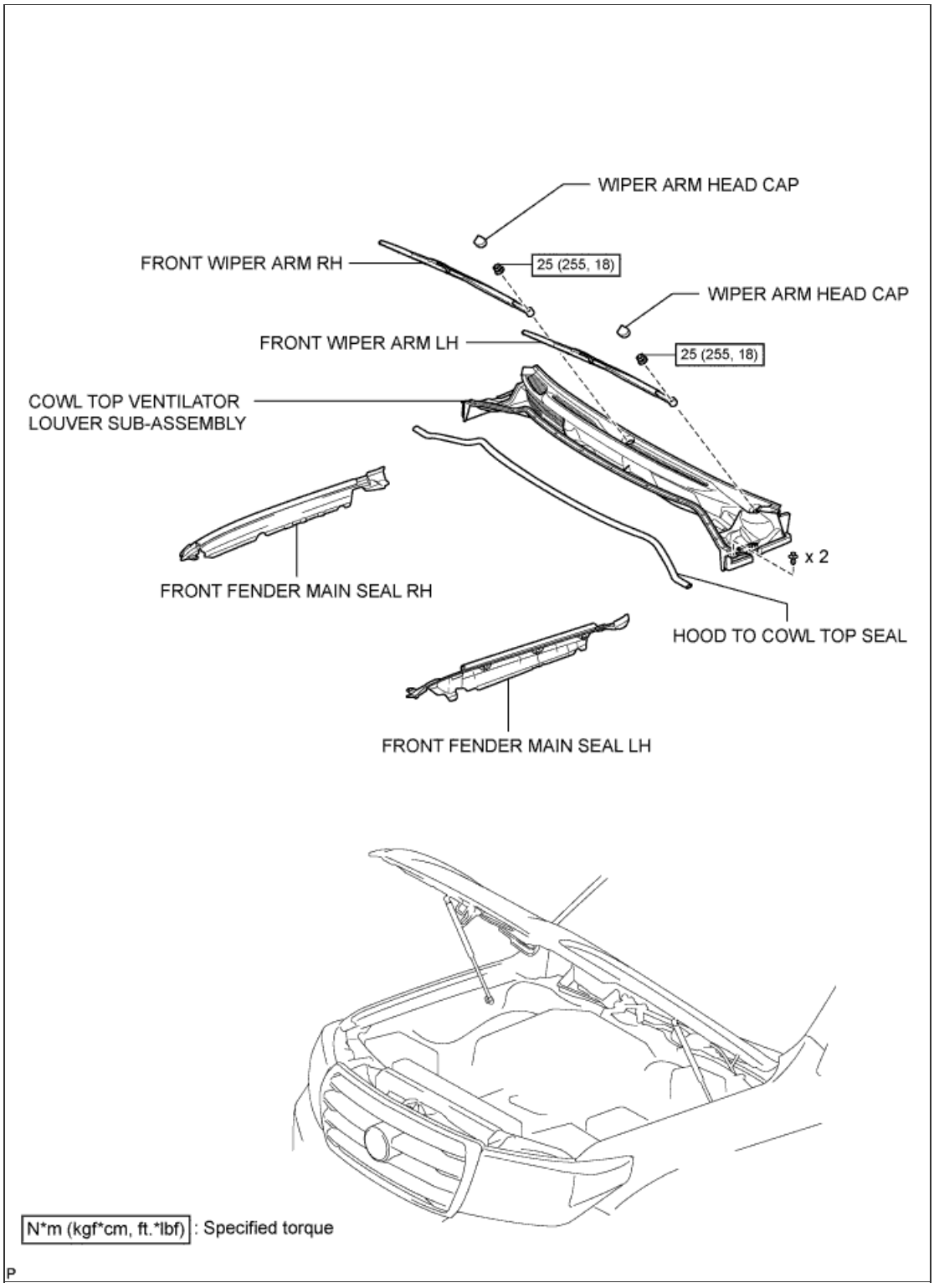


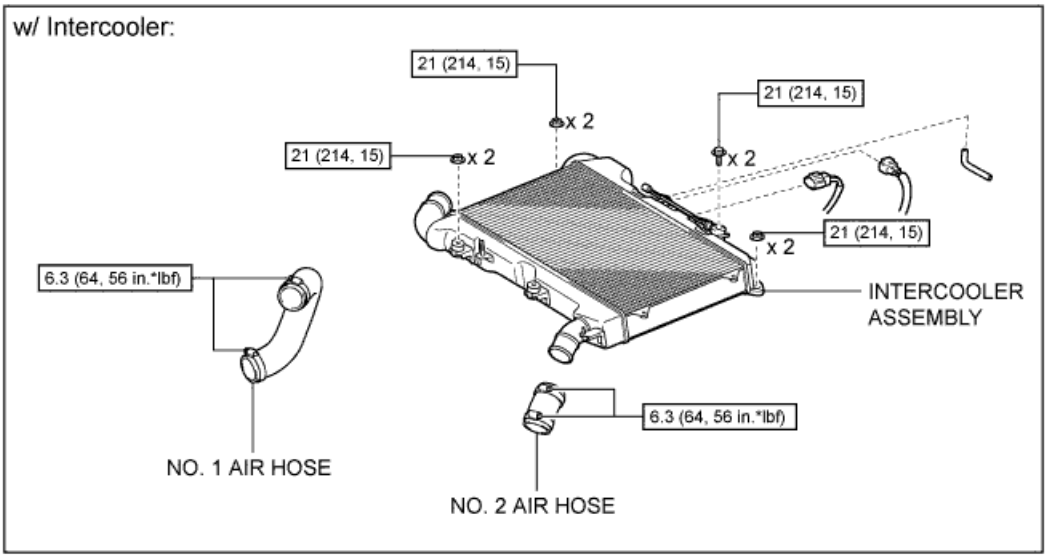
w/ Viscous Heater:

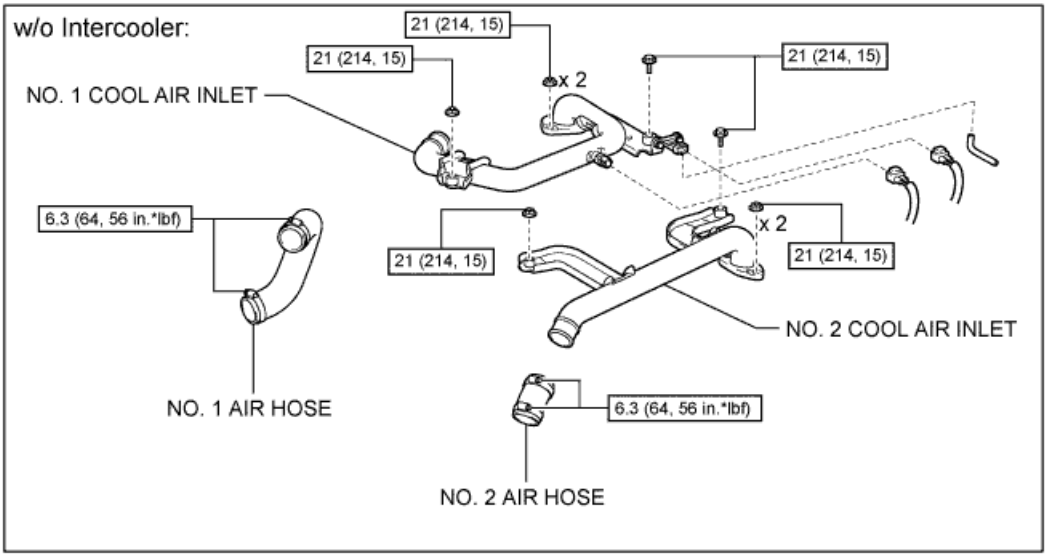


P


8.0 (82, 71 in.*lbf)
4.5 (46, 40 in.*lbf)
x 2
VANE PUMP OIL RESERVOIR ASSEMBLY
O-RING
29 (296, 21)
NO. 1 OIL RESERVOIR BRACKET
RADIATOR RESERVOIR ASSEMBLY
VANE PUMP ASSEMBLY
for Automatic Transmission:
x 2
5.0 (51, 44 in.*lbf)
OIL COOLER TUBE
7.6 (77, 67 in.*lbf)
x 2
NO. 3 ENGINE ROOM WIRE
21 (214, 15)
x 4
FAN
FAN PULLEY
8.0 (82, 71 in.*lbf)
x 2
NO. 2 RADIATOR HOSE
NO. 1 RADIATOR HOSE
FAN SHROUD
FRONT FENDER APRON SEAL REAR RH
FRONT FENDER APRON SEAL FRONT RH
x 3
x 2
w/ KDSS:
x 2
FRONT FENDER APRON SEAL FRONT LH
x 2
x 2
x 3
FRONT FENDER APRON SEAL REAR LH
FRONT FENDER APRON SEAL FRONT LH (w/o KDSS)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P


WIPER ARM HEAD CAP
FRONT WIPER ARM RH
25 (255, 18)
WIPER ARM HEAD CAP
FRONT WIPER ARM LH
25 (255, 18)
COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY
x 2
FRONT FENDER MAIN SEAL RH
HOOD TO COWL TOP SEAL
FRONT FENDER MAIN SEAL LH
N*m (kgf*cm, ft.*lbf) : Specified torque
P

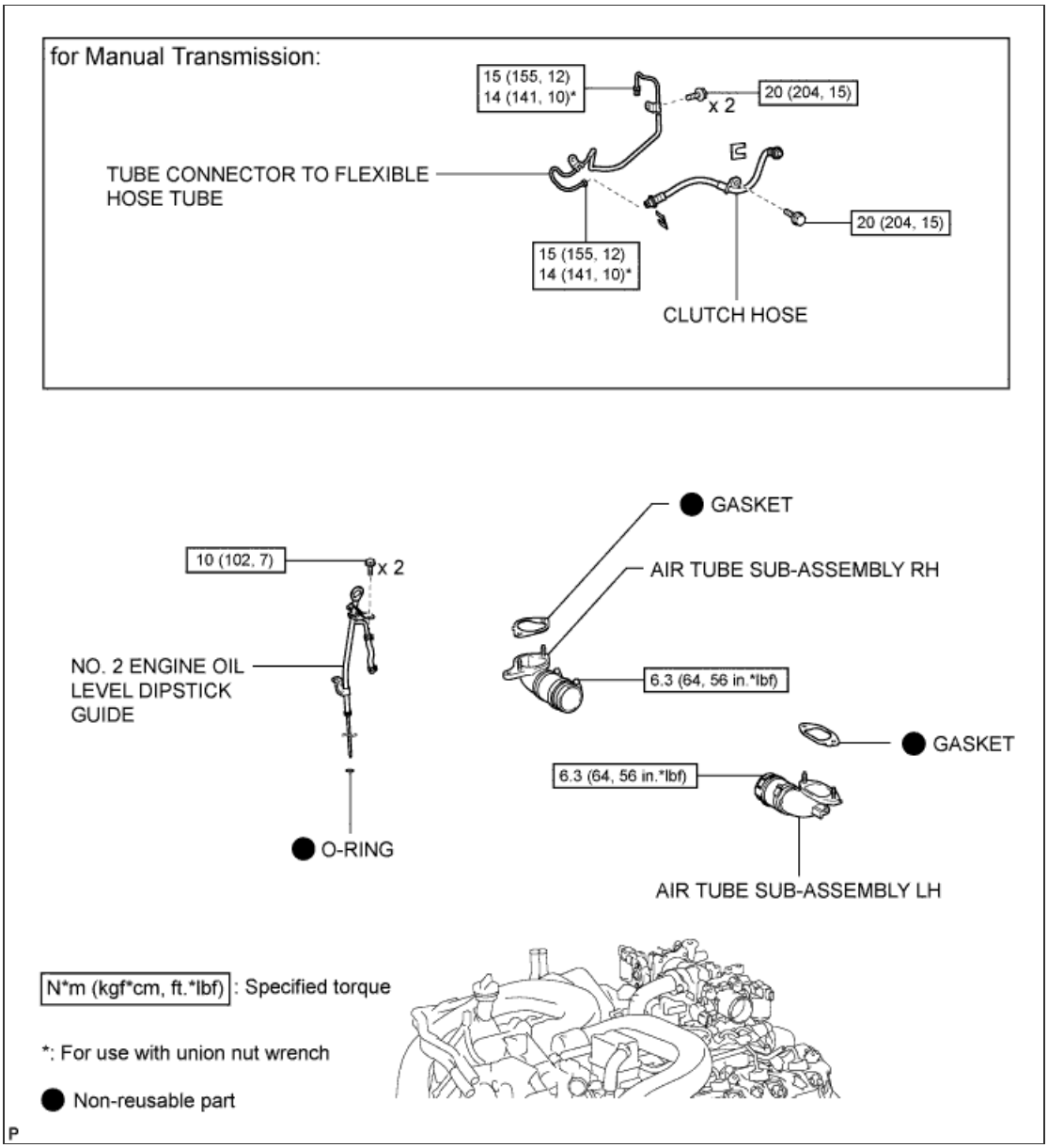


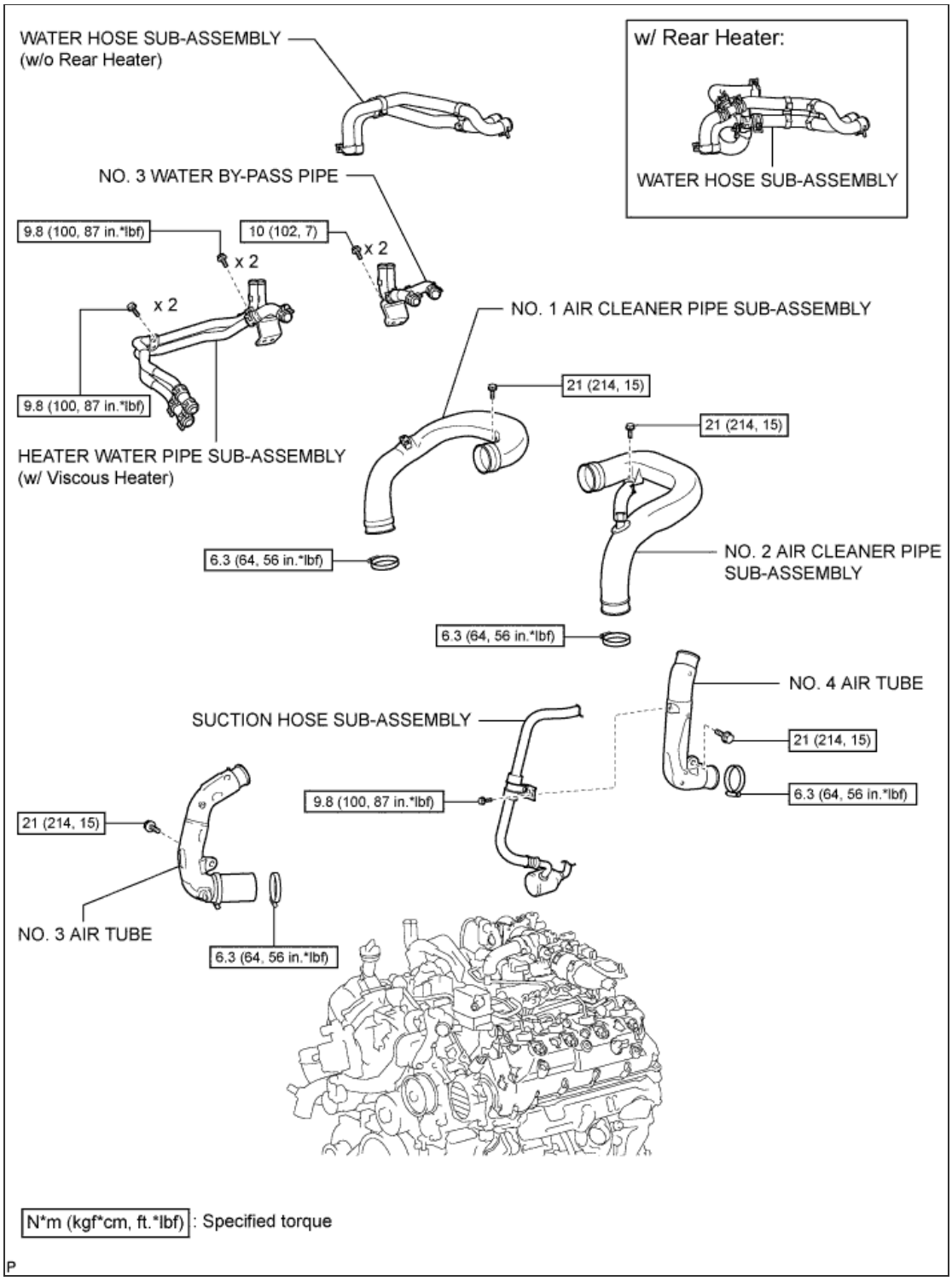


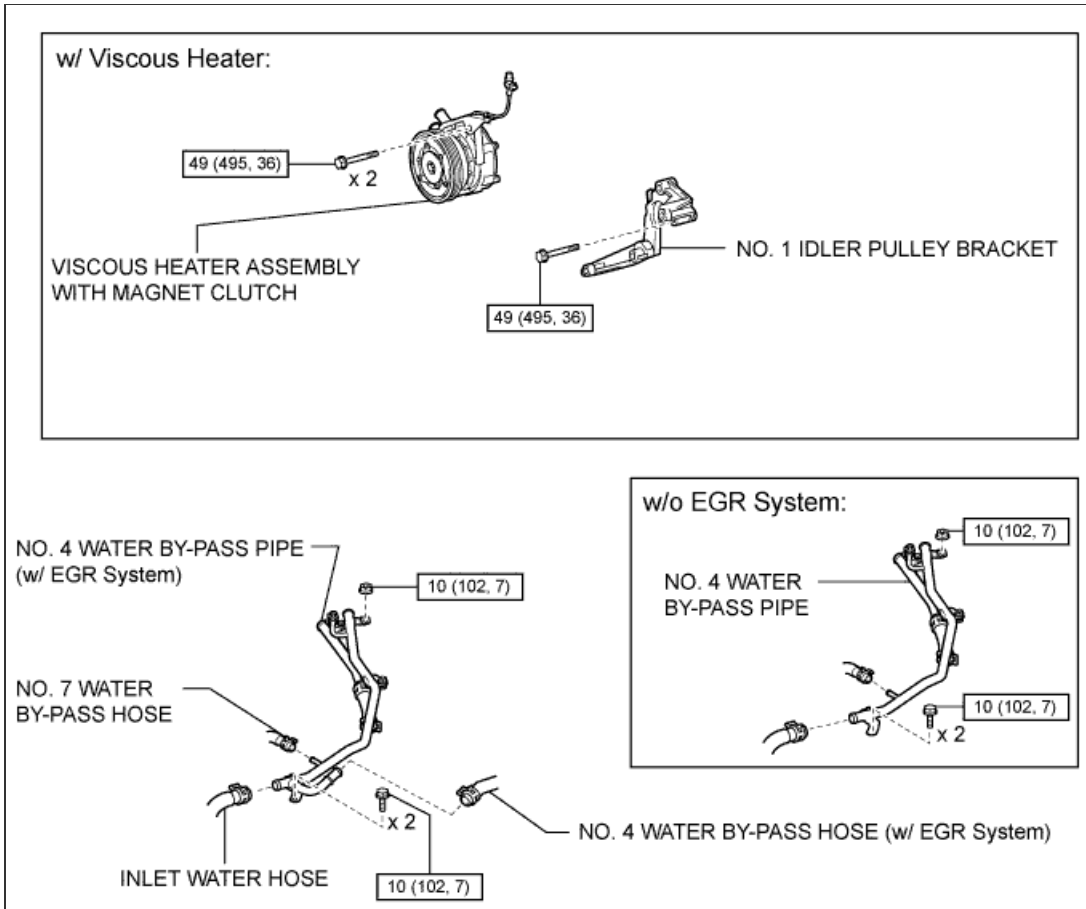


N*m (kgf*cm, ft.*lbf) : Specified torque

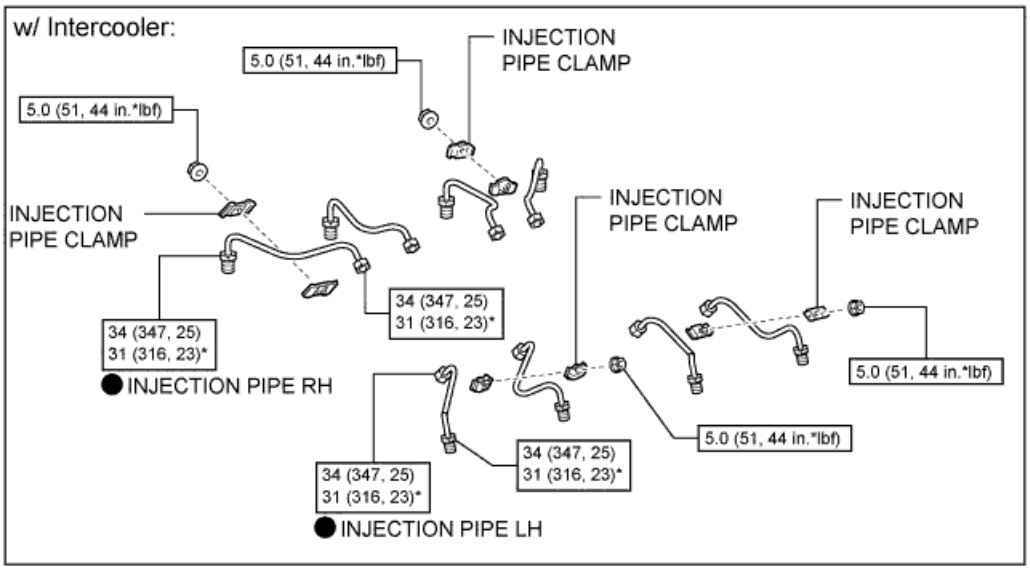
P

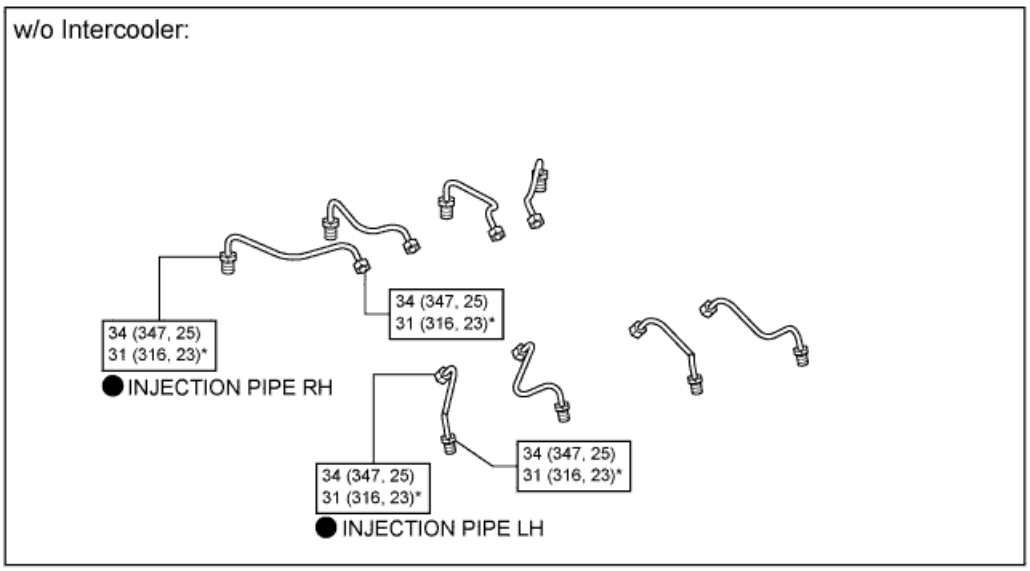

for Manual Transmission:
15 (155, 12)
14 (141, 10)*
x 2
20 (204, 15)
TUBE CONNECTOR TO FLEXIBLE HOSE TUBE
20 (204, 15)
15 (155, 12)
14 (141, 10)*
CLUTCH HOSE
GASKET
AIR TUBE SUB-ASSEMBLY RH
10 (102, 7)
x 2
NO. 2 ENGINE OIL LEVEL DIPSTICK GUIDE
6.3 (64, 56 in.*lbf)
GASKET
6.3 (64, 56 in.*lbf)
O-RING
AIR TUBE SUB-ASSEMBLY LH
N*m (kgf*cm, ft.*lbf) : Specified torque
*: For use with union nut wrench
Non-reusable part
P

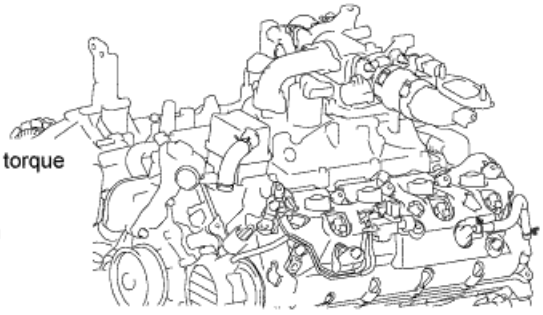

WATER HOSE SUB-ASSEMBLY
(w/o Rear Heater)
w/ Rear Heater:
WATER HOSE SUB-ASSEMBLY
NO. 3 WATER BY-PASS PIPE
9.8 (100, 87 in.*lbf)
x 2
10 (102, 7)
x 2
x 2
9.8 (100, 87 in.*lbf)
HEATER WATER PIPE SUB-ASSEMBLY
(w/ Viscous Heater)
NO. 1 AIR CLEANER PIPE SUB-ASSEMBLY
21 (214, 15)
21 (214, 15)
6.3 (64, 56 in.*lbf)
NO. 2 AIR CLEANER PIPE
SUB-ASSEMBLY
6.3 (64, 56 in.*lbf)
NO. 4 AIR TUBE
SUCTION HOSE SUB-ASSEMBLY
21 (214, 15)
9.8 (100, 87 in.*lbf)
6.3 (64, 56 in.*lbf)
21 (214, 15)
NO. 3 AIR TUBE
6.3 (64, 56 in.*lbf)
N*m (kgf*cm, ft.*lbf): Specified torque
P


w/ Viscous Heater:
49 (495, 36)
x 2
VISCOUS HEATER ASSEMBLY
WITH MAGNET CLUTCH
NO. 1 IDLER PULLEY BRACKET
49 (495, 36)
w/o EGR System:
10 (102, 7)
NO. 4 WATER
BY-PASS PIPE
10 (102, 7)
x 2
NO. 4 WATER BY-PASS PIPE
(w/ EGR System)
10 (102, 7)
NO. 7 WATER
BY-PASS HOSE
x 2
NO. 4 WATER BY-PASS HOSE (w/ EGR System)
INLET WATER HOSE
10 (102, 7)
x 5
ENGINE WIRE
FUEL HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque

P





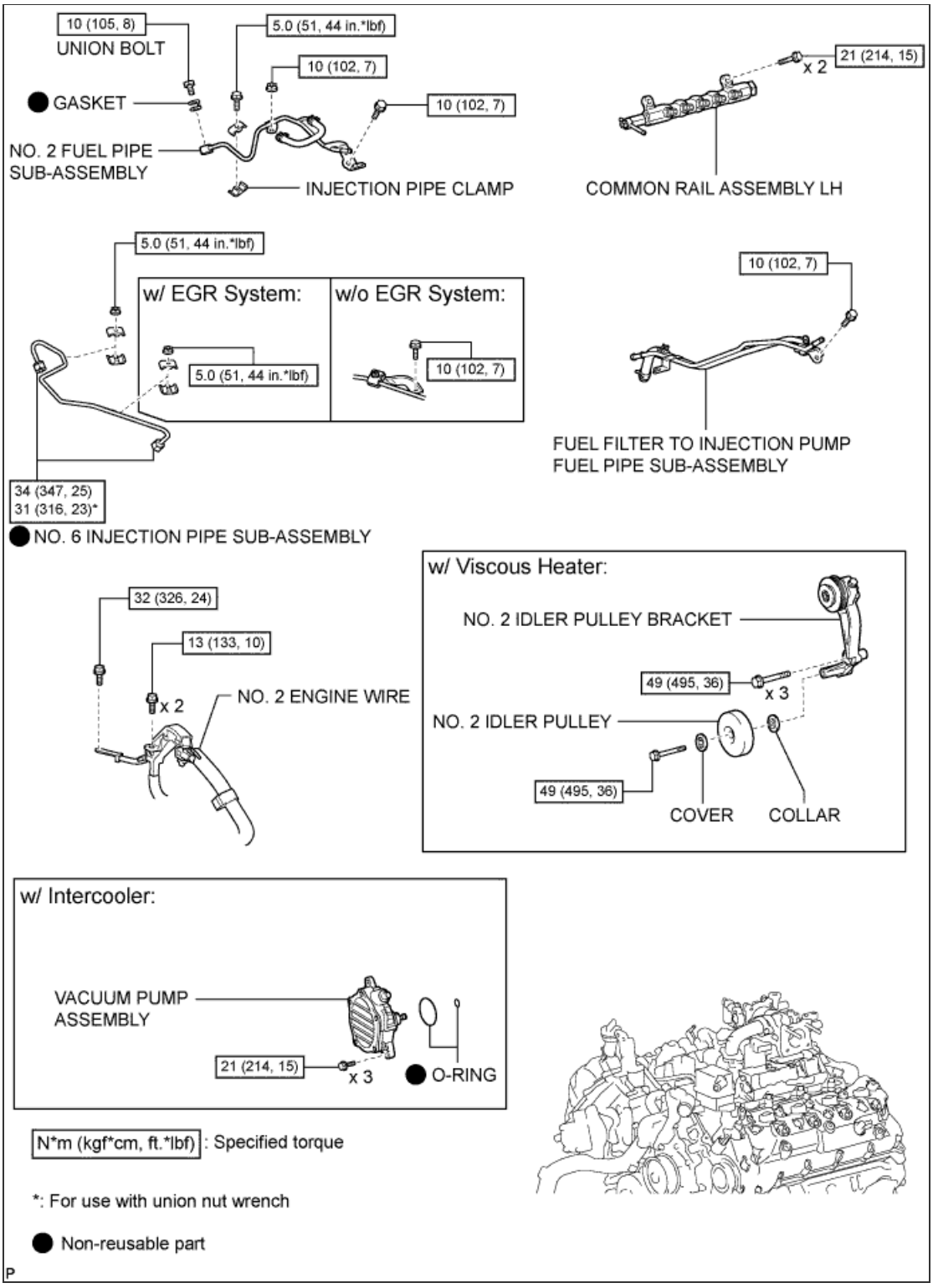


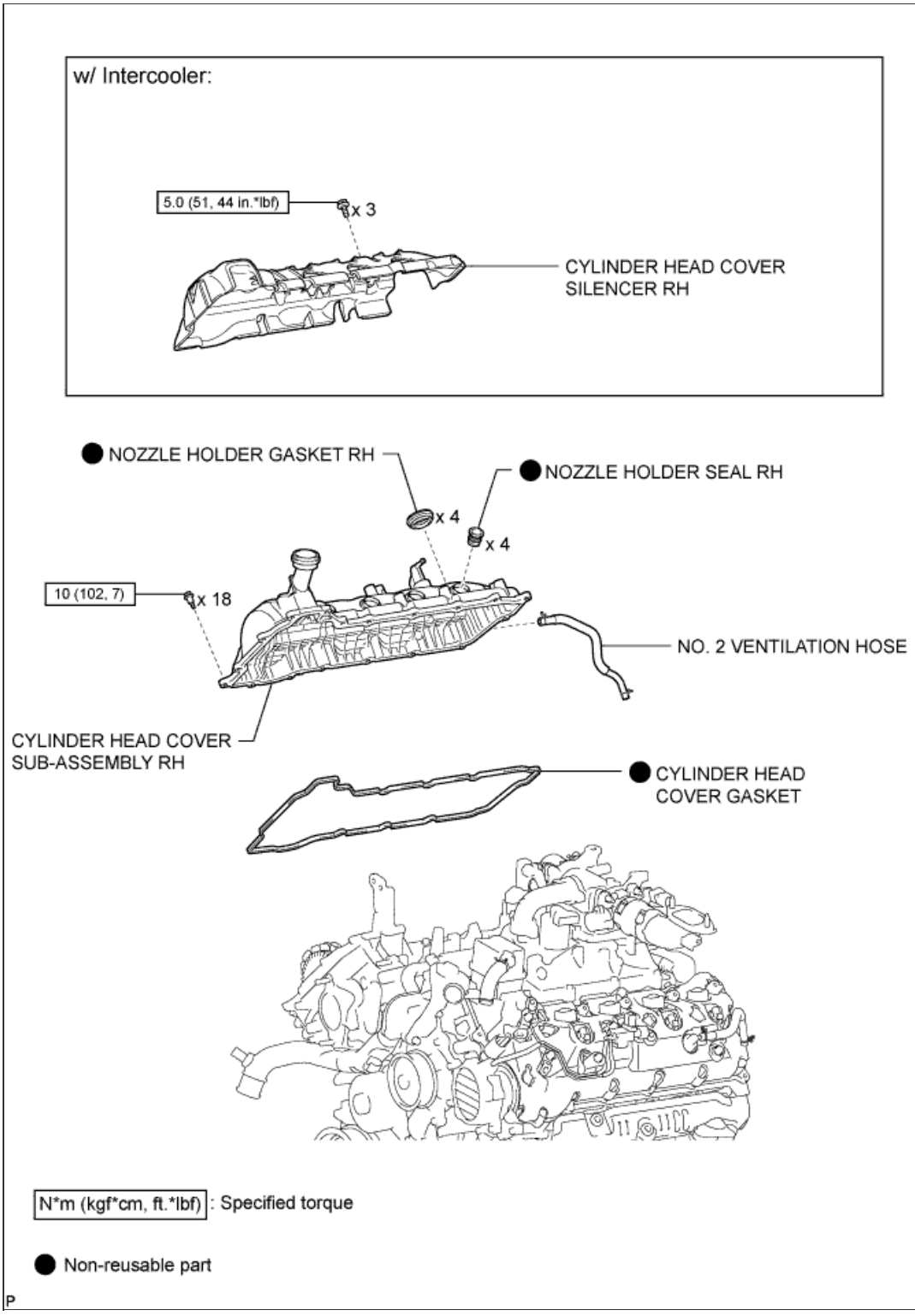
N*m (kgf*cm, ft.*lbf): Specified torque

*: For use with union nut wrench

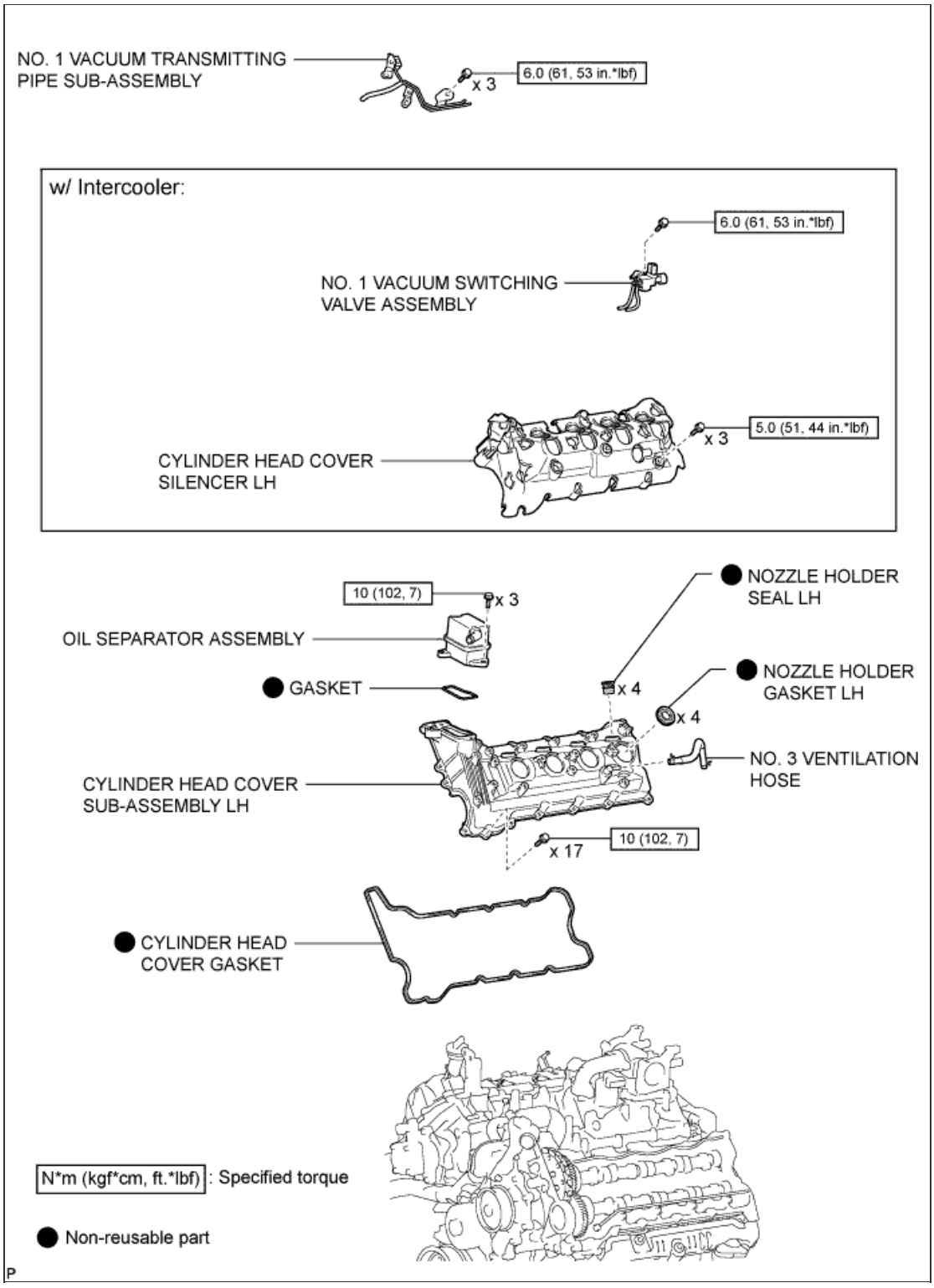
● Non-reusable part

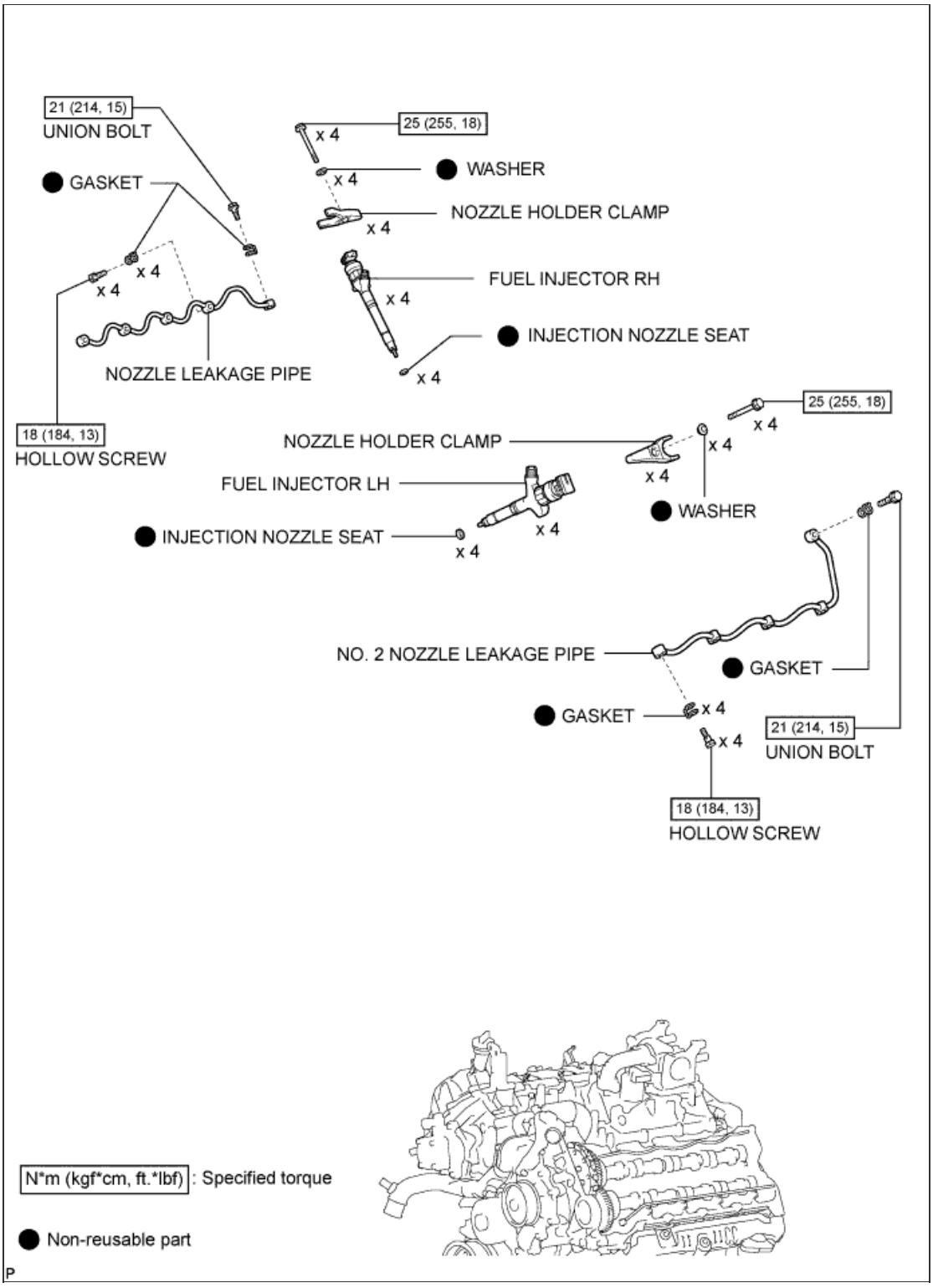
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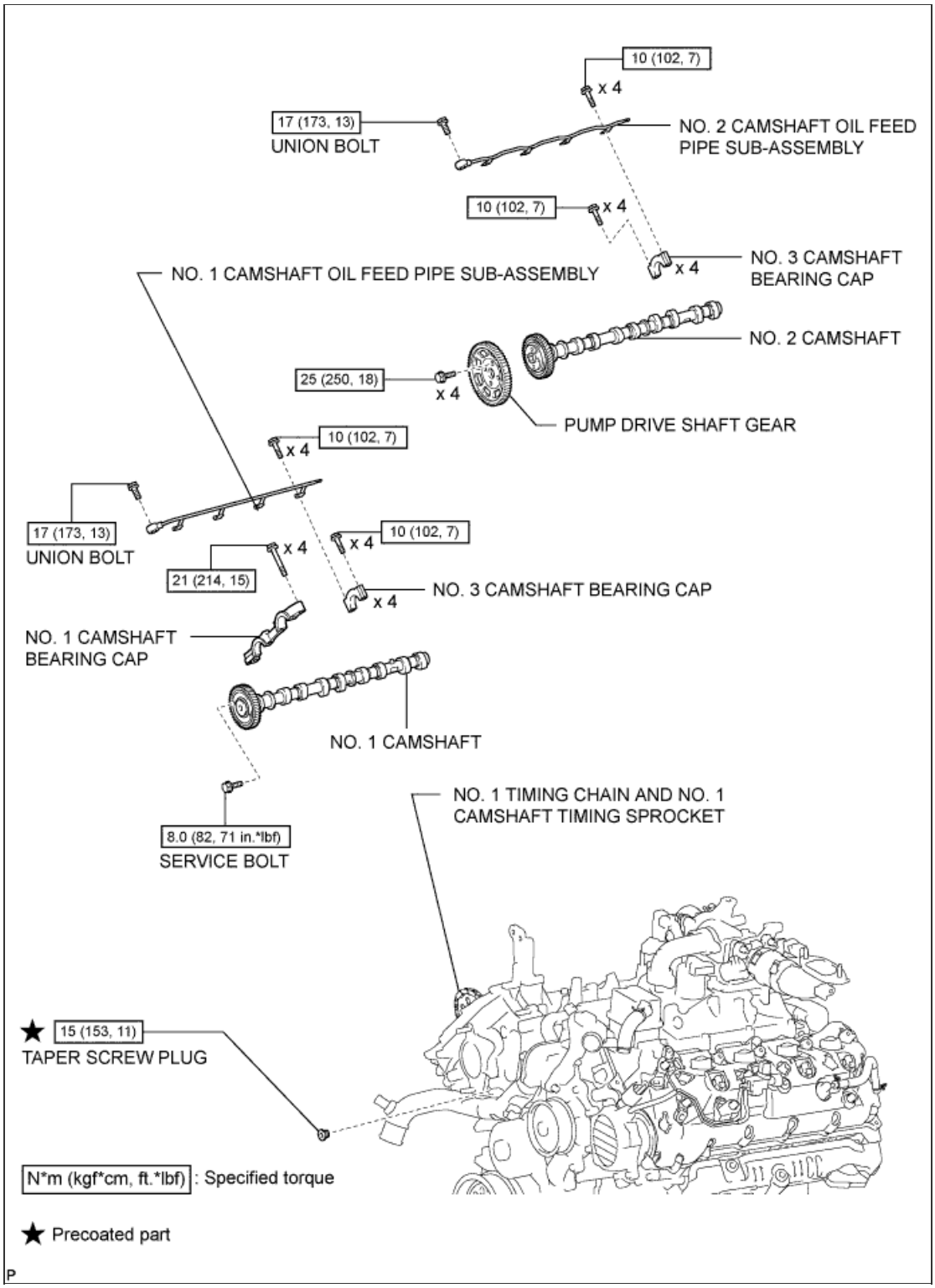

10 (105, 8)
UNION BOLT
5.0 (51, 44 in.*lbf)
10 (102, 7)
GASKET
10 (102, 7)
NO. 2 FUEL PIPE SUB-ASSEMBLY
INJECTION PIPE CLAMP
21 (214, 15)
x 2
COMMON RAIL ASSEMBLY LH
5.0 (51, 44 in.*lbf)
w/ EGR System:
w/o EGR System:
5.0 (51, 44 in.*lbf)
10 (102, 7)
10 (102, 7)
FUEL FILTER TO INJECTION PUMP FUEL PIPE SUB-ASSEMBLY
34 (347, 25)
31 (316, 23)*
NO. 6 INJECTION PIPE SUB-ASSEMBLY
w/ Viscous Heater:
32 (326, 24)
13 (133, 10)
x 2
NO. 2 ENGINE WIRE
NO. 2 IDLER PULLEY BRACKET
49 (495, 36)
x 3
NO. 2 IDLER PULLEY
49 (495, 36)
COVER
COLLAR
w/ Intercooler:
VACUUM PUMP ASSEMBLY
21 (214, 15)
x 3
O-RING
N*m (kgf*cm, ft.*lbf) : Specified torque
*: For use with union nut wrench
Non-reusable part
P

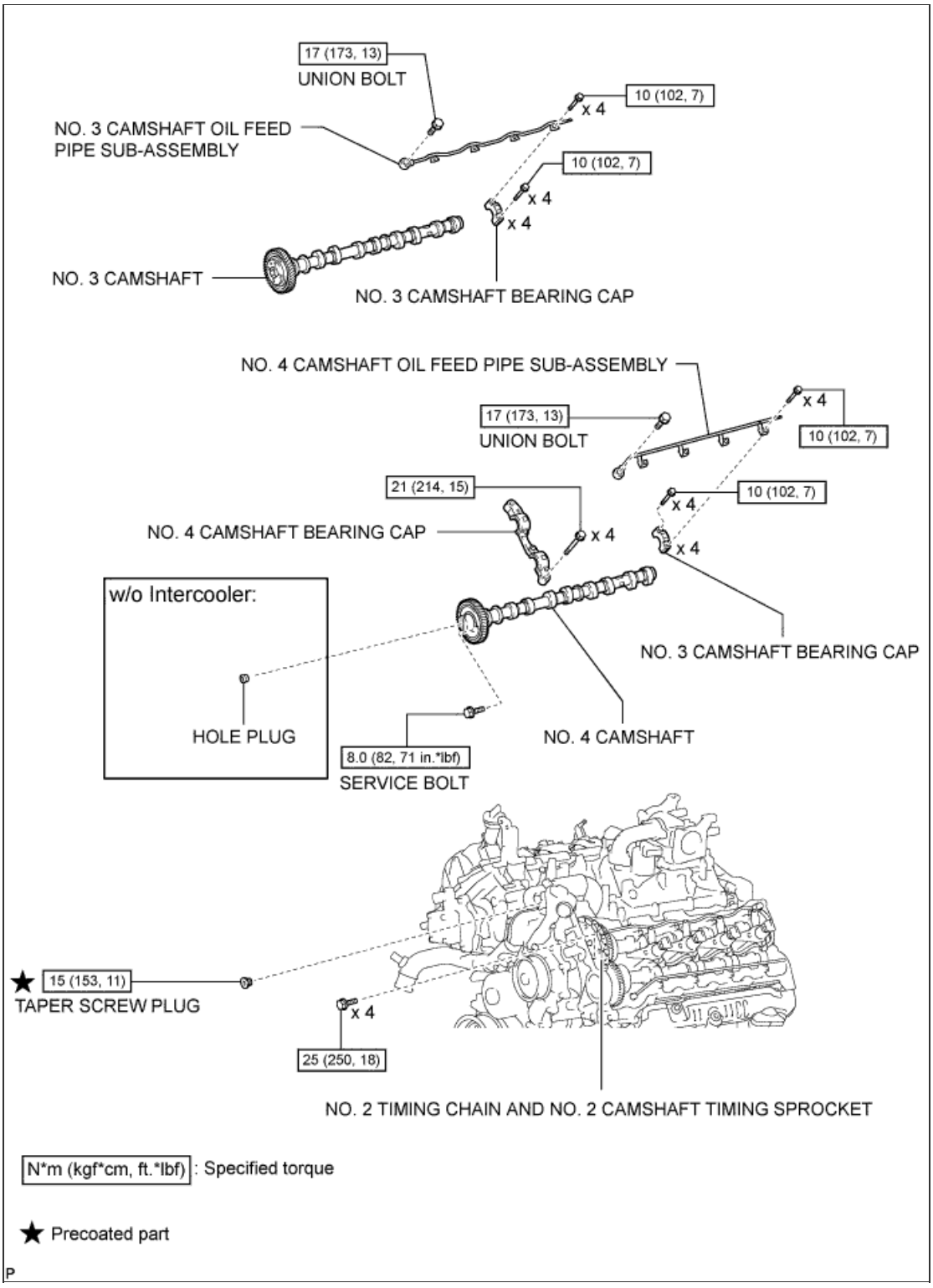

w/ Intercooler:
5.0 (51, 44 in.*lbf)
x 3
CYLINDER HEAD COVER SILENCER RH
NOZZLE HOLDER GASKET RH
NOZZLE HOLDER SEAL RH
x 4
x 4
10 (102, 7)
x 18
NO. 2 VENTILATION HOSE
CYLINDER HEAD COVER SUB-ASSEMBLY RH
CYLINDER HEAD COVER GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P


NO. 1 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY
x 3
6.0 (61, 53 in.*lbf)
w/ Intercooler:
6.0 (61, 53 in.*lbf)
NO. 1 VACUUM SWITCHING VALVE ASSEMBLY
CYLINDER HEAD COVER SILENCER LH
x 3
5.0 (51, 44 in.*lbf)
10 (102, 7)
x 3
OIL SEPARATOR ASSEMBLY
GASKET
NOZZLE HOLDER SEAL LH
x 4
NOZZLE HOLDER GASKET LH
x 4
NO. 3 VENTILATION HOSE
CYLINDER HEAD COVER SUB-ASSEMBLY LH
x 17
10 (102, 7)
CYLINDER HEAD COVER GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part


21 (214, 15)
UNION BOLT
GASKET
x 4
x 4
NOZZLE LEAKAGE PIPE
18 (184, 13)
HOLLOW SCREW
x 4
25 (255, 18)
x 4
WASHER
NOZZLE HOLDER CLAMP
x 4
FUEL INJECTOR RH
x 4
INJECTION NOZZLE SEAT
x 4
NOZZLE HOLDER CLAMP
x 4
25 (255, 18)
x 4
WASHER
FUEL INJECTOR LH
x 4
INJECTION NOZZLE SEAT
x 4
NO. 2 NOZZLE LEAKAGE PIPE
GASKET
GASKET
x 4
x 4
21 (214, 15)
UNION BOLT
18 (184, 13)
HOLLOW SCREW
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P


10 (102, 7)
x 4
17 (173, 13)
UNION BOLT
NO. 2 CAMSHAFT OIL FEED PIPE SUB-ASSEMBLY
10 (102, 7)
x 4
NO. 3 CAMSHAFT BEARING CAP
x 4
NO. 1 CAMSHAFT OIL FEED PIPE SUB-ASSEMBLY
NO. 2 CAMSHAFT
25 (250, 18)
x 4
PUMP DRIVE SHAFT GEAR
10 (102, 7)
x 4
17 (173, 13)
UNION BOLT
10 (102, 7)
x 4
21 (214, 15)
x 4
NO. 3 CAMSHAFT BEARING CAP
x 4
NO. 1 CAMSHAFT BEARING CAP
NO. 1 CAMSHAFT
NO. 1 TIMING CHAIN AND NO. 1 CAMSHAFT TIMING SPROCKET
8.0 (82, 71 in.*lbf)
SERVICE BOLT
★ 15 (153, 11)
TAPER SCREW PLUG
N*m (kgf*cm, ft.*lbf) : Specified torque
★ Precoated part
P


17 (173, 13)
UNION BOLT
10 (102, 7)
x 4
NO. 3 CAMSHAFT OIL FEED PIPE SUB-ASSEMBLY
10 (102, 7)
x 4
x 4
NO. 3 CAMSHAFT
NO. 3 CAMSHAFT BEARING CAP
NO. 4 CAMSHAFT OIL FEED PIPE SUB-ASSEMBLY
17 (173, 13)
UNION BOLT
x 4
10 (102, 7)
21 (214, 15)
10 (102, 7)
x 4
NO. 4 CAMSHAFT BEARING CAP
x 4
x 4
w/o Intercooler:
NO. 3 CAMSHAFT BEARING CAP
HOLE PLUG
NO. 4 CAMSHAFT
8.0 (82, 71 in.*lbf)
SERVICE BOLT
15 (153, 11)
TAPER SCREW PLUG
x 4
25 (250, 18)
NO. 2 TIMING CHAIN AND NO. 2 CAMSHAFT TIMING SPROCKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Precoated part
P

for Preparation Click here

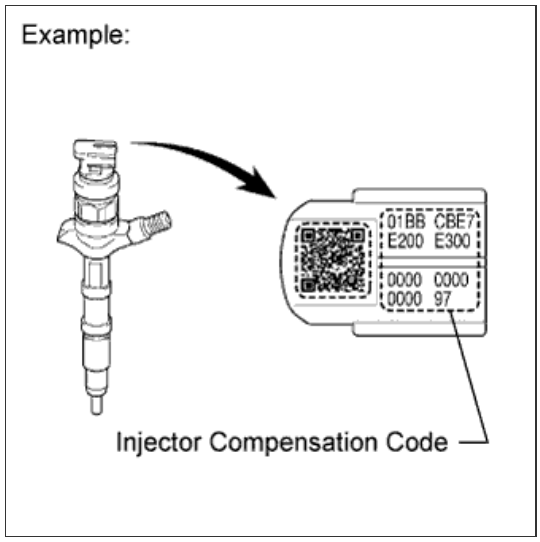
CAUTION:

When replacing an injector (including interchanging injectors between cylinders), common rail, cylinder head, or intake manifold, replace the corresponding injection pipes with a new one.

1. CHECK INJECTOR COMPENSATION CODE

NOTICE:

- **When a fuel injector is replaced, the new fuel injector compensation code must be input into the ECM. When the ECM is replaced, all of the existing fuel injector compensation codes must be input into the new ECM.**
- **Fuel injector compensation codes are unique, 30 digit, alphanumeric values printed on the head portion of each fuel injector. If an incorrect fuel injector compensation code is input into the ECM, the engine assembly may rattle or engine idling may become rough. In addition, engine failure may occur and the life of the engine may be shortened.**



a. After replacing fuel injector(s) with new one(s), input compensation code(s) of fuel injector(s) into ECM as follows:

HINT:

- **Each fuel injector has different fuel injection characteristics. In order to optimize the fuel injections, the ECM uses the compensation codes to balance the different fuel injections between each fuel injector.**
- **When you first turn the ignition switch to ON after replacing the ECM or a fuel injector(s), DTC P1601 is set. This is to inform you that registration of a fuel injector compensation code(s) is/are required. Manually clear the DTC upon completion of the compensation code registration.**

i. Input the compensation code(s), which is/are imprinted on the head portion(s) of the new fuel injector(s), into the intelligent tester.

ii. Input the new compensation code(s) into the ECM using the tester.

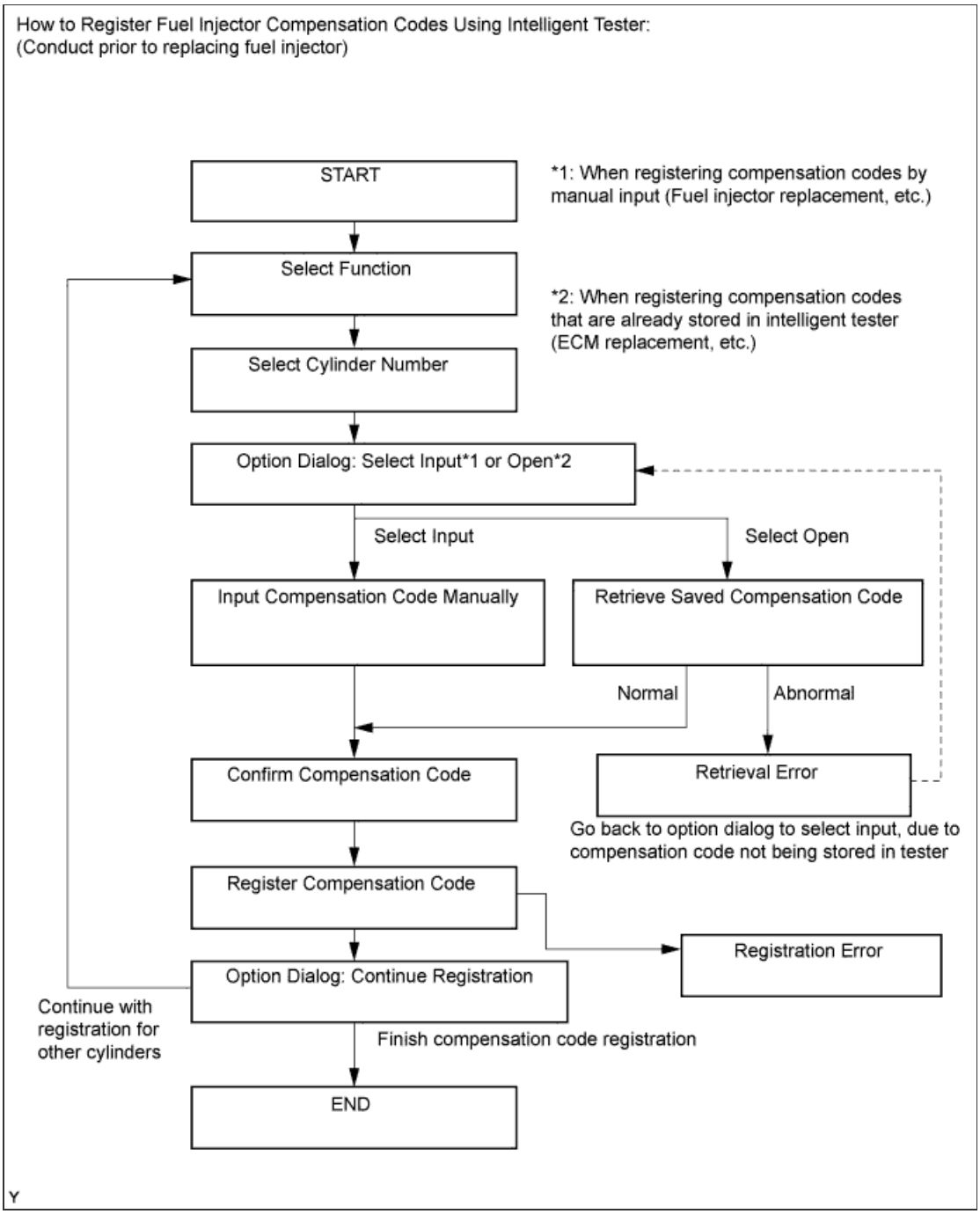
iii. Turn the tester off and turn the ignition switch off.

iv. Wait for at least 30 seconds.

v. Turn the ignition switch to ON and turn the tester on.

vi. Clear DTC P1601 stored in the ECM using the tester (Click here).

b. Register compensation code.



i. Connect the intelligent tester to the DLC3.

ii. Turn the ignition switch to ON.

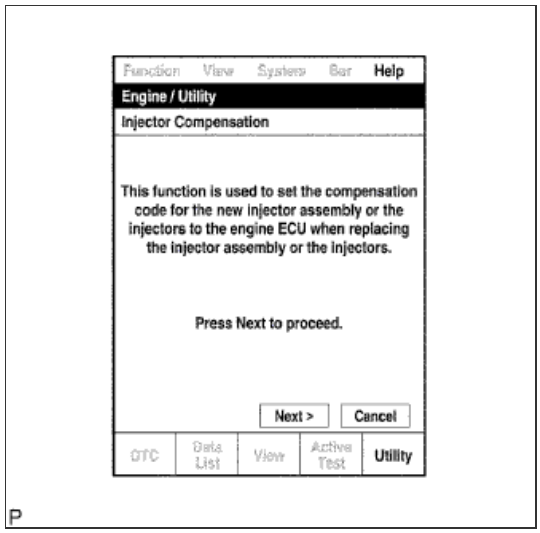
NOTICE:

Do not start the engine.

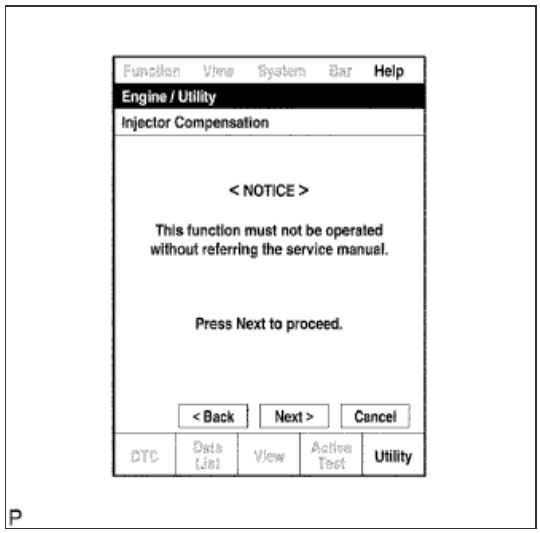
iii. Turn the tester on.

iv. Enter the following menus: Powertrain / Engine / Utility / Injector Compensation.

v. Press Next.

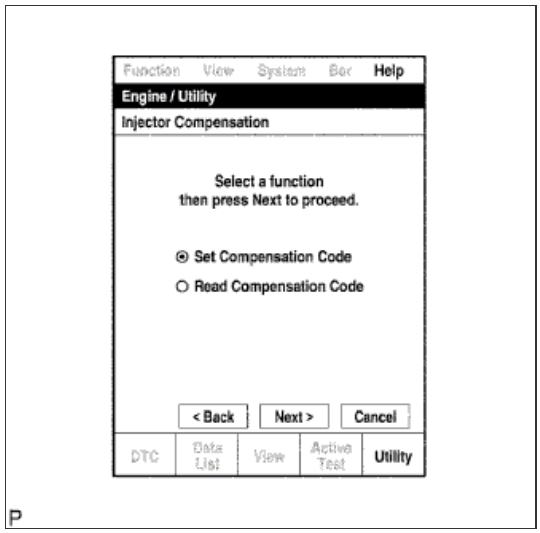


vi. Press Next again to proceed.



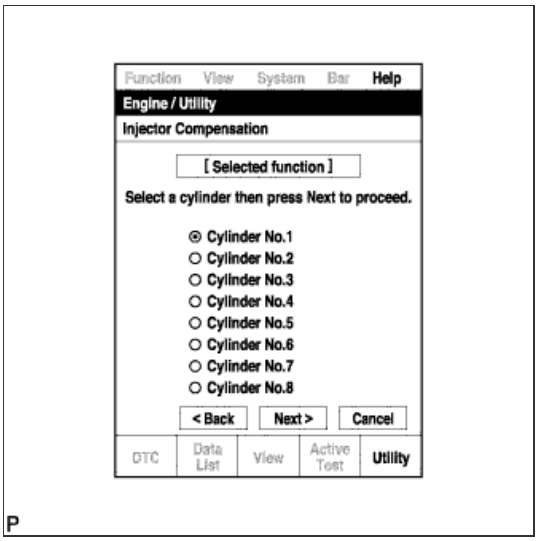
vii. Select et Compensation Code .

viii. Press Next.



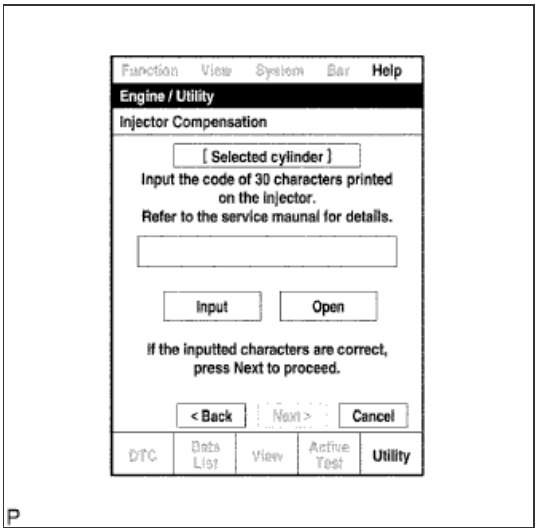
ix. Select the number of the cylinder corresponding to the fuel injector compensation code that you want to read.

x. Press Next.



xi. Register compensation code.

1. Press Input.



2. Manually input the cylinder compensation code using the keyboard on the tester screen. The code is a 30 digit, alphanumeric value printed on the injector head portion.

HINT:

Each fuel injector compensation code is uni ue. The compensation code for each selected cylinder must be input into the tester correctly.

3. Confirm that the compensation code for the selected cylinder is correct, and then press O .



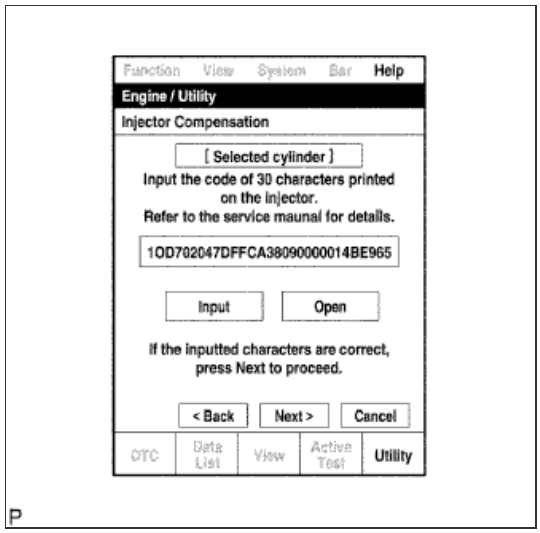
xii. Check that the compensation code displayed on the screen is correct by comparing it with the 30 digit alphanumeric value on the head portion of the fuel injector.

NOTICE:

If an incorrect fuel injector compensation code is input into the ECM, the engine may rattle or engine idling may become rough. In addition, engine failure may occur and the life of the engine may be shortened.

HINT:

- **If a wrong compensation code is input or read, return to the Input Value screen by pressing Input.**
- **The saving process may fail due to a problem with the wire harness or a bad connection with the DLC3. Check the wire harness and DLC3 connection. If no problem is found with either, the ECM may be malfunctioning. Check the ECM and repeat this operation.**



xiii. Press Next to register the compensation code in the ECM.

HINT:

- **If the registration process fails, the compensation code may be incorrect. Check the compensation code again.**
- **If the input compensation code fails to register even though it is input correctly, there may be a problem with the wire harness or a bad connection with the DLC3. Check the wire harness and DLC3 connection. If no problem is found with either, the ECM may be malfunctioning. Check the ECM and restart this operation.**

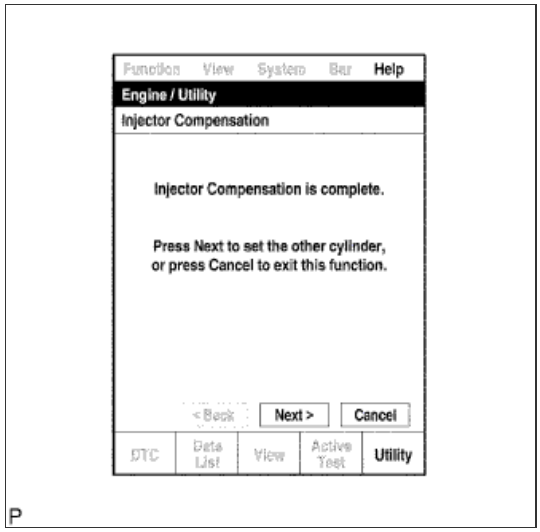
xiv. If you want to continue with other compensation code registrations, press Next. To finish the registration, press Cancel.

xv. Turn the ignition switch off and then turn the tester off.

xvi. Wait for at least 30 seconds.

xvii. Turn the ignition switch to ON and then turn the tester on.

xviii. Clear DTC P1601 stored in the ECM using the tester (Click here).



2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Disconnect the cables from the negative (-) main battery and sub-battery terminals.

3. DRAIN ENGINE OIL

a. Remove the 2 bolts and No. 2 engine under cover seal from the No. 2 engine under cover.

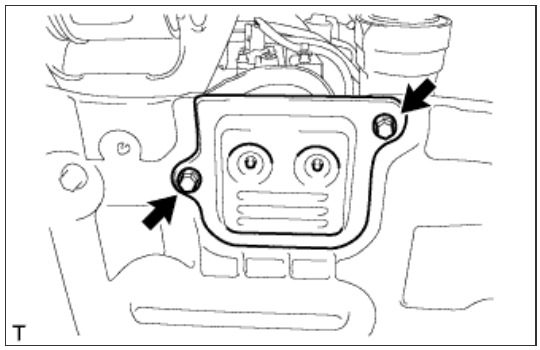
b. Remove the oil filler cap.

c. Remove the oil pan drain plug and gasket, and then drain the engine oil into a container.

d. Install a new gasket and the oil pan drain plug.

Torque:

3 N m{ 387 kgf*cm , 28 ft.*lbf }



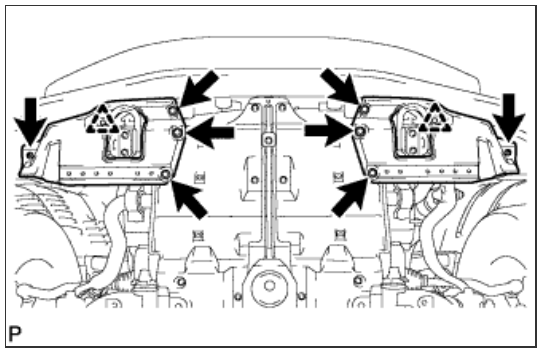
4. REMOVE FRONT WHEEL

5. DRAIN CLUTCH FLUID (for Manual Transmission)

6. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.



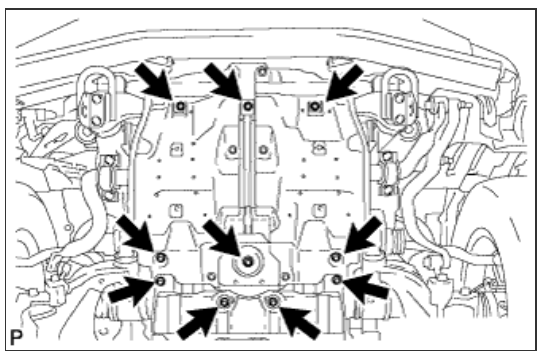
7. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.

8. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



9. REMOVE ENGINE COOLANT

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

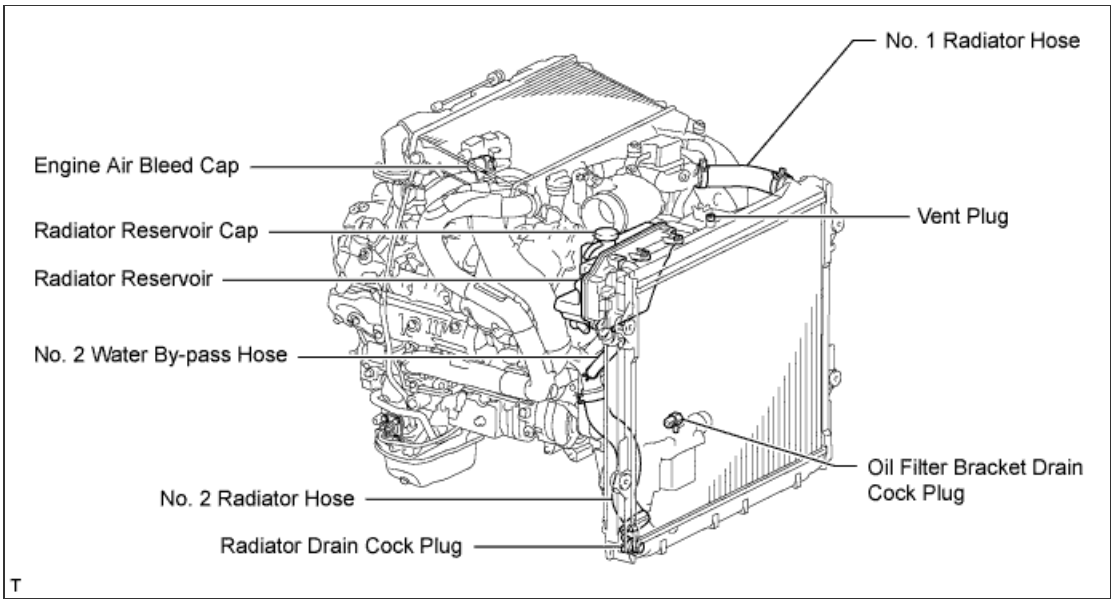
HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

a. Loosen the radiator drain cock plug.

b. Remove the radiator reservoir cap to drain the coolant in the radiator.

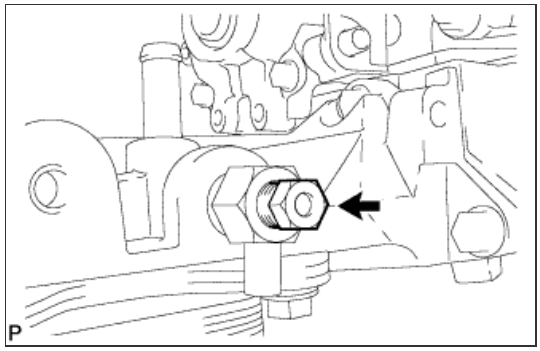
c. Loosen the oil filter bracket drain cock plug to drain the coolant in the engine.



d. Tighten the radiator drain cock plug by hand.

e. Tighten the oil filter bracket drain cock plug.

Torque:
13 N m{ 133 kgf*cm , 10 ft.*lbf }



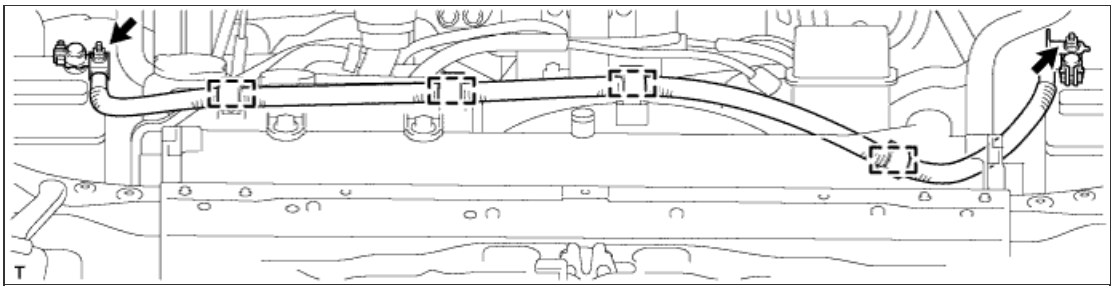
10. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and upper radiator support seal.

11. REMOVE NO. 3 ENGINE ROOM WIRE

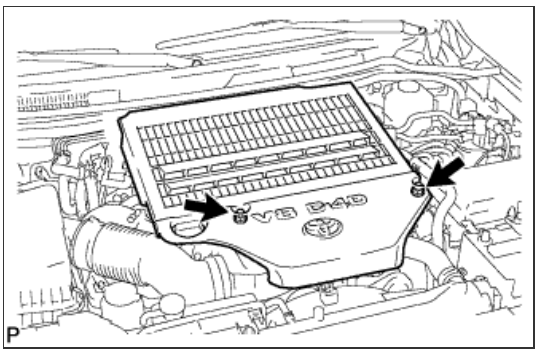
a. Disconnect the 4 wire harness clamps.

b. Remove the 2 nuts and No. 3 engine room wire.



12. REMOVE NO. 1 ENGINE COVER SUB-ASSEMBLY (w/ Intercooler)

a. Remove the 2 nuts and No. 1 engine cover.

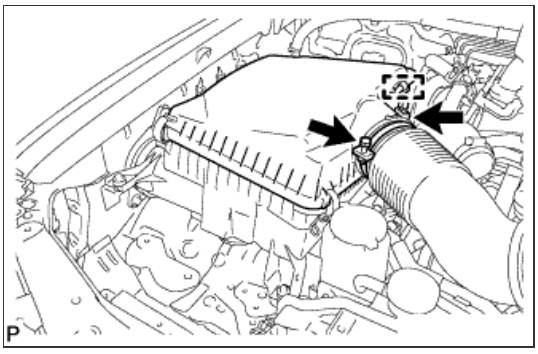


13. REMOVE AIR CLEANER CAP SUB-ASSEMBLY

a. Loosen the hose clamp.

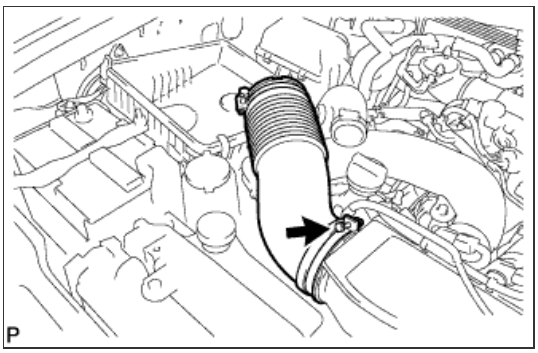
b. Disconnect the mass air flow meter connector and using a clip remover, detach the wire harness clamp from the air cleaner cap.

c. Detach the 4 clamps and remove the air cleaner cap.



14. REMOVE NO. 1 AIR CLEANER HOSE

a. Loosen the hose clamp and remove the No. 1 air cleaner hose.



15. REMOVE INTAKE AIR CONNECTOR

a. w/o Viscous Heater:

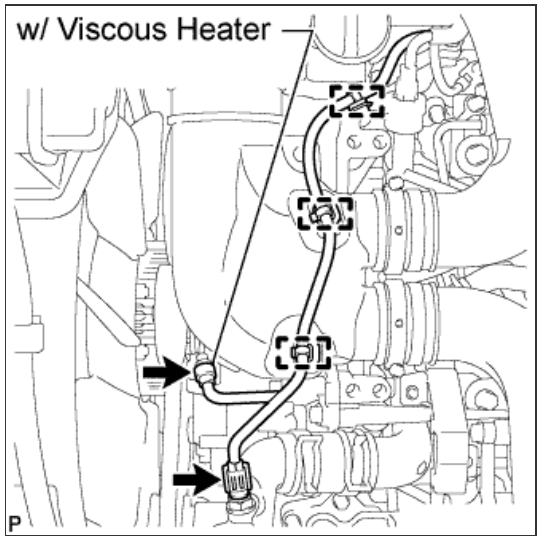
i. Disconnect the connector from the water temperature sensor.

ii. Using a clip remover, detach the 3 wire harness clamps.

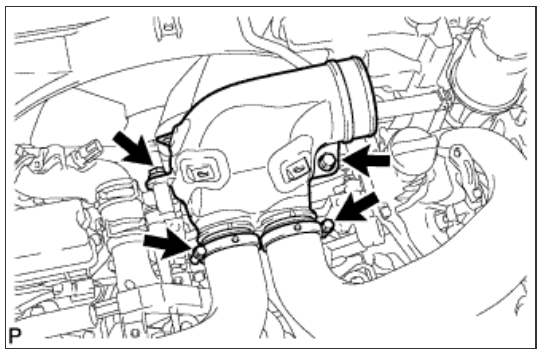
b. w/ Viscous Heater:

i. Disconnect the 2 connectors from the viscous with magnet clutch heater and water temperature sensor.

ii. Using a clip remover, detach the 3 wire harness clamps.



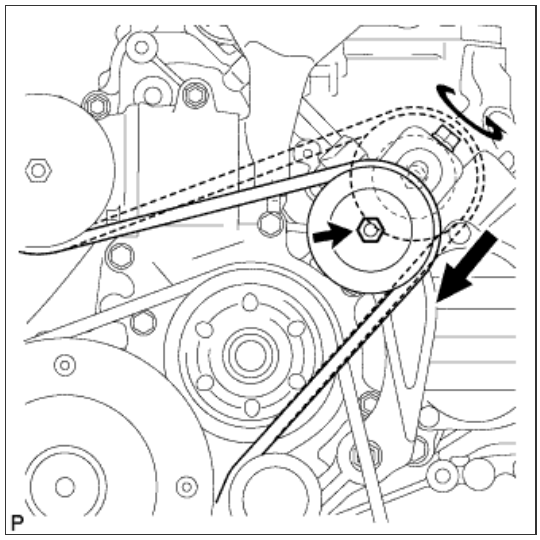
c. Loosen the 2 hose clamps and remove the 2 bolts and intake air connector.



16. REMOVE V RIBBED BELT (w/ Viscous Heater)

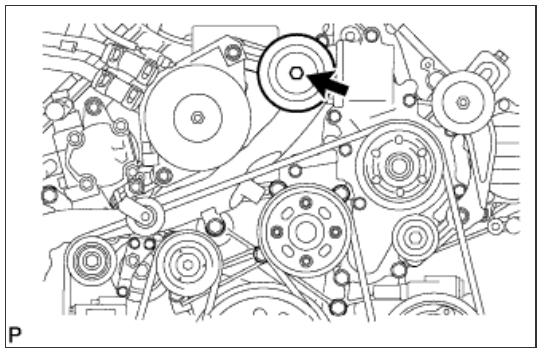
a. Loosen the lock nut and turn the bolt counterclockwise.

b. Remove the V-ribbed belt.



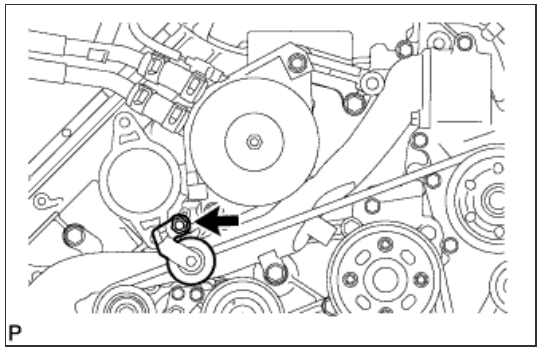
17. REMOVE NO. 1 IDLER PULLEY (w/ Viscous Heater)

a. Remove the bolt, cover, No. 1 idler pulley and collar.



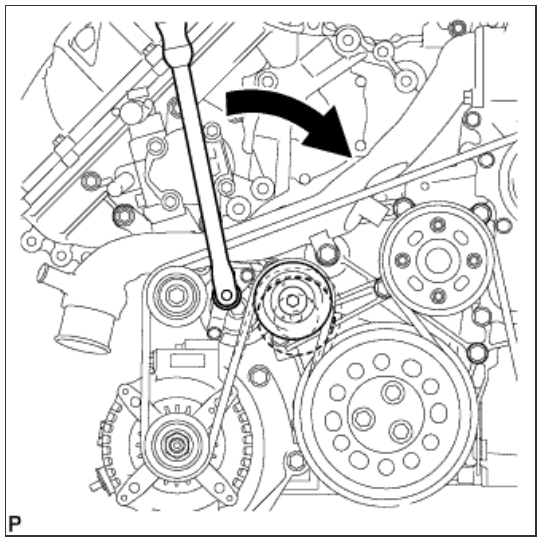
1 . REMOVE NO. 3 IDLER PULLEY (w/ Viscous Heater)

a. Remove the nut and No. 3 idler pulley.



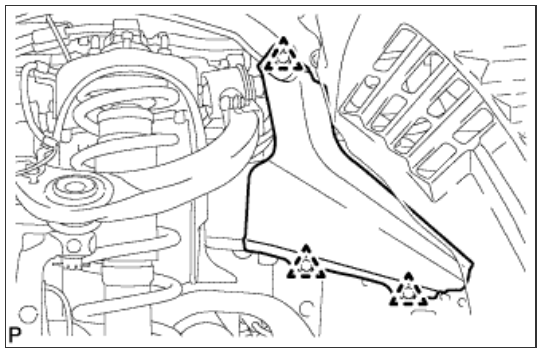
19. REMOVE V-RIBBED BELT

a. Using a wrench to the V-ribbed belt tensioner bracket, turn the wrench clockwise and remove the V-ribbed belt.



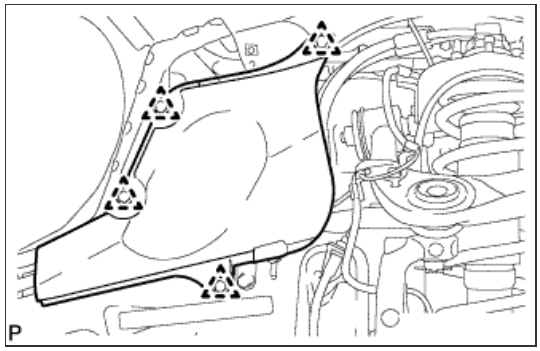
20. REMOVE FRONT FENDER APRON SEAL FRONT RH

a. Remove the 3 clips and front fender apron seal front RH.



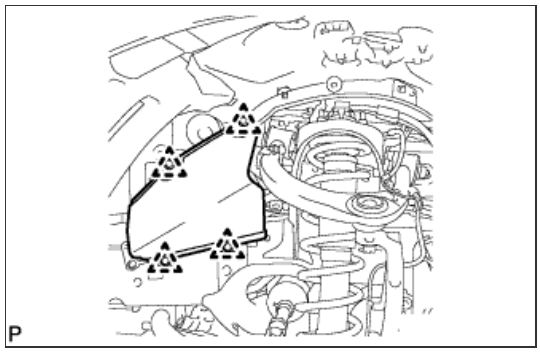
21. REMOVE FRONT FENDER APRON SEAL REAR RH

a. Remove the 4 clips and front fender apron seal rear RH.

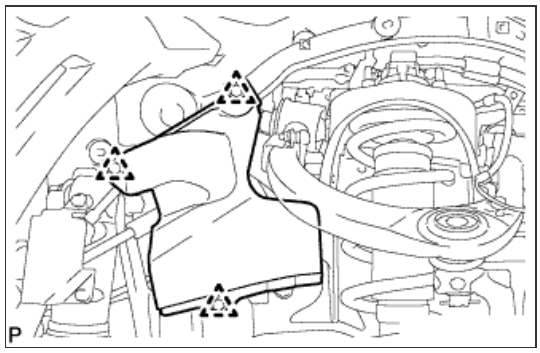


22. REMOVE FRONT FENDER APRON SEAL FRONT LH

a. w/o DSS:
Remove the 4 clips and front fender apron seal front LH.

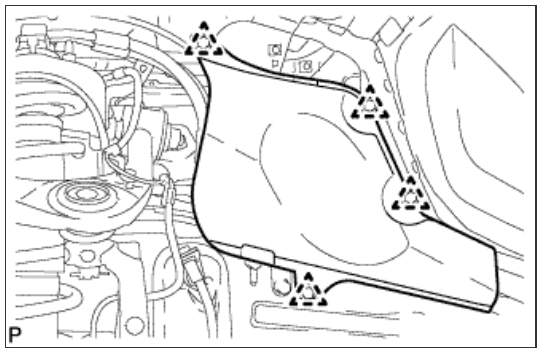


b. w/ DSS:
Remove the 3 clips and front fender apron seal front LH.



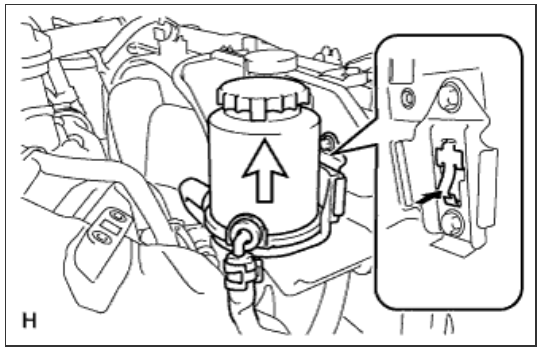
23. REMOVE FRONT FENDER APRON SEAL REAR LH

a. Install the front fender apron seal rear LH with the 4 clips.



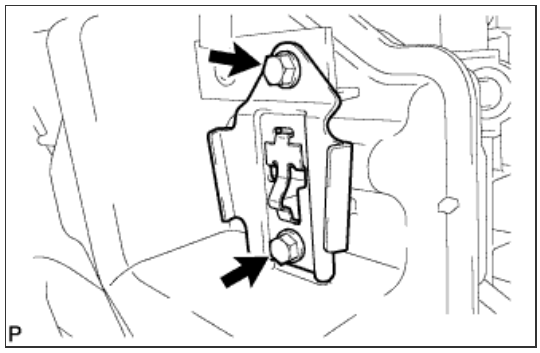
24. REMOVE VANE PUMP OIL RESERVOIR ASSEMBLY

a. Insert a screwdriver between the reservoir and oil reservoir bracket, push the claw, and then disconnect the reservoir by pulling it upwards.



25. REMOVE NO. 1 OIL RESERVOIR BRACKET

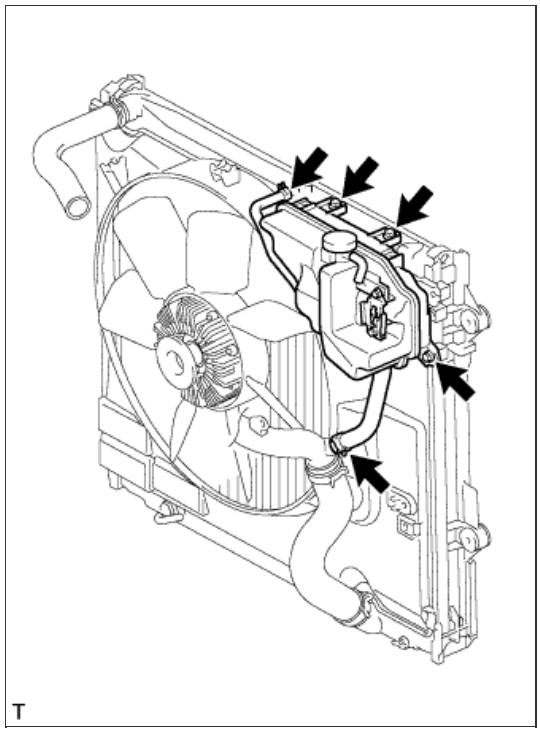
a. Remove the 2 bolts and bracket.



26. REMOVE RADIATOR RESERVOIR ASSEMBLY

a. Disconnect the 2 hoses.

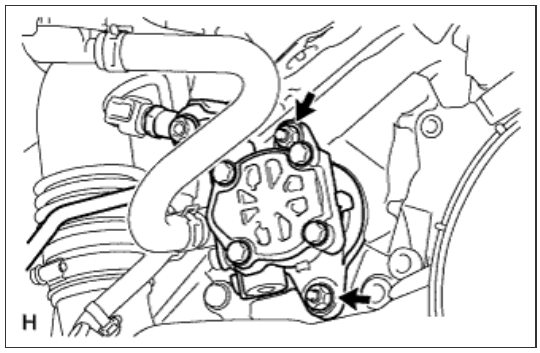
b. Remove the 3 bolts and radiator reservoir.



27. REMOVE VANE PUMP ASSEMBLY

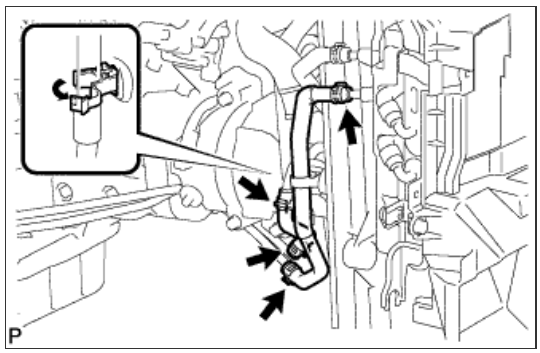
a. Remove the 2 nuts and vane pump.

b. Remove the O-ring from the vane pump.

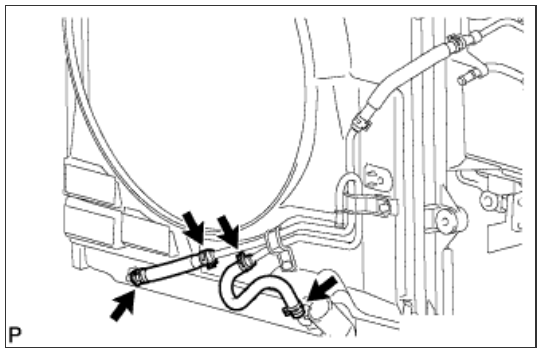


28. REMOVE OIL COOLER TUBE (for Automatic Transmission)

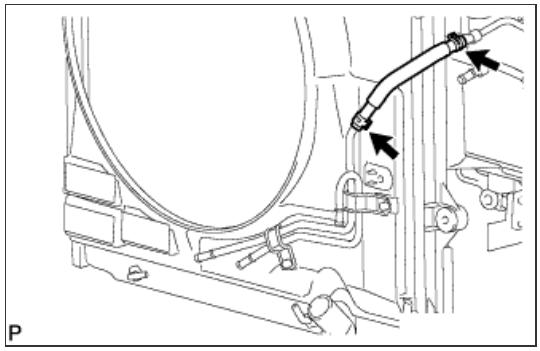
a. Disconnect the inlet and outlet No. 1 oil cooler hose.



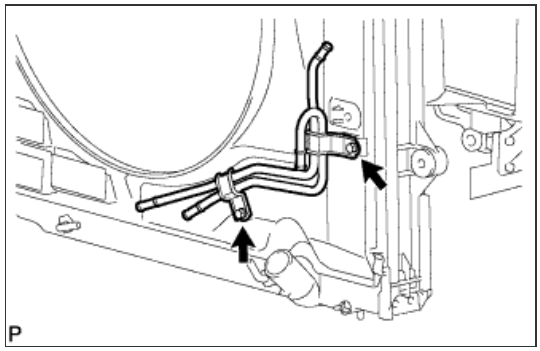
b. Disconnect the inlet No. 2 and No. 3 oil cooler hoses.



c. Disconnect the inlet No. 4 oil cooler hose.

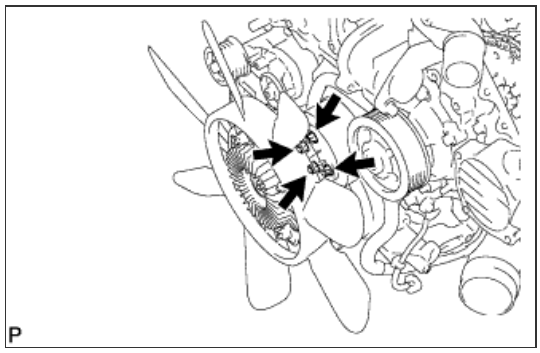


d. Remove the 2 bolts and transmission oil cooler tube.

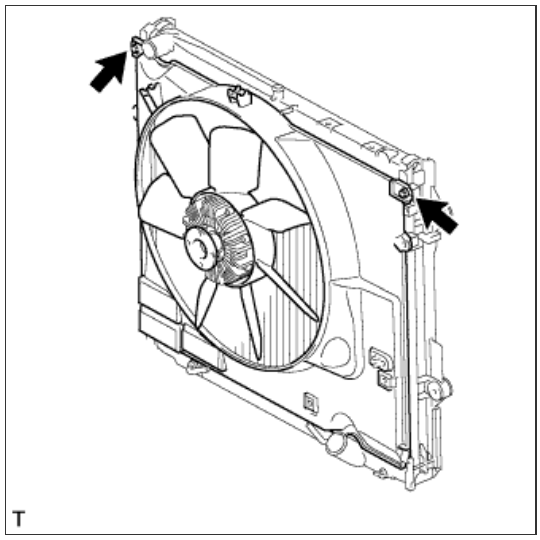


29. REMOVE FAN SHROUD WITH FAN

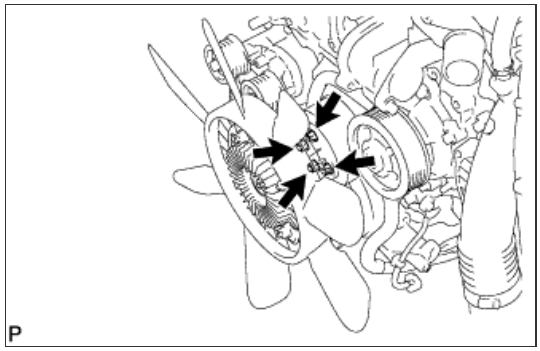
a. Loosen the 4 nuts holding the fluid coupling fan.



b. Remove the 2 bolts holding the fan shroud.

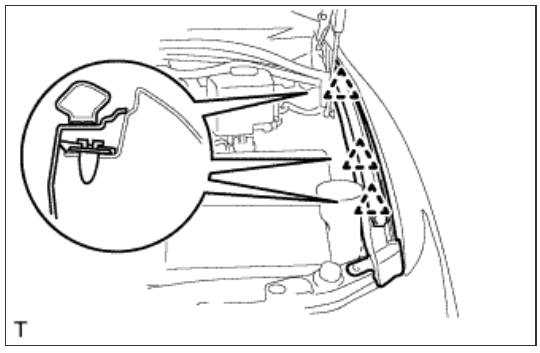


c. Remove the 4 nuts of the fluid coupling fan, and then remove the shroud together with the fluid coupling fan.



30. REMOVE FRONT FENDER MAIN SEAL LH

a. Using a clip remover, detach the 3 clips and remove the fender main seal.



31. REMOVE FRONT FENDER MAIN SEAL RH

HINT:

Use the same procedures described for the LH side.

32. REMOVE FRONT WIPER ARM LH

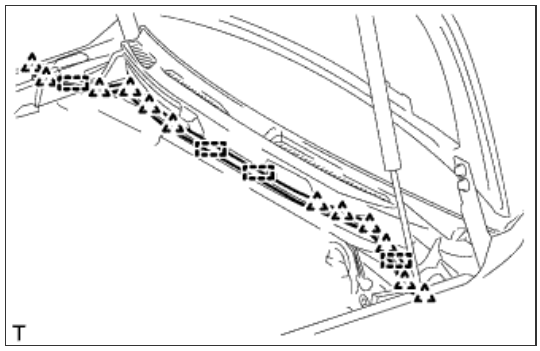
a. Remove the nut, wiper arm and blade.

33. REMOVE FRONT WIPER ARM RH

a. Remove the nut, wiper arm and blade.

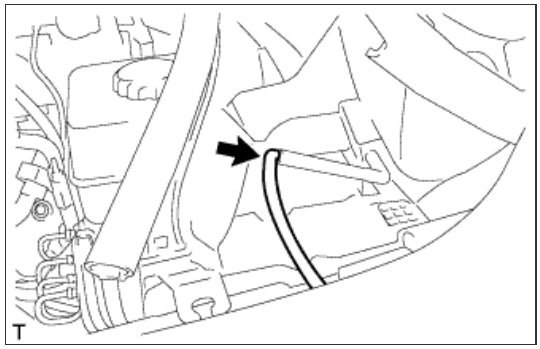
3 . REMOVE HOOD TO COWL TOP SEAL

a. Using a clip remover, detach the 12 clips, 4 clamps and remove the hood to cowl top seal.



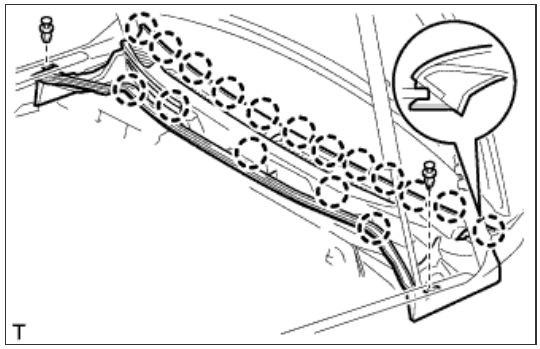
35. REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Remove the washer hose.



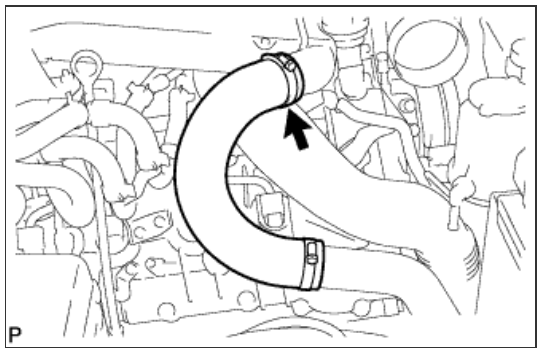
b. Remove the 2 clips.

c. Detach the 17 claws and remove the cowl top ventilator louver sub-assembly.

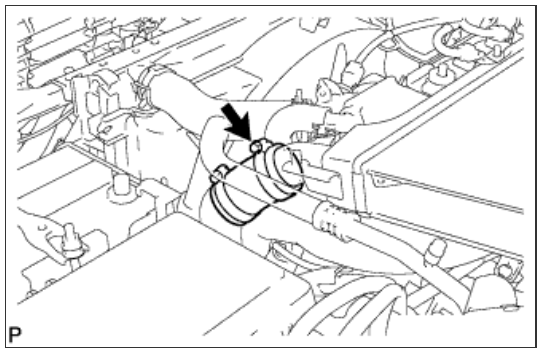


36. REMOVE INTERCOOLER ASSEMBLY (w/ Intercooler)

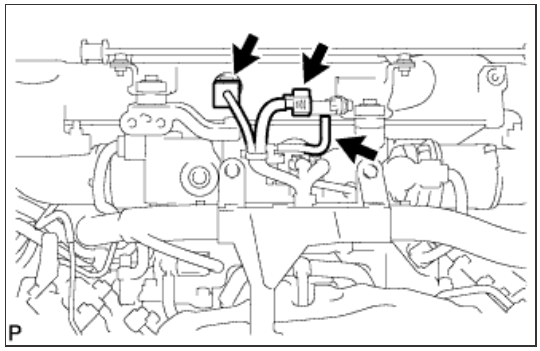
a. Loosen the No. 1 air hose clamp.



b. Loosen the No. 2 air hose clamp.



c. Disconnect the turbo pressure sensor connector, intake air temperature sensor connector and vacuum hose.



d. Remove the 6 nuts, 2 bolts and intercooler.

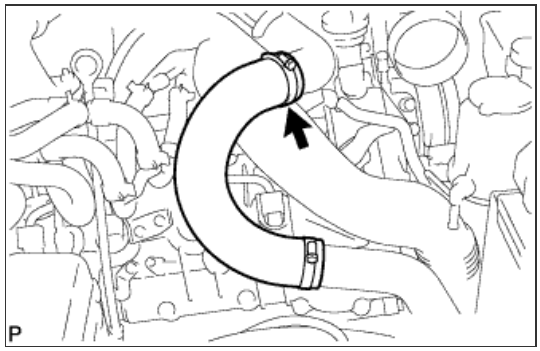
e. Remove the 2 gaskets from the air tube LH and RH.



3 . REMOVE NO. 1 COOL AIR INLET (w/o Intercooler)

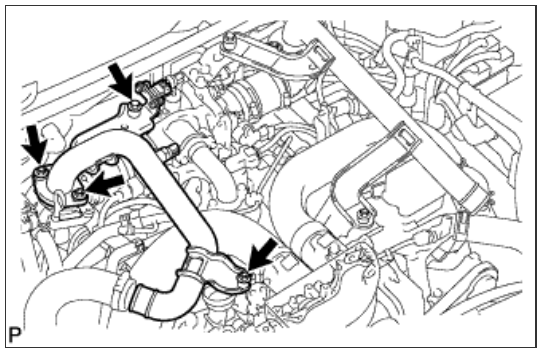
a. Loosen the No. 1 air hose clamp.

b. Disconnect the turbo pressure sensor connector, intake air temperature sensor connector and vacuum hose.



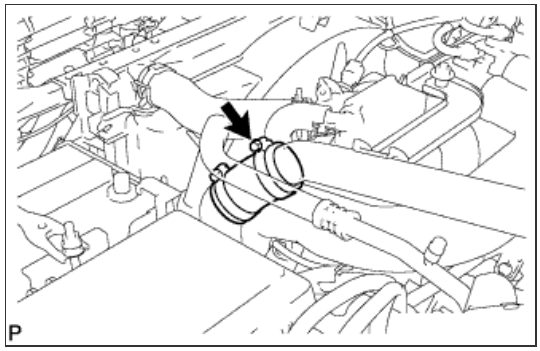
c. Remove the 3 nuts, bolt and No. 1 cool air inlet.

d. Remove the gasket from the air tube RH.



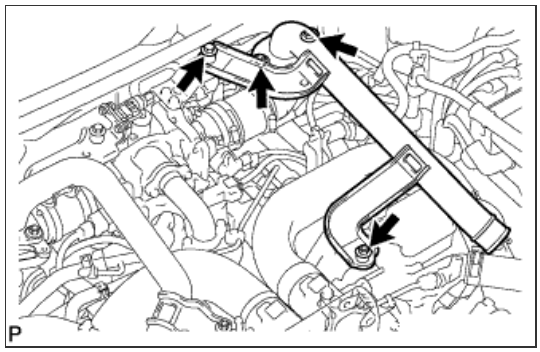
3 . REMOVE NO. 2 COOL AIR INLET (w/o Intercooler)

a. Loosen the No. 2 air hose clamp.



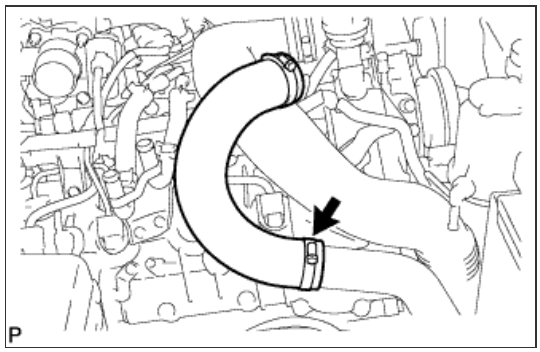
b. Remove the 3 nuts, bolt and No. 2 cool air inlet.

c. Remove the gasket from the air tube LH.



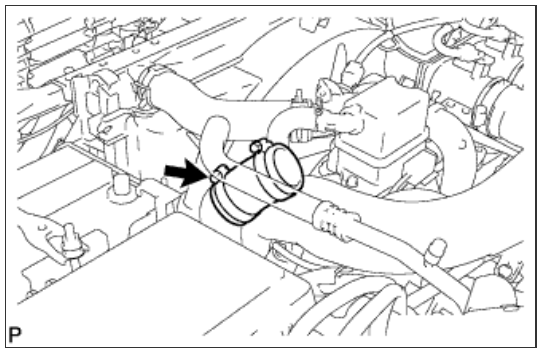
39. REMOVE NO. 1 AIR HOSE

a. Loosen the hose clamp and remove the No. 1 air hose.



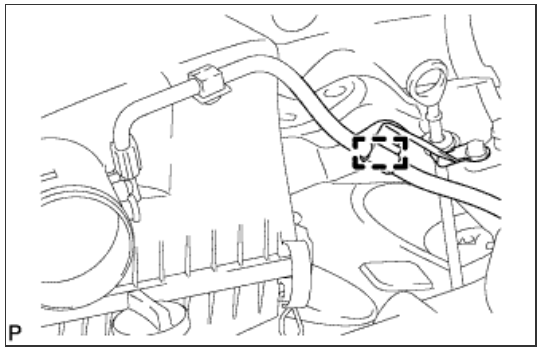
40. REMOVE NO. 2 AIR HOSE

a. Loosen the hose clamp and remove the No. 2 air hose.



1. REMOVE NO. 2 ENGINE OIL LEVEL DIPSTICK GUIDE

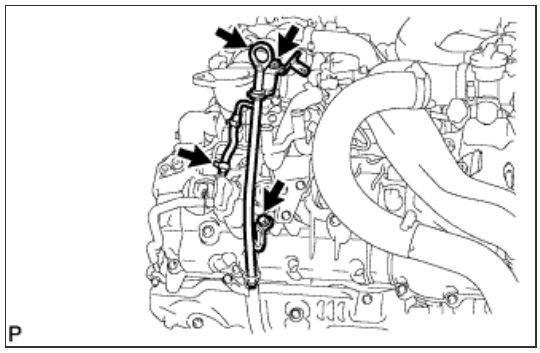
a. Disconnect the wire harness clamp from the No. 2 engine oil level dipstick guide.



b. Disconnect the ventilation hose from the cylinder head cover RH.

c. Remove the 2 bolts and No. 2 engine oil level dipstick guide.

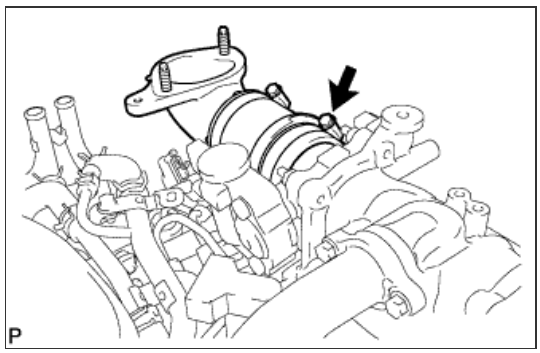
d. Remove the O-ring from the No. 2 engine oil level dipstick guide.



42. REMOVE AIR TUBE SUB-ASSEMBLY RH

a. Loosen the hose clamp.

b. Remove the air tube from the throttle body.



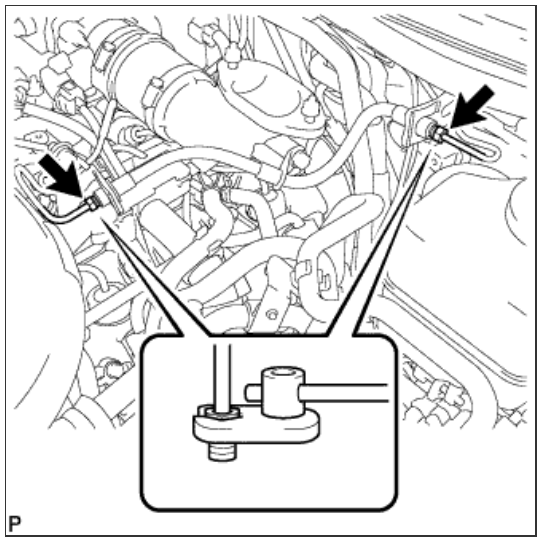
43. REMOVE CLUTCH HOSE (for Manual Transmission)

a. Disconnect the 2 flexible hose tubes from the clutch hose with a 10 mm union nut wrench while holding the flexible hose with a wrench.

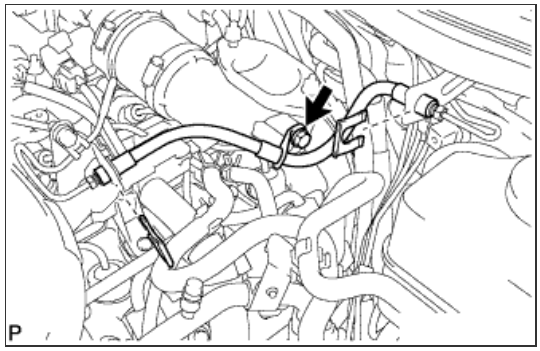
NOTICE:

- **Do not bend or damage the flexible hose tubes.**
- **Do not allow any foreign matter such as dirt and dust to enter the flexible hose tubes from the connecting point.**

b. Remove the 2 clips.



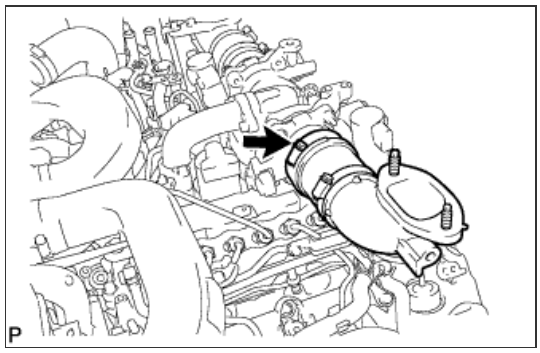
c. Remove the bolt and clutch hose.



44. REMOVE AIR TUBE SUB-ASSEMBLY LH

a. Loosen the hose clamp.

b. Remove the air tube from the throttle body.

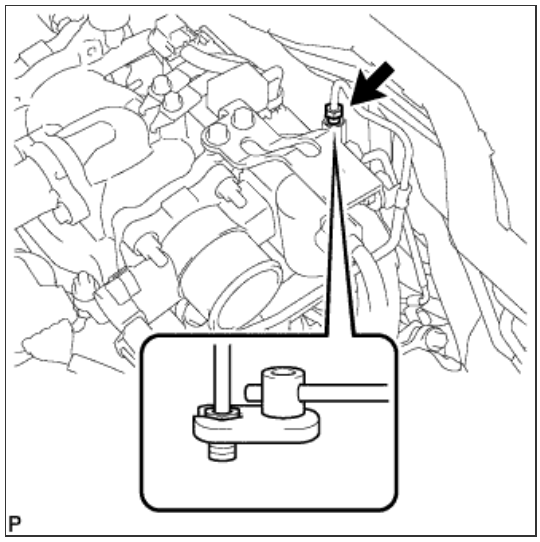


45. REMOVE TUBE CONNECTOR TO FLEXIBLE HOSE TUBE (for Manual Transmission)

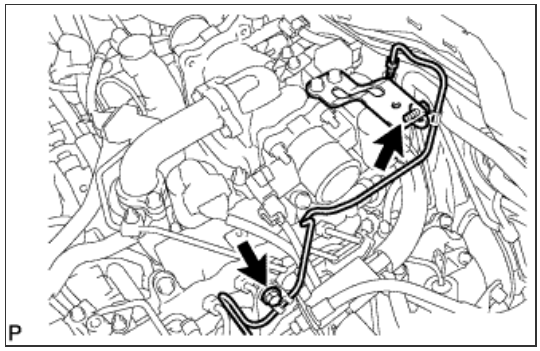
a. Using a 10 mm union nut wrench, disconnect the tube connector to flexible hose tube from the clutch tube to release cylinder 2 way.

NOTICE:

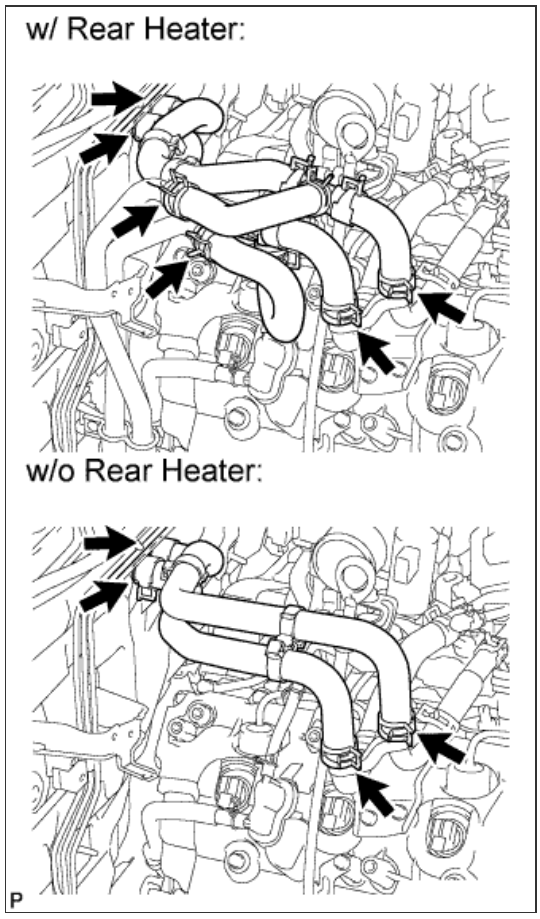
- **Do not bend or damage the flexible hose tube.**
- **Do not allow any foreign matter such as dirt and dust to enter the flexible hose tube from the connecting point.**



b. Remove the 2 bolts and tube connector to flexible hose tube.

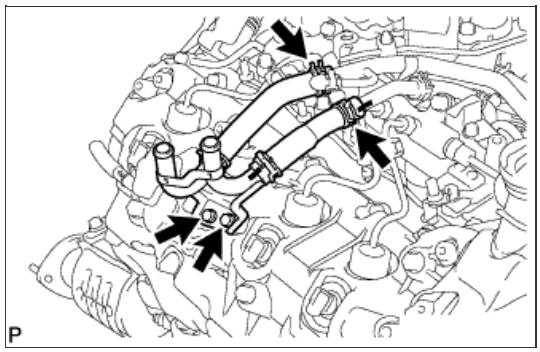


6. DISCONNECT WATER HOSE SUB-ASSEMBLY



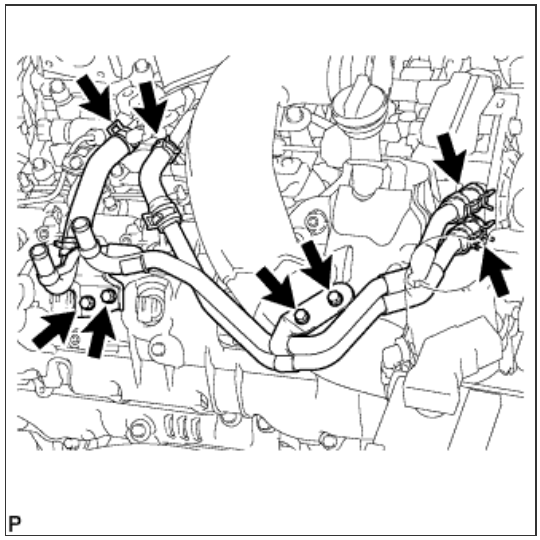
. REMOVE NO. 3 WATER BY PASS PIPE (w/o Viscous Heater)

a. Remove the 2 bolts and disconnect the 2 water hose ends, and then remove the No. 3 water by-pass pipe.



. REMOVE HEATER WATER PIPE SUB-ASSEMBLY (w/ Viscous Heater)

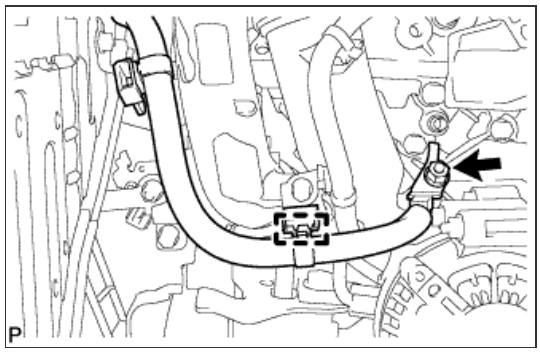
a. Remove the 4 bolts and disconnect the 4 water hose ends, and then remove the heater water pipe.



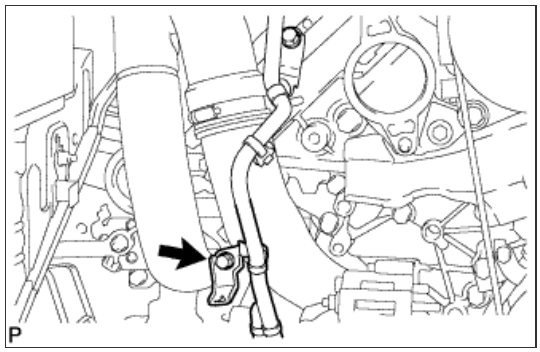
49. REMOVE NO. 3 AIR TUBE

a. Disconnect the wire harness from the clamp.

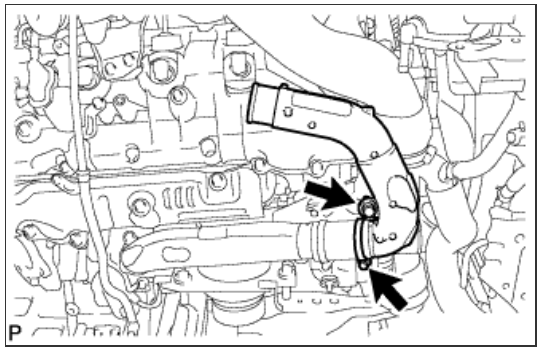
b. Remove the nut and ground wire.



c. Remove the bolt and disconnect the wire harness bracket.



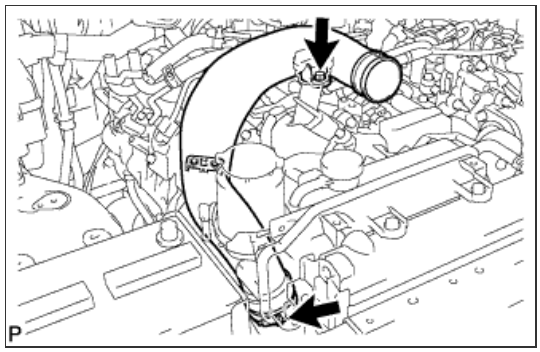
d. Loosen the hose clamp and remove the bolt and No. 3 air tube.



0. REMOVE NO. 1 AIR CLEANER PIPE SUB-ASSEMBLY

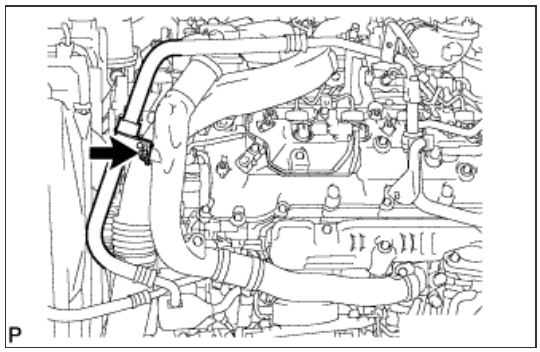
a. Loosen the hose clamp.

b. Remove the bolt and No. 1 air cleaner pipe.

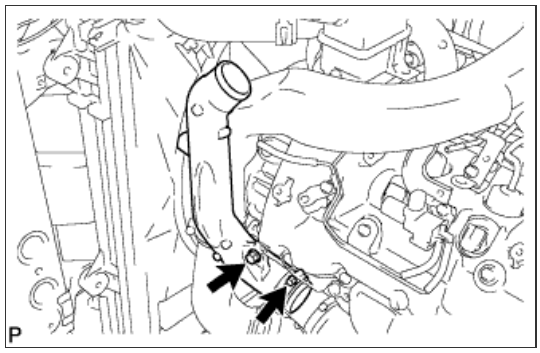


51. REMOVE NO. 4 AIR TUBE

a. Remove the bolt and disconnect the suction hose.



b. Loosen the hose clamp and remove the bolt and No. 4 air tube.

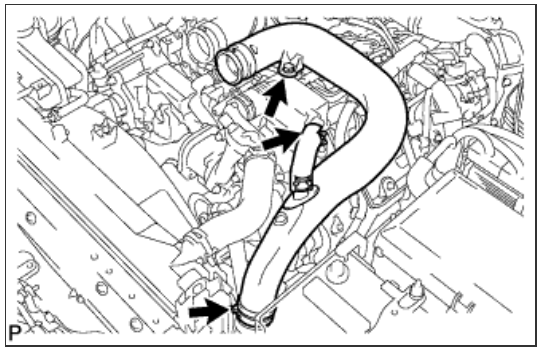


2. REMOVE NO. 2 AIR CLEANER PIPE SUB-ASSEMBLY

a. Disconnect the ventilation hose from the oil separator.

b. Loosen the hose clamp.

c. Remove the bolt and No. 2 air cleaner pipe.



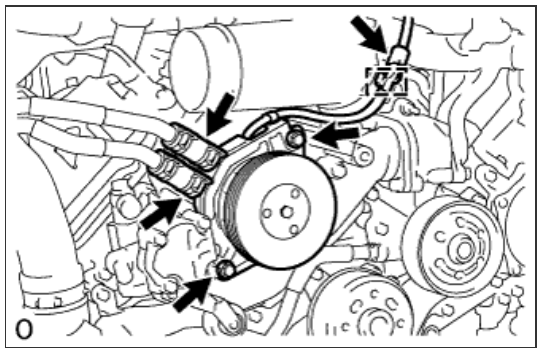
53. REMOVE VISCOUS HEATER ASSEMBLY WITH MAGNET CLUTCH (w/ Viscous Heater)

a. Disconnect the connector and detach the clamp.

b. Using pliers, grip the claws of the clips and slide the 2 clips.

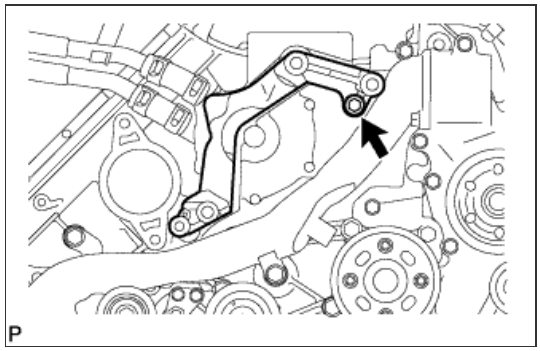
c. Disconnect the 2 heater hoses.

d. Remove the 2 bolts and heater assembly.



54. REMOVE NO. 1 IDLER PULLEY BRACKET (w/ Viscous Heater)

a. Remove the bolt and No. 1 idler pulley bracket.

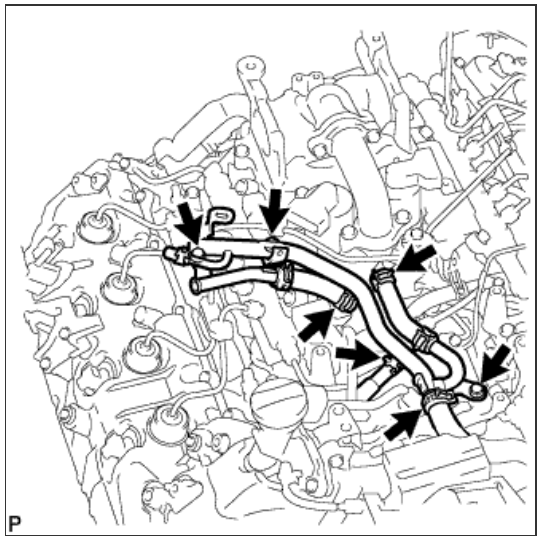


55. REMOVE NO. 4 WATER BY-PASS PIPE

a. w/ EGR System:

i. Remove the 2 bolts and nut.

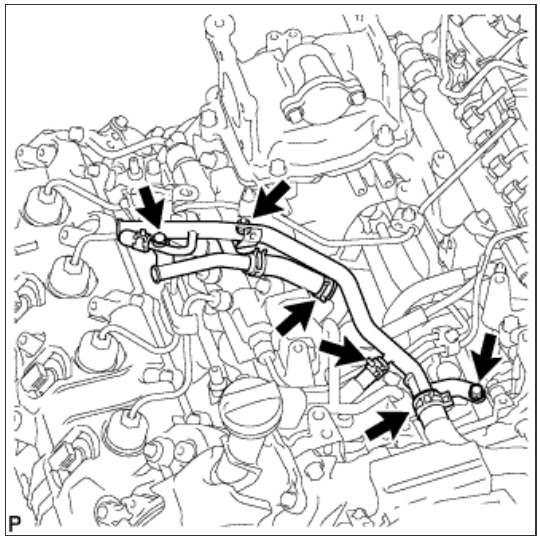
ii. Disconnect the 4 water hose ends, and then remove the No. 4 water by-pass pipe.



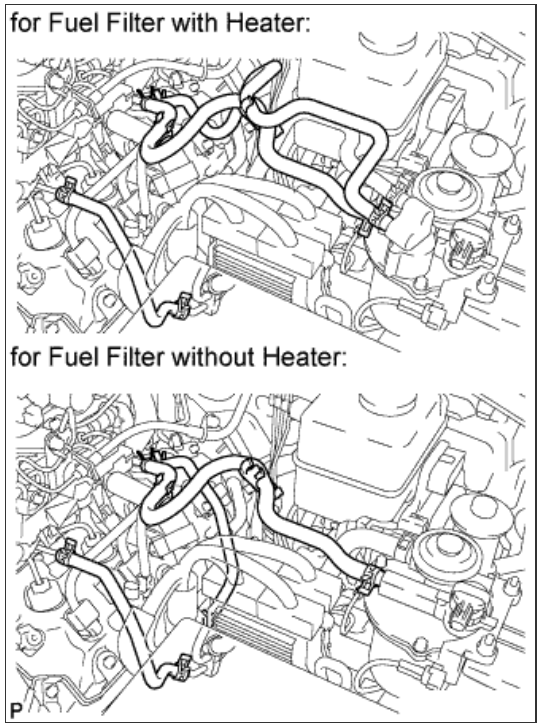
b. w/o EGR System:

i. Remove the 2 bolts and nut.

ii. Disconnect the 3 water hose ends, and then remove the No. 4 water by-pass pipe.



6. DISCONNECT FUEL HOSE



. DISCONNECT ENGINE WIRE

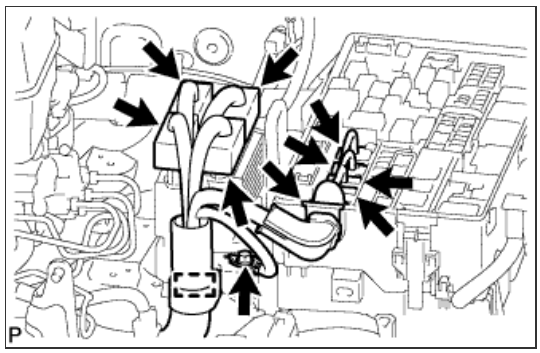
a. LH Side:

i. Disconnect the 4 connectors from the injector driver.

ii. Remove the 4 connectors and detach the wire harness holder from the relay block.

iii. Remove the bolt and disconnect the ground wire.

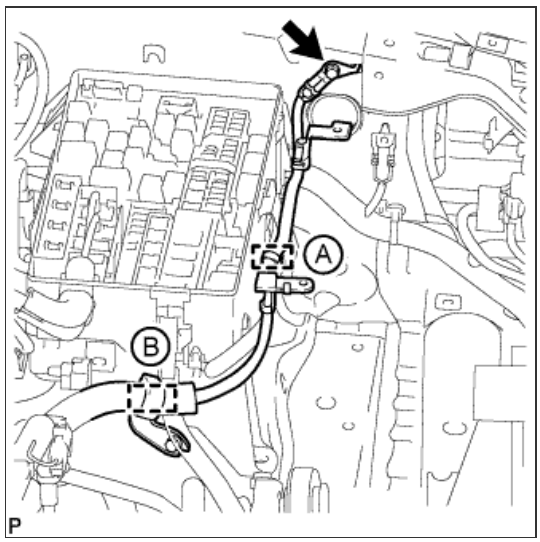
iv. Disconnect the wire harness from the wire harness clamp holder.



v. Remove the bolt and disconnect the ground wire from the body panel.

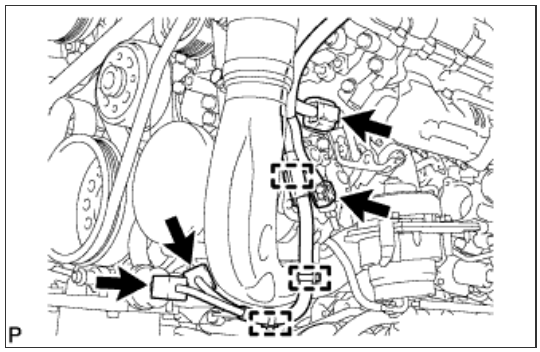
vi. Using a clip remover, detach the ground wire clamp labeled A from the relay block side.

vii. Disconnect the wire harness from the wire harness clamp holder labeled B.



viii. Disconnect the 4 connectors.

ix. Using a clip remover, detach the 3 wire harness clamps.



x. Disconnect the 2 connectors.

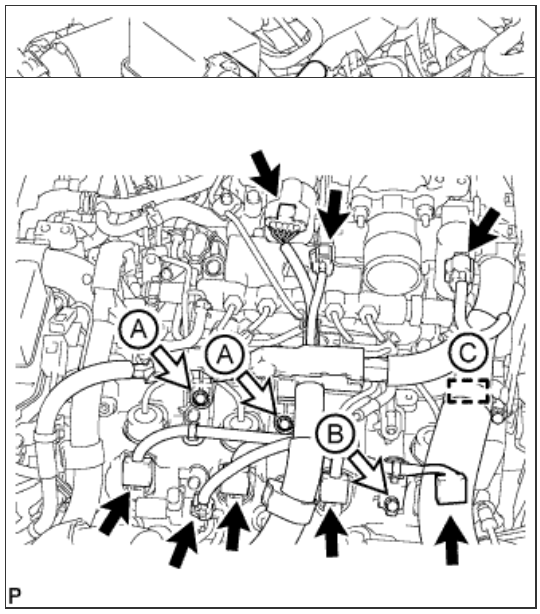
xi. Using a clip remover, detach the 3 wire harness clamps.

xii. Disconnect the connectors.

xiii. Remove the 2 bolts labeled A and disconnect the engine wire protector.

xiv. Remove the bolt labeled B and engine wire harness bracket.

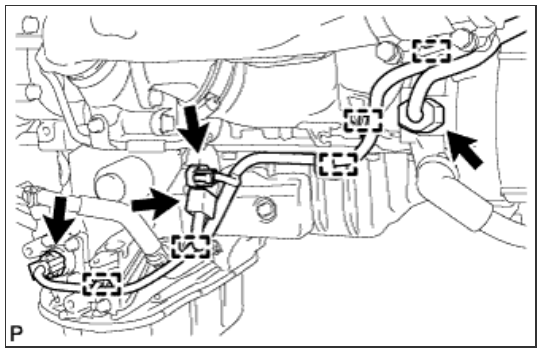
xv. for RHD:
Disconnect the wire harness from the wire harness clamp holder labeled C.



b. RH Side:

i. Disconnect the 4 connectors.

ii. Using a clip remover, detach the wire harness clamps.



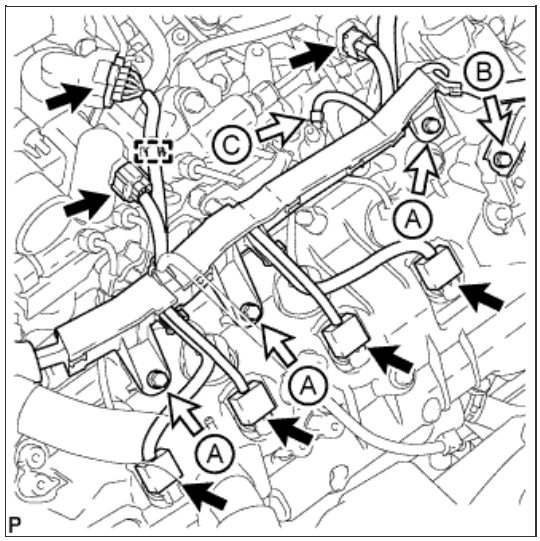
iii. Disconnect the 7 connectors.

iv. Using a clip remover, detach the wire harness clamp.

v. Remove the 3 bolts labeled A and disconnect the wire harness protector.

vi. Remove the bolt labeled B and wire harness bracket.

vii. Remove the nut labeled C and glow plug wire harness.

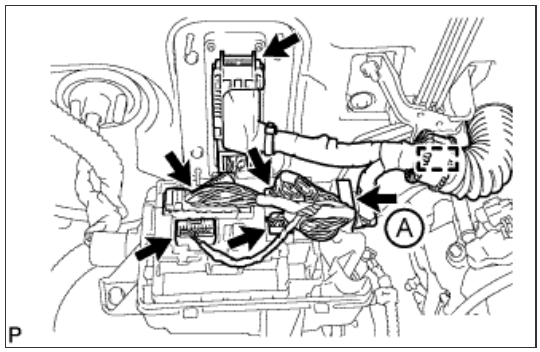


c. for LHD:

i. Disconnect the 4 connectors, and detach the wire harness tab labeled A from the relay block.

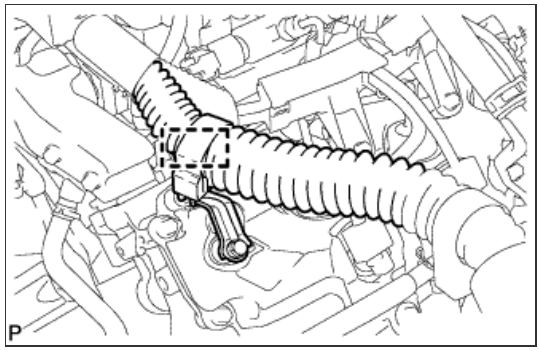
ii. Disconnect the ECM connector.

iii. Disconnect the wire harness from the wire harness clamp holder.



d. for RHD:

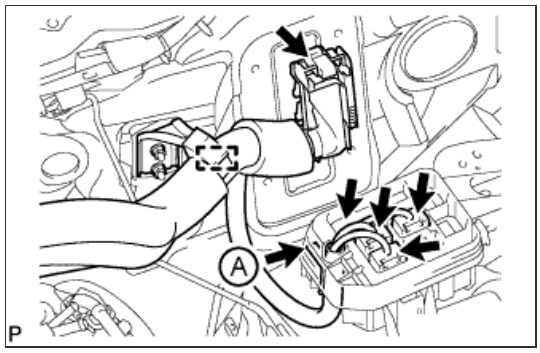
i. Disconnect the wire harness from the wire harness clamp holder.



ii. Disconnect the 4 connectors, and detach the wire harness tab labeled A from the relay block.

iii. Disconnect the ECM connector.

iv. Disconnect the wire harness from the wire harness clamp holder.



. REMOVE NO. 2 FUEL PIPE SUB-ASSEMBLY

NOTICE:

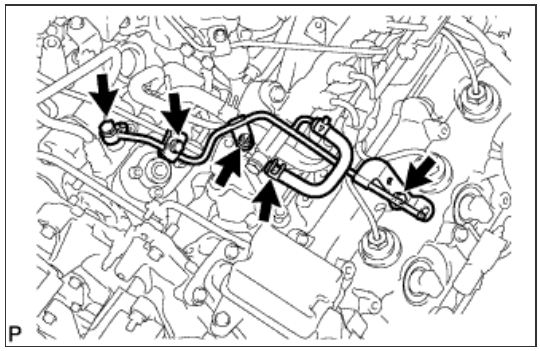
- **After removing a fuel pipe, to prevent dirt or foreign objects from entering the fuel pipe ends, cover the fuel pipe ends with plastic bags.**
- **After removing a fuel pipe, to prevent dirt or foreign objects from entering the fuel supply pump hole, cover the hole with protective tape.**

a. Disconnect the fuel hose from the No. nozzle leakage pipe.

b. Remove the bolt and No. 2 injection pipe clamp.

c. Remove the union bolt and gasket.

d. Remove the bolt, nut and No. 2 fuel pipe.



59. REMOVE NO. 6 INJECTION PIPE SUB-ASSEMBLY

NOTICE:

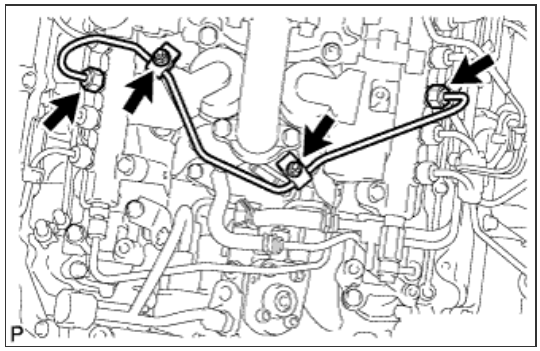
After removing an injection pipe, to prevent dirt or foreign objects from entering the common rail holes, cover the holes with protective tape.

a. w/ EGR System:

i. Using a union nut wrench, loosen the No. 6 injection pipe ends.

ii. Remove the 2 nuts and 2 No. 2 injection pipe clamps.

iii. Remove the No. 6 injection pipe.

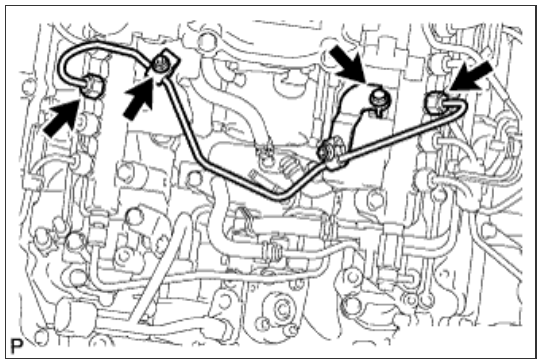


b. w/o EGR System:

i. Using a union nut wrench, loosen the No. 6 injection pipe ends.

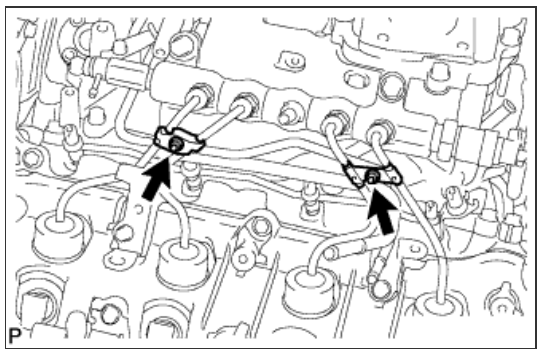
ii. Remove the nut and No. 2 injection pipe clamp.

iii. Remove the bolt and No. 6 injection pipe.



60. REMOVE INJECTION PIPE LH

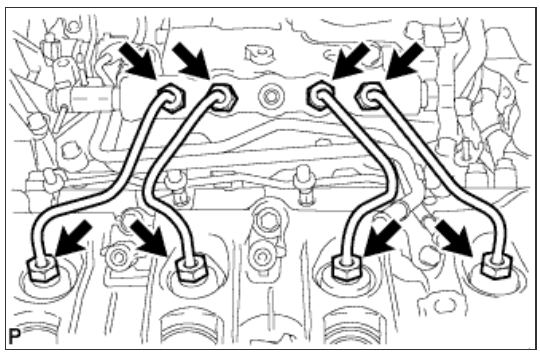
a. w/ Intercooler:
Remove the 2 nuts and 4 injection pipe clamps.



b. Using a union nut wrench, remove the 4 injection pipes.

NOTICE:

After removing an injection pipe, to prevent dirt or foreign objects from entering the common rail holes or injector holes, cover the holes with protective tape.

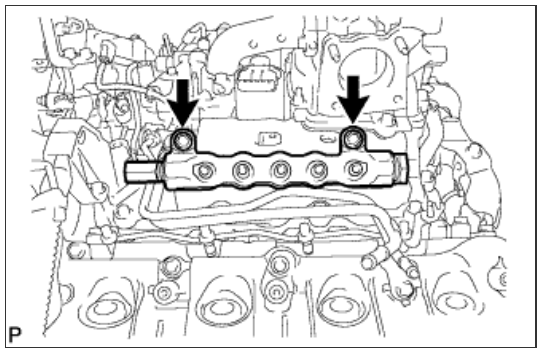


61. REMOVE COMMON RAIL ASSEMBLY LH

a. Remove the 2 bolts and common rail.

NOTICE:

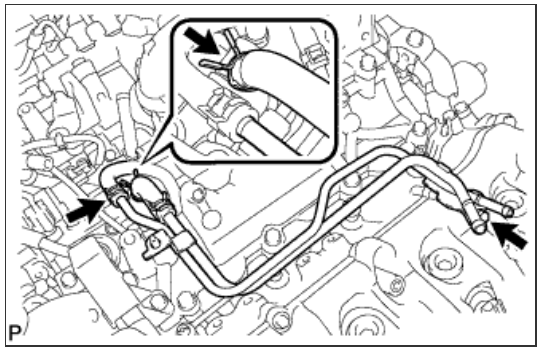
Do not remove the fuel pressure limiter from the common rail. If it is removed, replace the common rail.



62. REMOVE FUEL FILTER TO INJECTION PUMP FUEL PIPE SUB-ASSEMBLY

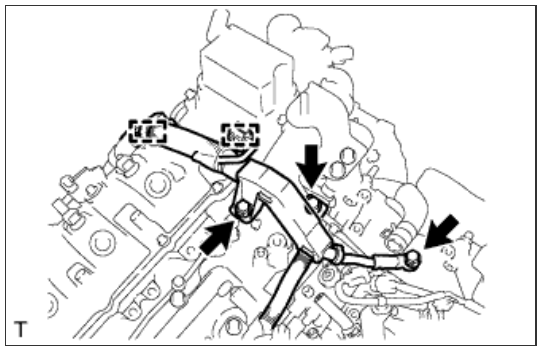
a. Disconnect the 2 hoses from the fuel pipe.

b. Remove the bolt and fuel filter to injection pump fuel pipe.



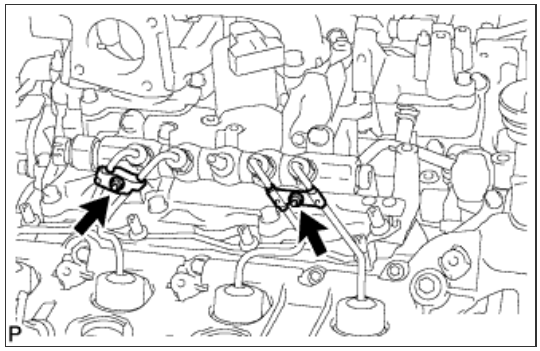
63. DISCONNECT NO. 2 ENGINE WIRE

a. Remove the 3 bolts and using a clip remover, detach the 2 wire harness clamps, and then disconnect the No. 2 engine wire.



64. REMOVE INJECTION PIPE RH

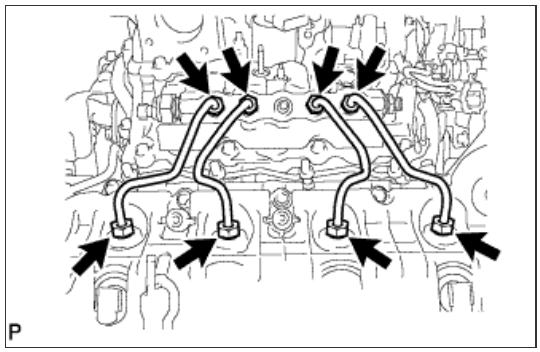
a. w/ Intercooler:
Remove the 2 nuts and 4 injection pipe clamps.



b. Using a union nut wrench, remove the 4 injection pipes.

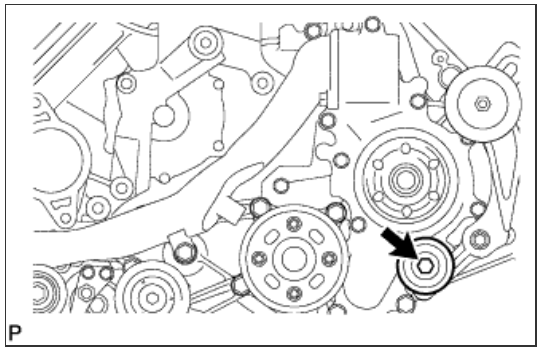
NOTICE:

After removing an injection pipe, to prevent dirt or foreign objects from entering the common rail holes or injector holes, cover the holes with protective tape.



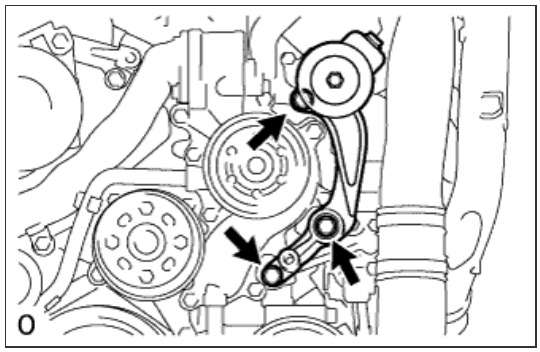
6 . REMOVE NO. 2 IDLER PULLEY (w/ Viscous Heater)

a. Remove the bolt and No. 2 idler pulley.



66. REMOVE NO. 2 IDLER PULLEY BRACKET (w/ Viscous Heater)

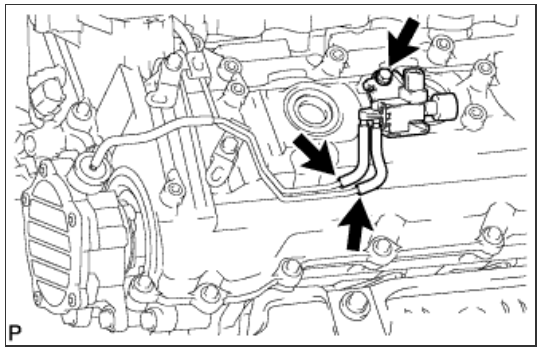
a. Remove the 3 bolts and idler pulley bracket.



67. REMOVE NO. 1 VACUUM SWITCHING VALVE ASSEMBLY (w/ Intercooler)

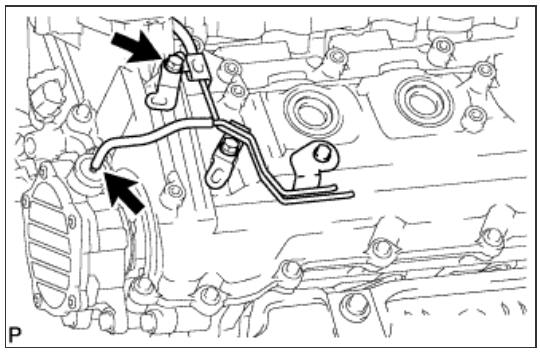
a. Disconnect the 2 vacuum hoses.

b. Remove the bolt and vacuum switching valve.

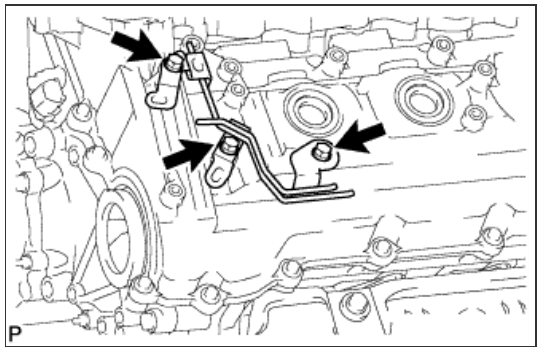


68. REMOVE NO. 1 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY

a. w/ Intercooler:
Disconnect the 2 vacuum hoses.



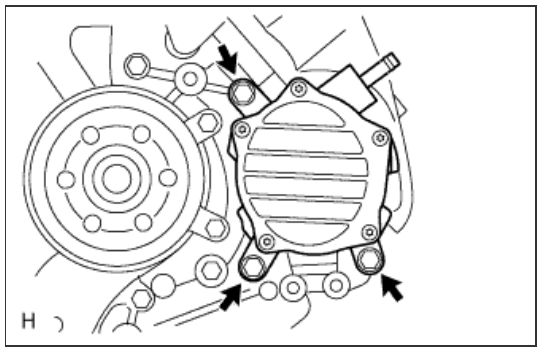
b. Remove the 3 bolts and vacuum transmitting pipe.



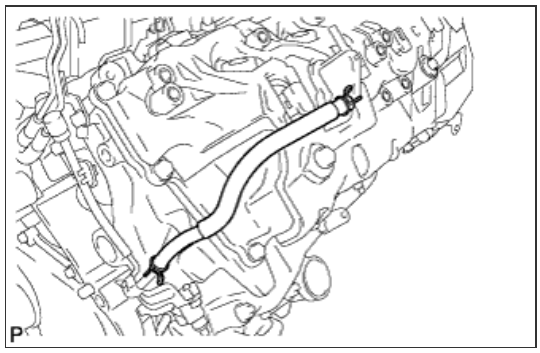
6 . REMOVE VACUUM PUMP ASSEMBLY (w/ Intercooler)

a. Remove the 3 bolts and vacuum pump.

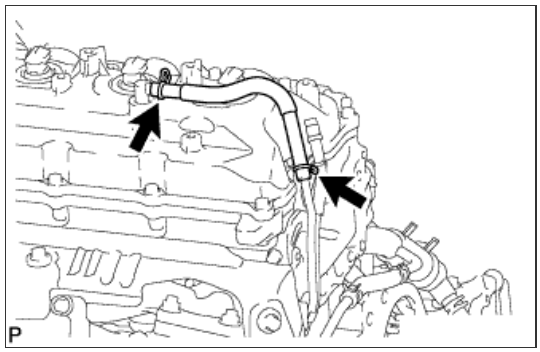
b. Remove the 2 O-rings.



70. DISCONNECT NO. 2 VENTILATION HOSE

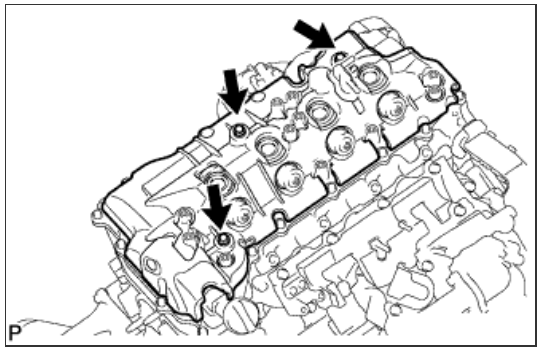


71. DISCONNECT NO. 3 VENTILATION HOSE



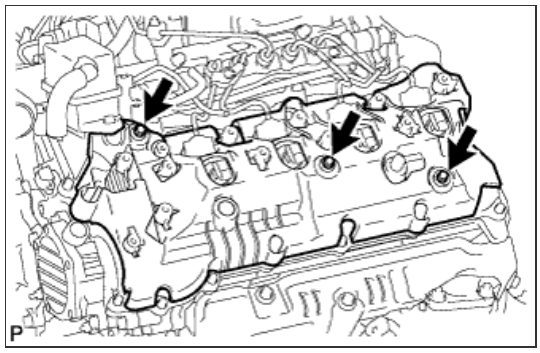
2. REMOVE CYLINDER HEAD COVER SILENCER RH (w/ Intercooler)

a. Remove the 3 bolts and cylinder head cover silencer.



73. REMOVE CYLINDER HEAD COVER SILENCER LH (w/ Intercooler)

a. Remove the 3 bolts and cylinder head cover silencer.

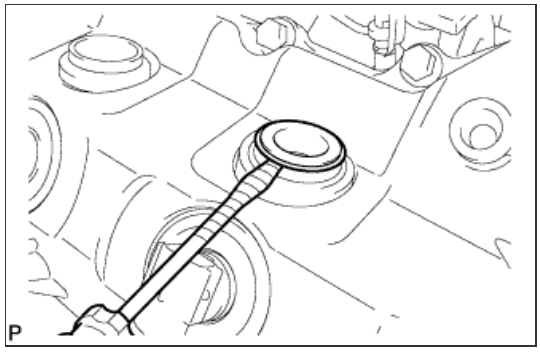


74. REMOVE NOZZLE HOLDER SEAL RH

a. Using a small screwdriver, remove the 4 holder seals by prying the portion between each holder seal and the cutout part of the cylinder head cover.

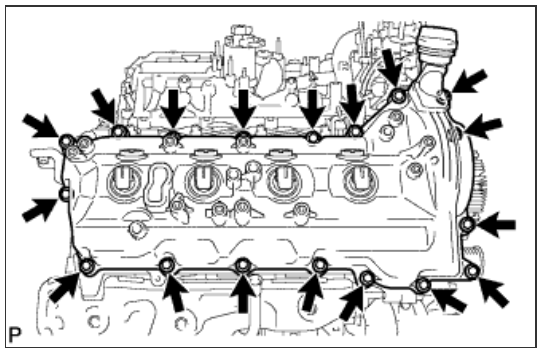
HINT:

Tape the screwdriver tip before use.



75. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY RH

a. Remove the 1 bolts, cylinder head cover and gasket.

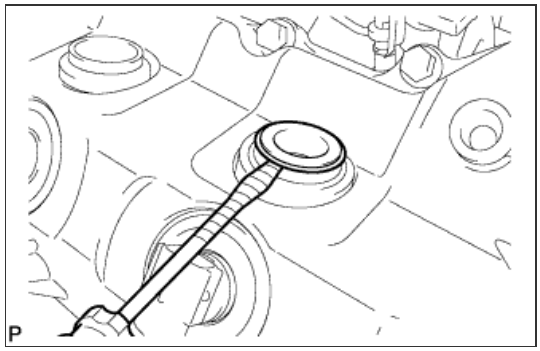


6. REMOVE NO LE HOLDER GASKET RH

a. Using a small screwdriver, remove the 4 holder seals by prying the portion between each holder seal and the cutout part of the cylinder head cover.

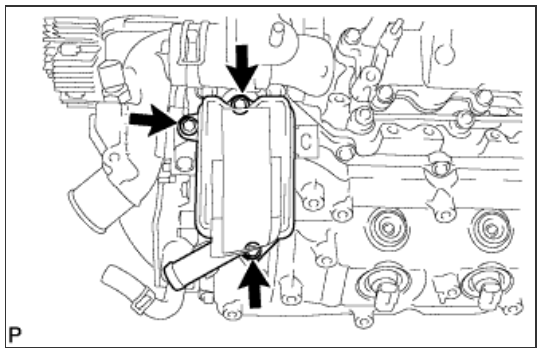
HINT:

Tape the screwdriver tip before use.



77. REMOVE OIL SEPARATOR ASSEMBLY

a. Remove the 3 bolts, oil separator and gasket.

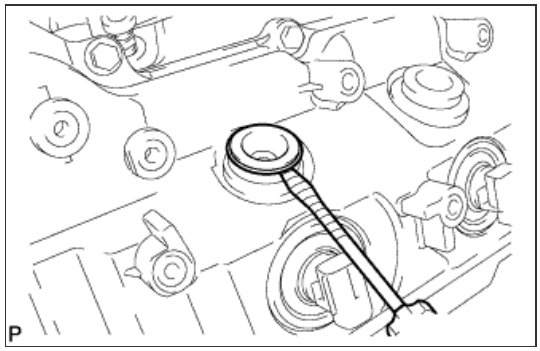


78. REMOVE NOZZLE HOLDER SEAL LH

a. Using a small screwdriver, remove the 4 holder seals by prying the portion between each holder seal and the cutout part of the cylinder head cover.

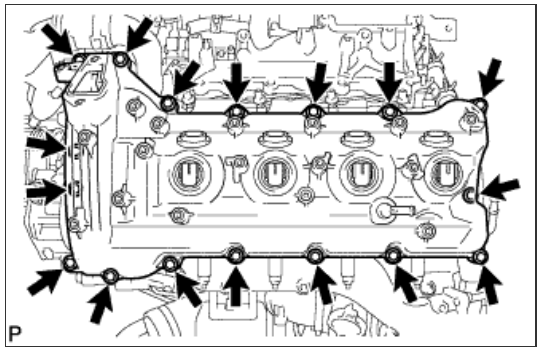
HINT:

Tape the screwdriver tip before use.



. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY LH

a. Remove the 17 bolts, cylinder head cover and gasket.

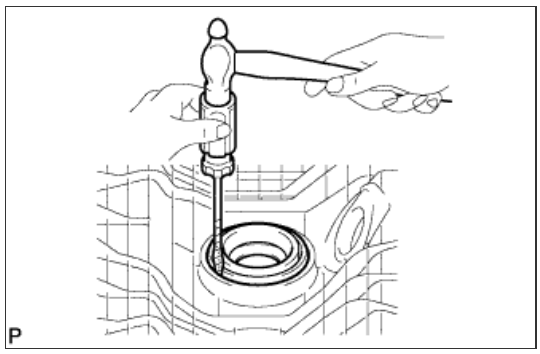


80. REMOVE NOZZLE HOLDER GASKET LH

a. Using a small screwdriver and hammer, remove the 4 nozzle holder gaskets.

HINT:

Tape the screwdriver tip before use.

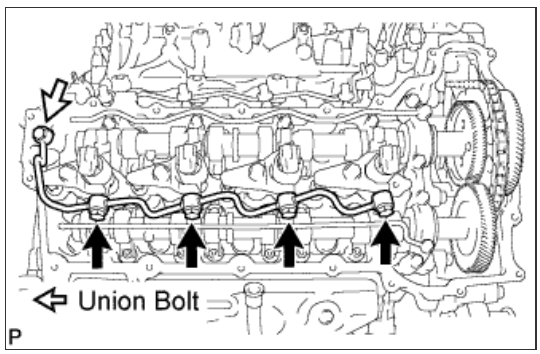


81. REMOVE FUEL INJECTOR RH

a. Remove the union bolt, 4 hollow screws, gaskets and nozzle leakage pipe.

NOTICE:

- **When removing the nozzle leakage pipe, place a cushion under the pipe.**
- **Be careful not to deform or scratch the union seal surface.**
- **After removing the nozzle leakage pipe, put it in a plastic bag to prevent foreign matter from contaminating its injector inlet.**



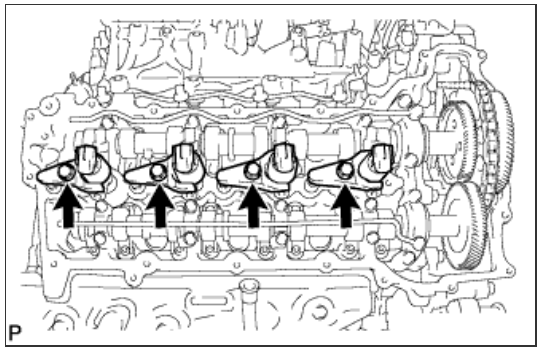
b. Remove the 4 bolts, 4 washers, 4 nozzle holder clamps and 4 injectors.

HINT:

Arrange the injectors, holder clamps, washers and bolts in the correct order.

c. Remove the O-ring from each injector.

d. Remove the 4 injection nozzle seats from the cylinder head.

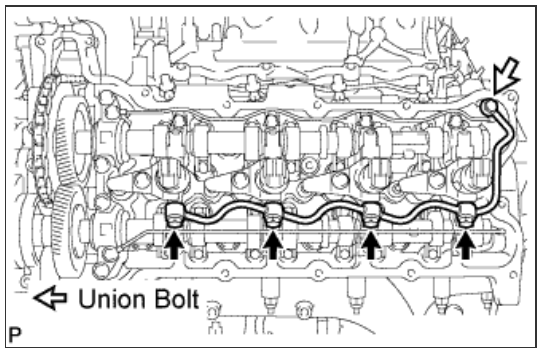


82. REMOVE FUEL INJECTOR LH

a. Remove the union bolt, 4 hollow screws, gaskets and No. 2 nozzle leakage pipe.

NOTICE:

- **When removing the nozzle leakage pipe, place a cushion under the pipe.**
- **Be careful not to deform or scratch the union seal surface.**
- **After removing the nozzle leakage pipe, put it in a plastic bag to prevent foreign matter from contaminating its injector inlet.**



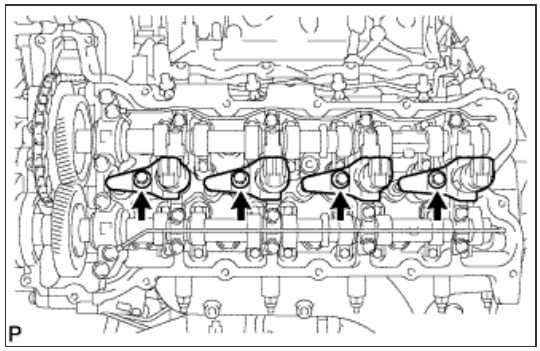
b. Remove the 4 bolts, 4 washers, 4 nozzle holder clamps and 4 injectors.

HINT:

Arrange the injectors, holder clamps, washers and bolts in the correct order.

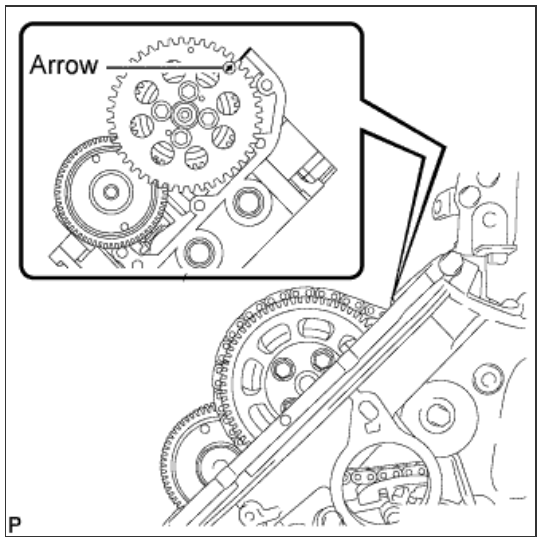
c. Remove the O-ring from each injector.

d. Remove the 4 injection nozzle seats from the cylinder head.

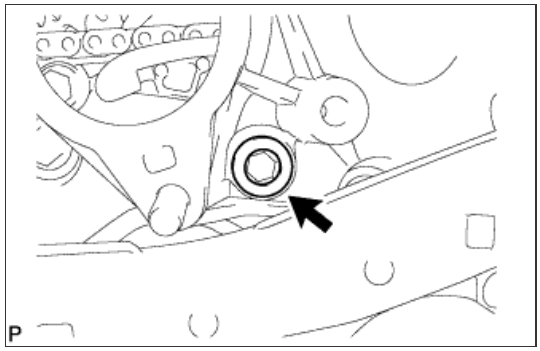


83. REMOVE NO. 1 AND NO. 2 CAMSHAFTS

a. Rotate the crankshaft clockwise, and align the No. 1 camshaft timing sprocket arrow with the cylinder head upper surface.



b. Using a 10 mm hexagon wrench, remove the taper screw plug.



c. Fix the No. 1 chain tensioner in place.

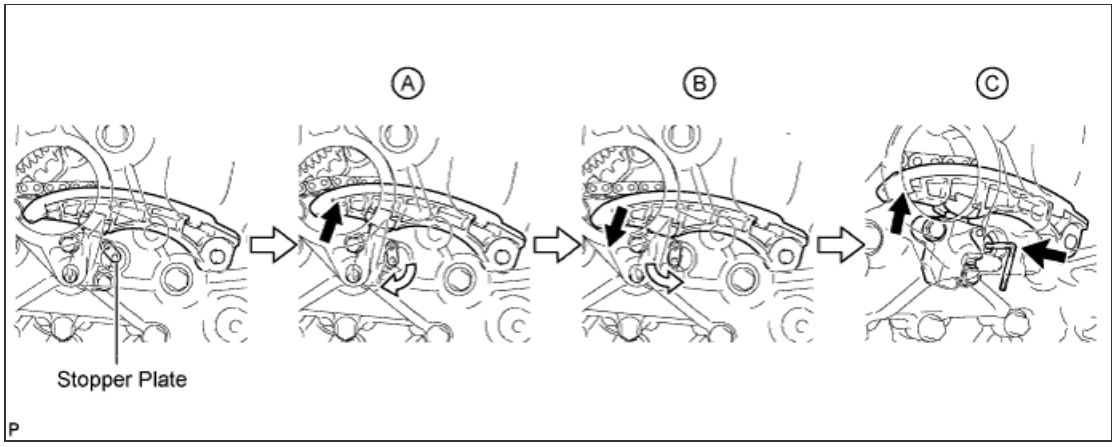
i. Push the tensioner slipper away from the tensioner, and move the stopper plate clockwise to release the lock as shown in A.

ii. Push down the tensioner slipper and move the stopper plate counterclockwise to set the lock as shown in B.

iii. Push the tensioner slipper away from the tensioner, and insert a hexagon wrench into the stopper plate hole as shown in C.

NOTICE:

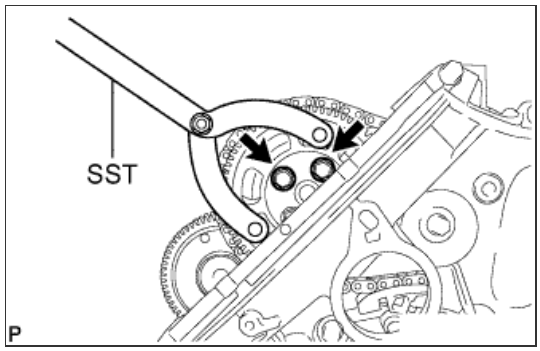
Do not drop the hexagon wrench into the engine.



d. Using SST, hold the pump drive shaft gear.

SST

0 60 10010 (0 62-01000, 09963-01000)

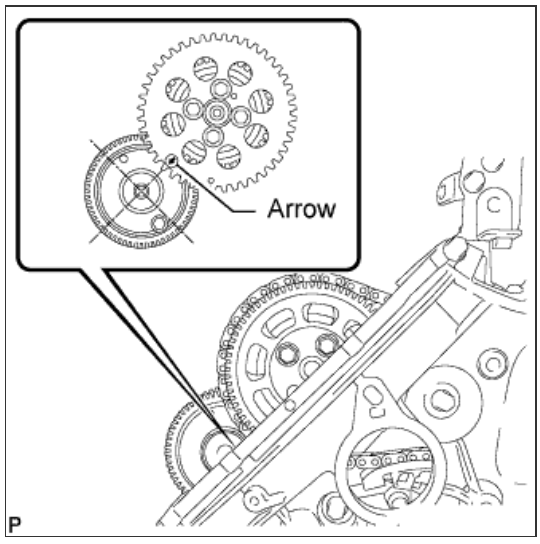


e. Remove the 2 bolts.

f. Rotate the crankshaft clockwise 360° so that the No. 1 camshaft timing sprocket arrow points at the No. 1 camshaft center.

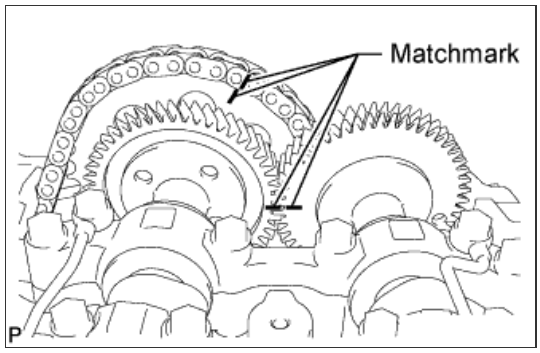
NOTICE:

Do not rotate the crankshaft counterclockwise in order to align the sprocket arrow and camshaft center.



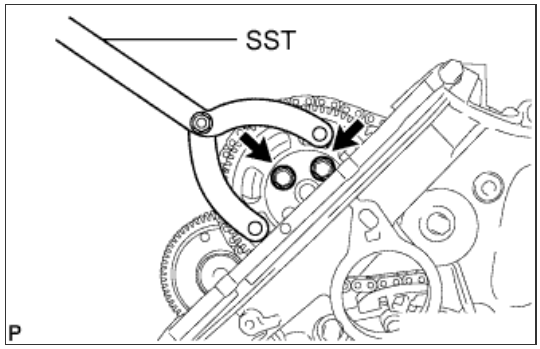
g. Place matchmarks on the No. 1 timing chain and No. 1 camshaft timing sprocket.

h. Place matchmarks on the No. 1 and No. 2 camshaft gears.



i. Using SST, hold the pump drive shaft gear.

SST
0 60 10010 (0 62-01000, 09963-01000)



j. Remove the 2 bolts and pump drive shaft gear.

k. Disconnect the No. 1 timing chain and No. 1 camshaft timing sprocket from the No. 2 camshaft.

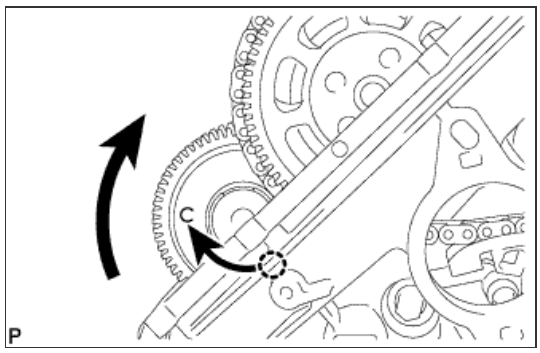
NOTICE:

- **Do not remove the No. 1 camshaft timing sprocket from the No. 1 timing chain.**
- **Do not rotate the crankshaft until the No. 1 timing chain and No. 1 camshaft timing sprocket are connected to the No. 2 camshaft.**

HINT:

If fixing the No. 1 camshaft timing sprocket in place, pass a rope or e uivalent through one of the No. 1 camshaft timing sprocket holes and tie the sprocket and chain together.

l. Turn the No. 1 camshaft clockwise so that the bolt is easier to install.



m. Using a 6 mm x 1.0 pitch service bolt with a length of 16 mm or more, fix the No. 1 camshaft in place.

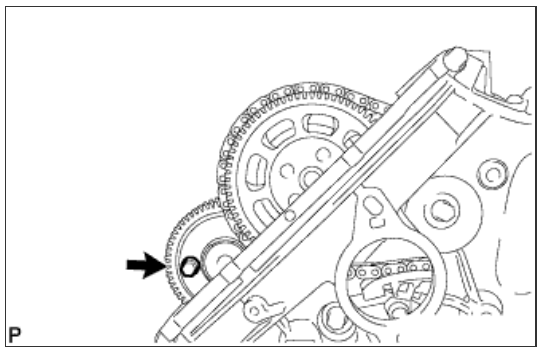
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

NOTICE:

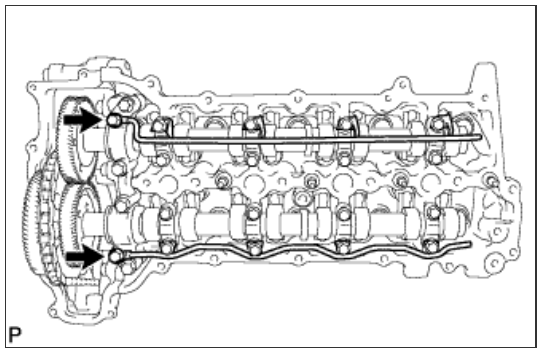
Do not drop the bolt into the engine.

HINT:

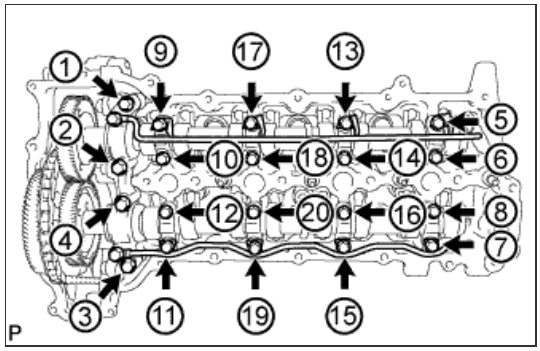
If it is difficult to install the bolt, rotate the camshaft so that the bolt is easier to install.



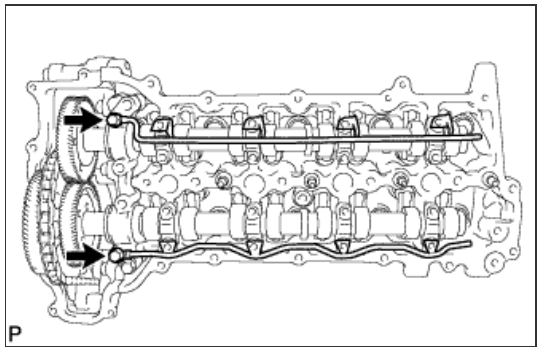
n. Loosen the 2 union bolts.



o. Uniformly loosen and remove the 20 bolts in the se uence shown in the illustration.



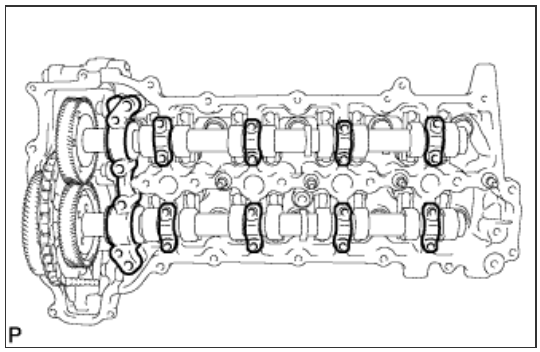
p. Remove the 2 union bolts and No. 1 and No. 2 oil feed pipes.



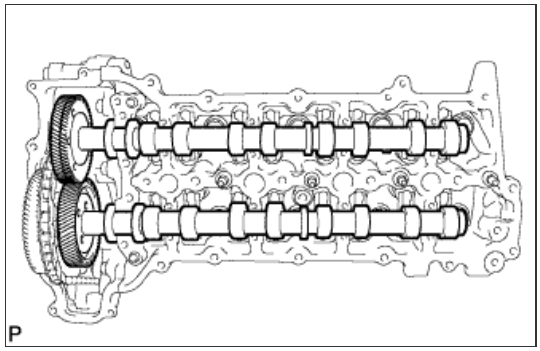
q. Remove the No. 3 camshaft bearing caps and No. 1 camshaft bearing cap.

HINT:

Be sure to arrange the removed parts for each installation position separately.

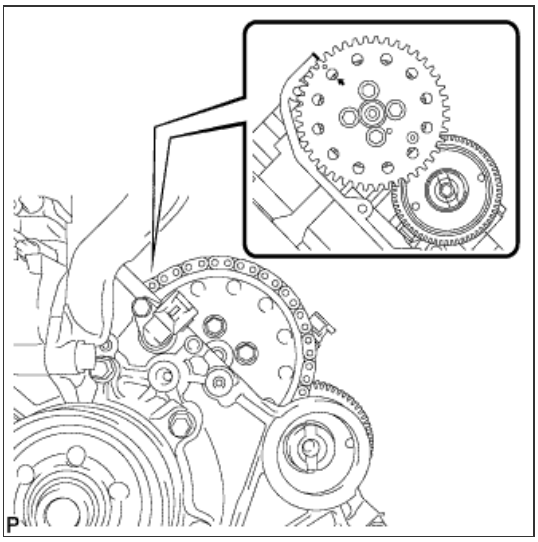


r. Remove the No. 1 and No. 2 camshafts.

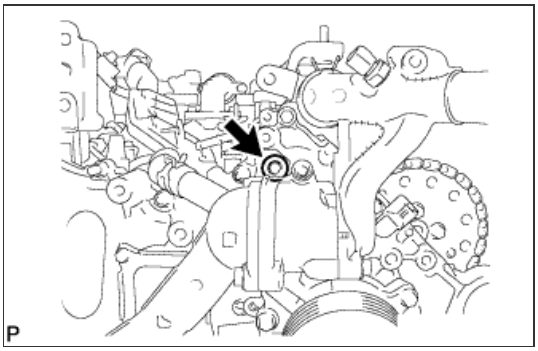


. REMOVE NO. 3 AND NO. 4 CAMSHAFTS

a. Rotate the crankshaft clockwise, and align the No. 2 camshaft timing sprocket arrow with the cylinder head upper surface.



b. Using a 10 mm hexagon wrench, remove the taper screw plug.



c. Fix the No. 2 chain tensioner in place.

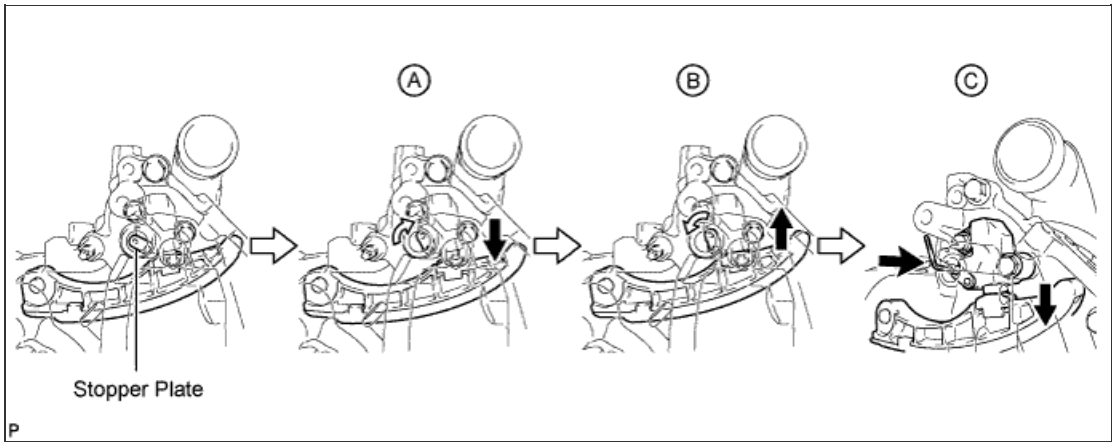
i. Push the tensioner slipper away from the tensioner, and move the stopper plate clockwise to release the lock as shown in A.

ii. Push up the tensioner slipper and move the stopper plate counterclockwise to set the lock as shown in B.

iii. Push the tensioner slipper away from the tensioner, and insert a hexagon wrench into the stopper plate hole as shown in C.

NOTICE:

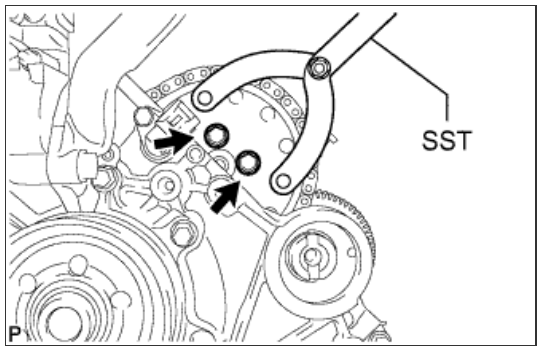
Do not drop the hexagon wrench into the engine.



d. Using SST, hold the No. 2 camshaft timing sprocket.

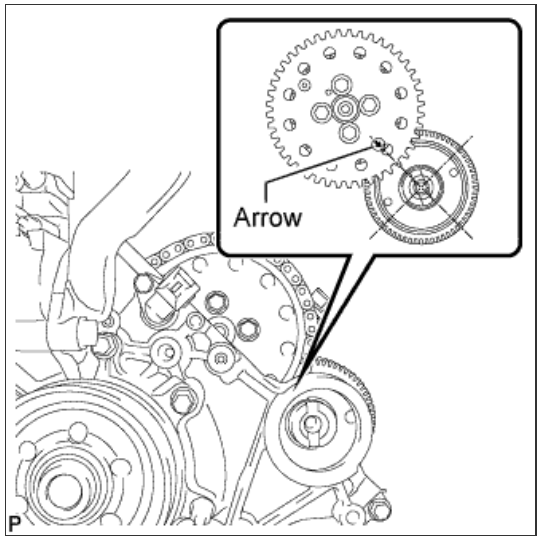
SST

0 60 10010 (0 62-01000, 09963-01000)



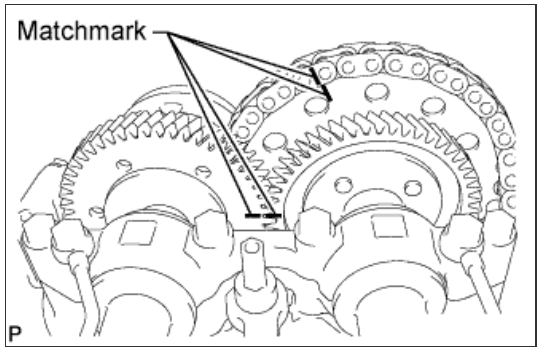
e. Remove the 2 bolts.

f. Rotate the crankshaft clockwise 360° so that the No. 2 camshaft timing sprocket arrow points at the No. 4 camshaft center.



g. Place matchmarks on the No. 2 timing chain and No. 2 camshaft timing sprocket.

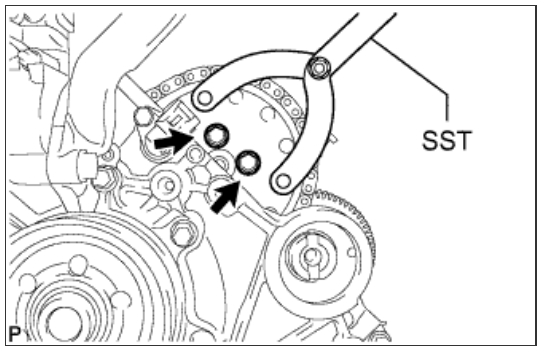
h. Place matchmarks on the No. 3 and No. 4 camshaft gears.



i. Using SST, hold the No. 2 camshaft timing sprocket.

SST

09960-10010 (09962-01000, 09963-01000)



j. Remove the 2 bolts, and disconnect the No. 2 timing chain and No. 2 camshaft timing sprocket from the No. 3 camshaft.

NOTICE:

- **Do not remove the No. 2 camshaft timing sprocket from the No. 2 timing chain.**
- **Do not rotate the crankshaft until the No. 2 timing chain and No. 2 camshaft timing sprocket are connected to the No. 3 camshaft.**

HINT:

If fixing the No. 2 camshaft timing sprocket in place, pass a rope or e uivalent through one of the No. 2 camshaft timing sprocket holes and tie the sprocket and chain together.

k. Using a 6 mm x 1.0 pitch service bolt with a length of 16 mm or more, fix the No.

4 camshaft in place.

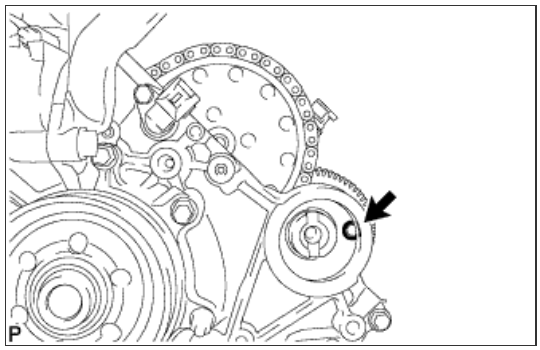
Torque:
.0 N m{ 82 kgf*cm , 71 in.*lbf }

NOTICE:

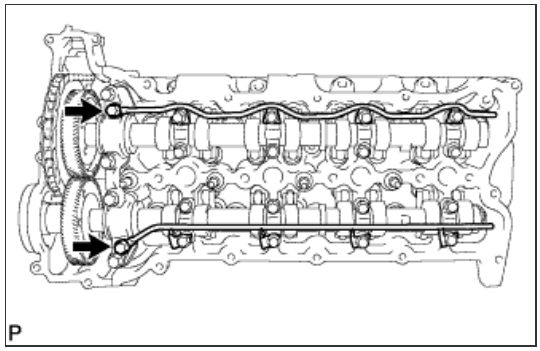
Do not drop the bolt into the chain cover.

HINT:

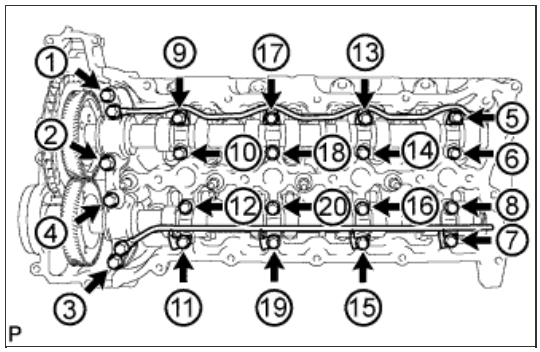
If it is difficult to install the bolt, rotate the camshaft so that the bolt is easier to install.



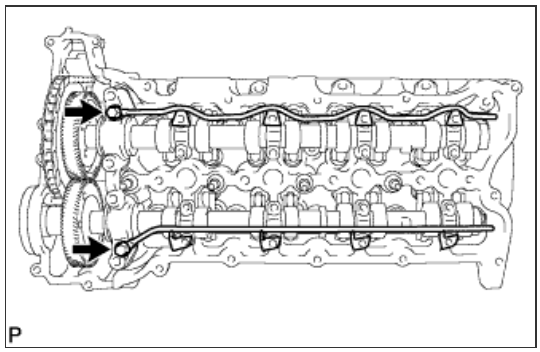
l. Loosen the 2 union bolts.



m. Uniformly loosen and remove the 20 bolts in the se uence shown in the illustration.



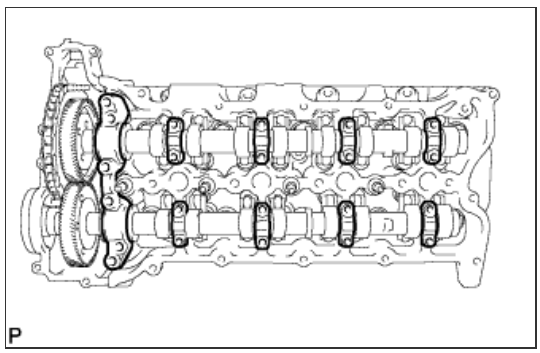
n. Remove the 2 union bolts and No. 3 and No. 4 oil feed pipes.



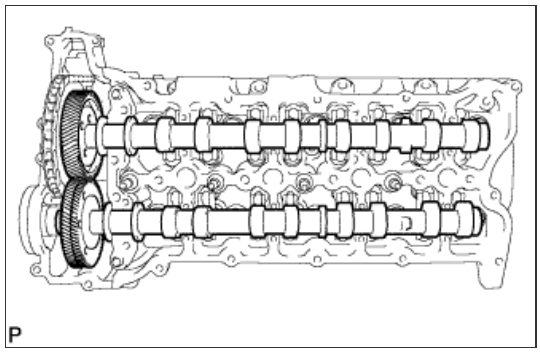
o. Remove the No. 3 camshaft bearing caps and No. 4 camshaft bearing cap.

HINT:

Be sure to arrange the removed parts for each installation position separately.



p. Remove the No. 3 and No. 4 camshafts.


P

for Preparation Click here

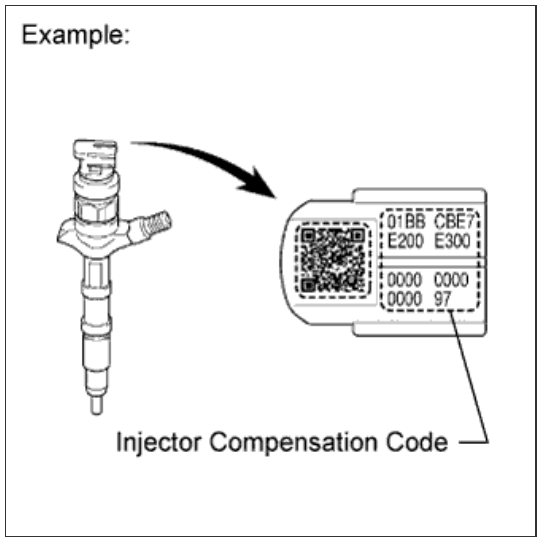
CAUTION:

When replacing an injector (including interchanging injectors between cylinders), common rail, cylinder head, or intake manifold, replace the corresponding injection pipes with a new one.

1. CHECK INJECTOR COMPENSATION CODE

NOTICE:

- **When a fuel injector is replaced, the new fuel injector compensation code must be input into the ECM. When the ECM is replaced, all of the existing fuel injector compensation codes must be input into the new ECM.**
- **Fuel injector compensation codes are unique, 30 digit, alphanumeric values printed on the head portion of each fuel injector. If an incorrect fuel injector compensation code is input into the ECM, the engine assembly may rattle or engine idling may become rough. In addition, engine failure may occur and the life of the engine may be shortened.**



a. After replacing fuel injector(s) with new one(s), input compensation code(s) of fuel injector(s) into ECM as follows:

HINT:

- **Each fuel injector has different fuel injection characteristics. In order to optimize the fuel injections, the ECM uses the compensation codes to balance the different fuel injections between each fuel injector.**
- **When you first turn the ignition switch to ON after replacing the ECM or a fuel injector(s), DTC P1601 is set. This is to inform you that registration of a fuel injector compensation code(s) is/are required. Manually clear the DTC upon completion of the compensation code registration.**

i. Input the compensation code(s), which is/are imprinted on the head portion(s) of the new fuel injector(s), into the intelligent tester.

ii. Input the new compensation code(s) into the ECM using the tester.

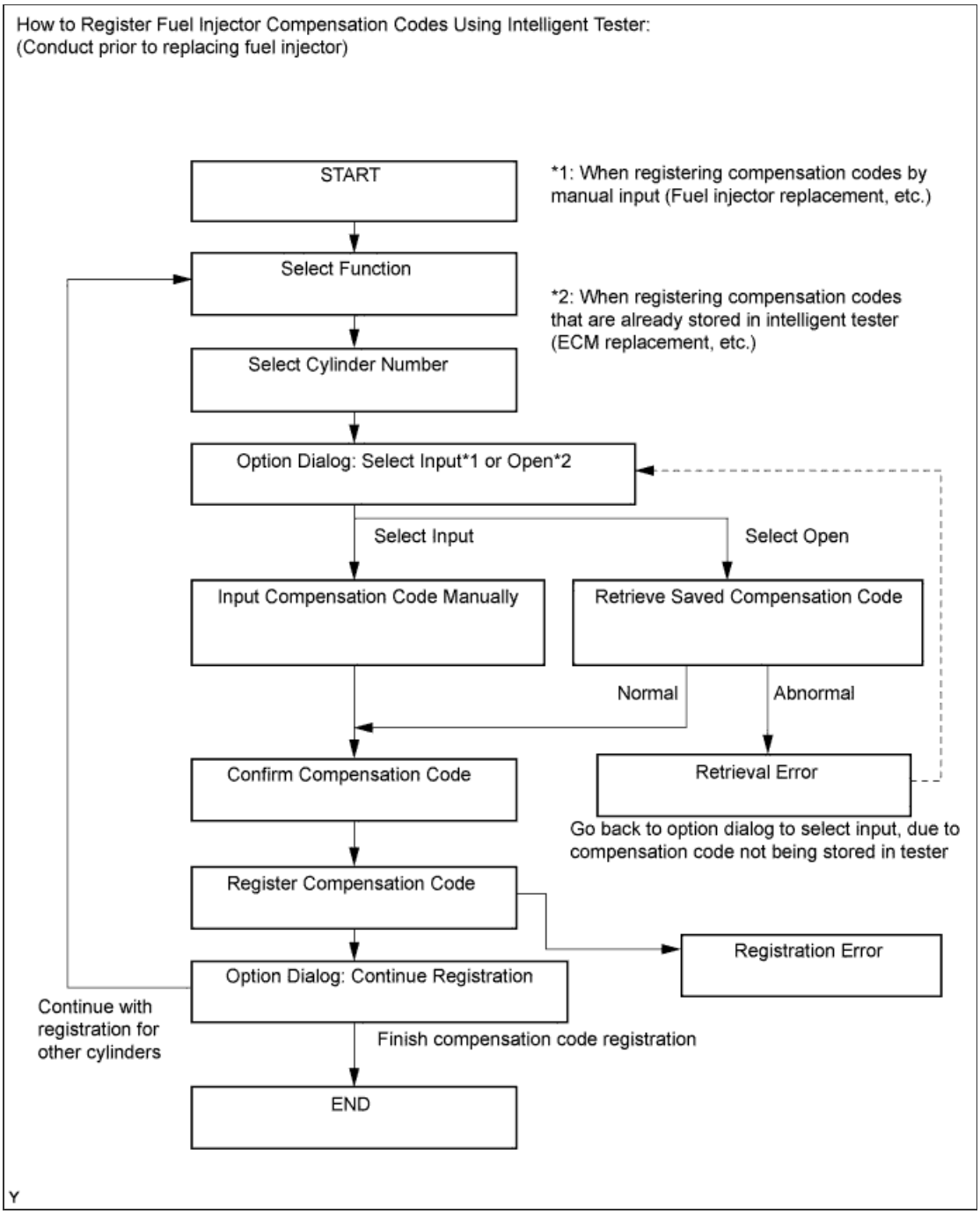
iii. Turn the tester off and turn the ignition switch off.

iv. Wait for at least 30 seconds.

v. Turn the ignition switch to ON and turn the tester on.

vi. Clear DTC P1601 stored in the ECM using the tester (Click here).

b. Register compensation code.



i. Connect the intelligent tester to the DLC3.

ii. Turn the ignition switch to ON.

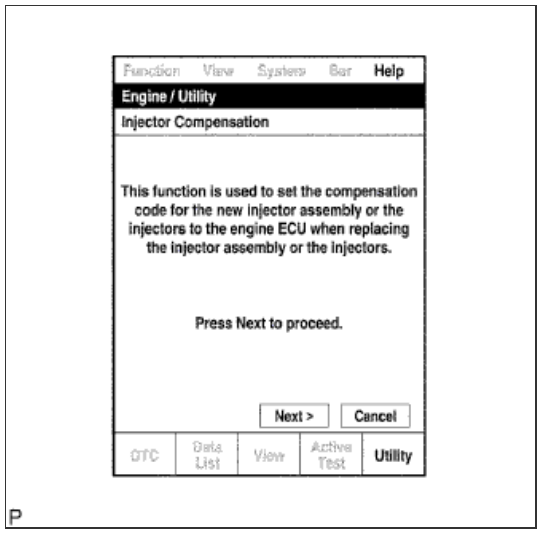
NOTICE:

Do not start the engine.

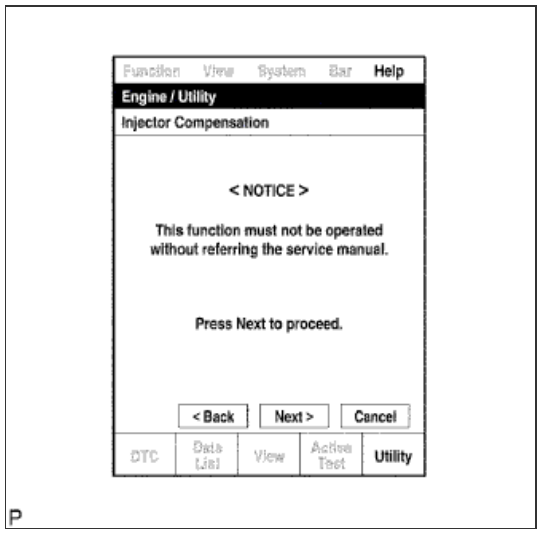
iii. Turn the tester on.

iv. Enter the following menus: Powertrain / Engine / Utility / Injector Compensation.

v. Press Next.

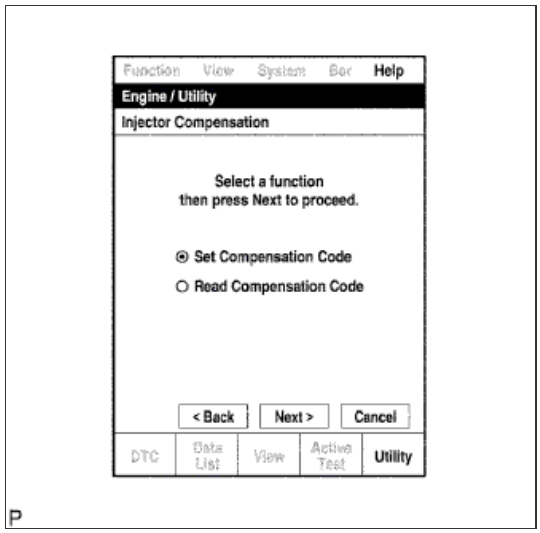


vi. Press Next again to proceed.



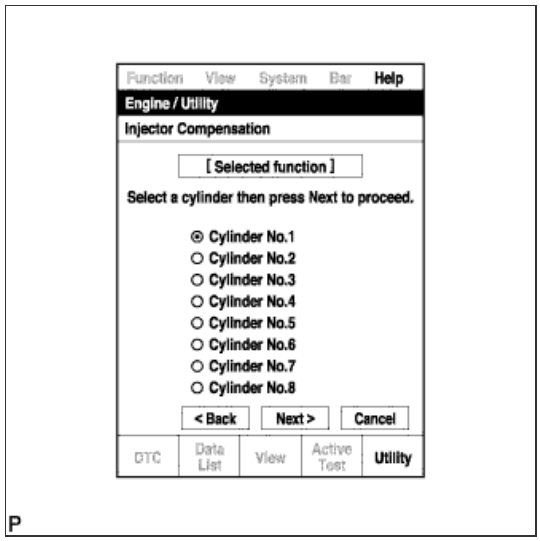
vii. Select et Compensation Code .

viii. Press Next.



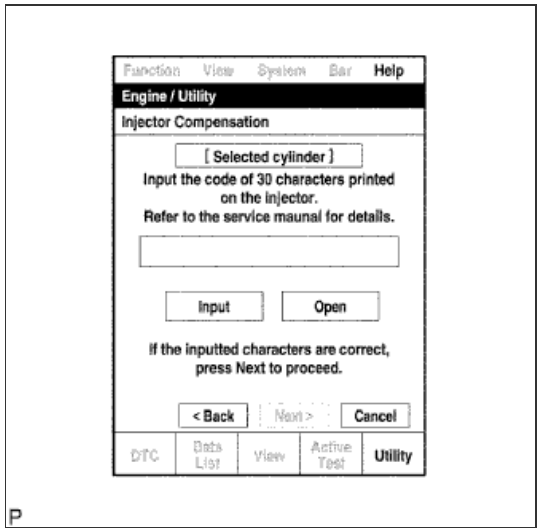
ix. Select the number of the cylinder corresponding to the fuel injector compensation code that you want to read.

x. Press Next.



xi. Register compensation code.

1. Press Input.



2. Manually input the cylinder compensation code using the keyboard on the tester screen. The code is a 30 digit, alphanumeric value printed on the injector head portion.

HINT:

Each fuel injector compensation code is uni ue. The compensation code for each selected cylinder must be input into the tester correctly.

3. Confirm that the compensation code for the selected cylinder is correct, and then press O .



xii. Check that the compensation code displayed on the screen is correct by comparing it with the 30 digit alphanumeric value on the head portion of the fuel injector.

NOTICE:

If an incorrect fuel injector compensation code is input into the ECM, the engine may rattle or engine idling may become rough. In addition, engine failure may occur and the life of the engine may be shortened.

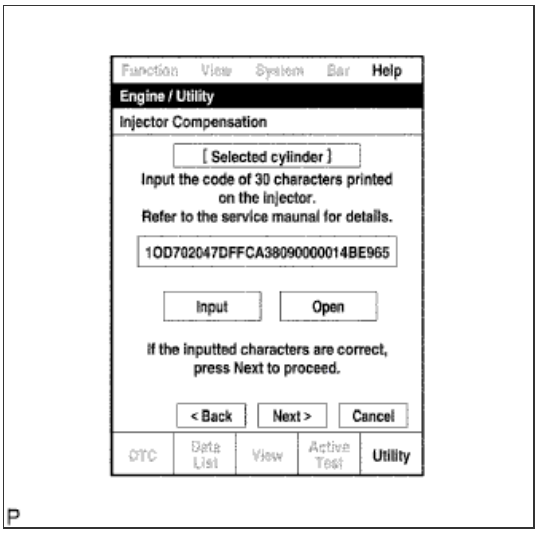
HINT:

- **If a wrong compensation code is input or read, return to the Input Value screen by pressing Input.**
- **The saving process may fail due to a problem with the wire harness or a bad connection with the DLC3. Check the wire harness and DLC3 connection. If no problem is found with either, the ECM may be malfunctioning. Check the ECM and repeat this operation.**

xiii. Press Next to register the compensation code in the ECM.

HINT:

- **If the registration process fails, the compensation code may be incorrect. Check the compensation code again.**
- **If the input compensation code fails to register even though it is input correctly, there may be a problem with the wire harness or a bad connection with the DLC3. Check the wire harness and DLC3 connection. If no problem is found with either, the ECM may be malfunctioning. Check the ECM and restart this operation.**



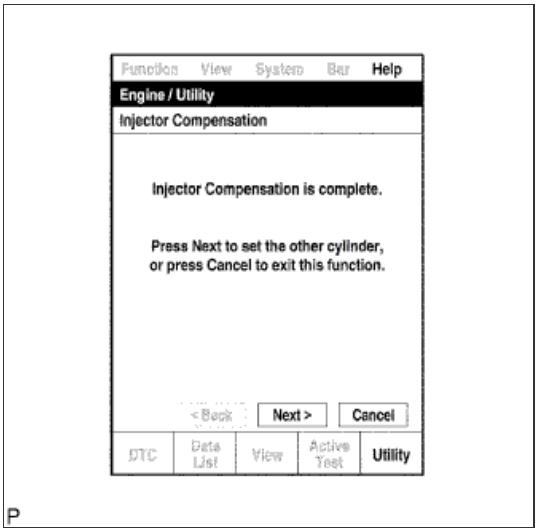
xiv. If you want to continue with other compensation code registrations, press Next. To finish the registration, press Cancel.

xv. Turn the ignition switch off and then turn the tester off.

xvi. Wait for at least 30 seconds.

xvii. Turn the ignition switch to ON and then turn the tester on.

xviii. Clear DTC P1601 stored in the ECM using the tester (Click here).

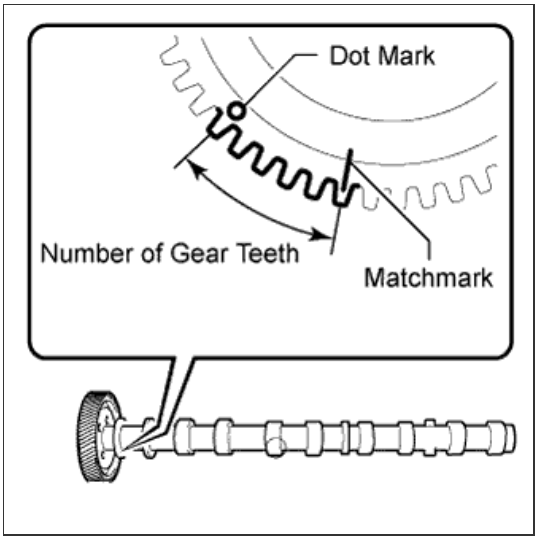


2. INSTALL NO. 3 AND NO. 4 CAMSHAFTS

NOTICE:

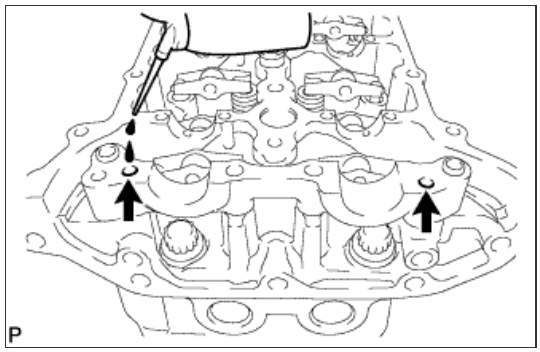
If replacing a camshaft with a new one, make a matchmark on the new camshaft in the same place as the old camshaft. Determine the matchmark placement by using the dot mark as a reference point and counting the number of gear teeth from the dot mark to the matchmark as shown in the illustration.

a. w/o Intercooler:
When replacing the No. 4 camshaft with a new one, install a new hole plug (Click here).

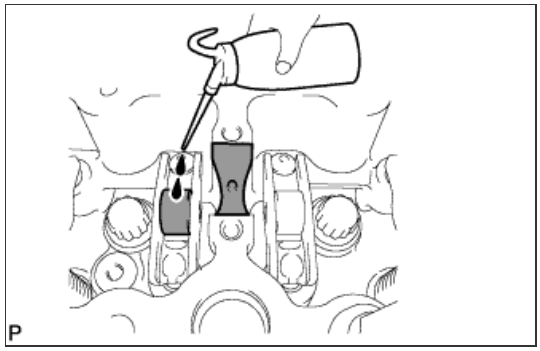


b. Add more than 19 cc (1.16 cu. in.) of engine oil into the cylinder head side oil

holes.



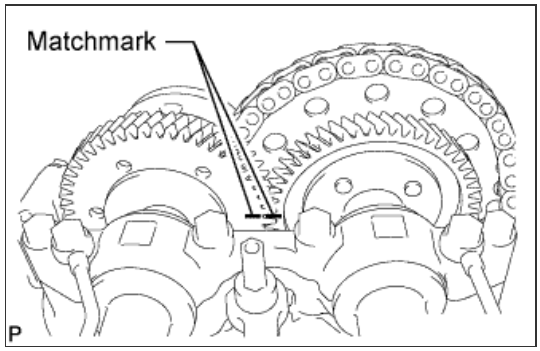
c. Apply engine oil to the rollers of the valve rocker arms and the camshaft housing of the cylinder head.



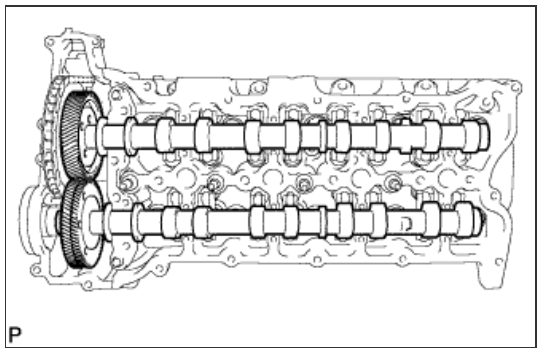
d. Install the No. 3 and No. 4 camshafts.

i. Apply engine oil to the camshaft journals, lobes, thrust portion and gears.

ii. Align the matchmarks of the No. 3 and No. 4 camshaft timing gears as shown in the illustration.

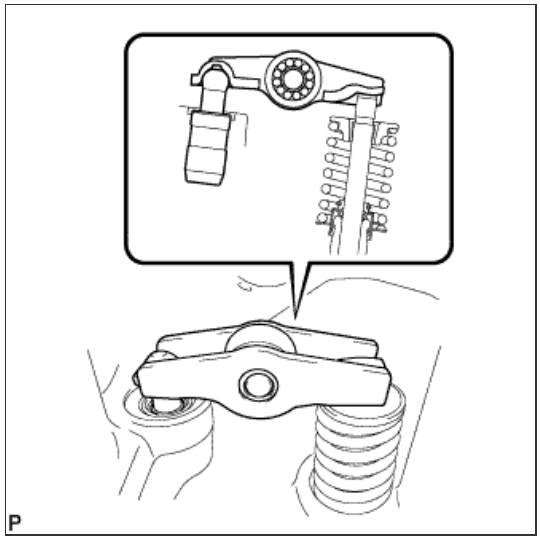


e. Place the camshafts into the cylinder head.



NOTICE:

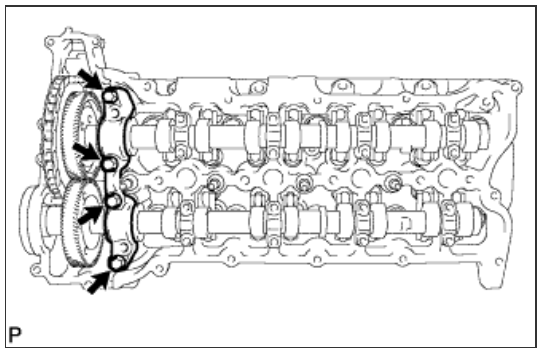
Before and after setting the camshafts, firmly set the rocker arms to the lash adjusters.



f. Install the No. 4 camshaft bearing cap.

i. Align the No. 4 camshaft bearing cap and the ring pins of the No. 5 camshaft bearing cap.

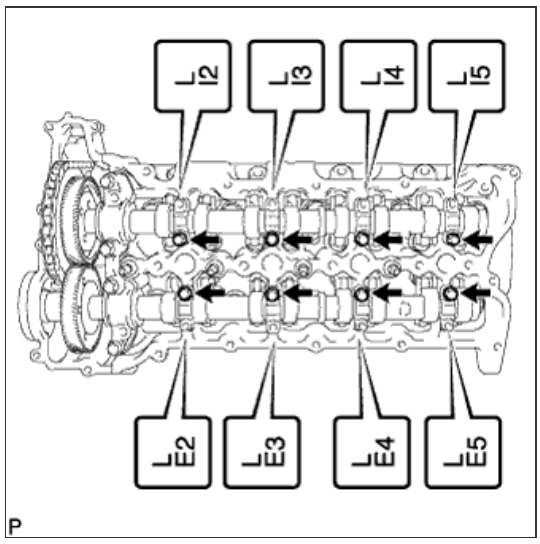
ii. Temporarily install the 4 bolts by hand.



g. Install the No. 3 camshaft bearing caps.

i. Confirm the marks and numbers on the camshaft bearing caps and place them in their proper position and direction.

ii. Temporarily install the 8 bolts, which are not installed with the oil feed pipe, by hand.



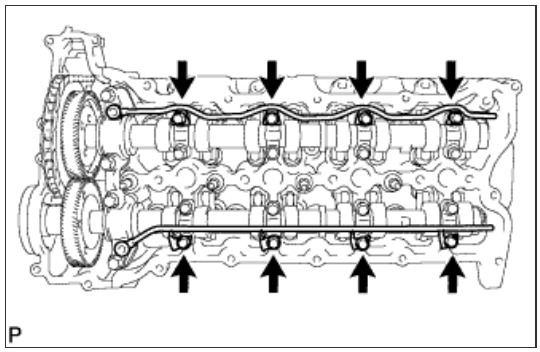
h. Temporarily install the No. 3 and No. 4 camshaft oil feed pipes with the 8 bolts by hand.

NOTICE:

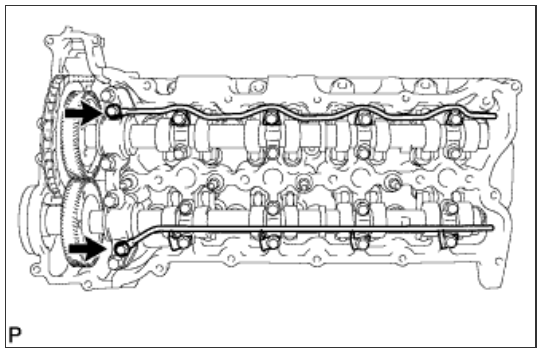
If even one of the pipe bolt holes does not match its camshaft bearing cap bolt hole, replace the camshaft oil feed pipe.

HINT:

The pipe is bent on the intake side, and straight on the exhaust side.

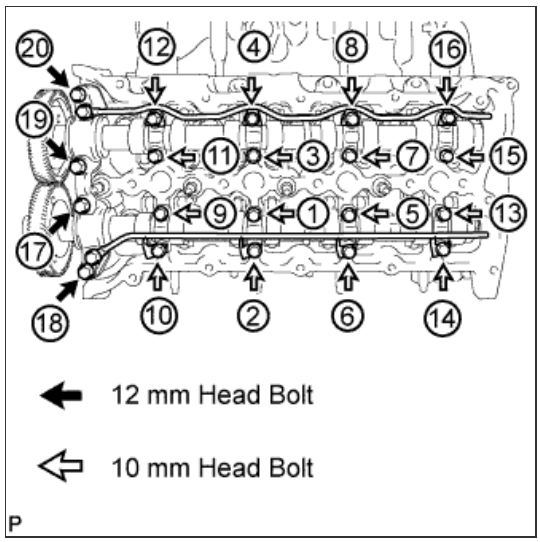


i. Temporarily install the 2 union bolts by hand.



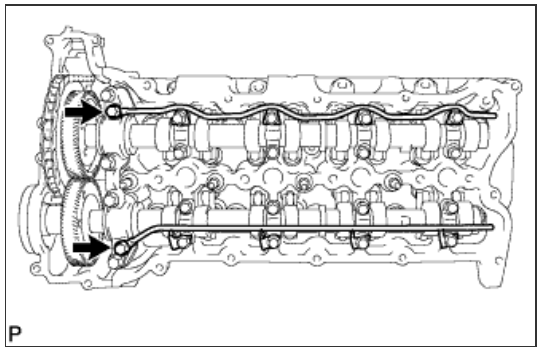
j. Uniformly tighten the 20 bolts in several steps in the order shown in the illustration.

Torque:
for 12 mm head bolt of No. 4 camshaft bearing cap:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for 10 mm head bolt of No. 3 camshaft bearing cap:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



k. Tighten the 2 union bolts.

Torque:
17 N*m{ 173 kgf*cm , 13 ft.*lbf }



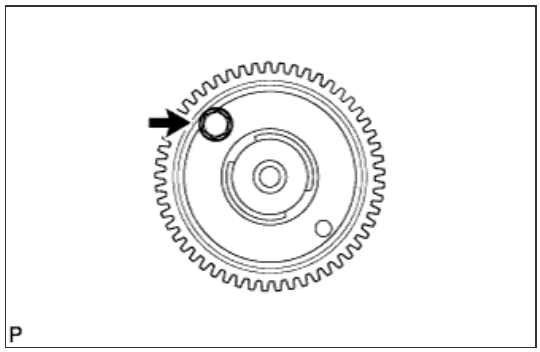
l. Remove the service bolt from the No. 4 camshaft timing gear.

NOTICE:

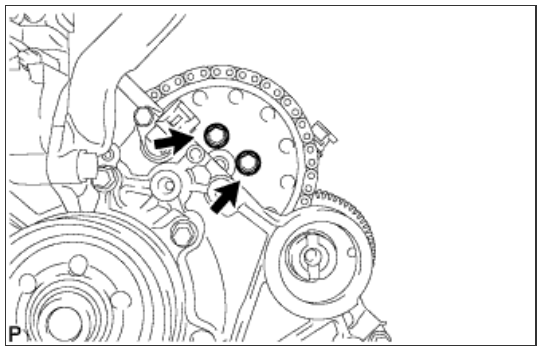
Do not drop the bolt into the engine.

HINT:

If the bolt is difficult to remove, rotate the camshaft and remove the bolt. Then realign the matchmarks of the No. 3 and No. 4 camshaft timing gears.



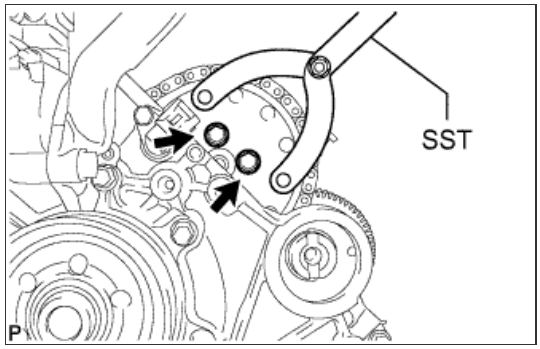
m. Temporarily install the No. 2 timing chain and No. 2 camshaft timing sprocket to the No. 3 camshaft with the 2 bolts.



n. Using SST, hold the No. 2 camshaft timing sprocket. Tighten the 2 bolts.

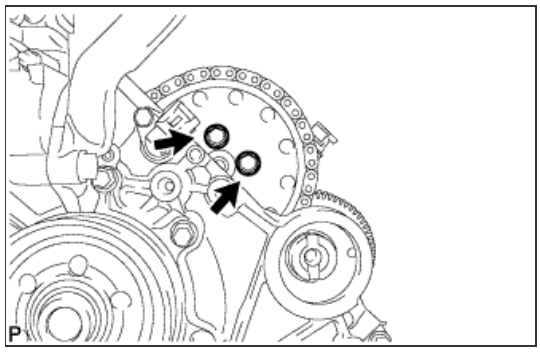
SST
09960-10010 (09962-01000, 09963-01000)

Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }



o. Rotate the crankshaft pulley clockwise so that the 2 remaining pump drive shaft gear bolts can be installed.

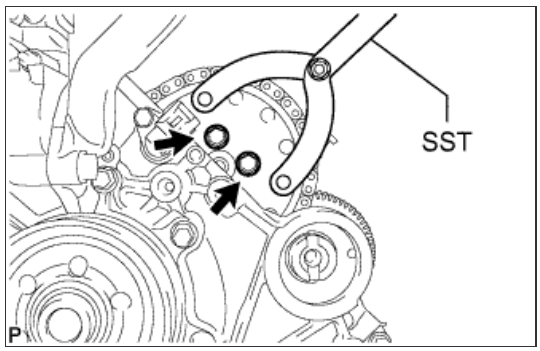
p. Temporarily install the 2 bolts to the No. 3 camshaft.



q. Using SST, hold the No. 2 camshaft timing sprocket. Tighten the 2 bolts.

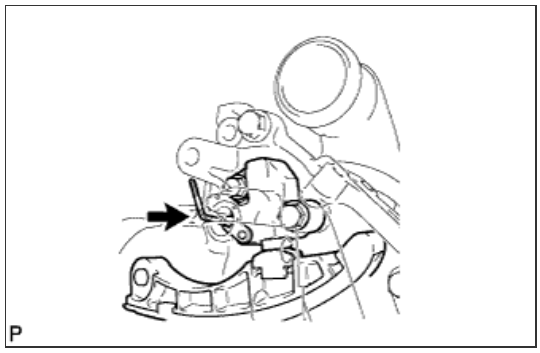
SST
09960-10010 (09962-01000, 09963-01000)

Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }



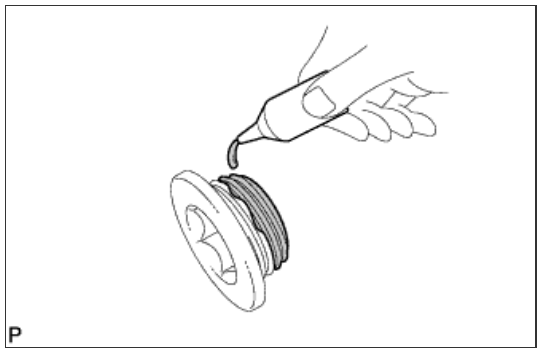
r. Remove the hexagon wrench from the No. 2 chain tensioner.

s. Remove the adhesive from the threads of the taper screw plug and the bolt hole of the timing gear case.



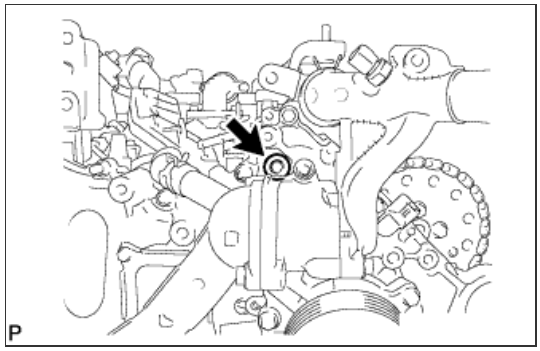
t. Apply adhesive to 3 or more threads of the taper screw plug.

Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent



u. Using a 10 mm hexagon wrench, install the taper screw plug.

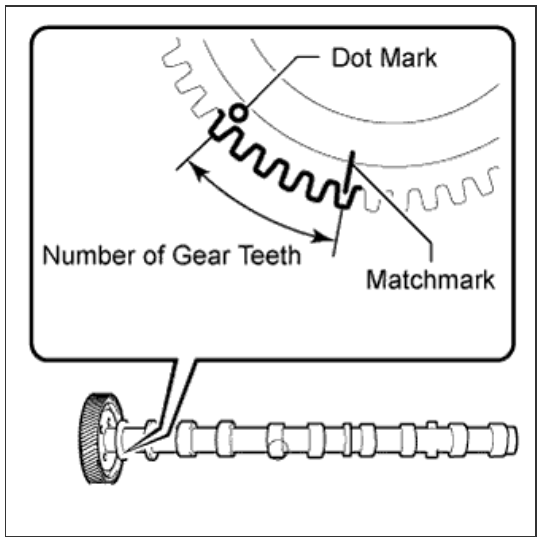
Torque:
15 N*m{ 153 kgf*cm , 11 ft.*lbf }



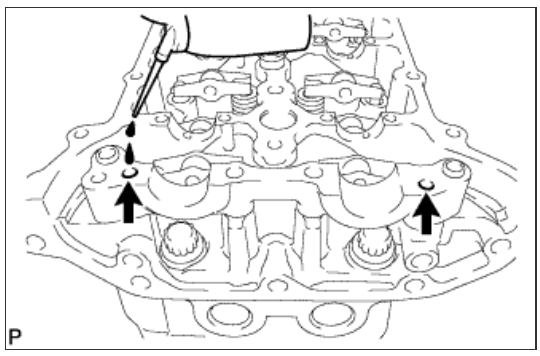
3. INSTALL NO. 1 AND NO. 2 CAMSHAFTS

NOTICE:

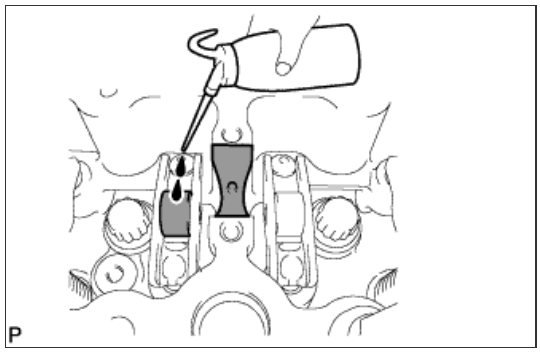
If replacing a camshaft with a new one, make a matchmark on the new camshaft in the same place as the old camshaft. Determine the matchmark placement by using the dot mark as a reference point and counting the number of gear teeth from the dot mark to the matchmark as shown in the illustration.



a. Add more than 19 cc (1.16 cu. in.) of engine oil into the cylinder head side oil holes.



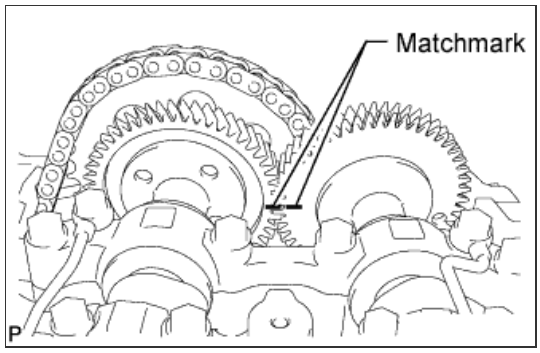
b. Apply engine oil to the rollers of the valve rocker arms and the camshaft housing of the cylinder head.



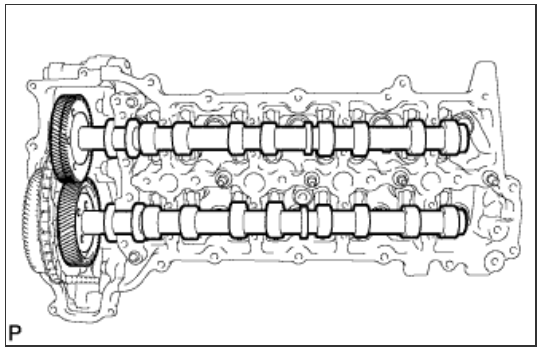
c. Install the No. 1 and No. 2 camshafts.

i. Apply engine oil to the camshaft journals, lobes, thrust portion and gears.

ii. Align the matchmarks of the No. 1 and No. 2 camshaft timing gears as shown in the illustration.

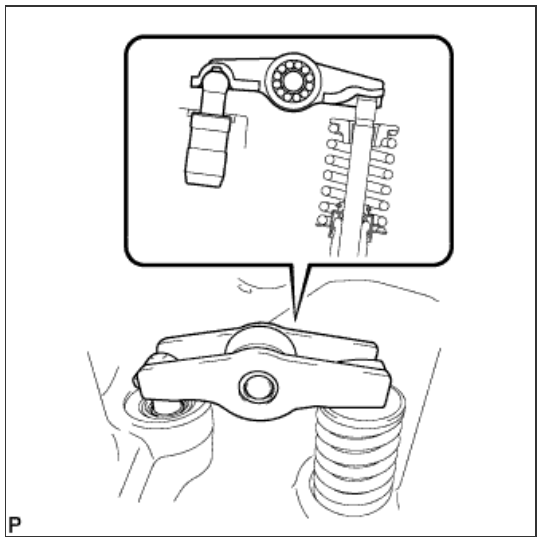


iii. Place the 2 camshafts into the cylinder head.



NOTICE:

Before and after setting the camshafts, firmly set the rocker arms to the lash adjusters.

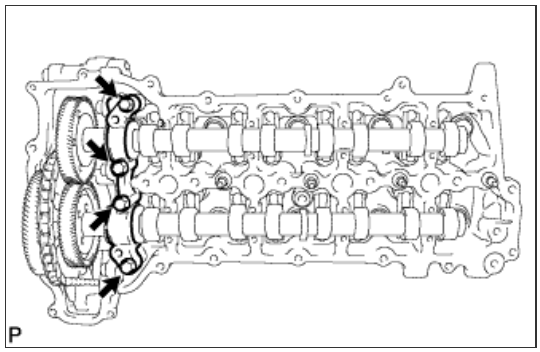


d. Install the No. 1 camshaft bearing cap.

d. Install the No. 1 camshaft bearing cap.

i. Align the No. 1 camshaft bearing cap and the ring pins of the No. 2 camshaft bearing cap.

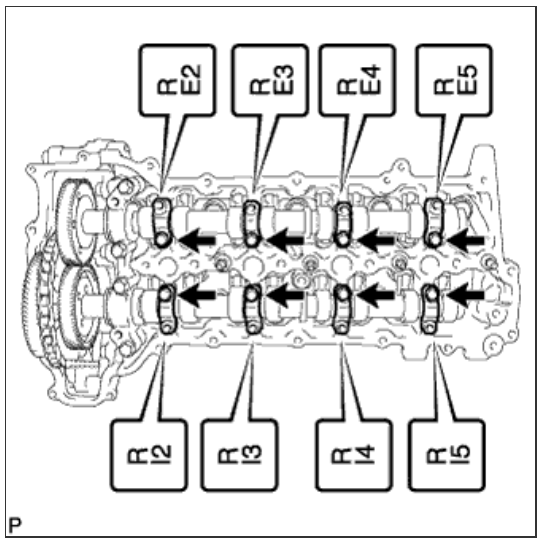
ii. Temporarily install the 4 bolts by hand.



e. Install the No. 3 camshaft bearing caps.

i. Confirm the marks and numbers on the camshaft bearing caps and place them in their proper position and direction.

ii. Temporarily install the 8 bolts, which are not installed with the oil feed pipe, by hand.



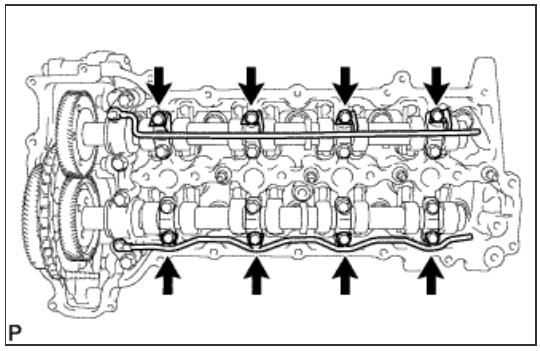
f. Temporarily install the No. 1 and No. 2 camshaft oil feed pipes with the 8 bolts by hand.

NOTICE:

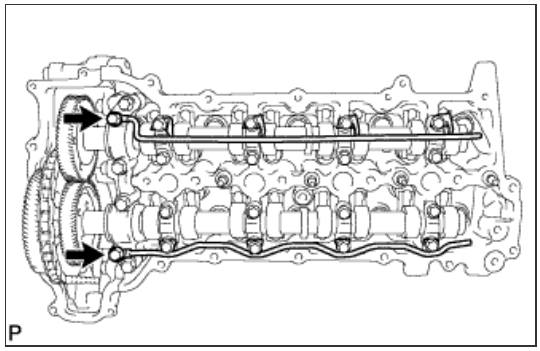
If even one of the pipe bolt holes does not match its camshaft bearing cap bolt hole, replace the camshaft oil feed pipe.

HINT:

The pipe is bent on the intake side, and straight on the exhaust side.

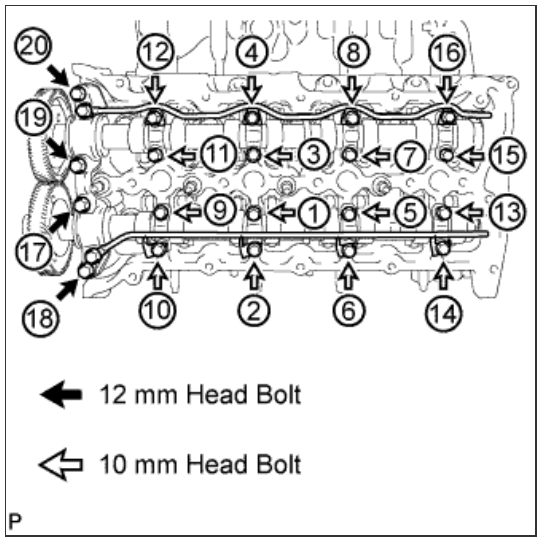


g. Temporarily install the 2 union bolts by hand.



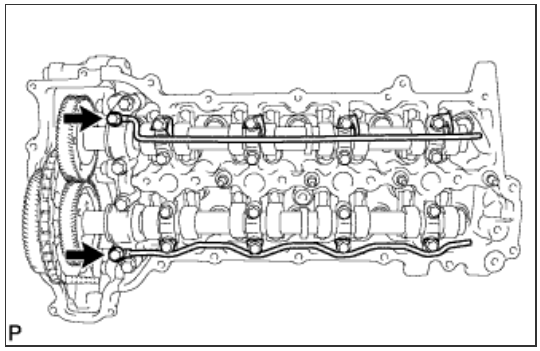
h. Uniformly tighten the 20 bolts in several steps in the order shown in the illustration.

Torque:
for 12 mm head bolt of No. 1 camshaft bearing cap:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for 10 mm head bolt of No. 3 camshaft bearing cap:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



i. Tighten the 2 union bolts.

Torque:
17 N*m{ 173 kgf*cm , 13 ft.*lbf }



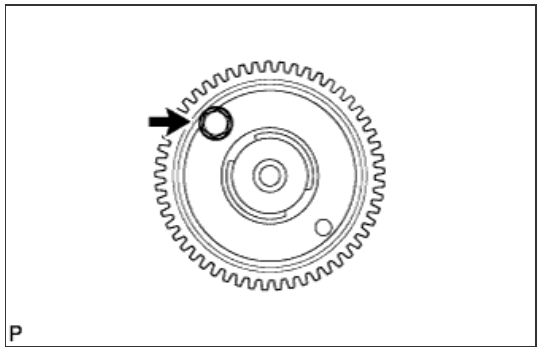
j. Remove the service bolt from the No. 1 camshaft timing gear.

NOTICE:

Do not drop the bolt into the engine.

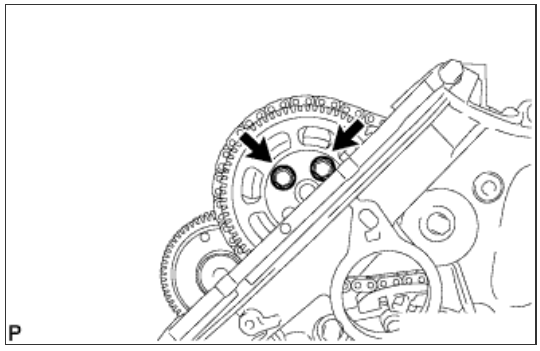
HINT:

If the bolt is difficult to remove, rotate the camshaft and remove the bolt. Then realign the matchmarks of the No. 1 and No. 2 camshaft timing gears.



k. Temporarily install the No. 1 timing chain and No. 1 camshaft timing sprocket to the No. 2 camshaft.

l. Temporarily install the pump drive shaft gear with the 2 bolts.



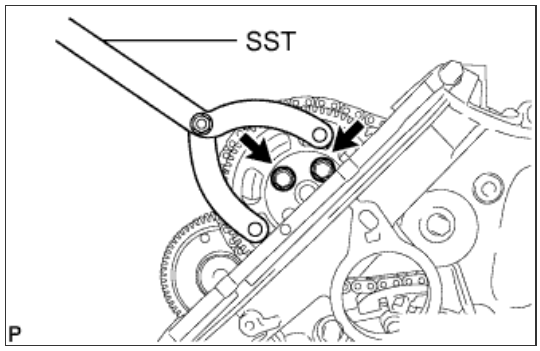
m. Using SST, hold the pump drive shaft gear. Tighten the 2 bolts.

SST
09960-10010 (09962-01000, 09963-01000)

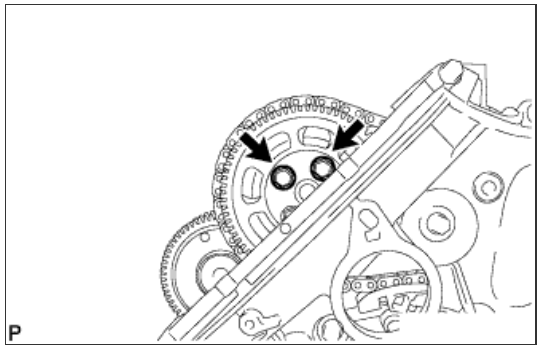
Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }

n. Rotate the crankshaft clockwise so that the 2 remaining pump drive shaft gear

bolts can be installed.



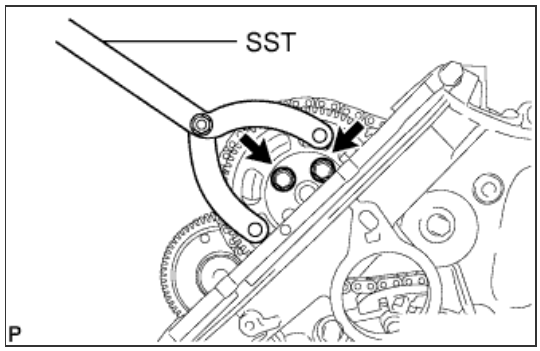
o. Temporarily install the 2 bolts to the pump drive shaft gear.



p. Using SST, hold the pump drive shaft gear. Tighten the 2 bolts.

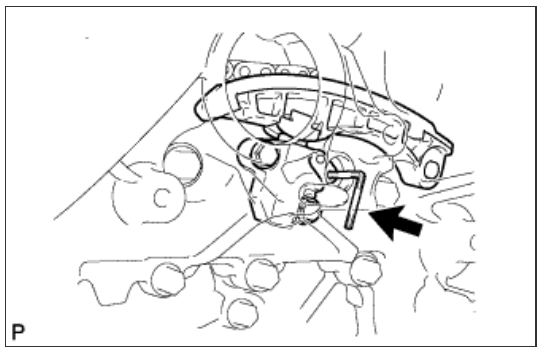
SST
09960-10010 (09962-01000, 09963-01000)

Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }



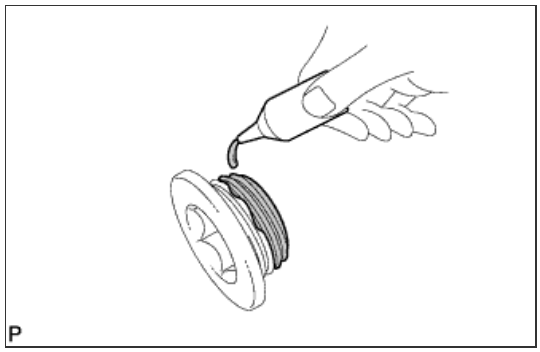
q. Remove the hexagon wrench.

r. Remove the adhesive from the threads of the taper screw plug and the bolt hole of the timing gear case.



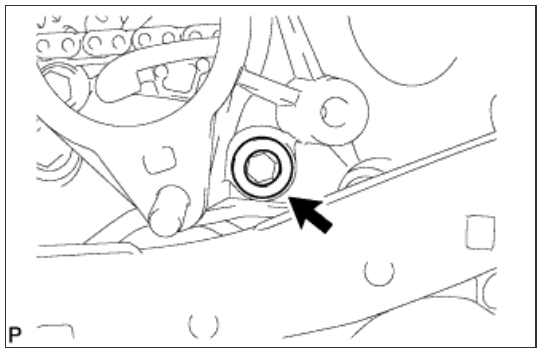
s. Apply adhesive to 3 or more threads of the taper screw plug.

Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent



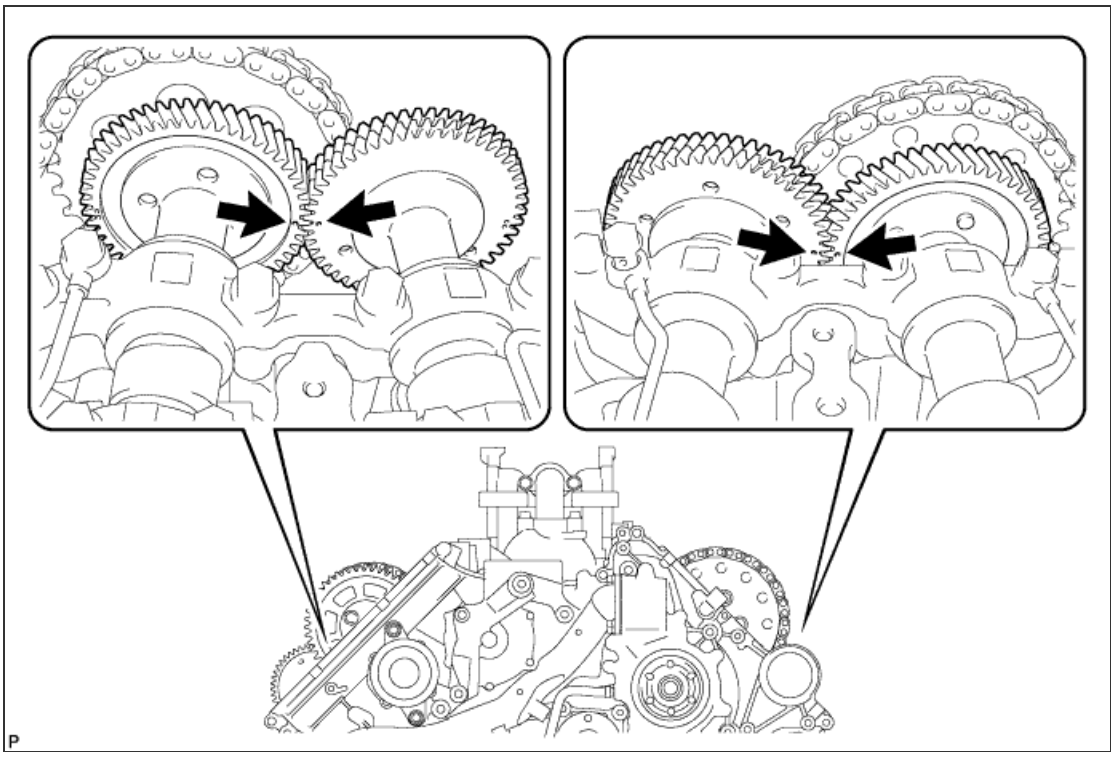
t. Using a 10 mm hexagon wrench, install the taper screw plug.

Torque:
15 N*m{ 153 kgf*cm , 11 ft.*lbf }



4. CHECK NO. 1 CYLINDER TO TDC/COMPRESSION

a. Rotate the crankshaft clockwise 3 times or more, and check that the timing marks of the camshafts (1 dot mark each) align. If the timing marks of the camshafts do not align, repeat the rIstall No. 3 and No. 4 Camshafts and rIstall No. 1 and No. 2 Camshafts procedures.

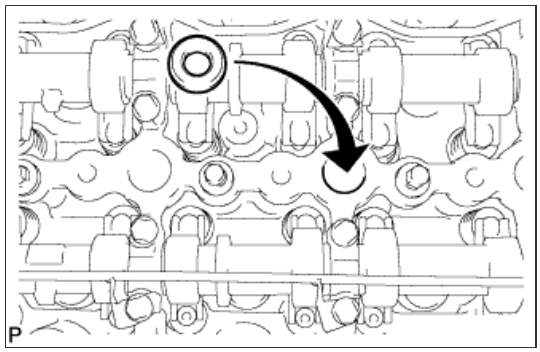


5. INSTALL FUEL INJECTOR LH

NOTICE:

Be sure to install the injector, holder clamp and bolt in their original positions.

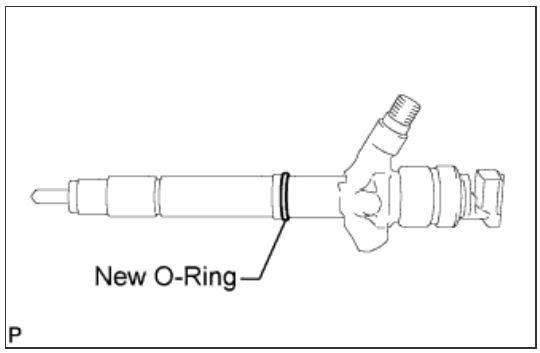
a. Install 4 new injection nozzle seats to the cylinder head.



b. Apply a light amount of clean engine oil to 4 new O rings.

c. Install the O rings to each injector as shown in the illustration.

d. Insert the 4 injectors into the cylinder head.



NOTICE:

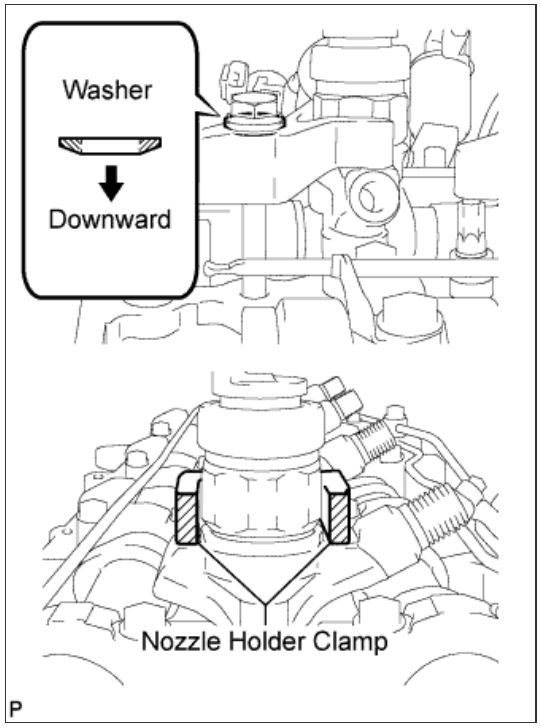
- **Insert the injector until it touches the nozzle seat surface.**
- **After installing the injector to the cylinder head, the O-ring may prevent the injector from fully seating. If so, pull out the injector and reinstall it.**
- **Always return an injector to the same place it was removed from.**

e. For an injector that has been replaced with a new injector, register the injector compensation code.

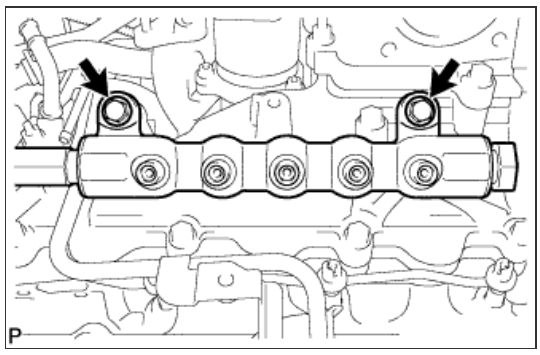
f. Temporarily install 4 new washers and the 4 nozzle clamps with the 4 clamp bolts.

NOTICE:

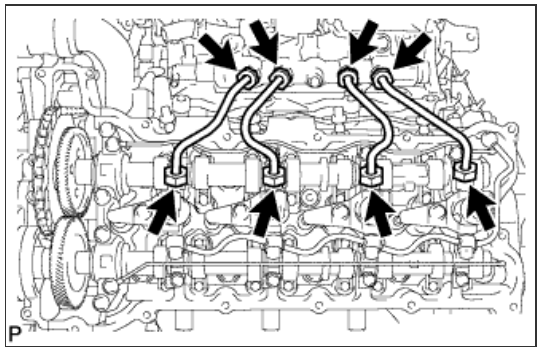
- **The fork portion of the nozzle holder clamp must be set to the injector.**
- **Before tightening the bolts, check that the nozzle holder clamp is set properly.**
- **To tighten the clamp bolts, first tighten them by hand until they cannot be turned further. Then, tighten the bolts to the specified torque in a later step.**
- **When tightening the bolts, be careful not to tilt the bolt and clamp.**
- **Do not reuse the washer.**



g. Temporarily install the common rail L with the 2 bolts.

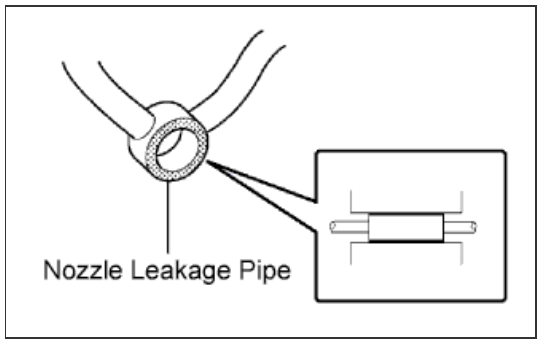


h. Temporarily install the 4 new injection pipes to the common rail and injector.



i. Check the nozzle leakage pipe. Check that there are no scratches or dents on the 5 union seal surfaces. If scratches or dents are present, replace the nozzle leakage pipe.

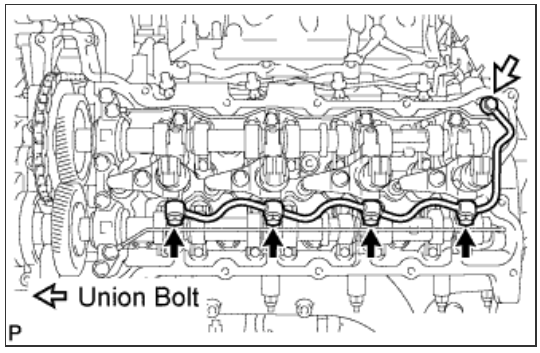
j. Set the leakage pipe and 5 new gaskets in place.



k. Temporarily install the leakage pipe with the 4 hollow screws and union bolt.

HINT:

To position the injectors, loosely tighten the 4 hollow screws and union bolt.

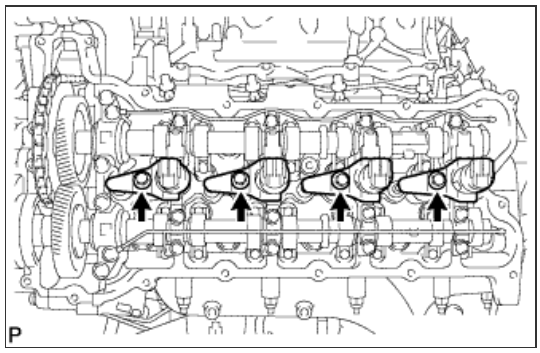


l. Tighten the 4 holder clamp bolts.

Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }

m. Remove the 4 injection pipes.

n. Remove the 2 bolts and common rail L .

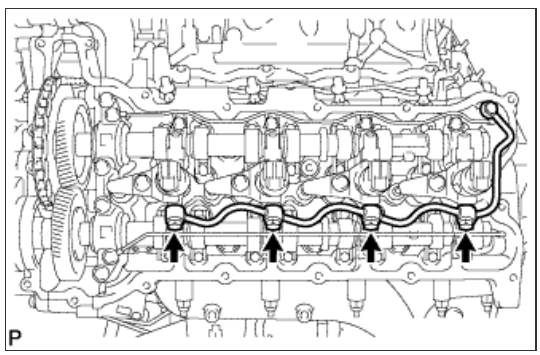


o. Tighten the 4 hollow screws.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

NOTICE:

If a hollow screw is accidentally tightened beyond the tor ue specification, it must be replaced together with the nozzle leakage pipe.

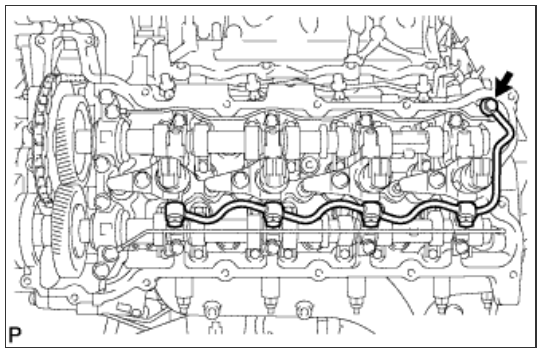


p. Tighten the union bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

NOTICE:

If a hollow screw is accidentally tightened beyond the tor ue specification, it must be replaced together with the nozzle leakage pipe.

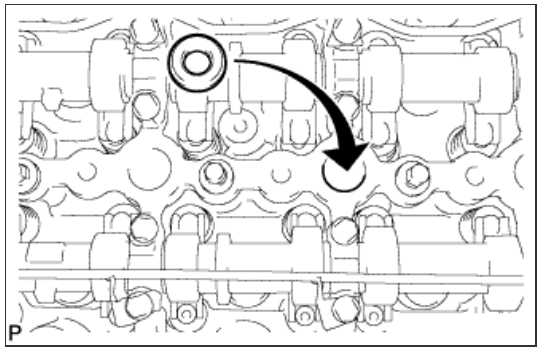


6. INSTALL FUEL INJECTOR RH

NOTICE:

Be sure to install the injector, holder clamp and bolt in their original positions.

a. Install 4 new injection nozzle seats to the cylinder head.



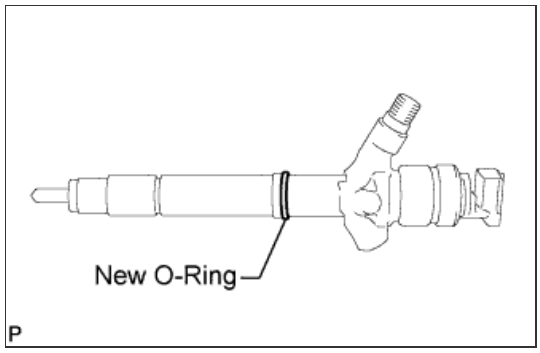
b. Apply a light amount of clean engine oil to 4 new O rings.

c. Install the O rings to each injector as shown in the illustration.

d. Insert the 4 injectors into the cylinder head.

NOTICE:

- **Insert the injector until it touches the nozzle seat surface.**
- **After installing the injector to the cylinder head, the O-ring may prevent the injector from fully seating. If so, pull out the injector and reinstall it.**
- **Always return an injector to the same place it was removed from.**

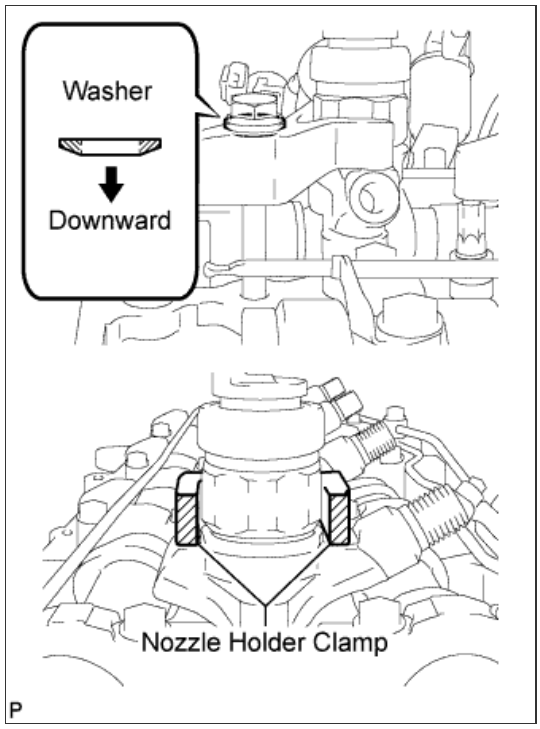


e. For an injector that has been replaced with a new injector, register the injector compensation code.

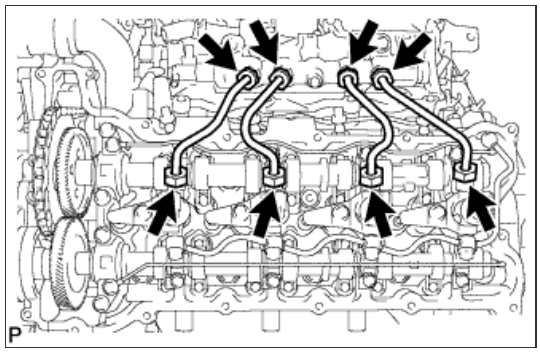
f. Temporarily install 4 new washers and the 4 nozzle clamps with the 4 clamp bolts.

NOTICE:

- **The fork portion of the nozzle holder clamp must be set to the injector.**
- **Before tightening the bolts, check that the nozzle holder clamp is set properly.**
- **To tighten the clamp bolts, first tighten them by hand until they cannot be turned further. Then, tighten the bolts to the specified torque in a later step.**
- **When tightening the bolts, be careful not to tilt the bolt and clamp.**
- **Do not reuse the washer.**

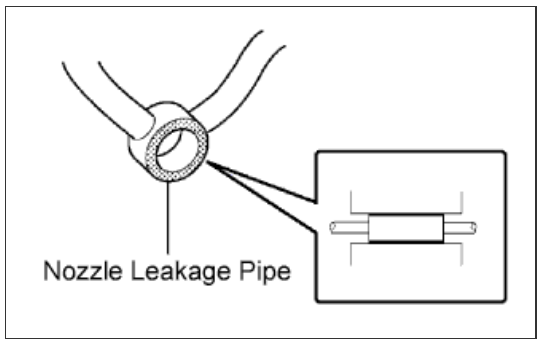


g. Temporarily install the 4 new injection pipes to the common rail and injector.



h. Check the nozzle leakage pipe. Check that there are no scratches or dents on the 5 union seal surfaces. If scratches or dents are present, replace the nozzle leakage pipe.

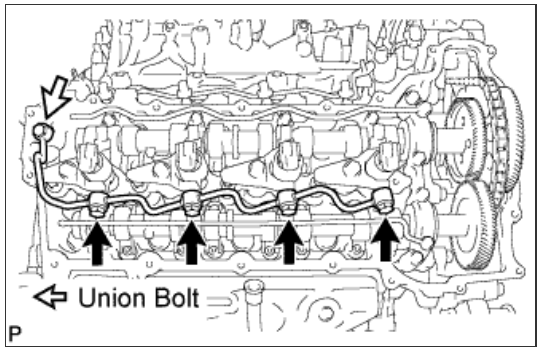
i. Set the leakage pipe and 5 new gaskets in place.



j. Temporarily install the leakage pipe with the 4 hollow screws and union bolt.

HINT:

To position the injectors, loosely tighten the 4 hollow screws and union bolt.

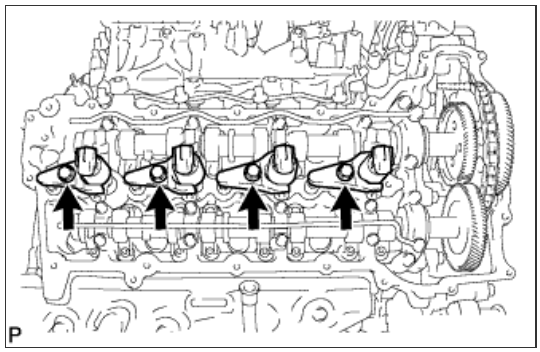


k. Tighten the 4 holder clamp bolts.

Torque:

25 N*m{ 255 kgf*cm , 18 ft.*lbf }

l. Remove the 4 injection pipes.

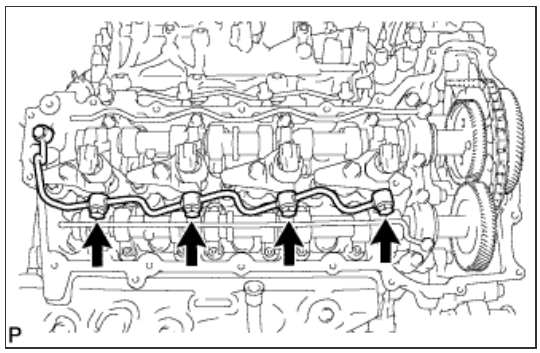


m. Tighten the 4 hollow screws.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

NOTICE:

If a hollow screw is accidentally tightened beyond the tor ue specification, it must be replaced together with the nozzle leakage pipe.

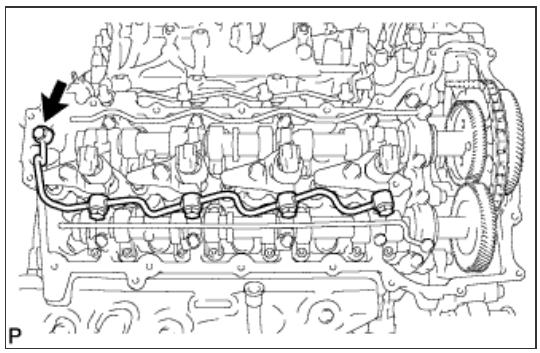


n. Tighten the union bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

NOTICE:

If a hollow screw is accidentally tightened beyond the tor ue specification, it must be replaced together with the nozzle leakage pipe.

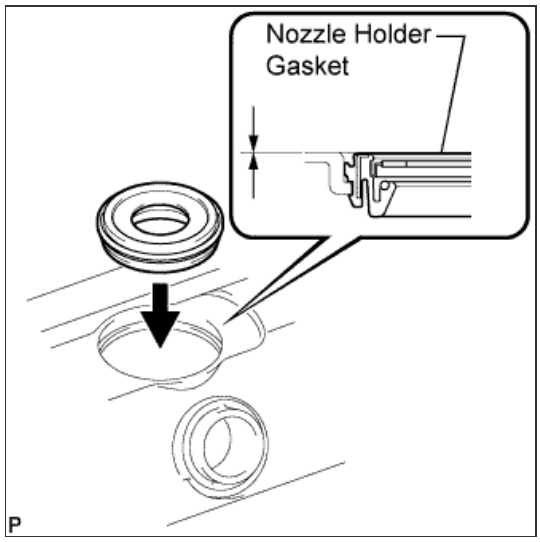


7. INSTALL NOZZLE HOLDER GASKET LH

a. Press 4 new nozzle holder gaskets into the cylinder head cover L .

NOTICE:

After installing the nozzle holder gasket, check that it dose not protrude from the cylinder head cover.



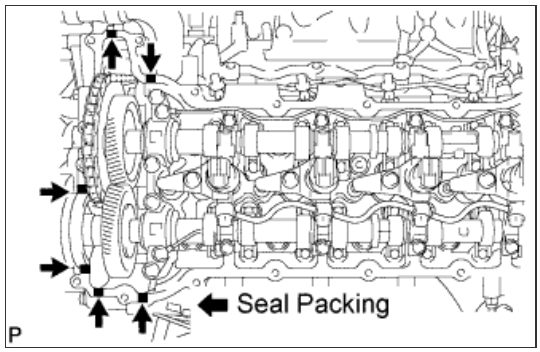
8. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY LH

a. Apply seal packing as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the cylinder head cover within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after the installation.**



b. Install a new gasket to the cylinder head cover.

NOTICE:

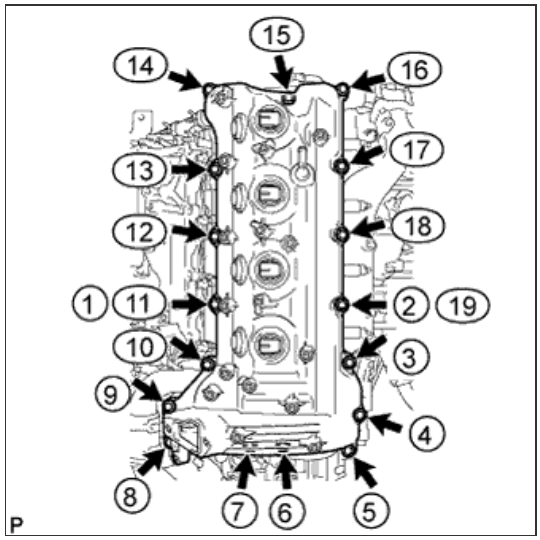
Remove any oil from the contact surface.

c. Temporarily install the cylinder head cover with the 17 bolts. Tighten the 17 bolts in the order shown in the illustration.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

HINT:

After tightening the bolts, check that the bolts at step 11 and 19 are tightened to the specified tor ue.



9. INSTALL NOZZLE HOLDER SEAL LH

a. Press 4 new holder seals into the cylinder head cover L .

10. INSTALL OIL SEPARATOR ASSEMBLY

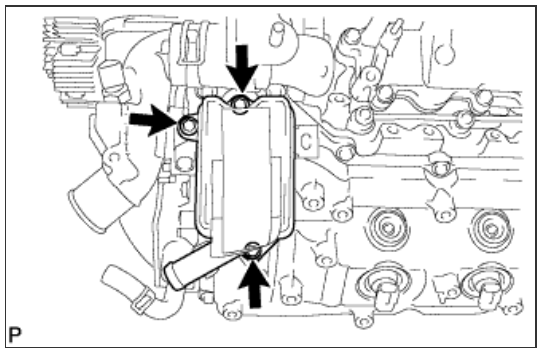
a. Install a new gasket to the oil separator.

NOTICE:

Remove any oil from the contact surface.

b. Install the oil separator with the 3 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



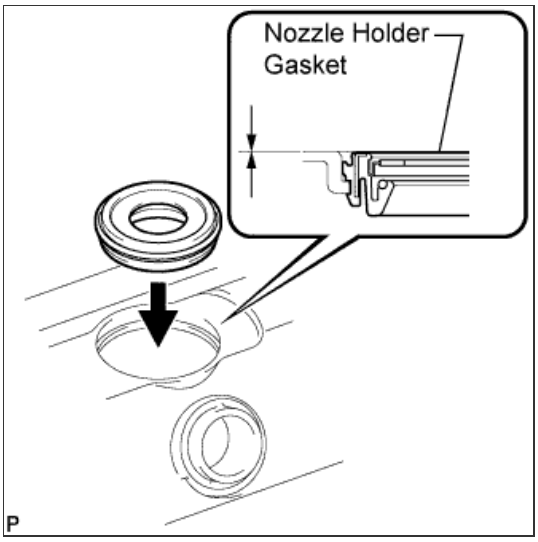
11. INSTALL NOZZLE HOLDER GASKET RH

a. Press 4 new nozzle holder gaskets into the cylinder head cover R .

NOTICE:

After installing the nozzle holder gasket, check that it dose not protrude from

the cylinder head cover.



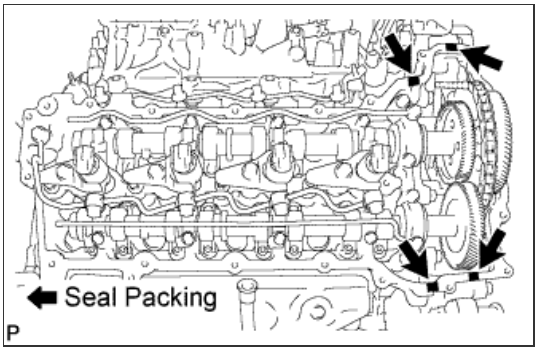
12. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY RH

a. Apply seal packing as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the cylinder head cover within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after the installation.**



b. Install a new gasket to the cylinder head cover.

NOTICE:

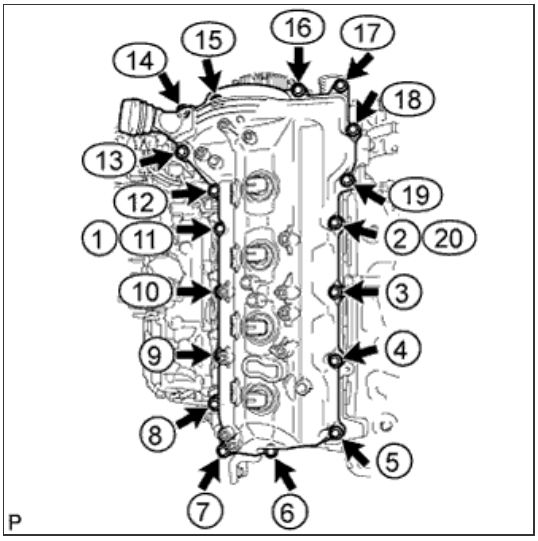
Remove any oil from the contact surface.

c. Temporarily install the cylinder head cover with the 18 bolts. Tighten the 18 bolts in the order shown in the illustration.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

HINT:

After tightening the bolts, check that the bolts at step 11 and 20 are tightened to the specified tor ue.



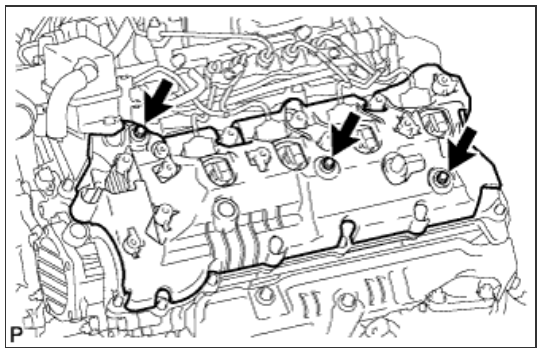
13. INSTALL NOZZLE HOLDER SEAL RH

a. Press 4 new holder seals into the cylinder head cover R .

14. INSTALL CYLINDER HEAD COVER SILENCER LH (w/ Intercooler)

a. Install the cylinder head cover silencer with the 3 bolts.

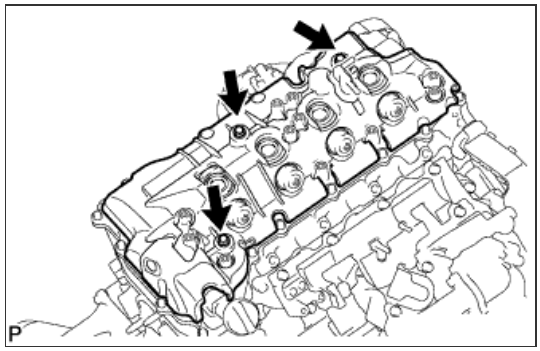
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



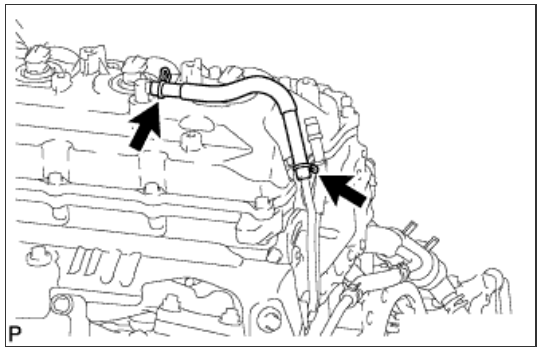
15. INSTALL CYLINDER HEAD COVER SILENCER RH (w/ Intercooler)

a. Install the cylinder head cover silencer with the 3 bolts.

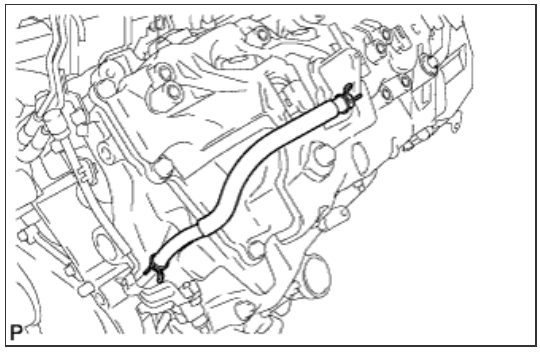
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



16. CONNECT NO. 3 VENTILATION HOSE



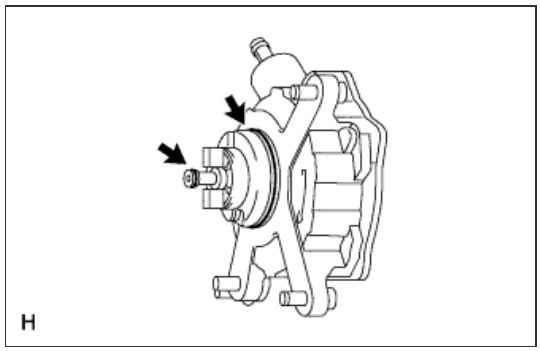
17. CONNECT NO. 2 VENTILATION HOSE



18. INSTALL VACUUM PUMP ASSEMBLY (w/ Intercooler)

a. Apply engine oil to 2 new O rings.

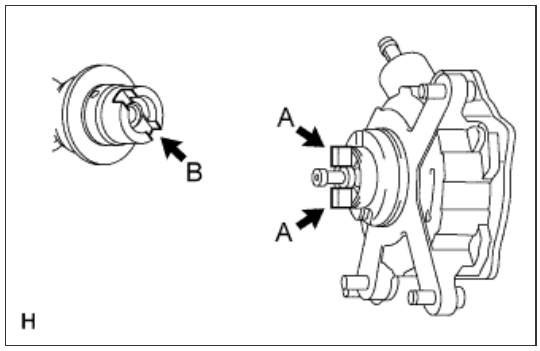
b. Install the 2 O rings to the vacuum pump.



c. Install the vacuum pump so that the coupling teeth of the vacuum pump (labeled A) and the groove of the camshaft (labeled B) are aligned.

NOTICE:

Be careful not to damage the O ring.

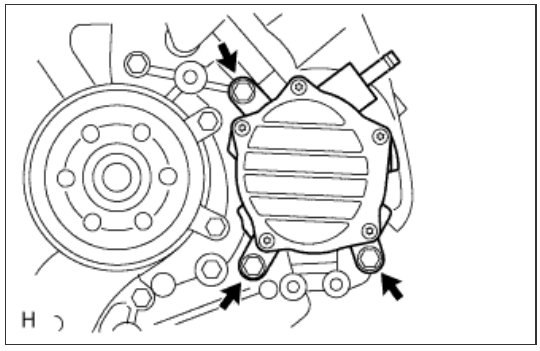


d. Install the vacuum pump with the 3 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

NOTICE:

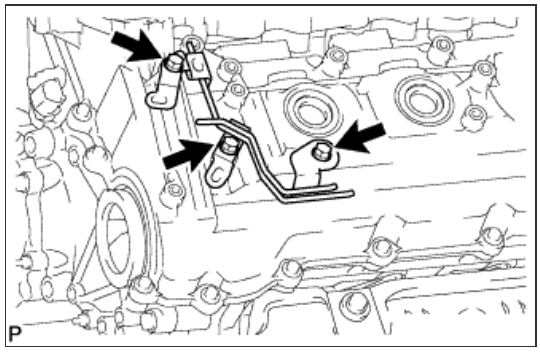
Confirm that the vacuum pump is not at an angle, and that there is no clearance between the fitting surfaces.



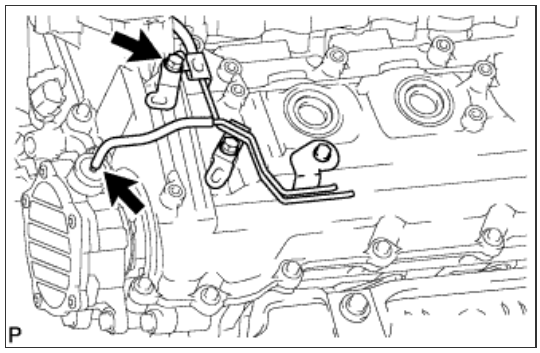
19. INSTALL NO. 1 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY

a. Install the vacuum transmitting pipe with the 3 bolts.

Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }



b. w/ Intercooler:
Connect the 2 vacuum hoses.

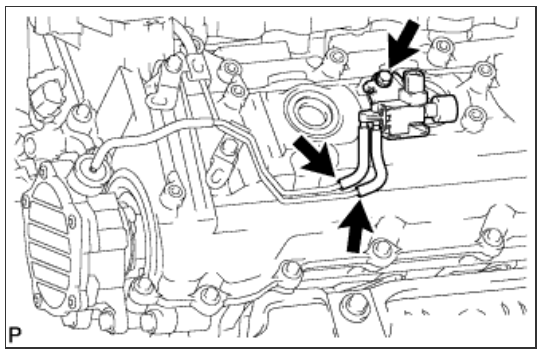


20. INSTALL NO. 1 VACUUM SWITCHING VALVE ASSEMBLY (w/ Intercooler)

a. Install vacuum switching valve with the bolt.

Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }

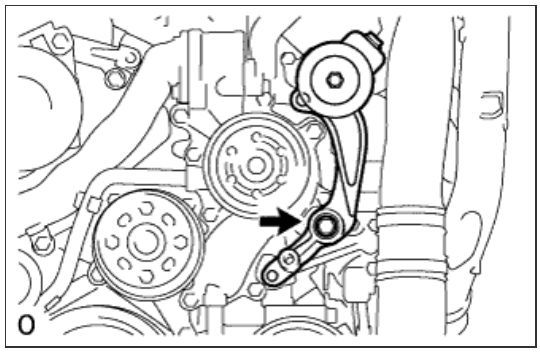
b. Connect the 2 vacuum hoses.



21. INSTALL NO. 2 IDLER PULLEY BRACKET (w/ Viscous Heater)

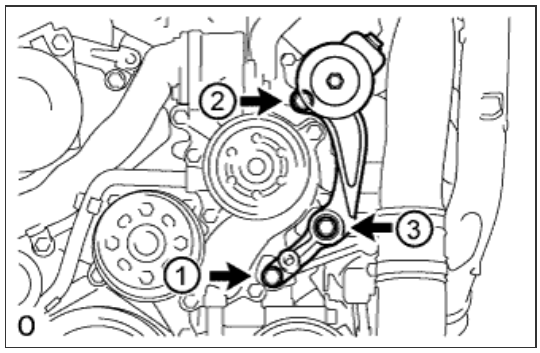
a. Temporarily install the No. 2 idler pulley bracket with the bolt.

b. Temporarily install the 2 bolts to the No. 2 idler pulley bracket bolt hole.



c. Uniformly tighten the 3 bolts of the No. 2 idler pulley bracket in the order shown in the illustration.

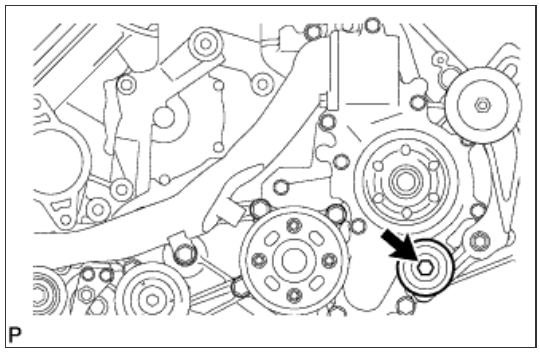
Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }



22. INSTALL NO. 2 IDLER PULLEY (w/ Viscous Heater)

a. Install the collar, No. 2 idler pulley and cover with the bolt.

Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }



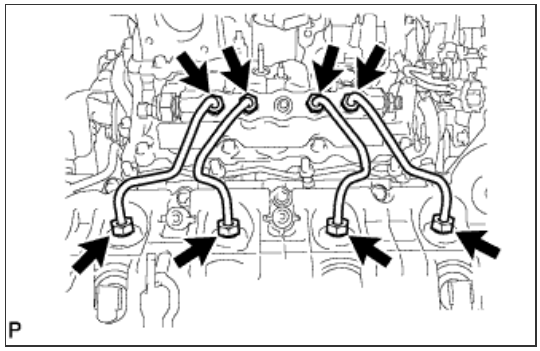
23. INSTALL INJECTION PIPE RH

a. Using a union nut wrench, install the 4 new injection pipes.

Torque:
without union nut wrench:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }
with union nut wrench:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

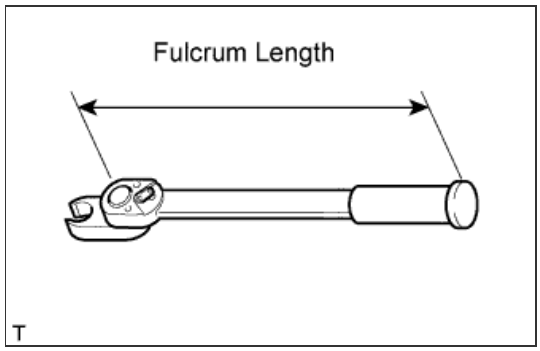
NOTICE:

Make sure there is no damage or foreign matter on the seal surfaces.



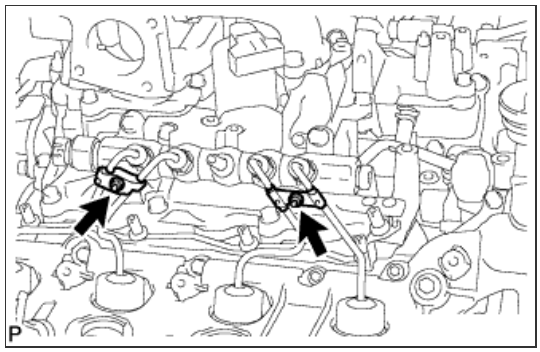
HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure the union nut wrench and the torque wrench are connected in a straight line.**



b. w/ Intercooler:
Install the 4 injection pipe clamps with the 2 nuts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



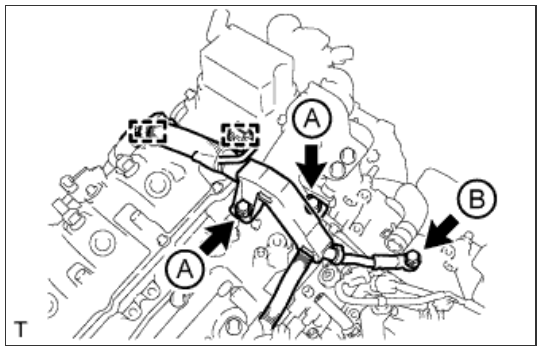
24. CONNECT NO. 2 ENGINE WIRE

a. Connect the No. 2 engine wire with the 3 bolts.

Torque:
for bolt A:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }
for bolt B:

32 N*m{ 326 kgf*cm , 24 ft.*lbf }

b. Attach the 2 wire harness clamps.

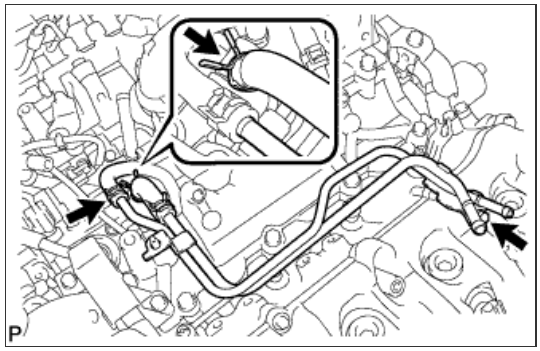


25. INSTALL FUEL FILTER TO INJECTION PUMP FUEL PIPE SUB-ASSEMBLY

a. Install the fuel filter to injection pump fuel pipe with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

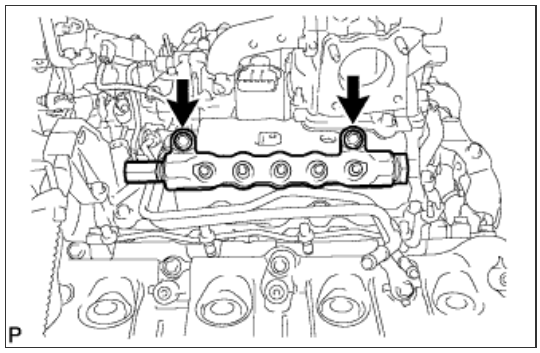
b. Connect the 2 hoses to the fuel pipe.



26. INSTALL COMMON RAIL ASSEMBLY LH

a. Install the common rail with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



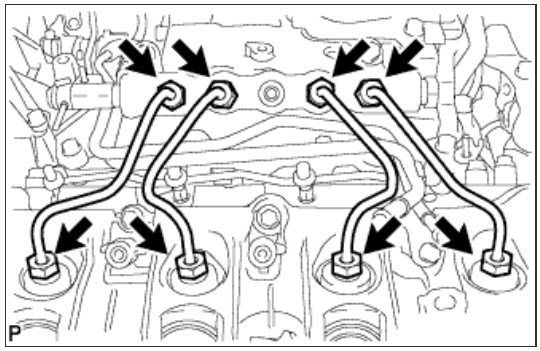
27. INSTALL INJECTION PIPE LH

a. Using a union nut wrench, install the 4 new injection pipes.

Torque:
without union nut wrench:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }
with union nut wrench:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

NOTICE:

Make sure there is no damage or foreign matter on the seal surfaces.

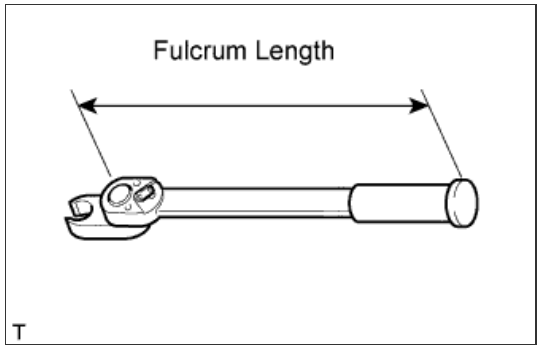


HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8**

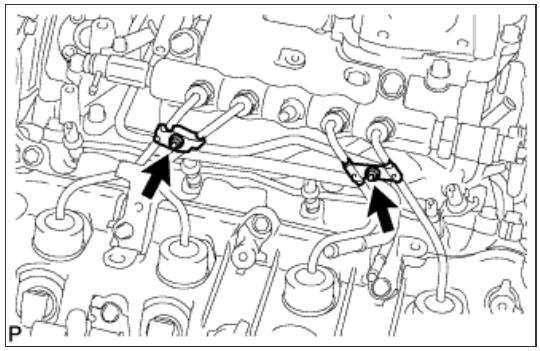
in.).

- **Make sure the union nut wrench and the torque wrench are connected in a straight line.**



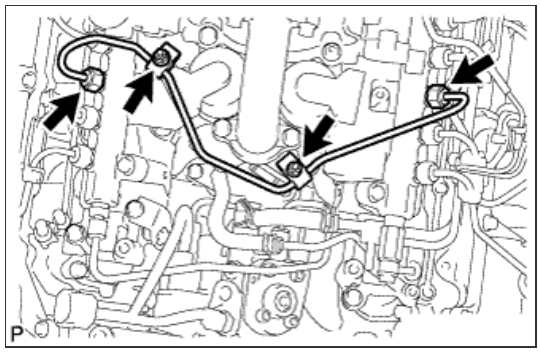
b. w/ Intercooler:
Install the 4 injection pipe clamps with the 2 nuts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



28. INSTALL NO. 6 INJECTION PIPE SUB-ASSEMBLY

a. w/ EGR System:



i. Temporarily install a new No. 6 injection pipe to the common rail L and R .

NOTICE:

Make sure there is no damage or foreign matter on the seal surfaces.

ii. Install the 2 No. 2 injection pipe clamps with the 2 nuts.

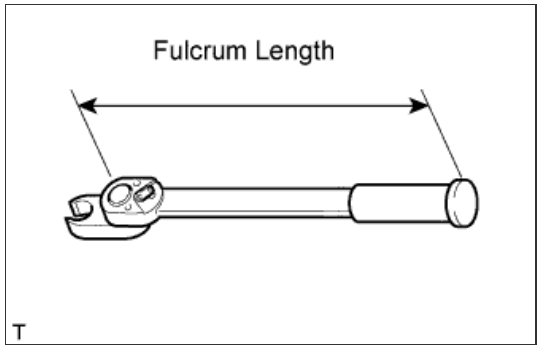
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

iii. Using a union nut wrench, tighten the No. 6 injection pipe ends.

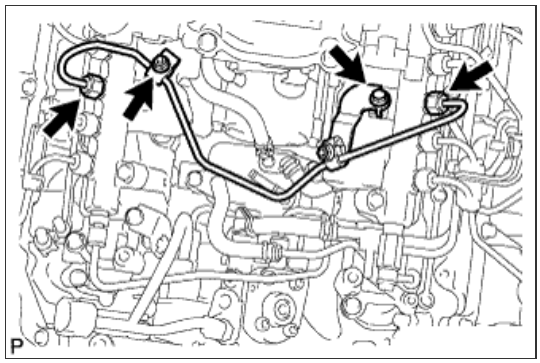
Torque:
without union nut wrench:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }
with union nut wrench:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure the union nut wrench and the torque wrench are connected in a straight line.**



b. w/o EGR System:



i. Temporarily install a new No. 6 injection pipe to the common rail L and R .

NOTICE:

Make sure there is no damage or foreign matter on the seal surfaces.

ii. Install the bracket to the No. 3 intake manifold with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

iii. Install the No. 2 injection pipe clamp with the nut.

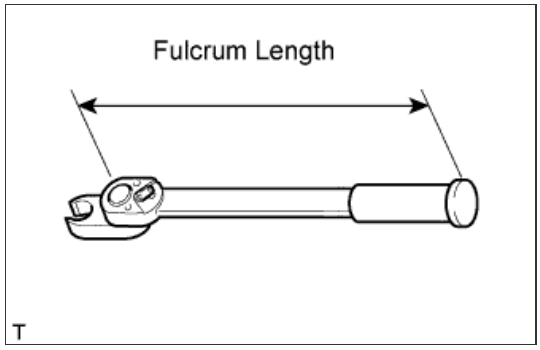
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

iv. Using a union nut wrench, tighten the No. 6 injection pipe ends.

Torque:
without union nut wrench:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }
with union nut wrench:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure the union nut wrench and the torque wrench are connected in a straight line.**

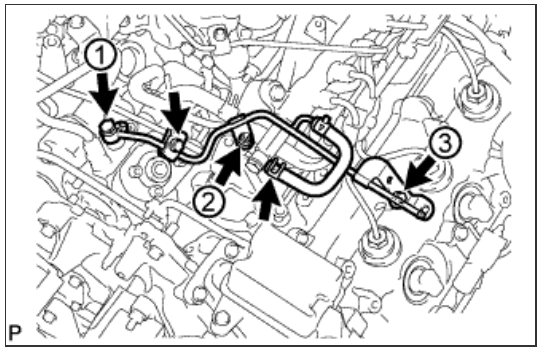


29. INSTALL NO. 2 FUEL PIPE SUB-ASSEMBLY

NOTICE:

Check for damage and foreign matter on the fuel pipe installation surface of the supply pump.

If there is foreign matter, remove it from the installation surface. If the installation surface is damaged, replace the fuel supply pump.



a. Temporarily install a new gasket and the No. 2 fuel pipe with the union bolt, nut and bolt.

b. Tighten the union bolt, nut and bolt in the order shown in the illustration.

Torque:
for union bolt:
10 N*m{ 105 kgf*cm , 8 ft.*lbf }
for bolt and nut:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

c. Install the No. 2 injection pipe clamp with the bolt.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

d. Connect the fuel hose to the No. 5 nozzle leakage pipe.

30. CONNECT ENGINE WIRE

a. R side:

i. Install the engine wire harness protector with the 3 bolts labeled A.

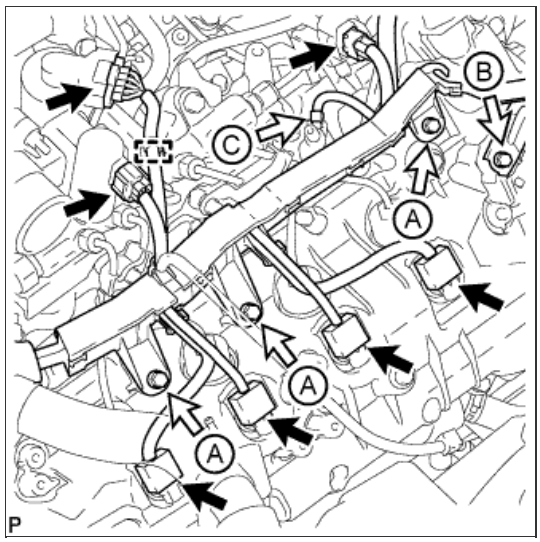
ii. Connect the 7 connectors.

iii. Attach the wire harness clamp.

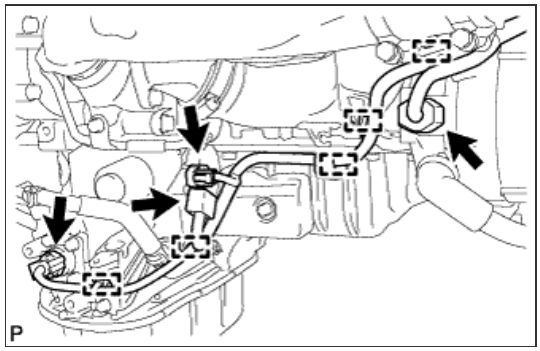
iv. Install the wire harness bracket with the bolt labeled B.

v. Install the glow plug wire harness with the nut labeled C.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }



vi. Attach the 5 wire harness clamps and connect the 4 connectors.



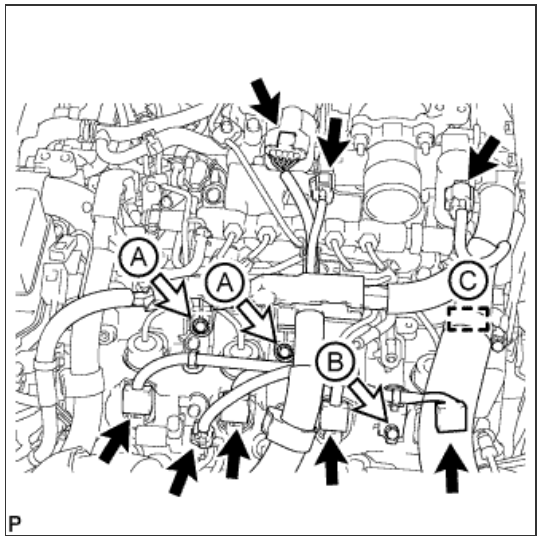
b. L side:

i. Install the engine wire harness protector with the 2 bolts labeled A.

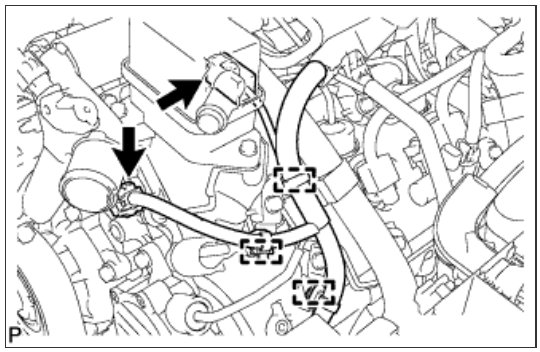
ii. Connect the 8 connectors.

iii. Install the wire harness bracket with the bolt labeled B.

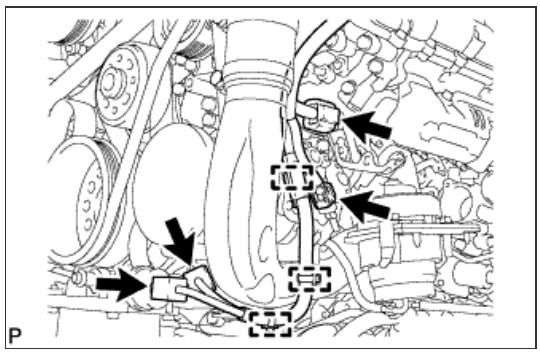
iv. for R D:
Connect the wire harness with the wire harness clamp holder labeled C.



v. Attach the 3 wire harness clamps and connect the 2 connectors.



vi. Attach the 3 wire harness clamps and connect the 4 connectors.

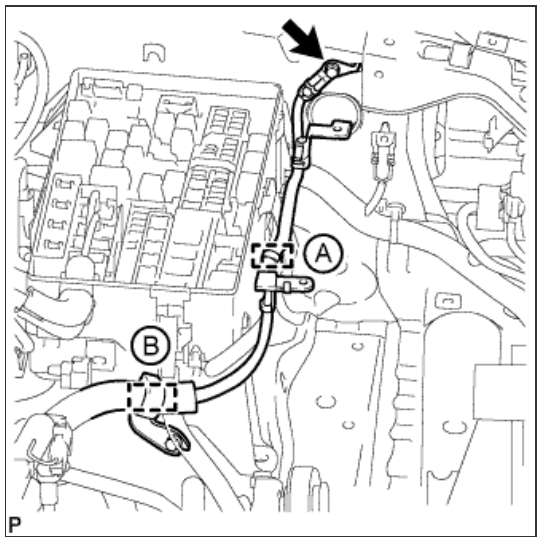


vii. Connect the wire harness with the wire harness clamp holder labeled B.

viii. Attach the ground wire clamp labeled A to the relay block side.

ix. Install the ground wire to the body panel with the bolt.

Torque:
8.4 N*m{ 87 kgf*cm , 74 in.*lbf }



x. Connect the 4 connectors to the injector driver.

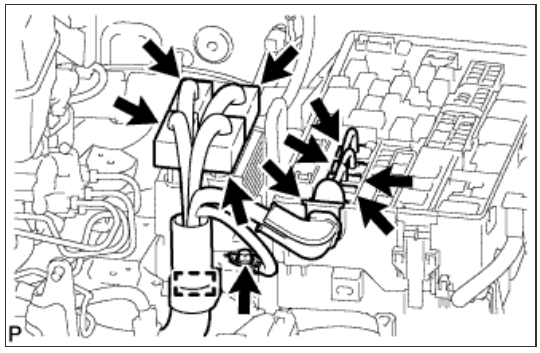
xi. Install the ground wire with the bolt.

Torque:
8.4 N*m{ 86 kgf*cm , 74 in.*lbf }

xii. Connect the wire harness holder to the relay block.

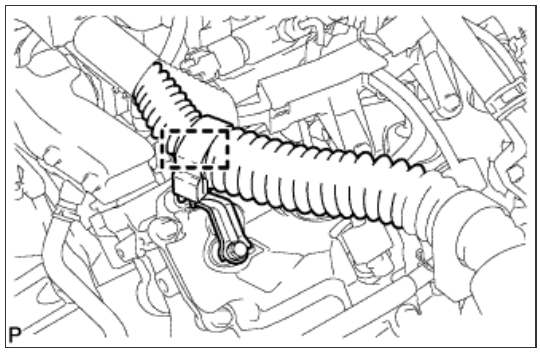
xiii. Connect the 4 connectors to the relay block.

xiv. Connect the wire harness with the wire harness clamp holder.



c. for R D:

i. Connect the wire harness with the wire harness clamp holder.

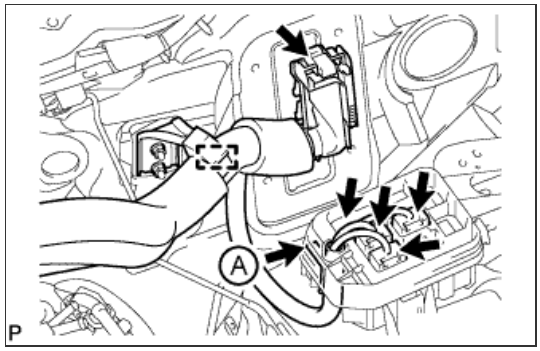


ii. Connect the ECM connector to the ECM.

iii. Connect the wire harness with the wire harness clamp holder.

iv. Attach the wire harness tab labeled A to the relay block.

v. Connect the 4 connectors to the relay block.



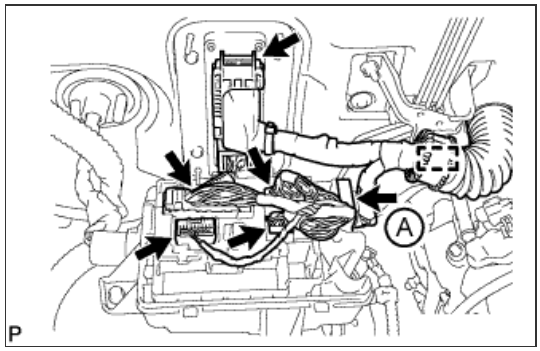
d. for L D:

i. Connect the wire harness with the wire harness clamp holder.

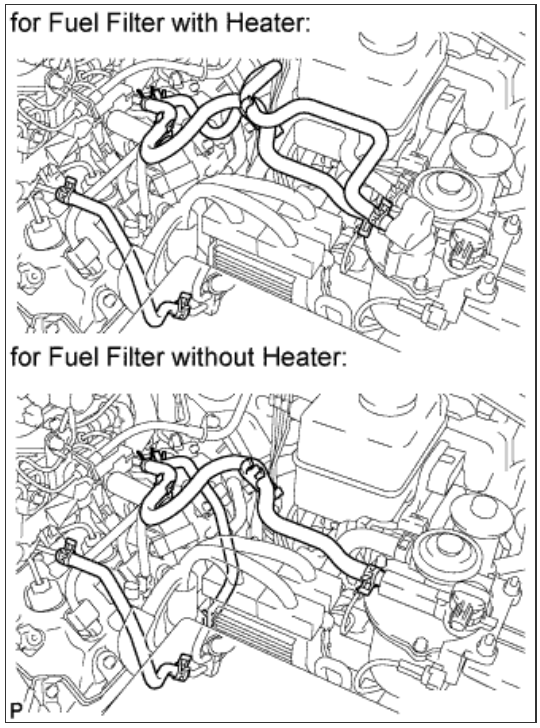
ii. Connect the ECM connector to the ECM.

iii. Attach the wire harness tab labeled A to the relay block.

iv. Connect the 4 connectors to the relay block.



31. CONNECT FUEL HOSE

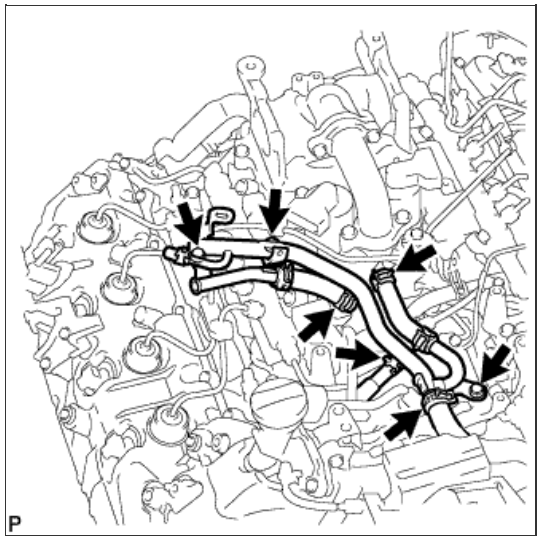


32. INSTALL NO. 4 WATER BY-PASS PIPE

a. w/ EGR System:
Connect the 4 water hose ends, and temporarily install the No. 4 water by pass pipe with the 2 bolts and nut.

b. First tighten the 2 bolts and then tighten the nut.

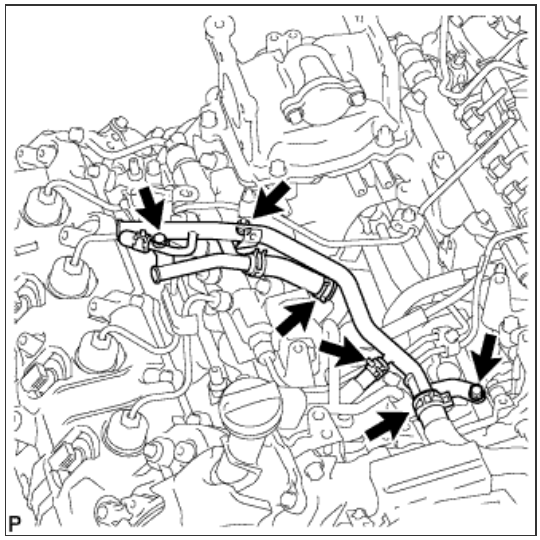
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



c. w/o EGR System:
Connect the 3 water hose ends, and temporarily install the No. 4 water by pass pipe with the 2 bolts and nut.

d. First tighten the 2 bolts and then tighten the nut.

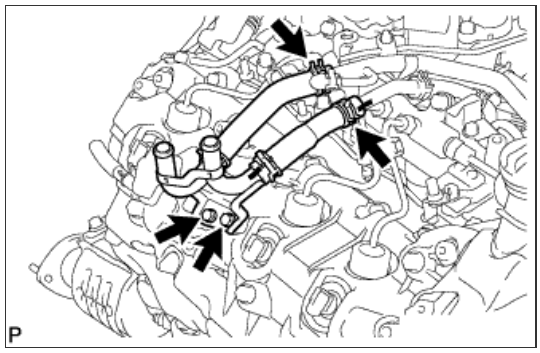
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



33. INSTALL NO. 3 WATER BY-PASS PIPE (w/o Viscous Heater)

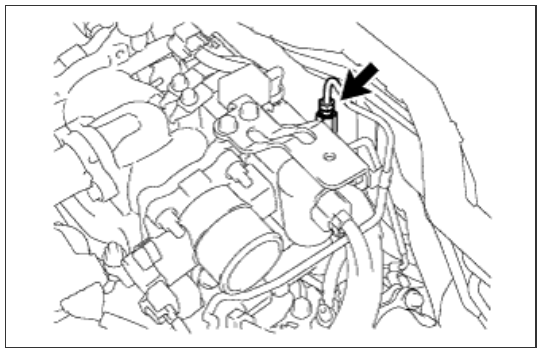
a. Connect the 2 water hose ends, and install the No. 3 water by pass pipe with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



34. INSTALL TUBE CONNECTOR TO FLEXIBLE HOSE TUBE (for Manual Transaxle)

a. Temporarily install the flare nut of the tube connector to flexible hose tube to the clutch tube to release cylinder 2 way by hand.



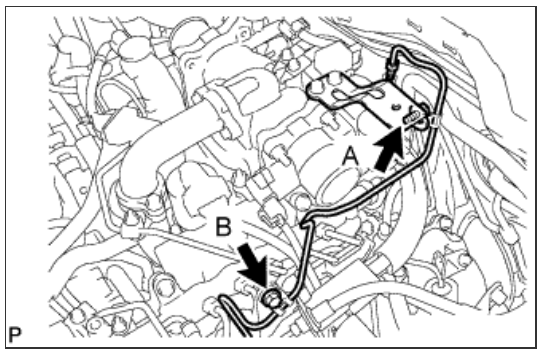
b. Temporarily install the tube connector to flexible hose tube with the 2 bolts.

c. Tighten the bolt labeled A.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

NOTICE:

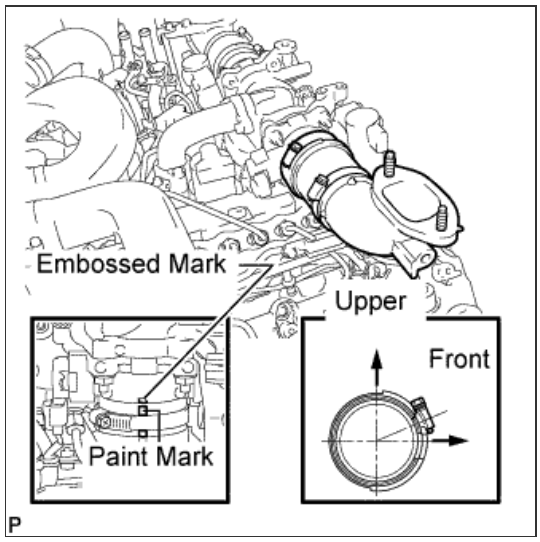
Tighten the bolt labeled B after installing the clutch hose.



35. INSTALL AIR TUBE SUB-ASSEMBLY LH

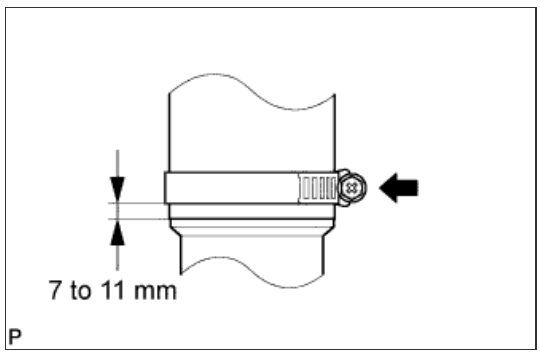
a. Install the air tube to the throttle body.

b. Align the embossed mark of the throttle body with the paint mark of the No. 4 air hose.



c. Tighten the hose clamp so that it is 7 to 11 mm (0.276 to 0.433 in.) from the end of the hose as shown in the illustration.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



36. INSTALL CLUTCH HOSE (for Manual Transmission)

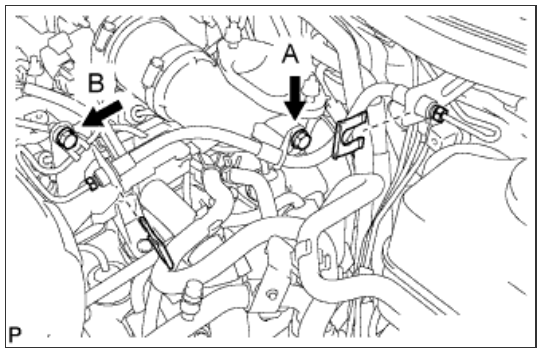
a. Connect the clutch hose to the air tube with the bolt labeled A.

b. Temporarily install the clutch hose to the clutch master cylinder tube to flexible hose tube and tube connector to flexible hose tube, and fix it in place with the 2 clips.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

c. Tighten the bolt labeled B.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }



d. Tighten the flexible hose tube.

NOTICE:

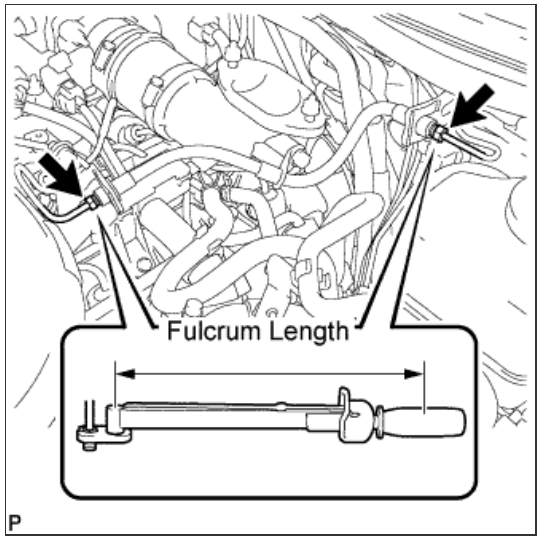
- **Do not bend or damage the flexible hose tube.**
- **Do not allow any foreign matter such as dirt and dust to enter the flexible hose tube from the connecting points.**

HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.). If using a torque wrench with a length that is not 30 cm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the "without SST" torque specification (Click here).**
- **Make sure union nut wrench and the wrench are connected in a straight line.**

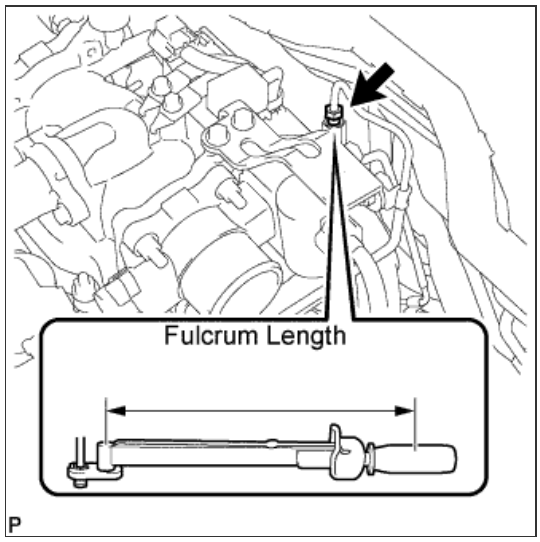
i. Using a 10 mm union nut wrench, tighten the 2 flare nuts of the flexible hose tube.

Torque:
without union nut wrench:
15 N*m{ 154 kgf*cm , 11 ft.*lbf }
with union nut wrench:
14 N*m{ 141 kgf*cm , 10 ft.*lbf }



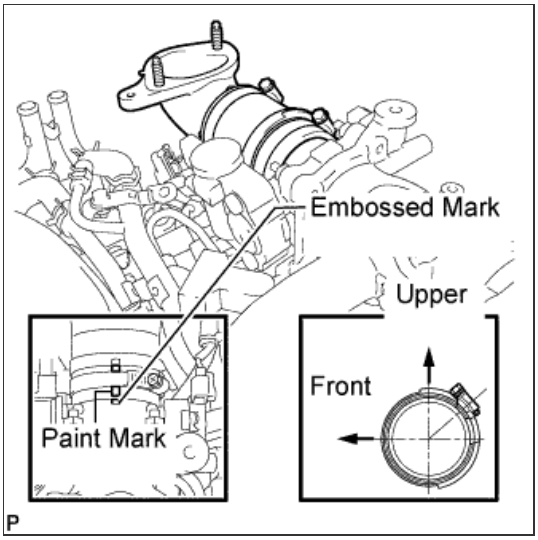
ii. Using a 10 mm union nut wrench, tighten the flare nut of the flexible hose tube.

Torque:
without union nut wrench:
15 N*m{ 154 kgf*cm , 11 ft.*lbf }
with union nut wrench:
14 N*m{ 141 kgf*cm , 10 ft.*lbf }



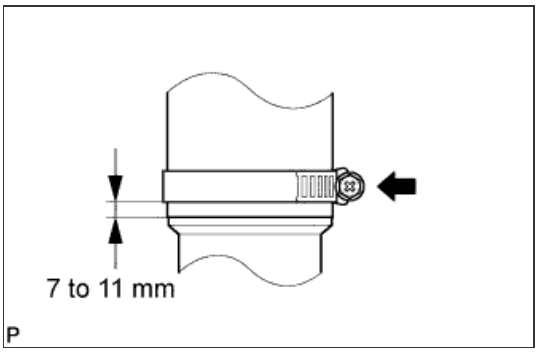
a. Install the air tube to the throttle body.

b. Align the embossed mark of the throttle body with the paint mark of the No. 4 air hose.



c. Tighten the hose clamp so that it is 7 to 11 mm (0.276 to 0.433 in.) from the end of the hose as shown in the illustration.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



38. INSTALL NO. 2 ENGINE OIL LEVEL DIPSTICK GUIDE

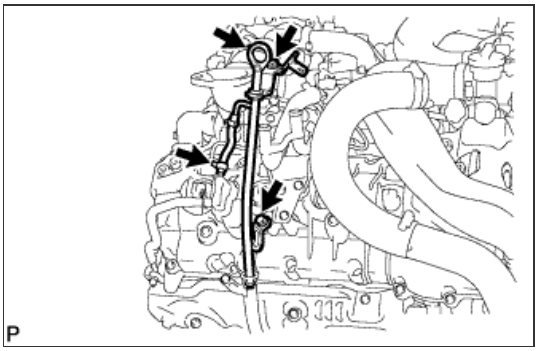
a. Apply a light coat of engine oil to a new O ring.

b. Install the O ring to the No. 2 engine oil level dipstick guide.

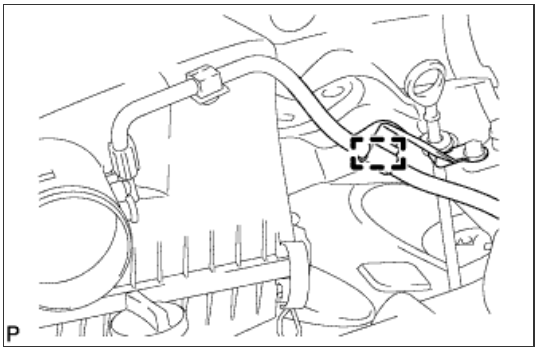
c. Install the No. 2 engine oil level dipstick guide with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

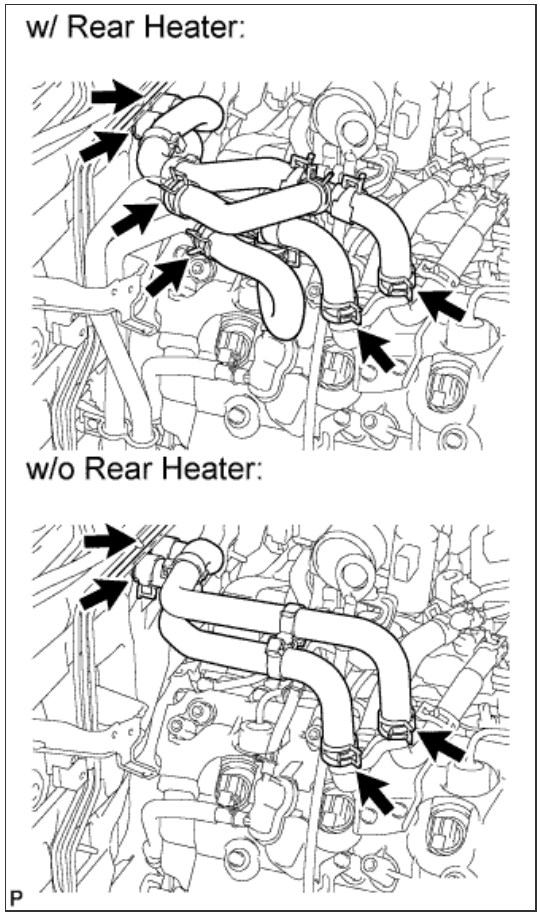
d. Connect the ventilation hose to the cylinder head cover R .



e. Connect the wire harness clamp to the No. 2 engine oil level dipstick guide bracket.



39. CONNECT WATER HOSE SUB-ASSEMBLY



40. INSTALL NO. 2 AIR CLEANER PIPE SUB-ASSEMBLY

a. Connect the No. 2 air cleaner pipe to the No. 2 intake air connector pipe.

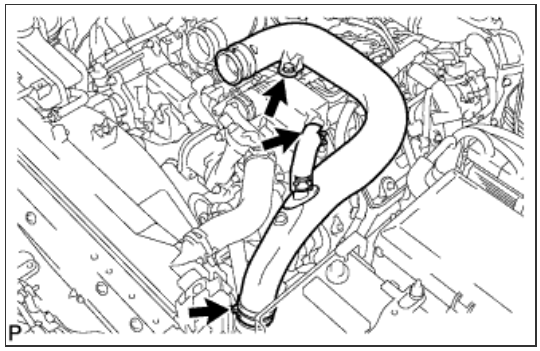
b. Connect the ventilation hose to the oil separator.

c. Install the pipe with the bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

d. Tighten the hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



41. INSTALL NO. 4 AIR TUBE

a. Install the No. 4 air tube with the bolt.

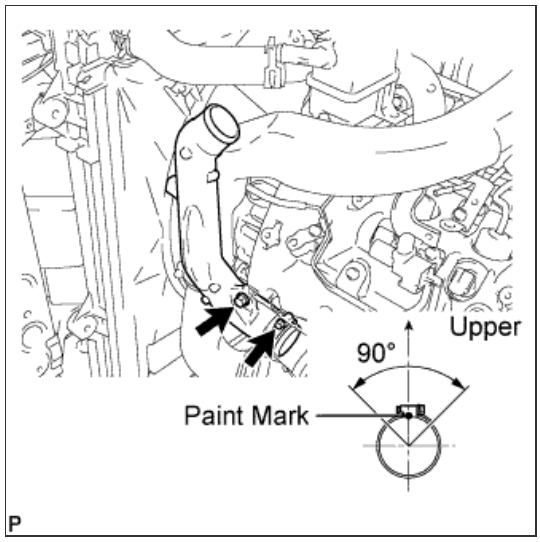
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

b. Tighten the hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

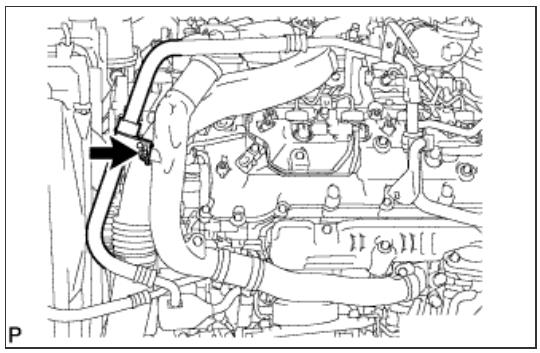
HINT:

Make sure the direction of the hose clamp is as shown in the illustration.



c. Install the suction hose with the bolt.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }



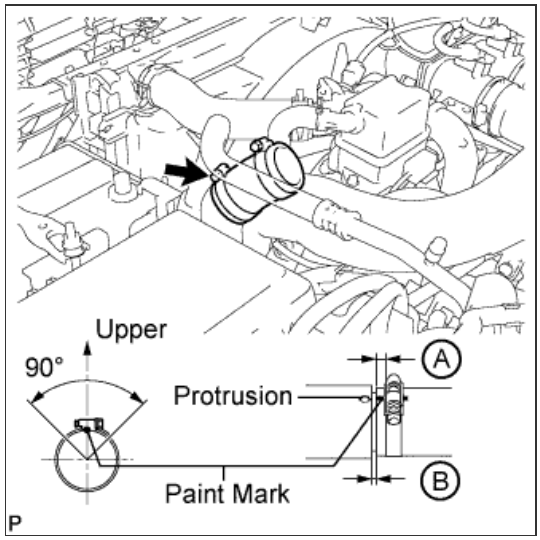
42. INSTALL NO. 2 AIR HOSE

a. Connect the No. 2 air hose with the hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion and push in the air hose so that distance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that distance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make sure the direction of the hose clamp is as shown in the illustration.**



43. INSTALL NO. 1 AIR CLEANER PIPE SUB-ASSEMBLY

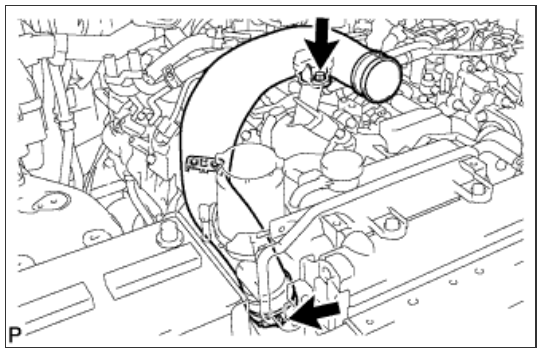
a. Connect the No. 1 air cleaner pipe to the No. 1 intake air connector pipe.

b. Install the pipe with the bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Tighten the hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



44. INSTALL NO. 3 AIR TUBE

a. Install the No. 3 air tube with the bolt.

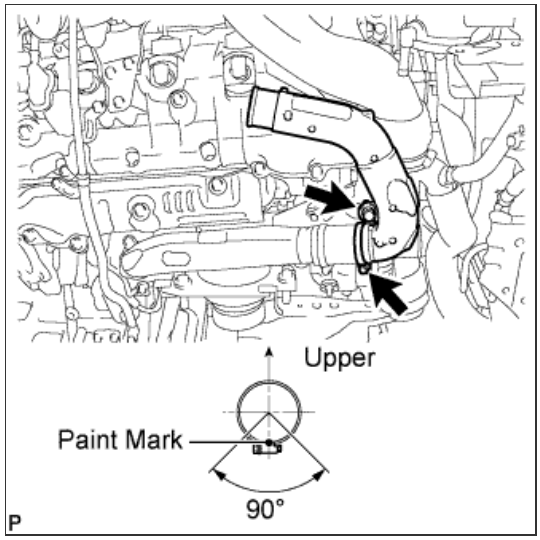
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

b. Tighten the hose clamp.

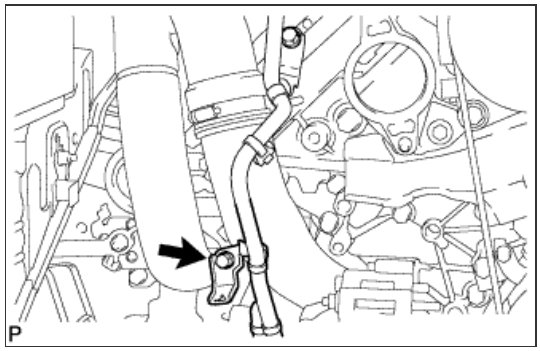
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

Make sure the direction of the hose clamp is as shown in the illustration.

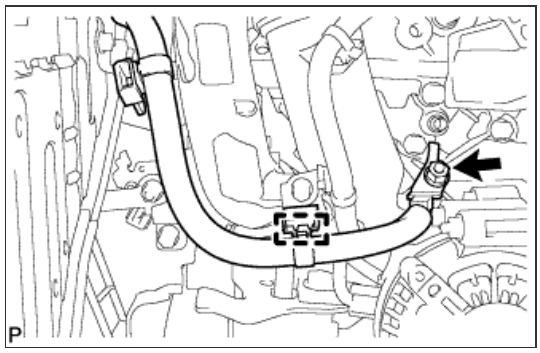


c. Install the wire harness bracket with the bolt.



d. Install the ground wire with the nut, and attach the wire harness clamp.

Torque:
8.4 N*m{ 87 kgf*cm , 74 in.*lbf }



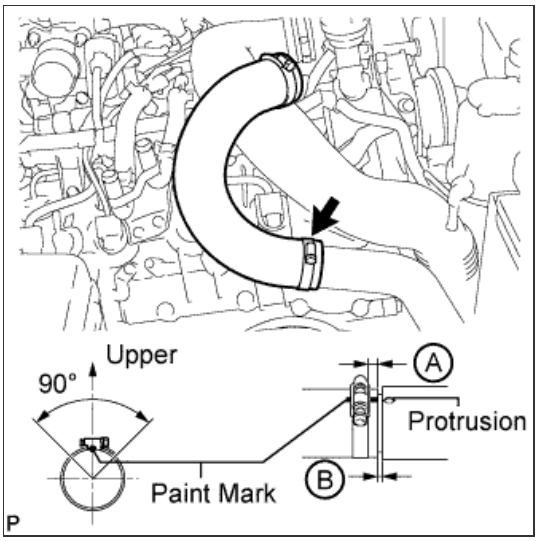
45. INSTALL NO. 1 AIR HOSE

a. Connect the No. 1 air hose with the hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

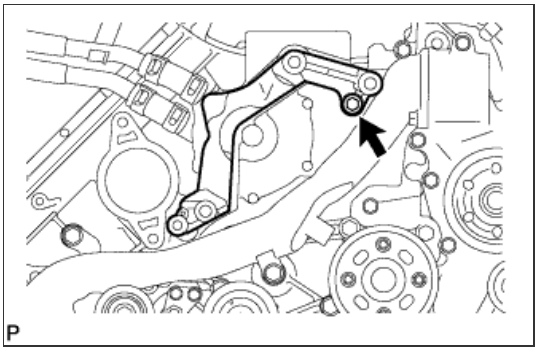
- **Align the paint mark of the air hose with the protrusion and push in the air hose so that distance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that distance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make sure the direction of the hose clamp is as shown in the illustration.**



46. INSTALL NO. 1 IDLER PULLEY BRACKET (w/ Viscous Heater)

a. Install the No. 1 idler pulley bracket with the bolt.

Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }



47. INSTALL VISCOUS HEATER ASSEMBLY WITH MAGNET CLUTCH (w/ Viscous Heater)

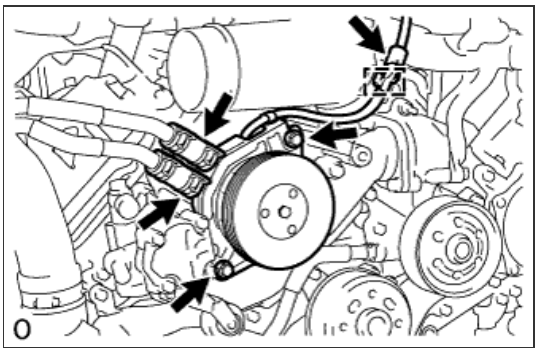
a. Install the heater assembly with the 2 bolts.

Torque:
48.5 N*m{ 495 kgf*cm , 36 ft.*lbf }

b. Connect the 2 heater hoses.

c. Using pliers, grip the claws of the clips and slide the 2 clips.

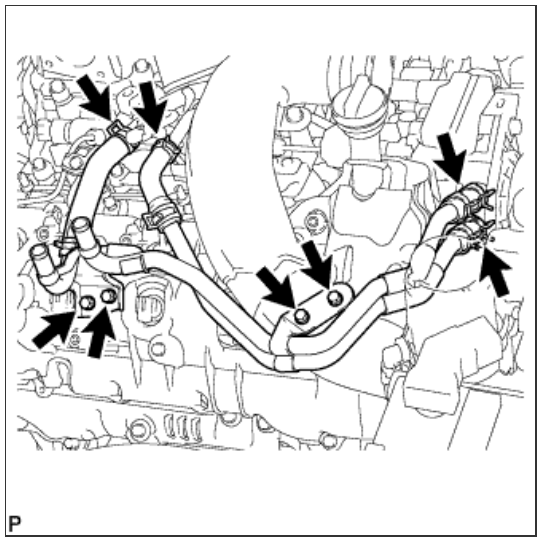
d. Connect the connector and attach the clamp.



48. INSTALL HEATER WATER PIPE SUB-ASSEMBLY (w/ Viscous Heater)

a. Connect the 4 water hose ends, and install the water pipe with the 4 bolts.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }

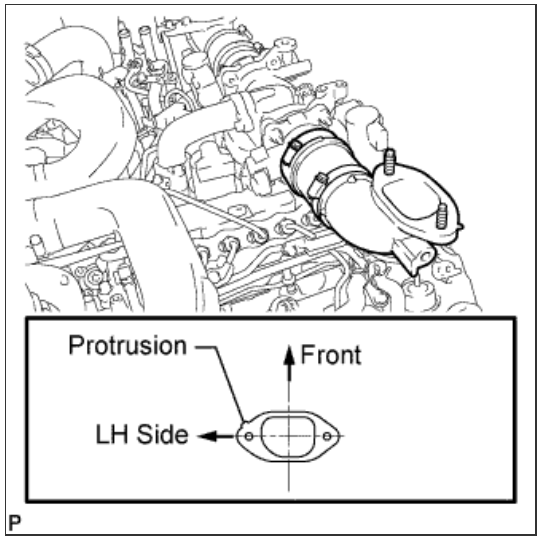


49. INSTALL NO. 2 COOL AIR INLET (w/o Intercooler)

a. Install a new gasket to the air tube L .

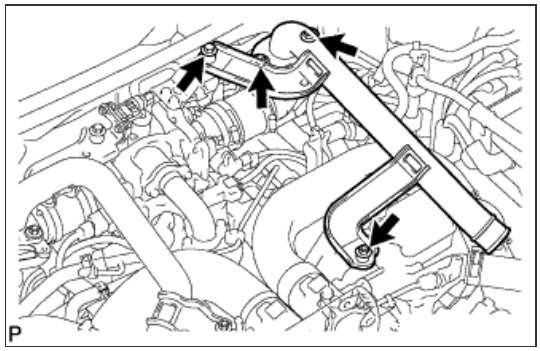
HINT:

Install the gasket with the protrusion facing as shown in the illustration.



b. Install the No. 2 cool air inlet with the 3 nuts and bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



c. Connect the No. 2 air hose to the No. 2 cool air inlet.

d. Tighten the No. 2 air hose clamp.

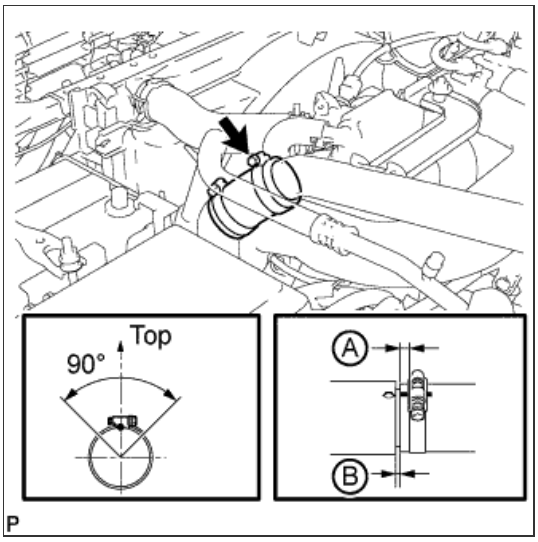
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion and push on the air hose so that distance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that distance A is 2 to 6 mm (0.0787 to**

0.236 in.).

- **Make sure the direction of the hose clamp is as shown in the illustration.**

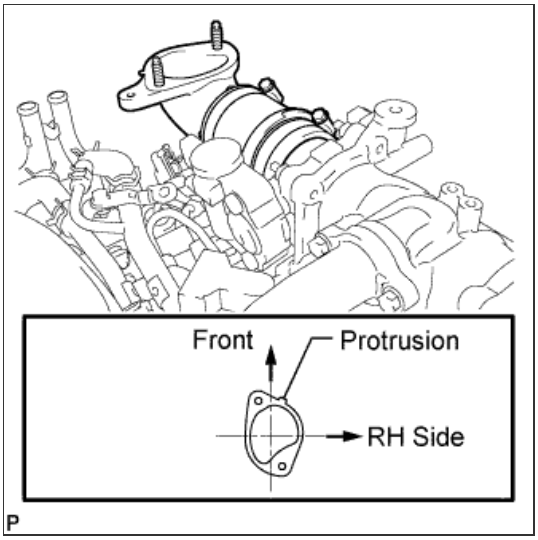


50. INSTALL NO. 1 COOL AIR INLET (w/o Intercooler)

a. Install a new gasket to the air tube R .

HINT:

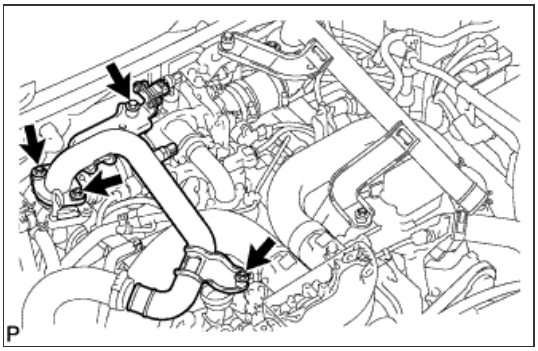
Install the gasket with the protrusion facing as shown in the illustration.



b. Install the No. 1 cool air inlet with the 3 nuts and bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Connect the vacuum hose, intake air temperature sensor connector and turbo pressure sensor connector.



d. Connect the No. 1 air hose to the No. 1 cool air inlet.

e. Tighten the No. 1 air hose clamp.

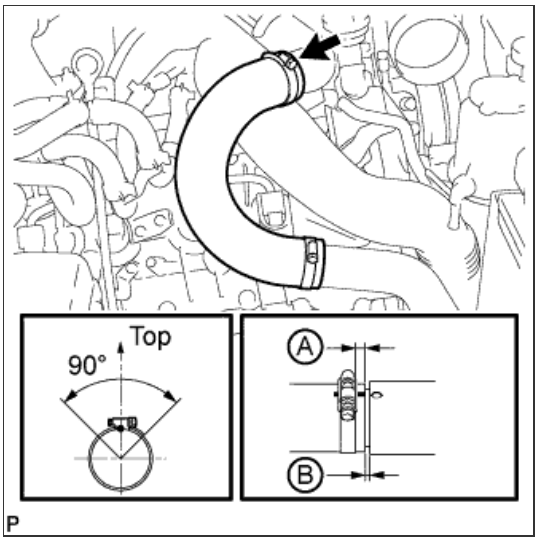
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion and push on the air hose so that distance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that distance A is 2 to 6 mm (0.0787 to**

0.236 in.).

- **Make sure the direction of the hose clamp is as shown in the illustration.**

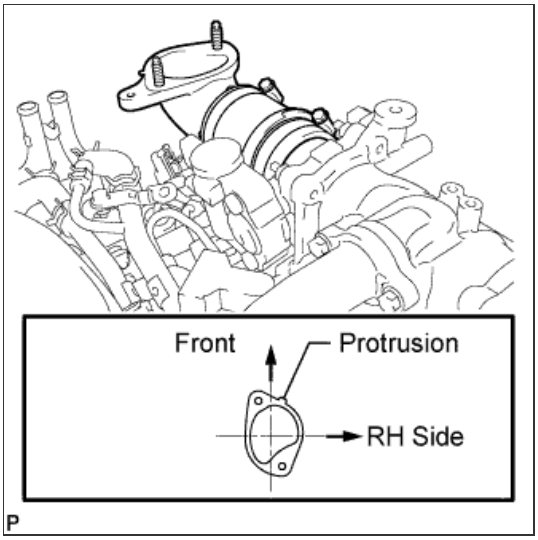


51. INSTALL INTERCOOLER ASSEMBLY (w/ Intercooler)

a. Install a new gasket to the air tube R .

HINT:

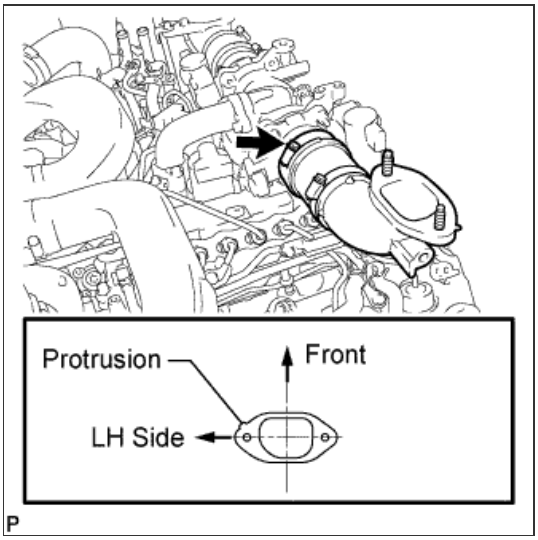
Install the gasket with the protrusion facing as shown in the illustration.



b. Install a new gasket to the air tube L .

HINT:

Install the gasket with the protrusion facing as shown in the illustration.



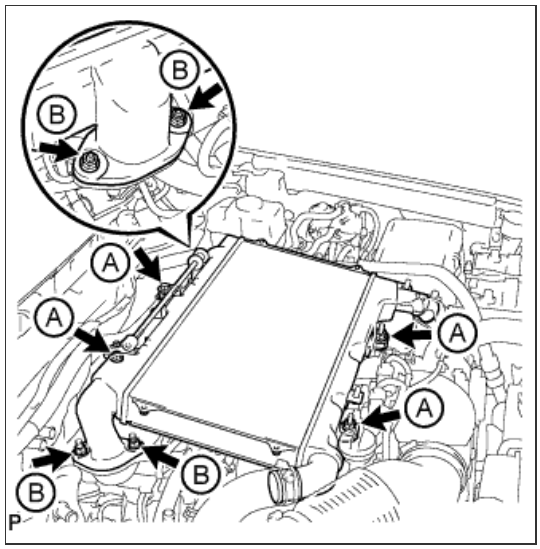
c. Align the No. 1 and No. 2 air hoses and intercooler pipes and connect them, and install the intercooler with the 2 bolts and 2 nuts labeled A in the illustration.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

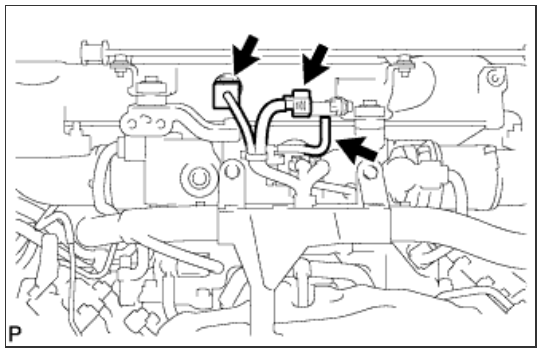
d. Temporarily install the 4 nuts labeled B in the illustration.

e. Tighten the air tube L and R with the 4 nuts labeled B shown in the illustration.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



f. Connect the vacuum hose, intake air temperature sensor connector and turbo pressure sensor connector.

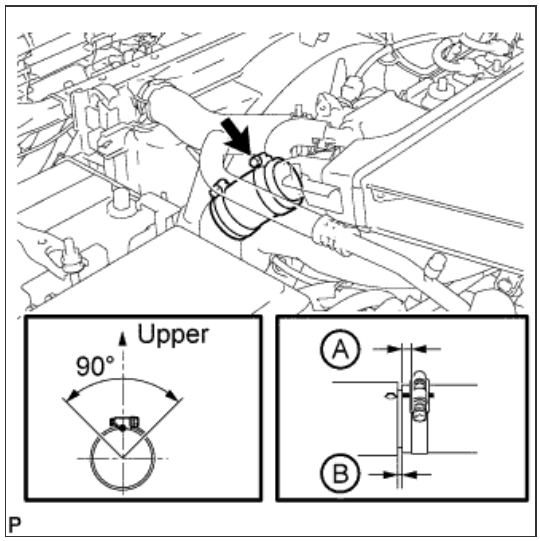


g. Tighten the clamp of the No. 2 air hose.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion and push in the air hose so that distance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that distance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make sure the direction of the hose clamp is as shown in the illustration.**

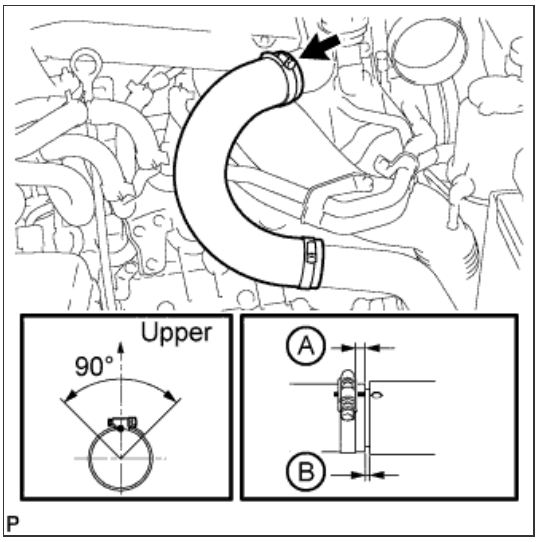


h. Tighten the clamp of the No. 1 air hose.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion and push in the air hose so that distance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that distance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make sure the direction of the hose clamp is as shown in the illustration.**



2. INSTALL FAN SHROUD WITH FAN

a. Install the shroud together with the fluid coupling fan between the radiator and engine components.

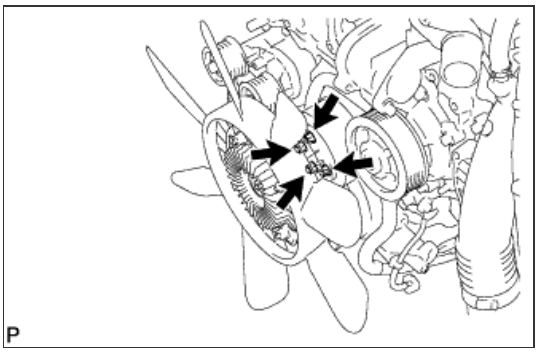
NOTICE:

Be careful not to damage the radiator core.

b. Temporarily install the fluid coupling fan to the fan bracket with the 4 nuts.

HINT:

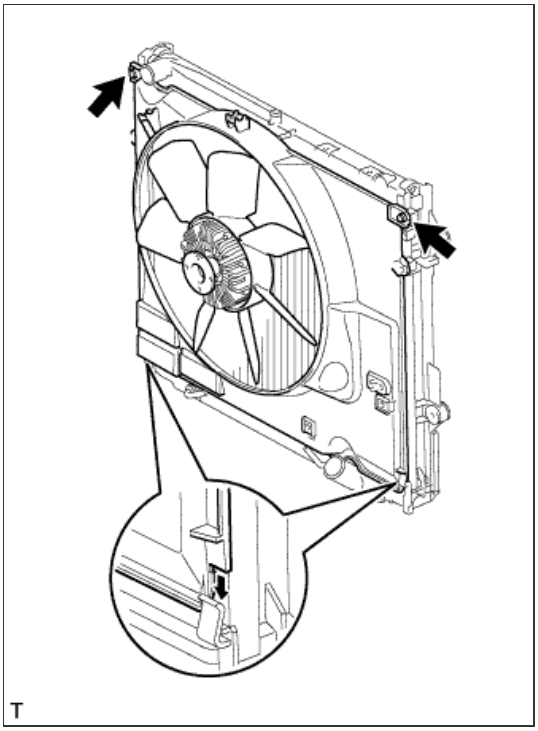
Tighten the nuts as much as possible by hand.



c. Attach the shroud claws to the radiator.

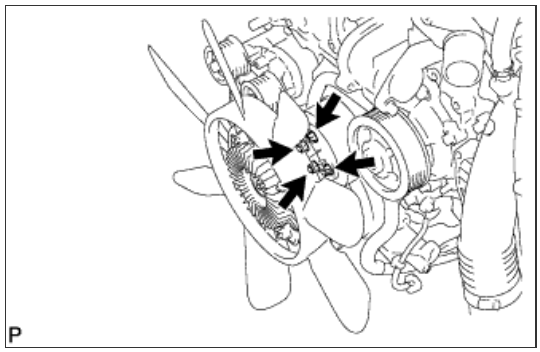
d. Install the shroud with the 2 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }



e. Tighten the 4 nuts of the fluid coupling fan.

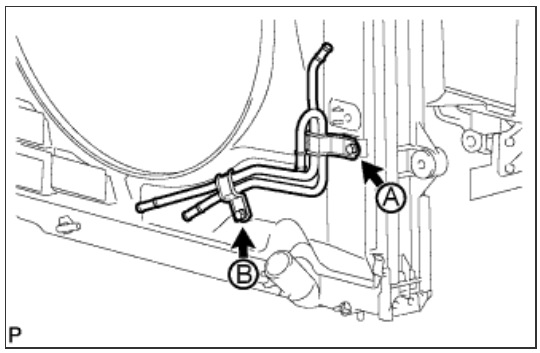
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



53. INSTALL OIL COOLER TUBE (for Automatic Transmission)

a. Temporarily install the oil cooler tube to the fan shroud with the bolt labeled A. Install the bolt labeled B. Then tighten the bolt labeled A to the specified tor ue.

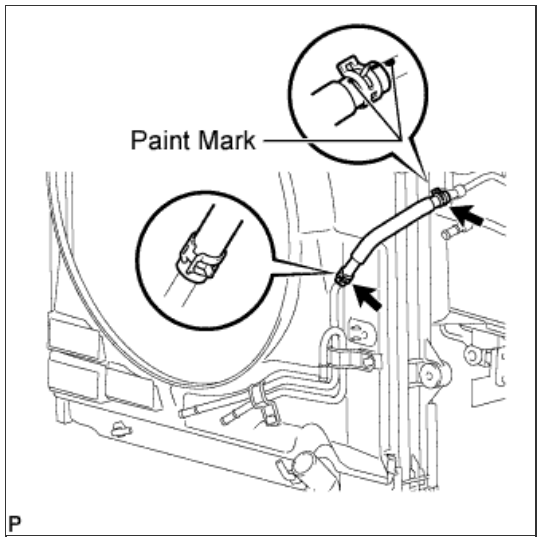
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



b. Connect the inlet No. 4 oil cooler hose as shown in the illustration.

NOTICE:

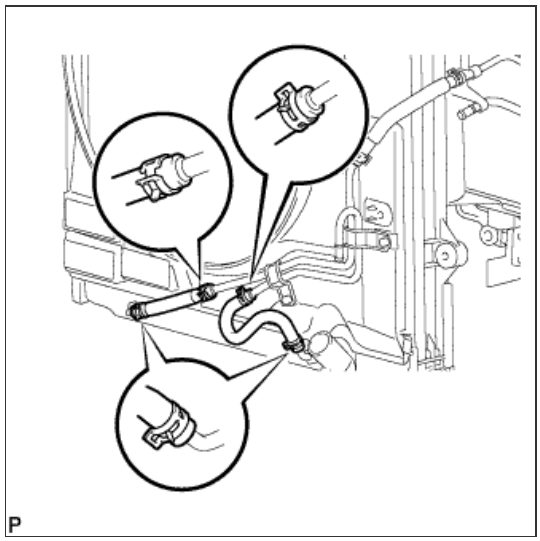
Make sure the pinching portion of each clip is facing the direction shown in the illustration.



c. Connect the inlet No. 2 and No. 3 oil cooler hoses as shown in the illustration.

NOTICE:

Make sure the pinching portion of each clip is facing the direction shown in the illustration.

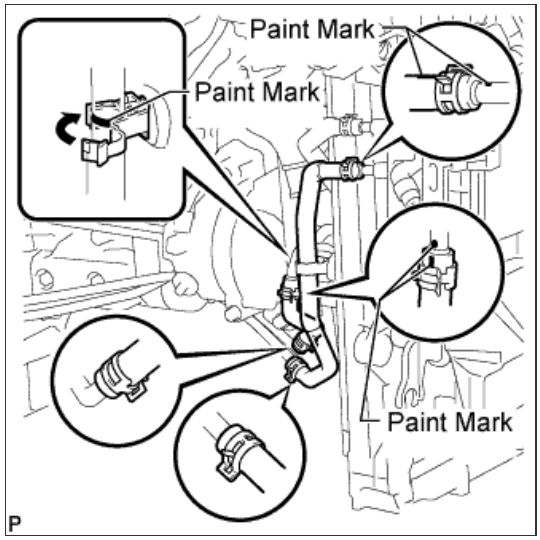


d. Connect the inlet and outlet No. 1 oil cooler hoses as shown in the illustration.

NOTICE:

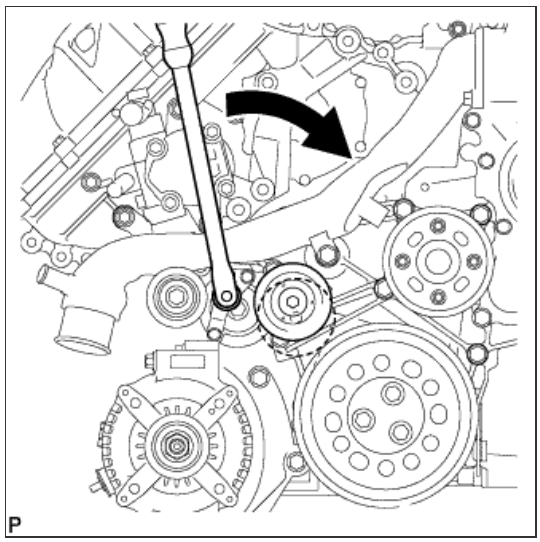
Make sure the pinching portion of each clip is facing the direction shown in the illustration.

e. Pass the hose through the flexible hose clamp and close the clamp shown in the illustration.

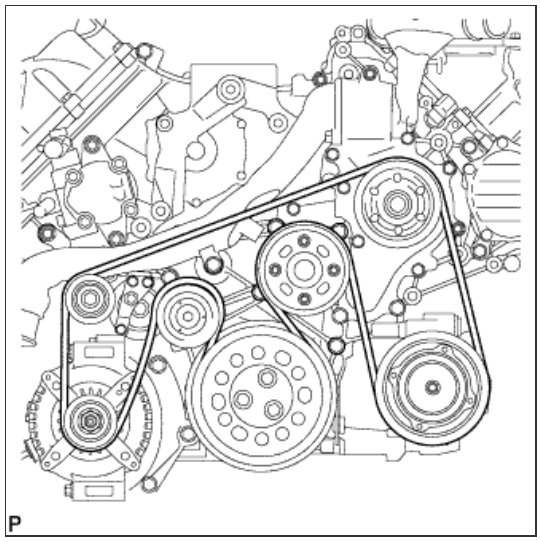


54. INSTALL V-RIBBED BELT

a. Attach a wrench to the ribbed belt tensioner bracket and turn the wrench clockwise.



b. Install the ribbed belt as shown in the illustration.

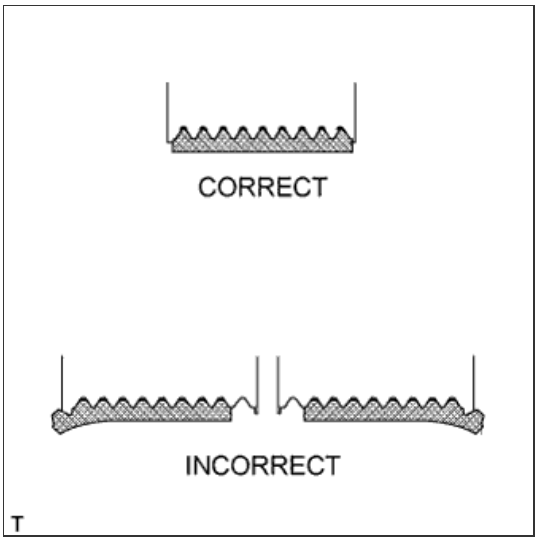


c. Check that the belt fits properly in the ribbed grooves.

HINT:

Check with your hand to confirm that the belt has not slipped out of the groove on the bottom of the pulley.

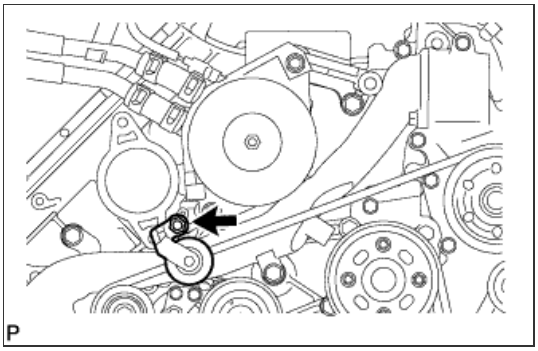
If it has slipped out, replace the ribbed belt. Install a new ribbed belt.



. INSTALL NO. 3 IDLER PULLEY (w/ Viscous Heater)

a. Align the No. 3 idler pulley bracket knock pin and No. 1 idler pulley bracket knock pin hole and install the No. 3 idler pulley with the nut.

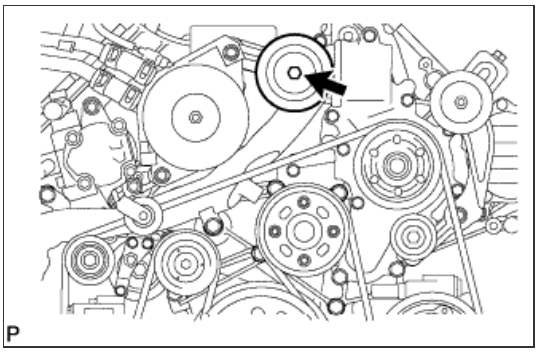
Torque:
88 N*m{ 898 kgf*cm , 64 ft.*lbf }



56. INSTALL NO. 1 IDLER PULLEY (w/ Viscous Heater)

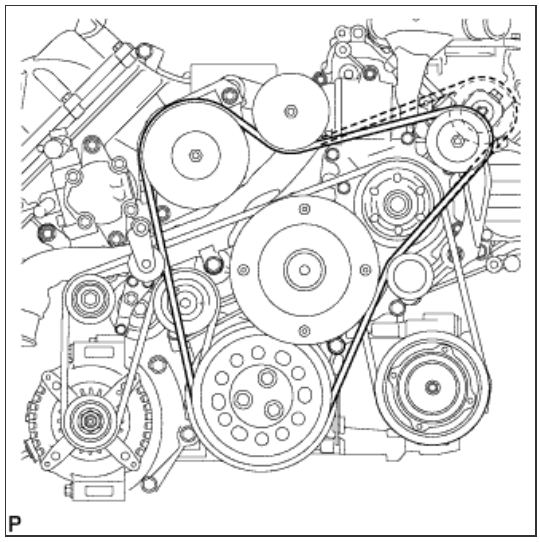
a. Install the collar, No. 1 idler pulley and cover with the bolt.

Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }

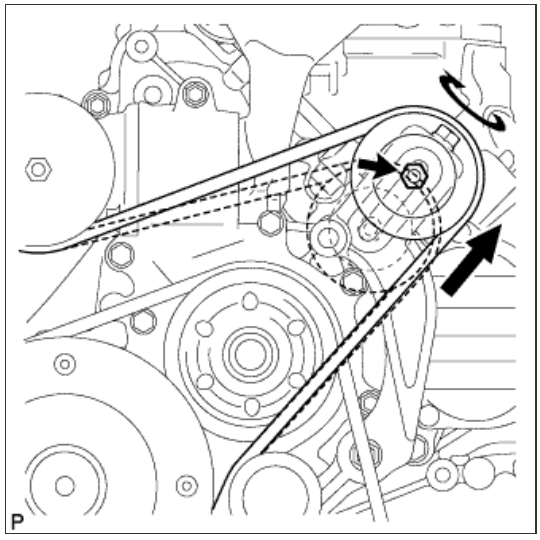


57. INSTALL V-RIBBED BELT (w/ Viscous Heater)

a. Install the ribbed belt as shown in the illustration.



b. Temporarily install the lock nut, and turn the bolt clockwise.



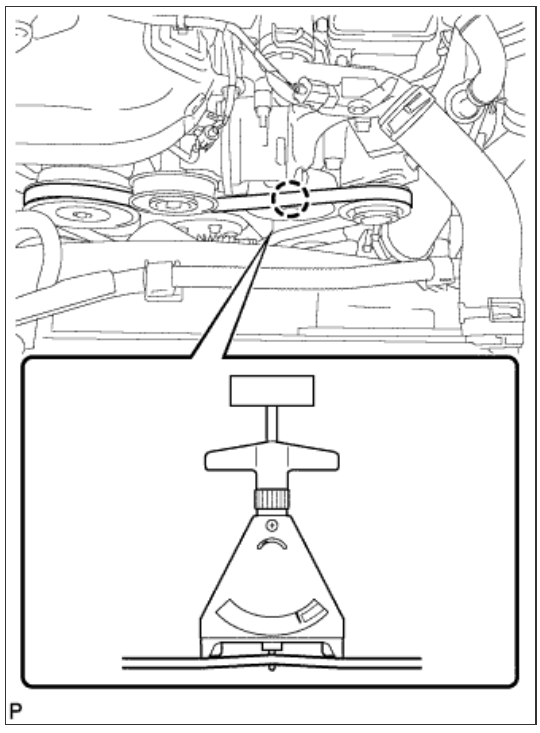
c. Using a belt tension gauge, adjust belt tension.

Standard elt Tension:

Item	Specified Condition
New belt	400 to 650 N (41 to 66 kgf, 89.9 to 146.1 lbf)
Used belt	300 to 500 N (31 to 51 kgf, 67.4 to 112.4 lbf)

HINT:

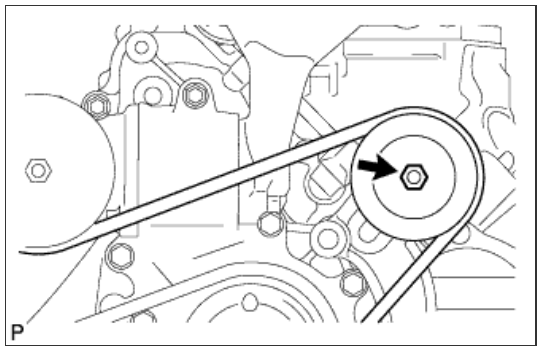
- **A "new belt" is a belt which has been used for less than 5 minutes on a running engine.**
- **A "used belt" is a belt which has been used on a running engine for 5 minutes or more.**
- **After installing a new belt, run the engine for approximately 5 minutes and then recheck the tension.**



d. Tighten the nut.

Torque:

40 N*m{ 408 kgf*cm , 30 ft.*lbf }

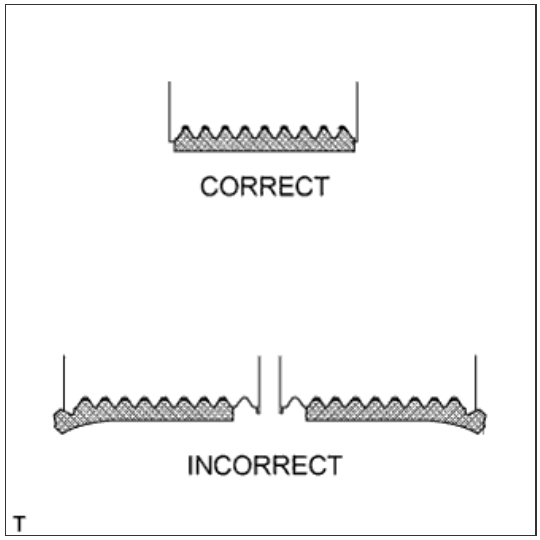


e. Check that the belt fits properly in the ribbed grooves.

HINT:

Check with your hand to confirm that the belt has not slipped out of the groove on the bottom of the pulley.

If it has slipped out, replace the ribbed belt. Install a new ribbed belt.

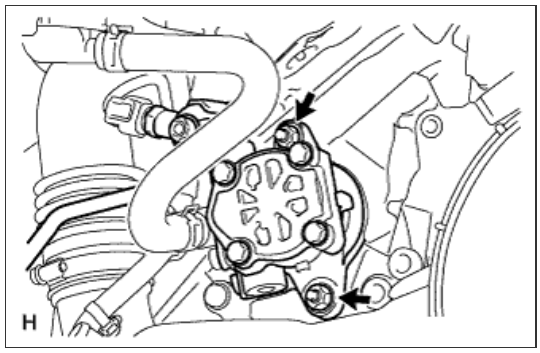


58. INSTALL VANE PUMP ASSEMBLY

a. Apply a light coat of engine oil to a new O ring, and install it to the vane pump.

b. Install the vane pump with 2 new nuts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



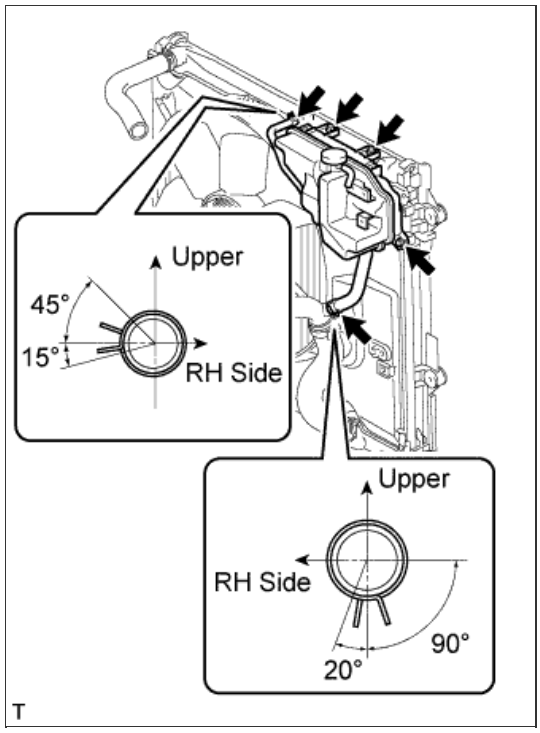
59. INSTALL RADIATOR RESERVOIR ASSEMBLY

a. Install the radiator reservoir with the 3 bolts.

b. Connect the 2 hoses to the upper radiator tank and water inlet.

HINT:

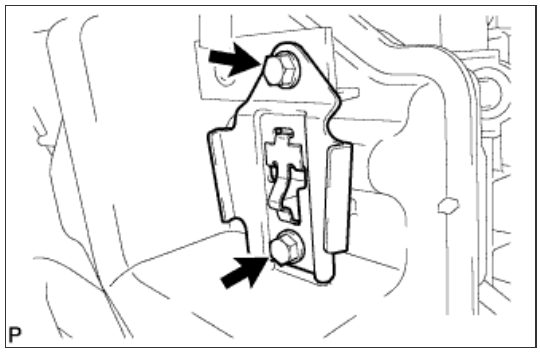
Make sure the directions of the hose clamps are as shown in the illustration.



60. INSTALL NO. 1 OIL RESERVOIR BRACKET

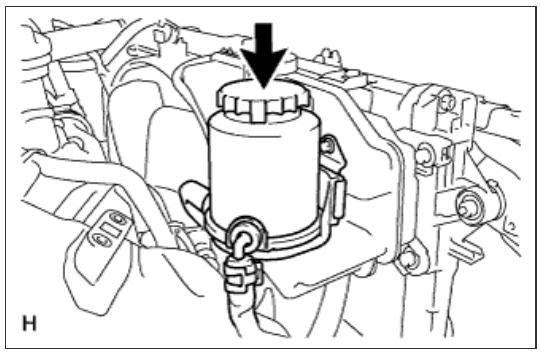
a. Install a new bracket with the 2 bolts.

Torque:
4.5 N*m{ 46 kgf*cm , 40 in.*lbf }



61. INSTALL VANE PUMP OIL RESERVOIR ASSEMBLY

a. Install the vane pump oil reservoir to the bracket.



62. INSTALL INTAKE AIR CONNECTOR

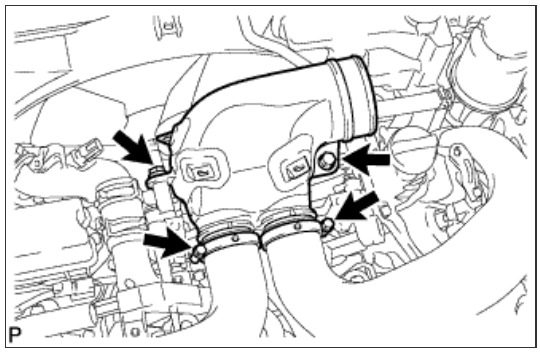
a. Connect the intake air connector to the No. 1 and No. 2 air cleaner pipes.

b. Install the connector with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Tighten the 2 hose clamps.

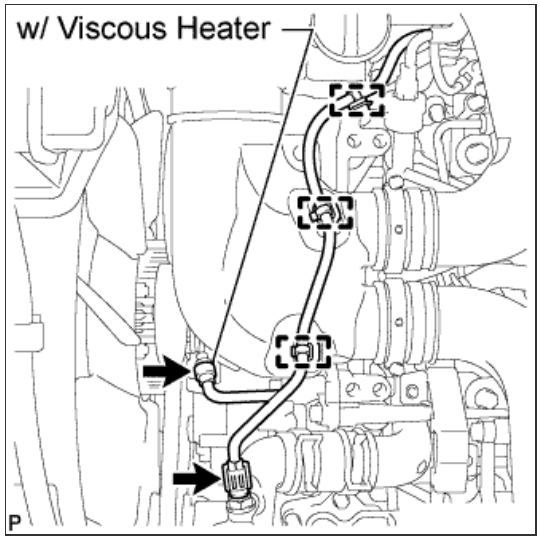
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



d. Attach the 3 wire harness clamps.

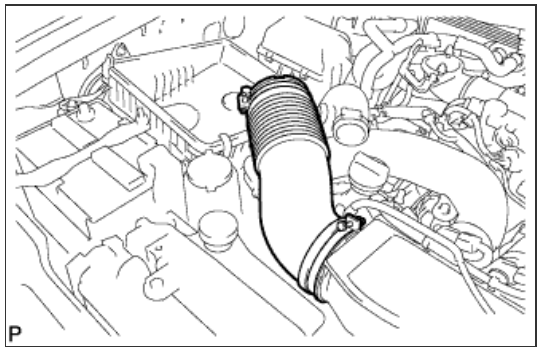
e. w/o iscous eater:
Connect the connector to the water temperature sensor.

f. w/ iscous eater:
Connect the 2 connectors to the water temperature sensor and viscous with magnet clutch heater.



63. TEMPORARILY INSTALL NO. 1 AIR CLEANER HOSE

a. Temporarily install the air cleaner hose to the intake air connector.

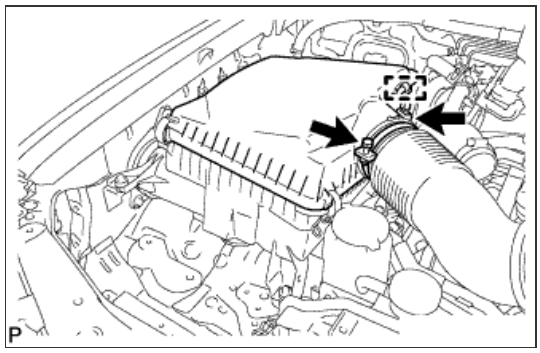


64. INSTALL AIR CLEANER CAP SUB-ASSEMBLY

a. Connect the air cleaner cap to the air cleaner hose, and install the air cleaner cap with the 4 clamps.

b. Connect the mass air flow meter connector and attach the wire harness clamp to the air cleaner cap.

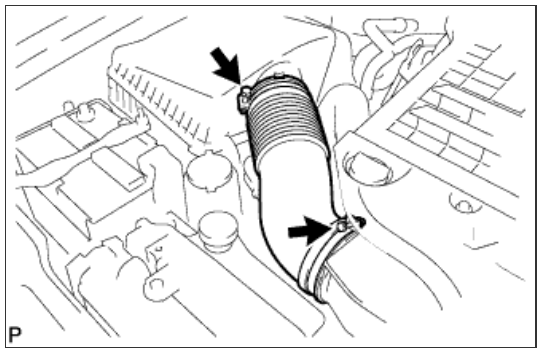
c. Attach the wire harness clamp.



d. Align the protrusion of air cleaner cap and concave portion of air cleaner hose.

e. Tighten the 2 hose clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

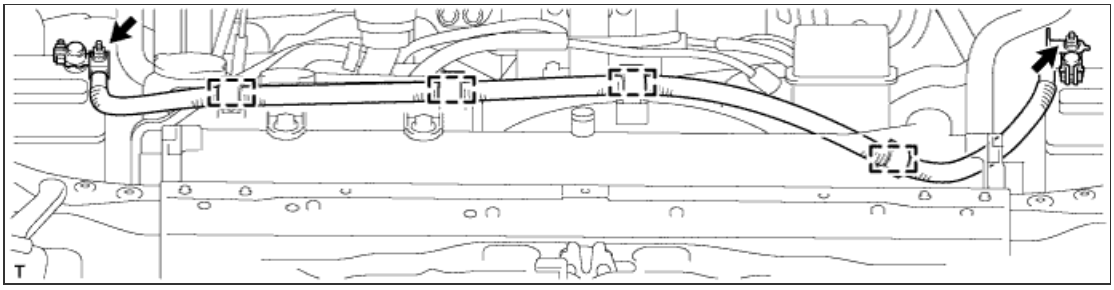


65. INSTALL NO. 3 ENGINE ROOM WIRE

a. Install the No. 3 engine room wire to the main battery and sub attery positive terminals with the 2 nuts.

Torque:
7.6 N*m{ 77 kgf*cm , 67 in.*lbf }

b. Connect the No. 3 engine room wire with the 4 clamps.



66. ADD ENGINE OIL

a. Add fresh oil.

Standard Engine Oil:

Oil Grade	Oil iscosity (SAE)
G DLD 1, API CF , API CF or ACEA B1 (You may also use API CE or CD)	5W 30 10W 30 15W 0 20W 0 (5W 30 is best choice for fuel economy and good starting in cold weather).

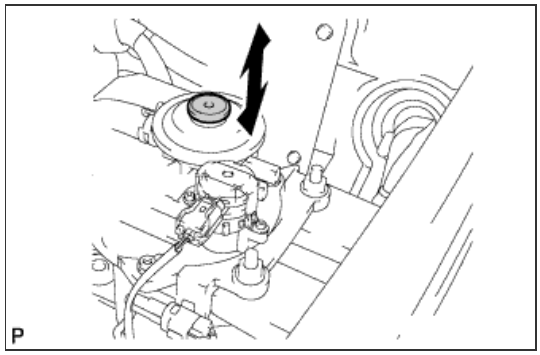
Standard Capacity:

Item	Specified Condition
Drain and refill with oil filter change	9.2 liters (9.7 US ts, 8.1 Imp. ts)
Drain and refill without oil filter change	8.2 liters (8.7 US ts, 7.2 Imp. ts)
Dry fill	9.9 liters (10.5 US ts, 8.7 Imp. ts)

b. Install the oil filler cap.

67. BLEED AIR FROM FUEL SYSTEM

a. Using the hand pump indicated by the arrow in the illustration, bleed the fuel system. Continue pumping until pumping becomes difficult.



6 . EED CLUTCH LINE

a. Remove the release cylinder bleeder plug cap.

b. Connect a vinyl tube to the bleeder plug.

c. Depress the clutch pedal several times, and then loosen the bleeder plug while the pedal is depressed.

d. When fluid no longer comes out, tighten the bleeder plug, and then release the clutch pedal.

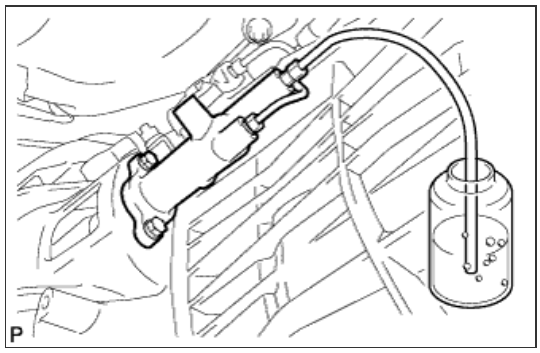
e. Repeat the previous 2 steps until all the air in the fluid is completely bled.

f. Tighten the bleeder plug.

Torque:
11 N*m{ 110 kgf*cm , 8 ft.*lbf }

g. Install the bleeder plug cap.

h. Check that all the air has been bled from the clutch line.



69. INSPECT FOR CLUTCH FLUID LEAK

70. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

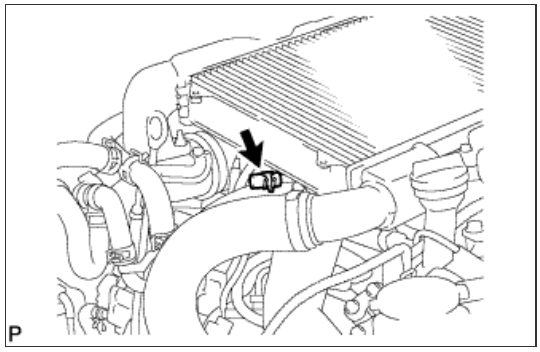
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

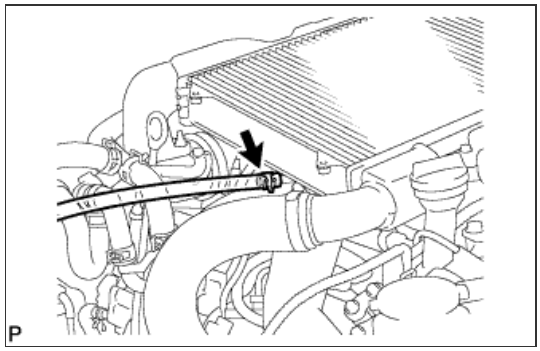
a. Connect the cables to negative ( ) main battery and sub attery battery terminals.

71. ADD ENGINE COOLANT

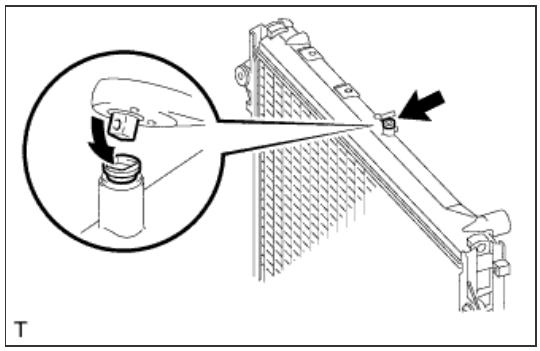
a. Remove the engine air bleed cap.



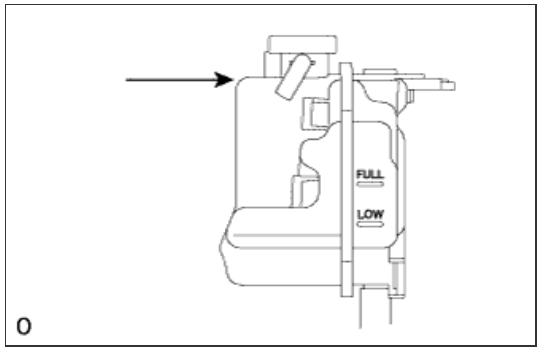
b. Connect a clear hose to the engine air bleed pipe.



c. Using a wrench, remove the vent plug.



d. Fill the radiator with TOYOTA SLLC to the radiator reservoir filler neck.



HINT:

Pour TOYOTA SLLC until it spills out of the engine air bleed pipe.

Standard Capacity (for Automatic Transmission):

Item	Specified Condition
Front heater only	14.8 liters (15.6 US ts, 13.0 Imp. ts)
Front heater and rear heater	17.6 liters (18.6 US ts, 15.5 Imp. ts)
Front heater with viscous heater	15.2 liters (16.1 US ts, 13.4 Imp. ts)
Front heater and rear heater with viscous heater	18.0 liters (19.0 US ts, 15.4 Imp. ts)

Standard capacity (for Manual Transmission):
15.4 liters (16.3 US qts, 13.6 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

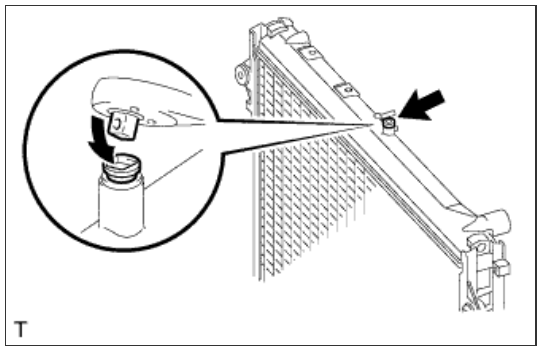
TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high uality ethylene glycol based non silicate, non amine, non nitrite, non brate coolant with long life hybrid organic acid technology (coolant with long life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

e. Install the vent plug.

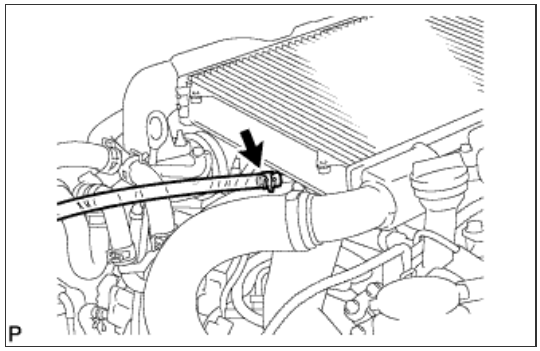
Torque:
2.0 N*m{ 20 kgf*cm , 18 in.*lbf }

NOTICE:

Do not tighten the plug to 5.0 N m (51 kgf cm, 44 in. lbf) or more, as the plug will be damaged.



f. Disconnect the clear hose from the engine air bleed pipe.



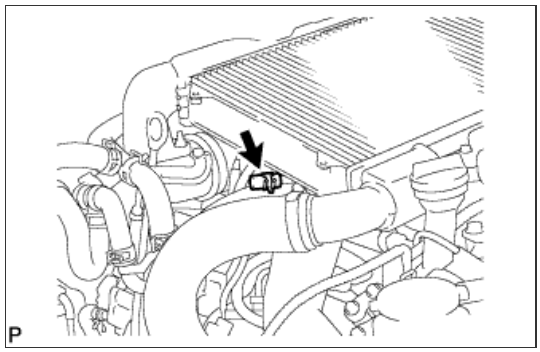
g. Install the engine air bleed cap when coolant comes out.

h. Install the radiator reservoir cap.

i. Start the engine.

NOTICE:

Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the FULL line.



j. Maintain an engine speed of 3000 rpm for approximately 10 minutes so that the thermostat opens and air bleeding is performed.

CAUTION:

When pressing the radiator hoses:

- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the radiator fan**

NOTICE:

- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**

HINT:

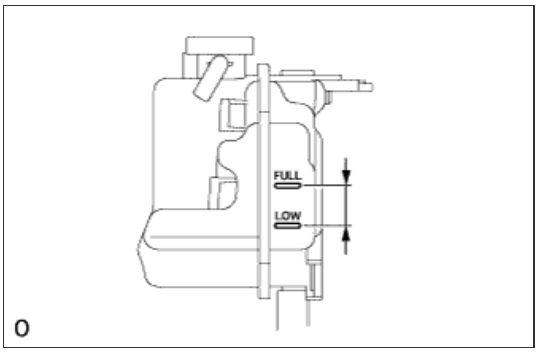
The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

k. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

l. Check that the coolant level is between the FULL and LOW lines.
If the coolant level is above the FULL line, drain coolant so that the coolant level is between the FULL and LOW lines.



72. INSPECT FOR FUEL LEAK

a. Perform Active Test.

i. Connect the intelligent tester to the DLC3.

ii. Turn the ignition switch to ON.

iii. Start the engine.

iv. Turn the intelligent tester ON.

v. Enter the following menus: Powertrain / Engine / Active Test.

vi. Perform the Active Test.

Tester Display	Test Detail	Control Range	Diagnostic Note
Test the Fuel Leak	Pressurizes fuel inside common rail and checks for fuel leaks	Stop/Start	• The fuel inside the common rail is pressurized to the specified value and the engine speed increases to 2000 rpm when Start is selected. • The above conditions are preserved while Start is selected.

73. INSPECT FOR OIL LEAK

74. INSPECT FOR COOLANT LEAK

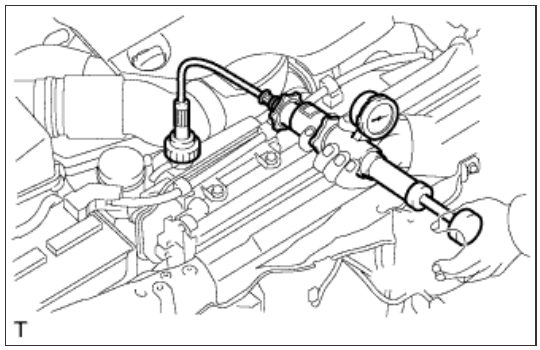
CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester to the radiator reservoir.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 17.8 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks.
If no external leaks are found, check the cylinder block and cylinder head.



7 . WARM UP ENGINE

NOTICE:

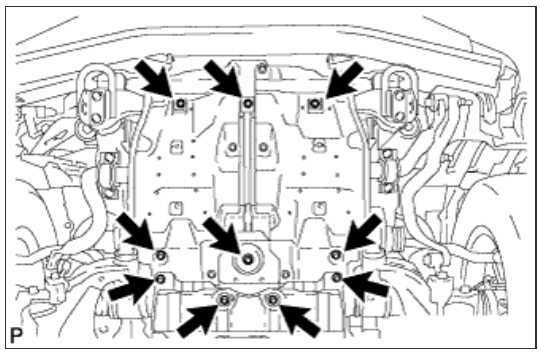
In order to bleed air from the chain tensioner, drive the vehicle with the engine at 3000 rpm for 60 seconds or more.

76. INSPECT FOR EXHAUST GAS LEAK

77. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

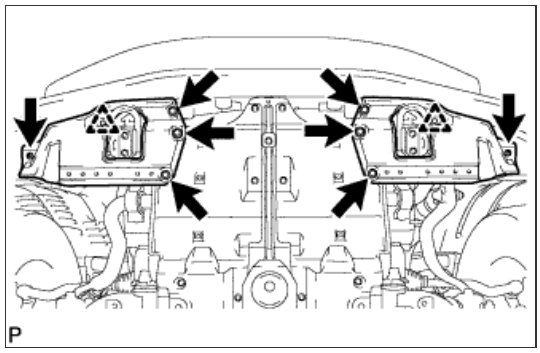
a. Install the engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



78. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

a. Install the splash shield with the clip, and then install the 3 bolts and screw.

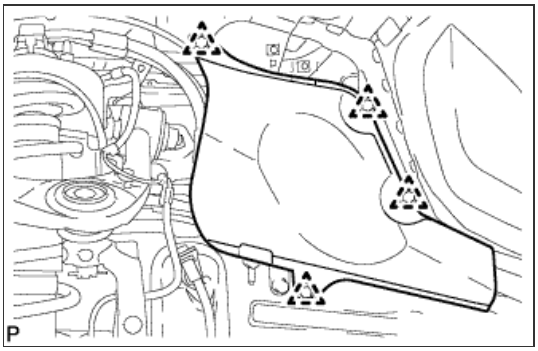


79. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Install the splash shield with the clip, and then install the 3 bolts and screw.

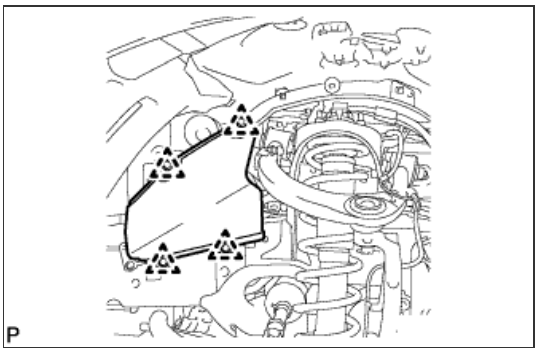
80. INSTALL FRONT FENDER APRON SEAL REAR LH

a. Install the front fender apron seal rear L with the 4 clips.

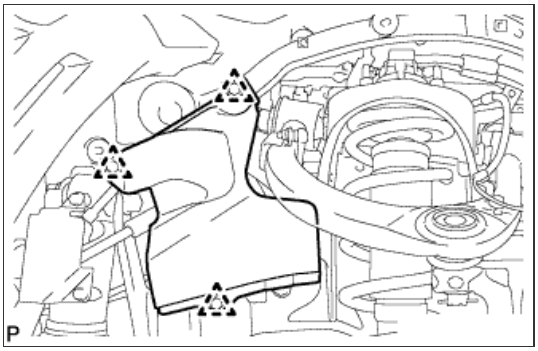


1. INSTALL FRONT FENDER APRON SEAL FRONT LH

a. w/o DSS:
Install the front fender apron seal front L with the 4 clips.

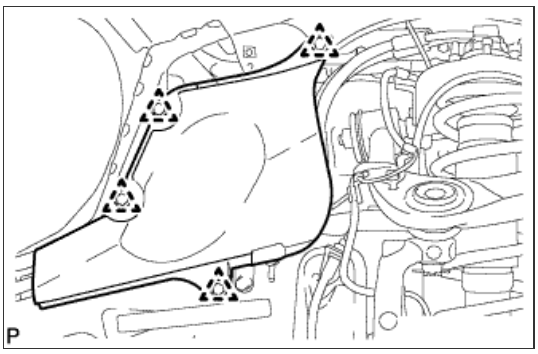


b. w/ DSS:
Install the front fender apron seal front L with the 3 clips.



82. INSTALL FRONT FENDER APRON SEAL REAR RH

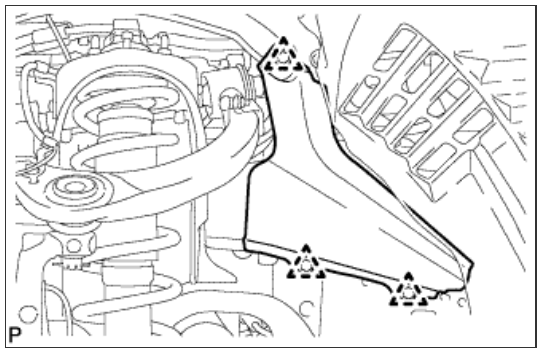
a. Install the front fender apron seal rear R with the 4 clips.



83. INSTALL FRONT FENDER APRON SEAL FRONT RH

a. Install the front fender apron seal front R with the 3 clips.

a. Install the front fender apron seal front RH with the 3 clips.



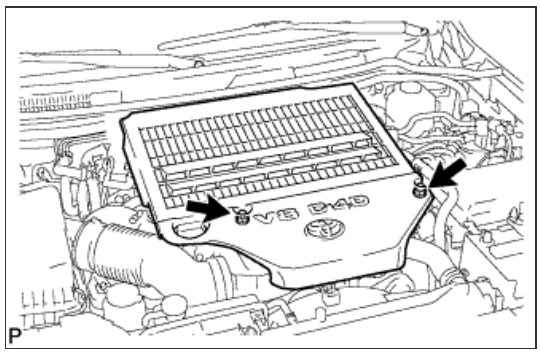
4. INSTALL FRONT WHEEL

Torque:
for Aluminum Wheel:
131 N*m{ 1336 kgf*cm , 97 ft.*lbf }
for Steel Wheel:
209 N*m{ 2131 kgf*cm , 154 ft.*lbf }

85. INSTALL NO. 1 ENGINE COVER SUB-ASSEMBLY (w/ Intercooler)

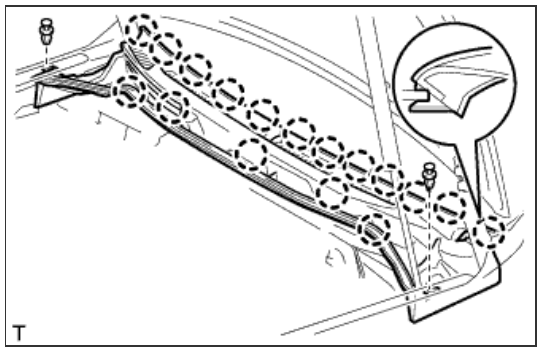
a. Install the engine cover with the 2 nuts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }



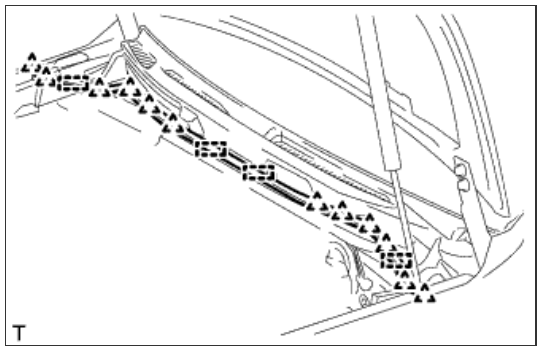
86. INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Push the ventilator louver in the direction indicated by the arrow in the illustration to attach the 17 claws and 2 clips and install the ventilator louver.

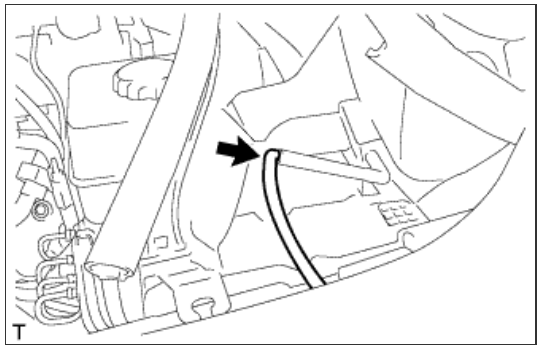


87. INSTALL HOOD TO COWL TOP SEAL

a. Attach the 12 clips and 4 clamps to install the hood to cowl top seal.



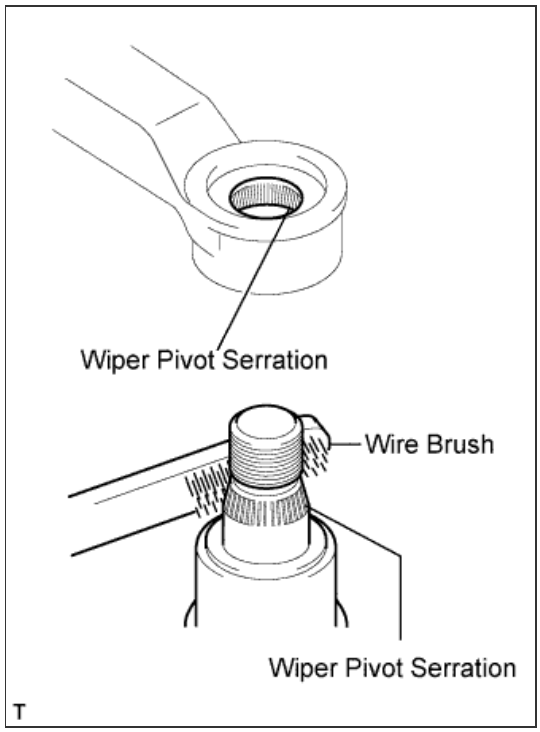
b. Install the washer hose.



. INSTALL FRONT WIPER ARM RH

a. Stop the wiper motor at the automatic stop position.

b. Clean the wiper pivot serration with a wire brush.



c. Install the wiper arm and blade with the nut. Make sure that the wiper arm and blade comes to the position shown in the illustration.

Standard Measurement:

Position	Specified Condition
B	20.0 to 40.0 mm (0.787 to 1.57 in.)

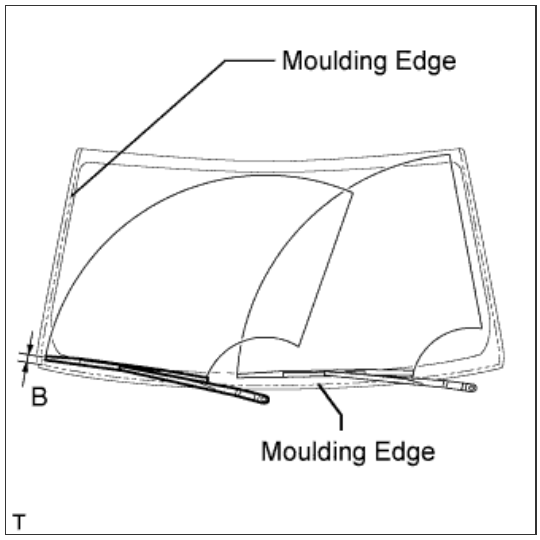
Torque:

25 N*m{ 255 kgf*cm , 18 ft.*lbf }

HINT:

old down the wiper arm hinge with your hand while tightening the nut.

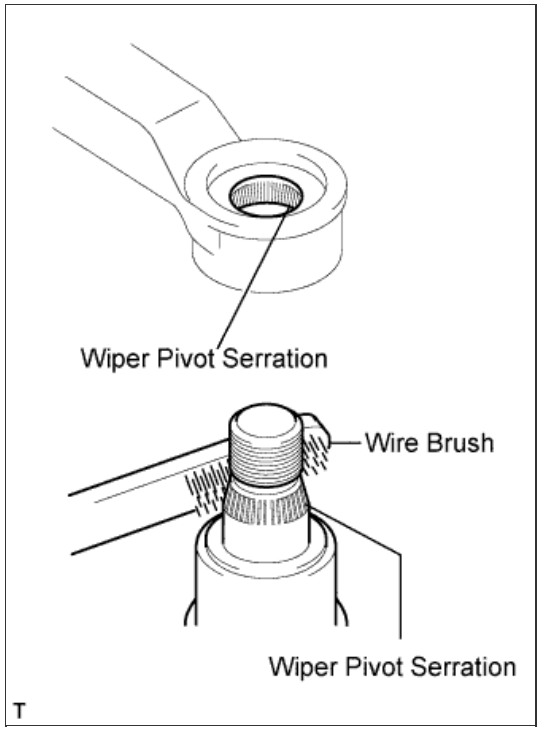
d. Operate the front wipers while spraying washer fluid on the windshield glass. Make sure that the front wipers function properly and there is no interference with the vehicle body.



9. INSTALL FRONT WIPER ARM LH

a. Stop the wiper motor at the automatic stop position.

b. Clean the wiper pivot serration with a wire brush.



c. Install the wiper arm and blade with the nut. Make sure that the wiper arm and blade comes to the position shown in the illustration.

Standard Measurement:

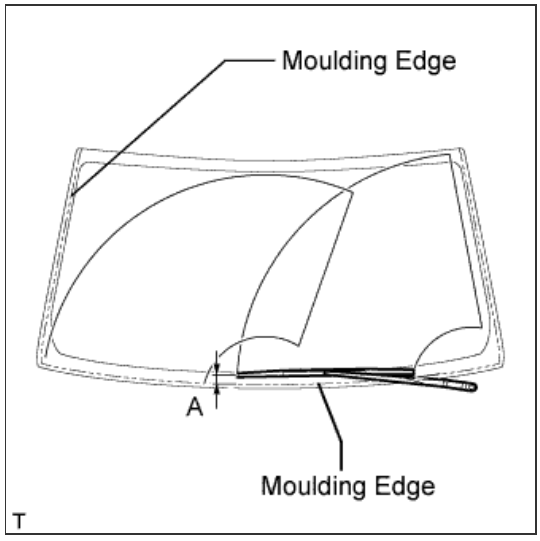
Position	Specified Condition
A	16.8 to 36.8 mm (0.661 to 1.45 in.)

Torque:

25 N*m{ 255 kgf*cm , 18 ft.*lbf }

HINT:

old down the wiper arm hinge with your hand while tightening the nut.



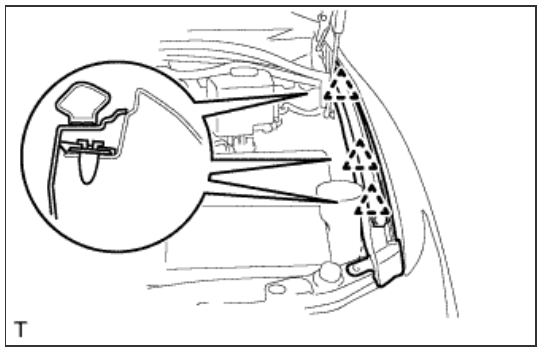
90. INSTALL FRONT FENDER MAIN SEAL RH

HINT:

Use the same procedures described for the L side.

91. INSTALL FRONT FENDER MAIN SEAL LH

a. Attach the 3 clips to install the fender main seal.



92. INSTALL UPPER RADIATOR SUPPORT SEAL

a. Install the upper radiator support seal with the 7 clips.

93. INSPECT ENGINE IDLE SPEED

NOTICE:

- **Turn all the electrical systems and the A/C off.**
- **When checking the idle speed, move the shift lever to neutral.**

HINT:

- **For more information about the intelligent tester, refer to its operator's manual.**
- **If an intelligent tester is not available, use a tachometer tester probe as a substitute.**

a. When using the intelligent tester:

i. Warm up the engine.

ii. Connect the intelligent tester to the DLC3.

iii. Enter the following menus:
Powertrain / Engine / Data List / Engine Speed.

HINT:

Refer to the intelligent tester operator s manual for help selecting the Data List.

iv. Inspect the engine idle speed.

Standard Idle Speed:

Item	Specified Condition
for Automatic Transmission	550 to 650 rpm
for Manual Transmission	500 to 600 rpm

v. Disconnect the intelligent tester from the DLC3.

b. When not using the intelligent tester:

i. Warm up and stop the engine.

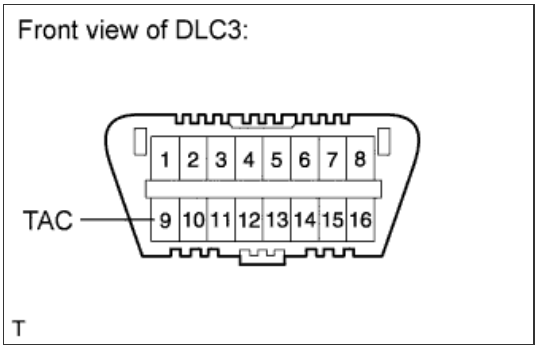
ii. Connect a tester probe of a tachometer to terminal 9 (TAC) of the DLC3 with SST.

SST
09843-18030

iii. Inspect the engine idle speed.

Standard Idle Speed:

Item	Specified Condition
for Automatic Transmission	550 to 650 rpm
for Manual Transmission	500 to 600 rpm



iv. Disconnect the tester probe from terminal 9 (TAC) of the DLC3.

94. INSPECT MAXIMUM ENGINE SPEED

a. Start the engine.

b. Fully depress the accelerator pedal.

c. Check the maximum engine speed.

Maximum engine speed:
4700 to 4900 rpm

95. CHECK ENGINE OIL LEVEL

a. Warm up the engine, stop the engine and wait 5 minutes. The engine oil level should be between the dipstick low level mark and full level mark.
If low, check for leakage and add oil up to the full level mark.

NOTICE:

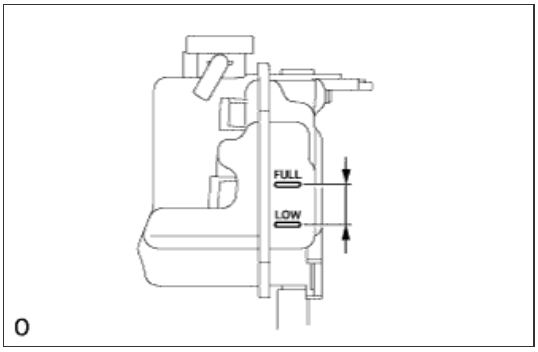
Do not fill engine oil above the full level mark.

96. INSPECT ENGINE COOLANT LEVEL IN RESERVOIR

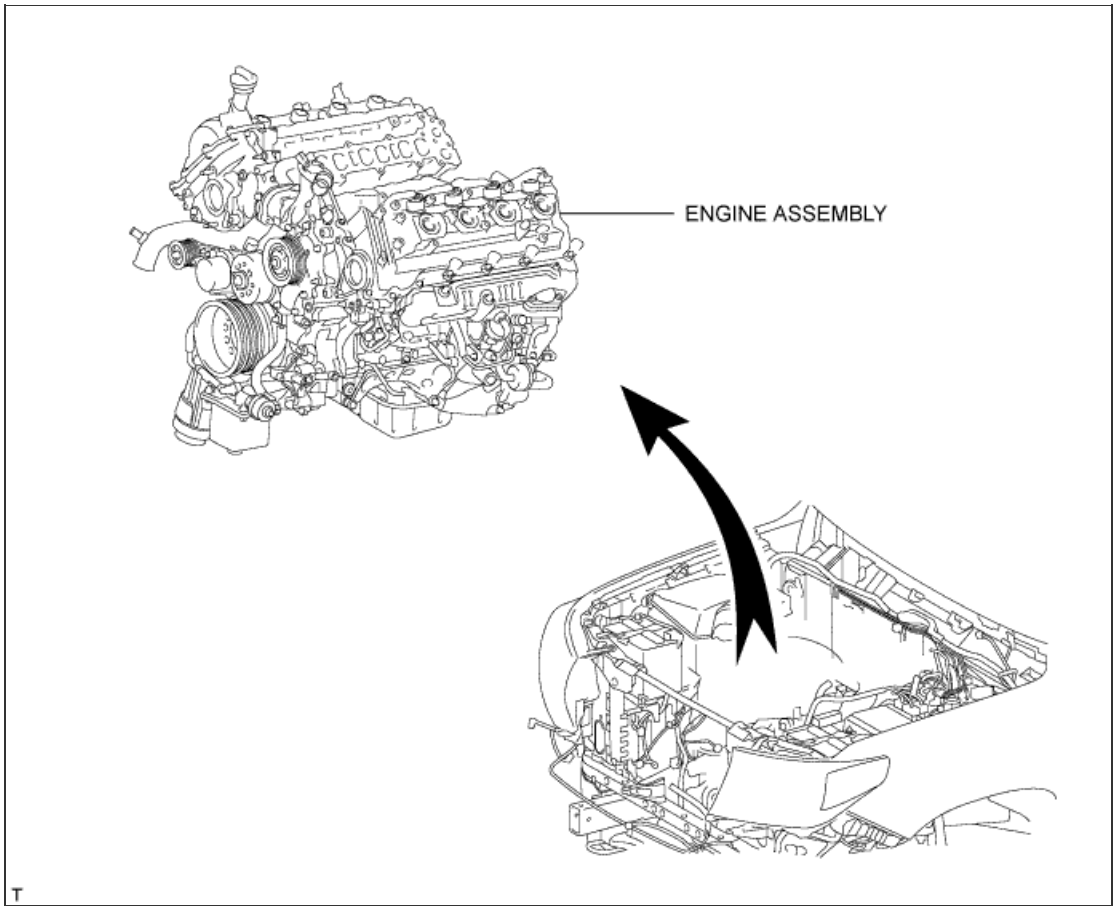
a. Check that the engine coolant level is between the LOW and FULL lines when the engine is cold.
If the engine coolant is low, check for leaks and add TOYOTA Super Long Life Coolant (SLLC) or similar high uality ethylene glycol based non silicate, non amine, non nitrite and non brate coolant with long life hybrid organic acid technology to the FULL line.

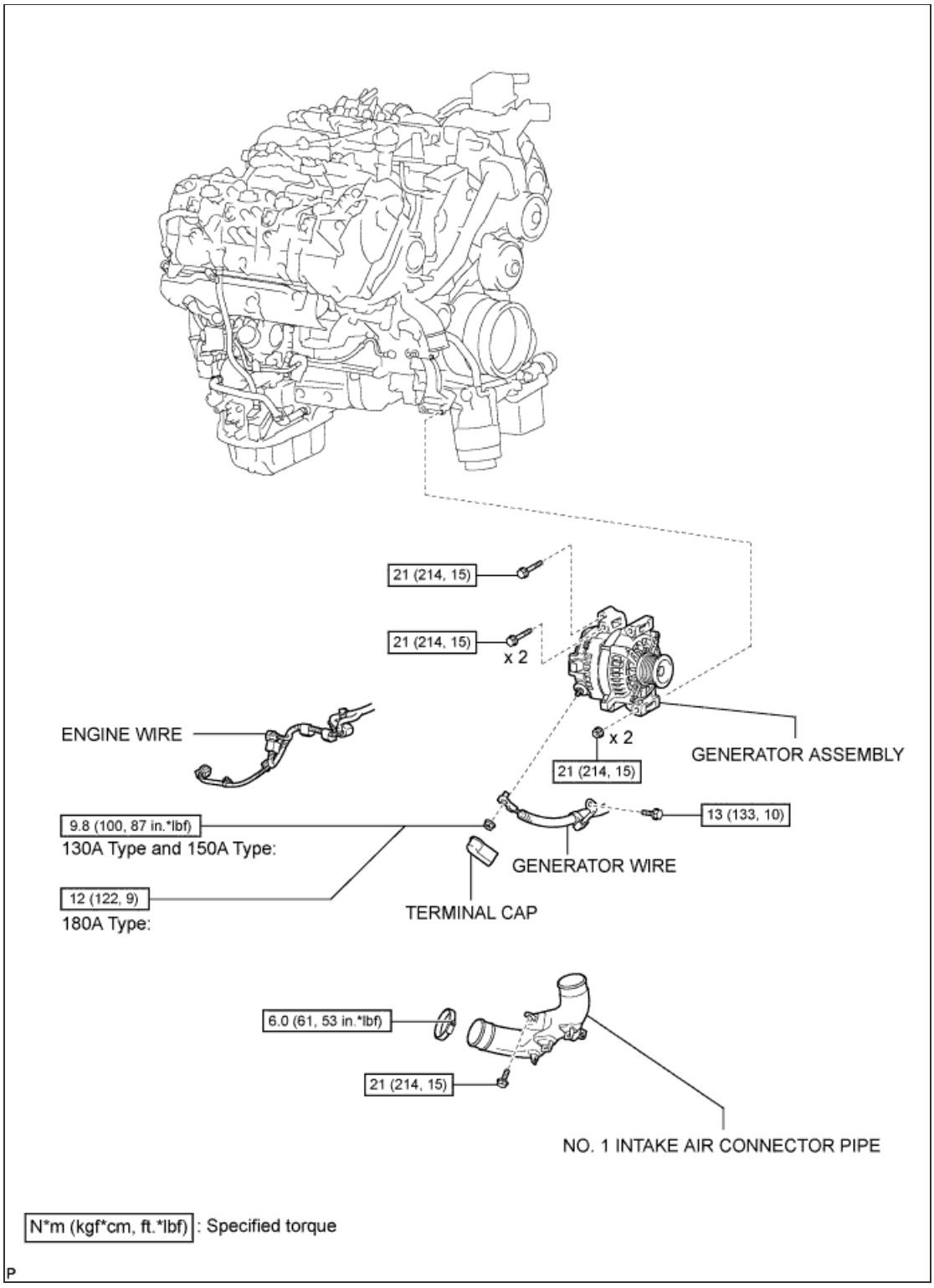
NOTICE:

Do not substitute plain water for engine coolant.

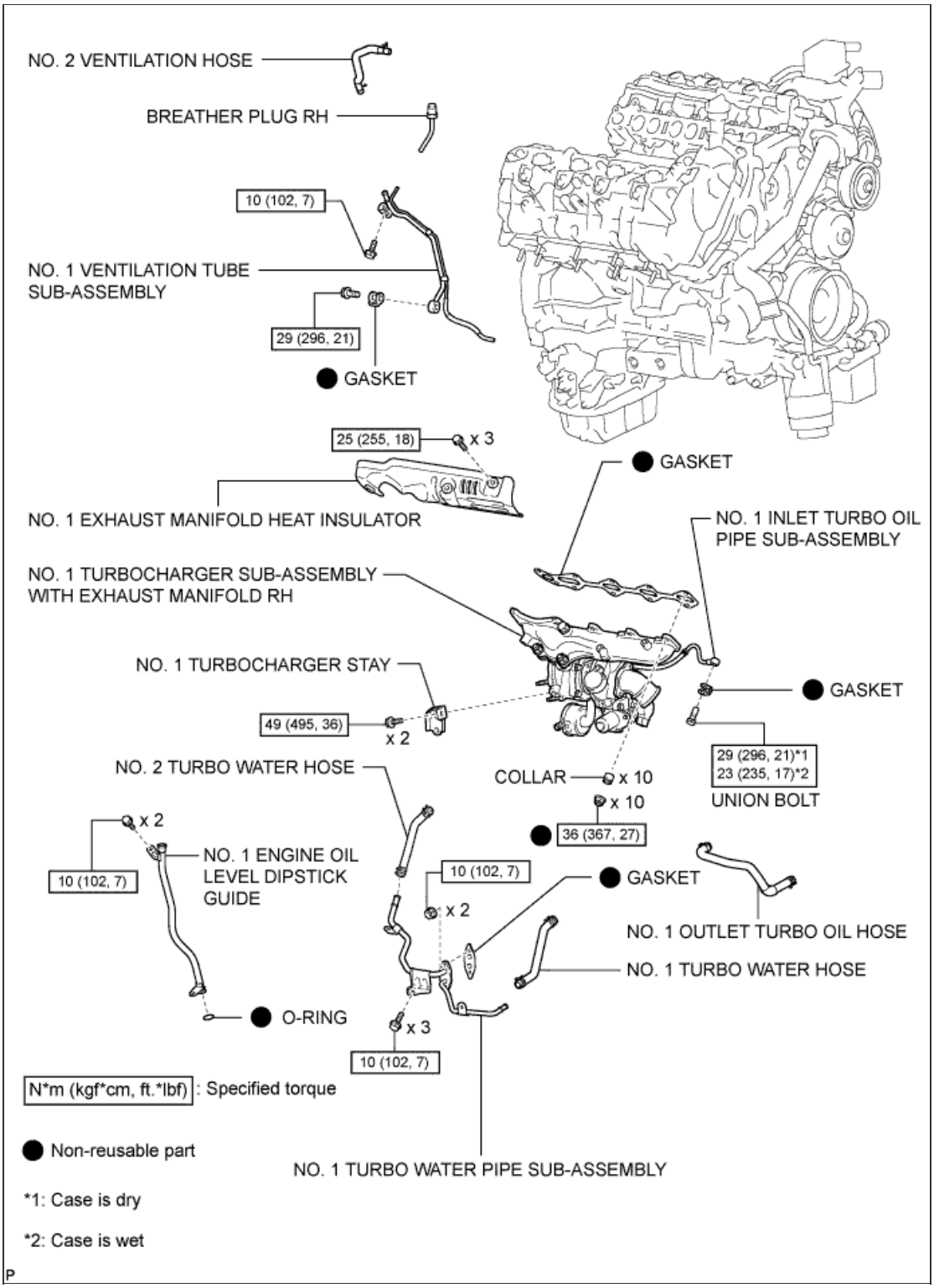


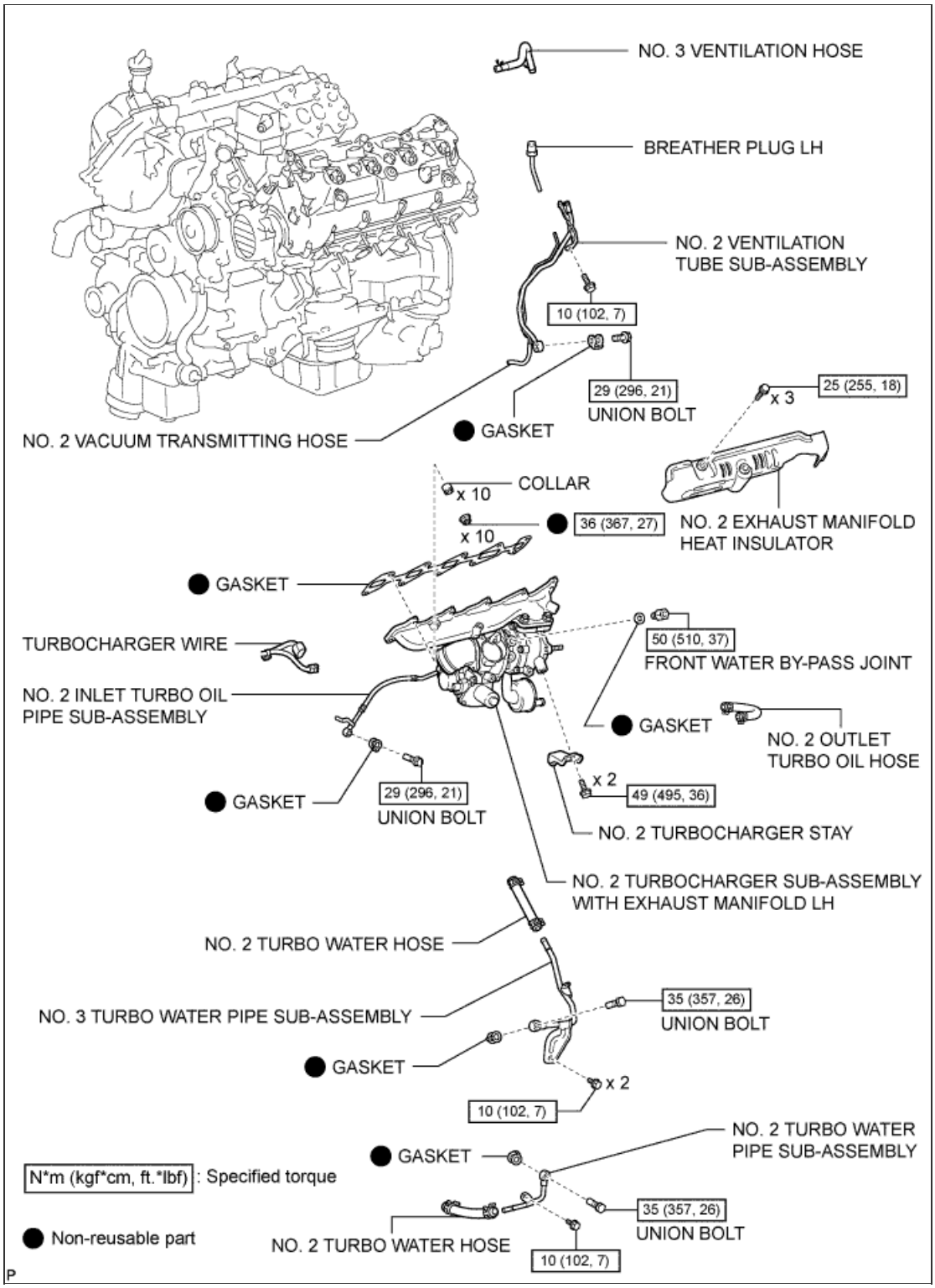
for Preparation [Click here]

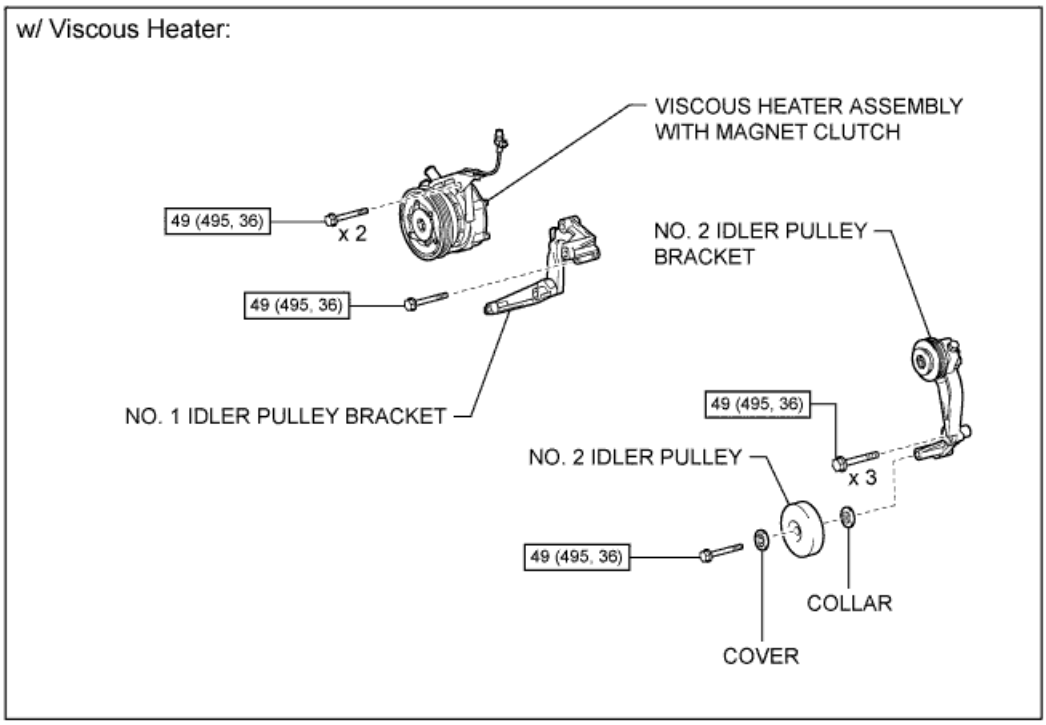


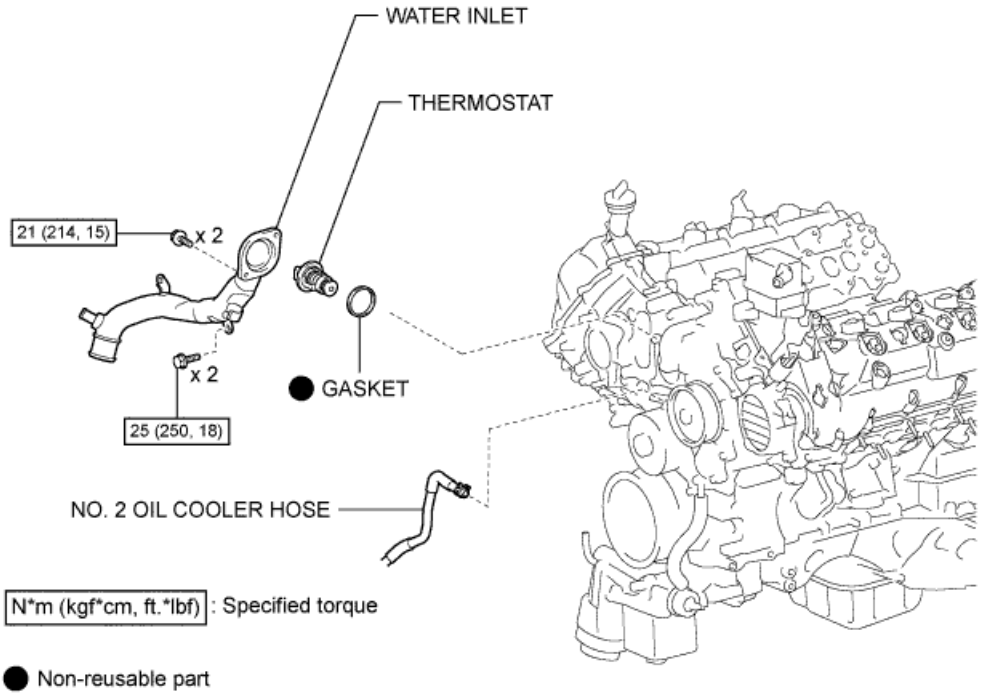

21 (214, 15)
21 (214, 15)
x 2
ENGINE WIRE
x 2
GENERATOR ASSEMBLY
21 (214, 15)
9.8 (100, 87 in.*lbf)
130A Type and 150A Type:
13 (133, 10)
GENERATOR WIRE
12 (122, 9)
180A Type:
TERMINAL CAP
6.0 (61, 53 in.*lbf)
21 (214, 15)
NO. 1 INTAKE AIR CONNECTOR PIPE
N*m (kgf*cm, ft.*lbf) : Specified torque

P


NO. 2 VENTILATION HOSE
BREATHER PLUG RH
10 (102, 7)
NO. 1 VENTILATION TUBE SUB-ASSEMBLY
29 (296, 21)
GASKET
25 (255, 18)
x 3
NO. 1 EXHAUST MANIFOLD HEAT INSULATOR
GASKET
NO. 1 INLET TURBO OIL PIPE SUB-ASSEMBLY
NO. 1 TURBOCHARGER SUB-ASSEMBLY WITH EXHAUST MANIFOLD RH
NO. 1 TURBOCHARGER STAY
49 (495, 36)
x 2
GASKET
29 (296, 21)*1
23 (235, 17)*2
UNION BOLT
NO. 2 TURBO WATER HOSE
COLLAR
x 10
x 10
36 (367, 27)
x 2
10 (102, 7)
NO. 1 ENGINE OIL LEVEL DIPSTICK GUIDE
10 (102, 7)
x 2
GASKET
NO. 1 OUTLET TURBO OIL HOSE
NO. 1 TURBO WATER HOSE
O-RING
x 3
10 (102, 7)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
NO. 1 TURBO WATER PIPE SUB-ASSEMBLY
*1: Case is dry
*2: Case is wet
P

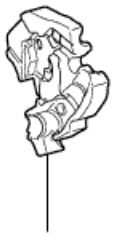
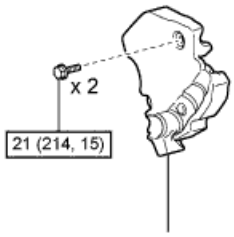

NO. 3 VENTILATION HOSE
BREATHER PLUG LH
NO. 2 VENTILATION TUBE SUB-ASSEMBLY
10 (102, 7)
29 (296, 21)
UNION BOLT
NO. 2 VACUUM TRANSMITTING HOSE
GASKET
x 3
25 (255, 18)
x 10
COLLAR
x 10
36 (367, 27)
NO. 2 EXHAUST MANIFOLD HEAT INSULATOR
GASKET
TURBOCHARGER WIRE
50 (510, 37)
FRONT WATER BY-PASS JOINT
NO. 2 INLET TURBO OIL PIPE SUB-ASSEMBLY
GASKET
NO. 2 OUTLET TURBO OIL HOSE
GASKET
29 (296, 21)
UNION BOLT
x 2
49 (495, 36)
NO. 2 TURBOCHARGER STAY
NO. 2 TURBOCHARGER SUB-ASSEMBLY WITH EXHAUST MANIFOLD LH
NO. 2 TURBO WATER HOSE
NO. 3 TURBO WATER PIPE SUB-ASSEMBLY
35 (357, 26)
UNION BOLT
GASKET
x 2
10 (102, 7)
GASKET
NO. 2 TURBO WATER PIPE SUB-ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
35 (357, 26)
UNION BOLT
Non-reusable part
NO. 2 TURBO WATER HOSE
10 (102, 7)
P

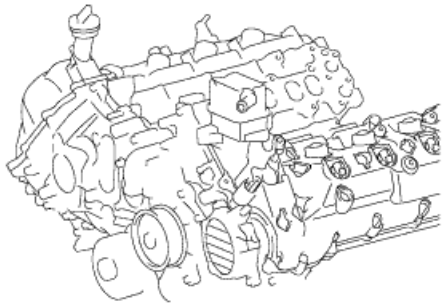

w/ Viscous Heater:
VISCOUS HEATER ASSEMBLY WITH MAGNET CLUTCH
49 (495, 36)
x 2
NO. 2 IDLER PULLEY BRACKET
49 (495, 36)
NO. 1 IDLER PULLEY BRACKET
49 (495, 36)
x 3
NO. 2 IDLER PULLEY
49 (495, 36)
COLLAR
COVER


WATER INLET
THERMOSTAT
21 (214, 15)
x 2
x 2
25 (250, 18)
GASKET
NO. 2 OIL COOLER HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P

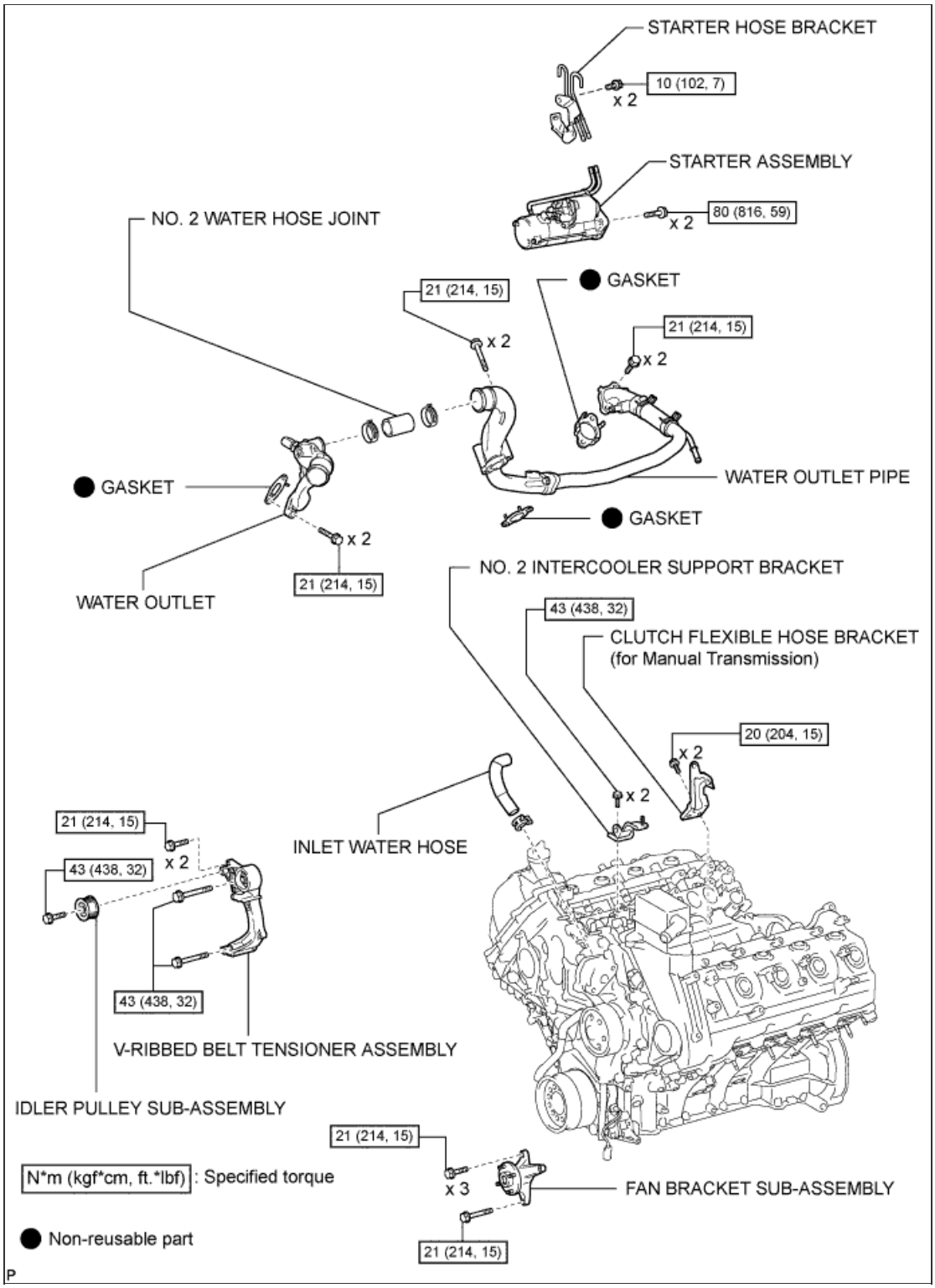
w/ Intercooler:

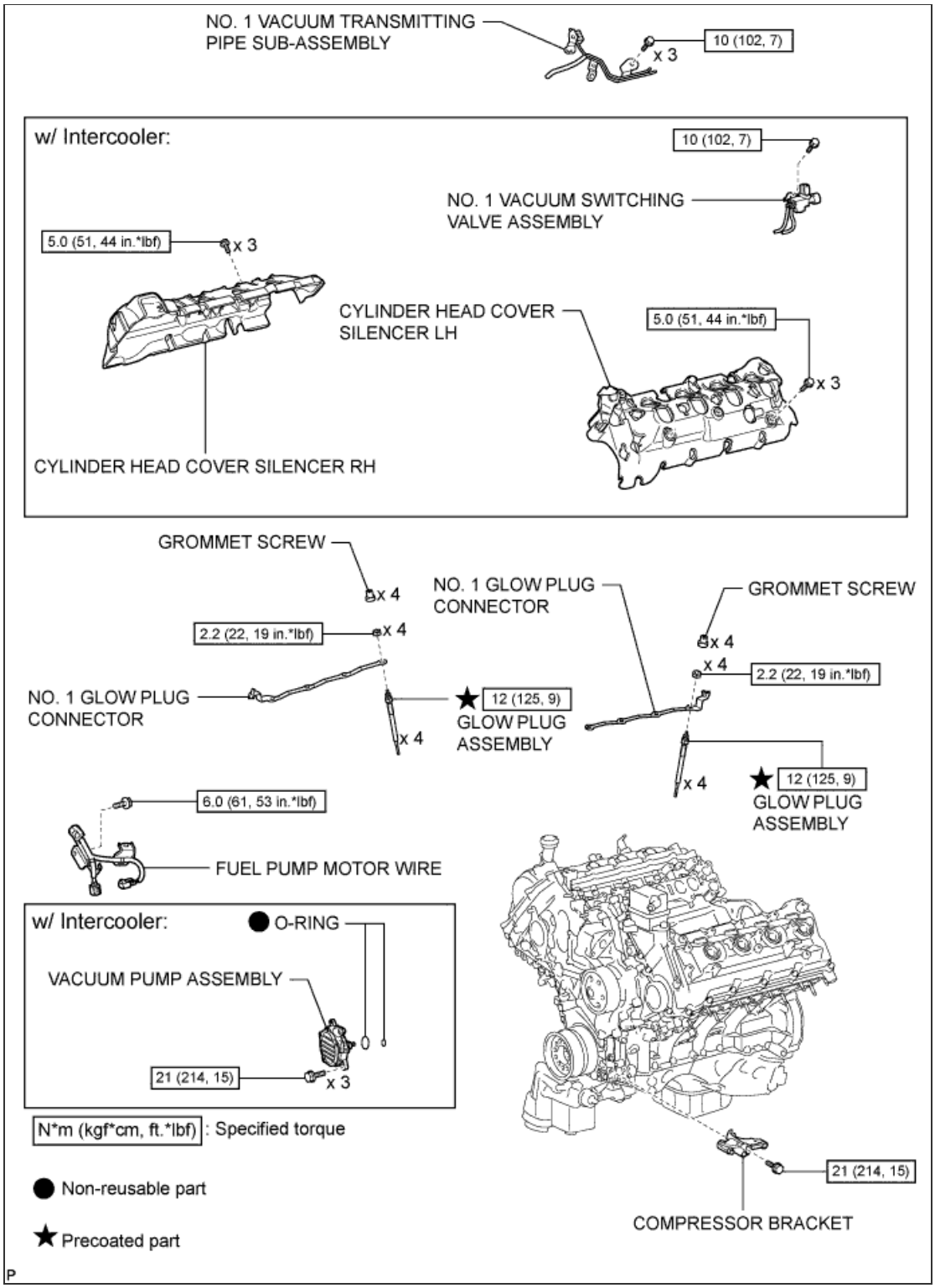
w/ Viscous Heater:	w/o Viscous Heater:
 TIMING GEAR COVER INSULATOR	 TIMING GEAR COVER INSULATOR

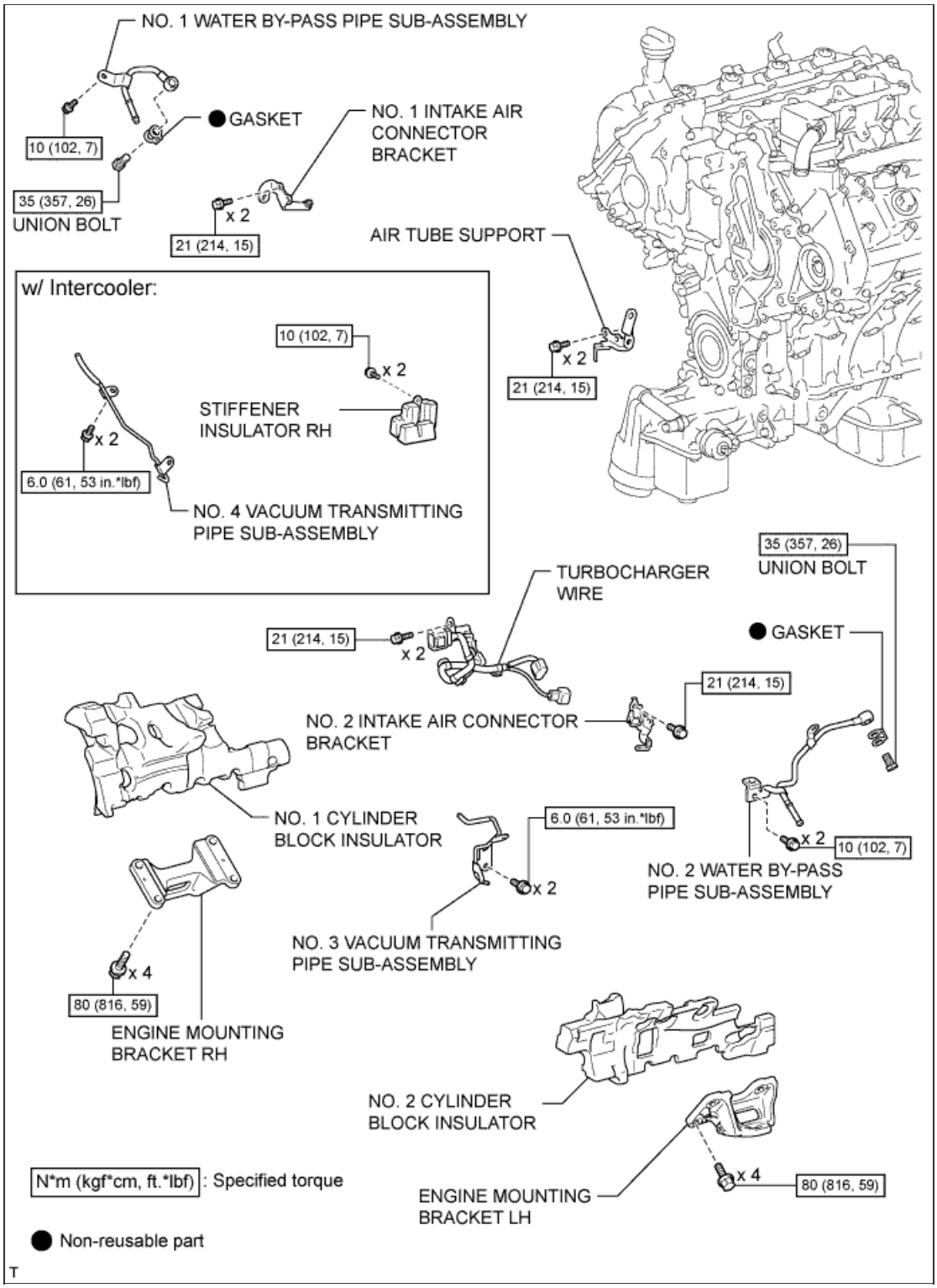


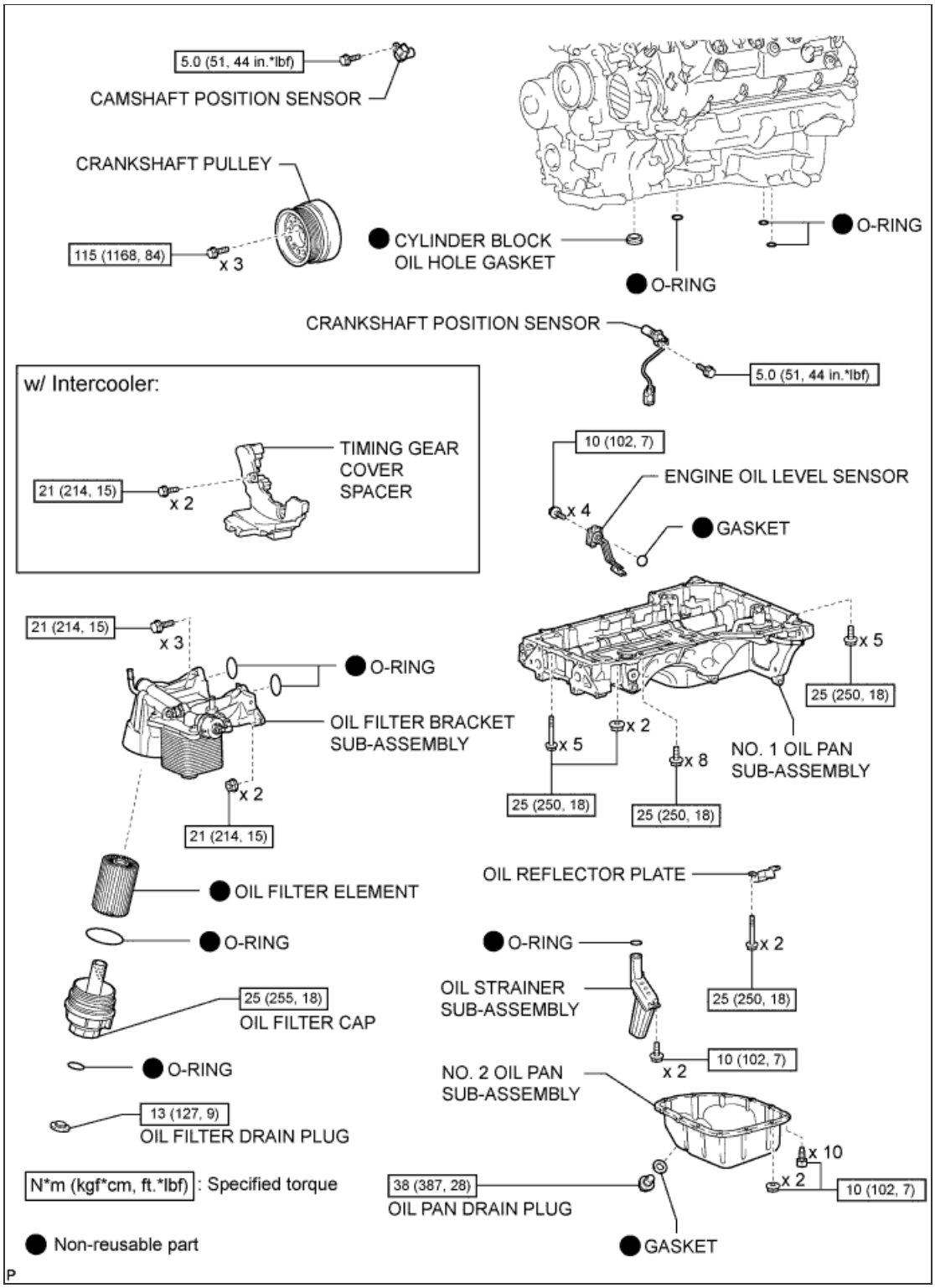
N*m (kgf*cm, ft.*lbf) : Specified torque

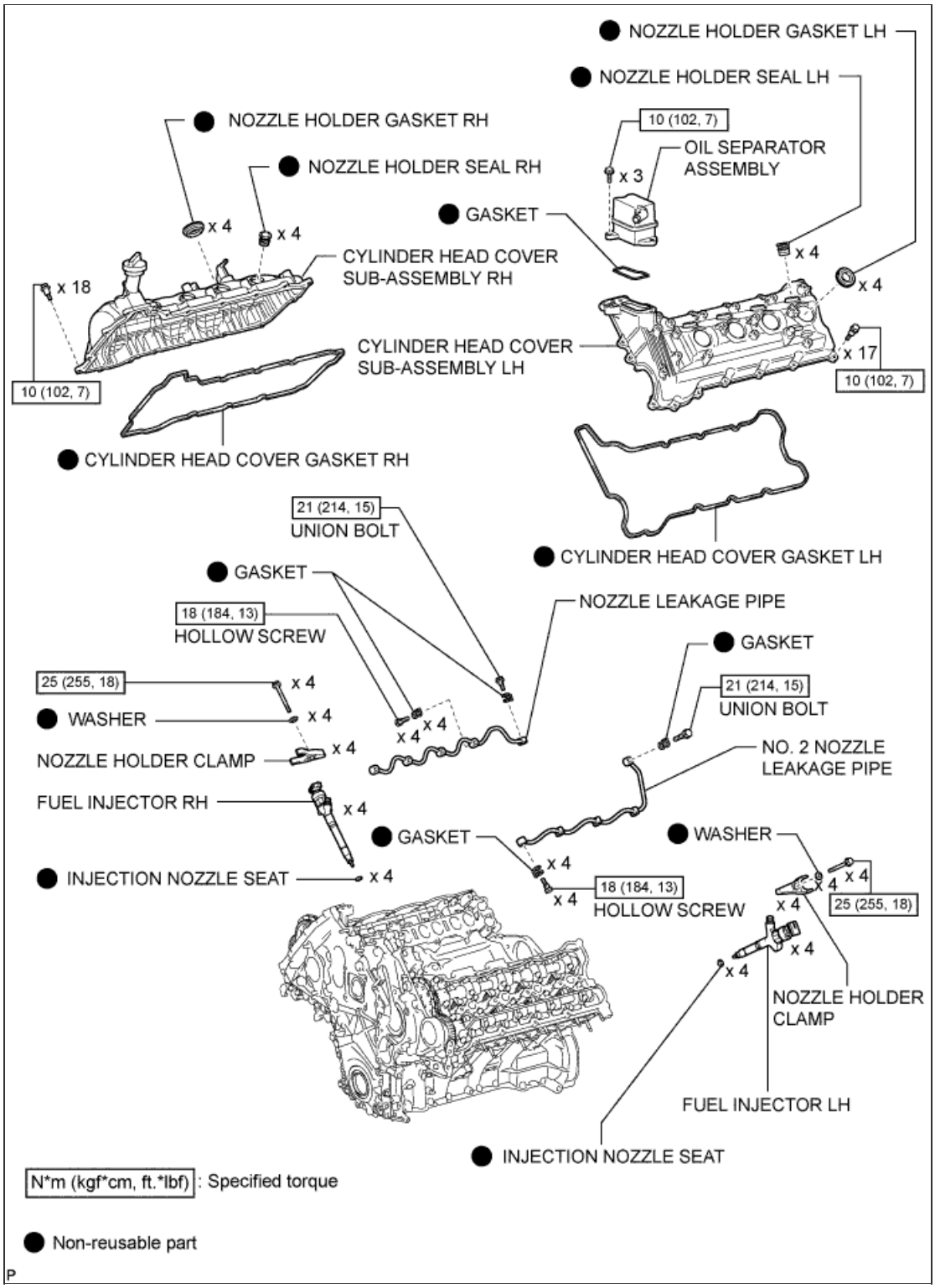
P


STARTER HOSE BRACKET
10 (102, 7)
x 2
STARTER ASSEMBLY
80 (816, 59)
x 2
NO. 2 WATER HOSE JOINT
GASKET
21 (214, 15)
x 2
21 (214, 15)
x 2
WATER OUTLET PIPE
GASKET
GASKET
x 2
21 (214, 15)
WATER OUTLET
NO. 2 INTERCOOLER SUPPORT BRACKET
43 (438, 32)
CLUTCH FLEXIBLE HOSE BRACKET
(for Manual Transmission)
20 (204, 15)
x 2
x 2
INLET WATER HOSE
21 (214, 15)
x 2
43 (438, 32)
43 (438, 32)
V-RIBBED BELT TENSIONER ASSEMBLY
IDLER PULLEY SUB-ASSEMBLY
21 (214, 15)
x 3
FAN BRACKET SUB-ASSEMBLY
21 (214, 15)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

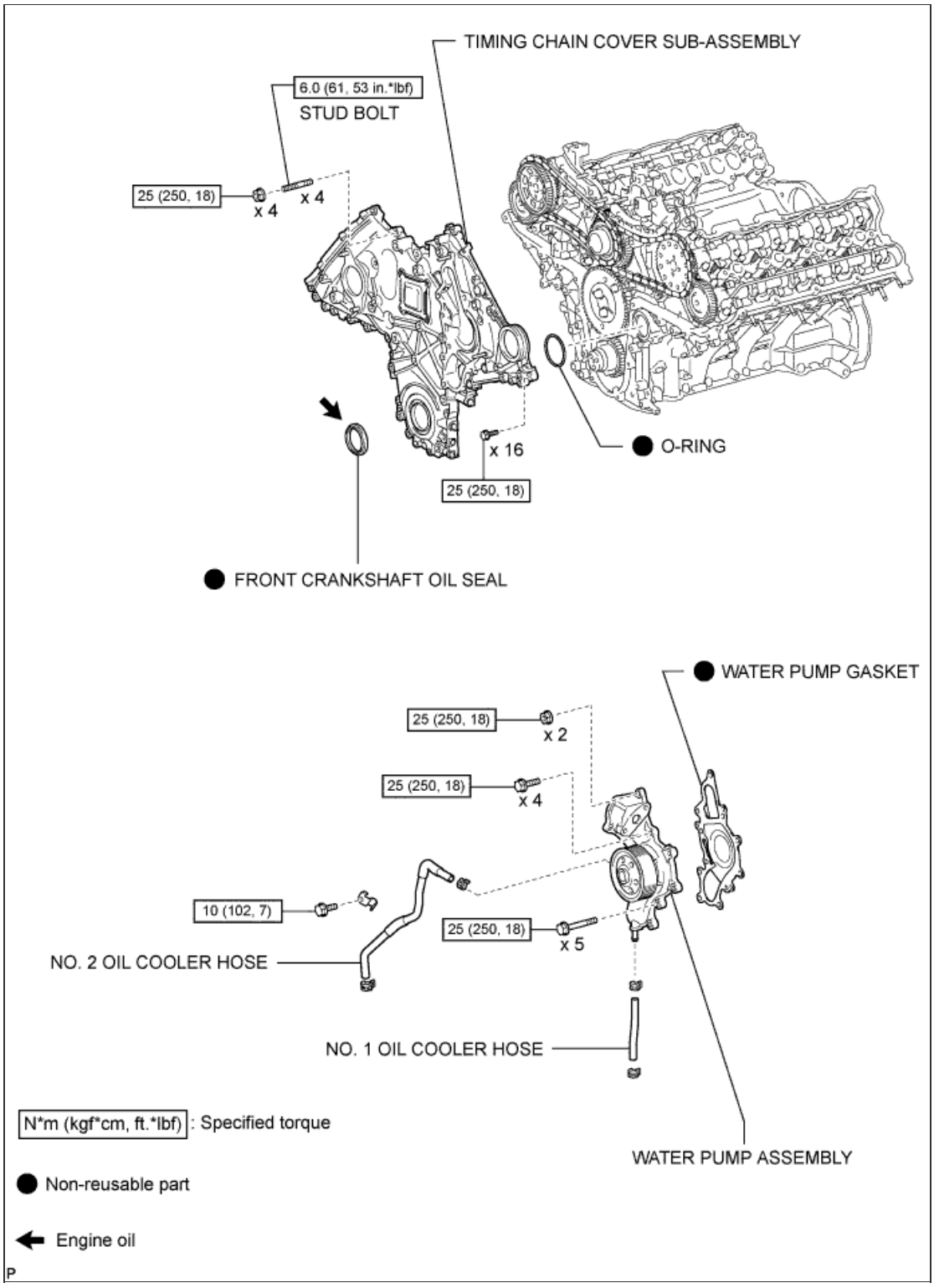

NO. 1 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY
10 (102, 7)
x 3
w/ Intercooler:
10 (102, 7)
NO. 1 VACUUM SWITCHING VALVE ASSEMBLY
5.0 (51, 44 in.*lbf)
x 3
CYLINDER HEAD COVER SILENCER LH
5.0 (51, 44 in.*lbf)
x 3
CYLINDER HEAD COVER SILENCER RH
GROMMET SCREW
x 4
2.2 (22, 19 in.*lbf)
x 4
NO. 1 GLOW PLUG CONNECTOR
12 (125, 9)
GLOW PLUG ASSEMBLY
x 4
NO. 1 GLOW PLUG CONNECTOR
GROMMET SCREW
x 4
x 4
2.2 (22, 19 in.*lbf)
x 4
12 (125, 9)
GLOW PLUG ASSEMBLY
6.0 (61, 53 in.*lbf)
FUEL PUMP MOTOR WIRE
w/ Intercooler:
O-RING
VACUUM PUMP ASSEMBLY
21 (214, 15)
x 3
21 (214, 15)
COMPRESSOR BRACKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
Precoated part
P

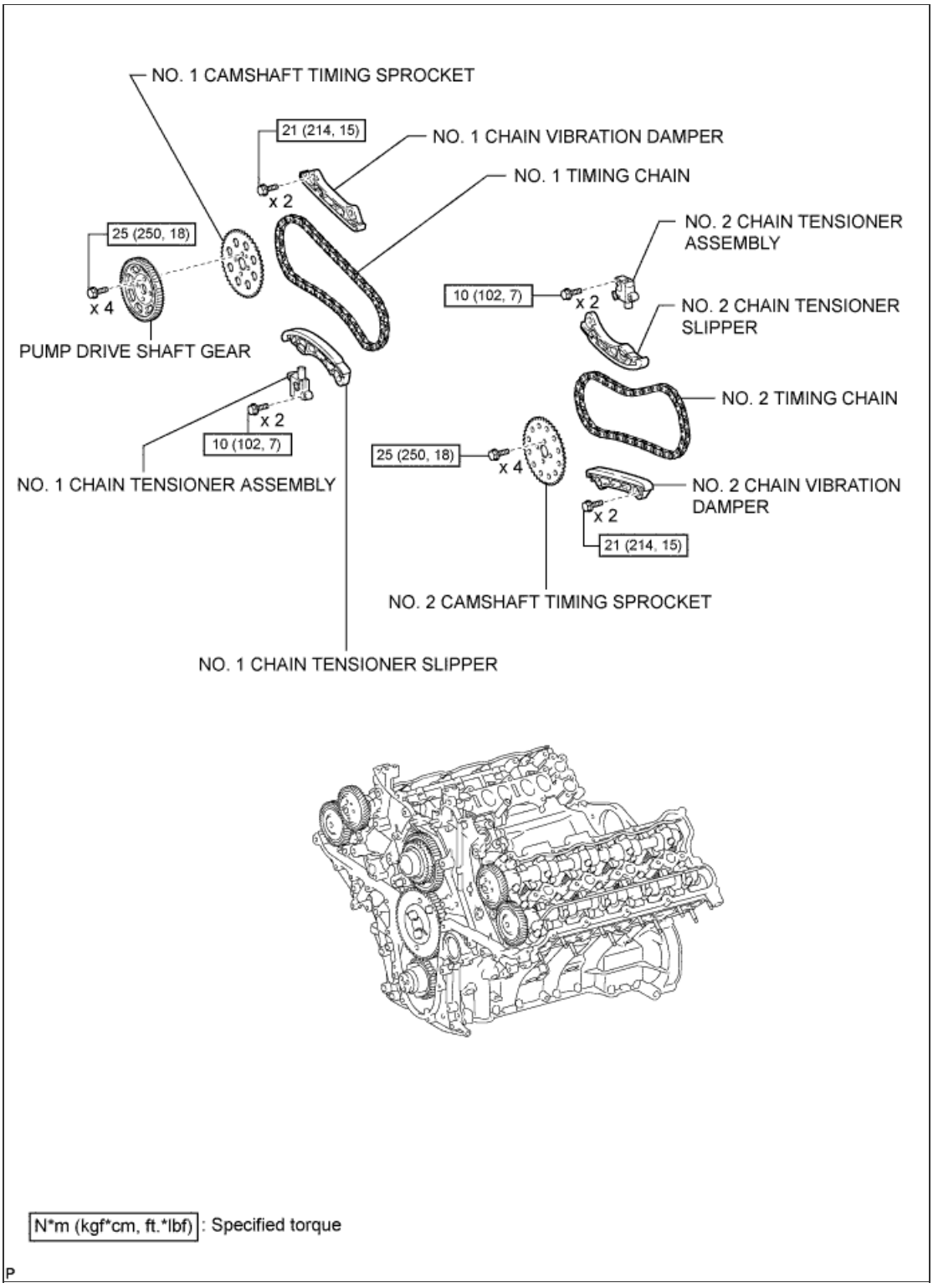

NO. 1 WATER BY-PASS PIPE SUB-ASSEMBLY
GASKET
10 (102, 7)
35 (357, 26)
UNION BOLT
NO. 1 INTAKE AIR CONNECTOR BRACKET
x 2
21 (214, 15)
AIR TUBE SUPPORT
x 2
21 (214, 15)
w/ Intercooler:
10 (102, 7)
x 2
STIFFENER INSULATOR RH
x 2
6.0 (61, 53 in.*lbf)
NO. 4 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY
35 (357, 26)
UNION BOLT
TURBOCHARGER WIRE
21 (214, 15)
x 2
GASKET
21 (214, 15)
NO. 2 INTAKE AIR CONNECTOR BRACKET
NO. 1 CYLINDER BLOCK INSULATOR
6.0 (61, 53 in.*lbf)
x 2
NO. 3 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY
x 2
10 (102, 7)
NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY
x 4
80 (816, 59)
ENGINE MOUNTING BRACKET RH
NO. 2 CYLINDER BLOCK INSULATOR
x 4
80 (816, 59)
ENGINE MOUNTING BRACKET LH
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
T


5.0 (51, 44 in.*lbf)
CAMSHAFT POSITION SENSOR
CRANKSHAFT PULLEY
115 (1168, 84)
x 3
CYLINDER BLOCK OIL HOLE GASKET
O-RING
O-RING
CRANKSHAFT POSITION SENSOR
5.0 (51, 44 in.*lbf)
w/ Intercooler:
21 (214, 15)
x 2
TIMING GEAR COVER SPACER
10 (102, 7)
x 4
ENGINE OIL LEVEL SENSOR
GASKET
21 (214, 15)
x 3
O-RING
OIL FILTER BRACKET SUB-ASSEMBLY
x 2
21 (214, 15)
x 5
25 (250, 18)
x 5
25 (250, 18)
x 2
x 8
25 (250, 18)
NO. 1 OIL PAN SUB-ASSEMBLY
OIL FILTER ELEMENT
O-RING
25 (255, 18)
OIL FILTER CAP
O-RING
13 (127, 9)
OIL FILTER DRAIN PLUG
OIL REFLECTOR PLATE
x 2
25 (250, 18)
O-RING
OIL STRAINER SUB-ASSEMBLY
x 2
10 (102, 7)
NO. 2 OIL PAN SUB-ASSEMBLY
x 10
x 2
10 (102, 7)
N*m (kgf*cm, ft.*lbf) : Specified torque
38 (387, 28)
OIL PAN DRAIN PLUG
GASKET
Non-reusable part
P


NOZZLE HOLDER GASKET LH
NOZZLE HOLDER SEAL LH
NOZZLE HOLDER GASKET RH
NOZZLE HOLDER SEAL RH
10 (102, 7)
OIL SEPARATOR ASSEMBLY
x 3
GASKET
x 4
x 4
CYLINDER HEAD COVER SUB-ASSEMBLY RH
x 18
10 (102, 7)
CYLINDER HEAD COVER SUB-ASSEMBLY LH
x 4
x 4
x 17
10 (102, 7)
CYLINDER HEAD COVER GASKET RH
CYLINDER HEAD COVER GASKET LH
21 (214, 15)
UNION BOLT
GASKET
NOZZLE LEAKAGE PIPE
18 (184, 13)
HOLLOW SCREW
GASKET
25 (255, 18)
x 4
WASHER
x 4
NOZZLE HOLDER CLAMP
x 4
FUEL INJECTOR RH
x 4
INJECTION NOZZLE SEAT
x 4
x 4
x 4
21 (214, 15)
UNION BOLT
NO. 2 NOZZLE LEAKAGE PIPE
GASKET
WASHER
x 4
x 4
18 (184, 13)
HOLLOW SCREW
x 4
x 4
x 4
25 (255, 18)
x 4
x 4
NOZZLE HOLDER CLAMP
FUEL INJECTOR LH
INJECTION NOZZLE SEAT
N*m (kgf*cm, ft.*lbf): Specified torque
Non-reusable part

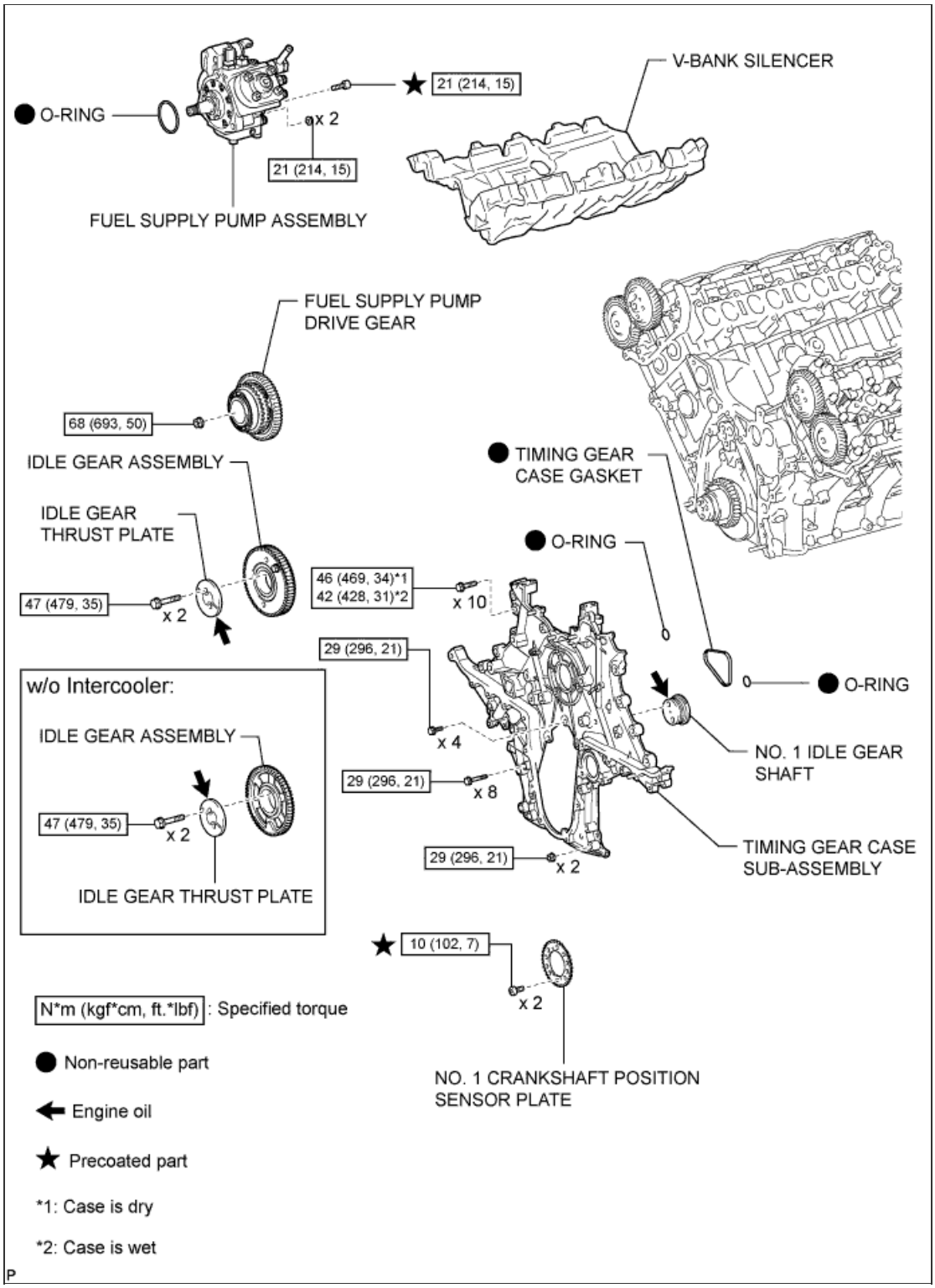
P

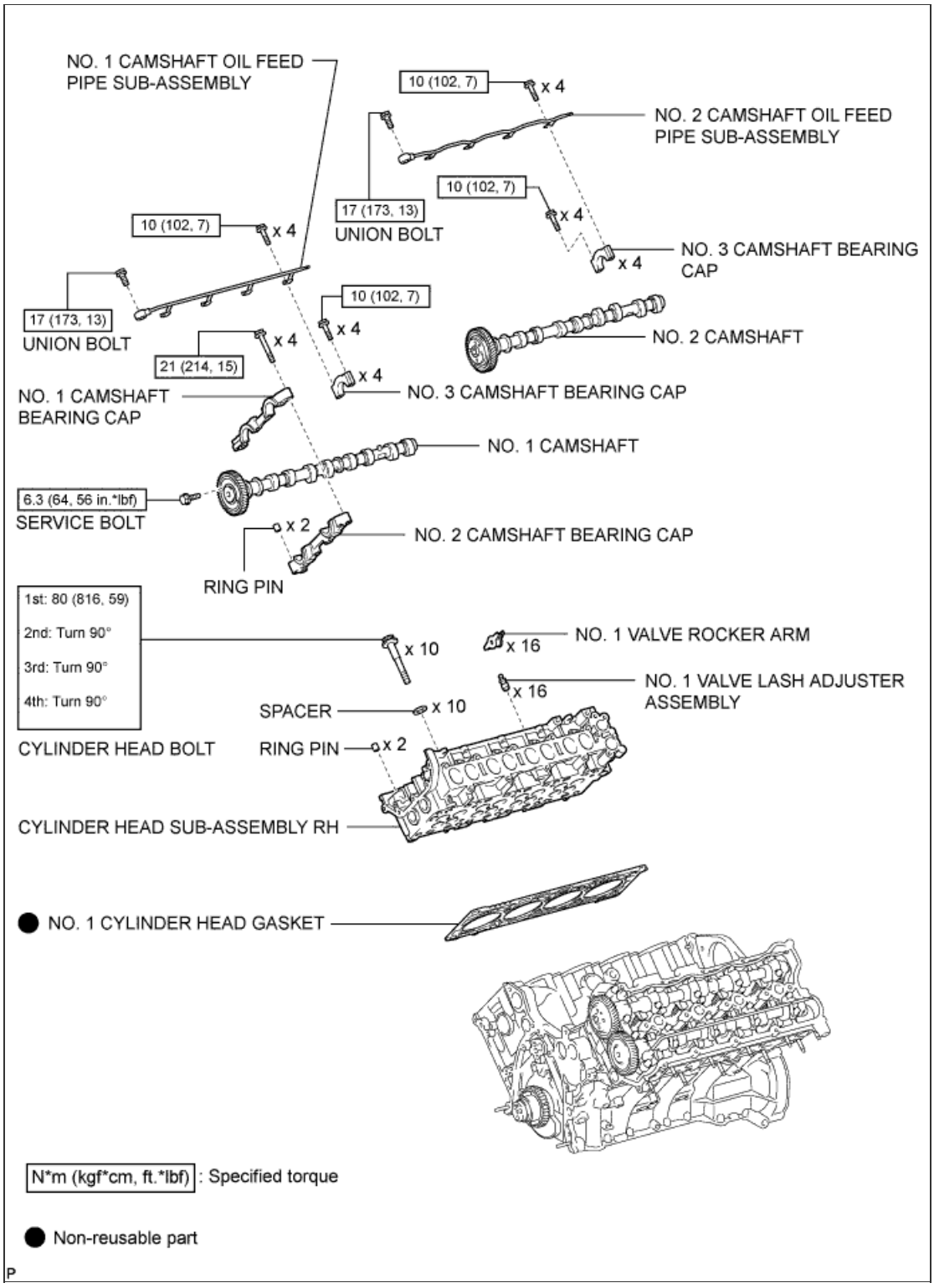

TIMING CHAIN COVER SUB-ASSEMBLY
6.0 (61, 53 in.*lbf)
STUD BOLT
25 (250, 18)
x 4
x 4
x 16
25 (250, 18)
O-RING
FRONT CRANKSHAFT OIL SEAL
WATER PUMP GASKET
25 (250, 18)
x 2
25 (250, 18)
x 4
10 (102, 7)
25 (250, 18)
x 5
NO. 2 OIL COOLER HOSE
NO. 1 OIL COOLER HOSE
WATER PUMP ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
Engine oil
P



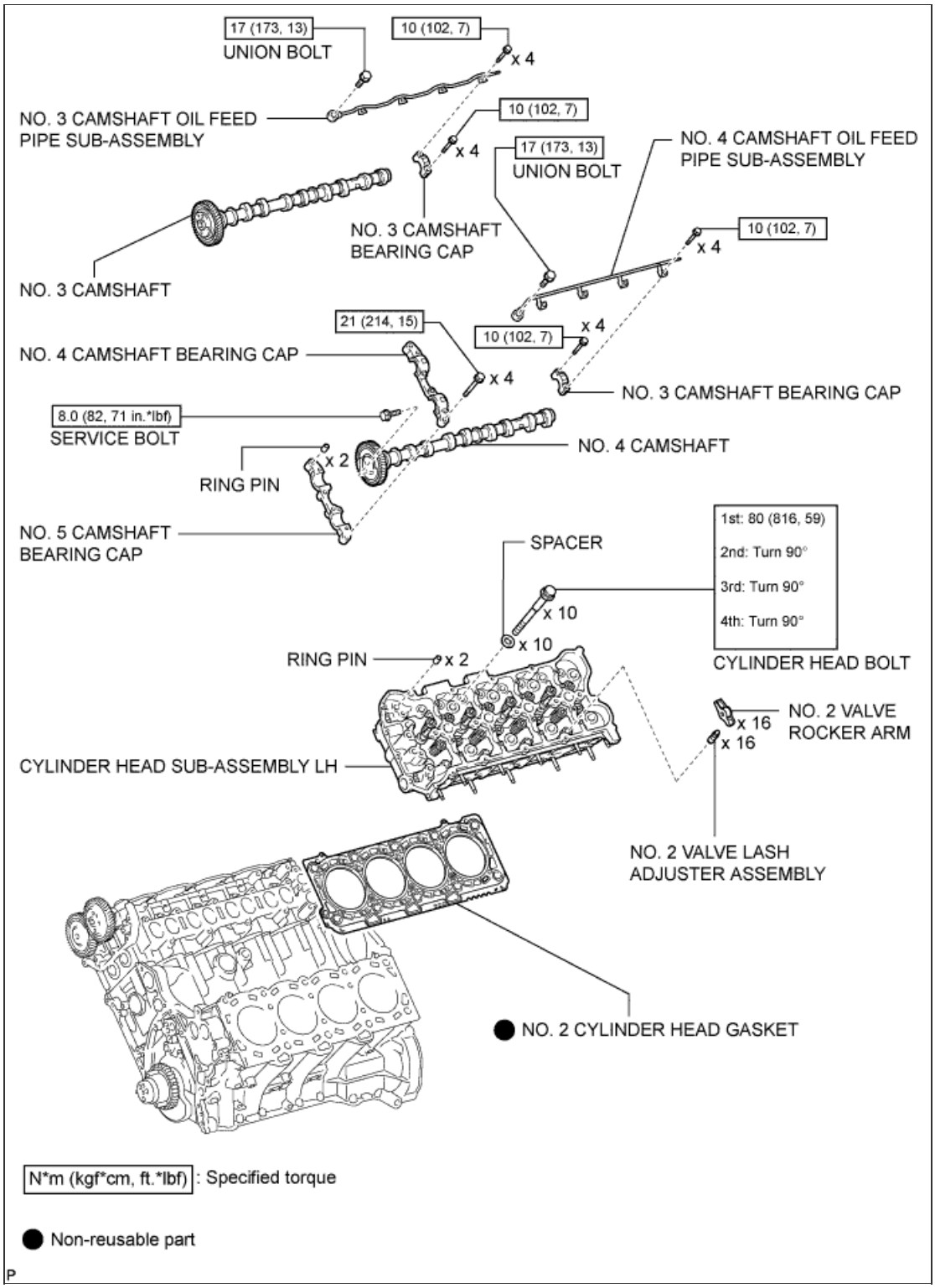
N*m (kgf*cm, ft.*lbf) : Specified torque

P


O-RING
21 (214, 15)
x 2
21 (214, 15)
FUEL SUPPLY PUMP ASSEMBLY
V-BANK SILENCER
FUEL SUPPLY PUMP DRIVE GEAR
68 (693, 50)
IDLE GEAR ASSEMBLY
IDLE GEAR THRUST PLATE
47 (479, 35)
x 2
TIMING GEAR CASE GASKET
O-RING
46 (469, 34)*1
42 (428, 31)*2
x 10
29 (296, 21)
x 4
29 (296, 21)
x 8
29 (296, 21)
x 2
O-RING
NO. 1 IDLE GEAR SHAFT
TIMING GEAR CASE SUB-ASSEMBLY
w/o Intercooler:
IDLE GEAR ASSEMBLY
47 (479, 35)
x 2
IDLE GEAR THRUST PLATE
10 (102, 7)
x 2
NO. 1 CRANKSHAFT POSITION SENSOR PLATE
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
Engine oil
Precoated part
*1: Case is dry
*2: Case is wet
P


NO. 1 CAMSHAFT OIL FEED PIPE SUB-ASSEMBLY
10 (102, 7)
x 4
NO. 2 CAMSHAFT OIL FEED PIPE SUB-ASSEMBLY
17 (173, 13)
UNION BOLT
10 (102, 7)
x 4
NO. 3 CAMSHAFT BEARING CAP
x 4
10 (102, 7)
x 4
17 (173, 13)
UNION BOLT
NO. 2 CAMSHAFT
10 (102, 7)
x 4
21 (214, 15)
x 4
NO. 3 CAMSHAFT BEARING CAP
NO. 1 CAMSHAFT BEARING CAP
NO. 1 CAMSHAFT
6.3 (64, 56 in.*lbf)
SERVICE BOLT
x 2
NO. 2 CAMSHAFT BEARING CAP
RING PIN
1st: 80 (816, 59)
2nd: Turn 90°
3rd: Turn 90°
4th: Turn 90°
x 10
CYLINDER HEAD BOLT
x 16
NO. 1 VALVE ROCKER ARM
x 16
NO. 1 VALVE LASH ADJUSTER ASSEMBLY
SPACER
x 10
RING PIN
x 2
CYLINDER HEAD SUB-ASSEMBLY RH
NO. 1 CYLINDER HEAD GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P


17 (173, 13)
UNION BOLT
10 (102, 7)
x 4
NO. 3 CAMSHAFT OIL FEED PIPE SUB-ASSEMBLY
10 (102, 7)
x 4
17 (173, 13)
UNION BOLT
NO. 4 CAMSHAFT OIL FEED PIPE SUB-ASSEMBLY
NO. 3 CAMSHAFT BEARING CAP
10 (102, 7)
x 4
NO. 3 CAMSHAFT
21 (214, 15)
10 (102, 7)
x 4
NO. 4 CAMSHAFT BEARING CAP
x 4
NO. 3 CAMSHAFT BEARING CAP
8.0 (82, 71 in.*lbf)
SERVICE BOLT
NO. 4 CAMSHAFT
x 2
RING PIN
NO. 5 CAMSHAFT BEARING CAP
SPACER
1st: 80 (816, 59)
2nd: Turn 90°
3rd: Turn 90°
4th: Turn 90°
x 10
x 10
RING PIN
x 2
CYLINDER HEAD BOLT
x 16
NO. 2 VALVE ROCKER ARM
x 16
CYLINDER HEAD SUB-ASSEMBLY LH
NO. 2 VALVE LASH ADJUSTER ASSEMBLY
NO. 2 CYLINDER HEAD GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P

for Preparation Click here

CAUTION:

When replacing an injector (including interchanging injectors between cylinders), common rail, cylinder head, or intake manifold, replace the corresponding injection pipes with a new one.

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Disconnect the cables from the negative (-) main battery and sub-battery terminals.

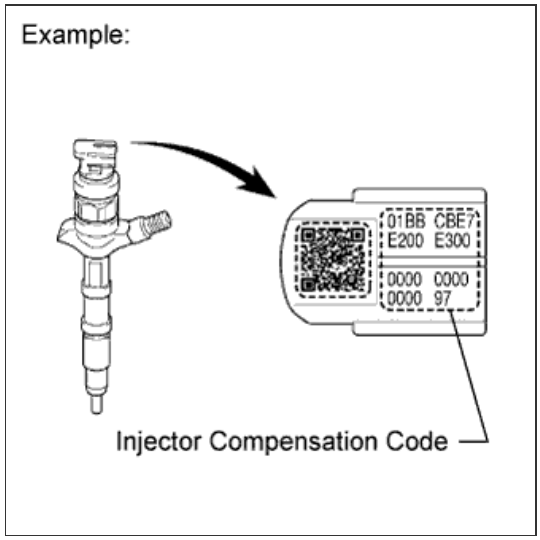
2. REMOVE ENGINE ASSEMBLY

a. Remove the engine assembly from the vehicle (Click here).

3. CHECK INJECTOR COMPENSATION CODE

NOTICE:

- **When a fuel injector is replaced, the new fuel injector compensation code must be input into the ECM. When the ECM is replaced, all of the existing fuel injector compensation codes must be input into the new ECM.**
- **Fuel injector compensation codes are unique, 30 digit, alphanumeric values printed on the head portion of each fuel injector. If an incorrect fuel injector compensation code is input into the ECM, the engine assembly may rattle or engine idling may become rough. In addition, engine failure may occur and the life of the engine may be shortened.**



a. After replacing fuel injector(s) with new one(s), input compensation code(s) of fuel injector(s) into ECM as follows:

HINT:

- **Each fuel injector has different fuel injection characteristics. In order to optimize the fuel injections, the ECM uses the compensation codes to balance the different fuel injections between each fuel injector.**
- **When you first turn the ignition switch to ON after replacing the ECM or a fuel injector(s), DTC P1601 is set. This is to inform you that registration of a fuel injector compensation code(s) is/are required. Manually clear the DTC upon completion of the compensation code registration.**

i. Input the compensation code(s), which is/are imprinted on the head portion(s) of the new fuel injector(s), into the intelligent tester.

ii. Input the new compensation code(s) into the ECM using the tester.

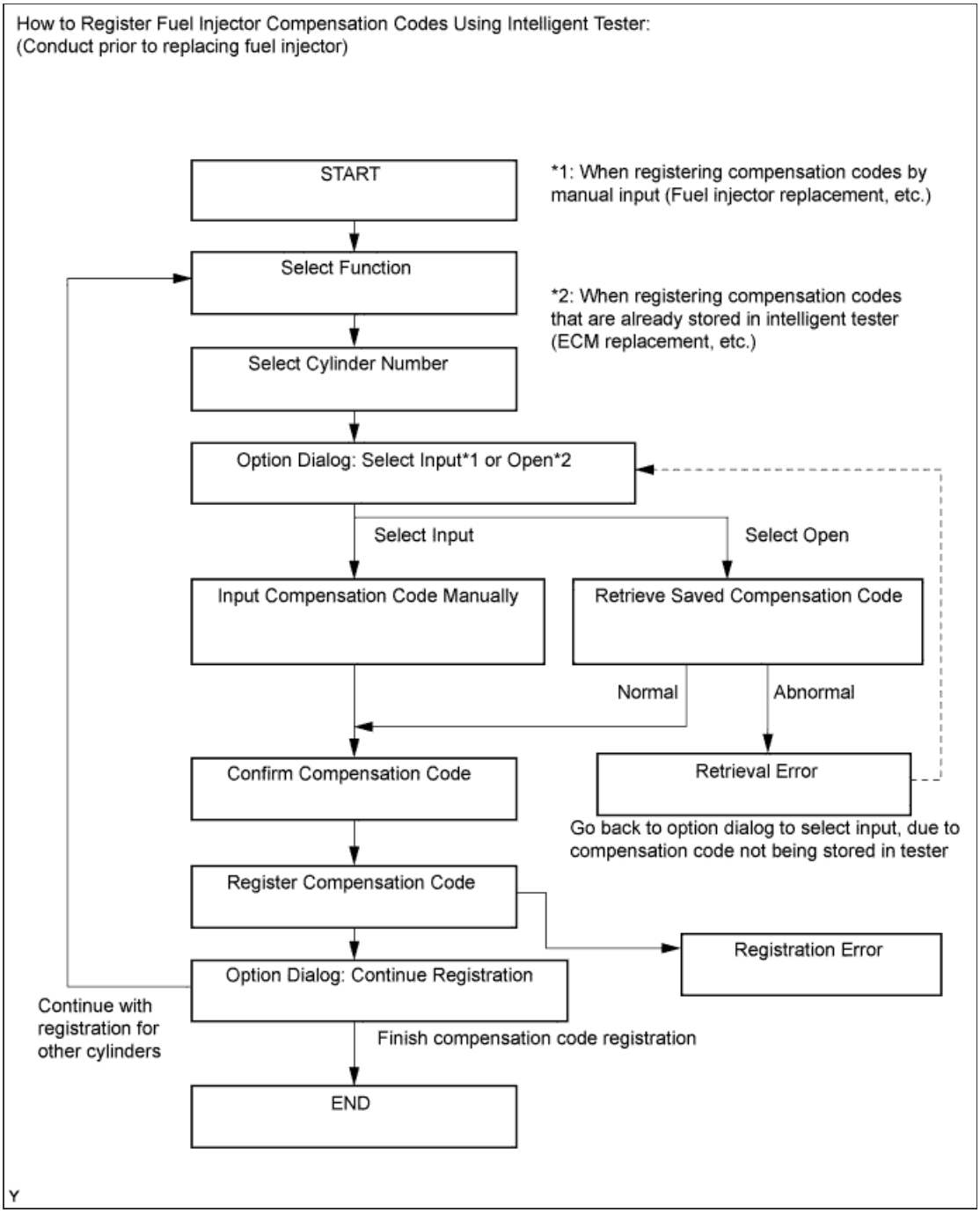
iii. Turn the tester off and turn the ignition switch off.

iv. Wait for at least 30 seconds.

v. Turn the ignition switch to ON and turn the tester on.

vi. Clear DTC P1601 stored in the ECM using the tester (Click here).

b. Register compensation code.



i. Connect the intelligent tester to the DLC3.

ii. Turn the ignition switch to ON.

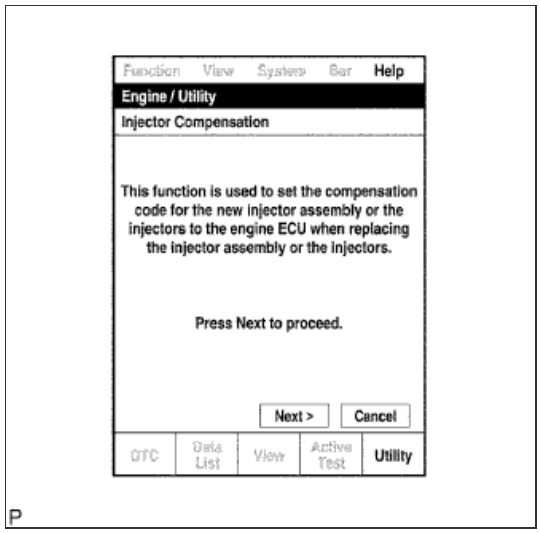
NOTICE:

Do not start the engine.

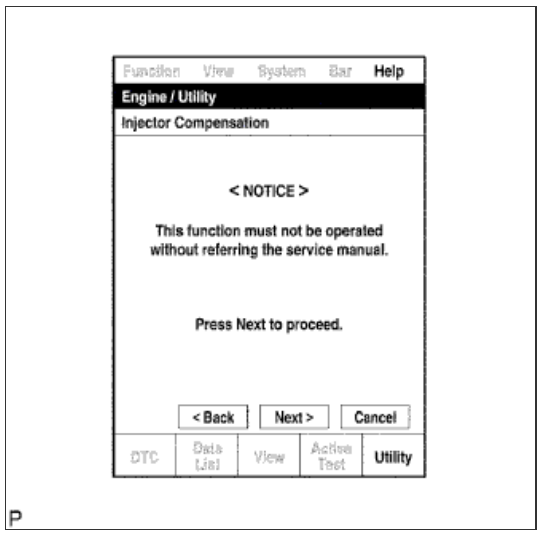
iii. Turn the tester on.

iv. Enter the following menus: Powertrain / Engine / Utility / Injector Compensation.

v. Press Next.

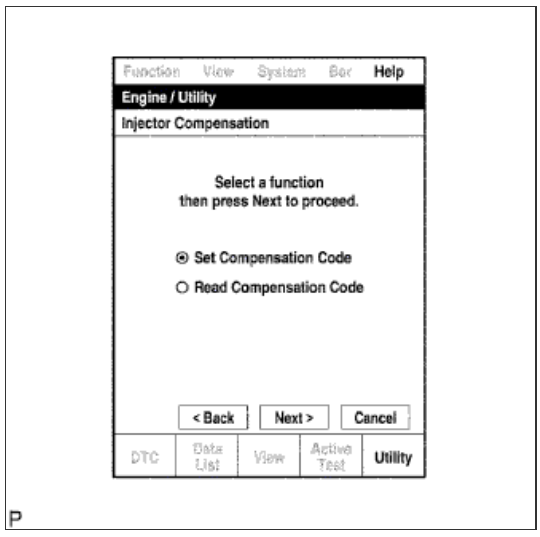


vi. Press Next again to proceed.



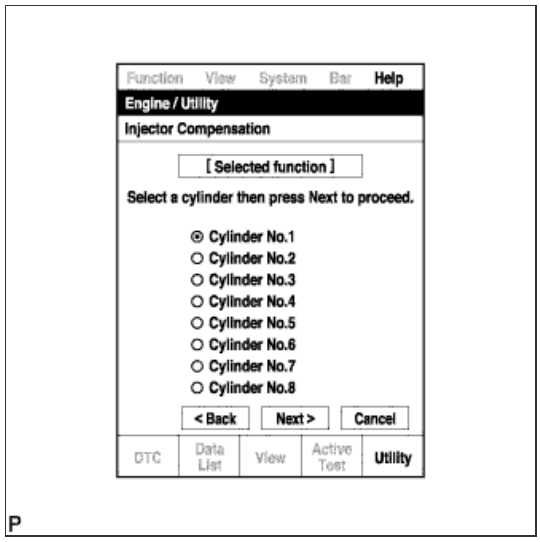
vii. Select "Set Compensation Code".

viii. Press Next.



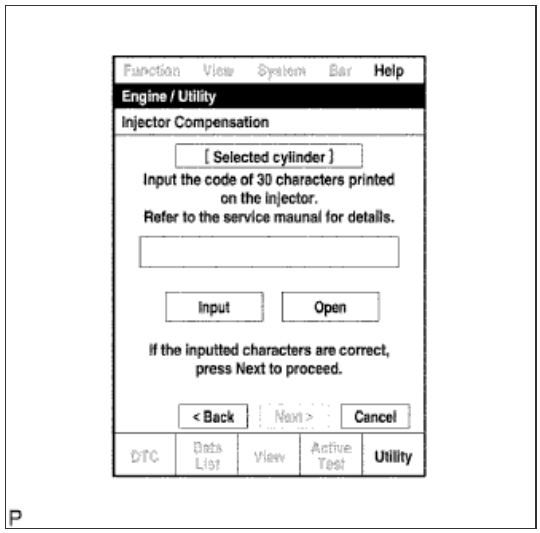
ix. Select the number of the cylinder corresponding to the fuel injector compensation code that you want to read.

x. Press Next.



xi. Register compensation code.

1. Press Input.



2. Manually input the cylinder compensation code using the keyboard on the tester screen. The code is a 30 digit, alphanumeric value printed on the injector head portion.

HINT:

Each fuel injector compensation code is unique. The compensation code for each selected cylinder must be input into the tester correctly.

3. Confirm that the compensation code for the selected cylinder is correct, and then press OK.



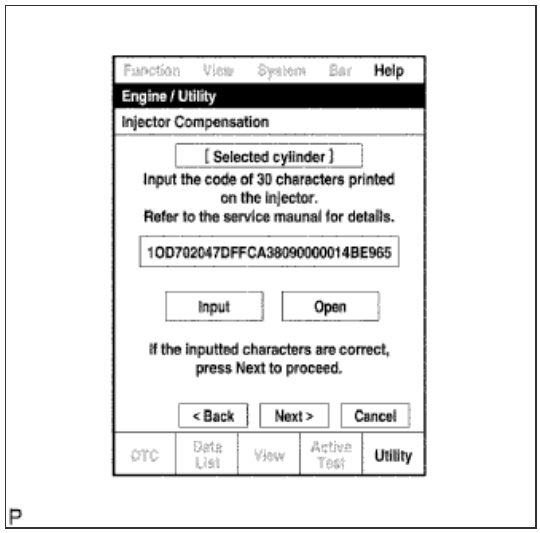
xii. Check that the compensation code displayed on the screen is correct by comparing it with the 30 digit alphanumeric value on the head portion of the fuel injector.

NOTICE:

If an incorrect fuel injector compensation code is input into the ECM, the engine may rattle or engine idling may become rough. In addition, engine failure may occur and the life of the engine may be shortened.

HINT:

- **If a wrong compensation code is input or read, return to the Input Value screen by pressing Input.**
- **The saving process may fail due to a problem with the wire harness or a bad connection with the DLC3. Check the wire harness and DLC3 connection. If no problem is found with either, the ECM may be malfunctioning. Check the ECM and repeat this operation.**



xiii. Press Next to register the compensation code in the ECM.

HINT:

- **If the registration process fails, the compensation code may be incorrect. Check the compensation code again.**
- **If the input compensation code fails to register even though it is input correctly, there may be a problem with the wire harness or a bad connection with the DLC3. Check the wire harness and DLC3 connection. If no problem is found with either, the ECM may be malfunctioning. Check the ECM and restart this operation.**

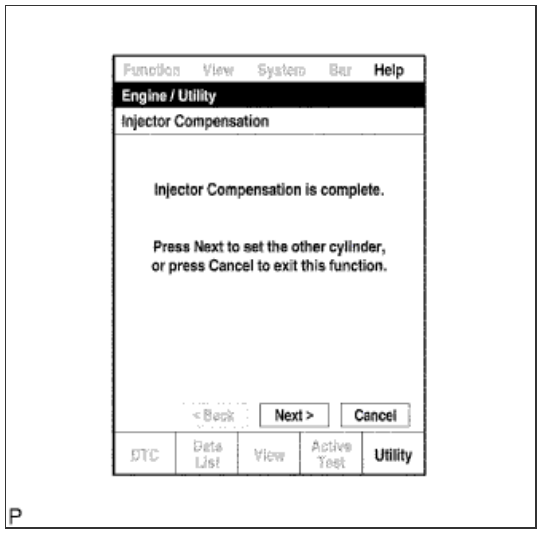
xiv. If you want to continue with other compensation code registrations, press Next. To finish the registration, press Cancel.

xv. Turn the ignition switch off and then turn the tester off.

xvi. Wait for at least 30 seconds.

xvii. Turn the ignition switch to ON and then turn the tester on.

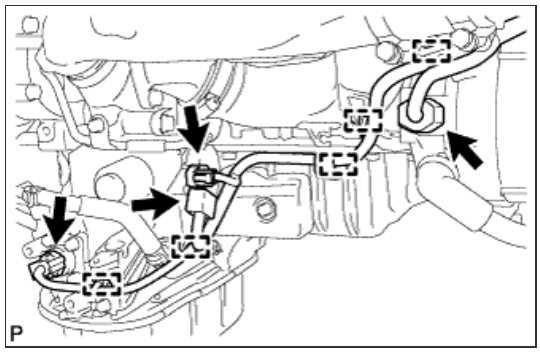
xviii. Clear DTC P1601 stored in the ECM using the tester (Click here).



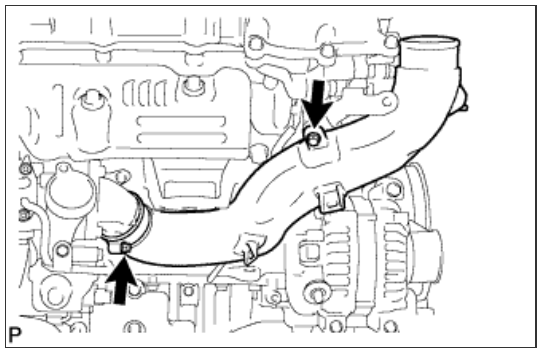
4. REMOVE NO. 1 INTAKE AIR CONNECTOR PIPE

a. Disconnect the 4 connectors.

b. Using a clip remover, detach the 5 wire harness clamps.

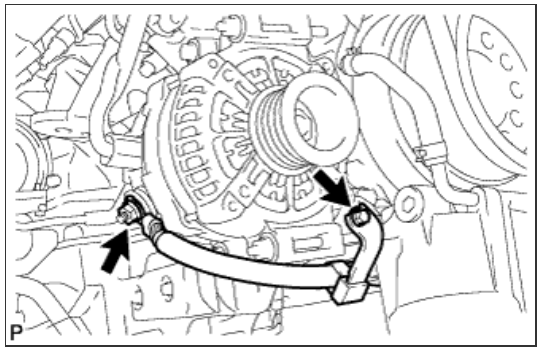


c. Loosen the hose clamp, and remove the bolt and No. 1 intake air connector pipe.

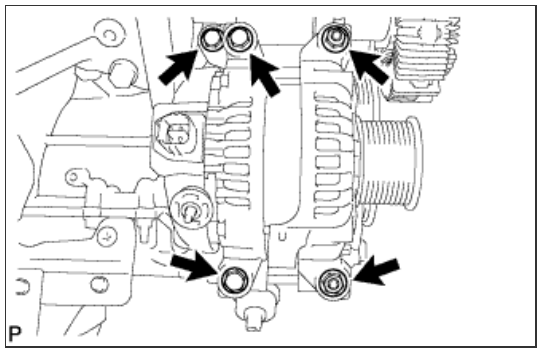


. REMOVE GENERATOR ASSEMBLY

a. Remove the nut and bolt, and disconnect the generator positive (+) cable.

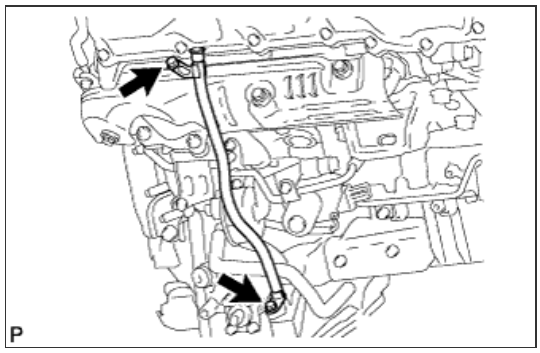


b. Remove the 3 bolts, 2 nuts and generator.

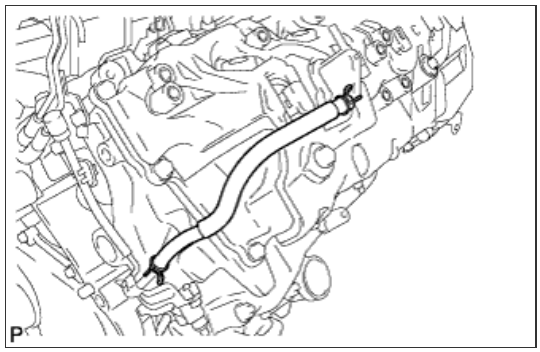


. REMOVE NO. 1 ENGINE OIL LEVEL DIPSTICK GUIDE

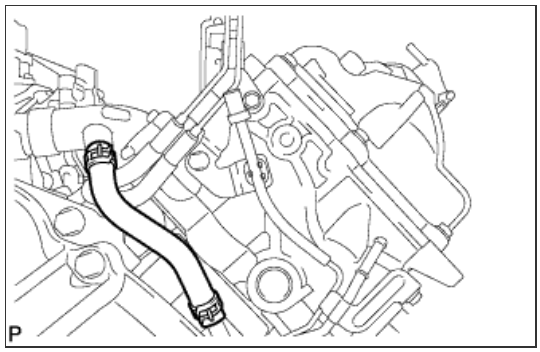
a. Remove the 2 bolts and No. 1 engine oil level dipstick guide.



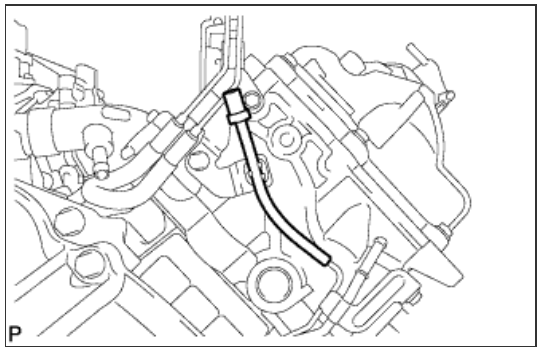
7. DISCONNECT NO. 2 VENTILATION HOSE



8. DISCONNECT NO. 2 TURBO WATER HOSE

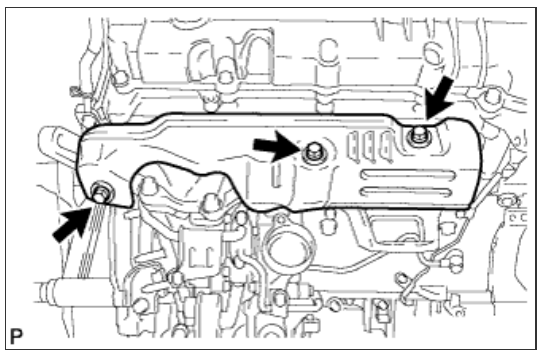


. DISCONNECT BREATHER PLUG RH

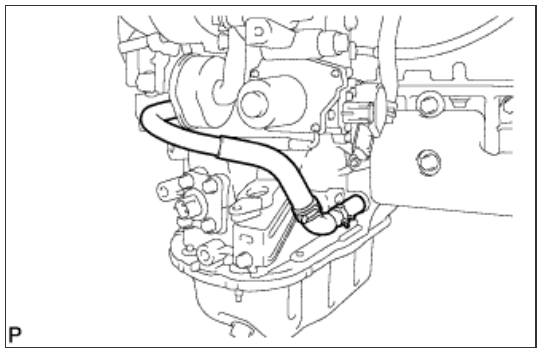


10. REMOVE NO. 1 E HAUST MANIFOLD HEAT INSULATOR

a. Remove the 3 bolts and No. 1 exhaust manifold heat insulator.



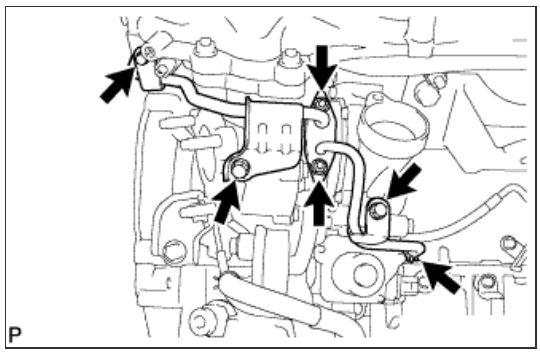
11. DISCONNECT NO. 1 OUTLET TURBO OIL HOSE



12. REMOVE NO. 1 TURBO WATER PIPE SUB ASSEMBLY

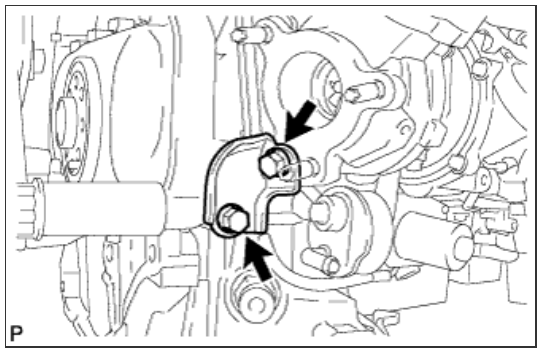
a. Disconnect the water hose.

b. Remove the 3 bolts, 2 nuts, No. 1 turbo water pipe and gasket.



13. REMOVE NO. 1 TURBOCHARGER STAY

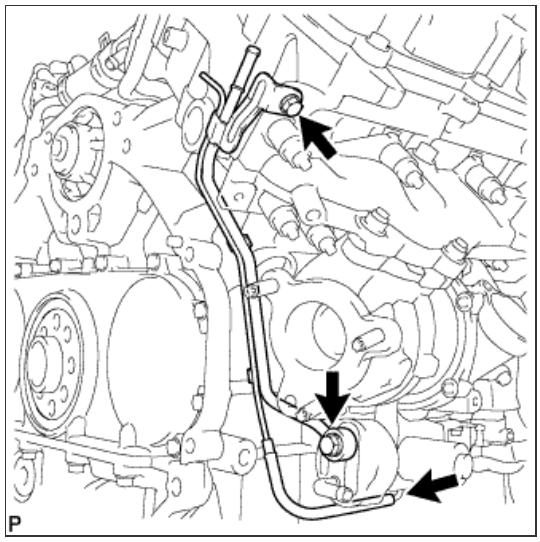
a. Remove the 2 bolts and No. 1 turbocharger stay.



14. REMOVE NO. 1 VENTILATION TUBE SUB ASSEMBLY

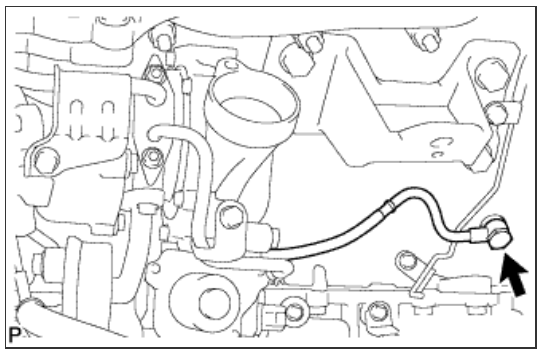
a. Disconnect the vacuum hose.

b. Remove the union bolt, bolt, No. 1 ventilation tube and gasket.

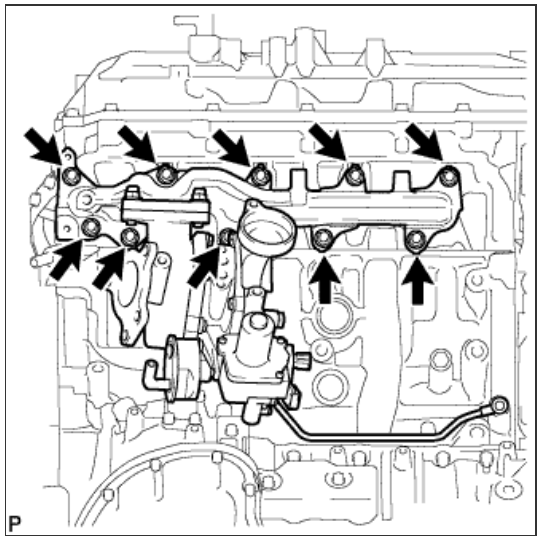


1 . REMOVE NO. 1 TURBOCHARGER SUB ASSEMBLY WITH E HAUST MANIFOLD RH

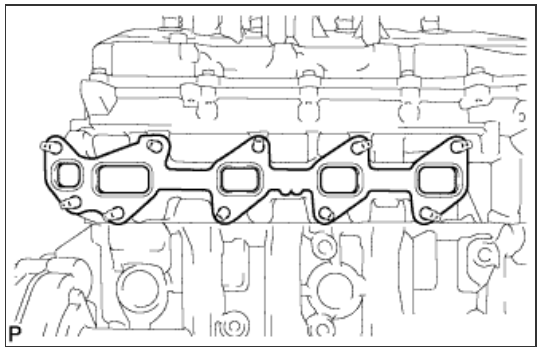
a. Remove the union bolt and gasket, and disconnect the No. 1 inlet turbo oil pipe from the cylinder block.



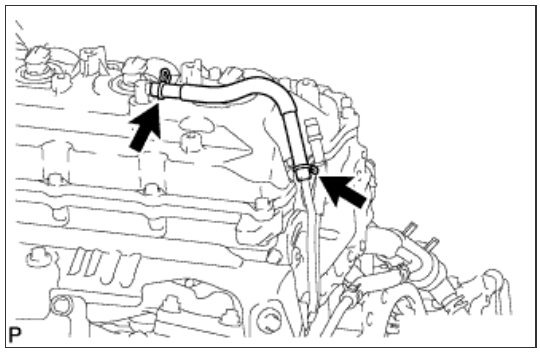
b. Remove the 10 nuts, 10 collars, and No. 1 turbocharger with exhaust manifold RH.



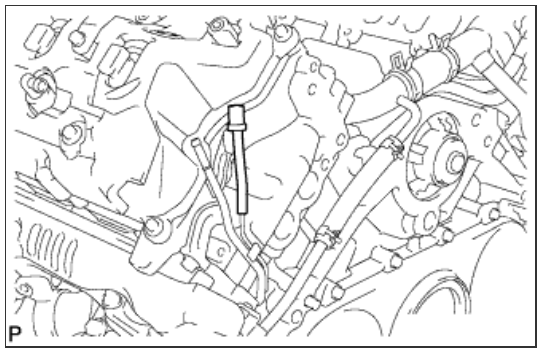
c. Remove the gasket from the cylinder head RH.



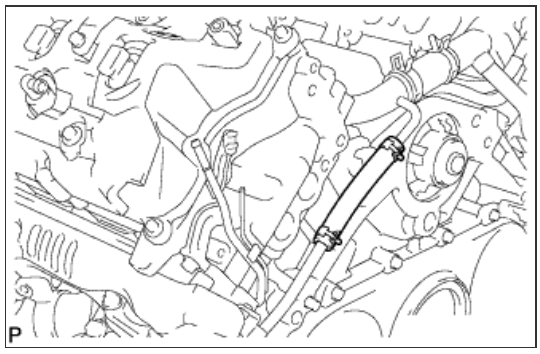
1 . DISCONNECT NO. 3 VENTILATION HOSE



17. DISCONNECT BREATHER PLUG LH

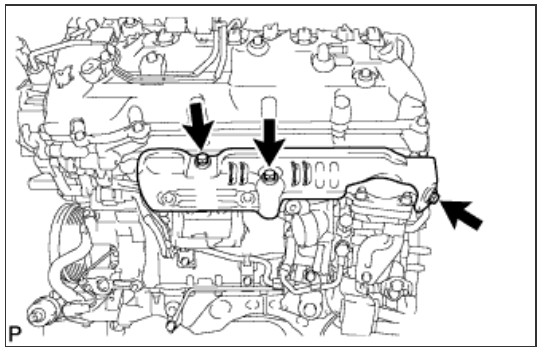


18. DISCONNECT NO. 2 TURBO WATER HOSE



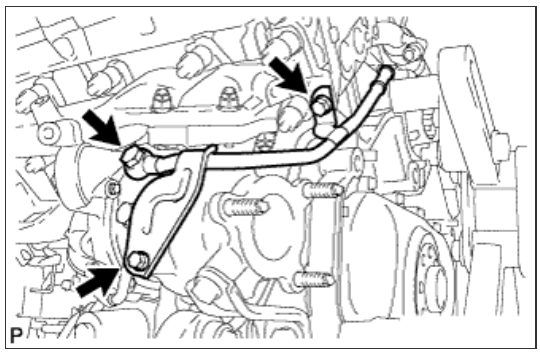
1 . REMOVE NO. 2 E HAUST MANIFOLD HEAT INSULATOR

a. Remove the 3 bolts and No. 2 exhaust manifold heat insulator.



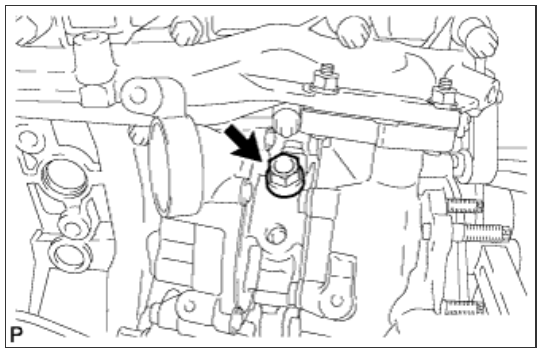
20. REMOVE NO. 3 TURBO WATER PIPE SUB ASSEMBLY

a. Remove the 2 bolts, union bolt, No. 3 turbo water pipe and gasket.



21. REMOVE FRONT WATER BY-PASS JOINT

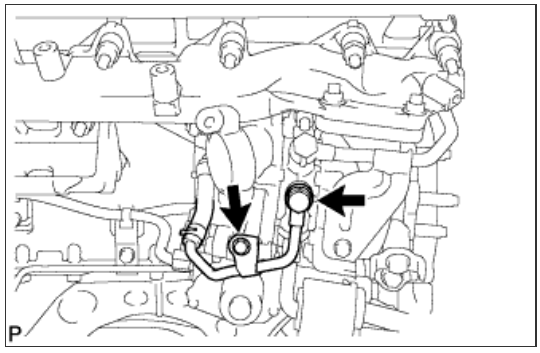
a. Remove the front water by-pass joint and gasket.



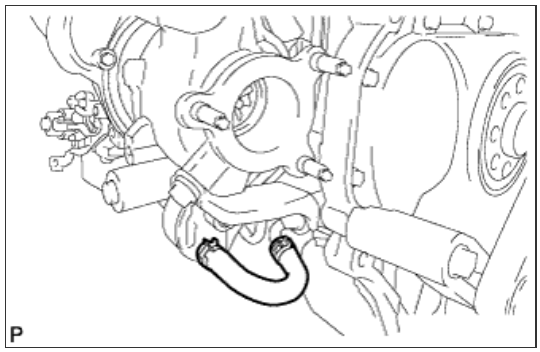
22. REMOVE NO. 2 TURBO WATER PIPE SUB-ASSEMBLY

a. Disconnect the water hose.

b. Remove the union bolt, bolt, No. 2 turbo water pipe and gasket.

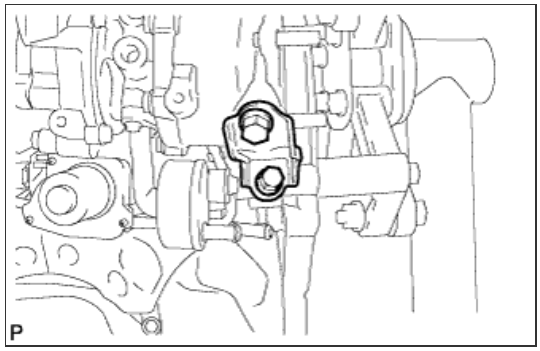


23. DISCONNECT NO. 2 OUTLET TURBO OIL HOSE



24. REMOVE NO. 2 TURBOCHARGER STAY

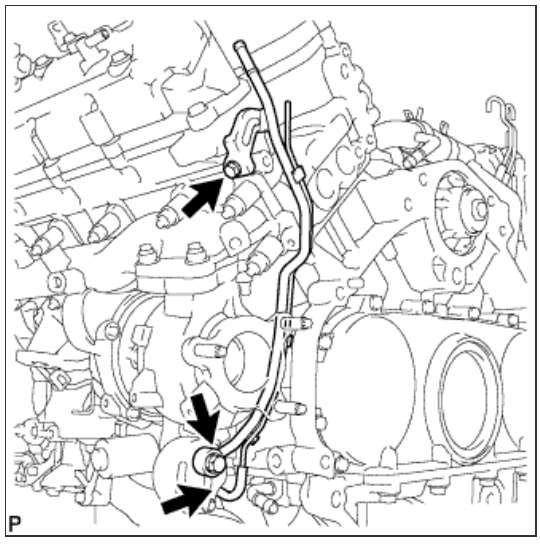
a. Remove the 2 bolts and No. 2 turbocharger stay.



2 . REMOVE NO. 2 VENTILATION TUBE SUB ASSEMBLY

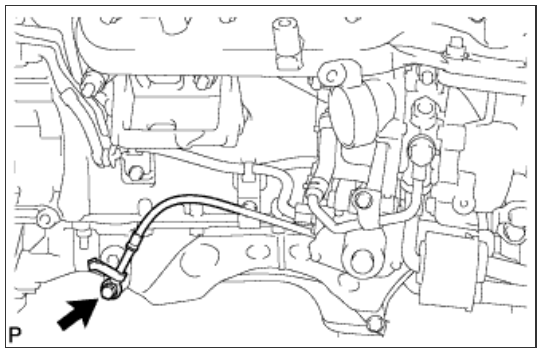
a. Disconnect the No. 2 vacuum transmitting hose.

b. Remove the union bolt, bolt, No. 2 ventilation tube and gasket.

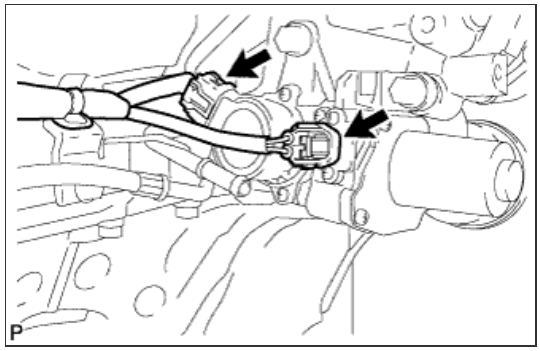


2 . REMOVE NO. 2 TURBOCHARGER SUB ASSEMBLY WITH E HAUST MANIFOLD LH

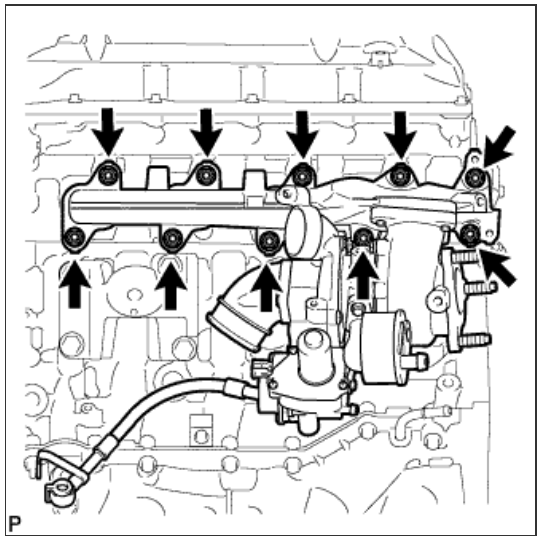
a. Remove the union bolt and gasket, and disconnect the No. 2 inlet turbo oil pipe.



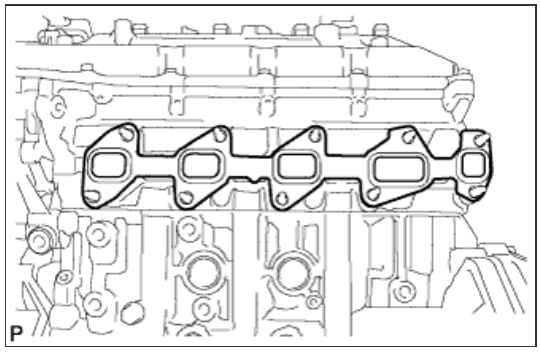
b. Disconnect the 2 connectors from the turbocharger.



c. Remove the 10 nuts, 10 collars, and No. 2 turbocharger with exhaust manifold LH.

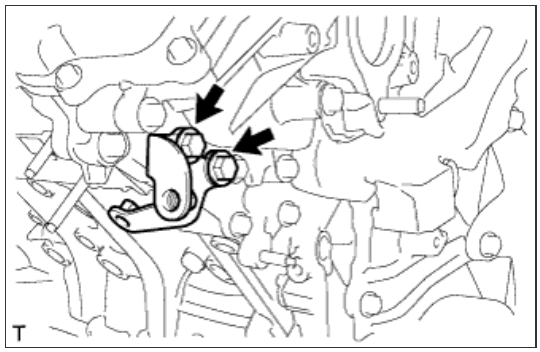


d. Remove the gasket from the cylinder head LH.



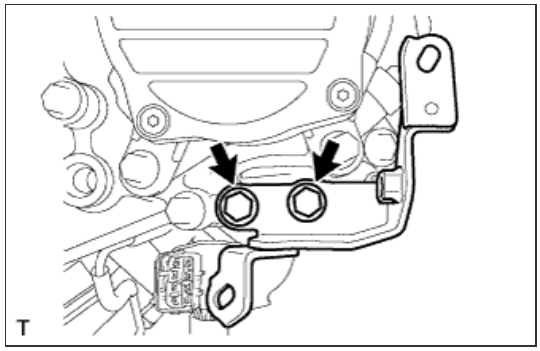
27. REMOVE NO. 1 INTAKE AIR CONNECTOR BRACKET

a. Remove the 2 bolts and No. 1 intake air connector bracket.



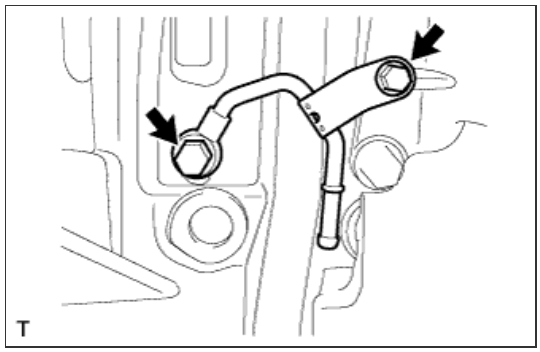
28. REMOVE AIR TUBE SUPPORT

a. Remove the 2 bolts and air tube support.



2 . REMOVE NO. 1 WATER BY PASS PIPE SUB ASSEMBLY

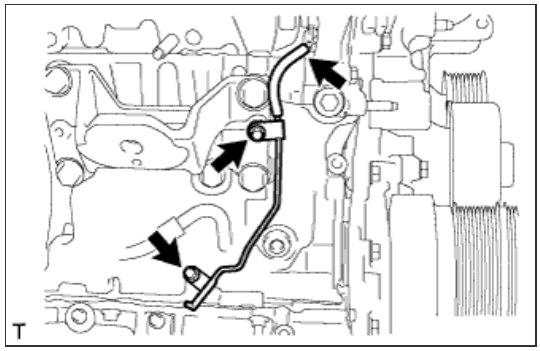
a. Remove the union bolt, bolt, No. 1 water by-pass pipe and gasket.



30. REMOVE NO. 4 VACUUM TRANSMITTING PIPE SUB ASSEMBLY (w/ Intercooler)

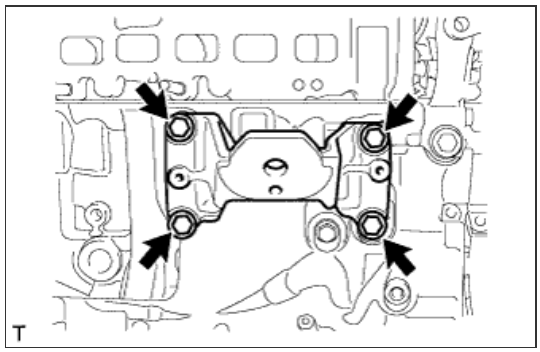
a. Disconnect the vacuum hose.

b. Remove the 2 bolts and No. 4 vacuum transmitting pipe.

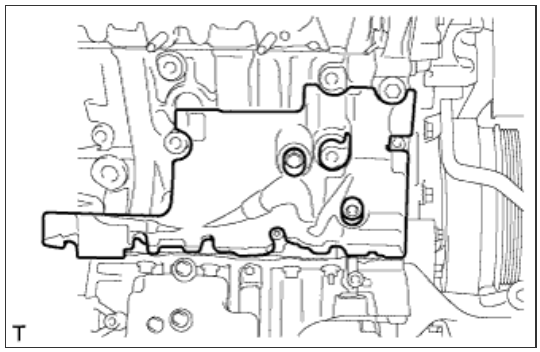


31. REMOVE ENGINE MOUNTING BRACKET RH

a. Remove the 4 bolts and engine mounting bracket RH.

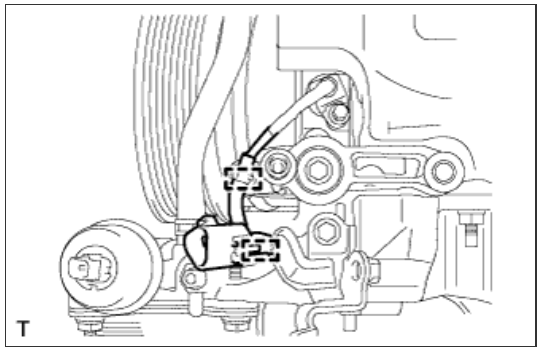


32. REMOVE NO. 1 CYLINDER BLOCK INSULATOR

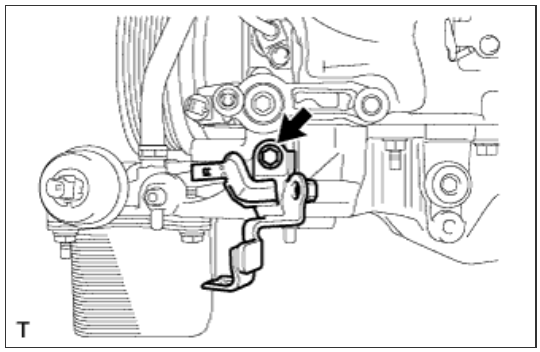


33. REMOVE NO. 2 INTAKE AIR CONNECTOR BRACKET

a. Detach the 2 wire harness clamps.



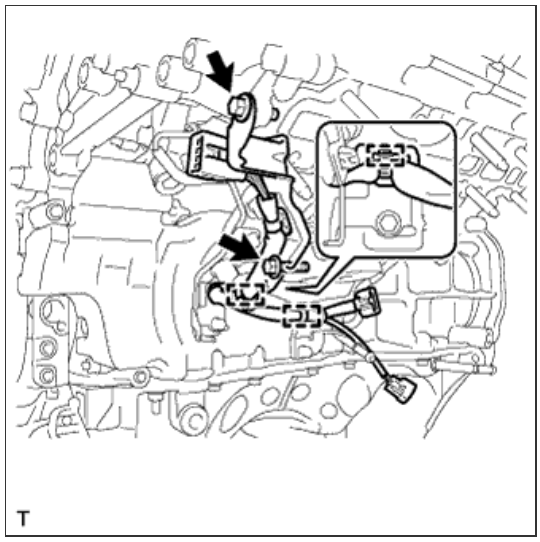
b. Remove the bolt and No. 2 intake air connector bracket.



34. REMOVE TURBOCHARGER WIRE

a. Detach the 3 wire harness clamps.

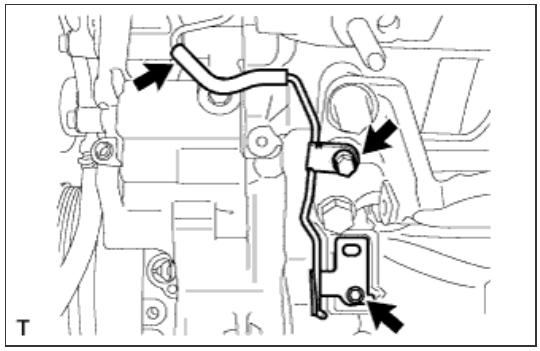
b. Remove the 2 bolts and turbocharger wire.



3 . REMOVE NO. 3 VACUUM TRANSMITTING PIPE SUB ASSEMBLY

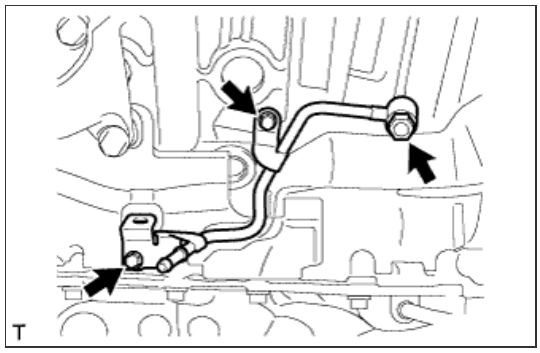
a. w/ Intercooler:
Disconnect the vacuum hose.

b. Remove the 2 bolts and No. 3 vacuum transmitting pipe.



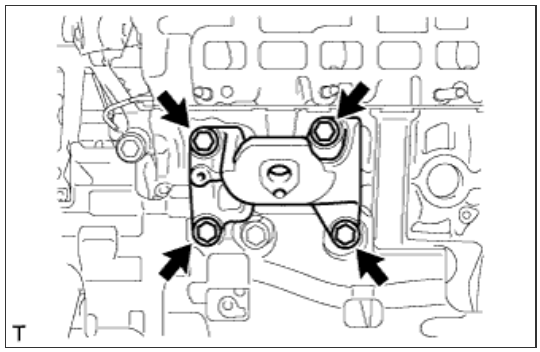
3 . REMOVE NO. 2 WATER BY PASS PIPE SUB ASSEMBLY

a. Remove the union bolt, 2 bolts, No. 2 water by-pass pipe and gasket.

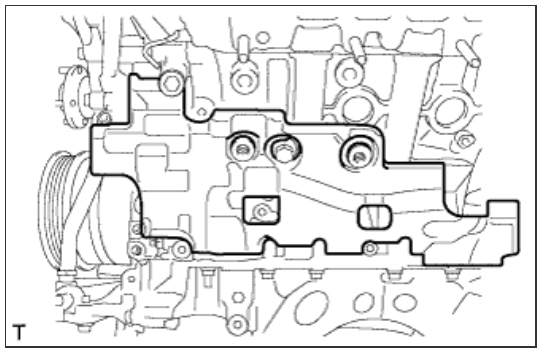


37. REMOVE ENGINE MOUNTING BRACKET LH

a. Remove the 4 bolts and engine mounting bracket LH.

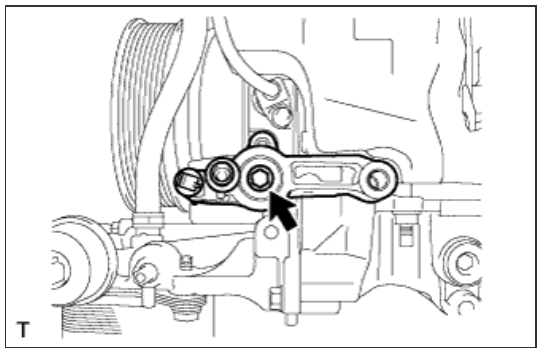


38. REMOVE NO. 2 CYLINDER BLOCK INSULATOR



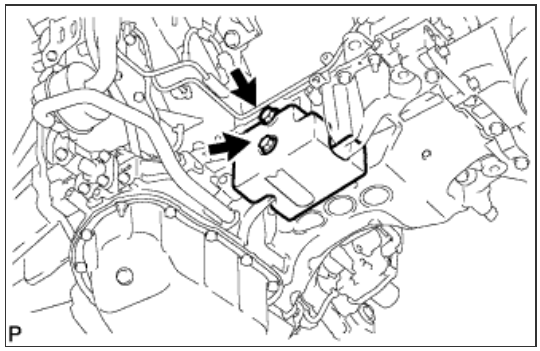
3 . REMOVE COMPRESSOR BRACKET

a. Remove the bolt and compressor bracket.

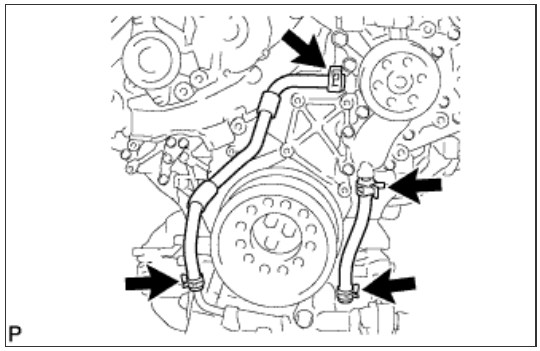


40. REMOVE STIFFENER INSULATOR RH (w/ Intercooler)

a. Remove the 2 bolts and stiffener insulator RH.



41. DISCONNECT NO. 1 OIL COOLER HOSE



42. DISCONNECT NO. 2 OIL COOLER HOSE

43. REMOVE CRANKSHAFT PULLEY

NOTICE:

This procedure is intended for removal/installation of the crankshaft pulley only. Do not use this procedure for removal/installation of the flywheel or the drive plate and ring gear.

a. Install the 2 bolts to the bolt holes of the crankshaft rear side.

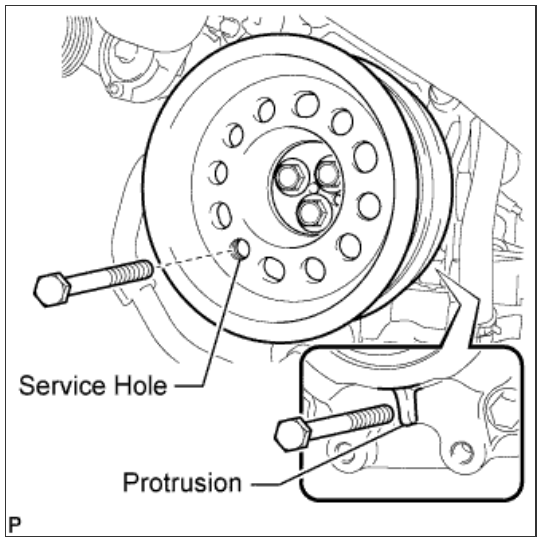
b. Using a bar, turn the crankshaft until the crankshaft pulley service hole is a little to the left of bottom dead center.

c. Install a 14 mm x 1.5 pitch service bolt with a length of 70 mm or more to the crankshaft pulley service hole, and hold the crankshaft using the timing chain cover protrusion.

d. Remove the 3 bolts and crankshaft pulley.

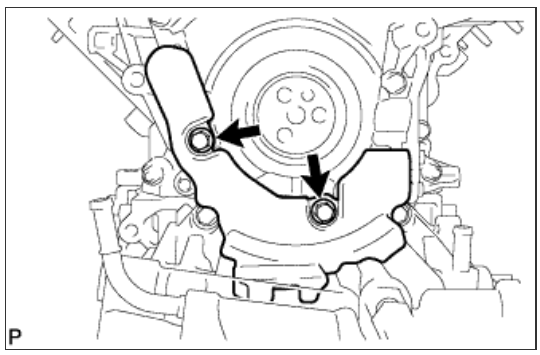
NOTICE:

If the crankshaft pulley cannot be removed, temporarily install a bolt to the crankshaft so that the pulley does not fall, and lightly tap the outer edge of the mass damper with a plastic-faced hammer to remove the pulley. Do not tap the pulley V-ribbed belt ribs, as the crankshaft may be damaged.



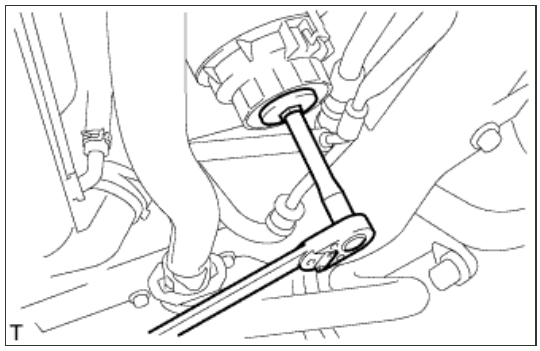
44. REMOVE TIMING GEAR COVER SPACER (w/ Intercooler)

a. Remove the 2 bolts and timing gear cover spacer.



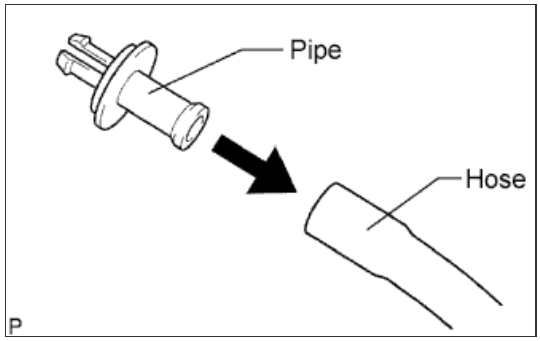
45. REMOVE OIL FILTER ELEMENT

a. Remove the oil filter drain plug.



b. Connect a hose with an inside diameter of 15 mm (0.591 in.) to the pipe.

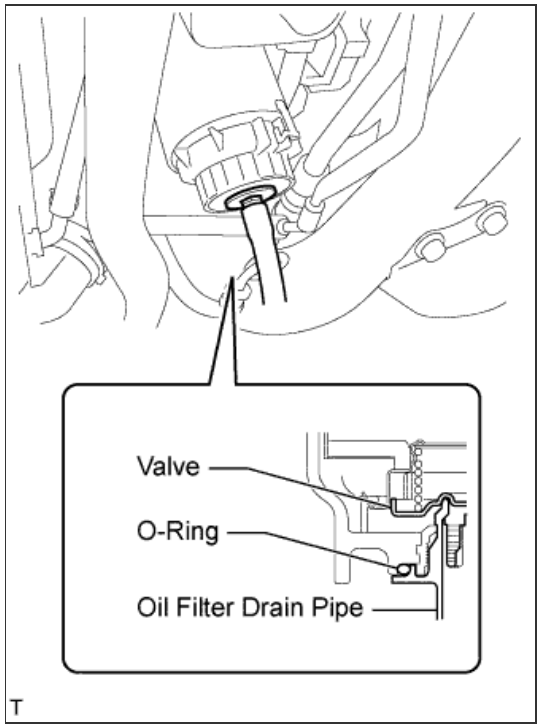
c. Remove the O-ring from the oil filter drain plug and install it to the drain pipe.



d. Install the oil filter drain pipe to the oil filter cap and drain the engine oil.

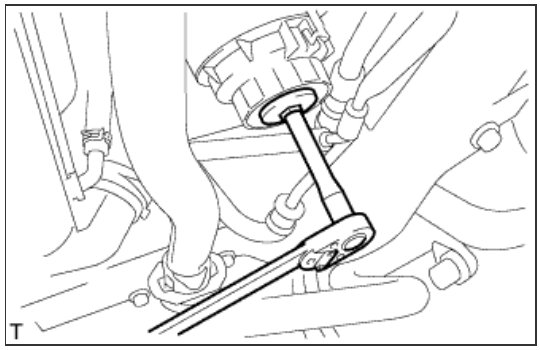
e. Remove the oil filter drain pipe.

f. Apply a light coat of engine oil to a new O-ring, and install it to the oil filter drain plug.



g. Install the oil filter drain plug to the oil filter cap.

Torque:
13 N m 127 kgf cm , ft. lbf



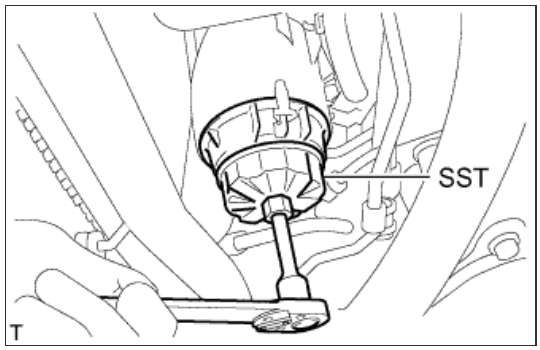
h. Using SST, remove the oil filter cap.

SST

0 228 0 01

HINT:

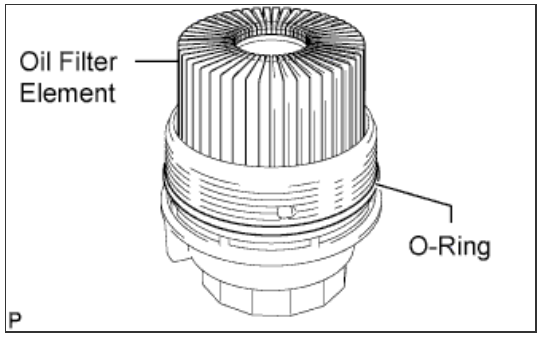
Use a container to catch the draining oil. After the oil filter cap is loosened approximately 4 turns and the cap ribs are vertical, engine oil drains from the gap between the oil filter cap and oil pan.



i. Remove the oil filter element and O-ring from the oil filter cap.

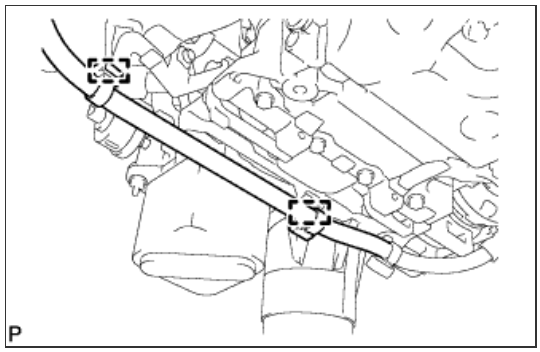
NOTICE:

Be sure to remove the cap O-ring by hand, without using any tools, to prevent damage to the cap O-ring groove.

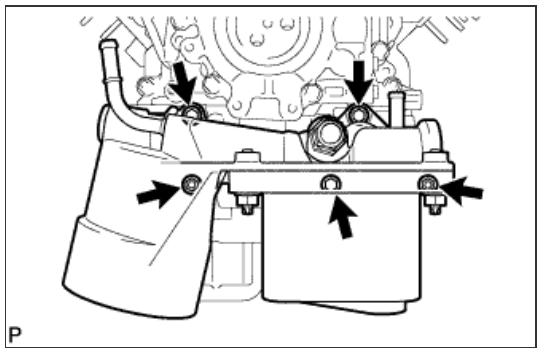


4 . REMOVE OIL FILTER BRACKET SUB-ASSEMBLY

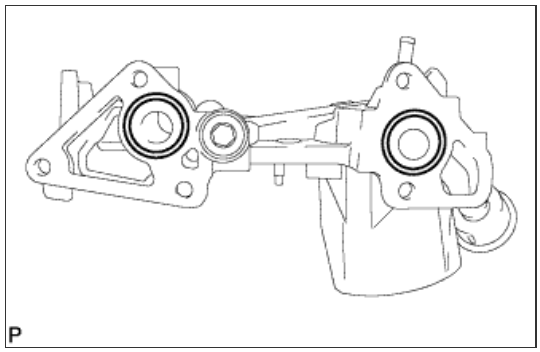
a. Disconnect the 2 wire harness clamps.



b. Remove the 3 bolts, 2 nuts and oil filter bracket.



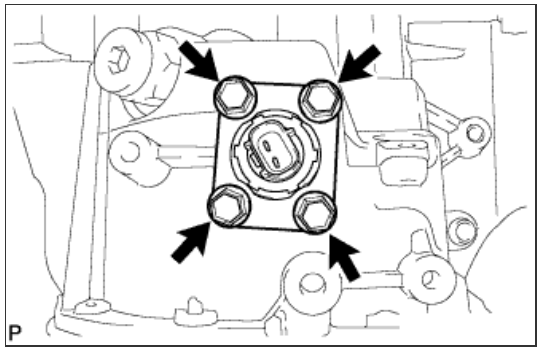
c. Remove the 2 O-rings.



47. REMOVE ENGINE OIL LEVEL SENSOR

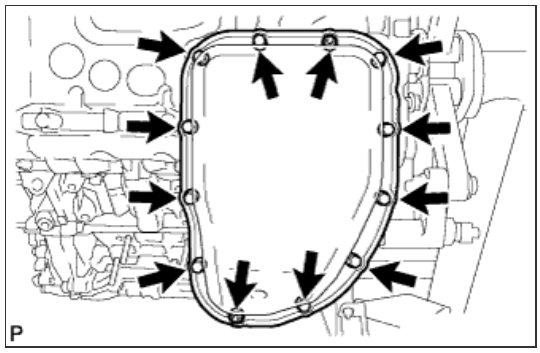
a. Remove the 4 bolts and engine oil level sensor.

b. Remove the gasket.



48. REMOVE NO. 2 OIL PAN SUB ASSEMBLY

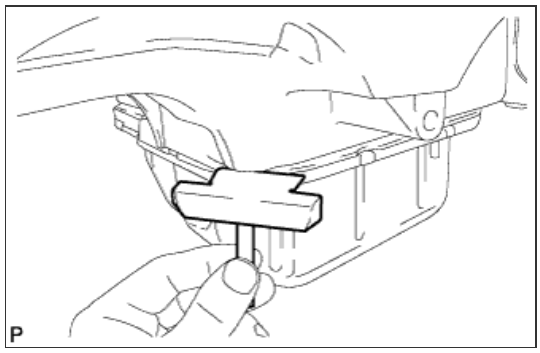
a. Remove the 10 bolts and 2 nuts.



b. Insert the blade of an oil pan seal cutter between the oil pans. Cut through the applied sealer and remove the No. 2 oil pan.

NOTICE:

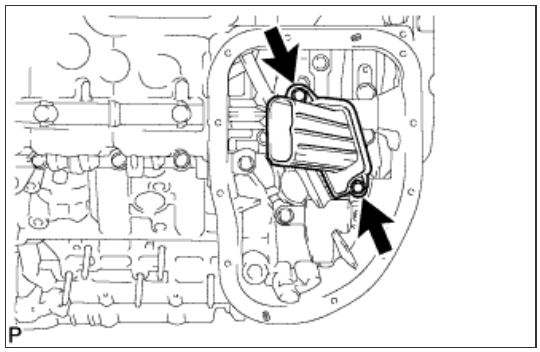
Be careful not to damage the contact surfaces of the oil pans.



4 . REMOVE OIL STRAINER SUB ASSEMBLY

a. Remove the 2 bolts and oil strainer.

b. Remove the O-ring from the oil strainer.



0. REMOVE NO. 1 OIL PAN SUB ASSEMBLY

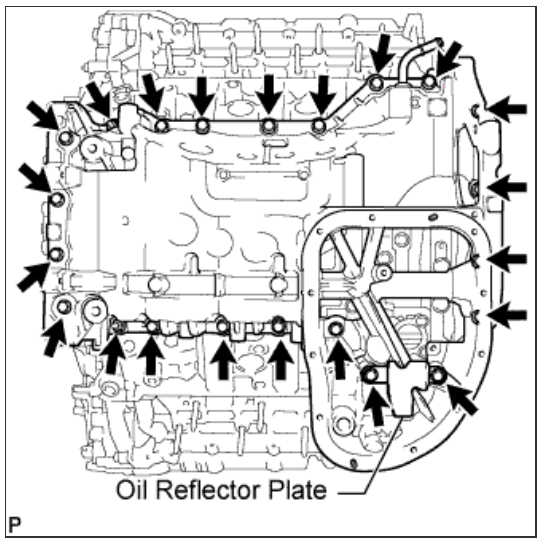
a. Remove the 20 bolts, 2 nuts and oil reflector plate.

NOTICE:

If the oil reflector plate is deformed, replace it.

HINT:

Be sure to clean the bolts and stud bolts, and check the threads for cracks or other damage.



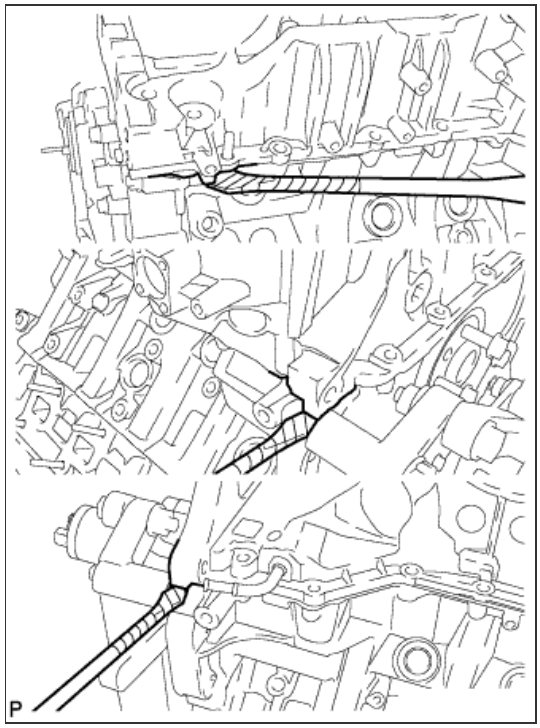
b. Remove the No. 1 oil pan by prying between the No. 1 oil pan and cylinder block with a screwdriver.

NOTICE:

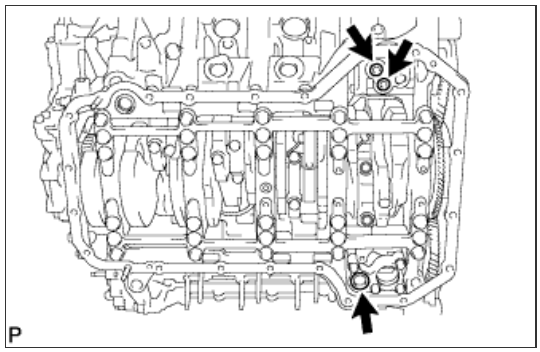
Be careful not to damage the contact surfaces of the cylinder block and oil pan.

HINT:

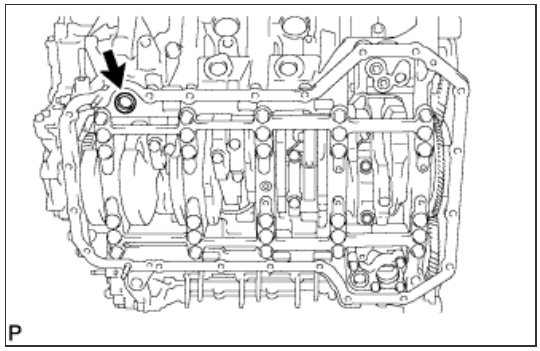
Tape the screwdriver tip before use.



c. Remove the 3 O-rings.

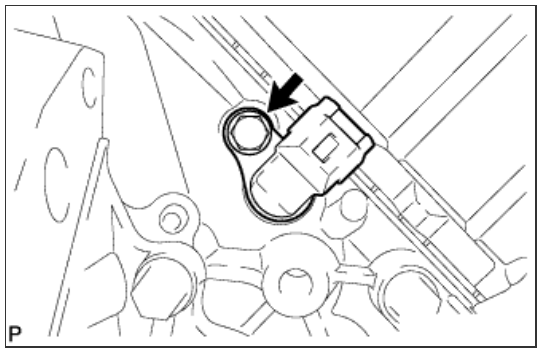


d. Remove the cylinder block oil hole gasket.



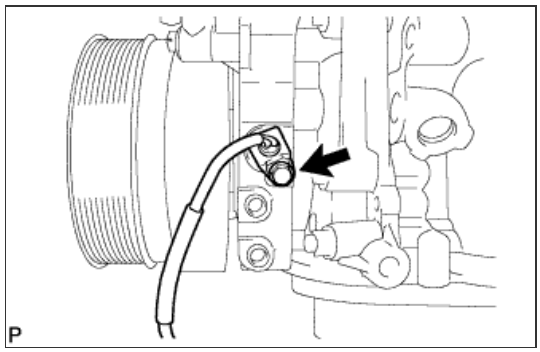
1. REMOVE CAMSHAFT POSITION SENSOR

a. Remove the bolt and sensor.



52. REMOVE CRANKSHAFT POSITION SENSOR

a. Remove the bolt and sensor.



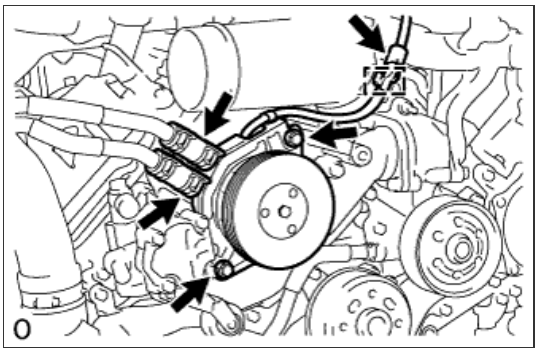
53. REMOVE VISCOUS HEATER ASSEMBLY WITH MAGNET CLUTCH (w/ Viscous Heater)

a. Disconnect the connector and detach the clamp.

b. Using pliers, grip the claws of the clips and slide the 2 clips.

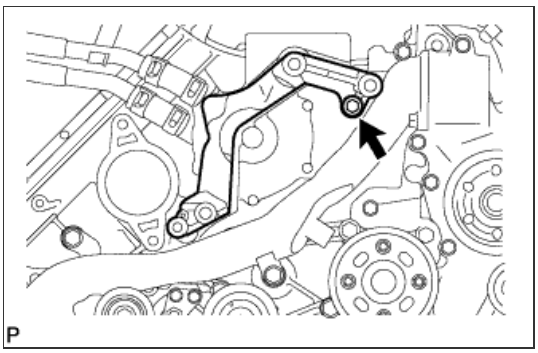
c. Disconnect the 2 heater hoses.

d. Remove the 2 bolts and heater assembly.



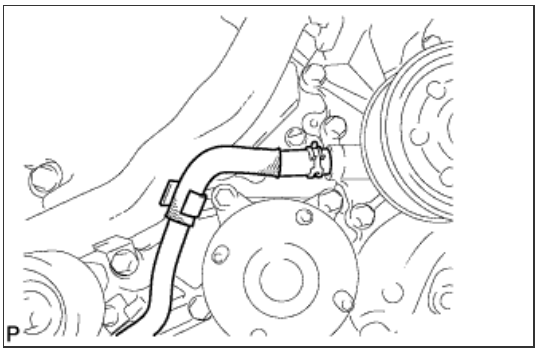
. REMOVE NO. 1 IDLER PULLEY BRACKET (w/ Viscous Heater)

a. Remove the bolt and No. 1 idler pulley bracket.

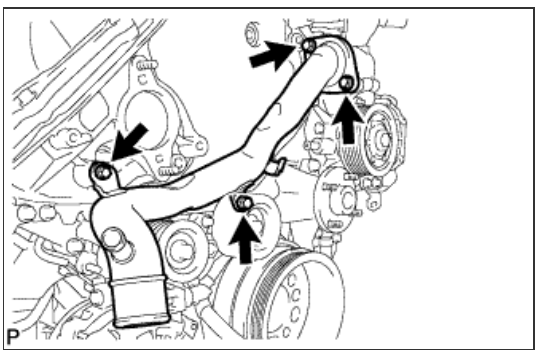


55. REMOVE WATER INLET

a. Disconnect the No. 2 oil cooler hose from the water pump and clamp.



b. Remove the 4 bolts and water inlet.



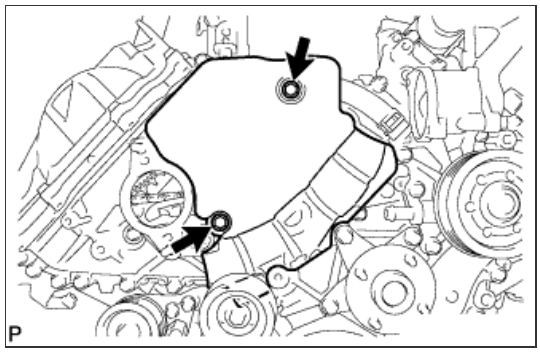
56. REMOVE THERMOSTAT

a. Remove the thermostat.

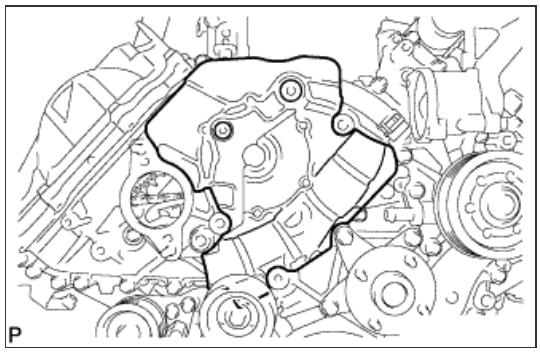
b. Remove the gasket from the thermostat.

. REMOVE TIMING GEAR COVER INSULATOR (w/ Intercooler)

a. w/o Viscous Heater:
Remove the 2 bolts and timing gear cover insulator.

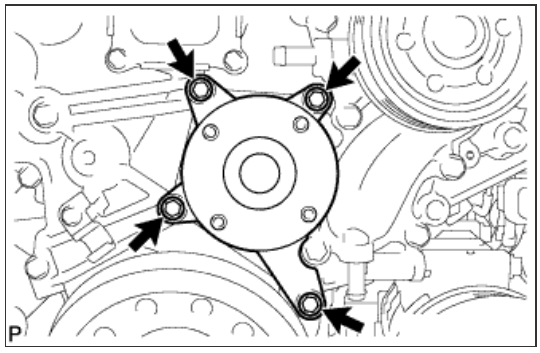


b. w/ Viscous Heater:
Remove the timing gear cover insulator.



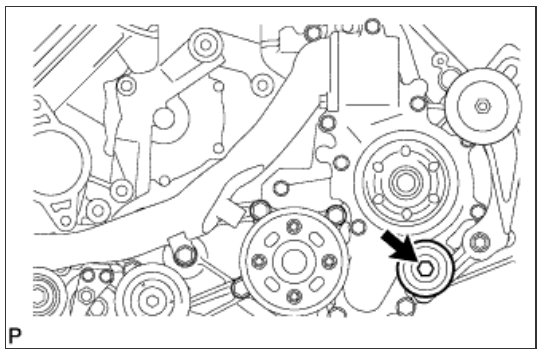
58. REMOVE FAN BRACKET SUB-ASSEMBLY

a. Remove the 4 bolts and fan bracket.



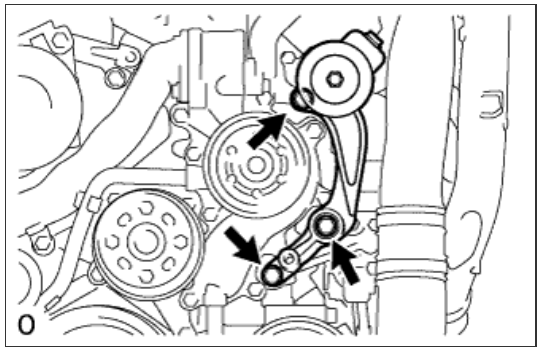
59. REMOVE NO. 2 IDLER PULLEY (w/ Viscous Heater)

a. Remove the bolt, cover, No. 2 idler pulley and collar.



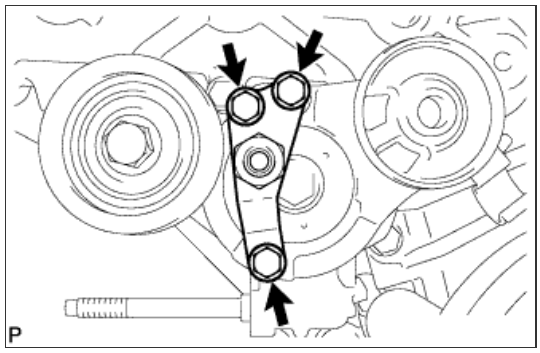
60. REMOVE NO. 2 IDLER PULLEY BRACKET (w/ Viscous Heater)

a. Remove the 3 bolts and idler pulley bracket.

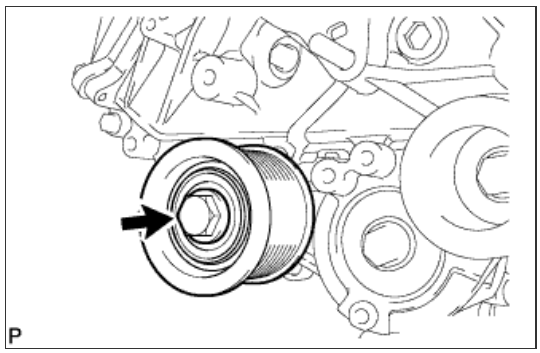


1. REMOVE V RIBBED BELT TENSIONER ASSEMBLY

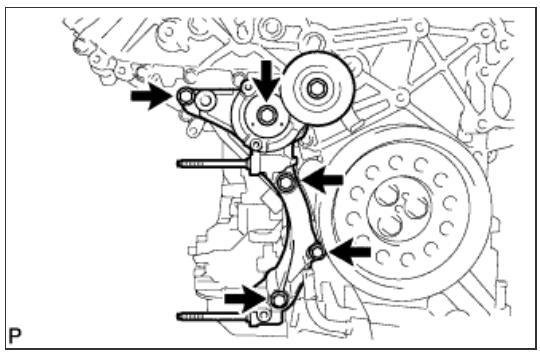
a. Remove the 3 bolts and V-ribbed belt tensioner bracket.



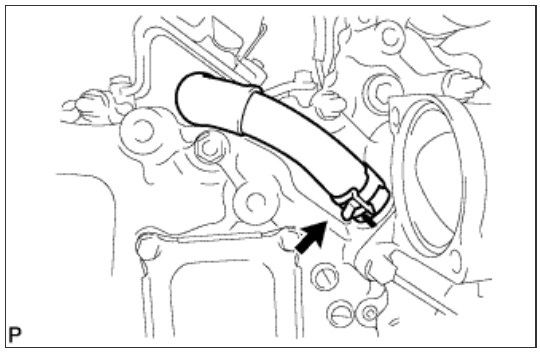
b. Remove the bolt and No. 1 idler pulley.



c. Remove the 5 bolts and V-ribbed belt tensioner.



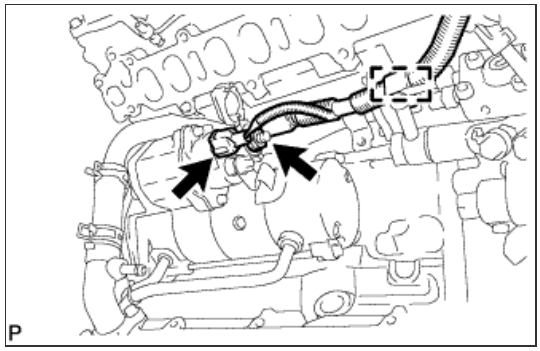
2. DISCONNECT INLET WATER HOSE



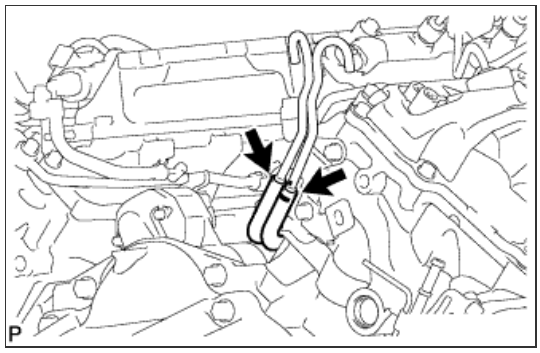
3. REMOVE STARTER ASSEMBLY

a. Disconnect the connector and detach the wire harness clamp.

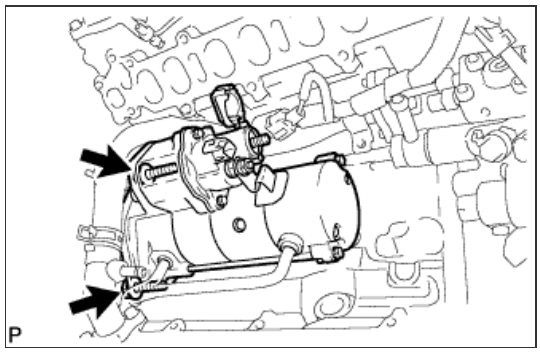
b. Remove the nut and No. 2 engine wire.



c. Disconnect the 2 hoses.

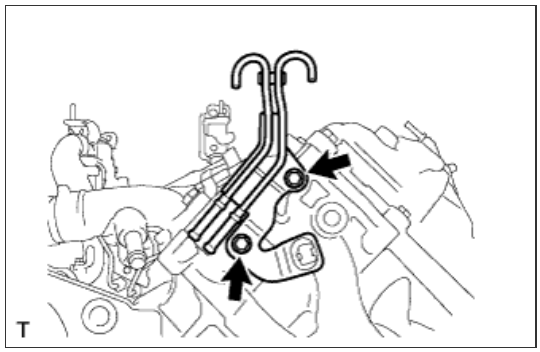


d. Remove the 2 bolts and starter.



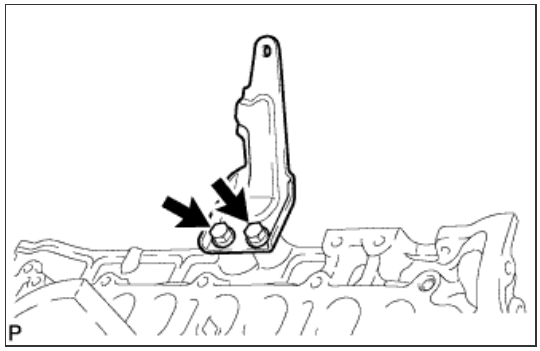
. REMOVE STARTER HOSE BRACKET

a. Remove the 2 bolts and starter hose bracket.



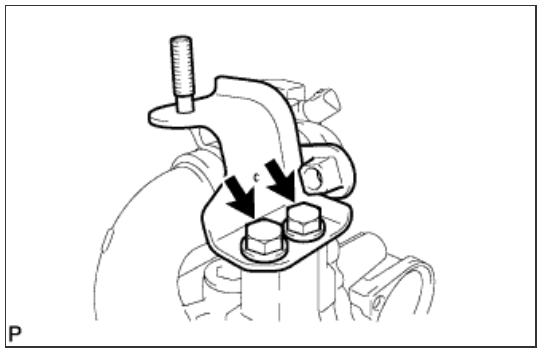
. REMOVE CLUTCH FLEXIBLE HOSE BRACKET (for Manual Transmission)

a. Remove the 2 bolts and clutch flexible hose bracket.



66. REMOVE NO. 2 INTERCOOLER SUPPORT BRACKET

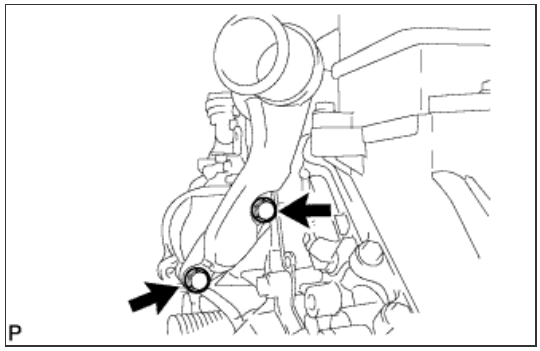
a. Remove the 2 bolts and No. 2 intercooler support bracket.



67. REMOVE WATER OUTLET

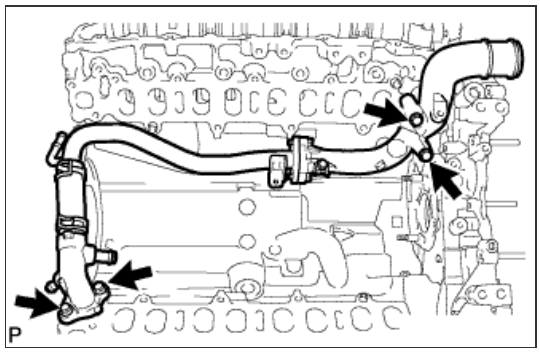
a. Disconnect the engine coolant temperature sensor connector.

b. Remove the 2 bolts, disconnect the water outlet from the No. 2 water hose joint, and remove the water outlet and gasket.



68. REMOVE WATER OUTLET PIPE

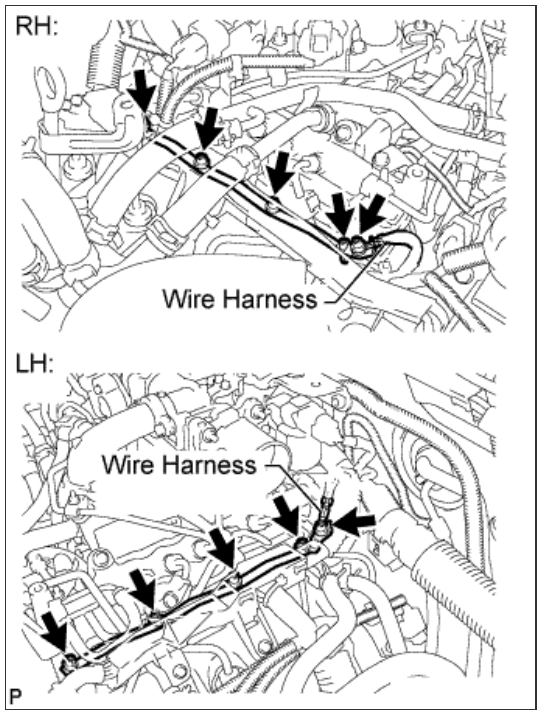
a. Remove the 4 bolts, water outlet pipe and 2 gaskets.



. REMOVE NO. 1 GLOW PLUG CONNECTOR

a. Remove the 2 screw grommets and 2 nuts, and disconnect the 2 wire harnesses.

b. Remove the screw grommets, nuts and 2 glow plug connectors.

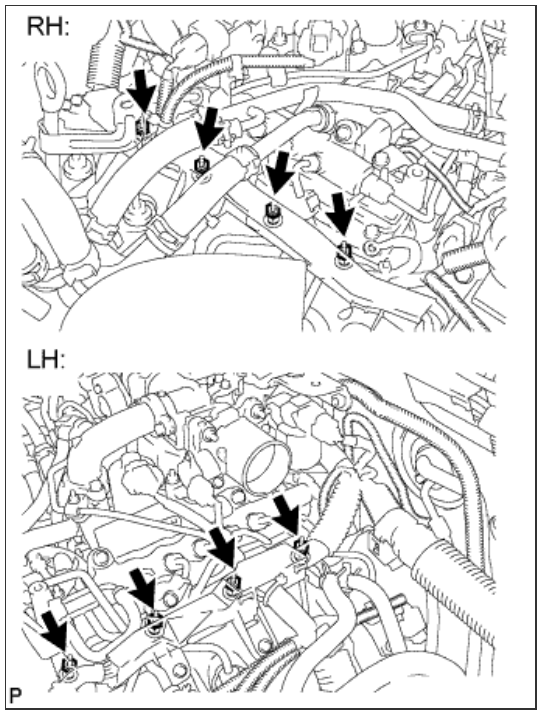


70. REMOVE GLOW PLUG ASSEMBLY

a. Using a 10 mm deep socket wrench, remove the glow plugs.

HINT:

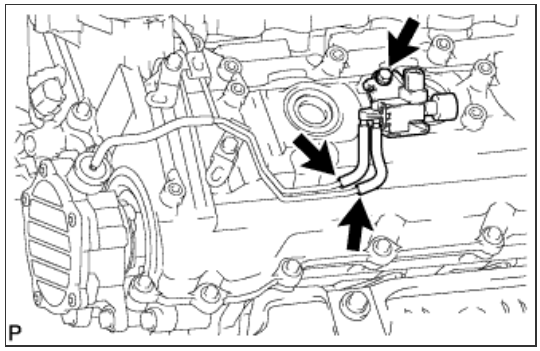
Before removing the glow plugs, thoroughly clean off all dirt, sand, etc.



71. REMOVE NO. 1 VACUUM SWITCHING VALVE ASSEMBLY (w/ Intercooler)

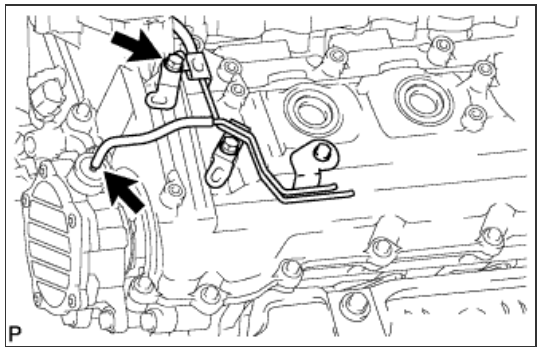
a. Disconnect the 2 vacuum hoses.

b. Remove the bolt and vacuum switching valve.

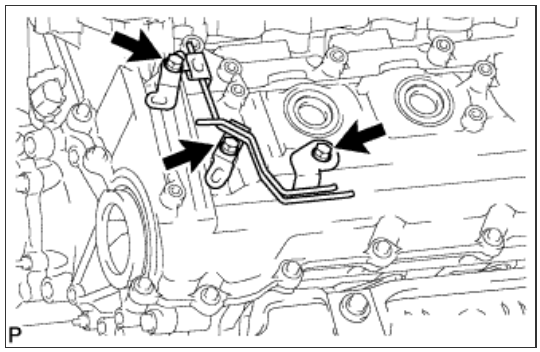


72. REMOVE NO. 1 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY

a. w/ Intercooler:
Disconnect the 2 vacuum hoses.

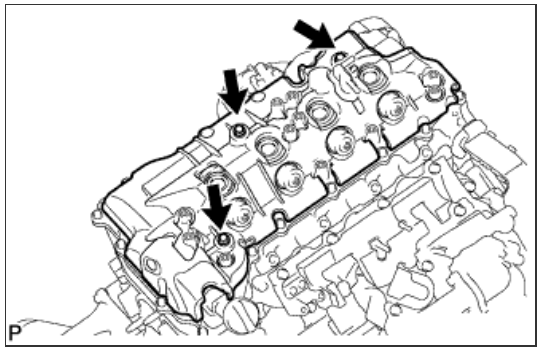


b. Remove the 3 bolts and vacuum transmitting pipe.



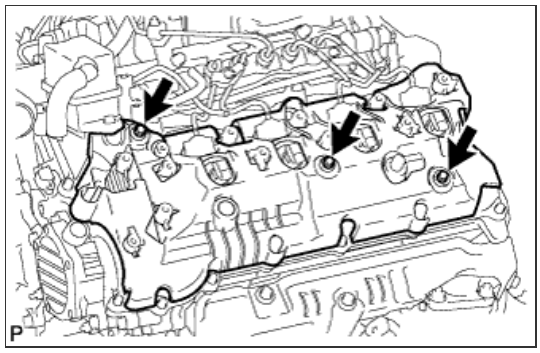
73. REMOVE CYLINDER HEAD COVER SILENCER RH (w/ Intercooler)

a. Remove the 3 bolts and cylinder head cover silencer.



74. REMOVE CYLINDER HEAD COVER SILENCER LH (w/ Intercooler)

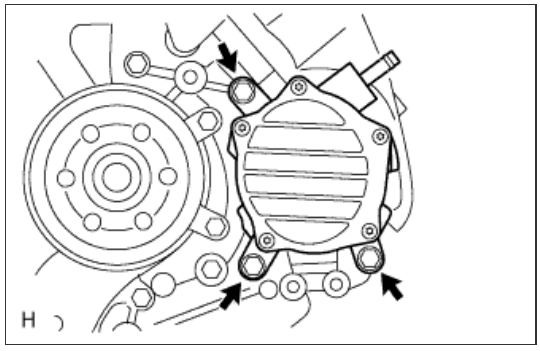
a. Remove the 3 bolts and cylinder head cover silencer.



75. REMOVE VACUUM PUMP ASSEMBLY (w/ Intercooler)

a. Remove the 3 bolts and vacuum pump.

b. Remove the 2 O-rings.

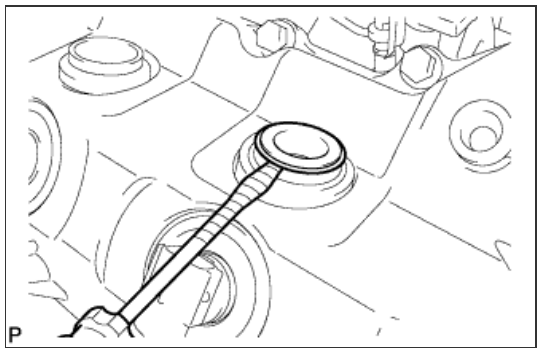


76. REMOVE NOZZLE HOLDER SEAL RH

a. Using a small screwdriver, remove the 4 holder seals by prying the portion between each holder seal and the cutout part of the cylinder head cover.

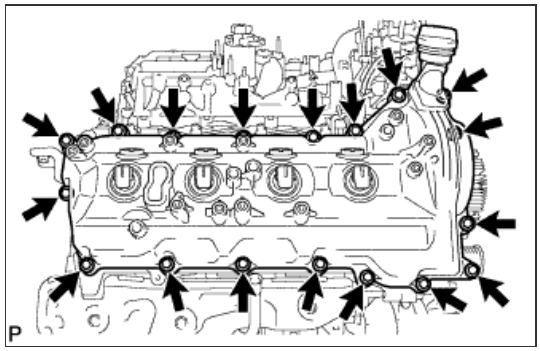
HINT:

Tape the screwdriver tip before use.



77. REMOVE CYLINDER HEAD COVER SUB ASSEMBLY RH

a. Remove the 1 bolts, cylinder head cover and gasket.

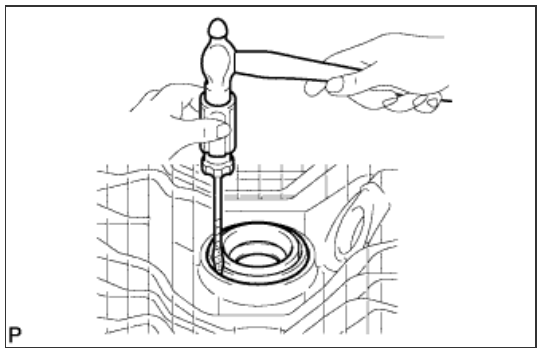


78. REMOVE NO LE HOLDER GASKET RH

a. Using a small screwdriver and hammer, remove the 4 nozzle holder gaskets.

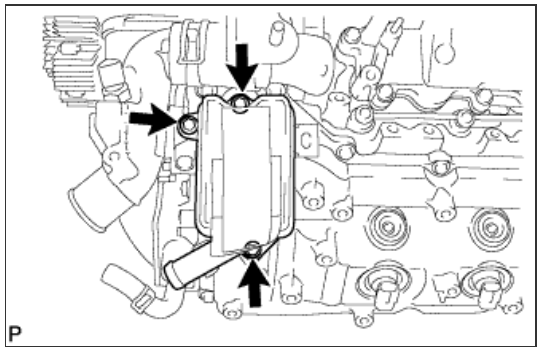
HINT:

Tape the screwdriver tip before use.



7 . REMOVE OIL SEPARATOR ASSEMBLY

a. Remove the 3 bolts, oil separator and gasket.

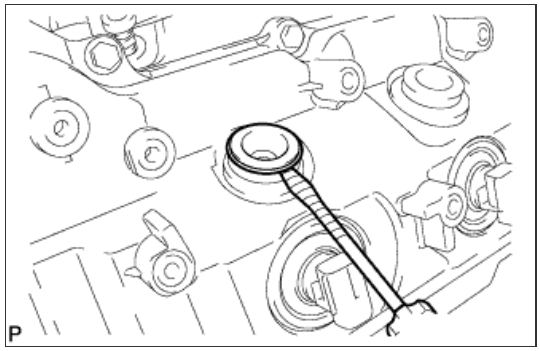


80. REMOVE NO LE HOLDER SEAL LH

a. Using a small screwdriver, remove the 4 holder seals by prying the portion between each holder seal and the cutout part of the cylinder head cover.

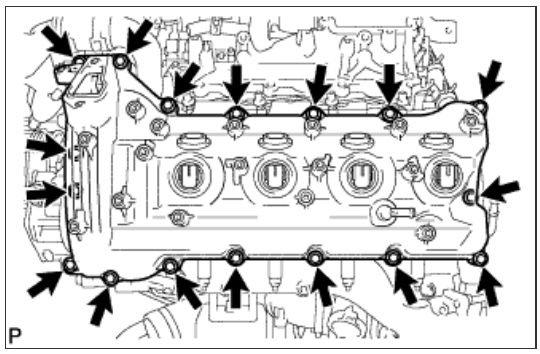
HINT:

Tape the screwdriver tip before use.



81. REMOVE CYLINDER HEAD COVER SUB ASSEMBLY LH

a. Remove the 17 bolts, cylinder head cover and gasket.

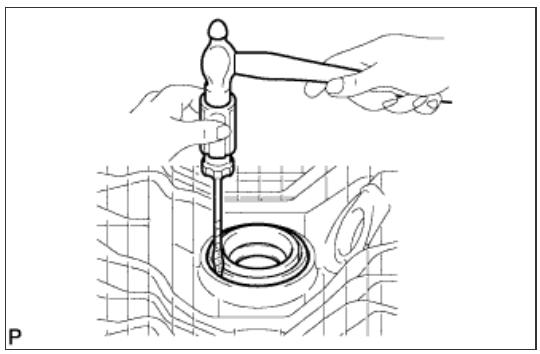


82. REMOVE NO LE HOLDER GASKET LH

a. Using a small screwdriver and hammer, remove the 4 nozzle holder gaskets.

HINT:

Tape the screwdriver tip before use.

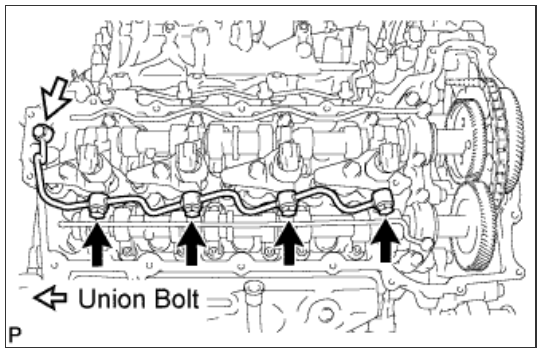


83. REMOVE FUEL INJECTOR RH

a. Remove the union bolt, 4 hollow screws, 5 gaskets and nozzle leakage pipe.

NOTICE:

- **When removing the nozzle leakage pipe, place a cushion under the pipe.**
- **Be careful not to deform or scratch the union seal surface.**
- **After removing the nozzle leakage pipe, put it in a plastic bag to prevent foreign matter from contaminating its injector inlet.**



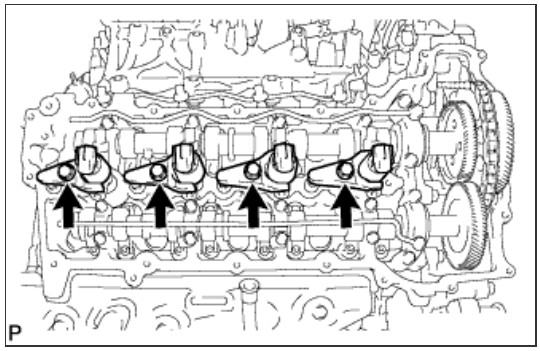
b. Remove the 4 bolts, 4 washers, 4 nozzle holder clamps and 4 injectors.

HINT:

Arrange the injectors, holder clamps, washers and bolts in the correct order.

c. Remove the O-ring from each injector.

d. Remove the 4 injection nozzle seats from the cylinder head.

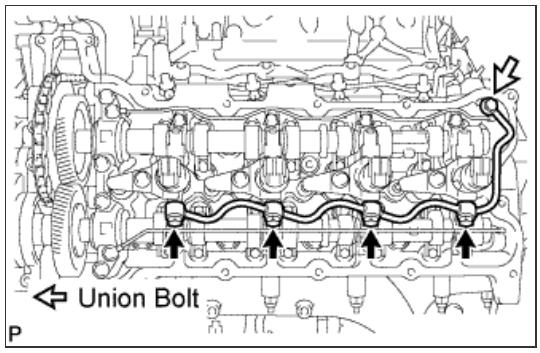


84. REMOVE FUEL INJECTOR LH

a. Remove the union bolt, 4 hollow screws, 5 gaskets and No. 2 nozzle leakage pipe.

NOTICE:

- **When removing the nozzle leakage pipe, place a cushion under the pipe.**
- **Be careful not to deform or scratch the union seal surface.**
- **After removing the nozzle leakage pipe, put it in a plastic bag to prevent foreign matter from contaminating its injector inlet.**



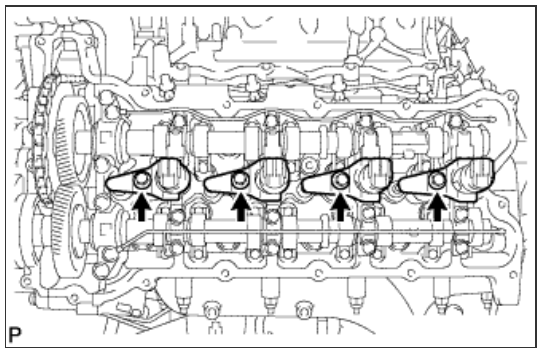
b. Remove the 4 bolts, 4 washers, 4 nozzle holder clamps and 4 injectors.

HINT:

Arrange the injectors, holder clamps, washers and bolts in the correct order.

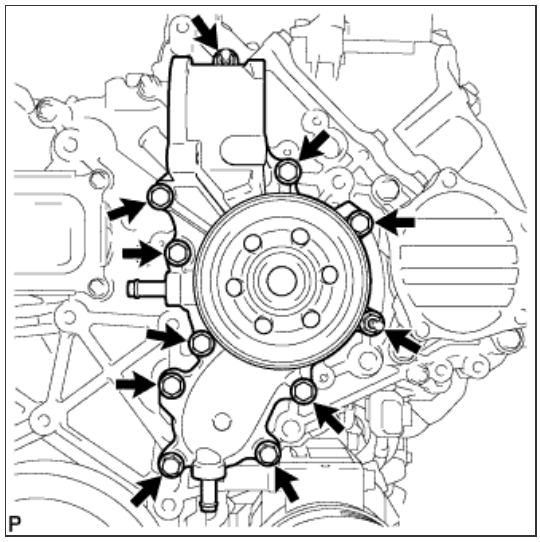
c. Remove the O-ring from each injector.

d. Remove the 4 injection nozzle seats from the cylinder head.



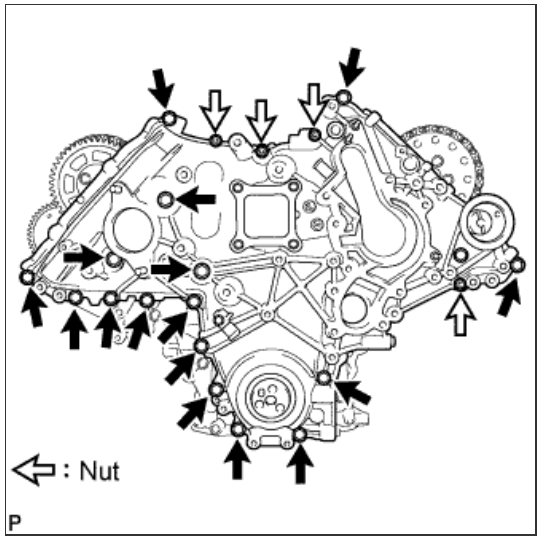
85. REMOVE WATER PUMP ASSEMBLY

a. Remove the 9 bolts, 2 nuts, water pump and gasket.



8 . REMOVE TIMING CHAIN COVER SUB ASSEMBLY

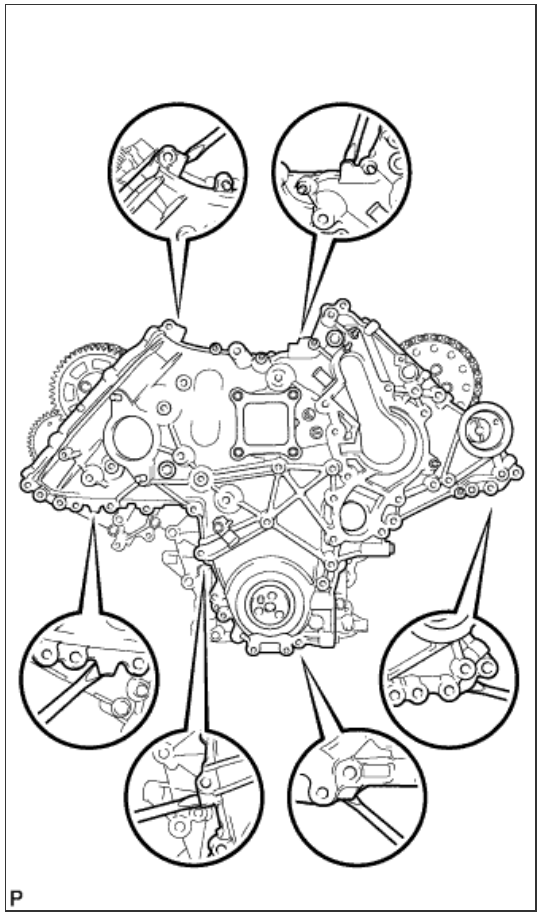
a. Remove the 4 nuts and 16 bolts.



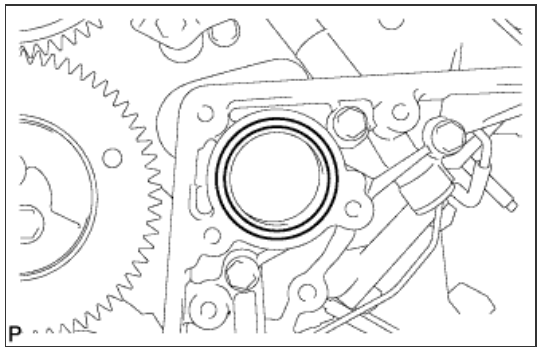
b. Using a screwdriver, remove the timing chain cover by prying between the timing chain cover and cylinder head or cylinder block.

HINT:

Tape the screwdriver tip before use.



c. Remove the O-ring from the timing gear case.



87. REMOVE FRONT CRANKSHAFT OIL SEAL

a. Place the timing chain cover on wooden blocks.

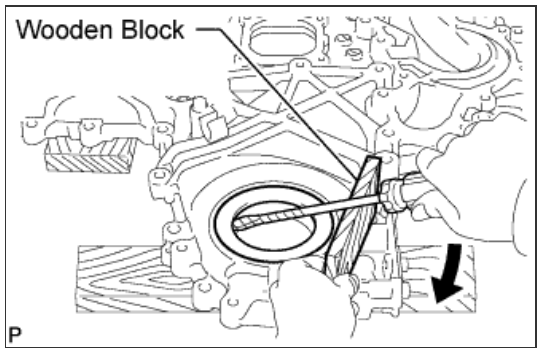
b. Using a screwdriver and wooden block, pry out the oil seal.

NOTICE:

Do not damage the surface of the oil seal press fit hole.

HINT:

Tape the screwdriver tip before use.

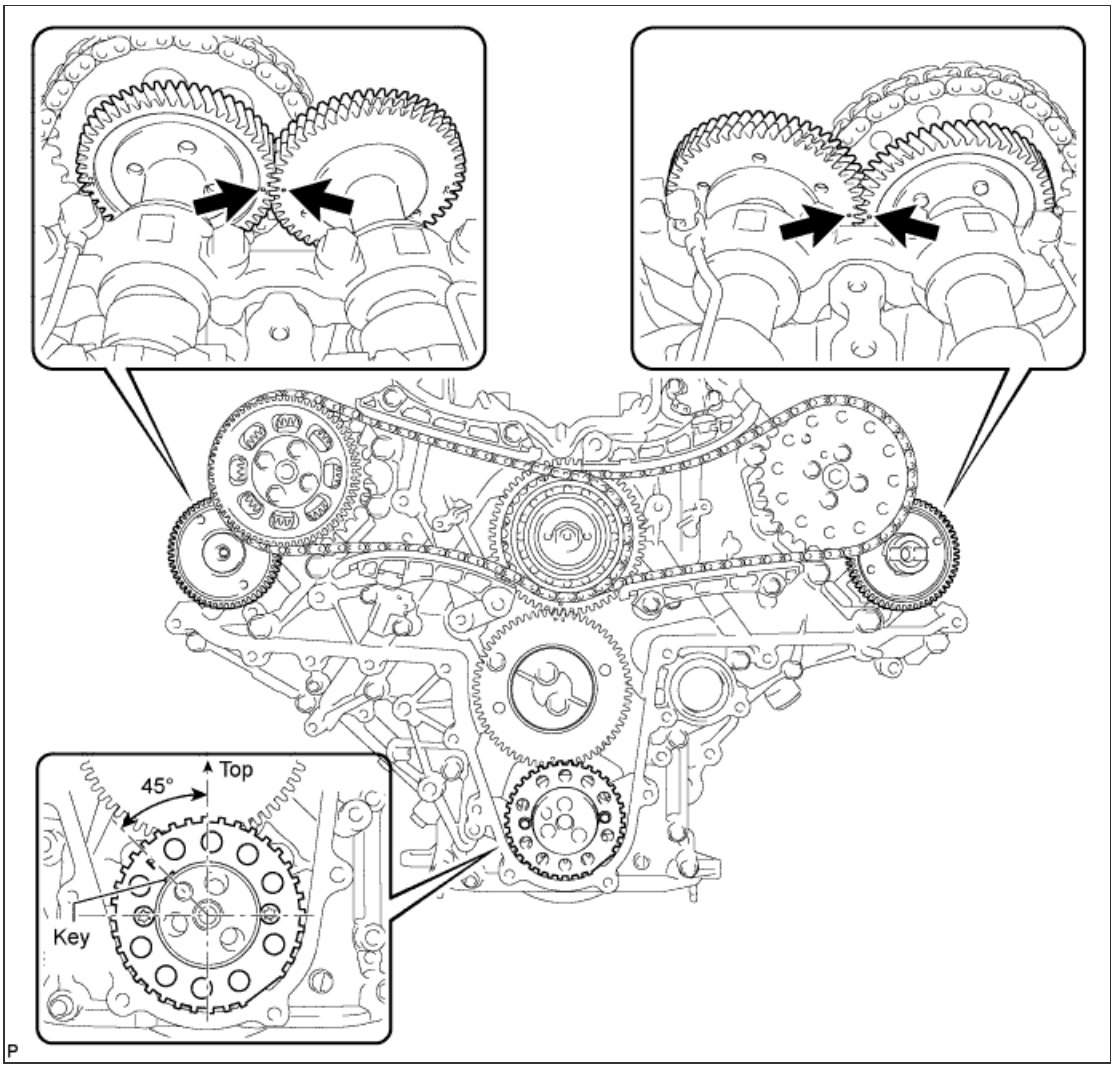


88. SET NO. 1 CYLINDER TO TDC/COMPRESSION

a. Temporarily install the 2 crankshaft pulley set bolts to the crankshaft.

b. Turn the crankshaft clockwise to set the No. 1 cylinder to TDC.

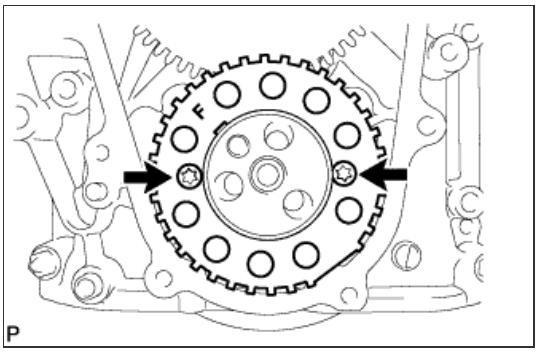
c. With the crankshaft key 45° counterclockwise from the top position, check that the timing marks of the RH and LH camshaft timing gears are aligned. If not as specified, turn the crankshaft 1 revolution (360°) and align the timing marks as shown below.



d. Remove the 2 crankshaft pulley set bolts.

8 . REMOVE NO. 1 CRANKSHAFT POSITION SENSOR PLATE

a. Using a T30 "TORX" wrench, remove the 2 screws and crankshaft position sensor plate.

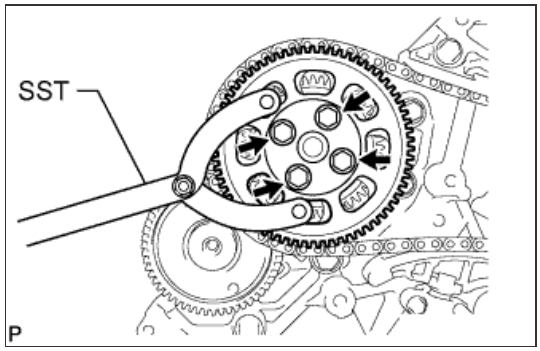


90. REMOVE PUMP DRIVE SHAFT GEAR

a. Using SST, hold the pump drive shaft gear.

SST

0 0 10010 (09962-01000, 09963-01000)



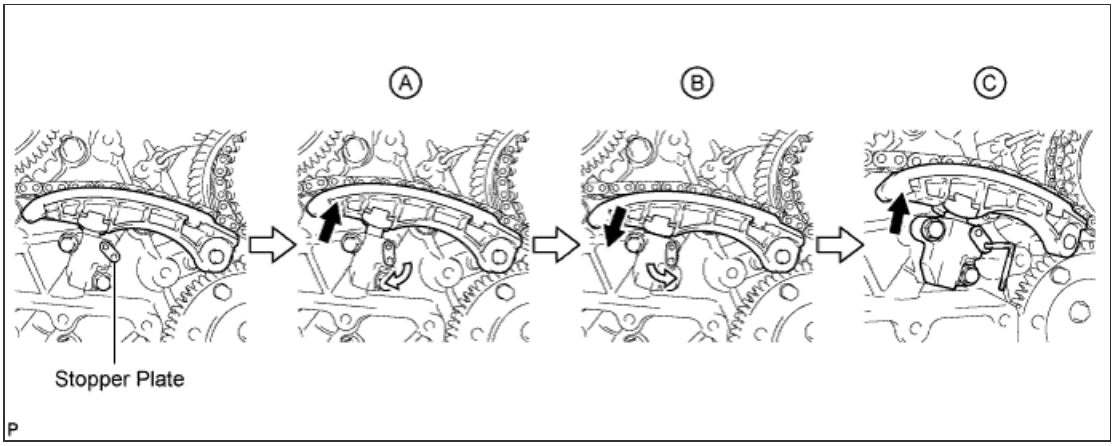
b. Remove the 4 bolts and pump drive shaft gear.

91. REMOVE NO. 1 CHAIN TENSIONER ASSEMBLY

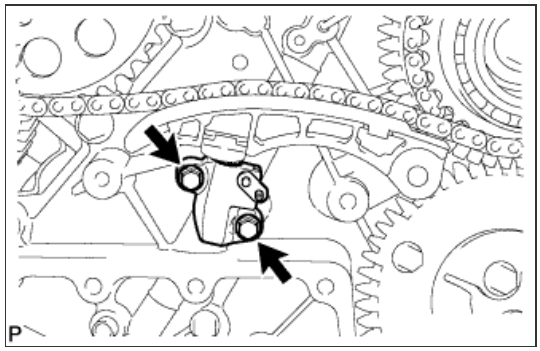
a. Push the tensioner slipper away from the tensioner, and move the stopper plate clockwise to release the lock as shown in A.

b. Push down the tensioner slipper and move the stopper plate counterclockwise to set the lock as shown in B.

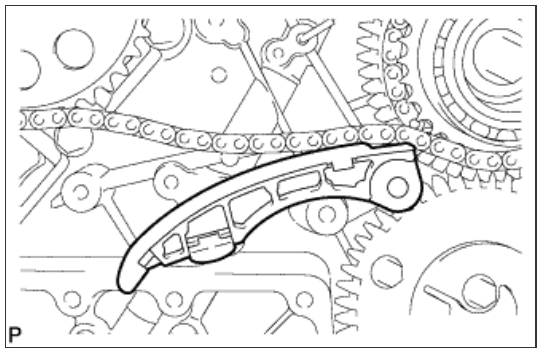
c. Push the tensioner slipper away from the tensioner, and insert a hexagon wrench into the stopper plate hole as shown in C.



d. Remove the 2 bolts and No. 1 chain tensioner.

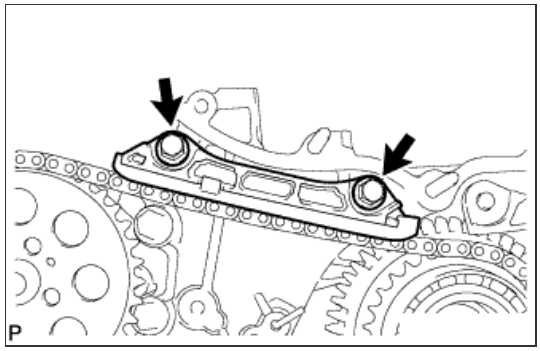


92. REMOVE NO. 1 CHAIN TENSIONER SLIPPER

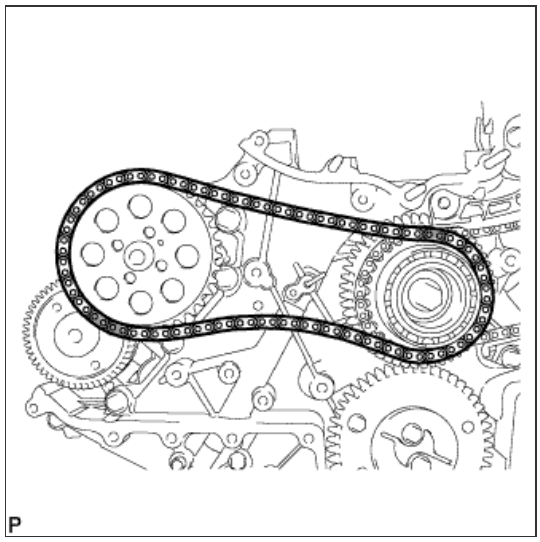


3. REMOVE NO. 1 CHAIN VIBRATION DAMPER

a. Remove the 2 bolts and No. 1 chain vibration damper.



. REMOVE NO. 1 CAMSHAFT TIMING SPROCKET AND NO. 1 TIMING CHAIN

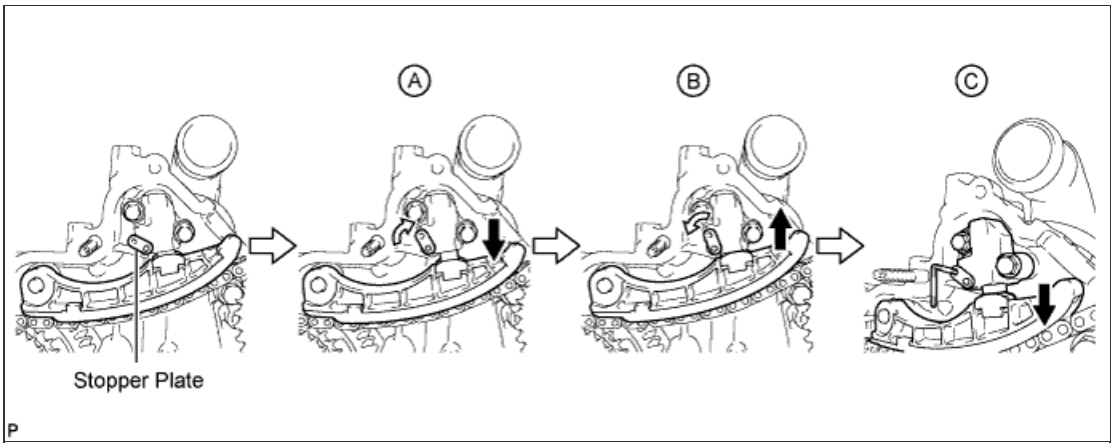


95. REMOVE NO. 2 CHAIN TENSIONER ASSEMBLY

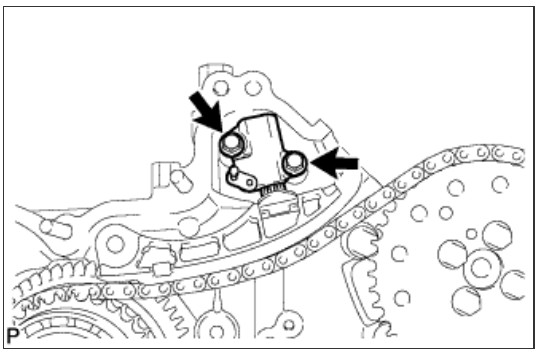
a. Push the tensioner slipper away from the tensioner, and move the stopper plate clockwise to release the lock as shown in A.

b. Push up the tensioner slipper and move the stopper plate counterclockwise to set the lock as shown in B.

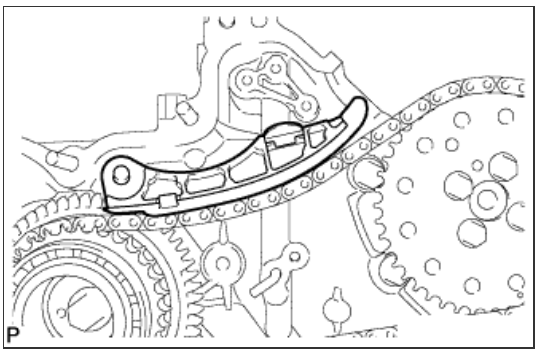
c. Push the tensioner slipper away from the tensioner, and insert a hexagon wrench into the stopper plate hole as shown in C.



d. Remove the 2 bolts and No. 2 chain tensioner.

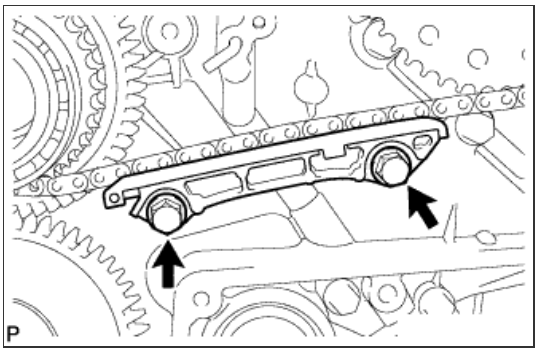


. REMOVE NO. 2 CHAIN TENSIONER SLIPPER



. REMOVE NO. 2 CHAIN VIBRATION DAMPER

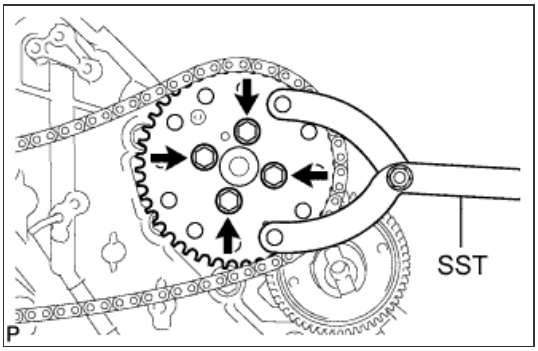
a. Remove the 2 bolts and No. 2 chain vibration damper.



. REMOVE NO. 2 CAMSHAFT TIMING SPROCKET AND NO. 2 TIMING CHAIN

a. Using SST, hold the No. 2 camshaft timing sprocket.

SST
0 0 10010 (09962-01000, 09963-01000)



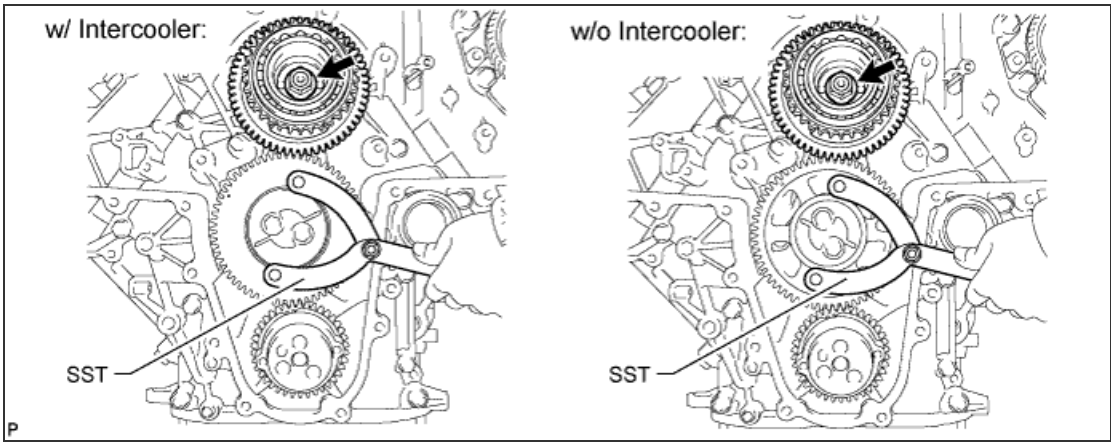
b. Remove the 4 bolts, No. 2 camshaft timing sprocket and No. 2 timing chain.

99. REMOVE FUEL SUPPLY PUMP DRIVE GEAR NUT

a. Using SST, hold the idle gear.

SST
09960-10010 (09962-01000, 09963-00700)

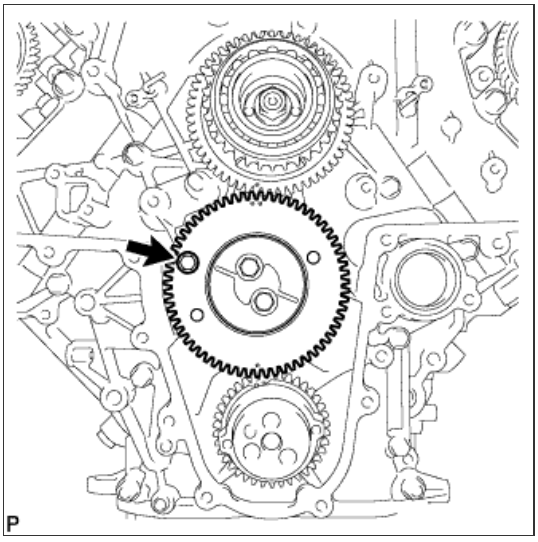
b. Remove the nut.



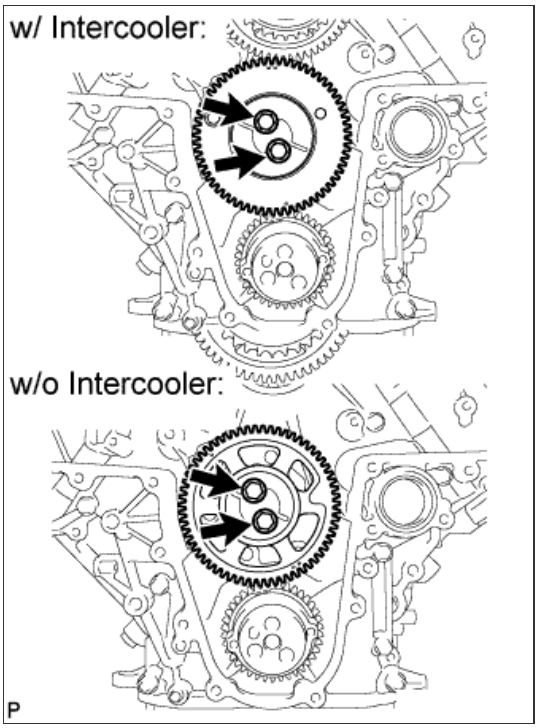
100. REMOVE IDLE GEAR ASSEMBLY

a. w/ Intercooler:
Using a mm x 1.25 pitch service bolt with a length of 15 mm or more, fix the idle gear in place.

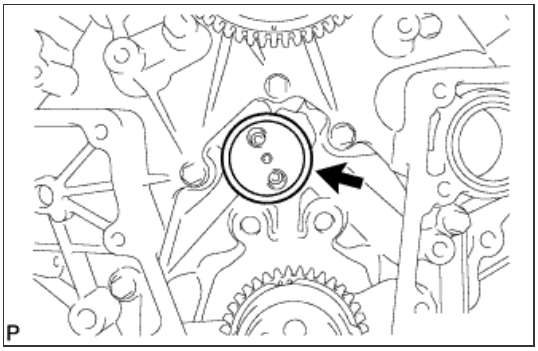
Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



b. Remove the 2 bolts, idle gear thrust plate and idle gear.



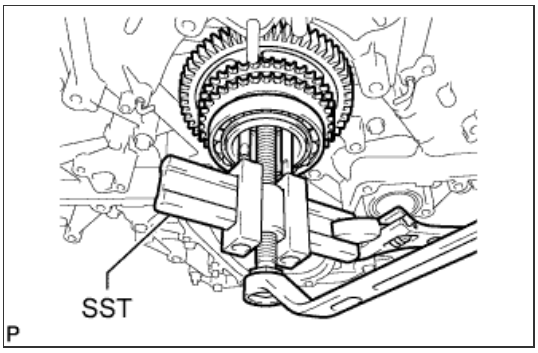
101. REMOVE NO. 1 IDLE GEAR SHAFT



102. REMOVE FUEL SUPPLY PUMP DRIVE GEAR

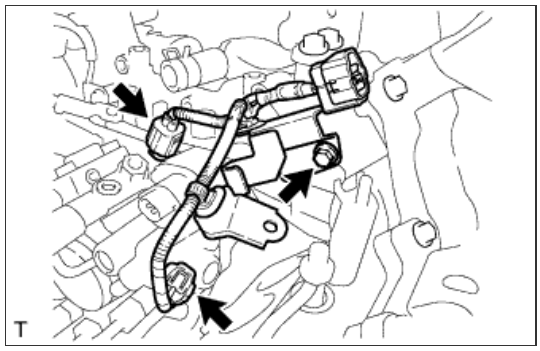
a. Using SST, remove the fuel supply pump drive gear.

SST
09950-50013 (09951-05010, 09952-05010, 09953-05020, 09954-05031)



103. REMOVE FUEL PUMP MOTOR WIRE

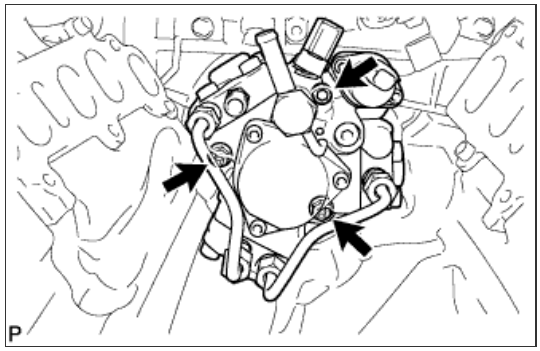
a. Disconnect the 2 connectors and remove the bolt and fuel pump motor wire.



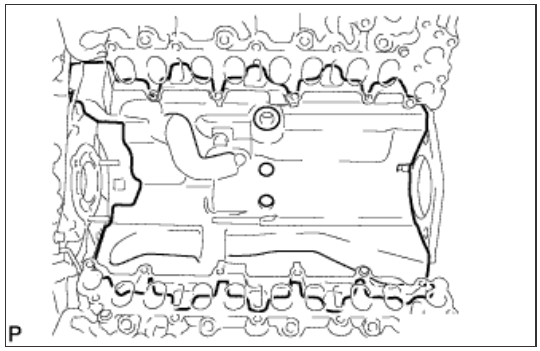
104. REMOVE FUEL SUPPLY PUMP ASSEMBLY

a. Using a 6 mm hexagon wrench, remove the hexagon bolt. Then remove the 2 nuts and fuel supply pump.

b. Remove the O-ring.

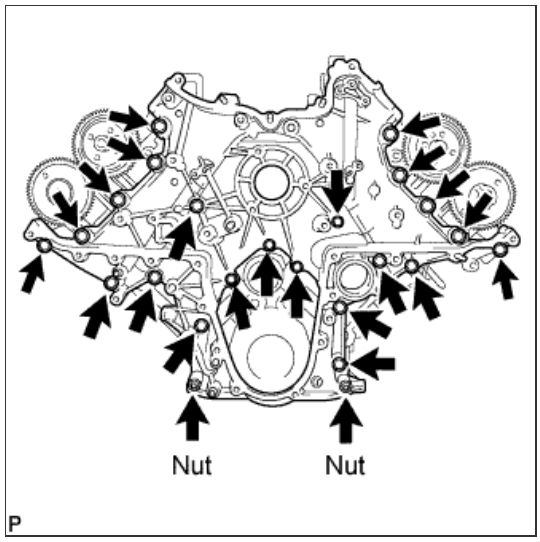


105. REMOVE V-BANK SILENCER

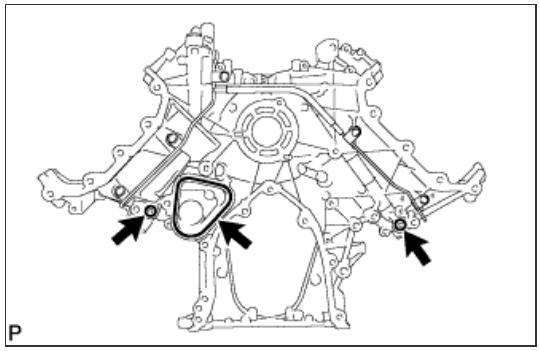


106. REMOVE TIMING GEAR CASE SUB-ASSEMBLY

a. Remove the 22 bolts, 2 nuts and timing gear case shown in the illustration.



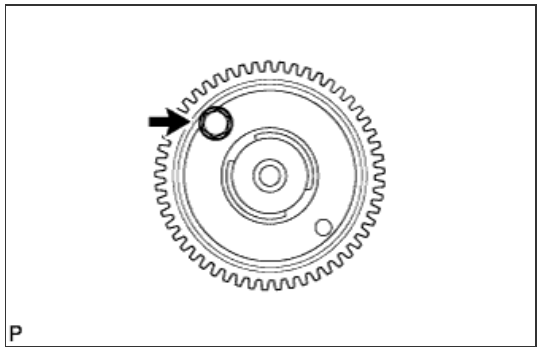
b. Remove the 2 O-rings and timing gear case gasket.



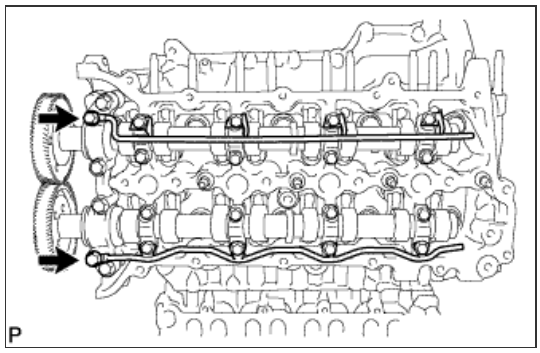
107. REMOVE NO. 1 AND NO. 2 CAMSHAFTS

a. Using a 6 mm x 1.0 pitch service bolt with a length of 16 mm or more, fix the No. 1 camshaft in place.

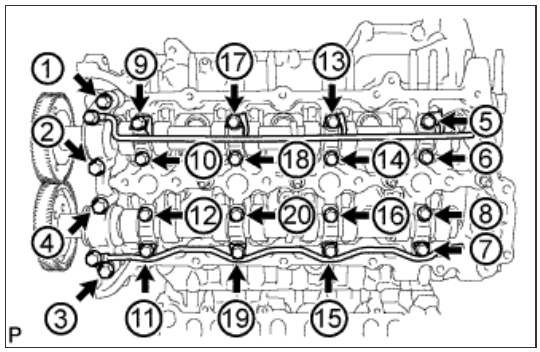
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }



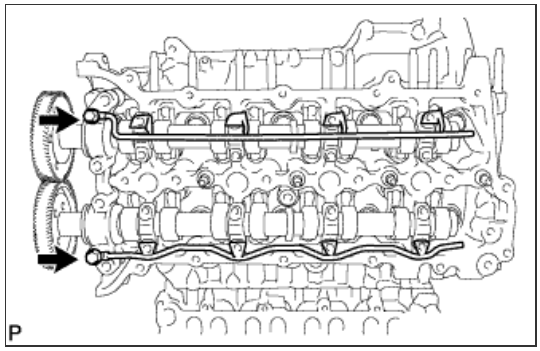
b. Loosen the 2 union bolts.



c. Uniformly loosen and remove the 20 bolts in the sequence shown in the illustration.



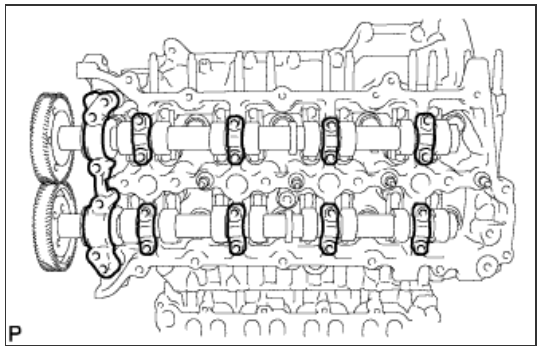
d. Remove the 2 union bolts and No. 1 and No. 2 oil feed pipes.



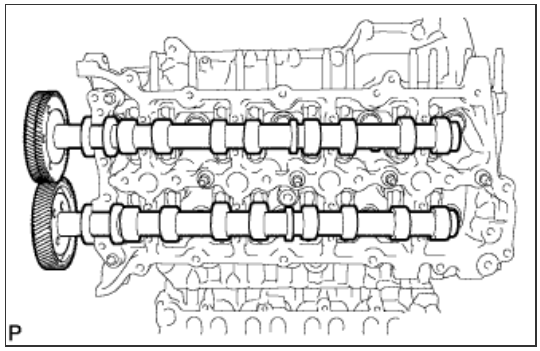
e. Remove the No. 3 camshaft bearing caps and No. 1 camshaft bearing cap.

HINT:

Be sure to arrange the removed parts for each installation position separately.



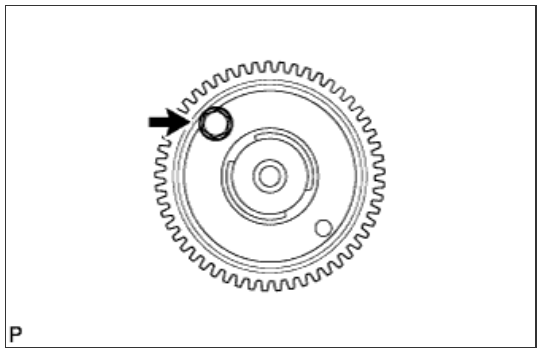
f. Remove the No. 1 and No. 2 camshafts.



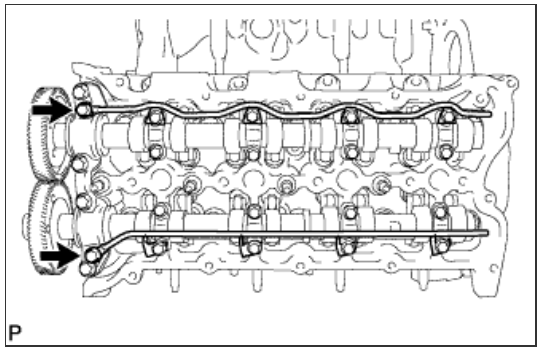
108. REMOVE NO. 3 AND NO. 4 CAMSHAFTS

a. Using an 6 mm x 1.0 pitch service bolt with a length of 16 mm or more, fix the No. 4 camshaft in place.

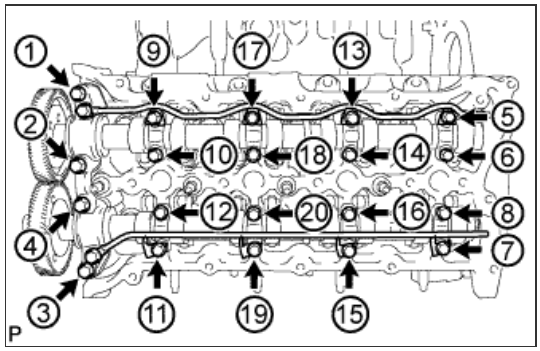
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }



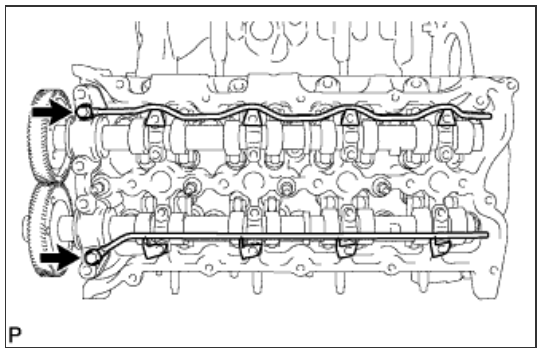
b. Loosen the 2 union bolts.



c. Uniformly loosen and remove the 20 bolts in the sequence shown in the illustration.



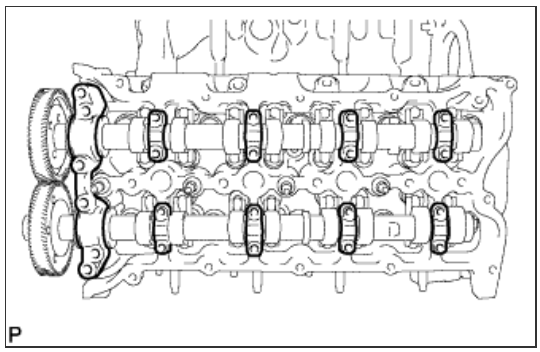
d. Remove the 2 union bolts, and No. 3 and No. 4 oil feed pipes.



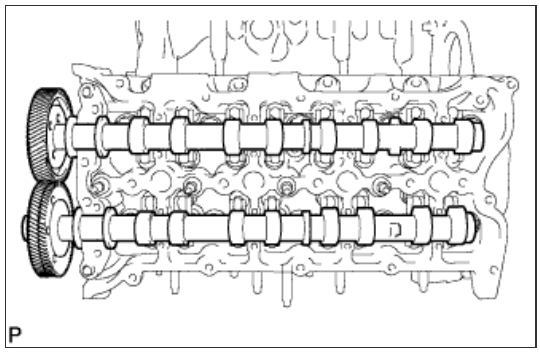
e. Remove the No. 3 camshaft bearing caps and No. 4 camshaft bearing cap.

HINT:

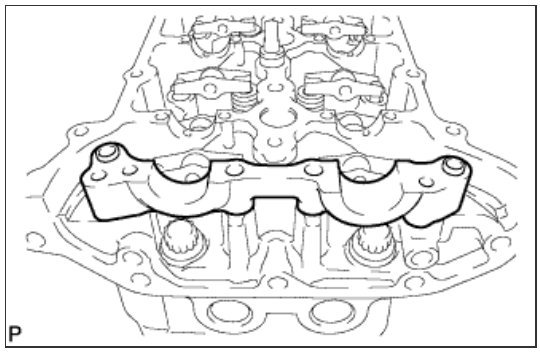
Be sure to arrange the removed parts for each installation position separately.



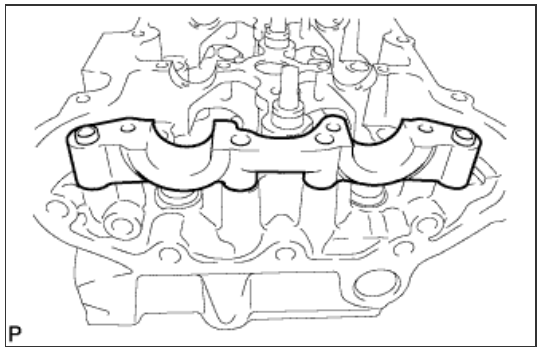
f. Remove the No. 3 and No. 4 camshafts.



10 . REMOVE NO. 2 CAMSHAFT BEARING CAP



110. REMOVE NO. 5 CAMSHAFT BEARING CAP

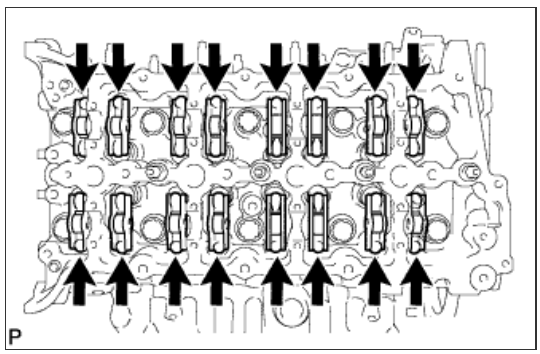


111. REMOVE NO. 1 VALVE ROCKER ARM

a. Remove the 16 No. 1 valve rocker arms.

HINT:

Be sure to arrange the removed parts for each installation position separately.

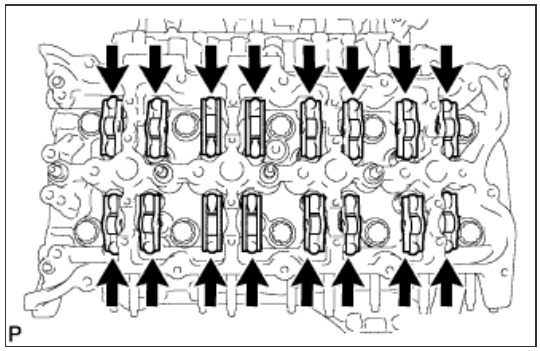


112. REMOVE NO. 2 VALVE ROCKER ARM

a. Remove the 16 No. 2 valve rocker arms.

HINT:

Be sure to arrange the removed parts for each installation position separately.

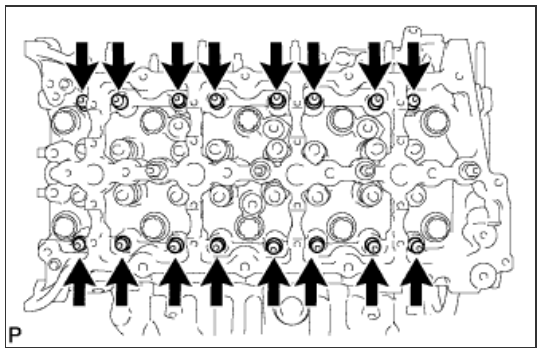


113. REMOVE NO. 1 VALVE LASH ADJUSTER ASSEMBLY

a. Remove the 16 No. 1 valve lash adjusters.

HINT:

Be sure to arrange the removed parts for each installation position separately.

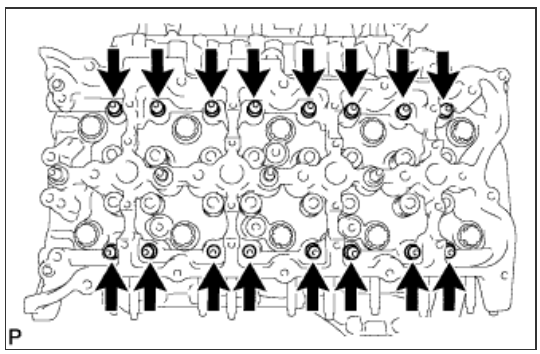


114. REMOVE NO. 2 VALVE LASH ADJUSTER ASSEMBLY

a. Remove the 16 No. 2 valve lash adjusters.

HINT:

Be sure to arrange the removed parts for each installation position separately.



115. REMOVE CYLINDER HEAD SUB-ASSEMBLY RH

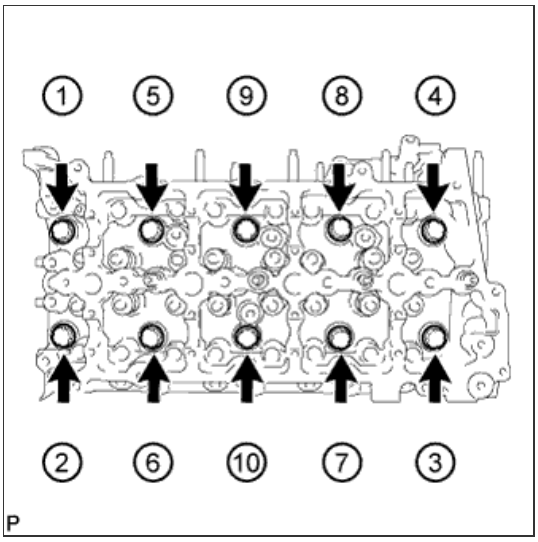
a. Uniformly loosen and remove the 10 bolts and 10 spacers in the sequence shown in the illustration. Then remove the cylinder head.

NOTICE:

- **Be careful not to drop washers into the cylinder head.**
- **Head warpage or cracking could result from removing bolts in an incorrect order.**

HINT:

Be sure to arrange the removed parts for each installation position separately.



11 . REMOVE CYLINDER HEAD SUB ASSEMBLY LH

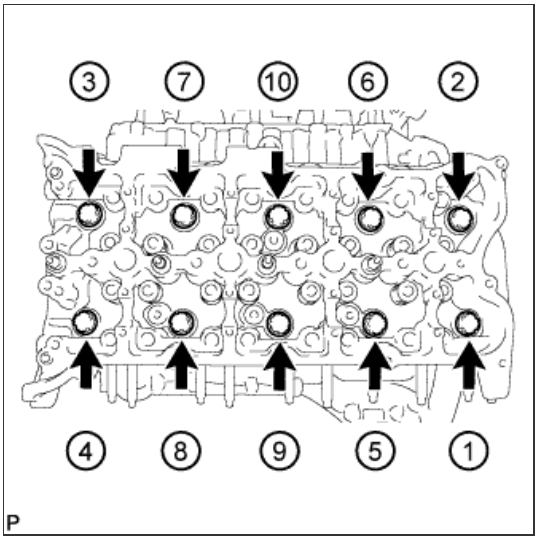
a. Uniformly loosen and remove the 10 bolts and 10 spacers in the sequence shown in the illustration. Then remove the cylinder head.

NOTICE:

- **Be careful not to drop washers into the cylinder head.**
- **Head warpage or cracking could result from removing bolts in an incorrect order.**

HINT:

Be sure to arrange the removed parts for each installation position separately.



117. REMOVE NO. 1 CYLINDER HEAD GASKET

118. REMOVE NO. 2 CYLINDER HEAD GASKET

for Preparation Click here

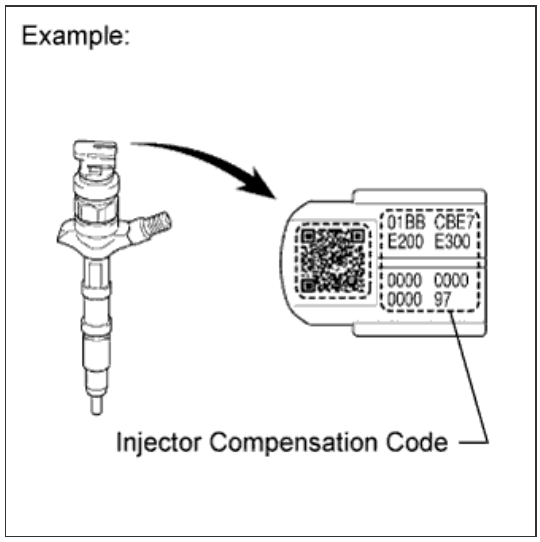
NOTICE:

- **Before performing these installation procedures, sufficiently clean and remove any foreign matter from the cylinder block, cylinder head, camshaft and other parts.**
- **When replacing an injector (including interchanging injectors between cylinders), common rail, cylinder head, or intake manifold, replace the corresponding injection pipes with a new one.**

1. CHECK INJECTOR COMPENSATION CODE

NOTICE:

- **When a fuel injector is replaced, the new fuel injector compensation code must be input into the ECM. When the ECM is replaced, all of the existing fuel injector compensation codes must be input into the new ECM.**
- **Fuel injector compensation codes are unique, 30 digit, alphanumeric values printed on the head portion of each fuel injector. If an incorrect fuel injector compensation code is input into the ECM, the engine assembly may rattle or engine idling may become rough. In addition, engine failure may occur and the life of the engine may be shortened.**



a. After replacing fuel injector(s) with new one(s), input compensation code(s) of fuel injector(s) into ECM as follows:

HINT:

- **Each fuel injector has different fuel injection characteristics. In order to optimize the fuel injections, the ECM uses the compensation codes to balance the different fuel injections between each fuel injector.**
- **When you first turn the ignition switch to ON after replacing the ECM or a fuel injector(s), DTC P1601 is set. This is to inform you that registration of a fuel injector compensation code(s) is/are required. Manually clear the DTC upon completion of the compensation code registration.**

i. npt the compensation code(s), which is/are imprinted on the head portion(s) of the new fuel injector(s), into the intelligent tester.

ii. npt the new compensation code(s) into the ECM using the tester.

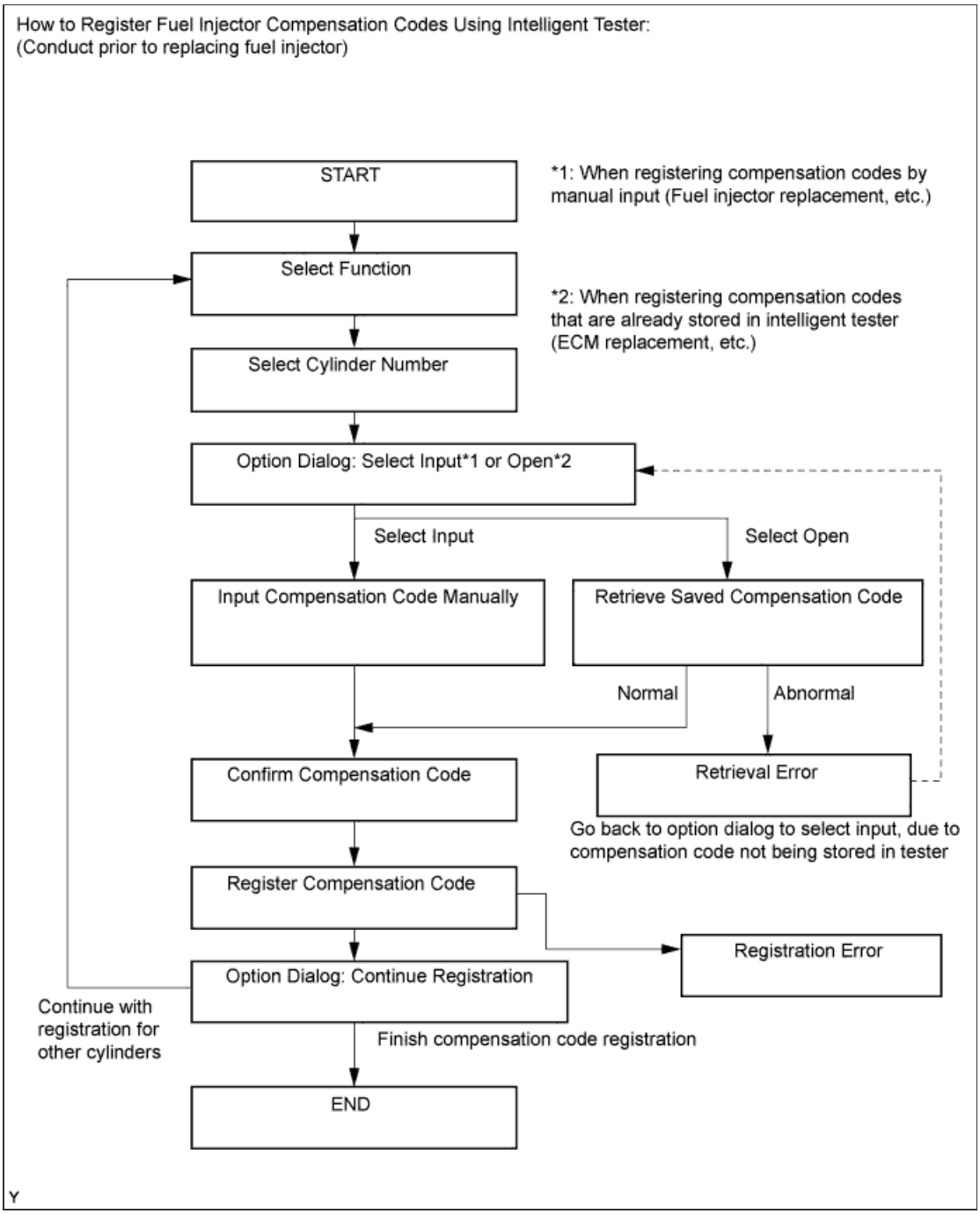
iii. Turn the tester off and turn the ignition switch off.

iv. Wait for at least 30 seconds.

v. Turn the ignition switch to ON and turn the tester on.

vi. Clear DTC P1601 stored in the ECM using the tester (Click here).

b. Register compensation code.



i. Connect the intelligent tester to the DLC3.

ii. Turn the ignition switch to ON.

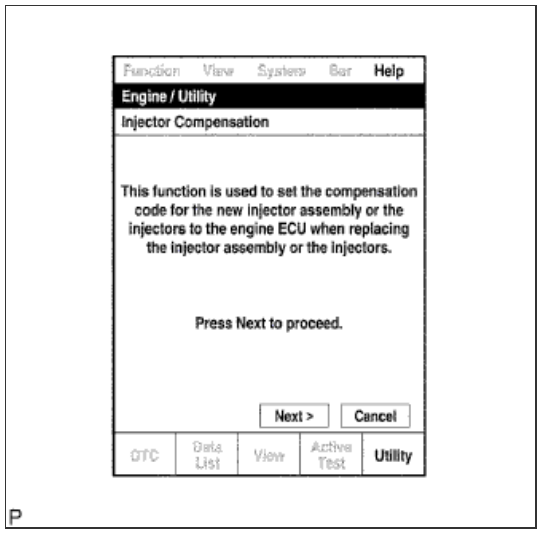
NOTICE:

Do not start the engine.

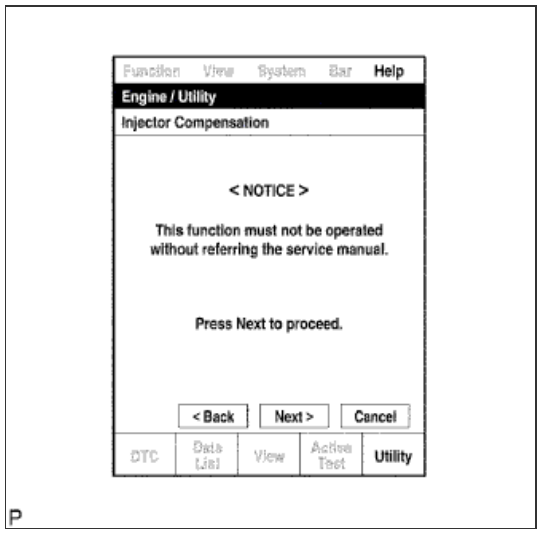
iii. Turn the tester on.

iv. Enter the following menus: Powertrain / Engine / Utility / rector Compensation.

v. Press Next.

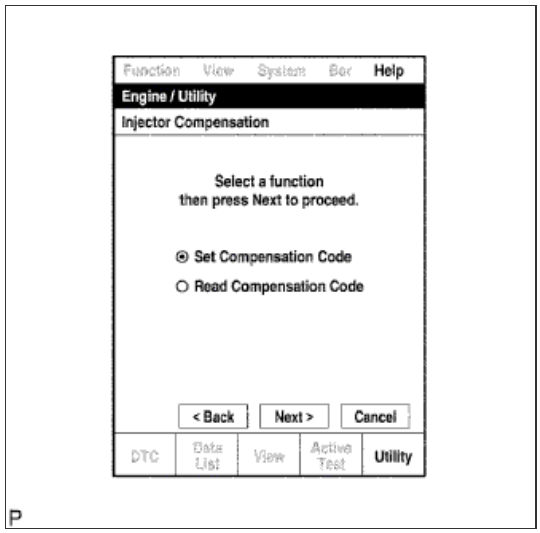


vi. Press Next again to proceed.



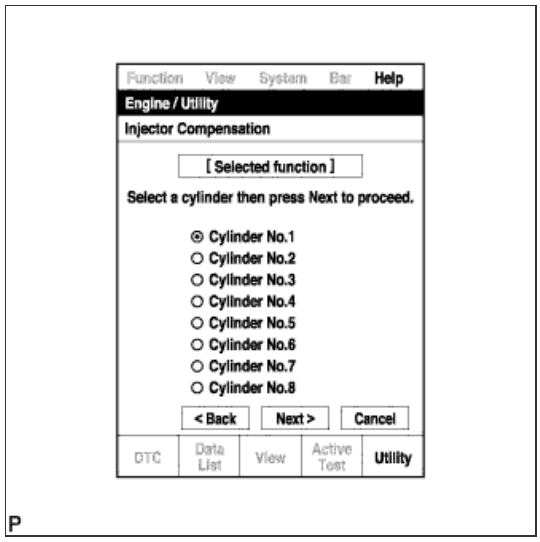
vii. Select "Set Compensation Code".

viii. Press Next.



ix. Select the num er of the cylinder corresponding to the fuel injector compensation code that you want to read.

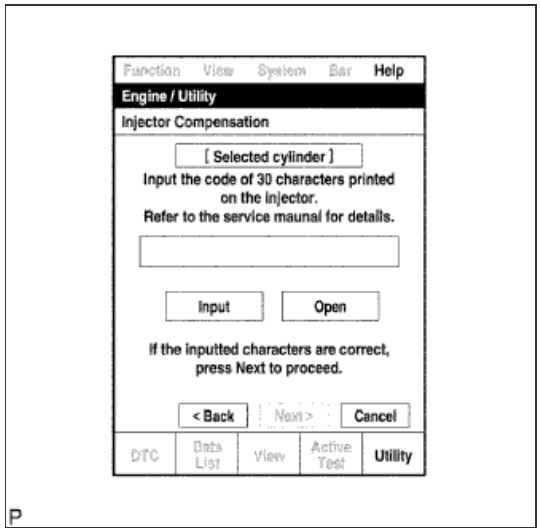
x. Press Next.



P

xi. Register compensation code.

1. Press npt.



P

2. Manually input the cylinder compensation code using the key oard on the tester screen. The code is a 30 digit, alphanumeric value printed on the injector head portion.

HINT:

Each fuel injector compensation code is uni ue. The compensation code for each selected cylinder must e input into the tester correctly.

3. Confirm that the compensation code for the selected cylinder is correct, and then press O .



P

xii. Check that the compensation code displayed on the screen is correct y comparing it with the 30 digit alphanumeric value on the head portion of the fuel injector.

NOTICE:

f an incorrect fuel injector compensation code is input into the ECM, the engine may rattle or engine idling may ecome rough. n a tidn, engine failure may occur and the life of the engine may e shortened.

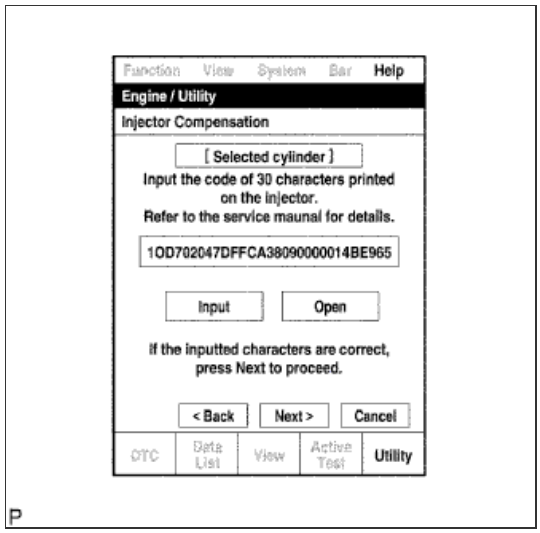
HINT:

- **If a wrong compensation code is input or read, return to the Input Value screen by pressing Input.**
- **The saving process may fail due to a problem with the wire harness or a bad connection with the DLC3. Check the wire harness and DLC3 connection. If no problem is found with either, the ECM may be malfunctioning. Check the ECM and repeat this operation.**

xiii. Press Next to register the compensation code in the ECM.

HINT:

- **If the registration process fails, the compensation code may be incorrect. Check the compensation code again.**
- **If the input compensation code fails to register even though it is input correctly, there may be a problem with the wire harness or a bad connection with the DLC3. Check the wire harness and DLC3 connection. If no problem is found with either, the ECM may be malfunctioning. Check the ECM and restart this operation.**



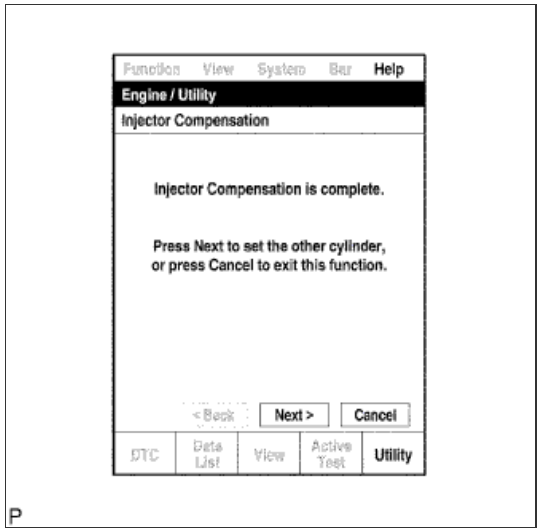
xiv. f you want to continue with other compensation code registrations, press Next. To finish the registration, press Cancel.

xv. Turn the ignition switch off and then turn the tester off.

xvi. Wait for at least 30 seconds.

xvii. Turn the ignition switch to ON and then turn the tester on.

xviii. Clear DTC P1601 stored in the ECM using the tester (Click here).



2. SELECT CYLINDER HEAD GASKET

a. Set the 2 crankshaft pulley set olts to the crankshaft.

b. Clean the cylinder dck with solvent.

c. n ept the protrusion for each cylinder.

i. Set the piston of the cylinder to e measured to slightly efore TDC.

ii. Place a dial indicator on the cylinder dck, and set the measuring tip as shown in the illustration.

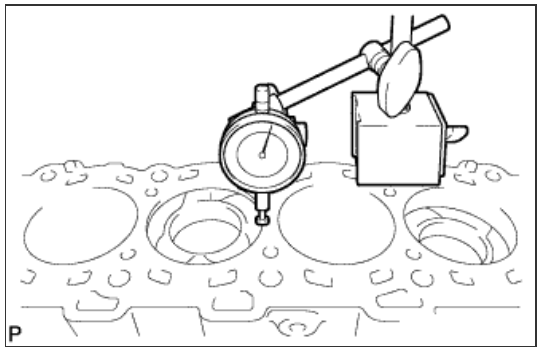
NOTICE:

Make sure that the dial indicator is at a right angle to the cylinder dck top surface.

iii. Set the dial indicator at 0 mm (0 in.).

HINT:

Make sure that the measuring tip is flat against the cylinder dck surface and piston head when taking the measurements.

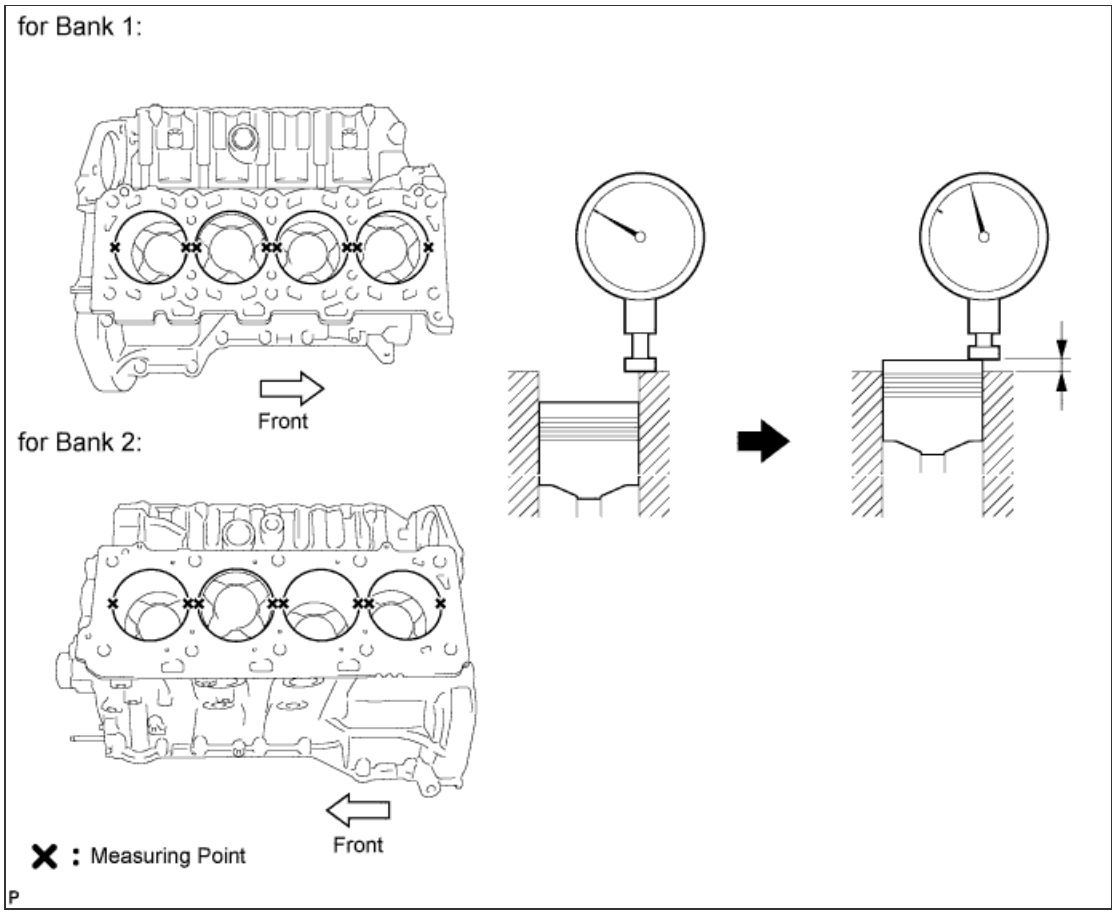


iv. ind where the piston head protrudes most y slowly turning the crankshaft clockwise and counterclockwise.

v. Measure the piston protrusion value of each cylinder at 2 places as shown in the illustration elow, making a total of 8 measurements.

Standard piston protrusion:
0.520 to 0.780 mm (0.0205 to 0.0307 in.)

f the protrusion is not as specified, remove and reinstall the piston and connecting rod.



d. Select a new cylinder head gasket.

HINT:

Cylinder head gaskets are marked A, B, C, D or E accordingly.

New Installed Cylinder Head Gasket Thickness:

tem	Cutout	Specified Condition
A	1	1.20 to 1.30 mm (0.0472 to 0.0512 in.)
B	2	1.25 to 1.35 mm (0.0492 to 0.0394 in.)
C	3	1.30 to 1.40 mm (0.0512 to 0.0551 in.)
D	4	1.35 to 1.45 mm (0.0531 to 0.0571 in.)
E	5	1.40 to 1.50 mm (0.0551 to 0.0591 in.)

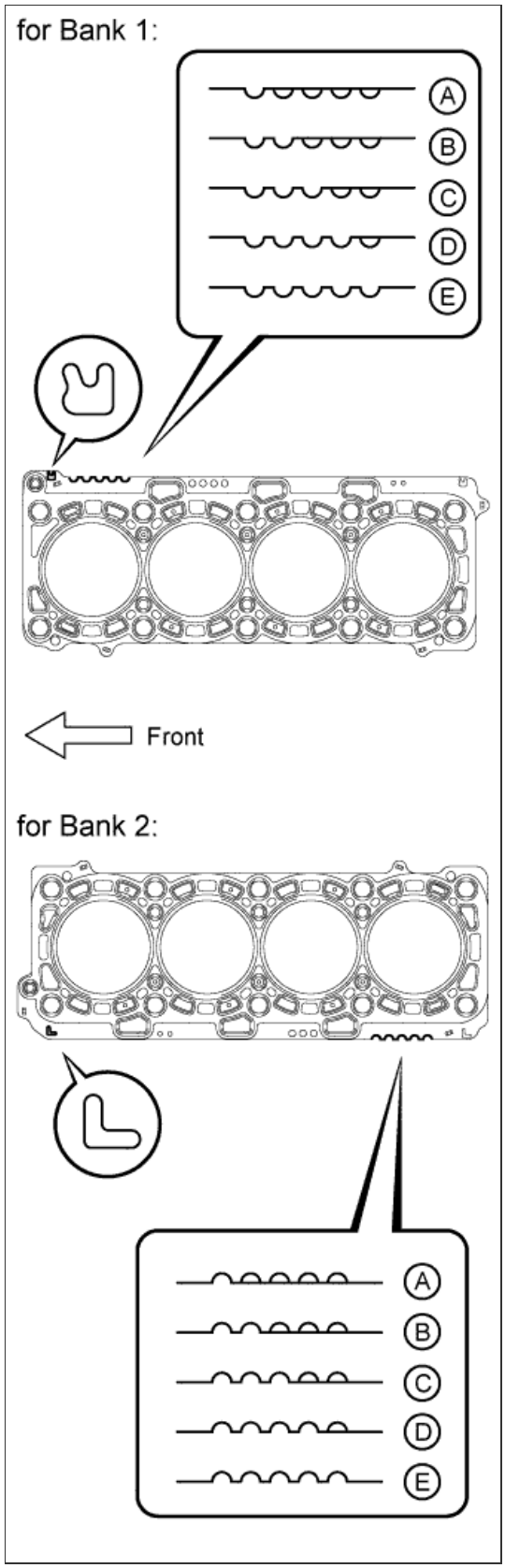
HINT:

: The specified condition indicates the thickness of the gasket after tightening the cylinder head.

i. Select the largest piston protrusion value from the measurements and then select a new appropriate gasket according to the ta d elow.

Standard Piston Protrusion:

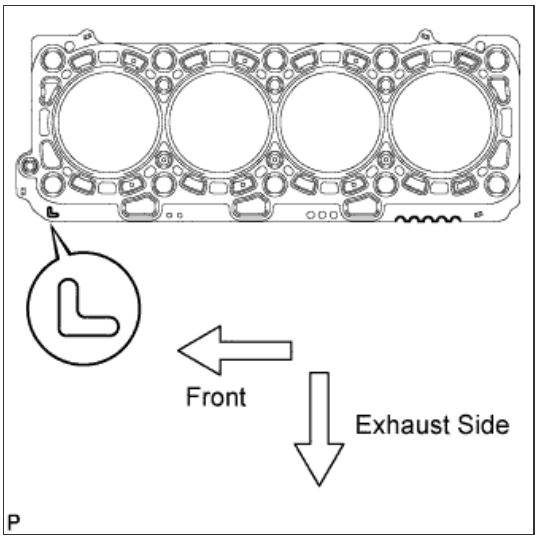
tem	Specified Condition
A	0.520 to 0.575 mm (0.0205 to 0.0226 in.)
B	0.575 to 0.625 mm (0.0226 to 0.0246 in.)
C	0.625 to 0.675 mm (0.0246 to 0.0266 in.)
D	0.675 to 0.725 mm (0.0266 to 0.0285 in.)
E	0.725 to 0.780 mm (0.0285 to 0.0307 in.)



3. INSTALL NO. 2 CYLINDER HEAD GASKET

a. Remove any oil from the contact surface.

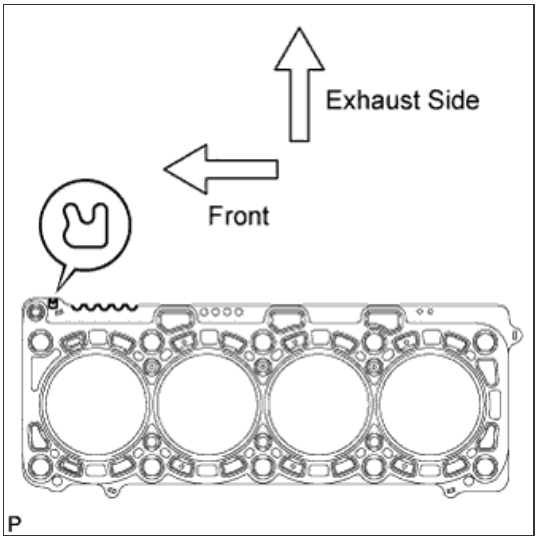
b. Place the cylinder head gasket on the cylinder dck surface with the front face of the indicated mark "L" upward and facing the exhaust side.



4. INSTALL NO. 1 CYLINDER HEAD GASKET

a. Remove any oil from the contact surface.

b. Place the cylinder head gasket on the cylinder dck surface with the front face of the indicated mark "R" upward and facing the exhaust side.



5. INSTALL CYLINDER HEAD SUB-ASSEMBLY LH

a. Place the cylinder head on the cylinder head gasket.

NOTICE:

Ensure that no oil is on the mounting surface of the cylinder head.

b. n ept the cylinder head olts (Click here).

c. Apply a light coat of engine oil to the threads and under the heads of the cylinder head olts.

d. Step 1:

i. ntall and uniformly tighten the 10 cylinder head olts with the spacers in several steps, in the se uence shown in the illustration.

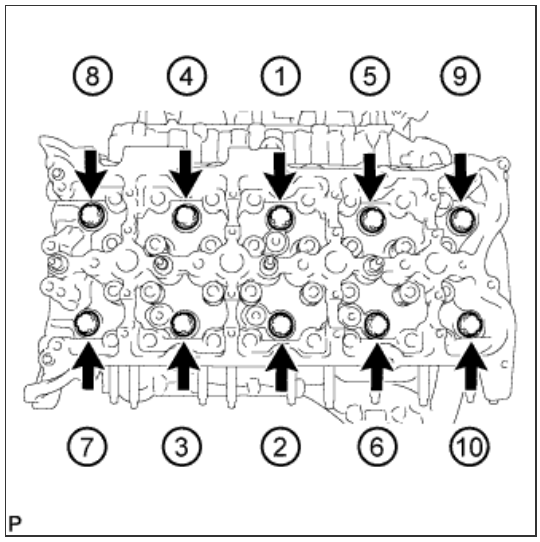
Torque:
80 N*m{ 816 kgf*cm , 59 ft.*lbf }

HINT:

- **The cylinder head bolts are tightened in 4 progressive**

steps.

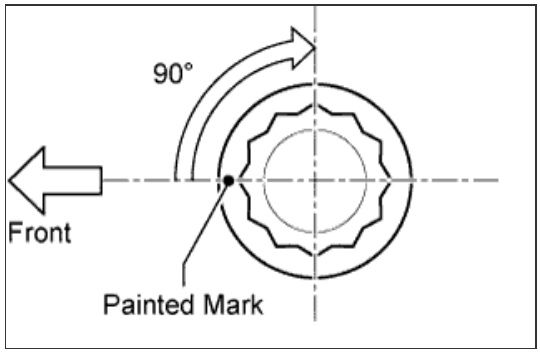
- If a cylinder head bolt is broken or deformed, replace it.



e. Step 2:

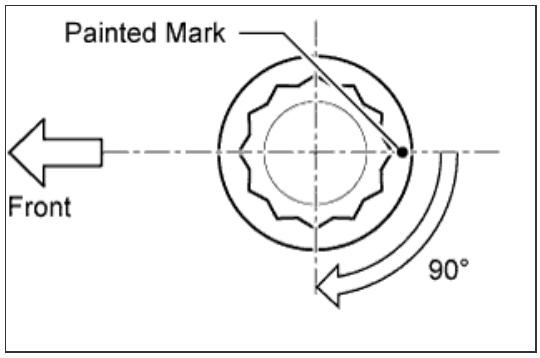
i. Mark the cylinder head olt heads with paint as shown in the illustration.

ii. Tighten the cylinder head olts 90° in the se uence shown in step 1.



f. Step 3:

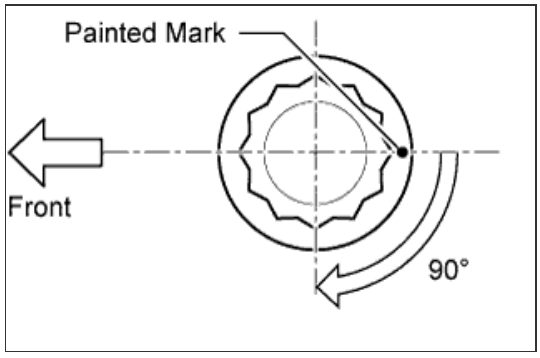
i. Tighten the cylinder head olts another 90° in the se uence shown in step 1.



g. Step 4:

i. Tighten the cylinder head olts y an additional 90° in the se uence shown in step 1.

h. Check that the painted marks are now facing the exhaust port side.



6. INSTALL CYLINDER HEAD SUB-ASSEMBLY RH

a. Place the cylinder head on the cylinder head gasket.

NOTICE:

Ensure that no oil is on the mounting surface of the cylinder head.

b. n ept the cylinder head olts (Click here).

c. Apply a light coat of engine oil to the threads and under the heads of the cylinder head olts.

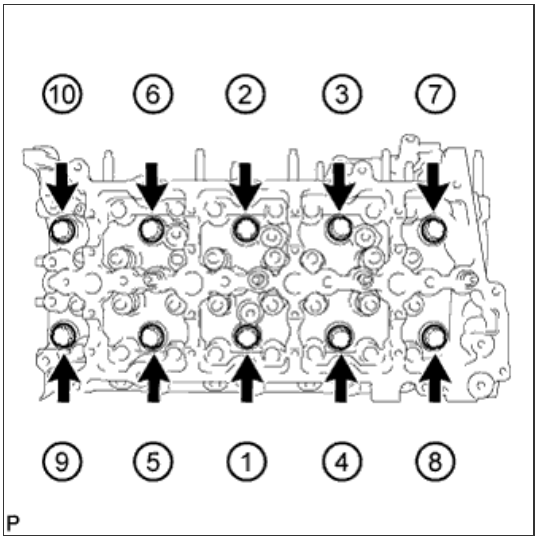
d. Step 1:

i. ntall and uniformly tighten the 10 cylinder head olts with the spacers in several steps, in the se uence shown in the illustration.

Torque:
80 N*m{ 816 kgf*cm , 59 ft.*lbf }

HINT:

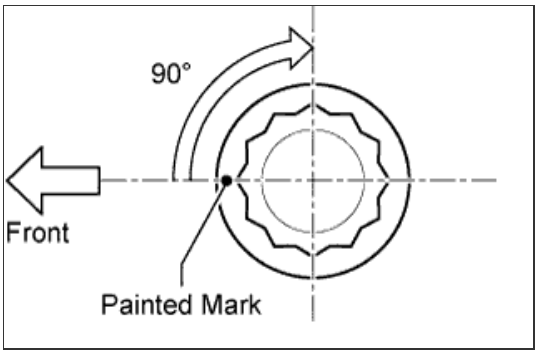
- **The cylinder head bolts are tightened in 4 progressive steps.**
- **If a cylinder head bolt is broken or deformed, replace it.**



e. Step 2:

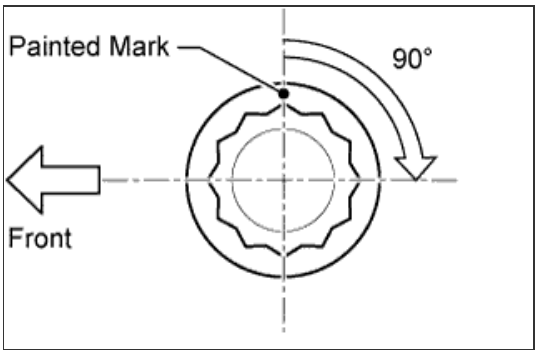
i. Mark the cylinder head olt heads with paint as shown in the illustration.

ii. Tighten the cylinder head olts 90° in the se uence shown in step 1.



f. Step 3:

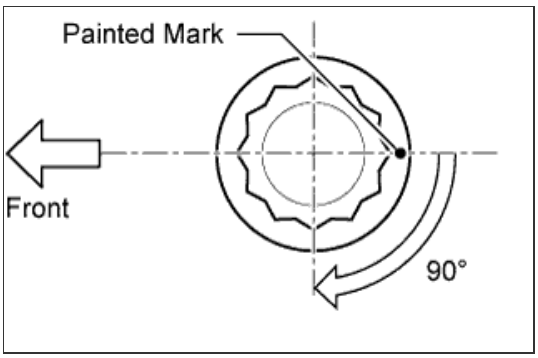
i. Tighten the cylinder head olts another 90° in the se uence shown in step 1.



g. Step 4:

i. Tighten the cylinder head olts y an additional 90° in the se uence shown in step 1.

h. Check that the painted marks are now facing the intake port side.



. SET NO. 1 CYLINDER TO 45° BEFORE TDC

a. Using a ar, turn the crankshaft counterclockwise until the No. 1 cylinder is at a position 45° efore TDC.

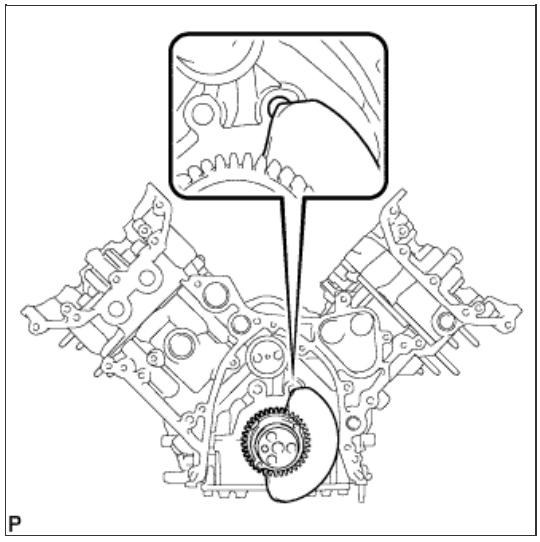
NOTICE:

Do not turn the crankshaft again until after the timing gear is installed.

HINT:

The No. 1 cylinder is at a position 45° efore TDC if the crankshaft counterweight is overlapping the cylinder dck hole as shown in the illustration.

b. Remove the 2 crankshaft pulley set olts.



8. INSTALL NO. 2 VALVE LASH ADJUSTER ASSEMBLY

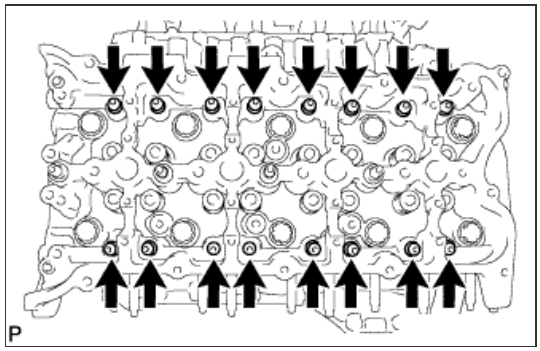
NOTICE:

Be sure to inspect the valve lash adjuster efore installing it (Click here).

a. ntall the 16 No. 2 valve lash adjusters to the cylinder head.

HINT:

ntall the lash adjuster at the same place it was removed from.



9. INSTALL NO. 1 VALVE LASH ADJUSTER ASSEMBLY

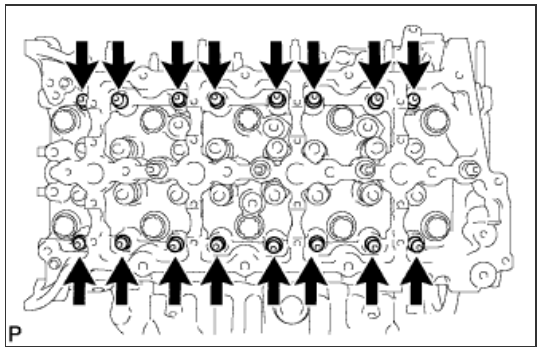
NOTICE:

Be sure to inspect the valve lash adjuster efore installing it (Click here).

a. ntall the 16 No. 1 valve lash adjusters to the cylinder head.

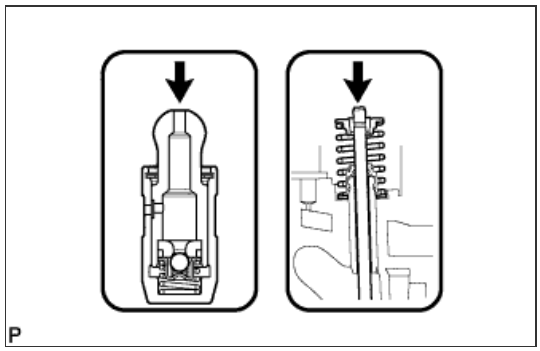
HINT:

ntall the lash adjuster at the same place it was removed from.



10. INSTALL NO. 2 VALVE ROCKER ARM

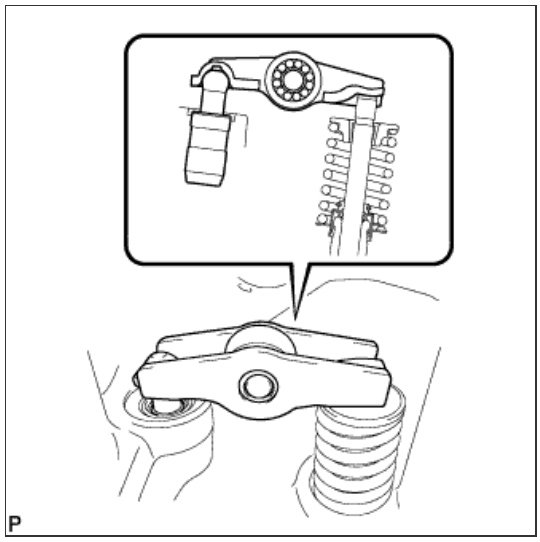
a. Apply engine oil to the lash adjuster tips and valve stem ends.



b. ntall the 16 No. 2 valve rocker arms as shown in the illustration.

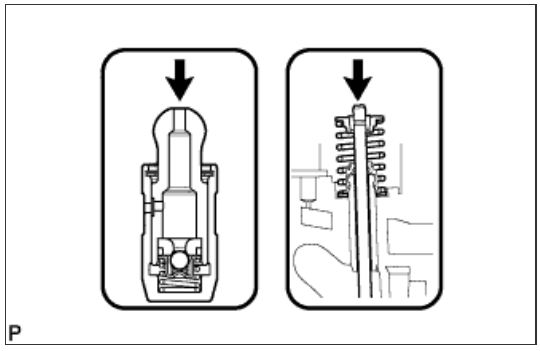
HINT:

ntall the valve rocker arm at the same place it was removed from.



11. INSTALL NO. 1 VALVE ROCKER ARM

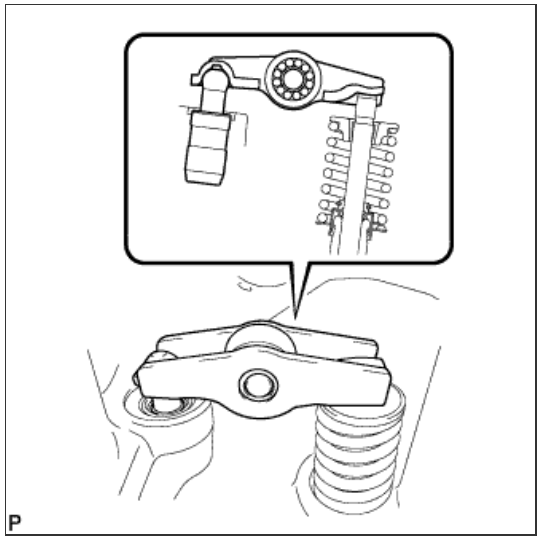
a. Apply engine oil to the lash adjuster tips and valve stem ends.



b. ntall the 16 No. 1 valve rocker arms as shown in the illustration.

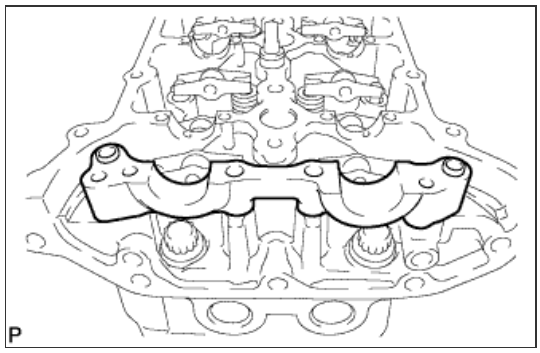
HINT:

ntall the valve rocker arm at the same place it was removed from.



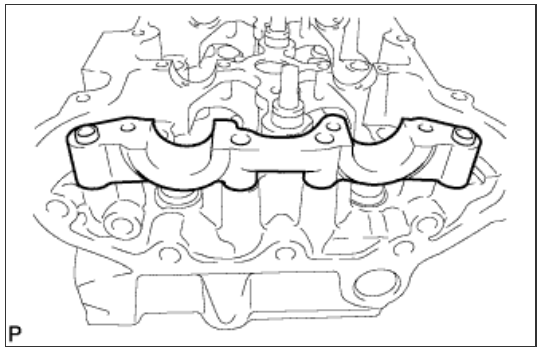
12. INSTALL NO. 5 CAMSHAFT BEARING CAP

a. Align the camshaft earing cap and the ring pins of the cylinder head, and install the cap.



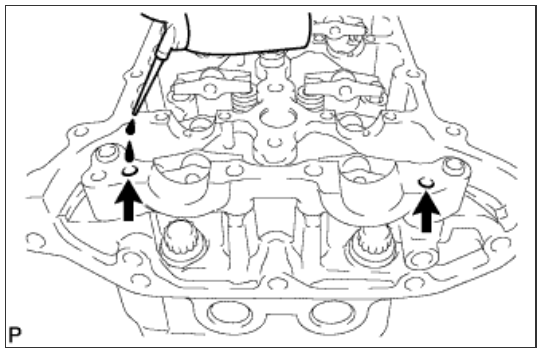
13. INSTALL NO. 2 CAMSHAFT BEARING CAP

a. Align the camshaft earing cap and the ring pins of the cylinder head, and install the cap.

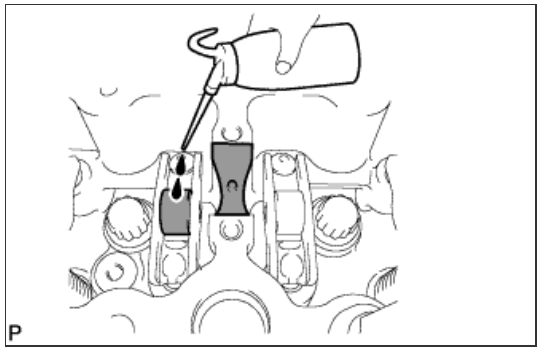


14. INSTALL NO. 3 AND NO. 4 CAMSHAFTS

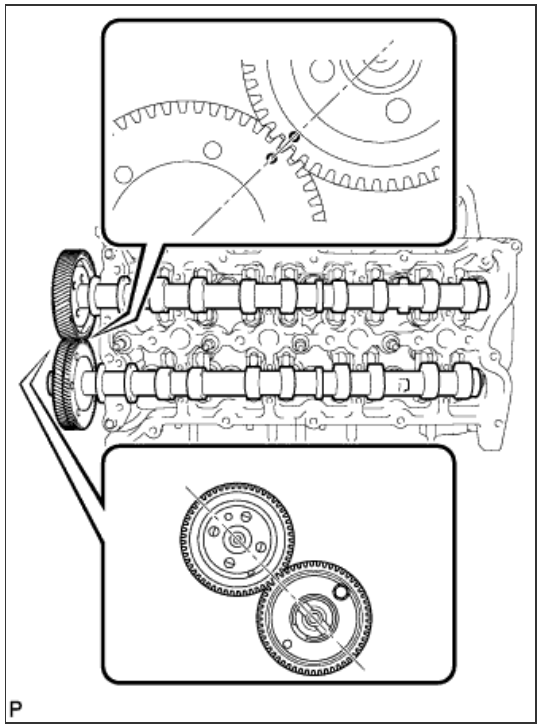
a. Add more than 19 cc (1.16 cu. in.) of engine oil into the cylinder head side oil holes.



b. Apply engine oil to the rollers of the valve rocker arms and the camshaft housing of the cylinder head.



c. ntall the camshafts.



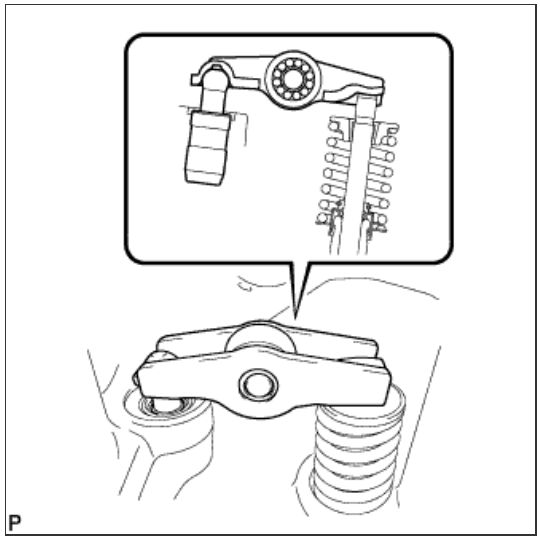
i. Apply engine oil to the camshaft journals, lo es, thrust portion and gears.

ii. Align the timing marks (1 dot mark) on the ack side of the No. 3 and No. 4 camshaft timing gears as shown in the illustration.

iii. Place the camshafts into the cylinder head.

NOTICE:

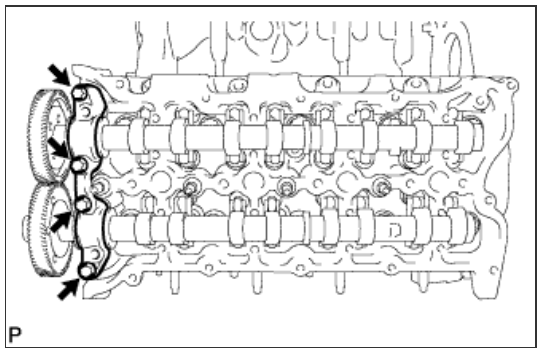
Before and after setting the camshafts, firmly set the rocker arms to the lash adjusters.



d. ntall the No. 4 camshaft earing cap.

i. Align the No. 4 camshaft earing cap and the ring pins of the No. 5 camshaft earing cap.

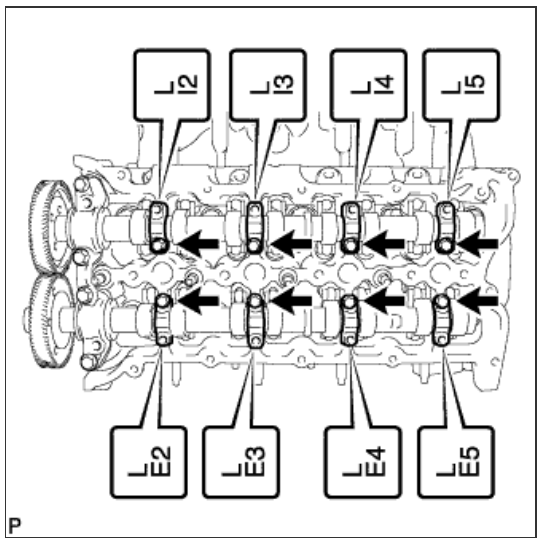
ii. Temporarily install the 4 olts y hand.



e. ntall the No. 3 camshaft earing caps.

i. Confirm the marks and num ers on the camshaft earing caps and place them in their proper position and direction.

ii. Temporarily install the 8 olts, which are not installed with the oil feed pipe, y hand.



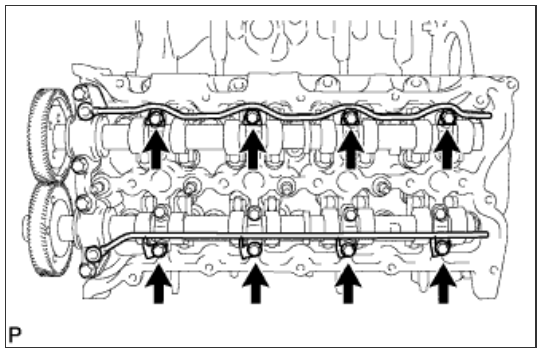
f. Temporarily install the No. 3 and No. 4 camshaft oil feed pipes with the 8 olts y hand.

NOTICE:

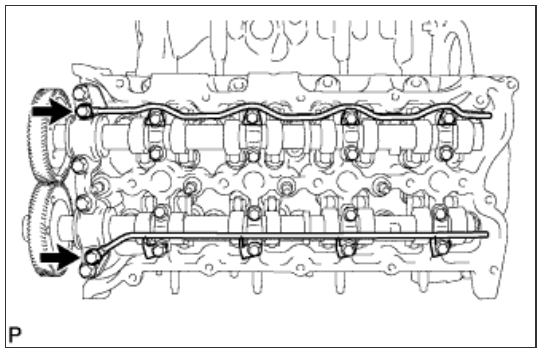
f even one of the pipe olt holes does not match its camshaft earing cap olt hole, replace the camshaft oil feed pipe.

HINT:

The pipe is ent on the intake side, and straight on the exhaust side.

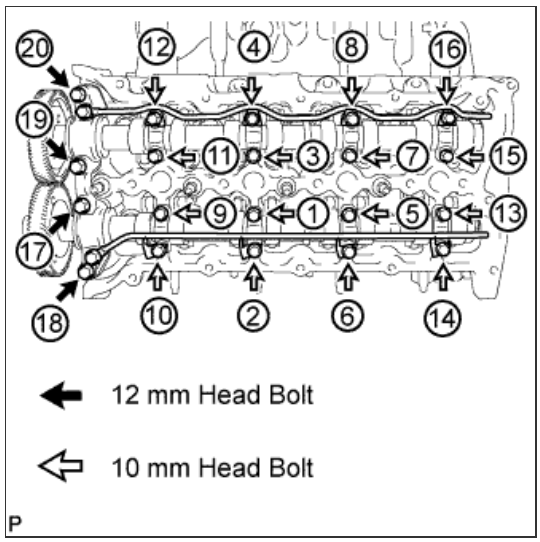


g. Temporarily install the 2 union olts y hand.



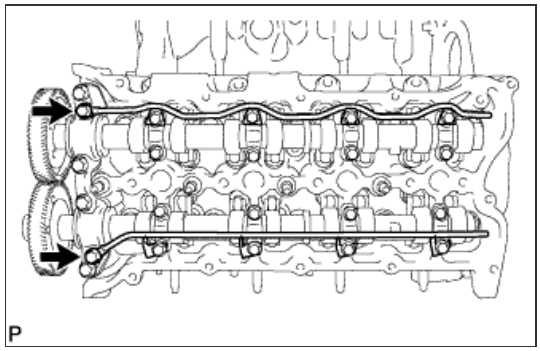
h. Uniformly tighten the 20 olts in several steps in the order shown in the illustration.

Torque:
for 12 mm head bolt of No. 4 camshaft bearing cap:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for 10 mm head bolt of No. 3 camshaft bearing cap:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



i. Tighten the 2 union olts.

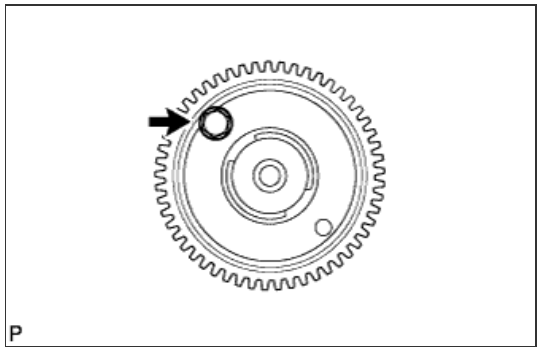
Torque:
17 N*m{ 173 kgf*cm , 13 ft.*lbf }



j. Remove the olt from the No. 4 camshaft timing gear.

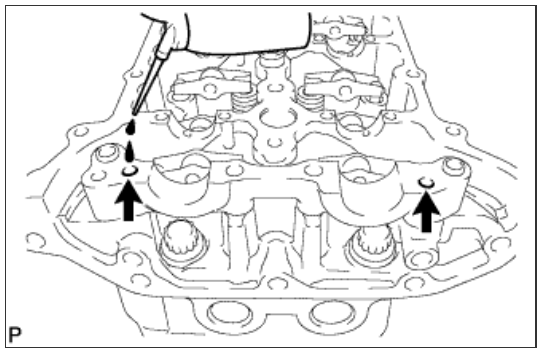
NOTICE:

Do not drop the olt into the engine.

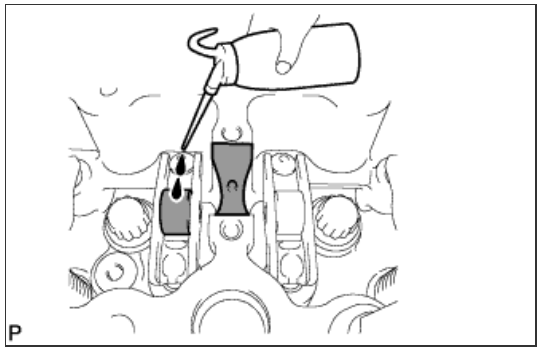


15. INSTALL NO. 1 AND NO. 2 CAMSHAFT

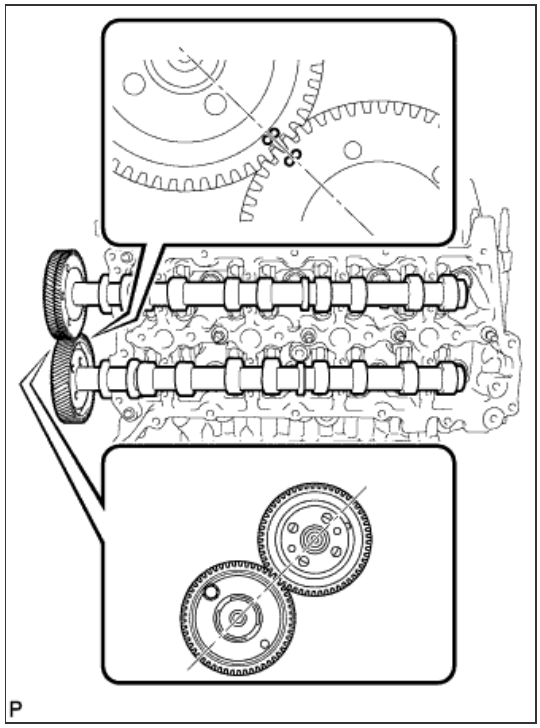
a. Add more than 19 cc (1.16 cu. in.) of engine oil into the cylinder head side oil holes.



b. Apply engine oil to the rollers of the valve rocker arms and the camshaft housing of the cylinder head.



c. ntall the camshafts.



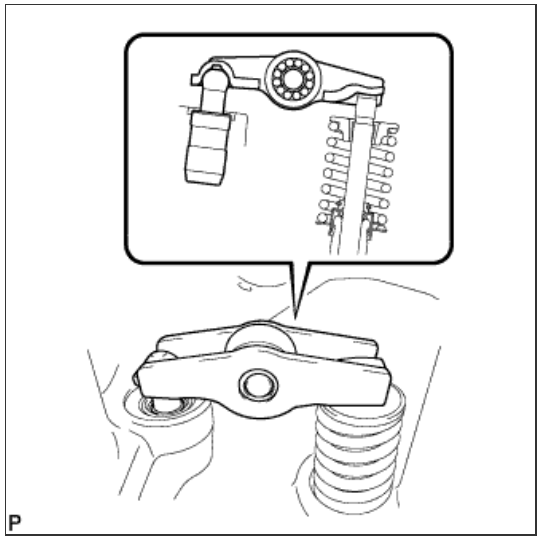
i. Apply engine oil to the camshaft journals, lo es, thrust portion and gears.

ii. Align the timing marks (2 dot marks) on the ack side of the No. 1 and No. 2 camshaft timing gears as shown in the illustration.

iii. Place the camshafts into the cylinder head.

NOTICE:

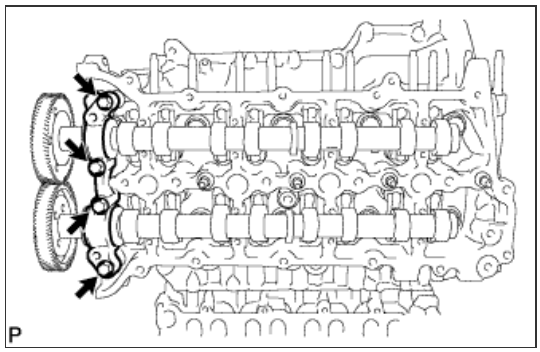
Before and after setting the camshafts, firmly set the rocker arms to the lash adjusters.



d. ntall the No. 1 camshaft earing cap.

i. Align the No. 1 camshaft earing cap and the ring pins of the No. 2 camshaft earing cap.

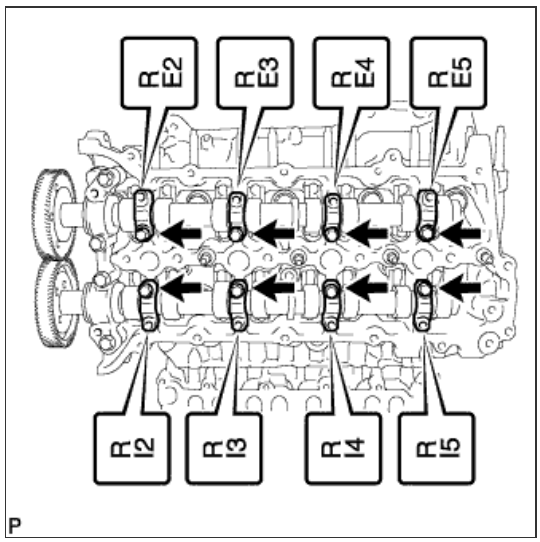
ii. Temporarily install the 4 olts y hand.



e. ntall the No. 3 camshaft earing caps.

i. Confirm the marks and num ers on the camshaft earing caps and place them in their proper position and direction.

ii. Temporarily install the 8 olts, which are not installed with the oil feed pipe, y hand.



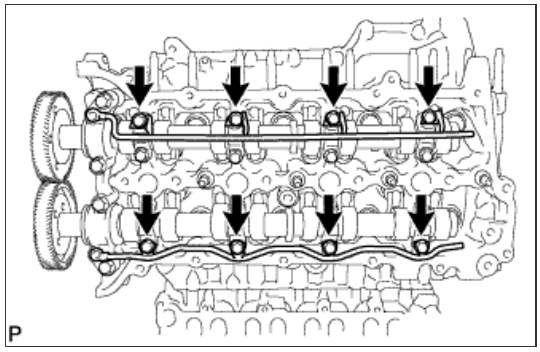
f. Temporarily install the No. 1 and No. 2 camshaft oil feed pipes with the 8 olts y hand.

NOTICE:

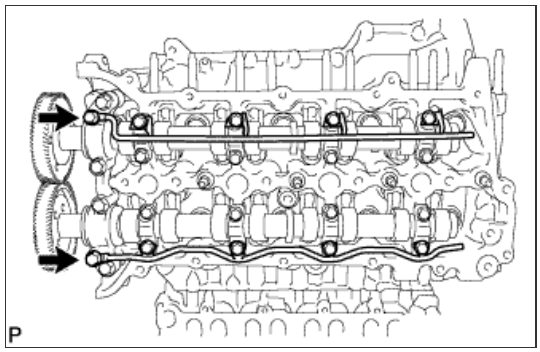
f even one of the pipe olt holes does not match its camshaft earing cap olt hole, replace the camshaft oil feed pipe.

HINT:

The pipe is ent on the intake side, and straight on the exhaust side.

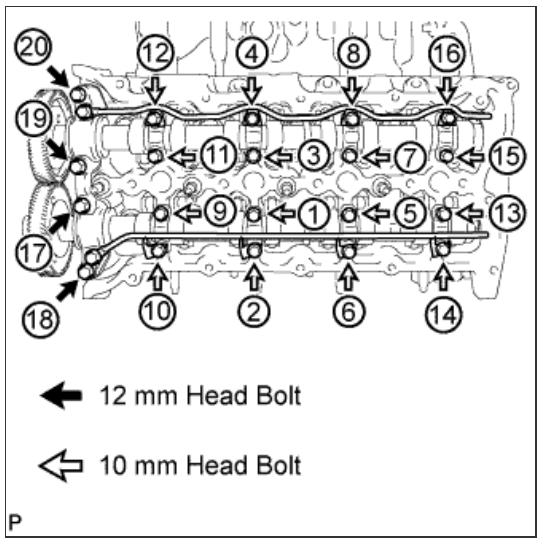


g. Temporarily install the 2 union olts y hand.



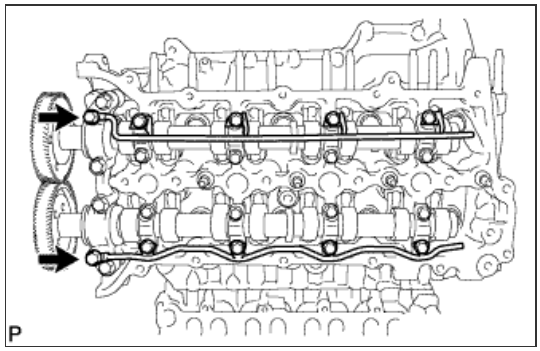
h. Uniformly tighten the 20 olts in several steps in the order shown in the illustration.

Torque:
for 12 mm head bolt of No. 1 camshaft bearing cap:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for 10 mm head bolt of No. 3 camshaft bearing cap:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



i. Tighten the 2 union olts.

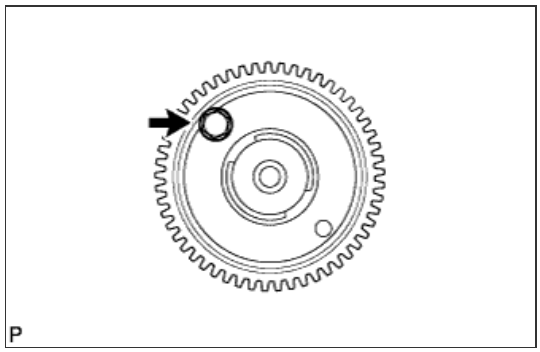
Torque:
17 N*m{ 173 kgf*cm , 13 ft.*lbf }



j. Remove the olt from the No. 1 camshaft timing gear.

NOTICE:

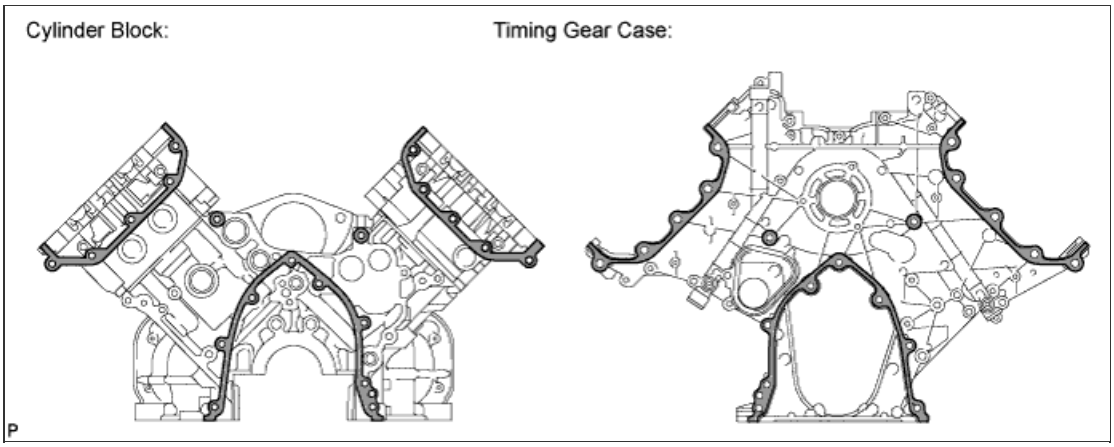
Do not drop the olt into the engine.



16. INSTALL TIMING GEAR CASE SUB-ASSEMBLY

NOTICE:

When the contact surfaces shown elow are wet, wipe them with an oil free cloth efore applying seal packing.



a. Apply seal packing to the timing gear case as shown in the following illustration.

Standard seal diameter:
4 to 5 mm (0.157 to 0.197 in.)

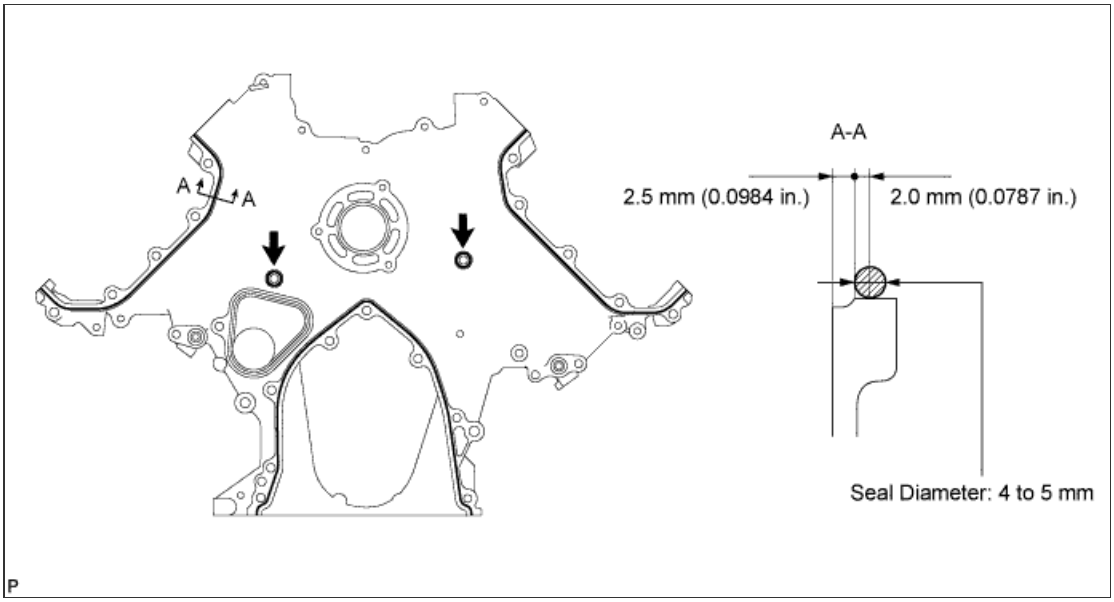
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

- **After applying seal packing, align the timing gear case with the engine within 3 minutes and tighten the bolts and nuts within 15 minutes.**
- **Apply the seal packing in a continuous line.**

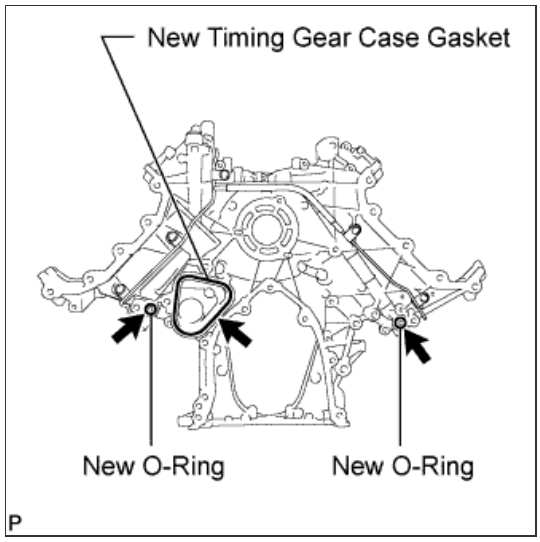
HINT:

- **The FIPG line is shown below.**
- **Apply packing to the 5 seal surface areas.**



b. ntall a new timing gear case gasket.

c. Apply engine oil to 2 new O rings and install them to the timing gear case.



d. ntall the timing gear case with the 22 olts and 2 nuts.

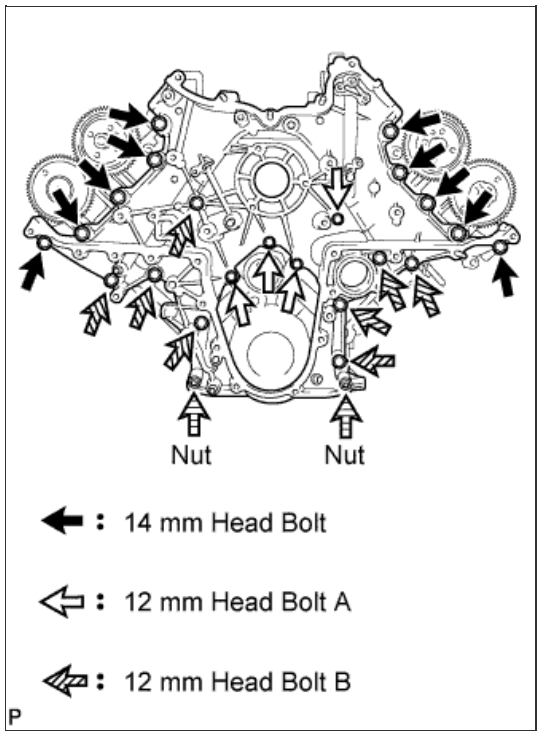
Torque:
for 14 mm head bolt (case is dry):
46 N*m{ 469 kgf*cm , 34 ft.*lbf }
for 14 mm head bolt (case is wet):
42 N*m{ 428 kgf*cm , 31 ft.*lbf }
for 12 mm head bolt A and B:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }
for nut:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

NOTICE:

- **The case is "dry" when there is absolutely no engine oil on the 14 mm head bolts and cylinder head bolt holes.**
- **The case is "wet" when there is engine oil on the 14 mm head bolts and cylinder head bolt holes.**

Bolt Length

tem	uantity	Length
A	4	20 mm (0.787 in.)
B	8	45 mm (1.77 in.)

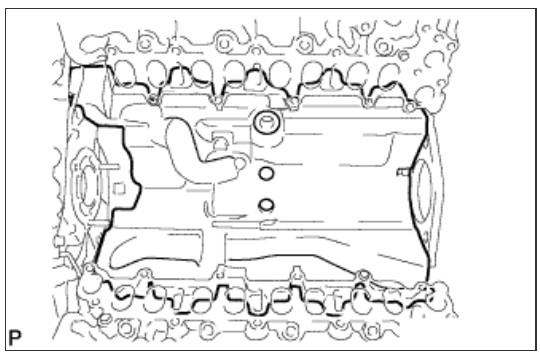


17. INSTALL V-BANK SILENCER

a. Align the alignment areas of the ank silencer and cylinder dck, and install the ank silencer.

NOTICE:

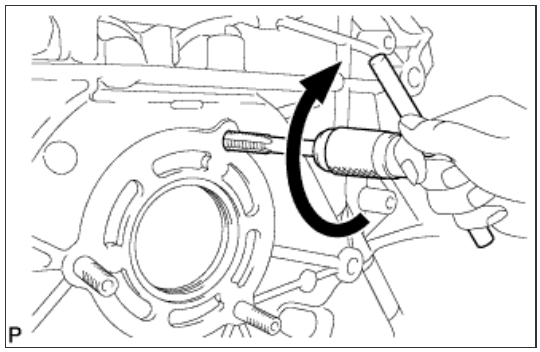
erify that the ank silencer is elow the top surface of the intake port of the cylinder head R and L .



18. INSTALL FUEL SUPPLY PUMP ASSEMBLY

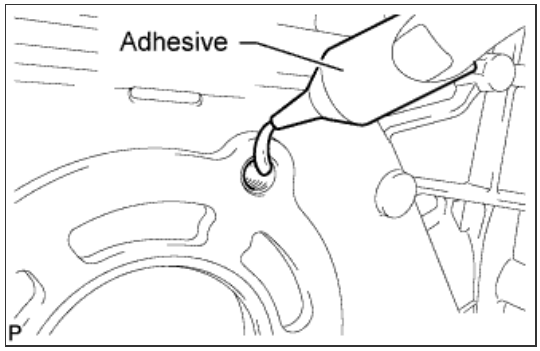
a. Using an 8 mm x 1.25 pitch tap, remove the adhesive from the timing gear case

side olt hole.

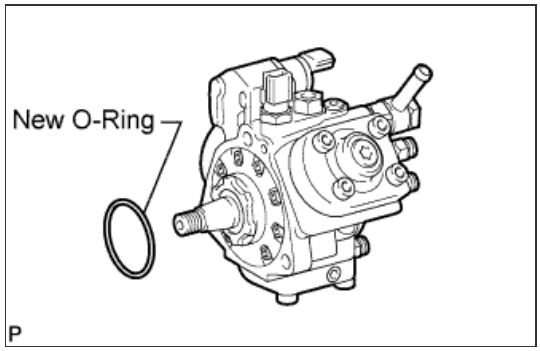


b. Apply adhesive to 2 or more threads of the timing gear case olt hole.

Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent



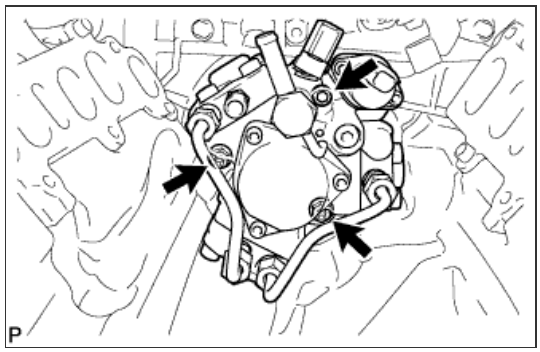
c. Apply engine oil to a new O ring and install it to the supply pump.



d. ntall the supply pump to the timing gear case.

NOTICE:

When installing the supply pump, do not hold the fuel pipe to prevent fuel leaks.



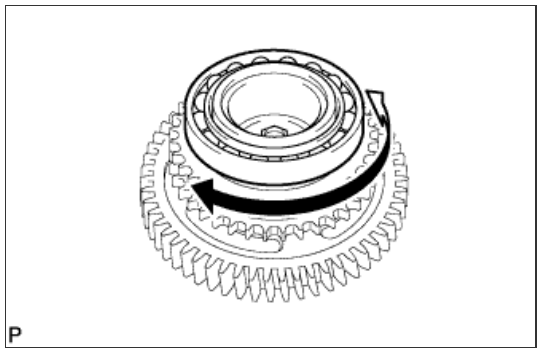
i. Temporarily install the 2 nuts.

ii. Using a 6 mm hexagon wrench, install the hexagon olt, and then tighten the 2 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

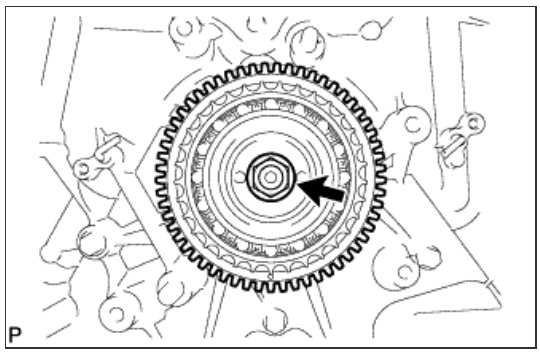
19. INSPECT RADIAL BALL BEARING

a. Turn the earing, and check that the earing moves smoothly and uietly.
f it moves roughly or noisily, replace the radial all earing.



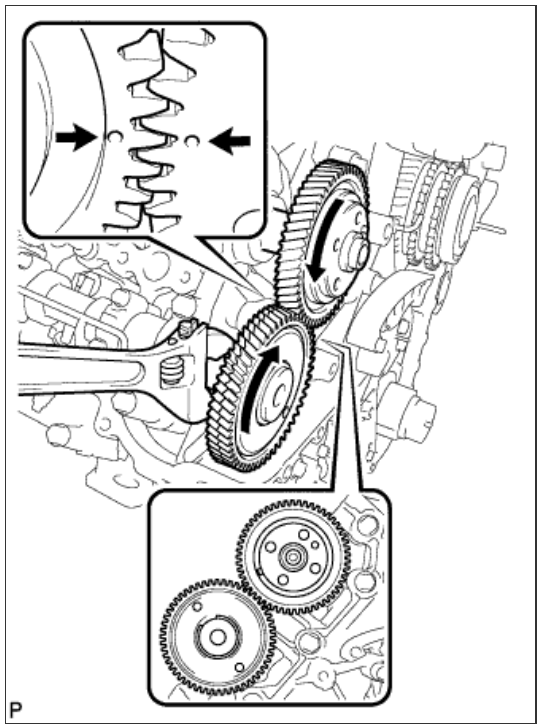
0. TEMPORARILY INSTALL FUEL SUPPLY PUMP DRIVE GEAR

a. Align the cutout of the supply pump drive gear and key of the supply pump, and temporarily install the nut.



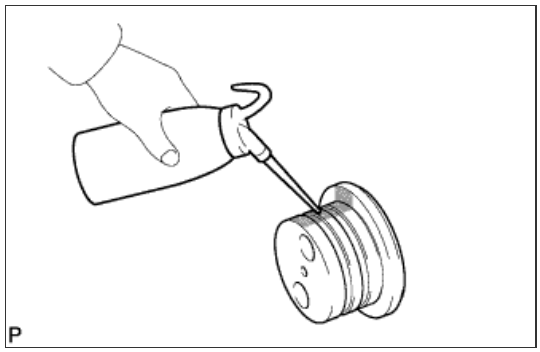
21. SET NO. 1 AND NO. 2 CAMSHAFTS TO TDC

a. Using a wrench, turn the No. 1 camshaft and align the timing marks (1 dot mark) on the ack side of the timing gears as shown in the illustration.

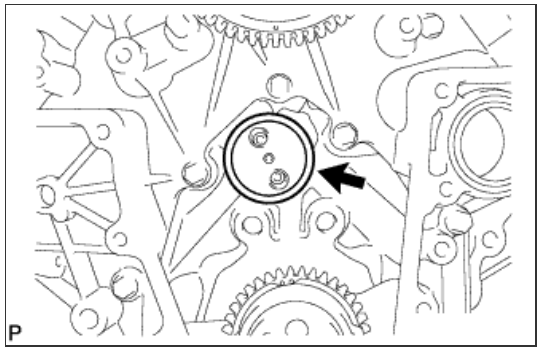


22. INSTALL NO. 1 IDLE GEAR SHAFT

a. Apply engine oil to the contact surface of the idle gear shaft and the ack side of the protrusion.



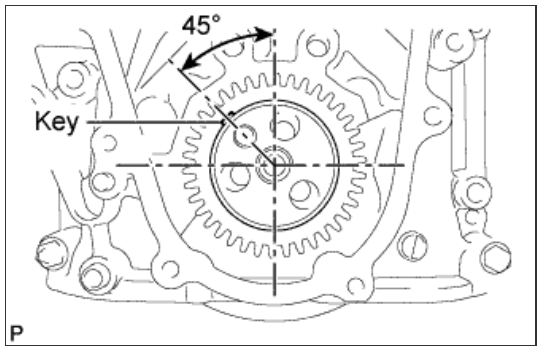
b. ntall the idle gear shaft to the cylinder dck.



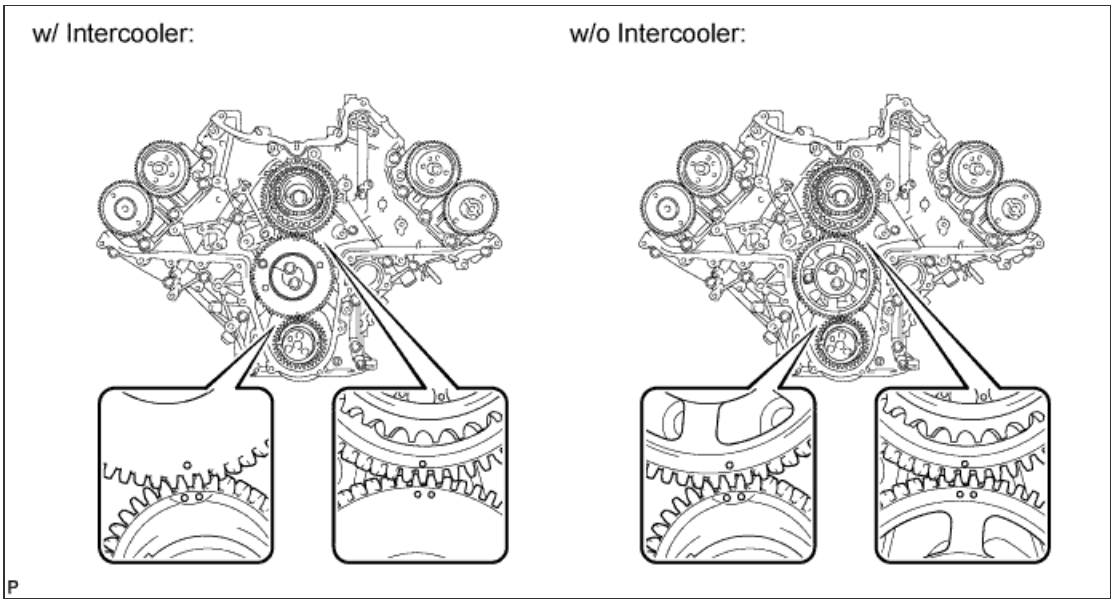
23. INSTALL IDLE GEAR ASSEMBLY

a. Temporarily install the 2 crankshaft pulley set olts to the crankshaft.

b. Using a ar, turn the crankshaft clockwise to the No. 1 cylinder TDC position.



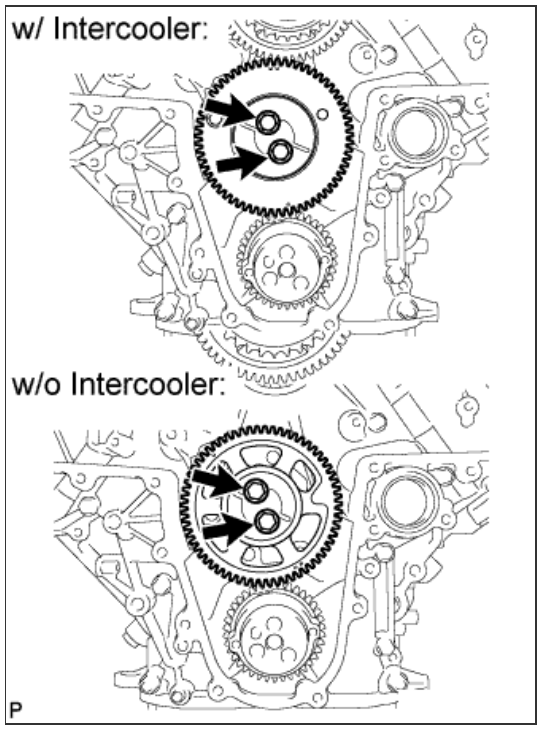
c. Align the timing marks of the supply pump drive gear and idle gear, and the timing marks of the crankshaft timing gear and idle gear as shown in the illustration.



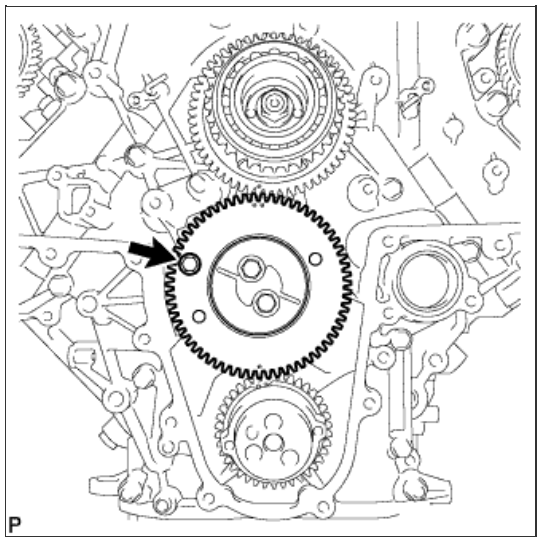
d. Apply engine oil to the idle gear thrust plate and gears.

e. ntall the idle gear thrust plate with the 2 olts.

Torque:
47 N*m{ 479 kgf*cm , 35 ft.*lbf }



f. w/ tercooler:
Remove the service olt.

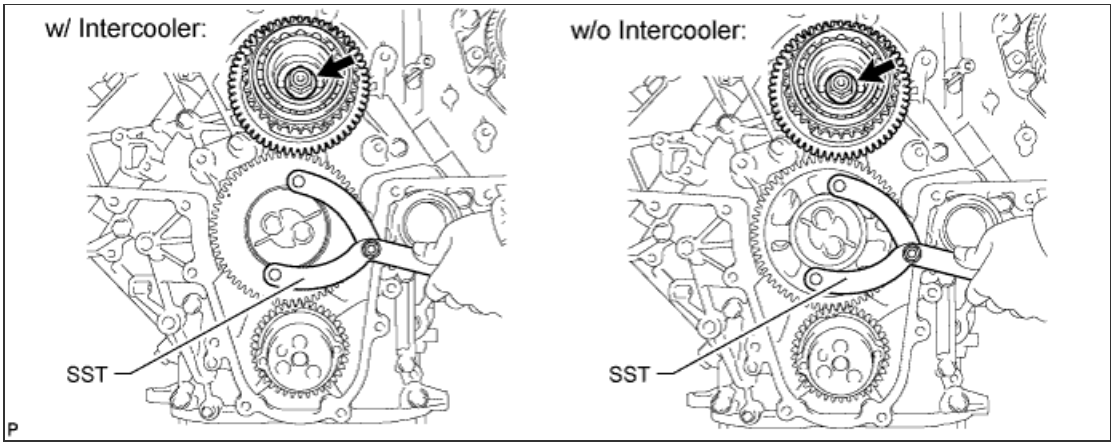


. TIGHTEN FUEL SUPPLY PUMP DRIVE GEAR NUT

a. Using SST, hold the idle gear and tighten the nut.

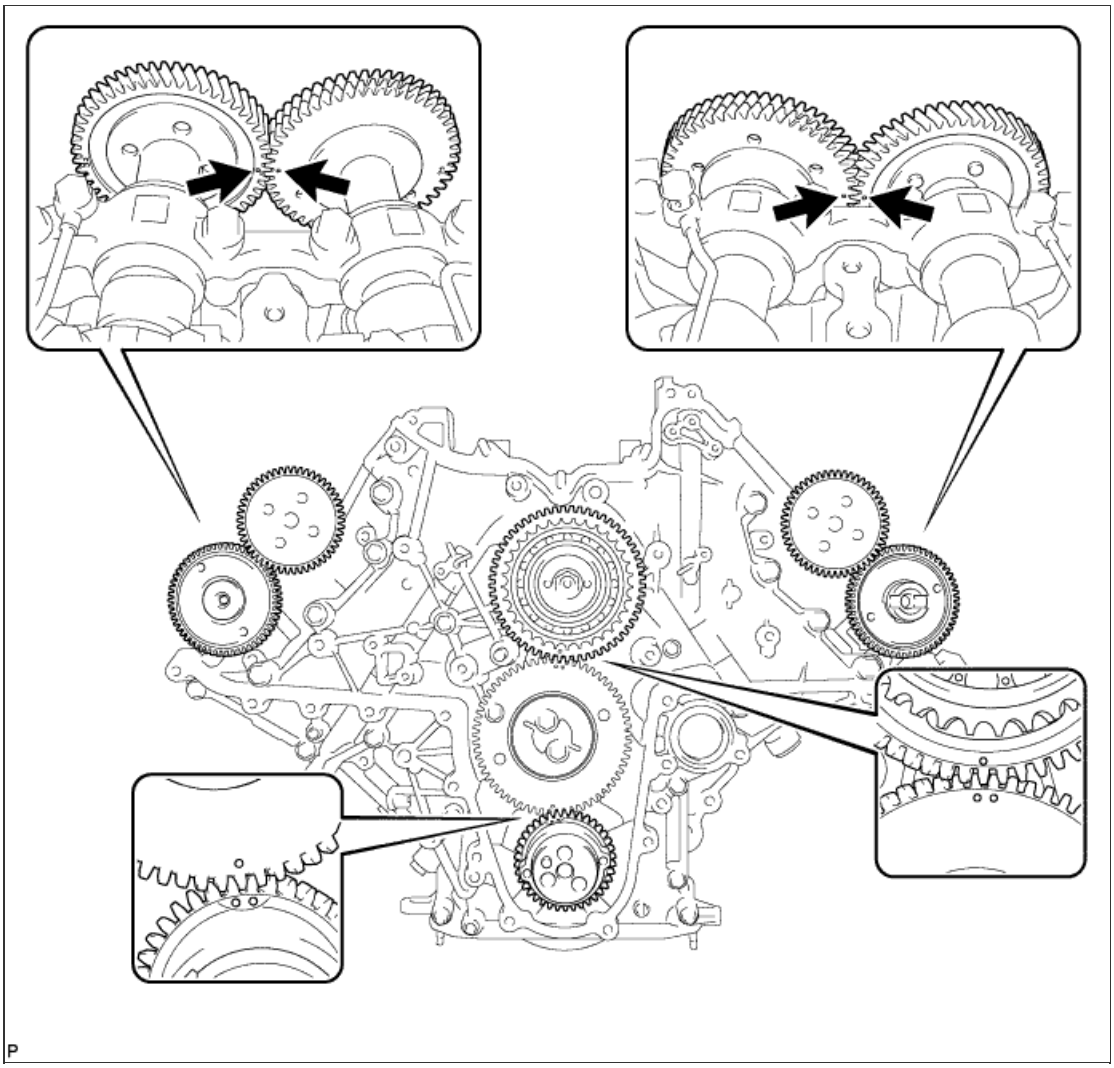
SST
09960-10010 (09962-01000, 09963-00700)

Torque:
68 N*m{ 693 kgf*cm , 50 ft.*lbf }



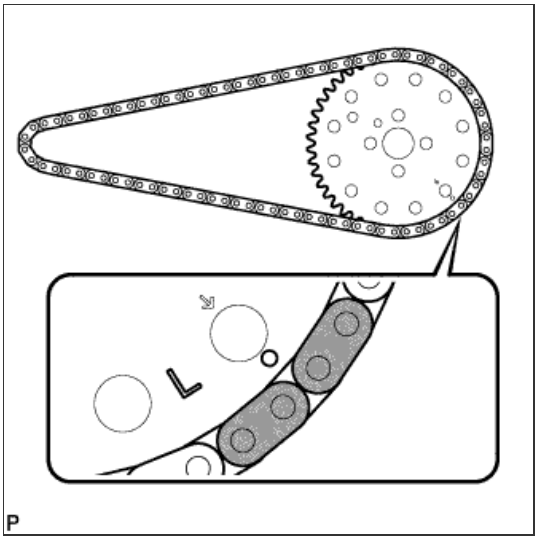
25. CHECK NO. 1 CYLINDER TO TDC/COMPRESSION

a. Check that the timing marks of the following pairs of parts are aligned: 1) supply pump drive gear and idle gear: 2) crankshaft timing gear and idle gear: 3) R and L camshaft timing gears.

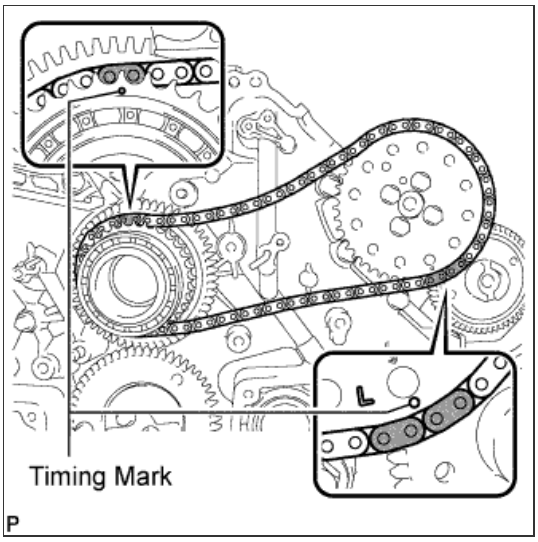


6. INSTALL NO. 2 CAMSHAFT TIMING SPROCKET AND NO. 2 TIMING CHAIN

a. Align the 2 mark plates (yellow) on the No. 2 timing chain with the timing mark (1 dot mark) of the No. 2 camshaft timing sprocket as shown in the illustration.



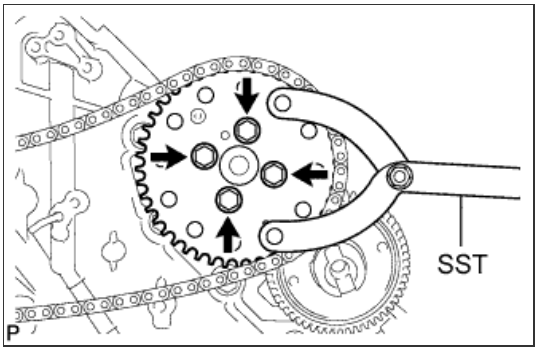
b. Align the No. 2 timing chain mark plate (yellow) with the supply pump drive gear timing mark, and temporarily install the No. 2 camshaft timing sprocket with the 4 olts.



c. Using SST, hold the No. 2 camshaft timing sprocket, and tighten the 4 olts.

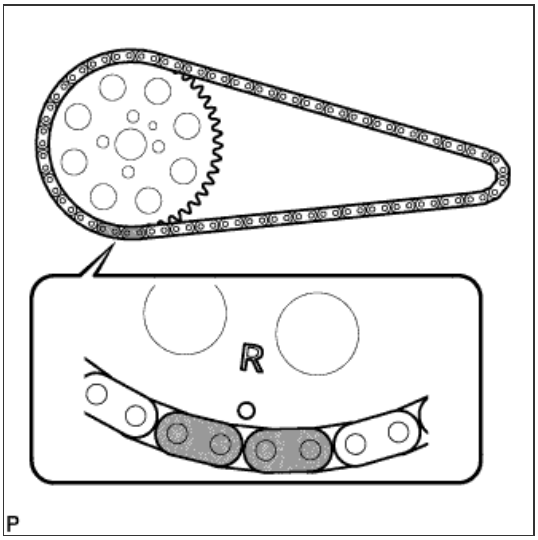
SST
09960-10010 (09962-01000, 09963-01000)

Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }

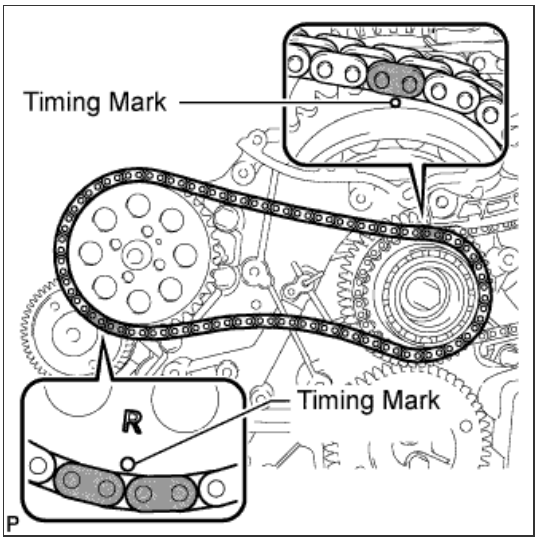


27. INSTALL NO. 1 CAMSHAFT TIMING SPROCKET AND NO. 1 TIMING CHAIN

a. Align the 2 mark plates (yellow) on the No. 1 timing chain with the timing mark (1 dot mark) of the No. 1 camshaft timing sprocket as shown in the illustration.



b. Align the No. 1 timing chain mark plate (yellow) with the supply pump drive gear timing mark, and temporarily install the No. 1 camshaft timing sprocket.



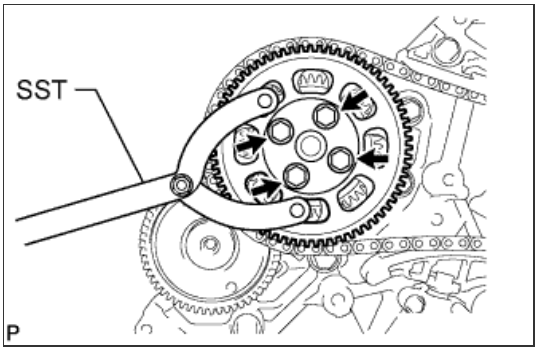
. INSTALL PUMP DRIVE SHAFT GEAR

a. Temporarily install the pump drive shaft gear with the 4 olts.

b. Using SST, hold the pump drive shaft gear and tighten the 4 olts.

SST
09960-10010 (09962-01000, 09963-01000)

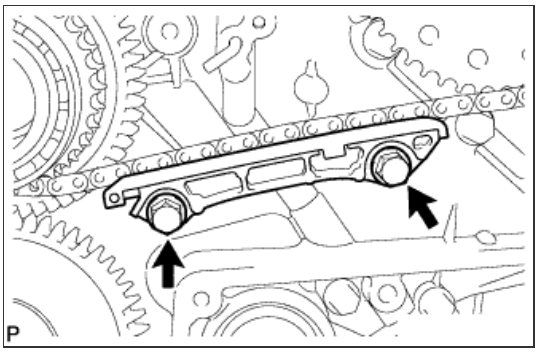
Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }



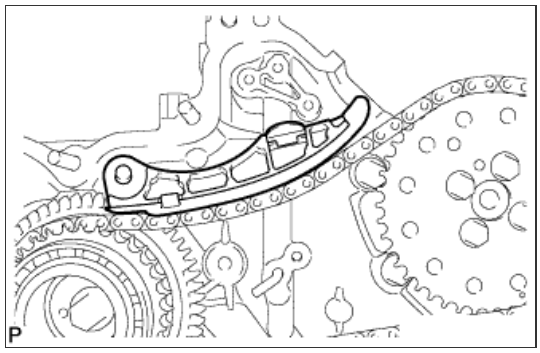
29. INSTALL NO. 2 CHAIN VIBRATION DAMPER

a. ntall the No. 2 chain vi ration damper with the 2 olts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



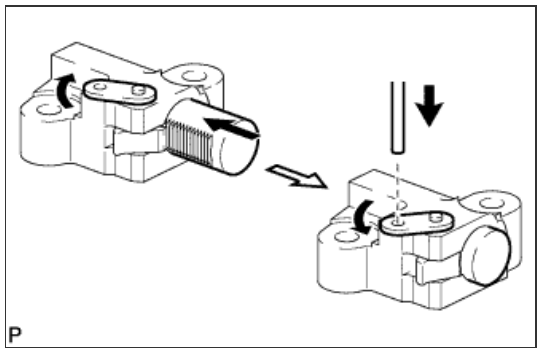
30. INSTALL NO. 2 CHAIN TENSIONER SLIPPER



31. INSTALL NO. 2 CHAIN TENSIONER ASSEMBLY

a. Move the stopper plate clockwise to release the lock, and push the plunger into the tensioner.

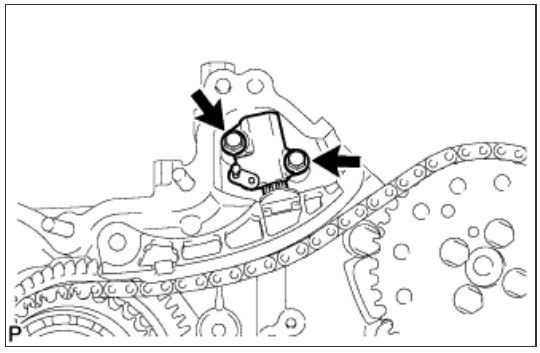
b. Move the stopper plate counterclockwise to set the lock, and insert a hexagon wrench into the stopper plate hole.



c. ntall the No. 2 chain tensioner with the 2 olts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

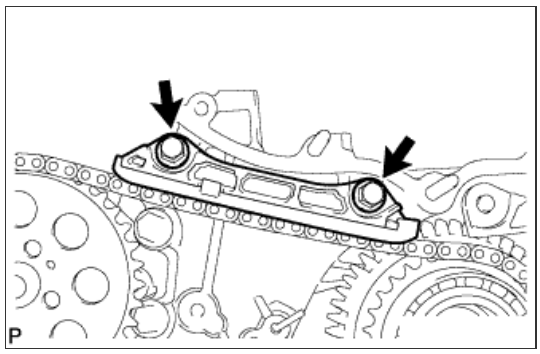
d. Remove the hexagon wrench.



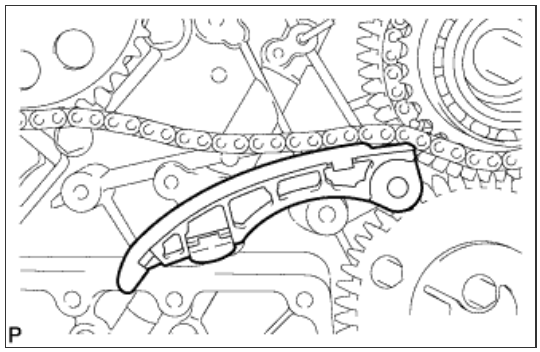
32. INSTALL NO. 1 CHAIN VIBRATION DAMPER

a. ntall the No. 1 chain vi ration damper with the 2 olts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



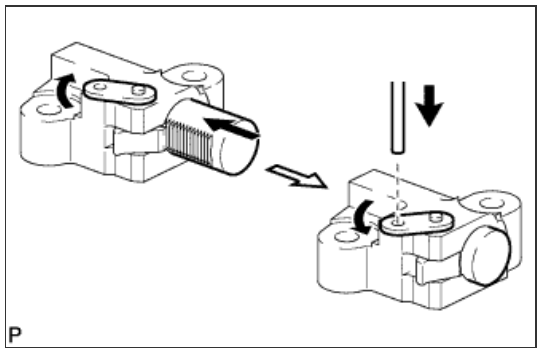
33. INSTALL NO. 1 CHAIN TENSIONER SLIPPER



34. INSTALL NO. 1 CHAIN TENSIONER ASSEMBLY

a. Move the stopper plate clockwise to release the lock, and push the plunger into the tensioner.

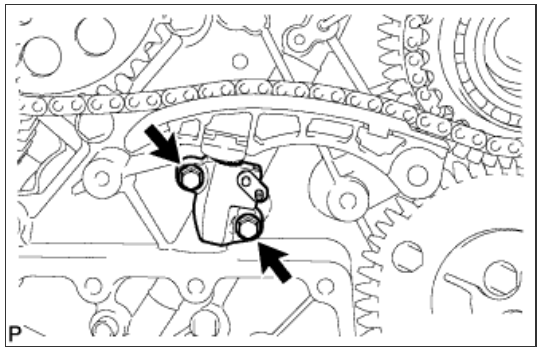
b. Move the stopper plate counterclockwise to set the lock, and insert a hexagon wrench into the stopper plate hole.



c. ntall the No. 1 chain tensioner with the 2 olts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

d. Remove the hexagon wrench.

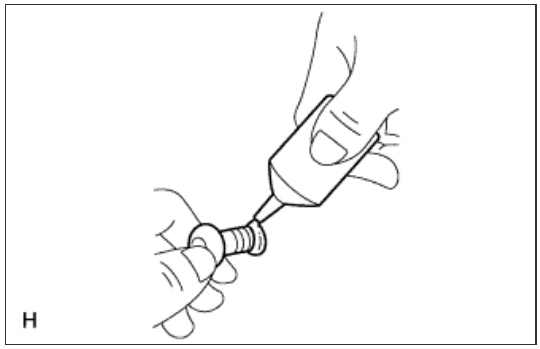


35. INSTALL NO. 1 CRANKSHAFT POSITION SENSOR PLATE

a. Remove the adhesive from the threads of the screws and the olt holes of the crankshaft.

b. Apply adhesive to 2 or 3 threads of the 2 screws.

Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent

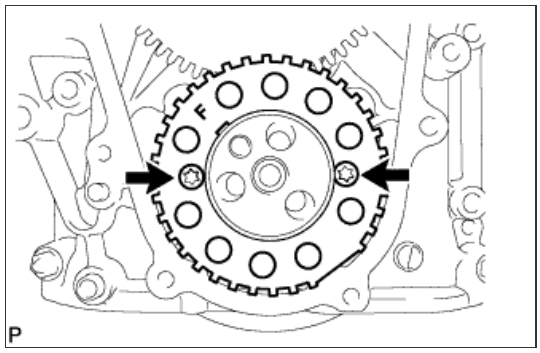


c. Using a T30 "TOR " wrench, install the No. 1 crankshaft position sensor plate with the 2 screws.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

NOTICE:

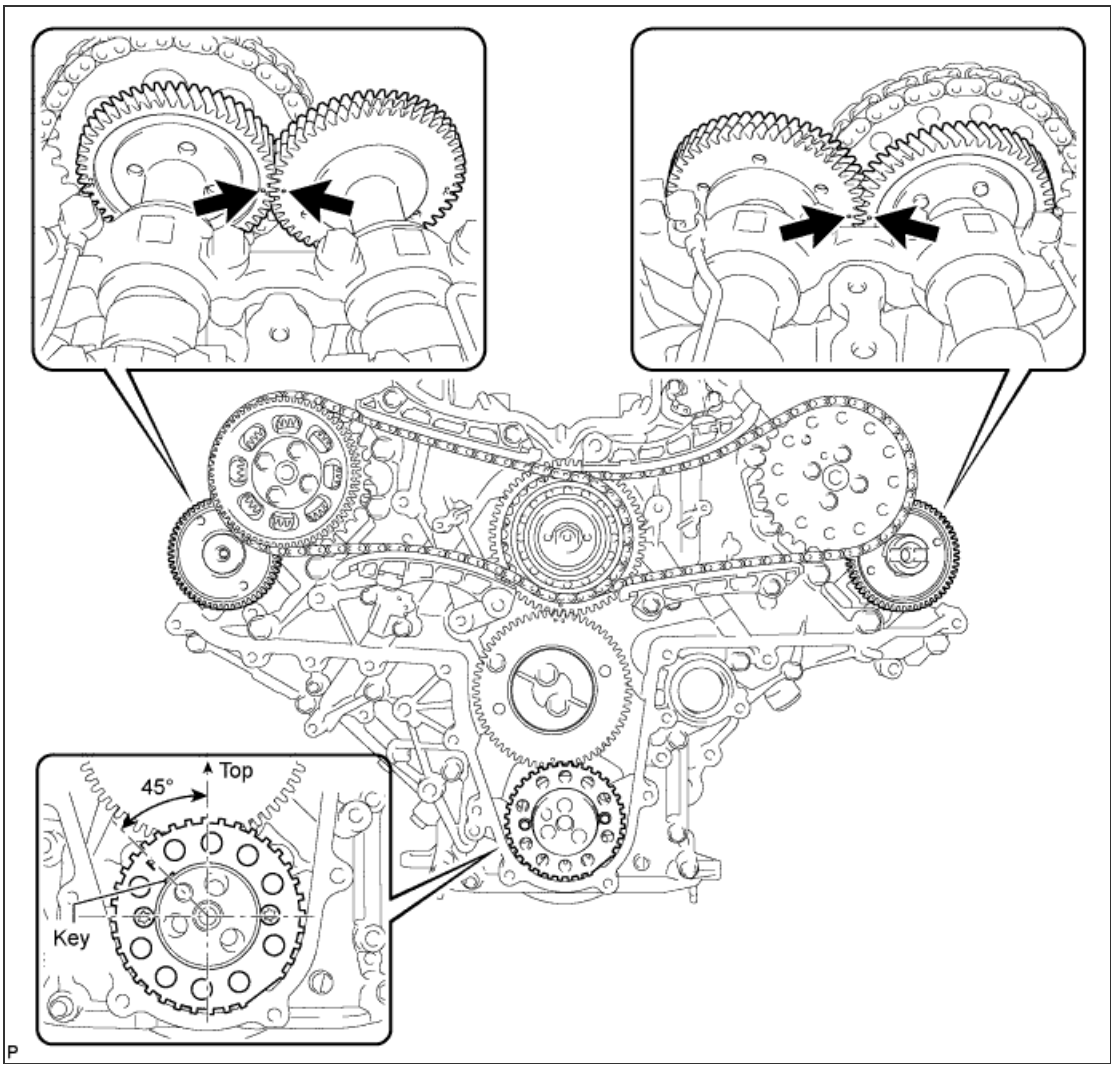
Make sure the " " mark on the plate is facing towards the front side of the engine.



36. CHECK NO. 1 CYLINDER TO TDC/COMPRESSION

a. Temporarily install the 2 crankshaft pulley set olts to the crankshaft.

b. Rotate the crankshaft 2 revolutions or more so that the crankshaft key is 45° counterclockwise from the top. Check that the timing marks (1 dot mark each) of the R and L camshaft timing gears align. f not as specified, turn the crankshaft 1 revolution (360°) and align the timing marks. f the timing marks are deviated, reinstall the chain and camshaft.



c. Remove the 2 crankshaft pulley set olts.

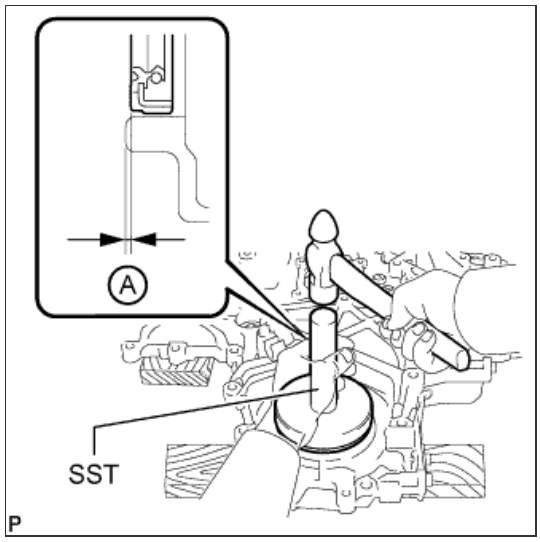
37. INSTALL FRONT CRANKSHAFT OIL SEAL

a. Place the timing chain cover on wooden dcks.

b. Using SST and a hammer, tap in a new oil seal as shown in the illustration.

SST
09316-12010
09950-70010 (09951-07100)
09950-60020 (09951-00890)

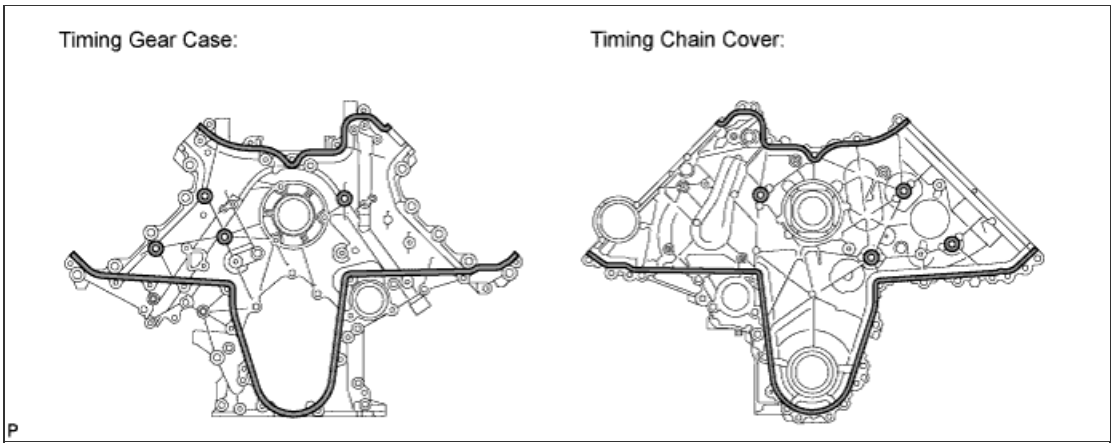
Standard depth A:
0.6 to 1.4 mm (0.0236 to 0.0551 in.)



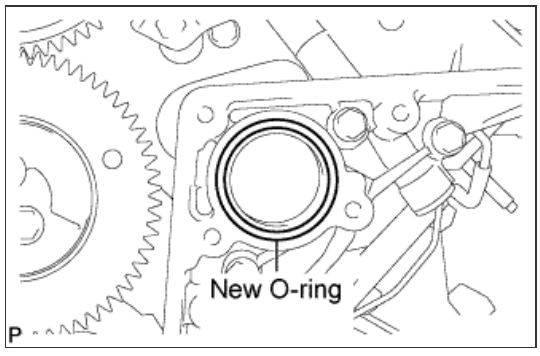
38. INSTALL TIMING CHAIN COVER SUB-ASSEMBLY

NOTICE:

When the contact surfaces shown elow are wet, wipe them with an oil free cloth efore applying seal packing.



a. ntall a new O ring to the timing gear case.



b. Apply seal packing to the timing chain cover as shown in the following illustration.

Standard seal diameter:
4 to 5 mm (0.157 to 0.197 in.)

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

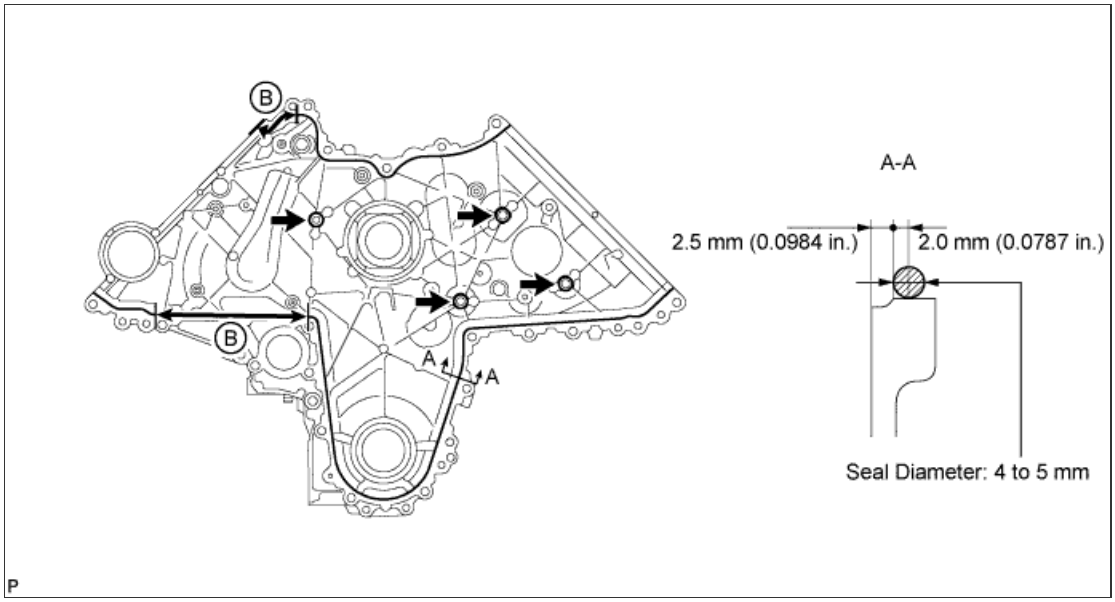
- **After applying seal packing, align the timing chain cover with the timing gear case within 3 minutes and tighten the**

bolts and nuts within 15 minutes.

- Apply the seal packing in a continuous line.
- Make sure the seal packing does not become thinner than 4 mm (0.157 in.) at the areas labeled "B" in the illustration below.

HINT:

- The FIPG line is shown below.
- Apply packing to the 6 seal surface areas.



c. Apply engine oil to the lip of the oil seal.

d. Align and install the timing chain cover to the timing gear case knock pin and supply pump earing.

NOTICE:

Make sure that the lip of the oil seal is properly installed.

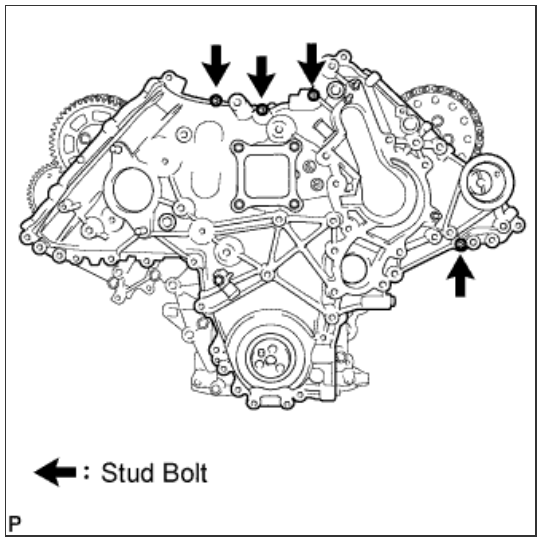
Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }

HINT:

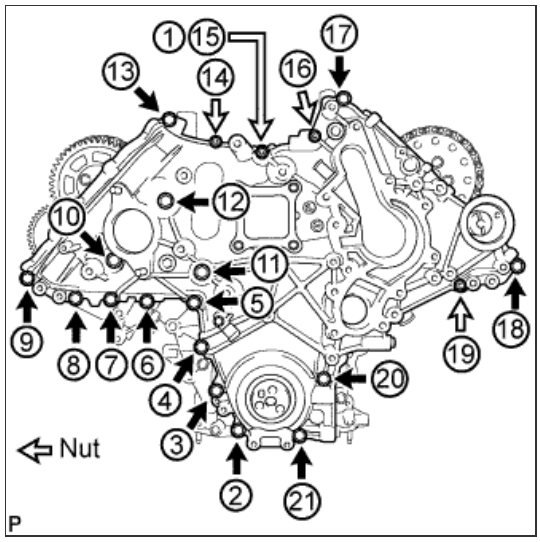
f the stud olts are loose, tighten them efore performing this procedure.

i. Using an E7 "TOR " wrench, tighten the stud olts.

Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }

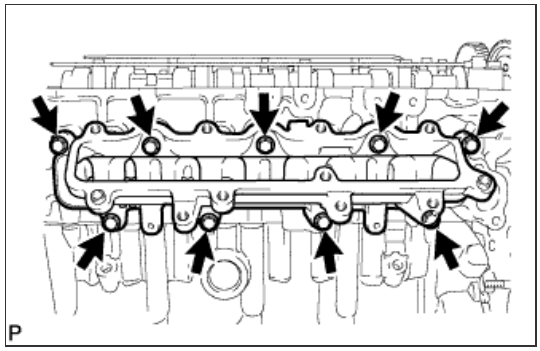


e. ntall and uniformly tighten the 16 olts and 4 nuts in the order shown in the illustration.

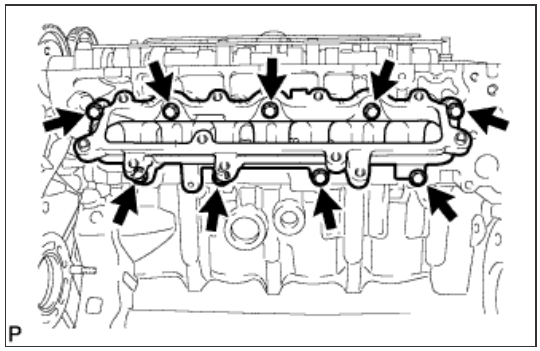


3 . TEMPORARILY INSTALL INTAKE MANIFOLD

a. ntall the gasket and temporarily install the No. 2 intake manifold with the 9 olts.



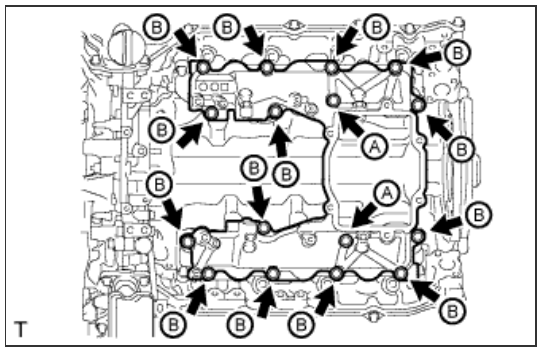
b. ntall the gasket and temporarily install the No. 1 intake manifold with the 9 olts.



c. ntall the 2 gaskets and temporarily install the No. 3 intake manifold with the 16 olts.

Bolt Length

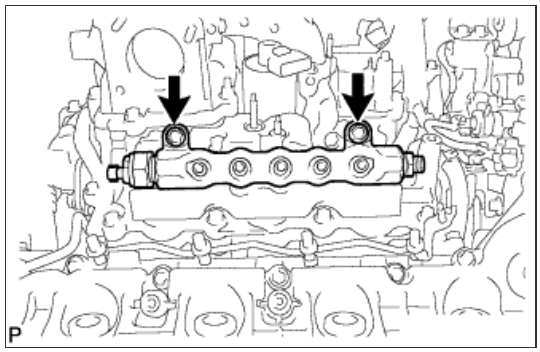
tem	Length
Bolt A	70 mm (2.76 in.)
Bolt B	25 mm (0.984 in.)



40. TEMPORARILY INSTALL COMMON RAIL ASSEMBLY RH

a. ntall the common rail with the 2 olts.

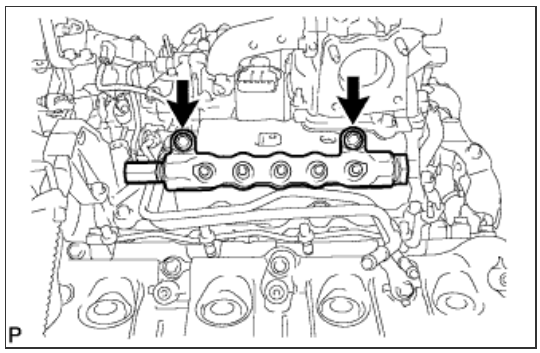
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



41. TEMPORARILY INSTALL COMMON RAIL ASSEMBLY LH

a. ntall the common rail with the 2 olts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

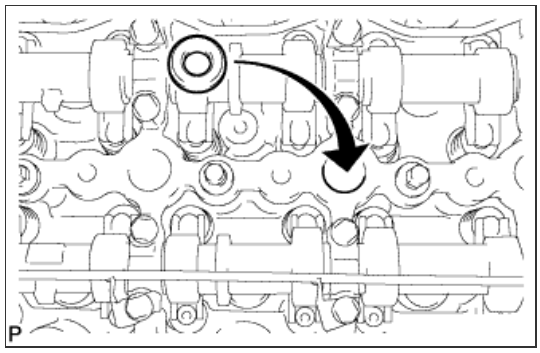


42. INSTALL FUEL INJECTOR RH

NOTICE:

Be sure to install the injector, holder clamp and olt in their original positions.

a. ntall 4 new injection nozzle seats to the cylinder head.



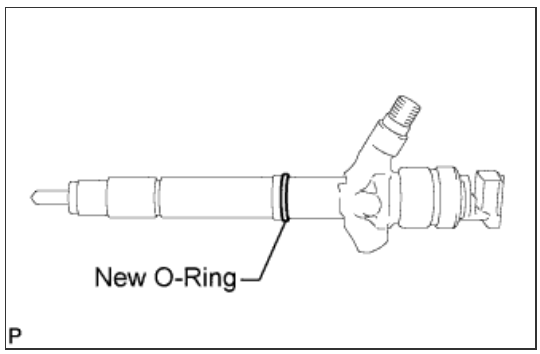
b. Apply a light amount of clean engine oil to 4 new O rings.

c. ntall the O rings to each injector as shown in the illustration.

d. nert the 4 injectors into the cylinder head.

NOTICE:

- **Insert the injector until it touches the nozzle seat surface.**
- **After installing the injector to the cylinder head, the O-ring may prevent the injector from fully seating. If so, pull out the injector and reinstall it.**
- **Always return an injector to the same place it was removed from.**

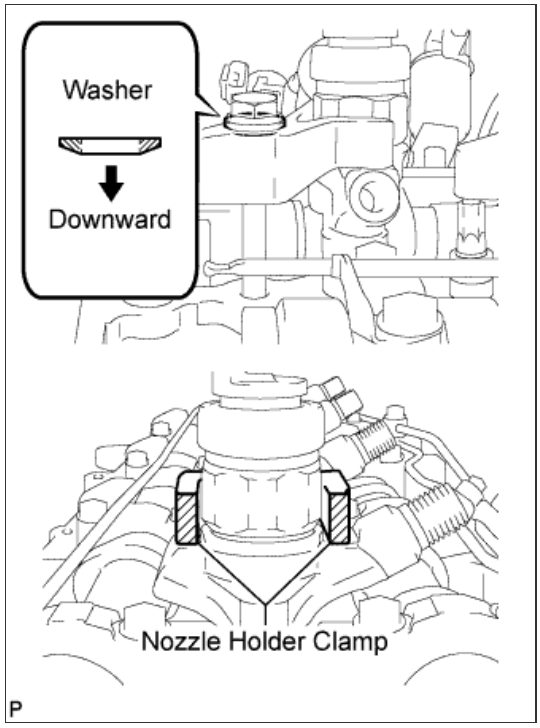


e. or an injector that has een replaced with a new injector, register the injector compensation code.

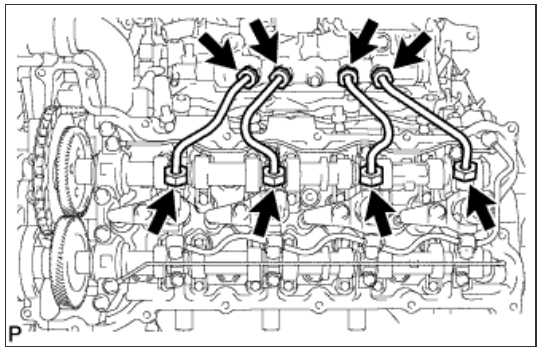
f. Temporarily install 4 new washers and the 4 nozzle clamps with the 4 clamp olts.

NOTICE:

- **The fork portion of the nozzle holder clamp must be set to the injector.**
- **Before tightening the bolts, check that the nozzle holder clamp is set properly.**
- **To tighten the clamp bolts, first tighten them by hand until they cannot be turned further. Then, tighten the bolts to the specified torque in a later step.**
- **When tightening the bolts, be careful not to tilt the bolt and clamp.**
- **Do not reuse the washer.**

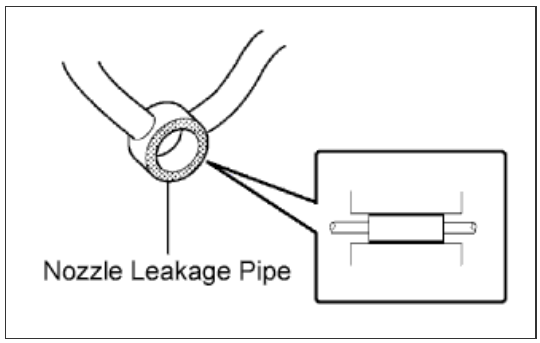


g. Temporarily install the 4 new injection pipes to the common rail and injector.



h. Check the nozzle leakage pipe. Check that there are no scratches or dents on the 5 union seal surfaces. f scratches or dents are present, replace the nozzle leakage pipe.

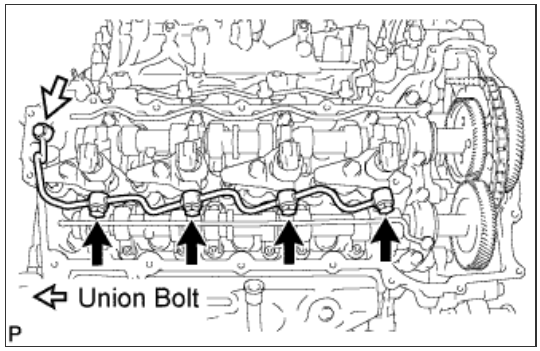
i. Set the leakage pipe and 5 new gaskets in place.



j. Temporarily install the leakage pipe with the 4 hollow screws and union olt.

HINT:

To position the injectors, loosely tighten the 4 hollow screws and union olt.

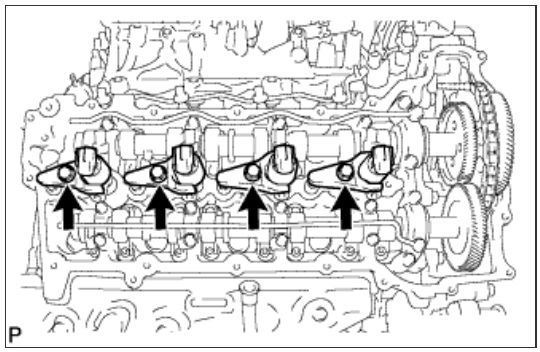


k. Tighten the 4 holder clamp olts.

Torque:

N*m{ 255 kgf*cm , 18 ft.*lbf }

l. Remove the 4 injection pipes.



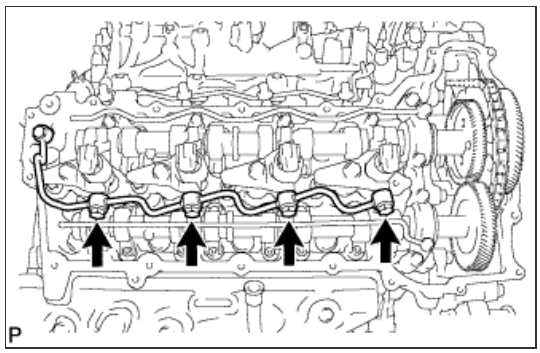
m. Tighten the 4 hollow screws.

Torque:

18 N*m{ 184 kgf*cm , 13 ft.*lbf }

NOTICE:

f a hollow screw is accidentally tightened eyond the tor ue specification, it must e replaced together with the nozzle leakage pipe.



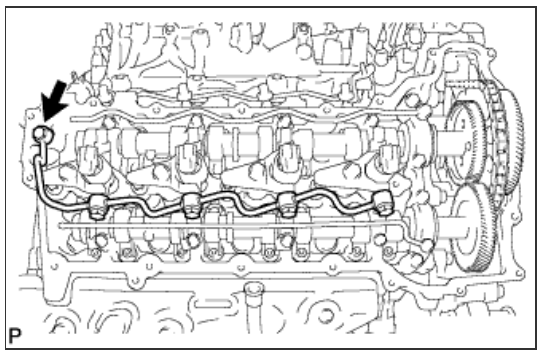
n. Tighten the union olt.

Torque:

21 N*m{ 214 kgf*cm , 15 ft.*lbf }

NOTICE:

f a hollow screw is accidentally tightened eyond the tor ue specification, it must e replaced together with the nozzle leakage pipe.

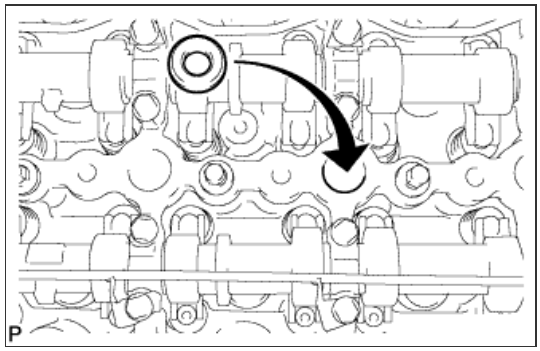


43. INSTALL FUEL INJECTOR LH

NOTICE:

Be sure to install the injector, holder clamp and olt in their original positions.

a. ntall 4 new injection nozzle seats to the cylinder head.



b. Apply a light amount of clean engine oil to 4 new O rings.

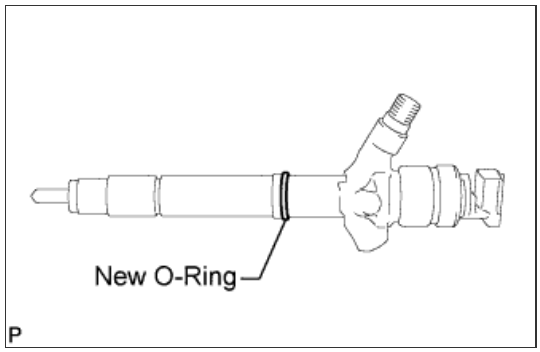
c. ntall the O rings to each injector as shown in the illustration.

d. nert the 4 injectors into the cylinder head.

NOTICE:

- **Insert the injector until it touches the nozzle seat surface.**
- **After installing the injector to the cylinder head, the O-ring may prevent the injector from fully seating. If so, pull out the injector and reinstall it.**
- **Always return an injector to the same place it was removed from.**

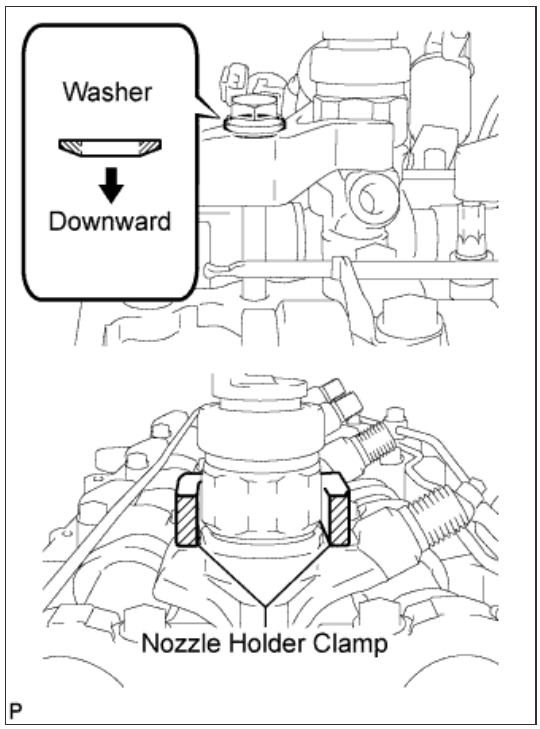
e. or an injector that has een replaced with a new injector, register the injector compensation code.



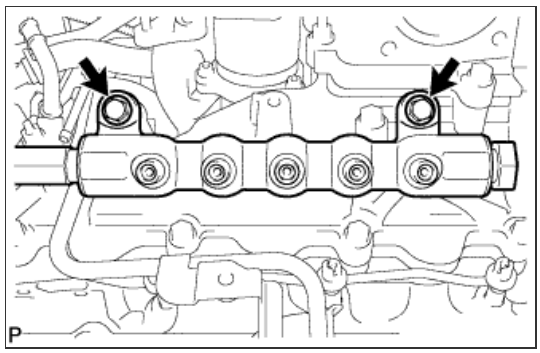
f. Temporarily install 4 new washers and the 4 nozzle clamps with the 4 clamp olts.

NOTICE:

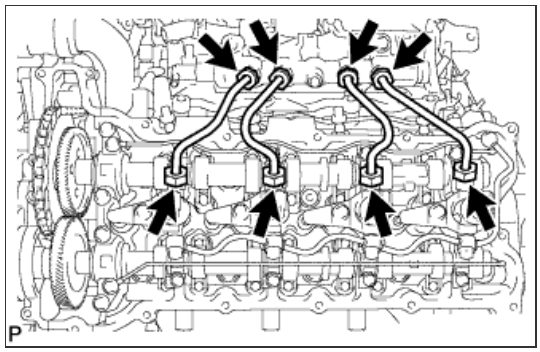
- **The fork portion of the nozzle holder clamp must be set to the injector.**
- **Before tightening the bolts, check that the nozzle holder clamp is set properly.**
- **To tighten the clamp bolts, first tighten them by hand until they cannot be turned further. Then, tighten the bolts to the specified torque in a later step.**
- **When tightening the bolts, be careful not to tilt the bolt and clamp.**
- **Do not reuse the washer.**



g. Temporarily install the common rail L with the 2 olts.



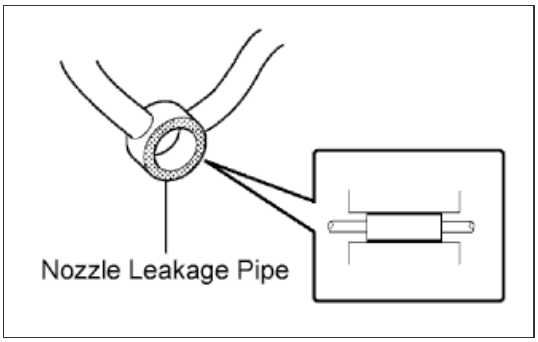
h. Temporarily install the 4 new injection pipes to the common rail and injector.



i. Check the nozzle leakage pipe. Check that there are no scratches or dents on the 5 union seal surfaces. f scratches or dents are present, replace the nozzle

leakage pipe.

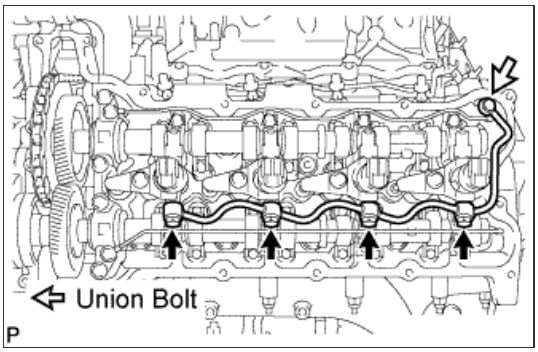
j. Set the leakage pipe and 5 new gaskets in place.



k. Temporarily install the leakage pipe with the 4 hollow screws and union olt.

HINT:

To position the injectors, loosely tighten the 4 hollow screws and union olt.

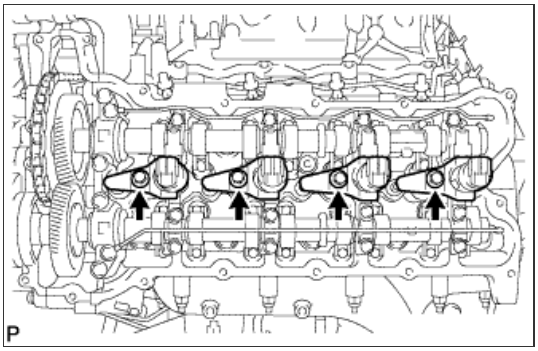


l. Tighten the 4 holder clamp olts.

Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }

m. Remove the 4 injection pipes.

n. Remove the 2 olts and common rail L .

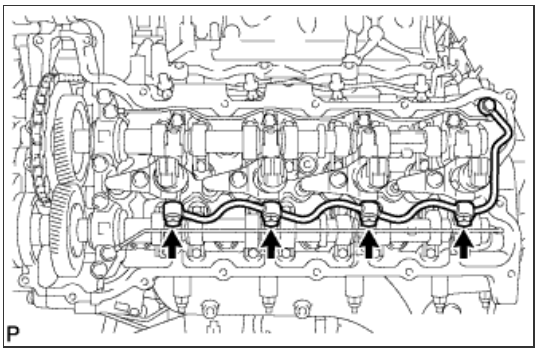


o. Tighten the 4 hollow screws.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

NOTICE:

f a hollow screw is accidentally tightened eyond the tor ue specification, it must e replaced together with the nozzle leakage pipe.

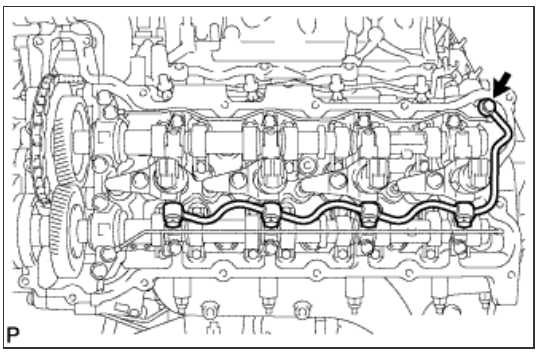


p. Tighten the union olt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

NOTICE:

f a hollow screw is accidentally tightened eyond the tor ue specification, it must e replaced together with the nozzle leakage pipe.

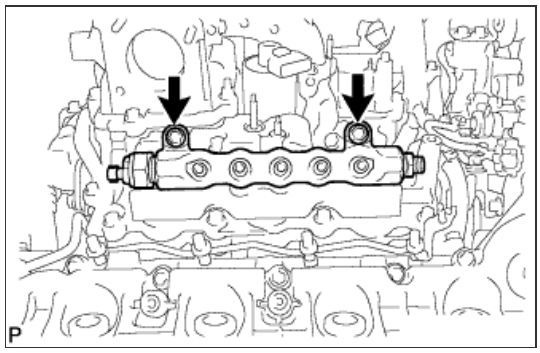


44. REMOVE COMMON RAIL ASSEMBLY RH

a. Remove the 2 olts and common rail.

NOTICE:

Do not remove the fuel pressure sensor from the common rail. f it is removed, replace the common rail.

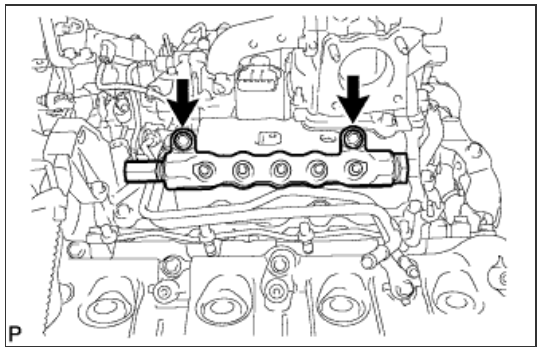


45. REMOVE COMMON RAIL ASSEMBLY LH

a. Remove the 2 olts and common rail.

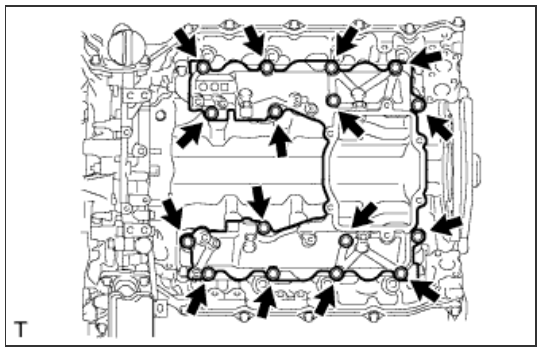
NOTICE:

Do not remove the fuel pressure limiter from the common rail. f it is removed, replace the common rail.

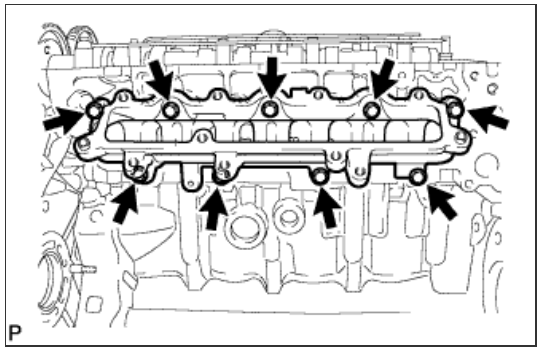


46. REMOVE INTAKE MANIFOLD

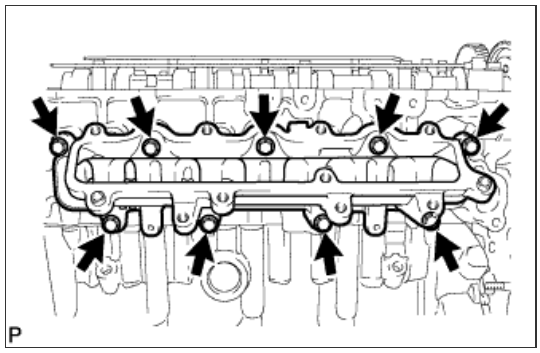
a. Remove the 16 olts, 2 gaskets and intake manifold.



b. Remove the 9 olts, No. 1 intake manifold and gasket.



c. Remove the 9 olts, No. 2 intake manifold and gasket.

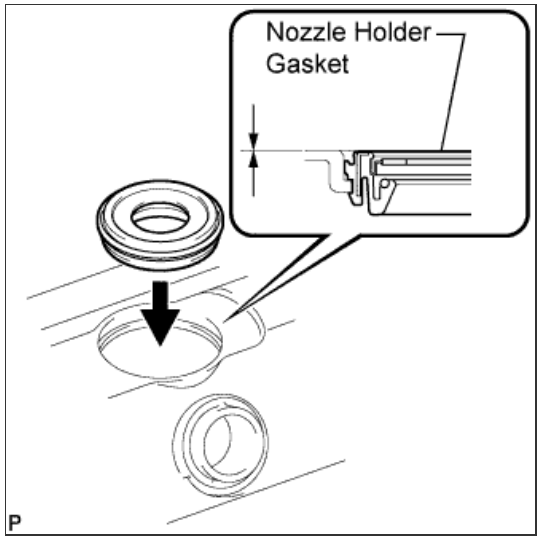


4 . INSTALL NOZZLE HOLDER GASKET LH

a. Press 4 new nozzle holder gaskets into the cylinder head cover L .

NOTICE:

After installing the nozzle holder gasket, check that it dose not protrude from the cylinder head cover.



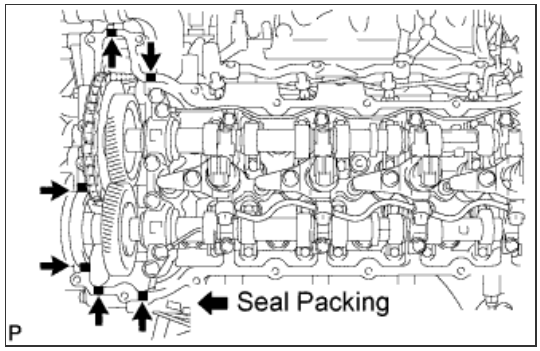
48. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY LH

a. Apply seal packing as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the cylinder head cover within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after the installation.**



b. ntall a new gasket to the cylinder head cover.

NOTICE:

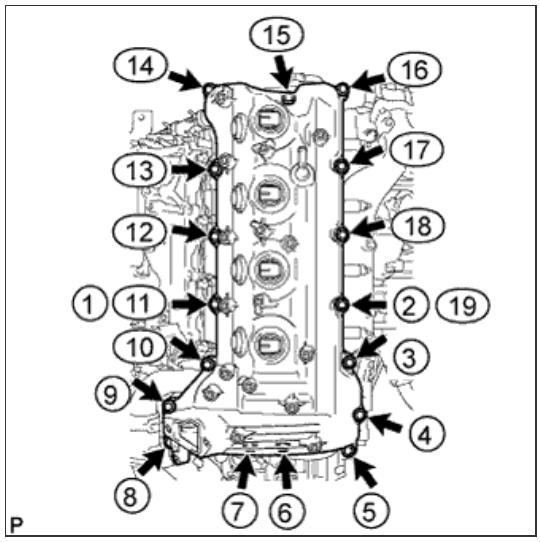
Remove any oil from the contact surface.

c. Temporarily install the cylinder head cover with the 17 olts. Tighten the 17 olts in the order shown in the illustration.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

HINT:

After tightening the olts, check that the olts at step 11 and 19 are tightened to the specified tor ue.



4 . INSTALL NOZZLE HOLDER SEAL LH

a. Press 4 new holder seals into the cylinder head cover L .

50. INSTALL OIL SEPARATOR ASSEMBLY

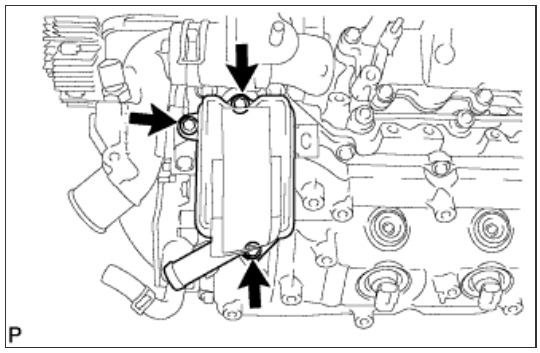
a. ntall a new gasket to the oil separator.

NOTICE:

Remove any oil from the contact surface.

b. ntall the oil separator with the 3 olts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

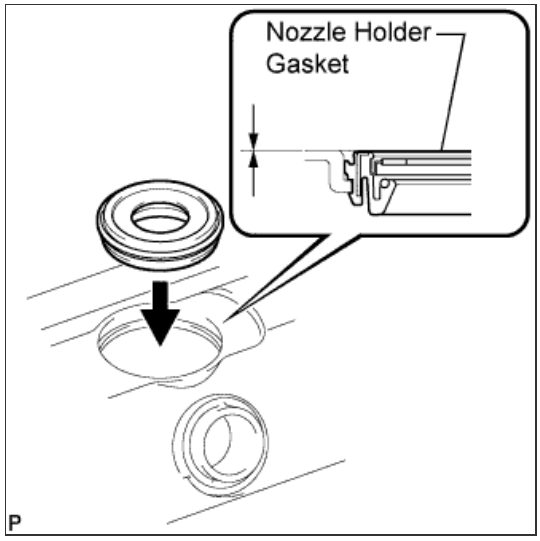


51. INSTALL NOZZLE HOLDER GASKET RH

a. Press 4 new nozzle holder gaskets into the cylinder head cover R .

NOTICE:

After installing the nozzle holder gasket, check that it dose not protrude from the cylinder head cover.



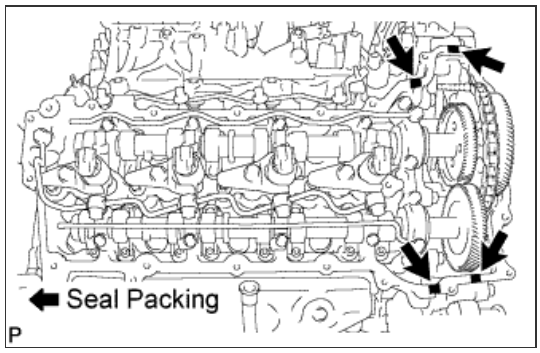
52. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY RH

a. Apply seal packing as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the cylinder head cover within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after the installation.**



b. ntall a new gasket to the cylinder head cover.

NOTICE:

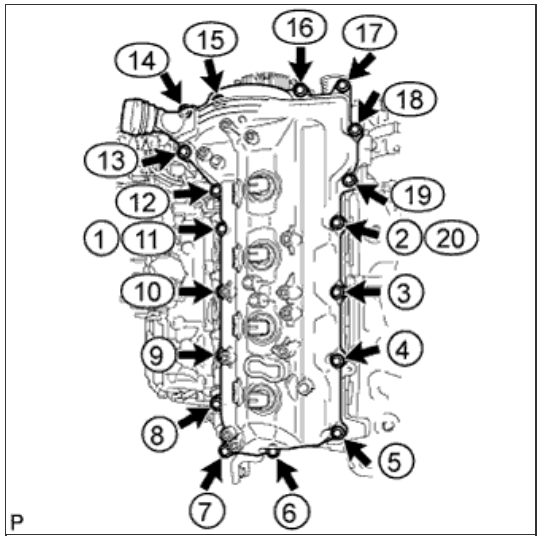
Remove any oil from the contact surface.

c. Temporarily install the cylinder head cover with the 18 olts. Tighten the 18 olts in the order shown in the illustration.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

HINT:

After tightening the olts, check that the olts at step 11 and 20 are tightened to the specified tor ue.



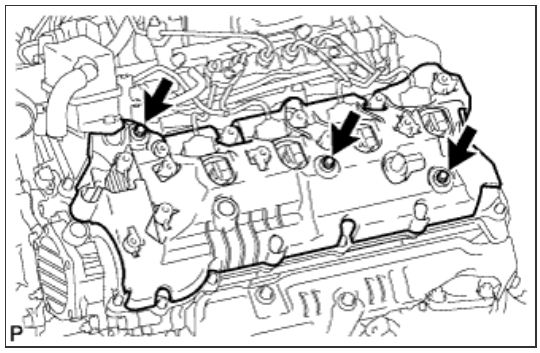
53. INSTALL NOZZLE HOLDER SEAL RH

a. Press 4 new holder seals into the cylinder head cover R .

54. INSTALL CYLINDER HEAD COVER SILENCER LH (w/ Intercooler)

a. ntall the cylinder head cover silencer with the 3 olts.

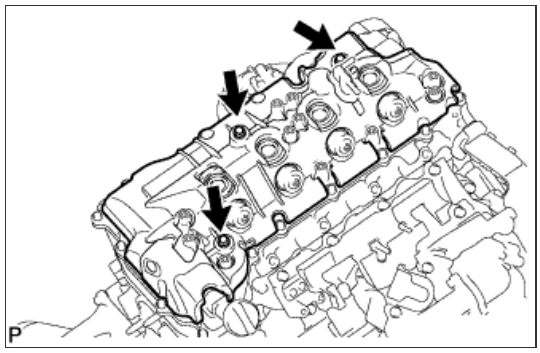
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



55. INSTALL CYLINDER HEAD COVER SILENCER RH (w/ Intercooler)

a. ntall the cylinder head cover silencer with the 3 olts.

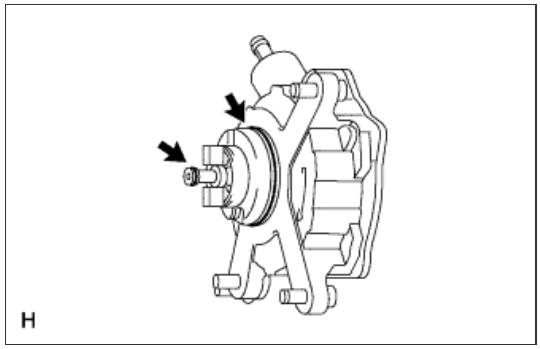
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



56. INSTALL VACUUM PUMP ASSEMBLY (w/ Intercooler)

a. Apply engine oil to 2 new O rings.

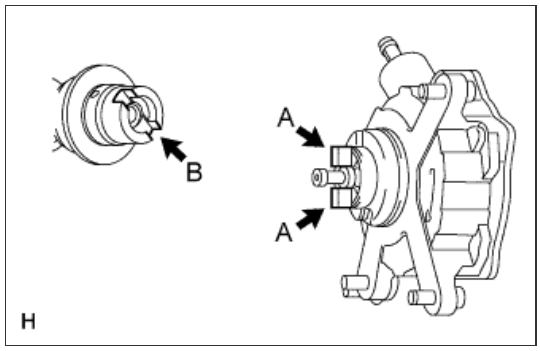
b. ntall the 2 O rings to the vacuum pump.



c. ntall the vacuum pump so that the coupling teeth of the vacuum pump (la eled A) and the groove of the camshaft (la eled B) are aligned.

NOTICE:

Be careful not to damage the O ring.

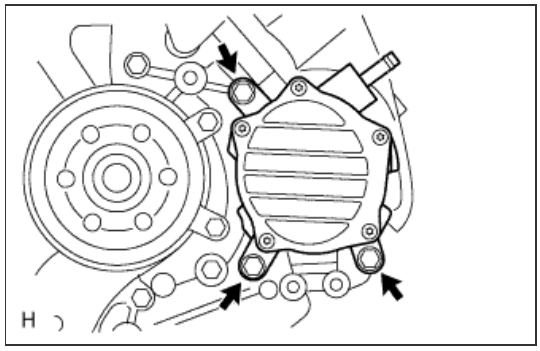


d. ntall the vacuum pump with the 3 olts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

NOTICE:

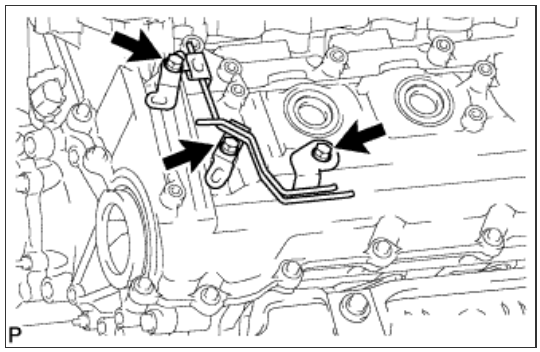
Confirm that the vacuum pump is not at an angle, and that there is no clearance etween the fitting surfaces.



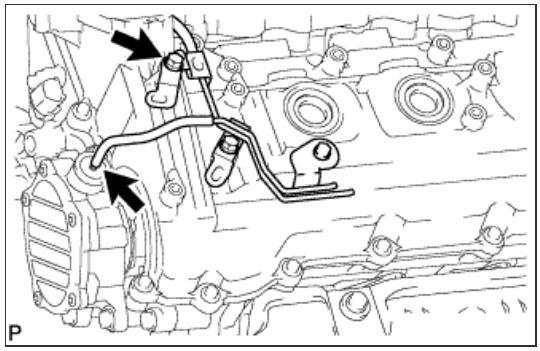
57. INSTALL NO. 1 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY

a. ntall the vacuum transmitting pipe with the 3 olts.

Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }



b. w/ tercooler:
Connect the 2 vacuum hoses.

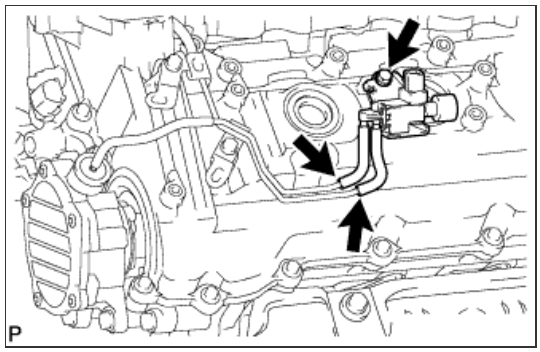


58. INSTALL NO. 1 VACUUM SWITCHING VALVE ASSEMBLY (w/ Intercooler)

a. ntall vacuum switching valve with the olt.

Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }

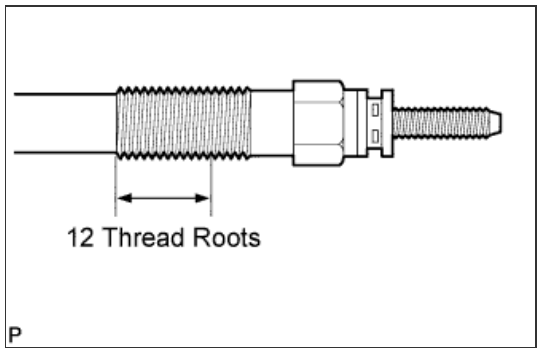
b. Connect the 2 vacuum hoses.



59. INSTALL GLOW PLUG ASSEMBLY

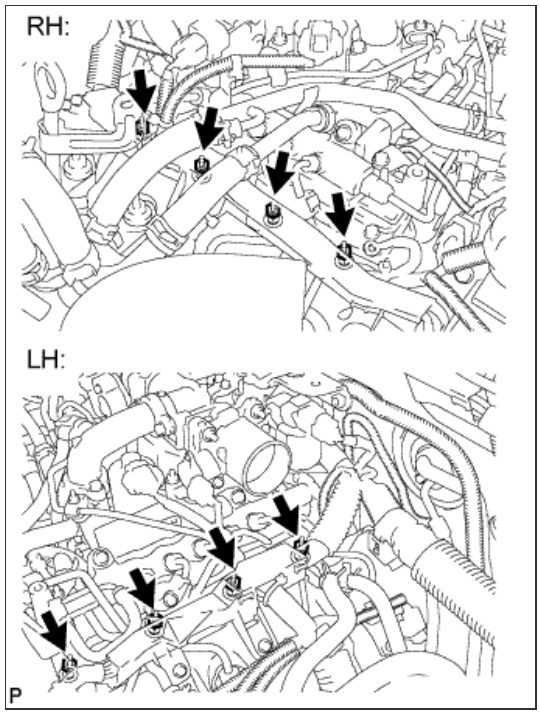
a. Apply adhesive to 3 or more thread roots in the area shown in the illustration.

Adhesive:
Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent



b. Using a 10 mm deep socket wrench, install the 8 glow plugs.

Torque:
12 N*m{ 125 kgf*cm , 9 ft.*lbf }



60. INSTALL NO. 1 GLOW PLUG CONNECTOR

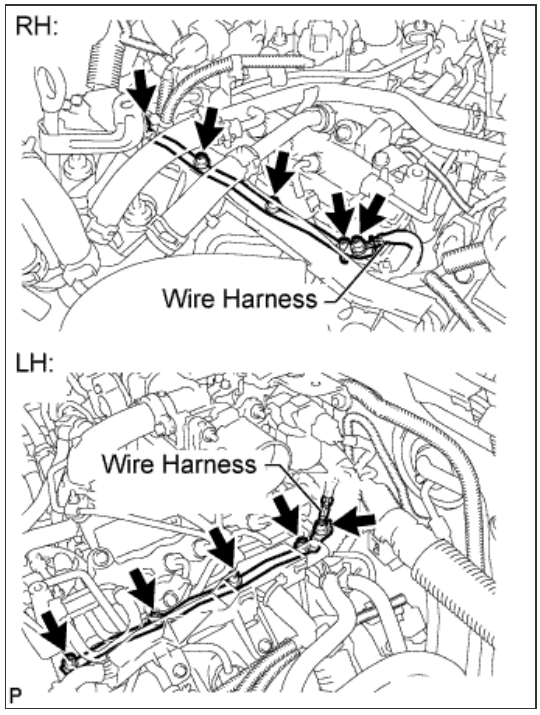
a. ntall the 2 glow plug connectors y uniformly tightening the 8 nuts.

Torque:
2.2 N*m{ 22 kgf*cm , 19 in.*lbf }

b. ntall the 8 screw grommets.

c. Connect the 2 wire harnesses with the 2 nuts and 2 screw grommets.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }



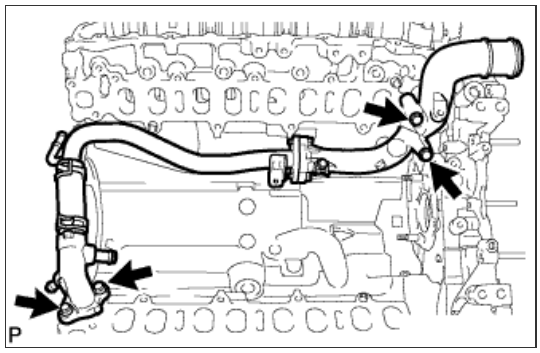
61. INSTALL WATER OUTLET PIPE

a. ntall 2 new gaskets and the water outlet pipe with the 4 olts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

HINT:

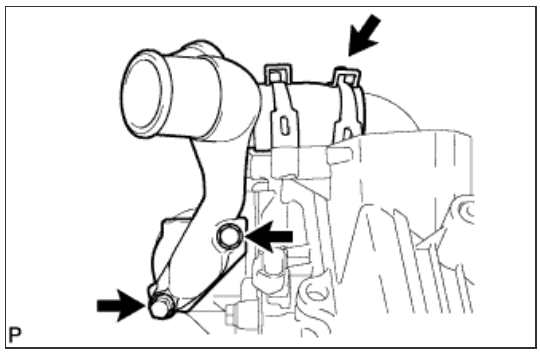
The gasket claw should face toward the water outlet pipe.



6 . INSTALL WATER OUTLET

a. ntall a new gasket and the water outlet with the 2 olts, and then connect the water outlet to the No. 2 water hose joint.

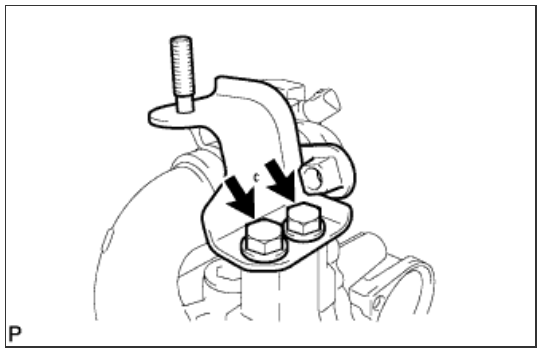
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



63. INSTALL NO. 2 INTERCOOLER SUPPORT BRACKET

a. ntall the No. 2 intercooler support racket with the 2 olts.

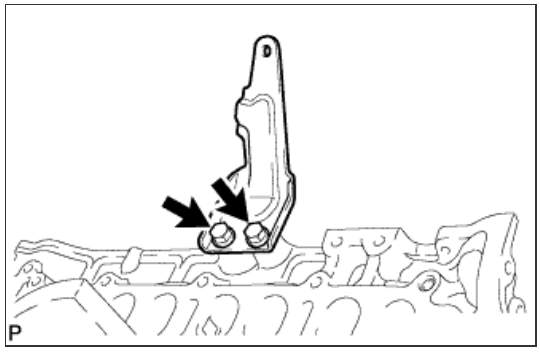
Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }



64. INSTALL CLUTCH FLEXIBLE HOSE BRACKET (for Manual Transmission)

a. ntall the clutch flexi d hose racket with the 2 olts.

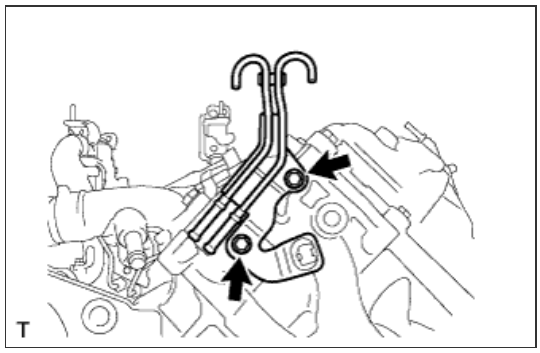
Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }



65. INSTALL STARTER HOSE BRACKET

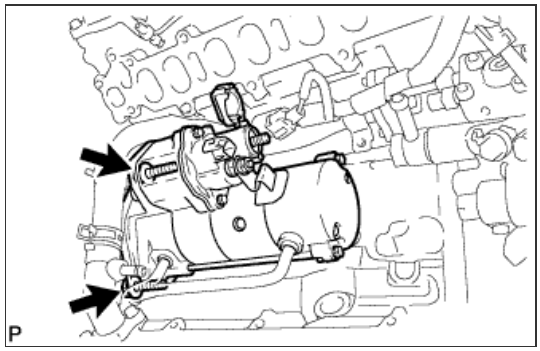
a. ntall the starter hose racket with the 2 olts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



66. INSTALL STARTER ASSEMBLY

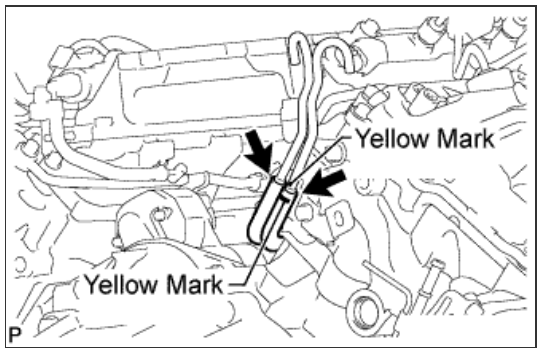
a. ntall the starter with the 2 olts.



b. Connect the 2 hoses to the starter hose racket.

HINT:

Align the paint marks of the hose and racket.

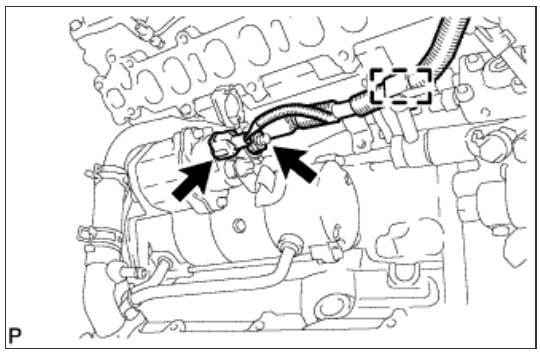


c. ntall the No. 2 engine wire to the starter with the nut.

Torque:
80 N*m{ 816 kgf*cm , 59 ft.*lbf }

d. Connect the connector to the starter.

e. Attach the wire harness clamp.



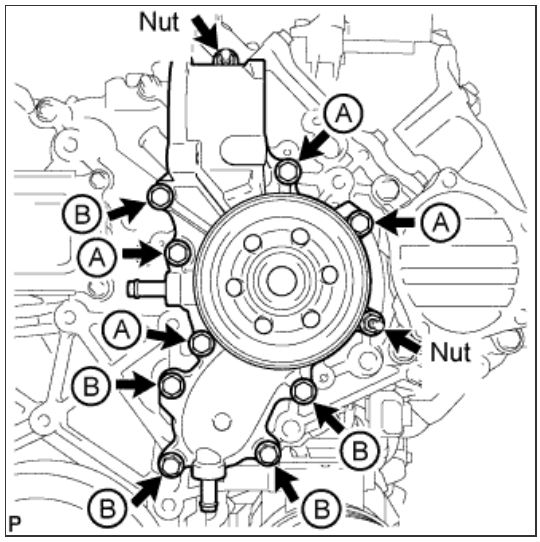
67. INSTALL WATER PUMP ASSEMBLY

a. Temporarily install a new gasket and the water pump with the 9 olts and 2 nuts.

Bolt Length

tem	Length

Bolt A	30 mm (1.18 in.)
Bolt B	80 mm (3.15 in.)

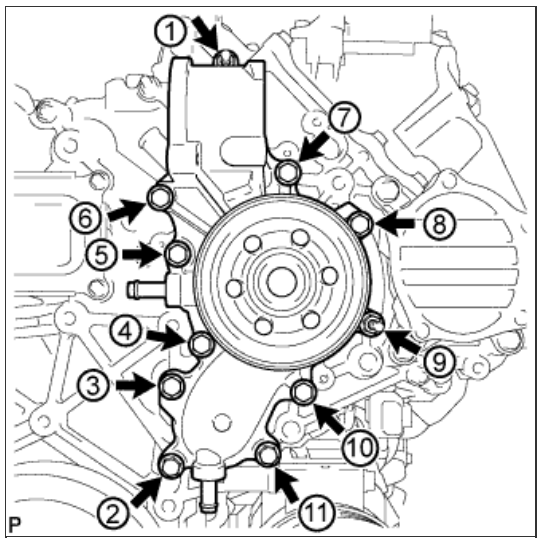


b. Uniformly tighten the 9 olts and 2 nuts of the water pump in the order shown in the illustration.

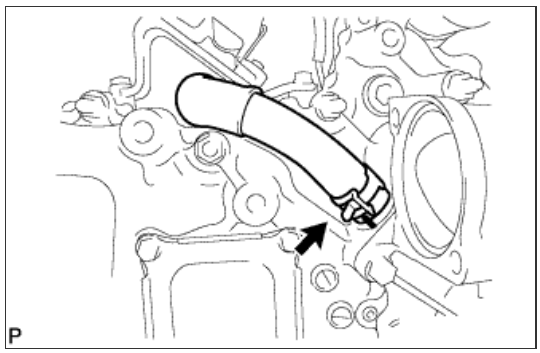
Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }

NOTICE:

After installing all of the olts and nuts, check that all of the olts and nuts are tightened to the tor ue specification.



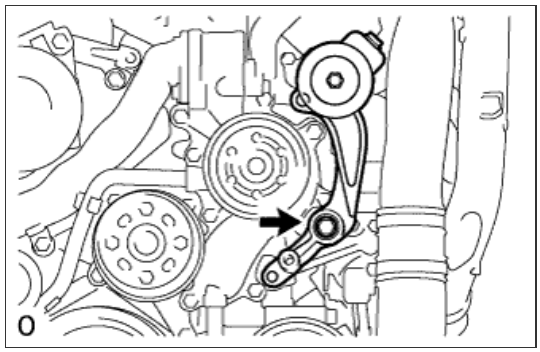
68. CONNECT INLET WATER HOSE



69. INSTALL NO. 2 IDLER PULLEY BRACKET (w/ Viscous Heater)

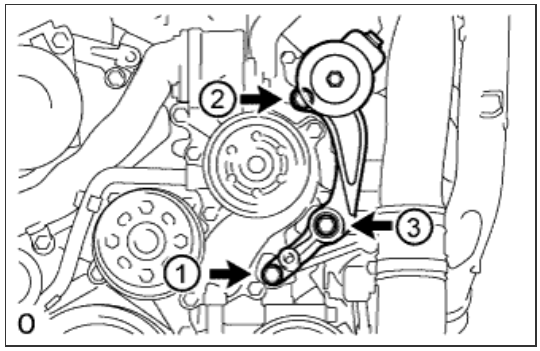
a. Temporarily install the No. 2 idler pulley racket with the olt.

b. Temporarily install the 2 olts to the No. 2 idler pulley racket olt hole.



c. Uniformly tighten the 3 olts of the No. 2 idler pulley racket in the order shown in the illustration.

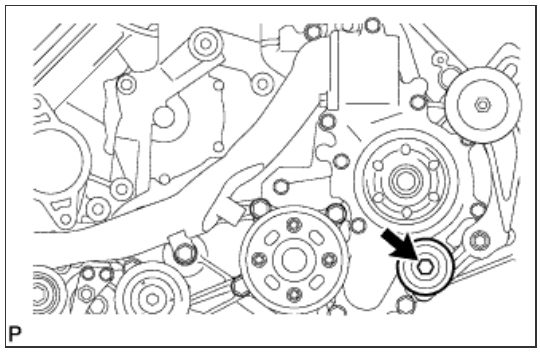
Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }



70. INSTALL NO. 2 IDLER PULLEY (w/ Viscous Heater)

a. ntall the collar, No. 2 idler pulley and cover with the olt.

Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }



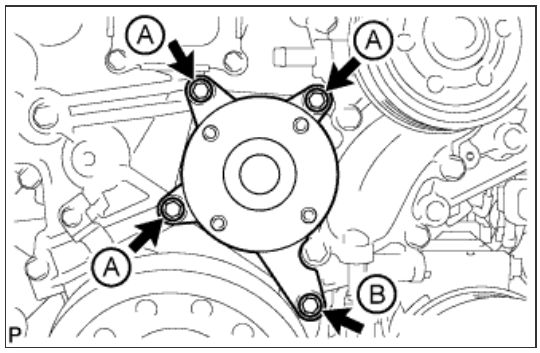
71. INSTALL FAN BRACKET SUB-ASSEMBLY

a. ntall the fan racket with the 4 olts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

Bolt Length

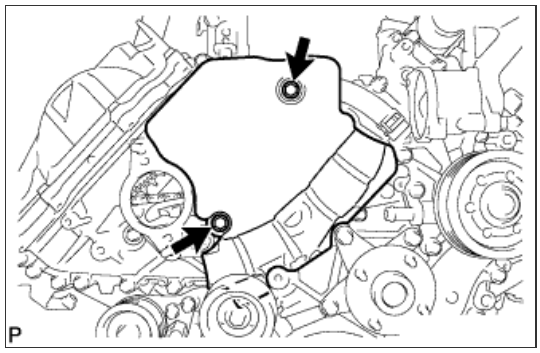
tem	Length
Bolt A	30 mm (1.18 in.)
Bolt B	80 mm (3.15 in.)



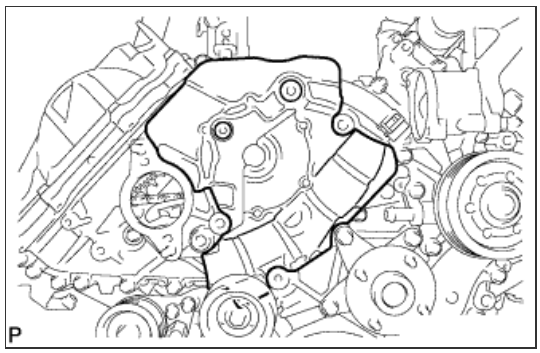
72. INSTALL TIMING GEAR COVER INSULATOR (w/ Intercooler)

a. w/o iscous eater:
ntall the timing gear cover insulator with the 2 olts.

Torque:
1 N*m{ 214 kgf*cm , 15 ft.*lbf }



b. w/ iscous eater:
ntall the timing gear cover insulator.



73. INSTALL THERMOSTAT

a. ntall a new gasket to the thermostat.

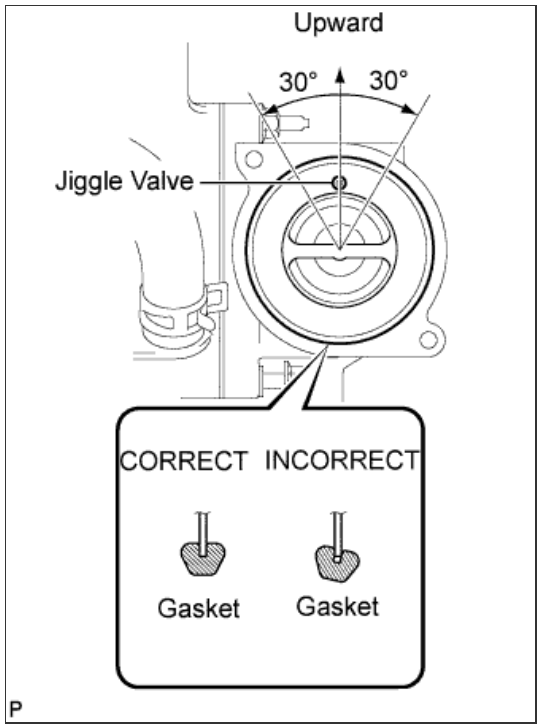
NOTICE:

When installing the gasket to the thermostat, e careful not to deform the gasket. Make sure that the groove of the gasket is properly installed onto the thermostat, as shown in the illustration.

b. nert the thermostat into the water pump with the jiggle valve facing straight upward.

HINT:

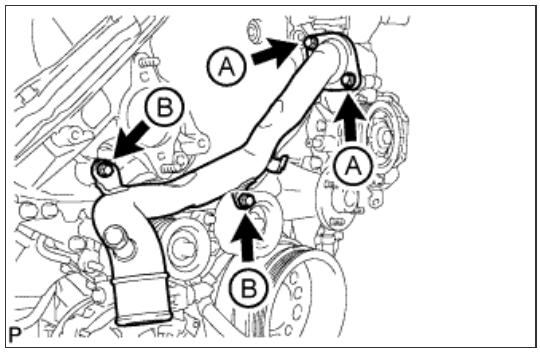
The jiggle valve may e set within 30° of either side of the prescri ed position.



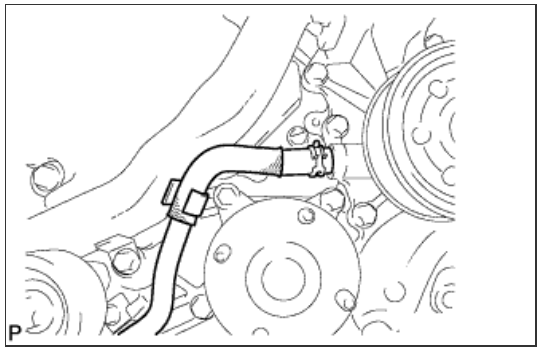
74. INSTALL WATER INLET

a. ntall the water inlet with the 4 olts.

Torque:
for bolt A:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for bolt B:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }



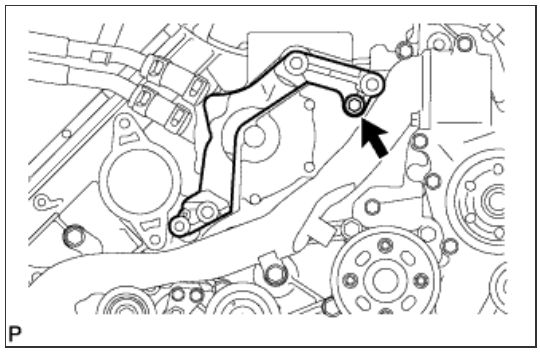
b. Connect the No. 2 oil cooler hose to the clamp and water pump.



75. INSTALL NO. 1 IDLER PULLEY BRACKET (w/ Viscous Heater)

a. ntall the No. 1 idler pulley racket with the olt.

Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }



76. INSTALL VISCOUS HEATER ASSEMBLY WITH MAGNET CLUTCH (w/ Viscous Heater)

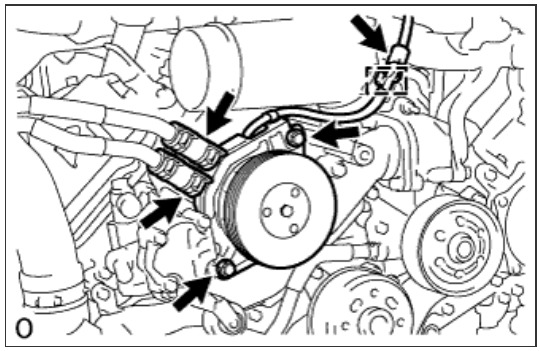
a. ntall the heater assem y with the 2 olts.

Torque:
48.5 N*m{ 495 kgf*cm , 36 ft.*lbf }

b. Connect the 2 heater hoses.

c. Using pliers, grip the claws of the clips and slide the 2 clips.

d. Connect the connector and attach the clamp.



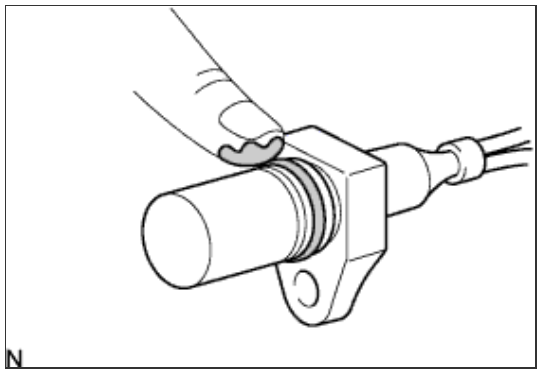
77. INSTALL CRANKSHAFT POSITION SENSOR

a. Apply a light coat of engine oil to the O ring.

NOTICE:

When reusing the sensor, inspect the O ring.

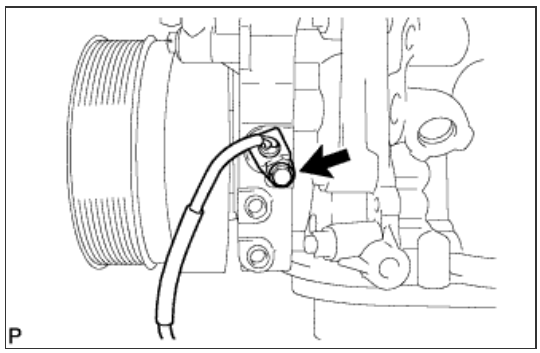
f the O ring has scratches of cuts, replace the crankshaft position sensor.



b. ntall the sensor with the olt.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the wire harness to the clamp.



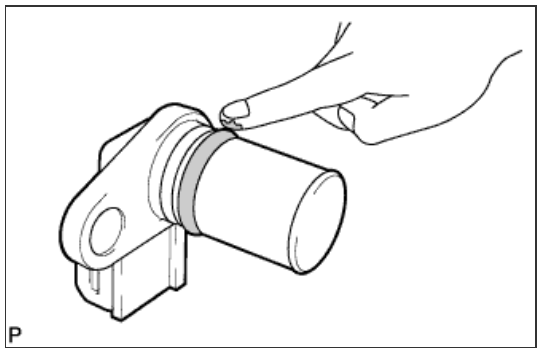
78. INSTALL CAMSHAFT POSITION SENSOR

a. Apply a light coat of engine oil to the O ring.

NOTICE:

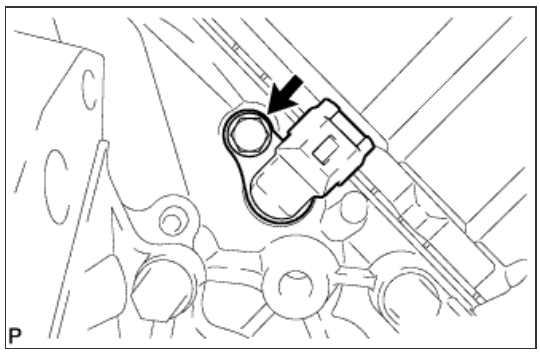
When reusing the sensor, inspect the O ring.

f the O ring has scratches of cuts, replace the crankshaft position sensor.



b. ntall the sensor with the olt.

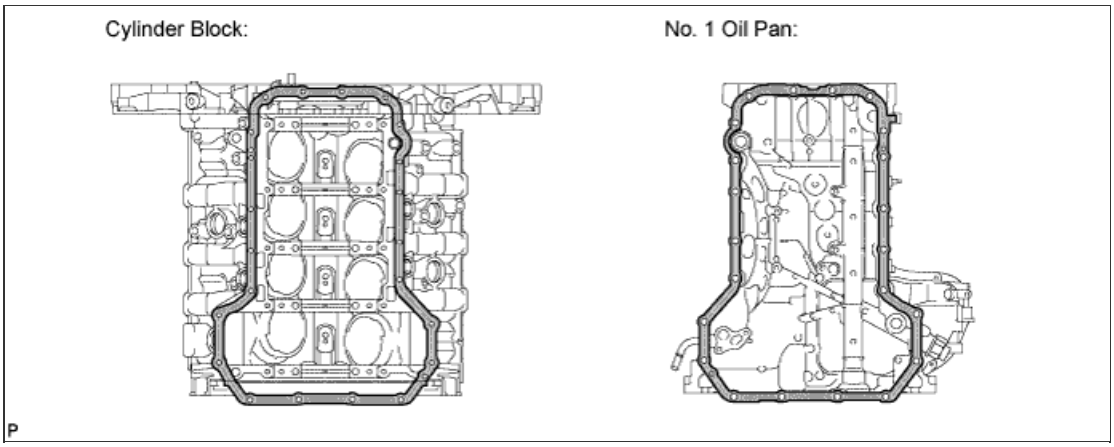
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



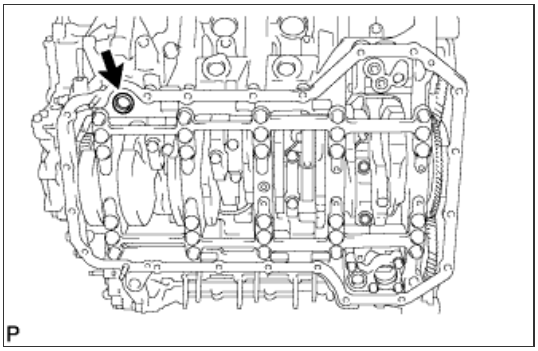
79. INSTALL NO. 1 OIL PAN SUB-ASSEMBLY

NOTICE:

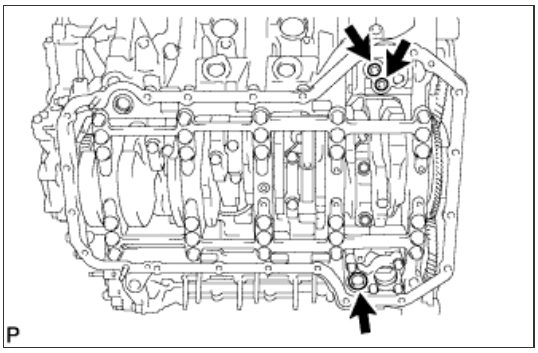
When the contact surfaces shown elow are wet, wipe them with an oil free cloth efore applying seal packing.



a. ntall the cylinder dck oil hole gasket.



b. Apply a light coat of engine oil to 3 new O rings and set the 3 O rings to the oil regulator and scavenging pump.



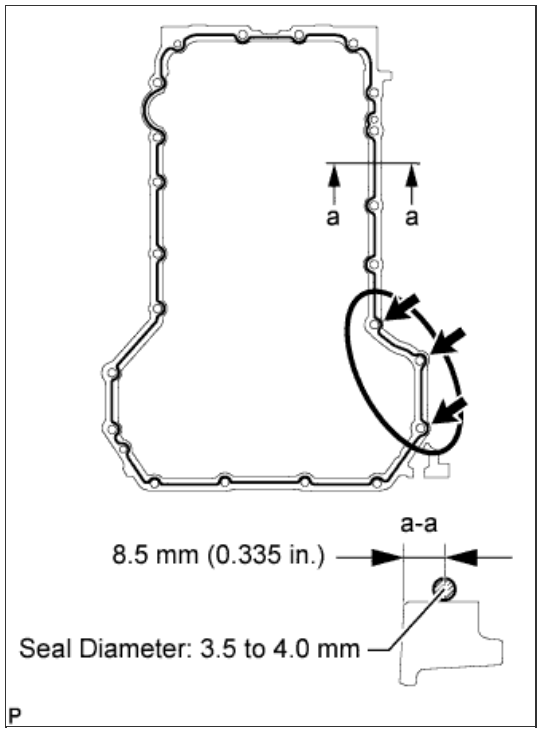
c. Apply seal packing to the No. 1 oil pan as shown in the illustration.

Standard seal diameter:
3.5 to 4.0 mm (0.134 to 0.157 in.)

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

- **For the 3 bolt holes labeled with arrows, apply the seal packing on the outer edges. For the other bolt holes, apply the seal packing on the inner edges.**
- **Make sure to apply a continuous bead of seal packing as shown in the illustration. If the bead breaks, overlap 3 mm (0.118 in.) of seal packing and continue the bead.**
- **Install the No. 1 oil pan within 3 minutes and tighten the bolts and nuts within 15 minutes after applying seal packing.**
- **Remove any oil and old seal packing from the contact surface.**
- **Do not start the engine for at least 2 hours after installation.**



d. ntall the No. 1 oil pan and oil reflector plate with the 20 olts and 2 nuts.

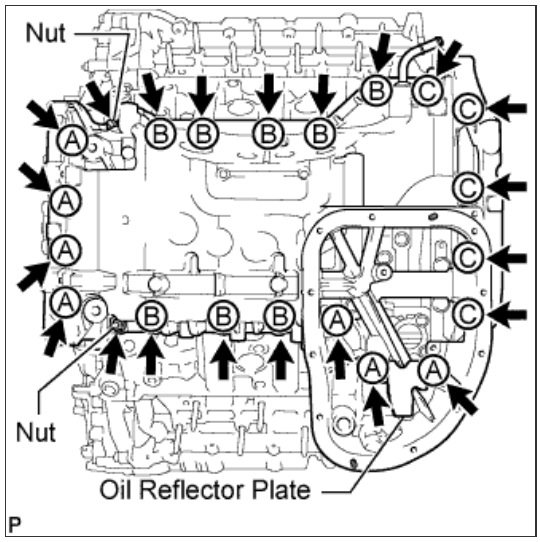
NOTICE:

f the oil reflector plate is deformed, replace it.

Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }

Bolt Length

tem	uantity	Length
Bolt A	7	70 mm (2.76 in.)
Bolt B	8	20 mm (0.787 in.)
Bolt C	5	30 mm (1.18 in.)

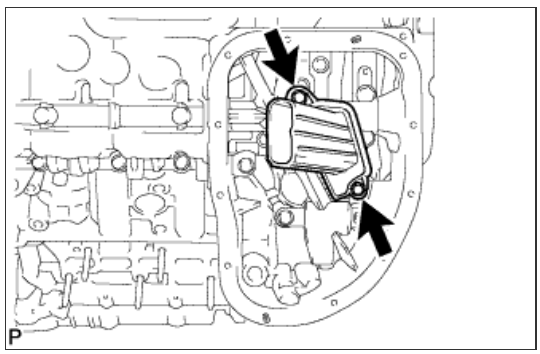


80. INSTALL OIL STRAINER SUB-ASSEMBLY

a. Apply a light coat of engine oil to a new O ring, and install it to the oil strainer.

b. ntall the oil strainer with the 2 olts.

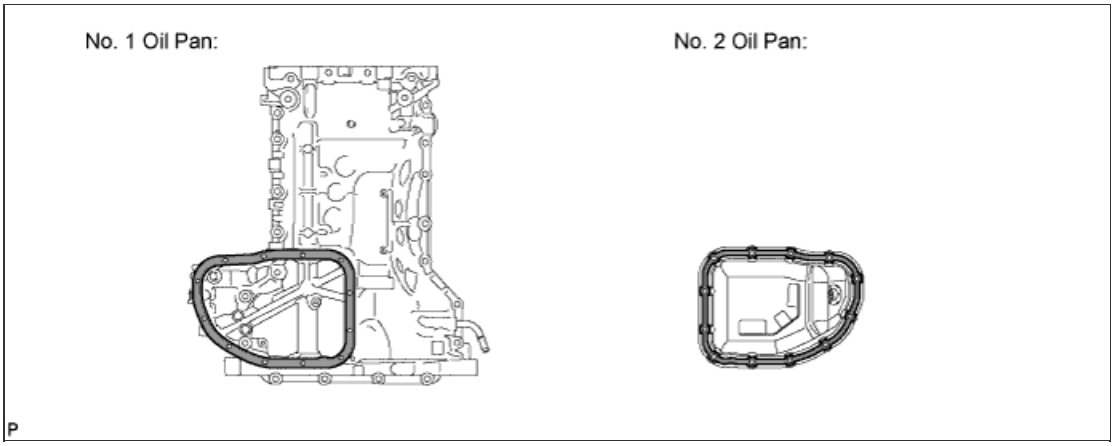
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



81. INSTALL NO. 2 OIL PAN SUB-ASSEMBLY

NOTICE:

When the contact surfaces shown elow are wet, wipe them with an oil free cloth efore applying seal packing.



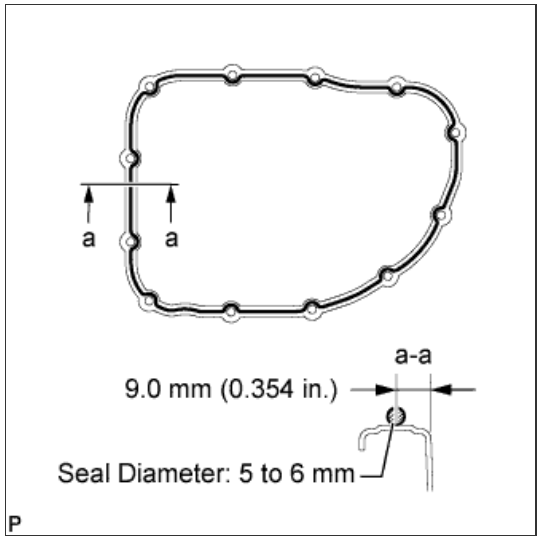
a. Apply seal packing to the No. 2 oil pan as shown in the illustration.

Standard seal diameter:
5 to 6 mm (0.197 to 0.236 in.)

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

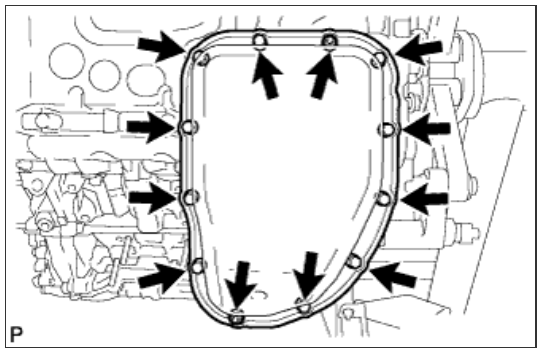
NOTICE:

- **For the bolt and pin holes, make sure to apply seal packing to the inner sides.**
- **Make sure to apply a continuous bead of seal packing as shown in the illustration. If the bead breaks, overlap 3 mm (0.118 in.) of seal packing and continue the bead.**
- **Install the No. 2 oil pan within 3 minutes and tighten the bolts and nuts within 15 minutes after applying seal packing.**
- **Remove any oil from the contact surface.**
- **Do not start the engine for at least 2 hours after installation.**



b. ntall the No. 2 oil pan with the 10 olts and 2 nuts.

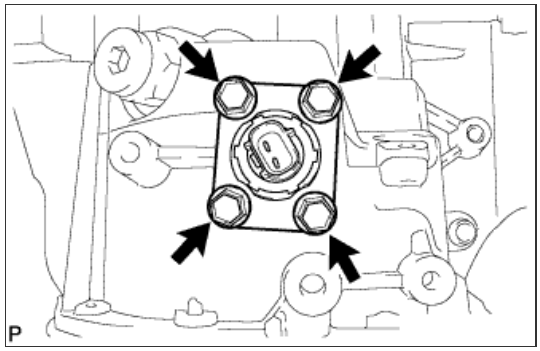
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



82. INSTALL ENGINE OIL LEVEL SENSOR

a. ntall a new gasket and the engine oil level sensor with the 4 olts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



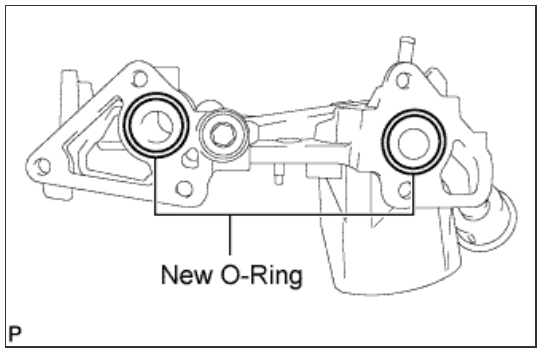
3. INSTALL OIL FILTER BRACKET SUB-ASSEMBLY

a. Apply a light coat of engine oil to 2 new O rings, and set them to the oil filter racket.

b. ntall the oil filter racket with the 3 olts and 2 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Connect the 2 wire harness clamps.



84. INSTALL OIL FILTER ELEMENT

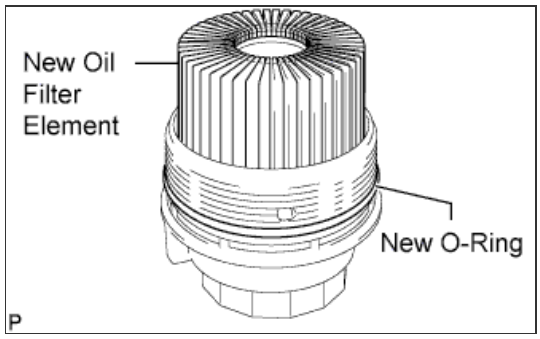
a. Clean the inside of the oil filter cap, its threads and its O ring groove.

b. Apply a small amount of engine oil to a new O ring and install it to the oil filter cap.

c. Set a new oil filter element in the oil filter cap.

d. Remove any dirt or foreign matter from the installation surface of the engine.

e. Apply a small amount of engine oil to the O ring again and temporarily install the oil filter cap y hand.



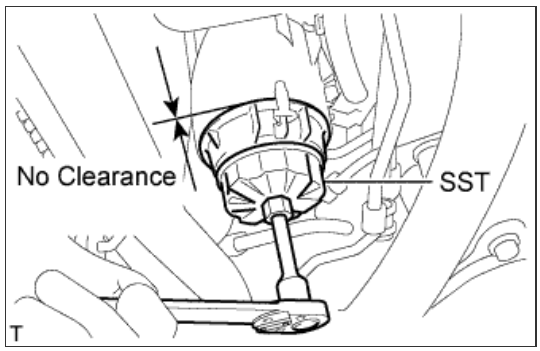
f. Using SST, tighten the oil filter cap.

SST
09228-06501

Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }

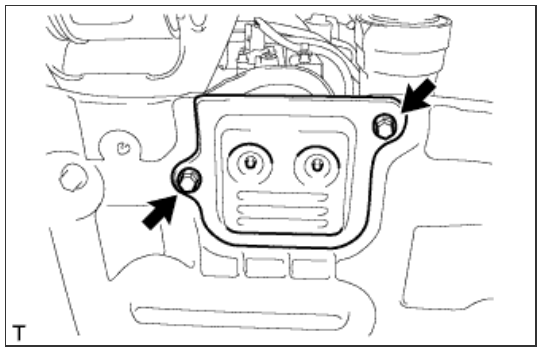
NOTICE:

- **Make sure that the oil filter is installed securely as shown in the illustration.**
- **Be careful that the O-ring does not get caught between any surrounding parts.**



g. ntall the No. 2 engine under cover seal to the No. 2 engine under cover with the 2 olts.

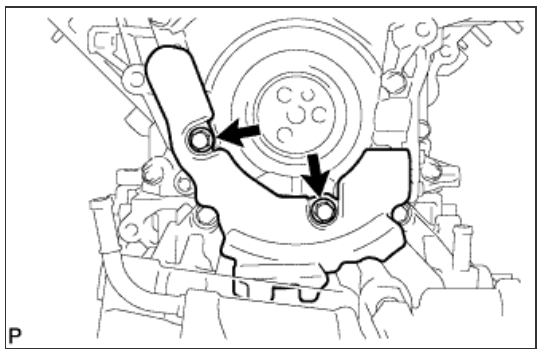
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



85. INSTALL TIMING GEAR COVER SPACER (w/ Intercooler)

a. ntall the timing gear cover spacer with the 2 olts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



86. INSTALL CRANKSHAFT PULLEY

NOTICE:

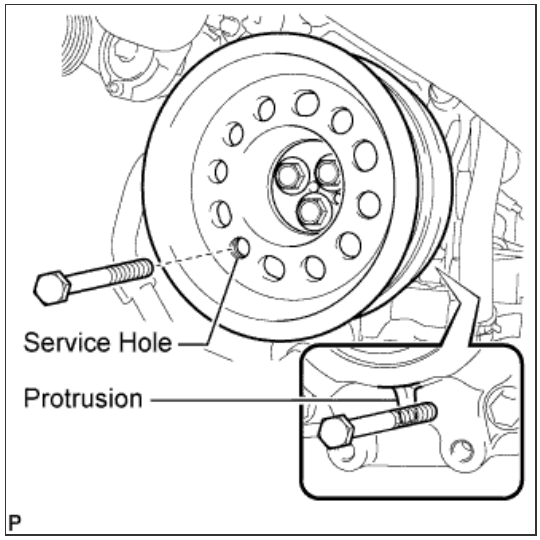
This procedure is intended for removal/installation of the crankshaft pulley only. Do not use this procedure for removal/installation of the flywheel or the drive plate and ring gear.

a. Align the crankshaft pulley and the crankshaft knock pin, and temporarily install the crankshaft pulley with the 3 olts.

b. ntall the 2 olts to the olt holes of the crankshaft rear side.

c. Using a ar, turn the crankshaft until the crankshaft pulley service hole is a little to the right of ottom dead center.

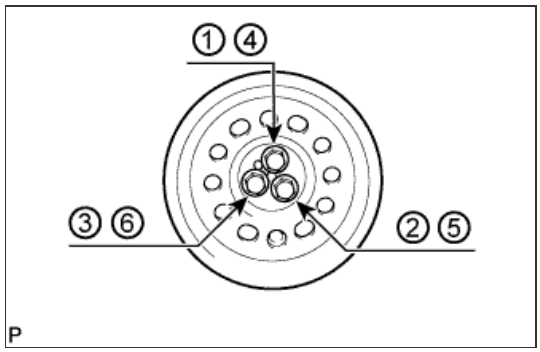
d. ntall a 14 mm x 1.5 pitch service olt with a length of 70 mm or more to the crankshaft pulley service hole, and hold the crankshaft using the timing chain cover protrusion.



e. Uniformly tighten the 3 olts in 2 passes in the order shown in the illustration.

Torque:
115 N*m{ 1168 kgf*cm , 84 ft.*lbf }

f. Remove the service olt.

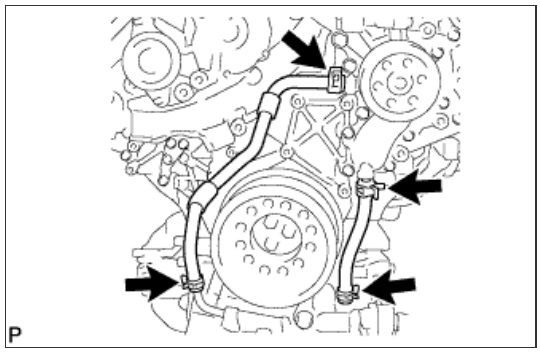


87. CONNECT NO. 2 OIL COOLER HOSE

a. Align the white paint marks on the oil cooler hose and oil filter racket and connect the hose. Then connect the other side to the water pump and attach the oil cooler hose to the clamp.

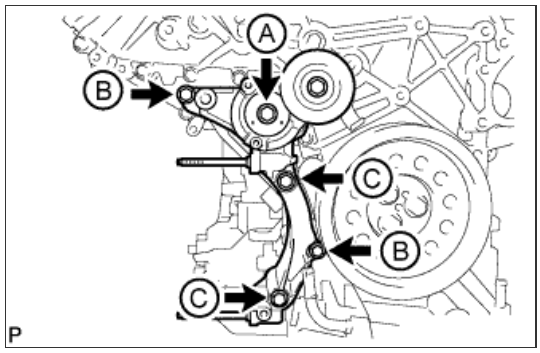
NOTICE:

Make sure to maintain a space etween the oil cooler hose and crankshaft pulley, and the oil cooler hose and ri ed elt idler pulley.



. CONNECT NO. 1 OIL COOLER HOSE

89. INSTALL V-RIBBED BELT TENSIONER ASSEMBLY



a. ntall the ri ed elt tensioner with the 5 olts.

Torque:
for bolt A and C:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }
for bolt B:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

Bolt Length

tem	uantity	Length
Bolt A	1	116 mm (4.57 in.)
Bolt B	2	40 mm (1.58 in.)
Bolt C	2	95 mm (3.74 in.)

b. ntall the No. 1 idler pulley with the olt.

Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }

c. ntall the ri ed elt tensioner racket with the 3 olts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

90. INSTALL STIFFENER INSULATOR RH (w/ Intercooler)

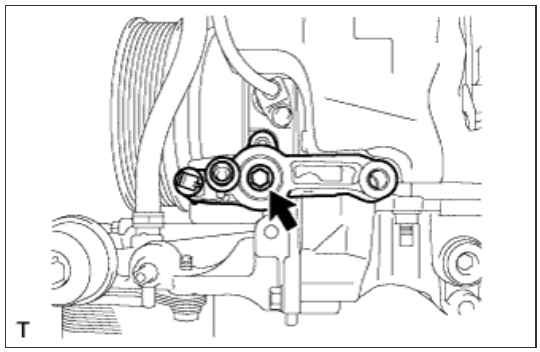
a. ntall the stiffener insulator R with the 2 olts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

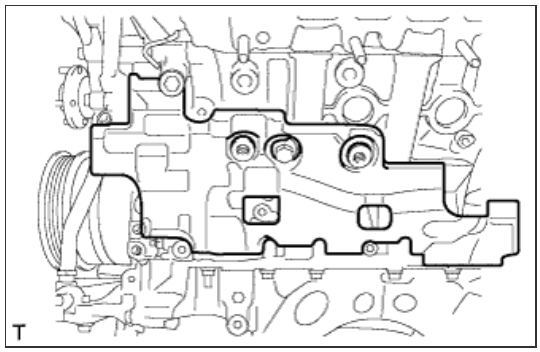
91. INSTALL COMPRESSOR BRACKET

a. ntall the compressor racket with the olt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



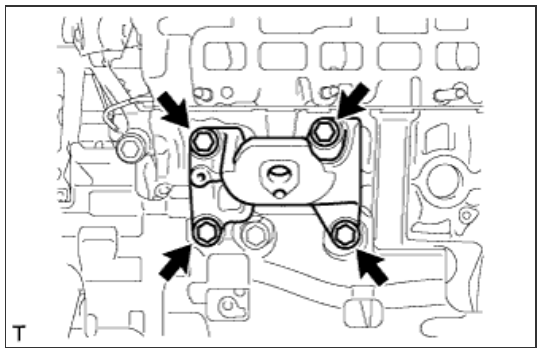
. INSTALL NO. 2 CYLINDER BLOCK INSULATOR



93. INSTALL ENGINE MOUNTING BRACKET LH

a. ntall the engine mounting racket L with the 4 olts.

Torque:
80 N*m{ 816 kgf*cm , 59 ft.*lbf }

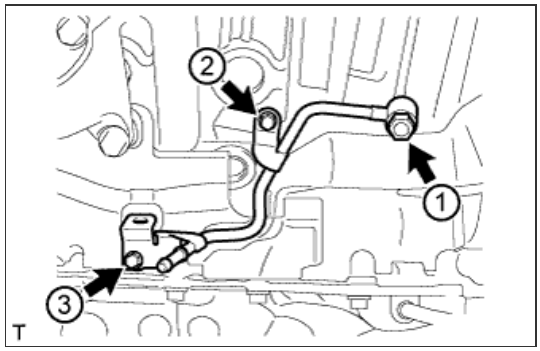


94. INSTALL NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY

a. Temporarily install a new gasket and No. 2 water y pass pipe with the union olt and 2 olts.

b. Tighten the union olt and 2 olts of the No. 2 water y pass pipe in the order shown in the illustration.

Torque:
for union bolt:
35 N*m{ 357 kgf*cm , 26 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

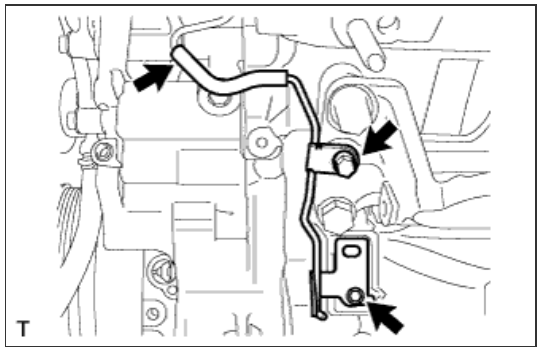


95. INSTALL NO. 3 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY

a. ntall the No. 3 vacuum transmitting pipe with the 2 olts.

Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }

b. w/ tercooler:
Connect the vacuum hose.

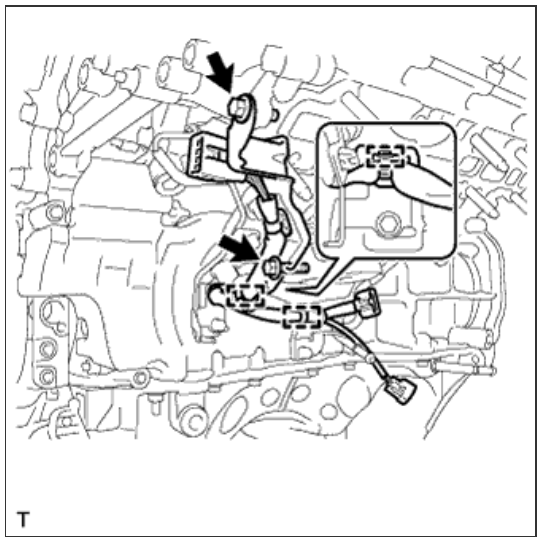


96. INSTALL TURBOCHARGER WIRE

a. ntall the tur ocharger wire with the 2 olts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

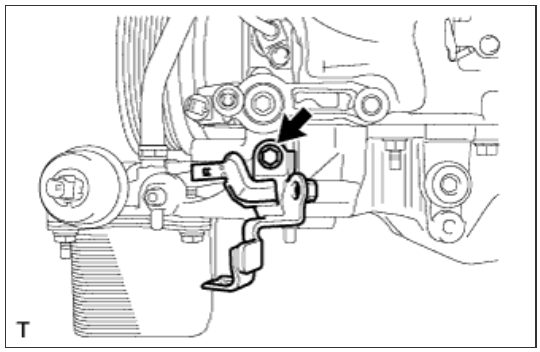
b. Attach the 3 wire harness clamps.



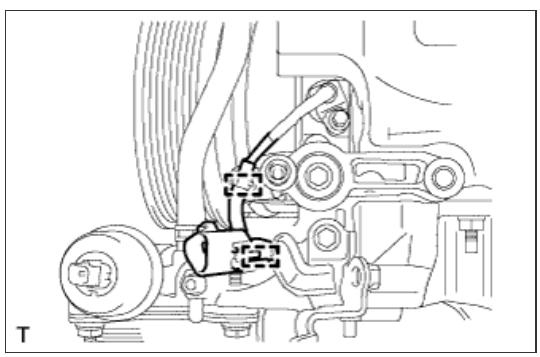
97. INSTALL NO. 2 INTAKE AIR CONNECTOR BRACKET

a. ntall the No. 2 intake air connector racket with the olt.

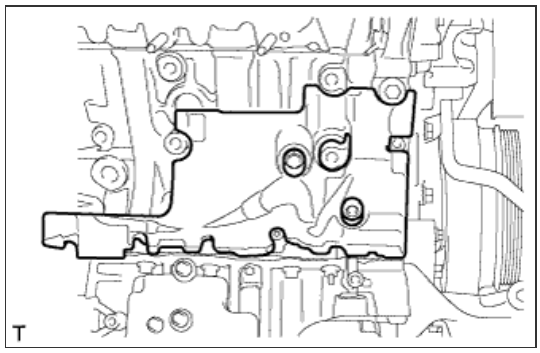
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



b. Attach the 2 wire clamps.



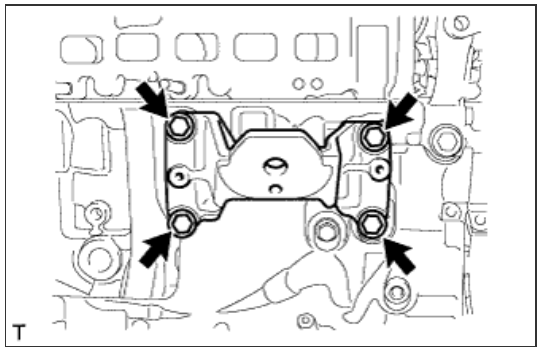
. INSTALL NO. 1 CYLINDER BLOCK INSULATOR



99. INSTALL ENGINE MOUNTING BRACKET RH

a. ntall the engine mounting racket R with the 4 olts.

Torque:
80 N*m{ 816 kgf*cm , 59 ft.*lbf }

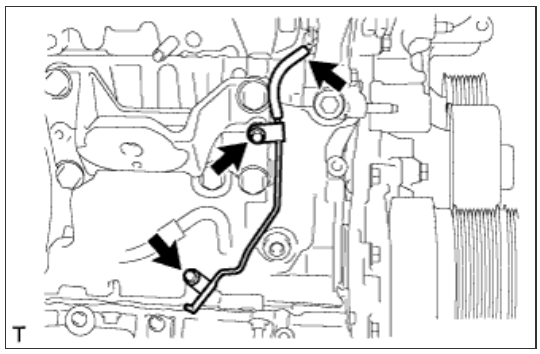


100. INSTALL NO. 4 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY (w/ Intercooler)

a. ntall the No. 4 vacuum transmitting pipe with the 2 olts.

Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }

b. Connect the vacuum hose.

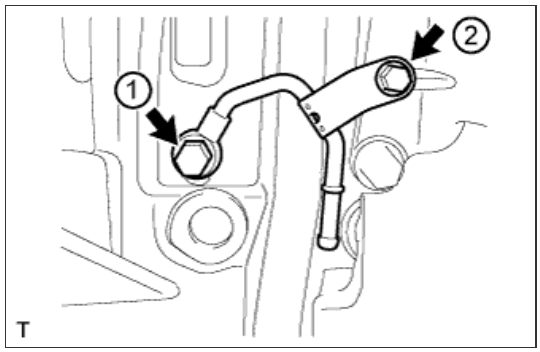


101. INSTALL NO. 1 WATER BY-PASS PIPE SUB-ASSEMBLY

a. Temporarily install a new gasket and the No. 1 water y pass pipe with the union olt and olt.

b. Tighten the union olt and olt of the No. 1 water y pass pipe in the order shown in the illustration.

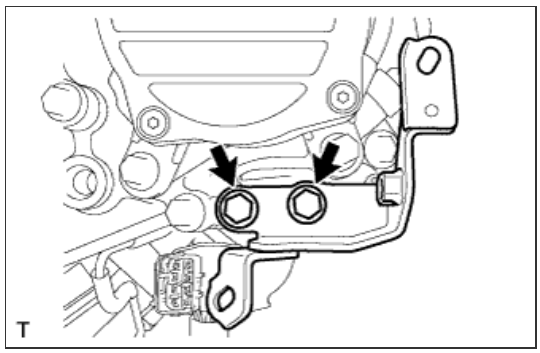
Torque:
for union bolt:
35 N*m{ 357 kgf*cm , 26 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



102. INSTALL AIR TUBE SUPPORT

a. ntall the air tu e support with the 2 olts.

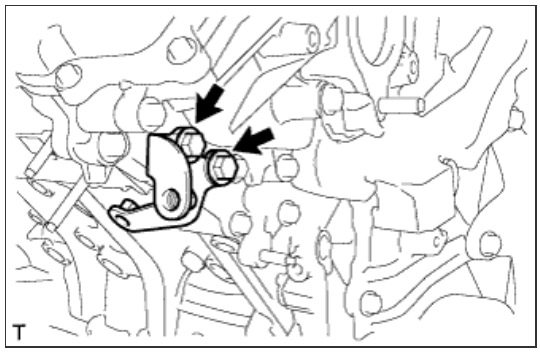
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



103. INSTALL NO. 1 INTAKE AIR CONNECTOR BRACKET

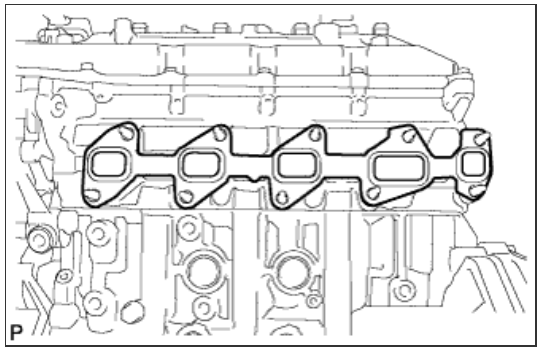
a. ntall the No. 1 intake air connector racket with the 2 olts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



104. INSTALL NO. 2 TURBOCHARGER SUB-ASSEMBLY WITH EXHAUST MANIFOLD LH

a. Set a new gasket to the cylinder head L .

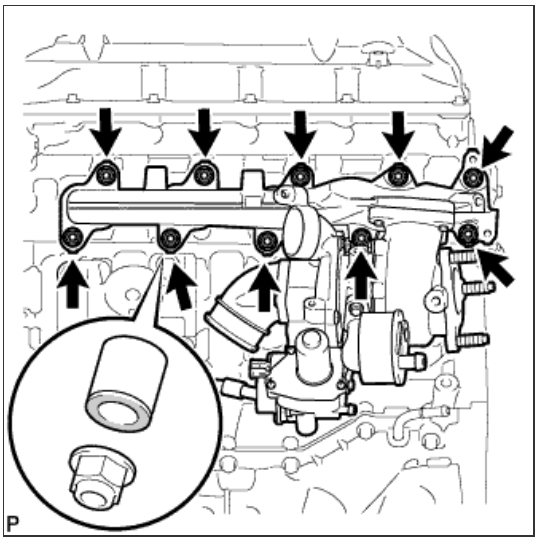


b. ntall the No. 2 tur ocharger with exhaust manifold L and 10 collars to the cylinder head L with 10 new nuts.

Torque:
36 N m{ 367 kgf*cm , 27 ft.*lbf }

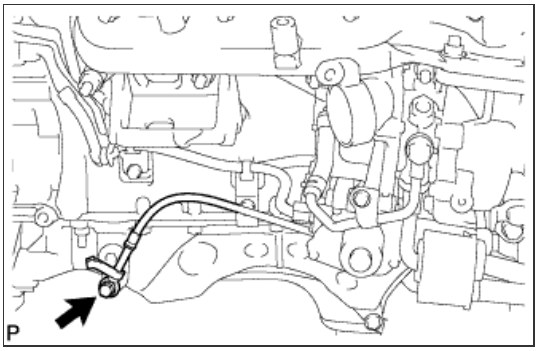
HINT:

ntall the collars with the colored side facing the nuts.

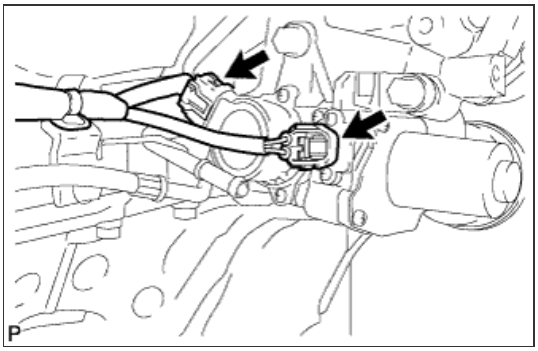


c. ntall a new gasket and the No. 2 inlet tur o oil pipe to the No. 1 oil pan with the union olt.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



d. Connect the 2 connectors to the tur ocharger.



105. INSTALL NO. 2 VENTILATION TUBE SUB-ASSEMBLY

a. Temporarily install a new gasket and the No. 2 ventilation tu e with the union olt and olt.

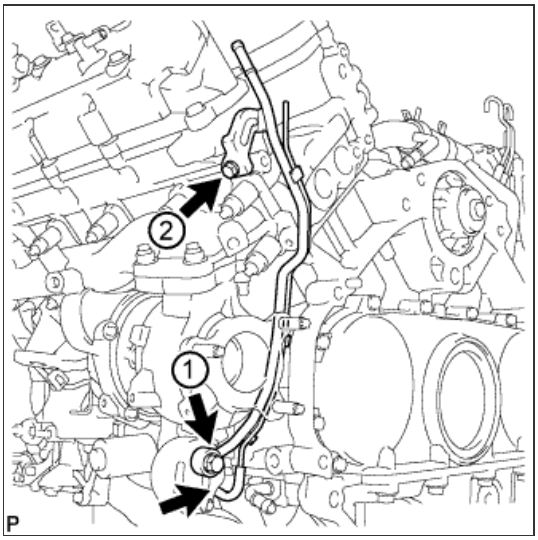
b. Tighten the union olt and olt in the order shown in the illustration.

Torque:
for union bolt:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

NOTICE:

Clean and remove any oil la eled 1shown in the illustration.

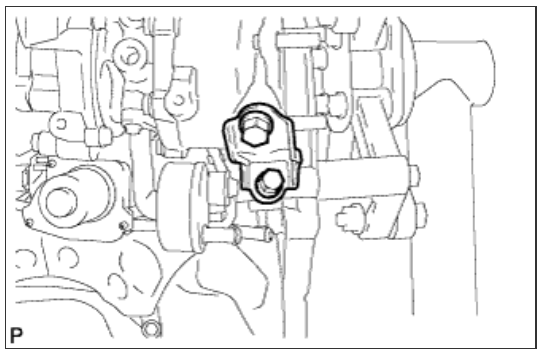
c. Connect the No. 2 vacuum transmitting hose.



106. INSTALL NO. 2 TURBOCHARGER STAY

a. ntall the No. 2 tur ocharger stay with the 2 olts.

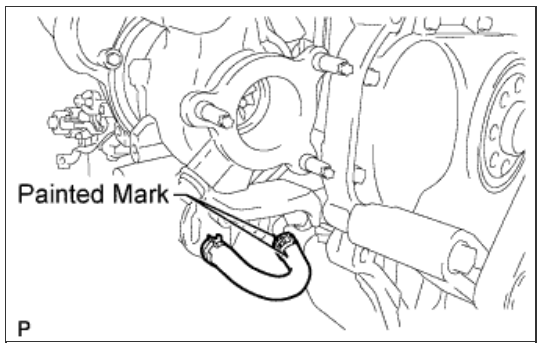
Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }



107. CONNECT NO. 2 OUTLET TURBO OIL HOSE

HINT:

Align the white paint marks on the oil hose and pipe, and connect the hose.



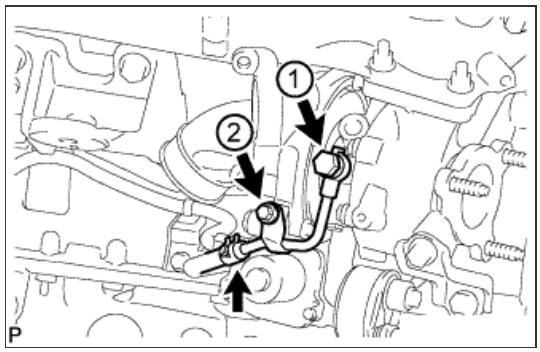
108. INSTALL NO. 2 TURBO WATER PIPE SUB-ASSEMBLY

a. Temporarily install a new gasket and the No. 2 tur o water pipe with the union olt and olt.

b. Tighten the union olt and olt in the order shown in the illustration.

Torque:
for union bolt:
35 N*m{ 357 kgf*cm , 26 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

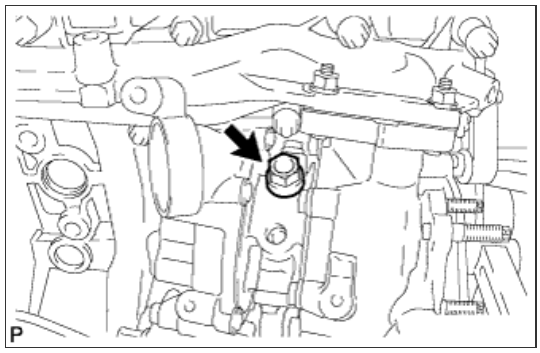
c. Connect the water hose to the pipe.



109. INSTALL FRONT WATER BY-PASS JOINT

a. ntall a new gasket and the front water y pass joint.

Torque:
50 N*m{ 510 kgf*cm , 37 ft.*lbf }

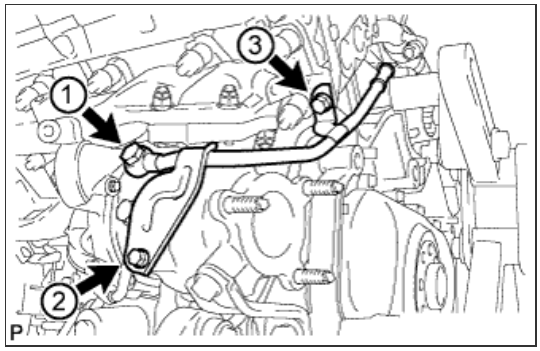


110. INSTALL NO. 3 TURBO WATER PIPE SUB-ASSEMBLY

a. Temporarily install a new gasket and the No. 3 tur o water pipe with the union olt and 2 olts.

b. Tighten the union olt and 2 olts in the order shown in the illustration.

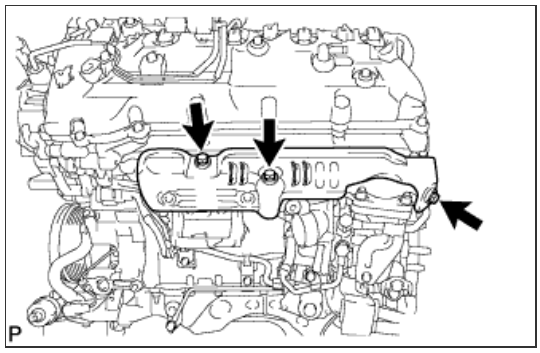
Torque:
for union bolt:
35 N*m{ 357 kgf*cm , 26 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



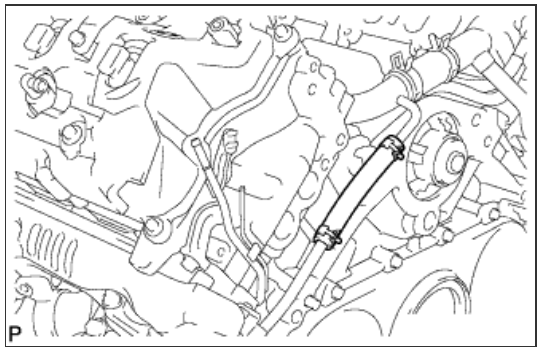
111. INSTALL NO. 2 EXHAUST MANIFOLD HEAT INSULATOR

a. ntall the No. 2 exhaust manifold heat insulator with the 3 olts.

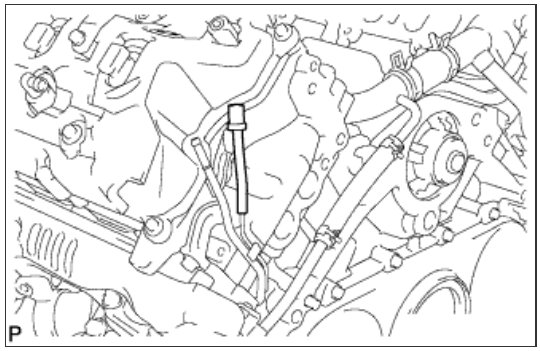
Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }



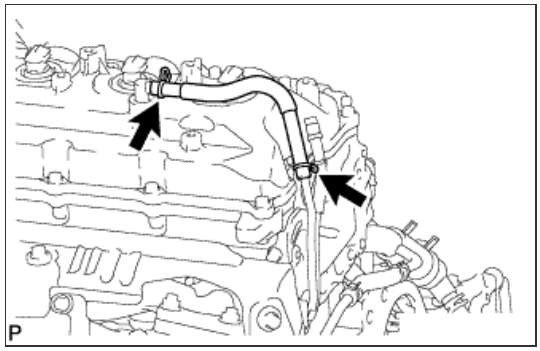
112. CONNECT NO. 2 TURBO WATER HOSE



113. CONNECT BREATHER PLUG LH

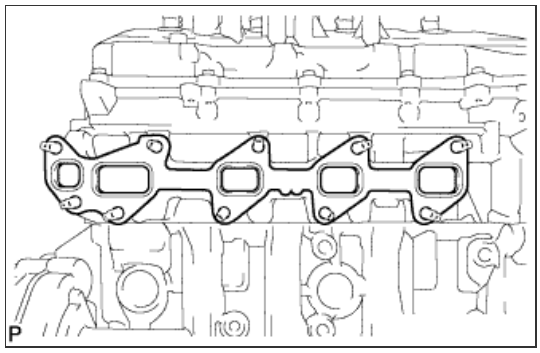


114. CONNECT NO. 3 VENTILATION HOSE



115. INSTALL NO. 1 TURBOCHARGER SUB-ASSEMBLY WITH EXHAUST MANIFOLD RH

a. Set a new gasket to the cylinder head R .

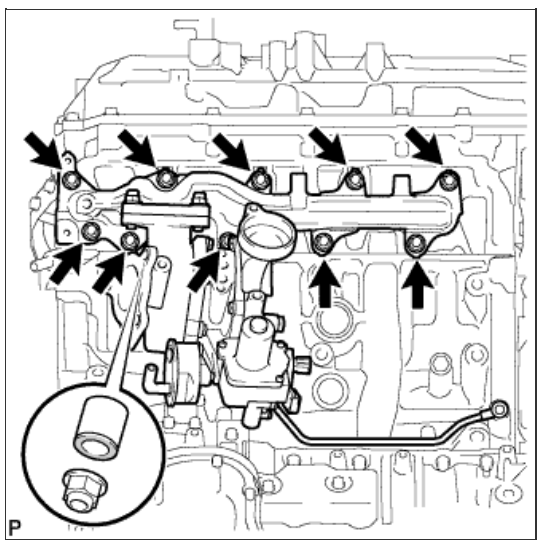


b. ntall the No. 1 tur ocharger with exhaust manifold R and 10 collars to the cylinder head R with 10 new nuts.

Torque:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }

HINT:

ntall the collars with the colored side facing the nuts.

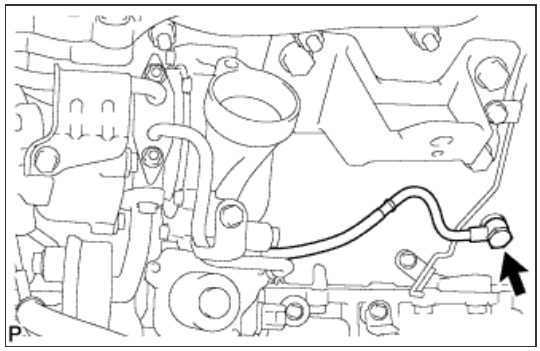


c. ntall a new gasket and the No. 1 inlet tur o oil pipe to the cylinder dck with the union olt.

Torque:
Case is dry:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }
Case is wet:
23 N*m{ 235 kgf*cm , 17 ft.*lbf }

NOTICE:

- **The case is "dry" when there is absolutely no engine oil on the union bolt and cylinder block bolt hole.**
- **The case is "wet" when there is engine oil on the union bolt and cylinder block bolt hole.**



116. INSTALL NO. 1 VENTILATION TUBE SUB-ASSEMBLY

a. Temporarily install a new gasket and the No. 1 ventilation tu e with the union olt and olt.

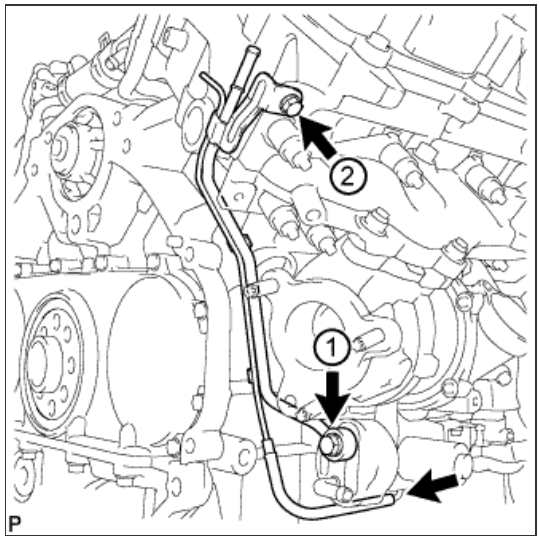
b. Tighten the union olt and olt in the order shown in the illustration.

Torque:
for union bolt:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 in.*lbf }

NOTICE:

Clean and remove any oil la eled 1 shown in the illustration.

c. Connect the vacuum hose.

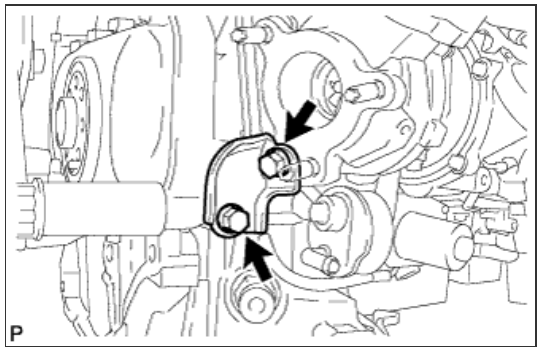


117. INSTALL NO. 1 TURBOCHARGER STAY

a. Temporarily install the No. 1 tur ocharger stay with the 2 olts.

b. Tighten the 2 olts.

Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }

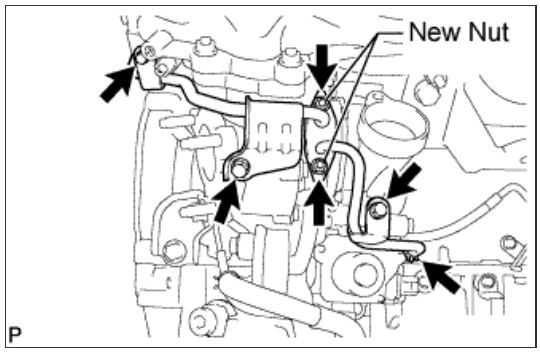


118. INSTALL NO. 1 TURBO WATER PIPE SUB-ASSEMBLY

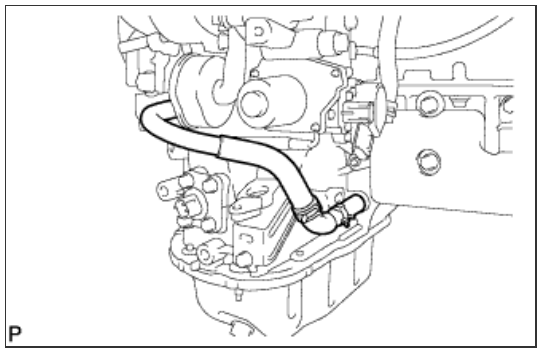
a. ntall a new gasket and the No. 1 tur o water pipe with 2 new nuts and 3 olts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Connect the water hose.



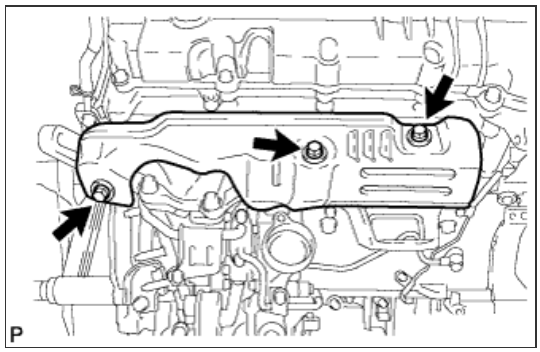
119. CONNECT NO. 1 OUTLET TURBO OIL HOSE



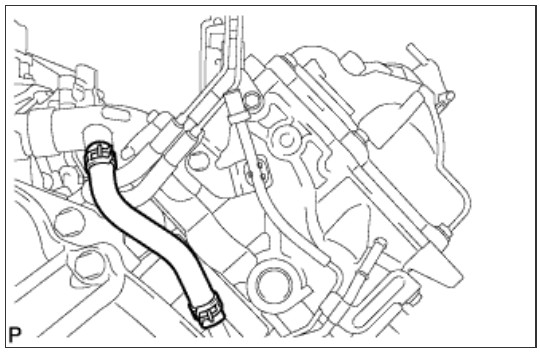
120. INSTALL NO. 1 EXHAUST MANIFOLD HEAT INSULATOR

a. ntall the No. 1 exhaust manifold heat insulator with the 3 olts.

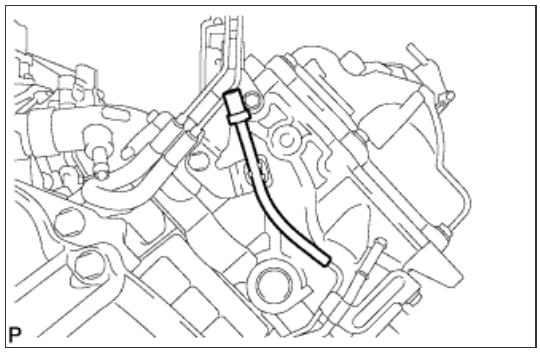
Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }



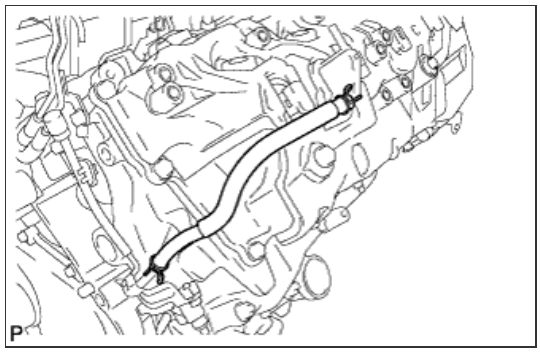
121. CONNECT NO. 2 TURBO WATER HOSE



122. CONNECT BREATHER PLUG RH



123. CONNECT NO. 2 VENTILATION HOSE



124. INSTALL GENERATOR ASSEMBLY

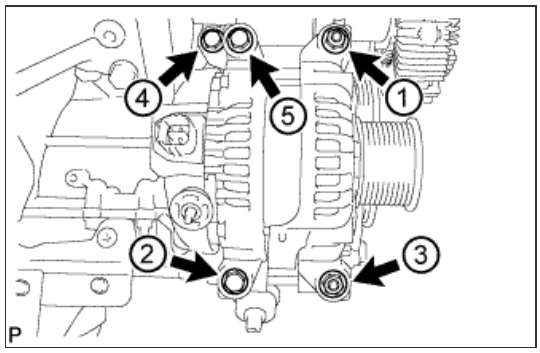
a. Temporarily install the generator with the 3 olts and 2 nuts.

b. Uniformly tighten the 3 olts and 2 nuts in the order shown in the illustration.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Connect the generator ca d and install the nut and olt.

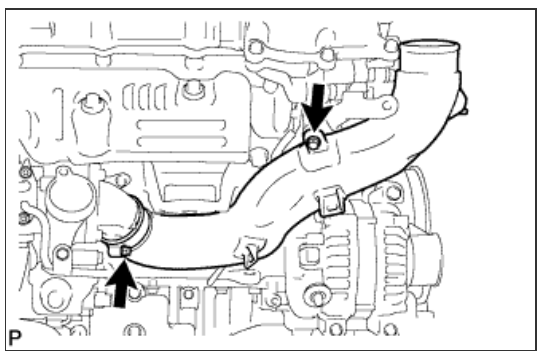
Torque:
for bolt:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }
for nut (130A Type and 150A Type:):
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }
for nut (180A Type:):
12 N*m{ 122 kgf*cm , 9 ft.*lbf }



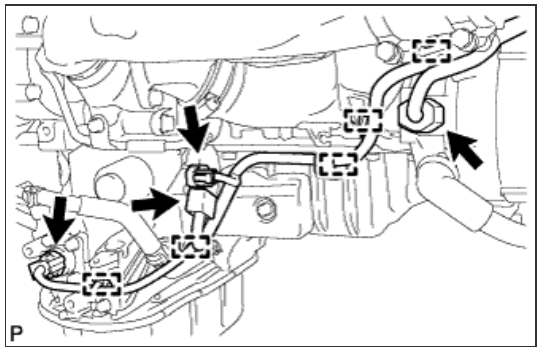
125. INSTALL NO. 1 INTAKE AIR CONNECTOR PIPE

a. ntall the No. 1 intake air connector pipe with the olt. Then tighten the hose clamp.

Torque:
for bolt:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for clamp:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }



b. Connect the 4 connectors and attach the 5 wire harness clamps.



126. INSTALL NO. 1 ENGINE OIL LEVEL DIPSTICK GUIDE

a. Apply a light coat of engine oil to a new O ring, and install it to the No. 1 engine oil level dipstick guide.

b. ntall the No. 1 engine oil level dipstick guide with the 2 olts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

127. INSTALL ENGINE ASSEMBLY

a. ntall the engine assem yl to the vehicle (Click here).

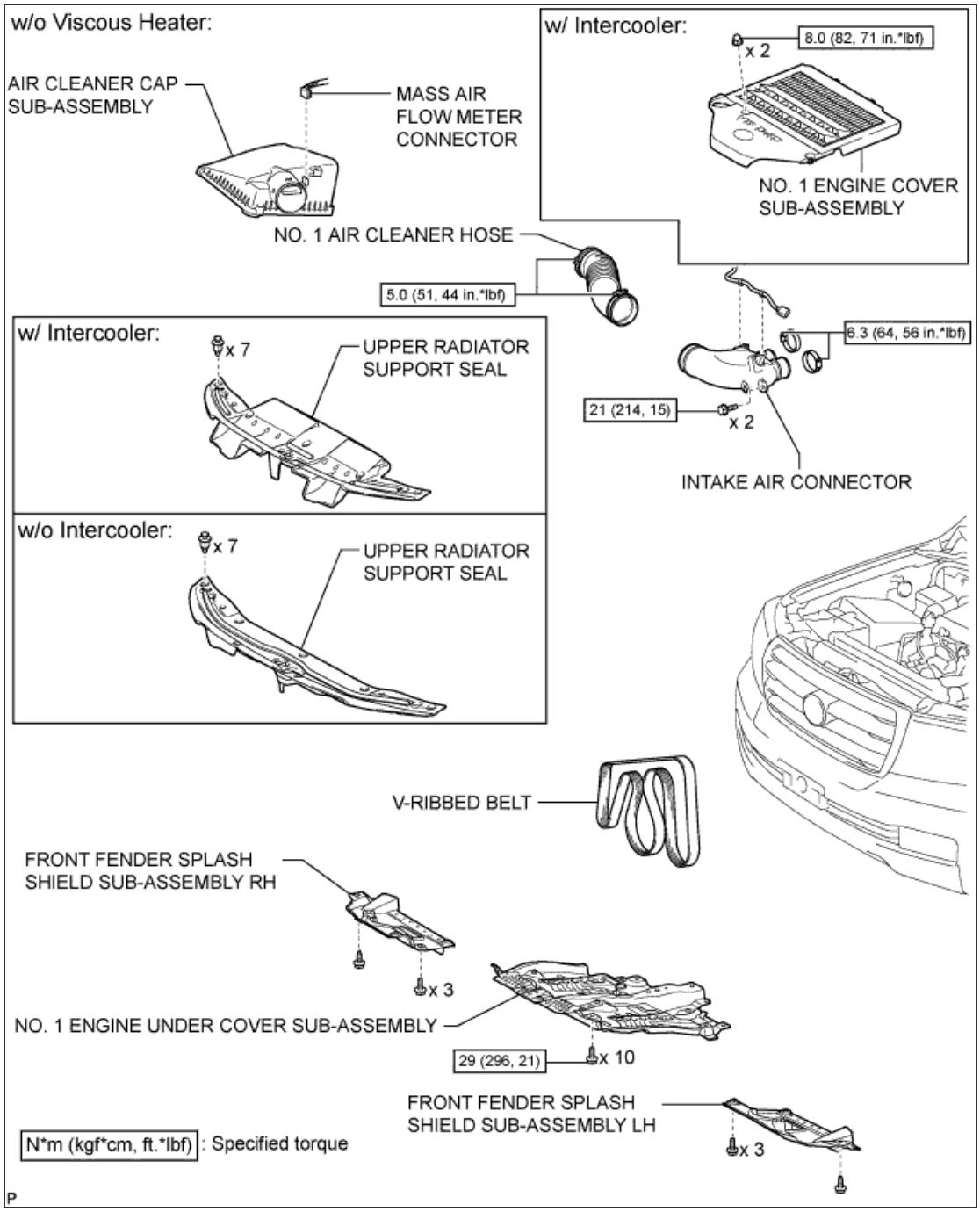
128. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

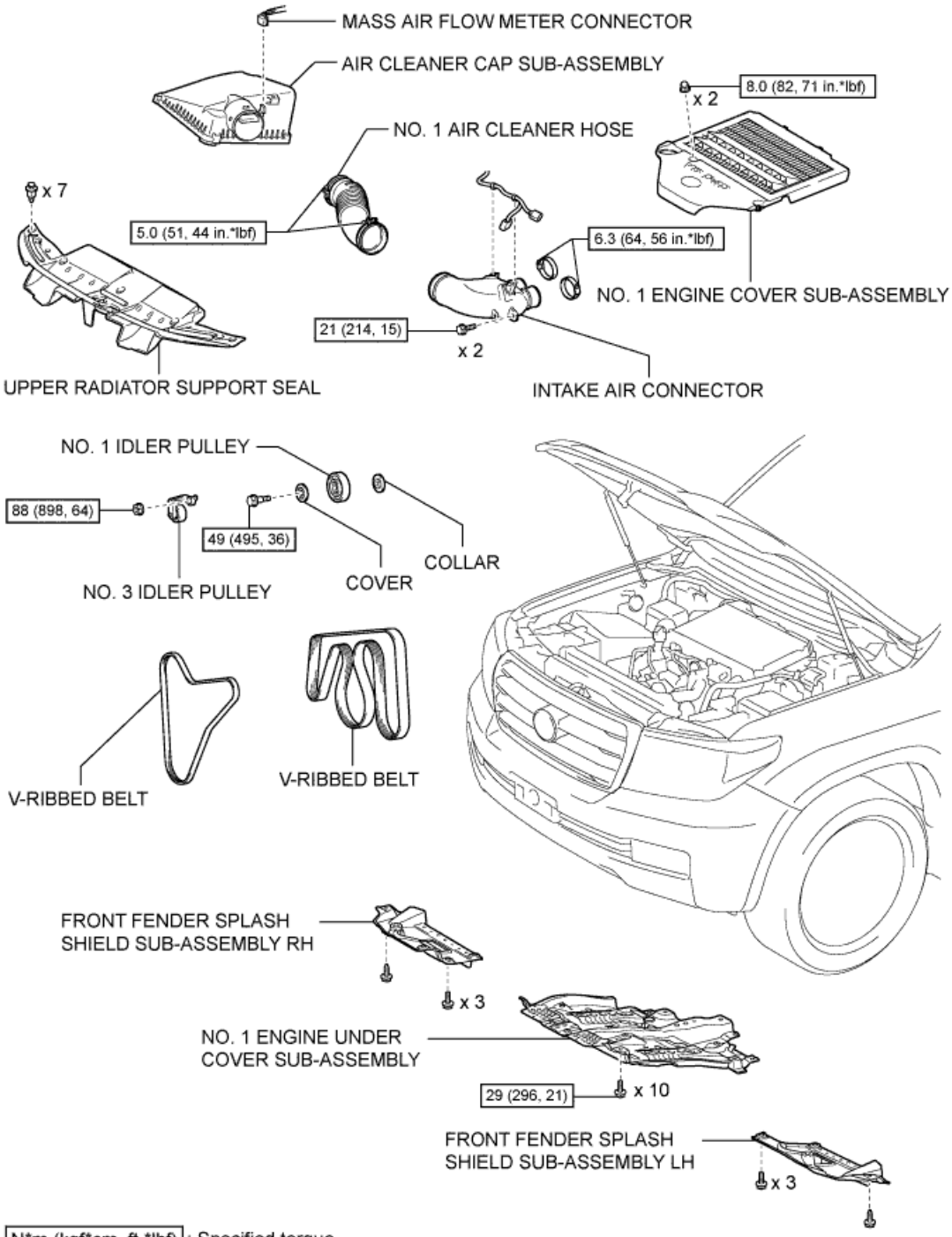
When disconnecting the ca d, some systems need to e initialized after the ca d is reconnected (Click here).

a. Connect the ca ds to the negative ( ) main attery and su attery terminals.

for Preparation Click here

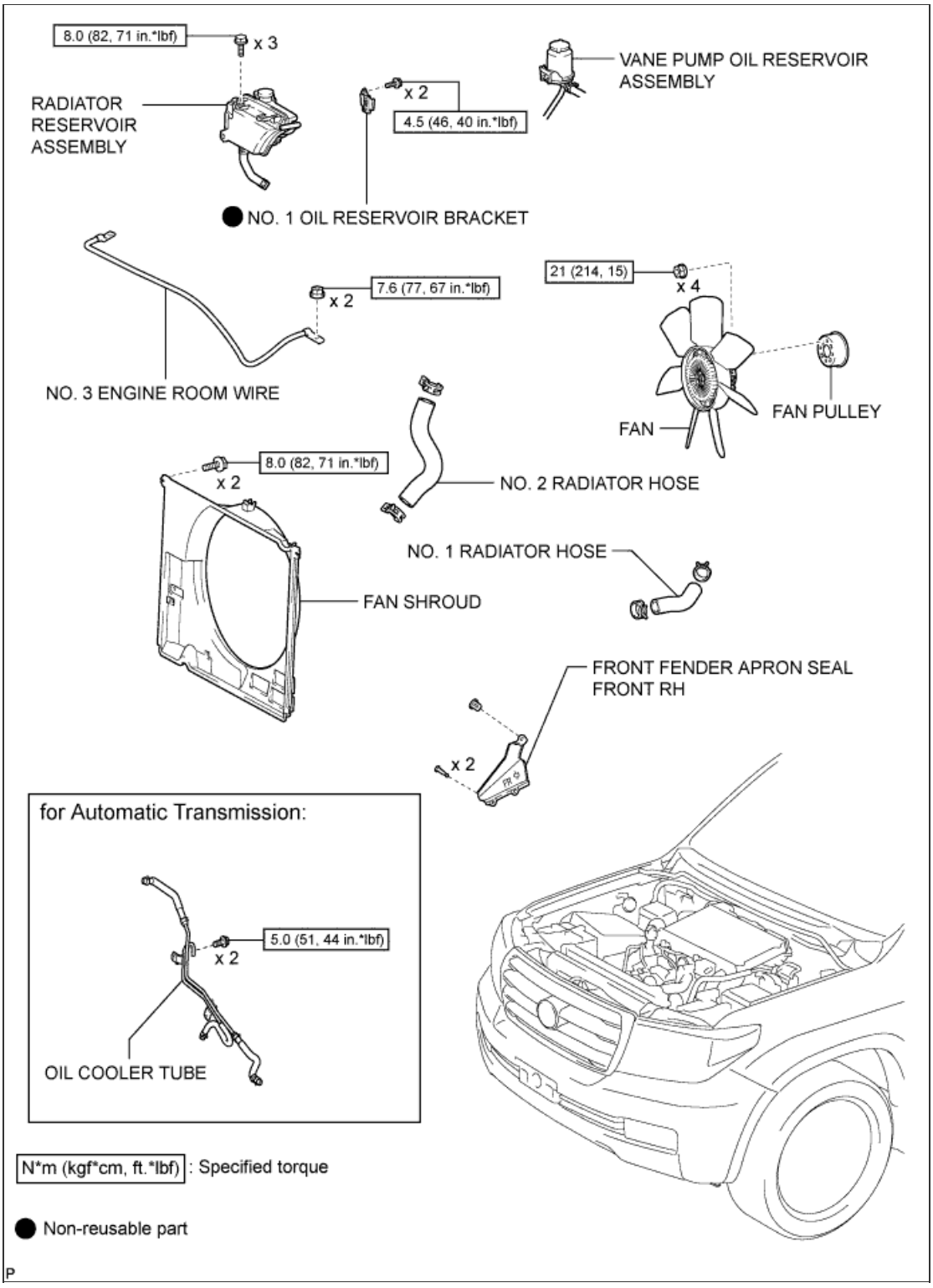


w/ Viscous Heater:

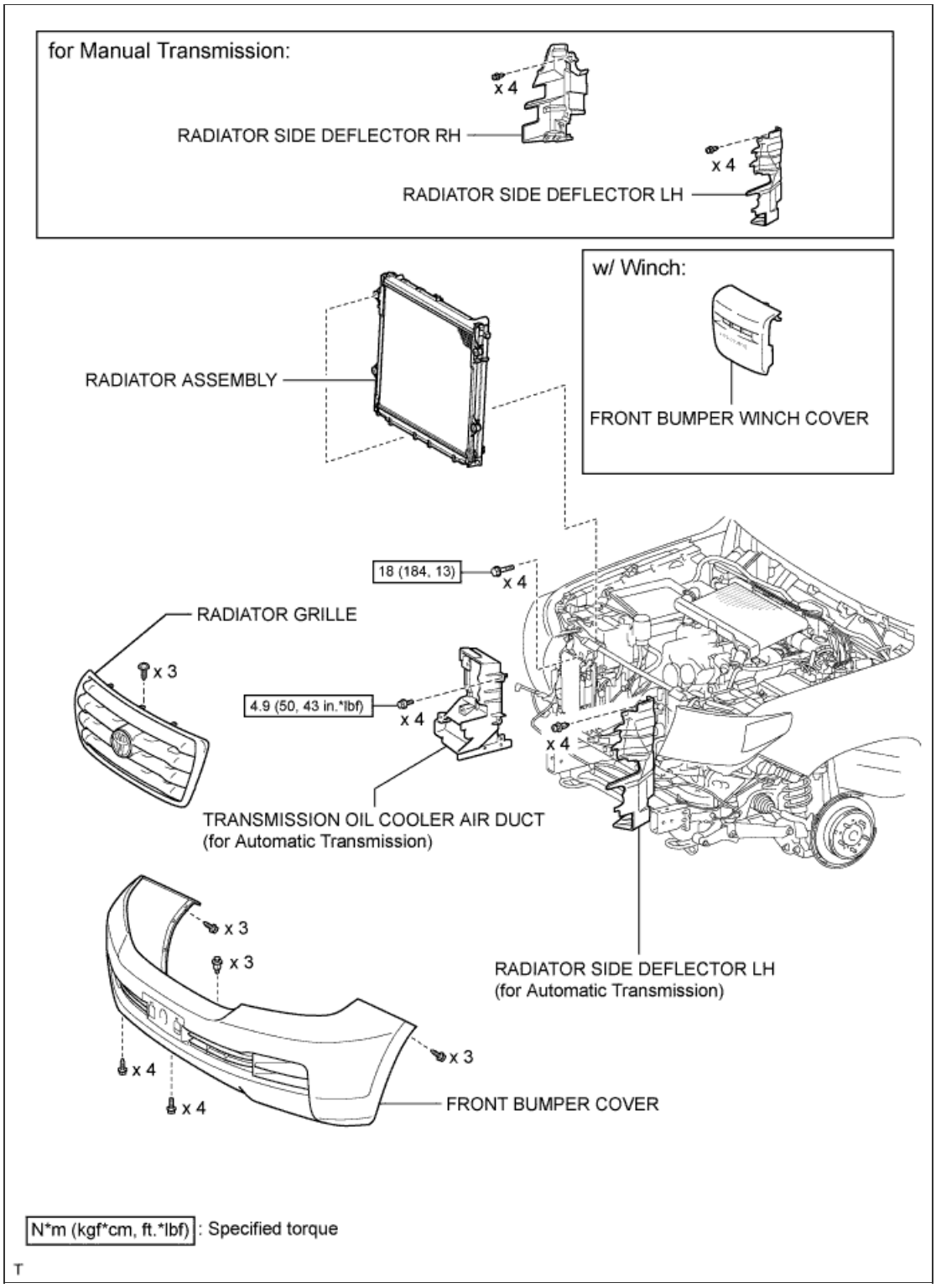


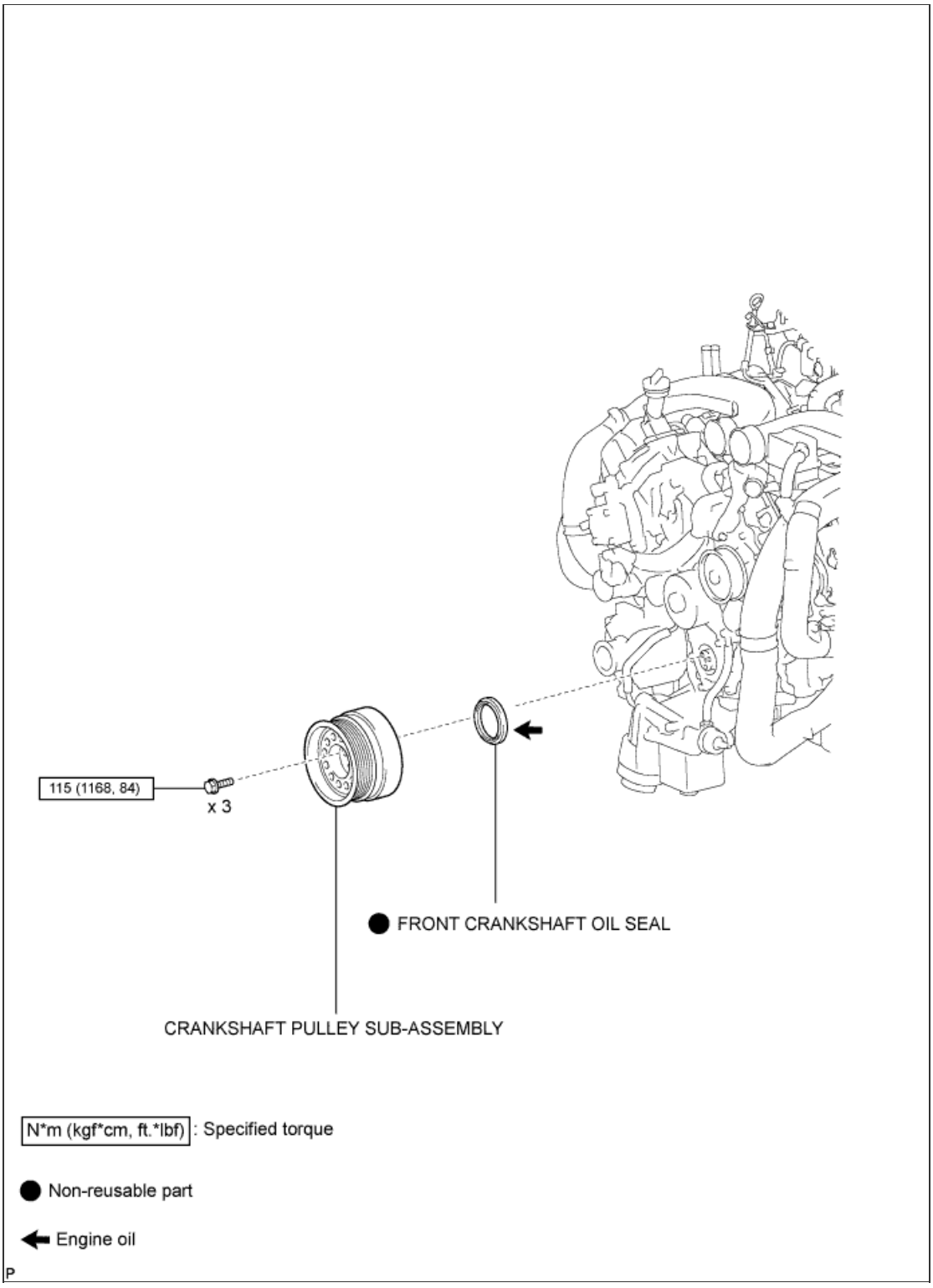
N*m (kgf*cm, ft.*lbf) : Specified torque

P


8.0 (82, 71 in.*lbf)
x 3
RADIATOR RESERVOIR ASSEMBLY
x 2
4.5 (46, 40 in.*lbf)
VANE PUMP OIL RESERVOIR ASSEMBLY
NO. 1 OIL RESERVOIR BRACKET
7.6 (77, 67 in.*lbf)
x 2
NO. 3 ENGINE ROOM WIRE
21 (214, 15)
x 4
FAN
FAN PULLEY
8.0 (82, 71 in.*lbf)
x 2
NO. 2 RADIATOR HOSE
NO. 1 RADIATOR HOSE
FAN SHROUD
FRONT FENDER APRON SEAL FRONT RH
x 2
for Automatic Transmission:
5.0 (51, 44 in.*lbf)
x 2
OIL COOLER TUBE
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P


for Manual Transmission:
x 4
RADIATOR SIDE DEFLECTOR RH
x 4
RADIATOR SIDE DEFLECTOR LH
w/ Winch:
FRONT BUMPER WINCH COVER
RADIATOR ASSEMBLY
18 (184, 13)
x 4
RADIATOR GRILLE
x 3
4.9 (50, 43 in.*lbf)
x 4
x 4
TRANSMISSION OIL COOLER AIR DUCT
(for Automatic Transmission)
x 3
x 3
x 3
x 4
x 4
RADIATOR SIDE DEFLECTOR LH
(for Automatic Transmission)
FRONT BUMPER COVER
N*m (kgf*cm, ft.*lbf) : Specified torque
T


115 (1168, 84)
x 3
FRONT CRANKSHAFT OIL SEAL
CRANKSHAFT PULLEY SUB-ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
Engine oil
P

for Preparation Click here

1. REMOVE RADIATOR ASSEMBLY

a. Remove the radiator (Click here).

2. REMOVE CRANKSHAFT PULLEY SUB-ASSEMBLY

NOTICE:

This procedure is intended for removal installation of the crankshaft pulley only. Do not use this procedure for removal installation of the flywheel or the drive plate and ring gear.

a. Install the 2 bolts to the bolt holes of the crankshaft rear side.

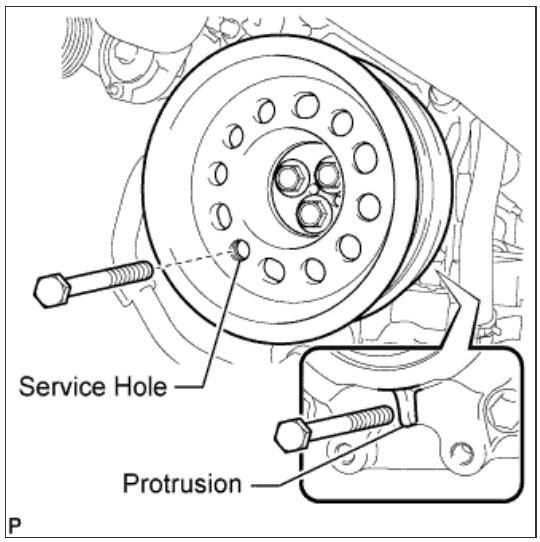
b. Using a bar, turn the crankshaft until the crankshaft pulley service hole is a little to the left of bottom dead center.

c. Install a 14 mm x 1.5 pitch service bolt with a length of 70 mm or more to the crankshaft pulley service hole, and hold the crankshaft using the timing chain cover protrusion.

d. Remove the 3 bolts and crankshaft pulley.

NOTICE:

If the crankshaft pulley cannot be removed, temporarily install a bolt to the crankshaft so that the pulley does not fall, and lightly tap the outer edge of the mass damper with a plastic-faced hammer to remove the pulley. Do not tap the pulley V-ribbed belt ribs, as the crankshaft may be damaged.



3. REMOVE FRONT CRANKSHAFT OIL SEAL

a. Using a knife, cut off the lip of the oil seal.

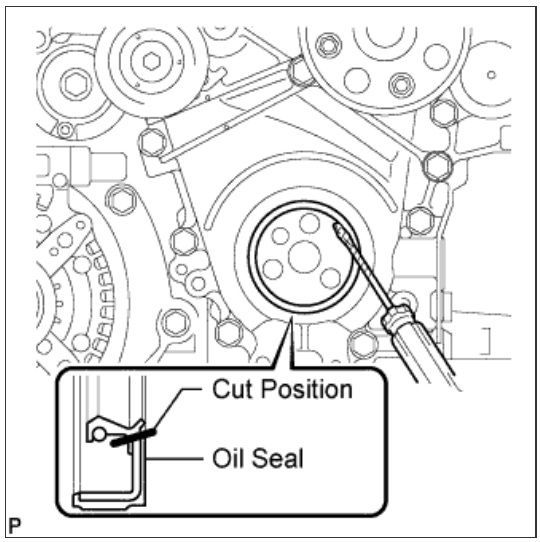
b. Using a screwdriver, pry out the oil seal.

NOTICE:

Be careful not to damage the crankshaft.

HINT:

Tape the screwdriver tip before use.



for Preparation Click here

1. INSTALL FRONT CRANKSHAFT OIL SEAL

a. Apply engine oil to the lip of a new oil seal.

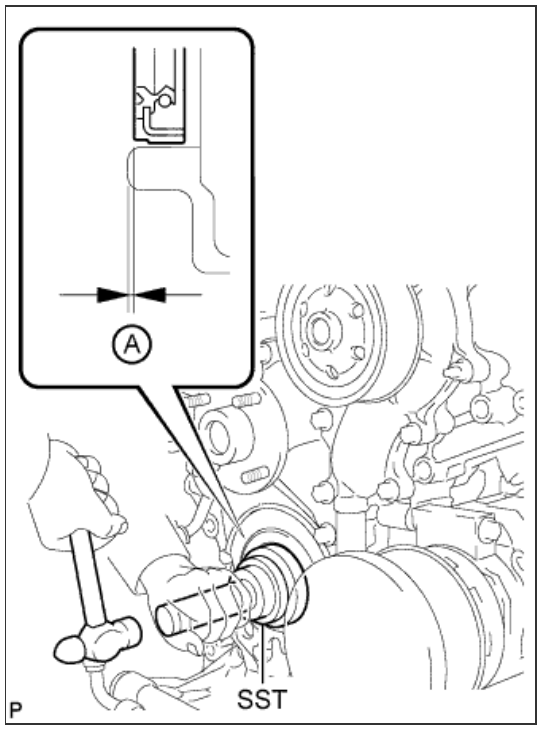
b. Using nd a hammer, tap in the oil seal as shown in the illustration.

SST
09316-12010
09950-70010 (09951-07100)
09950-60020 (09951-00890)

Standard depth A:
0.6 to 1.4 mm (0.0236 to 0.0551 in.)

NOTICE:

Make sure that the lip of the oil seal is properly installed.



2. INSTALL CRANKSHAFT PULLEY SUB-ASSEMBLY

NOTICE:

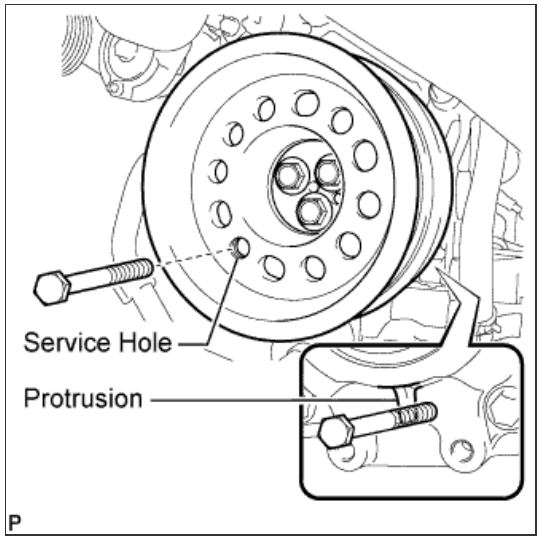
This procedure is intended for removal installation of the crankshaft pulley only. Do not use this procedure for removal installation of the flywheel or the drive plate and ring gear.

a. Align the crankshaft pulley and the crankshaft knock pin, and temporarily install the crankshaft pulley with the 3 bolts.

b. Install the 2 bolts to the bolt holes of the crankshaft rear side.

c. Using a bar, turn the crankshaft until the crankshaft pulley service hole is a little to the right of bottom dead center.

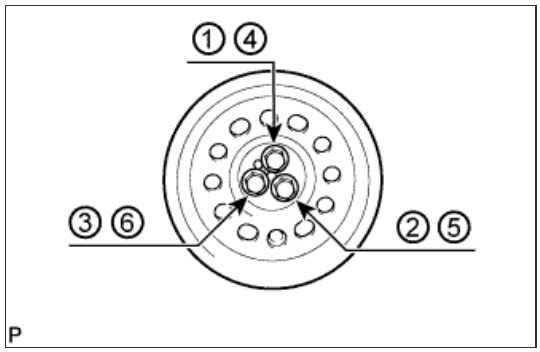
d. Install a 14 mm x 1.5 pitch service bolt with a length of 70 mm or more to the crankshaft pulley service hole, and hold the crankshaft using the timing chain cover protrusion.



e. Uniformly tighten the 3 bolts in 2 passes in the order shown in the illustration.

Torque:
115 N*m{ 1168 kgf*cm , 84 ft.*lbf }

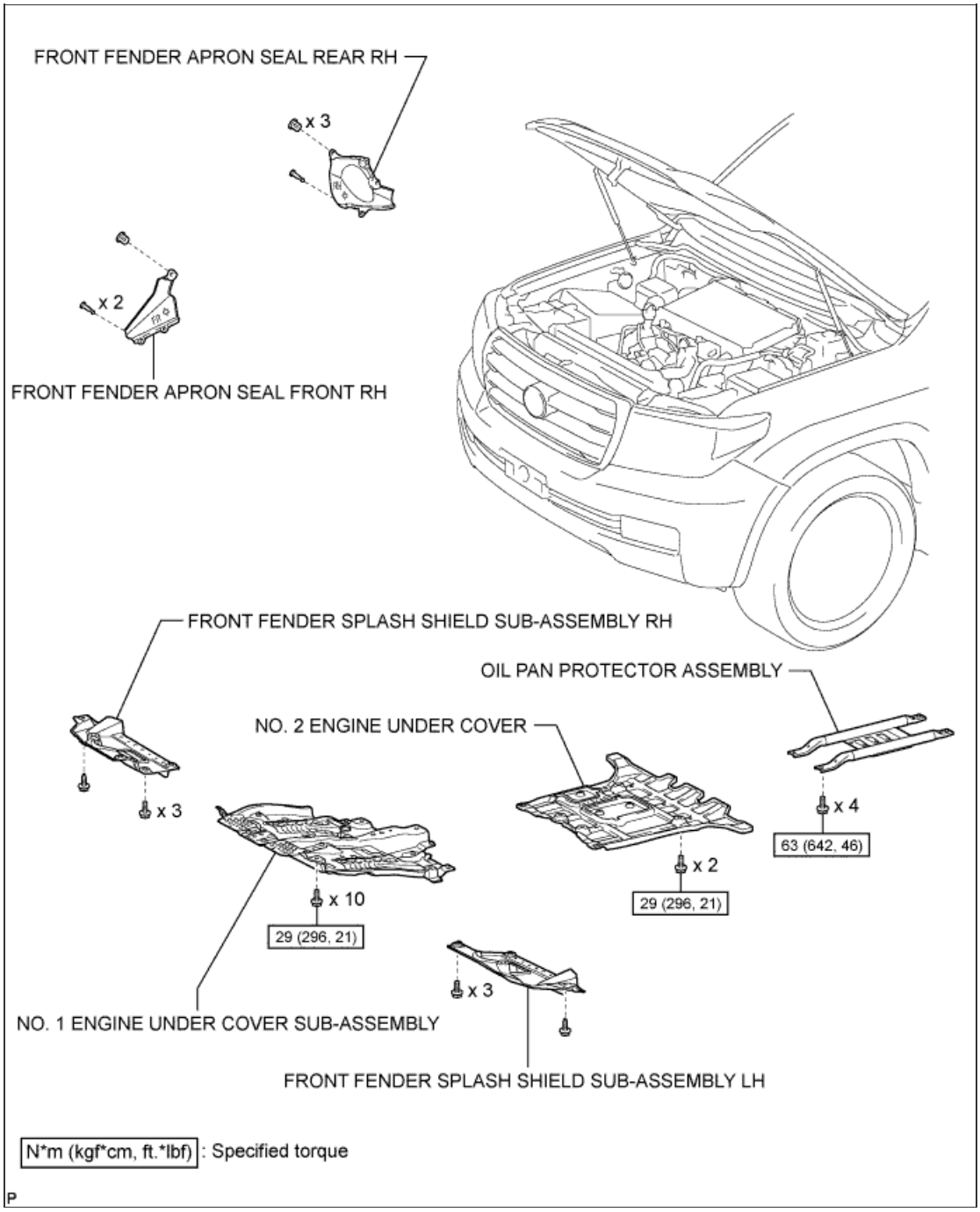
f. Remove the service bolt.

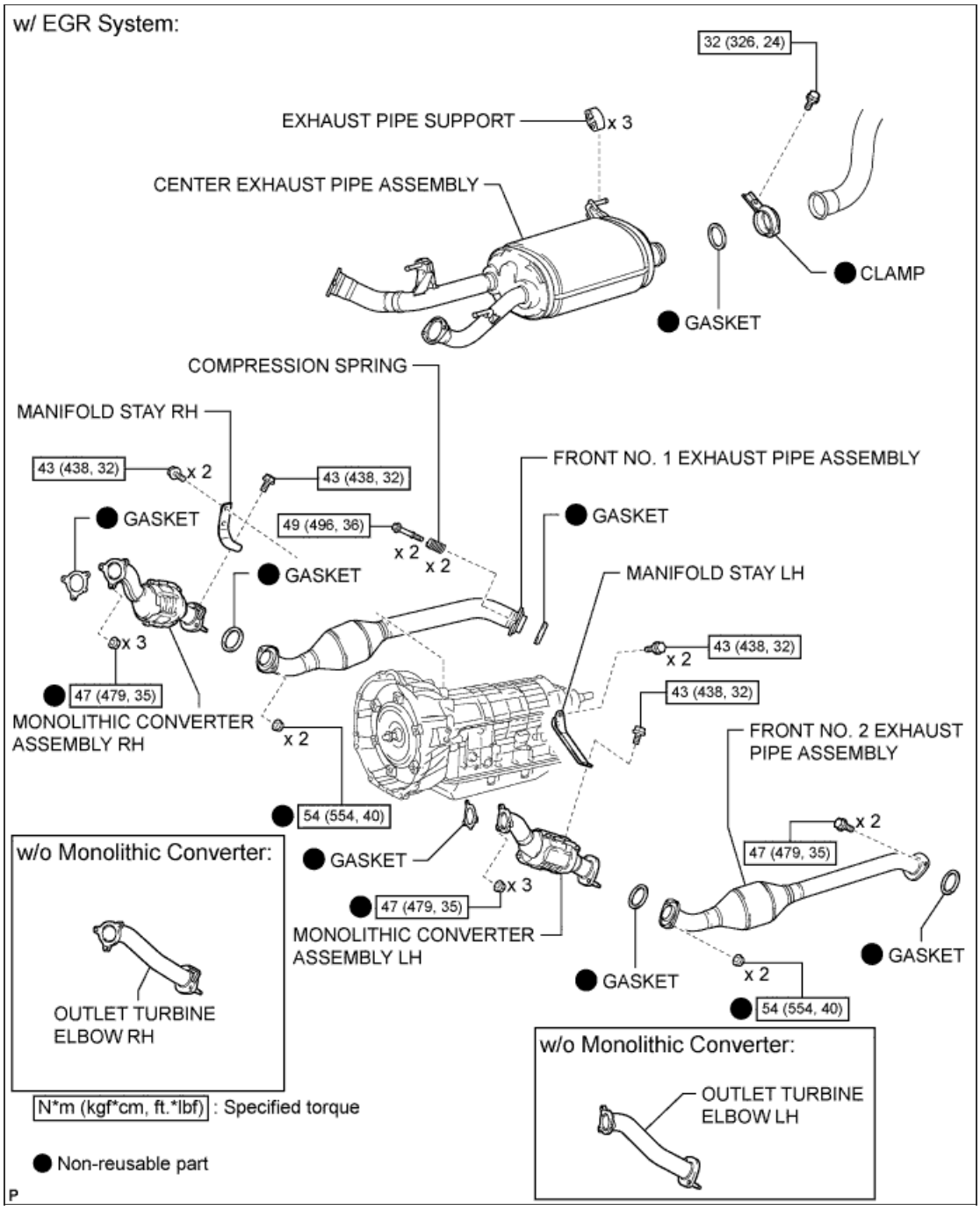


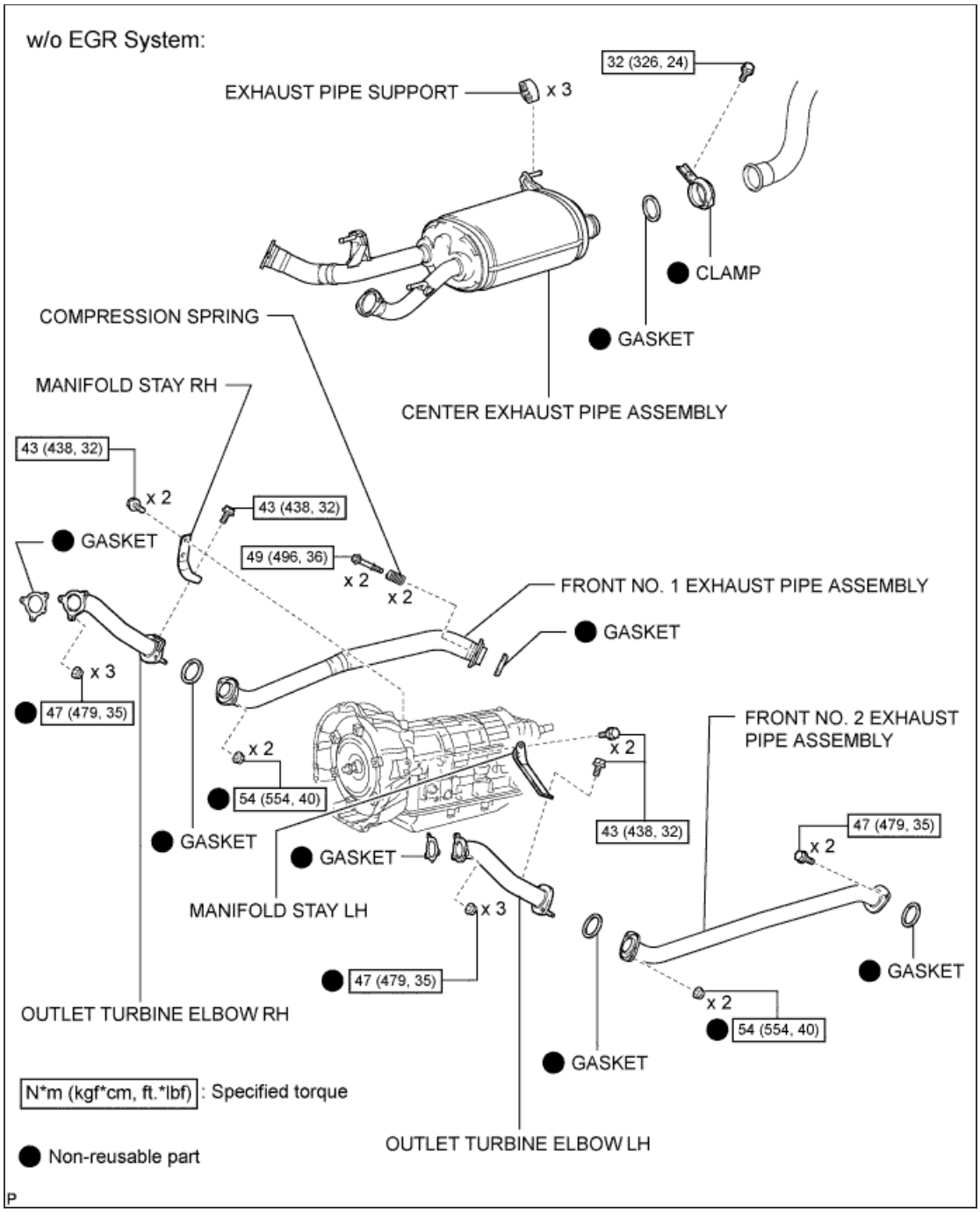
3. INSTALL RADIATOR ASSEMBLY

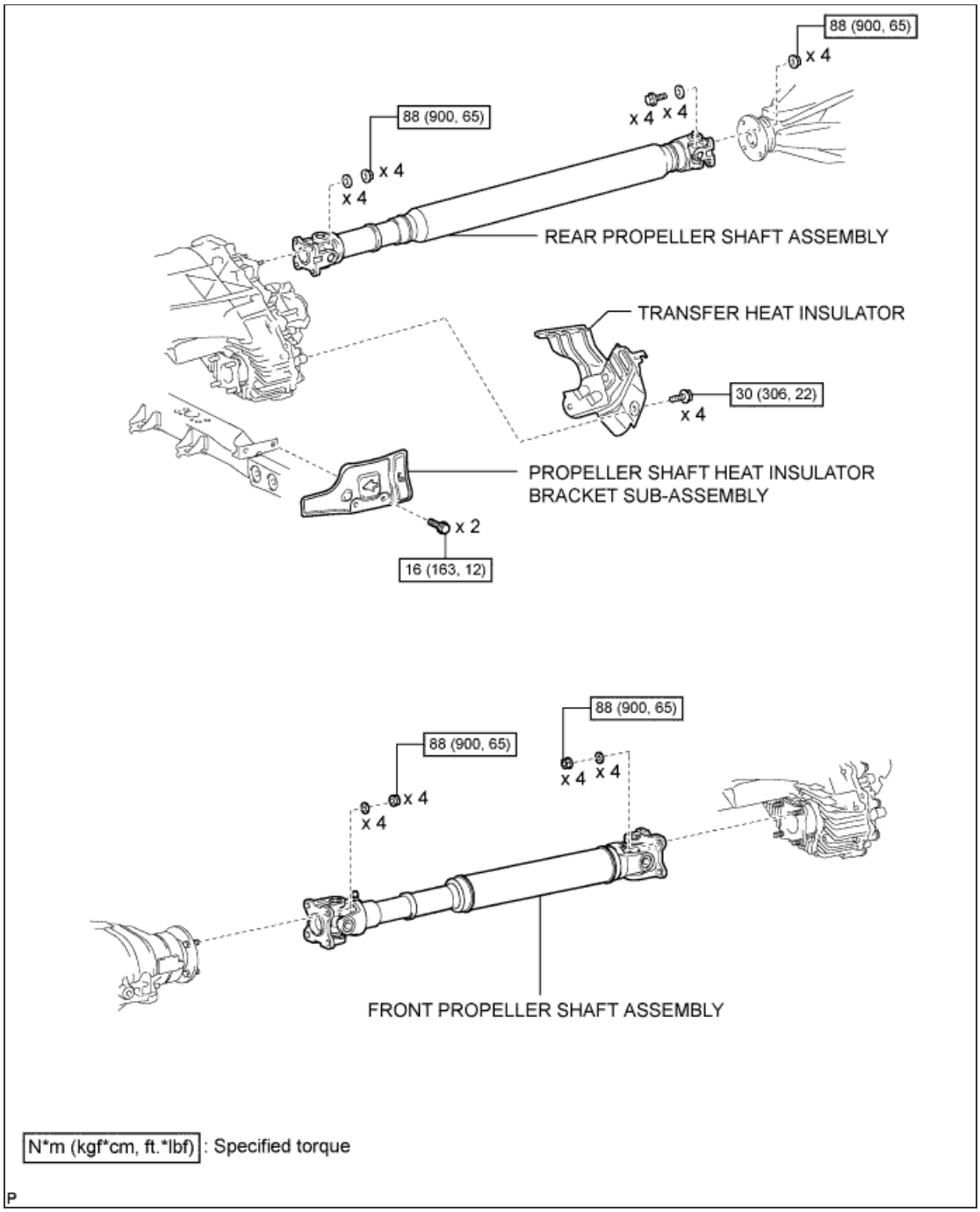
a. Install the radiator (Click here).

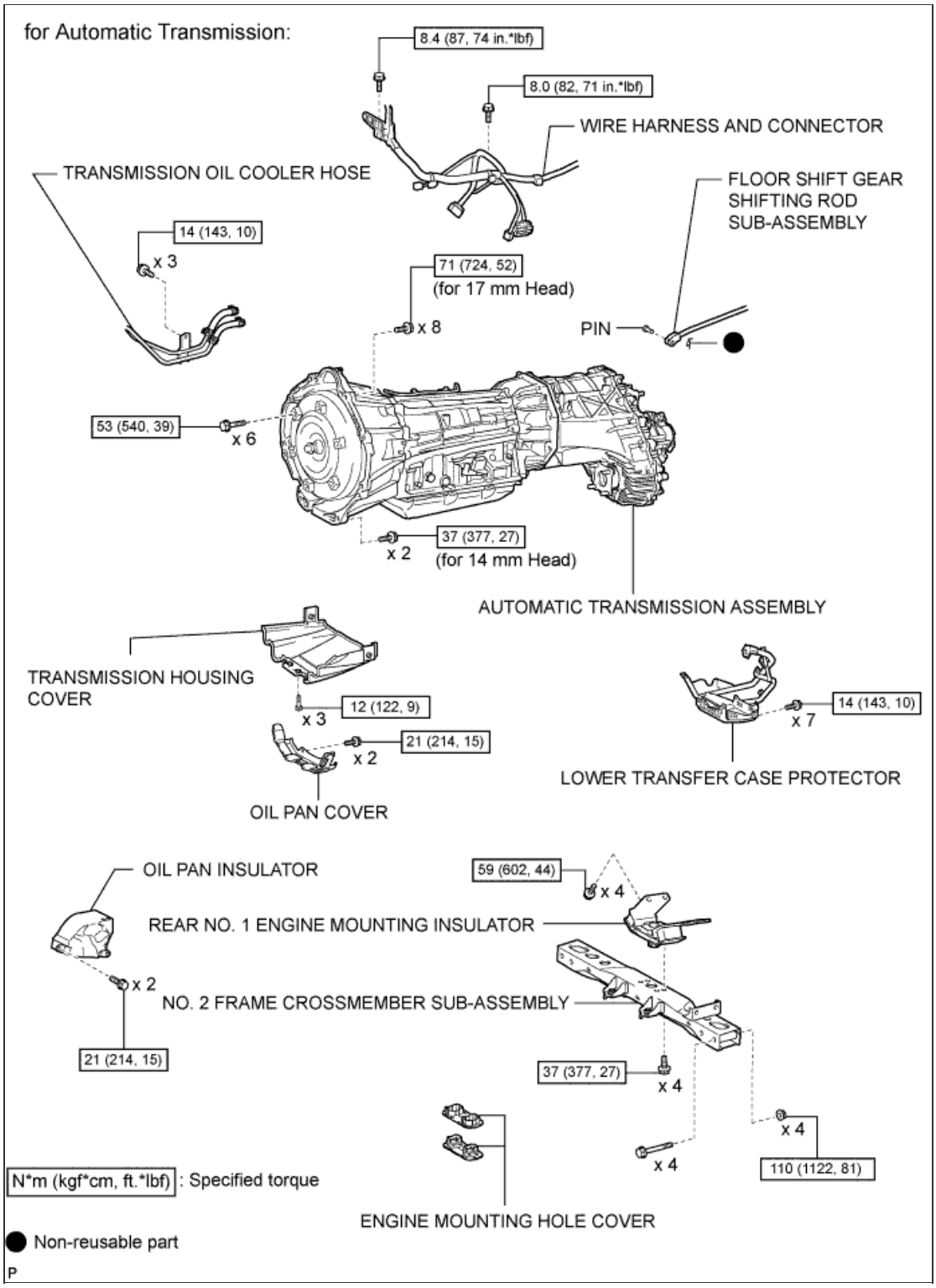
for Preparation Click here

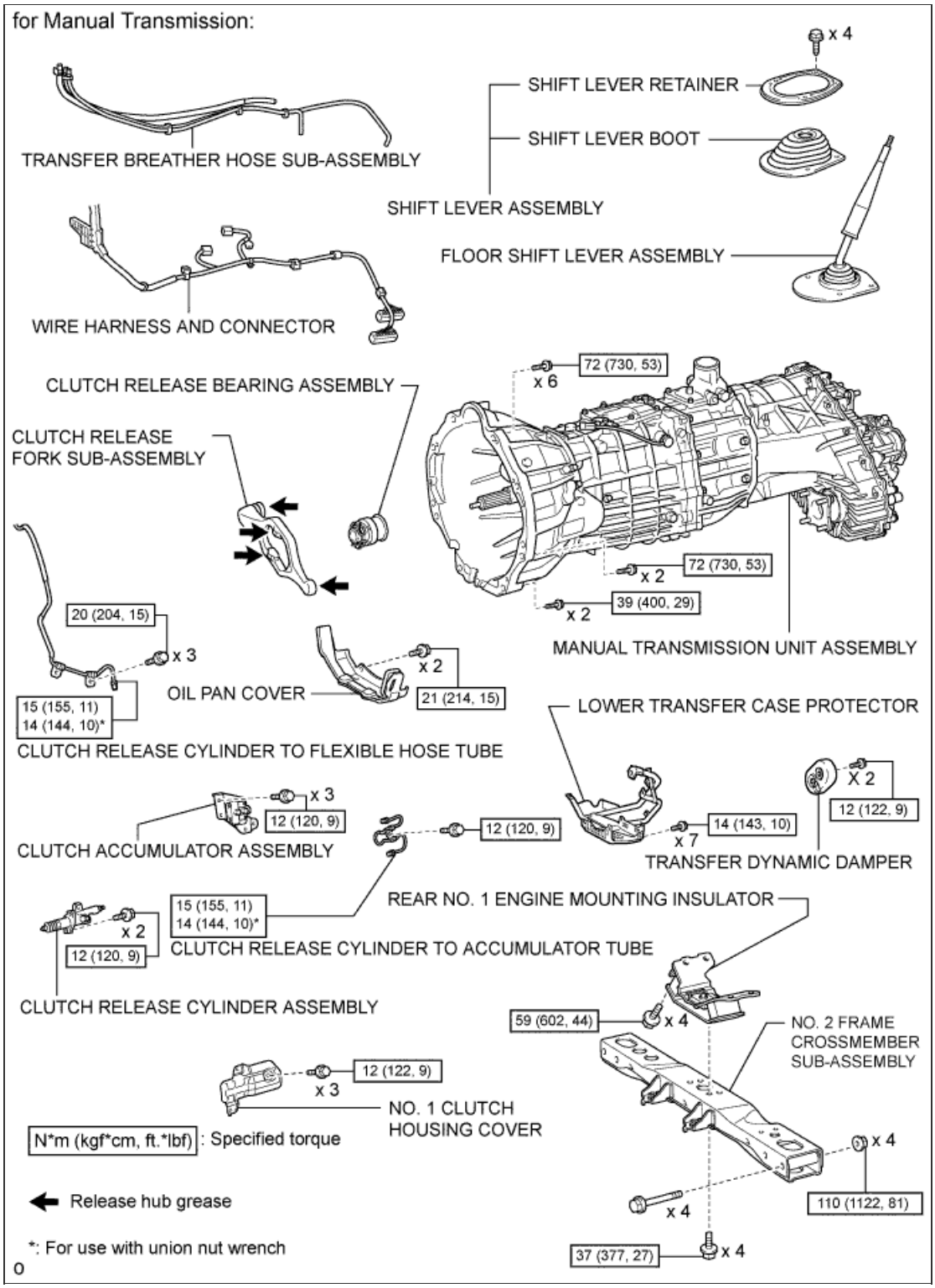



w/ EGR System:
32 (326, 24)
EXHAUST PIPE SUPPORT
x 3
CENTER EXHAUST PIPE ASSEMBLY
CLAMP
GASKET
COMPRESSION SPRING
MANIFOLD STAY RH
43 (438, 32)
x 2
43 (438, 32)
FRONT NO. 1 EXHAUST PIPE ASSEMBLY
GASKET
49 (496, 36)
x 2
x 2
GASKET
GASKET
MANIFOLD STAY LH
x 3
43 (438, 32)
x 2
47 (479, 35)
43 (438, 32)
MONOLITHIC CONVERTER ASSEMBLY RH
x 2
FRONT NO. 2 EXHAUST PIPE ASSEMBLY
54 (554, 40)
w/o Monolithic Converter:
GASKET
x 3
47 (479, 35)
MONOLITHIC CONVERTER ASSEMBLY LH
x 2
47 (479, 35)
GASKET
GASKET
x 2
54 (554, 40)
OUTLET TURBINE ELBOW RH
w/o Monolithic Converter:
OUTLET TURBINE ELBOW LH
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

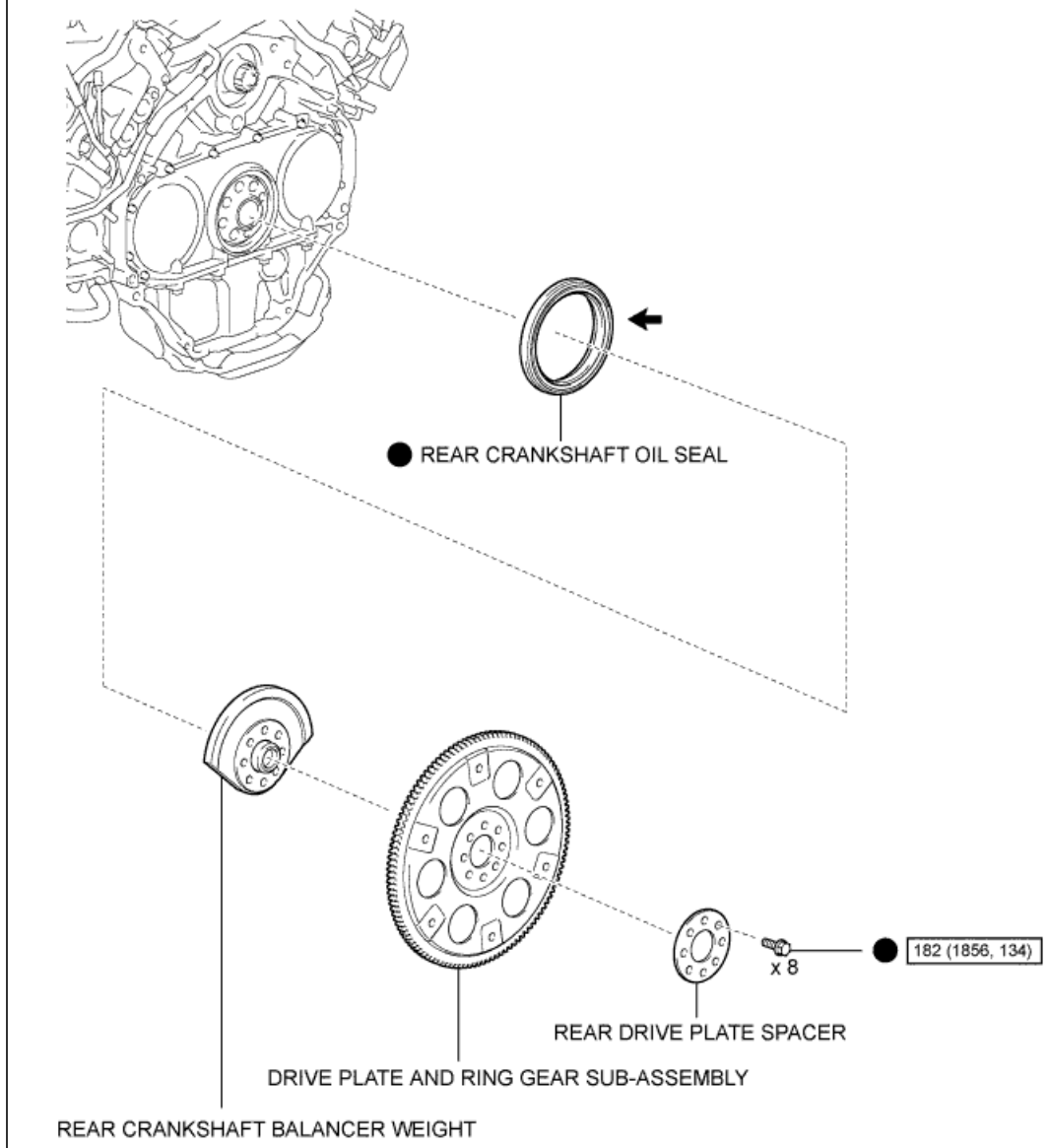

w/o EGR System:
EXHAUST PIPE SUPPORT
x 3
32 (326, 24)
CLAMP
GASKET
COMPRESSION SPRING
MANIFOLD STAY RH
CENTER EXHAUST PIPE ASSEMBLY
43 (438, 32)
x 2
43 (438, 32)
GASKET
49 (496, 36)
x 2
x 2
FRONT NO. 1 EXHAUST PIPE ASSEMBLY
GASKET
x 3
47 (479, 35)
x 2
54 (554, 40)
x 2
43 (438, 32)
FRONT NO. 2 EXHAUST PIPE ASSEMBLY
GASKET
GASKET
MANIFOLD STAY LH
x 3
47 (479, 35)
x 2
GASKET
47 (479, 35)
x 2
54 (554, 40)
OUTLET TURBINE ELBOW RH
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
OUTLET TURBINE ELBOW LH
P


88 (900, 65)
x 4
x 4
x 4
88 (900, 65)
x 4
x 4
REAR PROPELLER SHAFT ASSEMBLY
TRANSFER HEAT INSULATOR
30 (306, 22)
x 4
PROPELLER SHAFT HEAT INSULATOR
BRACKET SUB-ASSEMBLY
x 2
16 (163, 12)
88 (900, 65)
88 (900, 65)
x 4
x 4
x 4
x 4
FRONT PROPELLER SHAFT ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
P


for Automatic Transmission:
8.4 (87, 74 in.*lbf)
8.0 (82, 71 in.*lbf)
WIRE HARNESS AND CONNECTOR
TRANSMISSION OIL COOLER HOSE
FLOOR SHIFT GEAR SHIFTING ROD SUB-ASSEMBLY
14 (143, 10)
x 3
71 (724, 52)
(for 17 mm Head)
x 8
PIN
53 (540, 39)
x 6
37 (377, 27)
x 2
(for 14 mm Head)
AUTOMATIC TRANSMISSION ASSEMBLY
TRANSMISSION HOUSING COVER
12 (122, 9)
x 3
21 (214, 15)
x 2
OIL PAN COVER
14 (143, 10)
x 7
LOWER TRANSFER CASE PROTECTOR
OIL PAN INSULATOR
59 (602, 44)
x 4
REAR NO. 1 ENGINE MOUNTING INSULATOR
x 2
NO. 2 FRAME CROSSMEMBER SUB-ASSEMBLY
21 (214, 15)
37 (377, 27)
x 4
x 4
x 4
110 (1122, 81)
N*m (kgf*cm, ft.*lbf) : Specified torque
ENGINE MOUNTING HOLE COVER
Non-reusable part
P


for Manual Transmission:
x 4
SHIFT LEVER RETAINER
SHIFT LEVER BOOT
TRANSFER BREATHER HOSE SUB-ASSEMBLY
SHIFT LEVER ASSEMBLY
FLOOR SHIFT LEVER ASSEMBLY
WIRE HARNESS AND CONNECTOR
CLUTCH RELEASE BEARING ASSEMBLY
72 (730, 53)
x 6
CLUTCH RELEASE
FORK SUB-ASSEMBLY
x 2
72 (730, 53)
x 2
39 (400, 29)
MANUAL TRANSMISSION UNIT ASSEMBLY
20 (204, 15)
x 3
x 2
OIL PAN COVER
21 (214, 15)
15 (155, 11)
14 (144, 10)*
CLUTCH RELEASE CYLINDER TO FLEXIBLE HOSE TUBE
LOWER TRANSFER CASE PROTECTOR
x 3
12 (120, 9)
CLUTCH ACCUMULATOR ASSEMBLY
12 (120, 9)
14 (143, 10)
x 7
X 2
12 (122, 9)
TRANSFER DYNAMIC DAMPER
REAR NO. 1 ENGINE MOUNTING INSULATOR
15 (155, 11)
14 (144, 10)*
x 2
12 (120, 9)
CLUTCH RELEASE CYLINDER TO ACCUMULATOR TUBE
CLUTCH RELEASE CYLINDER ASSEMBLY
59 (602, 44)
x 4
NO. 2 FRAME
CROSSMEMBER
SUB-ASSEMBLY
12 (122, 9)
x 3
NO. 1 CLUTCH
HOUSING COVER
x 4
N*m (kgf*cm, ft.*lbf) : Specified torque
110 (1122, 81)
x 4
Release hub grease
*: For use with union nut wrench
37 (377, 27)
x 4

for Automatic Transmission:



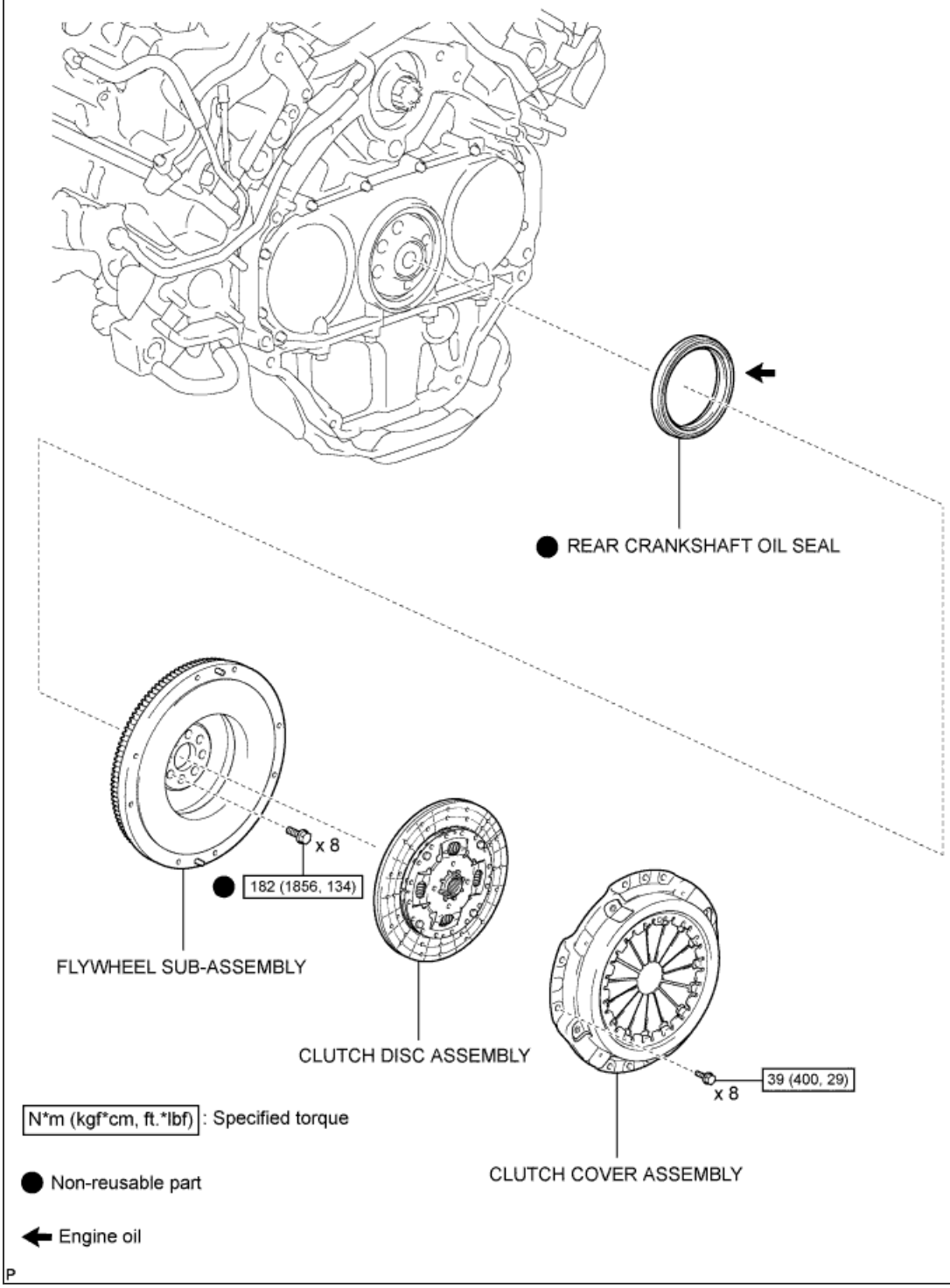
N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

← Engine oil

P

for Manual Transmission:



P

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Disconnect the cable from the negative (-) main battery and sub-battery terminals.

2. REMOVE AUTOMATIC TRANSMISSION ASSEMBLY

a. Remove the automatic transmission assembly (Click here).

3. REMOVE MANUAL TRANSMISSION UNIT ASSEMBLY

a. Remove the manual transmission unit assembly (Click here).

4. REMOVE CLUTCH COVER ASSEMBLY (for Manual Transmission)

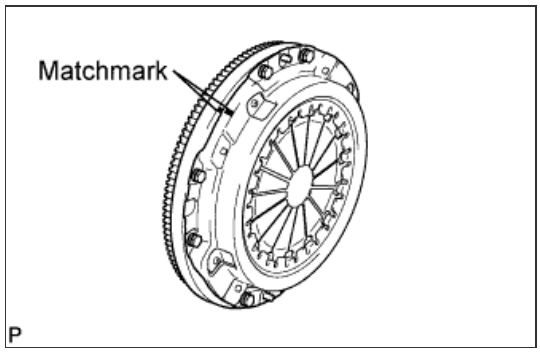
a. Put matchmarks on the clutch cover and flywheel.

b. Loosen each set bolt one turn at a time until spring tension is released.

c. Remove the 8 set bolts, and pull off the clutch cover.

NOTICE:

Do not drop the clutch disc.



5. REMOVE CLUTCH DISC ASSEMBLY (for Manual Transmission)

NOTICE:

Keep the lining part of the clutch disc, pressure plate and surface of the flywheel away from oil and foreign matter.

6. REMOVE DRIVE PLATE AND RING GEAR SUB-ASSEMBLY (for Automatic Transmission)

a. Using a wrench, hold the crankshaft.

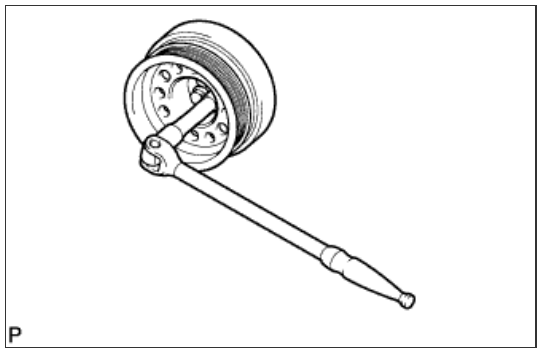
NOTICE:

Do not turn the crankshaft counterclockwise.

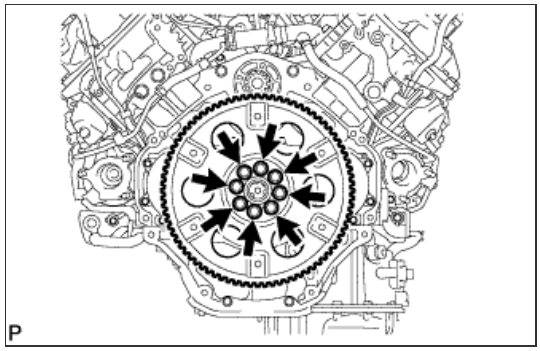
If it is turned counterclockwise, check that the crankshaft pulley set bolt is not loose. If loose, tighten the bolt (Click here).

Torque:

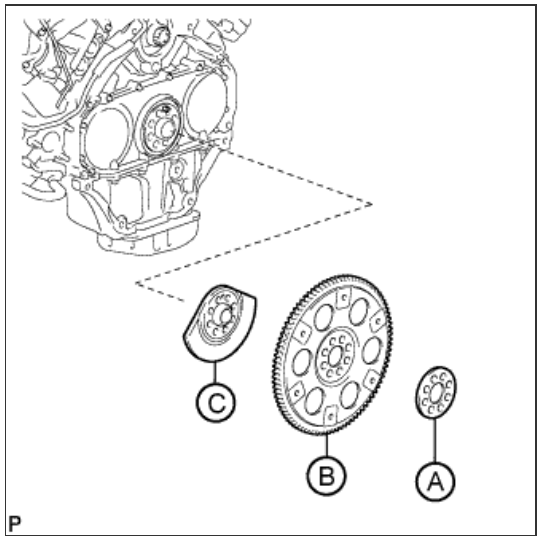
108 N*m{ 1101 kgf*cm , 80 ft.*lbf } or more



b. Remove the 8 bolts.



c. Remove the rear drive plate spacer labeled A, drive plate and ring gear labeled B and rear crankshaft balancer weight labeled C.



7. REMOVE FLYWHEEL SUB-ASSEMBLY (for Manual Transmission)

a. Using a wrench, hold the crankshaft.

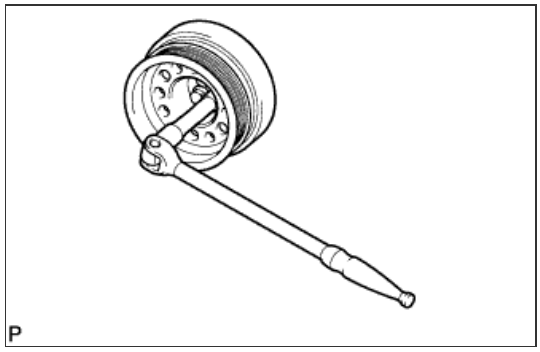
NOTICE:

Do not turn the crankshaft counterclockwise.

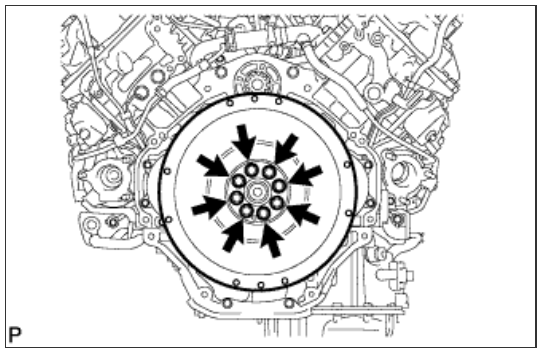
If it is turned counterclockwise, check that the crankshaft pulley set bolt is not loose. If loose, tighten the bolt (Click here).

Torque:

108 N*m{ 1101 kgf*cm , 80 ft.*lbf } or more



b. Remove the 8 bolts and flywheel.



8. REMOVE REAR CRANKSHAFT OIL SEAL

a. Using a knife, cut off the lip of the oil seal.

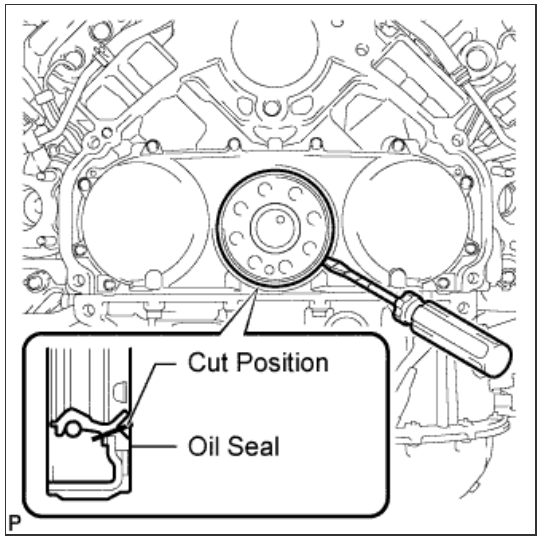
b. Using a screwdriver, pry out the oil seal.

NOTICE:

Be careful not to damage the crankshaft.

HINT:

Tape the screwdriver tip before use.



for Preparation Click here

1. INSTALL REAR CRANKSHAFT OIL SEAL

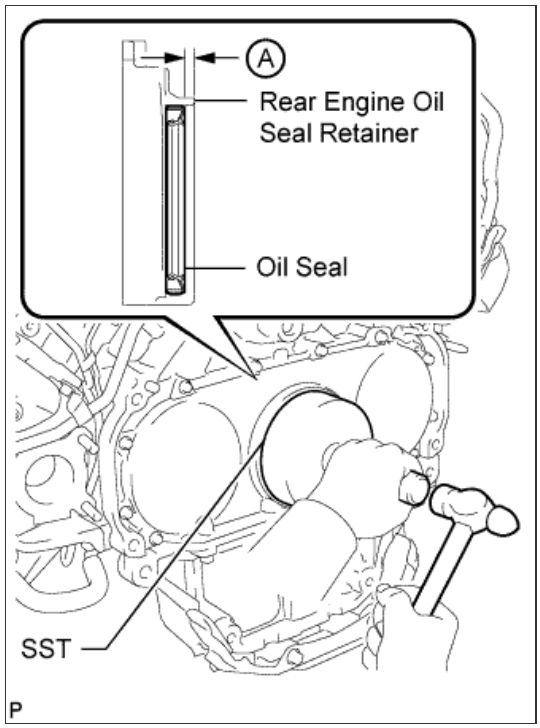
a. Using SST and a hammer, tap in a new oil seal as shown in the illustration.

SST
09223-56010

Standard depth A:
2.7 to 3.7 mm (0.106 to 0.147 in.)

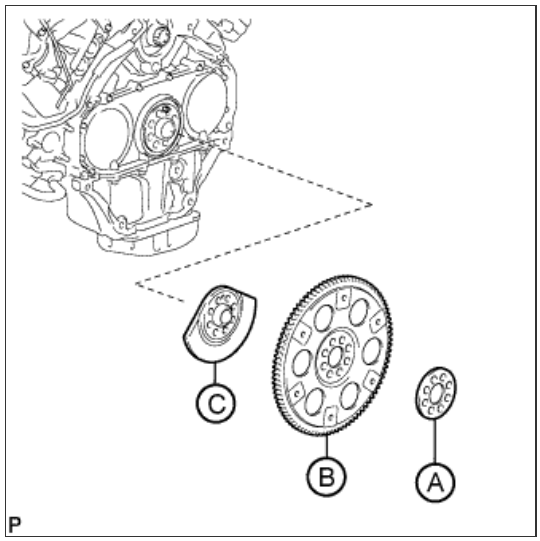
NOTICE:

- **Keep the lip free from foreign matter.**
- **Do not tap on the seal at an angle.**
- **Make sure that the lip of the oil seal is properly installed.**

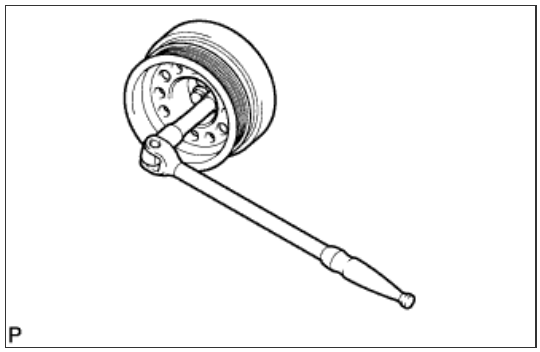


2. INSTALL DRIVE PLATE AND RING GEAR SUB-ASSEMBLY (for Automatic Transmission)

a. Install the rear crankshaft balancer weight labeled C, ring gear labeled B and rear drive plate spacer labeled A with 8 new bolts.

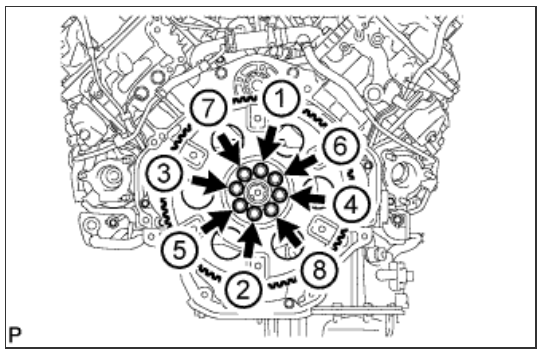


b. Using a wrench, hold the crankshaft.



c. Uniformly install and tighten the 8 bolts in the sequence shown in the illustration.

Torque:
182 N*m{ 1856 kgf*cm , 134 ft.*lbf }

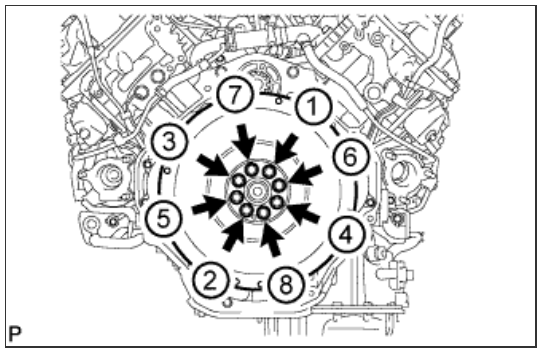


3. INSTALL FLYWHEEL SUB-ASSEMBLY (for Manual Transmission)

a. Temporarily install the flywheel with 8 new bolts.

NOTICE:

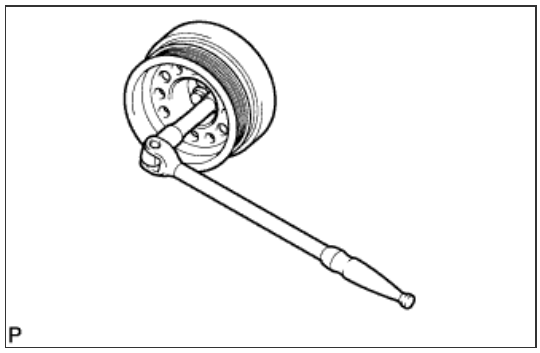
- **Align the crankshaft knock pin and flywheel knock pin hole.**
- **Do not strike or damage the flywheel installation bolts. Be sure to handle them carefully.**
- **Make sure there is no oil on the bolts.**



b. Using a wrench, hold the crankshaft.

c. Uniformly install and tighten the 8 bolts in the sequence shown in the illustration.

Torque:
182 N*m{ 1856 kgf*cm , 134 ft.*lbf }



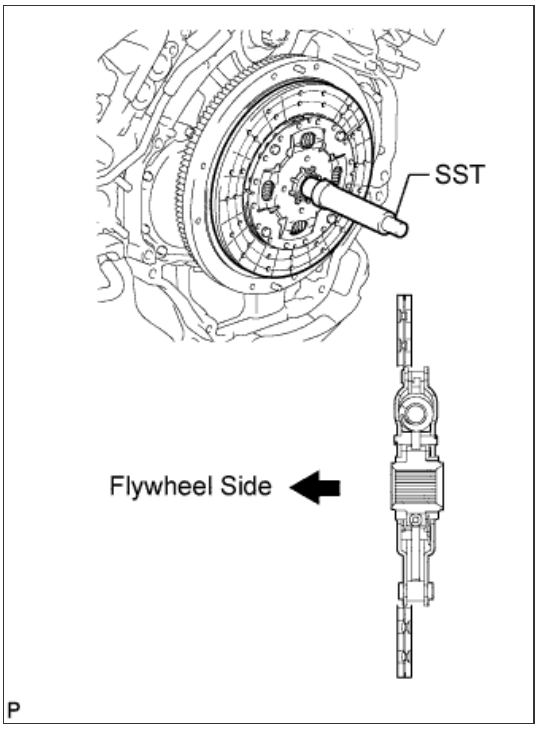
4. INSTALL CLUTCH DISC ASSEMBLY (for Manual Transmission)

a. Insert SST into the clutch disc, then insert the clutch disc into the flywheel.

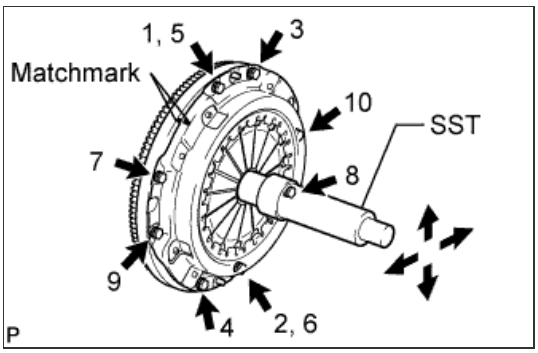
SST
09301-00120

NOTICE:

Take care not to insert the clutch disc in the wrong direction.



5. INSTALL CLUTCH COVER ASSEMBLY (for Manual Transmission)



a. Align the matchmark on the clutch cover with the one on the flywheel.

b. In the order shown in the illustration, temporarily install the 8 bolts starting from the bolt located near the knock pin on the top.

c. Check that the disc is in the center by lightly moving SST up and down, and left and right.

SST
09301-00120

d. Evenly tighten the bolts by following the order shown in the illustration.

Torque:
39 N*m{ 400 kgf*cm , 29 ft.*lbf }

6. INSTALL AUTOMATIC TRANSMISSION ASSEMBLY

a. Install the automatic transmission assembly (Click here).

7. INSTALL MANUAL TRANSMISSION UNIT ASSEMBLY

a. Install the manual transmission unit assembly (Click here).

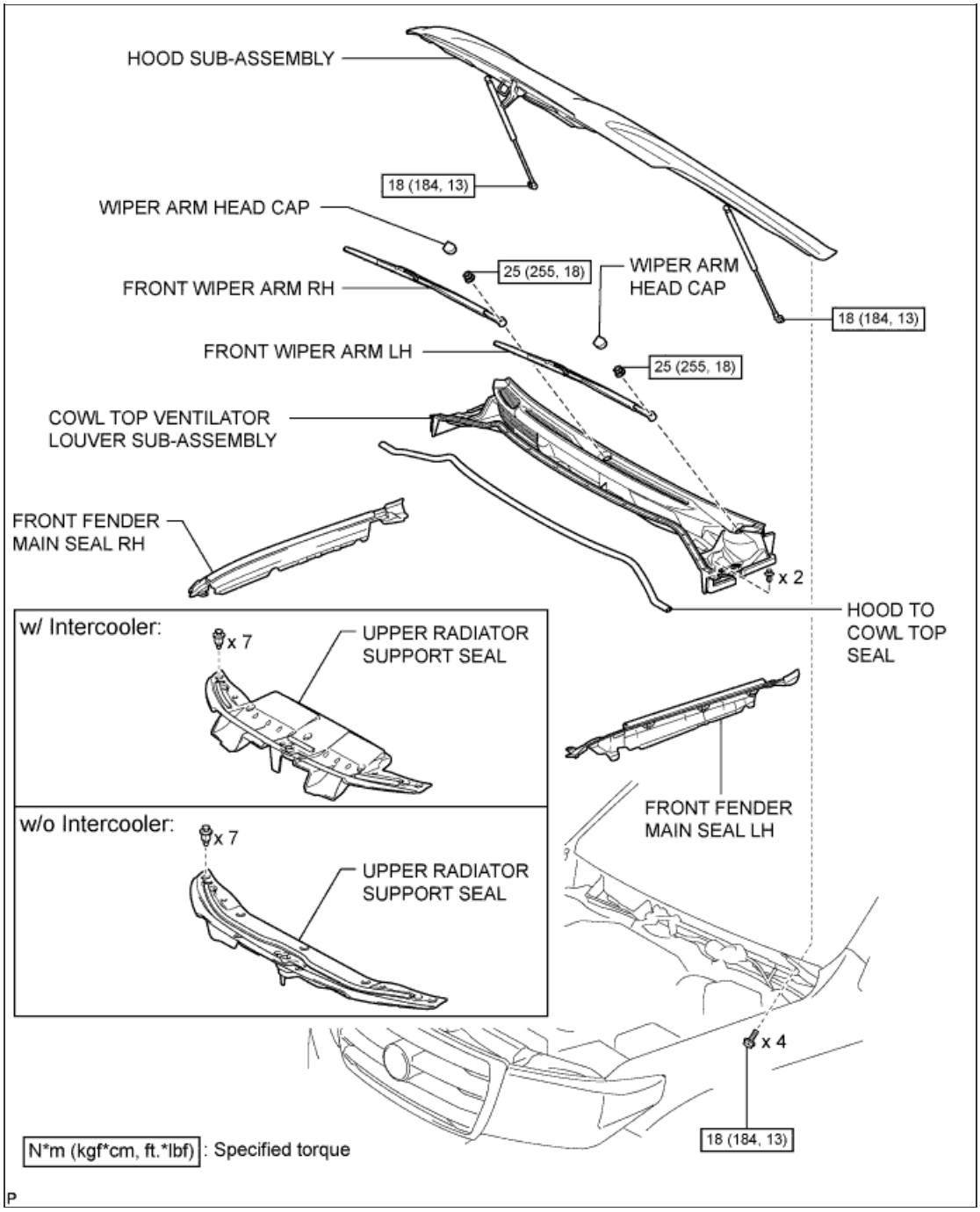
8. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

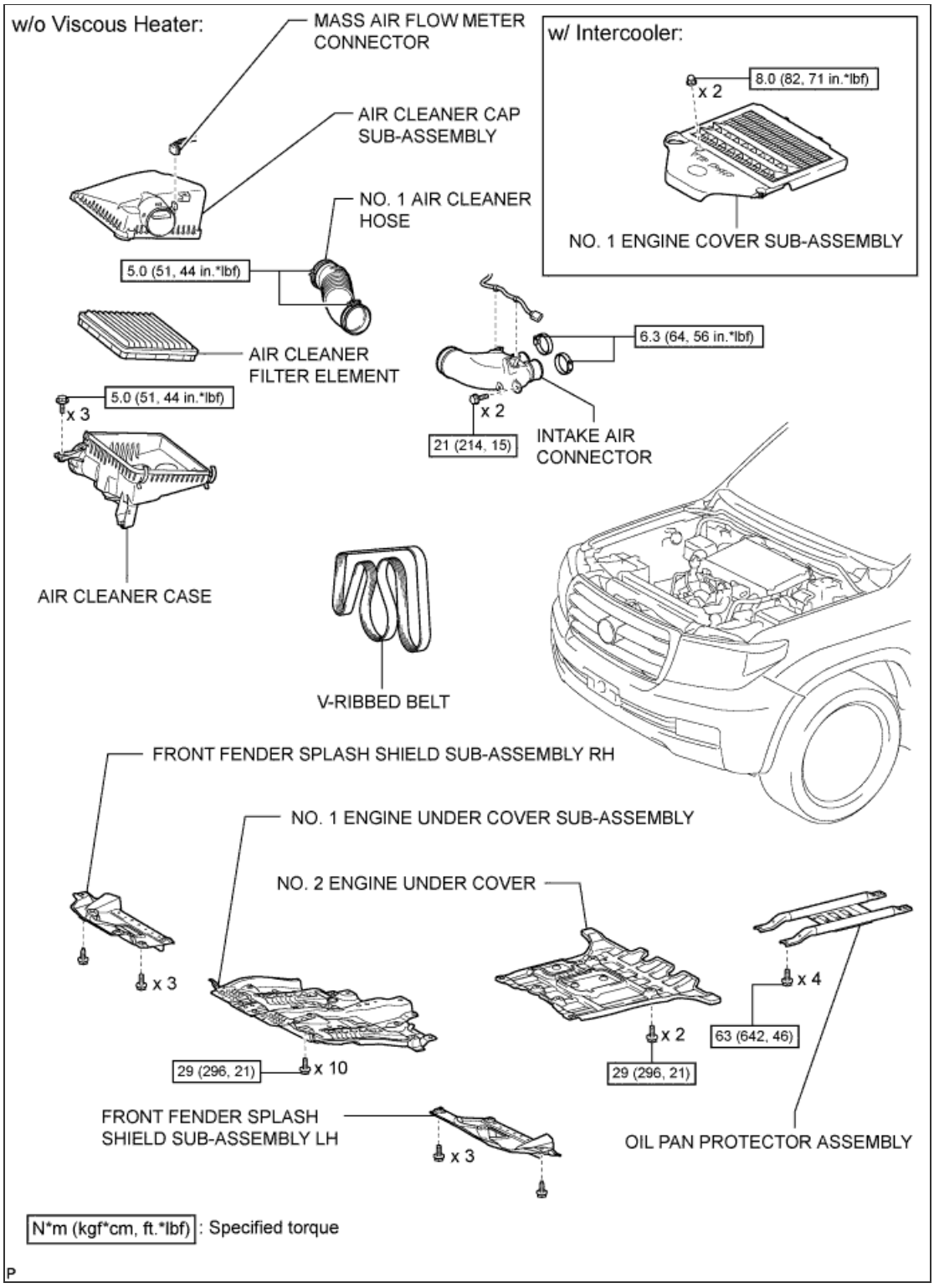
NOTICE:

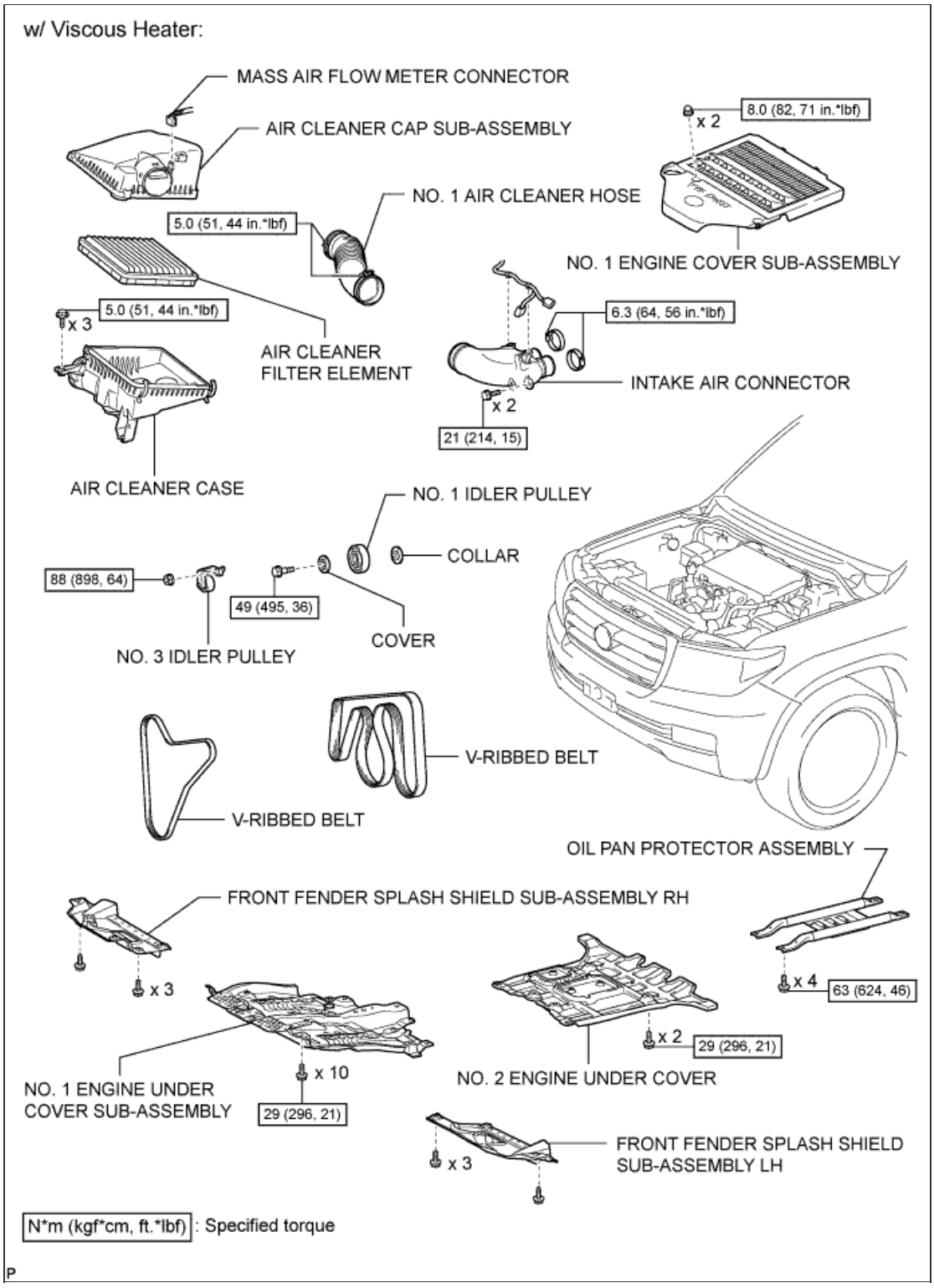
When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Connect the cables to the negative (-) main battery and sub-battery terminals.

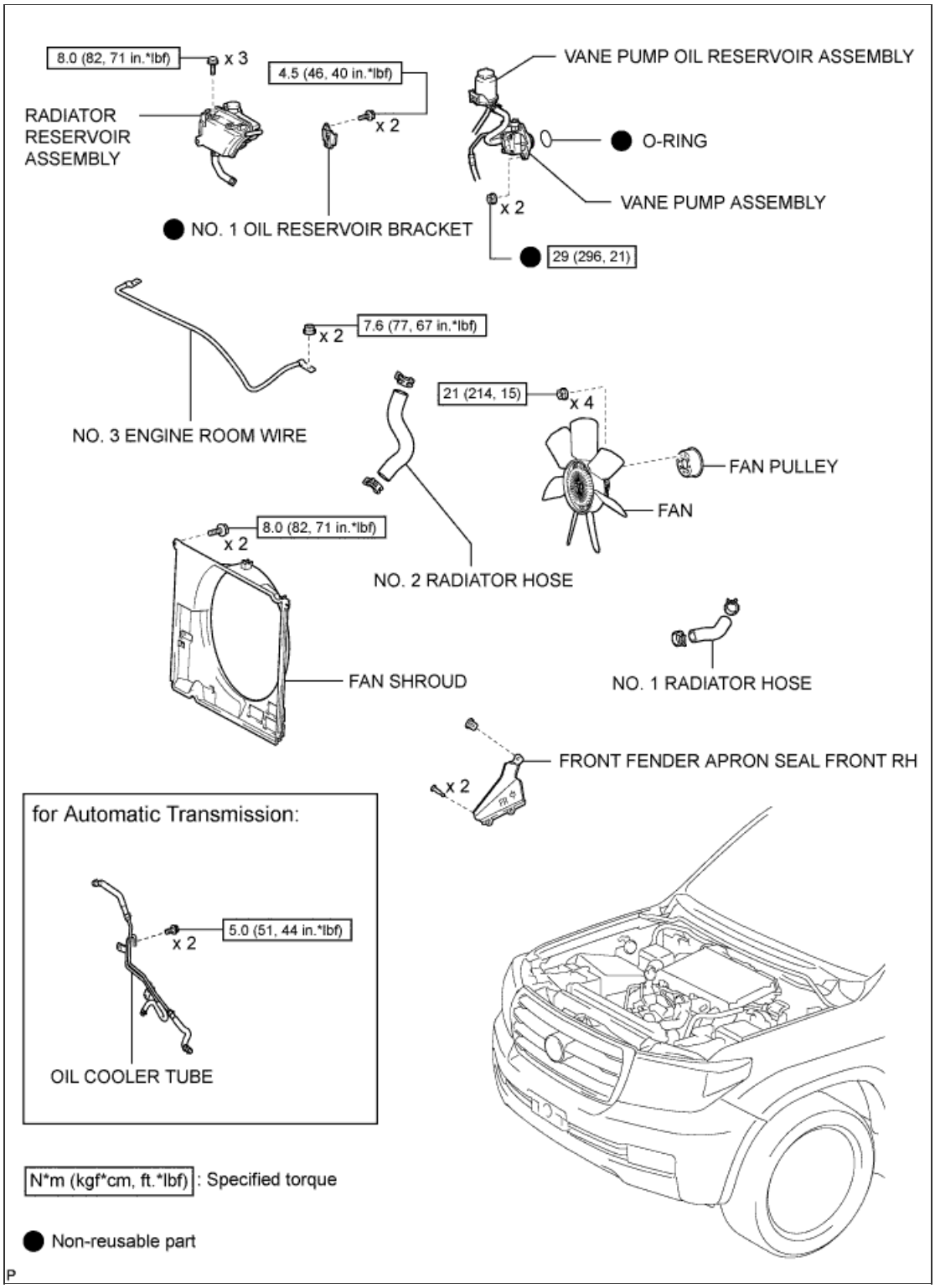
for Preparation Click here

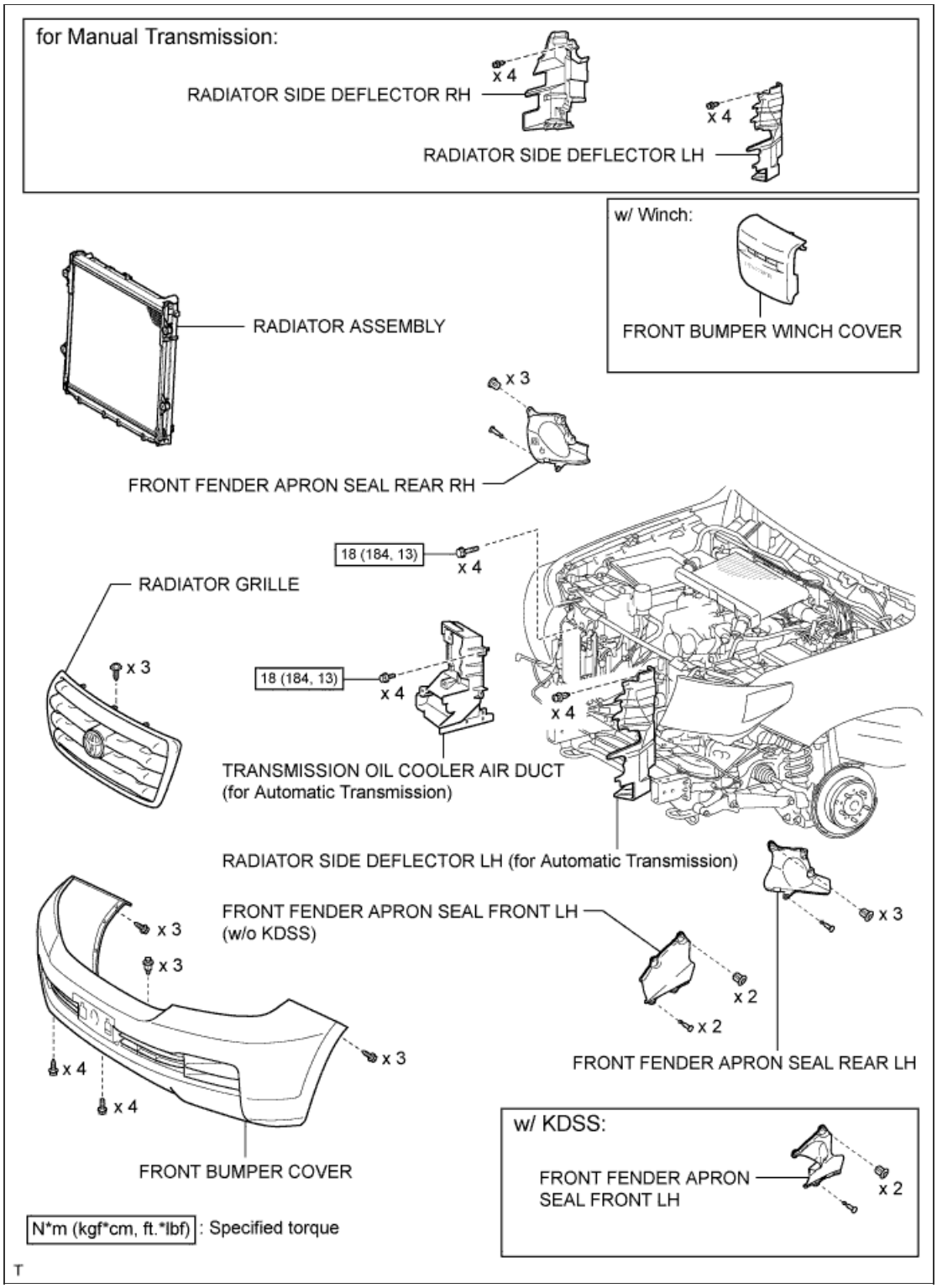


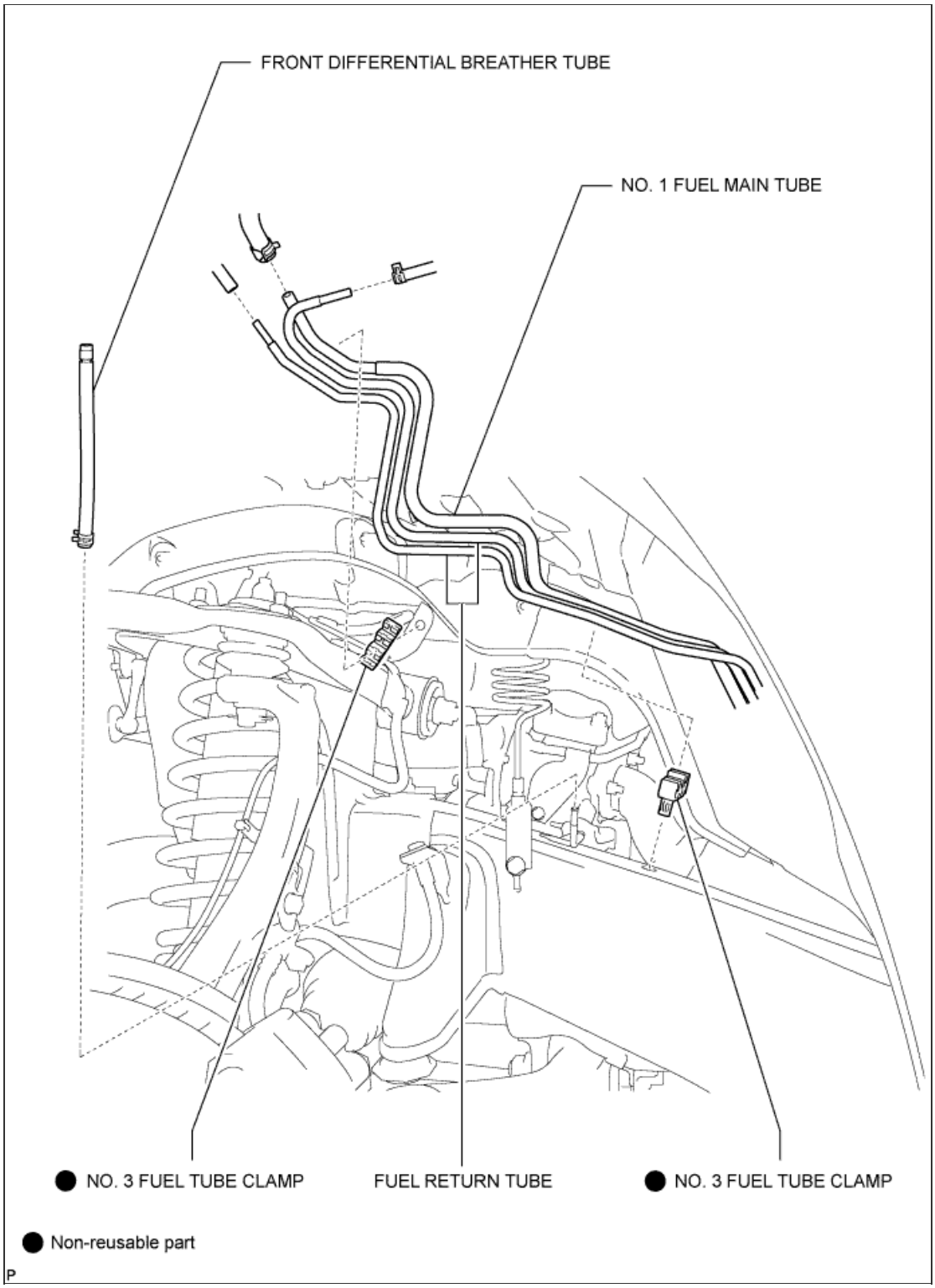

w/o Viscous Heater:
MASS AIR FLOW METER CONNECTOR
AIR CLEANER CAP SUB-ASSEMBLY
NO. 1 AIR CLEANER HOSE
5.0 (51, 44 in.*lbf)
AIR CLEANER FILTER ELEMENT
5.0 (51, 44 in.*lbf)
x 3
AIR CLEANER CASE
w/ Intercooler:
8.0 (82, 71 in.*lbf)
x 2
NO. 1 ENGINE COVER SUB-ASSEMBLY
6.3 (64, 56 in.*lbf)
x 2
21 (214, 15)
INTAKE AIR CONNECTOR
V-RIBBED BELT
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH
NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY
NO. 2 ENGINE UNDER COVER
x 3
29 (296, 21)
x 10
x 2
29 (296, 21)
x 4
63 (642, 46)
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH
x 3
OIL PAN PROTECTOR ASSEMBLY
N*m (kgf*cm, ft.*lbf): Specified torque
P

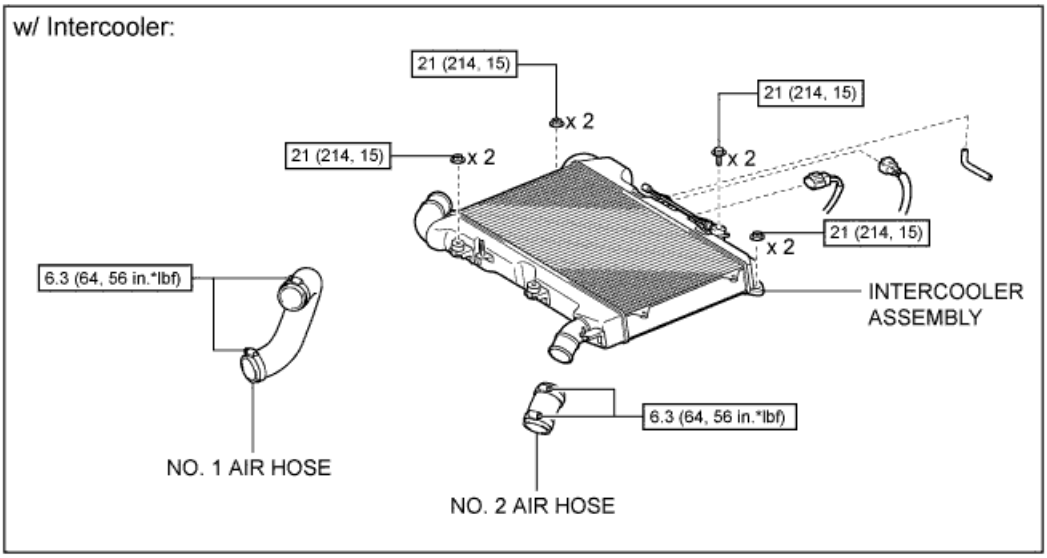

w/ Viscous Heater:
MASS AIR FLOW METER CONNECTOR
AIR CLEANER CAP SUB-ASSEMBLY
NO. 1 AIR CLEANER HOSE
5.0 (51, 44 in.*lbf)
x 2
8.0 (82, 71 in.*lbf)
NO. 1 ENGINE COVER SUB-ASSEMBLY
5.0 (51, 44 in.*lbf)
x 3
AIR CLEANER
FILTER ELEMENT
6.3 (64, 56 in.*lbf)
INTAKE AIR CONNECTOR
x 2
21 (214, 15)
AIR CLEANER CASE
NO. 1 IDLER PULLEY
COLLAR
88 (898, 64)
49 (495, 36)
COVER
NO. 3 IDLER PULLEY
V-RIBBED BELT
V-RIBBED BELT
OIL PAN PROTECTOR ASSEMBLY
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH
x 3
x 4
63 (624, 46)
x 10
x 2
29 (296, 21)
NO. 1 ENGINE UNDER
COVER SUB-ASSEMBLY
29 (296, 21)
NO. 2 ENGINE UNDER COVER
x 3
FRONT FENDER SPLASH SHIELD
SUB-ASSEMBLY LH
N*m (kgf*cm, ft.*lbf) : Specified torque

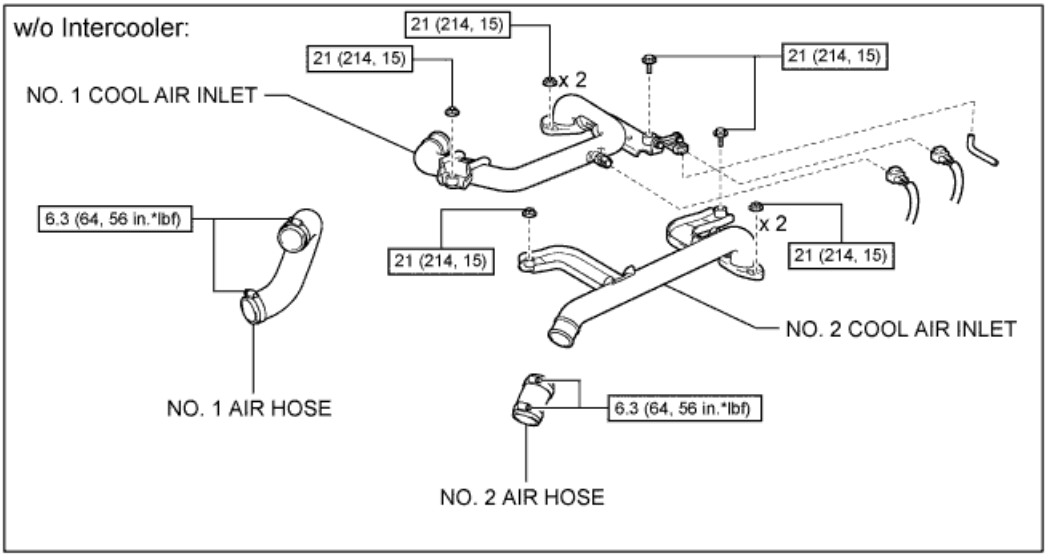
P


8.0 (82, 71 in.*lbf)
x 3
4.5 (46, 40 in.*lbf)
x 2
RADIATOR RESERVOIR ASSEMBLY
NO. 1 OIL RESERVOIR BRACKET
VANE PUMP OIL RESERVOIR ASSEMBLY
O-RING
VANE PUMP ASSEMBLY
x 2
29 (296, 21)
x 2
7.6 (77, 67 in.*lbf)
NO. 3 ENGINE ROOM WIRE
21 (214, 15)
x 4
FAN PULLEY
FAN
8.0 (82, 71 in.*lbf)
x 2
NO. 2 RADIATOR HOSE
FAN SHROUD
NO. 1 RADIATOR HOSE
FRONT FENDER APRON SEAL FRONT RH
x 2
for Automatic Transmission:
x 2
5.0 (51, 44 in.*lbf)
OIL COOLER TUBE
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P


for Manual Transmission:
RADIATOR SIDE DEFLECTOR RH
x 4
x 4
RADIATOR SIDE DEFLECTOR LH
w/ Winch:
FRONT BUMPER WINCH COVER
RADIATOR ASSEMBLY
x 3
FRONT FENDER APRON SEAL REAR RH
18 (184, 13)
x 4
RADIATOR GRILLE
x 3
18 (184, 13)
x 4
x 4
TRANSMISSION OIL COOLER AIR DUCT
(for Automatic Transmission)
RADIATOR SIDE DEFLECTOR LH (for Automatic Transmission)
x 3
FRONT FENDER APRON SEAL FRONT LH
(w/o KDSS)
x 2
x 2
FRONT FENDER APRON SEAL REAR LH
x 3
x 3
x 3
x 4
x 4
FRONT BUMPER COVER
w/ KDSS:
FRONT FENDER APRON
SEAL FRONT LH
x 2
N*m (kgf*cm, ft.*lbf) : Specified torque
T


FRONT DIFFERENTIAL BREATHER TUBE
NO. 1 FUEL MAIN TUBE
NO. 3 FUEL TUBE CLAMP
FUEL RETURN TUBE
NO. 3 FUEL TUBE CLAMP
Non-reusable part
P

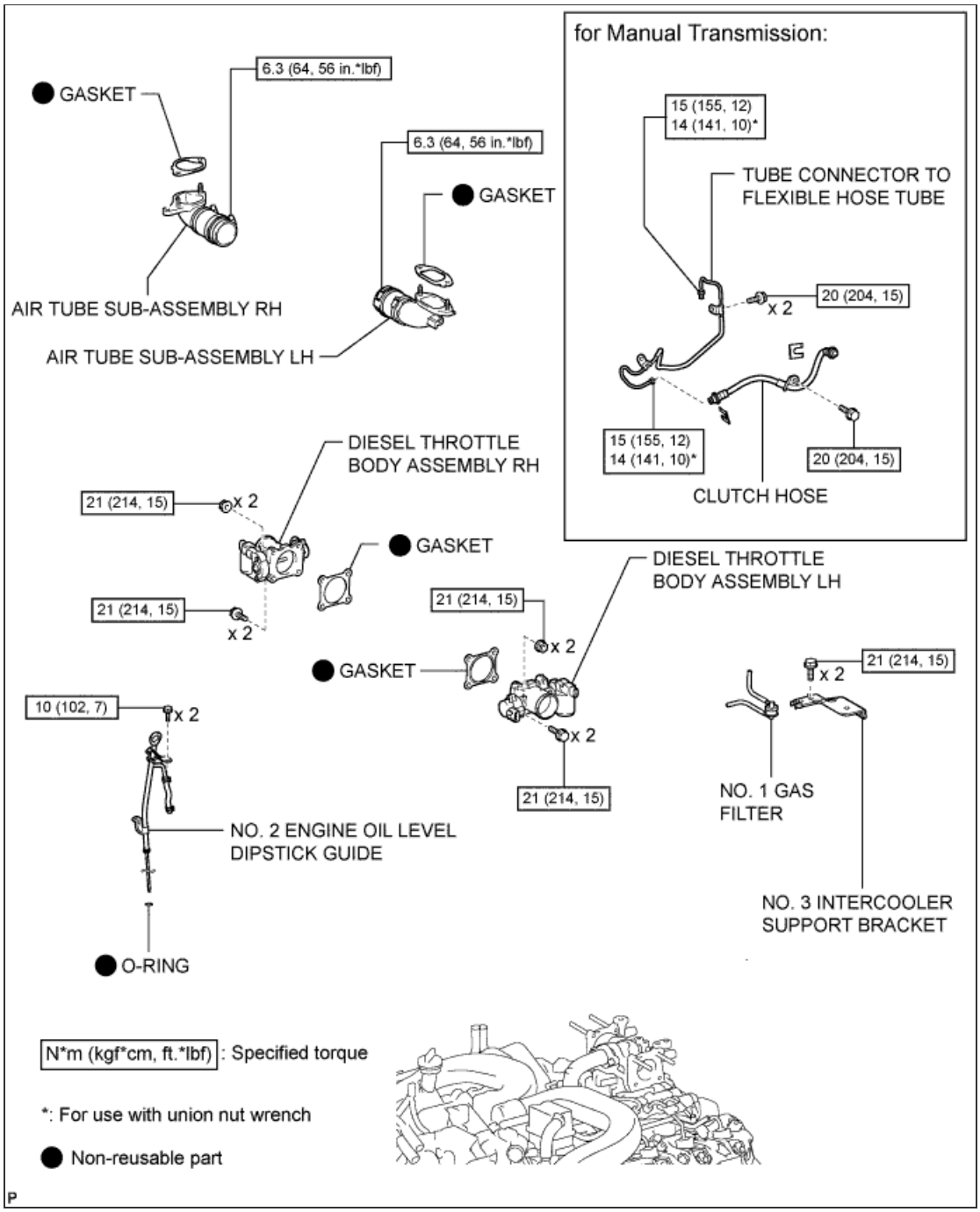


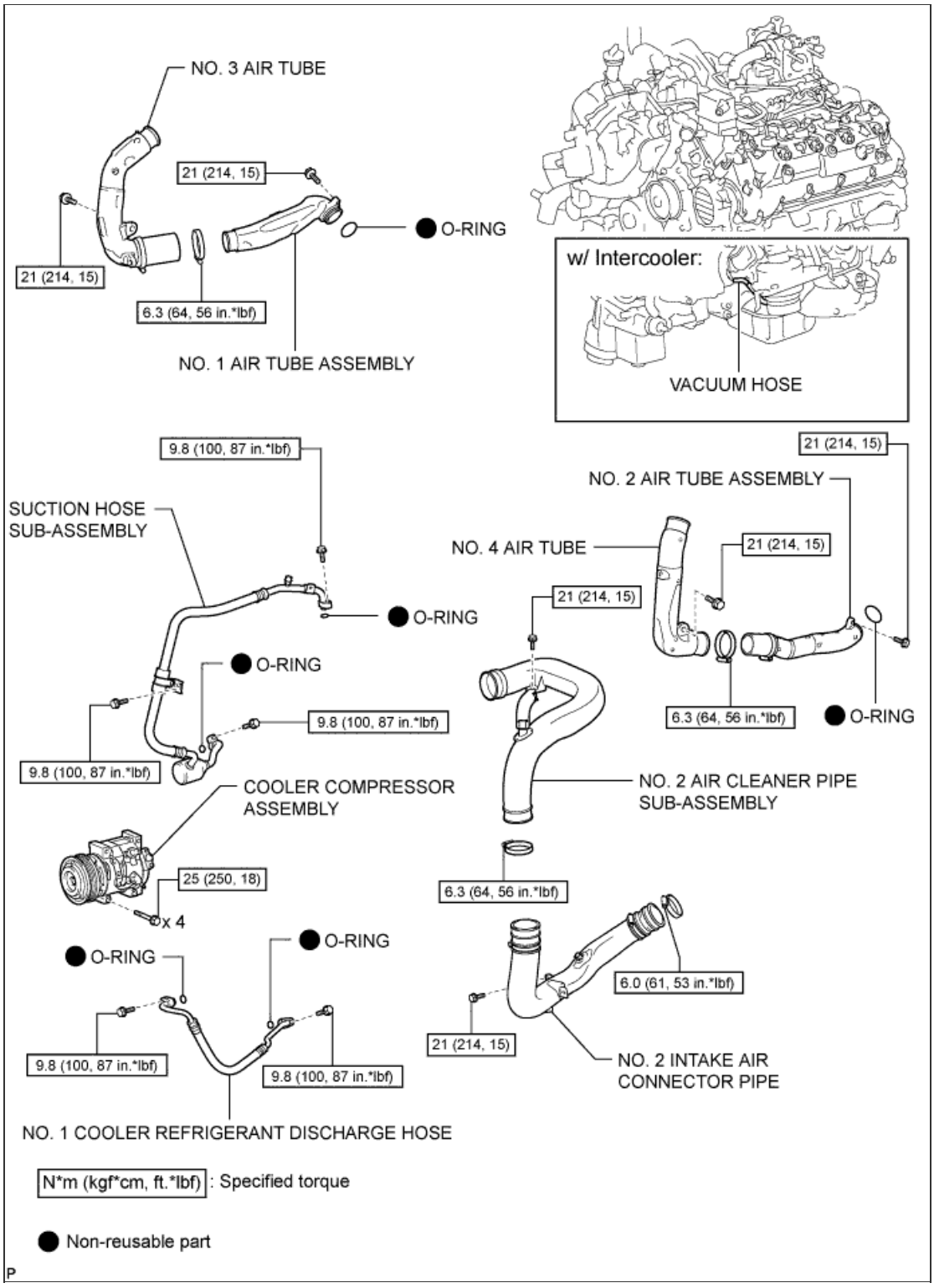


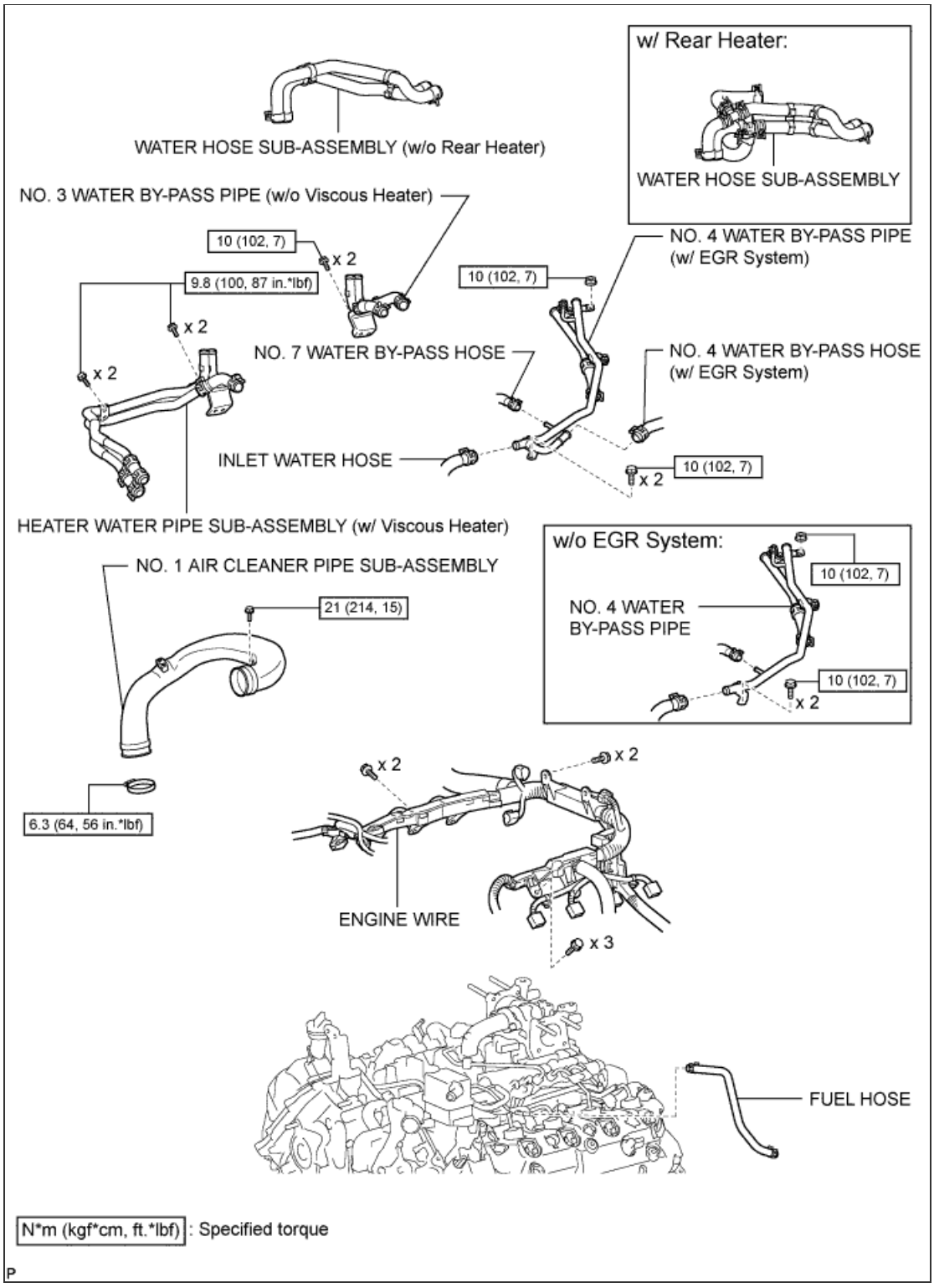


N*m (kgf*cm, ft.*lbf) : Specified torque

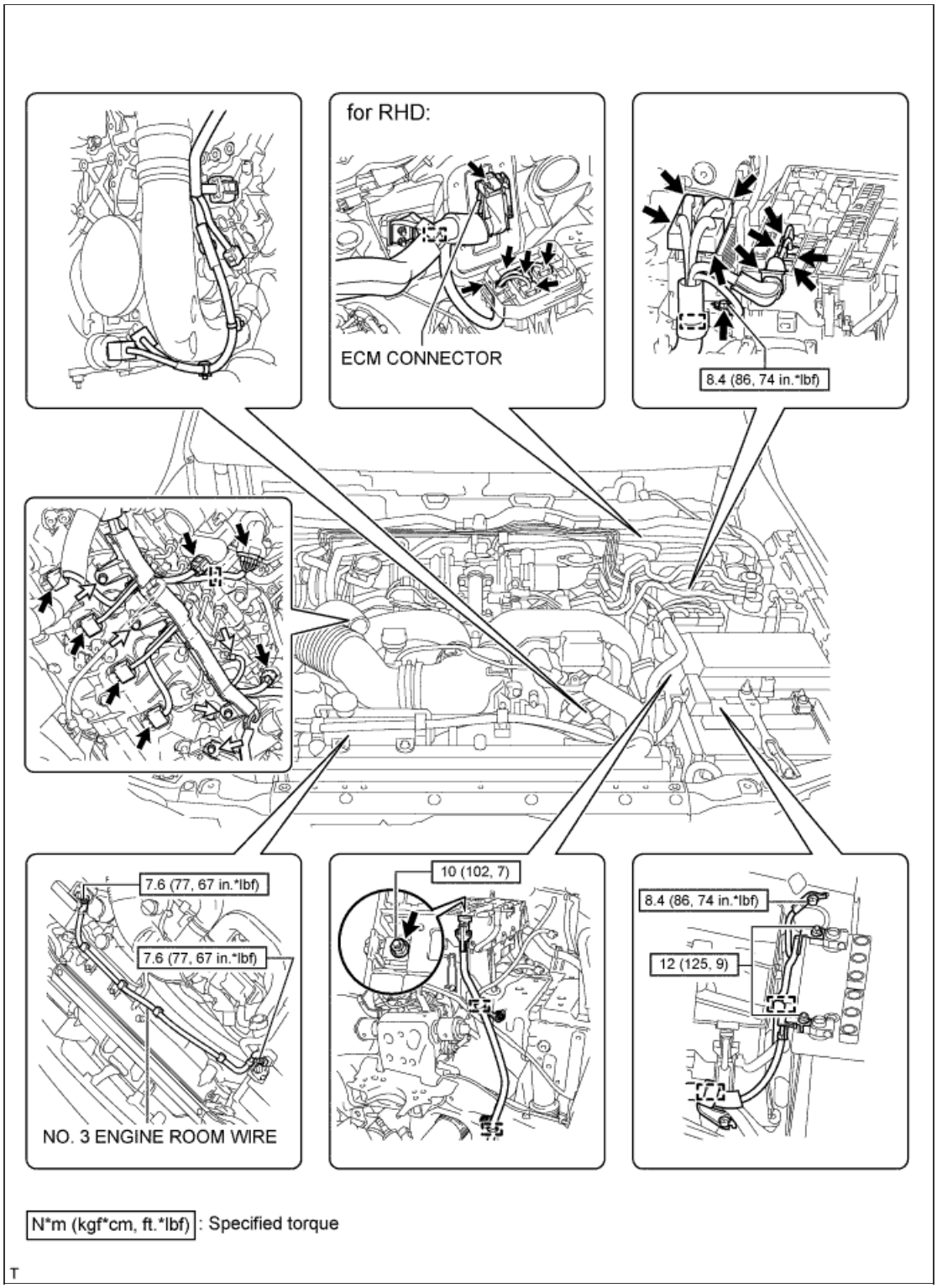
P


for Manual Transmission:
GASKET
6.3 (64, 56 in.*lbf)
AIR TUBE SUB-ASSEMBLY RH
6.3 (64, 56 in.*lbf)
GASKET
AIR TUBE SUB-ASSEMBLY LH
15 (155, 12)
14 (141, 10)*
TUBE CONNECTOR TO
FLEXIBLE HOSE TUBE
20 (204, 15)
x 2
15 (155, 12)
14 (141, 10)*
20 (204, 15)
CLUTCH HOSE
DIESEL THROTTLE
BODY ASSEMBLY RH
21 (214, 15)
x 2
GASKET
21 (214, 15)
x 2
DIESEL THROTTLE
BODY ASSEMBLY LH
21 (214, 15)
x 2
GASKET
x 2
21 (214, 15)
21 (214, 15)
x 2
10 (102, 7)
x 2
NO. 1 GAS
FILTER
NO. 2 ENGINE OIL LEVEL
DIPSTICK GUIDE
NO. 3 INTERCOOLER
SUPPORT BRACKET
O-RING
N*m (kgf*cm, ft.*lbf): Specified torque
*: For use with union nut wrench
Non-reusable part
P

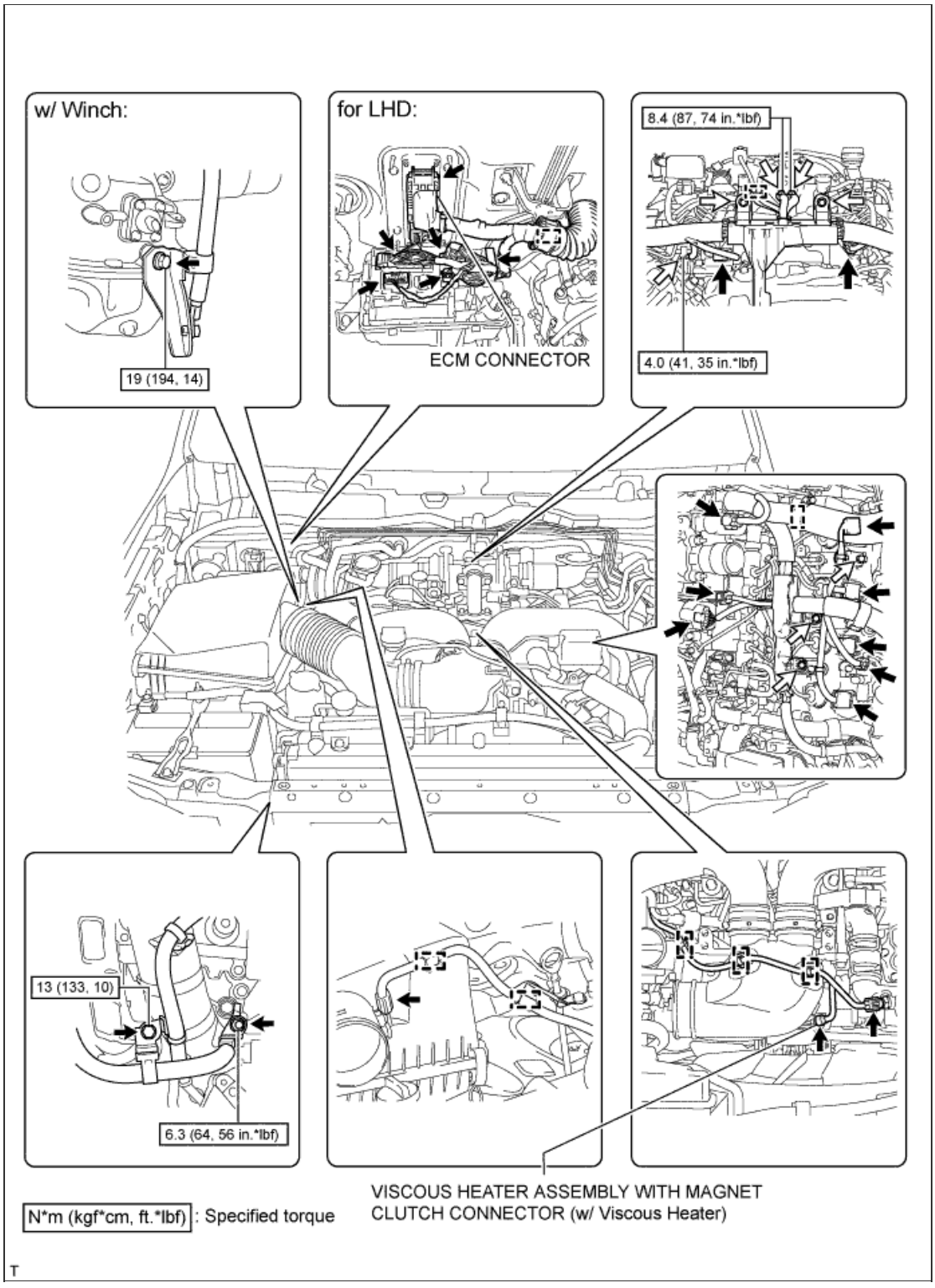

NO. 3 AIR TUBE
21 (214, 15)
O-RING
21 (214, 15)
6.3 (64, 56 in.*lbf)
NO. 1 AIR TUBE ASSEMBLY
w/ Intercooler:
VACUUM HOSE
9.8 (100, 87 in.*lbf)
SUCTION HOSE SUB-ASSEMBLY
O-RING
O-RING
9.8 (100, 87 in.*lbf)
9.8 (100, 87 in.*lbf)
COOLER COMPRESSOR ASSEMBLY
25 (250, 18)
x 4
O-RING
O-RING
9.8 (100, 87 in.*lbf)
9.8 (100, 87 in.*lbf)
NO. 1 COOLER REFRIGERANT DISCHARGE HOSE
21 (214, 15)
NO. 2 AIR TUBE ASSEMBLY
NO. 4 AIR TUBE
21 (214, 15)
21 (214, 15)
6.3 (64, 56 in.*lbf)
O-RING
NO. 2 AIR CLEANER PIPE SUB-ASSEMBLY
6.3 (64, 56 in.*lbf)
6.0 (61, 53 in.*lbf)
21 (214, 15)
NO. 2 INTAKE AIR CONNECTOR PIPE
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P


w/ Rear Heater:
WATER HOSE SUB-ASSEMBLY
WATER HOSE SUB-ASSEMBLY (w/o Rear Heater)
NO. 3 WATER BY-PASS PIPE (w/o Viscous Heater)
10 (102, 7)
x 2
9.8 (100, 87 in.*lbf)
x 2
x 2
NO. 7 WATER BY-PASS HOSE
10 (102, 7)
NO. 4 WATER BY-PASS PIPE
(w/ EGR System)
NO. 4 WATER BY-PASS HOSE
(w/ EGR System)
INLET WATER HOSE
x 2
10 (102, 7)
HEATER WATER PIPE SUB-ASSEMBLY (w/ Viscous Heater)
NO. 1 AIR CLEANER PIPE SUB-ASSEMBLY
21 (214, 15)
w/o EGR System:
10 (102, 7)
NO. 4 WATER
BY-PASS PIPE
10 (102, 7)
x 2
6.3 (64, 56 in.*lbf)
x 2
x 2
ENGINE WIRE
x 3
FUEL HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque

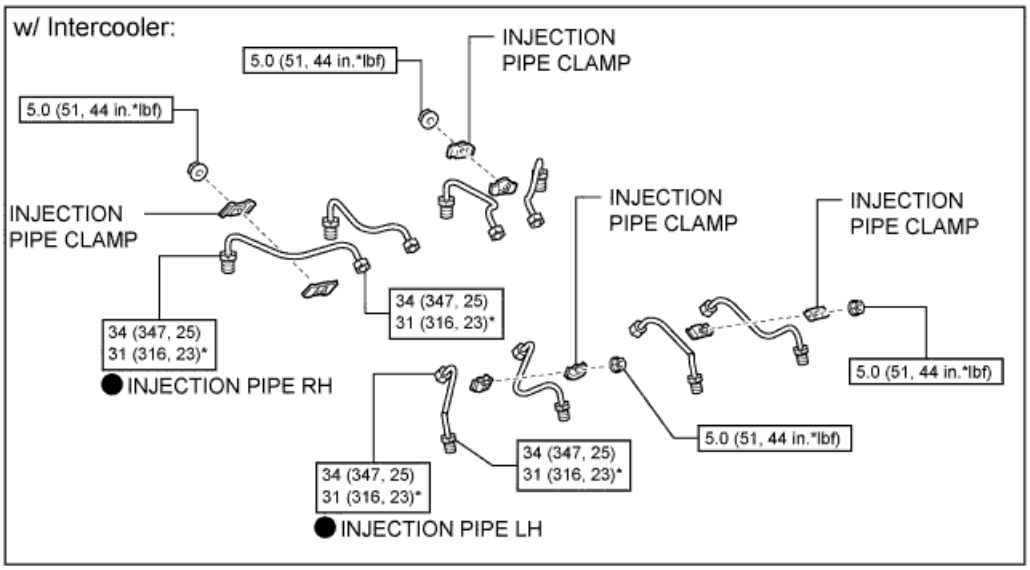
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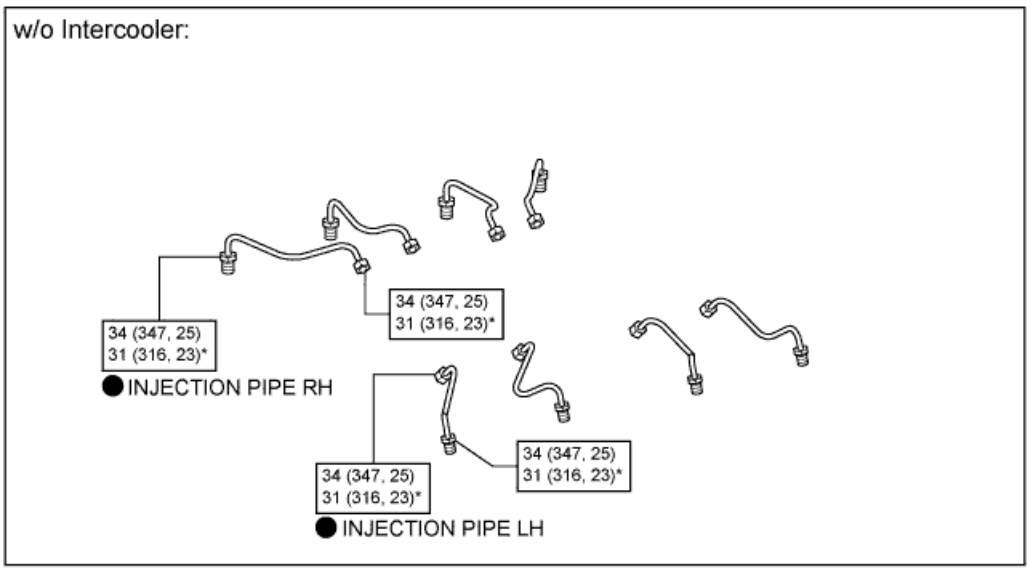

for RHD:
ECM CONNECTOR
8.4 (86, 74 in.*lbf)
7.6 (77, 67 in.*lbf)
7.6 (77, 67 in.*lbf)
NO. 3 ENGINE ROOM WIRE
10 (102, 7)
8.4 (86, 74 in.*lbf)
12 (125, 9)
N*m (kgf*cm, ft.*lbf) : Specified torque

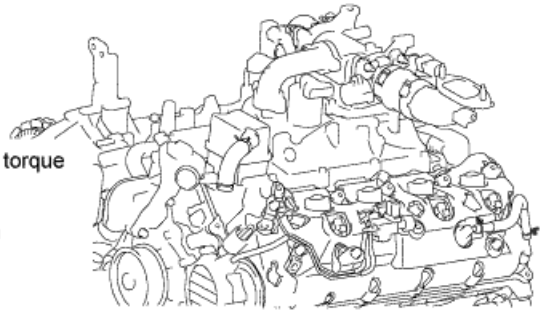
T


w/ Winch:
19 (194, 14)
for LHD:
ECM CONNECTOR
8.4 (87, 74 in.*lbf)
4.0 (41, 35 in.*lbf)
13 (133, 10)
6.3 (64, 56 in.*lbf)
VISCOUS HEATER ASSEMBLY WITH MAGNET
CLUTCH CONNECTOR (w/ Viscous Heater)
N*m (kgf*cm, ft.*lbf) : Specified torque

T





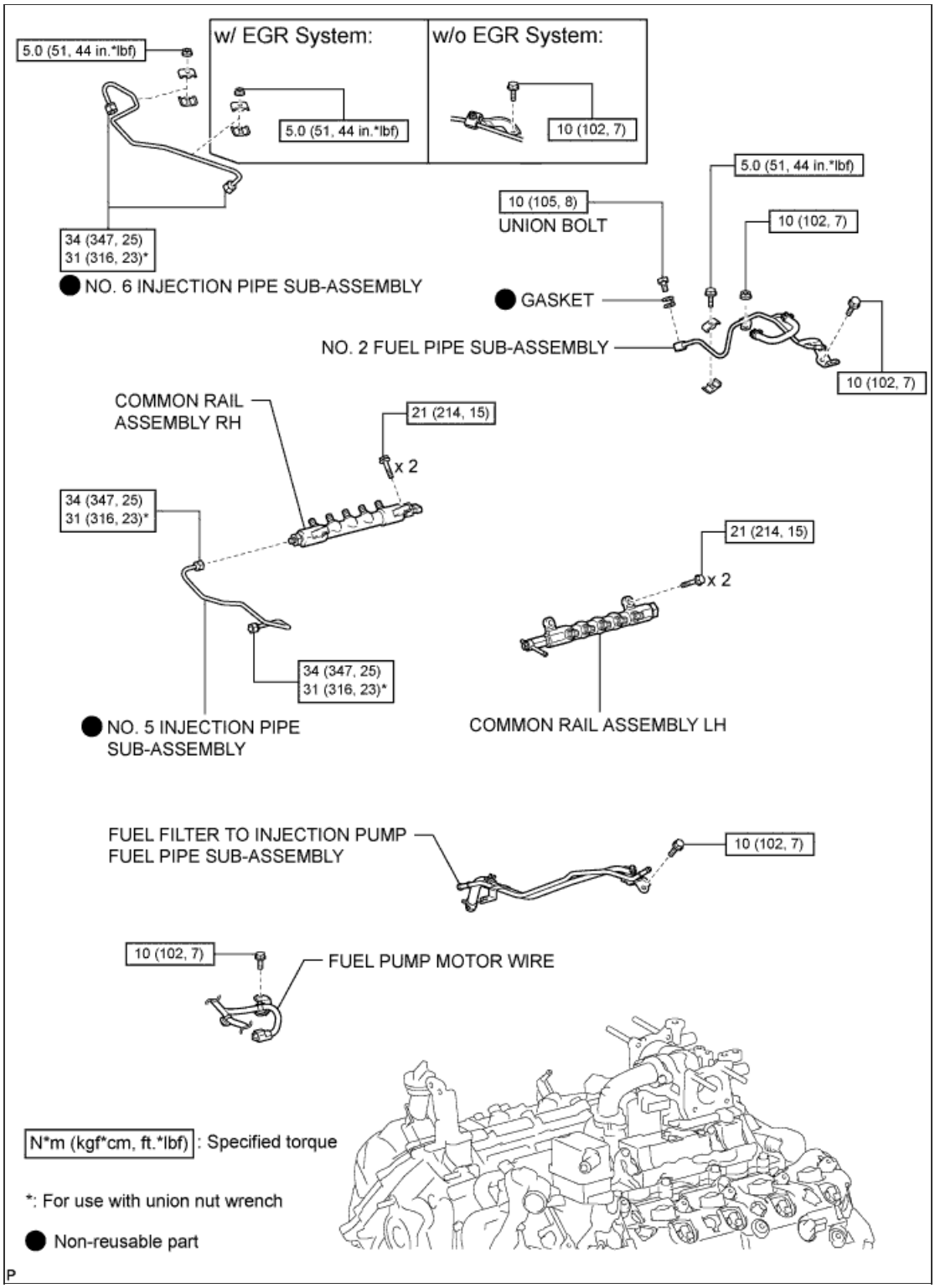


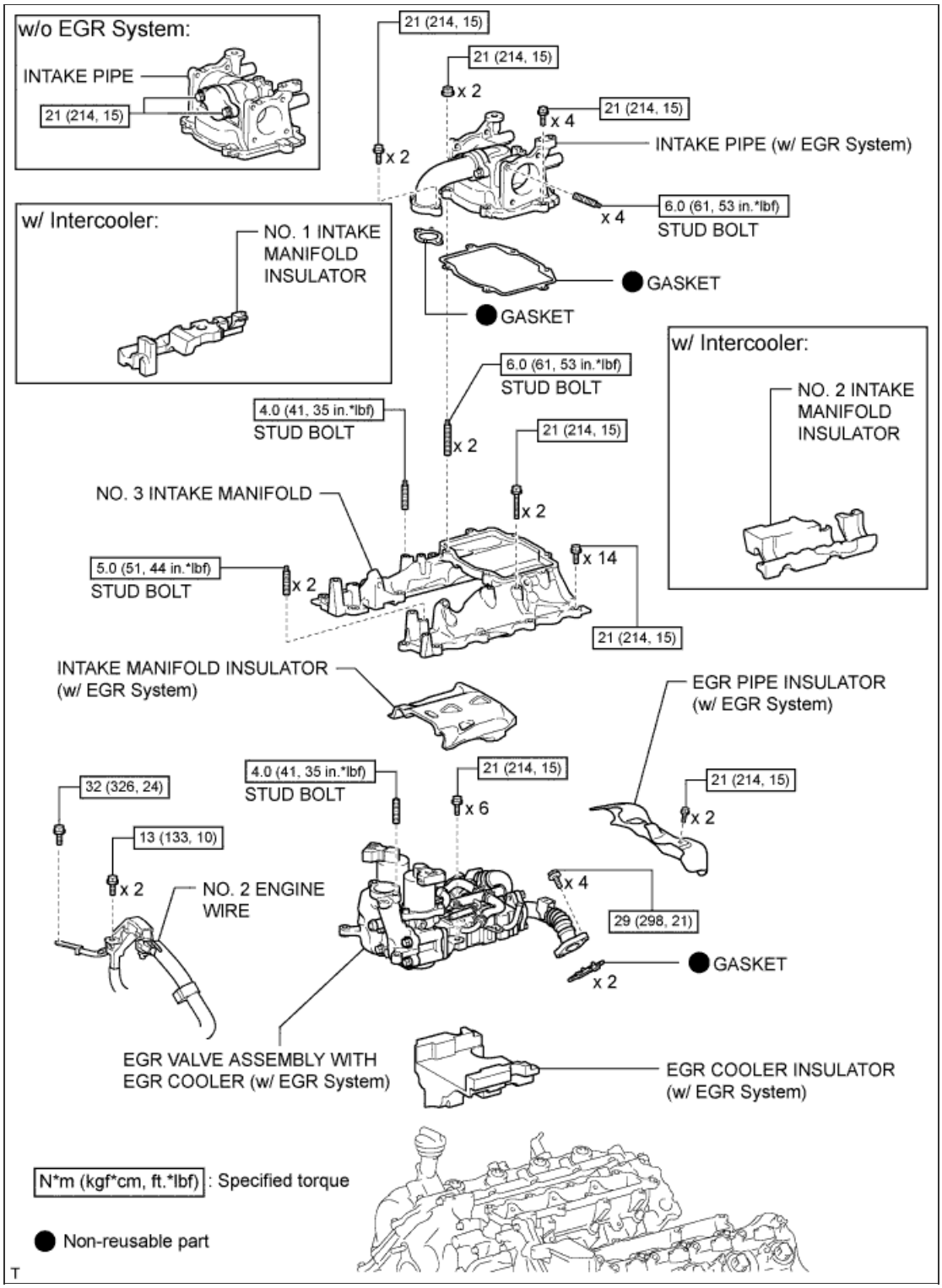
N*m (kgf*cm, ft.*lbf): Specified torque

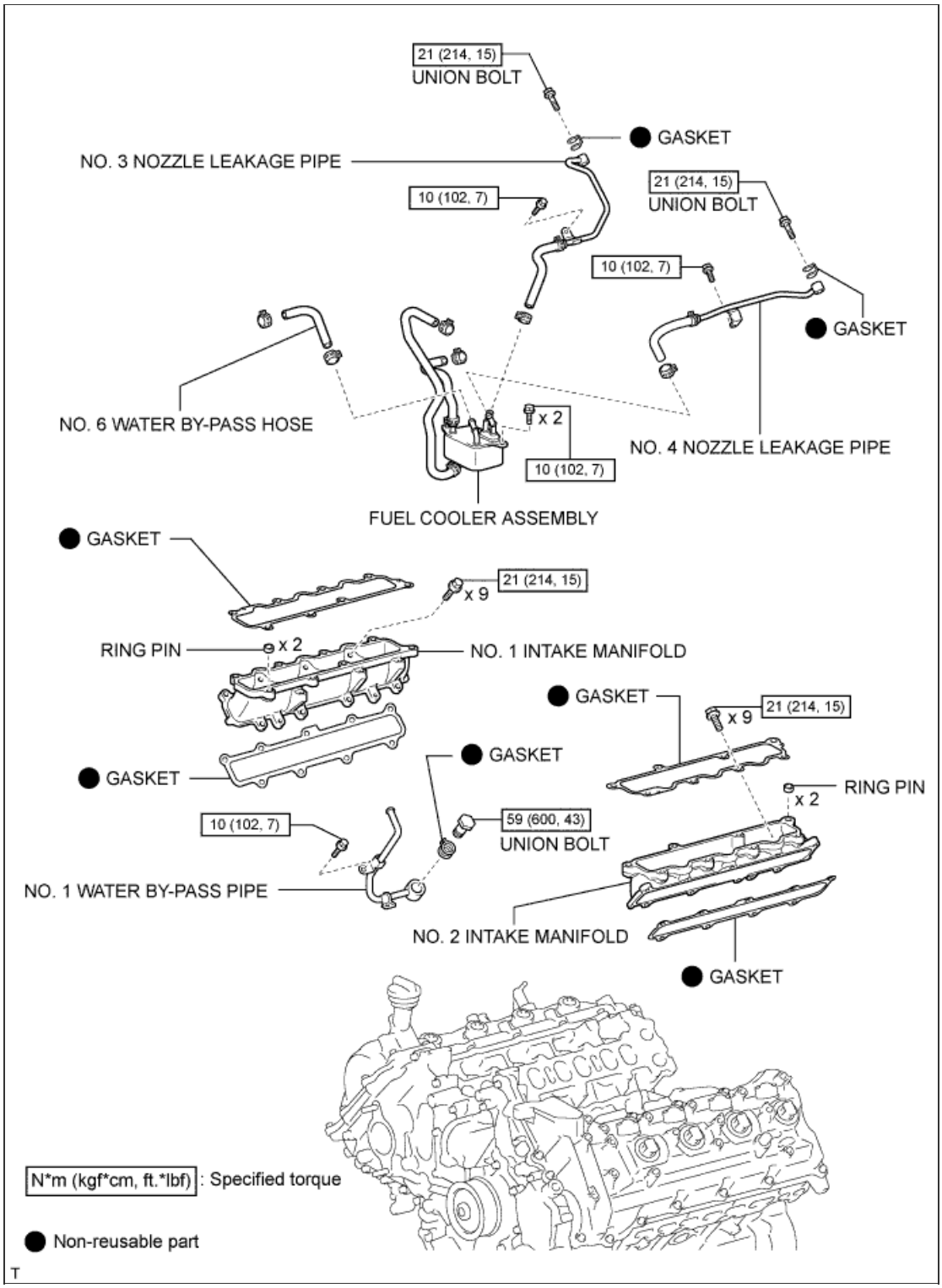
*: For use with union nut wrench

● Non-reusable part

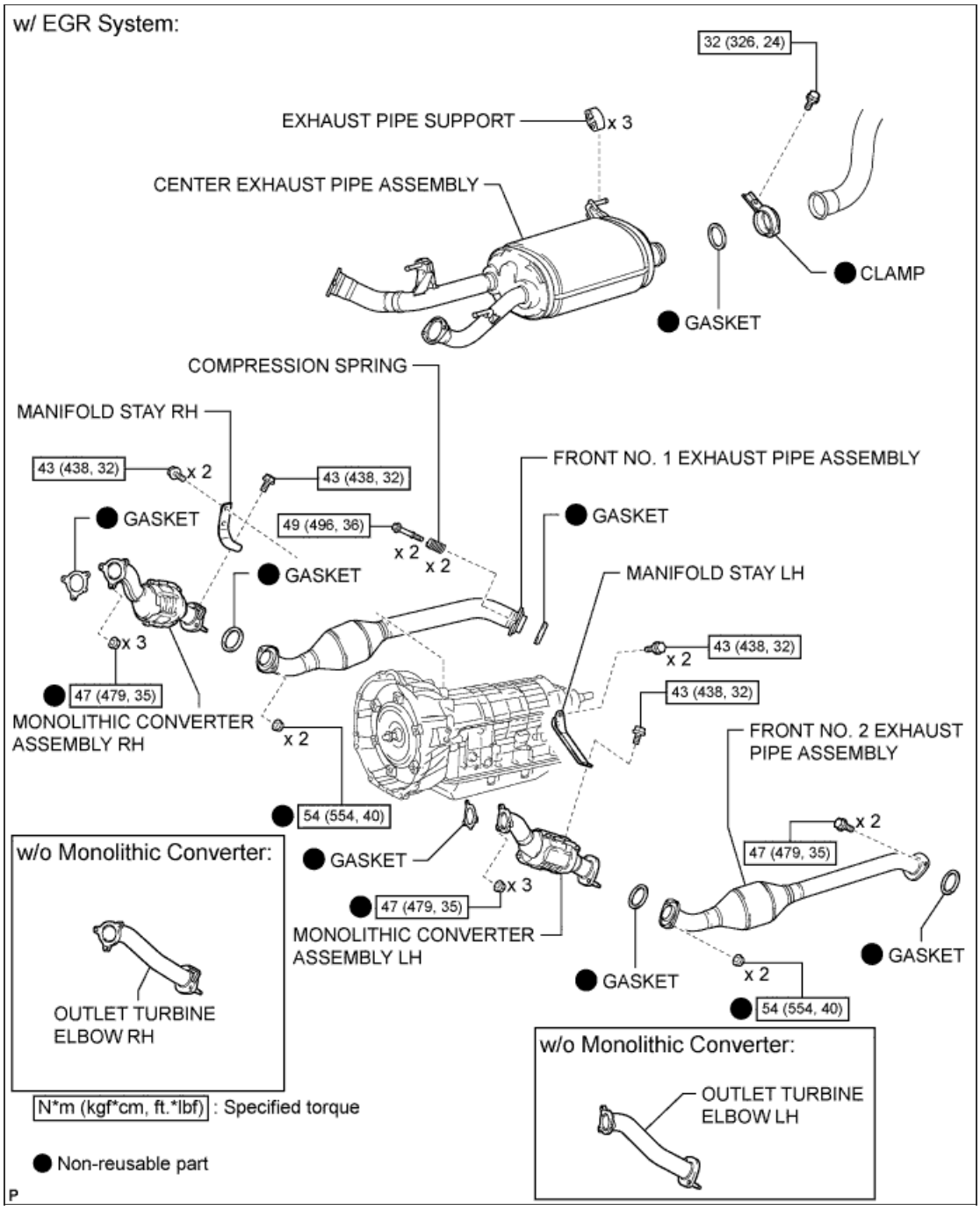
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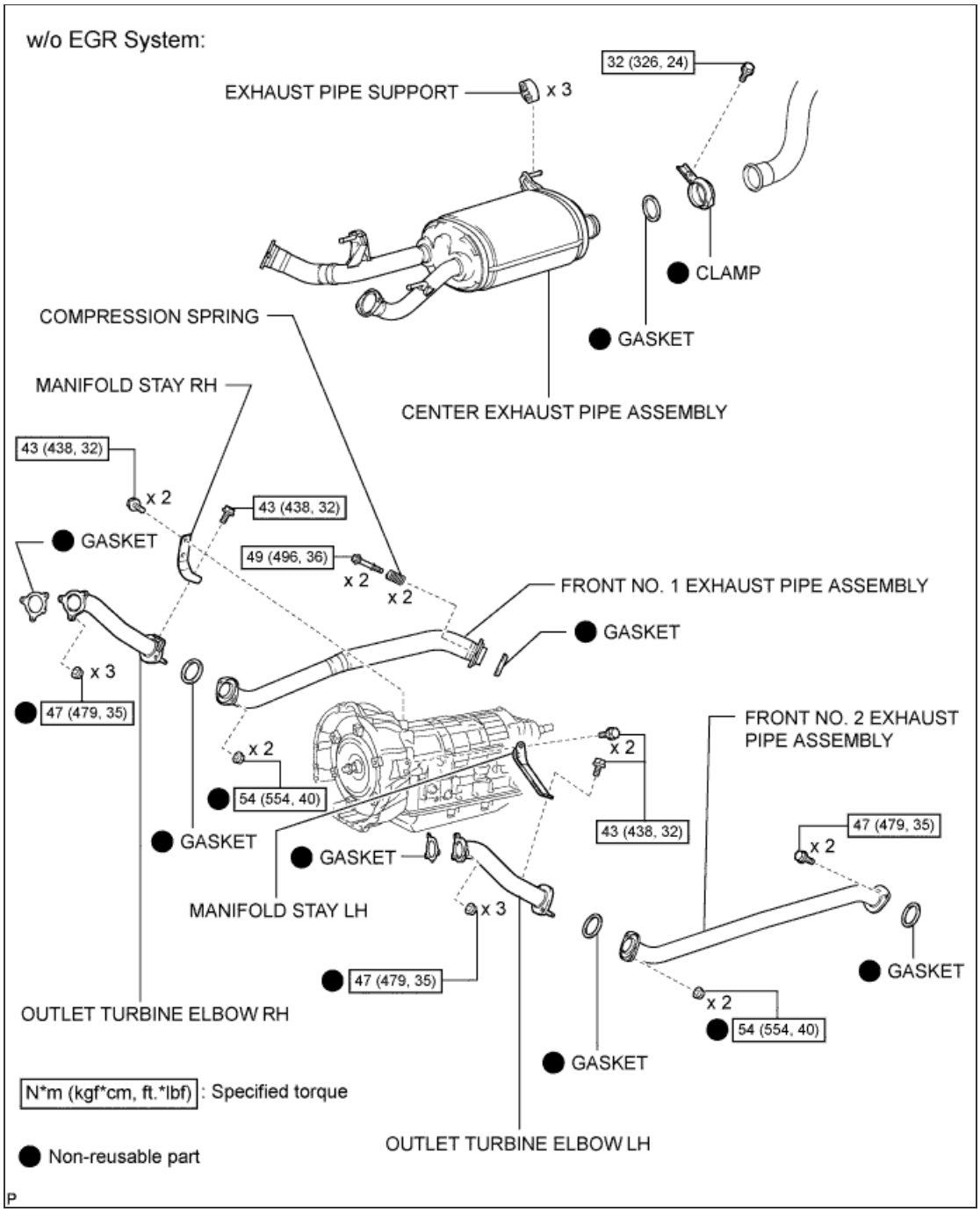

w/ EGR System:
w/o EGR System:
5.0 (51, 44 in.*lbf)
5.0 (51, 44 in.*lbf)
10 (102, 7)
5.0 (51, 44 in.*lbf)
10 (105, 8)
UNION BOLT
10 (102, 7)
34 (347, 25)
31 (316, 23)*
NO. 6 INJECTION PIPE SUB-ASSEMBLY
GASKET
NO. 2 FUEL PIPE SUB-ASSEMBLY
10 (102, 7)
COMMON RAIL ASSEMBLY RH
21 (214, 15)
x 2
34 (347, 25)
31 (316, 23)*
21 (214, 15)
x 2
34 (347, 25)
31 (316, 23)*
NO. 5 INJECTION PIPE SUB-ASSEMBLY
COMMON RAIL ASSEMBLY LH
FUEL FILTER TO INJECTION PUMP FUEL PIPE SUB-ASSEMBLY
10 (102, 7)
10 (102, 7)
FUEL PUMP MOTOR WIRE
N*m (kgf*cm, ft.*lbf) : Specified torque
*: For use with union nut wrench
Non-reusable part
P

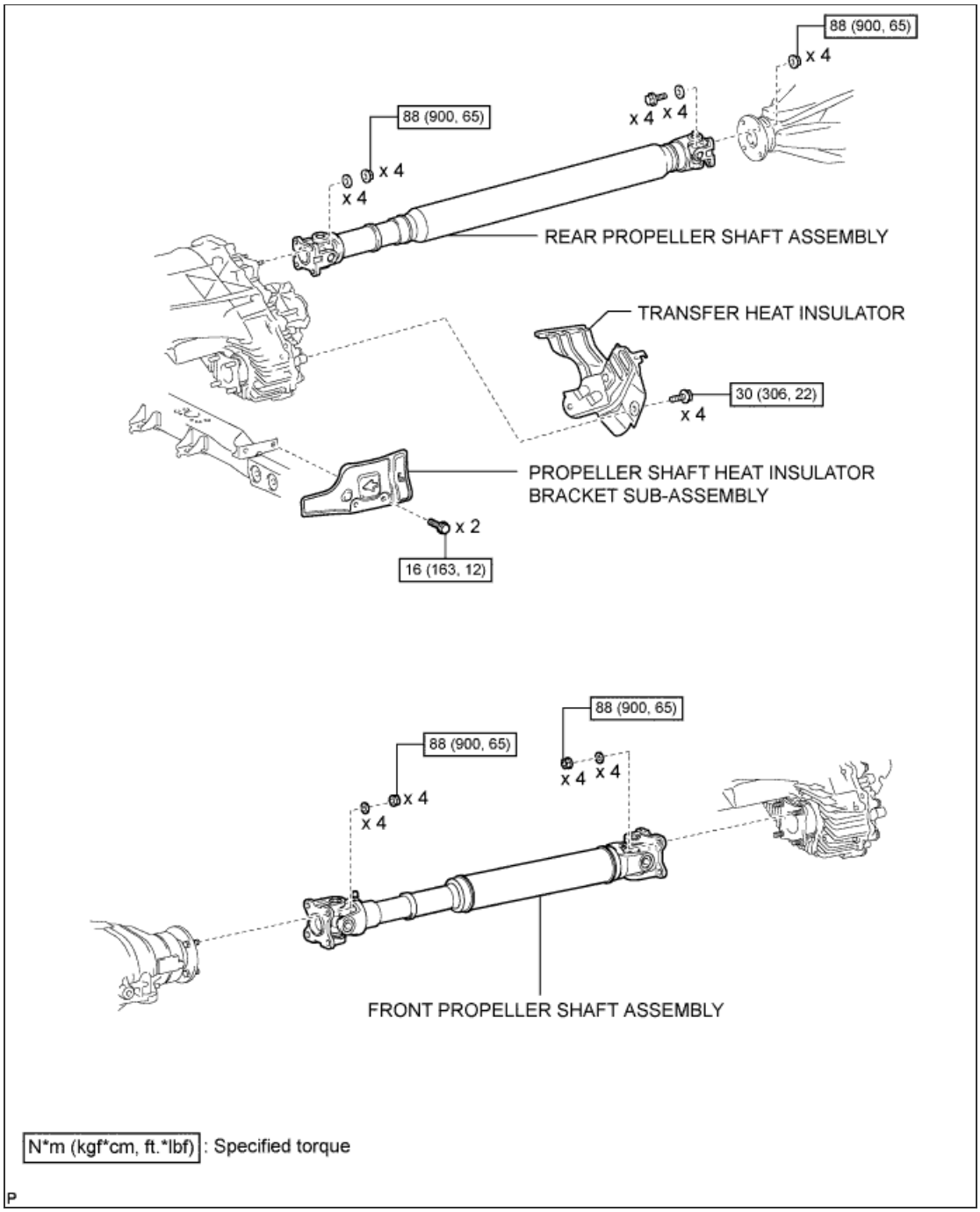

w/o EGR System:
INTAKE PIPE
21 (214, 15)
w/ Intercooler:
NO. 1 INTAKE MANIFOLD INSULATOR
21 (214, 15)
21 (214, 15)
x 2
x 4
21 (214, 15)
INTAKE PIPE (w/ EGR System)
x 2
6.0 (61, 53 in.*lbf)
STUD BOLT
x 4
GASKET
GASKET
w/ Intercooler:
NO. 2 INTAKE MANIFOLD INSULATOR
6.0 (61, 53 in.*lbf)
STUD BOLT
4.0 (41, 35 in.*lbf)
STUD BOLT
x 2
21 (214, 15)
x 2
NO. 3 INTAKE MANIFOLD
5.0 (51, 44 in.*lbf)
STUD BOLT
x 2
x 14
21 (214, 15)
INTAKE MANIFOLD INSULATOR
(w/ EGR System)
EGR PIPE INSULATOR
(w/ EGR System)
32 (326, 24)
4.0 (41, 35 in.*lbf)
STUD BOLT
21 (214, 15)
x 6
21 (214, 15)
x 2
13 (133, 10)
x 2
NO. 2 ENGINE WIRE
x 4
29 (298, 21)
GASKET
x 2
EGR VALVE ASSEMBLY WITH
EGR COOLER (w/ EGR System)
EGR COOLER INSULATOR
(w/ EGR System)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
T

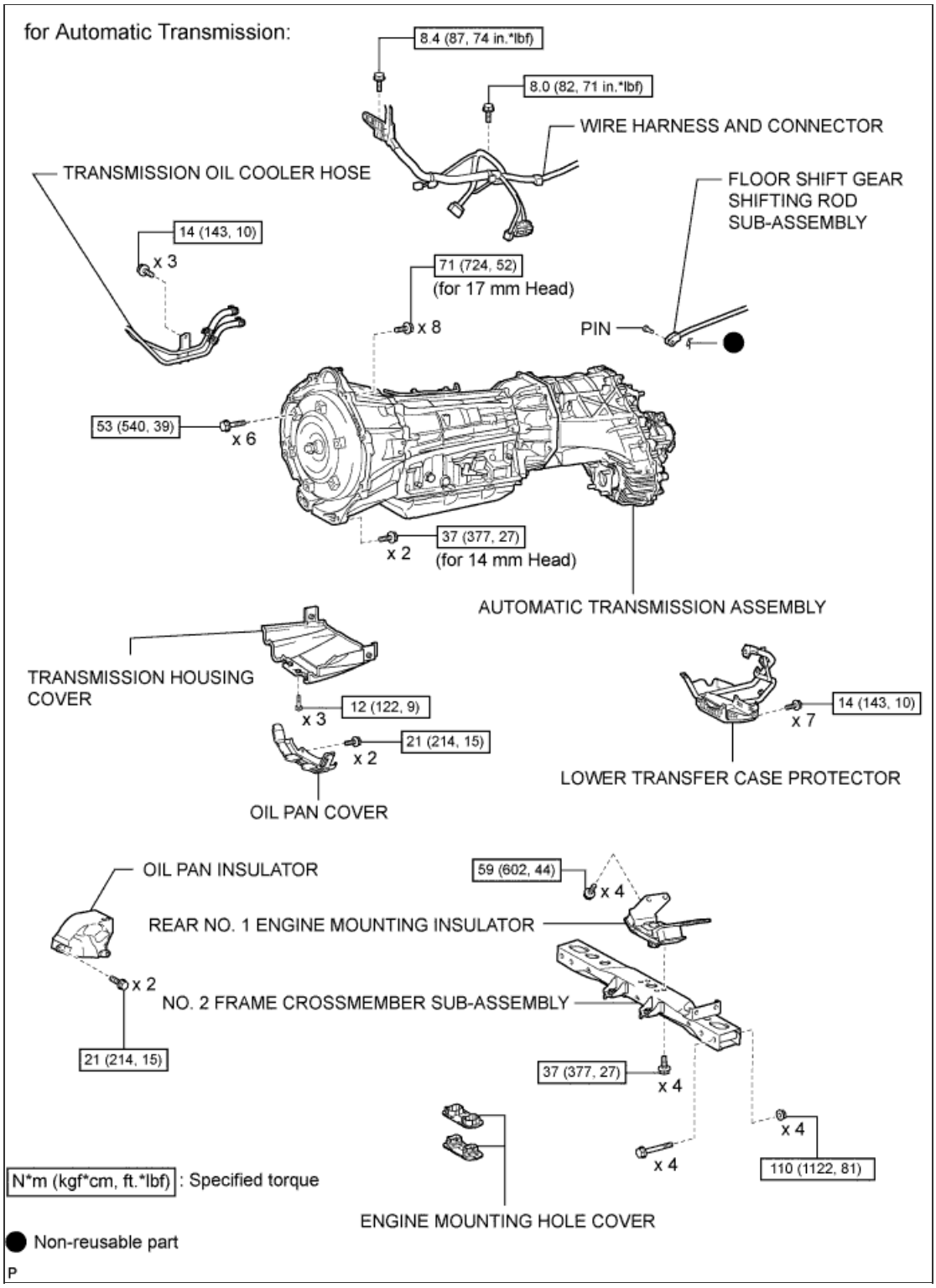

21 (214, 15)
UNION BOLT
GASKET
NO. 3 NOZZLE LEAKAGE PIPE
10 (102, 7)
21 (214, 15)
UNION BOLT
10 (102, 7)
GASKET
NO. 6 WATER BY-PASS HOSE
x 2
10 (102, 7)
NO. 4 NOZZLE LEAKAGE PIPE
FUEL COOLER ASSEMBLY
GASKET
21 (214, 15)
x 9
RING PIN
x 2
NO. 1 INTAKE MANIFOLD
GASKET
GASKET
21 (214, 15)
x 9
GASKET
RING PIN
x 2
10 (102, 7)
59 (600, 43)
UNION BOLT
NO. 1 WATER BY-PASS PIPE
NO. 2 INTAKE MANIFOLD
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

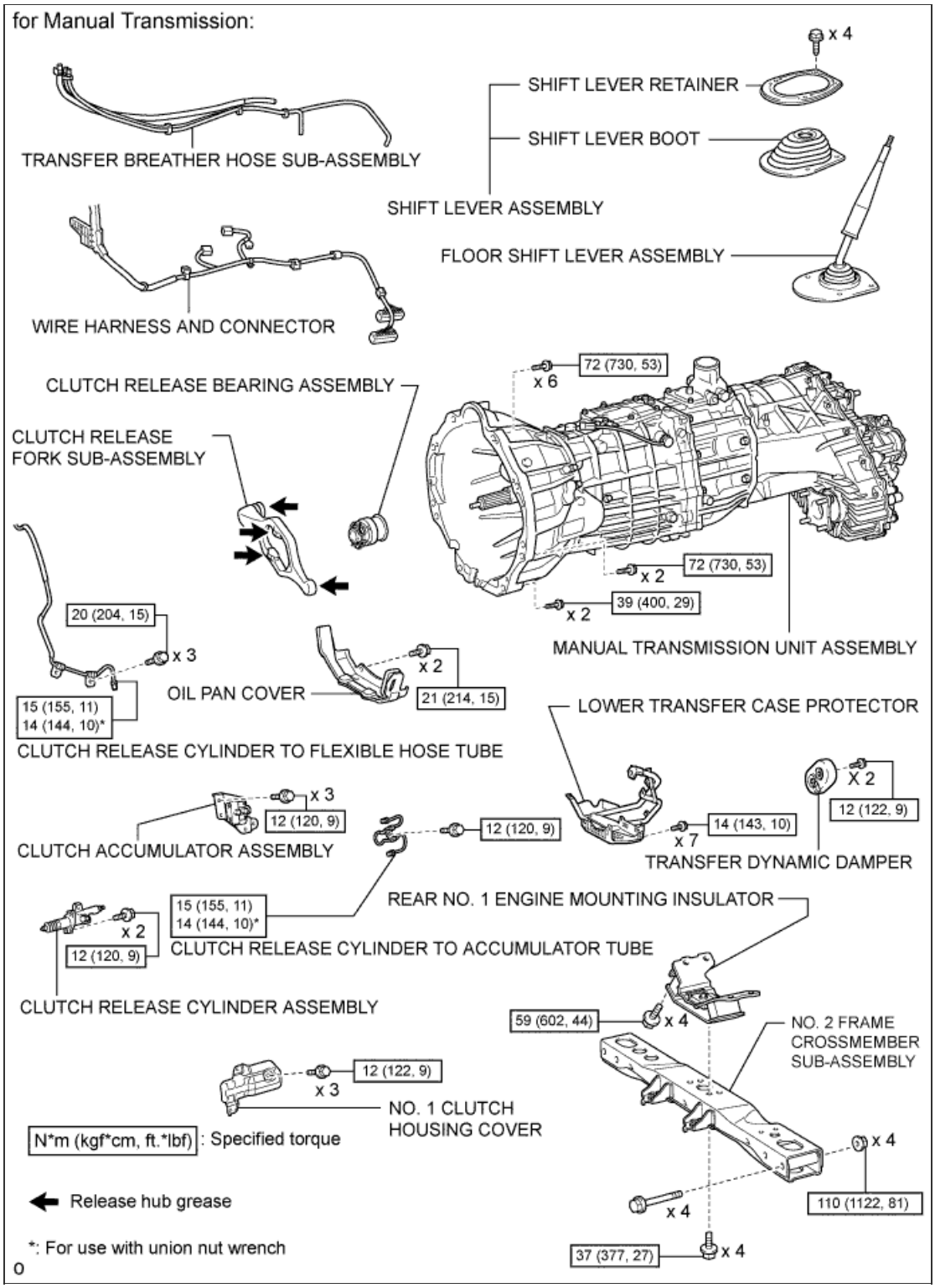
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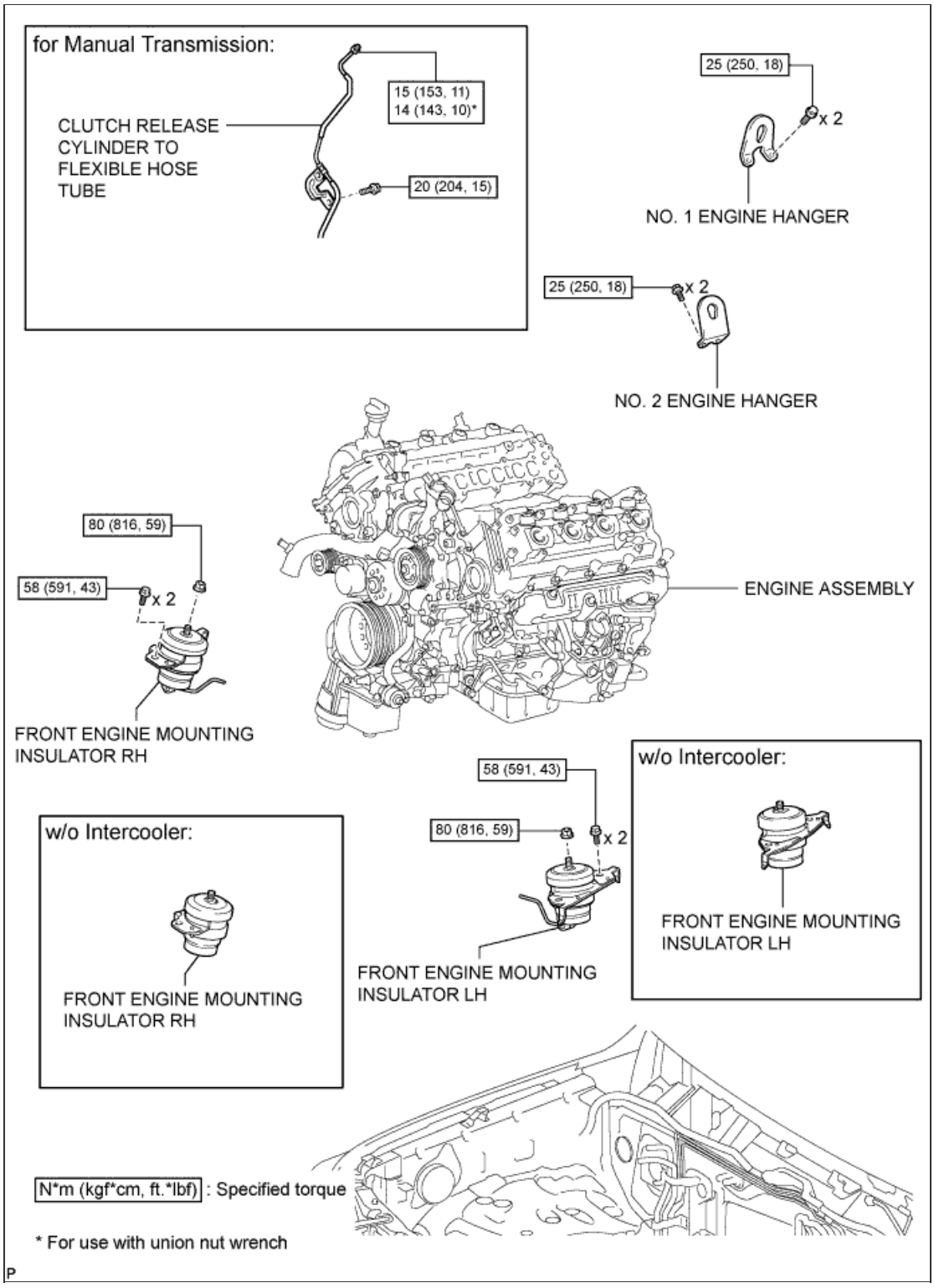

w/ EGR System:
32 (326, 24)
EXHAUST PIPE SUPPORT
x 3
CENTER EXHAUST PIPE ASSEMBLY
CLAMP
GASKET
COMPRESSION SPRING
MANIFOLD STAY RH
43 (438, 32)
x 2
43 (438, 32)
FRONT NO. 1 EXHAUST PIPE ASSEMBLY
GASKET
49 (496, 36)
x 2
x 2
GASKET
GASKET
MANIFOLD STAY LH
x 3
43 (438, 32)
x 2
47 (479, 35)
43 (438, 32)
MONOLITHIC CONVERTER ASSEMBLY RH
x 2
FRONT NO. 2 EXHAUST PIPE ASSEMBLY
54 (554, 40)
w/o Monolithic Converter:
GASKET
x 3
x 2
47 (479, 35)
47 (479, 35)
MONOLITHIC CONVERTER ASSEMBLY LH
GASKET
GASKET
x 2
54 (554, 40)
OUTLET TURBINE ELBOW RH
w/o Monolithic Converter:
OUTLET TURBINE ELBOW LH
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P


w/o EGR System:
EXHAUST PIPE SUPPORT
x 3
32 (326, 24)
CLAMP
GASKET
COMPRESSION SPRING
MANIFOLD STAY RH
CENTER EXHAUST PIPE ASSEMBLY
43 (438, 32)
x 2
43 (438, 32)
GASKET
49 (496, 36)
x 2
x 2
FRONT NO. 1 EXHAUST PIPE ASSEMBLY
GASKET
x 3
47 (479, 35)
x 2
54 (554, 40)
x 2
43 (438, 32)
FRONT NO. 2 EXHAUST PIPE ASSEMBLY
GASKET
GASKET
MANIFOLD STAY LH
x 3
47 (479, 35)
x 2
GASKET
47 (479, 35)
x 2
54 (554, 40)
OUTLET TURBINE ELBOW RH
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
OUTLET TURBINE ELBOW LH
P

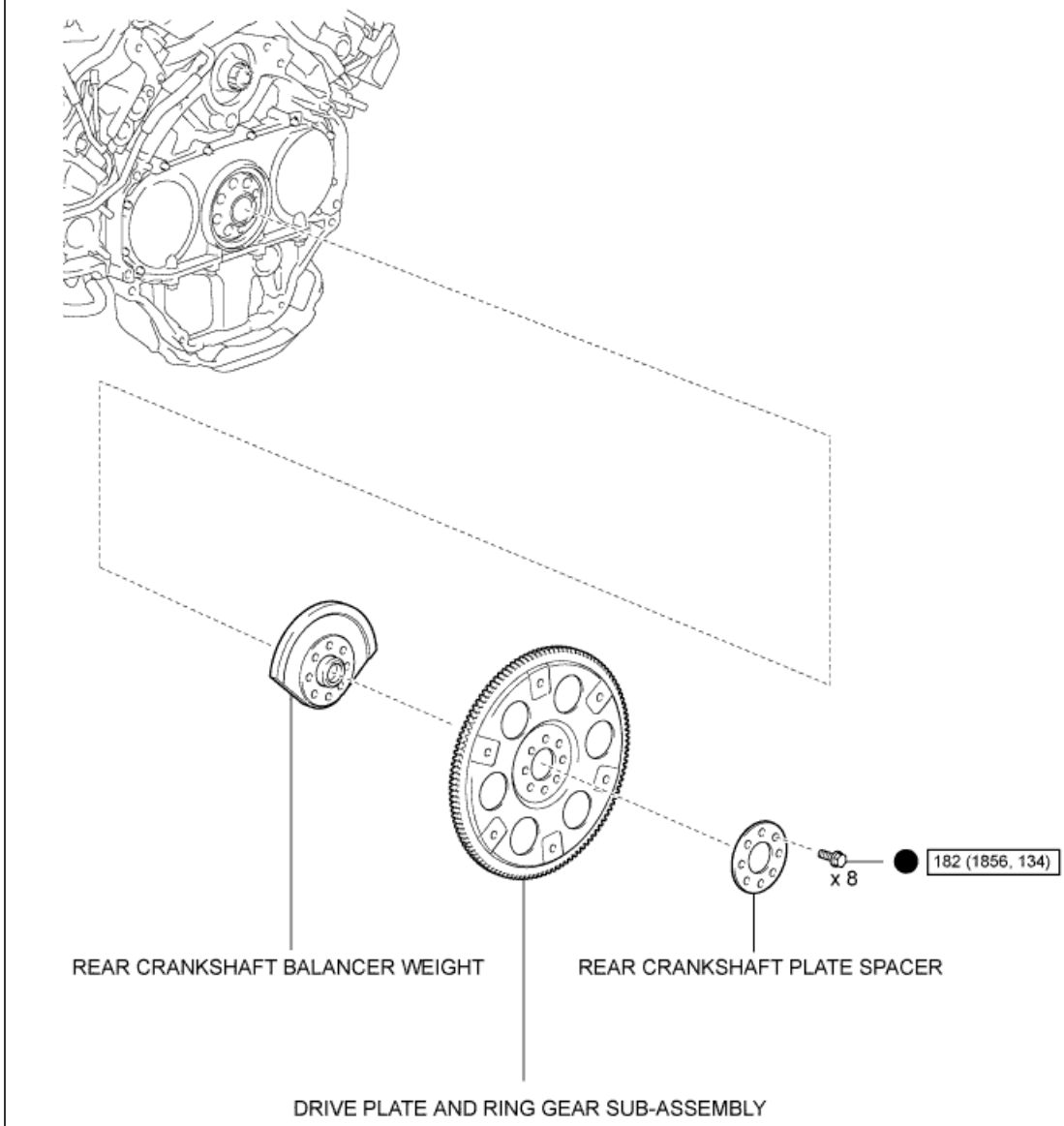

88 (900, 65)
x 4
x 4
x 4
88 (900, 65)
x 4
x 4
REAR PROPELLER SHAFT ASSEMBLY
TRANSFER HEAT INSULATOR
30 (306, 22)
x 4
PROPELLER SHAFT HEAT INSULATOR
BRACKET SUB-ASSEMBLY
x 2
16 (163, 12)
88 (900, 65)
88 (900, 65)
x 4
x 4
x 4
x 4
FRONT PROPELLER SHAFT ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
P


for Automatic Transmission:
8.4 (87, 74 in.*lbf)
8.0 (82, 71 in.*lbf)
WIRE HARNESS AND CONNECTOR
TRANSMISSION OIL COOLER HOSE
14 (143, 10)
x 3
FLOOR SHIFT GEAR SHIFTING ROD SUB-ASSEMBLY
71 (724, 52)
(for 17 mm Head)
x 8
PIN
53 (540, 39)
x 6
37 (377, 27)
x 2
(for 14 mm Head)
AUTOMATIC TRANSMISSION ASSEMBLY
TRANSMISSION HOUSING COVER
12 (122, 9)
x 3
21 (214, 15)
x 2
OIL PAN COVER
14 (143, 10)
x 7
LOWER TRANSFER CASE PROTECTOR
OIL PAN INSULATOR
59 (602, 44)
x 4
REAR NO. 1 ENGINE MOUNTING INSULATOR
x 2
NO. 2 FRAME CROSSMEMBER SUB-ASSEMBLY
21 (214, 15)
37 (377, 27)
x 4
x 4
x 4
110 (1122, 81)
N*m (kgf*cm, ft.*lbf) : Specified torque
ENGINE MOUNTING HOLE COVER
Non-reusable part
P


for Manual Transmission:
x 4
SHIFT LEVER RETAINER
SHIFT LEVER BOOT
TRANSFER BREATHER HOSE SUB-ASSEMBLY
SHIFT LEVER ASSEMBLY
FLOOR SHIFT LEVER ASSEMBLY
WIRE HARNESS AND CONNECTOR
CLUTCH RELEASE BEARING ASSEMBLY
72 (730, 53)
x 6
CLUTCH RELEASE
FORK SUB-ASSEMBLY
x 2
72 (730, 53)
x 2
39 (400, 29)
MANUAL TRANSMISSION UNIT ASSEMBLY
20 (204, 15)
x 3
x 2
OIL PAN COVER
21 (214, 15)
15 (155, 11)
14 (144, 10)*
CLUTCH RELEASE CYLINDER TO FLEXIBLE HOSE TUBE
LOWER TRANSFER CASE PROTECTOR
x 3
12 (120, 9)
CLUTCH ACCUMULATOR ASSEMBLY
12 (120, 9)
14 (143, 10)
x 7
X 2
12 (122, 9)
TRANSFER DYNAMIC DAMPER
REAR NO. 1 ENGINE MOUNTING INSULATOR
15 (155, 11)
14 (144, 10)*
x 2
12 (120, 9)
CLUTCH RELEASE CYLINDER TO ACCUMULATOR TUBE
CLUTCH RELEASE CYLINDER ASSEMBLY
59 (602, 44)
x 4
NO. 2 FRAME
CROSSMEMBER
SUB-ASSEMBLY
12 (122, 9)
x 3
NO. 1 CLUTCH
HOUSING COVER
x 4
N*m (kgf*cm, ft.*lbf) : Specified torque
110 (1122, 81)
x 4
Release hub grease
*: For use with union nut wrench
37 (377, 27)
x 4


for Manual Transmission:
CLUTCH RELEASE CYLINDER TO FLEXIBLE HOSE TUBE
15 (153, 11)
14 (143, 10)*
20 (204, 15)
25 (250, 18)
x 2
NO. 1 ENGINE HANGER
25 (250, 18)
x 2
NO. 2 ENGINE HANGER
ENGINE ASSEMBLY
80 (816, 59)
58 (591, 43)
x 2
FRONT ENGINE MOUNTING INSULATOR RH
w/o Intercooler:
FRONT ENGINE MOUNTING INSULATOR RH
58 (591, 43)
80 (816, 59)
x 2
FRONT ENGINE MOUNTING INSULATOR LH
w/o Intercooler:
FRONT ENGINE MOUNTING INSULATOR LH
N*m (kgf*cm, ft.*lbf) : Specified torque
* For use with union nut wrench
P

for Automatic Transmission:

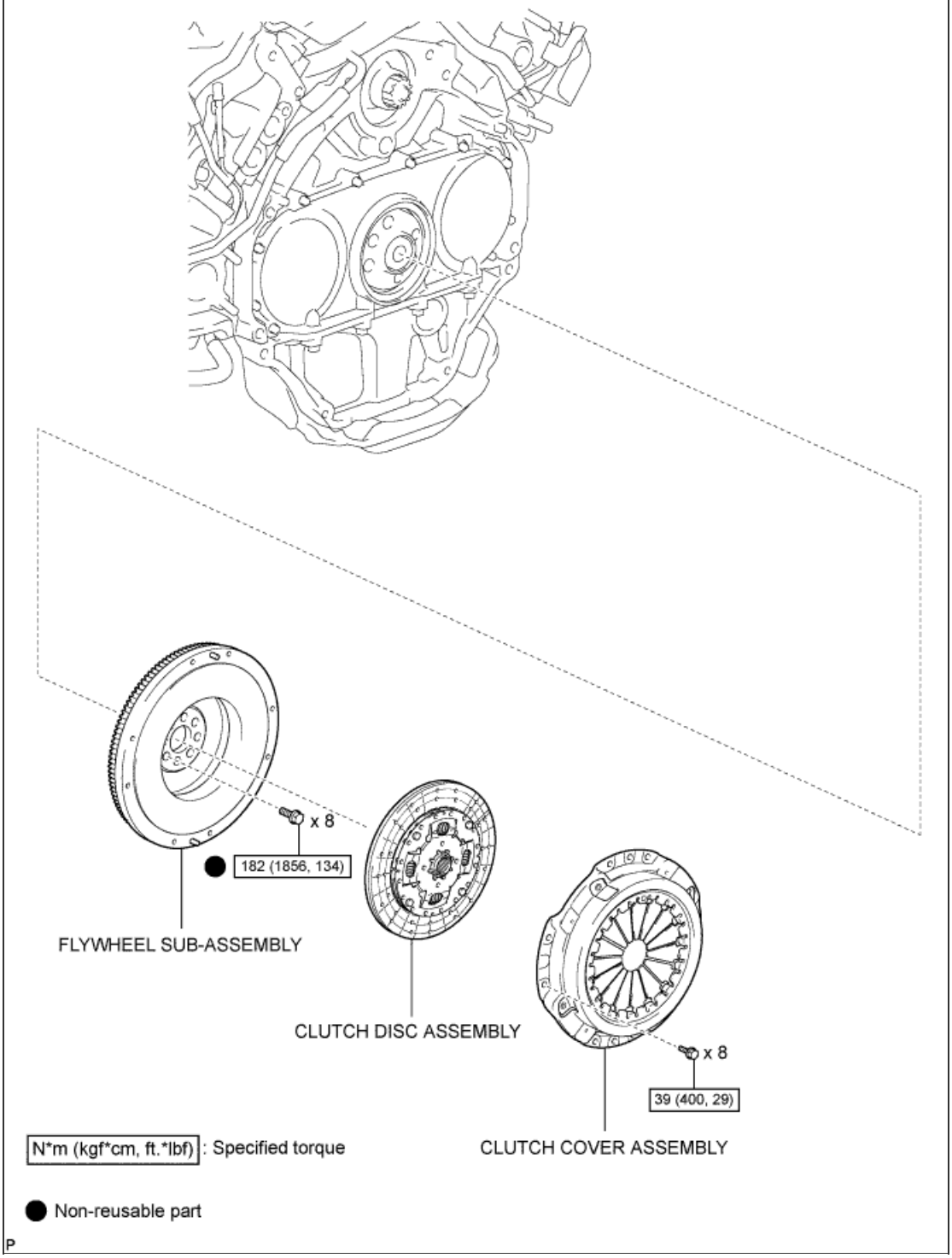


N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P

for Manual Transmission:



N*m (kgf*cm, ft.*lbf): Specified torque

● Non-reusable part

P

for Preparation Click here

1. RECOVER REFRIGERANT FROM REFRIGERATION SYSTEM

a. Start the engine.

b. Turn the A/C switch on.

c. Operate the cooler compressor while the engine speed is approximately 1000 rpm for 5 to 6 minutes to circulate the refrigerant and collect the compressor oil remaining in each component into the cooler compressor.

d. Stop the engine.

e. Recover the refrigerant from the A/C system using a refrigerant recovery unit.

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Disconnect the cables from the negative (-) main battery and sub-battery terminals.

3. REMOVE MAIN BATTERY

4. REMOVE SUB-BATTERY

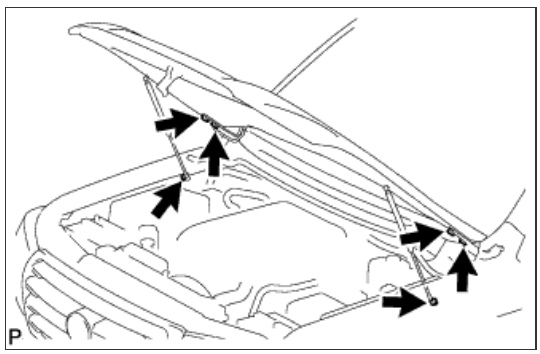
5. REMOVE FRONT WHEEL

6. REMOVE HOOD SUB-ASSEMBLY

a. Remove the 2 hood stay bolts. Then disconnect the 2 hood supports.

NOTICE:

- **Avoid touching the stroke portions of the rod as much as possible to prevent foreign matter from attaching to it. Be sure to hold the cylinders while servicing.**
- **Do not wear cotton gloves or other similar materials when handling the rod. Fibers may attach to the rod and result in gas leaks.**
- **Do not apply any load to the cylinders in the horizontal direction in order to prevent the rod from being deformed.**
- **Remove the hood support while supporting the hood by hand.**



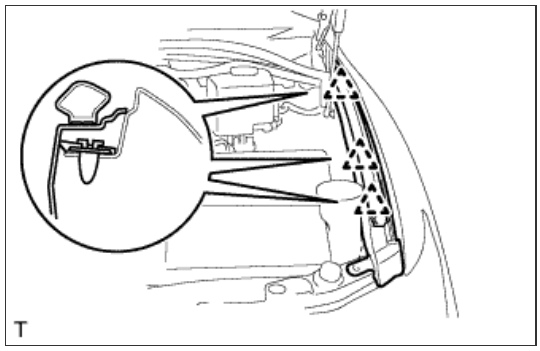
b. Remove the 4 bolts and hood.

7. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and upper radiator support seal.

8. REMOVE FRONT FENDER MAIN SEAL LH

a. Using a clip remover, detach the 3 clips and remove the fender main seal.



9. REMOVE FRONT FENDER MAIN SEAL RH

HINT:

Use the same procedures described for the LH side.

10. REMOVE FRONT WIPER ARM LH

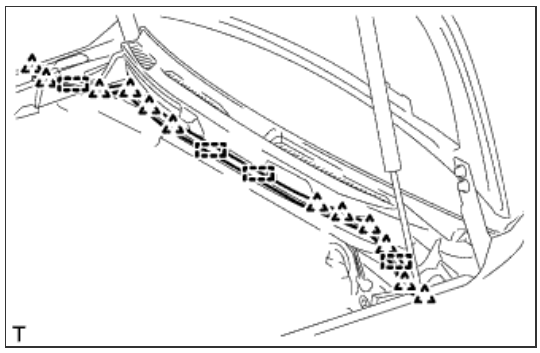
a. Remove the nut, wiper arm and blade.

11. REMOVE FRONT WIPER ARM RH

a. Remove the nut, wiper arm and blade.

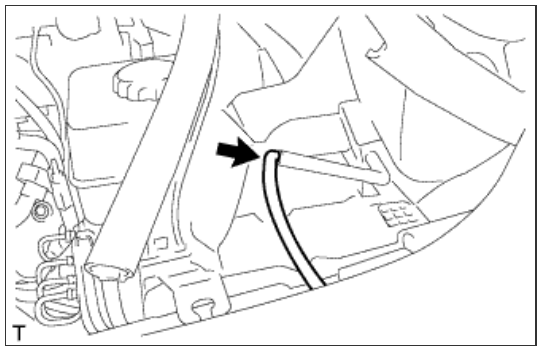
12. REMOVE HOOD TO COWL TOP SEAL

a. Using a clip remover, detach the 12 clips, 4 clamps and remove the hood to cowl top seal.



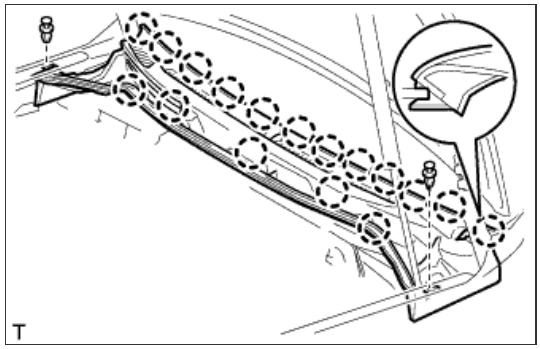
13. REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Remove the washer hose.



b. Remove the 2 clips.

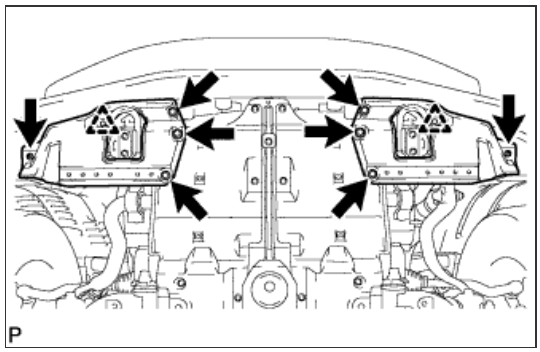
c. Detach the 17 claws and remove the cowl top ventilator louver sub-assembly.



14. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.



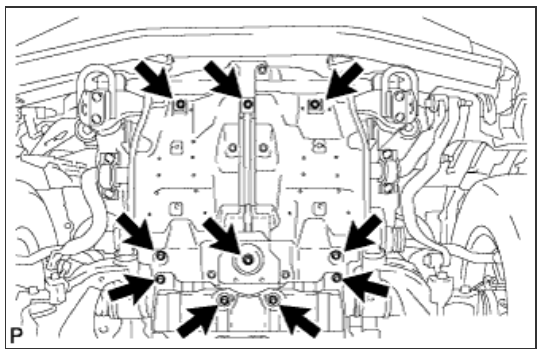
15. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.

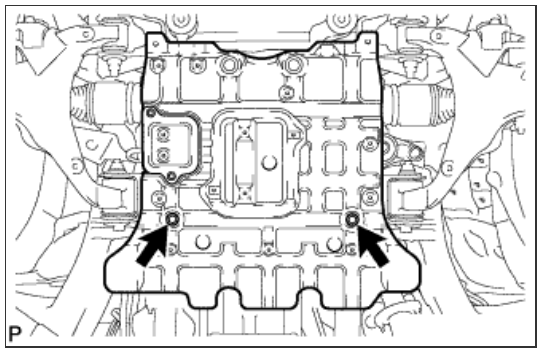
16. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



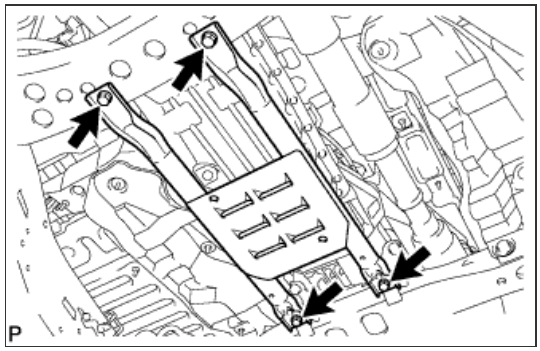
17. REMOVE NO. 2 ENGINE UNDER COVER

a. Remove the 2 bolts and under cover.



18. REMOVE OIL PAN PROTECTOR ASSEMBLY

a. Remove the 4 bolts and oil pan protector.



19. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

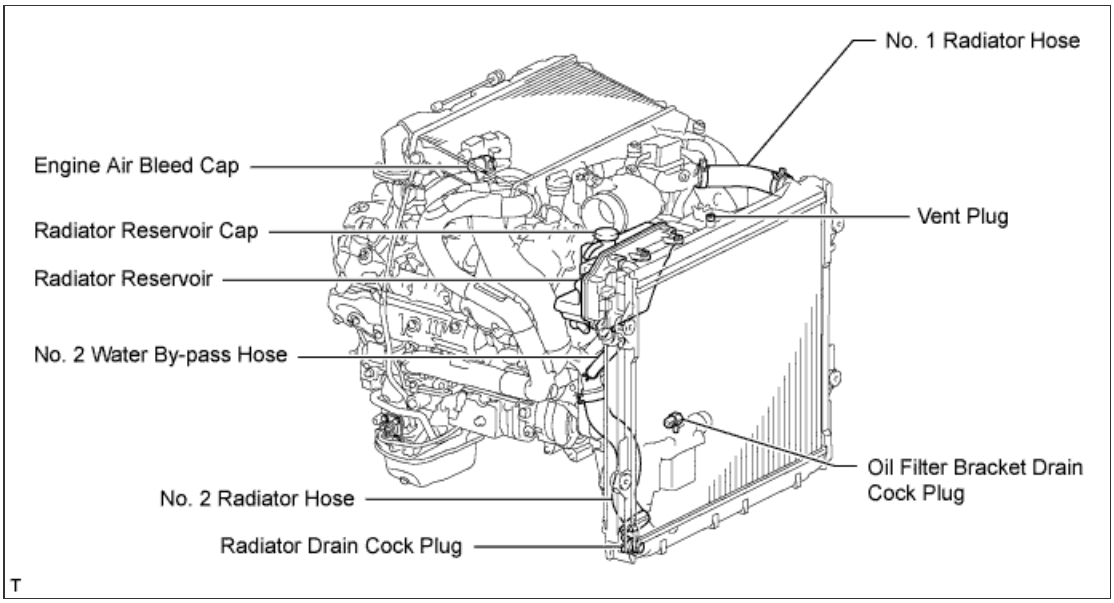
HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

a. Loosen the radiator drain cock plug.

b. Remove the radiator reservoir cap to drain the coolant in the radiator.

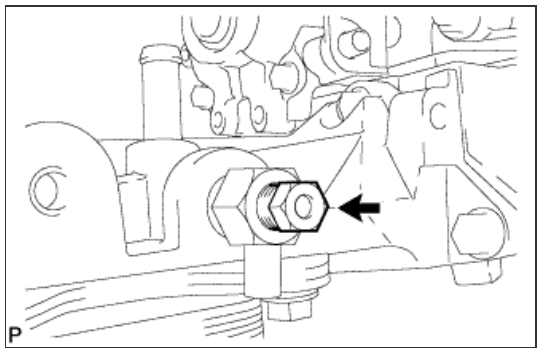
c. Loosen the oil filter bracket drain cock plug to drain the coolant in the engine.



d. Tighten the radiator drain cock plug by hand.

e. Tighten the oil filter bracket drain cock plug.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



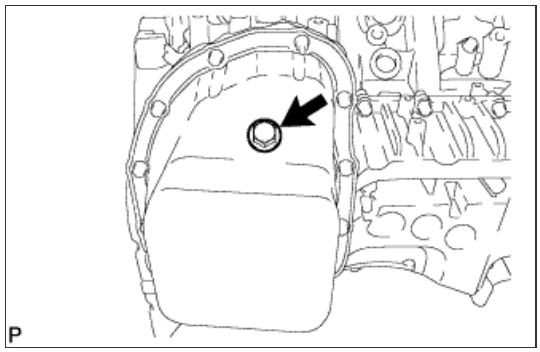
20. DRAIN ENGINE OIL

a. Remove the oil filler cap.

b. Remove the oil pan drain plug and gasket, and then drain the engine oil into a container.

c. Install a new gasket and the oil pan drain plug.

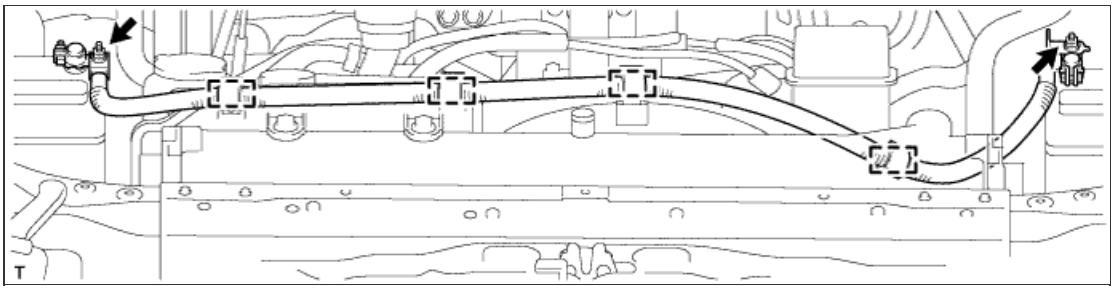
Torque:
38 N*m{ 387 kgf*cm , 28 ft.*lbf }



21. REMOVE NO. 3 ENGINE ROOM WIRE

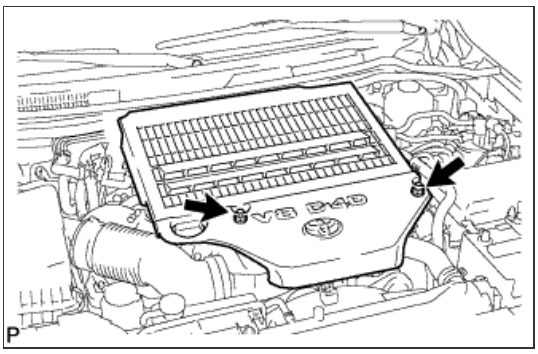
a. Disconnect the 4 wire harness clamps.

b. Remove the 2 nuts and No. 3 engine room wire.



22. REMOVE NO. 1 ENGINE COVER SUB-ASSEMBLY (w/ Intercooler)

a. Remove the 2 nuts and No. 1 engine cover.

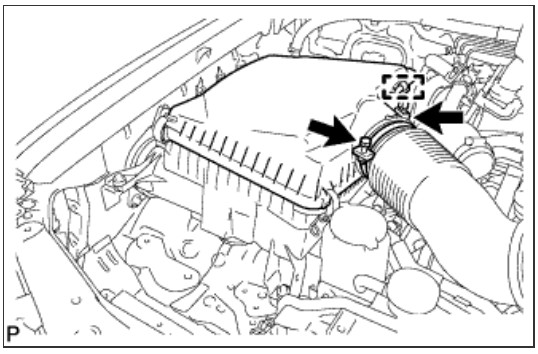


23. REMOVE AIR CLEANER CAP SUB-ASSEMBLY

a. Loosen the hose clamp.

b. Disconnect the mass air flow meter connector and using a clip remover, detach the wire harness clamp from the air cleaner cap.

c. Detach the 4 clamps and remove the air cleaner cap.

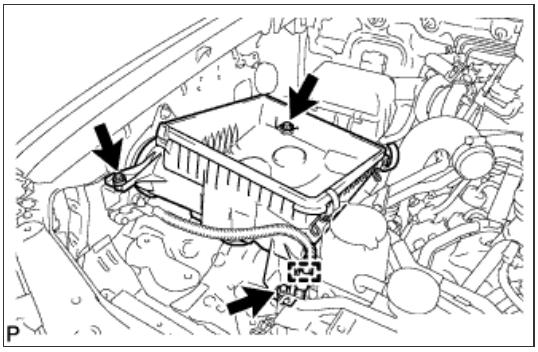


24. REMOVE AIR CLEANER FILTER ELEMENT

25. REMOVE AIR CLEANER CASE

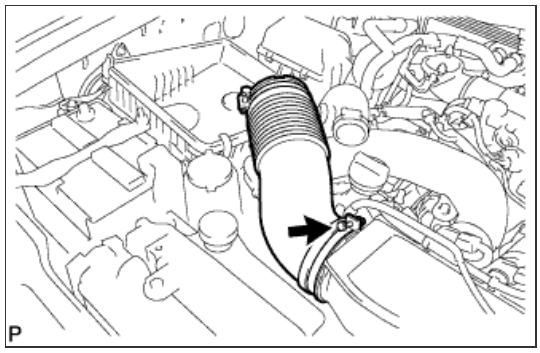
a. Using a clip remover, detach the wire harness clamp.

b. Remove the 3 bolts and air cleaner case.



26. REMOVE NO. 1 AIR CLEANER HOSE

a. Loosen the hose clamp and remove the No. 1 air cleaner hose.



27. REMOVE INTAKE AIR CONNECTOR

a. w/o Viscous Heater:

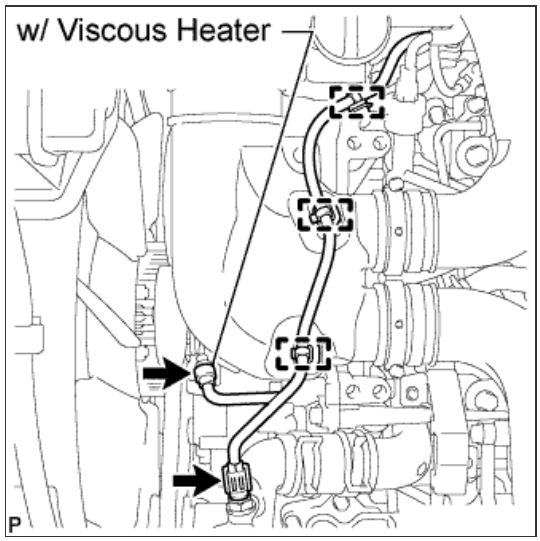
i. Disconnect the connector from the water temperature sensor.

ii. Using a clip remover, detach the 3 wire harness clamps.

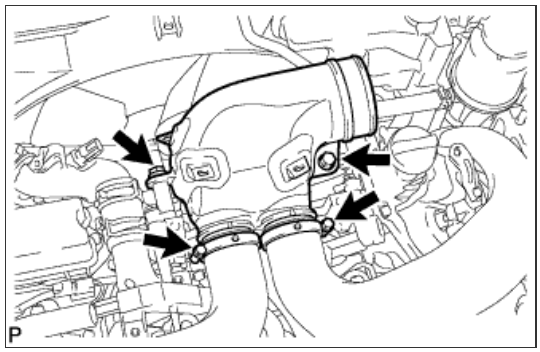
b. w/ Viscous Heater:

i. Disconnect the 2 connectors from the viscous with magnet clutch heater and water temperature sensor.

ii. Using a clip remover, detach the 3 wire harness clamps.

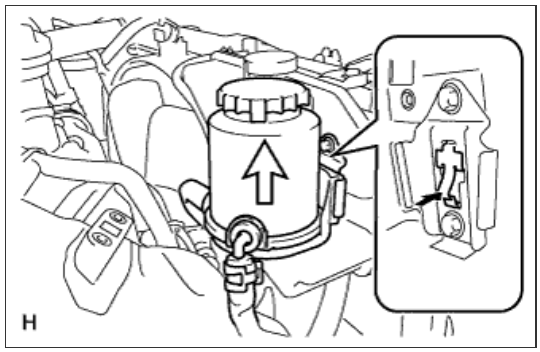


c. Loosen the 2 hose clamps and remove the 2 bolts and intake air connector.



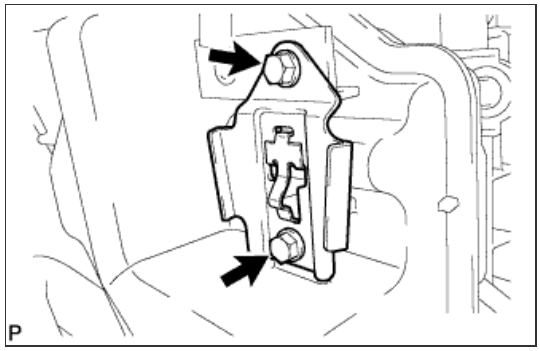
28. REMOVE VANE PUMP OIL RESERVOIR ASSEMBLY

a. Insert a screwdriver between the reservoir and oil reservoir bracket, push the claw, and then disconnect the reservoir by pulling it upwards.



29. REMOVE NO. 1 OIL RESERVOIR BRACKET

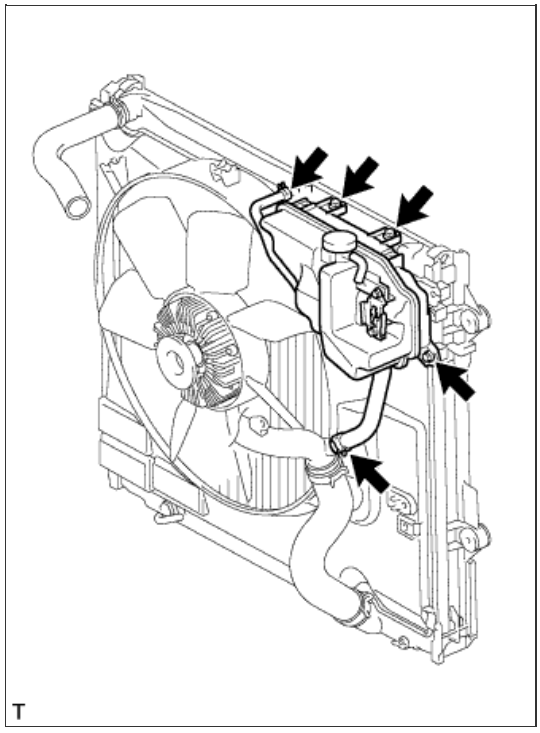
a. Remove the 2 bolts and bracket.



30. REMOVE RADIATOR RESERVOIR ASSEMBLY

a. Disconnect the 2 hoses.

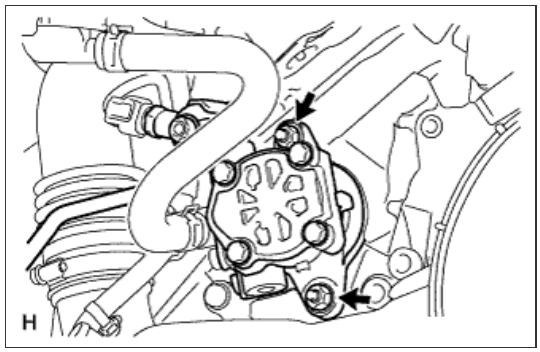
b. Remove the 3 bolts and radiator reservoir.



31. REMOVE VANE PUMP ASSEMBLY

a. Remove the 2 nuts and vane pump.

b. Remove the O-ring from the vane pump.



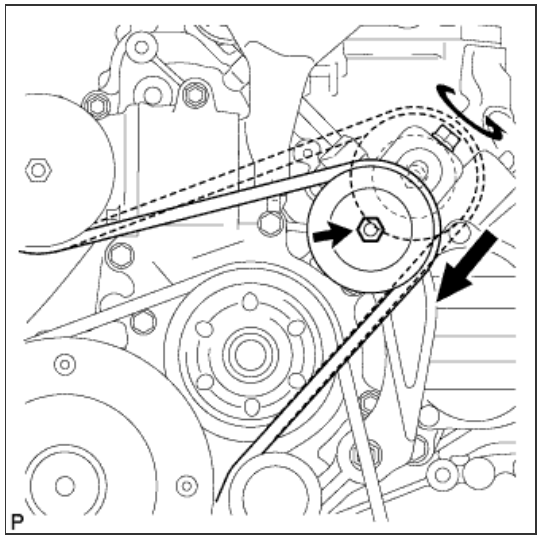
32. DISCONNECT NO. 1 RADIATOR HOSE

33. DISCONNECT NO. 2 RADIATOR HOSE

34. REMOVE V-RIBBED BELT (w/ Viscous Heater)

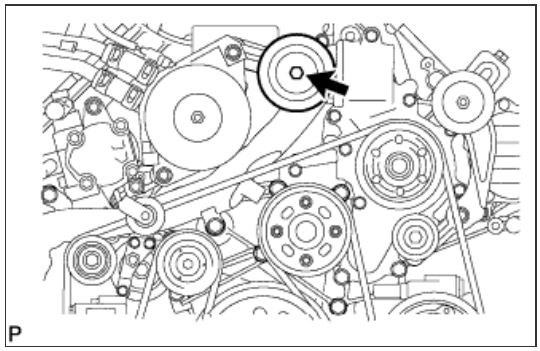
a. Loosen the lock nut and turn the bolt counterclockwise.

b. Remove the V-ribbed belt.



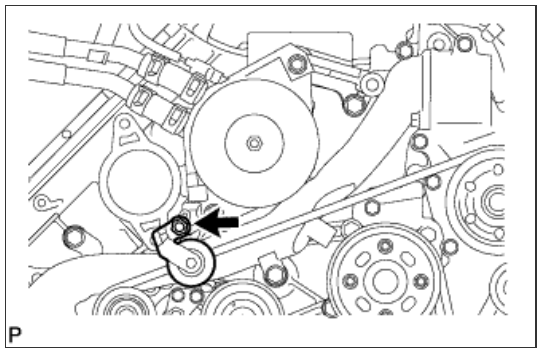
35. REMOVE NO. 1 IDLER PULLEY (w/ Viscous Heater)

a. Remove the bolt, cover, No. 1 idler pulley and collar.



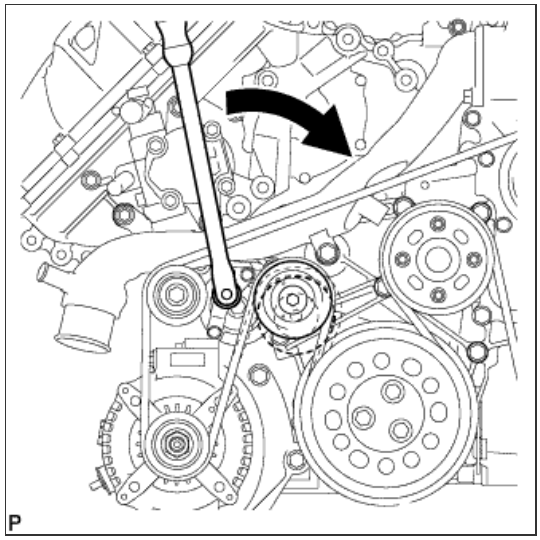
36. REMOVE NO. 3 IDLER PULLEY (w/ Viscous Heater)

a. Remove the nut and No. 3 idler pulley.



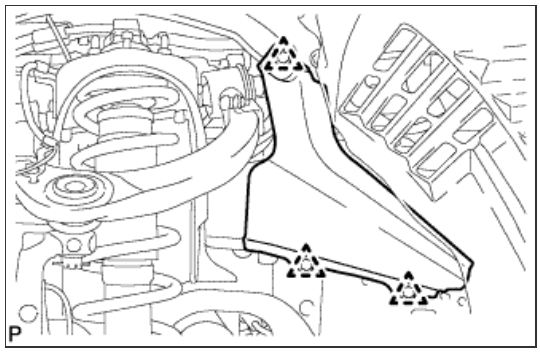
37. REMOVE V-RIBBED BELT

a. Using a wrench to the V-ribbed belt tensioner bracket, turn the wrench clockwise and remove the V-ribbed belt.



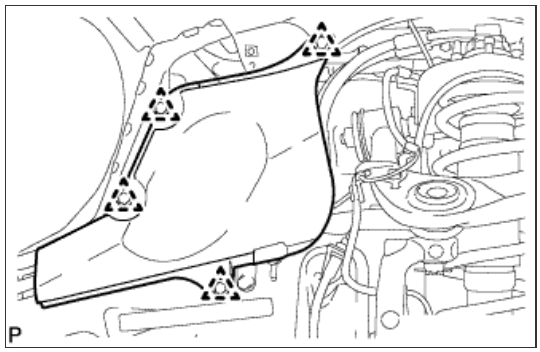
38. REMOVE FRONT FENDER APRON SEAL FRONT RH

a. Remove the 3 clips and front fender apron seal front RH.



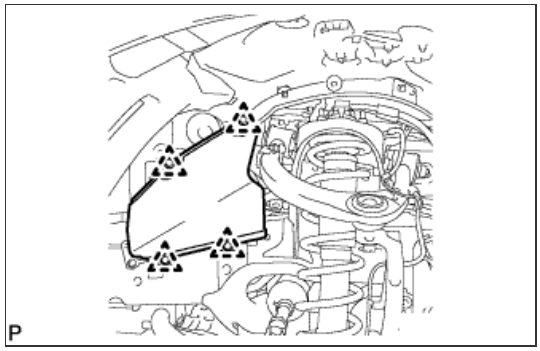
39. REMOVE FRONT FENDER APRON SEAL REAR RH

a. Remove the 4 clips and front fender apron seal rear RH.

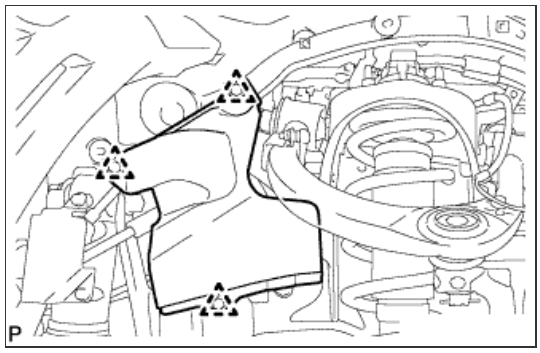


40. REMOVE FRONT FENDER APRON SEAL FRONT LH

a. w/o KDSS:
Remove the 4 clips and front fender apron seal front LH.

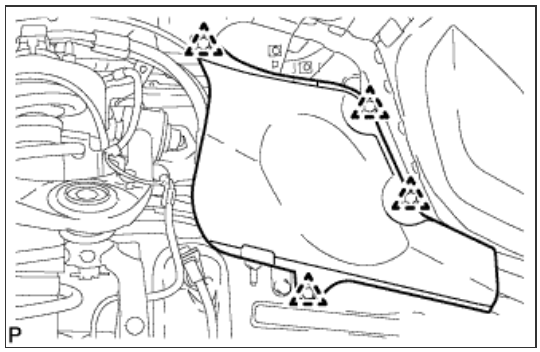


b. w/ KDSS:
Remove the 3 clips and front fender apron seal front LH.



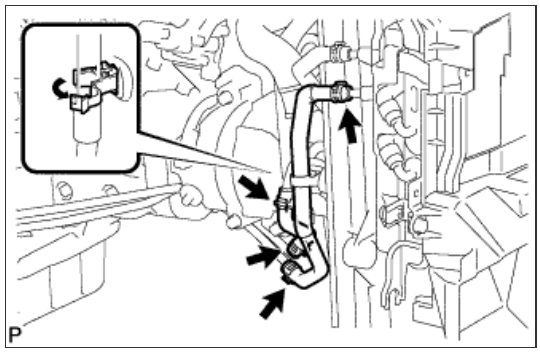
41. REMOVE FRONT FENDER APRON SEAL REAR LH

a. Remove the 4 clips and front fender apron seal rear LH.

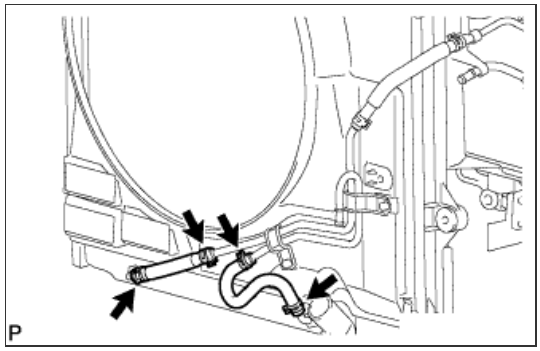


42. REMOVE OIL COOLER TUBE (for Automatic Transmission)

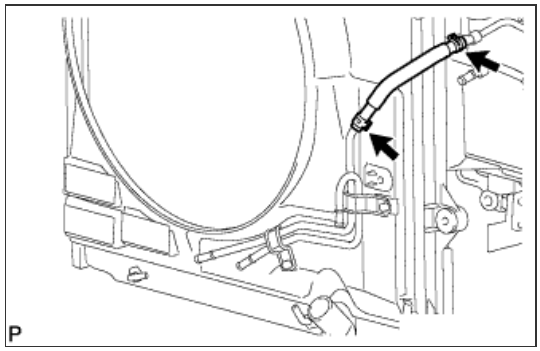
a. Disconnect the inlet and outlet No. 1 oil cooler hose.



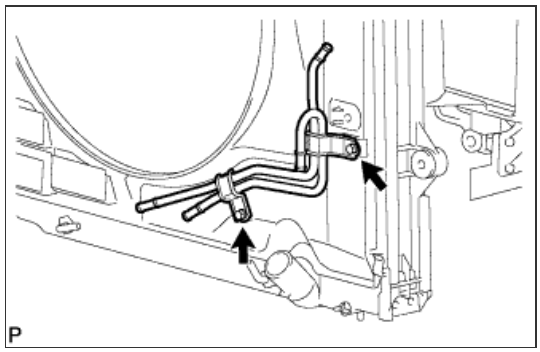
b. Disconnect the inlet No. 2 and No. 3 oil cooler hoses.



c. Disconnect the inlet No. 4 oil cooler hose.

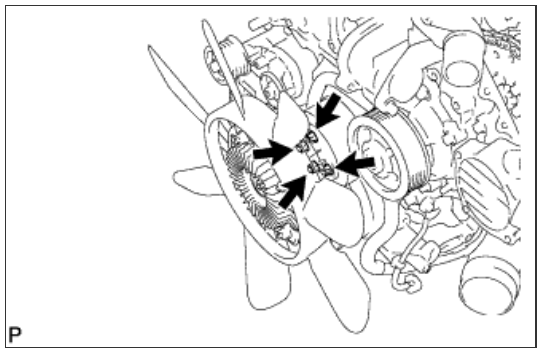


d. Remove the 2 bolts and transmission oil cooler tube.

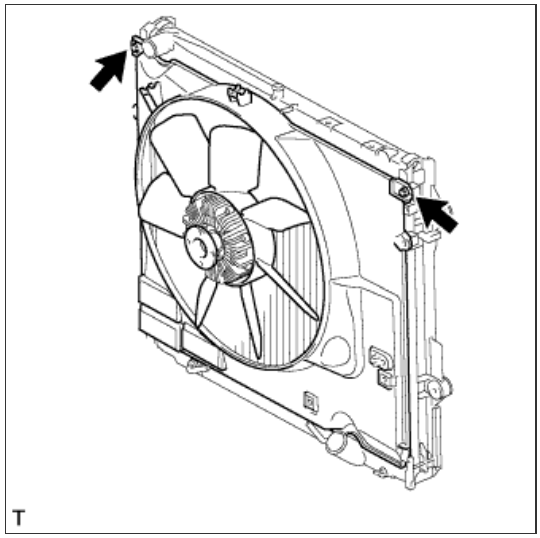


43. REMOVE FAN SHROUD WITH FAN

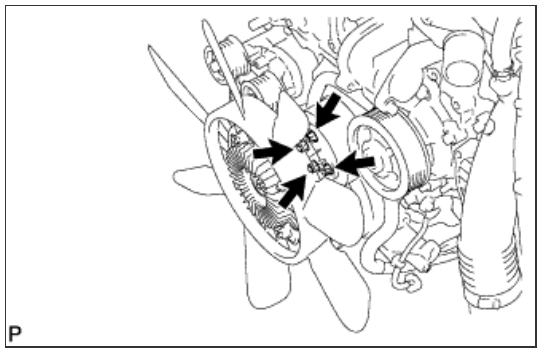
a. Loosen the 4 nuts holding the fluid coupling fan.



b. Remove the 2 bolts holding the fan shroud.



c. Remove the 4 nuts of the fluid coupling fan, and then remove the shroud together with the fluid coupling fan.



44. REMOVE FAN PULLEY

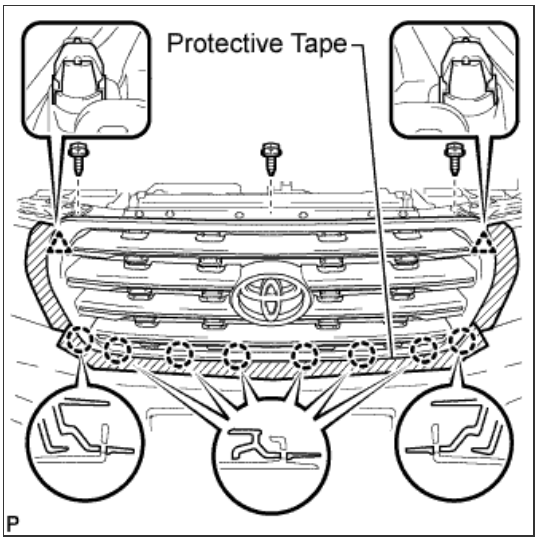
45. REMOVE FRONT BUMPER WINCH COVER (w/ Winch)

46. REMOVE RADIATOR GRILLE

a. Put protective tape around the radiator grille.

b. Remove the 3 screws.

c. Detach the 2 clips and 8 claws, and remove the radiator grille.

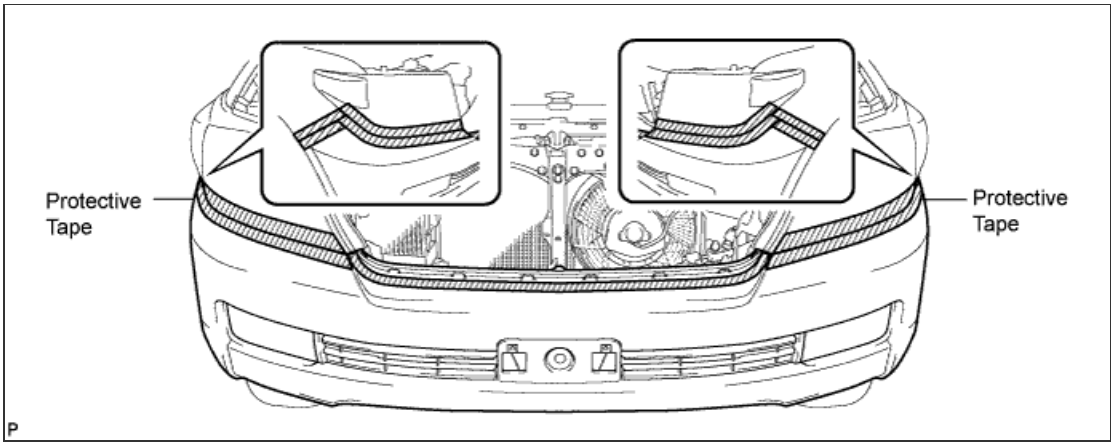


47. REMOVE FRONT BUMPER COVER

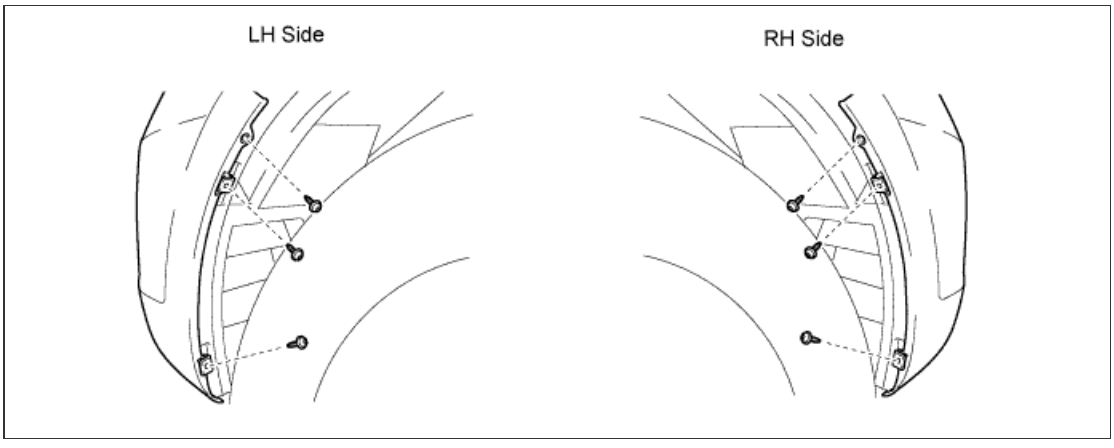
HINT:

For the front bumper cover with garnish, use the procedures described below.

a. Put protective tape around the bumper cover.



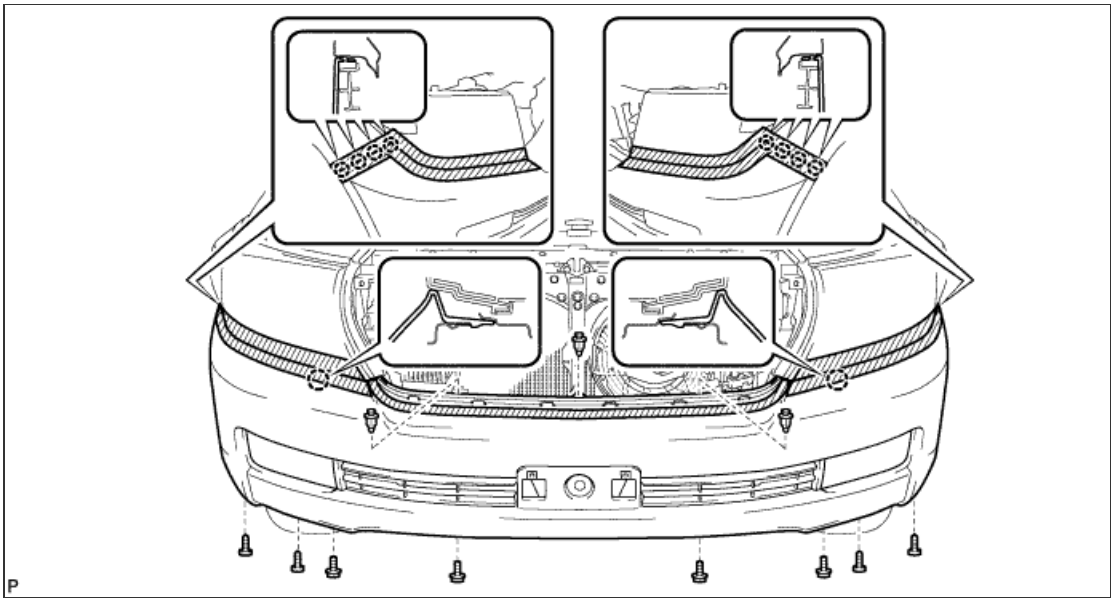
b. Using a T30 "TORX" socket, remove the 6 screws.



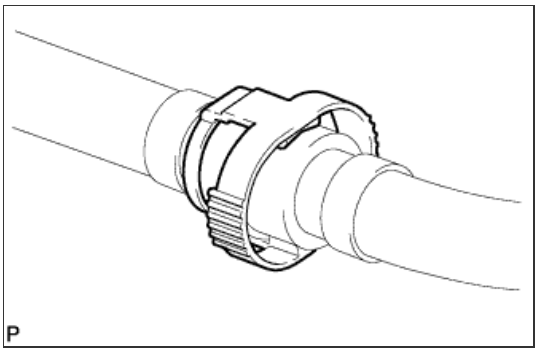
c. Remove the 3 clips, 4 screws and 4 bolts.

d. w/o TOYOTA Parking Assist-sensor System, w/o Fog Light:
Detach the 10 claws and remove the bumper cover.

e. w/ TOYOTA Parking Assist-sensor System or w/ Fog Light:
Detach the 10 claws, disconnect the No. 4 engine room wire connector and remove the bumper cover.

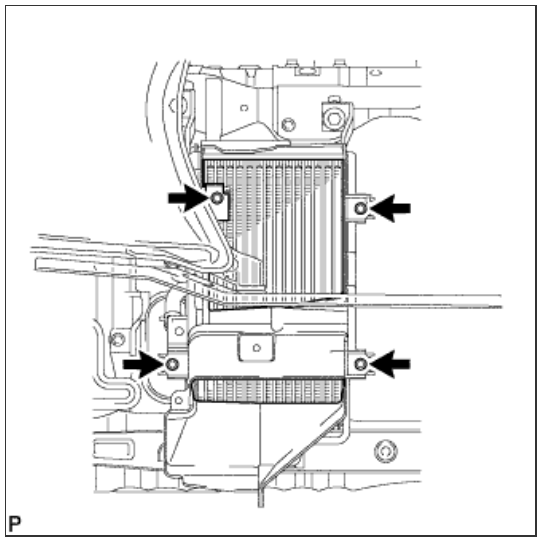


f. w/ Headlight Cleaner System:
Disconnect the headlight cleaner hose and remove the bumper cover.



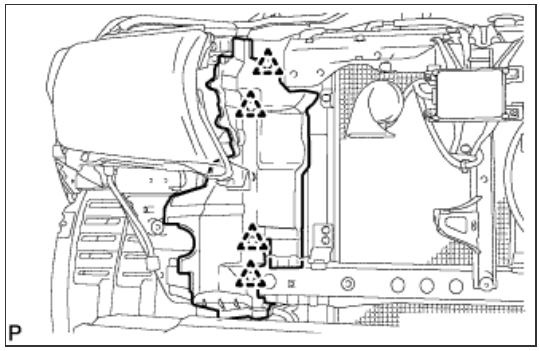
48. REMOVE TRANSMISSION OIL COOLER AIR DUCT (for Automatic Transmission)

a. Remove the 4 bolts and oil cooler air duct.



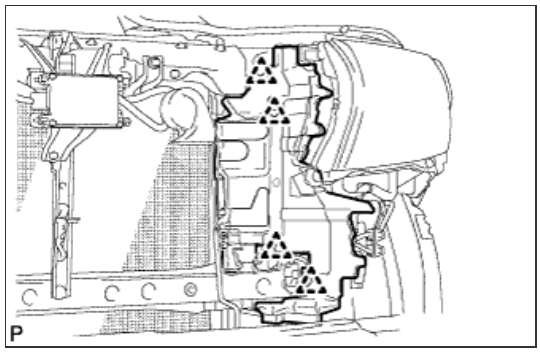
49. DISCONNECT RADIATOR SIDE DEFLECTOR RH (for Manual Transmission)

a. Using a clip remover, remove the 4 clips, and remove the side deflector.



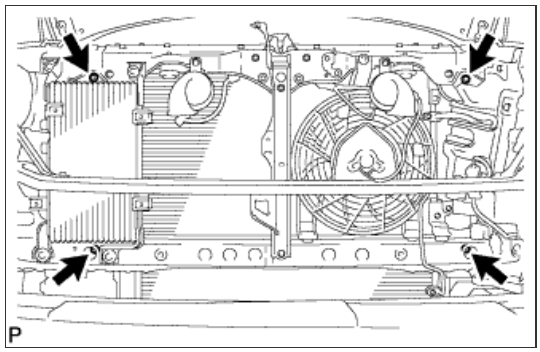
50. DISCONNECT RADIATOR SIDE DEFLECTOR LH

a. Using a clip remover, remove the 4 clips, and remove the side deflector.

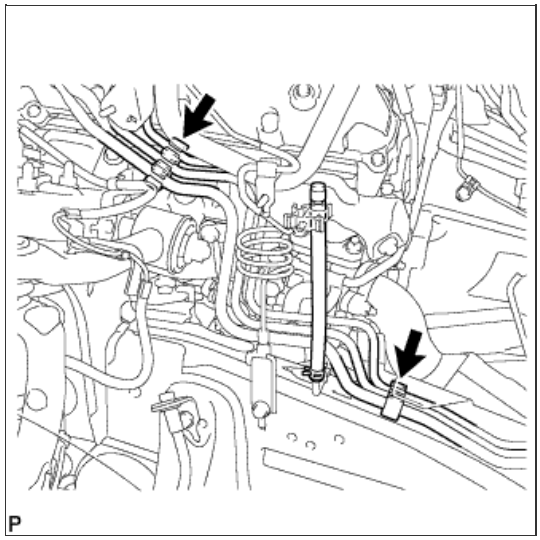


51. REMOVE RADIATOR ASSEMBLY

a. Remove the 4 bolts and radiator.



52. DISCONNECT FRONT DIFFERENTIAL BREATHER TUBE

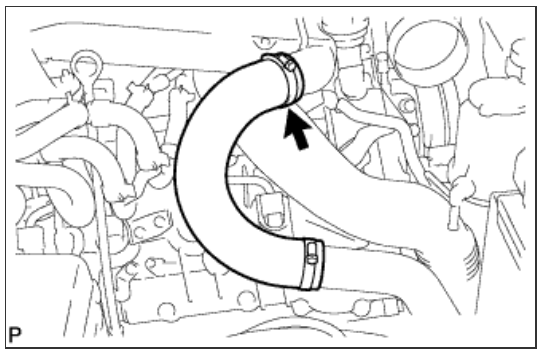


53. DISCONNECT FUEL TUBE

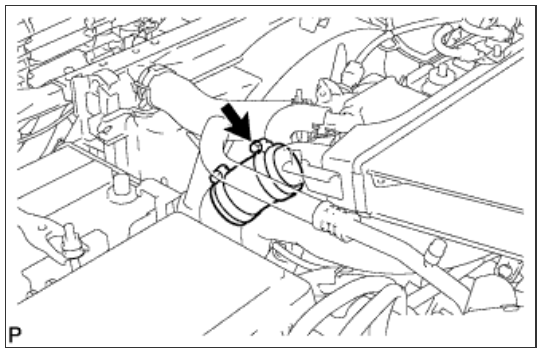
a. Disconnect the 3 fuel tubes from the No. 1 and No. 3 fuel tube clamps.

54. REMOVE INTERCOOLER ASSEMBLY (w/ Intercooler)

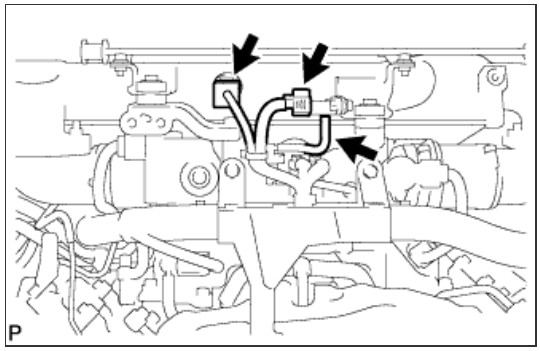
a. Loosen the No. 1 air hose clamp.



b. Loosen the No. 2 air hose clamp.



c. Disconnect the turbo pressure sensor connector, intake air temperature sensor connector and vacuum hose.



d. Remove the 6 nuts, 2 bolts and intercooler.

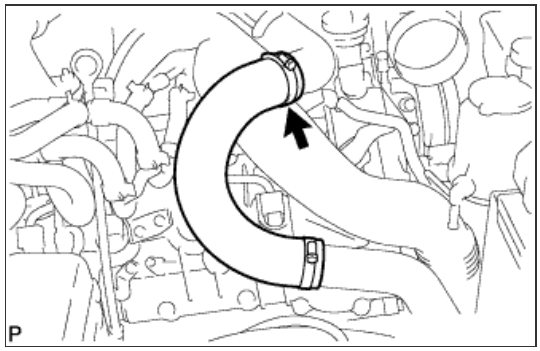
e. Remove the 2 gaskets from the air tube LH and RH.



55. REMOVE NO. 1 COOL AIR INLET (w/o Intercooler)

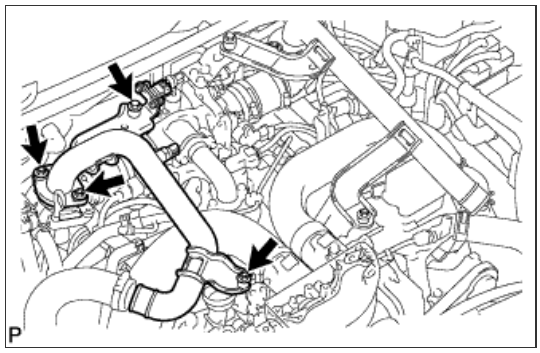
a. Loosen the No. 1 air hose clamp.

b. Disconnect the turbo pressure sensor connector, intake air temperature sensor connector and vacuum hose.



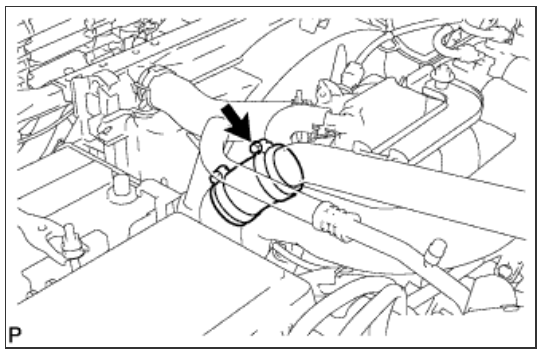
c. Remove the 3 nuts, bolt and No. 1 cool air inlet.

d. Remove the gasket from the air tube RH.



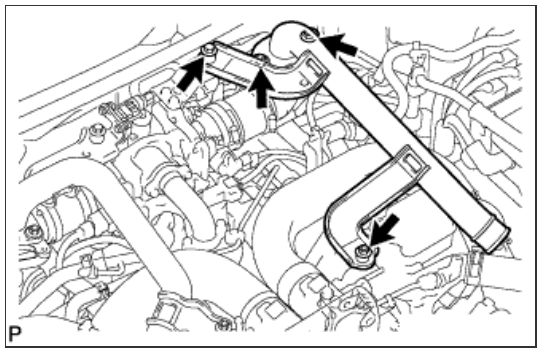
56. REMOVE NO. 2 COOL AIR INLET (w/o Intercooler)

a. Loosen the No. 2 air hose clamp.

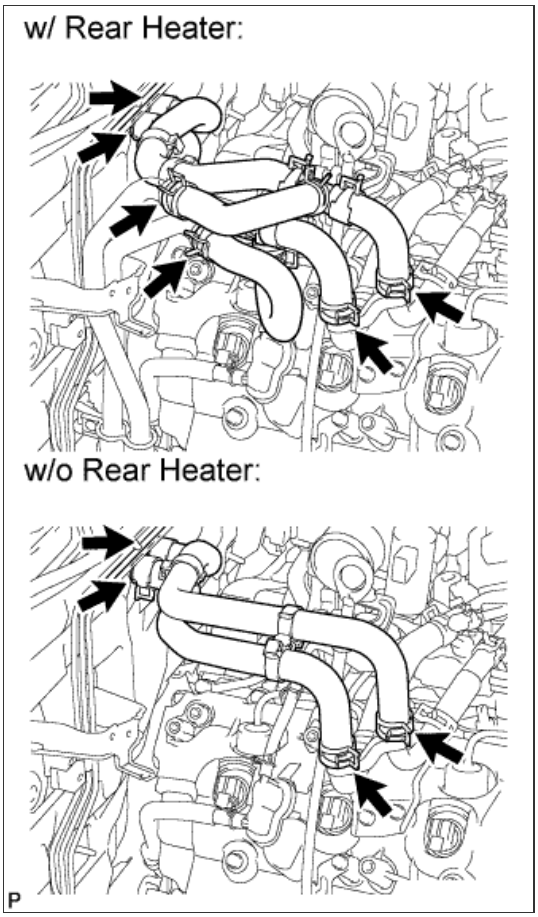


b. Remove the 3 nuts, bolt and No. 2 cool air inlet.

c. Remove the gasket from the air tube LH.

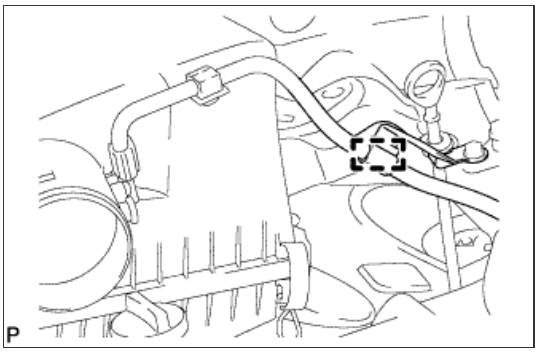


57. DISCONNECT WATER HOSE SUB-ASSEMBLY



58. REMOVE NO. 2 ENGINE OIL LEVEL DIPSTICK GUIDE

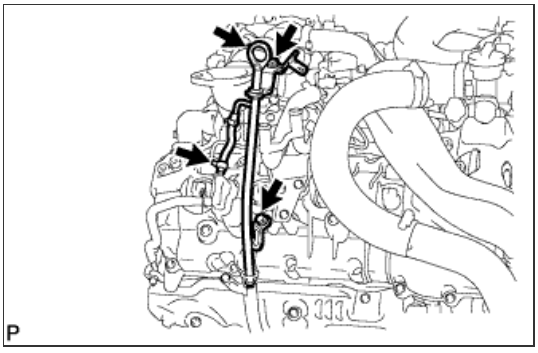
a. Disconnect the wire harness clamp from the No. 2 engine oil level dipstick guide.



b. Disconnect the ventilation hose from the cylinder head cover RH.

c. Remove the 2 bolts and No. 2 engine oil level dipstick guide.

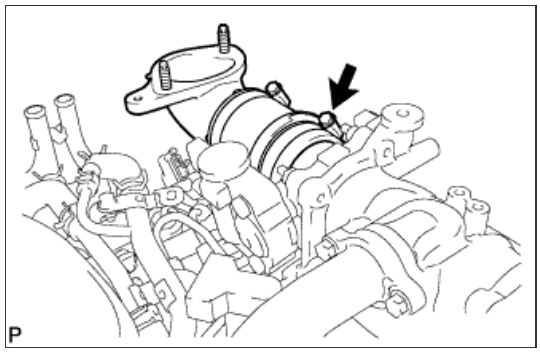
d. Remove the O-ring from the No. 2 engine oil level dipstick guide.



59. REMOVE AIR TUBE SUB-ASSEMBLY RH

a. Loosen the hose clamp.

b. Remove the air tube from the throttle body.



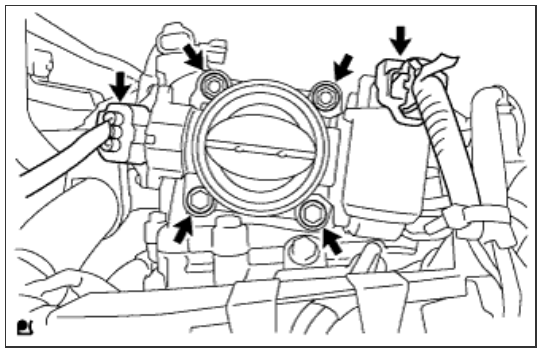
60. REMOVE DIESEL THROTTLE BODY ASSEMBLY RH

a. Disconnect the throttle position sensor connector.

b. Disconnect the throttle motor connector.

c. Remove the 2 bolts, 2 nuts and throttle body.

d. Remove the gasket from the intake pipe.



61. DRAIN CLUTCH FLUID (for Manual Transmission)

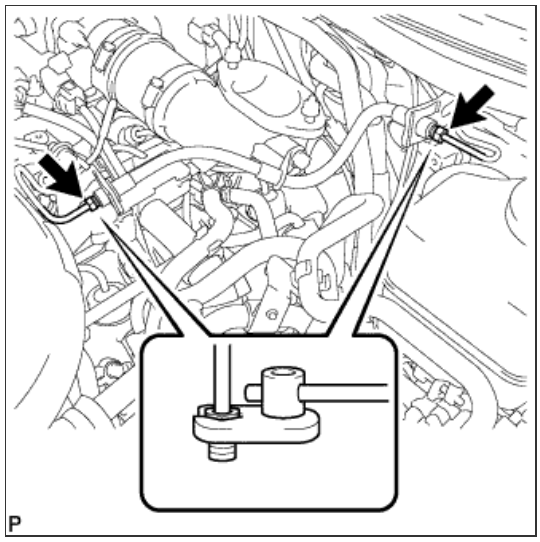
62. REMOVE CLUTCH HOSE (for Manual Transmission)

a. Disconnect the 2 flexible hose tubes from the clutch hose with a 10 mm union nut wrench while holding the flexible hose with a wrench.

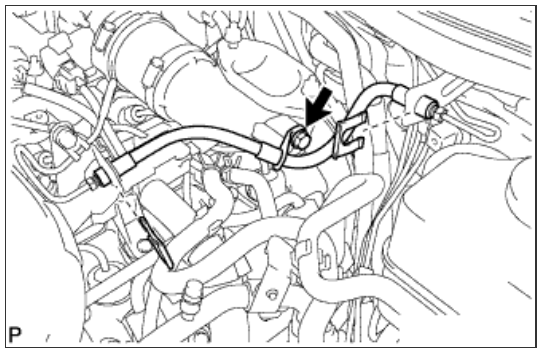
NOTICE:

- **Do not bend or damage the flexible hose tubes.**
- **Do not allow any foreign matter such as dirt and dust to enter the flexible hose tubes from the connecting point.**

b. Remove the 2 clips.



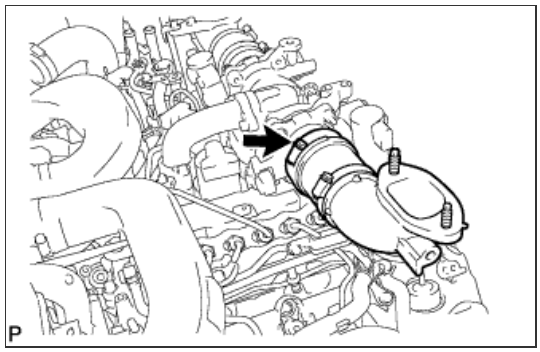
c. Remove the bolt and clutch hose.



63. REMOVE AIR TUBE SUB-ASSEMBLY LH

a. Loosen the hose clamp.

b. Remove the air tube from the throttle body.

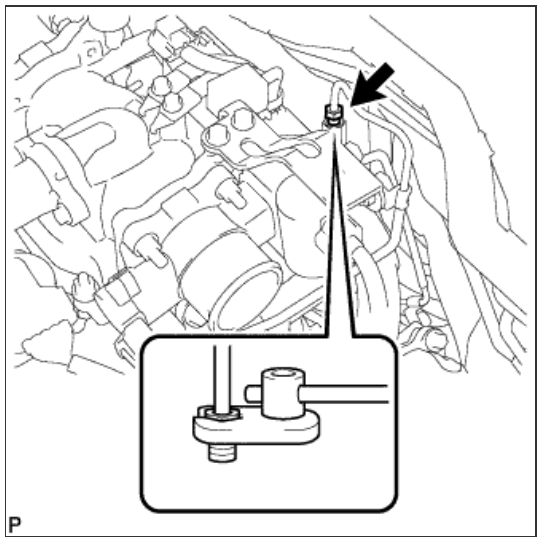


64. REMOVE TUBE CONNECTOR TO FLEXIBLE HOSE TUBE (for Manual Transmission)

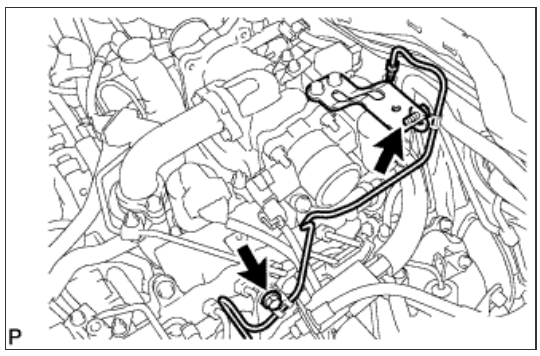
a. Using a 10 mm union nut wrench, disconnect the tube connector to flexible hose tube from the clutch tube to release cylinder 2 way.

NOTICE:

- **Do not bend or damage the flexible hose tube.**
- **Do not allow any foreign matter such as dirt and dust to enter the flexible hose tube from the connecting point.**



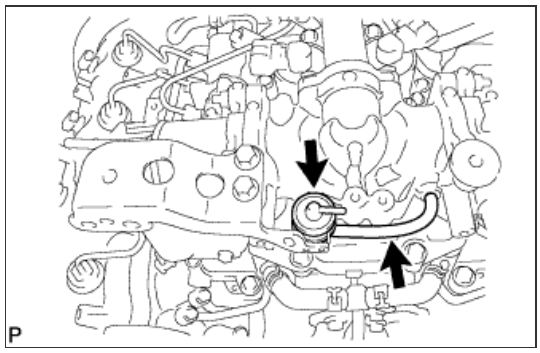
b. Remove the 2 bolts and tube connector to flexible hose tube.



65. REMOVE NO. 1 GAS FILTER

a. Disconnect the hose from the intake pipe.

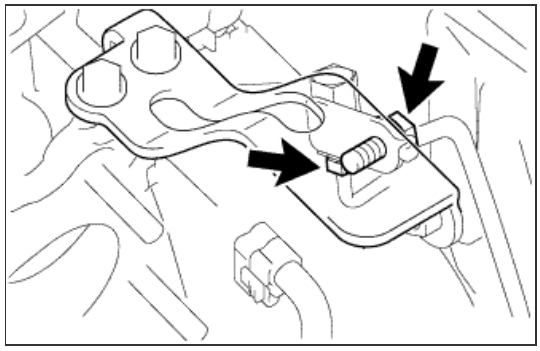
b. Remove the gas filter.



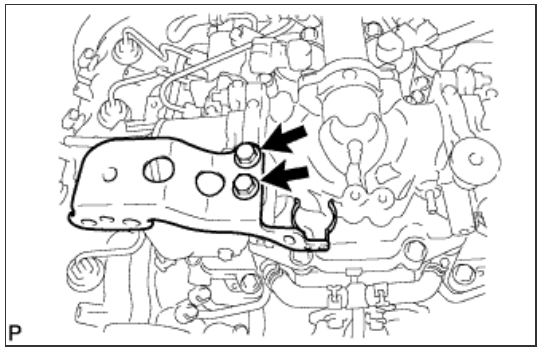
66. REMOVE NO. 3 INTERCOOLER SUPPORT BRACKET

a. for Manual Transmission:

i. Remove the bolt and disconnect the clutch tube to release cylinder 2 way from the bracket.



b. Remove the 2 bolts and bracket.



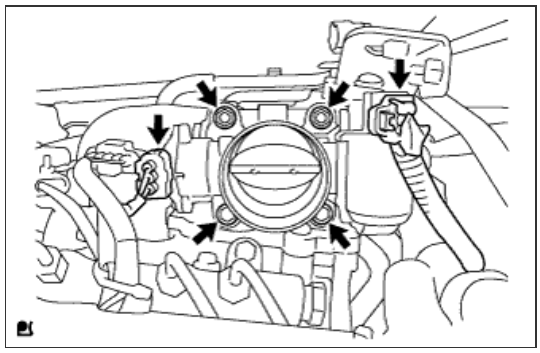
67. REMOVE DIESEL THROTTLE BODY ASSEMBLY LH

a. Disconnect the throttle position sensor connector.

b. Disconnect the throttle motor connector.

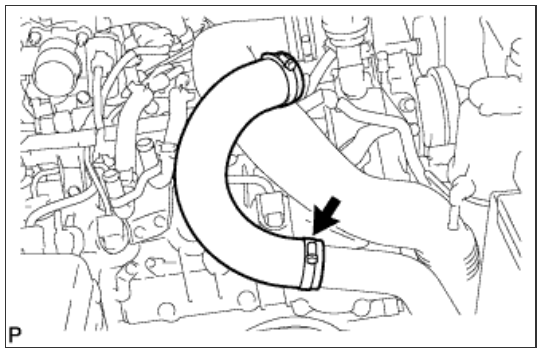
c. Remove the 2 bolts, 2 nuts and throttle body.

d. Remove the gasket from the intake pipe.



68. REMOVE NO. 1 AIR HOSE

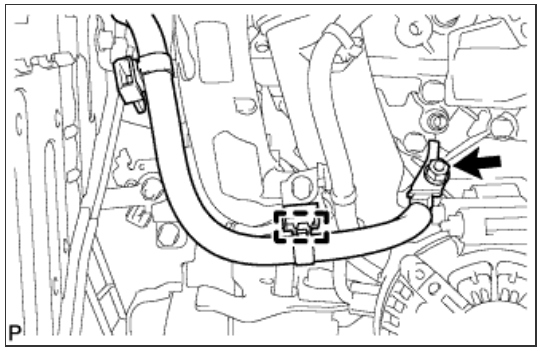
a. Loosen the hose clamp and remove the No. 1 air hose.



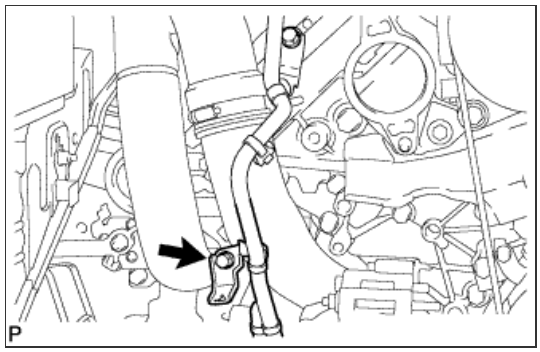
69. REMOVE NO. 3 AIR TUBE

a. Disconnect the wire harness from the clamp.

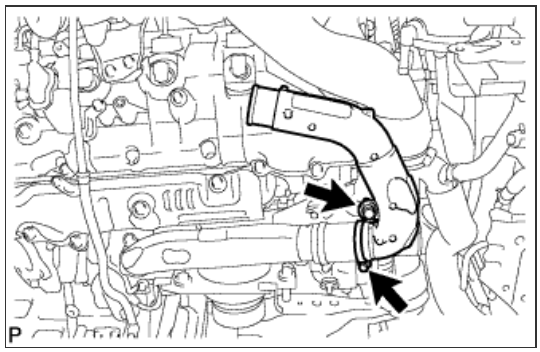
b. Remove the nut and ground wire.



c. Remove the bolt and disconnect the wire harness bracket.



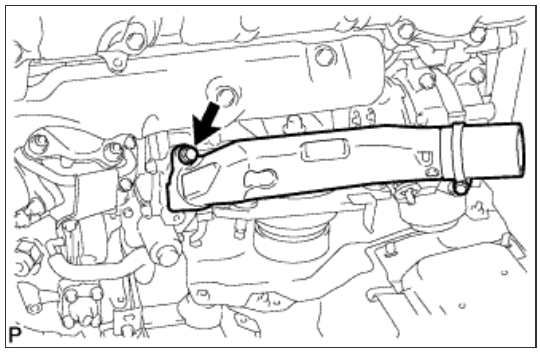
d. Loosen the hose clamp and remove the bolt and No. 3 air tube.



70. REMOVE NO. 1 AIR TUBE ASSEMBLY

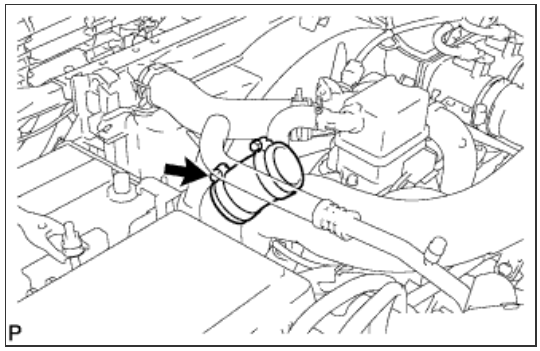
a. Remove the bolt and No. 1 air tube.

b. Remove the O-ring.



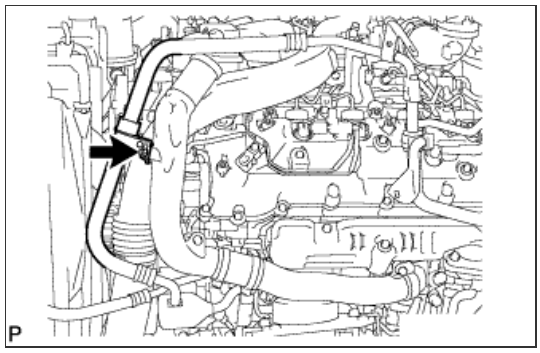
71. REMOVE NO. 2 AIR HOSE

a. Loosen the hose clamp and remove the No. 2 air hose.

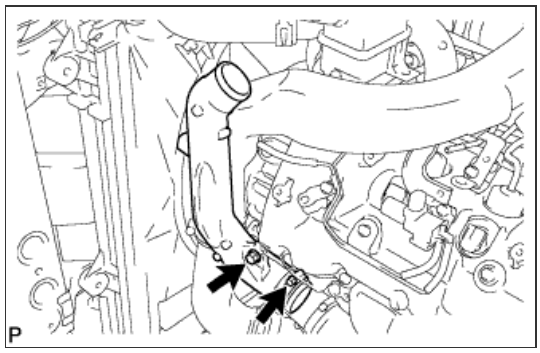


72. REMOVE NO. 4 AIR TUBE

a. Remove the bolt and disconnect the suction hose.



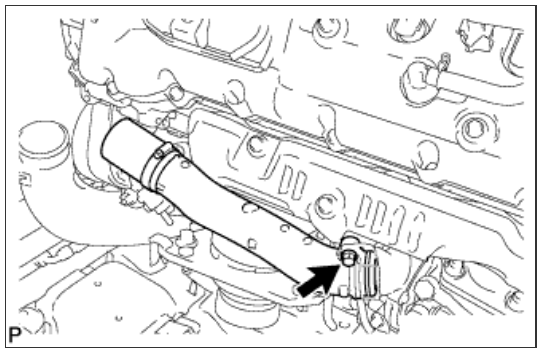
b. Loosen the hose clamp and remove the bolt and No. 4 air tube.



73. REMOVE NO. 2 AIR TUBE ASSEMBLY

a. Remove the bolt and No. 2 air tube.

b. Remove the O-ring.

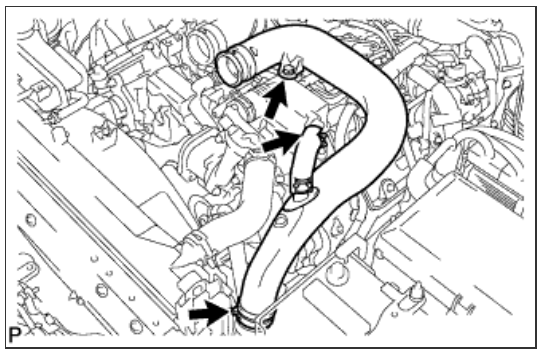


74. REMOVE NO. 2 AIR CLEANER PIPE SUB-ASSEMBLY

a. Disconnect the ventilation hose from the oil separator.

b. Loosen the hose clamp.

c. Remove the bolt and No. 2 air cleaner pipe.



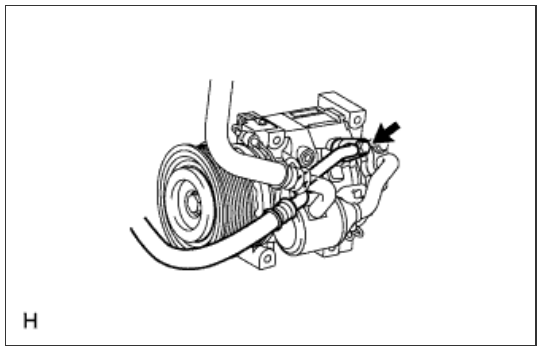
75. REMOVE NO. 1 COOLER REFRIGERANT DISCHARGE HOSE

a. Remove the bolt and disconnect the discharge hose from the cooler compressor.

b. Remove the O-ring from the discharge hose.

NOTICE:

Seal the openings of the disconnected parts using vinyl tape to prevent moisture and foreign matter from entering them.



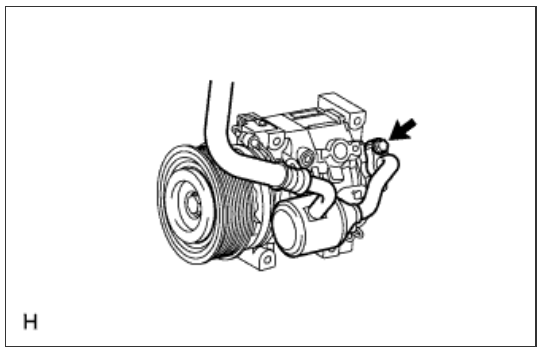
76. REMOVE SUCTION HOSE SUB-ASSEMBLY

a. Remove the bolt and disconnect the suction hose from the cooler compressor.

b. Remove the O-ring from the suction hose.

NOTICE:

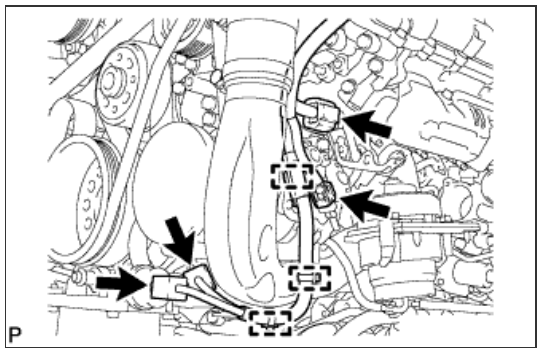
Seal the openings of the disconnected parts using vinyl tape to prevent moisture and foreign matter from entering them.



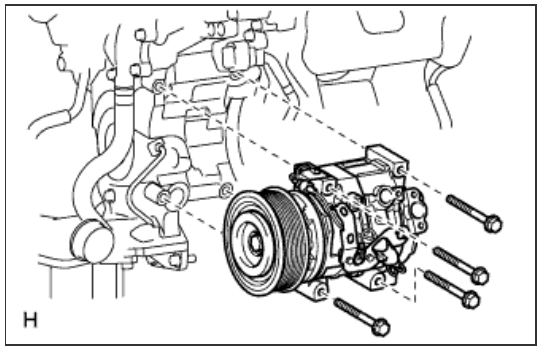
77. REMOVE COOLER COMPRESSOR ASSEMBLY

a. Disconnect the 4 connectors.

b. Using a clip remover, detach the 3 wire harness clamps.

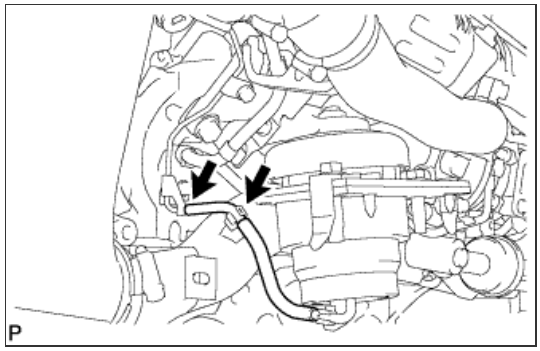


c. Remove the 4 bolts and cooler compressor.

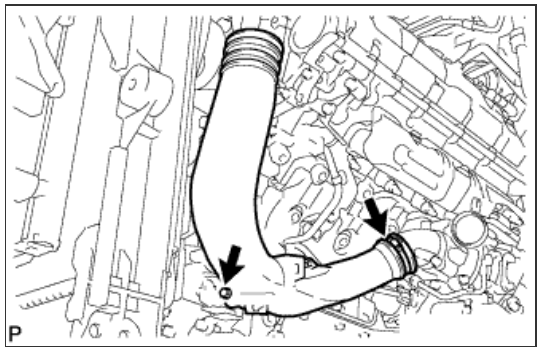


78. REMOVE NO. 2 INTAKE AIR CONNECTOR PIPE

a. w/ Intercooler:
Disconnect the vacuum hose.

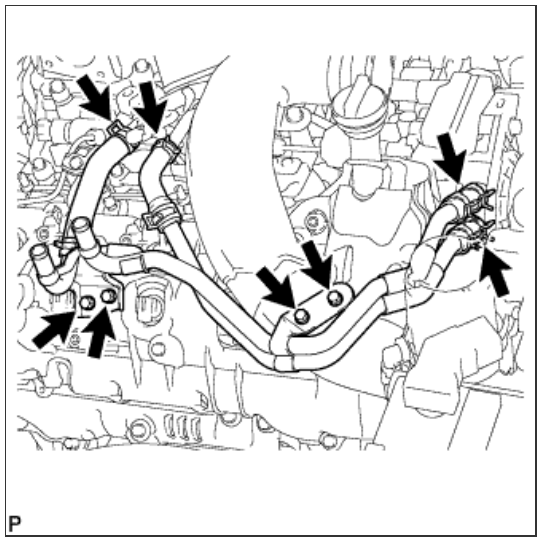


b. Loosen the hose clamp, and remove the bolt and No. 2 intake air connector pipe.



79. REMOVE HEATER WATER PIPE SUB-ASSEMBLY (w/ Viscous Heater)

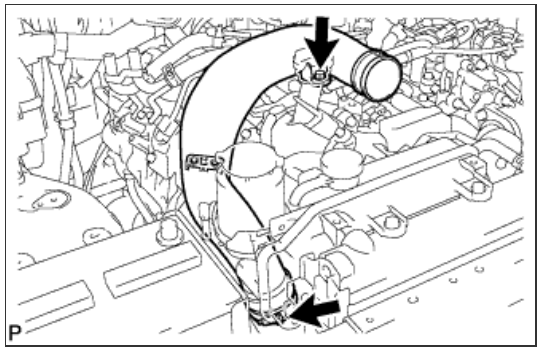
a. Remove the 4 bolts and disconnect the 4 water hose ends, and then remove the heater water pipe.



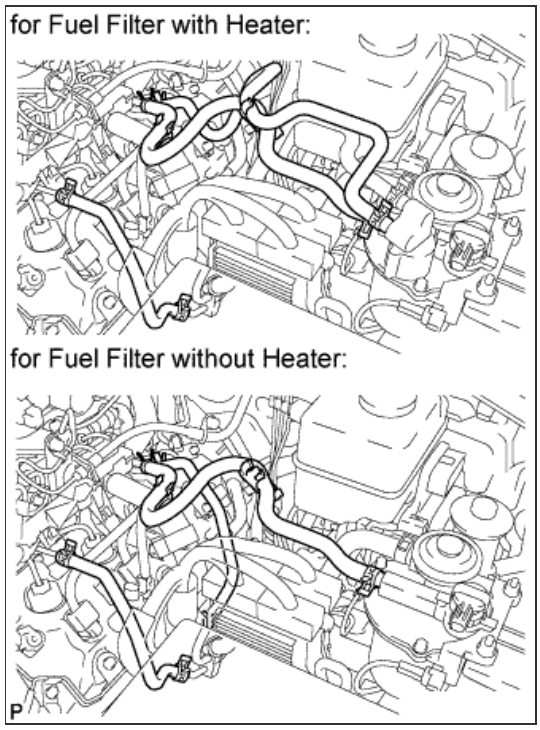
80. REMOVE NO. 1 AIR CLEANER PIPE SUB-ASSEMBLY

a. Loosen the hose clamp.

b. Remove the bolt and No. 1 air cleaner pipe.

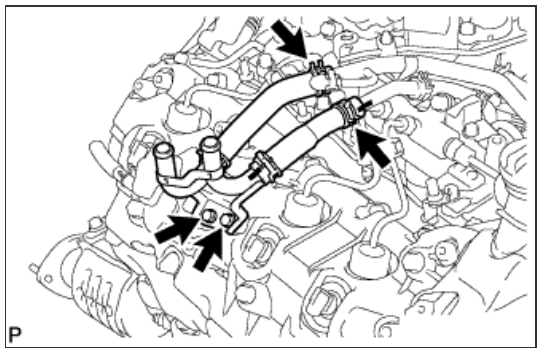


81. DISCONNECT FUEL HOSE



82. REMOVE NO. 3 WATER BY-PASS PIPE (w/o Viscous Heater)

a. Remove the 2 bolts and disconnect the 2 water hose ends, and then remove the No. 3 water by-pass pipe.

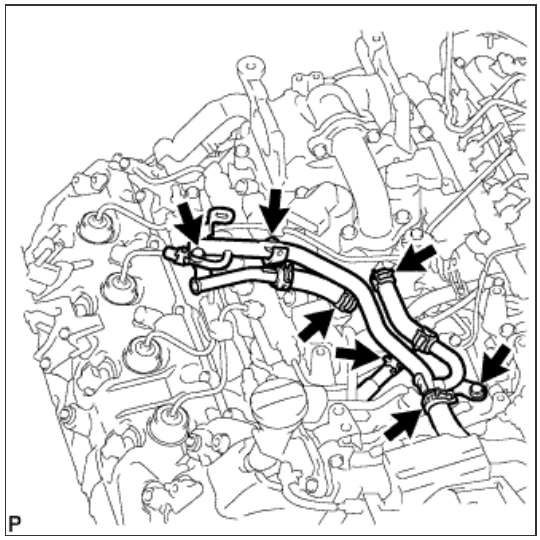


83. REMOVE NO. 4 WATER BY-PASS PIPE

a. w/ EGR System:

i. Remove the 2 bolts and nut.

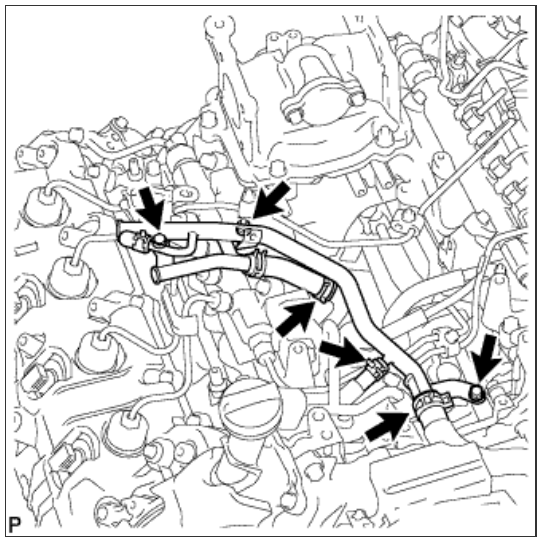
ii. Disconnect the 4 water hose ends, and then remove the No. 4 water by-pass pipe.



b. w/o EGR System:

i. Remove the 2 bolts and nut.

ii. Disconnect the 3 water hose ends, and then remove the No. 4 water by-pass pipe.



84. DISCONNECT ENGINE WIRE

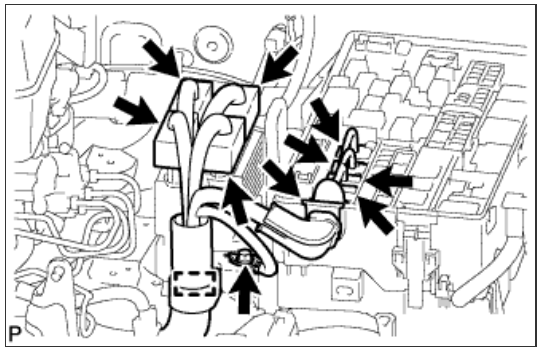
a. LH Side:

i. Disconnect the 4 connectors from the injector driver.

ii. Disconnect the 4 connectors and detach the wire harness holder from the relay block.

iii. Remove the bolt and disconnect the ground wire.

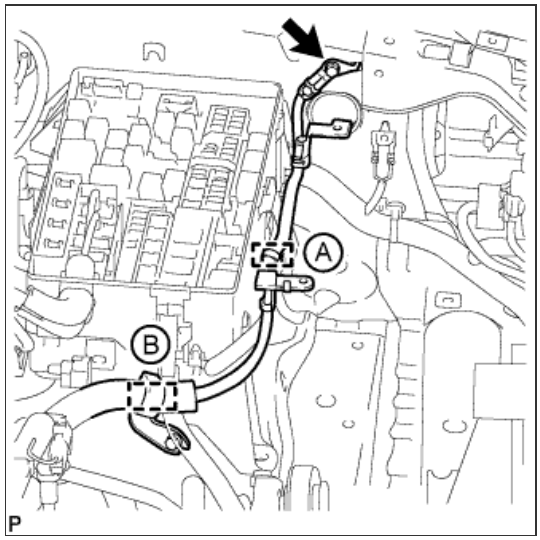
iv. Disconnect the wire harness from the wire harness clamp holder.



v. Remove the bolt and disconnect the ground wire from the body panel.

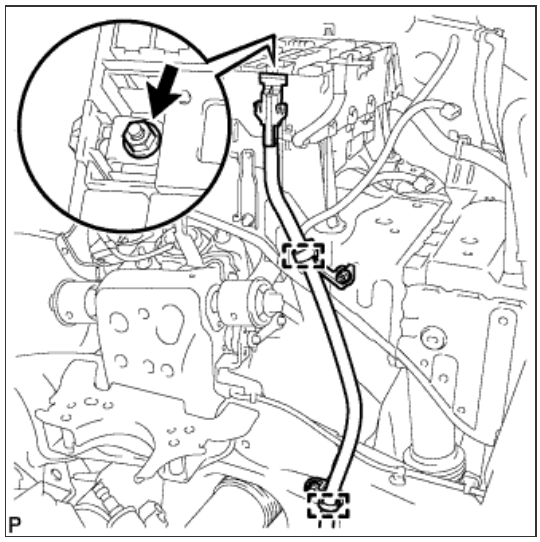
vi. Using a clip remover, detach the ground wire clamp labeled A from the relay block side.

vii. Disconnect the wire harness from the wire harness clamp holder labeled B.



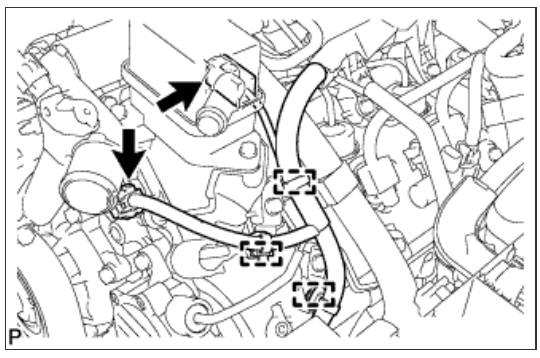
viii. Remove the nut and detach the generator positive (+) cable holder from the relay block.

ix. Disconnect the generator positive (+) cable from the 2 clamps.



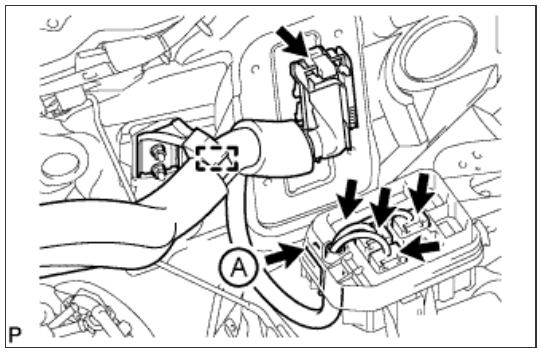
x. Disconnect the 2 connectors.

xi. Using a clip remover, detach the 3 wire harness clamps.



xii. for RHD:

Disconnect the 4 connectors and detach the wire harness tab labeled A from the relay block.



xiii. for RHD:
Disconnect the ECM connector.

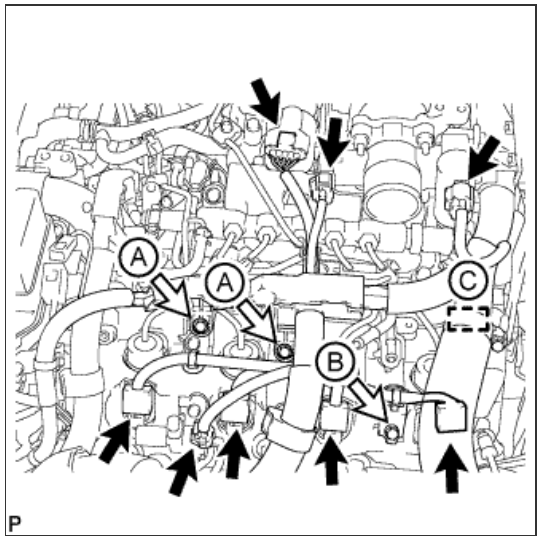
xiv. for RHD:
Disconnect the wire harness from the wire harness clamp holder.

xv. Disconnect the 8 connectors.

xvi. Remove the 2 bolts labeled A and disconnect the engine wire protector.

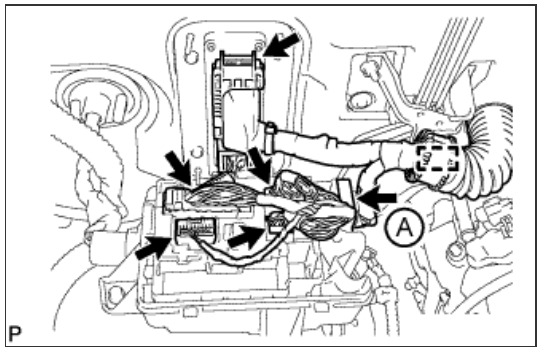
xvii. Remove the bolt labeled B and the engine wire harness bracket.

xviii. for RHD:
Disconnect the ECM wire harness from the wire harness clamp holder labeled C.



b. RH Side:

i. for LHD:
Disconnect the 4 connectors, and detach the wire harness holder labeled A from the relay block.



ii. for LHD:
Disconnect the ECM connector.

iii. for LHD:
Disconnect the wire harness from the wire harness clamp holder.

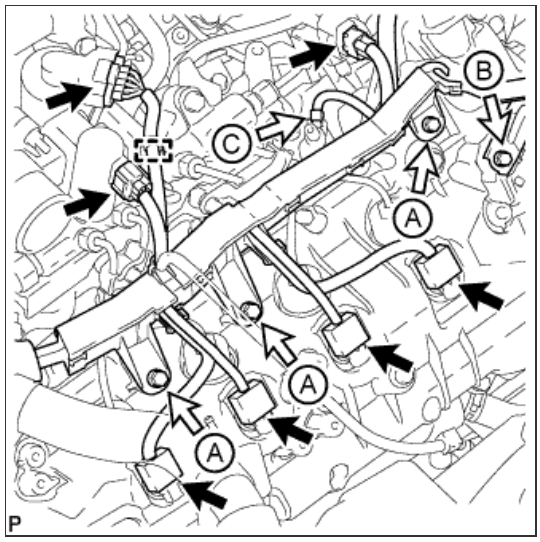
iv. Disconnect the 7 connectors.

v. Using a clip remover, detach the wire harness clamp.

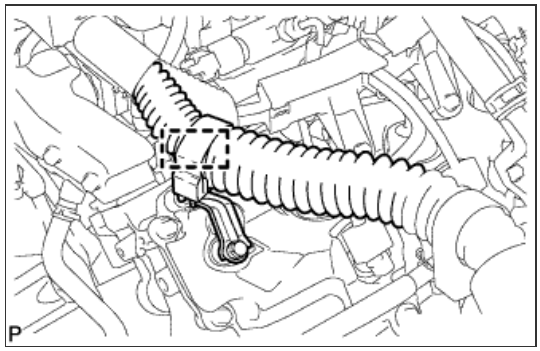
vi. Remove the 3 bolts labeled A and disconnect the engine wire protector.

vii. Remove the bolt labeled B and the wire harness bracket.

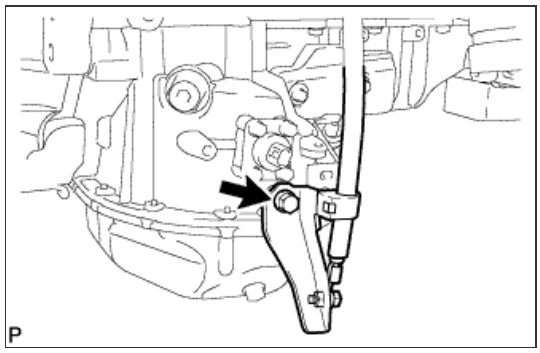
viii. Remove the nut labeled C and the glow plug wire harness.



ix. for RHD:
Disconnect the wire harness from the wire harness clamp holder.



x. w/ Winch:
Remove the bolt and disconnect the ground wire.



c. Rear Side:

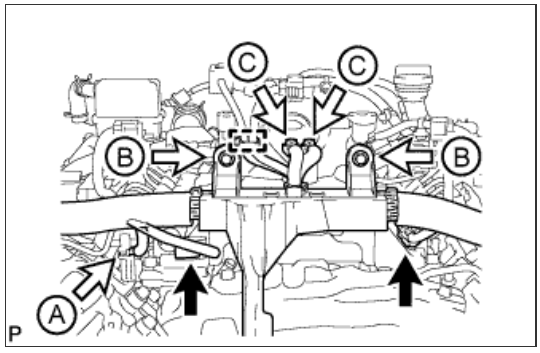
i. Using a clip remover, detach the wire harness clamp.

ii. Remove the 2 bolts and 2 ground wires labeled C.

iii. Remove the 2 bolts labeled B and disconnect the engine wire harness protector.

iv. Disconnect the 2 common rail connectors.

v. Remove the nut and disconnect the glow plug wire harness labeled A.



85. REMOVE NO. 2 FUEL PIPE SUB-ASSEMBLY

NOTICE:

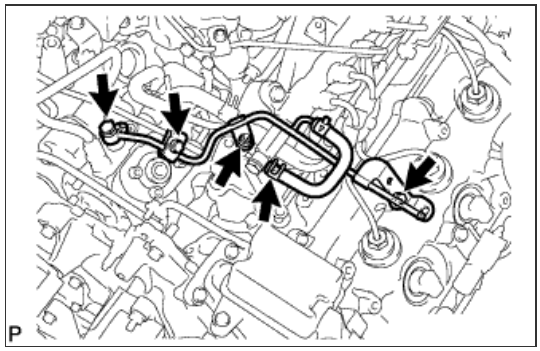
- **After removing a fuel pipe, to prevent dirt or foreign objects from entering the fuel pipe ends, cover the fuel pipe ends with plastic bags.**
- **After removing a fuel pipe, to prevent dirt or foreign objects from entering the fuel supply pump hole, cover the hole with protective tape.**

a. Disconnect the fuel hose from the No. 5 nozzle leakage pipe.

b. Remove the bolt and No. 2 injection pipe clamp.

c. Remove the union bolt and gasket.

d. Remove the bolt, nut and No. 2 fuel pipe.



86. REMOVE NO. 6 INJECTION PIPE SUB-ASSEMBLY

NOTICE:

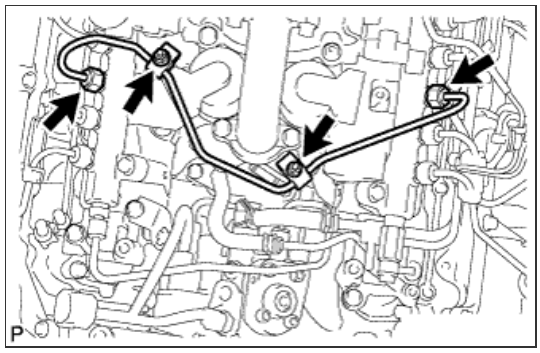
After removing an injection pipe, to prevent dirt or foreign objects from entering the common rail holes, cover the holes with protective tape.

a. w/ EGR System:

i. Using a union nut wrench, loosen the No. 6 injection pipe ends.

ii. Remove the 2 nuts and 2 No. 2 injection pipe clamps.

iii. Remove the No. 6 injection pipe.

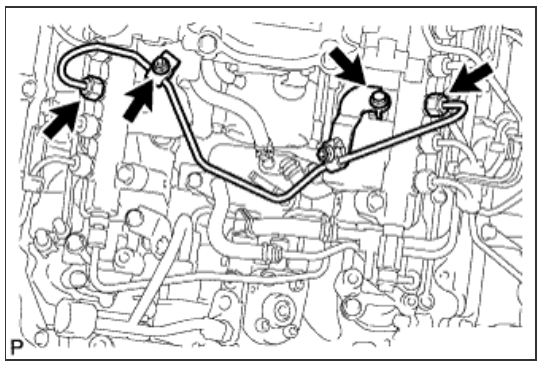


b. w/o EGR System:

i. Using a union nut wrench, loosen the No. 6 injection pipe ends.

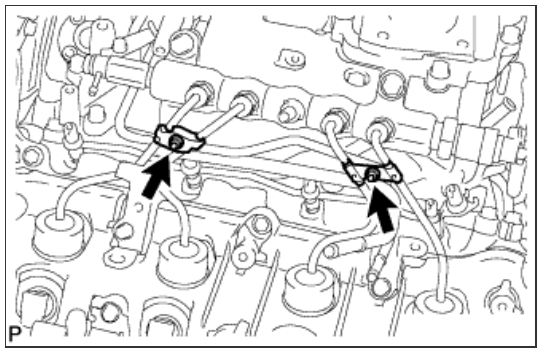
ii. Remove the nut and No. 2 injection pipe clamp.

iii. Remove the bolt and No. 6 injection pipe.



87. REMOVE INJECTION PIPE LH

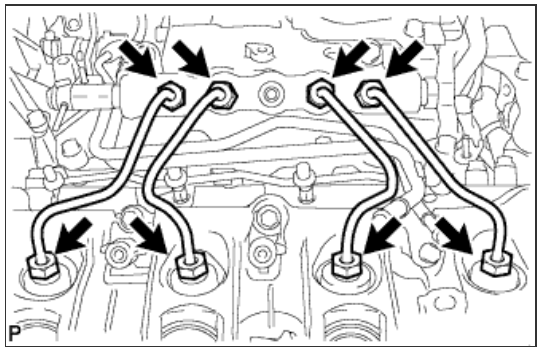
a. w/ Intercooler:
Remove the 2 nuts and 4 injection pipe clamps.



b. Using a union nut wrench, remove the 4 injection pipes.

NOTICE:

After removing an injection pipe, to prevent dirt or foreign objects from entering the common rail holes or injector holes, cover the holes with protective tape.

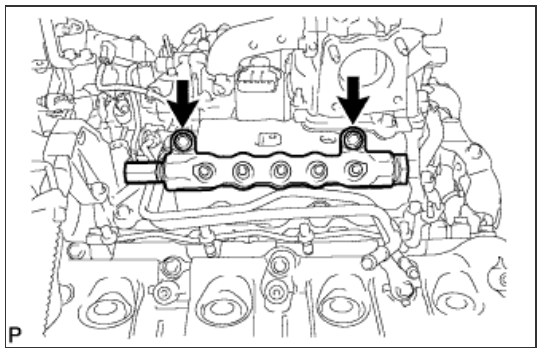


88. REMOVE COMMON RAIL ASSEMBLY LH

a. Remove the 2 bolts and common rail.

NOTICE:

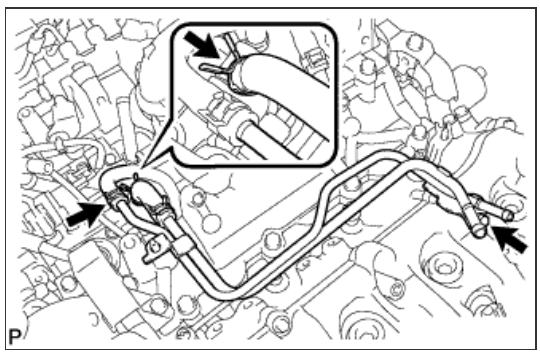
Do not remove the fuel pressure limiter from the common rail. If it is removed, replace the common rail.



89. REMOVE FUEL FILTER TO INJECTION PUMP FUEL PIPE SUB-ASSEMBLY

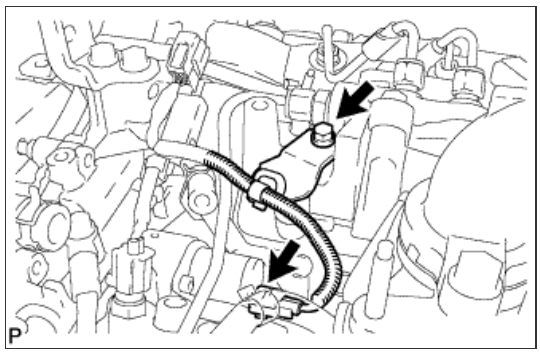
a. Disconnect the 2 hoses from the fuel pipe.

b. Remove the bolt and fuel filter to injection pump fuel pipe.



90. DISCONNECT FUEL PUMP MOTOR WIRE

a. Remove the bolt and disconnect the connector from the fuel supply pump.

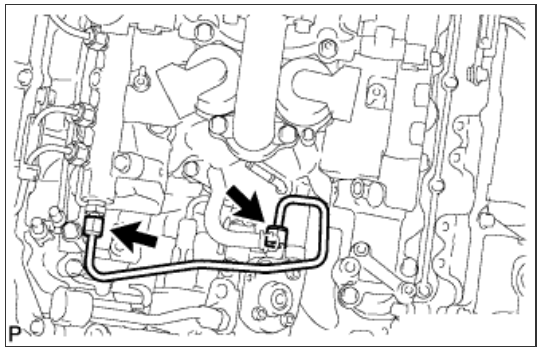


91. REMOVE NO. 5 INJECTION PIPE SUB-ASSEMBLY

a. Using a union nut wrench, remove the No. 5 injection pipe.

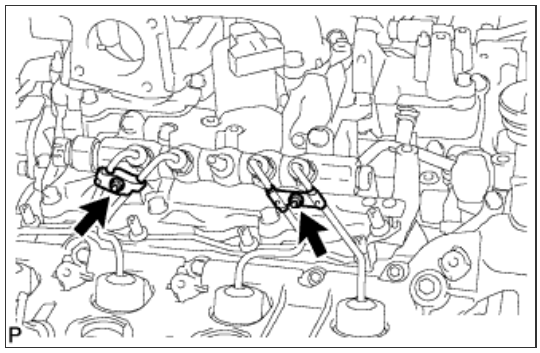
NOTICE:

After removing an injection pipe, to prevent dirt or foreign objects from entering the common rail hole or injection pump hole, cover the holes with protective tape.



92. REMOVE INJECTION PIPE RH

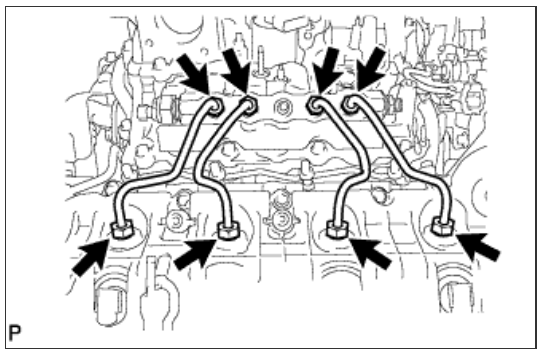
a. w/ Intercooler:
Remove the 2 nuts and 4 injection pipe clamps.



b. Using a union nut wrench, remove the 4 injection pipes.

NOTICE:

After removing an injection pipe, to prevent dirt or foreign objects from entering the common rail holes or injector holes, cover the holes with protective tape.

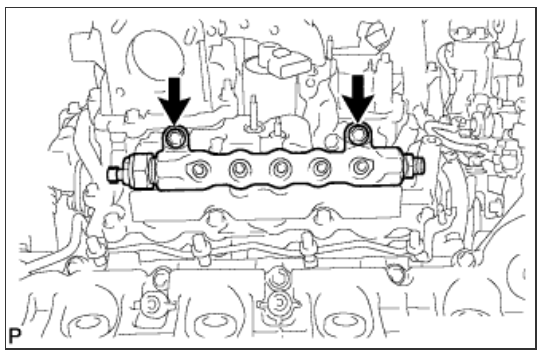


93. REMOVE COMMON RAIL ASSEMBLY RH

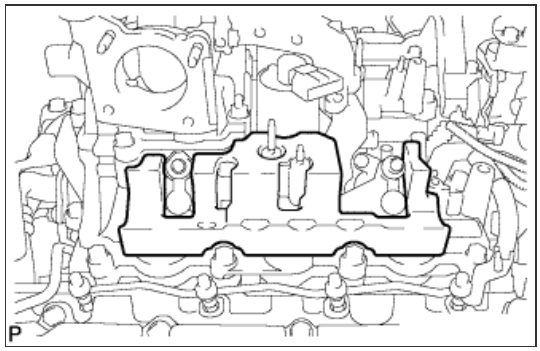
a. Remove the 2 bolts and common rail.

NOTICE:

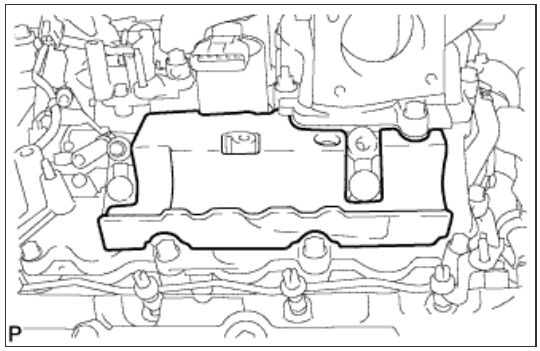
Do not remove the fuel pressure sensor from the common rail. If it is removed, replace the common rail.



94. REMOVE NO. 1 INTAKE MANIFOLD INSULATOR (w/ Intercooler)

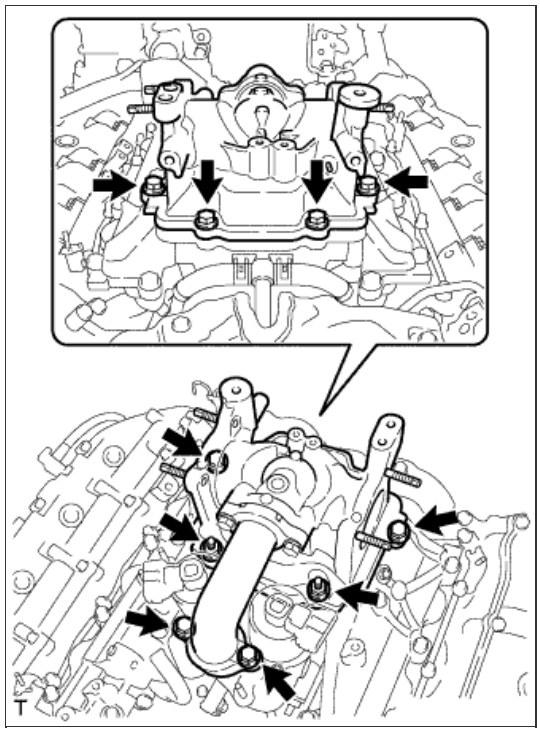


95. REMOVE NO. 2 INTAKE MANIFOLD INSULATOR (w/ Intercooler)

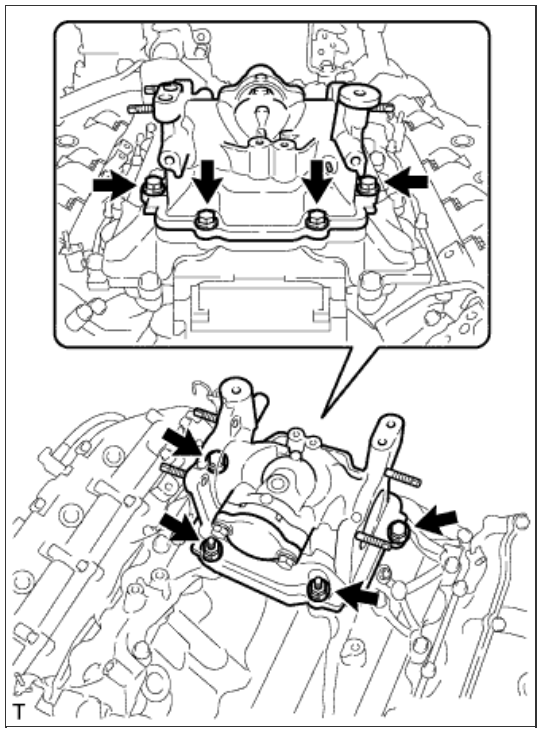


96. REMOVE INTAKE PIPE

a. w/ EGR System:
Remove the 2 nuts, 6 bolts, intake pipe and 2 gaskets.

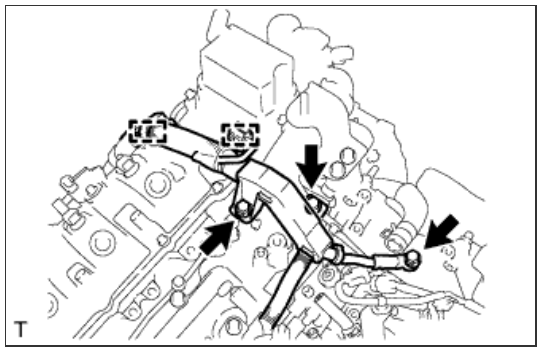


b. w/o EGR System:
Remove the 2 nuts, 4 bolts, intake pipe and gasket.



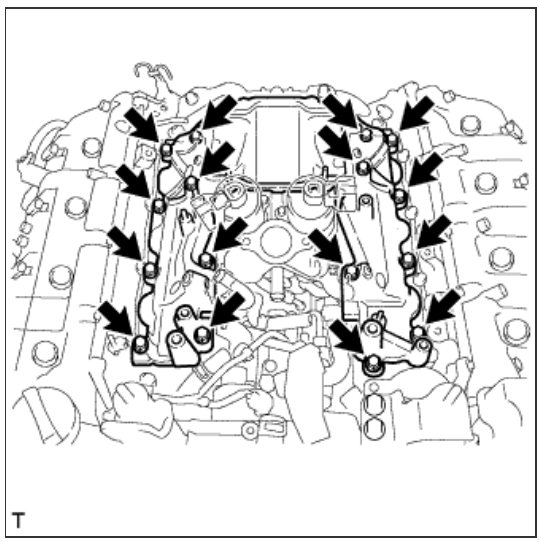
97. DISCONNECT NO. 2 ENGINE WIRE

a. Remove the 3 bolts and using a clip remover, detach the 2 wire harness clamps, and then disconnect the No. 2 engine wire.

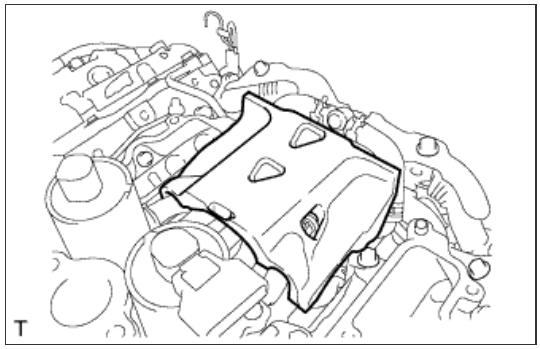


98. REMOVE NO. 3 INTAKE MANIFOLD

a. Remove the 16 bolts, No. 3 intake manifold and 2 gaskets.

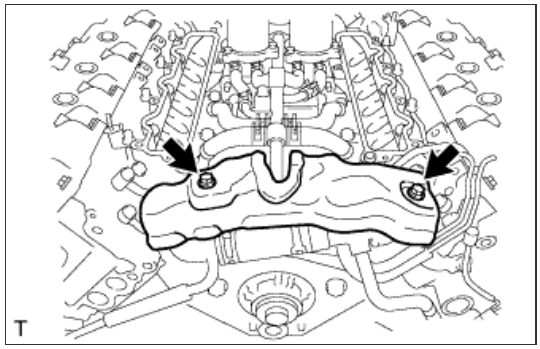


99. REMOVE INTAKE MANIFOLD INSULATOR (w/ EGR System)



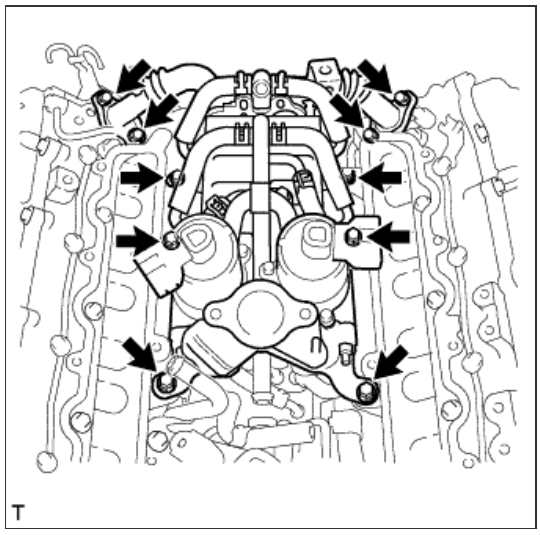
100. REMOVE EGR PIPE INSULATOR (w/ EGR System)

a. Remove the 2 bolts and EGR pipe insulator.

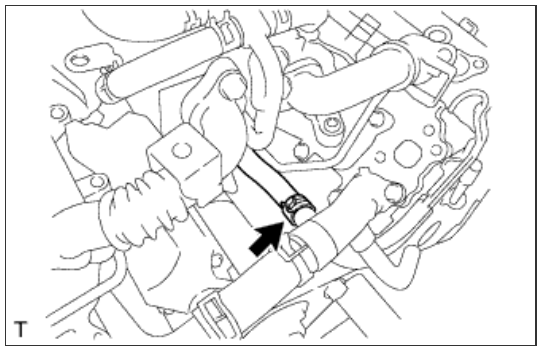


101. REMOVE EGR VALVE ASSEMBLY WITH EGR COOLER (w/ EGR System)

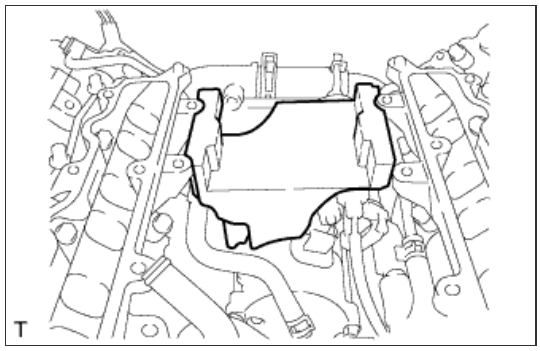
a. Remove the 10 bolts, EGR valve with EGR cooler and 2 gaskets.



b. Disconnect the No. 5 water by-pass hose from the water by-pass outlet.



102. REMOVE EGR COOLER INSULATOR (w/ EGR System)



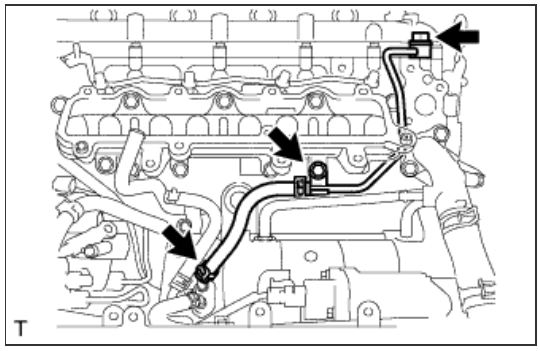
103. REMOVE NO. 3 NOZZLE LEAKAGE PIPE

a. Disconnect the No. 1 fuel hose from the fuel cooler.

b. Remove the union bolt, bolt, No. 3 nozzle leakage pipe and gasket.

NOTICE:

After removing the nozzle leakage pipe, to prevent dirt or foreign objects from entering the nozzle leakage pipe, cover the nozzle leakage pipe ends with plastic bags.



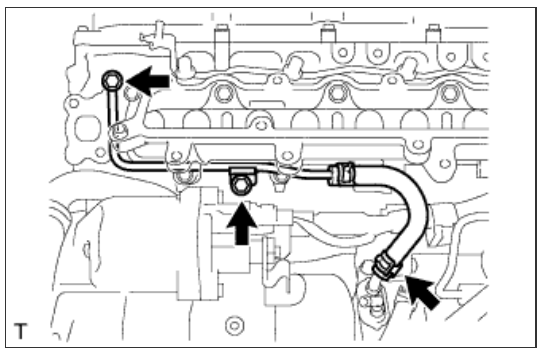
104. REMOVE NO. 4 NOZZLE LEAKAGE PIPE

a. Disconnect the No. 2 fuel hose from the fuel cooler.

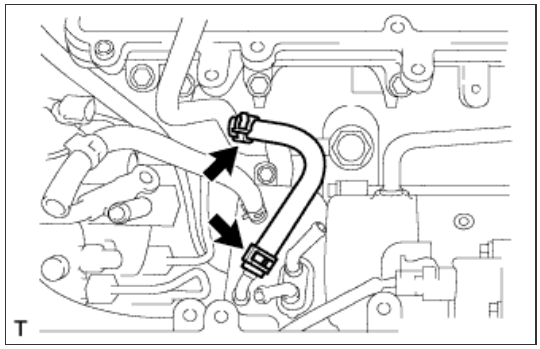
b. Remove the union bolt, bolt, No. 4 nozzle leakage pipe and gasket.

NOTICE:

After removing the nozzle leakage pipe, to prevent dirt or foreign objects from entering the nozzle leakage pipe, cover the nozzle leakage pipe ends with plastic bags.

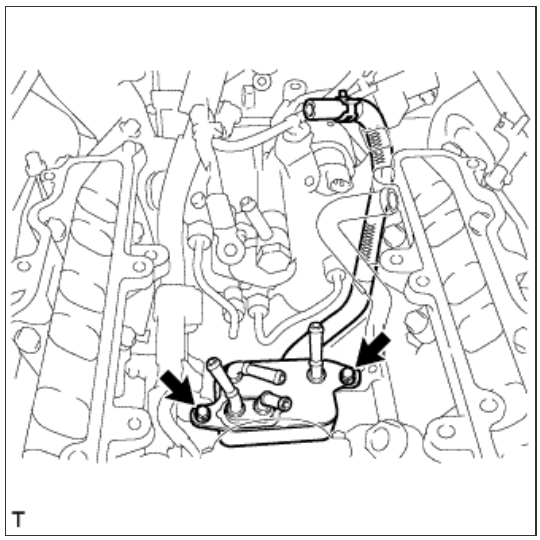


105. DISCONNECT NO. 6 WATER BY-PASS HOSE



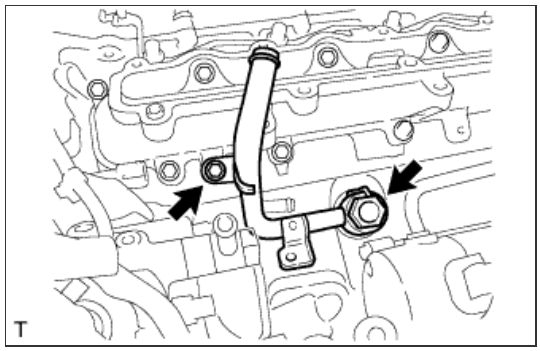
106. REMOVE FUEL COOLER ASSEMBLY

a. Remove the 2 bolts and fuel cooler.



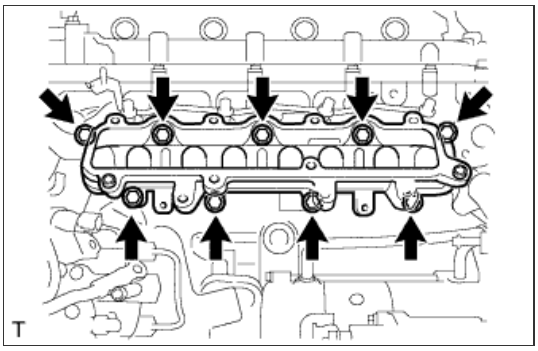
107. REMOVE NO. 1 WATER BY-PASS PIPE

a. Remove the union bolt, bolt, No. 1 water by-pass pipe and gasket.



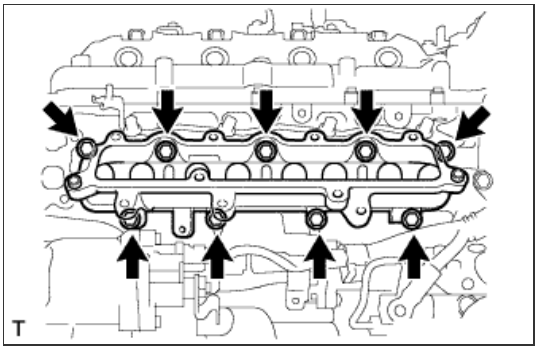
108. REMOVE NO. 1 INTAKE MANIFOLD

a. Remove the 9 bolts, No. 1 intake manifold and gasket.



109. REMOVE NO. 2 INTAKE MANIFOLD

a. Remove the 9 bolts, No. 2 intake manifold and gasket.



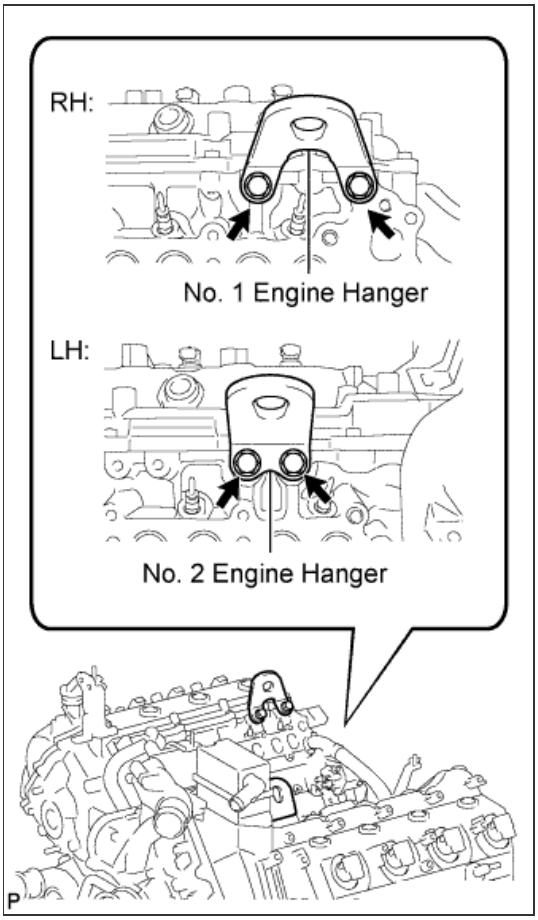
110. INSTALL NO. 1 AND NO. 2 ENGINE HANGER

a. Install the No. 1 and No. 2 engine hangers to the cylinder head RH and LH with the 4 bolts as shown in the illustration.

Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }

Engine Hanger Part No.

Item	Part No.
No. 1 engine hanger	12281-51040
No. 2 engine hanger	12282-51040
Bolt	91671-80825



111. REMOVE AUTOMATIC TRANSMISSION ASSEMBLY

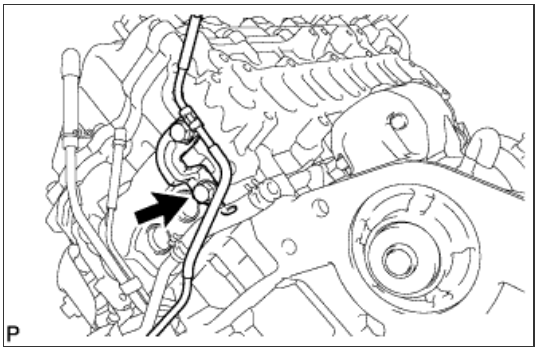
a. Remove the automatic transmission assembly (Click here).

112. REMOVE MANUAL TRANSMISSION UNIT ASSEMBLY

a. Remove the manual transmission unit assembly (Click here).

113. REMOVE CLUTCH RELEASE CYLINDER TO FLEXIBLE HOSE TUBE (for Manual Transmission)

a. Remove the bolt and tube.



114. REMOVE ENGINE ASSEMBLY

a. Attach an engine sling device and hang the engine with a chain block.

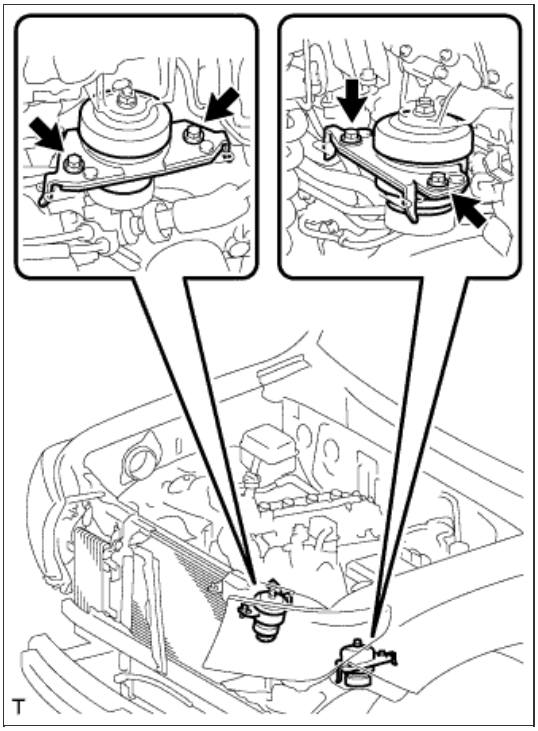
b. Remove the 4 bolts from the engine mounting RH and LH side.

c. Lift the engine out of the vehicle carefully.

NOTICE:

Make sure the engine is clear of all wiring and hoses.

d. Place the engine onto a work bench.



115. REMOVE CLUTCH COVER ASSEMBLY (for Manual Transmission)

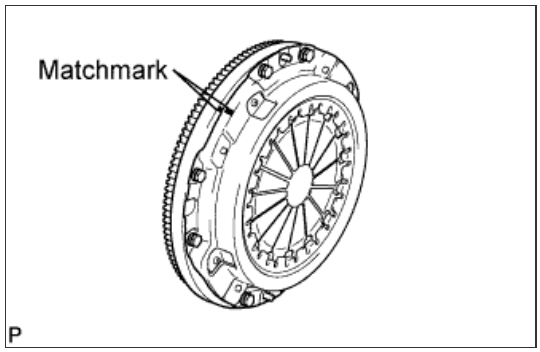
a. Put matchmarks on the clutch cover and flywheel.

b. Loosen each set bolt one turn at a time until spring tension is released.

c. Remove the 8 set bolts, and pull off the clutch cover.

NOTICE:

Do not drop the clutch disc.



116. REMOVE CLUTCH DISC ASSEMBLY (for Manual Transmission)

NOTICE:

Keep the lining part of the clutch disc, pressure plate and surface of the flywheel away from oil and foreign matter.

117. REMOVE DRIVE PLATE AND RING GEAR SUB-ASSEMBLY (for Automatic Transmission)

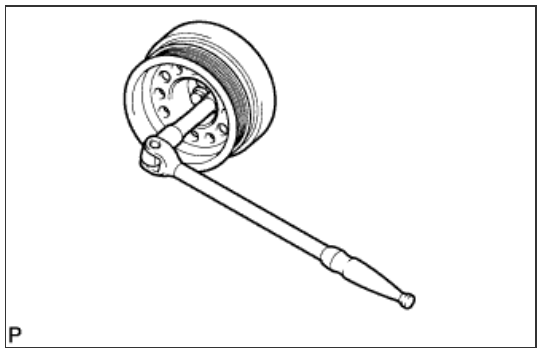
a. Using a wrench, hold the crankshaft.

NOTICE:

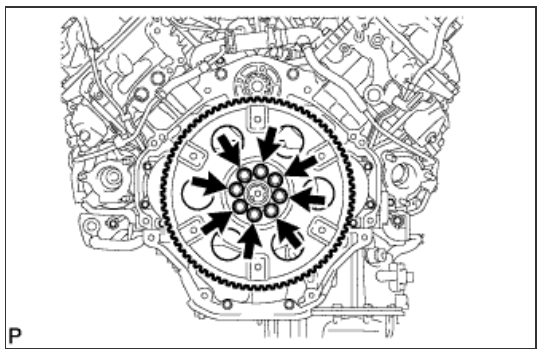
Do not turn the crankshaft counterclockwise.

If it is turned counterclockwise, check that the crankshaft pulley set bolt is not loose. If loose, tighten the bolt (Click here).

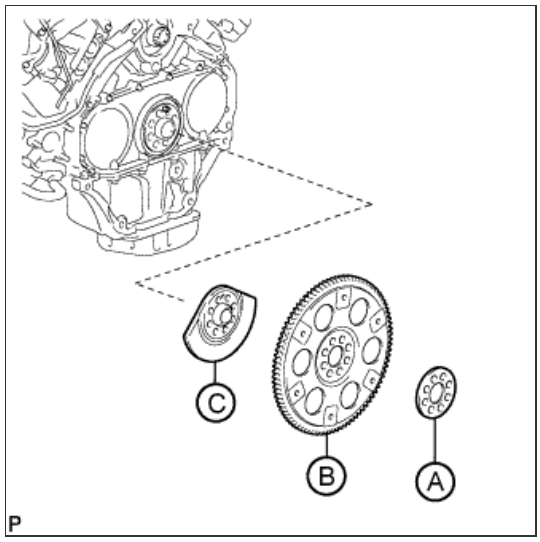
Torque:
108 N*m{ 1101 kgf*cm , 80 ft.*lbf } or more



b. Remove the 8 bolts.



c. Remove the rear drive plate spacer labeled A, drive plate and ring gear labeled B and rear crankshaft balancer weight labeled C.



118. REMOVE FLYWHEEL SUB-ASSEMBLY (for Manual Transmission)

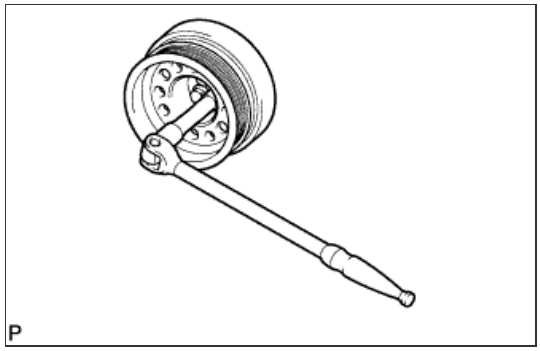
a. Using a wrench, hold the crankshaft.

NOTICE:

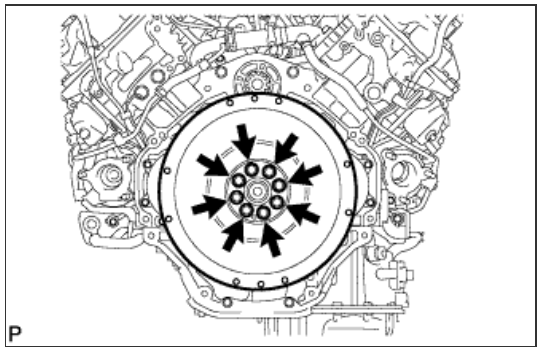
Do not turn the crankshaft counterclockwise.

If it is turned counterclockwise, check that the crankshaft pulley set bolt is not loose. If loose, tighten the bolt (Click here).

Torque:
108 N*m{ 1101 kgf*cm , 80 ft.*lbf } or more



b. Remove the 8 bolts and flywheel.



119. INSTALL ENGINE STAND

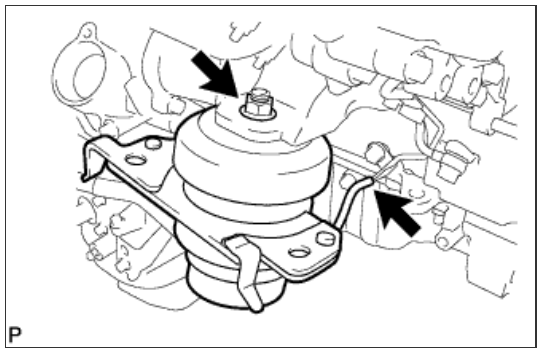
a. Install the engine onto an engine stand with bolts.

b. Remove the 4 bolts and No. 1 and No. 2 engine hangers.

120. REMOVE FRONT ENGINE MOUNTING INSULATOR RH

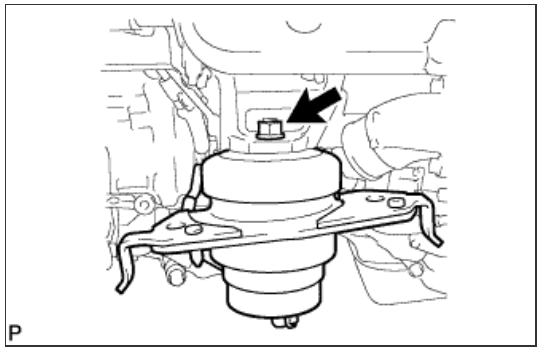
a. Disconnect the vacuum hose.

b. Remove the nut and mounting insulator.



121. REMOVE FRONT ENGINE MOUNTING INSULATOR LH

a. Remove the nut and mounting insulator.

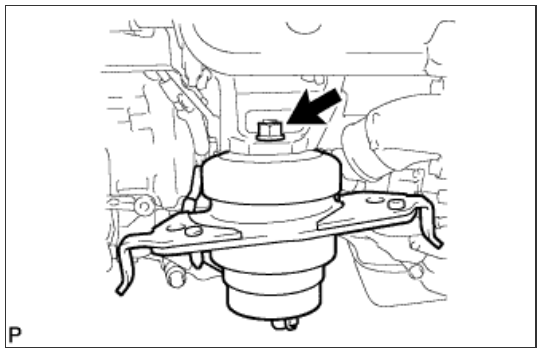


for Preparation Click here

1. INSTALL FRONT ENGINE MOUNTING INSULATOR LH

a. Install the mounting insulator with the nut.

Torque:
80 N*m{ 816 kgf*cm , 59 ft.*lbf }

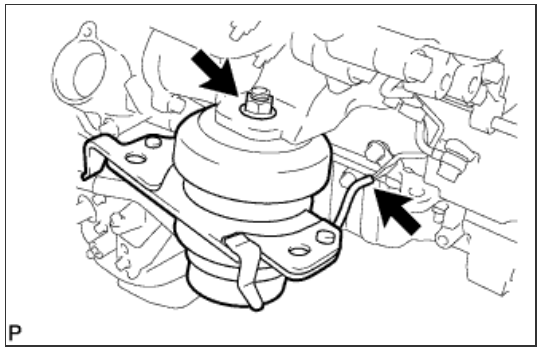


2. INSTALL FRONT ENGINE MOUNTING INSULATOR RH

a. Install the mounting insulator with the nut.

Torque:
80 N*m{ 816 kgf*cm , 59 ft.*lbf }

b. Connect the vacuum hose.



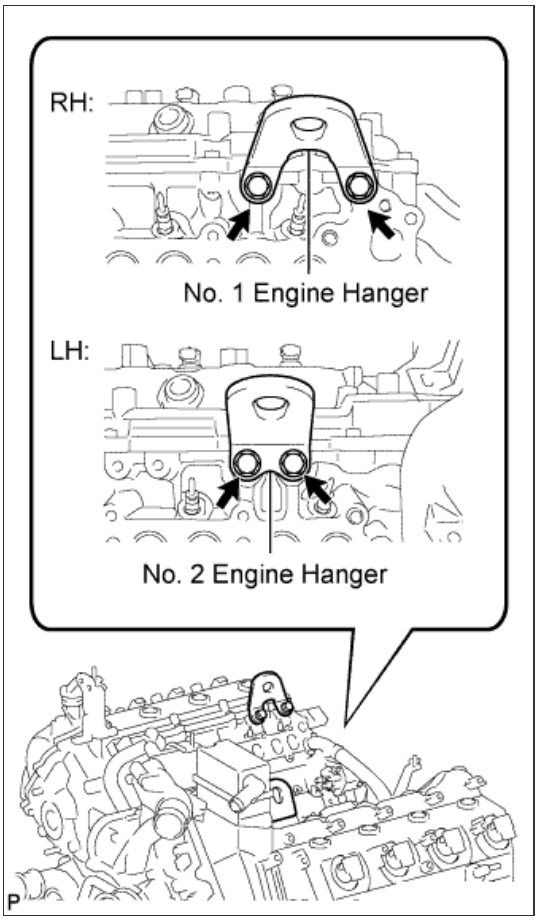
3. INSTALL NO. 1 AN NO. 2 ENGINE HANGER

a. Install the No. and No. engine hangers to the cylinder head R and L with the bolts as shown in the illustration.

Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }

Engine Hanger Part No.

Item	art No.
No. engine hanger	
o. engine hanger	
olt	9



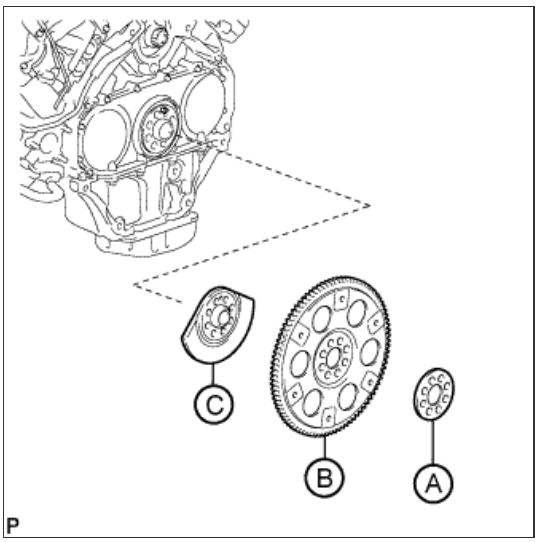
4. REMOVE ENGINE STAN

a. Attach an engine sling device and hang the engine with a chain block.

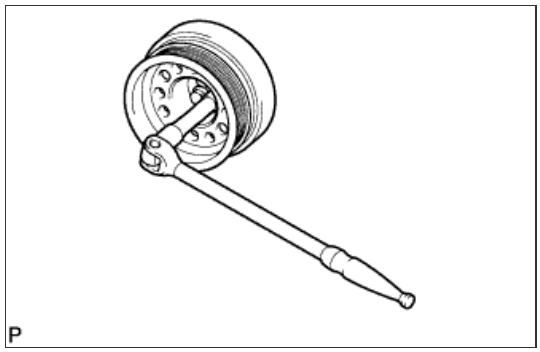
b. Lift the engine, and remove it from the engine stand.

5. INSTALL RIVE PLATE AN RING GEAR SUB-ASSEMBLY (for Automatic Transmission)

a. Install the rear crankshaft balancer weight labeled C, ring gear labeled B and rear drive late s acer labeled A with 8 new bolts.

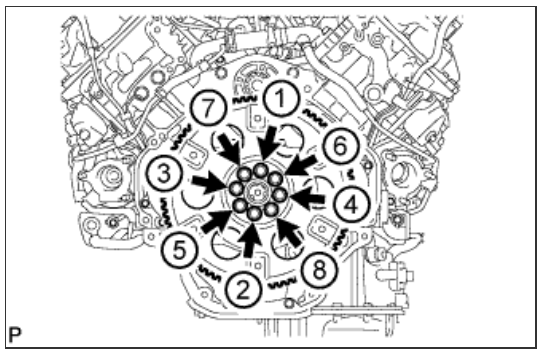


b. Using a wrench, hold the crankshaft.



c. Uniforml install and tighten the 8 bolts in the sequence shown in the illustration.

Torque:
182 N*m{ 1856 kgf*cm , 134 ft.*lbf }

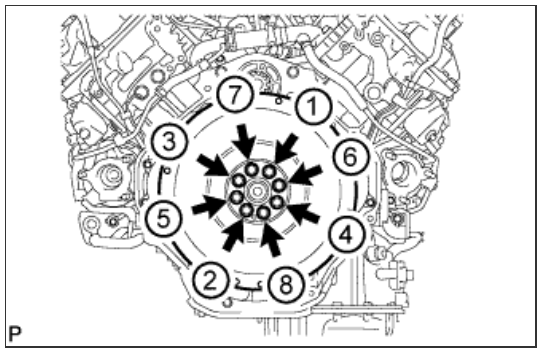


6. INSTALL FLYWHEEL SUB-ASSEMBLY (for Manual Transmission)

a. Tem orarily install the flywheel with 8 new bolts.

NOTICE:

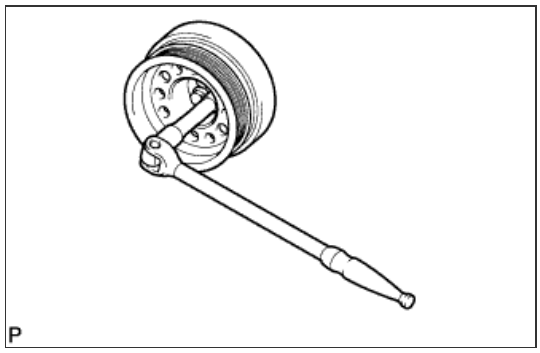
- **Align the crankshaft knock pin an flywheel knock pin hole.**
- **o not strike or amage the flywheel installation bolts. Be sure to han le them carefully.**
- **Make sure there is no oil on the bolts.**



b. Using a wrench, hold the crankshaft.

c. Uniforml install and tighten the 8 bolts in the sequence shown in the illustration.

Torque:
182 N*m{ 1856 kgf*cm , 134 ft.*lbf }



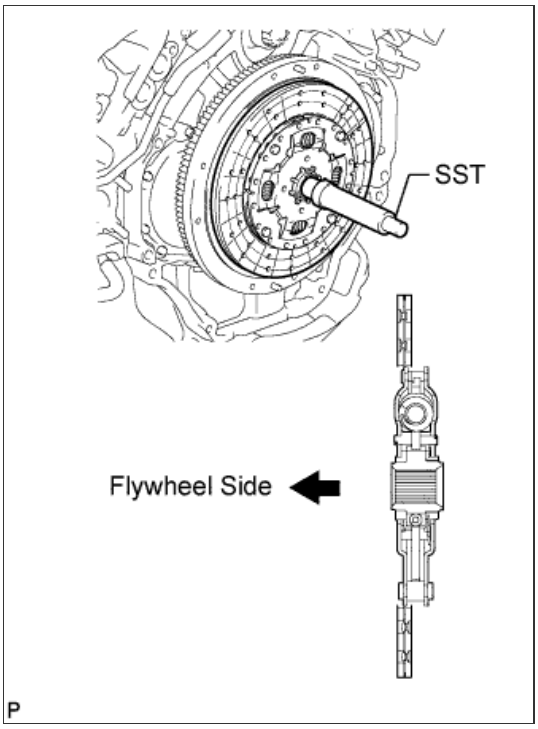
7. INSTALL CLUTCH ISC ASSEMBLY (for Manual Transmission)

a. Insert SST into the clutch disc, then insert the clutch disc into the flywheel.

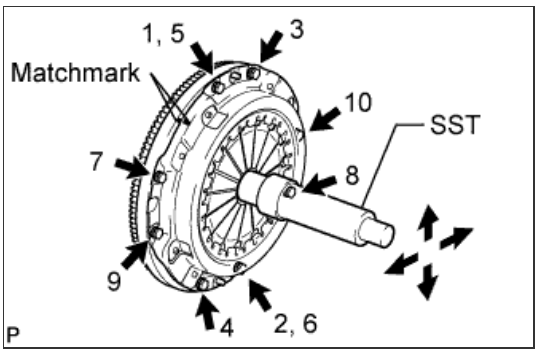
SST
09301-00120

NOTICE:

Take care not to insert the clutch disc in the wrong direction.



8. INSTALL CLUTCH COVER ASSEMBLY (for Manual Transmission)



a. Align the matchmark on the clutch cover with the one on the flywheel.

b. In the order shown in the illustration, tem orarily install the 8 bolts starting from the bolt located near the knock n on the to

c. ck that the disc is in the center by lightly moving SST up and down, and left and right.

SST
09301-00120

. Evenly tighten the bolts by following the order shown in the illustration.

Torque:
39 N*m{ 400 kgf*cm , 29 ft.*lbf }

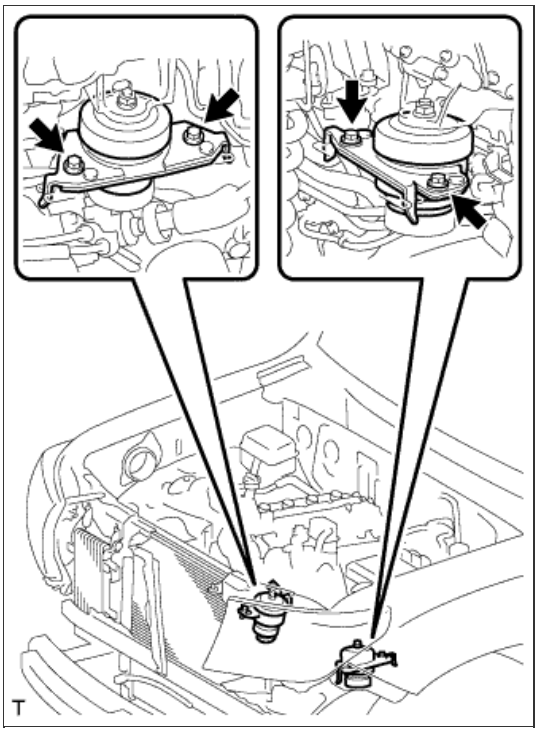
9. INSTALL ENGINE ASSEMBLY

a. Slowly lower the engine into the engine com artment.

b. Install the 4 bolts to the front mounting insulator R and L

Torque:
58 N*m{ 591 kgf*cm , 43 ft.*lbf }

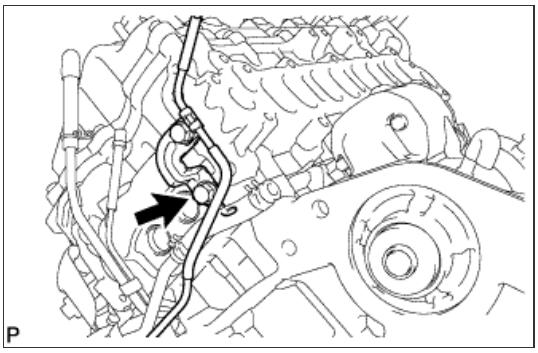
c. emove the 4 bolts and No. and No. engine hangers.



10. INSTALL CLUTCH RELEASE CYLIN ER TO FLEXIBLE HOSE TUBE (for Manual Transmission)

a. Install the tube with the bolt.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }



11. INSTALL MANUAL TRANSMISSION UNIT ASSEMBLY

a. Install the manual transm ssion unit assem l (Click here).

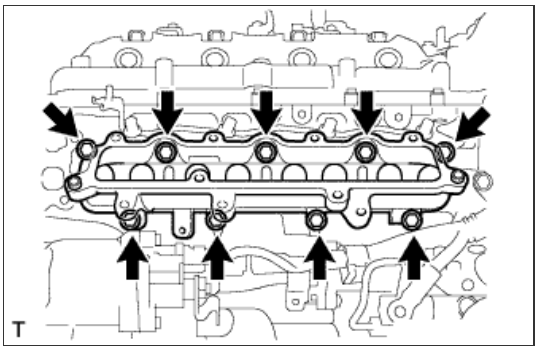
12. INSTALL AUTOMATIC TRANSMISSION ASSEMBLY

a. Install the automatic transm ssion assem l (Click here).

13. INSTALL NO. 2 INTAKE MANIFOL

a. Install a new gasket and the No. intake manifold with the 9 bolts.

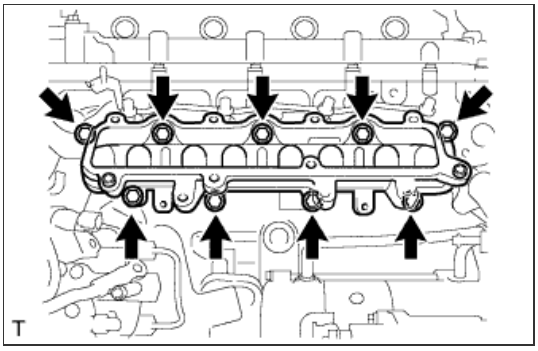
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



14. INSTALL NO. 1 INTAKE MANIFOL

a. Install a new gasket and the No. intake manifold with the 9 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

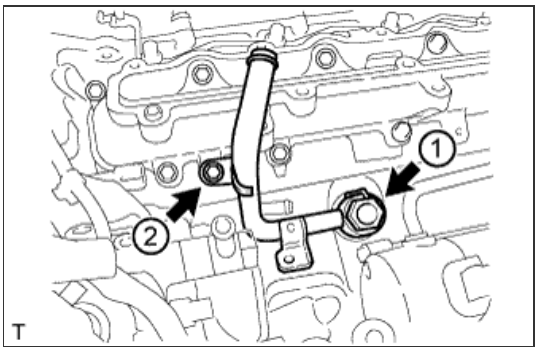


15. INSTALL NO. 1 WATER BY-PASS PIPE

a. Tem orarily install a new gasket and the No. water by-pass pipe with the union bolt and bolt.

b. Tighten the union bolt and bolt in the order shown in the illustration.

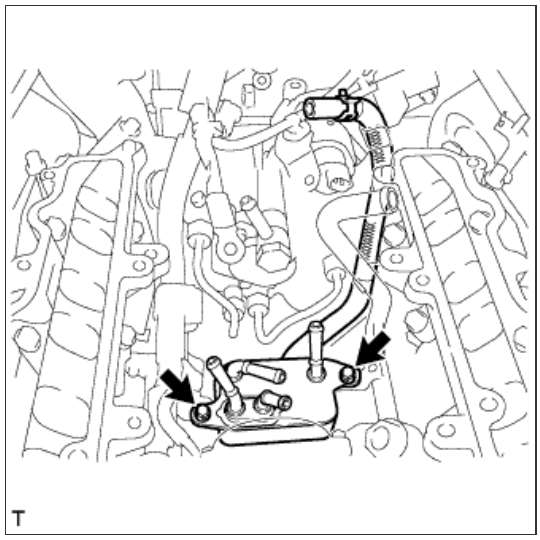
Torque:
for union bolt:
59 N*m{ 600 kgf*cm , 43 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



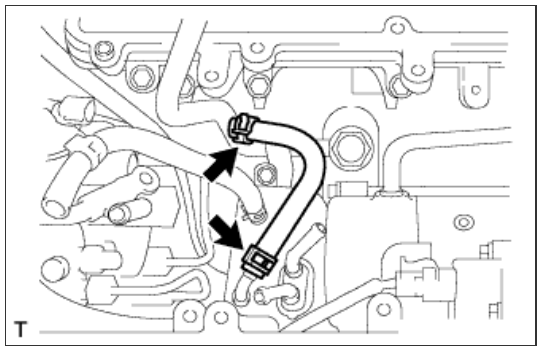
16. INSTALL FUEL COOLER ASSEMBLY

a. Install the fuel cooler with the bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



17. CONNECT NO. 6 WATER BY-PASS HOSE



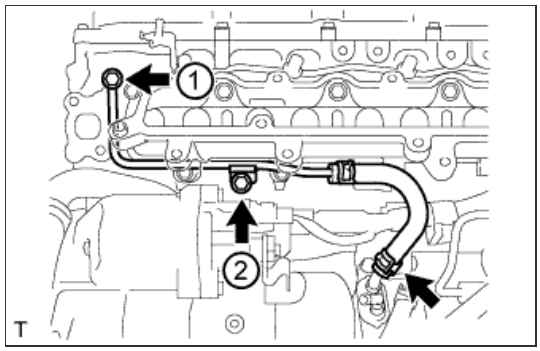
18. INSTALL NO. 4 NO LE LEAKAGE PIPE

a. Tem orarily install a new gasket and the No. 4 nozzle leakage pipe with the union bolt and bolt.

b. Tighten the union bolt and bolt in the order shown in the illustration.

Torque:
for union bolt:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

c. Connect the No. fuel hose to the fuel cooler.



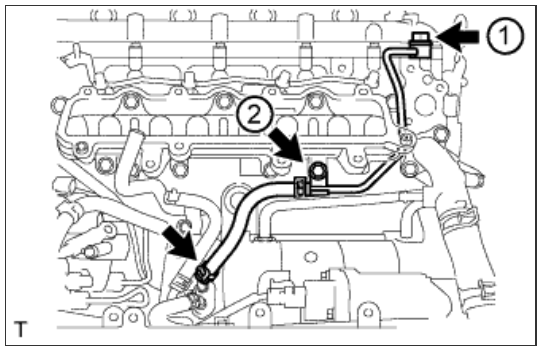
19. INSTALL NO. 3 NO LE LEAKAGE PIPE

a. Tem orarily install a new gasket and the No. 3 nozzle leakage pipe with the union bolt and bolt.

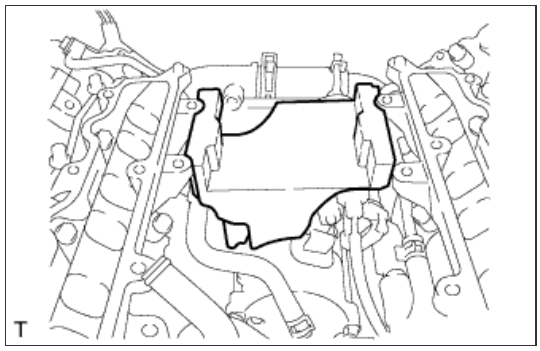
b. Tighten the union bolt and bolt in the order shown in the illustration.

Torque:
for union bolt:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

c. Connect the No. fuel hose to the fuel cooler.

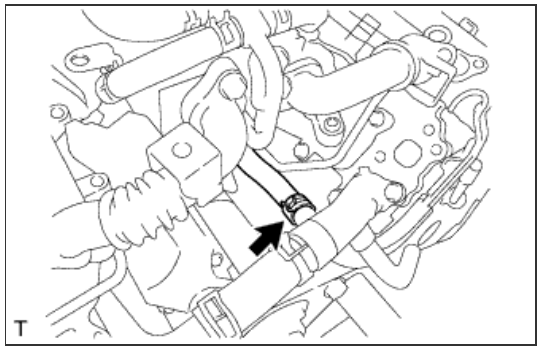


20. INSTALL EGR COOLER INSULATOR (w/ EGR System)



21. INSTALL EGR VALVE ASSEMBLY WITH EGR COOLER (w/ EGR System)

a. Connect the No. 5 water by-pass hose to the water by-pass outlet.

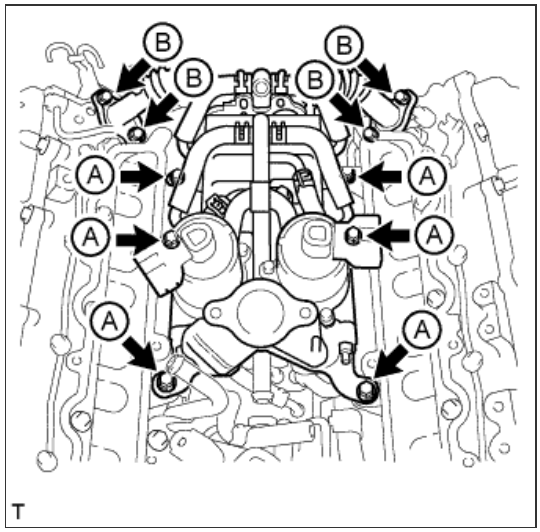


b. Install new gaskets and the EGR valve with EGR cooler with the 6 bolts labeled A and 4 bolts labeled B shown in the illustration.

Torque:
for bolt A:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for bolt B:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

HINT:

The gasket claws should face toward the No. and No. EGR pipes.



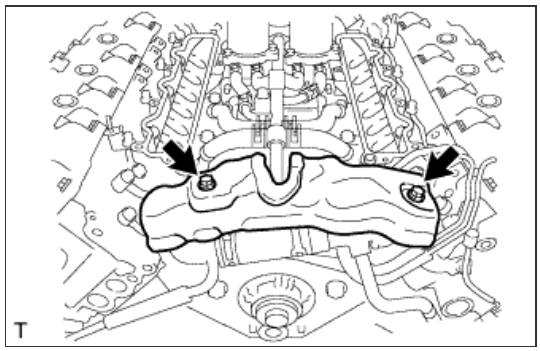
22. INSTALL EGR PIPE INSULATOR (w/ EGR System)

a. Install the EGR pipe insulator with the bolts.

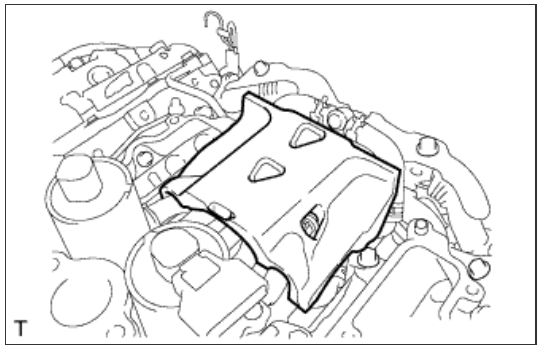
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

NOTICE:

If the No. and No. EGR pipe insulator installation stay is deformed, or the bolt holes of the EGR pipe insulator do not align, replace the No. and No. pipes as a set.



23. INSTALL INTAKE MANIFOL INSULATOR (w/ EGR System)



24. INSTALL NO. 3 INTAKE MANIFOL

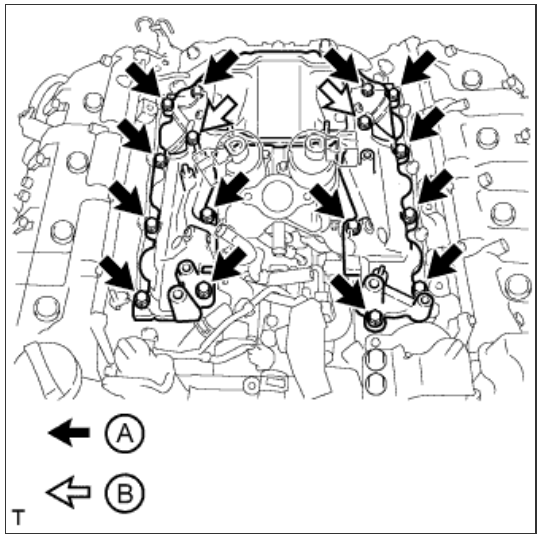
a. Set new gaskets to the No. and No. intake manifolds.

b. Install the No. 3 intake manifold with the bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

Bolt Length

Item	engthength
Bolt A	mm (0.984 in.)
Bolt B	70 mm (in.)

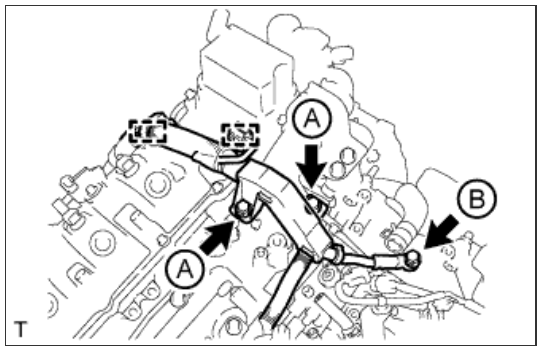


25. CONNECT NO. 2 ENGINE WIRE

a. Connect the No. engine wire with the 3 bolts.

Torque:
for bolt A:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }
for bolt B:
32 N*m{ 326 kgf*cm , 24 ft.*lbf }

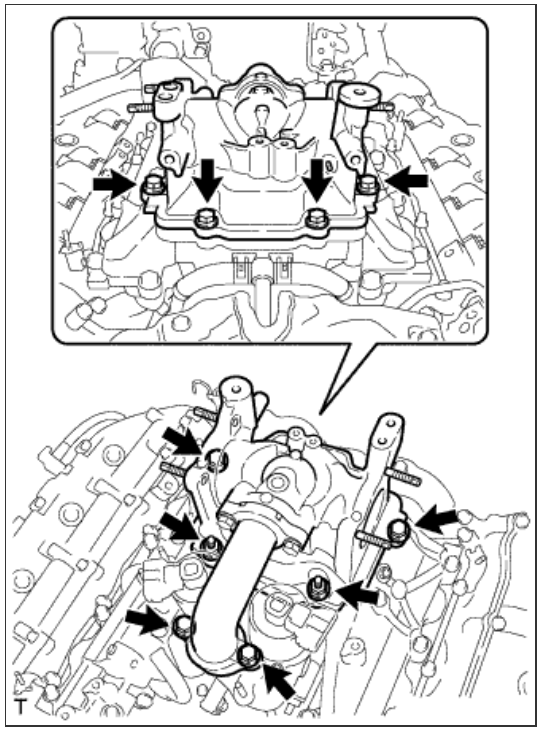
b. Attach the wire harness clam s.



26. INSTALL INTAKE PIPE

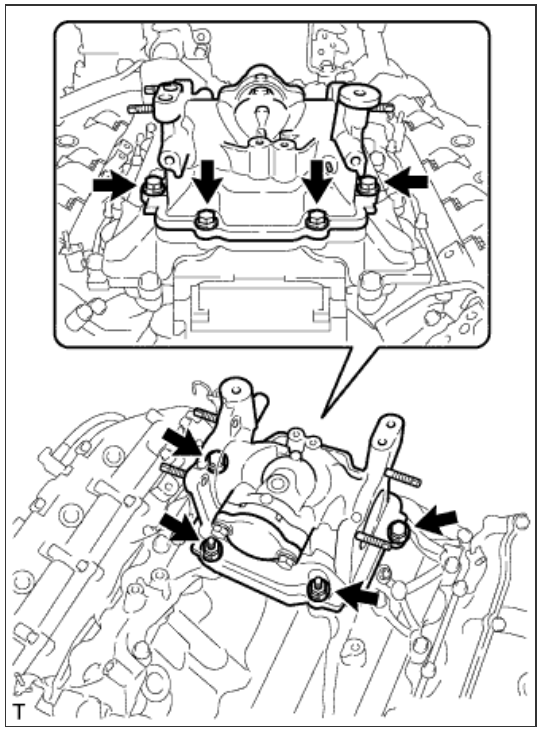
a. w/ EGR System
Install new gaskets and the intake pipe with the 6 bolts and nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

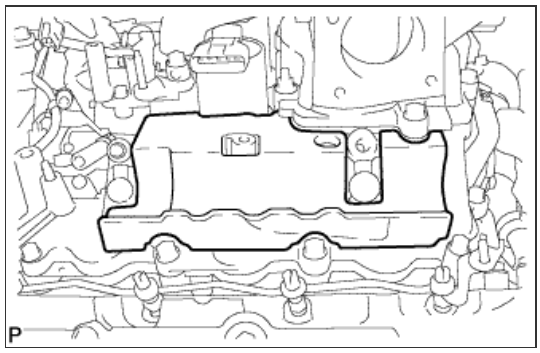


b. w/o EGR System
Install a new gasket and the intake pipe with the 4 bolts and nuts.

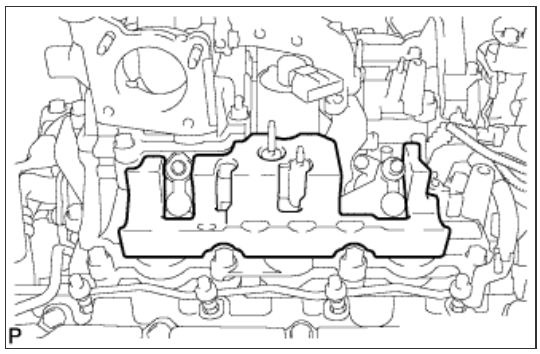
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



27. INSTALL NO. 2 INTAKE MANIFOL INSULATOR (w/ Intercooler)



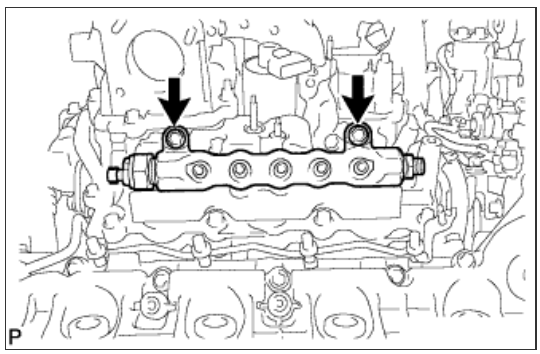
28. INSTALL NO. 1 INTAKE MANIFOL INSULATOR (w/ Intercooler)



29. INSTALL COMMON RAIL ASSEMBLY RH

a. Install the common rail with the bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



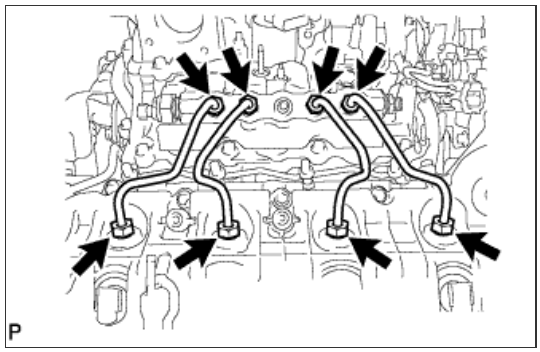
30. INSTALL INJECTION PIPE RH

a. Using a union nut wrench, install the 4 new injection pipes.

Torque:
without union nut wrench:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }
with union nut wrench:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

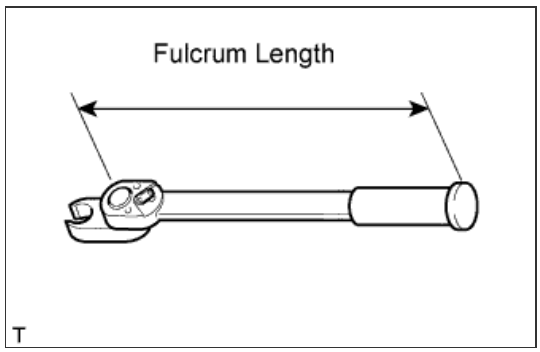
NOTICE:

Make sure there is no damage or foreign matter on the seal surfaces.



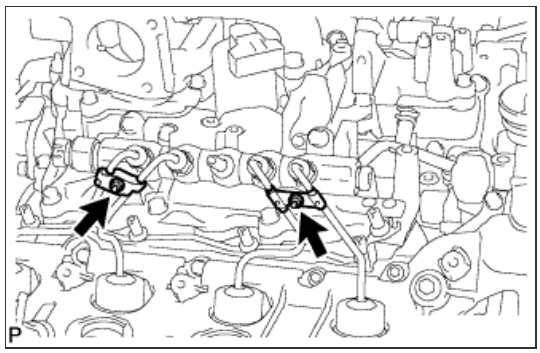
HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure the union nut wrench an the torque wrench are connecte in a straight line.**



b. w/ Intercooler:
Install the 4 injection pipe clam s with the nuts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

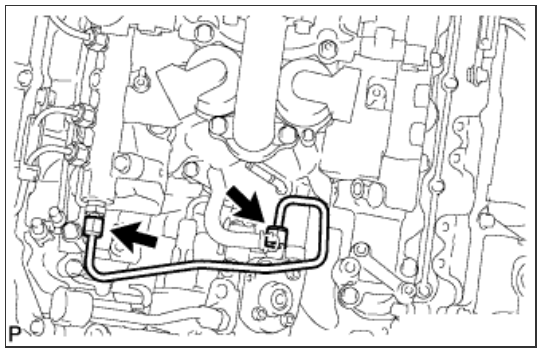


31. INSTALL NO. 5 INJECTION PIPE SUB-ASSEMBLY

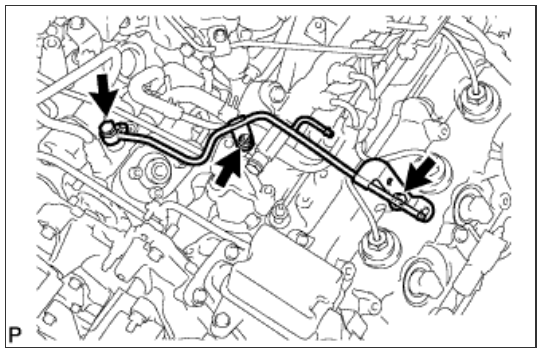
a. Tem orarily install a new No. 5 injection pipe by hand.

NOTICE:

Make sure there is no damage or foreign matter on the seal surfaces.

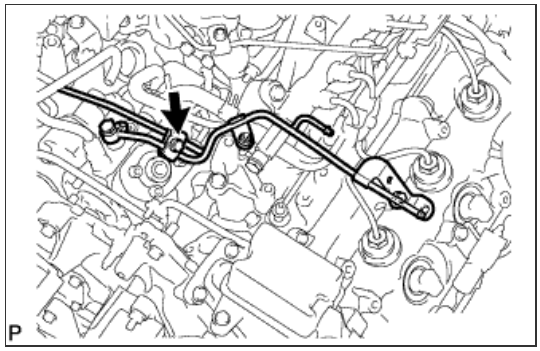


b. Tem orarily install the used gasket and No. fuel pipe with the nut, bolt and union bolt.



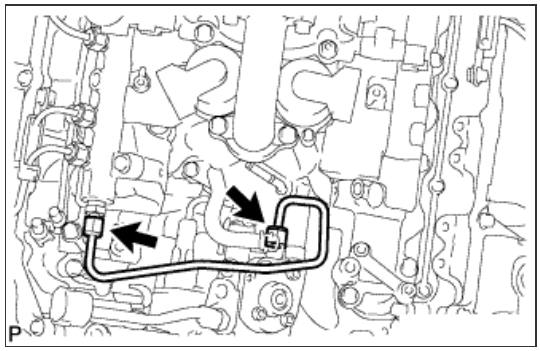
c. Tem orarily install the No. injection pipe clam with the bolt.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



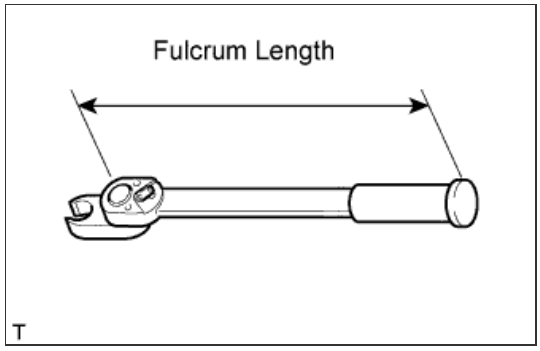
. Using a union nut wrench, tighten the No. 5 injection pipe ends.

Torque:
without union nut wrench:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }
with union nut wrench:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

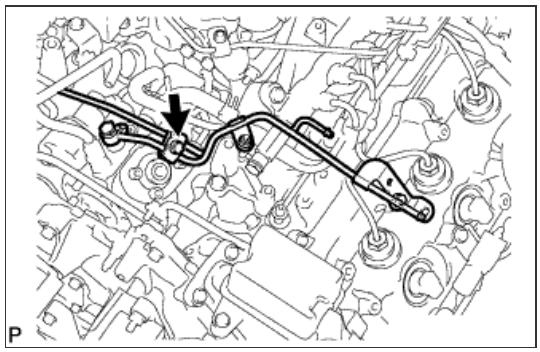


HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure the union nut wrench an the torque wrench are connecte in a straight line.**

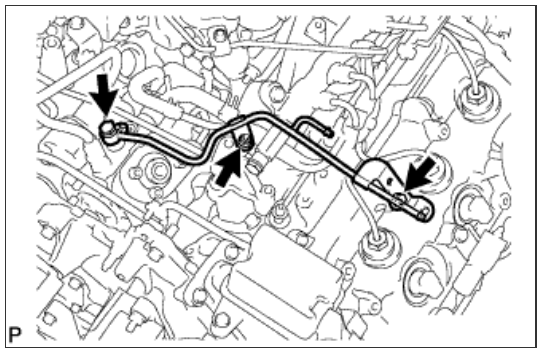


e. Remove the bolt and No. injection pipe clam



f. Remove the union bolt and gasket.

g. Remove the bolt, nut and No. fuel pipe.

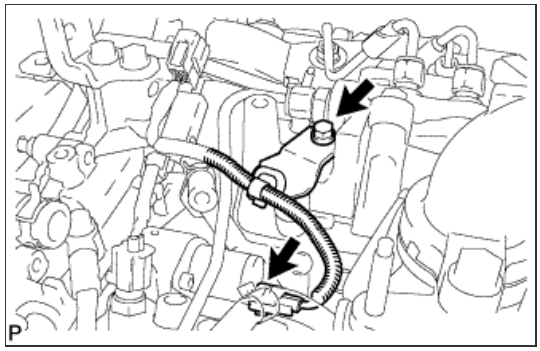


32. CONNECT FUEL PUMP MOTOR WIRE

a. Install the fuel pum motor wire bracket to the No. 3 intake manifold with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Connect the connector to the fuel supply pum

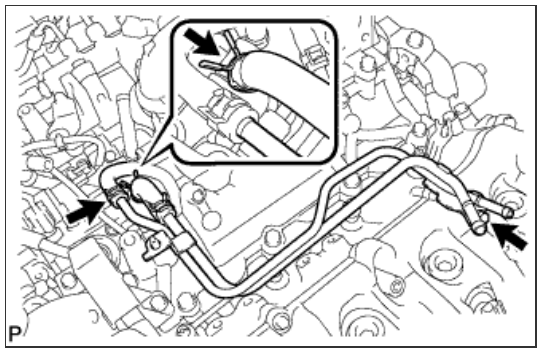


33. INSTALL FUEL FILTER TO INJECTION PUMP FUEL PIPE SUB-ASSEMBLY

a. Install the fuel filter to injection pum fuel pipe with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

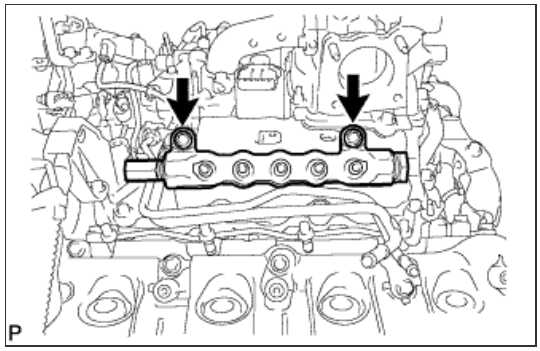
b. Connect the hoses to the fuel pipe.



34. INSTALL COMMON RAIL ASSEMBLY LH

a. Install the common rail with the bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



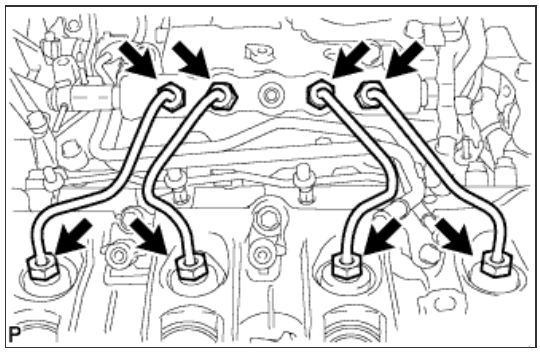
35. INSTALL INJECTION PIPE LH

a. Using a union nut wrench, install the 4 new injection pipes.

Torque:
without union nut wrench:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }
with union nut wrench:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

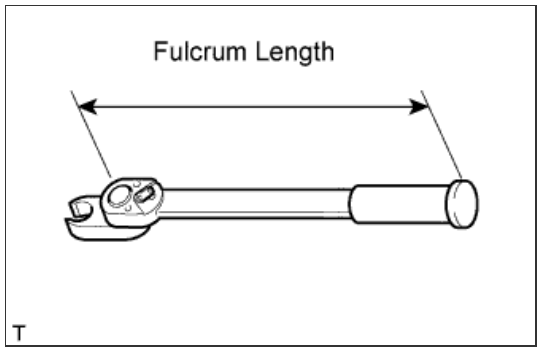
NOTICE:

Make sure there is no damage or foreign matter on the seal surfaces.



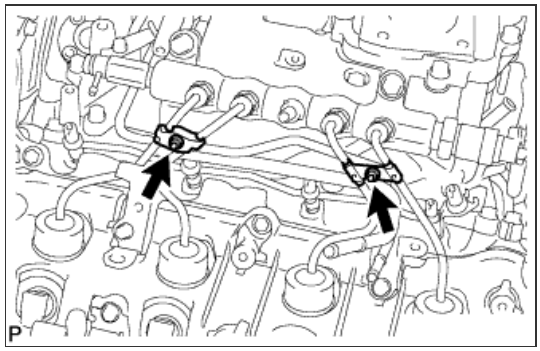
HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure the union nut wrench an the torque wrench are connecte in a straight line.**



b. w/ Intercooler:
Install the 4 injection pipe clam s with the nuts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



36. CONNECT NO. 6 IN ETION PIPE SUB-ASSEMBLY

a. w/ EGR System

i. em orarily install a new No. 6 injection pipe to the common rail L and R

NOTICE:

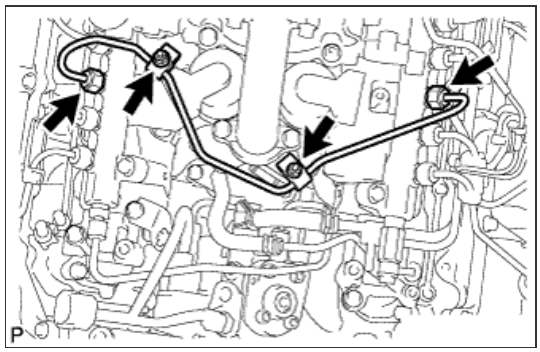
ake sure there is no damage or foreign matter on the seal surfaces.

ii. Install the No. injection pipe clam s with the nuts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

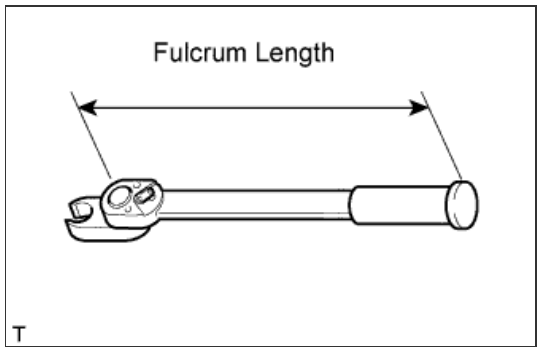
iii. Using a union nut wrench, tighten the No. 6 injection pipe ends.

Torque:
without union nut wrench:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }
with union nut wrench:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

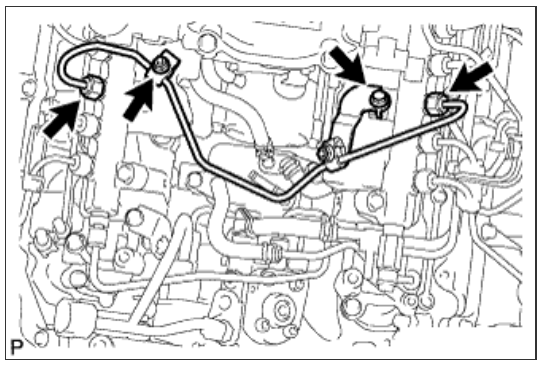


HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure the union nut wrench an the torque wrench are connecte in a straight line.**



b. w/o EGR System



i. em orarily install a new No. 6 injection pipe to the common rail L and R

NOTICE:

ake sure there is no damage or foreign matter on the seal surfaces.

ii. Install the bracket to the No. 3 intake manifold with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

iii. Install the No. injection pipe clam with the nut.

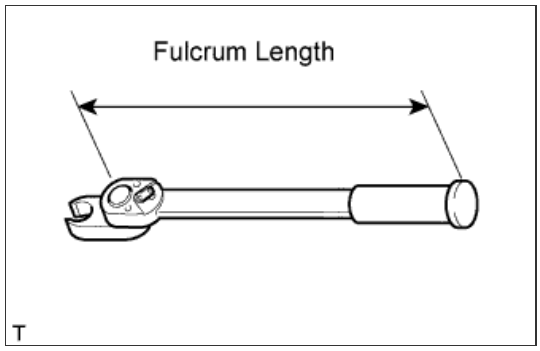
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

i . Using a union nut wrench, tighten the No. 6 injection pipe ends.

Torque:
without union nut wrench:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }
with union nut wrench:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure the union nut wrench an the torque wrench are connecte in a straight line.**



37. INSTALL NO. 2 FUEL PIPE SUB-ASSEMBLY

NOTICE:

Check for damage and foreign matter on the fuel pipe installation surface of the supply pum

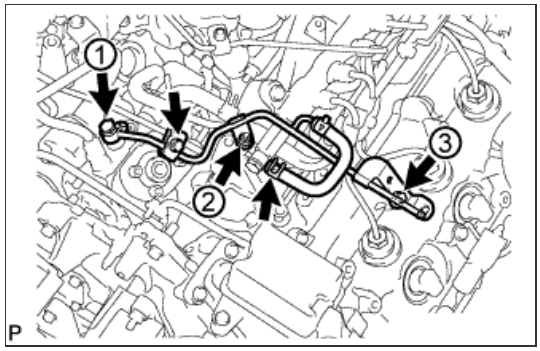
If there is foreign matter, remove it from the installation surface. If the installation surface is damaged, replace the fuel supply pum

a. em orarily install a new gasket and the No. fuel pipe with the union

bolt, nut and bolt.

b. Tighten the union bolt, nut and bolt in the order shown in the illustration.

Torque:
for union bolt:
10 N*m{ 105 kgf*cm , 8 ft.*lbf }
for bolt an nut:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



c. Install the No. injection pipe clam with the bolt.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

. Connect the fuel hose to the No. 5 nozzle leakage pipe.

38. CONNECT ENGINE WIRE

a. Rear Side:

i. Install the glow plug wire harness with the nut labeled A.

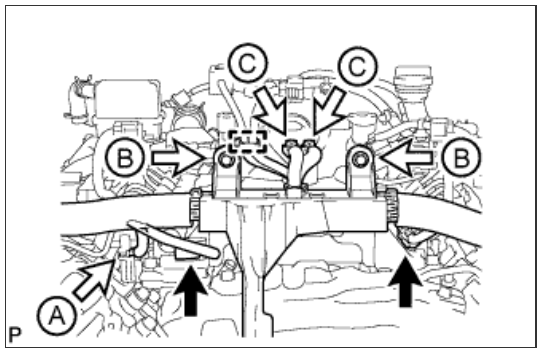
Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }

ii. Connect the common rail connectors.

iii. Install the engine wire harness protector with the bolts labeled B.

i . Install the ground wires with the bolts labeled C.

Torque:
8.4 N*m{ 87 kgf*cm , 74 in.*lbf }



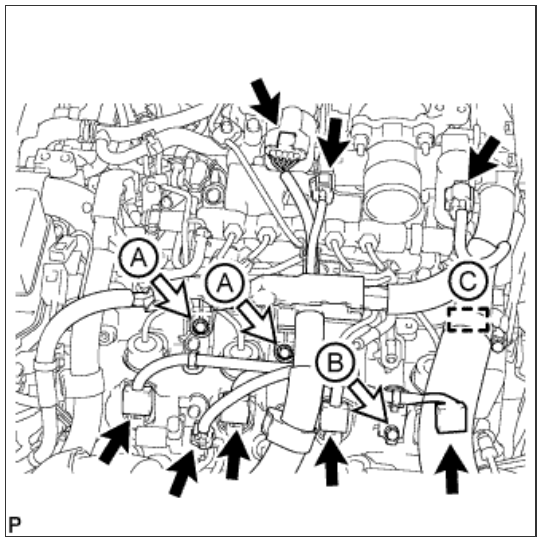
b. L Side:

i. Install the engine wire protector with the bolts labeled A.

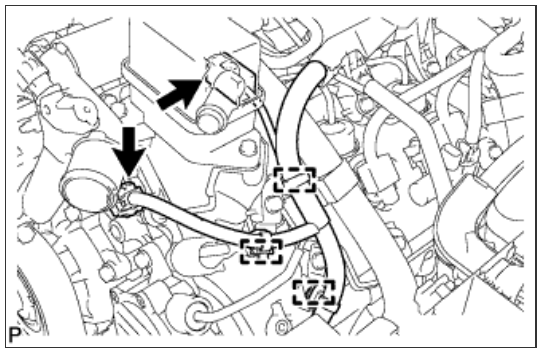
ii. Connect the 8 connectors.

iii. Install the engine wire harness bracket with the bolt labeled B.

i . for R
onnect the wire harness with the wire harness clam holder labeled C.



. Attach the 3 wire harness clam s and connect the connectors.



.i Connect the 4 connectors to the injection driver.

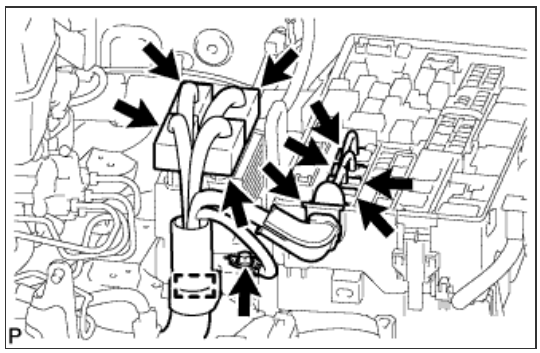
ii Install the ground wire with the bolt.

Torque:
8.4 N*m{ 87 kgf*cm , 74 in.*lbf }

iii Connect the wire harness holder to the relay block.

ix. Connect the 4 connectors to the relay block.

x. Connect the wire harness with the wire harness clam holder.

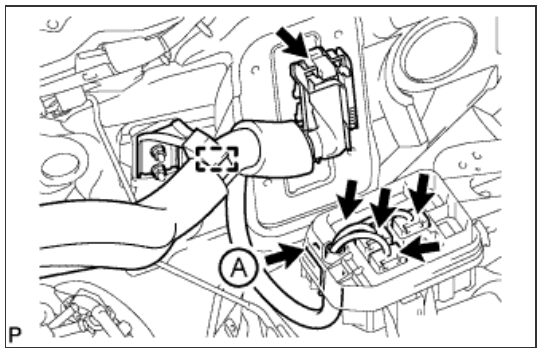


xi. for R
onnect the wire harness with the wire harness clam holder.

xii. for R
onnect the ECM connector to the ECM.

xiii. for R
ttach the wire harness tab labeled A to the relay block.

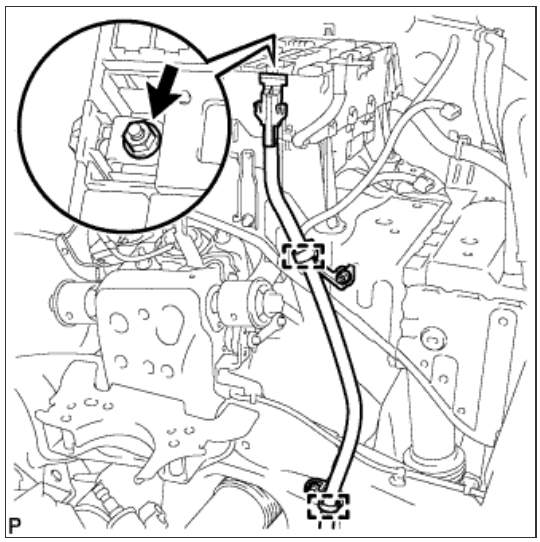
xi . Connect the 4 connectors to the relay block.



x . Connect the generator positive (+) cable to the body panel with the
dm s.

x .i Attach the generator positive (+) cable holder to the relay block, and install the cable to the relay block with the nut.

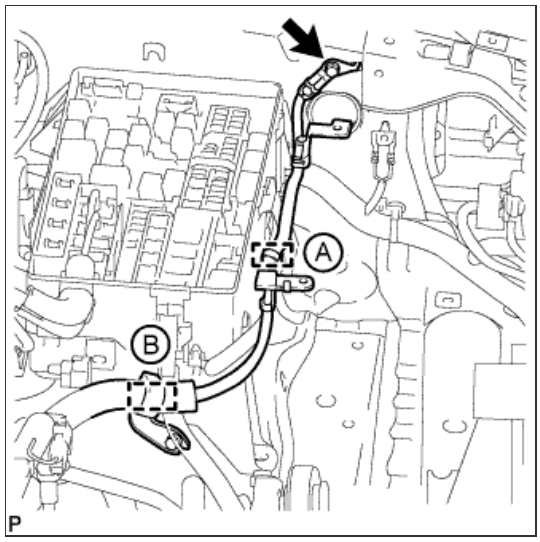
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



x ii Connect the wire harness with the wire harness clam holder labeled B, and attach the ground wire clam to the relay block side labeled A.

x iii Install the ground wire to the body panel with the bolt.

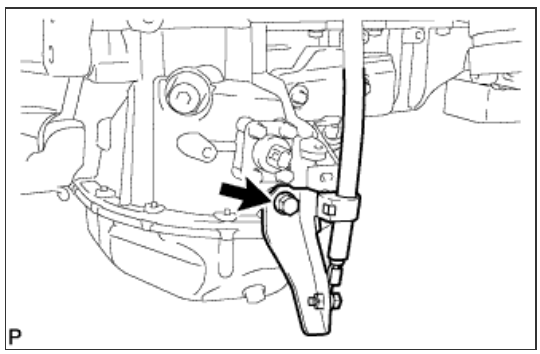
Torque:
8.4 N*m{ 87 kgf*cm , 74 in.*lbf }



c. R Side:

i. w/ Winch:
Install the ground wire with the bolt.

Torque:
19 N*m{ 194 kgf*cm , 14 ft.*lbf }



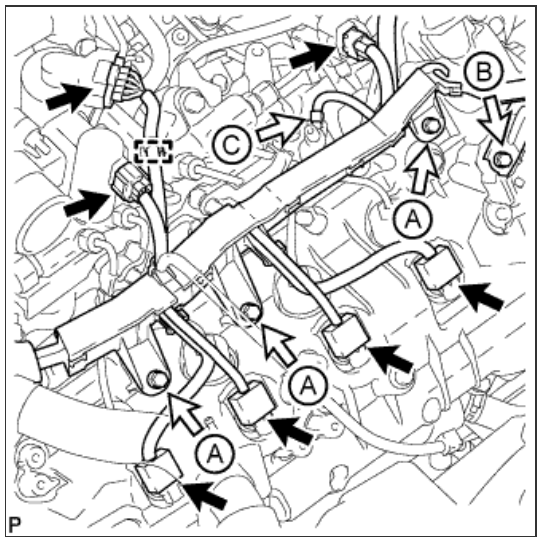
ii. Install the engine wire harness protector with the 3 bolts labeled A.

iii. Connect the 7 connectors.

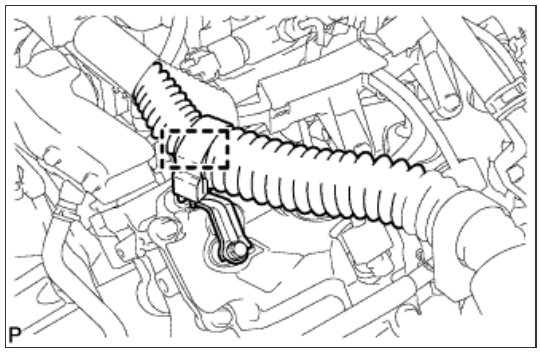
i . Install the wire harness bracket with the bolt labeled B.

. Install the glow plug wire harness with the nut labeled C.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }



.i for R
onnect the wire harness with the wire harness holder.

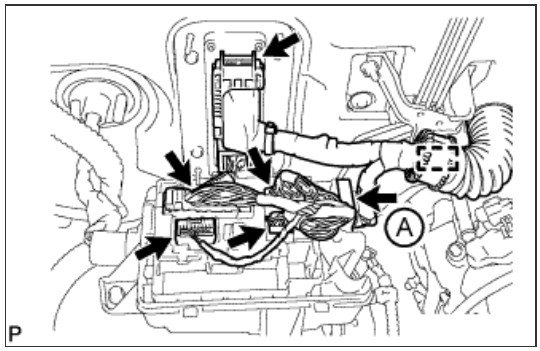


ii for L
onnect the wire harness with the wire harness clam holder.

iii for L
onnect the ECM connector to the ECM.

ix. for L
ttach the wire harness tab labeled A to the relay block.

x. for L
onnect the 4 connectors to the relay block.

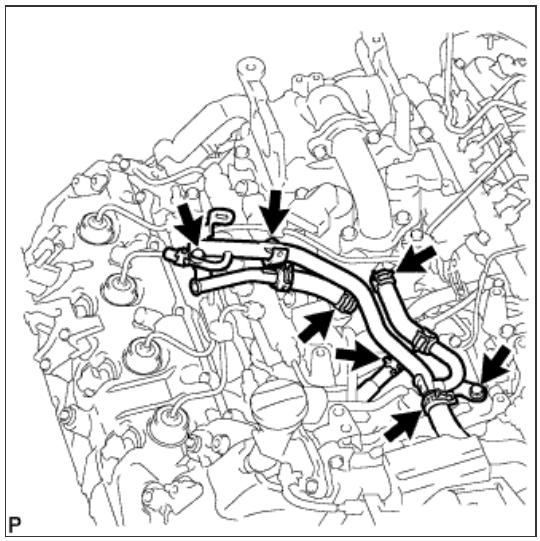


39. INSTALL NO. 4 WATER BY-PASS PIPE

a. w/ EGR System
onnect the 4 water hose ends, and tem orarily install the No. 4 water by-pass pipe with the bolts and nut.

b. First tighten the bolts and then tighten the nut.

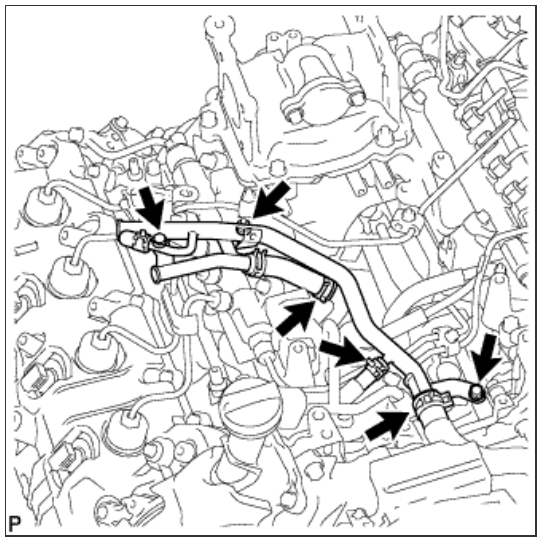
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



c. w/o EGR System
onnect the 3 water hose ends, and tem orarily install the No. 4 water by-pass pipe with the bolts and nut.

. First tighten the bolts and then tighten the nut.

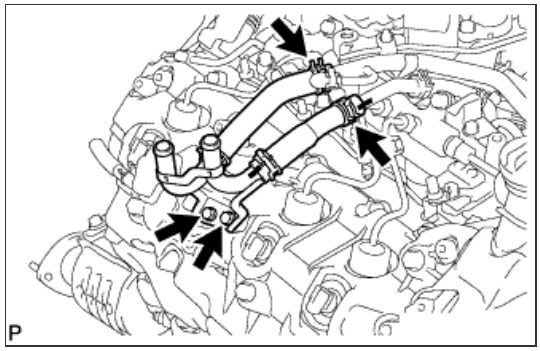
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



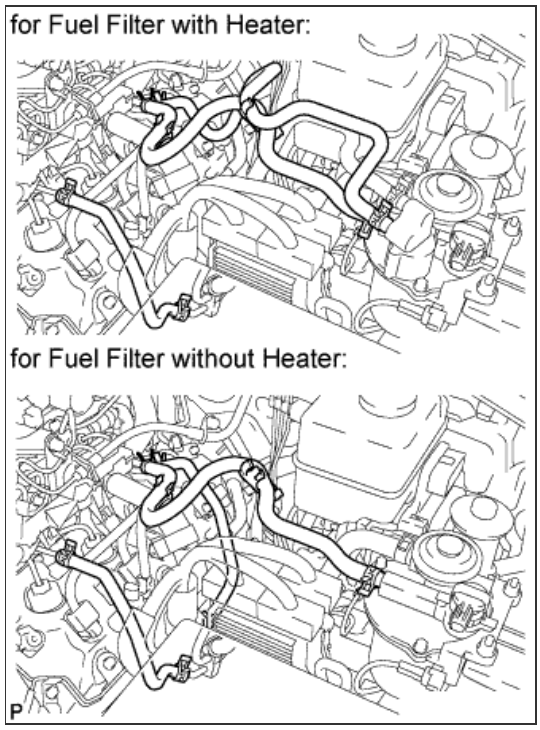
40. INSTALL NO. 3 WATER BY-PASS PIPE (w/o Viscous Heater)

a. Connect the water hose ends, and install the No. 3 water by-pass pipe with the bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



41. CONNECT FUEL HOSE



42. INSTALL NO. 1 AIR CLEANER PIPE SUB-ASSEMBLY

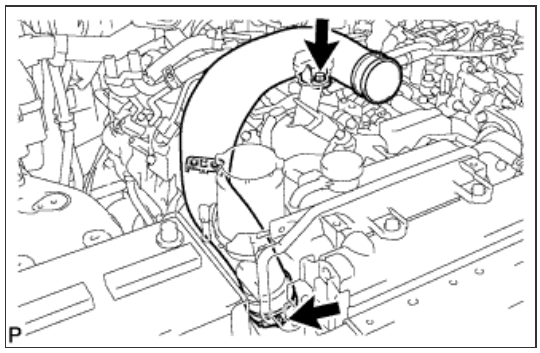
a. Connect the No. air cleaner pipe to the No. intake air connector pipe.

b. Install the pipe with the bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Tighten the hose clam

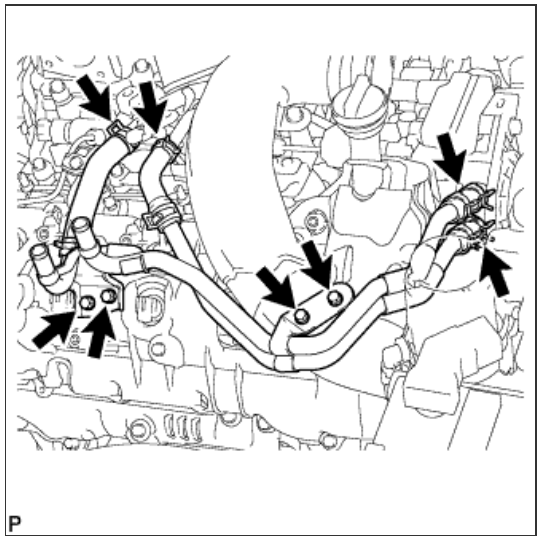
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



43. INSTALL HEATER WATER PIPE SUB-ASSEMBLY (w/ Viscous Heater)

a. onnect the 4 water hose ends, and install the water pipe with the 4 bolts.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }

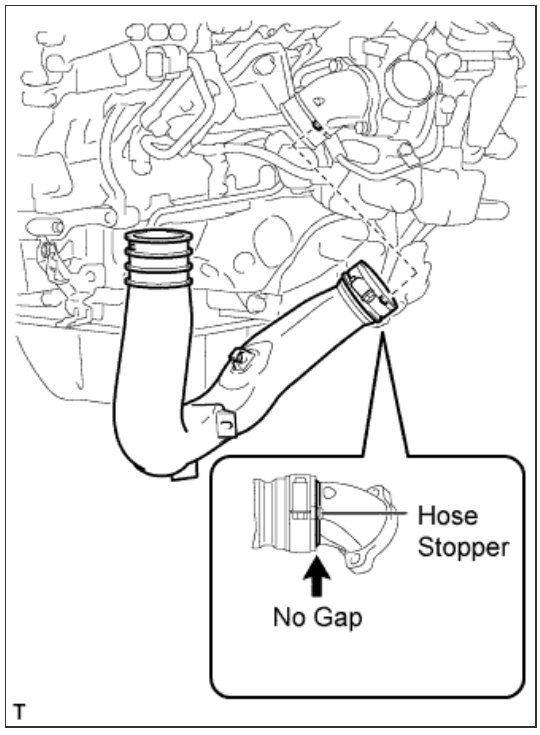


44. INSTALL NO. 2 INTAKE AIR CONNECTOR PIPE

a. Install the No. intake air connector pipe to the No. inlet com essor elbow.

NOTICE:

Make sure there is no gap between the air pipe and hose stopper on the elbow side.

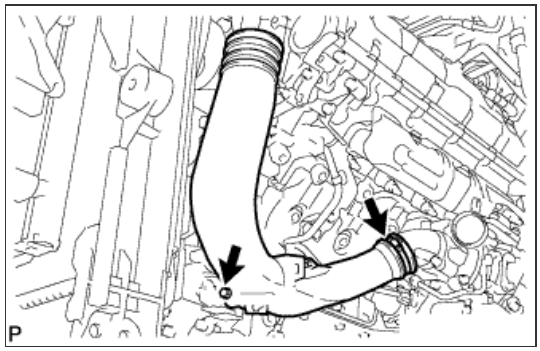


b. Install the bolt of the air pipe.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

NOTICE:

Do not excessively pull the air pipe towards the front of the engine.

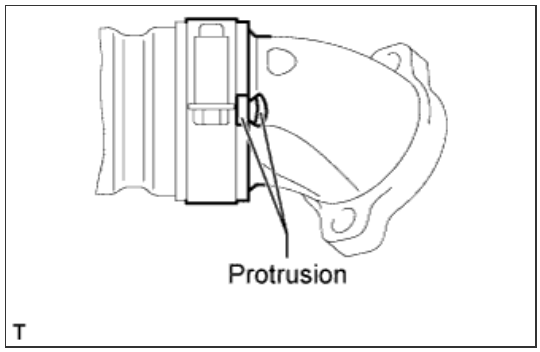


c. Tighten the hose clam on the elbow side.

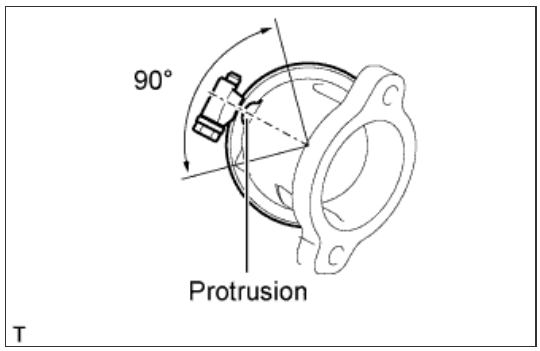
Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }

HINT:

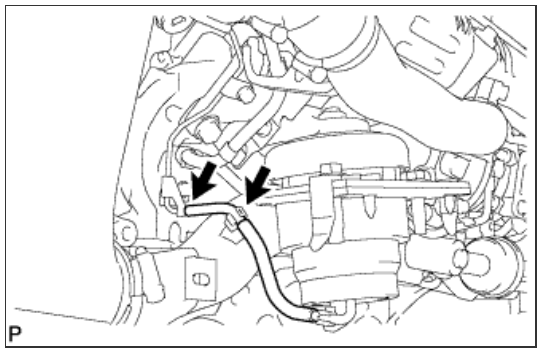
- **Align the 2 protrusions of the air pipe an elbow.**
- **Install the air pipe so that the protrusion on the pipe si ds within the range of the protrusion on the elbow si e**
- **After tightening, a gap between the air pipe an hose stopper on the elbow si ds acceptable.**



- **Make sure the rection of the hose clamp is as shown in the illustration.**



. w/ Intercooler:
Connect the vacuum hose.



45. A UST COMPRESSOR OIL

a. When replacing the com essor and magnetic clutch with a new one, gradually discharge the refrigerant gas from the service valve, and drain the following amount of oil from the new com essor and magnetic clutch before installation.

Stan a :
V 200L-GNMN V, GNTN V, GPMN V:
(Oil capacity insi the new compressor an magnetic clutch: 140 + 15 cc (4.7 + 0.51 fl.o .)) - (Remaining oil amount in the remo e compressor an magnetic clutch) (Oil amount to be remo e from the new compressor when replacing)
Except V 200L-GNMN V, GNTN V, GPMN V:
(Oil capacity insi the new compressor an magnetic clutch: 135 + 15 cc (4.6 0.51 fl.o .)) - (Remaining oil amount in the remo e compressor an magnetic clutch) (Oil amount to be remo e from the new compressor when replacing)

NOTICE:

- **When checking the compressor oil le , follow the A/C system precautions.**

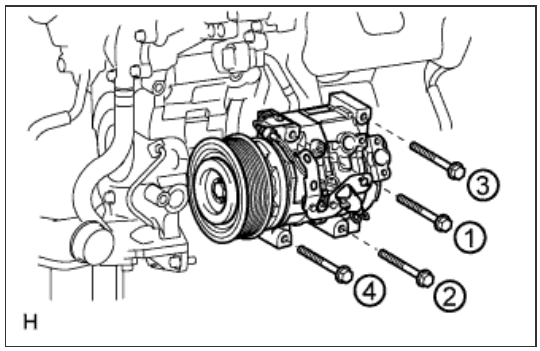
- If a new compressor an magnetic clutch is installe without remo ig some oil remaining in the pipes of the icle, the oil amount will be too large. This pre ent heat exchange in the refrigerant cycle an causes refrigerant failure.
- If the olume of oil remaining in the remo e compressor an magnetic clutch is too small, check for oil leakage.
- Be sure to use N OIL 8 or equi lent for compressor oil.

46. INSTALL COOLER COMPRESSOR ASSEMBLY

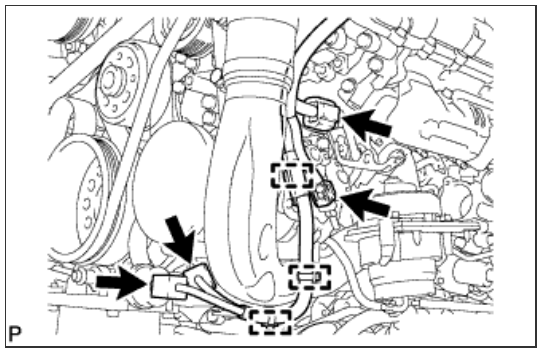
a. Tem orarily install the cooler com essor with the 4 bolts.

b. Tighten the 4 bolts in the order shown in the illustration.

Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }



c. Attach the 3 wire harness clam s and connect the 4 connectors.



47. INSTALL SUCTION HOSE SUB-ASSEMBLY

a. Remove the attached vinyl tape from the cooler refrigerant suction hose.

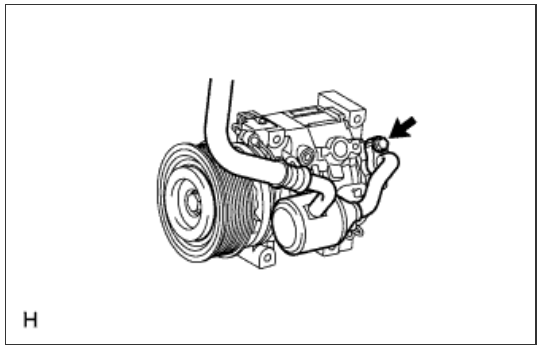
b. Sufficiently apply com essor oil to a new O-ring and the fitting surface of the cooler com essor.

Compressor oil:
N OIL 8 or equi lent

c. Install the O-ring to the suction hose.

. Connect the suction hose to the cooler com essor with the bolt.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }



48. INSTALL NO. 1 COOLER REFRIGERANT ISCHARGE HOSE

a. Remove the attached vinyl tape from the discharge hose.

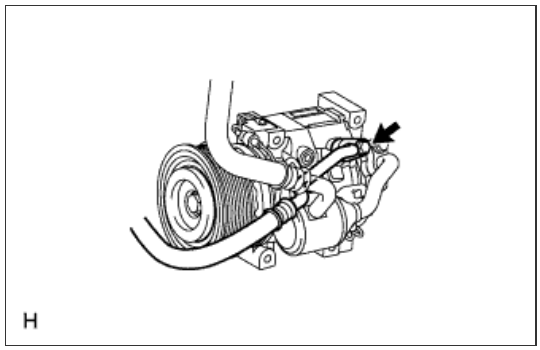
b. Sufficiently apply com essor oil to a new O-ring and the fitting surface of the cooler com essor.

Compressor oil:
N OIL 8 or equi lent

c. Install the O-ring to the discharge hose.

. Connect the discharge hose to the cooler com essor with the bolt.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }



49. INSTALL NO. 2 AIR CLEANER PIPE SUB-ASSEMBLY

a. Connect the No. air cleaner pipe to the No. intake air connector pipe.

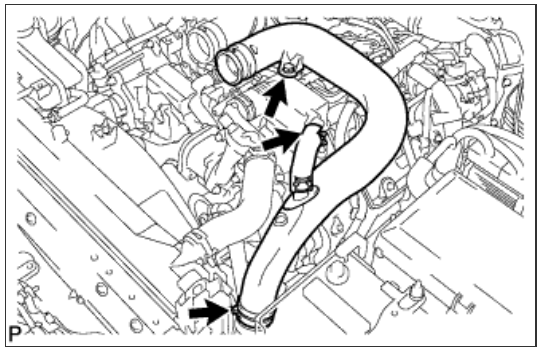
b. Connect the ventilation hose to the oil separator.

c. Install the pipe with the bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

. Tighten the hose clam

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

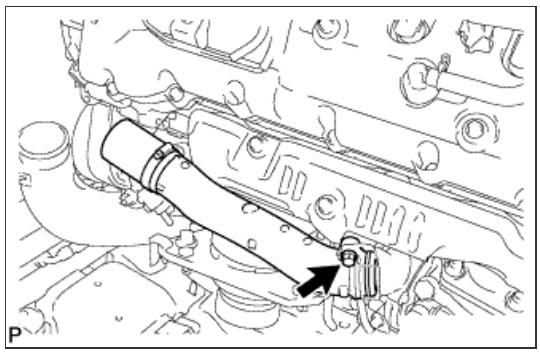


50. INSTALL NO. 2 AIR TUBE ASSEMBLY

a. allight coat of washer fluid to a new O-ring, and install it to the No. air tube.

b. Install the No. air tube with the bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



51. INSTALL NO. 4 AIR TUBE

a. Install the No. 4 air tube with the bolt.

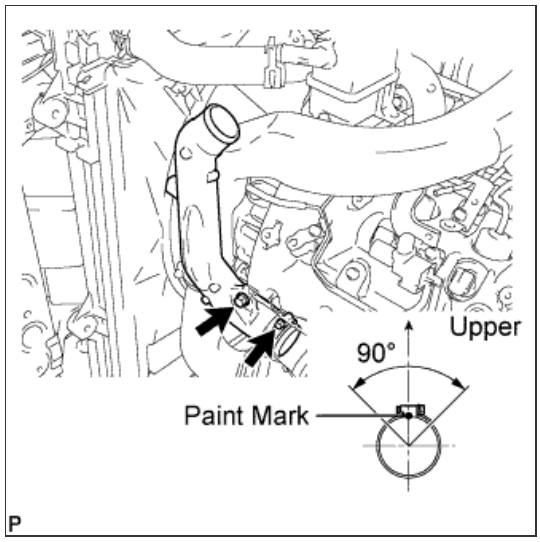
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

b. Tighten the hose clam

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

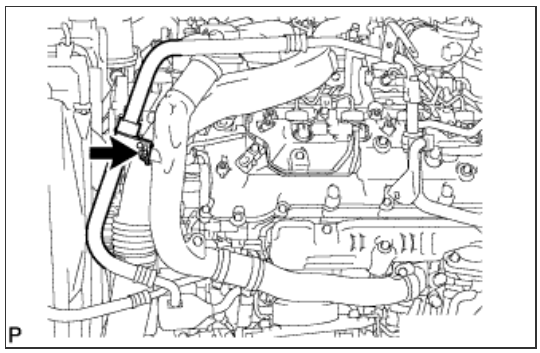
HINT:

ake sure the direction of the hose clam is as shown in the illustration.



c. Install the suction hose with the bolt.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }



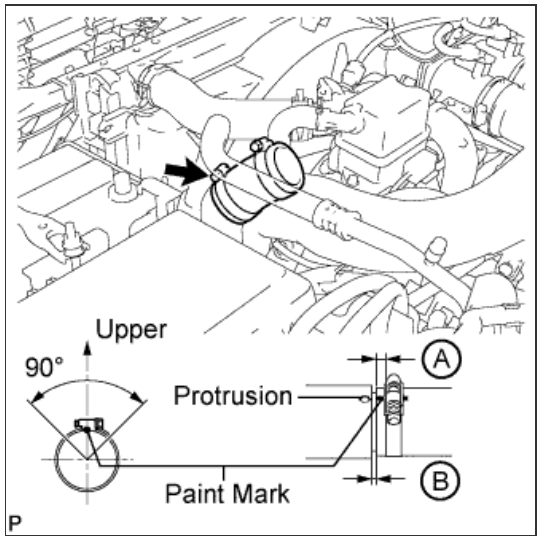
52. INSTALL NO. 2 AIR HOSE

a. Connect the No. air hose with the hose clam

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion an push in the air hose so that stance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that stance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make sure the rection of the hose clamp is as shown in the illustration.**

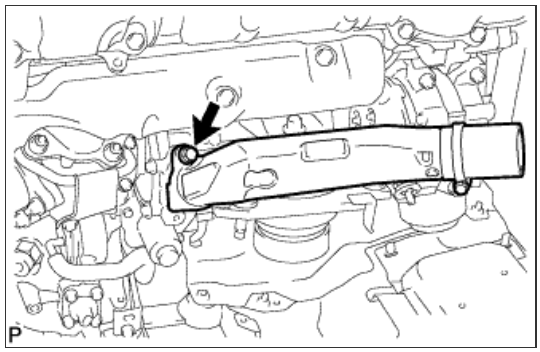


53. INSTALL NO. 1 AIR TUBE ASSEMBLY

a. allight coat of washer fluid to a new O-ring, and install it to the No. air tube.

b. Install the No. air tube with the bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



54. INSTALL NO. 3 AIR TUBE

a. Install the No. 3 air tube with the bolt.

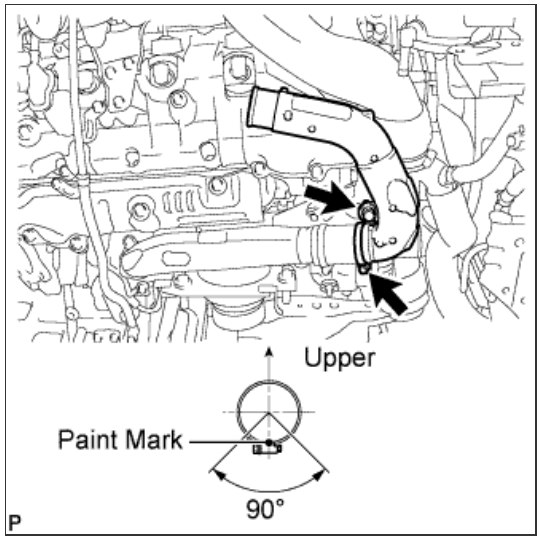
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

b. Tighten the hose clam

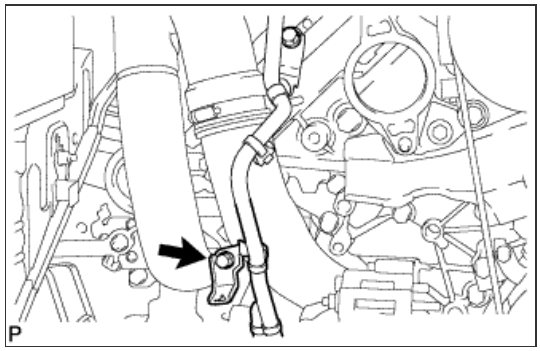
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

ake sure the direction of the hose clam is as shown in the illustration.

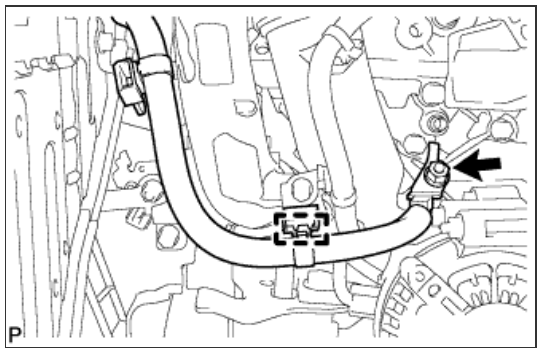


c. Install the wire harness bracket with the bolt.



. Install the ground wire with the nut, and attach the wire harness clam

Torque:
8.4 N*m{ 87 kgf*cm , 74 in.*lbf }



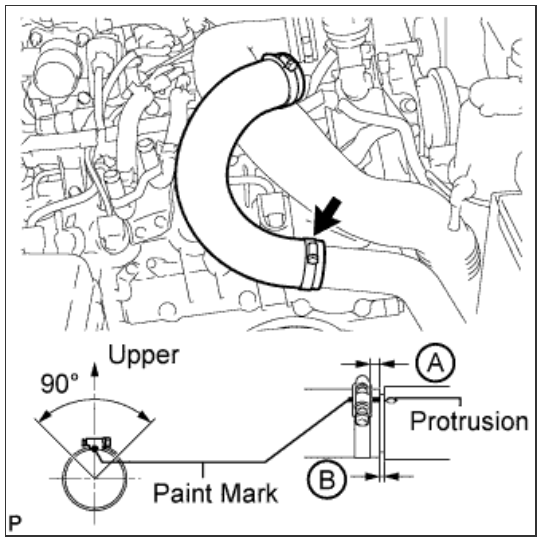
55. INSTALL NO. 1 AIR HOSE

a. Connect the No. air hose with the hose clam

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion an push in the air hose so that stance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that stance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make sure the rection of the hose clamp is as shown in the illustration.**



56. INSTALL IESEL THROTTLE BO Y ASSEMBLY LH

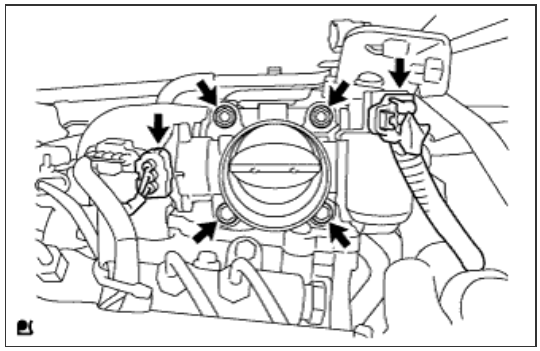
a. Install a new gasket to the intake pipe.

b. Install the throttle body with the bolts and nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Connect the throttle position sensor connector.

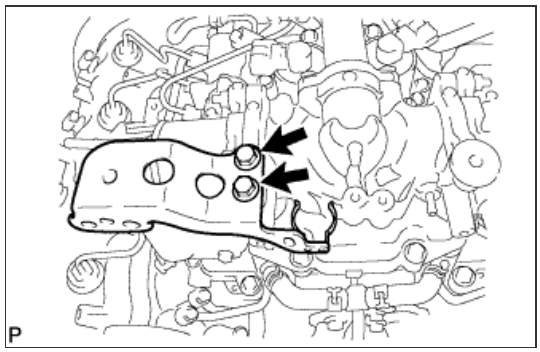
. Connect the throttle motor connector.



5 . INSTALL NO. 3 INTERCOOLER SUPPORT BRACKET

a. Install the bracket with the bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



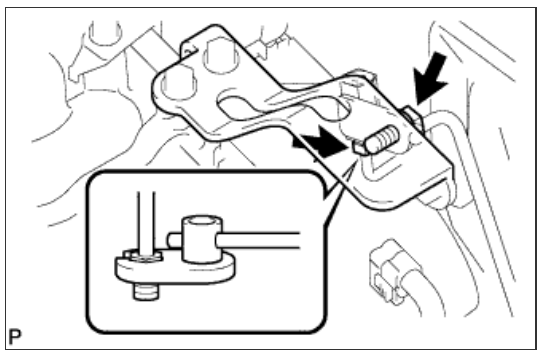
b. for Manual Transm ssion:

i. Connect the clutch tube to release cylinder way with the bolt.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

ii. Check that the union nut is tightened to the specified torque.

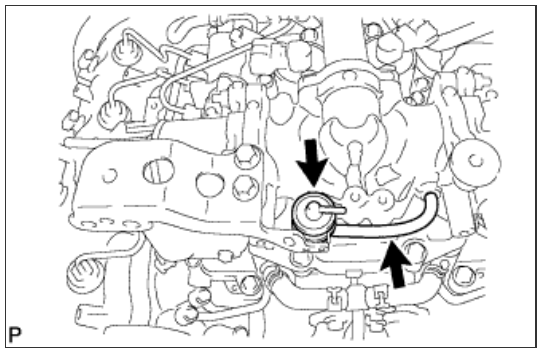
Torque:
without union nut wrench:
15 N*m{ 154 kgf*cm , 11 ft.*lbf }
with union nut wrench:
14 N*m{ 141 kgf*cm , 10 ft.*lbf }



58. INSTALL NO. 1 GAS FILTER

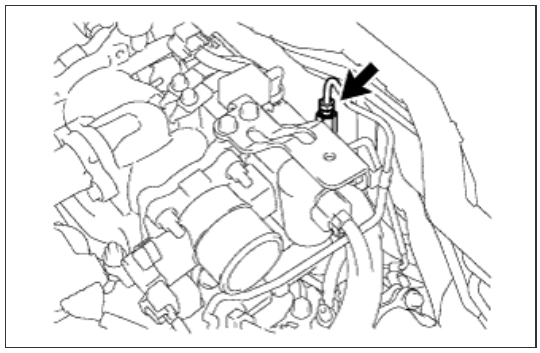
a. Install the gas filter.

b. Connect the hose to the intake pipe.



59. INSTALL TUBE CONNECTOR TO FLEXIBLE HOSE TUBE (for Manual Transmission)

a. Tem orarily install the flare nut of the tube connector to flexible hose tube to the clutch tube to release cylinder way by hand.



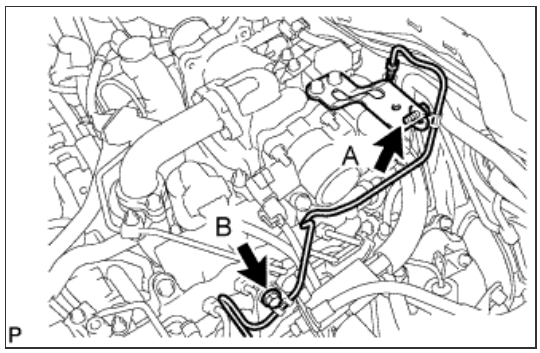
b. Tem orarily install the tube connector to flexible hose tube with the bolts.

c. Tighten the bolt labeled A.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

NOTICE:

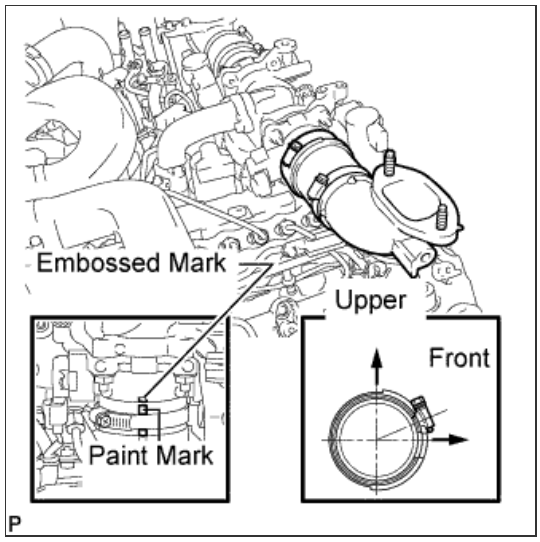
Tighten the bolt labeled B after installing the clutch hose.



60. INSTALL AIR TUBE SUB-ASSEMBLY LH

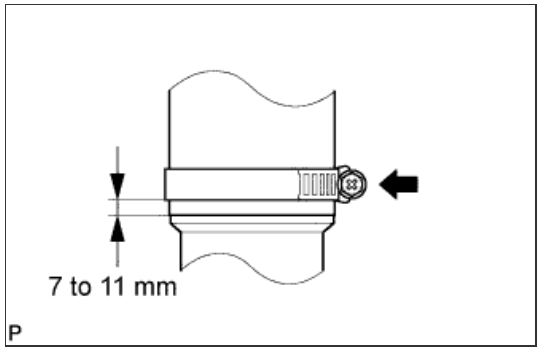
a. Install the air tube to the throttle body.

b. Align the em ossed mark of the throttle body with the paint mark of the No. 4 air hose.



c. Tighten the hose clam so that it is 7 to mm (0. to 0.433 in.) from the end of the hose as shown in the illustration.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



61. INSTALL CLUTCH HOSE (for Manual Transmission)

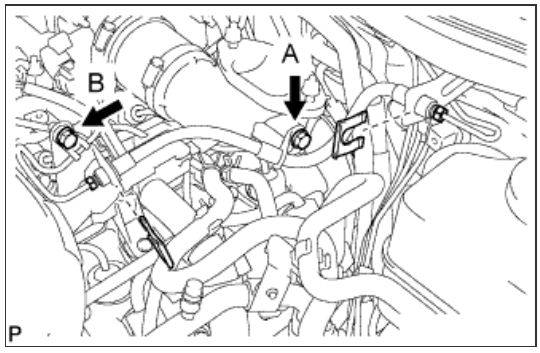
a. Connect the clutch hose to the air tube with the bolt labeled A.

b. Tem orarily install the clutch hose to the clutch master cylinder tube to flexible hose tube and tube connector to flexible hose tube, and fix it in place with the l s.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

c. Tighten the bolt labeled B.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }



. Tighten the flexible hose tube.

NOTICE:

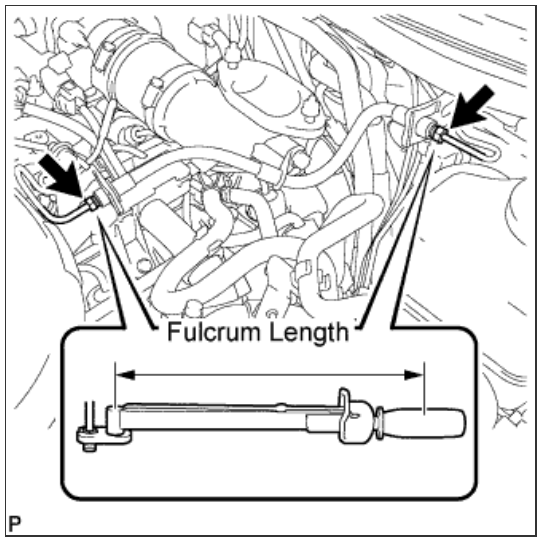
- **o not ben or mage the flexible hose tube.**
- **o not allow any foreign matter such as nt an ust to enter the flexible hose tube from the connecting points.**

HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.). If using a torque wrench with a length that is not 30 cm (11.8 in.), calculate the torque specification for the torque wrench an SST base on the without SST torque specification (Click here).**
- **Make sure union nut wrench an the wrench are connecte in a straight line.**

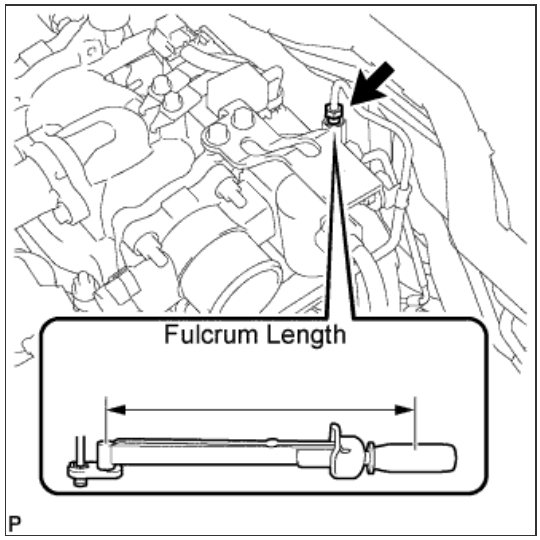
i. Using a mm union nut wrench, tighten the flare nuts of the flexible hose tube.

Torque:
without union nut wrench:
15 N*m{ 154 kgf*cm , 11 ft.*lbf }
with union nut wrench:
14 N*m{ 141 kgf*cm , 10 ft.*lbf }



ii. Using a mm union nut wrench, tighten the flare nut of the flexible hose tube.

Torque:
without union nut wrench:
15 N*m{ 154 kgf*cm , 11 ft.*lbf }
with union nut wrench:
14 N*m{ 141 kgf*cm , 10 ft.*lbf }



62. INSTALL IESEL THROTTLE BO Y ASSEMBLY RH

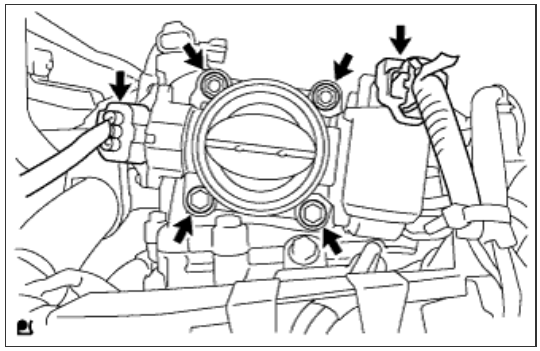
a. Install a new gasket to the intake pipe.

b. Install the throttle body with the bolts and nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Connect the throttle position sensor connector.

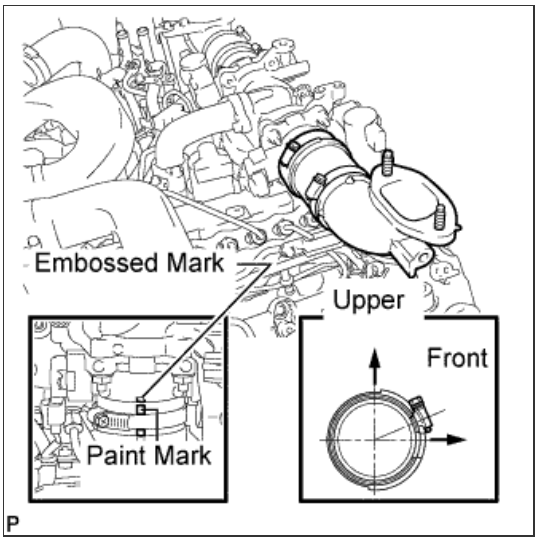
. Connect the throttle motor connector.



63. INSTALL AIR TUBE SUB-ASSEMBLY RH

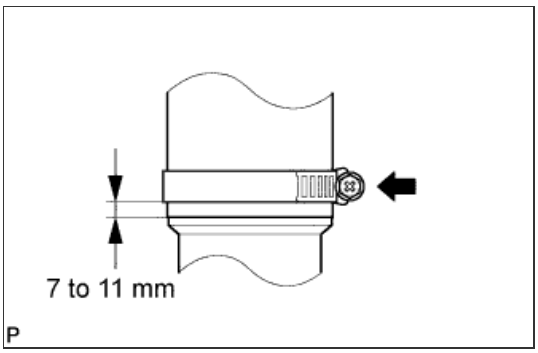
a. Install the air tube to the throttle body.

b. Align the em ossed mark of the throttle body with the paint mark of the No. 4 air hose.



c. Tighten the hose clam so that it is 7 to mm (0. to 0.433 in.) from the end of the hose as shown in the illustration.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



64. INSTALL NO. 2 ENGINE OIL LEVEL IPSTICK GUI E

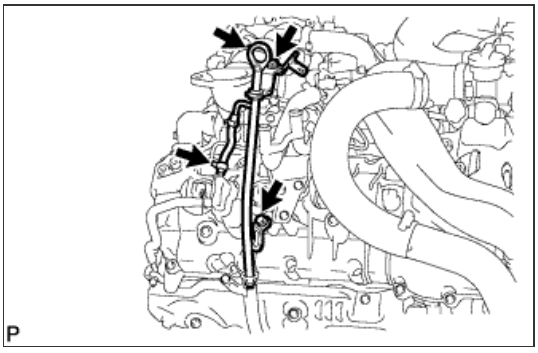
a. Apply a light coat of engine oil to a new O-ring.

b. Install the O-ring to the No. engine oil level dipstick guide.

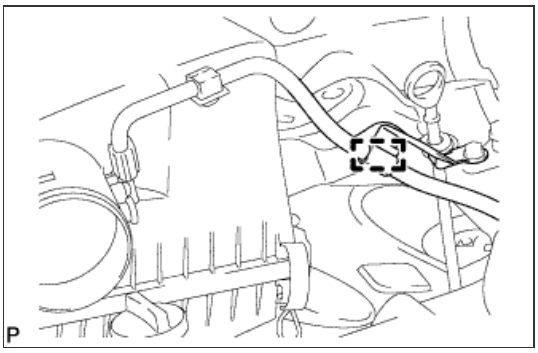
c. Install the No. engine oil level dipstick guide with the bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

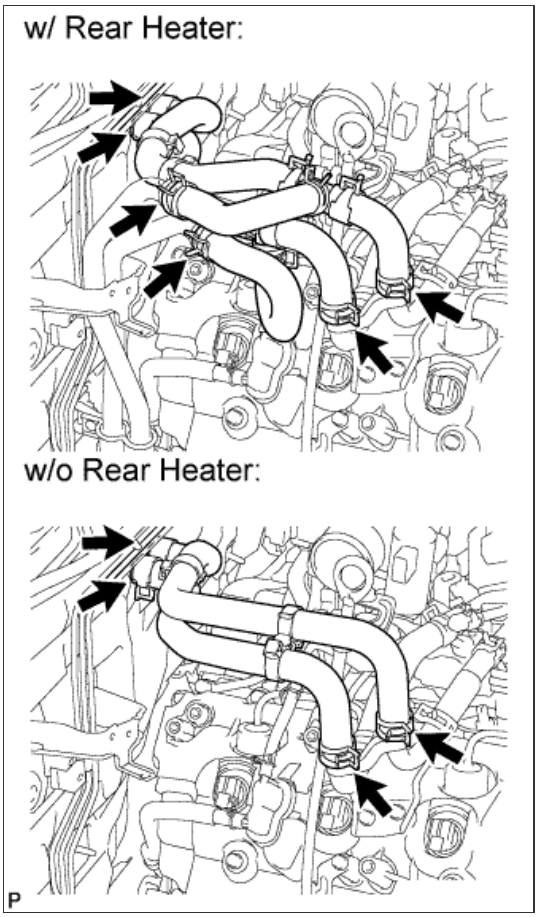
. Connect the ventilation hose to the cylinder head cover R



e. onnect the wire harness clam to the No. engine oil level dipstick guide bracket.



65. CONNECT WATER HOSE SUB-ASSEMBLY

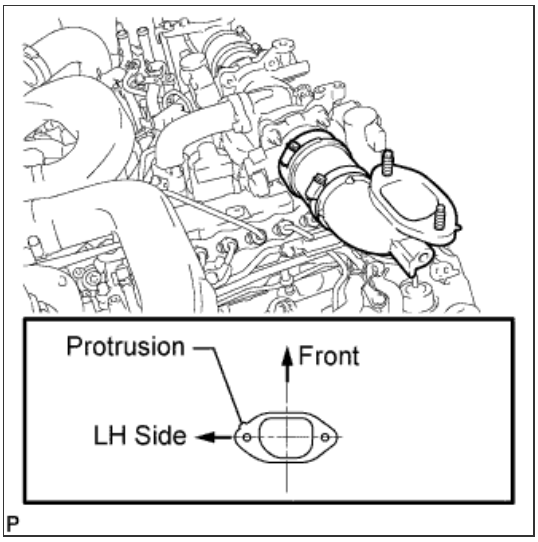


66. INSTALL NO. 2 COOL AIR INLET (w/o Intercooler)

a. Install a new gasket to the air tube L

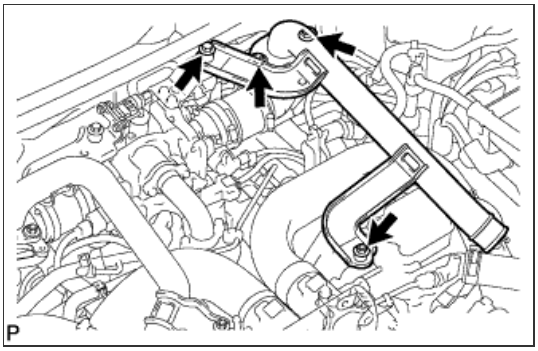
HINT:

Install the gasket with the protrusion facing as shown in the illustration.



b. Install the No. cool air inlet with the 3 nuts and bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



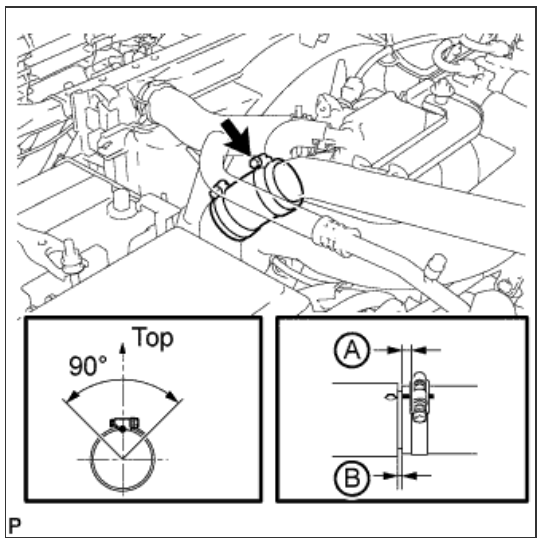
c. Connect the No. air hose to the No. cool air inlet.

. Tighten the No. air hose clam

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion an push on the air hose so that stance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that stance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make sure the rection of the hose clamp is as shown in the illustration.**

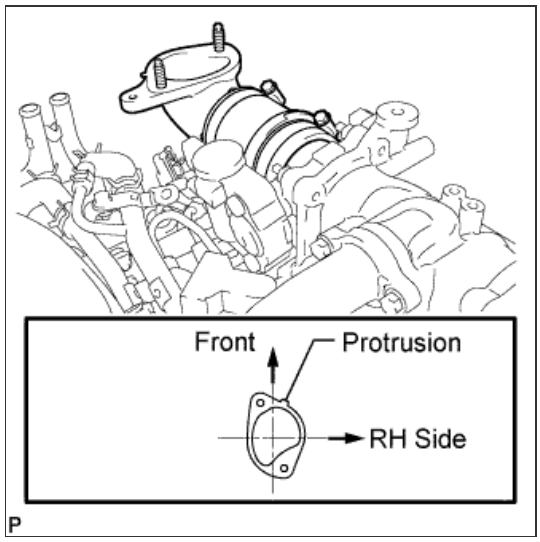


67. INSTALL NO. 1 COOL AIR INLET (w/o Intercooler)

a. Install a new gasket to the air tube R

HINT:

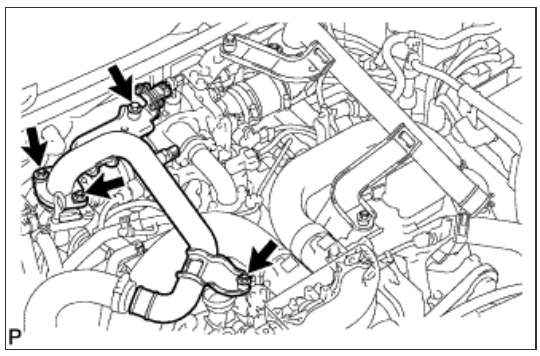
Install the gasket with the protrusion facing as shown in the illustration.



b. Install the No. cool air inlet with the 3 nuts and bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Connect the vacuum hose, intake air tem erature sensor connector and turbo pressure sensor connector.



. Connect the No. air hose to the No. cool air inlet.

e. Tighten the No. air hose clam

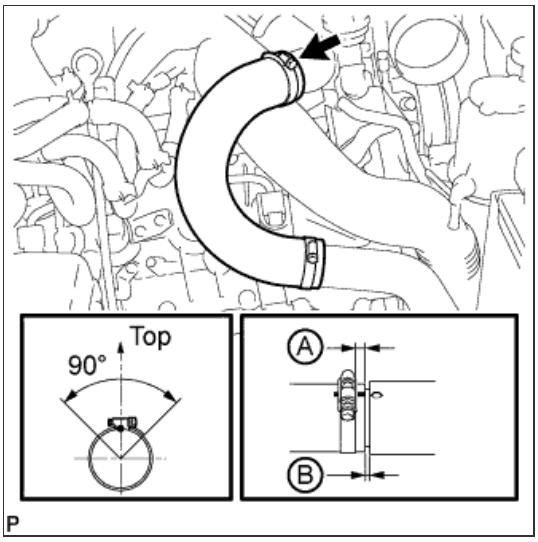
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion an push on the air hose so that stance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that stance A is 2 to 6 mm (0.0787 to**

0.236 in.).

- Make sure the direction of the hose clamp is as shown in the illustration.

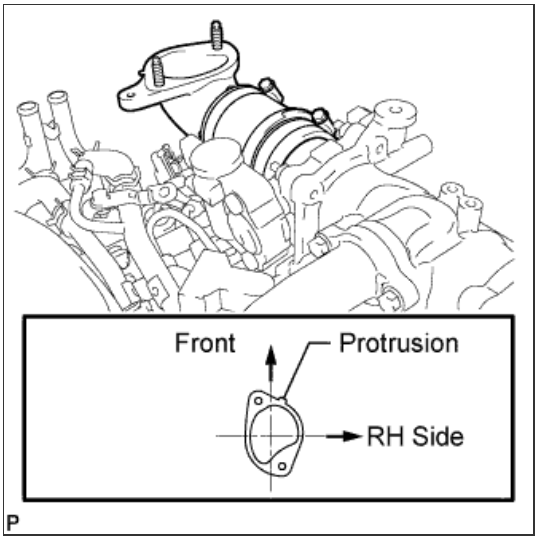


68. INSTALL INTERCOOLER ASSEMBLY (w/ Intercooler)

a. Install a new gasket to the air tube R

HINT:

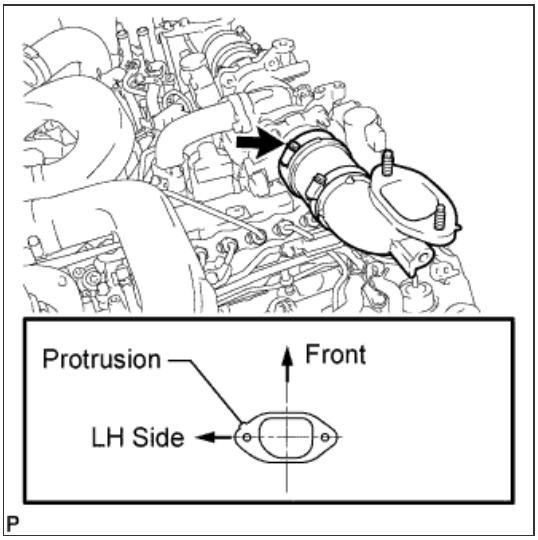
Install the gasket with the protrusion facing as shown in the illustration.



b. Install a new gasket to the air tube L

HINT:

Install the gasket with the protrusion facing as shown in the illustration.



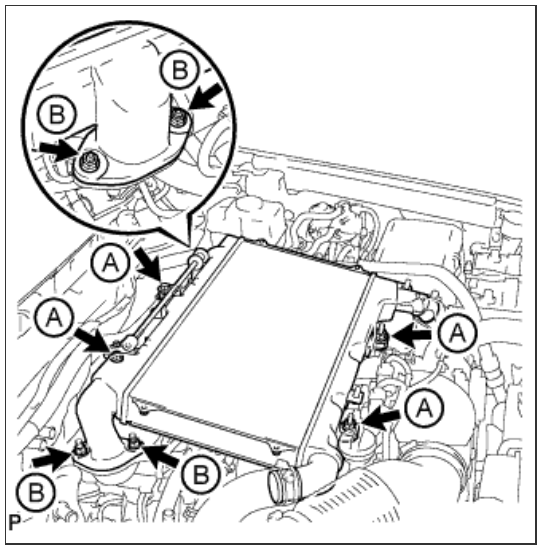
c. Align the No. and No. air hoses and intercooler pipes and connect them and install the intercooler with the bolts and nuts labeled A in the illustration.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

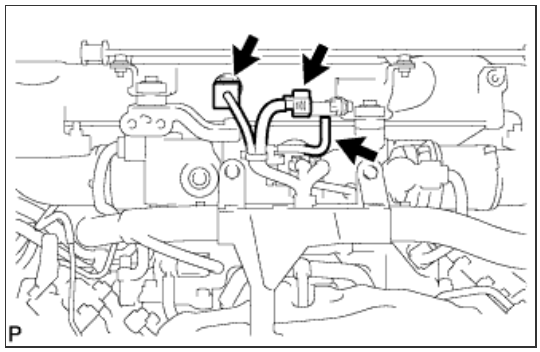
. Tem orarily install the 4 nuts labeled B in the illustration.

e. Tighten the air tube L and R with the 4 nuts labeled B shown in the illustration.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



f. Connect the vacuum hose, intake air tem erature sensor connector and turbo pressure sensor connector.

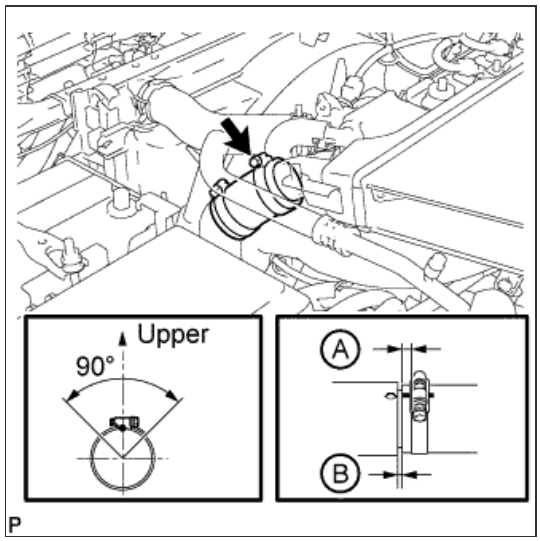


g. Tighten the clam of the No. air hose.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion an push in the air hose so that stance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that stance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make sure the rection of the hose clamp is as shown in the illustration.**

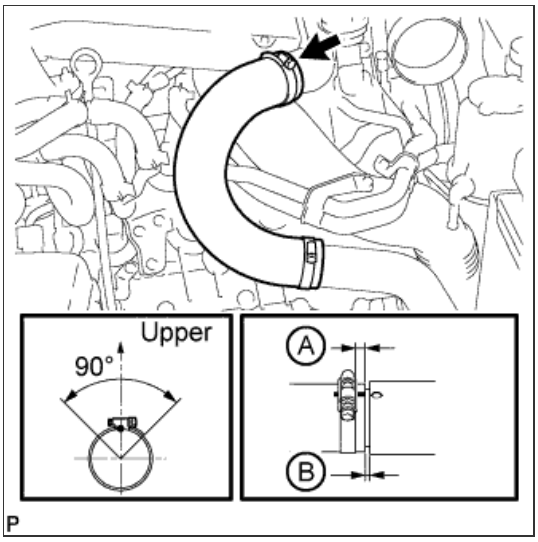


h. Tighten the clam of the No. air hose.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

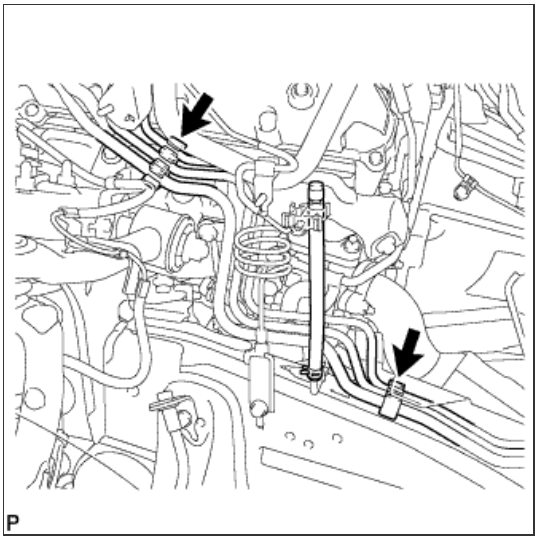
- **Align the paint mark of the air hose with the protrusion an push in the air hose so that stance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that stance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make sure the rection of the hose clamp is as shown in the illustration.**



69. CONNECT FUEL TUBE

a. Install new No. and No. 3 fuel tube clam s.

b. Connect the 3 fuel tubes to the clam s.



70. CONNECT FRONT IFFERENTIAL BREATHER TUBE

71. A ENGINE OIL

a. Add fresh oil.

Stan a Engine Oil:

Oil Grade	Oil iscosity (SAE)
G-DLD- API CF-4, API CF or ACEA B ou may also use API CE or CD)	- 5W-30 - is best choice for fuel econom and good starting in cold weather).

Stan a Capacity:

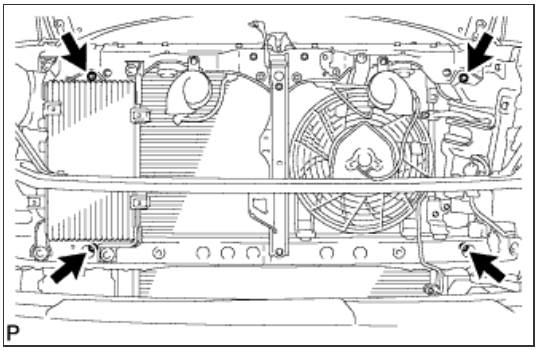
Item	ecified Condition
Drain and refill with oil filter change	9. liters (9.7 US qts, 8. lm qts)
Drain and refill without oil filter change	8. liters (8.7 US qts, 7. lm qts)
Dry fill	9.9 liters (US qts, 8.7 lm qts)

b. Install the oil filler cap.

72. INSTALL RA IATOR ASSEMBLY

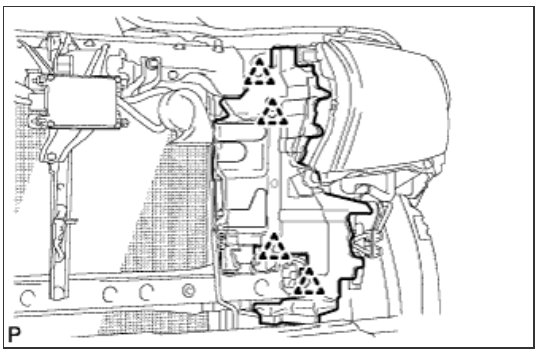
a. Install the radiator with the 4 bolts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }



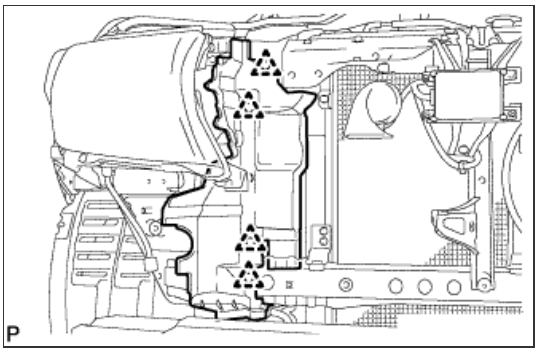
73. CONNECT RA IATOR SI E EFLECTOR LH

a. Install the side deflector with the 4 clips.



74. CONNECT RA IATOR SI E EFLECTOR RH (for Manual Transmission)

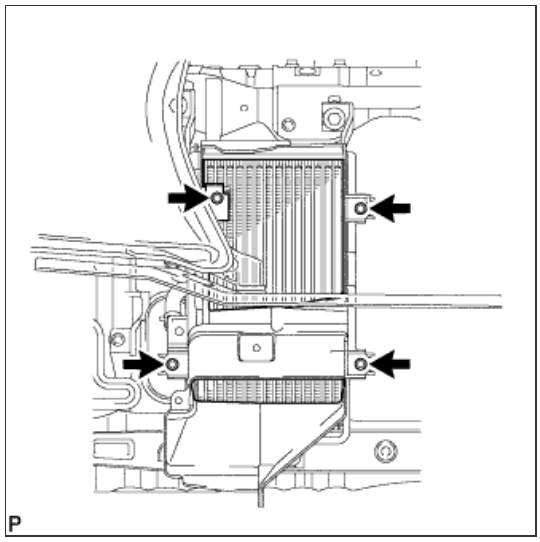
a. Install the deflector with the 4 clips.



75. INSTALL TRANSMISSION OIL COOLER AIR UCT (for Automatic Transmission)

a. Install the oil cooler air duct with the 4 bolts.

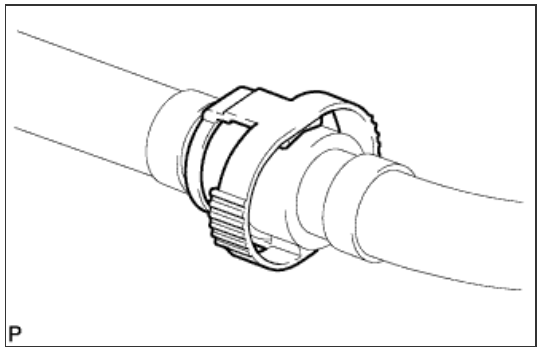
Torque:
4.9 N*m{ 50 kgf*cm , 43 in.*lbf }



76. INSTALL FRONT BUMPER COVER

HINT:

For the front bum er cover with garnish, use the procedures described below.

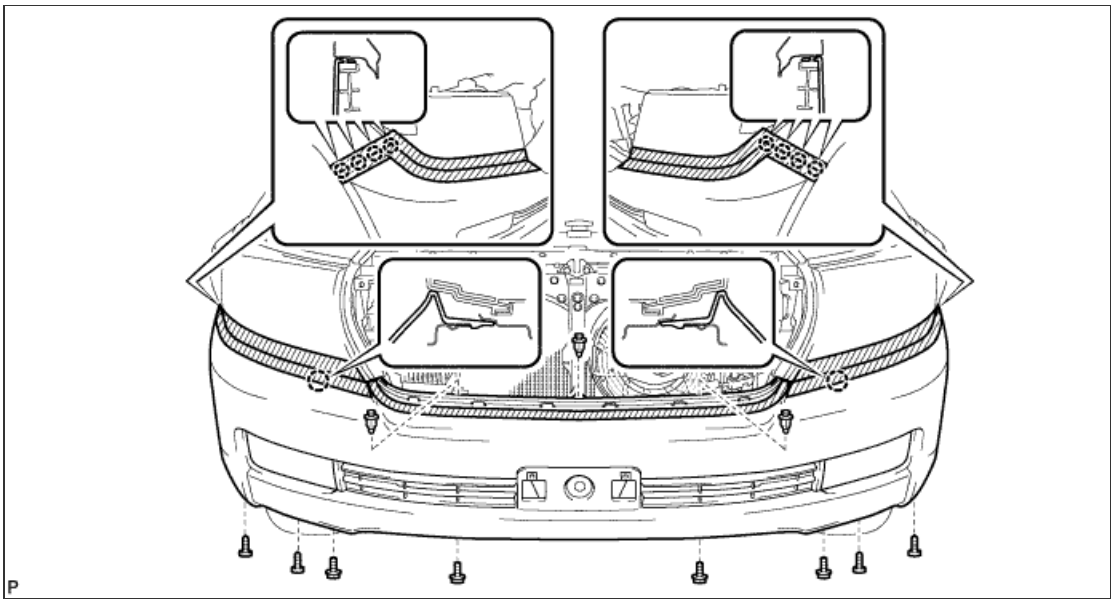


a. w/ eadlight Cleaner System
onnect the headlight cleaner hose.

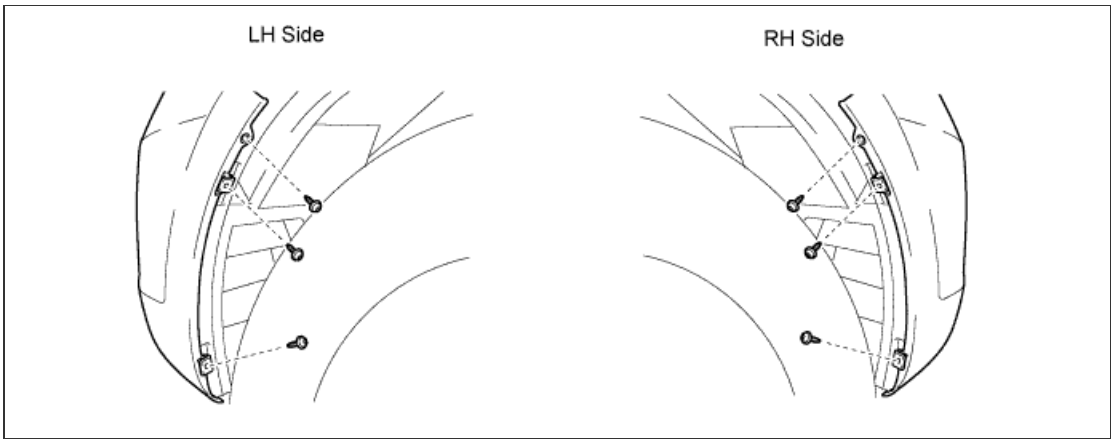
b. w/o TO TA Parking Assist-sensor System w/o Fog Light:
Attach the claws to install the bum er cover.

c. w/ TO TA Parking Assist-sensor System or w/ Fog Light:
Connect the No. 4 engine room wire connector and attach the claws to install the bum er cover.

. Install the 3 clips, 4 screws and 4 bolts.



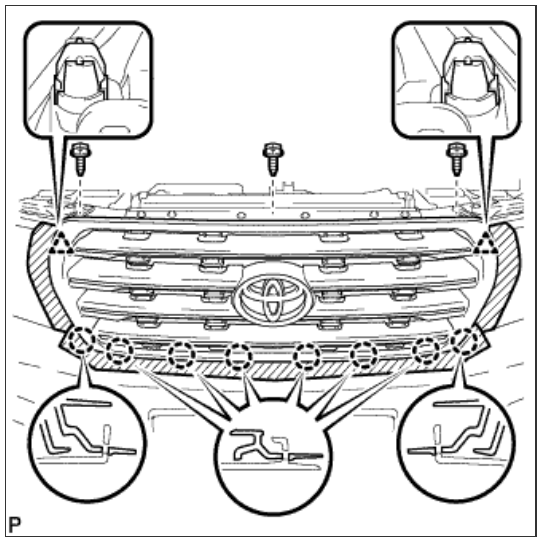
e. Using a T30 "TOR socket, install the 6 screws.



77. INSTALL RA IATOR GRILLE

a. Attach the clips and 8 claws to install the radiator grille.

b. Install the 3 screws.



78. INSTALL FRONT BUMPER WINCH COVER (w/ Winch)

79. INSTALL FAN PULLEY

80. INSTALL FAN SHROU WITH FAN

a. Install the shroud together with the fluid coupling fan between the radiator and engine com onents.

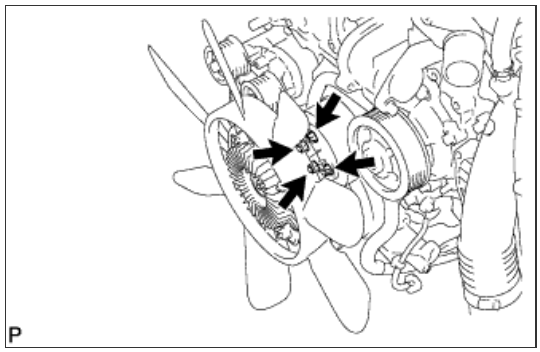
NOTICE:

Be careful not to damage the radiator core.

b. Tem orarily install the fluid coupling fan to the fan bracket with the 4 nuts.

HINT:

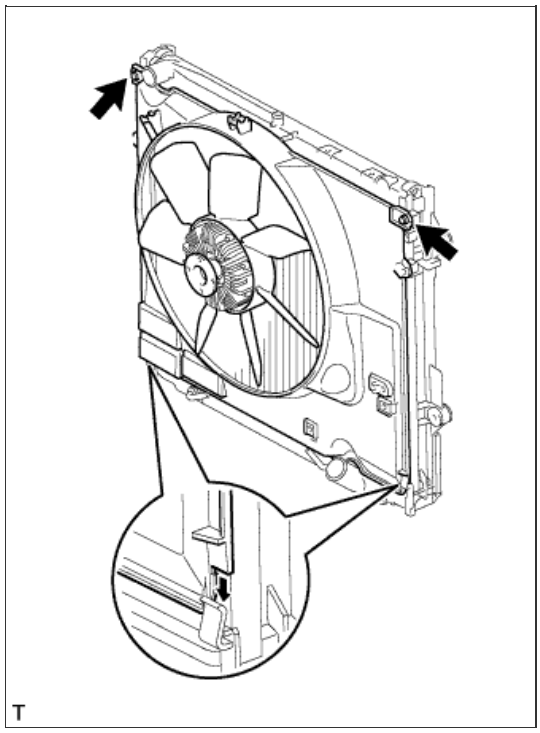
Tighten the nuts as much as possible by hand.



c. Attach the shroud claws to the radiator.

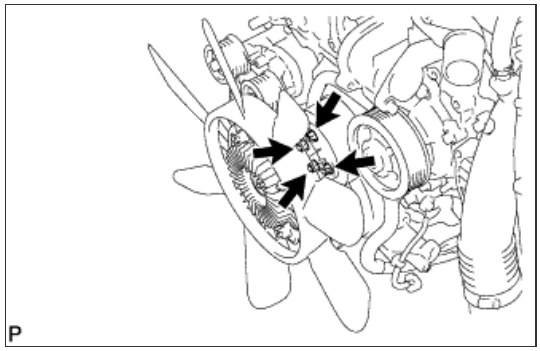
. Install the shroud with the bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }



e. Tighten the 4 nuts of the fluid coupling fan.

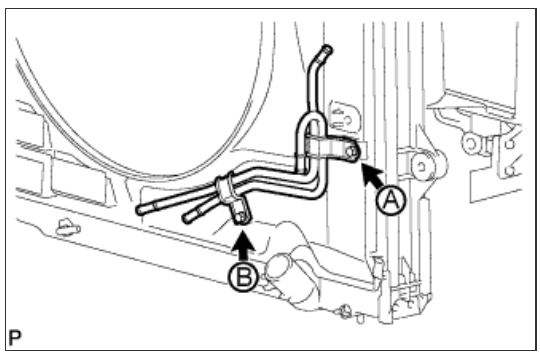
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



81. INSTALL OIL COOLER TUBE (for Automatic Transmission)

a. Tem orarily install the oil cooler tube to the fan shroud with the bolt labeled A. Install the bolt labeled B. Then tighten the bolt labeled A to the specified torque.

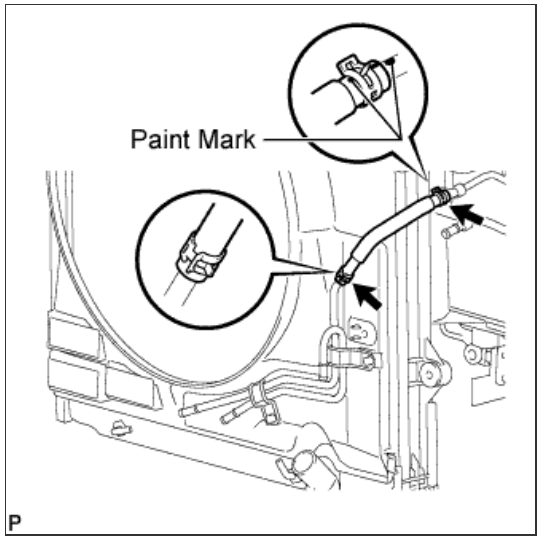
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



b. Connect the inlet No. 4 oil cooler hose as shown in the illustration.

NOTICE:

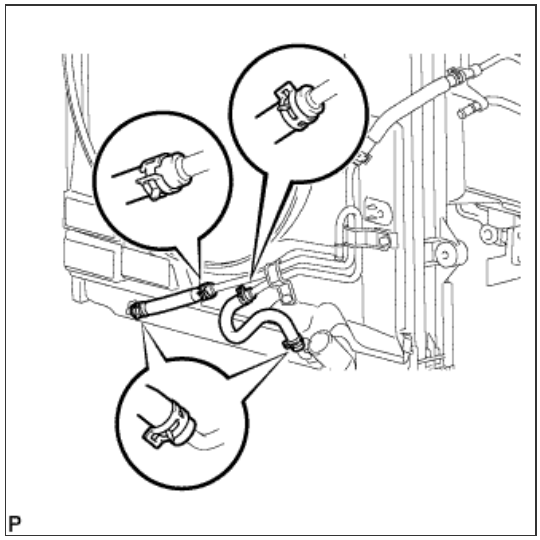
Make sure the pinching portion of each clip is facing the direction shown in the illustration.



c. Connect the inlet No. and No. 3 oil cooler hoses as shown in the illustration.

NOTICE:

Make sure the pinching portion of each clip is facing the direction shown in the illustration.

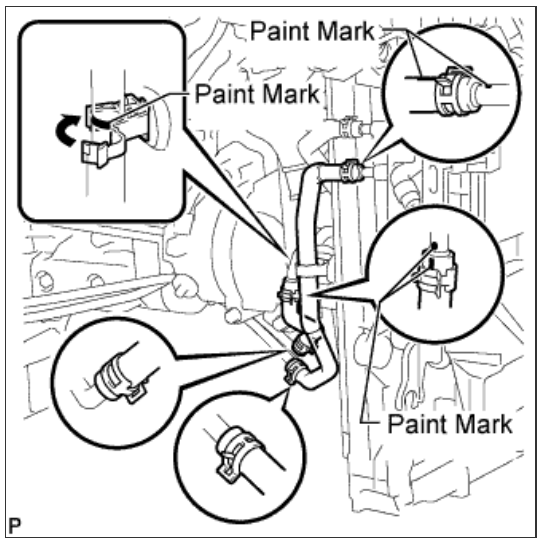


. Connect the inlet and outlet No. oil cooler hoses as shown in the illustration.

NOTICE:

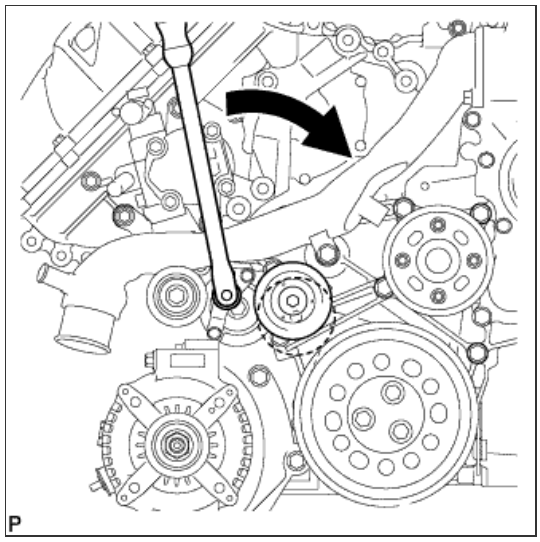
Make sure the pinching portion of each clip is facing the direction shown in the illustration.

e. Pass the hose through the flexible hose clam and close the clam shown in the illustration.

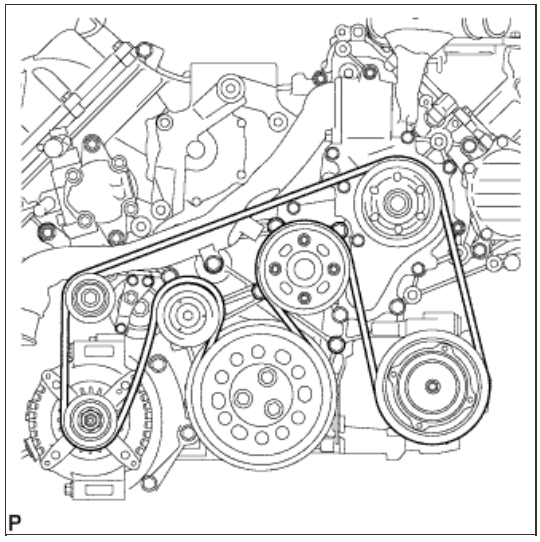


82. INSTALL V-RIBBE BELT

a. Attach a wrench to the -ribbed belt tensioner bracket and turn the wrench clockwise.



b. Install the -ribbed belt as shown in the illustration.

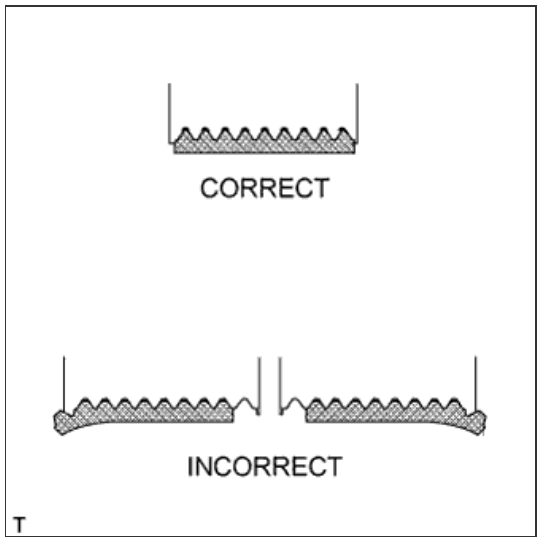


c. Check that the belt fits properly in the ribbed grooves.

HINT:

Check with your hand to confirm that the belt has not slipped out of the groove on the bottom of the pulley.

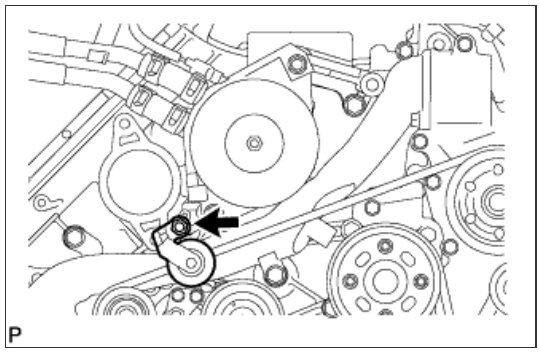
If it has slipped out, replace the -ribbed belt. Install a new -ribbed belt.



83. INSTALL NO. 3 I LER PULLEY (w/ Viscous Heater)

a. Align the No. 3 idler pulley bracket knock pin and No. idler pulley bracket knock pin hole and install the No. 3 idler pulley with the nut.

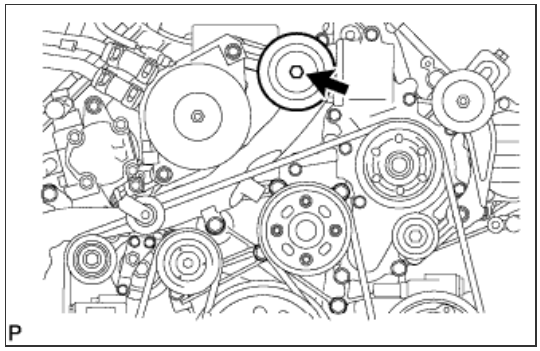
Torque:
88 N*m{ 898 kgf*cm , 64 ft.*lbf }



84. INSTALL NO. 1 I LER PULLEY (w/ Viscous Heater)

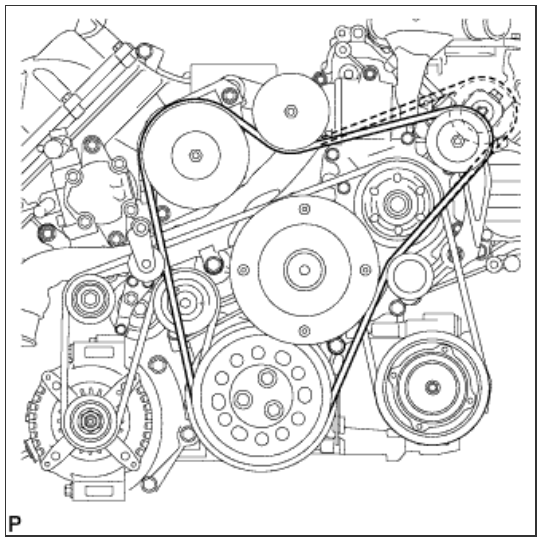
a. Install the collar, No. idler pulley and cover with the bolt.

Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }

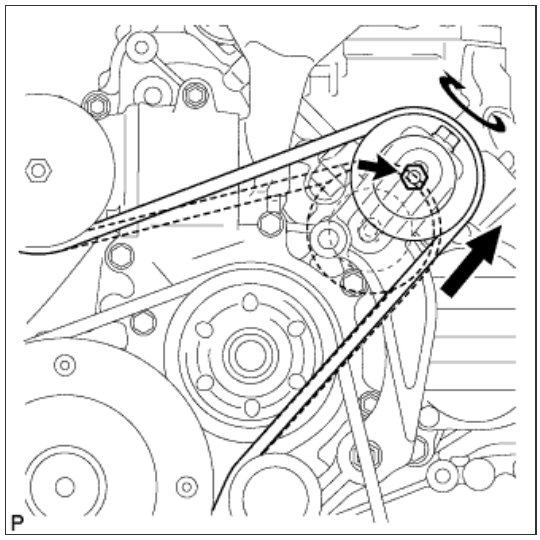


85. INSTALL V-RIBBE BELT (w/ Viscous Heater)

a. Install the -ribbed belt as shown in the illustration.



b. Tem orarily install the lock nut, and turn the bolt clockwise.



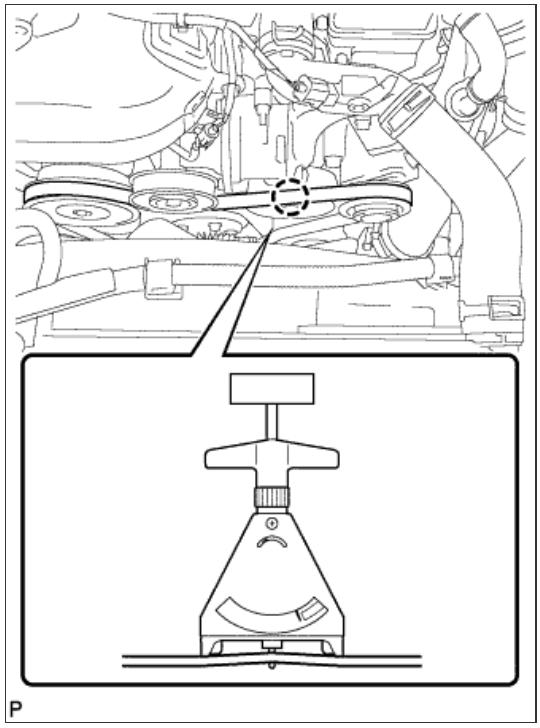
c. Using a belt tension gauge, adjust belt tension.

Stan a Belt Tension:

Item	ecified Condition
New belt	400 to 650 N (4 to 66 kgf, 89.9 to lbf)
Used belt	300 to 500 N (3 to 5 kgf, 67.4 to lbf)

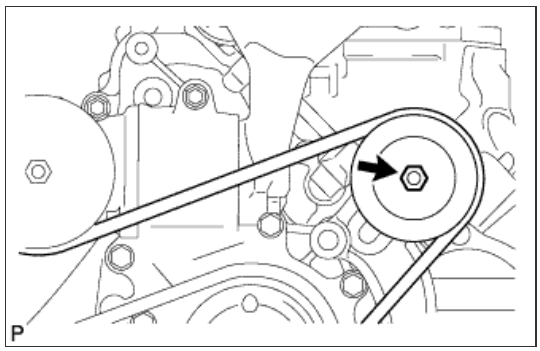
HINT:

- **A new belt is a belt which has been use for less than 5 minutes on a running engine.**
- **A use belt is a belt which has been use on a running engine for 5 minutes or more.**
- **After installing a new belt, run the engine for approximately 5 minutes an then recheck the tension.**



. Tighten the nut.

Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

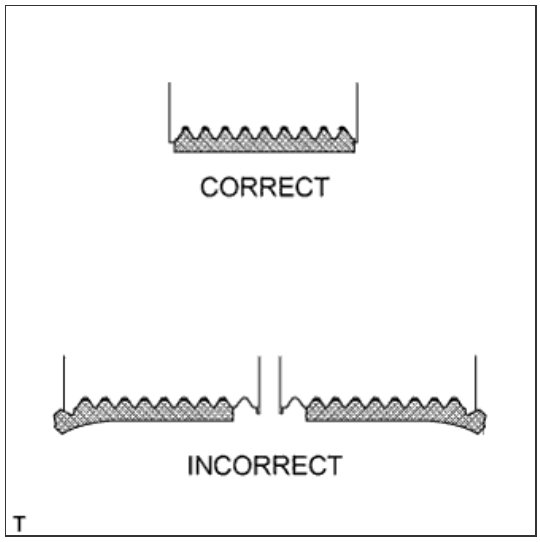


e. Check that the belt fits properly in the ribbed grooves.

HINT:

Check with your hand to confirm that the belt has not slipped out of the groove on the bottom of the pulley.

If it has slipped out, replace the -ribbed belt. Install a new -ribbed belt.



86. CONNECT NO. 2 RA IATOR HOSE

87. CONNECT NO. 1 RA IATOR HOSE

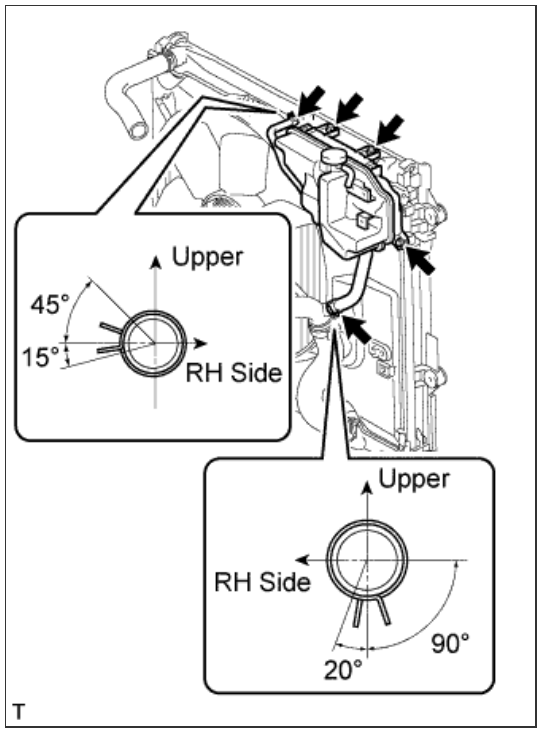
88. INSTALL RA IATOR RESERVOIR ASSEMBLY

a. Install the radiator reservoir with the 3 bolts.

b. Connect the hoses to the upper radiator tank and water inlet.

HINT:

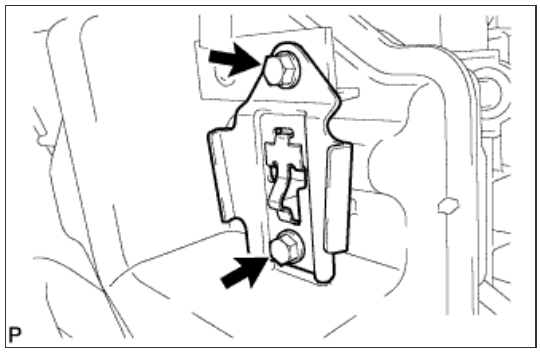
Make sure the directions of the hose clam s are as shown in the illustration.



89. INSTALL NO. 1 OIL RESERVOIR BRACKET

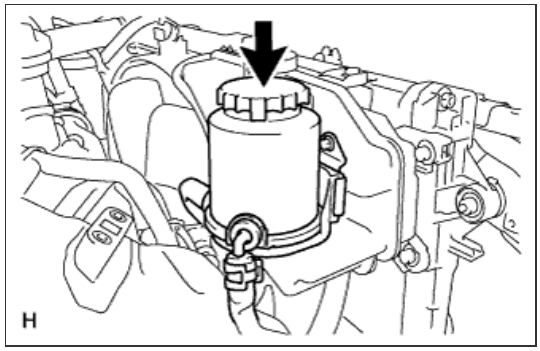
a. Install a new bracket with the bolts.

Torque:
4.5 N*m{ 46 kgf*cm , 40 in.*lbf }



90. INSTALL VANE PUMP OIL RESERVOIR ASSEMBLY

a. Install the vane pum oil reservoir to the bracket.

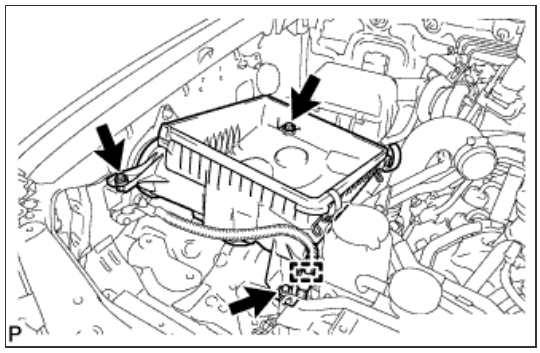


91. INSTALL AIR CLEANER CASE

a. Install the air cleaner case with the 3 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

b. Attach the wire harness clam to the air cleaner case.



92. INSTALL AIR CLEANER FILTER ELEMENT

93. INSTALL INTAKE AIR CONNECTOR

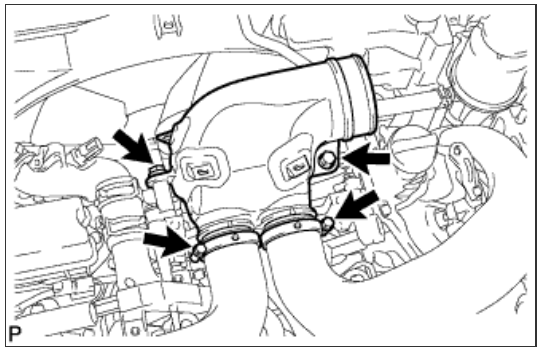
a. Connect the intake air connector to the No. and No. air cleaner pipes.

b. Install the connector with the bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Tighten the hose clam s.

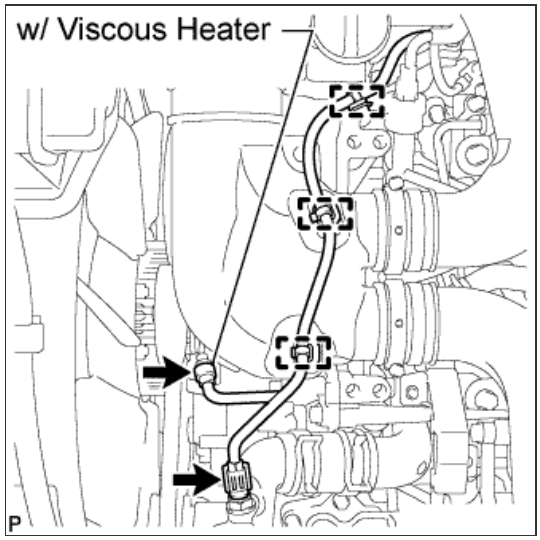
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



. Attach the 3 wire harness clam s.

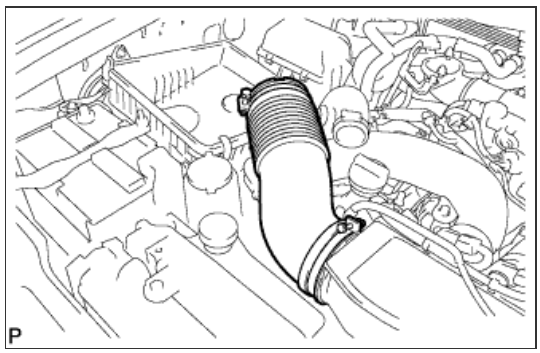
e. w/o iscous eater:
Connect the connector to the water tem erature sensor.

f. w/ iscous eater:
Connect the connectors to the water tem erature sensor and viscous with magnet clutch heater.



94. TEMPORARILY INSTALL NO. 1 AIR CLEANER HOSE

a. Tem orarily install the air cleaner hose to the intake air connector.

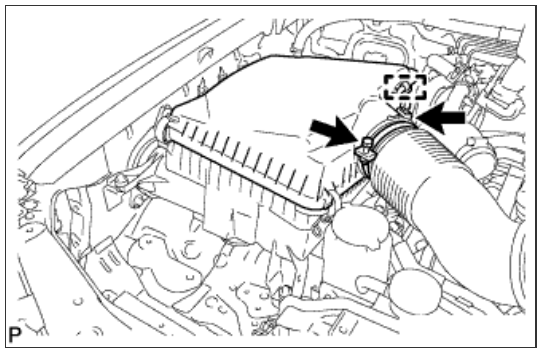


95. INSTALL AIR CLEANER CAP SUB-ASSEMBLY

a. Connect the air cleaner cap to the air cleaner hose, and install the air cleaner cap with the 4 clam s.

b. Connect the mass air flow meter connector and attach the wire harness clam to the air cleaner cap.

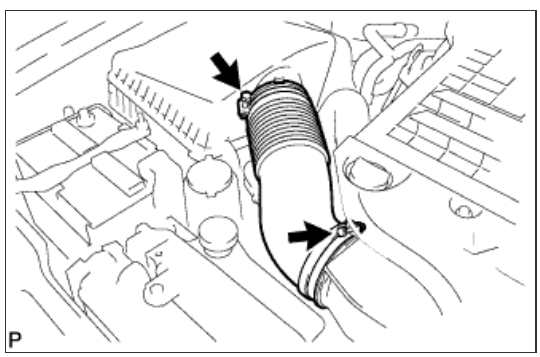
c. Attach the wire harness clam



. I n the protrusion of air cleaner cap and concave portion of air cleaner hose.

e. Tighten the hose clam s.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



96. INSTALL SUB-BATTERY

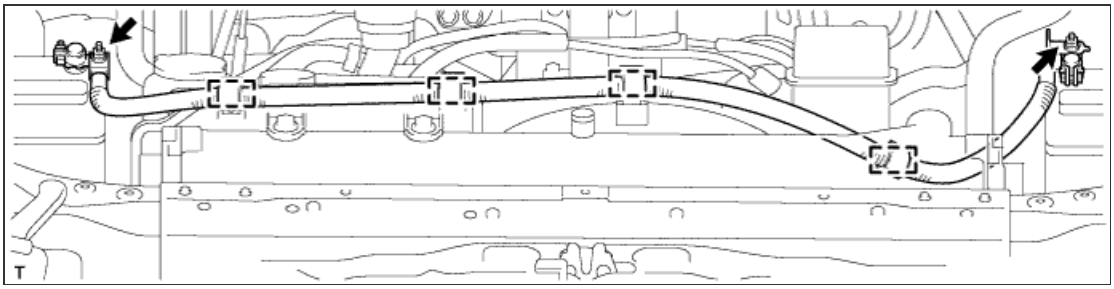
97. INSTALL MAIN BATTERY

98. INSTALL NO. 3 ENGINE ROOM WIRE

a. Install the No. 3 engine room wire to the main battery and sub-battery positive term nals with the nuts.

Torque:
7.6 N*m{ 77 kgf*cm , 67 in.*lbf }

b. Connect the No. 3 engine room wire with the 4 clam s.



99. BLEE CLUTCH LINE

a. Remove the release cylinder bleeder plug cap.

b. Connect a vinyl tube to the bleeder plug.

c. Depress the clutch pedal several times, and then loosen the bleeder plug while the pedal is depressed.

. When fluid no longer comes out, tighten the bleeder plug, and then release the clutch pedal.

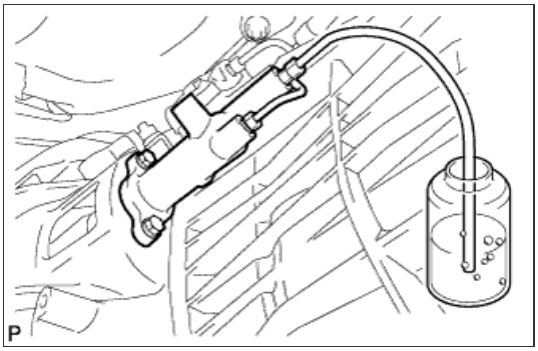
e. Repeat the previous steps until all the air in the fluid is com dtely bled.

f. Tighten the bleeder plug.

Torque:
11 N*m{ 110 kgf*cm , 8 ft.*lbf }

g. Install the bleeder plug cap.

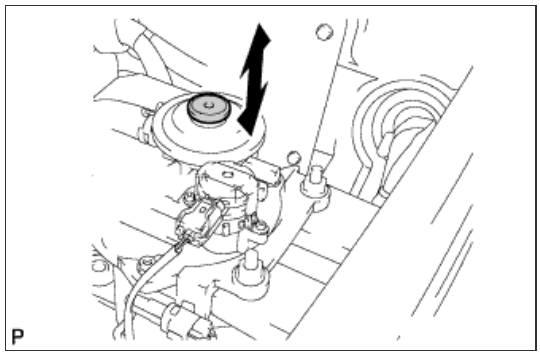
h. Check that all the air has been bled from the clutch line.



100. CHECK FOR CLUTCH FLUI LEAK

101. BLEE AIR FROM FUEL SYSTEM

a. Using the hand pum indicated by the arrow in the illustration, bleed the fuel system Continue pum ng until pum ng becomes difficult.



102. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

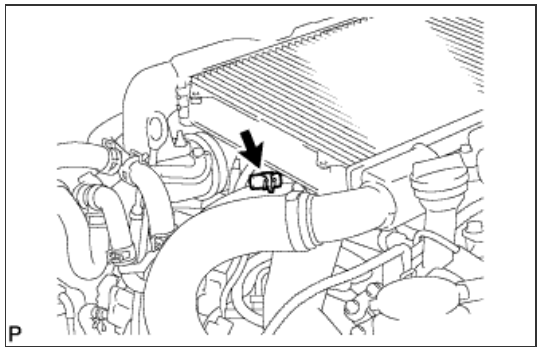
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

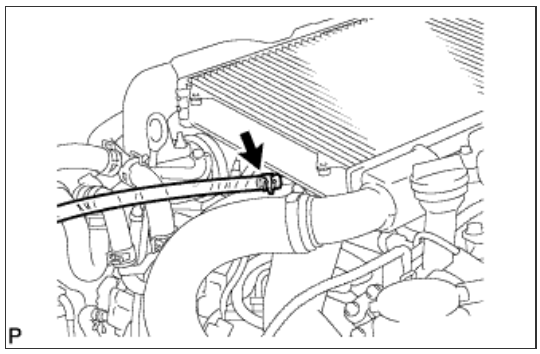
a. Connect the cables to the negative (-) main battery and sub-battery term nals.

103. A ENGINE COOLANT

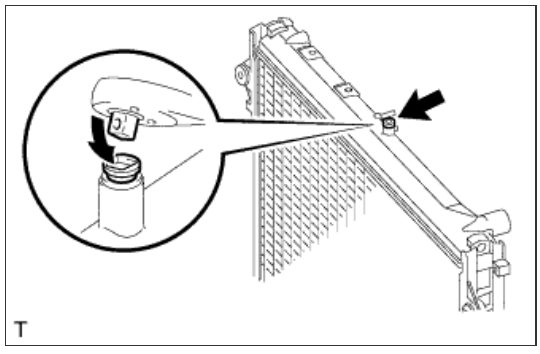
a. Remove the engine air bleed cap.



b. Connect a clear hose to the engine air bleed pipe.



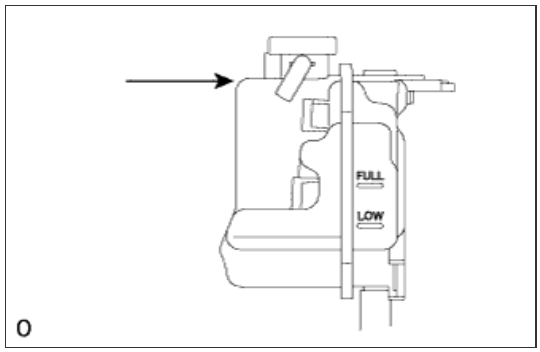
c. Using a wrench, remove the vent plug.



. Fill the radiator with TO TA SLLC to the radiator reservoir filler neck.

HINT:

Pour TO TA SLLC until it spills out of the engine air bleed pipe.



Stan a Capacity (for Automatic Transmission):

Item	ecified Condition
Front heater only	liters (US qts, Im qts)
Front heater and rear heater	liters (US qts, Im qts)
Front heater with viscous heater	liters (US qts, Im qts)
Front heater and rear heater with viscous heater	liters (US qts, Im qts)

Stan a capacity (for Manual Transmission):
15.4 liters (16.3 US qts, 13.6 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

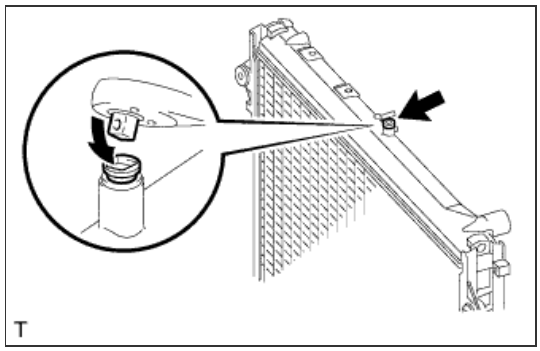
TO TA vehicles are filled with TO TA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TO TA SLLC or sim ar high quality ethylene glycol based non-silicate, non-am ne, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a com nation of low phosphates and organic acids).

e. Install the vent plug.

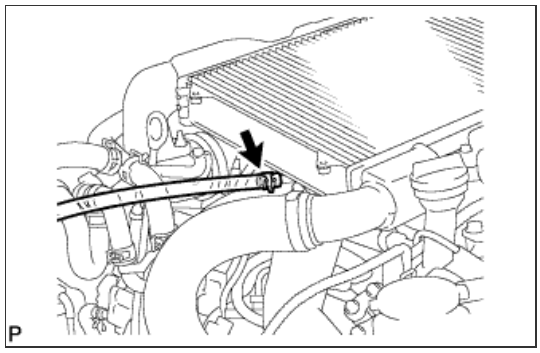
Torque:
2.0 N*m{ 20 kgf*cm , 18 in.*lbf }

NOTICE:

Do not tighten the plug to 5.0 N m (5 kgf cm 44 in. lbf) or more, as the plug will be damaged.



f. Disconnect the clear hose from the engine air bleed pipe.



g. Install the engine air bleed cap when coolant comes out.

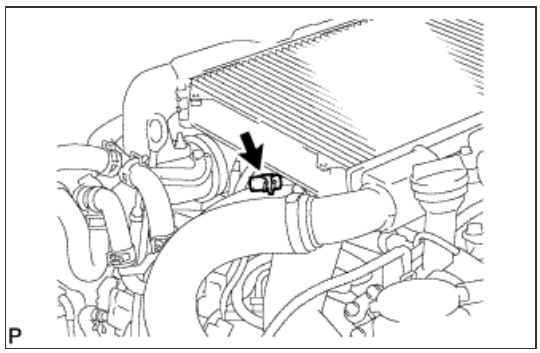
h. Install the radiator reservoir cap.

i. Start the engine.

NOTICE:

Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: stop the engine, wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the FULL line.

. Maintain an engine speed of 3000 rpm for approximately m nutes so that the thermostat opens and air bleeding is performed.



CAUTION:

When pressing the ra iador hoses:

- **Wear protecti eglo es.**
- **Be careful as the ra iador hoses are hot.**
- **Keep your han s away from the ra iador fan**

NOTICE:

- **Pay attention to the nee le of the water temperature meter. Make sure that the nee le oes not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or o eheat.**

HINT:

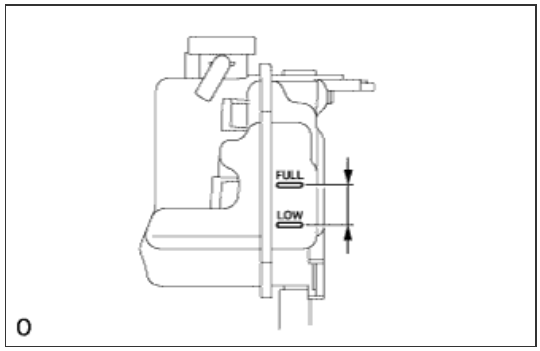
The thermostat opening tim ng can be confirmed by pressing the No. radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

k. Stop the engine, and wait until the engine coolant cools down to am ent tem erature.

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

l. Check that the coolant level is between the FULL and LOW lines.
If the coolant level is above the FULL line, drain coolant so that the coolant level is between the FULL and LOW lines.



104. INSPECT FOR FUEL LEAK

a. Perform Active Test.

i. Connect the intelligent tester to the DLC3.

ii. Turn the ignition switch to ON.

iii. Start the engine.

i . Turn the intelligent tester ON.

. Enter the following menus: Powertrain / Engine / Active Test.

.i Perform the Active Test.

Tester Display	Test Detail	Control Range	Diagnostic Note
Test the Fuel Leak	Pressurizes fuel inside common rail and checks for fuel leaks	Stop/Start	• The fuel inside the common rail is pressurized to the specified value and the engine speed increases to rpm when Start is selected. • The above conditions are preserved while Start is selected.

105. INSPECT FOR OIL LEAK

a. Perform Active Test.

i. Connect the intelligent tester to the DLC3.

ii. Turn the ignition switch to ON.

iii. Start the engine.

i . Turn the intelligent tester ON.

. Enter the following menus: Powertrain / Engine / Active Test.

.i Perform the Active Test.

Tester Display	Test Detail	Control Range	Diagnostic Note
Test the Fuel Leak	Pressurizes fuel inside common rail and checks for fuel leaks	Stop/Start	• The fuel inside the common rail is pressurized to the specified value and the engine speed increases to rpm when Start is selected. • The above conditions are preserved while Start is selected.

106. INSPECT FOR COOLANT LEAK

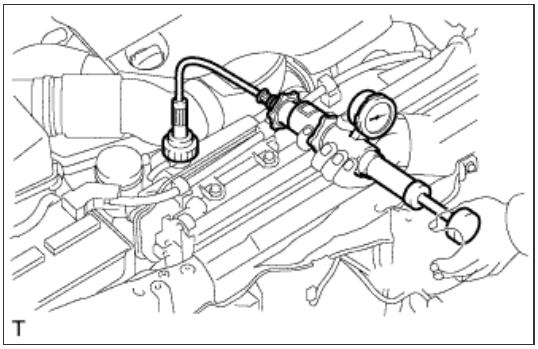
CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester to the radiator reservoir.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to a (kgf/cm psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pum for leaks.
If no external leaks are found, check the cylinder block and cylinder head.



107. INSPECT FOR EXHAUST GAS LEAK

108. CHARGE REFRIGERANT

SST

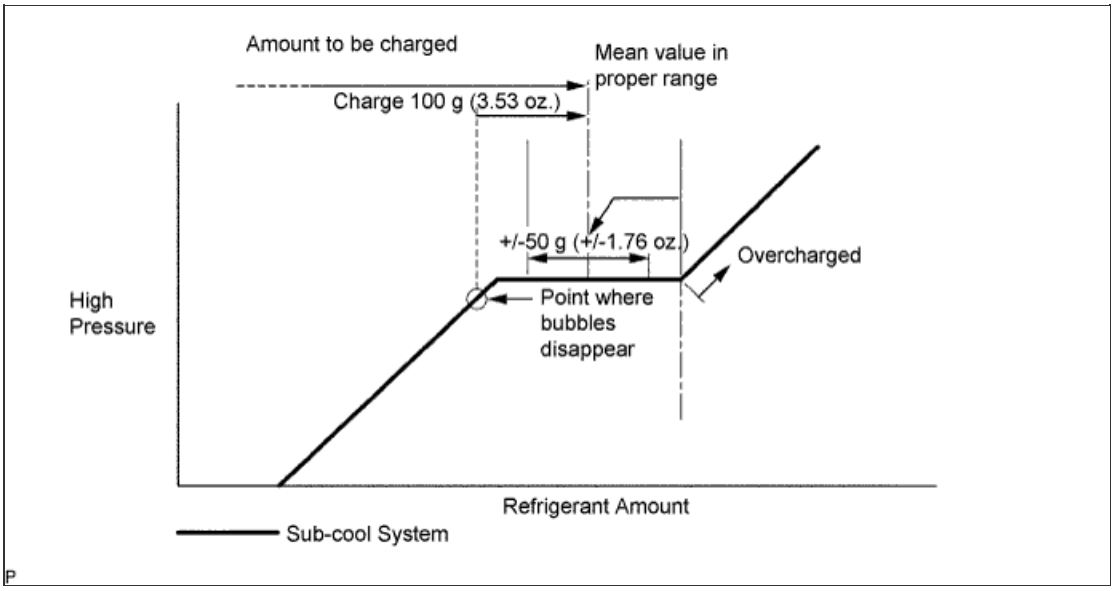
09985-20010 (09985-02130, 09985-02150, 09985-02090, 09985-02110, 09985-02010, 09985-02050, 09985-02060, 09985-02070)

a. Perform vacuum purging using a vacuum pum

b. Charge refrigerant a (R a).

Stan a :

Condenser Core Thickness	Air Conditioning Type	Cool Box	Refrigerant Charging Amount
mm (0.866 in.)	w/o Rear Cooler	w/ Cool Box	870 +/-30 g (30.7 +/- oz.)
		w/o Cool Box	870 +/-30 g (30.7 +/- oz.)
	w/ Rear Cooler	w/ Cool Box	+/-30 g (35.6 +/- oz.)
		w/o Cool Box	960 +/-30 g (33.9 +/- oz.)
mm (0.630 in.)	w/o Rear Cooler	w/ Cool Box	770 +/-30 g (+/- oz.)
		w/o Cool Box	770 +/-30 g (+/- oz.)
	w/ Rear Cooler	w/ Cool Box	970 +/-30 g (34. +/- oz.)
		w/o Cool Box	9 +/-30 g (3 +/- oz.)



NOTICE:

- **o not operate the cooler compressor before charging refrigerant as the cooler compressor will not work properly without any refrigerant, an will o eheat.**
- **Approximately 200 g (7.05 o .) of refrigerant may nee to be charge after bubbles sappear. The refrigerant amount shoul be checke by measuring its quantity, an not with the sight glass.**

109. WARM UP ENGINE

a. Warm up the engine at less than rpm for m nutes or more after charging the refrigerant.

NOTICE:

Be sure to warm up the com essor when turning the A/C switch is on after removing and installing the cooler refrigerant lines (including the com essor), to prevent damage to the com essor.

110. CHECK FOR REFRIGERANT GAS LEAK

a. After recharging the refrigerant gas, check for refrigerant gas leakage using a halogen leak detector.

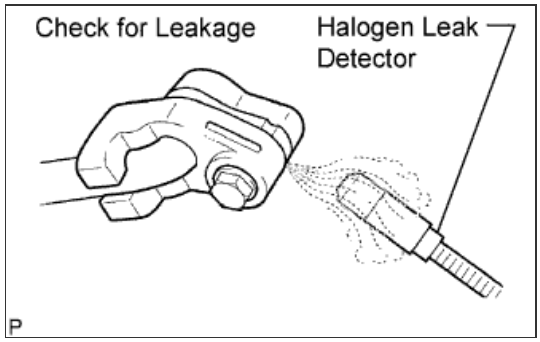
b. Perform the operation under these conditions:

- Stop the engine.
- Secure good ventilation (the halogen leak detector may react to volatile gases other than refrigerant, such as evaporated gasoline or exhaust gas).
- Repeat the test or 3 times.
- Make sure that some refrigerant remains in the refrigeration system When com essor is off: approximately 39 to 588 kPa (4.0 to 6.0 kgf/cm 57 to 85 psi).

c. Using a halogen leak detector, check the refrigerant line for leakage.

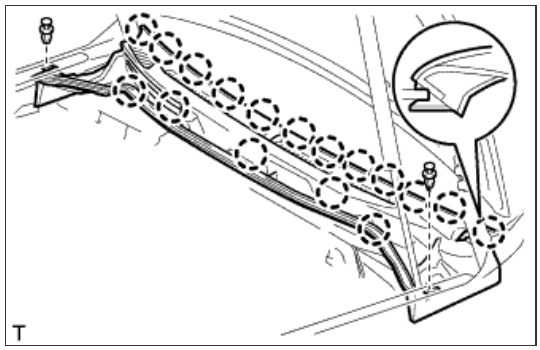
. If a gas leak is not detected on the drain hose, remove the blower motor control (blower resistor) from the cooling unit. Insert the halogen leak detector sensor into the unit and perform the test.

e. Disconnect the connector and wait for approximately m nutes. Bring the halogen leak detector close to the pressure switch and perform the test.



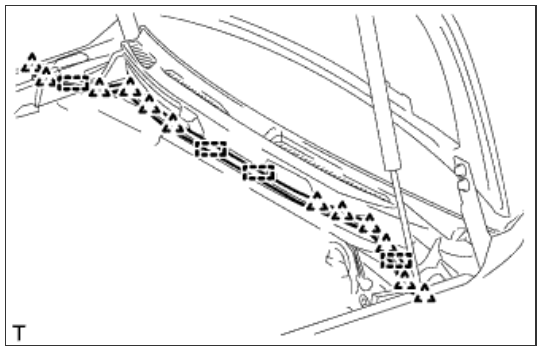
111. INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Push the ventilator louver in the direction indicated by the arrow in the illustration to attach the claws and clips and install the ventilator louver.

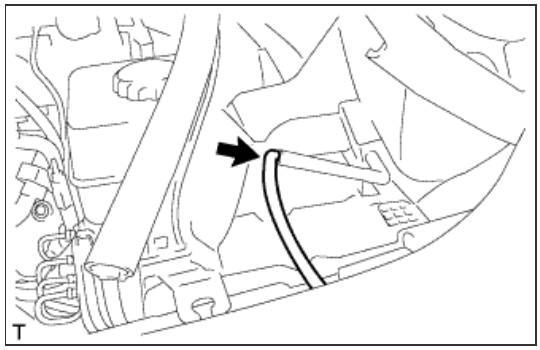


112. INSTALL HOO TO COWL TOP SEAL

a. Attach the clips and 4 clam s to install the hood to cowl top seal.



b. Install the washer hose.



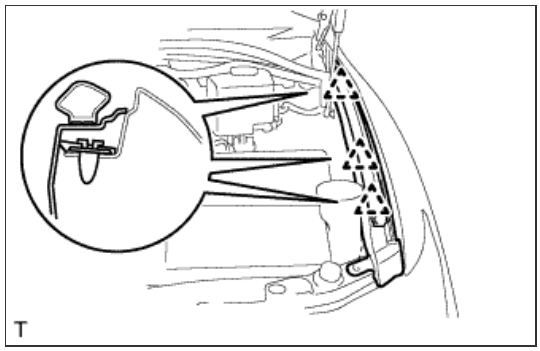
113. INSTALL FRONT FEN ER MAIN SEAL RH

HINT:

Use the same procedures described for the L side.

114. INSTALL FRONT FEN ER MAIN SEAL LH

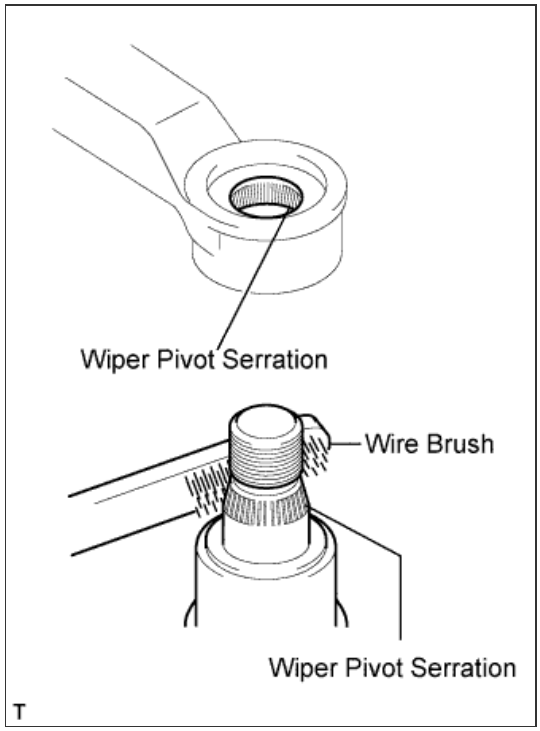
a. Attach the 3 clips to install the fender main seal.



115. INSTALL FRONT WIPER ARM RH

a. Stop the wiper motor at the automatic stop position.

b. Clean the wiper pivot serration with a wire brush.



c. Install the wiper arm and blade with the nut. Make sure that the wiper arm and blade comes to the position shown in the illustration.

Stan a Measurement:

Position	Specified Condition
B	to 40.0 mm (0.787 to in.)

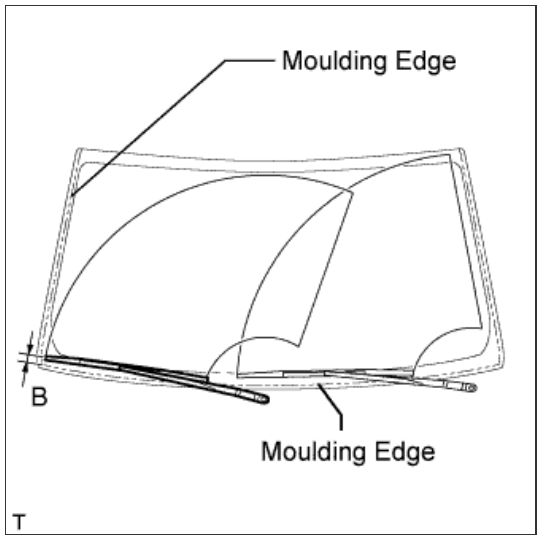
Torque:

25 N*m{ 255 kgf*cm , 18 ft.*lbf }

HINT:

old down the wiper arm hinge with your hand while tightening the nut.

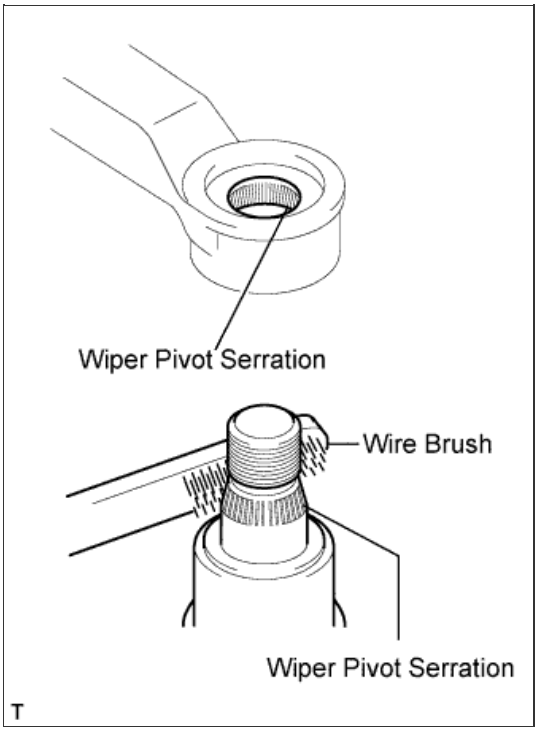
. Operate the front wipers while spraying washer fluid on the windshield glass. Make sure that the front wipers function properly and there is no interference with the vehicle body.



116. INSTALL FRONT WIPER ARM LH

a. Stop the wiper motor at the automatic stop position.

b. Clean the wiper pivot serration with a wire brush.



c. Install the wiper arm and blade with the nut. Make sure that the wiper arm and blade comes to the position shown in the illustration.

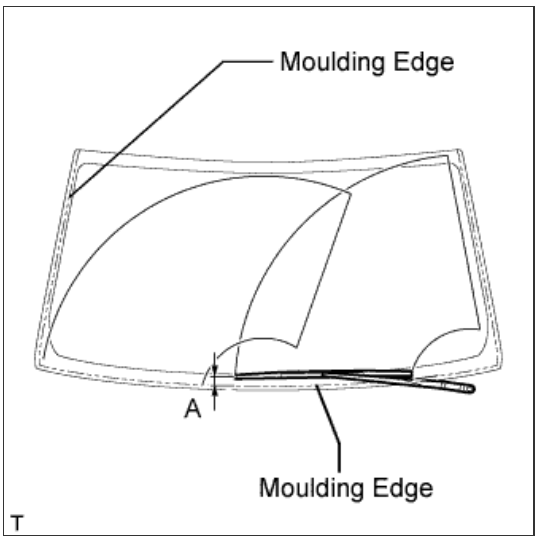
Stan a Measurement:

Position	Specified Condition
A	to 36.8 mm (0.66 to in.)

Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }

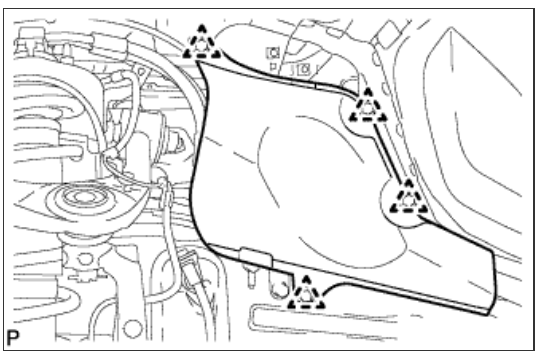
HINT:

old down the wiper arm hinge with your hand while tightening the nut.



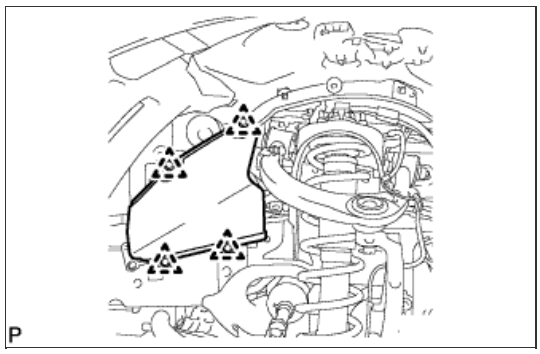
117. INSTALL FRONT FEN ER APRON SEAL REAR LH

a. Install the front fender apron seal rear L with the 4 clips.

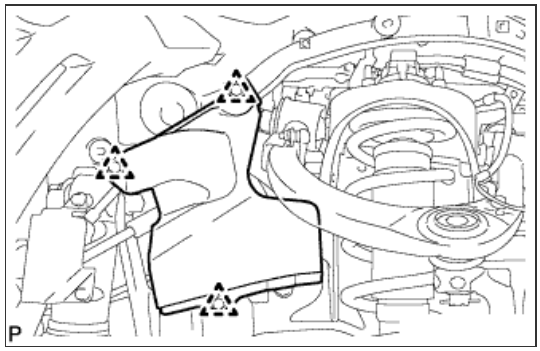


118. INSTALL FRONT FEN ER APRON SEAL FRONT LH

a. w/o KDSS:
Install the front fender apron seal front L with the 4 clips.

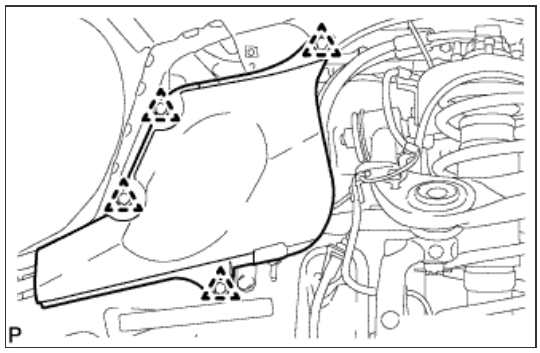


b. w/ KDSS:
Install the front fender apron seal front L with the 3 clips.



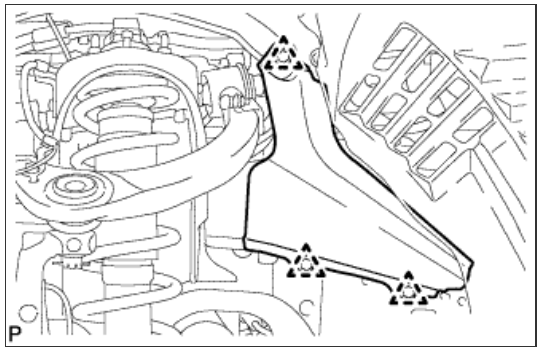
119. INSTALL FRONT FEN ER APRON SEAL REAR RH

a. Install the front fender apron seal rear R with the 4 clips.



120. INSTALL FRONT FEN ER APRON SEAL FRONT RH

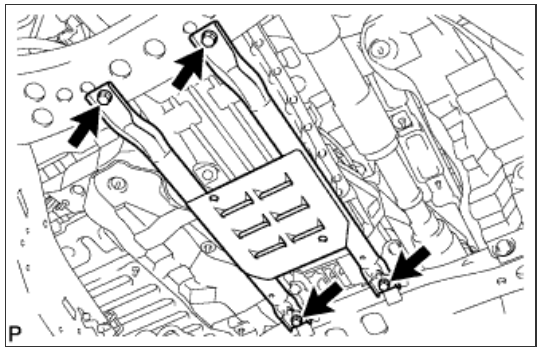
a. Install the front fender apron seal front R with the 3 clips.



121. INSTALL OIL PAN PROTECTOR ASSEMBLY

a. Install the oil pan protector with the 4 bolts.

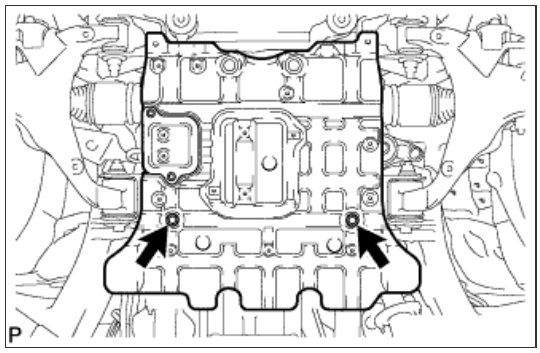
Torque:
63 N*m{ 642 kgf*cm , 46 ft.*lbf }



122. INSTALL NO. 2 ENGINE UN ER COVER

a. Install the engine under cover with the bolts.

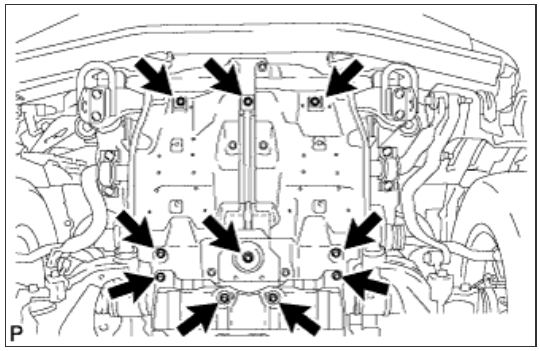
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



123. INSTALL NO. 1 ENGINE UN ER COVER SUB-ASSEMBLY

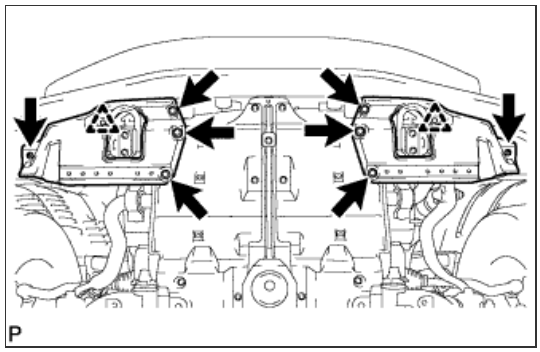
a. Install the engine under cover with the bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



124. INSTALL FRONT FEN ER SPLASH SHIEL SUB-ASSEMBLY RH

a. Install the splash shield with the clip, and then install the 3 bolts and screw.



125. INSTALL FRONT FEN ER SPLASH SHIEL SUB-ASSEMBLY LH

a. Install the splash shield with the clip, and then install the 3 bolts and screw.

126. INSTALL HOO SUB-ASSEMBLY

a. Install the hood with the 4 bolts.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }

b. Install the hood supports with the bolts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

NOTICE:

- **As much as possible a oi touching the stroke portions of the ro to pre enforeign matter from attaching to it. Be sure to hol the cylin es while ser ding.**
- **o not wear cotton glo e or other similar materials when han ling the ro . Fibers may attach to the ro an result in gas leaks.**
- **o not apply any loa to the cylin es in the hori ontal rection in or e to pre entthe ro from being torme .**
- **Install the hoo support while supporting the hoo by han .**

127. A UST HOO SUB-ASSEMBLY

a. Adjust the hood (Click here).

128. INSPECT ENGINE OIL LEVEL

a. Warm up the engine, stop the engine and wait 5 m nutes. The engine oil level should be between the dipstick low level mark and full level mark.
If low, check for leakage and add oil up to the full level mark.

NOTICE:

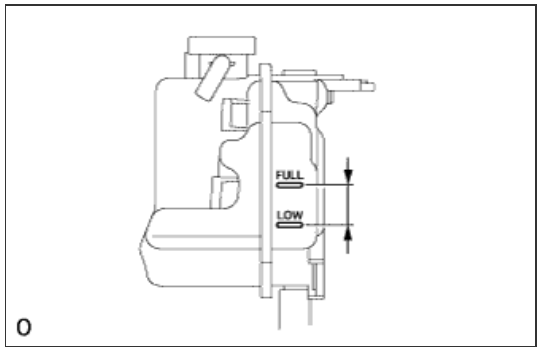
Do not fill engine oil above the full level mark.

129. INSPECT ENGINE COOLANT LEVEL IN RESERVOIR

a. Check that the engine coolant level is between the LOW and FULL lines when the engine is cold.
If the engine coolant is low, check for leaks and add "TO TA Super Long Life Coolant (SLLC)" or sim ar high quality ethylene glycol based non-silicate, non-am ne, non-nitrite and non-borate coolant with long-life hybrid organic acid technology to the FULL line.

NOTICE:

Do not substitute plain water for engine coolant.



130. INSPECT ENGINE I LE SPEE

NOTICE:

- **Turn all the electrical systems an the A/C off.**
- **When checking the i le spee , mo e the shift le e to neutral.**

HINT:

- **For more information about the intelligent tester, refer to its operator s manual.**
- **If an intelligent tester is not a dable, use a tachometer tester probe as a substitute.**

a. When using the intelligent tester:

i. Warm up the engine.

ii. Connect the intelligent tester to the DLC3.

iii. Enter the following menus:
Powertrain / Engine / Data List / Engine Speed.

HINT:

Refer to the intelligent tester operator's manual for help selecting the Data List.

i . Inspect the engine idle speed.

Stan a l le Spee :

Item	ecified Condition
for Automatic Transm ssion	550 to 650 rpm
or Manual Transm ssion	500 to 600 rpm

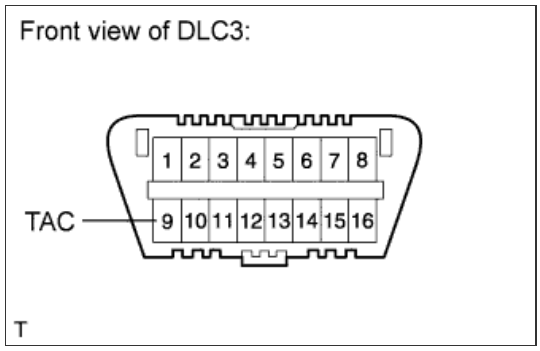
. sconnect the intelligent tester from the DLC3.

b. When not using the intelligent tester:

i. Warm up and stop the engine.

ii. Connect a tester probe of a tachometer to term nal 9 (TAC) of the DLC3 with SST.

SST
09843-18030



iii. Inspect the engine idle speed.

Stan a l le Spee :

Item	ecified Condition
for Automatic Transm ssion	550 to 650 rpm
or Manual Transm ssion	500 to 600 rpm

i . sconnect the tester probe from term nal 9 (TAC) of the DLC3.

131. INSPECT MAXIMUM ENGINE SPEE

a. Start the engine.

b. Fully depress the accelerator pedal.

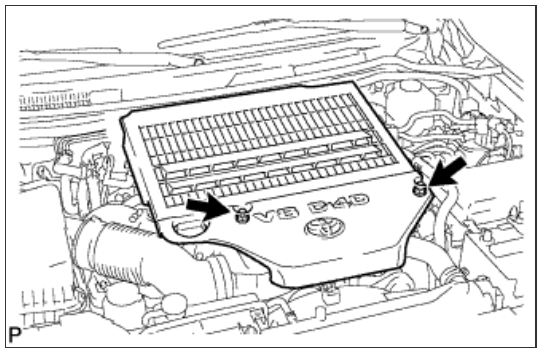
c. Check the maximum engine speed.

Maximum engine spee :
4700 to 4900 rpm

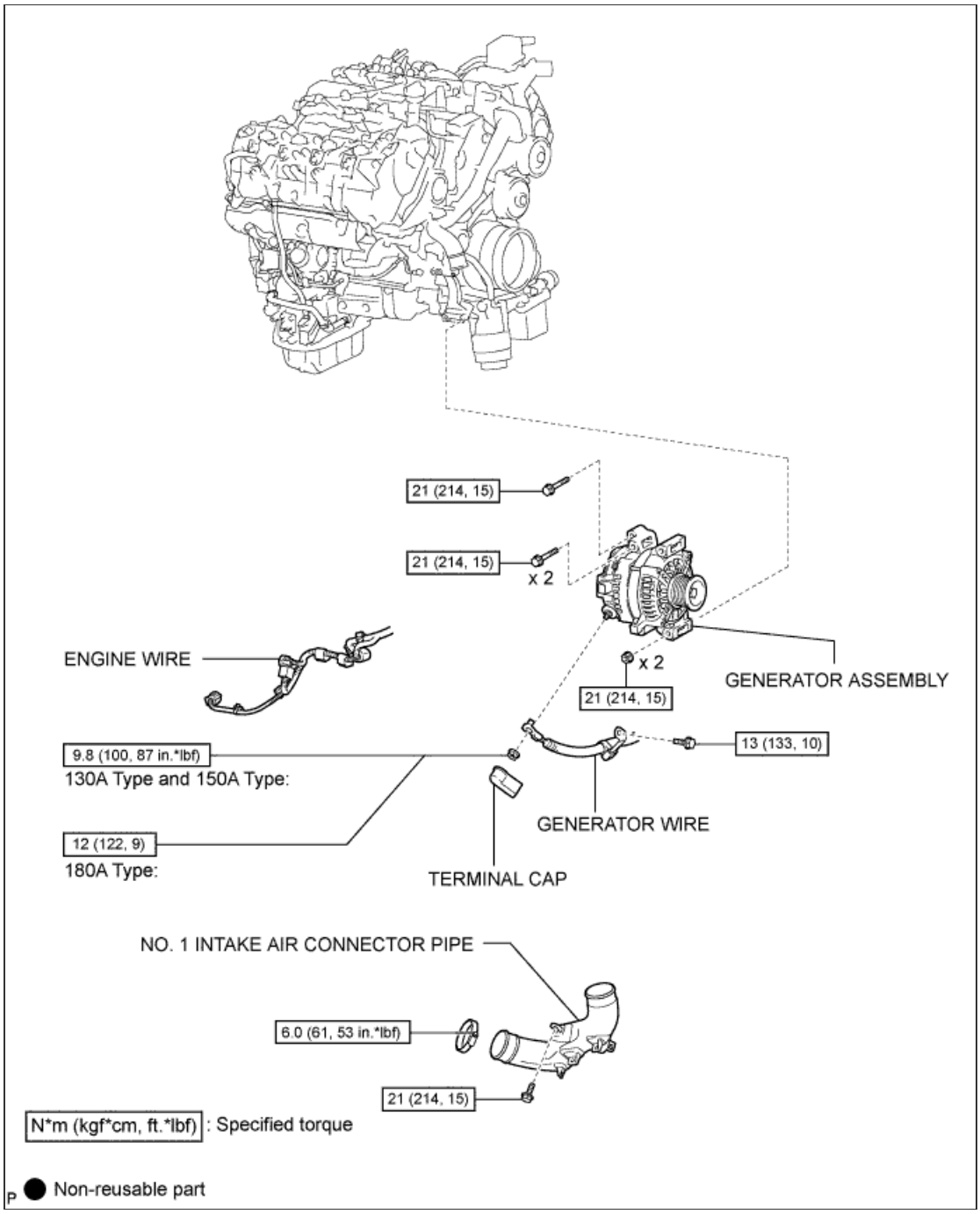
132. INSTALL NO. 1 ENGINE COVER SUB-ASSEMBLY (w/ Intercooler)

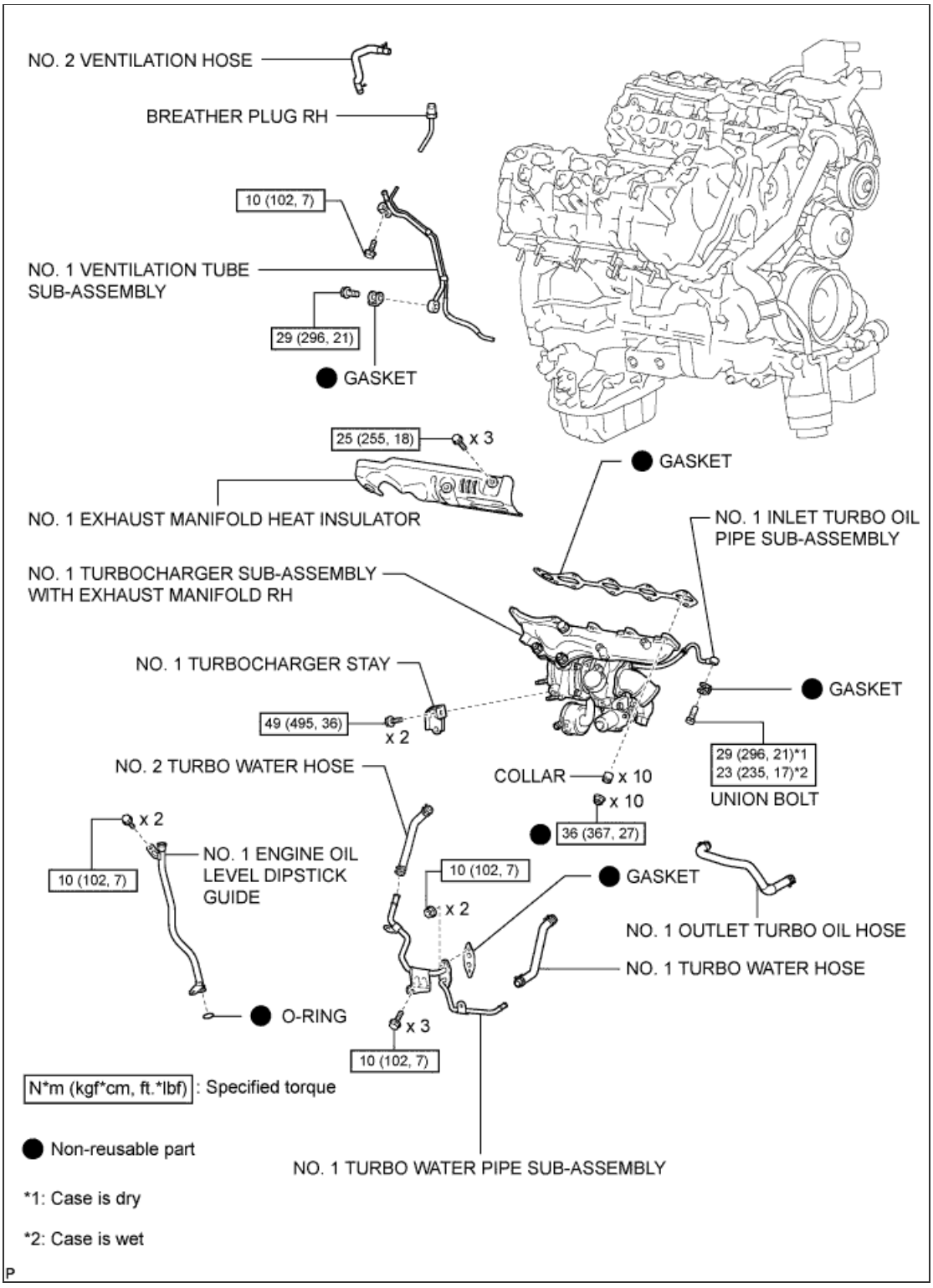
a. Install the engine cover with the nuts.

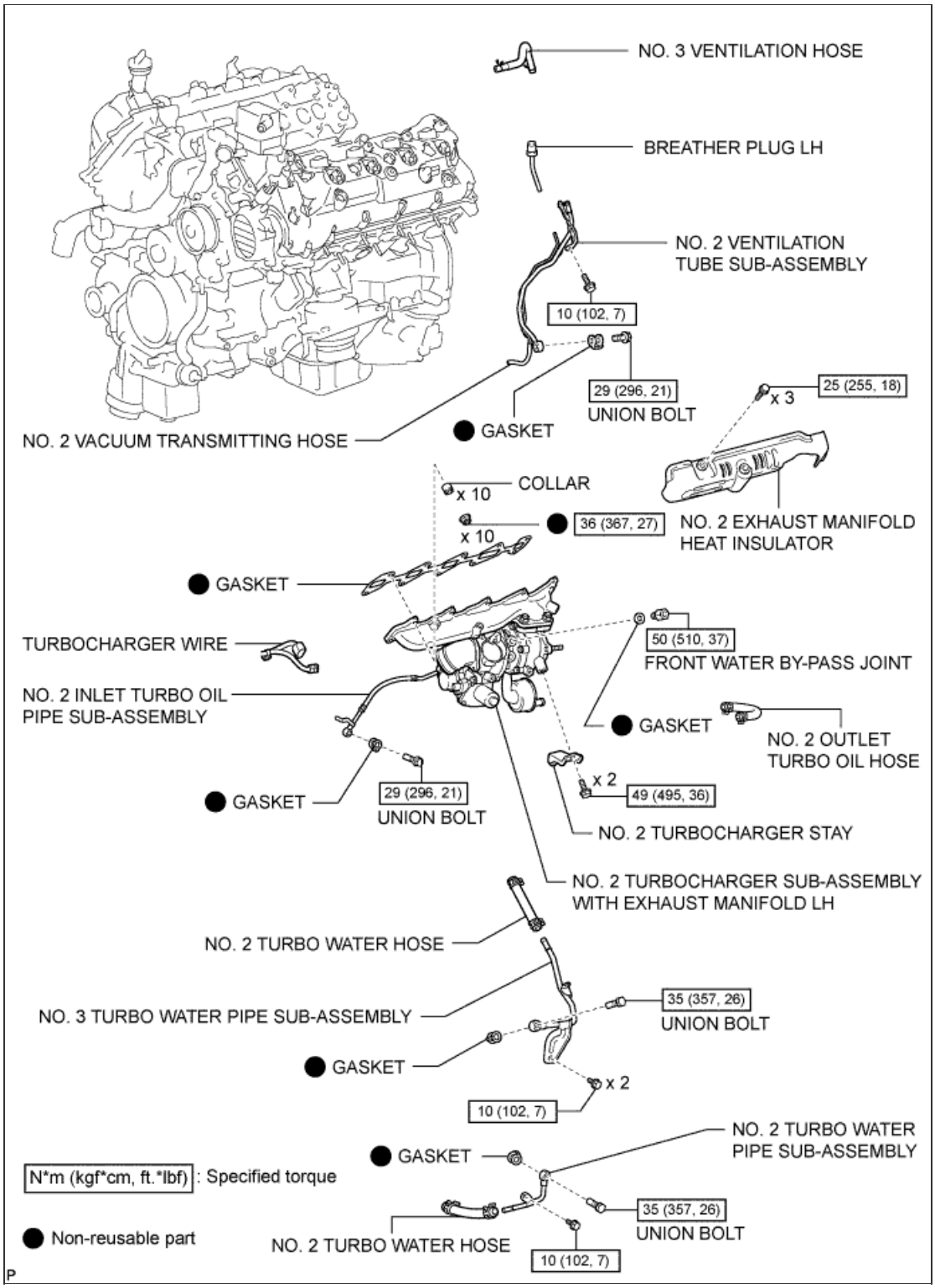
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

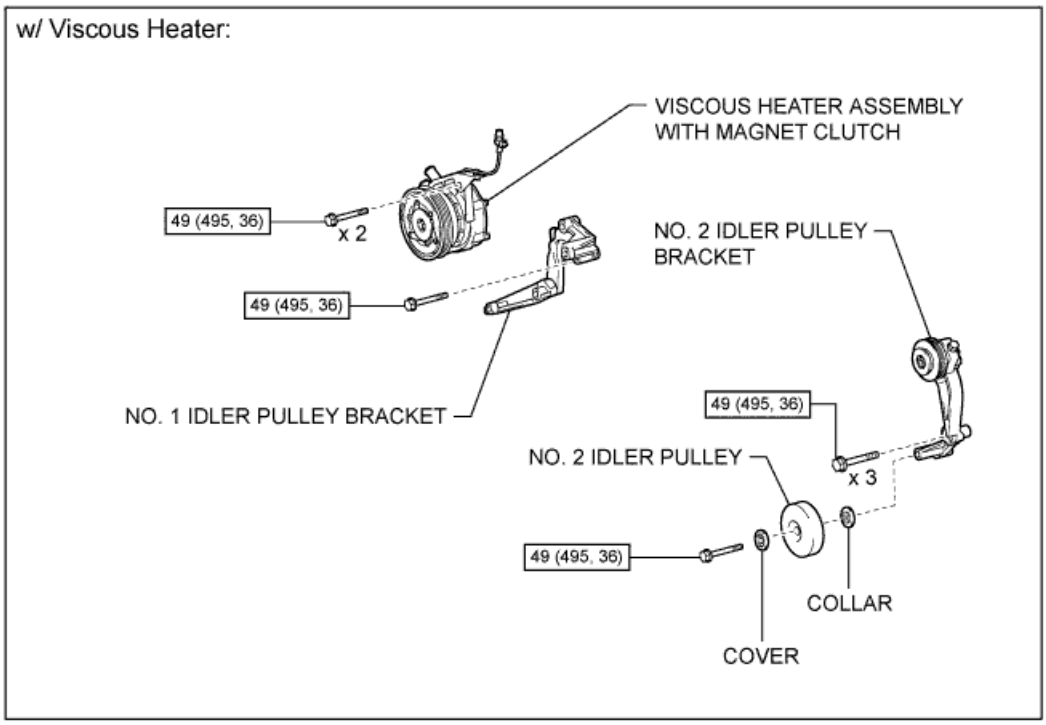

V8 D4D

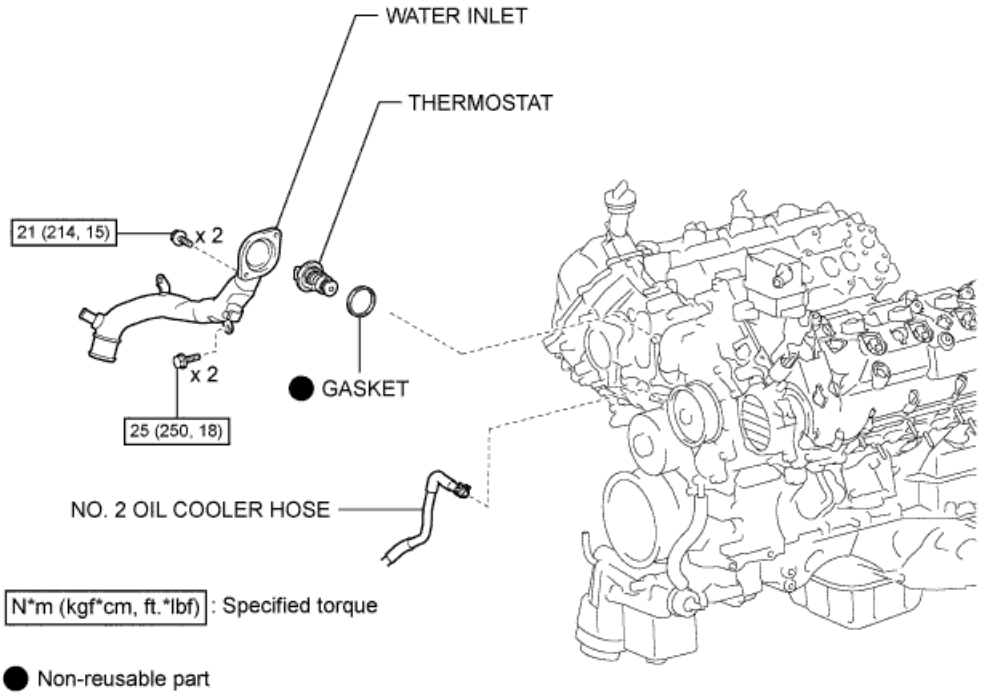
for Preparation Click here




NO. 2 VENTILATION HOSE
BREATHER PLUG RH
10 (102, 7)
NO. 1 VENTILATION TUBE SUB-ASSEMBLY
29 (296, 21)
GASKET
25 (255, 18)
x 3
NO. 1 EXHAUST MANIFOLD HEAT INSULATOR
GASKET
NO. 1 INLET TURBO OIL PIPE SUB-ASSEMBLY
NO. 1 TURBOCHARGER SUB-ASSEMBLY WITH EXHAUST MANIFOLD RH
NO. 1 TURBOCHARGER STAY
49 (495, 36)
x 2
GASKET
29 (296, 21)*1
23 (235, 17)*2
UNION BOLT
NO. 2 TURBO WATER HOSE
COLLAR
x 10
x 10
36 (367, 27)
x 2
10 (102, 7)
NO. 1 ENGINE OIL LEVEL DIPSTICK GUIDE
10 (102, 7)
x 2
GASKET
NO. 1 OUTLET TURBO OIL HOSE
NO. 1 TURBO WATER HOSE
O-RING
x 3
10 (102, 7)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
NO. 1 TURBO WATER PIPE SUB-ASSEMBLY
*1: Case is dry
*2: Case is wet
P

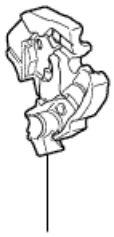
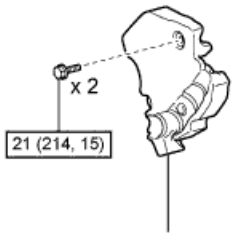

NO. 3 VENTILATION HOSE
BREATHER PLUG LH
NO. 2 VENTILATION TUBE SUB-ASSEMBLY
10 (102, 7)
29 (296, 21)
UNION BOLT
25 (255, 18)
x 3
NO. 2 VACUUM TRANSMITTING HOSE
GASKET
COLLAR
x 10
36 (367, 27)
NO. 2 EXHAUST MANIFOLD HEAT INSULATOR
GASKET
TURBOCHARGER WIRE
50 (510, 37)
FRONT WATER BY-PASS JOINT
NO. 2 INLET TURBO OIL PIPE SUB-ASSEMBLY
GASKET
NO. 2 OUTLET TURBO OIL HOSE
GASKET
29 (296, 21)
UNION BOLT
x 2
49 (495, 36)
NO. 2 TURBOCHARGER STAY
NO. 2 TURBOCHARGER SUB-ASSEMBLY WITH EXHAUST MANIFOLD LH
NO. 2 TURBO WATER HOSE
NO. 3 TURBO WATER PIPE SUB-ASSEMBLY
35 (357, 26)
UNION BOLT
GASKET
x 2
10 (102, 7)
GASKET
NO. 2 TURBO WATER PIPE SUB-ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
35 (357, 26)
UNION BOLT
Non-reusable part
NO. 2 TURBO WATER HOSE
10 (102, 7)
P

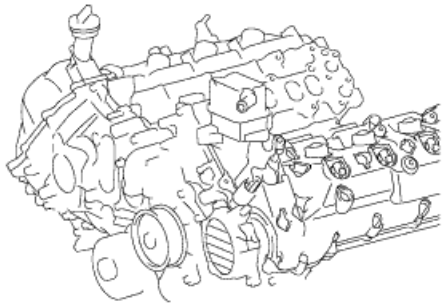

w/ Viscous Heater:
VISCOUS HEATER ASSEMBLY WITH MAGNET CLUTCH
49 (495, 36)
x 2
NO. 2 IDLER PULLEY BRACKET
49 (495, 36)
NO. 1 IDLER PULLEY BRACKET
49 (495, 36)
x 3
NO. 2 IDLER PULLEY
49 (495, 36)
COLLAR
COVER


WATER INLET
THERMOSTAT
21 (214, 15)
x 2
x 2
25 (250, 18)
GASKET
NO. 2 OIL COOLER HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P

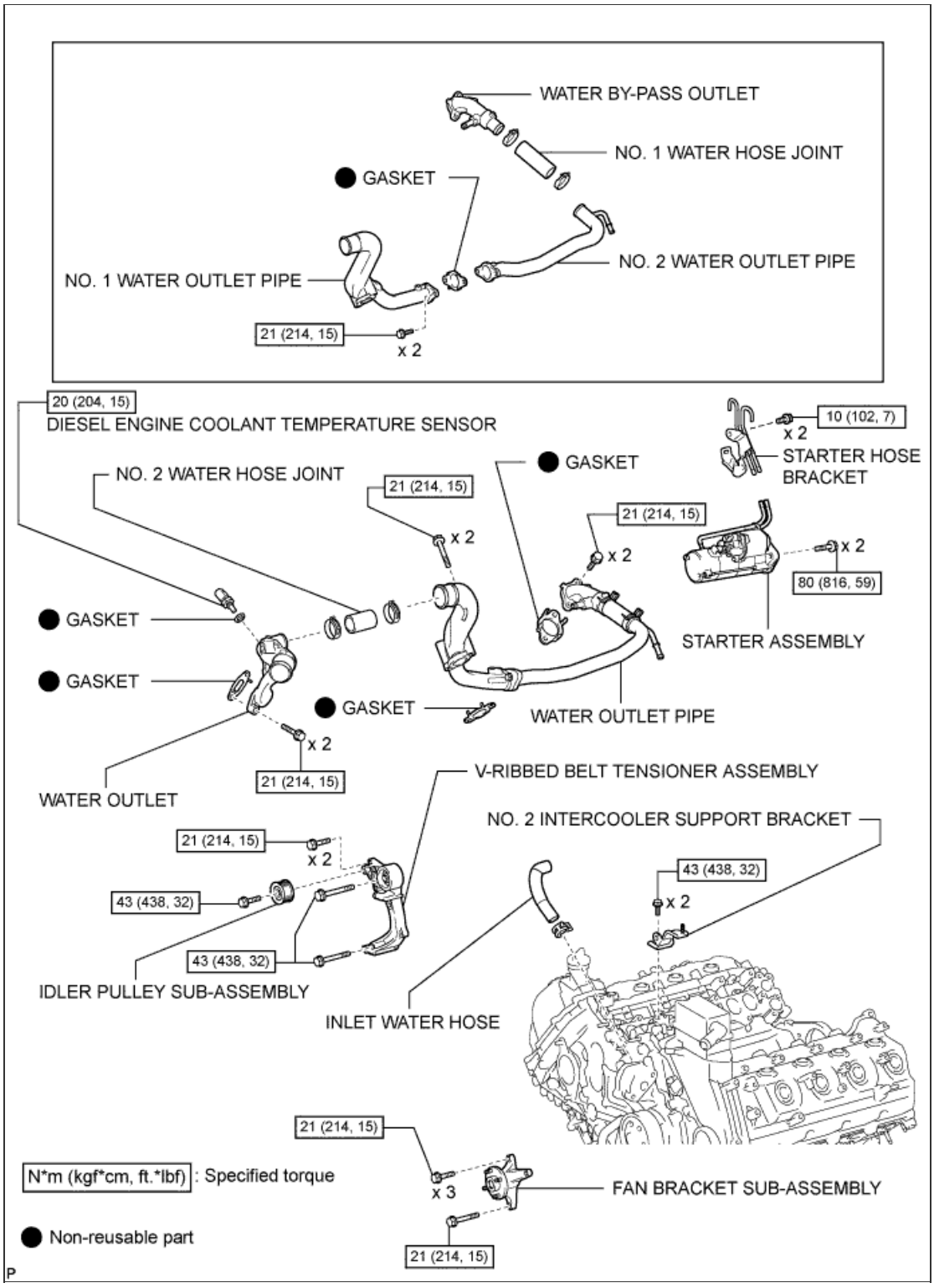
w/ Intercooler:

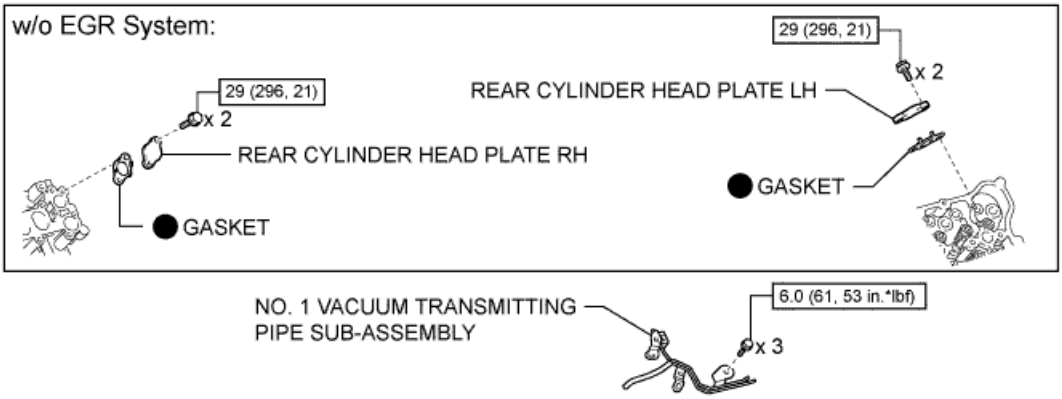
w/ Viscous Heater:	w/o Viscous Heater:
 TIMING GEAR COVER INSULATOR	 TIMING GEAR COVER INSULATOR

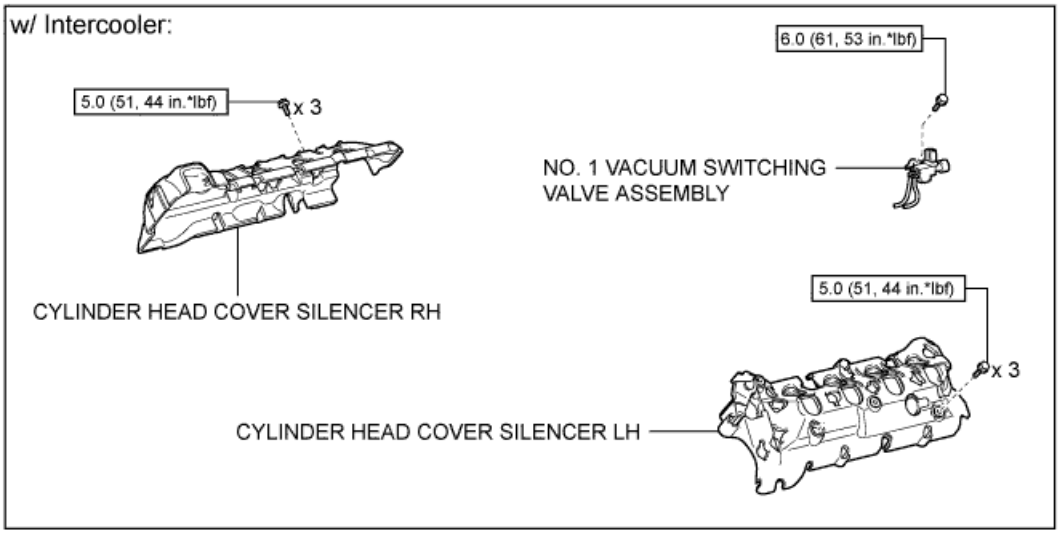


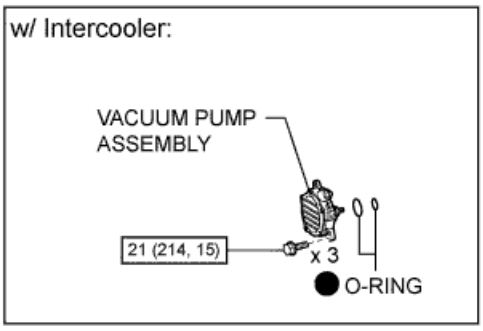
N*m (kgf*cm, ft.*lbf) : Specified torque

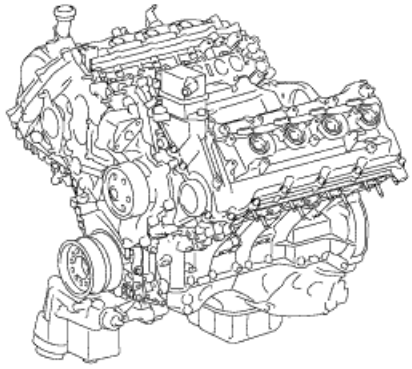
P


WATER BY-PASS OUTLET
NO. 1 WATER HOSE JOINT
GASKET
NO. 2 WATER OUTLET PIPE
NO. 1 WATER OUTLET PIPE
21 (214, 15)
x 2
20 (204, 15)
DIESEL ENGINE COOLANT TEMPERATURE SENSOR
10 (102, 7)
x 2
STARTER HOSE BRACKET
NO. 2 WATER HOSE JOINT
21 (214, 15)
x 2
GASKET
21 (214, 15)
x 2
x 2
80 (816, 59)
GASKET
GASKET
STARTER ASSEMBLY
GASKET
WATER OUTLET PIPE
x 2
21 (214, 15)
WATER OUTLET
V-RIBBED BELT TENSIONER ASSEMBLY
NO. 2 INTERCOOLER SUPPORT BRACKET
21 (214, 15)
x 2
43 (438, 32)
43 (438, 32)
x 2
43 (438, 32)
IDLER PULLEY SUB-ASSEMBLY
INLET WATER HOSE
21 (214, 15)
x 3
FAN BRACKET SUB-ASSEMBLY
21 (214, 15)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P





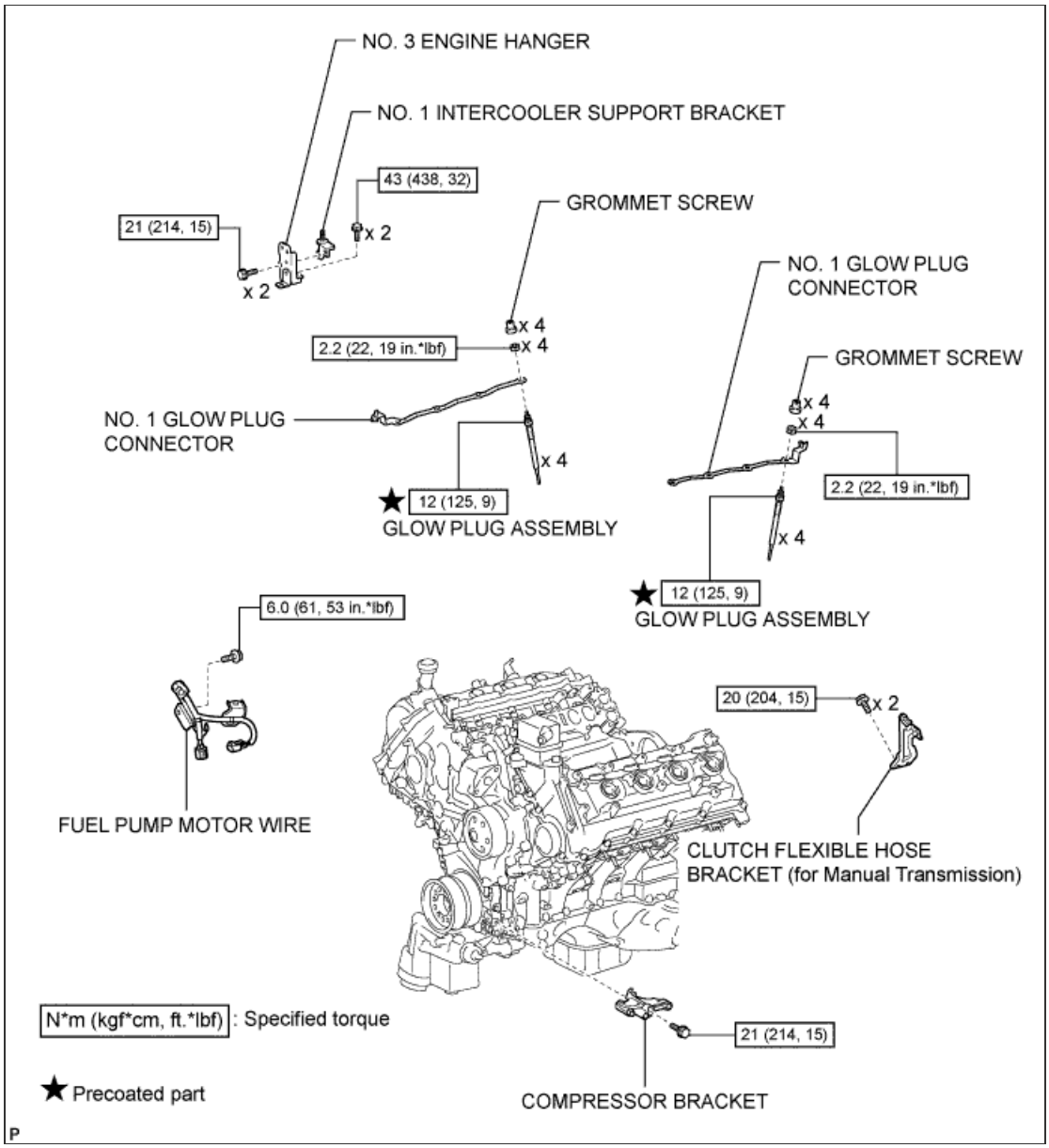


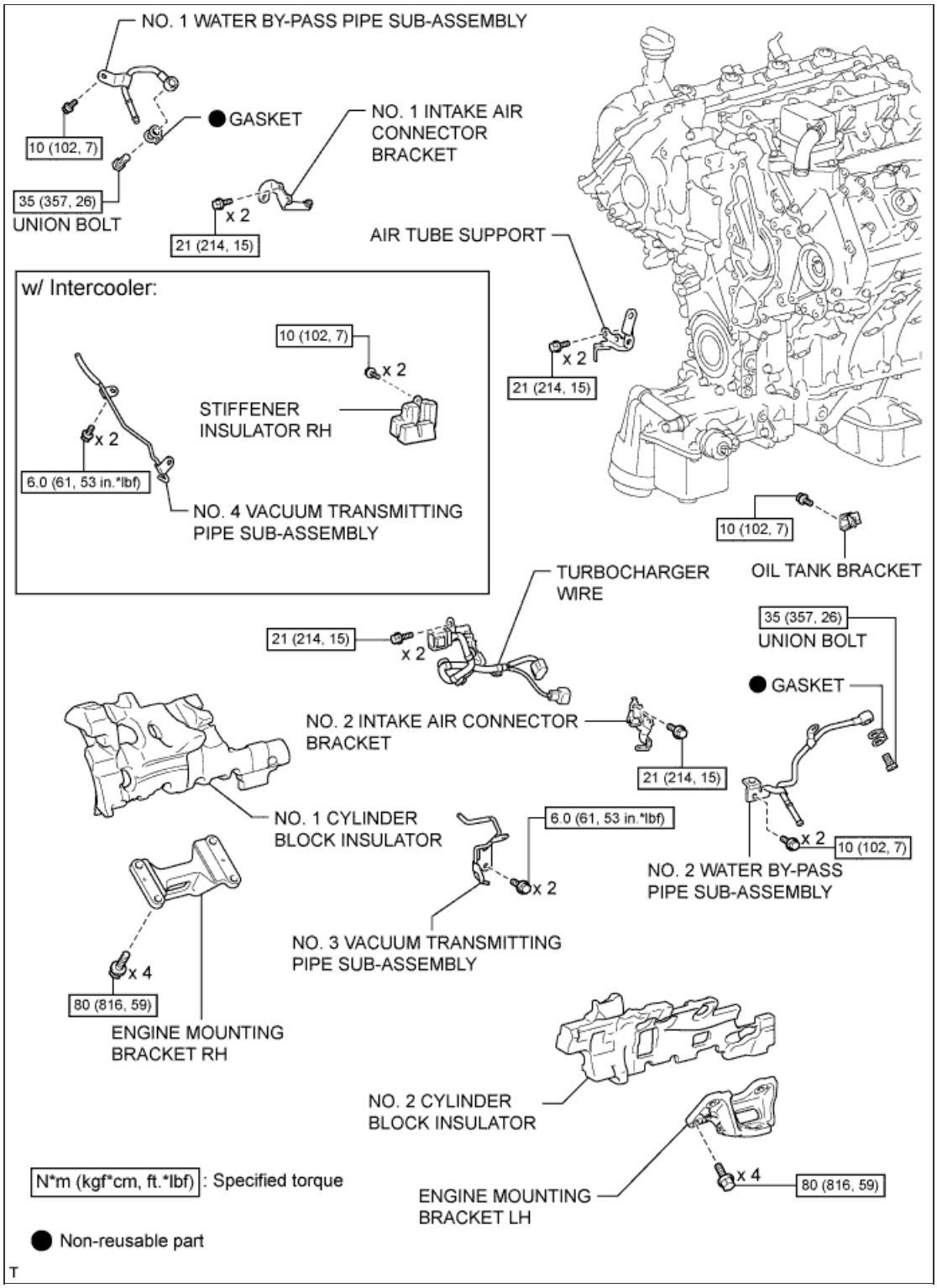


N*m (kgf*cm, ft.*lbf) : Specified torque

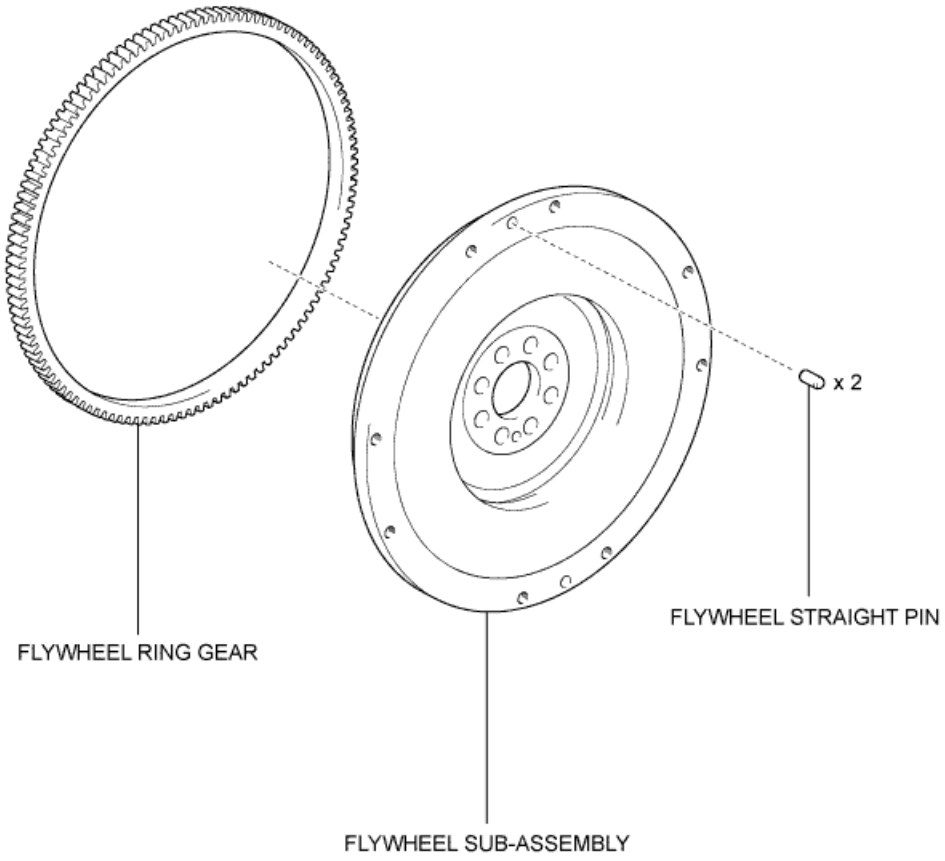
● Non-reusable part

P

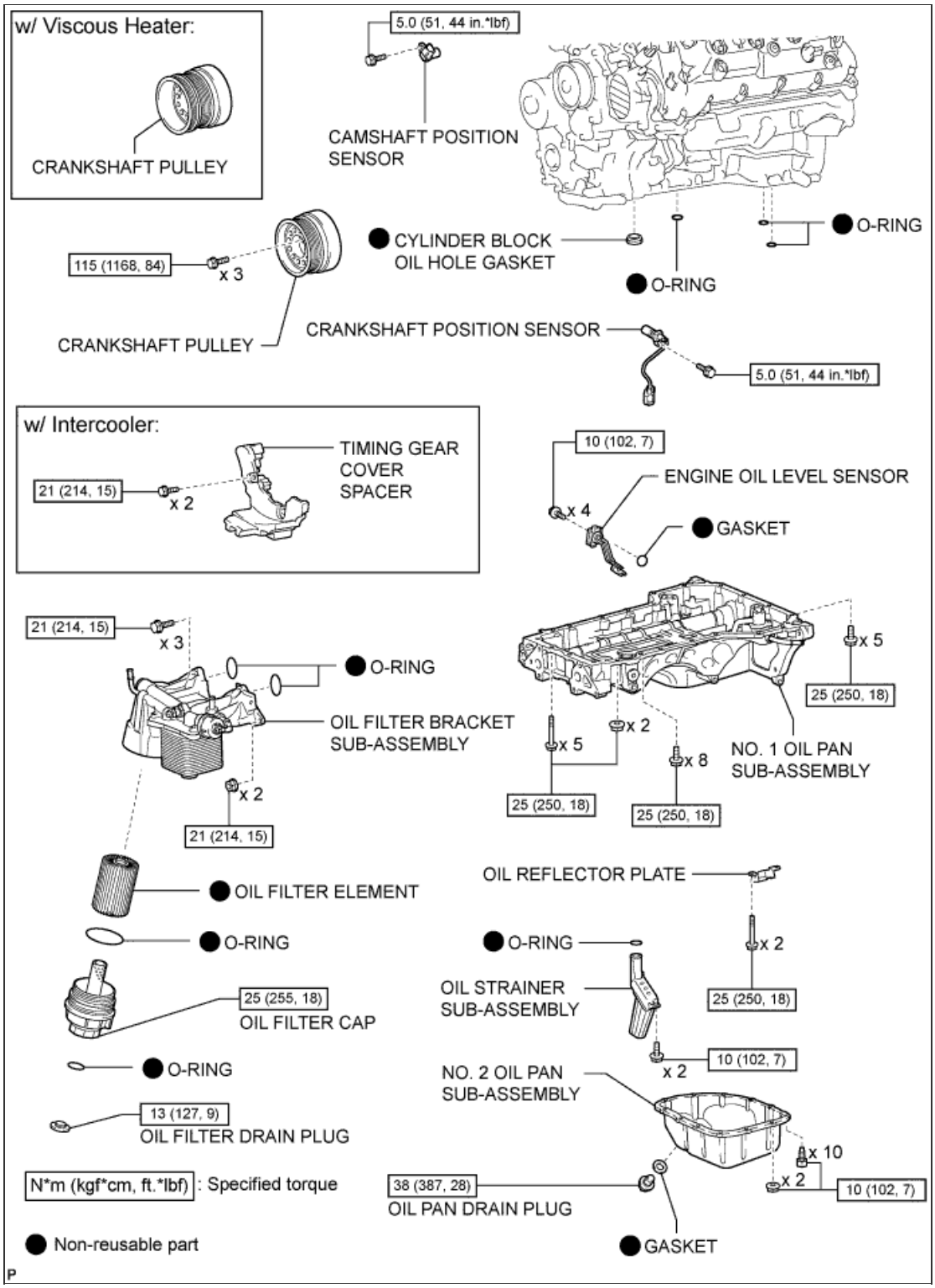

NO. 3 ENGINE HANGER
NO. 1 INTERCOOLER SUPPORT BRACKET
43 (438, 32)
21 (214, 15)
x 2
x 2
GROMMET SCREW
x 4
x 4
2.2 (22, 19 in.*lbf)
NO. 1 GLOW PLUG CONNECTOR
x 4
12 (125, 9)
GLOW PLUG ASSEMBLY
NO. 1 GLOW PLUG CONNECTOR
GROMMET SCREW
x 4
x 4
2.2 (22, 19 in.*lbf)
x 4
12 (125, 9)
GLOW PLUG ASSEMBLY
6.0 (61, 53 in.*lbf)
FUEL PUMP MOTOR WIRE
20 (204, 15)
x 2
CLUTCH FLEXIBLE HOSE BRACKET (for Manual Transmission)
N*m (kgf*cm, ft.*lbf) : Specified torque
Precoated part
21 (214, 15)
COMPRESSOR BRACKET
P

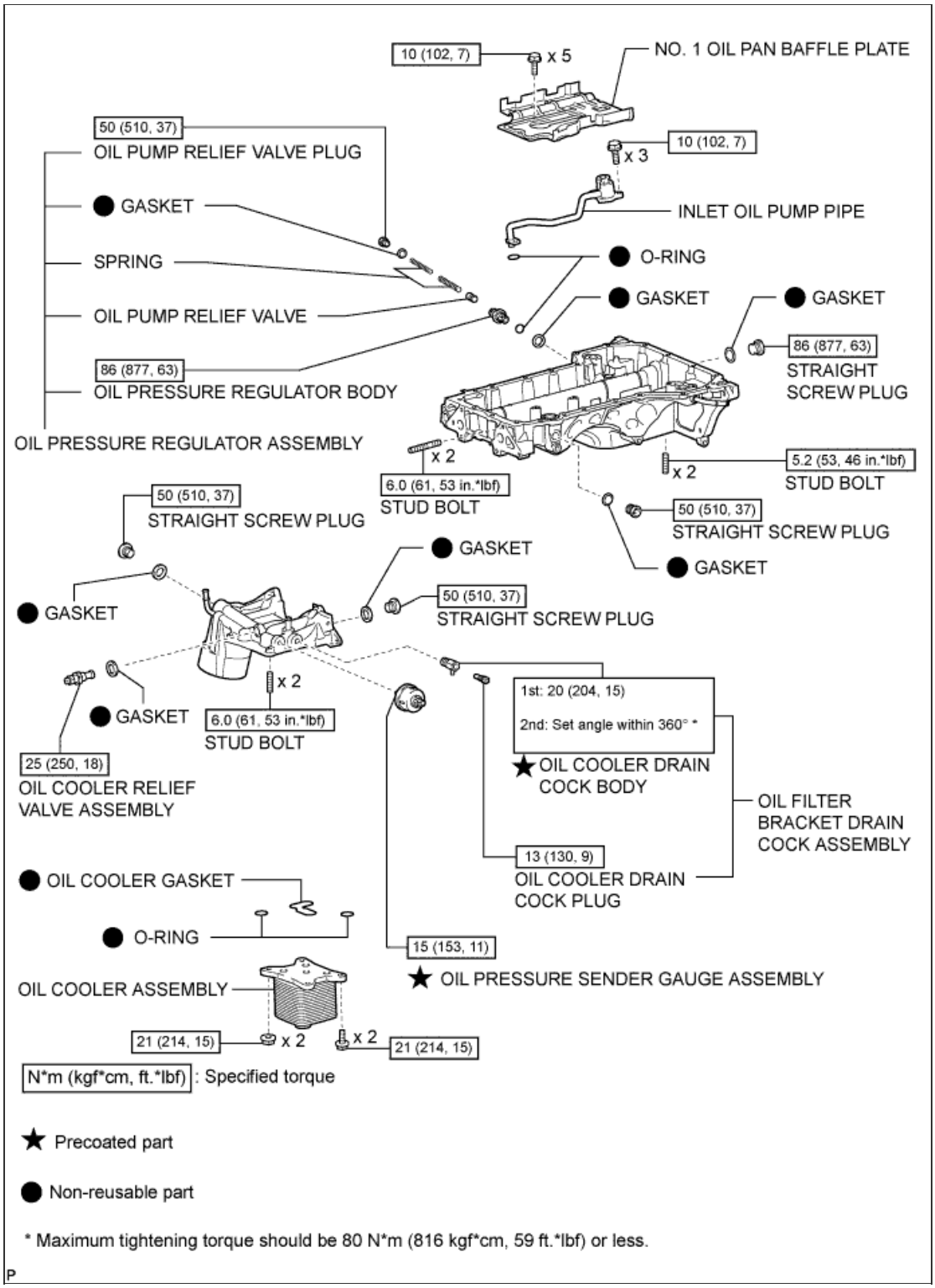

NO. 1 WATER BY-PASS PIPE SUB-ASSEMBLY
GASKET
10 (102, 7)
35 (357, 26)
UNION BOLT
NO. 1 INTAKE AIR CONNECTOR BRACKET
x 2
21 (214, 15)
AIR TUBE SUPPORT
x 2
21 (214, 15)
w/ Intercooler:
10 (102, 7)
x 2
STIFFENER INSULATOR RH
x 2
6.0 (61, 53 in.*lbf)
NO. 4 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY
10 (102, 7)
OIL TANK BRACKET
TURBOCHARGER WIRE
21 (214, 15)
x 2
35 (357, 26)
UNION BOLT
GASKET
NO. 2 INTAKE AIR CONNECTOR BRACKET
21 (214, 15)
NO. 1 CYLINDER BLOCK INSULATOR
6.0 (61, 53 in.*lbf)
x 2
x 2
10 (102, 7)
NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY
NO. 3 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY
x 4
80 (816, 59)
ENGINE MOUNTING BRACKET RH
NO. 2 CYLINDER BLOCK INSULATOR
x 4
80 (816, 59)
ENGINE MOUNTING BRACKET LH
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
T

for Manual Transmission:

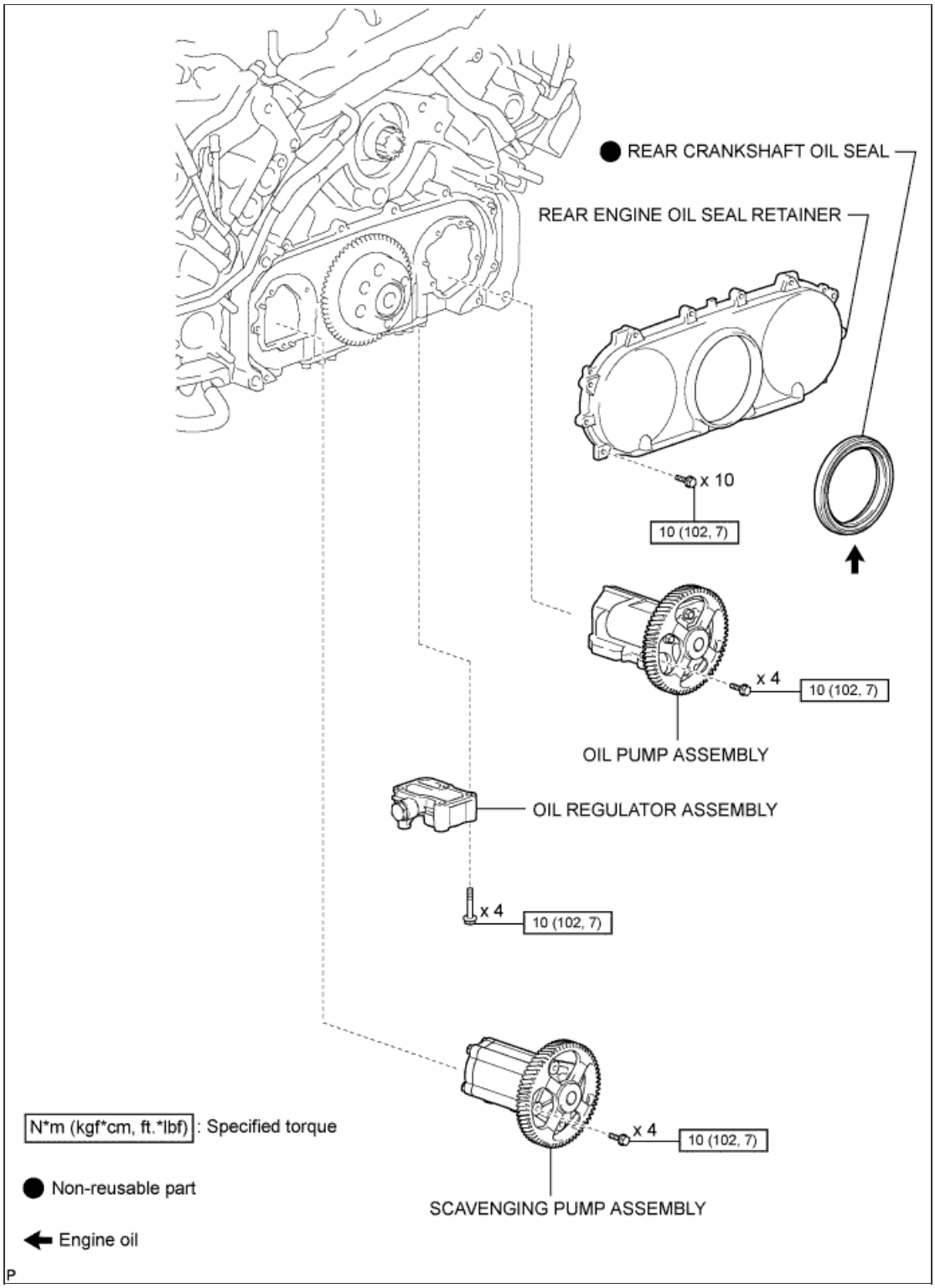


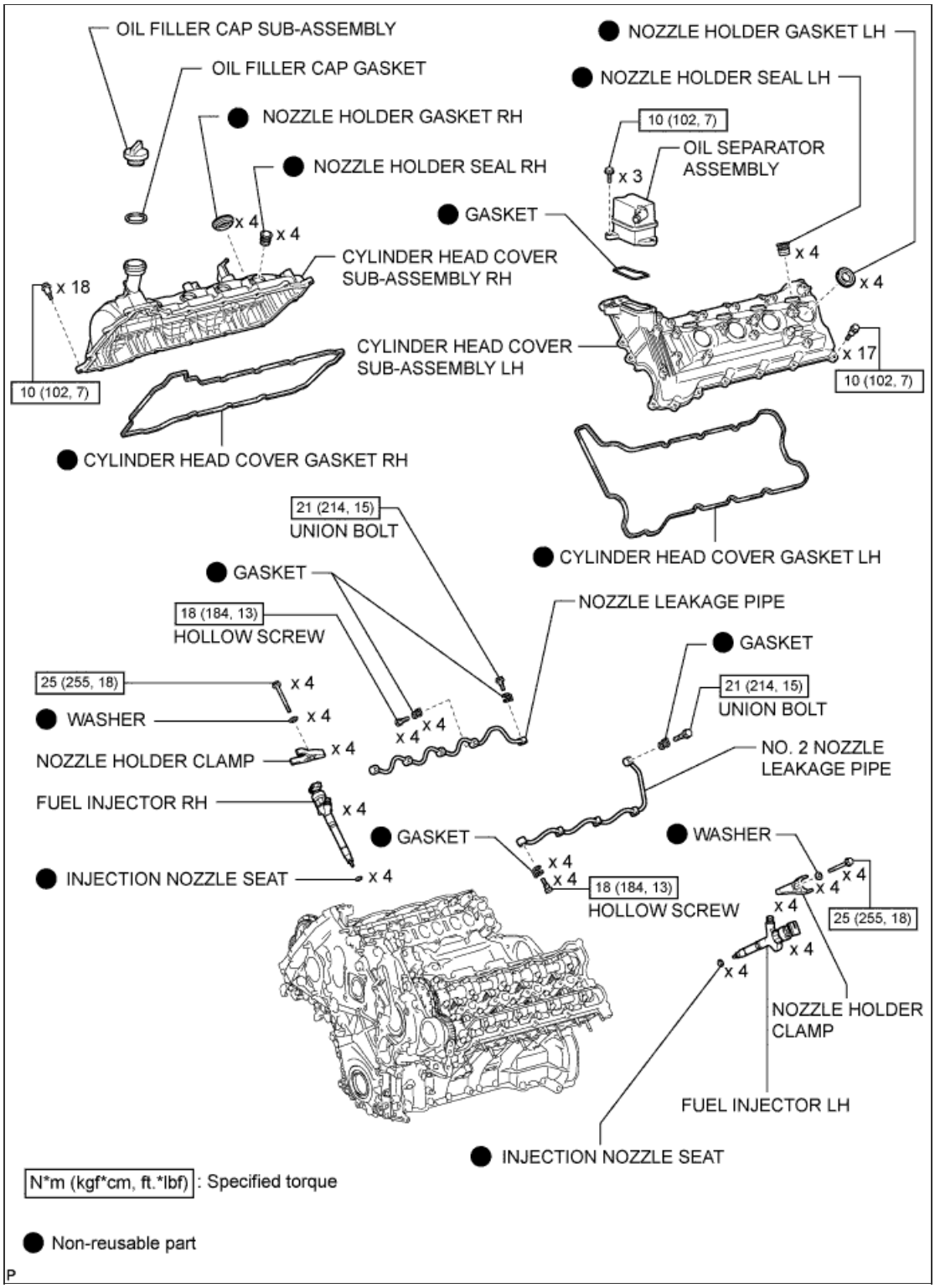
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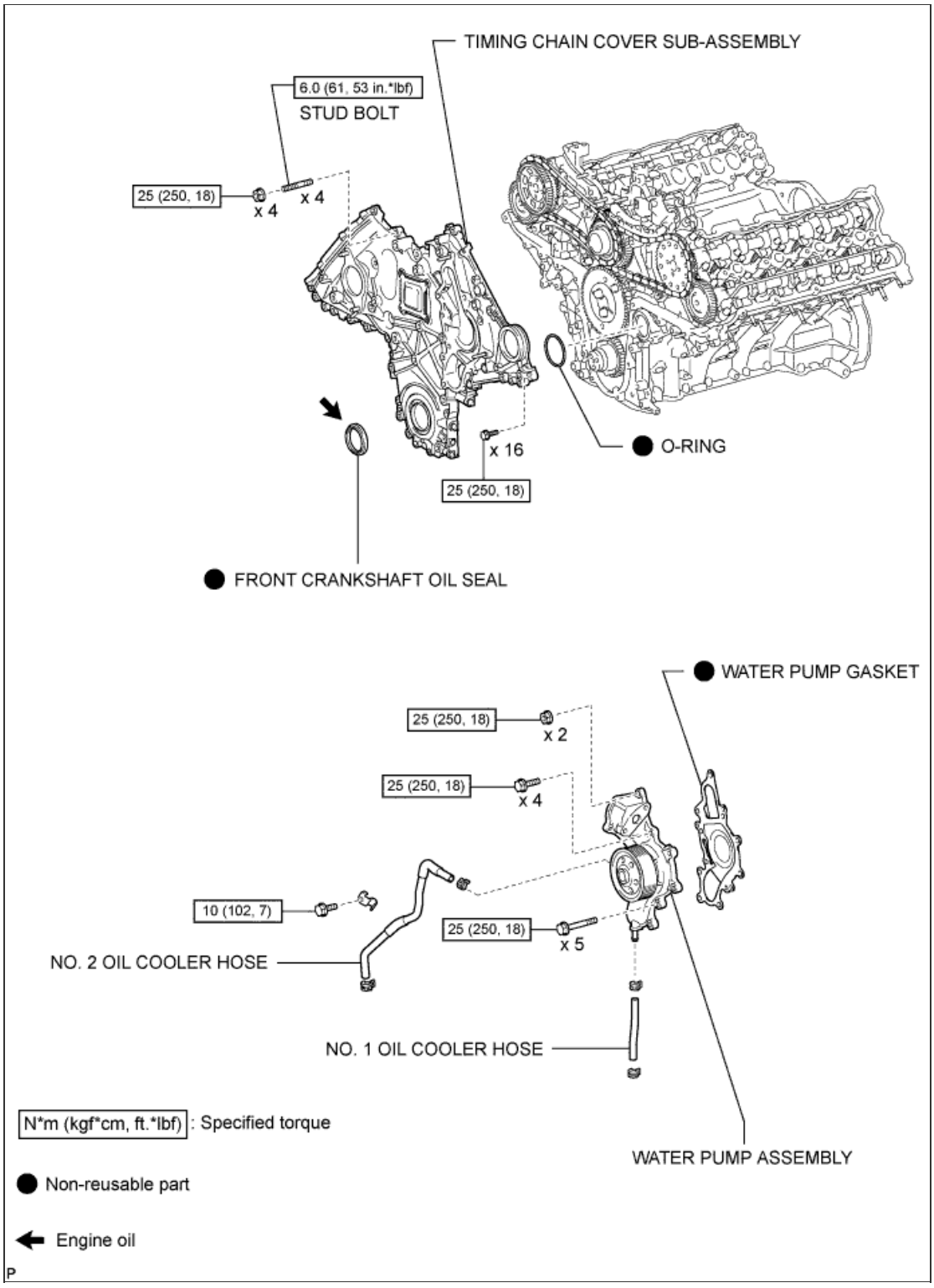

w/ Viscous Heater:
CRANKSHAFT PULLEY
5.0 (51, 44 in.*lbf)
CAMSHAFT POSITION SENSOR
O-RING
CYLINDER BLOCK OIL HOLE GASKET
O-RING
115 (1168, 84)
x 3
CRANKSHAFT PULLEY
CRANKSHAFT POSITION SENSOR
5.0 (51, 44 in.*lbf)
w/ Intercooler:
21 (214, 15)
x 2
TIMING GEAR COVER SPACER
10 (102, 7)
ENGINE OIL LEVEL SENSOR
x 4
GASKET
21 (214, 15)
x 3
O-RING
OIL FILTER BRACKET SUB-ASSEMBLY
x 2
21 (214, 15)
x 5
25 (250, 18)
x 5
x 2
x 8
NO. 1 OIL PAN SUB-ASSEMBLY
25 (250, 18)
25 (250, 18)
OIL FILTER ELEMENT
O-RING
25 (255, 18)
OIL FILTER CAP
O-RING
13 (127, 9)
OIL FILTER DRAIN PLUG
OIL REFLECTOR PLATE
O-RING
x 2
OIL STRAINER SUB-ASSEMBLY
25 (250, 18)
x 2
10 (102, 7)
NO. 2 OIL PAN SUB-ASSEMBLY
x 10
x 2
10 (102, 7)
N*m (kgf*cm, ft.*lbf) : Specified torque
38 (387, 28)
OIL PAN DRAIN PLUG
GASKET
Non-reusable part
P

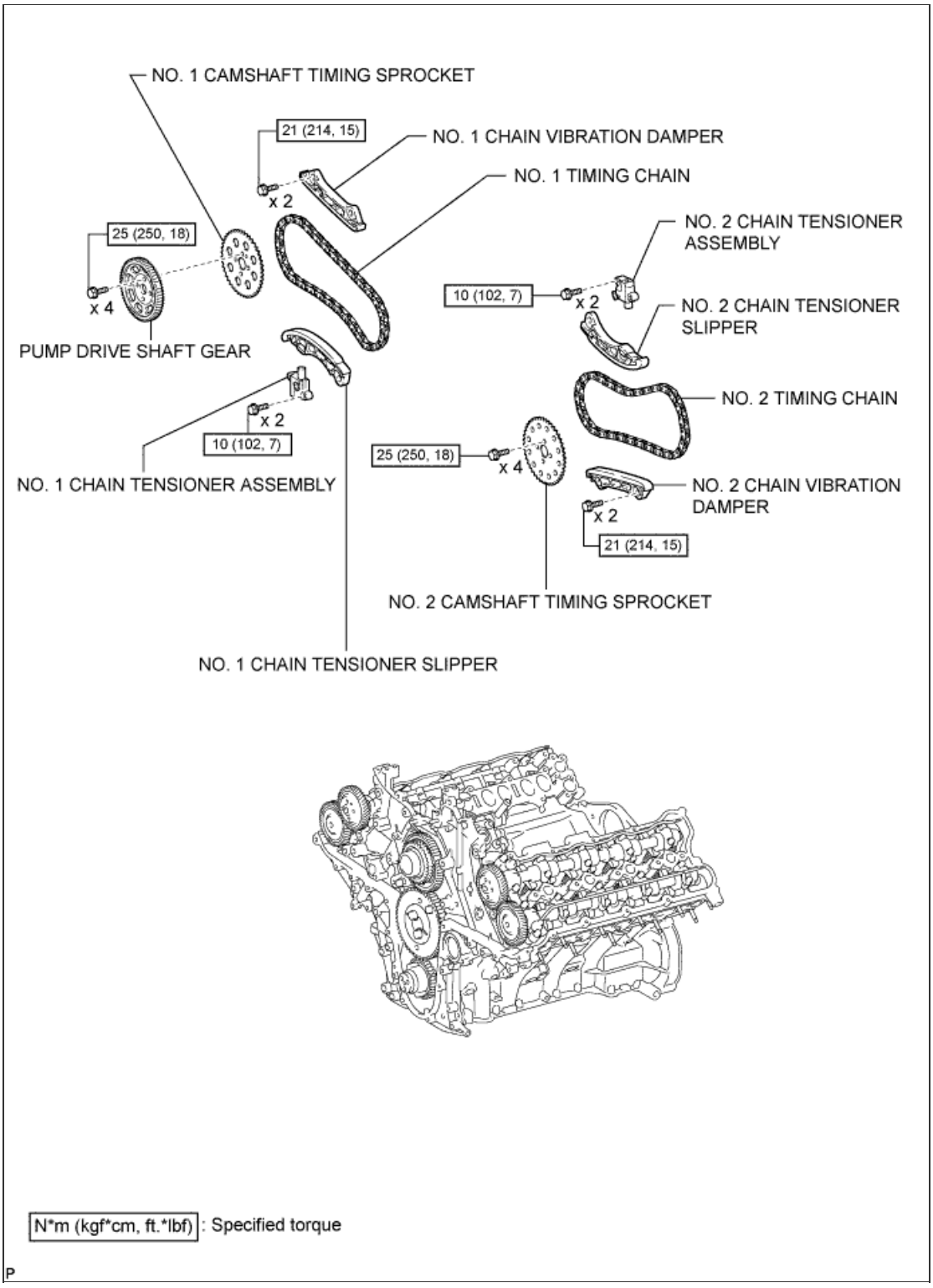

10 (102, 7)
x 5
NO. 1 OIL PAN BAFFLE PLATE
10 (102, 7)
x 3
50 (510, 37)
OIL PUMP RELIEF VALVE PLUG
GASKET
SPRING
OIL PUMP RELIEF VALVE
86 (877, 63)
OIL PRESSURE REGULATOR BODY
OIL PRESSURE REGULATOR ASSEMBLY
INLET OIL PUMP PIPE
O-RING
GASKET
GASKET
86 (877, 63)
STRAIGHT SCREW PLUG
x 2
6.0 (61, 53 in.*lbf)
STUD BOLT
x 2
5.2 (53, 46 in.*lbf)
STUD BOLT
50 (510, 37)
STRAIGHT SCREW PLUG
GASKET
50 (510, 37)
STRAIGHT SCREW PLUG
GASKET
GASKET
50 (510, 37)
STRAIGHT SCREW PLUG
x 2
GASKET
6.0 (61, 53 in.*lbf)
STUD BOLT
25 (250, 18)
OIL COOLER RELIEF VALVE ASSEMBLY
1st: 20 (204, 15)
2nd: Set angle within 360° *
OIL COOLER DRAIN COCK BODY
OIL FILTER BRACKET DRAIN COCK ASSEMBLY
13 (130, 9)
OIL COOLER DRAIN COCK PLUG
OIL COOLER GASKET
O-RING
OIL COOLER ASSEMBLY
15 (153, 11)
OIL PRESSURE SENDER GAUGE ASSEMBLY
21 (214, 15)
x 2
x 2
21 (214, 15)
N*m (kgf*cm, ft.*lbf) : Specified torque
Precoated part
Non-reusable part
* Maximum tightening torque should be 80 N*m (816 kgf*cm, 59 ft.*lbf) or less.

P

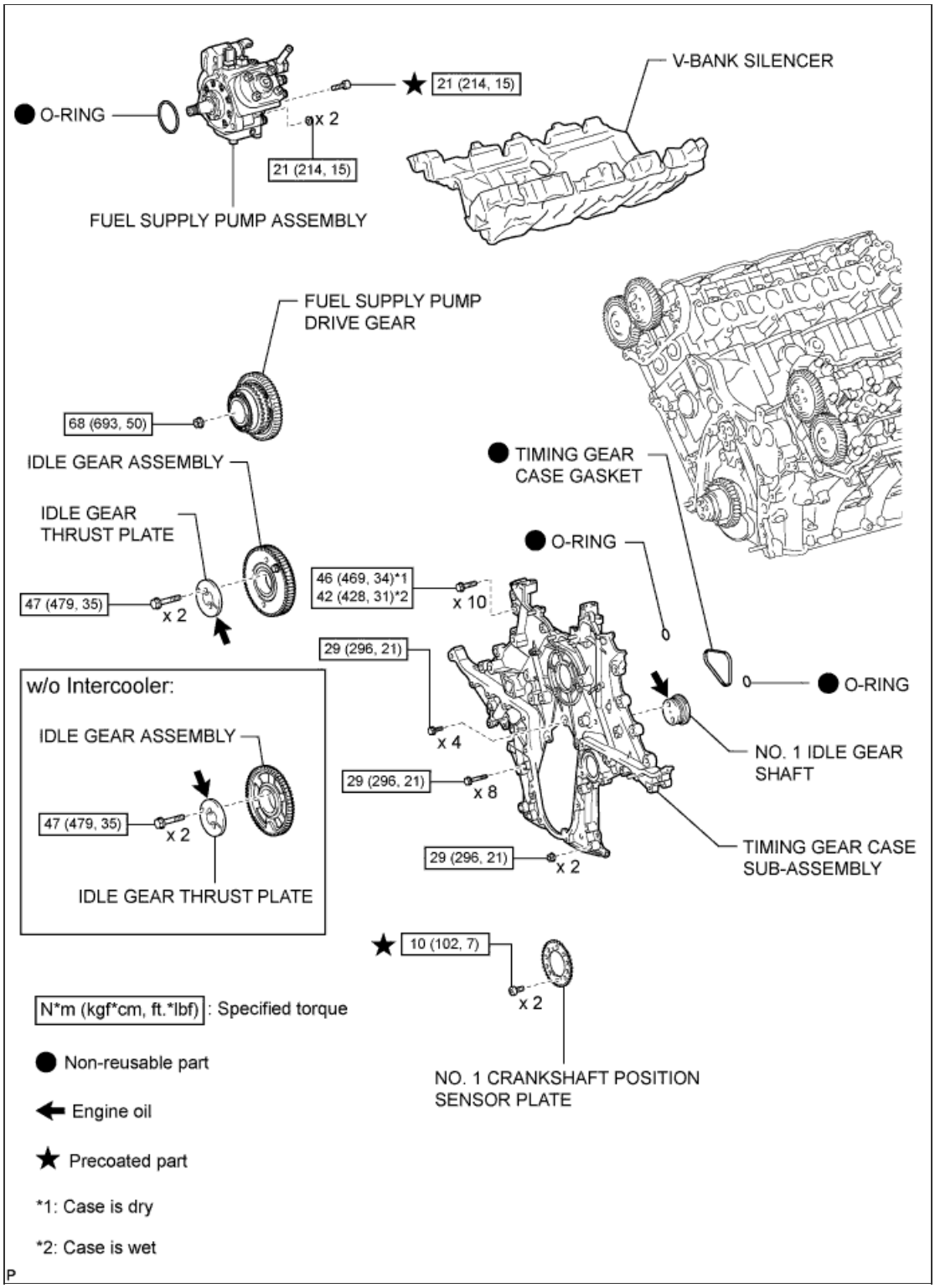

REAR CRANKSHAFT OIL SEAL
REAR ENGINE OIL SEAL RETAINER
x 10
10 (102, 7)
x 4
10 (102, 7)
OIL PUMP ASSEMBLY
OIL REGULATOR ASSEMBLY
x 4
10 (102, 7)
x 4
10 (102, 7)
SCAVENGING PUMP ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
Engine oil
P

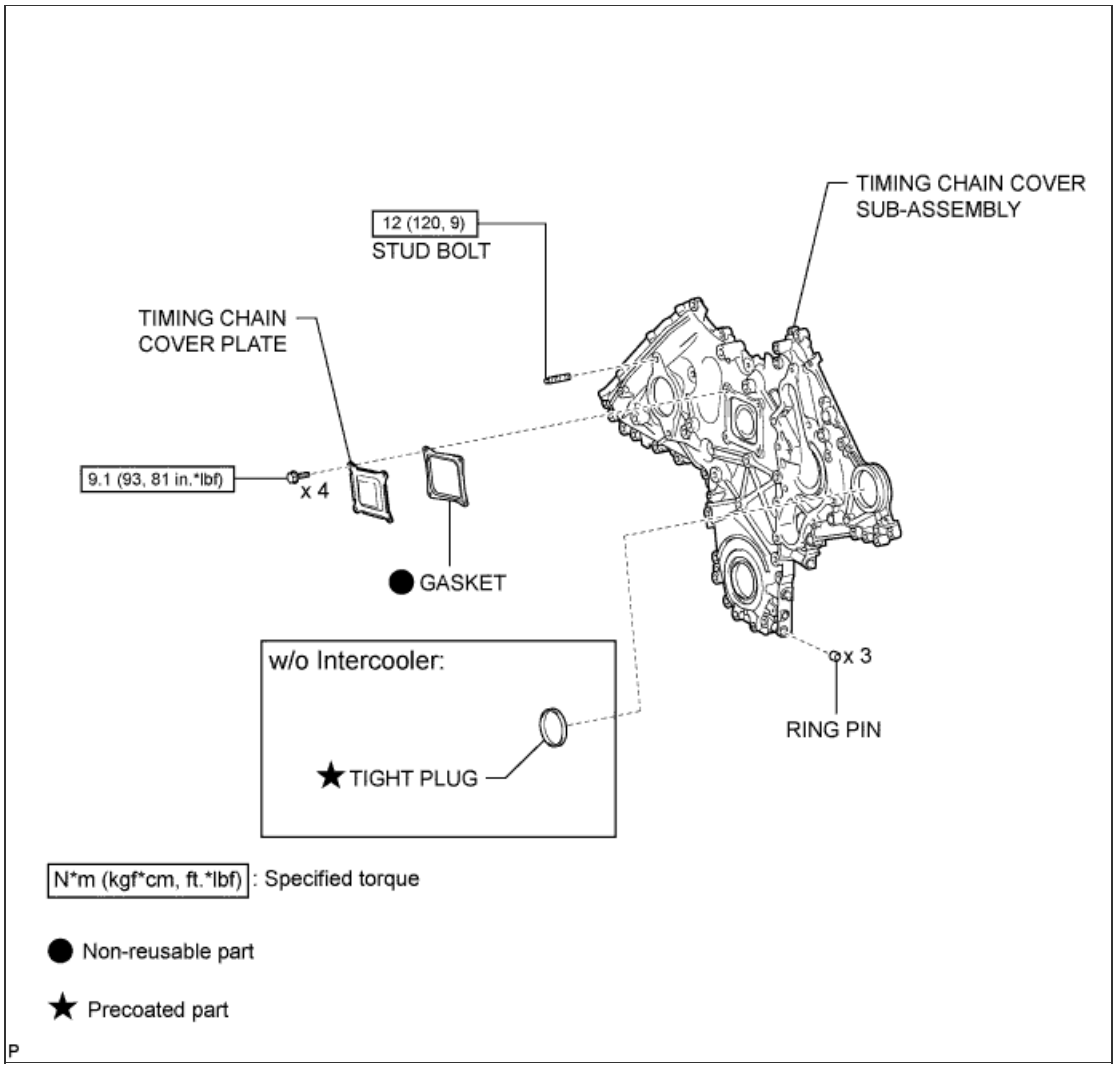

OIL FILLER CAP SUB-ASSEMBLY
OIL FILLER CAP GASKET
NOZZLE HOLDER GASKET RH
NOZZLE HOLDER SEAL RH
x 4
x 4
x 18
CYLINDER HEAD COVER SUB-ASSEMBLY RH
10 (102, 7)
CYLINDER HEAD COVER GASKET RH
NOZZLE HOLDER GASKET LH
NOZZLE HOLDER SEAL LH
10 (102, 7)
OIL SEPARATOR ASSEMBLY
x 3
GASKET
x 4
x 4
CYLINDER HEAD COVER SUB-ASSEMBLY LH
x 17
10 (102, 7)
CYLINDER HEAD COVER GASKET LH
21 (214, 15)
UNION BOLT
GASKET
18 (184, 13)
HOLLOW SCREW
NOZZLE LEAKAGE PIPE
25 (255, 18)
x 4
WASHER
x 4
NOZZLE HOLDER CLAMP
x 4
FUEL INJECTOR RH
x 4
INJECTION NOZZLE SEAT
x 4
x 4
x 4
GASKET
21 (214, 15)
UNION BOLT
NO. 2 NOZZLE LEAKAGE PIPE
GASKET
x 4
x 4
18 (184, 13)
HOLLOW SCREW
WASHER
x 4
x 4
25 (255, 18)
x 4
x 4
x 4
NOZZLE HOLDER CLAMP
FUEL INJECTOR LH
INJECTION NOZZLE SEAT
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P


TIMING CHAIN COVER SUB-ASSEMBLY
6.0 (61, 53 in.*lbf)
STUD BOLT
25 (250, 18)
x 4
x 4
x 16
25 (250, 18)
O-RING
FRONT CRANKSHAFT OIL SEAL
WATER PUMP GASKET
25 (250, 18)
x 2
25 (250, 18)
x 4
10 (102, 7)
25 (250, 18)
x 5
NO. 2 OIL COOLER HOSE
NO. 1 OIL COOLER HOSE
WATER PUMP ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
Engine oil
P

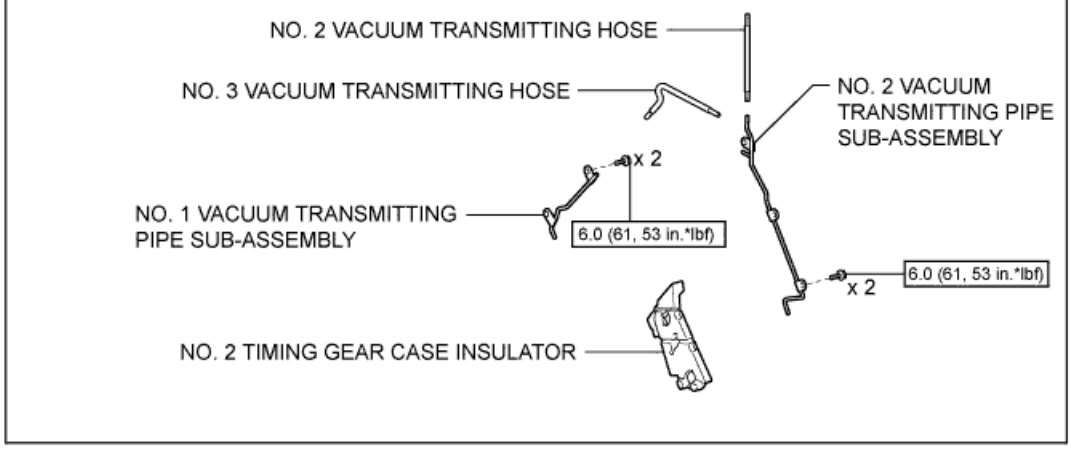

NO. 1 CAMSHAFT TIMING SPROCKET
21 (214, 15)
x 2
NO. 1 CHAIN VIBRATION DAMPER
NO. 1 TIMING CHAIN
25 (250, 18)
x 4
PUMP DRIVE SHAFT GEAR
NO. 2 CHAIN TENSIONER ASSEMBLY
10 (102, 7)
x 2
NO. 2 CHAIN TENSIONER SLIPPER
NO. 2 TIMING CHAIN
x 2
10 (102, 7)
NO. 1 CHAIN TENSIONER ASSEMBLY
25 (250, 18)
x 4
NO. 2 CHAIN VIBRATION DAMPER
x 2
21 (214, 15)
NO. 2 CAMSHAFT TIMING SPROCKET
NO. 1 CHAIN TENSIONER SLIPPER
N*m (kgf*cm, ft.*lbf) : Specified torque

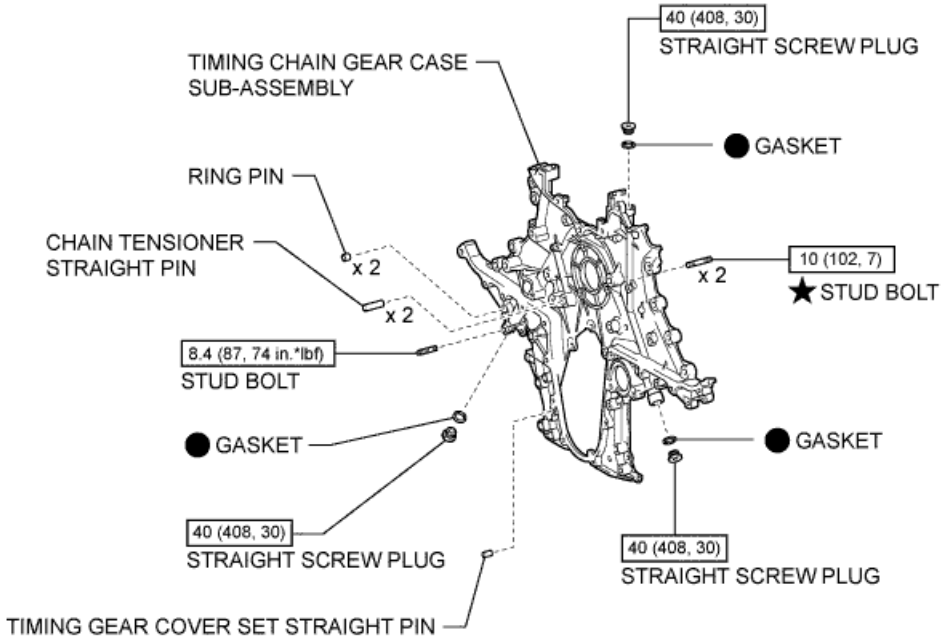
P


O-RING
21 (214, 15)
x 2
21 (214, 15)
FUEL SUPPLY PUMP ASSEMBLY
V-BANK SILENCER
FUEL SUPPLY PUMP DRIVE GEAR
68 (693, 50)
IDLE GEAR ASSEMBLY
IDLE GEAR THRUST PLATE
47 (479, 35)
x 2
TIMING GEAR CASE GASKET
O-RING
46 (469, 34)*1
42 (428, 31)*2
x 10
29 (296, 21)
x 4
29 (296, 21)
x 8
29 (296, 21)
x 2
O-RING
NO. 1 IDLE GEAR SHAFT
TIMING GEAR CASE SUB-ASSEMBLY
w/o Intercooler:
IDLE GEAR ASSEMBLY
47 (479, 35)
x 2
IDLE GEAR THRUST PLATE
10 (102, 7)
x 2
NO. 1 CRANKSHAFT POSITION SENSOR PLATE
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
Engine oil
Precoated part
*1: Case is dry
*2: Case is wet
P


TIMING CHAIN COVER SUB-ASSEMBLY
12 (120, 9)
STUD BOLT
TIMING CHAIN COVER PLATE
9.1 (93, 81 in.*lbf)
x 4
GASKET
w/o Intercooler:
TIGHT PLUG
x 3
RING PIN
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
Precoated part
P

w/ Intercooler:



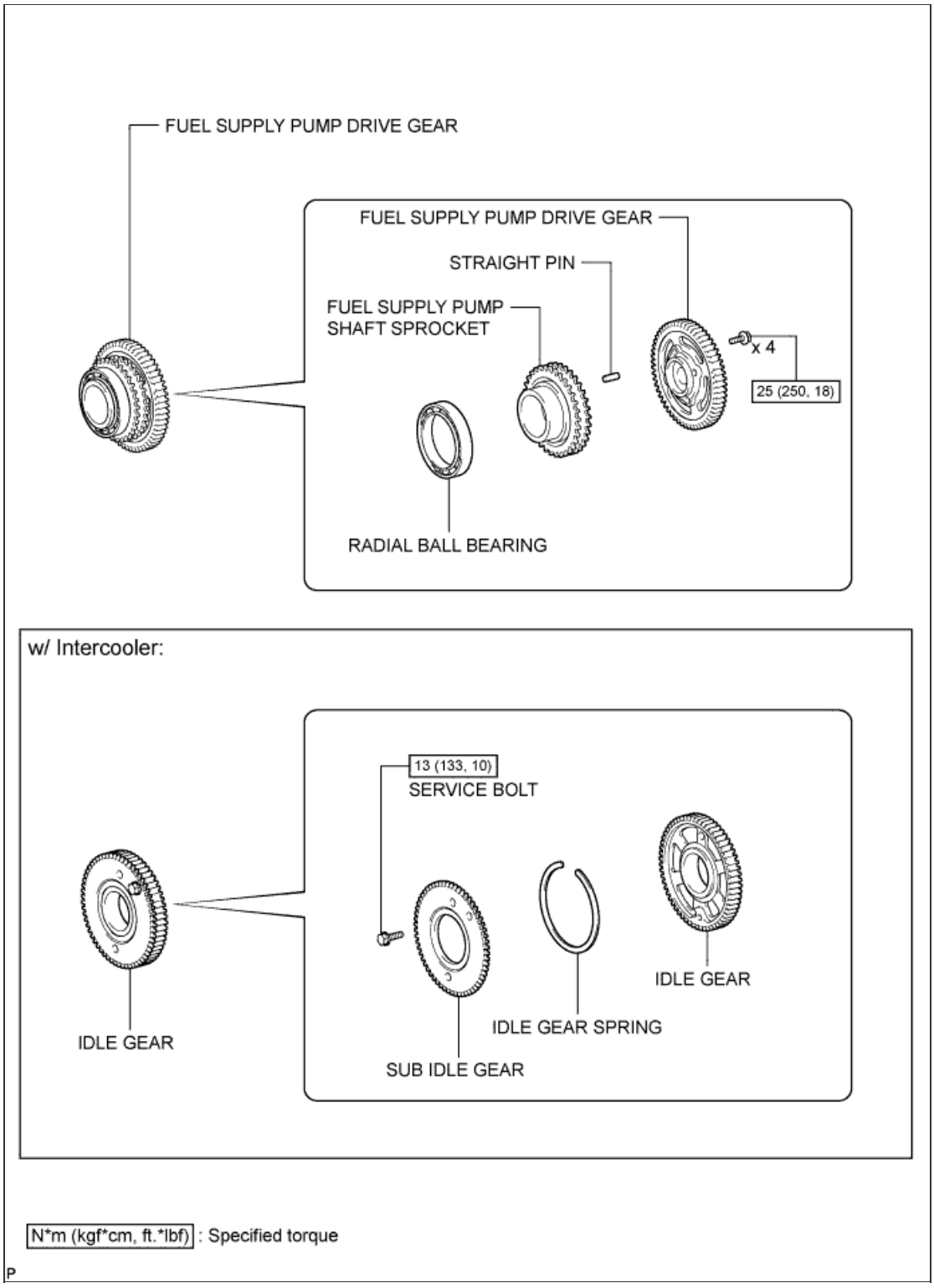


N*m (kgf*cm, ft.*lbf) : Specified torque

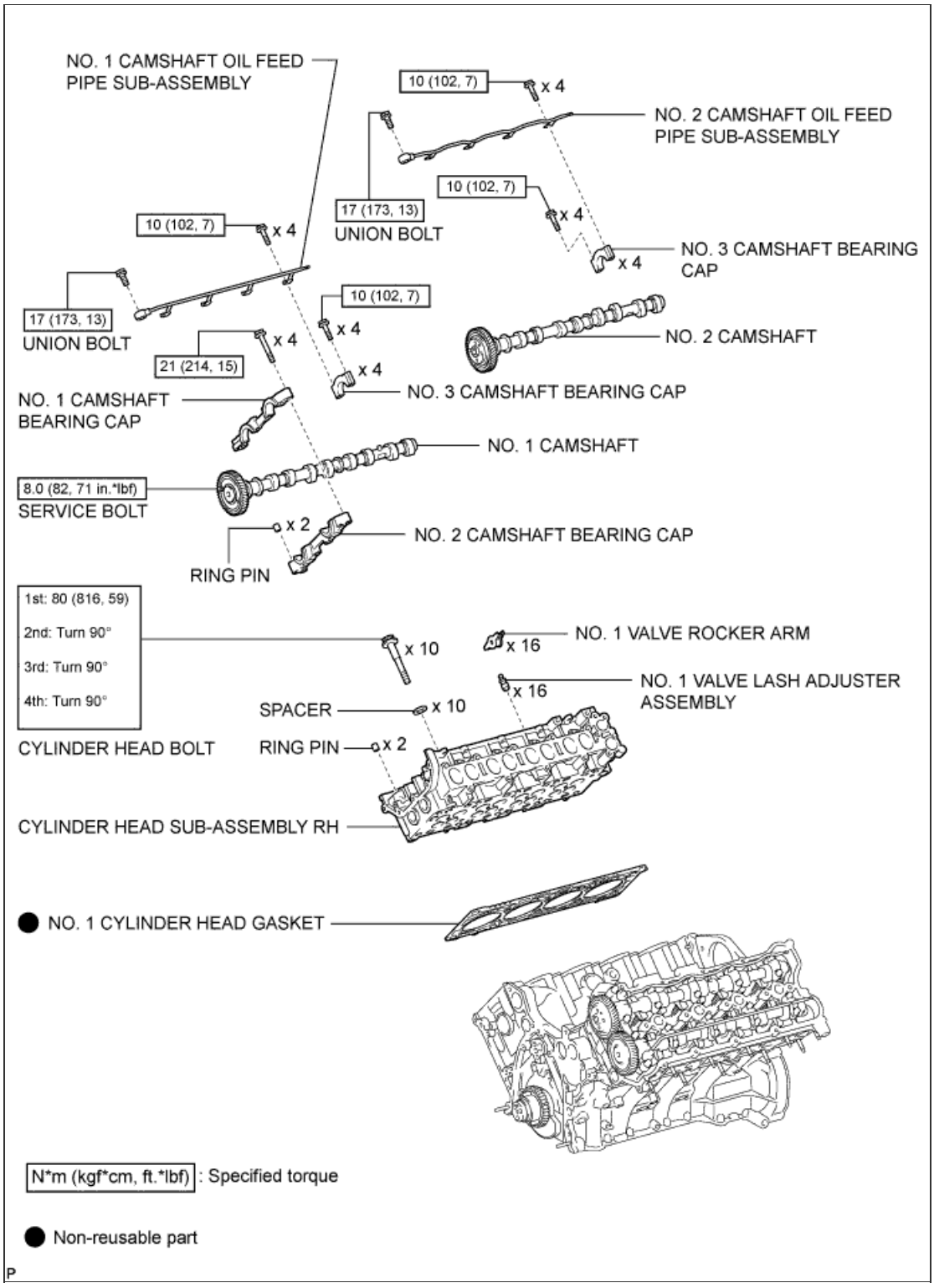
★ Precoated part

● Non-reusable part

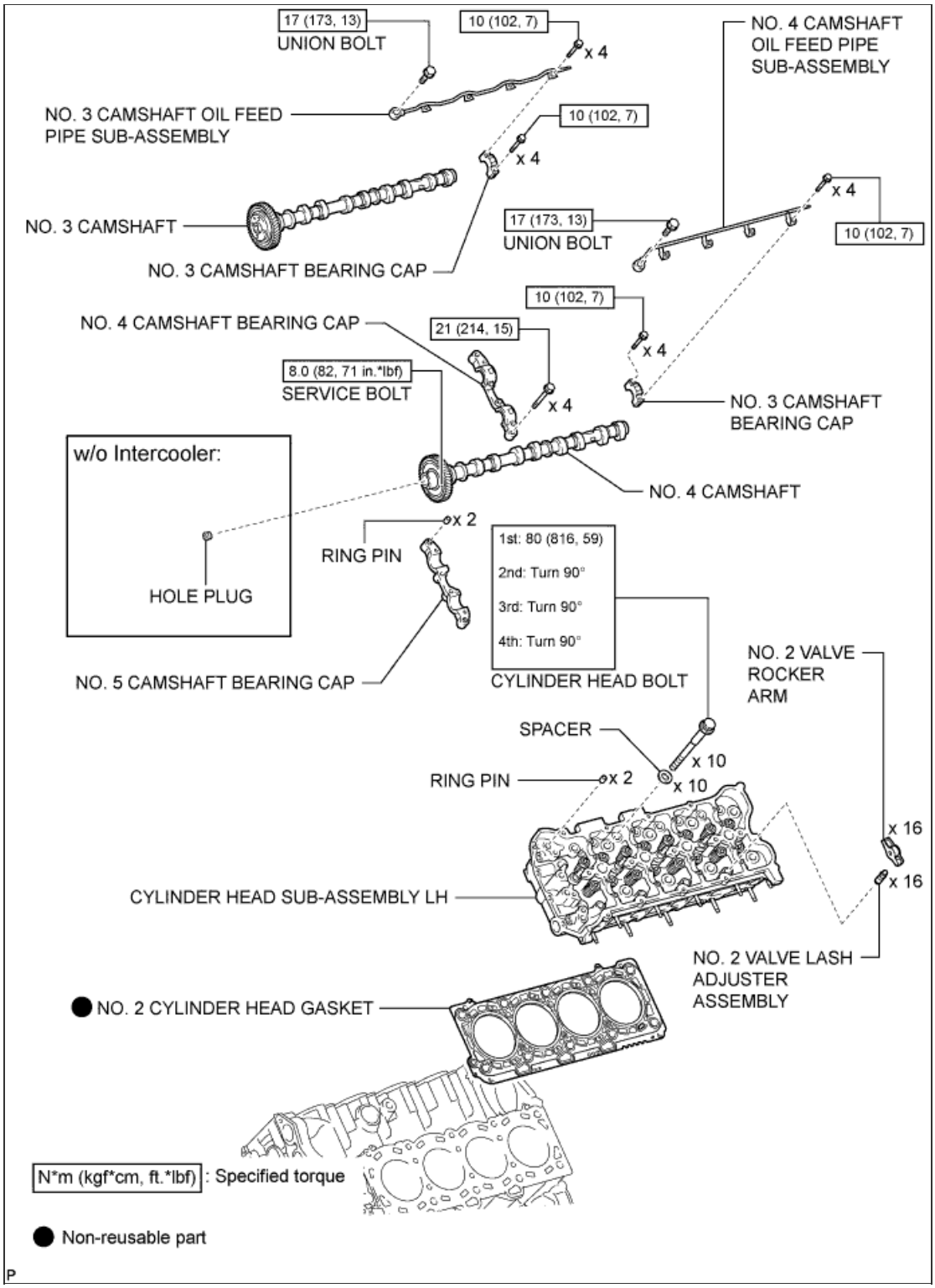
P


FUEL SUPPLY PUMP DRIVE GEAR
FUEL SUPPLY PUMP DRIVE GEAR
STRAIGHT PIN
FUEL SUPPLY PUMP SHAFT SPROCKET
x 4
25 (250, 18)
RADIAL BALL BEARING
w/ Intercooler:
13 (133, 10)
SERVICE BOLT
IDLE GEAR
IDLE GEAR
IDLE GEAR SPRING
SUB IDLE GEAR
N*m (kgf*cm, ft.*lbf) : Specified torque

P


NO. 1 CAMSHAFT OIL FEED PIPE SUB-ASSEMBLY
10 (102, 7)
x 4
NO. 2 CAMSHAFT OIL FEED PIPE SUB-ASSEMBLY
17 (173, 13)
UNION BOLT
10 (102, 7)
x 4
NO. 3 CAMSHAFT BEARING CAP
x 4
10 (102, 7)
x 4
17 (173, 13)
UNION BOLT
10 (102, 7)
x 4
NO. 2 CAMSHAFT
21 (214, 15)
x 4
x 4
NO. 3 CAMSHAFT BEARING CAP
NO. 1 CAMSHAFT BEARING CAP
NO. 1 CAMSHAFT
8.0 (82, 71 in.*lbf)
SERVICE BOLT
x 2
NO. 2 CAMSHAFT BEARING CAP
RING PIN
1st: 80 (816, 59)
2nd: Turn 90°
3rd: Turn 90°
4th: Turn 90°
x 10
CYLINDER HEAD BOLT
x 16
NO. 1 VALVE ROCKER ARM
x 16
NO. 1 VALVE LASH ADJUSTER ASSEMBLY
SPACER
x 10
RING PIN
x 2
CYLINDER HEAD SUB-ASSEMBLY RH
NO. 1 CYLINDER HEAD GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P

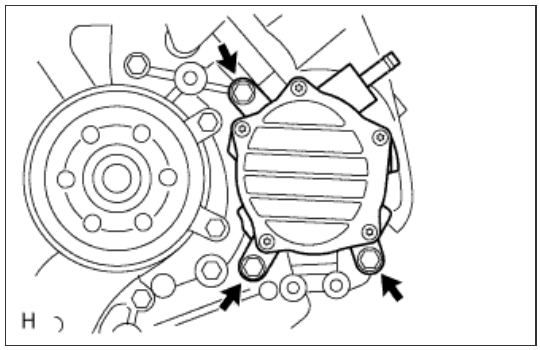

17 (173, 13)
UNION BOLT
10 (102, 7)
x 4
NO. 4 CAMSHAFT OIL FEED PIPE SUB-ASSEMBLY
NO. 3 CAMSHAFT OIL FEED PIPE SUB-ASSEMBLY
10 (102, 7)
x 4
NO. 3 CAMSHAFT
NO. 3 CAMSHAFT BEARING CAP
17 (173, 13)
UNION BOLT
x 4
10 (102, 7)
10 (102, 7)
x 4
NO. 4 CAMSHAFT BEARING CAP
21 (214, 15)
8.0 (82, 71 in.*lbf)
SERVICE BOLT
x 4
NO. 3 CAMSHAFT BEARING CAP
w/o Intercooler:
HOLE PLUG
NO. 4 CAMSHAFT
x 2
RING PIN
1st: 80 (816, 59)
2nd: Turn 90°
3rd: Turn 90°
4th: Turn 90°
CYLINDER HEAD BOLT
NO. 5 CAMSHAFT BEARING CAP
NO. 2 VALVE ROCKER ARM
SPACER
x 10
x 10
RING PIN
x 2
x 16
x 16
CYLINDER HEAD SUB-ASSEMBLY LH
NO. 2 VALVE LASH ADJUSTER ASSEMBLY
NO. 2 CYLINDER HEAD GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

for Preparation Click here

1. REMOVE VACUUM PUMP ASSEMBLY (w/ Intercooler)

a. Remove the 3 bolts and vacuum pump.

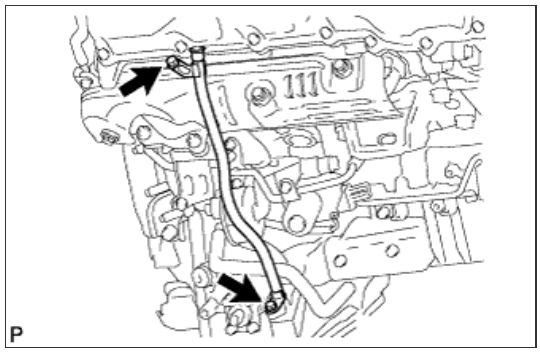
b. Remove the O s.



2. REMOVE NO. 1 ENGINE OIL LEVEL DIPSTICK GUIDE

a. Remove the bolts and No. 1 engine oil level dipstick guide.

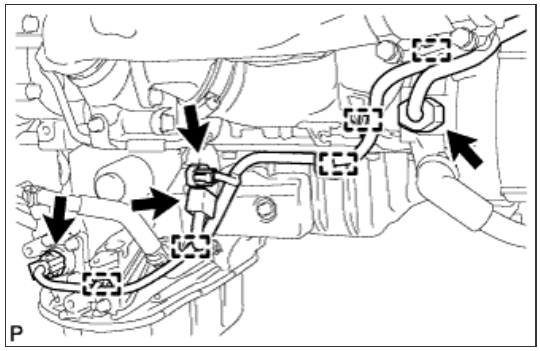
b. Remove the O f om the No. 1 engine oil level dipstick.



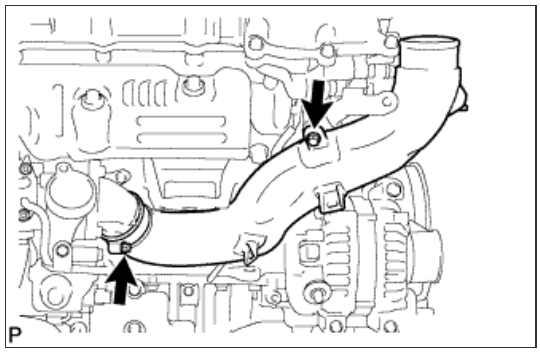
3. REMOVE NO. 1 INTAKE AIR CONNECTOR PIPE

a. Remove the 4 connecto s.

b. Using a clip emove detach the 5 wi e ha ess clamps.

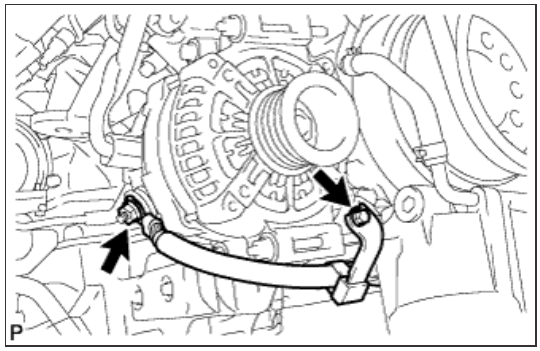


c. Loosen the hose clamp, and emove the bolt and No. 1 intake ai connecto e.

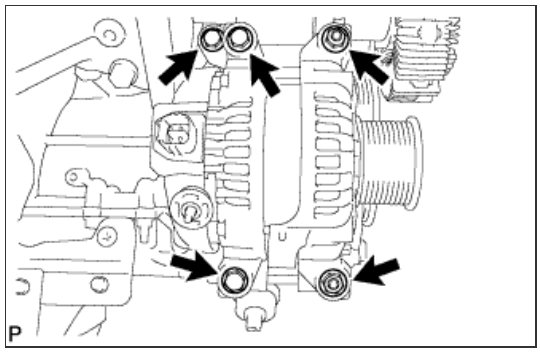


4. REMOVE GENERATOR ASSEMBLY

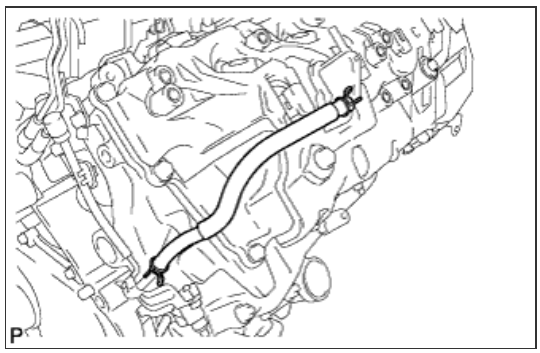
a. Remove the nut and bolt, and disconnect the gene to positive (cable.



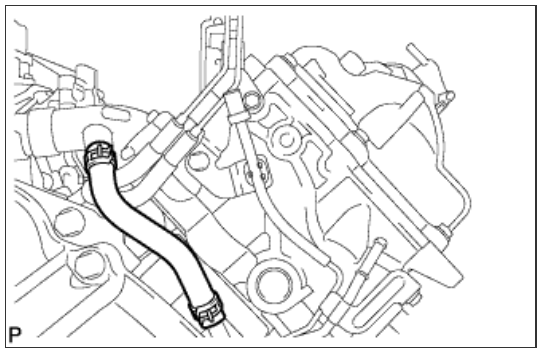
b. Remove the 3 bolts, nuts and gene to



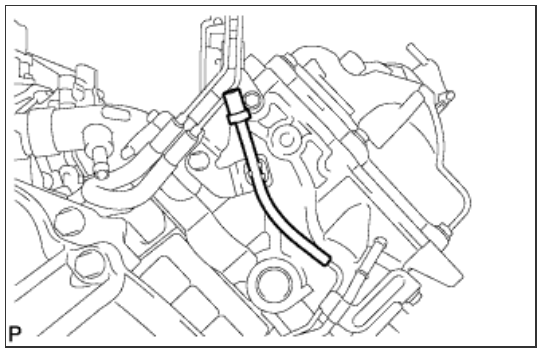
5. DISCONNECT NO. 2 VENTILATION HOSE



6. DISCONNECT NO. 2 TURBO WATER HOSE

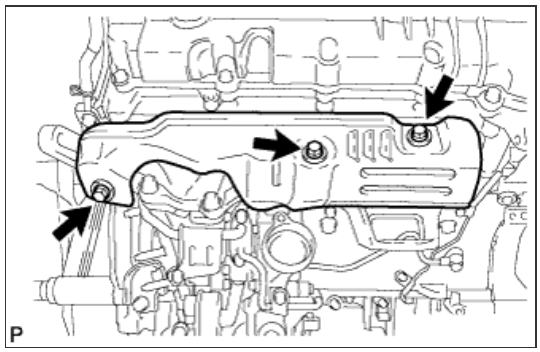


7. DISCONNECT BREATHER PLUG RH

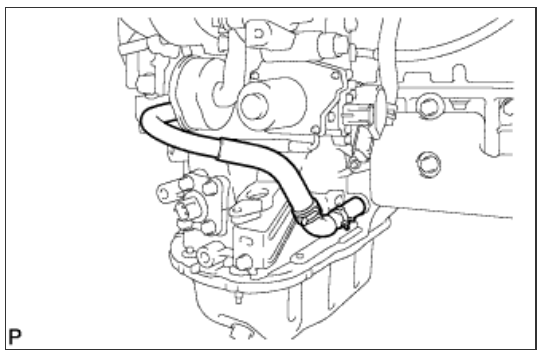


8. REMOVE NO. 1 EXHAUST MANIFOLD HEAT INSULATOR

a. Remove the 3 bolts and No. 1 exhaust manifold heat insulato



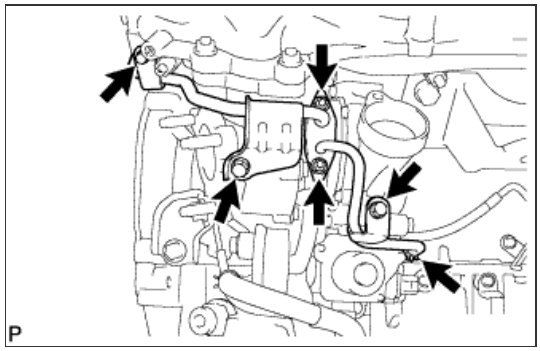
9. DISCONNECT NO. 1 OUTLET TURBO OIL HOSE



10. REMOVE NO. 1 TURBO WATER PIPE SUB-ASSEMBLY

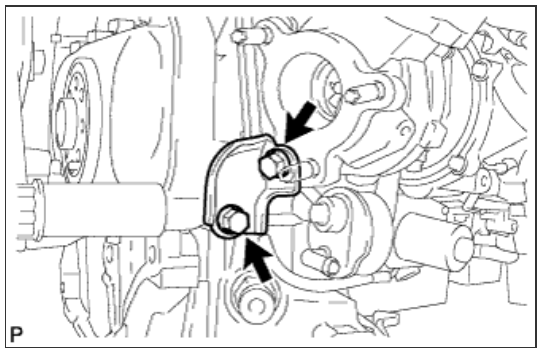
a. Disconnect the wate hose.

b. Remove the 3 bolts, nuts, No. 1 tu bo wate pipe and gasket.



11. REMOVE NO. 1 TURBOCHARGER STAY

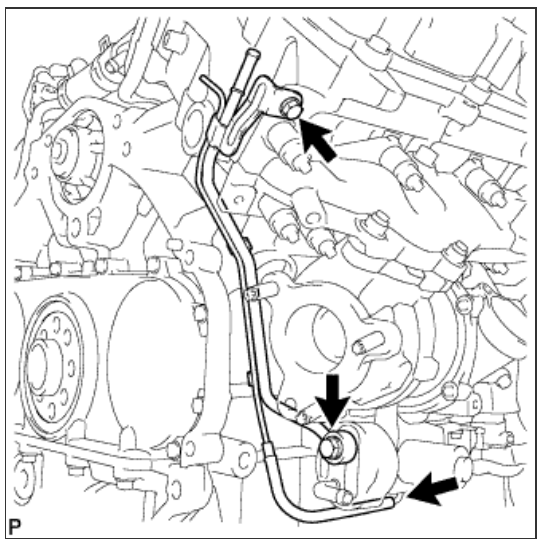
a. Remove the bolts and No. 1 tu bocha e stay.



12. REMOVE NO. 1 VENTILATION TUBE SUB-ASSEMBLY

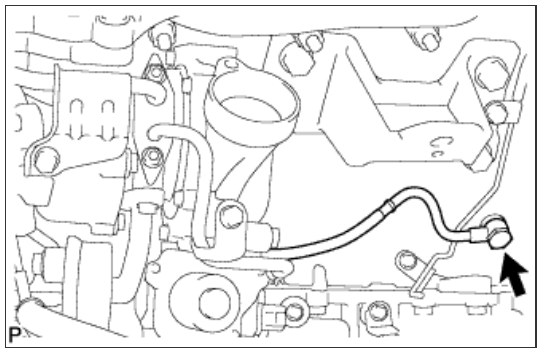
a. Disconnect the vacuum hose.

b. Remove the union bolt, bolt, No. 1 ventilation tube and gasket.

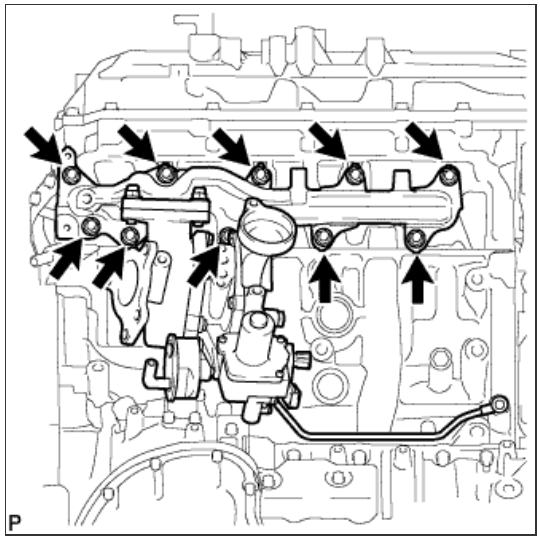


13. REMOVE NO. 1 TURBOCHARGER SUB-ASSEMBLY WITH EXHAUST MANIFOLD RH

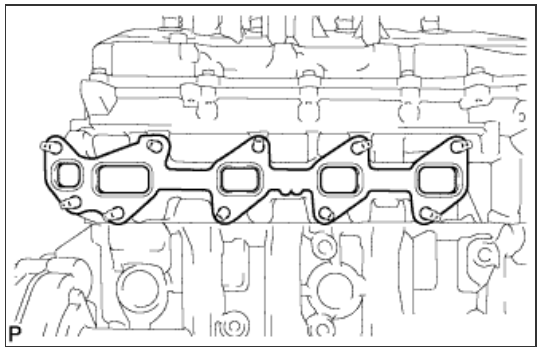
a. Remove the union bolt and gasket, and disconnect the No. 1 inlet tu bo oil pipe f om the cylinde block.



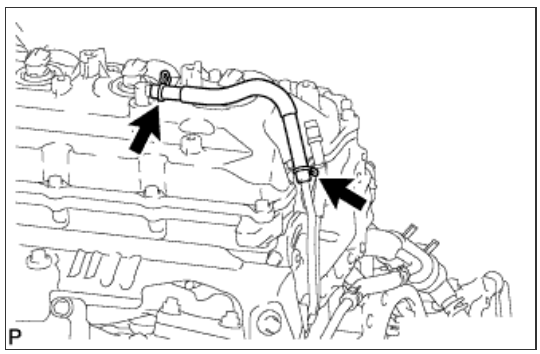
b. Remove the 10 nuts, 10 colla s, and No. 1 tu bocha e with exhaust manifold RH.



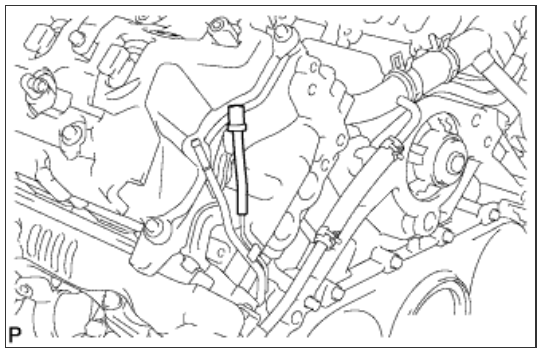
c. Remove the gasket f om the cylinde head RH.



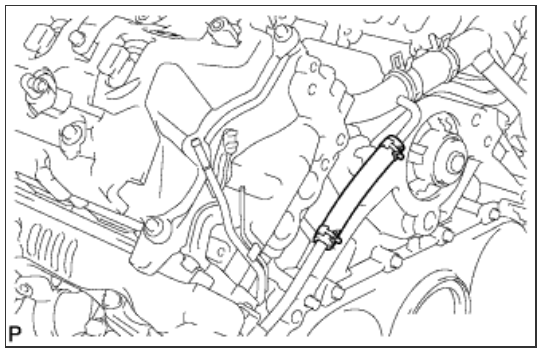
14. DISCONNECT NO. 3 VENTILATION HOSE



15. DISCONNECT BREATHER PLUG LH

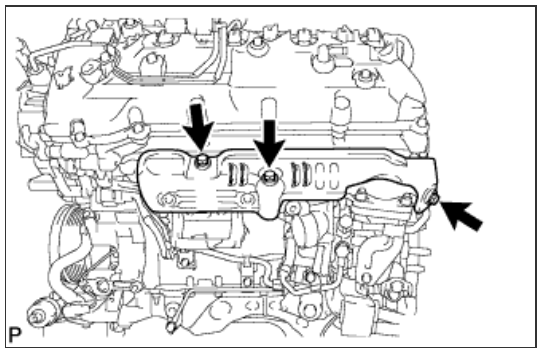


16. DISCONNECT NO. 2 TURBO WATER HOSE



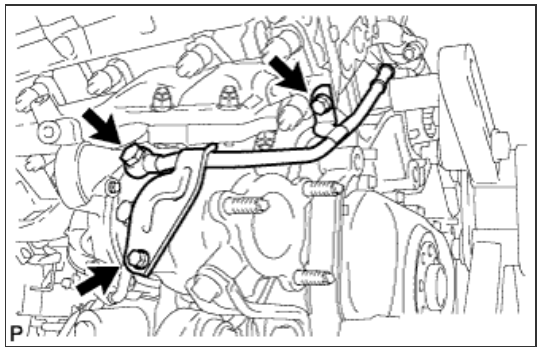
17. REMOVE NO. 2 EXHAUST MANIFOLD HEAT INSULATOR

a. Remove the 3 bolts and No. exhaust manifold heat insulato



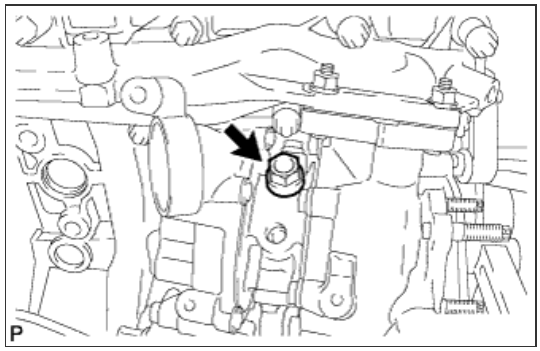
18. REMOVE NO. 3 TURBO WATER PIPE SUB-ASSEMBLY

a. Remove the bolts, union bolt, No. 3 tu bo wate pipe and gasket.



19. REMOVE FRONT WATER BY-PASS JOINT

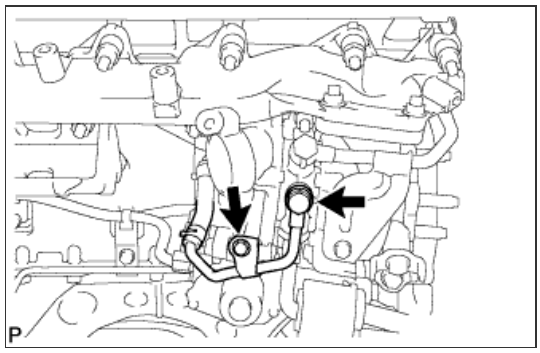
a. Remove the f ont wate by ss joint and gasket.



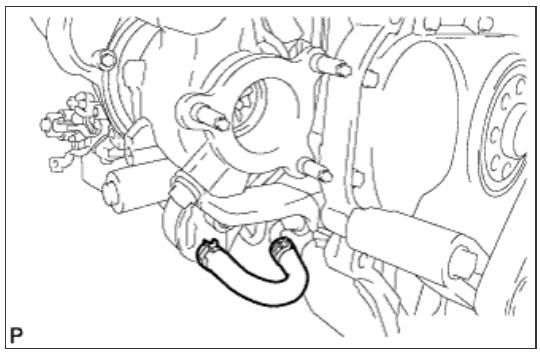
20. REMOVE NO. 2 TURBO WATER PIPE SUB-ASSEMBLY

a. Disconnect the wate hose.

b. Remove the union bolt, bolt, No. tu bo wate pipe and gasket.

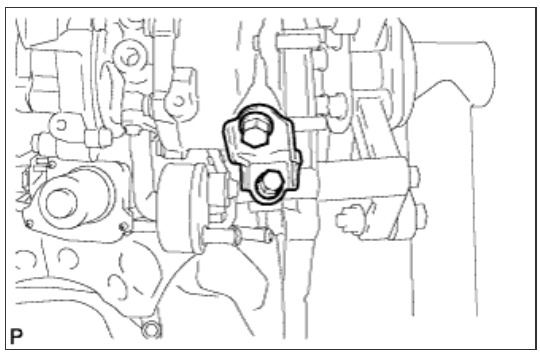


21. DISCONNECT NO. 2 OUTLET TURBO OIL HOSE



22. REMOVE NO. 2 TURBOCHARGER STAY

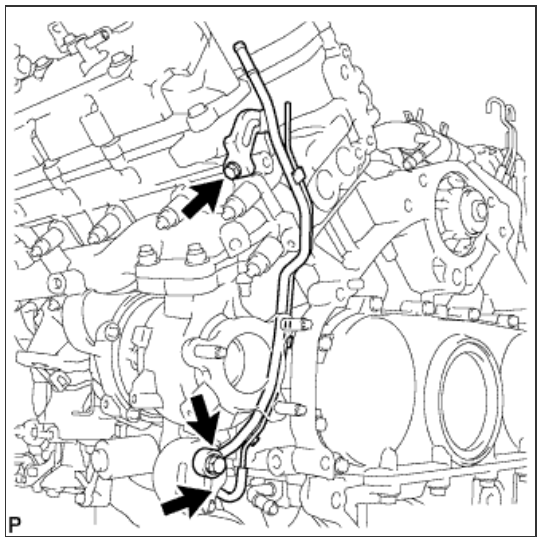
a. Remove the bolts and No. tu bocha e stay.



23. REMOVE NO. 2 VENTILATION TUBE SUB-ASSEMBLY

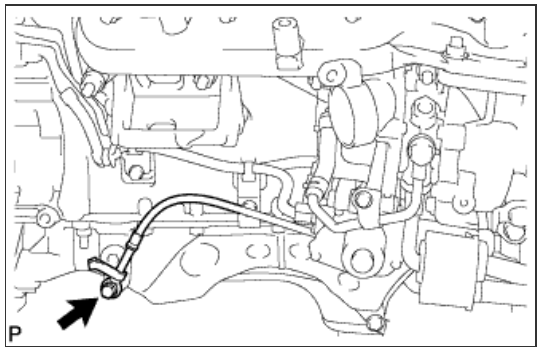
a. Disconnect the No. vacuum t smitting hose.

b. Remove the union bolt, bolt, No. ventilation tube and gasket.

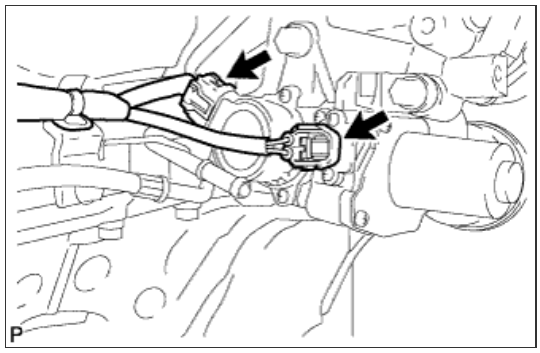


24. REMOVE NO. 2 TURBOCHARGER SUB-ASSEMBLY WITH EXHAUST MANIFOLD LH

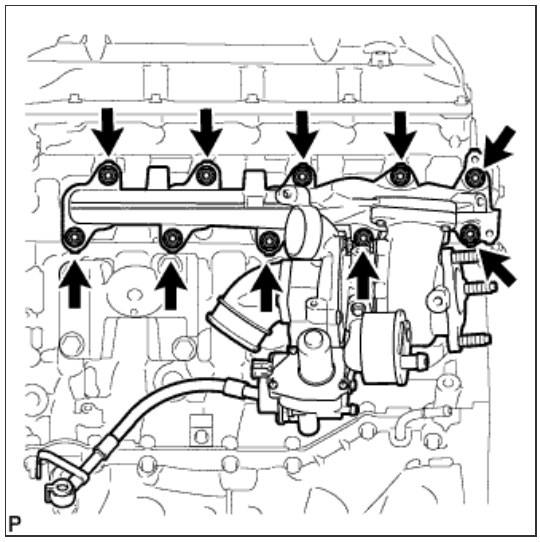
a. Remove the union bolt and gasket, and disconnect the No. inlet tu bo oil pipe.



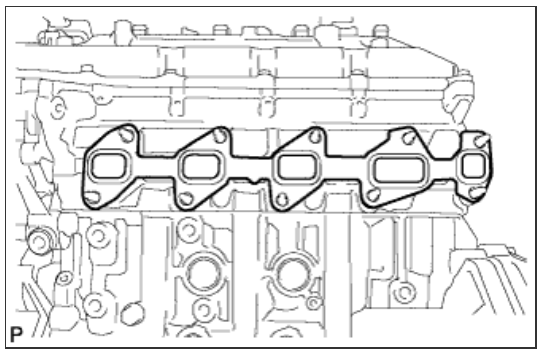
b. Disconnect the connecto s f om the tu bocha e



c. Remove the 10 nuts, 10 colla s, and No. tu bocha e with exhaust manifold LH.



d. Remove the gasket f om the cylinde head LH.



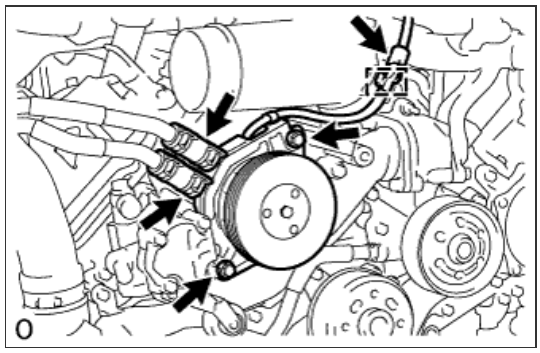
25. REMOVE VISCOUS HEATER ASSEMBLY WITH MAGNET CLUTCH (w/ Viscous Heater)

a. Disconnect the connecto and detach the clamp.

b. Using plie s, g the claws of the clips and slide the clips.

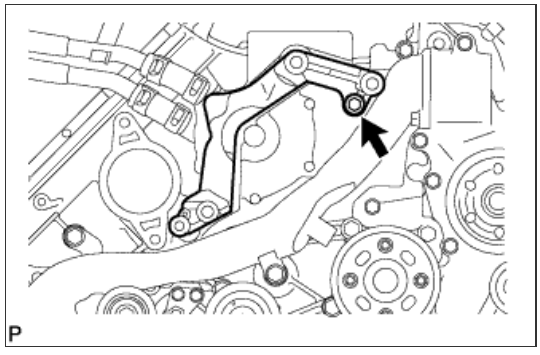
c. Disconnect the heate hoses.

d. Remove the bolts and heate assembly.



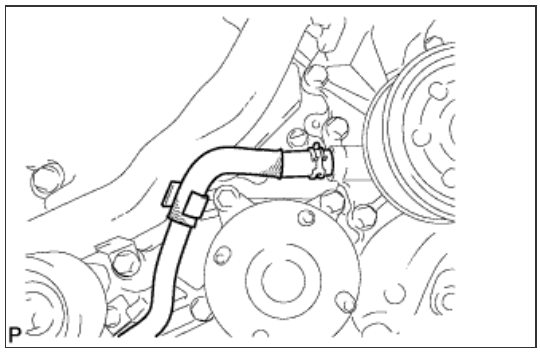
26. REMOVE NO. 1 IDLER PULLEY BRACKET (w/ Viscous Heater)

a. Remove the bolt and No. 1 idle pulley b et.

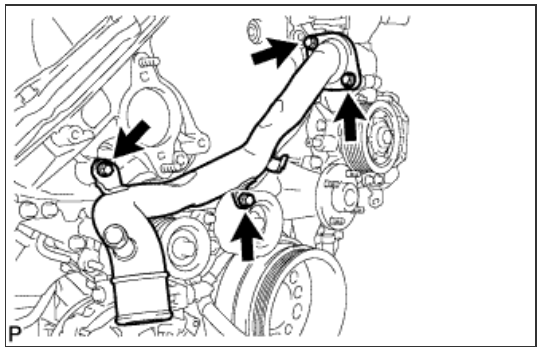


27. REMOVE WATER INLET

a. Disconnect the No. oil coole hose f om the wate pump and clamp.



b. Remove the 4 bolts and wate inlet.



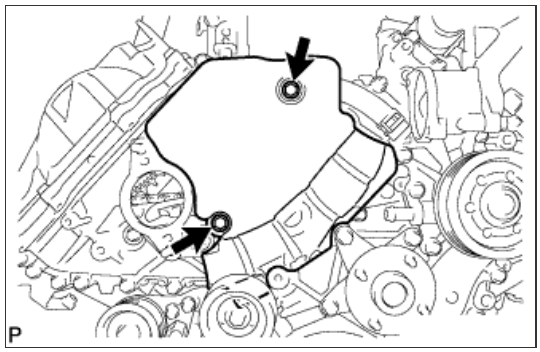
28. REMOVE THERMOSTAT

a. Remove the the mostat.

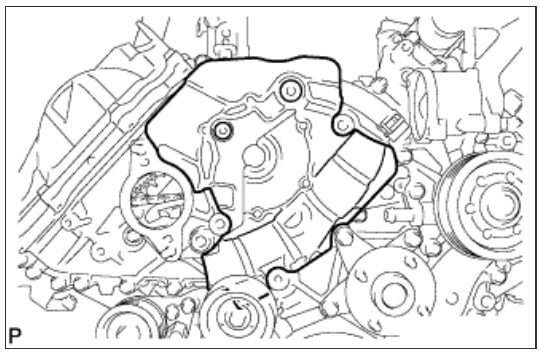
b. Remove the gasket f om the the mostat.

29. REMOVE TIMING GEAR COVER INSULATOR (w/ Intercooler)

a. w/o Viscous Heate
Remove the bolts and timing gea cove insulato

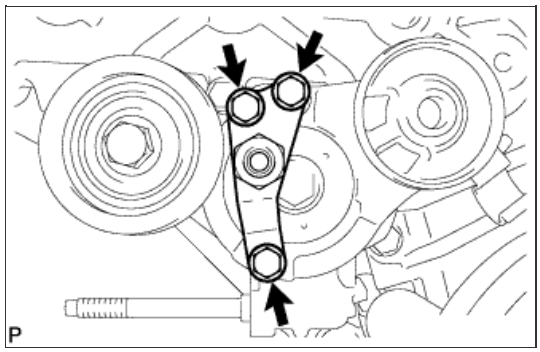


b. Viscous Heate
Remove the timing gea cove insulato

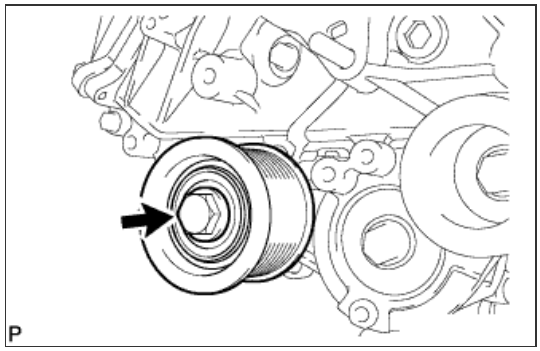


30. REMOVE V-RIBBED BELT TENSIONER ASSEMBLY

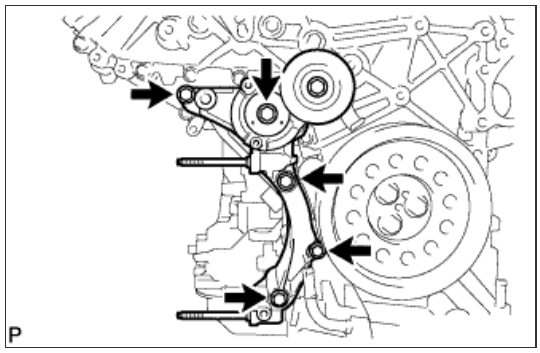
a. Remove the 3 bolts and V bbed belt tensione b et.



b. Remove the bolt and No. 1 idle pulley.



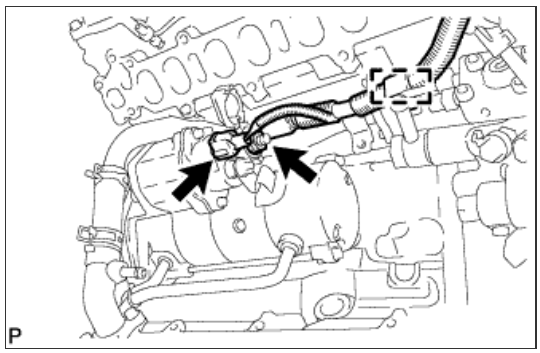
c. Remove the 5 bolts and V bbed belt tensione



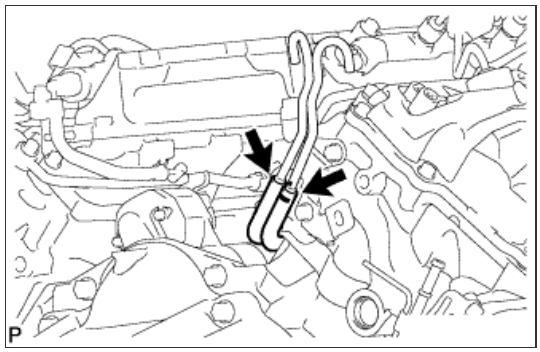
31. REMOVE STARTER ASSEMBLY

a. sconnect the connecto and detach the wi e ha ess clamp.

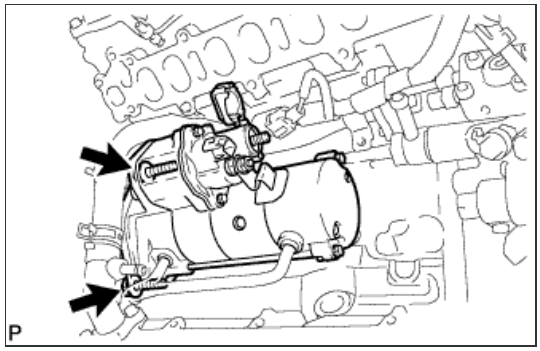
b. Remove the nut and No. engine wi e.



c. Disconnect the hoses.

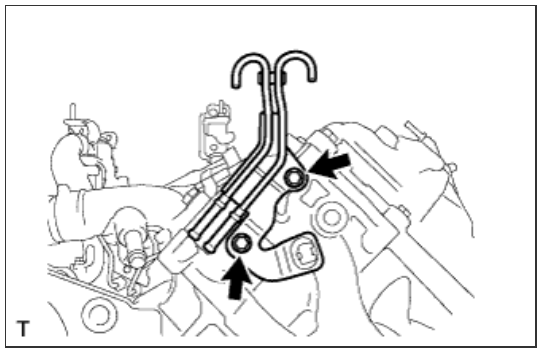


d. Remove the bolts and sta te

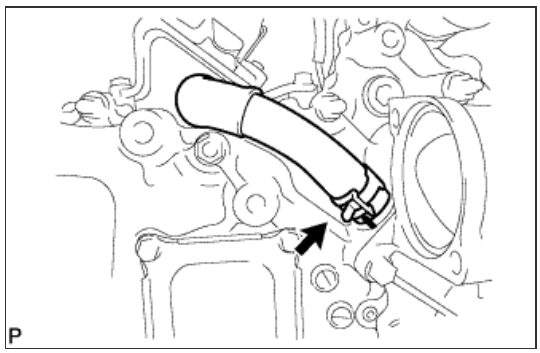


32. REMOVE STARTER HOSE BRACKET

a. Remove the bolts and sta te hose b et.



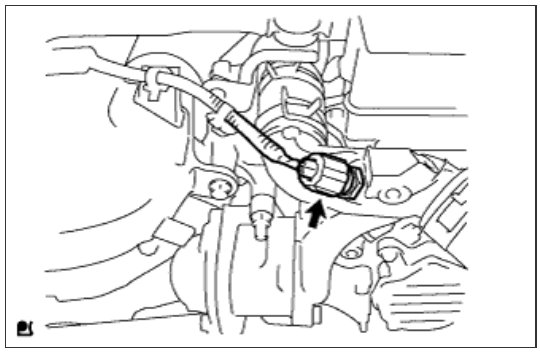
33. DISCONNECT INLET WATER HOSE



34. REMOVE DIESEL ENGINE COOLANT TEMPERATURE SENSOR

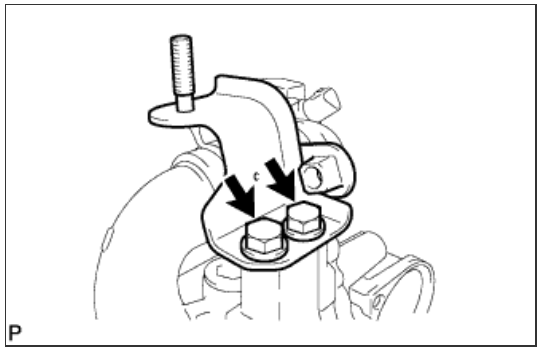
a. Disconnect the senso connecto

b. sing a 19 mm deep socket w ench, emove the senso and gasket.



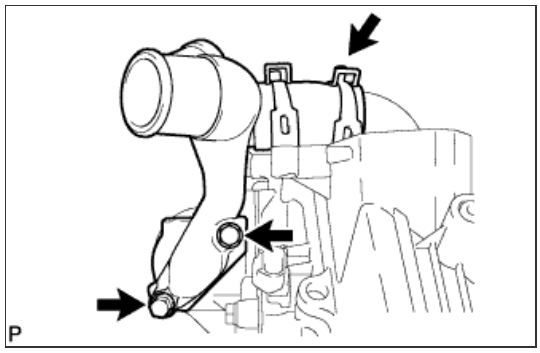
35. REMOVE NO. 2 INTERCOOLER SUPPORT BRACKET

a. Remove the bolts and No. inte oole suppo t b et.



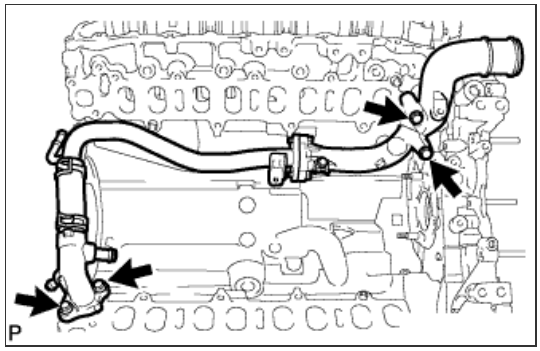
36. REMOVE WATER OUTLET

a. Remove the bolts and gasket and disconnect the wate outlet f om the No. te hose joint.



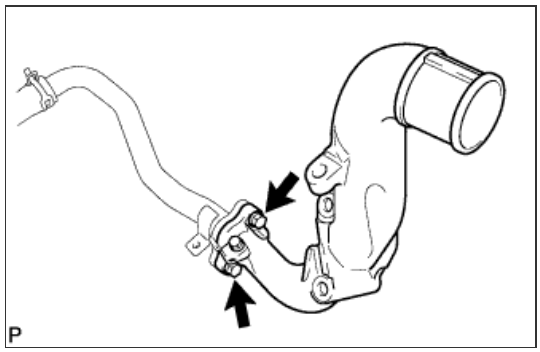
37. REMOVE WATER OUTLET PIPE

a. Remove the 4 bolts, wate outlet pipe and gaskets.

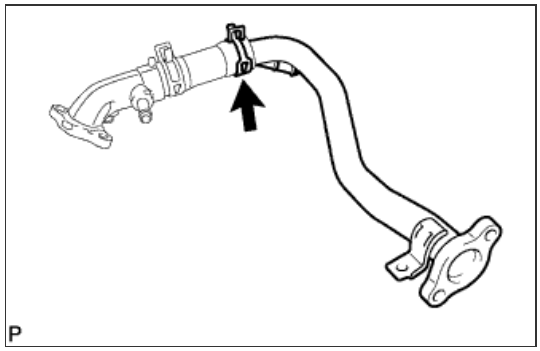


38. SEPARATE NO. 1 AND NO. 2 WATER OUTLET PIPES AND WATER BY-PASS OUTLET

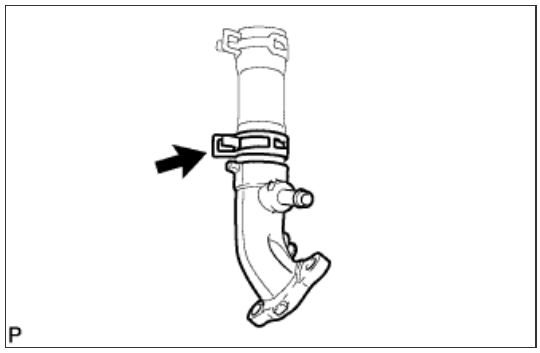
a. Remove the bolts and No. 1 water outlet pipe from the No. water outlet pipe.



b. Disconnect the No. water outlet pipe from the No. 1 water hose joint.

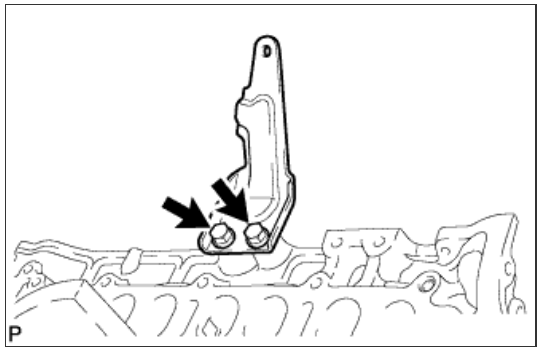


c. Disconnect the water bypass outlet from the No. 1 water hose joint.



39. REMOVE CLUTCH FLEXIBLE HOSE BRACKET (for Manual Transmission)

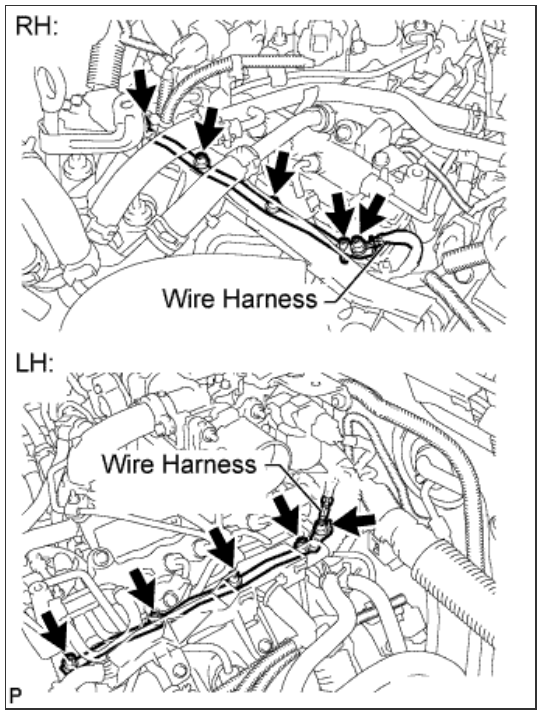
a. Remove the bolts and clutch flexible hose bracket.



40. REMOVE NO. 1 GLOW PLUG CONNECTOR

a. Remove the screw grommets and nuts, and disconnect the wire harnesses.

b. Remove the 8 screw grommets, 8 nuts and glow plug connectors.

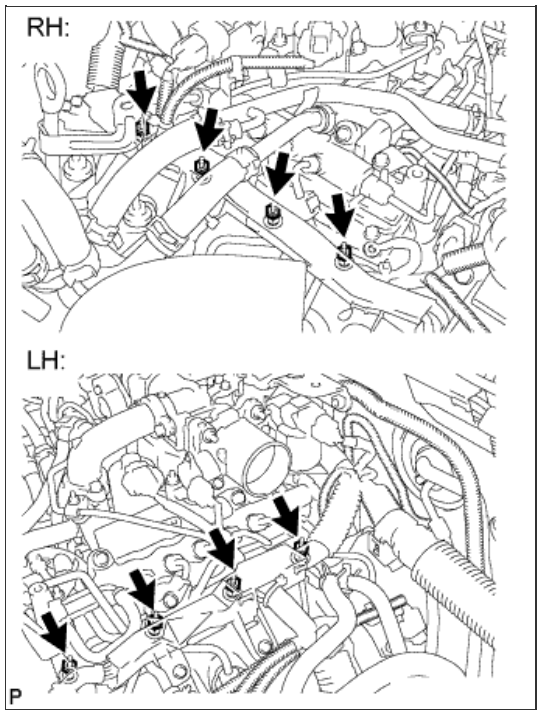


41. REMOVE GLOW PLUG ASSEMBLY

a. Using a 10 mm deep socket w ench, emove the 8 glow plugs.

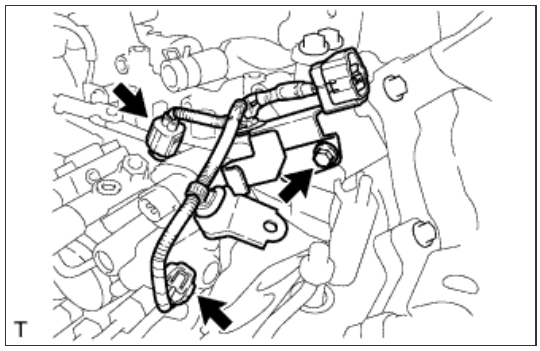
HINT

Befo e emoving the glow plugs, tho oughly clean off all di t, sand, etc.



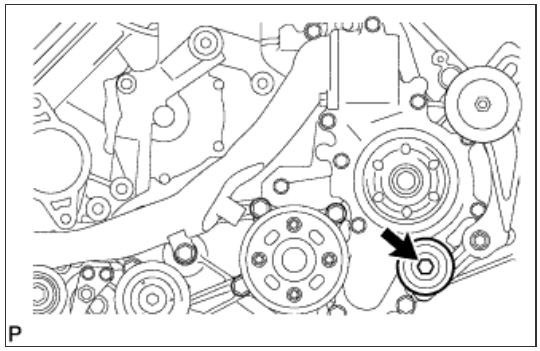
42. REMOVE FUEL PUMP MOTOR WIRE

a. Disconnect the connecto s and emove the bolt and fuel pump moto wi e.



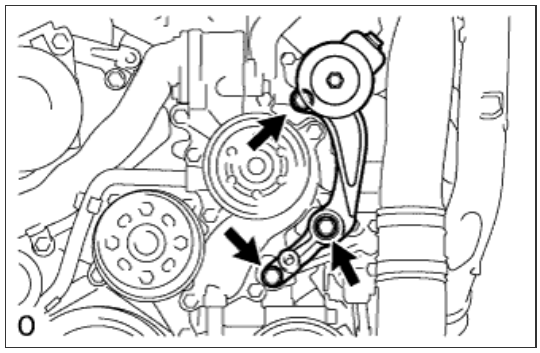
43. REMOVE NO. 2 IDLER PULLEY (w/ Viscous Heater)

a. Remove the bolt and No. idle pulley.



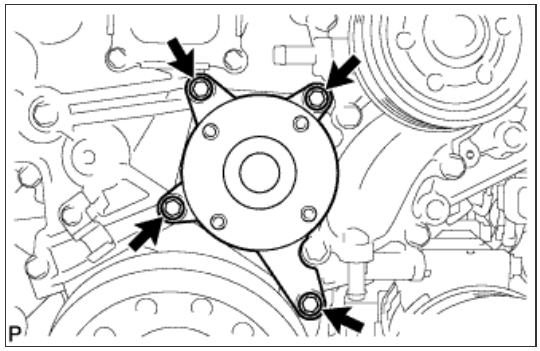
44. REMOVE NO. 2 IDLER PULLEY BRACKET (w/ Viscous Heater)

a. Remove the 3 bolts and idle pulley b et.



45. REMOVE FAN BRACKET SUB-ASSEMBLY

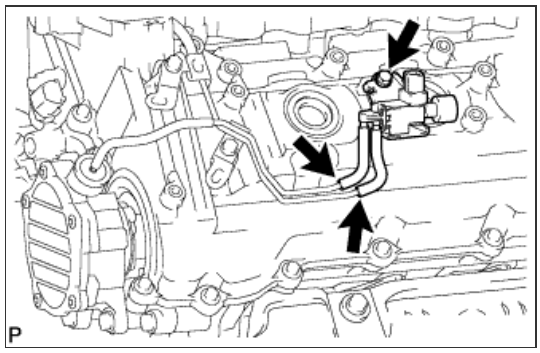
a. Remove the 4 bolts and fan b et.



46. REMOVE NO. 1 VACUUM SWITCHING VALVE ASSEMBLY (w/ Intercooler)

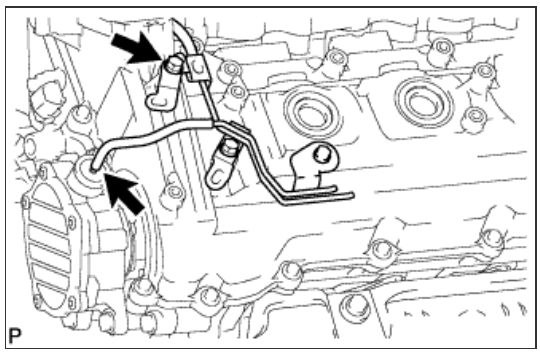
a. Disconnect the vacuum hoses.

b. Remove the bolt and vacuum switching valve.

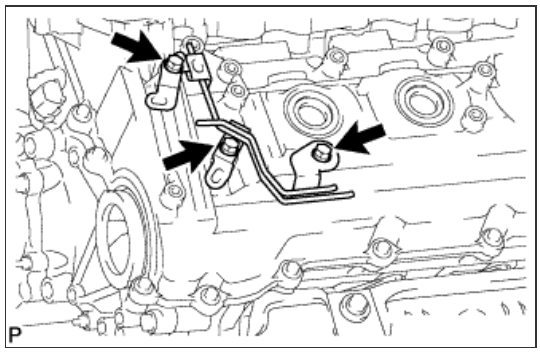


47. REMOVE NO. 1 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY

a. w/ Inte oole
sconnect the vacuum hoses.

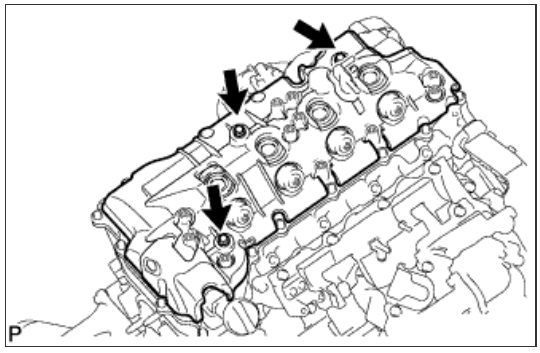


b. Remove the 3 bolts and vacuum t smitting pipe.



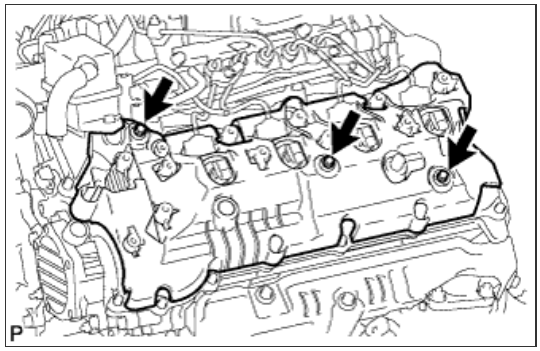
48. REMOVE CYLINDER HEAD COVER SILENCER RH (w/ Intercooler)

a. Remove the 3 bolts and cylinde head cove silence



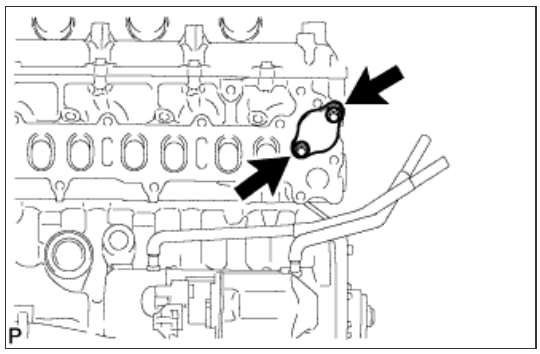
49. REMOVE CYLINDER HEAD COVER SILENCER LH (w/ Intercooler)

a. Remove the 3 bolts and cylinde head cove silence



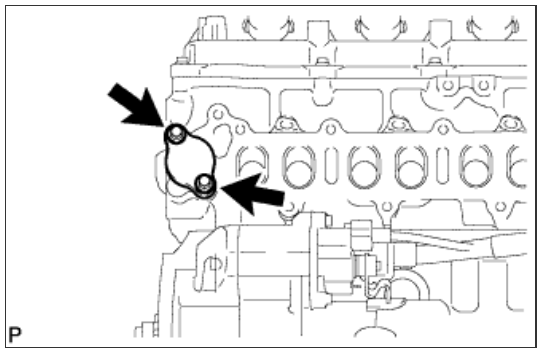
50. REMOVE REAR CYLINDER HEAD PLATE RH (w/o EGR Syste)

a. Remove the bolts, ea cylinde head plate RH and gasket.



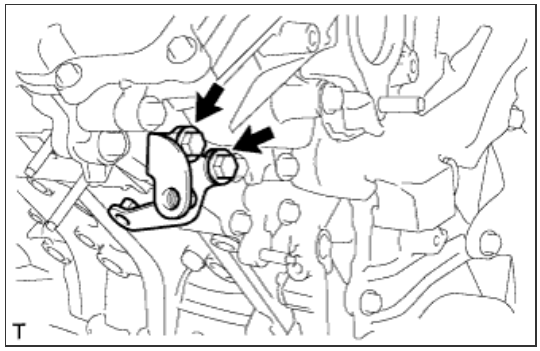
51. REMOVE REAR CYLINDER HEAD PLATE LH (w/o EGR Syste)

a. Remove the bolts, ea cylinde head plate LH and gasket.



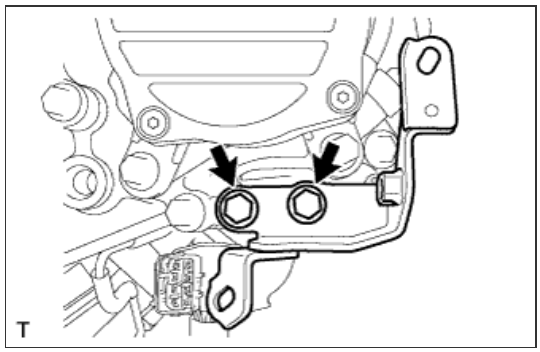
52. REMOVE NO. 1 INTAKE AIR CONNECTOR BRACKET

a. Remove the bolts and No. 1 intake ai connecto b et.



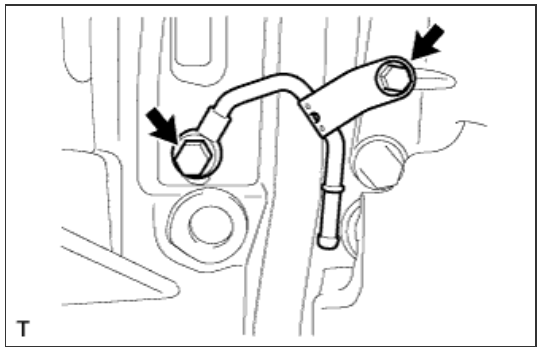
53. REMOVE AIR TUBE SUPPORT

a. Remove the bolts and air tube support.



54. REMOVE NO. 1 WATER BY-PASS PIPE SUB-ASSEMBLY

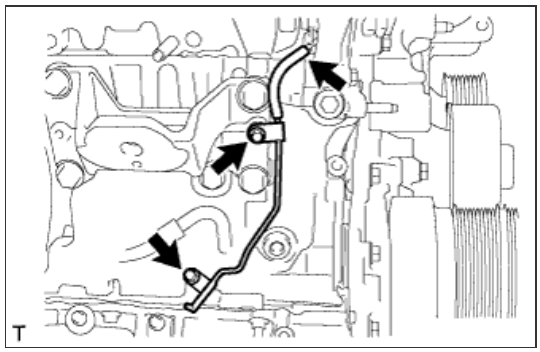
a. Remove the union bolt, bolt, No. 1 water bypass pipe and gasket.



55. REMOVE NO. 4 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY (w/ Intercooler)

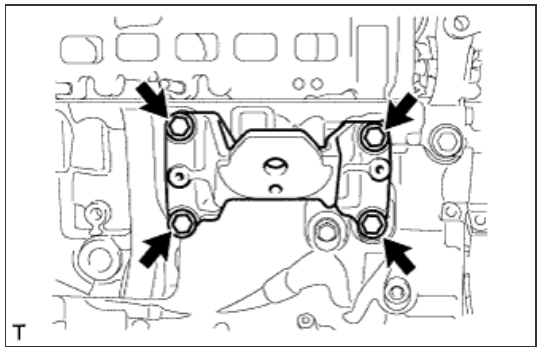
a. Disconnect the vacuum hose.

b. Remove the bolts and No. 4 vacuum transmitting pipe.

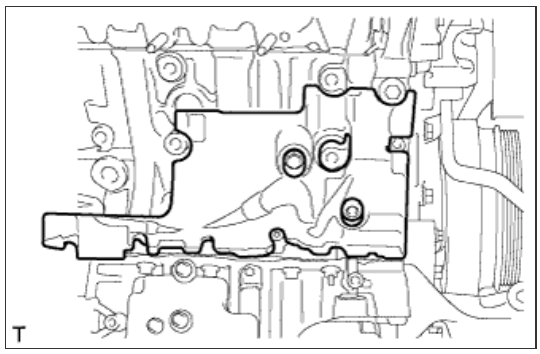


56. REMOVE ENGINE MOUNTING BRACKET RH

a. Remove the 4 bolts and engine mounting bracket RH.

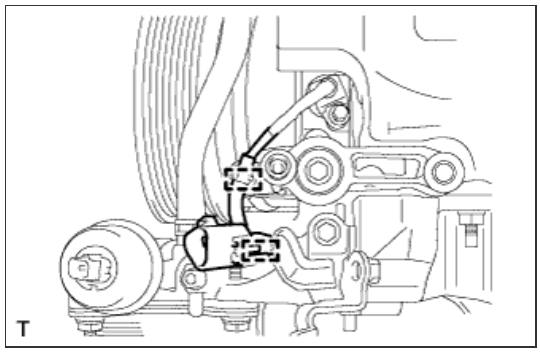


57. REMOVE NO. 1 CYLINDER BLOCK INSULATOR

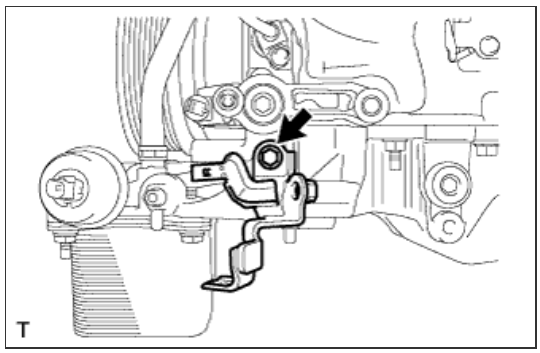


58. REMOVE NO. 2 INTAKE AIR CONNECTOR BRACKET

a. Detach the wire harness clamps.



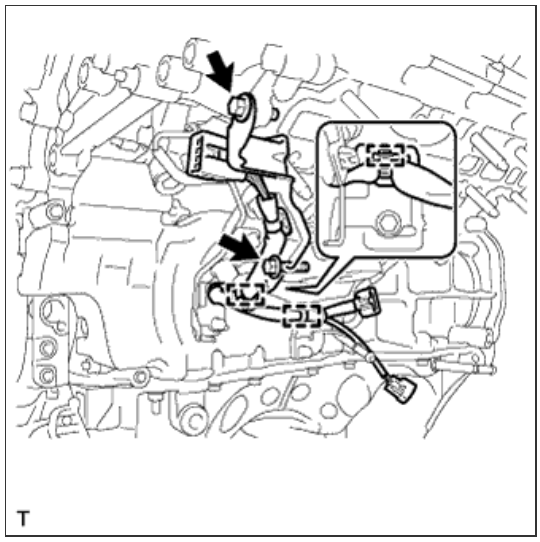
b. Remove the bolt and No. intake air connector bracket.



59. REMOVE TURBOCHARGER WIRE

a. Detach the 3 wire harness clamps.

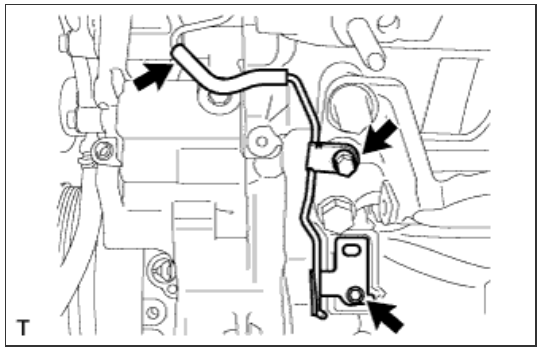
b. Remove the bolts and turbocharger wire.



60. REMOVE NO. 3 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY

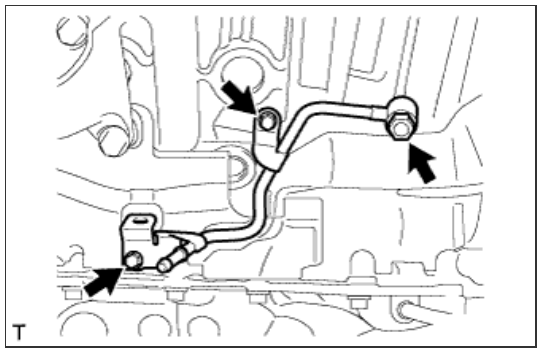
a. w/ Inte oole
sconnect the vacuum hose.

b. Remove the bolts and No. 3 vacuum t smitting pipe.



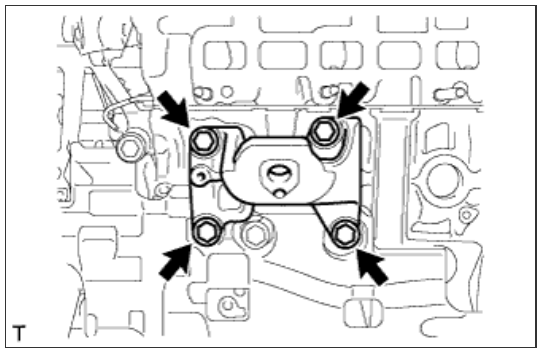
61. REMOVE NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY

a. Remove the union bolt, bolts, No. wate by ss pipe and gasket.

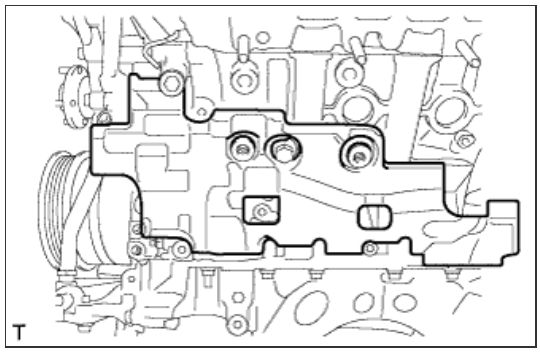


62. REMOVE ENGINE MOUNTING BRACKET LH

a. Remove the 4 bolts and engine mounting b et LH.

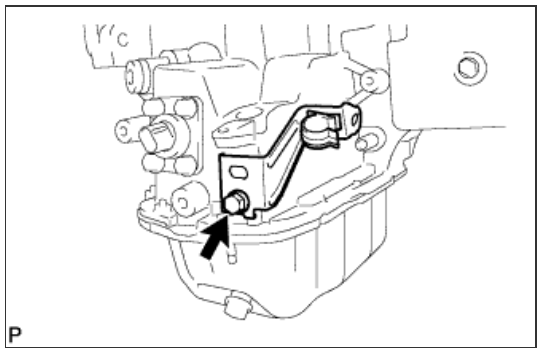


63. REMOVE NO. 2 CYLINDER BLOCK INSULATOR



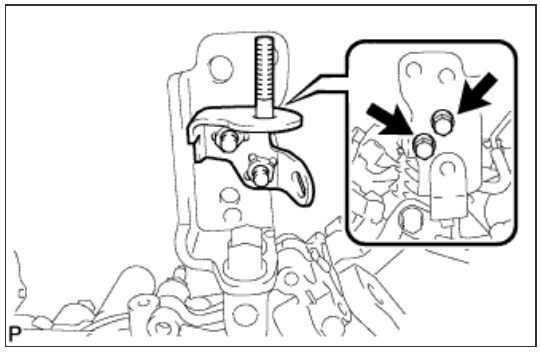
64. REMOVE OIL TANK BRACKET

a. Remove the bolt and oil tank b et.



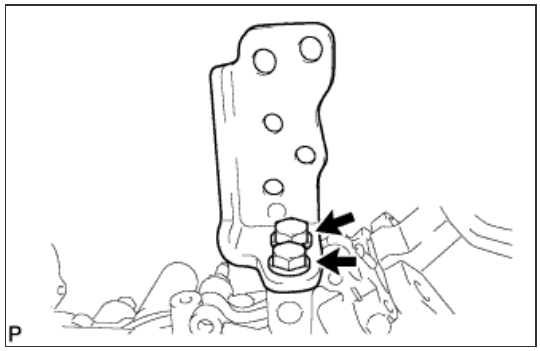
65. REMOVE NO. 1 INTERCOOLER SUPPORT BRACKET

a. Remove the bolts and No. 1 inte oole suppo t b et.



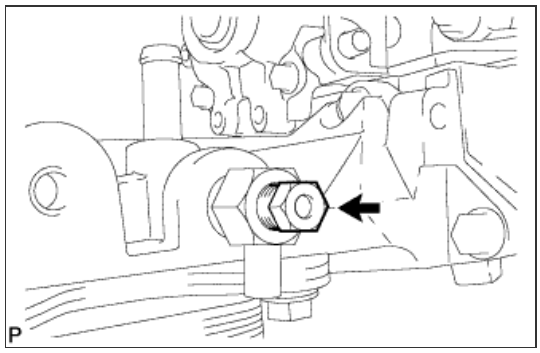
66. REMOVE NO. 3 ENGINE HANGER

a. Remove the bolts and No. 3 engine hange



67. REMOVE OIL FILTER BRACKET DRAIN COCK ASSEMBLY

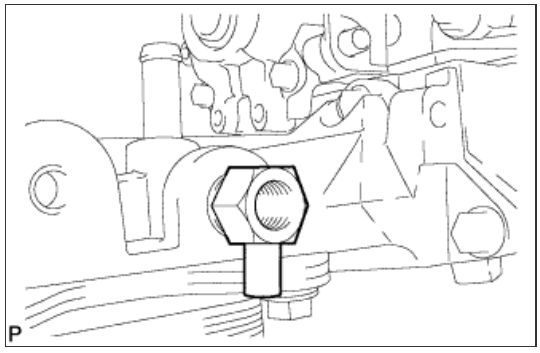
a. Remove the oil filte d cock plug.



b. Remove the oil filte d cock body.

HINT

If the d cock is defo med o clogged, eplace o epai it.



68. REMOVE OIL PRESSURE REGULATOR ASSEMBLY

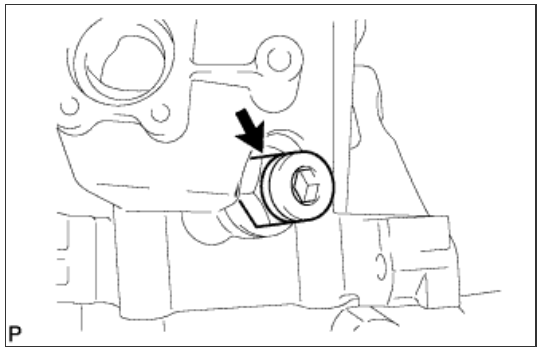
a. Using a mm w ench, emove the oil p essu e egulato and gasket.

b. Remove the O f om the oil p essu e egulato body.

c. Hold the oil p essu e egulato body in a vise between aluminum plates.

NOTICE

Be ca eful not to damage the oil p essu e egulato body.



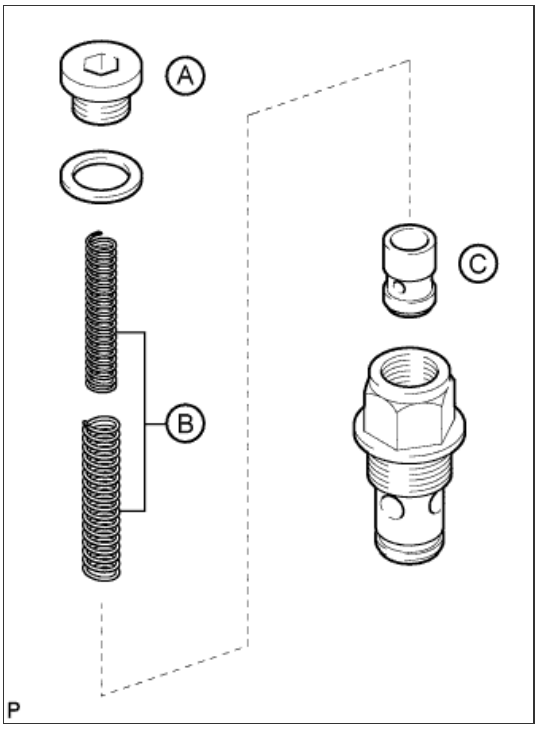
d. Using a 10 mm hexagon w ench, emove the oil pump elief valve plug labeled A.

CAUTION

When removing the plug, be careful as the spring will be jumped out.

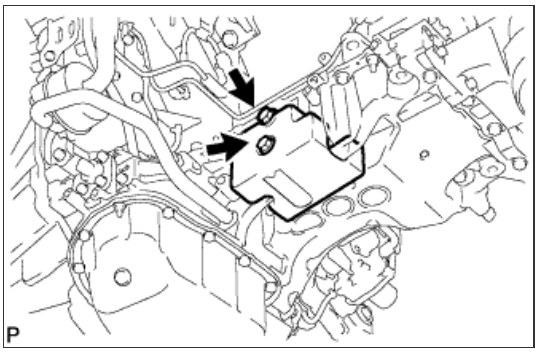
e. Remove the spring labeled B.

f. Remove the oil pump relief valve labeled C.



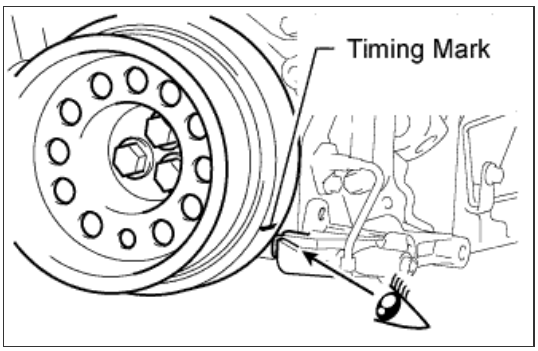
69. REMOVE STIFFENER INSULATOR RH (w/ Intercooler)

a. Remove the 2 bolts and stiffener insulator RH.



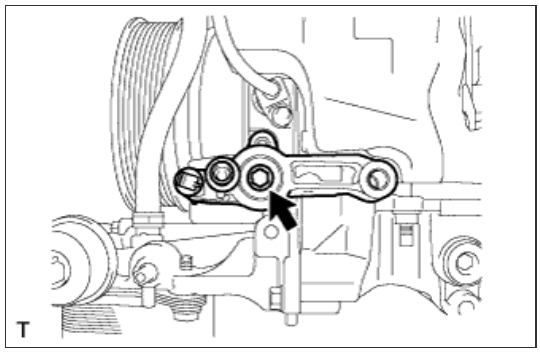
70. SET NO. 1 CYLINDER TO TDC/COMPRESSION

a. Align the timing mark of the crankshaft pulley and the chain cover and compression bolt.



71. REMOVE COMPRESSOR BRACKET

a. Remove the bolt and compression bolt.



72. REPLACE FLYWHEEL RING GEAR

CAUTION

When to ing the flywheel:

- **Wear protective gloves.**
- **Be careful as the flywheel is hot.**

HINT

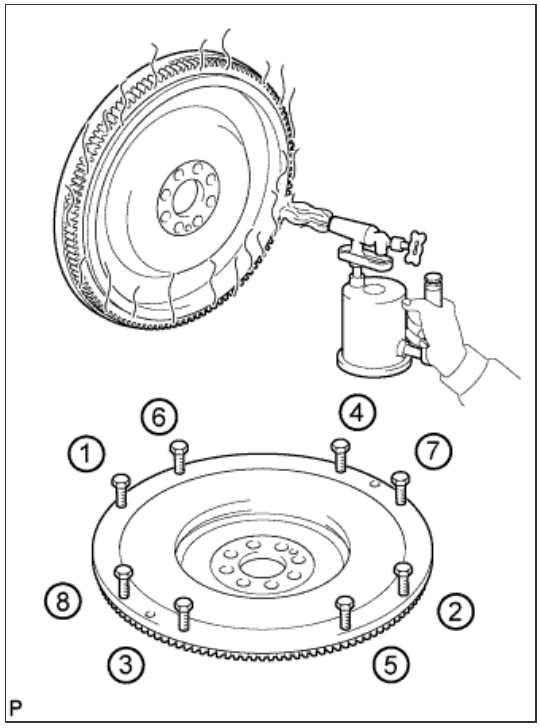
If the flywheel ring gear is deformed or the gear teeth are damaged, replace it.

a. Using a torch, heat the ring gear evenly to approximately 200°C (392°F).

b. Install 8 10 mm x 1.25 pitch bolts with a length of 70 mm or more to the flywheel.

c. Uniformly tighten the 8 bolts in the order shown in the illustration.

d. Remove the ring gear from the flywheel.



e. Using a torch, heat a new ring gear evenly to approximately 200°C (392°F).

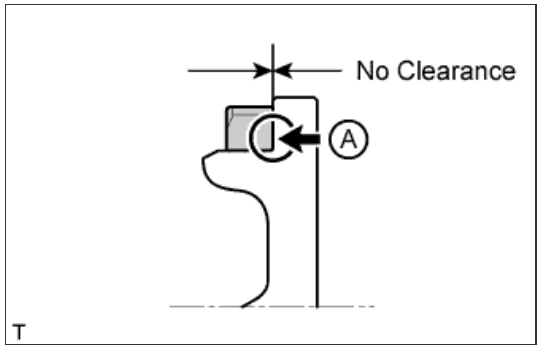
NOTICE

Be careful not to overheat the ring gear.

f. Using a brass bar, tap the ring gear onto the flywheel with its chamfered gear teeth facing the block.

NOTICE

- **Make sure to press in the ring gear until the ring gear contacts the flywheel as shown in A in the illustration.**
- **After installing allow the ring gear to cool before handling.**



73. REPLACE FLYWHEEL STRAIGHT PIN

HINT

It is not necessary to remove the straight pin unless it is being replaced.

a. Replace the flywheel straight pin.

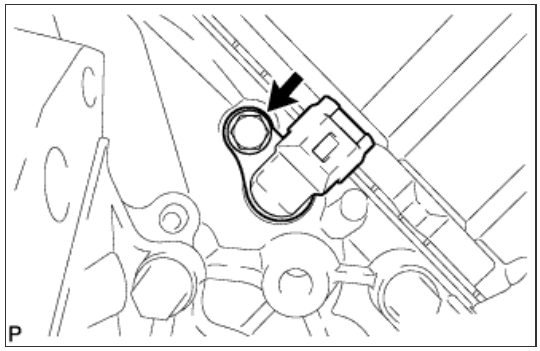
for Preparation Click here

CAUTION:

When replacing an injector (including interchanging injectors between cylinders), common rail, cylinder head, or intake manifold, replace the corresponding injection pipes with a new one.

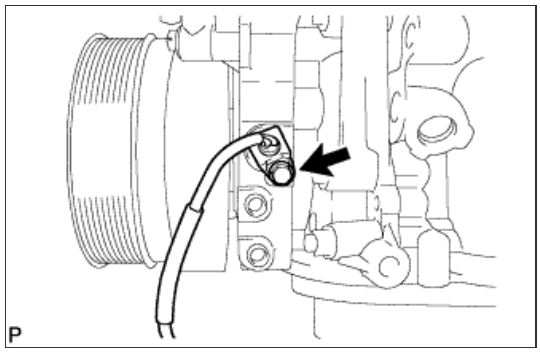
1. REMOVE CAMSHAFT POSITION SENSOR

a. Remove the bolt and sensor.

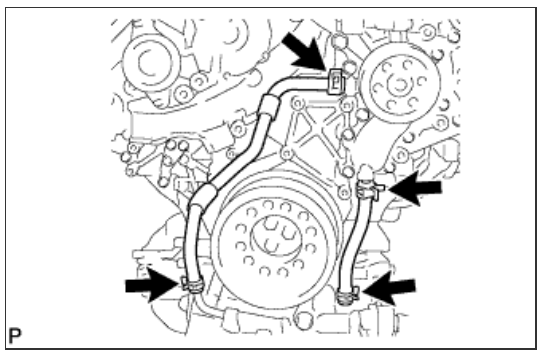


2. REMOVE CRANKSHAFT POSITION SENSOR

a. Remove the bolt and sensor.



3. DISCONNECT NO. 1 OIL COOLER HOSE



4. DISCONNECT NO. 2 OIL COOLER HOSE

5. REMOVE CRANKSHAFT PULLEY

NOTICE:

This procedure is intended for removal/installation of the crankshaft pulley only. Do not use this procedure for removal/installation of the flywheel or the drive plate and ring gear.

a. Install the 2 bolts to the bolt holes of the crankshaft rear side.

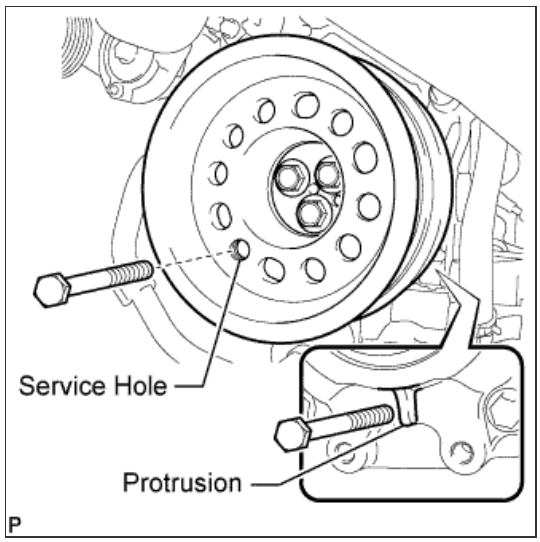
b. Using a bar, turn the crankshaft until the crankshaft pulley service hole is a little to the left of bottom dead center.

c. Install a 14 mm x 1.5 pitch service bolt with a length of 70 mm or more to the crankshaft pulley service hole, and hold the crankshaft using the timing chain cover protrusion.

d. Remove the 3 bolts and crankshaft pulley.

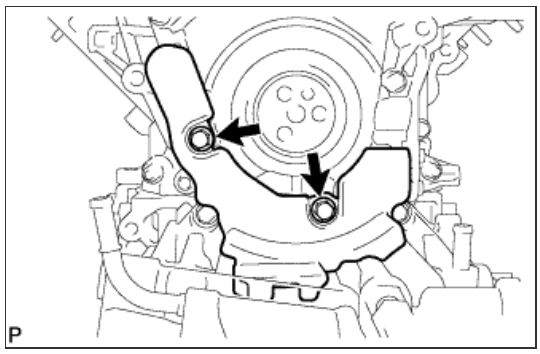
NOTICE:

If the crankshaft pulley cannot be removed, temporarily install a bolt to the crankshaft so that the pulley does not fall, and lightly tap the outer edge of the mass damper with a plastic-faced hammer to remove the pulley. Do not tap the pulley V-ribbed belt ribs, as the crankshaft may be damaged.



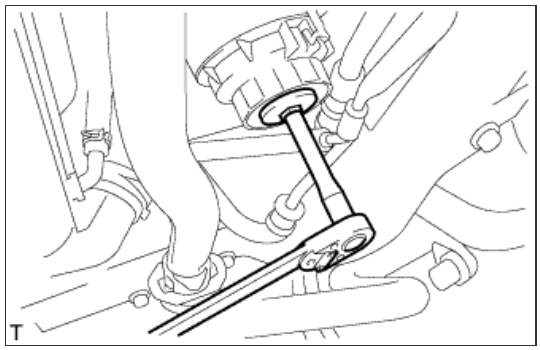
6. REMOVE TIMING GEAR COVER SPACER (w/ Intercooler)

a. Remove the 2 bolts and timing gear cover spacer.



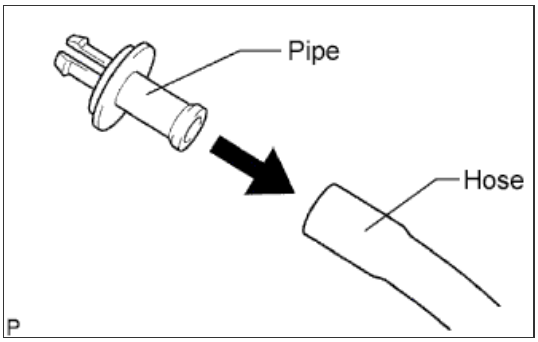
7. REMOVE OIL FILTER CAP WITH ELEMENT

a. Remove the oil filter drain plug.



b. Connect a hose with an inside diameter of 15 mm (0.591 in.) to the pipe.

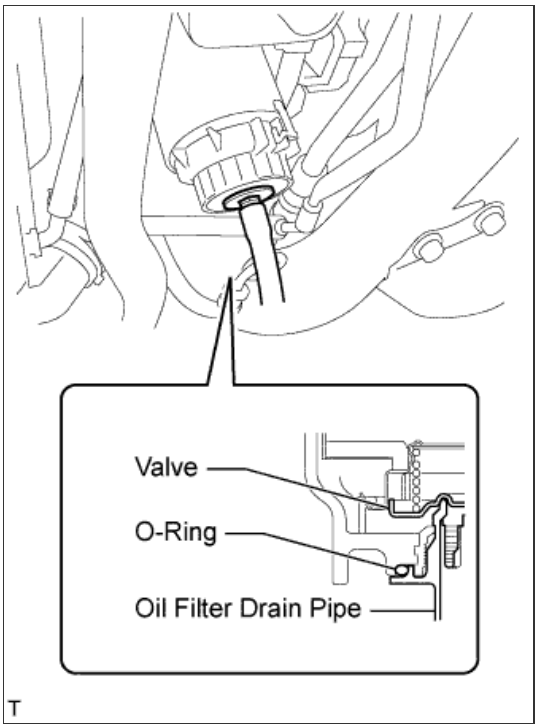
c. Remove the O-ring from the oil filter drain plug and install it to the drain pipe.



d. Install the oil filter drain pipe to the oil filter cap and drain the engine oil.

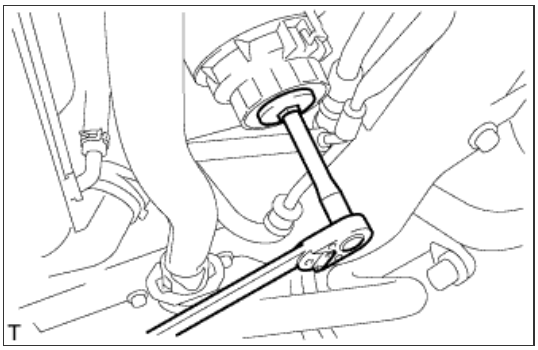
e. Remove the oil filter drain pipe.

f. Apply a light coat of engine oil to a new O-ring, and install it to the oil filter drain plug.



g. Install the oil filter drain plug to the oil filter cap.

Torq e:
13 N*m{ 127 kgf*cm 9 ft.*lbf }

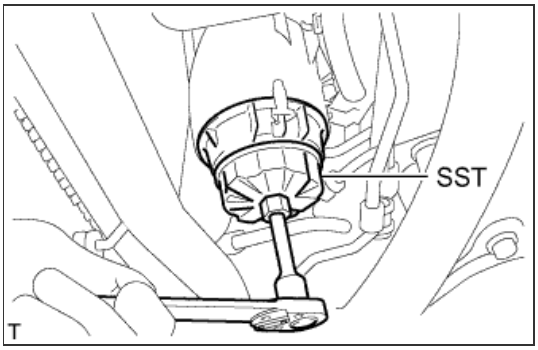


h. Using SST, remove the oil filter cap.

SST
922 65 1

HINT:

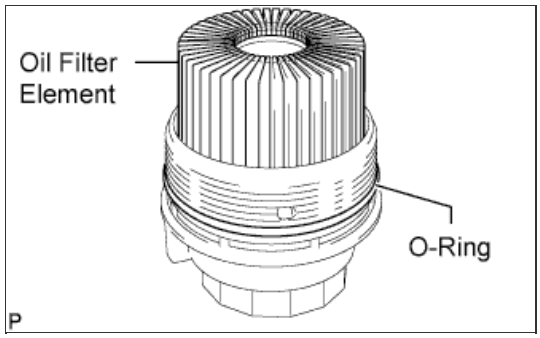
Use a container to catch the draining oil. After the oil filter cap is loosened approximately 4 turns and the cap ribs are vertical, engine oil drains from the gap between the oil filter cap and oil pan.



i. Remove the oil filter element and O-ring from the oil filter cap.

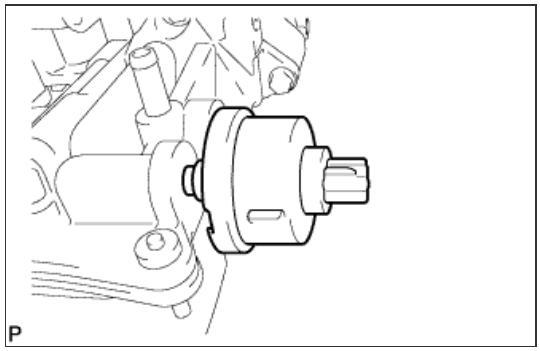
NOTICE:

Be sure to remove the cap O-ring by hand, without using any tools, to prevent damage to the cap O-ring groove.



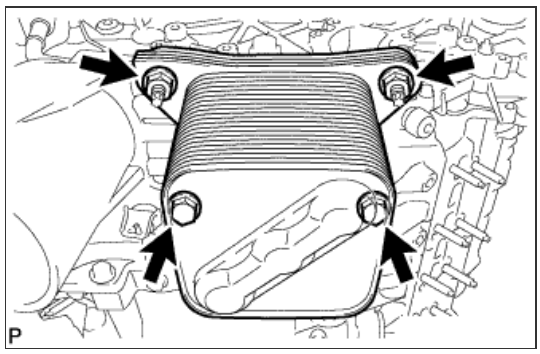
. REMOVE OIL PRESSURE SENDER GAUGE ASSEMBLY

a. Remove the oil pressure sender gauge.

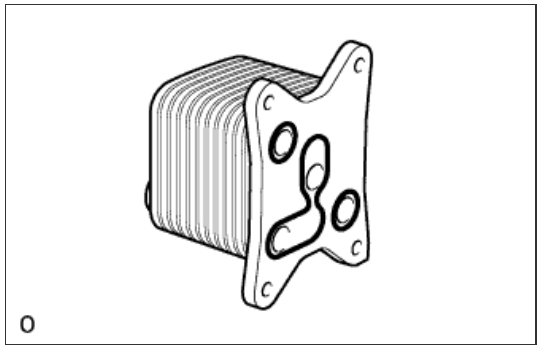


9. REMOVE OIL COOLER ASSEMBLY

a. Remove the 2 bolts, 2 nuts and oil cooler.

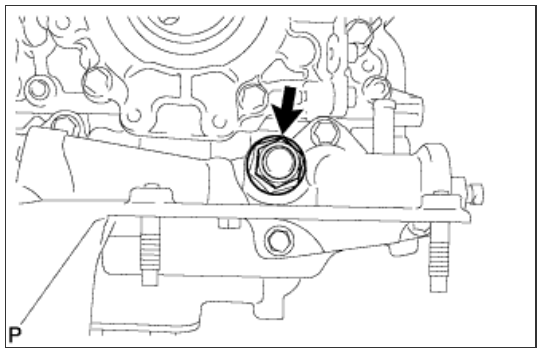


b. Remove the 2 O-rings and oil cooler gasket.



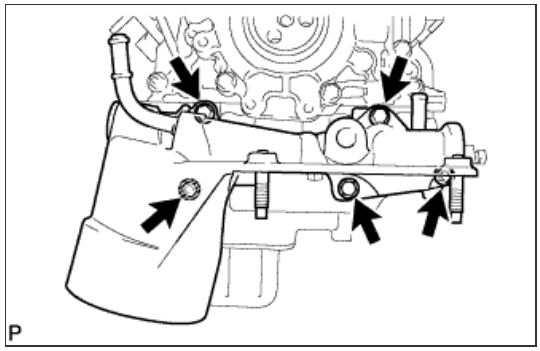
1 . REMOVE OIL COOLER RELIEF VALVE ASSEMBLY

a. Remove the oil cooler relief valve and gasket.

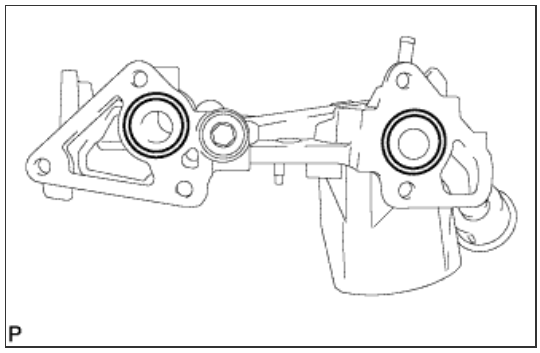


11. REMOVE OIL FILTER BRACKET SUB-ASSEMBLY

a. Remove the 3 bolts, 2 nuts and oil filter bracket.



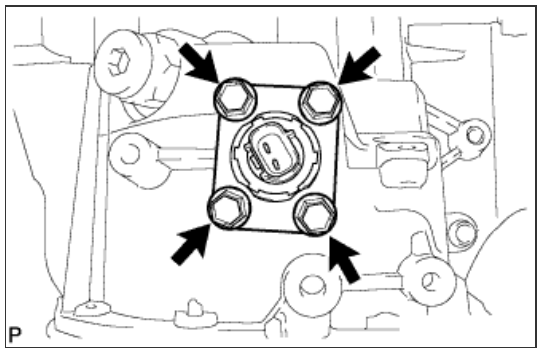
b. Remove the 2 O-rings.



12. REMOVE ENGINE OIL LEVEL SENSOR

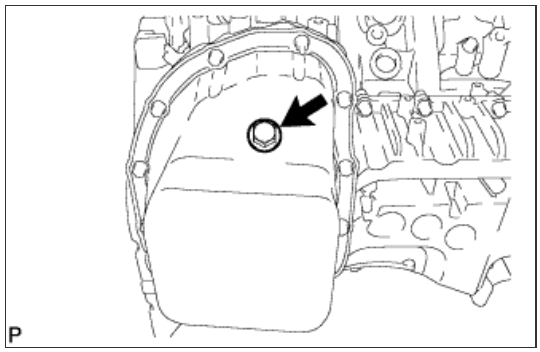
a. Remove the 4 bolts and engine oil level sensor.

b. Remove the gasket.



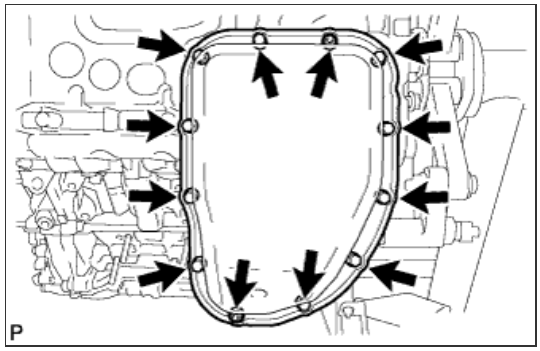
13. REMOVE OIL PAN DRAIN PLUG

a. Remove the oil pan drain plug and gasket.



14. REMOVE NO. 2 OIL PAN SUB-ASSEMBLY

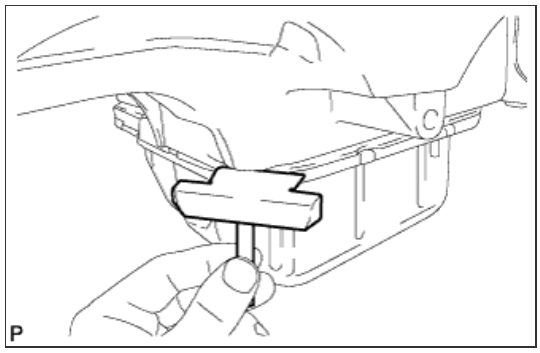
a. Remove the 10 bolts and 2 nuts.



b. Insert the blade of an oil pan seal cutter between the oil pans. Cut through the applied sealer and remove the No. 2 oil pan.

NOTICE:

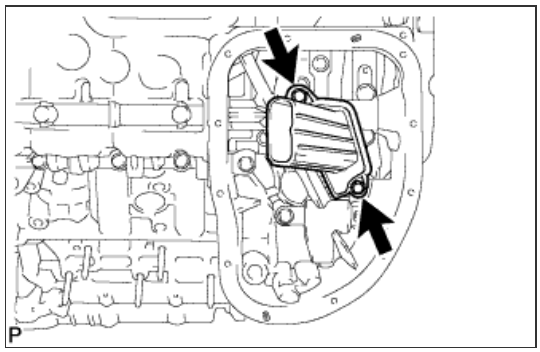
Be careful not to damage the contact surfaces of the oil pans.



15. REMOVE OIL STRAINER SUB-ASSEMBLY

a. Remove the 2 bolts and oil strainer.

b. Remove the O-ring from the oil strainer.



16. REMOVE NO. 1 OIL PAN SUB-ASSEMBLY

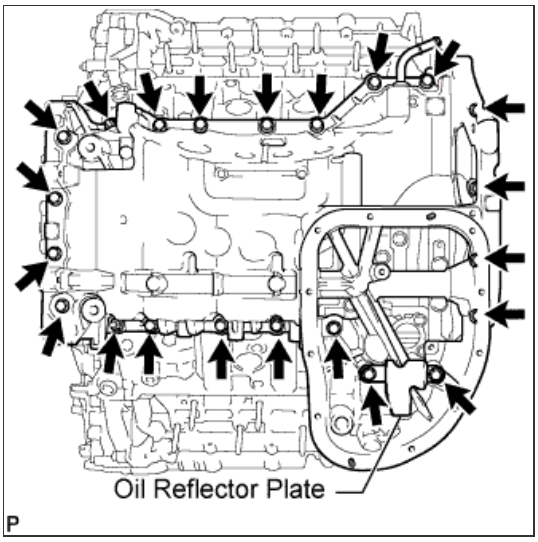
a. Remove the 20 bolts, 2 nuts and oil reflector plate.

NOTICE:

If the oil reflector plate is deformed, replace it.

HINT:

Be sure to clean the bolts and stud bolts, and check the threads for cracks or other damage.



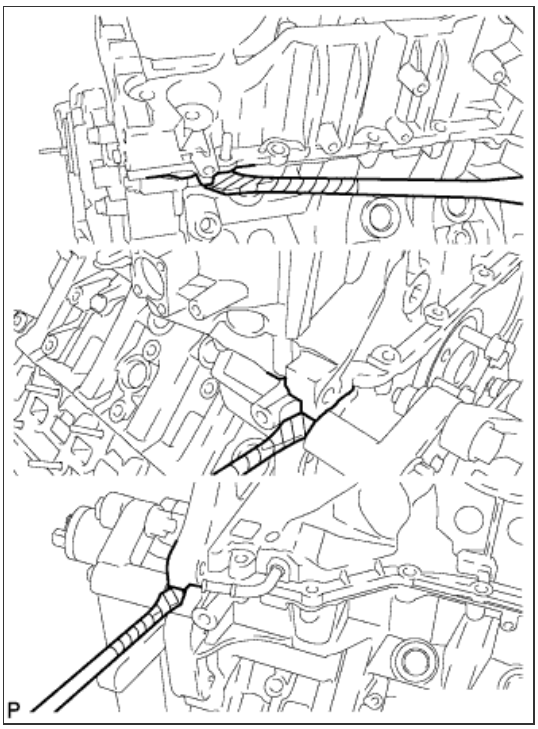
b. Remove the No. 1 oil pan by prying between the No. 1 oil pan and cylinder block with a screwdriver.

NOTICE:

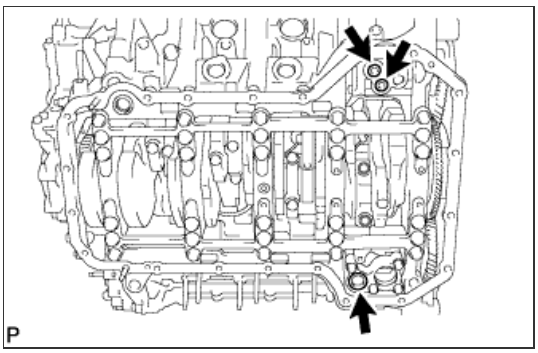
Be careful not to damage the contact surfaces of the cylinder block and oil pan.

HINT:

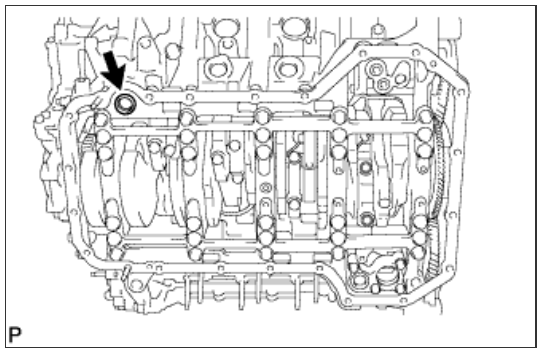
Tape the screwdriver tip before use.



c. Remove the 3 O-rings.

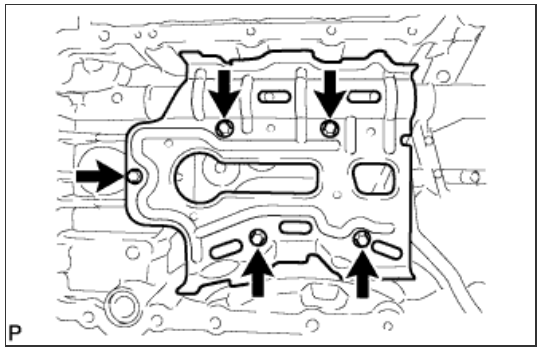


d. Remove the cylinder block oil hole gasket.



17. REMOVE NO. 1 OIL PAN BAFFLE PLATE

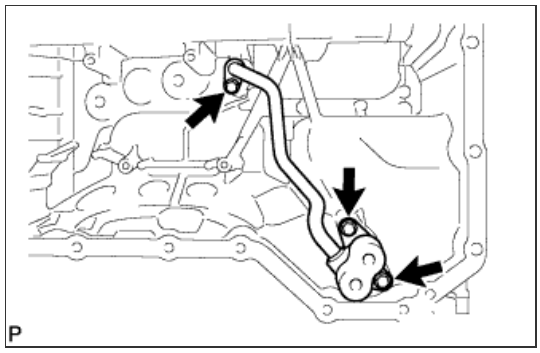
a. Remove the 5 bolts and No. 1 oil pan baffle plate.



1 . REMOVE INLET OIL PUMP PIPE

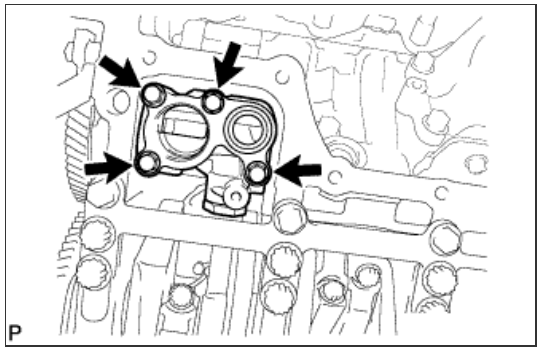
a. Remove the 3 bolts and inlet oil pump pipe.

b. Remove the O-ring from the inlet oil pump pipe.



19. REMOVE OIL REGULATOR ASSEMBLY

a. Remove the 4 bolts and oil regulator.



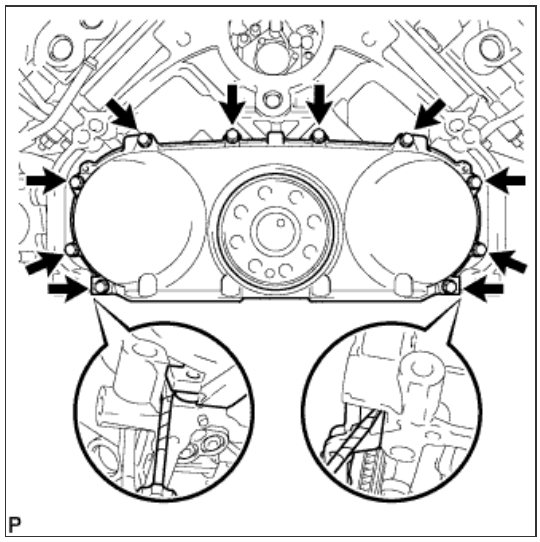
2 . REMOVE REAR ENGINE OIL SEAL RETAINER

a. Remove the 10 bolts.

b. Remove the oil seal retainer by prying between the oil seal retainer and cylinder block with a screwdriver.

HINT:

Tape the screwdriver tip before use.



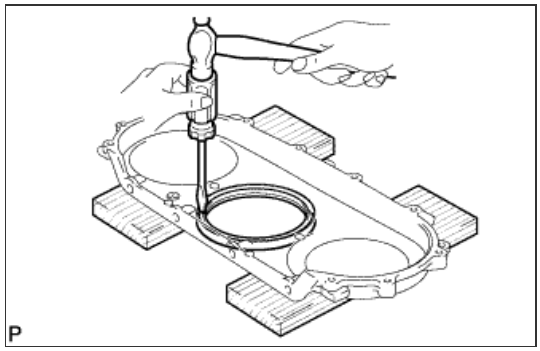
21. REMOVE REAR CRANKSHAFT OIL SEAL

a. Place the oil seal retainer on wooden blocks.

b. Using a screwdriver and hammer, tap out the oil seal.

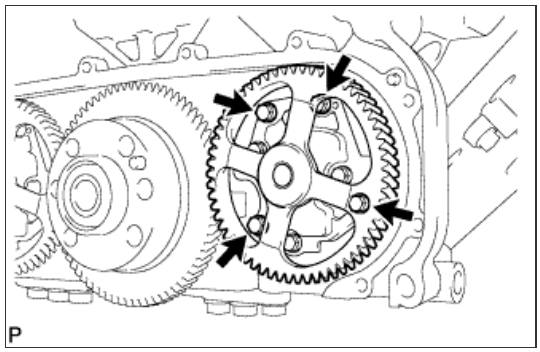
HINT:

Tape the screwdriver tip before use.



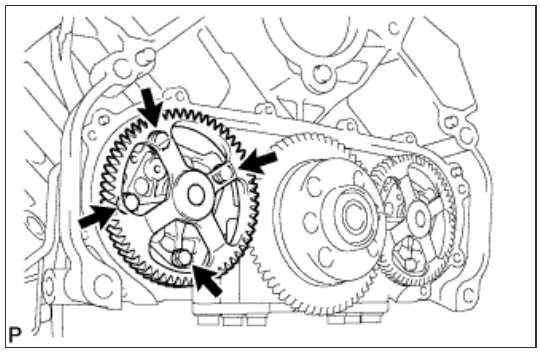
22. REMOVE OIL PUMP ASSEMBLY

a. Remove the 4 bolts and oil pump.

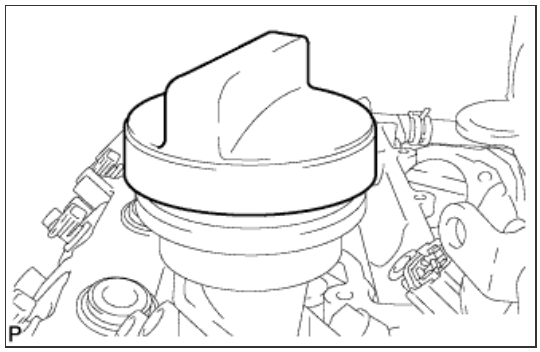


23. REMOVE SCAVENGING PUMP ASSEMBLY

a. Remove the 4 bolts and scavenging pump.



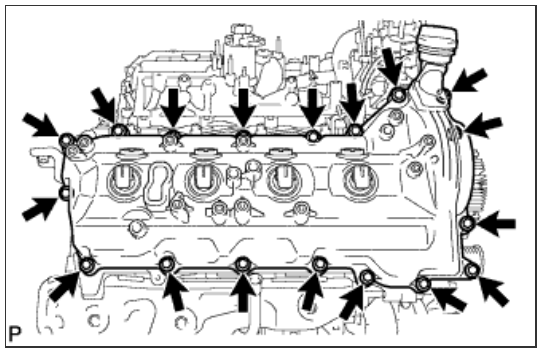
24. REMOVE OIL FILLER CAP SUB-ASSEMBLY



25. REMOVE OIL FILLER CAP GASKET

26. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY RH

a. Remove the 18 bolts, cylinder head cover and gasket.

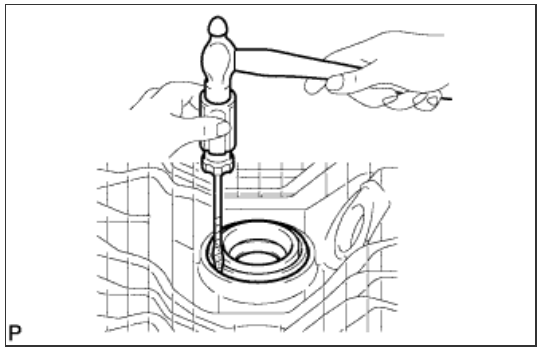


27. REMOVE NO LE HOLDER GASKET RH

a. Using a small screwdriver and hammer, remove the 4 nozzle holder gaskets.

HINT:

Tape the screwdriver tip before use.

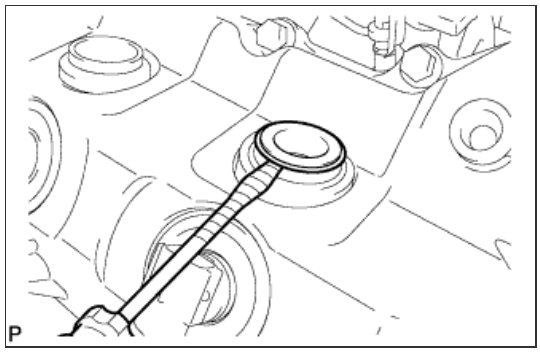


2 . REMOVE NO LE HOLDER SEAL RH

a. Using a small screwdriver, remove the 4 holder seals by prying the portion between each holder seal and the cutout part of the cylinder head cover.

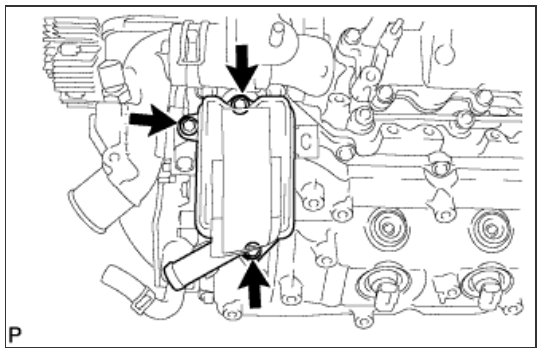
HINT:

Tape the screwdriver tip before use.



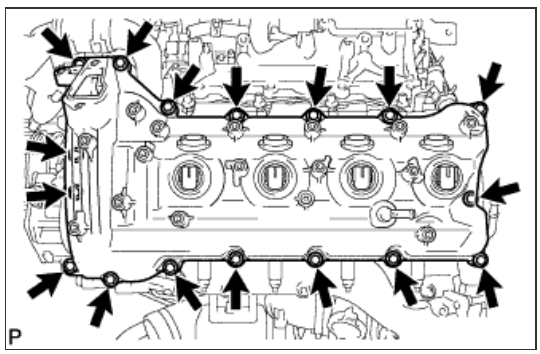
29. REMOVE OIL SEPARATOR ASSEMBLY

a. Remove the 3 bolts, oil separator and gasket.



3 . REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY LH

a. Remove the 17 bolts, cylinder head cover and gasket.

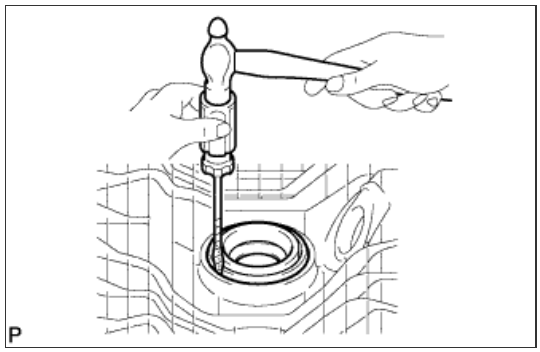


31. REMOVE NO LE HOLDER GASKET LH

a. Using a small screwdriver and hammer, remove the 4 nozzle holder gaskets.

HINT:

Tape the screwdriver tip before use.

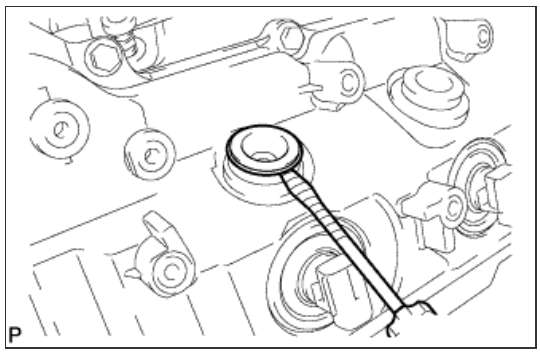


32. REMOVE NO LE HOLDER SEAL LH

a. Using a small screwdriver, remove the 4 holder seals by prying the portion between each holder seal and the cutout part of the cylinder head cover.

HINT:

Tape the screwdriver tip before use.

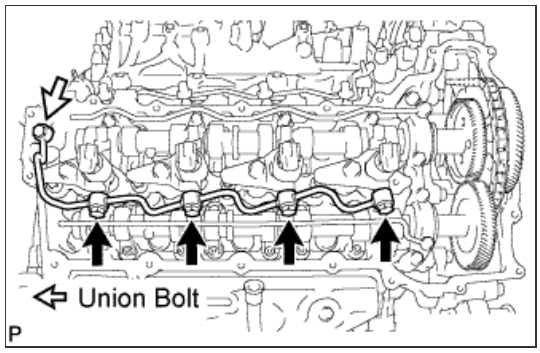


33. REMOVE FUEL IN ECTOR RH

a. Remove the union bolt, 4 hollow screws, 5 gaskets and nozzle leakage pipe.

NOTICE:

- **When remo ing the nozzle leakage pipe place a c hion nder the pipe.**
- **Be caref l not to deform or cratch the nion eal rface.**
- **After remo ing the nozzle leakage pipe p t it in a pla tic bag to pre ent foreign matter from contaminating it injector inlet.**



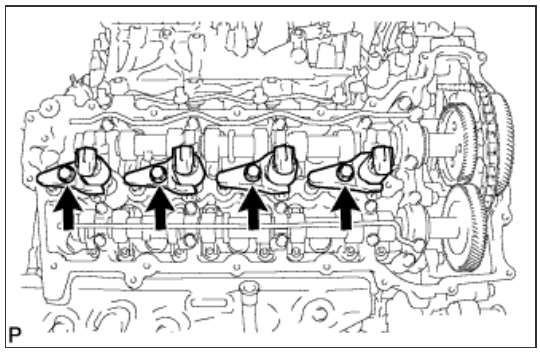
b. Remove the 4 bolts, 4 washers, 4 nozzle holder clamps and 4 injectors.

HINT:

Arrange the injectors, holder clamps, washers and bolts in the correct order.

c. Remove the O-ring from each injector.

d. Remove the 4 injection nozzle seats from the cylinder head.

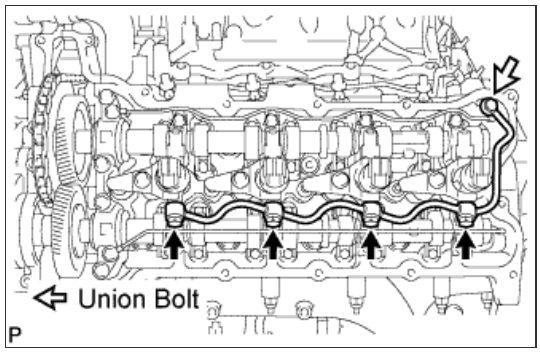


34. REMOVE FUEL IN ECTOR LH

a. Remove the union bolt, 4 hollow screws, 5 gaskets and No. 2 nozzle leakage pipe.

NOTICE:

- **When remo ing the nozzle leakage pipe place a c hion nder the pipe.**
- **Be caref l not to deform or cratch the nion eal rface.**
- **After remo ing the nozzle leakage pipe p t it in a pla tic bag to pre ent foreign matter from contaminating it injector inlet.**



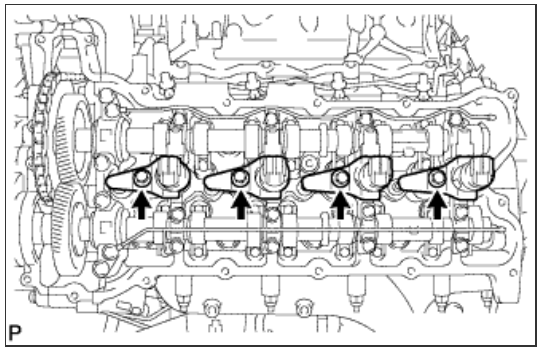
b. Remove the 4 bolts, 4 washers, 4 nozzle holder clamps and 4 injectors.

HINT:

Arrange the injectors, holder clamps, washers and bolts in the correct order.

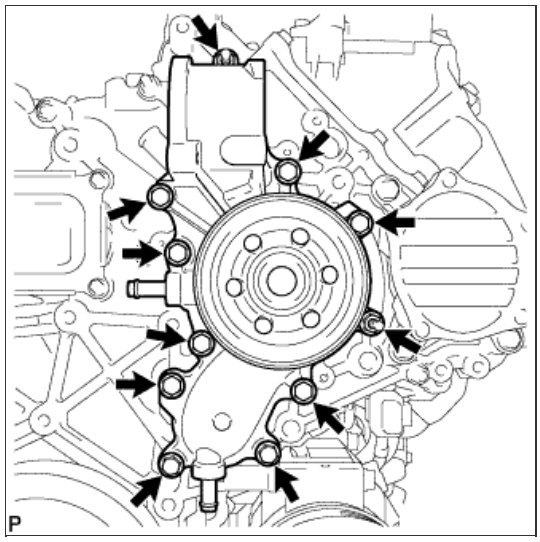
c. Remove the O-ring from each injector.

d. Remove the 4 injection nozzle seats from the cylinder head.



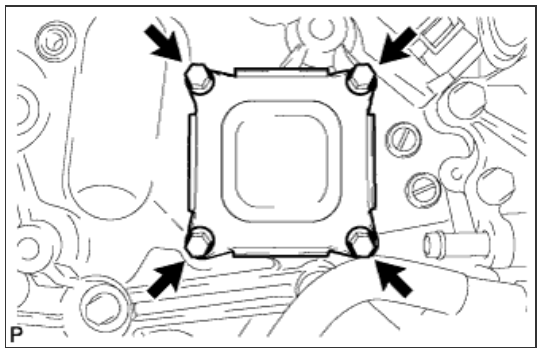
35. REMOVE WATER PUMP ASSEMBLY

a. Remove the 9 bolts, 2 nuts, water pump and gasket.



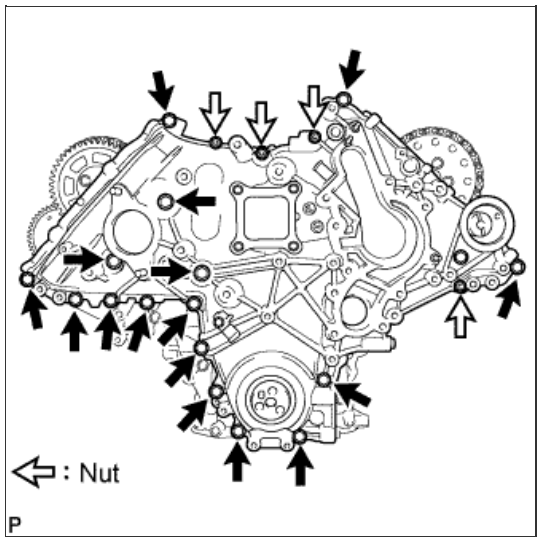
36. REMOVE TIMING CHAIN COVER PLATE

a. Remove the 4 bolts, timing chain cover plate and gasket.



37. REMOVE TIMING CHAIN COVER SUB-ASSEMBLY

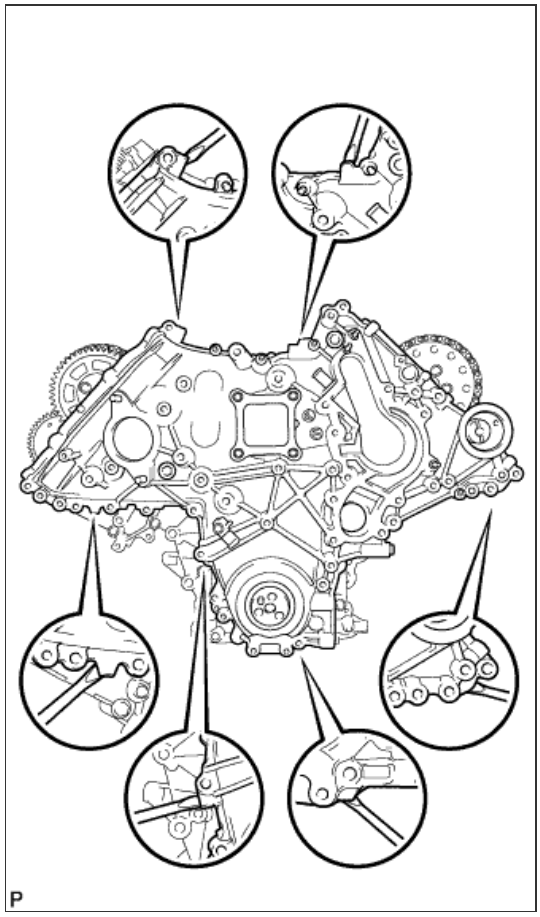
a. Remove the 4 nuts and 16 bolts.



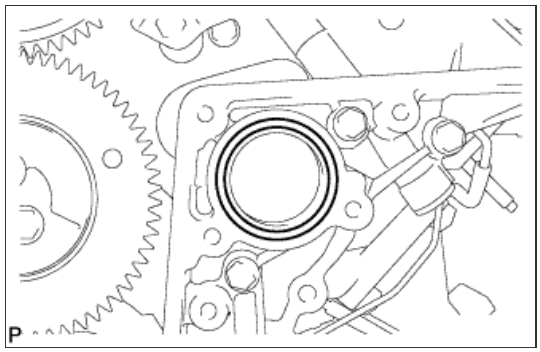
b. Using a screwdriver, remove the timing chain cover by prying between the timing chain cover and timing gear case.

HINT:

Tape the screwdriver tip before use.



c. Remove the O-ring from the timing gear case.



3 . REMOVE FRONT CRANKSHAFT OIL SEAL

a. Place the timing chain cover on wooden blocks.

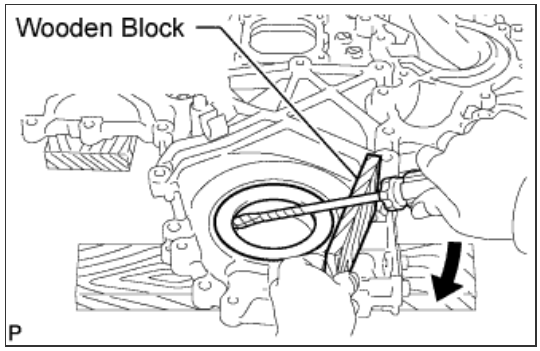
b. Using a screwdriver and wooden block, pry out the oil seal.

NOTICE:

Do not damage the surface of the oil seal press fit hole.

HINT:

Tape the screwdriver tip before use.

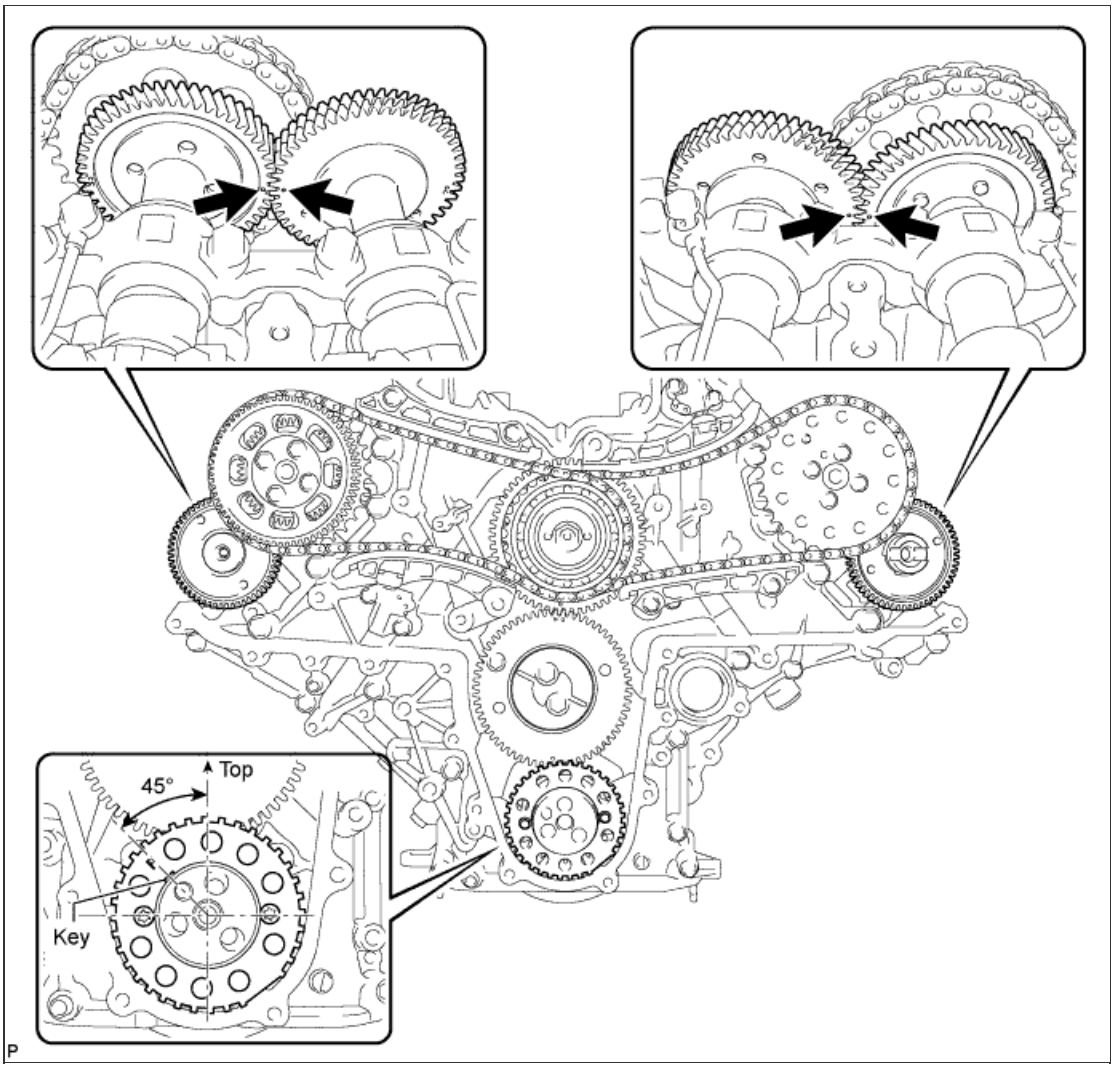


39. SET NO. 1 CYLINDER TO TDC/COMPRESSION

a. Temporarily install the 2 crankshaft pulley set bolts to the crankshaft.

b. Turn the crankshaft clockwise to set the No. 1 cylinder to TDC.

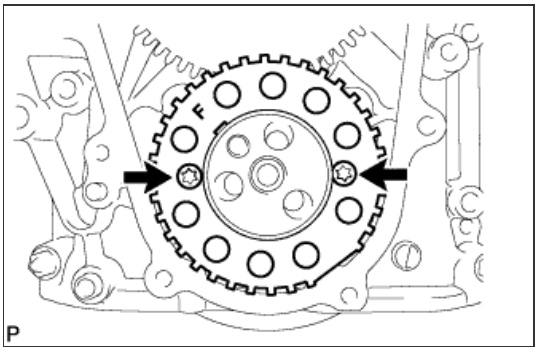
c. With the crankshaft key 45° counterclockwise from the top position, check that the timing marks of the RH and LH camshaft timing gears are aligned. If not as specified, turn the crankshaft 1 revolution (360°) and align the timing marks as shown below.



d. Remove the 2 crankshaft pulley set bolts.

4 . REMOVE NO. 1 CRANKSHAFT POSITION SENSOR PLATE

a. Using a T30 "TORX" wrench, remove the 2 screws and crankshaft position sensor plate.



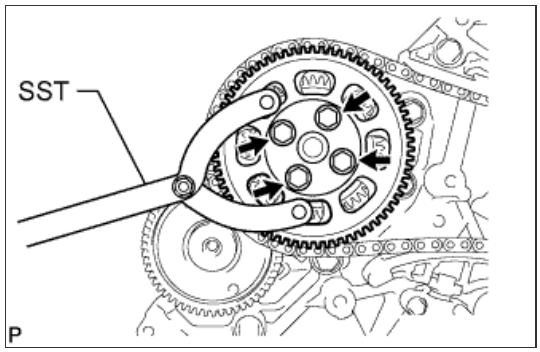
41. REMOVE PUMP DRIVE SHAFT GEAR

a. Using SST, hold the pump drive shaft gear.

SST

996 1 1 (9962- 1 9963- 1)

b. Remove the 4 bolts and pump drive shaft gear.

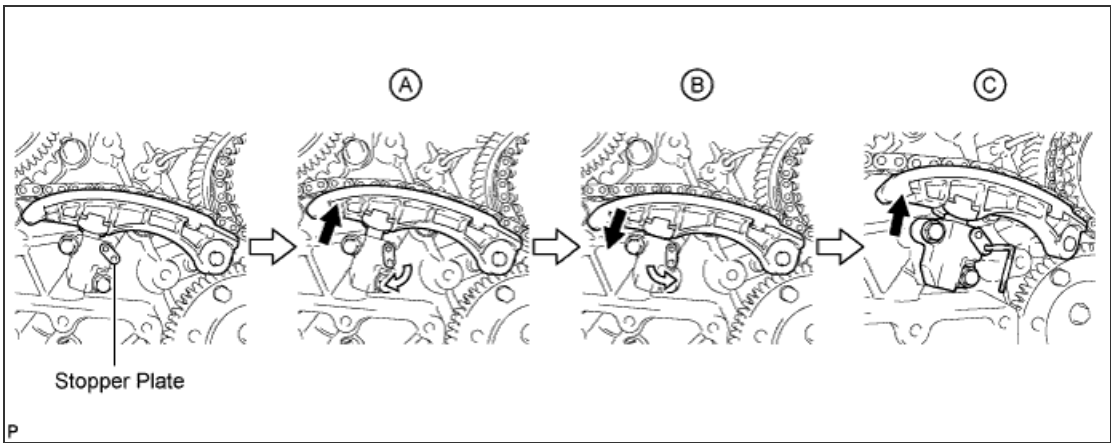


42. REMOVE NO. 1 CHAIN TENSIONER ASSEMBLY

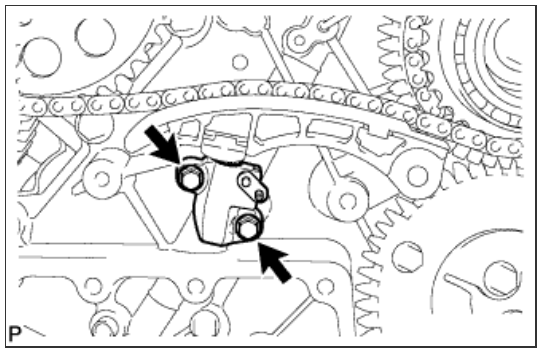
a. Push the tensioner slipper away from the tensioner, and move the stopper plate clockwise to release the lock as shown in A.

b. Push down the tensioner slipper and move the stopper plate counterclockwise to set the lock as shown in B.

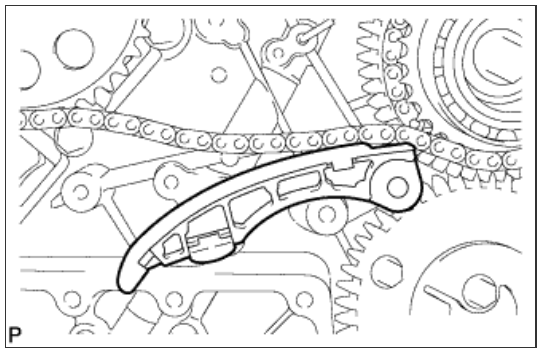
c. Push the tensioner slipper away from the tensioner, and insert a hexagon wrench into the stopper plate hole as shown in C.



d. Remove the 2 bolts and No. 1 chain tensioner.

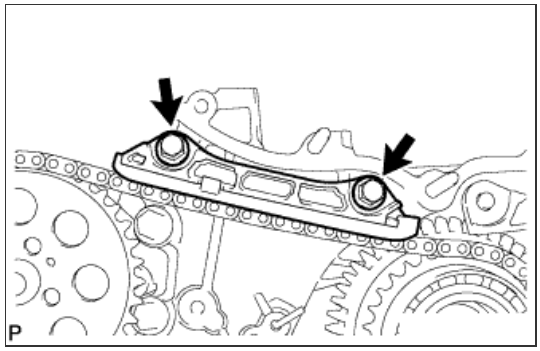


43. REMOVE NO. 1 CHAIN TENSIONER SLIPPER

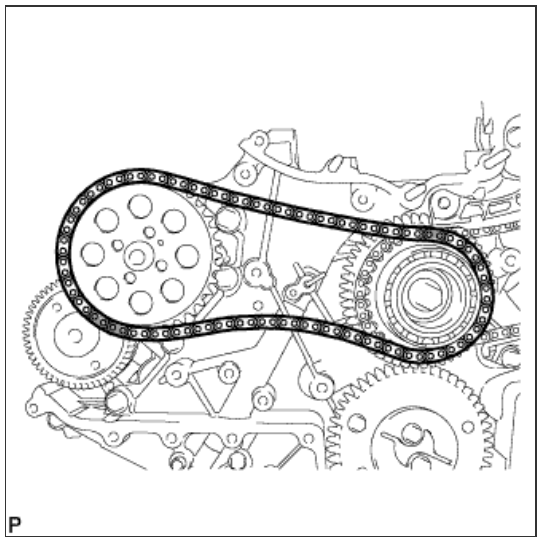


44. REMOVE NO. 1 CHAIN VIBRATION DAMPER

a. Remove the 2 bolts and No. 1 chain vibration damper.



45. REMOVE NO. 1 CAMSHAFT TIMING SPROCKET AND NO. 1 TIMING CHAIN

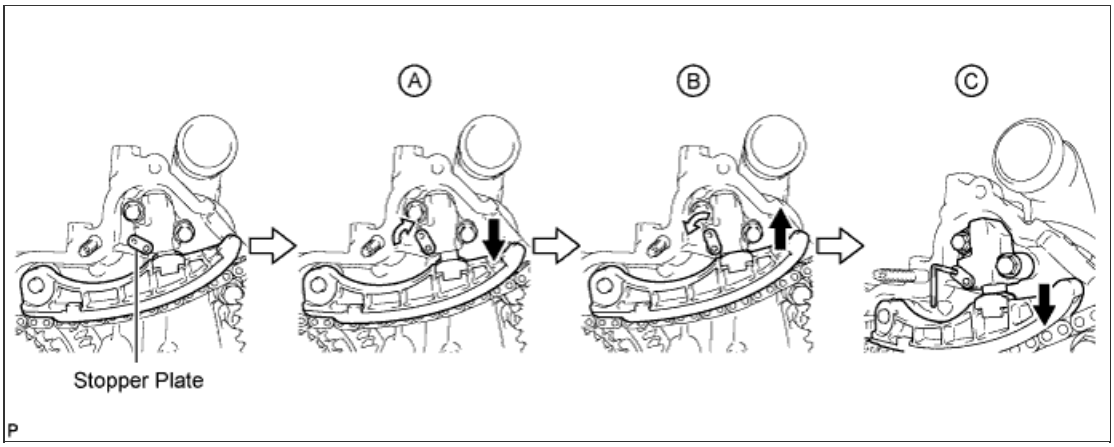


46. REMOVE NO. 2 CHAIN TENSIONER ASSEMBLY

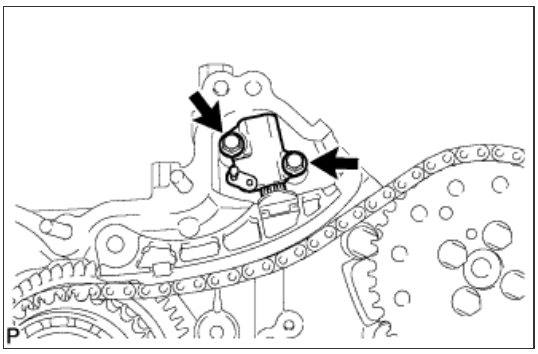
a. Push the tensioner slipper away from the tensioner, and move the stopper plate clockwise to release the lock as shown in A.

b. Push up the tensioner slipper and move the stopper plate counterclockwise to set the lock as shown in B.

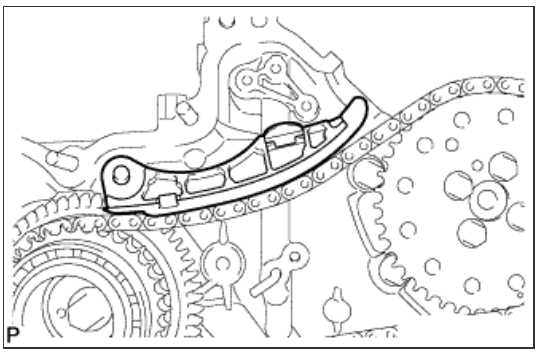
c. Push the tensioner slipper away from the tensioner, and insert a hexagon wrench into the stopper plate hole as shown in C.



d. Remove the 2 bolts and No. 2 chain tensioner.

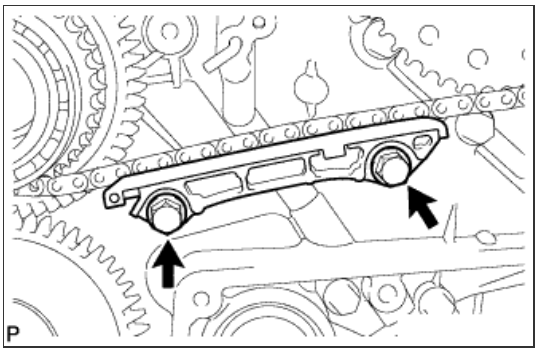


47. REMOVE NO. 2 CHAIN TENSIONER SLIPPER



4 . REMOVE NO. 2 CHAIN VIBRATION DAMPER

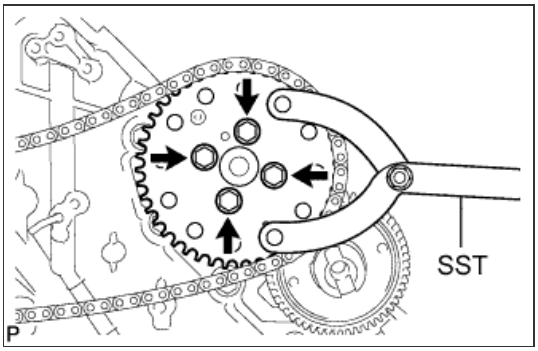
a. Remove the 2 bolts and No. 2 chain vibration damper.



49. REMOVE NO. 2 CAMSHAFT TIMING SPROCKET AND NO. 2 TIMING CHAIN

a. Using SST, hold the No. 2 camshaft timing sprocket.

SST
996 1 1 (9962- 1 9963- 1)



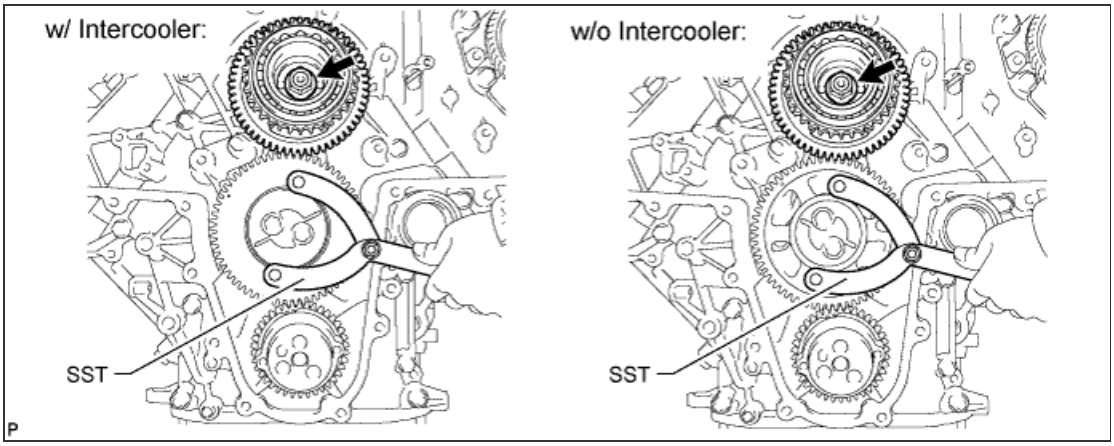
b. Remove the 4 bolts, No. 2 camshaft timing sprocket and No. 2 timing chain.

5 . REMOVE FUEL SUPPLY PUMP DRIVE GEAR NUT

a. Using SST, hold the idle gear.

SST
996 1 1 (9962- 1 9963- 7)

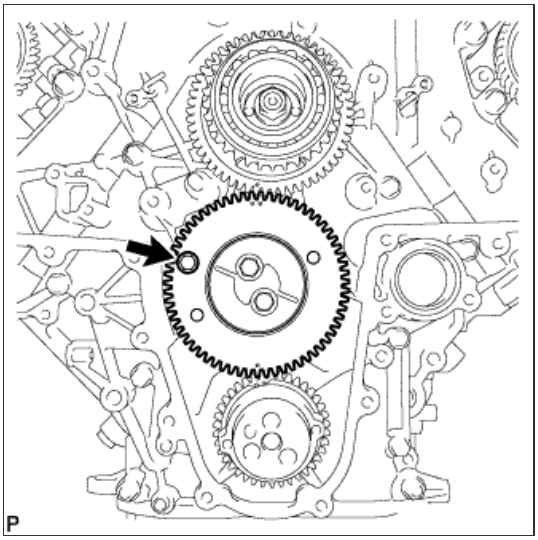
b. Remove the nut.



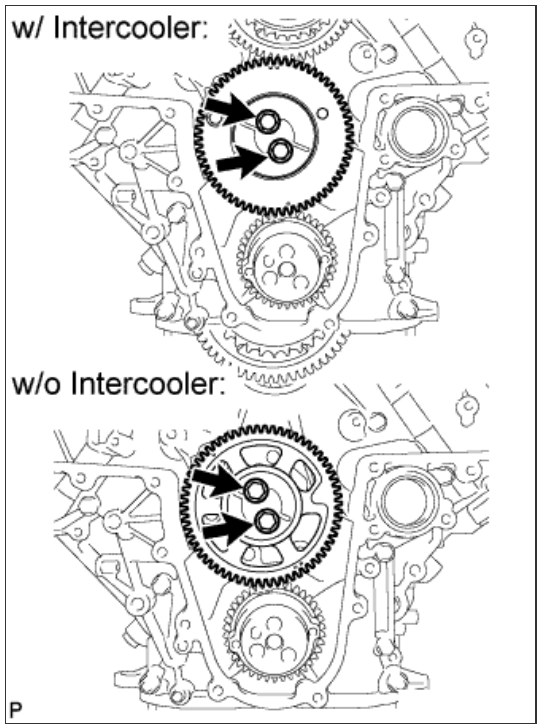
51. REMOVE IDLE GEAR ASSEMBLY

a. w/ Intercooler:
Using a 8 mm x 1.25 pitch bolt with a length of 15 mm or more, fix the idle gear in place.

Torq e:
13 N*m{ 133 kgf*cm 1 ft.*lbf }



b. Remove the 2 bolts, idle gear thrust plate and idle gear.

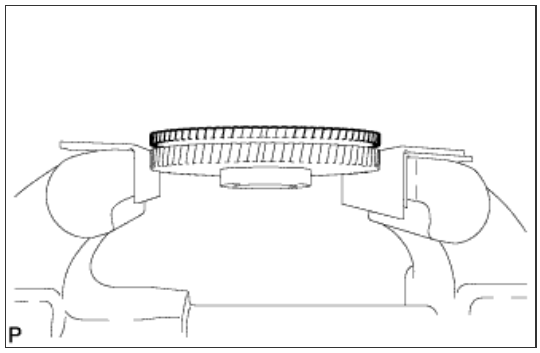


52. SEPARATE SUB IDLE GEAR IDLE GEAR SPRING AND IDLE GEAR (w/ Intercooler)

a. Hold the idle gear in a vise between aluminum plates.

NOTICE:

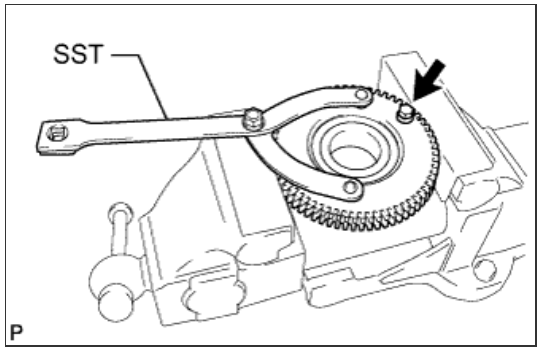
Be careful not to damage the gears.



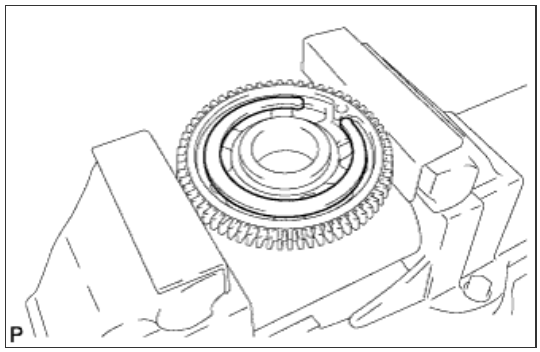
b. Using SST, hole the idle gear, and remove the bolt and sub idle gear.

SST

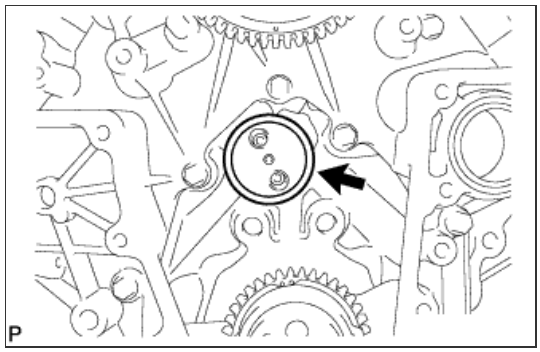
996 1 1 (9962- 1 9963- 7)



c. Remove the idle gear spring from the idle gear.



53. REMOVE NO. 1 IDLE GEAR SHAFT

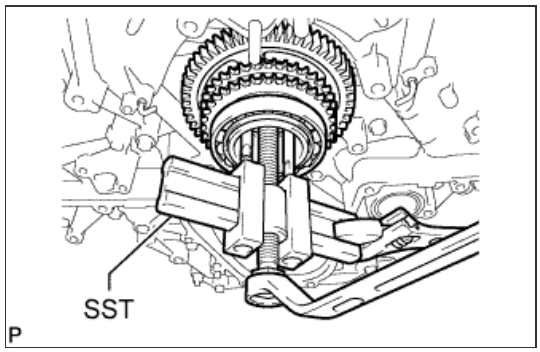


54. REMOVE FUEL SUPPLY PUMP DRIVE GEAR

a. Using SST, remove the fuel supply pump drive gear.

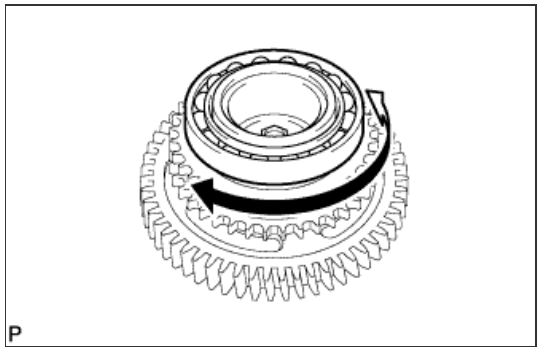
SST

995 5 13 (9951- 5 1 9952- 5 1 9953- 5 2 9954- 5 31)



55. INSPECT RADIAL BALL BEARING

a. Turn the bearing, and check that the bearing moves smoothly and quietly.
If it moves roughly or noisily, replace the radial ball bearing.



56. REMOVE RADIAL BALL BEARING

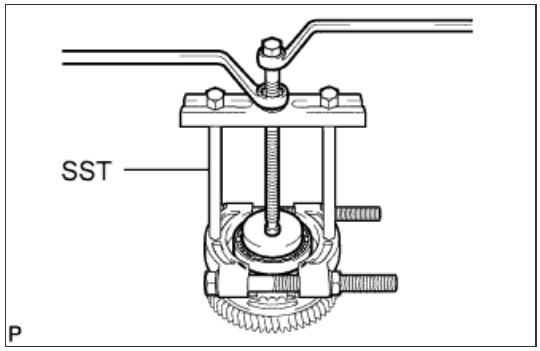
HINT:

It is not necessary to remove the bearing unless it is being replaced.

a. Using SST, remove the radial ball bearing.

SST

995		2		
995		3		
995	6	1	(9951-	5)
995	4	11	(9957-	4 1)



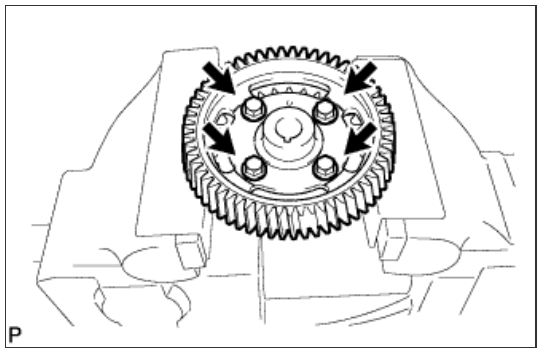
57. SEPARATE FUEL SUPPLY PUMP DRIVE GEAR AND FUEL SUPPLY PUMP SHAFT SPROCKET

a. Hold the fuel supply pump shaft sprocket in a vise between aluminum plates.

NOTICE:

Be careful not to damage the gears.

b. Remove the 4 bolts and separate the fuel supply pump drive gear and fuel supply pump shaft sprocket.

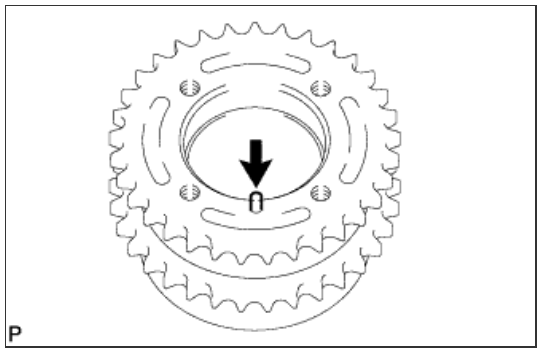


5 . REMOVE STRAIGHT PIN

HINT:

It is not necessary to remove the straight pin unless it is being replaced.

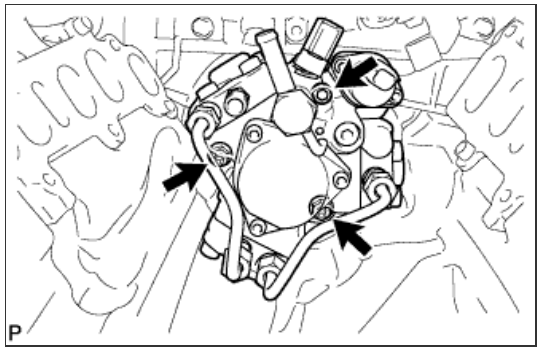
a. Remove the straight pin.



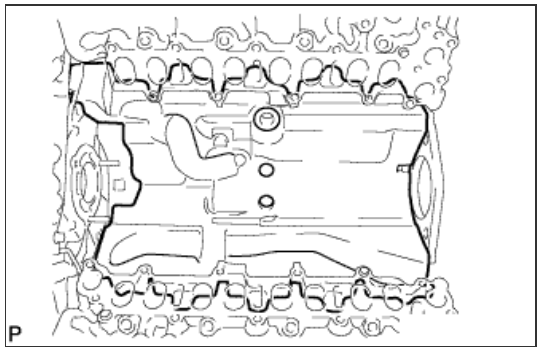
59. REMOVE FUEL SUPPLY PUMP ASSEMBLY

a. Using a 6 mm hexagon wrench, remove the hexagon bolt. Then remove the 2 nuts and fuel supply pump.

b. Remove the O-ring.

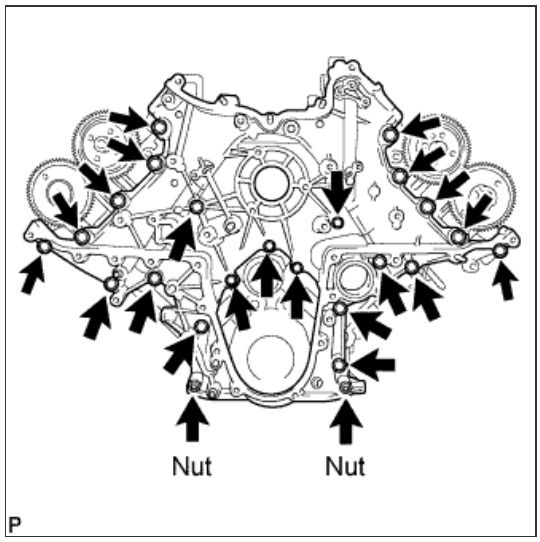


6 . REMOVE V-BANK SILENCER

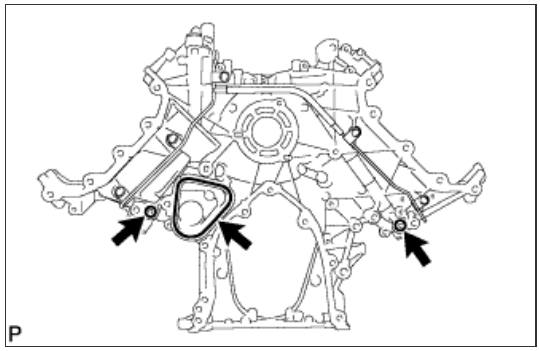


61. REMOVE TIMING GEAR CASE SUB-ASSEMBLY

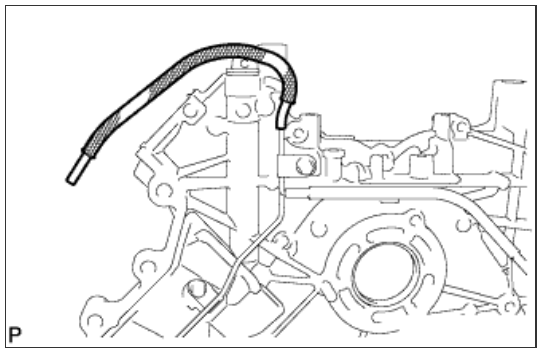
a. Remove the 22 bolts, 2 nuts and timing gear case shown in the illustration.



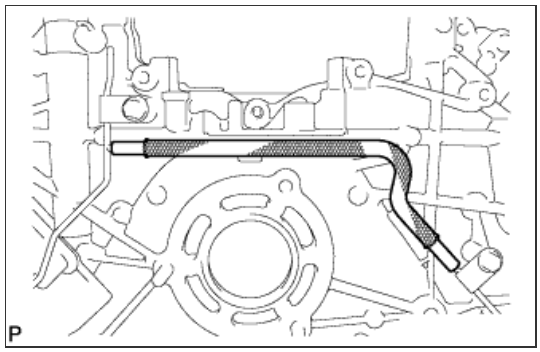
b. Remove the 2 O-rings and timing gear case gasket.



62. DISCONNECT NO. 2 VACUUM TRANSMITTING HOSE (w/ Intercooler)

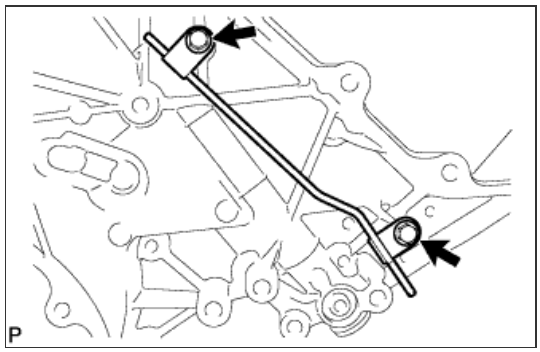


63. DISCONNECT NO. 3 VACUUM TRANSMITTING HOSE (w/ Intercooler)



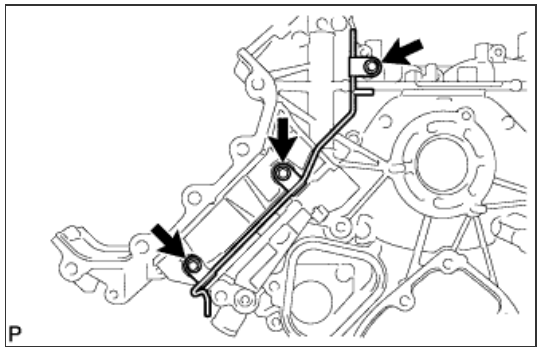
64. REMOVE NO. 1 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY (w/ Intercooler)

a. Remove the 2 bolts and No. 1 vacuum transmitting pipe.

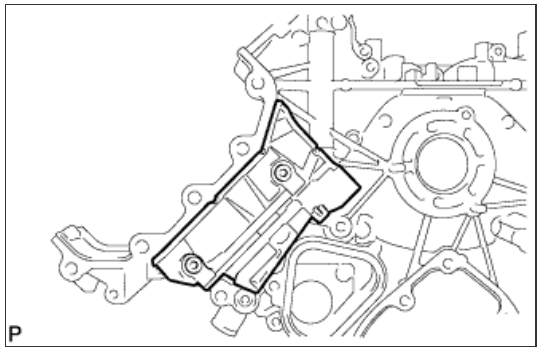


65. REMOVE NO. 2 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY (w/ Intercooler)

a. Remove the 3 bolts and No. 2 vacuum transmitting pipe.



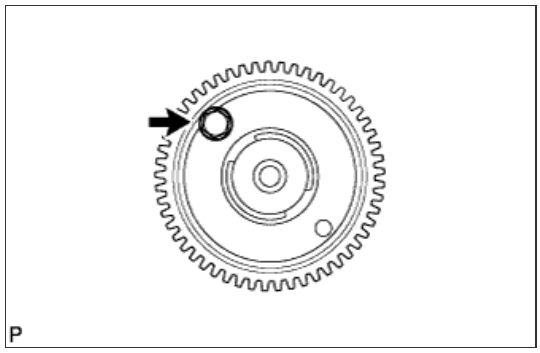
66. REMOVE NO. 2 TIMING GEAR CASE INSULATOR (w/ Intercooler)



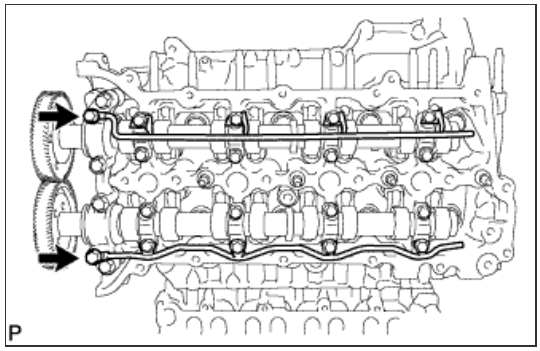
67. REMOVE NO. 1 AND NO. 2 CAMSHAFTS

a. Using a 6 mm x 1.0 pitch service bolt with a length of 16 mm or more, fix the No. 1 camshaft in place.

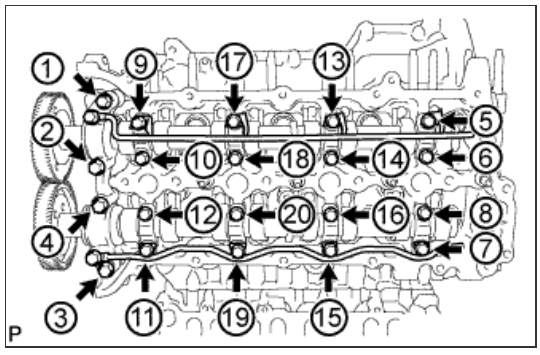
Torq e:
. N*m{ 2 kgf*cm 71 in.*lbf }



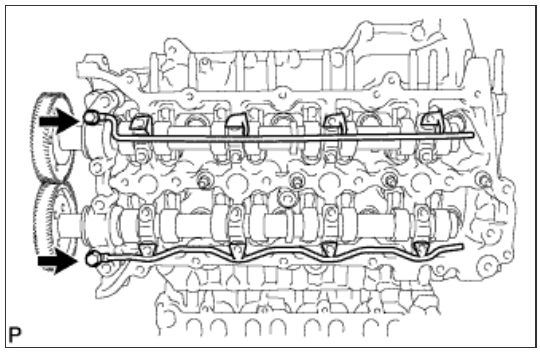
b. Loosen the 2 union bolts.



c. Uniformly loosen and remove the 20 bolts in the sequence shown in the illustration.



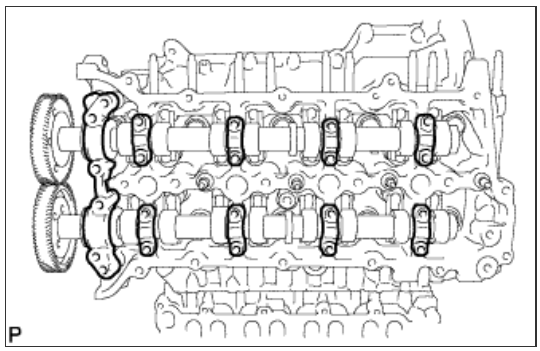
d. Remove the 2 union bolts and No. 1 and No. 2 oil feed pipes.



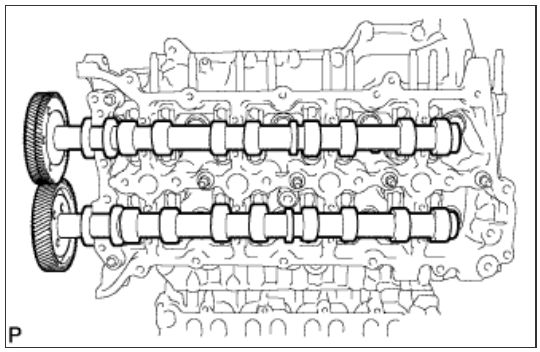
e. Remove the 8 No. 3 camshaft bearing caps and No. 1 camshaft bearing cap.

HINT:

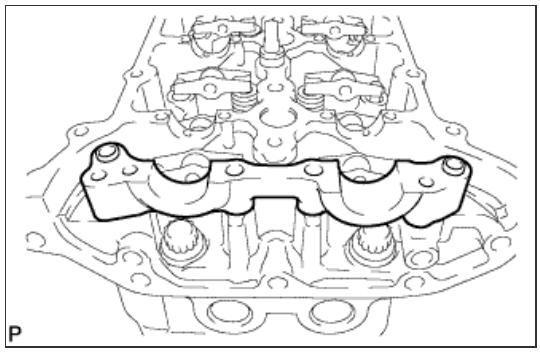
Be sure to arrange the removed parts for each installation position separately.



f. Remove the No. 1 and No. 2 camshafts.



6 . REMOVE NO. 2 CAMSHAFT BEARING CAP

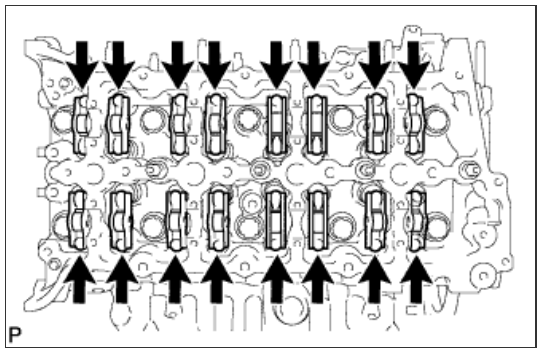


69. REMOVE NO. 1 VALVE ROCKER ARM

a. Remove the 16 No. 1 valve rocker arms.

HINT:

Be sure to arrange the removed parts for each installation position separately.

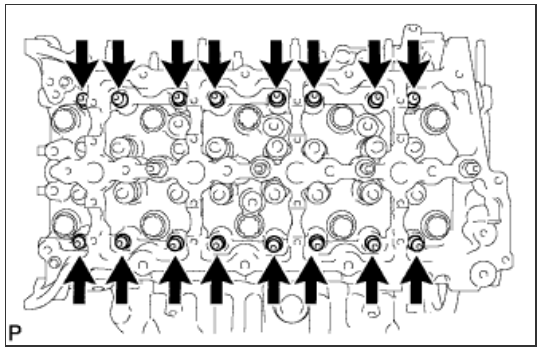


7 . REMOVE NO. 1 VALVE LASH AD USTER ASSEMBLY

a. Remove the 16 No. 1 valve lash adjusters.

HINT:

Be sure to arrange the removed parts for each installation position separately.

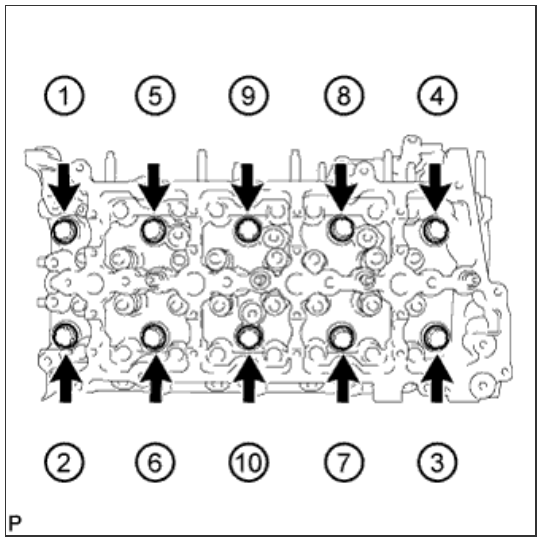


71. REMOVE CYLINDER HEAD SUB-ASSEMBLY RH

a. Uniformly loosen and remove the 10 bolts and 10 spacers in the sequence shown in the illustration. Then remove the cylinder head.

NOTICE:

- **Be caref l not to drop wa her into the c linder head.**
- **Head warpage or cracking co ld re lt from remo ing bolt in an incorrect order.**



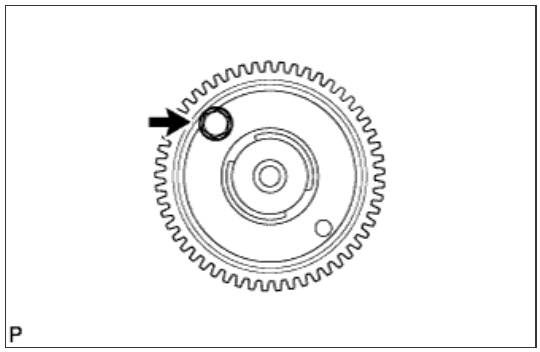
72. REMOVE NO. 1 CYLINDER HEAD GASKET

73. REMOVE NO. 3 AND NO. 4 CAMSHAFTS

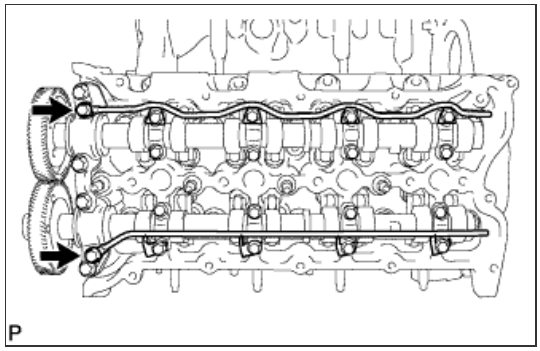
a. Using a 6 mm x 1.0 pitch service bolt with a length of 16 mm or more, fix the No. 4 camshaft in place.

Torq e:

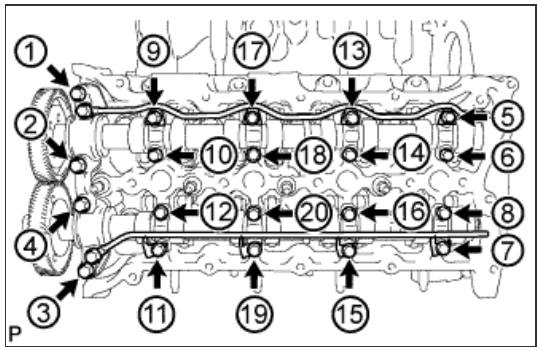
. N*m{ 2 kgf*cm 71 in.*lbf }



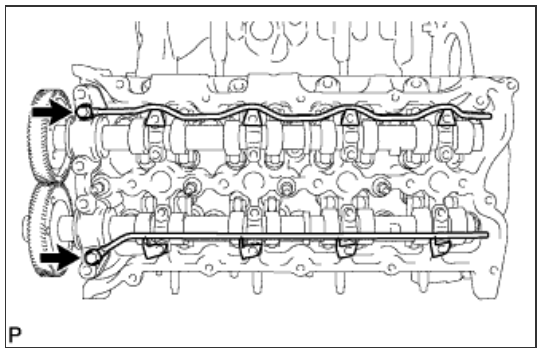
b. Loosen the 2 union bolts.



c. Uniformly loosen and remove the 20 bolts in the sequence shown in the illustration.



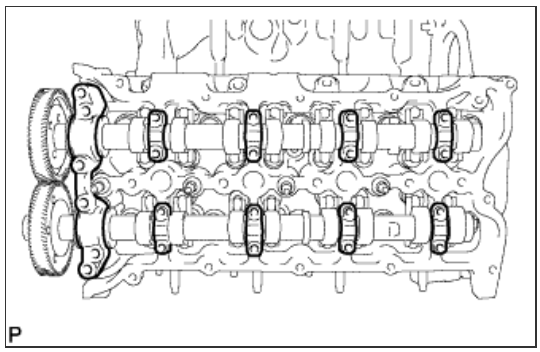
d. Remove the 2 union bolts and No. 3 and No. 4 oil feed pipes.



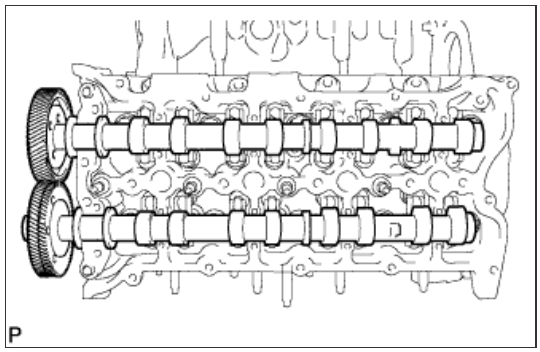
e. Remove the 8 No. 3 camshaft bearing caps and No. 4 camshaft bearing cap.

HINT:

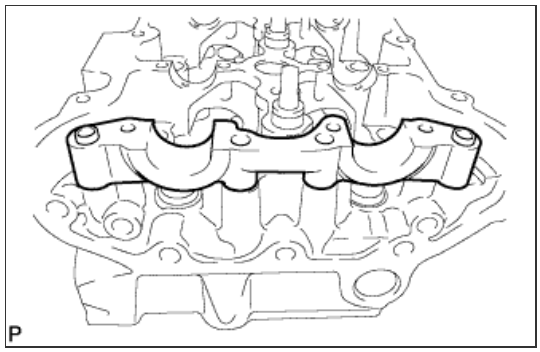
Be sure to arrange the removed parts for each installation position separately.



f. Remove the No. 3 and No. 4 camshafts.



74. REMOVE NO. 5 CAMSHAFT BEARING CAP

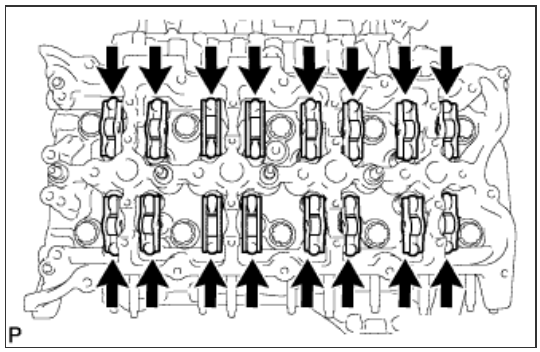


75. REMOVE NO. 2 VALVE ROCKER ARM

a. Remove the 16 No. 2 valve rocker arms.

HINT:

Be sure to arrange the removed parts for each installation position separately.

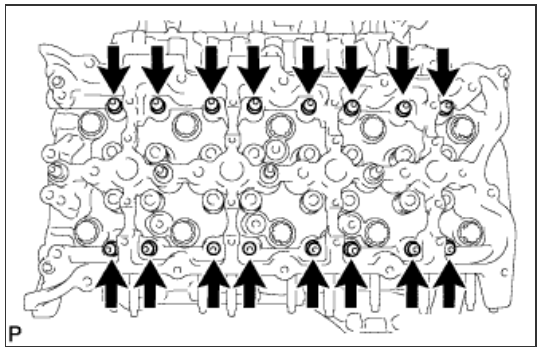


76. REMOVE NO. 2 VALVE LASH AD USTER ASSEMBLY

a. Remove the 16 No. 2 valve lash adjusters.

HINT:

Be sure to arrange the removed parts for each installation position separately.

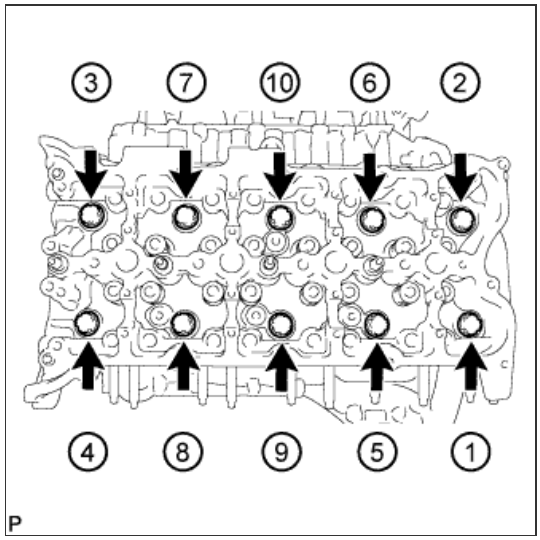


77. REMOVE CYLINDER HEAD SUB-ASSEMBLY LH

a. Uniformly loosen and remove the 10 bolts and 10 spacers in the sequence shown in the illustration. Then remove the cylinder head.

NOTICE:

- **Be caref l not to drop wa her into the c linder head.**
- **Head warpage or cracking co ld re lt from remo ing bolt in an incorrect order.**



7 . REMOVE NO. 2 CYLINDER HEAD GASKET

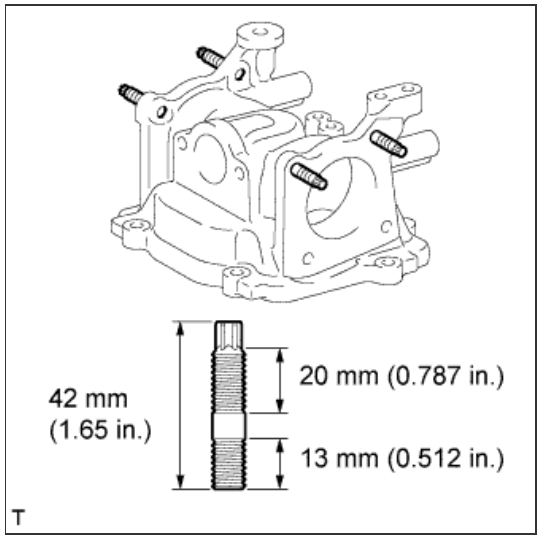
79. REPLACE STUD BOLT

HINT:

If the stud bolt is deformed or the threads are damaged, replace it.

a. Intake Pipe:

i. Using an E8 "TORX" wrench, replace the 4 stud bolts.



b. No. 3 Intake anifold:

i. Using an E8 "TORX" wrench, replace the 2 stud bolts labeled A.

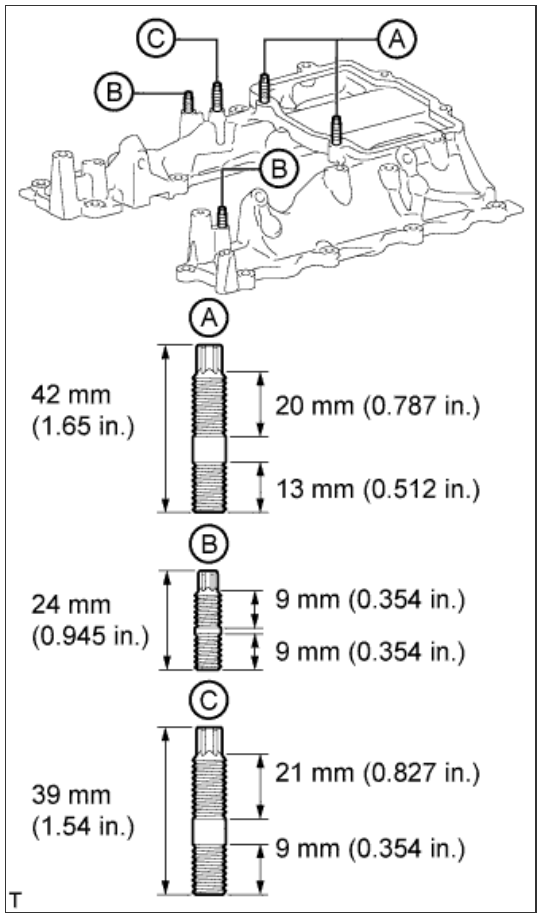
Torq e:
6. N*m{ 61 kgf*cm 53 in.*lbf }

ii. Using an E6 "TORX" wrench, replace the 2 stud bolts labeled B.

Torq e:
4.5 N*m{ 46 kgf*cm 4 in.*lbf }

iii. Using an E6 "TORX" wrench, replace the stud bolt labeled C.

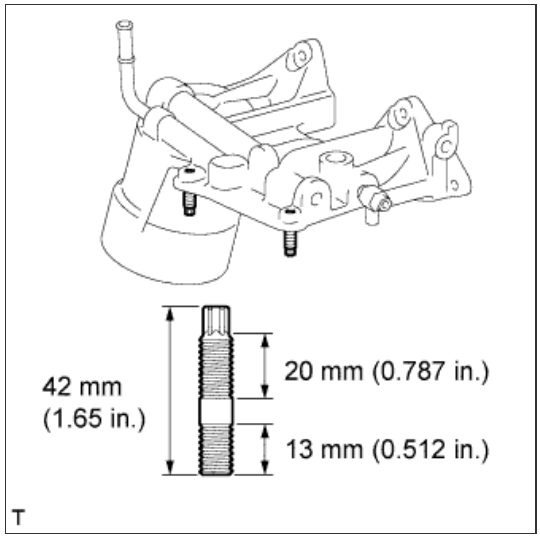
Torq e:
4. N*m{ 41 kgf*cm 35 in.*lbf }



c. Oil Filter Bracket:

i. Using an E8 "TORX" wrench, replace the 2 stud bolts.

Torq e:
6. N*m{ 61 kgf*cm 53 in.*lbf }



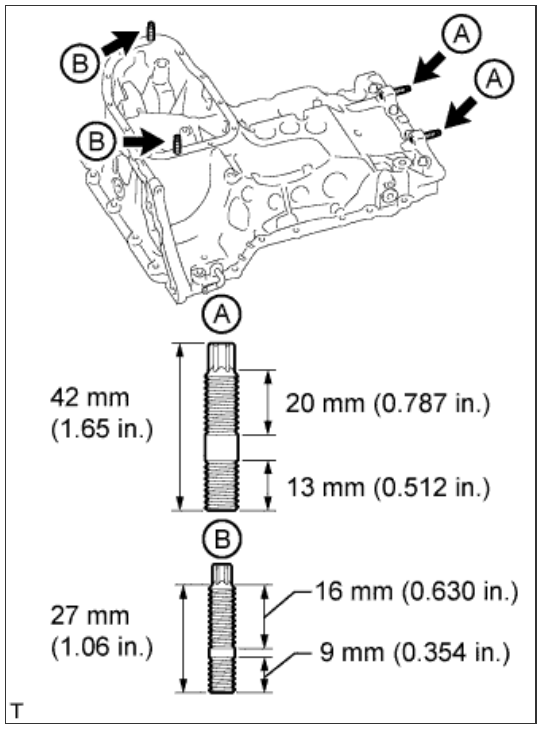
d. No. 1 Oil Pan:

i. Using an E8 "TORX" wrench, replace the 2 stud bolts labeled A.

Torq e:
6. N*m{ 61 kgf*cm 53 in.*lbf }

ii. Using an E7 "TORX" wrench, replace the 2 stud bolts labeled B.

Torq e:
5.2 N*m{ 53 kgf*cm 46 in.*lbf }



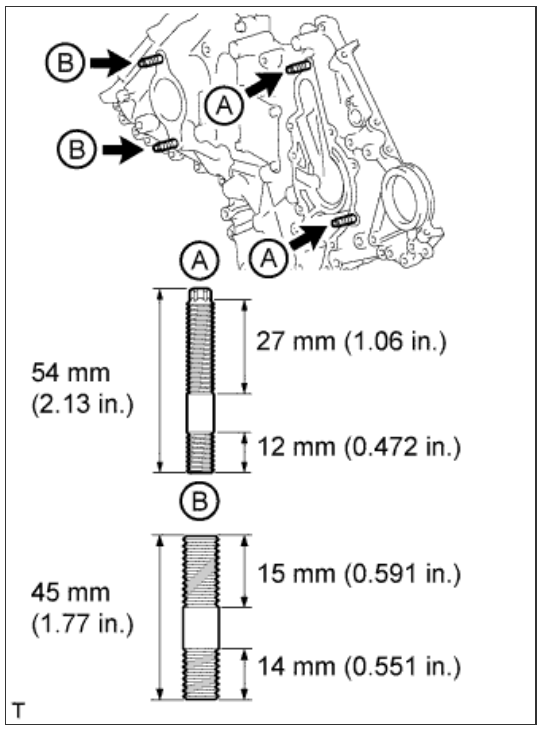
e. Timing Chain Cover:

i. Using an E7 "TORX" wrench, replace the 2 stud bolts labeled A.

Torq e:
6. N*m{ 61 kgf*cm 53 in.*lbf }

ii. Replace the 2 stud bolts labeled B.

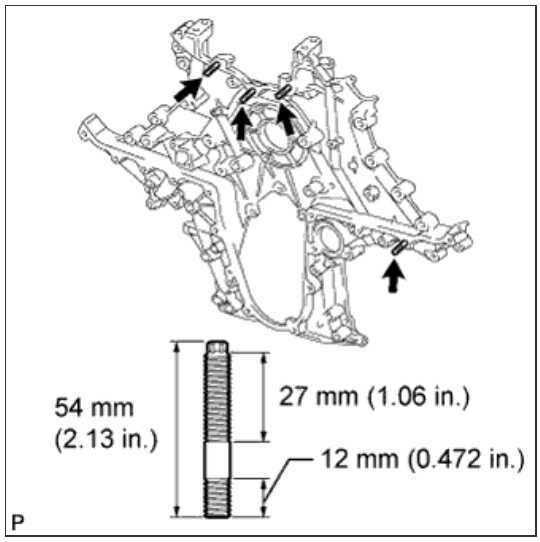
Torq e:
12 N*m{ 12 kgf*cm 9 ft.*lbf }



f. Timing ear Case:

i. Using an E7 "TORX" wrench, replace the 4 stud bolts.

Torq e:
6. N*m{ 61 kgf*cm 53 in.*lbf }



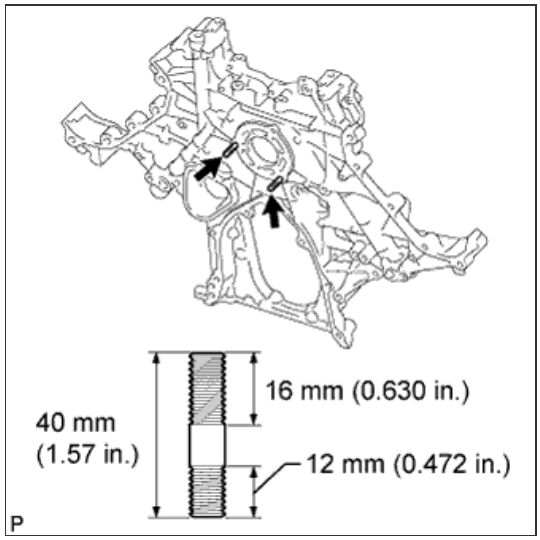
ii. Remove the 2 stud bolts.

iii. Remove the adhesive from the threads of the timing gear case.

i . Apply adhesive to 2 or more threads of the 2 stud bolts.

. Install the 2 stud bolts.

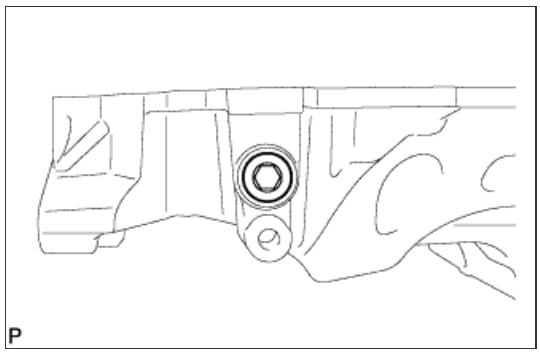
Torq e:
1 N*m{ 1 2 kgf*cm 7 ft.*lbf }



. REPLACE STRAIGHT SCREW PLUG

HINT:

If water or oil leaks from the straight screw plug or the plug is corroded, replace it.



a. No. 1 Oil Pan:

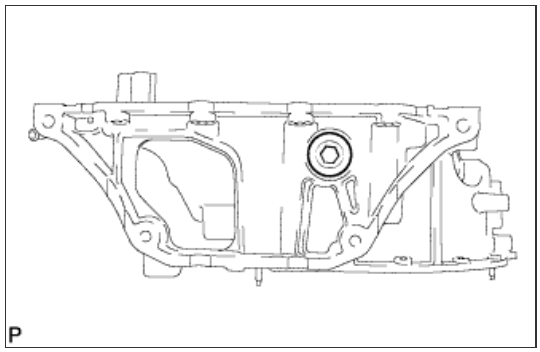
i. Using a 10 mm hexagon wrench, replace the straight screw plug and/or gasket.

Torq e:
5 N*m{ 51 kgf*cm 37 ft.*lbf }

ii. Using a 14 mm hexagon wrench, replace the straight screw plug

and/or gasket.

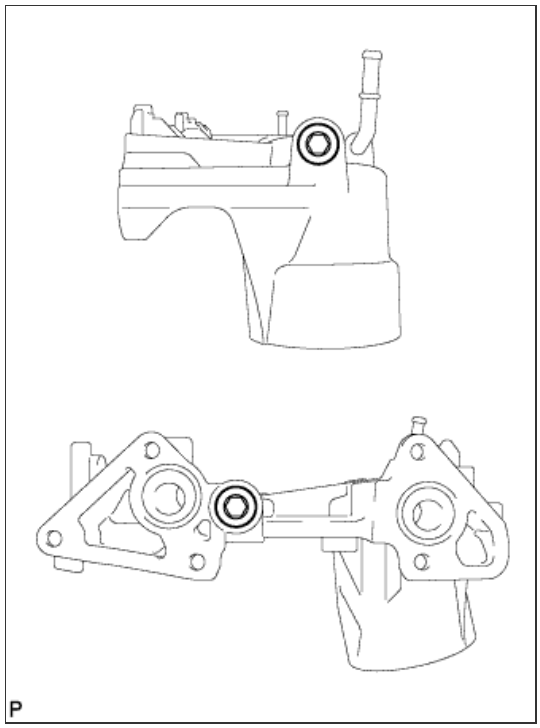
Torq e:
6 N*m{ 77 kgf*cm 63 ft.*lbf }



b. Oil Filter Bracket:

i. Using a 10 mm hexagon wrench, replace the straight screw plug and/or gasket.

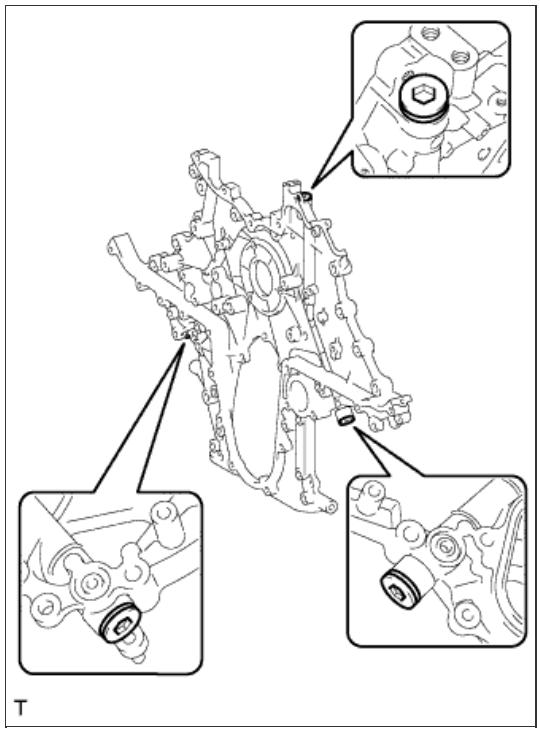
Torq e:
5 N*m{ 51 kgf*cm 37 ft.*lbf }



c. Timing ear Case:

i. Using a 10 mm hexagon wrench, replace the straight screw plug and/or gasket.

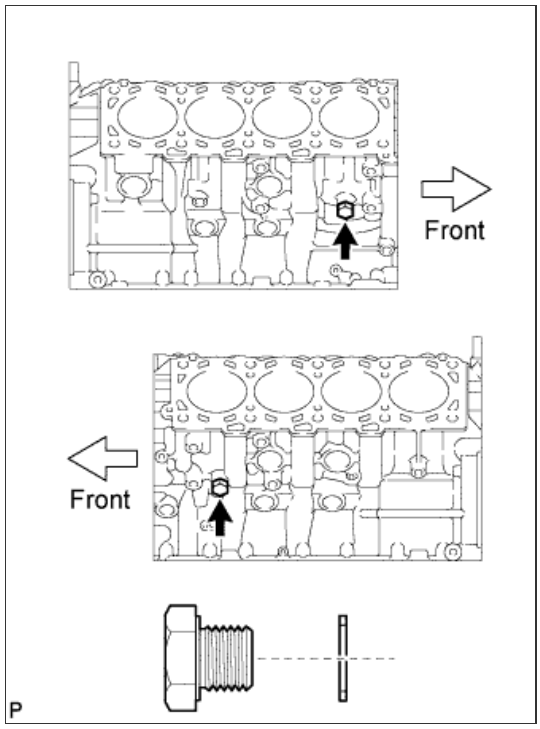
Torq e:
4 N*m{ 4 kgf*cm 3 ft.*lbf }



1. REPLACE CYLINDER BLOCK STRAIGHT SCREW PLUG

HINT:

If water leaks from the straight screw plug or the plug is corroded, replace it.



a. Replace the 2 straight screw plugs and 2 gaskets.

Torq e:
3 N*m{ 3 7 kgf*cm 2 ft.*lbf }

2. REPLACE RING PIN

HINT:

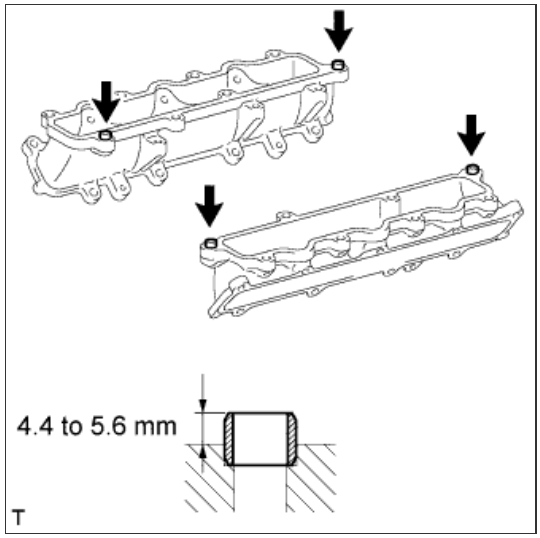
It is not necessary to remove the ring pin unless it is being replaced.

a. No. 1 and No. 2 Intake anifold:

i. Replace the ring pin.

Standard protr ion:

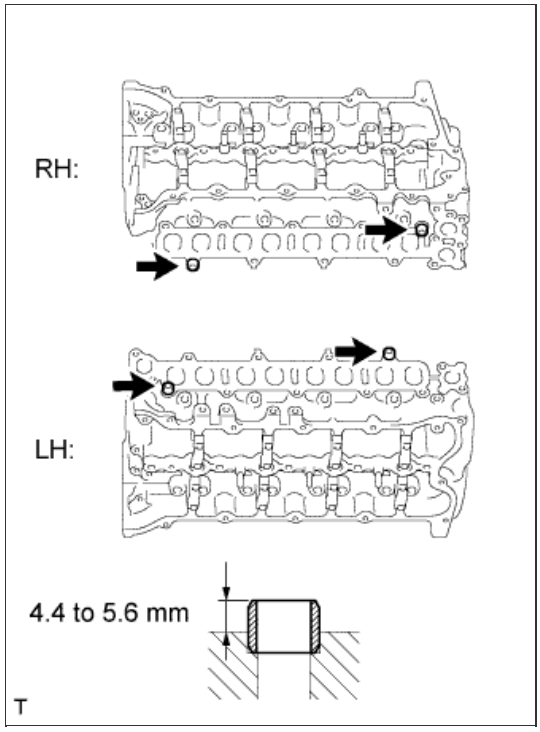
4.4 to 5.6 mm (.173 to .222 in.)



b. Cylinder Head:

i. Replace the ring pin.

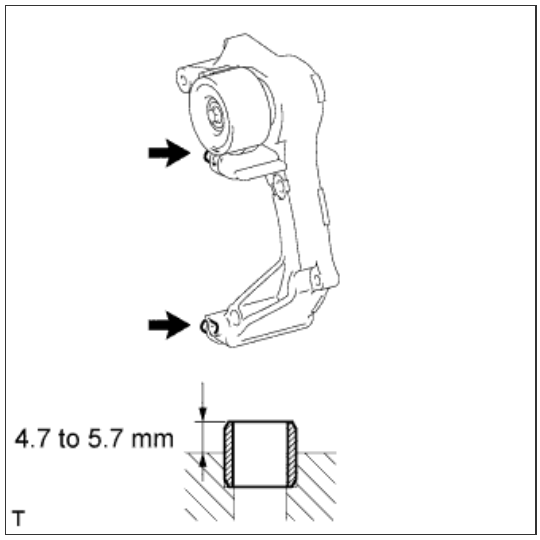
Standard protr ion:
4.4 to 5.6 mm (.173 to .222 in.)



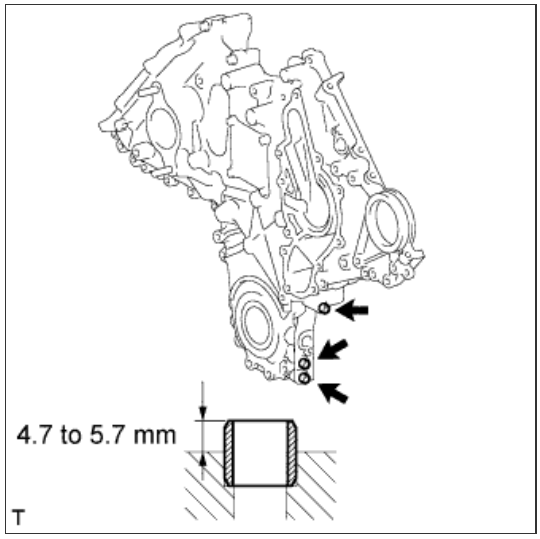
c. V-ribbed Belt Tensioner:

i. Replace the ring pin.

Standard protr ion:
4.7 to 5.7 mm (.1 5 to .224 in.)



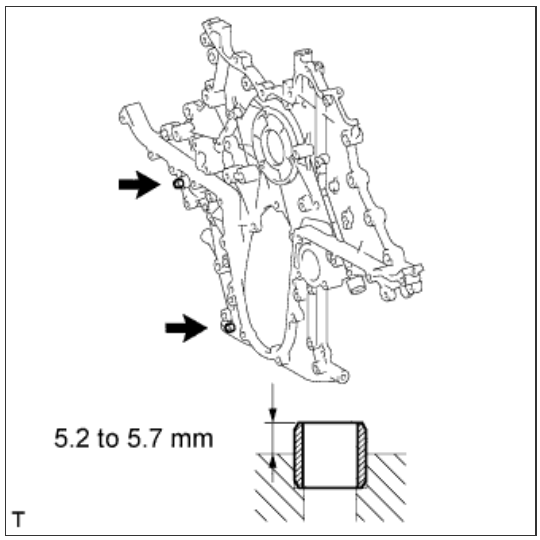
d. Timing Chain Case:



i. Replace the ring pin.

Standard protr ion:
4.7 to 5.7 mm (.1 5 to .224 in.)

e. Timing ear Case:



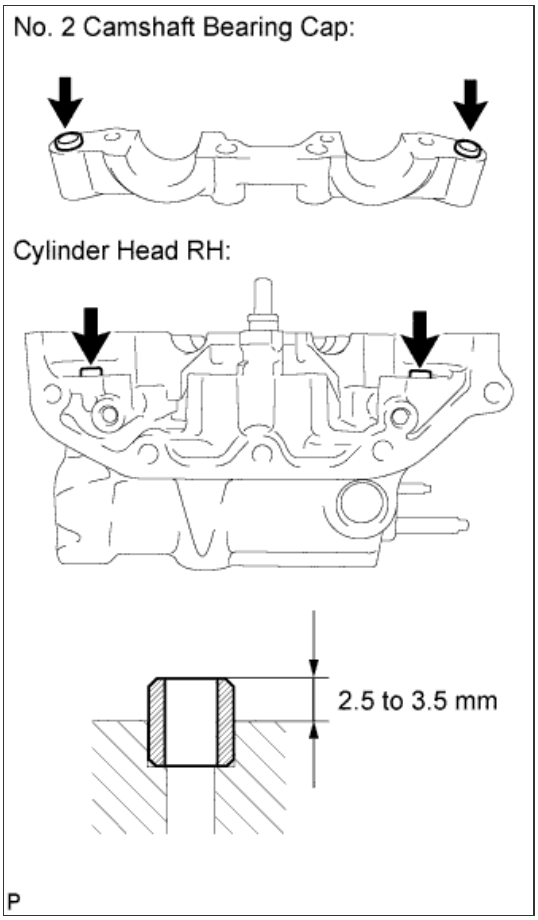
i. Replace the ring pin.

Standard protr ion:
5.2 to 5.7 mm (.2 5 to .224 in.)

f. Cylinder Head RH:

i. Replace the ring pin.

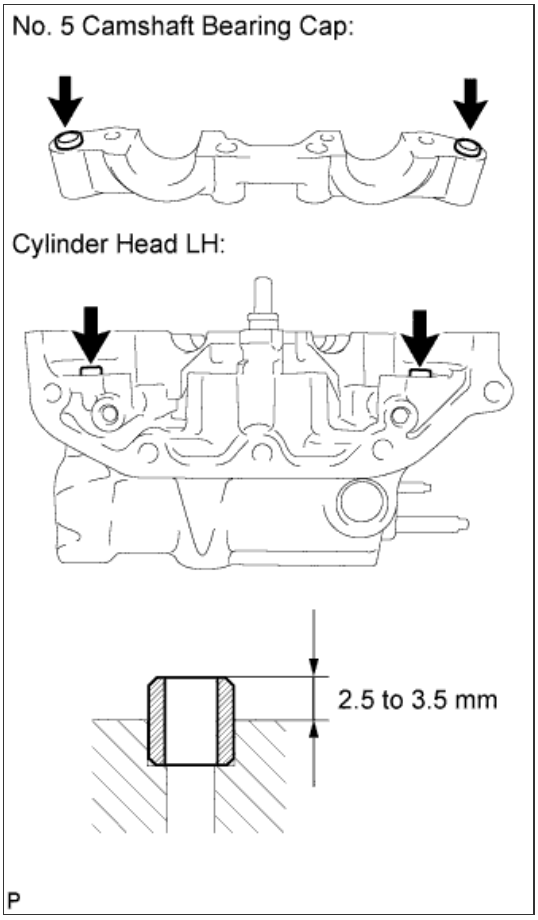
Standard protr ion:
2.5 to 3.5 mm (. 9 4 to .13 in.)



g. Cylinder Head LH:

i. Replace the ring pin.

Standard protr ion:
2.5 to 3.5 mm (. 9 4 to .13 in.)



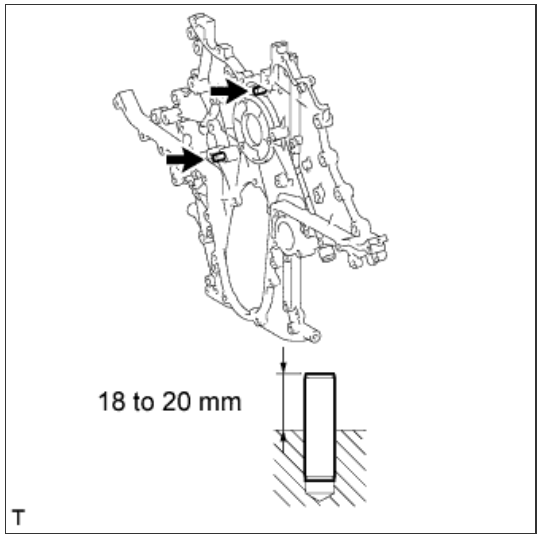
3. REPLACE CHAIN TENSIONER STRAIGHT PIN

HINT:

It is not necessary to remove the straight pin unless it is being replaced.

a. Replace the straight pin.

Standard protr ion:
1 to 2 mm (.7 9 to .7 7 in.)



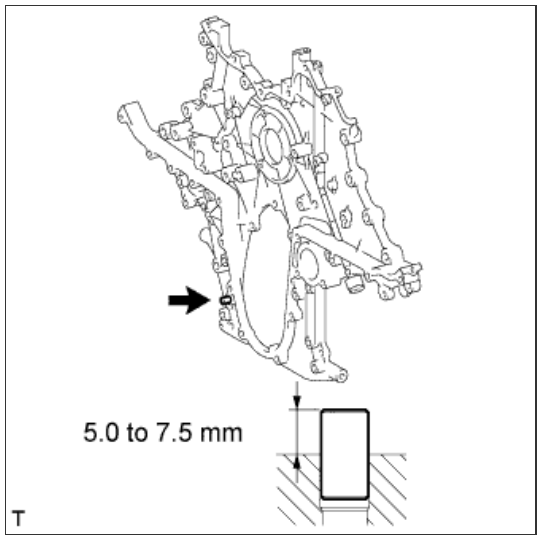
4. REPLACE TIMING GEAR COVER SET STRAIGHT PIN

HINT:

It is not necessary to remove the straight pin unless it is being replaced.

a. Replace the straight pin.

Standard protr ion:
5. to 7.5 mm (.197 to .295 in.)



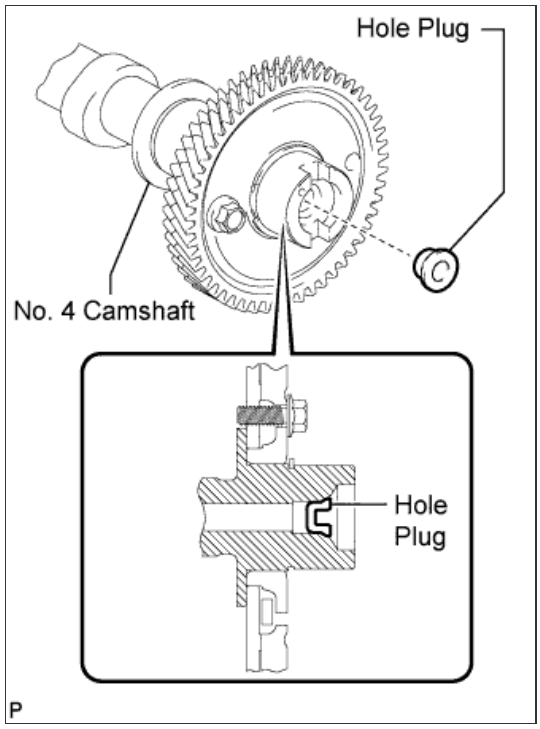
5. REPLACE HOLE PLUG (w/o Intercooler)

HINT:

It is not necessary to remove a hole plug unless it is being replaced.

a. Remove the hole plug from the No. 4 camshaft.

b. Using a 12 mm steel bar and hammer, tap in the hole plug as shown in the illustration.



6. REPLACE TIGHT PLUG (w/o Intercooler)

NOTICE:

If oil leaks from a tight plug or a plug is corroded, replace it.

a. Remove the tight plug from the timing chain cover.

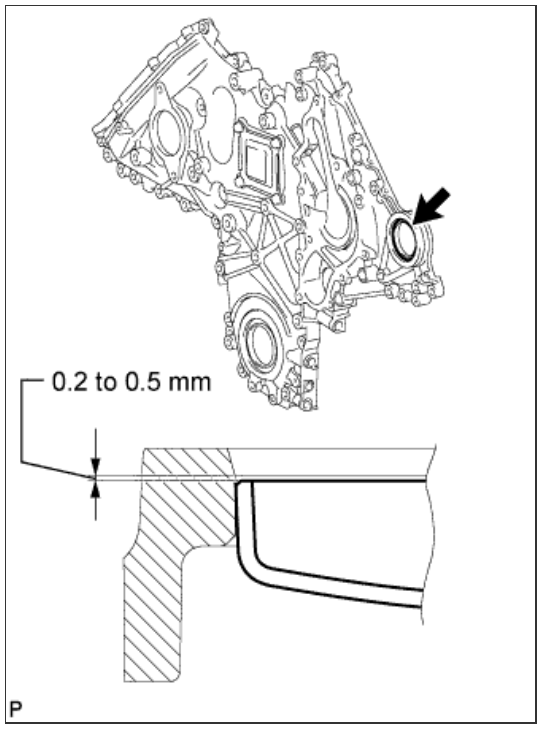
b. Apply adhesive to a new tight plug.

Adhesive:
Toyota Genuine Adhesive 1324 Three Bond 1324 or equivalent

c. Using SST and a hammer, tap in the tight plug as shown in the illustration.

SST
995 6 1 (9951- 55)
995 7 1 (9951- 71)

Standard depth:
.2 to .5 mm (. 7 7 to . 197 in.)



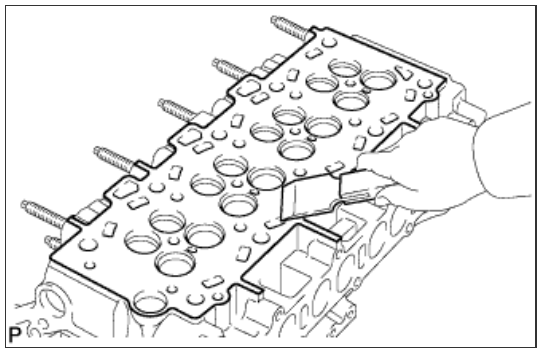
for Preparation Click here

1. CLEAN CYLINDER HEAD SUB-ASSEMBLY

a. Using a gasket scraper, remove all the gasket material from the cylinder block contact surface.

NOTICE:

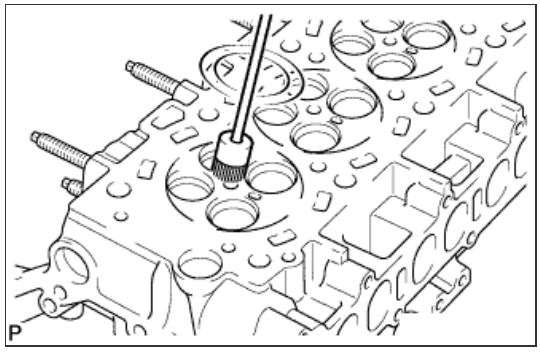
Be careful not to scratch the cylinder block contact surface.



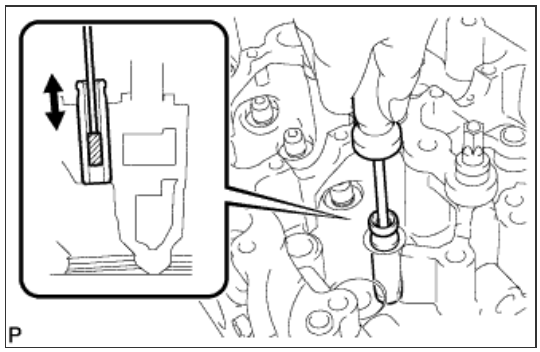
b. Using a wire brush, remove all the carbon from the combustion chambers.

NOTICE:

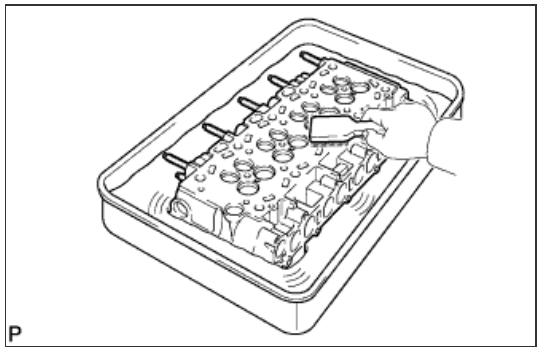
Be careful not to damage the combustion chambers and valve seats.



c. Using a valve guide bushing brush and solvent, clean all the valve guide bushes.



d. Using a soft brush and solvent, thoroughly clean the cylinder head.



2. INSPECT CYLINDER HEAD SUB-ASSEMBLY

a. Using a precision straightedge and feeler gauge, measure the warpage of the contact surface between the cylinder head and cylinder block, and the cylinder head and manifolds.

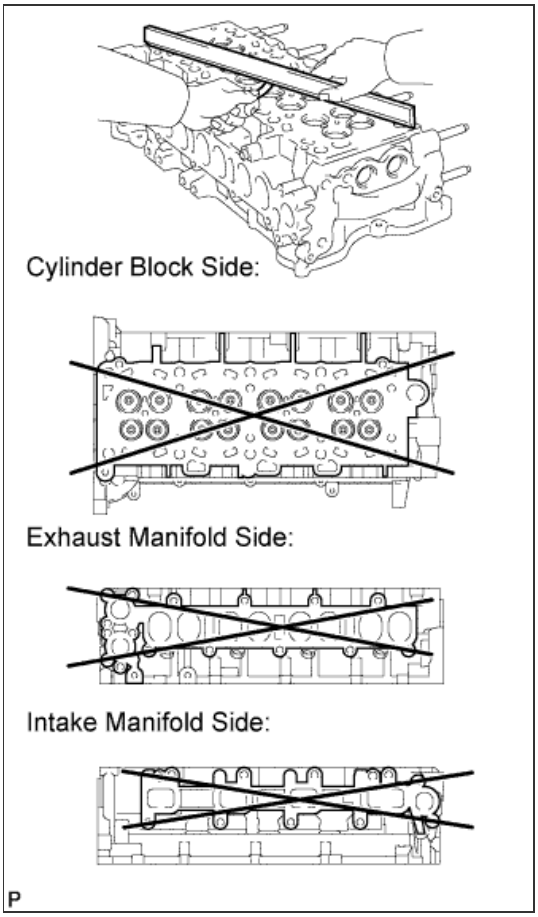
Standard Warpage:

Item	Specified Condition
Cylinder block side	0 to 0.05 mm (0 to 0.00197 in.)
Intake manifold side	0 to 0.08 mm (0 to 0.00315 in.)
Exhaust manifold side	0 to 0.08 mm (0 to 0.00315 in.)

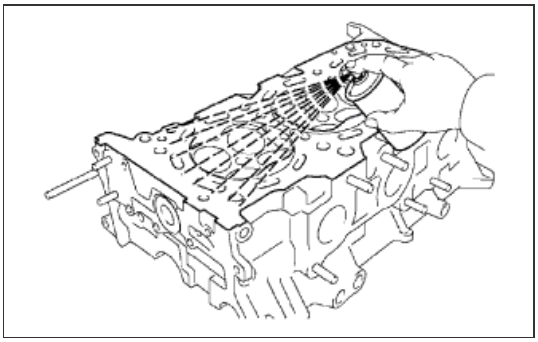
Maximum Warpage:

Item	Specified Condition
Cylinder block side	0.05 mm (0.00197 in.)
Intake manifold side	0.08 mm (0.00315 in.)
Exhaust manifold side	0.08 mm (0.00315 in.)

If the warpage is more than the maximum, replace the cylinder head sub-assembly.



b. Using a dye penetrant, check the intake ports, exhaust ports and cylinder surface for cracks.
If there are cracks, replace the cylinder head sub-assembly.



3. INSPECT CYLINDER HEAD BOLT

a. Using a vernier caliper, measure the outside thread diameter of the bolt.

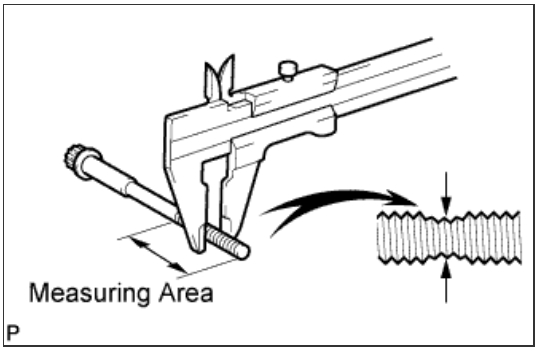
Standard diameter:
12.8 to 13.0 mm (0.504 to 0.512 in.)

Minimum diameter:
12.5 mm (0.492 in.)

HINT:

If a visual check reveals no excessively thin areas, check the center of the bolt (see illustration) and find the area that has the smallest diameter.

If the diameter is less than the minimum, replace the cylinder head bolt.



4. INSPECT NO. 2 AND NO. 3 CAMSHAFT THRUST CLEARANCE (for Intake Camshaft)

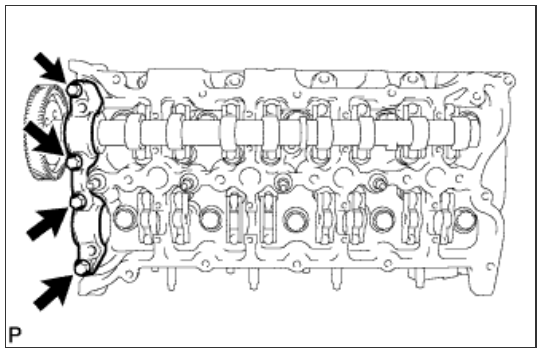
a. Install the No. 2 and No. 5 camshaft bearing caps to the cylinder head.

b. Place the camshafts on the cylinder head.

c. Temporarily install the No. 1 and No. 4 camshaft bearing caps with the 4 bolts by hand.

NOTICE:

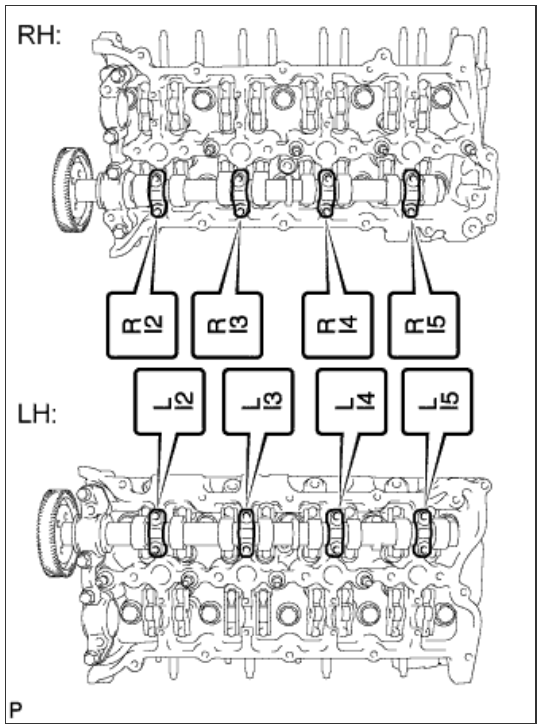
Do not turn the camshafts.



d. Install the No. 3 camshaft bearing caps.

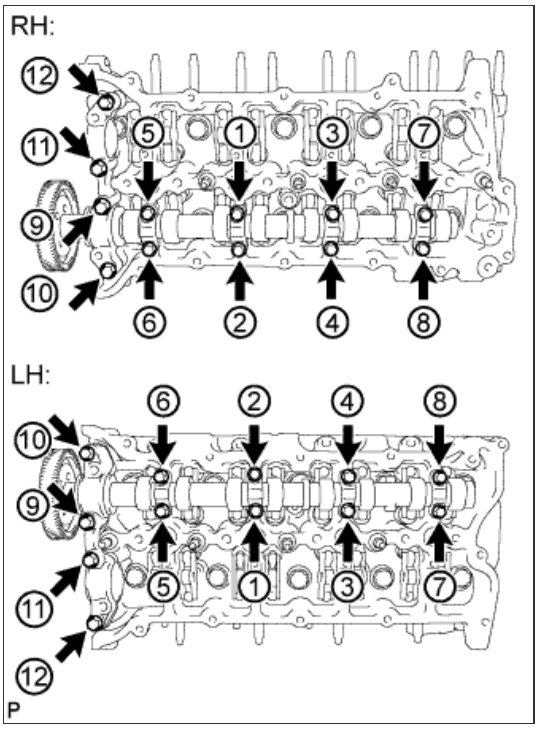
i. Confirm the marks and numbers on the camshaft bearing caps and place them in their proper position and direction.

ii. Temporarily install the 16 bolts.



e. Uniformly tighten the 24 bolts in several steps in the order shown in the illustration.

Tor ue:
for 12 mm head bolt of No. 1 and No. 4 camshaft bearing cap:
21 N*m{ 214 kgf*cm 15 ft.*lbf
for 10 mm head bolt of No. 3 camshaft bearing cap:
10 N*m{ 102 kgf*cm 7 ft.*lbf

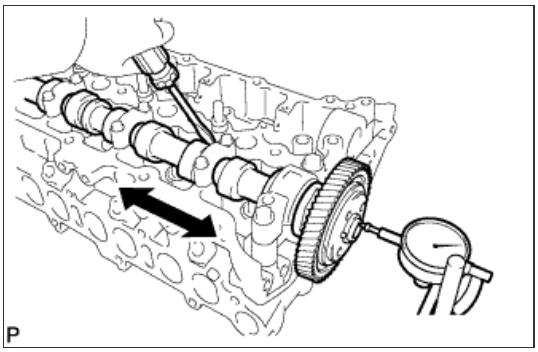


f. Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.

Standard thrust clearance:
0.035 to 0.160 mm (0.00138 to 0.00630 in.)

Maximum thrust clearance:
0.180 mm (0.00709 in.)

If the thrust clearance is more than the maximum, replace the camshaft.
If necessary, replace the cylinder head sub-assembly.



5. INSPECT NO. 1 AND NO. 4 CAMSHAFT THRUST CLEARANCE (for Exhaust Camshaft)

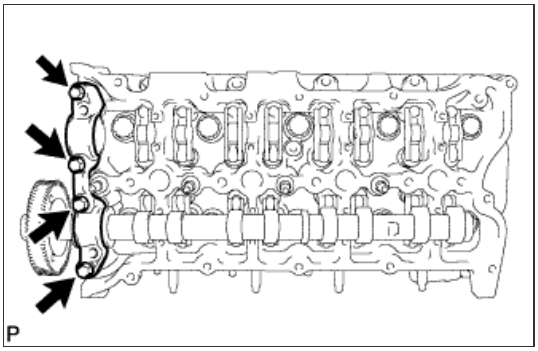
a. Install the No. 2 and No. 5 camshaft bearing caps to the cylinder head.

b. Place the camshafts on the cylinder head.

c. Temporarily install the No. 1 and No. 4 camshaft bearing caps with the 4 bolts by hand.

NOTICE:

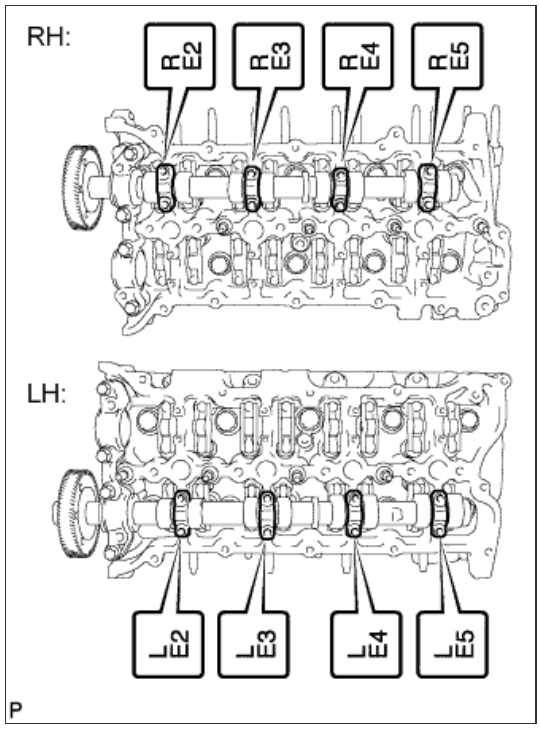
Do not turn the camshafts.



d. Install the No. 3 camshaft bearing caps.

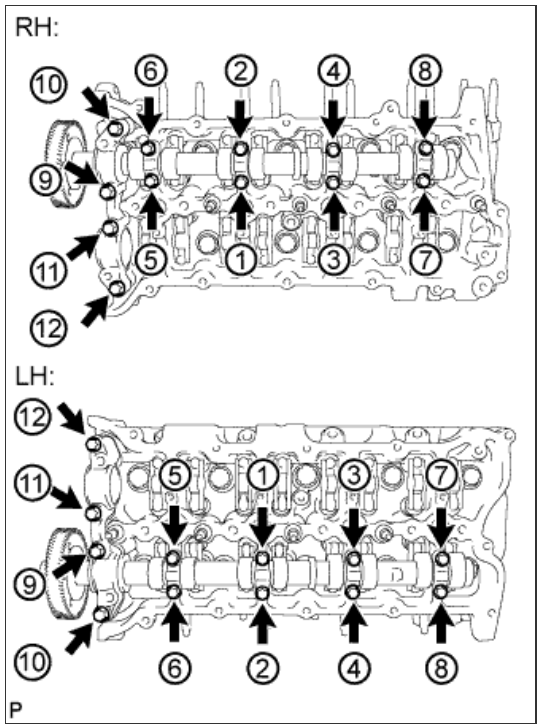
i. Confirm the marks and numbers on the camshaft bearing caps and place them in their proper position and direction.

ii. Temporarily install the 16 bolts.



e. Uniformly tighten the 24 bolts in several steps in the order shown in the illustration.

Tor ue:
for 12 mm head bolt of No. 1 and No. 4 camshaft bearing cap:
21 N*m{ 214 kgf*cm 15 ft.*lbf
for 10 mm head bolt of No. 3 camshaft bearing cap:
10 N*m{ 102 kgf*cm 7 ft.*lbf

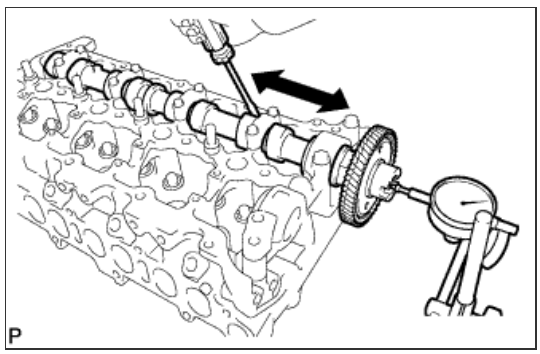


f. Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.

Standard thrust clearance:
0.035 to 0.160 mm (0.00138 to 0.00630 in.)

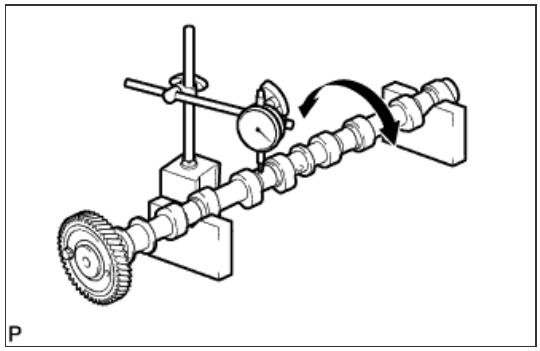
Maximum thrust clearance:
0.180 mm (0.00709 in.)

If the thrust clearance is more than the maximum, replace the camshafts.
If necessary, replace the cylinder head sub-assembly.



6. INSPECT CAMSHAFT

a. Inspect the camshaft for runout.



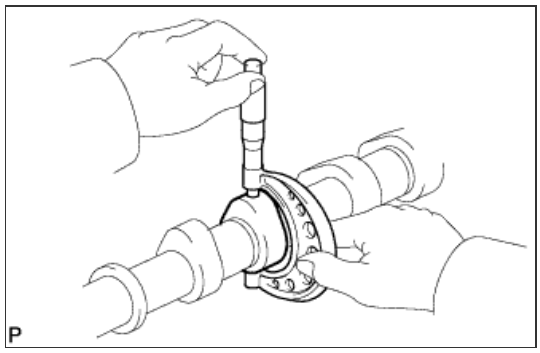
i. Place the camshaft on V-blocks.

ii. Using a dial indicator, measure the runout at the center journal.

Maximum runout:
0.03 mm (0.00118 in.)

If the runout is more than the maximum, replace the camshaft.

b. Inspect the cam lobe height.



i. Using a micrometer, measure the cam lobe height.

Standard Cam Lobe Height:

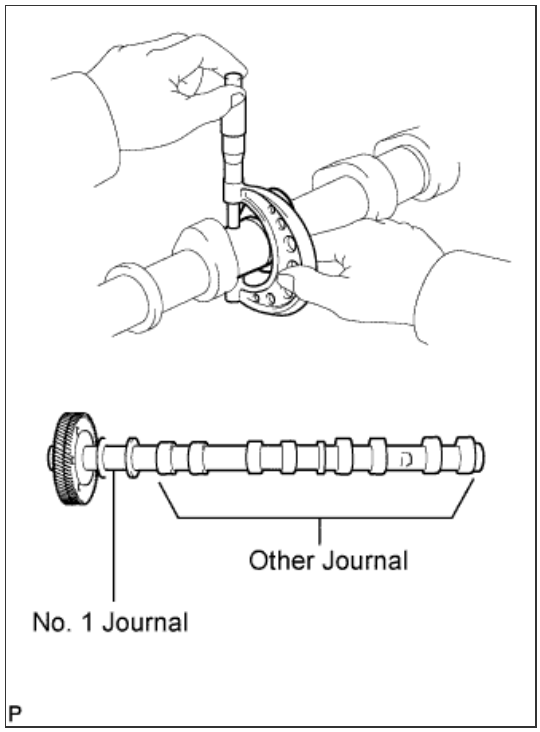
Item	Specified Condition
No. 2 and No. 3 camshaft (intake)	37.277 to 37.387 mm (1.468 to 1.472 in.)
No. 1 and No. 4 camshaft (exhaust)	38.324 to 38.434 mm (1.509 to 1.513 in.)

Minimum Cam Lobe Height:

Item	Specified Condition
No. 2 and No. 3 camshaft (intake)	37.277 mm (1.468 in.)
No. 1 and No. 4 camshaft (exhaust)	38.324 mm (1.509 in.)

If the cam lobe height is less than the minimum, replace the camshaft.

c. Inspect the camshaft journal diameter.



i. Using a micrometer, measure the journal diameter.

Standard Journal Diameter:

Item	Specified Condition
No. 1 journal	29.969 to 29.985 mm (1.180 to 1.181 in.)
Other journal	26.969 to 26.985 mm (1.0618 to 1.0624 in.)

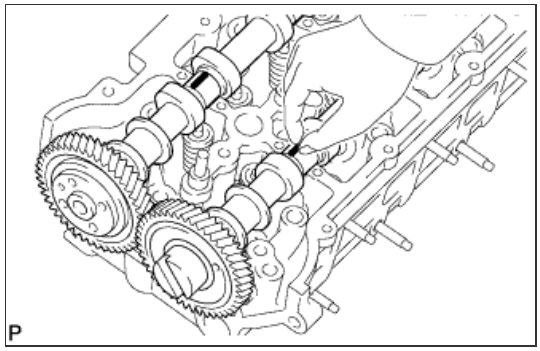
If the journal diameter is not as specified, check the oil clearance.

7. INSPECT CAMSHAFT OIL CLEARANCE

a. Clean the camshaft bearing caps and camshaft journals.

b. Place the camshafts on the cylinder head.

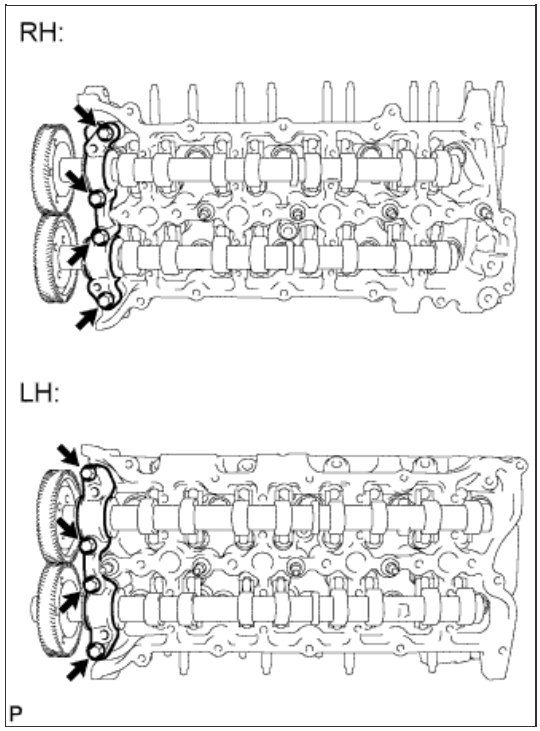
c. Lay a strip of Plastigage across each of the camshaft journals.



d. Temporarily install the camshaft bearing cap with the 4 bolts by hand.

NOTICE:

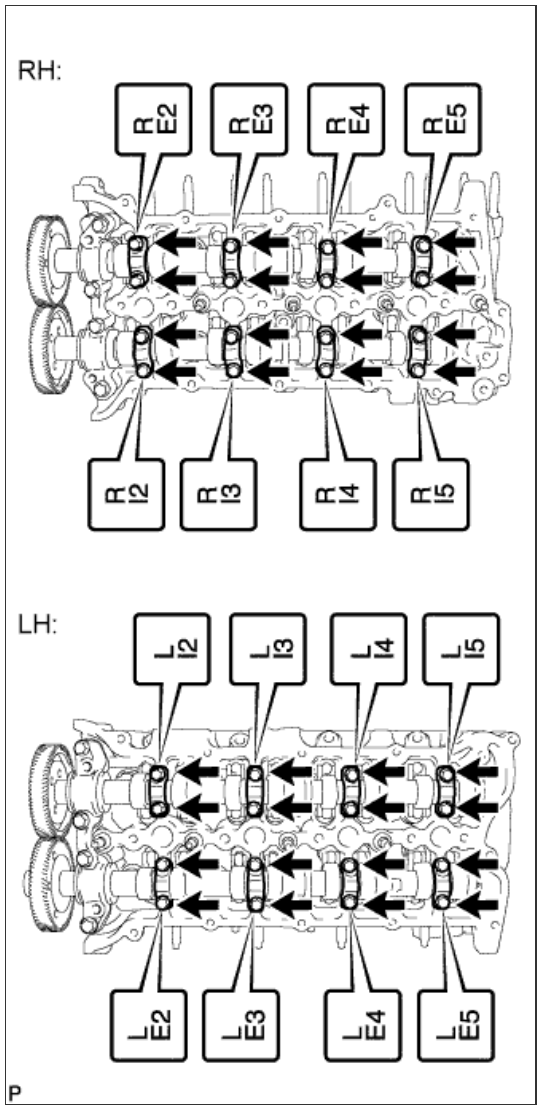
Do not turn the camshafts.



e. Install the No. 3 camshaft bearing caps with the 16 bolts.

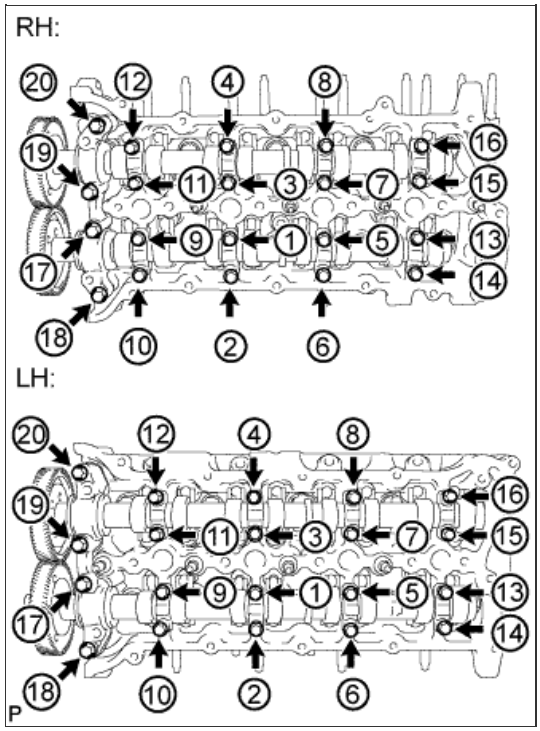
i. Confirm the marks and numbers on the camshaft bearing caps and place them in their proper position and direction.

ii. Temporarily install the 16 bolts.

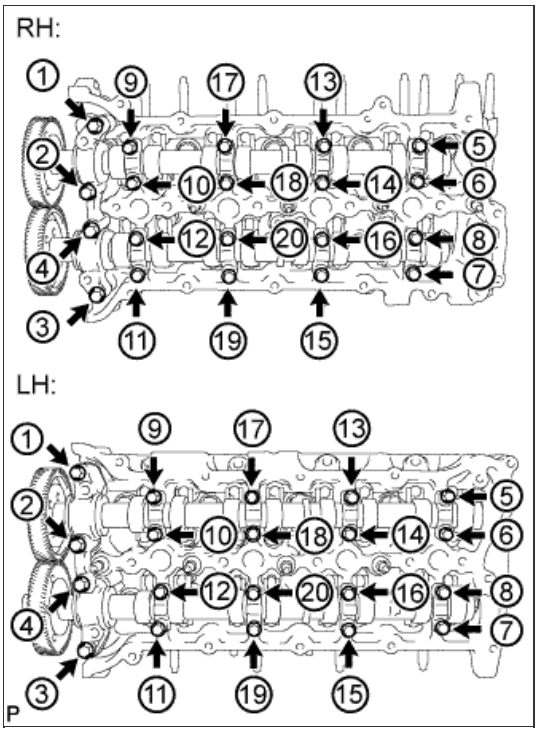


f. Uniformly tighten the 20 bolts in several steps in the order shown in the illustration.

Tor ue:
for 12 mm head bolt of No. 1 and No. 4 camshaft bearing cap:
21 N*m{ 214 kgf*cm 15 ft.*lbf
for 10 mm head bolt of No. 3 camshaft bearing cap:
10 N*m{ 102 kgf*cm 7 ft.*lbf



g. Uniformly loosen and remove the 20 bolts in the sequence shown in the illustration.

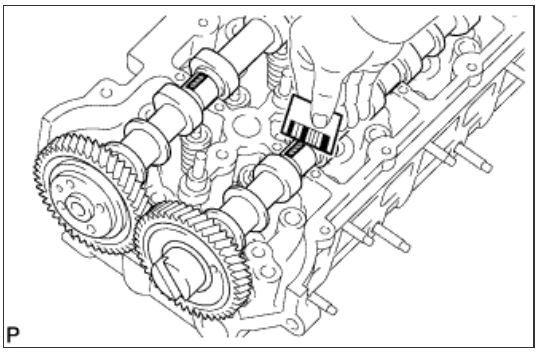


h. Measure the Plastigage at its widest point.

Standard oil clearance:
0.025 to 0.062 mm (0.000984 to 0.00244 in.)

Maximum oil clearance:
0.072 mm (0.00283 in.)

If the oil clearance is more than the maximum, replace the camshaft.
If necessary, replace the cylinder head sub-assembly.

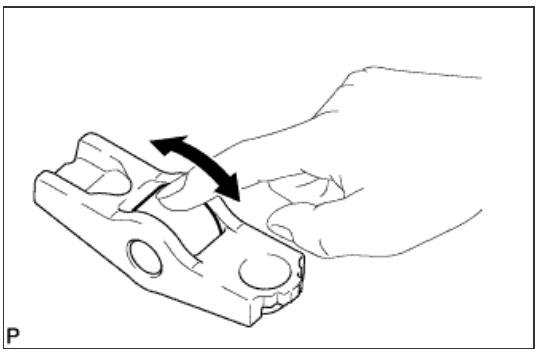


i. Remove the Plastigage completely.

j. Remove the camshafts.

8. INSPECT VALVE ROCKER ARM SUB-ASSEMBLY

a. Turn the roller by hand to check that it turns smoothly.
If the roller does not turn smoothly, replace the valve rocker arm.



9. INSPECT VALVE LASH ADJUSTER ASSEMBLY

NOTICE:

- **Keep the adjuster free from dirt and foreign objects.**
- **Use only clean engine oil.**

a. Place the lash adjuster into a container full of new engine oil.

b. Insert SST tip into the lash adjuster plunger and use the tip to press down on the check ball inside the plunger.

SST

09276-75010

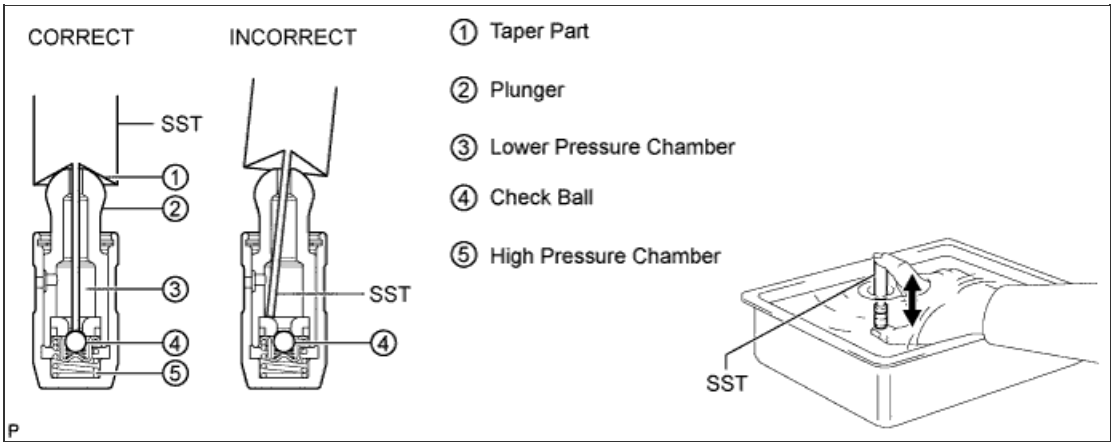
c. Squeeze SST and the lash adjuster together to move the plunger up and down 5 to 6 times.

d. Check the movement of the plunger and bleed air.

OK:
Plunger moves up and down.

NOTICE:

When bleeding high-pressure air from the compression chamber, make sure that the tip of SST is actually pressing the check ball as shown in the illustration. If the check ball is not pressed, air will not bleed.



e. After bleeding the air, remove SST. Then try to quickly and firmly press the plunger with your fingers.

OK:
Plunger can be pressed 3 times.

If the plunger can still be compressed after pressing it 3 times, replace the lash adjuster with a new one.

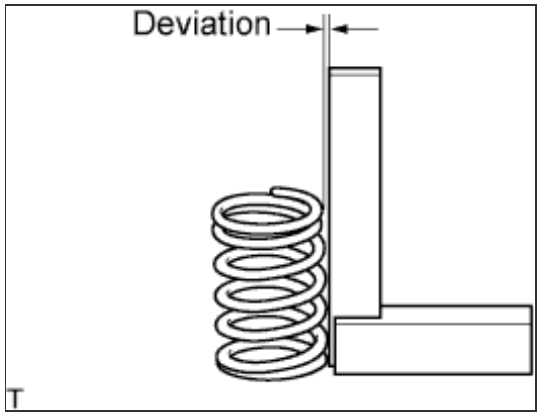
10. INSPECT INNER COMPRESSION SPRING

a. Inspect the inner compression spring deviation.

i. Using a steel square, measure the deviation of the inner compression spring.

Maximum deviation:
1.5 mm (0.0591 in.)

If the deviation is more than the maximum, replace the inner compression spring.

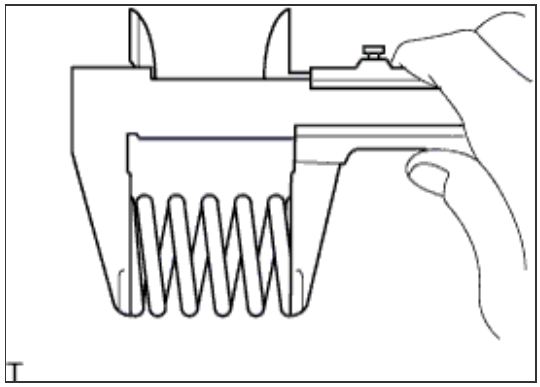


b. Inspect the inner compression spring free length.

i. Using a vernier caliper, measure the free length of the inner compression spring.

Standard free length:
45.9 mm (1.81 in.)

If the free length is not as specified, replace the inner compression spring.

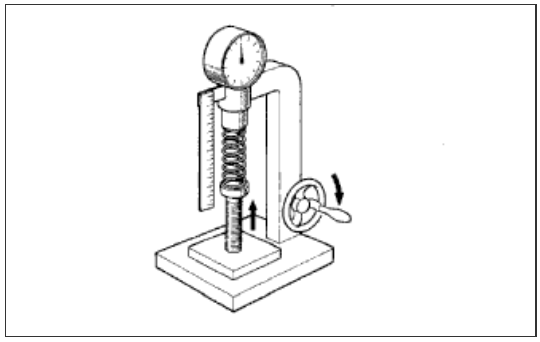


c. Inspect the inner compression spring tension.

i. Using a spring tester, measure the tension of the inner compression spring at the specified installed length.

Installed tension:
219 to 242 N (22 to 25 kgf 49.2 to 54.4 lbf) at 31.0 mm (1.22 in.)

If the installed tension is not as specified, replace the inner compression spring.



11. INSPECT VALVE GUIDE BUSH OIL CLEARANCE

a. Using a caliper gauge, measure the inside diameter of the guide bush.

Standard bush inside diameter:
6.01 to 6.03 mm (0.2366 to 0.2374 in.)

b. Subtract the valve stem diameter measurement from the guide bush inside diameter measurement.

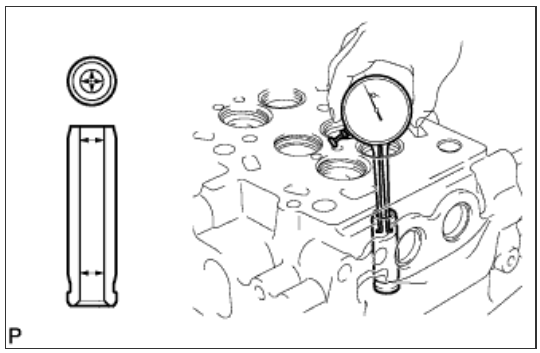
Standard Oil Clearance:

Item	Specified Condition
Intake	0.025 to 0.060 mm (0.000984 to 0.00236 in.)
Exhaust	0.035 to 0.070 mm (0.00138 to 0.00276 in.)

Maximum Oil Clearance:

Item	Specified Condition
Intake	0.120 mm (0.00472 in.)
Exhaust	0.130 mm (0.00512 in.)

If the oil clearance is more than the maximum, replace the valve guide bush.



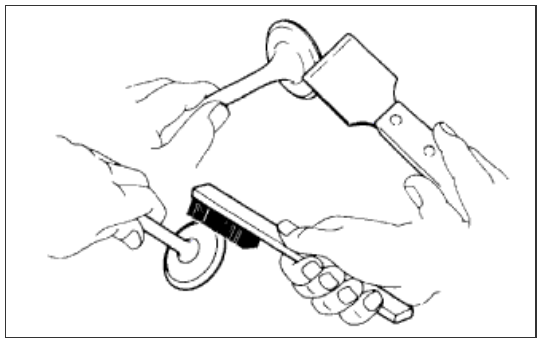
12. CLEAN VALVE

a. Using a gasket scraper, chip off any carbon from the valve head.

NOTICE:

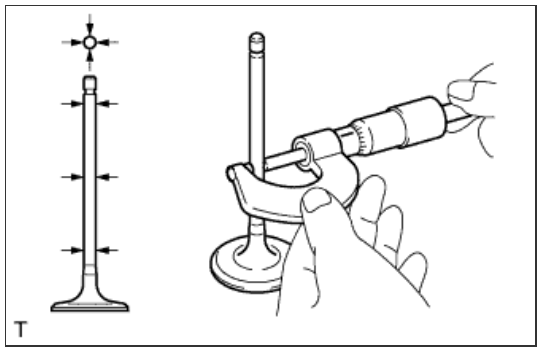
Be careful not to damage the valve face.

b. Using a wire brush, thoroughly clean the valve.



13. INSPECT VALVE

a. Inspect the valve stem diameter.

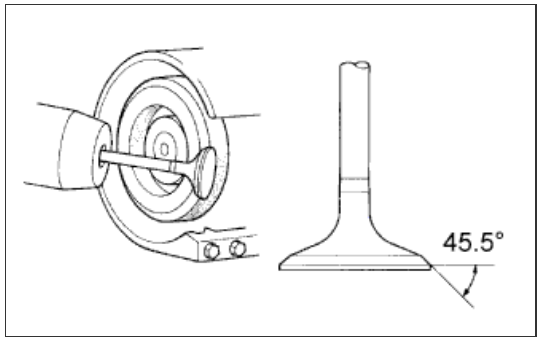


i. Using a micrometer, measure the diameter of the valve stem.

Standard Valve Stem Diameter:

Item	Specified Condition
Intake	5.970 to 5.985 mm (0.2350 to 0.2356 in.)
Exhaust	5.960 to 5.975 mm (0.2346 to 0.2352 in.)

b. Inspect the valve face angle.

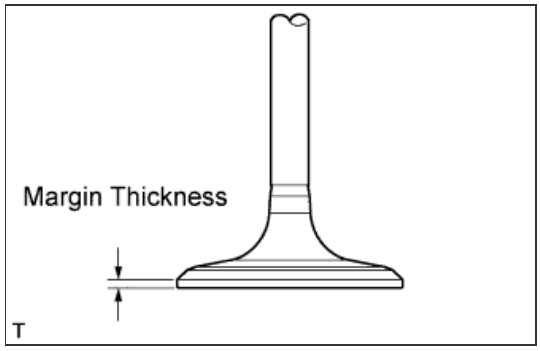


i. Grind the valve enough to remove pits and carbon.

ii. Check that the valve is ground to the correct valve face angle.

Standard valve face angle:
45.5°

c. Inspect the valve head margin thickness.



i. Using a vernier caliper, measure the valve head margin thickness.

Standard margin thickness:
1.0 mm (0.0394 in.)

Minimum margin thickness:
0.5 mm (0.0197 in.)

If the margin thickness is less than the minimum, replace the valve.

d. Inspect the valve overall length.

i. Using a vernier caliper, measure the overall length.

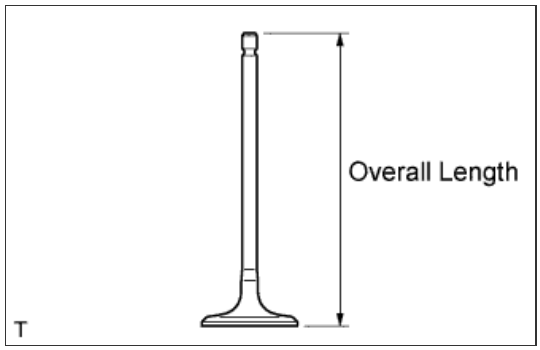
Standard Overall Length:

Item	Specified Condition
Intake	104.4 mm (4.11 in.)
Exhaust	104.1 mm (4.10 in.)

Minimum Overall Length:

Item	Specified Condition
Intake	104.1 mm (4.10 in.)
Exhaust	103.8 mm (4.09 in.)

If the overall length is less than the minimum, replace the valve.



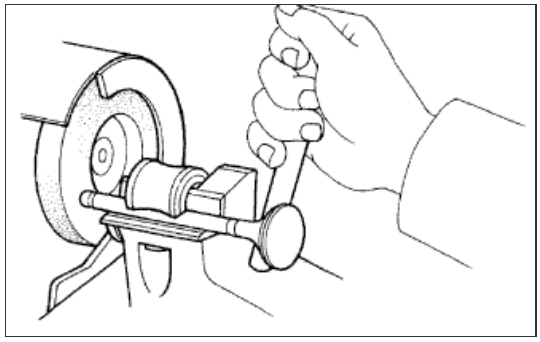
e. Inspect the valve stem tip.

i. Check the surface of the valve stem tip for wear.

NOTICE:

Do not grind the valve so it becomes shorter than the minimum overall length.

If the valve stem tip is worn, resurface the tip with a grinder or replace the valve.



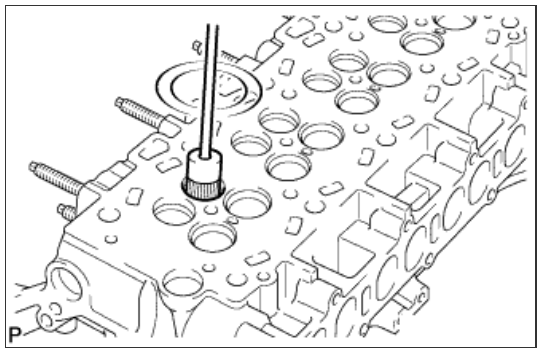
14. CLEAN VALVE SEAT

a. Using a 45° carbide cutter, resurface the valve seats.

NOTICE:

Be careful not to damage the combustion chambers and valve seats.

b. Clean the valve seats.



15. INSPECT INTA E VALVE SEAT

a. Apply a light coat of Prussian blue to the valve face.

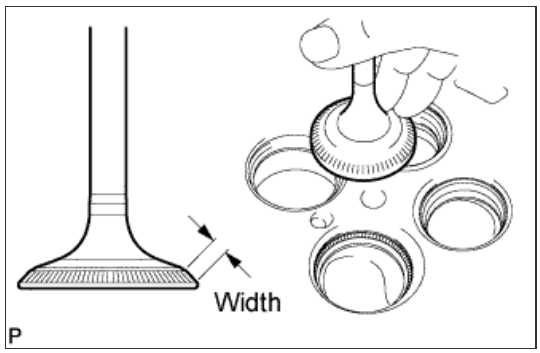
b. Lightly press the valve face against the valve seat.

NOTICE:

Do not rotate the valve while pressing the valve.

c. Check the valve face and valve seat.

i. Check that the contact surfaces of the valve seat and valve face are in the middle area of their respective surfaces, with the width between 1.0 to 1.4 mm (0.0394 to 0.0551 in.).
If not, correct the valve seat.



ii. Check that the contact surfaces of the valve seat and valve face are even around the entire valve seat.
If not, correct the valve seat.

16. INSPECT E HAUST VALVE SEAT

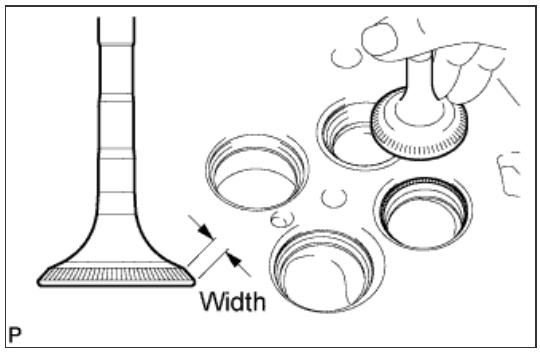
a. Apply a light coat of Prussian blue to the valve face.

b. Lightly press the valve face against the valve seat.

NOTICE:

Do not rotate the valve while pressing the valve.

c. Check the valve face and valve seat.

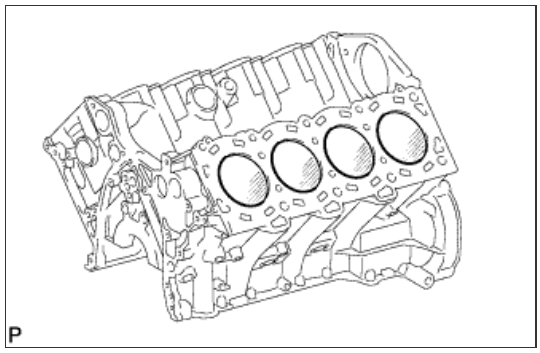


i. Check that the contact surfaces of the valve seat and valve face are in the middle area of their respective surfaces, with the width between 1.0 to 1.4 mm (0.0394 to 0.0551 in.).
If not, correct the valve seat.

ii. Check that the contact surfaces of the valve seat and valve face are even around the entire valve seat.
If not, correct the valve seat.

17. VISUALLY CHECK CYLINDER BLOCK

a. Visually check the cylinder for vertical scratches.
If deep scratches are present, rebore all 8 cylinders. If necessary, replace the cylinder block sub-assembly.

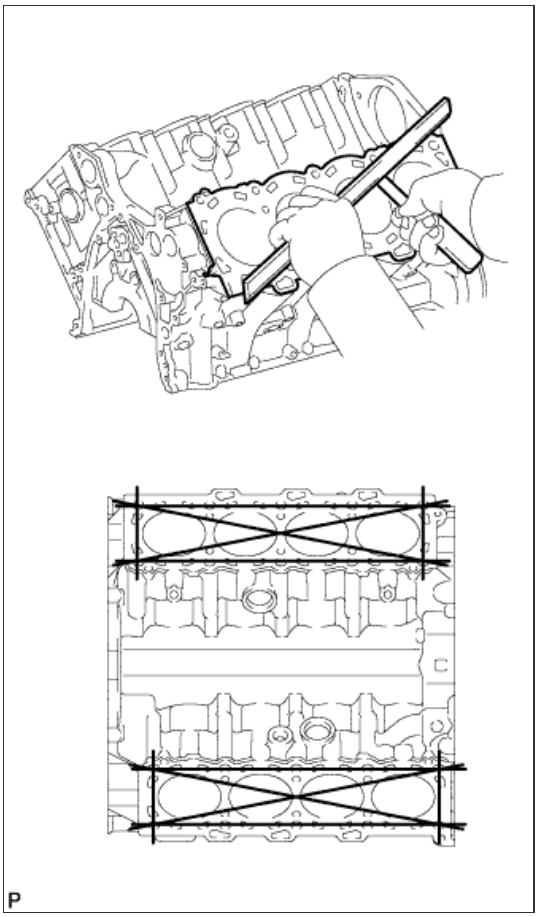


18. INSPECT CYLINDER BLOCK FOR FLATNESS

a. Using a precision straightedge and feeler gauge, measure the warpage of the contact surface between the cylinder head and cylinder head gaskets.

Maximum warpage:
0.05 mm (0.00197 in.)

If the warpage is more than the maximum, replace the cylinder block sub-assembly.



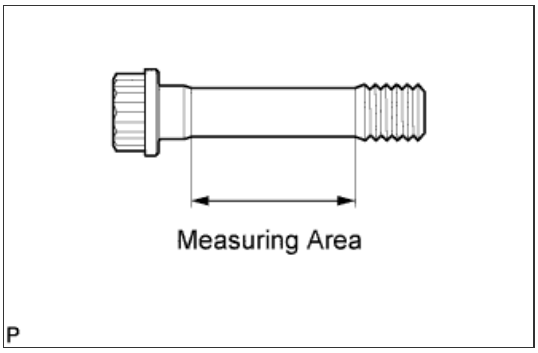
19. INSPECT CONNECTING ROD BOLT

a. Using a vernier caliper, measure the tension portion diameter of the bolt.

Standard diameter:
8.7 to 8.8 mm (0.343 to 0.346 in.)

Minimum diameter:
8.5 mm (0.335 in.)

If the diameter is less than the minimum, replace the connecting rod bolt.



20. INSPECT CRANKSHAFT BEARING CAP BOLT

a. Using a vernier caliper, measure the outside thread diameter of bolt A and B.

Bolt Length

Item	Specified Condition
Bolt A	106 mm (4.17 in.)
Bolt B	90.5 mm (3.56 in.)

Measuring Area:

Item	Specified Condition
Bolt A	73 mm (2.87 in.)
Bolt B	63 mm (2.48 in.)

Standard diameter:
for bolt A:
10.8 to 11.0 mm (0.425 to 0.433 in.)

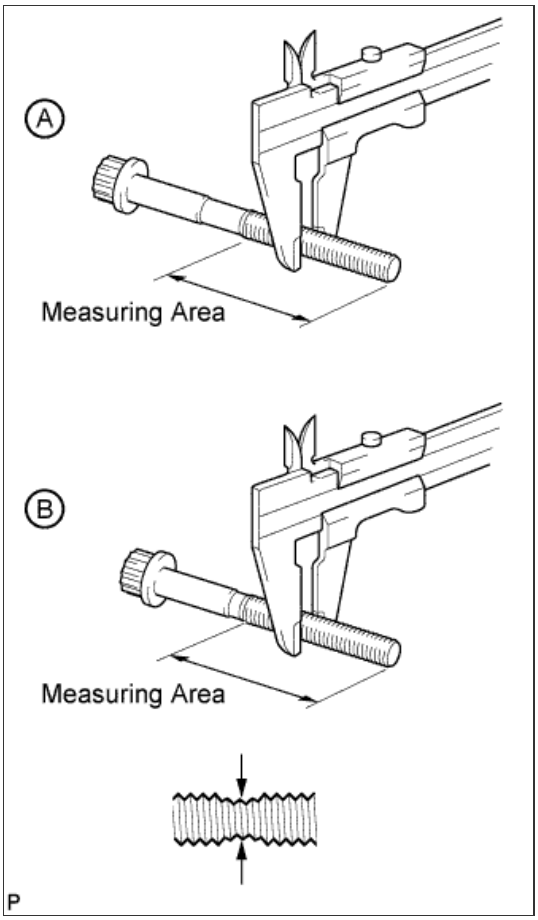
for bolt B:
9.8 to 10.0 mm (0.386 to 0.394 in.)

Minimum diameter:
for bolt A:
10.5 mm (0.413 in.)
for bolt B:
9.5 mm (0.374 in.)

HINT:

If a visual check reveals no excessively thin areas, check the center of the bolt (see illustration) and find the area that has the lowest diameter.

If the diameter is less than the minimum, replace the crankshaft bearing cap bolt.



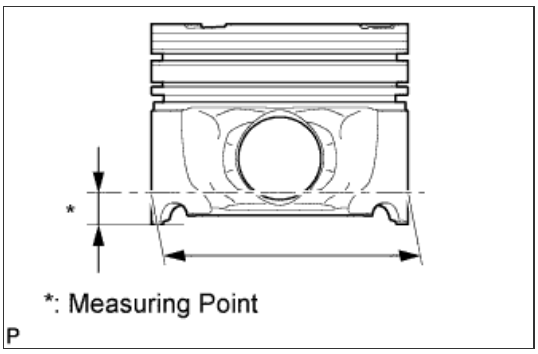
21. INSPECT PISTON WITH PIN SUB-ASSEMBLY

a. Using a micrometer, measure the piston diameter at a right angle to the piston pin center line, 12 mm (0.472 in.) from the piston skirt.

Standard piston diameter:
85.932 to 85.966 mm (3.383 to 3.384 in.)

Minimum piston diameter:
85.910 mm (3.382 in.)

If the diameter is less than the minimum, replace the piston with pin sub-assembly.



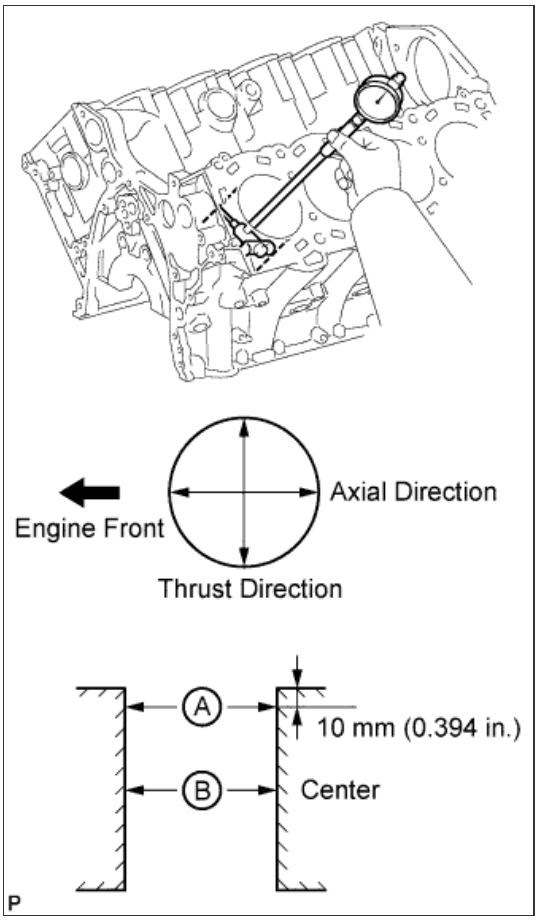
22. INSPECT CYLINDER BORE

a. Using a cylinder gauge, measure the cylinder bore diameter at positions A and B in the thrust and axial directions.

Standard diameter:
86.000 to 86.013 mm (3.3858 to 3.3863 in.)

Maximum diameter:
86.03 mm (3.3870 in.)

If the diameter is more than the maximum, replace the cylinder block.



23. INSPECT PISTON OIL CLEARANCE

a. Subtract the piston diameter measurement from the cylinder bore diameter measurement.

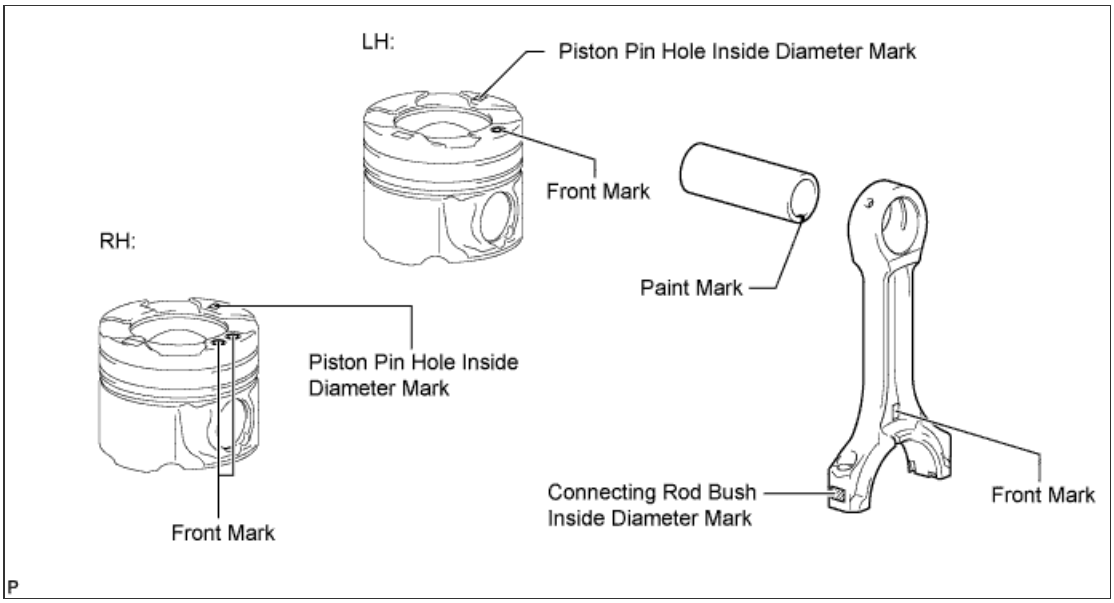
Standard oil clearance:
0.034 to 0.081 mm (0.00134 to 0.00319 in.)

Maximum oil clearance:
0.091 mm (0.00358 in.)

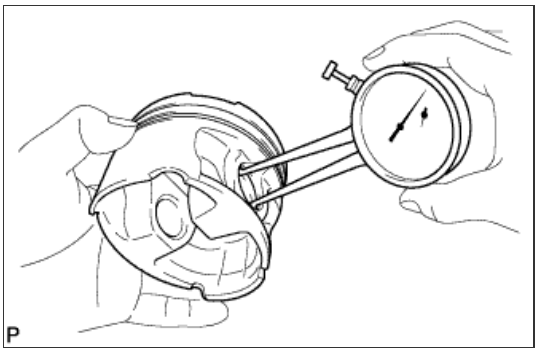
If the oil clearance is more than the maximum, replace all 8 pistons. If necessary, replace the cylinder block.

24. INSPECT PISTON PIN OIL CLEARANCE

a. Check each mark on the piston, piston pin and connecting rod.



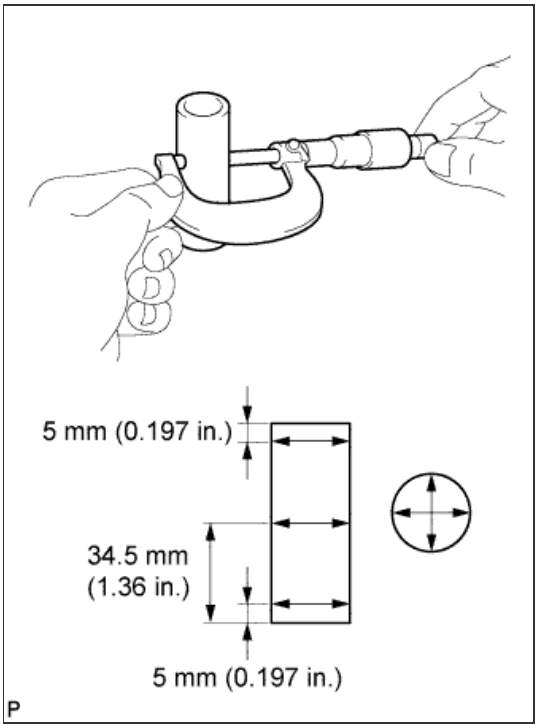
b. Using a caliper gauge, measure the inside diameter of the piston pin hole.



Standard Piston Pin Hole Inside Diameter:

Mark	Specified Condition
A	29.009 to 29.013 mm (1.1421 to 1.1422 in.)
B	29.013 to 29.017 mm (1.1422 to 1.1424 in.)
C	29.017 to 29.021 mm (1.1424 to 1.1426 in.)

c. Using a micrometer, measure the piston pin diameter.



Standard Piston Pin Diameter:

Mark	Paint Color	Specified Condition
A	White	29.000 to 29.004 mm (1.1417 to 1.1419 in.)
B	Pink	29.004 to 29.008 mm (1.1419 to 1.1420 in.)
C	Blue	29.008 to 29.012 mm (1.1420 to 1.1422 in.)

d. Subtract the piston pin diameter measurement from the piston pin hole diameter measurement.

Standard oil clearance:
0.005 to 0.013 mm (0.000197 to 0.000512 in.)

Maximum oil clearance:
0.018 mm (0.000709 in.)

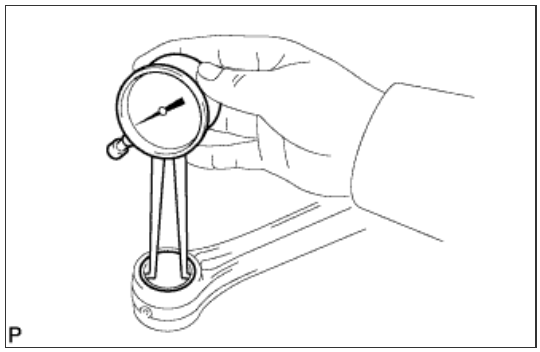
If the oil clearance is more than the maximum, replace the piston and piston pin as a set.

e. Using a caliper gauge, measure the inside diameter of the connecting rod bush.

Standard Bush Inside Diameter:

Mark	Specified Condition
A	29.019 to 29.023 mm (1.1425 to 1.1426 in.)

B	29.023 to 29.027 mm (1.1426 to 1.1428 in.)
C	29.027 to 29.031 mm (1.1428 to 1.1430 in.)



f. Subtract the piston pin diameter measurement from the bush inside diameter measurement.

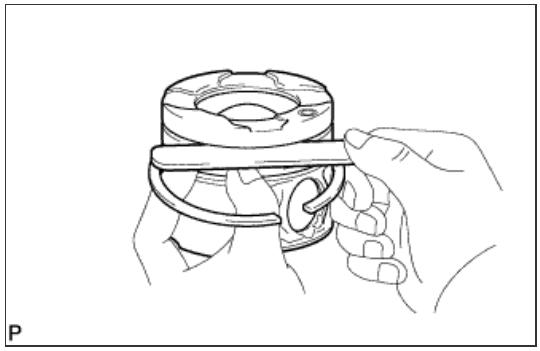
Standard oil clearance:
0.015 to 0.023 mm (0.000591 to 0.000906 in.)

Maximum oil clearance:
0.028 mm (0.00110 in.)

If the oil clearance is more than the maximum, replace the connecting rod and piston with pin as a set.

25. INSPECT RING GROOVE CLEARANCE

a. Using a feeler gauge, measure the clearance between a new piston ring and the wall of the ring groove.



Standard Ring Groove Clearance:

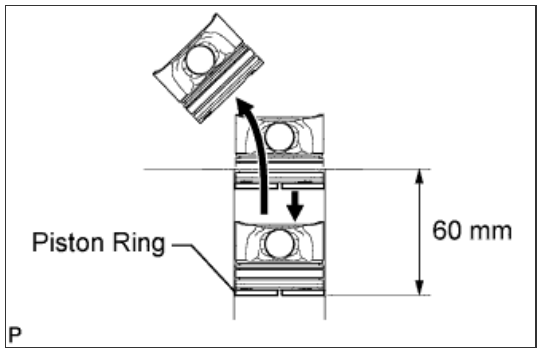
Item	Specified Condition
No. 1 compression ring	0.11 to 0.15 mm (0.00433 to 0.00591 in.)
No. 2 compression ring	0.08 to 0.12 mm (0.00315 to 0.00472 in.)
Oil ring	0.03 to 0.07 mm (0.00118 to 0.00276 in.)

If the clearance is not as specified, replace the piston.

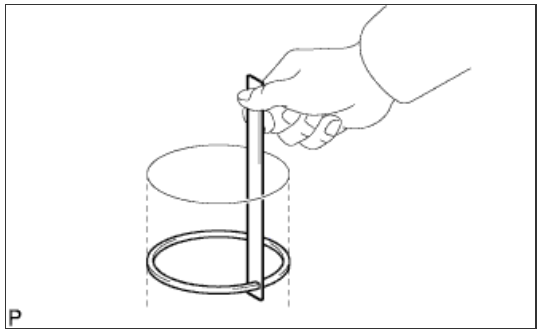
26. INSPECT PISTON RING END GAP

a. Insert the piston ring into the cylinder bore.

b. Using a piston, push the piston ring a little beyond the bottom of the ring travel, 60 mm (2.36 in.) from the top of the cylinder block.



c. Using a feeler gauge, measure the end gap.



Standard End Gap:

Item	Type of Engine	Specified Condition
No. 1 compression ring	w/ EGR System	0.22 to 0.32 mm (0.00866 to 0.0126 in.)
	w/o EGR System	0.20 to 0.30 mm (0.00787 to 0.0118 in.)
No. 2 compression ring	-	0.47 to 0.62 mm (0.0185 to 0.0244 in.)
Oil ring	-	0.10 to 0.40 mm (0.00394

		to 0.0157 in.)

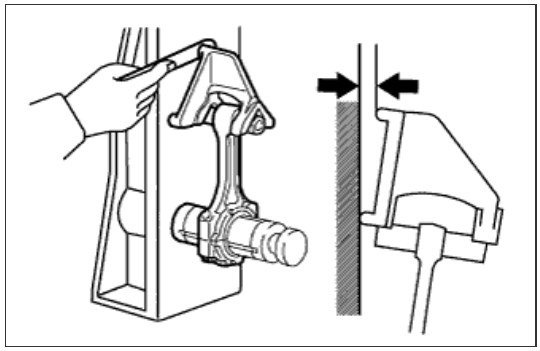
Maximum End Gap:

Item	Specified Condition
No. 1 compression ring	0.40 mm (0.0157 in.)
No. 2 compression ring	0.75 mm (0.0295 in.)
Oil ring	0.50 mm (0.0197 in.)

If the end gap is more than the maximum, replace the piston ring. If the end gap is more than the maximum even with a new piston ring, replace the cylinder block.

27. INSPECT CONNECTING ROD SUB-ASSEMBLY

a. Using a rod aligner and feeler gauge, check the connecting rod alignment.

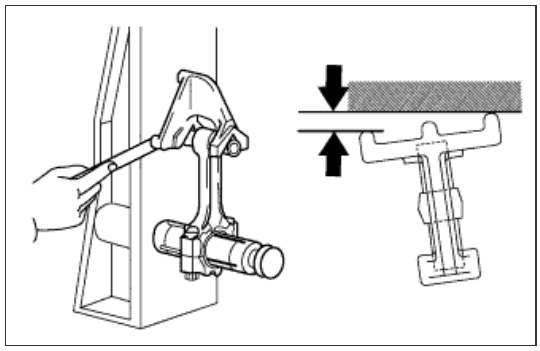


i. Check for bend.

Maximum bend:
0.07 mm (0.00276 in.) per 100 mm (3.94 in.)

If the bend is more than the maximum, replace the connecting rod sub-assembly.

ii. Check for twist.

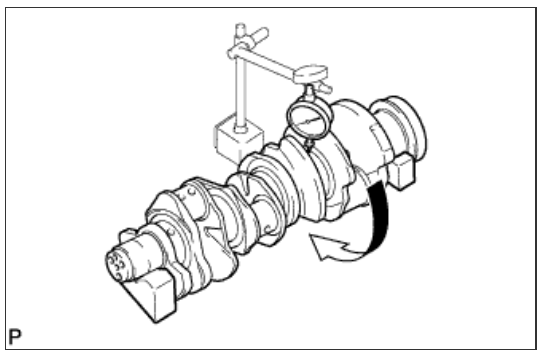


Maximum twist:
0.15 mm (0.00591 in.) per 100 mm (3.94 in.)

If the twist is more than the maximum, replace the connecting rod sub-assembly.

28. INSPECT CRANKSHAFT

a. Using a dial indicator and V-blocks, measure the runout as shown in the illustration.



Maximum circle runout:
0.04 mm (0.00157 in.)

If the circle runout is more than the maximum, replace the crankshaft.

b. Using a micrometer, measure the diameter of each main journal.

Standard diameter:
74.982 to 75.000 mm (2.9520 to 2.9527 in.)

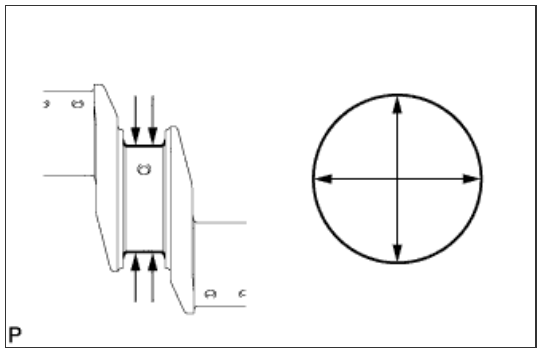
If the diameter is not as specified, check the oil clearance. If necessary, replace

the crankshaft.

c. Check each main journal for taper and out-of-round as shown in the illustration.

Maximum taper and out-of-round:
0.01 mm (0.000394 in.)

If the taper and out-of-round is more than the maximum, replace the crankshaft.



d. Using a micrometer, measure the diameter of each crank pin.

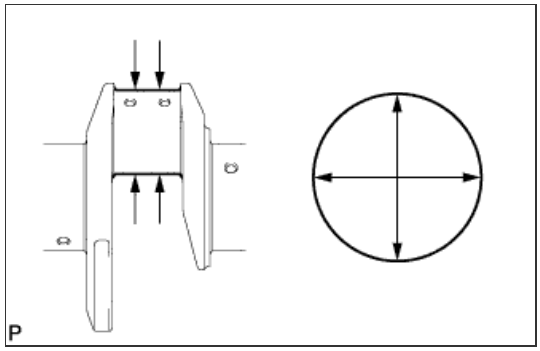
Standard diameter:
54.982 to 55.000 mm (2.1646 to 2.1653 in.)

If the diameter is not as specified, check the oil clearance. If necessary, replace the crankshaft.

e. Check each crank pin for taper and out-of-round as shown in the illustration.

Maximum taper and out-of-round:
0.01 mm (0.000394 in.)

If the taper and out-of-round is more than the maximum, replace the crankshaft.



29. INSPECT CRANKSHAFT THRUST CLEARANCE

a. Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

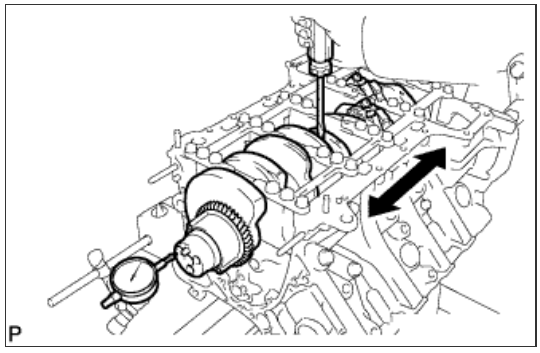
Standard thrust clearance:
0.02 to 0.22 mm (0.000787 to 0.00866 in.)

Maximum thrust clearance:
0.30 mm (0.0118 in.)

If the thrust clearance is more than the maximum, replace the thrust washers as a set.

Standard thrust washer thickness:
2.44 to 2.49 mm (0.0961 to 0.0980 in.)

If necessary, replace the crankshaft.



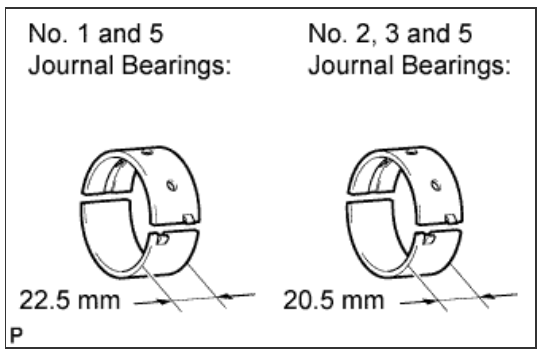
30. INSPECT CRANKSHAFT OIL CLEARANCE

HINT:

Main bearings come in widths of 20.5 mm (0.807 in.) and 22.5 mm (0.886 in.).

Standard Bearing Width

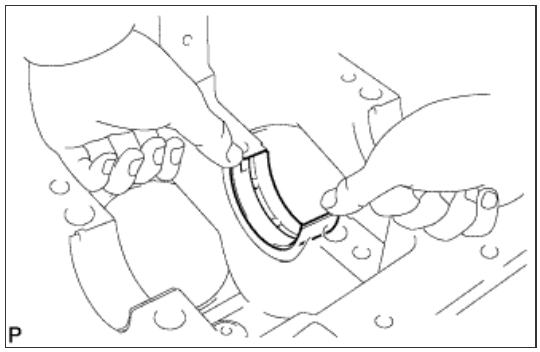
Item	Specified Condition
No. 1 and 5 journal bearings	22.5 mm (0.886 in.)
No. 2, 3 and 4 journal bearings	20.5 mm (0.807 in.)



a. Clean each main journal and bearing.

b. Align the bearing claw with the claw groove of the cylinder block, and push in the

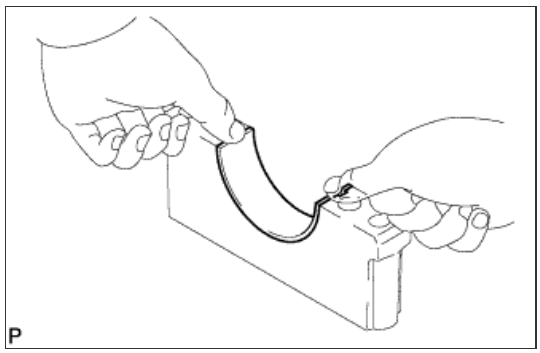
5 upper bearings.



NOTICE:

- **Do not apply engine oil to the bearings and the contact surfaces.**
- **Do not allow coolant to come into contact with the bearing inner surface. If any coolant comes into contact with the bearing inner surface replace the bearing with a new one.**
- **Both sides of the oil groove in the cylinder block should be visible through the oil feed holes in the bearing. The amount visible on each side of the holes should be e ual.**

c. Align the bearing claw with the claw groove of the main bearing cap, and push in the 5 lower bearings.



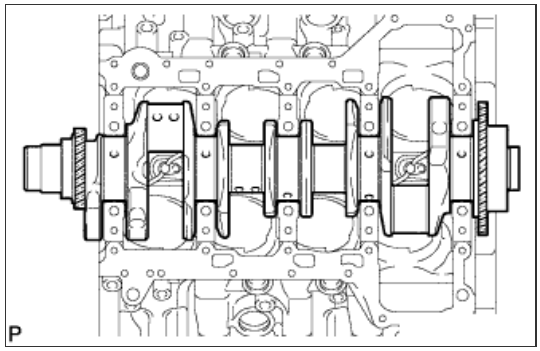
NOTICE:

- **Do not apply engine oil to the bearings and the contact surfaces.**
- **Do not allow coolant to come into contact with the bearing inner surface.**
  If any coolant comes into contact with the bearing inner surface replace the bearing with a new one.

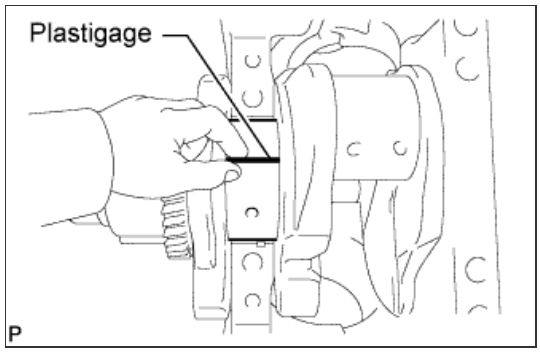
HINT:

A number marked on each main bearing cap indicates the installation position.

d. Place the crankshaft on the cylinder block.



e. Lay a strip of Plastigage across each journal.

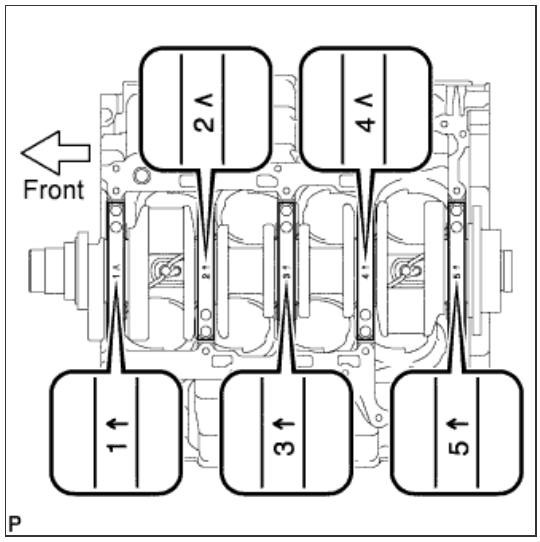


f. Examine the front marks and numbers and install the crankshaft bearing caps to the cylinder block.

NOTICE:

Do not turn the crankshaft.

g. Apply a light coat of engine oil to the threads of the crankshaft bearing cap bolts.



h. Temporarily install the crankshaft bearing cap bolts labeled A or the bolts labeled B.

HINT:

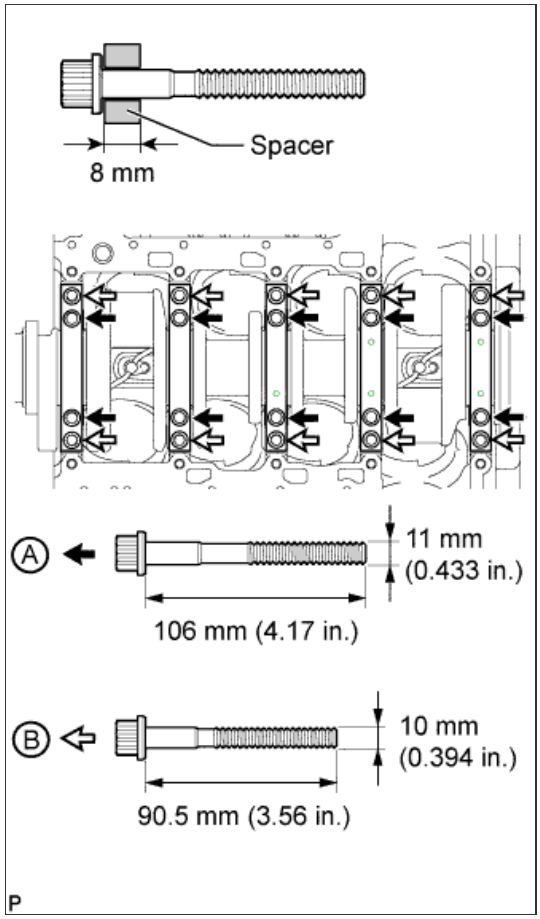
In place of cylinder block stiffening plates, install 8 mm (0.315 in.) thick spacers to the crankshaft bearing cap bolts.

i. Uniformly tighten the 2 crankshaft bearing cap bolts for each bearing cap in several passes to ensure a proper fit.

NOTICE:

Do not tap the bearing cap with a plastic-faced hammer.

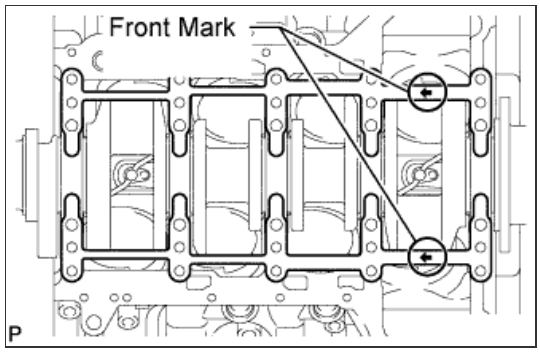
j. Remove the crankshaft bearing cap bolts and spacers.



k. Set the 2 cylinder block stiffening plates on the cylinder block.

HINT:

Make sure the arrows on the stiffening plates face the engine front.



l. Step 1:

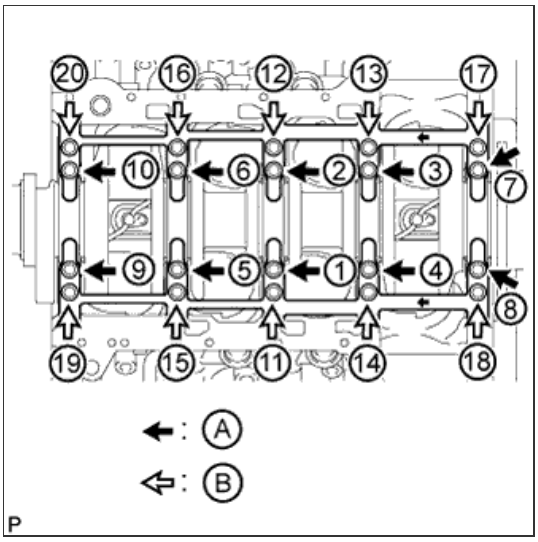
HINT:

- **The crankshaft bearing cap bolts are tightened in 3 progressive steps.**
- **If any crankshaft bearing cap bolt is broken or deformed replace it.**

i. Apply a light coat of engine oil to the threads and under the heads of the 20 crankshaft bearing cap bolts.

ii. Install the 20 crankshaft bearing cap bolts. Using several steps, tighten the bolts uniformly in the sequence shown in the illustration.

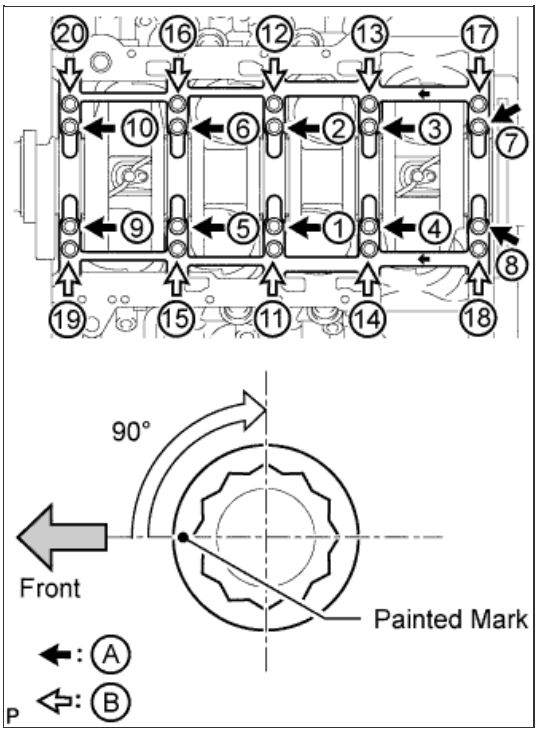
Tor ue:
for bolt A:
35 N*m{ 357 kgf*cm 26 ft.*lbf
for bolt B:
60 N*m{ 612 kgf*cm 44 ft.*lbf



m. Step 2:

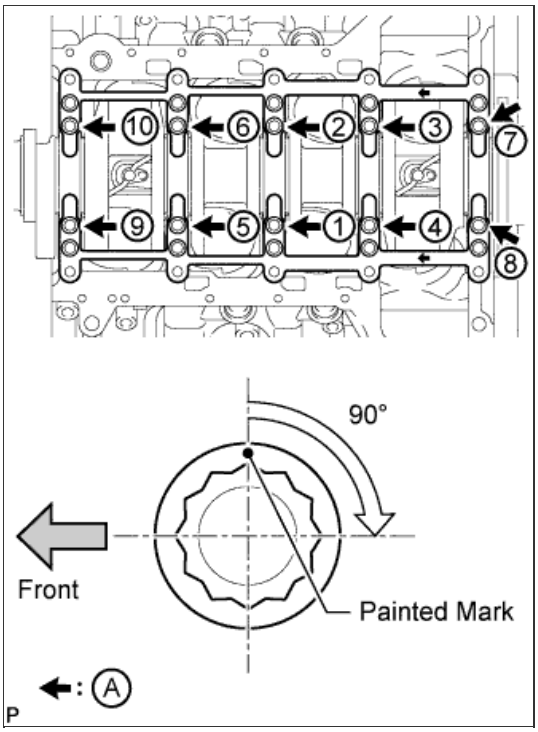
i. Mark the front side of the crankshaft bearing cap bolts A and B with paint.

ii. Tighten the crankshaft bearing cap bolts A and B 90° in the sequence shown in the illustration.

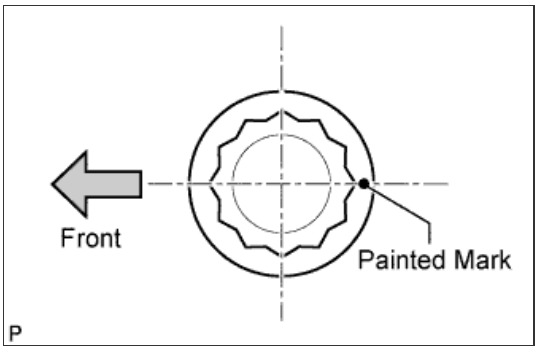


n. Step 3:

i. Tighten the crankshaft bearing cap bolts A another 90° in the sequence shown in the illustration.



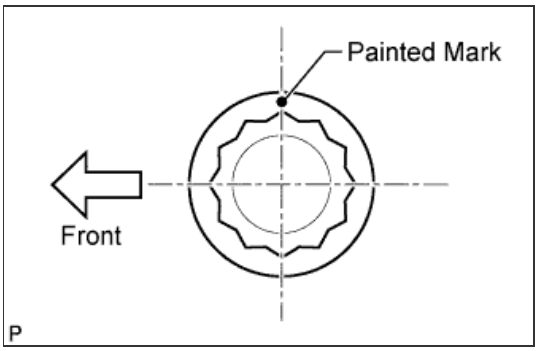
ii. Check that the painted marks of bolts A are now at a 180° angle to the front.



iii. Check that the painted marks of bolts B are now at a 90° angle to the front.

NOTICE:

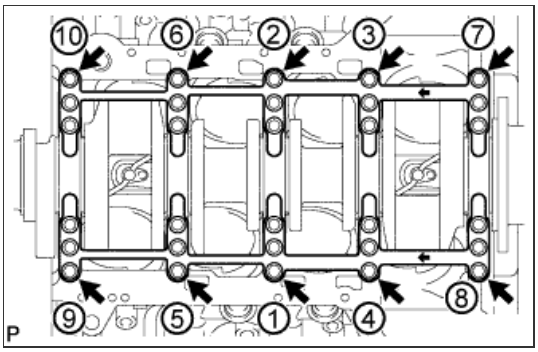
Do not turn the crankshaft.



o. Step 4:

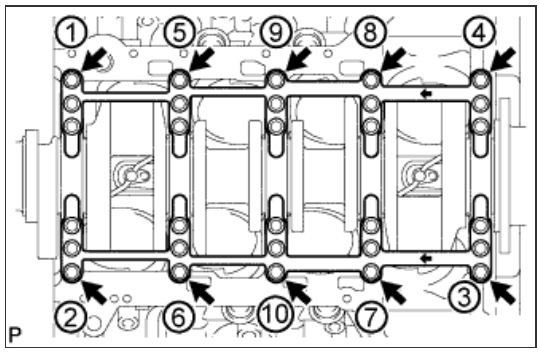
i. Using several steps, install the 10 crankshaft bearing cap bolts uniformly in the sequence shown in the illustration.

Tor ue:
56 N*m{ 571 kgf*cm 41 ft.*lbf

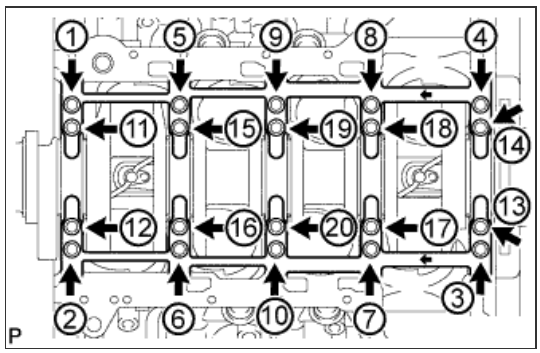


p. Remove the crankshaft bearing caps.

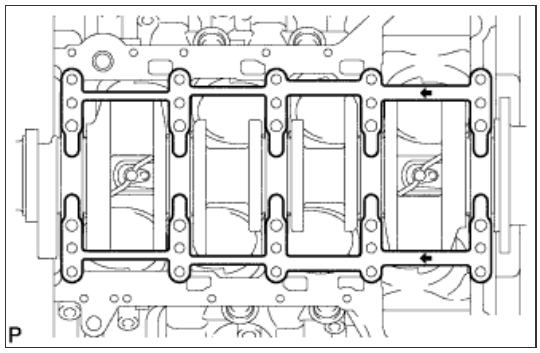
i. Step 1:
Using several steps, loosen and remove the 10 crankshaft bearing cap set bolts uniformly in the sequence shown in the illustration.



ii. Step 2:
Using several steps, loosen and remove the 20 crankshaft bearing cap set bolts uniformly in the sequence shown in the illustration.



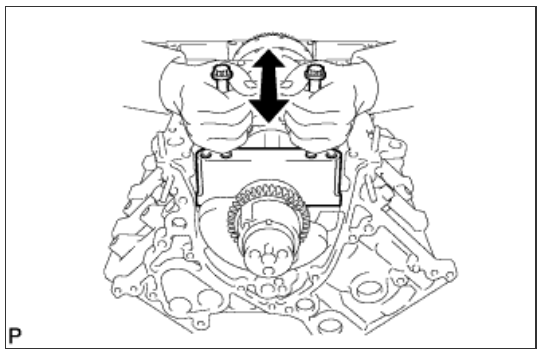
. Remove the 2 cylinder block stiffening plates.



r. Using 2 crankshaft bearing cap set bolts, pull out the 5 bearing caps.

NOTICE:

Take care not to damage the contact surface of the crankshaft bearing cap and cylinder block.



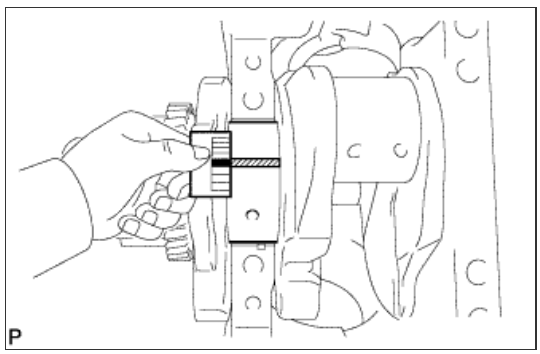
s. Measure the Plastigage at its widest point.

Standard Oil Clearance:

Item	Specified Condition
No. 1 and 3 journals	0.020 to 0.038 mm (0.000787 to 0.00150 in.)
No. 2, 4 and 5 journals	0.032 to 0.050 mm (0.00126 to 0.00197 in.)

Maximum Clearance:

Item	Specified Condition
No. 1 and 3 journals	0.048 mm (0.00189 in.)



No. 2, 4 and 5 journals	0.060 mm (0.00236 in.)

If the oil clearance is more than the maximum, use an over size bearing and correct or regrind the crankshaft so that the oil clearance is as shown in the table below.

Oil Clearance (Use for Over Size Bearing):

Item	Specified Condition
No. 1 and 3 journals	0.021 to 0.061 mm (0.000827 to 0.00240 in.)
No. 2, 4 and 5 journals	0.033 to 0.073 mm (0.00130 to 0.00287 in.)

HINT:

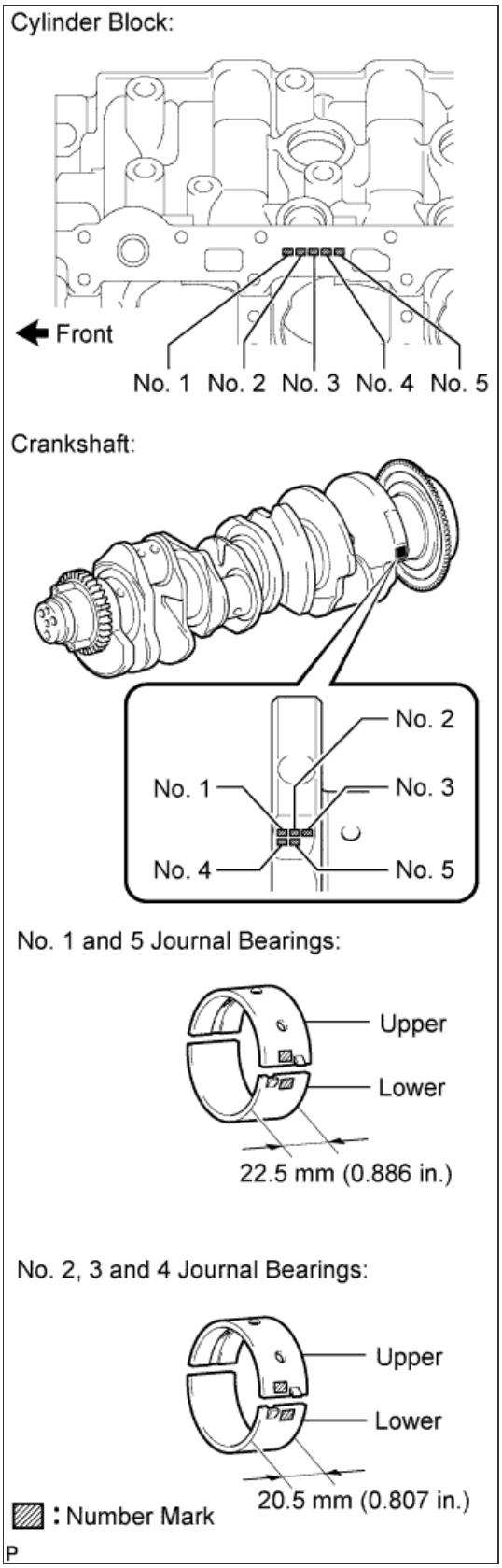
Make sure to replace the upper and lower main bearings as one set.

t. Completely remove the Plastigage.

u. If replacing a bearing, replace it with one that has the same number. If the number of the bearing cannot be determined, select the correct bearing by adding together the numbers imprinted on the cylinder block and crankshaft, then refer to the appropriate bearing number. There are 7 sizes of standard bearings, marked "1", "2", "3", "4", "5", "6" and "7" accordingly.
E PLE
Cylinder block main journal bore diameter "1" (A) + Crankshaft main journal diameter "2" (B) = Total number 3 (use bearing "3" (C))

No. 1 to No. 5 on Cylinder Block:

Cylinder Block (A)	Crankshaft (B)	Use Bearing (C)
"1"	"0"	"1"
	"1"	"2"
	"2"	"3"
	"3"	"4"
	"4"	"5"
"2"	"0"	"2"
	"1"	"3"
	"2"	"4"
	"3"	"5"
	"4"	"6"
"3"	"0"	"3"
	"1"	"4"
	"2"	"5"
	"3"	"6"
	"4"	"7"



Standard Cylinder Block Main Journal Bore Diameter (A):

Item	Mark	Specified Condition
No. 1 and 3 journals	"1"	79.000 to 79.006 mm (3.11023 to 3.11047 in.)
	"2"	More than 79.006 to 79.012 mm (more than 3.11047 to 3.11070 in.)
	"3"	More than 79.012 to 79.018 mm (more than 3.11070 to 3.11094 in.)
No. 2, 4 and 5 journals	"1"	79.000 to 79.006 mm (3.11023 to 3.11047 in.)
	"2"	More than 79.006 to 79.012 mm (more than 3.11047 to 3.11070 in.)
	"3"	More than 79.012 to 79.018 mm (more than 3.11070 to 3.11094 in.)

Standard Crankshaft Main Journal Diameter (B):

Item	Mark	Specified Condition
No. 1 and 3 journals	"2"	More than 74.994 to 75.000 mm (more than 2.95251 to 2.95275 in.)
	"3"	More than 74.988 to 74.994 mm (more than 2.95228 to 2.95251 in.)
	"4"	74.982 to 74.988 mm (2.95204 to 2.95228 in.)
No. 2, 4 and 5 journals	"0"	More than 74.994 to 75.000 mm (more than 2.95251 to 2.95275 in.)
	"1"	More than 74.988 to 74.994 mm (more than 2.95288 to 2.95251 in.)
	"2"	74.982 to 74.988 mm (2.95204 to 2.95228 in.)

Standard Crankshaft Bearing Center Wall Thickness (C):

Item	Mark	Specified Condition (for Upper Bearing)	Specified Condition (for Lower Bearing)
No. 1 and 5 journal bearings	"1"	More than 1.987 to 1.990 mm (more than 0.07823 to 0.07835 in.)	More than 1.975 to 1.978 mm (more than 0.07776 to 0.07787 in.)
	"2"	More than 1.990 to 1.993 mm (more than 0.07835 to 0.07846 in.)	More than 1.978 to 1.981 mm (more than 0.07787 to 0.07799 in.)
	"3"	More than 1.993 to 1.996 mm (more than 0.07846 to 0.07858 in.)	More than 1.981 to 1.984 mm (more than 0.07799 to 0.07811 in.)
	"4"	More than 1.996 to 1.999 mm (more than 0.07858 to 0.07870 in.)	More than 1.984 to 1.987 mm (more than 0.07811 to 0.07823 in.)
	"5"	More than 1.999 to 2.002 mm (more than 0.07870 to 0.07882 in.)	More than 1.987 to 1.990 mm (more than 0.07823 to 0.07835 in.)
	"6"	More than 2.002 to 2.005 mm (more than 0.07882 to 0.07894 in.)	More than 1.990 to 1.993 mm (more than 0.07835 to 0.07846 in.)
	"7"	More than 2.005 to 2.008 mm (more than 0.07894 to 0.07905 in.)	More than 1.993 to 1.996 mm (more than 0.07846 to 0.07858 in.)
No. 2, 3 and 4 journal bearings	"1"	More than 1.975 to 1.978 mm (more than 0.07776 to 0.07787 in.)	More than 1.987 to 1.990 mm (more than 0.07823 to 0.07835 in.)
	"2"	More than 1.978 to 1.981 mm (more than 0.07787 to 0.07799 in.)	More than 1.990 to 1.993 mm (more than 0.07835 to 0.07846 in.)
	"3"	More than 1.981 to 1.984 mm (more than 0.07799 to 0.07811 in.)	More than 1.993 to 1.996 mm (more than 0.07846 to 0.07858 in.)
	"4"	More than 1.984 to 1.987 mm (more than 0.07811 to 0.07823 in.)	More than 1.996 to 1.999 mm (more than 0.07858 to 0.07870 in.)
	"5"	More than 1.987 to 1.990 mm (more than 0.07823 to 0.07835 in.)	More than 1.999 to 2.002 mm (more than 0.07870 to 0.07882 in.)
	"6"	More than 1.990 to 1.993 mm (more than 0.07835 to 0.07846 in.)	More than 2.002 to 2.005 mm (more than 0.07882 to 0.07894 in.)
	"7"	More than 1.993 to 1.996 mm (more than 0.07846 to 0.07858 in.)	More than 2.005 to 2.008 mm (more than 0.07894 to 0.07905 in.)

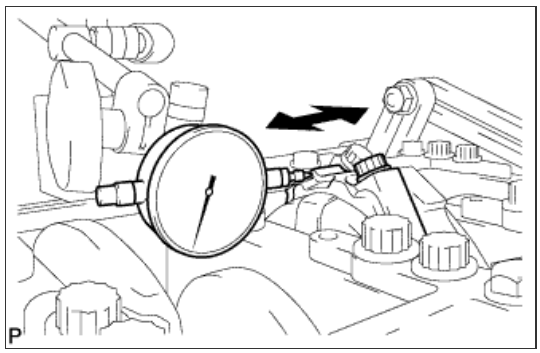
31. INSPECT CONNECTING ROD THRUST CLEARANCE

a. Using a dial indicator, measure the thrust clearance while moving the connecting rod back and forth.

Standard thrust clearance:
0.14 to 0.54 mm (0.00551 to 0.0213 in.)

Maximum thrust clearance:
0.60 mm (0.0236 in.)

If the thrust clearance is more than the maximum, replace one or more connecting rods as necessary.
If necessary, replace the crankshaft.

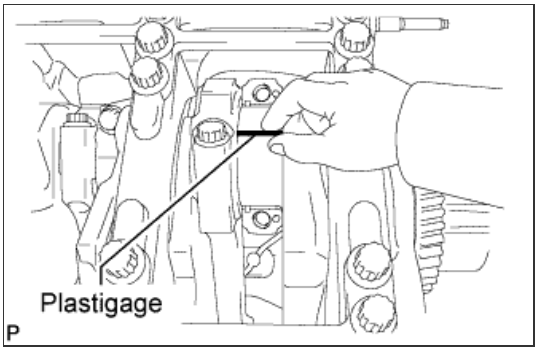


32. INSPECT CONNECTING ROD OIL CLEARANCE

a. Install the crankshaft bearing (Click here).

b. Install the crankshaft (Click here).

c. Lay a strip of Plastigage across the crank pin.

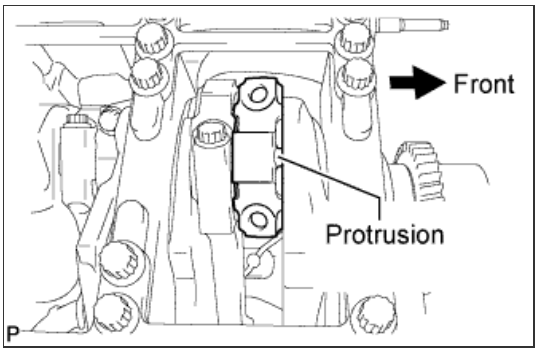


d. Install the connecting rod cap so that its protrusion is facing the correct direction.

NOTICE:

Match the numbered connecting rod cap with the connecting rod.

e. Apply a light coat of engine oil to the threads of the connecting rod cap bolts.



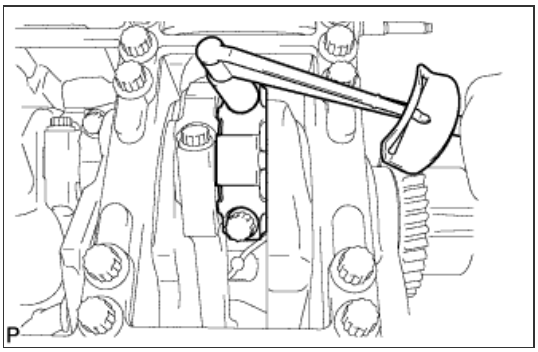
f. Step 1:

HINT:

- **The connecting rod bearing cap bolts are tightened in 2 progressive steps.**
- **If any connecting rod bearing cap bolt is broken or deformed replace it.**

i. Install and alternately tighten the bolts of the connecting rod cap in several steps.

Tor ue:
35 N*m{ 357 kgf*cm 26 ft.*lbf

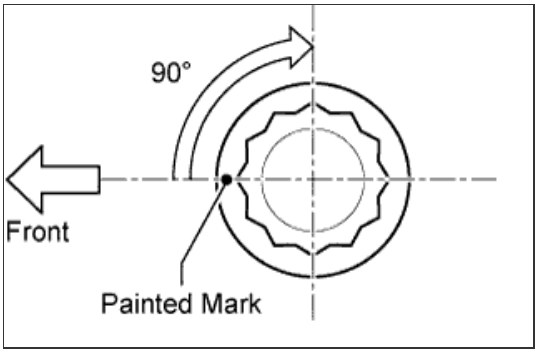


g. Step 2:

i. Mark the front side of each connecting rod cap bolt with paint.

ii. Tighten the bearing cap bolts in step 1 90°.

h. Remove the 2 bolts, connecting rod cap and lower bearing.



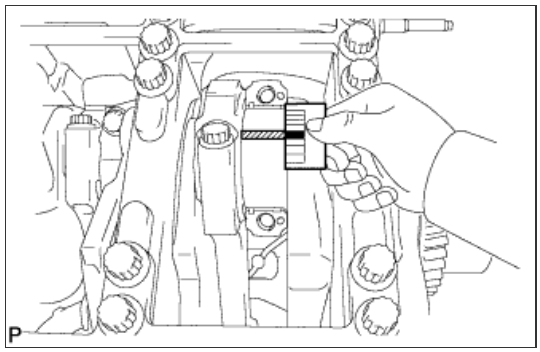
i. Measure the Plastigage at its widest point.

Standard oil clearance:
0.024 to 0.042 mm (0.000945 to 0.00165 in.)

Maximum oil clearance:

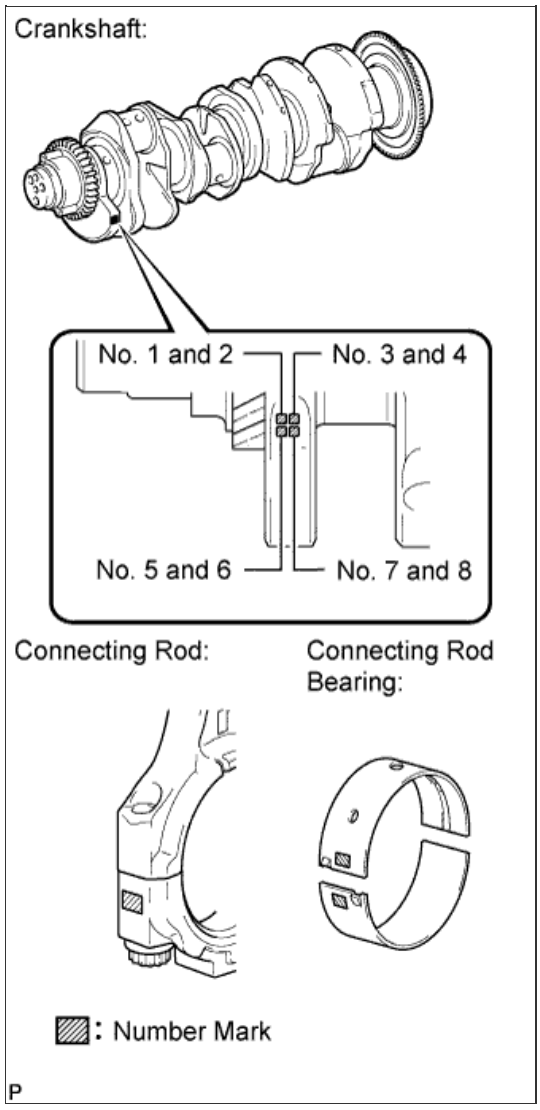
0.052 mm (0.00205 in.)

If the oil clearance is more than the maximum, replace the bearings. If necessary, replace the crankshaft.



j. Completely remove the Plastigage.

k. If replacing a bearing, replace it with one that has the same number marked on the connecting rod. There are 5 sizes of standard bearings, marked "1 ", "2", "3", "4" and "5" accordingly.
Select the correct bearing by adding together the number marks imprinted on the connecting rod and crankshaft.
E PLE
Connecting rod "1" (A) + Crank pin "2" (B) = Total number 3 (use bearing "3" (C))



Standard Connecting Rod Big End Inside Diameter (A):

Mark	Specified Condition
"1"	58.000 to 58.006 mm (2.28346 to 2.28370 in.)
"2"	More than 58.006 to 58.012 mm (more than 2.28370 to 2.28393 in.)
"3"	More than 58.012 to 58.018 mm (more than 2.28393 to 2.28417 in.)

Standard Crankshaft Pin Diameter (B):

Mark	Specified Condition
"0"	More than 54.994 to 55.000 mm (more than 2.16511 to 2.16535 in.)
"1"	More than 54.988 to 54.994 mm (more than 2.16488 to 2.16511 in.)
"2"	54.982 to 54.988 mm (2.16464 to 2.16488 in.)

Standard Bearing Center Wall Thickness (C):

Mark	Specified Condition
"1"	More than 1.485 to 1.488 mm (more than 0.05846 to 0.05858 in.)
"2"	More than 1.488 to 1.491 mm (more than 0.05858 to 0.05870 in.)
"3"	More than 1.491 to 1.494 mm (more than 0.05870 to 0.05882 in.)
"4"	More than 1.494 to 1.497 mm (more than 0.05882 to 0.05894 in.)
"5"	More than 1.497 to 1.500 mm (more than 0.05894 to 0.05910 in.)

l. Remove the crankshaft (Click here).

m. Remove the crankshaft bearing.

33. INSPECT NO. 1 CHAIN

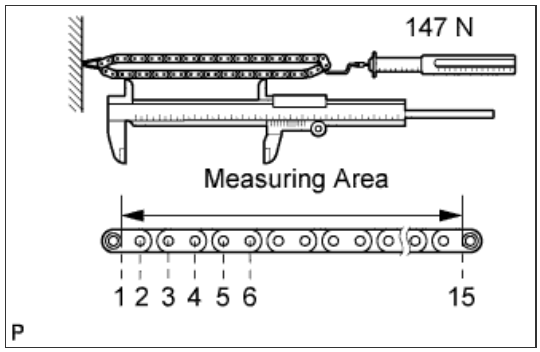
a. Using a spring scale, pull the No. 1 chain with a force of 147 N (15 kgf, 33.1 lbf) and measure the length of the No. 1 chain using a vernier caliper.

Maximum chain elongation:
143.95 mm (5.67 in.)

NOTICE:

Perform the measurement at 3 random places.

If the elongation is more than the maximum, replace the No. 1 chain.



34. INSPECT NO. 2 CHAIN

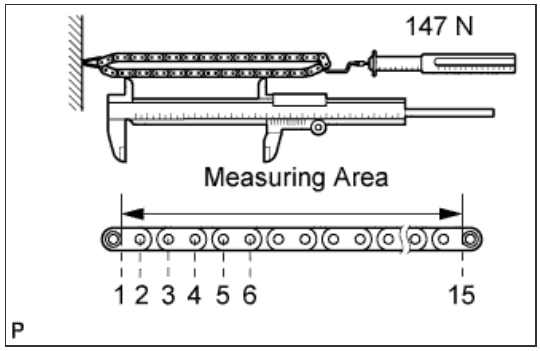
a. Using a spring scale, pull the No. 2 chain with a force of 147 N (15 kgf, 33.1 lbf) and measure the length of the No. 2 chain using a vernier caliper.

Maximum chain elongation:
143.95 mm (5.67 in.)

NOTICE:

Perform the measurement at 3 random places.

If the elongation is more than the maximum, replace the No. 2 chain.



35. INSPECT FUEL SUPPLY PUMP SHAFT SPROCKET

a. Wrap the No. 1 chain around the sprocket place for the No. 1 chain.

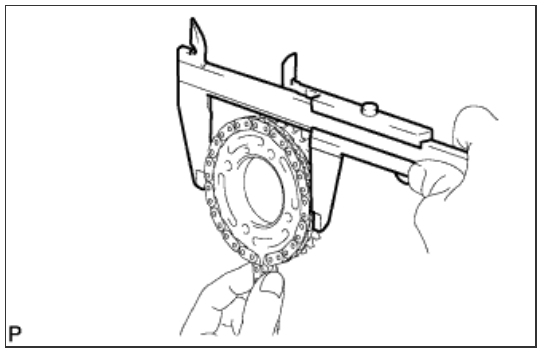
b. Using a vernier caliper, measure the sprocket with the chain.

Minimum gear diameter (with chain):
101.55 mm (4.00 in.)

HINT:

The vernier caliper must contact the chain rollers for the measurement.

If the diameter is less than the minimum, replace the No. 1 chain sub-assembly and fuel supply pump shaft sprocket.



c. Wrap the No. 2 chain around the sprocket place for the No. 2 chain.

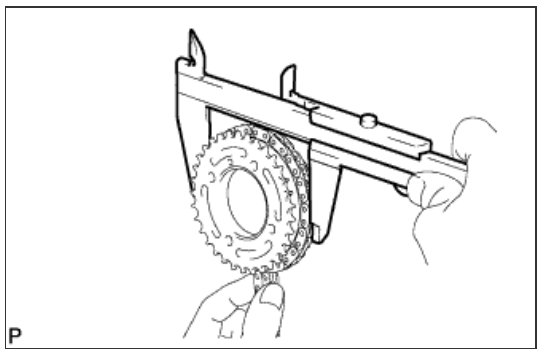
d. Using a vernier caliper, measure the sprocket with the No. 2 chain.

Minimum gear diameter (with chain):
101.55 mm (4.00 in.)

HINT:

The vernier caliper must contact the chain rollers for the measurement.

If the diameter is less than the minimum, replace the No. 2 chain sub-assembly and fuel supply pump shaft sprocket.



36. INSPECT NO. 1 CAMSHAFT TIMING SPROCKET

a. Wrap the No. 1 chain around the sprocket.

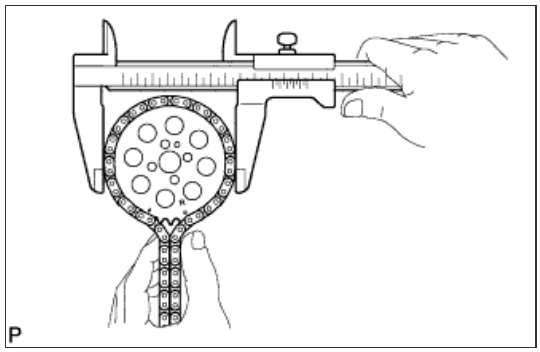
b. Using a vernier caliper, measure the No. 1 camshaft timing sprocket diameter with the No. 1 chain.

Minimum gear diameter (with chain):
134.90 mm (5.31 in.)

HINT:

The vernier caliper must contact the chain rollers for the measurement.

If the diameter is less than the minimum, replace the No. 1 chain sub-assembly and No. 1 camshaft timing sprocket.



37. INSPECT NO. 2 CAMSHAFT TIMING SPROCKET

a. Wrap the No. 2 chain around the sprocket.

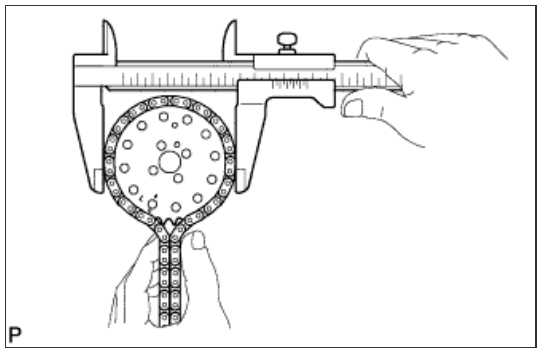
b. Using a vernier caliper, measure the No. 2 camshaft timing sprocket diameter with the No. 2 chain.

Minimum gear diameter (with chain):
134.90 mm (5.31 in.)

HINT:

The vernier caliper must contact the chain rollers for the measurement.

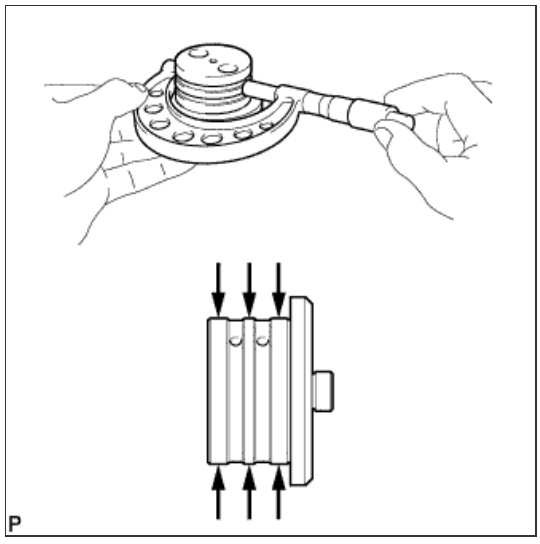
If the diameter is less than the minimum, replace the No. 2 chain sub-assembly and No. 2 camshaft timing sprocket.



38. INSPECT NO. 1 IDLE GEAR SHAFT OIL CLEARANCE

a. Using a micrometer, measure the No. 1 idle gear shaft diameter.

Standard idle gear shaft diameter:
44.947 to 44.975 mm (1.770 to 1.771 in.)



b. Using a caliper gauge, measure the inside diameter of the idle gear.

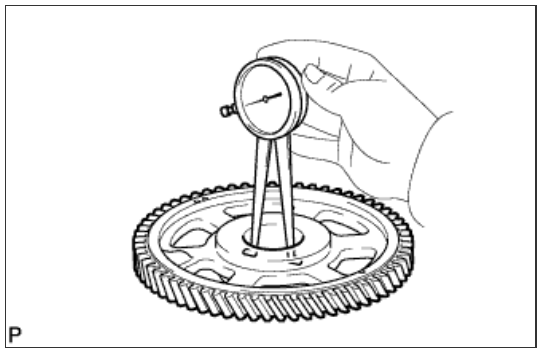
Standard idle gear inside diameter:
45.000 to 45.025 mm (1.772 to 1.773 in.)

c. Subtract the No. 1 idle gear shaft diameter measurement from the idle gear inside diameter measurement.

Standard oil clearance:
0.025 to 0.078 mm (0.000984 to 0.00307 in.)

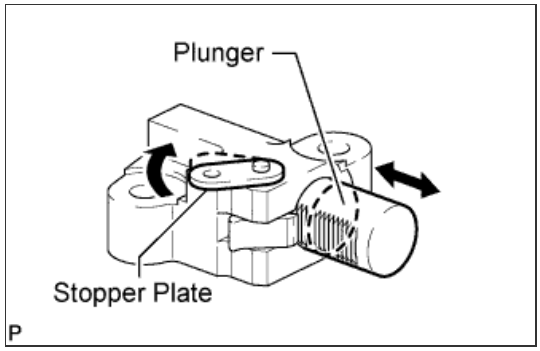
Maximum oil clearance:
0.078 mm (0.00307 in.)

If the thrust oil clearance is more than the maximum, replace the No. 1 idle gear shaft and idle gear as a set.



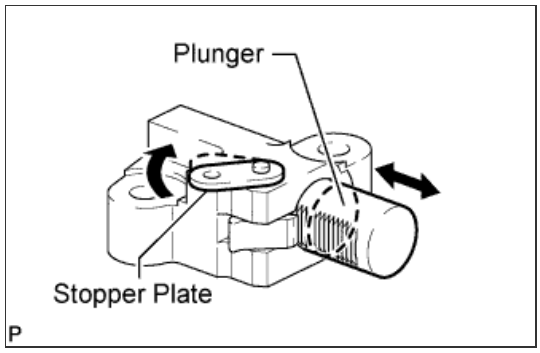
39. INSPECT NO. 1 CHAIN TENSIONER ASSEMBLY

a. Move the stopper plate clockwise to release the lock. Push the plunger and check that it moves smoothly.
If necessary, replace the No. 1 chain tensioner assembly.



40. INSPECT NO. 2 CHAIN TENSIONER ASSEMBLY

a. Move the stopper plate clockwise to release the lock. Push the plunger and check that it moves smoothly.
If necessary, replace the No. 2 chain tensioner assembly.

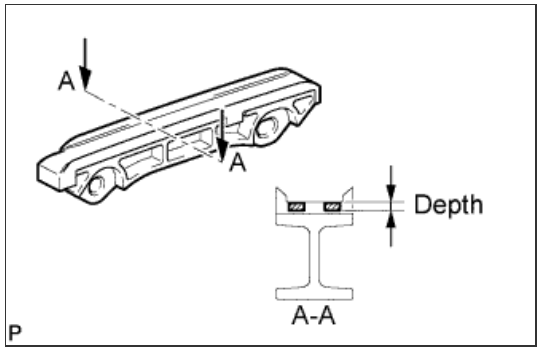


41. INSPECT NO. 1 CHAIN TENSIONER SLIPPER

a. Measure the worn depth of the No. 1 chain tensioner slipper.

Maximum depth:
1.0 mm (0.0394 in.)

If the depth is more than the maximum, replace the No. 1 chain tensioner slipper.

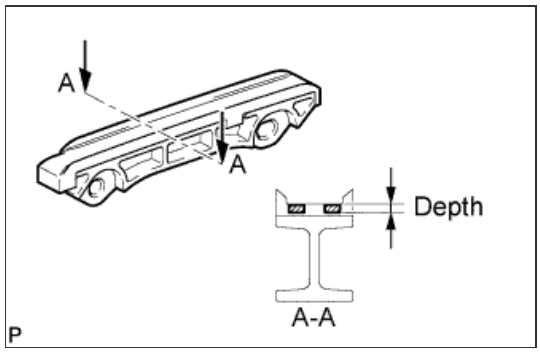


42. INSPECT NO. 2 CHAIN TENSIONER SLIPPER

a. Measure the worn depth of the No. 2 chain tensioner slipper.

Maximum depth:
1.0 mm (0.0394 in.)

If the depth is more than the maximum, replace the No. 2 chain tensioner slipper.

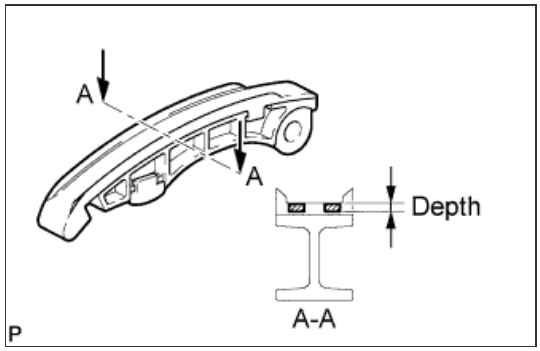


43. INSPECT NO. 1 CHAIN VIBRATION DAMPER

a. Measure the worn depth of the No. 1 chain vibration damper.

Maximum depth:
1.0 mm (0.0394 in.)

If the depth is more than the maximum, replace the No. 1 chain vibration damper.

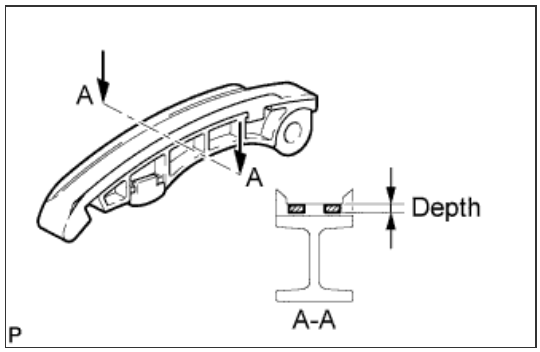


44. INSPECT NO. 2 CHAIN VIBRATION DAMPER

a. Measure the worn depth of the No. 2 chain vibration damper.

Maximum depth:
1.0 mm (0.0394 in.)

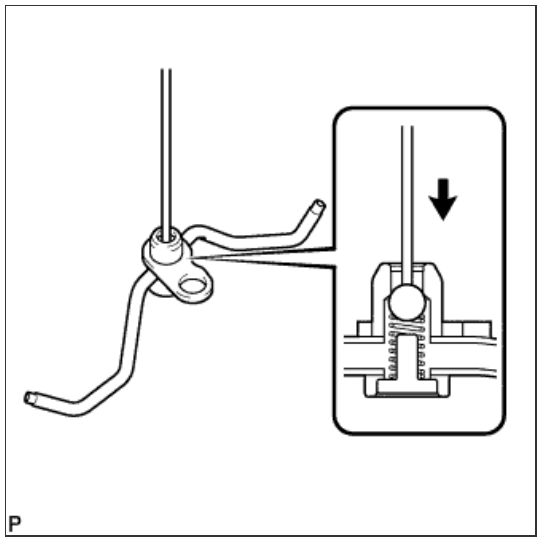
If the depth is more than the maximum, replace the No. 2 chain vibration damper.



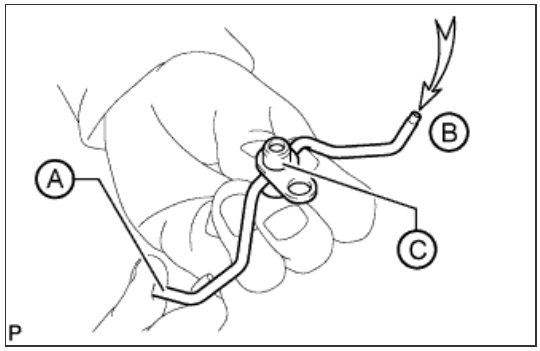
45. INSPECT NO. 1 OIL NOZZLE SUB-ASSEMBLY

a. Push the check valve with a pin to check if it is stuck.
If stuck, replace the No. 1 oil nozzle sub-assembly.

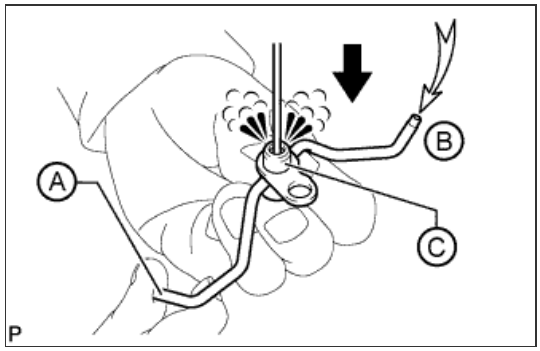
b. Push the check valve with a pin to check if it moves smoothly.



c. While covering A, apply air into B. Check that air does not leak through C.
Perform the check again while covering B and applying air into A.
If air leaks, clean or replace the No. 1 oil nozzle sub-assembly.



d. Push the check valve while covering A, and apply air into B. Check that air passes through C. Perform the check again while covering B, pushing the check valve and applying air into A.
If air does not pass through C, clean or replace the No. 1 oil nozzle sub-assembly.



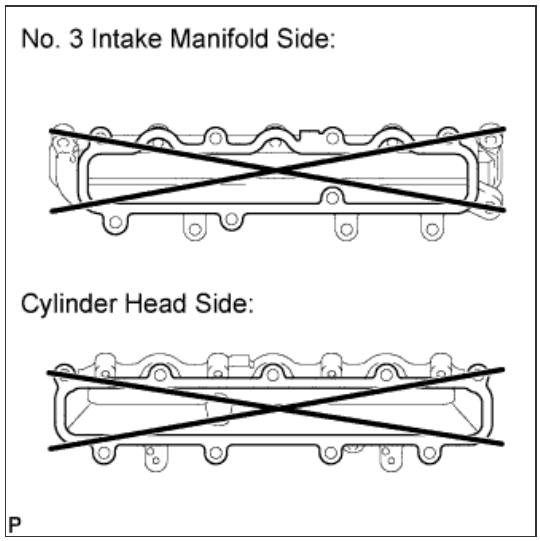
46. INSPECT NO. 1 INTA E MANIFOLD FOR FLATNESS

a. Using a precision straightedge and feeler gauge, measure the warpage of the contact surface between the No. 1 and No. 3 intake manifold, and the No. 1 intake manifold and cylinder head.

Maximum Warpage:

Item	Specified Condition
No. 3 intake manifold	0.10 mm (0.00394 in.)
Cylinder head	0.10 mm (0.00394 in.)

If the warpage is more than the maximum, replace the No. 1 intake manifold.



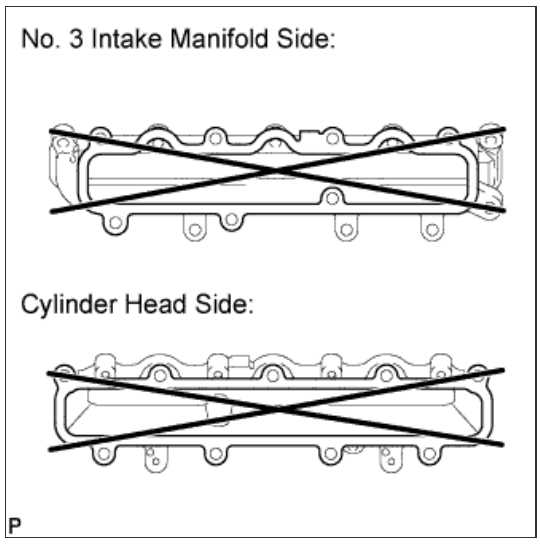
47. INSPECT NO. 2 INTA E MANIFOLD FOR FLATNESS

a. Using a precision straightedge and feeler gauge, measure the warpage of the contact surface between the No. 2 and No. 3 intake manifold, and the No. 2 intake manifold and cylinder head.

Maximum Warpage:

Item	Specified Condition
No. 3 intake manifold	0.10 mm (0.00394 in.)
Cylinder head	0.10 mm (0.00394 in.)

If the warpage is more than the maximum, replace the No. 2 intake manifold.



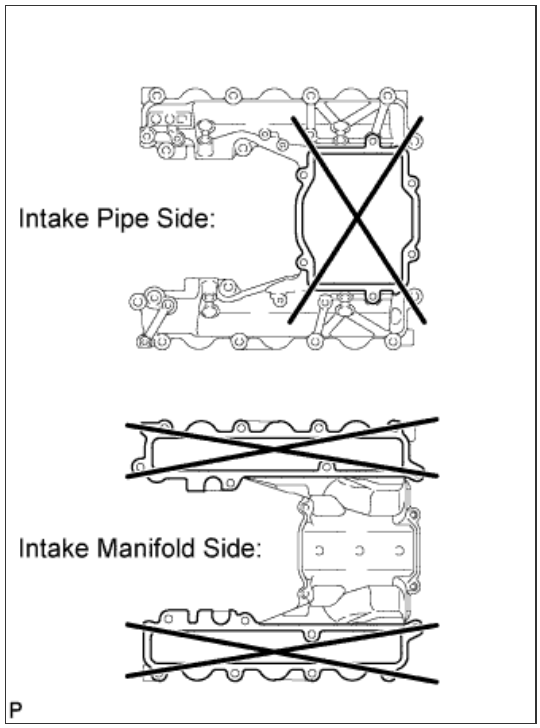
48. INSPECT NO. 3 INTA E MANIFOLD FOR FLATNESS

a. Using a precision straightedge and feeler gauge, measure the warpage of the contact surface between the No. 3 and No. 1 intake manifold, the No. 3 and No. 2 intake manifold, and the No. 3 intake manifold and intake pipe.

Maximum Warpage:

Item	Specified Condition
Intake pipe	0.10 mm (0.00394 in.)
No. 2 and No. 3 intake manifold	0.15 mm (0.00591 in.)

If the warpage is more than the maximum, replace the No. 3 intake manifold.

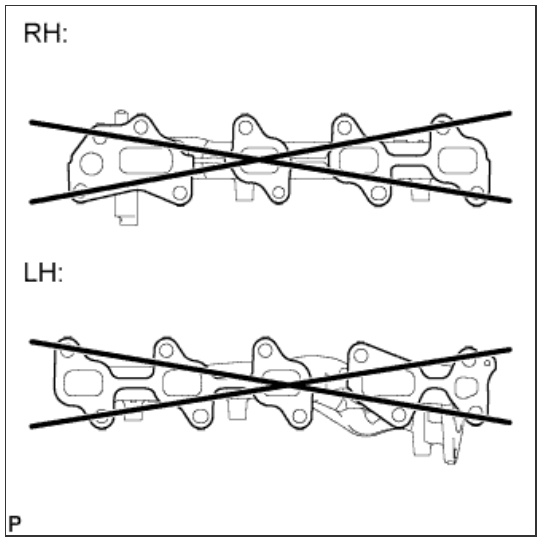


49. INSPECT E HAUST MANIFOLD FOR FLATNESS

a. Using a precision straightedge and feeler gauge, measure the warpage of the contact surface between the exhaust manifold and cylinder head.

Maximum warpage:
0.80 mm (0.0315 in.)

If the warpage is more than the maximum, replace the exhaust manifold.


RH:
LH:
P

for Preparation Click here

NOTICE:

- **Before performing these installation procedures, sufficiently clean and remove any foreign matter from the cylinder block, cylinder head, crankshaft, connecting rod, camshaft and other parts.**
- **When replacing an injector (including interchanging injectors between cylinders), common rail, cylinder head, or intake manifold, replace the corresponding injection pipes with a new one.**

1. SELECT NO. 2 CYLINDER HEAD GASKET

a. Set the 2 crankshaft pulley set bolts to the crankshaft.

b. Clean the cylinder block with solvent.

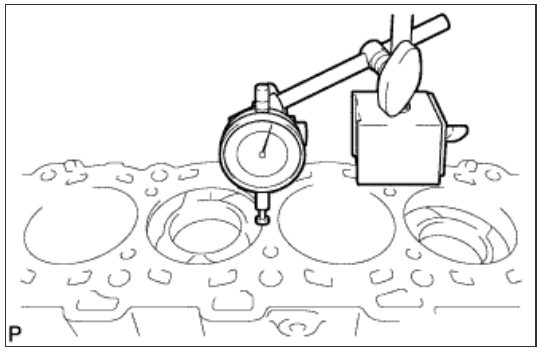
c. Inspect the protrusion for each cylinder.

i. Set the piston of the cylinder to be measured to slightly before TDC.

ii. Place a dial indicator on the cylinder block, and set the measuring tip as shown in the illustration.

NOTICE:

Make sure that the dial indicator is at a right angle to the cylinder block top surface.



iii. Set the dial indicator at 0 mm (0 in.).

HINT:

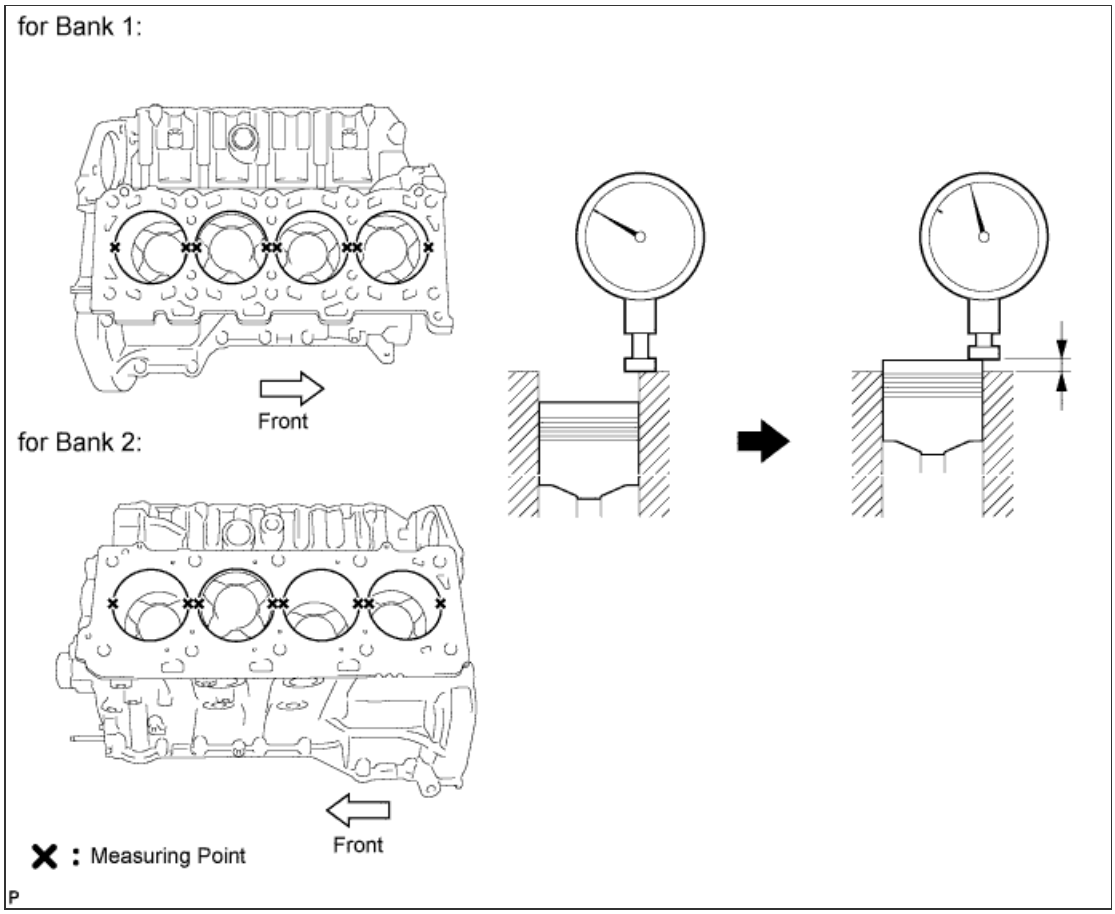
Make sure that the measuring tip is flat against the cylinder block surface and piston head when taking the measurements.

iv. Find where the piston head protrudes most by slowly turning the crankshaft clockwise and counterclockwise.

v. Measure the piston protrusion value of each cylinder at 2 places as shown in the illustration below, making a total of 8 measurements.

Standard piston protrusion:
0.520 to 0.780 mm (0.0205 to 0.0307 in.)

If the protrusion is not as specified, remove and reinstall the piston and connecting rod.



d. Select a new cylinder head gasket.

HINT:

Cylinder head gaskets are marked A, B, C, D or E accordingly.

New Installed Cylinder Head Gasket Thickness:

Item	Cutout	Specified Condition*
A	1	1.20 to 1.30 mm (0.0472 to 0.0512 in.)
B	2	1.25 to 1.35 mm (0.0492 to 0.0394 in.)
C	3	1.30 to 1.40 mm (0.0512 to 0.0551 in.)
D	4	1.35 to 1.45 mm (0.0531 to 0.0571 in.)
E	5	1.40 to 1.50 mm (0.0551 to 0.0591 in.)

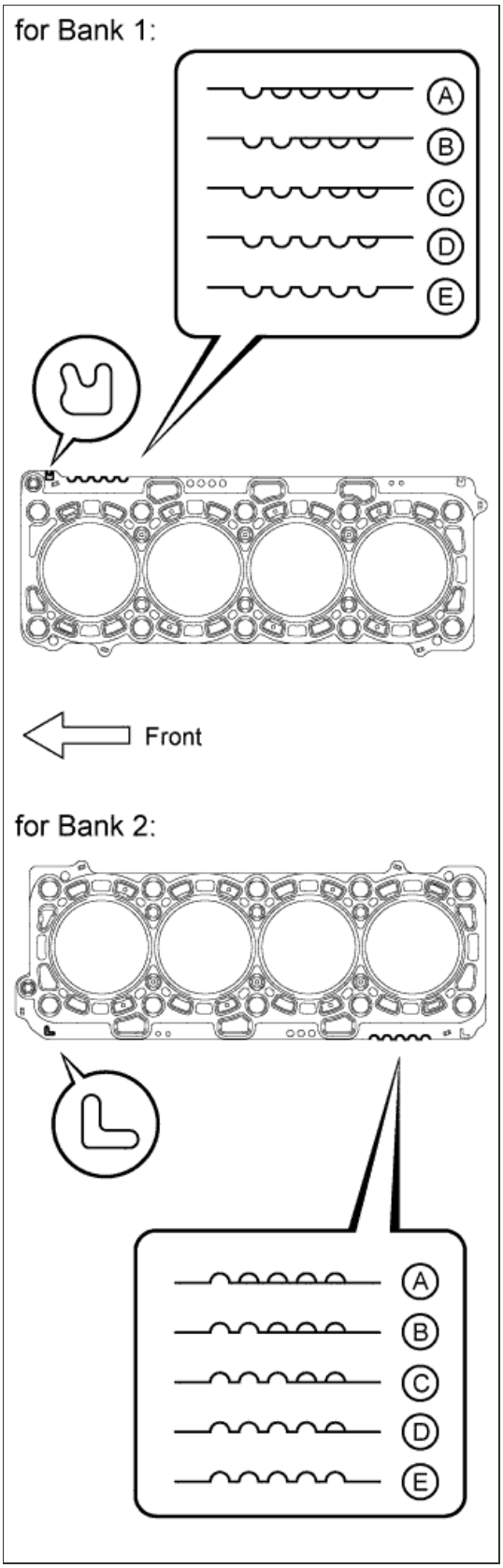
HINT:

*: The specified condition indicates the thickness of the gasket after tightening the cylinder head.

i. Select the largest piston protrusion value from the measurements and then select a new appropriate gasket according to the table below.

Standard Piston Protrusion:

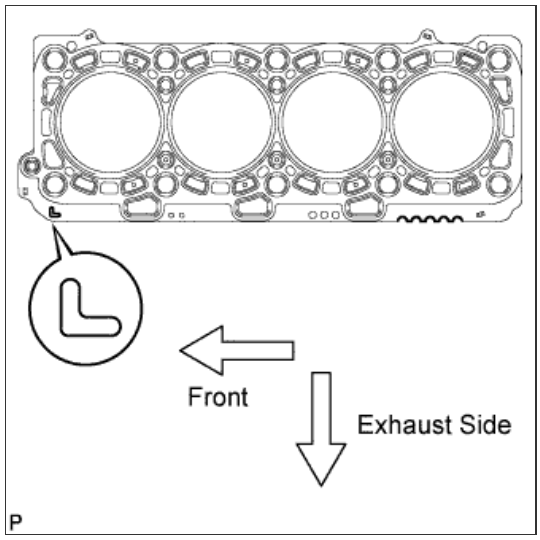
Item	Specified Condition
A	0.520 to 0.575 mm (0.0205 to 0.0226 in.)
B	0.575 to 0.625 mm (0.0226 to 0.0246 in.)
C	0.625 to 0.675 mm (0.0246 to 0.0266 in.)
D	0.675 to 0.725 mm (0.0266 to 0.0285 in.)
E	0.725 to 0.780 mm (0.0285 to 0.0307 in.)



2. INSTALL NO. 2 CYLINDER HEAD GASKET

a. Remove any oil from the contact surface.

b. Place the cylinder head gasket on the cylinder block surface with the front face of the indicated mark "L" upward and facing the exhaust side.



3. INSTALL CYLINDER HEAD SUB-ASSEMBLY LH

a. Place the cylinder head on the cylinder head gasket.

NOTICE:

Ensure that no oil is on the mounting surface of the cylinder head.

b. Inspect the cylinder head bolts (Click here).

c. Apply a light coat of engine oil to the threads and under the heads of the cylinder head bolts.

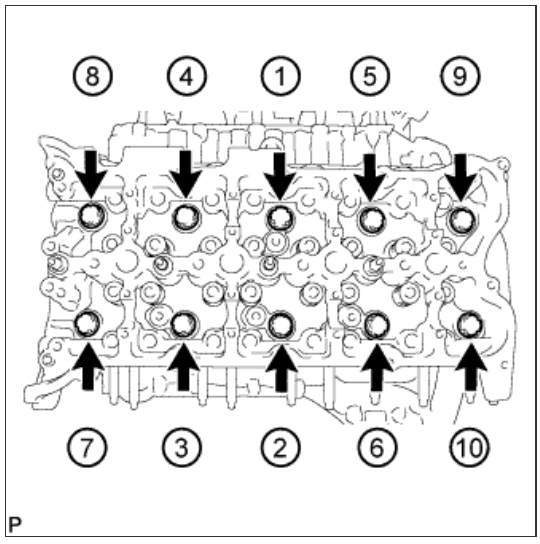
d. Step 1:

i. Install and uniformly tighten the 10 cylinder head bolts with the spacers in several steps, in the sequence shown in the illustration.

Torque:
80 N*m{ 816 kgf*cm , 59 ft.*lbf }

HINT:

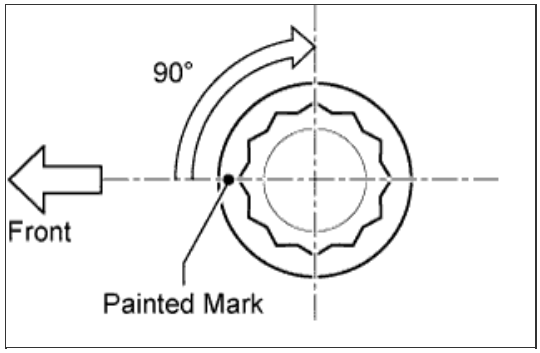
- **The cylinder head bolts are tightened in 4 progressive steps.**
- **If a cylinder head bolt is broken or deformed, replace it.**



e. Step 2:

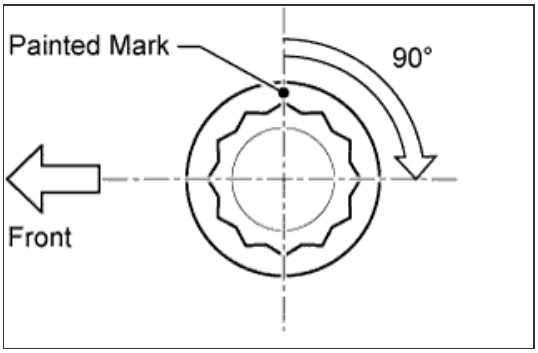
i. Mark the cylinder head bolt heads with paint as shown in the illustration.

ii. Tighten the cylinder head bolts 90° in the sequence shown in step 1.



f. Step 3:

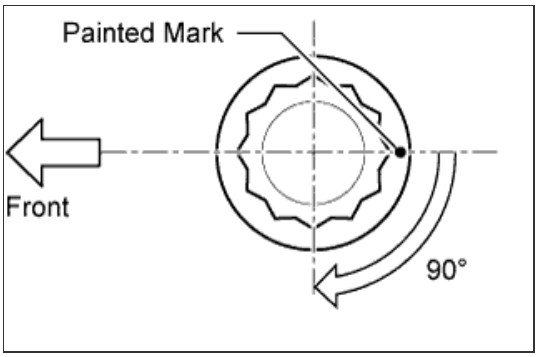
i. Tighten the cylinder head bolts another 90° in the sequence shown in step 1.



g. Step 4:

i. Tighten the cylinder head bolts by an additional 90° in the sequence shown in step 1.

h. Check that the painted marks are now facing the exhaust port side.



4. INSTALL NO. 2 VALVE LASH ADJUSTER ASSEMBLY

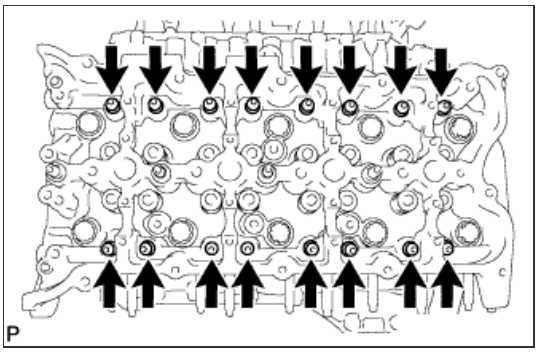
NOTICE:

Be sure to inspect the valve lash adjuster before installing it (Click here).

a. Install the 16 No. 2 valve lash adjusters to the cylinder head.

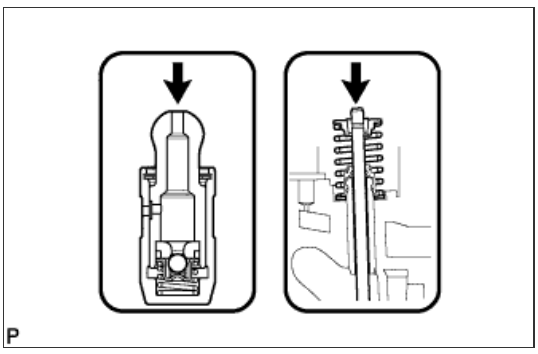
HINT:

Install the lash adjuster at the same place it was removed from.



5. INSTALL NO. 2 VALVE ROCKER ARM

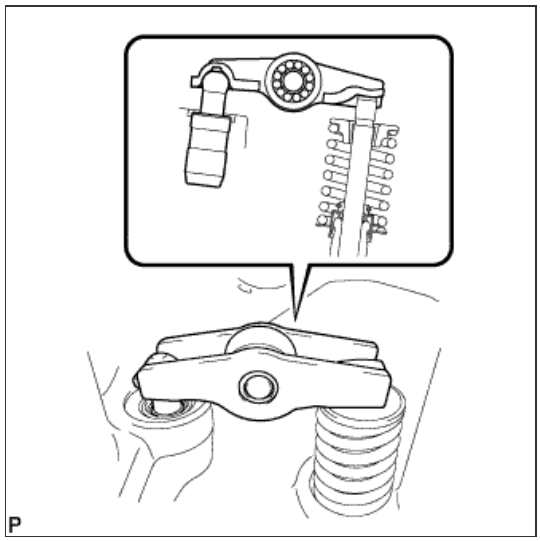
a. Apply engine oil to the lash adjuster tips and valve stem ends.



b. Install the 16 No. 2 valve rocker arms as shown in the illustration.

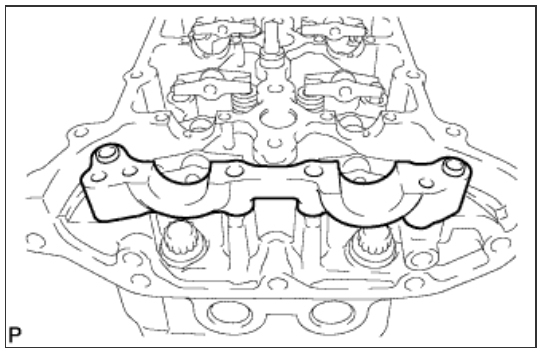
HINT:

Install the valve rocker arm at the same place it was removed from.



6. INSTALL NO. 5 CAMSHAFT BEARING CAP

a. Align the camshaft bearing cap and the ring pins of the cylinder head, and install the cap.



7. SELECT NO. 1 CYLINDER HEAD GASKET

a. Set the 2 crankshaft pulley set bolts to the crankshaft.

b. Clean the cylinder block with solvent.

c. Inspect the protrusion for each cylinder.

i. Set the piston of the cylinder to be measured to slightly before TDC.

ii. Place a dial indicator on the cylinder block, and set the measuring tip as shown in the illustration.

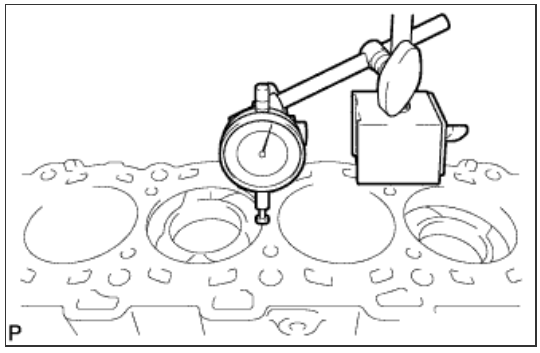
NOTICE:

Make sure that the dial indicator is at a right angle to the cylinder block top surface.

iii. Set the dial indicator at 0 mm (0 in.).

HINT:

Make sure that the measuring tip is flat against the cylinder block surface and piston head when taking the measurements.

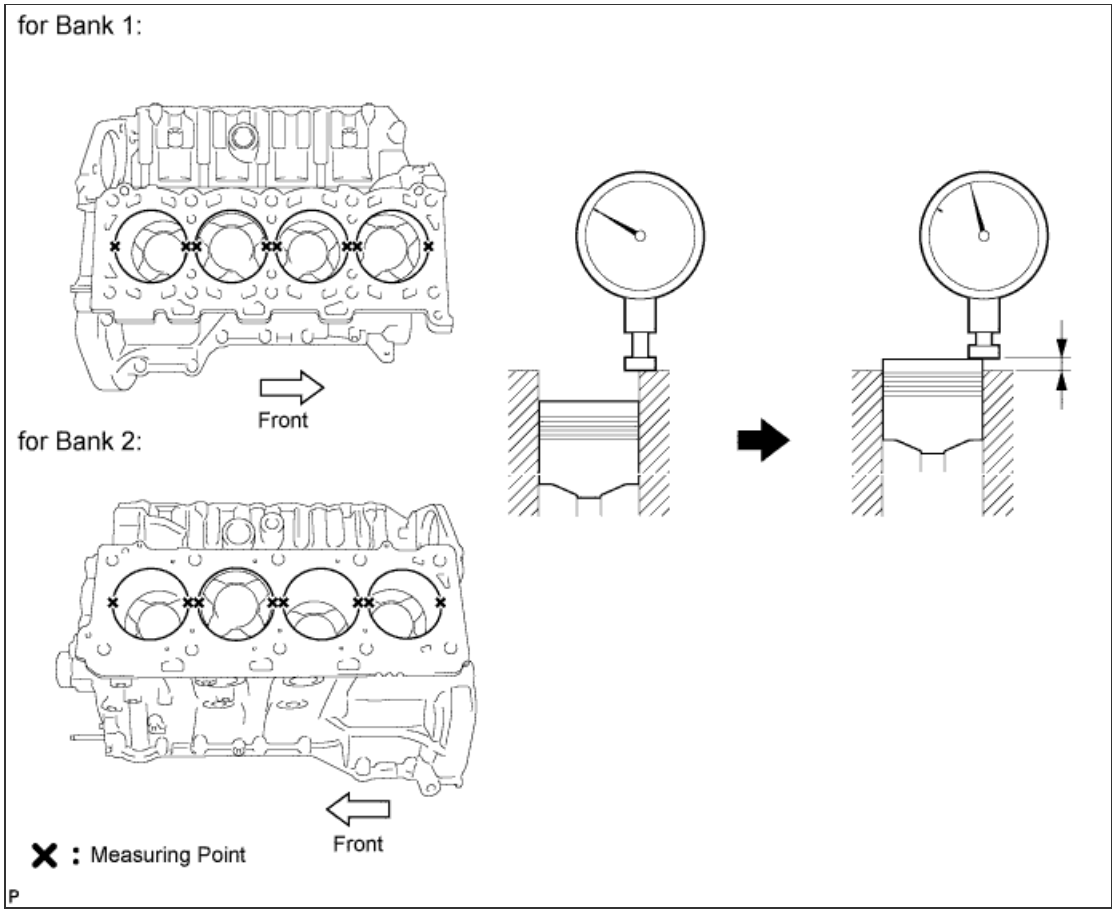


iv. Find where the piston head protrudes most by slowly turning the crankshaft clockwise and counterclockwise.

v. Measure the piston protrusion value of each cylinder at 2 places as shown in the illustration below, making a total of 8 measurements.

Standard piston protrusion:
0.520 to 0.780 mm (0.0205 to 0.0307 in.)

If the protrusion is not as specified, remove and reinstall the piston and connecting rod.



d. Select a new cylinder head gasket.

HINT:

Cylinder head gaskets are marked A, B, C, D or E accordingly.

New Installed Cylinder Head Gasket Thickness:

Item	Cutout	Specified Condition*
A	1	1.20 to 1.30 mm (0.0472 to 0.0512 in.)
B	2	1.25 to 1.35 mm (0.0492 to 0.0394 in.)
C	3	1.30 to 1.40 mm (0.0512 to 0.0551 in.)
D	4	1.35 to 1.45 mm (0.0531 to 0.0571 in.)
E	5	1.40 to 1.50 mm (0.0551 to 0.0591 in.)

HINT:

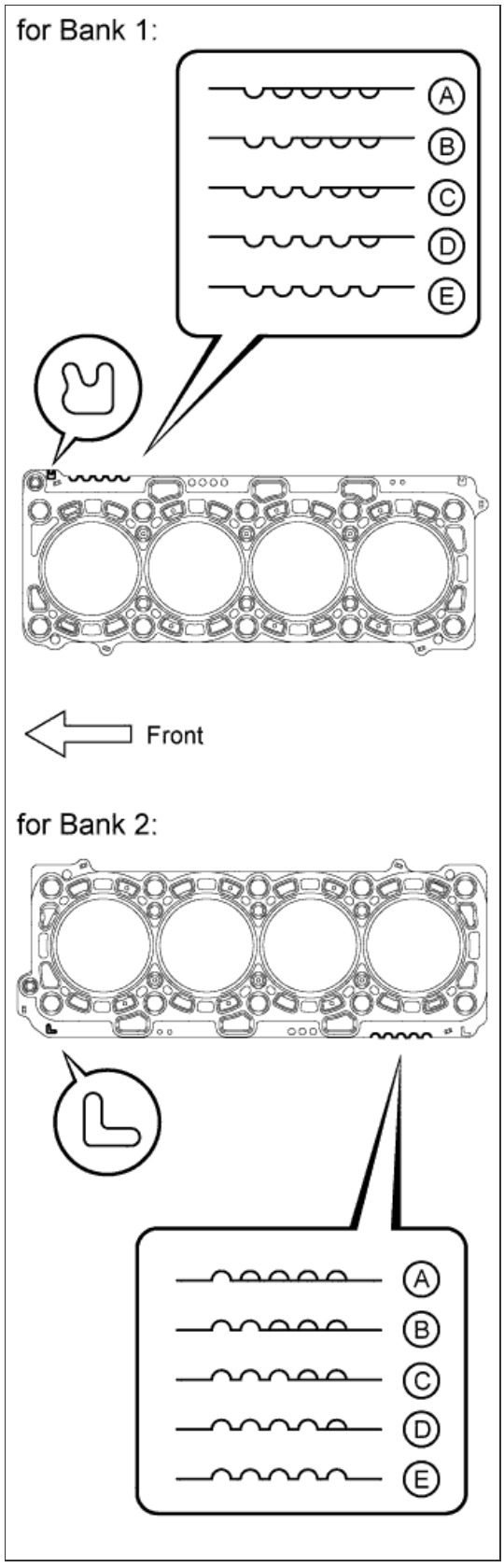
*: The specified condition indicates the thickness of the gasket after tightening the cylinder head.

i. Select the largest piston protrusion value from the measurements and then select a new appropriate gasket according to the table below.

Standard Piston Protrusion:

Item	Specified Condition

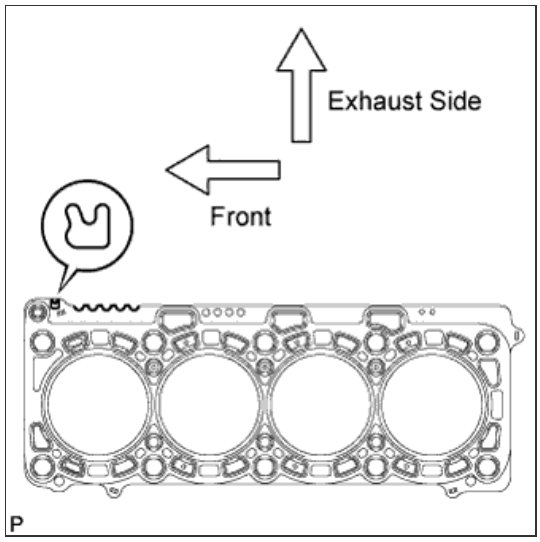
A	0.520 to 0.575 mm (0.0205 to 0.0226 in.)
B	0.575 to 0.625 mm (0.0226 to 0.0246 in.)
C	0.625 to 0.675 mm (0.0246 to 0.0266 in.)
D	0.675 to 0.725 mm (0.0266 to 0.0285 in.)
E	0.725 to 0.780 mm (0.0285 to 0.0307 in.)



8. INSTALL NO. 1 CYLINDER HEAD GASKET

a. Remove any oil from the contact surface.

b. Place the cylinder head gasket on the cylinder block surface with the front face of the indicated mark "R" upward and facing the exhaust side.



9. INSTALL CYLINDER HEAD SUB-ASSEMBLY RH

a. Place the cylinder head on the cylinder head gasket.

NOTICE:

Ensure that no oil is on the mounting surface of the cylinder head.

b. Inspect the cylinder head bolts (Click here).

c. Apply a light coat of engine oil to the threads and under the heads of the cylinder head bolts.

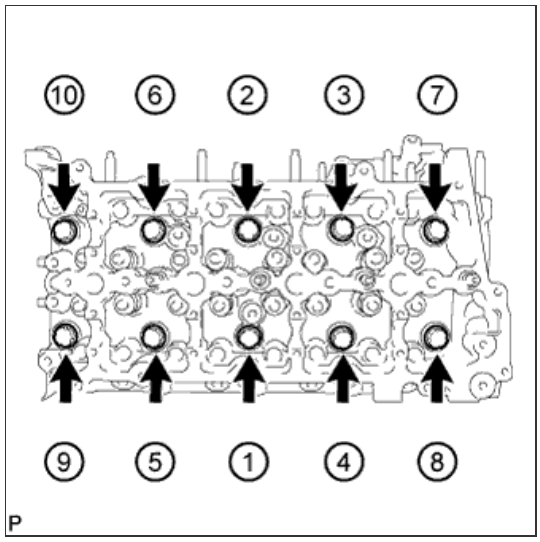
d. Step 1:

i. Install and uniformly tighten the 10 cylinder head bolts with the spacers in several steps, in the sequence shown in the illustration.

Torque:
80 N*m{ 816 kgf*cm , 59 ft.*lbf }

HINT:

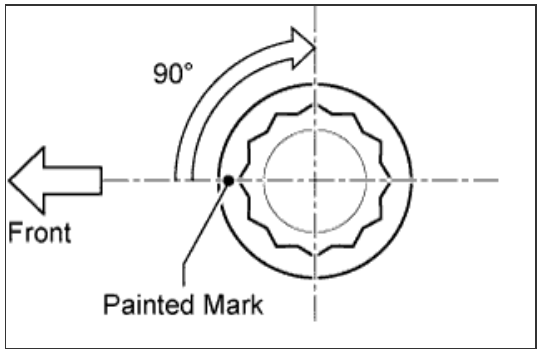
- **The cylinder head bolts are tightened in 4 progressive steps.**
- **If a cylinder head bolt is broken or deformed, replace it.**



e. Step 2:

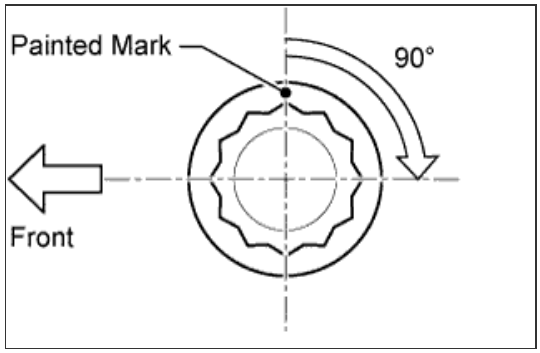
i. Mark the cylinder head bolt heads with paint as shown in the illustration.

ii. Tighten the cylinder head bolts 90° in the sequence shown in step 1.



f. Step 3:

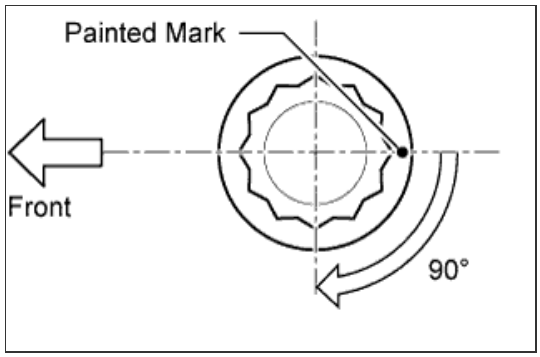
i. Tighten the cylinder head bolts another 90° in the sequence shown in step 1.



g. Step 4:

i. Tighten the cylinder head bolts by an additional 90° in the sequence shown in step 1.

h. Check that the painted marks are now facing the intake port side.



10. INSTALL NO. 1 VALVE LASH ADJUSTER ASSEMBLY

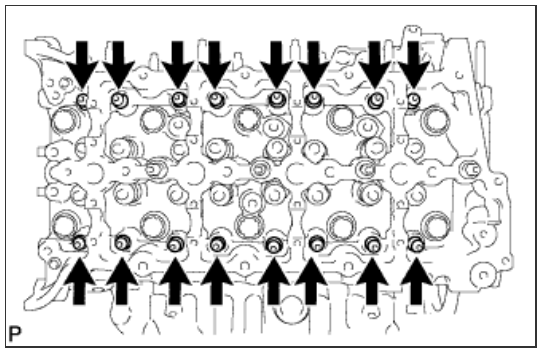
NOTICE:

Be sure to inspect the valve lash adjuster before installing it (Click here).

a. Install the 16 No. 1 valve lash adjusters to the cylinder head.

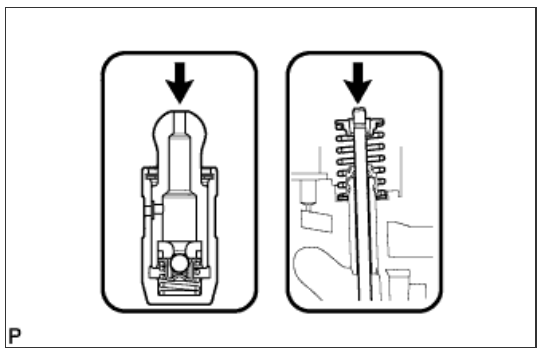
HINT:

Install the lash adjuster at the same place it was removed from.



11. INSTALL NO. 1 VALVE ROCKER ARM

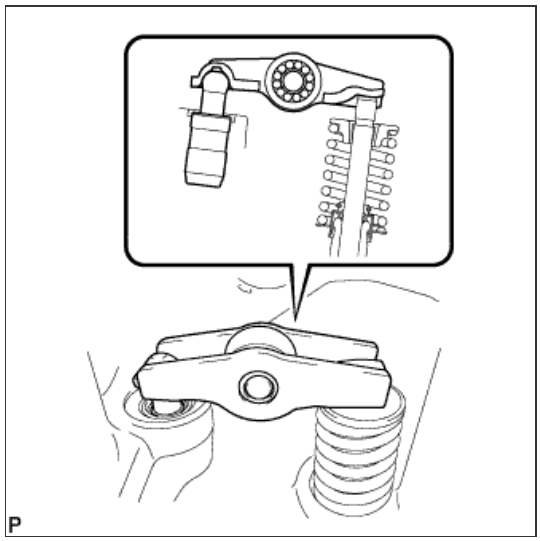
a. Apply engine oil to the lash adjuster tips and valve stem ends.



b. Install the 16 No. 1 valve rocker arms as shown in the illustration.

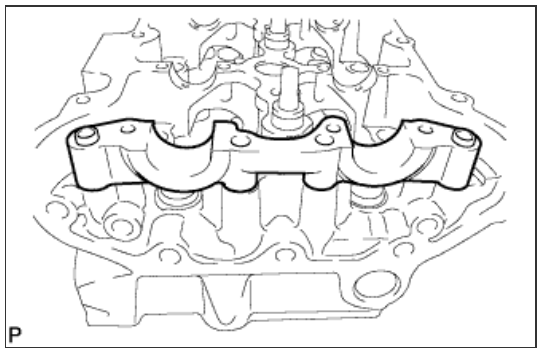
HINT:

Install the valve rocker arm at the same place it was removed from.



12. INSTALL NO. 2 CAMSHAFT BEARING CAP

a. Align the camshaft bearing cap and the ring pins of the cylinder head, and install the cap.



13. SET NO. 1 CYLINDER TO 45° BEFORE TDC

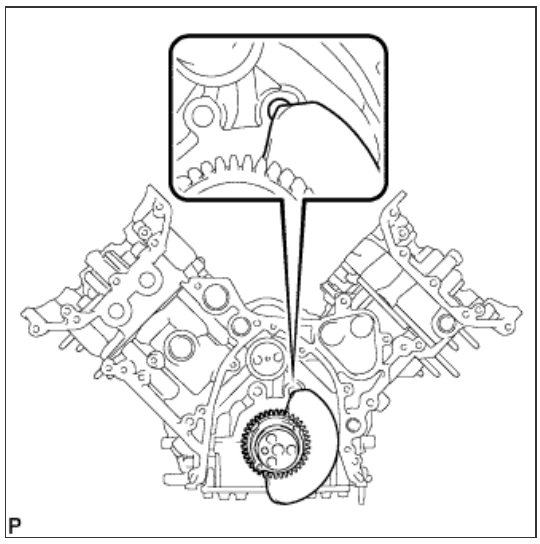
a. Turn the crankshaft counterclockwise until the No. 1 cylinder is at a position 45° before TDC.

NOTICE:

Do not turn the crankshaft again until after the timing gear is installed.

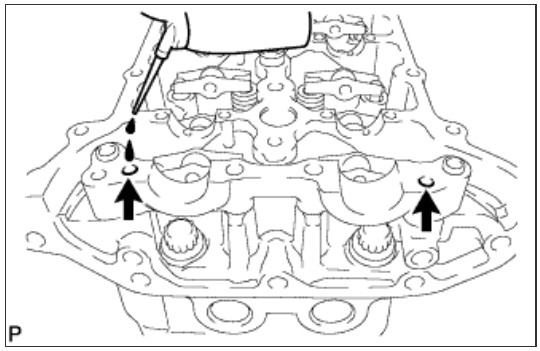
HINT:

The No. 1 cylinder is at a position 45° before TDC if the crankshaft counterweight is overlapping the cylinder block hole as shown in the illustration.

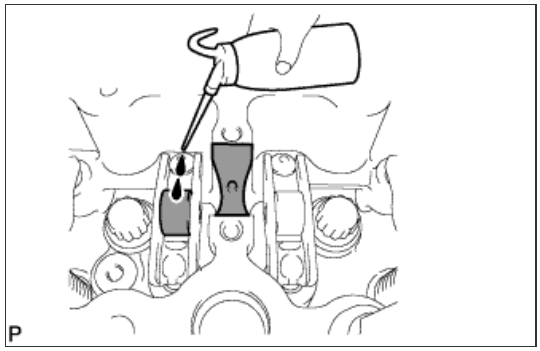


14. INSTALL NO. 1 AND NO. 2 CAMSHAFTS

a. Add more than 19 cc (1.16 cu. in.) of engine oil into the cylinder head side oil holes.



b. Apply engine oil to the rollers of the valve rocker arms and camshaft housing of the cylinder head.

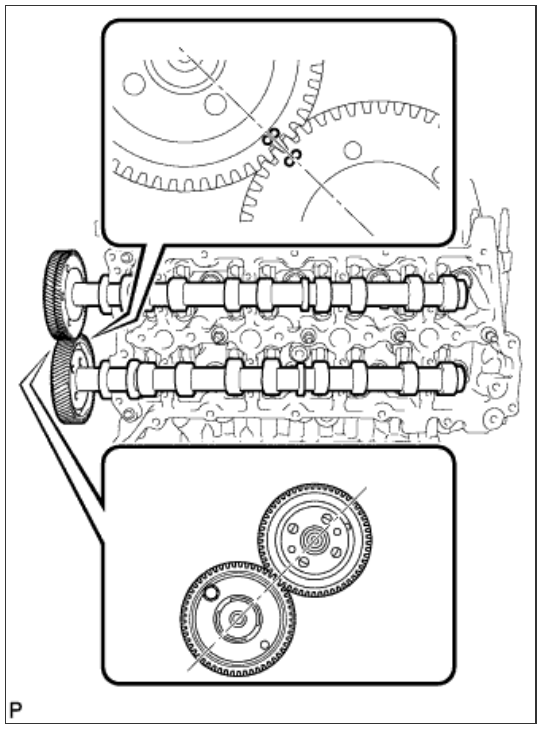


c. Install the camshafts.

i. Apply engine oil to the camshaft journals, lobes, thrust portion and gears.

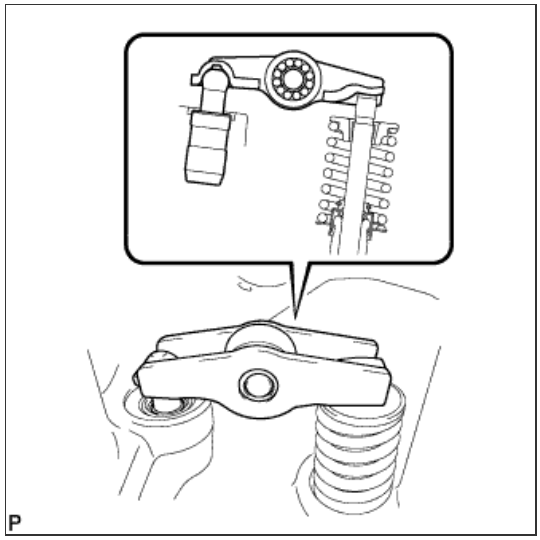
ii. Align the timing marks (2 dot marks) on the back side of the No. 1 and No. 2 camshaft timing gears as shown in the illustration.

iii. Place the camshafts into the cylinder head.



NOTICE:

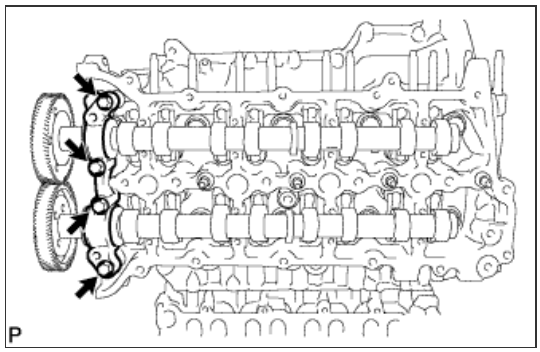
Before and after setting the camshafts, firmly set the rocker arms to the lash adjusters.



d. Install the No. 1 camshaft bearing cap.

i. Align the No. 1 camshaft bearing cap and the ring pins of the No. 2 camshaft bearing cap.

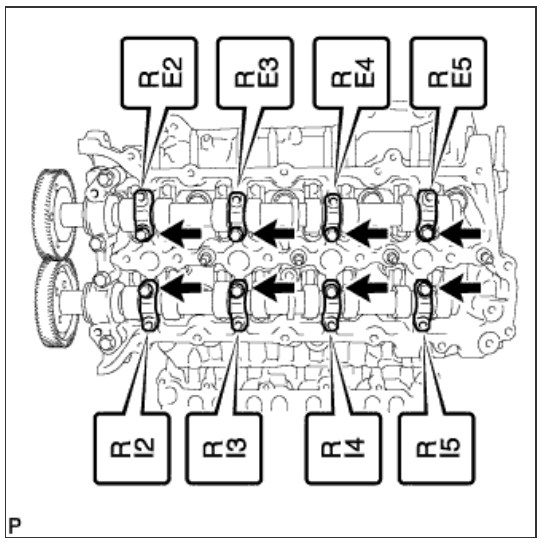
ii. Temporarily install the 4 bolts by hand.



e. Install the No. 3 camshaft bearing caps.

i. Confirm the marks and numbers on the camshaft bearing caps and place them in their proper position and direction.

ii. Temporarily install the 8 bolts, which are not installed with the oil feed pipe, by hand.



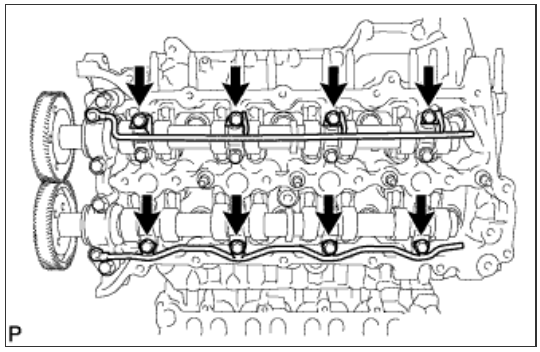
f. Temporarily install the No. 1 and No. 2 camshaft oil feed pipes with the 8 bolts by hand.

NOTICE:

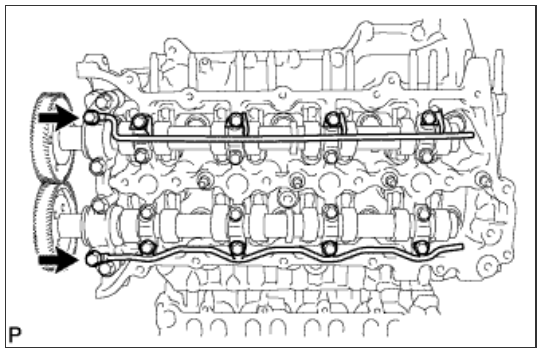
If even one of the pipe bolt holes does not match its camshaft bearing cap bolt hole, replace the camshaft oil feed pipe.

HINT:

The pipe is bent on the intake side, and straight on the exhaust side.

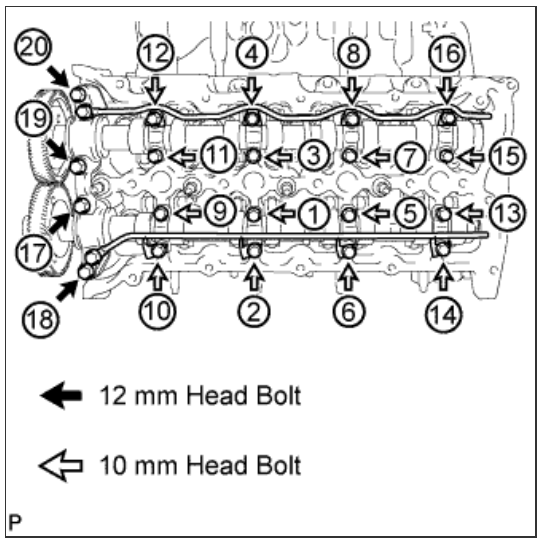


g. Temporarily install the 2 union bolts by hand.



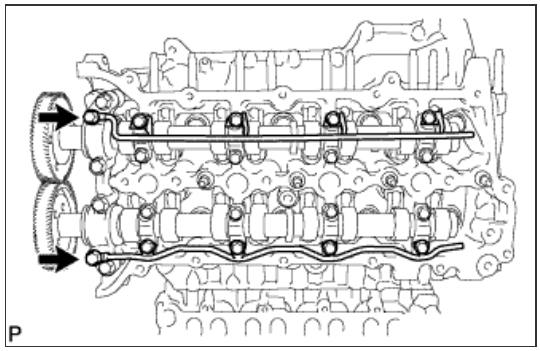
h. Uniformly tighten the 20 bolts in several steps in the order shown in the illustration.

Torque:
for 12 mm head bolt of No. 1 camshaft bearing cap:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for 10 mm head bolt of No. 3 camshaft bearing cap:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



i. Tighten the 2 union bolts.

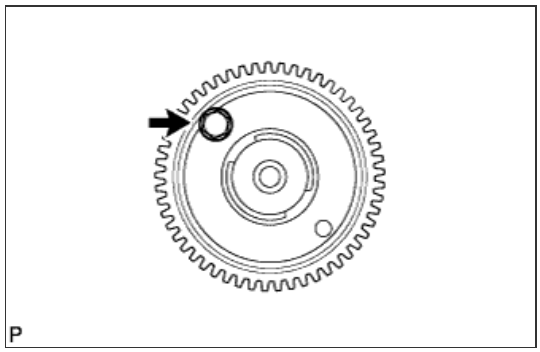
Torque:
17 N*m{ 173 kgf*cm , 13 ft.*lbf }



j. Remove the service bolt from the No. 1 camshaft timing gear.

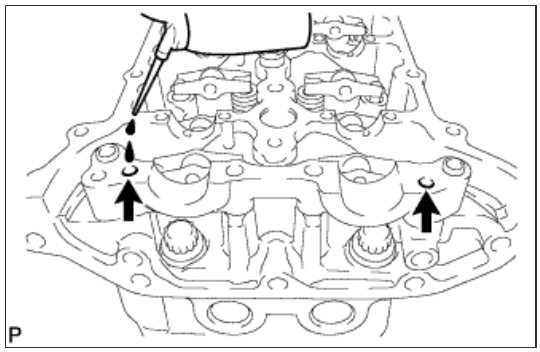
NOTICE:

Do not drop the bolt into the engine.

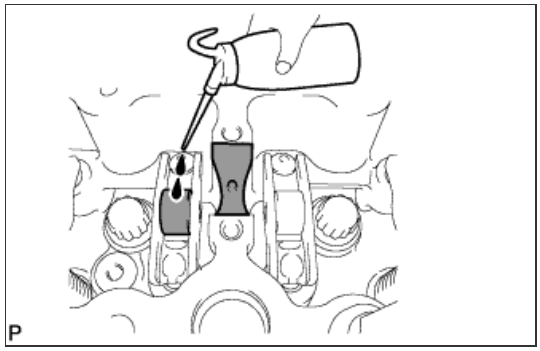


15. INSTALL NO. 3 AND NO. 4 CAMSHAFTS

a. Add more than 19 cc (1.16 cu. in.) of engine oil into the cylinder head side oil holes.



b. Apply engine oil to the rollers of the valve rocker arms and camshaft housing of the cylinder head.

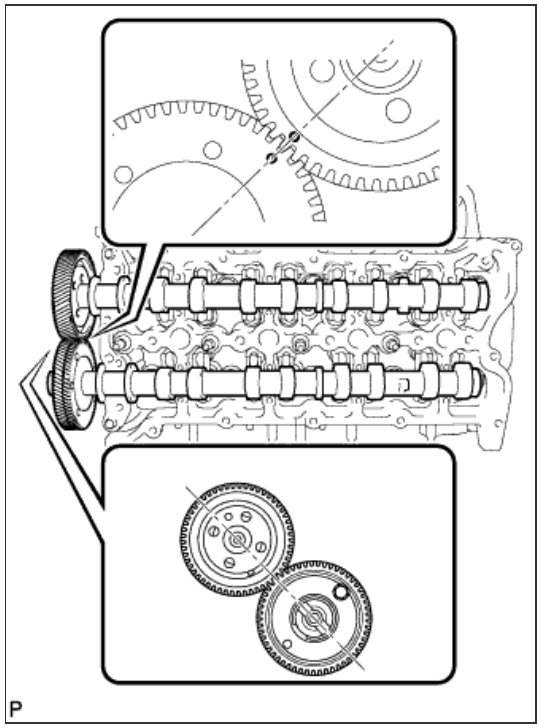


c. Install the camshafts.

i. Apply engine oil to the camshaft journals, lobes, thrust portion and gears.

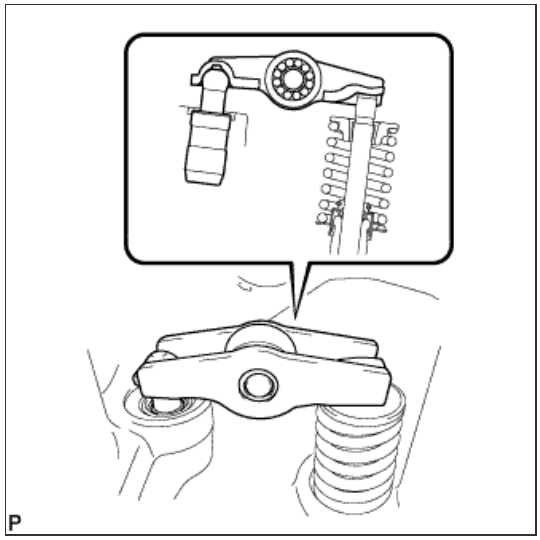
ii. Align the timing marks (1 dot mark) on the back side of the No. 3 and No. 4 camshaft timing gears as shown in the illustration.

iii. Place the camshafts into the cylinder head.



NOTICE:

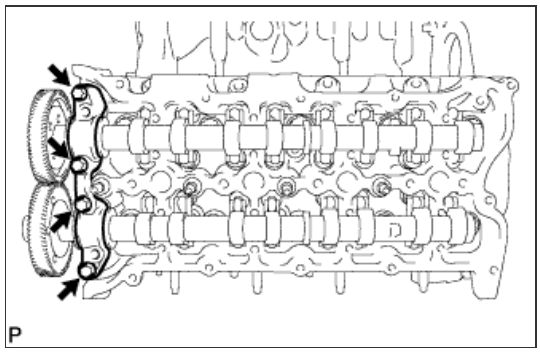
Before and after setting the camshafts, firmly set the rocker arms to the lash adjusters.



d. Install the No. 4 camshaft bearing cap.

i. Align the No. 4 camshaft bearing cap and the ring pins of the No. 5 camshaft bearing cap.

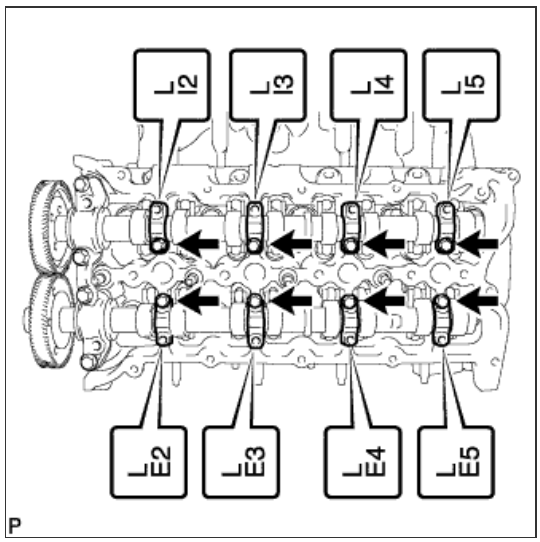
ii. Temporarily install the 4 bolts by hand.



e. Install the No. 3 camshaft bearing caps.

i. Confirm the marks and numbers on the camshaft bearing caps and place them in their proper position and direction.

ii. Temporarily install the 8 bolts, which are not installed with the oil feed pipe, by hand.



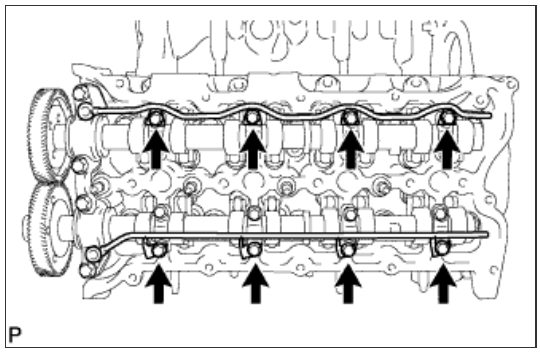
f. Temporarily install the No. 3 and No. 4 camshaft oil feed pipes with the 8 bolts by hand.

NOTICE:

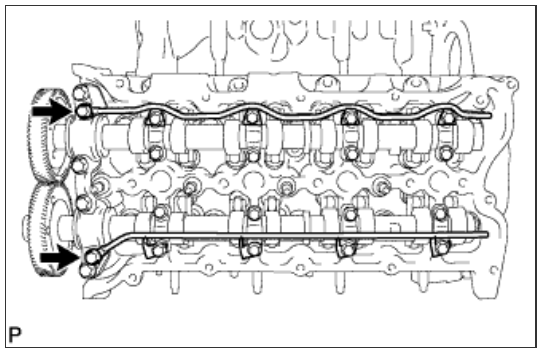
If even one of the pipe bolt holes does not match its camshaft bearing cap bolt hole, replace the camshaft oil feed pipe.

HINT:

The pipe is bent on the intake side, and straight on the exhaust side.

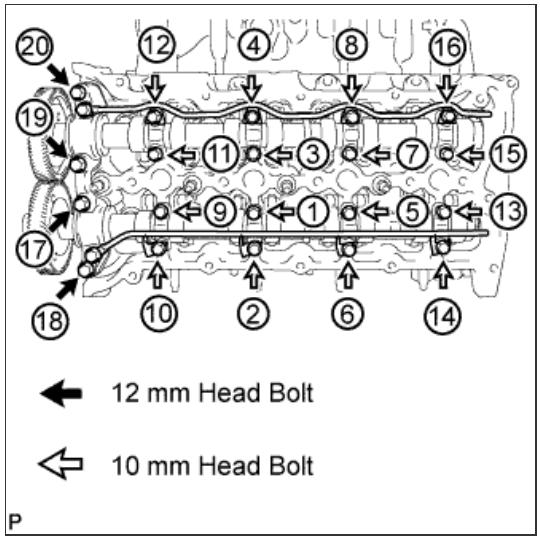


g. Temporarily install the 2 union bolts by hand.



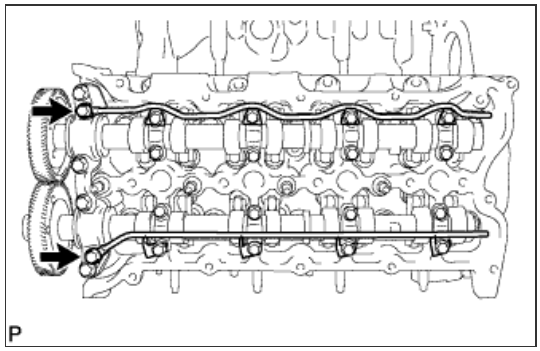
h. Uniformly tighten the 20 bolts in several steps in the order shown in the illustration.

Torque:
for 12 mm head bolt of No. 4 camshaft bearing cap:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for 10 mm head bolt of No. 3 camshaft bearing cap:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



i. Tighten the 2 union bolts.

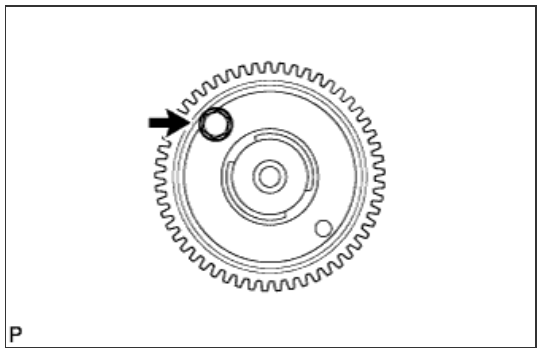
Torque:
17 N*m{ 173 kgf*cm , 13 ft.*lbf }



j. Remove the service bolt from the No. 4 camshaft timing gear.

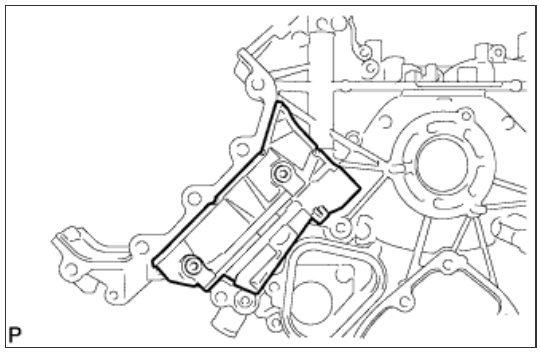
NOTICE:

Do not drop the bolt into the engine.



16. INSTALL NO. 2 TIMING GEAR CASE INSULATOR (w/ Intercooler)

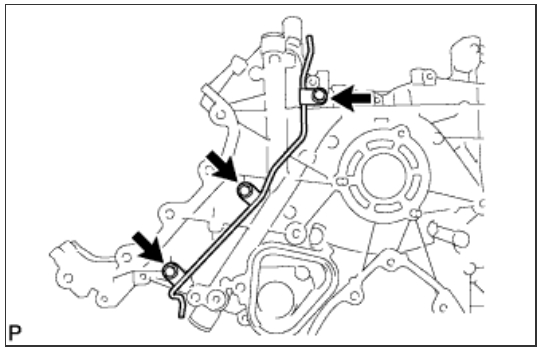
a. Install the No. 2 timing gear case insulator.



17. INSTALL NO. 2 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY (w/ Intercooler)

a. Install the No. 2 vacuum transmitting pipe with the 3 bolts.

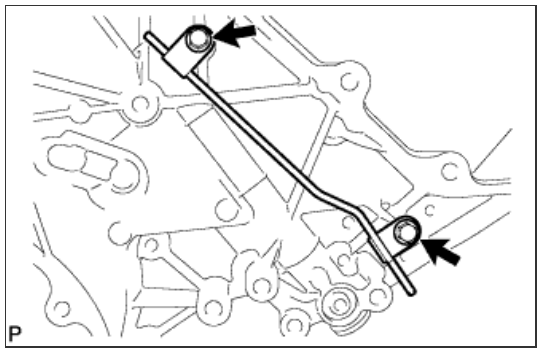
Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }



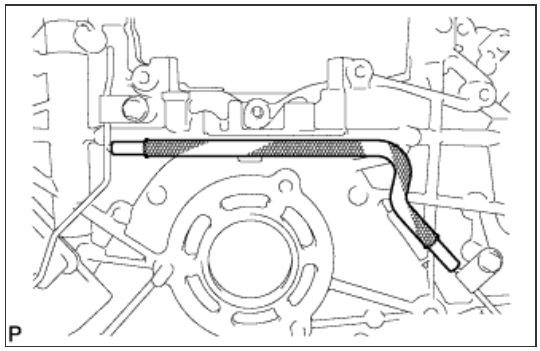
18. INSTALL NO. 1 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY (w/ Intercooler)

a. Install the No. 1 vacuum transmitting pipe with the 2 bolts.

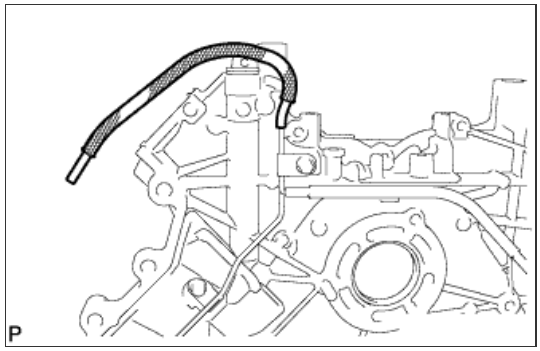
Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }



19. CONNECT NO. 3 VACUUM TRANSMITTING HOSE (w/ Intercooler)



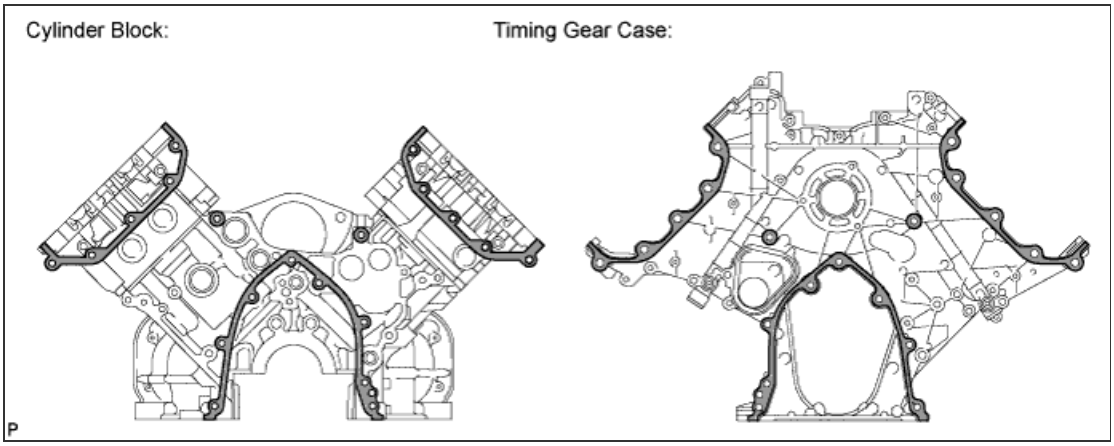
20. CONNECT NO. 2 VACUUM TRANSMITTING HOSE (w/ Intercooler)



21. INSTALL TIMING GEAR CASE SUB-ASSEMBLY

NOTICE:

When the contact surfaces shown below are wet, wipe them with an oil-free cloth before applying seal packing.



a. Apply seal packing to the timing gear case as shown in the following illustration.

Standard seal diameter:
4 to 5 mm (0.157 to 0.197 in.)

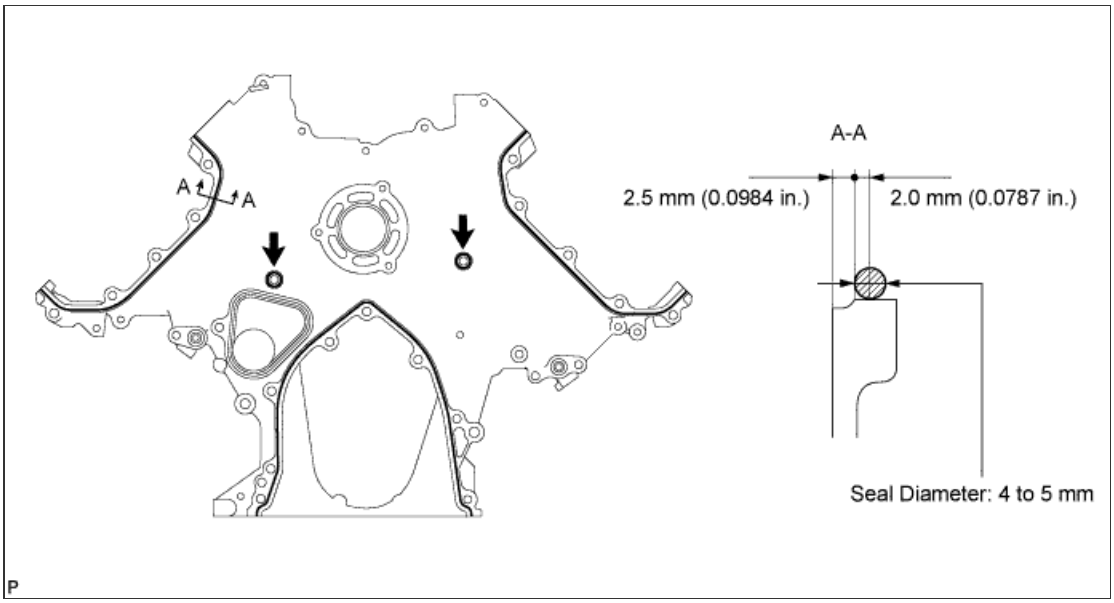
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

- **After applying seal packing, align the timing gear case with the engine within 3 minutes and tighten the bolts and nuts within 15 minutes.**
- **Apply the seal packing in a continuous line.**

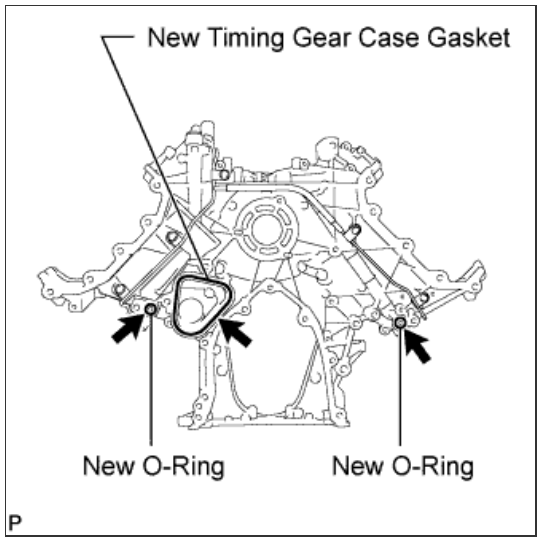
HINT:

- **The FIPG line is shown below.**
- **Apply packing to the 5 seal surface areas.**



b. Install a new timing gear case gasket.

c. Apply engine oil to 2 new O-rings and install them to the timing gear case.



d. Install the timing gear case with the 22 bolts and 2 nuts.

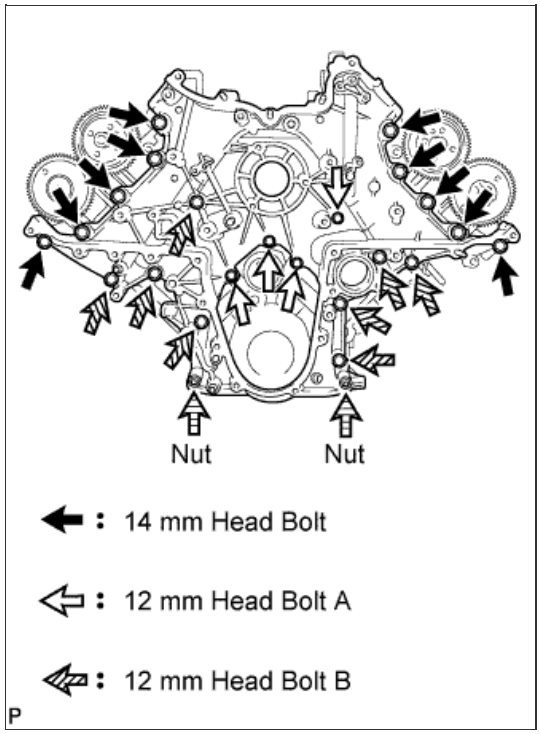
Torque:
for 14 mm head bolt (case is dry):
46 N*m{ 469 kgf*cm , 34 ft.*lbf }
for 14 mm head bolt (case is wet):
42 N*m{ 428 kgf*cm , 31 ft.*lbf }
for 12 mm head bolt A and B:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }
for nut:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

NOTICE:

- **The case is "dry" when there is absolutely no engine oil on the 14 mm head bolts and cylinder head bolt holes.**
- **The case is "wet" when there is engine oil on the 14 mm head bolts and cylinder head bolt holes.**

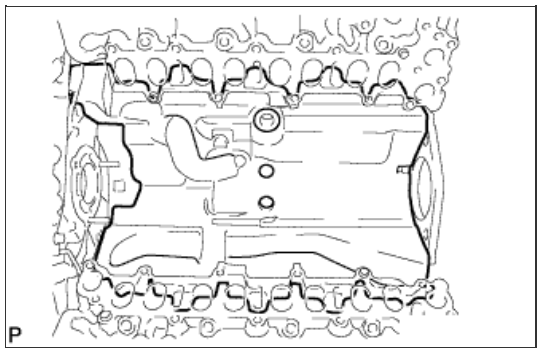
Bolt Length

Item	Quantity	Length
A	4	20 mm (0.787 in.)
B	8	45 mm (1.77 in.)



22. INSTALL V-BANK SILENCER

a. Align the alignment areas of the V-bank silencer and cylinder block, and install the V-bank silencer.

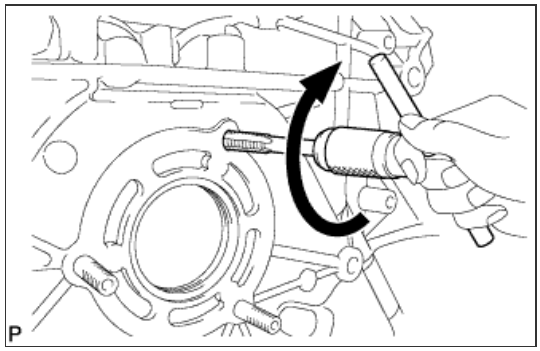


NOTICE:

Verify that the V-bank silencer is below the top surface of the intake port of the cylinder head RH and LH.

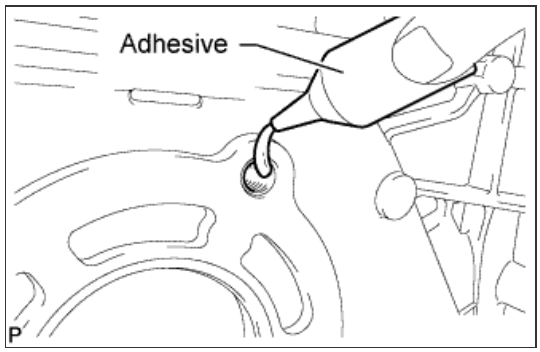
23. INSTALL FUEL SUPPLY PUMP ASSEMBLY

a. Using an 8 mm x 1.25 pitch tap, remove the adhesive from the timing gear case side bolt hole.

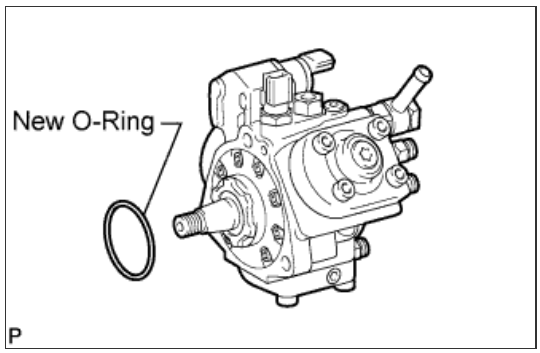


b. Apply adhesive to 2 or more threads of the timing gear case bolt hole.

Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent



c. Apply engine oil to a new O-ring and install it to the supply pump.



d. Install the supply pump to the timing gear case.

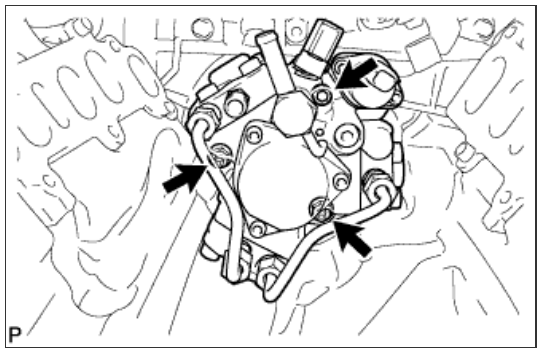
NOTICE:

When installing the supply pump, do not hold the fuel pipe to prevent fuel leaks.

i. Temporarily install the 2 nuts.

ii. Using a 6 mm hexagon wrench, install the hexagon bolt, and then tighten the 2 nuts.

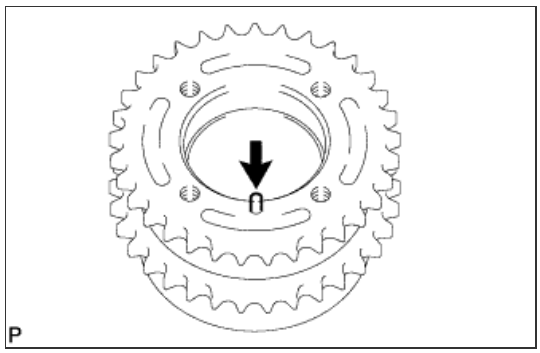
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



24. INSTALL STRAIGHT PIN

a. Install the straight pin.

Standard protrusion height:
4.5 to 7.0 mm (0.177 to 0.276 in.)



25. ASSEMBLE FUEL SUPPLY PUMP DRIVE GEAR AND FUEL SUPPLY PUMP SHAFT SPROCKET

a. Align the fuel supply pump drive gear to the fuel supply pump shaft sprocket straight pin and temporarily install it with the 4 bolts.

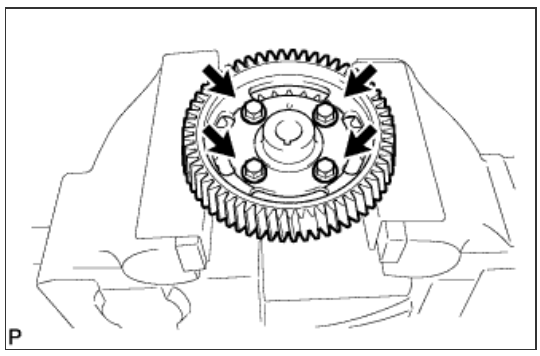
b. Hold the fuel supply pump shaft sprocket in a vise between aluminum plates.

NOTICE:

Be careful not to damage the gears.

c. Tighten the 4 bolts.

Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }



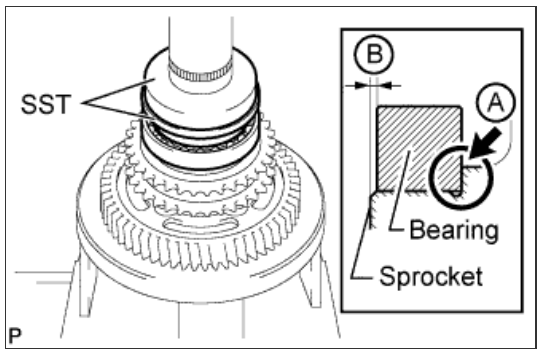
26. INSTALL RADIAL BALL BEARING

a. Using SST and a press, press in the radial ball bearing to the fuel supply pump shaft sprocket.

SST
09316-12010
09950-60010 (09951-00580)

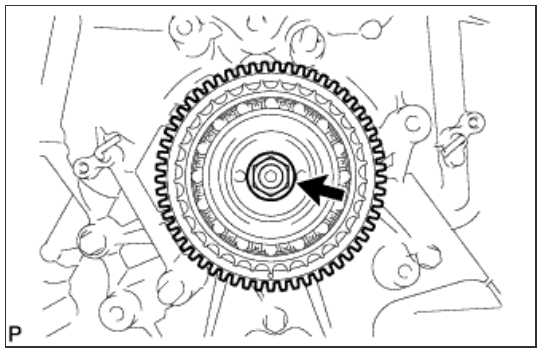
NOTICE:

- **Make sure to press in the bearing until the bearing contacts the fuel supply pump shaft sprocket, as shown in A in the illustration.**
- **Make sure the sprocket outer edge is further outward than the bearing outer edge, as shown in B in the illustration.**



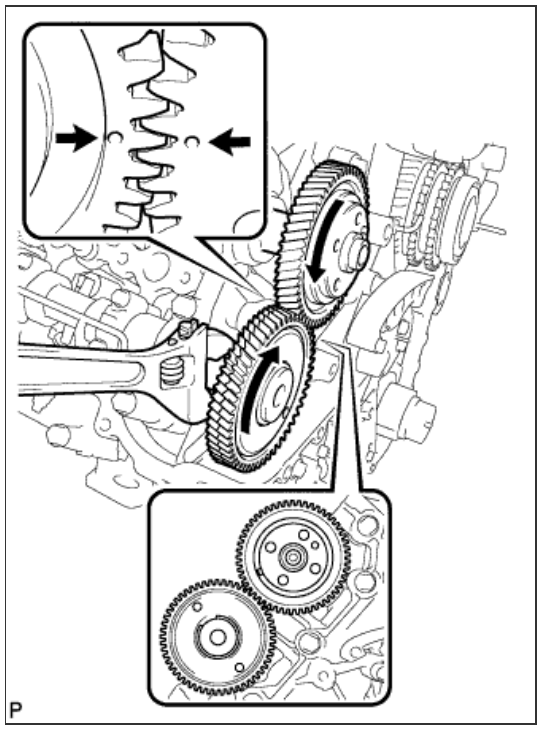
27. TEMPORARILY INSTALL FUEL SUPPLY PUMP DRIVE GEAR

a. Align the cutout of the supply pump drive gear and key of the supply pump, and temporarily install the nut.



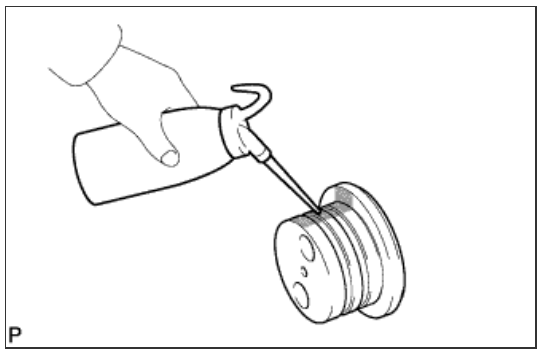
28. SET NO. 1 AND NO. 2 CAMSHAFTS TO TDC

a. Using a wrench, turn the No. 1 camshaft and align the timing marks (1 dot mark) on the back side of the timing gears as shown in the illustration.

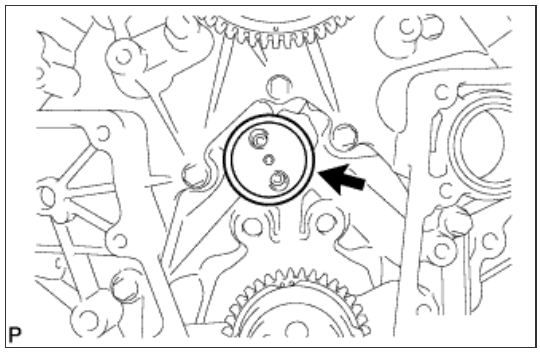


29. INSTALL NO. 1 IDLE GEAR SHAFT

a. Apply engine oil to the contact surface of the idle gear shaft.

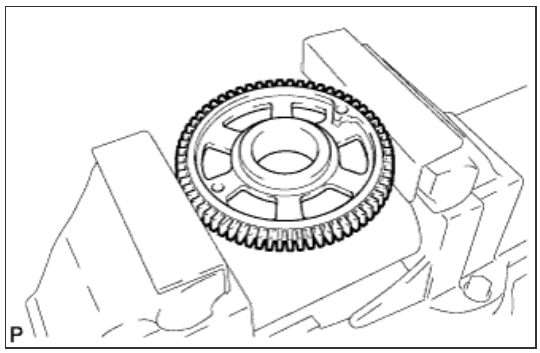


b. Install the idle gear shaft to the cylinder block.



30. ASSEMBLE SUB GEAR, IDLE GEAR SPRING AND IDLE GEAR (w/ Intercooler)

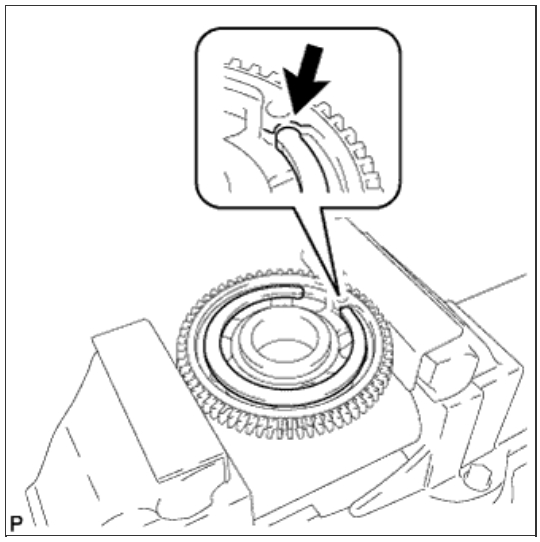
a. Hold the idle gear in a vise between aluminum plates.



NOTICE:

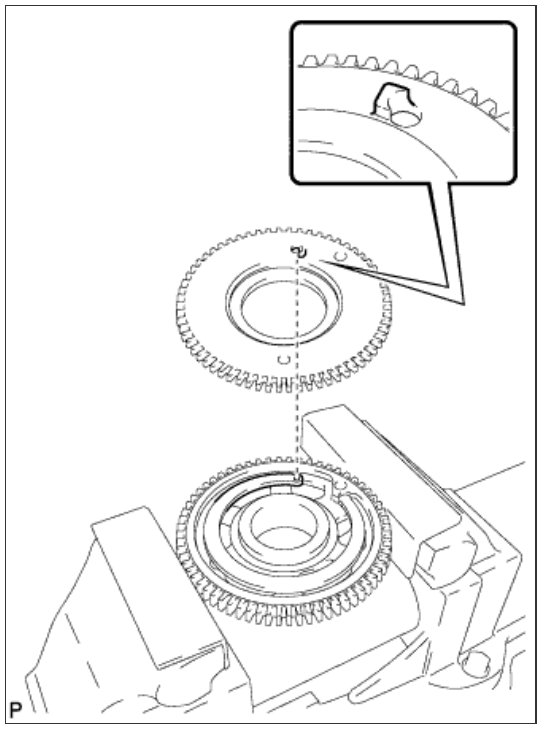
Be careful not to damage the gears.

b. Align the right end of the idle gear spring to the notch of the idle gear and set it to the gear.



c. Install the sub idle gear.

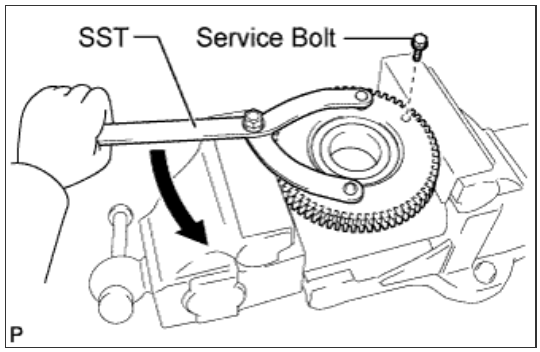
i. Align the notch of the sub idle gear protrusion with the left end of the idle gear spring and install the sub idle gear to the idle gear.



ii. Using SST, turn the sub idle gear counterclockwise, and install an 8 mm x 1.25 pitch bolt with a length of 15 mm or more to the service hole.

SST
09960-10010 (09962-01000, 09963-00700)

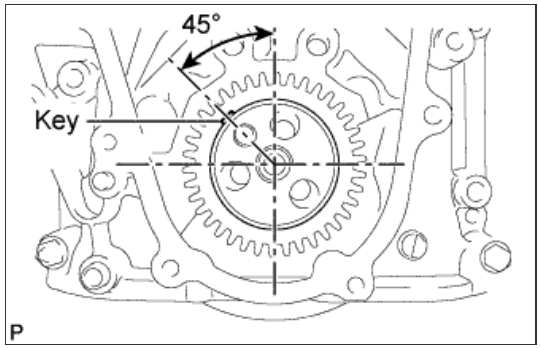
Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



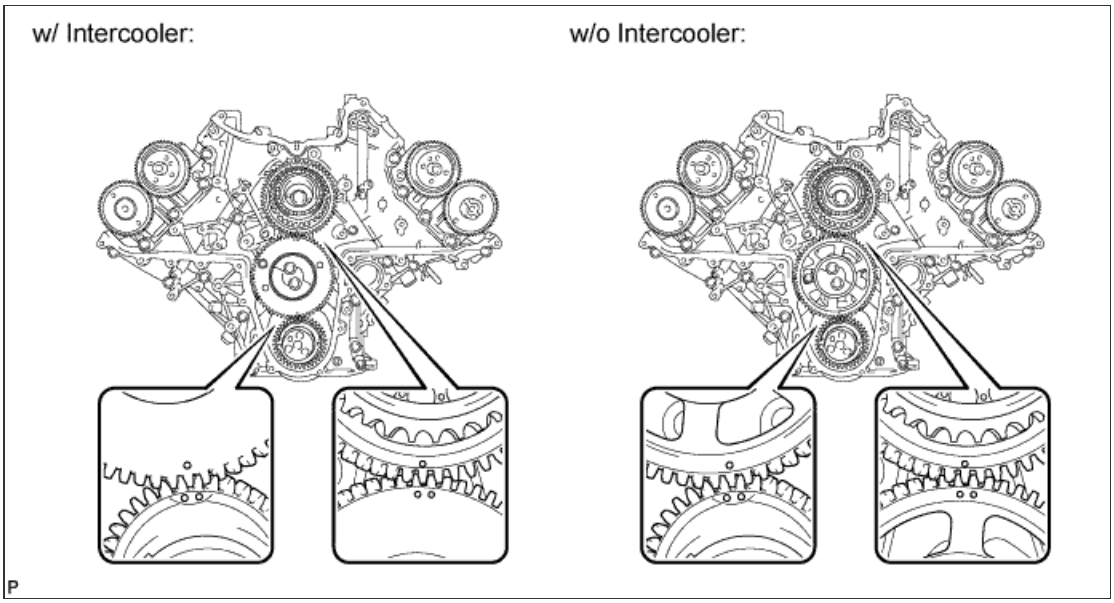
31. INSTALL IDLE GEAR ASSEMBLY

a. Temporarily install the 2 crankshaft pulley set bolts to the crankshaft.

b. Using a bar, turn the crankshaft clockwise to the No. 1 cylinder TDC position.



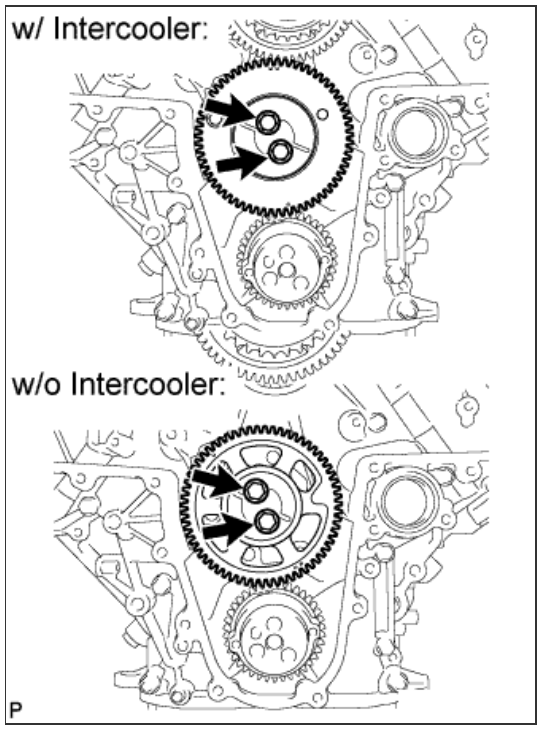
c. Align the timing marks of the supply pump drive gear and idle gear, and the timing marks of the crankshaft timing gear and idle gear as shown in the illustration.



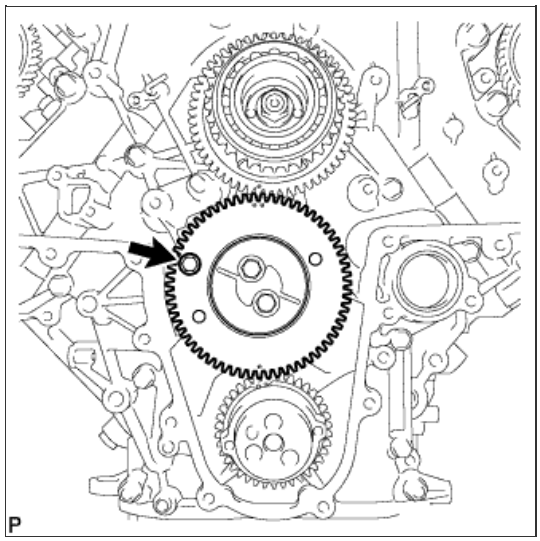
d. Apply engine oil to the idle gear thrust plate and gears.

e. Install the idle gear thrust plate with the 2 bolts.

Torque:
47 N*m{ 479 kgf*cm , 35 ft.*lbf }



f. w/ Intercooler:
Remove the service bolt.

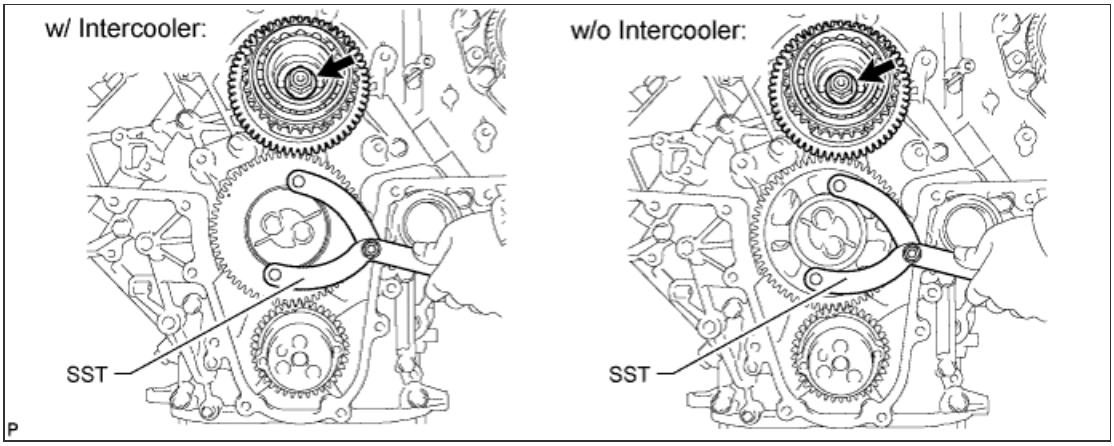


32. TIGHTEN FUEL SUPPLY PUMP DRIVE GEAR NUT

a. Using SST, hold the idle gear and tighten the nut.

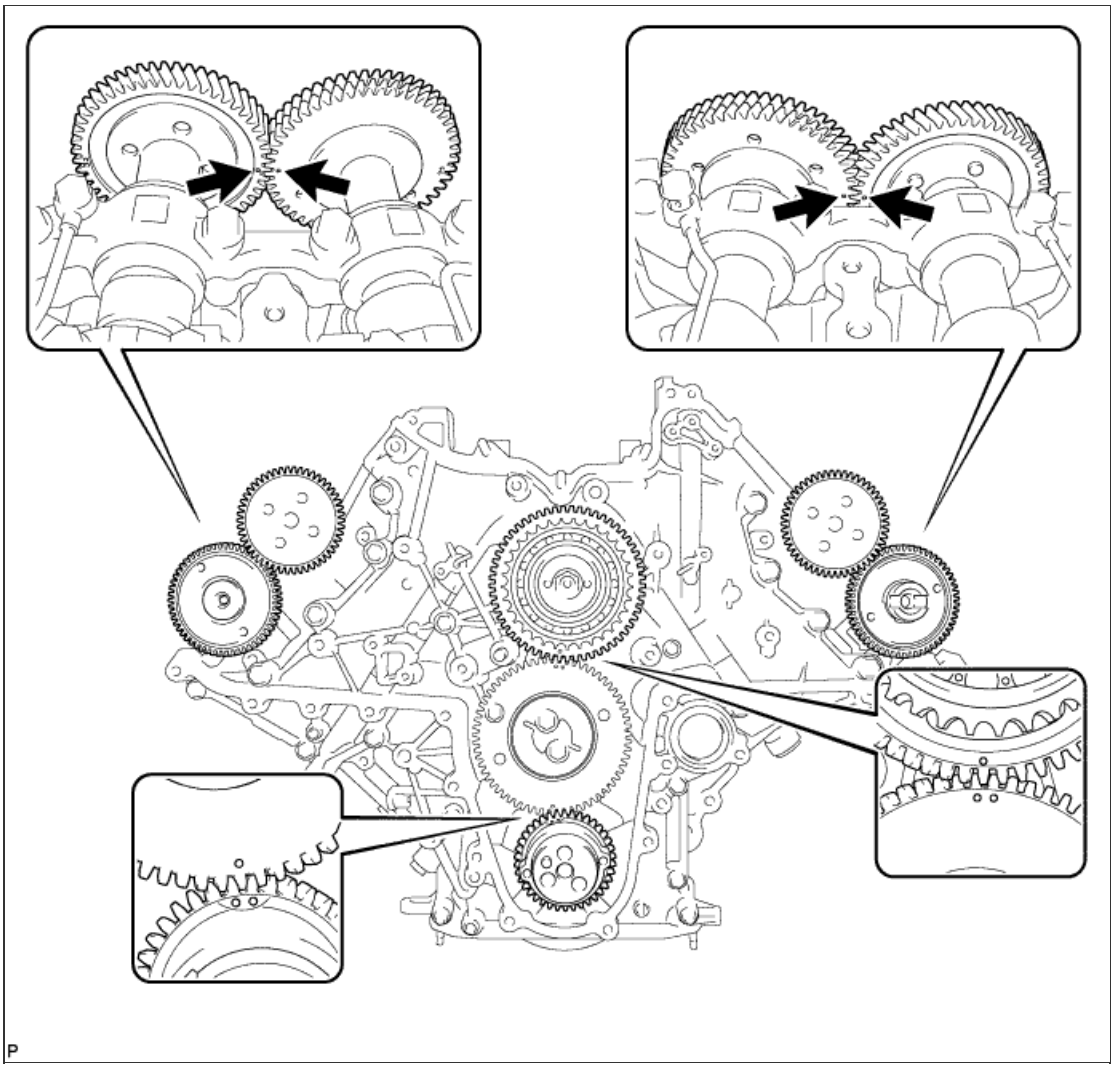
SST
09960-10010 (09962-01000, 09963-00700)

Torque:
68 N*m{ 693 kgf*cm , 50 ft.*lbf }



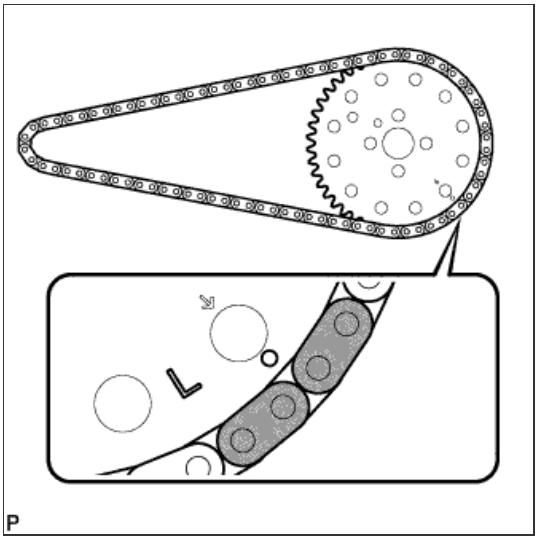
33. CHECK NO. 1 CYLINDER TO TDC/COMPRESSION

a. Check that the timing marks of the following pairs of parts are aligned: 1) supply pump drive gear and idle gear: 2) crankshaft timing gear and idle gear: 3) RH and LH camshaft timing gears.

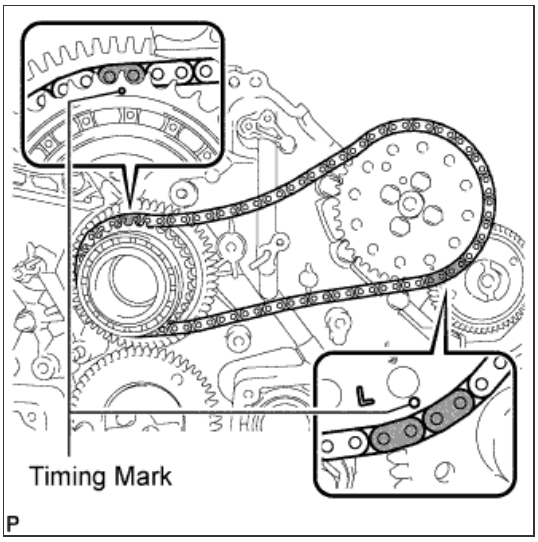


34. INSTALL NO. 2 CAMSHAFT TIMING SPROCKET AND NO. 2 TIMING CHAIN

a. Align the 2 mark plates (yellow) on the No. 2 timing chain with the timing mark (1 dot mark) of the No. 2 camshaft timing sprocket as shown in the illustration.



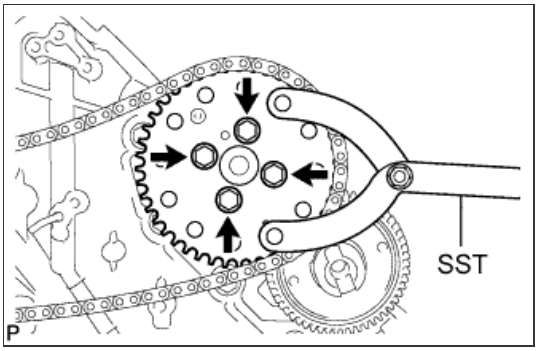
b. Align the No. 2 timing chain mark plate (yellow) with the supply pump drive gear timing mark, and temporarily install the No. 2 camshaft timing sprocket with the 4 bolts.



c. Using SST, hold the No. 2 camshaft timing sprocket, and tighten the 4 bolts.

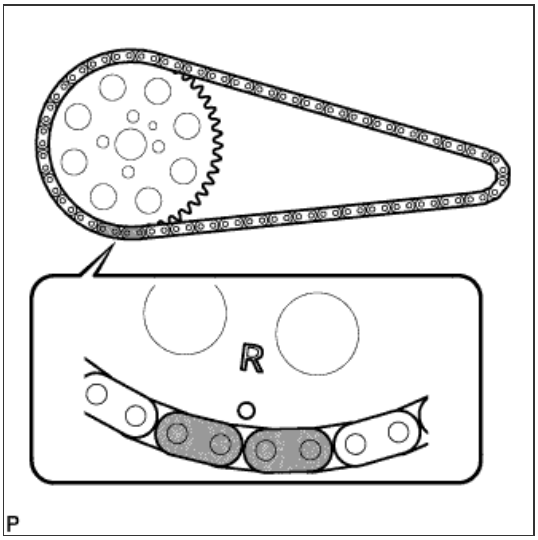
SST
09960-10010 (09962-01000, 09963-01000)

Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }

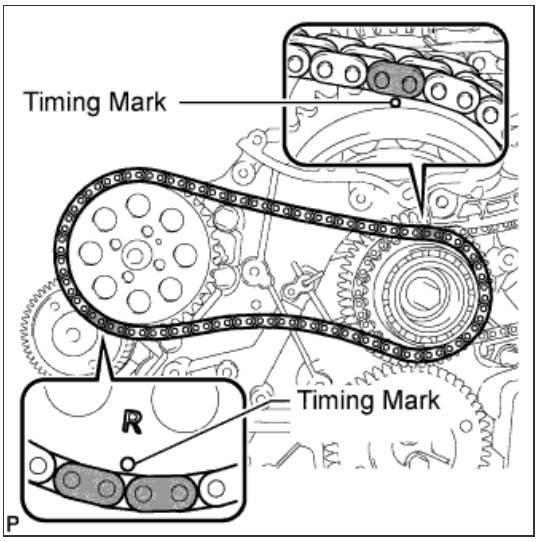


35. INSTALL NO. 1 CAMSHAFT TIMING SPROCKET AND NO. 1 TIMING CHAIN

a. Align the 2 mark plates (yellow) on the No. 1 timing chain with the timing mark (1 dot mark) of the No. 1 camshaft timing sprocket as shown in the illustration.



b. Align the No. 1 timing chain mark plate (yellow) with the supply pump drive gear timing mark, and temporarily install the No. 1 camshaft timing sprocket.



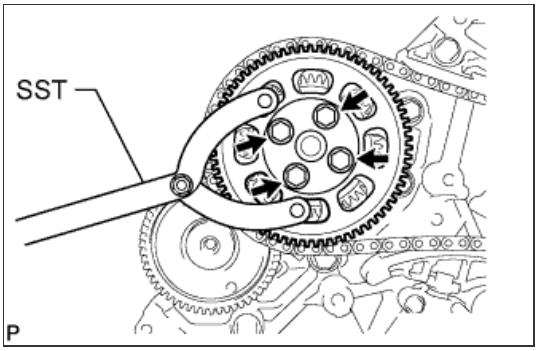
36. INSTALL PUMP DRIVE SHAFT GEAR

a. Temporarily install the pump drive shaft gear with the 4 bolts.

b. Using SST, hold the pump drive shaft gear and tighten the 4 bolts.

SST
09960-10010 (09962-01000, 09963-01000)

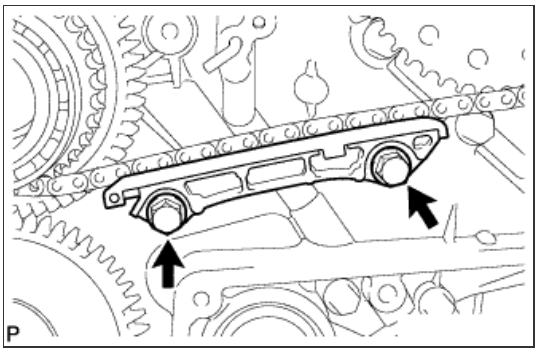
Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }



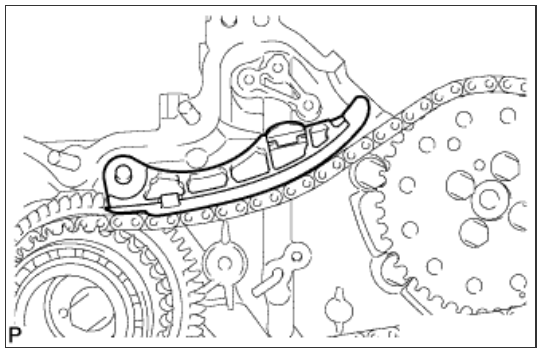
37. INSTALL NO. 2 CHAIN VIBRATION DAMPER

a. Install the No. 2 chain vibration damper with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



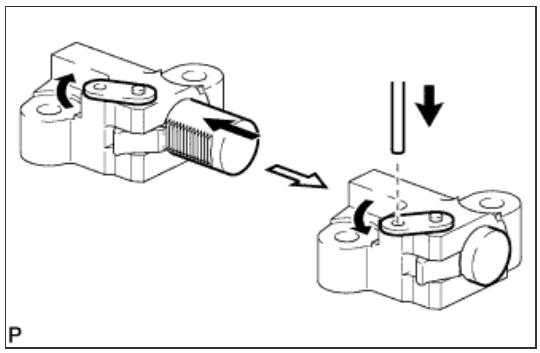
38. INSTALL NO. 2 CHAIN TENSIONER SLIPPER



39. INSTALL NO. 2 CHAIN TENSIONER ASSEMBLY

a. Move the stopper plate clockwise to release the lock, and push the plunger into the tensioner.

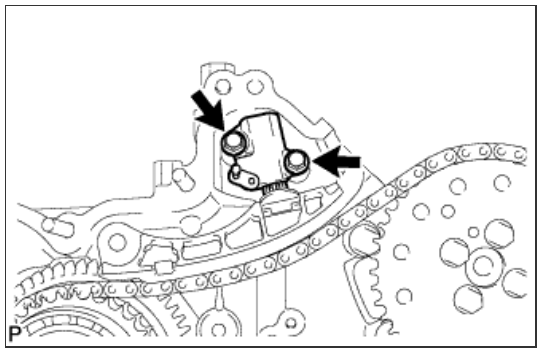
b. Move the stopper plate counterclockwise to set the lock, and insert a hexagon wrench into the stopper plate hole.



c. Install the No. 2 chain tensioner with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

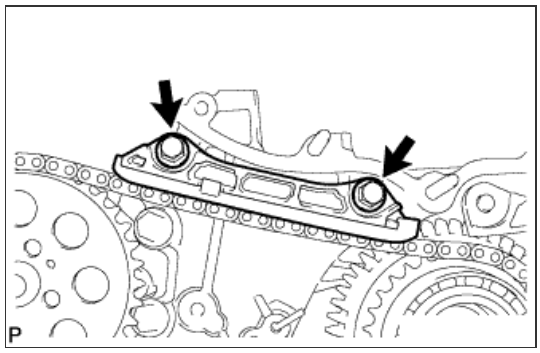
d. Remove the hexagon wrench.



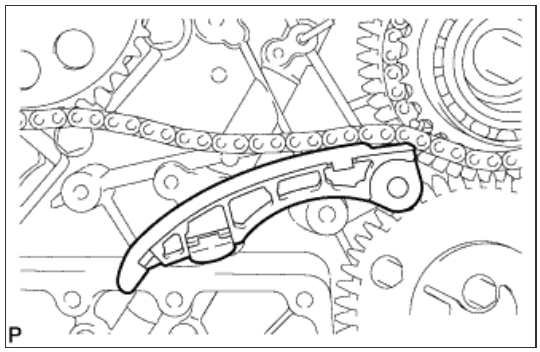
40. INSTALL NO. 1 CHAIN VIBRATION DAMPER

a. Install the No. 1 chain vibration damper with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



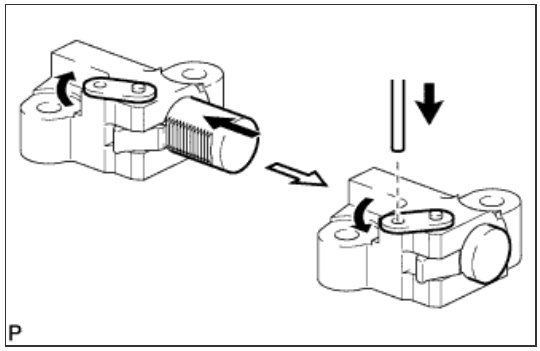
41. INSTALL NO. 1 CHAIN TENSIONER SLIPPER



42. INSTALL NO. 1 CHAIN TENSIONER ASSEMBLY

a. Move the stopper plate clockwise to release the lock, and push the plunger into the tensioner.

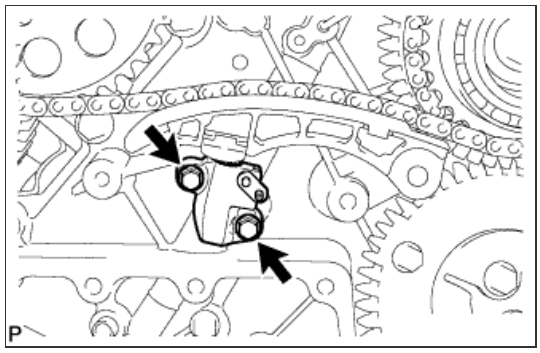
b. Move the stopper plate counterclockwise to set the lock, and insert a hexagon wrench into the stopper plate hole.



c. Install the No. 1 chain tensioner with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

d. Remove the hexagon wrench.

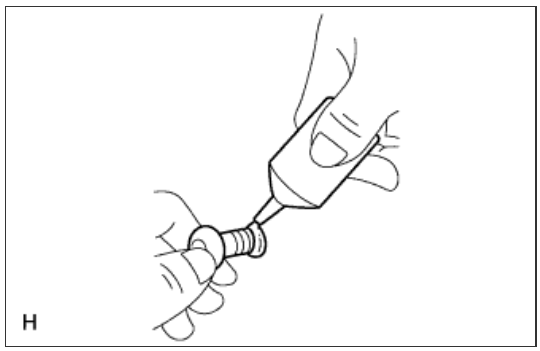


43. INSTALL NO. 1 CRANKSHAFT POSITION SENSOR PLATE

a. Remove the adhesive from the threads of the 2 screws and the bolt holes of the crankshaft.

b. Apply adhesive to 2 or 3 threads of the 2 screws.

Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent

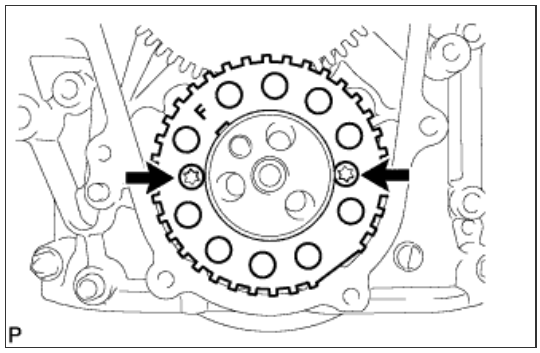


c. Using a T30 "TORX" wrench, install the No. 1 crankshaft position sensor plate with the 2 screws.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

NOTICE:

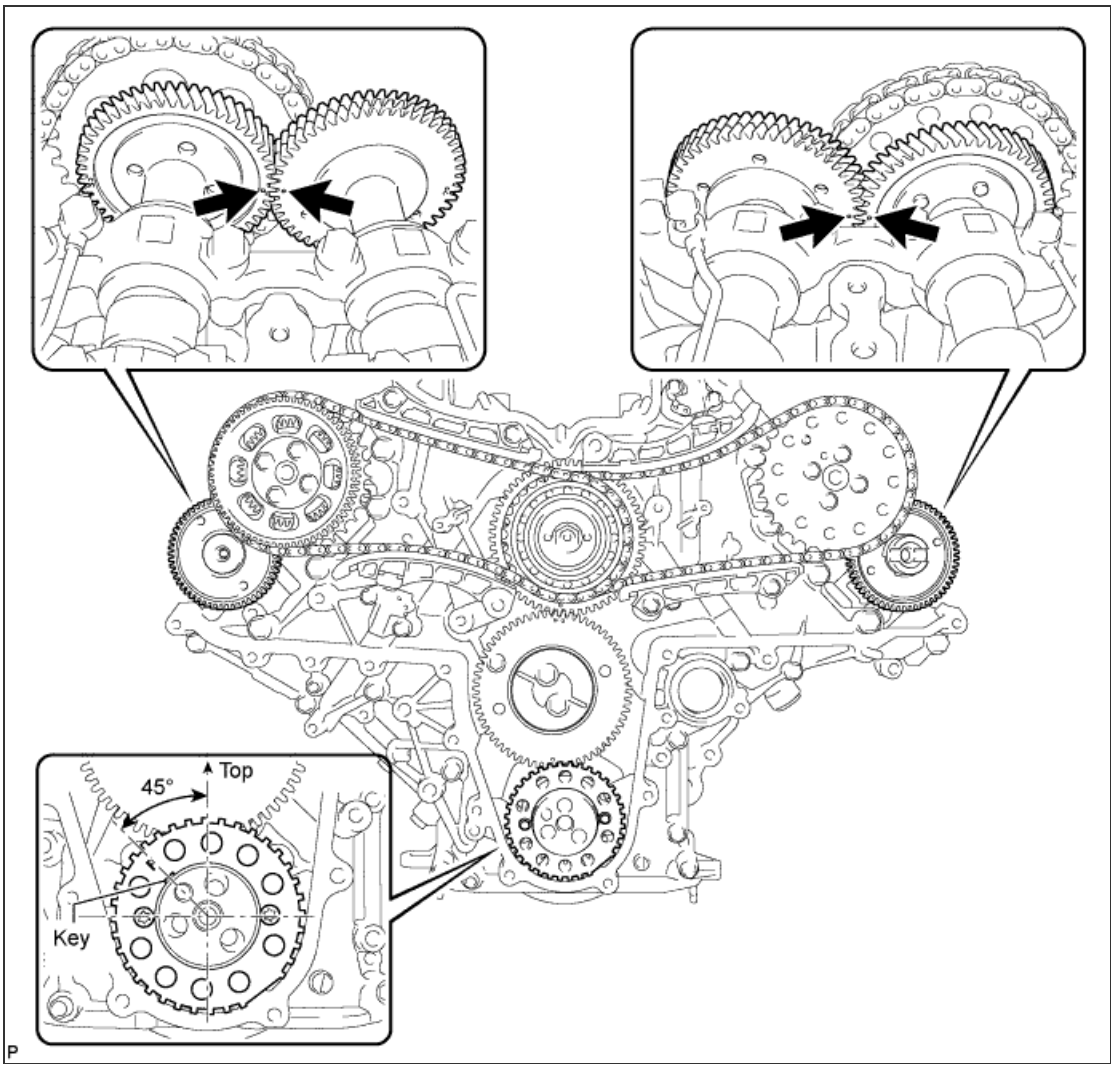
Make sure the "F" mark on the plate is facing towards the front side of the engine.



44. CHECK NO. 1 CYLINDER TO TDC/COMPRESSION

a. Temporarily install the 2 crankshaft pulley set bolts to the crankshaft.

b. Rotate the crankshaft 2 revolutions or more so that the crankshaft key is 45° counterclockwise from the top. Check that the timing marks (1 dot mark each) of the RH and LH camshaft timing gears align. If not as specified, turn the crankshaft 1 revolution (360°) and align the timing marks. If the timing marks are deviated, reinstall the chain and camshaft.



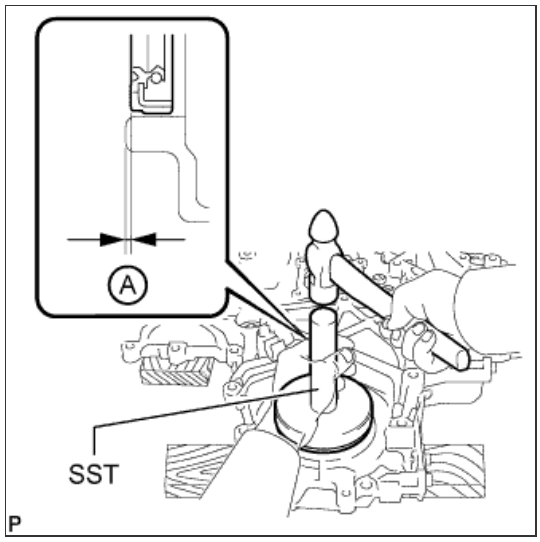
45. INSTALL FRONT CRANKSHAFT OIL SEAL

a. Place the timing chain cover on wooden blocks.

b. Using SST and a hammer, tap in a new oil seal as shown in the illustration.

SST
09316-12010
09950-70010 (09951-07100)
09950-60020 (09951-00890)

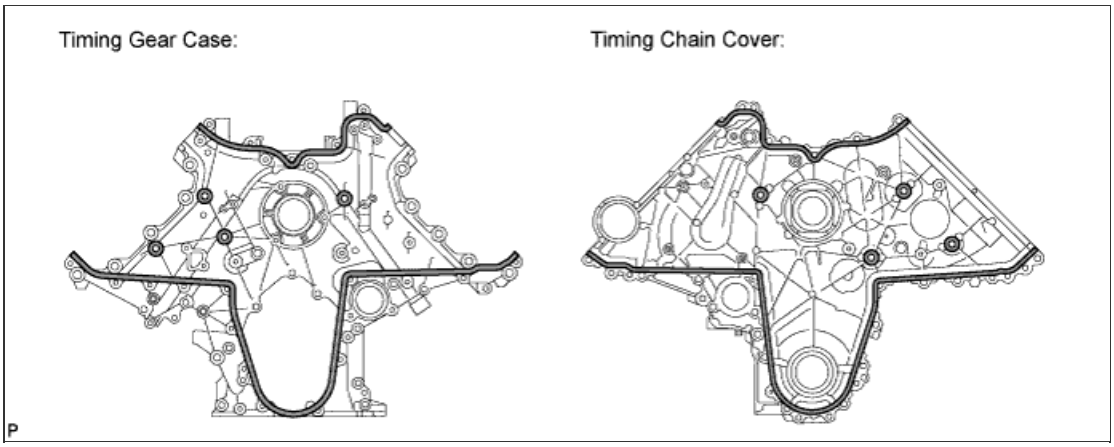
Standard depth A:
0.6 to 1.4 mm (0.0236 to 0.0551 in.)



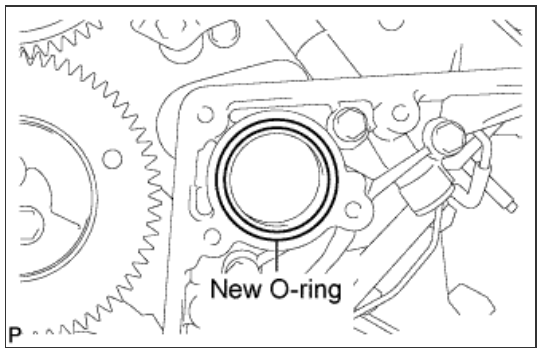
46. INSTALL TIMING CHAIN COVER SUB-ASSEMBLY

NOTICE:

When the contact surfaces shown below are wet, wipe them with an oil-free cloth before applying seal packing.



a. Install a new O-ring to the timing gear case.



b. Apply seal packing to the timing chain cover as shown in the following illustration.

Standard seal diameter:
4 to 5 mm (0.157 to 0.197 in.)

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

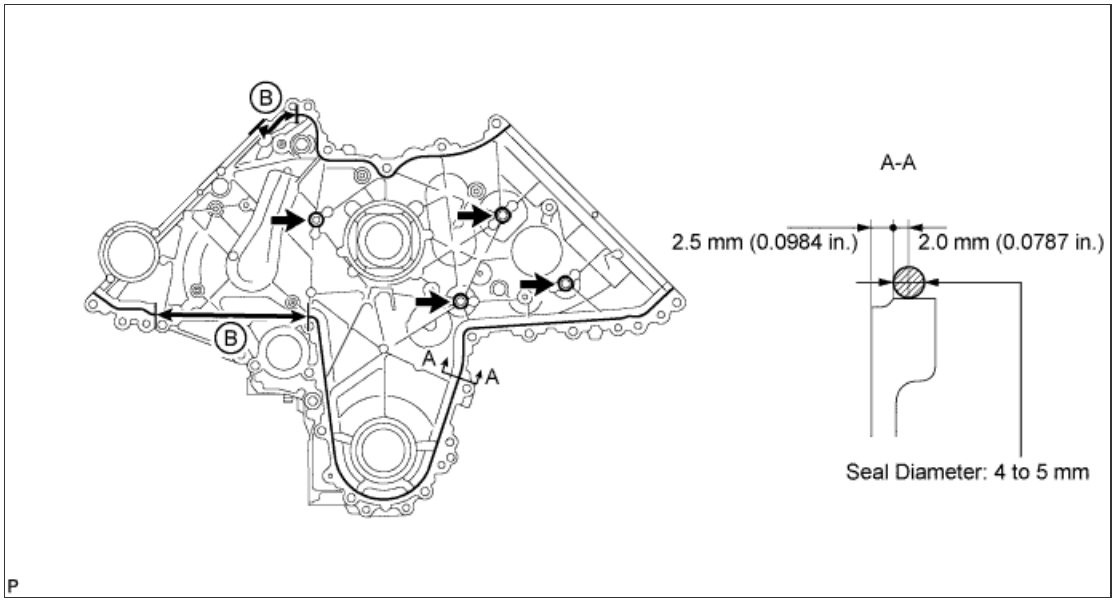
NOTICE:

- **After applying seal packing, align the timing chain cover with the timing gear case within 3 minutes and tighten the bolts and nuts within 15 minutes.**

- Apply the seal packing in a continuous line.
- Make sure the seal packing does not become thinner than 4 mm (0.157 in.) at the areas labeled "B" in the illustration below.

HINT:

- The FIPG line is shown below.
- Apply packing to the 6 seal surface areas.



c. Apply engine oil to the lip of the oil seal.

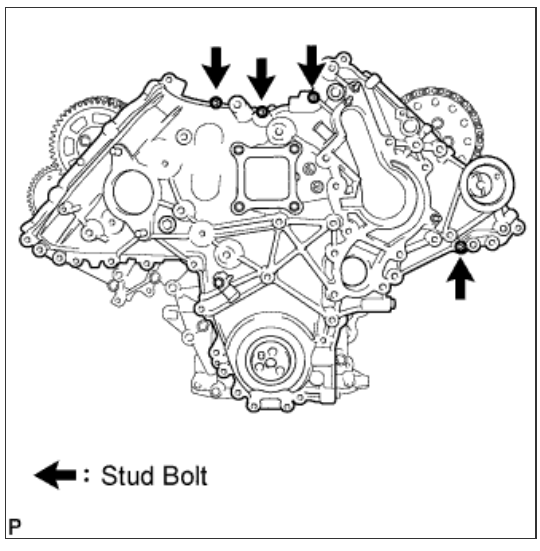
d. Align and install the timing chain cover to the timing gear case knock pin and supply pump bearing.

NOTICE:

Make sure that the lip of the oil seal is properly installed.

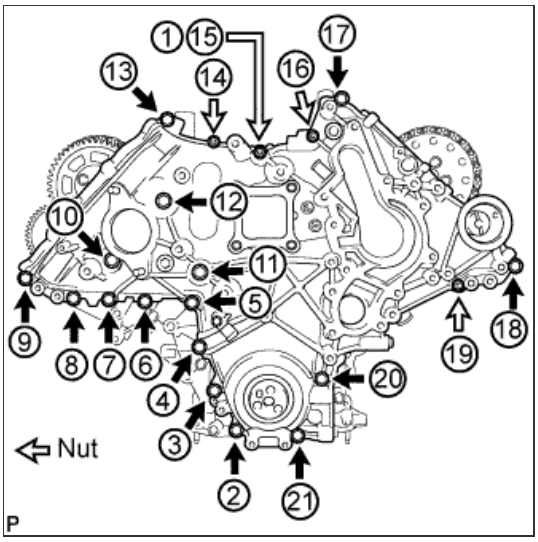
e. If the stud bolts are loose, tighten them using an E7 "TORX" wrench.

Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }



f. Install and uniformly tighten the 16 bolts and 4 nuts in the order shown in the illustration.

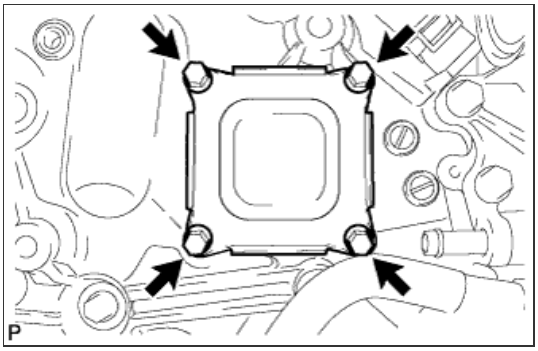
Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }



47. INSTALL TIMING CHAIN COVER PLATE

a. Install a new gasket and the timing chain cover plate with the 4 bolts.

Torque:
9.1 N*m{ 93 kgf*cm , 81 in.*lbf }

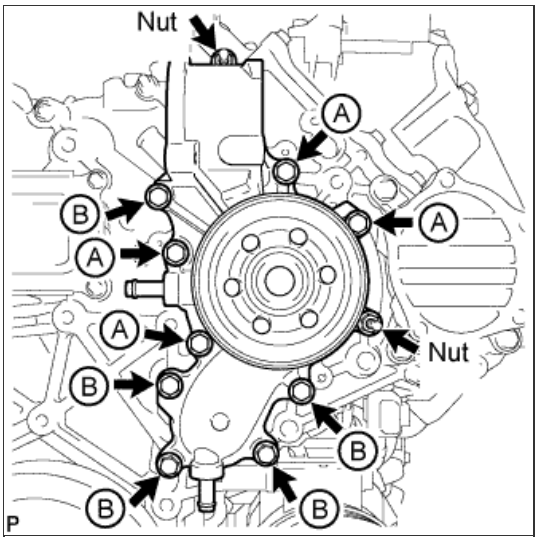


48. INSTALL WATER PUMP ASSEMBLY

a. Temporarily install a new gasket and the water pump with the 9 bolts and 2 nuts.

Bolt Length

Item	Length
Bolt A	30 mm (1.18 in.)
Bolt B	80 mm (3.15 in.)



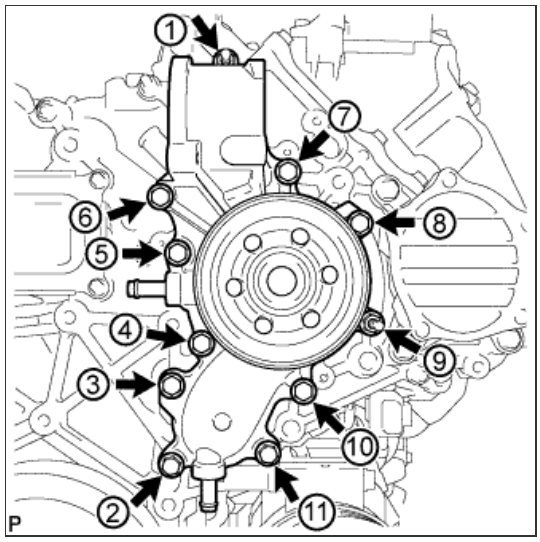
b. Uniformly tighten the 9 bolts and 2 nuts of the water pump in the order shown in the illustration.

Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }

NOTICE:

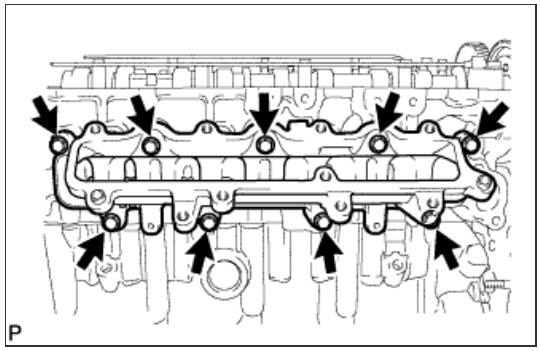
After installing all of the bolts and nuts, check that all of the bolts and nuts are

tightened to the torque specification.

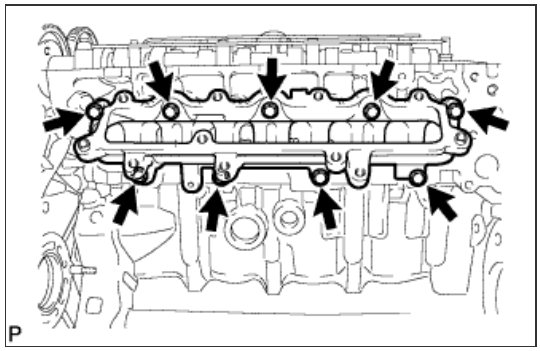


49. TEMPORARILY INSTALL INTAKE MANIFOLD

a. Install the gasket and temporarily install the No. 2 intake manifold with the 9 bolts.



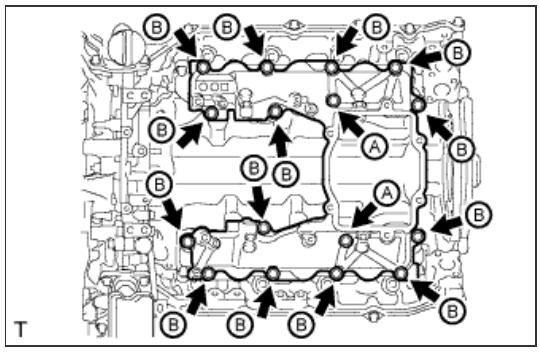
b. Install the gasket and temporarily install the No. 1 intake manifold with the 9 bolts.



c. Install the 2 gaskets and temporarily install the No. 3 intake manifold with the 16 bolts.

Bolt Length

Item	Length
Bolt A	70 mm (2.76 in.)
Bolt B	25 mm (0.984 in.)

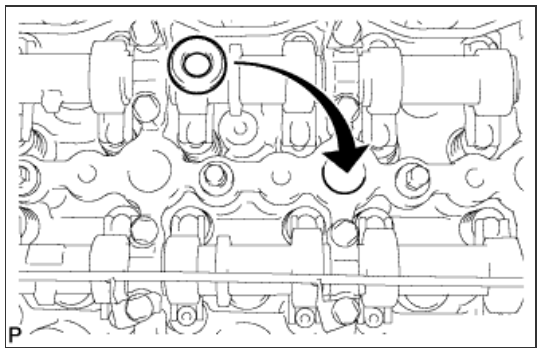


50. INSTALL FUEL INJECTOR LH

NOTICE:

Be sure to install the injector, holder clamp and bolt in their original positions.

a. Install 4 new injection nozzle seats to the cylinder head.



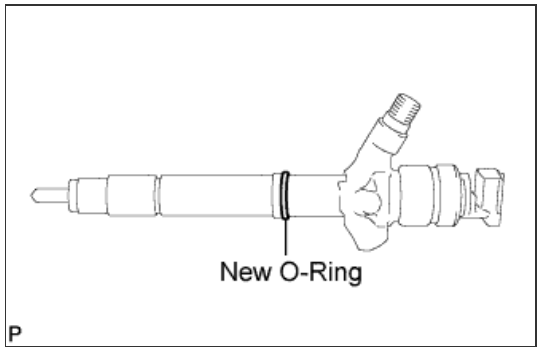
b. Apply a light coat of clean engine oil to 4 new O-rings.

c. Install an O-ring to each injector as shown in the illustration.

d. Insert the 4 injectors into the cylinder head.

NOTICE:

- **Insert the injector until it touches the nozzle seat surface.**
- **After installing the injector to the cylinder head, the O-ring may prevent the injector from fully seating. If so, pull out the injector and reinstall it.**
- **Always return an injector to the same place it was removed from.**

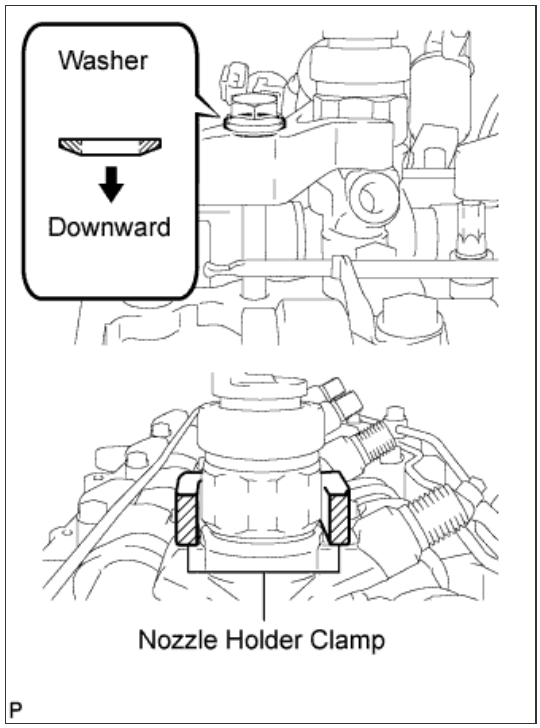


e. For an injector that has been replaced with a new injector, register the new injector compensation code.

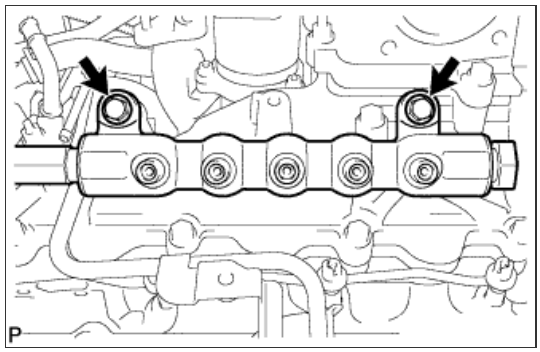
f. Temporarily install 4 new washers and the 4 nozzle clamps with the 4 clamp bolts.

NOTICE:

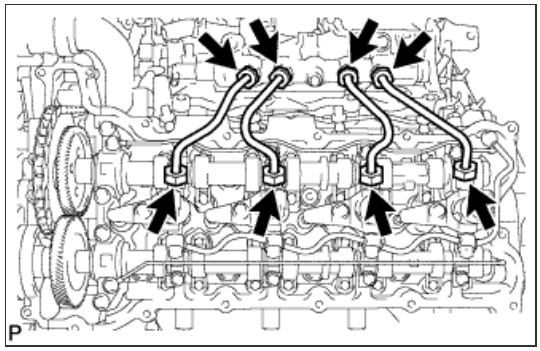
- **The fork portion of the nozzle holder clamp must be set to the injector.**
- **Before tightening the bolts, check that the nozzle holder clamps are set properly.**
- **To tighten the clamp bolts, first tighten them by hand until they cannot be turned further. Then, tighten the bolts to the specified torque in a later step.**
- **When tightening the bolts, pay attention not to tilt the bolt and clamp.**
- **Do not reuse the washer.**



g. Temporarily install the common rail LH with the 2 bolts.

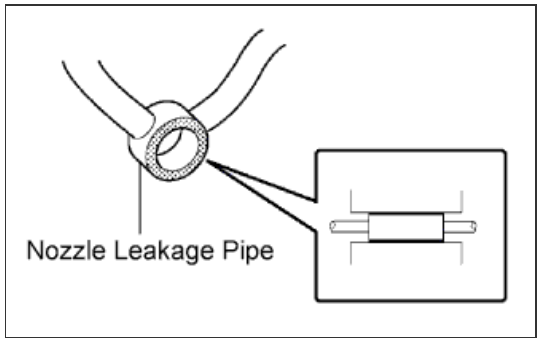


h. Temporarily install the 4 new injector pipes to the common rail and injectors.



i. Check the nozzle leakage pipe. Check that there are no scratches or dents on the 5 union seal surfaces. If scratches or dents are present, replace the nozzle leakage pipe.

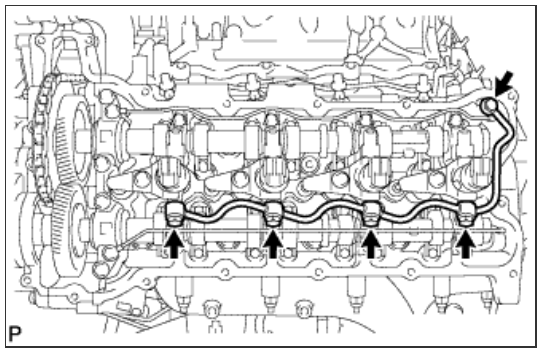
j. Set the leakage pipe and 5 new gaskets in place.



k. Temporarily install the leakage pipe with the 4 hollow screws and union bolt.

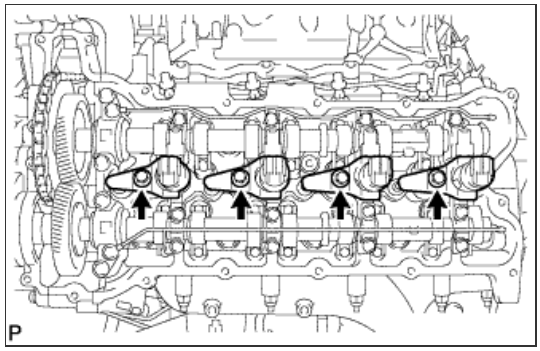
HINT:

To position the injectors, loosely tighten the 4 hollow screws and union bolt.

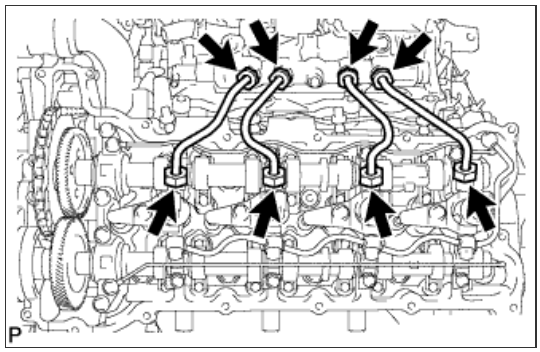


l. Tighten the 4 holder clamp bolts.

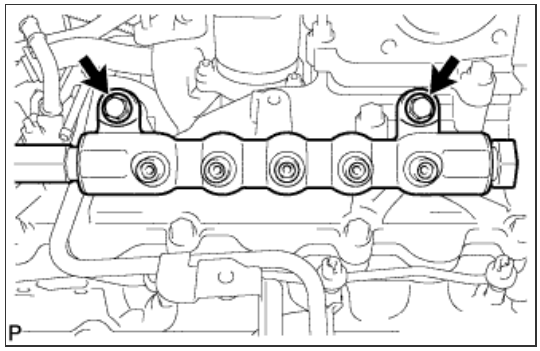
Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }



m. Remove the 4 injection pipes.



n. Remove the 2 bolts and common rail LH.

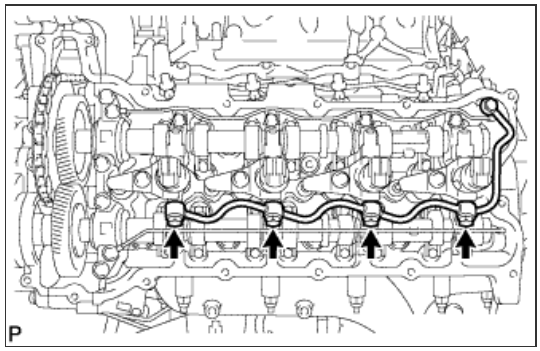


o. Tighten the 4 hollow screws.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

NOTICE:

If a hollow screw is accidentally tightened beyond the torque specification, it must be replaced.

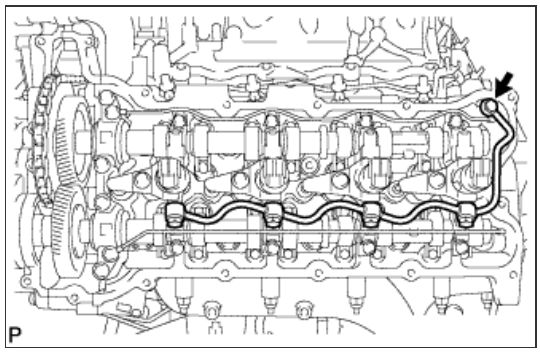


p. Tighten the union bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

NOTICE:

If the union bolt is accidentally tightened beyond the torque specification, it must be replaced.

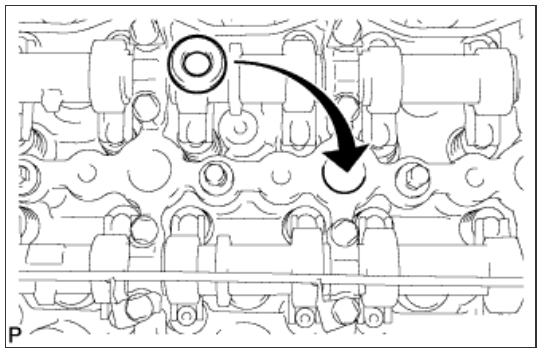


51. INSTALL FUEL INJECTOR RH

NOTICE:

Be sure to install the injector, holder clamp and bolt in their original positions.

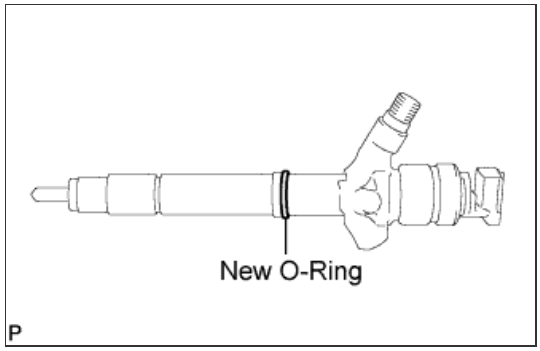
a. Install 4 new injection nozzle seats to the cylinder head.



b. Apply a light coat of clean engine oil to 4 new O-rings.

c. Install an O-ring to each injector as shown in the illustration.

d. Insert the 4 injectors into the cylinder head.



NOTICE:

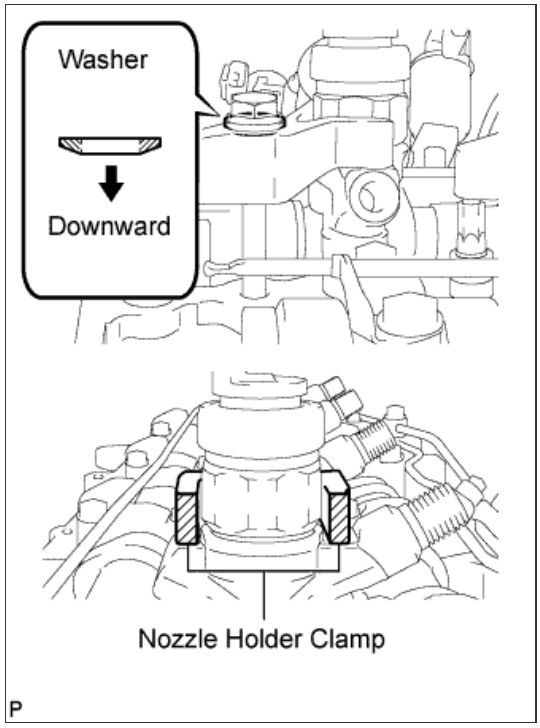
- **Insert the injector until it touches the nozzle seat surface.**
- **After installing the injector to the cylinder head, the O-ring may prevent the injector from fully seating. If so, pull out the injector and reinstall it.**
- **Always return an injector to the same place it was removed from.**

e. For an injector that has been replaced with a new injector, register the injector compensation code.

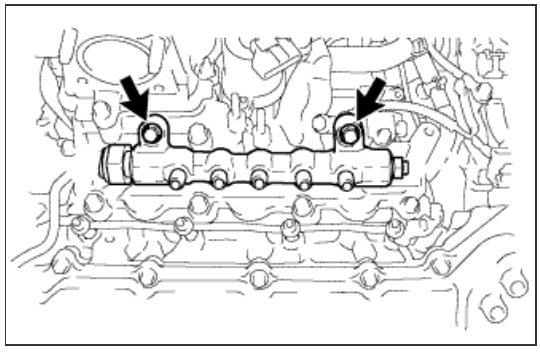
f. Temporarily install 4 new washers and the 4 nozzle clamps with the 4 clamp bolts.

NOTICE:

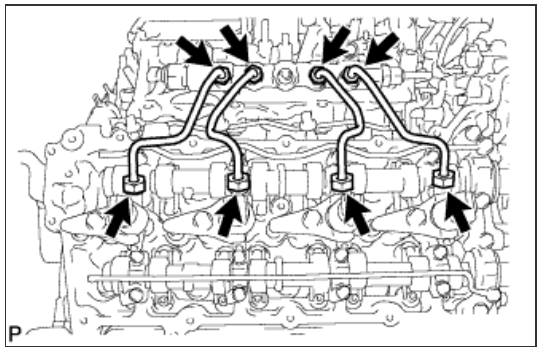
- **The fork portion of the nozzle holder clamp must be set to the injector.**
- **Before tightening the bolts, check that the nozzle holder clamp is set properly.**
- **To tighten the clamp bolts, first tighten them by hand until they cannot be turned further. Then, tighten the bolts to the specified torque in a later step.**
- **When tightening the bolts, pay attention not to tilt the bolt and clamp.**
- **Do not reuse the washer.**



g. Temporarily install the common rail RH with the 2 bolts.

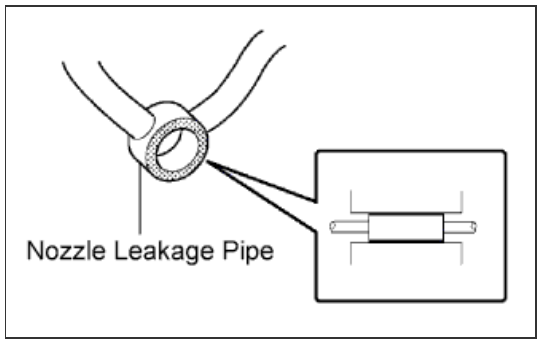


h. Temporarily install the 4 new injector pipes to the common rail and injectors.



i. Check the nozzle leakage pipe. Check that there are no scratches or dents on the 5 union seal surfaces. If scratches or dents are present, replace the nozzle leakage pipe.

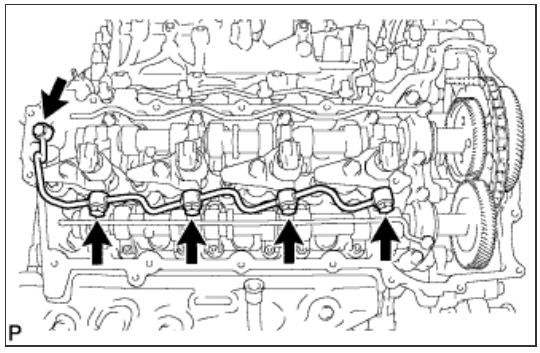
j. Set the leakage pipe and 5 new gaskets in place.



k. Temporarily install the leakage pipe with the 4 hollow screws and union bolt.

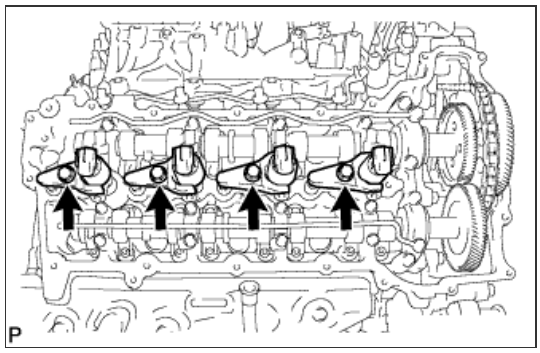
HINT:

To position the injectors, loosely tighten the 4 hollow screws and union bolt.

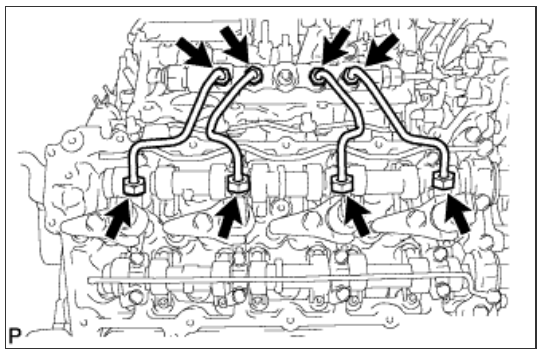


l. Tighten the 4 holder clamp bolts.

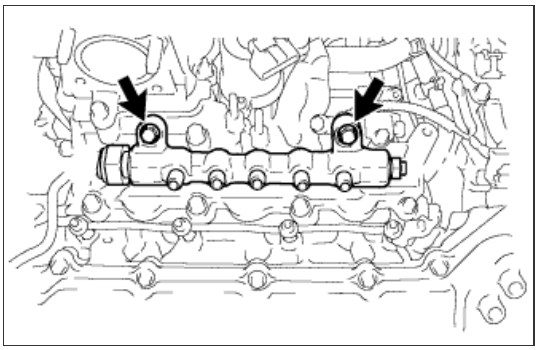
Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }



m. Remove the 4 injection pipes.



n. Remove the 2 bolts and common rail RH.

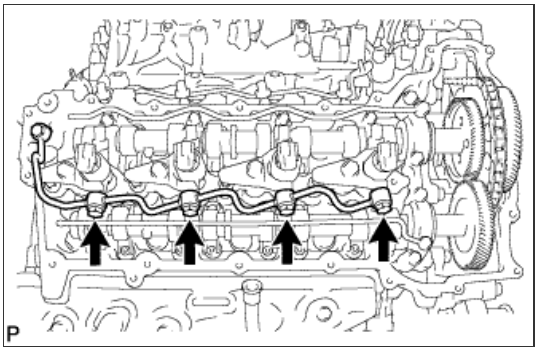


o. Tighten the 4 hollow screws.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

NOTICE:

If a hollow screw is accidentally tightened beyond the torque specification, it must be replaced.

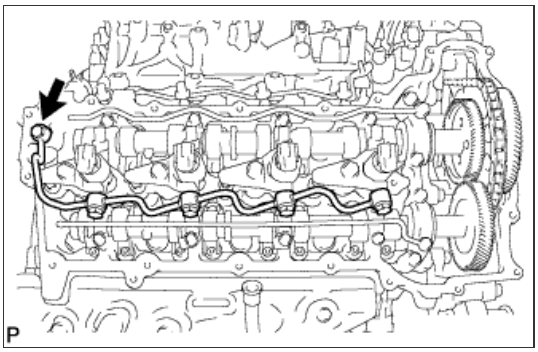


p. Tighten the union bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

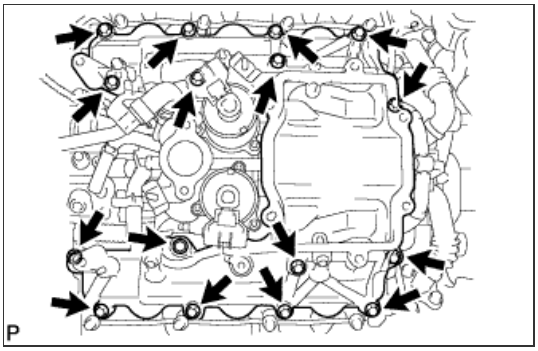
NOTICE:

If the union bolt is accidentally tightened beyond the torque specification, it must be replaced.

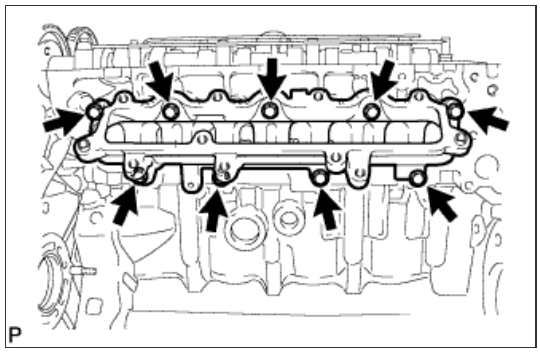


52. REMOVE INTAKE MANIFOLD

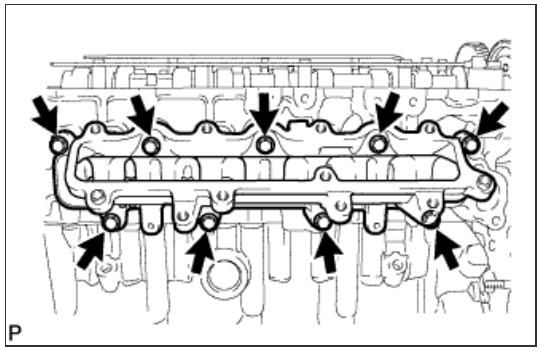
a. Remove the 16 bolts, 2 gaskets and intake manifold.



b. Remove the 9 bolts, No. 1 intake manifold and gasket.



c. Remove the 9 bolts, No. 2 intake manifold and gasket.

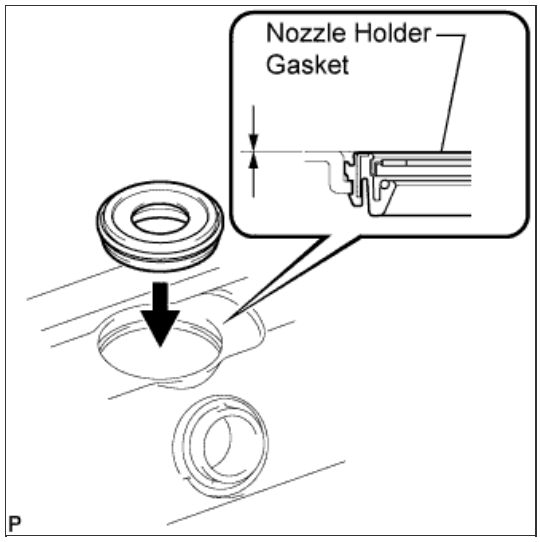


53. INSTALL NOZZLE HOLDER GASKET LH

a. Press 4 new nozzle holder gaskets into the cylinder head cover LH.

NOTICE:

After installing the nozzle holder gasket, check that it dose not protrude from the cylinder head cover.



54. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY LH

a. Apply seal packing as shown in the illustration.

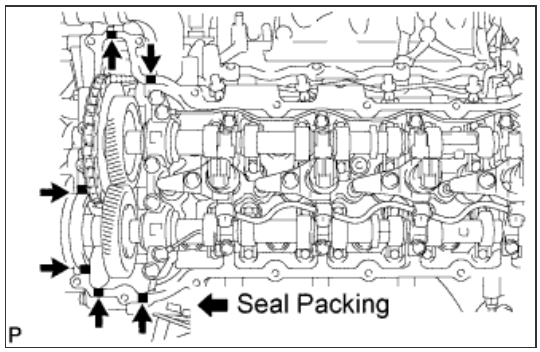
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the cylinder head cover within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after the installation.**

b. Install a new gasket to the cylinder head cover.

NOTICE:



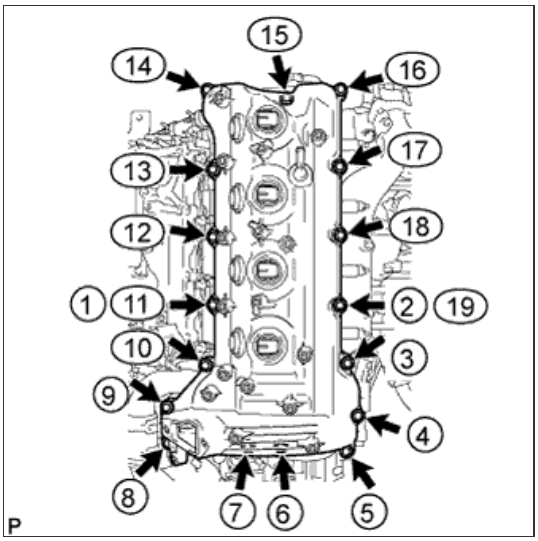
Remove any oil from the contact surface.

c. Temporarily install the cylinder head cover with the 17 bolts. Tighten the 17 bolts in the order shown in the illustration.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

HINT:

After tightening the bolts, check that the bolts at step 11 and 19 are tightened to the specified torque.



55. INSTALL NOZZLE HOLDER SEAL LH

a. Press 4 new holder seals into the cylinder head cover LH.

56. INSTALL OIL SEPARATOR ASSEMBLY

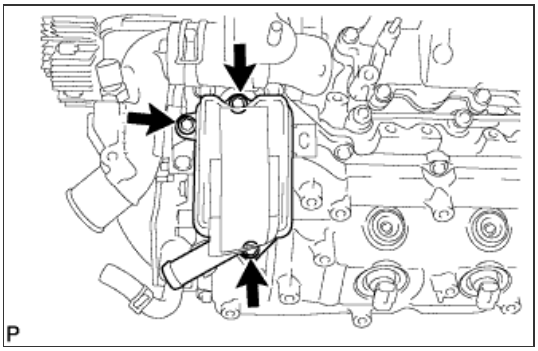
a. Install a new gasket to the oil separator.

NOTICE:

Remove any oil from the contact surface.

b. Install the oil separator with the 3 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

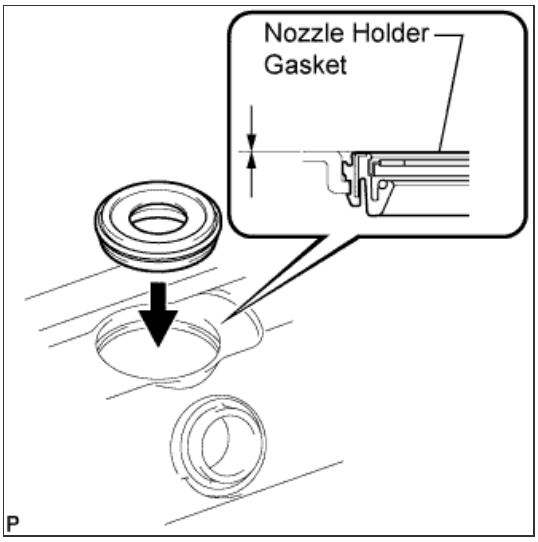


57. INSTALL NOZZLE HOLDER GASKET RH

a. Press 4 new nozzle holder gaskets into the cylinder head cover RH.

NOTICE:

After installing the nozzle holder gasket, check that it dose not protrude from the cylinder head cover.



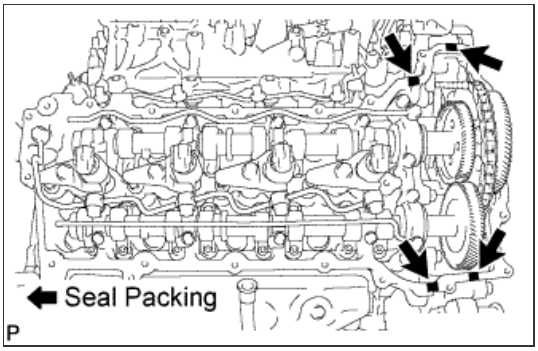
58. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY RH

a. Apply seal packing as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the cylinder head cover within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after the installation.**



b. Install a new gasket to the cylinder head cover.

NOTICE:

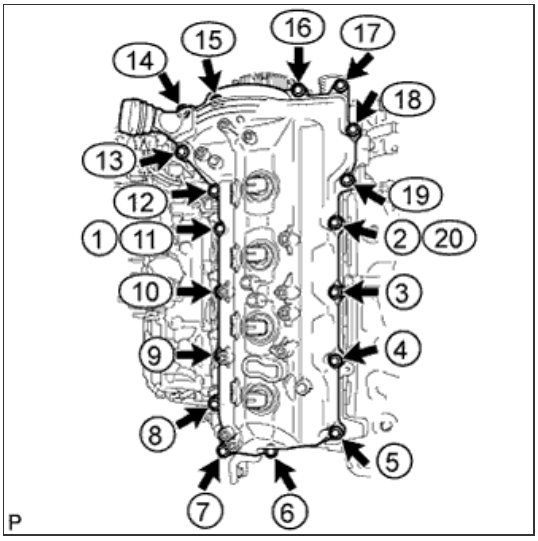
Remove any oil from the contact surface.

c. Temporarily install the cylinder head cover with the 18 bolts. Tighten the 18 bolts in the order shown in the illustration.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

HINT:

After tightening the bolts, check that the bolts at step 11 and 20 are tightened to the specified torque.

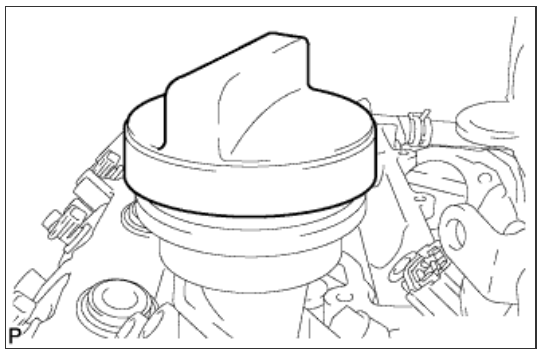


59. INSTALL NOZZLE HOLDER SEAL RH

a. Press 4 new holder seals into the cylinder head cover RH.

60. INSTALL OIL FILLER CAP GASKET

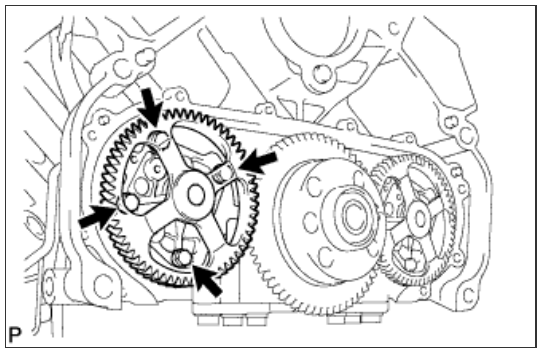
61. INSTALL OIL FILLER CAP SUB-ASSEMBLY



62. INSTALL SCAVENGING PUMP ASSEMBLY

a. Install the scavenging pump with the 4 bolts.

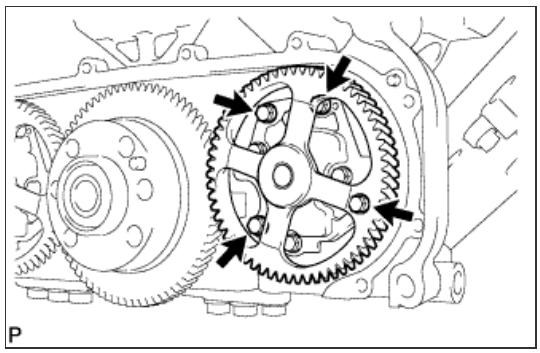
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



63. INSTALL OIL PUMP ASSEMBLY

a. Install the oil pump with the 4 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



64. INSTALL REAR CRANKSHAFT OIL SEAL

a. Place the oil seal retainer on wooden blocks.

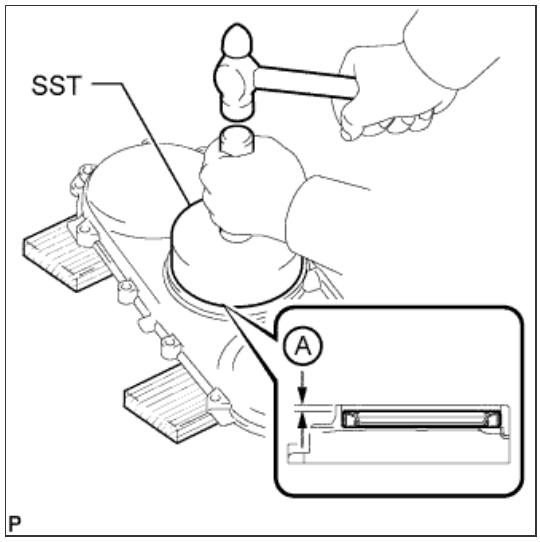
b. Using SST and a hammer, tap in a new oil seal as shown in the illustration.

SST
09223-56010

Standard depth A:
2.7 to 3.7 mm (0.106 to 0.147 in.)

NOTICE:

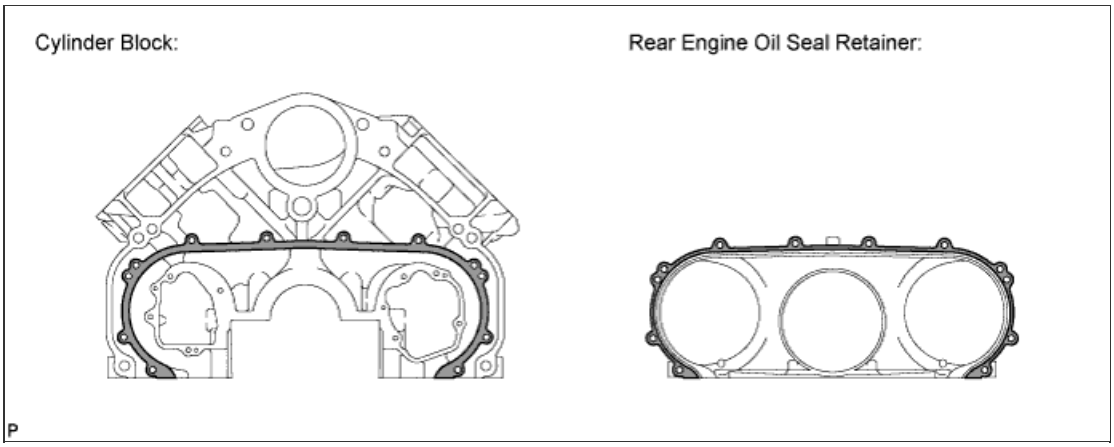
- **Keep the lip free from foreign matter.**
- **Do not tap on the seal at an angle.**



65. INSTALL REAR ENGINE OIL SEAL RETAINER

NOTICE:

When the contact surfaces shown below are wet, wipe them with an oil-free cloth before applying seal packing.



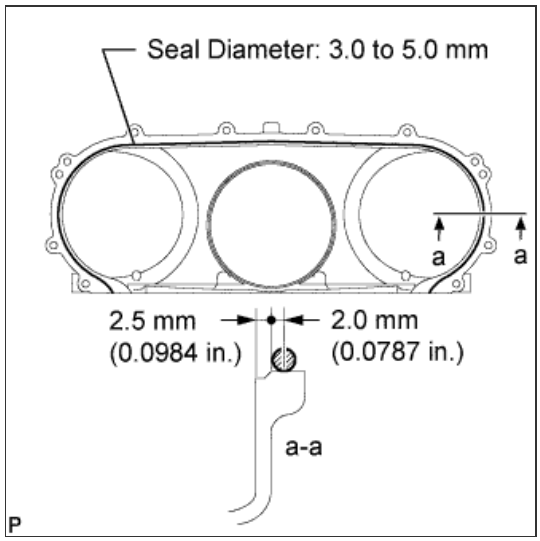
a. Apply seal packing in a continuous line as shown in the illustration.

Seal diameter:
3.0 to 5.0 mm (0.118 to 0.197 in.)

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the rear engine oil seal retainer within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after installation.**



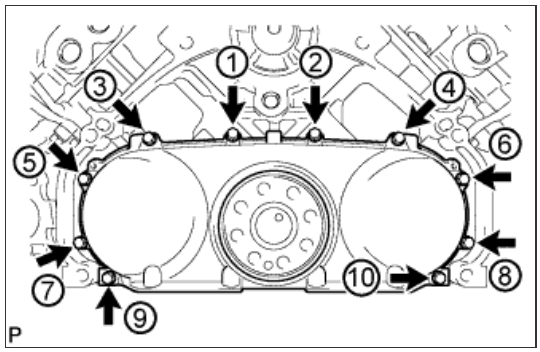
b. Apply engine oil to the lip of a new oil seal.

c. Install and uniformly tighten the 10 bolts in the order shown in the illustration.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

NOTICE:

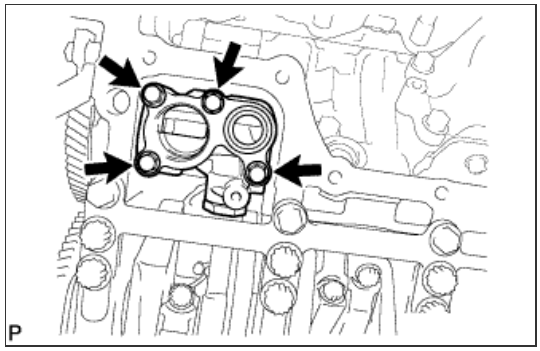
- **Make sure that the lip of the oil seal is properly installed.**
- **When installing the oil seal retainer, make sure the lip of the oil seal is not damaged.**
- **When installing the oil seal retainer, make sure the lip of the oil seal is not folded incorrectly.**



66. INSTALL OIL REGULATOR ASSEMBLY

a. Install the oil regulator with the 4 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

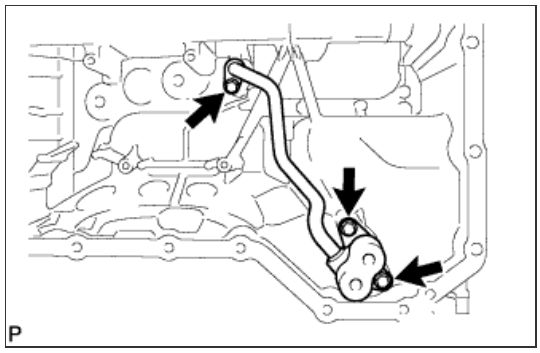


67. INSTALL INLET OIL PUMP PIPE

a. Apply a light coat of engine oil to a new O-ring, and install it to the inlet oil pump pipe.

b. Install the inlet oil pump pipe with the 3 bolts.

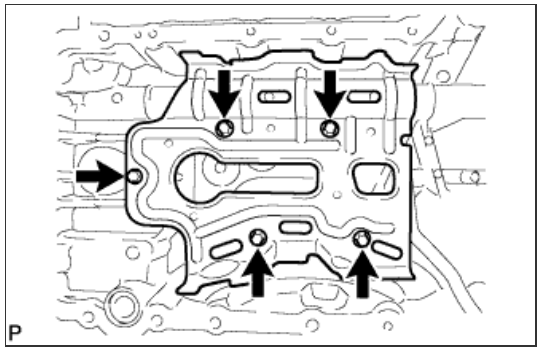
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



68. INSTALL NO. 1 OIL PAN BAFFLE PLATE

a. Install the No. 1 oil pan baffle plate with the 5 bolts.

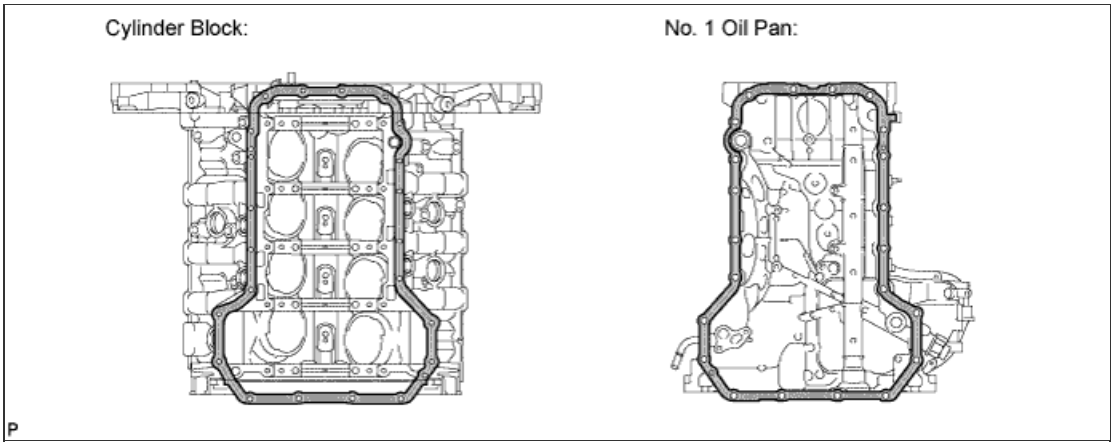
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



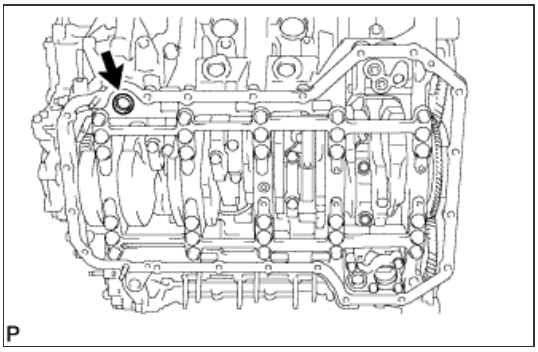
69. INSTALL NO. 1 OIL PAN SUB-ASSEMBLY

NOTICE:

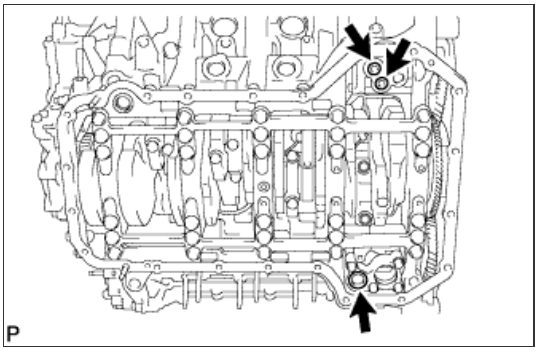
When the contact surfaces shown below are wet, wipe them with an oil-free cloth before applying seal packing.



a. Install the cylinder block oil hole gasket.



b. Apply a light coat of engine oil to 3 new O-rings and set the 3 O-rings to the oil regulator and scavenging pump.



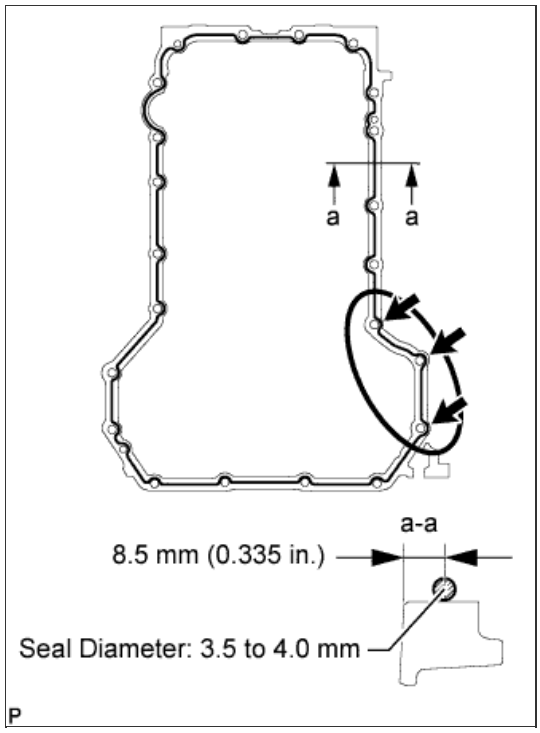
c. Apply seal packing to the No. 1 oil pan as shown in the illustration.

Standard seal diameter:
3.5 to 4.0 mm (0.134 to 0.157 in.)

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

- **For the 3 bolt holes labeled with arrows, apply the seal packing on the outer edges. For the other bolt holes, apply the seal packing on the inner edges.**
- **Make sure to apply a continuous bead of seal packing as shown in the illustration. If the bead breaks, overlap 3 mm (0.118 in.) of seal packing and continue the bead.**
- **Install the No. 1 oil pan within 3 minutes and tighten the bolts and nuts within 15 minutes after applying seal packing.**
- **Remove any oil and old seal packing from the contact surface.**
- **Do not start the engine for at least 2 hours after installation.**



d. Install the No. 1 oil pan and oil reflector plate with the 20 bolts and 2 nuts.

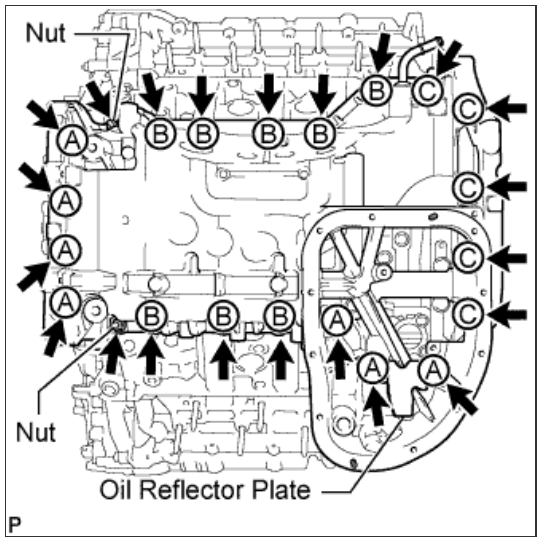
NOTICE:

If the oil reflector plate is deformed, replace it.

Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }

Bolt Length

Item	Quantity	Length
Bolt A	7	70 mm (2.76 in.)
Bolt B	8	20 mm (0.787 in.)
Bolt C	5	30 mm (1.18 in.)

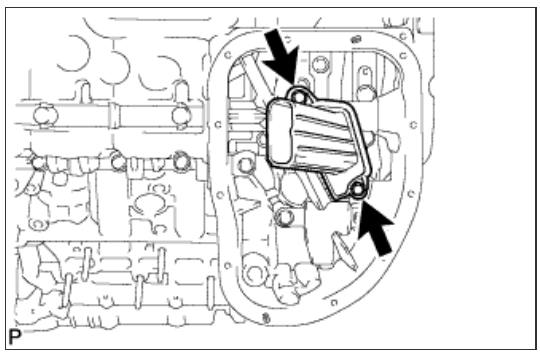


70. INSTALL OIL STRAINER SUB-ASSEMBLY

a. Apply a light coat of engine oil to a new O-ring, and install it to the oil strainer.

b. Install the oil strainer with the 2 bolts.

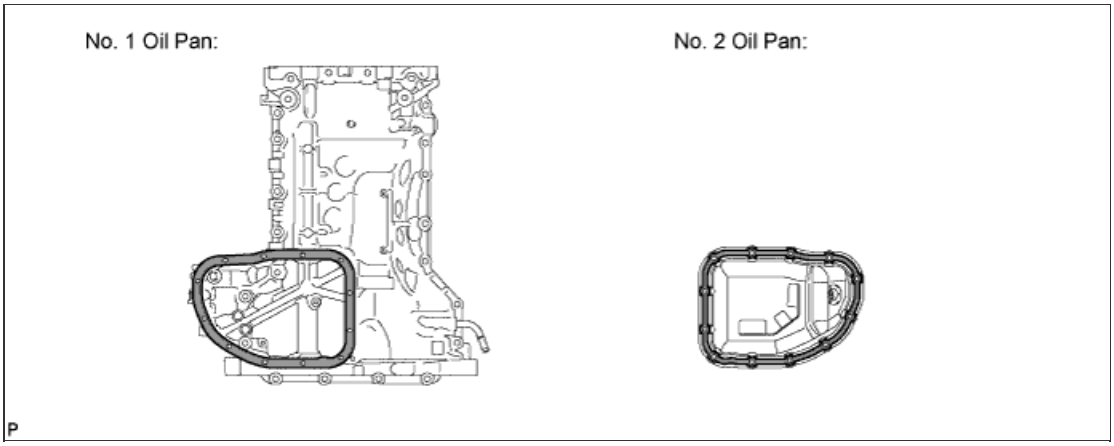
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



71. INSTALL NO. 2 OIL PAN SUB-ASSEMBLY

NOTICE:

When the contact surfaces shown below are wet, wipe them with an oil-free cloth before applying seal packing.



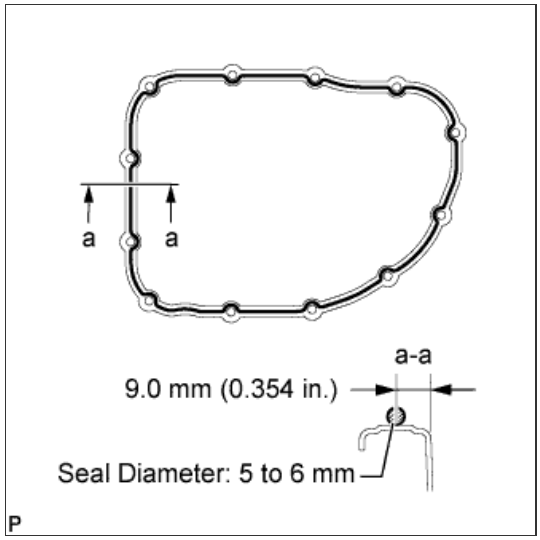
a. Apply seal packing to the No. 2 oil pan as shown in the illustration.

Standard seal diameter:
5 to 6 mm (0.197 to 0.236 in.)

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

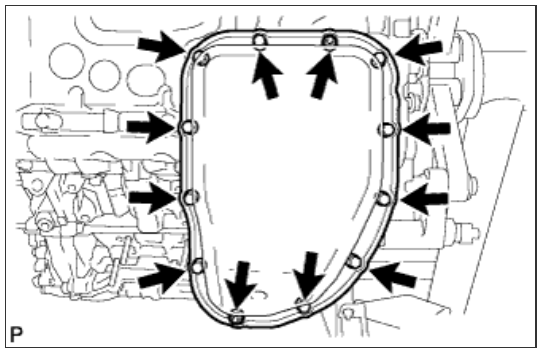
NOTICE:

- **For the bolt and pin holes, make sure to apply seal packing to the inner sides.**
- **Make sure to apply a continuous bead of seal packing as shown in the illustration. If the bead breaks, overlap 3 mm (0.118 in.) of seal packing and continue the bead.**
- **Install the No. 2 oil pan within 3 minutes and tighten the bolts and nuts within 15 minutes after applying seal packing.**
- **Remove any oil from the contact surface.**
- **Do not start the engine for at least 2 hours after installation.**



b. Install the No. 2 oil pan with the 10 bolts and 2 nuts.

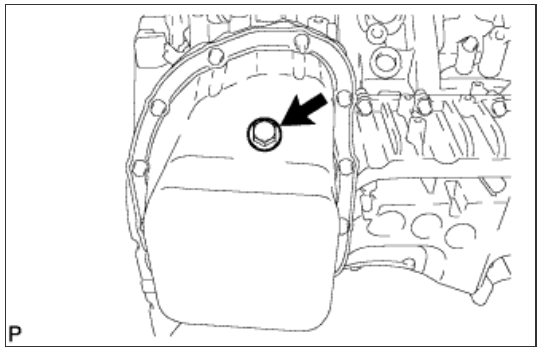
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



72. INSTALL OIL PAN DRAIN PLUG

a. Install a new gasket and the oil pan drain plug.

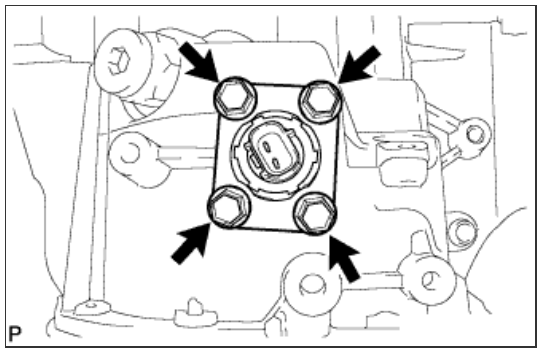
Torque:
38 N*m{ 387 kgf*cm , 28 ft.*lbf }



73. INSTALL ENGINE OIL LEVEL SENSOR

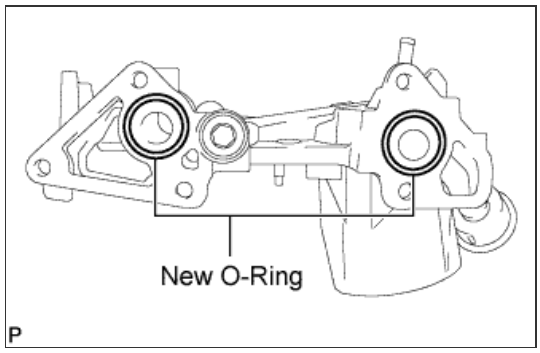
a. Install a new gasket and the engine oil level sensor with the 4 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



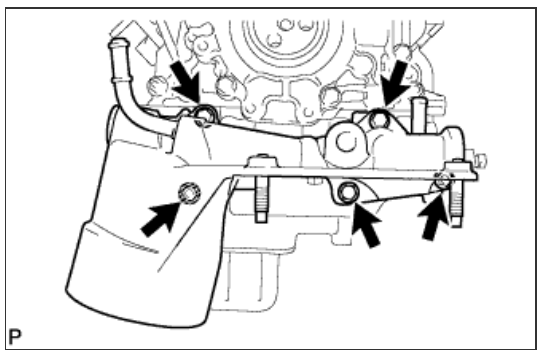
74. INSTALL OIL FILTER BRACKET SUB-ASSEMBLY

a. Apply a light coat of engine oil to 2 new O-rings, and set them to the oil filter bracket.



b. Install the oil filter bracket with the 3 bolts and 2 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



75. INSTALL OIL FILTER ELEMENT

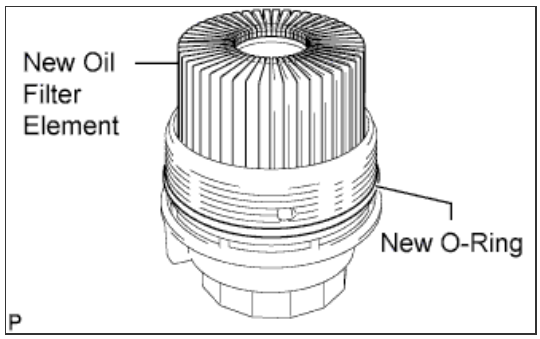
a. Clean the inside of the oil filter cap, its threads and its O-ring groove.

b. Apply a small amount of engine oil to a new O-ring and install it to the oil filter cap.

c. Set a new oil filter element in the oil filter cap.

d. Remove any dirt or foreign matter from the installation surface of the engine.

e. Apply a small amount of engine oil to the O-ring again and temporarily install the oil filter cap by hand.



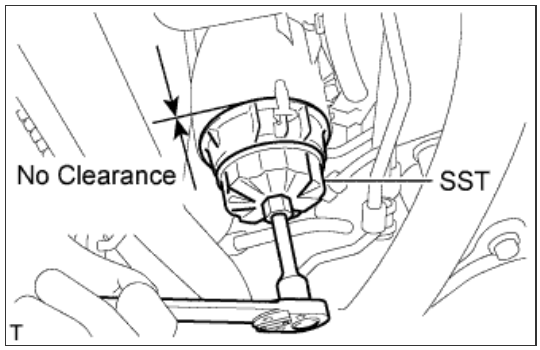
f. Using SST, tighten the oil filter cap.

SST
09228-06501

Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }

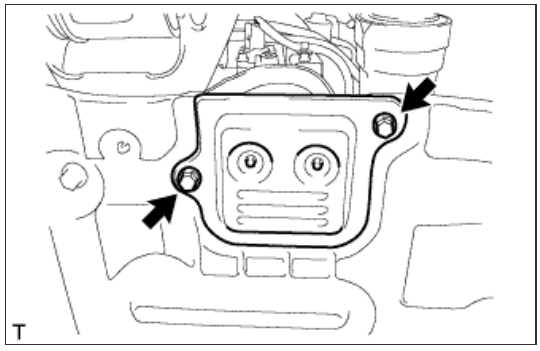
NOTICE:

- **Make sure that the oil filter is installed securely as shown in the illustration.**
- **Be careful that the O-ring does not get caught between any surrounding parts.**



g. Install the No. 2 engine under cover seal to the No. 2 engine under cover with the 2 bolts.

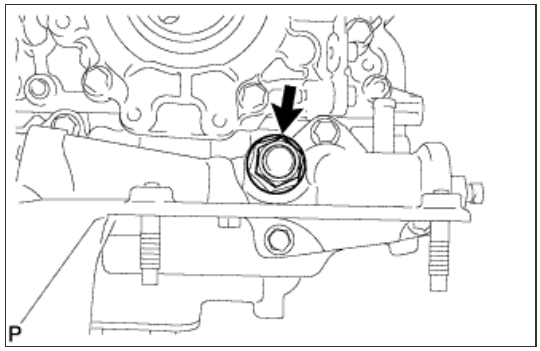
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



76. INSTALL OIL COOLER RELIEF VALVE ASSEMBLY

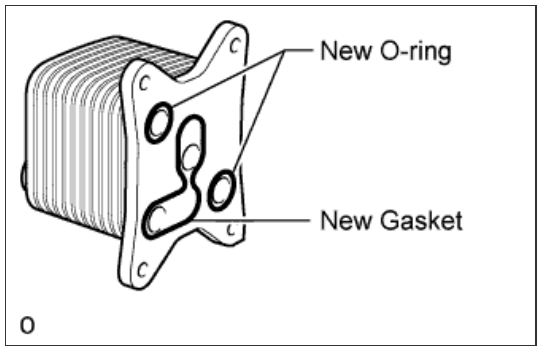
a. Install a new gasket and the oil cooler relief valve.

Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }



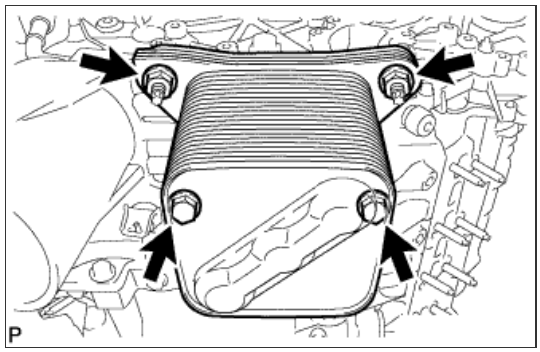
77. INSTALL OIL COOLER ASSEMBLY

a. Apply a light coat of engine oil to 2 new O-rings and a new oil cooler gasket, and install them to the oil cooler.



b. Install the oil cooler with the 2 bolts and 2 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

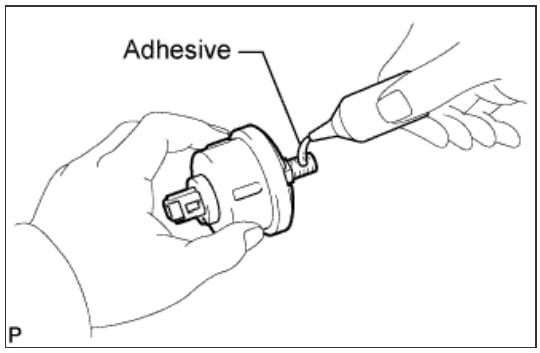


78. INSTALL OIL PRESSURE SENDER GAUGE ASSEMBLY

a. Remove the adhesive from the oil pressure sender gauge and the bolt hole f the oil filter bracket.

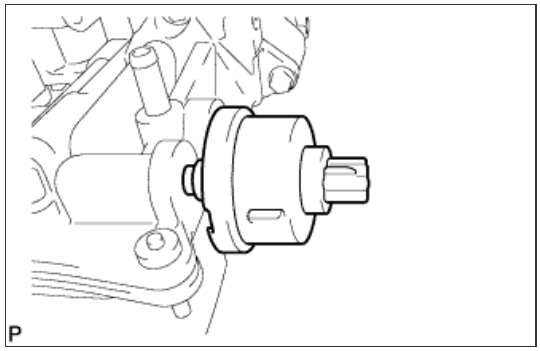
b. Apply adhesive to 2 or 3 threads of the oil pressure sender gauge.

Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent



c. Install the oil pressure sender gauge.

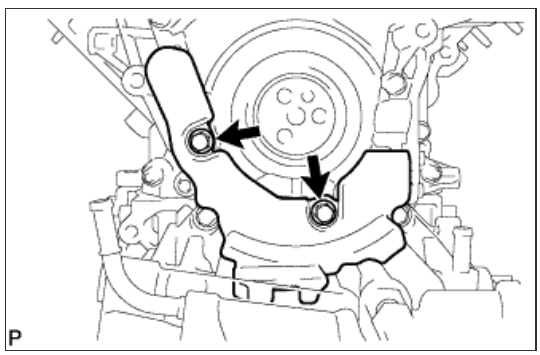
Torque:
15 N*m{ 153 kgf*cm , 11 ft.*lbf }



79. INSTALL TIMING GEAR COVER SPACER (w/ Intercooler)

a. Install the timing gear cover spacer with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



80. INSTALL CRANKSHAFT PULLEY

NOTICE:

This procedure is intended for removal/installation of the crankshaft pulley only. Do not use this procedure for removal/installation of the flywheel or

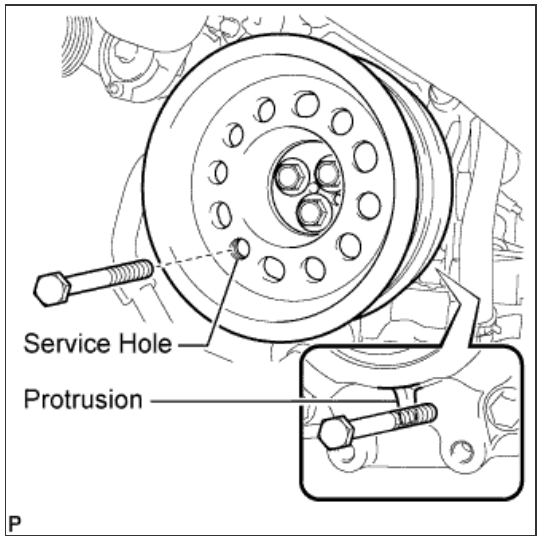
the drive plate and ring gear.

a. Align the crankshaft pulley and the crankshaft knock pin, and temporarily install the crankshaft pulley with the 3 bolts.

b. Install the 2 bolts to the bolt holes of the crankshaft rear side.

c. Using a bar, turn the crankshaft until the crankshaft pulley service hole is a little to the right of bottom dead center.

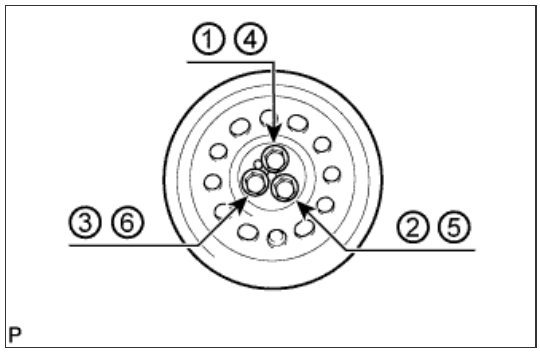
d. Install a 14 mm x 1.5 pitch service bolt with a length of 70 mm or more to the crankshaft pulley service hole, and hold the crankshaft using the timing chain cover protrusion.



e. Uniformly tighten the 3 bolts in 2 passes in the order shown in the illustration.

Torque:
115 N*m{ 1168 kgf*cm , 84 ft.*lbf }

f. Remove the service bolt.

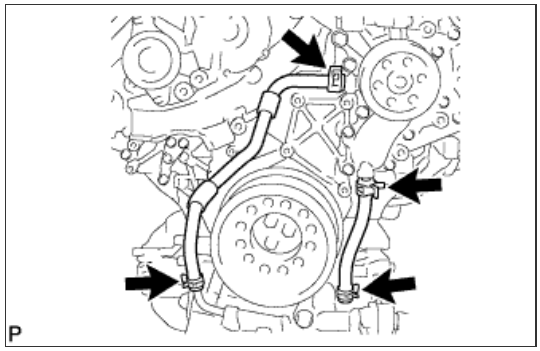


81. CONNECT NO. 2 OIL COOLER HOSE

a. Align the white paint marks on the oil cooler hose and oil filter bracket and connect the hose. Then connect the other side to the water pump and attach the oil cooler hose to the clamp.

NOTICE:

Make sure to maintain a space between the oil cooler hose and crankshaft pulley, and the oil cooler hose and V-ribbed belt idler pulley.



82. CONNECT NO. 1 OIL COOLER HOSE

a. Face the pink paint mark on the oil cooler hose toward the front side of the engine and connect the hose to the oil filter bracket. Then connect the other side to the water pump.

NOTICE:

Make sure to maintain a space between the oil cooler hose and crankshaft pulley.

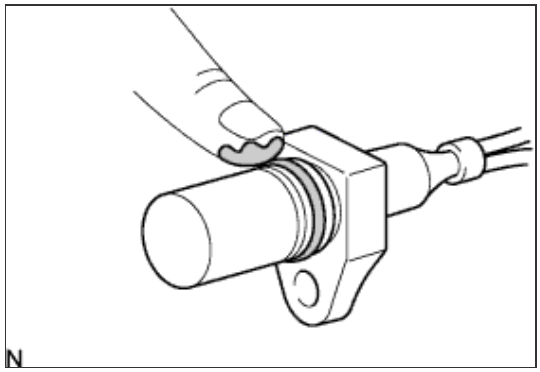
83. INSTALL CRANKSHAFT POSITION SENSOR

a. Apply a light coat of engine oil to the O-ring.

NOTICE:

When reusing the sensor, inspect the O-ring.

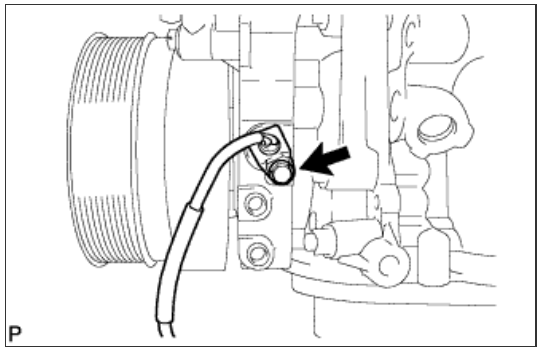
If the O-ring has scratches of cuts, replace the crankshaft position sensor.



b. Install the sensor with the bolt.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the wire harness to the clamp.



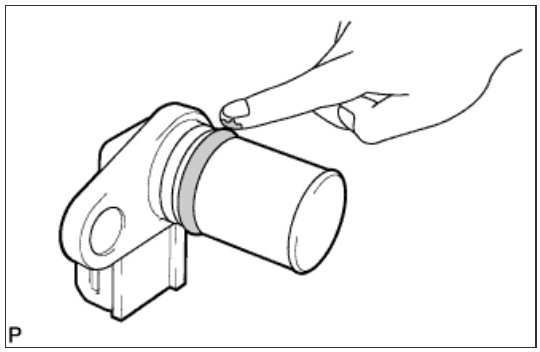
84. INSTALL CAMSHAFT POSITION SENSOR

a. Apply a light coat of engine oil to the O-ring.

NOTICE:

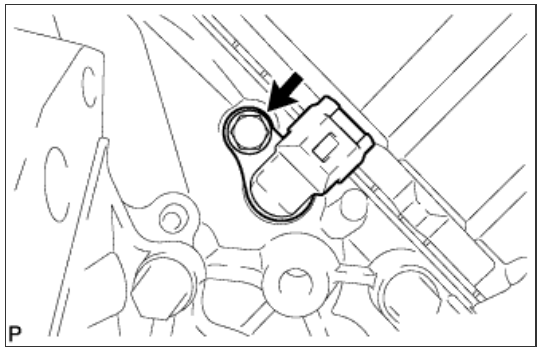
When reusing the sensor, inspect the O-ring.

If the O-ring has scratches of cuts, replace the crankshaft position sensor.



b. Install the sensor with the bolt.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

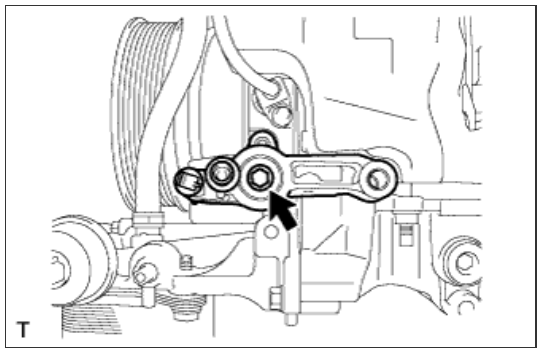


for Preparation Click here

1. INSTALL COMPRESSOR BRACKET

a. Install the compressor bracket with the bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



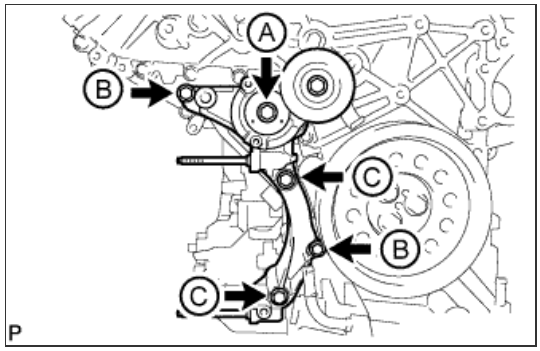
2. INSTALL V-RIBBED BELT TENSIONER ASSEMBLY

a. Install the V-ribbed belt tensioner with the 5 bolts.

Torque:
for bolt A and C:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }
for bolt B:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

Bolt Length

Item	Quantity	Length
Bolt A	1	116 mm (4.57 in.)
Bolt B	2	40 mm (1.58 in.)
Bolt C	2	95 mm (3.74 in.)



b. Install the No. 1 idler pulley with the bolt.

Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }

c. Install the V-ribbed belt tensioner bracket with the 3 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

3. INSTALL STIFFENER INSULATOR RH (w/ Intercooler)

a. Install the stiffener insulator RH with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

4. INSTALL OIL PRESSURE REGULATOR ASSEMBLY

a. Hold the oil pressure regulator body in a vise between aluminum plates.

b. Apply a light coat of engine oil to the oil pump relief valve labeled C.

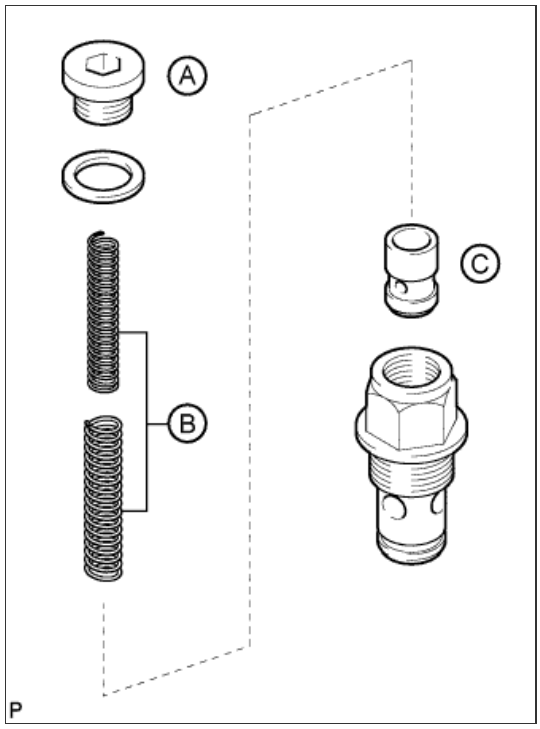
c. Install the oil pump relief valve labeled C to the oil pressure regulator body.

d. Install the 2 springs labeled B to the oil pressure regulator body.

e. Using a 10 mm hexagon wrench, install a new gasket and the oil pump relief valve plug labeled A.

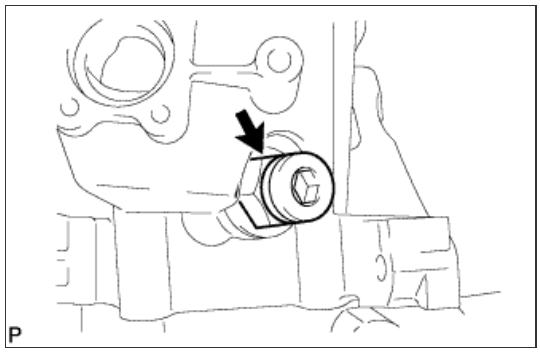
Torque:
50 N*m{ 510 kgf*cm , 37 ft.*lbf }

f. Apply a light coat of engine oil to a new O-ring, and install it to the oil pressure regulator body.



g. Using a 26 mm wrench, install a new gasket and the oil pressure regulator.

Torque:
86 N*m{ 877 kgf*cm , 63 ft.*lbf }



5. INSTALL OIL FILTER BRACKET DRAIN COCK ASSEMBLY

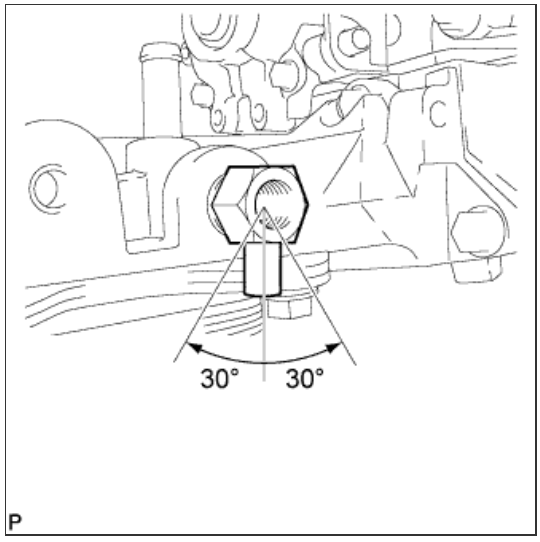
a. Install the drain cock.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

b. Using a 17 mm wrench, rotate the drain cock clockwise (360°) and align the position of the drain hole so that it is within the range shown in the illustration after tightening the drain cock to the specified torque.

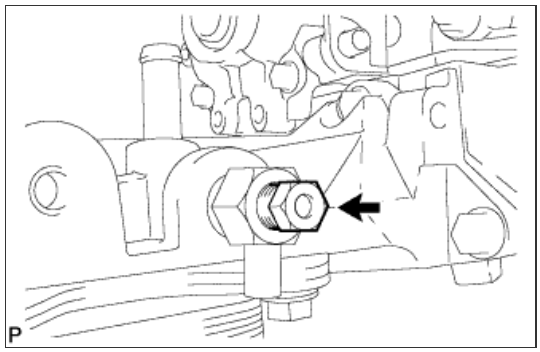
NOTICE:

- **As the oil filter bracket ma be damaged, the maximum tightening torque should be 80 N*m (816 kgf*cm, 59 ft.*lbf) or less.**
- **Do not rotate the drain cock more than 1 re olution (360) after tightening the drain cock with the specified torque.**
- **Do not expose the drain cock to coolant within 1 hour after installation.**



c. Install the oil filter drain cock plug.

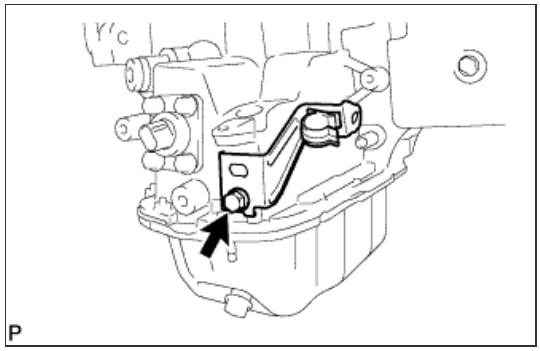
Torque:
13 N*m{ 130 kgf*cm , 9 ft.*lbf }



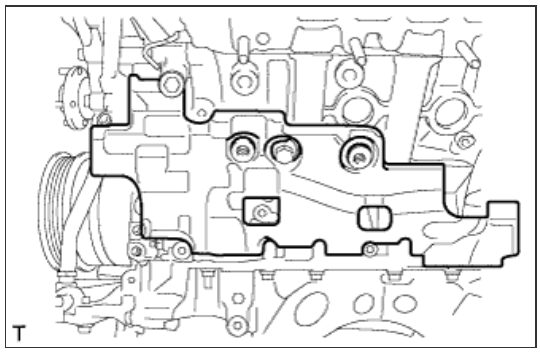
6. INSTALL OIL TANK BRACKET

a. Install the oil tank bracket with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



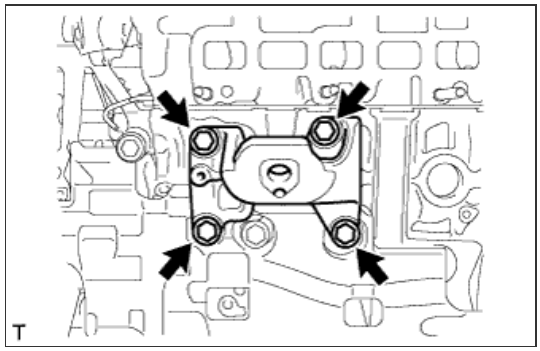
7. INSTALL NO. 2 CYLINDER BLOCK INSULATOR



8. INSTALL ENGINE MOUNTING BRACKET LH

a. Install the engine mounting bracket LH with the 4 bolts.

Torque:
80 N*m{ 816 kgf*cm , 59 ft.*lbf }

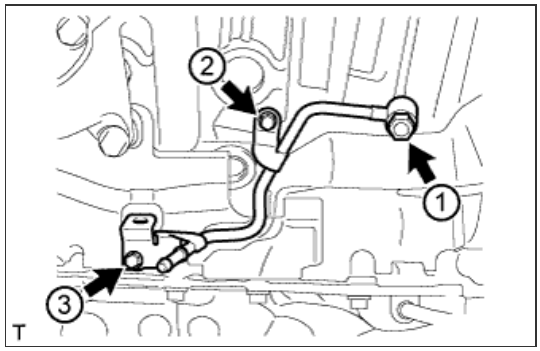


9. INSTALL NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY

a. emporarily install a new gasket and No. 2 water by-pass pipe with the union bolt and 2 bolts.

b. Tighten the union bolt and 2 bolts of the No. 2 water by-pass pipe in the order shown in the illustration.

Torque:
for union bolt:
35 N*m{ 357 kgf*cm , 26 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

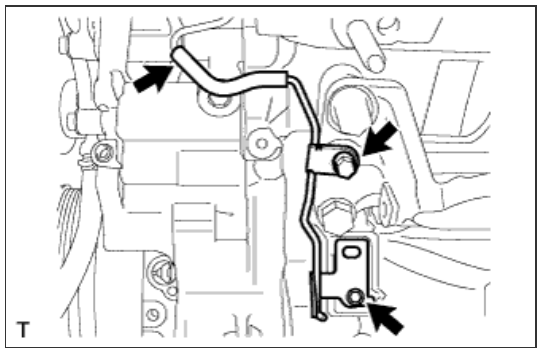


10. INSTALL NO. 3 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY

a. Install the No. 3 vacuum transmitting pipe with the 2 bolts.

Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }

b. w/ Intercooler:
Connect the vacuum hose.

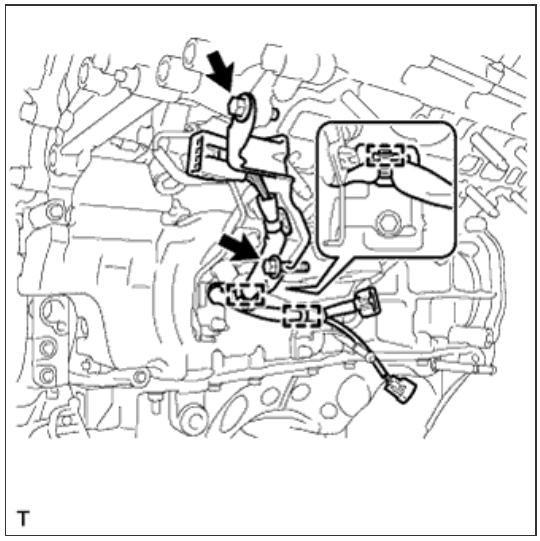


11. INSTALL TURBOCHARGER WIRE

a. Install the turbocharger wire with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

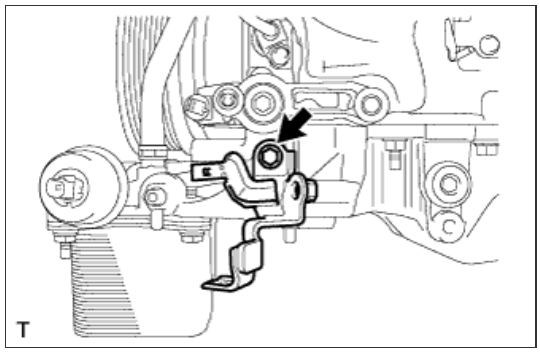
b. Attach the 3 wire harness clamps.



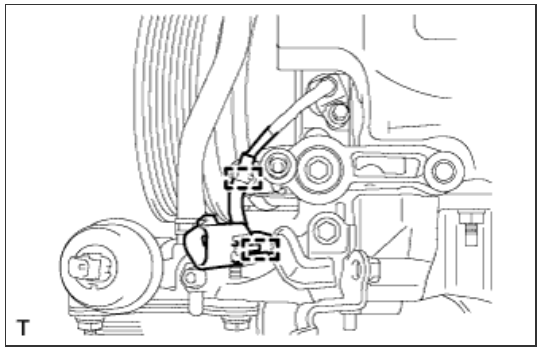
12. INSTALL NO. 2 INTAKE AIR CONNECTOR BRACKET

a. Install the No. 2 intake air connector bracket with the bolt.

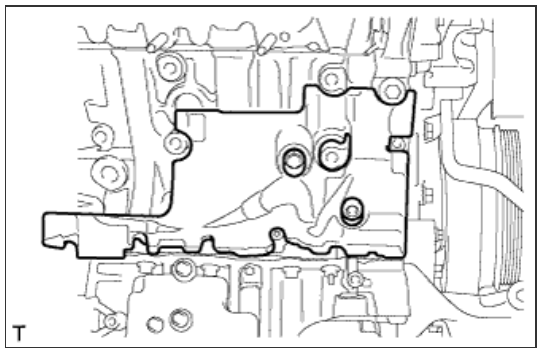
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



b. Attach the 2 wire clamps.



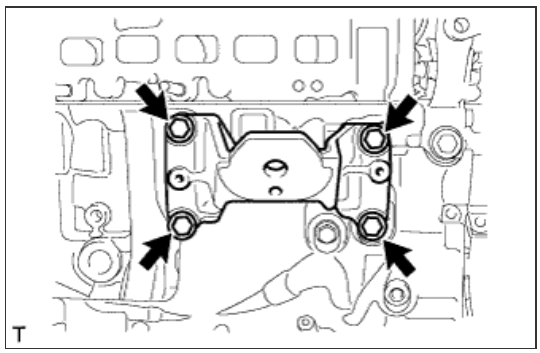
13. INSTALL NO. 1 CYLINDER BLOCK INSULATOR



14. INSTALL ENGINE MOUNTING BRACKET RH

a. Install the engine mounting bracket RH with the 4 bolts.

Torque:
80 N*m{ 816 kgf*cm , 59 ft.*lbf }



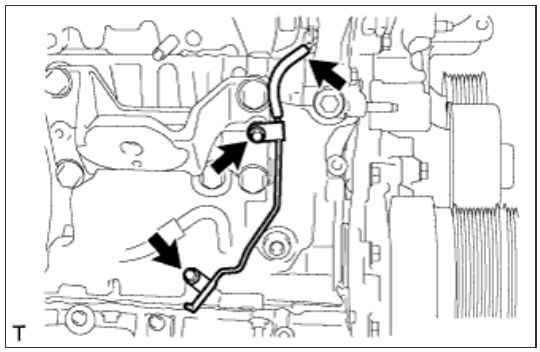
15. INSTALL NO. 4 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY (w/ Intercooler)

a. Install the No. 4 vacuum transmitting pipe with the 2 bolts.

Torque:

6.0 N*m{ 61 kgf*cm , 53 in.*lbf }

b. Connect the vacuum hose.

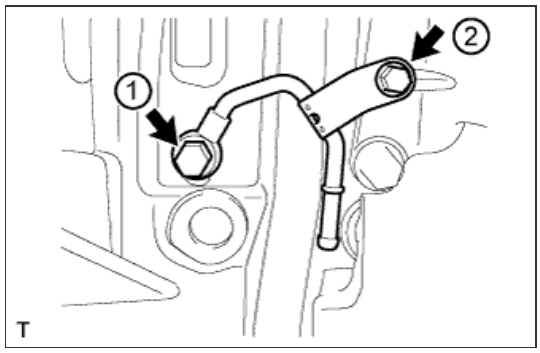


16. INSTALL NO. 1 WATER BY-PASS PIPE SUB-ASSEMBLY

a. Temporarily install a new gasket and the No. 1 water by-pass pipe with the union bolt and bolt.

b. Tighten the union bolt and bolt of the No. 1 water by-pass pipe in the order shown in the illustration.

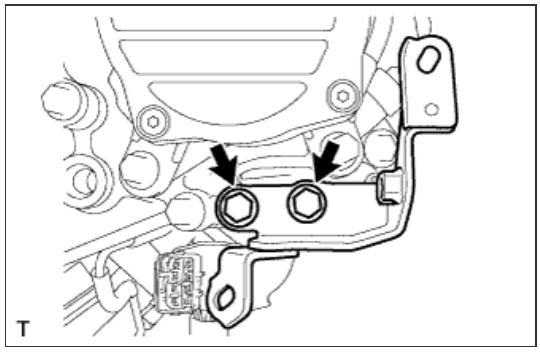
Torque:
for union bolt:
35 N*m{ 357 kgf*cm , 26 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



17. INSTALL AIR TUBE SUPPORT

a. Install the air tube support with the 2 bolts.

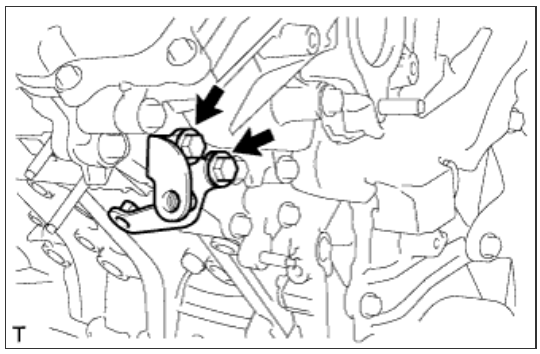
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



18. INSTALL NO. 1 INTAKE AIR CONNECTOR BRACKET

a. Install the No. 1 intake air connector bracket with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



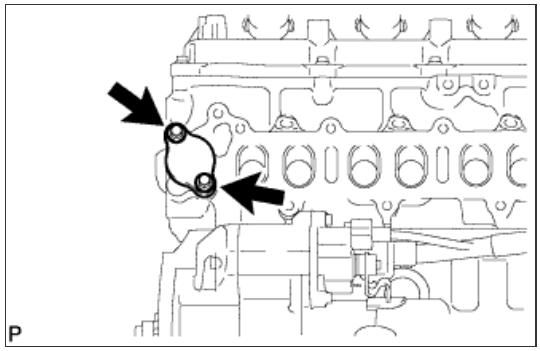
19. INSTALL REAR CYLINDER HEAD PLATE LH (w/o EGR S tem)

a. Install a new gasket and the rear cylinder head plate LH with the 2 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

HINT:

he gasket claw should face toward the plate.



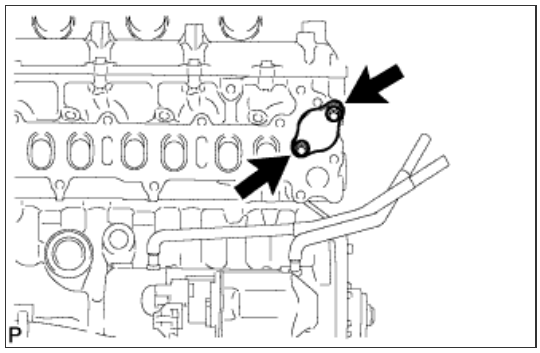
20. INSTALL REAR CYLINDER HEAD PLATE RH (w/o EGR S tem)

a. Install a new gasket and the rear cylinder head plate RH with the 2 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

HINT:

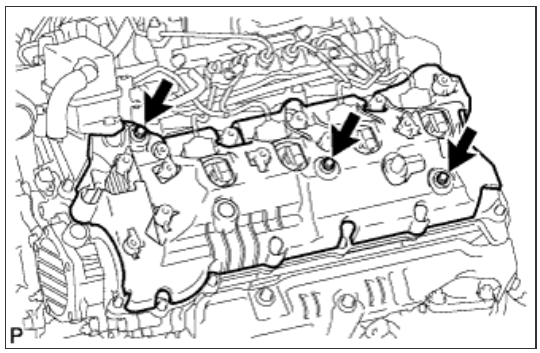
The gasket claw should face toward the plate.



21. INSTALL CYLINDER HEAD COVER SILENCER LH (w/ Intercooler)

a. Install the cylinder head cover silencer with the 3 bolts.

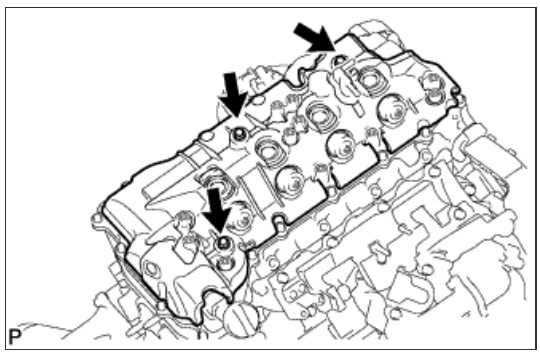
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



22. INSTALL CYLINDER HEAD COVER SILENCER RH (w/ Intercooler)

a. Install the cylinder head cover silencer with the 3 bolts.

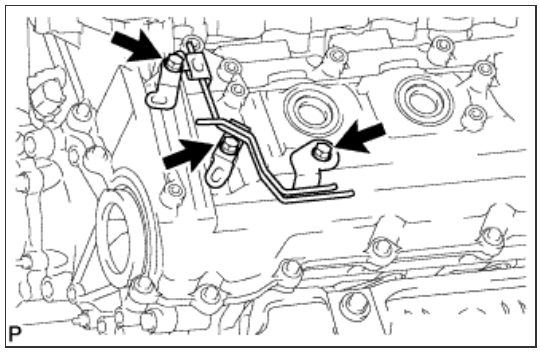
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



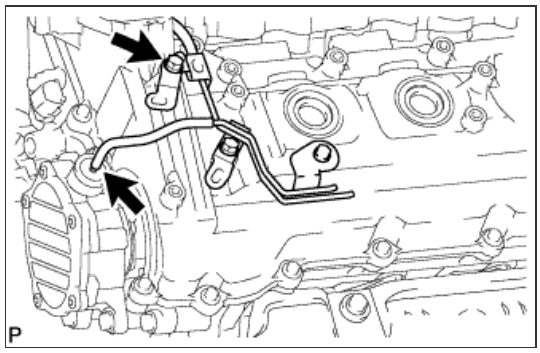
23. INSTALL NO. 1 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY

a. Install the vacuum transmitting pipe with the 3 bolts.

Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }



b. w/ Intercooler:
Connect the 2 vacuum hoses.

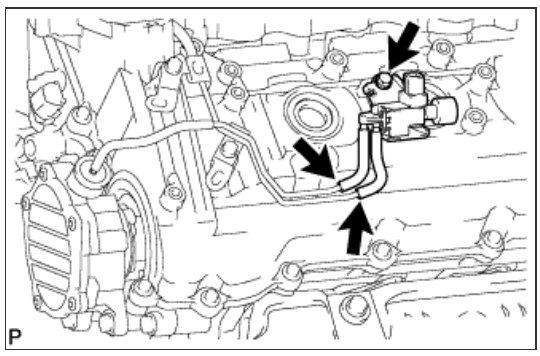


24. INSTALL NO. 1 VACUUM SWITCHING VALVE ASSEMBLY (w/ Intercooler)

a. Install vacuum switching valve with the bolt.

Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }

b. Connect the 2 vacuum hoses.



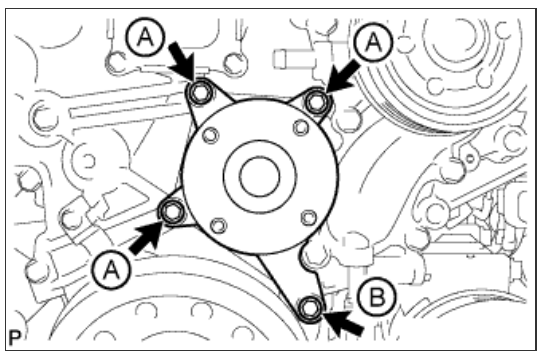
25. INSTALL FAN BRACKET SUB-ASSEMBLY

a. Install the fan bracket with the 4 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

Bolt Length

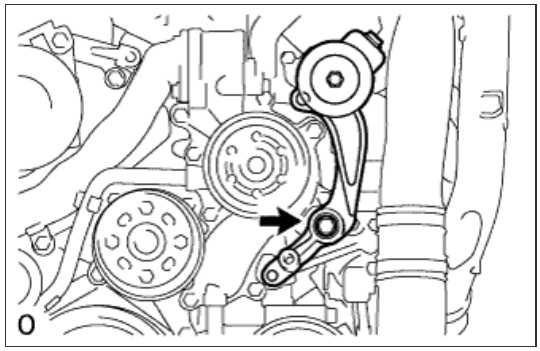
Item	Length
Bolt A	30 mm (1.18 in.)
Bolt B	80 mm (3.15 in.)



26. INSTALL NO. 2 IDLER PULLEY BRACKET (w/ Viscous Heater)

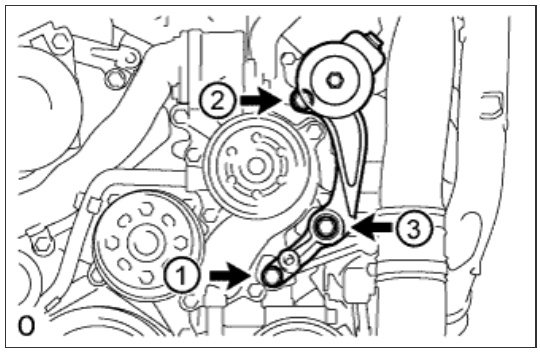
a. emporarily install the No. 2 idler pulley bracket with the bolt.

b. emporarily install the 2 bolts to the No. 2 idler pulley bracket bolt hole.



c. Uniformly tighten the 3 bolts of the No. 2 idler pulley bracket in the order shown in the illustration.

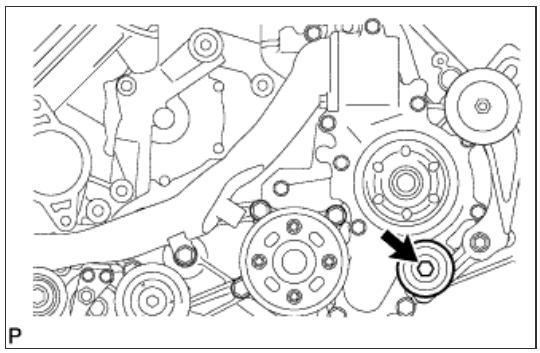
Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }



27. INSTALL NO. 2 IDLER PULLEY (w/ Viscous Heater)

a. Install the collar, No. 2 idler pulley and cover with the bolt.

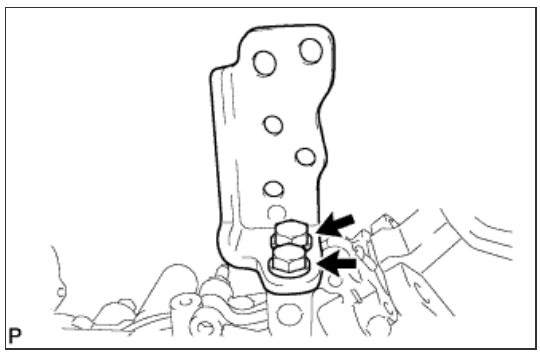
Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }



28. INSTALL NO. 3 ENGINE HANGER

a. Install the No. 3 engine hanger with the 2 bolts.

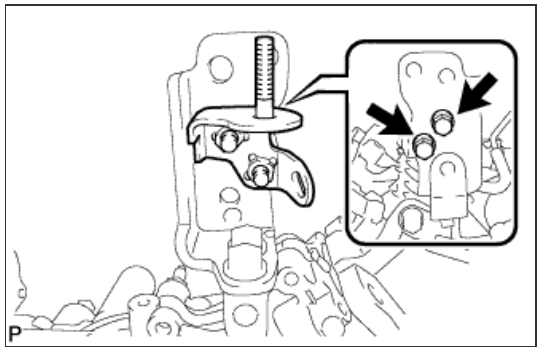
Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }



29. INSTALL NO. 1 INTERCOOLER SUPPORT BRACKET

a. Install the No. 1 intercooler support bracket with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



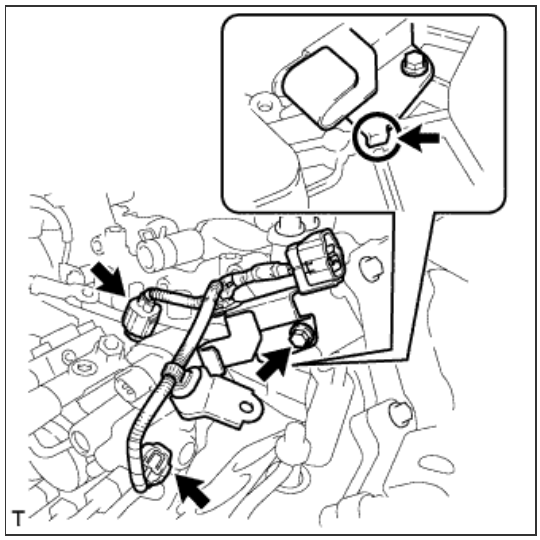
30. INSTALL FUEL PUMP MOTOR WIRE

a. Install the fuel pump wire with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

HINT:

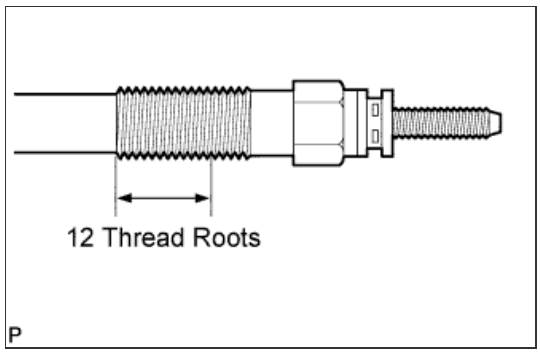
Attach the claw of the bracket to the timing gear case when installing the bracket.



31. INSTALL GLOW PLUG ASSEMBLY

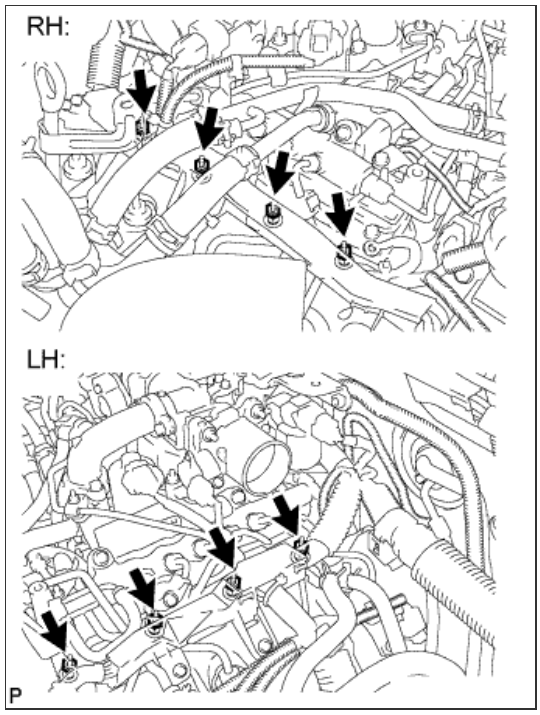
a. Apply adhesive to 3 or more thread roots in the area shown in the illustration.

Adhesi e:
To ota Genuine Adhesi e 1324, Three Bond 1324 or equi alent



b. Using a 10 mm deep socket wrench, install the 8 glow plugs.

Torque:
12 N*m{ 125 kgf*cm , 9 ft.*lbf }



32. INSTALL NO. 1 GLOW PLUG CONNECTOR

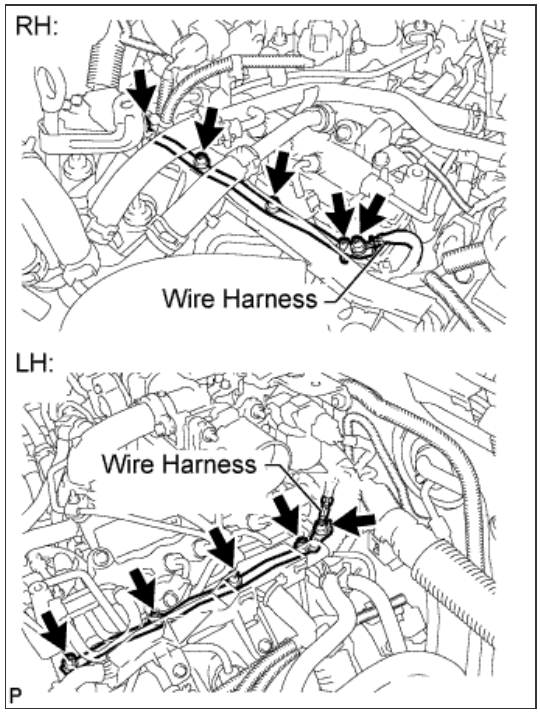
a. Install the 2 glow plug connectors by uniformly tightening the 8 nuts.

Torque:
2.2 N*m{ 22 kgf*cm , 19 in.*lbf }

b. Install the 8 screw grommets.

c. Connect the 2 wire harnesses with the 2 nuts and 2 screw grommets.

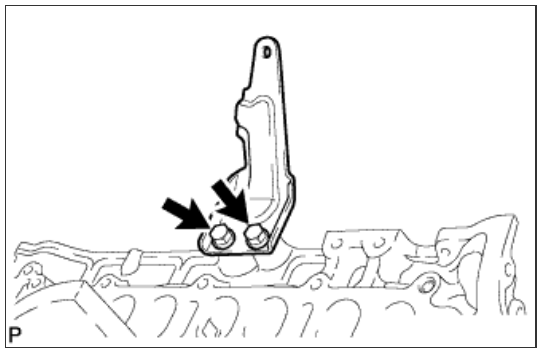
Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }



33. INSTALL CLUTCH FLEXIBLE HOSE BRACKET (for Manual Transmission)

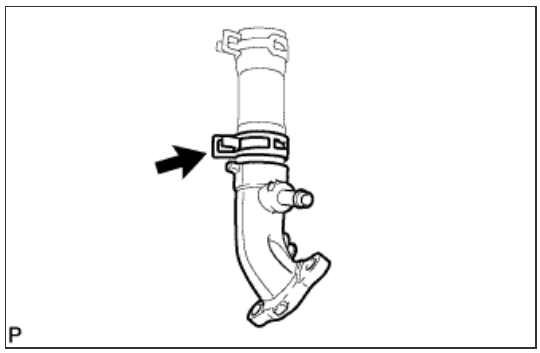
a. Install the clutch flexible hose bracket with the 2 bolts.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

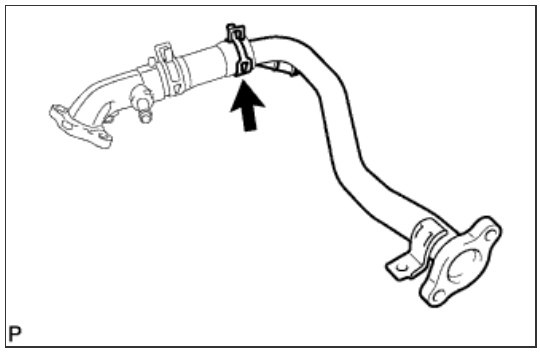


34. INSTALL NO. 1 AND NO. 2 WATER OUTLET PIPES AND WATER BY-PASS OUTLET

a. Align the painted mark of the No. 1 water hose joint with the protrusion of the water by-pass outlet and connect the water by-pass outlet to the No. 1 water hose joint.



b. Align the painted mark of the No. 1 water hose joint with the painted mark of the No. 2 water outlet pipe and connect the No. 2 water outlet pipe to the No. 1 water hose joint.

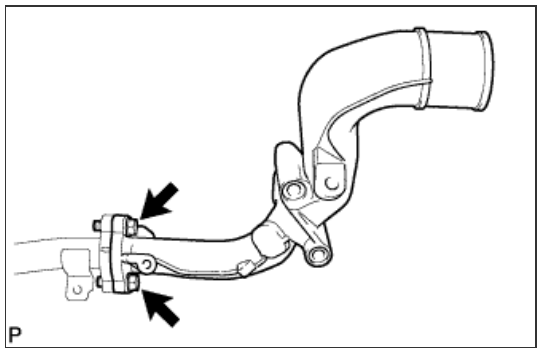


c. Connect a new gasket and the No. 1 and No. 2 water outlet pipes with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

HINT:

The gasket claws can face the No. 1 or No. 2 water outlet pipe.



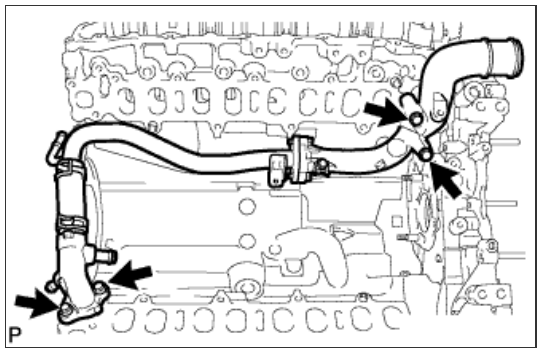
35. INSTALL WATER OUTLET PIPE

a. Install 2 new gaskets and the water outlet pipe with the 4 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

HINT:

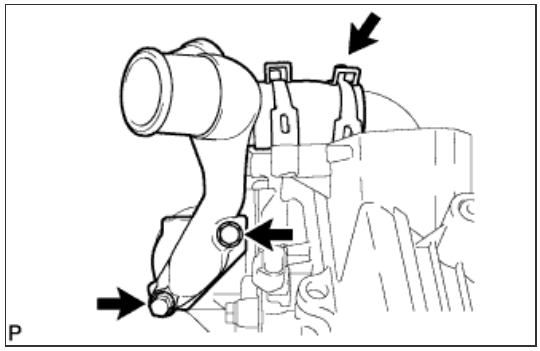
he gasket claw should face toward the water outlet pipe.



36. INSTALL WATER OUTLET

a. Install a new gasket and the water outlet with the 2 bolts, and then connect the water outlet to the No. 2 water hose joint.

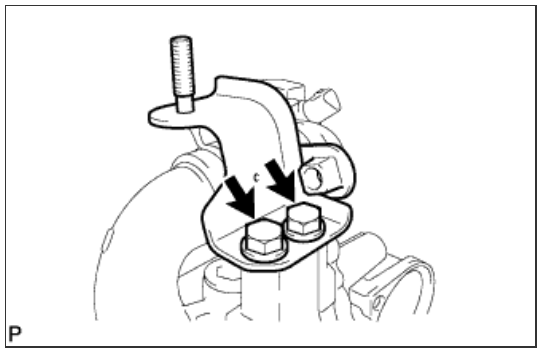
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



37. INSTALL NO. 2 INTERCOOLER SUPPORT BRACKET

a. Install the No. 2 intercooler support bracket with the 2 bolts.

Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }



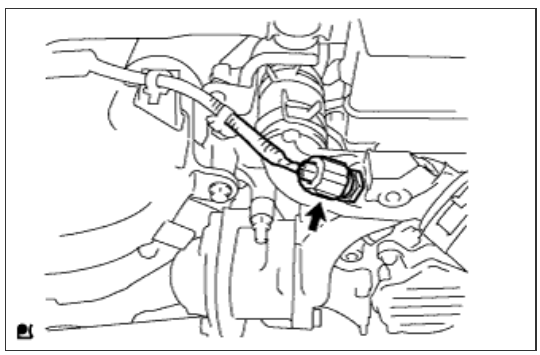
38. INSTALL DIESEL ENGINE COOLANT TEMPERATURE SENSOR

a. Install a new gasket to the sensor.

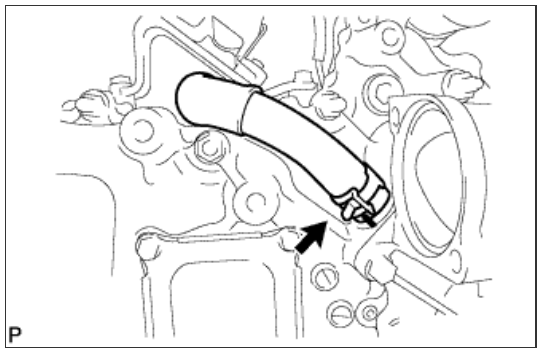
b. Using a 19 mm deep socket wrench, install the sensor.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

c. Connect the sensor connector.



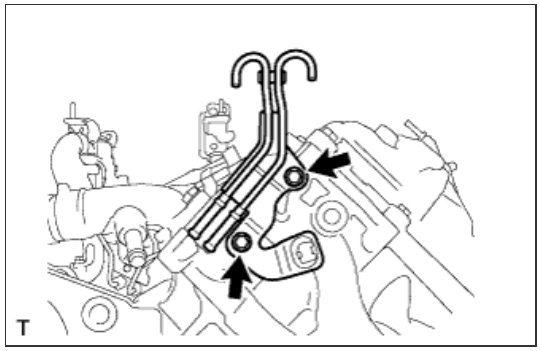
39. CONNECT INLET WATER HOSE



40. INSTALL STARTER HOSE BRACKET

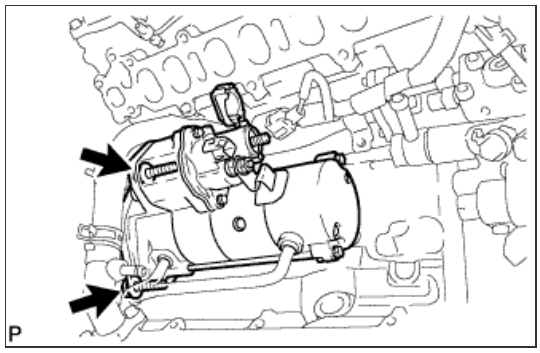
a. Install the starter hose bracket with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



41. INSTALL STARTER ASSEMBLY

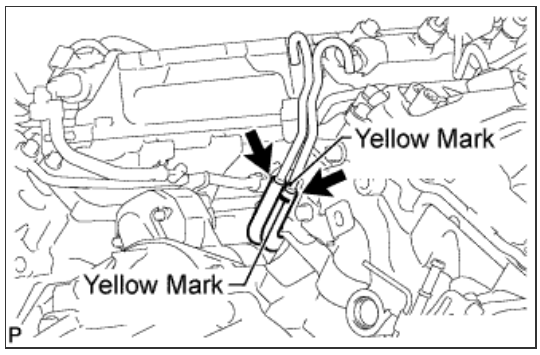
a. Install the starter with the 2 bolts.



b. Connect the 2 hoses to the starter hose bracket.

HINT:

Align the paint marks of the hose and bracket.

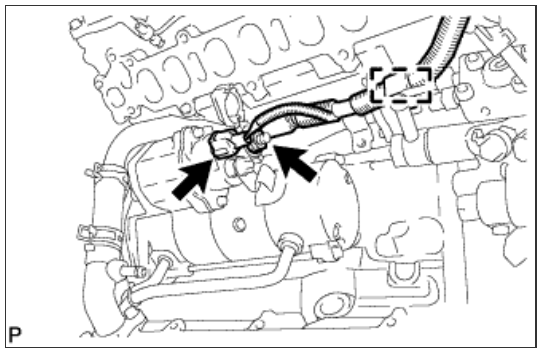


c. Install the No. 2 engine wire to the starter with the nut.

Torque:
80 N*m{ 816 kgf*cm , 59 ft.*lbf }

d. Connect the connector to the starter.

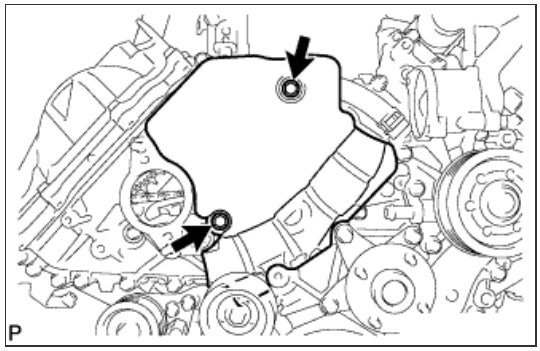
e. Attach the wire harness clamp.



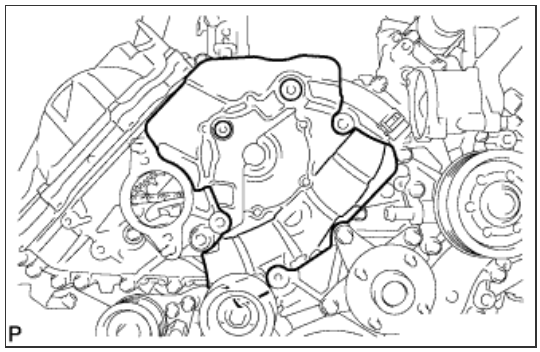
42. INSTALL TIMING GEAR COVER INSULATOR (w/ Intercooler)

a. w/o Viscous Heater:
Install the timing gear cover insulator with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



b. w/ Viscous Heater:
Install the timing gear cover insulator.



43. INSTALL THERMOSTAT

a. Install a new gasket to the thermostat.

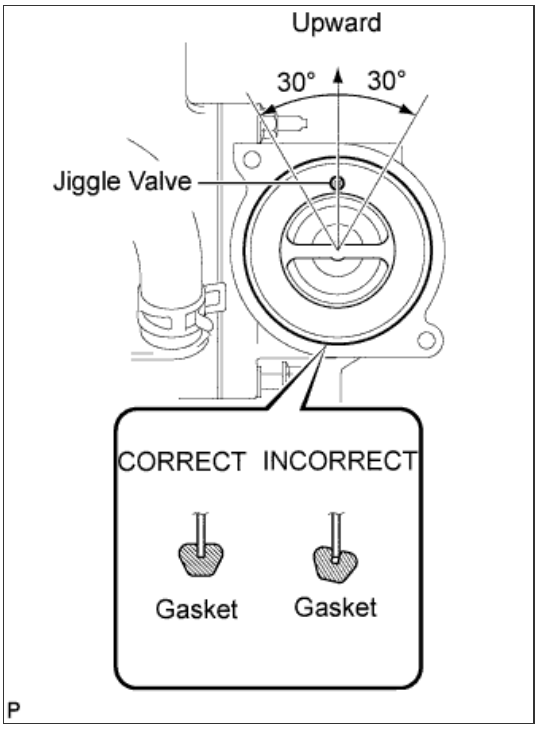
NOTICE:

When installing the gasket to the thermostat, be careful not to deform the gasket. Make sure that the groove of the gasket is properly installed onto the thermostat, as shown in the illustration.

b. Insert the thermostat into the water pump with the jiggle valve facing straight upward.

HINT:

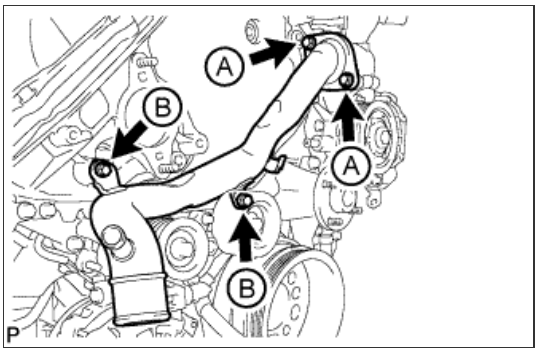
The jiggle valve may be set within 30° of either side of the prescribed position.



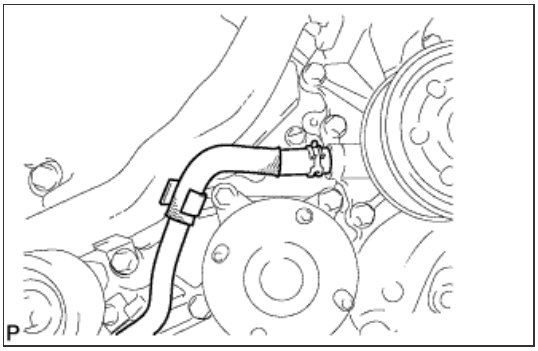
44. INSTALL WATER INLET

a. Install the water inlet with the 4 bolts.

Torque:
for bolt A:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for bolt B:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }



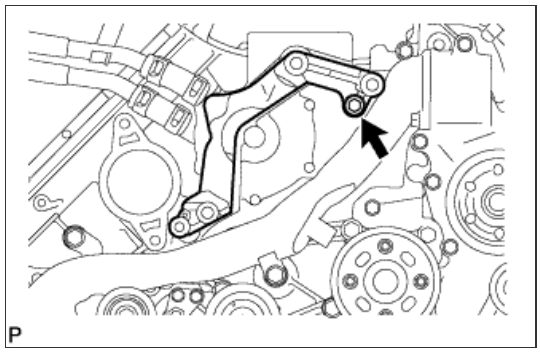
b. Connect the No. 2 oil cooler hose to the clamp and water pump.



45. INSTALL NO. 1 IDLER PULLEY BRACKET (w/ Viscous Heater)

a. Install the No. 1 idler pulley bracket with the bolt.

Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }



46. INSTALL VISCOUS HEATER ASSEMBLY WITH MAGNET CLUTCH (w/ Viscous Heater)

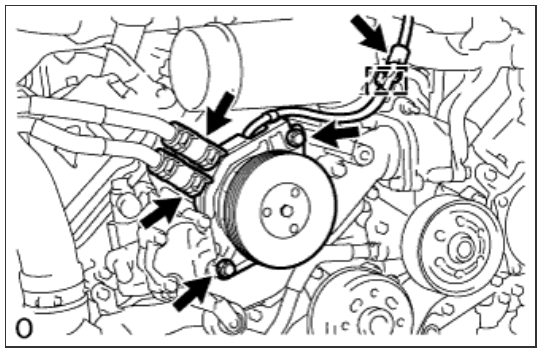
a. Install the heater assembly with the 2 bolts.

Torque:
48.5 N*m{ 495 kgf*cm , 36 ft.*lbf }

b. Connect the 2 heater hoses.

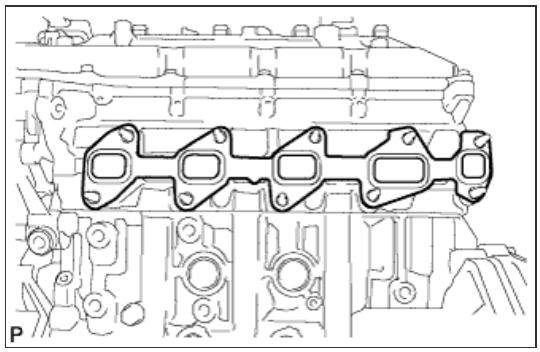
c. Using pliers, grip the claws of the clips and slide the 2 clips.

d. Connect the connector and attach the clamp.



47. INSTALL NO. 2 TURBOCHARGER SUB-ASSEMBLY WITH EXHAUST MANIFOLD LH

a. Set a new gasket to the cylinder head LH.

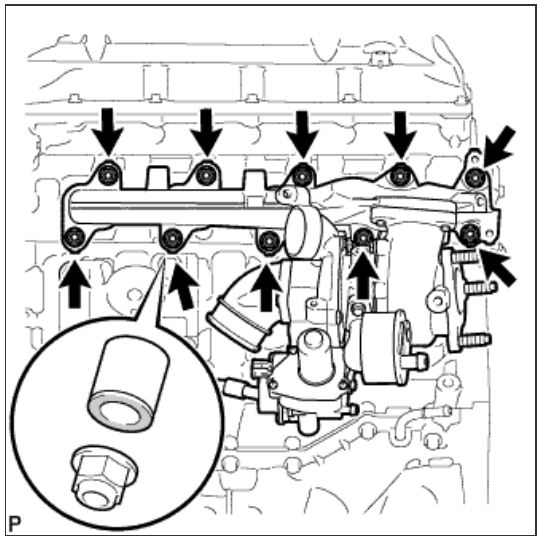


b. Install the No. 2 turbocharger with exhaust manifold LH and 10 collars to the cylinder head LH with 10 new nuts.

Torque:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }

HINT:

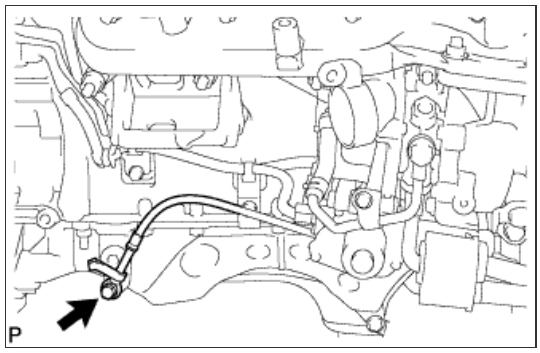
Install the collars with the colored side facing the nuts.



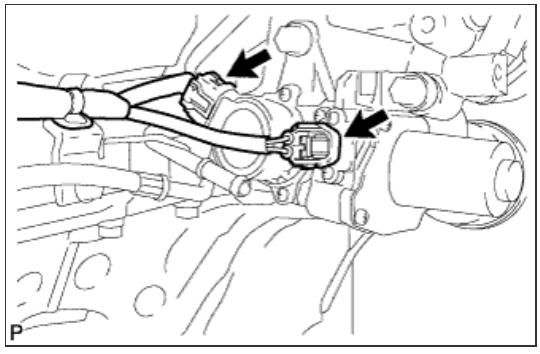
c. Install a new gasket and the No. 2 inlet turbo oil pipe to the No. 1 oil pan with the

union bolt.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



d. Connect the 2 connectors to the turbocharger.



48. INSTALL NO. 2 VENTILATION TUBE SUB-ASSEMBLY

a. Temporarily install a new gasket and the No. 2 ventilation tube with the union bolt and bolt.

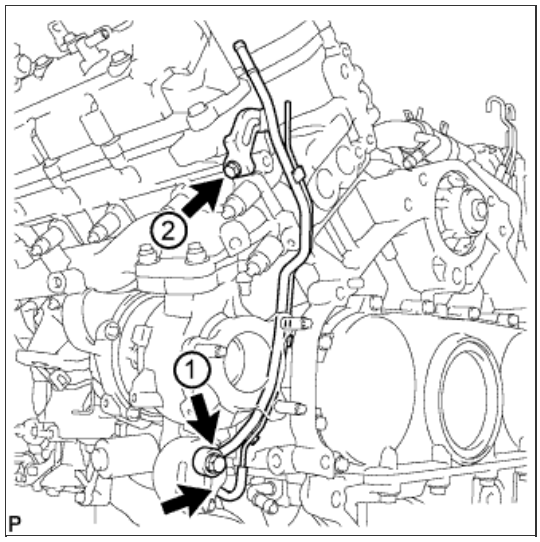
b. Tighten the union bolt and bolt in the order shown in the illustration.

Torque:
for union bolt:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

NOTICE:

Clean and remove any oil labeled 1shown in the illustration.

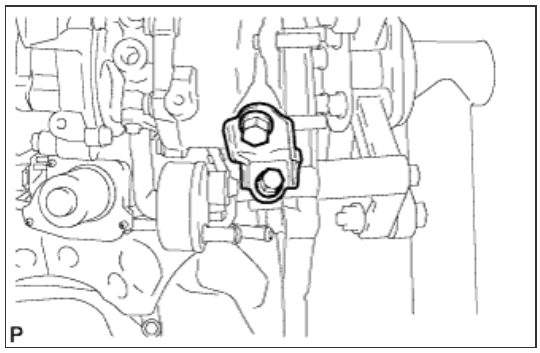
c. Connect the No. 2 vacuum transmitting hose.



49. INSTALL NO. 2 TURBOCHARGER STAY

a. Install the No. 2 turbocharger stay with the 2 bolts.

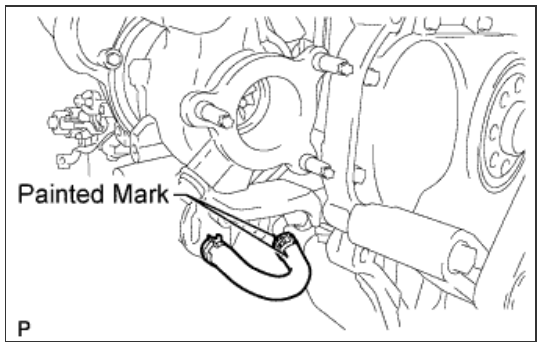
Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }



50. CONNECT NO. 2 OUTLET TURBO OIL HOSE

HINT:

Align the white paint marks on the oil hose and pipe, and connect the hose.



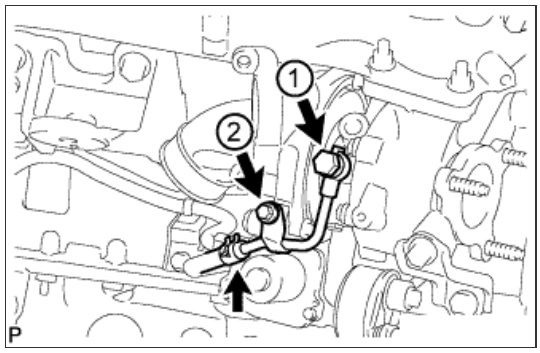
51. INSTALL NO. 2 TURBO WATER PIPE SUB-ASSEMBLY

a. Temporarily install a new gasket and the No. 2 turbo water pipe with the union bolt and bolt.

b. Tighten the union bolt and bolt in the order shown in the illustration.

Torque:
for union bolt:
35 N*m{ 357 kgf*cm , 26 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

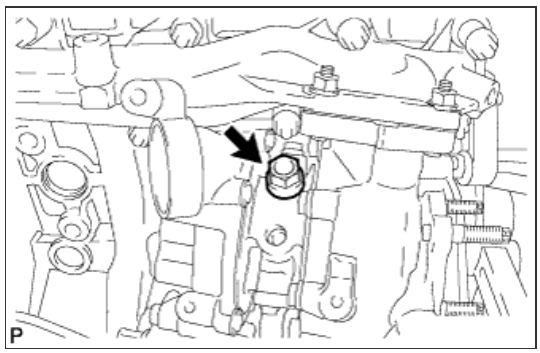
c. Connect the water hose to the pipe.



52. INSTALL FRONT WATER BY-PASS JOINT

a. Install a new gasket and the front water by-pass joint.

Torque:
50 N*m{ 510 kgf*cm , 37 ft.*lbf }

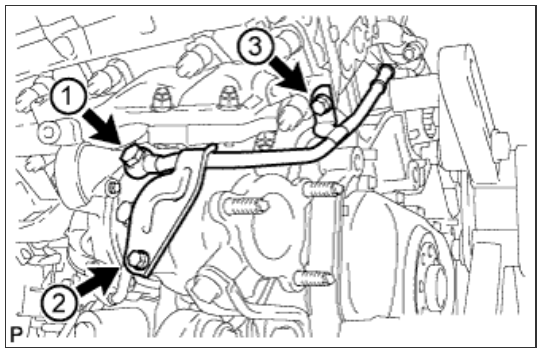


53. INSTALL NO. 3 TURBO WATER PIPE SUB-ASSEMBLY

a. Temporarily install a new gasket and the No. 3 turbo water pipe with the union bolt and 2 bolts.

b. Tighten the union bolt and 2 bolts in the order shown in the illustration.

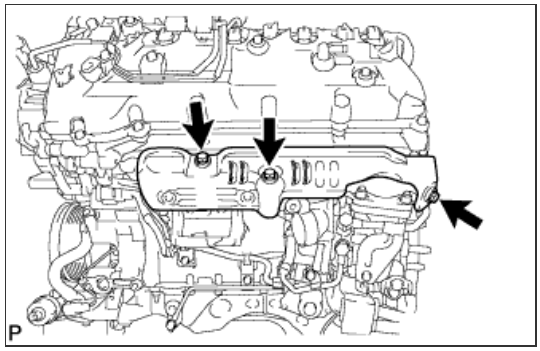
Torque:
for union bolt:
35 N*m{ 357 kgf*cm , 26 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



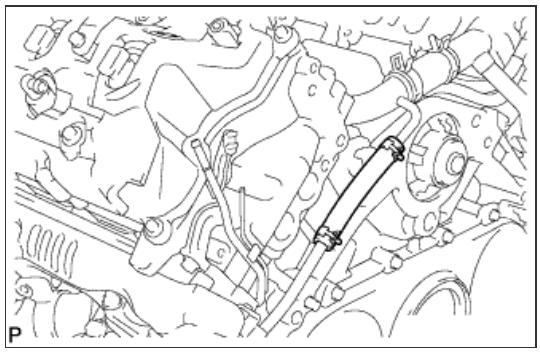
54. INSTALL NO. 2 EXHAUST MANIFOLD HEAT INSULATOR

a. Install the No. 2 exhaust manifold heat insulator with the 3 bolts.

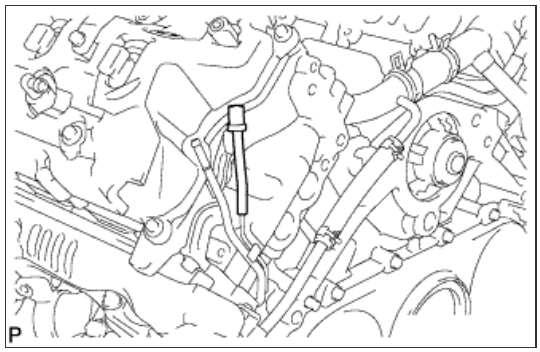
Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }



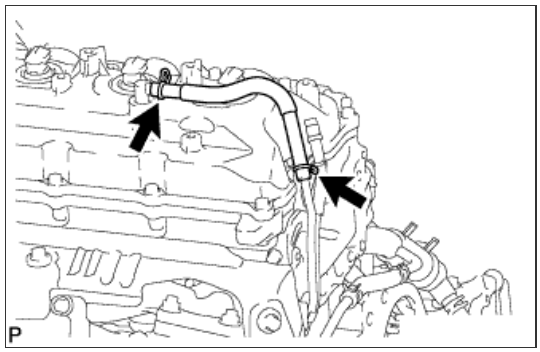
55. CONNECT NO. 2 TURBO WATER HOSE



56. CONNECT BREATHER PLUG LH

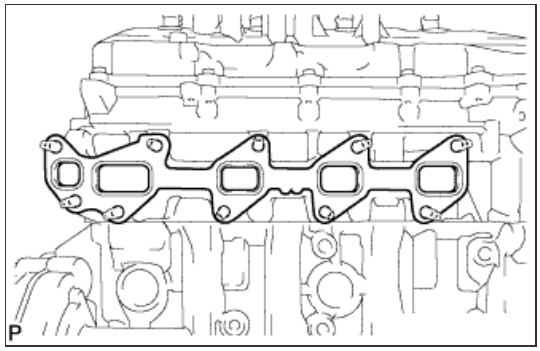


57. CONNECT NO. 3 VENTILATION HOSE



58. INSTALL NO. 1 TURBOCHARGER SUB-ASSEMBLY WITH EXHAUST MANIFOLD RH

a. Set a new gasket to the cylinder head RH.

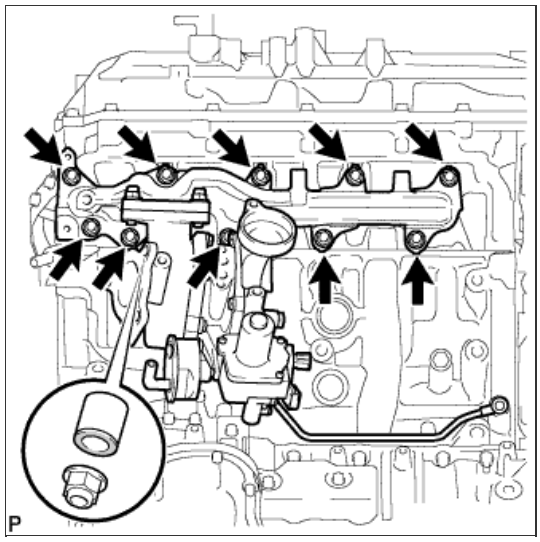


b. Install the No. 1 turbocharger with exhaust manifold RH and 10 collars to the cylinder head RH with 10 new nuts.

Torque:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }

HINT:

Install the collars with the colored side facing the nuts.

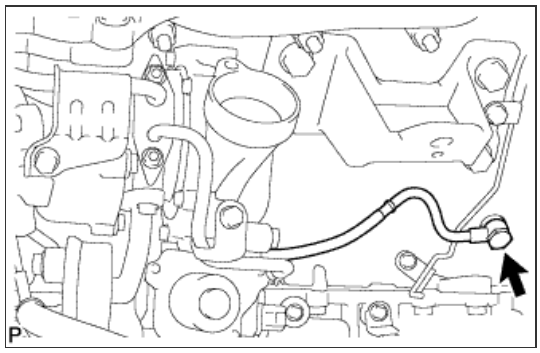


c. Install a new gasket and the No. 1 inlet turbo oil pipe to the cylinder block with the union bolt.

Torque:
Case is dr :
29 N*m{ 296 kgf*cm , 21 ft.*lbf }
Case is wet:
23 N*m{ 235 kgf*cm , 17 ft.*lbf }

NOTICE:

- **The case is dr when there is absolutel no engine oil on the union bolt and c linder block bolt hole.**
- **The case is wet when there is engine oil on the union bolt and c linder block bolt hole.**



59. INSTALL NO. 1 VENTILATION TUBE SUB-ASSEMBLY

a. emporarily install a new gasket and the No. 1 ventilation tube with the union bolt and bolt.

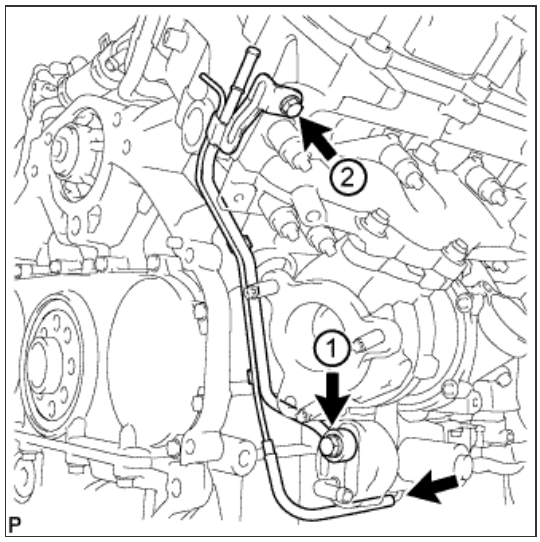
b. ighten the union bolt and bolt in the order shown in the illustration.

Torque:
for union bolt:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 in.*lbf }

NOTICE:

Clean and remove any oil labeled 1 shown in the illustration.

c. Connect the vacuum hose.

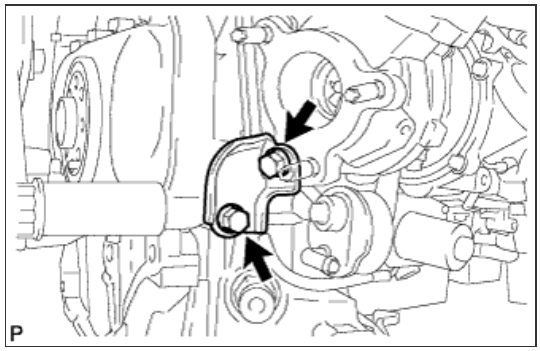


60. INSTALL NO. 1 TURBOCHARGER STAY

a. Temporarily install the No. 1 turbocharger stay with the 2 bolts.

b. Tighten the 2 bolts.

Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }

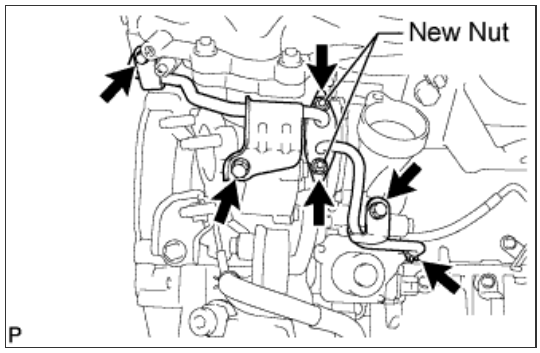


61. INSTALL NO. 1 TURBO WATER PIPE SUB-ASSEMBLY

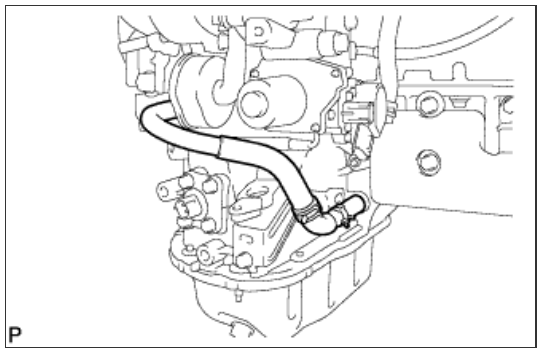
a. Install a new gasket and the No. 1 turbo water pipe with 2 new nuts and 3 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Connect the water hose.



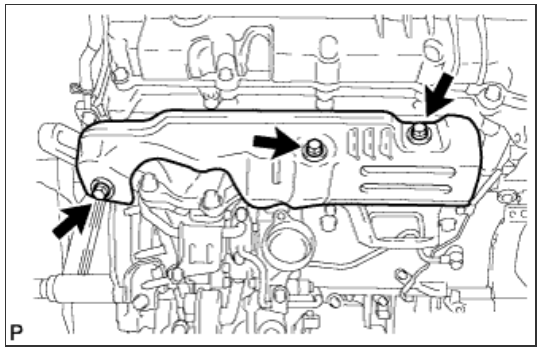
62. CONNECT NO. 1 OUTLET TURBO OIL HOSE



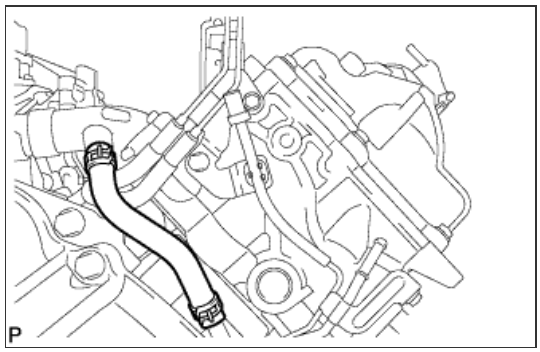
63. INSTALL NO. 1 EXHAUST MANIFOLD HEAT INSULATOR

a. Install the No. 1 exhaust manifold heat insulator with the 3 bolts.

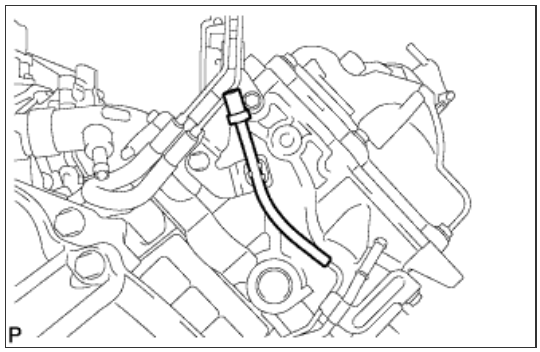
Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }



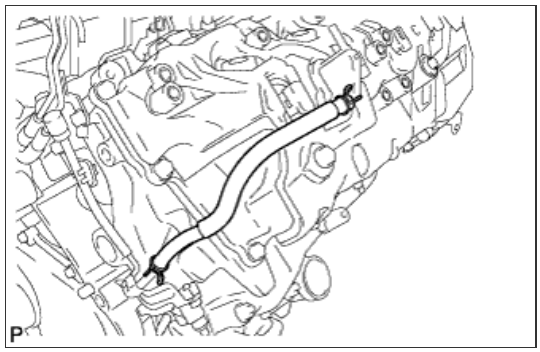
64. CONNECT NO. 2 TURBO WATER HOSE



65. CONNECT BREATHER PLUG RH



66. CONNECT NO. 2 VENTILATION HOSE



67. INSTALL GENERATOR ASSEMBLY

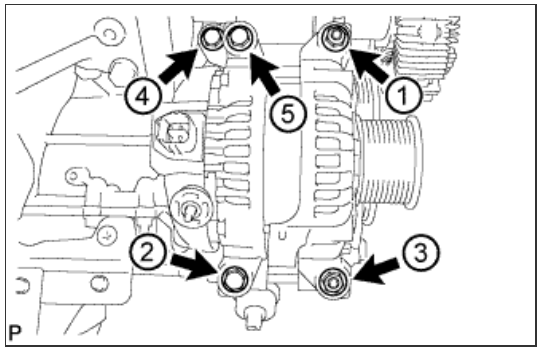
a. emporarily install the generator with the 3 bolts and 2 nuts.

b. Uniformly tighten the 3 bolts and 2 nuts in the order shown in the illustration.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Connect the generator cable and install the nut and bolt.

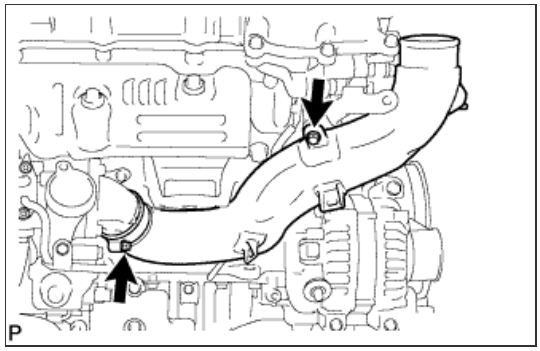
Torque:
for bolt:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }
for nut (130A Type and 150A Type:):
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }
for nut (180A Type:):
12 N*m{ 122 kgf*cm , 9 ft.*lbf }



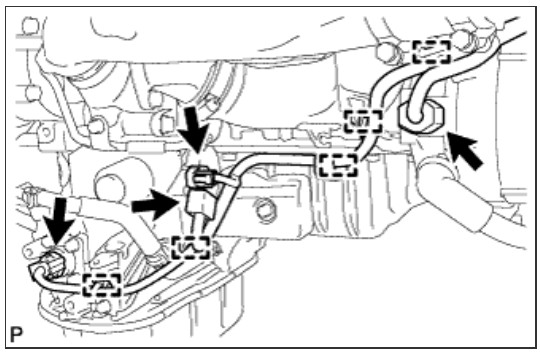
68. INSTALL NO. 1 INTAKE AIR CONNECTOR PIPE

a. Install the No. 1 intake air connector pipe with the bolt. Then tighten the hose clamp.

Torque:
for bolt:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for clamp:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }



b. Connect the 4 connectors and attach the 5 wire harness clamps.

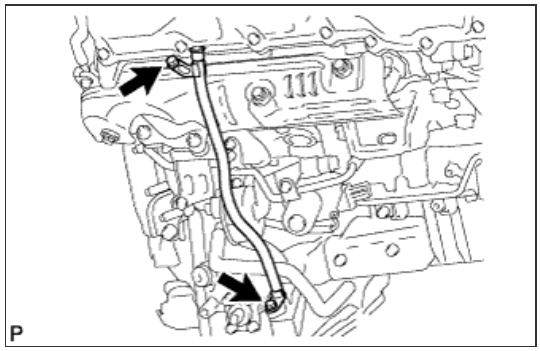


69. INSTALL NO. 1 ENGINE OIL LEVEL DIPSTICK GUIDE

a. Apply a light coat of engine oil to a new O-ring and install it to the No. 1 engine oil level dipstick guide.

b. Install the No. 1 engine oil level dipstick guide with the 2 bolts.

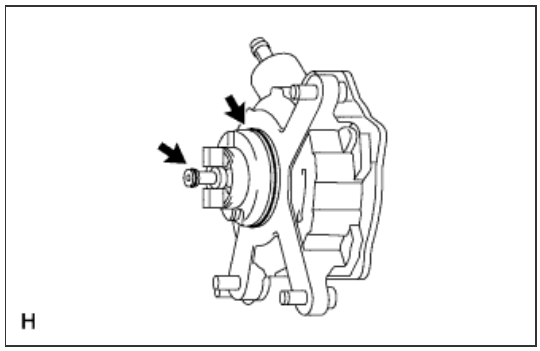
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



70. INSTALL VACUUM PUMP ASSEMBLY (w/ Intercooler)

a. Apply engine oil to 2 new O-rings.

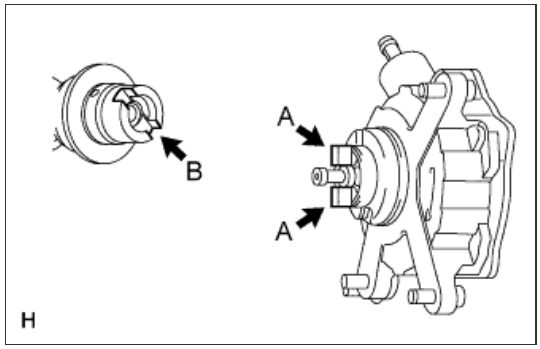
b. Install the 2 O-rings to the vacuum pump.



c. Install the vacuum pump so that the coupling teeth of the vacuum pump (labeled A) and the groove of the camshaft (labeled B) are aligned.

NOTICE:

Be careful not to damage the O-ring.

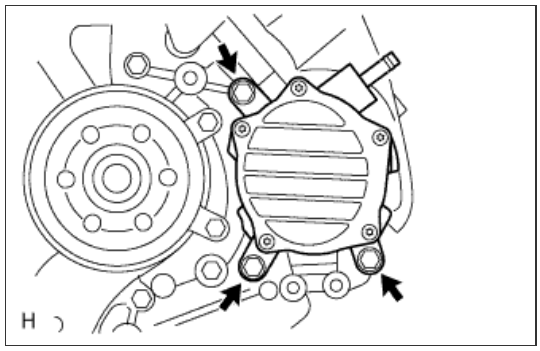


d. Install the vacuum pump with the 3 bolts.

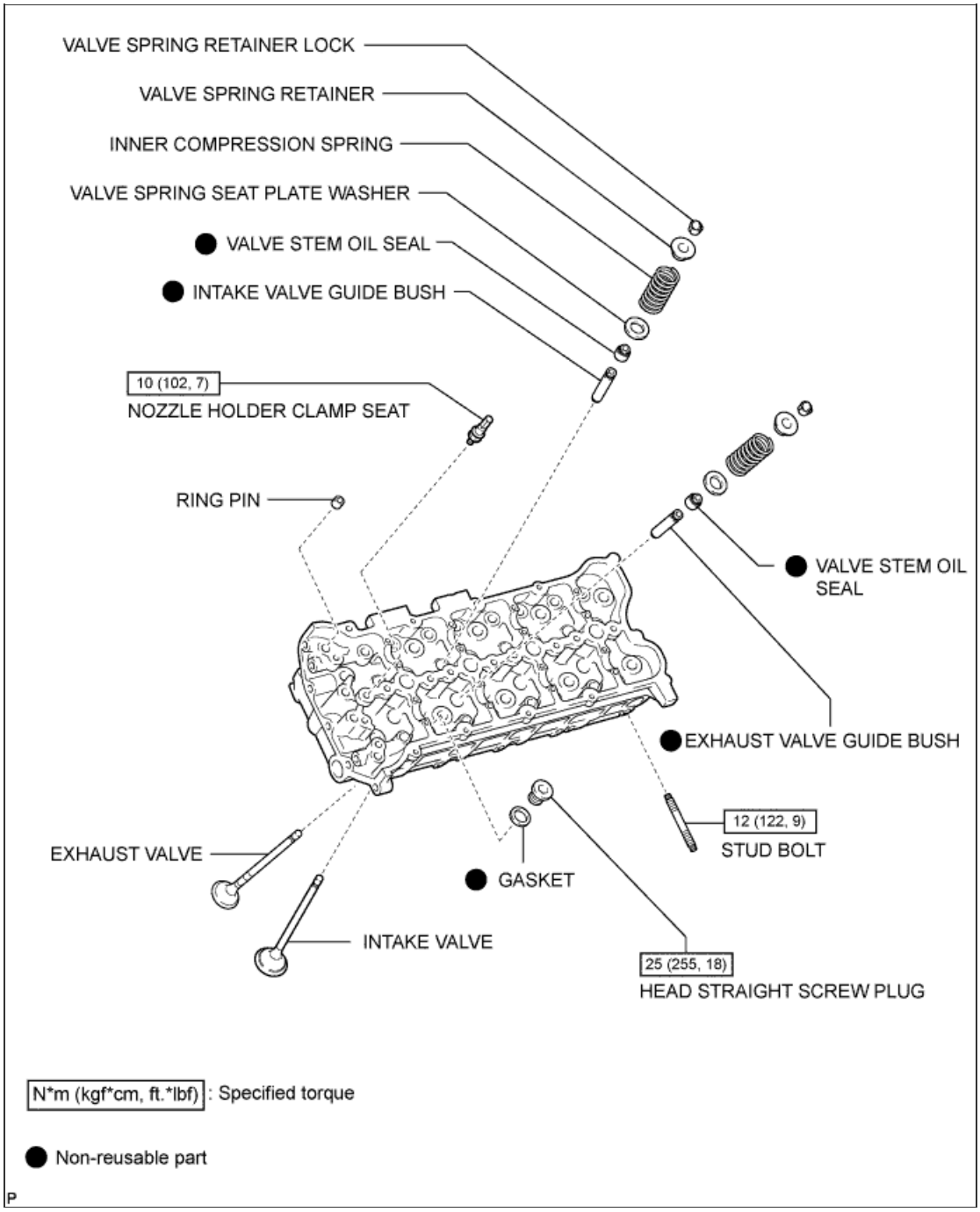
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

NOTICE:

Confirm that the vacuum pump is not at an angle, and that there is no clearance between the fitting surfaces.



for Preparation Click here



for Preparation Click here

1. REMOVE VALVE

HINT:

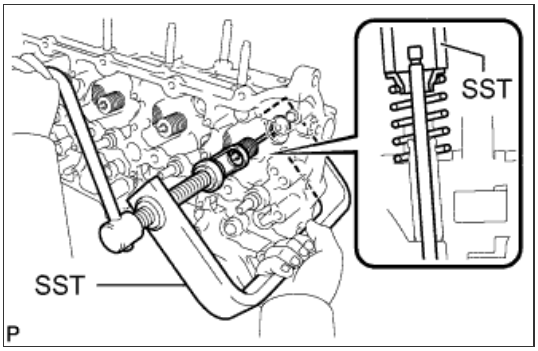
Arrange the valves, inner compression springs, valve spring retainers and valve spring retainer locks in the correct order.

a. Place the cylinder head on a wooden block.

b. Using SST, compress the inner compression spring and remove the valve spring retainer lock.

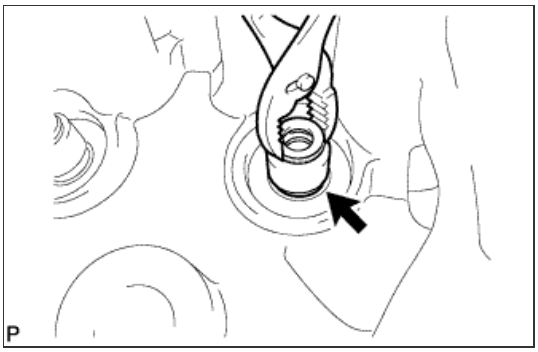
SST
09202-70020 (09202-00010)

c. Remove the inner compression spring, valve spring retainer and valve.



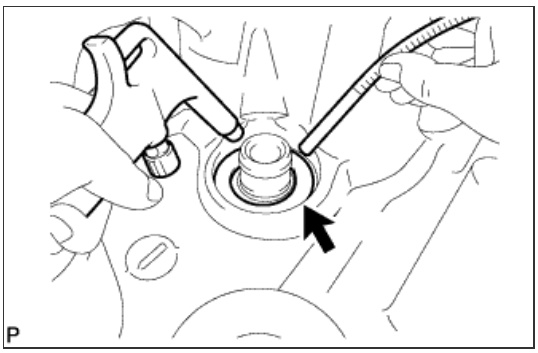
2. REMOVE VALVE STEM OIL SEAL

a. Using pliers, remove the valve stem oil seal.

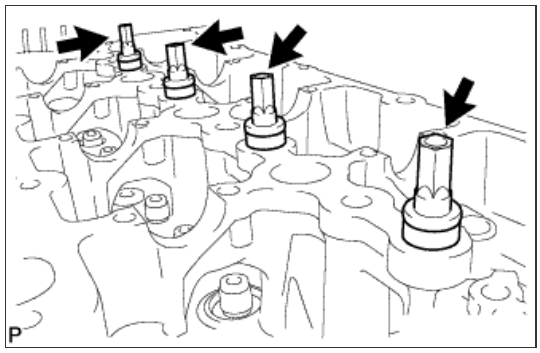


REMOVE VALVE SPRING SEAT PLATE WASHER

a. Using compressed air and a magnetic finger, remove the valve spring seat plate washer by blowing air.



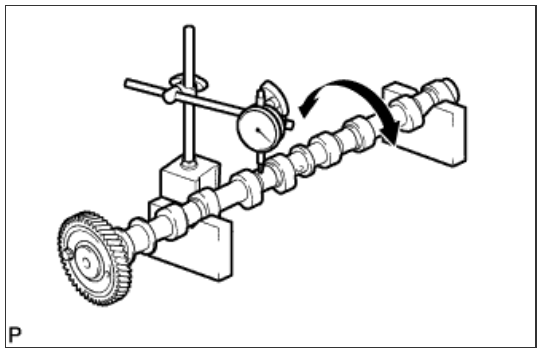
4. REMOVE NO ELHOLDER CLAMP SEAT


P

for Preparation Click here

1. INSPECT CAMSHAFT

a. Inspect the camshaft for runout.



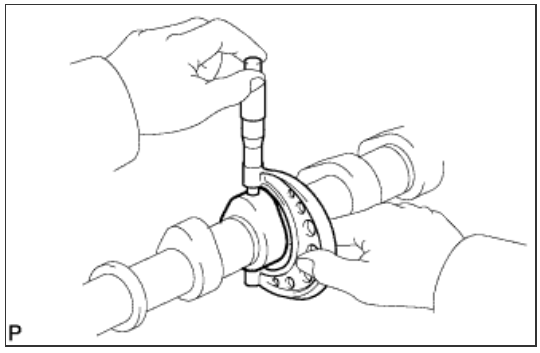
i. Place the camshaft on V-blocks.

ii. Using a dial indicator, measure the runout at the center journal.

Maximum runout:
0.03 mm (0.00118 in.)

If the runout is more than the maximum, replace the camshaft.

b. Inspect the cam lobe height.



i. Using a micrometer, measure the cam lobe height.

Standard Cam Lobe Height:

Item	Specified Condition
No. 2 and No. 3 camshaft (intake)	37.277 to 37.387 mm (1.468 to 1.472 in.)
No. 1 and No. 4 camshaft (exhaust)	38.324 to 38.434 mm (1.509 to 1.513 in.)

Minimum Cam Lobe Height:

Item	Specified Condition
No. 2 and No. 3 camshaft (intake)	37.277 mm (1.468 in.)
No. 1 and No. 4 camshaft (exhaust)	38.324 mm (1.509 in.)

If the cam lobe height is less than the minimum, replace the camshaft.

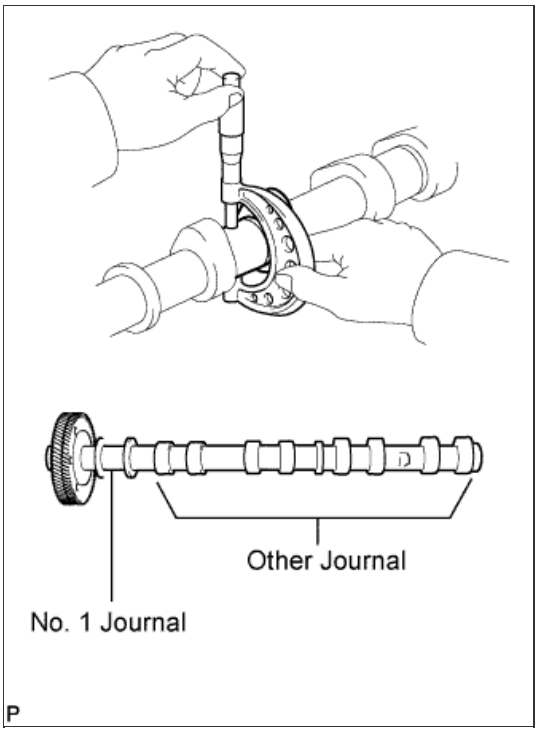
c. Inspect the camshaft journal diameter.

i. Using a micrometer, measure the journal diameter.

Standard Journal Diameter:

Item	Specified Condition
No. 1 journal	29.969 to 29.985 mm (1.180 to 1.181 in.)
Other journal	26.969 to 26.985 mm (1.0618 to 1.0624 in.)

If the journal diameter is not as specified, check the oil clearance.

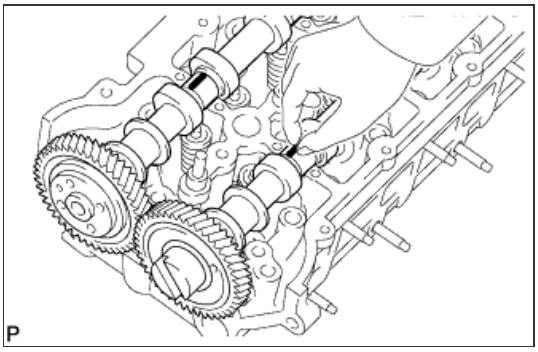


2. INSPECT CAMSHAFT OIL CLEARANCE

a. Clean the camshaft bearing caps and camshaft journals.

b. Place the camshafts on the cylinder head.

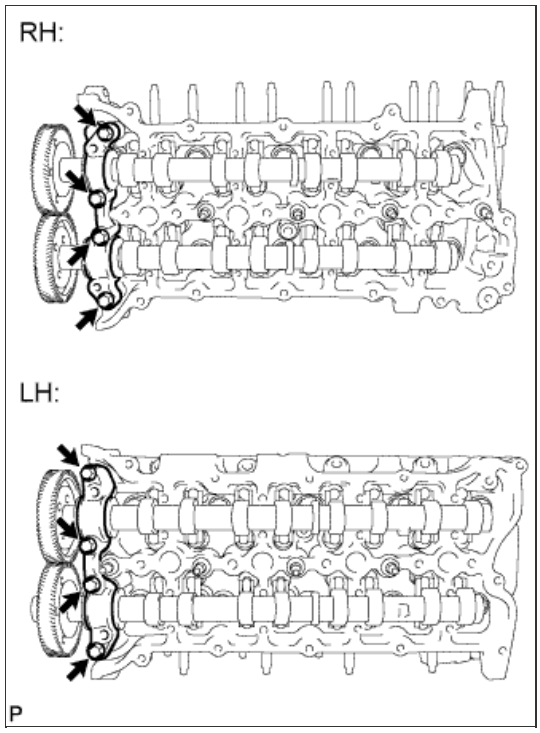
c. Lay a strip of Plastigage across each of the camshaft journals.



d. Temporarily install the camshaft bearing cap ith the 4 bolts by hand.

NOTICE:

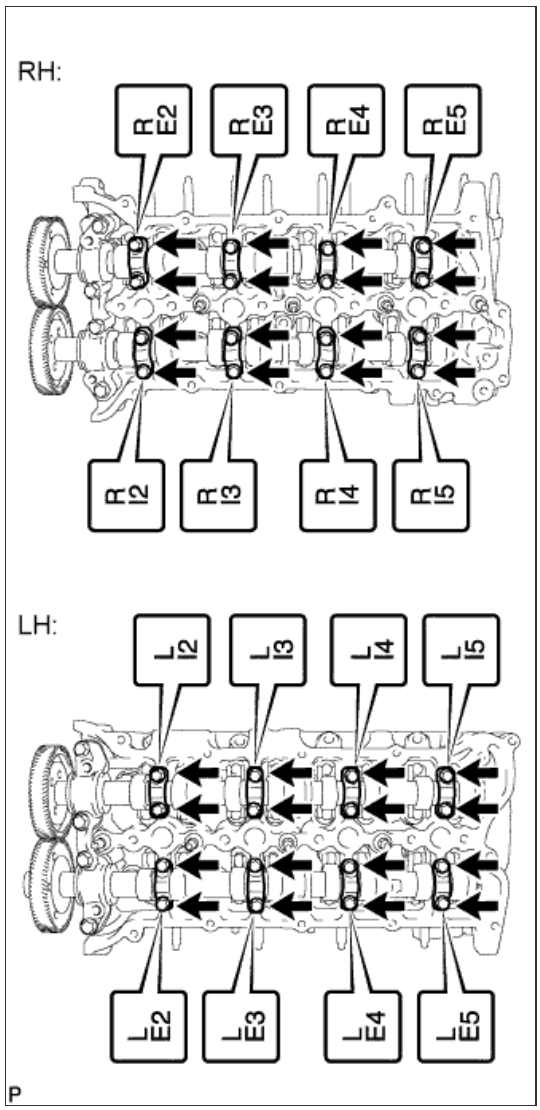
Do not turn the camshafts.



e. Install the No. 3 camshaft bearing caps ith the 16 bolts.

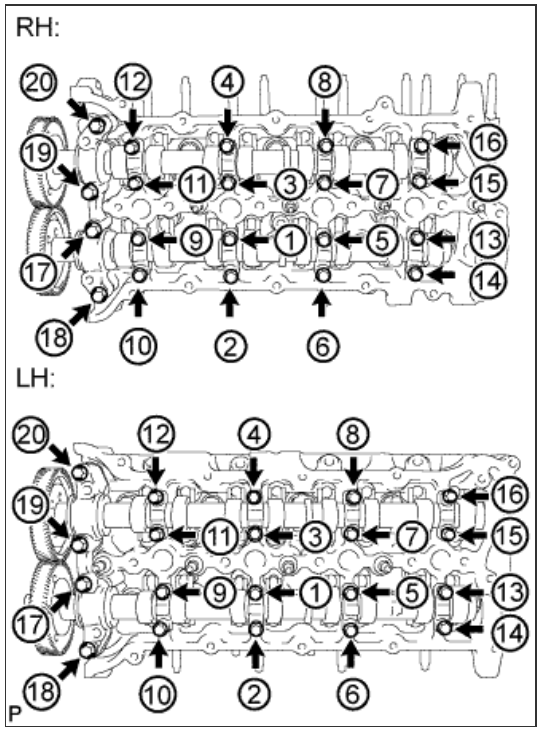
i. Confirm the marks and numbers on the camshaft bearing caps and place them in their proper position and direction.

ii. Temporarily install the 16 bolts.

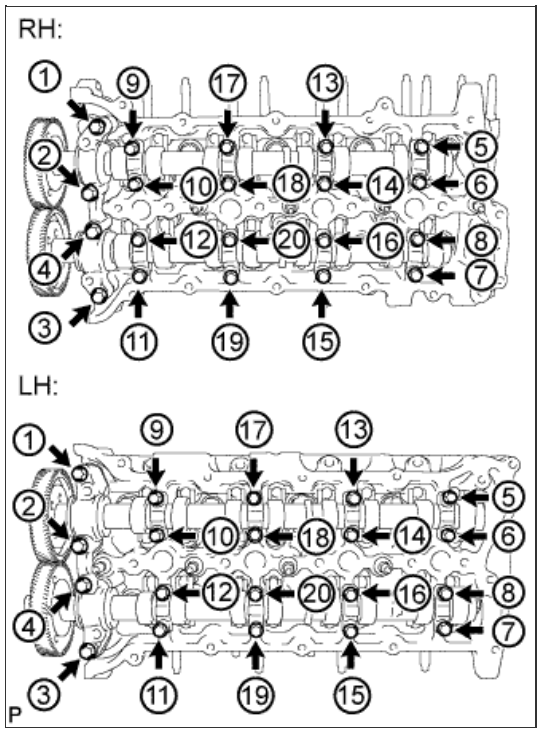


f. Uniformly tighten the 20 bolts in several steps in the order sho n in the illustration.

Torque:
for 12 mm head bolt of No. 1 and No. 4 camshaft bearing cap:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for 10 mm head bolt of No. 3 camshaft bearing cap:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



g. Uniformly loosen and remove the 20 bolts in the sequence sho n in the illustration.

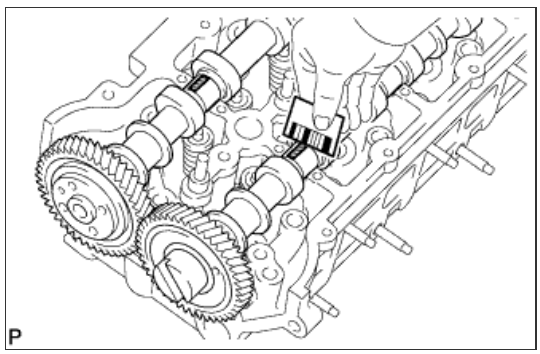


h. Measure the Plastigage at its idest point.

Standard oil clearance:
0.025 to 0.062 mm (0.000984 to 0.00244 in.)

Maximum oil clearance:
0.072 mm (0.00283 in.)

If the oil clearance is more than the maximum, replace the camshaft.
If necessary, replace the cylinder head sub-assembly.



i. Remove the Plastigage completely.

j. Remove the camshafts.

3. INSPECT NO. 2 AND NO. 3 CAMSHAFT THRUST CLEARANCE (for Intake Camshaft)

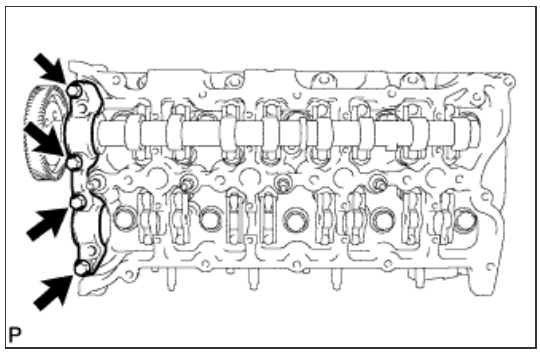
a. Install the No. 2 and No. 5 camshaft bearing caps to the cylinder head.

b. Place the camshafts on the cylinder head.

c. Temporarily install the No. 1 and No. 4 camshaft bearing caps ith the 4 bolts by hand.

NOTICE:

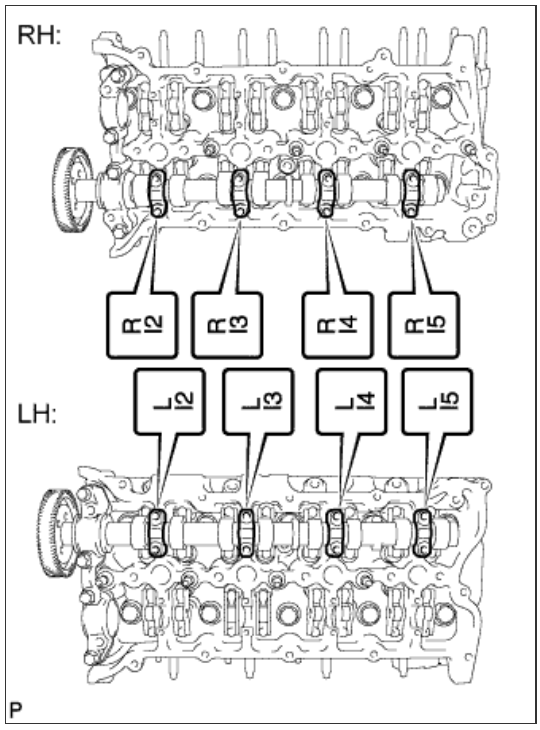
Do not turn the camshafts.



d. Install the No. 3 camshaft bearing caps.

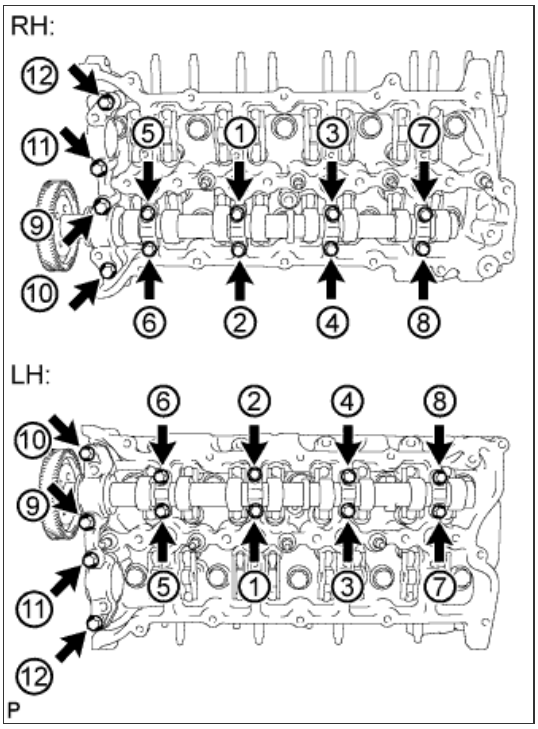
i. Confirm the marks and numbers on the camshaft bearing caps and place them in their proper position and direction.

ii. Temporarily install the 16 bolts.



e. Uniformly tighten the 24 bolts in several steps in the order sho n in the illustration.

Torque:
for 12 mm head bolt of No. 1 and No. 4 camshaft bearing cap:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for 10 mm head bolt of No. 3 camshaft bearing cap:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

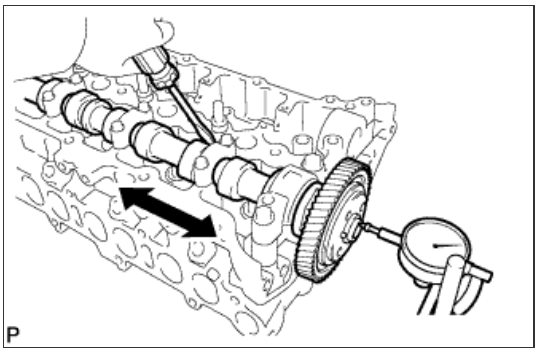


f. Using a dial indicator, measure the thrust clearance hile moving the camshaft back and forth.

Standard thrust clearance:
0.035 to 0.160 mm (0.00138 to 0.00630 in.)

Maximum thrust clearance:
0.180 mm (0.00709 in.)

If the thrust clearance is more than the maximum, replace the camshaft.
If necessary, replace the cylinder head sub-assembly.



4. INSPECT NO. 1 AND NO. 4 CAMSHAFT THRUST CLEARANCE (for Exhaust Camshaft)

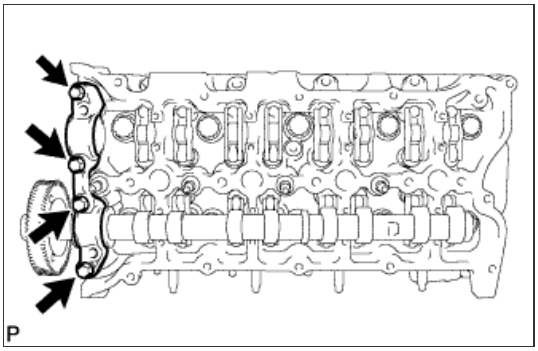
a. Install the No. 2 and No. 5 camshaft bearing caps to the cylinder head.

b. Place the camshafts on the cylinder head.

c. Temporarily install the No. 1 and No. 4 camshaft bearing caps ith the 4 bolts by hand.

NOTICE:

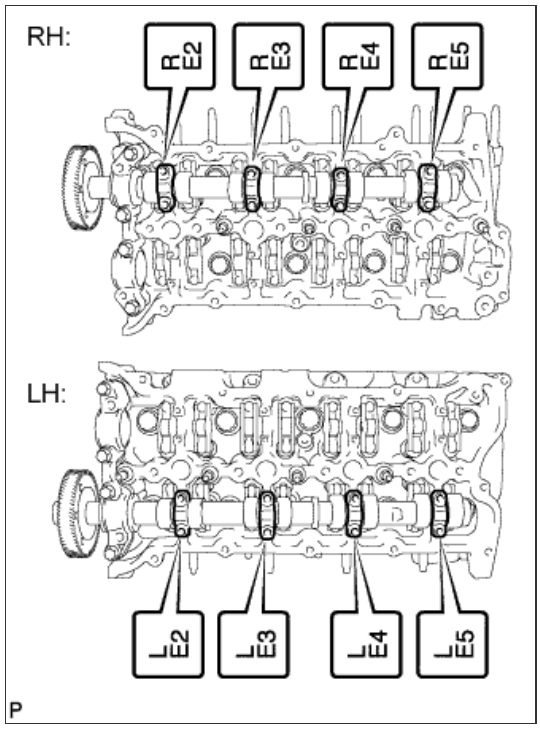
Do not turn the camshafts.



d. Install the No. 3 camshaft bearing caps.

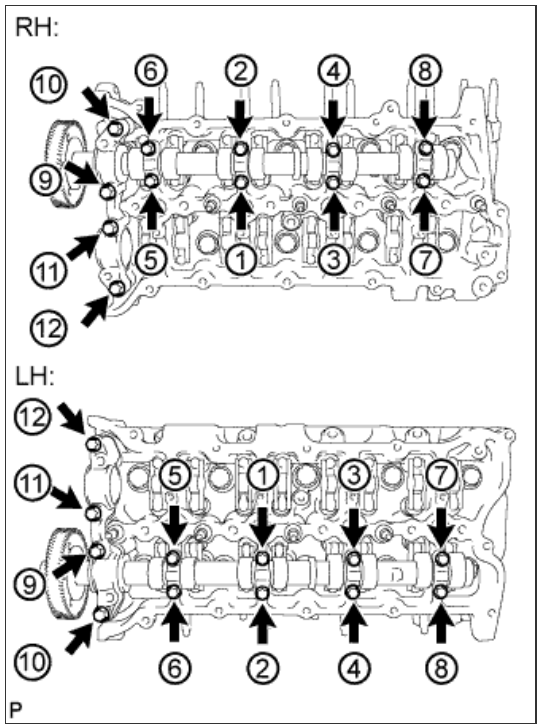
i. Confirm the marks and numbers on the camshaft bearing caps and place them in their proper position and direction.

ii. Temporarily install the 16 bolts.



e. Uniformly tighten the 24 bolts in several steps in the order sho n in the illustration.

Torque:
for 12 mm head bolt of No. 1 and No. 4 camshaft bearing cap:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for 10 mm head bolt of No. 3 camshaft bearing cap:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

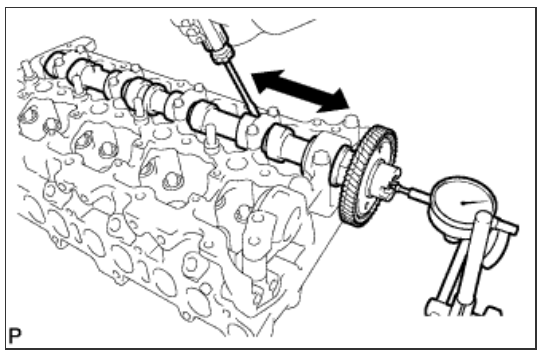


f. Using a dial indicator, measure the thrust clearance hile moving the camshaft back and forth.

Standard thrust clearance:
0.035 to 0.160 mm (0.00138 to 0.00630 in.)

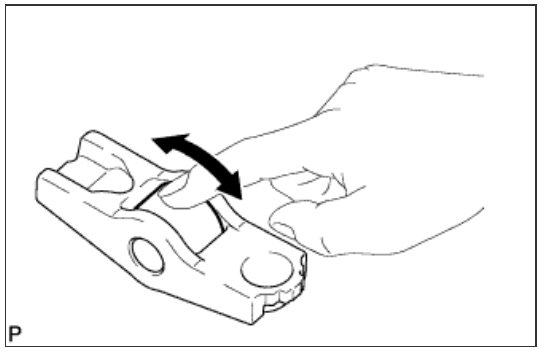
Maximum thrust clearance:
0.180 mm (0.00709 in.)

If the thrust clearance is more than the maximum, replace the camshafts.
If necessary, replace the cylinder head sub-assembly.



5. INSPECT VALVE ROCKER ARM SUB-ASSEMBLY

a. Turn the roller by hand to check that it turns smoothly.
If the roller does not turn smoothly, replace the valve rocker arm.



6. INSPECT VALVE LASH ADJUSTER ASSEMBLY

NOTICE:

- **Keep the adjuster free from dirt and foreign objects.**
- **Use onl lean engine oil.**

a. Place the lash adjuster into a container full of ne engine oil.

b. Insert SST tip into the lash adjuster plunger and use the tip to press do n on the check ball inside the plunger.

SST
09276-75010

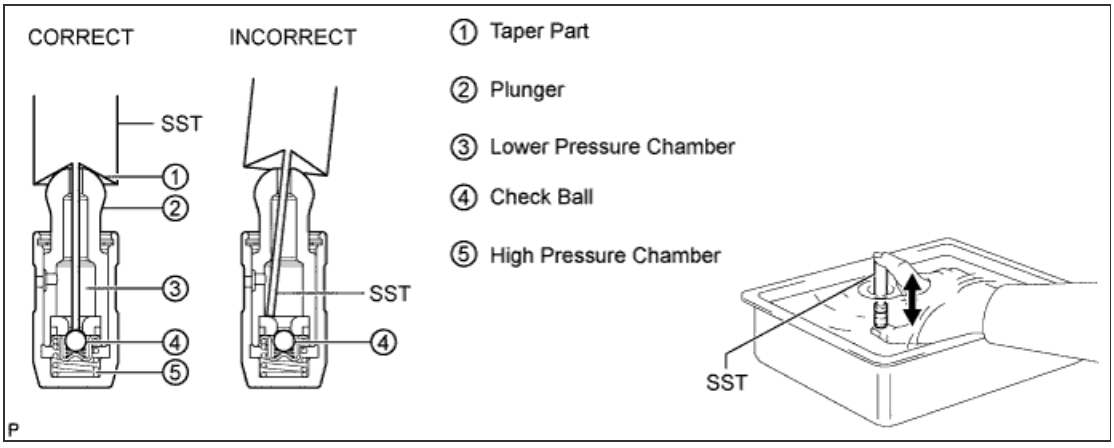
c. Squeeze SST and the lash adjuster together to move the plunger up and do n 5 to 6 times.

d. Check the movement of the plunger and bleed air.

OK:
Plunger moves up and down.

NOTICE:

When bleeding high-pressure air from the compression chamber, make sure that the tip of SST is actually pressing the check ball as sho n in the illustration. If the check ball is not pressed, air ill not bleed.



e. After bleeding the air, remove SST. Then try to quickly and firmly press the plunger ith your fingers.

OK:
Plunger can be pressed 3 times.

If the plunger can still be compressed after pressing it 3 times, replace the lash adjuster ith a ne one.

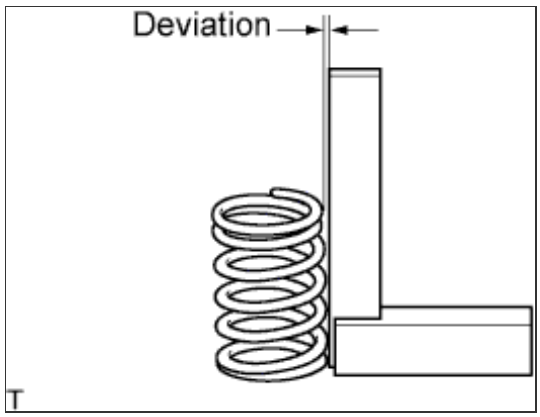
7. INSPECT INNER COMPRESSION SPRIN

a. Inspect the inner compression spring deviation.

i. Using a steel square, measure the deviation of the inner compression spring.

Maximum deviation:
1.5 mm (0.0591 in.)

If the deviation is more than the maximum, replace the inner compression spring.

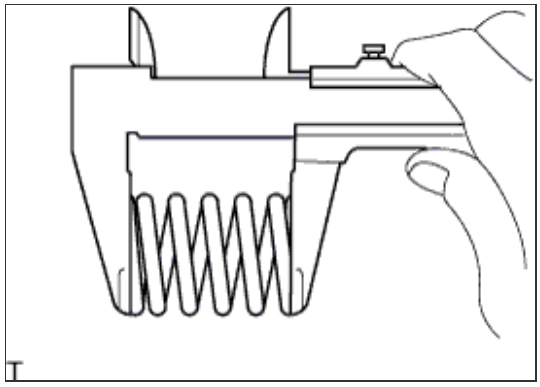


b. Inspect the inner compression spring free length.

i. Using a vernier caliper, measure the free length of the inner compression spring.

Standard free length:
45.9 mm (1.81 in.)

If the free length is not as specified, replace the inner compression spring.

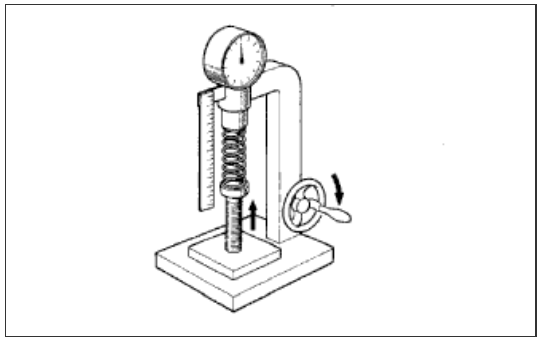


c. Inspect the inner compression spring tension.

i. Using a spring tester, measure the tension of the inner compression spring at the specified installed length.

Installed tension:
219 to 242 N (22 to 25 kgf, 49.2 to 54.4 lbf) at 31.0 mm (1.22 in.)

If the installed tension is not as specified, replace the inner compression spring.



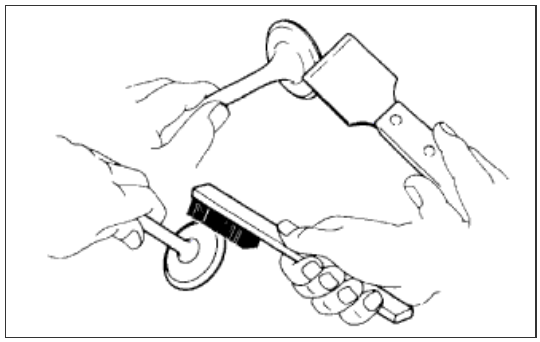
8. CLEAN VALVE

a. Using a gasket scraper, chip off any carbon from the valve head.

NOTICE:

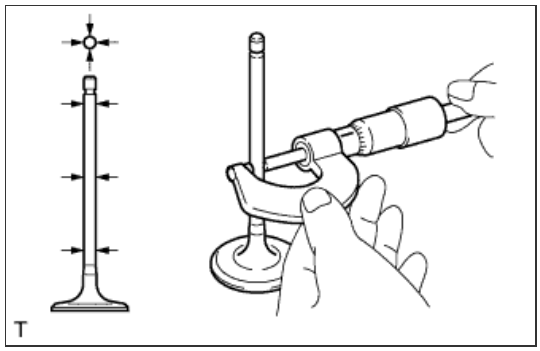
Be careful not to damage the valve face.

b. Using a ire brush, thoroughly clean the valve.



9. INSPECT VALVE

a. Inspect the valve stem diameter.

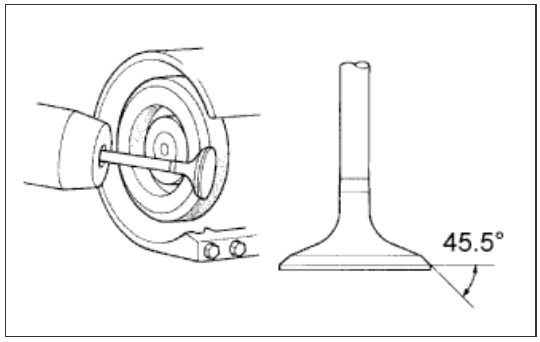


i. Using a micrometer, measure the diameter of the valve stem.

Standard Valve Stem Diameter:

Item	Specified Condition
Intake	5.970 to 5.985 mm (0.2350 to 0.2356 in.)
xhaust	5.960 to 5.975 mm (0.2346 to 0.2352 in.)

b. Inspect the valve face angle.

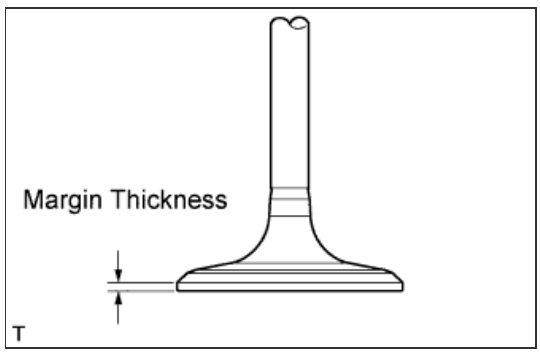


i. Grind the valve enough to remove pits and carbon.

ii. Check that the valve is ground to the correct valve face angle.

Standard valve face angle:
45.5°

c. Inspect the valve head margin thickness.



i. Using a vernier caliper, measure the valve head margin thickness.

Standard margin thickness:
1.0 mm (0.0394 in.)

Minimum margin thickness:
0.5 mm (0.0197 in.)

If the margin thickness is less than the minimum, replace the valve.

d. Inspect the valve overall length.

i. Using a vernier caliper, measure the overall length.

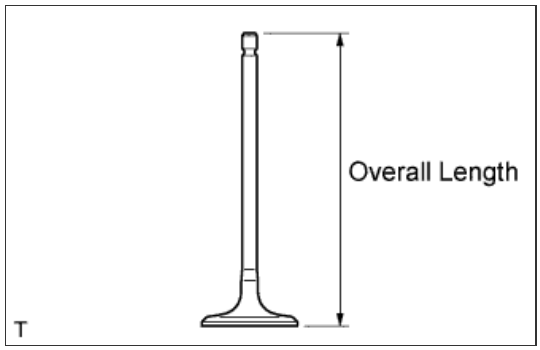
Standard Overall Length:

Item	Specified Condition
Intake	104.4 mm (4.11 in.)
xhaust	104.1 mm (4.10 in.)

Minimum Overall Length:

Item	Specified Condition
Intake	104.1 mm (4.10 in.)
xhaust	103.8 mm (4.09 in.)

If the overall length is less than the minimum, replace the valve.



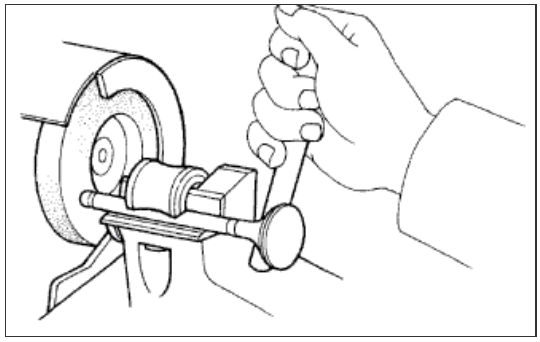
e. Inspect the valve stem tip.

i. Check the surface of the valve stem tip for ear.

NOTICE:

Do not grind the valve so it becomes shorter than the minimum overall length.

If the valve stem tip is orn, resurface the tip ith a grinder or replace the valve.



10. INSPECT VALVE UIDE BUSH OIL CLEARANCE

a. Using a caliper gauge, measure the inside diameter of the guide bush.

Standard bush inside diameter:
6.01 to 6.03 mm (0.2366 to 0.2374 in.)

b. Subtract the valve stem diameter measurement from the guide bush inside diameter measurement.

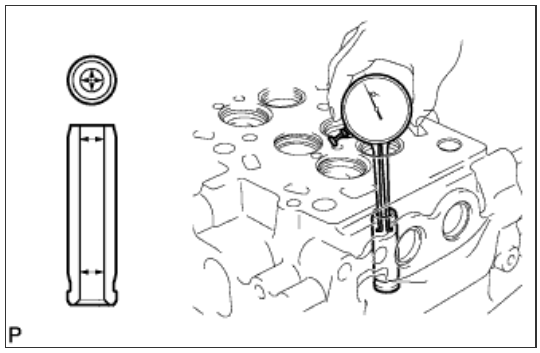
Standard Oil Clearance:

Item	Specified Condition
Intake	0.025 to 0.060 mm (0.000984 to 0.00236 in.)
xhaust	0.035 to 0.070 mm (0.00138 to 0.00276 in.)

Maximum Oil Clearance:

Item	Specified Condition
Intake	0.120 mm (0.00472 in.)
xhaust	0.130 mm (0.00512 in.)

If the oil clearance is more than the maximum, replace the valve guide bush.

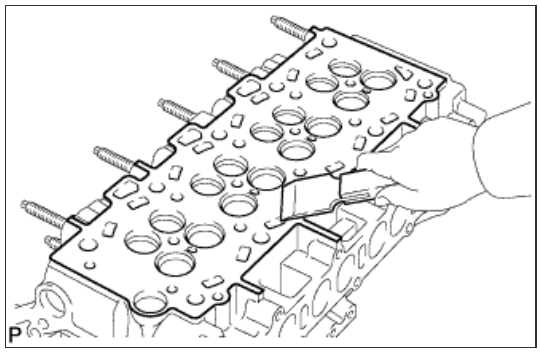


11. CLEAN CYLINDER HEAD SUB-ASSEMBLY

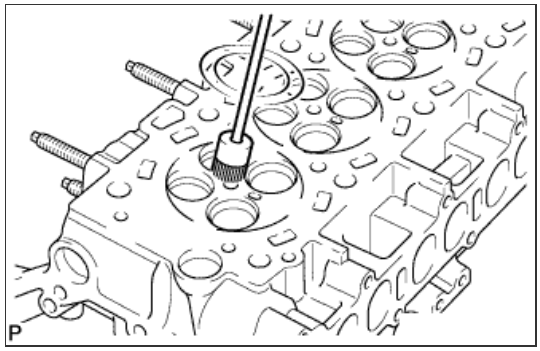
a. Using a gasket scraper, remove all the gasket material from the cylinder block contact surface.

NOTICE:

Be careful not to scratch the cylinder block contact surface.



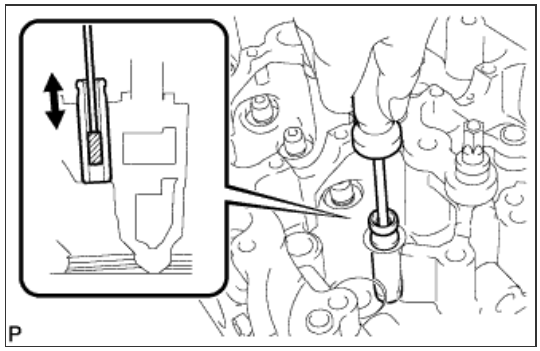
b. Using a ire brush, remove all the carbon from the combustion chambers.



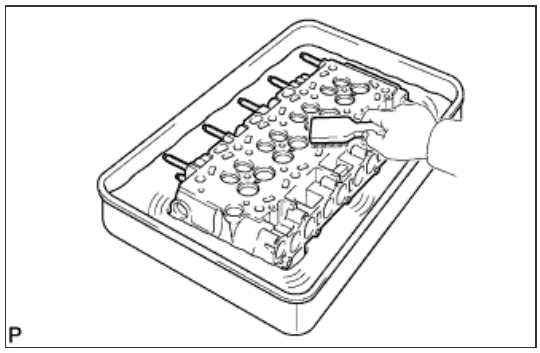
NOTICE:

Be careful not to damage the combustion chambers and valve seats.

c. Using a valve guide bushing brush and solvent, clean all the valve guide bushes.



d. Using a soft brush and solvent, thoroughly clean the cylinder head.



12. INSPECT CYLINDER HEAD SUB-ASSEMBLY

a. Using a precision straightedge and feeler gauge, measure the arpage of the contact surface bet een the cylinder head and cylinder block, and the cylinder head and manifolds.

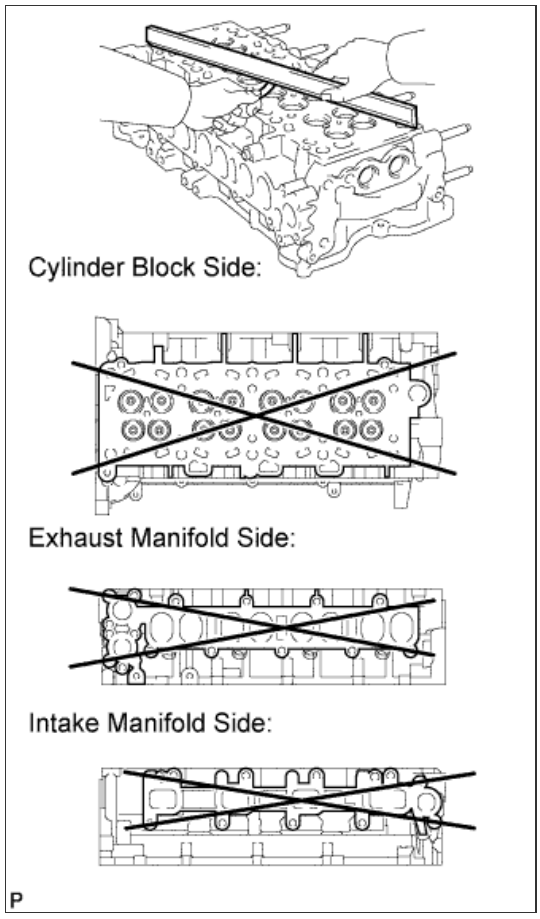
Standard arpage:

Item	Specified Condition
Cylinder block side	0 to 0.05 mm (0 to 0.00197 in.)
Intake manifold side	0 to 0.08 mm (0 to 0.00315 in.)
xhaust manifold side	0 to 0.08 mm (0 to 0.00315 in.)

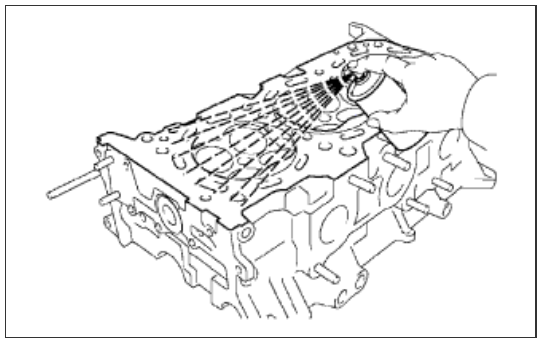
Maximum arpage:

Item	Specified Condition
Cylinder block side	0.05 mm (0.00197 in.)
Intake manifold side	0.08 mm (0.00315 in.)
xhaust manifold side	0.08 mm (0.00315 in.)

If the arpage is more than the maximum, replace the cylinder head sub-assembly.



b. Using a dye penetrant, check the intake ports, exhaust ports and cylinder surface for cracks.
If there are cracks, replace the cylinder head sub-assembly.



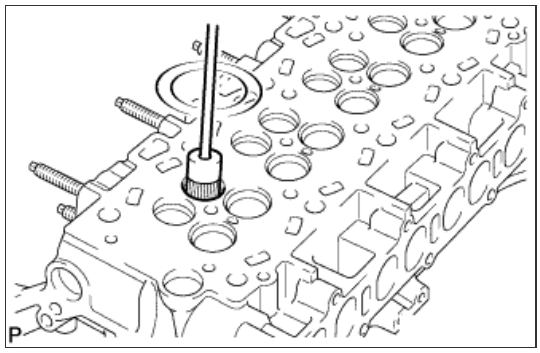
13. CLEAN VALVE SEAT

a. Using a 45° carbide cutter, resurface the valve seats.

NOTICE:

Be careful not to damage the combustion chambers and valve seats.

b. Clean the valve seats.



14. INSPECT INTAKE VALVE SEAT

a. Apply a light coat of Prussian blue to the valve face.

b. Lightly press the valve face against the valve seat.

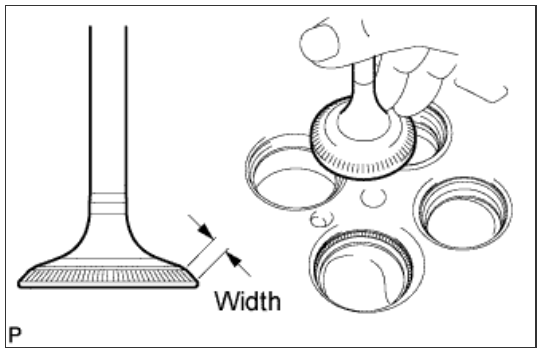
NOTICE:

Do not rotate the valve hile pressing the valve.

c. Check the valve face and valve seat.

i. Check that the contact surfaces of the valve seat and valve face are in the middle area of their respective surfaces, ith the idth bet een 1.0 to 1.4 mm (0.0394 to 0.0551 in.).
If not, correct the valve seat.

ii. Check that the contact surfaces of the valve seat and valve face are even around the entire valve seat.
If not, correct the valve seat.



15. INSPECT E HAUST VALVE SEAT

a. Apply a light coat of Prussian blue to the valve face.

b. Lightly press the valve face against the valve seat.

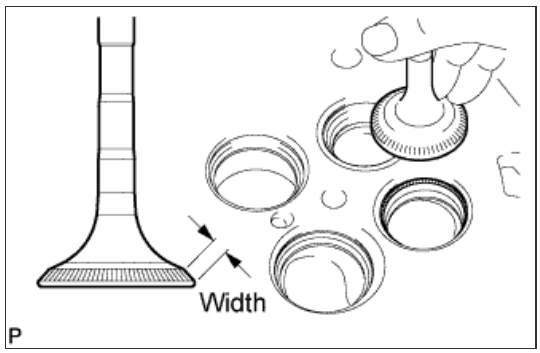
NOTICE:

Do not rotate the valve hile pressing the valve.

c. Check the valve face and valve seat.

i. Check that the contact surfaces of the valve seat and valve face are in the middle area of their respective surfaces, ith the idth bet een 1.0 to 1.4 mm (0.0394 to 0.0551 in.).
If not, correct the valve seat.

ii. Check that the contact surfaces of the valve seat and valve face are even around the entire valve seat.
If not, correct the valve seat.

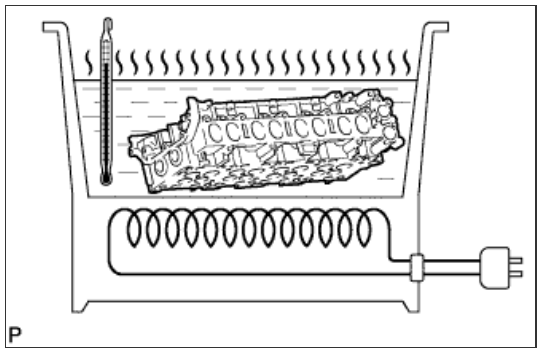


for Preparation Click here

1. REPLACE VALVE GUIDE BUSH

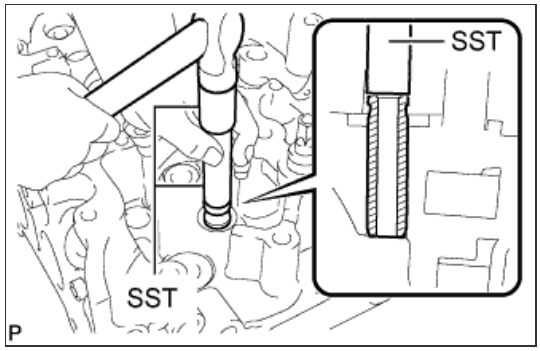
a. Gradually heat the cylinder head to 80 to 100°C (176 to 212°F).

b. Place the cylinder head on a wooden block.



c. Using SST, tap out the valve guide bush.

SST
09201-10000 (09201-01060)
09950-70010 (09951-07100)



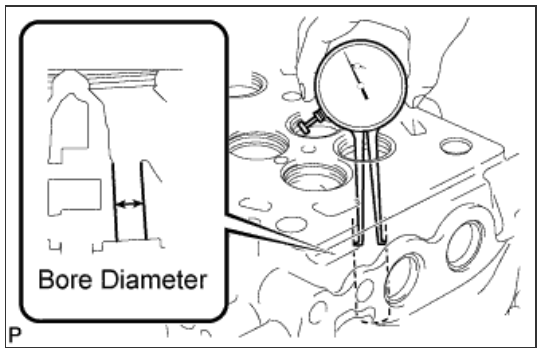
d. Using a caliper gauge, measure the bush bore diameter of the cylinder head.

Standard bush bore diameter:
10.985 to 11.006 mm (0.432 to 0.433 in.)

If the bush bore diameter of the cylinder head is more than 11.006 mm (0.433 in.), machine the bush bore to the dimension of 11.035 to 11.056 mm (0.434 to 0.435 in.).

Standard Valve Guide Bush Diameter:

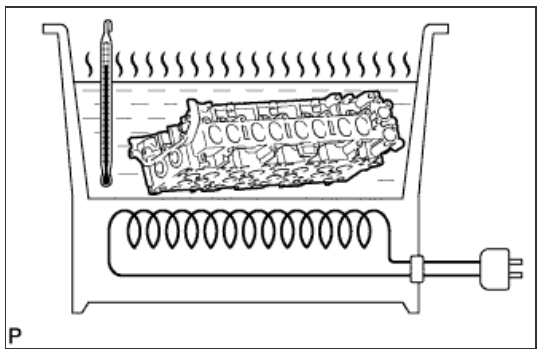
Item	Specified Condition
STD	11.033 to 11.044 mm (0.434 to 0.435 in.)
O/S 0.05	11.083 to 11.094 mm (0.436 to 0.437 in.)



If the bush bore diameter of the cylinder head is more than 11.056 mm (0.435 in.), replace the cylinder head sub-assembly.

e. Gradually heat the cylinder head to 80 to 100°C (176 to 212°F).

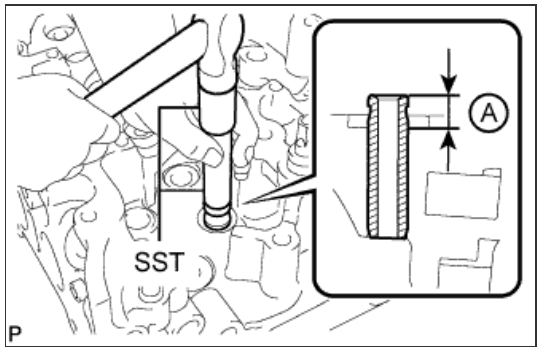
f. Place the cylinder head on a wooden block.



g. Using SST, tap in a new valve guide bush to the specified protrusion height A shown in the illustration.

SST
09201-10000 (09201-01060)
09950-70010 (09951-07100)

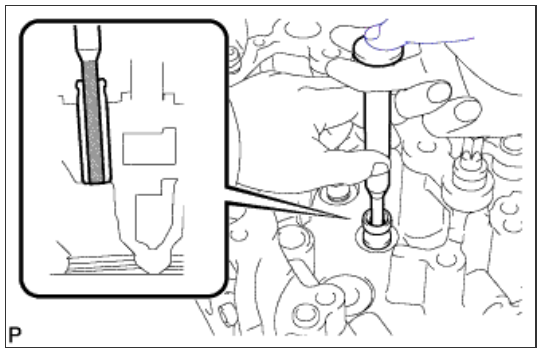
Standard protrusion height:
9.0 to 9.4 mm (0.354 to 0.370 in.)



h. Using a sharp 6.0 mm reamer, ream the valve guide bush to obtain the standard specified clearance between the valve guide bush and valve stem.

Standard Overall Length:

Item	Specified Condition
Intake	0.025 to 0.060 mm (0.000984 to 0.00236 in.)
Exhaust	0.035 to 0.070 mm (0.00138 to 0.00276 in.)

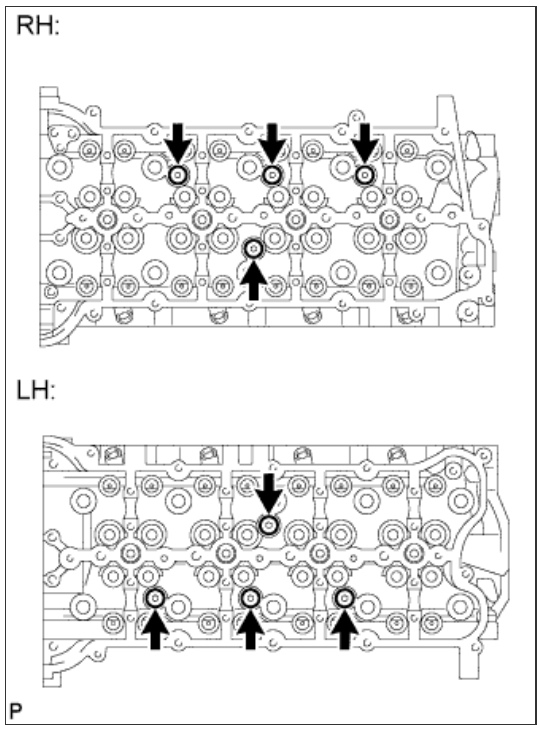


2. REPLACE HEAD STRAIGHT SCREW PLUG

a. Using a 6 mm hexagon wrench, remove the straight screw plug and gasket.

b. Using a 6 mm hexagon wrench, install a new gasket and straight screw plug.

Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf



3. REPLACE RING PIN

HINT:

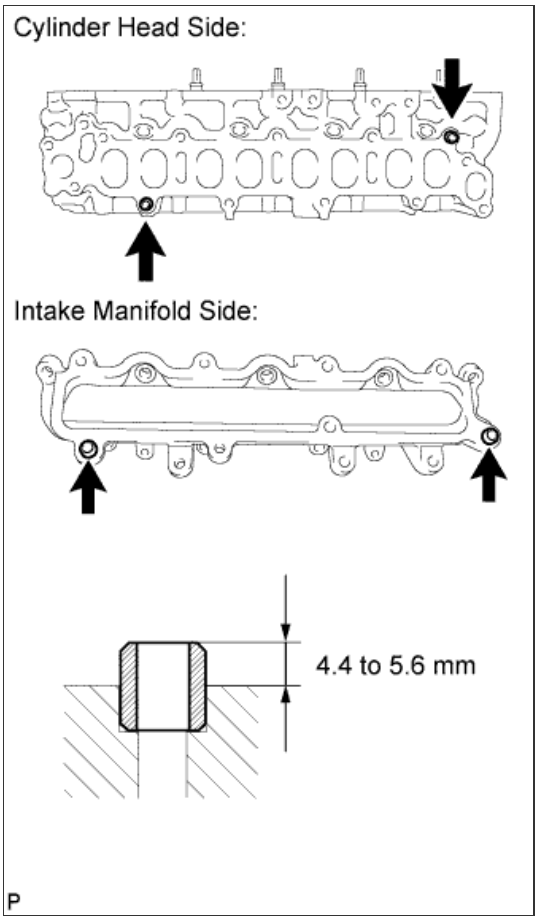
It is not necessary to remove the ring pin unless it is being replaced.

a. Remove the ring pins.

b. Using a plastic-faced hammer, tap in new ring pins.

Standard protrusion:

4.4 to 5.6 mm (0.173 to 0.220 in.)



4. REPLACE STUD BOLT

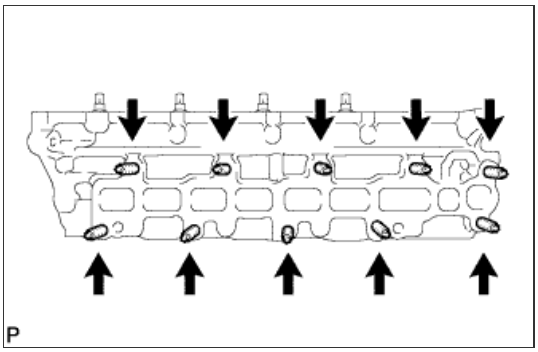
HINT:

If a stud bolt is deformed or the threads are damaged, replace it.

a. Using an E8 "TORX" wrench, remove the stud bolts.

b. Using an E8 "TORX" wrench, install new stud bolts.

Torque:
12 N*m{ 122 kgf*cm , 9 ft.*lbf

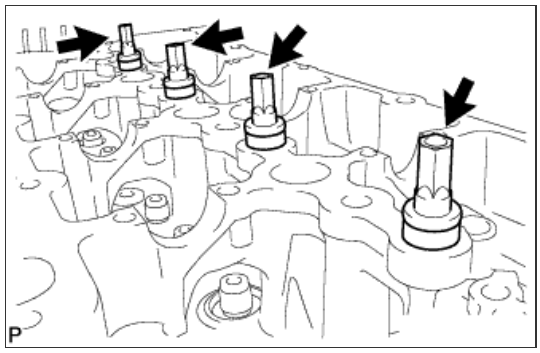


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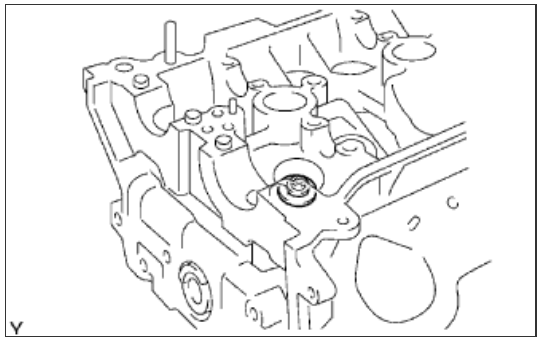
1. INSTALL NOZZLE HOLDER CLAMP SEAT

a. Install the nozzle holder clamp seat.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



2. INSTALL VALVE SPRING SEAT PLATE WASHER



3. INSTALL VALVE STEM OIL SEAL

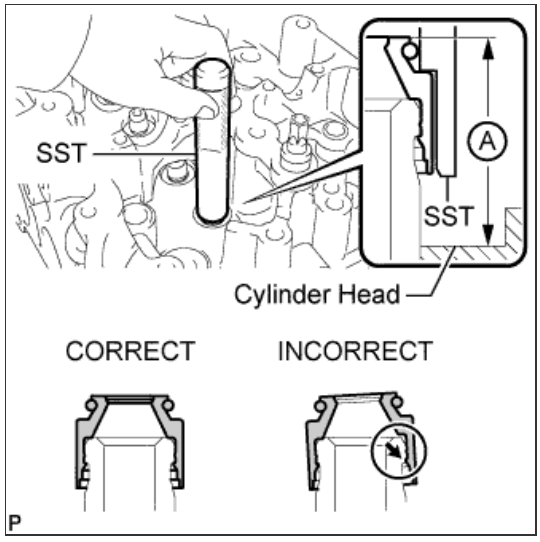
a. Apply a light coat of engine oil to the valve guide bush.

b. Using SST, push in a new valve stem oil seal.

SST
09201-41020

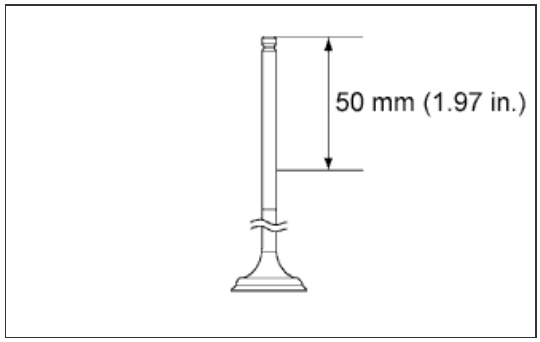
c. Check that the protrusion height of the valve stem oil seal labeled A in the illustration is as specified.

Standard protru ion height:
Below 14.7 mm (0. 79 in.)



4. INSTALL VALVE

a. Apply plenty of engine oil to the tip area of the valve as shown in the illustration.



b. Place the cylinder head on a wooden block.

c. Install the valve, inner compression spring and valve spring retainer to the cylinder head.

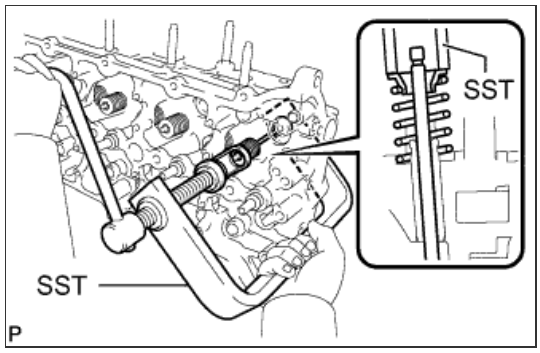
NOTICE:

Install the same parts in the same combination to their original locations.

d. Using SST, compress the inner compression spring and place the valve spring retainer lock around the valve stem.

SST

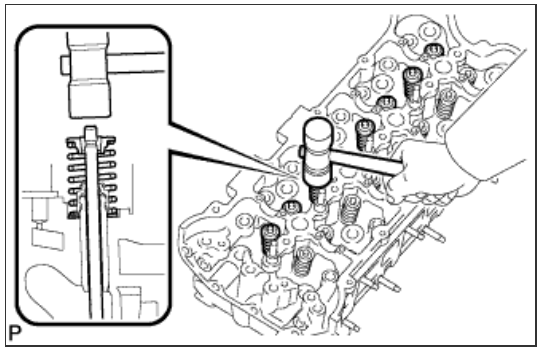
09202-70020 (09202-00010)



e. Using a plastic-faced hammer, lightly tap the valve stem tip to ensure a proper fit.

NOTICE:

Be careful not to damage the valve stem tip.



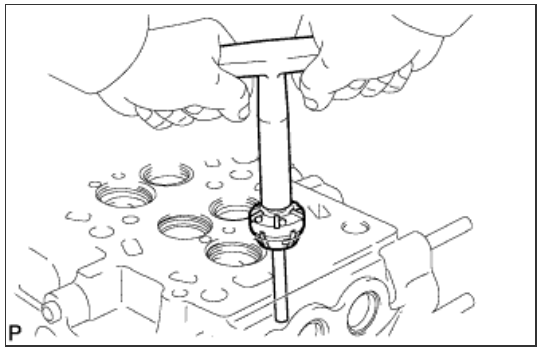
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1. REPAIR INTAKE VALVE SEAT

NOTICE:

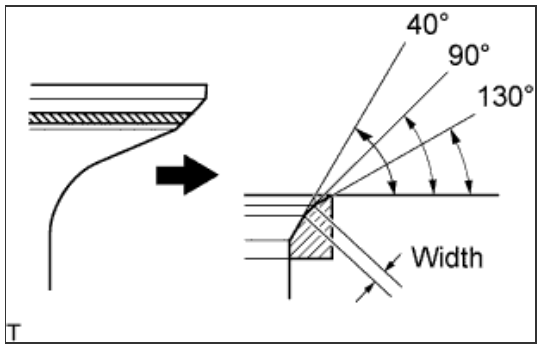
- **Repair the seat while checking the seating position.**
- **Keep the lip free of foreign matter.**

a. Using a 90° cutter, resurface the valve seat so that the valve seat width is more than the specification.



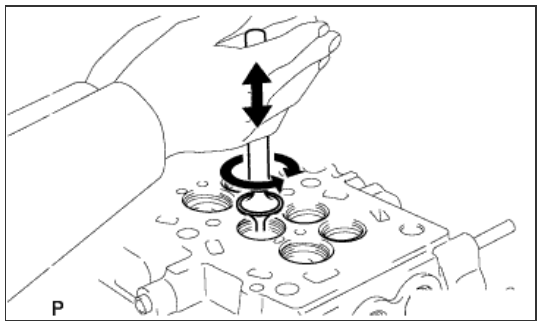
b. Using 40° and 130° cutters, correct the valve seat so that the valve contacts the entire circumference of the seat. The contact should be in the center of the valve seat, and the valve seat width should be maintained within the specified range around the entire circumference of the seat.

Standard width:
1.0 to 1.4 mm (0.0 4 to 0.0551 in.)



c. Hand-lap the valve and valve seat with an abrasive compound.

d. Check the valve seating position.

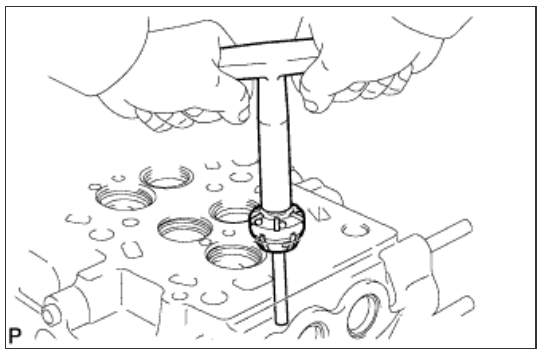


. REPAIR E HAUST VALVE SEAT

NOTICE:

- **Repair the seat while checking the seating position.**
- **Keep the lip free of foreign matter.**

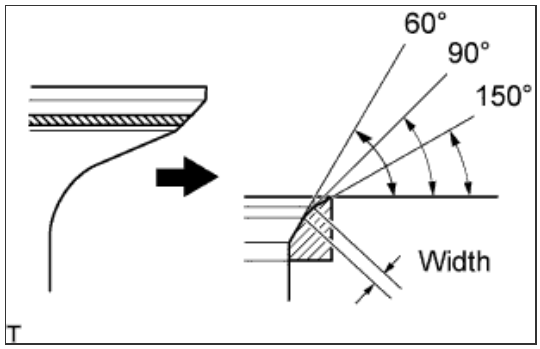
a. Using a 90° cutter, resurface the valve seat so that the valve seat width is more than the specification.



b. Using 60° and 150° cutters, correct the valve seat so that the valve contacts the

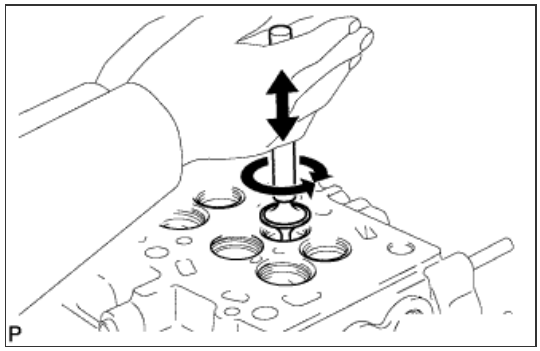
entire circumference of the seat. The contact should be in the center of the valve seat, and the valve seat width should be maintained within the specified range around the entire circumference of the seat.

Standard width:
1.0 to 1.4 mm (0.0 4 to 0.0551 in.)

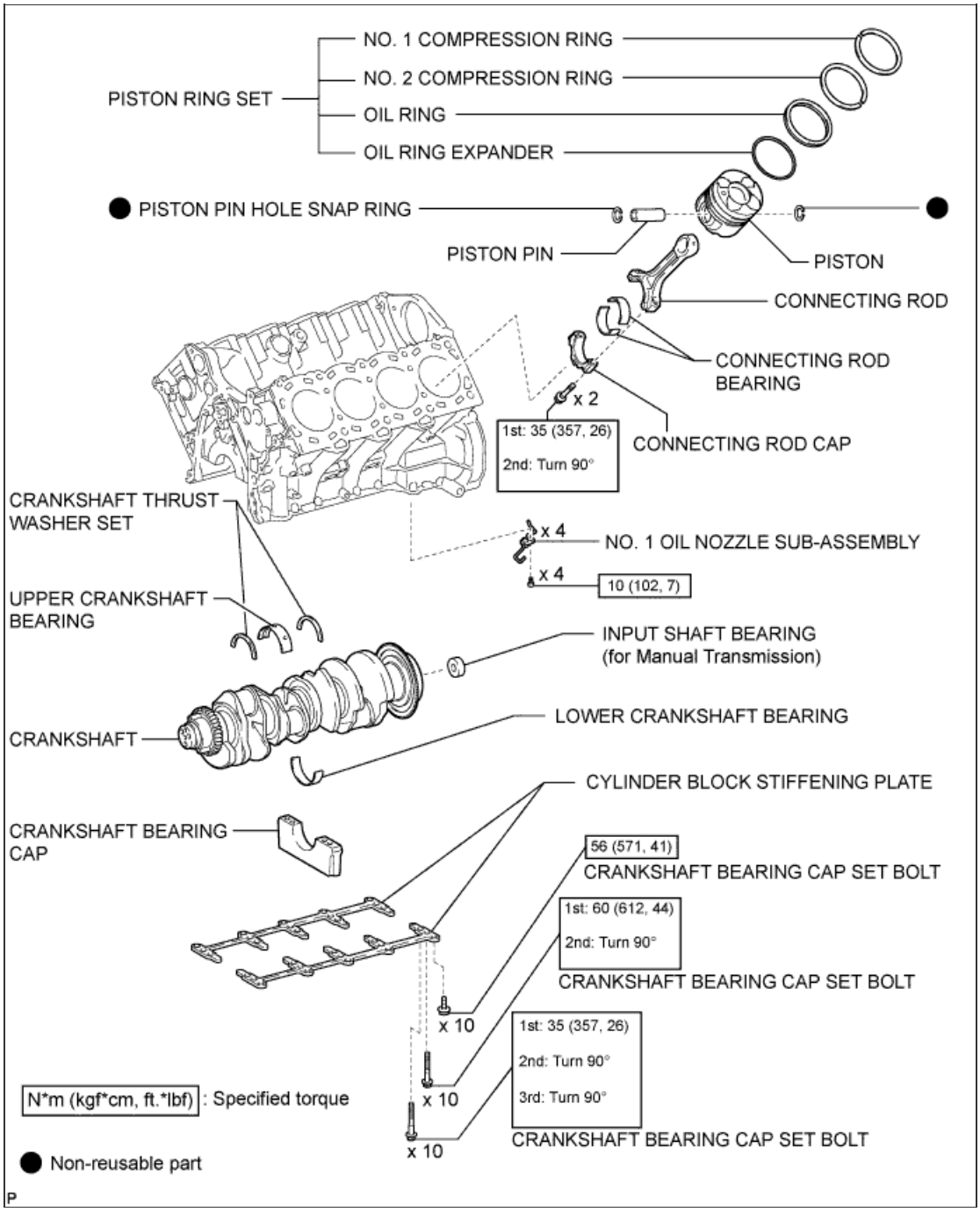


c. Hand-lap the valve and valve seat with an abrasive compound.

d. Check the valve seating position.



for Preparation Click here



for Preparation Click here

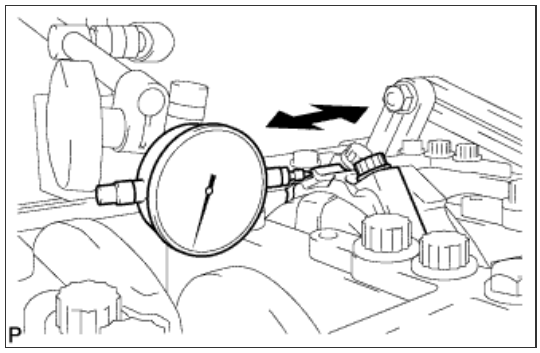
1. INSPECT CONNECTING ROD THRUST CLEARANCE

a. Using a dial indicator, measure the thrust clearance while moving the connecting rod back and forth.

Standard thrust clearance:
0.14 to 0.54 mm (0.00551 to 0.0213 in.)

Maximum thrust clearance:
0.60 mm (0.0236 in.)

If the thrust clearance is more than the maximum, replace one or more connecting rods as necessary.
If necessary, replace the crankshaft.



2. REMOVE PISTON SUB-ASSEMBLY WITH CONNECTING ROD

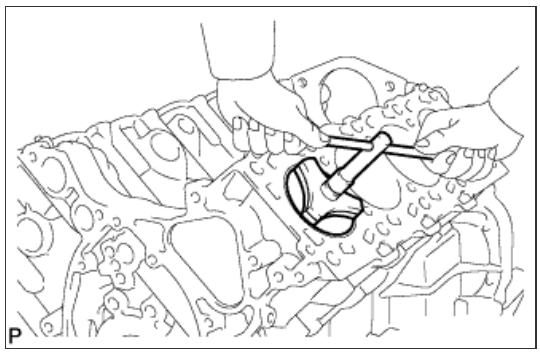
a. Using a ridge reamer, remove all the carbon from the top of the cylinder.

b. Uniformly loosen the connecting rod bolts, and remove the connecting rod cap with bearing.

c. Push out the piston and connecting rod with bearing through the top of the cylinder block.

HINT:

Arrange the piston and connecting rod assemblies in the correct order.

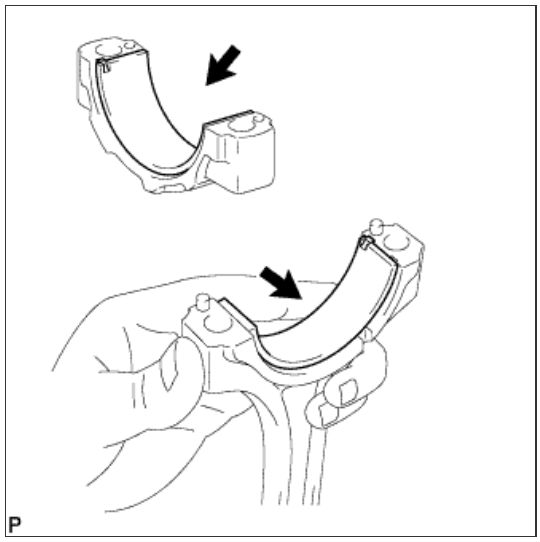


3. REMOVE CONNECTING ROD BEARING

a. Remove the connecting rod and connecting rod cap bearings.

HINT:

Arrange the removed parts in the correct order.



4. REMOVE PISTON RING SET

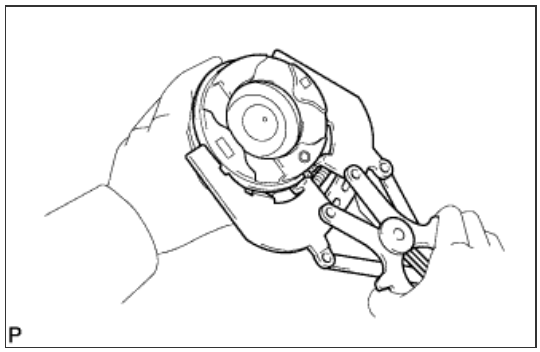
a. Using a piston ring expander, remove the No. 1 and No. 2 compression rings.

b. Using a piston ring expander, remove the oil ring.

c. Remove the oil ring expander by hand.

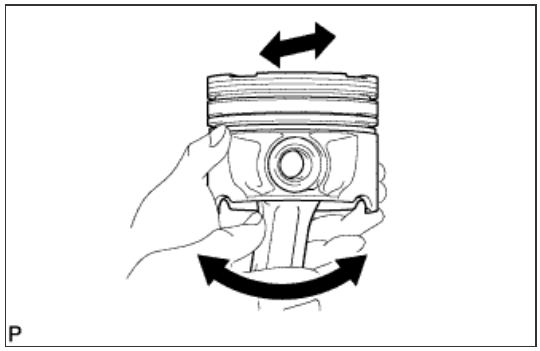
HINT:

Arrange the removed parts in the correct order.

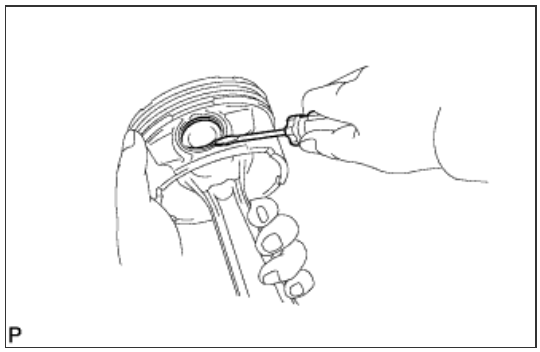


5. REMOVE PISTON WITH PIN SUB-ASSEMBLY

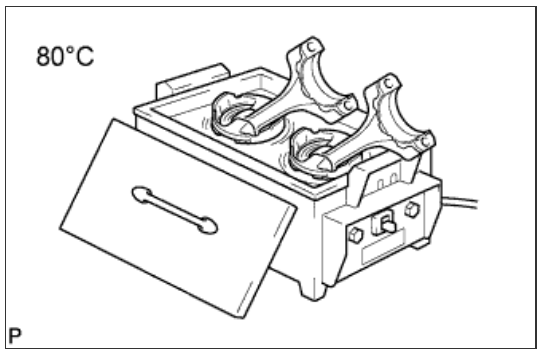
a. Check the fitting condition between the piston and piston pin by trying to move the piston back and forth on the piston pin.
If any movement is felt, replace the piston and pin as a set.



b. Using a screwdriver, pry out the 2 snap rings.



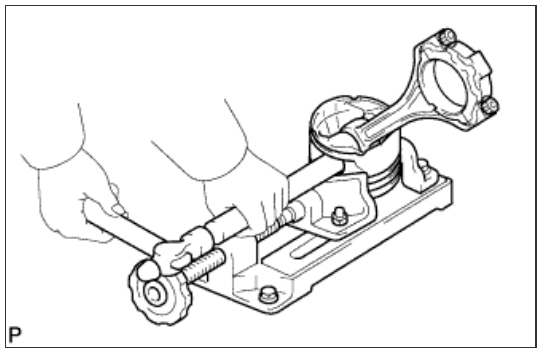
c. Gradually heat the piston to approximately 80°C (176°F).



d. Using a plastic-faced hammer and brass bar, lightly tap out the piston pin and remove the connecting rod.

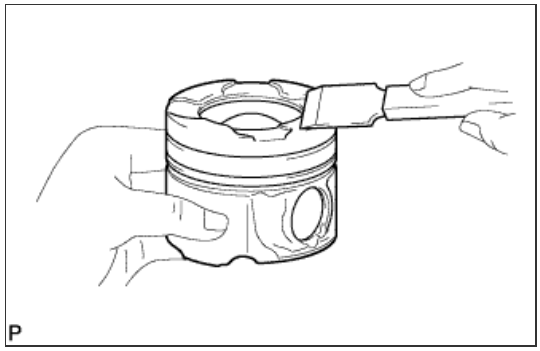
HINT:

- **The piston and pin are a matched set.**
- **Arrange the piston and connecting rod assemblies in the correct order.**

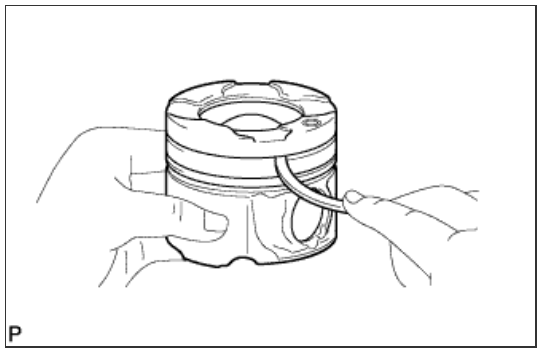


6. CLEAN PISTON

a. Using a gasket scraper, remove the carbon from the piston top.



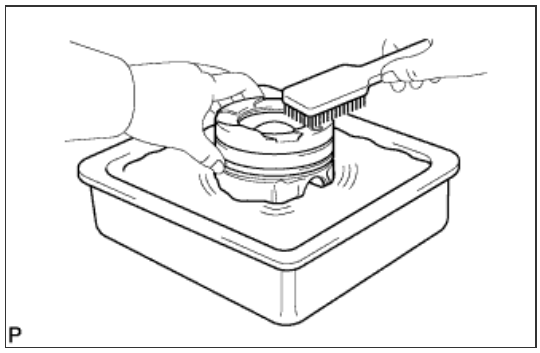
b. Using a groove cleaning tool or broken ring, clean the piston ring grooves.



c. Using solvent and a brush, thoroughly clean the piston.

NOTICE:

Do not use a wire brush.



7. INSPECT CRANKSHAFT THRUST CLEARANCE

a. Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

Standard thrust clearance:
0.02 to 0.22 mm (0.000787 to 0.00866 in.)

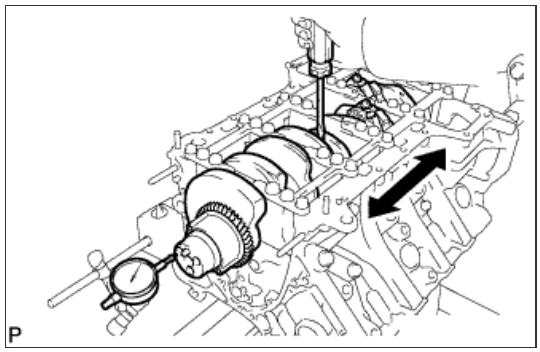
Maximum thrust clearance:

0.30 mm (0.0118 in.)

If the thrust clearance is more than the maximum, replace the thrust washers as a set.

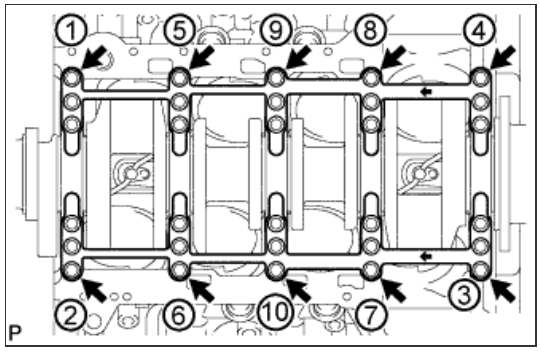
Standard thrust washer thickness:
2.44 to 2.49 mm (0.0961 to 0.0980 in.)

If necessary, replace the crankshaft.

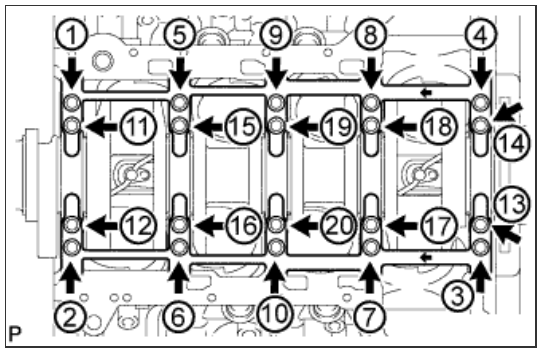


8. REMOVE CRANKSHAFT

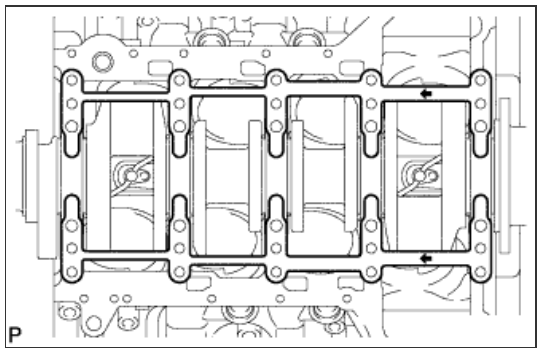
a. Using several steps, loosen and remove the 10 crankshaft bearing cap set bolts uniformly in the sequence shown in the illustration.



b. Using several steps, loosen and remove the 20 crankshaft bearing cap set bolts uniformly in the sequence shown in the illustration.



c. Remove the 2 cylinder block stiffening plates.



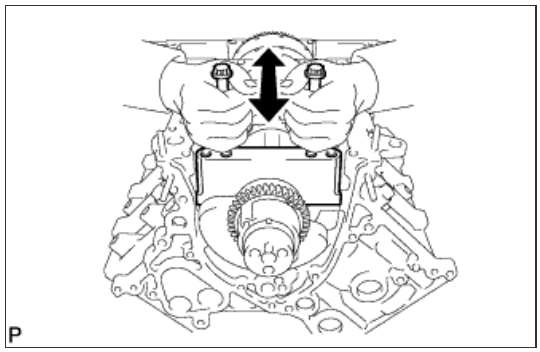
d. Using 2 crankshaft bearing cap set bolts, pull out the 5 bearing caps.

NOTICE:

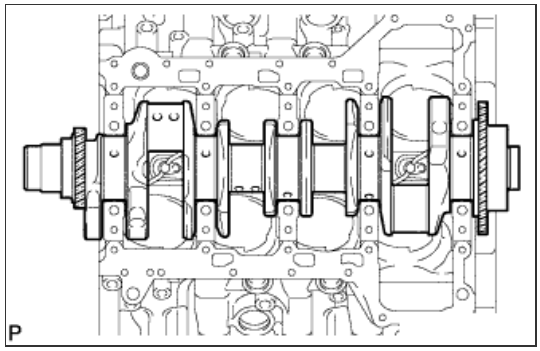
Take care not to damage the contact surfaces of the crankshaft bearing cap and cylinder block.

HINT:

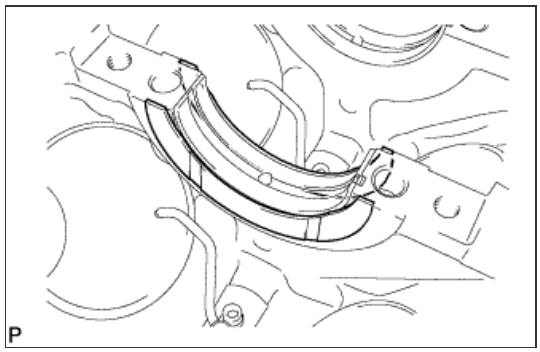
- **Keep the lower bearing and crankshaft bearing cap as a set.**
- **Arrange the crankshaft bearing caps in the correct order.**



e. Remove the crankshaft.



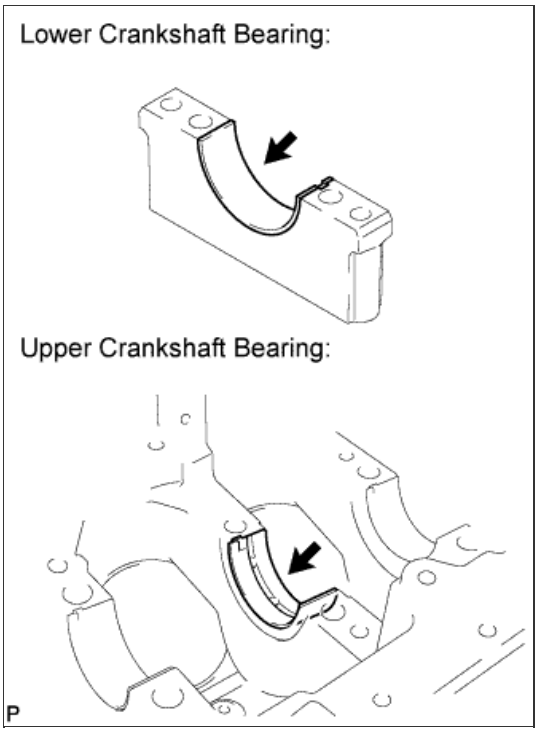
9. REMOVE CRANKSHAFT THRUST WASHER SET



10. REMOVE CRANKSHAFT BEARING

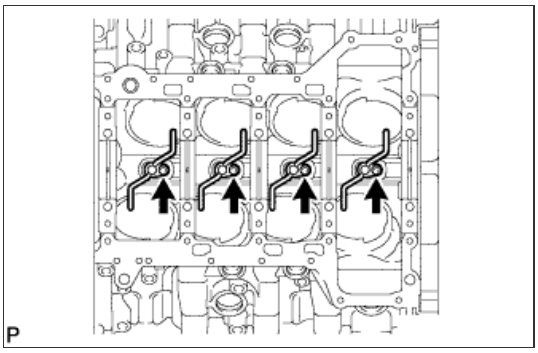
HINT:

- **Keep the upper and lower crankshaft bearings and crankshaft bearing cap as a set.**
- **Arrange the crankshaft bearing caps and bearings in the correct order.**



11. REMOVE NO. 1 OIL NOZZLE SUB-ASSEMBLY

a. Using a 5 mm hexagon wrench, remove the 4 bolts and 4 oil nozzles.



12. INSPECT INPUT SHAFT BEARING (for Manual Transmission)

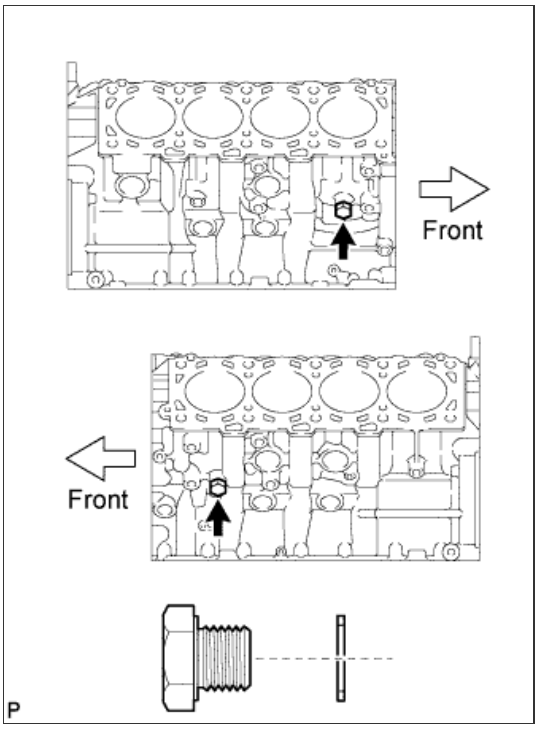
a. Turn the bearing by hand.
If the bearing is stuck or difficult to turn, replace the input shaft bearing. For removal procedures, refer to the following (Click here) and for installation procedures, refer to the following (Click here).

HINT:

The bearing is permanently lubricated and requires no cleaning or lubrication.

13. REMOVE CYLINDER BLOCK STRAIGHT SCREW PLUG

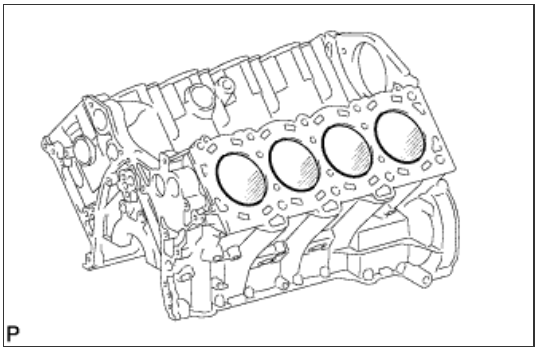
a. Remove the 2 straight screw plugs and 2 gaskets.


Front
Front
P

for Preparation Click here

1. VISUALLY CHECK CYLINDER BLOCK

a. Visually check the cylinder for vertical scratches.
If deep scratches are present, rebore all 8 cylinders. If necessary, replace the cylinder block sub-assembly.

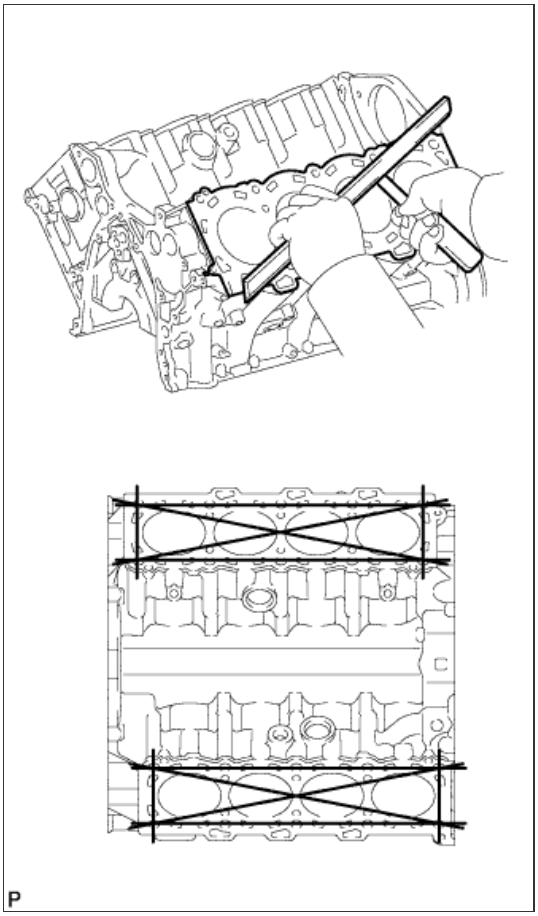


2. INSPECT CYLINDER BLOCK FOR FLATNESS

a. Using a precision straightedge and feeler gauge, measure the warpage of the contact surface between the cylinder head and cylinder head gaskets.

Maximum warpage:
0.05 mm (0.00197 in.)

If the warpage is more than the maximum, replace the cylinder block sub-assembly.



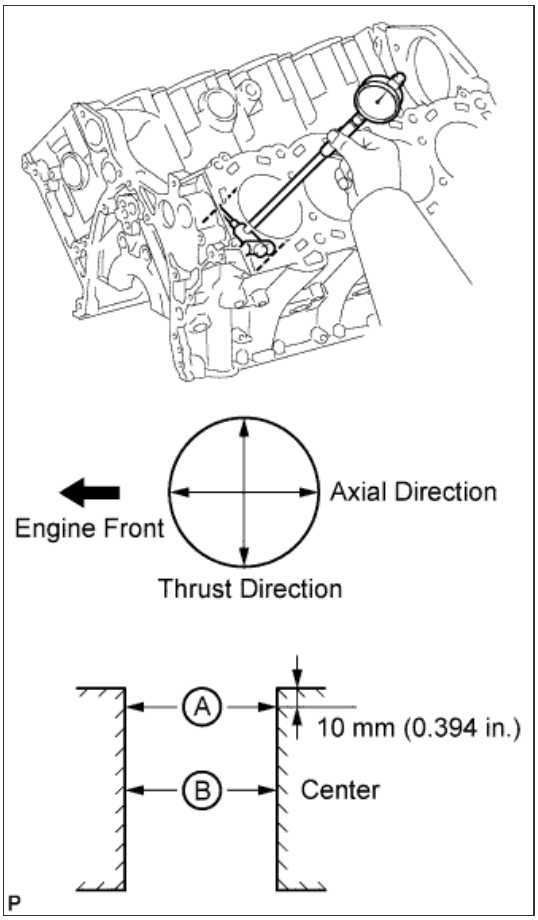
3. INSPECT CYLINDER BORE

a. Using a cylinder gauge, measure the cylinder bore diameter at positions A and B in the thrust and axial directions.

Stan ar aimeter:
86.000 to 86.013 mm (3.3858 to 3.3863 in.)

Maximum diameter:
86.03 mm (3.3870 in.)

If the diameter is more than the maximum, replace the cylinder block.



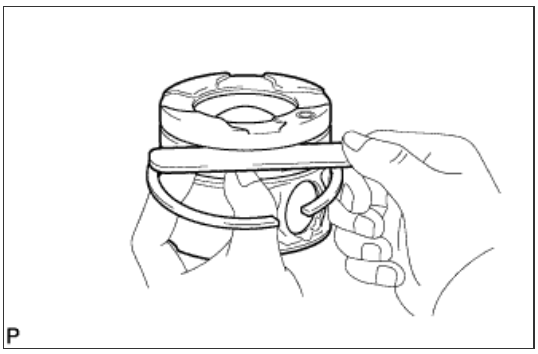
4. INSPECT RING GROOVE CLEARANCE

a. Using a feeler gauge, measure the clearance between a new piston ring and the wall of the ring groove.

Standard Ring Groove Clearance:

Item	Specified Condition
No. 1 compression ring	0.11 to 0.15 mm (0.00433 to 0.00591 in.)
No. 2 compression ring	0.08 to 0.12 mm (0.00315 to 0.00472 in.)
Oil ring	0.03 to 0.07 mm (0.00118 to 0.00276 in.)

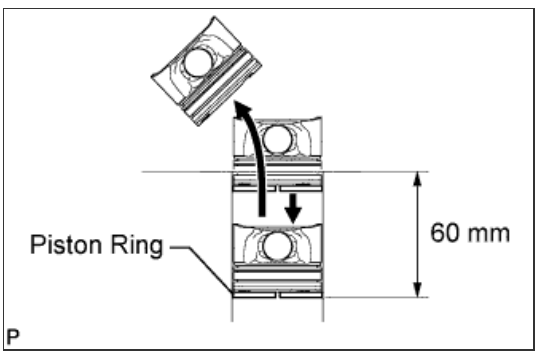
If the clearance is not as specified, replace the piston.



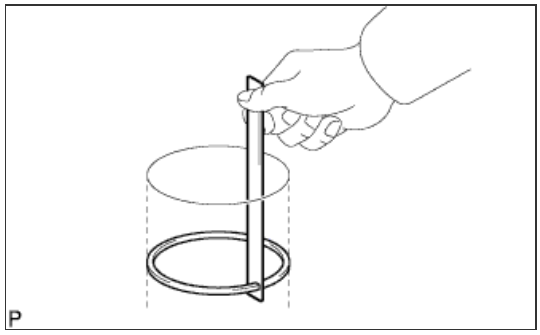
5. INSPECT PISTON RING END GAP

a. Insert the piston ring into the cylinder bore.

b. Using a piston, push the piston ring a little beyond the bottom of the ring travel, 60 mm (2.36 in.) from the top of the cylinder block.



c. Using a feeler gauge, measure the end gap.



Standard End Gap:

Item	Type of Engine	Specified Condition
No. 1 compression ring	w/ EGR System	0.22 to 0.32 mm (0.00866 to 0.0126 in.)
	w/o EGR System	0.20 to 0.30 mm (0.00787 to 0.0118 in.)
No. 2 compression ring	-	0.47 to 0.62 mm (0.0185 to 0.0244 in.)
Oil ring	-	0.10 to 0.40 mm (0.00394 to 0.0157 in.)

Maximum End Gap:

Item	Specified Condition
No. 1 compression ring	0.40 mm (0.0157 in.)
No. 2 compression ring	0.75 mm (0.0295 in.)
Oil ring	0.50 mm (0.0197 in.)

If the end gap is more than the maximum, replace the piston ring. If the end gap is more than the maximum even with a new piston ring, replace the cylinder block.

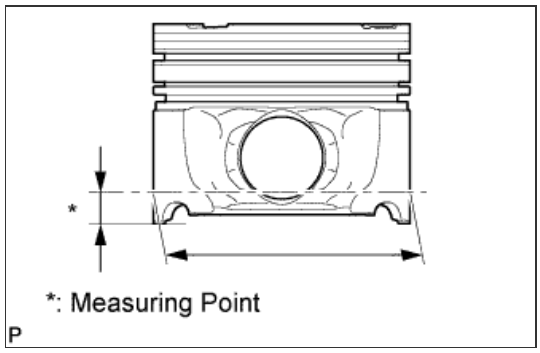
6. INSPECT PISTON WITH PIN SUB-ASSEMBLY

a. Using a micrometer, measure the piston diameter at a right angle to the piston pin center line, 12 mm (0.472 in.) from the piston skirt.

Standard piston diameter:
85.932 to 85.966 mm (3.383 to 3.384 in.)

Minimum piston diameter:
85.910 mm (3.382 in.)

If the diameter is less than the minimum, replace the piston with pin sub-assembly.



7. INSPECT PISTON OIL CLEARANCE

a. Subtract the piston diameter measurement from the cylinder bore diameter measurement.

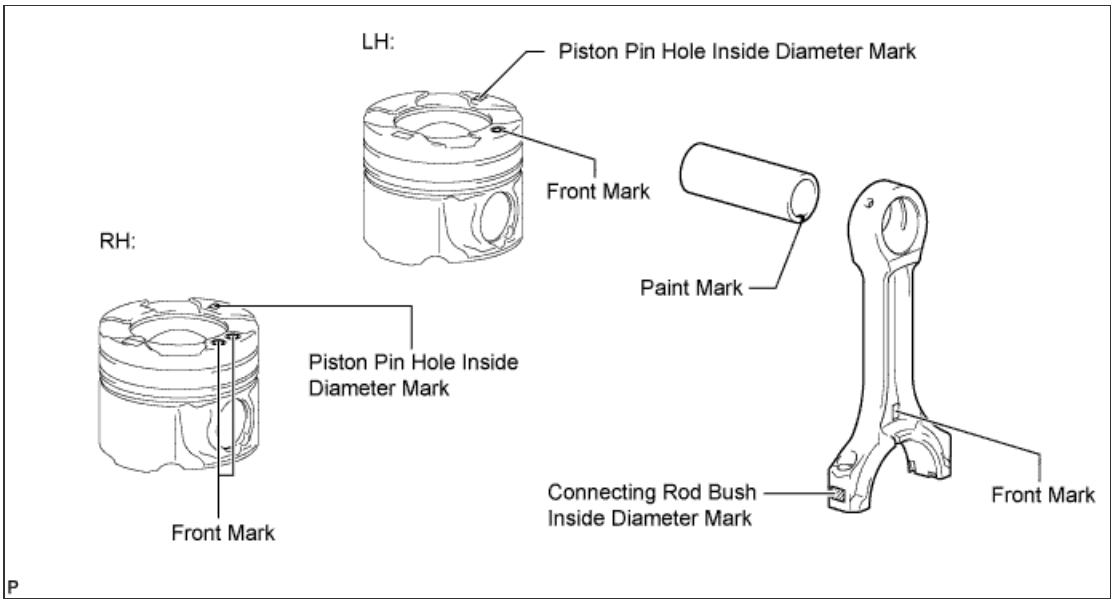
Standard oil clearance:
0.034 to 0.081 mm (0.00134 to 0.00319 in.)

Maximum oil clearance:
0.091 mm (0.00358 in.)

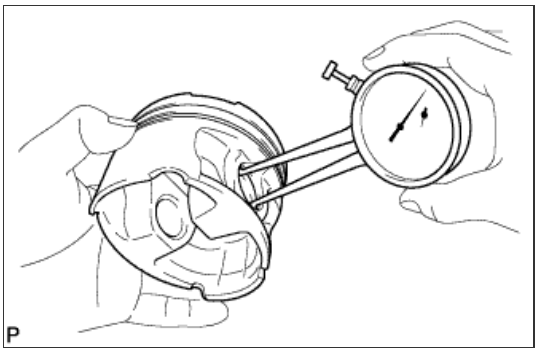
If the oil clearance is more than the maximum, replace all 8 pistons. If necessary, replace the cylinder block.

8. INSPECT PISTON PIN OIL CLEARANCE

a. Check each mark on the piston, piston pin and connecting rod.



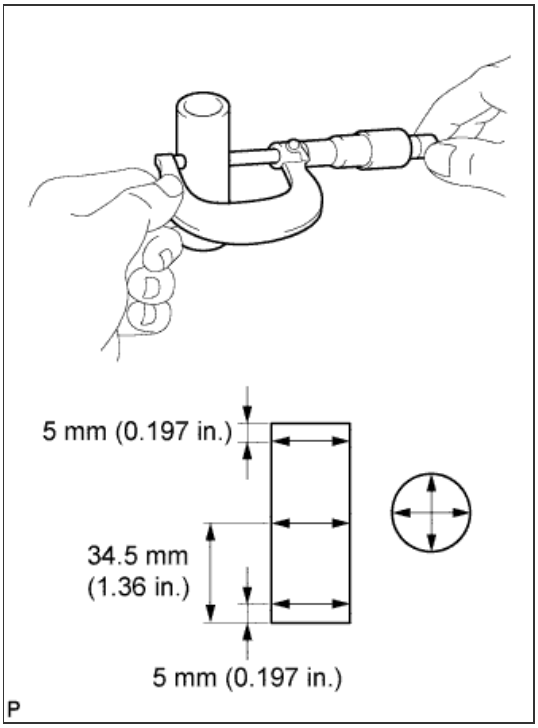
b. Using a caliper gauge, measure the inside diameter of the piston pin hole.



Standard Piston Pin Hole Inside Diameter:

ark	Specified Condition
A	29.009 to 29.013 mm (1.1421 to 1.1422 in.)
B	29.013 to 29.017 mm (1.1422 to 1.1424 in.)
C	29.017 to 29.021 mm (1.1424 to 1.1426 in.)

c. Using a micrometer, measure the piston pin diameter.



Standard Piston Pin Diameter:

ark	Paint Color	Specified Condition
A	White	29.000 to 29.004 mm (1.1417 to 1.1419 in.)
B	Pink	29.004 to 29.008 mm (1.1419 to 1.1420 in.)
C	Blue	29.008 to 29.012 mm (1.1420 to 1.1422 in.)

d. Subtract the piston pin diameter measurement from the piston pin hole diameter measurement.

Standard oil clearance:
0.005 to 0.013 mm (0.000197 to 0.000512 in.)

Maximum oil clearance:
0.018 mm (0.000709 in.)

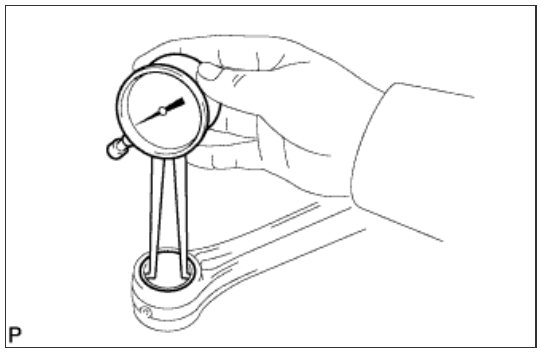
If the oil clearance is more than the maximum, replace the piston and piston pin as a set.

e. Using a caliper gauge, measure the inside diameter of the connecting rod bush.

Standard Bush Inside Diameter:

ark	Specified Condition
A	29.019 to 29.023 mm (1.1425 to 1.1426 in.)

B	29.023 to 29.027 mm (1.1426 to 1.1428 in.)
C	29.027 to 29.031 mm (1.1428 to 1.1430 in.)



f. Subtract the piston pin diameter measurement from the bush inside diameter measurement.

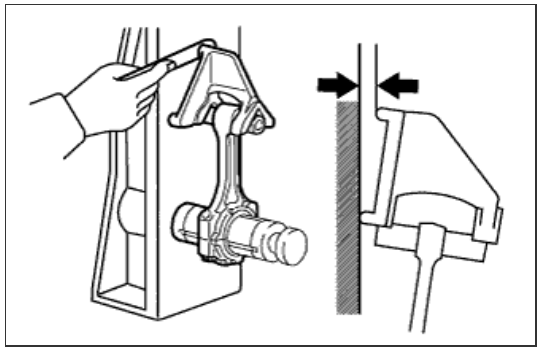
Standard oil clearance:
0.015 to 0.023 mm (0.000591 to 0.000906 in.)

Maximum oil clearance:
0.028 mm (0.00110 in.)

If the oil clearance is more than the maximum, replace the connecting rod and piston with pin as a set.

9. INSPECT CONNECTING ROD SUB-ASSEMBLY

a. Using a rod aligner and feeler gauge, check the connecting rod alignment.

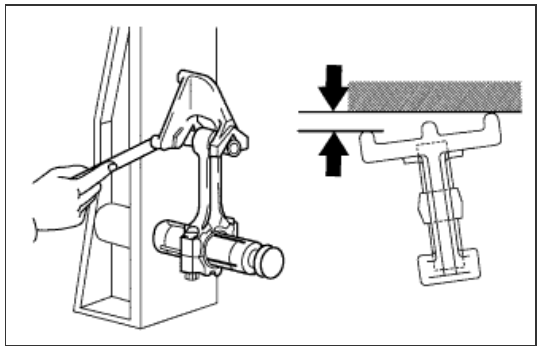


i. Check for bend.

Maximum bend:
0.07 mm (0.00276 in.) per 100 mm (3.94 in.)

If the bend is more than the maximum, replace the connecting rod sub-assembly.

ii. Check for twist.

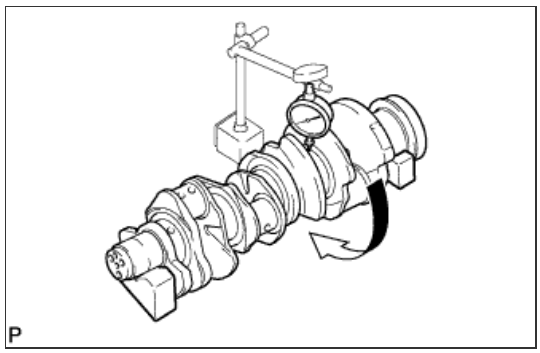


Maximum twist:
0.15 mm (0.00591 in.) per 100 mm (3.94 in.)

If the twist is more than the maximum, replace the connecting rod sub-assembly.

10. INSPECT CRANKSHAFT

a. Using a dial indicator and V-blocks, measure the runout as shown in the illustration.



Maximum circle runout:
0.04 mm (0.00157 in.)

If the circle runout is more than the maximum, replace the crankshaft.

b. Using a micrometer, measure the diameter of each main journal.

Standard diameter:

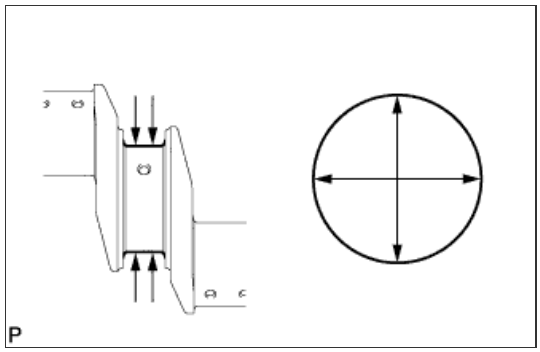
74.982 to 75.000 mm (2.9520 to 2.9527 in.)

If the diameter is not as specified, check the oil clearance. If necessary, replace the crankshaft.

c. Check each main journal for taper and out-of-round as shown in the illustration.

Maximum taper and out-of-round:
0.01 mm (0.000394 in.)

If the taper and out-of-round is more than the maximum, replace the crankshaft.



d. Using a micrometer, measure the diameter of each crank pin.

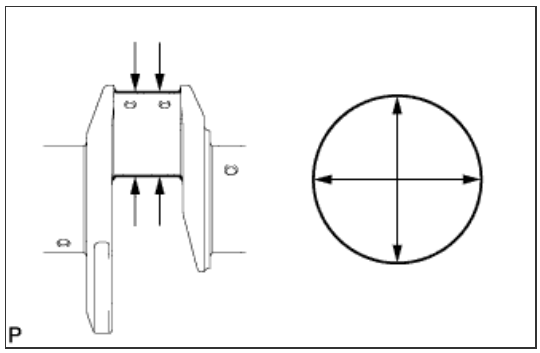
Standard diameter:
54.982 to 55.000 mm (2.1646 to 2.1653 in.)

If the diameter is not as specified, check the oil clearance. If necessary, replace the crankshaft.

e. Check each crank pin for taper and out-of-round as shown in the illustration.

Maximum taper and out-of-round:
0.01 mm (0.000394 in.)

If the taper and out-of-round is more than the maximum, replace the crankshaft.



11. INSPECT CRANKSHAFT OIL CLEARANCE

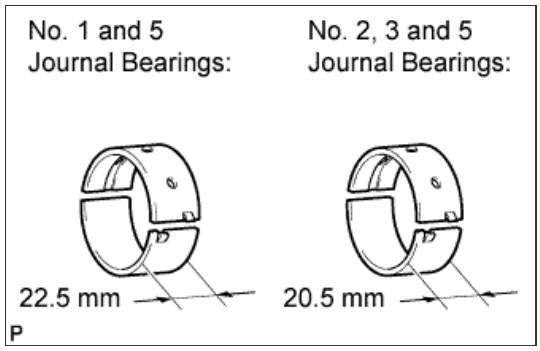
HINT:

ain bearings come in widths of 20.5 mm (0.807 in.) and 22.5 mm (0.886 in.).

Standard Bearing Width

Item	Specified Condition
No. 1 and 5 journal bearings	22.5 mm (0.886 in.)
No. 2, 3 and 4 journal bearings	20.5 mm (0.807 in.)

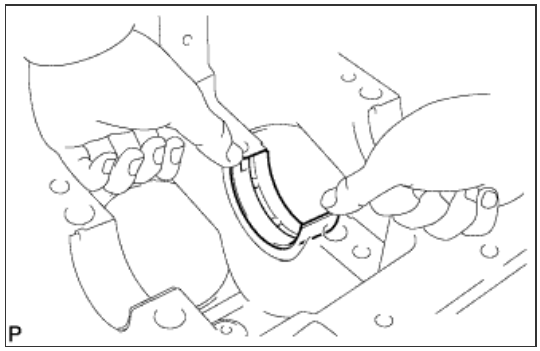
a. Clean each main journal and bearing.



b. Align the bearing claw with the claw groove of the cylinder block, and push in the 5 upper bearings.

NOTICE:

- **Do not apply engine oil to the bearings and the contact surfaces.**
- **Do not allow coolant to come into contact with the bearing inner surface. If any coolant comes into contact with the bearing inner surface, replace the bearing with a new one.**
- **Both sides of the oil groove in the cylinder block should be visible through the oil feed holes in the bearing. The amount visible on each side of the holes should be equal.**



c. Align the bearing claw with the claw groove of the main bearing cap, and push in the 5 lower bearings.

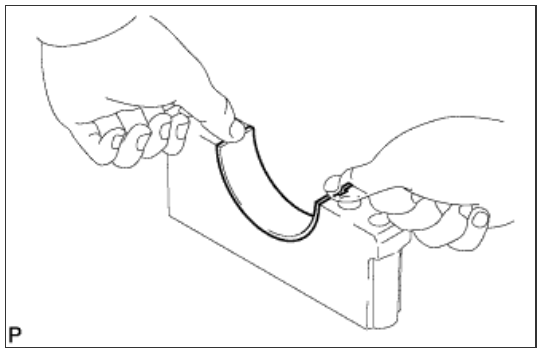
NOTICE:

- **Do not apply engine oil to the bearings and the contact surfaces.**
- **Do not allow coolant to come into contact with the bearing**

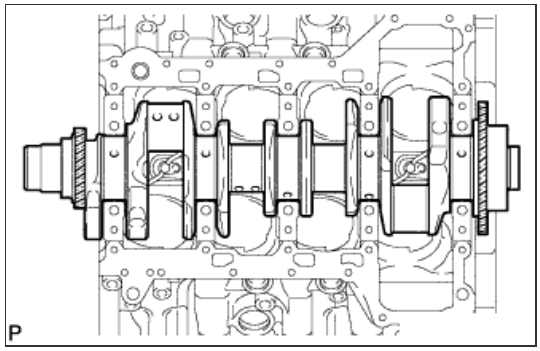
inner surface.
If any coolant comes into contact with the bearing inner surface, replace the bearing with a new one.

HINT:

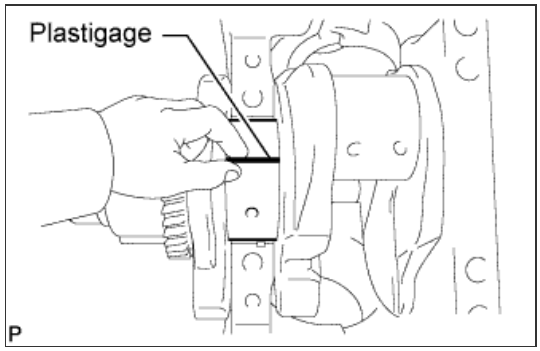
A number marked on each main bearing cap indicates the installation position.



d. Place the crankshaft on the cylinder block.



e. ay a strip of Plastigage across each journal.

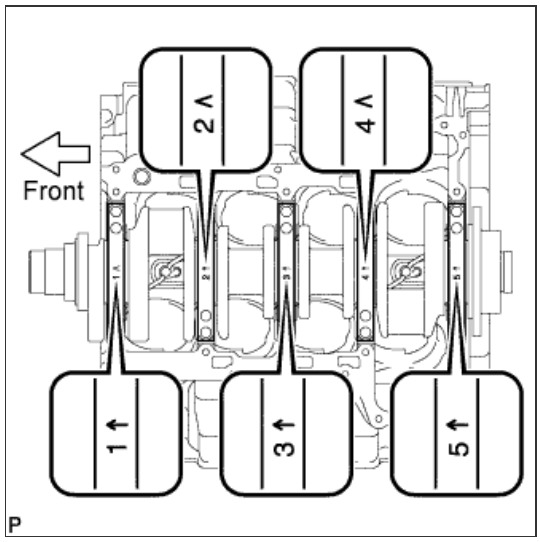


f. Examine the front marks and numbers and install the crankshaft bearing caps to the cylinder block.

NOTICE:

Do not turn the crankshaft.

g. Apply a light coat of engine oil to the threads of the crankshaft bearing cap bolts.



h. Temporarily install the crankshaft bearing cap bolts labeled A or the bolts labeled B.

HINT:

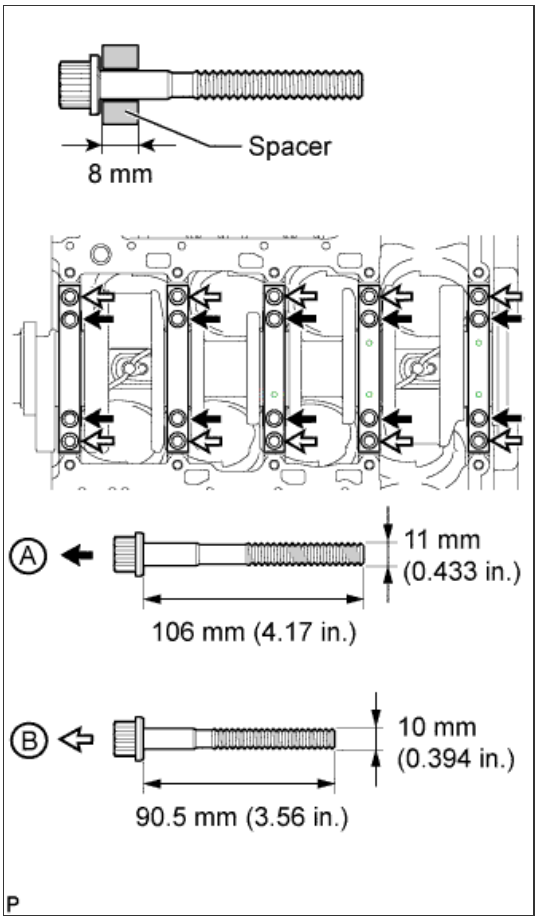
In place of cylinder block stiffening plates, install 8 mm (0.315 in.) thick spacers to the crankshaft bearing cap bolts.

i. Uniformly tighten the 2 crankshaft bearing cap bolts for each bearing cap in several passes to ensure a proper fit.

NOTICE:

Do not tap the bearing cap with a plastic-faced hammer.

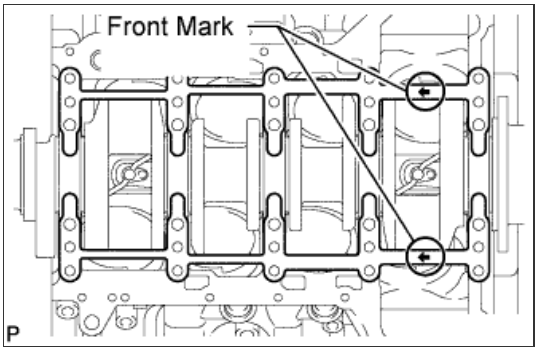
. Remove the crankshaft bearing cap bolts and spacers.



k. Set the 2 cylinder block stiffening plates on the cylinder block.

HINT:

ake sure the arrows on the stiffening plates face the engine front.



l. Step 1:

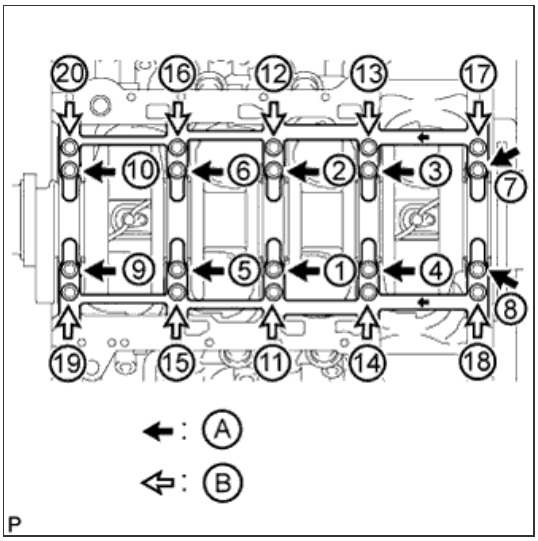
HINT:

- **The crankshaft bearing cap bolts are tightened in 3 progressive steps.**
- **If any crankshaft bearing cap bolt is broken or deformed, replace it.**

i. Apply a light coat of engine oil to the threads and under the heads of the 20 crankshaft bearing cap bolts.

ii. Install the 20 crankshaft bearing cap bolts. Using several steps, tighten the bolts uniformly in the sequence shown in the illustration.

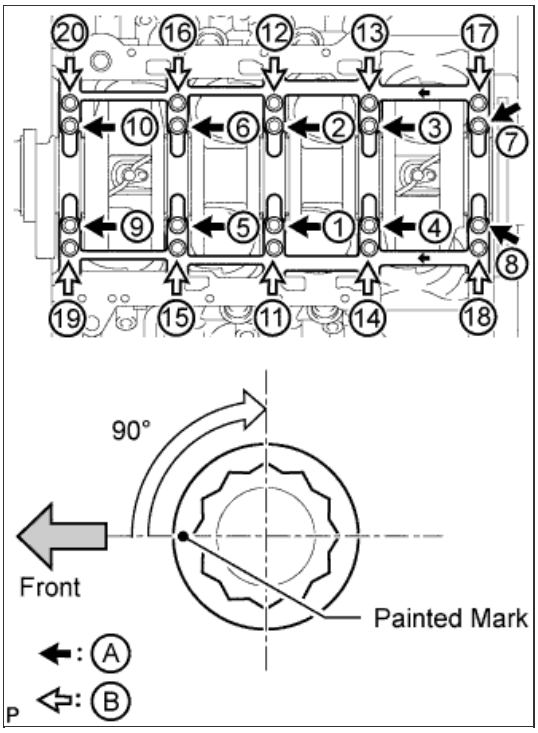
Torque:
for bolt A:
35 N*m{ 357 kgf*cm , 26 ft.*lbf }
for bolt B:
60 N*m{ 612 kgf*cm , 44 ft.*lbf }



m. Step 2:

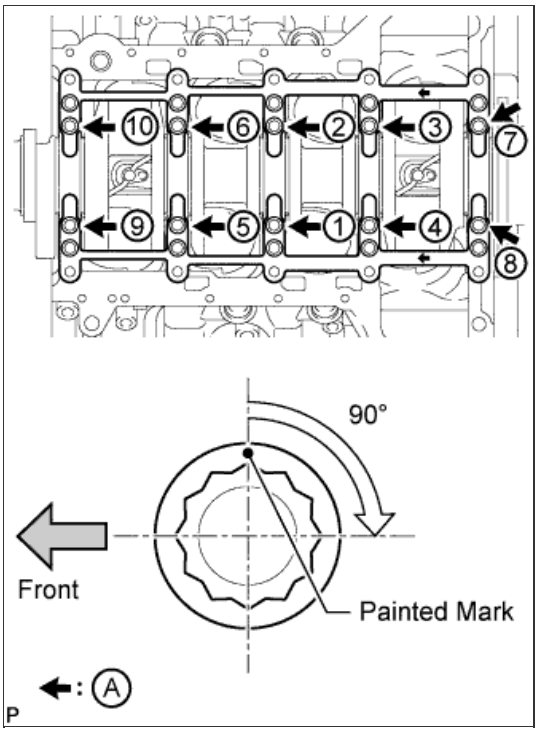
i. ark the front side of the crankshaft bearing cap bolts A and B with paint.

ii. Tighten the crankshaft bearing cap bolts A and B 90° in the sequence shown in the illustration.

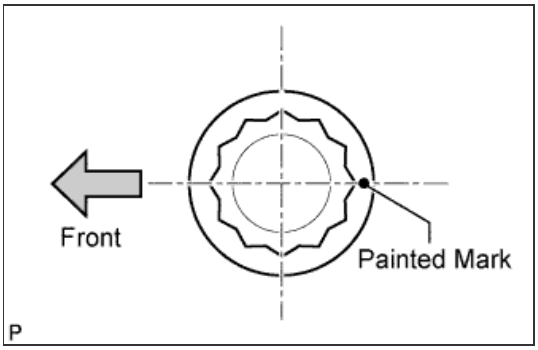


n. Step 3:

i. Tighten the crankshaft bearing cap bolts A another 90° in the sequence shown in the illustration.



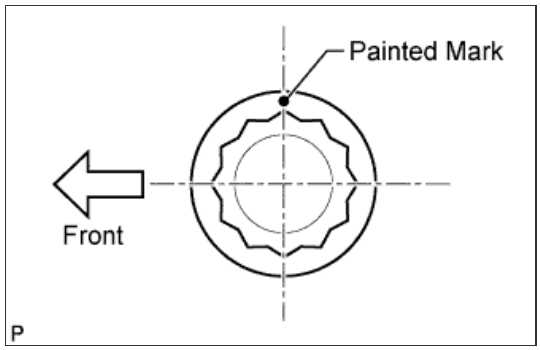
ii. Check that the painted marks of bolts A are now at a 180° angle to the front.



iii. Check that the painted marks of bolts B are now at a 90° angle to the front.

NOTICE:

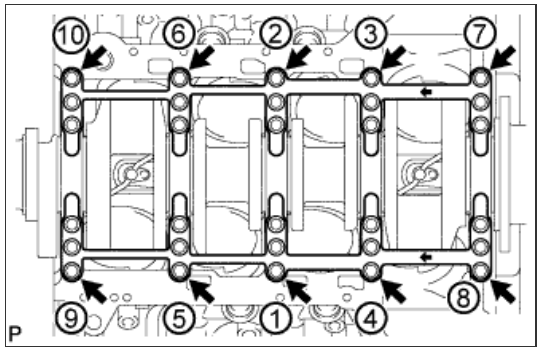
Do not turn the crankshaft.



o. Step 4:

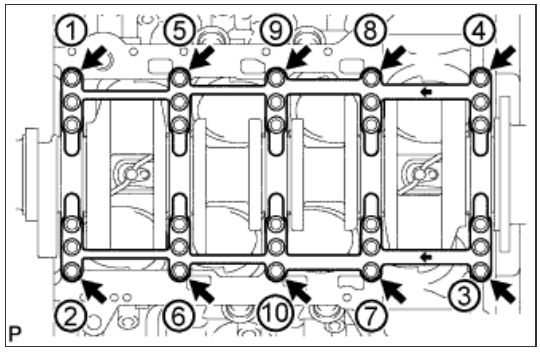
i. Using several steps, install the 10 crankshaft bearing cap bolts uniformly in the sequence shown in the illustration.

Torque:
56 N*m{ 571 kgf*cm , 41 ft.*lbf }

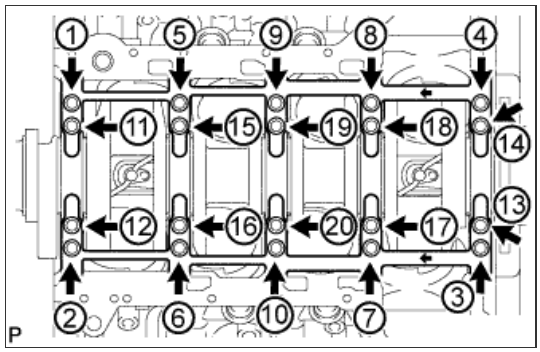


p. Remove the crankshaft bearing caps.

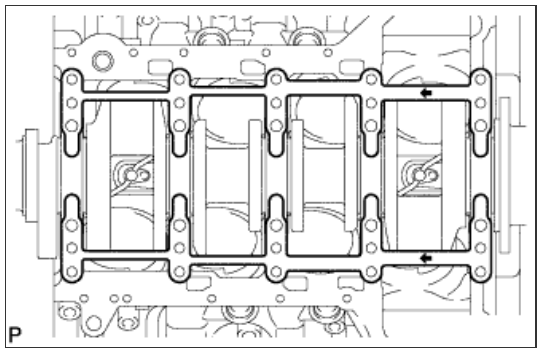
i. Step 1:
Using several steps, loosen and remove the 10 crankshaft bearing cap set bolts uniformly in the sequence shown in the illustration.



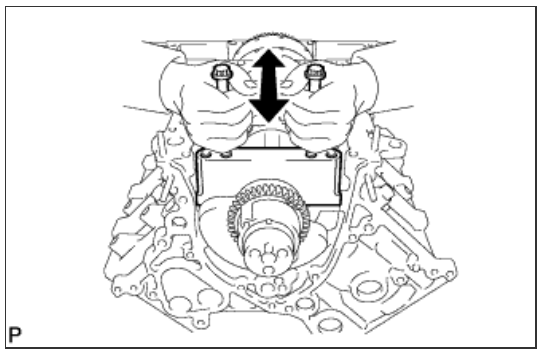
ii. Step 2:
Using several steps, loosen and remove the 20 crankshaft bearing cap set bolts uniformly in the sequence shown in the illustration.



q. Remove the 2 cylinder block stiffening plates.



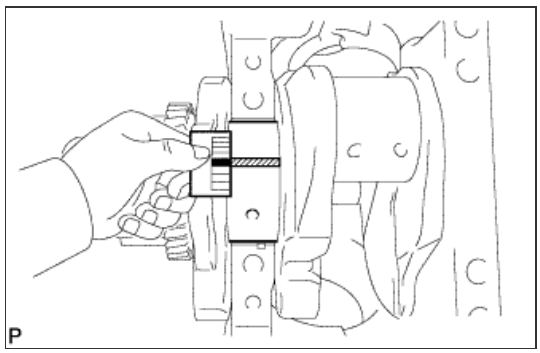
r. Using 2 crankshaft bearing cap set bolts, pull out the 5 bearing caps.



NOTICE:

Take care not to damage the contact surface of the crankshaft bearing cap and cylinder block.

s. easure the Plastigage at its widest point.



Standard Oil Clearance:

Item	Specified Condition
No. 1 and 3 journals	0.020 to 0.038 mm (0.000787 to 0.00150 in.)
No. 2, 4 and 5 journals	0.032 to 0.050 mm (0.00126 to 0.00197 in.)

Maximum Clearance:

Item	Specified Condition
No. 1 and 3 journals	0.048 mm (0.00189 in.)
No. 2, 4 and 5 journals	0.060 mm (0.00236 in.)

If the oil clearance is more than the maximum, use an over size bearing and correct or regrind the crankshaft so that the oil clearance is as shown in the table below.

Oil Clearance (Use for Over Size Bearing):

Item	Specified Condition
No. 1 and 3 journals	0.021 to 0.061 mm (0.000827 to 0.00240 in.)
No. 2, 4 and 5 journals	0.033 to 0.073 mm (0.00130 to 0.00287 in.)

HINT:

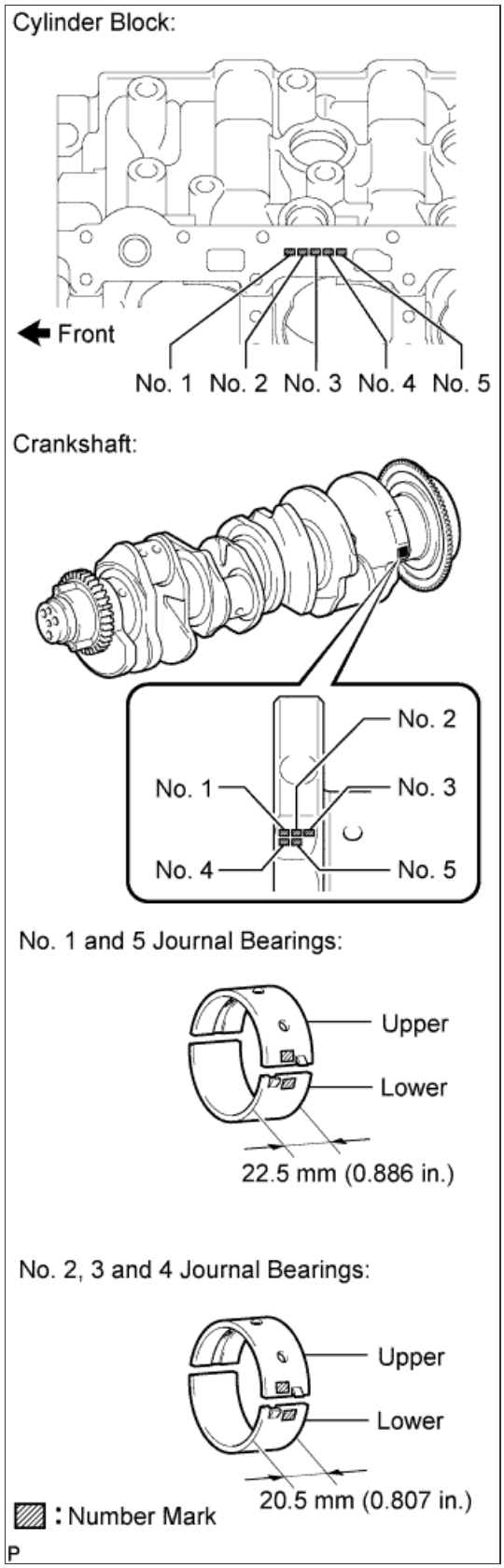
ake sure to replace the upper and lower main bearings as one set.

t. Completely remove the Plastigage.

u. If replacing a bearing, replace it with one that has the same number. If the number of the bearing cannot be determined, select the correct bearing by adding together the numbers imprinted on the cylinder block and crankshaft, then refer to the appropriate bearing number. There are 7 sizes of standard bearings, marked "1", "2", "3", "4", "5", "6" and "7" accordingly.
E A E
Cylinder block main journal bore diameter "1" (A) + Crankshaft main journal diameter "2" (B) = Total number 3 (use bearing "3" (C))

No. 1 to No. 5 on Cylinder Block:

Cylinder Block (A)	Crankshaft (B)	Use Bearing (C)
"1"	"0"	"1"
	"1"	"2"
	"2"	"3"
	"3"	"4"
	"4"	"5"
"2"	"0"	"2"
	"1"	"3"
	"2"	"4"
	"3"	"5"
	"4"	"6"
"3"	"0"	"3"
	"1"	"4"
	"2"	"5"
	"3"	"6"
	"4"	"7"



Standard Cylinder Block Main Journal Bore Diameter (A):

Item	ark	Specified Condition
No. 1 and 3 journals	"1"	79.000 to 79.006 mm (3.11023 to 3.11047 in.)
	"2"	ore than 79.006 to 79.012 mm (more than 3.11047 to 3.11070 in.)
	"3"	ore than 79.012 to 79.018 mm (more than 3.11070 to 3.11094 in.)
No. 2, 4 and 5 journals	"1"	79.000 to 79.006 mm (3.11023 to 3.11047 in.)
	"2"	ore than 79.006 to 79.012 mm (more than 3.11047 to 3.11070 in.)
	"3"	ore than 79.012 to 79.018 mm (more than 3.11070 to 3.11094 in.)

Standard Crankshaft Main Journal Diameter (B):

Item	ark	Specified Condition
No. 1 and 3 journals	"2"	ore than 74.994 to 75.000 mm (more than 2.95251 to 2.95275 in.)
	"3"	ore than 74.988 to 74.994 mm (more than 2.95228 to 2.95251 in.)
	"4"	74.982 to 74.988 mm (2.95204 to 2.95228 in.)
No. 2, 4 and 5 journals	"0"	ore than 74.994 to 75.000 mm (more than 2.95251 to 2.95275 in.)
	"1"	ore than 74.988 to 74.994 mm (more than 2.95288 to 2.95251 in.)
	"2"	74.982 to 74.988 mm (2.95204 to 2.95228 in.)

Standard Crankshaft Bearing Center Wall Thickness (C):

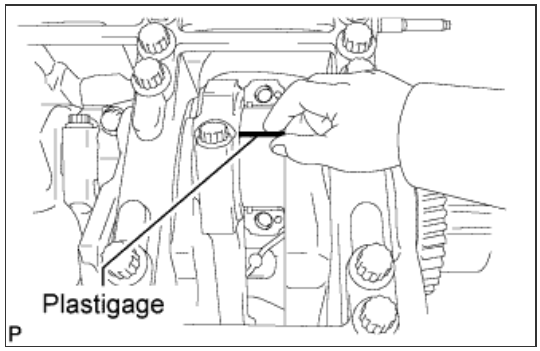
Item	ark	Specified Condition (for Upper Bearing)	Specified Condition (for ower Bearing)
No. 1 and 5 journal bearings	"1"	ore than 1.987 to 1.990 mm (more than 0.07823 to 0.07835 in.)	ore than 1.975 to 1.978 mm (more than 0.07776 to 0.07787 in.)
	"2"	ore than 1.990 to 1.993 mm (more than 0.07835 to 0.07846 in.)	ore than 1.978 to 1.981 mm (more than 0.07787 to 0.07799 in.)
	"3"	ore than 1.993 to 1.996 mm (more than 0.07846 to 0.07858 in.)	ore than 1.981 to 1.984 mm (more than 0.07799 to 0.07811 in.)
	"4"	ore than 1.996 to 1.999 mm (more than 0.07858 to 0.07870 in.)	ore than 1.984 to 1.987 mm (more than 0.07811 to 0.07823 in.)
	"5"	ore than 1.999 to 2.002 mm (more than 0.07870 to 0.07882 in.)	ore than 1.987 to 1.990 mm (more than 0.07823 to 0.07835 in.)
	"6"	ore than 2.002 to 2.005 mm (more than 0.07882 to 0.07894 in.)	ore than 1.990 to 1.993 mm (more than 0.07835 to 0.07846 in.)
	"7"	ore than 2.005 to 2.008 mm (more than 0.07894 to 0.07905 in.)	ore than 1.993 to 1.996 mm (more than 0.07846 to 0.07858 in.)
No. 2, 3 and 4 journal bearings	"1"	ore than 1.975 to 1.978 mm (more than 0.07776 to 0.07787 in.)	ore than 1.987 to 1.990 mm (more than 0.07823 to 0.07835 in.)
	"2"	ore than 1.978 to 1.981 mm (more than 0.07787 to 0.07799 in.)	ore than 1.990 to 1.993 mm (more than 0.07835 to 0.07846 in.)
	"3"	ore than 1.981 to 1.984 mm (more than 0.07799 to 0.07811 in.)	ore than 1.993 to 1.996 mm (more than 0.07846 to 0.07858 in.)
	"4"	ore than 1.984 to 1.987 mm (more than 0.07811 to 0.07823 in.)	ore than 1.996 to 1.999 mm (more than 0.07858 to 0.07870 in.)
	"5"	ore than 1.987 to 1.990 mm (more than 0.07823 to 0.07835 in.)	ore than 1.999 to 2.002 mm (more than 0.07870 to 0.07882 in.)
	"6"	ore than 1.990 to 1.993 mm (more than 0.07835 to 0.07846 in.)	ore than 2.002 to 2.005 mm (more than 0.07882 to 0.07894 in.)
	"7"	ore than 1.993 to 1.996 mm (more than 0.07846 to 0.07858 in.)	ore than 2.005 to 2.008 mm (more than 0.07894 to 0.07905 in.)

12. INSPECT CONNECTING ROD OIL CLEARANCE

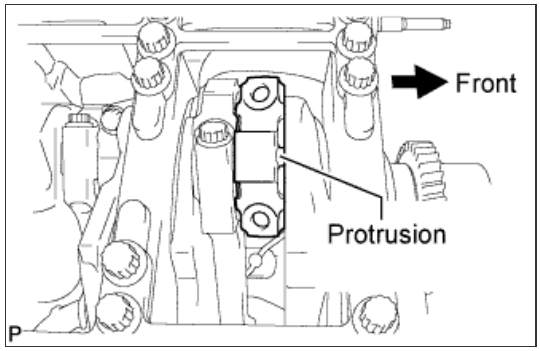
a. Install the crankshaft bearing (Click here).

b. Install the crankshaft (Click here).

c. ay a strip of Plastigage across the crank pin.



d. Install the connecting rod cap so that its protrusion is facing the correct direction.



NOTICE:

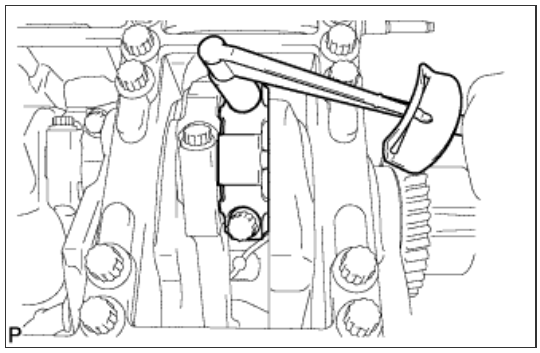
atch the numbered connecting rod cap with the connecting rod.

e. Apply a light coat of engine oil to the threads of the connecting rod cap bolts.

f. Step 1:

HINT:

- **The connecting rod bearing cap bolts are tightened in 2 progressive steps.**
- **If any connecting rod bearing cap bolt is broken or deformed, replace it.**



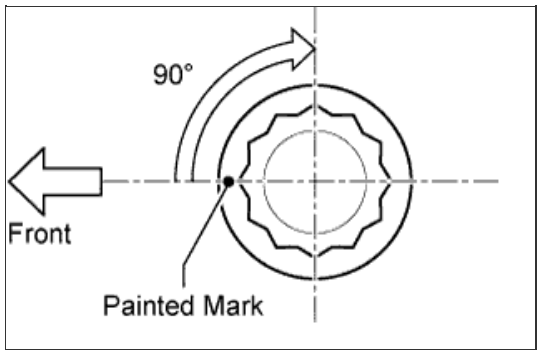
i. Install and alternately tighten the bolts of the connecting rod cap in several steps.

Torque:
35 N*m{ 357 kgf*cm , 26 ft.*lbf }

g. Step 2:

i. ark the front side of each connecting rod cap bolt with paint.

ii. Tighten the bearing cap bolts in step 1 90°.



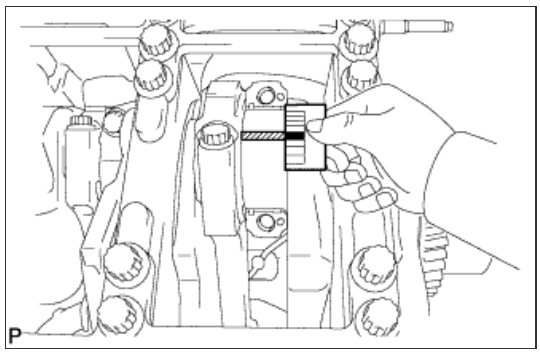
h. Remove the 2 bolts, connecting rod cap and lower bearing.

i. easure the Plastigage at its widest point.

Standard oil clearance:
0.024 to 0.042 mm (0.000945 to 0.00165 in.)

Maximum oil clearance:
0.052 mm (0.00205 in.)

If the oil clearance is more than the maximum, replace the bearings. If necessary, replace the crankshaft.



j. Completely remove the Plastigage.

k. If replacing a bearing, replace it with one that has the same number marked on the connecting rod. There are 5 sizes of standard bearings, marked "1 ", "2", "3", "4" and "5" accordingly.
Select the correct bearing by adding together the number marks imprinted on the connecting rod and crankshaft.
E A E
Connecting rod "1" (A) + Crank pin "2" (B) = Total number 3 (use bearing "3" (C))

Standard Connecting Rod Big End Inside Diameter (A):

ark	Specified Condition

"1"	58.000 to 58.006 mm (2.28346 to 2.28370 in.)
"2"	ore than 58.006 to 58.012 mm (more than 2.28370 to 2.28393 in.)
"3"	ore than 58.012 to 58.018 mm (more than 2.28393 to 2.28417 in.)

Standard Crankshaft Pin Diameter (B):

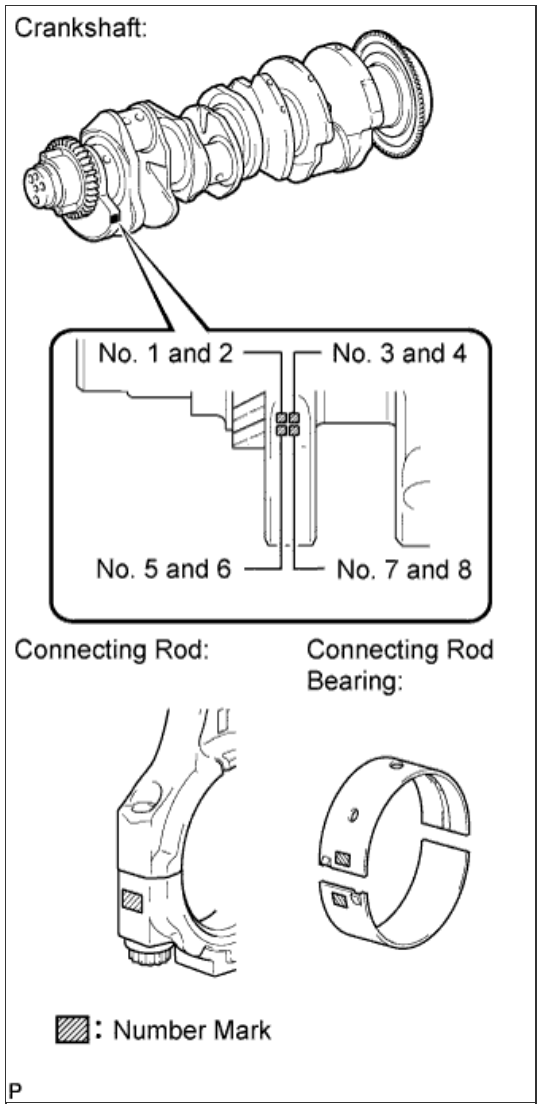
ark	Specified Condition
"0"	ore than 54.994 to 55.000 mm (more than 2.16511 to 2.16535 in.)
"1"	ore than 54.988 to 54.994 mm (more than 2.16488 to 2.16511 in.)
"2"	54.982 to 54.988 mm (2.16464 to 2.16488 in.)

Standard Bearing Center Wall Thickness (C):

ark	Specified Condition
"1"	ore than 1.485 to 1.488 mm (more than 0.05846 to 0.05858 in.)
"2"	ore than 1.488 to 1.491 mm (more than 0.05858 to 0.05870 in.)
"3"	ore than 1.491 to 1.494 mm (more than 0.05870 to 0.05882 in.)
"4"	ore than 1.494 to 1.497 mm (more than 0.05882 to 0.05894 in.)
"5"	ore than 1.497 to 1.500 mm (more than 0.05894 to 0.05910 in.)

l. Remove the crankshaft (Click here).

m. Remove the crankshaft bearing.



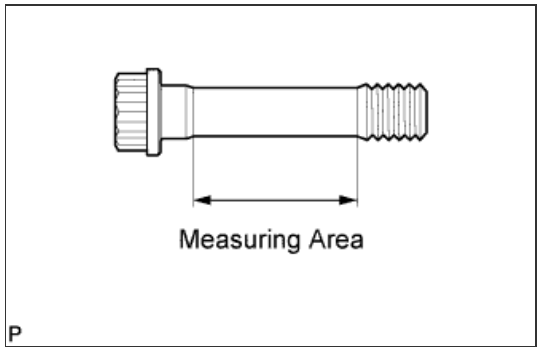
13. INSPECT CONNECTING ROD BOLT

a. Using a vernier caliper, measure the tension portion diameter of the bolt.

Standard diameter:
8.7 to 8.8 mm (0.343 to 0.346 in.)

Minimum diameter:
8.5 mm (0.335 in.)

If the diameter is less than the minimum, replace the connecting rod bolt.



14. INSPECT CRANKSHAFT BEARING CAP BOLT

a. Using a vernier caliper, measure the outside thread diameter of bolt A and B.

Bolt Length

Item	Specified Condition
Bolt A	106 mm (4.17 in.)
Bolt B	90.5 mm (3.56 in.)

Measuring Area:

Item	Specified Condition

Bolt A	73 mm (2.87 in.)
Bolt B	63 mm (2.48 in.)

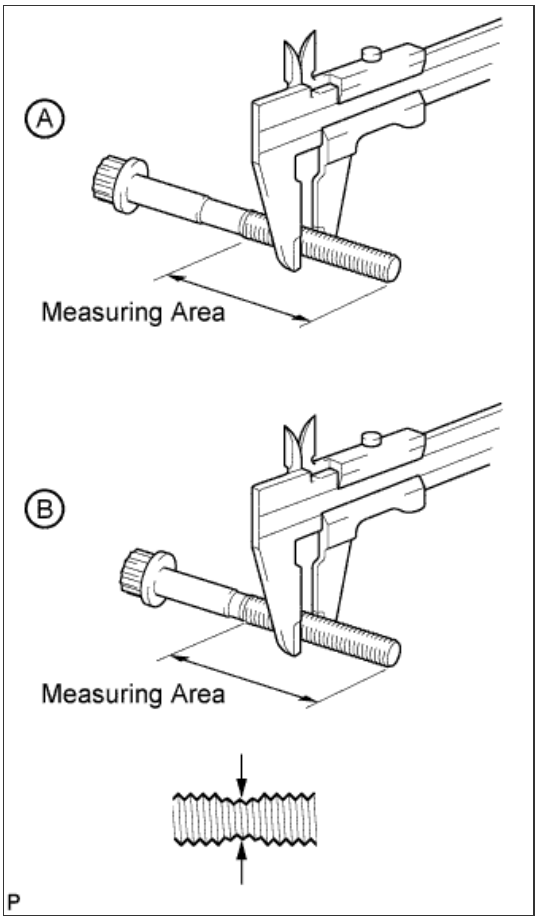
Standard diameter:
for bolt A:
10.8 to 11.0 mm (0.425 to 0.433 in.)
for bolt B:
9.8 to 10.0 mm (0.386 to 0.394 in.)

Minimum diameter:
for bolt A:
10.5 mm (0.413 in.)
for bolt B:
9.5 mm (0.374 in.)

HINT:

If a visual check reveals no excessively thin areas, check the center of the bolt (see illustration) and find the area that has the lowest diameter.

If the diameter is less than the minimum, replace the crankshaft bearing cap bolt.



for Preparation Click here

1. REPLACE STUD BOLT

HINT:

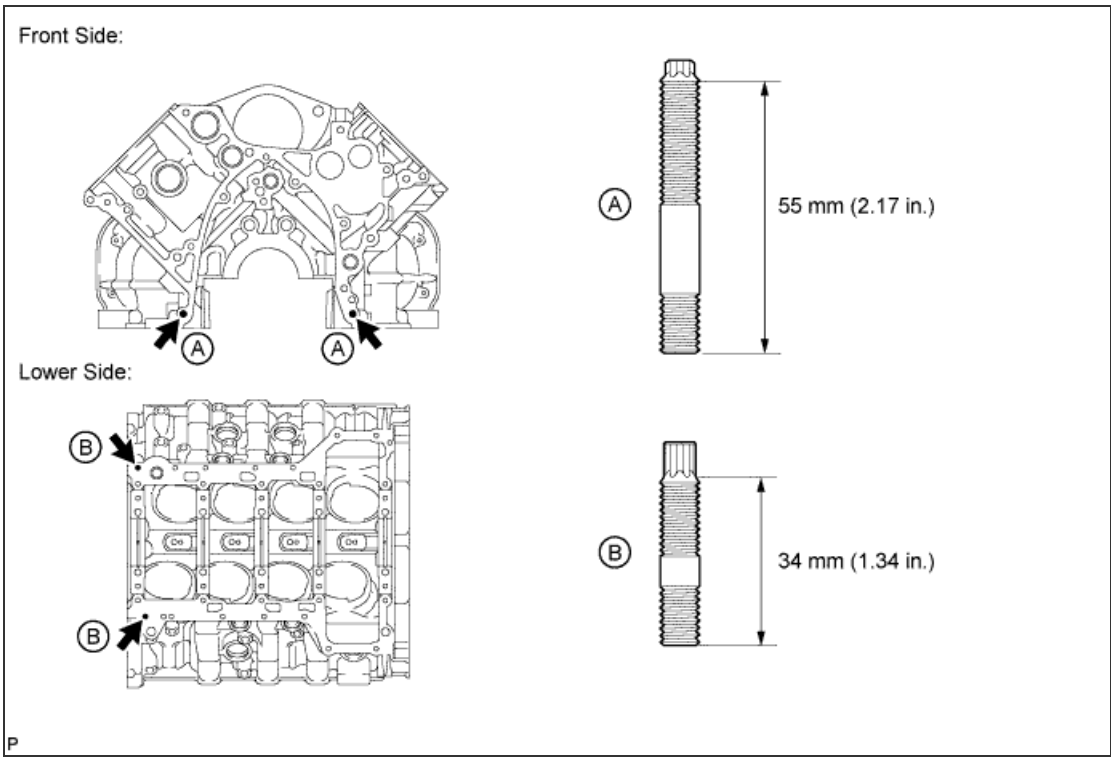
If a stud bolt is deformed or the threads are damaged, replace it.

a. Using an E7 "TORX" wrench, replace the stud bolts labeled A shown in the illustration below.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Using an E8 "TORX" wrench, replace the stud bolts labeled B shown in the illustration below.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



2. REPLACE STRAIGHT PIN

NOTICE:

It is not necessary to remove the straight pin unless it is being replaced.

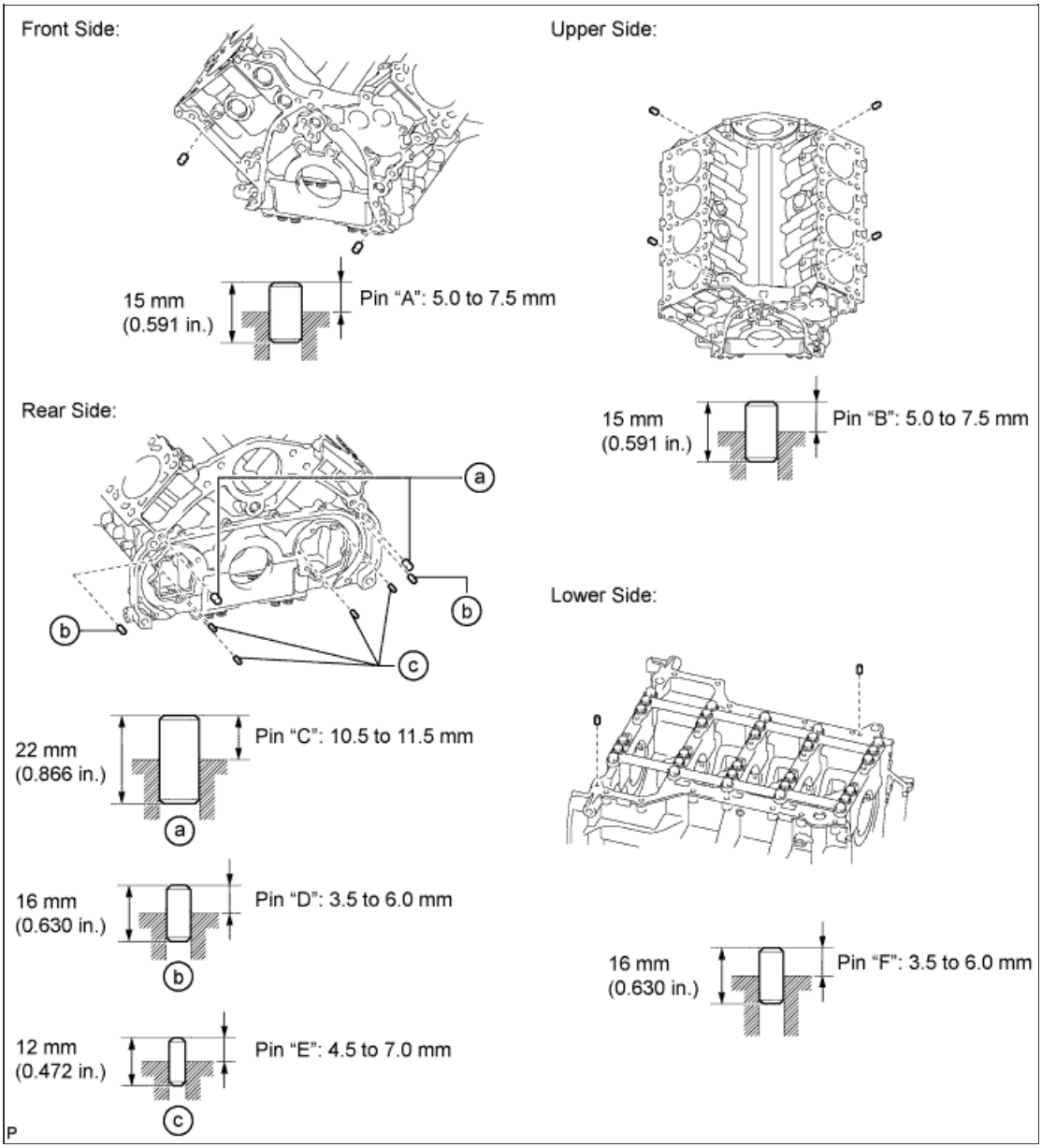
a. Remove the straight pins.

b. Using a plastic-faced hammer, tap in new straight pins to the cylinder block.

Standard Protrusion:

Item	Specified Condition
Pin "A" and "B"	5.0 to 7.5 mm (0.197 to 0.295 in.)

Pin "C"	10.5 to 11.5 mm (0.413 to 0.453 in.)
Pin "D" and "F"	3.5 to 6.0 mm (0.138 to 0.236 in.)
Pin "E"	4.5 to 7.0 mm (0.177 to 0.276 in.)



3. REPLACE CYLINDER BLOCK TIGHT PLUG

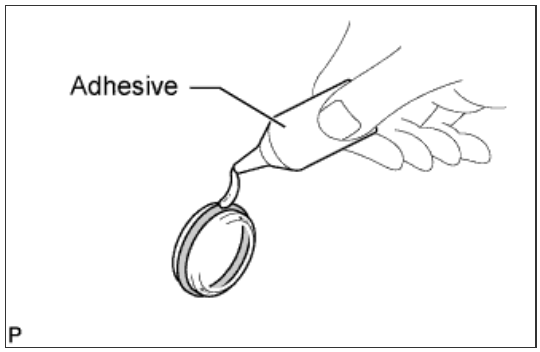
NOTICE:

If water leaks from the tight plug or the plug corrodes, replace it.

a. Remove the tight plugs.

b. Apply adhesive around new tight plugs.

Adhesive:
Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent



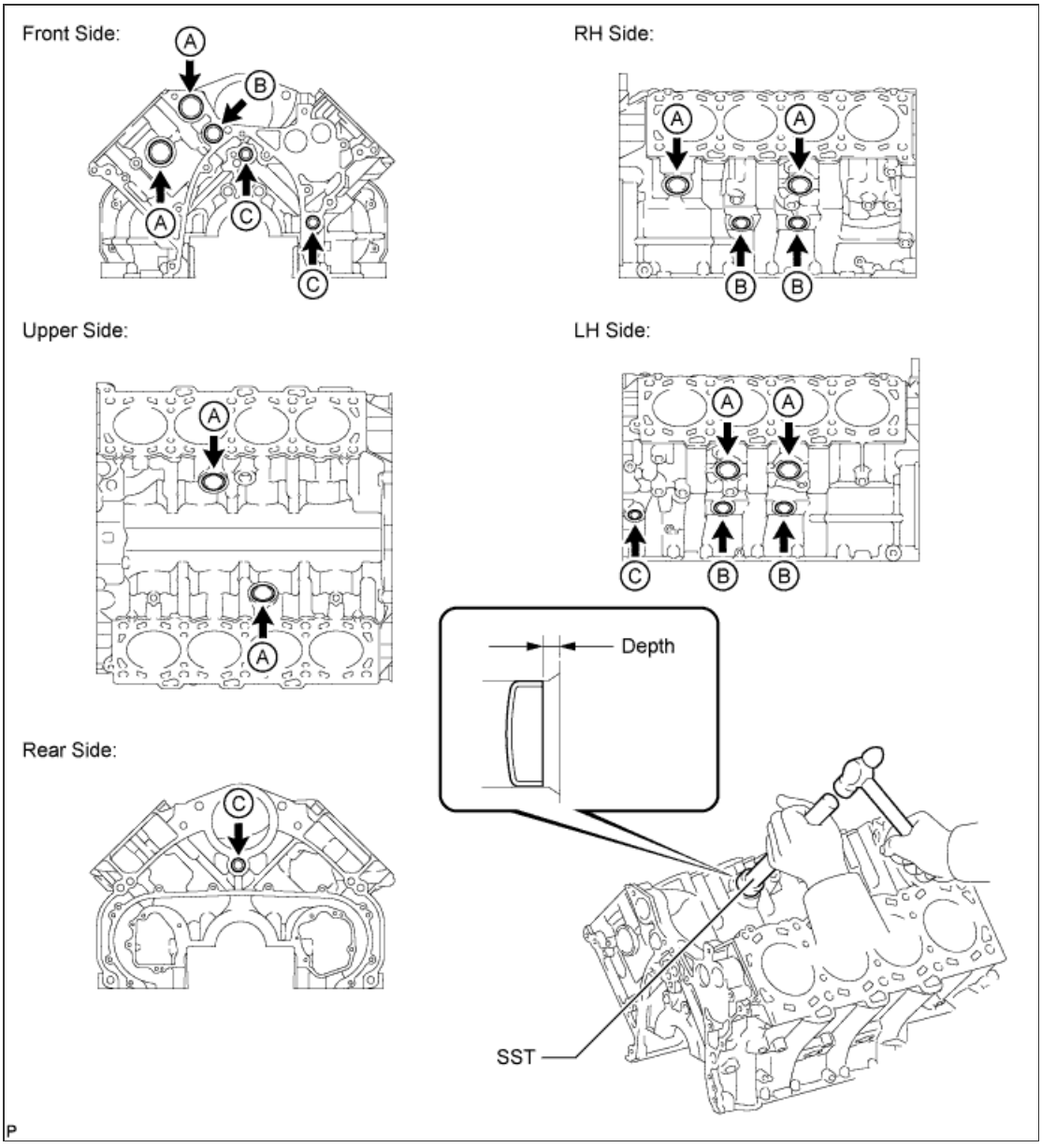
c. Using SST and a hammer, tap in the tight plugs to the specified depth.

SST

09950-60010 (09951-00180, 09951-00250, 09951-00350)
09950-70010 (09951-07150)

Standard depth:

1.7 to 2.7 mm (0.0669 to 0.106 in.)

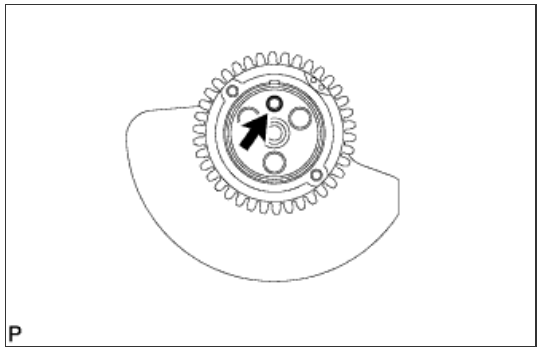


4. REPLACE CRANKSHAFT STRAIGHT PIN

NOTICE:

It is not necessary to remove the crankshaft straight pin unless it is being replaced.

a. Replace the pin.



for Preparation Click here

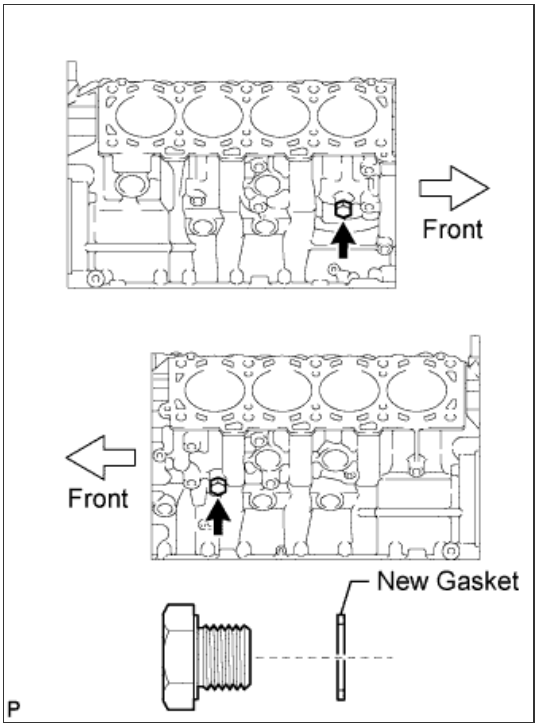
NOTICE:

Before performing these installation procedures, sufficiently clean and remove any foreign matter from the cylinder block, connecting rod and other parts.

1. INSTALL CYLINDER BLOCK STRAIGHT SCREW PLUG

a. Install 2 new gaskets and the 2 straight screw plugs.

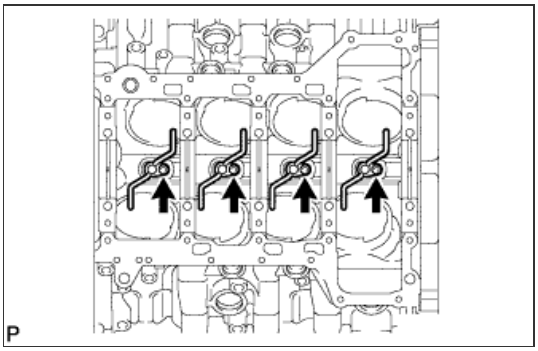
Torque:
38 N*m{ 387 kgf*cm , 28 ft.*lbf }



2. INSTALL NO. 1 OIL NOZZLE SUB-ASSEMBLY

a. Using a 5 mm hexagon wrench, install the 4 oil nozzles with the 4 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

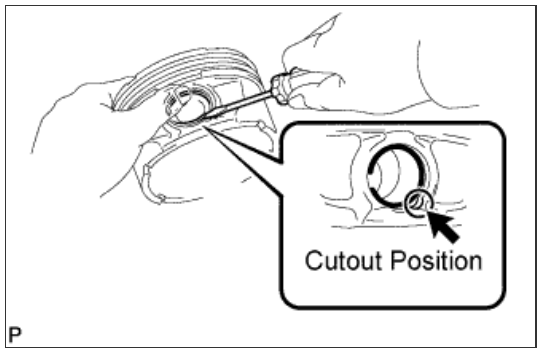


3. INSTALL PISTON PIN HOLE SNAP RING

a. Using a screwdriver, install a new snap ring on one side of the piston pin hole.

HINT:

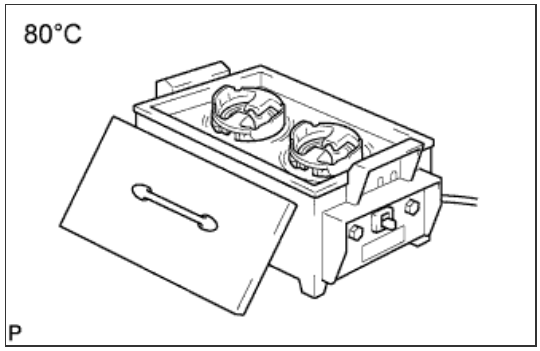
Be sure that the end gap of the snap ring is not aligned with the pin hole cutout portion of the piston.



4. INSTALL PISTON WITH PIN SUB-ASSEMBLY

a. Gradually heat the piston to approximately 80°C (176°F).

b. Coat the piston pin with engine oil.

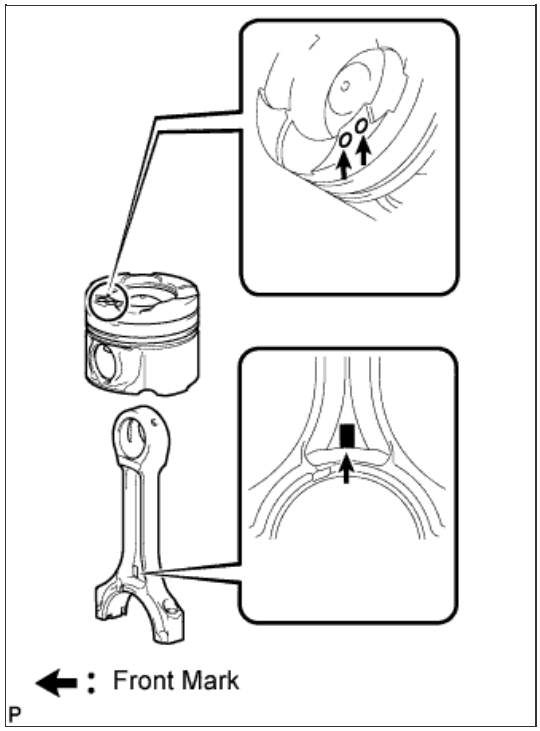


c. RH:

i. Align the front marks of the piston and connecting rod, and push in the piston pin with your thumb.

HINT:

- **The piston and pin are a matched set.**
- **The piston has 2 front marks.**

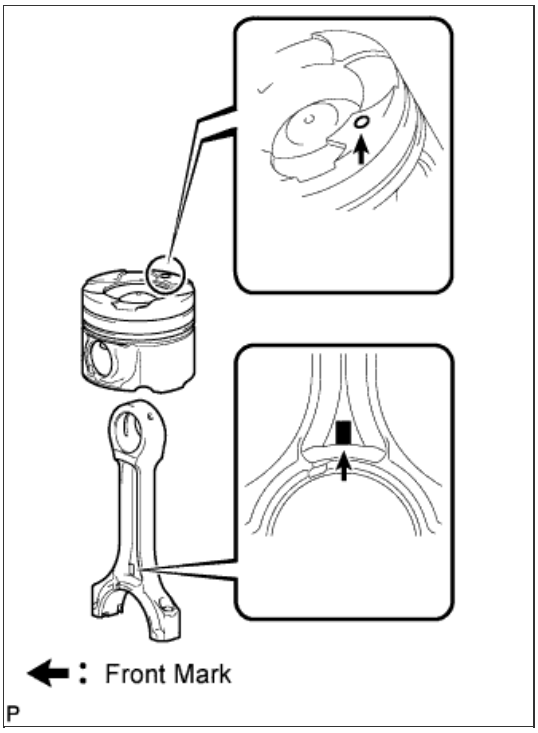


d. LH:

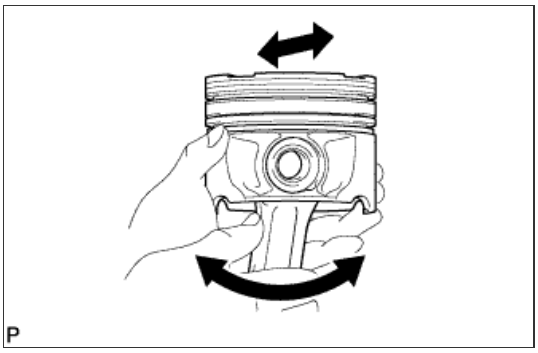
i. Face the front marks of the piston and connecting rod in opposite directions, and push in the piston pin with your thumb.

HINT:

- **The piston and pin are a matched set.**
- **The piston has 1 front mark.**



e. Check the fitting condition between the piston and piston pin by trying to move the piston back and forth on the piston pin.

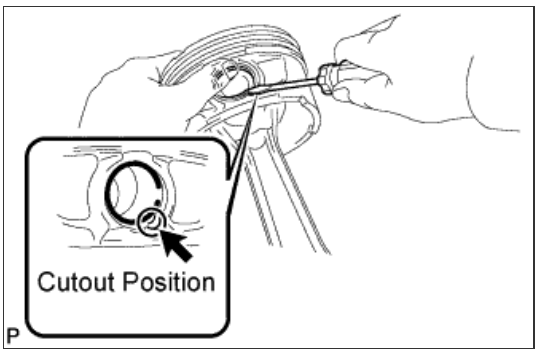


5. INSTALL PISTON PIN HOLE SNAP RING

a. Using a screwdriver, install a new snap ring at the other end of the piston pin hole.

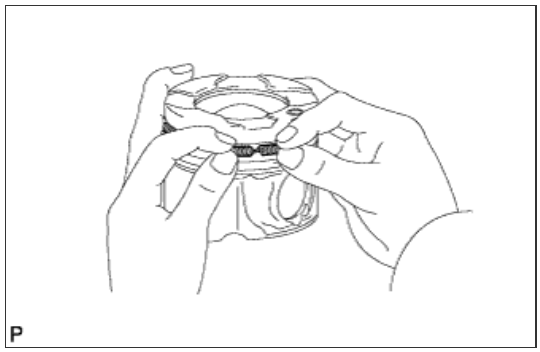
HINT:

Be sure that the end gap of the snap ring is not aligned with the pin hole cutout portion of the piston.



6. INSTALL PISTON RING SET

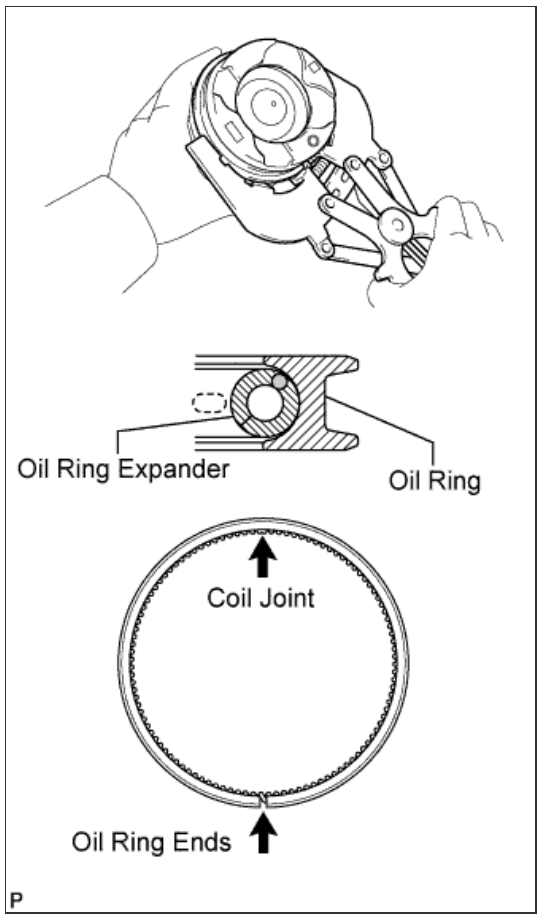
a. Install the oil ring expander by hand.



b. Using a piston ring expander, install the oil ring.

HINT:

Align the oil ring ends and coil joint as shown in the illustration.



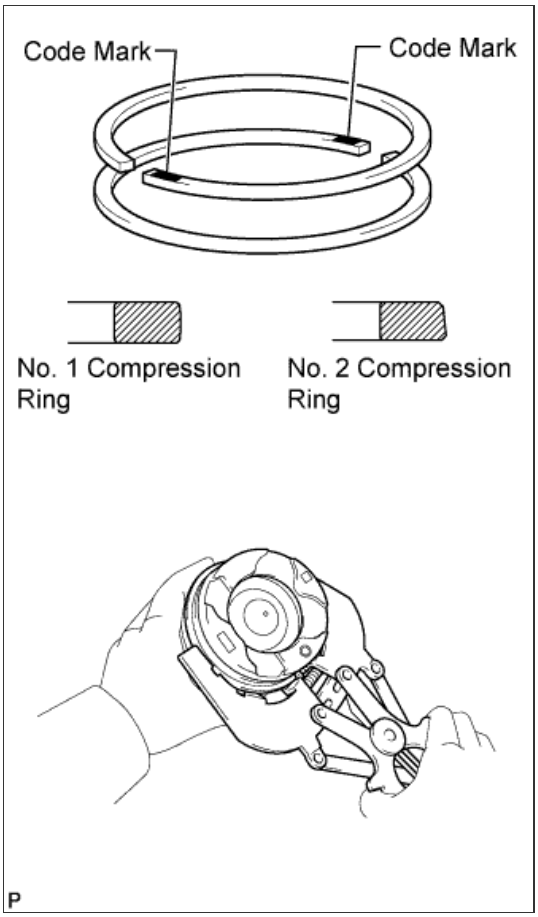
c. Using a piston ring expander, install the No. 1 and No. 2 compression rings so that the code marks are positioned as shown in the illustration.

HINT:

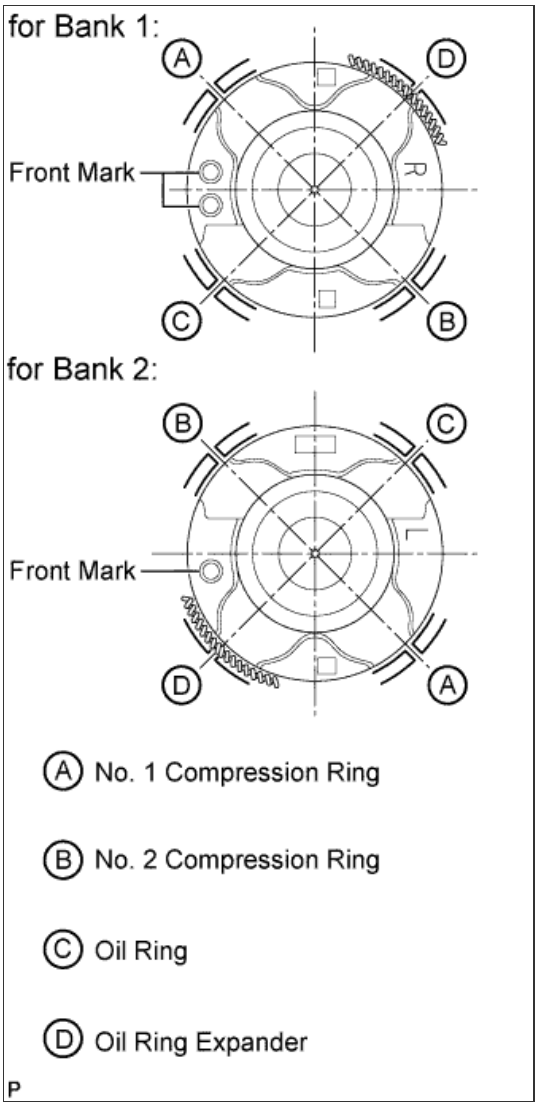
- **w/ EGR System:**
  Install the No. 1 compression ring with the code mark shown in the table below facing upward.
- **w/o EGR System:**
  Install the No. 1 compression ring with no code mark. The compression ring can be installed with either side facing upward.
- **Install the No. 2 compression ring with the code mark shown in the table below facing upward.**

Standard Code Mark:

Item	Code Mark (w/ GR System)	Code Mark (w/o GR System)
No. 1 compression ring	1	o mark
No. 2 compression ring	2	2



d. Position the piston rings so that the ring ends are as shown in the illustration.



7. INSTALL CONNECTING ROD BEARING

a. Align the bearing claw with the claw groove of the connecting rod cap.

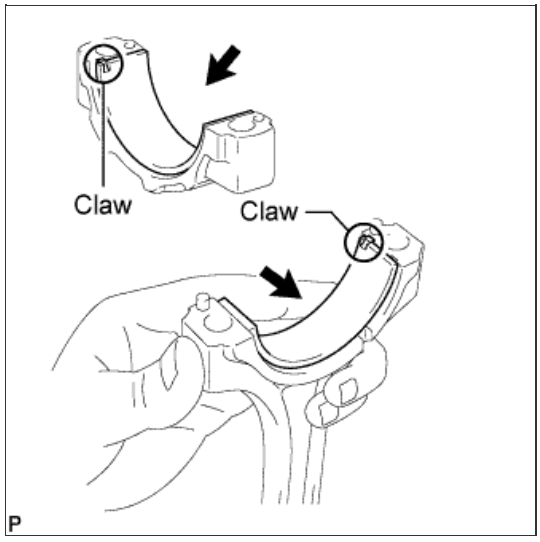
NOTICE:

- **Clean the contact surface of the bearing and connecting rod cap.**
- **Do not apply engine oil to the bearing and its contact surface.**

b. Align the bearing claw with the claw groove of the connecting rod.

NOTICE:

- **Clean the contact surface of the bearing and connecting rod.**
- **Do not apply engine oil to the bearing and its contact surface.**



8. INSTALL CRANKSHAFT BEARING

NOTICE:

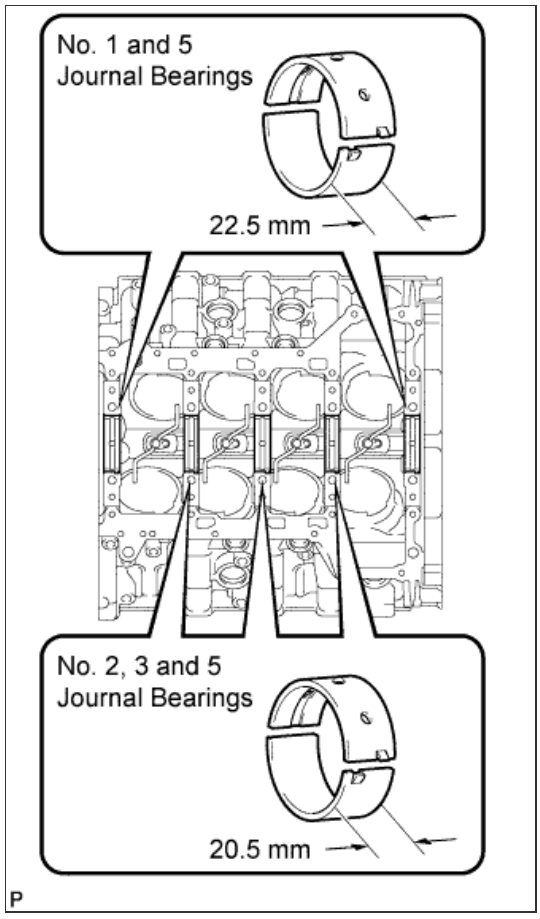
Be sure to install the selected bearing.

HINT:

Main bearings come in widths of 20.5 mm (0.807 in.) and 22.5 mm (0.886 in.).

Bearing Width

Item	Standard Width
No. 1 and 5 journal bearings	22.5 mm (0.886 in.)
No. 2, 3 and 4 journal bearings	20.5 mm (0.807 in.)

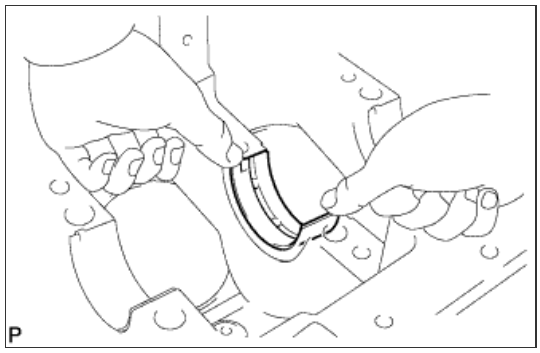


a. Clean each main journal and bearing.

b. Align the bearing claw with the claw groove of the cylinder block, and push in the 5 upper crankshaft bearings.

NOTICE:

- **Clean the contact surface of the bearing and cylinder block.**
- **Do not apply engine oil to the bearing and its contact surface.**
- **Both sides of the oil groove in the cylinder block should be visible through the oil feed holes in the bearing. The amount visible on each side of the holes should be equal.**



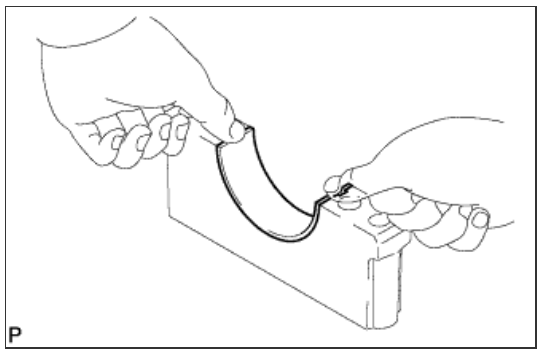
c. Align the bearing claw with the claw groove of the bearing cap, and push in the 5 lower crankshaft bearings.

NOTICE:

- **Clean the contact surface of the bearing and crankshaft bearing cap.**
- **Do not apply engine oil to the bearing and its contact surface.**

HINT:

he number marked on each bearing cap indicates the installation position.

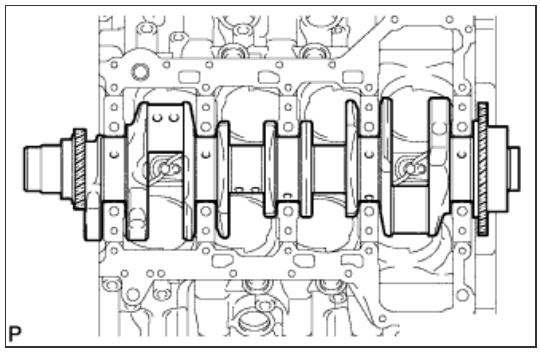


9. INSTALL CRANKSHAFT

NOTICE:

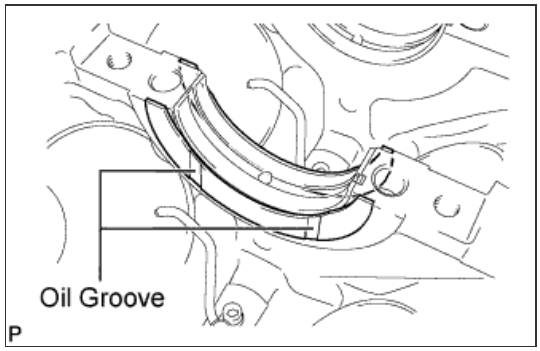
Clean the contact surface of each main journal and crank pin.

a. Apply new engine oil to the upper crankshaft bearing and install the crankshaft to the cylinder block.



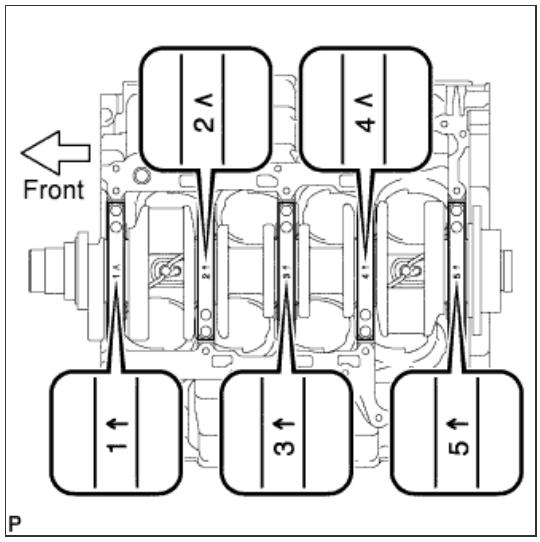
b. Push the crankshaft toward the rear thrust direction to create clearance, and install a thrust washer to the No. journal position with the oil groove facing the front of the engine.

c. Push the crankshaft toward the forward thrust direction to create clearance, and install a thrust washer to the No. journal position with the oil groove facing the rear of the engine.



d. xamine the front marks and numbers and install the bearing caps to the cylinder block.

e. Apply a light coat of engine oil to the threads of the crankshaft bearing cap bolts.



f. emporarily install the crankshaft bearing cap bolts labeled A or the bolts labeled B.

HINT:

In place of the cylinder block stiffening plates, install 8 mm (0.315 in.) thick spacers to the crankshaft bearing cap bolts.

Standard Length

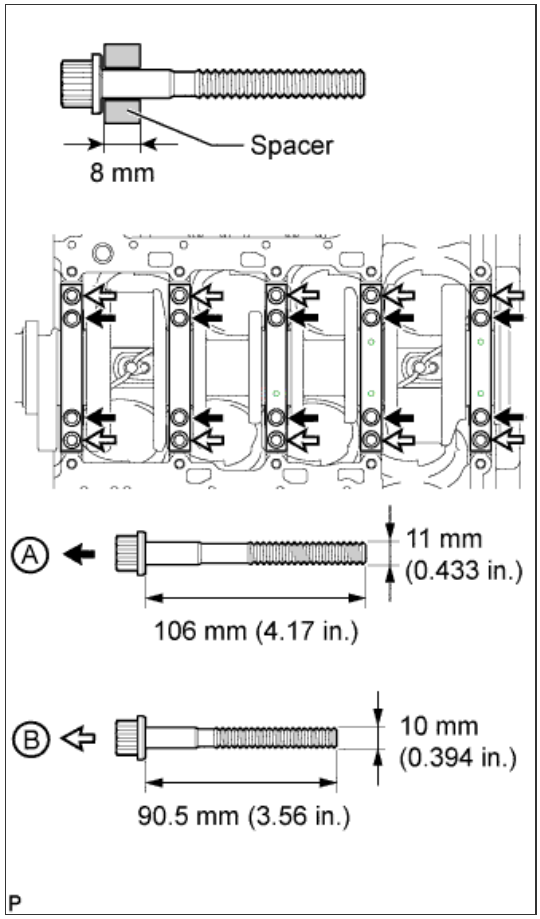
Item	Diameter	Length
A	11 mm (0.433 in.)	106 mm (4.17 in.)
B	10 mm (0.394 in.)	90.5 mm (3.56 in.)

g. Uniformly tighten the 2 crankshaft bearing cap bolts for each bearing cap in several passes to ensure a proper fit.

NOTICE:

Do not tap the bearing cap with a plastic-faced hammer.

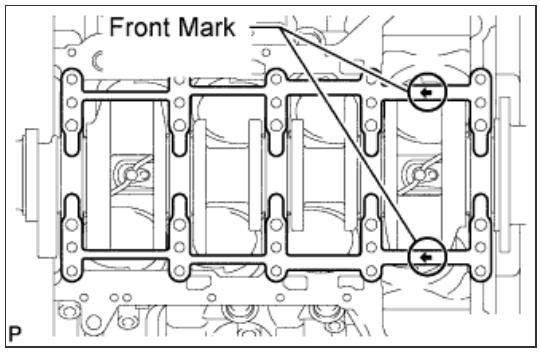
h. Remove the crankshaft bearing cap bolts and spacers.



i. Set the 2 cylinder block stiffening plates on the cylinder block.

HINT:

Make sure the arrows on the stiffening plates face the engine front.



j. Step 1:

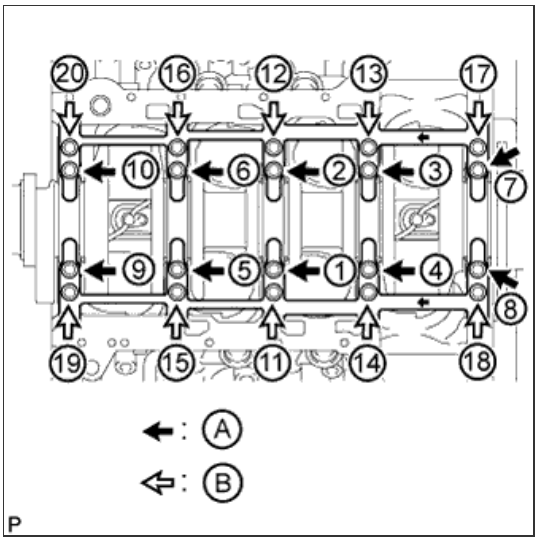
HINT:

- **The crankshaft bearing cap bolts are tightened in 4 progressive steps.**
- **If any crankshaft bearing cap bolt is broken or deformed, replace it.**

i. Apply a light coat of engine oil to the threads and under the heads of the 20 crankshaft bearing cap bolts A and B.

ii. Install the 20 crankshaft bearing cap bolts. Using several steps, tighten the bolts uniformly in the sequence shown in the illustration.

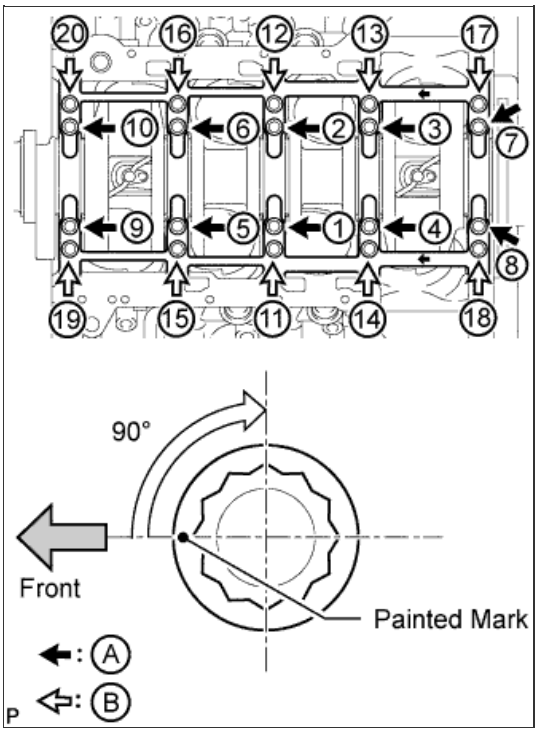
Torque:
for bolt A:
35 N*m{ 357 kgf*cm , 26 ft.*lbf }
for bolt B:
60 N*m{ 612 kgf*cm , 44 ft.*lbf }



k. Step 2:

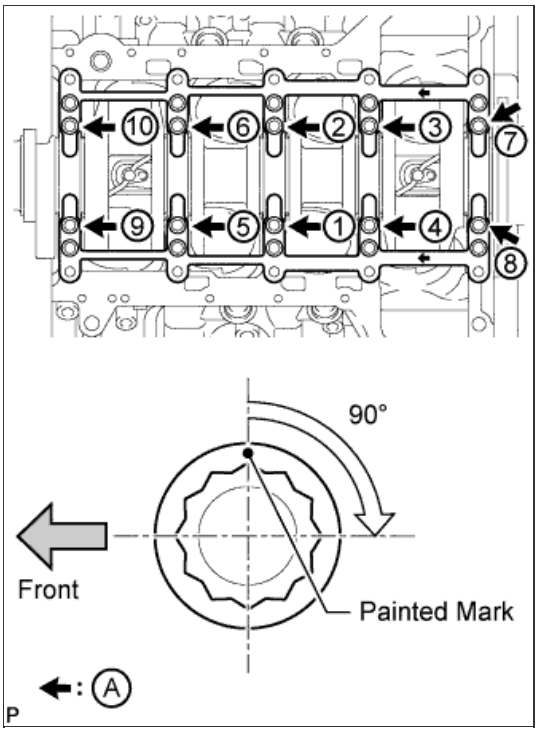
i. Mark the front side of the crankshaft bearing cap bolts A and B with paint.

ii. Tighten the crankshaft bearing cap bolts A and B 90° in the sequence shown in the illustration.

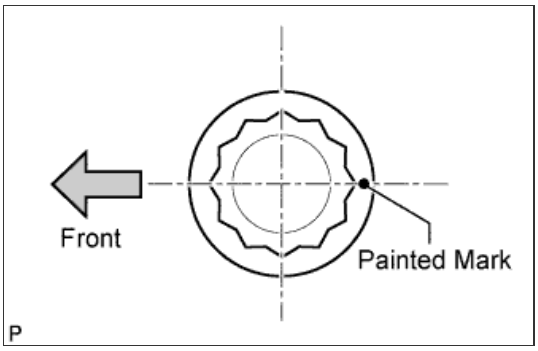


l. Step 3:

i. Tighten the crankshaft bearing cap bolts A another 90° in the sequence shown in the illustration.

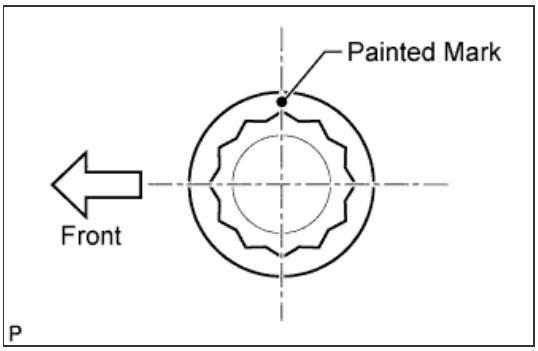


m. Check that the painted marks of bolt A are now at a 180° angle to the front.



n. Check that the painted marks of bolt B are now at a 90° angle to the front.

o. Check that the crankshaft turns smoothly.

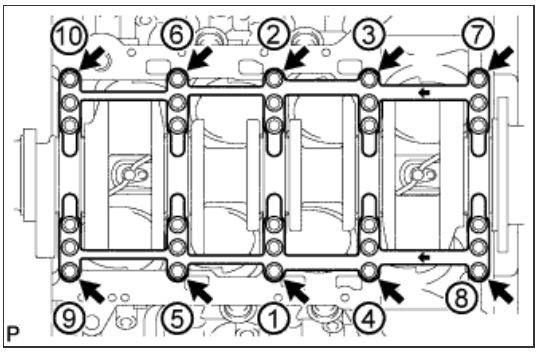


p. Step 4:

i. Using several steps, install the 10 crankshaft bearing cap bolts uniformly in the sequence shown in the illustration.

Torque:
56 N*m{ 571 kgf*cm , 41 ft.*lbf }

ii. Check that the crankshaft turns smoothly.



10. INSPECT CRANKSHAFT THRUST CLEARANCE

a. Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

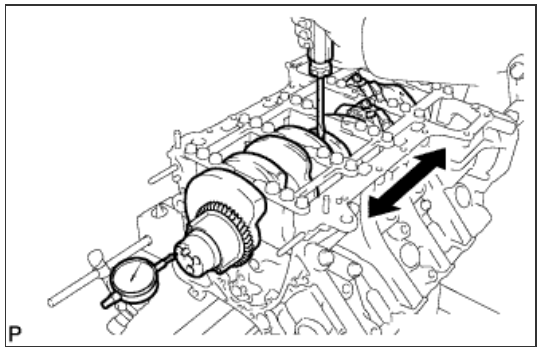
Standard thrust clearance:
0.02 to 0.22 mm (0.000787 to 0.00866 in.)

Maximum thrust clearance:
0.30 mm (0.0118 in.)

If the thrust clearance is more than the maximum, replace the thrust washers as a set.

Standard thrust washer thickness:
2.44 to 2.49 mm (0.0961 to 0.0980 in.)

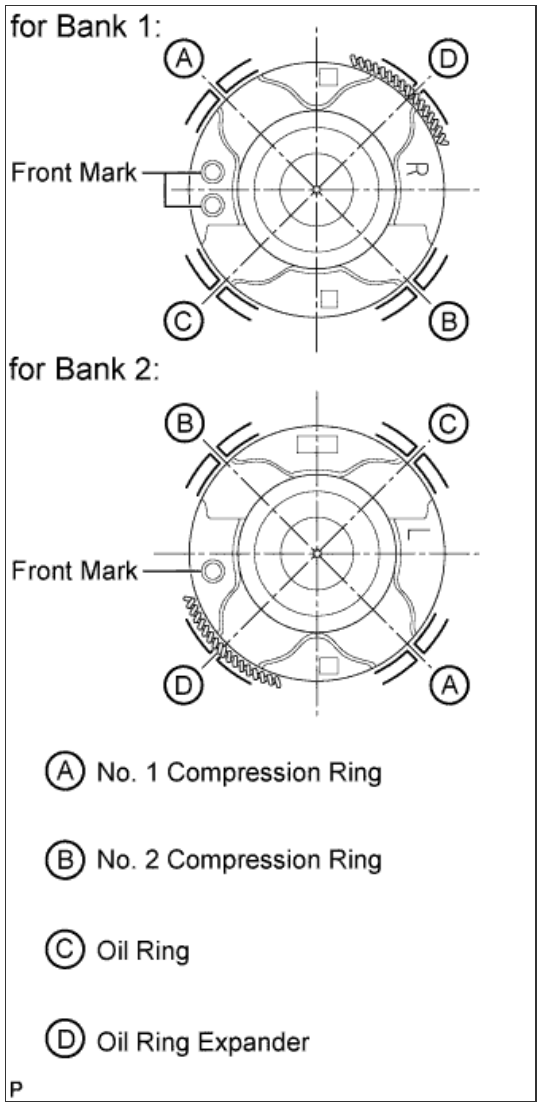
If necessary, replace the crankshaft.



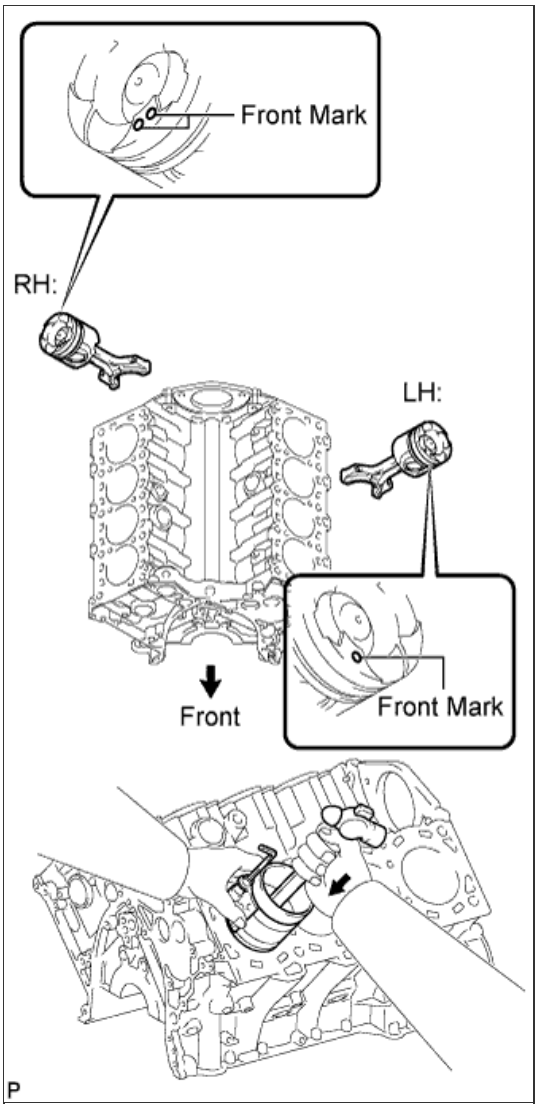
11. INSTALL PISTON SUB-ASSEMBLY WITH CONNECTING ROD

a. Apply engine oil to the cylinder walls, pistons, and the surfaces of the connecting rod bearings.

b. Check the positions of the piston ring ends.



c. Using a hammer handle and piston ring compressor, press a piston and connecting rod assembly into each cylinder with the front mark of the piston facing forward.

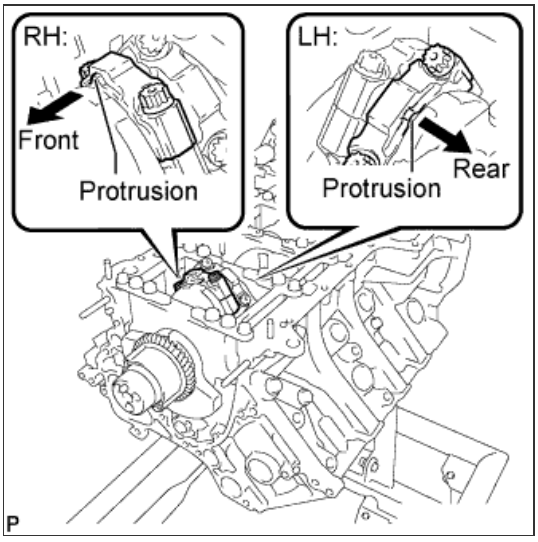


d. Install the connecting rod cap so that its protrusion is facing the correct direction.

NOTICE:

Match the numbered connecting rod cap with the connecting rod.

e. Apply a light coat of engine oil to the threads and under the heads of the connecting rod cap bolts.



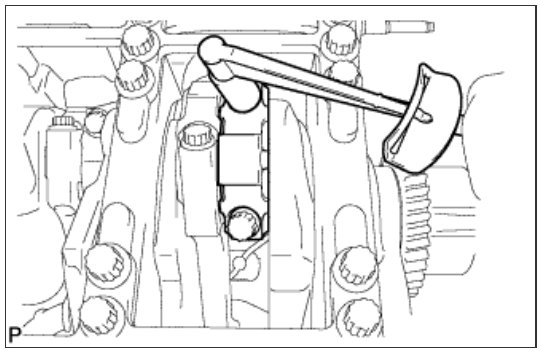
f. Step 1:

i. Install and alternately tighten the bolts of the connecting rod cap in several steps.

Torque:
35 N*m{ 357 kgf*cm , 26 ft.*lbf }

HINT:

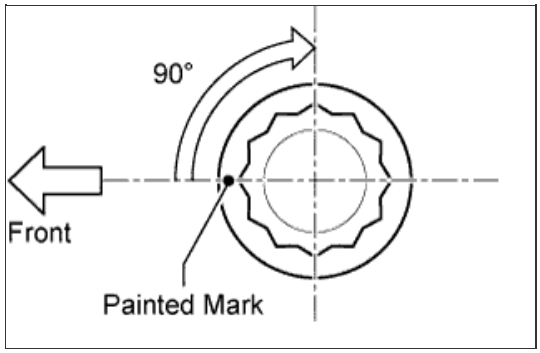
- **The connecting rod cap bolts are tightened in 2 progressive steps.**
- **If any connecting rod cap bolt is broken or deformed, replace it.**



g. Step 2:

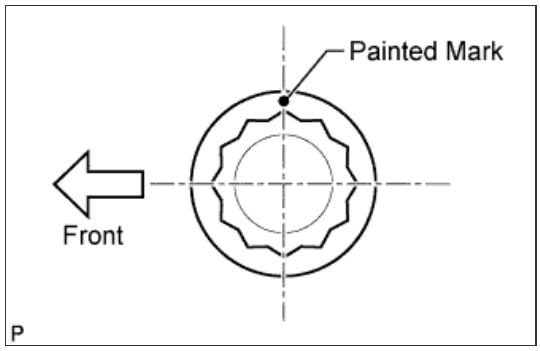
i. Mark the front side of each connecting rod cap bolt with paint.

ii. ighten the cap bolts 90°.



h. Check that the painted marks are now at a 90° angle to the front.

i. Check that the crankshaft turns smoothly.



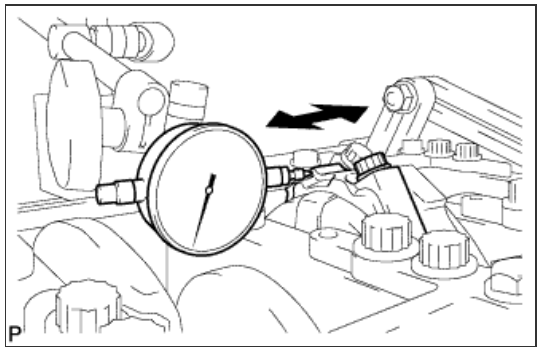
12. INSPECT CONNECTING ROD THRUST CLEARANCE

a. Using a dial indicator, measure the thrust clearance while moving the connecting rod back and forth.

Standard thrust clearance:
0.14 to 0.54 mm (0.00551 to 0.0213 in.)

Maximum thrust clearance:
0.60 mm (0.0236 in.)

If the thrust clearance is more than the maximum, replace one or more connecting rods as necessary.
If necessary, replace the crankshaft.



for Preparation Click here

CAUTION:

- **Before working on the fuel system, disconnect the cable from the negative (-) battery terminal.**
- **Do not smoke or be near an open flame when working on the fuel system.**
- **Keep gasoline away from rubber and leather parts.**

1.IGNITION SWITC EXPRESSION

INT:

The type of ignition switch used on this model differs depending on the specifications of the vehicle. The expressions listed in the table below are used in this section.

Expression	Ignition Switch (Position)	Engine Switch (Condition)
Ignition Switch off	LOCK	Off
Ignition Switch ACC	ACC	On (ACC)
Ignition Switch ON	ON	On (IG)
Engine Start	START	Start

2.DISC ARGE FUEL SYSTEM PRESSURE

CAUTION:

- **Do not disconnect any part of the fuel system until you have discharged the fuel system pressure.**
- **After discharging the fuel pressure, place a cloth or equivalent over fittings as you separate them to reduce the risk of fuel spray on yourself or in the engine compartment.**

a. Remove the engine room relay block cover.

b. Remove the circuit opening relay (C/OPN).

c. Start the engine. After the engine has stopped on its own, turn the engine switch off.

INT:

If DTC P0230 is output, clear the DTC (Click here).

d. Crank the engine, then check that the engine does not start.

e. Loosen the fuel tank cap, then discharge the pressure in the fuel tank completely.

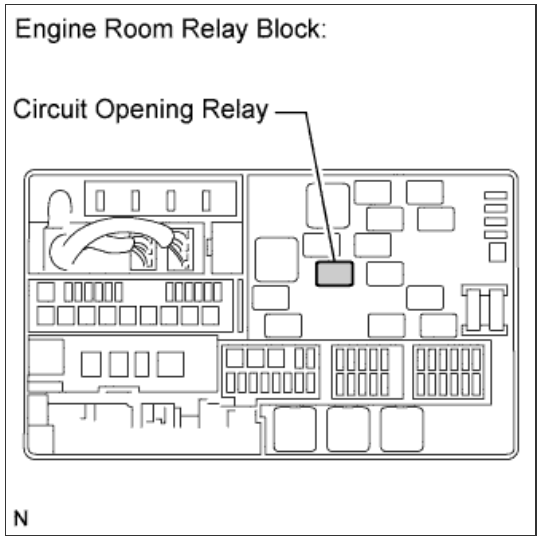
f. Disconnect the cable from the negative (-) battery terminal.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

g. Install the circuit opening relay (C/OPN).

h. Install the engine room relay block cover.



3.FUEL SYSTEM

a. When disconnecting the high fuel pressure line, a large amount of gasoline will spill out. Follow these procedures.

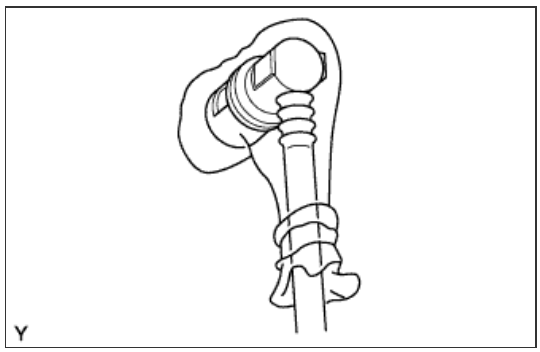
i. Discharge the fuel system pressure.

ii. Put a container under the connecting part of the pressure line.

iii. Slowly loosen the connection.

iv. Disconnect the connection.

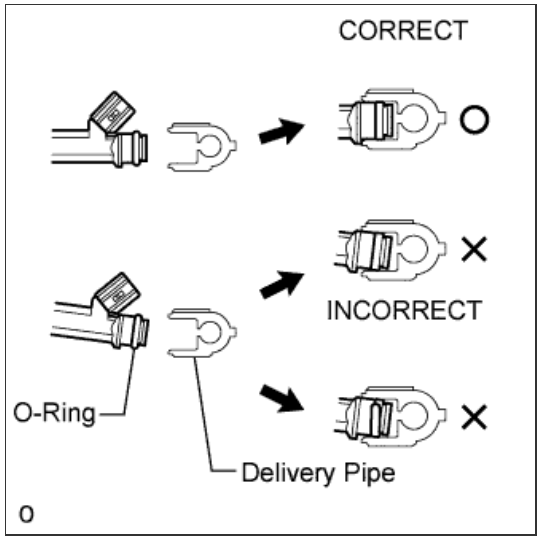
v. Plug the connection with a rubber plug.



b. Observe these precautions when removing and installing the injectors:

NOTICE:

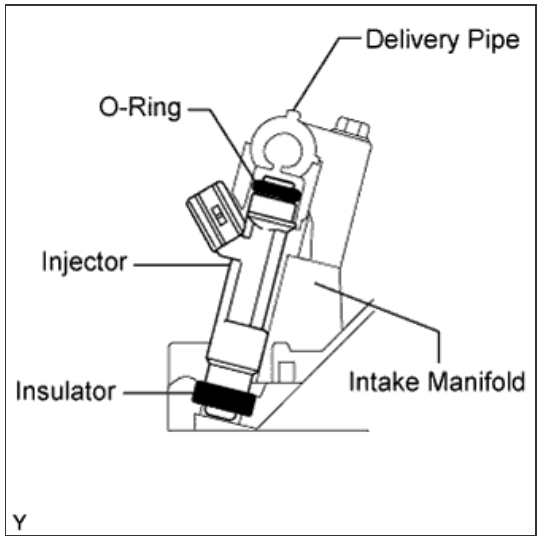
- **Never reuse the O-ring.**
- **When placing a new O-ring on the injector, do not damage it.**
- **Coat a new O-ring with spindle oil or gasoline before installing it. Do not use engine oil, gear oil or brake oil.**



c. Install the injector to the delivery pipe and cylinder head as shown in the illustration.

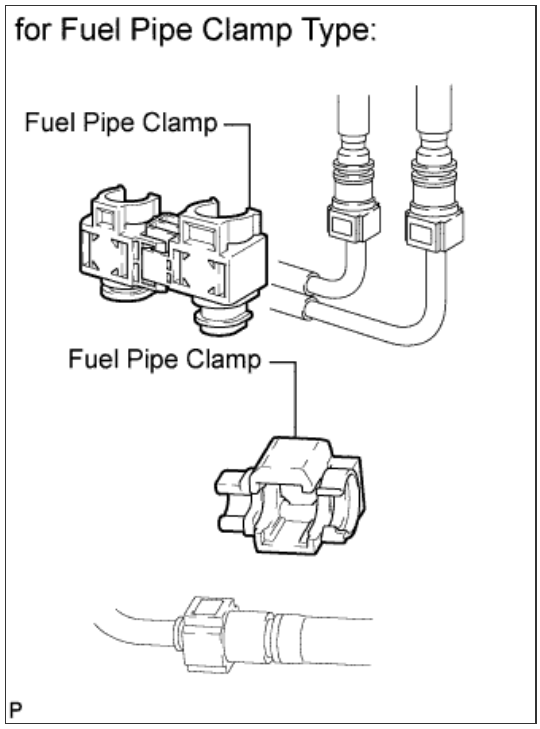
NOTICE:

Before installing the injector, apply spindle oil or gasoline on the place where the delivery pipe contacts the O-ring of the injector.

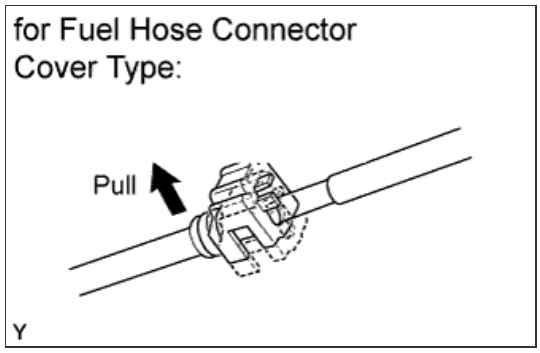


d. Observe these precautions when disconnecting the fuel tube connector (for quick type A).

i. for Fuel Pipe Clamp Type:
Remove the fuel pipe clamp from the fuel tube connector.



ii. for Fuel ose Connector Cover Type:
Detach the lock claw by lifting up the cover, as shown in the illustration.

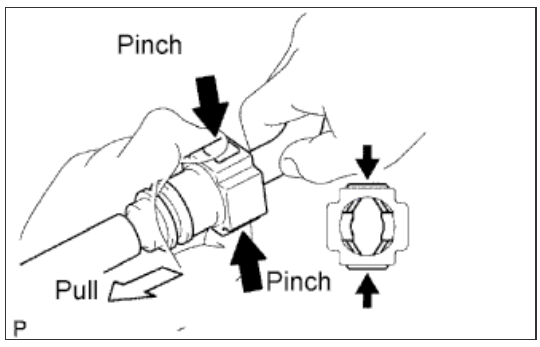


iii. Check for dirt or mud on the pipe and around the connector before disconnection. Clean if necessary.

iv. Pinch the connector and disconnect the connector and pipe.
If the connector and the pipe are stuck together, pinch the connector, then push and pull the pipe to disconnect the pipe and pull it out.

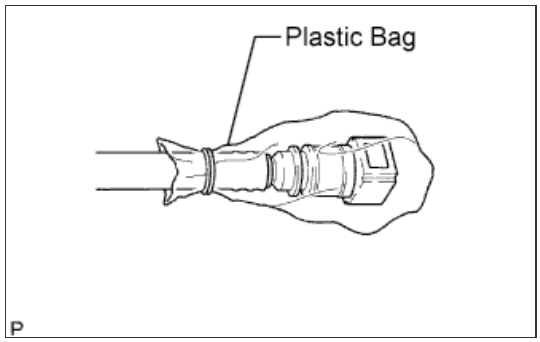
NOTICE:

Do not use any tools in this procedure.



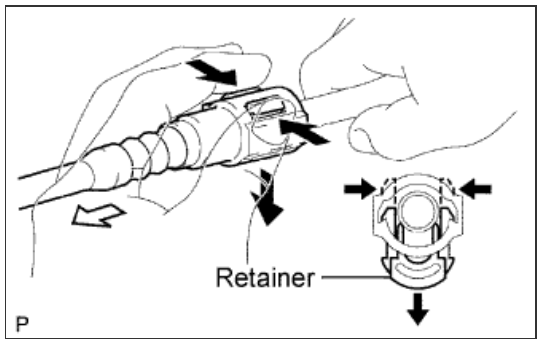
v. Check for dirt or mud on the seal surface of the disconnected pipe.
Clean if necessary.

vi. To protect the disconnected pipe and connector from damage and contamination, cover it with a plastic bag.



e. Observe these precautions when disconnecting the fuel tube connector (for quick type B).

i. Check that there is no damage or foreign matter on the part of the pipe that contacts the connector.



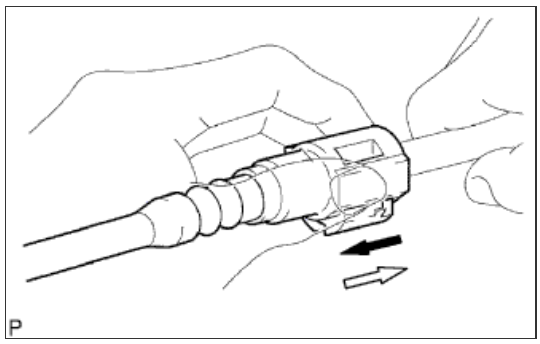
ii. Detach the 2 claws of the connector retainer. Push down on the connector and disconnect it from the pipe.

INT:

If the connector and pipe are stuck, pinch the fuel pipe by hand, and push and pull the connector to disconnect it.

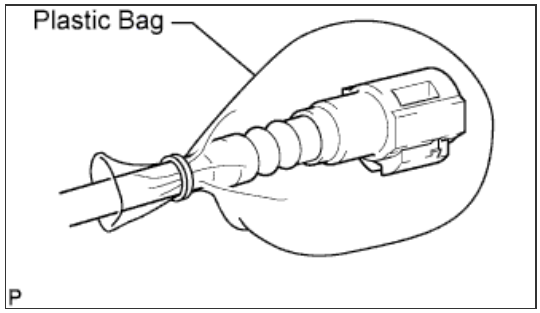
NOTICE:

Do not use any tools in this procedure.



iii. Check for foreign matter on the seal surface of the disconnected pipe. Clean it if necessary.

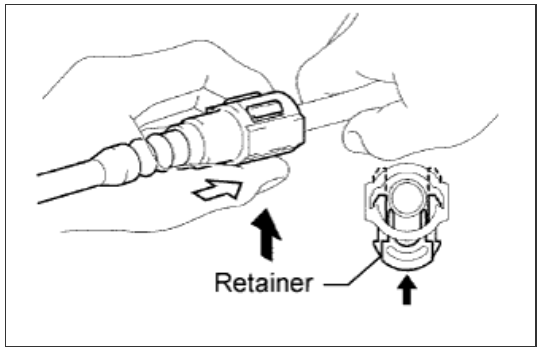
iv. To protect the disconnected pipe and connector from damage and foreign matter, cover it with a plastic bag.



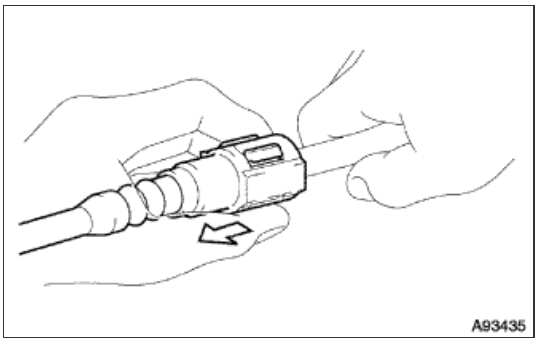
f. Observe these precautions when connecting the fuel tube connector (for quick type B).

i. Check for foreign matter on the pipe and around the connector before connecting it. Clean it if necessary.

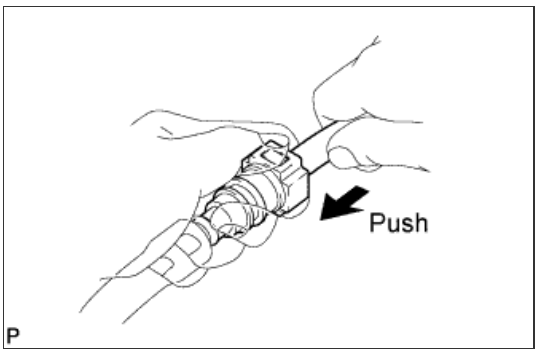
ii. Align the axis of the connector with the axis of the pipe. Push the pipe into the connector, and push up on the retainer.



iii. After connecting the pipe and connector, try to pull them apart to confirm that they are securely connected.

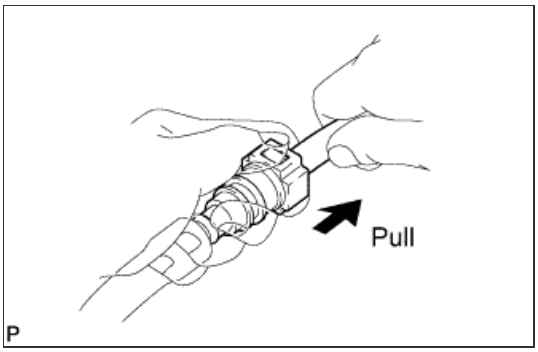


g. Observe these precautions when connecting the fuel tube connector (for quick type A).

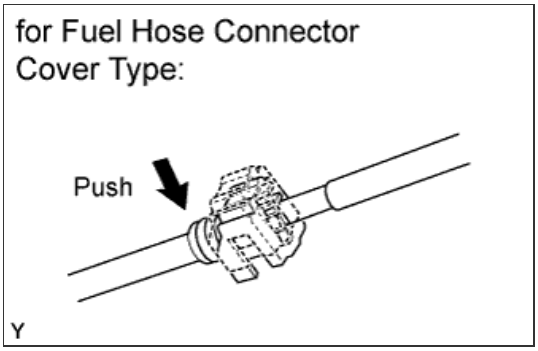


i. Check that there is no damage or contamination in the connected part of the pipe.

ii. Align the axis of the connector with the axis of the pipe. Push the pipe into the connector until the connector makes a "click" sound. If the connection is tight, apply a small amount of fresh spindle oil or gasoline on the tip of the pipe.



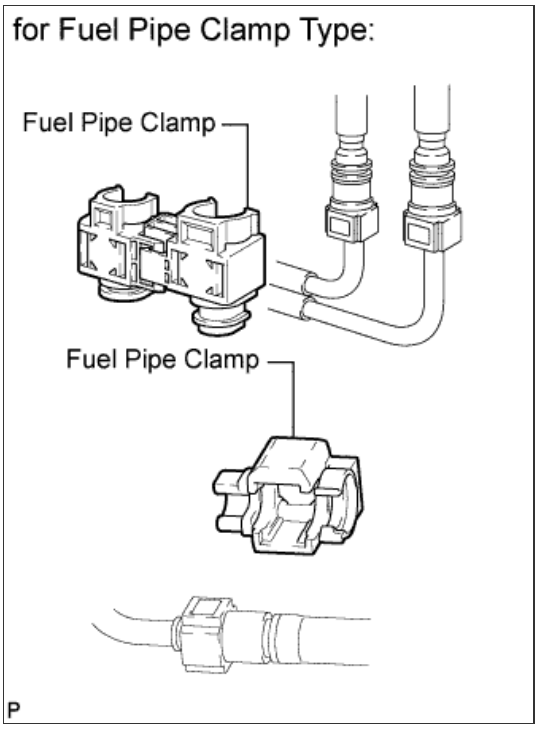
iii. After having finished the connection, try to pull apart the pipe and the connector to confirm that they are securely connected.



iv. for Fuel ose Connector Cover Type:
Attach the lock claw to the connector by pushing down on the cover, as shown in the illustration.

v. for Fuel Pipe Clamp Type:
Install the fuel pipe clamp to the connector.

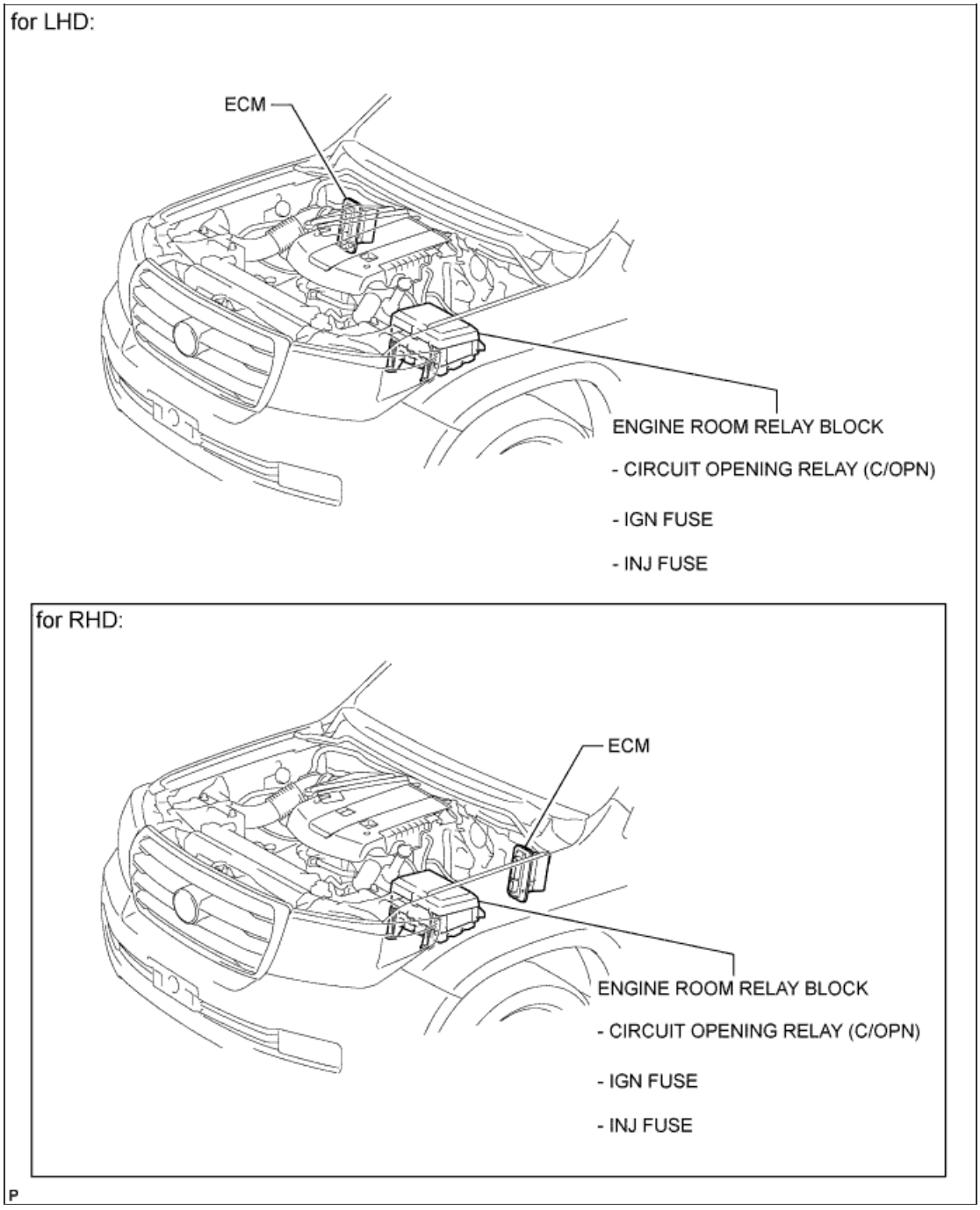
vi. Check that there is no fuel leakage.

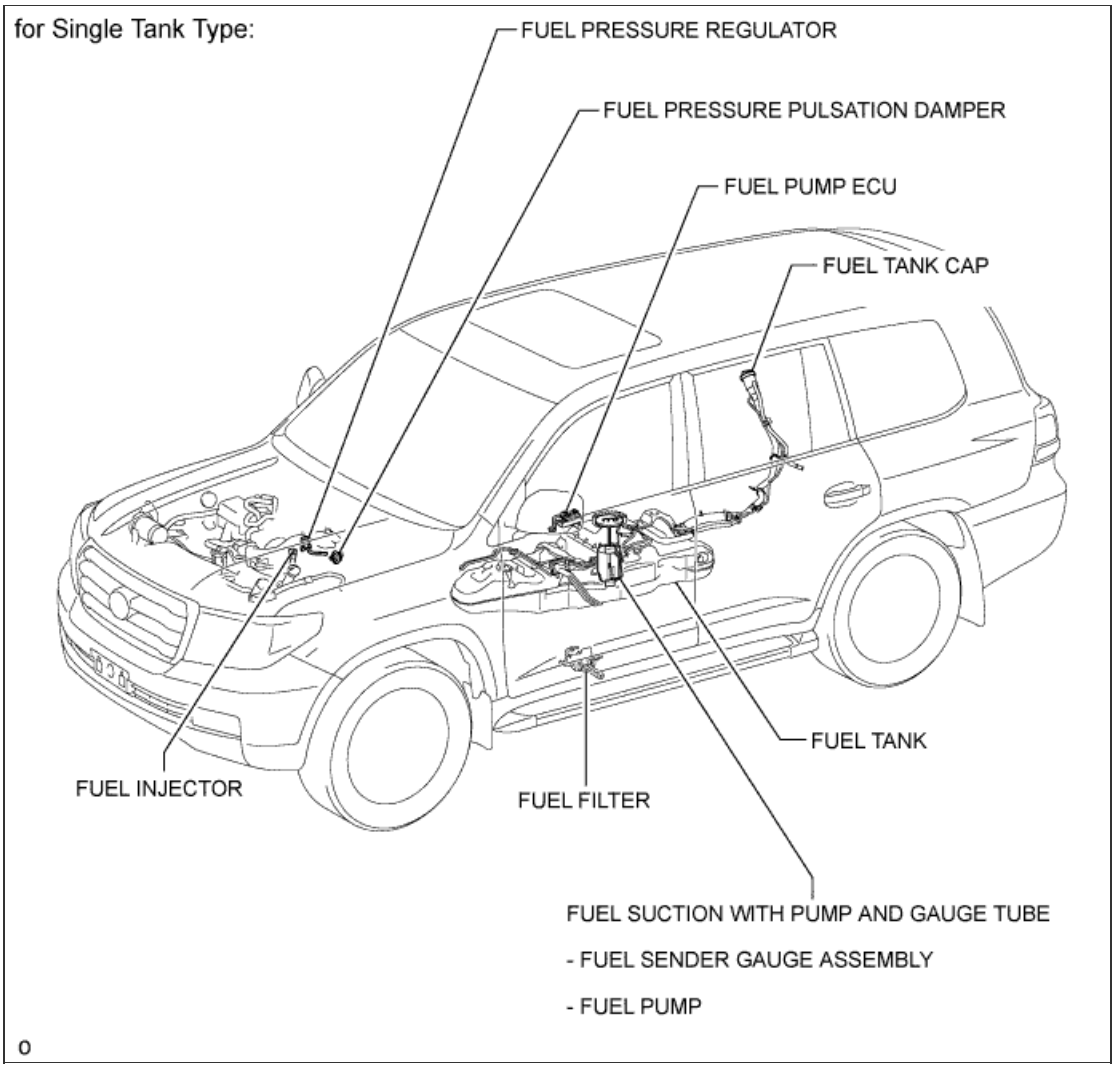


4.C ECK FOR FUEL LEAK

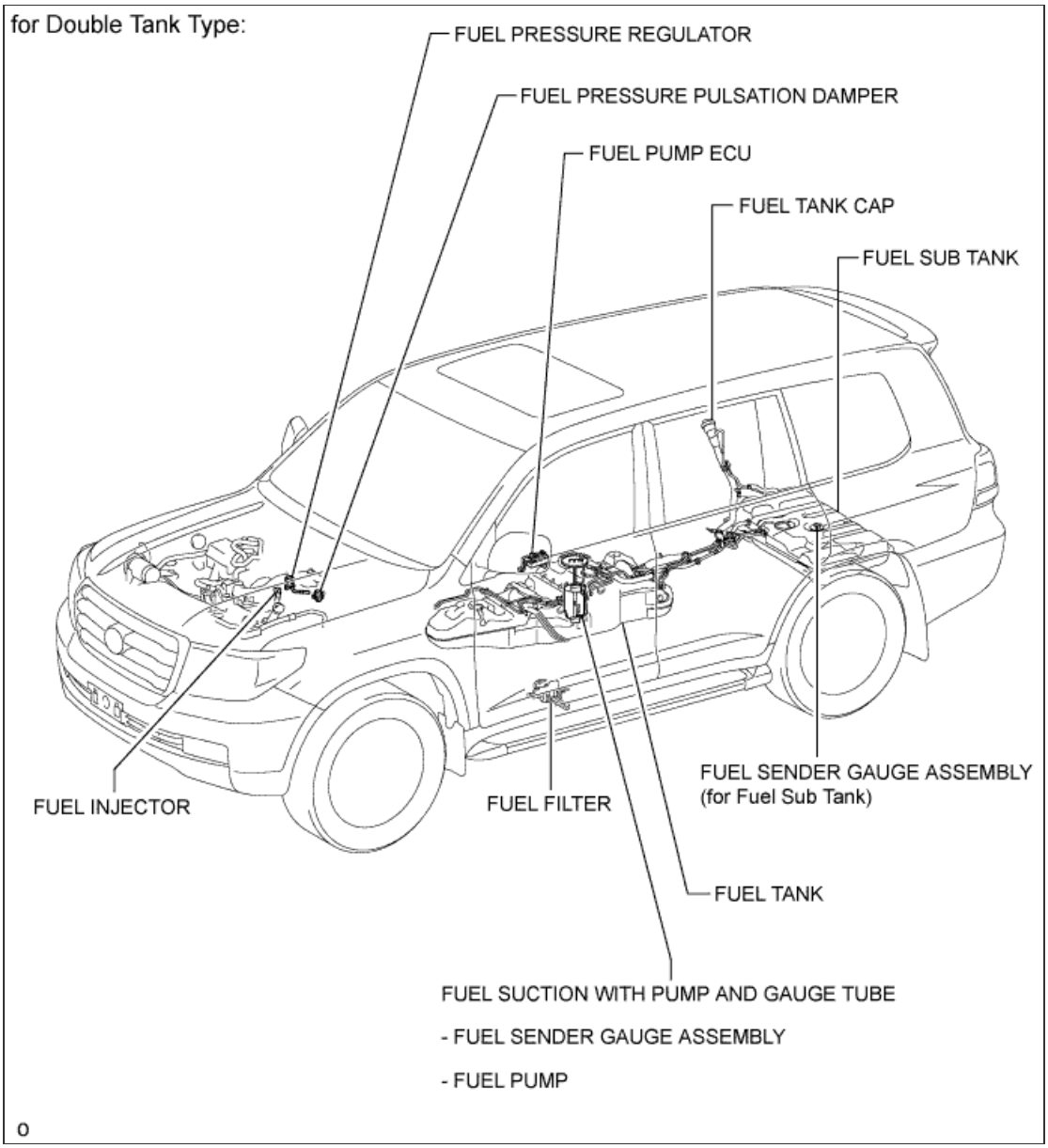
a. Check that there are no fuel leaks after performing maintenance anywhere on the fuel system (Click here).

for Preparation Click here



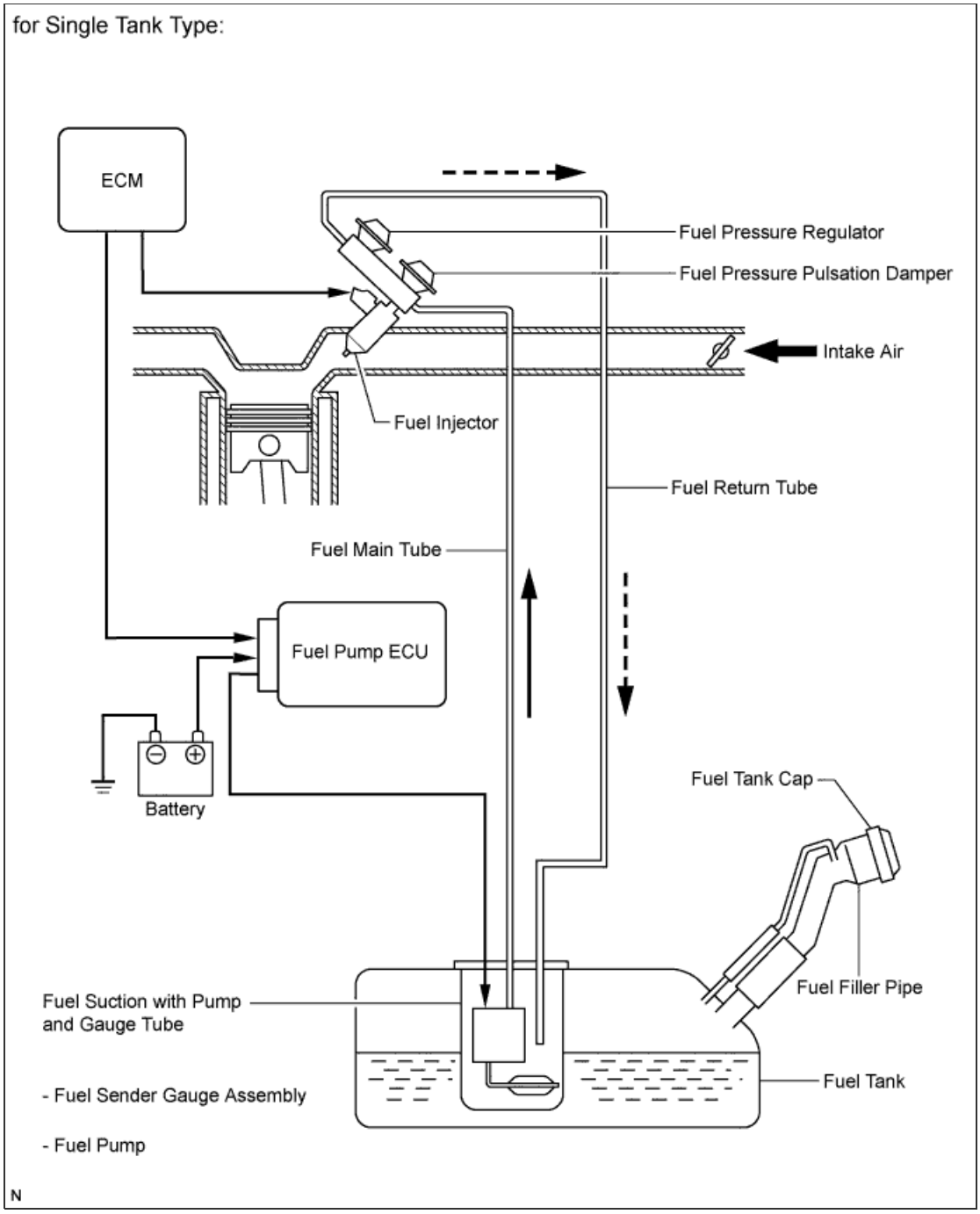

for Single Tank Type:
FUEL PRESSURE REGULATOR
FUEL PRESSURE PULSATION DAMPER
FUEL PUMP ECU
FUEL TANK CAP
FUEL TANK
FUEL INJECTOR
FUEL FILTER
FUEL SUCTION WITH PUMP AND GAUGE TUBE
- FUEL SENDER GAUGE ASSEMBLY
- FUEL PUMP

o

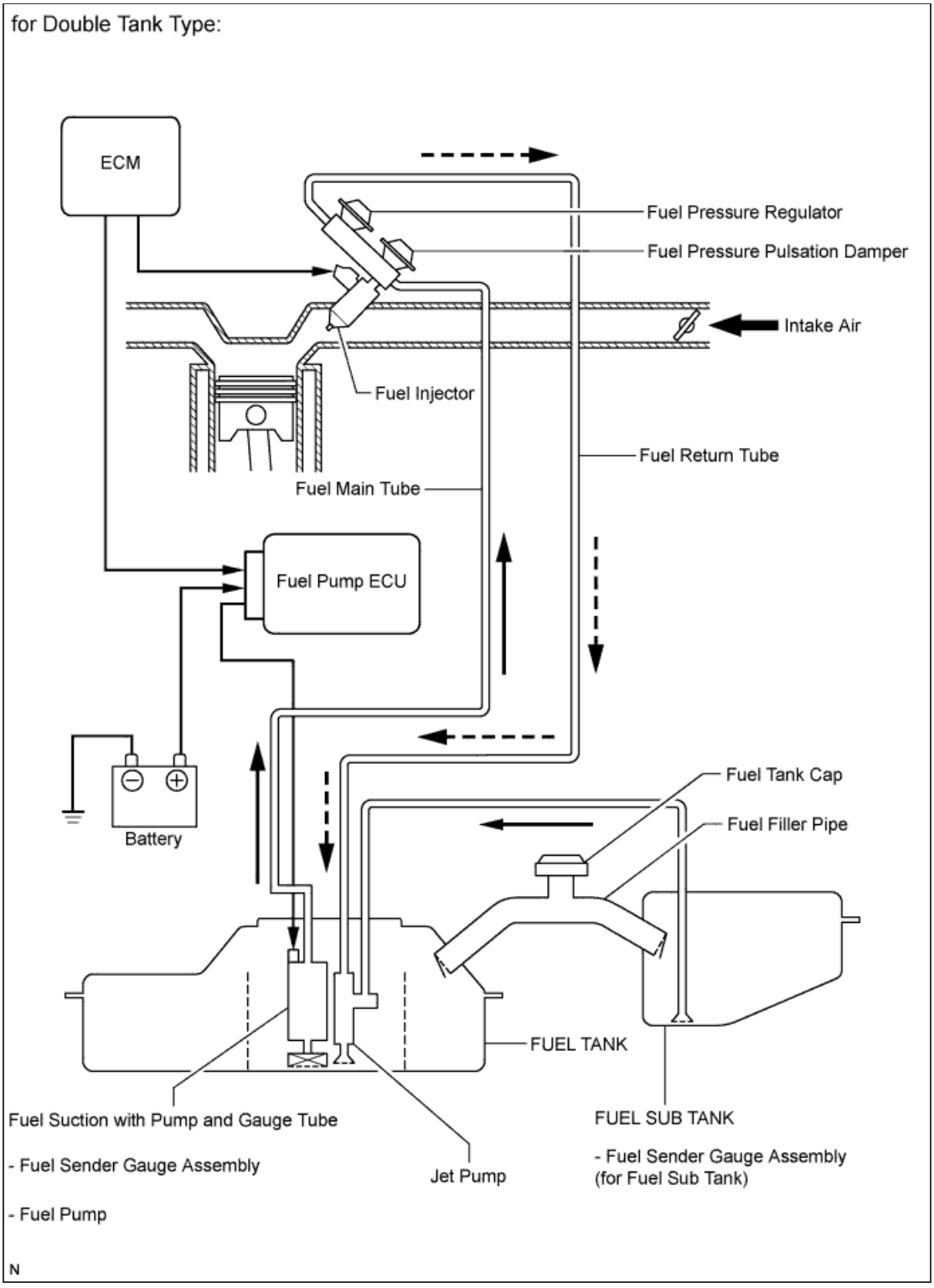

for Double Tank Type:
FUEL PRESSURE REGULATOR
FUEL PRESSURE PULSATION DAMPER
FUEL PUMP ECU
FUEL TANK CAP
FUEL SUB TANK
FUEL SENDER GAUGE ASSEMBLY
(for Fuel Sub Tank)
FUEL INJECTOR
FUEL FILTER
FUEL TANK
FUEL SUCTION WITH PUMP AND GAUGE TUBE
- FUEL SENDER GAUGE ASSEMBLY
- FUEL PUMP
o

for Preparation Click here

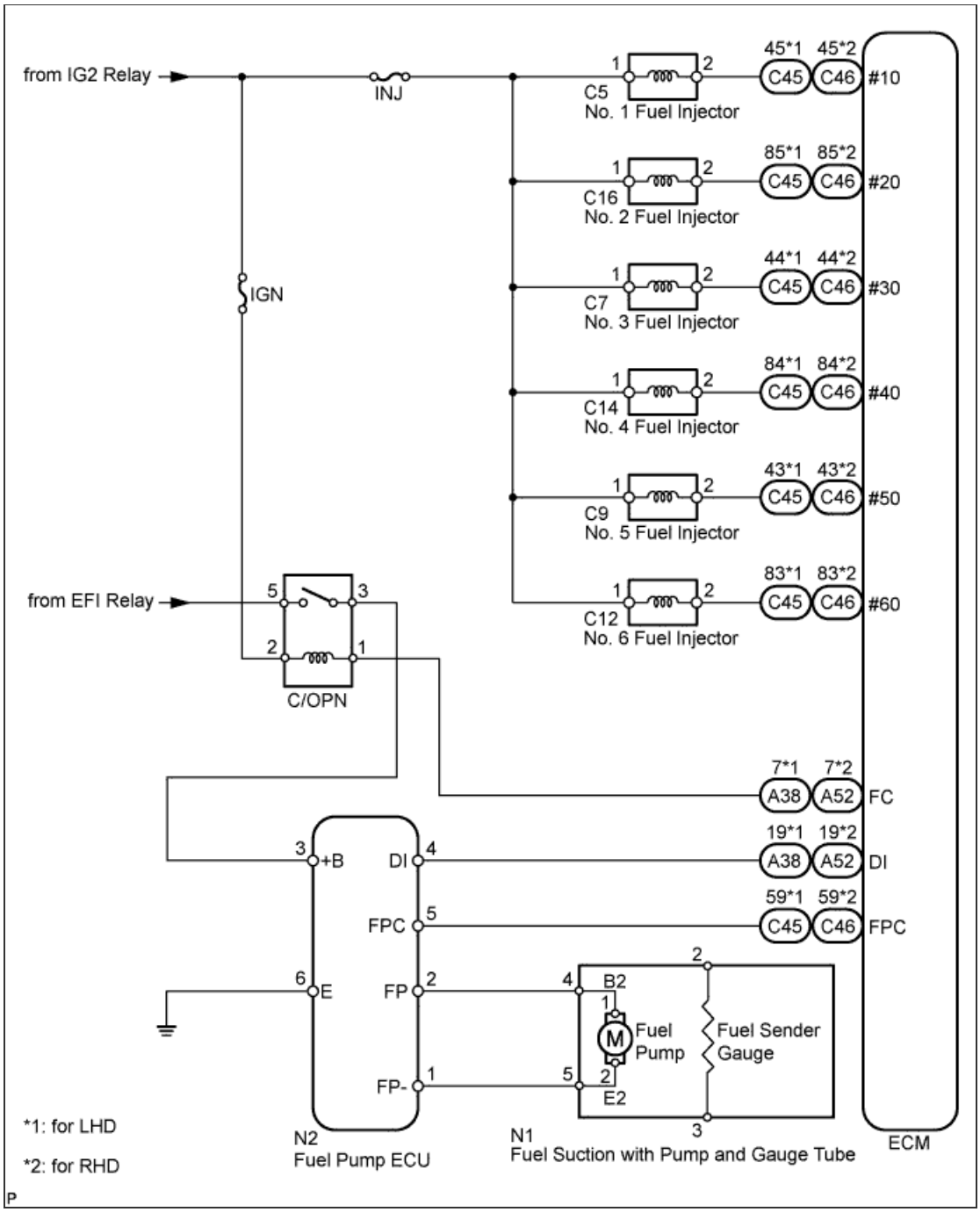
FUEL FLOW DIAGRAM



for Double Tank Type:



ELECTRICAL CONTROL DIAGRAM


from IG2 Relay
INJ
IGN
from EFI Relay
C/OPN
C5
No. 1 Fuel Injector
C16
No. 2 Fuel Injector
C7
No. 3 Fuel Injector
C14
No. 4 Fuel Injector
C9
No. 5 Fuel Injector
C12
No. 6 Fuel Injector
45*1 45*2 C45 C46 #10
85*1 85*2 C45 C46 #20
44*1 44*2 C45 C46 #30
84*1 84*2 C45 C46 #40
43*1 43*2 C45 C46 #50
83*1 83*2 C45 C46 #60
7*1 7*2 A38 A52 FC
19*1 19*2 A38 A52 DI
59*1 59*2 C45 C46 FPC
ECM
+B
DI
FPC
E
FP
FP-
B2
E2
Fuel Pump
Fuel Sender Gauge
N2
Fuel Pump ECU
N1
Fuel Suction with Pump and Gauge Tube
*1: for LHD
*2: for RHD
P

for Preparation Click here

1. CHECK FOR FUEL PUMP OPERATION AND FUEL LEAK

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

NOTICE:

Do not start the engine.

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the Fuel Pump Speed Control.

e. Check fuel pump operation.

i. Check for pressure in the fuel inlet tube from the fuel line. Check that the sound of fuel flowing in the fuel tank can be heard.
If there is no sound, check the integration relay, fuel pump, ECM and wiring connector.

f. Check for fuel leak.

i. Check that there are no fuel leaks after performing maintenance anywhere on the system.
If there are fuel leaks, repair or replace parts as necessary.

2. CHECK FUEL PRESSURE

a. Check that the battery voltage is 11 to 14 V.

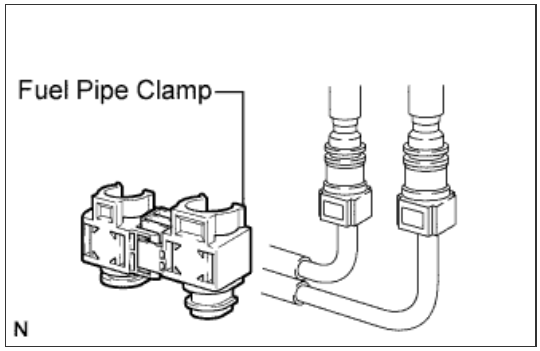
b. Discharge the fuel system pressure (Click here).

c. Disconnect the cable from the negative (-) battery terminal.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

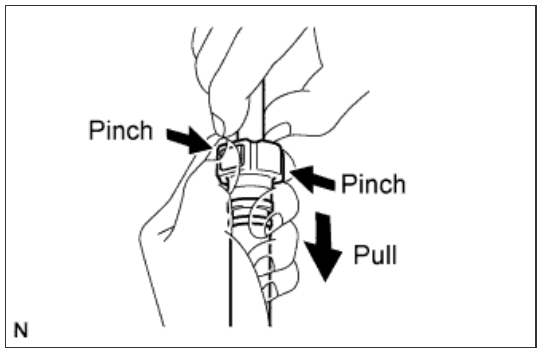
d. Remove the fuel pipe clamp from the fuel tube connector.



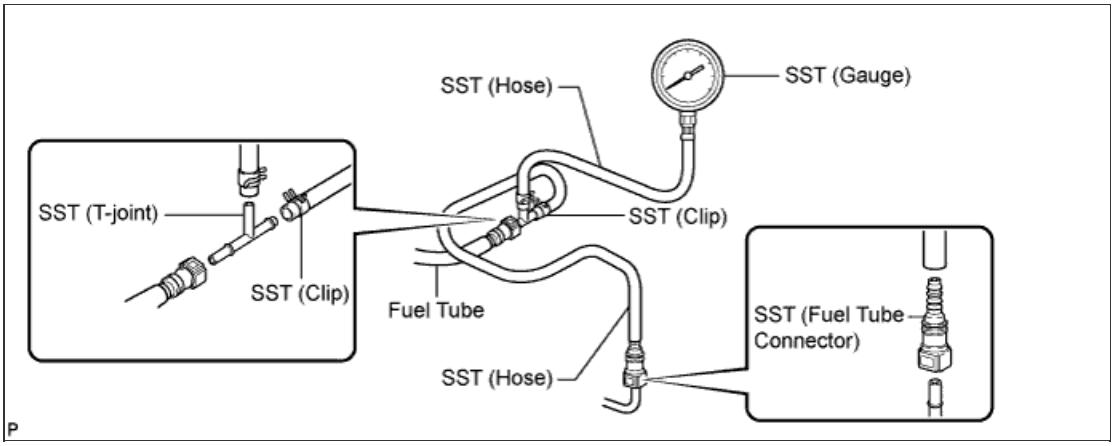
e. Pinch and pull the No. 1 fuel hose (fuel tube connector) to disconnect it.

CAUTION:

- **Always read the precautions (Click here) before disconnecting the fuel tube connector (quick type).**
- **The fuel tube may spray fuel as a result of pressure that remains in it. Do not allow fuel to be sprayed in the engine compartment.**



f. Install SST (pressure gauge) as shown in the illustration.



SST
09268-31012 (09268-41120, 09268-41500, 90467-13001, 95336-08070)
09268-45014 (09268-41200, 09268-41220)

g. Wipe off any gasoline.

h. Reconnect the cable to the negative (-) battery terminal.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

i. Operate the fuel pump.

i. Connect the intelligent tester to the DLC3.

ii. Turn the ignition switch to ON.

NOTICE:

Do not start the engine.

iii. Turn the intelligent tester on.

iv. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the Fuel Pump Speed Control / ON.

j. Measure the fuel pressure.

Standard fuel pressure:
281 to 287 kPa (2.87 to 2.93 kgf/cm ^{2}, 41 to 42 psi)

If the pressure is higher than the specification, replace the fuel pressure regulator.
If the pressure is below the specification, check the fuel hoses and connections, fuel pump, fuel filter and fuel pressure regulator.

k. Start the engine.

l. Measure the fuel pressure.

Standard fuel pressure:
281 to 287 kPa (2.87 to 2.93 kgf/cm ^{2}, 41 to 42 psi)

If the pressure is not as specified, check the fuel pump, pressure regulator and/or injectors.

m. Stop the engine.

n. Check that the fuel pressure remains as specified for 5 minutes after the engine has stopped.

Standard fuel pressure:
147 kPa (1.5 kgf/cm^2, 21 psi) or more

If the pressure is not as specified, check the fuel pump, pressure regulator and/or injectors.

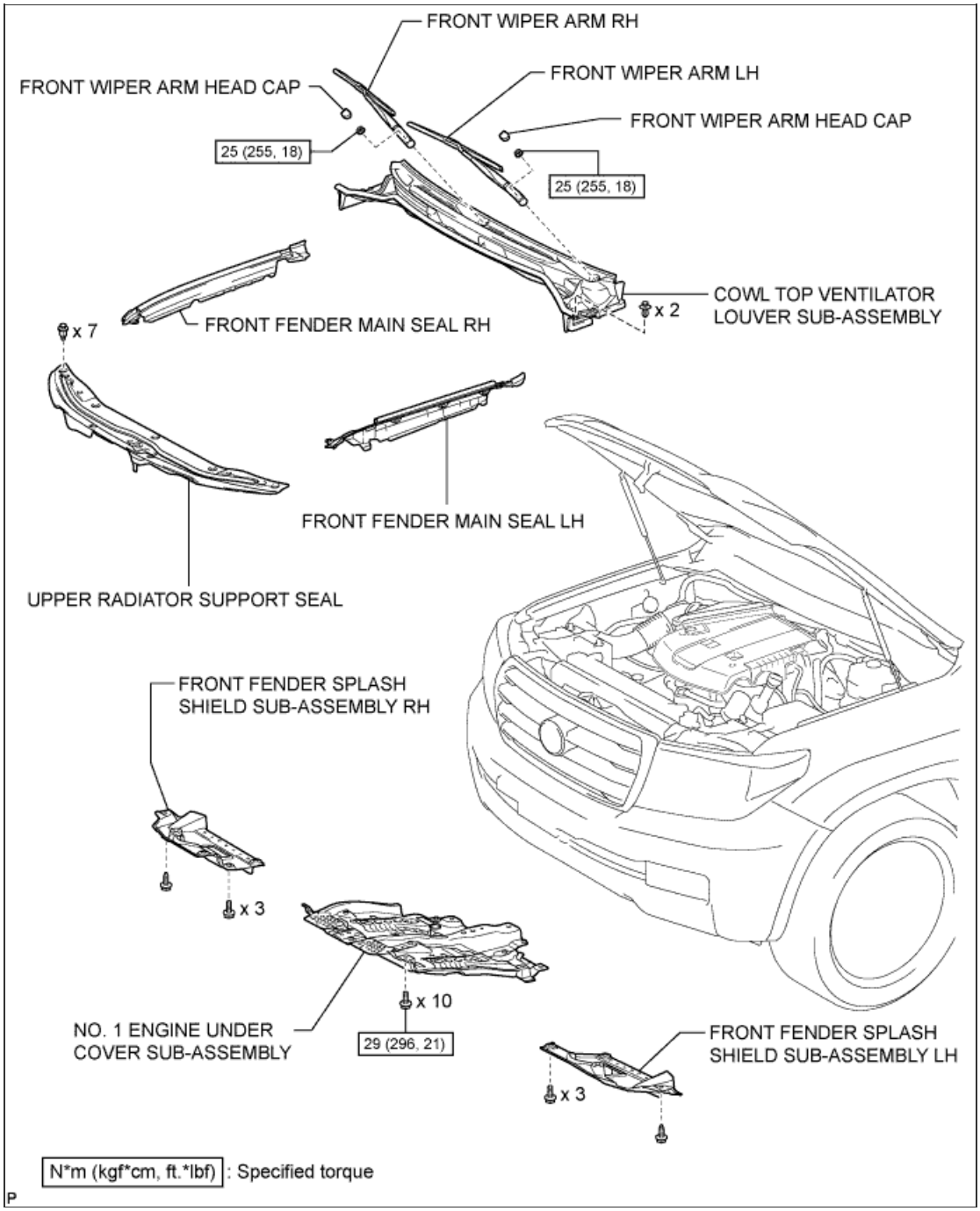
o. Disconnect the cable from the negative (-) battery terminal (Click here) and carefully remove SST and the fuel tube connector to prevent gasoline from spraying.

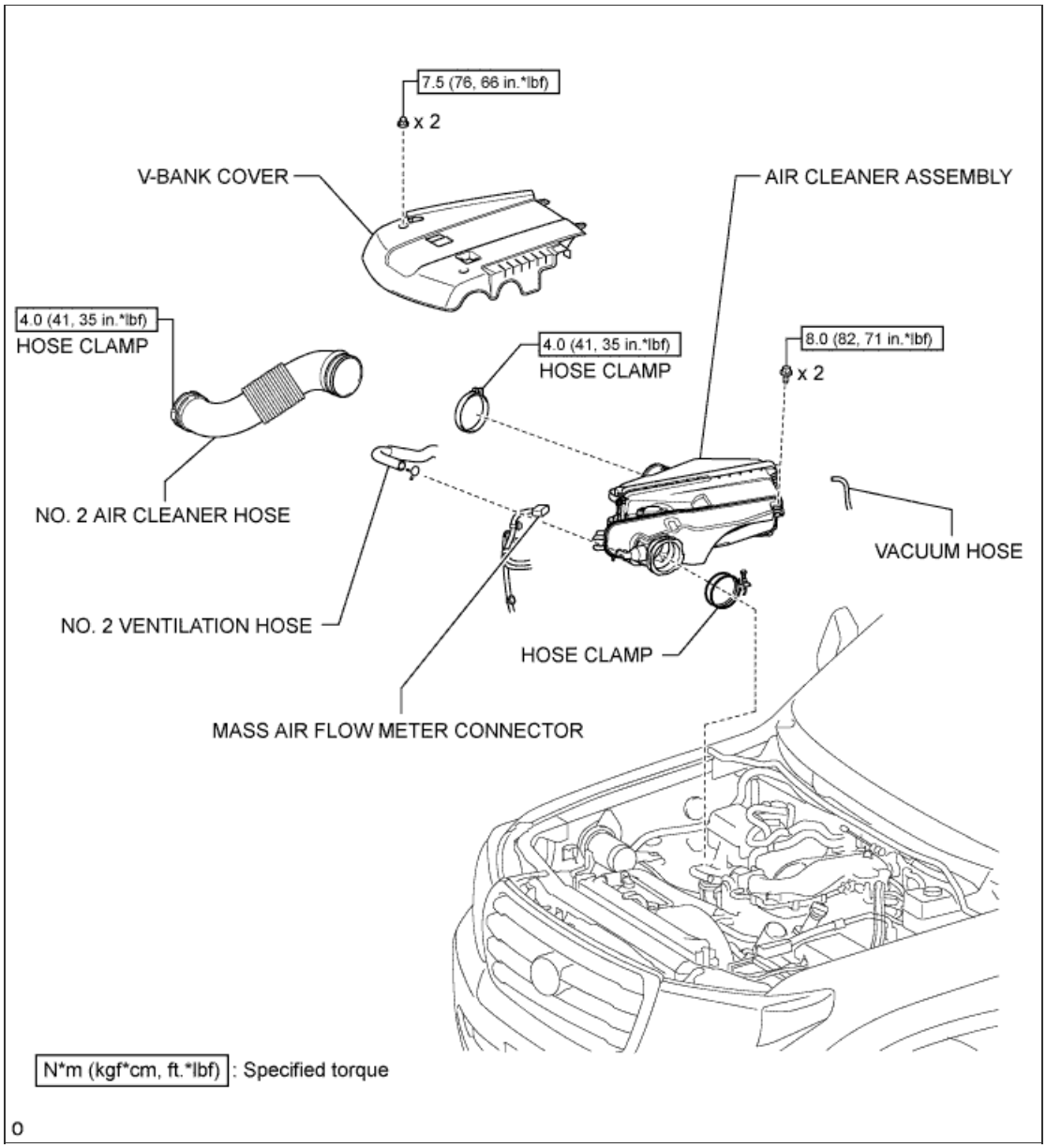
p. Reconnect the No. 1 fuel hose (fuel tube connector).

q. Check for fuel leaks.

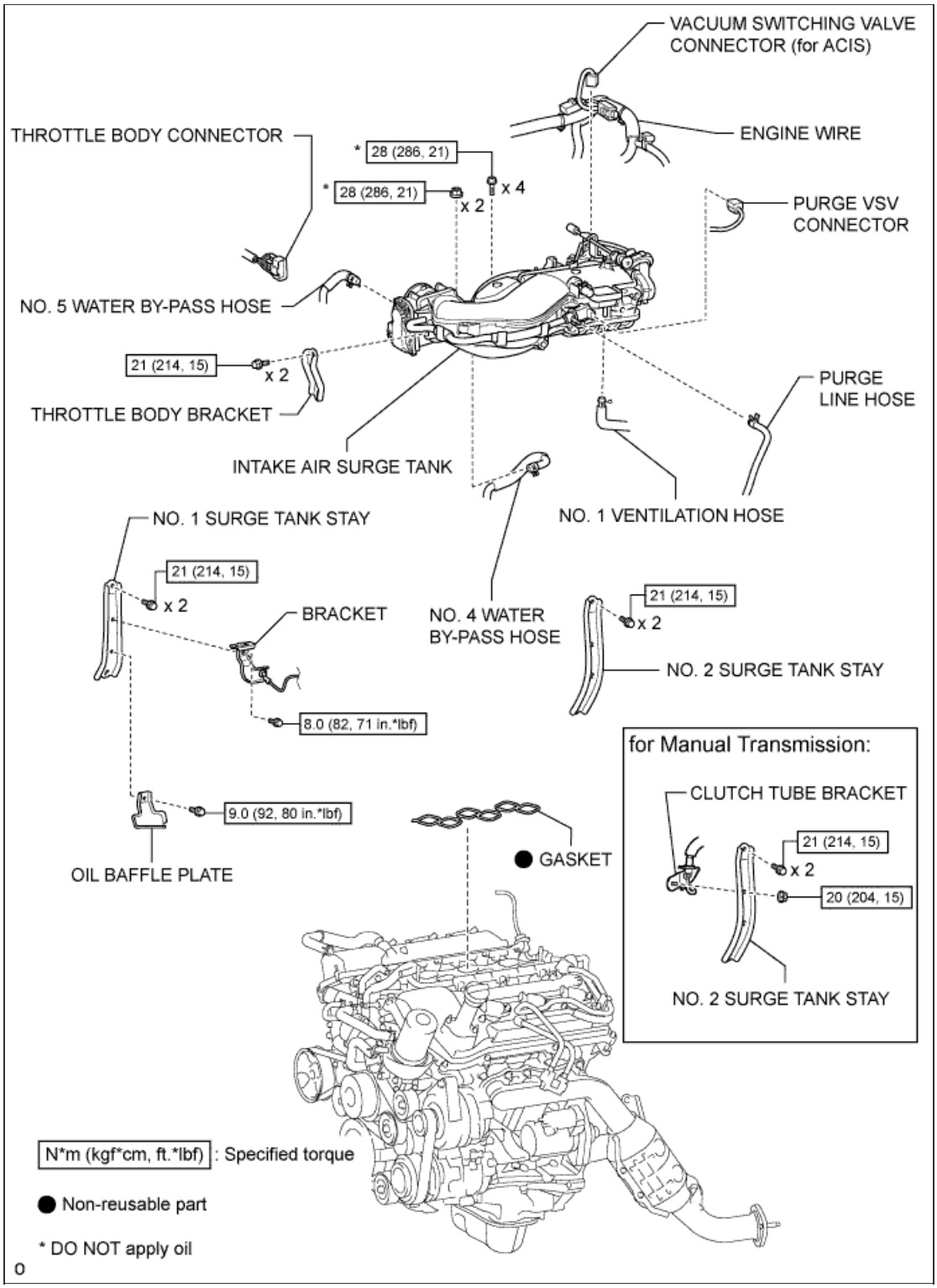
i. Check that there are no fuel leaks after performing maintenance anywhere on the system.
If there are fuel leaks, repair or replace parts as necessary.

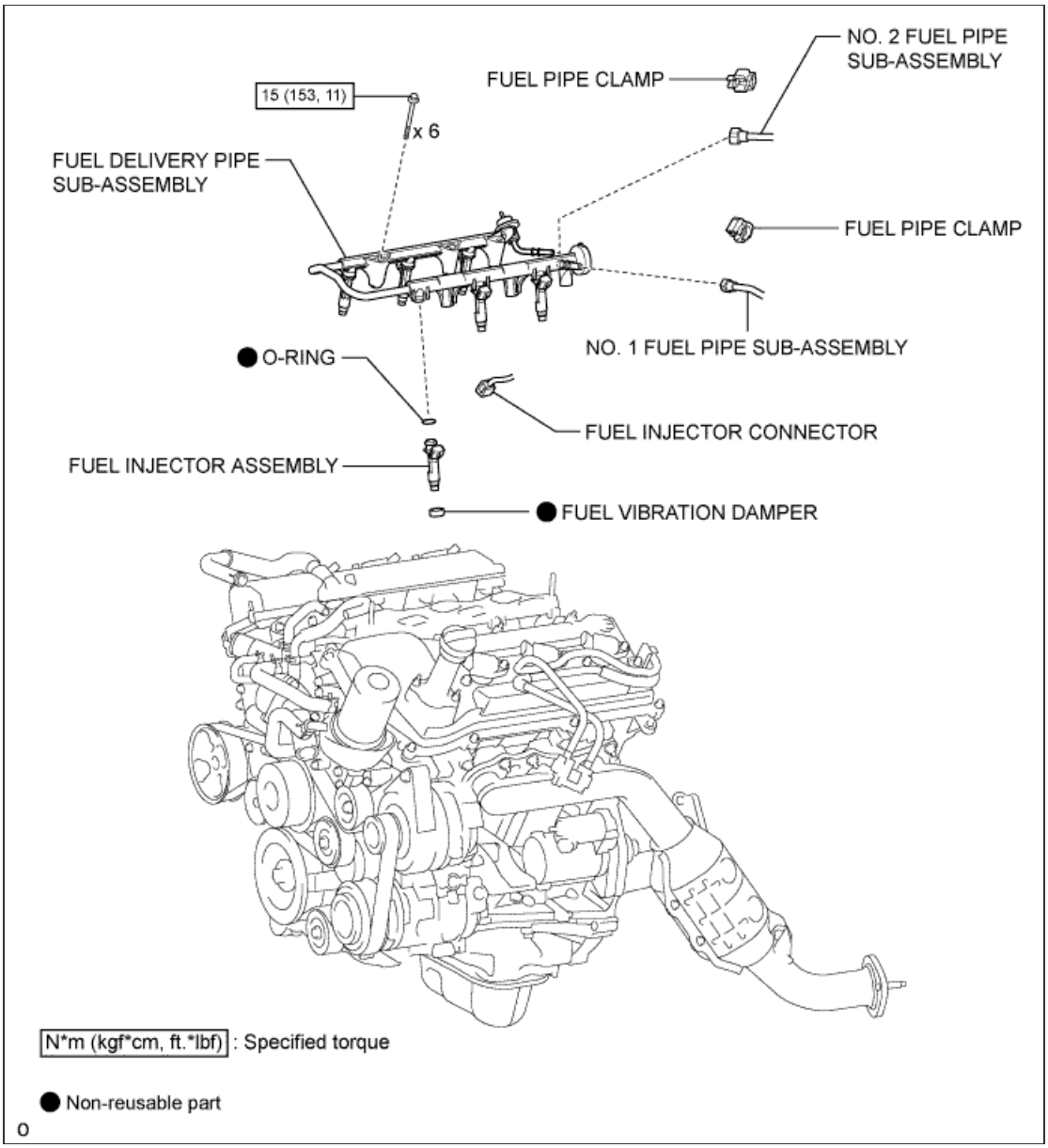
for Preparation Click here




7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER
AIR CLEANER ASSEMBLY
4.0 (41, 35 in.*lbf)
HOSE CLAMP
4.0 (41, 35 in.*lbf)
HOSE CLAMP
8.0 (82, 71 in.*lbf)
x 2
NO. 2 AIR CLEANER HOSE
VACUUM HOSE
NO. 2 VENTILATION HOSE
HOSE CLAMP
MASS AIR FLOW METER CONNECTOR
N*m (kgf*cm, ft.*lbf) : Specified torque

0


VACUUM SWITCHING VALVE CONNECTOR (for ACIS)
ENGINE WIRE
THROTTLE BODY CONNECTOR
* 28 (286, 21)
* 28 (286, 21)
x 2
x 4
PURGE VSV CONNECTOR
NO. 5 WATER BY-PASS HOSE
21 (214, 15)
x 2
THROTTLE BODY BRACKET
PURGE LINE HOSE
INTAKE AIR SURGE TANK
NO. 1 VENTILATION HOSE
NO. 1 SURGE TANK STAY
21 (214, 15)
x 2
BRACKET
NO. 4 WATER BY-PASS HOSE
21 (214, 15)
x 2
NO. 2 SURGE TANK STAY
8.0 (82, 71 in.*lbf)
for Manual Transmission:
CLUTCH TUBE BRACKET
21 (214, 15)
x 2
20 (204, 15)
NO. 2 SURGE TANK STAY
9.0 (92, 80 in.*lbf)
OIL BAFFLE PLATE
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
* DO NOT apply oil


NO. 2 FUEL PIPE SUB-ASSEMBLY
FUEL PIPE CLAMP
15 (153, 11)
x 6
FUEL DELIVERY PIPE SUB-ASSEMBLY
FUEL PIPE CLAMP
NO. 1 FUEL PIPE SUB-ASSEMBLY
O-RING
FUEL INJECTOR CONNECTOR
FUEL INJECTOR ASSEMBLY
FUEL VIBRATION DAMPER
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

a. Discharge the fuel system pressure (Click here).

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

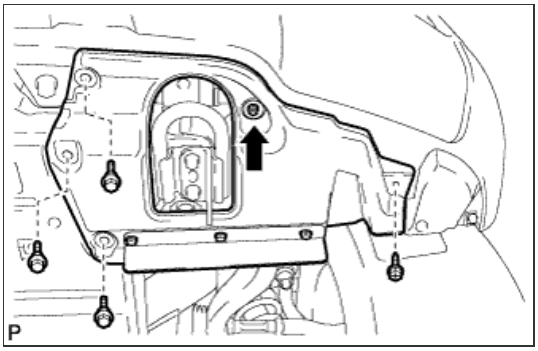
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



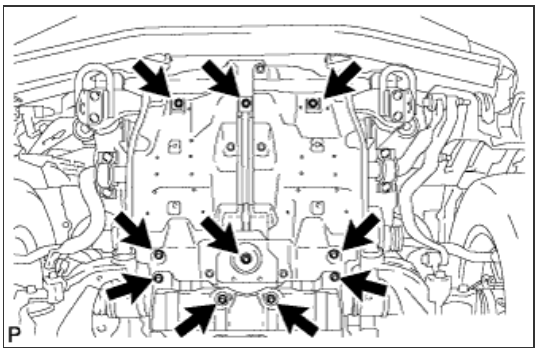
4. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

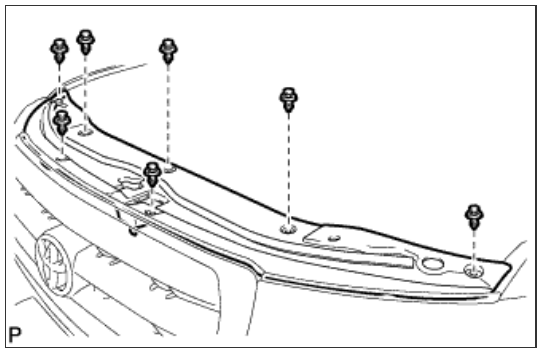
5. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



6. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and radiator support seal.



7. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug and 2 cylinder block drain cock plugs.

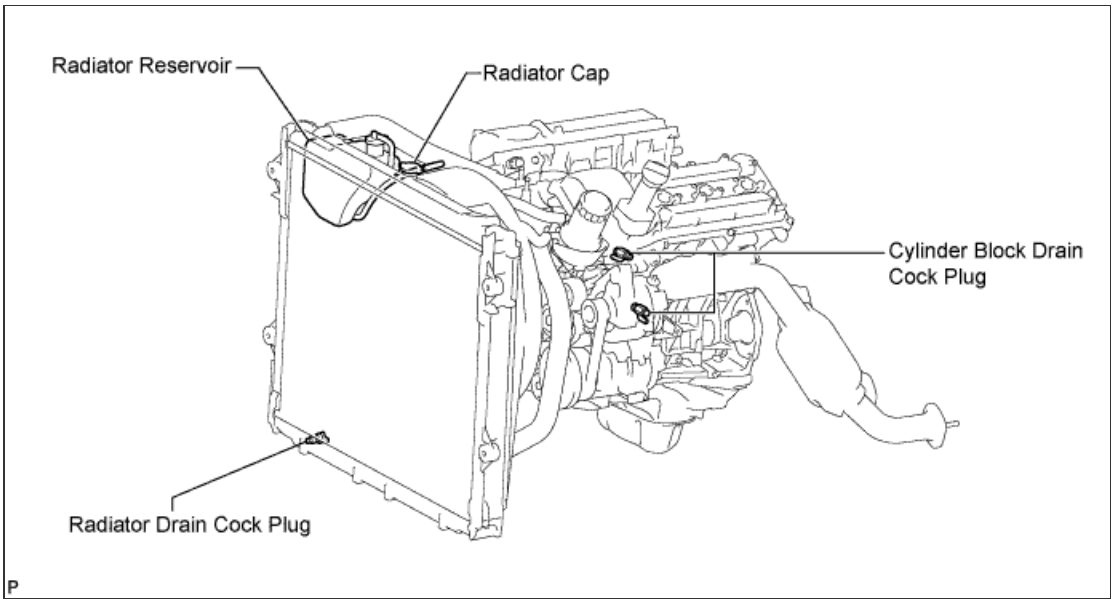
b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Tighten the 2 cylinder block drain cock plugs.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



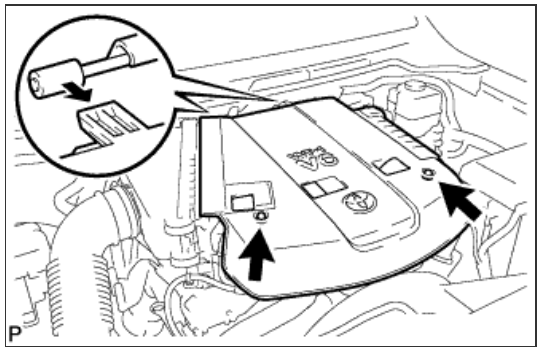
d. Tighten the radiator drain cock plug by hand.

8. REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Remove the cowl top ventilator louver (Click here).

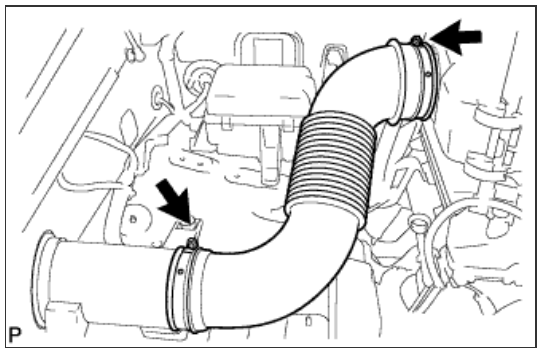
9. REMOVE V-BANK COVER

a. Remove the 2 nuts and V-bank cover.



10. REMOVE NO. 2 AIR CLEANER HOSE

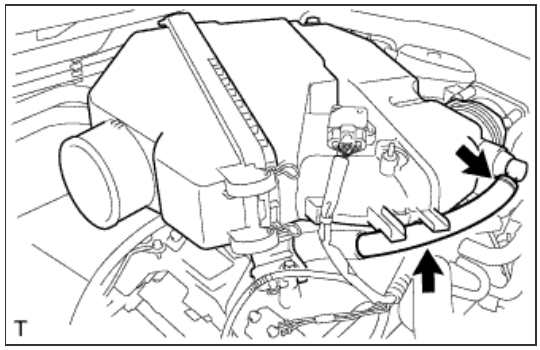
a. Loosen the 2 hose clamps and remove the air cleaner hose.



11. REMOVE AIR CLEANER ASSEMBLY

a. Disconnect the No. 2 ventilation hose.

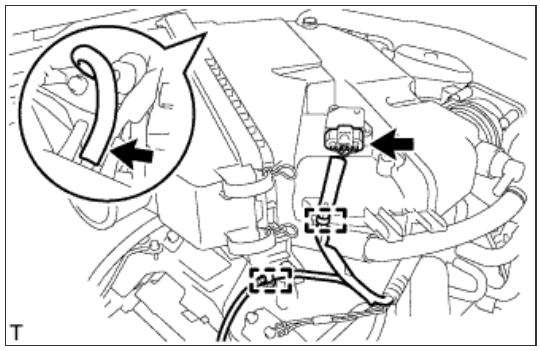
b. Detach the hose clamp.



c. Disconnect the vacuum hose.

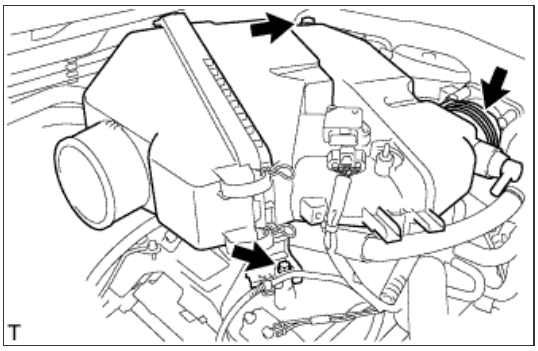
d. Disconnect the MAF meter connector.

e. Using a clip remover, detach the 2 wire harness clamps.



f. Loosen the hose clamp.

g. Remove the 2 bolts and air cleaner assembly.

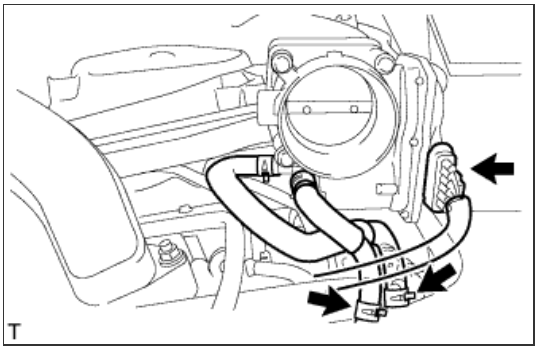


12. REMOVE INTAKE AIR SURGE TANK

a. Disconnect the throttle body connector.

b. Disconnect the No. 4 water by-pass hose.

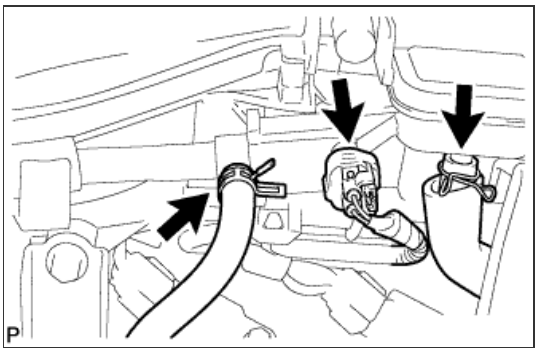
c. Disconnect the No. 5 water by-pass hose.



d. Disconnect the purge line hose.

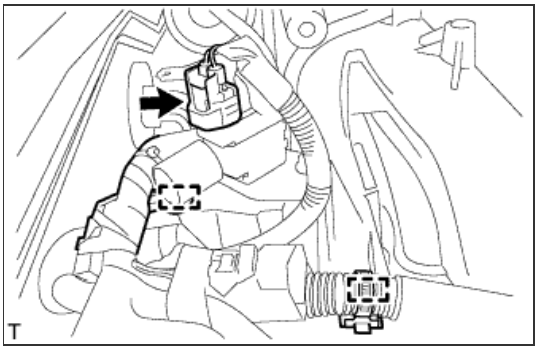
e. Disconnect the purge VSV connector.

f. Disconnect the No. 1 ventilation hose.

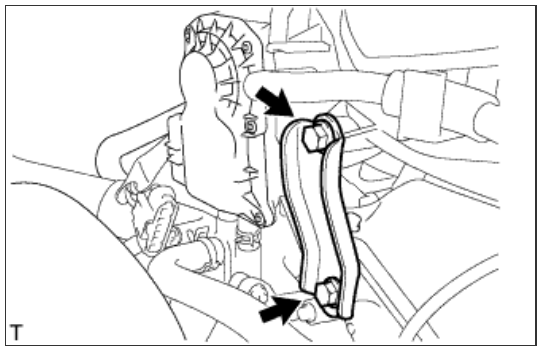


g. Disconnect the vacuum switching valve (for AC) connector.

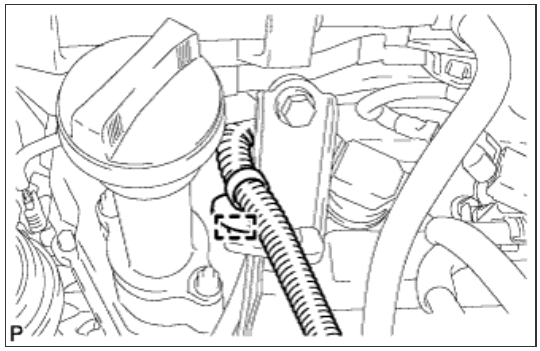
h. Using a clip remover, detach the 2 wire harness clamps.



i. Remove the 2 bolts and throttle body bracket.

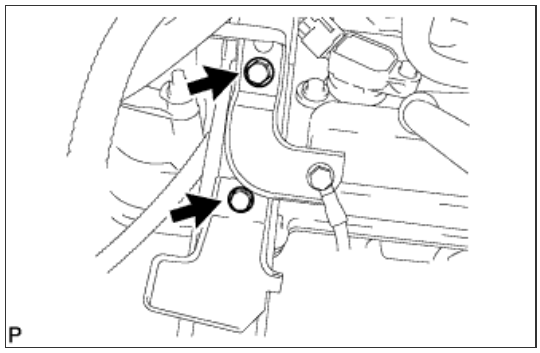


j. Using a clip remover, detach the wire harness clamp.

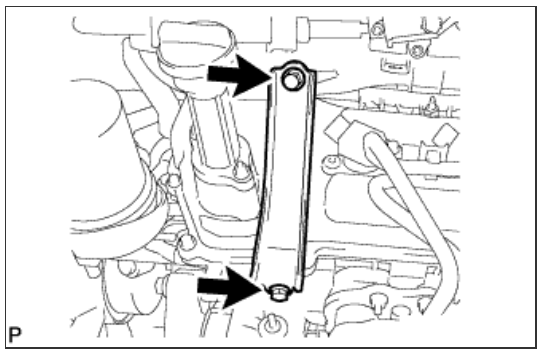


k. Remove the bolt and bracket from the No. 1 surge tank stay.

l. Remove the bolt and oil baffle plate.

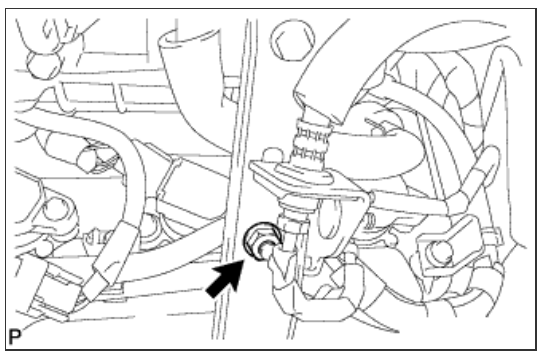


m. Remove the 2 bolts and No. 1 surge tank stay.

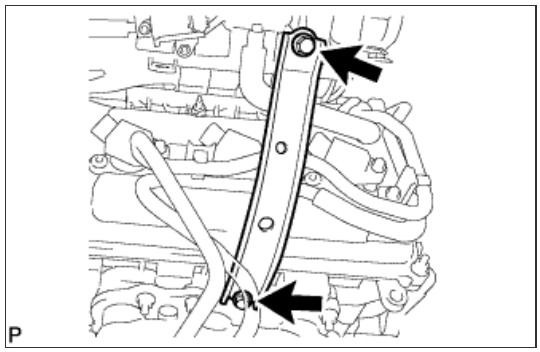


n. for Manual Transmission:

i. Remove the nut.

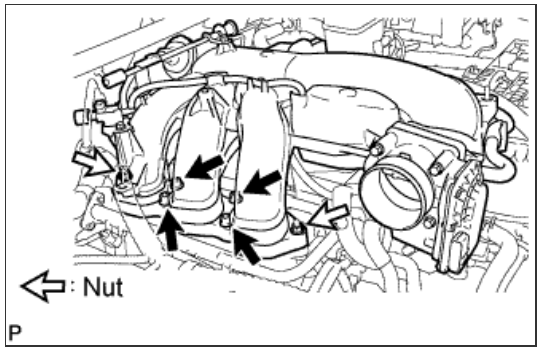


o. Remove the 2 bolts and No. 2 surge tank stay.



p. Remove the 2 nuts.

q. Using an 8 mm hexagon wrench, remove the 4 bolts. Then remove the intake air surge tank and gasket.



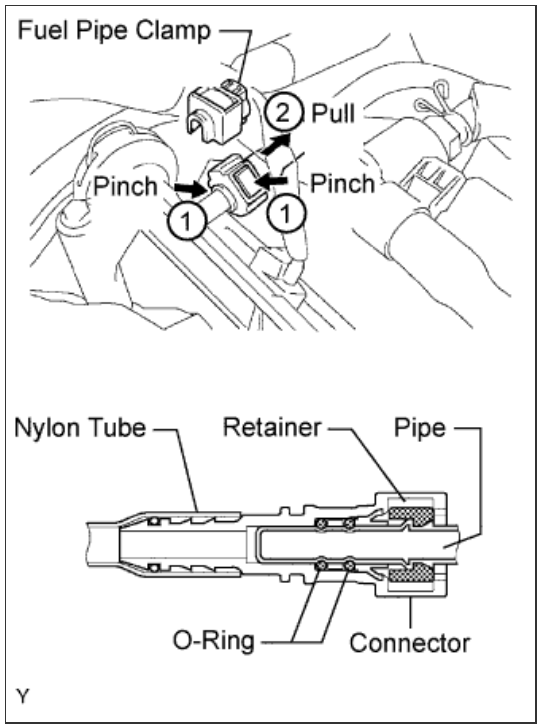
13. DISCONNECT NO. 1 FUEL PIPE SUB-ASSEMBLY

a. Remove the fuel pipe clamp.

b. Pinch the tube connector, and then pull the fuel pipe out of the delivery pipe as shown in the illustration.

NOTICE:

- **Remove an dirt and foreign objects from the fuel tube connector before performing this ork.**
- **Do not allo an cratches or foreign objects on the parts hen disconnecting, as the fuel tube connector has the O-ring that seals the pipe.**
- **Perform this ork b hand. Do not use an tools.**
- **Do not forcibl bend, t ist or turn the n lon tube.**
- **Keep the plug free from foreign objects.**
- **Protect the disconnected part b covering it ith a plastic bag after disconnecting the fuel tube.**
- **If the fuel tube connector and pipe are stuck, push and pull to release them.**



14. DISCONNECT NO. 2 FUEL PIPE SUB-ASSEMBLY

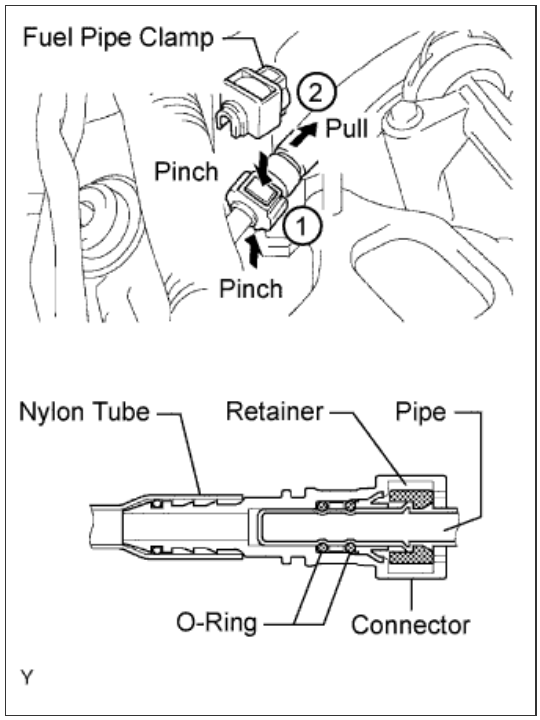
a. Remove the fuel pipe clamp.

b. Pinch the tube connector, and then pull the fuel pipe out of the pipe as shown in the illustration.

NOTICE:

- **Remove an dirt and foreign objects from the fuel tube connector before performing this ork.**

- **Do not allo an cratches or foreign objects on the parts hen disconnecting, as the fuel tube connector has the O-ring that seals the pipe.**
- **Perform this ork b hand. Do not use an tools.**
- **Do not forcibl bend, t ist or turn the n lon tube.**
- **Keep the plug free from foreign objects.**
- **Protect the disconnected part b covering it ith a plastic bag after disconnecting the fuel tube.**
- **If the fuel tube connector and pipe are stuck, push and pull to release them.**



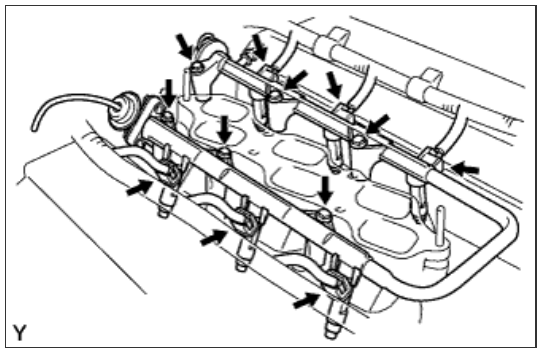
15. REMOVE FUEL DELIVERY PIPE SUB-ASSEMBLY

a. Disconnect the 6 fuel injector connectors.

b. Remove the 6 bolts and fuel delivery pipe together with the 6 fuel injectors.

NOTICE:

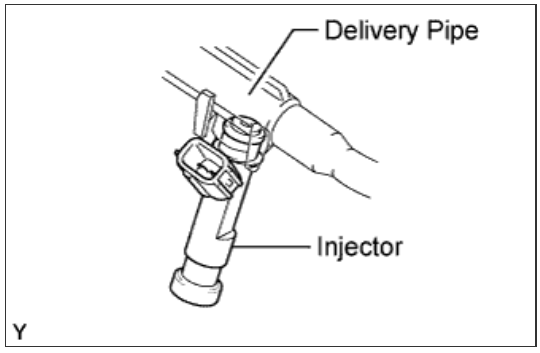
Be careful not to drop the injectors when removing the fuel delivery pipe.



16. REMOVE FUEL INJECTOR ASSEMBLY

a. Pull the 6 fuel injectors from the fuel delivery pipe.

b. Remove the O-ring and injector vibration insulator from each fuel injector.



for Preparation Click here

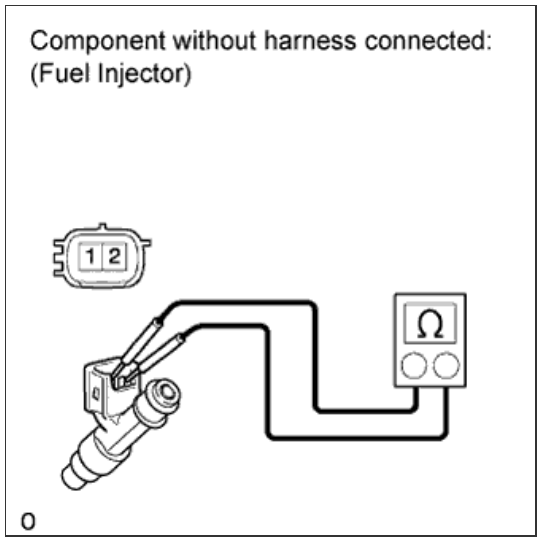
1. INSPECT INJECTOR ASSEMBLY

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	11.6 to 12.4 Ω

If the result is not as specified, replace the injector assembly.



2. INSPECT INJECTION VOLUME AND LEAKAGE

a. Check the injector injection.

CAUTION:

- **This test involves high-pressure fuel and electricity.**
- **Take every precaution regarding safe handling of both the fuel and the electrical parts.**
- **Perform this test in a safe area, and avoid any sparks or flame.**
- **Do not smoke.**

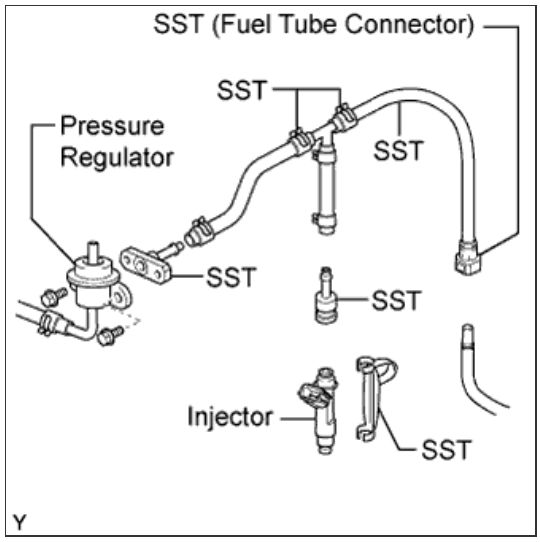
i. Assemble SST as shown in the illustration.

SST

09268-31012 (09268-41091, 09268-41120, 09268-41140, 09268-41400, 09268-41500, 90467-13001, 95333-06030, 95336-08070)

ii. Discharge the fuel system pressure (Click here).

iii. Disconnect the fuel inlet hose (fuel tube connector) from the fuel pipe.



iv. Remove the bolt and disconnect the fuel pressure regulator from the fuel delivery pipe.

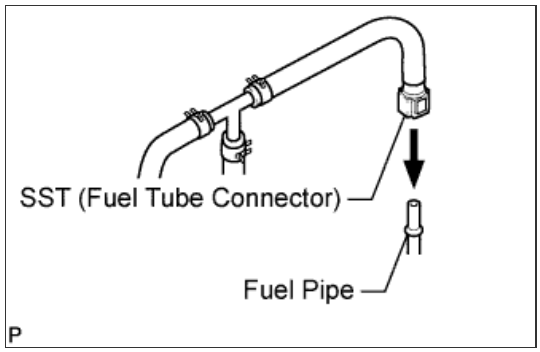
NOTICE:

Do not disconnect the No. 2 fuel pipe from the fuel pressure regulator.

v. Connect SST to the fuel pipe.

CAUTION:

Always read the precautions before connecting the fuel tube connector.

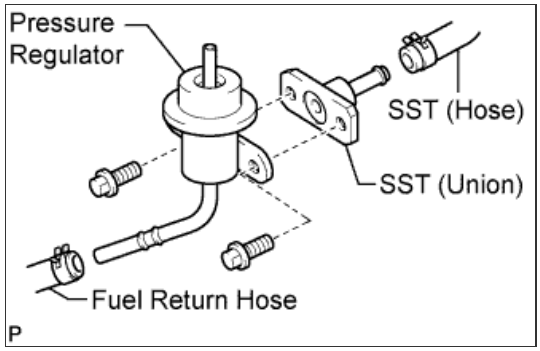


vi. Connect SST (hose) to the fuel inlet of the pressure regulator with another SST (union) and the 2 bolts.

SST
09268-31012 (09268-41091, 95336-08070)

Tor ue:
9.0 N m 2 kgf cm , 80 in. lbf }

vii. Connect the fuel return hose to the fuel outlet of the pressure regulator.



viii. Install a new O-ring to the injector.

ix. Connect SST (adapter and hose) to the injector, and hold the injector and adapter with SST (clamp).

SST
09268-31012 (09268-41140, 09268-41400, 95336-08070)

x. Put the injector into a graduated cylinder.

CAUTION:

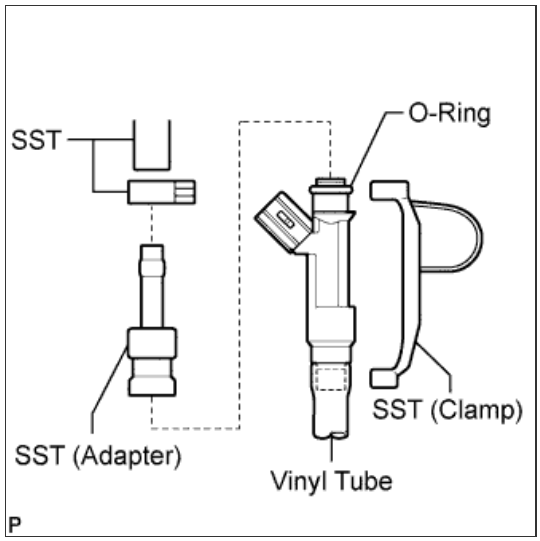
Install a suitable vinyl tube onto the injector to contain any gasoline spray.

xi. Connect the intelligent tester to the DLC3.

xii. Turn the ignition switch to ON.

NOTICE:

Do not start the engine.



xiii. Turn the intelligent tester ON.

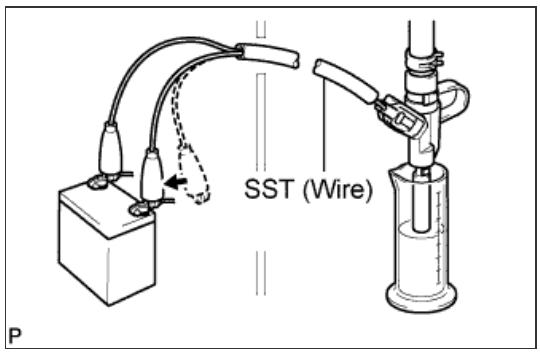
xiv. nter the following menus: Powertrain / ngine and CT / Active Test / Activate the Fuel Pump Speed Control.

xv. Connect SST (wire) to the injector and the battery for 15 seconds, and measure the injection volume with a graduated cylinder. Test each injector 2 or 3 times.

SST
09842-30080

Standard injection volume:
71 to 86 cm^3 (4.3 to 5.2 cu. in.) per 15 seconds

Difference between each injector:
15 cm^3 (0.9 cu. in.) or less



NOTICE:

Always turn the voltage on and off on the battery side, not the fuel pump side.

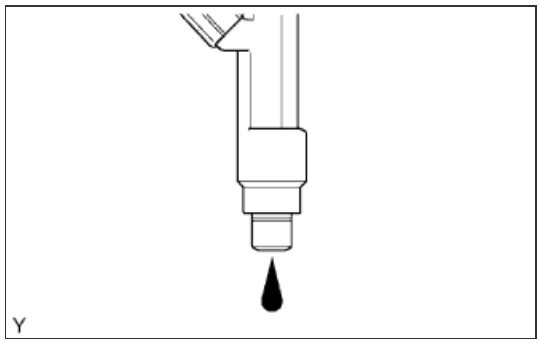
If the result is not as specified, replace the injector assembly.

b. Check for fuel drop.

i. In the condition above, disconnect the tester probes of SST (wire) from the battery and check for fuel drop from the injector.

Standard fuel drop:
1 drop or less per 12 minutes

If the fuel drop is not as specified, replace the injector assembly.

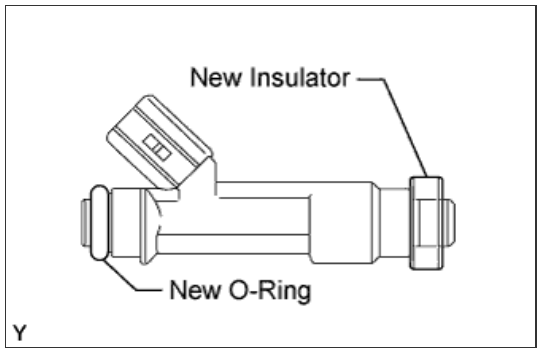


for Preparation Click here

1. INSTALL FUEL INJECTOR ASSEMBLY

a. Install a new insulator onto each fuel injector.

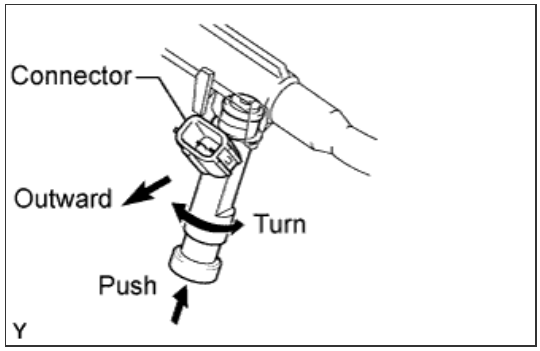
b. Apply a light coat of spindle oil or gasoline to each new O-ring and install one onto each fuel injector.



c. Install the 6 injectors.

i. While turning each fuel injector left and right, install it onto the fuel delivery pipe.

ii. Position the fuel injector connectors facing outward.



2. INSTALL FUEL DELIVERY PIPE SUB-ASSEMBLY

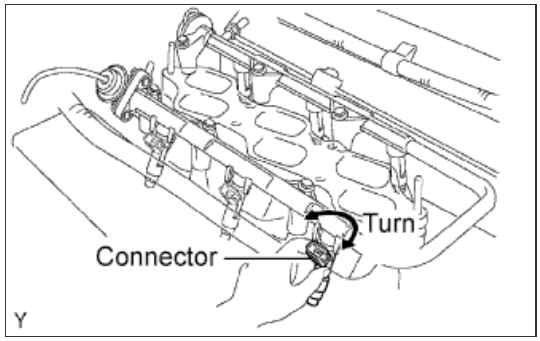
a. Place the fuel delivery pipe together with the 6 fuel injectors on the intake manifold.

b. Temporarily install the 6 bolts, which are used to hold the fuel delivery pipe, to the intake manifold.

c. Check that the fuel injectors rotate smoothly.

HINT:

If the fuel injectors do not rotate smoothly, replace the O-ring of any injector that does not rotate smoothly.



d. Position the fuel injector connectors facing outward.

e. Tighten the 6 bolts, which are used to hold the fuel delivery pipe, to the intake manifold.

Torque:
15 N*m{ 153 kgf*cm , 11 ft.*lbf }

f. Connect the 6 fuel injector connectors.

3. CONNECT NO. 2 FUEL PIPE SUB-ASSEMBLY

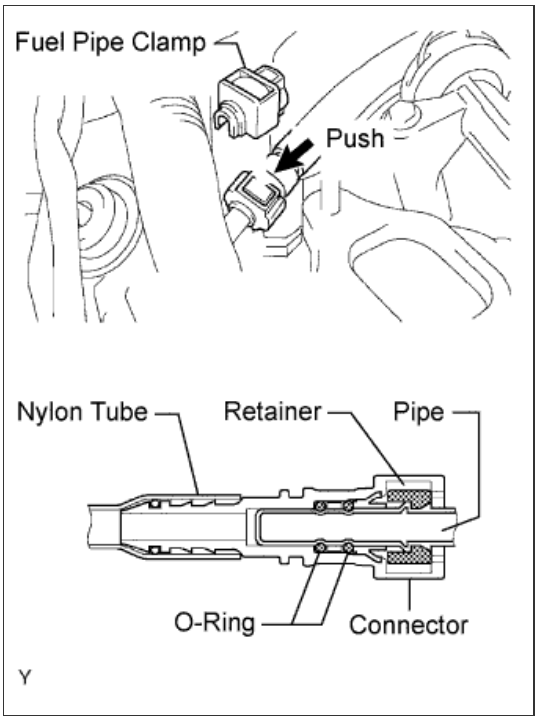
a. Push the tube connector into the pipe until the tube connector makes a "click"

sound.

NOTICE:

- **Check if there is any damage or foreign objects on the connected part of the fuel pipe.**
- **After connecting, check that the pipe and connector are securely connected by pulling them.**

b. Install the fuel pipe clamp.



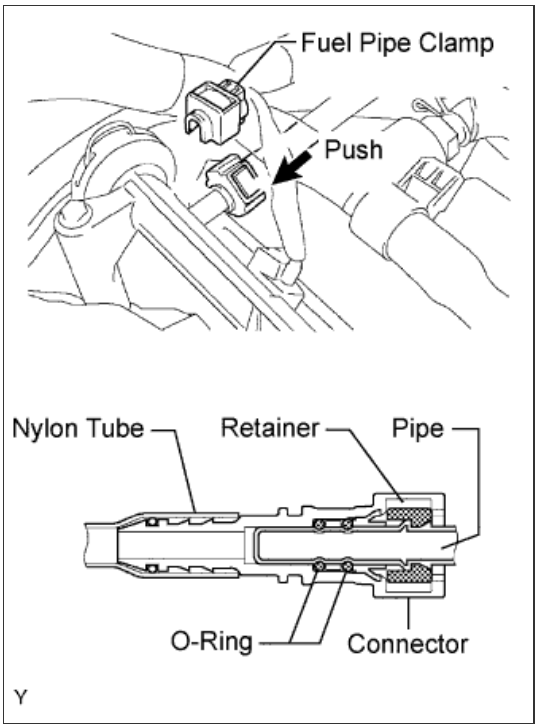
4. CONNECT NO. 1 FUEL PIPE SUB-ASSEMBLY

a. Push the tube connector into the pipe until the tube connector makes a "click" sound.

NOTICE:

- **Check if there is any damage or foreign objects on the connected part of the fuel pipe.**
- **After connecting, check that the pipe and connector are securely connected by pulling them.**

b. Install the fuel pipe clamp.



5. INSTALL INTAKE AIR SURGE TANK

NOTICE:

Do not apply oil to the bolts and nuts listed below: :

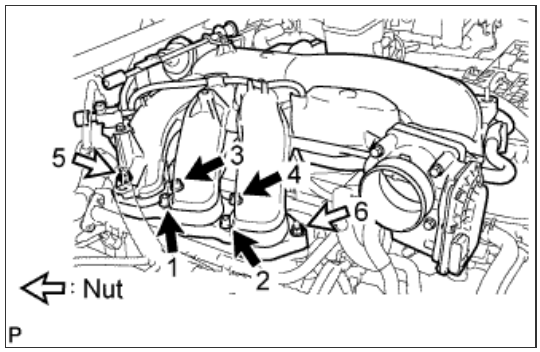
Oil Application Prohibited Bolt/Nut
Bolt for surge tank and intake manifold
Nut for surge tank and intake manifold

a. Install a new gasket to the intake air surge tank.

b. Using an 8 mm hexagon wrench, install the intake air surge tank with the 4 bolts

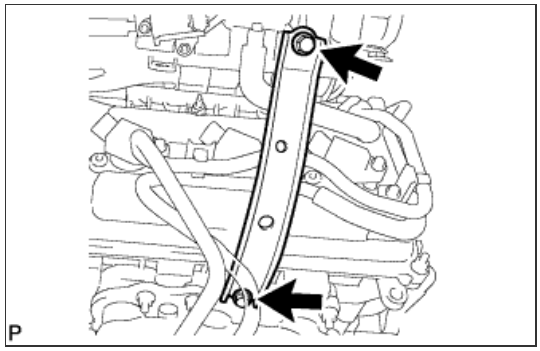
and 2 nuts in the order shown in the illustration.

Torque:
28 N*m{ 286 kgf*cm , 21 ft.*lbf }



c. Install the No. 2 surge tank stay with the 2 bolts.

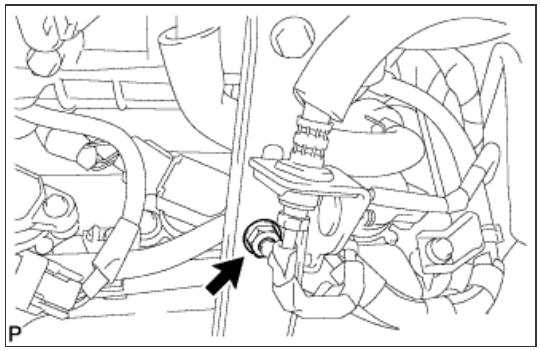
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



d. for Manual Transmission:

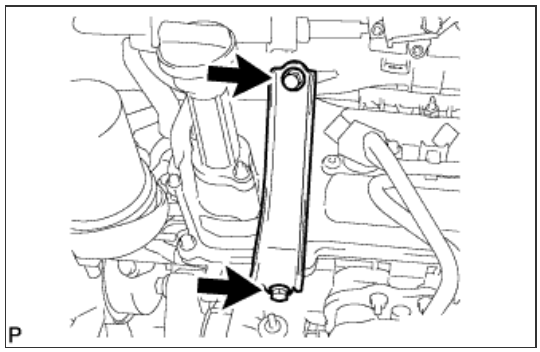
i. Install the bracket to the No. 2 surge tank stay with the nut.

Torque:
2 N*m{ 2 4 kgf*cm , 15 ft.*lbf }



e. Install the No. 1 surge tank stay with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

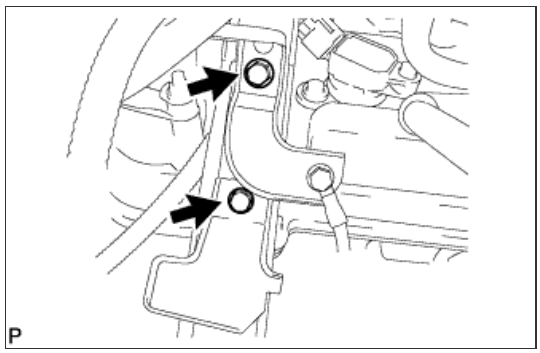


f. Install the oil baffle plate with the bolt.

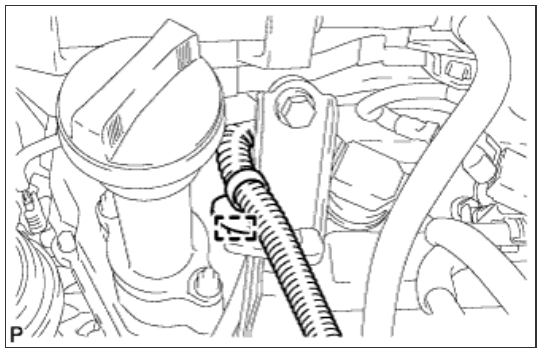
Torque:
9. N*m{ 92 kgf*cm , 8 in.*lbf }

g. Install the bracket to the No. 1 surge tank stay with the bolt.

Torque:
8. N*m{ 82 kgf*cm , 1 in.*lbf }

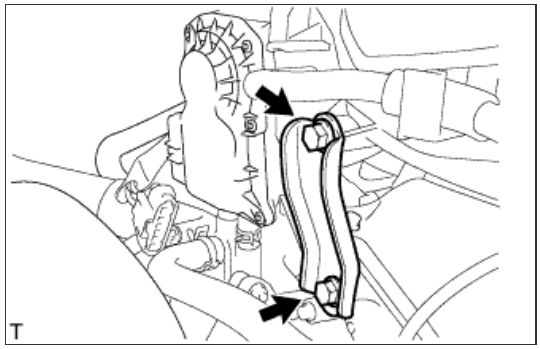


h. Attach the wire harness clamp.



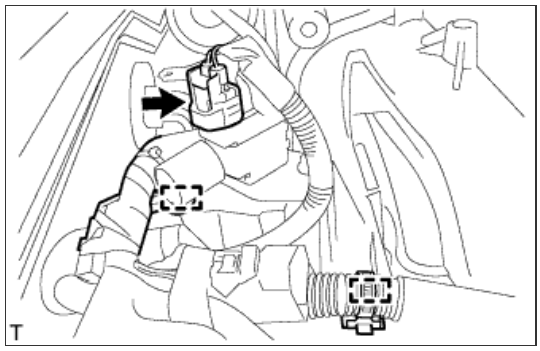
i. Install the throttle body bracket with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



j. Connect the vacuum switching valve (for ACIS) connector.

k. Attach the 2 wire harness clamps.



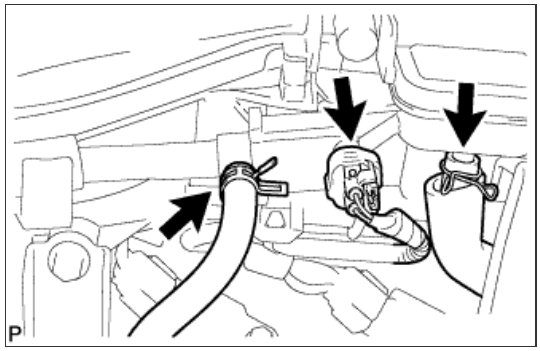
l. Connect the No. 1 ventilation hose.

m. Connect the purge VSV connector.

n. Connect the purge line hose.

HINT:

Connect the hose so that the direction of the hose clamp is as indicated in the illustration.

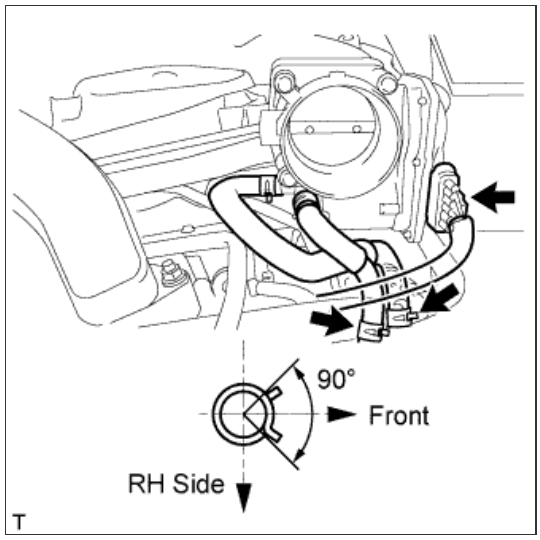


o. Connect the No. 4 and No. 5 water by-pass hose.

HINT:

Connect the hoses so that the direction of the hose clamps is as shown in the illustration.

p. Connect the throttle body connector.



6. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner assembly with the 2 bolts.

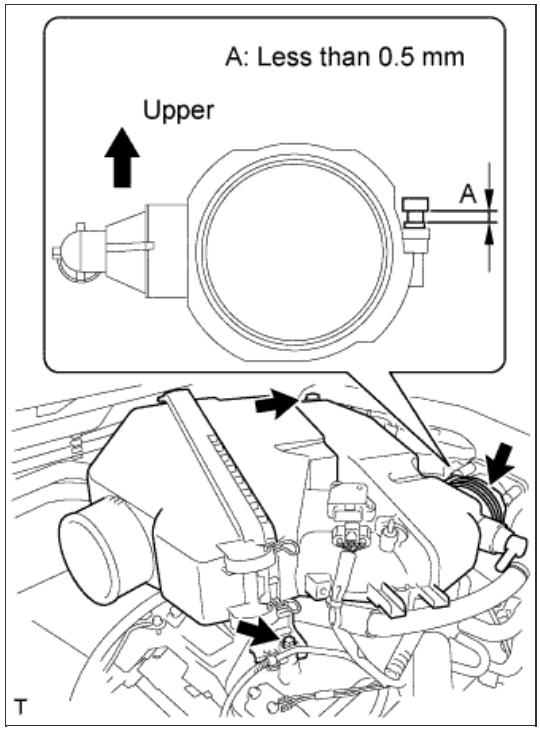
Torque:
8. N*m{ 82 kgf*cm , 1 in.*lbf }

b. Tighten the hose clamp.

HINT:

Tighten the hose clamp until it reaches the specified protrusion height labeled A shown in the illustration.

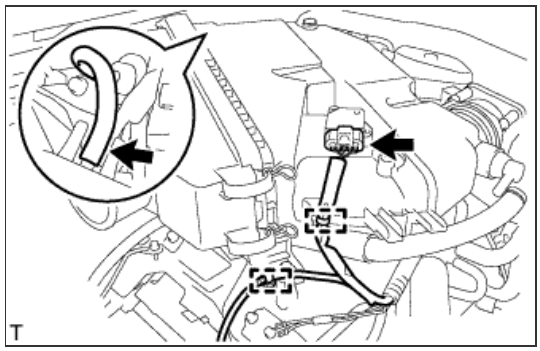
Standard protrusion height:
Less than 5 mm (. 1 in.)



c. Connect the MAF meter connector.

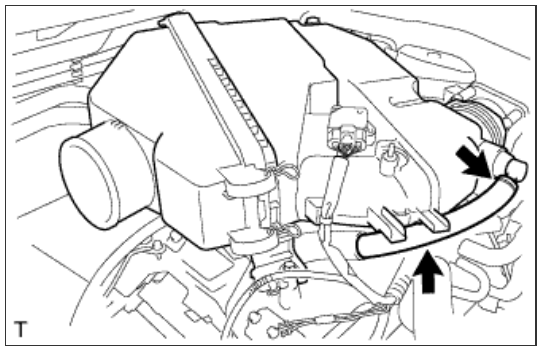
d. Attach the 2 wire harness clamps.

e. Connect the vacuum hose.



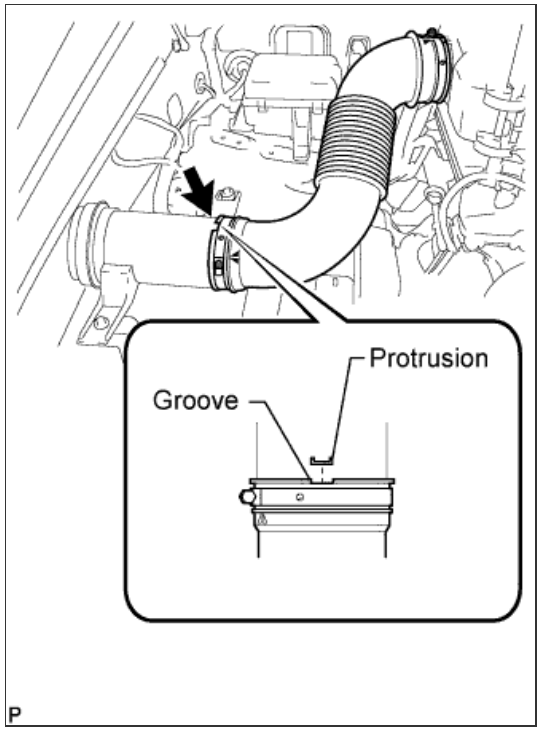
f. Attach the hose clamp.

g. Connect the No. 2 ventilation hose.



7. INSTALL NO. 2 AIR CLEANER HOSE

a. Align the protrusion of the pre-cleaner with the groove of the No. 2 air cleaner hose as shown in the illustration.



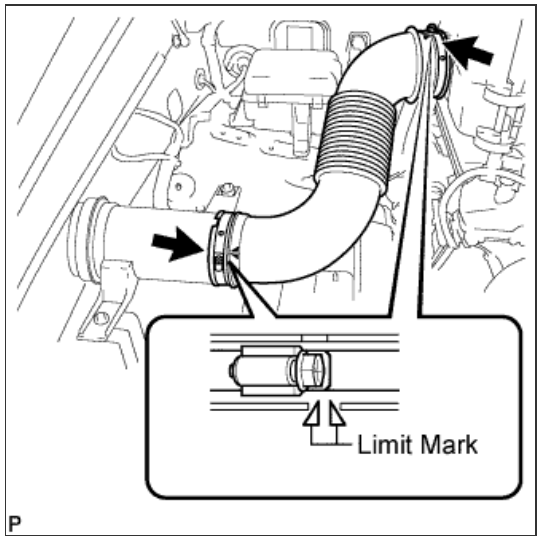
b. Tighten the 2 hose clamps.

Torque:

4. N*m{ 41 kgf*cm , 35 in.*lbf }

HINT:

Tighten the clamp until the end of the clamp band is within both limit marks.



8. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

9. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item		Specified condition
for Automatic transmission	w/o Rear Heater	11.2 liters (11.8 US qts, 9.9 Imp. qts)
	w/ Rear Heater	14.4 liters (15.2 US qts, 12. Imp. qts)
for Manual transmission	w/o Rear Heater	12. liters (12. US qts, 1 .6 Imp. qts)
	w/ Rear Heater	14.6 liters (15.4 US qts, 12.8 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

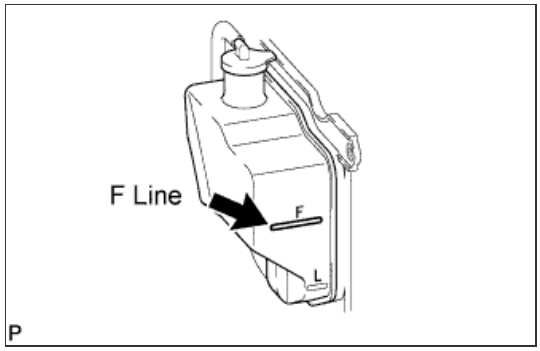
TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.



f. Set the air conditioning as follows while warming up the engine.

Item	Condition
Fan speed	Any setting except off
Temperature	Toward WARM
Air conditioning switch	Off

g. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

h. Maintain the engine speed at 2 to 25 rpm.

NOTICE:

- **Make sure that the radiator reser oir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or o erheat.**
- **Immediately after starting the engine, if the radiator reser oir does not ha e any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2 rpm until the coolant le el has stabilized.**

i. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

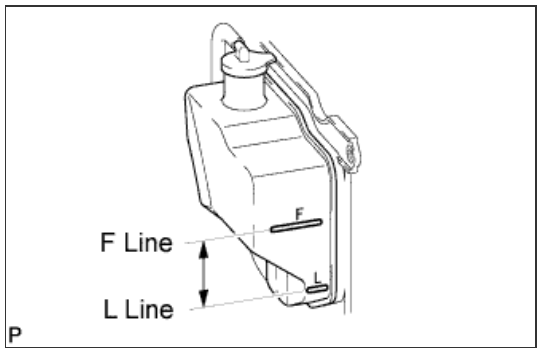
- **Wear protecti e glo es. Heat areas on the parts may injure your hands.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the fan.**

j. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

k. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.



1 INSPECT FOR COOLANT LEAK

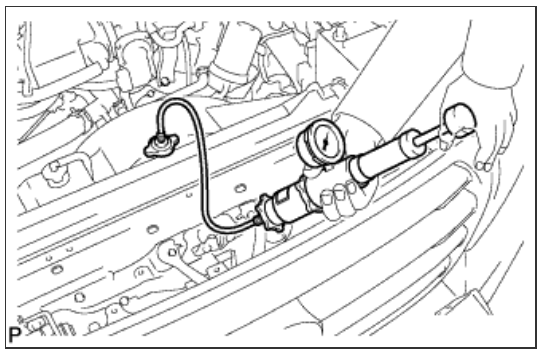
CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



11. INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and intelligent tester on.

NOTICE:

Do not start the engine.

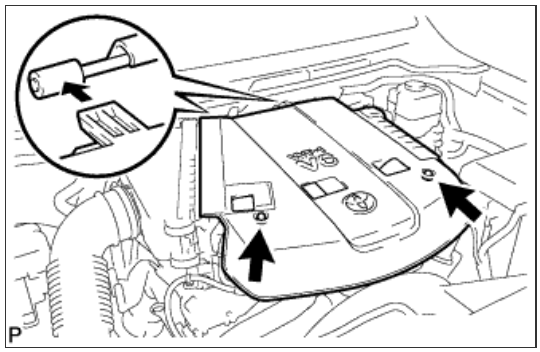
c. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the Fuel Pump Speed Control.

d. Check that there are no fuel leaks after doing maintenance anywhere on the fuel system.

12. INSTALL V-BANK COVER

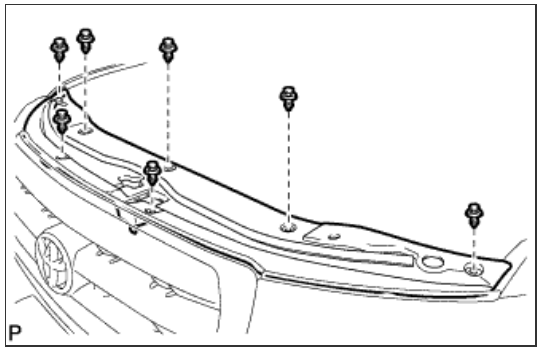
a. Install the V-bank cover with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



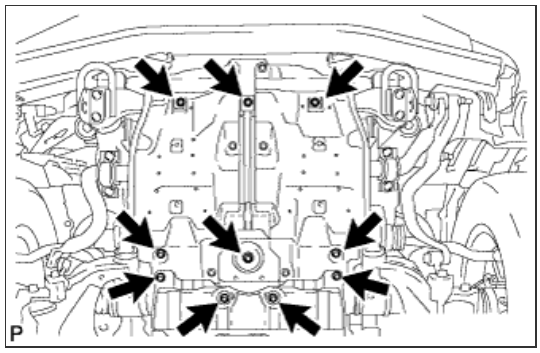
13. INSTALL UPPER RADIATOR SUPPORT SEAL

a. Install the radiator support seal with the clips.



14. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

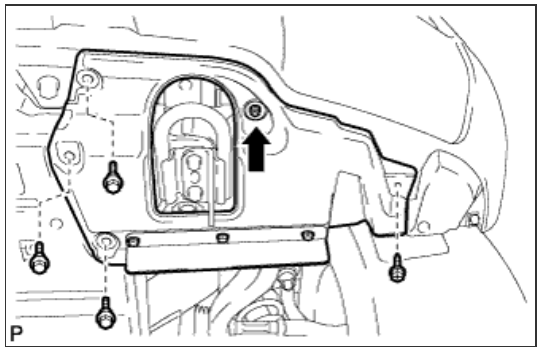
a. Install the under cover with the 1 bolts.



15. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



16. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

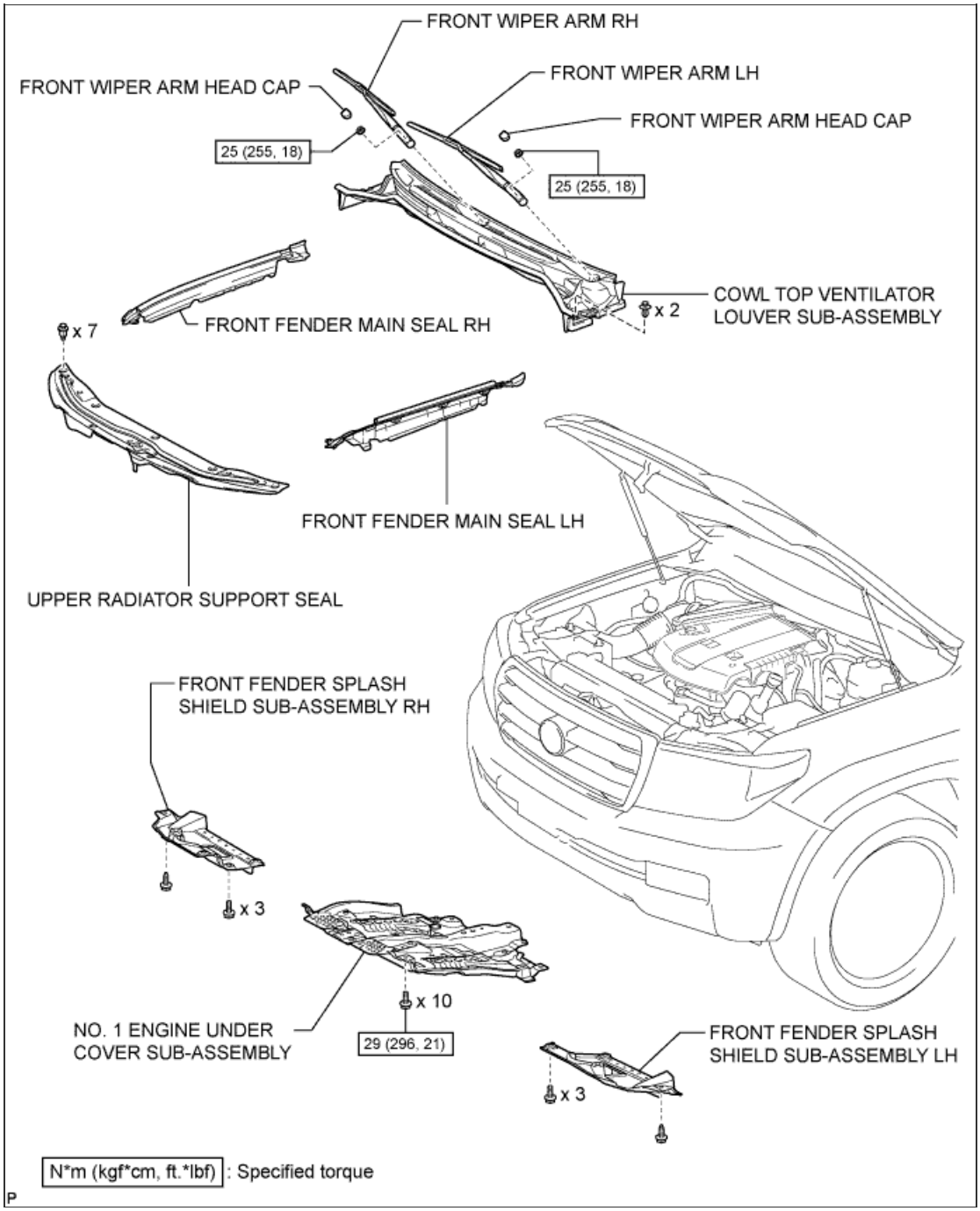
HINT:

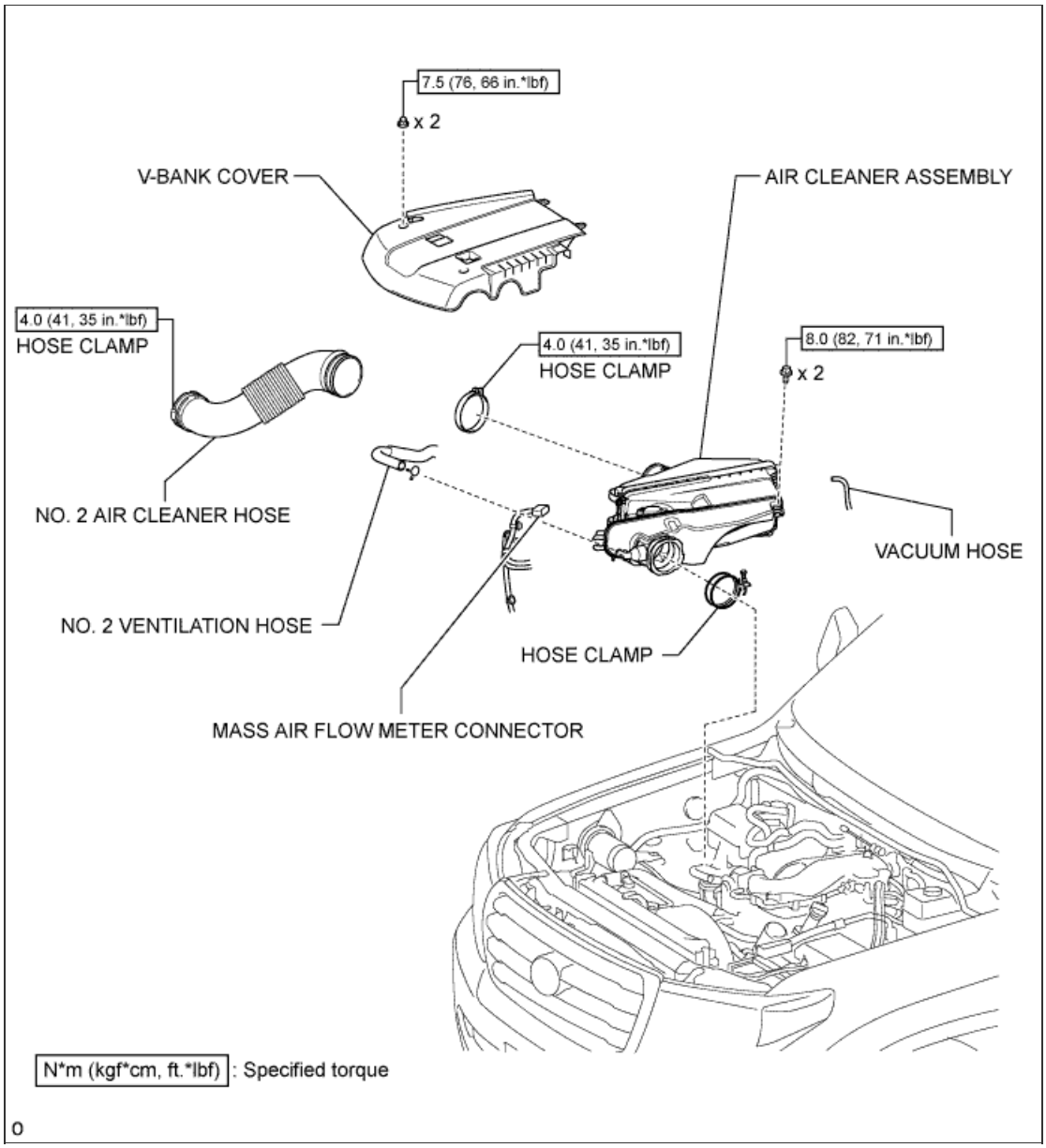
Use the same procedures described for the LH side.

17. INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

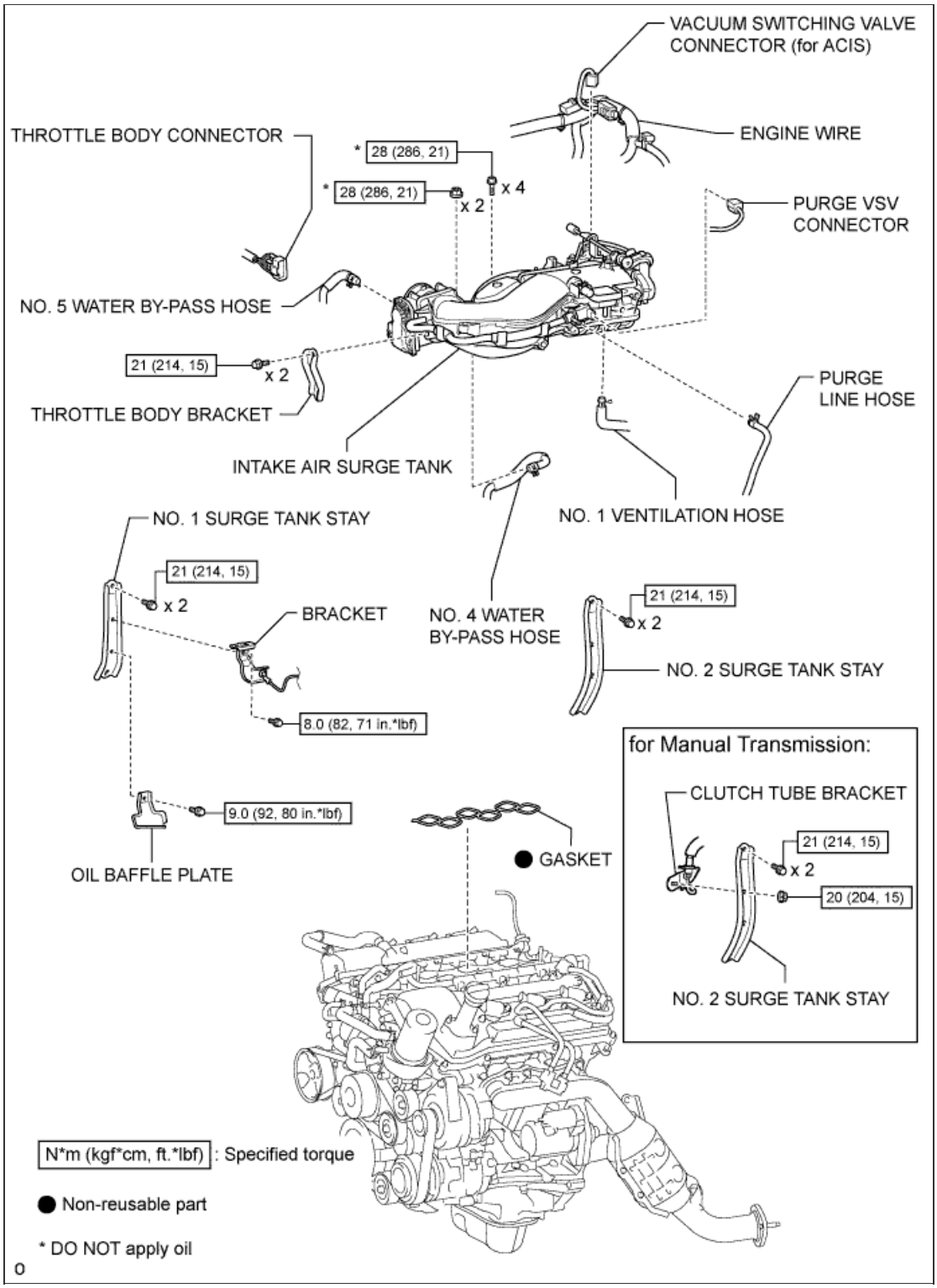
a. Install the cowl top ventilator louver (Click here).

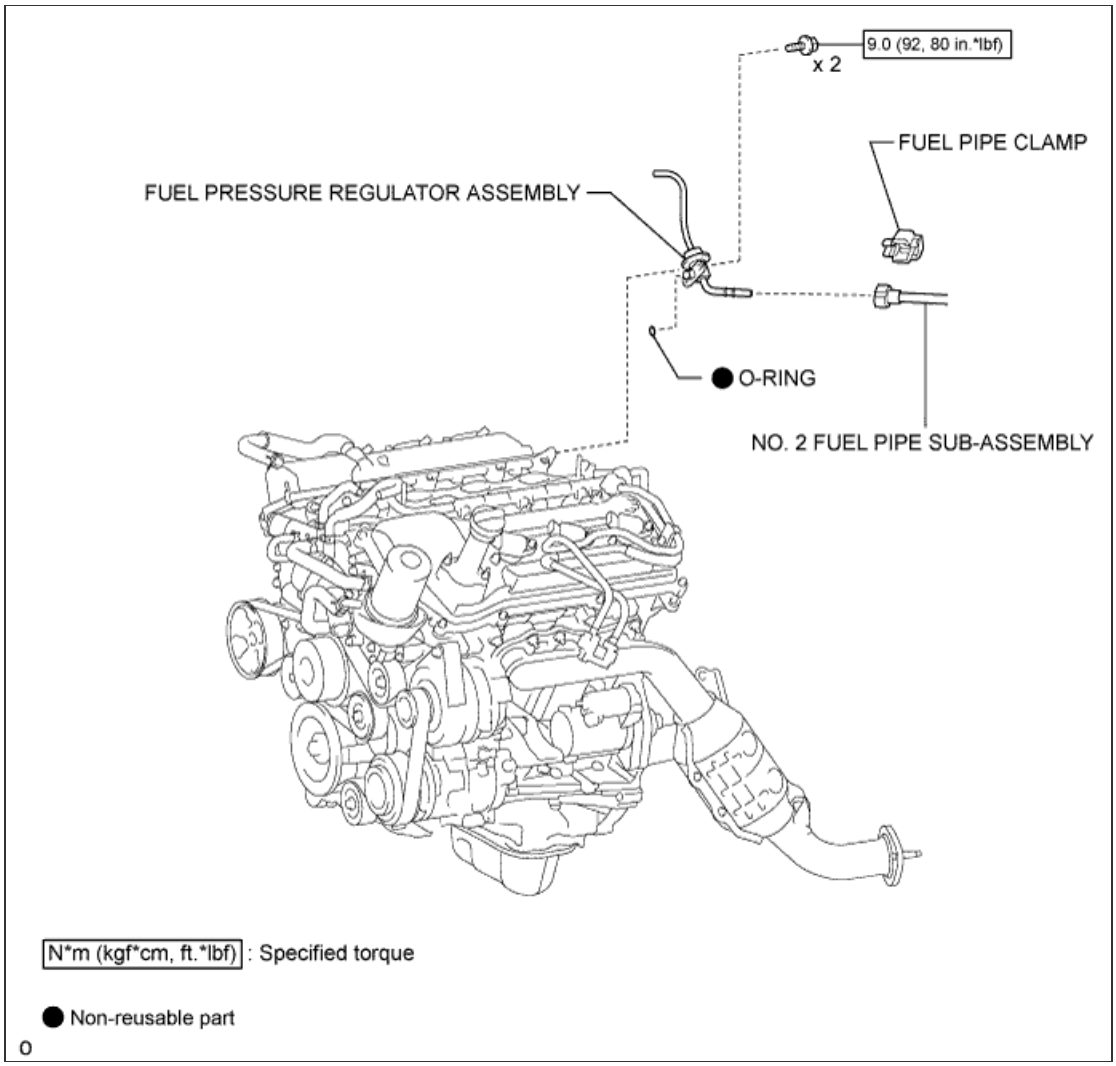
for Preparation [Click here]




7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER
AIR CLEANER ASSEMBLY
4.0 (41, 35 in.*lbf)
HOSE CLAMP
4.0 (41, 35 in.*lbf)
HOSE CLAMP
8.0 (82, 71 in.*lbf)
x 2
NO. 2 AIR CLEANER HOSE
VACUUM HOSE
NO. 2 VENTILATION HOSE
HOSE CLAMP
MASS AIR FLOW METER CONNECTOR
N*m (kgf*cm, ft.*lbf) : Specified torque

0


VACUUM SWITCHING VALVE CONNECTOR (for ACIS)
ENGINE WIRE
THROTTLE BODY CONNECTOR
* 28 (286, 21)
* 28 (286, 21)
x 2
x 4
PURGE VSV CONNECTOR
NO. 5 WATER BY-PASS HOSE
21 (214, 15)
x 2
THROTTLE BODY BRACKET
PURGE LINE HOSE
INTAKE AIR SURGE TANK
NO. 1 VENTILATION HOSE
NO. 1 SURGE TANK STAY
21 (214, 15)
x 2
BRACKET
NO. 4 WATER BY-PASS HOSE
21 (214, 15)
x 2
NO. 2 SURGE TANK STAY
8.0 (82, 71 in.*lbf)
for Manual Transmission:
CLUTCH TUBE BRACKET
21 (214, 15)
x 2
20 (204, 15)
NO. 2 SURGE TANK STAY
9.0 (92, 80 in.*lbf)
OIL BAFFLE PLATE
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
* DO NOT apply oil


9.0 (92, 80 in.*lbf)
x 2
FUEL PIPE CLAMP
FUEL PRESSURE REGULATOR ASSEMBLY
O-RING
NO. 2 FUEL PIPE SUB-ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

o

for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

a. Discharge the fuel system pressure (Click here).

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

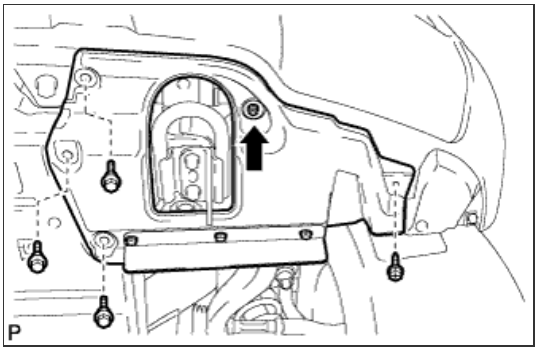
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



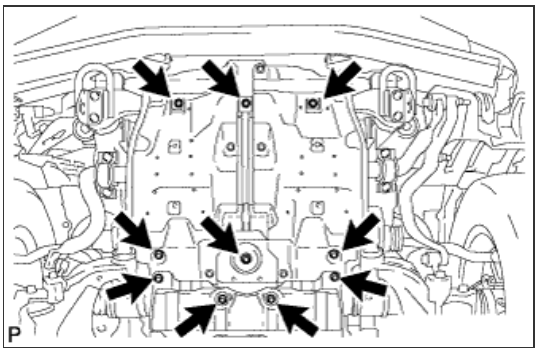
4. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

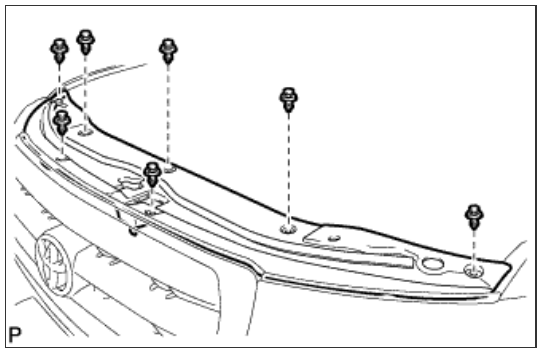
5. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



6. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and radiator support seal.



7. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug and 2 cylinder block drain cock plugs.

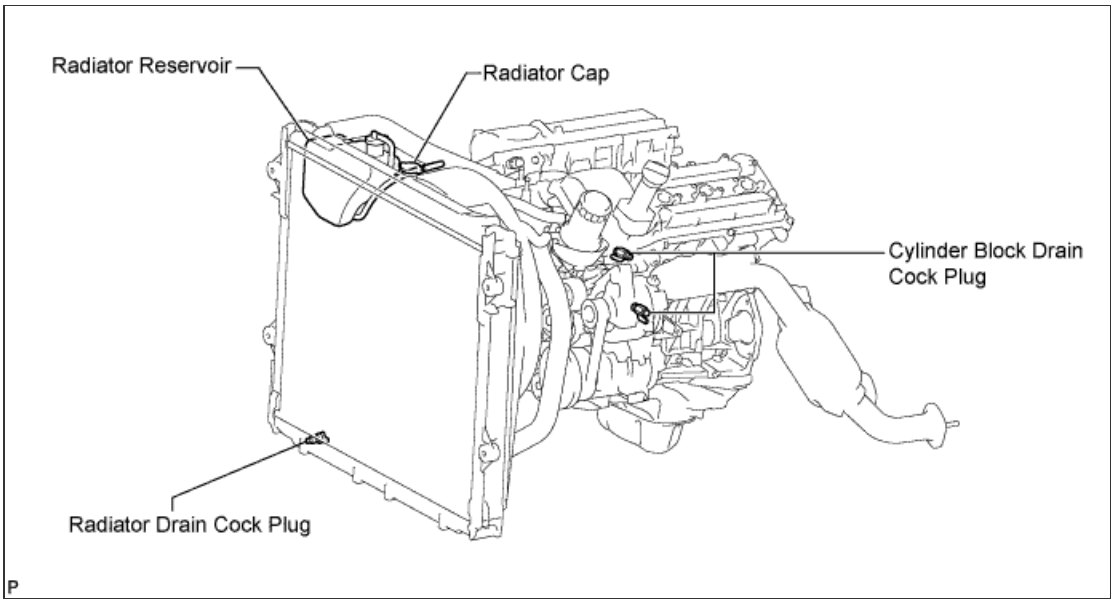
b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Tighten the 2 cylinder block drain cock plugs.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



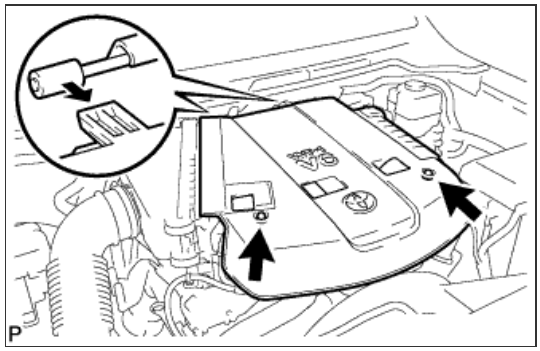
d. Tighten the radiator drain cock plug by hand.

8. REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Remove the cowl top ventilator louver (Click here).

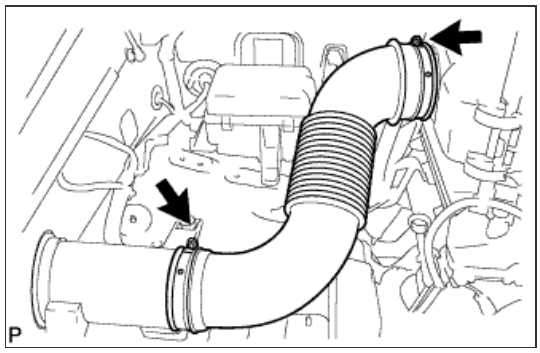
9. REMOVE V-BANK COVER

a. Remove the 2 nuts and V-bank cover.



10. REMOVE NO. 2 AIR CLEANER HOSE

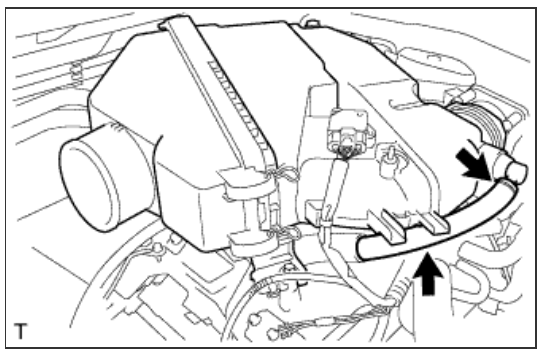
a. Loosen the 2 hose clamps and remove the air cleaner hose.



11. REMOVE AIR CLEANER ASSEMBLY

a. Disconnect the No. 2 ventilation hose.

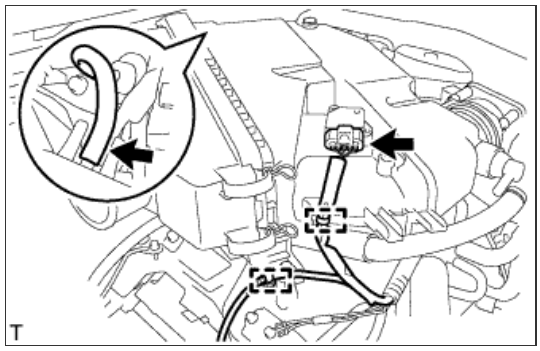
b. Detach the hose clamp.



c. Disconnect the vacuum hose.

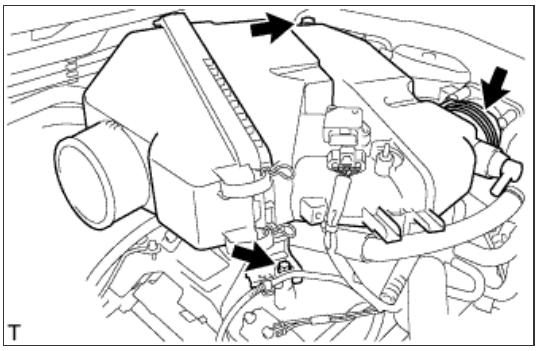
d. Disconnect the MAF meter connector.

e. Using a clip remover, detach the 2 wire harness clamps.



f. Loosen the hose clamp.

g. Remove the 2 bolts and air cleaner assembly.

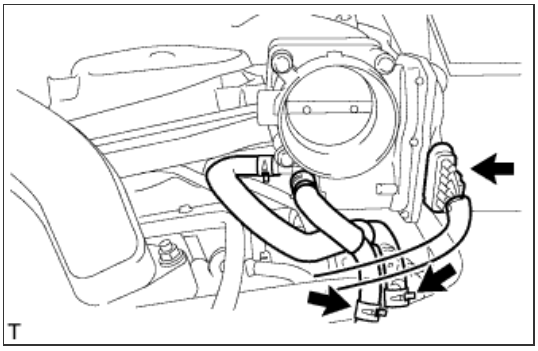


12. REMOVE INTAKE AIR SURGE TANK

a. Disconnect the throttle body connector.

b. Disconnect the No. 4 water by-pass hose.

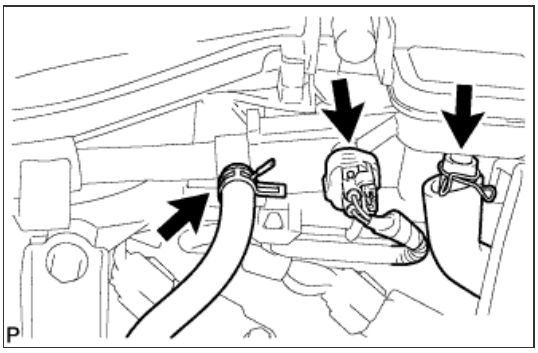
c. Disconnect the No. 5 water by-pass hose.



d. Disconnect the purge line hose.

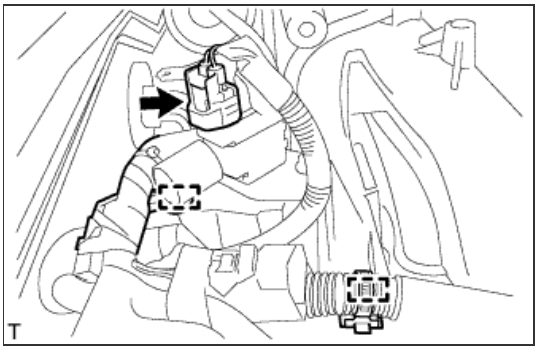
e. Disconnect the purge VSV connector.

f. Disconnect the No. 1 ventilation hose.

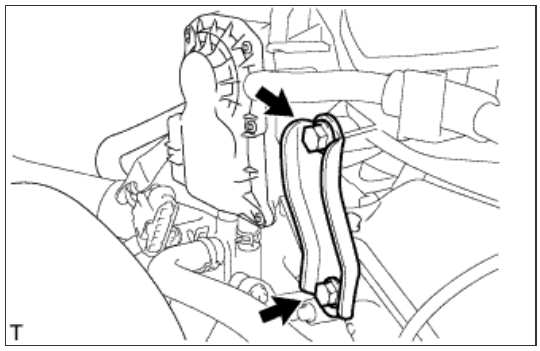


g. Disconnect the vacuum switching valve (for AC) connector.

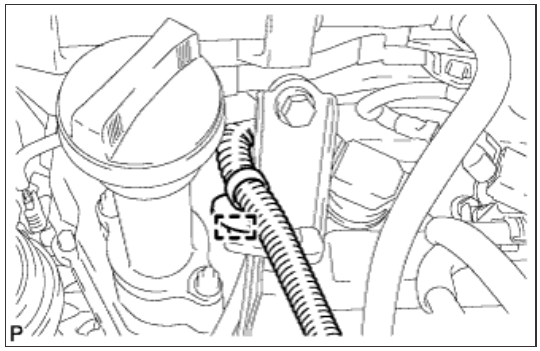
h. Using a clip remover, detach the 2 wire harness clamps.



i. Remove the 2 bolts and throttle body bracket.

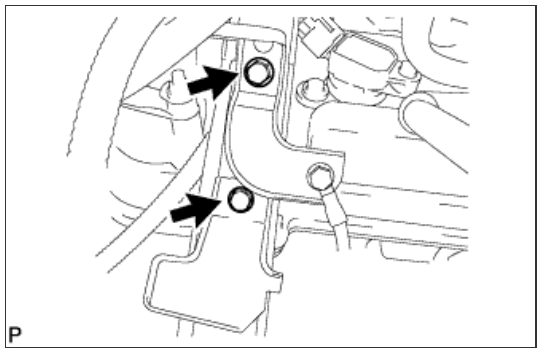


j. Using a clip remover, detach the wire harness clamp.

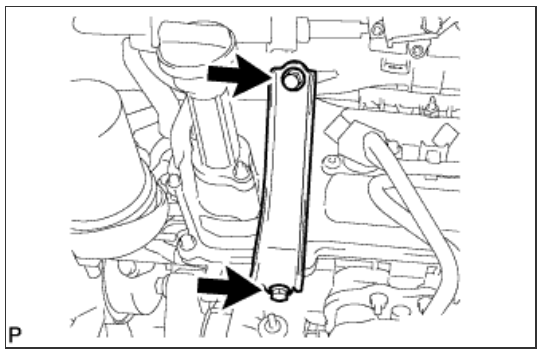


k. Remove the bolt and bracket from the No. 1 surge tank stay.

l. Remove the bolt and oil baffle plate.

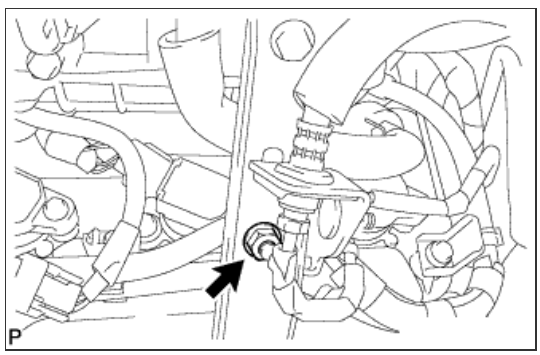


m. Remove the 2 bolts and No. 1 surge tank stay.

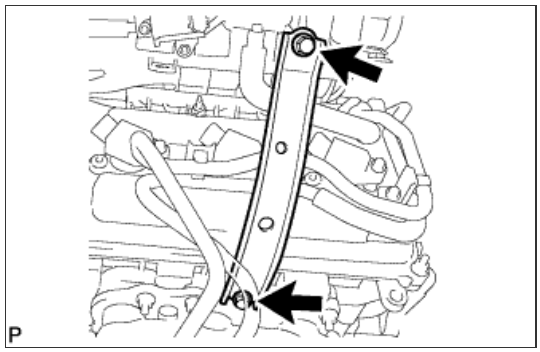


n. for Manual Transmission:

i. Remove the nut.

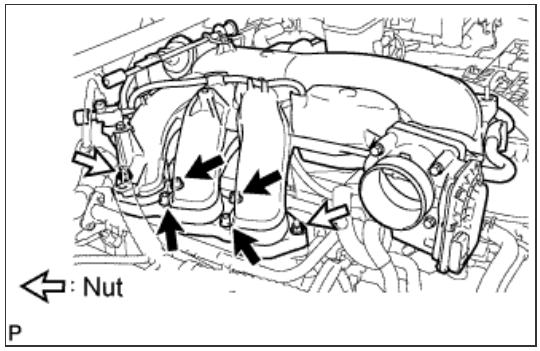


o. Remove the 2 bolts and No. 2 surge tank stay.



p. Remove the 2 nuts.

q. Using an 8 mm hexagon wrench, remove the 4 bolts. Then remove the intake air surge tank and gasket.



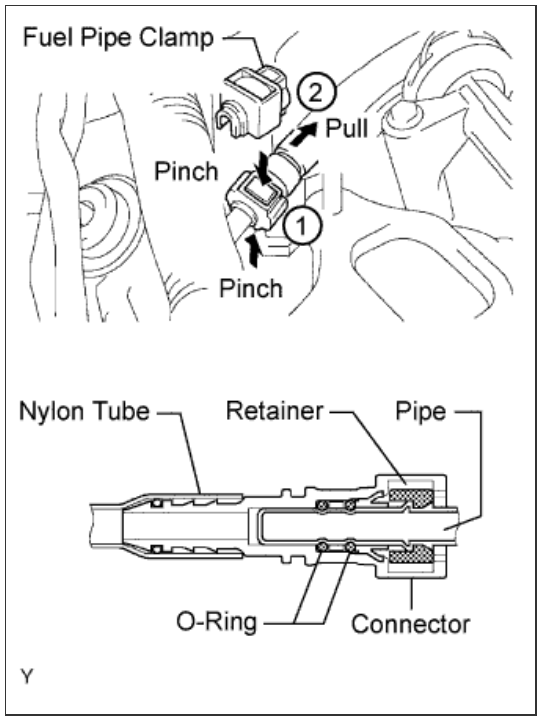
13. DISCONNECT NO. 2 FUEL PIPE SUB-ASSEMBLY

a. Remove the fuel pipe clamp.

b. Pinch the tube connector, and then pull the fuel pipe out of the pipe as shown in the illustration.

NOTICE:

- **Remove any dirt and foreign objects from the fuel tube connector before performing this work.**
- **Do not allow any scratches or foreign objects on the parts when disconnecting, as the fuel tube connector has the O-ring that seals the pipe.**
- **Perform this work by hand. Do not use any tools.**
- **Do not forcibly bend, twist or turn the nylon tube.**
- **Keep the plug free from foreign objects.**
- **Protect the disconnected part by covering it with a plastic bag after disconnecting the fuel tube.**
- **If the fuel tube connector and pipe are stuck, push and pull to release them.**

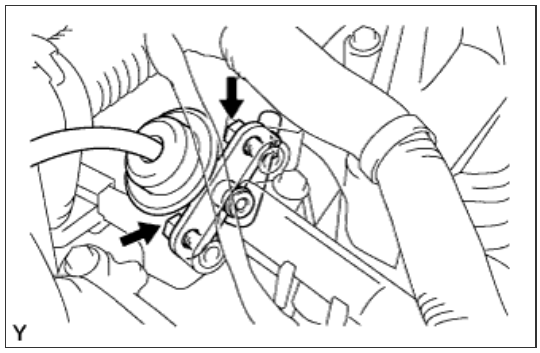


14. REMOVE FUEL PRESSURE REGULATOR ASSEMBLY

a. Disconnect the vacuum hose.

b. Remove the 2 bolts and fuel pressure regulator.

c. Remove the O-ring from the fuel pressure regulator.


Y

for Preparation Click here

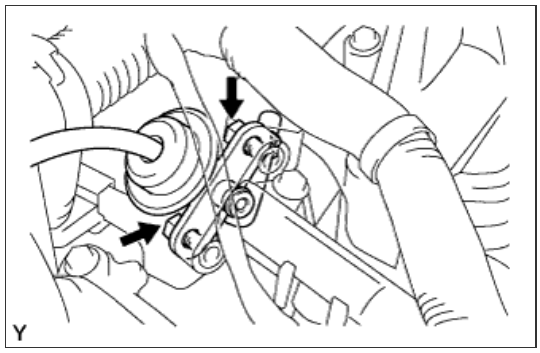
1. INSTALL FUEL PRESSURE REGULATOR ASSEMBLY

a. Apply a light coat of spindle oil or gasoline to a new O-ring and install it onto the fuel pressure regulator.

b. Install the fuel pressure regulator with the 2 bolts.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }

c. Connect the vacuum hose.



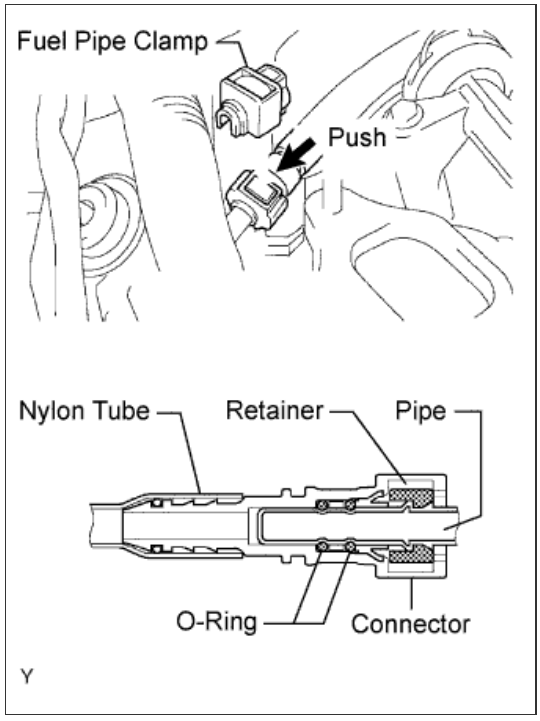
2. CONNECT NO. 2 FUEL PIPE SUB-ASSEMBLY

a. Push the tube connector into the pipe until the tube connector makes a "click" sound.

NOTICE:

- **Check if there is any damage or foreign objects on the connected part of the fuel pipe.**
- **After connecting, check that the pipe and connector are securely connected by pulling them.**

b. Install the fuel pipe clamp.



3. INSTALL INTAKE AIR SURGE TANK

NOTICE:
Do not apply oil to the bolts and nuts listed below: :

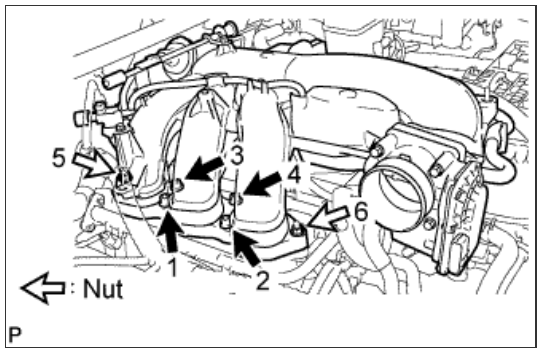
Oil Application Prohibited Bolt/Nut
Bolt for surge tank and intake manifold
Nut for surge tank and intake manifold

a. Install a new gasket to the intake air surge tank.

b. Using an 8 mm hexagon wrench, install the intake air surge tank with the 4 bolts

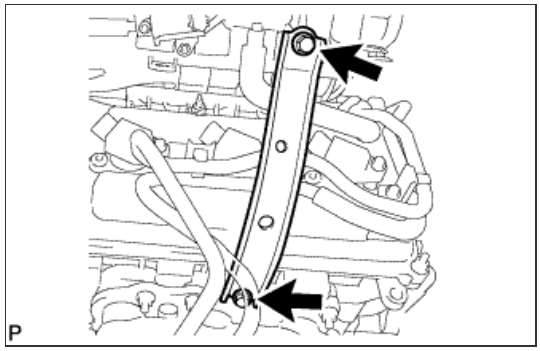
and 2 nuts in the order shown in the illustration.

Torque:
28 N*m{ 286 kgf*cm , 21 ft.*lbf }



c. Install the No. 2 surge tank stay with the 2 bolts.

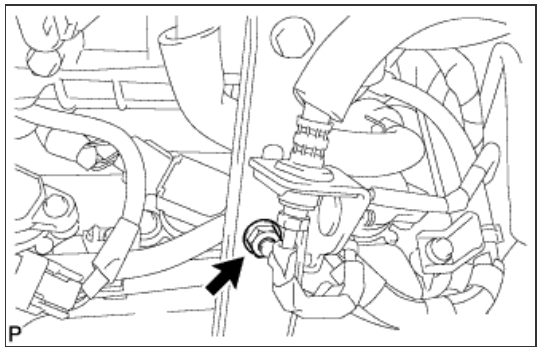
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



d. for Manual Transmission:

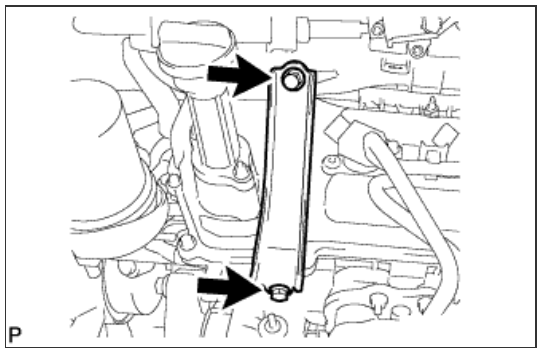
i. Install the bracket to the No. 2 surge tank stay with the nut.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }



e. Install the No. 1 surge tank stay with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

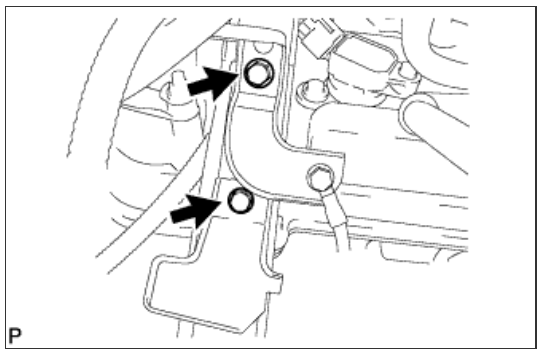


f. Install the oil baffle plate with the bolt.

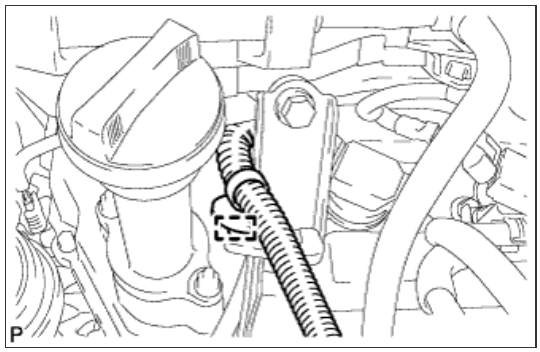
Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }

g. Install the bracket to the No. 1 surge tank stay with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

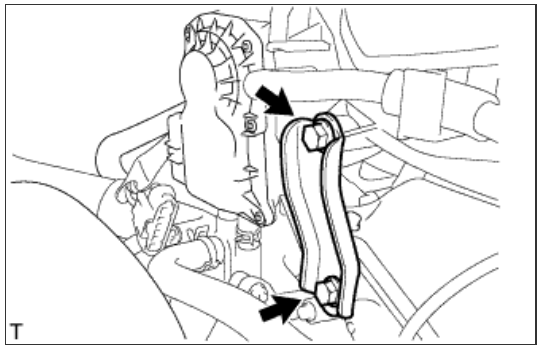


h. Attach the wire harness clamp.



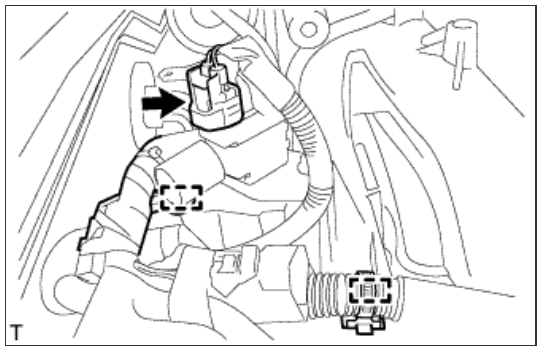
i. Install the throttle body bracket with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



j. Connect the vacuum switching valve (for ACIS) connector.

k. Attach the 2 wire harness clamps.



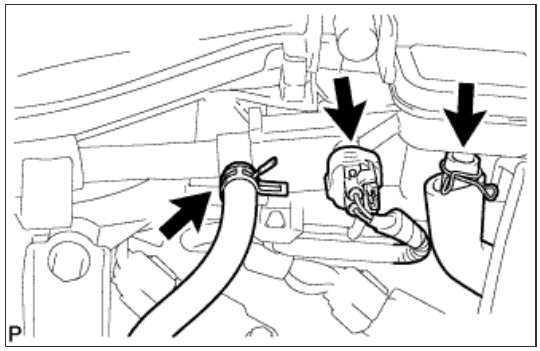
l. Connect the No. 1 ventilation hose.

m. Connect the purge VSV connector.

n. Connect the purge line hose.

HINT:

Connect the hose so that the direction of the hose clamp is as indicated in the illustration.

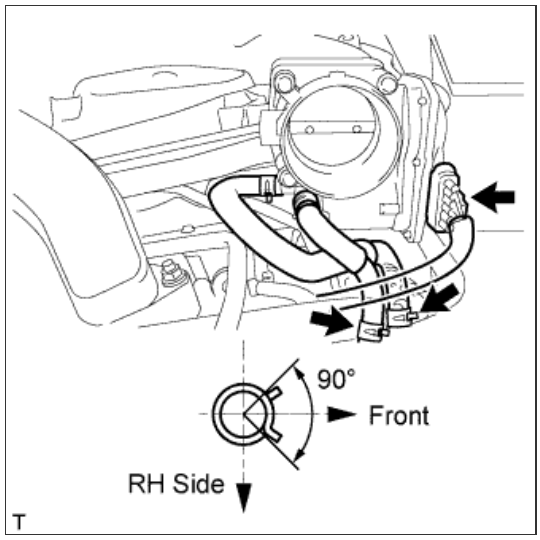


o. Connect the No. 4 and No. 5 water by-pass hose.

HINT:

Connect the hoses so that the direction of the hose clamps is as shown in the illustration.

p. Connect the throttle body connector.



4. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner assembly with the 2 bolts.

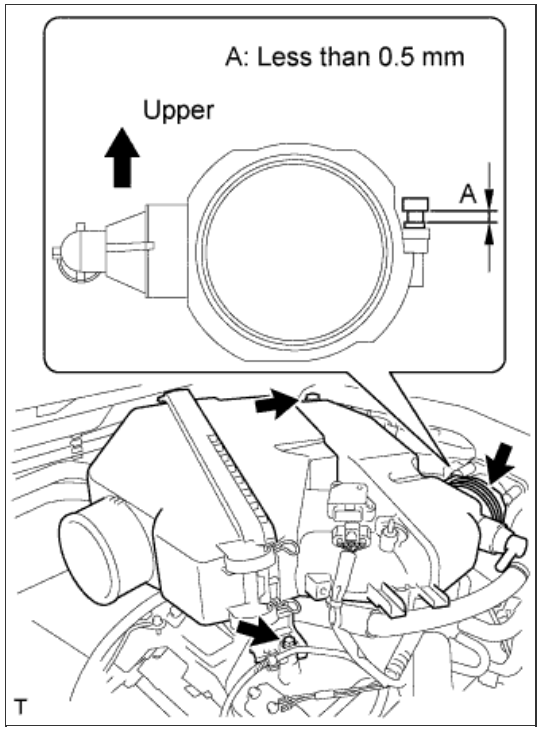
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

b. Tighten the hose clamp.

HINT:

Tighten the hose clamp until it reaches the specified protrusion height labeled A shown in the illustration.

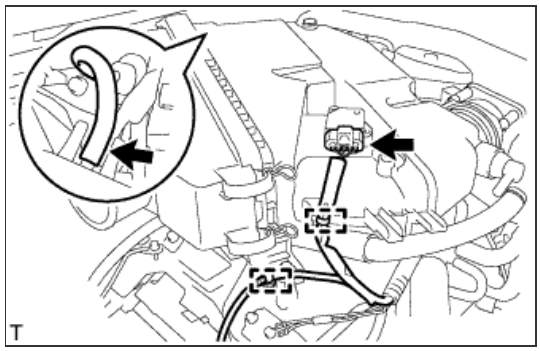
Standard protrusion height:
Less than 0.5 mm (0.0197 in.)



c. Connect the MAF meter connector.

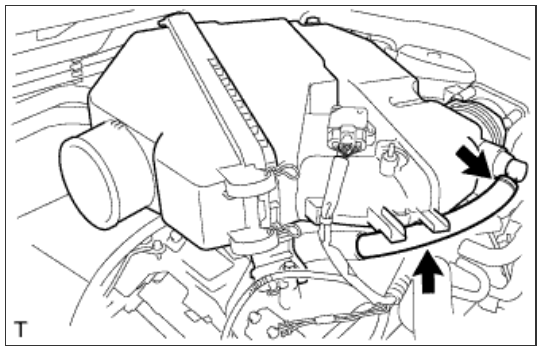
d. Attach the 2 wire harness clamps.

e. Connect the vacuum hose.



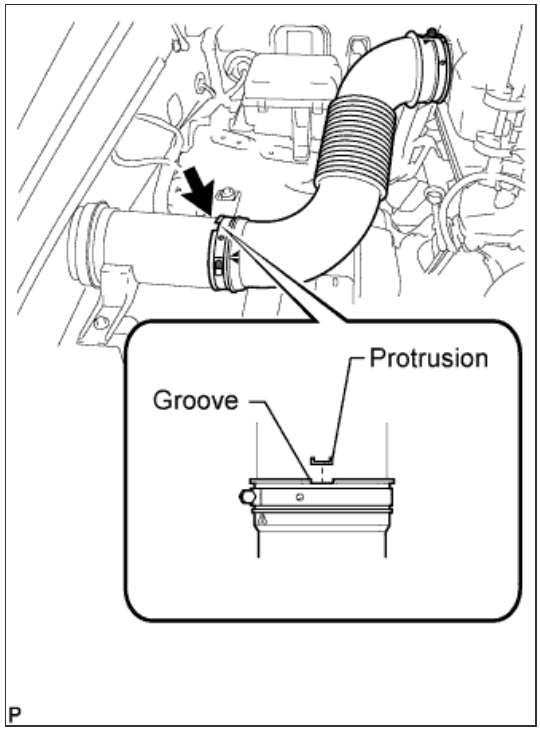
f. Attach the hose clamp.

g. Connect the No. 2 ventilation hose.



5. INSTALL NO. 2 AIR CLEANER HOSE

a. Align the protrusion of the pre-cleaner with the groove of the No. 2 air cleaner hose as shown in the illustration.

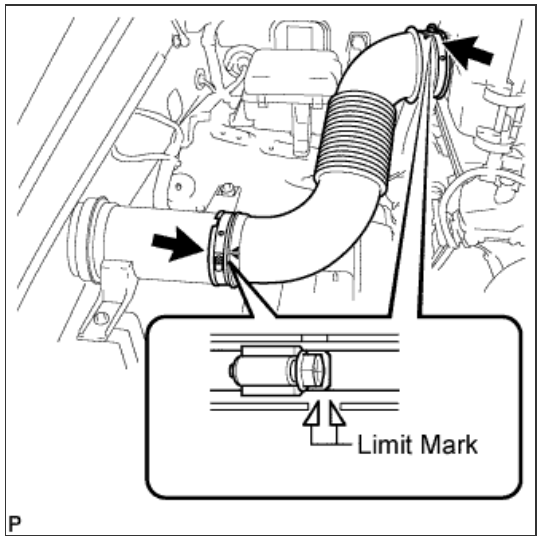


b. Tighten the 2 hose clamps.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }

HINT:

Tighten the clamp until the end of the clamp band is within both limit marks.



6. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

7. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item		Specified condition
for Automatic transmission	w/o Rear Heater	11.2 liters (11.8 US qts, 9.9 Imp. qts)
	w/ Rear Heater	14.4 liters (15.2 US qts, 12.7 Imp. qts)
for Manual transmission	w/o Rear Heater	12. liters (12.7 US qts, 1 .6 Imp. qts)
	w/ Rear Heater	14.6 liters (15.4 US qts, 12.8 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

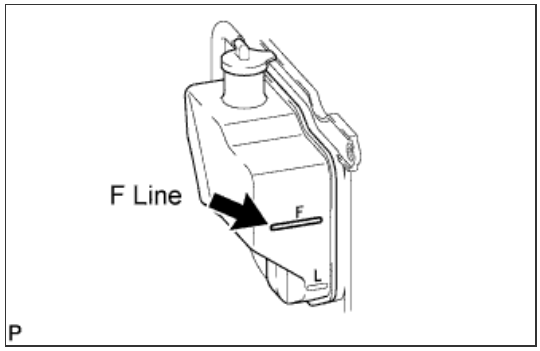
TO OTA vehicles are filled with TO OTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TO OTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.



f. Set the air conditioning as follows while warming up the engine.

Item	Condition
Fan speed	Any setting except off
Temperature	Toward WARM
Air conditioning switch	Off

g. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

h. Maintain the engine speed at 2 to 25 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

i. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

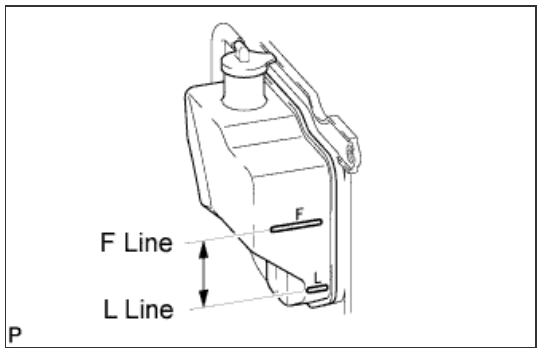
- **Wear protective gloves. Heat areas on the parts may injure your hands.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the fan.**

j. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

k. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.



8. INSPECT FOR COOLANT LEAK

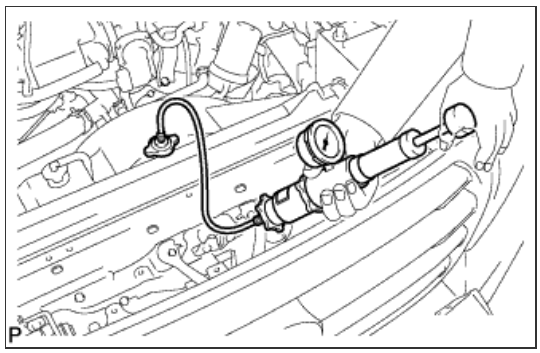
CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 12 kPa (1. kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



9. INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the DLC .

b. Turn the ignition switch to ON and intelligent tester on.

NOTICE:

Do not start the engine.

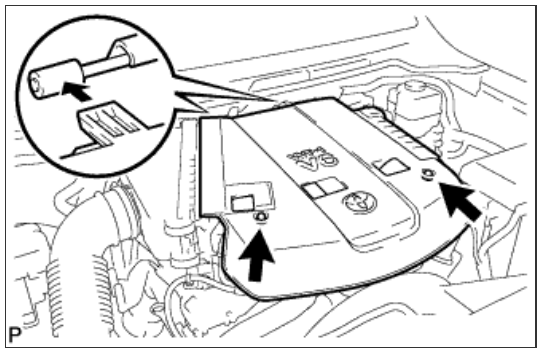
c. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the Fuel Pump Speed Control.

d. Check that there are no fuel leaks after doing maintenance anywhere on the fuel system.

10. INSTALL -BANK COVER

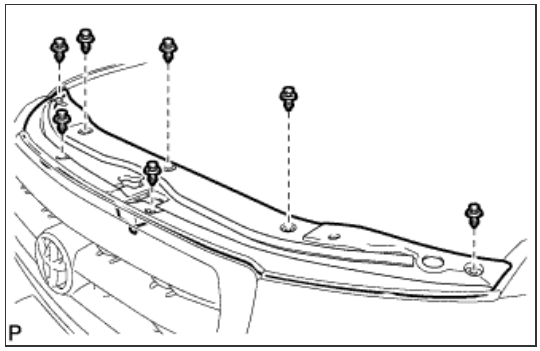
a. Install the V-bank cover with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



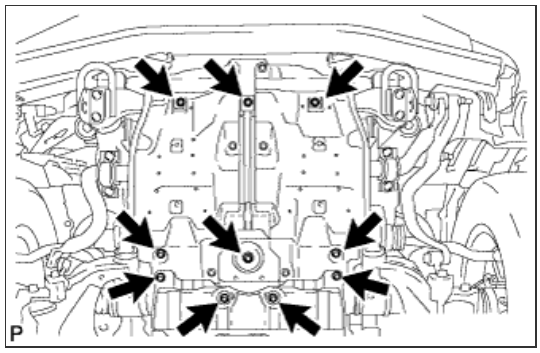
11. INSTALL UPPER RADIATOR SUPPORT SEAL

a. Install the radiator support seal with the 7 clips.



12. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

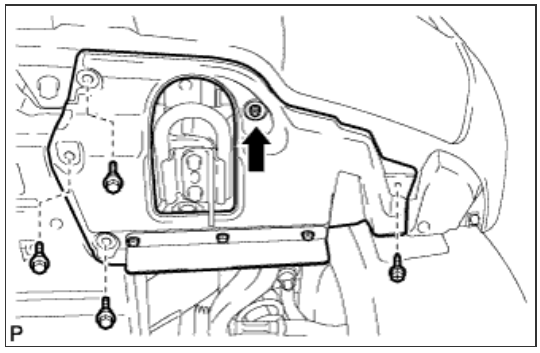
a. Install the under cover with the 1 bolts.



13. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the bolts and screw.



14. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

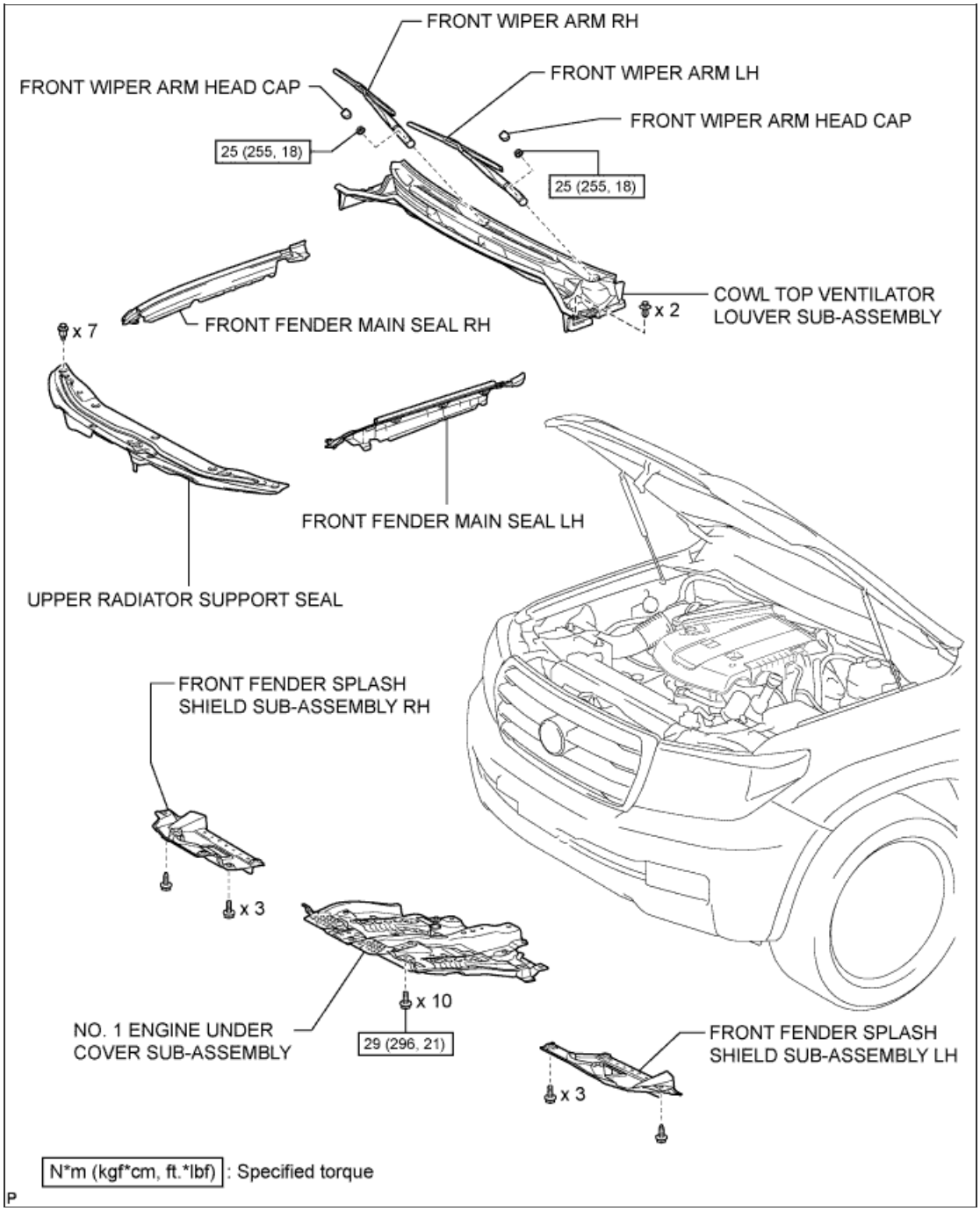
HINT:

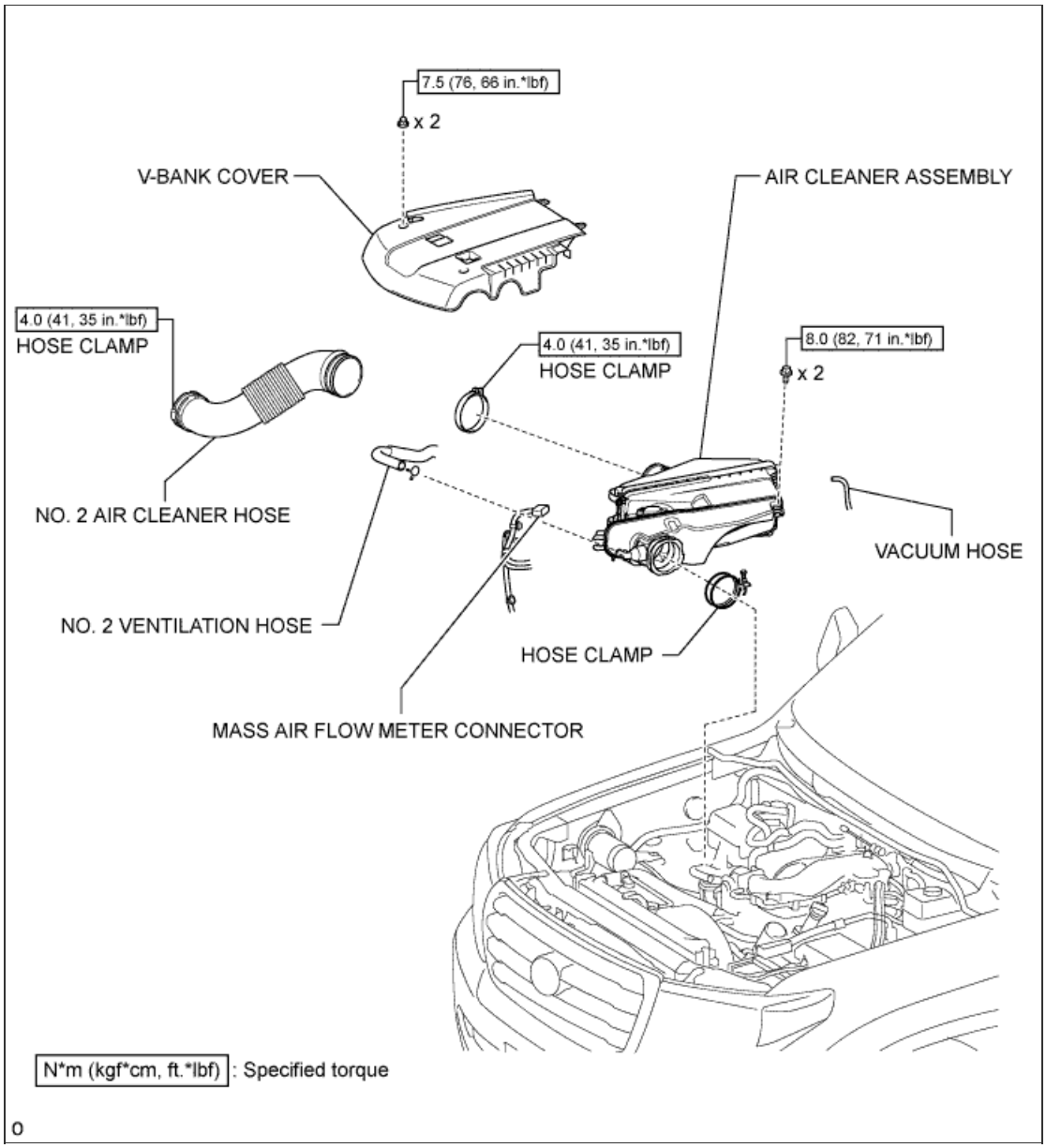
Use the same procedures described for the LH side.

15. INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

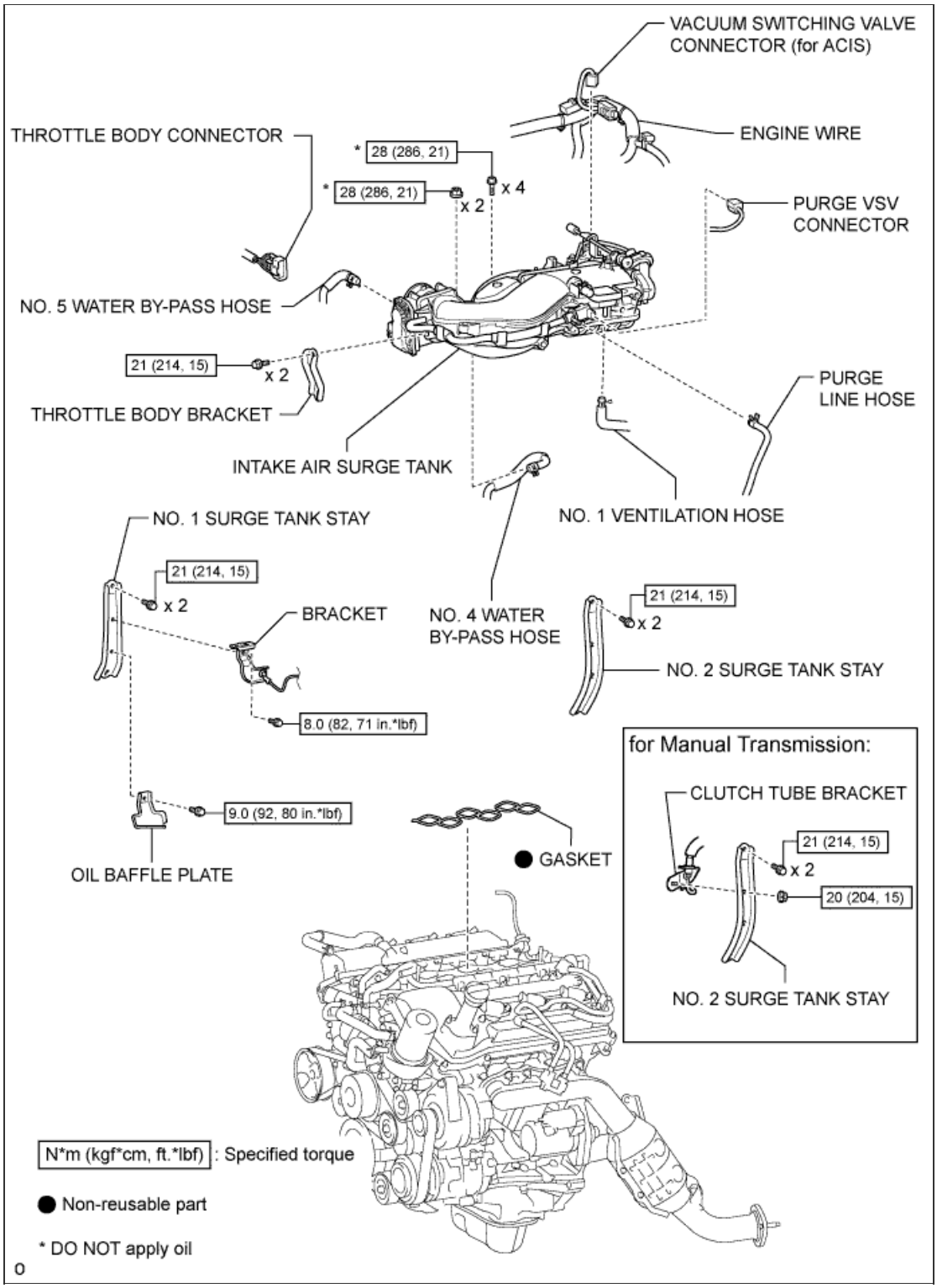
a. Install the cowl top ventilator louver (Click here).

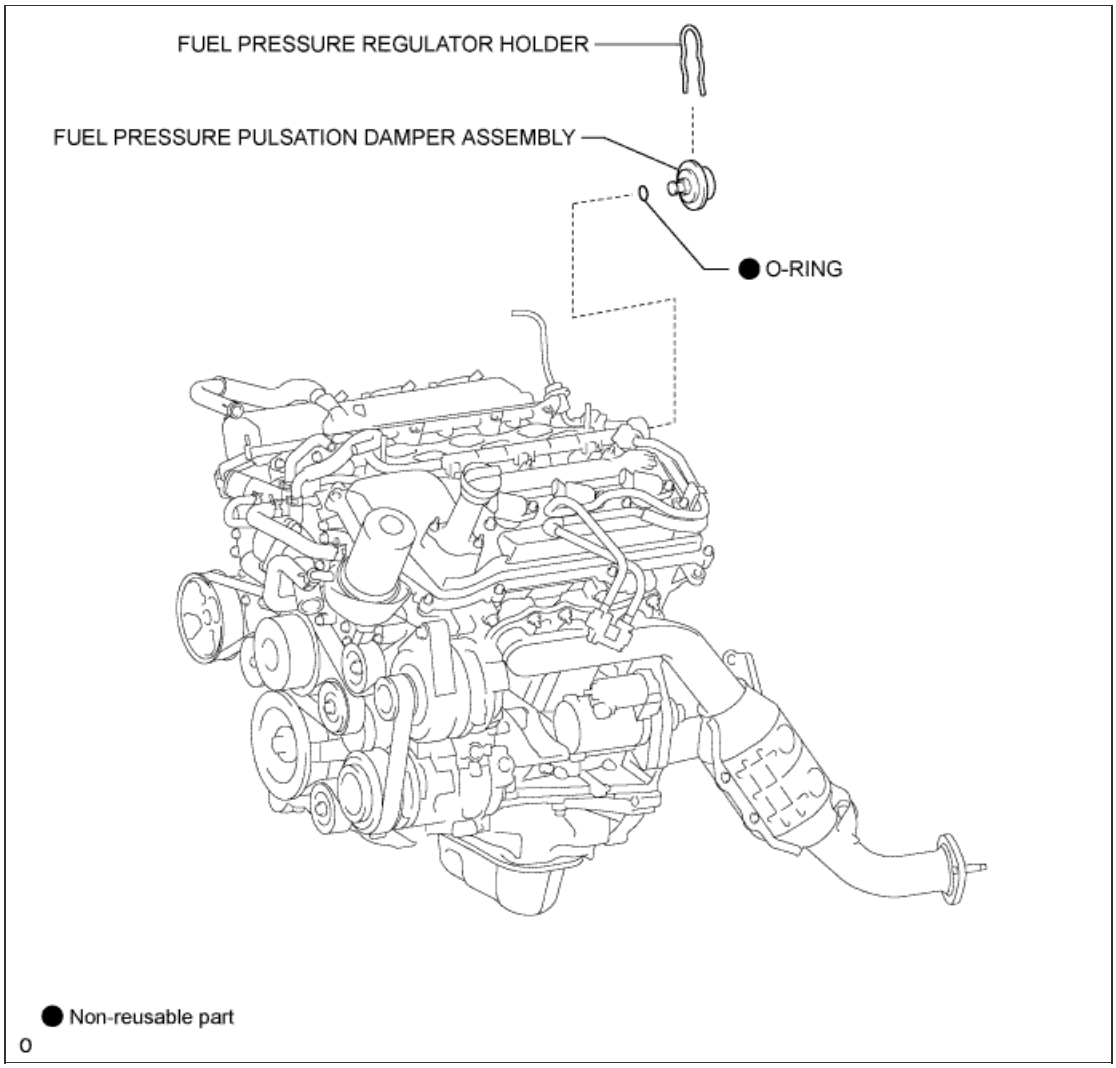
for Preparation [Click here]




7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER
AIR CLEANER ASSEMBLY
4.0 (41, 35 in.*lbf)
HOSE CLAMP
4.0 (41, 35 in.*lbf)
HOSE CLAMP
8.0 (82, 71 in.*lbf)
x 2
NO. 2 AIR CLEANER HOSE
VACUUM HOSE
NO. 2 VENTILATION HOSE
HOSE CLAMP
MASS AIR FLOW METER CONNECTOR
N*m (kgf*cm, ft.*lbf) : Specified torque

0


VACUUM SWITCHING VALVE CONNECTOR (for ACIS)
ENGINE WIRE
THROTTLE BODY CONNECTOR
* 28 (286, 21)
* 28 (286, 21)
x 2
x 4
PURGE VSV CONNECTOR
NO. 5 WATER BY-PASS HOSE
21 (214, 15)
x 2
THROTTLE BODY BRACKET
PURGE LINE HOSE
INTAKE AIR SURGE TANK
NO. 1 VENTILATION HOSE
NO. 1 SURGE TANK STAY
21 (214, 15)
x 2
BRACKET
NO. 4 WATER BY-PASS HOSE
21 (214, 15)
x 2
NO. 2 SURGE TANK STAY
8.0 (82, 71 in.*lbf)
for Manual Transmission:
CLUTCH TUBE BRACKET
21 (214, 15)
x 2
20 (204, 15)
NO. 2 SURGE TANK STAY
9.0 (92, 80 in.*lbf)
OIL BAFFLE PLATE
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
* DO NOT apply oil


FUEL PRESSURE REGULATOR HOLDER
FUEL PRESSURE PULSATION DAMPER ASSEMBLY
O-RING
Non-reusable part
O

FUEL PRESSURE PULSATION DAMPER > REMOVAL

for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

a. Discharge the fuel system pressure (Click here).

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

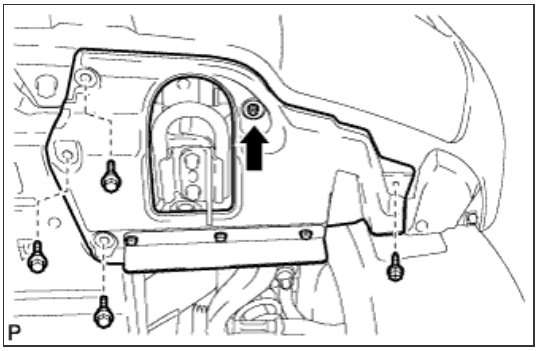
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



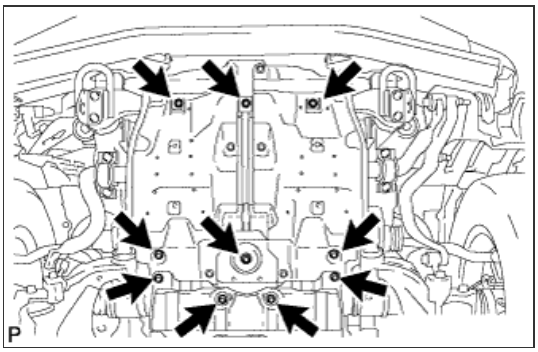
4. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

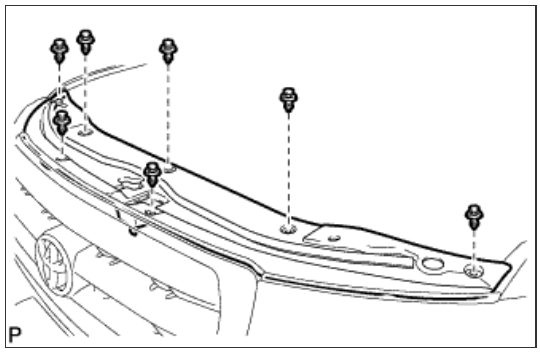
5. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



6. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and radiator support seal.



7. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug and 2 cylinder block drain cock plugs.

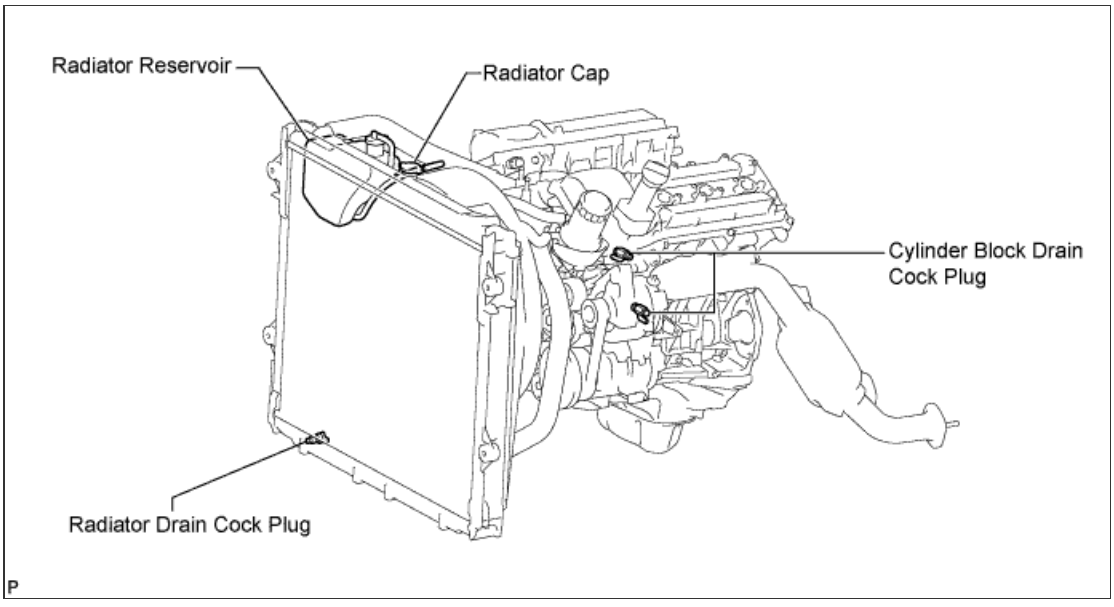
b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Tighten the 2 cylinder block drain cock plugs.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



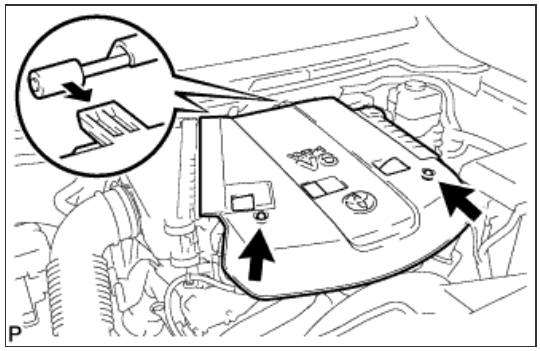
d. Tighten the radiator drain cock plug by hand.

8. REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Remove the cowl top ventilator louver (Click here).

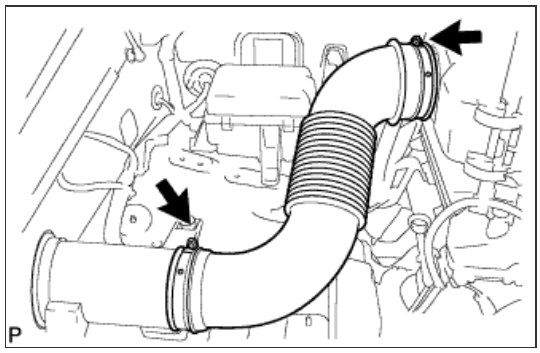
9. REMOVE V-BANK COVER

a. Remove the 2 nuts and V-bank cover.



10. REMOVE NO. 2 AIR CLEANER HOSE

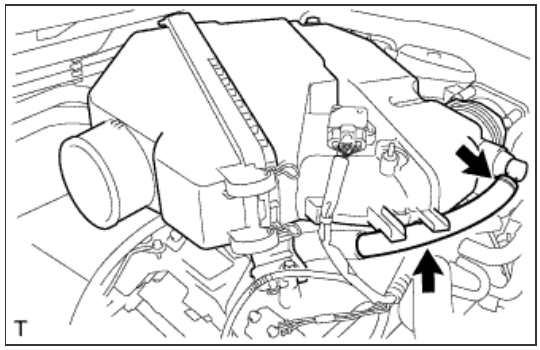
a. Loosen the 2 hose clamps and remove the air cleaner hose.



11. REMOVE AIR CLEANER ASSEMBLY

a. Disconnect the No. 2 ventilation hose.

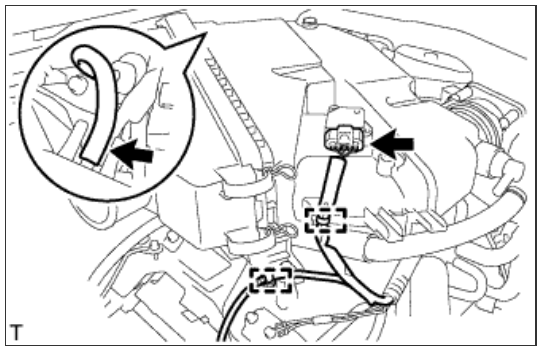
b. Detach the hose clamp.



c. Disconnect the vacuum hose.

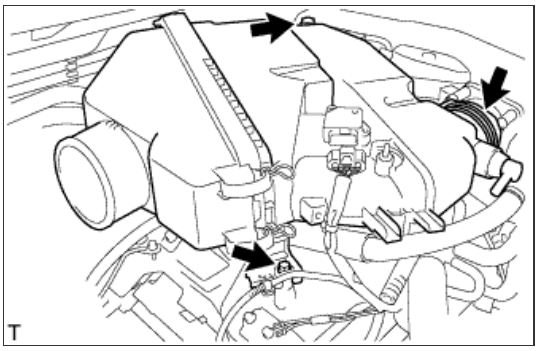
d. Disconnect the MAF meter connector.

e. Using a clip remover, detach the 2 wire harness clamps.



f. Loosen the hose clamp.

g. Remove the 2 bolts and air cleaner assembly.

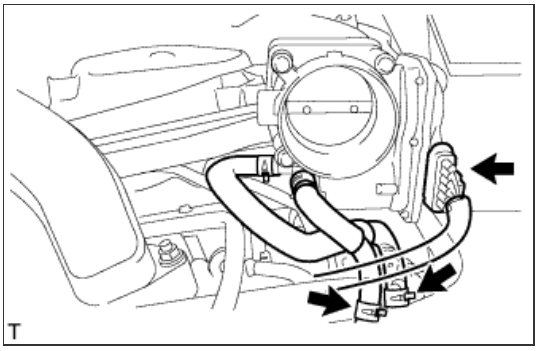


12. REMOVE INTAKE AIR SURGE TANK

a. Disconnect the throttle body connector.

b. Disconnect the No. 4 water by-pass hose.

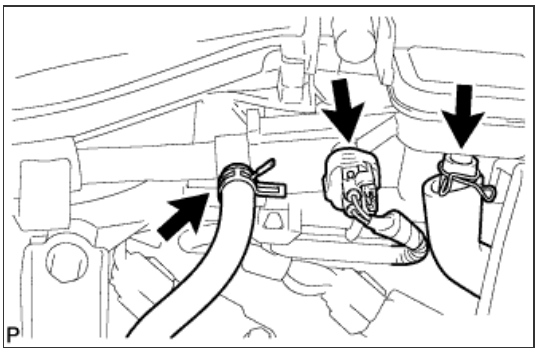
c. Disconnect the No. 5 water by-pass hose.



d. Disconnect the purge line hose.

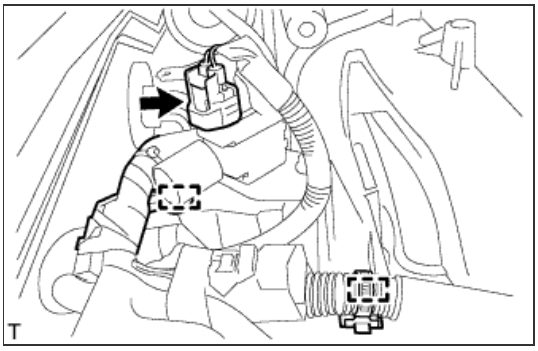
e. Disconnect the purge VSV connector.

f. Disconnect the No. 1 ventilation hose.

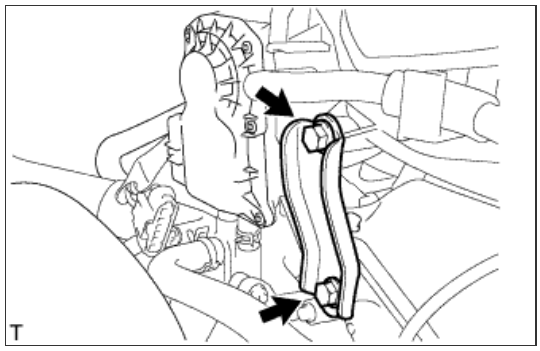


g. Disconnect the vacuum switching valve (for AC) connector.

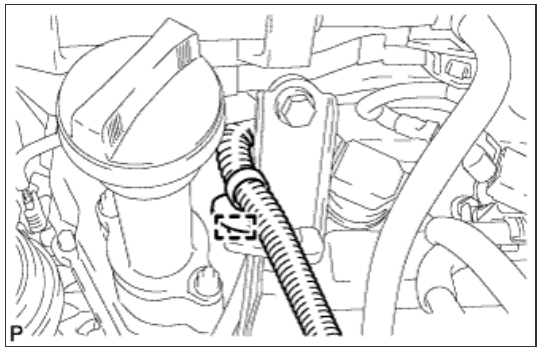
h. Using a clip remover, detach the 2 wire harness clamps.



i. Remove the 2 bolts and throttle body bracket.

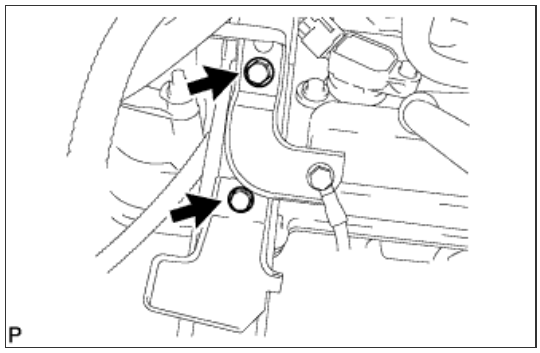


j. Using a clip remover, detach the wire harness clamp.

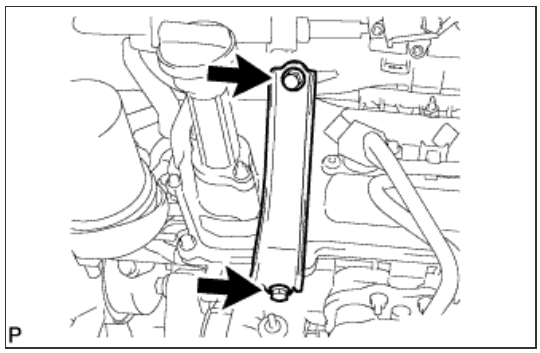


k. Remove the bolt and bracket from the No. 1 surge tank stay.

l. Remove the bolt and oil baffle plate.

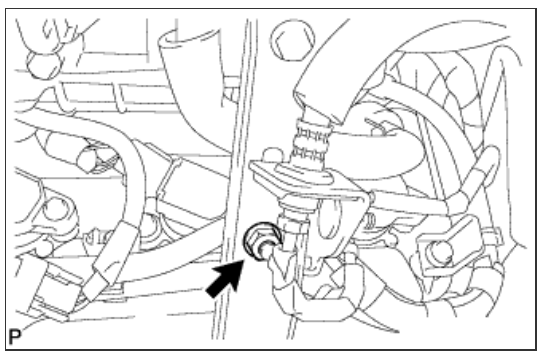


m. Remove the 2 bolts and No. 1 surge tank stay.

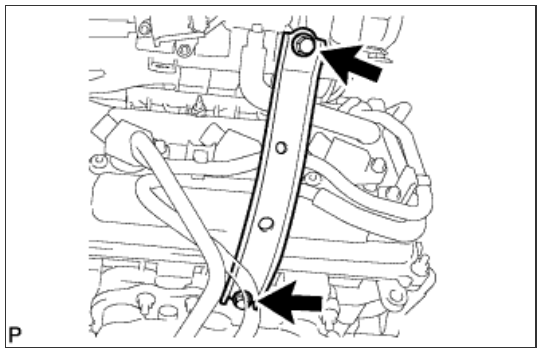


n. for Manual Transmission:

i. Remove the nut.

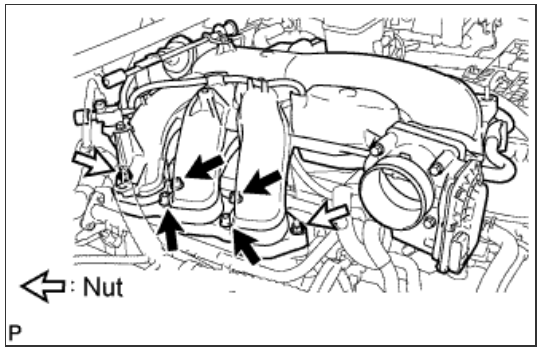


o. Remove the 2 bolts and No. 2 surge tank stay.



p. Remove the 2 nuts.

q. Using an 8 mm hexagon wrench, remove the 4 bolts. Then remove the intake air surge tank and gasket.

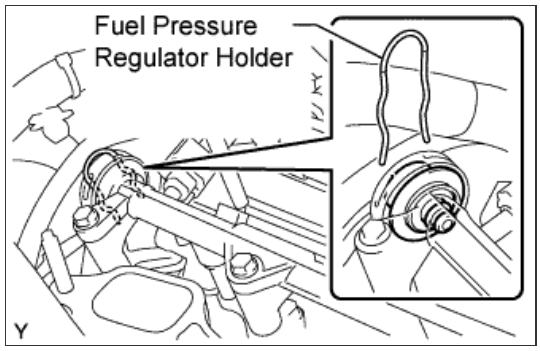


13. REMOVE FUEL PRESSURE PULSATION DAMPER ASSEMBLY

a. Remove the fuel pressure regulator holder.

b. Pull the fuel pressure pulsation damper out of the fuel delivery pipe.

c. Remove the O-ring from the fuel pressure pulsation damper.



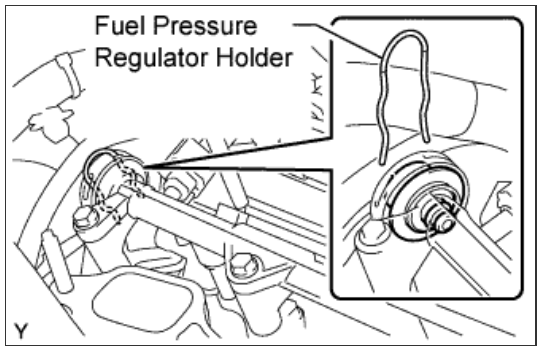
for Preparation Click here

1. INSTALL FUEL PRESSURE PULSATION DAMPER ASSEMBLY

a. Apply a light coat of spindle oil or gasoline to a new O-ring and install it onto the fuel pressure pulsation damper.

b. Install the fuel pressure pulsation damper into the fuel delivery pipe.

c. Install the fuel pressure regulator holder.



2. INSTALL INTAKE AIR SURGE TANK

NOTICE:

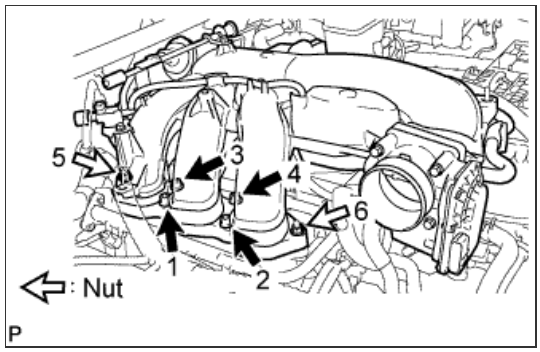
Do not apply oil to the bolts and nuts listed below: :

Oil Application Prohibited Bolt/Nut
Bolt for surge tank and intake manifold
Nut for surge tank and intake manifold

a. Install a new gasket to the intake air surge tank.

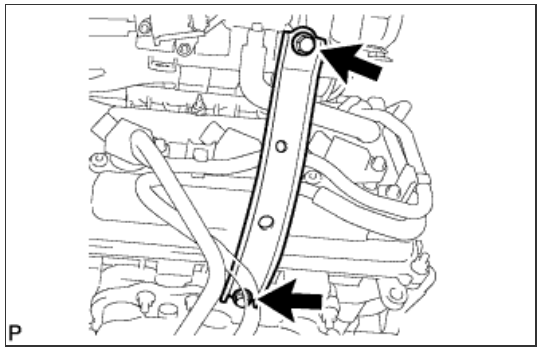
b. Using an 8 mm hexagon wrench, install the intake air surge tank with the 4 bolts and 2 nuts in the order shown in the illustration.

Torque:
28 N*m{ 286 kgf*cm , 21 ft.*lbf }



c. Install the No. 2 surge tank stay with the 2 bolts.

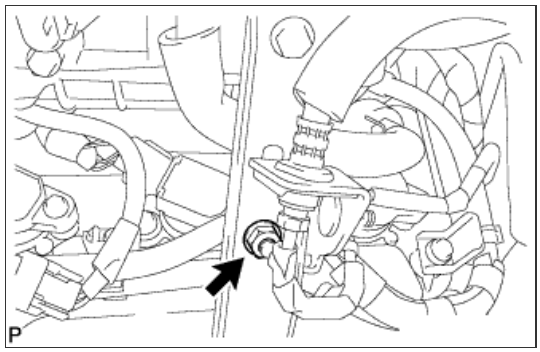
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



d. for Manual Transmission:

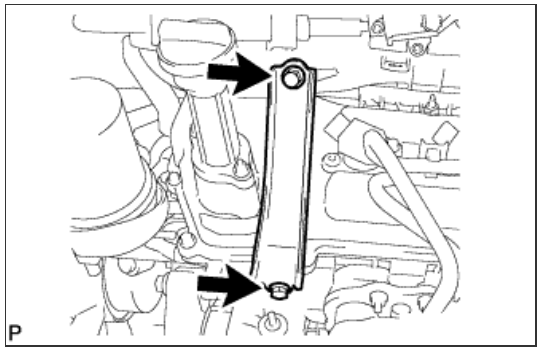
i. Install the bracket to the No. 2 surge tank stay with the nut.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }



e. Install the No. 1 surge tank stay with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

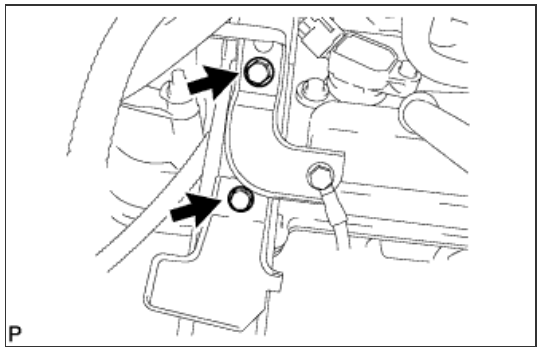


f. Install the oil baffle plate with the bolt.

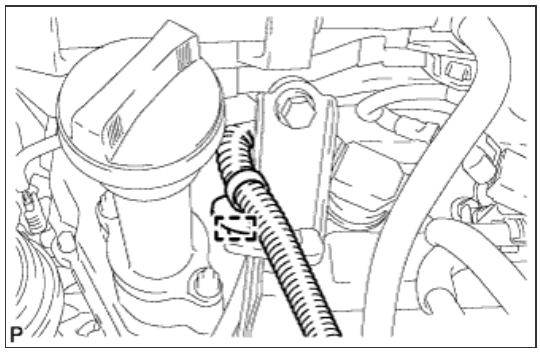
Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }

g. Install the bracket to the No. 1 surge tank stay with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

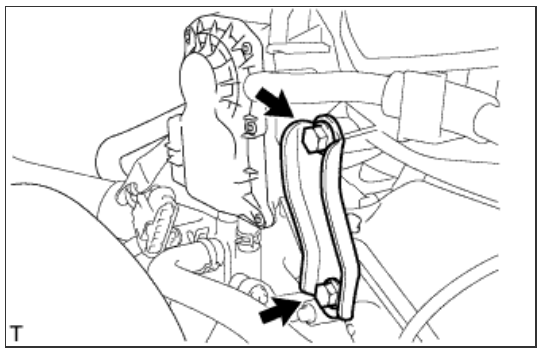


h. Attach the wire harness clamp.



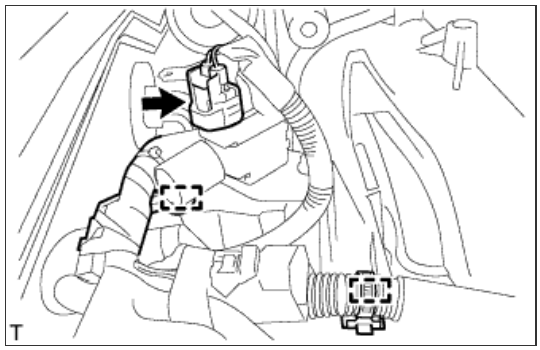
i. Install the throttle body bracket with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



j. Connect the vacuum switching valve (for ACIS) connector.

k. Attach the 2 wire harness clamps.



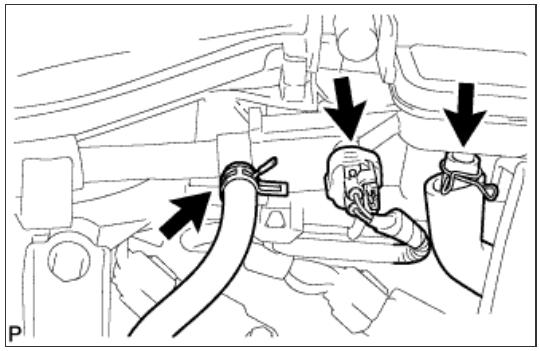
l. Connect the No. 1 ventilation hose.

m. Connect the purge VSV connector.

n. Connect the purge line hose.

HINT:

Connect the hose so that the direction of the hose clamp is as indicated in the illustration.

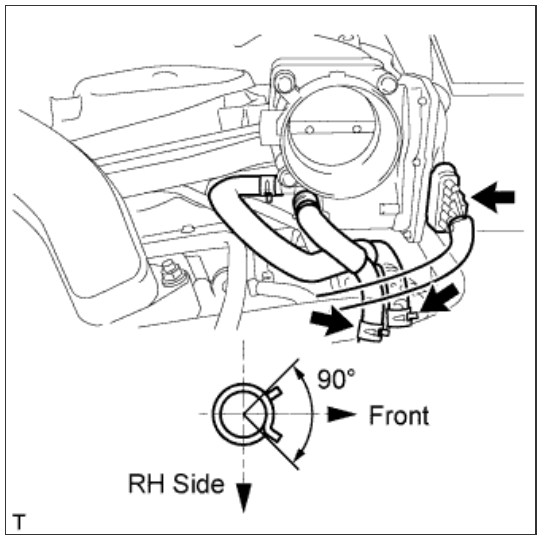


o. Connect the No. 4 and No. 5 water by-pass hose.

HINT:

Connect the hoses so that the direction of the hose clamps is as shown in the illustration.

p. Connect the throttle body connector.



3. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner assembly with the 2 bolts.

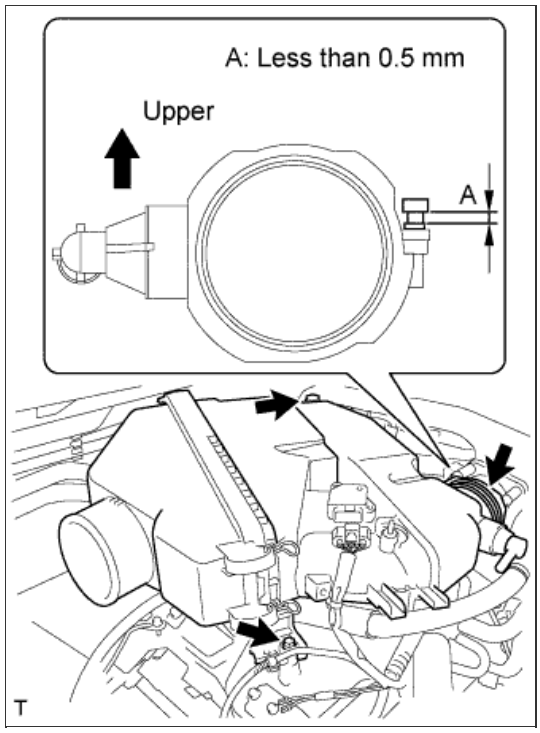
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

b. Tighten the hose clamp.

HINT:

Tighten the hose clamp until it reaches the specified protrusion height labeled A shown in the illustration.

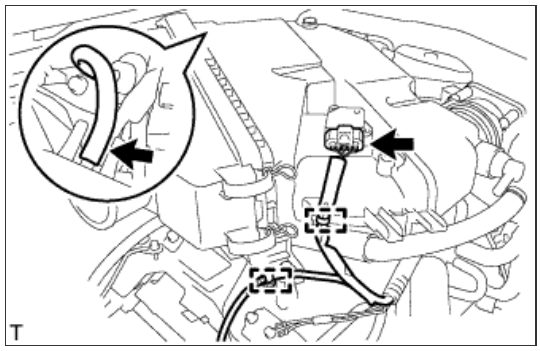
Standard protrusion height:
Less than 0.5 mm 0.0197 in.



c. Connect the MAF meter connector.

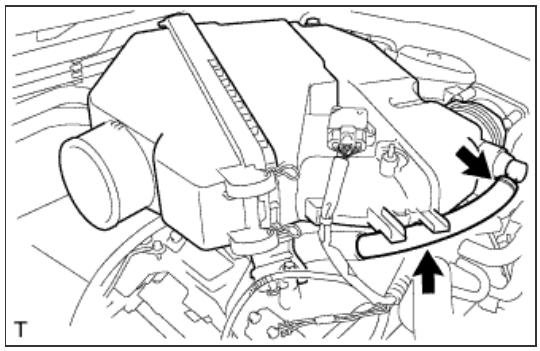
d. Attach the 2 wire harness clamps.

e. Connect the vacuum hose.



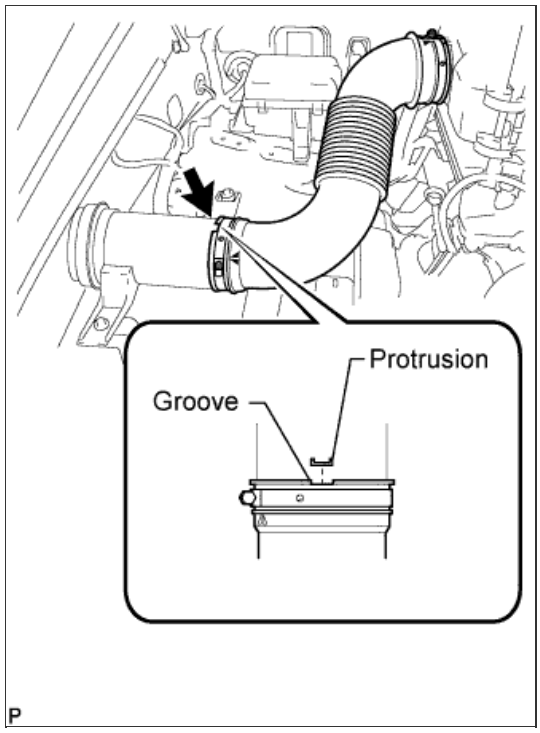
f. Attach the hose clamp.

g. Connect the No. 2 ventilation hose.



4. INSTALL NO. 2 AIR CLEANER HOSE

a. Align the protrusion of the pre-cleaner with the groove of the No. 2 air cleaner hose as shown in the illustration.

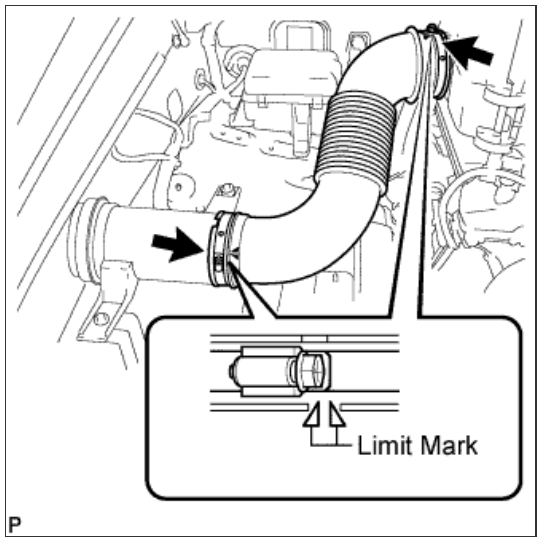


b. Tighten the 2 hose clamps.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }

INT:

Tighten the clamp until the end of the clamp band is within both limit marks.



5. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

6. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item		Specified condition
for Automatic transmission	w/o Rear Heater	11.2 liters (11.8 US qts, 9.9 Imp. qts)
	w/ Rear Heater	14.4 liters (15.2 US qts, 12.7 Imp. qts)
for Manual transmission	w/o Rear Heater	12.0 liters (12.7 US qts, 10.6 Imp. qts)
		14.6 liters (15.4

	w/ Rear Heater	US qts, 12.8 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

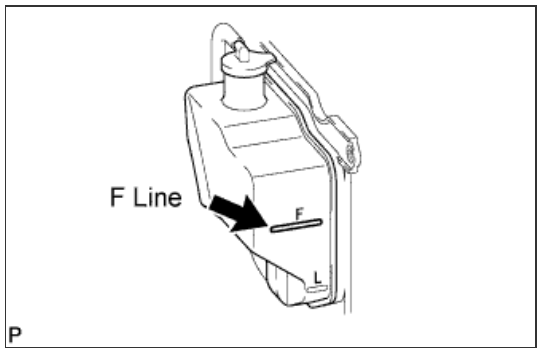
TO OTA vehicles are filled with TO OTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TO OTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.



f. Set the air conditioning as follows while warming up the engine.

Item	Condition
Fan speed	Any setting except off
Temperature	Toward WARM
Air conditioning switch	Off

g. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

h. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reser oir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or o erheat.**
- **Immediately after starting the engine, if the radiator reser oir does not ha e any coolant, perform the following: 1 stop the engine, 2 wait until the coolant has cooled down, and 3 add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant le el has stabilized.**

i. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

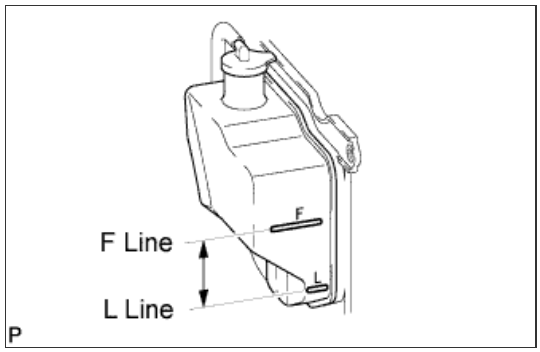
- **Wear protecti e glo es. Heat areas on the parts may injure your hands.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the fan.**

j. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

k. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.



7. INSPECT FOR COOLANT LEAK

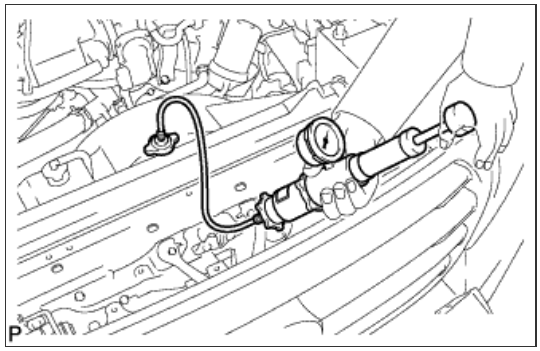
CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 12 kPa (1. kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



8. INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the DLC .

b. Turn the engine switch on (IG) and intelligent tester ON.

NOTICE:

Do not start the engine.

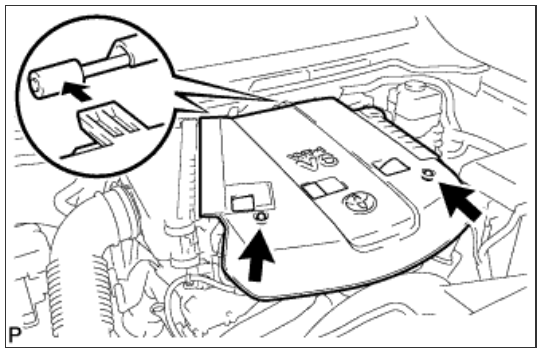
c. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the Fuel Pump Speed Control.

d. Check that there are no fuel leaks after doing maintenance anywhere on the fuel system.

9. INSTALL V BANK COVER

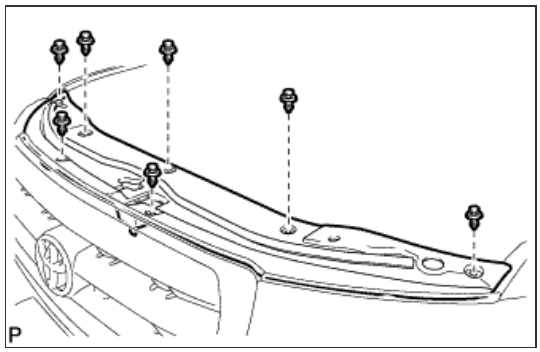
a. Install the V-bank cover with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



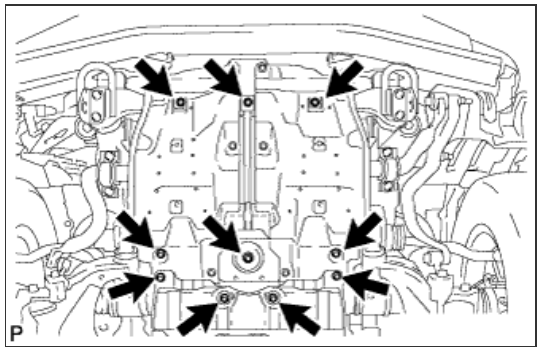
10. INSTALL UPPER RADIATOR SUPPORT SEAL

a. Install the radiator support seal with the 7 clips.



11. INSTALL NO. 1 ENGINE UNDER COVER SUB ASSEMBLY

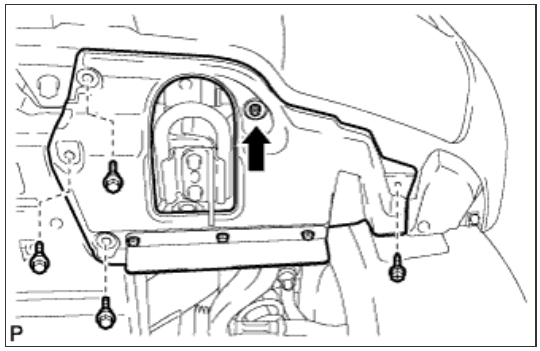
a. Install the under cover with the 10 bolts.



12. INSTALL FRONT FENDER SPLASH SHIELD SUB ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the bolts and screw.



13. INSTALL FRONT FENDER SPLASH SHIELD SUB ASSEMBLY RH

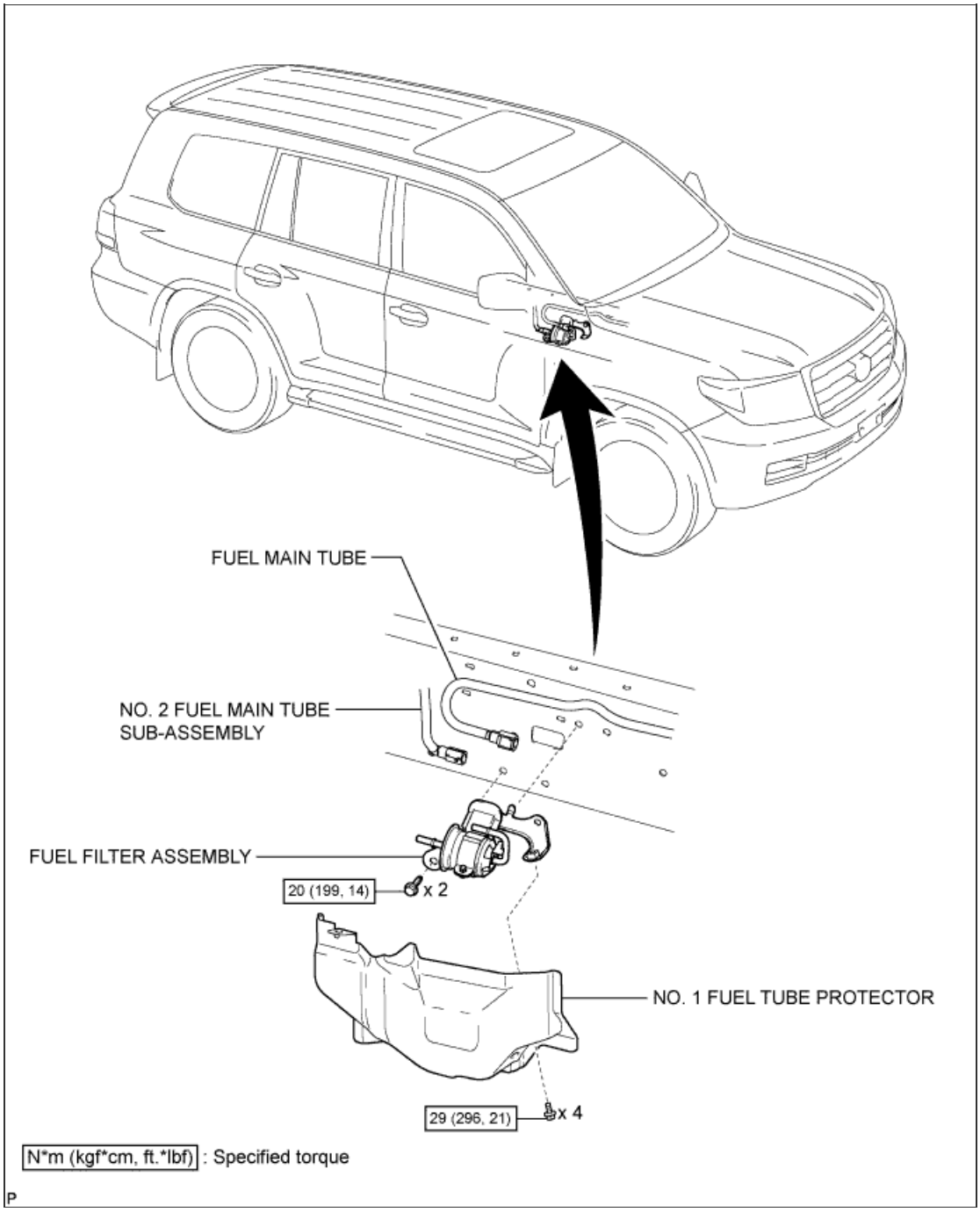
HINT:

Use the same procedures described for the LH side.

14. INSTALL COWL TOP VENTILATOR LOUVER SUB ASSEMBLY

a. Install the cowl top ventilator louver (Click here).

for Preparation Click here



for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

a. Discharge the fuel system pressure (Click here).

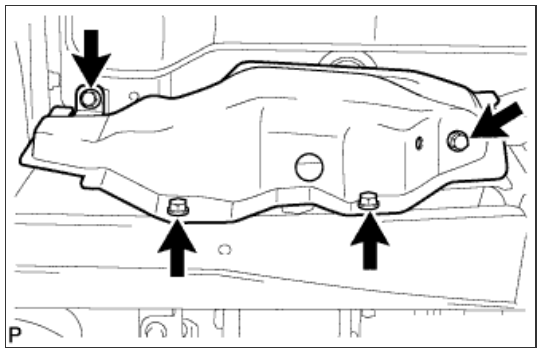
2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE NO. 1 FUEL TUBE PROTECTOR

a. Remove the 4 bolts and No. 1 fuel tube protector.

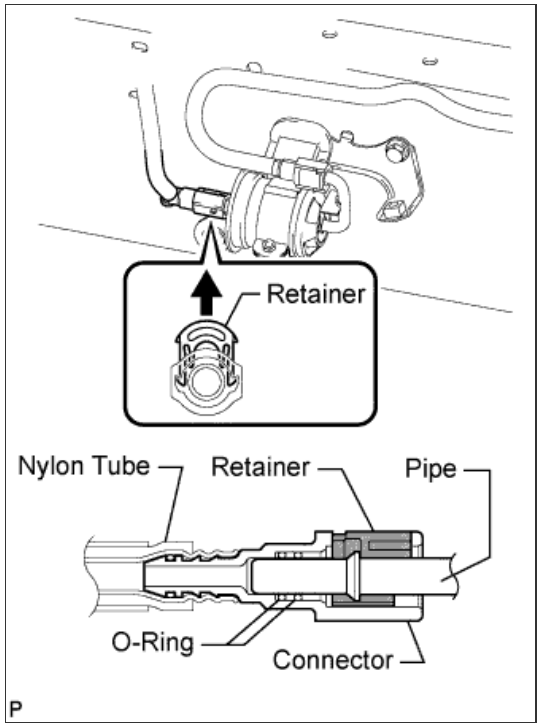


4. DISCONNECT NO. 2 FUEL MAIN TUBE SUB-ASSEMBLY

a. Pull up the retainer and disconnect the No. 2 fuel main tube.

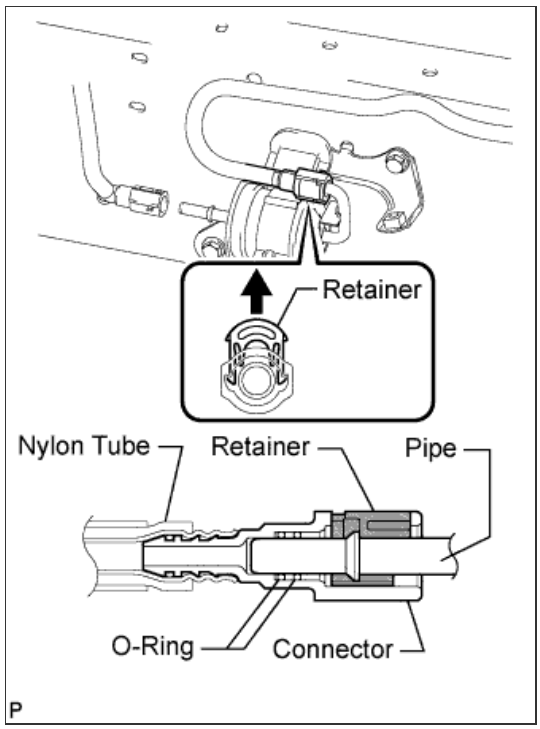
NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



5. DISCONNECT FUEL MAIN TUBE

a. Pull up the retainer and disconnect the fuel main tube.

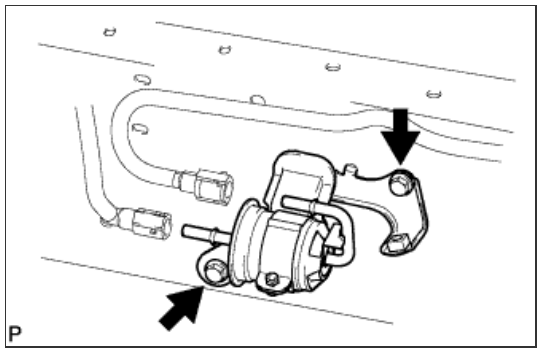


NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**

6. REMOVE FUEL FILTER ASSEMBLY

a. Remove the 2 bolts and fuel filter.



7. INSTALL FUEL FILTER ASSEMBLY

a. nstall the fuel filter with the 2 bolts.

Torque:
20 N*m{ 199 kgf*cm , 14 ft.*lbf }

8. CONNECT FUEL MAIN TUBE

a. Connect the fuel main tube and push the retainer.

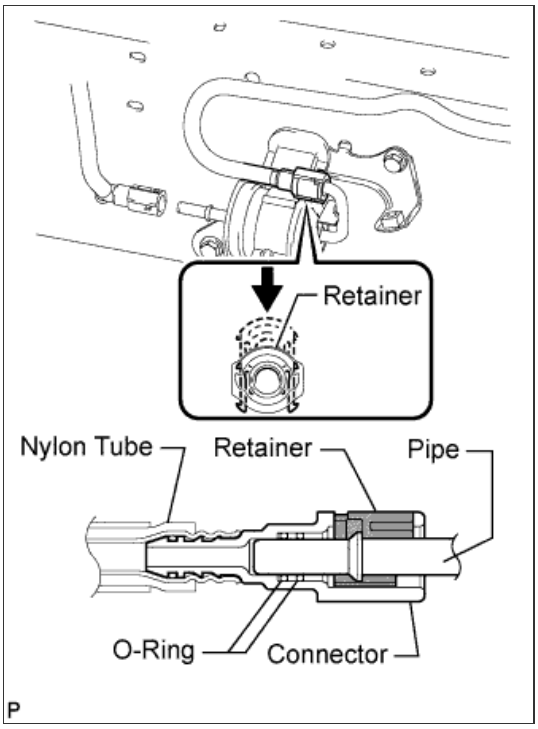
HINT:

Push the parts together firmly until a click sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**

- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**



9. CONNECT NO. 2 FUEL MAIN TUBE SUB-ASSEMBLY

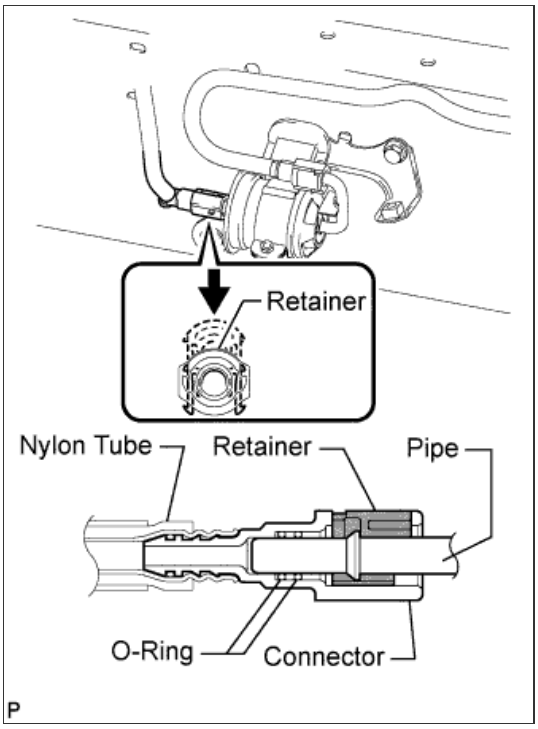
a. Connect the No. 2 fuel main tube and push the retainer.

HINT:

Push the parts together firmly until a click sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**



10. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

11. INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the DLC3.

b. urn the engine switch on ( ) and intelligent tester ON.

NOTICE:

Do not start the engine.

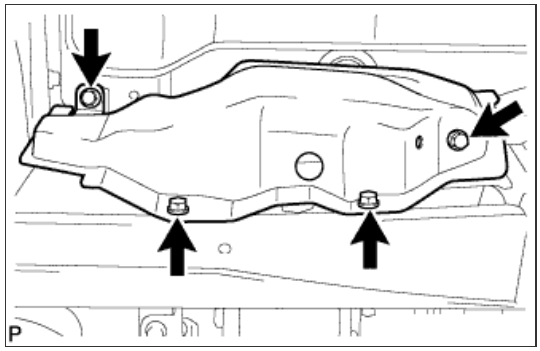
c. Enter the following menus: Powertrain / Engine and EC / Active st / Activate the Fuel Pump Speed Control.

d. Check that there are no fuel leaks after doing maintenance anywhere on the fuel system.

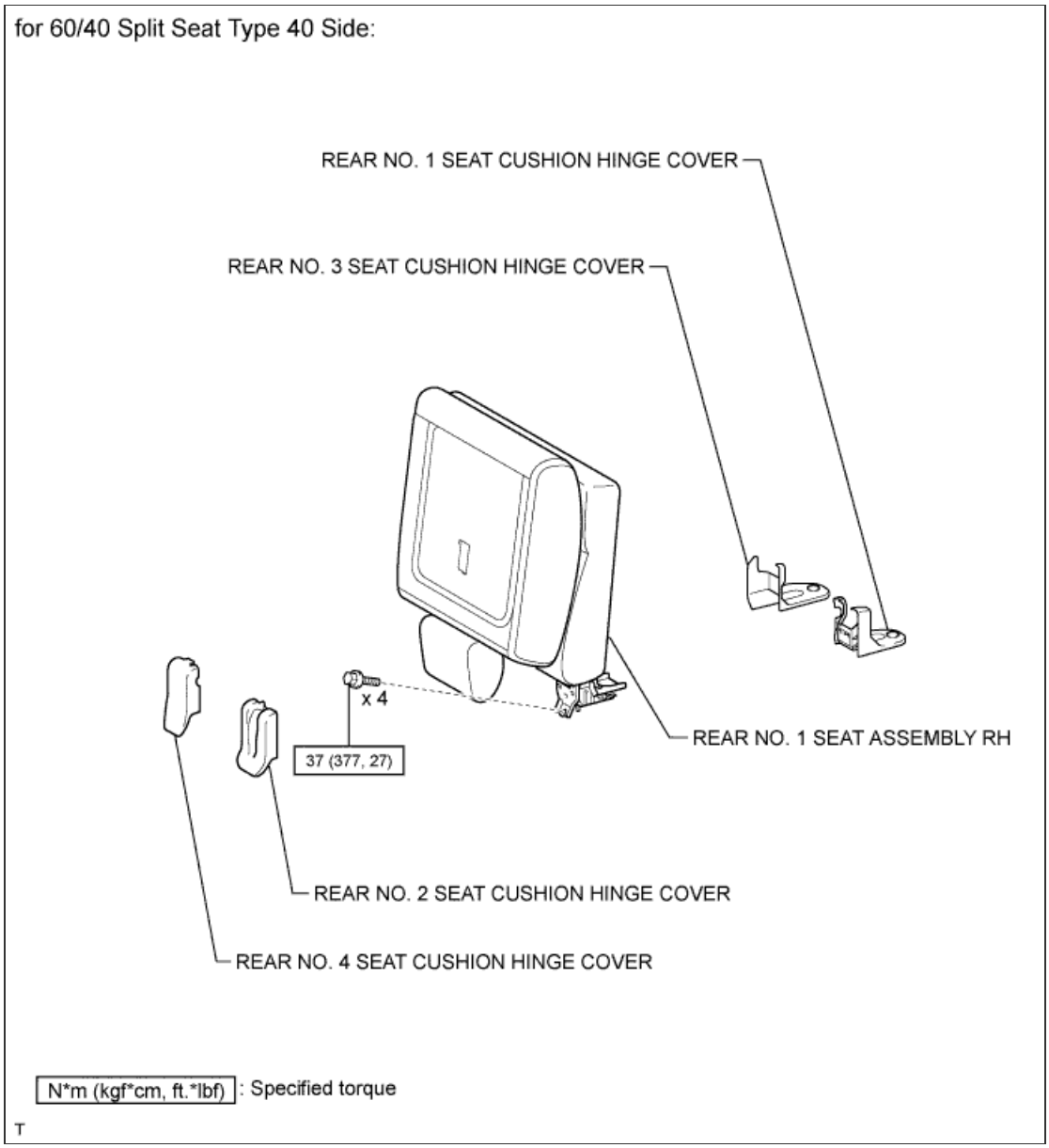
12. INSTALL NO. 1 FUEL TUBE PROTECTOR

a. nstall the No. 1 fuel tube protector and 4 bolts.

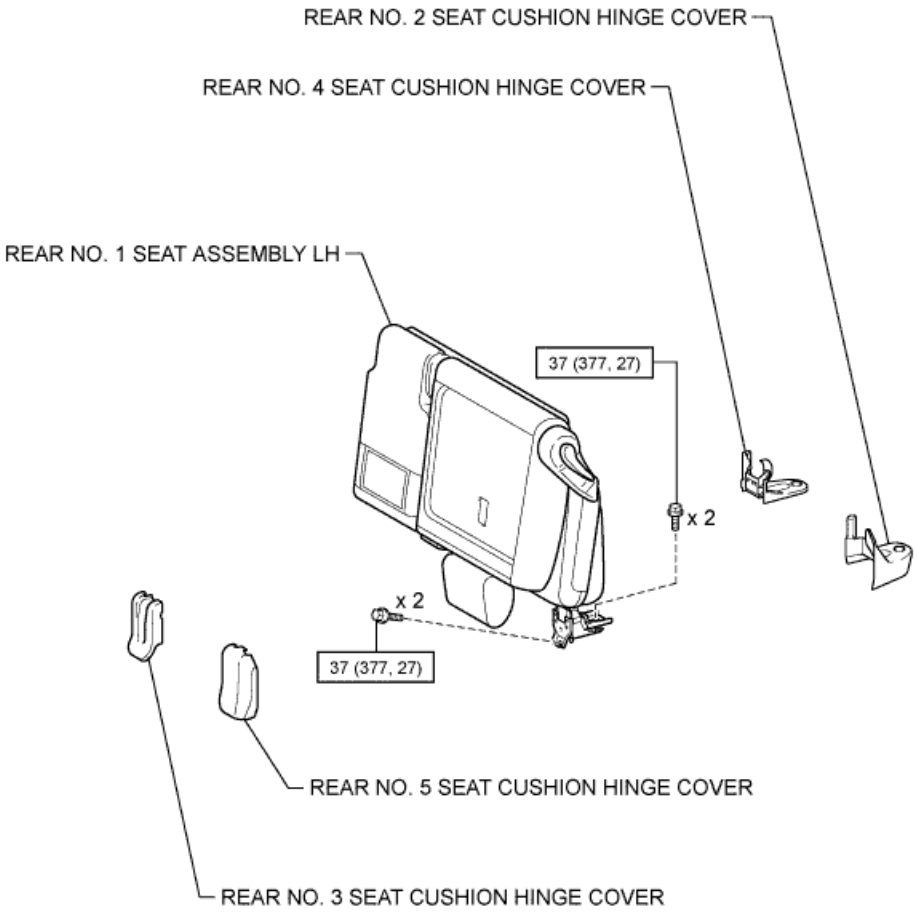
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



for Preparation Click here



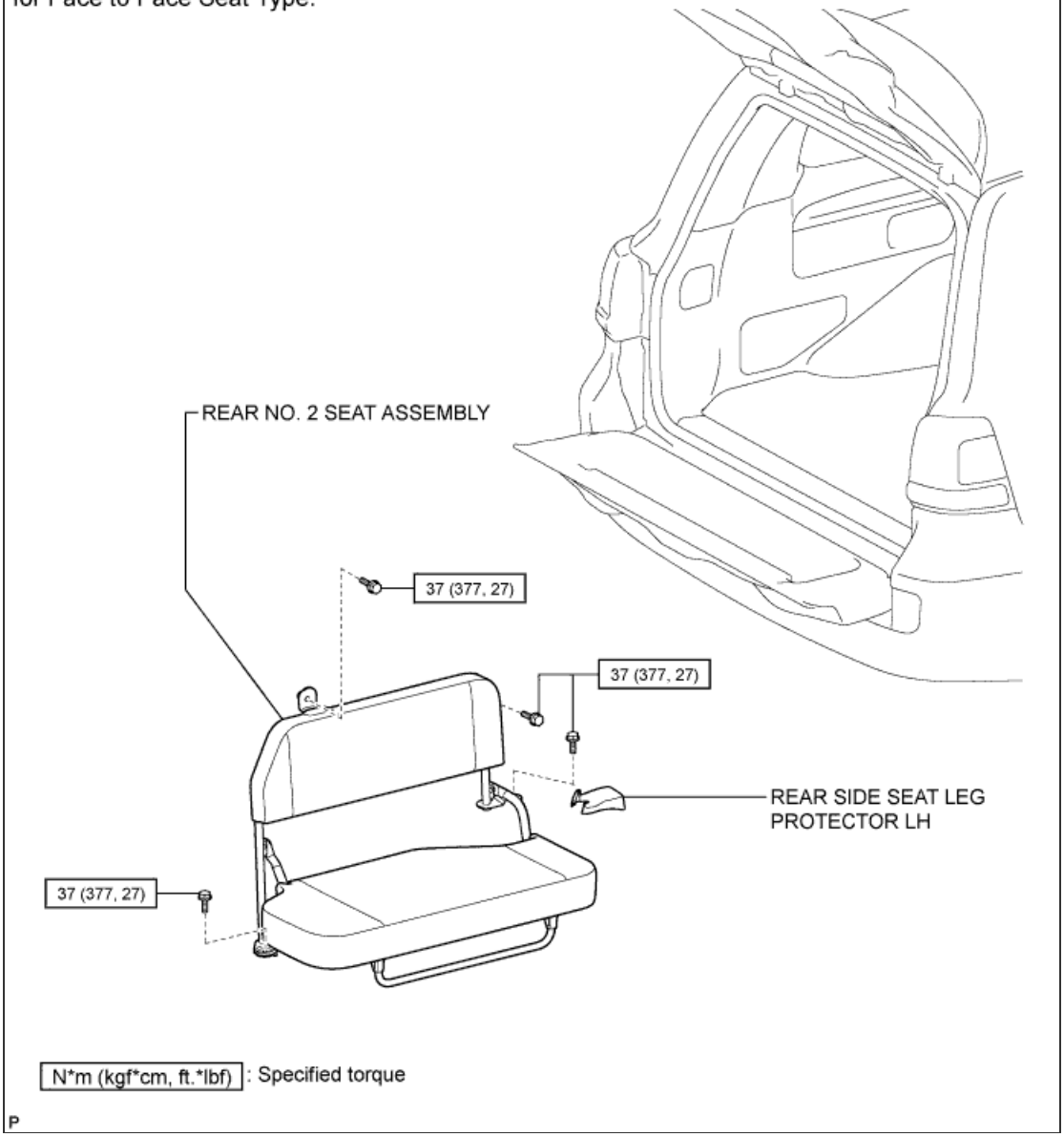
for 60/40 Split Seat Type 60 Side:



N*m (kgf*cm, ft.*lbf) : Specified torque

T

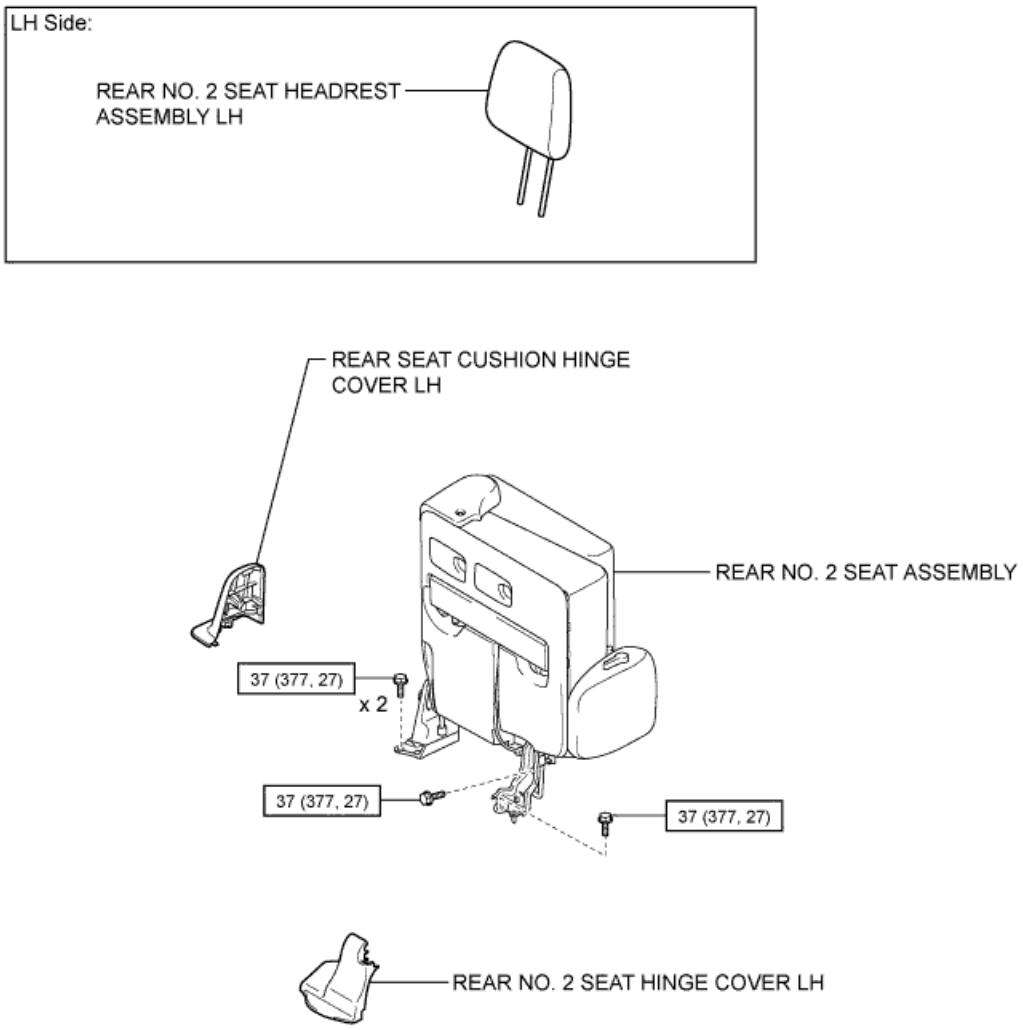
for Face to Face Seat Type:



N*m (kgf*cm, ft.*lbf) : Specified torque

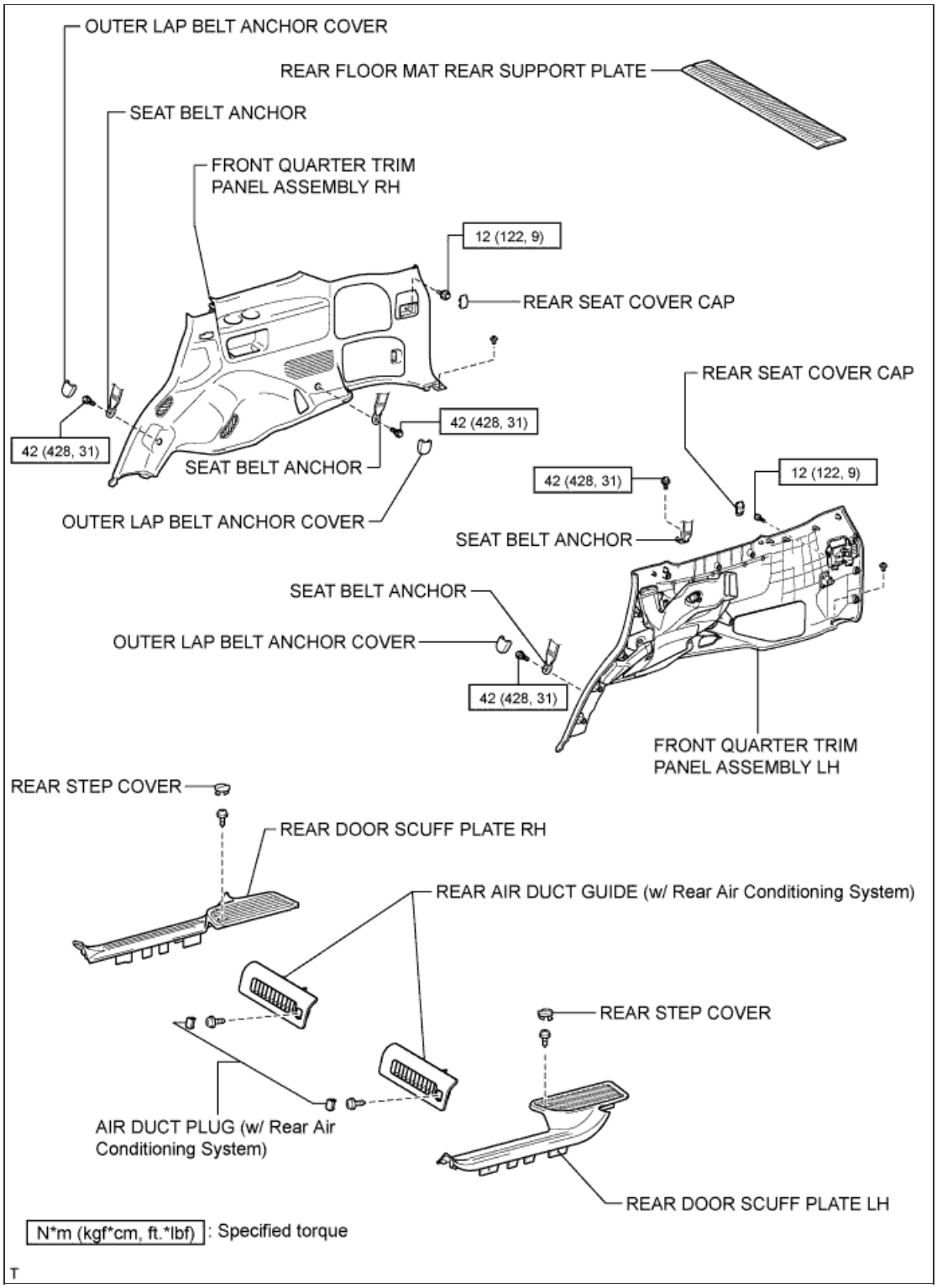
P

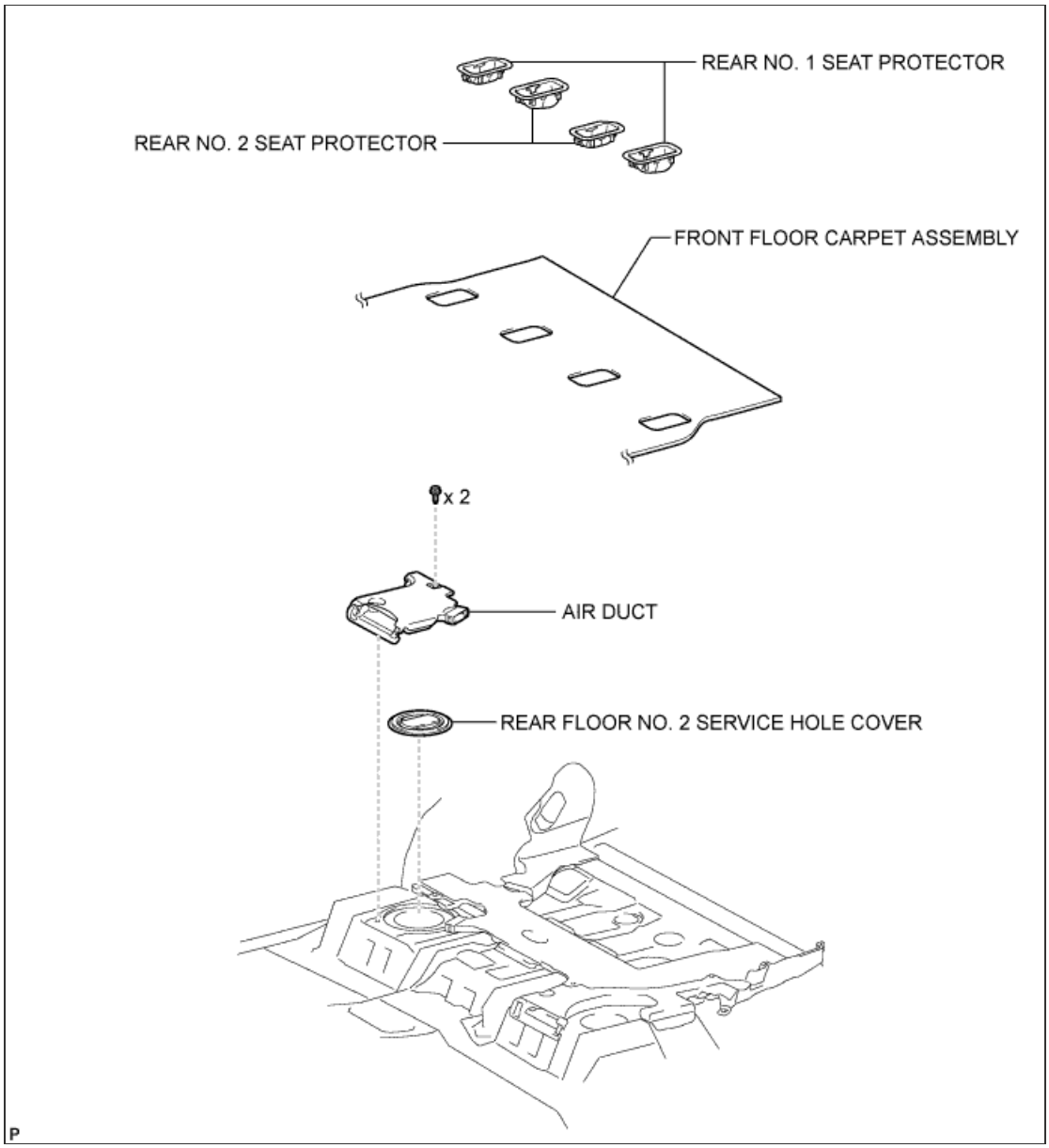
except Face to Face Seat Type:

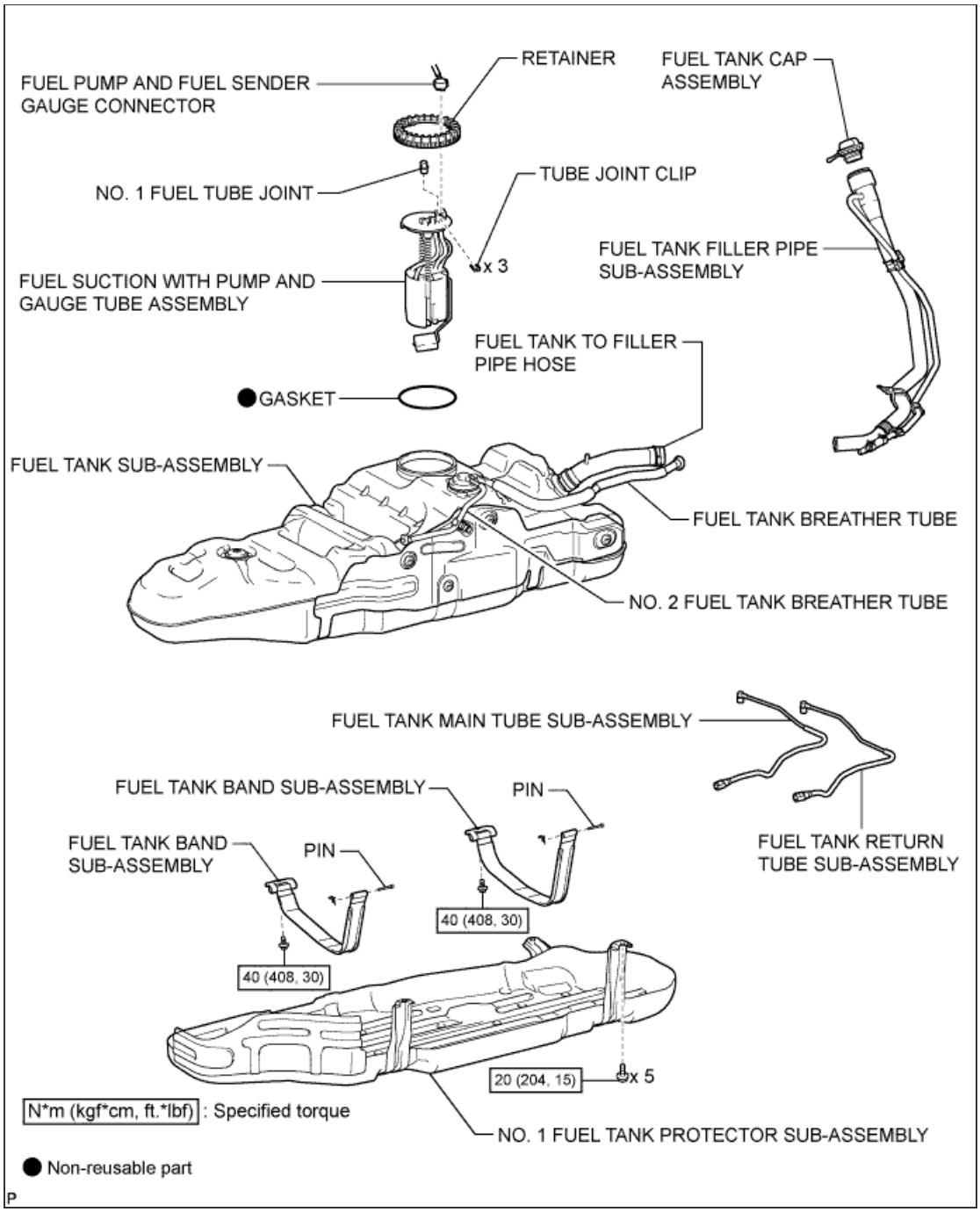


N*m (kgf*cm, ft.*lbf) : Specified torque

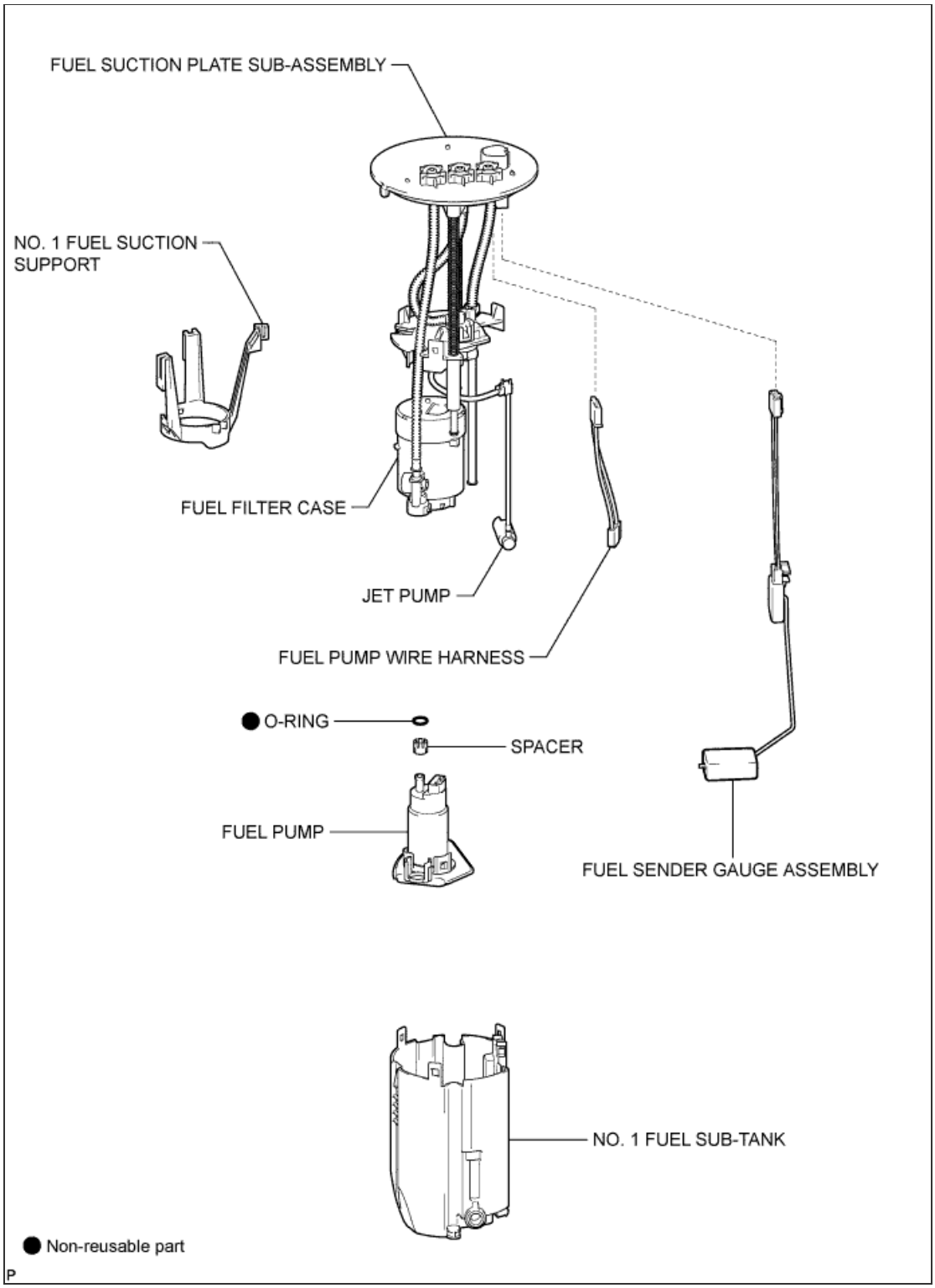
P


OUTER LAP BELT ANCHOR COVER
REAR FLOOR MAT REAR SUPPORT PLATE
SEAT BELT ANCHOR
FRONT QUARTER TRIM PANEL ASSEMBLY RH
12 (122, 9)
REAR SEAT COVER CAP
42 (428, 31)
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
REAR SEAT COVER CAP
42 (428, 31)
12 (122, 9)
SEAT BELT ANCHOR
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
42 (428, 31)
FRONT QUARTER TRIM PANEL ASSEMBLY LH
REAR STEP COVER
REAR DOOR SCUFF PLATE RH
REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)
REAR STEP COVER
AIR DUCT PLUG (w/ Rear Air Conditioning System)
REAR DOOR SCUFF PLATE LH
N*m (kgf*cm, ft.*lbf) : Specified torque
T


REAR NO. 1 SEAT PROTECTOR
REAR NO. 2 SEAT PROTECTOR
FRONT FLOOR CARPET ASSEMBLY
x 2
AIR DUCT
REAR FLOOR NO. 2 SERVICE HOLE COVER
P


FUEL PUMP AND FUEL SENDER GAUGE CONNECTOR
RETAINER
FUEL TANK CAP ASSEMBLY
NO. 1 FUEL TUBE JOINT
TUBE JOINT CLIP
x 3
FUEL TANK FILLER PIPE SUB-ASSEMBLY
FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY
FUEL TANK TO FILLER PIPE HOSE
GASKET
FUEL TANK SUB-ASSEMBLY
FUEL TANK BREATHER TUBE
NO. 2 FUEL TANK BREATHER TUBE
FUEL TANK MAIN TUBE SUB-ASSEMBLY
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TANK RETURN TUBE SUB-ASSEMBLY
40 (408, 30)
40 (408, 30)
20 (204, 15)
x 5
N*m (kgf*cm, ft.*lbf) : Specified torque
NO. 1 FUEL TANK PROTECTOR SUB-ASSEMBLY
Non-reusable part

P


FUEL SUCTION PLATE SUB-ASSEMBLY
NO. 1 FUEL SUCTION SUPPORT
FUEL FILTER CASE
JET PUMP
FUEL PUMP WIRE HARNESS
O-RING
SPACER
FUEL PUMP
FUEL SENDER GAUGE ASSEMBLY
NO. 1 FUEL SUB-TANK
Non-reusable part
P

for Preparation Click here

1. REMOVE FUEL TANK SUB-ASSEMBLY

a. Remove the fuel tank sub-assembly (Click here).

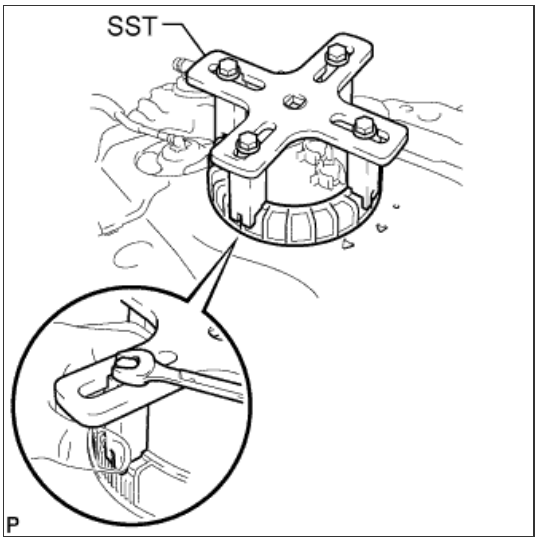
2. REMOVE FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

a. Set SST on the retainer.

SST
09808-14030

HINT:

- **Securely attach the claws of SST to the protrusion of the retainer and fix SST in place.**
- **Install SST while pressing the claws of SST against the retainer (towards the center of SST).**



b. Using SST, loosen the retainer.

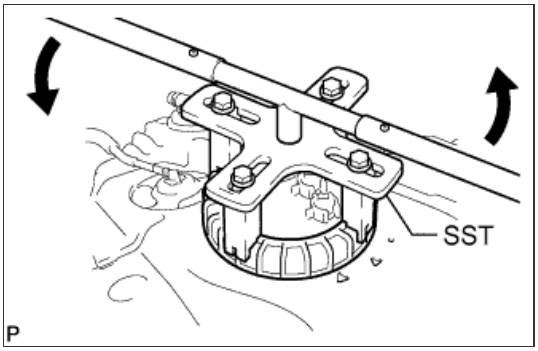
SST
09808-14030

NOTICE:

- **Do not use any tools other than those specified in this operation. Damage to the retainer or the fuel tank may result.**
- **While pressing down on SST so that the claws of SST do not slip off the protrusion of the retainer, turn the retainer counterclockwise to loosen it.**

HINT:

The protrusion of the retainer fit in the ends of SST.



Text in Illustration

➡	Turn

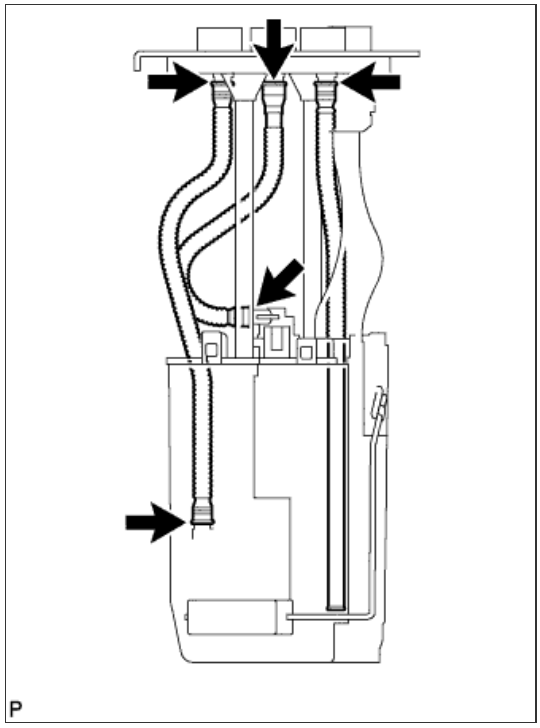
c. Remove the retainer while holding the fuel suction tube assembly by hand.

d. Remove the gasket from the fuel tank.

for Preparation Click here

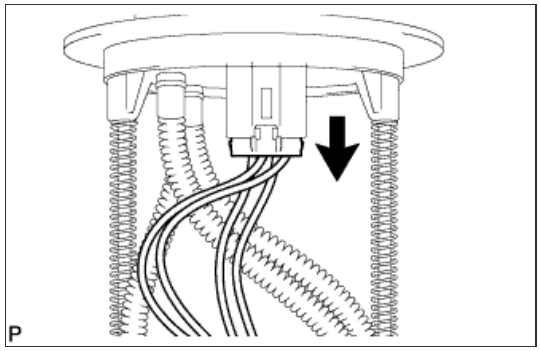
NOTICE:

Do not disconnect the hoses indicated in the illustration.

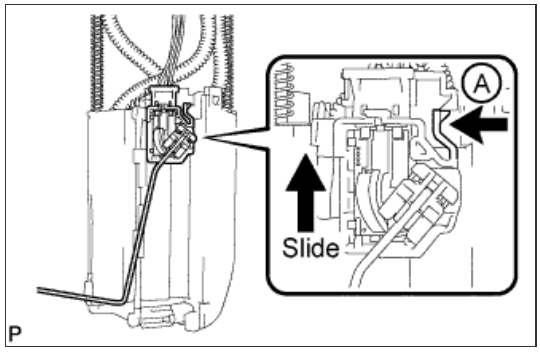


1. REMOVE FUEL SENDER GAUGE ASSEMBLY

a. Disconnect the fuel sender gauge connector.

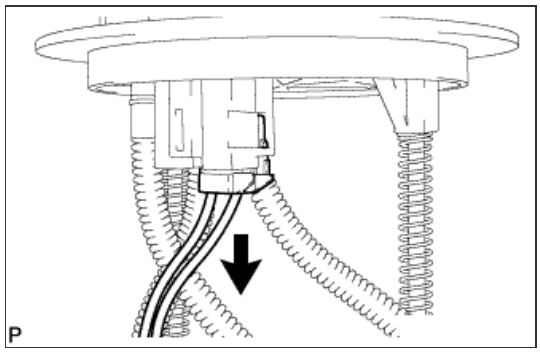


b. Press down on the sender gauge claw labeled A. Then slide the sender gauge upward to remove it.



2. REMOVE NO. 1 FUEL SUB-TANK

a. Disconnect the fuel pump connector.

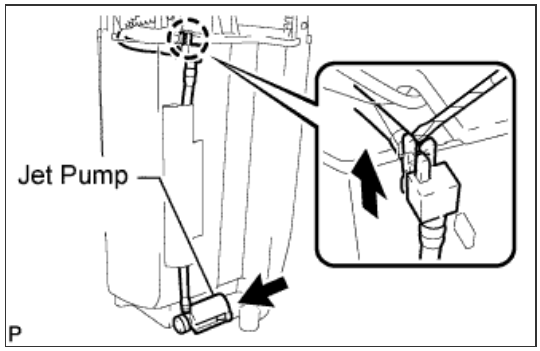


b. Disconnect the jet pump from the sub-tank.

c. Using a small screwdriver, detach the claw from the sub-tank.

HINT:

Tape the screwdriver tip before use.



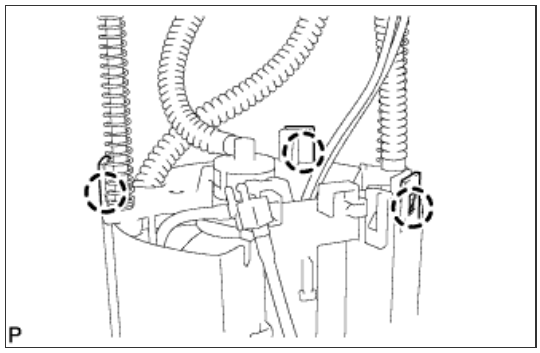
d. Using a screwdriver, detach the 3 claws from the claw holes.

NOTICE:

Do not damage the fuel sub-tank.

HINT:

Tape the screwdriver tip before use.



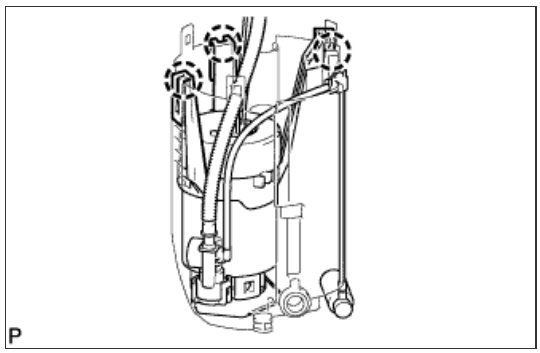
e. Using a screwdriver, detach the 3 claws from the claw holes.

NOTICE:

Do not damage the fuel sub-tank.

HINT:

Tape the screwdriver tip before use.

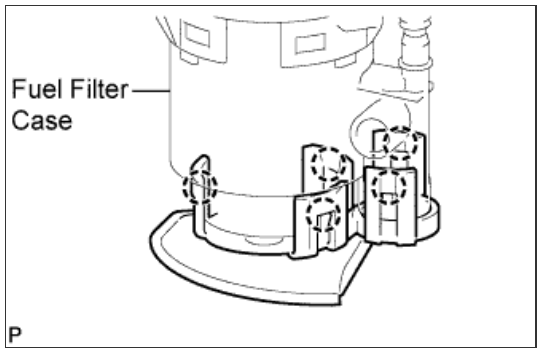


3. REMOVE FUEL PUMP

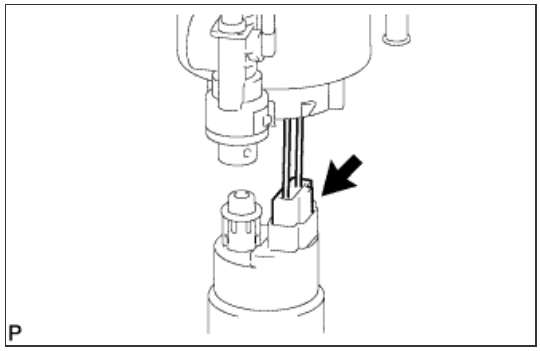
a. Using a screwdriver, detach the 5 claws from the claw holes and disconnect the fuel pump from the fuel filter case.

HINT:

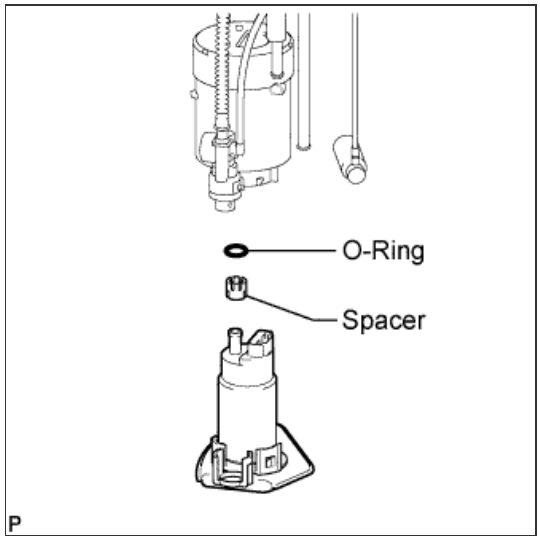
Tape the screwdriver tip before use.



b. Disconnect the fuel pump wire harness connector from the fuel pump to remove it.

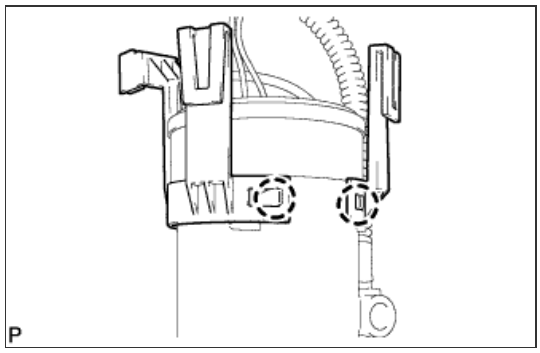


c. Remove the O-ring and spacer from the fuel pump.



4. REMOVE NO. 1 FUEL SUCTION SUPPORT

a. Detach the 2 claws from the claw holes to remove the fuel suction support.



for Preparation Click here

1. INSPECT FUEL PUMP

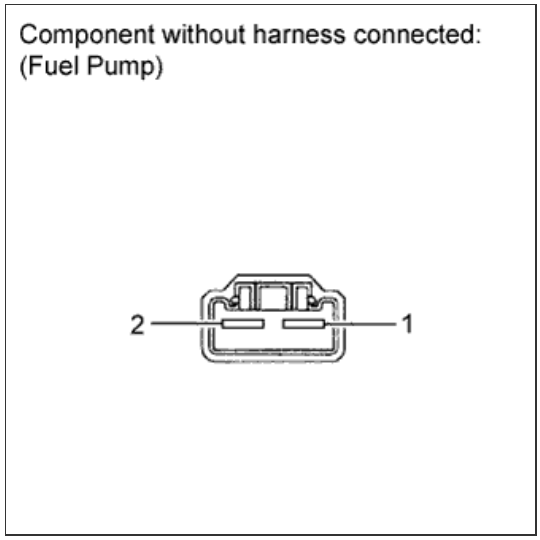
a. Inspect the resistance of the fuel pump.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	0.2 to 3.0 Ω

If the result is not as specified, replace the fuel pump.

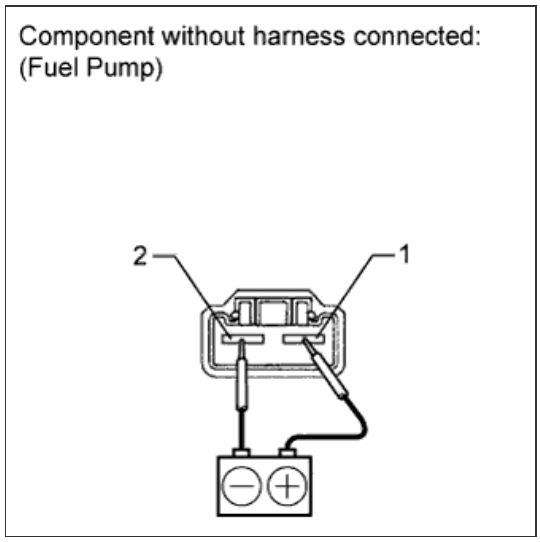


b. Inspect the operation of the fuel pump.

i. Connect the battery's positive (+) lead to terminal 1 of the connector, and the negative (-) lead to terminal 2. Check that the fuel pump operates.
If the result is not as specified, replace the fuel pump and fuel pump ECU.

NOTICE:

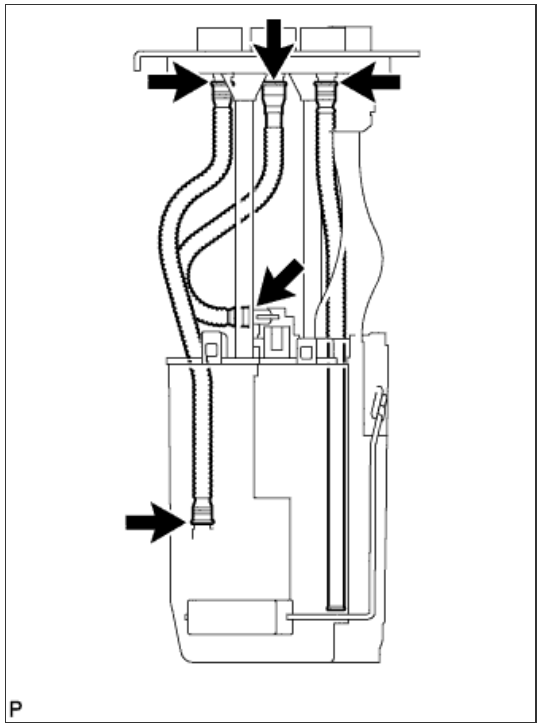
- **These tests must be performed thin 10 seconds to prevent the coil from burning out.**
- **eep the fuel pump as far a ay fro the battery as possible.**
- **I ay turn the voltage on and off on the battery side, not the fuel pump side.**
- **When the pump is locked and does not operate due to foreign matter being stuck, etc., replace the fuel pump ECU together th the fuel pump, as the fuel pump ECU may be damaged electrically.**



for Preparation Click here

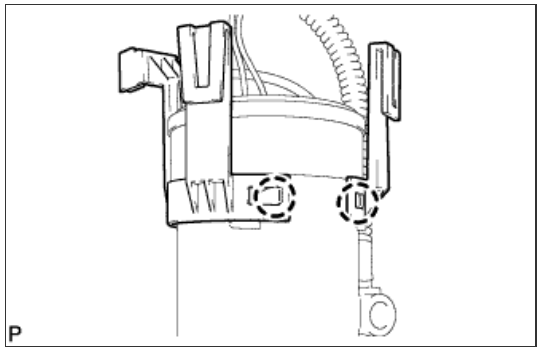
NOTICE:

Do not disconnect the hoses indicated in the illustration.



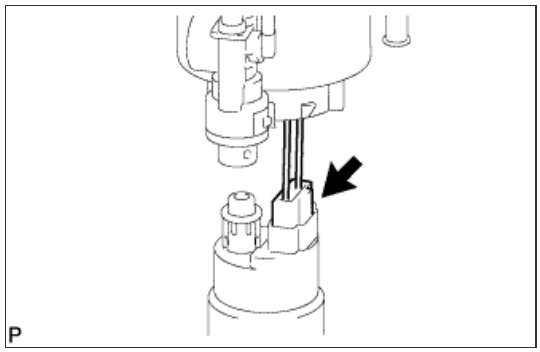
1. INSTALL NO. 1 FUEL SUCTION SUPPORT

a. Attach the 2 claws to the claw holes to install the fuel suction support.

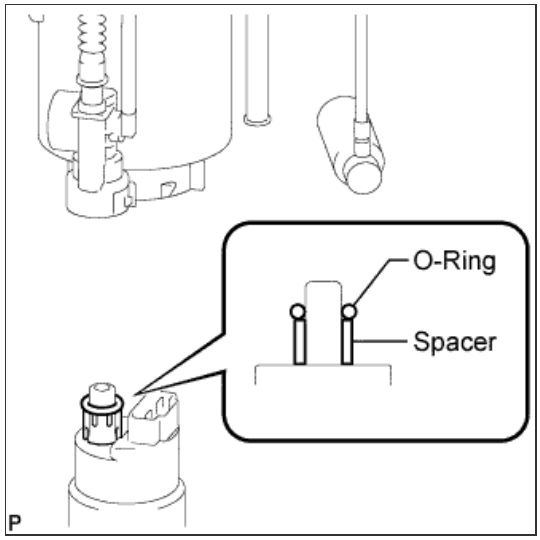


2. INSTALL FUEL PUMP

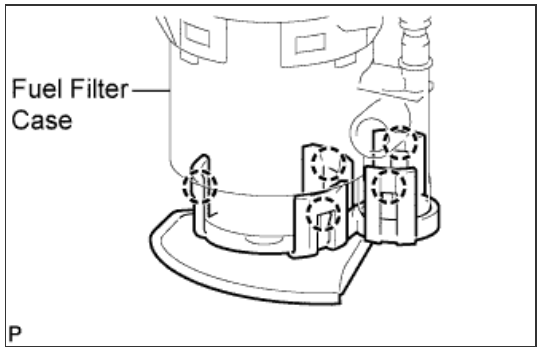
a. Connect the fuel pump wire harness connector to the fuel pump.



b. Apply a light coat of gasoline to a new ring. Then install the spacer and ring to the fuel pump.



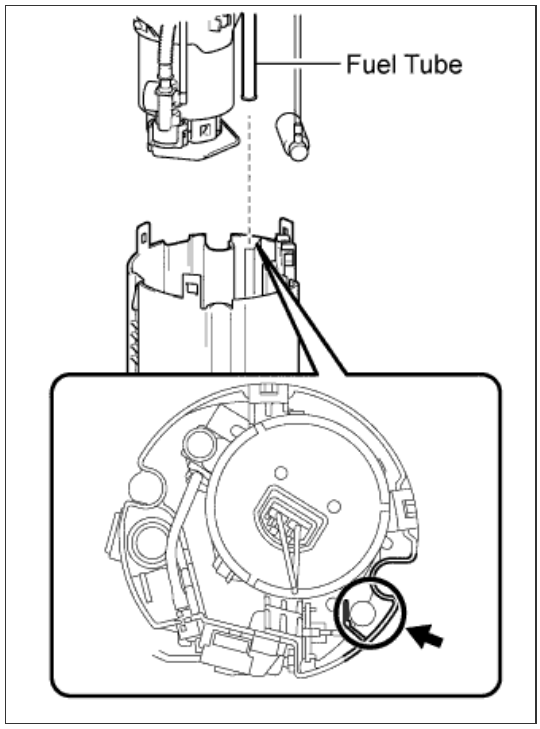
c. Attach the 5 claws to the claw holes and install the fuel pump to the fuel filter case.



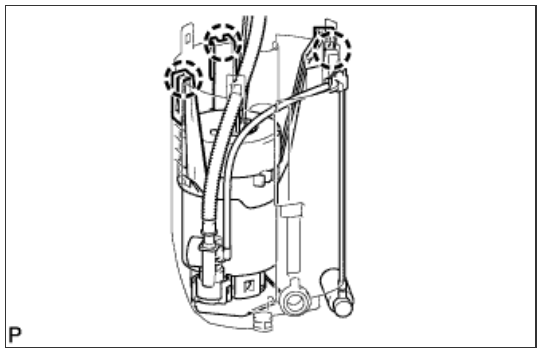
3. INSTALL NO. 1 FUEL SUB-TANK

NOTICE:

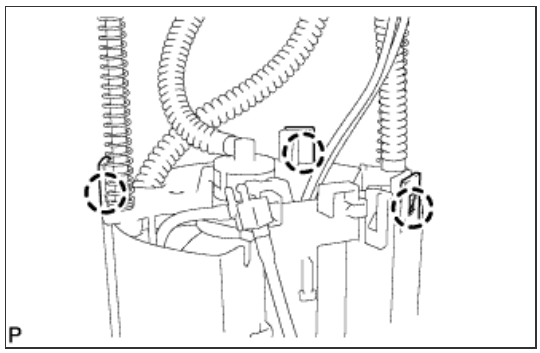
Make sure that the fuel tube passes into the section marked by the circle.



a. Attach the 3 claws to the claw holes and install the fuel sub-tank.



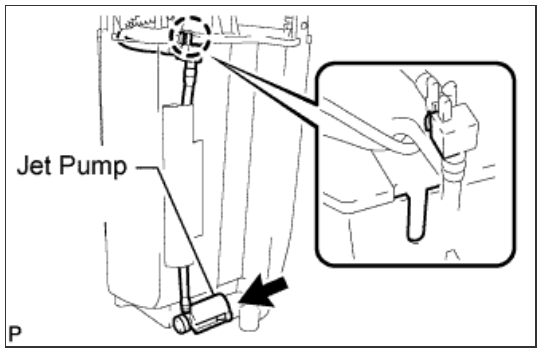
b. Attach the 3 claws to the claw holes.



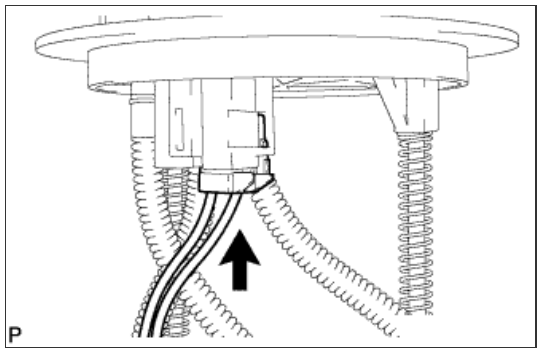
c. Install the tube part to the sub-tank.

i. Attach the claw on the end of the tube to the claw hole. Install the tube to the 2 clamps on the sub-tank.

d. Connect the jet pump to the sub-tank.

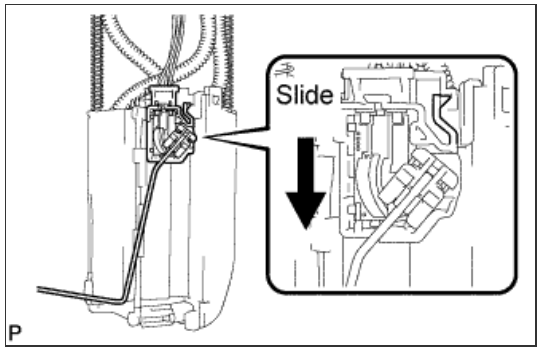


e. Connect the fuel pump connector.

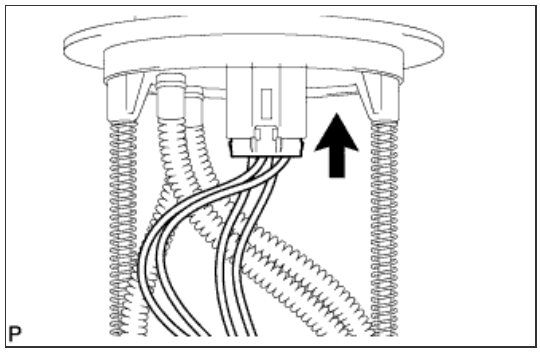


4. INSTALL FUEL SENDER GAUGE ASSEMBLY

a. Set the sender gauge to the fuel sub-tank. Then slide the sender gauge downward to install it.



b. Connect the fuel sender gauge connector.



for Preparation Click here

1. INSTALL FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

a. Apply a light coat of gasoline or grease to a new gasket, and install it to the fuel tank.

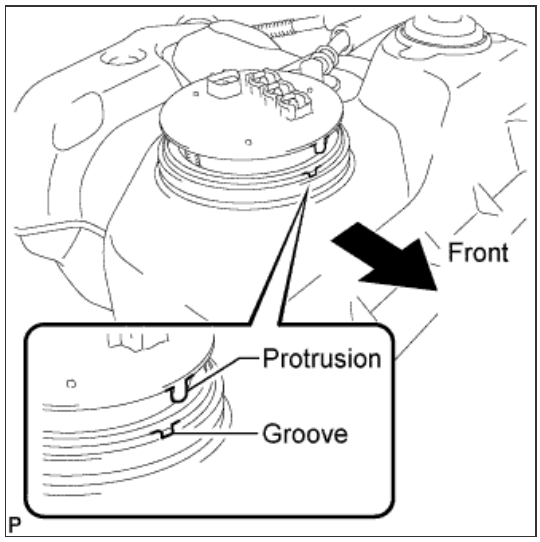
b. Install the fuel suction with pump and gauge tube into the fuel tank.

NOTICE:

Be careful not to bend the arm of the fuel sender gauge.

HINT:

Align the protrusion of the fuel suction with pump and gauge tube with the groove of the fuel tank.



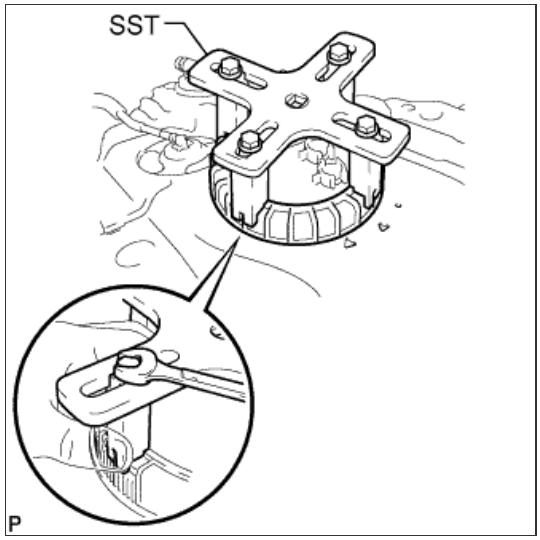
c. Put the retainer on the fuel tank. While holding the fuel suction with pump and gauge tube, tighten the retainer one complete turn by hand.

d. Set SST on the retainer.

SST
09808-14030

HINT:

- **Hold the fuel suction tube assembly upright by hand to ensure that the fuel suction tube gasket is not moved out of position.**
- **Securely attach the claws of SST to the protrusions of the retainer and fix SST in place.**
- **Install SST while pressing the claws of SST against the retainer (toward the center of SST).**

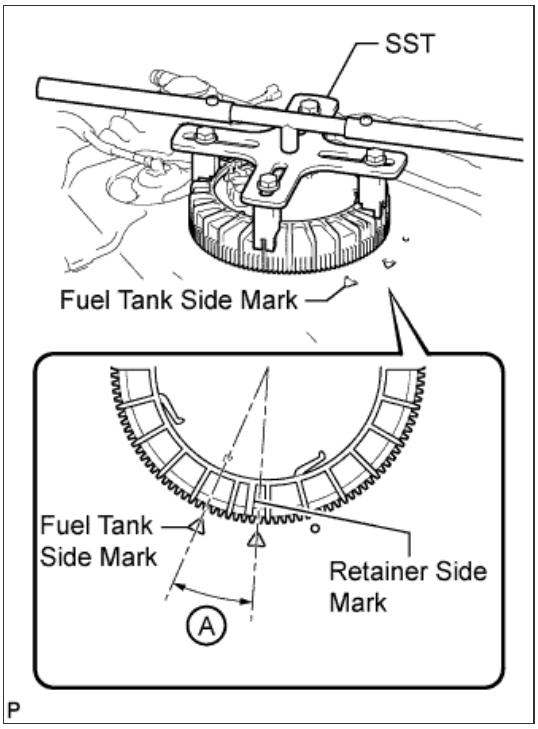


e. Using SST, tighten the retainer until the mark on the retainer is within range A on the fuel tank as shown in the illustration.

SST
09808-14030

HINT:

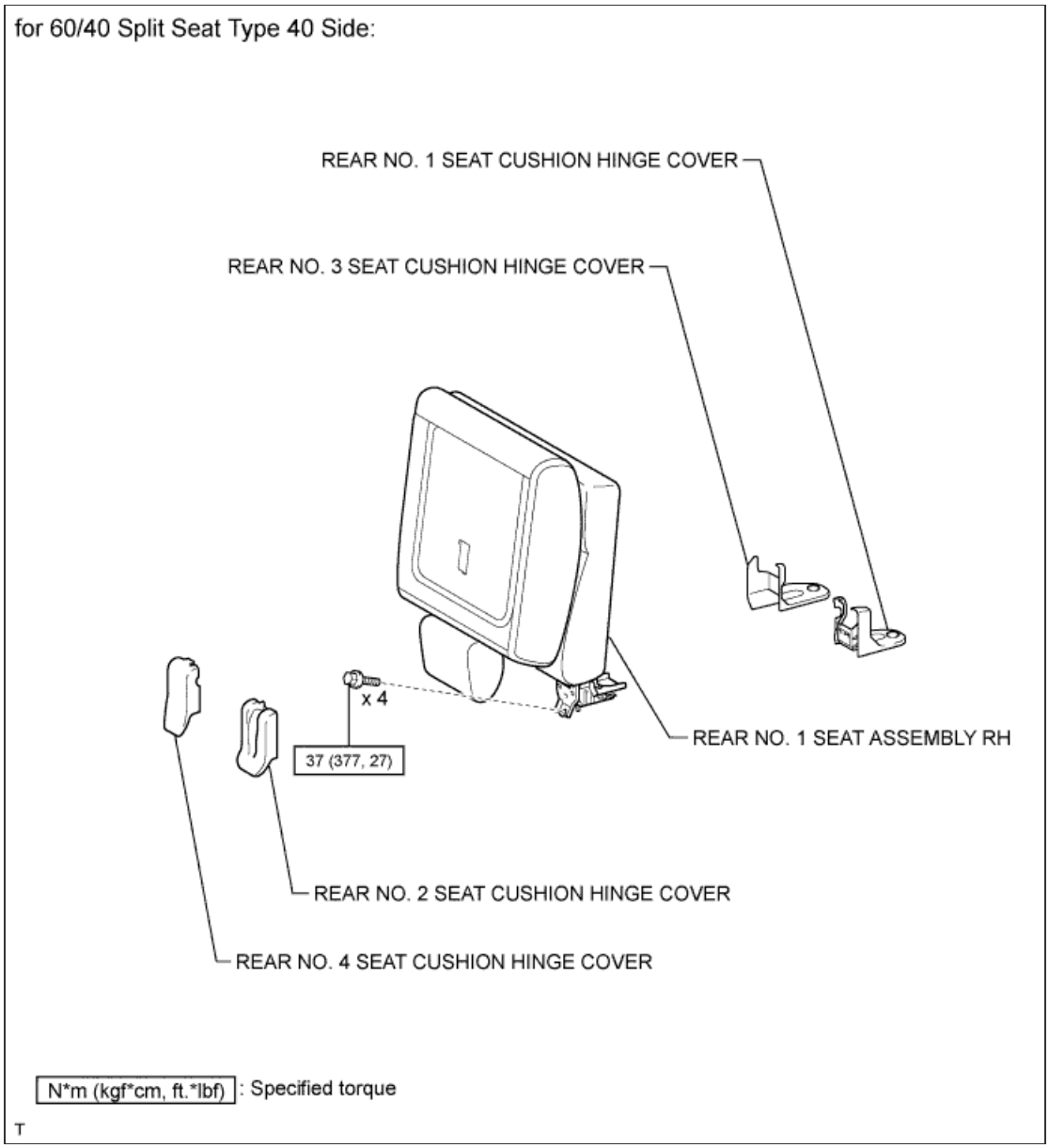
Fit the tips of SST onto the ribs of the retainer.



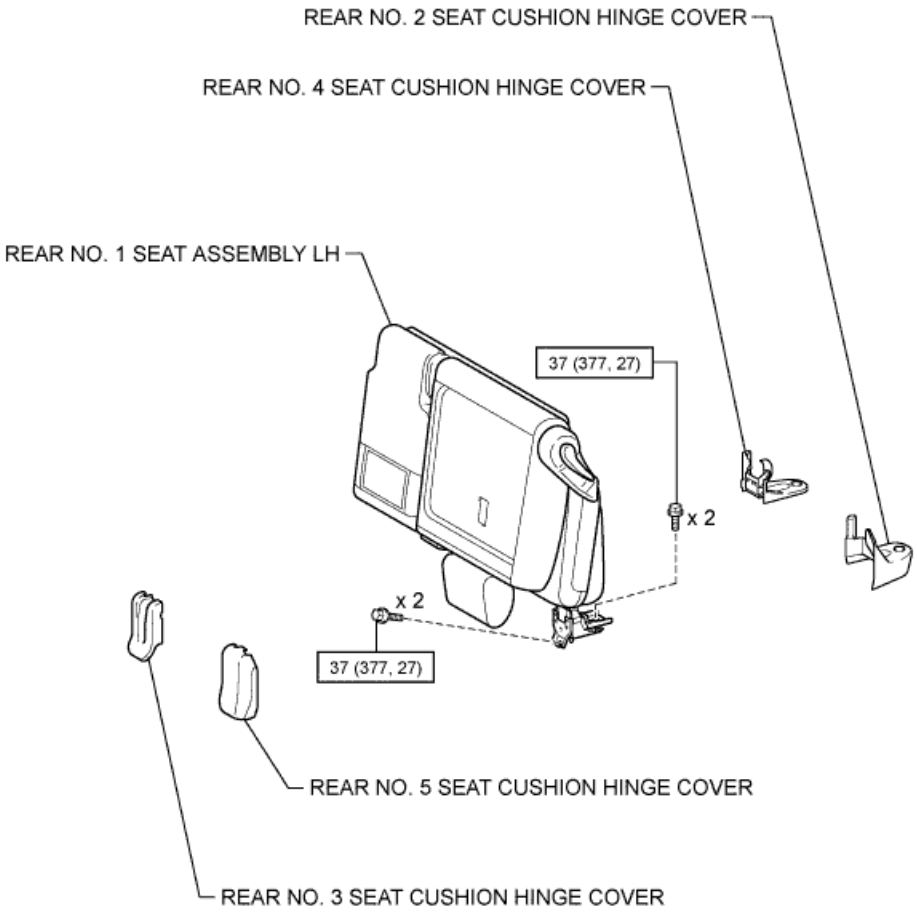
2. INSTALL FUEL TANK SUB-ASSEMBLY

a. Install the fuel tank sub-assembly (Click here).

for Preparat [Click here]



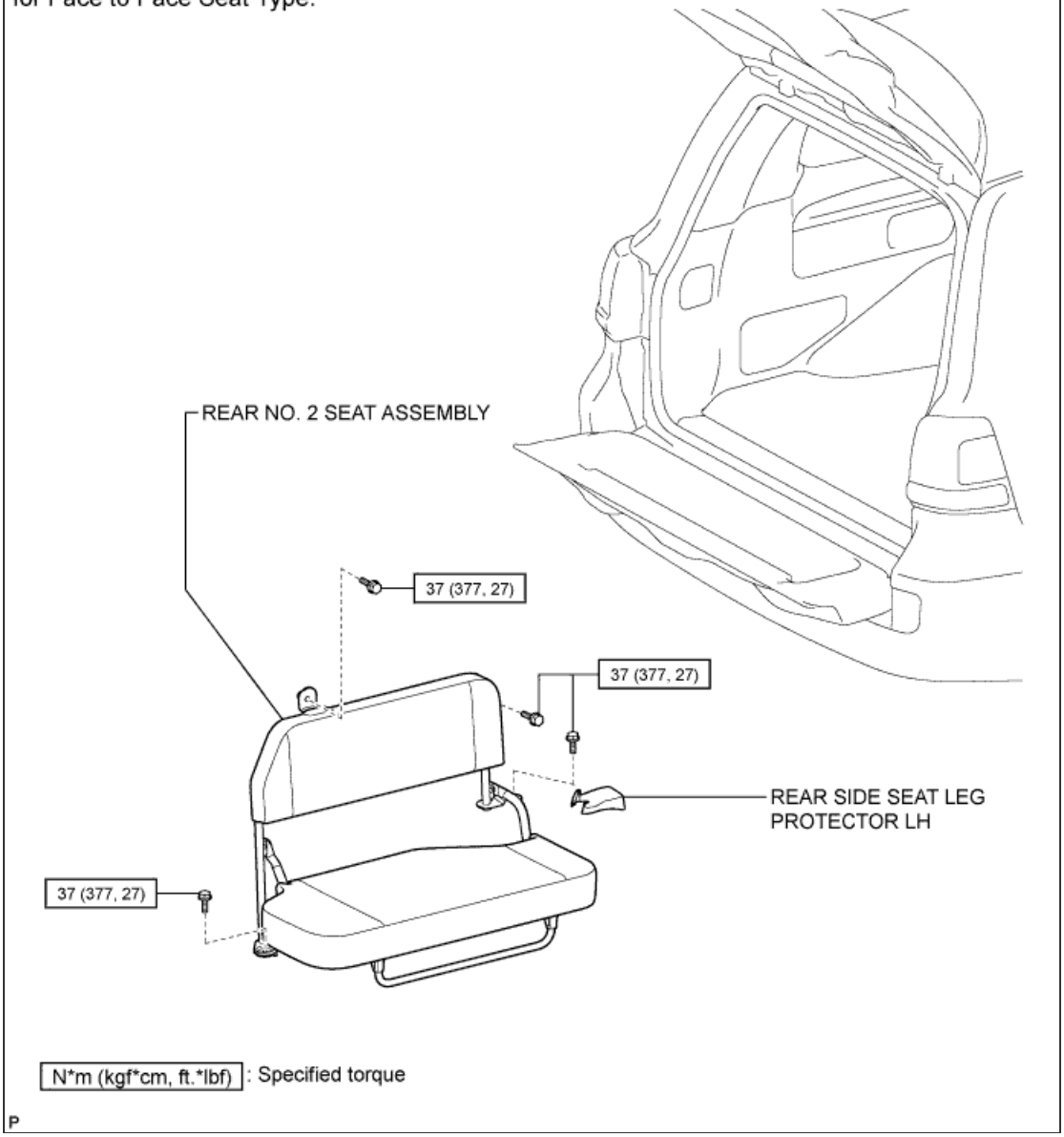
for 60/40 Split Seat Type 60 Side:



N*m (kgf*cm, ft.*lbf) : Specified torque

T

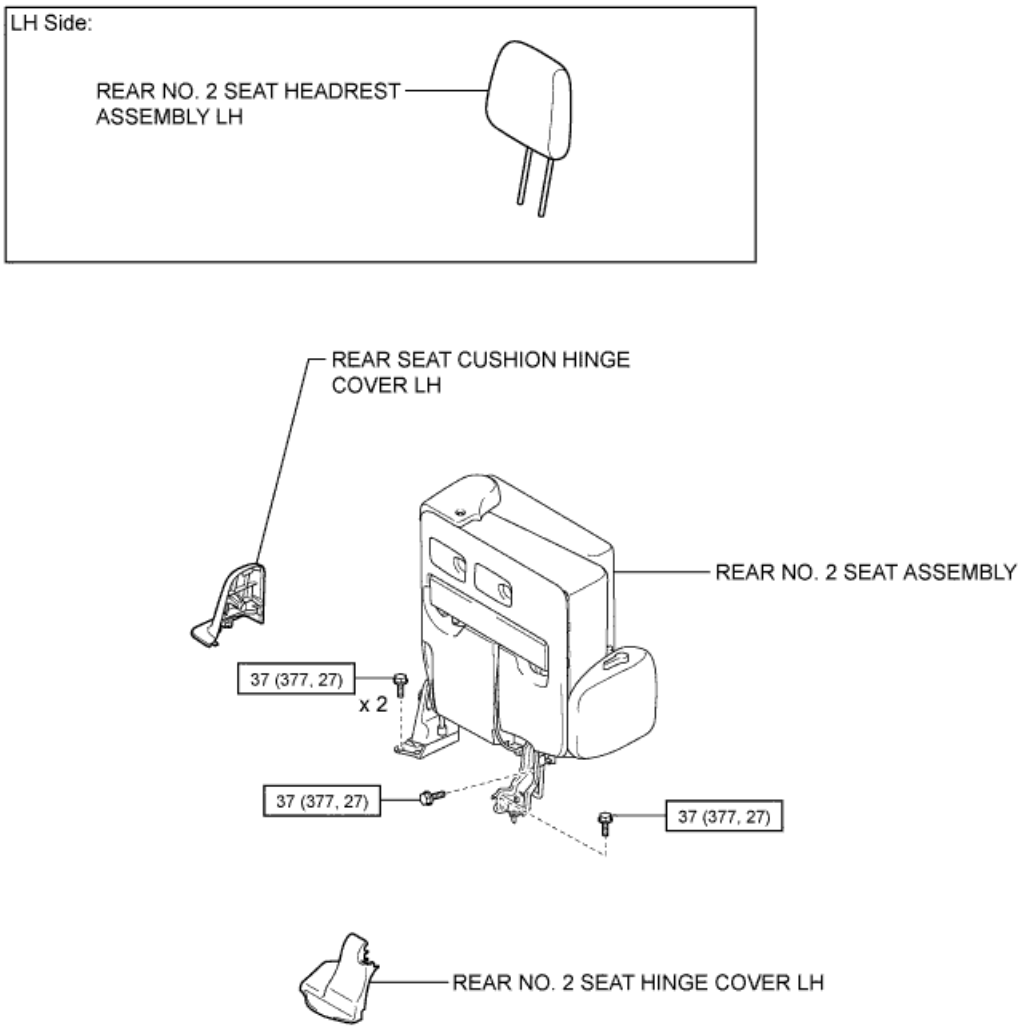
for Face to Face Seat Type:



N*m (kgf*cm, ft.*lbf) : Specified torque

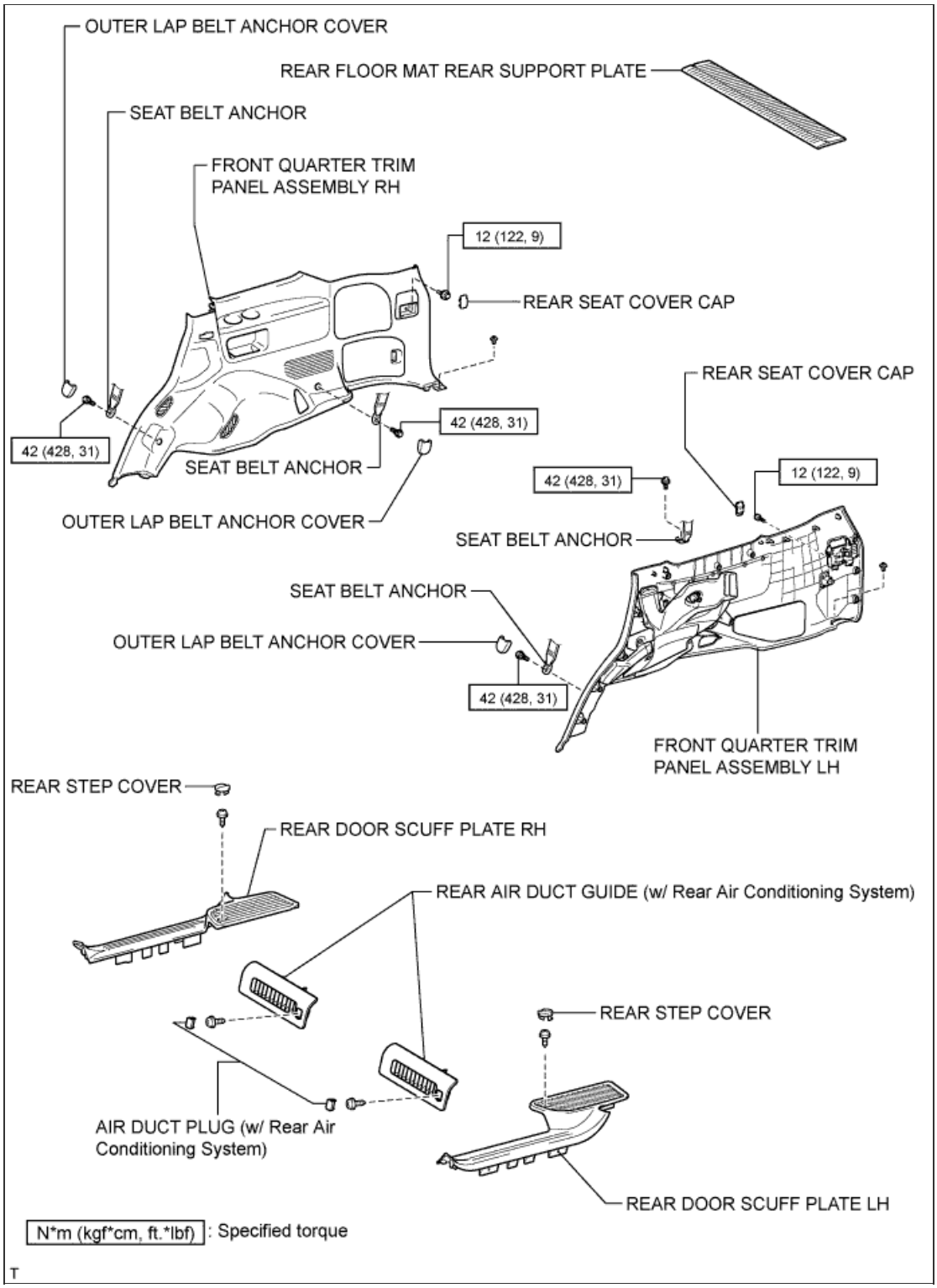
P

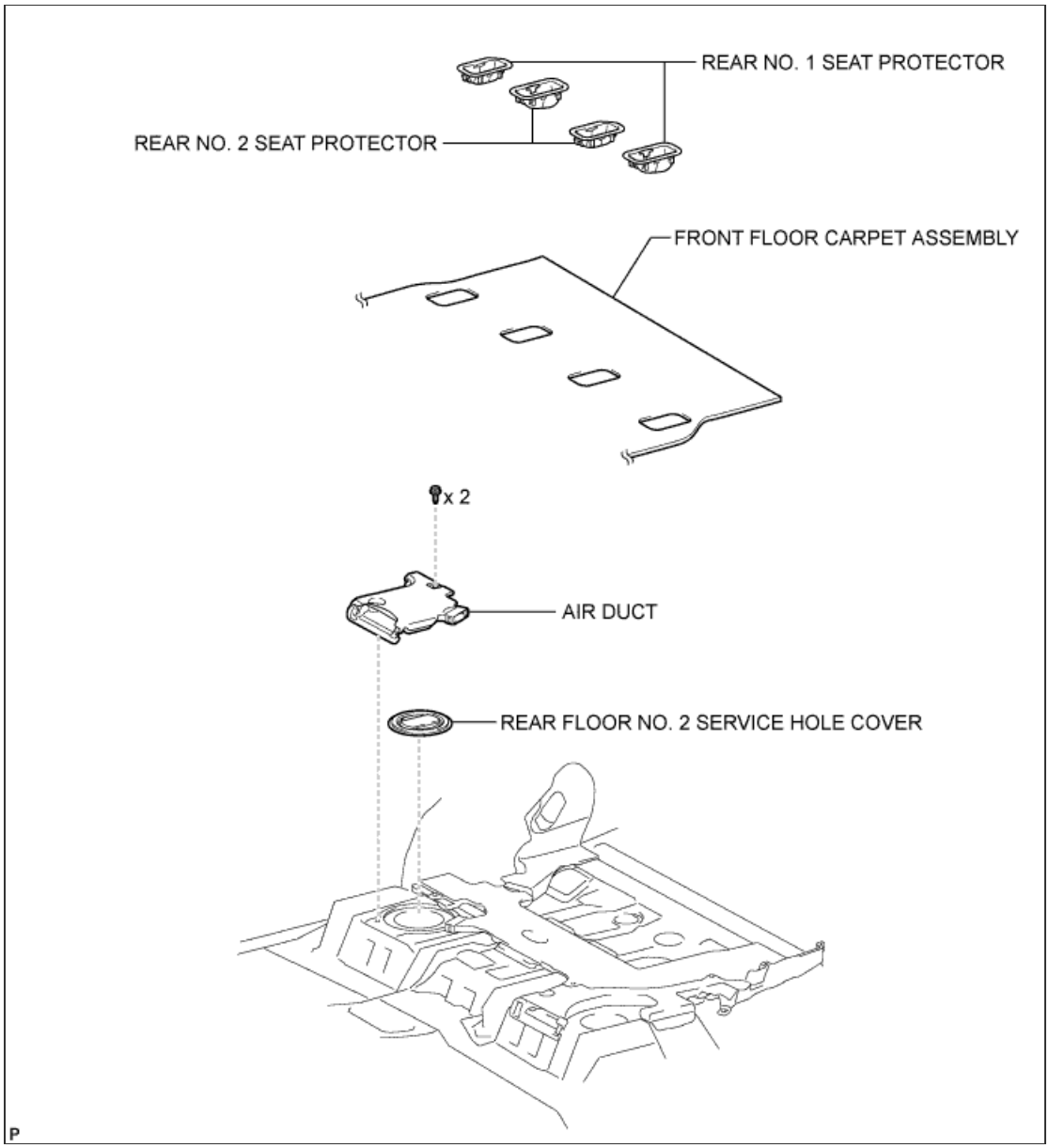
except Face to Face Seat Type:

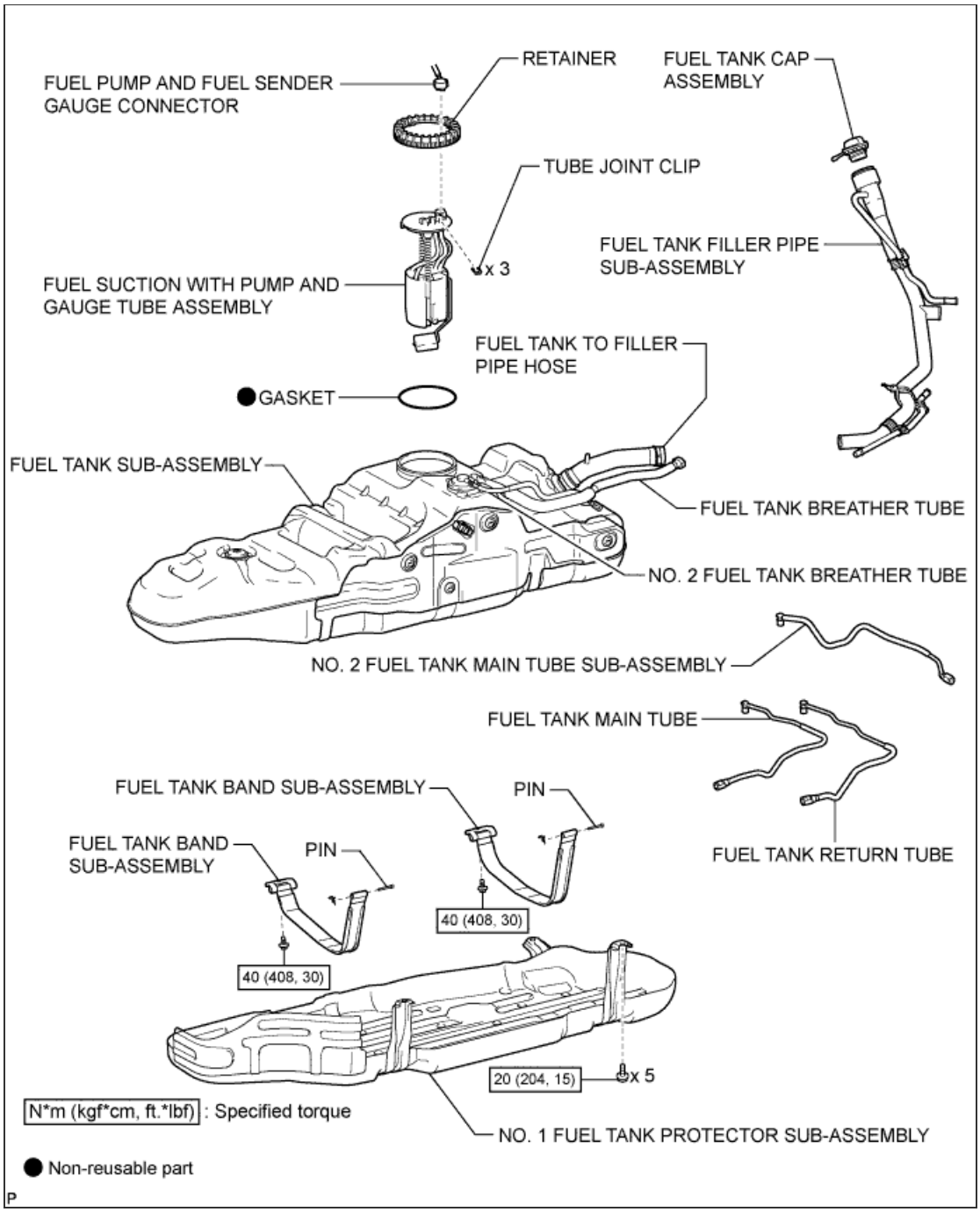


N*m (kgf*cm, ft.*lbf) : Specified torque

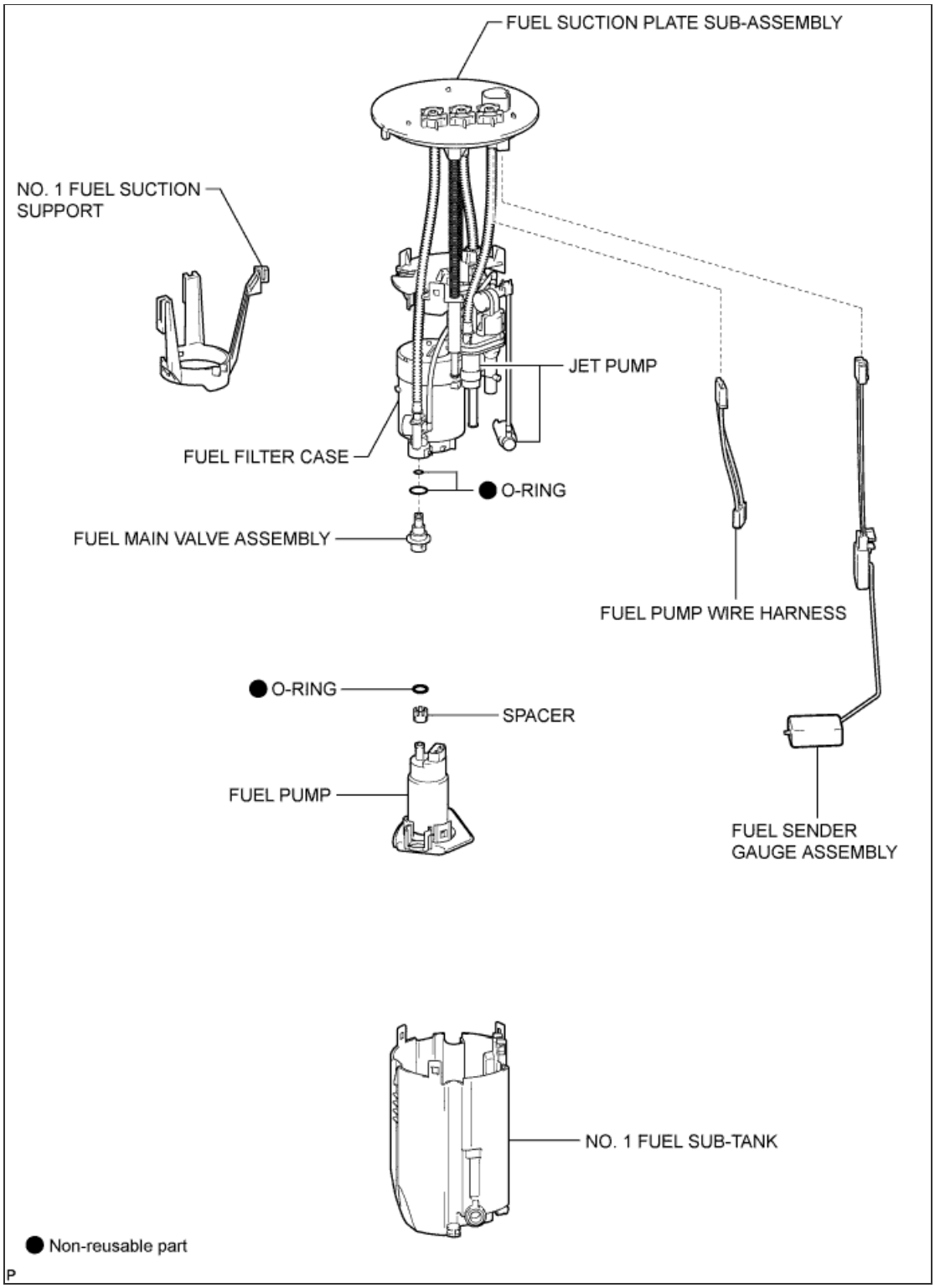
P


OUTER LAP BELT ANCHOR COVER
REAR FLOOR MAT REAR SUPPORT PLATE
SEAT BELT ANCHOR
FRONT QUARTER TRIM PANEL ASSEMBLY RH
12 (122, 9)
REAR SEAT COVER CAP
42 (428, 31)
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
REAR SEAT COVER CAP
42 (428, 31)
12 (122, 9)
SEAT BELT ANCHOR
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
42 (428, 31)
FRONT QUARTER TRIM PANEL ASSEMBLY LH
REAR STEP COVER
REAR DOOR SCUFF PLATE RH
REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)
REAR STEP COVER
AIR DUCT PLUG (w/ Rear Air Conditioning System)
REAR DOOR SCUFF PLATE LH
N*m (kgf*cm, ft.*lbf) : Specified torque
T


REAR NO. 1 SEAT PROTECTOR
REAR NO. 2 SEAT PROTECTOR
FRONT FLOOR CARPET ASSEMBLY
x 2
AIR DUCT
REAR FLOOR NO. 2 SERVICE HOLE COVER
P


FUEL PUMP AND FUEL SENDER GAUGE CONNECTOR
RETAINER
FUEL TANK CAP ASSEMBLY
TUBE JOINT CLIP
x 3
FUEL TANK FILLER PIPE SUB-ASSEMBLY
FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY
FUEL TANK TO FILLER PIPE HOSE
GASKET
FUEL TANK SUB-ASSEMBLY
FUEL TANK BREATHER TUBE
NO. 2 FUEL TANK BREATHER TUBE
NO. 2 FUEL TANK MAIN TUBE SUB-ASSEMBLY
FUEL TANK MAIN TUBE
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TANK RETURN TUBE
40 (408, 30)
40 (408, 30)
20 (204, 15)
x 5
N*m (kgf*cm, ft.*lbf) : Specified torque
NO. 1 FUEL TANK PROTECTOR SUB-ASSEMBLY
Non-reusable part

P


FUEL SUCTION PLATE SUB-ASSEMBLY
NO. 1 FUEL SUCTION SUPPORT
JET PUMP
FUEL FILTER CASE
O-RING
FUEL MAIN VALVE ASSEMBLY
FUEL PUMP WIRE HARNESS
O-RING
SPACER
FUEL PUMP
FUEL SENDER GAUGE ASSEMBLY
NO. 1 FUEL SUB-TANK
Non-reusable part
P

for Preparation Click here

1. REMOVE FUEL TANK SUB-ASSEMBLY

a. Remove the fuel tank sub-assembly (Click here).

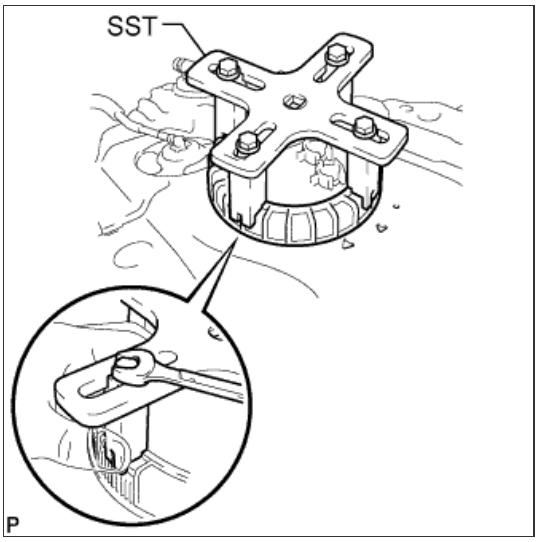
2. REMOVE FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

a. Set SST on the retainer.

SST
09808-14030

HINT:

- **Securely attach the claws of SST to the protrusion of the retainer and fix SST in place.**
- **Install SST while pressing the claws of SST against the retainer (towards the center of SST).**



b. Using SST, loosen the retainer.

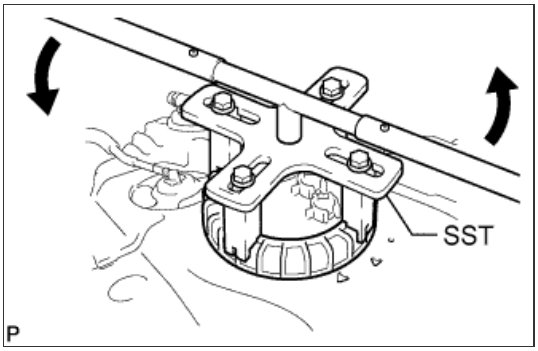
SST
09808-14030

NOTICE:

- **Do not use any tools other than those specified in this operation. Damage to the retainer or the fuel tank may result.**
- **While pressing down on SST so that the claws of SST do not slip off the protrusion of the retainer, turn the retainer counterclockwise to loosen it.**

HINT:

The protrusion of the retainer fit in the ends of SST.



Text in Illustration

➡	Turn

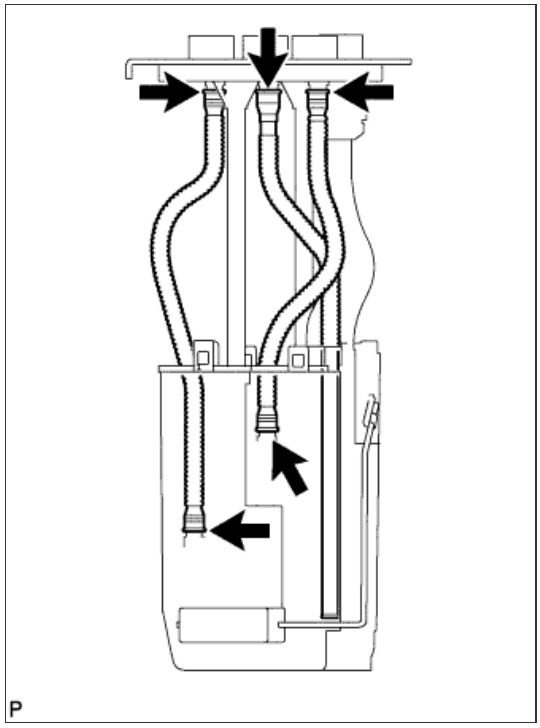
c. Remove the retainer while holding the fuel suction tube assembly by hand.

d. Remove the gasket from the fuel tank.

for Preparation Click here

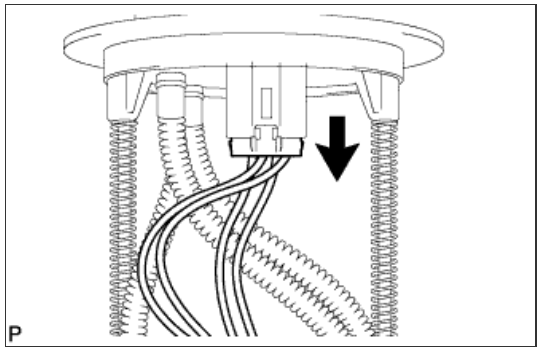
NOTICE:

Do not disconnect the hoses indicated in the illustration.

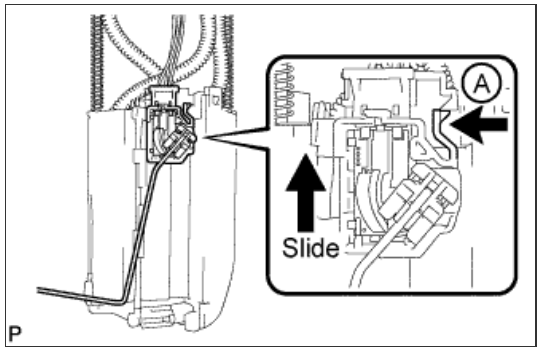


1. REMOVE FUEL SENDER GAUGE ASSEMBLY

a. Disconnect the fuel sender gauge connector.

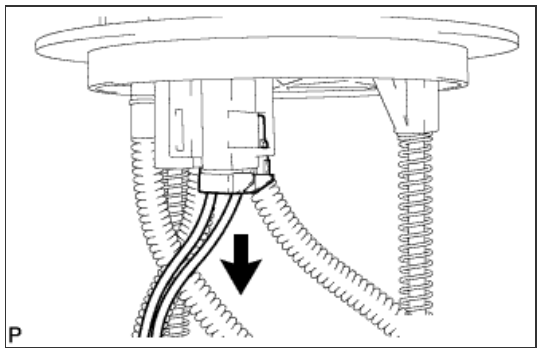


b. Press down on the sender gauge claw labeled A. Then slide the sender gauge upward to remove it.



2. REMOVE NO. 1 FUEL SUB-TANK

a. Disconnect the fuel pump connector.



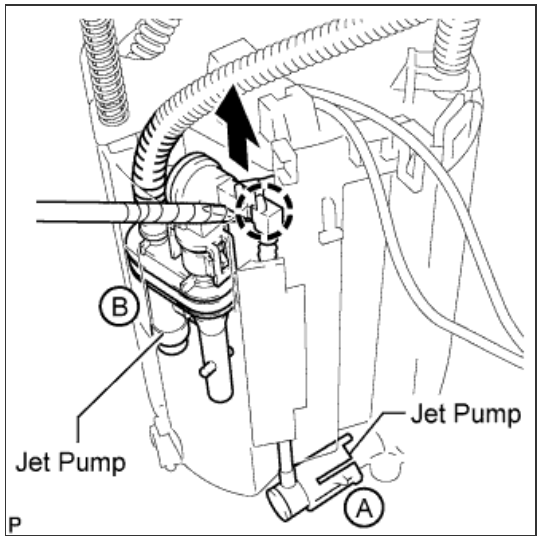
b. Disconnect the jet pump (labeled A) from the sub-tank.

c. Disconnect the jet pump (labeled B) from the sub-tank.

i. Using a small screwdriver, detach the claw from the sub-tank.

HINT:

Tape the screwdriver tip before use.



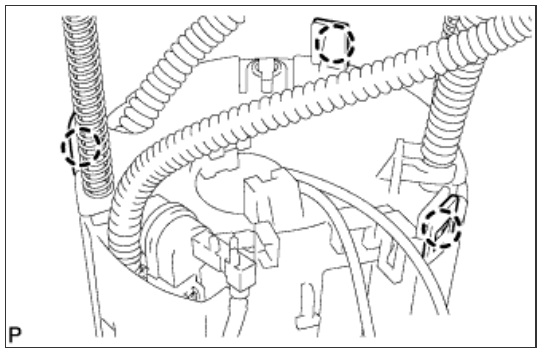
d. Using a screwdriver, detach the 3 claws from the claw holes.

NOTICE:

Do not damage the fuel sub-tank.

HINT:

Tape the screwdriver tip before use.



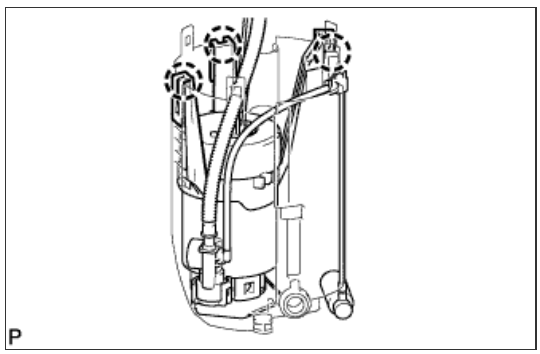
e. Using a screwdriver, detach the 3 claws from the claw holes.

NOTICE:

Do not damage the fuel sub-tank.

HINT:

Tape the screwdriver tip before use.



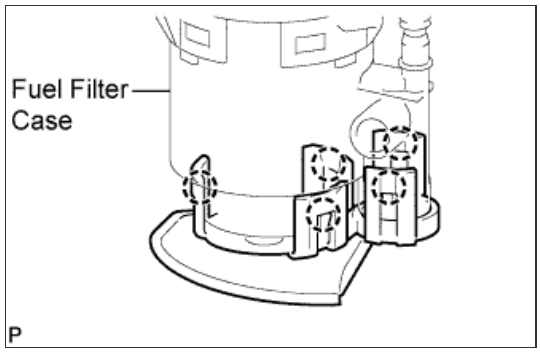
3. REMOVE FUEL PUMP

a. Using a screwdriver, detach the 5 claws from the claw holes and disconnect the

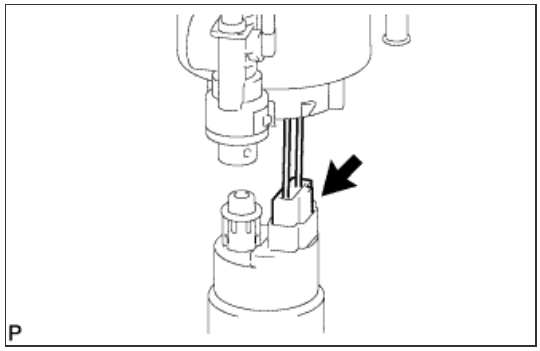
fuel pump from the fuel filter case.

HINT:

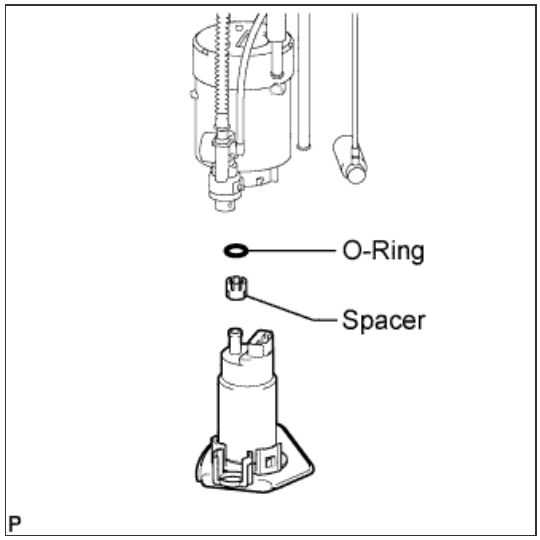
Tape the screwdriver tip before use.



b. Disconnect the fuel pump wire harness connector from the fuel pump to remove it.



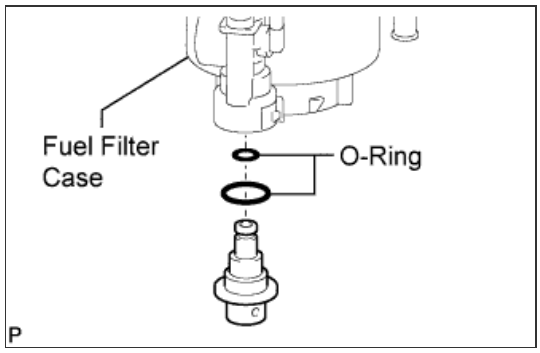
c. Remove the O-ring and spacer from the fuel pump.



4. REMOVE FUEL MAIN VALVE ASSEMBLY

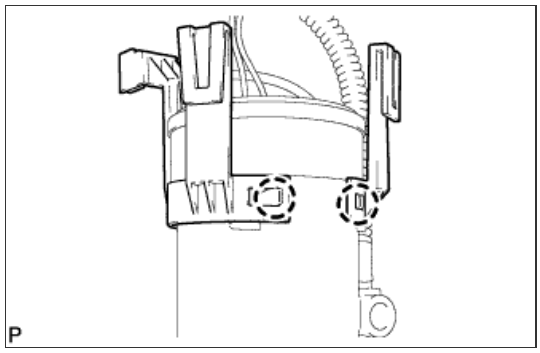
a. Remove the fuel main valve from the fuel filter case.

b. Remove the 2 O-rings from the fuel main valve.



5. REMOVE NO. 1 FUEL SUCTION SUPPORT

a. Detach the 2 claws from the claw holes to remove the fuel suction support.



for Preparation Click here

1. INSPECT FUEL PUMP

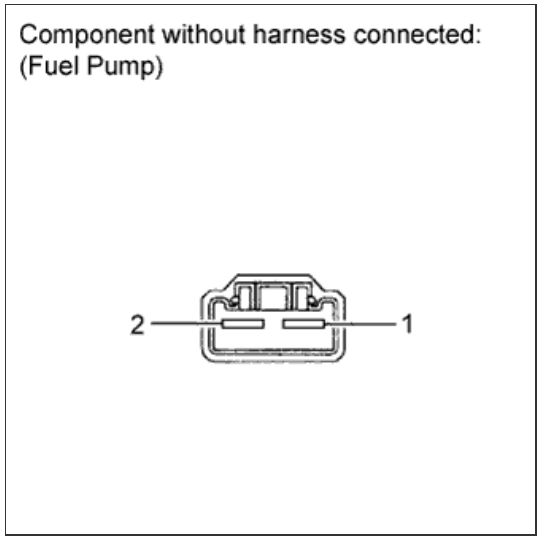
a. Inspect the resistance of the fuel pump.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	0.2 to 3.0 Ω

If the result is not as specified, replace the fuel pump.

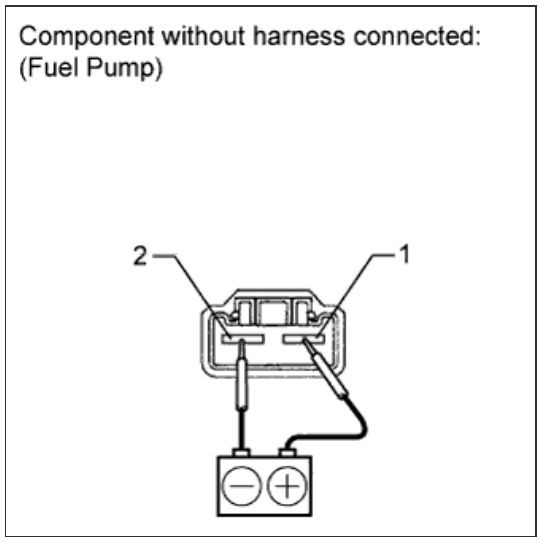


b. Inspect the operation of the fuel pump.

i. Connect the battery's positive (+) lead to terminal 1 of the connector, and the negative (-) lead to terminal 2. Check that the fuel pump operates.
If the result is not as specified, replace the fuel pump and fuel pump ECU.

NOTICE:

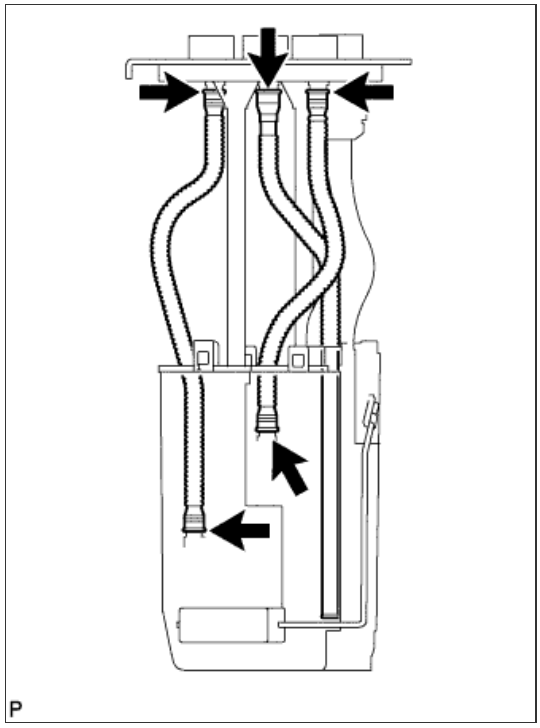
- **These tests must be performed thin 10 seconds to prevent the coil from burning out.**
- **eep the fuel pump as far a ay from the battery as possible.**
- **Al ays turn the voltage on and off on the battery side, not the fuel pump side.**
- **When the pump is locked and does not operate due to foreign matter being stuck, etc., replace the fuel pump ECU together th the fuel pump, as the fuel pump ECU may be damaged electrically.**



for Preparation Click here

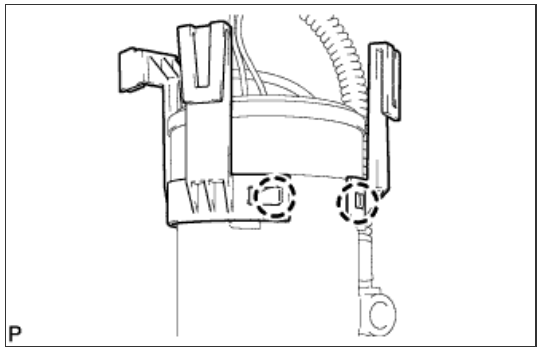
NOTICE:

Do not disconnect the hoses indicated in the illustration.



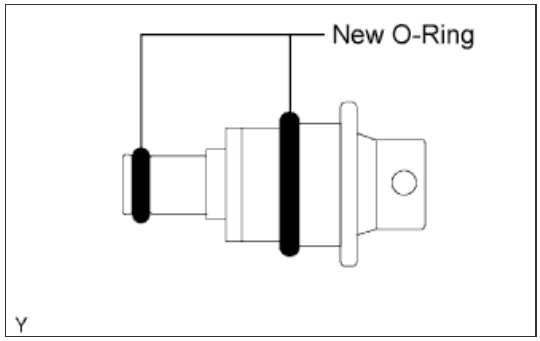
1. INSTALL NO. 1 FUEL SUCTION SUPPORT

a. Attach the 2 claws to the claw holes to install the fuel suction support.



2. INSTALL FUEL MAIN VALVE ASSEMBLY

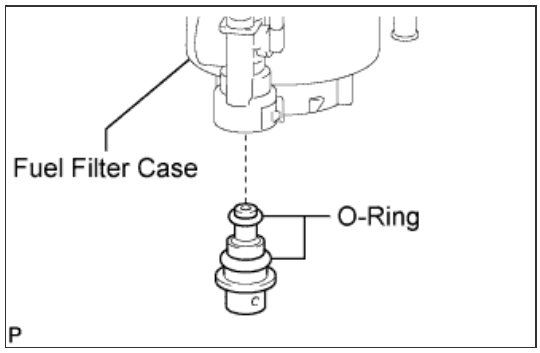
a. Apply a light coat of gasoline to 2 new O-rings, and install them onto the fuel main valve.



b. Install the fuel main valve to the fuel filter case.

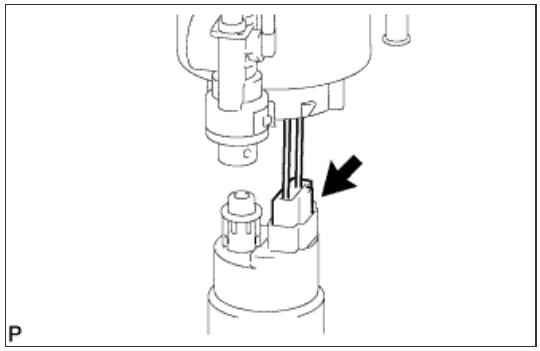
NOTICE:

Make sure the O-rings are not cut or pinched during the installation.

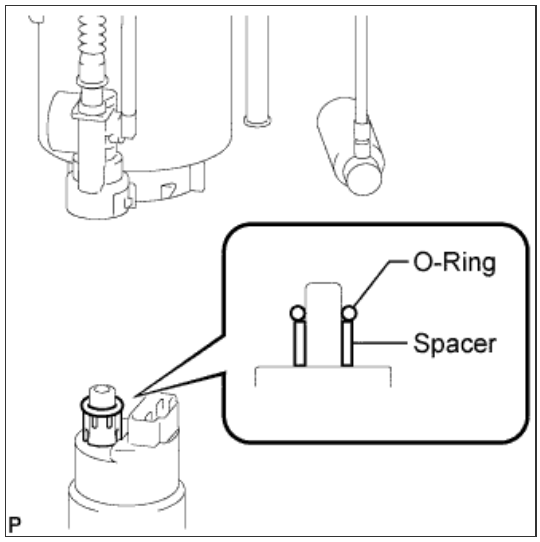


3. INSTALL FUEL PUMP

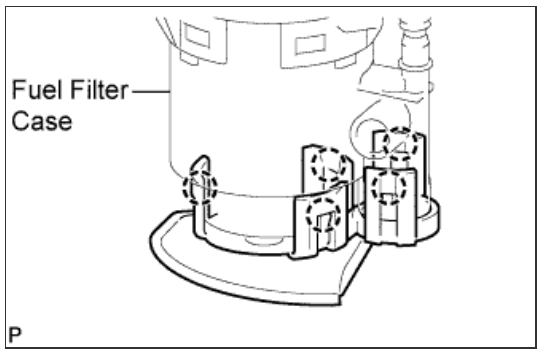
a. Connect the fuel pump wire harness connector to the fuel pump.



b. Apply a light coat of gasoline to a new O-ring. Then install the spacer and O-ring to the fuel pump.



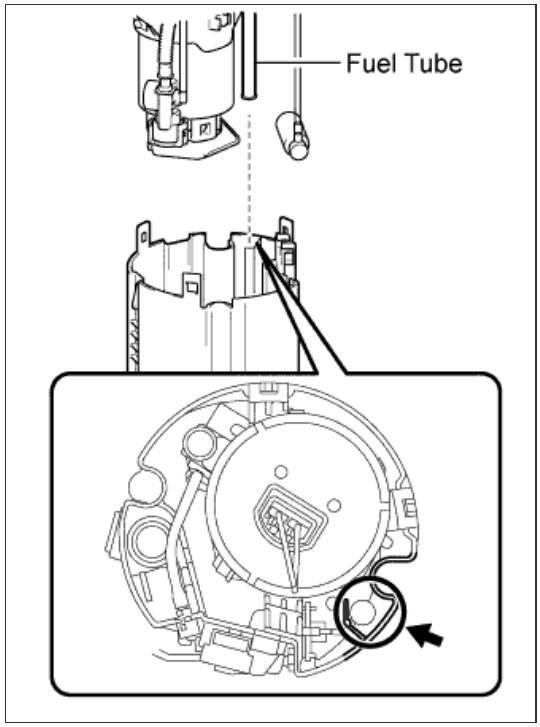
c. Attach the 5 claws to the claw holes and install the fuel pump to the fuel filter case.



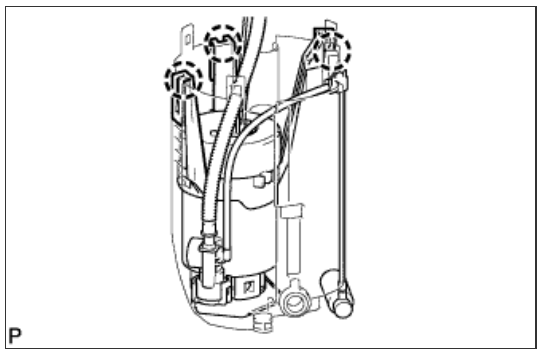
4. INSTALL NO. 1 FUEL SUB-TANK

NOTICE:

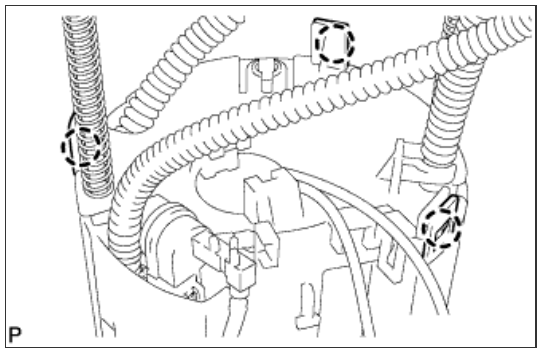
Make sure that the fuel tube passes into the section marked by the circle.



a. Attach the 3 claws to the claw holes and install the fuel sub-tank.



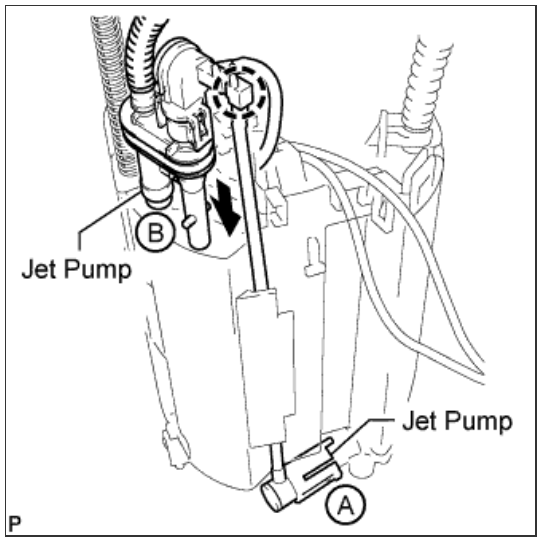
b. Attach the 3 claws to the claw holes.



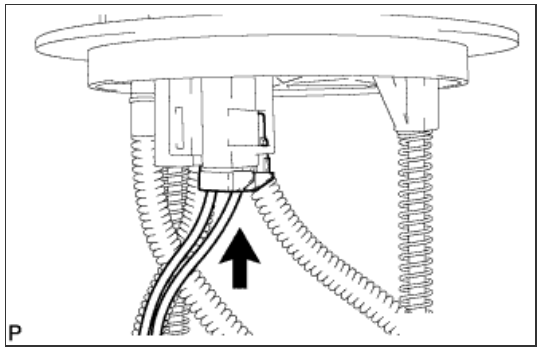
c. Connect the jet pump (labeled B) to the sub-tank.

i. Attach the claw on the end of the tube to the claw hole.

d. Connect the jet pump (labeled A) to the sub-tank.

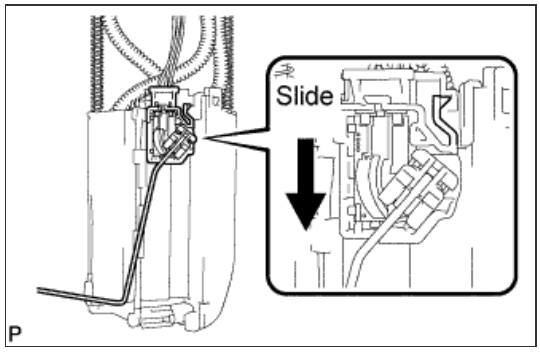


e. Connect the fuel pump connector.

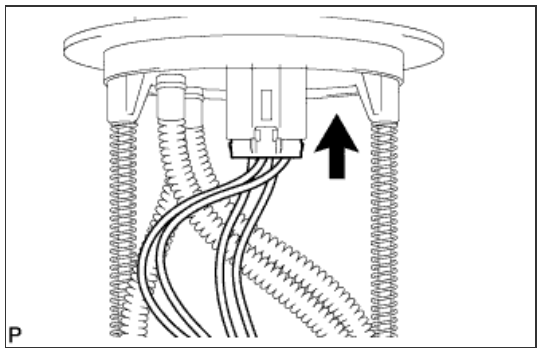


5. INSTALL FUEL SENDER GAUGE ASSEMBLY

a. Set the sender gauge to the fuel sub-tank. Then slide the sender gauge downward to install it.



b. Connect the fuel sender gauge connector.



for Preparation Click here

1. INSTALL FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

a. Apply a light coat of gasoline or grease to a new gasket, and install it to the fuel tank.

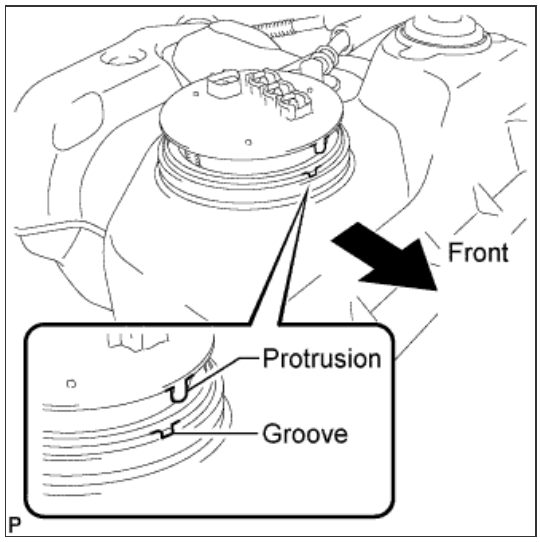
b. Install the fuel suction with pump and gauge tube into the fuel tank.

NOTICE:

Be careful not to bend the arm of the fuel sender gauge.

HINT:

Align the protrusion of the fuel suction with pump and gauge tube with the groove of the fuel tank.



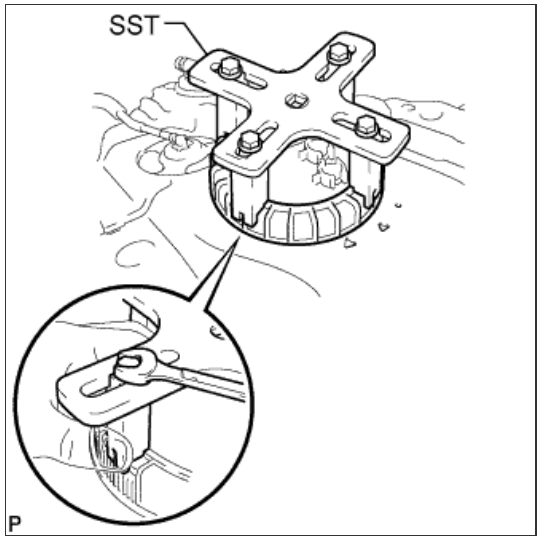
c. Put the retainer on the fuel tank. While holding the fuel suction with pump and gauge tube, tighten the retainer one complete turn by hand.

d. Set SST on the retainer.

SST
09808-14030

HINT:

- **Hold the fuel suction tube assembly upright by hand to ensure that the fuel suction tube gasket is not moved out of position.**
- **Securely attach the claws of SST to the protrusions of the retainer and fix SST in place.**
- **Install SST while pressing the claws of SST against the retainer (toward the center of SST).**

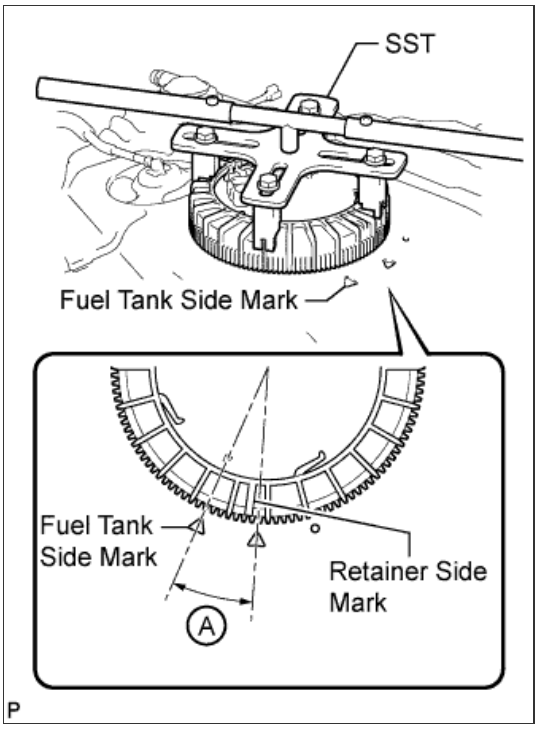


e. Using SST, tighten the retainer until the mark on the retainer is within range A on the fuel tank as shown in the illustration.

SST
09808-14030

HINT:

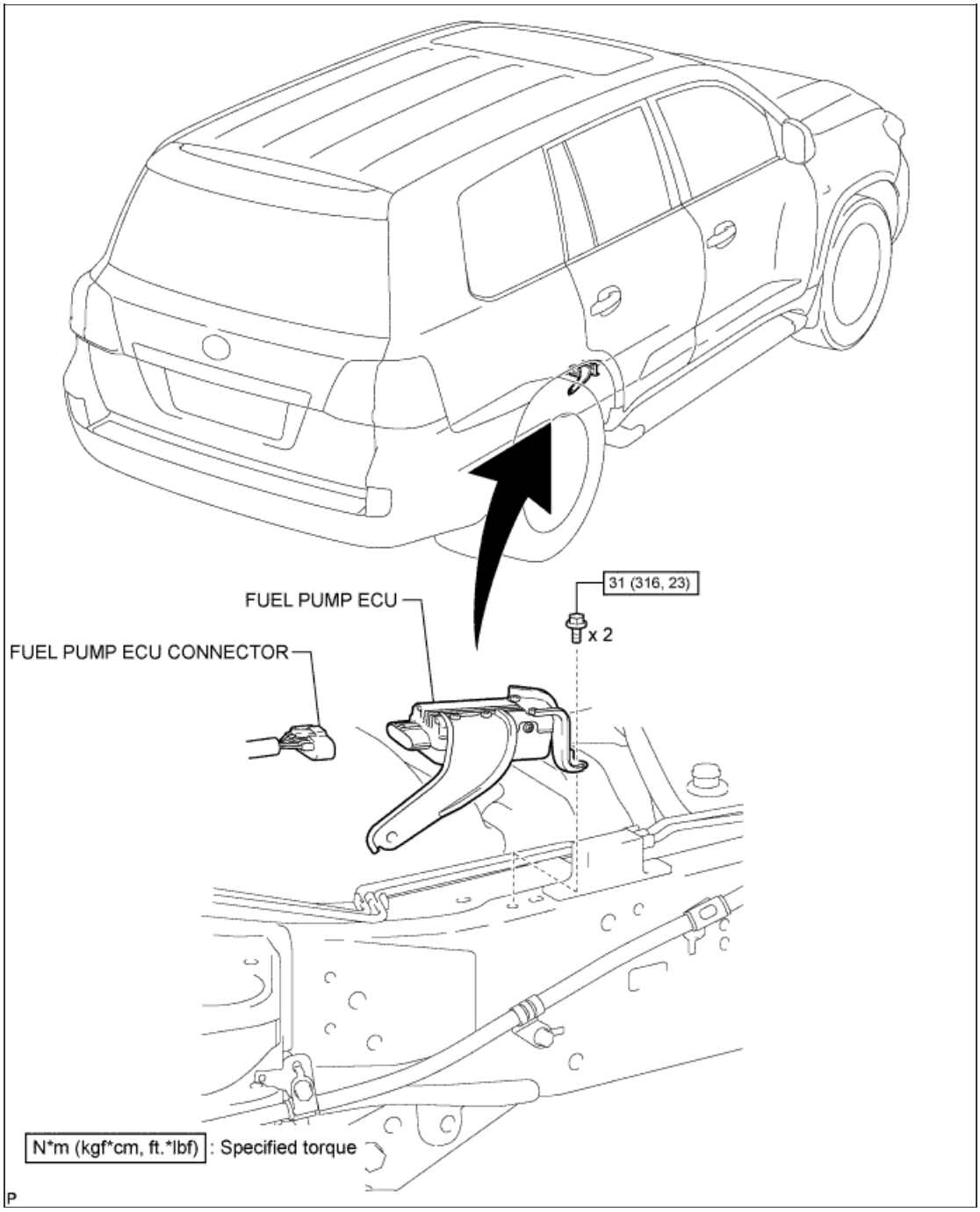
Fit the tips of SST onto the ribs of the retainer.



2. INSTALL FUEL TANK SUB-ASSEMBLY

a. Install the fuel tank sub-assembly (Click here).

for Preparation Click here



for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

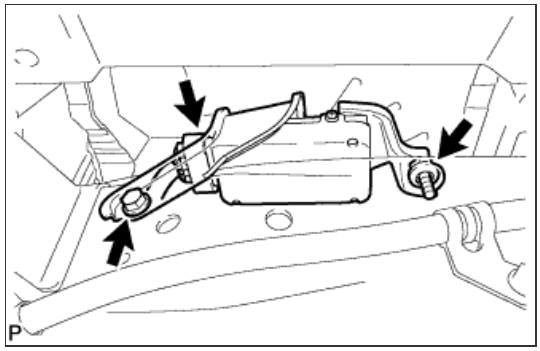
2. REMOVE FUEL PUMP ECU

a. Disconnect the fuel pump ECU connector.

b. Remove the 2 bolts and fuel pump ECU.

NOTICE:

Make sure the fuel pump ECU is not sub ected to physical shocks such as being dropped, etc.



for Preparation Click here

1. INSTALL FUEL PUMP ECU

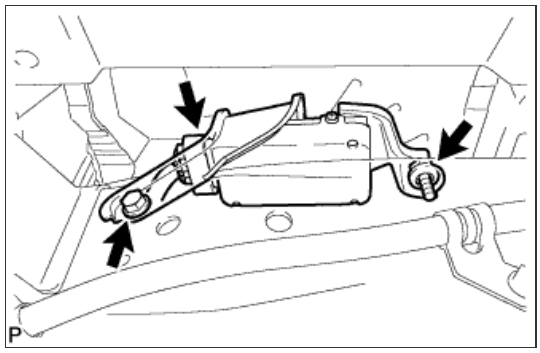
a. Install the fuel pump ECU with the 2 bolts.

Torque:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

NOTICE:

Do not use the fuel pump ECU if it has been subjected to physical shocks such as being dropped, etc.

b. Connect the fuel pump ECU connector.

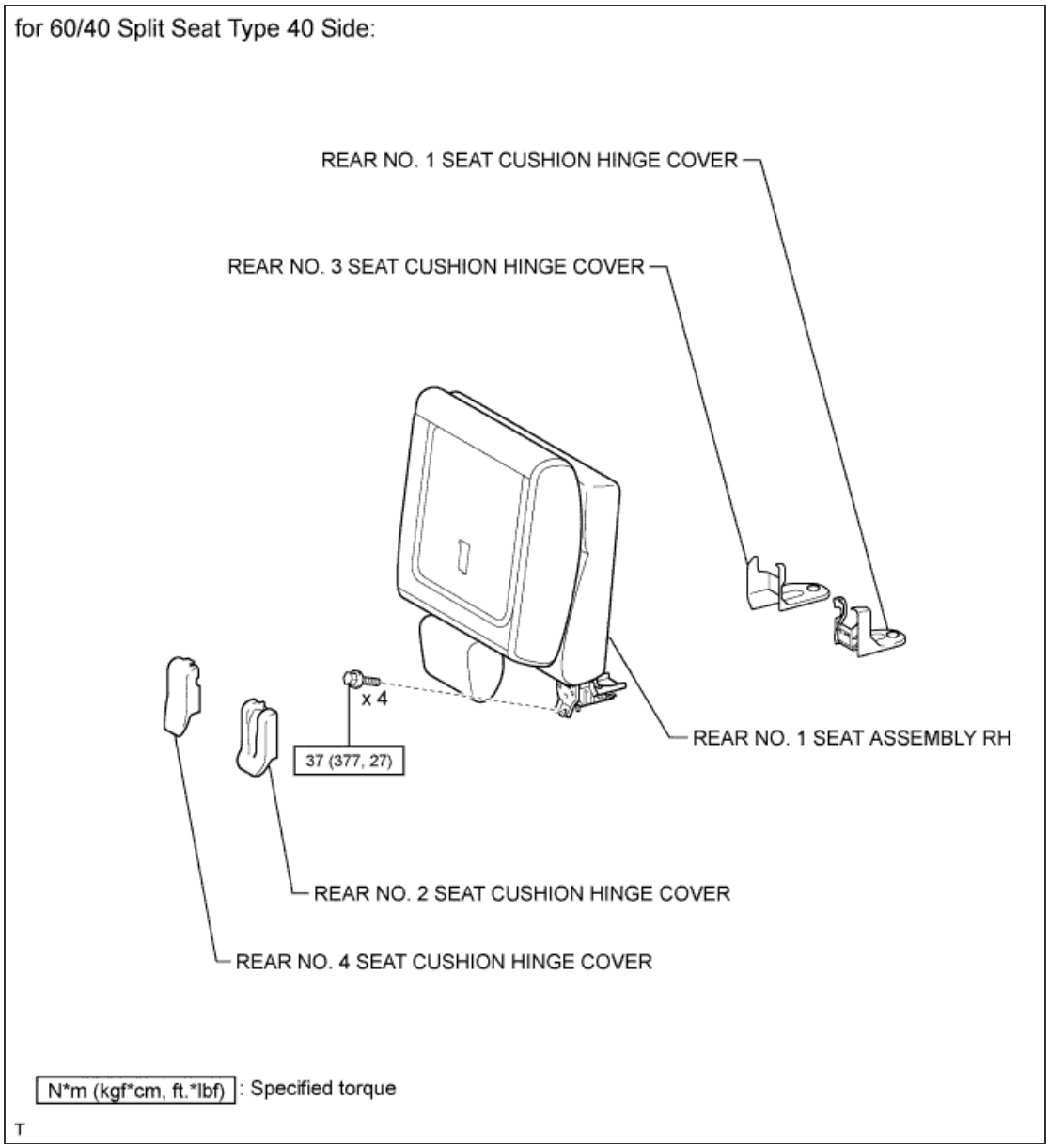


2. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

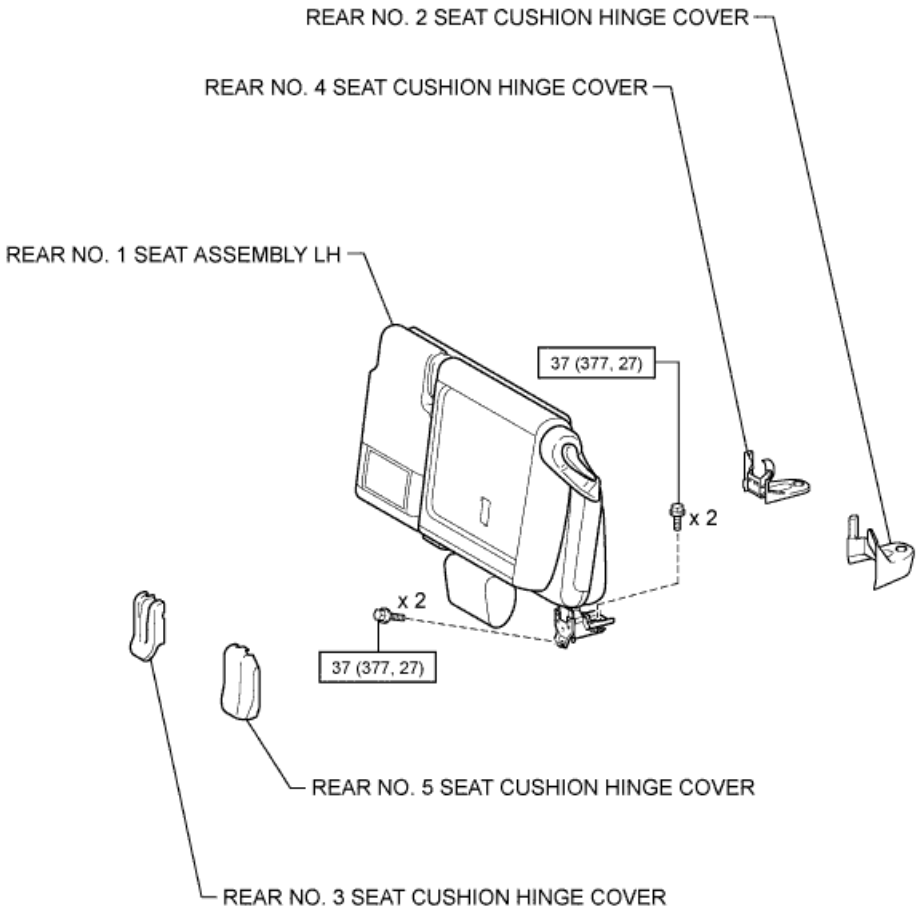
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

for Preparation [Click here]



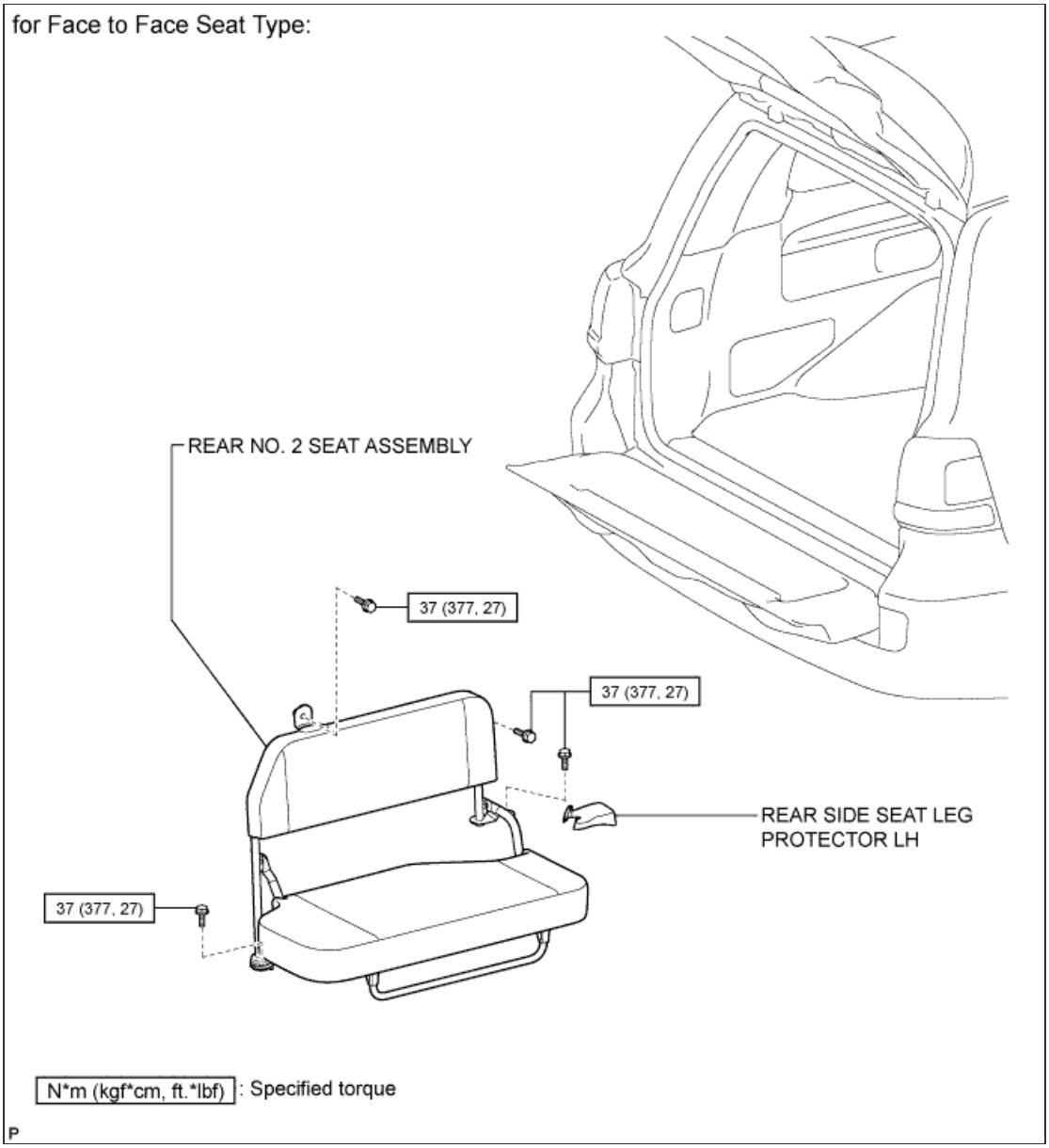
for 60/40 Split Seat Type 60 Side:



N*m (kgf*cm, ft.*lbf) : Specified torque

T

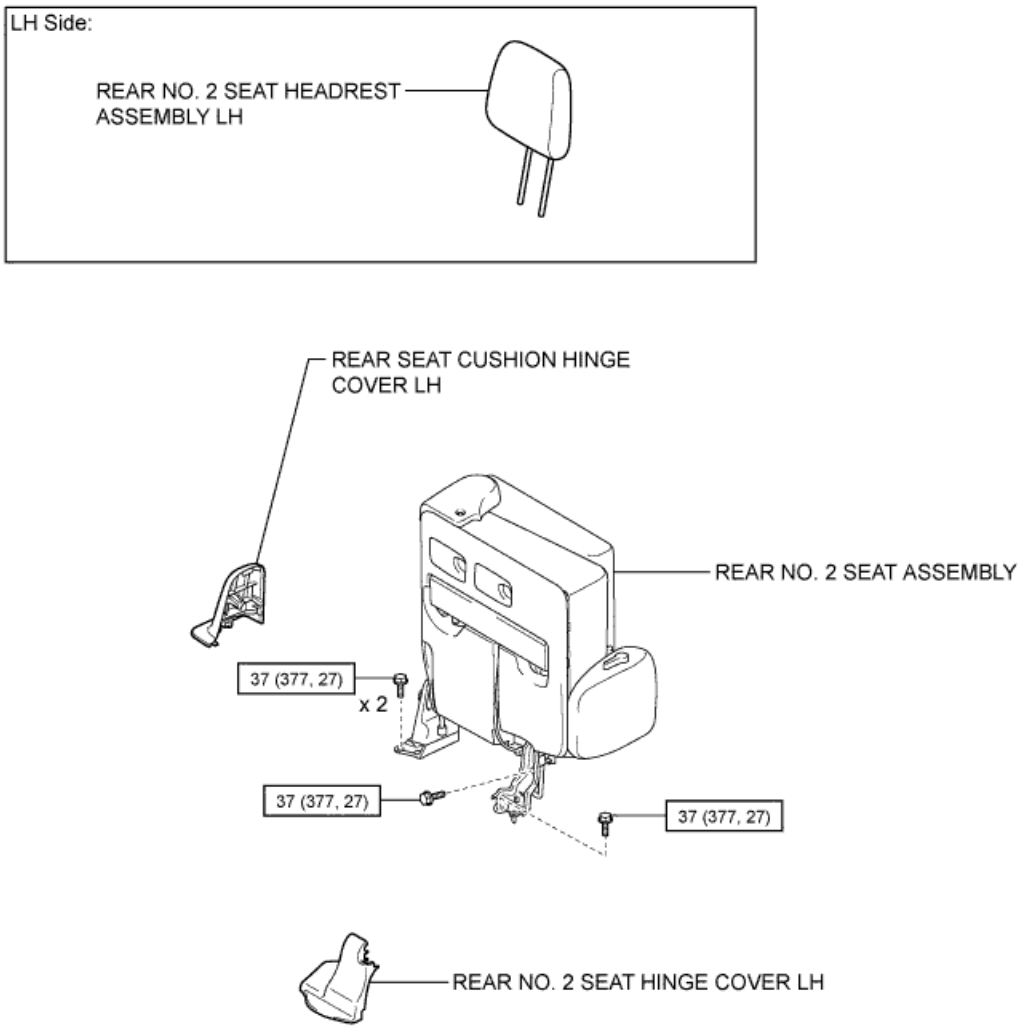
for Face to Face Seat Type:



N*m (kgf*cm, ft.*lbf) : Specified torque

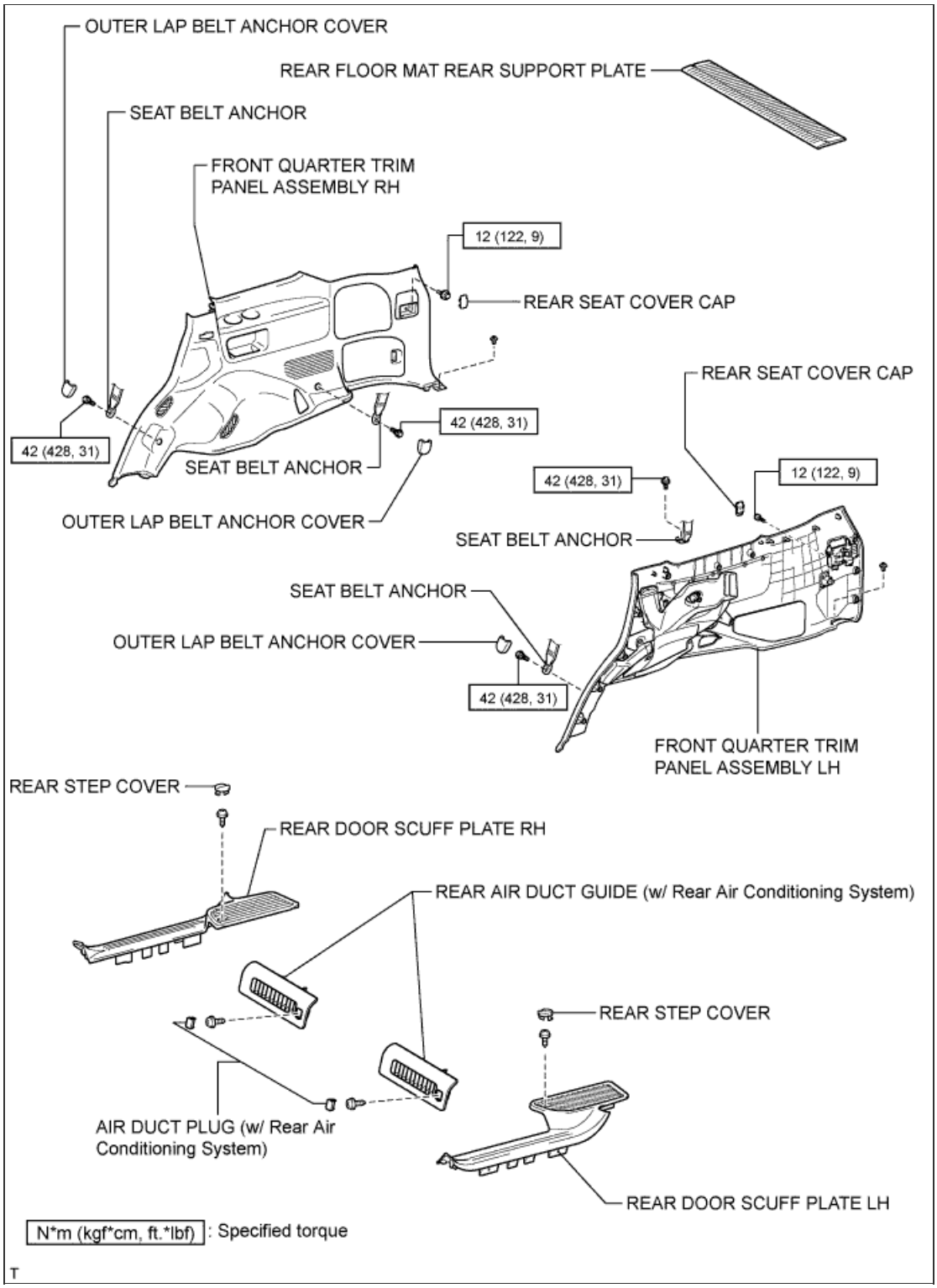
P

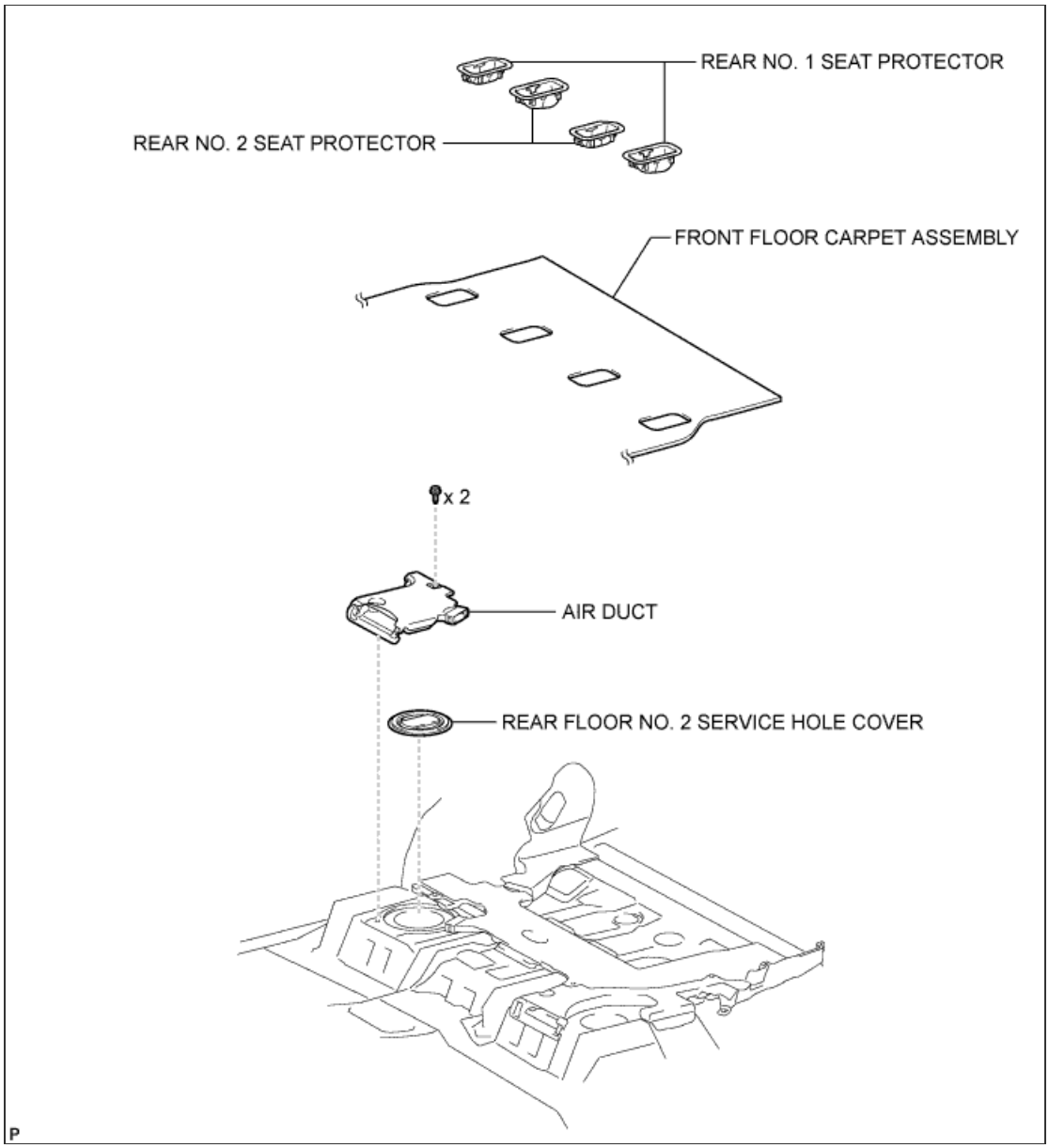
except Face to Face Seat Type:

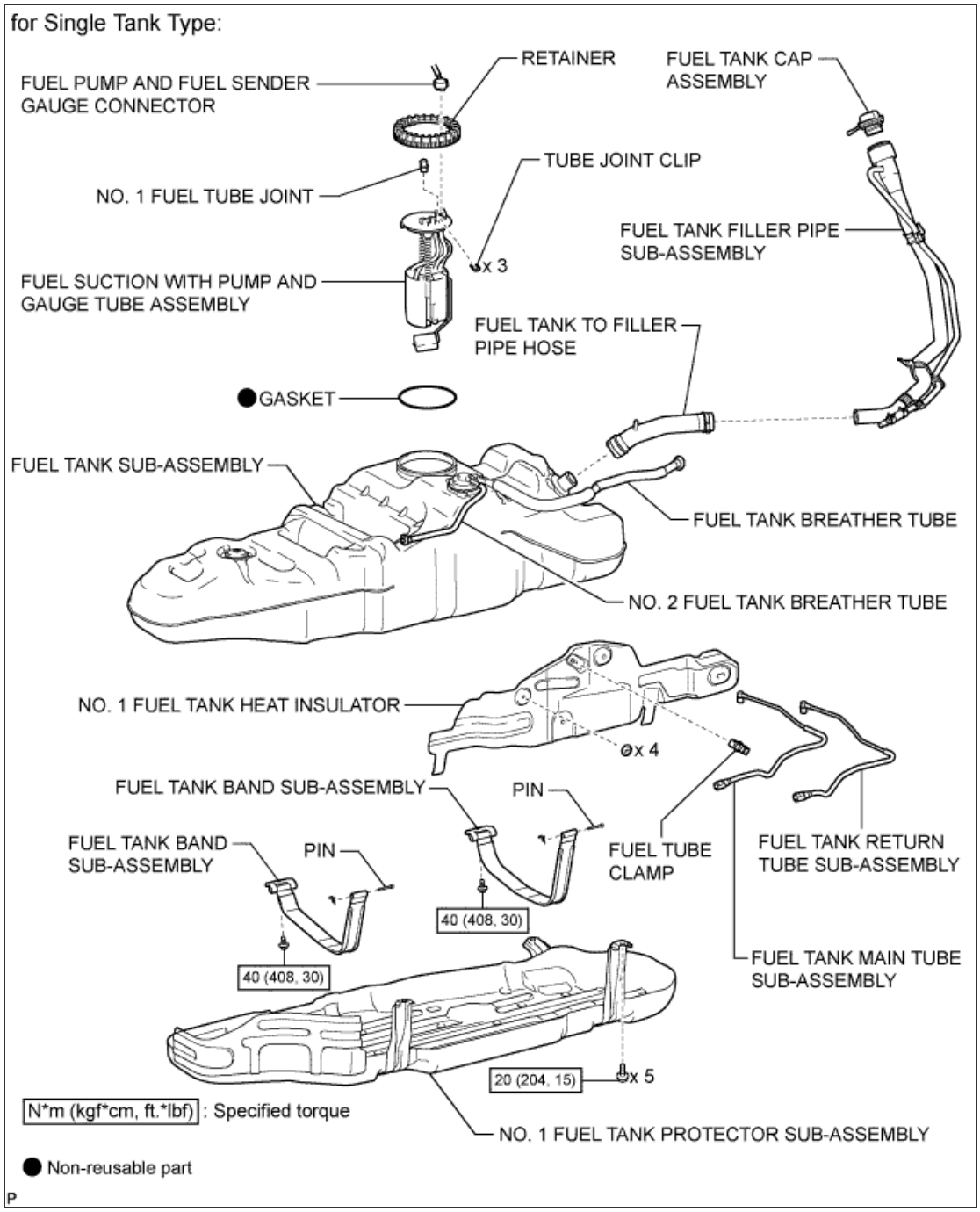


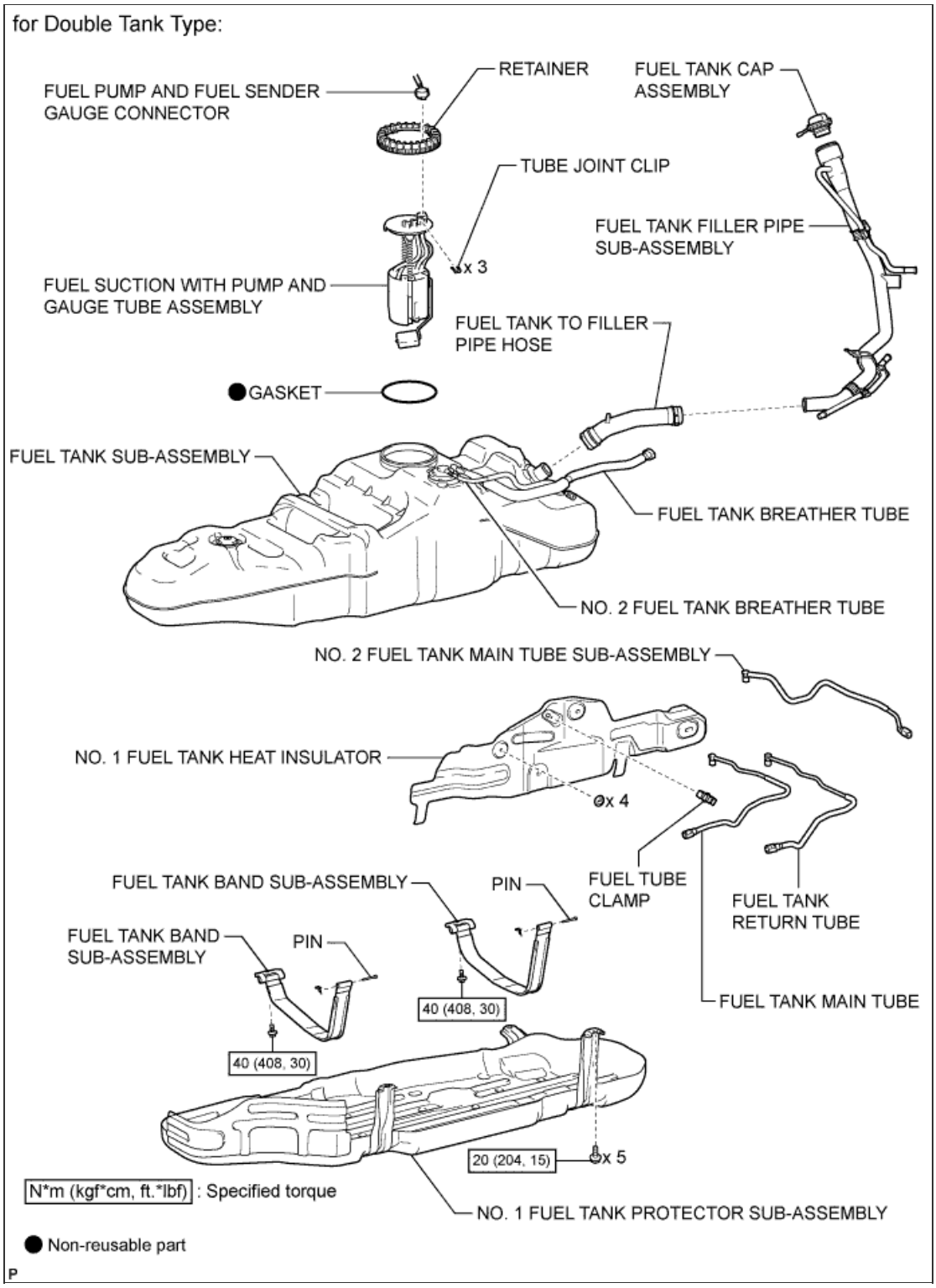
N*m (kgf*cm, ft.*lbf) : Specified torque

P


OUTER LAP BELT ANCHOR COVER
REAR FLOOR MAT REAR SUPPORT PLATE
SEAT BELT ANCHOR
FRONT QUARTER TRIM PANEL ASSEMBLY RH
12 (122, 9)
REAR SEAT COVER CAP
42 (428, 31)
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
REAR SEAT COVER CAP
12 (122, 9)
42 (428, 31)
SEAT BELT ANCHOR
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
42 (428, 31)
FRONT QUARTER TRIM PANEL ASSEMBLY LH
REAR STEP COVER
REAR DOOR SCUFF PLATE RH
REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)
REAR STEP COVER
AIR DUCT PLUG (w/ Rear Air Conditioning System)
REAR DOOR SCUFF PLATE LH
N*m (kgf*cm, ft.*lbf) : Specified torque
T


REAR NO. 1 SEAT PROTECTOR
REAR NO. 2 SEAT PROTECTOR
FRONT FLOOR CARPET ASSEMBLY
x 2
AIR DUCT
REAR FLOOR NO. 2 SERVICE HOLE COVER
P


for Single Tank Type:
FUEL PUMP AND FUEL SENDER GAUGE CONNECTOR
RETAINER
FUEL TANK CAP ASSEMBLY
TUBE JOINT CLIP
NO. 1 FUEL TUBE JOINT
x 3
FUEL TANK FILLER PIPE SUB-ASSEMBLY
FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY
FUEL TANK TO FILLER PIPE HOSE
GASKET
FUEL TANK SUB-ASSEMBLY
FUEL TANK BREATHER TUBE
NO. 2 FUEL TANK BREATHER TUBE
NO. 1 FUEL TANK HEAT INSULATOR
x 4
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TUBE CLAMP
FUEL TANK RETURN TUBE SUB-ASSEMBLY
40 (408, 30)
40 (408, 30)
FUEL TANK MAIN TUBE SUB-ASSEMBLY
20 (204, 15)
x 5
N*m (kgf*cm, ft.*lbf) : Specified torque
NO. 1 FUEL TANK PROTECTOR SUB-ASSEMBLY
Non-reusable part
P


for Double Tank Type:
FUEL PUMP AND FUEL SENDER GAUGE CONNECTOR
RETAINER
FUEL TANK CAP ASSEMBLY
TUBE JOINT CLIP
x 3
FUEL TANK FILLER PIPE SUB-ASSEMBLY
FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY
FUEL TANK TO FILLER PIPE HOSE
GASKET
FUEL TANK SUB-ASSEMBLY
FUEL TANK BREATHER TUBE
NO. 2 FUEL TANK BREATHER TUBE
NO. 2 FUEL TANK MAIN TUBE SUB-ASSEMBLY
NO. 1 FUEL TANK HEAT INSULATOR
x 4
FUEL TUBE CLAMP
FUEL TANK RETURN TUBE
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TANK MAIN TUBE
40 (408, 30)
40 (408, 30)
20 (204, 15)
x 5
N*m (kgf*cm, ft.*lbf) : Specified torque
NO. 1 FUEL TANK PROTECTOR SUB-ASSEMBLY
Non-reusable part
P

for Preparation Click here

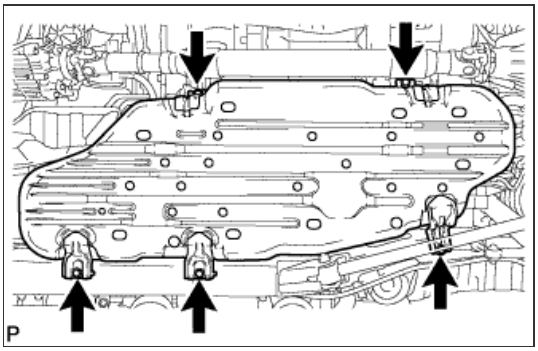
1. DISCHARGE FUEL SYSTEM PRESSURE

a. Discharge the fuel system pressure (Click here).

2. REMOVE FUEL TANK CAP ASSEMBLY

3. REMOVE NO. 1 FUEL TANK PROTECTOR SUB-ASSEMBLY

a. Remove the 5 bolts and fuel tank protector.



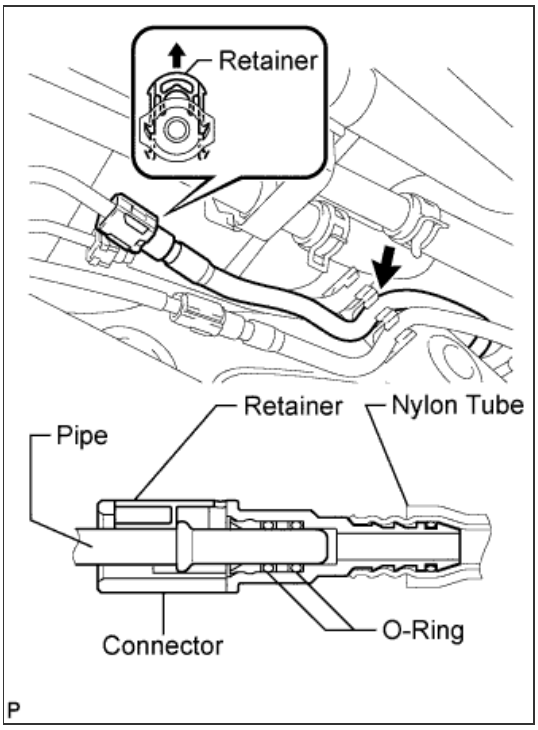
4. DISCONNECT FUEL TANK MAIN TUBE SUB-ASSEMBLY (for Single Tank Type)

a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel tank main tube.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



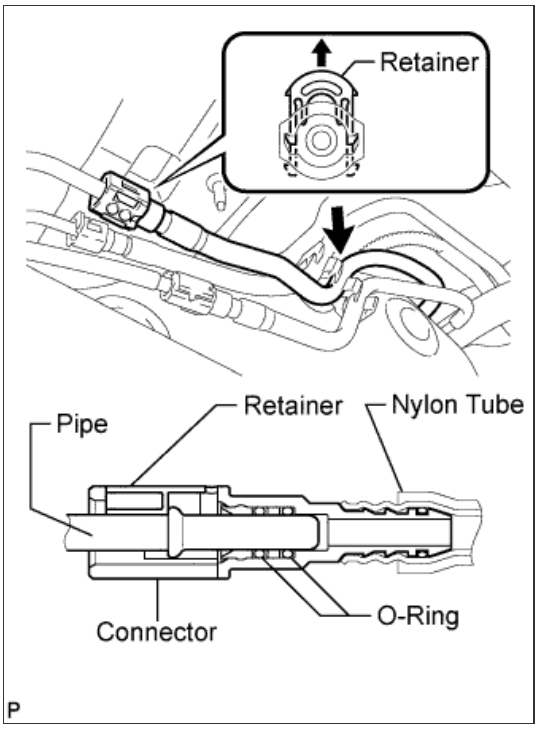
5. DISCONNECT FUEL TANK MAIN TUBE SUB-ASSEMBLY (for Double Tank Type)

a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel tank main tube.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



6. DRAIN FUEL

a. Connect the cable to the negative (-) battery terminal.

b. Connect the intelligent tester to the DLC3.

c. Turn the ignition switch to ON.

NOTICE:

Do not start the engine.

d. Turn the intelligent tester ON.

e. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Fuel Pump / Speed.

CAUTION:

- **Do not smoke or be near an open flame when working on the fuel system.**
- **Secure good ventilation.**
- **Keep gasoline away from rubber or leather parts.**

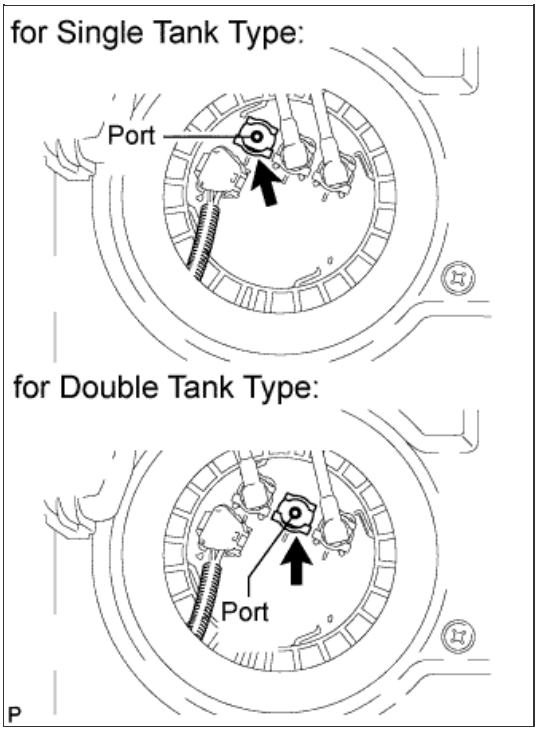
HINT:

for Single Tank Type:

If the fuel pump does not operate remove the fuel tube joint clip and No. 1 fuel tube joint and drain fuel from the port shown in the illustration.

for Double Tank Type:

If the fuel pump does not operate remove the fuel tube joint clip and disconnect the fuel tank return tube and drain fuel from the port shown in the illustration.



7. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable some systems need to be initialized after the cable is reconnected (Click here).

8. REMOVE REAR NO. 1 SEAT ASSEMBLY RH (for 60/40 Split Seat Type 40 Side)

a. Remove the rear No. 1 seat assembly RH (Click here).

9. REMOVE REAR NO. 1 SEAT ASSEMBLY LH (for 60/40 Split Seat Type 60 Side)

a. Remove the rear No. 1 seat assembly LH (Click here).

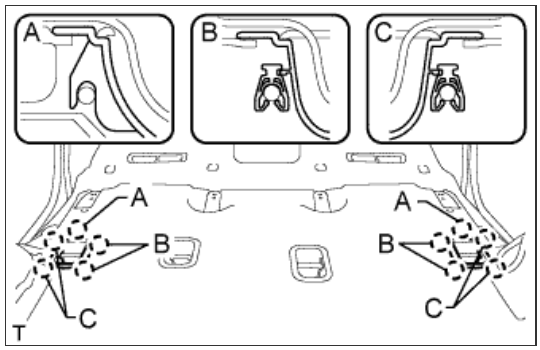
10. REMOVE REAR NO. 2 SEAT ASSEMBLY

a. for Face to Face Seat Type:
Remove the rear No. 2 seat assembly (Click here).

b. except Face to Face Seat Type:
Remove the rear No. 2 seat assembly (Click here).

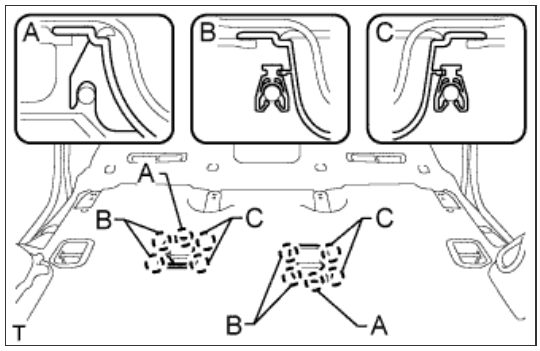
11. REMOVE REAR NO. 1 SEAT PROTECTOR

a. Detach the 10 claws and remove the 2 seat protectors.



12. REMOVE REAR NO. 2 SEAT PROTECTOR

a. Detach the 10 claws and remove the 2 seat protectors.

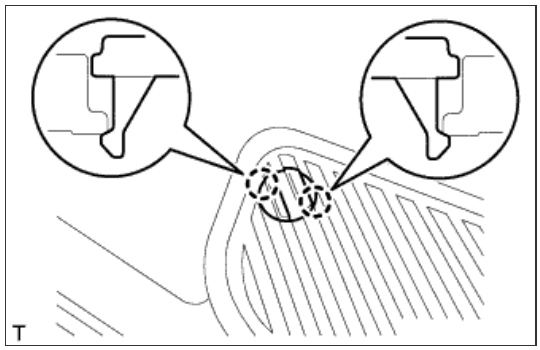


13. REMOVE REAR STEP COVER

HINT:

Use the same procedure to remove the step cover on the other side.

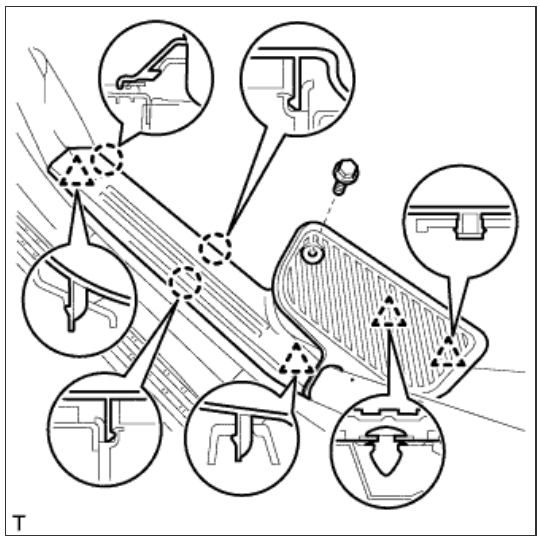
a. Detach the 2 claws and remove the step cover.



14. REMOVE REAR DOOR SCUFF PLATE LH

a. Remove the screw.

b. Detach the 3 claws and 4 clips and remove the scuff plate.



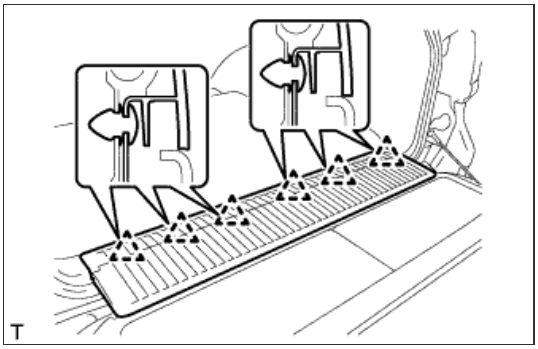
15. REMOVE REAR DOOR SCUFF PLATE RH

HINT:

Use the same procedures described for the LH side.

16. REMOVE REAR FLOOR MAT REAR SUPPORT PLATE

a. Detach the 6 clips and remove the support plate.



17. REMOVE REAR SEAT COVER CAP (w/ Rear No. 2 Seat, except Face to Face Seat Type)

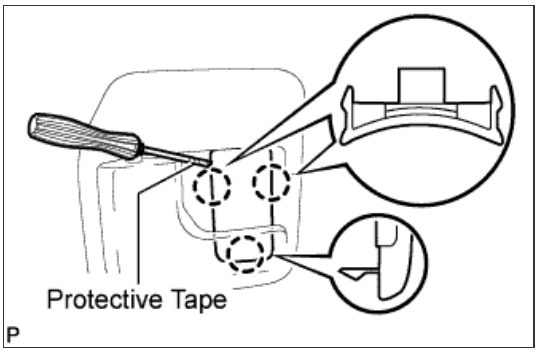
HINT:

Use the same procedure to remove the rear seat cover cap on the other side.

a. Using a screwdriver detach the 3 claws and remove the rear seat cover cap.

HINT:

Tape the screwdriver tip before use.



18. REMOVE FRONT QUARTER TRIM PANEL ASSEMBLY LH

a. w/ Sliding Roof:
Remove the front quarter trim panel assembly LH (Click here).

b. w/o Sliding Roof:
Remove the front quarter trim panel assembly LH (Click here).

19. REMOVE FRONT QUARTER TRIM PANEL ASSEMBLY RH

a. w/ Sliding Roof:
Remove the front quarter trim panel assembly RH (Click here).

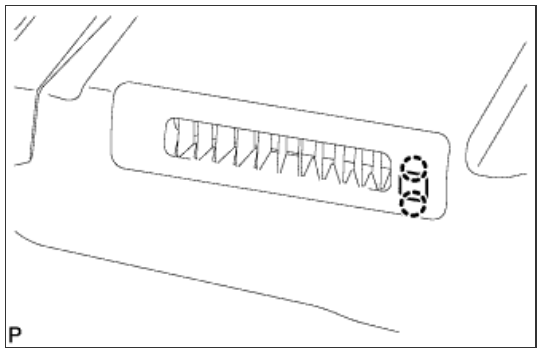
b. w/o Sliding Roof:
Remove the front quarter trim panel assembly RH (Click here).

20. REMOVE AIR DUCT PLUG (w/ Rear Air Conditioning System)

a. Detach the 2 claws and remove the plug.

HINT:

Use the same procedures for both sides.



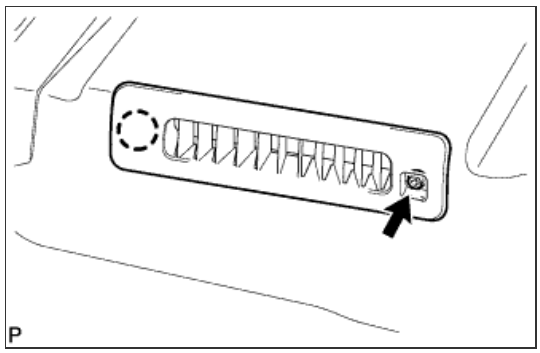
21. REMOVE REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)

a. Remove the screw.

b. Detach the claw and remove the guide.

HINT:

Use the same procedures for both sides.



22. REMOVE FRONT FLOOR CARPET ASSEMBLY

a. Turn over the floor carpet.
w/ Rear Air Conditioning System:

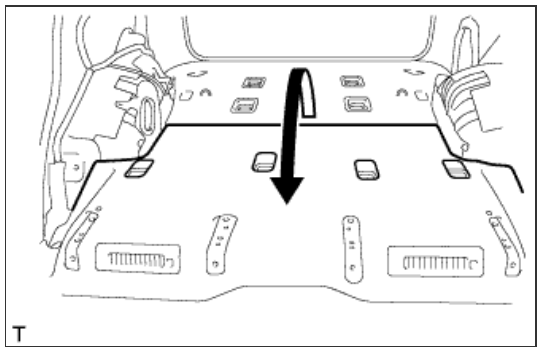
HINT:

Fold back the floor carpet so that the air duct can be removed.

w/o Rear Air Conditioning System:

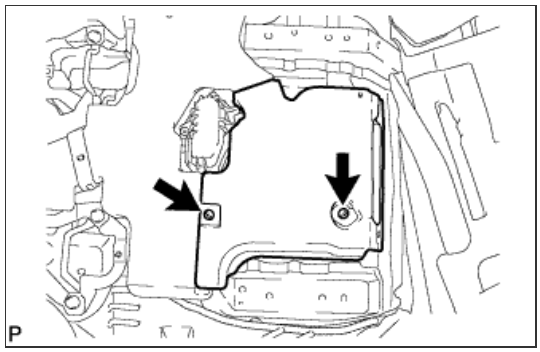
HINT:

Fold back the floor carpet so that the service hole cover can be removed.

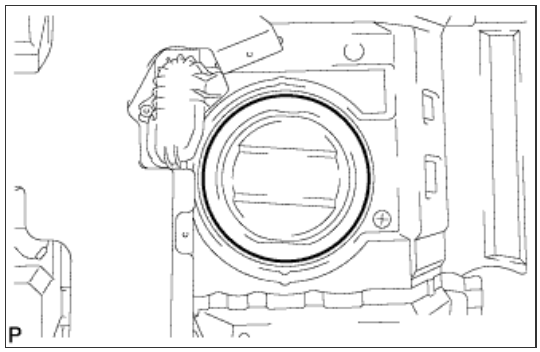


23. REMOVE REAR FLOOR NO. 2 SERVICE HOLE COVER

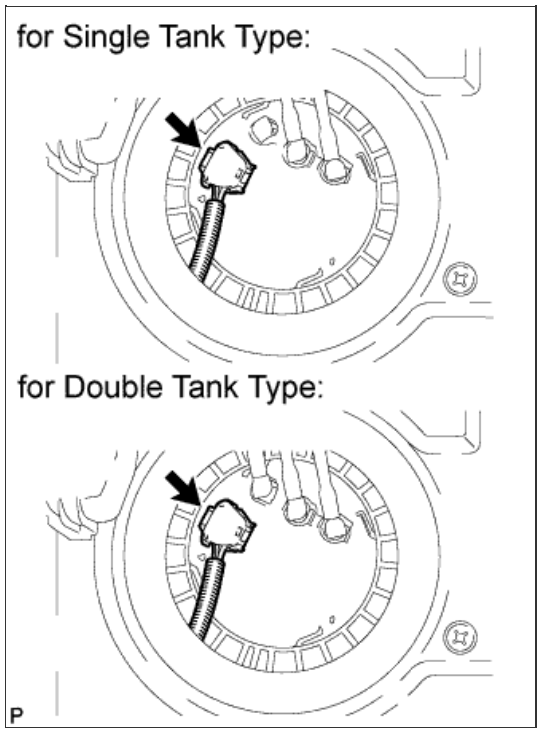
a. w/ Rear Air Conditioning System:
Remove the 2 screws and air duct.



b. Remove the service hole cover.



c. Disconnect the fuel pump and sender gauge connector.



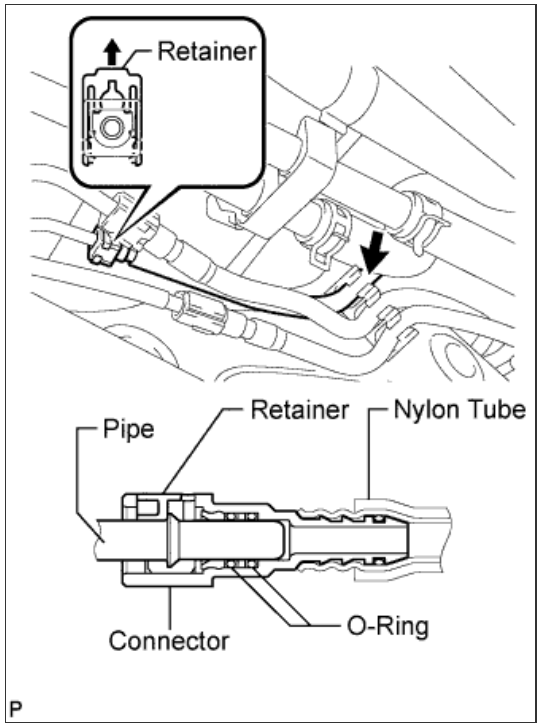
24. DISCONNECT NO. 2 FUEL TANK BREATHER TUBE (for Single Tank Type)

a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel tank breather tube.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



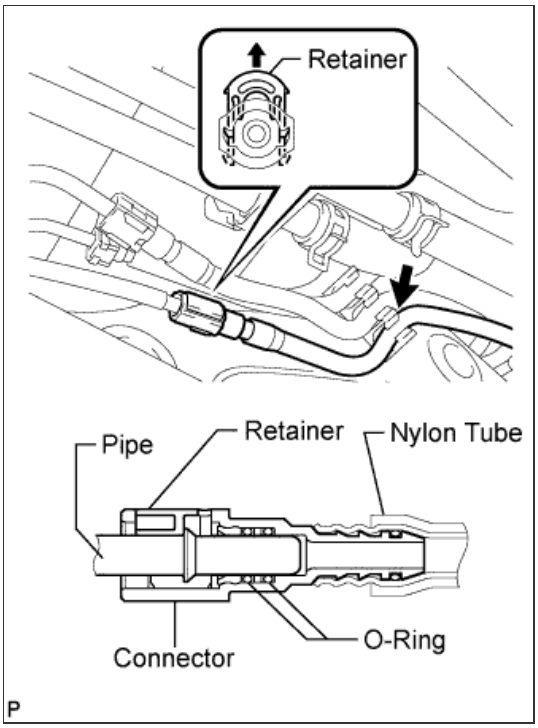
25. DISCONNECT FUEL TANK RETURN TUBE (for Single Tank Type)

a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel tank return tube.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



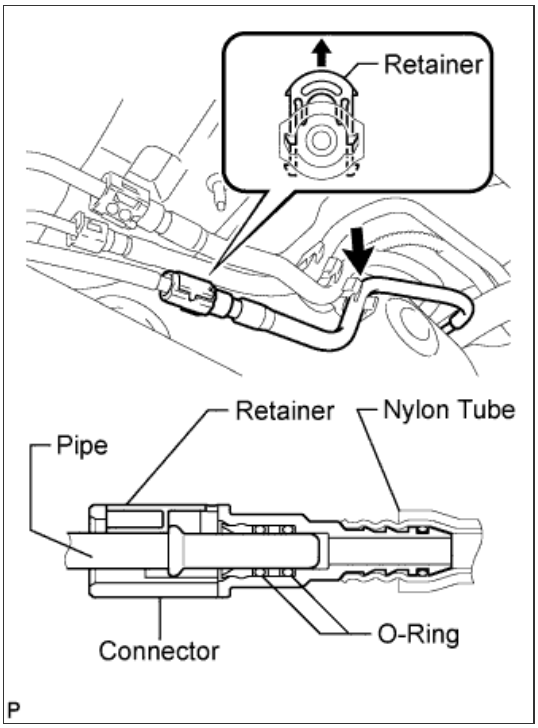
26. DISCONNECT FUEL TANK RETURN TUBE (for Double Tank Type)

a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel tank return tube.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



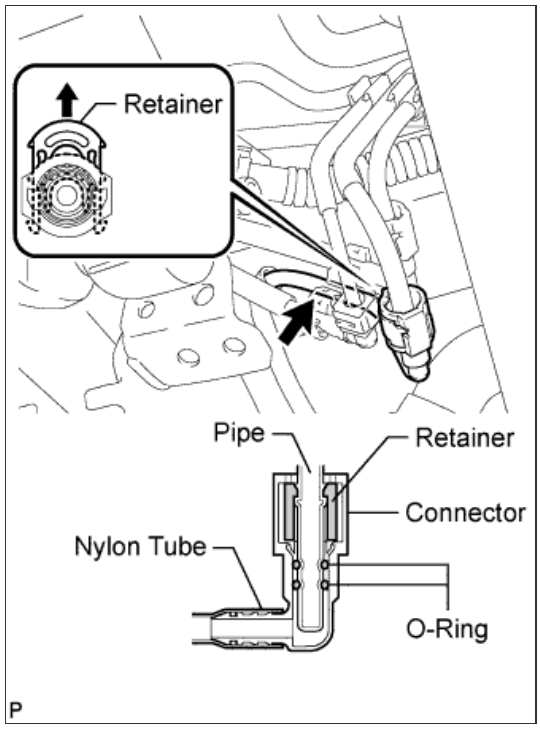
27. DISCONNECT NO. 2 FUEL MAIN TUBE SUB-ASSEMBLY (for Double Tank Type)

a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel tank main tube.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



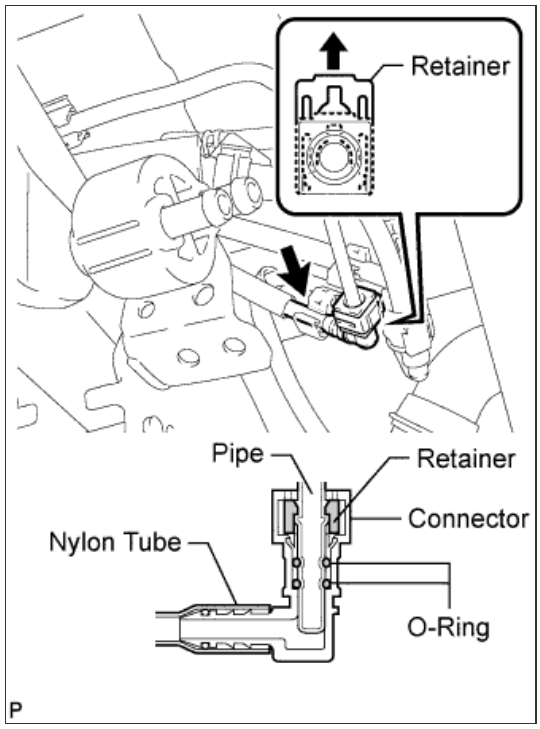
28. DISCONNECT NO. 2 FUEL TANK BREATHER TUBE (for Double Tank Type)

a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel tank breather tube.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



29. DISCONNECT FUEL TANK BREATHER TUBE (for Single Tank Type)

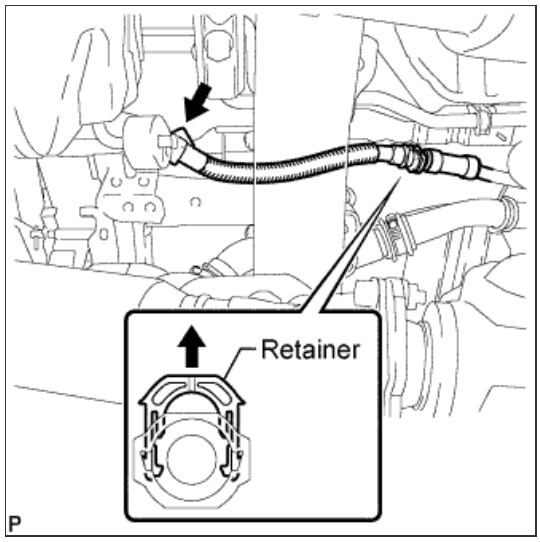
a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel tank breather tube from the filler pipe.

NOTICE:

- **Do not use any tools in this procedure.**
- **Check for any dirt and foreign matter contamination in the pipe and around the connector. Clean if necessary. Foreign matter**

may damage the O-rings or cause leaks in the seal between the pipe and connector.



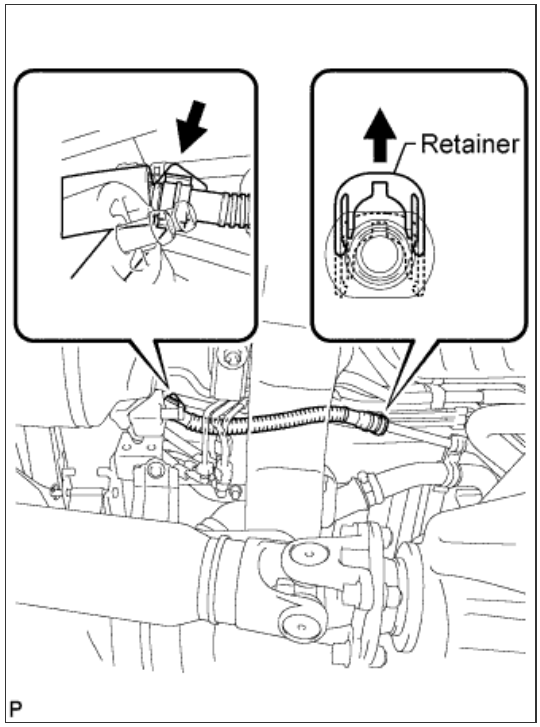
30. DISCONNECT FUEL TANK BREATHER TUBE (for Double Tank Type)

a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel tank breather tube from the filler pipe.

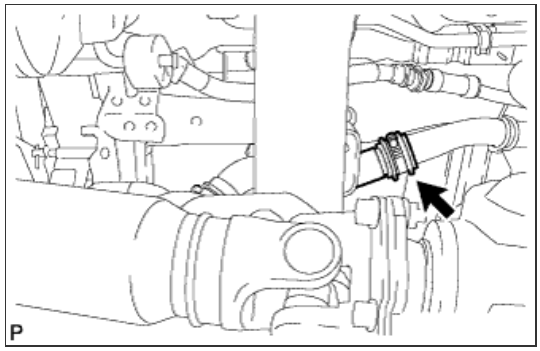
NOTICE:

- Do not use any tools in this procedure.
- Check for any dirt and foreign matter contamination in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-rings or cause leaks in the seal between the pipe and connector.



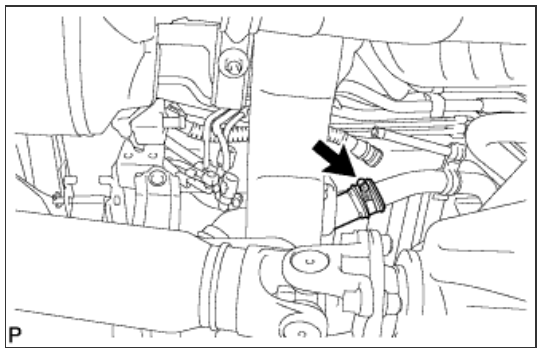
31. DISCONNECT FUEL TANK TO FILLER PIPE HOSE (for Single Tank Type)

a. Disconnect the hose from the filler pipe.



32. DISCONNECT FUEL TANK TO FILLER PIPE HOSE (for Double Tank Type)

a. Disconnect the hose from the filler pipe.

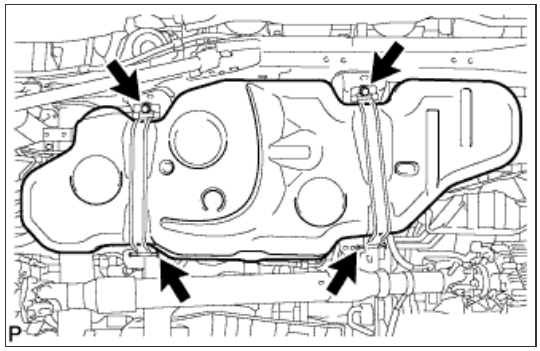


33. REMOVE FUEL TANK SUB-ASSEMBLY

a. Place a transmission jack under the fuel tank.

b. Remove the 2 bolts 2 clips 2 pins and 2 fuel tank bands.

c. Slowly lower the transmission jack slightly.

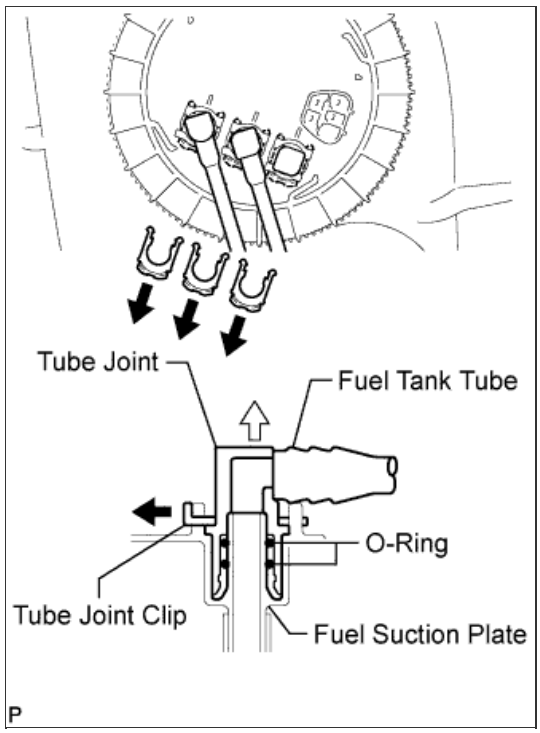


34. REMOVE FUEL TANK MAIN TUBE SUB-ASSEMBLY AND FUEL TANK RETURN TUBE SUB-ASSEMBLY (for Single Tank Type)

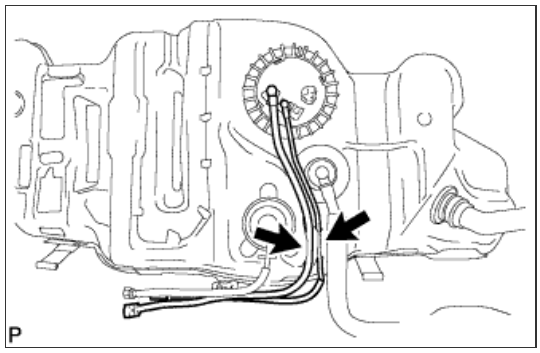
a. Remove the 3 fuel tube joint clips and pull out the 2 fuel tubes and No. 1 fuel tube joint.

NOTICE:

- **Remove any dirt and foreign matter on the fuel tube oint before performing this work.**
- **Do not allow any scratches or foreign matter on the parts when disconnecting them, as the fuel tube oint contains the O-rings that seal the plug.**
- **Perform this work by hand. Do not use any tools.**
- **Do not forcibly bend, twist or turn the nylon tube.**
- **Protect the disconnected part by covering it with a plastic bag and tape after disconnecting the fuel tubes.**



b. Remove the 2 fuel tubes from the fuel tank.

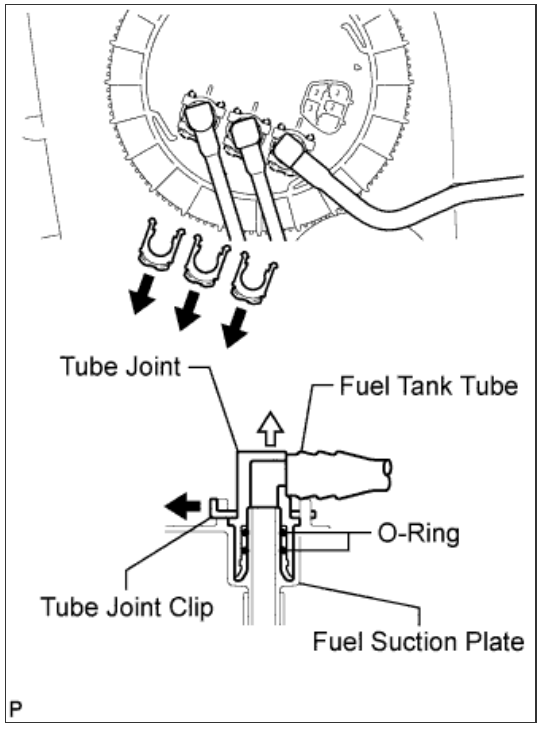


35. REMOVE FUEL TANK MAIN TUBE, FUEL TANK RETURN TUBE AND NO. 2 FUEL TANK MAIN TUBE SUB-ASSEMBLY (for Double Tank Type)

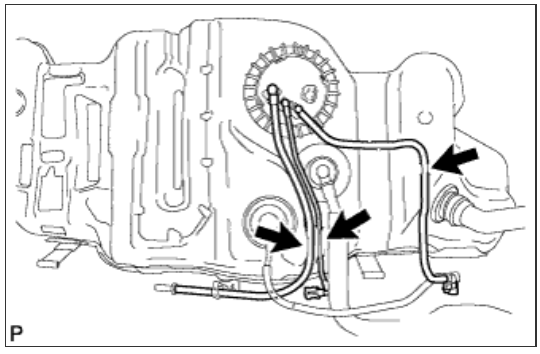
a. Remove the 3 fuel tube joint clips and pull out the 3 fuel tubes.

NOTICE:

- **Remove any dirt and foreign matter on the fuel tube oint before performing this work.**
- **Do not allow any scratches or foreign matter on the parts when disconnecting them, as the fuel tube oint contains the O-rings that seal the plug.**
- **Perform this work by hand. Do not use any tools.**
- **Do not forcibly bend, twist or turn the nylon tube.**
- **Protect the disconnected part by covering it with a plastic bag and tape after disconnecting the fuel tubes.**



b. Remove the 3 fuel tubes from the fuel tank.



36. REMOVE FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

a. Set SST on the retainer.

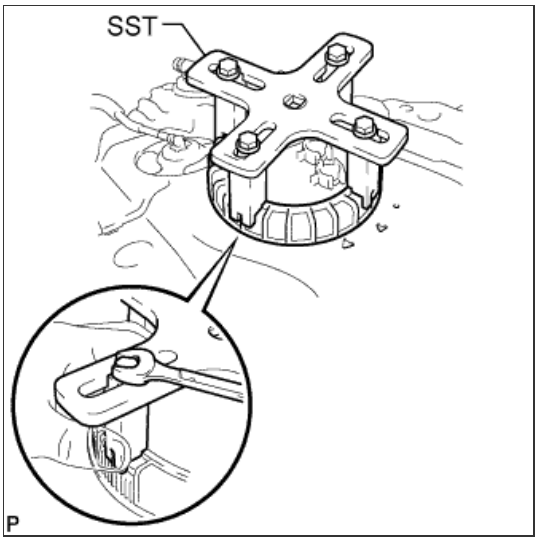
SST
09808-14030

HINT:

- **Securely attach the claws of SST to the protrusion of the**

retainer and fix SST in place.

- Install SST while pressing the claws of SST against the retainer (towards the center of SST).



b. Using SST loosen the retainer.

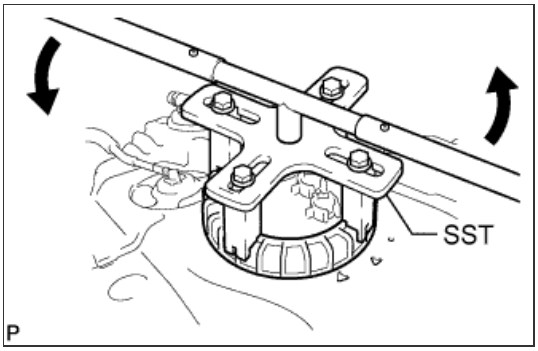
SST
09808-14030

NOTICE:

- Do not use any tools other than those specified in this operation. Damage to the retainer or the fuel tank may result.
- While pressing down on SST so that the claws of SST do not slip off the protrusion of the retainer, turn the retainer counterclockwise to loosen it.

HINT:

The protrusion of the retainer fit in the ends of SST.



Text in Illustration

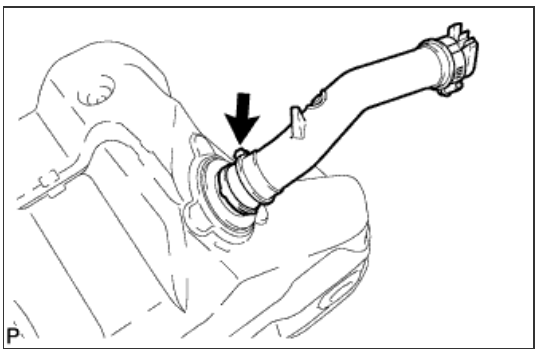
➡	Turn

c. Remove the retainer while holding the fuel suction tube assembly by hand.

d. Remove the gasket from the fuel tank.

37. REMOVE FUEL TANK TO FILLER PIPE HOSE

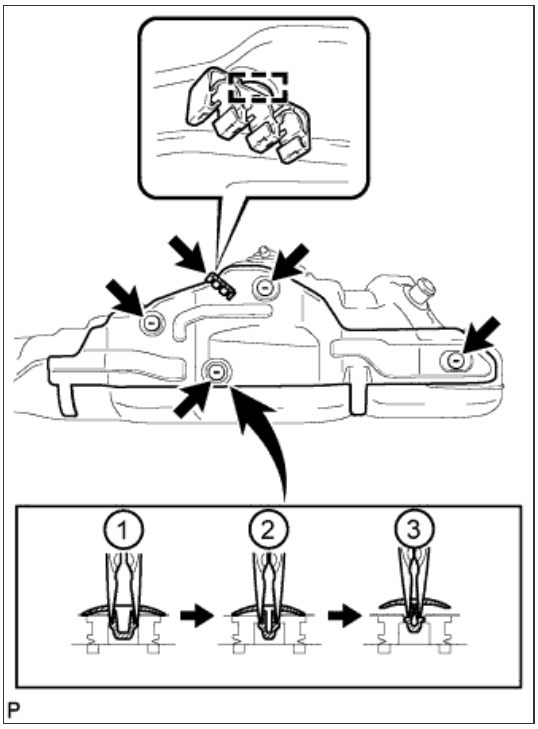
a. Remove the hose from the fuel tank.



38. REMOVE NO. 1 FUEL TANK HEAT INSULATOR

a. Remove the fuel tube clamp from the heat insulator.

b. Using needle-nose pliers remove the 4 clips shown in the illustration and then remove the heat insulator.

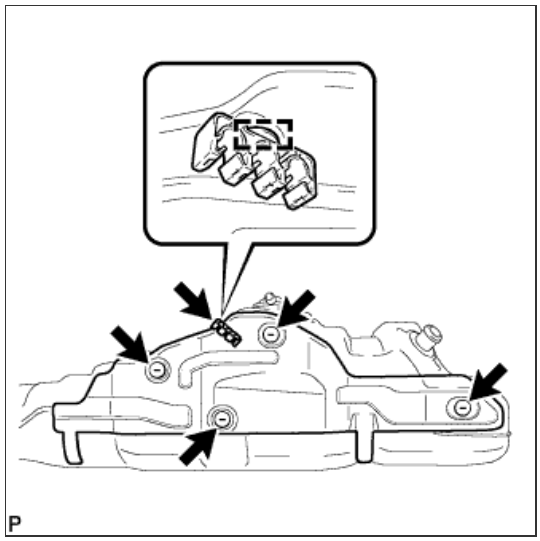


for Preparation Click here

1. INSTALL NO. 1 FUEL TANK HEAT INSULATOR

a. Install the heat insulator with the 4 clips.

b. Install the fuel tube clamp to the heat insulator.

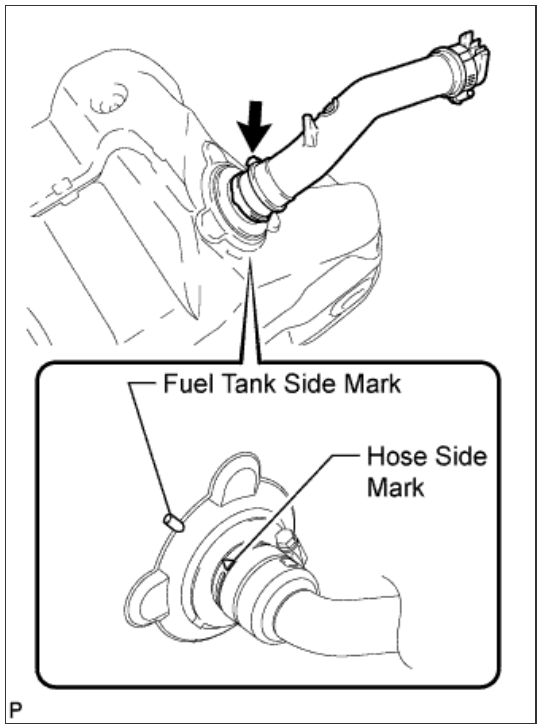


2. INSTALL FUEL TANK TO FILLER PIPE HOSE

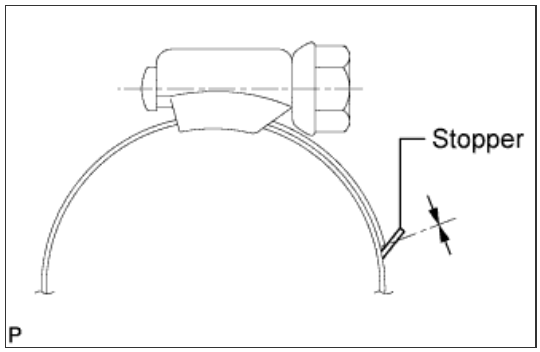
a. Install the hose to the fuel tank as shown in the illustration.

HINT:

- **Align the fuel tank side mark with the hose side mark when installing the hose.**



- **Tighten the hose clamp until the end of the hose clamp contacts the stopper as shown in the illustration.**



3. INSTALL FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

a. Apply a light coat of gasoline or grease to a new gasket, and install it to the fuel tank.

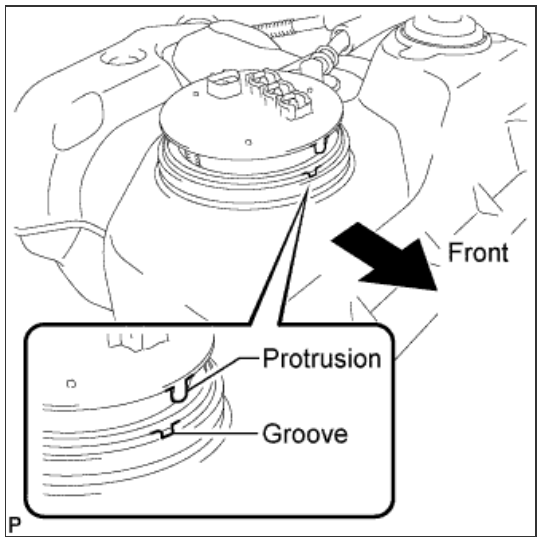
b. Install the fuel suction with pump and gauge tube into the fuel tank.

NOTICE:

Be careful not to bend the arm of the fuel sender gauge.

HINT:

Align the protrusion of the fuel suction with pump and gauge tube with the groove of the fuel tank.



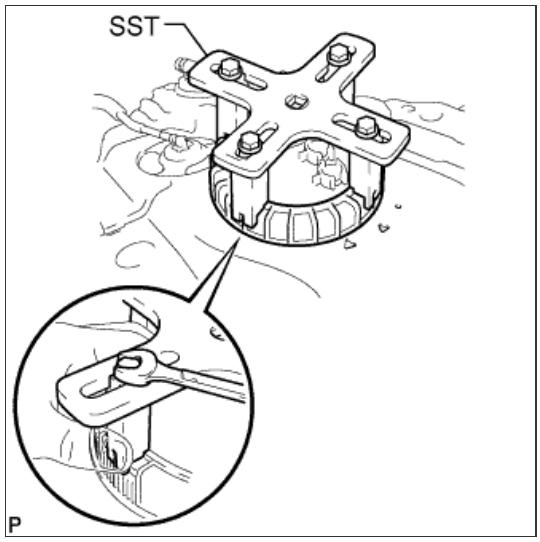
c. Put the retainer on the fuel tank. While holding the fuel suction with pump and gauge tube, tighten the retainer one complete turn by hand.

d. Set SST on the retainer.

SST
09808-14030

HINT:

- **Hold the fuel suction tube assembly upright by hand to ensure that the fuel suction tube gasket is not moved out of position.**
- **Securely attach the claws of SST to the protrusions of the retainer and fix SST in place.**
- **Install SST while pressing the claws of SST against the retainer (toward the center of SST).**

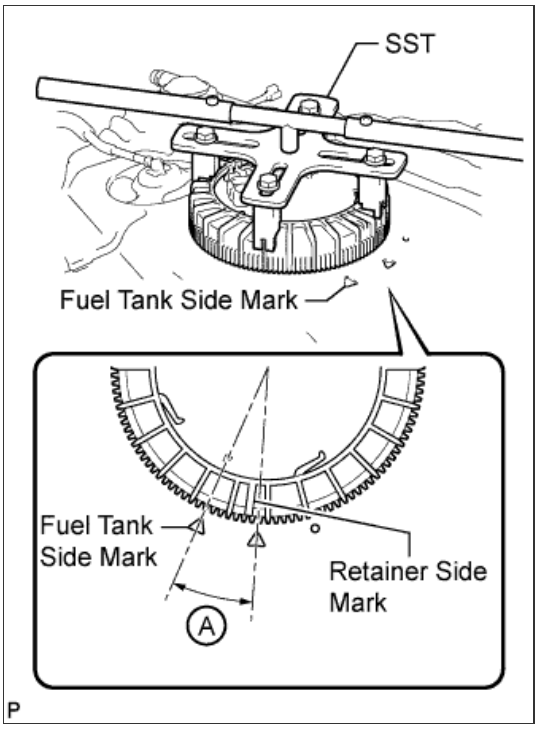


e. Using SST, tighten the retainer until the mark on the retainer is within range A on the fuel tank as shown in the illustration.

SST
09808-14030

HINT:

Fit the tips of SST onto the ribs of the retainer.

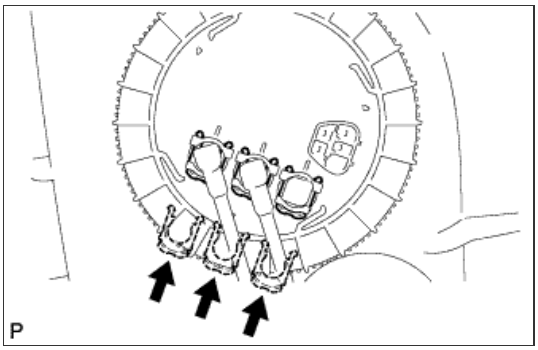


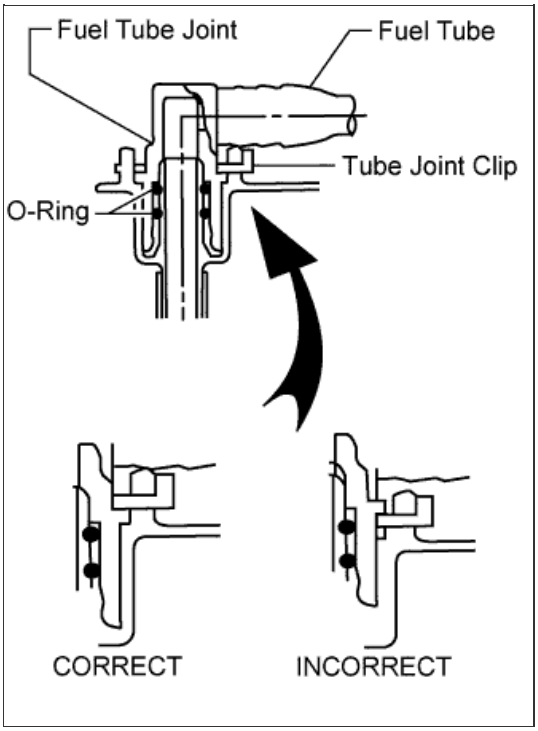
4. INSTALL FUEL TANK MAIN TUBE SUB-ASSEMBLY AND FUEL TANK RETURN TUBE SUB-ASSEMBLY (for Single Tank Type)

a. Install the 2 fuel tank tubes and No. 1 fuel tube joint with the 3 tube joint clips.

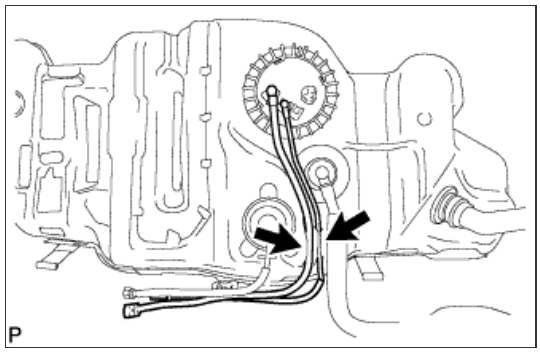
NOTICE:

- **Check that there are no scratches or foreign objects on the connecting parts.**
- **Check that the fuel tube joints are inserted securely.**
- **Check that the tube joint clips are on the collars of the fuel tube joints.**
- **After installing the tube joint clips, check that the fuel tube joints cannot be pulled off.**



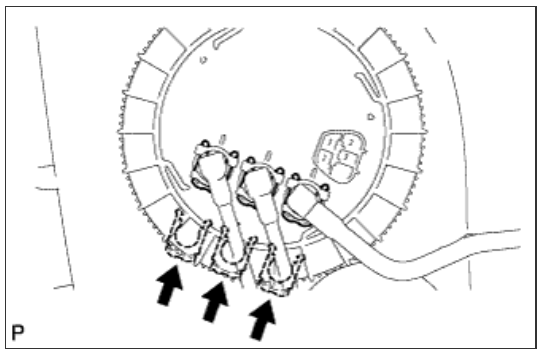


b. Install the 2 fuel tank tubes to the fuel tank.



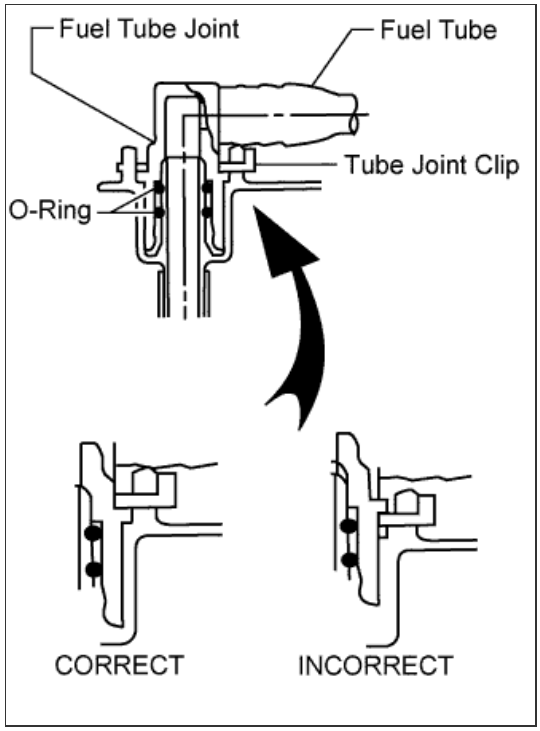
5. INSTALL FUEL TANK MAIN TUBE, FUEL TANK RETURN TUBE AND NO. 2 FUEL TANK MAIN TUBE SUB-ASSEMBLY (for Double Tank Type)

a. Install the 3 fuel tank tubes with the 3 tube joint clips.

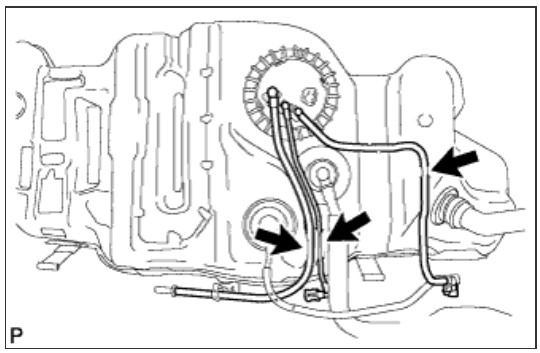


NOTICE:

- **Check that there are no scratches or foreign objects on the connecting parts.**
- **Check that the fuel tube joints are inserted securely.**
- **Check that the tube joint clips are on the collars of the fuel tube joints.**
- **After installing the tube joint clips, check that the fuel tube joints cannot be pulled off.**



b. Install the 3 fuel tank tubes to the fuel tank.



6. INSTALL FUEL TANK SUB-ASSEMBLY

a. Set the fuel tank on a transmission jack and raise the fuel tank.

NOTICE:

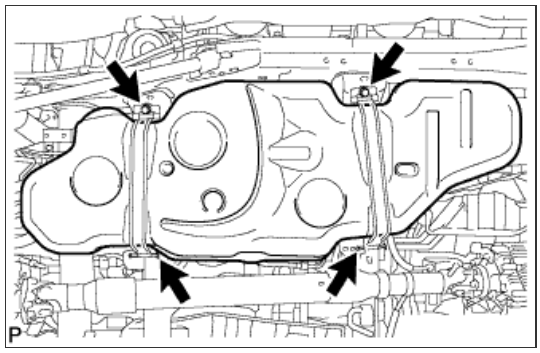
Do not allow the fuel tank to contact the vehicle, especially the differential.

b. Raise the transmission jack.

c. Install the 2 fuel tank bands with the 2 pins and 2 clips.

d. Connect the 2 fuel tank bands with the 2 bolts.

Tor ue:
40 N m 408 kgf cm , 30 ft. lbf

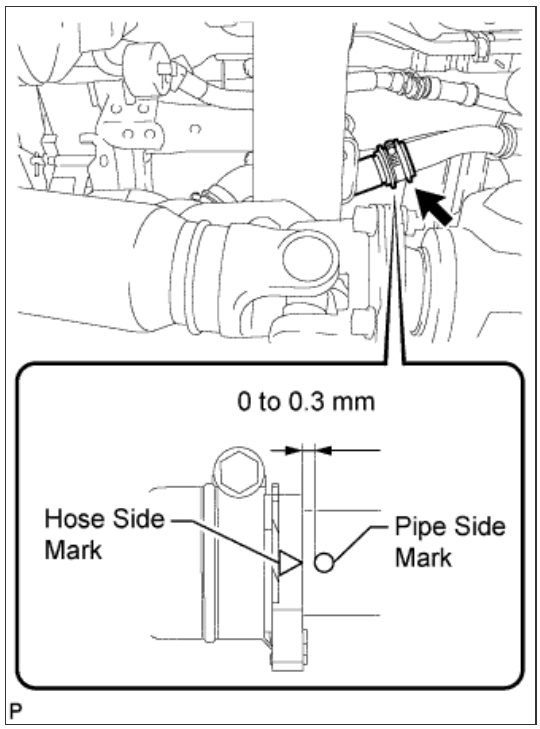


. CONNECT FUEL TANK TO FILLER PIPE HOSE (for Single Tank Type)

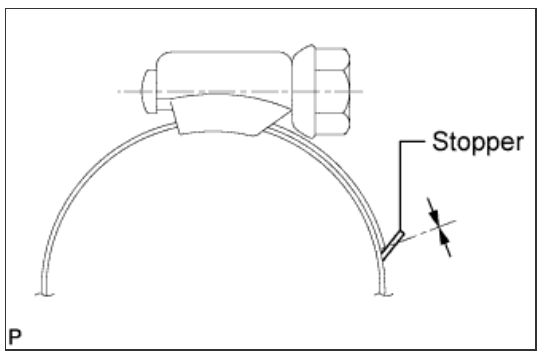
a. Connect the hose to the filler pipe as shown in the illustration.

HINT:

- **Install the hose so that the distance between the fuel tank inlet pipe side mark and fuel tank to filler pipe hose side mark is 0 to 0.3 mm (0 to 0.0118 in.) as shown in the illustration.**



- **Tighten the hose clamp until the end of the hose clamp contacts the stopper as shown in the illustration.**

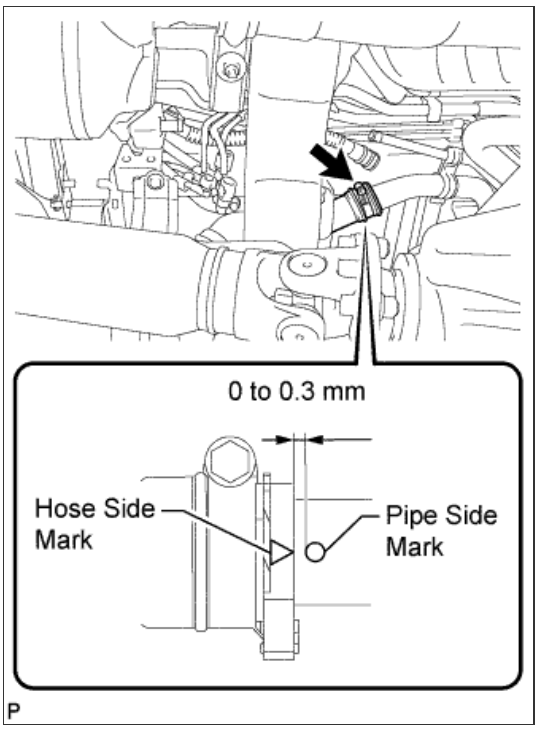


8. CONNECT FUEL TANK TO FILLER PIPE HOSE (for Double Tank Type)

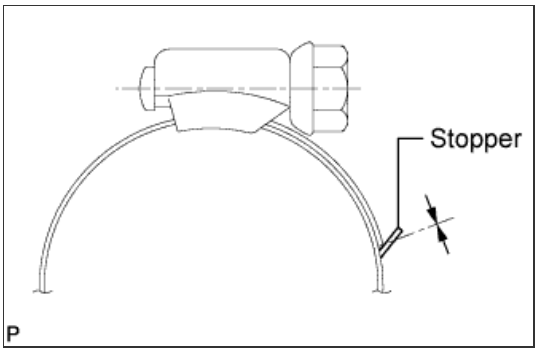
a. Connect the hose to the filler pipe as shown in the illustration.

HINT:

- **Install the hose so that the distance between the fuel tank inlet pipe side mark and fuel tank to filler pipe hose side mark is 0 to 0.3 mm (0 to 0.0118 in.) as shown in the illustration.**



- **Tighten the hose clamp until the end of the hose clamp contacts the stopper as shown in the illustration.**



9. CONNECT FUEL TANK BREATHER TUBE (for Single Tank Type)

a. Connect the fuel tank breather tube to the filler pipe and push the retainer.

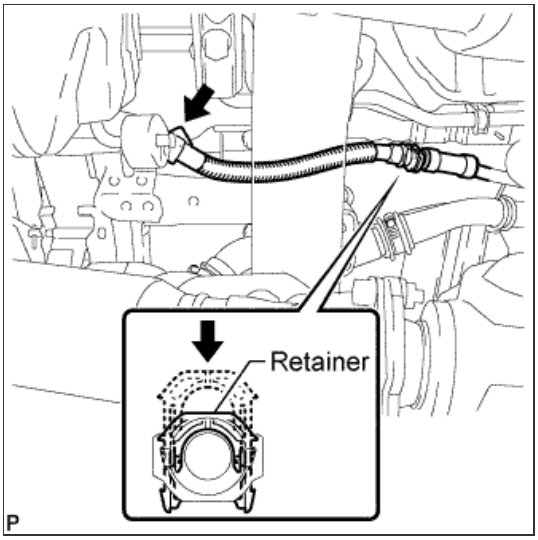
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Attach the fuel tube clamp.



10. CONNECT FUEL TANK BREATHER TUBE (for Double Tank Type)

a. Connect the fuel tank breather tube to the filler pipe and push the retainer.

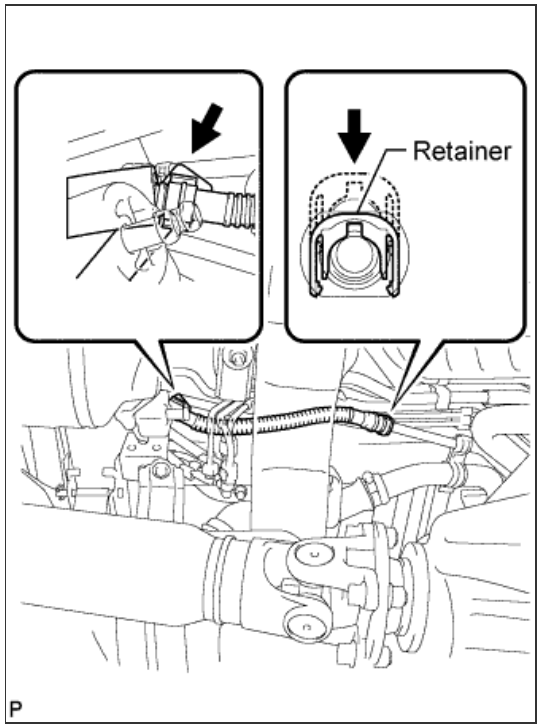
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Attach the fuel tube clamp.



11. CONNECT NO. 2 FUEL MAIN TUBE SUB-ASSEMBLY (for Double Tank Type)

a. Connect the fuel main tube and push the retainer.

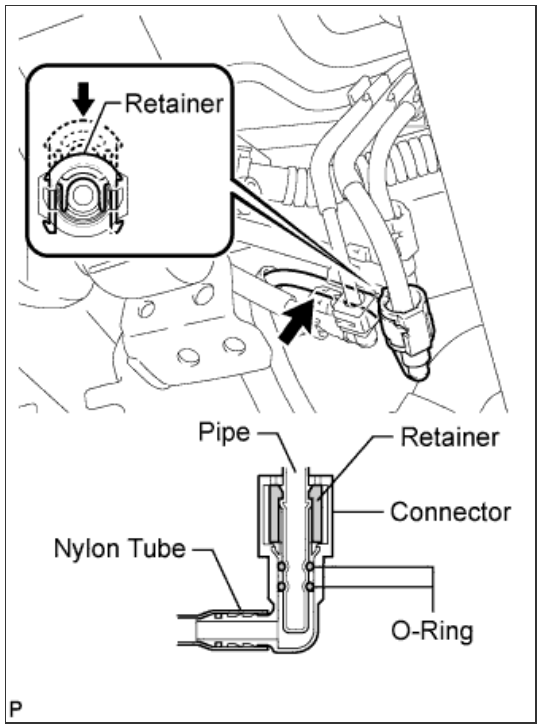
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Attach the fuel tube clamp.



12. CONNECT NO. 2 FUEL TANK BREATHER TUBE (for Double Tank Type)

a. Connect the fuel tank breather tube and push the retainer.

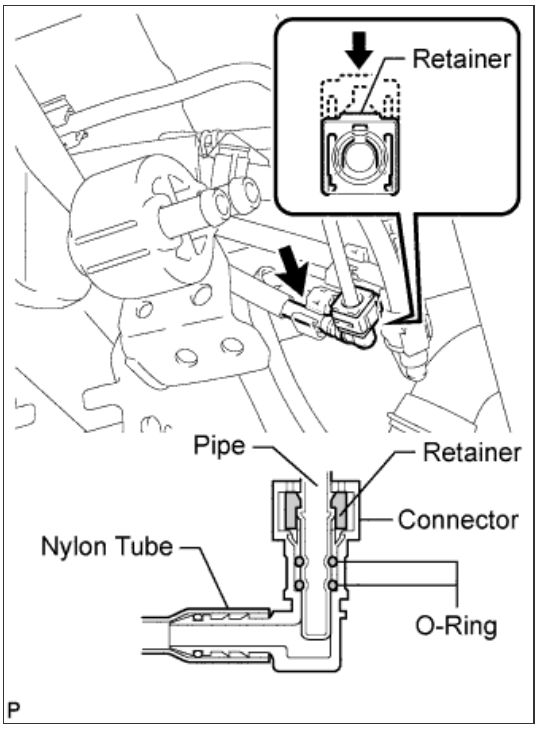
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Attach the fuel tube clamp.



13. CONNECT FUEL TANK RETURN TUBE (for Single Tank Type)

a. Connect the fuel tank return tube and push the retainer.

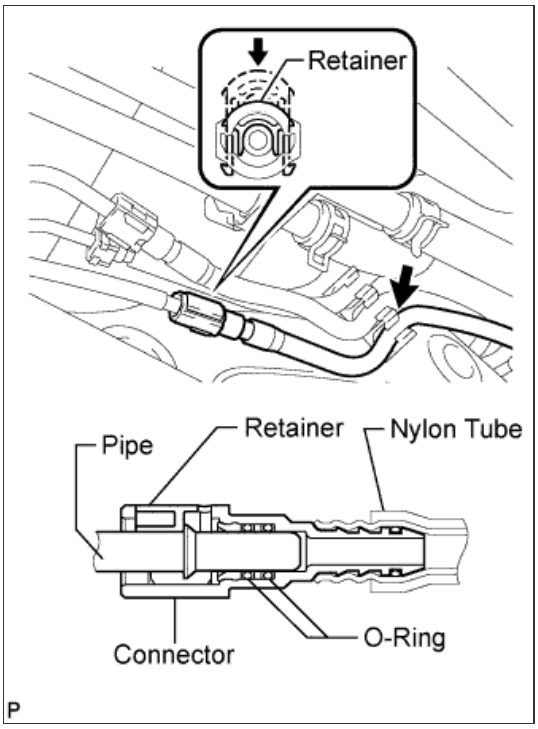
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Attach the fuel tube clamp.



14. CONNECT FUEL TANK RETURN TUBE (for Double Tank Type)

a. Connect the fuel tank return tube and push the retainer.

HINT:

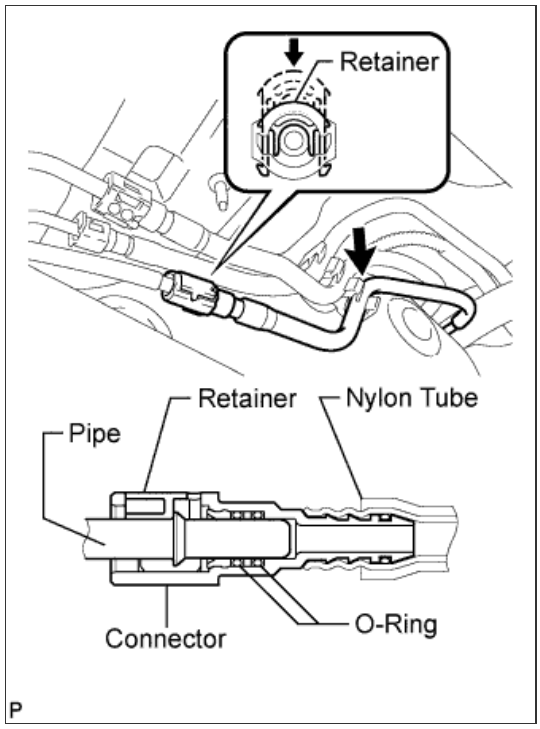
Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**

- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Attach the fuel tube clamp.



15. CONNECT NO. 2 FUEL TANK BREATHER TUBE (for Single Tank Type)

a. Connect the fuel tank breather tube and push the retainer.

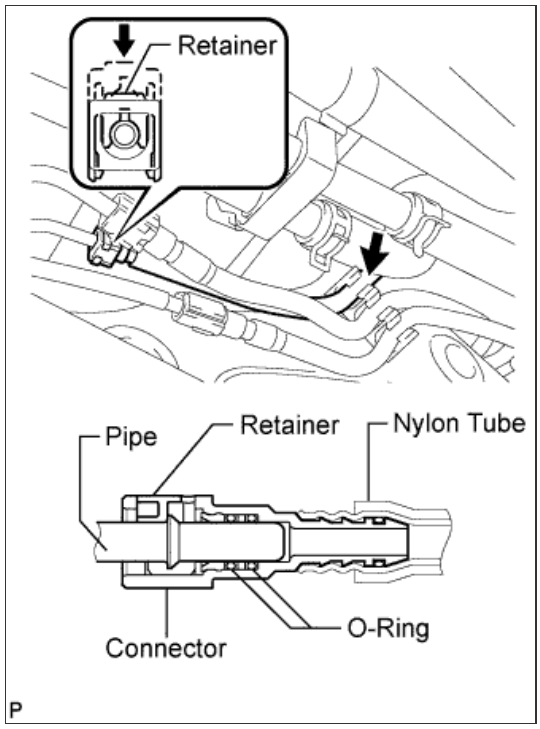
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Attach the fuel tube clamp.



16. CONNECT FUEL TANK MAIN TUBE SUB-ASSEMBLY (for Single Tank Type)

a. Connect the fuel tank main tube and push the retainer.

HINT:

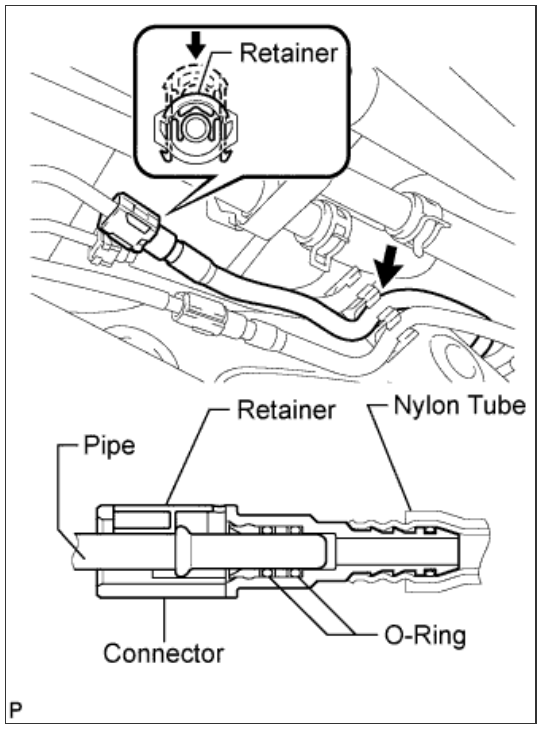
Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**

- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Attach the fuel tube clamp.



17. CONNECT FUEL TANK MAIN TUBE SUB-ASSEMBLY (for Double Tank Type)

a. Connect the fuel tank main tube and push the retainer.

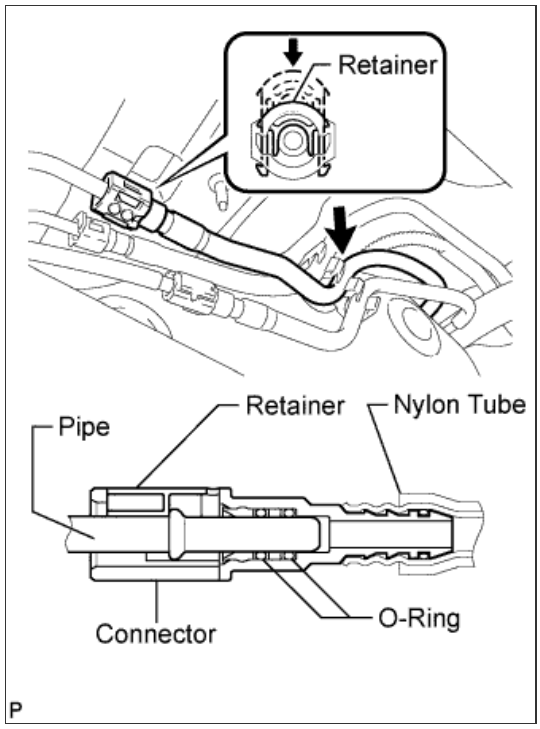
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

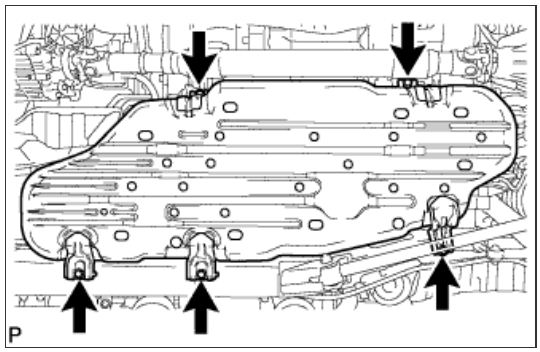
b. Attach the fuel tube clamp.



18. INSTALL NO. 1 FUEL TANK PROTECTOR SUB-ASSEMBLY

a. Install the tank protector with the 5 bolts.

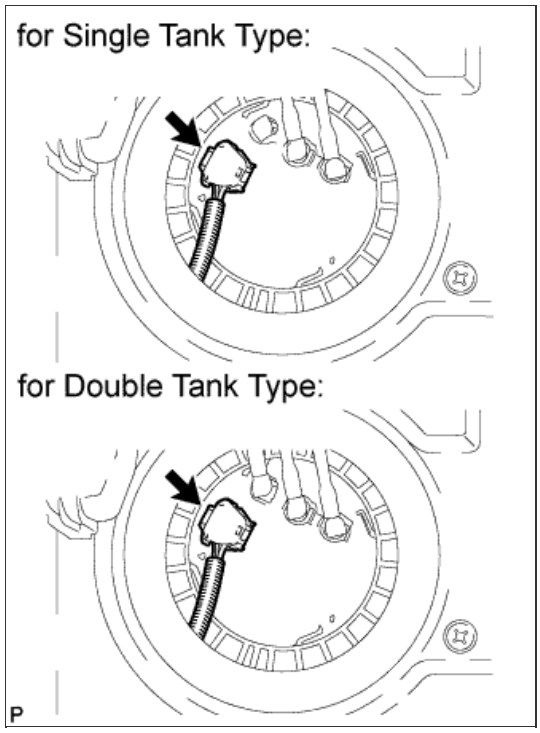
Tor ue:
20 N m 204 kgf cm , 15 ft. lbf



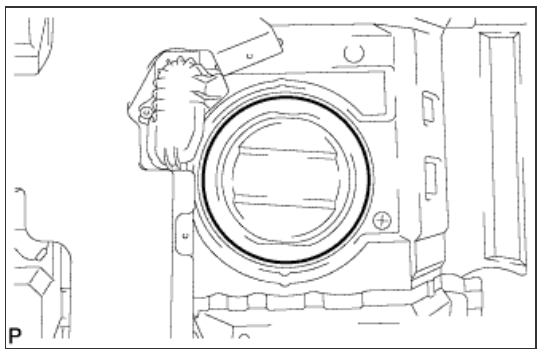
19. INSTALL FUEL TANK CAP ASSEMBLY

20. INSTALL REAR FLOOR NO. 2 SERVICE HOLE COVER

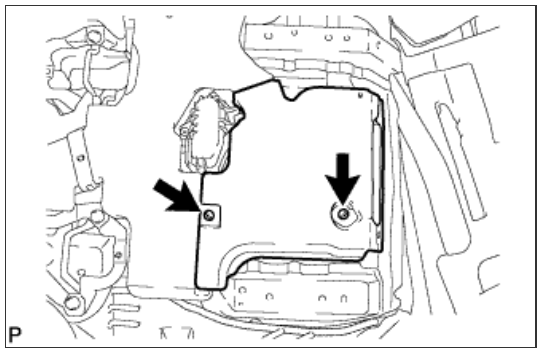
a. Connect the fuel pump and fuel sender gauge connector.



b. Install the service hole cover with new butyl tape.



c. w/ Rear Air Conditioning System:
Install the air duct and 2 screws.



21. INSTALL FRONT FLOOR CARPET ASSEMBLY

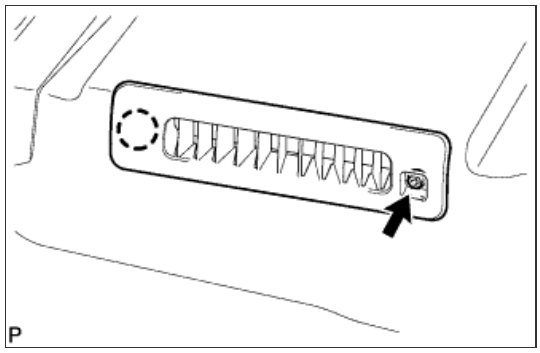
22. INSTALL REAR AIR DUCT GUIDE (w Rear Air Conditioning System)

a. Attach the claw to install the guide.

b. Install the screw.

HINT:

Use the same procedures for both sides.

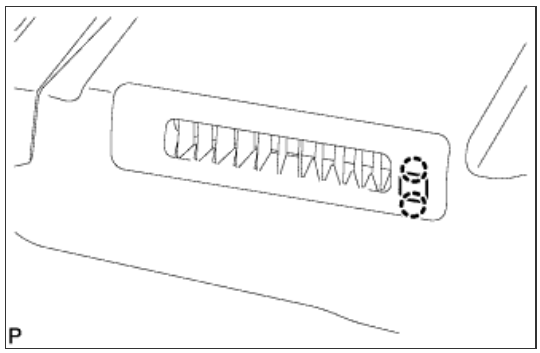


23. INSTALL AIR DUCT PLUG (w Rear Air Conditioning System)

a. Attach the 2 claws to install the plug.

HINT:

Use the same procedures for both sides.



24. INSTALL FRONT QUARTER TRIM PANEL ASSEMBLY LH

a. w/ Sliding Roof:
Install the front quarter trim panel assembly LH (Click here).

b. w/o Sliding Roof:
Install the front quarter trim panel assembly LH (Click here).

25. INSTALL FRONT QUARTER TRIM PANEL ASSEMBLY RH

a. w/ Sliding Roof:
Install the front quarter trim panel assembly RH (Click here).

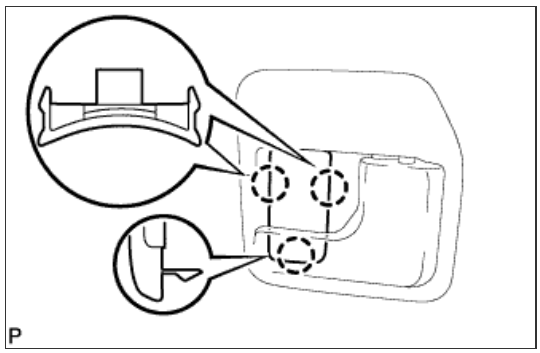
b. w/o Sliding Roof:
Install the front quarter trim panel assembly RH (Click here).

26. INSTALL REAR SEAT COVER CAP (w/ Rear No. 2 Seat, except Face to Face Seat Type)

HINT:

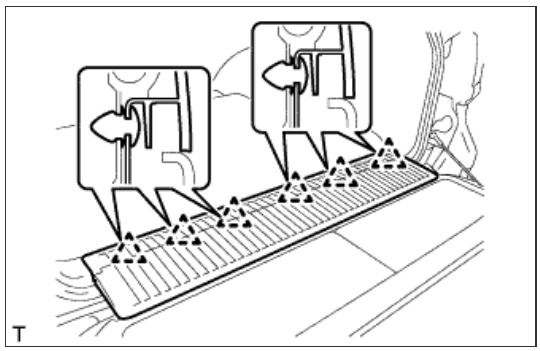
Use the same procedure to install the rear seat cover cap on the other side.

a. Attach the 3 claws to install the rear seat cover cap.



27. INSTALL REAR FLOOR MAT REAR SUPPORT PLATE

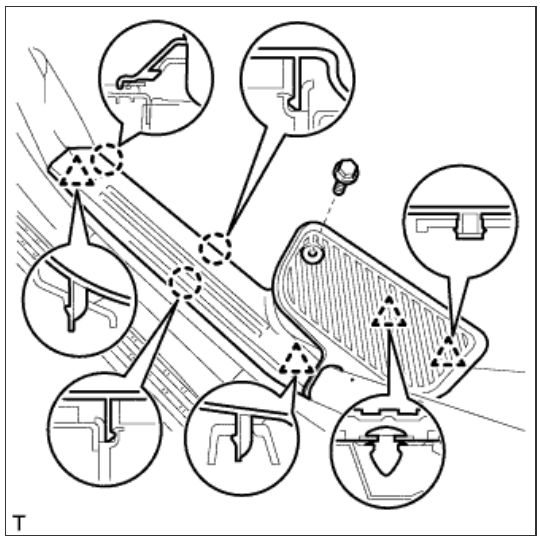
a. Attach the 6 clips to install the support plate.



28. INSTALL REAR DOOR SCUFF PLATE LH

a. Attach the 3 claws and 4 clips to install the scuff plate.

b. Install the screw.



29. INSTALL REAR DOOR SCUFF PLATE RH

HINT:

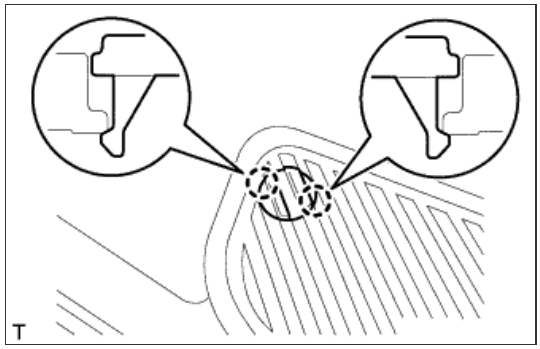
Use the same procedures described for the LH side.

30. INSTALL REAR STEP COVER

HINT:

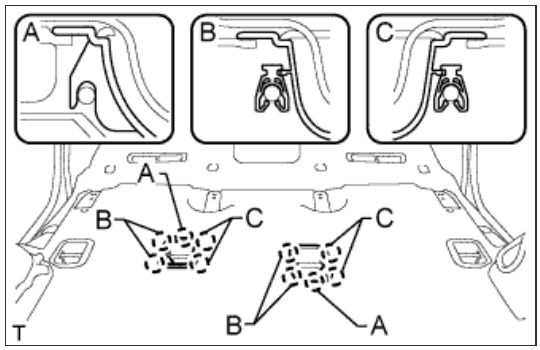
Use the same procedure to install the step cover on the other side.

a. Attach the 2 claws to install the step cover.



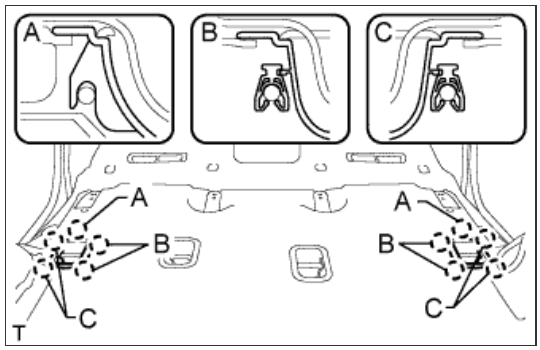
31. INSTALL REAR NO. 2 SEAT PROTECTOR

a. Attach the 10 claws to install the 2 seat protectors.



32. INSTALL REAR NO. 1 SEAT PROTECTOR

a. Attach the 10 claws to install the 2 seat protectors.



33. INSTALL REAR NO. 2 SEAT ASSEMBLY

a. for Face to Face Seat Type:
Install the rear No. 2 seat assembly (Click here).

b. except Face to Face Seat Type:
Install the rear No. 2 seat assembly (Click here).

34. INSTALL REAR NO. 1 SEAT ASSEMBLY RH (for 60 40 Split Seat Type 40 Side)

a. Install the rear No. 1 seat assembly RH (Click here).

35. INSTALL REAR NO. 1 SEAT ASSEMBLY LH (for 60 40 Split Seat Type 60 Side)

a. Install the rear No. 1 seat assembly LH (Click here).

36. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

37. CHECK SRS WARNING LIGHT

a. Check the SRS warning light (Click here).

38. ADD FUEL

39. INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and intelligent tester on.

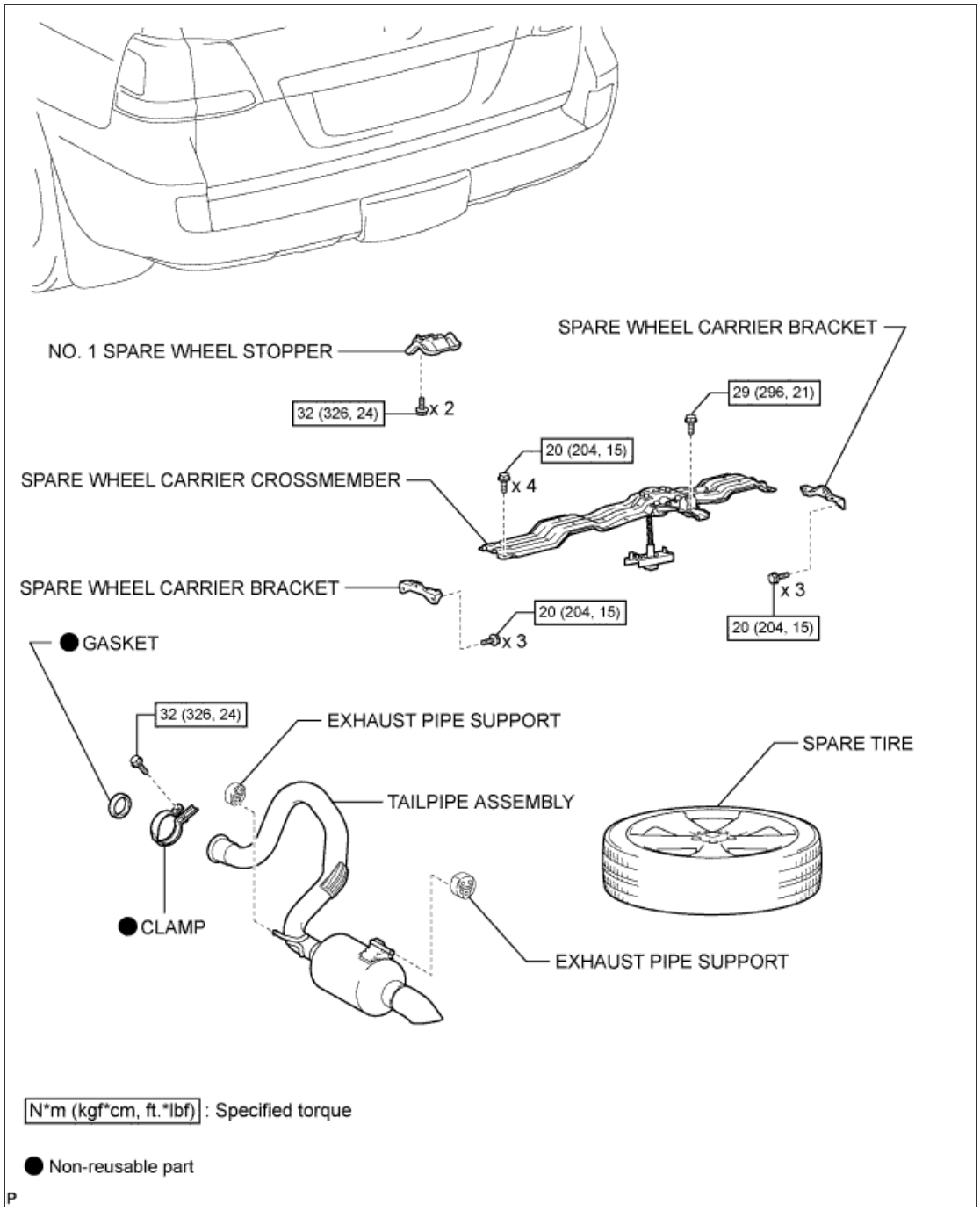
NOTICE:

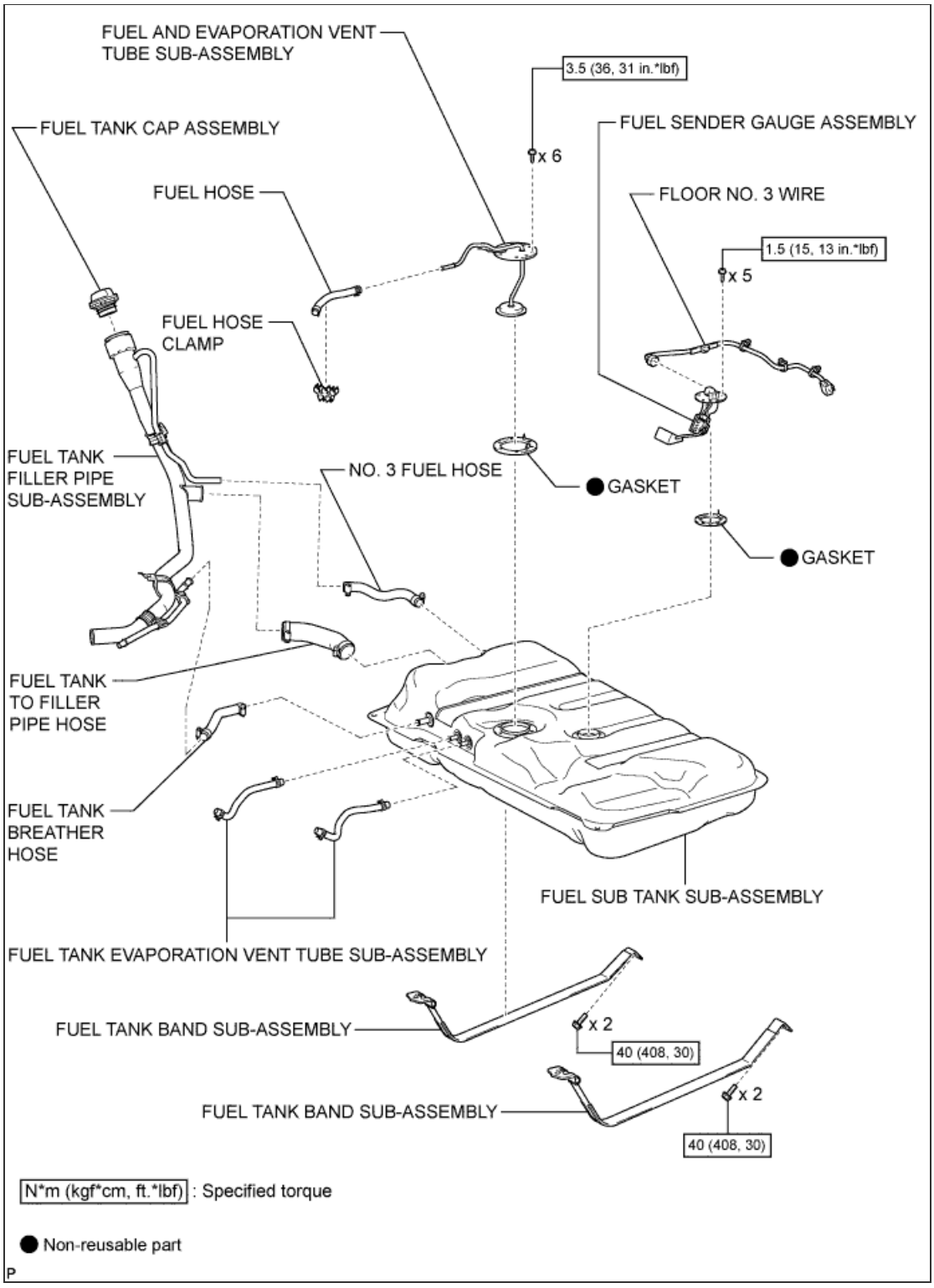
Do not start the engine.

c. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the Fuel Pump Speed Control.

d. Check that there are no fuel leaks after doing maintenance anywhere on the fuel system.

for Preparation Click here




FUEL AND EVAPORATION VENT TUBE SUB-ASSEMBLY
3.5 (36, 31 in.*lbf)
FUEL TANK CAP ASSEMBLY
x 6
FUEL SENDER GAUGE ASSEMBLY
FUEL HOSE
FLOOR NO. 3 WIRE
1.5 (15, 13 in.*lbf)
x 5
FUEL HOSE CLAMP
FUEL TANK FILLER PIPE SUB-ASSEMBLY
NO. 3 FUEL HOSE
GASKET
GASKET
FUEL TANK TO FILLER PIPE HOSE
FUEL TANK BREATHER HOSE
FUEL SUB TANK SUB-ASSEMBLY
FUEL TANK EVAPORATION VENT TUBE SUB-ASSEMBLY
FUEL TANK BAND SUB-ASSEMBLY
x 2
40 (408, 30)
FUEL TANK BAND SUB-ASSEMBLY
x 2
40 (408, 30)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

a. Discharge the fuel system pressure (Click here).

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE SPARE TIRE

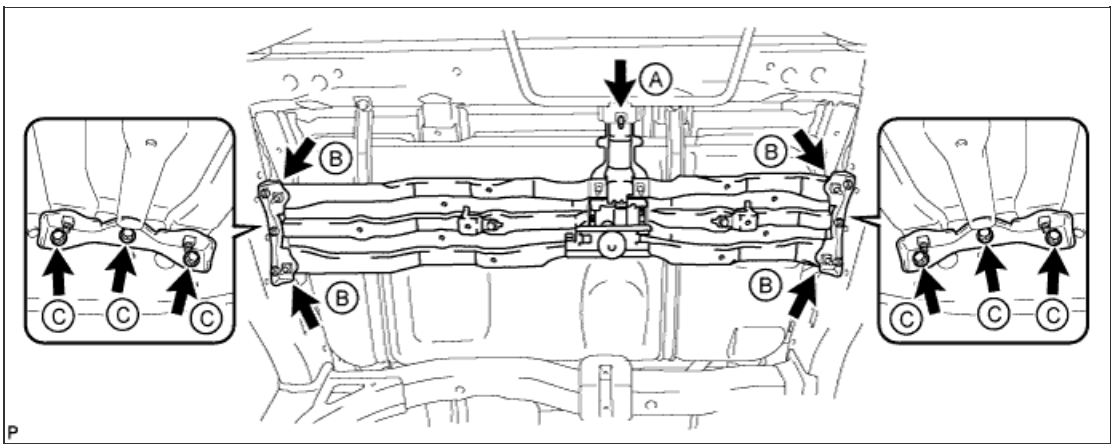
4. REMOVE TAILPIPE ASSEMBLY

a. Remove the bolt, clamp and gasket.

b. Remove the tailpipe from the 2 exhaust pipe supports.

5. REMOVE SPARE WHEEL CARRIER CROSSMEMBER AND SPARE WHEEL CARRIER BRACKET

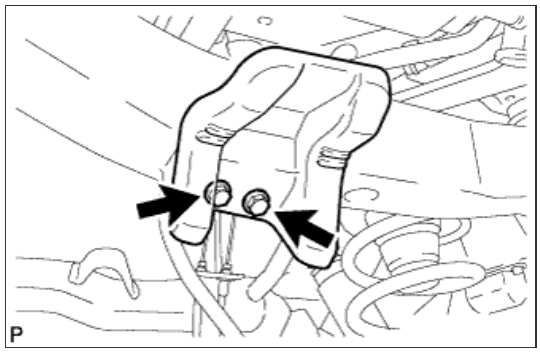
a. Remove the bolt labeled A, and then loosen the 4 bolts labeled B.



b. Slightly raise the spare wheel carrier crossmember, and then remove the 6 bolts labeled C, spare wheel carrier crossmember and 2 brackets.

6. REMOVE NO. 1 SPARE WHEEL STOPPER

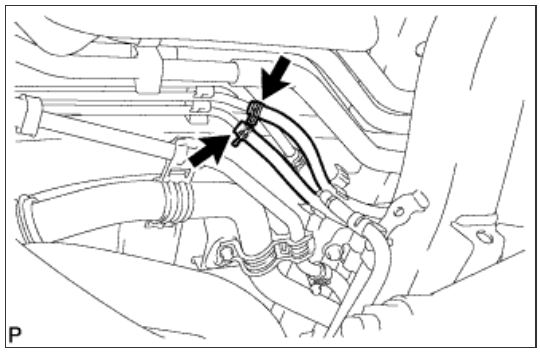
a. Remove the 2 bolts and spare wheel stopper.



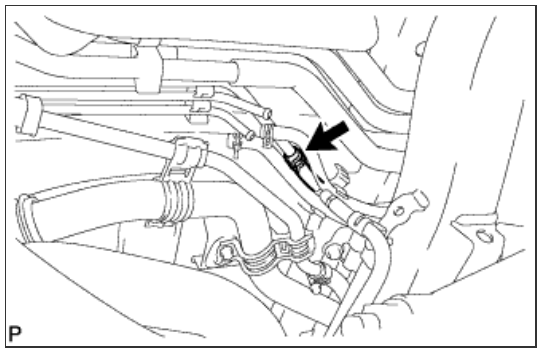
7. REMOVE FUEL TANK CAP ASSEMBLY

8. DISCONNECT FUEL TANK EVAPORATION VENT TUBE SUB-ASSEMBLY

a. Disconnect the 2 fuel tank evaporation vent tubes.

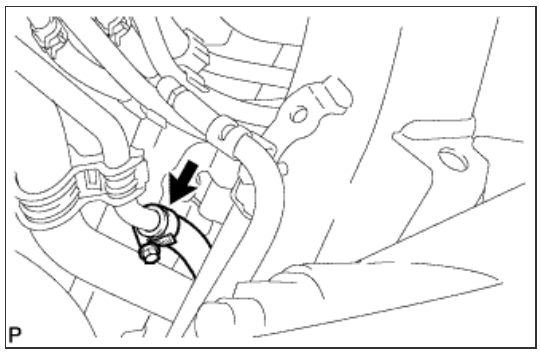


9. DISCONNECT FUEL HOSE



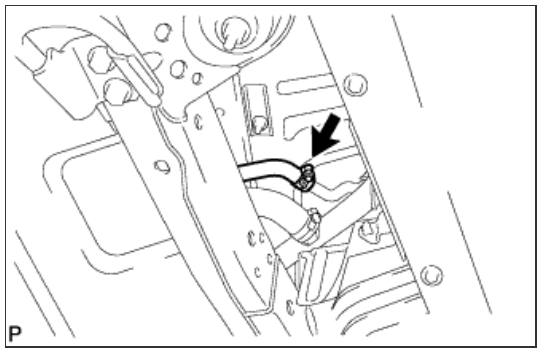
10. DISCONNECT FUEL TANK BREATHER HOSE

a. Disconnect the breather hose from the filler pipe.



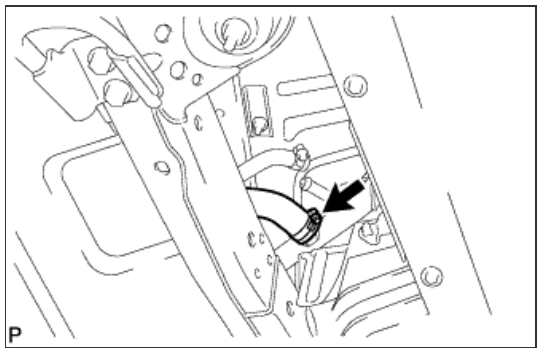
11. DISCONNECT NO. 3 FUEL HOSE

a. Disconnect the fuel hose from the filler pipe.



12. DISCONNECT FUEL TANK TO FILLER PIPE HOSE

a. Disconnect the hose from the filler pipe.

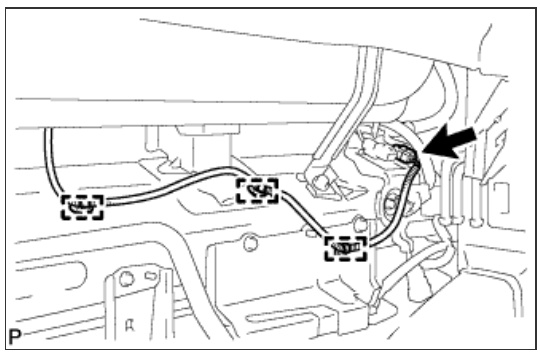


13. REMOVE FUEL SUB TANK SUB-ASSEMBLY

a. Disconnect the floor No. 3 wire connector.

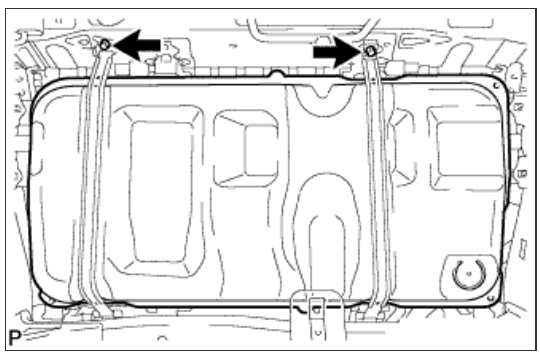
b. Using a clip remover, detach the 3 wire harness clamps.

c. Set a transmission jack underneath the fuel sub tank.



d. Remove the 2 bolts and disconnect the 2 fuel tank bands.

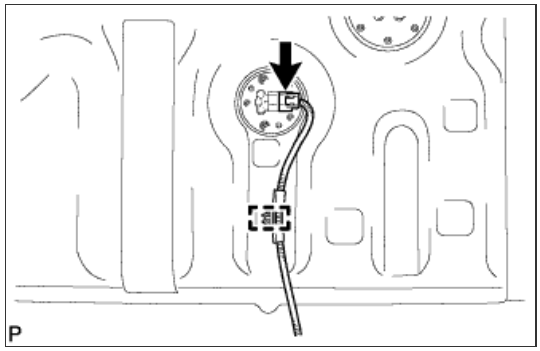
e. Remove the fuel sub tank.



14. REMOVE FLOOR NO. 3 WIRE

a. Disconnect the sender gauge connector.

b. Using a clip remover, detach the wire harness clamp.



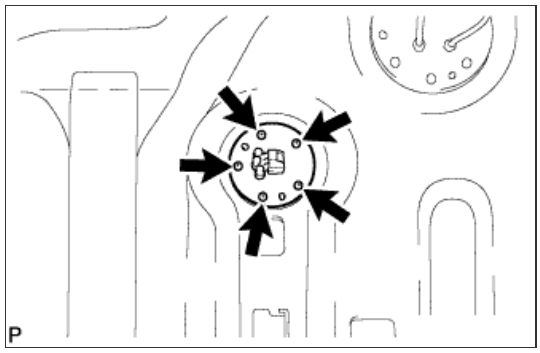
15. REMOVE FUEL SENDER GAUGE ASSEMBLY

a. Remove the 5 screws and sender gauge.

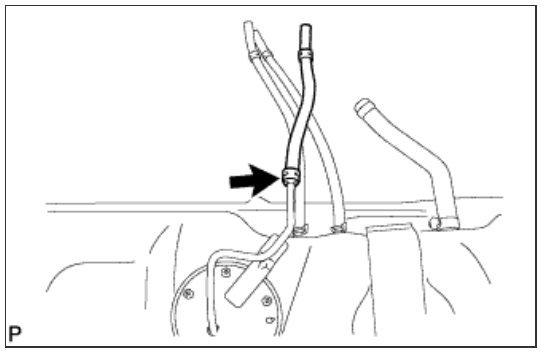
NOTICE:

Be careful not to bend the arm of the fuel sender gauge.

b. Remove the gasket from the sender gauge.

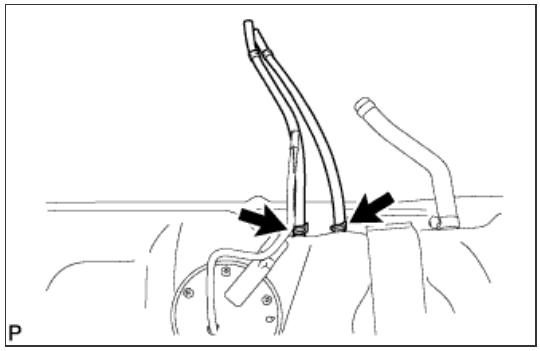


16. REMOVE FUEL HOSE



17. REMOVE FUEL TANK EVAPORATION VENT TUBE SUB-ASSEMBLY

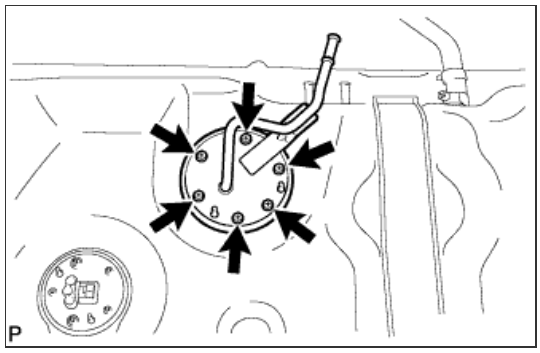
a. Remove the 2 fuel tank evaporation vent tubes.



18. REMOVE FUEL AND EVAPORATION VENT TUBE SUB-ASSEMBLY

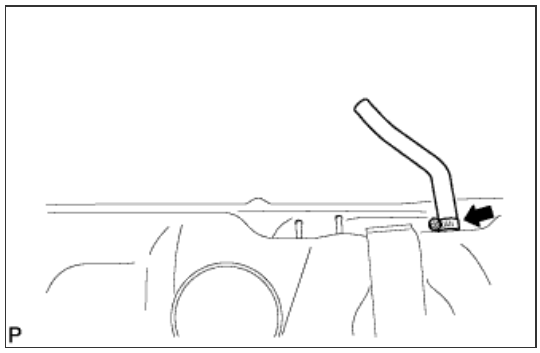
a. Remove the 6 bolts and fuel and evaporation vent tube.

b. Remove the gasket from the fuel and evaporation vent tube.



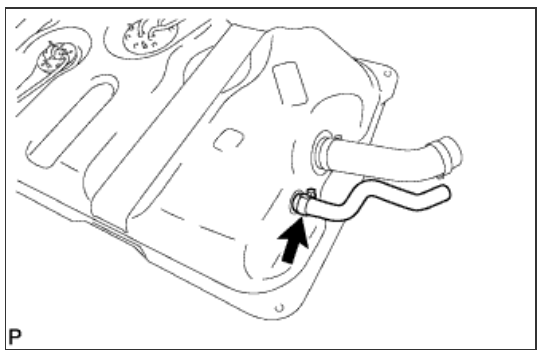
19. REMOVE FUEL TANK BREATHER HOSE

a. Remove the breather hose from the fuel sub tank.



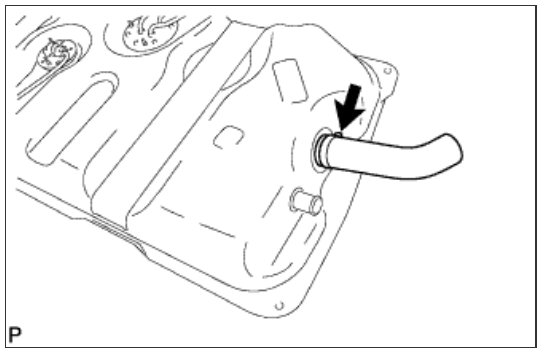
20. REMOVE NO. 3 FUEL HOSE

a. Remove the fuel hose from the fuel sub tank.



21. REMOVE FUEL TANK TO FILLER PIPE HOSE

a. Remove the hose from the fuel sub tank.


P

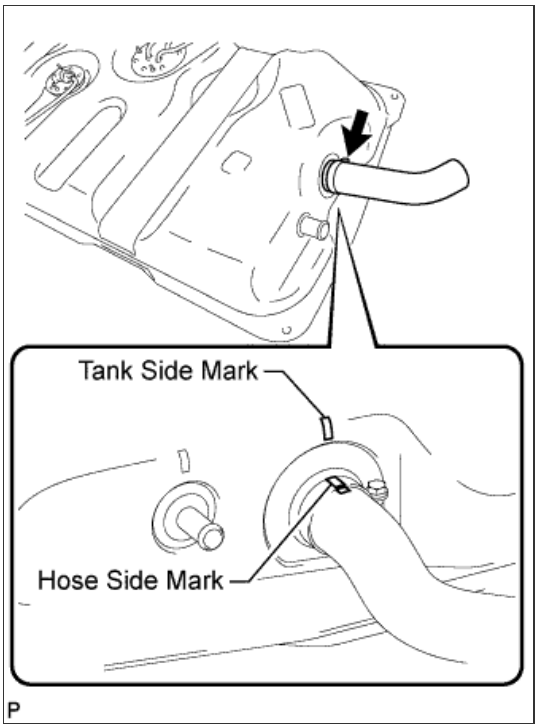
for Preparation Click here

1. INSTALL FUEL TANK TO FILLER PIPE HOSE

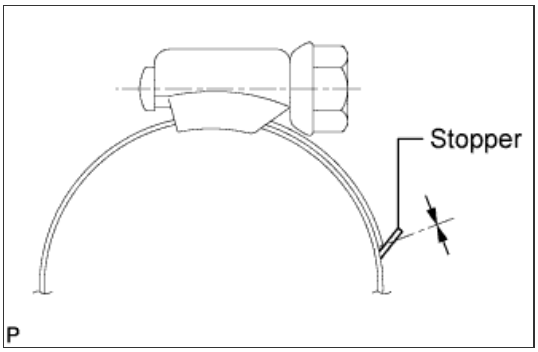
a. Install the hose to the fuel sub tank as shown in the illustration.

HINT:

- **Align the fuel sub tank side mark with the hose side mark when installing the hose.**



- **Tighten the hose clamp until the end of the hose clamp contacts the stopper as shown in the illustration.**

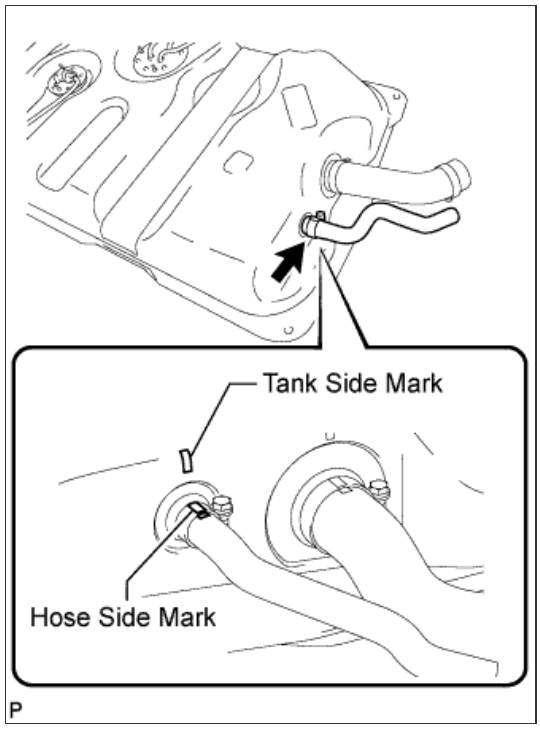


2. INSTALL NO. 3 FUEL HOSE

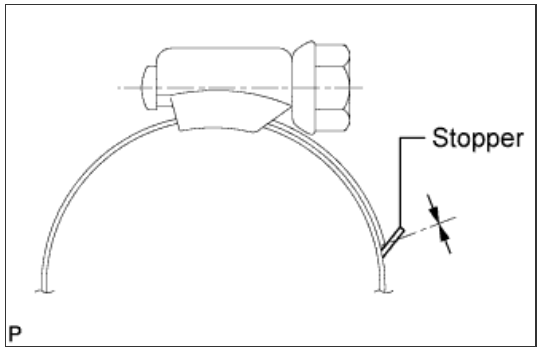
a. Install the fuel hose to the fuel sub tank as shown in the illustration.

HINT:

- **Align the fuel sub tank side mark with the hose side mark when installing the hose.**

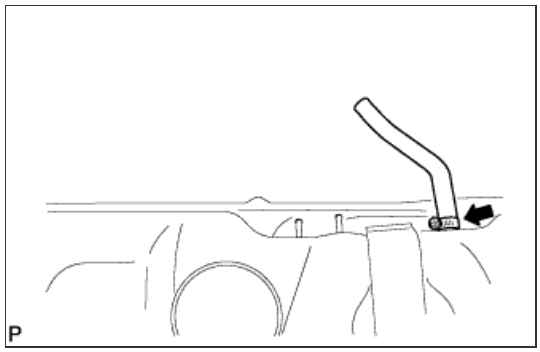


- **Tighten the hose clamp until the end of the hose clamp contacts the stopper as shown in the illustration.**



3. INSTALL FUEL TANK BREATHER HOSE

a. Install the breather hose to the fuel sub tank.

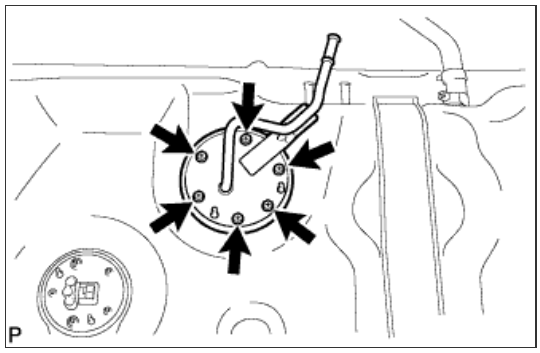


4. INSTALL FUEL AND EVAPORATION VENT TUBE SUB-ASSEMBLY

a. Install a new gasket to the fuel and evaporation vent tube.

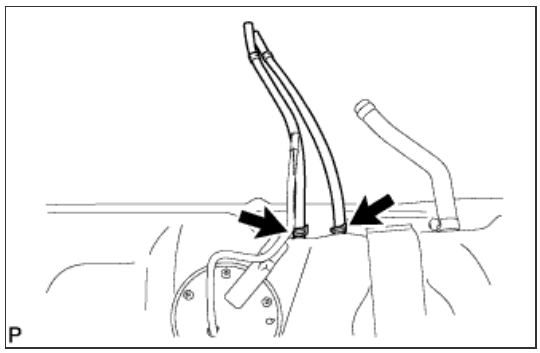
b. Install the fuel and evaporation vent tube with the 6 bolts.

Torque:
3.5 N*m 36 kgf*cm , 31 in.*lbf }

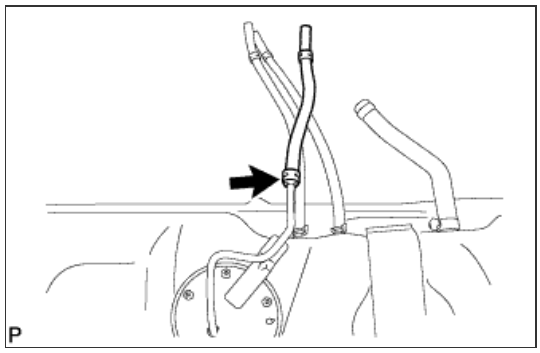


5. INSTALL FUEL TANK EVAPORATION VENT TUBE SUB-ASSEMBLY

a. Install the 2 fuel tank evaporation vent tubes.



6. INSTALL FUEL HOSE



7. INSTALL FUEL SENDER GAUGE ASSEMBLY

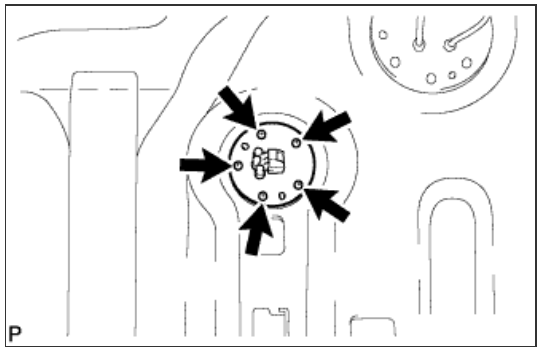
a. Install a new gasket to the sender gauge.

NOTICE:

Be careful not to bend the arm of the fuel sender gauge.

b. Install the sender gauge with the 5 screws.

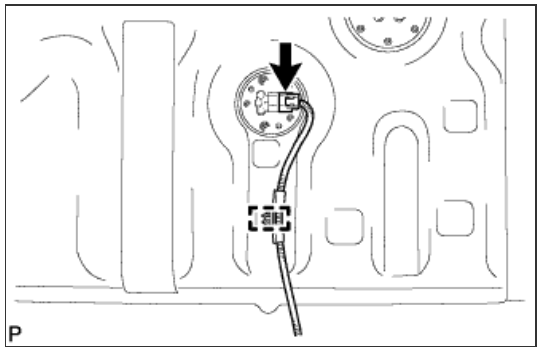
Torque:
1.5 N*m 15 kgf*cm , 13 in.*lbf }



. INSTALL FLOOR NO. 3 WIRE

a. Attach the wire harness clamp to the fuel sub tank.

b. Connect the sender gauge connector.

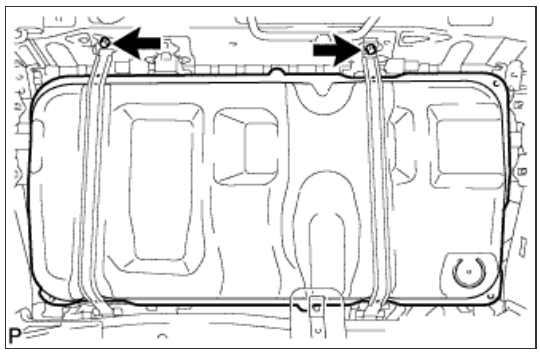


9. INSTALL FUEL SUB TANK SUB-ASSEMBLY

a. Set the fuel sub tank on a transmission jack and raise the fuel sub tank.

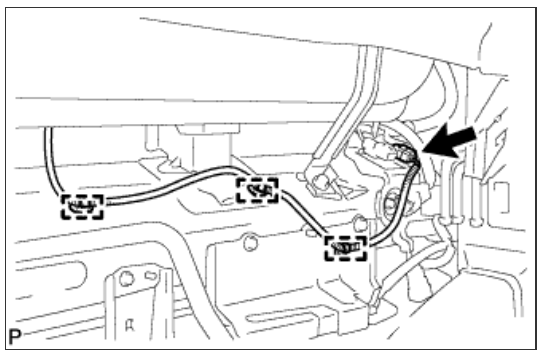
b. Connect the 2 fuel tank bands with the 2 bolts.

Torque:
4 N*m 4 kgf*cm , 3 ft.*lbf }



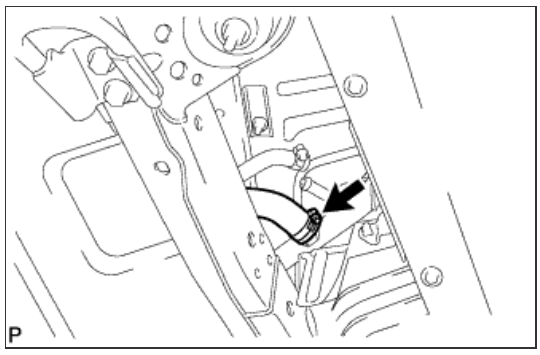
c. Connect the floor No. 3 wire connector.

d. Attach the 3 wire harness clamps.



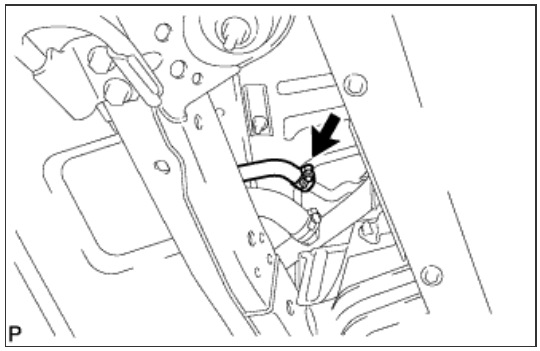
1 . CONNECT FUEL TANK TO FILLER PIPE HOSE

a. Connect the hose to the filler pipe.



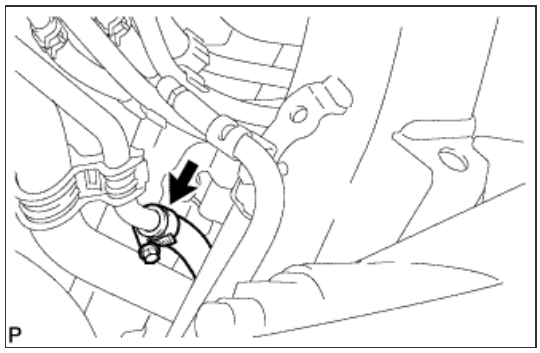
11. CONNECT NO. 3 FUEL HOSE

a. Connect the fuel hose to the filler pipe.

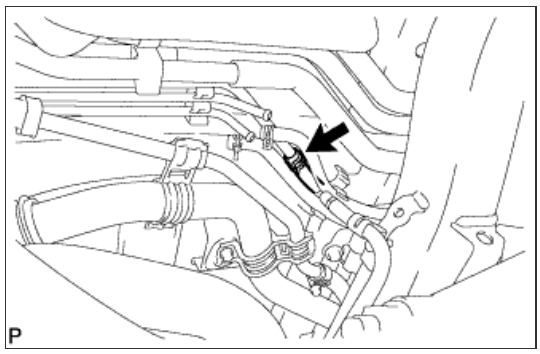


12. CONNECT FUEL TANK BREATHER HOSE

a. Connect the breather hose to the filler pipe.

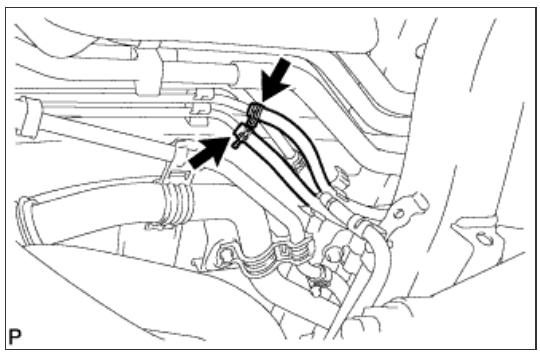


13. CONNECT FUEL HOSE



14. CONNECT FUEL TANK EVAPORATION VENT TUBE SUB-ASSEMBLY

a. Connect the 2 fuel tank evaporation vent tubes.

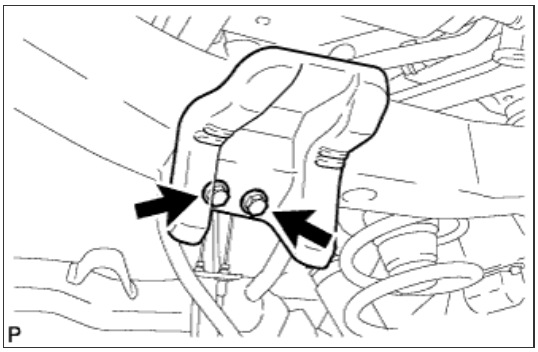


15. INSTALL FUEL TANK CAP ASSEMBLY

16. INSTALL NO. 1 SPARE WHEEL STOPPER

a. Install the spare wheel stopper with the 2 bolts.

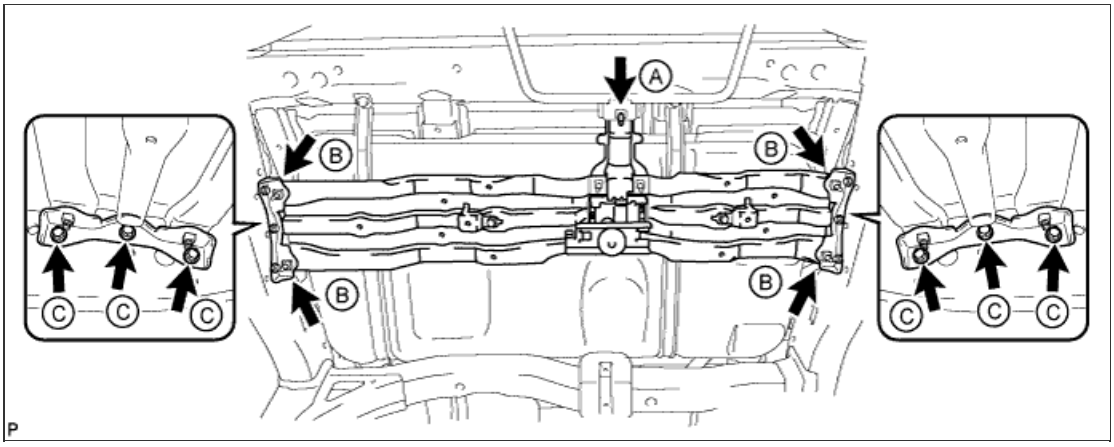
Torque:
32 N*m 326 kgf*cm , 24 ft.*lbf }



17. INSTALL SPARE WHEEL CARRIER CROSSMEMBER AND SPARE WHEEL CARRIER BRACKET

a. Install the spare wheel carrier crossmember and 2 brackets to the vehicle with the 6 bolts labeled C.

Torque:
for bolt C:
2 N*m 2 4 kgf*cm , 15 ft.*lbf }



b. Temporarily install the bolt labeled A, and then tighten the bolt labeled A and bolts labeled B.

Torque:
for bolt A:
29 N*m 296 kgf*cm , 21 ft.*lbf }
for bolt B:
2 N*m 2 4 kgf*cm , 15 ft.*lbf }

18. INSTALL TAILPIPE ASSEMBLY

a. Install the tailpipe to the 2 exhaust pipe supports.

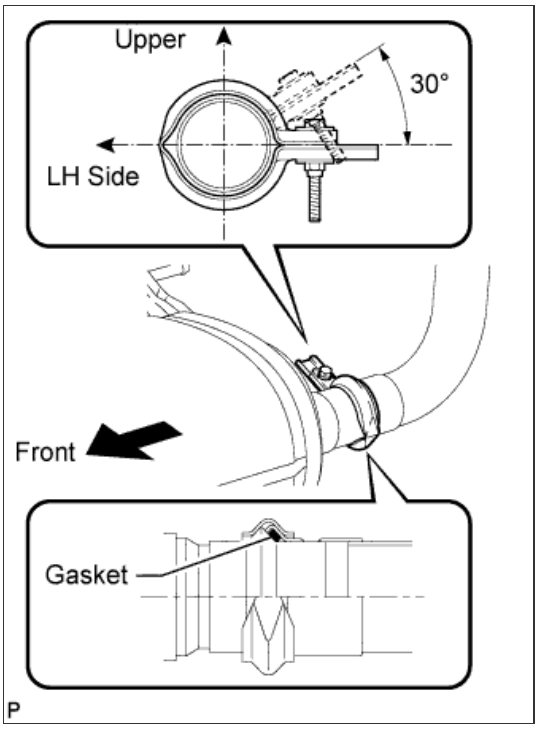
b. Set a new gasket to the center exhaust pipe.

c. Connect the tailpipe to the center pipe with a new clamp.

Torque:
32 N*m 326 kgf*cm , 24 ft.*lbf }

HINT:

Install the clamp within the angle range shown in the illustration.



19. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

2 . INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON and intelligent tester on.

NOTICE:

Do not start the engine.

c. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the Fuel Pump Speed Control.

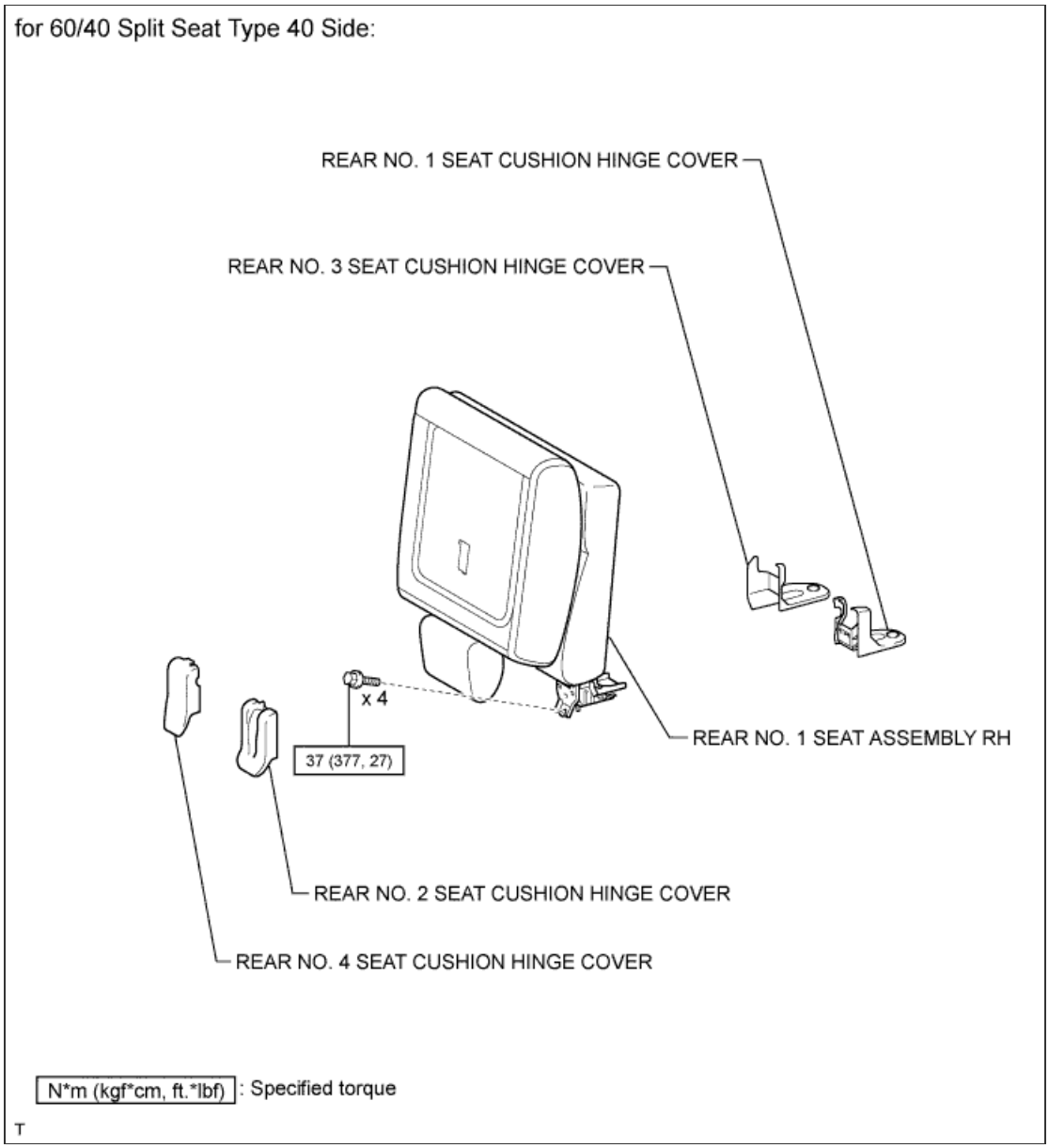
d. Check that there are no fuel leaks after doing maintenance anywhere on the fuel system.

21. INSPECT FOR EXHAUST GAS LEAK

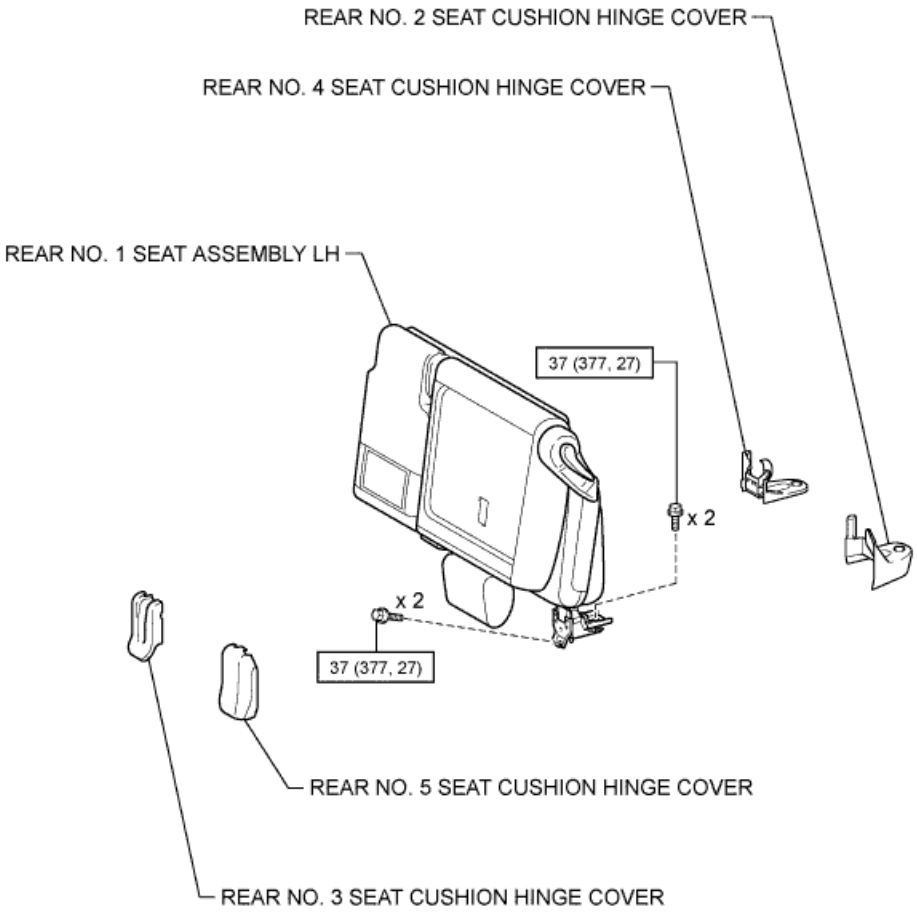
If gas is leaking, tighten the areas necessary to stop the leak. Replace damaged parts as necessary.

22. INSTALL SPARE TIRE

for Preparation Click here



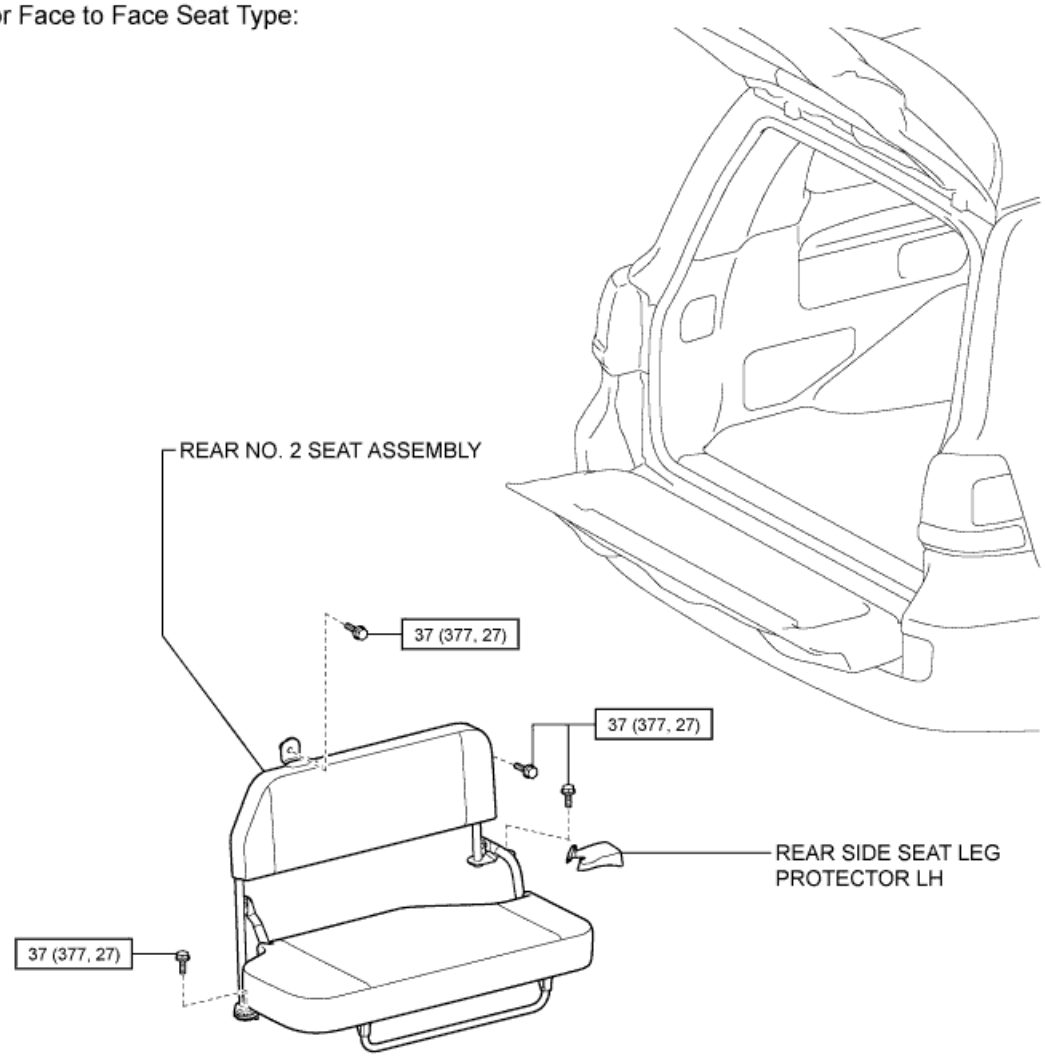
for 60/40 Split Seat Type 60 Side:



N*m (kgf*cm, ft.*lbf) : Specified torque

T

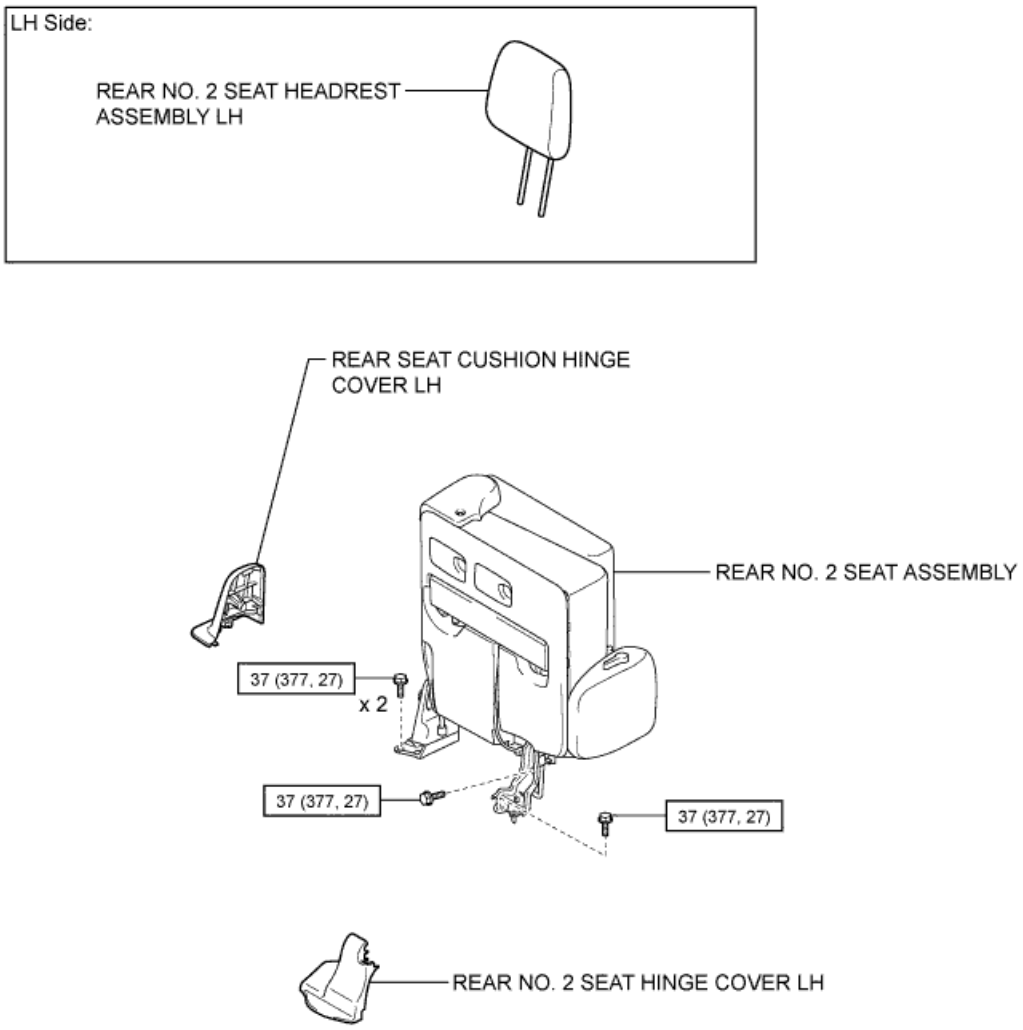
for Face to Face Seat Type:



N*m (kgf*cm, ft.*lbf) : Specified torque

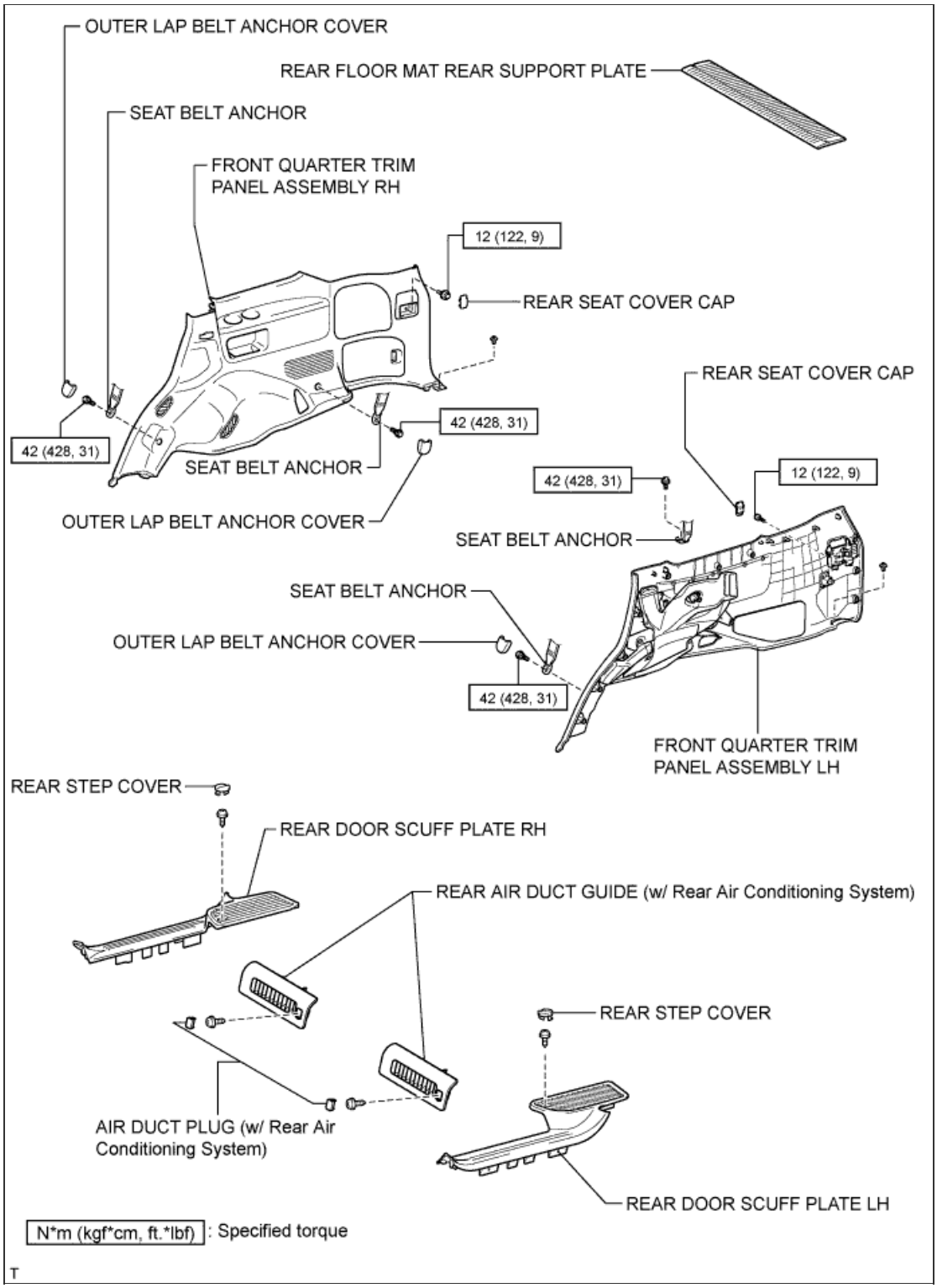
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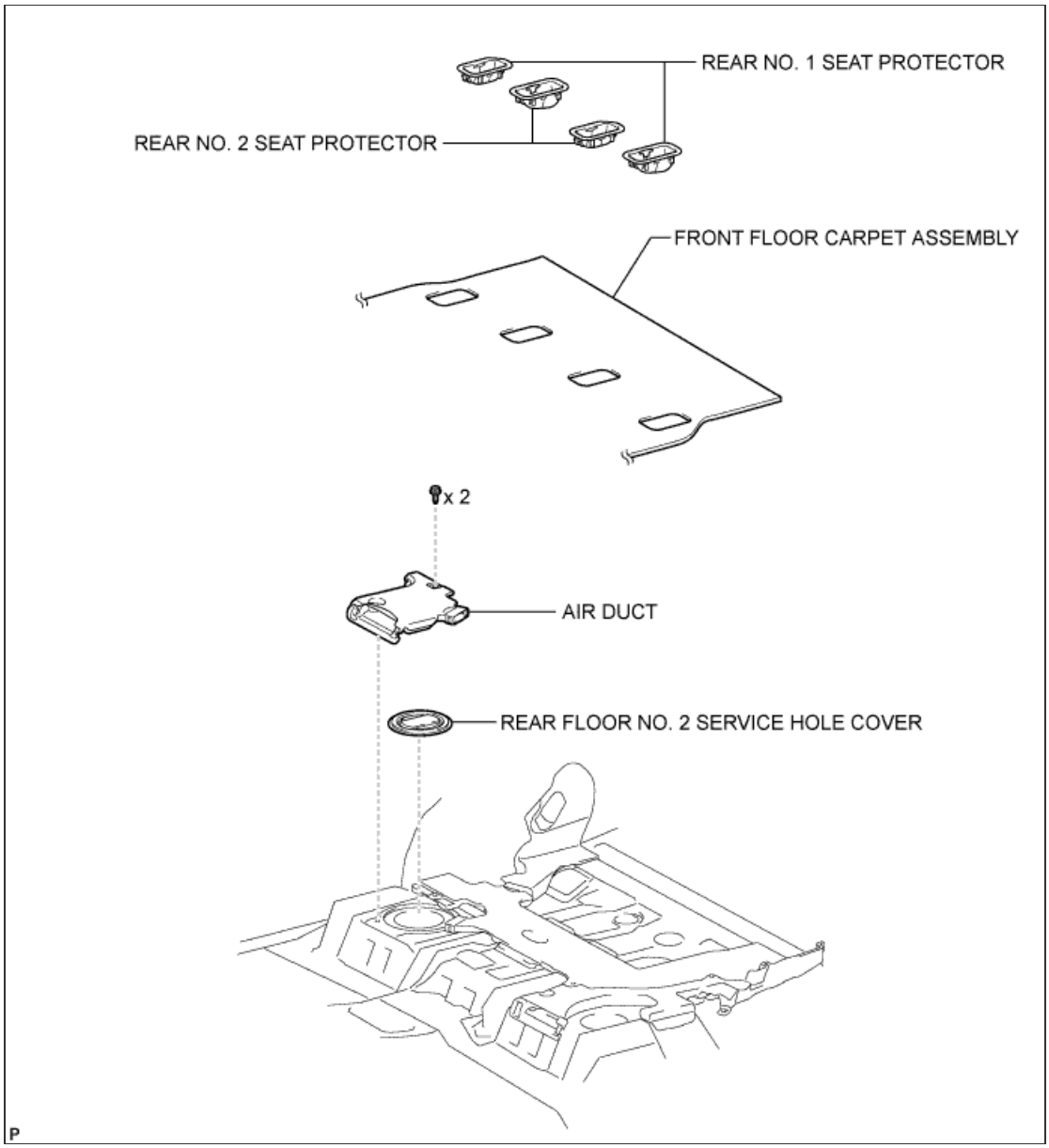
except Face to Face Seat Type:

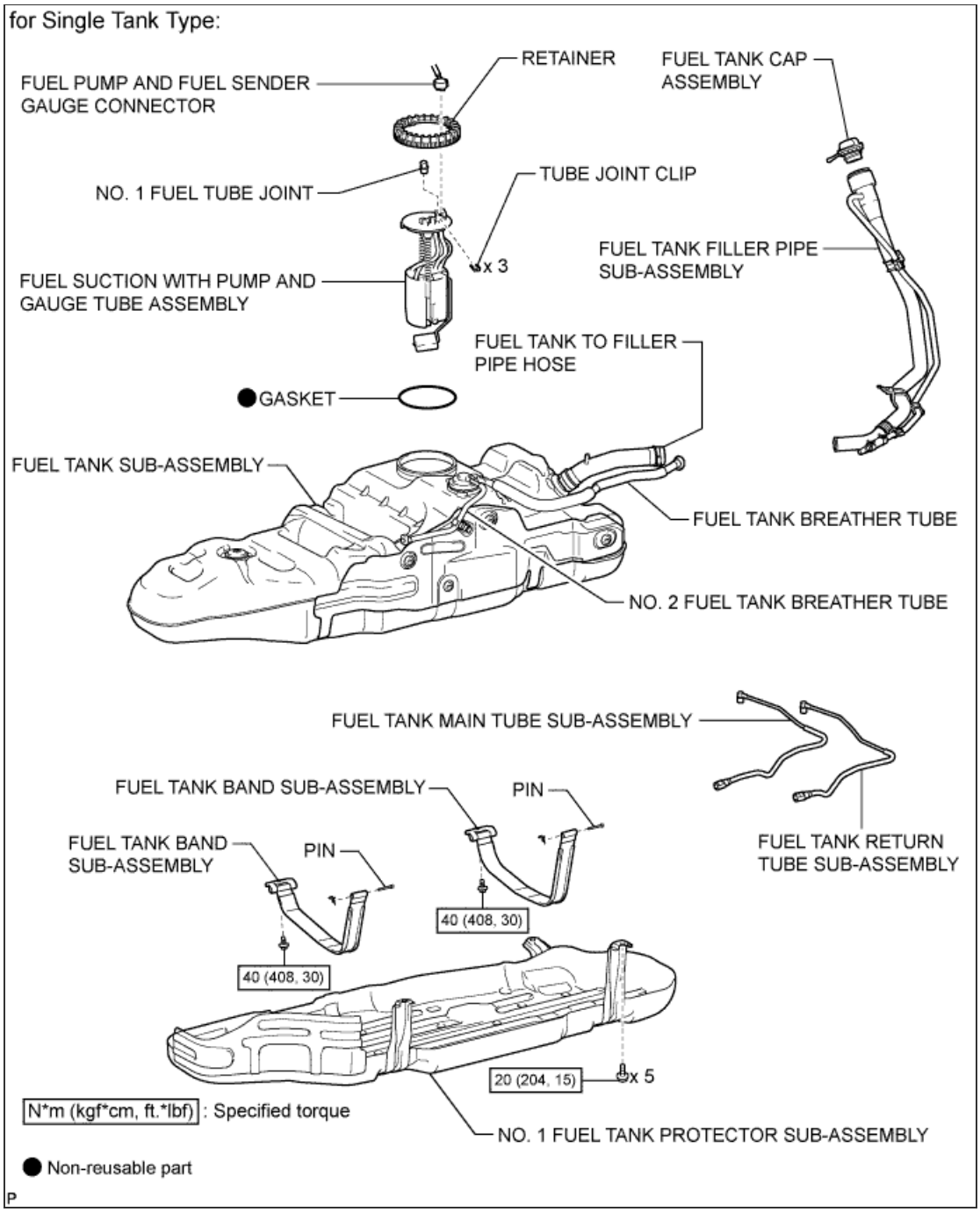


N*m (kgf*cm, ft.*lbf) : Specified torque

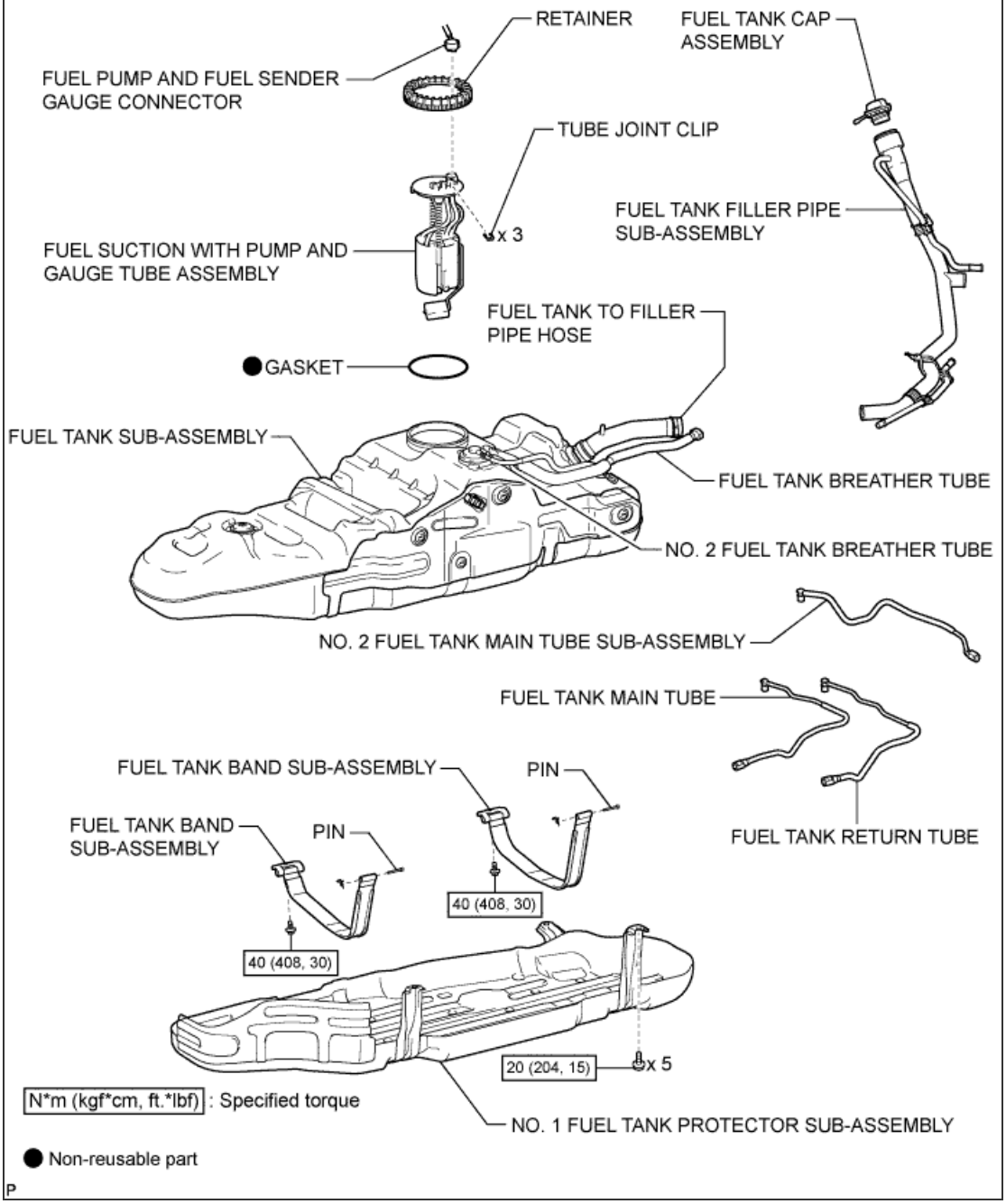
P


OUTER LAP BELT ANCHOR COVER
REAR FLOOR MAT REAR SUPPORT PLATE
SEAT BELT ANCHOR
FRONT QUARTER TRIM PANEL ASSEMBLY RH
12 (122, 9)
REAR SEAT COVER CAP
42 (428, 31)
SEAT BELT ANCHOR
42 (428, 31)
OUTER LAP BELT ANCHOR COVER
REAR SEAT COVER CAP
42 (428, 31)
12 (122, 9)
SEAT BELT ANCHOR
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
42 (428, 31)
FRONT QUARTER TRIM PANEL ASSEMBLY LH
REAR STEP COVER
REAR DOOR SCUFF PLATE RH
REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)
REAR STEP COVER
AIR DUCT PLUG (w/ Rear Air Conditioning System)
REAR DOOR SCUFF PLATE LH
N*m (kgf*cm, ft.*lbf) : Specified torque
T


REAR NO. 1 SEAT PROTECTOR
REAR NO. 2 SEAT PROTECTOR
FRONT FLOOR CARPET ASSEMBLY
x 2
AIR DUCT
REAR FLOOR NO. 2 SERVICE HOLE COVER
P

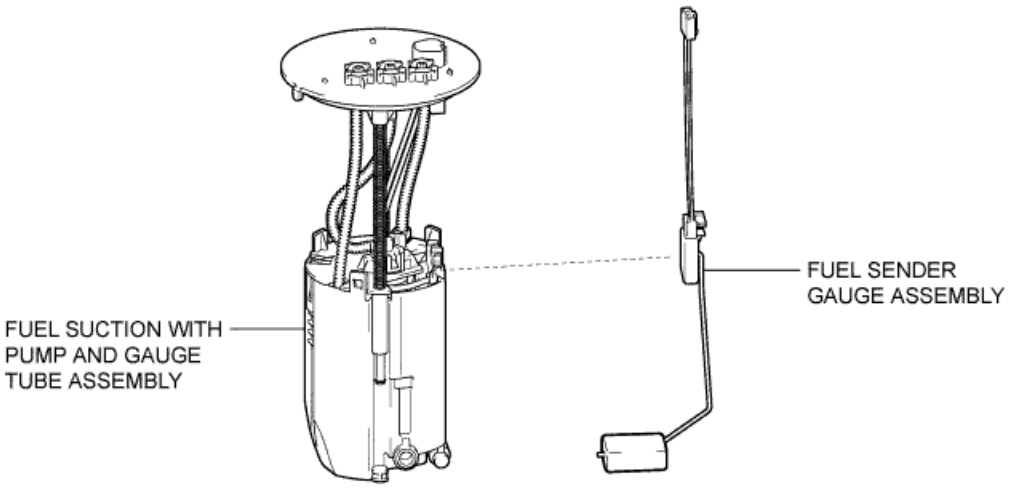

for Single Tank Type:
FUEL PUMP AND FUEL SENDER GAUGE CONNECTOR
RETAINER
FUEL TANK CAP ASSEMBLY
NO. 1 FUEL TUBE JOINT
TUBE JOINT CLIP
x 3
FUEL TANK FILLER PIPE SUB-ASSEMBLY
FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY
FUEL TANK TO FILLER PIPE HOSE
GASKET
FUEL TANK SUB-ASSEMBLY
FUEL TANK BREATHER TUBE
NO. 2 FUEL TANK BREATHER TUBE
FUEL TANK MAIN TUBE SUB-ASSEMBLY
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TANK RETURN TUBE SUB-ASSEMBLY
40 (408, 30)
40 (408, 30)
20 (204, 15)
x 5
N*m (kgf*cm, ft.*lbf) : Specified torque
NO. 1 FUEL TANK PROTECTOR SUB-ASSEMBLY
Non-reusable part
P

for Double Tank Type:

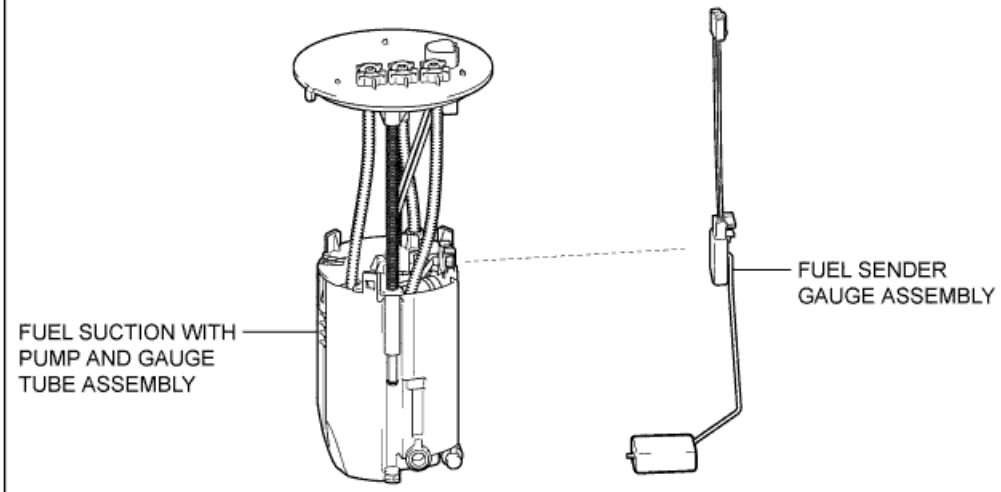


P

for Single Tank Type:



for Double Tank Type:



P

for Preparation Click here

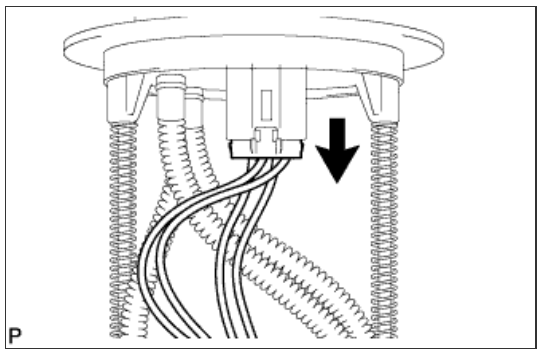
1. REMOVE FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

a. for Single Tank Type:
Remove the fuel suction with pump and gauge tube assembly (Click here).

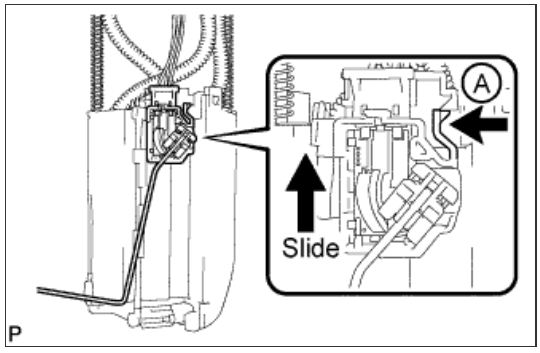
b. for Double Tank Type:
Remove the fuel suction with pump and gauge tube assembly (Click here).

2. REMOVE FUEL SENDER GAUGE ASSEMBLY

a. Disconnect the fuel sender gauge connector.



b. Press down on the sender gauge claw labeled A. Then slide the sender gauge upward to remove it.

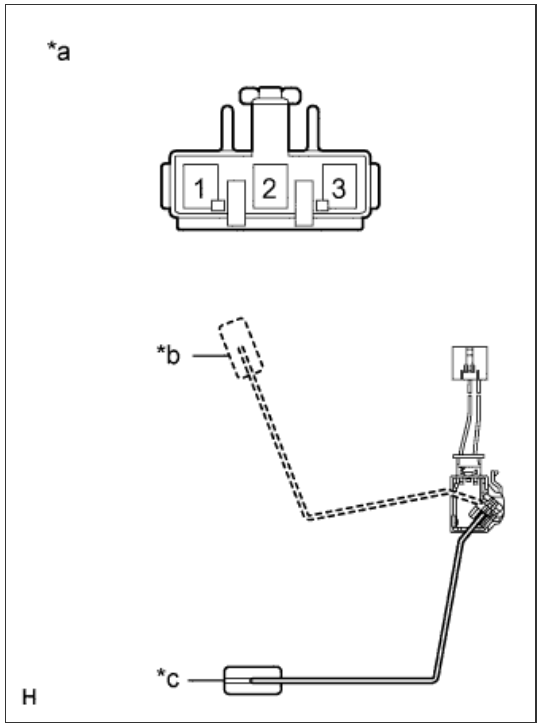


for Preparation Click here

1. INSPECT FUEL SENDER GAUGE ASSEMBLY

Text in Illustration

*a	Component without harness connected (Fuel Sender Gauge)
*b	F (Upper)
*c	E (Lower)



a. Check that the float moves smoothly between F and E.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

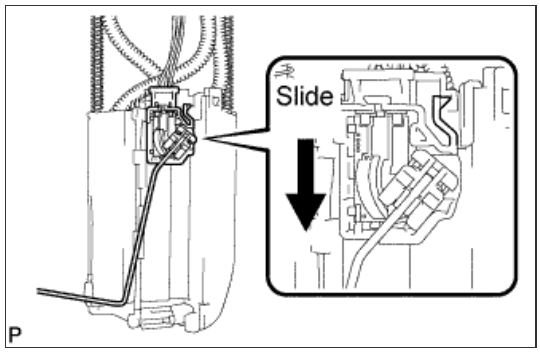
Tester Connection	Condition	Specified Condition
1 - 2	Float level is F (upper)	13.5 to 16.5 Ω
	Float level is E (lower)	405.5 to 414.5 Ω

If the result is not as specified, replace the fuel sender gauge assembly.

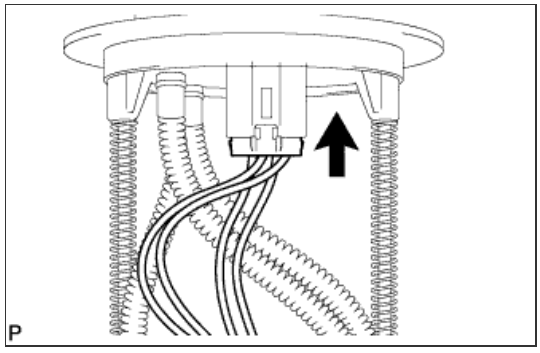
for Preparation Click here

1. INSTALL FUEL SENDER GAUGE ASSEMBLY

a. Set the sender gauge to the fuel sub-tank. Then slide the sender gauge downward to install it.



b. Connect the fuel sender gauge connector.

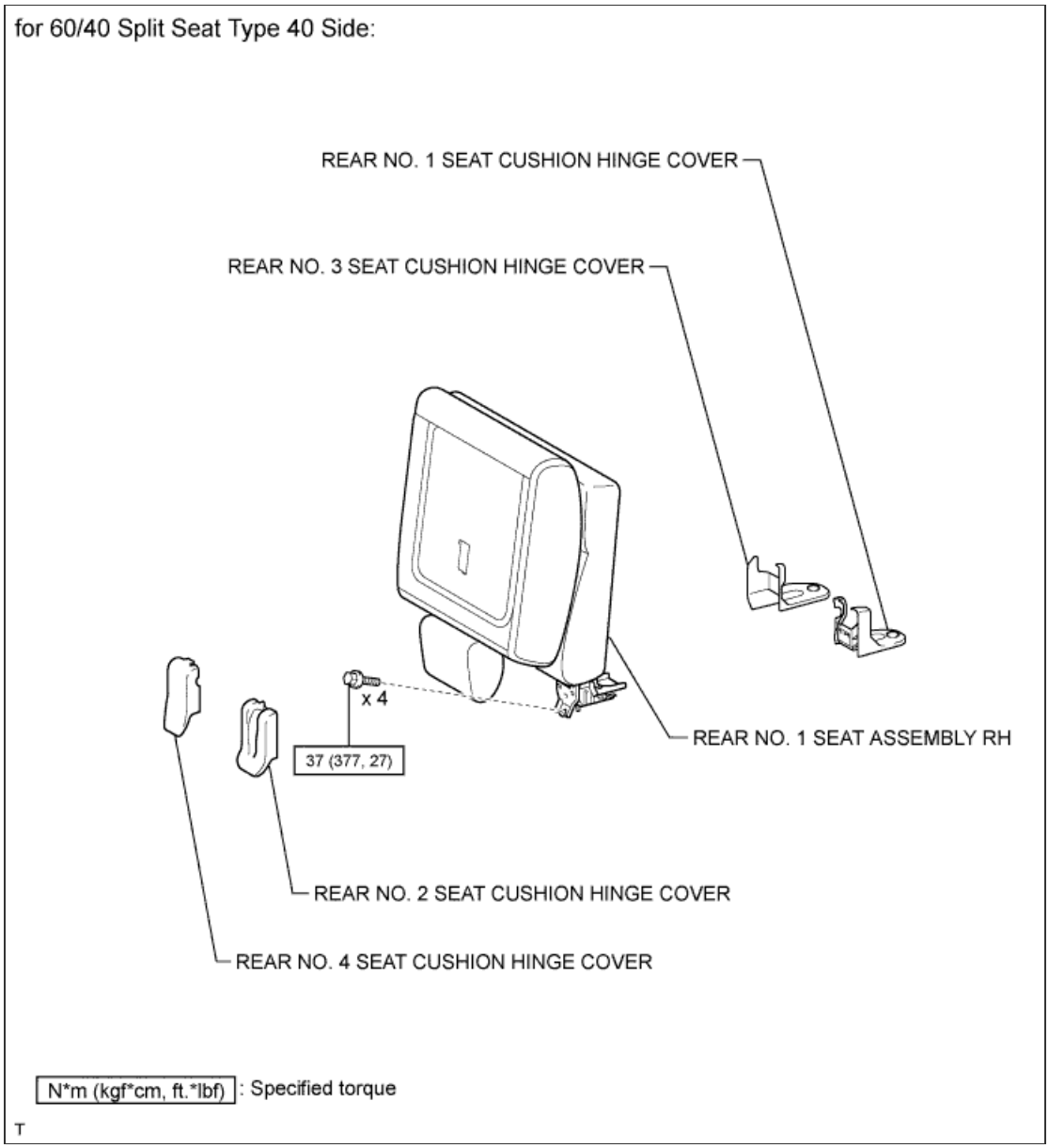


2. INSTALL FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

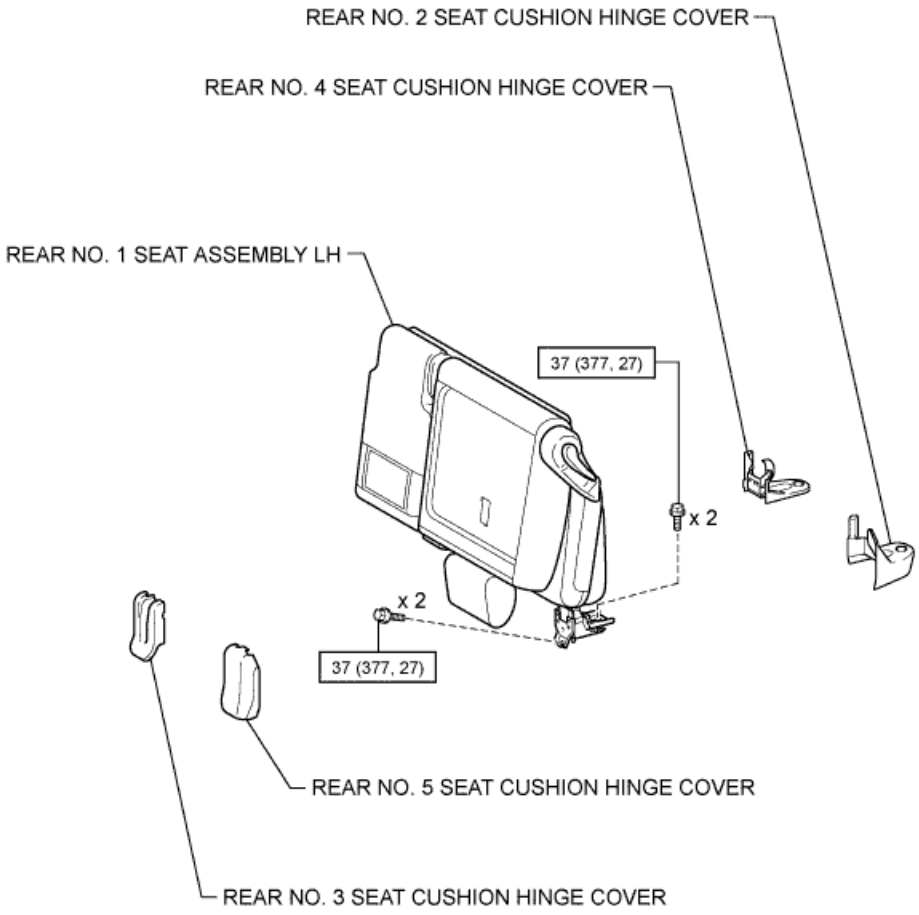
a. for Single Tank Type:
Install the fuel suction with pump and gauge tube assembly (Click here).

b. for Double Tank Type:
Install the fuel suction with pump and gauge tube assembly (Click here).

for Preparation Click here



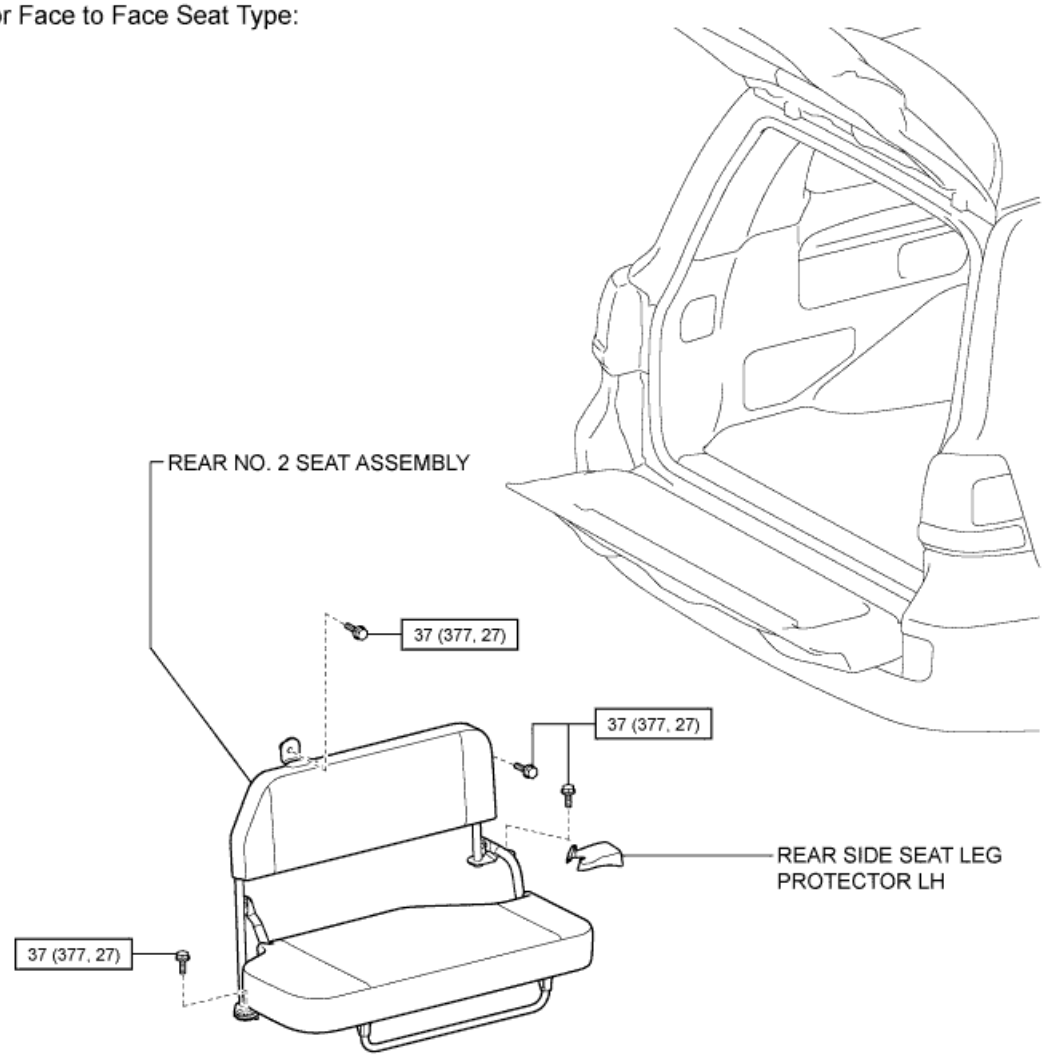
for 60/40 Split Seat Type 60 Side:



N*m (kgf*cm, ft.*lbf) : Specified torque

T

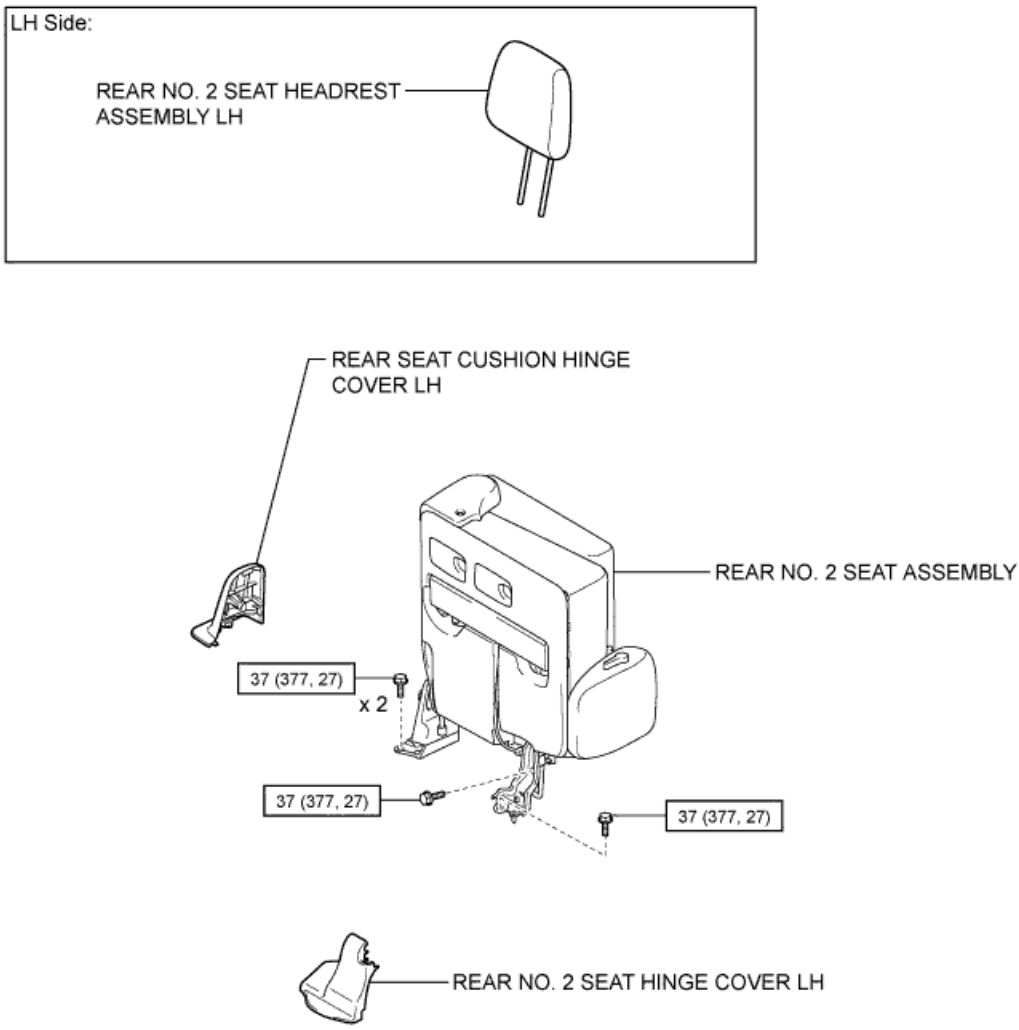
for Face to Face Seat Type:



N*m (kgf*cm, ft.*lbf) : Specified torque

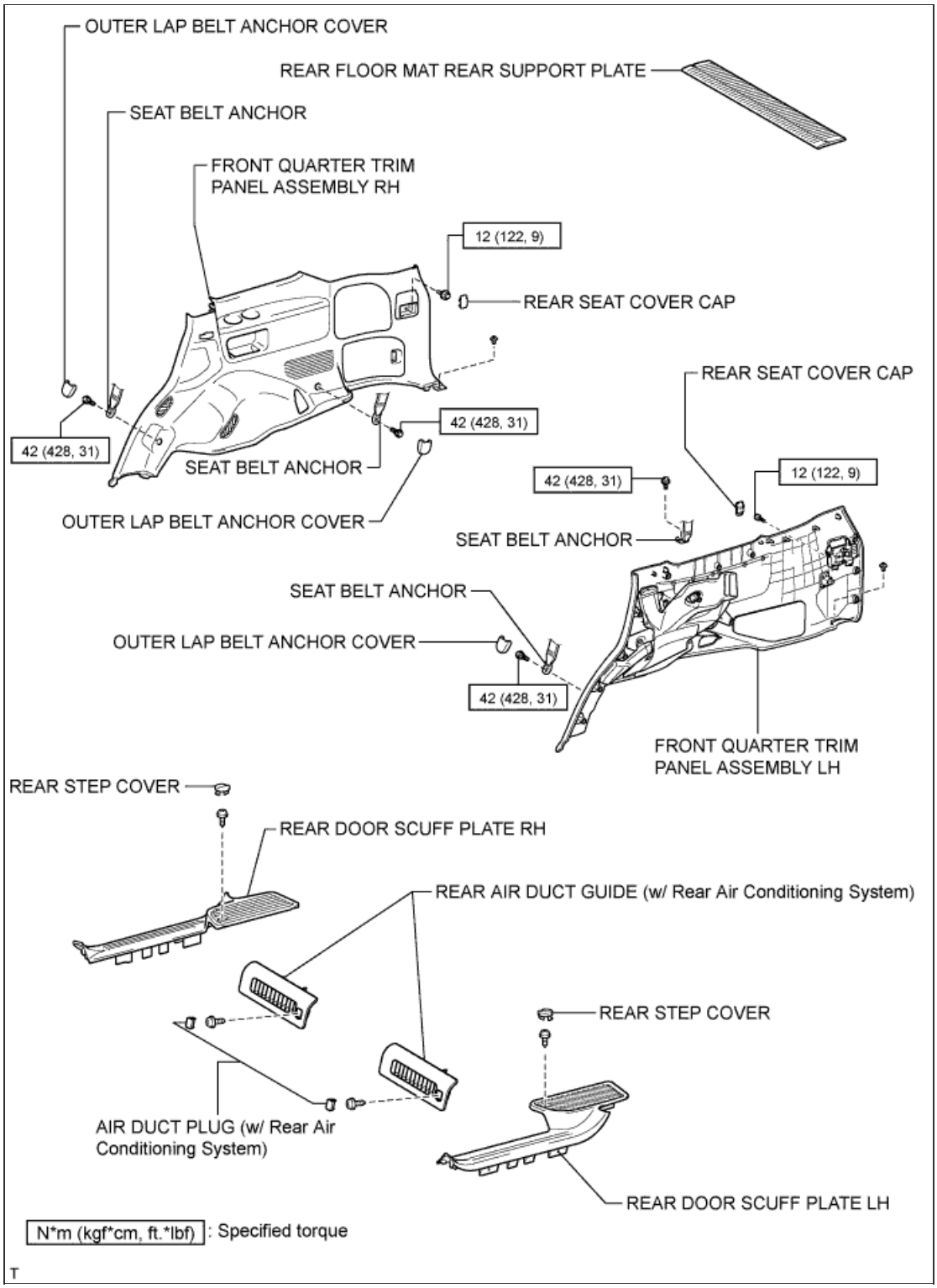
P

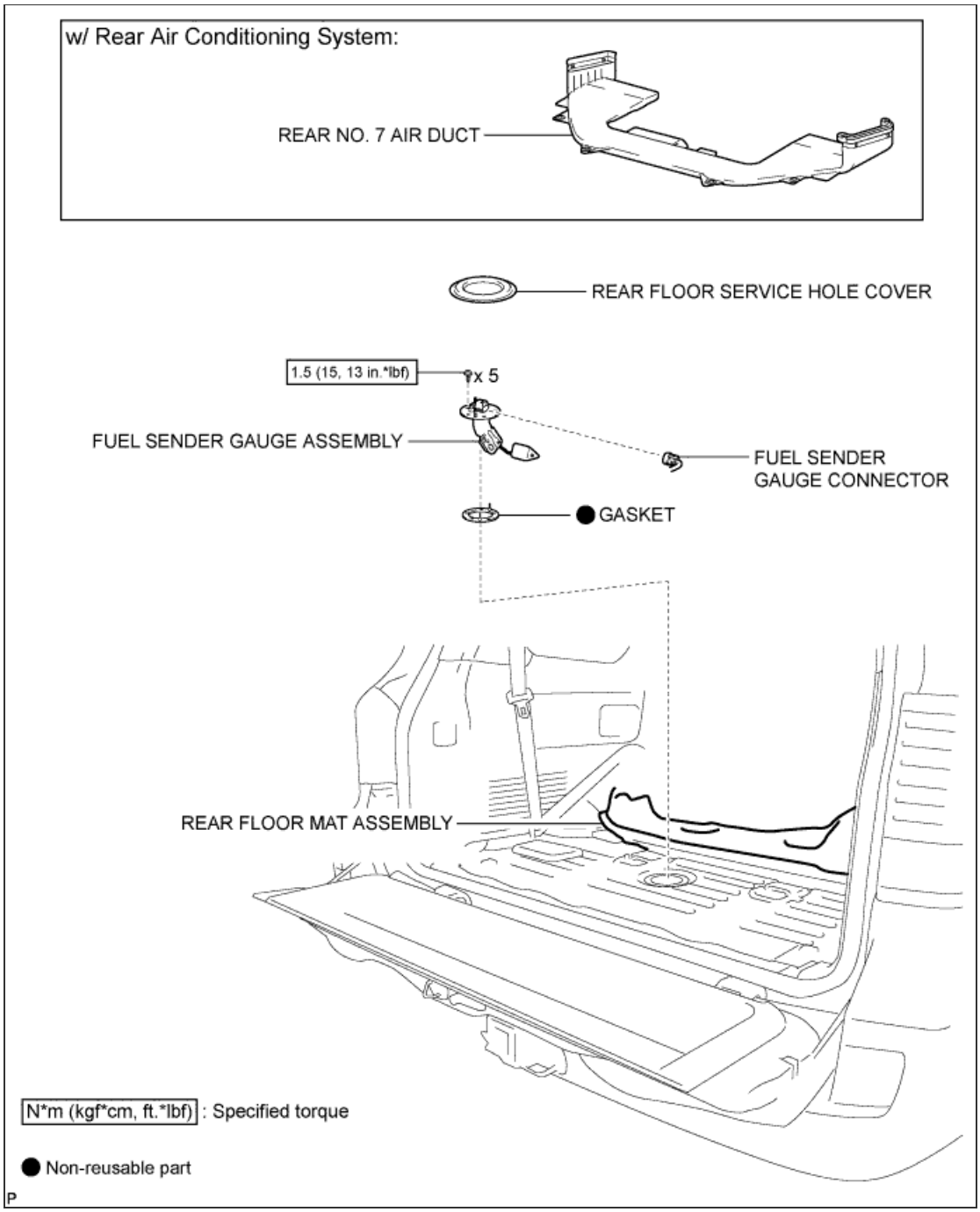
except Face to Face Seat Type:



N*m (kgf*cm, ft.*lbf) : Specified torque

P


OUTER LAP BELT ANCHOR COVER
REAR FLOOR MAT REAR SUPPORT PLATE
SEAT BELT ANCHOR
FRONT QUARTER TRIM PANEL ASSEMBLY RH
12 (122, 9)
REAR SEAT COVER CAP
42 (428, 31)
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
REAR SEAT COVER CAP
42 (428, 31)
12 (122, 9)
SEAT BELT ANCHOR
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
42 (428, 31)
FRONT QUARTER TRIM PANEL ASSEMBLY LH
REAR STEP COVER
REAR DOOR SCUFF PLATE RH
REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)
REAR STEP COVER
AIR DUCT PLUG (w/ Rear Air Conditioning System)
REAR DOOR SCUFF PLATE LH
N*m (kgf*cm, ft.*lbf) : Specified torque
T


w/ Rear Air Conditioning System:
REAR NO. 7 AIR DUCT
REAR FLOOR SERVICE HOLE COVER
1.5 (15, 13 in.*lbf)
x 5
FUEL SENDER GAUGE ASSEMBLY
FUEL SENDER GAUGE CONNECTOR
GASKET
REAR FLOOR MAT ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

FUEL SENDER GAUGE ASSEMBLY (for Fuel Sub Tank) > REMOVAL

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

2. REMOVE REAR NO. 1 SEAT ASSEMBLY RH (for 60/40 Split Seat Type 40 Side)

a. Remove the rear No. 1 seat assembly RH (Click here).

3. REMOVE REAR NO. 1 SEAT ASSEMBLY LH (for 60/40 Split Seat Type 60 Side)

a. Remove the rear No. 1 seat assembly LH (Click here).

4. REMOVE REAR NO. 2 SEAT ASSEMBLY

a. for Face to Face Seat Type:
Remove the rear No. 2 seat assembly (Click here).

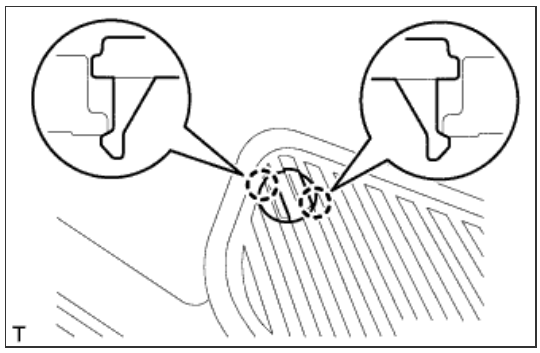
b. except Face to Face Seat Type:
Remove the rear No. 2 seat assembly (Click here).

5. REMOVE REAR STEP COVER

HINT:

Use the same procedure to remove the step cover on the other side.

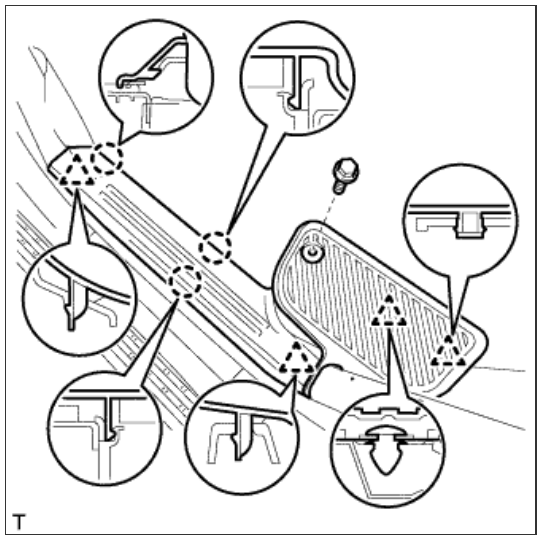
a. Detach the 2 claws and remove the step cover.



6. REMOVE REAR DOOR SCUFF PLATE LH

a. Remove the screw.

b. Detach the 3 claws and 4 clips, and remove the scuff plate.



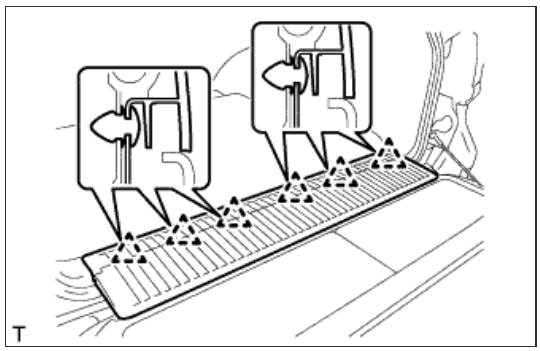
7. REMOVE REAR DOOR SCUFF PLATE RH

HINT:

Use the same procedures described for the LH side.

8. REMOVE REAR FLOOR MAT REAR SUPPORT PLATE

a. Detach the 6 clips and remove the support plate.



9. REMOVE REAR SEAT COVER CAP (w/ Rear No. 2 Seat, except Face to Face Seat Type)

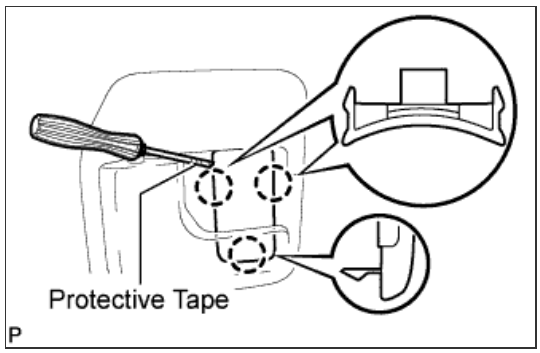
HINT:

Use the same procedure to remove the rear seat cover cap on the other side.

a. Using a screwdriver, detach the 3 claws and remove the rear seat cover cap.

HINT:

Tape the screwdriver tip before use.



10. REMOVE FRONT QUARTER TRIM PANEL ASSEMBLY LH

a. w/ Sliding Roof:
Remove the front quarter trim panel assembly LH (Click here).

b. w/o Sliding Roof:
Remove the front quarter trim panel assembly LH (Click here).

11. REMOVE FRONT QUARTER TRIM PANEL ASSEMBLY RH

a. w/ Sliding Roof:
Remove the front quarter trim panel assembly RH (Click here).

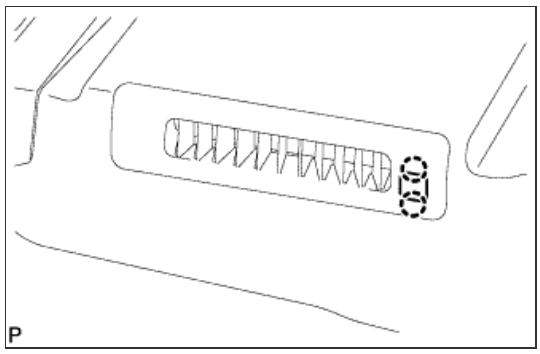
b. w/o Sliding Roof:
Remove the front quarter trim panel assembly RH (Click here).

12. REMOVE AIR DUCT PLUG (w/ Rear Air Conditioning System)

a. Detach the 2 claws and remove the plug.

HINT:

Use the same procedures for both sides.



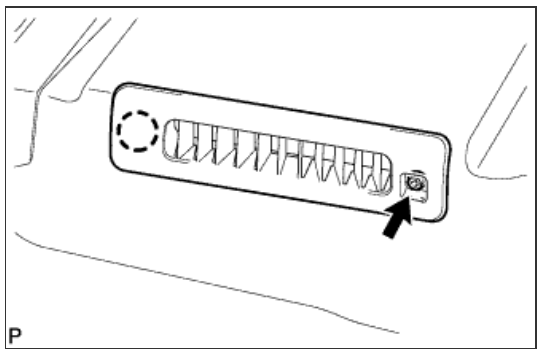
13. REMOVE REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)

a. Remove the screw.

b. Detach the claw and remove the guide.

HINT:

Use the same procedures for both sides.



14. REMOVE REAR FLOOR MAT ASSEMBLY

a. w/ Rear ir Conditioning System:
Detach the 5 clips and fold back the floor mat toward the front of the vehicle.

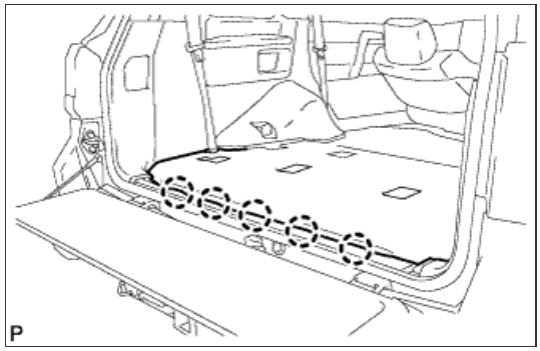
HINT:

Fold back the floor mat so that the rear No. 7 air duct can be removed.

b. w/o Rear ir Conditioning System:
Detach the 5 clips and fold back the floor mat toward the front of the vehicle.

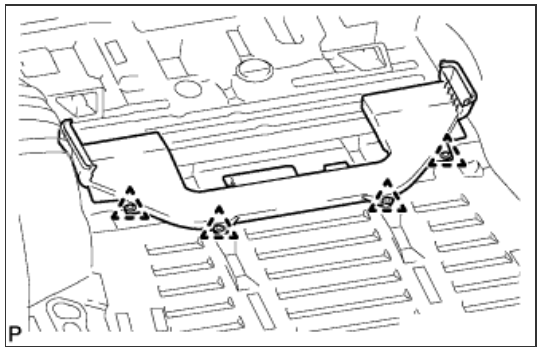
HINT:

Fold back the floor mat so that the service hole cover can be removed.

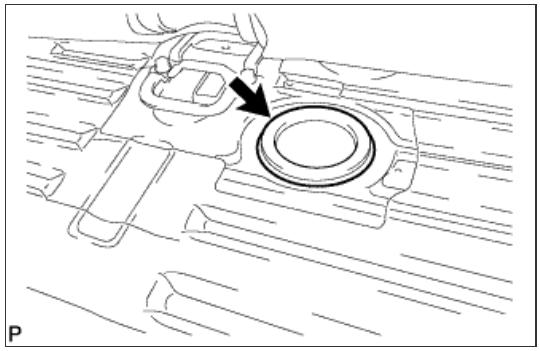


15. REMOVE REAR NO. 7 AIR DUCT (w/ Rear Air Conditioning System)

a. Detach the 4 clips and remove the air duct.



16. REMOVE REAR FLOOR SERVICE HOLE COVER



17. REMOVE FUEL SENDER GAUGE ASSEMBLY

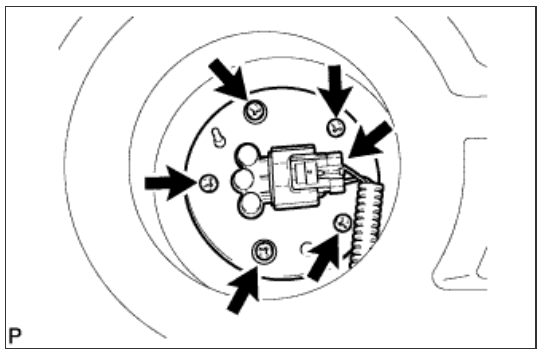
a. Disconnect the sender gauge connector.

b. Remove the 5 screws and sender gauge.

NOTICE:

Be careful not to bend the arm of the fuel sender gauge.

c. Remove the gasket from the sender gauge.



for Preparation Click here

1. INSPECT FUEL SENDER GAUGE ASSEMBLY

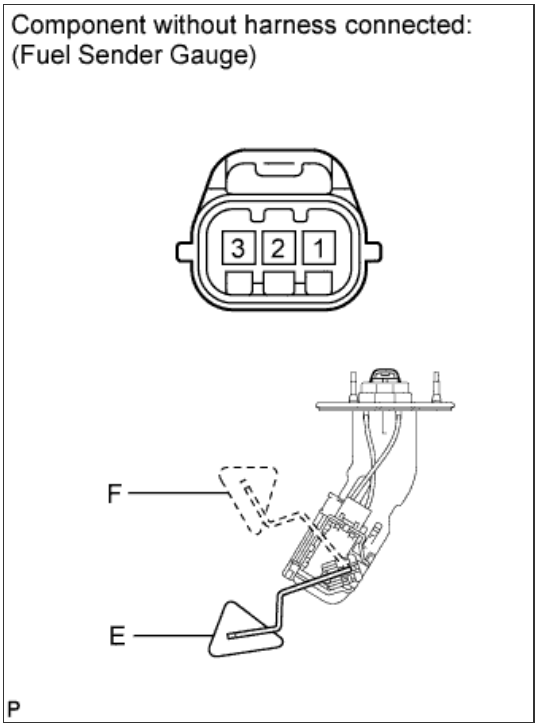
a. Check that the float moves smoothly between F and E.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
2 - 3	Float level is F (upper)	12 to 18 Ω
	Float level is E (lower)	405 to 415 Ω

If the result is not as specified, replace the fuel sender gauge assembly.



for Preparation Click here

1. INSTALL FUEL SENDER GAUGE ASSEMBLY

a. Install a new gasket to the sender gauge.

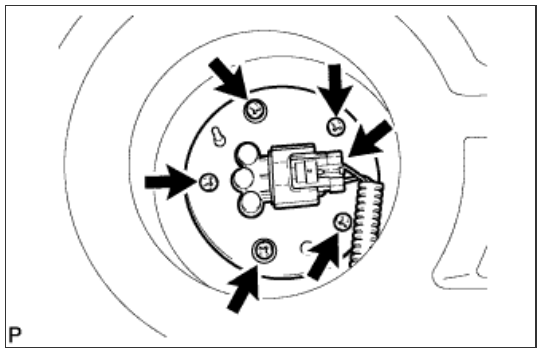
b. Install the sender gauge with the 5 screws.

Torque:
1.5 N*m{ 15 kgf*cm , 13 in.*lbf }

NOTICE:

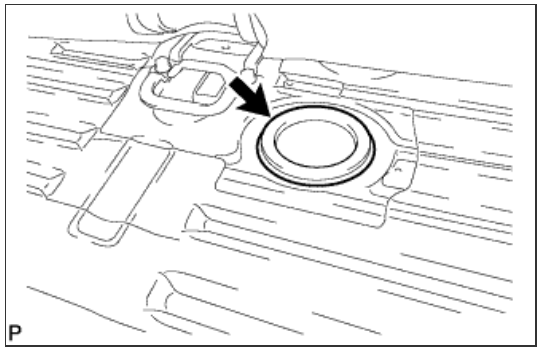
Be careful not to bend the arm of the fuel sender gauge.

c. Connect the sender gauge connector.



2. INSTALL REAR FLOOR SERVICE HOLE COVER

a. Install the service hole cover with new butyl tape.

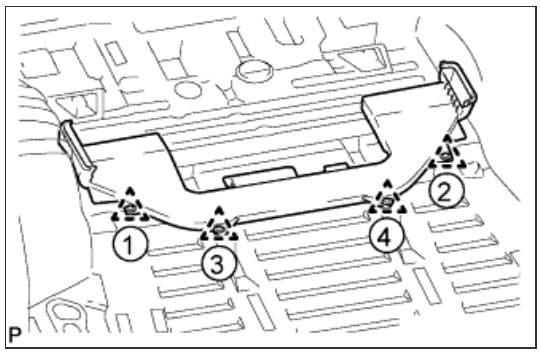


3. INSTALL REAR NO. 7 AIR DUCT (w/ Rear Air Conditioning Sy tem)

a. Attach the 4 clips to install the air duct.

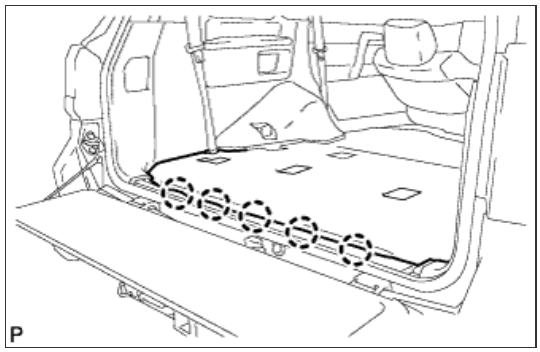
HINT:

Attach the clips in the order shown in the illustration.



4. INSTALL REAR FLOOR MAT ASSEMBLY

a. Attach the 5 clips to install the floor mat.



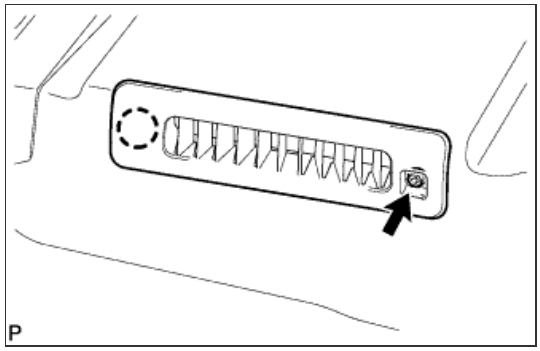
5. INSTALL REAR AIR DUCT GUIDE (w/ Rear Air Conditioning Sy tem)

a. Attach the claw to install the guide.

b. Install the screw.

HINT:

Use the same procedures for both sides.

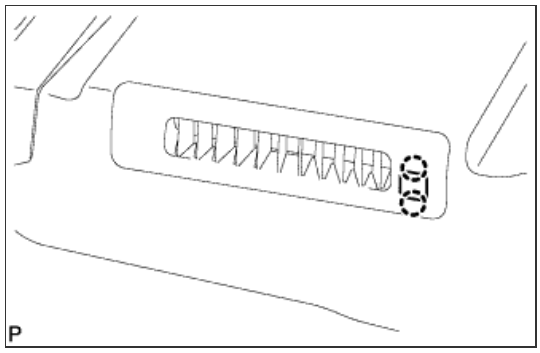


6. INSTALL AIR DUCT PLUG (w/ Rear Air Conditioning Sy tem)

a. Attach the 2 claws to install the plug.

HINT:

Use the same procedures for both sides.



7. INSTALL FRONT ARTER TRIM PANEL ASSEMBLY LH

a. w/ Sliding Roof:
Install the front quarter trim panel assembly LH (Click here).

b. w/o Sliding Roof:
Install the front quarter trim panel assembly LH (Click here).

8. INSTALL FRONT ARTER TRIM PANEL ASSEMBLY RH

a. w/ Sliding Roof:
Install the front quarter trim panel assembly RH (Click here).

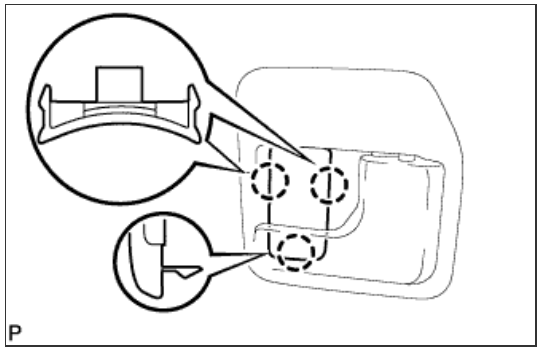
b. w/o Sliding Roof:
Install the front quarter trim panel assembly RH (Click here).

9. INSTALL REAR SEAT COVER CAP (w/ Reat No. 2 Seat, except Face to Face Seat Type)

HINT:

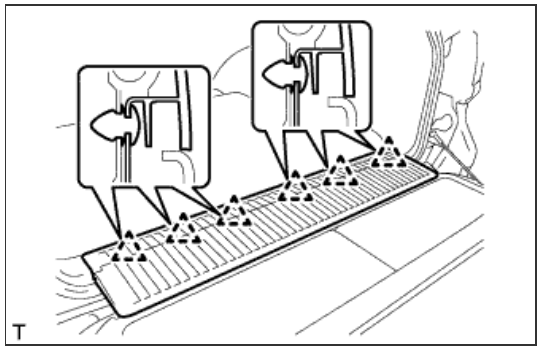
Use the same procedure to install the rear seat cover cap on the other side.

a. Attach the 3 claws to install the rear seat cover cap.



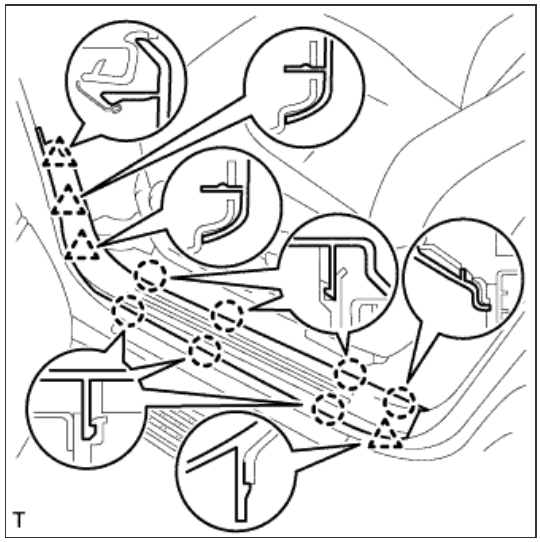
10. INSTALL REAR FLOOR MAT REAR SUPPORT PLATE

a. Attach the 6 clips to install the support plate.



11. INSTALL REAR DOOR SCUFF PLATE LH

a. Attach the 7 claws and 4 clips to install the scuff plate.



12. INSTALL REAR DOOR SCUFF PLATE RH

HINT:

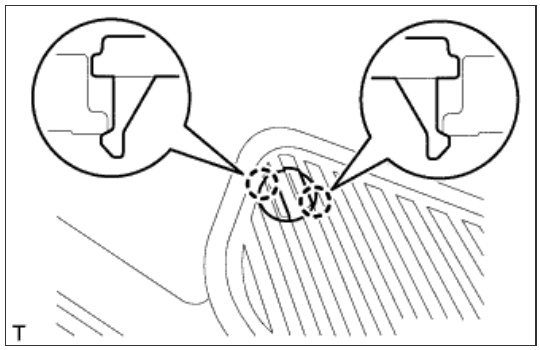
Use the same procedures described for the LH side.

13. INSTALL REAR STEP COVER

HINT:

Use the same procedure to install the step cover on the other side.

a. Attach the 2 claws to install the step cover.



14. INSTALL REAR NO. 2 SEAT ASSEMBLY

a. for Face to Face Seat Type:
Install the rear No. 2 seat assembly (Click here).

b. except Face to Face Seat Type:
Install the rear No. 2 seat assembly (Click here).

15. INSTALL REAR NO. 1 SEAT ASSEMBLY RH (for 60/40 Split Seat Type 40 Side)

a. Install the rear No. 1 seat assembly RH (Click here).

16. INSTALL REAR NO. 1 SEAT ASSEMBLY LH (for 60/40 Split Seat Type 60 Side)

a. Install the rear No. 1 seat assembly LH (Click here).

17. INSTALL CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

18. CHECK SRS WARNING LIGHT

a. Check the SRS warning light (Click here).

for Preparation Click here

CAUTION:

- **Before working on the fuel system, disconnect the cable from the negative (-) battery terminal.**
- **Do not smoke or be near an open flame when working on the fuel system.**
- **Keep gasoline away from rubber and leather parts.**

1.DISCHARGE FUEL SYSTEM PRESSURE

CAUTION:

- **Do not disconnect any part of the fuel system until you have discharged the fuel system pressure.**
- **After discharging the fuel pressure, place a cloth or equivalent over fittings as you separate them to reduce the risk of fuel spray on yourself or in the engine compartment.**

a. Remove the engine room relay block cover.

b. Remove the circuit opening relay (C/OPN).

c. Start the engine. After the engine has stopped on its own, turn the engine switch off.

HINT:

If DTC P0230 is output, clear the DTC (Click here).

d. Crank the engine, then check that the engine does not start.

e. Loosen the fuel tank cap, and then discharge the pressure in the fuel tank completely.

f. Disconnect the cable from the negative (-) battery terminal.

NOTICE:

hen disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

g. Install the circuit opening relay (C/OPN).

h. Install the engine room relay block cover.

.FUEL SYSTEM

a. hen disconnecting the high fuel pressure line, a large amount of gasoline will spill out. Follow these procedures.

i. Perform the Discharge Fuel System Pressure procedures above.

ii. Put a container under the connecting part of the pressure line.

iii. Slowly loosen the connection.

iv. Disconnect the connection.

v. Plug the connection with a rubber plug and cover it with a plastic bag.

b. Observe these precautions when installing the injectors:

- Never reuse the O-ring.
- hen placing a new O-ring on the injector, do not damage it.
- Coat a new O-ring with spindle oil or gasoline before installing it. Do not use engine oil, gear oil or brake oil.

c. Install the injector to the delivery pipe and cylinder head as shown in the illustration.

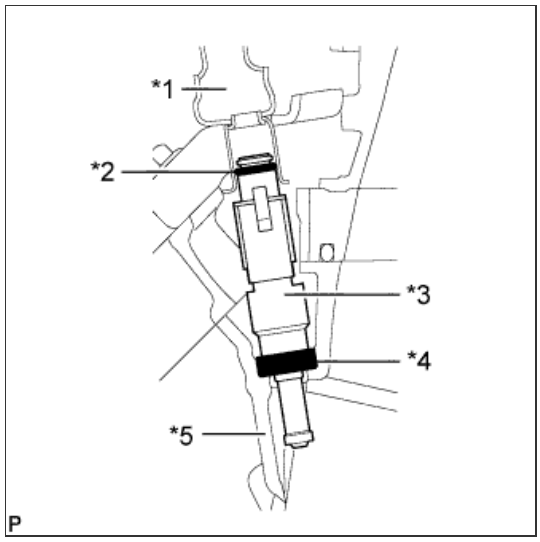
Text in Illustration

*1	Delivery Pipe
*2	O-Ring
*3	Injector
*4	Insulator

*5	Cylinder Head

NOTICE:

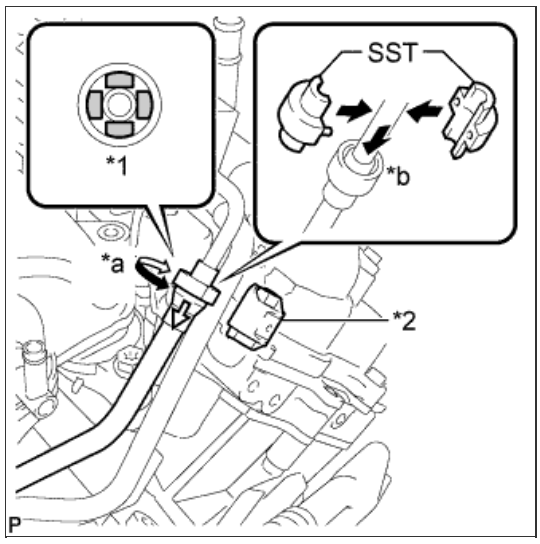
Before installing the injector, apply spindle oil or gasoline on the place where the delivery pipe contacts the O-ring of the injector.



d. Observe these precautions when disconnecting the fuel tube connector (for metallic type):

Text in Illustration

*1	Retainer
*2	No. 2 Fuel Pipe Clamp
*a	Turn
*b	Push



NOTICE:

Do not forcibly bend or twist the fuel main tube.

i. Remove the No. 2 fuel pipe clamp.

NOTICE:

Do not reuse the No. 2 fuel pipe clamp.

ii. ipe off any dirt on the fuel tube connector.

iii. Hold the fuel tube connector and install SST.

SST
09 - 1 11

iv. Turn SST to align the retainer inside the fuel tube connector with the chamfered part of SST.

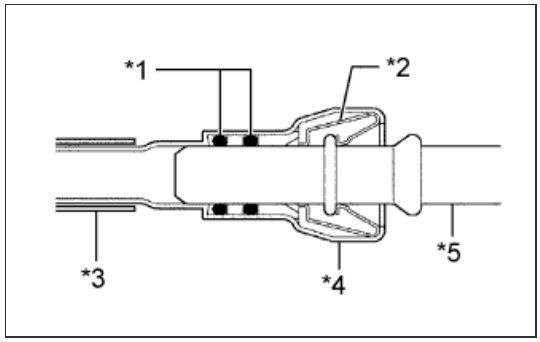
v. Insert SST into the fuel tube connector and hold it. Then push the fuel tube connector toward SST.

vi. Mount the retainer of the fuel tube connector onto the chamfered part of SST.

vii. Slide SST and the fuel tube connector together towards the fuel tube until they make a click sound, and then disconnect the fuel tube.

Text in Illustration

*1	O-Ring
*2	Retainer
*3	Nylon Tube
*4	Housing
*5	Pipe



HINT:

The structure of a fuel tube connector is as shown in the illustration.

viii. Drain the fuel remaining inside the fuel tube.

ix. Cover the fuel tube and fuel pipe with a plastic bag to protect the disconnected parts.

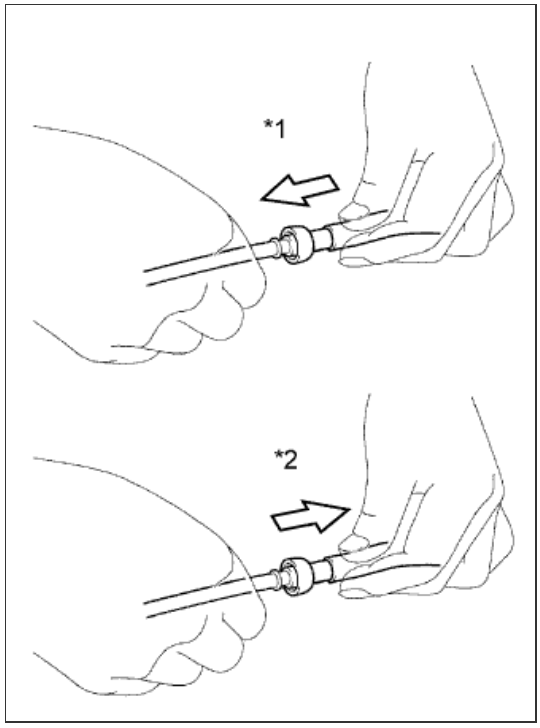
e. Observe these precautions when connecting the fuel tube connector (for metallic type):

i. Check if there is any damage or foreign objects on the pipe connection area.

ii. Match the axis of the connector with the axis of the pipe, and push the pipe into the connector until the connector makes a click sound. If the pipe is difficult to push into the connector, apply a small amount of clean engine oil to the tip of the pipe.

Text in Illustration

*1	Push
*2	Pull



iii. After connecting, check if the pipe and the connector are securely connected by pulling on them.

iv. Install a new No. 2 fuel pipe clamp.

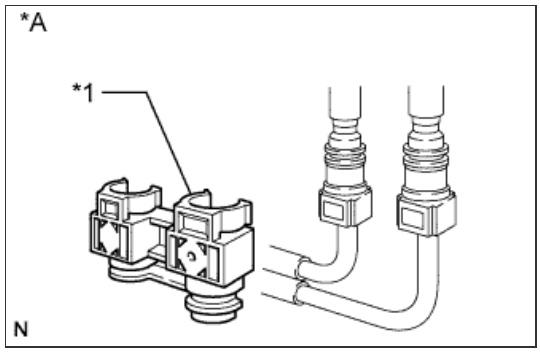
v. Check that there is no fuel leakage.

f. Observe these precautions when disconnecting the fuel tube connector (for quick type A).

i. for Fuel Pipe Clamp Type:
Remove the fuel pipe clamp from the fuel tube connector.

Text in Illustration

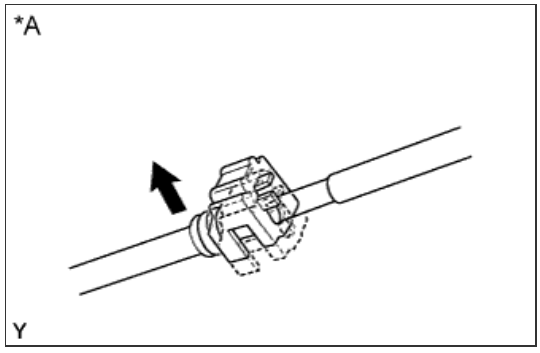
*A	for Fuel Pipe Clamp Type
*1	Fuel Pipe Clamp



ii. for Fuel Hose Connector Cover Type:
Detach the lock claw by lifting up the cover, as shown in the illustration.

Text in Illustration

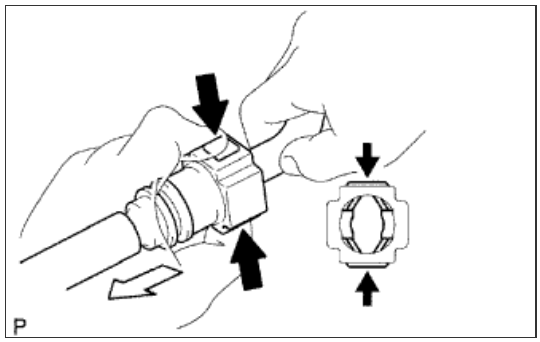
*A	for Fuel Hose Connector Cover Type
➡	Pull



iii. Check for dirt or mud on the pipe and around the connector before disconnection. Clean if necessary.

iv. Pinch the connector and disconnect the connector and pipe.

If the connector and the pipe are stuck together, pinch the connector, then push and pull the pipe to disconnect the pipe and pull it out.



Text in Illustration

➡	Pinch
⇨	Pull

NOTICE:

Do not use any tools in this procedure.

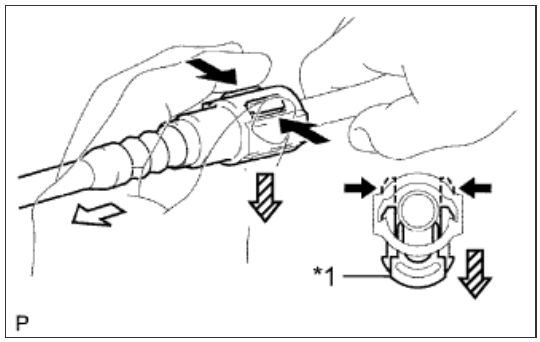
v. Check for dirt or mud on the seal surface of the disconnected pipe. Clean if necessary.

vi. To protect the disconnected pipe and connector from damage and contamination, cover it with a plastic bag.

g. Observe these precautions when disconnecting the fuel tube connector (for quick type B).

i. Check that there is no damage or foreign matter on the part of the pipe that contacts the connector.

ii. Detach the 2 claws of the connector retainer. Push down on the connector and disconnect it from the pipe.

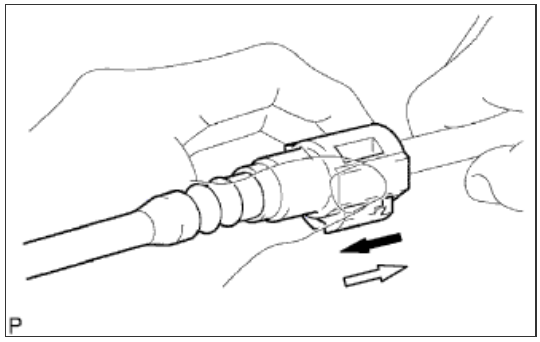


Text in Illustration

*1	Retainer
➡	Push
⇨	Pull
⇩	Down

HINT:

If the connector and pipe are stuck, pinch the fuel pipe by hand, and push and pull the connector to disconnect it.



Text in Illustration

➡	Pull
⇨	Push

NOTICE:

Do not use any tools in this procedure.

iii. Check for foreign matter on the seal surface of the disconnected pipe. Clean it if necessary.

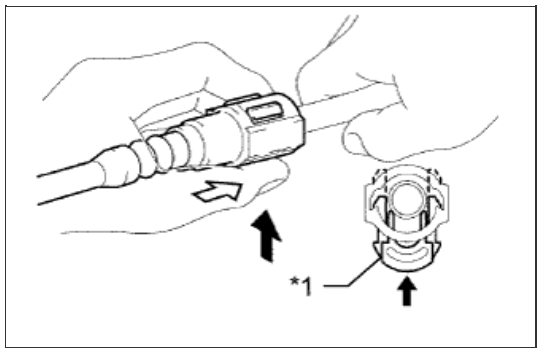
iv. To protect the disconnected pipe and connector from damage and foreign matter, cover it with a plastic bag.

h. Observe these precautions when connecting the fuel tube connector (for quick type B).

iii. Observe these precautions when connecting the fuel tube connector (for quick type B).

i. Check for foreign matter on the pipe and around the connector before connecting it. Clean it if necessary.

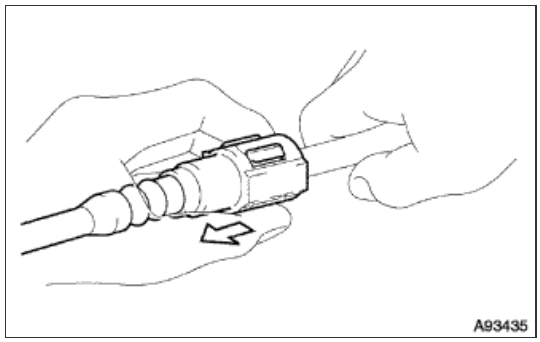
ii. Align the axis of the connector with the axis of the pipe. Push the pipe into the connector, and push up on the retainer.



Text in Illustration

*1	Retainer
➡	Push
⇨	Push

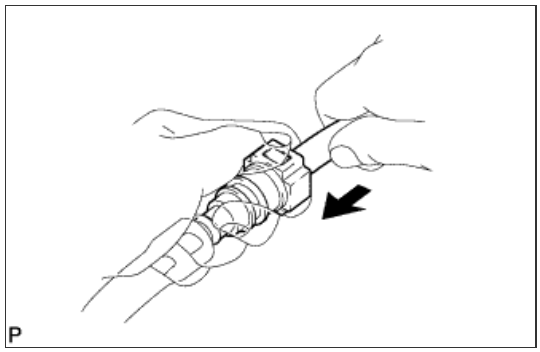
iii. After connecting the pipe and connector, try to pull them apart to confirm that they are securely connected.



Text in Illustration

⇨	Pull

i. Observe these precautions when connecting the fuel tube connector (for quick type A).



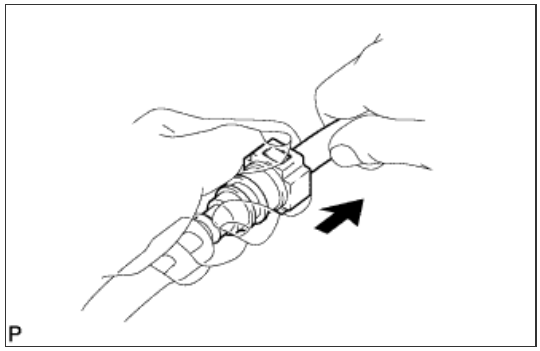
i. Check that there is no damage or contamination in the connection part of the pipe.

ii. Align the axis of the connector with the axis of the pipe. Push the pipe into the connector until the connector makes a click sound. If the connection is tight, apply a small amount of fresh spindle oil or gasoline on the tip of the pipe.

Text in Illustration

➡	Push

iii. After having finished the connection, try to pull apart the pipe and the connector to confirm that they are securely connected.



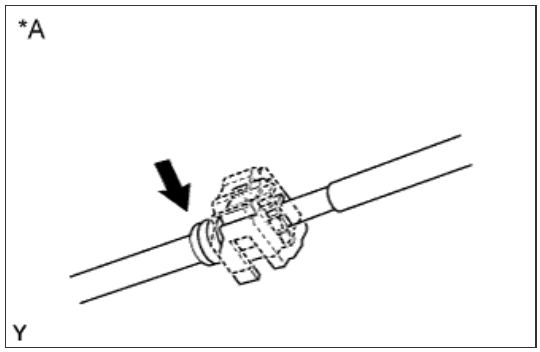
Text in Illustration

➡	Pull

iv. for Fuel Hose Connector Cover Type:
Attach the lock claw to the connector by pushing down on the cover, as shown in the illustration.

Text in Illustration

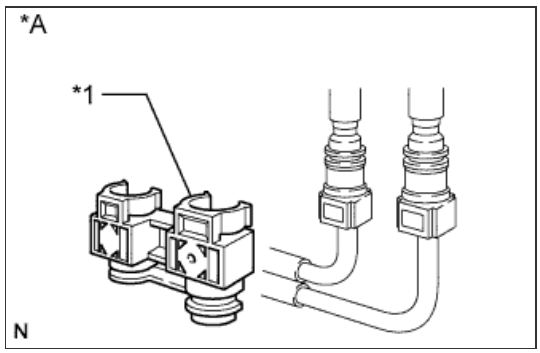
*A	for Fuel Hose Connector Cover Type
➡	Push



v. for Fuel Pipe Clamp Type:
Install the fuel pipe clamp to the connector.

Text in Illustration

*A	for Fuel Pipe Clamp Type
*1	Fuel Pipe Clamp

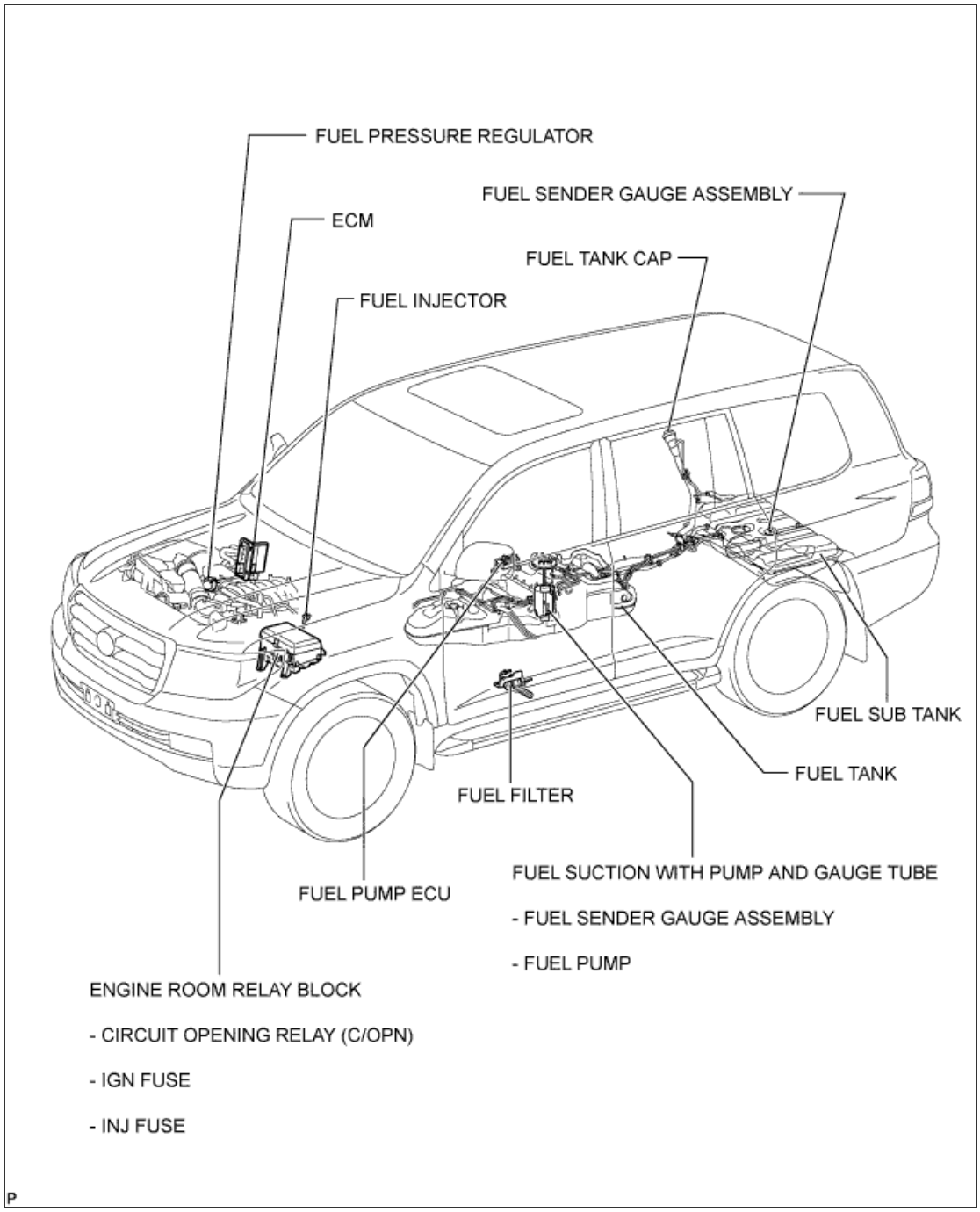


vi. Check that there is no fuel leakage.

3.CHECK FOR FUEL LEAK

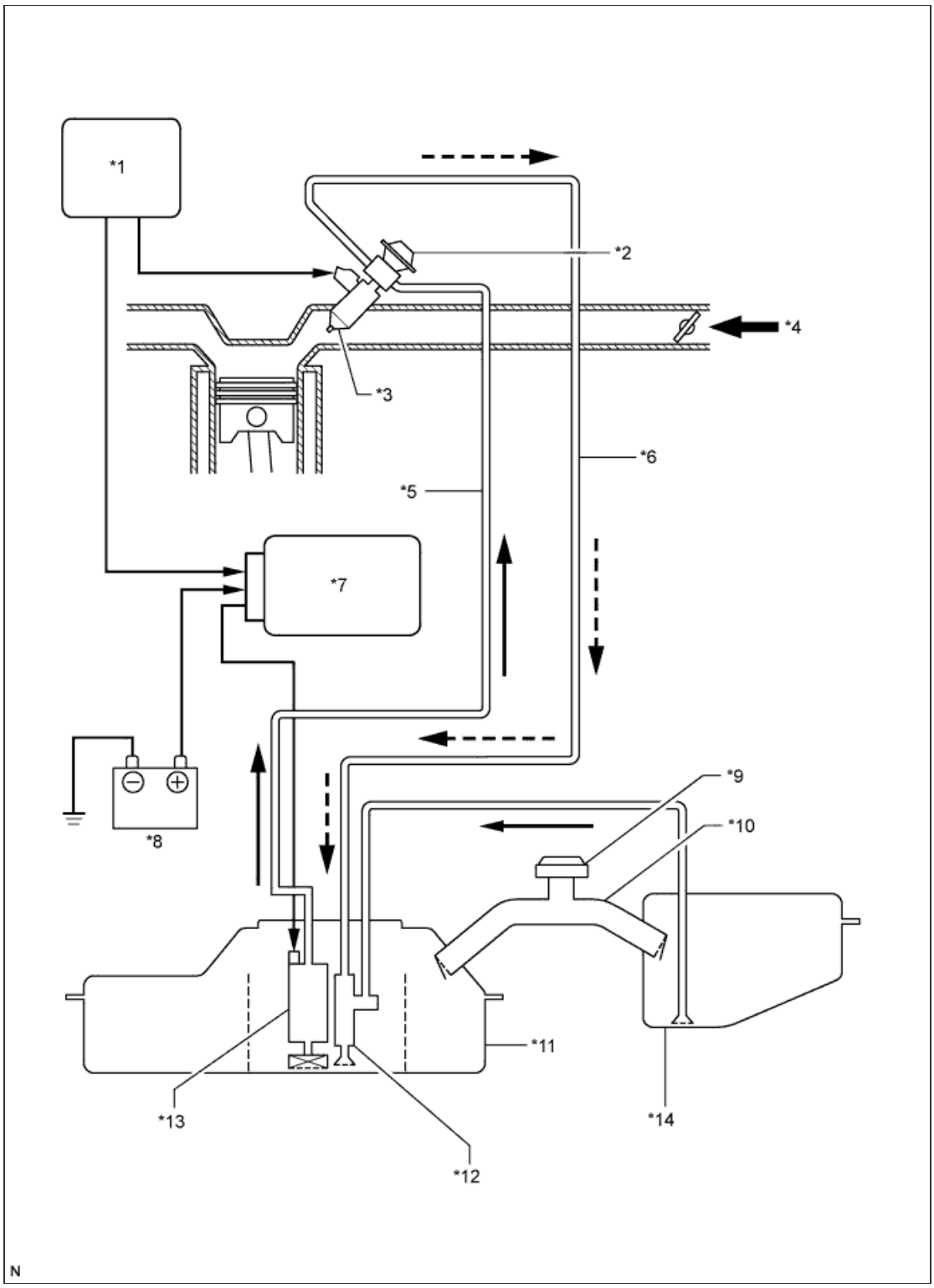
a. Check that there are no fuel leaks after performing maintenance anywhere on the fuel system (Click here).

for Preparation Click here



for Preparation Click here

FUEL FLOW DIAGRAM

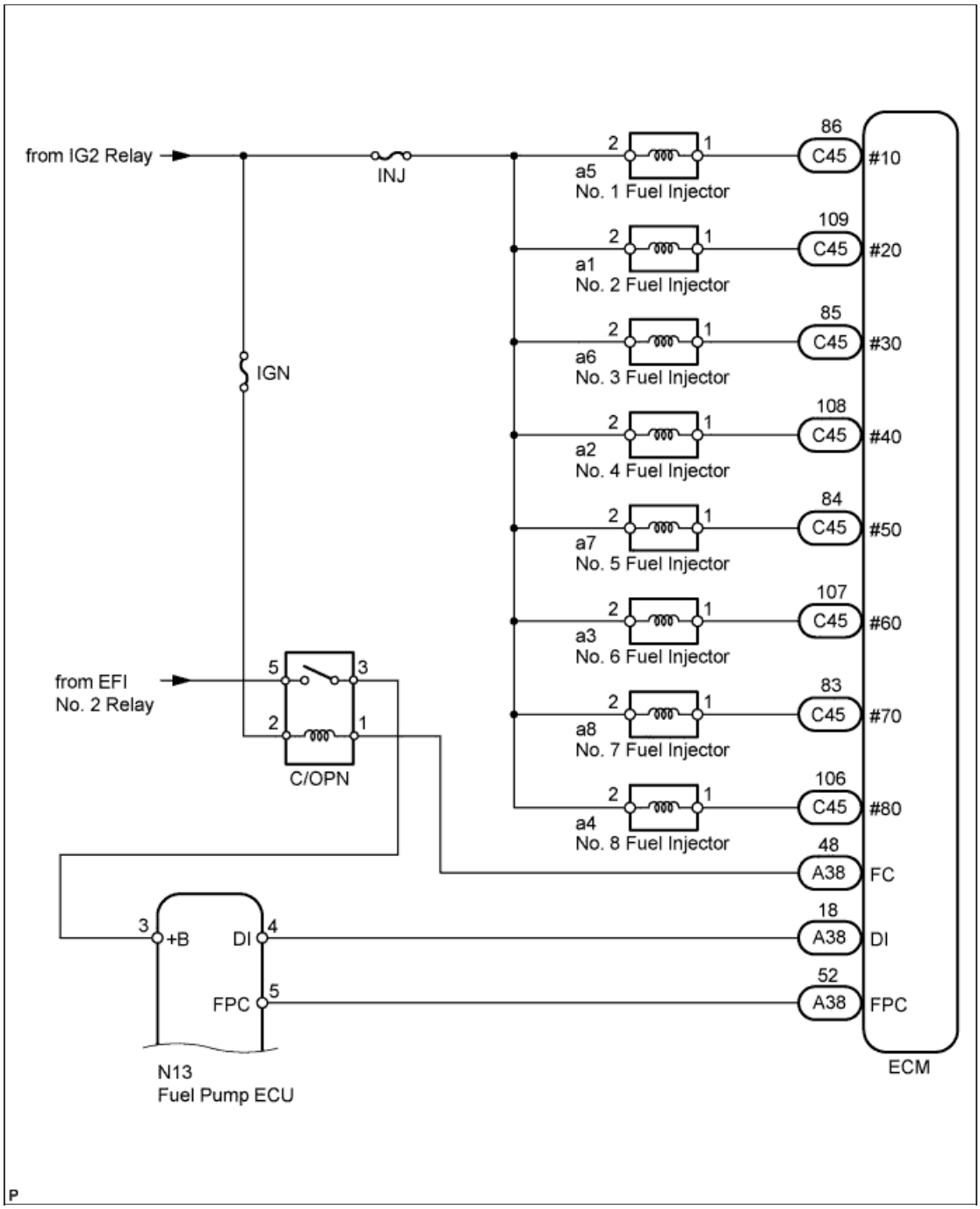


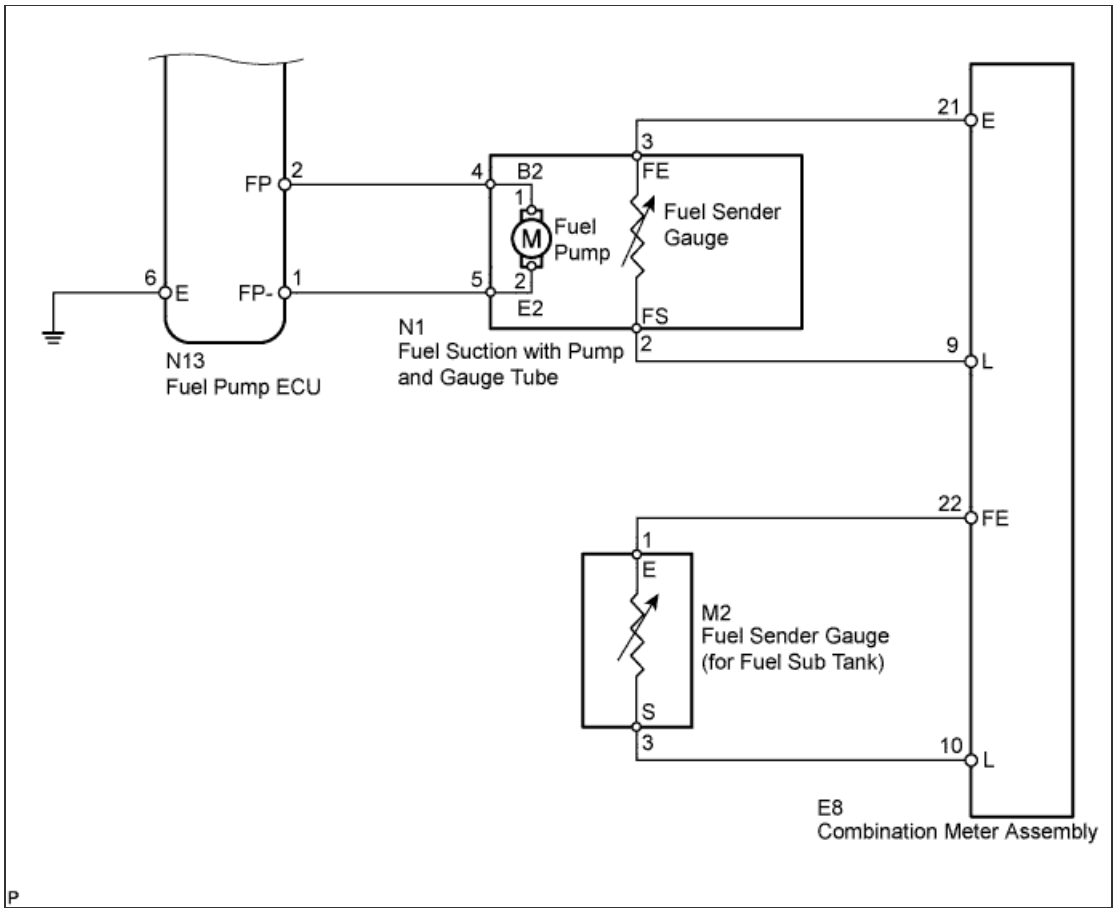
Text in Illustration

*1	ECM	*2	Fuel Pressure Regulator
*3	Fuel Injector	*4	Intake Air
*5	Fuel Main Tube	*6	Fuel Return Tube
*7	Fuel Pump ECU	*8	Battery
*9	Fuel Tank Cap	*10	Fuel Filler Pipe

*11	Fuel Tank	*12	Jet Pump
*13	Fuel Suction with Pump and Gauge Tube - Fuel Sender Gauge Assembly - Fuel Pump	*14	Fuel Sub Tank - Fuel Sender Gauge Assembly

ELECTRICAL CONTROL DIAGRAM




21
E
3
FE
FP
2
4
B2
1
Fuel
Pump
Fuel Sender
Gauge
6
E
FP-
1
5
2
E2
FS
N1
Fuel Suction with Pump
and Gauge Tube
2
9
L
N13
Fuel Pump ECU
22
FE
1
E
M2
Fuel Sender Gauge
(for Fuel Sub Tank)
S
3
10
L
E8
Combination Meter Assembly
P

for Preparation Click here

1. CHECK FUEL PUMP OPERATION AND FOR FUEL LEAK

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG).

NOTICE:

Do not start the engine.

c. Turn the intelligent tester main switch on.

d. Enter the following menus: Powertrain Engine and ECT tive Test Control the Fuel Pump / Speed.

e. Check the fuel pump operation.

i. Check for pressure in the fuel inlet tube from the fuel line. Check that the sound of fuel flowing in the fuel tank can be heard.
If there is no sound, check the integration relay, fuel pump, ECM and wiring connector.

f. Check for fuel leak.

i. Check that there are no fuel leaks after performing maintenance anywhere on the system.
If there are fuel leaks, repair or replace parts as necessary.

2. CHECK FUEL PRESSURE

a. Check that the battery voltage is 11 to 14 V.

b. Perform the "Discharge Fuel System Pressure" procedures (Click here).

c. Disconnect the cable from the negative (-) battery terminal.

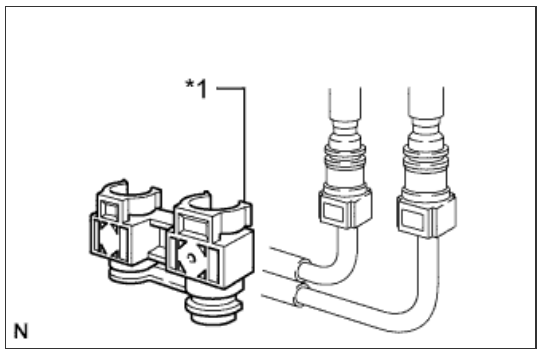
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

d. Remove the fuel pipe clamp from the fuel tube connector.

Text in Illustration

*1	Fuel Pipe Clamp

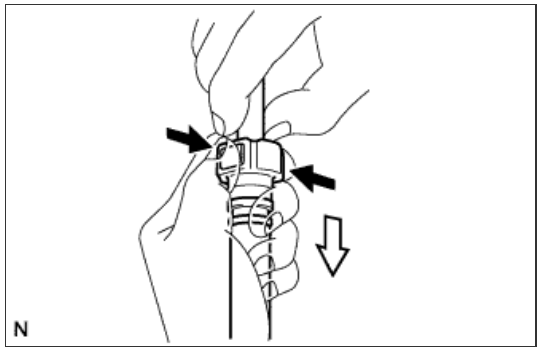


e. Pinch and pull the fuel tube (fuel tube connector) to disconnect it.

Text in Illustration

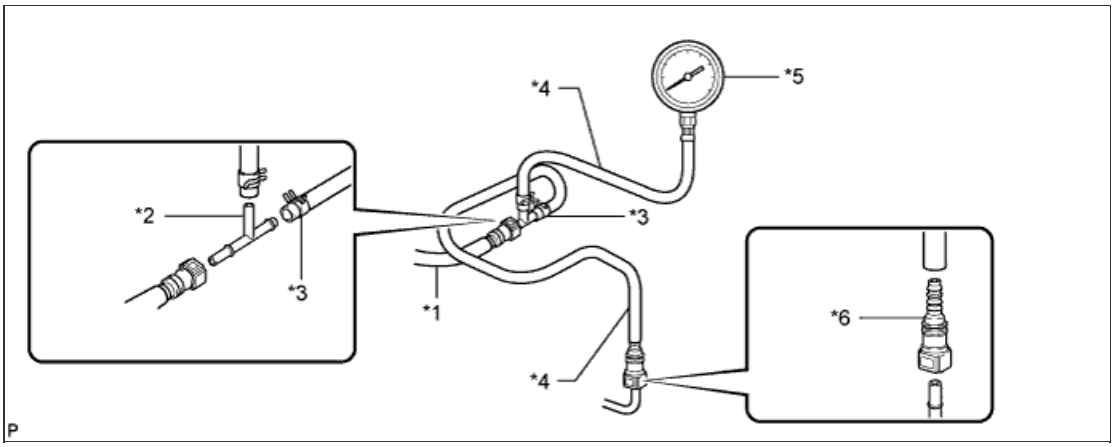
⇒	Pinch
⇨	Pull

CAUTION:



- **Always read the precautions (Click here) before disconnecting the fuel tube connector (quick type).**
- **The fuel tube may spray fuel as a result of pressure that remains in it. Do not allow fuel to be sprayed in the engine compartment.**

f. Install SST (pressure gauge) as shown in the illustration.



Text in Illustration

*1	Fuel Tube	*2	SST (T-joint)
*3	SST (Clip)	*4	SST (Hose)
*5	SST (Gauge)	*6	SST (Fuel Tube Connector)

SST

09268-31012 (09268-41120, 09268-41500, 90467-13001, 95336-08070)
09268-45014 (09268-41200, 09268-41220)

g. Wipe off any gasoline.

h. Reconnect the cable to the negative (-) battery terminal.

i. Operate the fuel pump.

i. Connect the intelligent tester to the DLC3.

ii. Turn the engine switch on (IG).

NOTICE:

Do not start the engine.

iii. Turn the intelligent tester main switch on.

iv. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Fuel Pump / Speed.

j. Measure the fuel pressure.

Standard fuel pressure:
281 to 287 kPa (2.87 to 2.93 kgf/cm ^{2}, 41 to 42 psi)

If the pressure is higher than the specification, replace the fuel pressure regulator.
If the pressure is below the specification, check the fuel hoses and connections, fuel pump, fuel filter and fuel pressure regulator assembly.

k. Start the engine.

l. Measure the fuel pressure.

Standard fuel pressure:
281 to 287 kPa (2.87 to 2.93 kgf/cm ^{2}, 41 to 42 psi)

If the pressure is not as specified, check the fuel pump, pressure regulator and/or injectors.

m. Stop the engine.

n. Check that the fuel pressure remains as specified for 5 minutes after the engine has stopped.

Standard fuel pressure:

147 kPa (1.5 kgf/cm^2, 21 psi) or more

If the pressure is not as specified, check the fuel pump, pressure regulator and/or injectors.

o. Disconnect the cable from the negative (-) battery terminal and carefully remove SST and the fuel tube connector to prevent gasoline from spraying.

NOTICE:

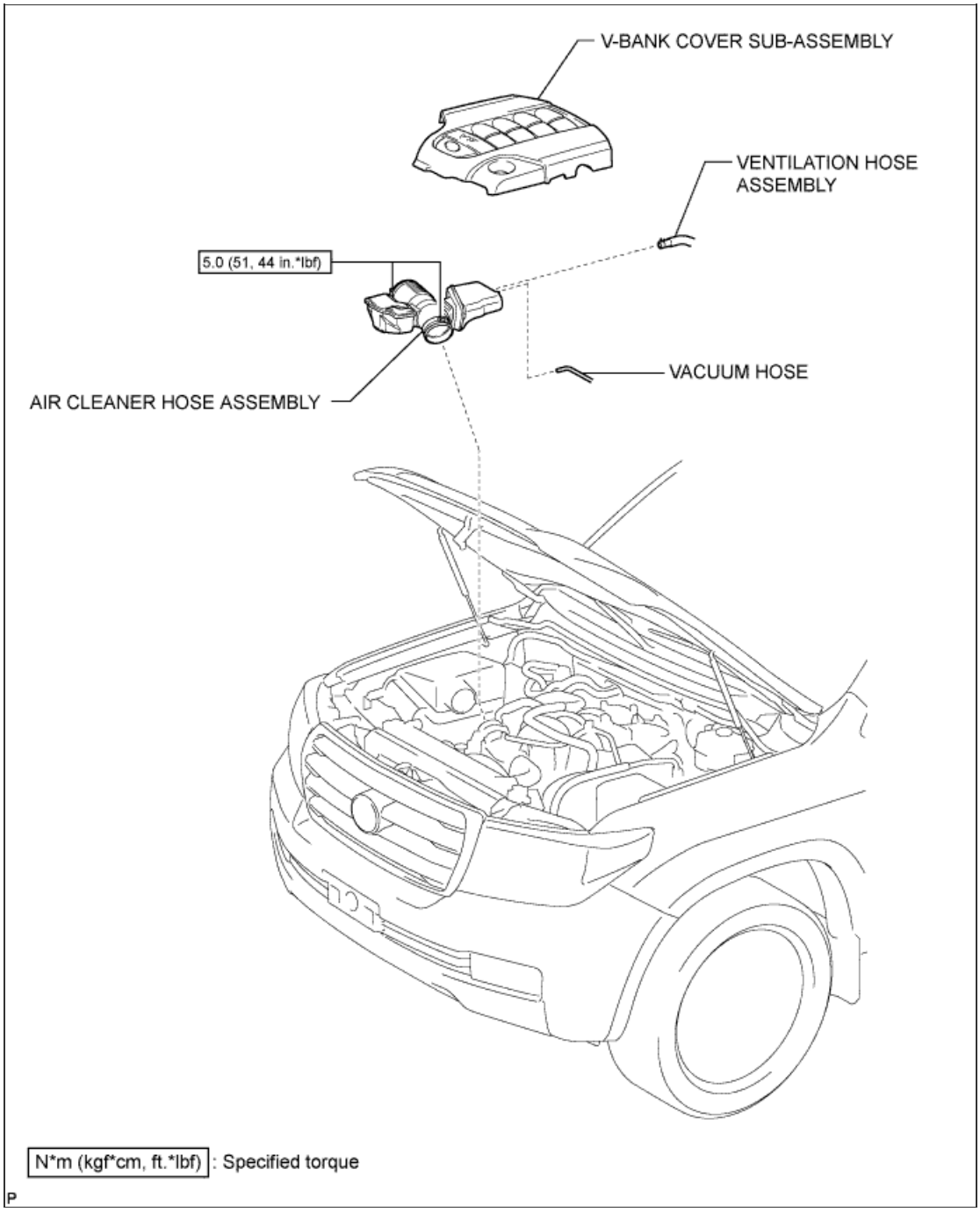
When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

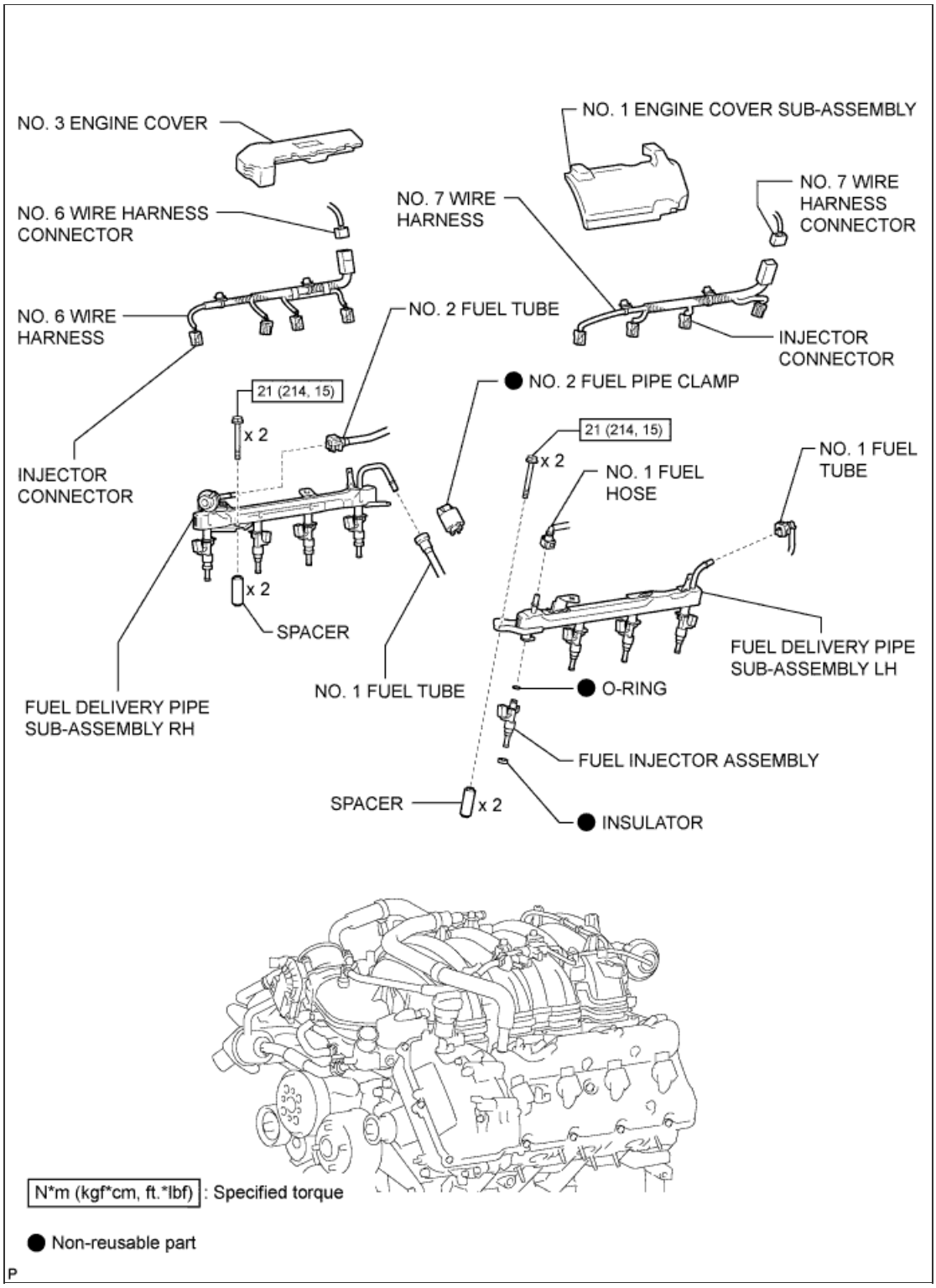
p. Reconnect the fuel tube (fuel tube connector).

q. Check for fuel leaks.

i. Check that there are no fuel leaks after performing maintenance anywhere on the system.
If there are fuel leaks, repair or replace parts as necessary.

for Preparation Click here




NO. 3 ENGINE COVER
NO. 1 ENGINE COVER SUB-ASSEMBLY
NO. 7 WIRE HARNESS CONNECTOR
NO. 7 WIRE HARNESS
NO. 6 WIRE HARNESS CONNECTOR
NO. 6 WIRE HARNESS
NO. 2 FUEL TUBE
INJECTOR CONNECTOR
21 (214, 15)
x 2
NO. 2 FUEL PIPE CLAMP
INJECTOR CONNECTOR
21 (214, 15)
x 2
NO. 1 FUEL HOSE
NO. 1 FUEL TUBE
x 2
SPACER
FUEL DELIVERY PIPE SUB-ASSEMBLY LH
FUEL DELIVERY PIPE SUB-ASSEMBLY RH
NO. 1 FUEL TUBE
O-RING
FUEL INJECTOR ASSEMBLY
SPACER
x 2
INSULATOR
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

(Click here)

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

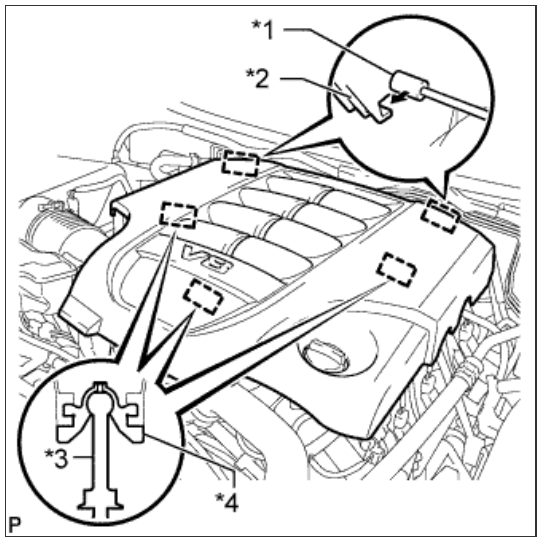
When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Raise the front of the V-bank cover to detach the 3 pins. Then remove the 2 V-bank cover hooks from the bracket, and remove the V-bank cover.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet

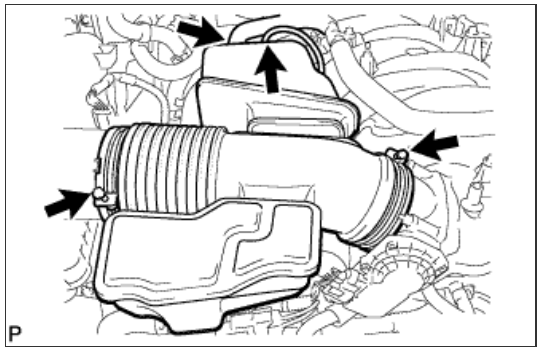


4. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vac m hose and No. 2 ventilation hose.

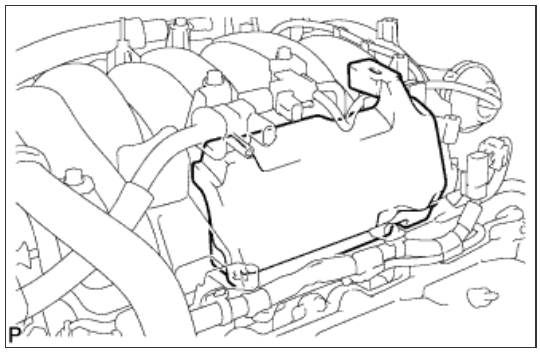
b. Loosen the 2 hose clamps.

c. Remove the air cleaner hose.



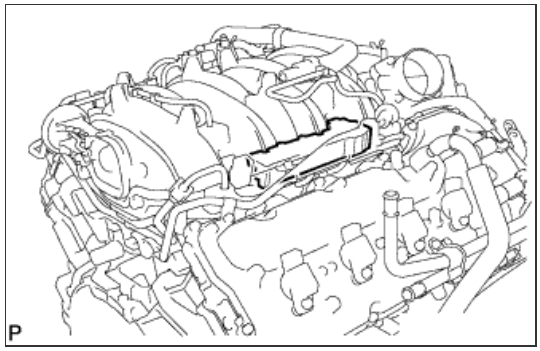
5. REMOVE NO. 1 ENGINE COVER SUB-ASSEMBLY

a. Remove the No. 1 engine cover s b-assembly.



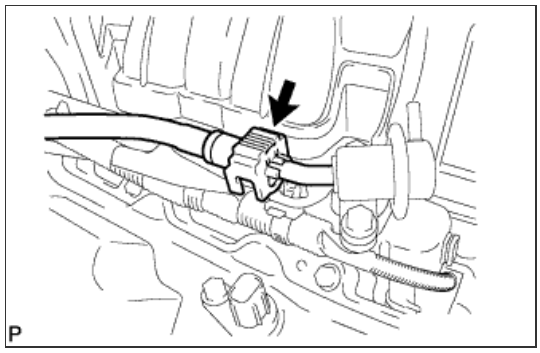
6. REMOVE NO. 3 ENGINE COVER

a. Remove the No. 3 engine cover.



7. DISCONNECT NO. 2 FUEL TUBE

a. Disconnect the No. 2 f el t be from the f el press re reg lator (Click here).



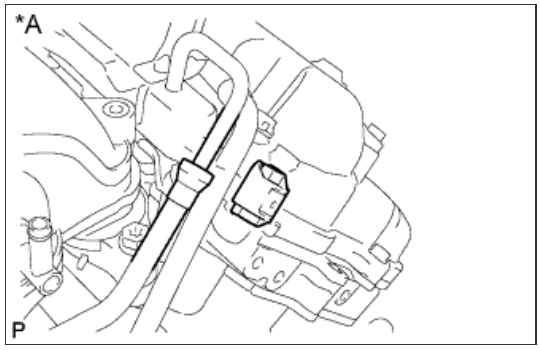
8. DISCONNECT NO. 1 FUEL TUBE

a. Disconnect the No. 1 f el t be from the f el delivery pipe RH (for metallic type) (Click here).

SST
09268-21011

Text in Illustration

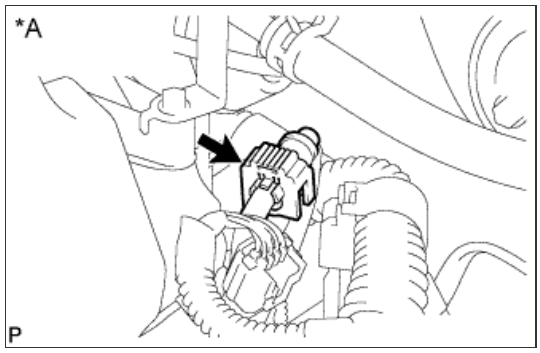
*A	RH Side



b. LH Side:
Disconnect the No. 1 f el t be from the f el delivery pipe LH (Click here).

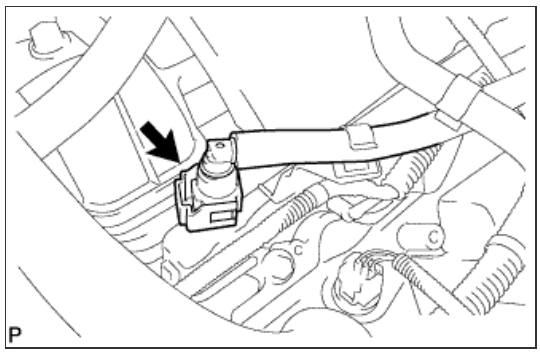
Text in Illustration

*A	LH Side



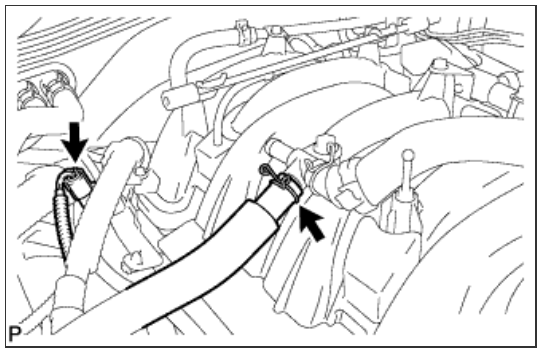
9. DISCONNECT NO. 1 FUEL HOSE

a. Disconnect the No. 1 f el hose from the f el delivery pipe LH (Click here).



10. REMOVE FUEL DELIVERY PIPE SUB-ASSEMBLY RH

a. Disconnect the ventilation hose and No. 6 ire harness connector.

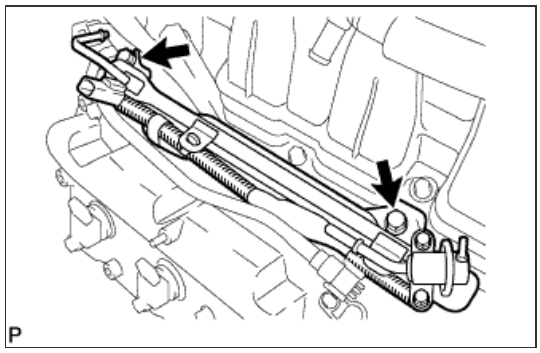


b. Remove the 2 bolts and f el delivery pipe RH.

NOTICE:

When removing the delivery pipe, hold the pipe by both ends and p ll it straight p ard.

c. Remove the 2 delivery pipe spacers and 4 ins lators from the cylinder head RH.



11. REMOVE FUEL DELIVERY PIPE SUB-ASSEMBLY LH

a. Disconnect the No. 7 ire harness connector.

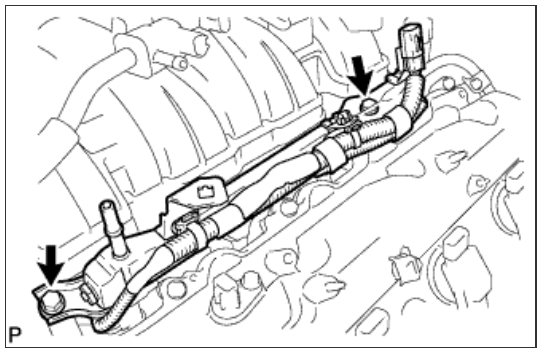
b. Remove the 2 bolts and f el delivery pipe LH

b. Remove the 2 bolts and Fuel delivery pipe LH.

NOTICE:

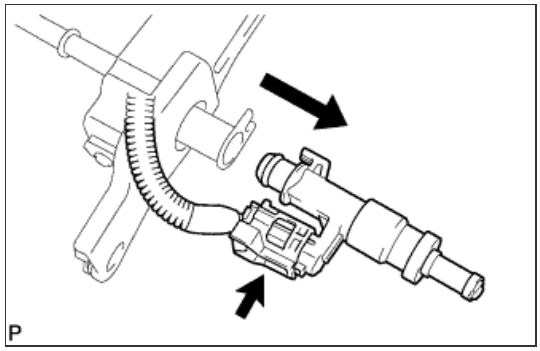
When removing the delivery pipe, hold the pipe by both ends and pull it straight upward.

c. Remove the 2 delivery pipe spacers and 4 insulators from the cylinder head LH.



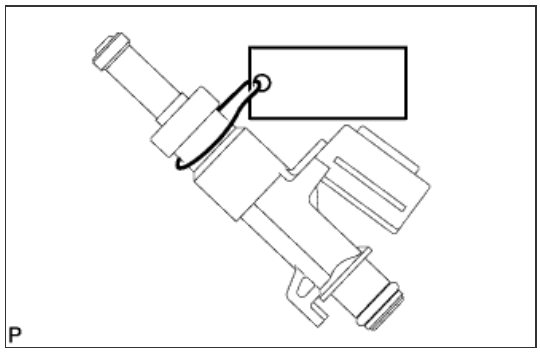
12. REMOVE FUEL INJECTOR ASSEMBLY

a. Remove the fuel injector from the fuel delivery pipe, and then disconnect the injector connector.



NOTICE:

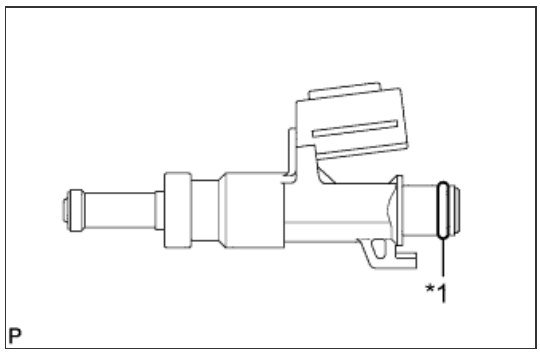
For reinstallation, attach a tag or label to the injector shaft.



b. Remove the O-ring from the fuel injector.

Text in Illustration

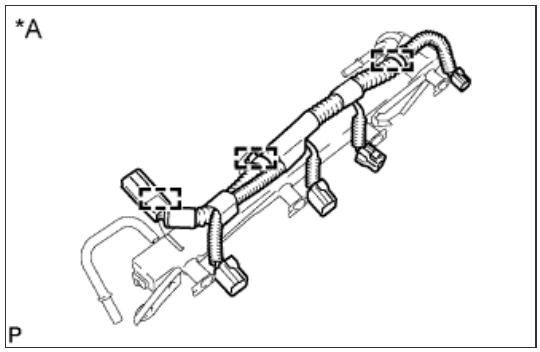
*1	O-Ring



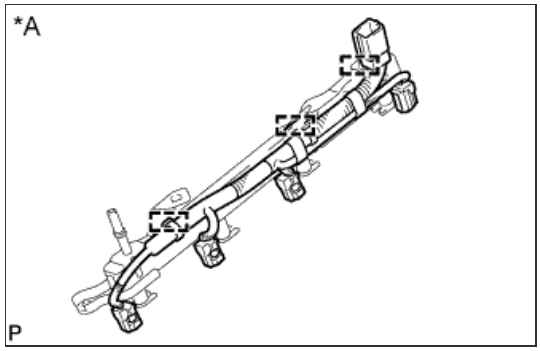
c. Detach the 3 clamps and then remove the No. 6 fuel tube assembly from the delivery pipe RH.

Text in Illustration

*A	Fuel Delivery Pipe RH



d. Detach the 3 clamps and then remove the No. 7 ire harness from the delivery pipe LH.



Text in Illustration

*A	Fuel Delivery Pipe LH

for Preparation Click here

1. INSPECT FUEL INJECTOR ASSEMBLY

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	11.6 to 12.4 Ω

If the result is not as specified, replace the injector assembly.

b. Inspect the injection volume.

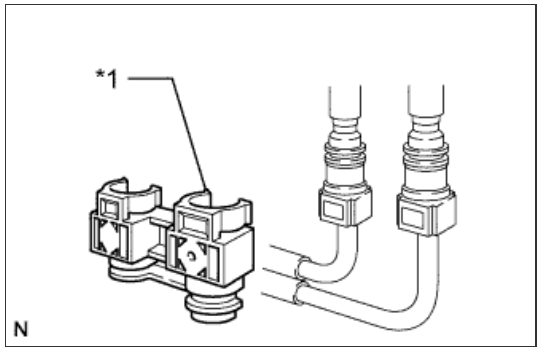
CAUTION:

This test involves high-pressure fuel and electricity. Take all precautions regarding safe handling of both the fuel and the electricity. Perform this test in a safe area, and avoid any sparks or flames. Do not smoke.

i. Remove the fuel pipe clamp.

Text in Illustration

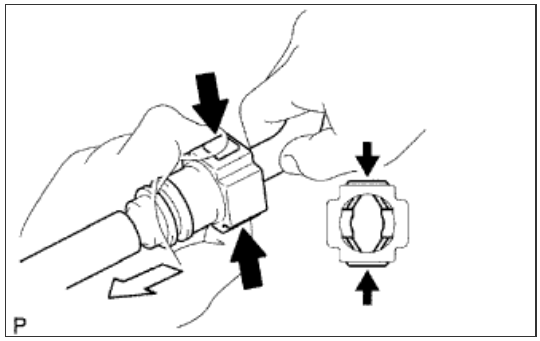
1	Fuel Pipe Clamp



ii. Disconnect the fuel tube.

Text in Illustration

➡	Pinch
⇨	Pull



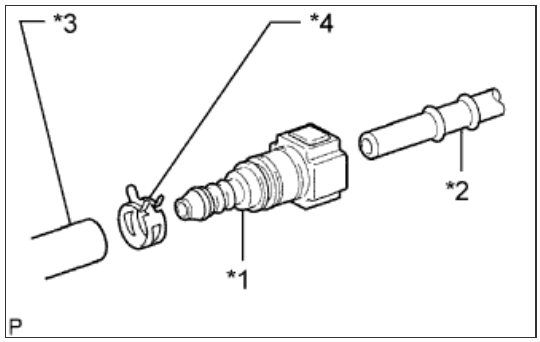
iii. Connect SST to the fuel pipe (the vehicle side).

SST

09268-31012 (09268-41500, 90467-13001, 95336-08070)

Text in Illustration

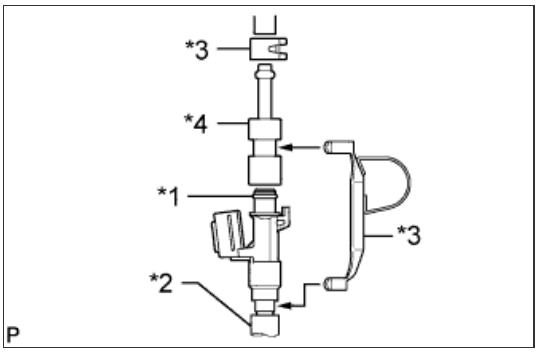
1	SST (Fuel Tube Connector)
2	Fuel Pipe
	SST (Hose)
4	SST (Clip)



iv. Install the O-ring to the fuel injector.

v. Install SST and the tube to the fuel injector.

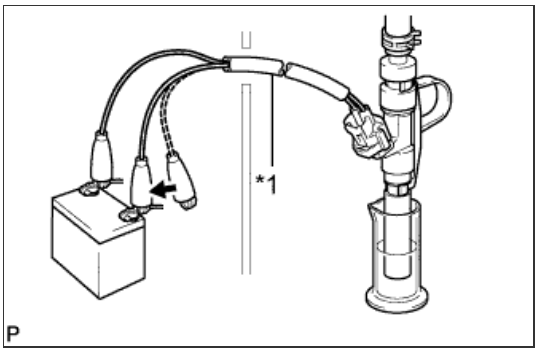
SST
09268-31012 (09268-41300, 09268-41600, 90467-13001, 95336-08070)



Text in Illustration

1	O-Ring
2	Tube
	SST (Clip)
4	SST (Adapter)

vi. Put the injector into a graduated cylinder.



Text in Illustration

1	SST (Wire)

CAUTION:

Install a strong rubber tube onto the injector to prevent gasoline from splashing.

vii. Operate the fuel pump (turn the engine switch on (IG)).

viii. Connect SST (wire) to the injector and the battery for 15 seconds, and measure the injection volume with the graduated cylinder. Test each injector 2 or 3 times.

SST
09842-30090

Standard injection volume:
87 to 105 cm^3 (5.3 to 6.4 cu in.) per 15 seconds

Difference between each injector:
18 cm^3 (1.1 cu in.) or less

If the injection volume is not as specified, replace the injector assembly.

c. Check for fuel drop.

i. In the condition above, disconnect the tester probes of SST (wire) from the battery and check for fuel drop from the injector.

Standard fuel drop:
1 drop or less in 12 minutes

If the fuel drop is not as specified, replace the injector assembly.

for Preparation Click here

1. INSTALL FUEL INJECTOR ASSEMBLY

a. Attach the 3 clamps to install the No. 6 wire harness to the delivery pipe RH.

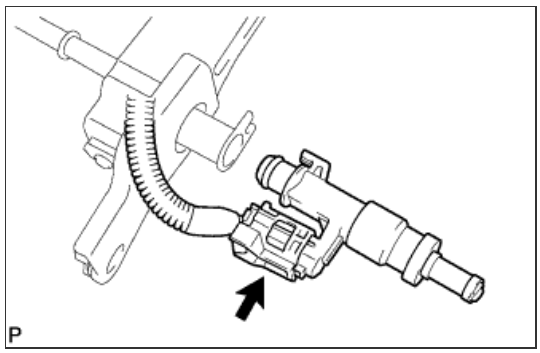
b. Attach the 3 clamps to install the No. 7 wire harness to the delivery pipe LH.

c. Apply gasoline or spindle oil to a new O-ring and install it to the injector.

NOTICE:

Make sure that there is no damage or foreign material in the groove of the injector when installing the O-ring.

d. Connect the injector connector.



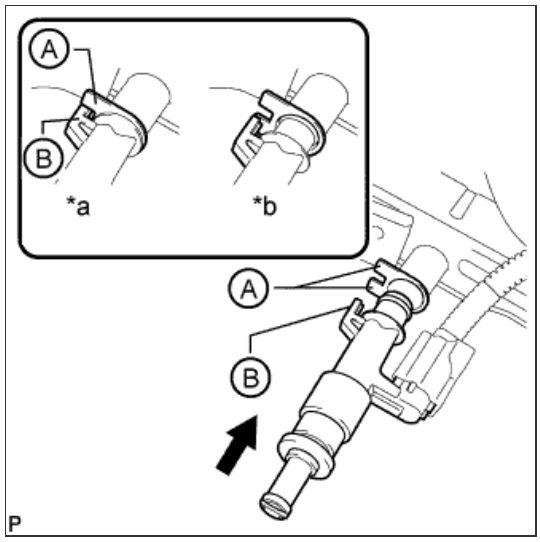
e. Install the injector to the delivery pipe as shown in the illustration.

Text in Illustration

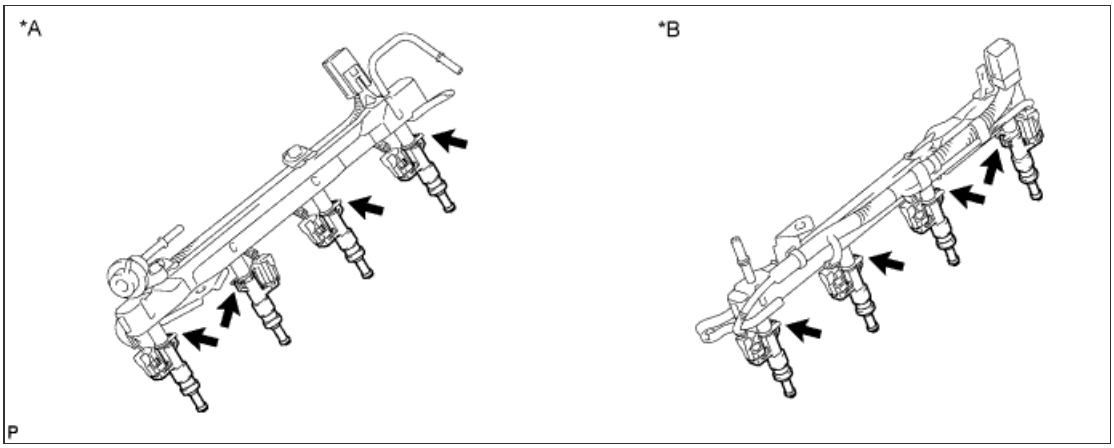
*a	CORRECT
*b	INCORRECT

NOTICE:

- **Make sure that there are no scratches or foreign matter in or around the insertion hole of the delivery pipe.**
- **When inserting the injector, be careful not to damage the O-ring.**
- **Attach the part of the injector labeled B between the parts of the delivery pipe labeled A.**



f. Check that each injector is installed to the delivery pipe facing the direction shown in the illustration.



Text in Illustration

*A	Fuel Delivery Pipe RH	*B	Fuel Delivery Pipe LH

2. INSTALL FUEL DELIVERY PIPE SUB-ASSEMBLY LH

a. Install the 2 delivery pipe spacers and 4 insulators to the cylinder head LH.

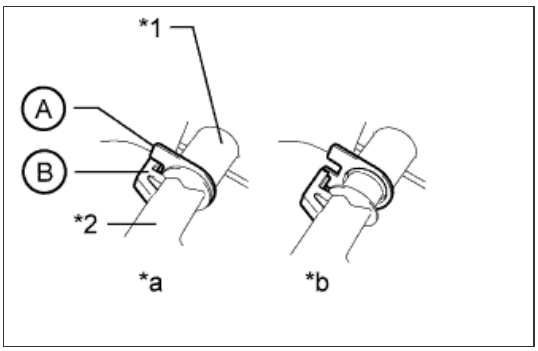
b. Install the delivery pipe (with injectors) to the cylinder head LH.

c. Install the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

NOTICE:

Make sure that the part of the injector labeled B is between the parts of the delivery pipe labeled A.



Text in Illustration

*1	Delivery Pipe
*2	Injector
*a	CORRECT
*b	INCORRECT

d. Connect the No. 7 wire harness connector.

3. INSTALL FUEL DELIVERY PIPE SUB-ASSEMBLY RH

a. Install the 2 delivery pipe spacers and 4 insulators to the cylinder head RH.

b. Install the delivery pipe (with injectors) to the cylinder head RH.

c. Install the 2 bolts.

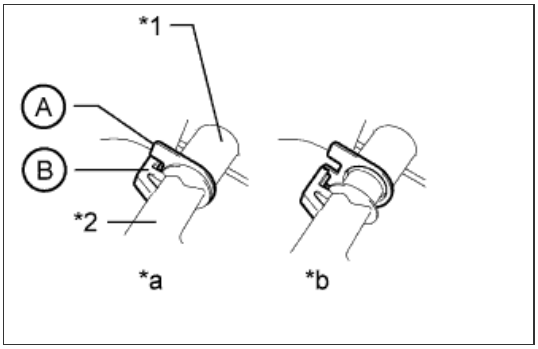
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

NOTICE:

Make sure that the part of the injector labeled B is between the parts of the delivery pipe labeled A.

Text in Illustration

*1	Delivery Pipe
*2	Injector
*a	CORRECT
*b	INCORRECT



d. Connect the No. 6 wire harness connector.

e. Connect the ventilation hose.

4. CONNECT NO. 1 FUEL HOSE

a. Connect the No. 1 fuel hose to the fuel delivery pipe LH (Click here).

5. CONNECT NO. 1 FUEL TUBE

a. LH Side:
Connect the No. 1 fuel tube to the delivery pipe LH (Click here).

b. Connect the No. 1 fuel tube to the delivery pipe RH (for metallic type) (Click here).

6. CONNECT NO. 2 FUEL TUBE

a. Connect the No. 2 fuel tube to the fuel pressure regulator (Click here).

7. INSTALL NO. 1 ENGINE COVER SUB-ASSEMBLY

8. INSTALL NO. 3 ENGINE COVER

9. INSTALL AIR CLEANER HOSE ASSEMBLY

a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

Text in Illustration

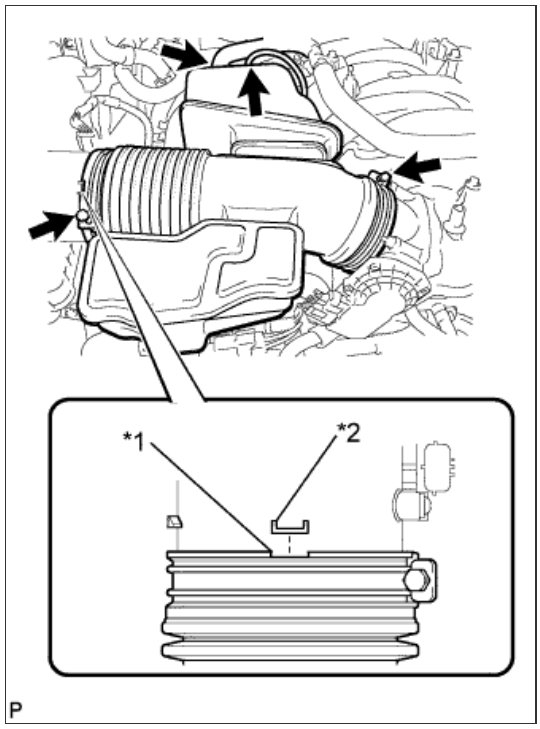
*1	Groove
*2	Protrusion

b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum hose.

d. Connect the No. 2 ventilation hose.

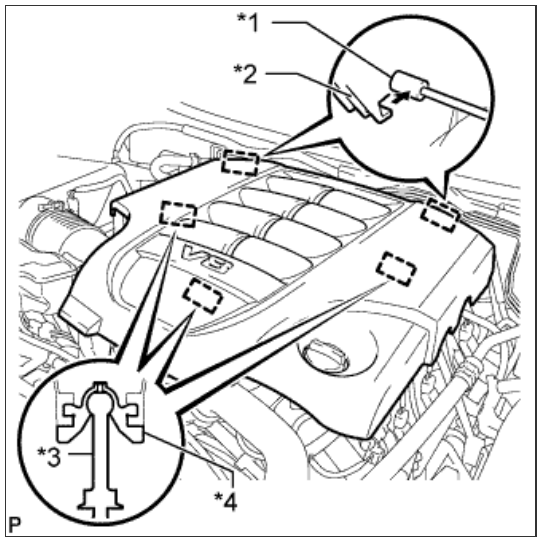


10. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 -bank cover hooks to the bracket. Then align the 3 V-bank cover grommets with the 3 pins, and press down on the V-bank cover to attach the pins.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet



11. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

12. INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and intelligent tester main switch on.

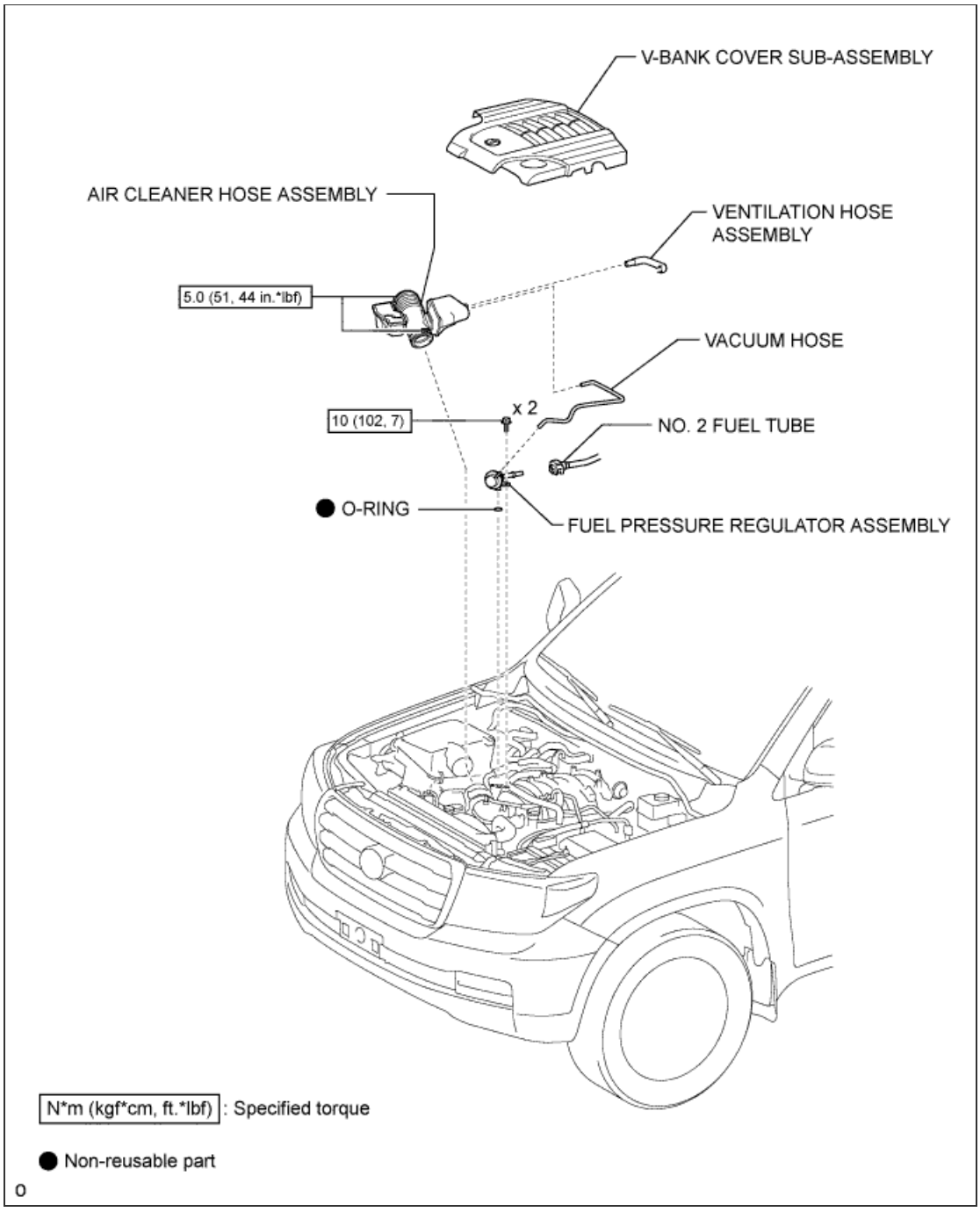
NOTICE:

Do not start the engine.

c. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Fuel Pump / Speed.

d. Check that there are no fuel leaks after doing maintenance anywhere on the fuel system.

for Preparation Click here



for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

(Click here)

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

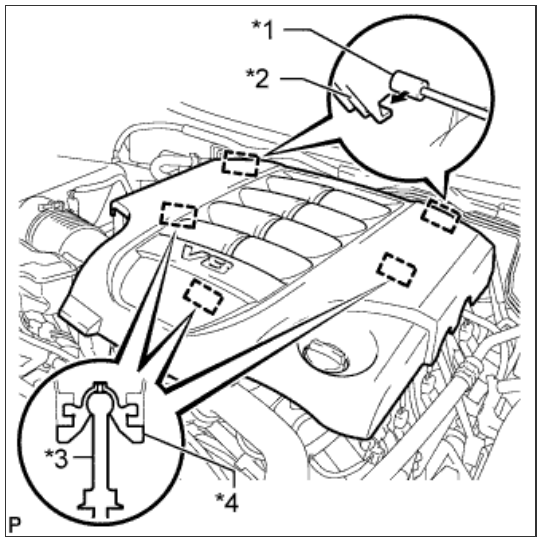
When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Raise the front of the V-bank cover to detach the 3 pins. Then remove the 2 V-bank cover hooks from the bracket, and remove the V-bank cover.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet

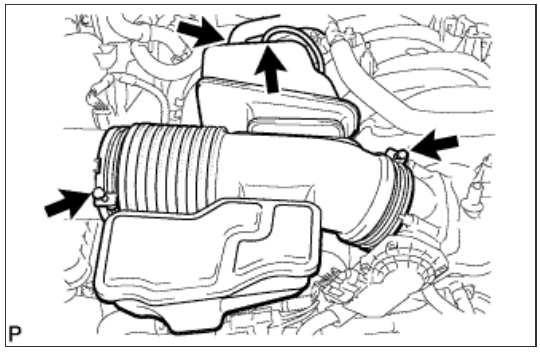


4. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vac m hose and No. 2 ventilation hose.

b. Loosen the 2 hose clamps.

c. Remove the air cleaner hose.

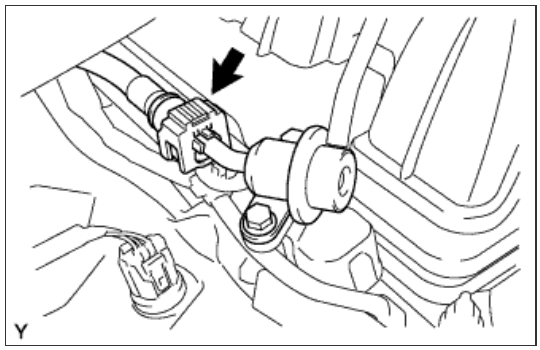


5. REMOVE FUEL PRESSURE REGULATOR ASSEMBLY

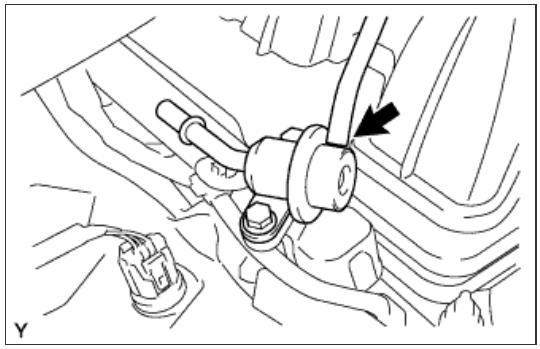
a. Disconnect the No. 2 f el t be from the press re reg lator (Click here).

CAUTION:

P t a cloth or eq ivalent nder the press re reg lator.

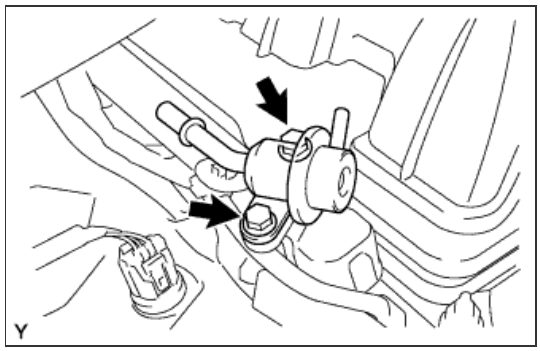


b. Disconnect the vac m sensing hose from the press re reg lator.



c. Remove the 2 bolts, and p ll o t the press re reg lator.

d. Remove the O-ring from the press re reg lator.



for Preparation Click here

1. INSTALL FUEL PRESSURE REGULATOR ASSEMBLY

a. Apply a light coat of gasoline or spindle oil to a new O-ring, and install it to the pressure regulator.

NOTICE:

- **Make sure that there are no scratches or foreign matter in or around the insertion hole of the delivery pipe.**
- **When inserting the injector, be careful not to damage the O-ring.**

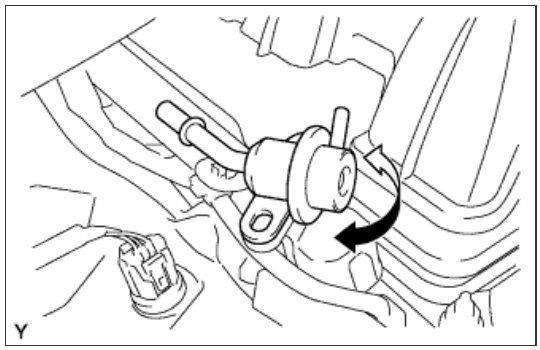
b. While turning the pressure regulator left and right, install it to the delivery pipe.

c. Install the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

d. Connect the vacuum sensing hose to the pressure regulator.

e. Connect the No. 2 fuel tube to the pressure regulator (Click here).



2. INSTALL AIR CLEANER OSE ASSEMBLY

a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

Text in Illustration

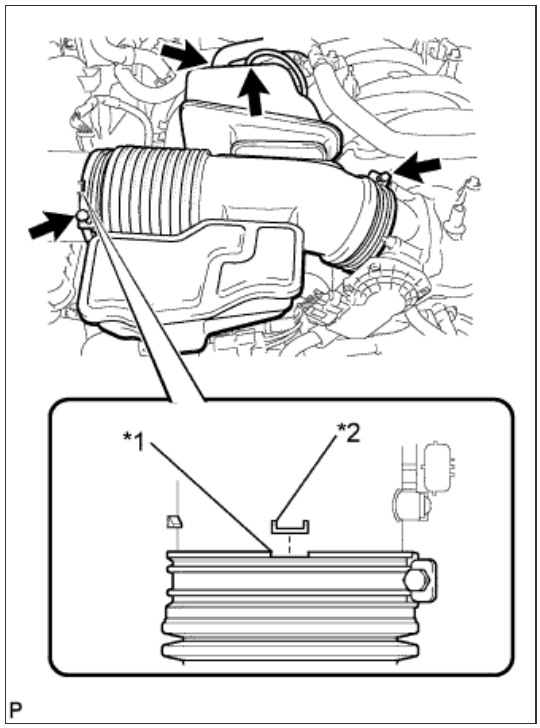
*1	Groove
*2	Protrusion

b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum hose.

d. Connect the No. 2 ventilation hose.

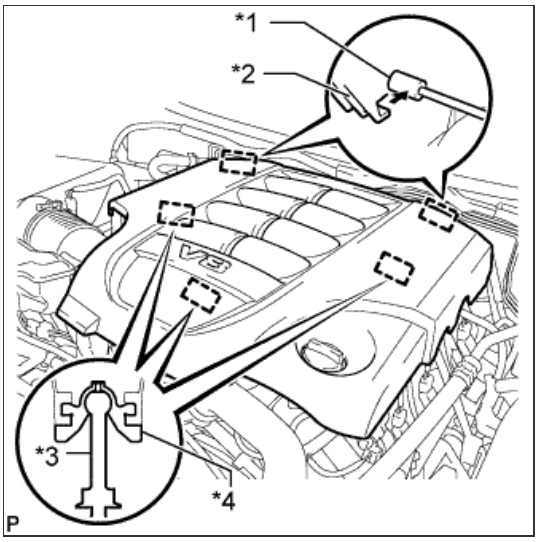


3. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket. Then align the 3 V-bank cover grommets with the 3 pins, and press down on the V-bank cover to attach the pins.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet



4. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

5. INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and intelligent tester main switch on.

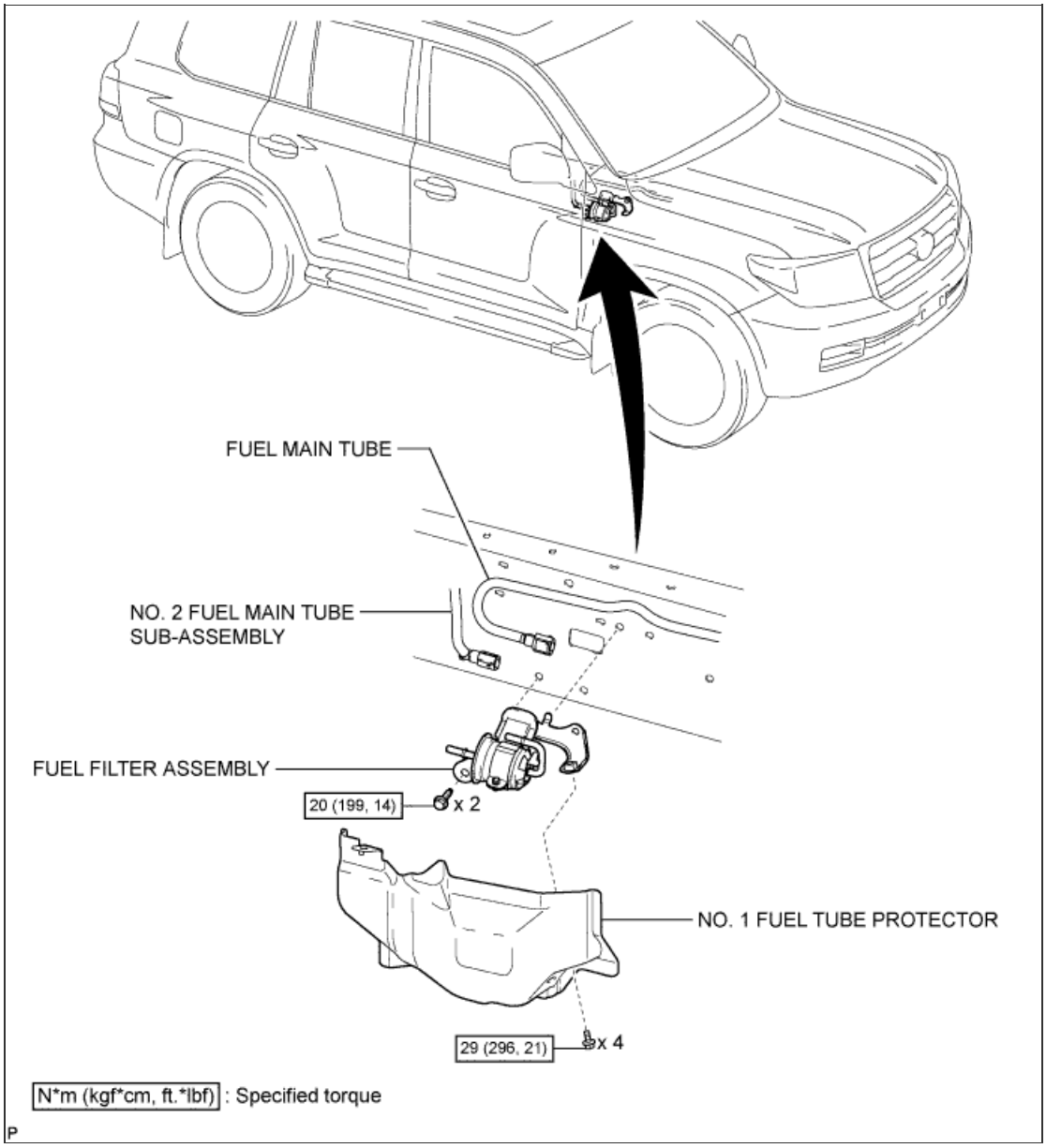
NOTICE:

Do not start the engine.

c. nter the following menus: Powertrain / ngine and CT / Active Test / Control the Fuel Pump / Speed.

d. Check that there are no fuel leaks after doing maintenance anywhere on the fuel system.

for Preparation [Click here]



for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

(Click here)

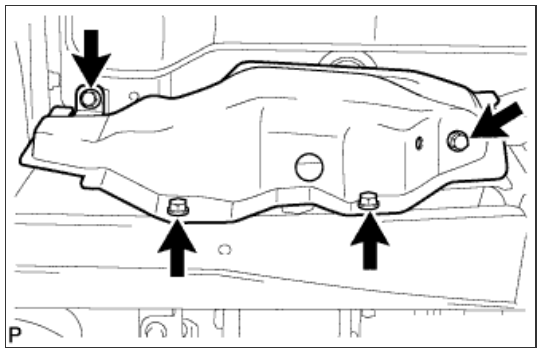
2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE NO. 1 FUEL TUBE PROTECTOR

a. Remove the bolts and No. 1 fuel tube protector.



4. DISCONNECT NO. 2 FUEL MAIN TUBE SUB-ASSEMBLY

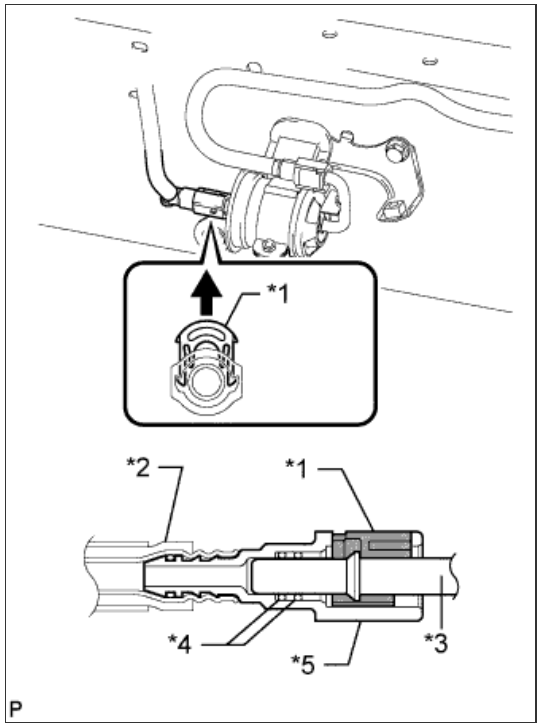
a. Pull up the retainer and disconnect the No. 2 fuel main tube.

Text in Illustration

*1	Retainer
*2	Nylon be
*3	Pipe
*	ng i
*5	Connector

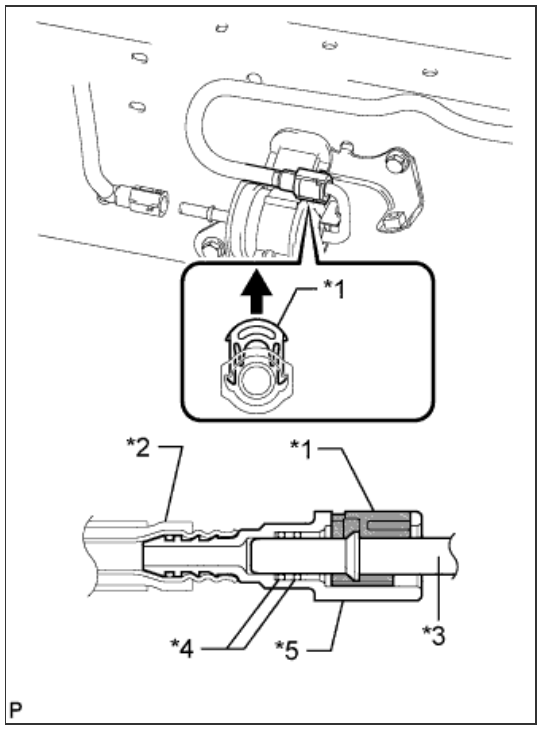
NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



5. DISCONNECT FUEL MAIN TUBE

a. Pull up the retainer and disconnect the fuel main tube.



Text in Illustration

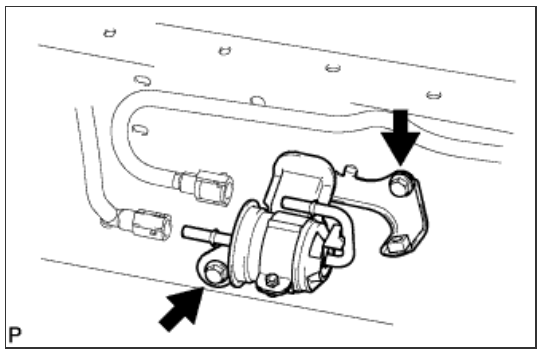
*1	Retainer
*2	Nylon be
*3	Pipe
*	ng i
*5	Connector

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**

6. REMOVE FUEL FILTER ASSEMBLY

a. Remove the 2 bolts and fuel filter.



7. INSTALL FUEL FILTER ASSEMBLY

a. Install the fuel filter ith the 2 bolts.

Tor ue:
20 N*m{ 199 kgf*cm , 14 ft.*lbf

. CONNECT FUEL MAIN TUBE

a. Connect the fuel main tube and push the retainer.

Text in Illustration

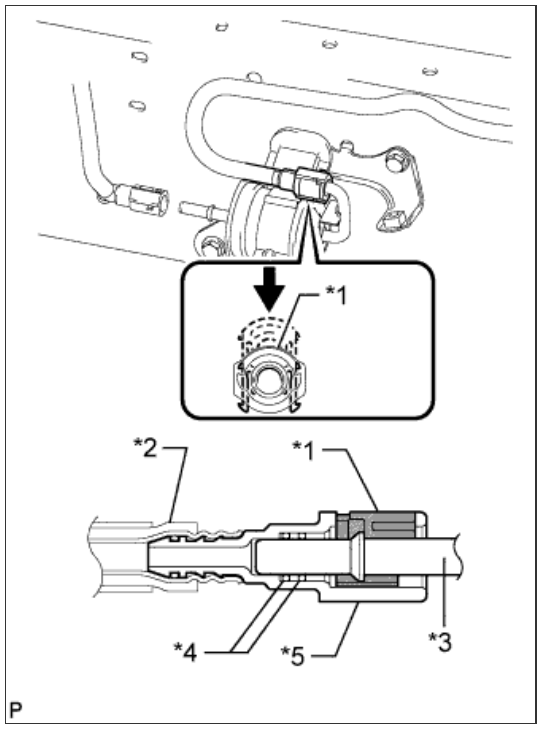
*1	Retainer
*2	Nylon be
*3	Pipe
*	ng i
*5	Connector

HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**



9. CONNECT NO. 2 FUEL MAIN TUBE SUB-ASSEMBLY

a. Connect the No. 2 fuel main tube and push the retainer.

Text in Illustration

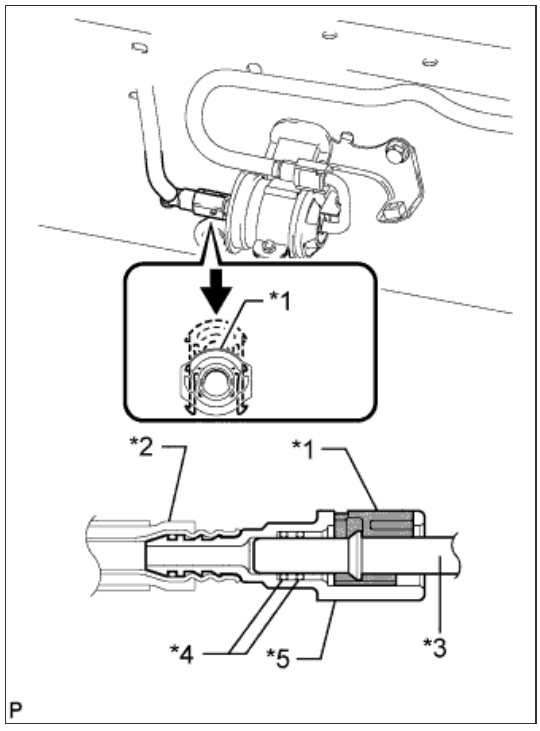
*1	Retainer
*2	Nylon be
*3	Pipe
*	ng i
*5	Connector

HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**



10. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

11. INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the DLC3.

b. n the engine s itch on (IG) and intelligent tester main s itch on.

NOTICE:

Do not start the engine.

c. Enter the follo ing menus: Po ertrain / Engine and EC tive e t / Control the Fuel Pump / Speed.

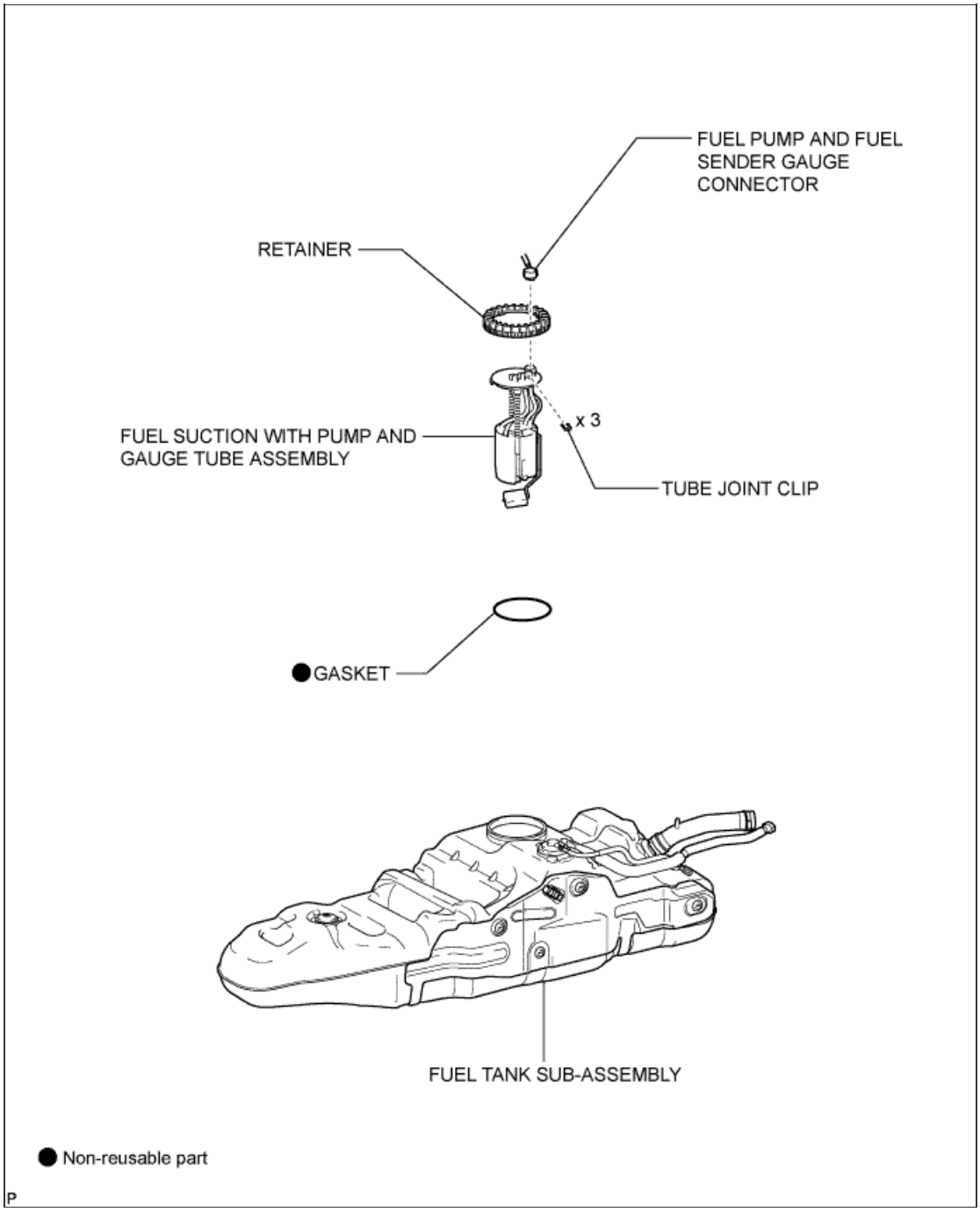
d. Check that there are no fuel leaks after doing maintenance any here on the fuel system.

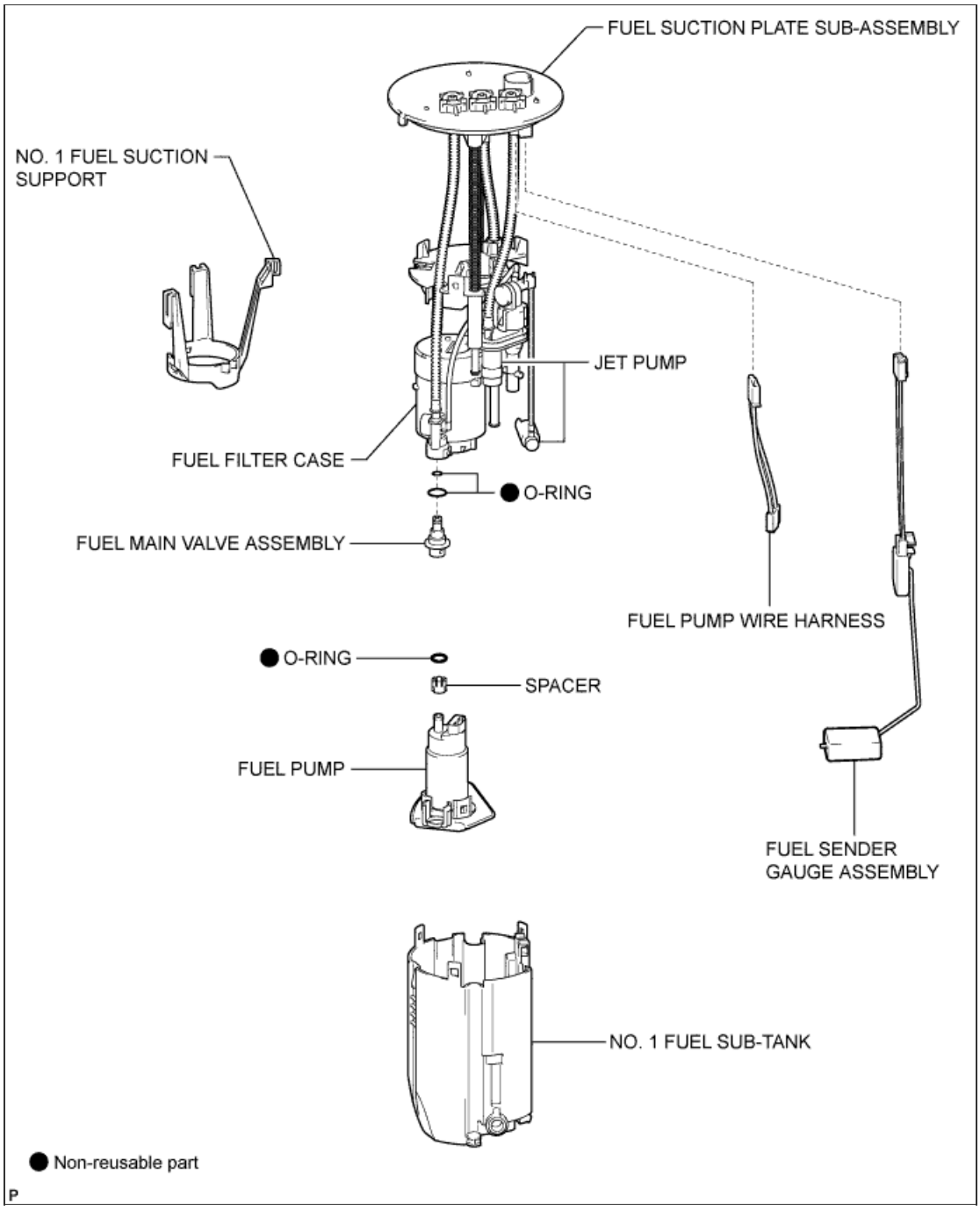
12. INSTALL NO. 1 FUEL TUBE PROTECTOR

a. Install the No. 1 fuel tube protector ith the bolts.

Tor ue:
29 N*m{ 296 kgf*cm , 21 ft.*lbf

for Preparation Click here




FUEL SUCTION PLATE SUB-ASSEMBLY
NO. 1 FUEL SUCTION SUPPORT
JET PUMP
FUEL FILTER CASE
O-RING
FUEL MAIN VALVE ASSEMBLY
FUEL PUMP WIRE HARNESS
O-RING
SPACER
FUEL PUMP
FUEL SENDER GAUGE ASSEMBLY
NO. 1 FUEL SUB-TANK
Non-reusable part
P

for Preparation Click here

1. REMOVE FUEL TANK SUB-ASSEMBLY

(Click here)

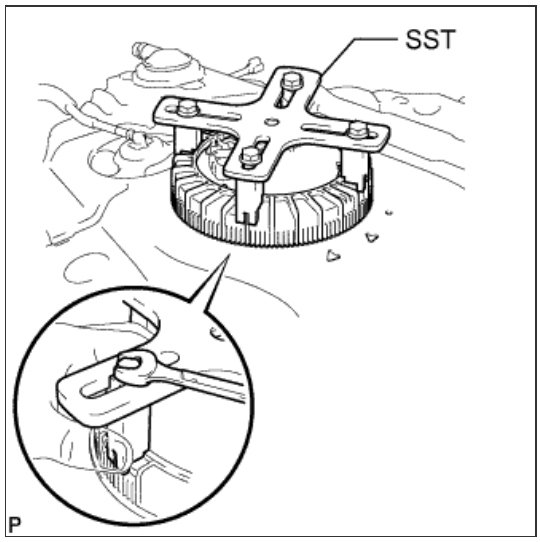
2. REMOVE FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

a. Set SST on the retainer.

SST
09808-14030

HINT:

- **Securely attach the claws of SST to the protrusion of the retainer and fix SST in place.**
- **Install SST while pressing the claws of SST against the retainer (towards the center of SST).**



b. Using SST, loosen the retainer.

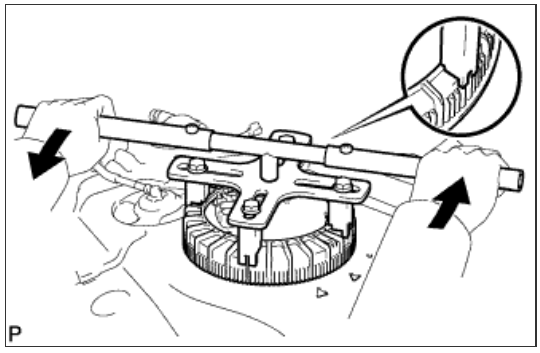
SST
09808-14030

NOTICE:

- **Do not use any tools other than those specified in this operation. Damage to the retainer or the fuel tank may result.**
- **While pressing down on SST so that the claws of SST do not slip off the protrusion of the retainer, turn the retainer counterclockwise to loosen it.**

HINT:

The protrusion of the retainer fit in the ends of SST.



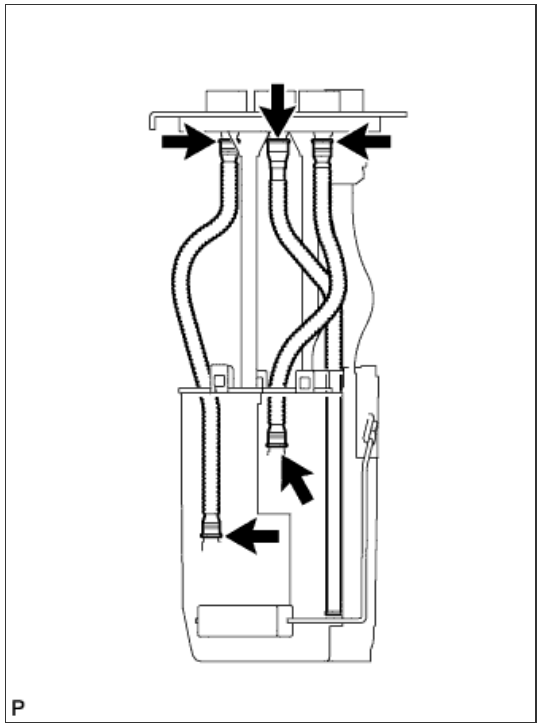
c. Remove the retainer while holding the fuel suction tube assembly by hand.

d. Remove the gasket from the fuel tank.

for Preparation Click here

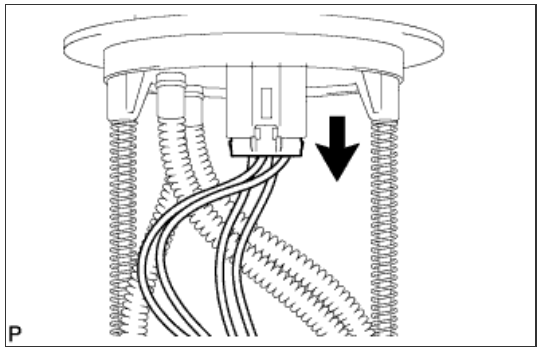
NOTICE:

Do not disconnect the hoses indicated in the illustration.



1. REMOVE FUEL SENDER GAUGE ASSEMBLY

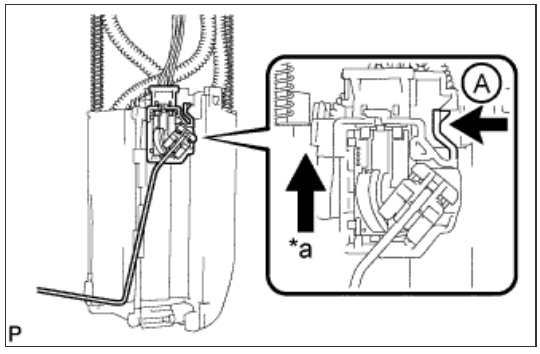
a. Disconnect the fuel sender gauge connector.



b. Press down on the sender gauge claw labeled A. Then slide the sender gauge upward to remove it.

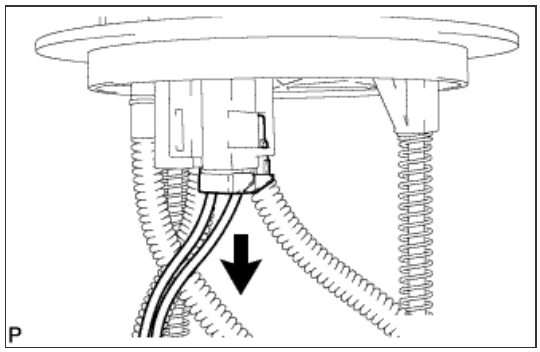
Text in Illustration

*a	Slide



2. REMOVE NO. 1 FUEL SUB-TANK

a. Disconnect the fuel pump connector.



b. Disconnect the jet pump (labeled A) from the sub-tank.

c. Disconnect the jet pump (labeled B) from the sub-tank.

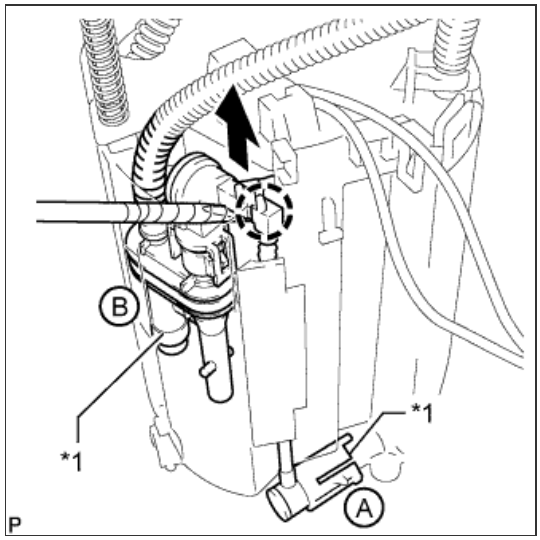
Text in Illustration

*1	Jet Pump

i. Using a small screwdriver, detach the claw from the sub-tank.

HINT:

Tape the screwdriver tip before use.



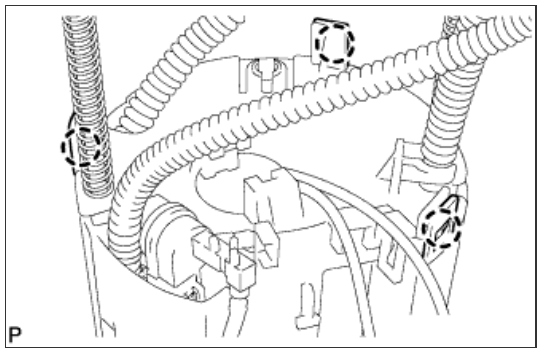
d. Using a screwdriver, detach the 3 claws from the claw holes.

NOTICE:

Do not damage the fuel sub-tank.

HINT:

Tape the screwdriver tip before use.



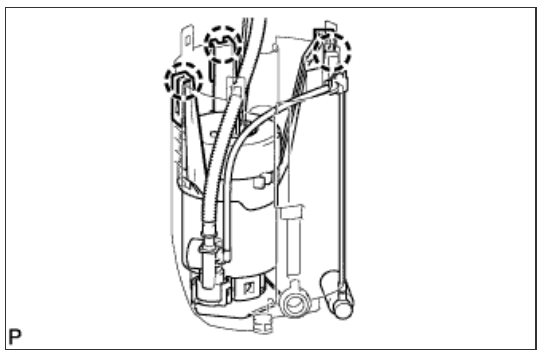
e. Using a screwdriver, detach the 3 claws from the claw holes.

NOTICE:

Do not damage the fuel sub-tank.

HINT:

Tape the screwdriver tip before use.



3. REMOVE FUEL PUMP

a. Using a screwdriver, detach the 5 claws from the claw holes and disconnect the

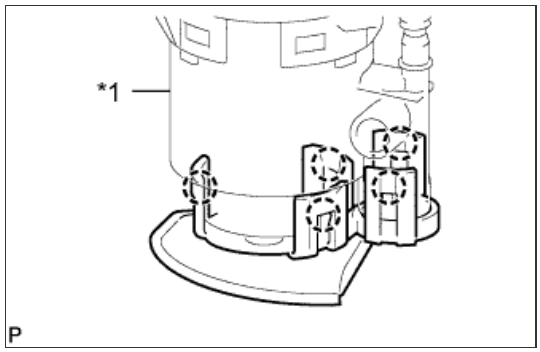
fuel pump from the fuel filter case.

Text in Illustration

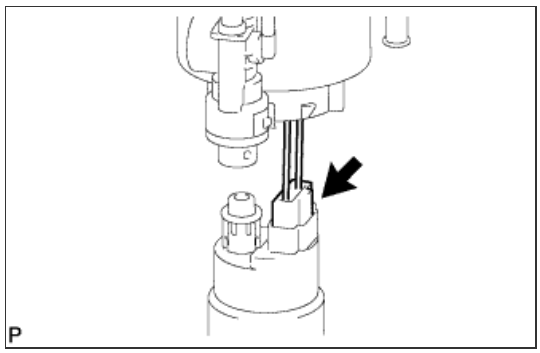
*1	Fuel Filter Case

HINT:

Tape the screwdriver tip before use.



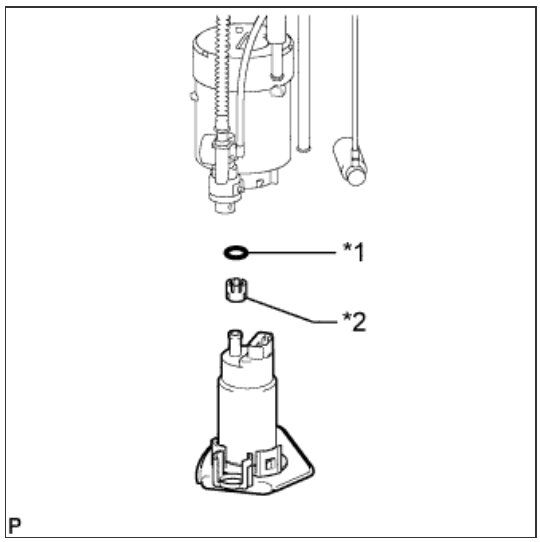
b. Disconnect the fuel pump wire harness connector from the fuel pump to remove it.



c. Remove the O-ring and spacer from the fuel pump.

Text in Illustration

*1	O-Ring
*2	Spacer



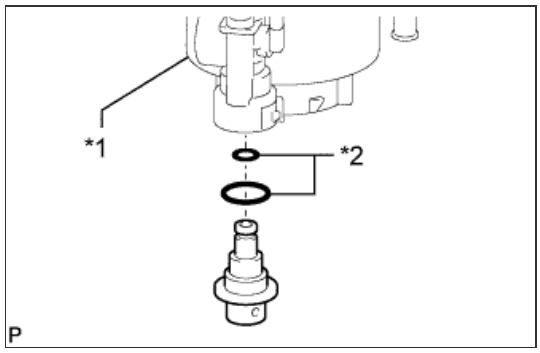
4. REMOVE FUEL MAIN VALVE ASSEMBLY

a. Remove the fuel main valve from the fuel filter case.

b. Remove the 2 O-rings from the fuel main valve.

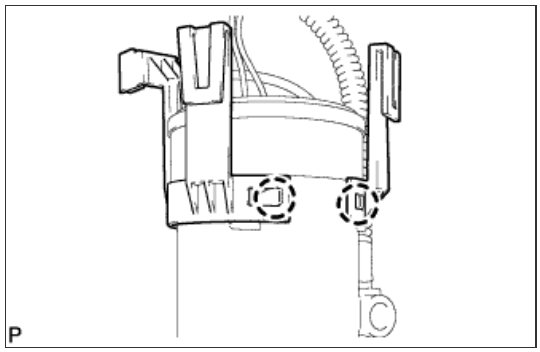
Text in Illustration

*1	Fuel Filter Case
*2	O-Ring



5. REMOVE NO. 1 FUEL SUCTION SUPPORT

a. Detach the 2 claws from the claw holes to remove the fuel suction support.



for Preparation Click here

1. INSPECT FUEL PUMP

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	0.2 to 3.0 Ω

If the result is not as specified, replace the fuel pump assembly.

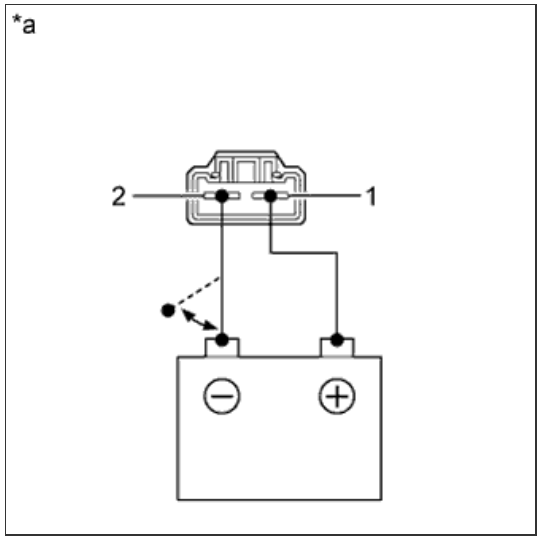
b. Inspect the operation of the fuel pump.

i. Connect the positive (+) lead of the battery to terminal 1 of the connector, and the negative (-) lead to terminal 2. Check that the fuel pump operates.

Text in Illustration

a	Component without harness connected (Fuel Pump)

If the result is not as specified, replace the fuel pump and fuel pump EC .



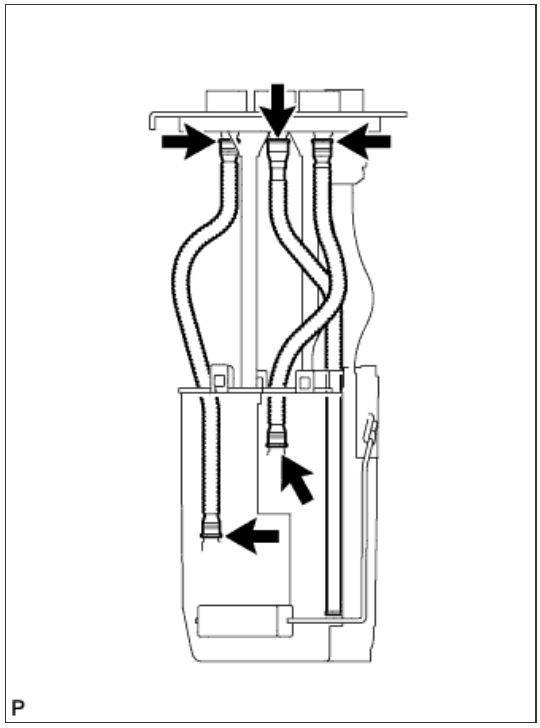
NOTICE:

- **These tests must be performed within 10 seconds to prevent the coil from burning out.**
- **Keep the fuel pump as far away from the battery as possible.**
- **Always turn the voltage on and off on the battery side, not the fuel pump side.**
- **When the pump is locked and does not operate due to foreign matter being stuck, etc., replace the fuel pump ECU together with the fuel pump, as the fuel pump ECU may be damaged electrically.**

for Preparation Click here

NOTICE:

Do not disconnect the hoses indicated in the illustration.



1. INSTALL NO. 1 FUEL SUCTION SUPPORT

a. Attach the 2 claws to the claw holes to install the fuel suction support.

2. INSTALL FUEL MAIN VALVE ASSEMBLY

a. Apply a light coat of gasoline to 2 new O-rings, and install them onto the fuel main valve.

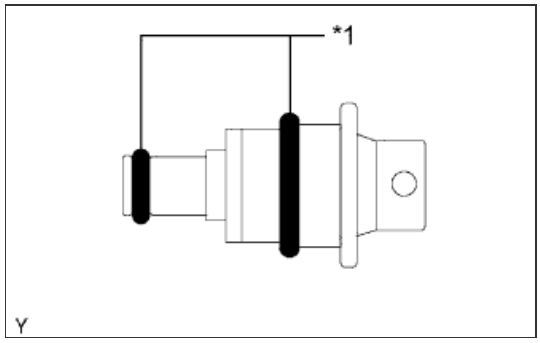
Text in Illustration

*1	New O-Ring

b. Install the fuel main valve to the fuel filter case.

NOTICE:

Make sure the O-rings are not cut or pinched during the installation.



3. INSTALL FUEL PUMP

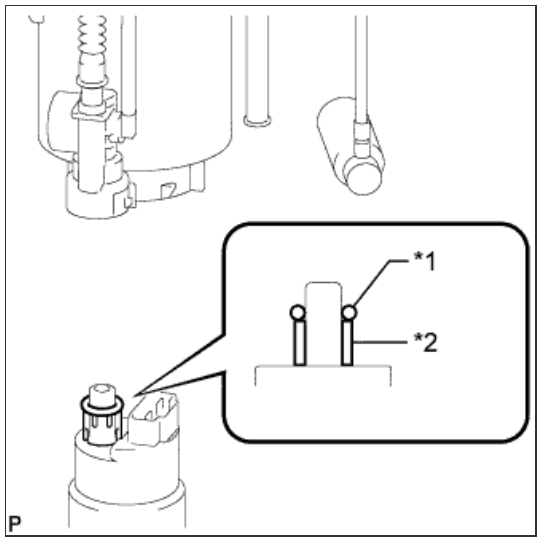
a. Connect the fuel pump wire harness connector to the fuel pump.

b. Apply a light coat of gasoline to a new O-ring. Then install the O-ring and spacer to the fuel pump.

Text in Illustration

*1	O-Ring
*2	Spacer

c. Attach the 5 claws to the claw holes and install the fuel pump to the fuel filter case.



4. INSTALL NO. 1 FUEL SUB-TANK

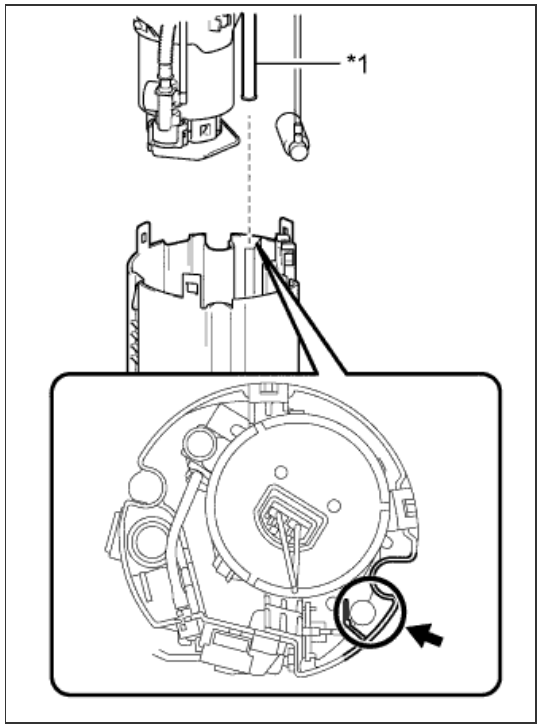
NOTICE:

Make sure that the fuel tube passes into the section marked by the circle.

Text in Illustration

*1	Fuel Tube

a. Attach the 3 claws to the claw holes and install the fuel sub-tank.



b. Connect the jet pump (labeled B) to the sub-tank.

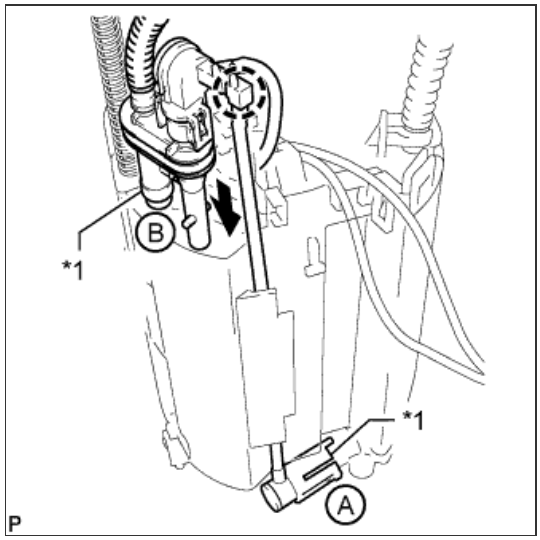
Text in Illustration

*1	et Pump

i. Attach the claw on the end of the tube to the claw hole.

c. Connect the jet pump (labeled A) to the sub-tank.

d. Connect the fuel pump connector.



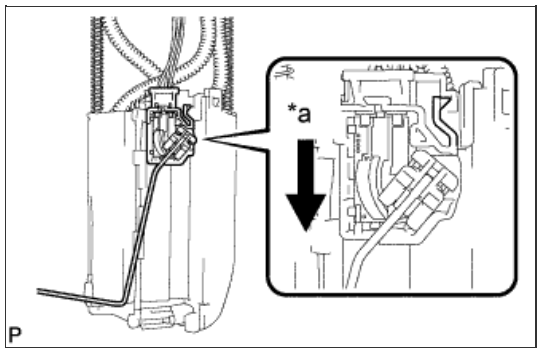
5. INSTALL FUEL SENDER GAUGE ASSEMBLY

a. Set the sender gauge to the fuel sub-tank. Then slide the sender gauge downward to install it.

Text in Illustration

*a	Slide

b. Connect the fuel sender gauge connector.

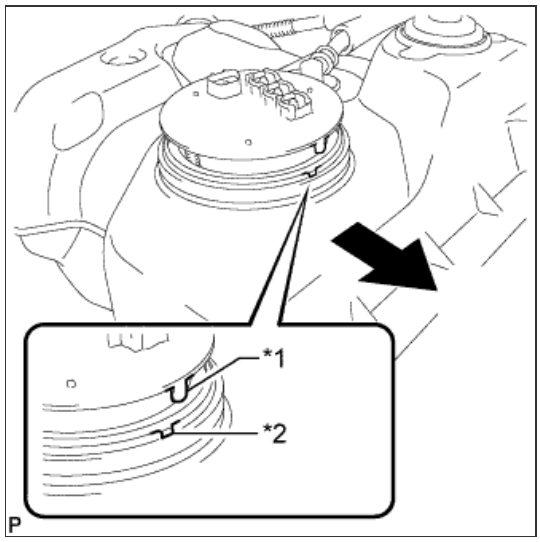


for Preparation Click here

1. INSTALL FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

a. Apply a light coat of gasoline or grease to a new gasket, and install it to the fuel tank.

b. Install the fuel suction with pump and gauge tube into the fuel tank.



Text in Illustration

*1	Protrusion
*2	Groove
➡	Front

NOTICE:

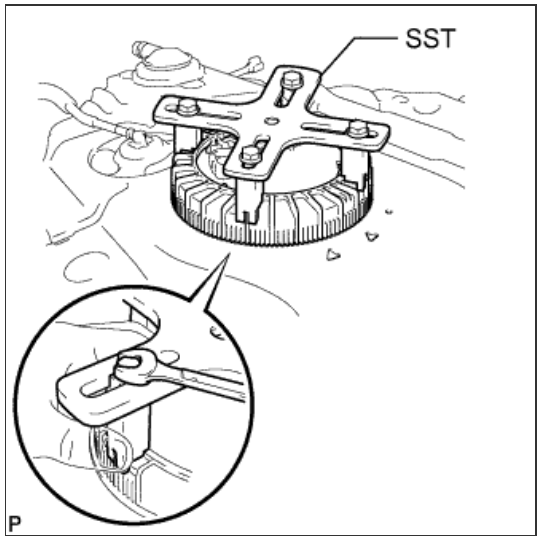
Be careful not to bend the arm of the fuel sender gauge.

HINT:

Align the protrusion of the fuel suction with pump and gauge tube with the groove of the fuel tank.

c. Put the retainer on the fuel tank. While holding the fuel suction with pump and gauge tube, tighten the retainer 1 complete turn by hand.

d. Set SST on the retainer.



SST
09808-14030

HINT:

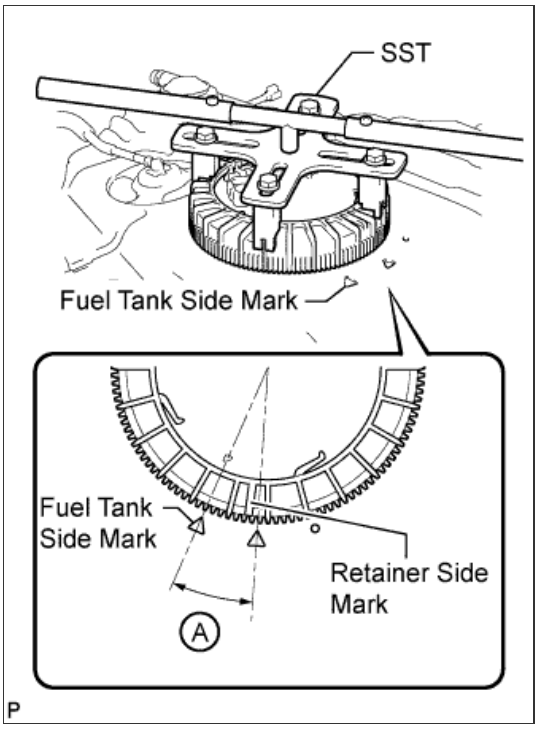
- **Hold the fuel suction tube assembl upright b hand to ensure that the fuel suction tube gasket is not moved out of position.**
- **Securel attach the claws of SST to the protrusions of the retainer and fix SST in place.**
- **Install SST while pressing the claws of SST against the retainer (toward the center of SST).**

e. Using SST, tighten the retainer until the mark on the retainer is within range A on the fuel tank as shown in the illustration.

SST
09808-14030

HINT:

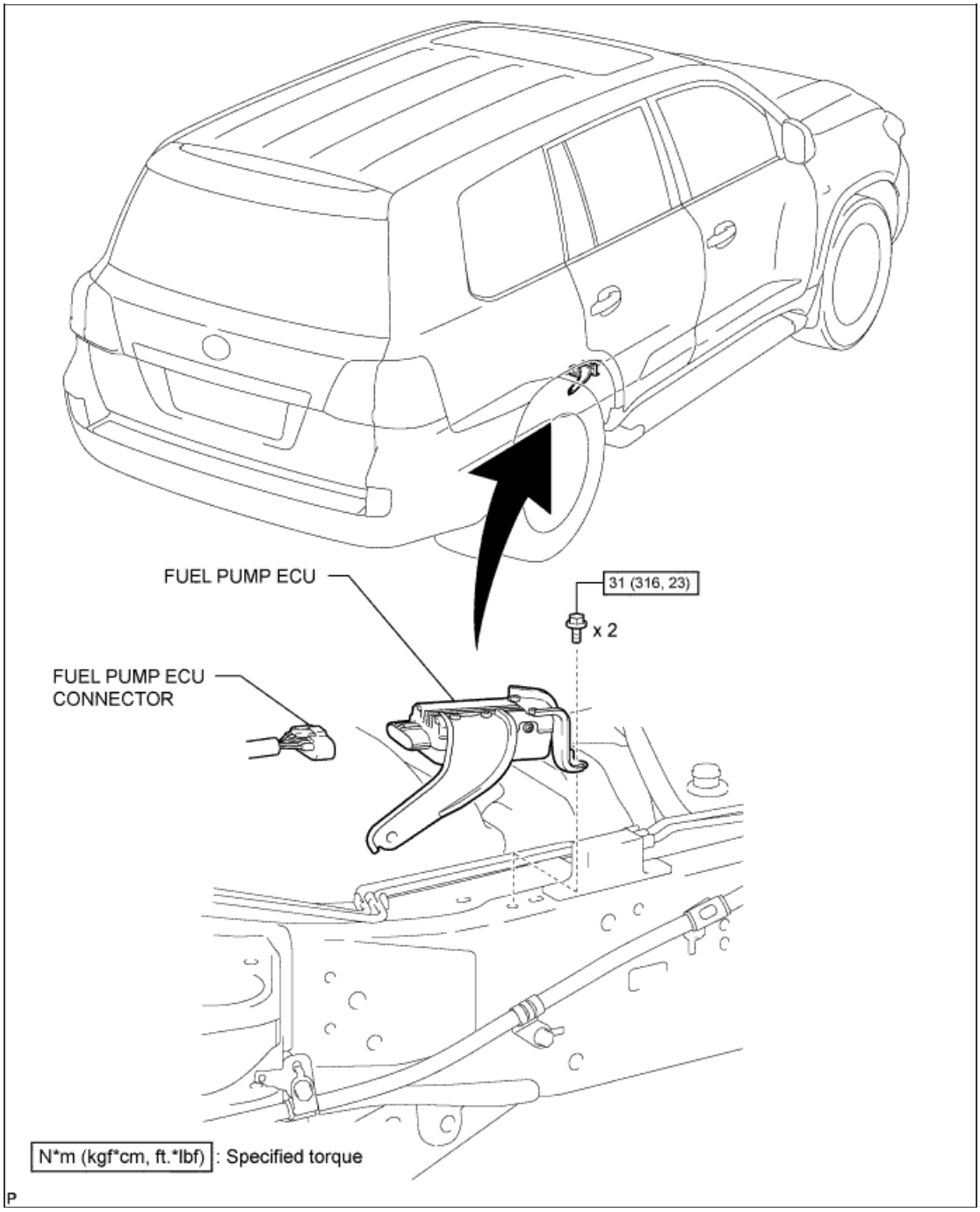
Fit the tips of SST onto the ribs of the retainer.



2. INSTALL FUEL TANK SUB-ASSEMBLY

(Click here)

for Preparation Click here



for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

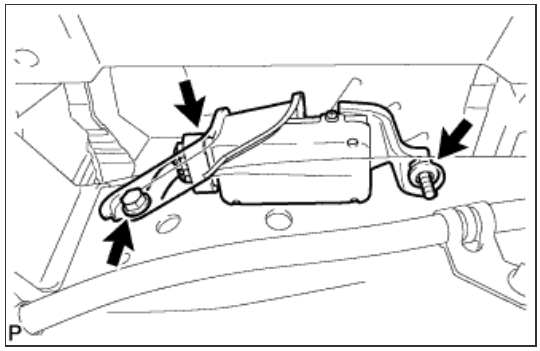
2. REMOVE FUEL PUMP ECU

a. Disconnect the fuel pump ECU connector.

b. Remove the 2 bolts and fuel pump ECU.

NOTICE:

Make sure the fuel pump ECU is not sub ected to physical shocks such as being dropped, etc.



for Preparation Click here

1. INSTALL FUEL PUMP ECU

a. Install the fuel pump ECU with the 2 bolts.

Torque:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

NOTICE:

Do not use the fuel pump ECU if it has been subjected to physical shocks such as being dropped, etc.

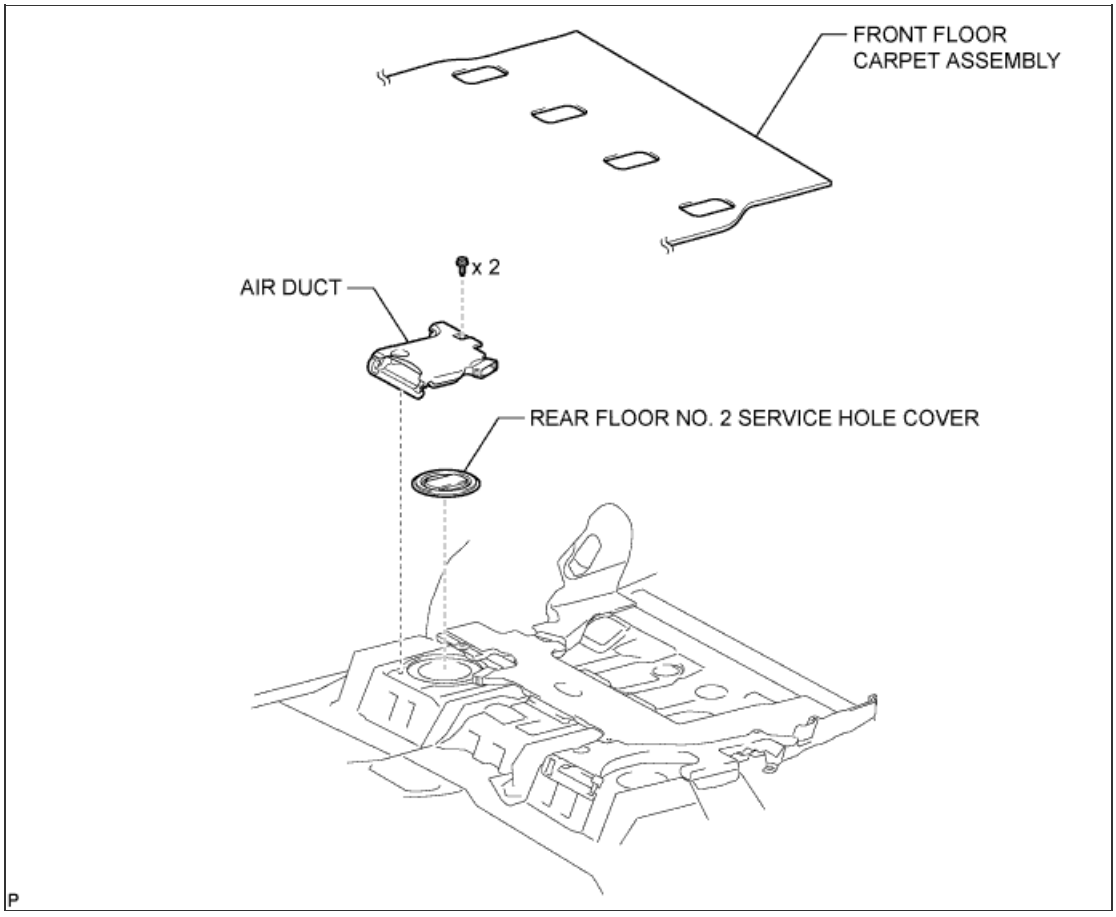
b. Connect the fuel pump ECU connector.

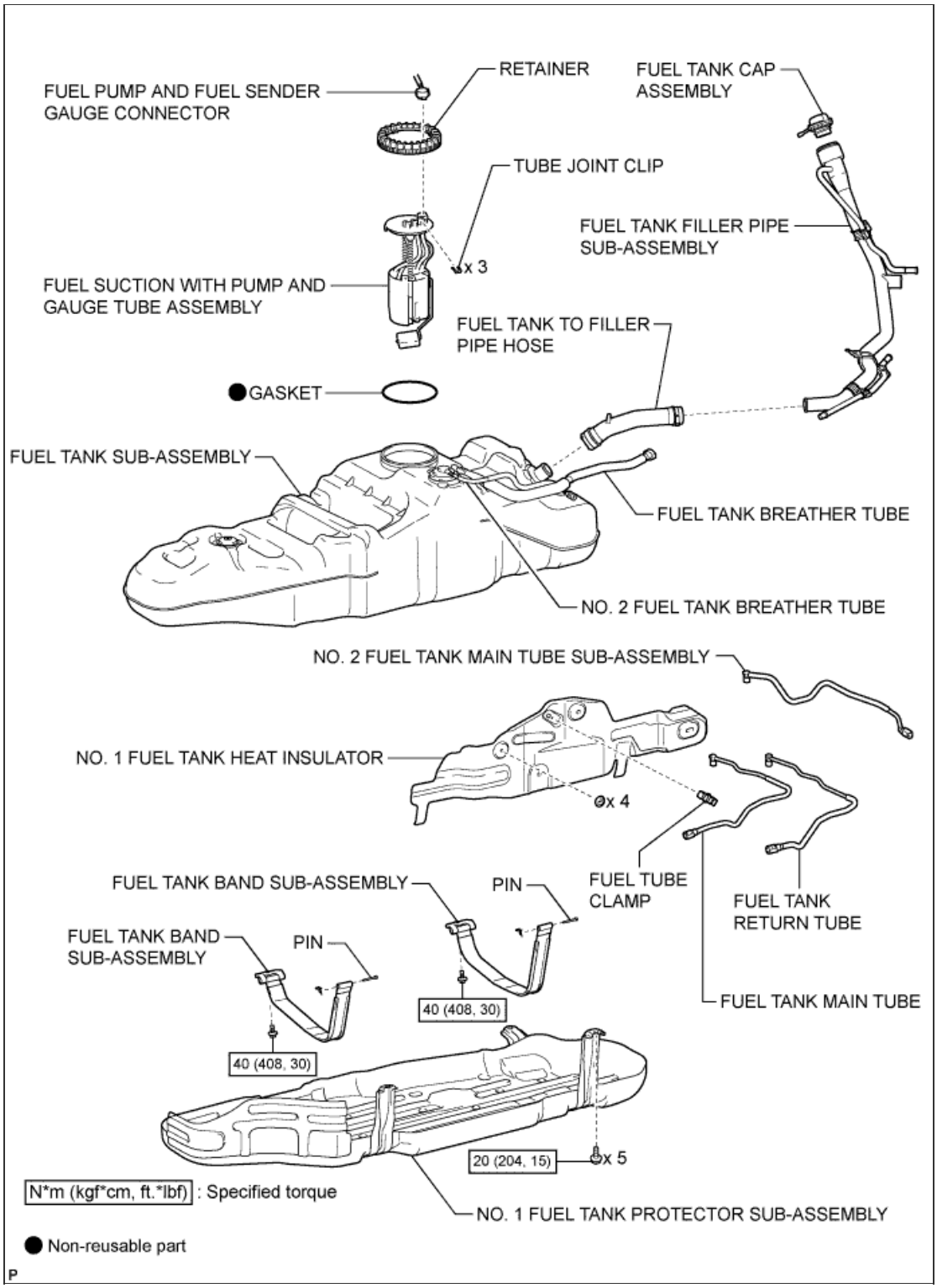
2. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

for Preparation Click here




FUEL PUMP AND FUEL SENDER GAUGE CONNECTOR
RETAINER
FUEL TANK CAP ASSEMBLY
TUBE JOINT CLIP
x 3
FUEL TANK FILLER PIPE SUB-ASSEMBLY
FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY
FUEL TANK TO FILLER PIPE HOSE
GASKET
FUEL TANK SUB-ASSEMBLY
FUEL TANK BREATHER TUBE
NO. 2 FUEL TANK BREATHER TUBE
NO. 2 FUEL TANK MAIN TUBE SUB-ASSEMBLY
NO. 1 FUEL TANK HEAT INSULATOR
x 4
FUEL TUBE CLAMP
FUEL TANK RETURN TUBE
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TANK MAIN TUBE
40 (408, 30)
40 (408, 30)
20 (204, 15)
x 5
N*m (kgf*cm, ft.*lbf) : Specified torque
NO. 1 FUEL TANK PROTECTOR SUB-ASSEMBLY
Non-reusable part
P

for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

(Click here)

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE REAR NO. 1 SEAT ASSEMBLY RH (for 60/40 Split Seat Type 40 Side)

(Click here)

4. REMOVE REAR NO. 1 SEAT ASSEMBLY LH (for 60/40 Split Seat Type 60 Side)

(Click here)

5. REMOVE REAR NO. 2 SEAT ASSEMBLY

a. for Face to Face Seat Type
   emove the rear No. 2 seat assembly (Click here).

b. except Face to Face Seat Type
   emove the rear No. 2 seat assembly (Click here).

6. REMOVE FRONT FLOOR CARPET ASSEMBLY

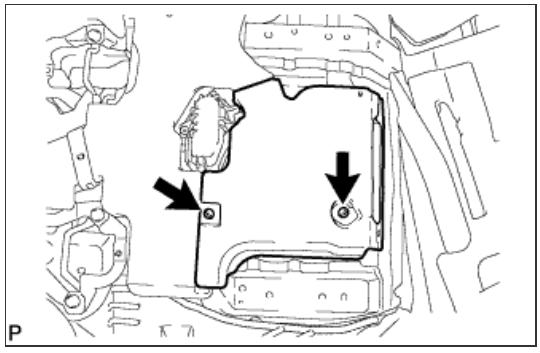
a. Turn over the floor carpet.

HINT:

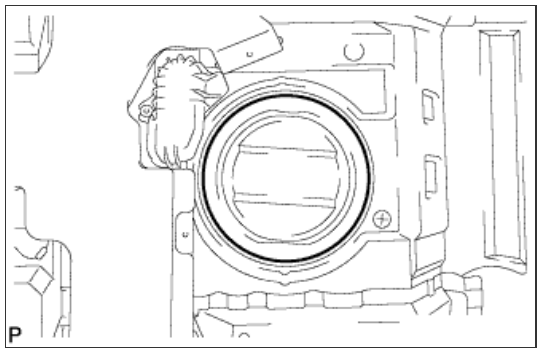
Fold back the floor carpet so that the air duct can be removed.

7. REMOVE REAR FLOOR NO. 2 SERVICE HOLE COVER

a. Remove the 2 screws and air duct.



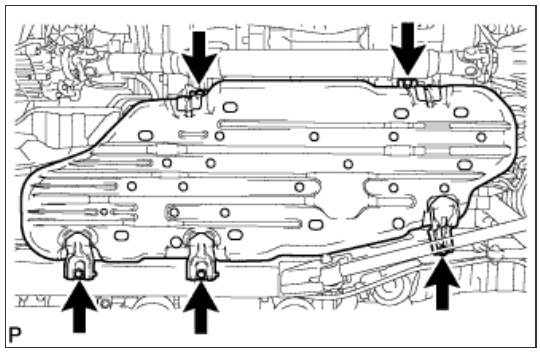
b. Remove the service hole cover.



8. REMOVE FUEL TANK CAP ASSEMBLY

9. REMOVE NO. 1 FUEL TANK PROTECTOR SUB-ASSEMBLY

a. Remove the 5 bolts and fuel tank protector.



10. DISCONNECT FUEL TANK MAIN TUBE SUB-ASSEMBLY

a. Detach the fuel tube clamp.

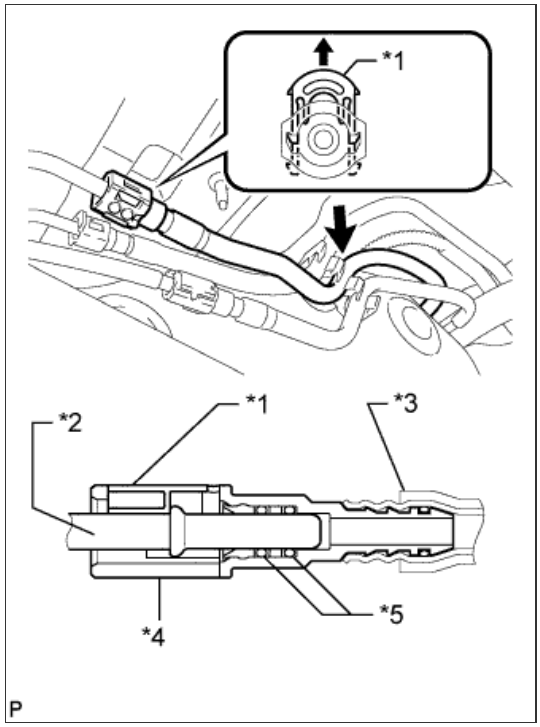
b. Pull up the retainer and disconnect the fuel tank main tube.

Text in Illustration

*1	Retainer
*2	Pipe
*3	Nylon Tube
*4	Connector
*5	O-Ring

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



11. DRAIN FUEL

a. Connect the cable to the negative (-) battery terminal.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

b. Connect the intelligent tester to the DLC3.

c. Turn the engine switch on (IG).

NOTICE:

Do not start the engine.

d. Turn the intelligent tester on.

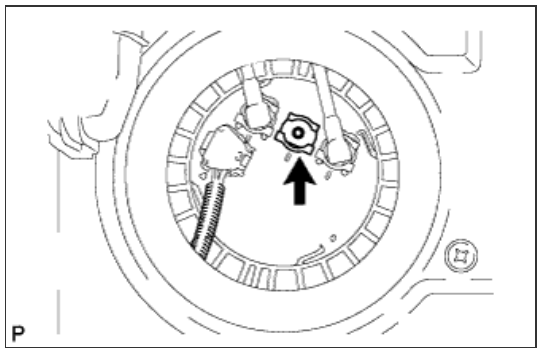
e. nter the following menus owertrain / ngine and CT / Active Test / Control the Fuel Pump / Speed.

CAUTION:

- **Do not smoke or be near an open flame when working on the fuel system.**
- **Secure good ventilation.**
- **Keep gasoline away from rubber or leather parts.**

HINT:

If the fuel pump does not operate, remove the fuel tube joint clip and disconnect the fuel tank return tube, and drain fuel from the port shown in the illustration.

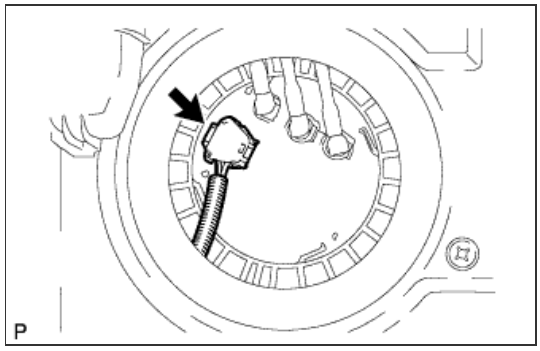


f. Disconnect the cable from the negative (-) battery terminal.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

g. Disconnect the fuel pump and fuel sender gauge connector.



12. DISCONNECT FUEL TANK RETURN TUBE

a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel tank return tube.

Text in Illustration

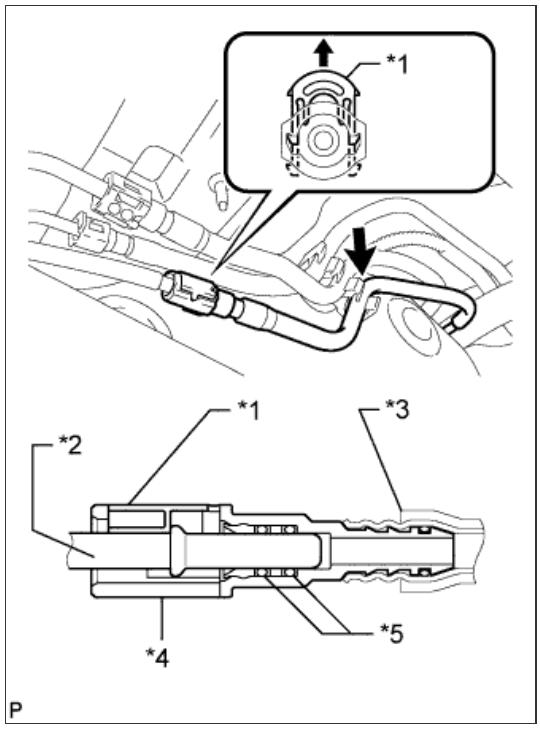
*1	Retainer
*2	Pipe
*3	Nylon Tube
*4	Connector
*5	O-Ring

NOTICE:

- **Check for foreign matter in the pipe and around the connector.**

Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.

- Do not use any tools to separate the pipe and connector.
- Do not forcefully bend or twist the nylon tube.
- Check for foreign matter on the pipe seal surface. Clean if necessary.
- Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.
- If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.



13. DISCONNECT NO. 2 FUEL MAIN TUBE SUB-ASSEMBLY

a. Detach the fuel tube clamp.

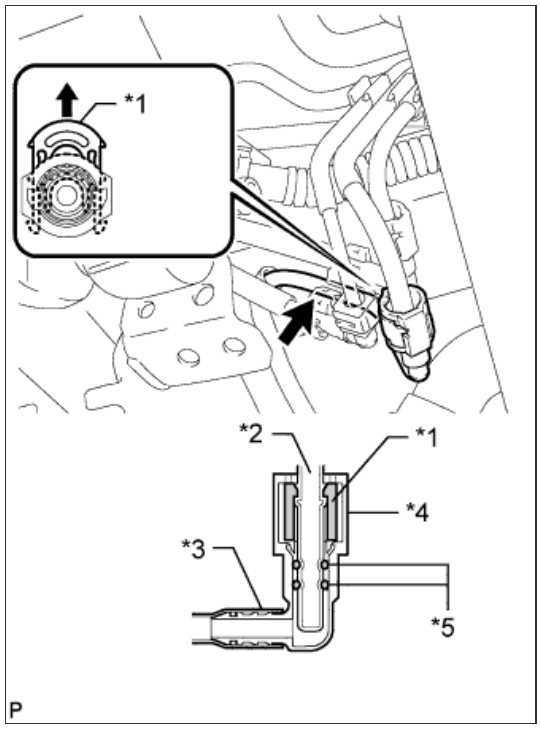
b. Pull up the retainer and disconnect the fuel tank main tube.

Text in Illustration

*1	Retainer
*2	Pipe
*3	Nylon Tube
*4	Connector
*5	O-Ring

NOTICE:

- Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.
- Do not use any tools to separate the pipe and connector.
- Do not forcefully bend or twist the nylon tube.
- Check for foreign matter on the pipe seal surface. Clean if necessary.
- Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.
- If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.



14. DISCONNECT NO. 2 FUEL TANK BREATHER TUBE

a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel tank breather tube.

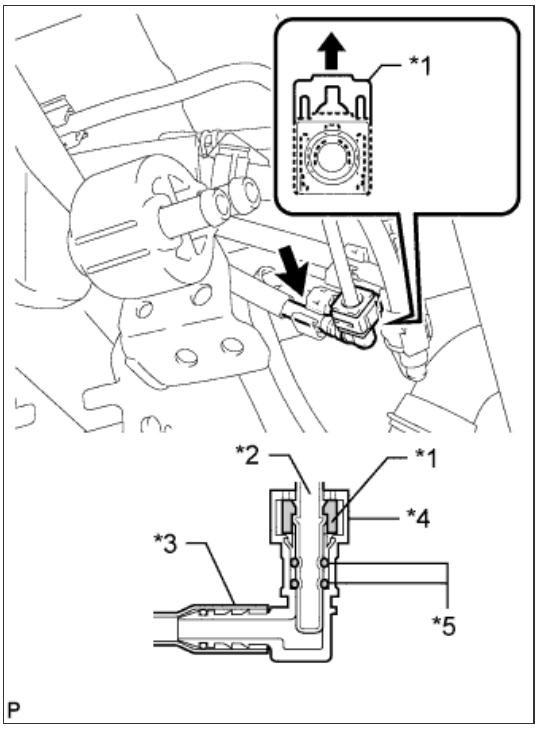
Text in Illustration

*1	Retainer
*2	Pipe
*3	Nylon Tube

*4	Connector
*5	O-Ring

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



15. DISCONNECT FUEL TANK BREATHER TUBE

a. Detach the fuel tube clamp.

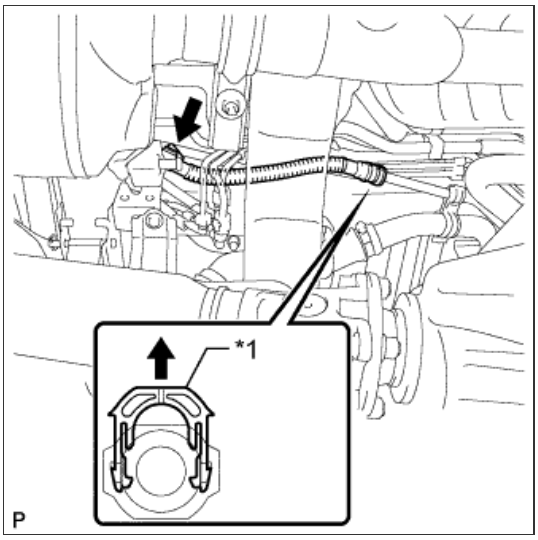
b. Pull up the retainer and disconnect the fuel tank breather tube from the filler pipe.

Text in Illustration

*1	Retainer

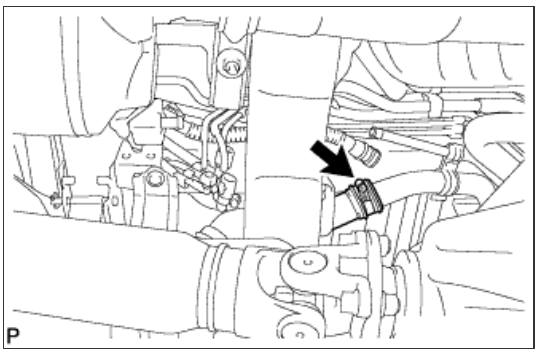
NOTICE:

- **Do not use any tools in this procedure.**
- **Check for any dirt and foreign matter contamination in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**



16. DISCONNECT FUEL TANK TO FILLER PIPE HOSE

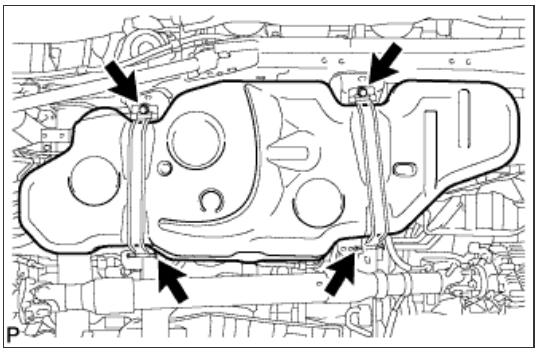
a. Disconnect the hose from the filler pipe.



17. REMOVE FUEL TANK SUB-ASSEMBLY

a. Place a transmission jack under the fuel tank.

b. Remove the 2 bolts, 2 clips, 2 pins and 2 fuel tank bands.



18. REMOVE FUEL TANK MAIN TUBE, FUEL TANK RETURN TUBE AND NO. 2 FUEL TANK MAIN TUBE SUB-ASSEMBLY

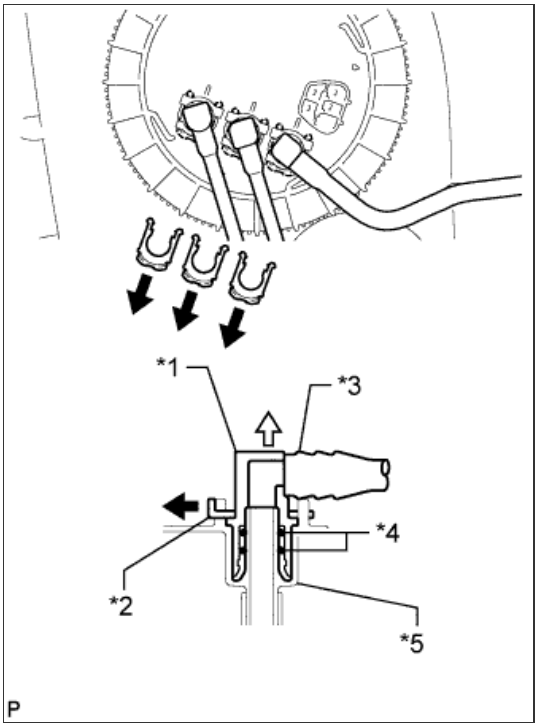
a. Remove the 3 fuel tube joint clips and pull out the 3 fuel tubes.

Text in Illustration

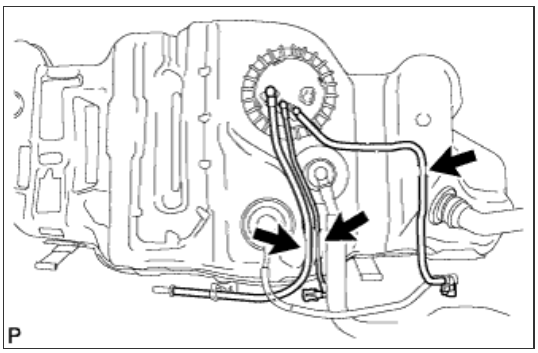
*1	Tube oint
*2	Tube oint Clip
*3	Fuel Tank Tube
*4	O-Ring
*5	Fuel Suction Plate

NOTICE:

- **Remove any dirt and foreign matter on the fuel tube joint before performing this work.**
- **Do not allow any scratches or foreign matter on the parts when disconnecting them, as the fuel tube joint contains the O-rings that seal the plug.**
- **Perform this work by hand. Do not use any tools.**
- **Do not forcibly bend, twist or turn the nylon tube.**
- **Protect the disconnected part by covering it with a plastic bag and tape after disconnecting the fuel tubes.**



b. Remove the 3 fuel tubes from the fuel tank.



19. REMOVE FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

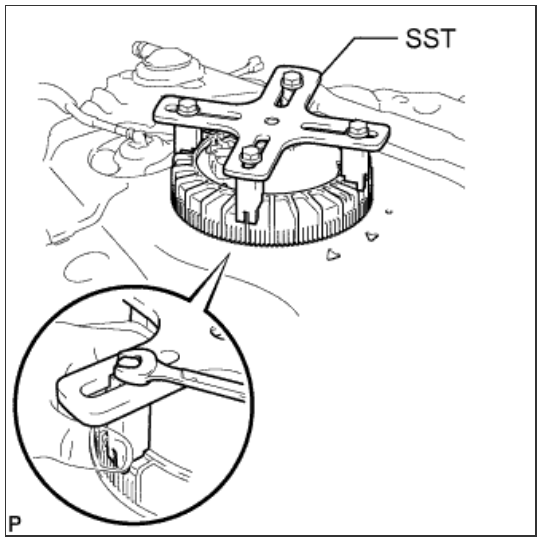
a. Set SST on the retainer.

SST

09808-14030

HINT:

- **Securely attach the claws of SST to the protrusion of the retainer and fix SST in place.**
- **Install SST while pressing the claws of SST against the retainer (towards the center of SST).**



b. Using SST, loosen the retainer.

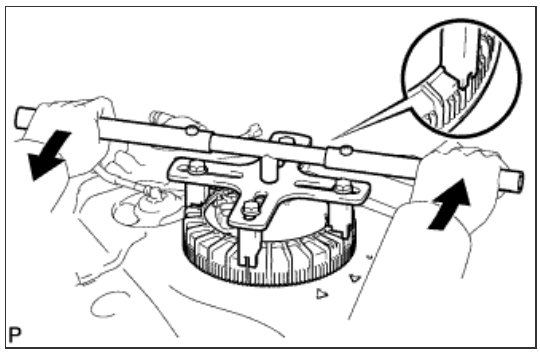
SST
09808-14030

NOTICE:

- **Do not use any tools other than those specified in this operation. Damage to the retainer or the fuel tank may result.**
- **While pressing down on SST so that the claws of SST do not slip off the protrusion of the retainer, turn the retainer counterclockwise to loosen it.**

HINT:

The protrusion of the retainer fit in the ends of SST.

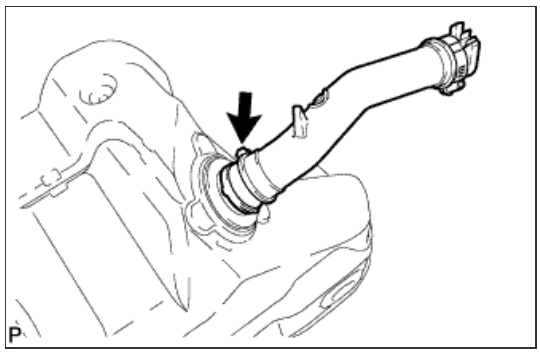


c. Remove the retainer while holding the fuel suction tube assembly by hand.

d. Remove the gasket from the fuel tank.

20. REMOVE FUEL TANK TO FILLER PIPE HOSE

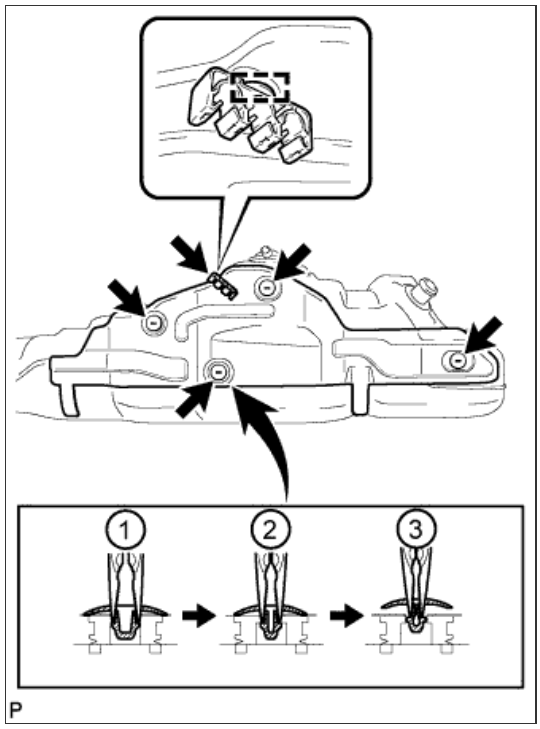
a. Remove the hose from the fuel tank.



21. REMOVE NO. 1 FUEL TANK HEAT INSULATOR

a. Remove the fuel tube clamp from the heat insulator.

b. Using needle-nose pliers, remove the 4 clips shown in the illustration and then remove the heat insulator.

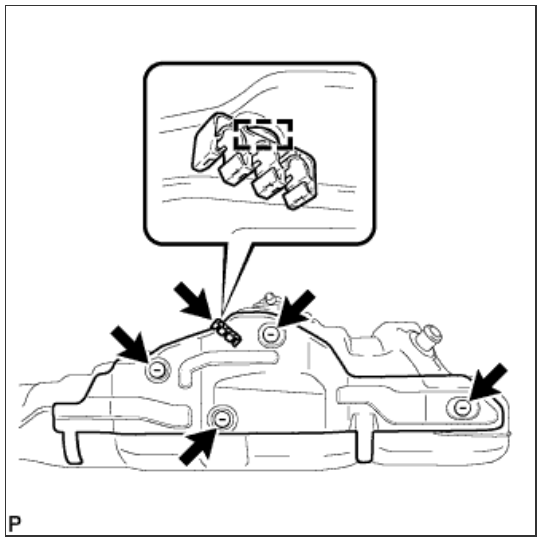

1
2
3
P

for Preparation Click here

1. INSTALL NO. 1 FUEL TANK HEAT INSULATOR

a. Install the heat insulator with the 4 clips.

b. Install the fuel tube clamp to the heat insulator.



2. INSTALL FUEL TANK TO FILLER PIPE HOSE

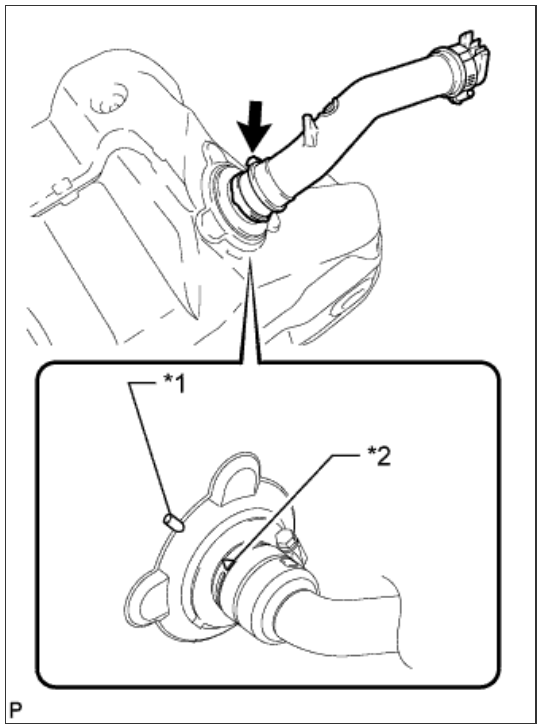
a. Install the hose to the fuel tank as shown in the illustration.

Text in Illustration

*1	Fuel Tank Side Mark
*2	Hose Side Mark

HINT:

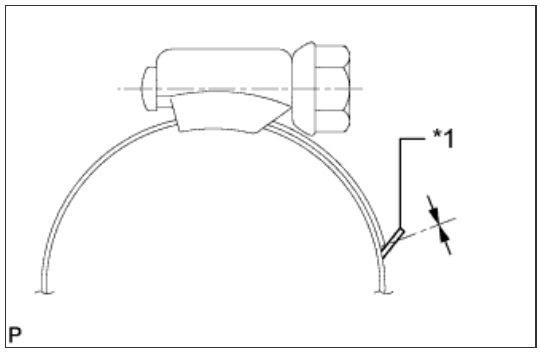
- **Align the fuel tank side mark with the hose side mark when installing the hose.**



- **Tighten the hose clamp until the end of the hose clamp contacts the stopper as shown in the illustration.**

Text in Illustration

*1	Stopper



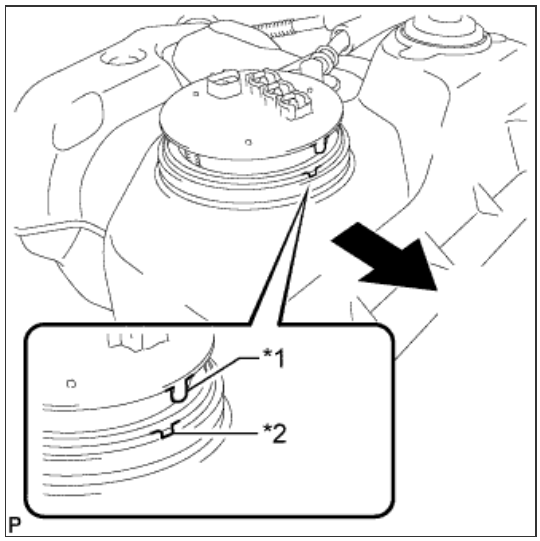
3. INSTALL FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

a. Apply a light coat of gasoline or grease to a new gasket, and install it to the fuel tank.

b. Install the fuel suction with pump and gauge tube into the fuel tank.

Text in Illustration

*1	Protrusion
*2	Groove
➡	Front



NOTICE:

Be careful not to bend the arm of the fuel sender gauge.

HINT:

Align the protrusion of the fuel suction with pump and gauge tube with the groove of the fuel tank.

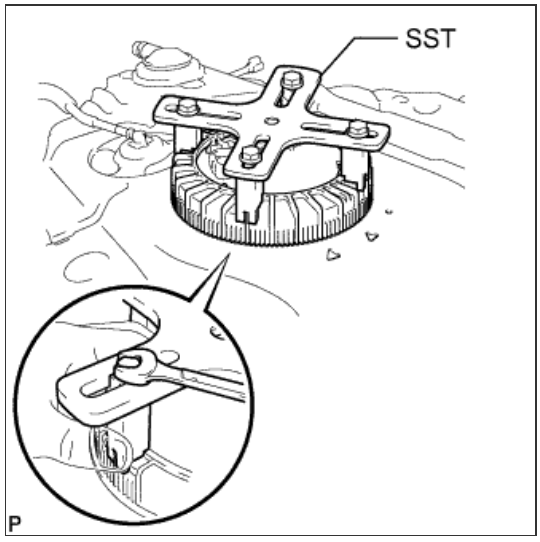
c. Put the retainer on the fuel tank. While holding the fuel suction with pump and gauge tube, tighten the retainer 1 complete turn by hand.

d. Set SST on the retainer.

SST
09808-14030

HINT:

- **Hold the fuel suction tube assembly upright by hand to ensure that the fuel suction tube gasket is not moved out of position.**
- **Securely attach the claws of SST to the protrusions of the retainer and fix SST in place.**
- **Install SST while pressing the claws of SST against the retainer (toward the center of SST).**

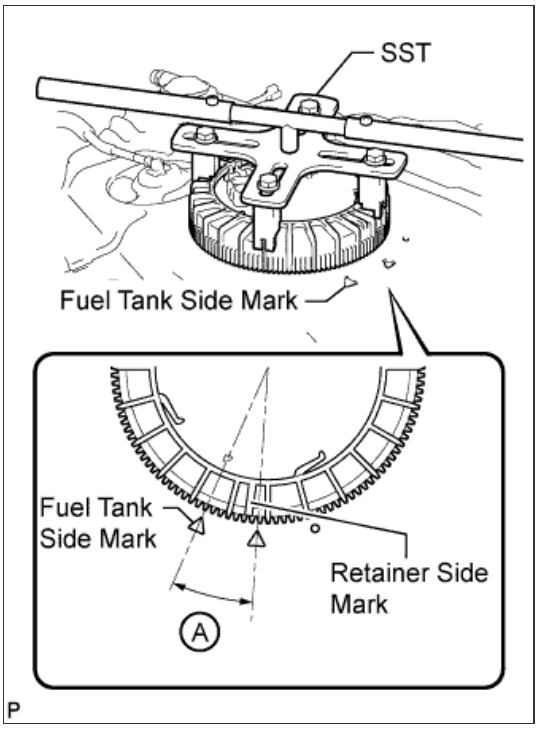


e. Using SST, tighten the retainer until the mark on the retainer is within range A on the fuel tank as shown in the illustration.

SST
09808-14030

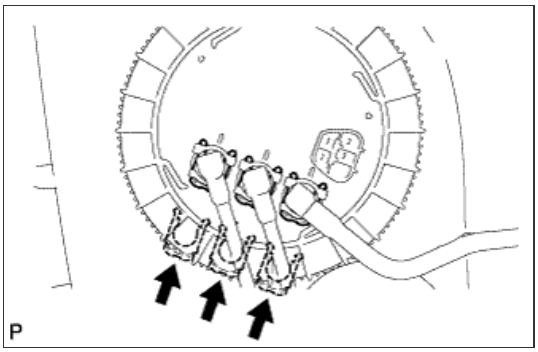
HINT:

Fit the tips of SST onto the ribs of the retainer.



4. INSTALL FUEL TANK MAIN TUBE, FUEL TANK RETURN TUBE AND NO. 2 FUEL TANK MAIN TUBE SUB-ASSEMBLY

a. Install the 3 fuel tank tubes with the 3 tube joint clips.

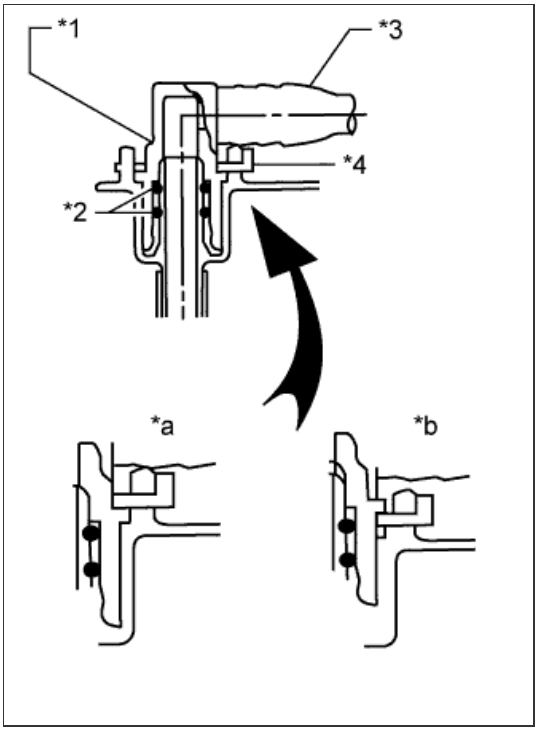


NOTICE:

- **Check that there are no scratches or foreign ob ects on the connecting parts.**
- **Check that the fuel tube oints are inserted securely.**
- **Check that the tube oint clips are on the collars of the fuel tube oints.**
- **After installing the tube oint clips, check that the fuel tube oints cannot be pulled off.**

Text in Illustration

*1	Fuel Tube oint
*2	O-Ring
*3	Fuel Tube
*4	Tube oint lip
*a	T
*b	IN T



b. Install the 3 fuel tank tubes to the fuel tank.

5. INSTALL FUEL TANK SUB-ASSEMBLY

a. Set the fuel tank on a transmission jack and raise the fuel tank.

NOTICE:

Do not allow the fuel tank to contact the vehicle, especially the differential.

b. Raise the transmission jack.

c. Install the 2 fuel tank bands with the 2 pins and 2 clips.

d. onnect the 2 fuel tank bands with the 2 bolts.

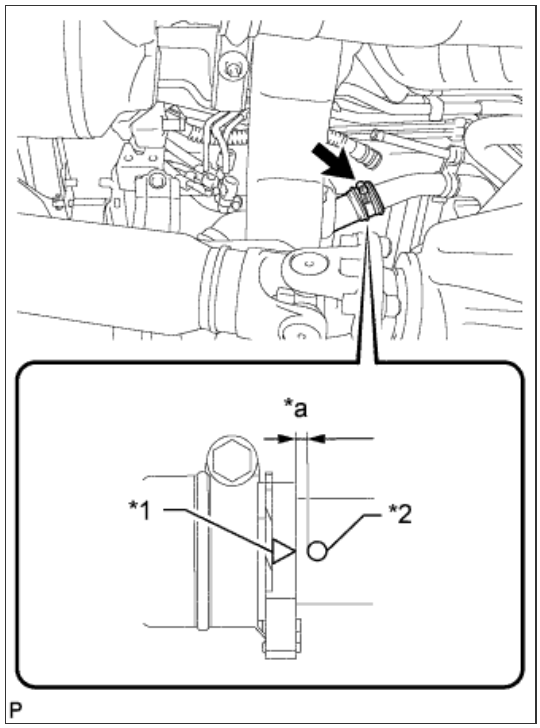
Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

6. CONNECT FUEL TANK TO FILLER PIPE HOSE

a. onnect the hose to the filler pipe as shown in the illustration.

Text in Illustration

*1	Hose Side Mark
*2	Pipe Side Mark
*a	d 3 mm



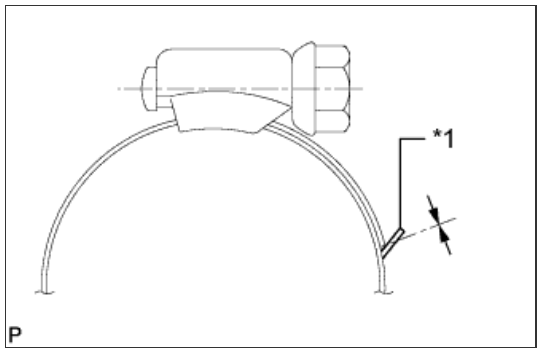
HINT:

- **Install the hose so that the distance between the fuel tank inlet pipe side mark and fuel tank to filler pipe hose side mark is 0 to 0.3 mm (0 to 0.0118 in.) as shown in the illustration.**

- **Tighten the hose clamp until the end of the hose clamp contacts the stopper as shown in the illustration.**

Text in Illustration

*1	Stopper



7. CONNECT FUEL TANK BREATHER TUBE

a. onnect the fuel tank breather tube to the filler pipe and push the retainer.

Text in Illustration

*1	Retainer

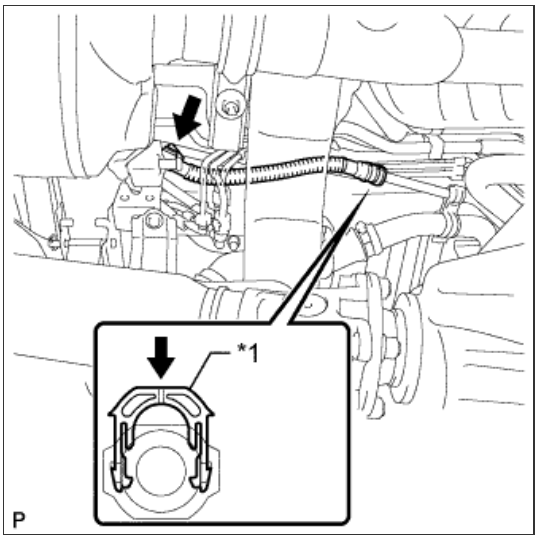
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Attach the fuel tube clamp.



8. CONNECT NO. 2 FUEL MAIN TUBE SUB-ASSEMBLY

a. onnect the fuel main tube and push the retainer.

Text in Illustration

*1	Retainer
*2	Pipe
*3	Nylon Tube
*4	onnector
*5	O-Ring

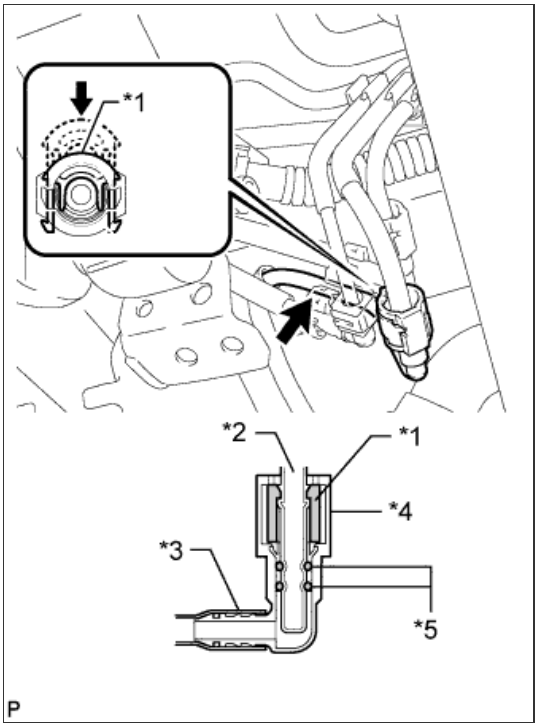
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Attach the fuel tube clamp.



9. CONNECT NO. 2 FUEL TANK BREATHER TUBE

a. onnect the fuel tank breather tube and push the retainer.

Text in Illustration

*1	Retainer
*2	Pipe
*3	Nylon Tube
*4	onnector
*5	O-Ring

HINT:

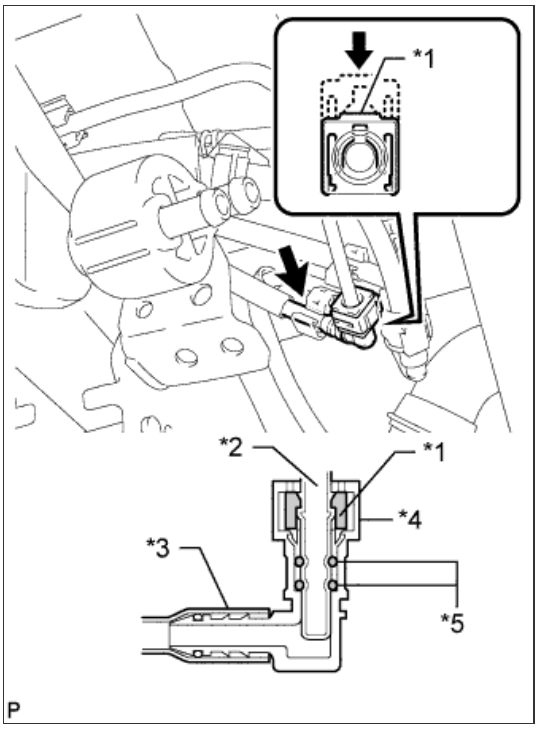
Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if**

there is any damage or foreign matter in the connectors.
- After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.

b. Attach the fuel tube clamp.



10. CONNECT FUEL TANK RETURN TUBE

a. onnect the fuel tank return tube and push the retainer.

Text in Illustration

*1	Retainer
*2	Pipe
*3	Nylon Tube
*4	onnector
*5	O-Ring

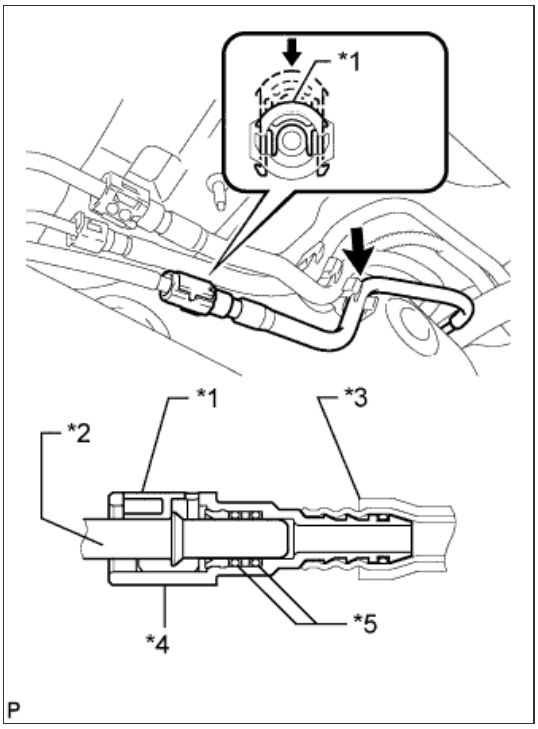
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.
- After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.

b. Attach the fuel tube clamp.



11. CONNECT FUEL TANK MAIN TUBE SUB-ASSEMBLY

a. onnect the fuel tank main tube and push the retainer.

Text in Illustration

*1	Retainer
*2	Pipe
*3	Nylon Tube
*4	onnector
*5	O-Ring

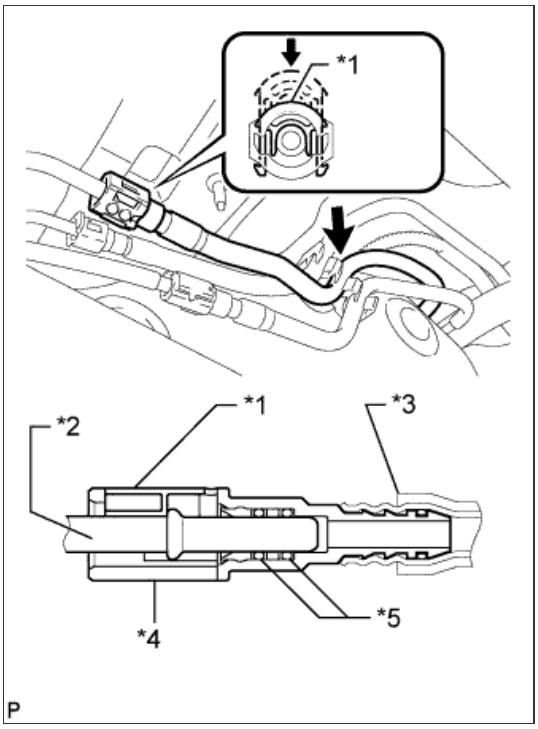
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Attach the fuel tube clamp.



12. INSTALL NO. 1 FUEL TANK PROTECTOR SUB-ASSEMBLY

a. Install the tank protector with the 5 bolts.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

13. INSTALL FUEL TANK CAP ASSEMBLY

14. INSTALL REAR FLOOR NO. 2 SER ICE HOLE CO B

a. onnect the fuel pump and fuel sender gauge connector.

b. Install the service hole cover with new butyl tape.

c. Install the air duct and 2 screws.

15. INSTALL FRONT FLOOR CARPET ASSEMBLY

16. INSTALL REAR NO. 2 SEAT ASSEMBLY

a. for Face to Face Seat Type:
Install the rear No. 2 seat assembly (lick here).

b. e cept Face to Face Seat Type:
Install the rear No. 2 seat assembly (lick here).

17. INSTALL REAR NO. 1 SEAT ASSEMBLY LH (for 60 40 Split Seat Type 60 Side)

(lick here)

18. INSTALL REAR NO. 1 SEAT ASSEMBLY RH (for 60 40 Split Seat Type 40 Side)

(lick here)

19. CONNECT CABLE TO NEGATI BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (lick here).

20. ADD FUEL

21. INSPECT FOR FUEL LEAK

a. onnect the intelligent tester to the D 3.

b. Turn the engine switch on (IG) and intelligent tester main switch on.

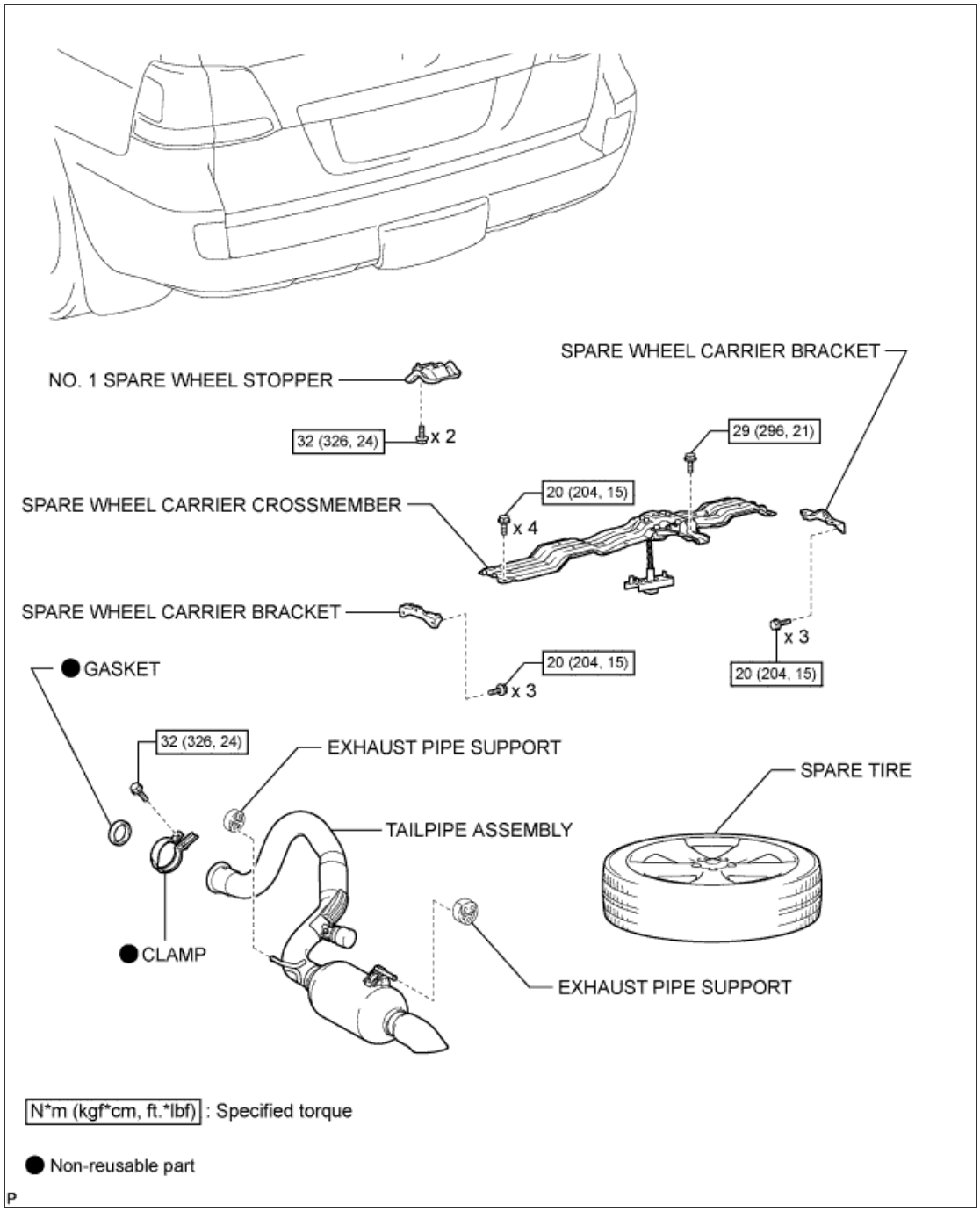
NOTICE:

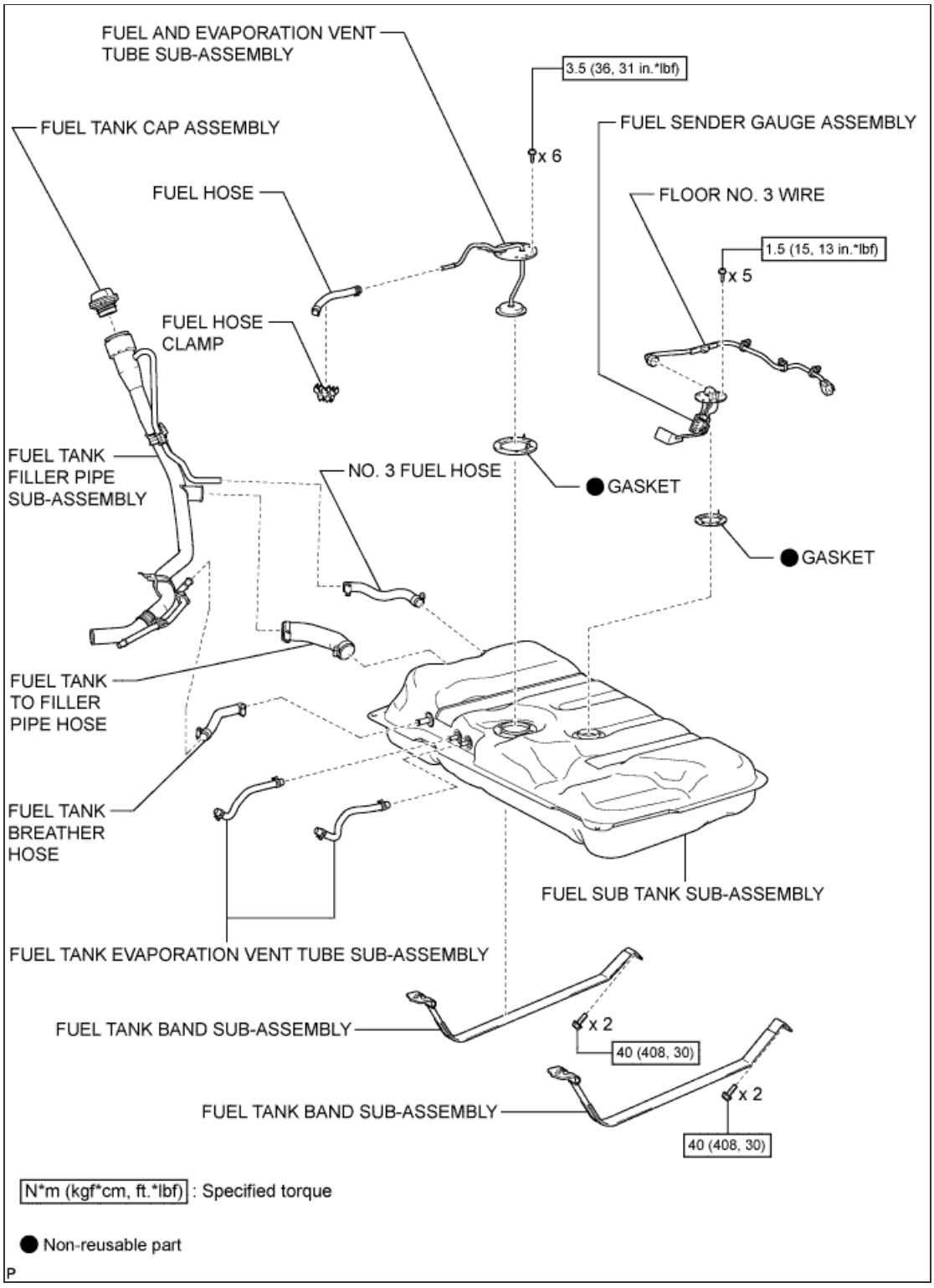
Do not start the engine.

c. nter the following menus: Powertrain ngine and T Active Test ontrol the Fuel Pump Speed.

d. heck that there are no fuel leaks after doing maintenance anywhere on the fuel system.

for Preparation Click here




FUEL AND EVAPORATION VENT TUBE SUB-ASSEMBLY
3.5 (36, 31 in.*lbf)
FUEL TANK CAP ASSEMBLY
FUEL SENDER GAUGE ASSEMBLY
x 6
FUEL HOSE
FLOOR NO. 3 WIRE
1.5 (15, 13 in.*lbf)
x 5
FUEL HOSE CLAMP
FUEL TANK FILLER PIPE SUB-ASSEMBLY
NO. 3 FUEL HOSE
GASKET
GASKET
FUEL TANK TO FILLER PIPE HOSE
FUEL TANK BREATHER HOSE
FUEL SUB TANK SUB-ASSEMBLY
FUEL TANK EVAPORATION VENT TUBE SUB-ASSEMBLY
FUEL TANK BAND SUB-ASSEMBLY
x 2
40 (408, 30)
FUEL TANK BAND SUB-ASSEMBLY
x 2
40 (408, 30)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

(Click here)

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE SPARE TIRE

4. REMOVE TAILPIPE ASSEMBLY

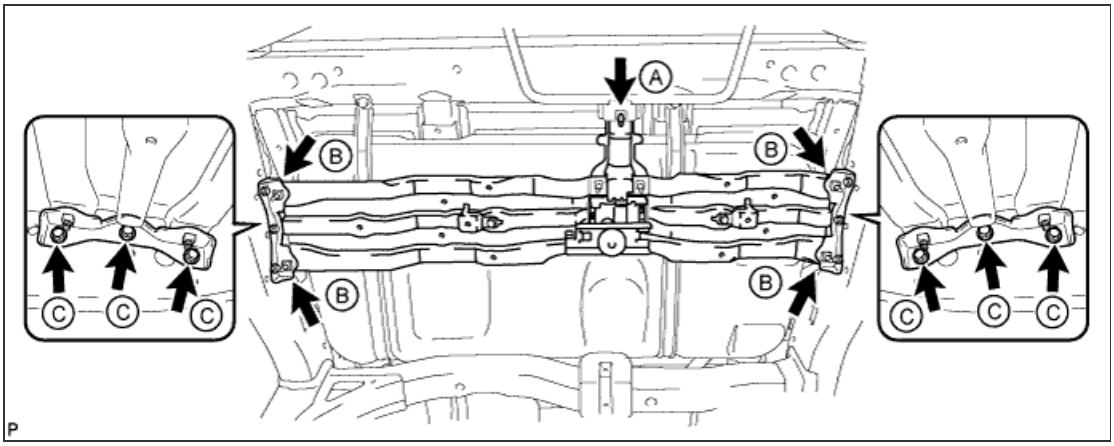
a. Remove the bolt, clamp and gasket.

b. Remove the tailpipe from the 2 exhaust pipe supports.

c. Remove the bolt and clamp, and then disconnect the tailpipe from the center exhaust pipe.

5. REMOVE SPARE WHEEL CARRIER CROSSMEMBER AND SPARE WHEEL CARRIER BRACKET

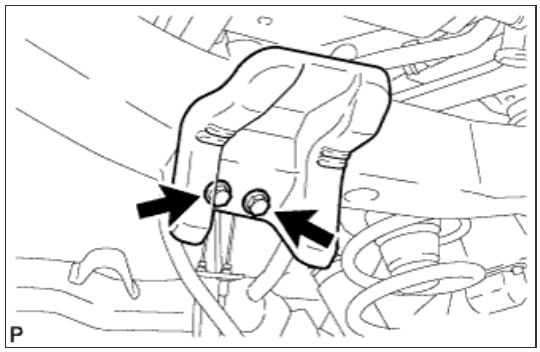
a. Remove the bolt labeled A, and then loosen the 4 bolts labeled B.



b. Slightly raise the spare wheel carrier crossmember, and then remove the 6 bolts labeled C, spare wheel carrier crossmember and 2 brackets.

6. REMOVE NO. 1 SPARE WHEEL STOPPER

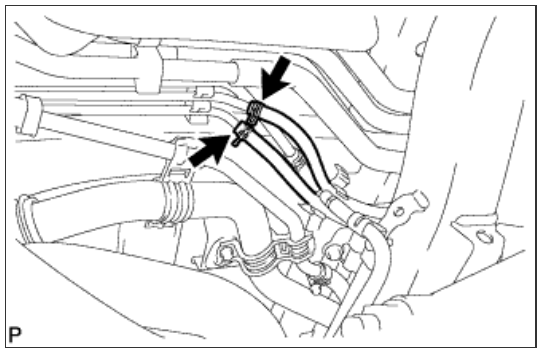
a. Remove the 2 bolts and spare wheel stopper.



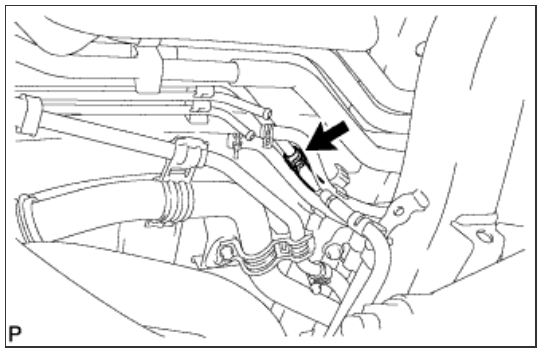
7. REMOVE FUEL TANK CAP ASSEMBLY

8. DISCONNECT FUEL TANK EVAPORATION VENT TUBE SUB-ASSEMBLY

a. Disconnect the 2 fuel tank evaporation vent tubes.

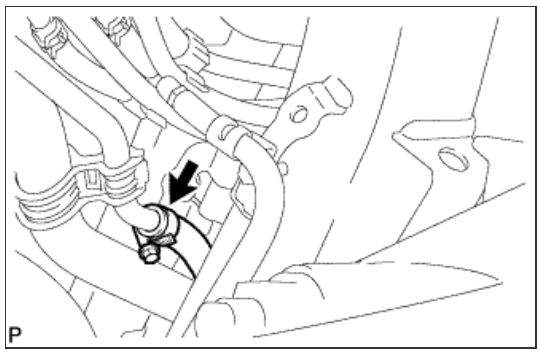


9. DISCONNECT FUEL HOSE



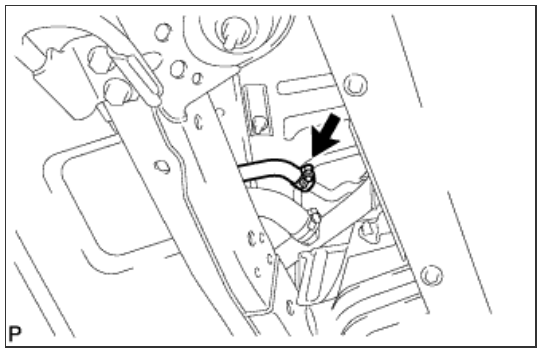
10. DISCONNECT FUEL TANK BREATHER HOSE

a. Disconnect the breather hose from the filler pipe.



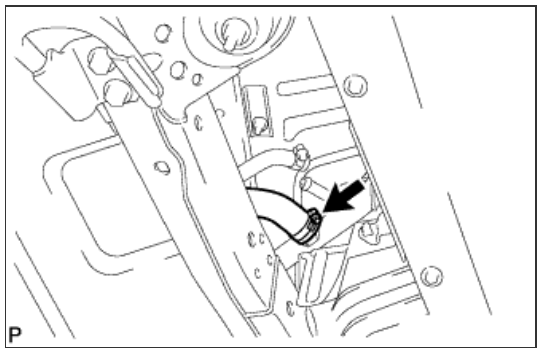
11. DISCONNECT NO. 3 FUEL HOSE

a. Disconnect the fuel hose from the filler pipe.



12. DISCONNECT FUEL TANK TO FILLER PIPE HOSE

a. Disconnect the hose from the filler pipe.

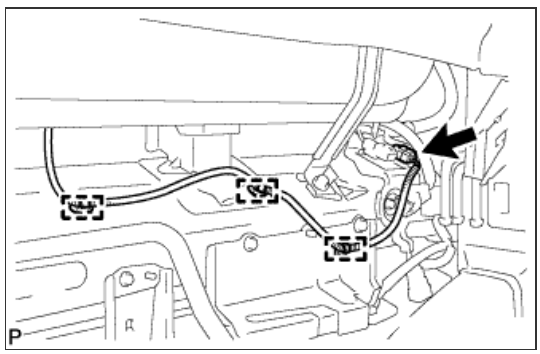


13. REMOVE FUEL SUB TANK SUB-ASSEMBLY

a. Disconnect the floor No. 3 wire connector.

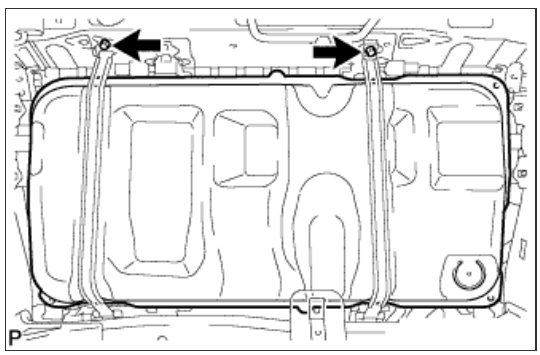
b. Using a clip remover, detach the 3 wire harness clamps.

c. Set a transmission jack underneath the fuel sub tank.



d. Remove the 2 bolts and disconnect the 2 fuel tank bands.

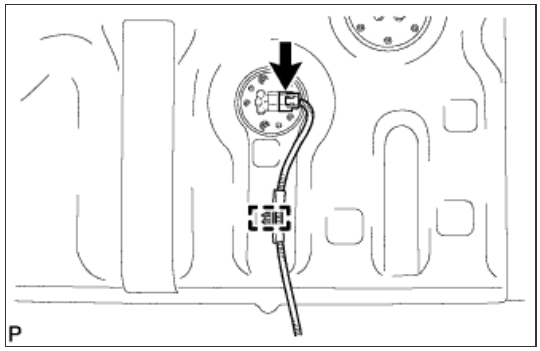
e. Remove the fuel sub tank.



14. REMOVE FLOOR NO. 3 WIRE

a. Disconnect the sender gauge connector.

b. Using a clip remover, detach the wire harness clamp.



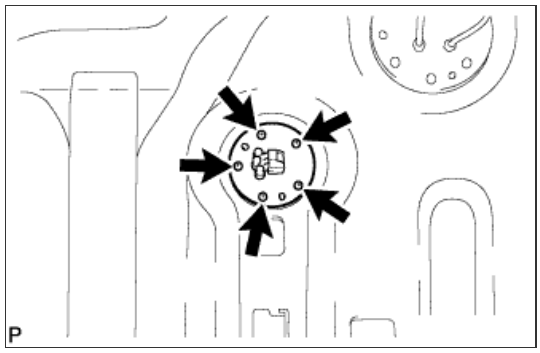
15. REMOVE FUEL SENDER GAUGE ASSEMBLY

a. Remove the 5 screws and sender gauge.

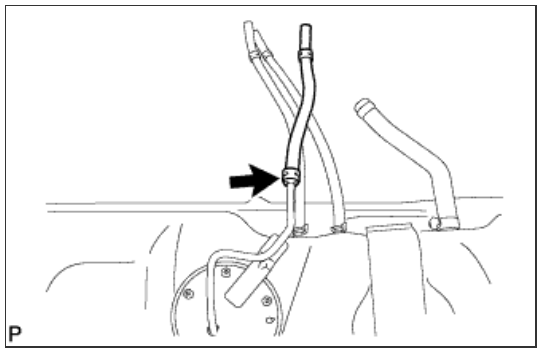
NOTICE:

Be careful not to bend the arm of the fuel sender gauge.

b. Remove the gasket from the sender gauge.

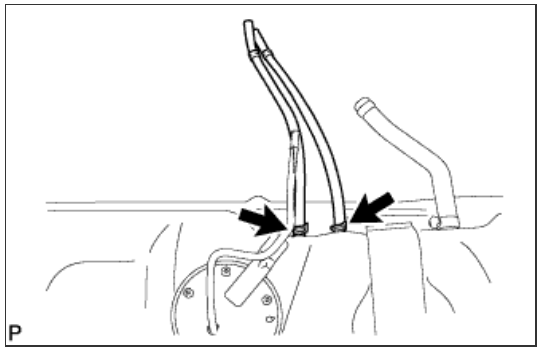


16. REMOVE FUEL HOSE



17. REMOVE FUEL TANK EVAPORATION VENT TUBE SUB-ASSEMBLY

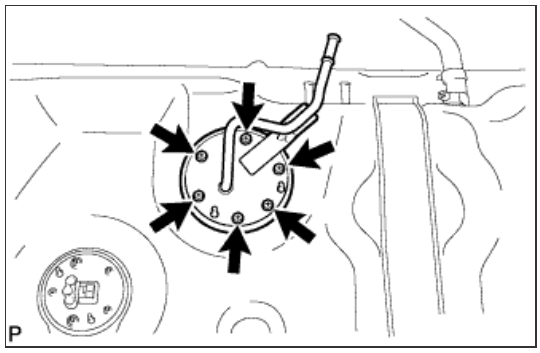
a. Remove the 2 fuel tank evaporation vent tubes.



18. REMOVE FUEL AND EVAPORATION VENT TUBE SUB-ASSEMBLY

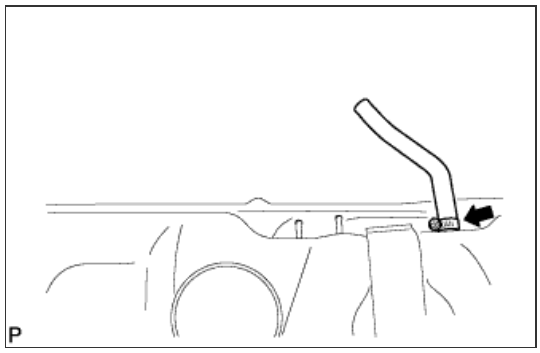
a. Remove the 6 bolts and fuel and evaporation vent tube.

b. Remove the gasket from the fuel and evaporation vent tube.



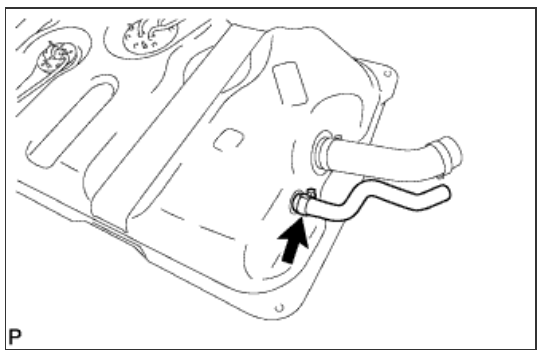
19. REMOVE FUEL TANK BREATHER HOSE

a. Remove the breather hose from the fuel sub tank.



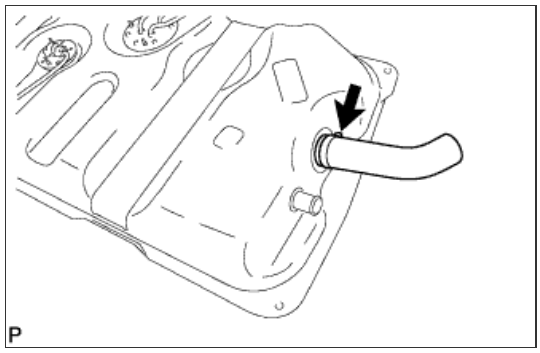
20. REMOVE NO. 3 FUEL HOSE

a. Remove the fuel hose from the fuel sub tank.



21. REMOVE FUEL TANK TO FILLER PIPE HOSE

a. Remove the hose from the fuel sub tank.


P

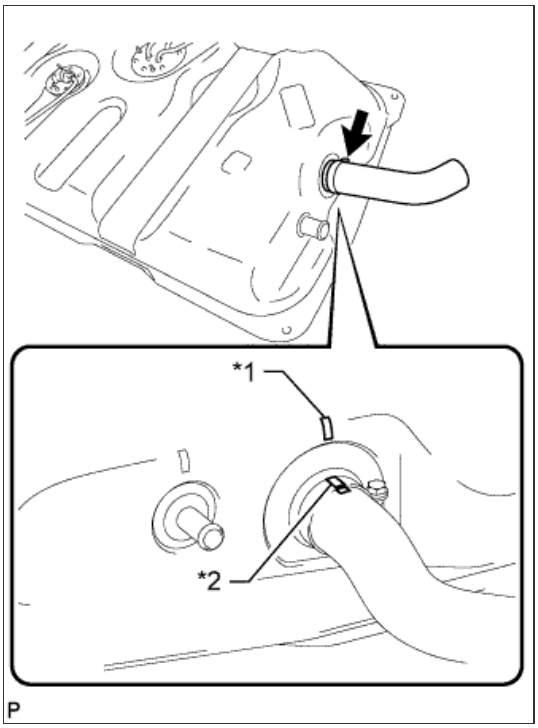
for Preparation [Click here]

1. INSTALL FUEL TANK TO FILLER PIPE HOSE

a. Install the hose to the fuel sub tank as shown in the illustration.

Text in Illustration

*1	Tank Side Mark
*2	Hose Side Mark



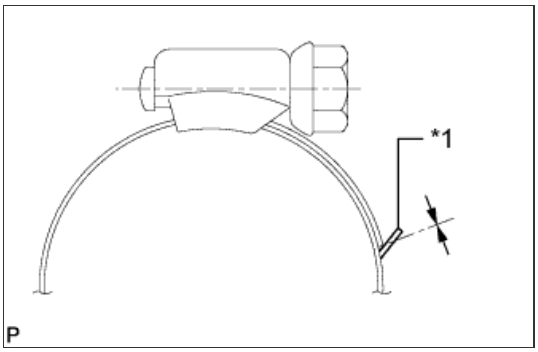
HINT:

- **Align the fuel sub tank side mark with the hose side mark when installing the hose.**

- **Tighten the hose clamp until the end of the hose clamp contacts the stopper as shown in the illustration.**

Text in Illustration

*1	Stopper



2. INSTALL NO. 3 FUEL HOSE

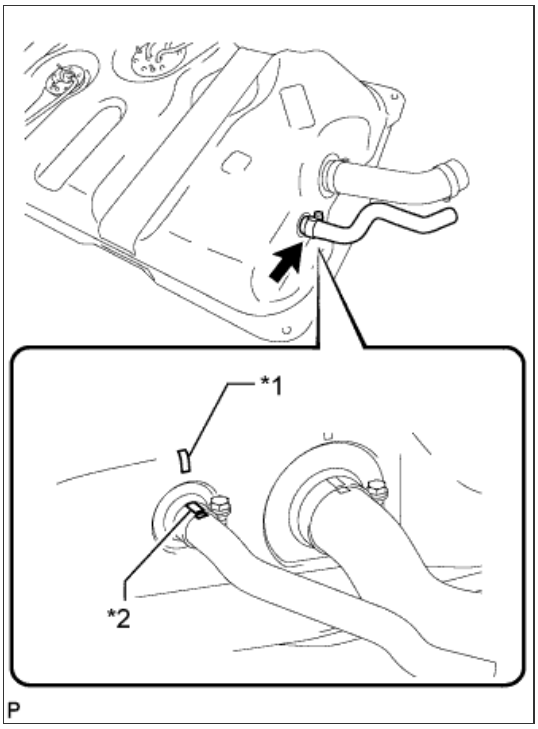
a. Install the fuel hose to the fuel sub tank as shown in the illustration.

Text in Illustration

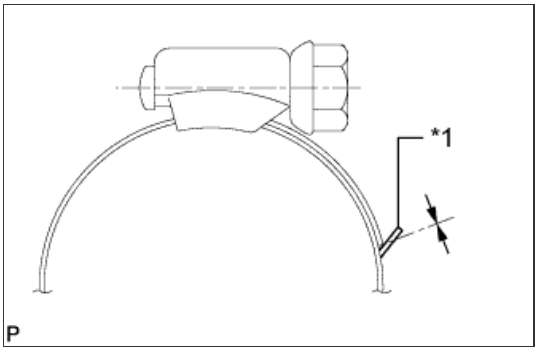
*1	Tank Side Mark
*2	Hose Side Mark

HINT:

- **Align the fuel sub tank side mark with the hose side mark when installing the hose.**



- **Tighten the hose clamp until the end of the hose clamp contacts the stopper as shown in the illustration.**



Text in Illustration

*1	Stopper

3. INSTALL FUEL TANK BREATHER HOSE

a. Install the breather hose to the fuel sub tank.

4. INSTALL FUEL AND EVAPORATION VENT TUBE SUB-ASSEMBLY

a. Install a new gasket to the fuel and evaporation vent tube.

b. Install the fuel and evaporation vent tube with the 6 bolts.

Tor ue:
3.5 N m{ 36 kgf , 31 in. bf }

5. INSTALL FUEL TANK EVAPORATION VENT TUBE SUB-ASSEMBLY

a. Install the 2 fuel tank evaporation vent tubes.

6. INSTALL FUEL HOSE

7. INSTALL FUEL SENDER GAUGE ASSEMBLY

a. Install a new gasket to the sender gauge.

NOTICE:

Be careful not to bend the arm of the fuel sender gauge.

b. Install the sender gauge with the 5 screws.

Tor ue:
1.5 N m{ 15 kgf cm , 13 in. lbf }

8. INSTALL FLOOR NO. 3 WIRE

a. Attach the wire harness clamp to the fuel sub tank.

b. Connect the sender gauge connector.

9. INSTALL FUEL SUB TANK SUB-ASSEMBLY

a. Set the fuel sub tank on a transmission jack and raise the fuel sub tank.

b. Connect the 2 fuel tank bands with the 2 bolts.

Tor ue:
40 N m{ 408 kgf cm , 3 ft. lbf }

c. Connect the floor No. 3 wire connector.

d. Attach the 3 wire harness clamps.

10. CONNECT FUEL TANK TO FILLER PIPE HOSE

a. Connect the hose to the filler pipe.

11. CONNECT NO. 3 FUEL HOSE

a. Connect the fuel hose to the filler pipe.

12. CONNECT FUEL TANK BREATHER HOSE

a. Connect the breather hose to the filler pipe.

13. CONNECT FUEL HOSE

14. CONNECT FUEL TANK EVAPORATION VENT TUBE SUB-ASSEMBLY

a. Connect the 2 fuel tubes.

15. INSTALL FUEL TANK CAP ASSEMBLY

16. INSTALL NO. 1 SPARE WHEEL STOPPER

a. Install the spare wheel stopper with the 2 bolts.

Tor ue:
32 N m{ 326 kgf cm , 24 ft. lbf }

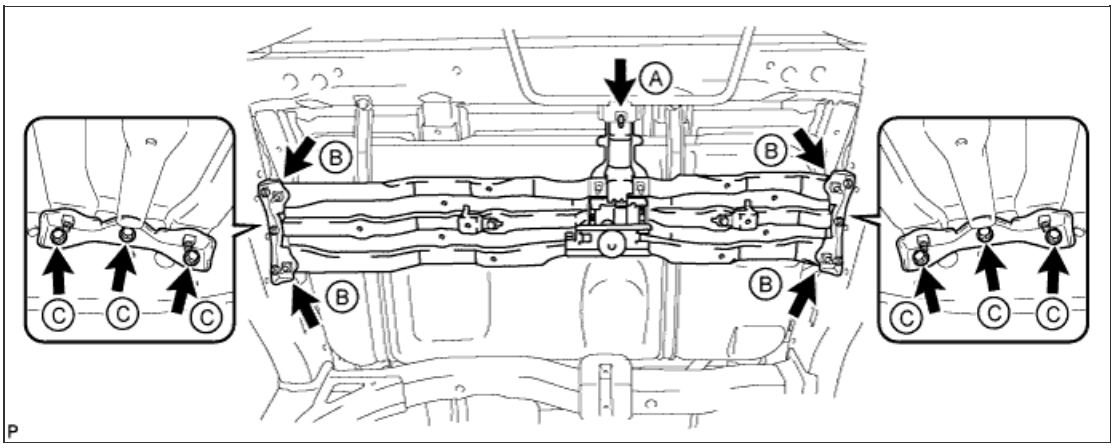
17. INSTALL SPARE WHEEL CARRIER CROSSMEMBER AND SPARE WHEEL CARRIER BRACKET

a. Install the spare wheel carrier crossmember and 2 brackets to the vehicle with the 6 bolts labeled C.

Tor ue:
for bolt C:
20 N m{ 204 kgf cm , 15 ft. lbf }

b. Temporarily install the bolt labeled A, and then tighten the bolt labeled A and bolts labeled B.

Tor ue:
for bolt A:
29 N m{ 296 kgf cm , 21 ft. lbf }
for bolt B:
20 N m{ 204 kgf cm , 15 ft. lbf }



18. INSTALL TAILPIPE ASSEMBLY

a. Install the tailpipe to the 2 exhaust pipe supports.

b. Install a new gasket to the center exhaust pipe.

c. Connect the tailpipe to the center exhaust pipe.

d. Attach a new clamp to the tailpipe and center exhaust pipe. Then install the bolt to the clamp.

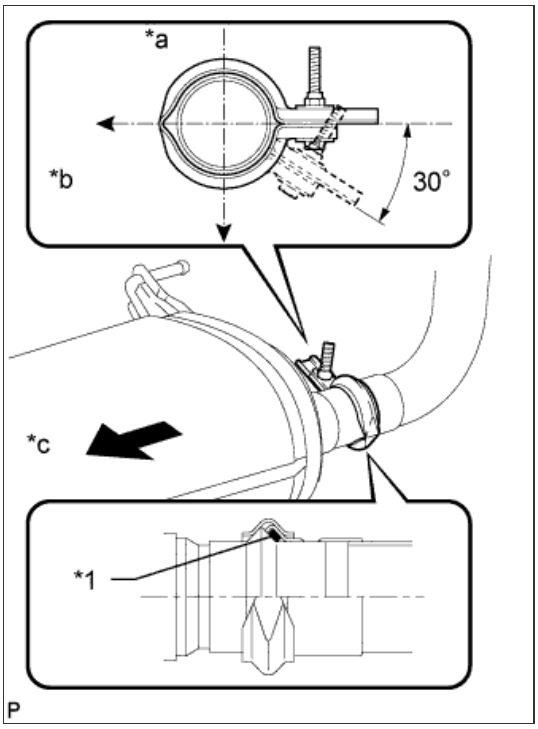
Tor ue:
32 N m{ 326 kgf cm , 24 ft. lbf }

Text in Illustration

*1	Gasket
*a	Top
*b	LH Side
*c	Front

HINT:

Install the clamp within the angle range shown in the illustration.



19. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

20. INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and intelligent tester main switch on.

NOTICE:

Do not start the engine.

c. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Fuel Pump / Speed.

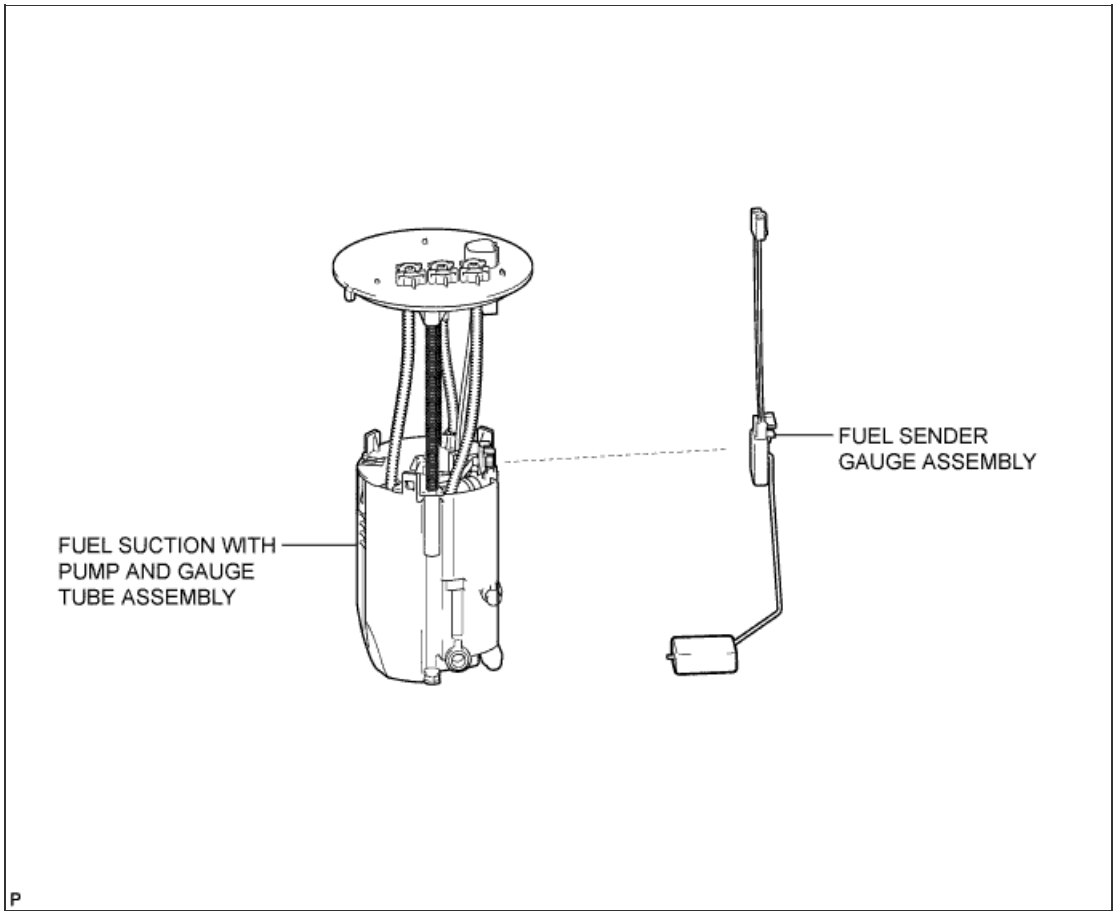
d. Check that there are no fuel leaks after doing maintenance anywhere on the fuel system.

21. INSPECT FOR EXHAUST GAS LEAK

If gas is leaking, tighten the areas necessary to stop the leak. Replace damaged parts as necessary.

22. INSTALL SPARE TIRE

for Preparation Click here



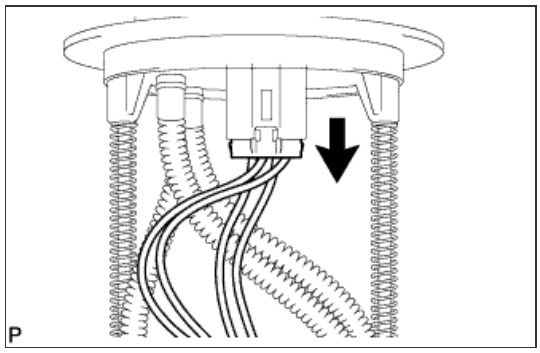
for Preparation Click here

1. REMOVE FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

(Click here)

2. REMOVE FUEL SENDER GAUGE ASSEMBLY

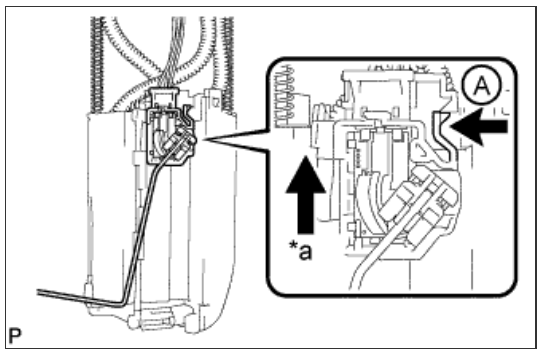
a. Disconnect the fuel sender gauge connector.



b. Press down on the sender gauge claw labeled A. Then slide the sender gauge upward to remove it.

Text in Illustration

*a	Slide



for Preparation Click here

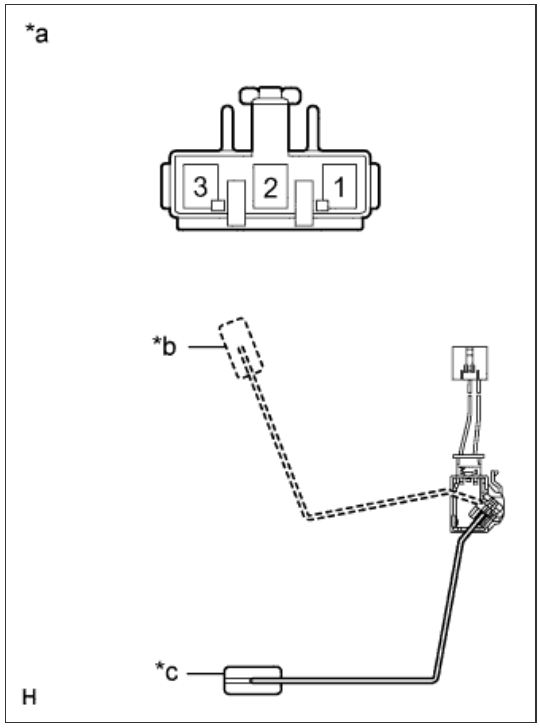
1. INSPECT FUEL SENDER GAUGE ASSEMBLY

a. Check that the float moves smoothly between F and E.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
2 - 3	Float level is F (upper)	13.5 to 16.5 Ω
	Float level is E (lower)	405.5 to 414.5 Ω



Text in Illustration

*a	Component without harness connected (Fuel Sender Gauge)
*b	F (pper)
*c	E (Lower)

f the result is not as specified replace the fuel sender gauge assembly.

for Preparation Click here

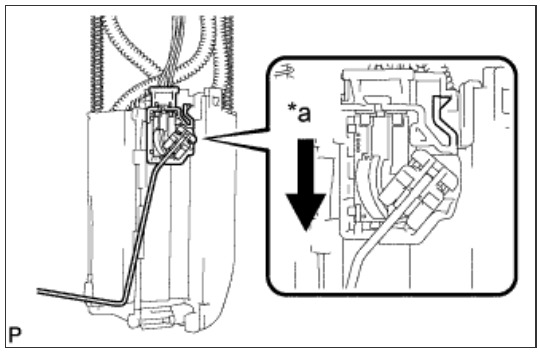
1. INSTALL FUEL SENDER GAUGE ASSEMBLY

a. Set the sender gauge to the fuel sub-tank. Then slide the sender gauge downward to install it.

Text in Illustration

*a	Slide

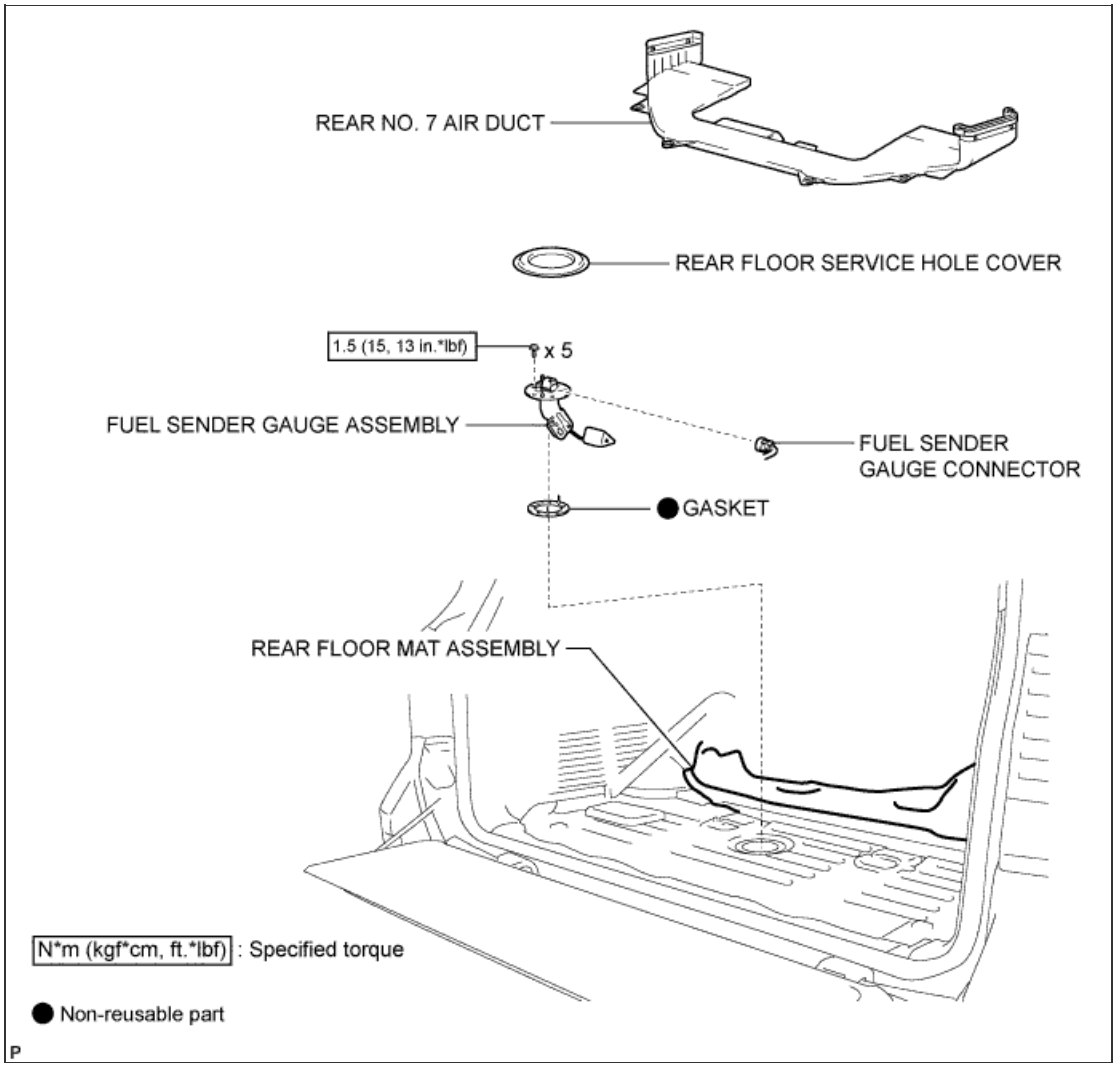
b. Connect the fuel sender gauge connector.



2. INSTALL FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

(Click here)

for Preparation Click here



FUEL SENDER GAUGE ASSEMBLY (for Fuel Sub Tank) > REMOVAL

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

2. REMOVE REAR NO. 1 SEAT ASSEMBLY RH (for 60/40 Split Seat Type 40 Side)

(Click here)

3. REMOVE REAR NO. 1 SEAT ASSEMBLY LH (for 60/40 Split Seat Type 60 Side)

(Click here)

4. REMOVE REAR NO. 2 SEAT ASSEMBLY

a. for Face to Face Seat Type:
Remove the rear No. 2 seat assembly (Click here).

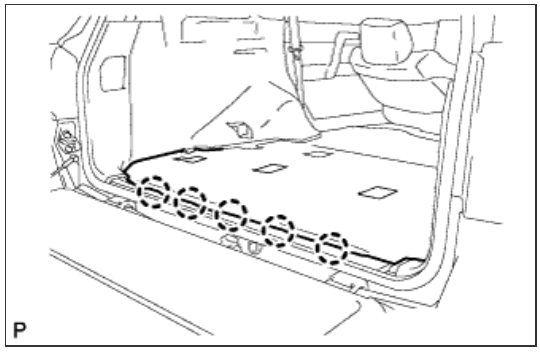
b. except Face to Face Seat Type:
Remove the rear No. 2 seat assembly (Click here).

5. REMOVE REAR FLOOR MAT ASSEMBLY

a. Detach the 5 clips and fold back the floor mat toward the front of the vehicle.

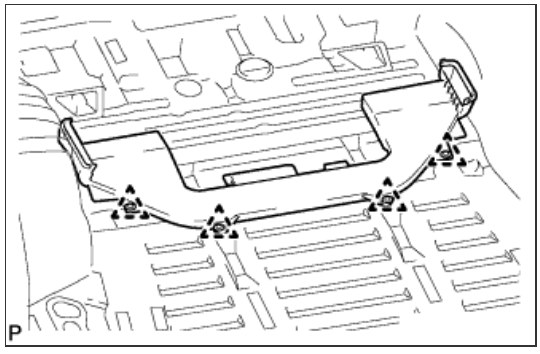
HINT:

Fold back the floor mat so that the rear No. 7 air duct can be removed.

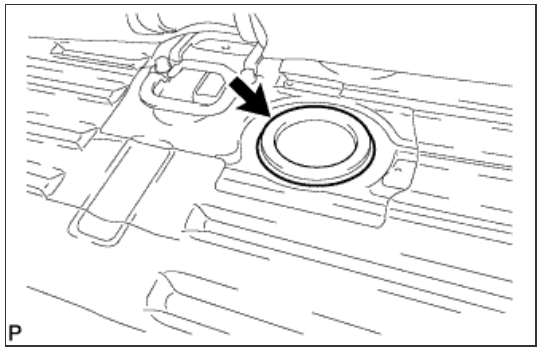


6. REMOVE REAR NO. 7 AIR DUCT

a. Detach the 4 clips and remove the air duct.



7. REMOVE REAR FLOOR SERVICE HOLE COVER



8. REMOVE FUEL SENDER GAUGE ASSEMBLY

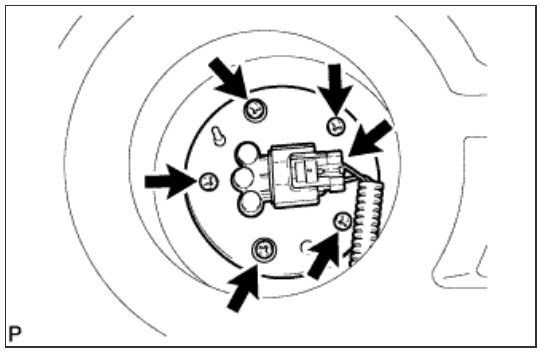
a. Disconnect the sender gauge connector.

b. Remove the 5 screws and sender gauge.

NOTICE:

Be careful not to bend the arm of the fuel sender gauge.

c. Remove the gasket from the sender gauge.



for Preparation Click here

1. INSPECT FUEL SENDER GAUGE ASSEMBLY

a. Check that the float moves smoothly between F and E.

b. Measure the resistance according to the value(s) in the table below.

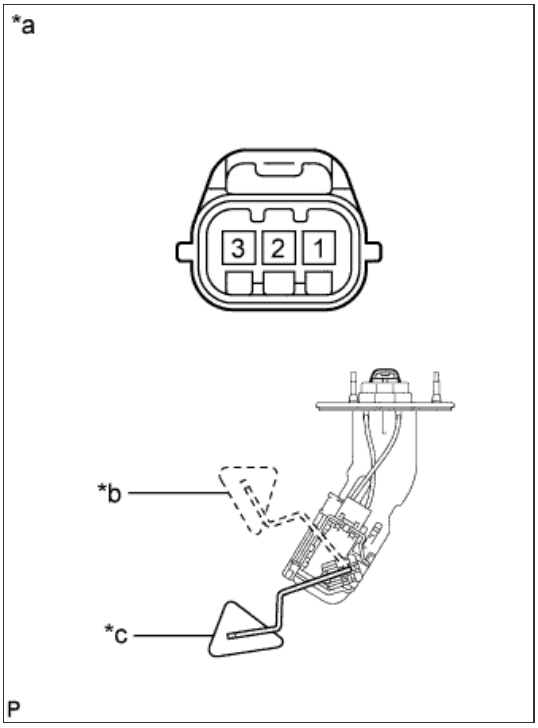
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 3	Float level is F (upper)	12 to 18 Ω
	Float level is E (lower)	405 to 415 Ω

Text in Illustration

*a	Component without harness connected (Fuel Sender Gauge)
*b	F (pper)
*c	E (Lower)

f the result is not as specified replace the fuel sender gauge assembly.



for Preparation Click here

1. INSTALL FUEL SENDER GAUGE ASSEMBLY

a. Install a new gasket to the sender gauge.

b. Install the sender gauge with the 5 screws.

Torque:
1.5 N*m{ 15 kgf*cm , 13 in.*lbf }

NOTICE:

Be careful not to bend the arm of the fuel sender gauge.

c. Connect the sender gauge connector.

2. INSTALL REAR FLOOR SERVICE HOLE COVER

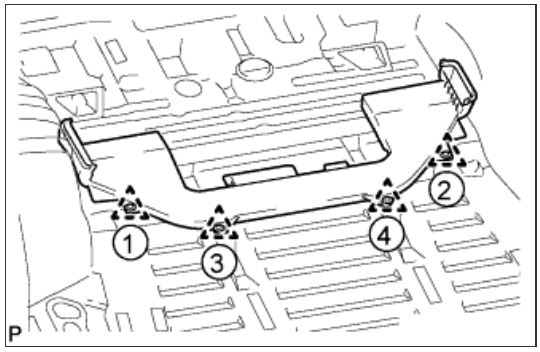
a. Install the service hole cover with new butyl tape.

3. INSTALL REAR NO. 7 AIR DUCT

a. Attach the 4 clips to install the air duct.

HINT:

Attach the clips in the order shown in the illustration.



4. INSTALL REAR FLOOR MAT ASSEMBLY

a. Attach the 5 clips to install the floor mat.

5. INSTALL REAR NO. 2 SEAT ASSEMBLY

a. for Face to Face Seat Type:
Install the rear No. 2 seat assembly (Click here).

b. except Face to Face Seat Type:
Install the rear No. 2 seat assembly (Click here).

6. INSTALL REAR NO. 1 SEAT ASSEMBLY LH (for 60/40 Split Seat T pe 60 Si e)

(Click here)

7. INSTALL REAR NO. 1 SEAT ASSEMBLY RH (for 60/40 Split Seat T pe 40 Si e)

(Click here)

8. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

for Preparation Click here

CAUTION:

- **Before working on the fuel system, disconnect the cable from the negative (-) battery terminal.**
- **Do not smoke or be near an open flame when working on the fuel system.**
- **Keep gasoline away from rubber and leather parts.**

1.DISCHARGE FUEL SYSTEM PRESSURE

CAUTION:

- **Do not disconnect any part of the fuel system until you have discharged the fuel system pressure.**
- **After discharging the fuel pressure, place a cloth or equivalent over fittings as you separate them to reduce the risk of fuel spray on yourself or in the engine compartment.**

a. Remove the engine room relay block cover.

b. Remove the circuit opening relay (C/OPN).

c. Start the engine. After the engine has stopped on its own, turn the engine switch off.

HINT:

If DTC P0230 is output, clear the DTC (Click here).

d. Crank the engine, then check that the engine does not start.

e. Loosen the fuel tank cap, then discharge the pressure in the fuel tank completely.

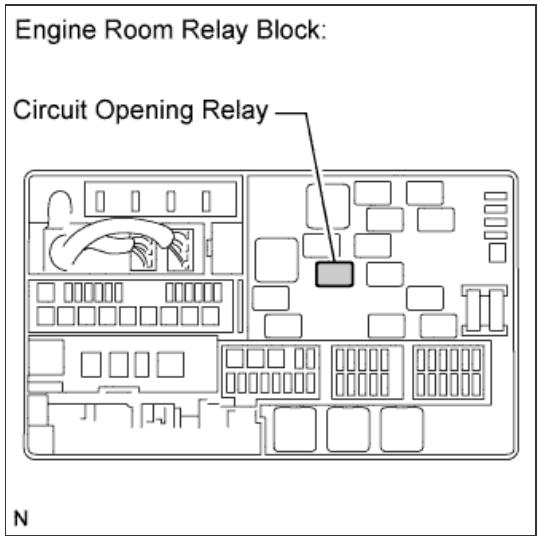
f. Disconnect the cable from negative (-) battery terminal.

NOTICE:

hen disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

g. Install the circuit opening relay (C/OPN).

h. Install the engine room relay block cover.



.FUEL SYSTEM

a. hen disconnecting the high fuel pressure line, a large amount of gasoline will spill out. Follow these procedures.

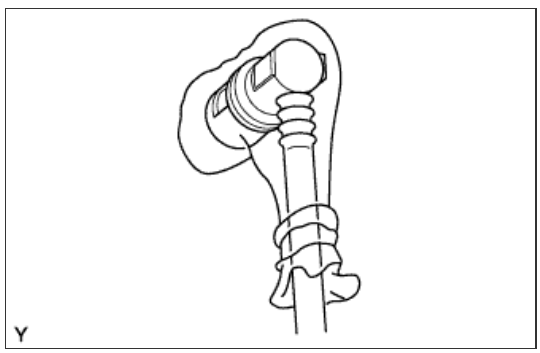
i. Discharge the fuel system pressure.

ii. Put a container under the connecting part of the pressure line.

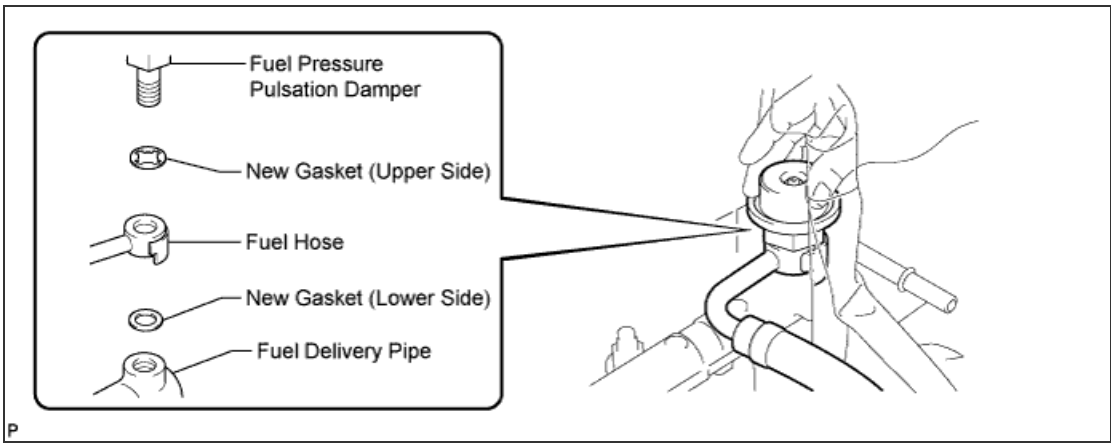
iii. Slowly loosen the connection.

iv. Disconnect the connection.

v. Plug the connection with a rubber plug.



b. hen connecting the union bolt (fuel pressure pulsation damper) on the high pressure pipe union, observe the following procedures.



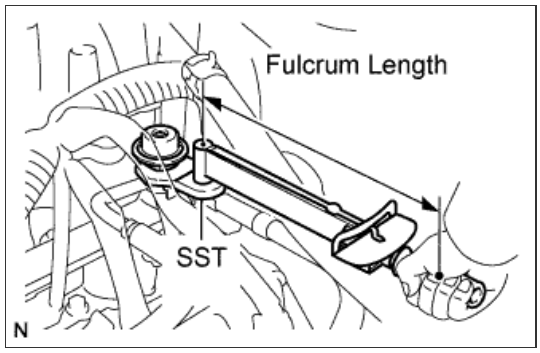
NOTICE:

ake sure to install the gaskets in the order shown in the illustration, as the shape of the upper side and lower side gaskets is different.

i. Always use 2 new gaskets.

ii. Tighten the union bolt by hand.

iii. Using SST, tighten the union bolt to the specified torque.



SST

0961 - (09617-) 11

Torque:

with SST:

33 N m{ 340 kgf*cm , ft.*lbf

without SST:

39 N m{ 398 kgf*cm , ft.*lbf

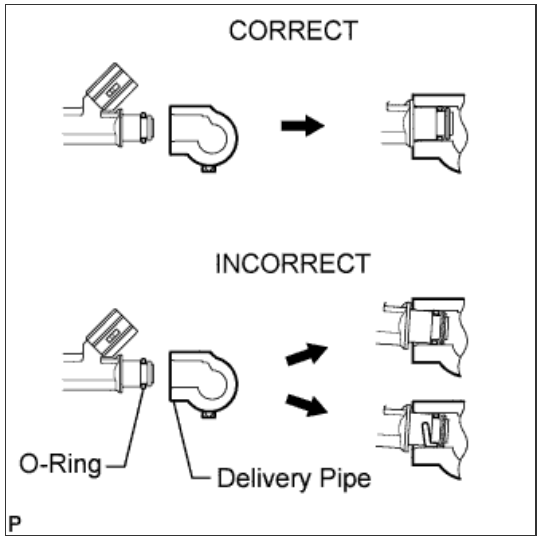
HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure SST and the wrench are connected in a straight line.**

c. Observe the following precautions when removing or installing the injectors:

NOTICE:

- **Never reuse the O-ring.**
- **When placing a new O-ring on the in ector, do not damage the O-ring.**
- **Coat the new O-ring with spindle oil or gasoline before installing. Do not use engine oil, gear oil or brake fluid.**

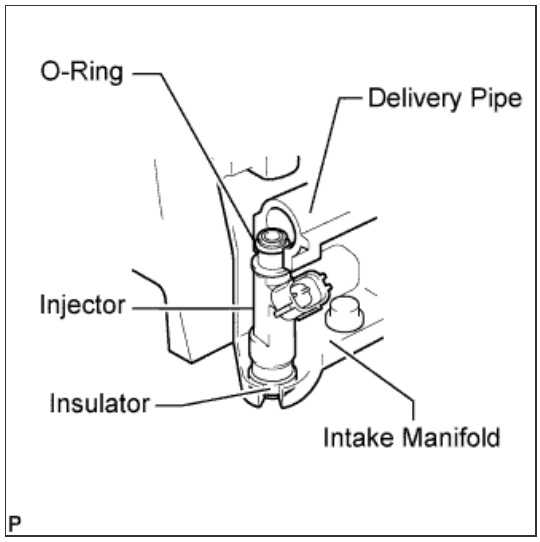


d. Install the injector to the delivery pipe and intake manifold, as shown in the

illustration.

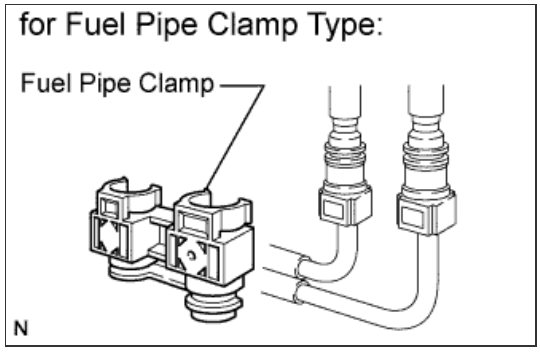
NOTICE:

efore installing the injector, apply spindle oil or gasoline where the delivery pipe or intake manifold contacts the O-ring of the injector.



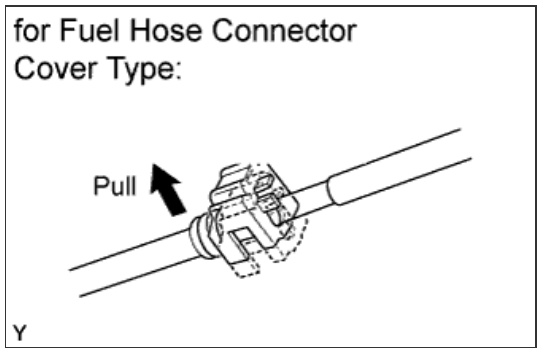
e. Observe these precautions when disconnecting the fuel tube connector (for quick type A).

i. for Fuel Pipe Clamp Type:
Remove the fuel pipe clamp from the fuel tube connector.



ii. for Fuel ose Connector Cover Type:
Detach the lock claw by lifting up the cover, as shown in the illustration.

iii. Check for dirt or mud on the pipe and around the connector before disconnection. Clean if necessary.

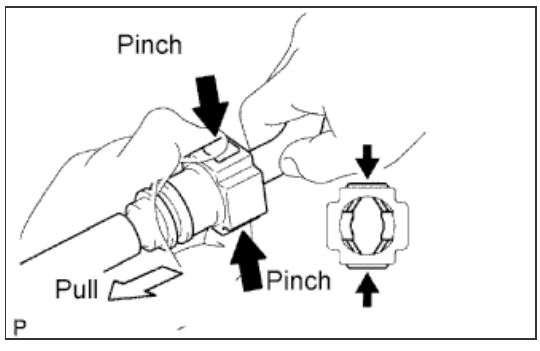


iv. Pinch the connector and disconnect the connector and pipe.
If the connector and the pipe are stuck together, pinch the connector, then push and pull the pipe to disconnect the pipe and pull it out.

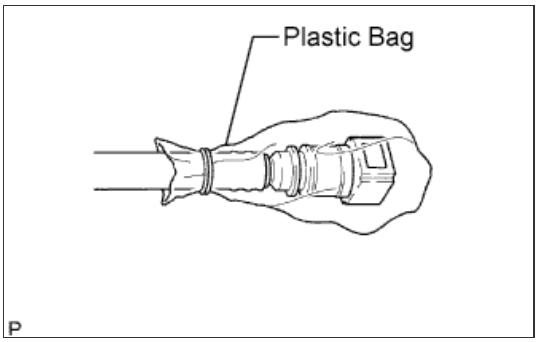
NOTICE:

Do not use any tools in this procedure.

v. Check for dirt or mud on the seal surface of the disconnected pipe.
Clean if necessary.

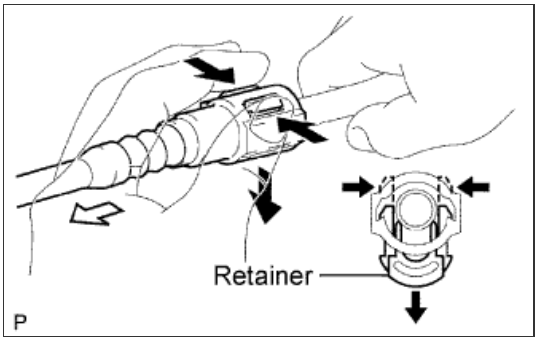


vi. To protect the disconnected pipe and connector from damage and contamination, cover it with a plastic bag.



f. Observe these precautions when disconnecting the fuel tube connector (for quick type).

i. Check that there is no damage or foreign matter on the part of the pipe that contacts the connector.



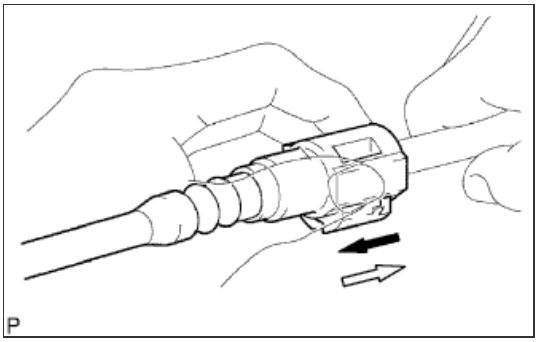
ii. Detach the 2 claws of the connector retainer. Push down on the connector and disconnect it from the pipe.

HINT:

If the connector and pipe are stuck, pinch the fuel pipe by hand, and push and pull the connector to disconnect it.

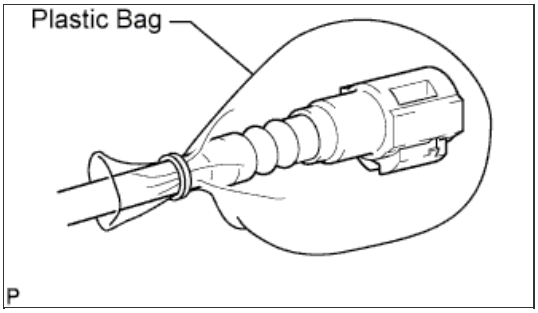
NOTICE:

Do not use any tools in this procedure.



iii. Check for foreign matter on the seal surface of the disconnected pipe. Clean it if necessary.

iv. To protect the disconnected pipe and connector from damage and foreign matter, cover it with a plastic bag.

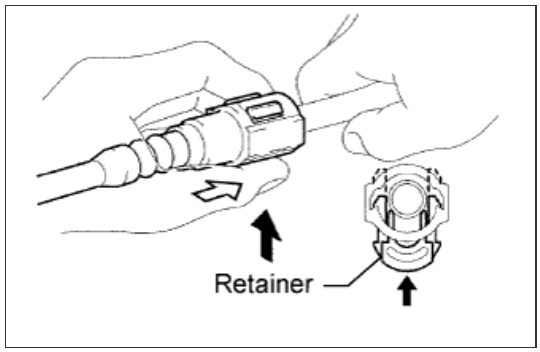


g. Observe these precautions when connecting the fuel tube connector (for quick type).

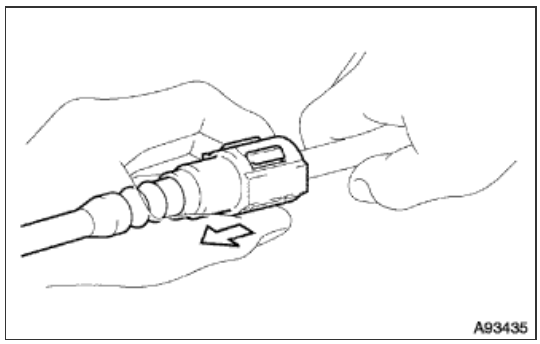
i. Check for foreign matter on the pipe and around the connector before connecting it. Clean it if necessary.

ii. Align the axis of the connector with the axis of the pipe. Push the pipe

into the connector, and push up on the retainer.



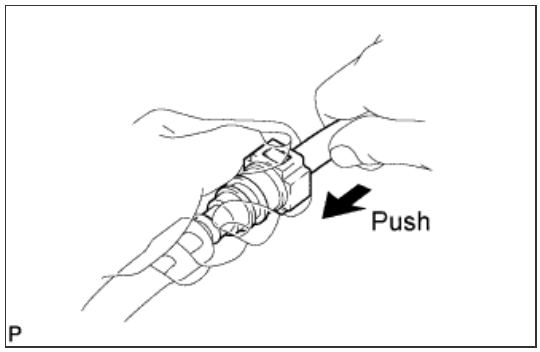
iii. After connecting the pipe and connector, try to pull them apart to confirm that they are securely connected.



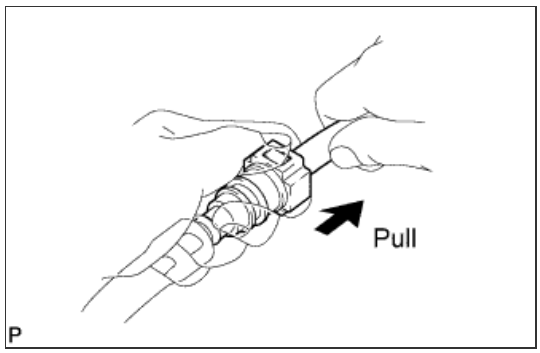
h. Observe these precautions when connecting the fuel tube connector (for quick type A).

i. Check that there is no damage or contamination in the connected part of the pipe.

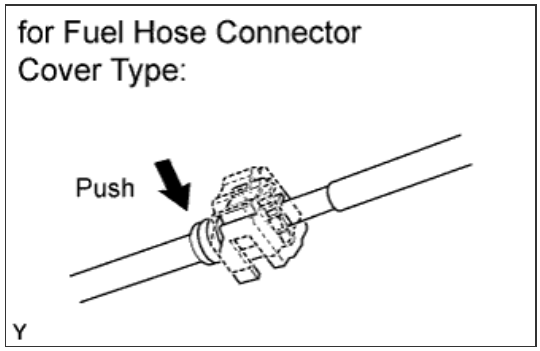
ii. Align the axis of the connector with the axis of the pipe. Push the pipe into the connector until the connector makes a "click" sound. If the connection is tight, apply a small amount of fresh spindle oil or gasoline on the tip of the pipe.



iii. After having finished the connection, try to pull apart the pipe and the connector to confirm that they are securely connected.



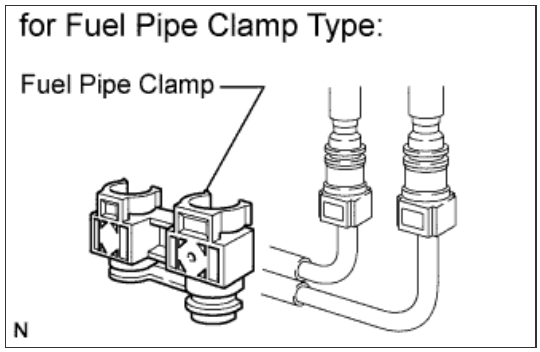
iv. for Fuel ose Connector Cover Type:
Attach the lock claw to the connector by pushing down on the cover, as shown in the illustration.



v. for Fuel Pipe Clamp Type:

Install the fuel pipe clamp to the connector.

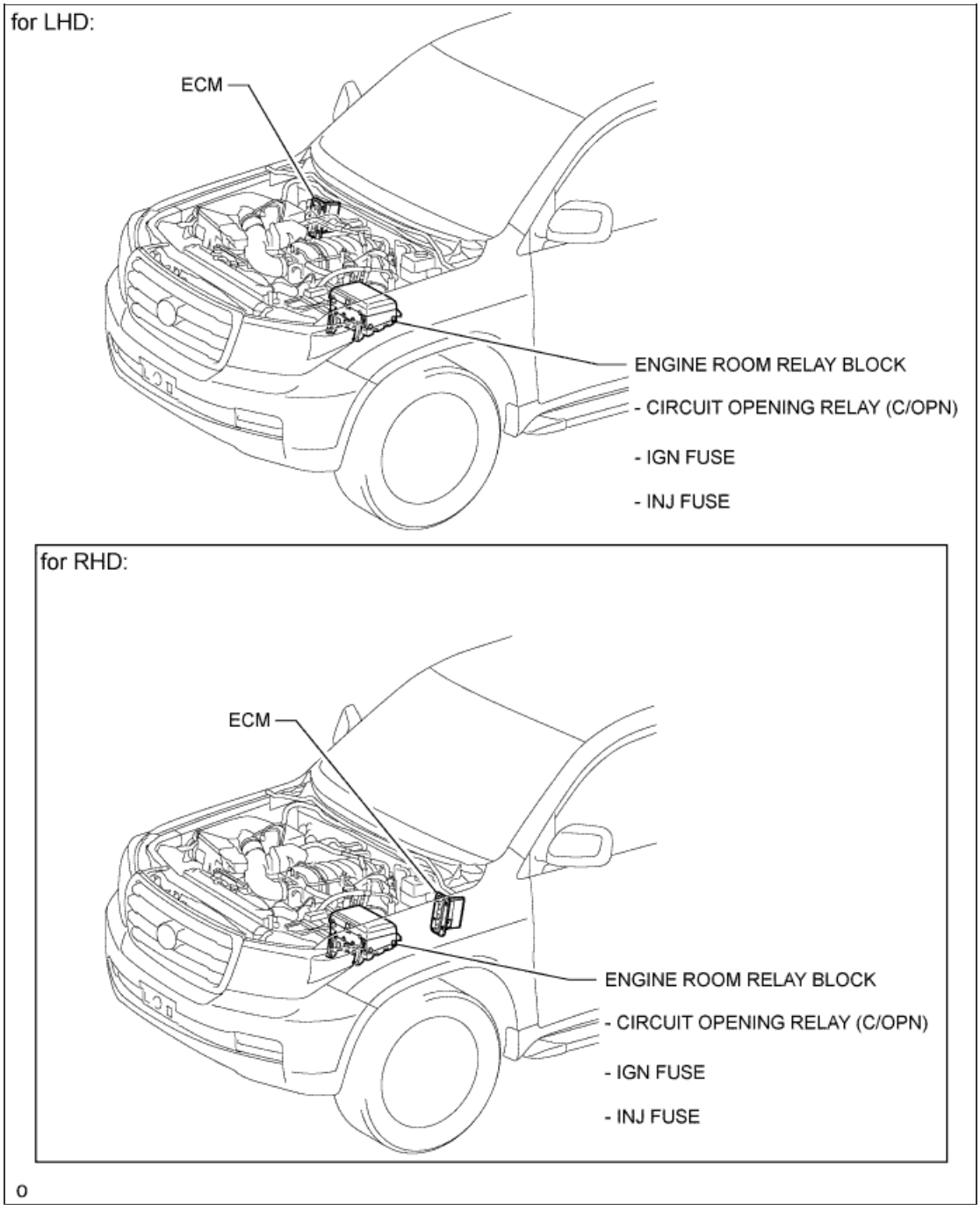
vi. Check that there is no fuel leakage.



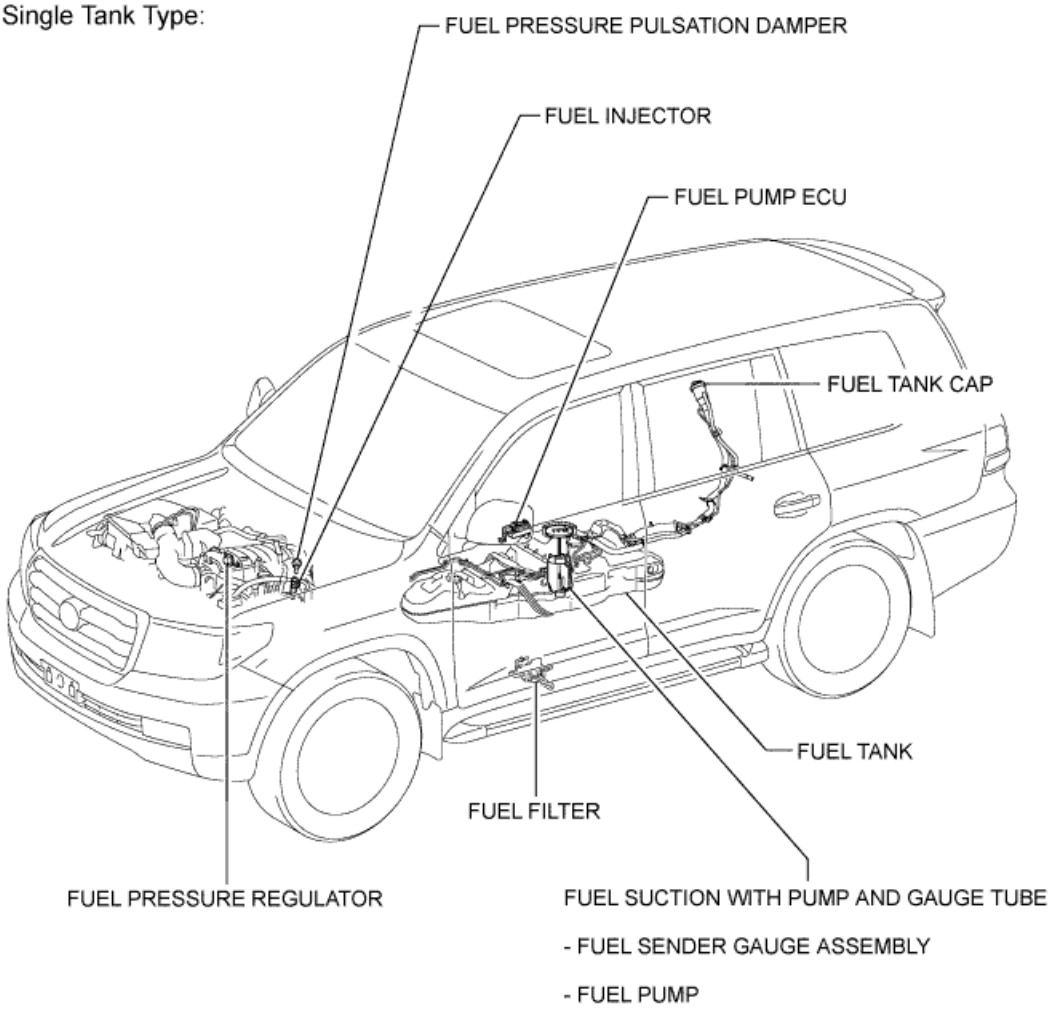
3.CHECK FOR FUEL LEAK

a. Check that there are no fuel leaks after performing maintenance anywhere on the fuel system (Click here).

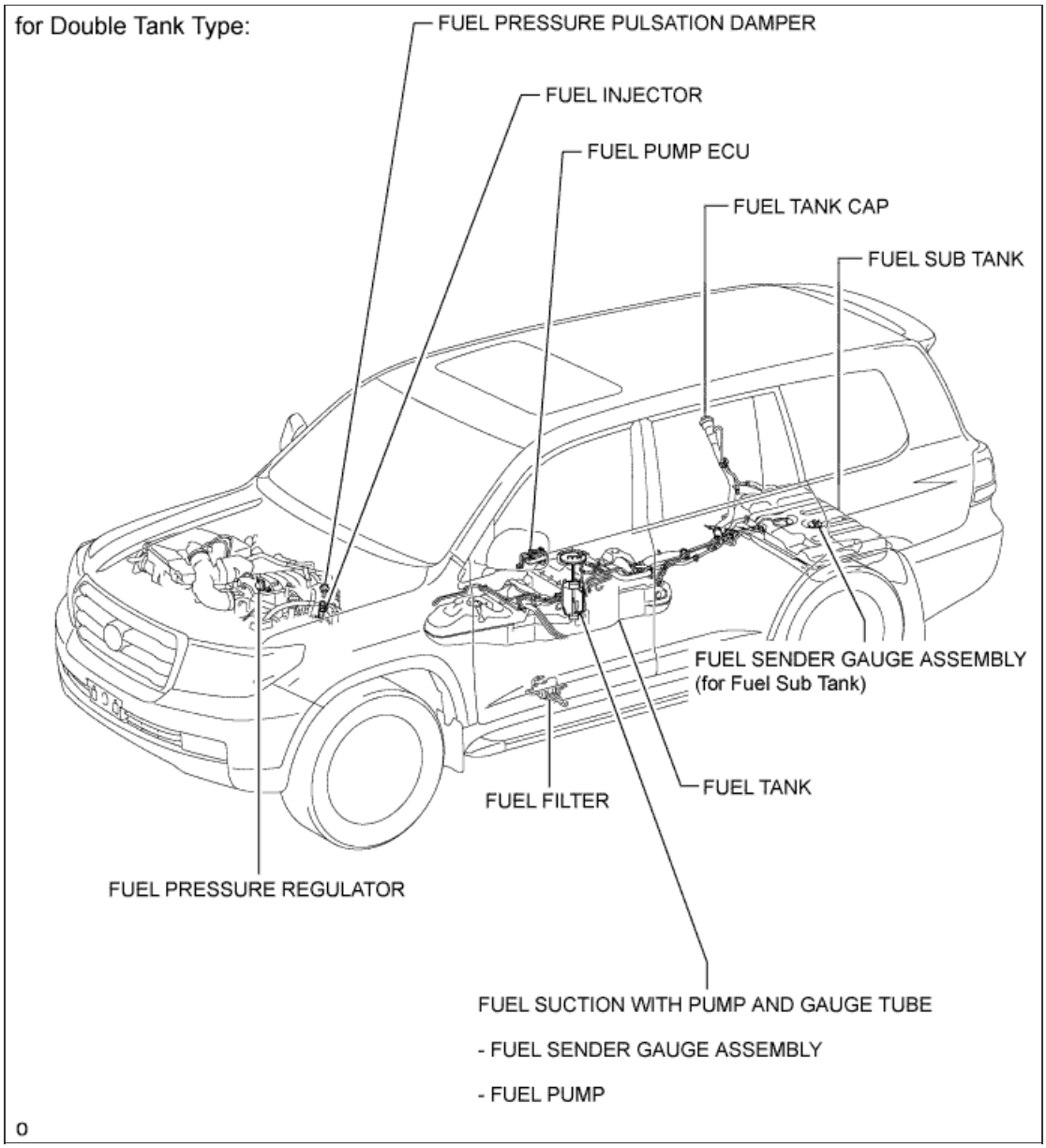
for Preparation Click here



for Single Tank Type:

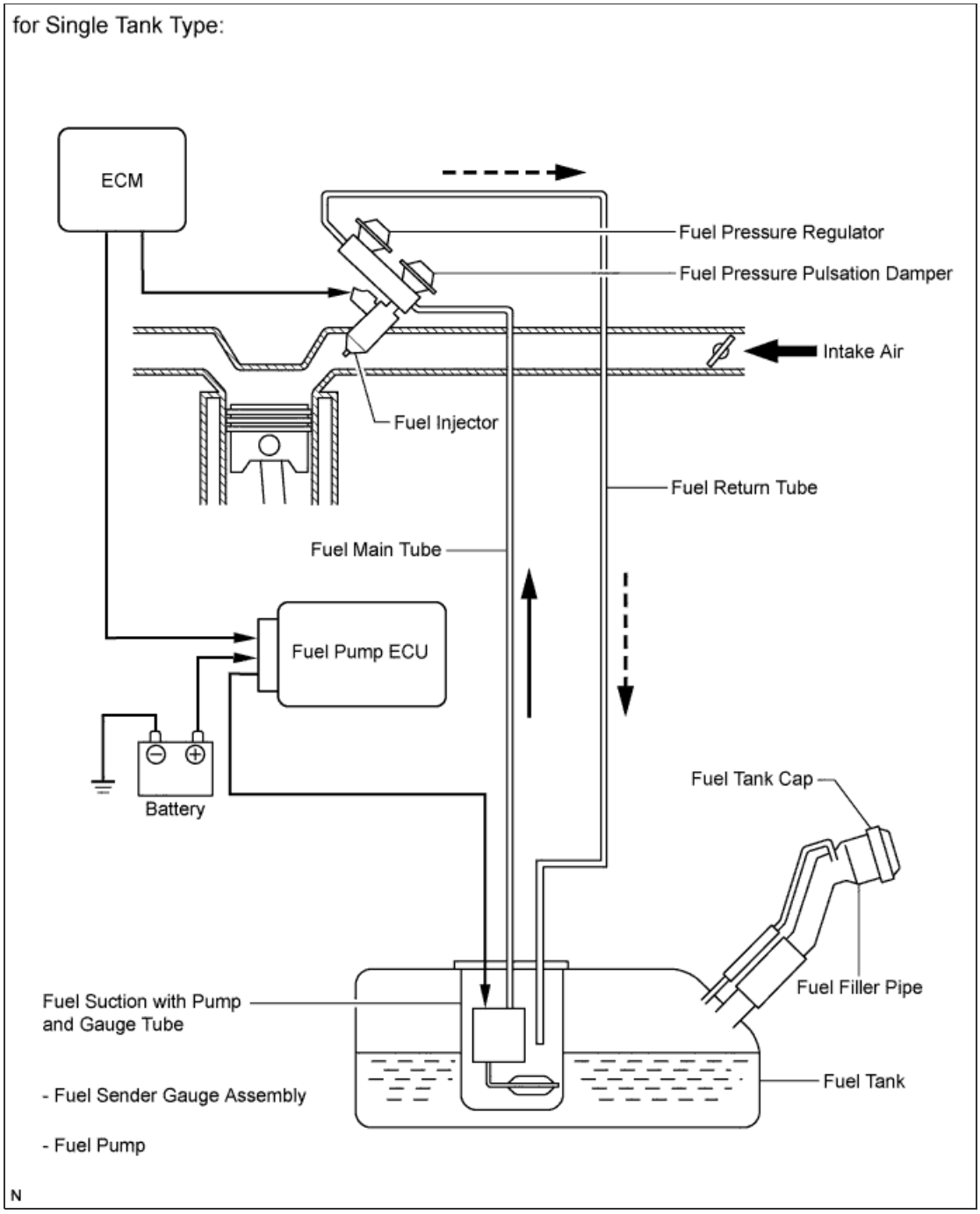


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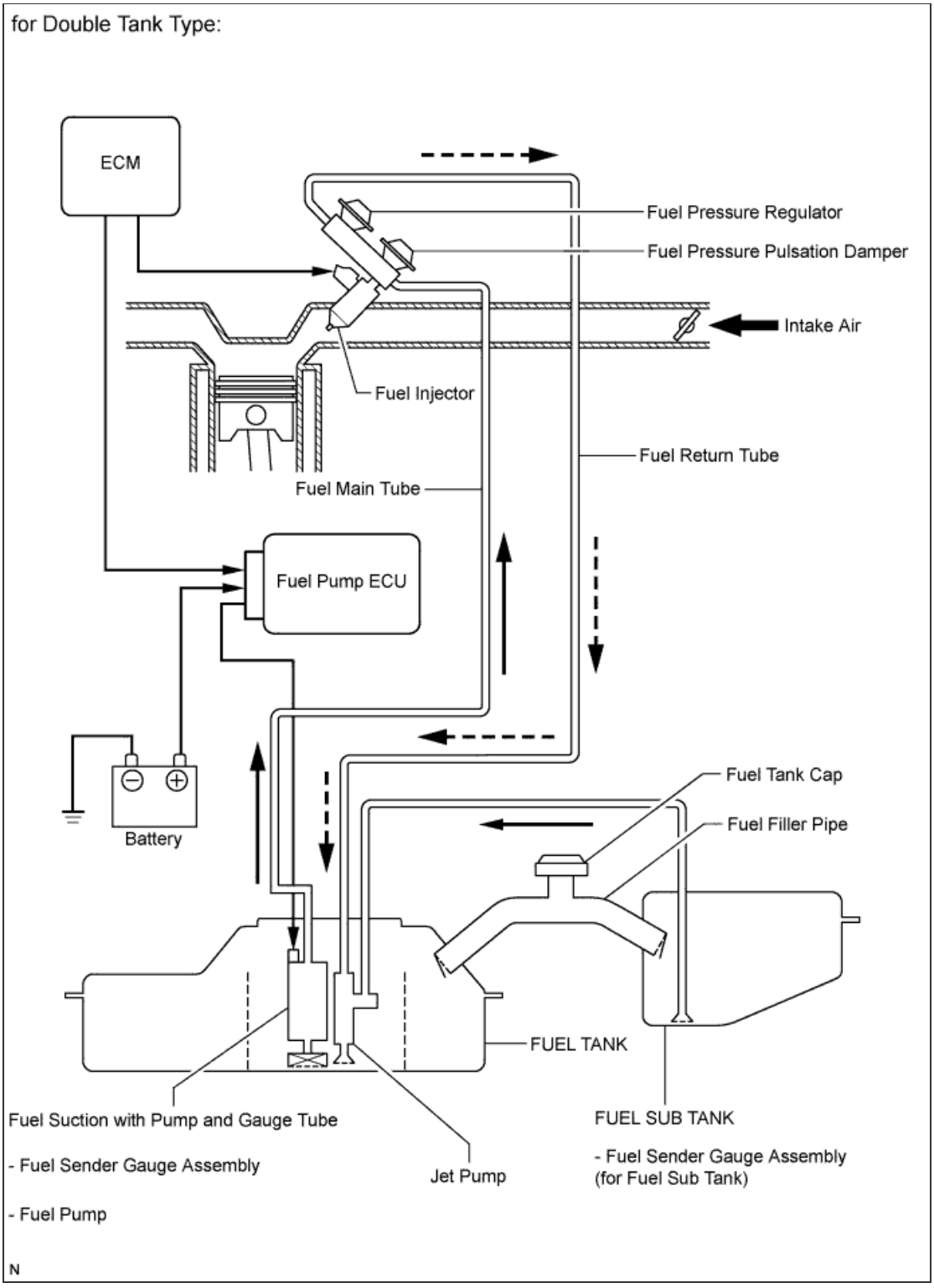

for Double Tank Type:
FUEL PRESSURE PULSATION DAMPER
FUEL INJECTOR
FUEL PUMP ECU
FUEL TANK CAP
FUEL SUB TANK
FUEL SENDER GAUGE ASSEMBLY
(for Fuel Sub Tank)
FUEL TANK
FUEL FILTER
FUEL PRESSURE REGULATOR
FUEL SUCTION WITH PUMP AND GAUGE TUBE
- FUEL SENDER GAUGE ASSEMBLY
- FUEL PUMP
o

for Preparation Click here

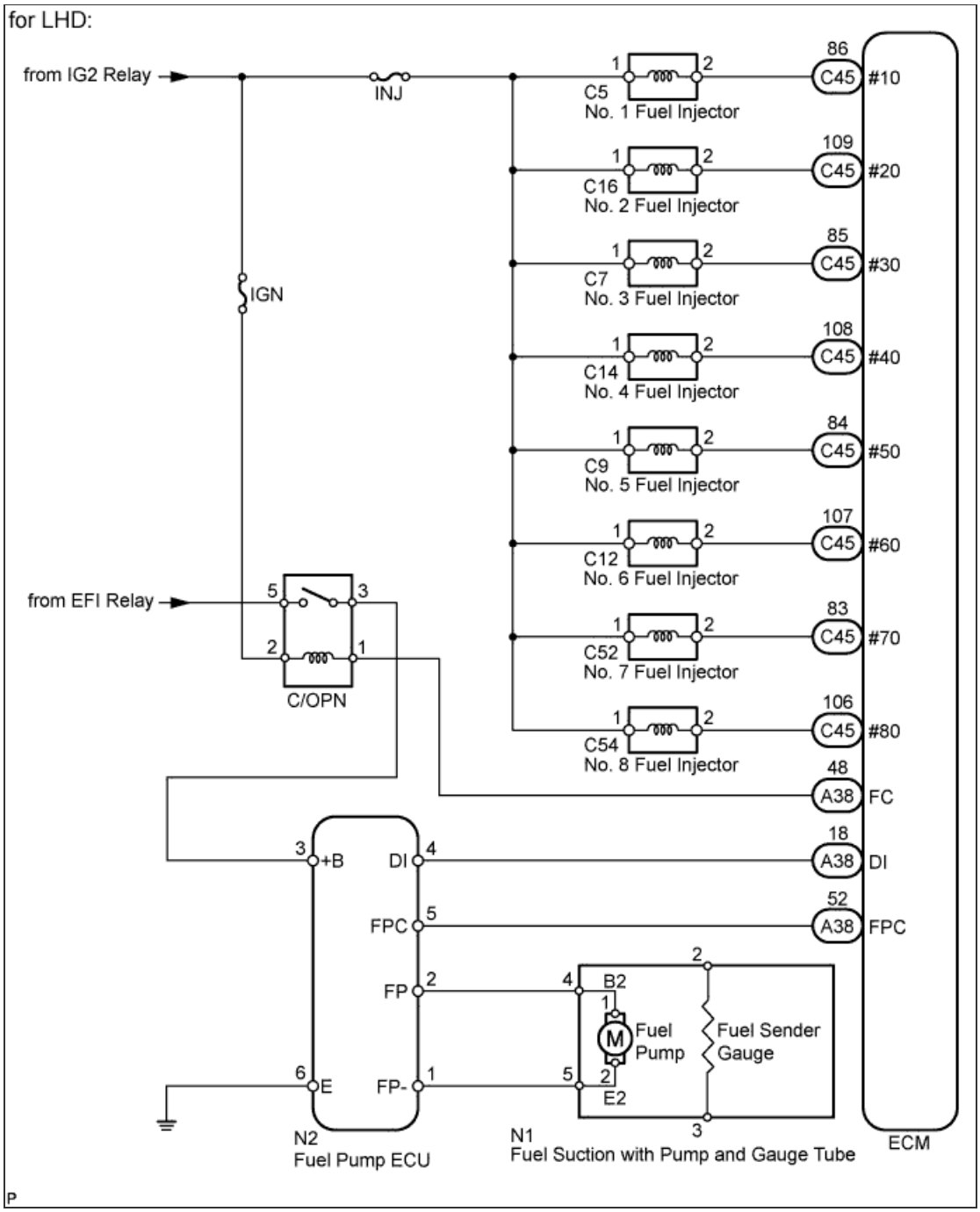
FUEL FLOW DIAGRAM

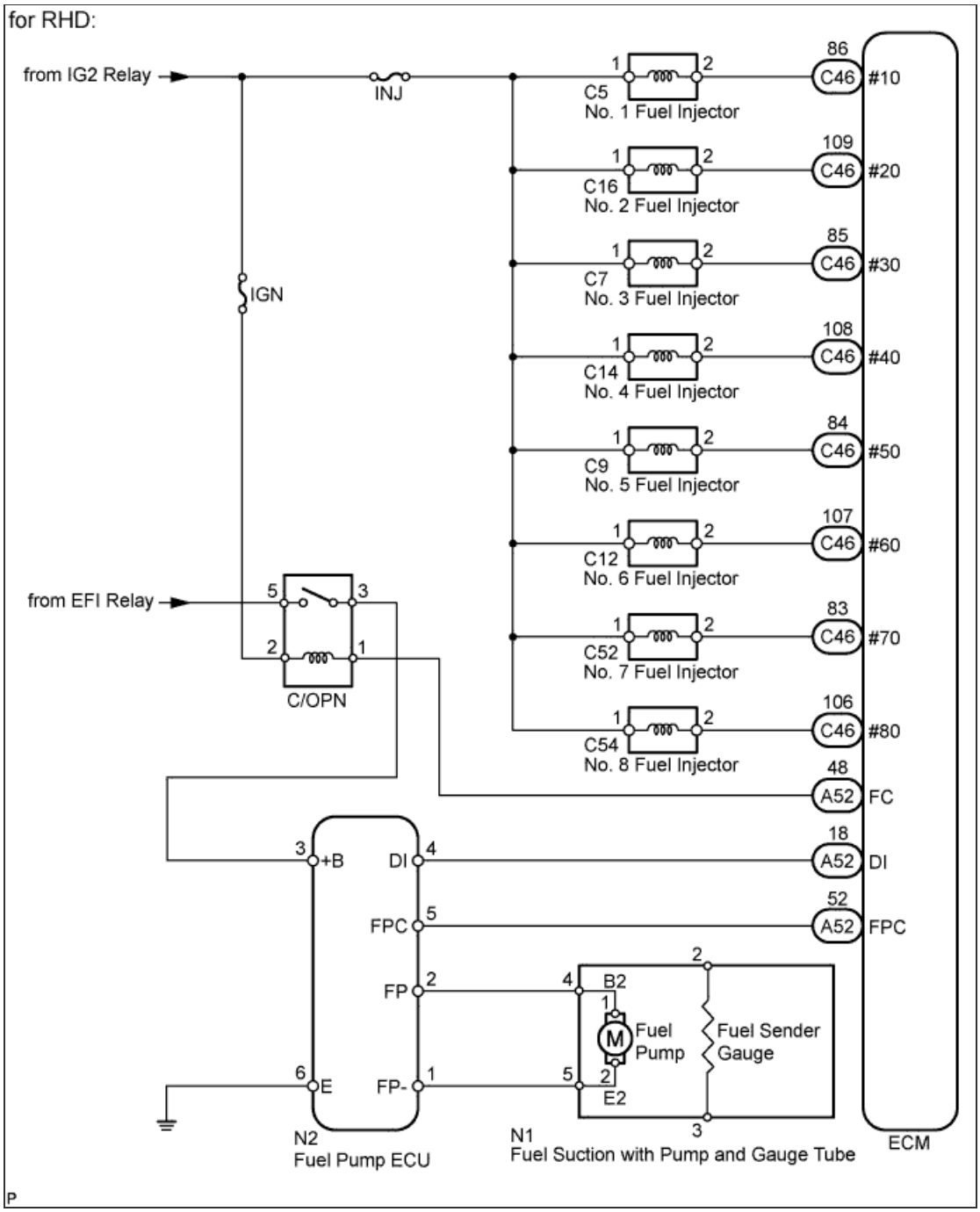


for Double Tank Type:



ELECTRICAL CONTROL DIAGRAM


for LHD:
from IG2 Relay
INJ
IGN
from EFI Relay
C/OPN
C5
No. 1 Fuel Injector
C16
No. 2 Fuel Injector
C7
No. 3 Fuel Injector
C14
No. 4 Fuel Injector
C9
No. 5 Fuel Injector
C12
No. 6 Fuel Injector
C52
No. 7 Fuel Injector
C54
No. 8 Fuel Injector
86 C45 #10
109 C45 #20
85 C45 #30
108 C45 #40
84 C45 #50
107 C45 #60
83 C45 #70
106 C45 #80
48 A38 FC
18 A38 DI
52 A38 FPC
+B
DI
FPC
FP
FP-
E
N2
Fuel Pump ECU
B2
E2
Fuel Pump
Fuel Sender Gauge
N1
Fuel Suction with Pump and Gauge Tube
ECM
P


for RHD:
from IG2 Relay
INJ
IGN
from EFI Relay
C/OPN
C5
No. 1 Fuel Injector
C16
No. 2 Fuel Injector
C7
No. 3 Fuel Injector
C14
No. 4 Fuel Injector
C9
No. 5 Fuel Injector
C12
No. 6 Fuel Injector
C52
No. 7 Fuel Injector
C54
No. 8 Fuel Injector
86 C46 #10
109 C46 #20
85 C46 #30
108 C46 #40
84 C46 #50
107 C46 #60
83 C46 #70
106 C46 #80
48 A52 FC
18 A52 DI
52 A52 FPC
+B
DI
FPC
FP
FP-
E
B2
E2
Fuel Pump
Fuel Sender Gauge
N2
Fuel Pump ECU
N1
Fuel Suction with Pump and Gauge Tube
ECM
P

for Preparation Click here

1. CHECK FUEL PUMP OPERATION AND FUEL LEAK

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and intelligent tester .

NOTICE:

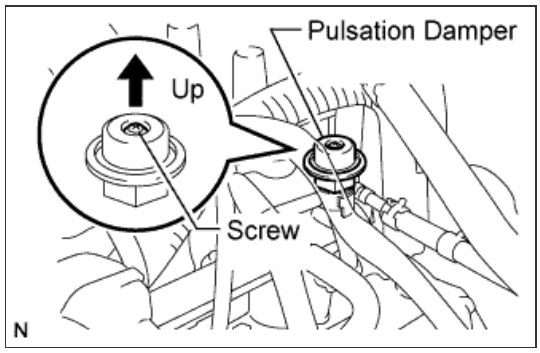
Do not start the engine.

c. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the Fuel Pump Speed Control.

d. Check that there are no fuel leaks after doing maintenance anywhere on the fuel system.

e. Check that the pulsation damper screw rises up when the fuel pump operates. If the operation is not as specified, check the following parts:

- Fusible link
- Fuses
- Circuit opening relay (C/)
- Fuel pump
- ECM
- iring connections



f. Turn the engine switch off.

g. Disconnect the intelligent tester from the DLC3.

2. CHECK FUEL PRESSURE

a. Check that the battery voltage is 11 to 14 V.

b. Discharge the fuel system pressure (Click here).

c. Disconnect the cable from the negative (-) battery terminal.

NOTICE:

hen disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

d. Remove the No. 1 fuel pipe from the LH delivery pipe (Click here).

e. Install the No. 1 fuel pipe and SST (union) to the delivery pipe with the 3 gaskets and another SST (adapter).

SST

09268-45014 (09268-41190, 09268-41200, 90405-06167, 09268-41210, 90467-11009)

Tor e:

39 N*m 398 kgf*cm , 29 ft.*lbf }

f. ipe off any splattered gasoline.

g. Reconnect the cable to the negative (-) battery terminal.

NOTICE:

hen disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

h. Connect the intelligent tester to the DLC3.

i. Turn the engine switch on (IG) and intelligent tester .

NOTICE:

Do not start the engine.

. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the Fuel Pump Speed Control.

k. Measure the fuel pressure.

Fuel pressure:
265 to 304 kPa (2.7 to 3.1 kgf/cm ^{2}, 38 to 44 psi)

If the pressure is high, replace the fuel pressure regulator.
If the pressure is low, check the following parts:

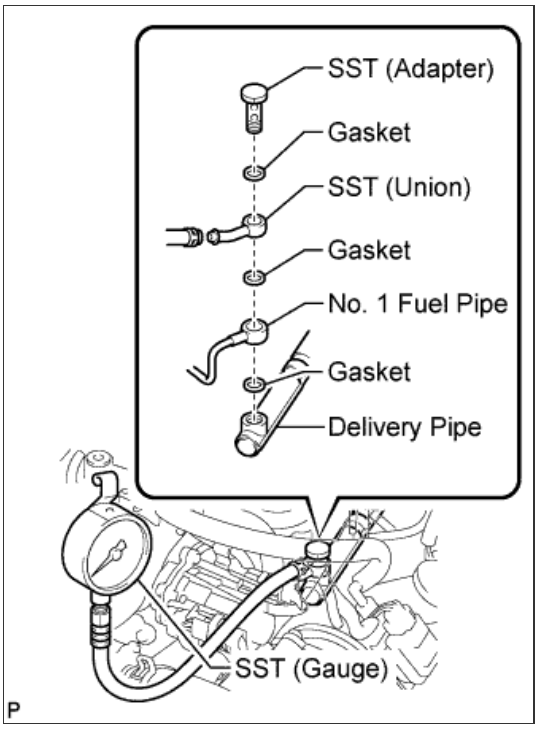
- Fuel hoses and connections
- Fuel pump
- Fuel filter
- Fuel pressure regulator

l. Disconnect the intelligent tester from the DLC3.

m. Start the engine.

n. Measure the fuel pressure at idle.

Fuel pressure:
265 to 304 kPa (2.7 to 3.1 kgf/cm ^{2}, 38 to 44 psi)



o. Stop the engine.

p. Check that the fuel pressure remains as specified for 5 minutes after the engine has stopped.

Fuel pressure:
147 kPa (1.5 kgf/cm^2, 21 psi) or more

If the pressure is not as specified, check the fuel pump, pressure regulator and/or injectors.

. After checking the fuel pressure, disconnect the cable from the negative (-) battery terminal and carefully remove SST to prevent gasoline from splashing.

r. Reinstall the No. 1 fuel pipe to the LH delivery pipe (Click here).

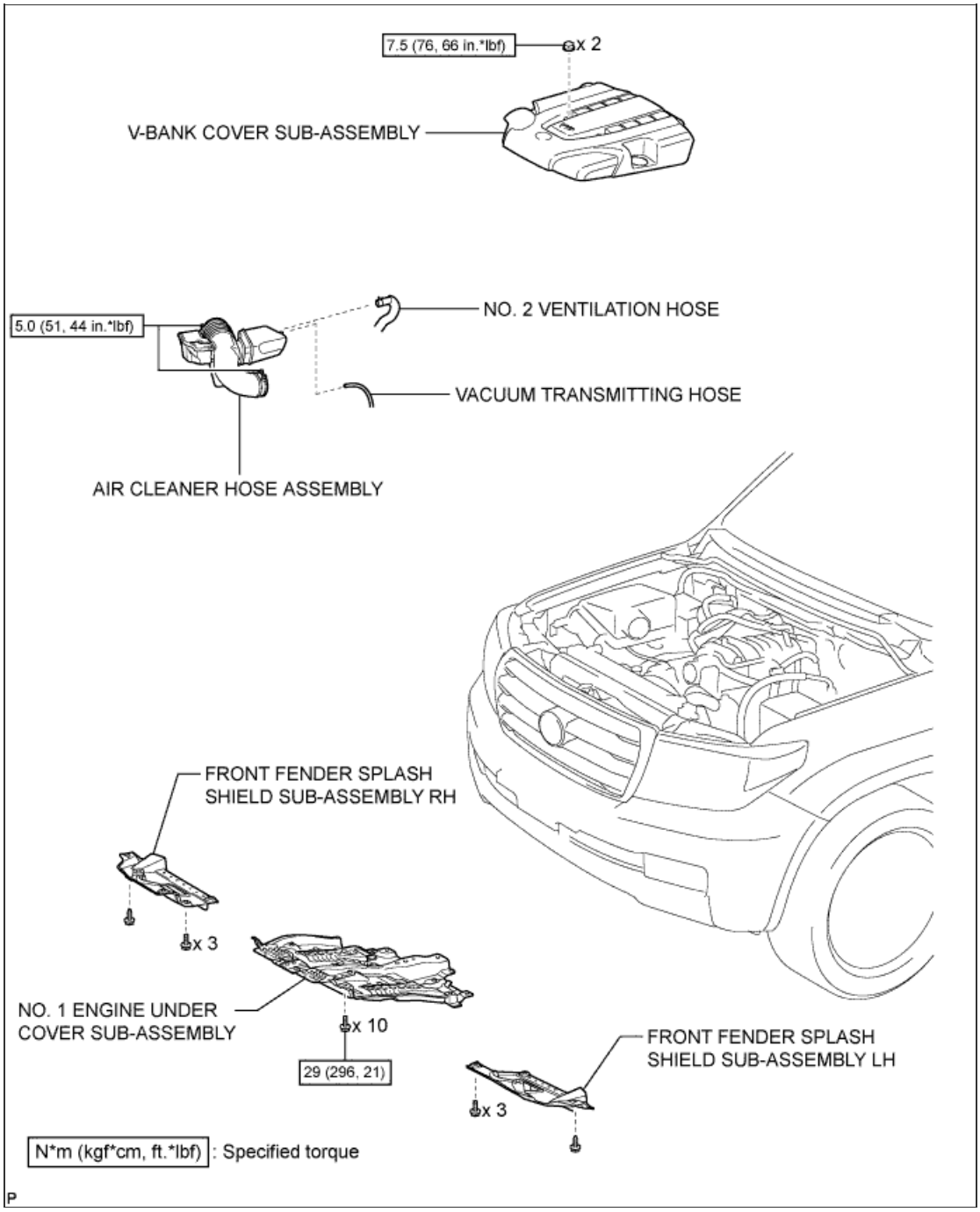
s. Reconnect the cable to the negative (-) battery terminal.

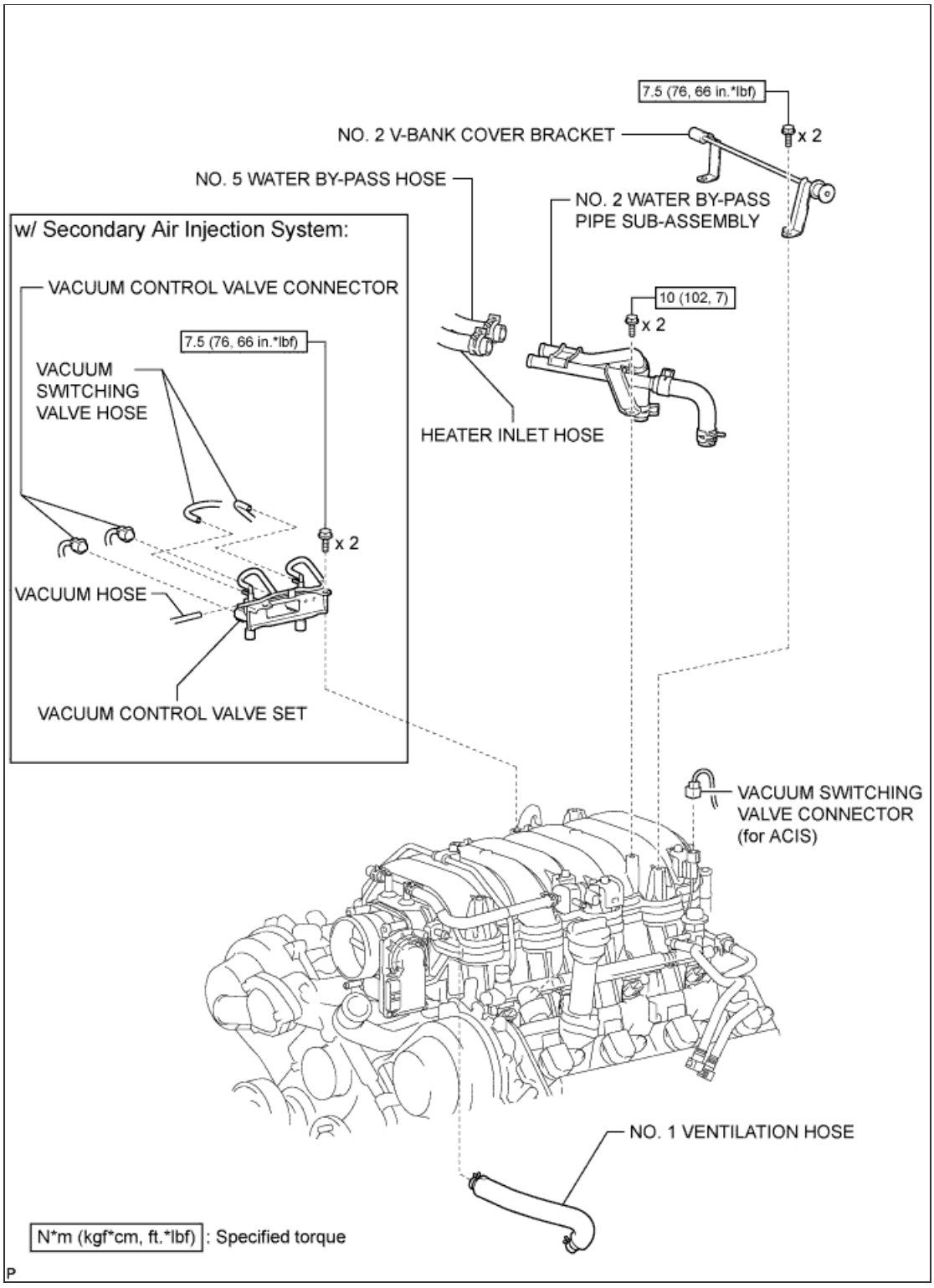
NOTICE:

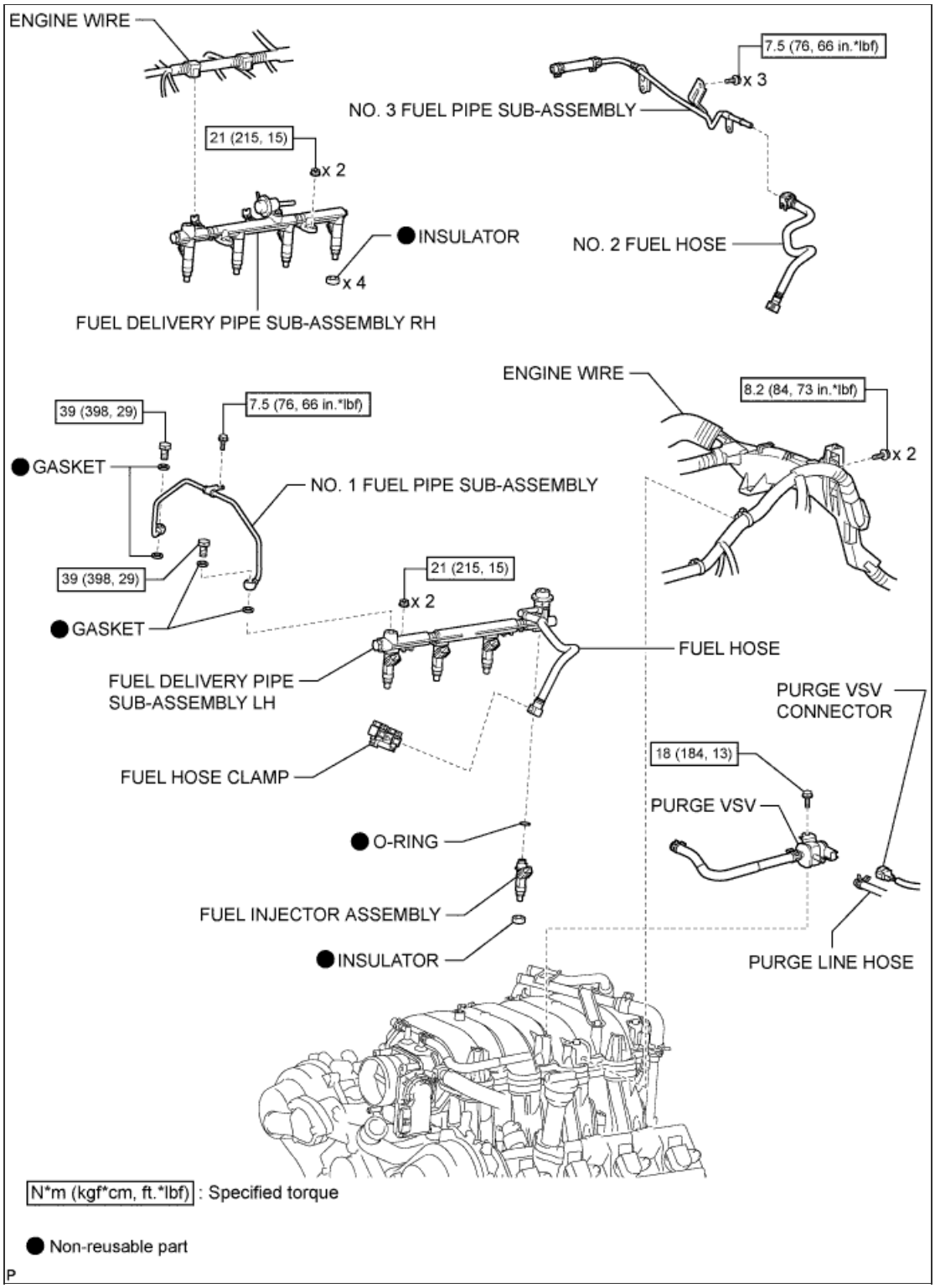
hen disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

t. Check for fuel leaks (refer to the "Check Fuel Pump eration And Fuel Leak" procedure).

for Preparation Click here




7.5 (76, 66 in.*lbf)
NO. 2 V-BANK COVER BRACKET
x 2
NO. 5 WATER BY-PASS HOSE
NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY
w/ Secondary Air Injection System:
VACUUM CONTROL VALVE CONNECTOR
10 (102, 7)
x 2
7.5 (76, 66 in.*lbf)
VACUUM SWITCHING VALVE HOSE
HEATER INLET HOSE
x 2
VACUUM HOSE
VACUUM CONTROL VALVE SET
VACUUM SWITCHING VALVE CONNECTOR (for ACIS)
NO. 1 VENTILATION HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
P


ENGINE WIRE
7.5 (76, 66 in.*lbf)
x 3
NO. 3 FUEL PIPE SUB-ASSEMBLY
21 (215, 15)
x 2
INSULATOR
x 4
NO. 2 FUEL HOSE
FUEL DELIVERY PIPE SUB-ASSEMBLY RH
ENGINE WIRE
8.2 (84, 73 in.*lbf)
x 2
39 (398, 29)
7.5 (76, 66 in.*lbf)
GASKET
NO. 1 FUEL PIPE SUB-ASSEMBLY
39 (398, 29)
21 (215, 15)
x 2
GASKET
FUEL HOSE
FUEL DELIVERY PIPE SUB-ASSEMBLY LH
PURGE VSV CONNECTOR
FUEL HOSE CLAMP
18 (184, 13)
PURGE VSV
O-RING
FUEL INJECTOR ASSEMBLY
INSULATOR
PURGE LINE HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

for Preparation Click here

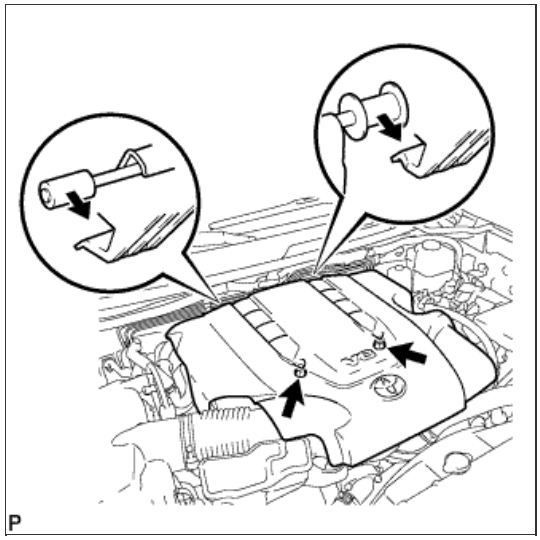
1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

2. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Remove the 2 nuts and V-bank cover.

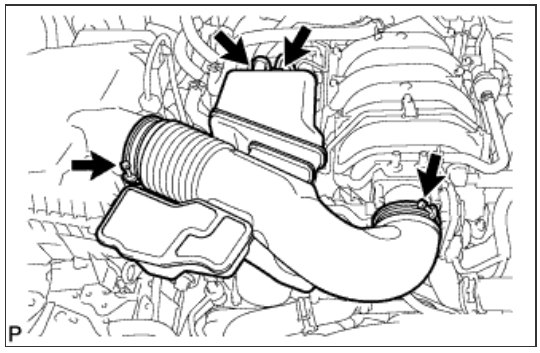


3. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum transmitting hose and No. 2 ventilation hose.

b. Loloosen the 2 hose clamps.

c. Remove the air cleaner hose.



4. INSPECT FUEL INJECTOR ASSEMBLY

a. Disconnect the 8 injector connectors.

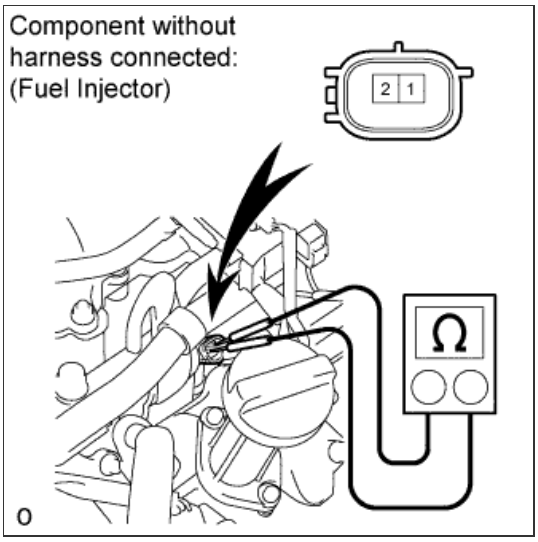
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	11.6 to 12.4 Ω

If the resistance is not as specified, replace the injector.

c. Reconnect the 8 injector connectors.



5. INSTALL AIR CLEANER HOSE ASSEMBLY

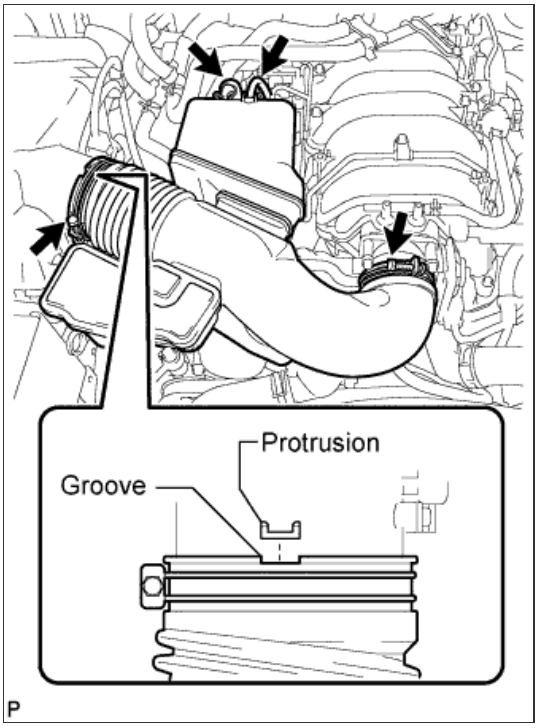
a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum transmitting hose.

d. Connect the No. 2 ventilation hose.

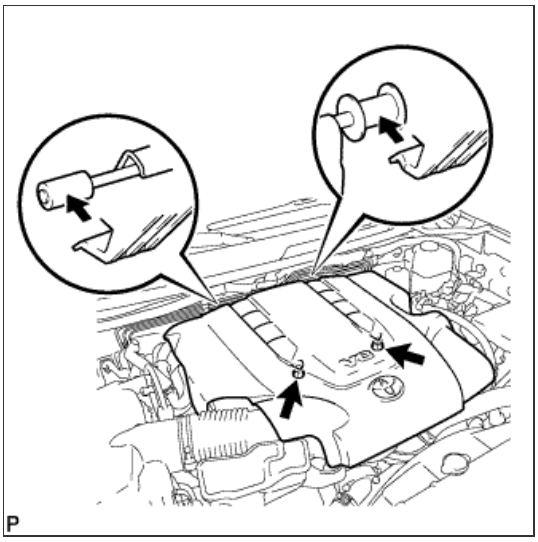


6. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket.

b. Install the V-bank cover with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



7. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

a. Discharge the fuel system pressure (Click here).

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

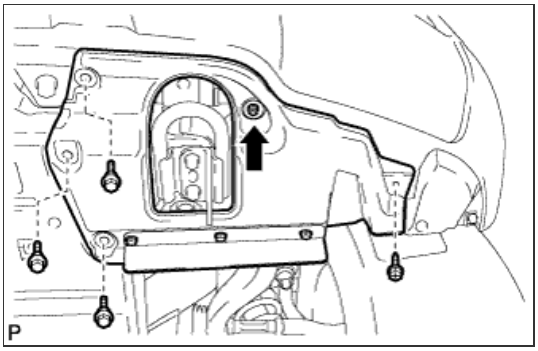
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



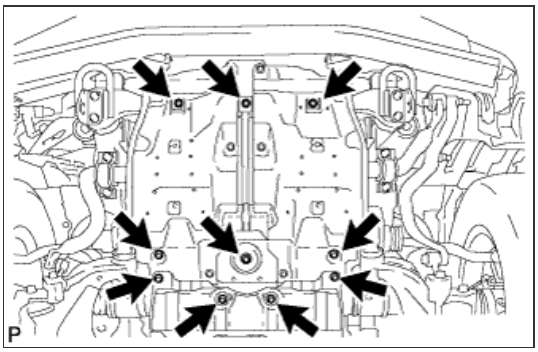
4. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

5. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

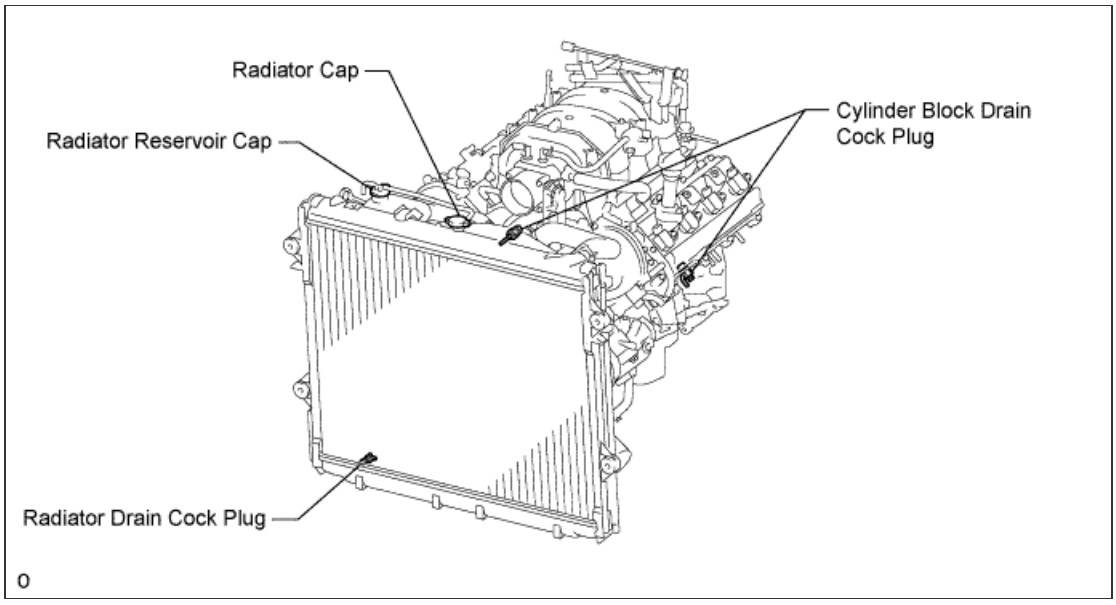
a. Remove the 10 bolts and No. 1 engine under cover.



6. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.



a. Loosen the radiator drain cock plug.

b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

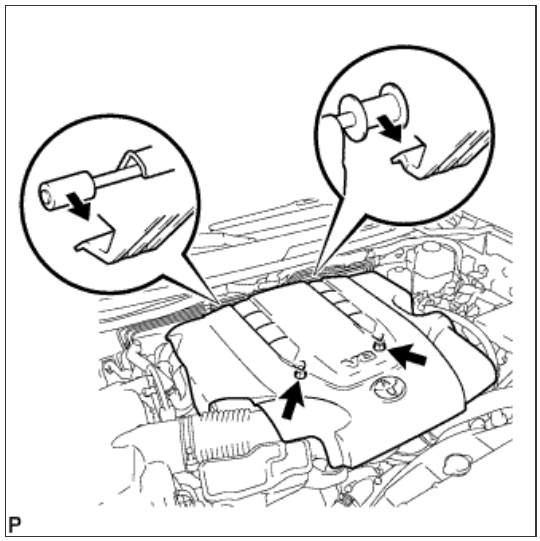
d. Tighten the 2 cylinder block drain cock plugs.

Torque:
13 N*m{ 130 kgf*cm , 9 ft.*lbf }

e. Tighten the radiator drain cock plug by hand.

7. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Remove the 2 nuts and V-bank cover.

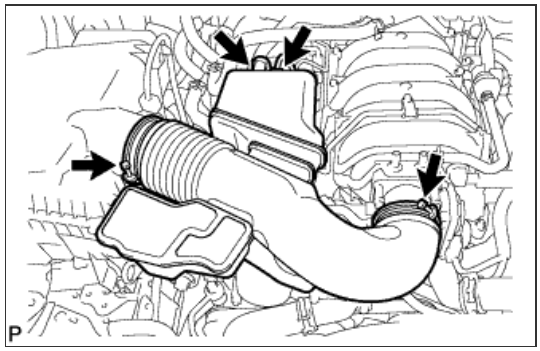


8. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum transmitting hose and No. 2 ventilation hose.

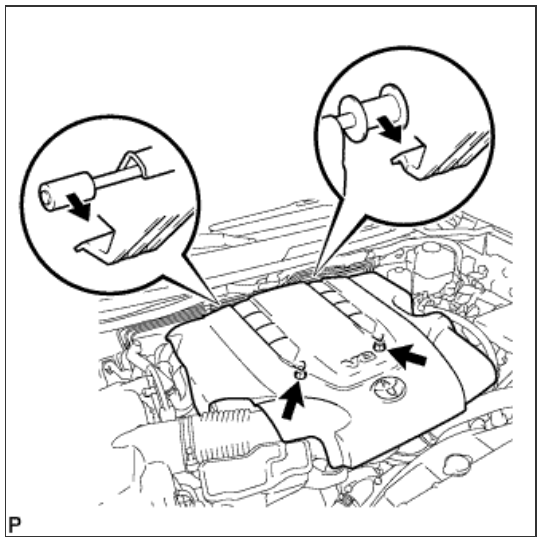
b. Loosen the 2 hose clamps.

c. Remove the air cleaner hose.



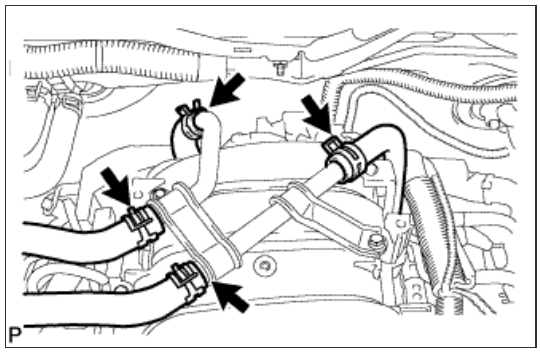
9. REMOVE NO. 2 V-BANK COVER BRACKET

a. Remove the 2 nuts and V-bank cover.



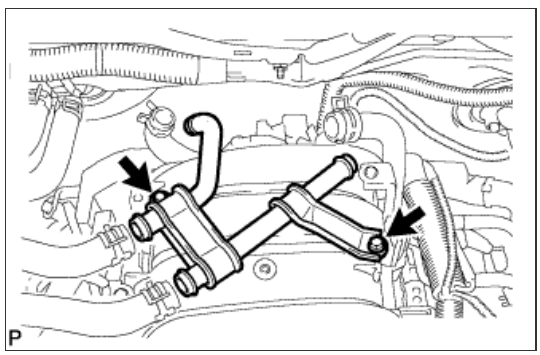
10. REMOVE NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY

a. Disconnect the 4 water hoses from the No. 2 water by-pass pipe.



b. Remove the 2 bolts.

c. Remove the No. 2 water by-pass pipe.



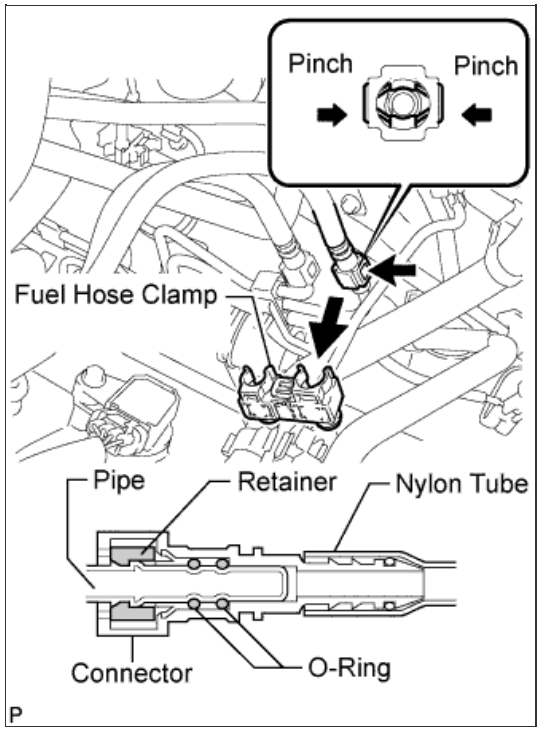
11. DISCONNECT FUEL HOSE

a. Remove the fuel hose clamp.

b. Pinch and pull the fuel hose connector to disconnect the connector from the fuel pipe.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to pre ent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



12. REMOVE NO. 2 FUEL HOSE

a. for engine side:

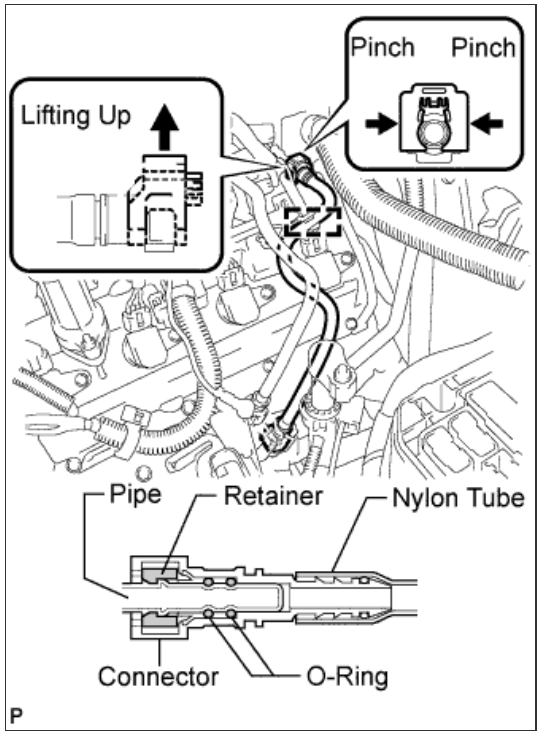
i. Detach the fuel hose clamp.

ii. Detach the lock claw by lifting up the cover, as shown in the illustration.

iii. Pinch and pull the No. 2 fuel hose connector to disconnect the connector from the No. 3 fuel pipe.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to pre ent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**

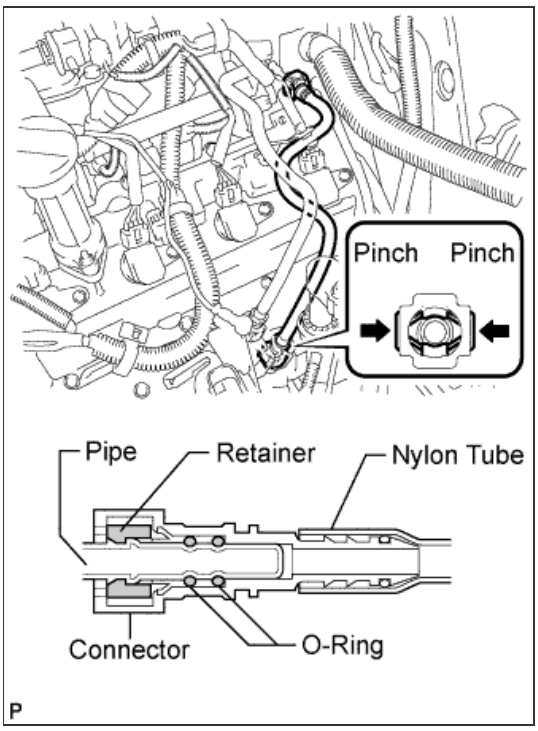


b. for body side:

i. Pinch and pull the No. 2 fuel hose connector to disconnect the connector from the fuel pipe.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to pre ent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



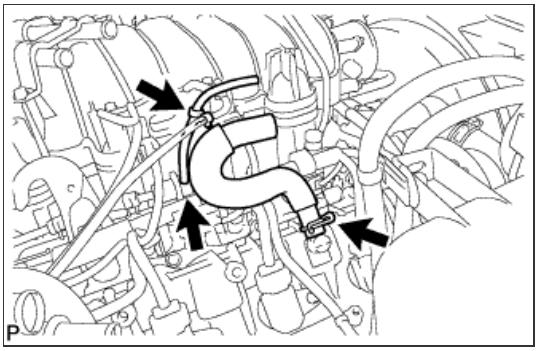
13. REMOVE NO. 2 VENTILATION HOSE

a. w/ Secondary Air Injection System:

i. Remove the No. 2 ventilation hose from the cylinder head cover.

ii. Remove the clamp.

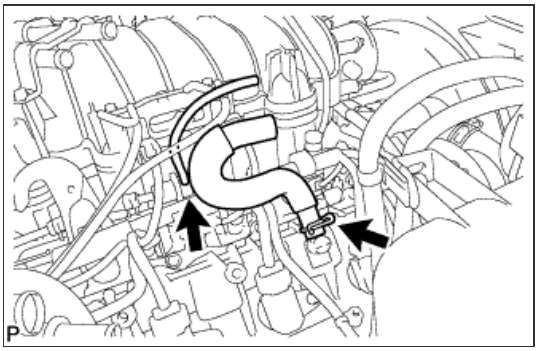
iii. Remove the vacuum transmitting hose from the fuel pressure regulator.



b. w/o Secondary Air Injection System:

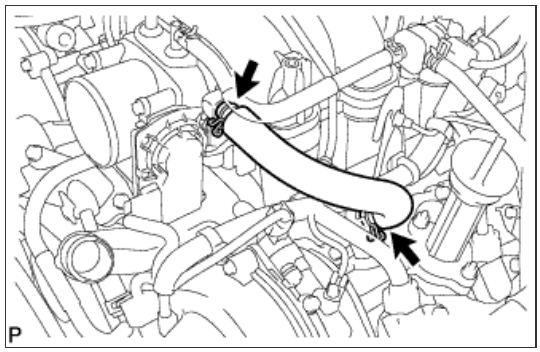
i. Remove the No. 2 ventilation hose from the cylinder head cover.

ii. Remove the vacuum transmitting hose from the fuel pressure regulator.



14. REMOVE NO. 1 VENTILATION HOSE

a. Remove the No. 1 ventilation hose from the intake manifold and ventilation valve.

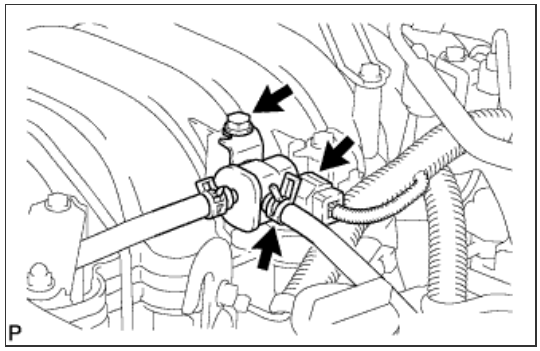


15. DISCONNECT PURGE VSV

a. Disconnect the purge VSV connector.

b. Disconnect the purge line hose from the purge VSV.

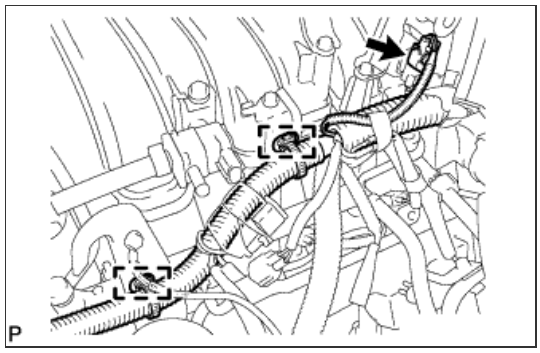
c. Remove the bolt and disconnect the purge VSV from the intake manifold.



16. DISCONNECT ENGINE WIRE

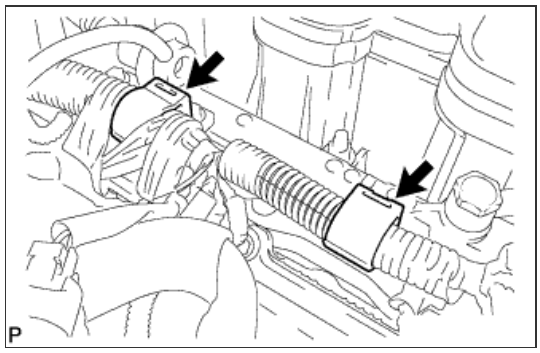
a. Disconnect the VSV connector (for ACIS).

b. Disconnect the 2 wire clamps from the wire bracket and engine hanger.

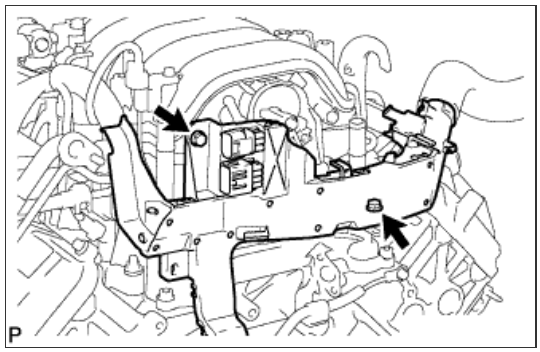


c. Disconnect the 2 wire clamps from the wire clamp bracket on the RH delivery pipe.

d. Disconnect the 8 injector connectors.



e. Remove the 2 bolts and disconnect the engine wire protector.

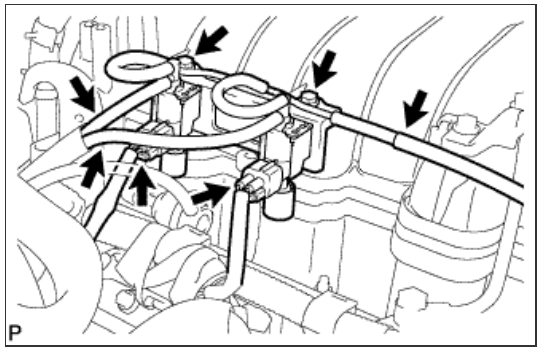


17. REMOVE VACUUM CONTROL VALVE SET

a. Disconnect the 2 VSV connectors.

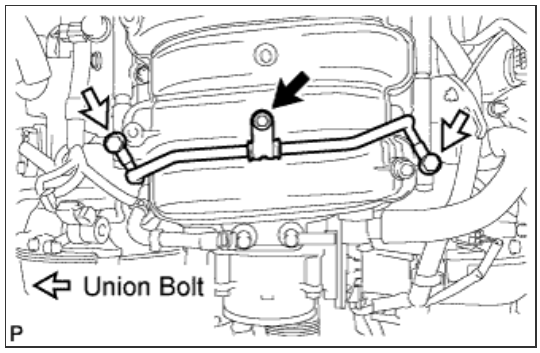
b. Disconnect the 3 vacuum hoses.

c. Remove the 2 bolts and vacuum control valve set.



18. REMOVE NO. 1 FUEL PIPE SUB-ASSEMBLY

a. Remove the bolt, 2 union bolts, 4 gaskets and No. 1 fuel pipe.

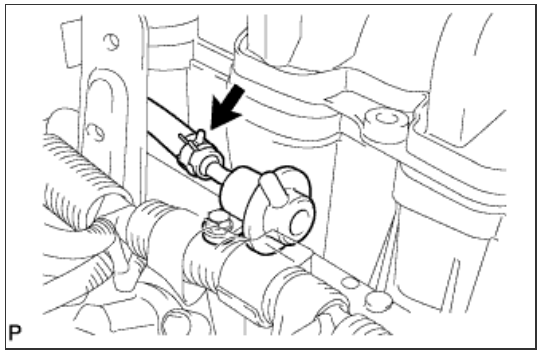


19. DISCONNECT NO. 3 FUEL PIPE SUB-ASSEMBLY

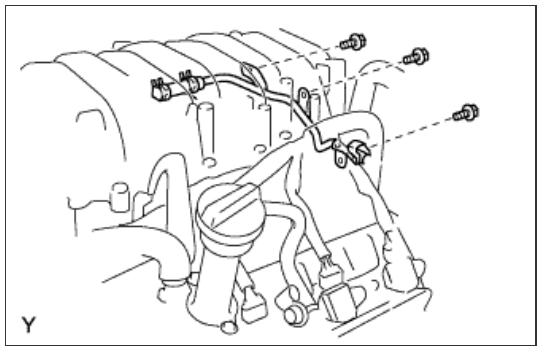
a. Disconnect the fuel return hose from the pressure regulator.

NOTICE:

Put a cloth or e uivalent under the pressure regulator.



b. Remove the 3 bolts and disconnect the No. 3 fuel pipe from the intake manifold and fuel delivery pipe LH.



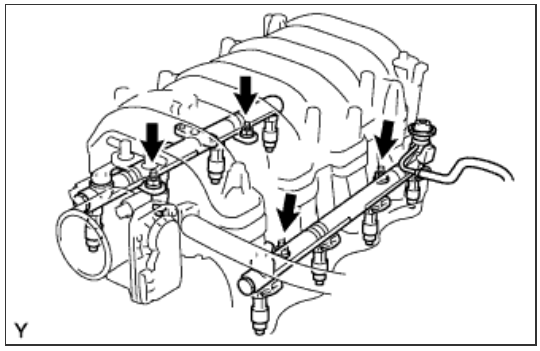
20. REMOVE FUEL DELIVERY PIPE SUB-ASSEMBLY

a. Remove the 4 nuts holding the delivery pipes to the intake manifold.

b. Remove the 2 delivery pipes from the intake manifold.

NOTICE:

Be careful not to drop the injectors when removing the delivery pipes.



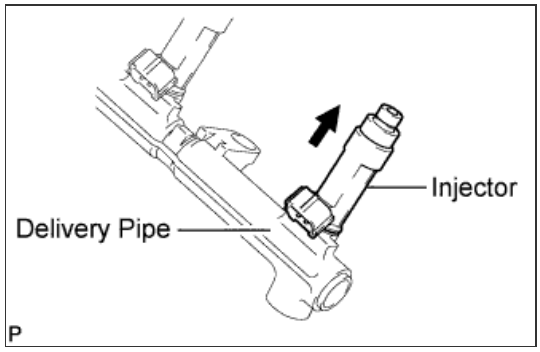
21. REMOVE FUEL INJECTOR ASSEMBLY

a. Remove the 8 injectors from the delivery pipe LH and RH.

NOTICE:

Do not apply any load to the injector in the horizontal direction.

b. Remove the -ring and insulator from each injector.



for Preparation Click here

1. INSPECT INJECTION VOLUME AND LEAKAGE

a. Check the injector injection.

CAUTION:

- **This test involves high-pressure fuel and electricity.**
- **Take every precaution regarding safe handling of both the fuel and the electrical parts.**
- **Perform this test in a safe area, and avoid any sparks or flame.**
- **Do not smoke.**

i. Assemble SST as shown in the illustration.

SST
09268-31012 (09268-41091, 09268-41110, 09268-41300, 09268-41500, 95336-08070)

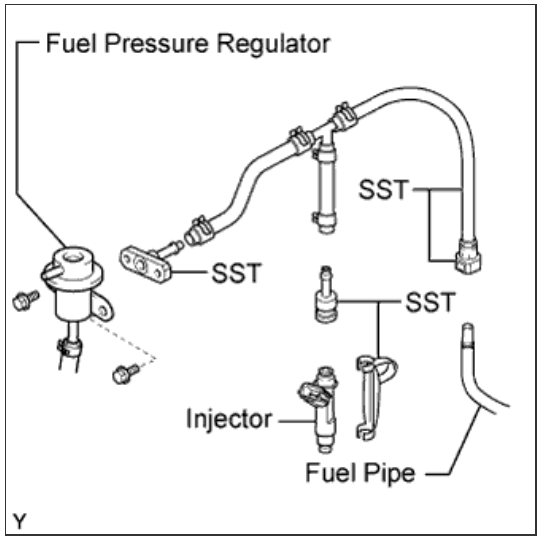
ii. Discharge the fuel system pressure (Click here).

iii. Disconnect the fuel inlet hose (fuel tube connector) from the fuel pipe.

iv. Remove the bolt and disconnect the fuel pressure regulator from the fuel delivery pipe.

NOTICE:

Do not disconnect the No. 2 fuel hose from the fuel pressure regulator.

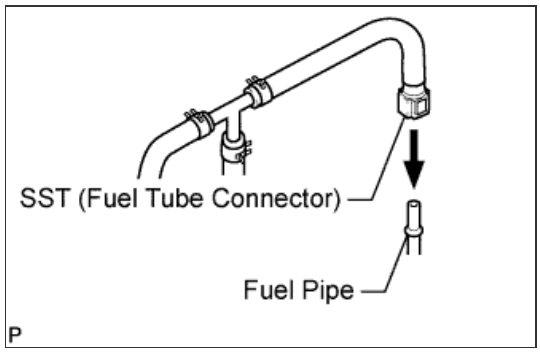


v. Connect SST to the fuel pipe.

SST
09268-31012 (09268-41091, 09268-41110, 09268-41300, 09268-41500, 95336-08070)

CAUTION:

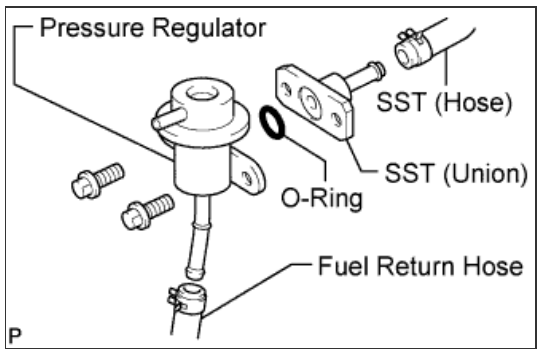
Always read the precautions before connecting the fuel tube connector.



vi. Connect SST (hose) to the fuel inlet of the pressure regulator with another SST (union), a new O-ring and the 2 bolts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf

vii. Connect the fuel return hose to the fuel outlet of the pressure regulator.



viii. Install the O-ring to the injector.

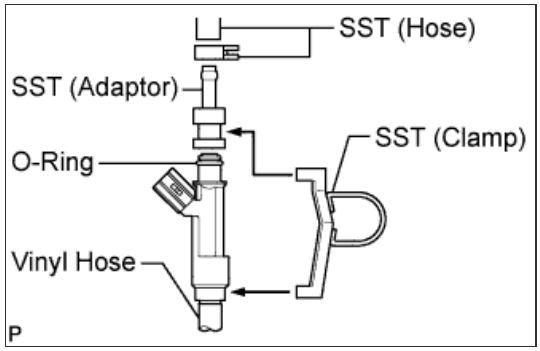
ix. Connect SST (adaptor and hose) to the injector, and hold the injector and union with another SST (clamp).

SST
09268-31012 (95336-08070, 09268-41110, 09268-41300)

x. Put the injector into a graduated cylinder.

CAUTION:

Install a suitable vinyl hose onto the injector to prevent gasoline from splashing out.



xi. Connect the intelligent tester to the DLC3.

xii. Operate the fuel pump (Click here).

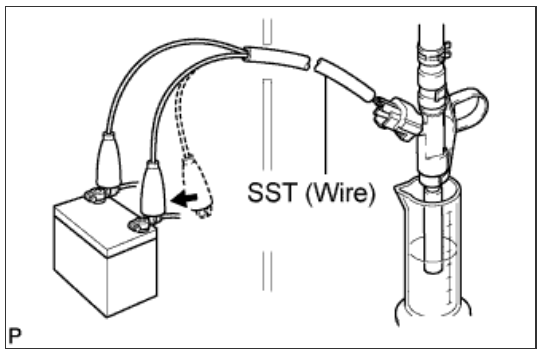
xiii. Connect SST (wire) to the injector and battery for 15 seconds, and measure the injection volume with the graduated cylinder. Test each injector 2 or 3 times.

SST
09842-30070

Standard injection volume:
56 to 69 cm^3 (3.4 to 4.2 cu. in.) per 15 seconds

Difference between each injector:
13 cm^3 (0.8 cu. in.) or less

If the injection volume is not as specified, replace the injector.



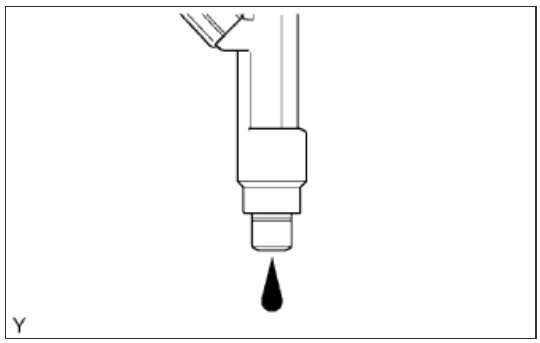
b. Check for fuel drop.

i. In the condition above, disconnect the tester probes of SST (wire) from the battery and check for fuel drop from the injector.

SST
09842-30070

Standard fuel drop:
1 drop or less per 12 minutes

If the fuel drop is not as specified, replace the injector assembly.



ii. Turn the engine switch off.

iii. Disconnect the cable from the negative (-) battery terminal.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

iv. Remove SST and fuel tube connector.

SST
09842-30070

v. Disconnect the intelligent tester from the DLC3.

vi. Reconnect the fuel inlet pipe to the fuel tube.

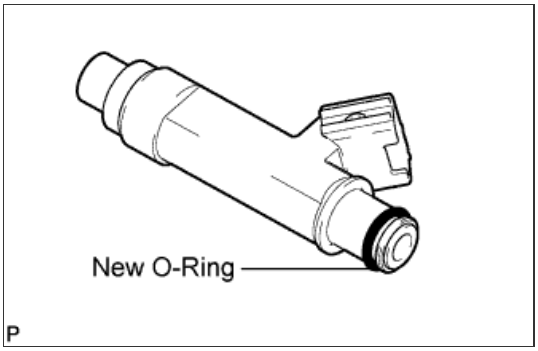
for Preparation Click here

1. INSTALL FUEL INJECTOR ASSEMBLY

NOTICE:

- **Be careful not to drop the injectors when installing the delivery pipes.**
- **Do not apply any load to the injector in the horizontal direction.**

a. Apply a light coat of gasoline to each new O-ring and install one to each injector.

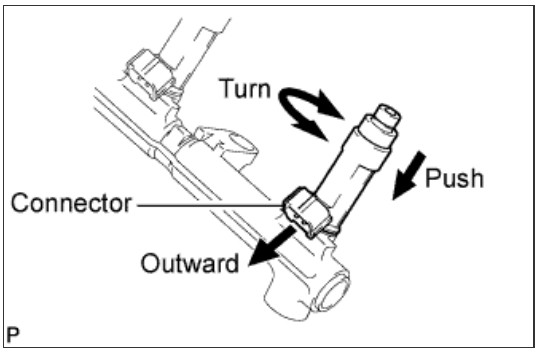


b. Install the 8 injectors.

i. While turning each injector clockwise and counterclockwise, push it onto the delivery pipes.

ii. Position the injector connectors outward.

c. Place 8 new insulators on the intake manifold.



2. INSTALL FUEL DELIVERY PIPE SUB-ASSEMBLY

NOTICE:

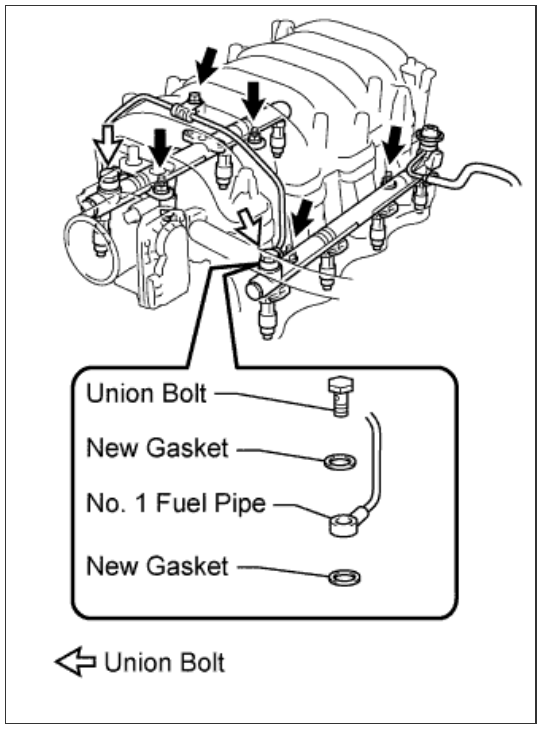
Be careful not to drop the injectors when installing the delivery pipes.

a. Place the 2 delivery pipes and injector assemblies on the lower intake manifold.

b. Temporarily install the 4 nuts.

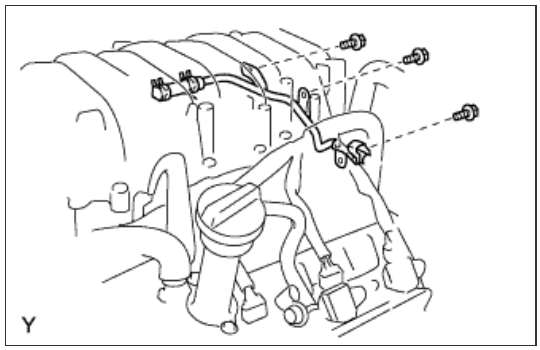
c. Install the No. 1 fuel pipe and 4 new gaskets with the bolt and 2 union bolts.

Torque:
for union bolt:
39 N*m{ 398 kgf*cm , 29 ft.*lbf }
for bolt:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

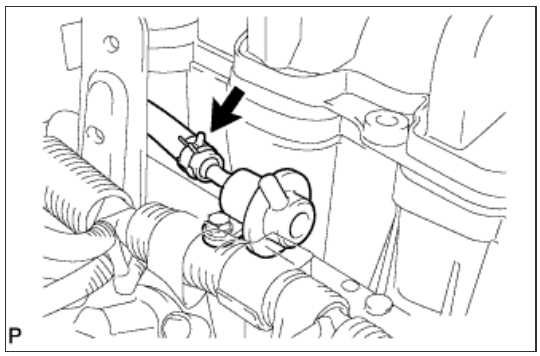


d. Connect the No. 3 fuel pipe with the 3 bolts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



e. Connect the fuel return hose to the fuel pressure regulator.



f. Check that the injectors rotate smoothly.

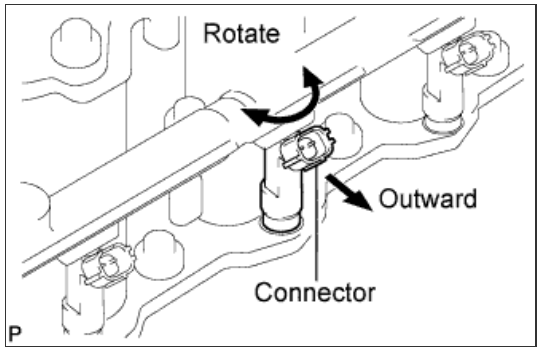
HINT:

If the injectors do not rotate smoothly, a probable cause is incorrect installation of the O-rings. Replace the O-ring of any injector that does not rotate smoothly.

g. Position the injector connectors outward.

h. Tighten the 4 nuts holding the delivery pipes to the lower intake manifold.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



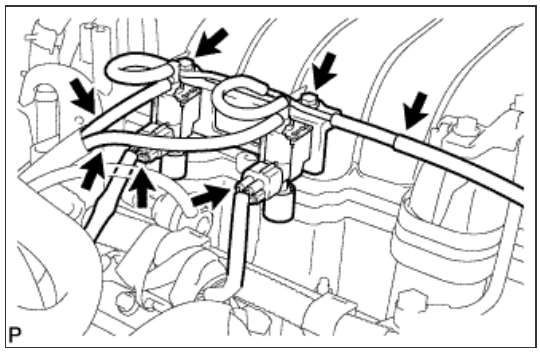
3. INSTALL VACUUM CONTROL VALVE SET (w/ Secondary Air Injection System)

a. Install the vacuum control valve set with the 2 bolts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

b. Connect the 3 vacuum hoses.

c. Connect the 2 VSV connectors.

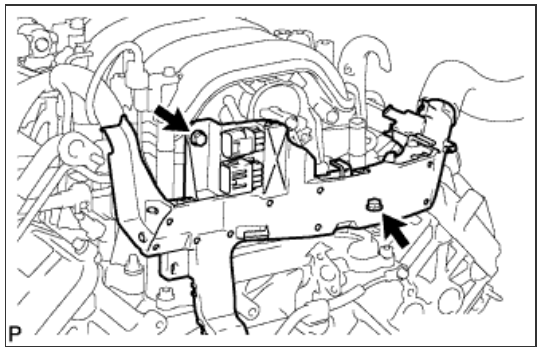


4. CONNECT ENGINE WIRE

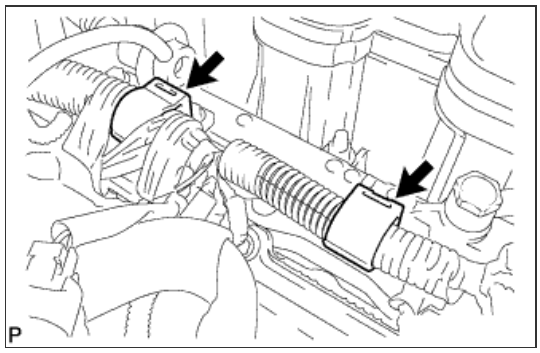
a. Install the engine wire protector with the 2 bolts.

Torque:
8.2 N*m{ 84 kgf*cm , 73 in.*lbf }

b. Connect the 8 injector connectors.

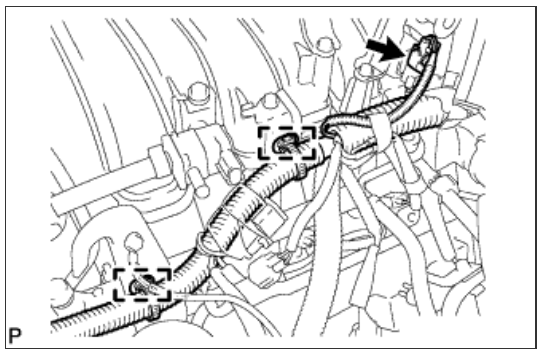


c. Connect the 2 wire clamps to the wire clamp brackets on the delivery pipe.



d. Connect the engine wire to the wire bracket and engine hanger.

e. Connect the VSV connector (for ACIS).



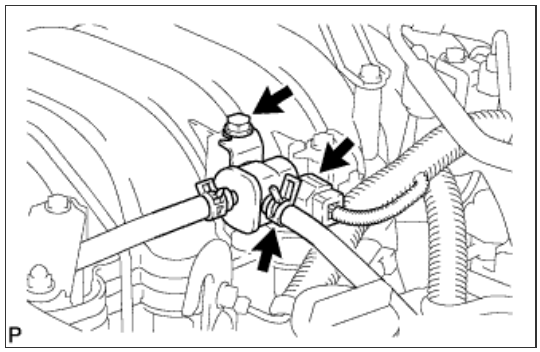
5. INSTALL PURGE VSV

a. Install the purge VSV to the intake manifold with the bolt.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

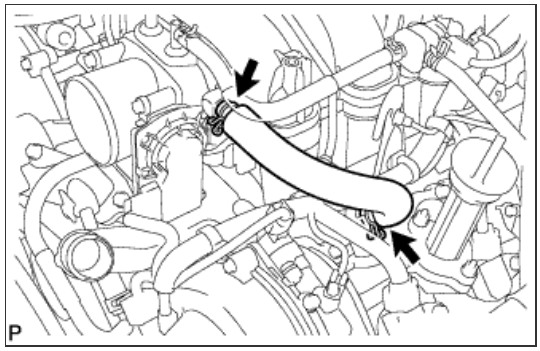
b. Connect the purge line hose.

c. Connect the purge VSV connector.



6. INSTALL NO. 1 VENTILATION HOSE

a. Install the No. 1 ventilation hose to the intake manifold and ventilation valve.



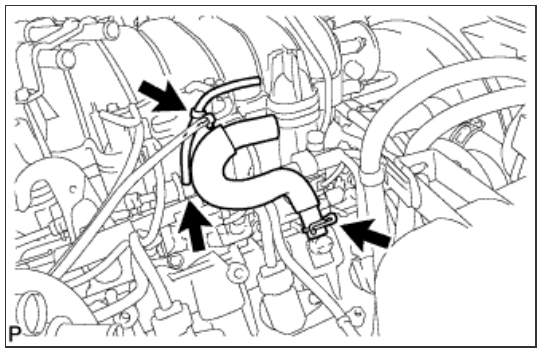
7. INSTALL NO. 2 VENTILATION HOSE

a. w/ Secondary Air Injection System:

i. Install the vacuum transmitting hose to the fuel pressure regulator.

ii. Install the clamp.

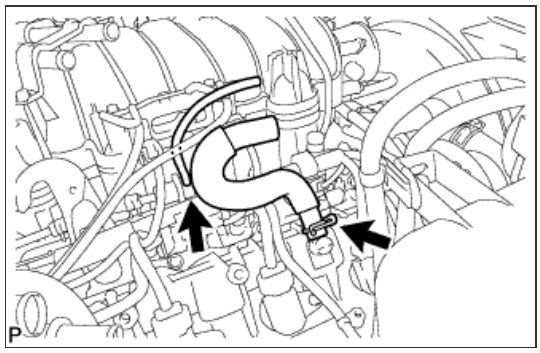
iii. Install the No. 2 ventilation hose to the cylinder head cover.



b. w/o Secondary Air Injection System:

i. Install the vacuum transmitting hose to the fuel pressure regulator.

ii. Install the No. 2 ventilation hose to the cylinder head cover.



8. INSTALL NO. 2 FUEL HOSE

a. for engine side:

i. Connect the fuel hose to the No. 3 fuel pipe.

HINT:

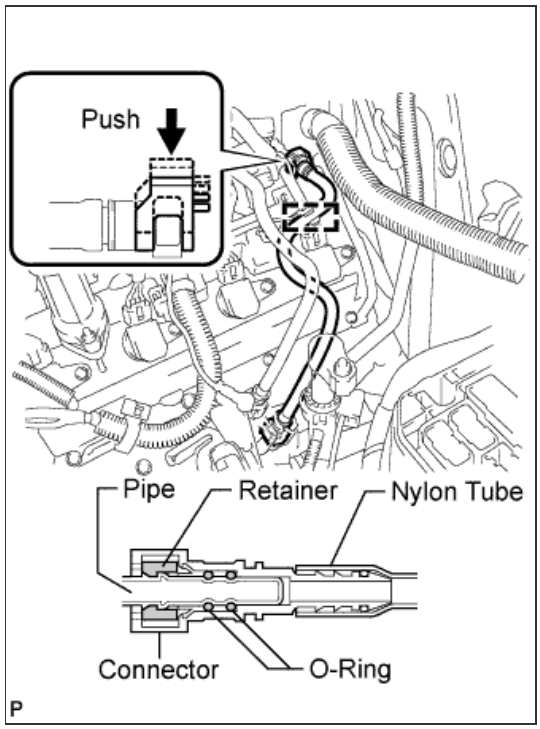
Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

ii. Attach the lock claws to the connector by pushing down on the cover, as shown in the illustration.

iii. Attach the fuel hose clamp.



b. for body side:

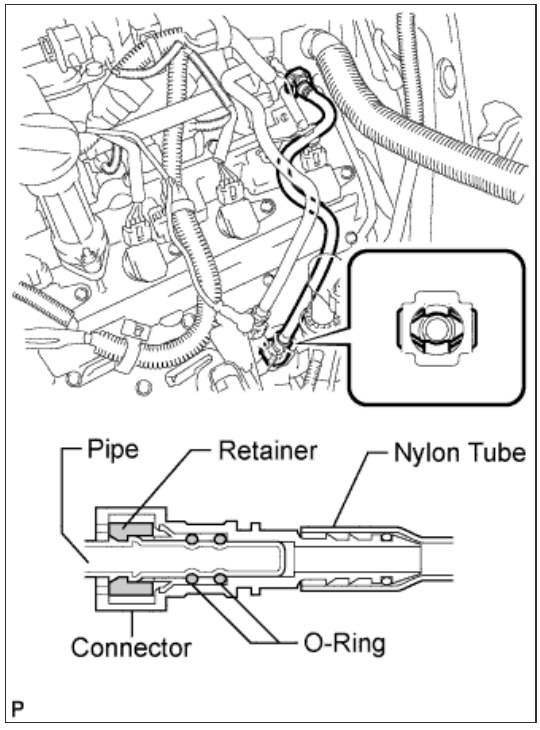
i. Connect the fuel hose to the fuel pipe.

HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**



9. CONNECT FUEL HOSE

a. Connect the fuel hose.

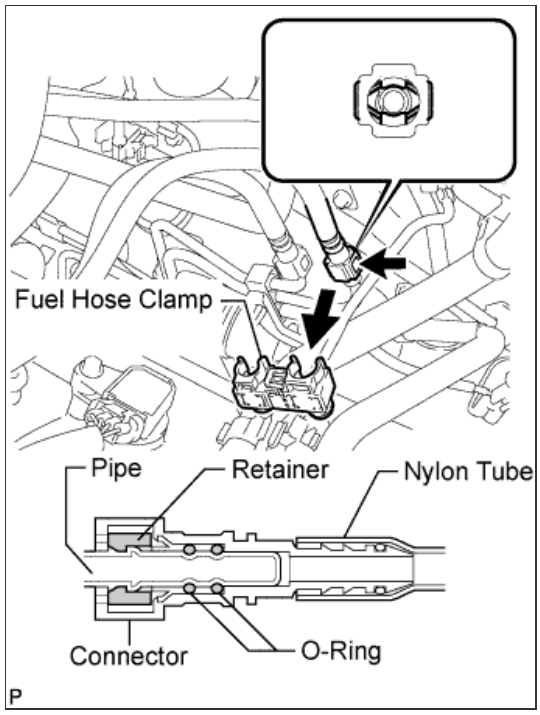
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

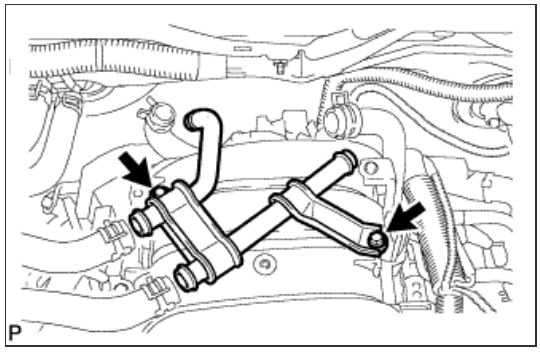
b. Install the fuel hose clamp.



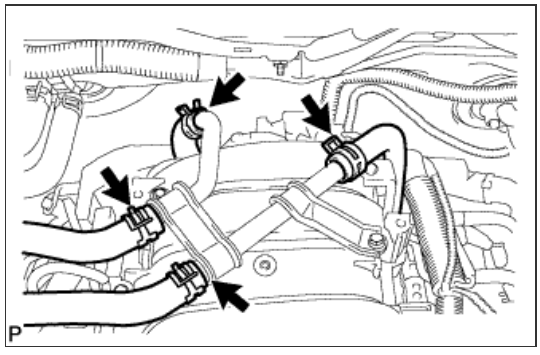
10. INSTALL NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY

a. Install the No. 2 water by-pass pipe with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



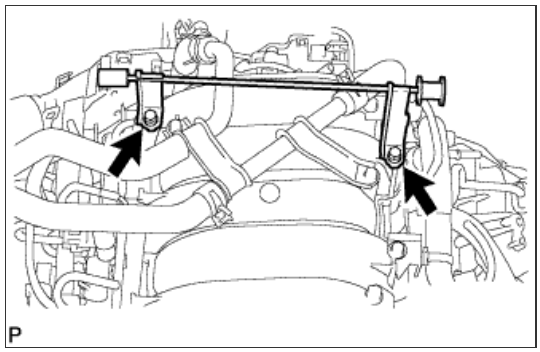
b. Connect the 4 water hoses.



11. INSTALL NO. 2 V-BANK COVER BRACKET

a. Install the bracket with the 2 bolts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



12. INSTALL AIR CLEANER HOSE ASSEMBLY

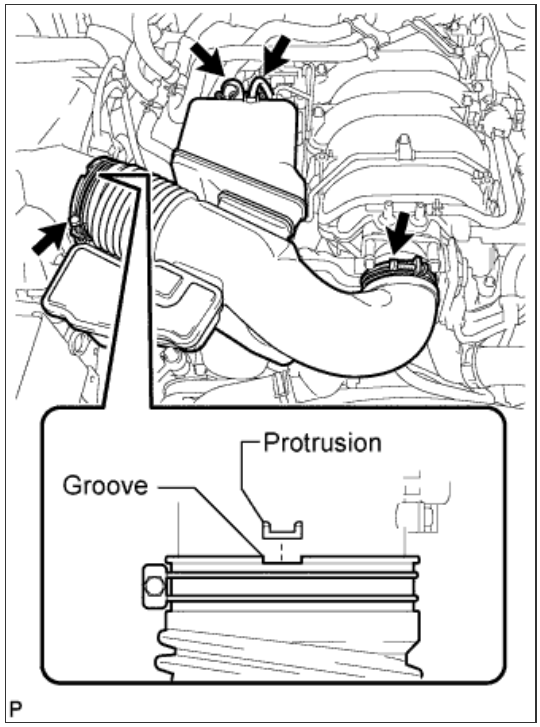
a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum transmitting hose.

d. Connect the No. 2 ventilation hose.

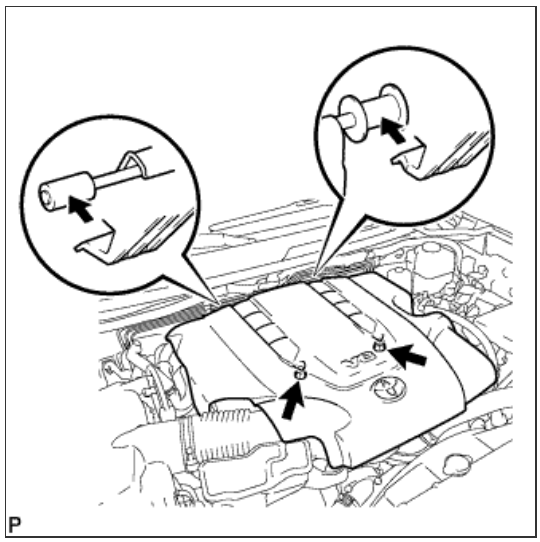


13. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket.

b. Install the V-bank cover with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



14. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

15. ADD ENGINE COOLANT

a. Add engine coolant.

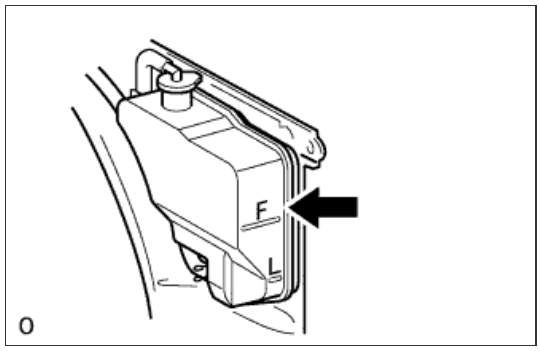
Standard Capacity:

Item		Specified Condition
w/o Transmission oil cooler	w/o Rear Heater	13.4 liters (14.2 US ts, 11.8 Imp. ts)
	w/ Rear Heater	16.3 liters (17.2 US ts, 14.3 Imp. ts)
w/ Transmission oil cooler	w/o Rear Heater	14.1 liters (14.9 US ts, 12.4 Imp. ts)
	w/ Rear Heater	16.9 liters (17.9 US ts, 14.9 Imp. ts)

HINT:

TOYOTA vehicles are filled with TOYOTA S C at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA S C or similar high uality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.



c. Install the radiator reservoir cap.

d. Press the inlet and outlet radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.

NOTICE:

Switch off the A/C.

g. aintain the engine speed at 2000 to 2 00rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

h. Press the inlet and outlet radiator hoses several times by hand to bleed air.

CAUTION:

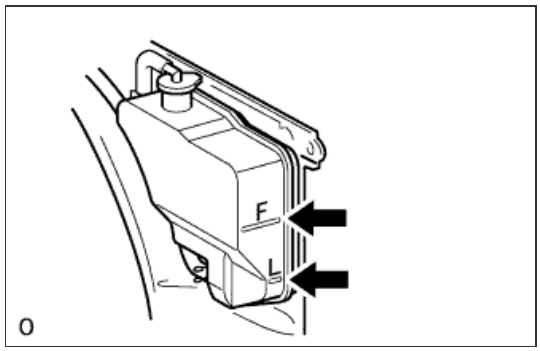
- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the cooling fan.**

i. Stop the engine, and wait until the engine coolant cools down to the ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

j. Check that the coolant level is between the F and lines. If the coolant level is below the line, repeat all of the procedures above. If the coolant level is above the F line, drain coolant so that the coolant level is between the F and lines.

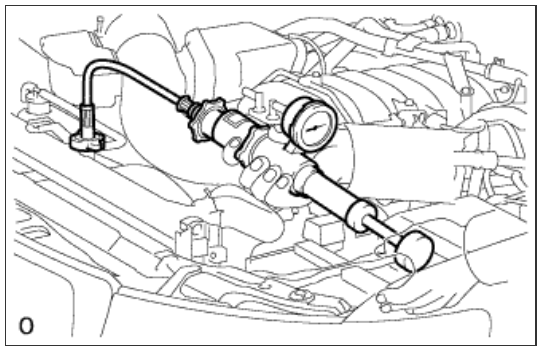


16. INSPECT FOR COOLANT LEAKS

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no e ternal leaks are found, check the heater core, cylinder block and head.



17. INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the D C3.

b. Turn the engine switch on (IG) and intelligent tester ON.

NOTICE:

Do not start the engine.

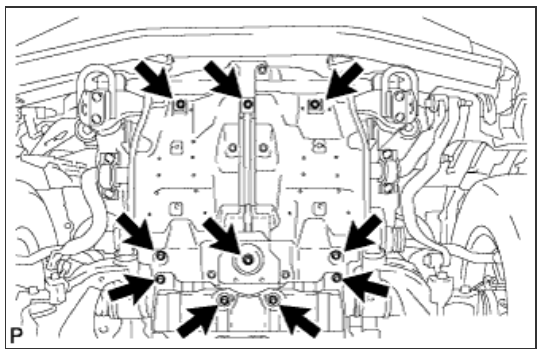
c. nter the following menus: Powertrain / ngine and CT / Active Test / Activate the Fuel Pump Speed Control.

d. Check that there are no fuel leaks after doing maintenance anywhere on the fuel system.

18. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the No. 1 engine under cover with the 10 bolts.

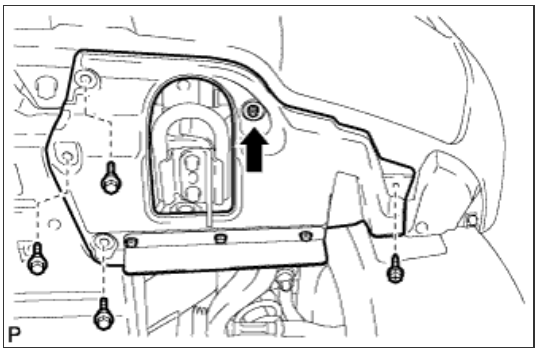
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



19. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.

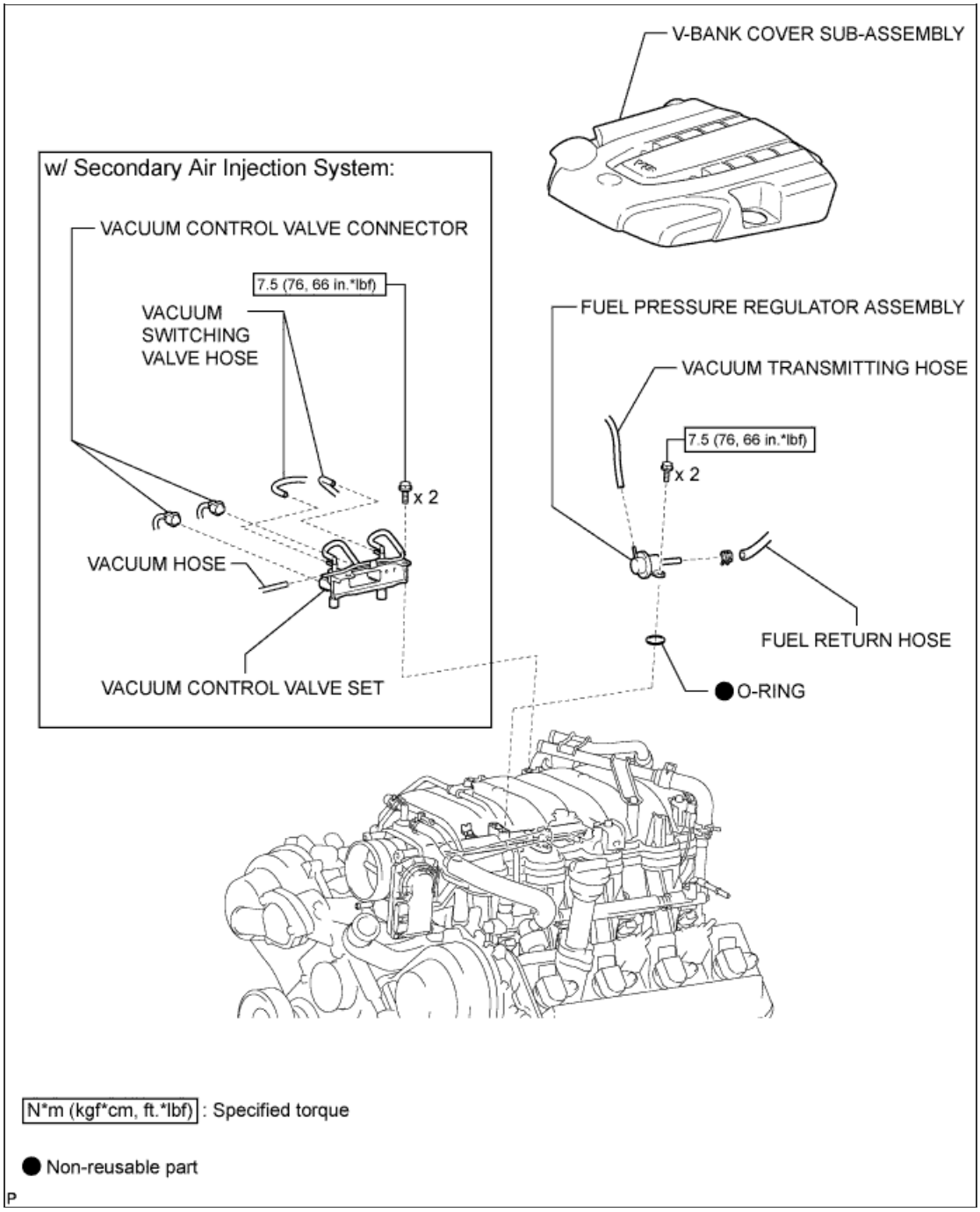


20. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the side.

for Preparation [Click here]



for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

a. Discharge the fuel system pressure (Click here).

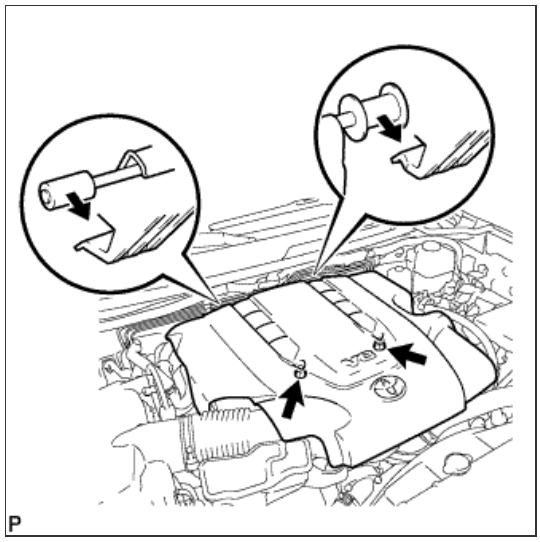
2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Remove the 2 nuts and V-bank cover.

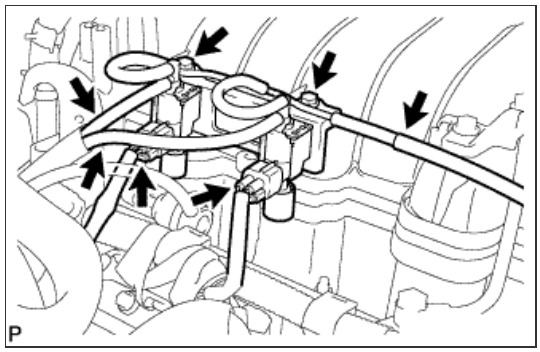


4. REMOVE VACUUM CONTROL VALVE SET (w/ Secondary Air Injection System)

a. Disconnect the 2 VSV connectors.

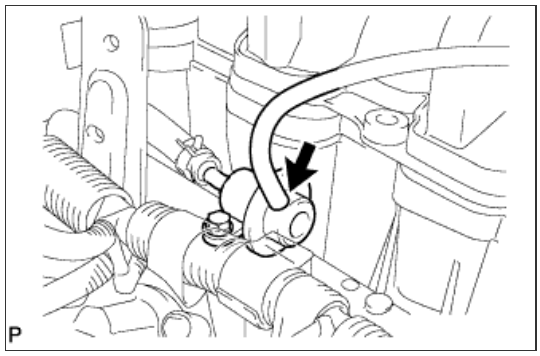
b. Disconnect the 3 vacuum hoses.

c. Remove the 2 bolts and vacuum control valve set.



5. REMOVE FUEL PRESSURE REGULATOR ASSEMBLY

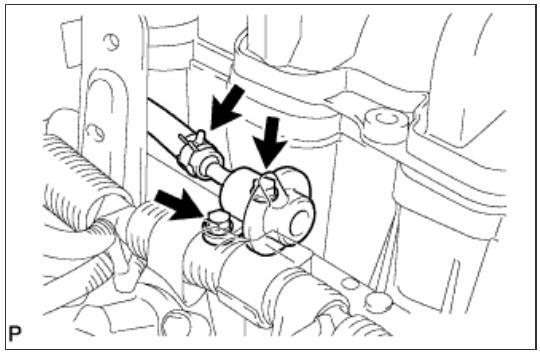
a. Disconnect the vacuum transmitting hose from the pressure regulator.



b. Disconnect the fuel return hose from the pressure regulator.

c. Remove the 2 bolts, and pull out the pressure regulator.

d. Remove the O-ring from the pressure regulator.

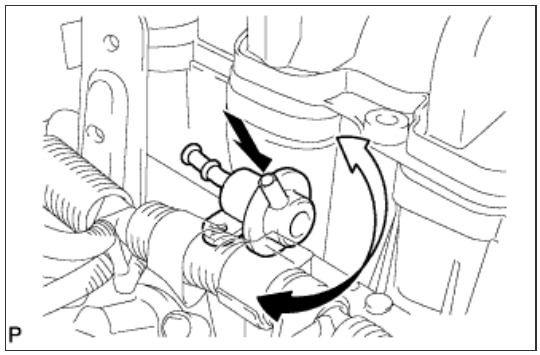


for Preparation Click here

1. INSTALL FUEL PRESSURE REGULATOR ASSEMBLY

a. Apply a light coat of gasoline to a new O-ring, and install it to the pressure regulator.

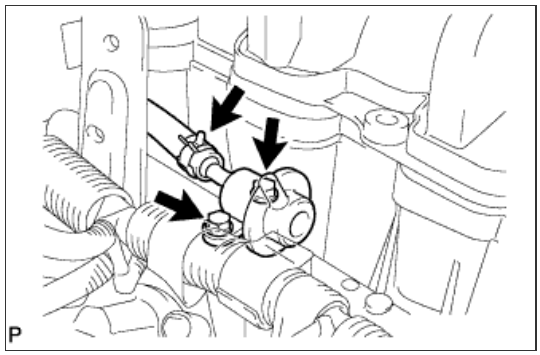
b. hile turning the pressure regulator to the left and right, install it to the delivery pipe.



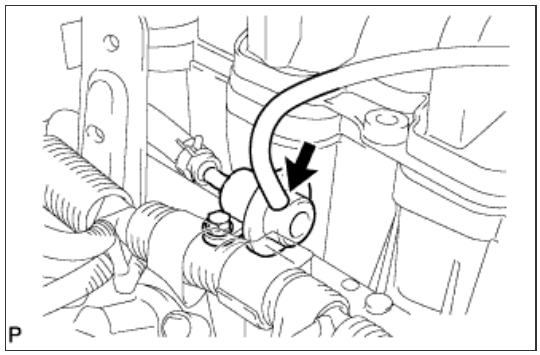
c. Install the 2 bolts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

d. Connect the fuel return hose to the pressure regulator.



e. Connect the vacuum transmitting hose to the pressure regulator.



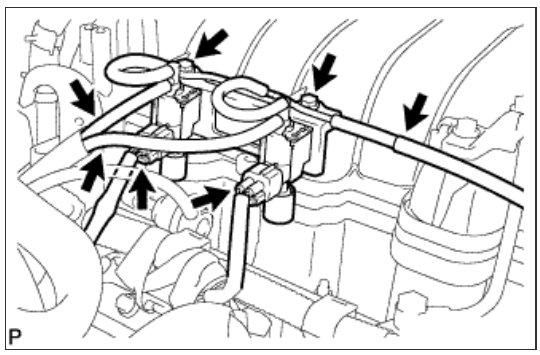
2. INSTALL VACUUM CONTROL VALVE SET (w/ Secondary Air Injection System)

a. Install the vacuum control valve set with the 2 bolts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

b. Connect the 3 vacuum hoses.

c. Connect the 2 VSV connectors.

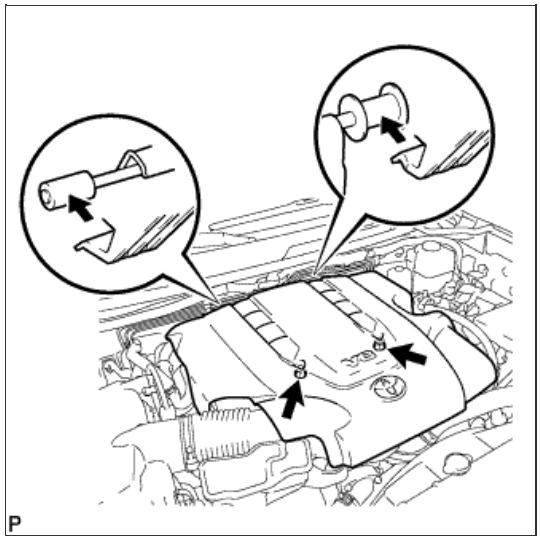


3. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket.

b. Install the V-bank cover with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



4. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

hen disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

5. INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and intelligent tester ON.

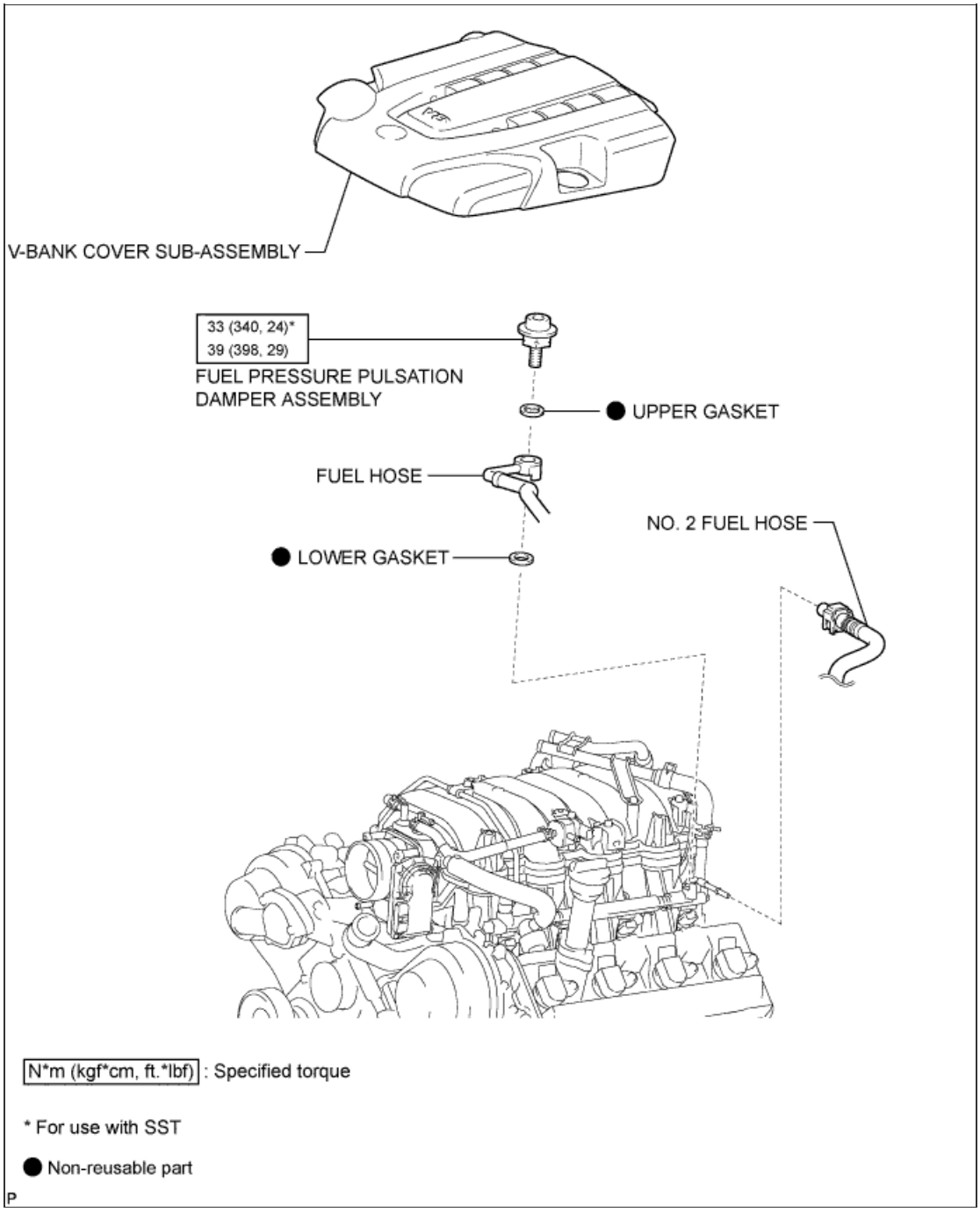
NOTICE:

Do not start the engine.

c. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the Fuel Pump Speed Control.

d. Check that there are no fuel leaks after doing maintenance anywhere on the fuel system.

for Preparation Click here



for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

a. Discharge the fuel system pressure (Click here).

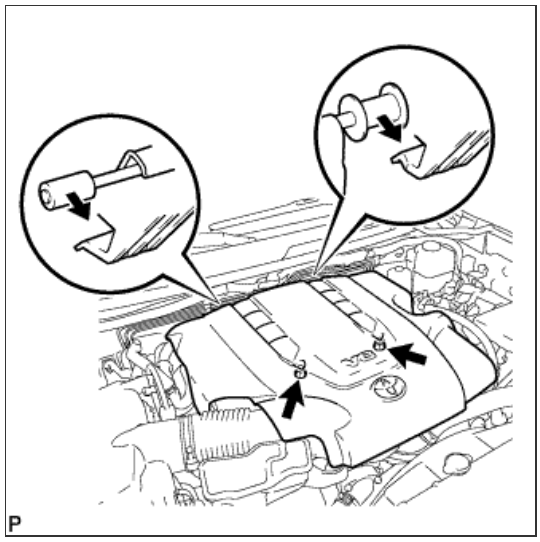
2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Remove the 2 nuts and V-bank cover.



4. DISCONNECT NO. 2 FUEL HOSE

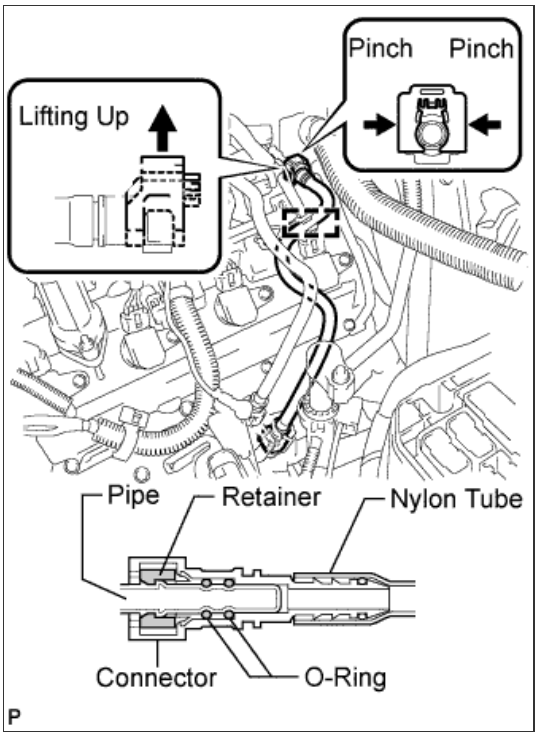
a. Detach the fuel hose clamp.

b. Detach the lock claw by lifting up the cover, as shown in the illustration.

c. Pinch and pull the No. 2 fuel hose connector to disconnect the connector from the No. 3 fuel pipe.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



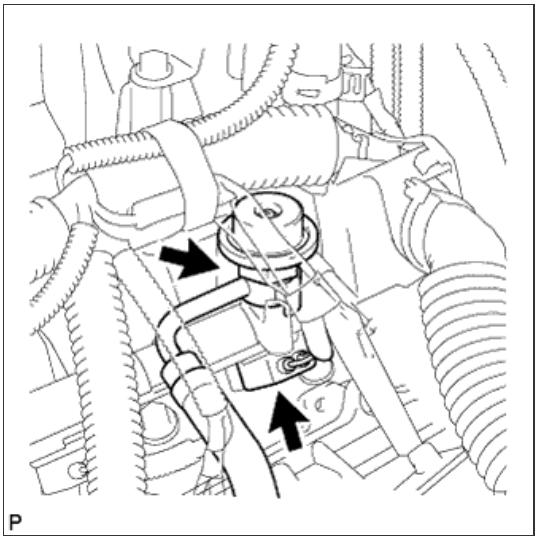
5. REMOVE FUEL PRESSURE PULSATION DAMPER ASSEMBLY

a. Disconnect the fuel injector connector.

b. Remove the pulsation damper, upper gasket, fuel hose and lower gasket.

NOTICE:

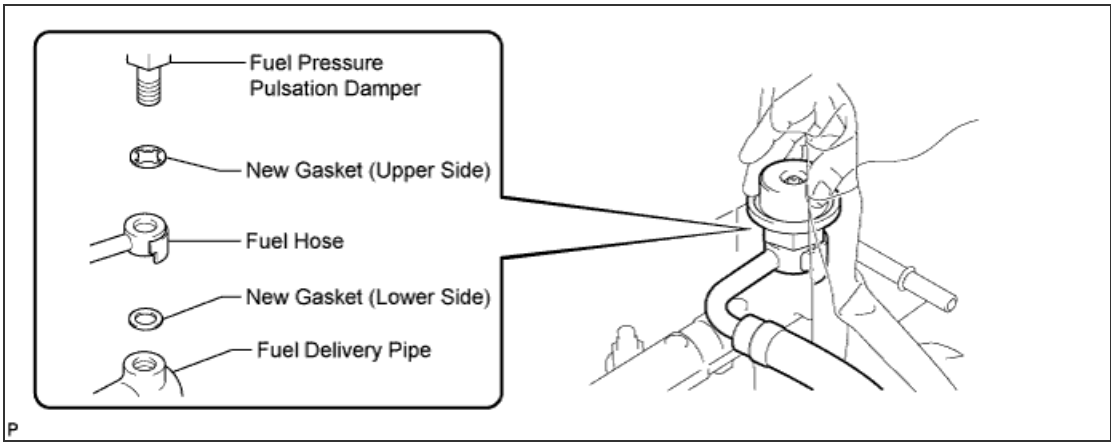
- **Put a cloth or e uivalent under the delivery pipe.**
- **Slowly loosen the pulsation damper.**



for Preparation Click here

1. INSTALL FUEL PRESSURE PULSATION DAMPER ASSEMBLY

a. Install 2 new gaskets and the fuel hose with the fuel pressure pulsation damper.



NOTICE:

Make sure to install the gaskets in the order shown in the illustration, as the shape of the upper side and lower side gaskets is different.

b. Tighten the fuel pressure pulsation damper by hand.

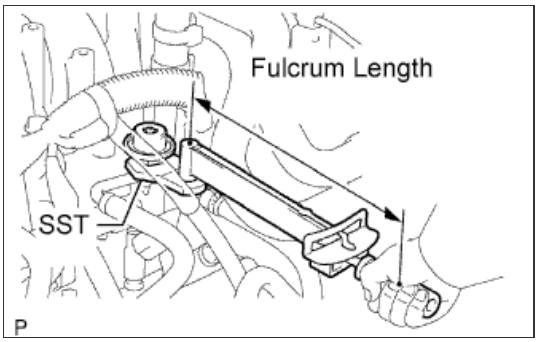
c. Using SST, tighten the union bolt.

SST
09612-24014 (09617-24011)

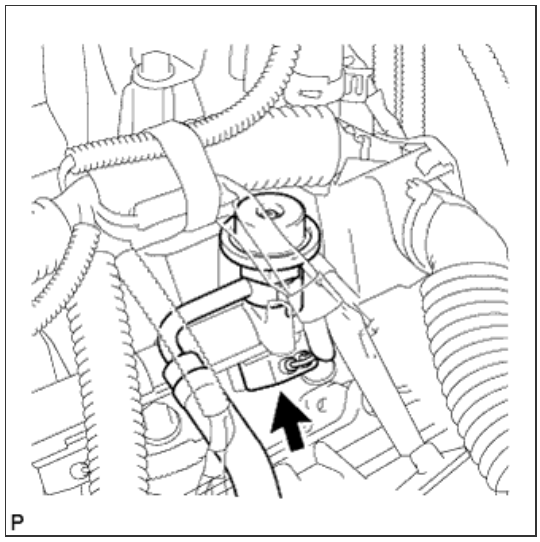
Torque:
with SST:
33 N*m{ 340 kgf*cm , 24 ft.*lbf }
without SST:
39 N*m{ 398 kgf*cm , 29 ft.*lbf }

HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure SST an the wrench are connecte ri a straight line.**



d. Conne t the fuel inje tor onne tor.



2. CONNECT NO. 2 FUEL HOSE

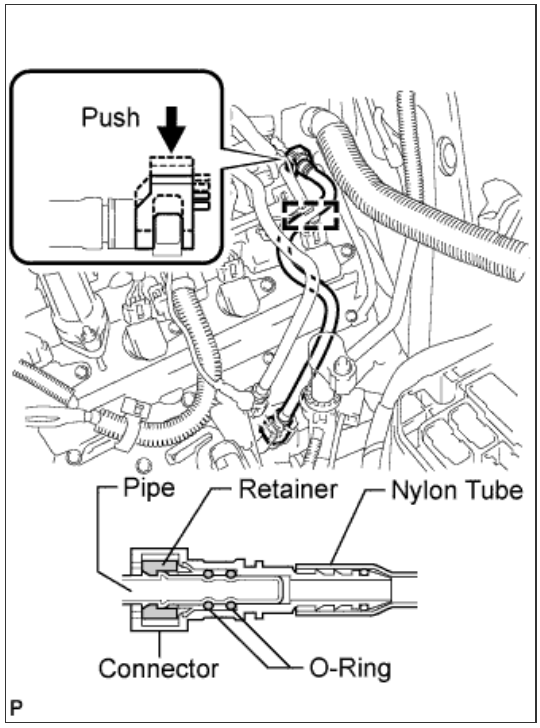
a. Conne t the No. 2 fuel hose to the No. 3 fuel pipe.

HINT:

Push the parts together firmly until a li k sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

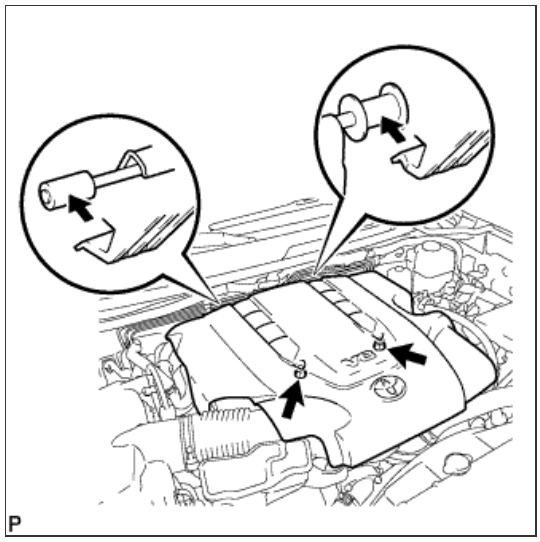


3. INSTALL V-BANK COVER SUB-ASSEMBLY

a. tta h the 2 V-bank over hooks to the bra ket.

b. Install the V-bank over with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



4. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When dis onne ting the able, some systems need to be initialized after the able is re onne ted (Cli k here).

5. INSPECT FOR FUEL LEAK

a. Conne t the intelligent tester to the DLC3.

b. Turn the engine swit h on (IG) and intelligent tester ON.

NOTICE:

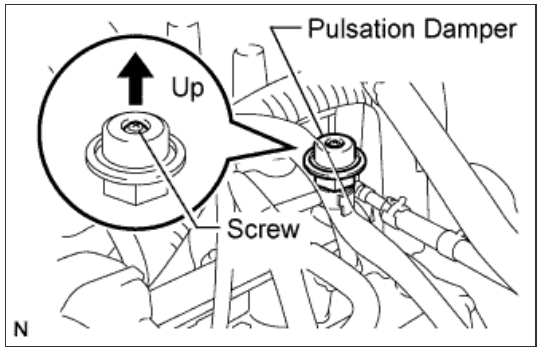
Do not start the engine.

c. nter the following menus: Powertrain / ngine and CT / tive Test / tivate the Fuel Pump Speed Control.

d. Che k that there are no fuel leaks after doing maintenan eanywhere on the fuel system.

e. Che k that the pulsation damper s rew rises up when the fuel pump operates.
If the operation is not as spe ified, he k the following parts:

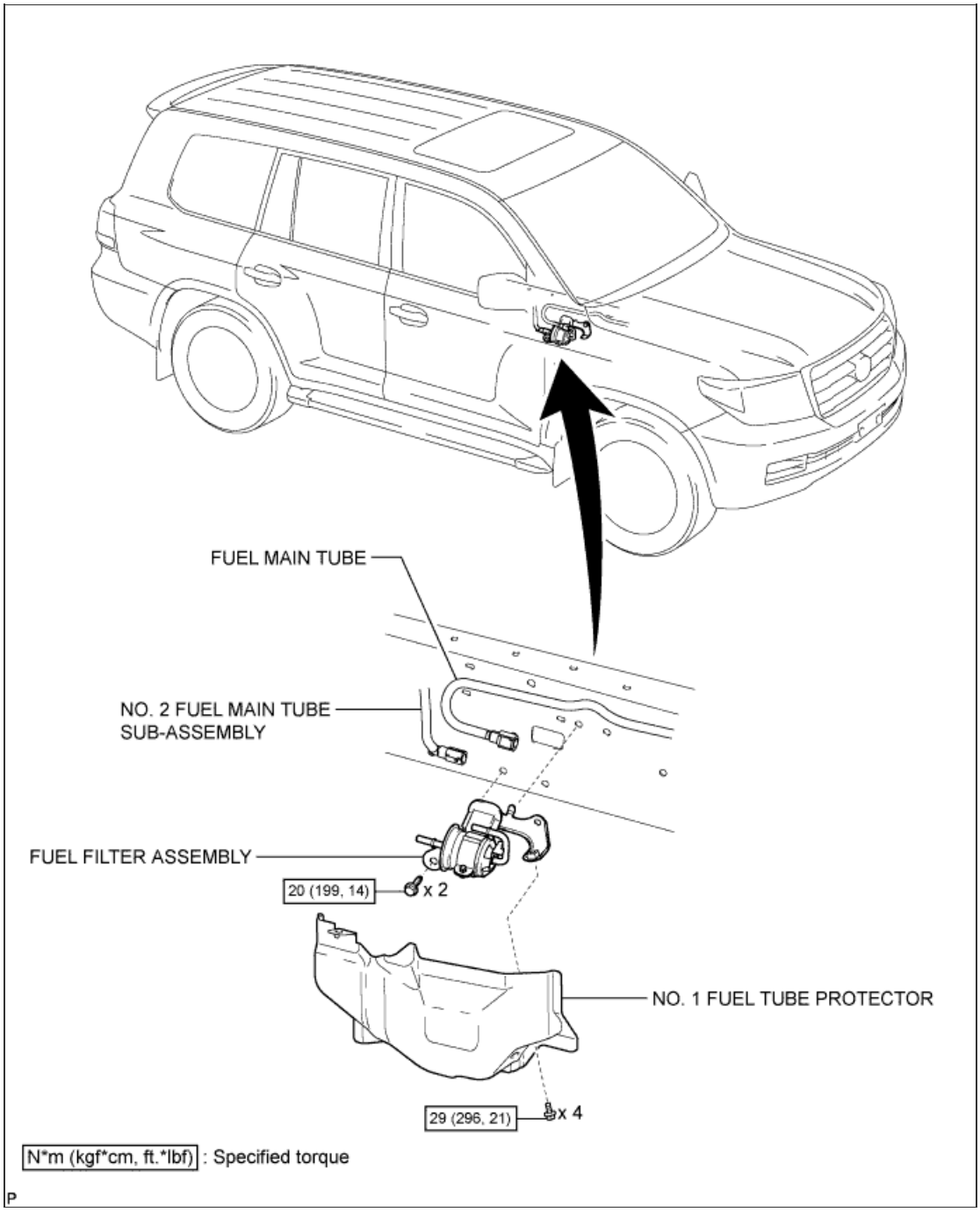
- Fusible link
- Fuses
- Cir uit opening relay (C/OPN)
- Fuel pump
- CM
- Wiring onne tions



f. Turn the engine swit h off.

g. Dis onne t the intelligent tester from the DLC3.

for Preparation [Click here]



for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

a. Discharge the fuel system pressure (Click here).

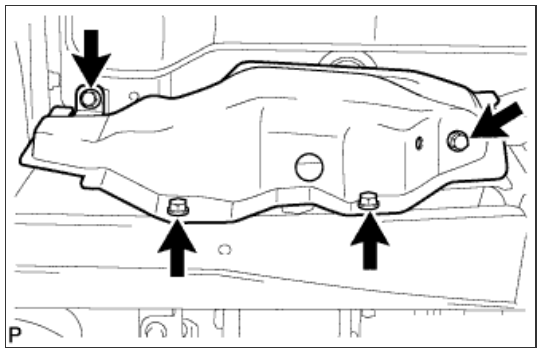
2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE NO. 1 FUEL TUBE PROTECTOR

a. Remove the 4 bolts and No. 1 fuel tube protector.

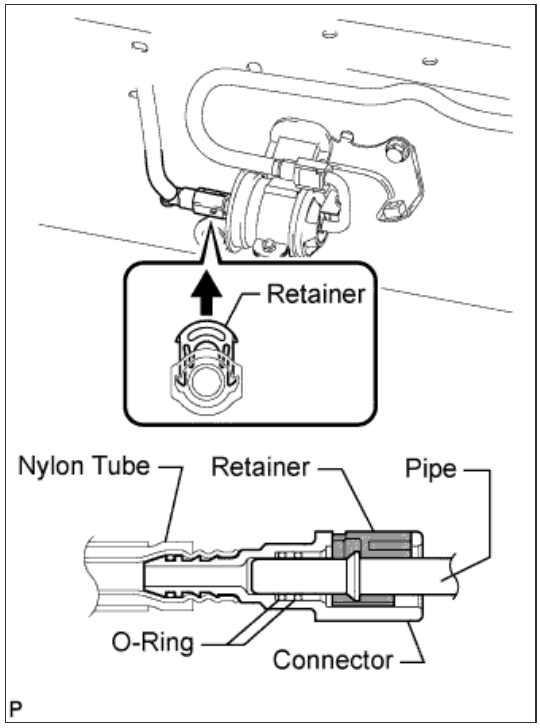


4. DISCONNECT NO. 2 FUEL MAIN TUBE SUB-ASSEMBLY

a. Pull up the retainer and disconnect the No. 2 fuel main tube.

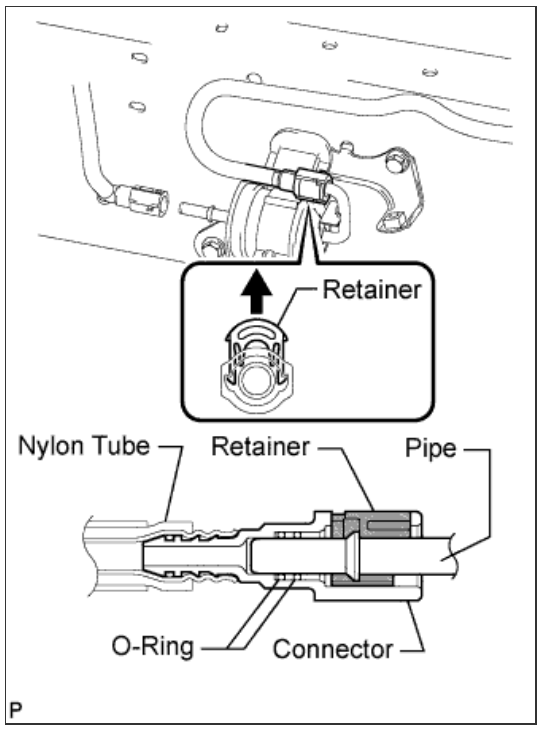
NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



5. DISCONNECT FUEL MAIN TUBE

a. Pull up the retainer and disconnect the fuel main tube.

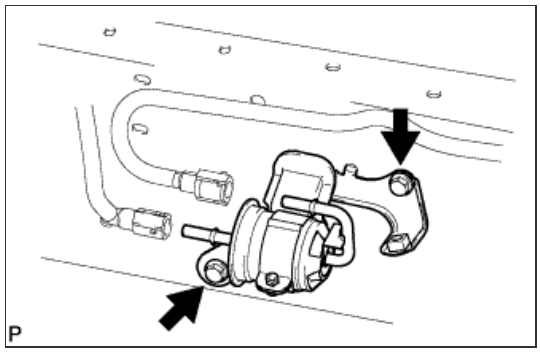


NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**

6. REMOVE FUEL FILTER ASSEMBLY

a. Remove the 2 bolts and fuel filter.



7. INSTALL FUEL FILTER ASSEMBLY

a. Install the fuel filter with the 2 bolts.

Torque:
20 N*m{ 199 kgf*cm , 14 ft.*lbf }

8. CONNECT FUEL MAIN TUBE

a. Connect the fuel main tube and push the retainer.

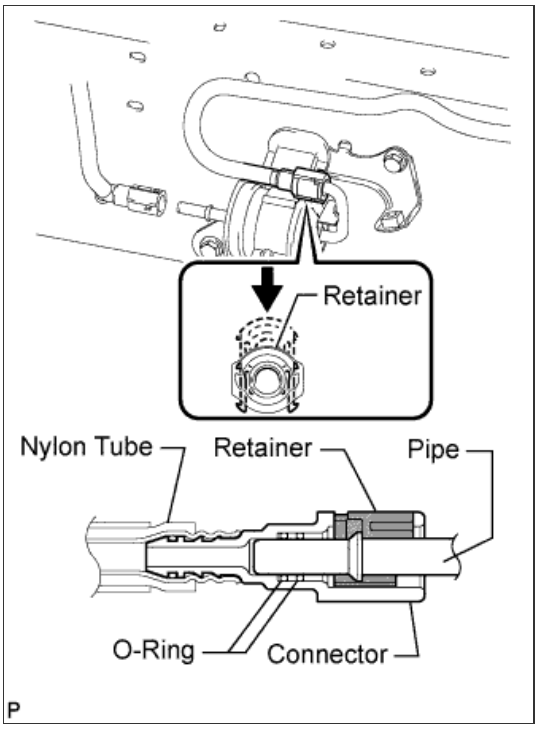
HINT:

Push the parts together firmly until a click sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**

- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**



9. CONNECT NO. 2 FUEL MAIN TUBE SUB-ASSEMBLY

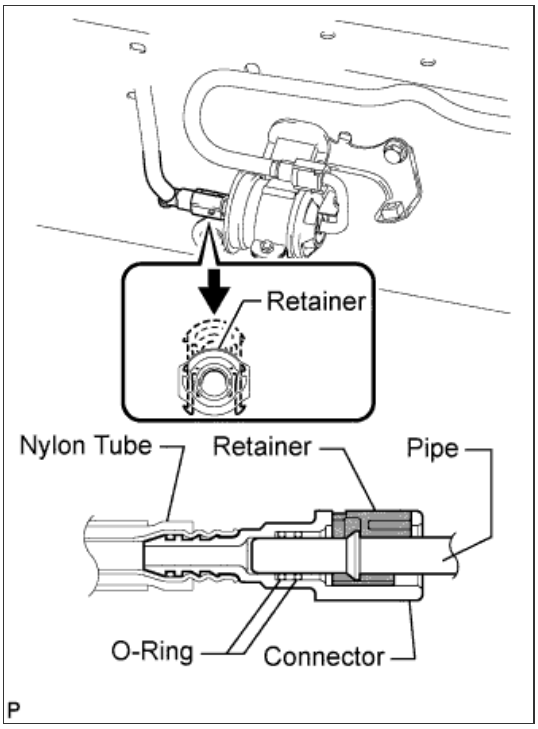
a. Connect the No. 2 fuel main tube and push the retainer.

HINT:

Push the parts together firmly until a click sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**



10. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

11. INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the DLC3.

b. urn the engine switch on (IG) and intelligent tester ON.

NOTICE:

Do not start the engine.

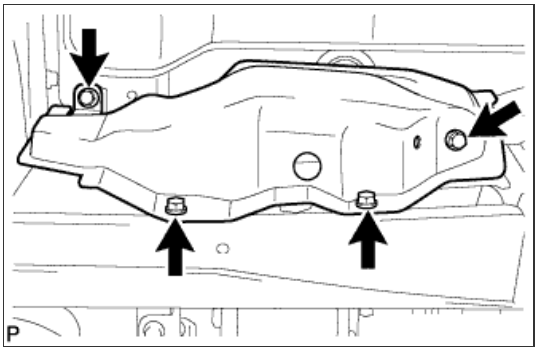
c. Enter the following menus: Powertrain / Engine and EC / Active st / Activate the Fuel Pump Speed Control.

d. Check that there are no fuel leaks after doing maintenance anywhere on the fuel system.

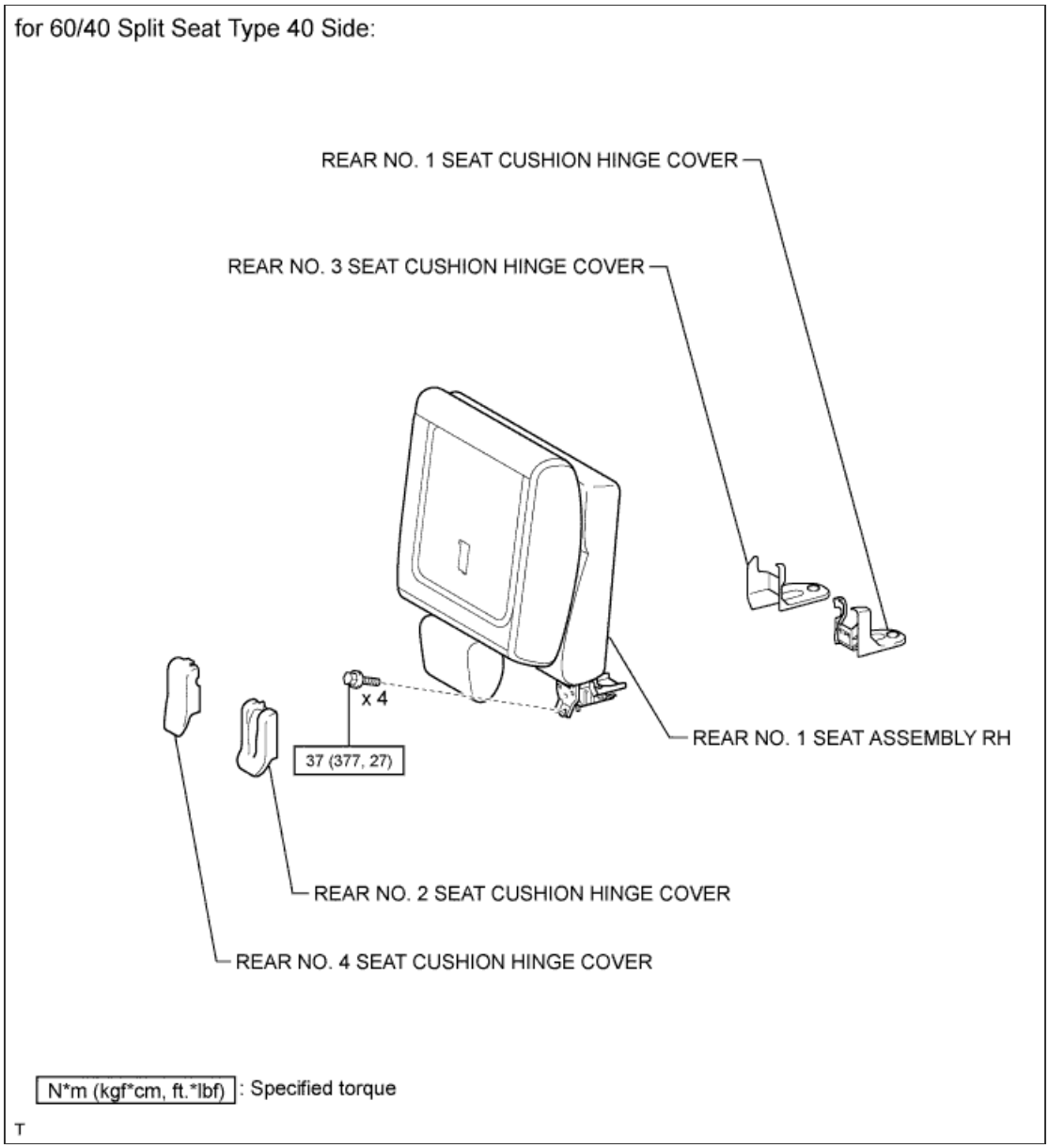
12. INSTALL NO. 1 FUEL TUBE PROTECTOR

a. Install the No. 1 fuel tube protector with the 4 bolts.

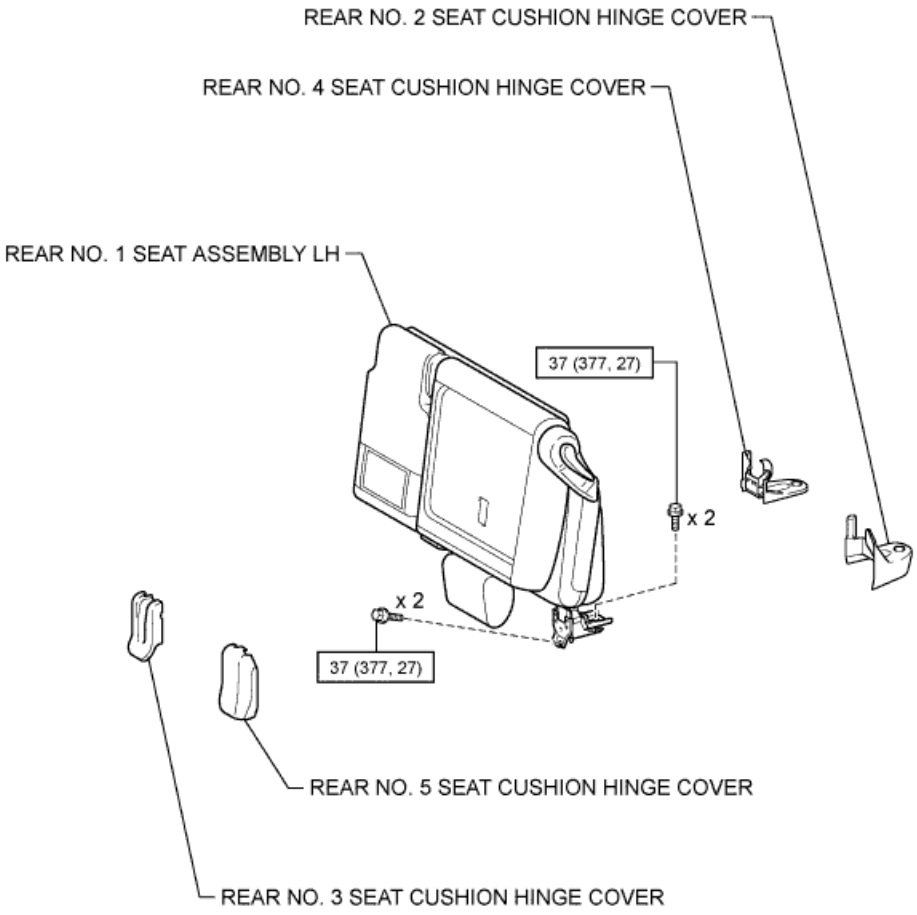
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



for Preparation Click here



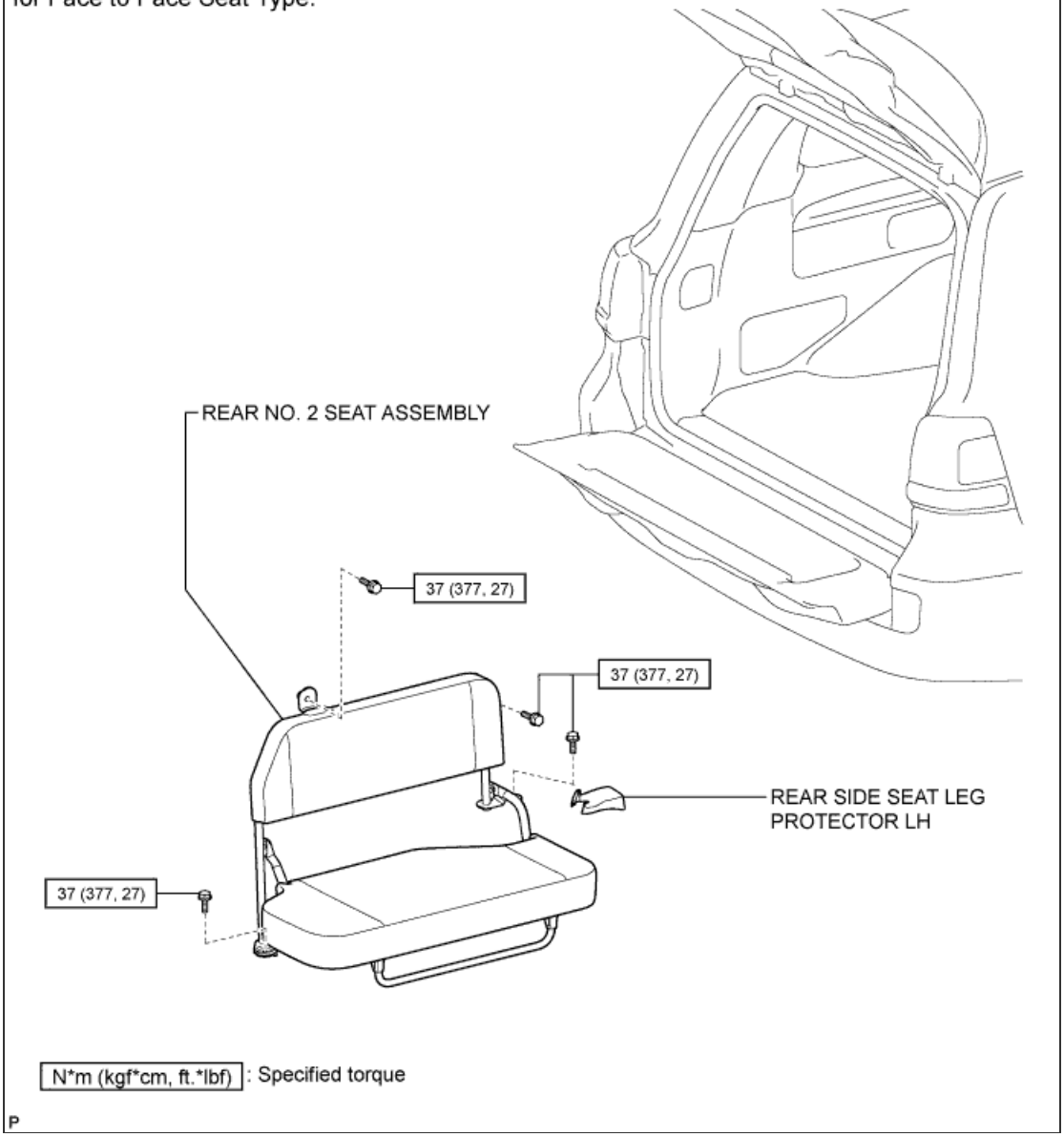
for 60/40 Split Seat Type 60 Side:



N*m (kgf*cm, ft.*lbf) : Specified torque

T

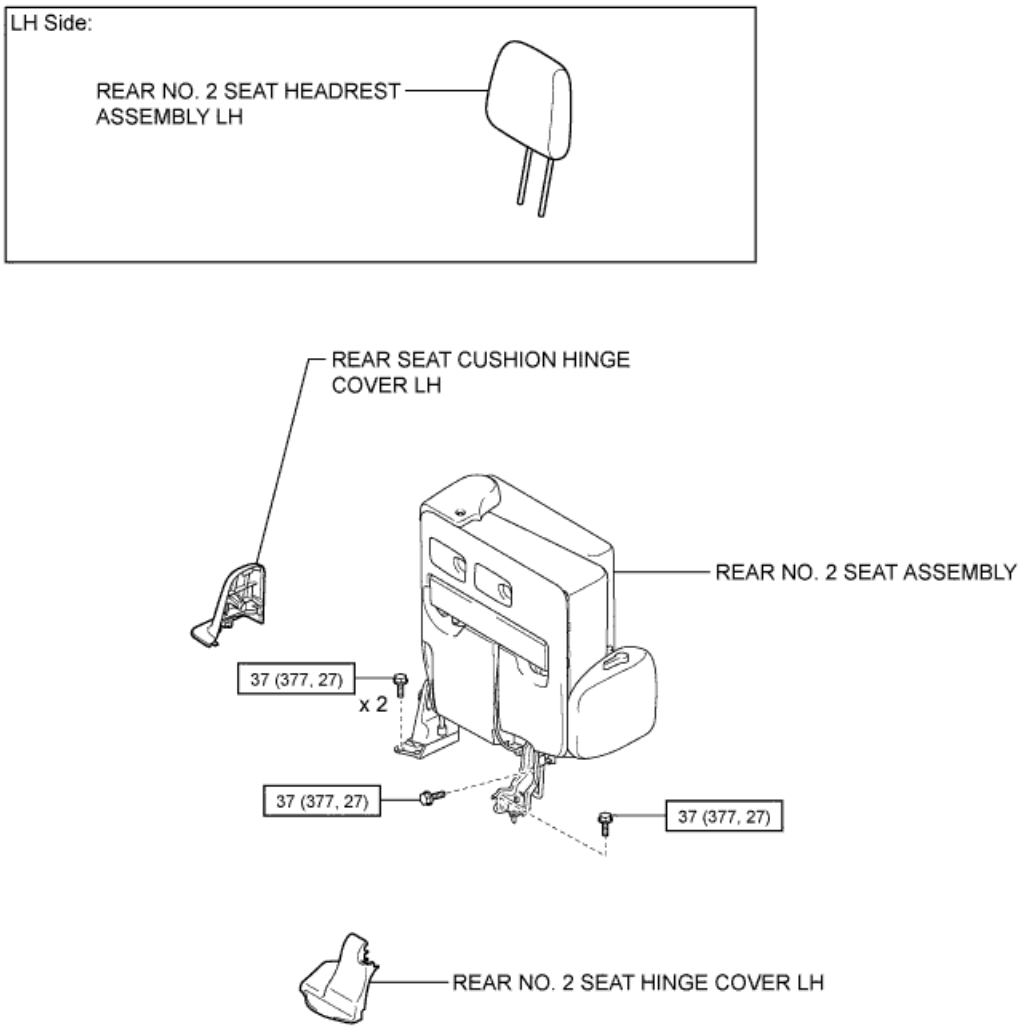
for Face to Face Seat Type:



N*m (kgf*cm, ft.*lbf) : Specified torque

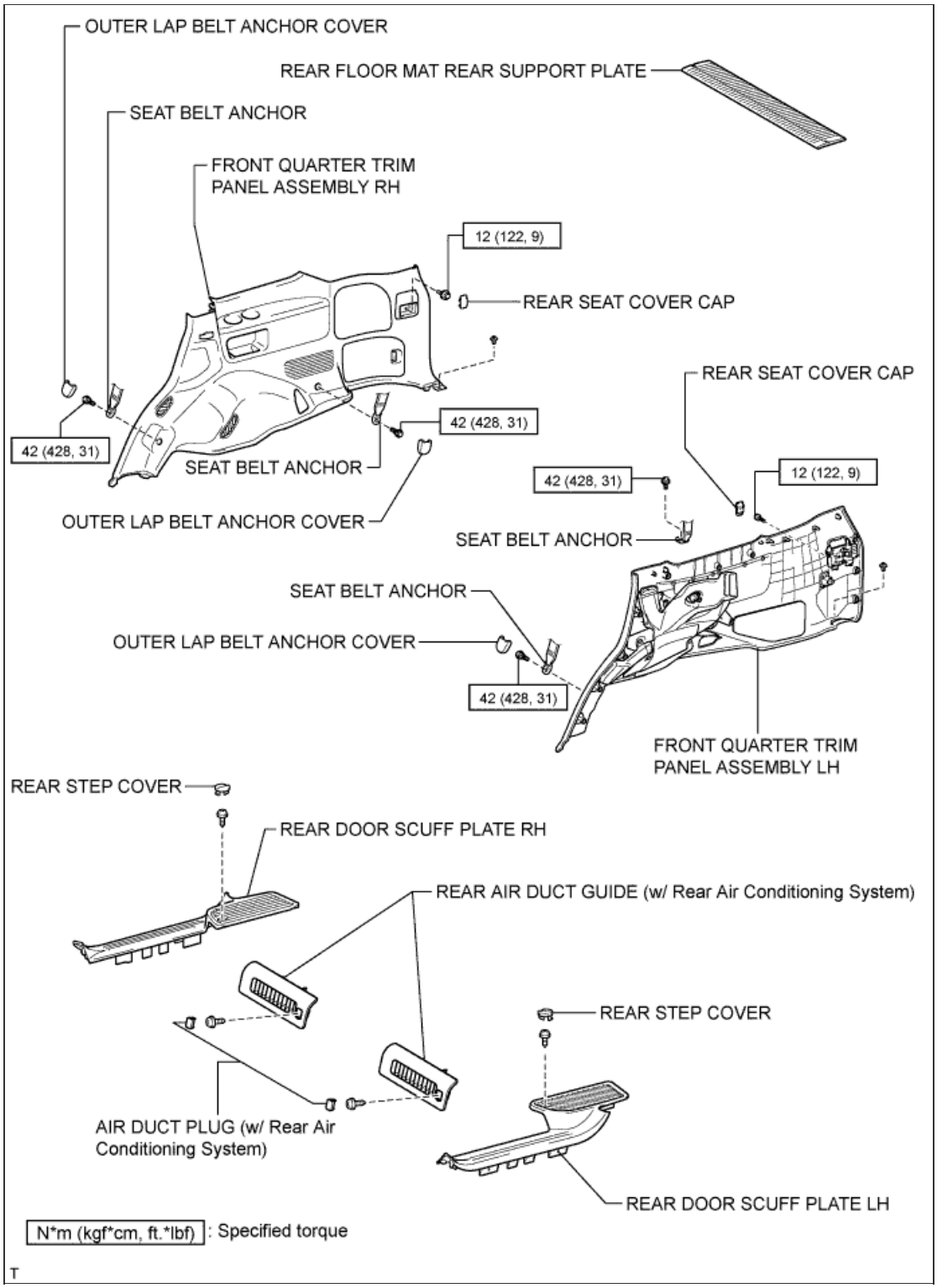
P

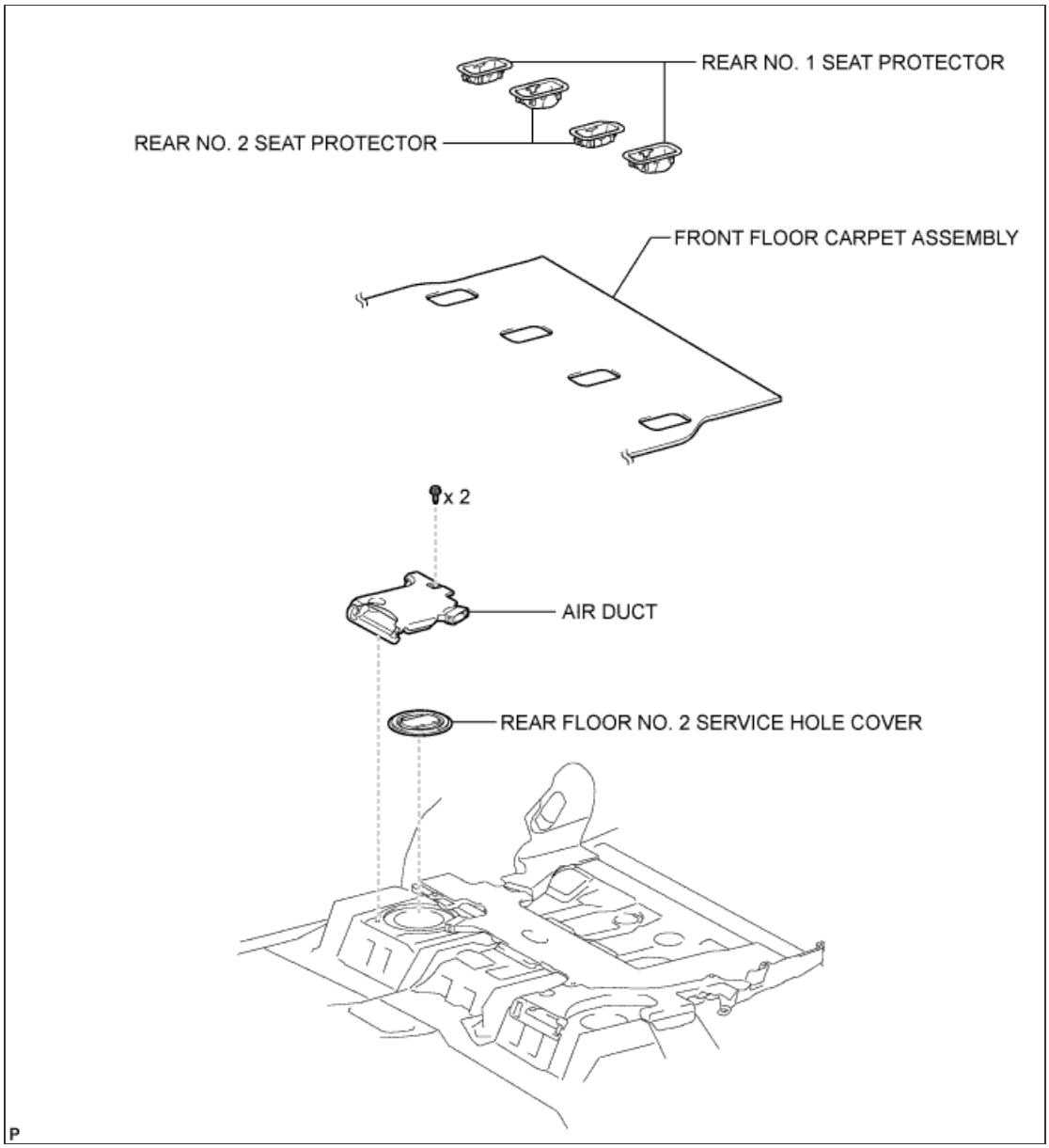
except Face to Face Seat Type:

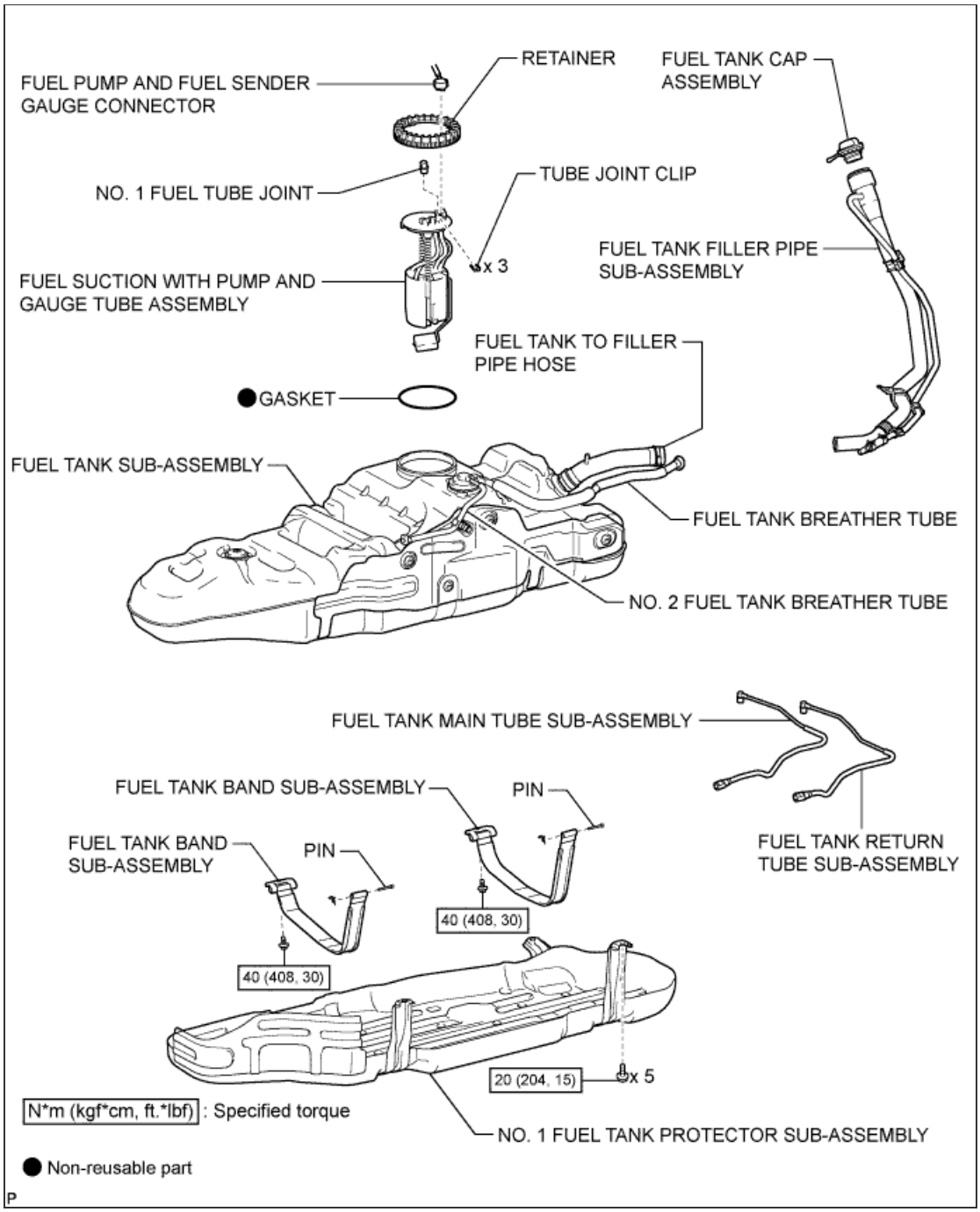


N*m (kgf*cm, ft.*lbf) : Specified torque

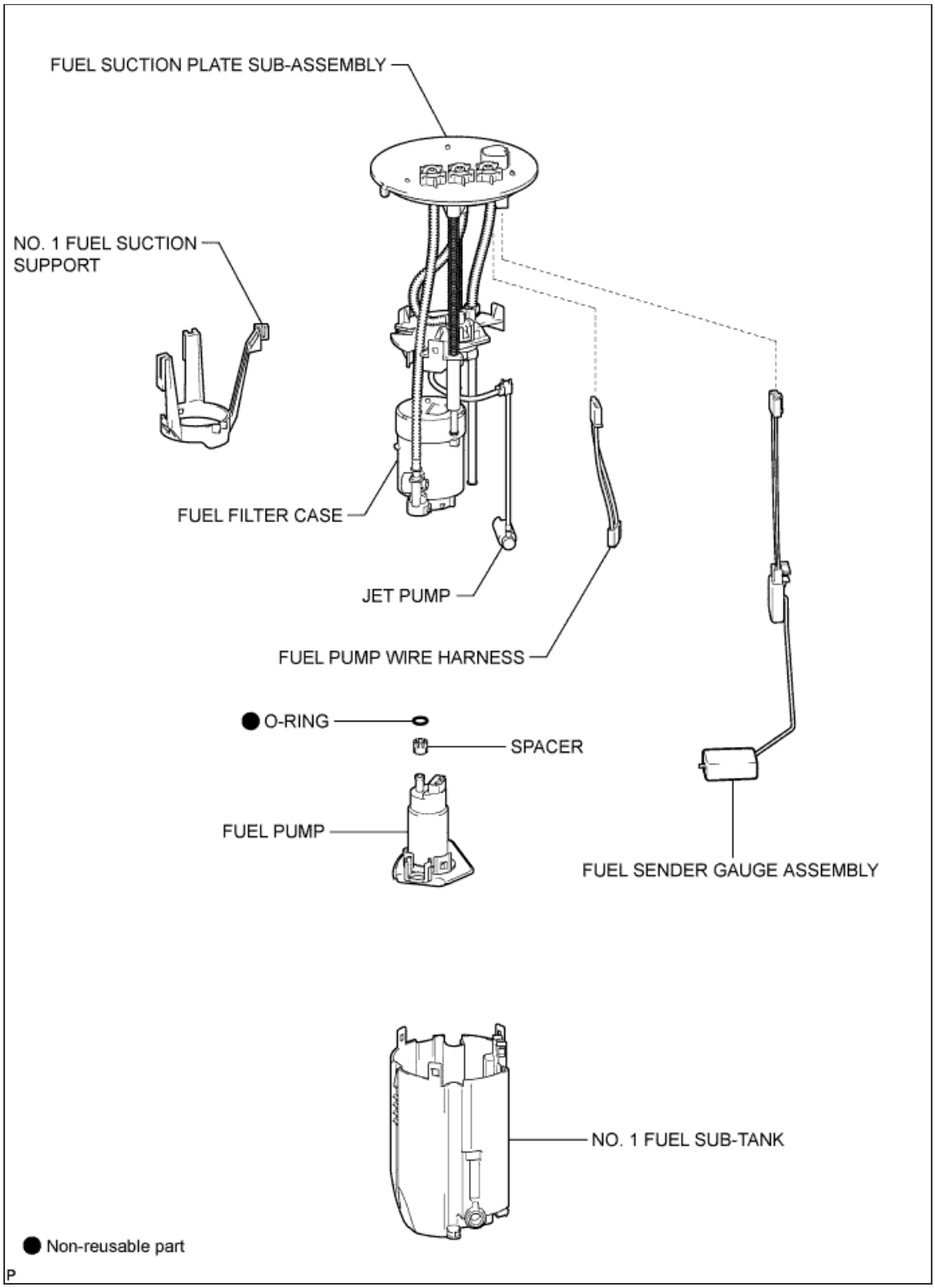
P


OUTER LAP BELT ANCHOR COVER
REAR FLOOR MAT REAR SUPPORT PLATE
SEAT BELT ANCHOR
FRONT QUARTER TRIM PANEL ASSEMBLY RH
12 (122, 9)
REAR SEAT COVER CAP
42 (428, 31)
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
REAR SEAT COVER CAP
42 (428, 31)
12 (122, 9)
SEAT BELT ANCHOR
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
42 (428, 31)
FRONT QUARTER TRIM PANEL ASSEMBLY LH
REAR STEP COVER
REAR DOOR SCUFF PLATE RH
REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)
REAR STEP COVER
AIR DUCT PLUG (w/ Rear Air Conditioning System)
REAR DOOR SCUFF PLATE LH
N*m (kgf*cm, ft.*lbf) : Specified torque
T


REAR NO. 1 SEAT PROTECTOR
REAR NO. 2 SEAT PROTECTOR
FRONT FLOOR CARPET ASSEMBLY
x 2
AIR DUCT
REAR FLOOR NO. 2 SERVICE HOLE COVER
P


FUEL PUMP AND FUEL SENDER GAUGE CONNECTOR
RETAINER
FUEL TANK CAP ASSEMBLY
NO. 1 FUEL TUBE JOINT
TUBE JOINT CLIP
x 3
FUEL TANK FILLER PIPE SUB-ASSEMBLY
FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY
FUEL TANK TO FILLER PIPE HOSE
GASKET
FUEL TANK SUB-ASSEMBLY
FUEL TANK BREATHER TUBE
NO. 2 FUEL TANK BREATHER TUBE
FUEL TANK MAIN TUBE SUB-ASSEMBLY
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TANK RETURN TUBE SUB-ASSEMBLY
40 (408, 30)
40 (408, 30)
20 (204, 15)
x 5
N*m (kgf*cm, ft.*lbf) : Specified torque
NO. 1 FUEL TANK PROTECTOR SUB-ASSEMBLY
Non-reusable part

P


FUEL SUCTION PLATE SUB-ASSEMBLY
NO. 1 FUEL SUCTION SUPPORT
FUEL FILTER CASE
JET PUMP
FUEL PUMP WIRE HARNESS
O-RING
SPACER
FUEL PUMP
FUEL SENDER GAUGE ASSEMBLY
NO. 1 FUEL SUB-TANK
Non-reusable part
P

for Preparation Click here

1. REMOVE FUEL TANK SUB-ASSEMBLY

a. Remove the fuel tank sub-assembly (Click here).

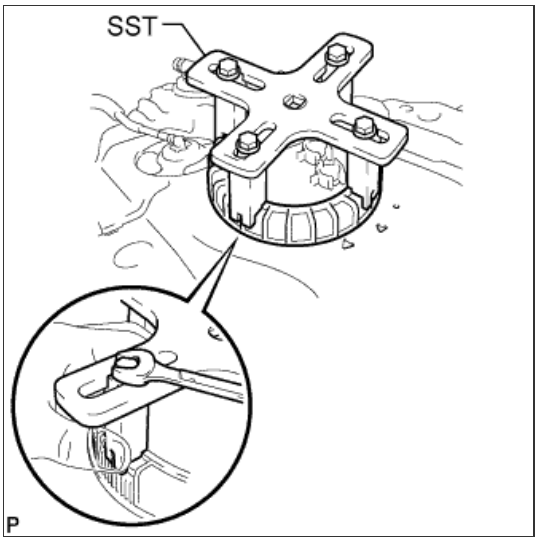
2. REMOVE FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

a. Set SST on the retainer.

SST
09808-14030

HINT:

- **Securely attach the claws of SST to the protrusion of the retainer and fix SST in place.**
- **Install SST while pressing the claws of SST against the retainer (towards the center of SST).**



b. Using SST, loosen the retainer.

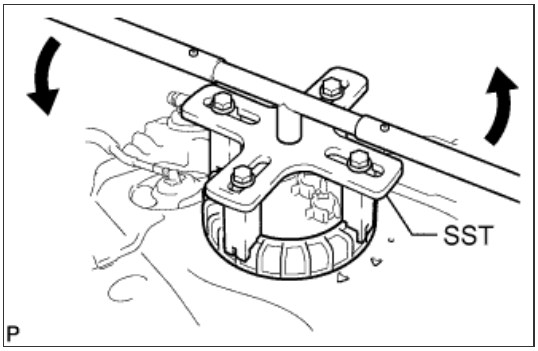
SST
09808-14030

NOTICE:

- **Do not use any tools other than those specified in this operation. Damage to the retainer or the fuel tank may result.**
- **While pressing down on SST so that the claws of SST do not slip off the protrusion of the retainer, turn the retainer counterclockwise to loosen it.**

HINT:

The protrusion of the retainer fit in the ends of SST.



Text in Illustration

➡	Turn

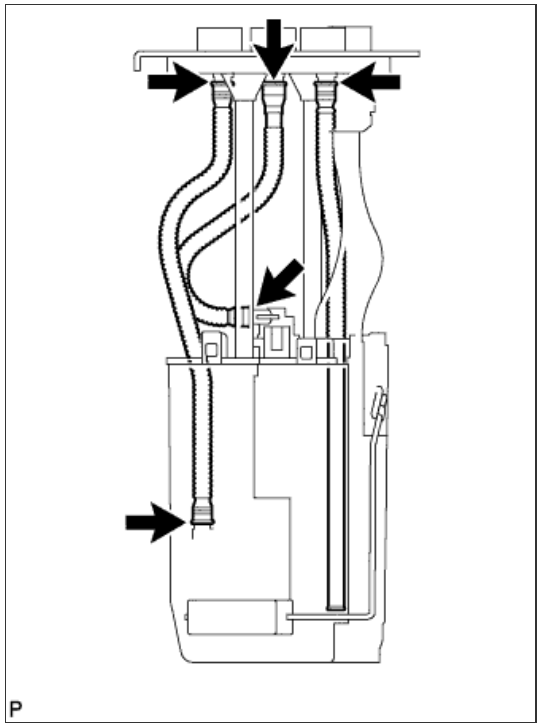
c. Remove the retainer while holding the fuel suction tube assembly by hand.

d. Remove the gasket from the fuel tank.

for Preparation Click here

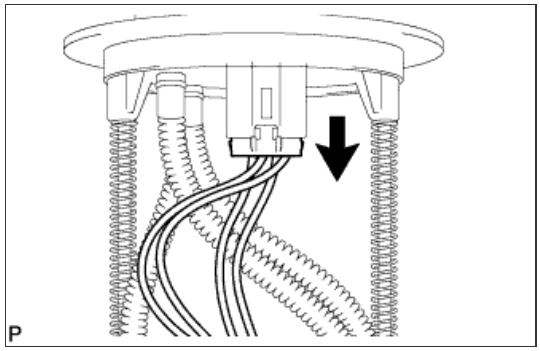
NOTICE:

Do not disconnect the hoses indicated in the illustration.

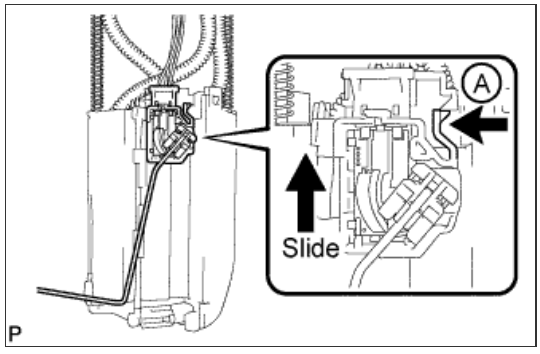


1. REMOVE FUEL SENDER GAUGE ASSEMBLY

a. Disconnect the fuel sender gauge connector.

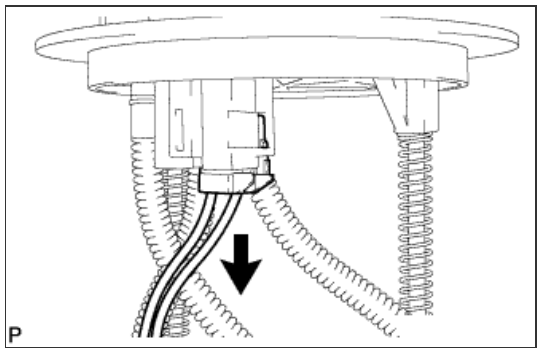


b. Press down on the sender gauge claw labeled A. Then slide the sender gauge upward to remove it.



2. REMOVE NO. 1 FUEL SUB-TANK

a. Disconnect the fuel pump connector.

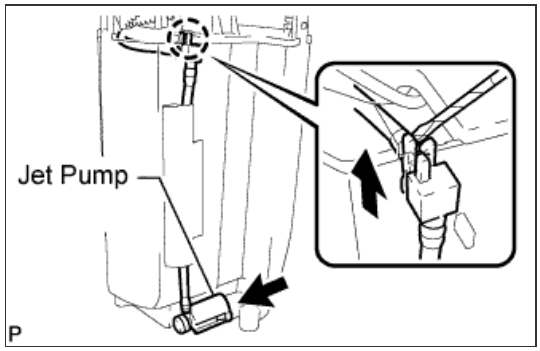


b. Disconnect the jet pump from the sub-tank.

c. Using a small screwdriver, detach the claw from the sub-tank.

HINT:

Tape the screwdriver tip before use.



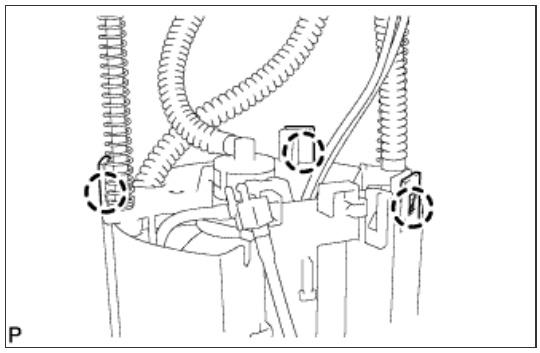
d. Using a screwdriver, detach the 3 claws from the claw holes.

NOTICE:

Do not damage the fuel sub-tank.

HINT:

Tape the screwdriver tip before use.



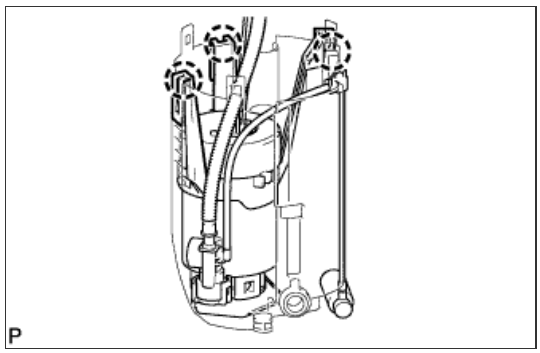
e. Using a screwdriver, detach the 3 claws from the claw holes.

NOTICE:

Do not damage the fuel sub-tank.

HINT:

Tape the screwdriver tip before use.

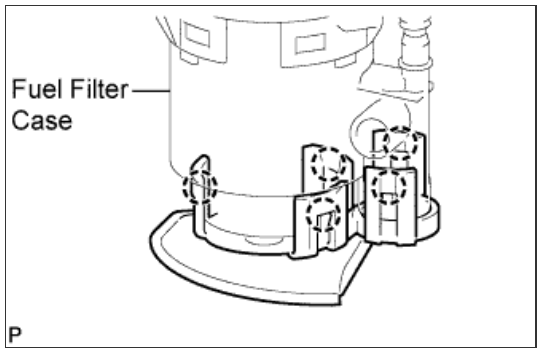


3. REMOVE FUEL PUMP

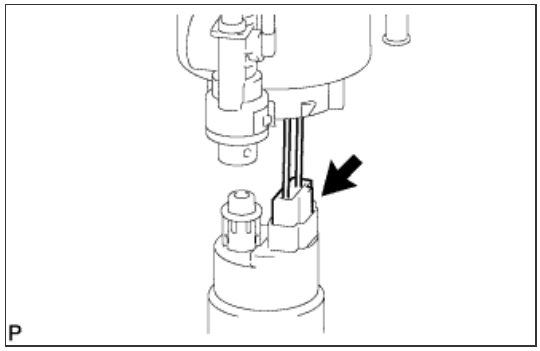
a. Using a screwdriver, detach the 5 claws from the claw holes and disconnect the fuel pump from the fuel filter case.

HINT:

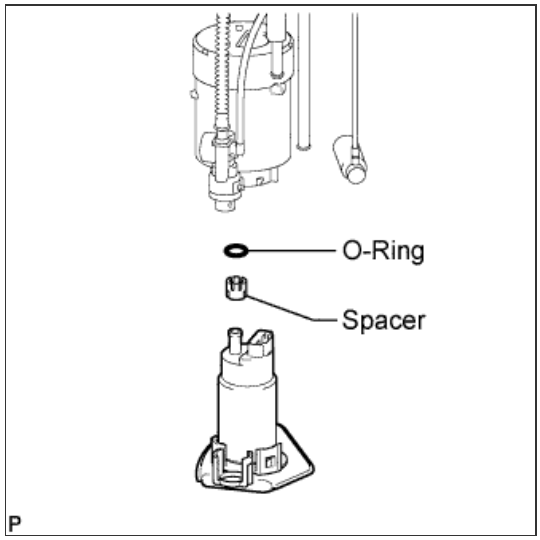
Tape the screwdriver tip before use.



b. Disconnect the fuel pump wire harness connector from the fuel pump to remove it.

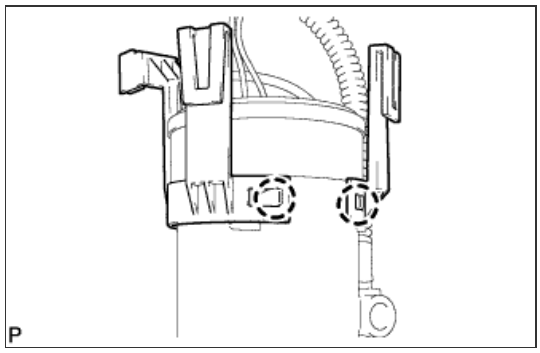


c. Remove the O-ring and spacer from the fuel pump.



4. REMOVE NO. 1 FUEL SUCTION SUPPORT

a. Detach the 2 claws from the claw holes to remove the fuel suction support.



for Preparation Click here

1. INSPECT FUEL PUMP

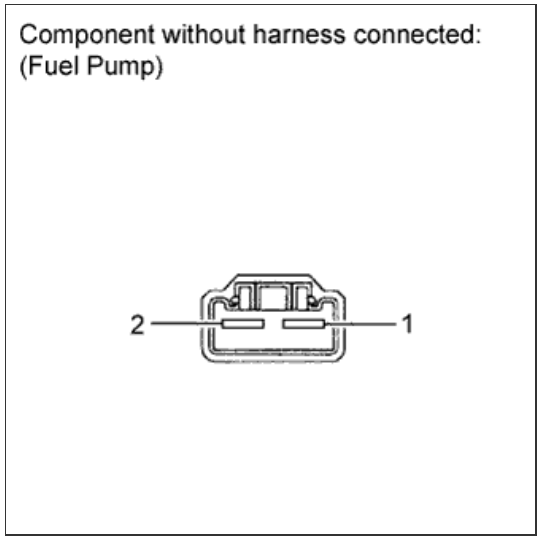
a. Inspect the resistance of the fuel pump.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	0.2 to 3.0 Ω

If the result is not as specified, replace the fuel pump.

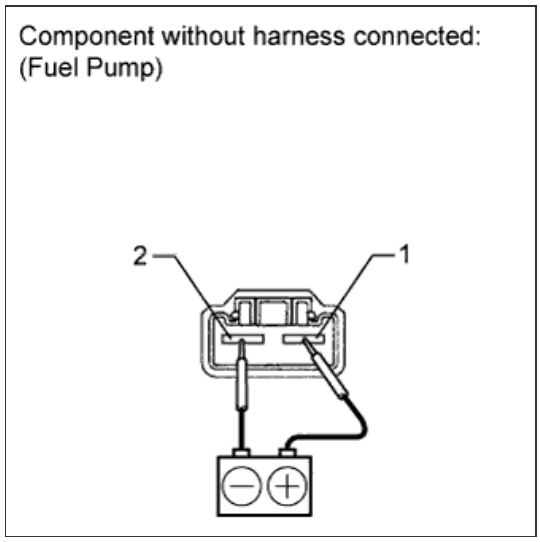


b. Inspect the operation of the fuel pump.

i. Connect the battery's positive (+) lead to terminal 1 of the connector, and the negative (-) lead to terminal 2. Check that the fuel pump operates.
If the result is not as specified, replace the fuel pump and fuel pump ECU.

NOTICE:

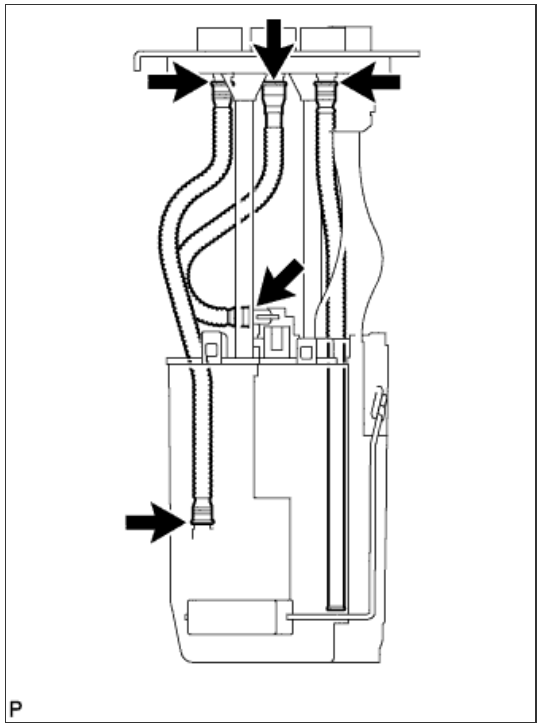
- **These tests must be performed thin 10 seconds to prevent the coil from burning out.**
- **eep the fuel pump as far a ay fro the battery as possible.**
- **I ay turn the voltage on and off on the battery side, not the fuel pump side.**
- **When the pump is locked and does not operate due to foreign matter being stuck, etc., replace the fuel pump ECU together th the fuel pump, as the fuel pump ECU may be damaged electrically.**



for Preparation Click here

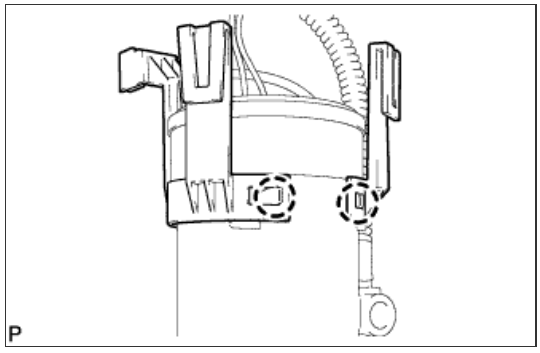
NOTICE:

Do not disconnect the hoses indicated in the illustration.



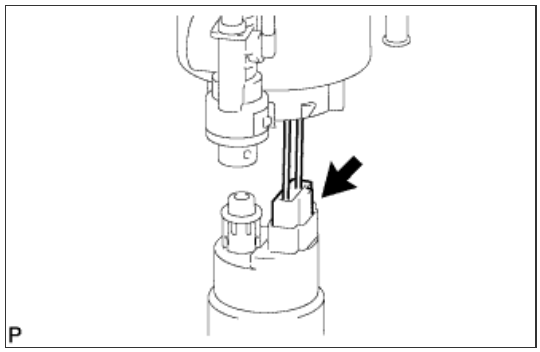
1. INSTALL NO. 1 FUEL SUCTION SUPPORT

a. Attach the 2 claws to the claw holes to install the fuel suction support.

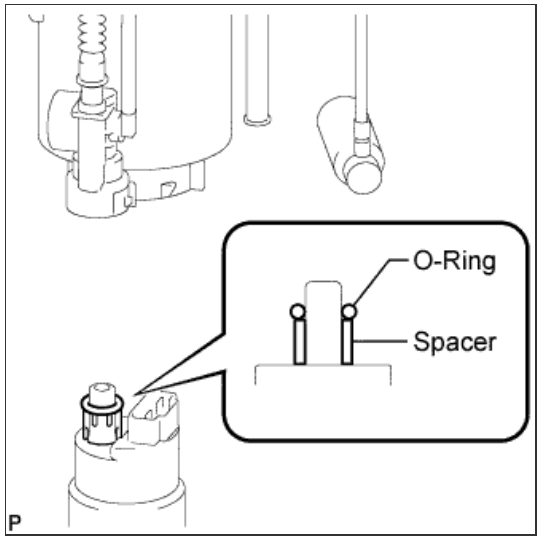


2. INSTALL FUEL PUMP

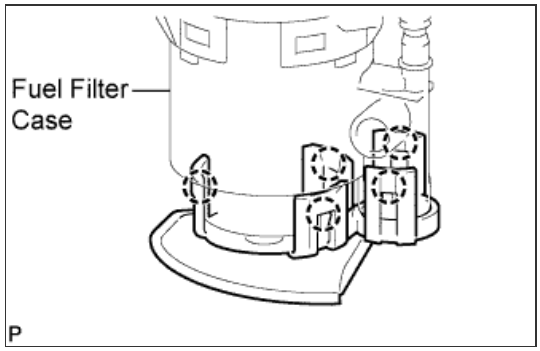
a. Connect the fuel pump wire harness connector to the fuel pump.



b. Apply a light coat of gasoline to a new ring. Then install the spacer and ring to the fuel pump.



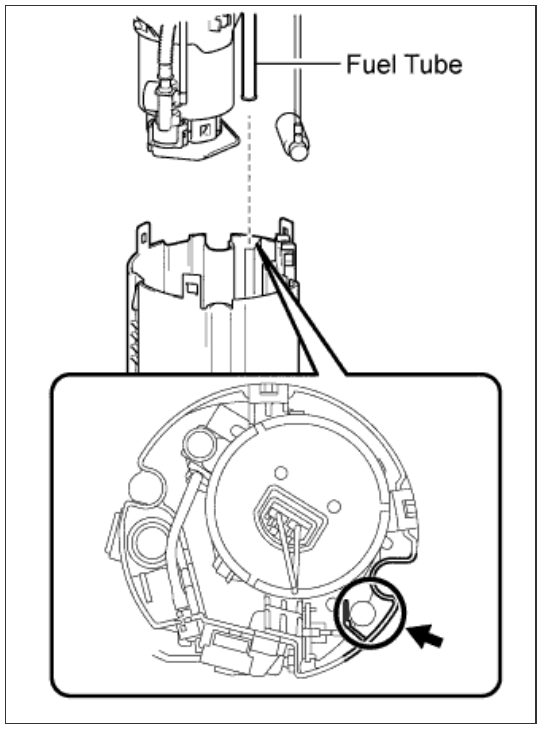
c. Attach the 5 claws to the claw holes and install the fuel pump to the fuel filter case.



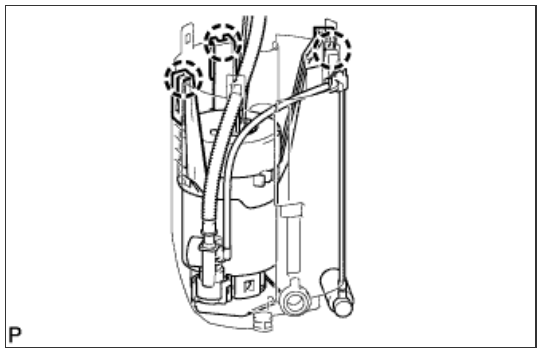
3. INSTALL NO. 1 FUEL SUB-TANK

NOTICE:

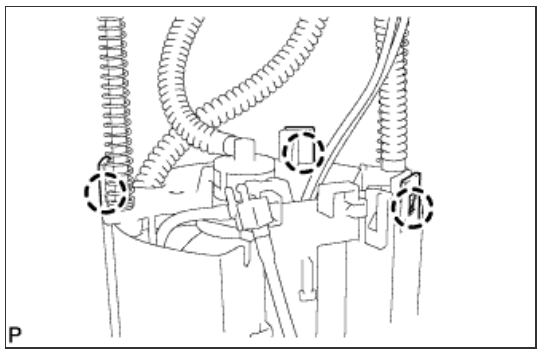
Make sure that the fuel tube passes into the section marked by the circle.



a. Attach the 3 claws to the claw holes and install the fuel sub-tank.



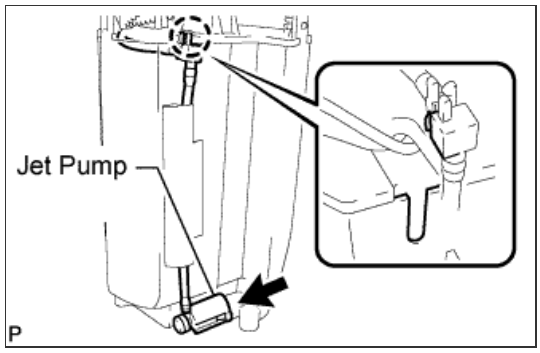
b. Attach the 3 claws to the claw holes.



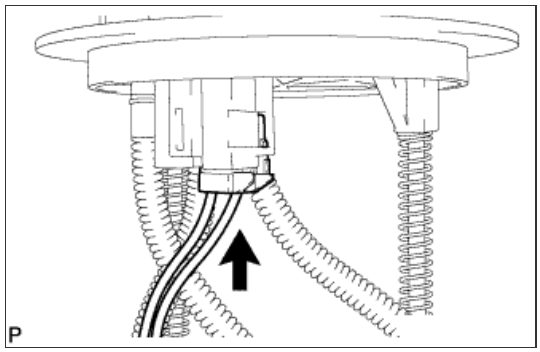
c. Install the tube part to the sub-tank.

i. Attach the claw on the end of the tube to the claw hole. Install the tube to the 2 clamps on the sub-tank.

d. Connect the jet pump to the sub-tank.

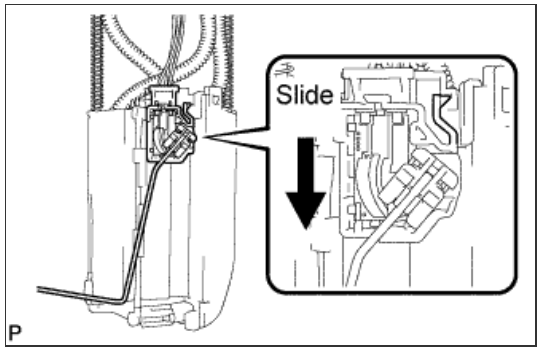


e. Connect the fuel pump connector.

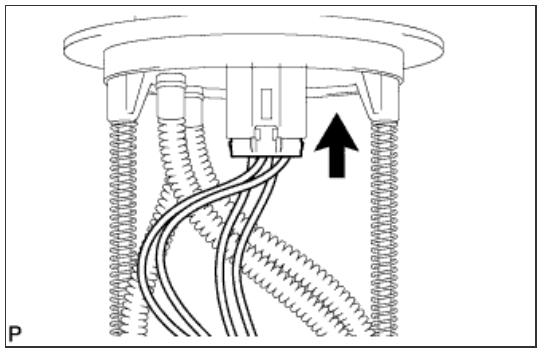


4. INSTALL FUEL SENDER GAUGE ASSEMBLY

a. Set the sender gauge to the fuel sub-tank. Then slide the sender gauge downward to install it.



b. Connect the fuel sender gauge connector.



for Preparation Click here

1. INSTALL FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

a. Apply a light coat of gasoline or grease to a new gasket, and install it to the fuel tank.

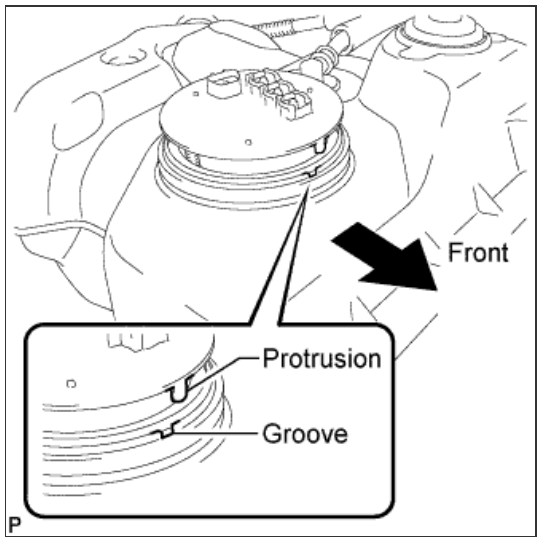
b. Install the fuel suction with pump and gauge tube into the fuel tank.

NOTICE:

Be careful not to bend the arm of the fuel sender gauge.

HINT:

Align the protrusion of the fuel suction with pump and gauge tube with the groove of the fuel tank.



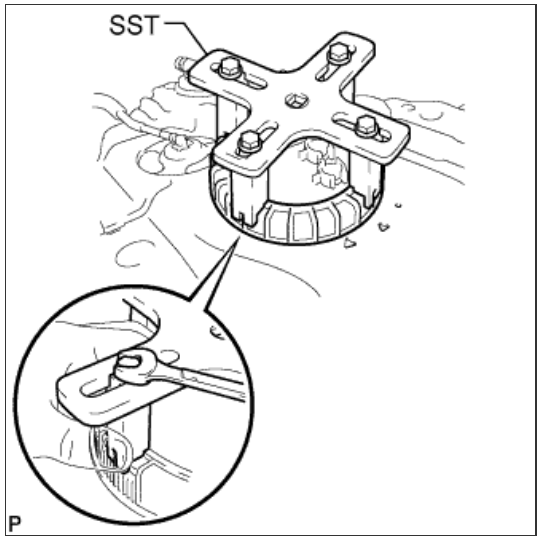
c. Put the retainer on the fuel tank. While holding the fuel suction with pump and gauge tube, tighten the retainer one complete turn by hand.

d. Set SST on the retainer.

SST
09808-14030

HINT:

- **Hold the fuel suction tube assembly upright by hand to ensure that the fuel suction tube gasket is not moved out of position.**
- **Securely attach the claws of SST to the protrusions of the retainer and fix SST in place.**
- **Install SST while pressing the claws of SST against the retainer (toward the center of SST).**

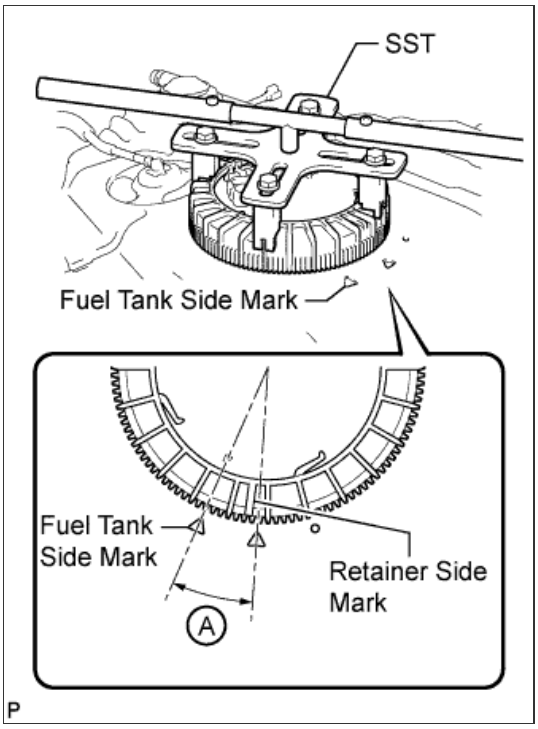


e. Using SST, tighten the retainer until the mark on the retainer is within range A on the fuel tank as shown in the illustration.

SST
09808-14030

HINT:

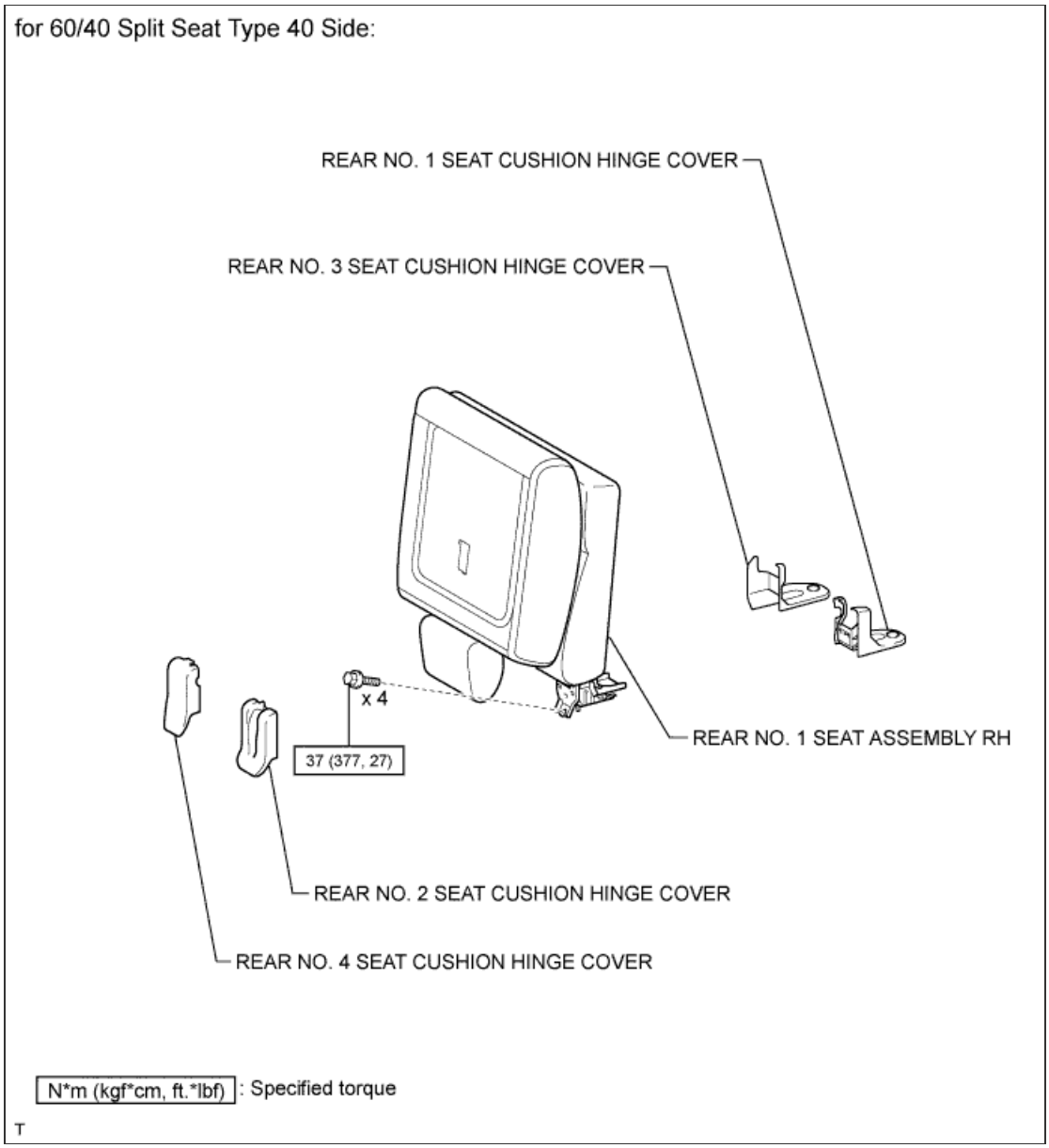
Fit the tips of SST onto the ribs of the retainer.



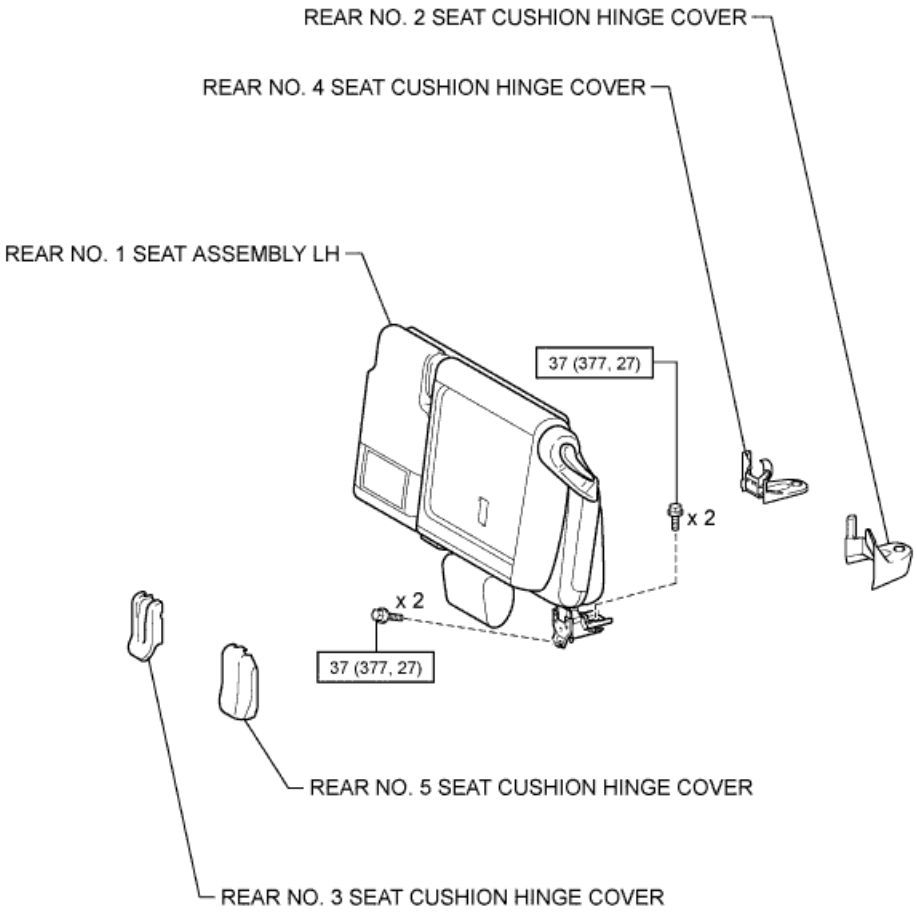
2. INSTALL FUEL TANK SUB-ASSEMBLY

a. Install the fuel tank sub-assembly (Click here).

for Preparation [Click here]



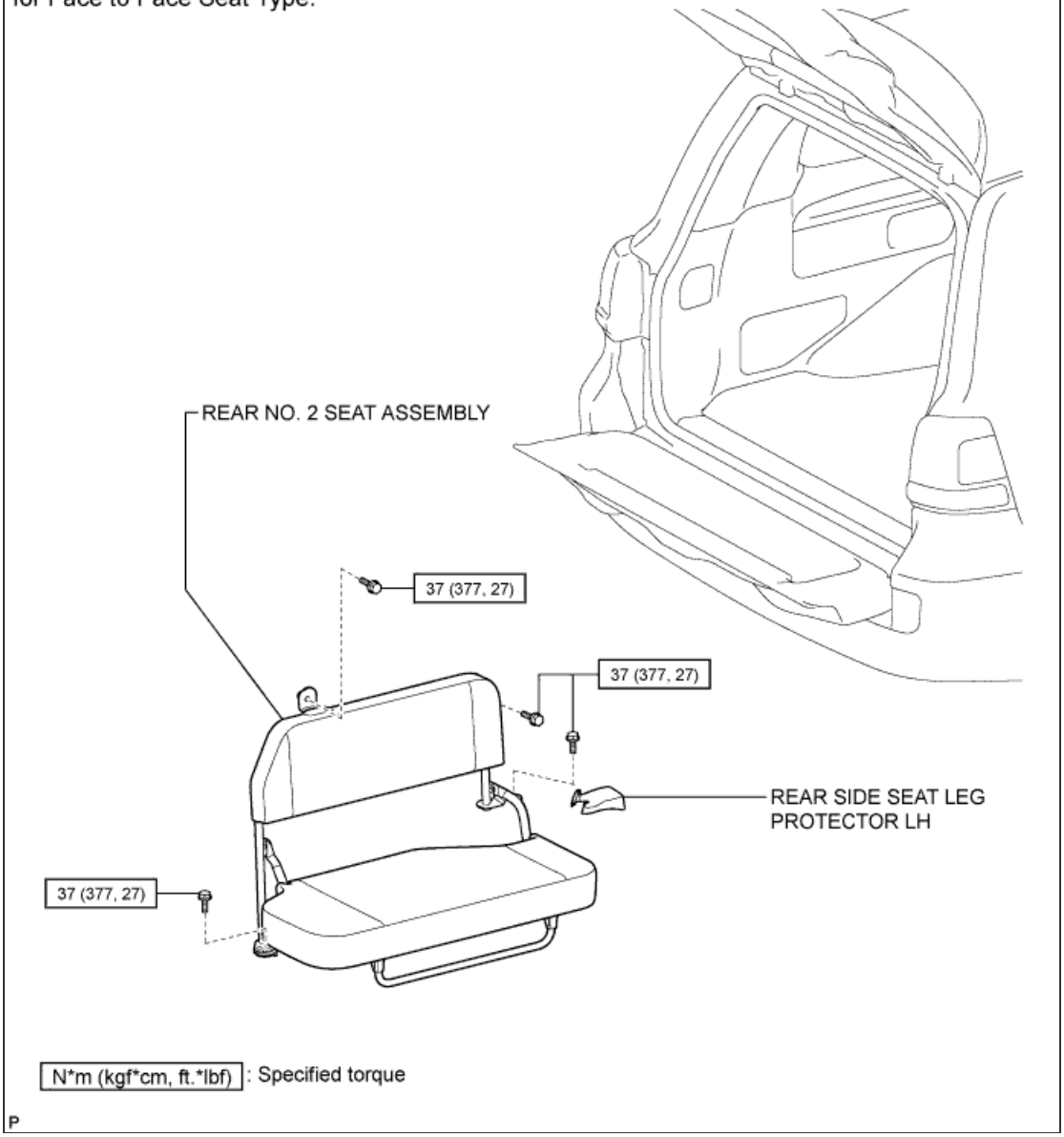
for 60/40 Split Seat Type 60 Side:



N*m (kgf*cm, ft.*lbf) : Specified torque

T

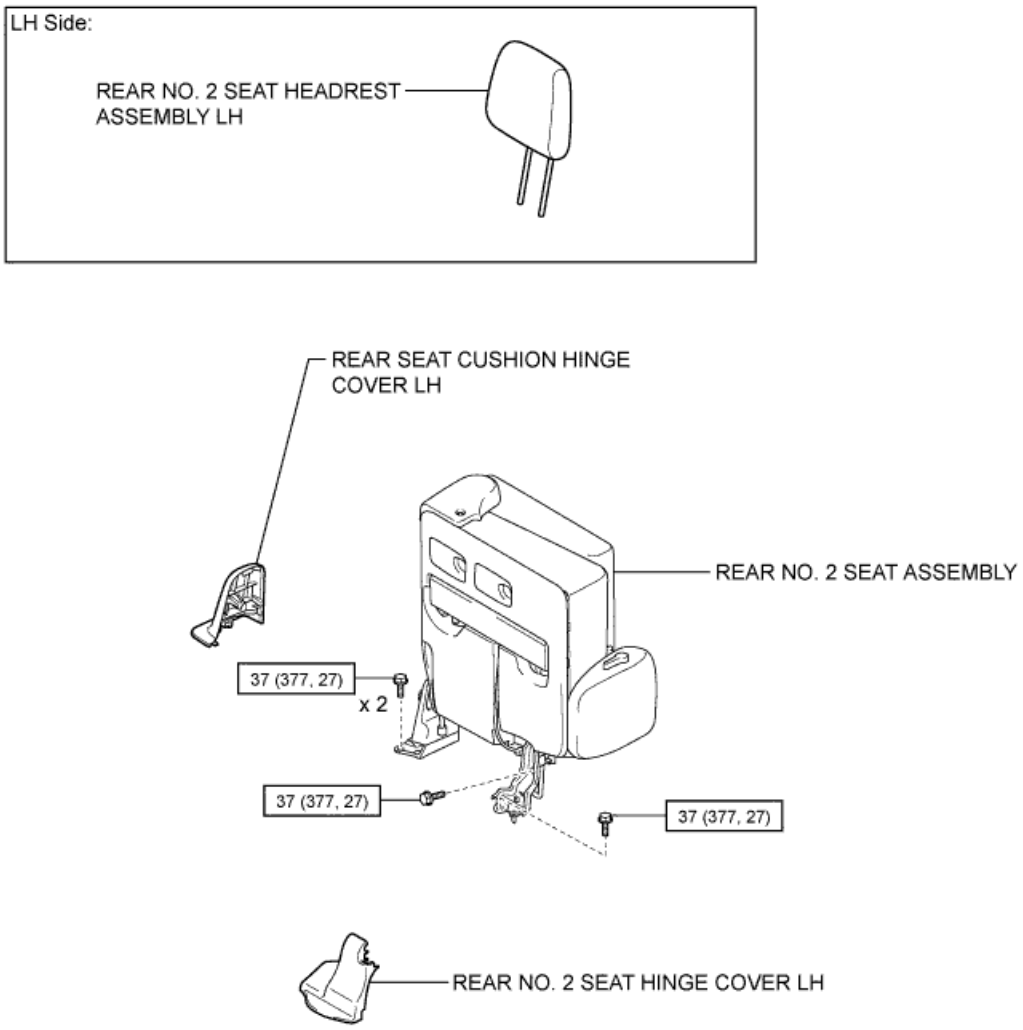
for Face to Face Seat Type:



N*m (kgf*cm, ft.*lbf) : Specified torque

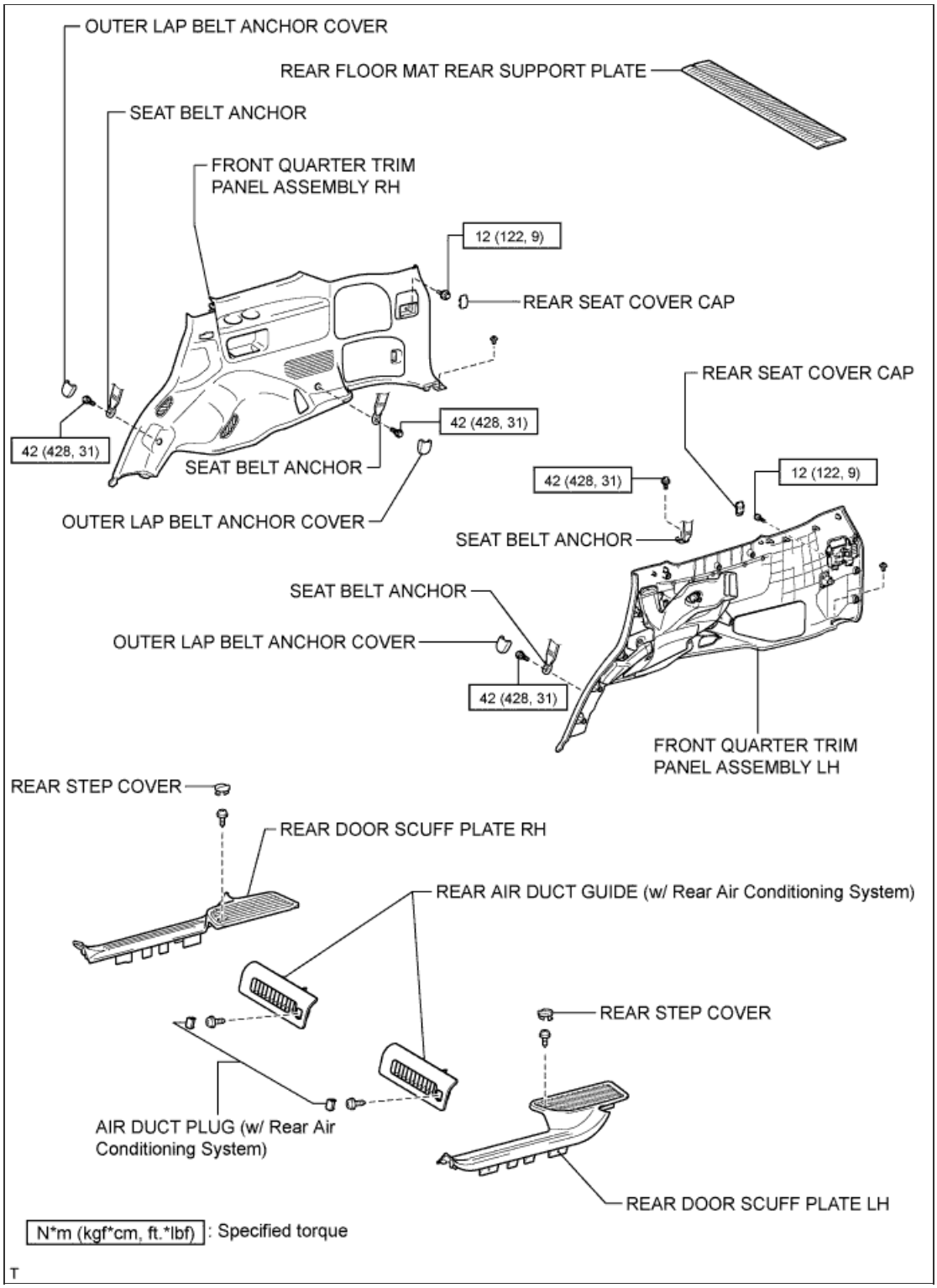
P

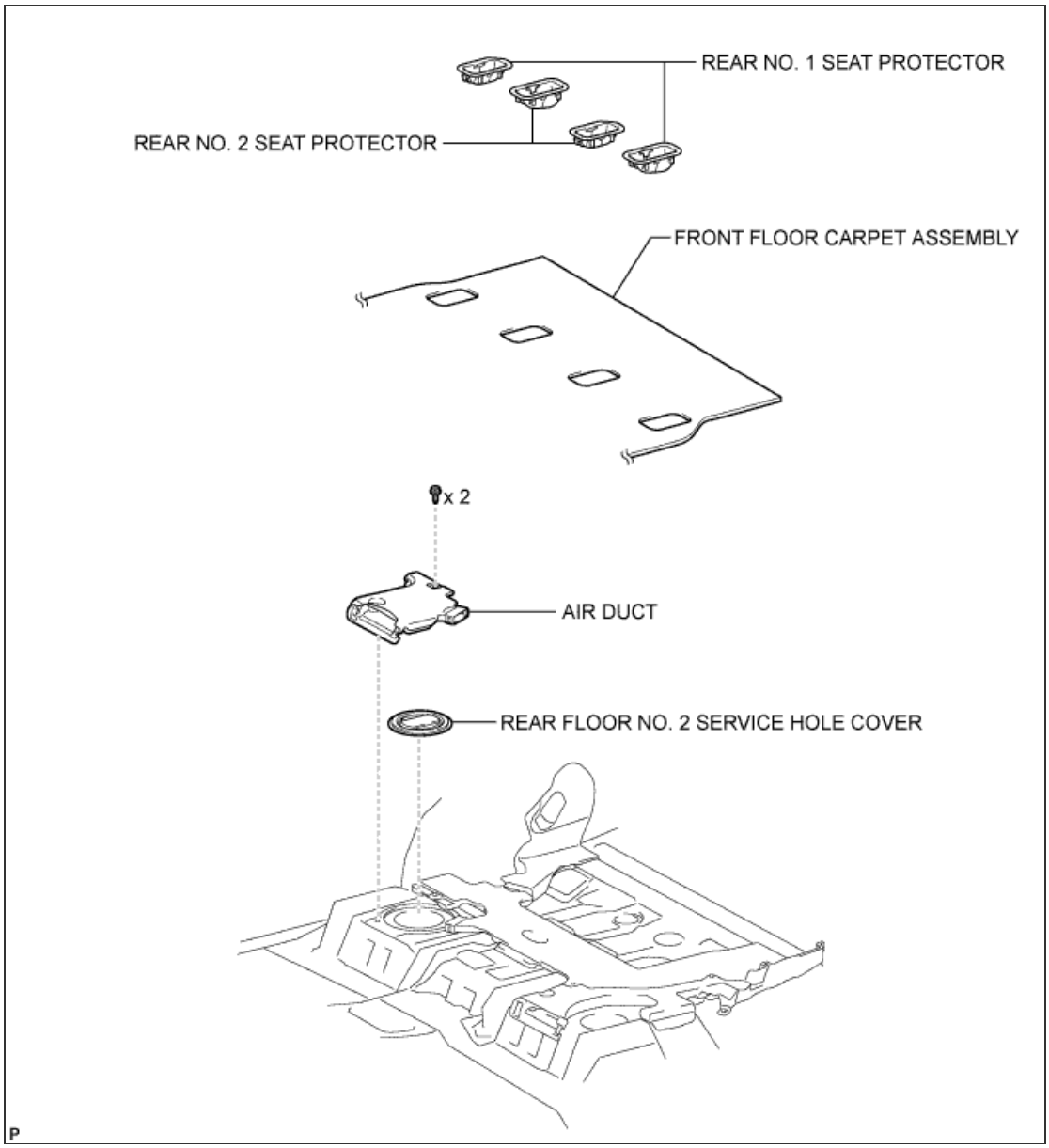
except Face to Face Seat Type:

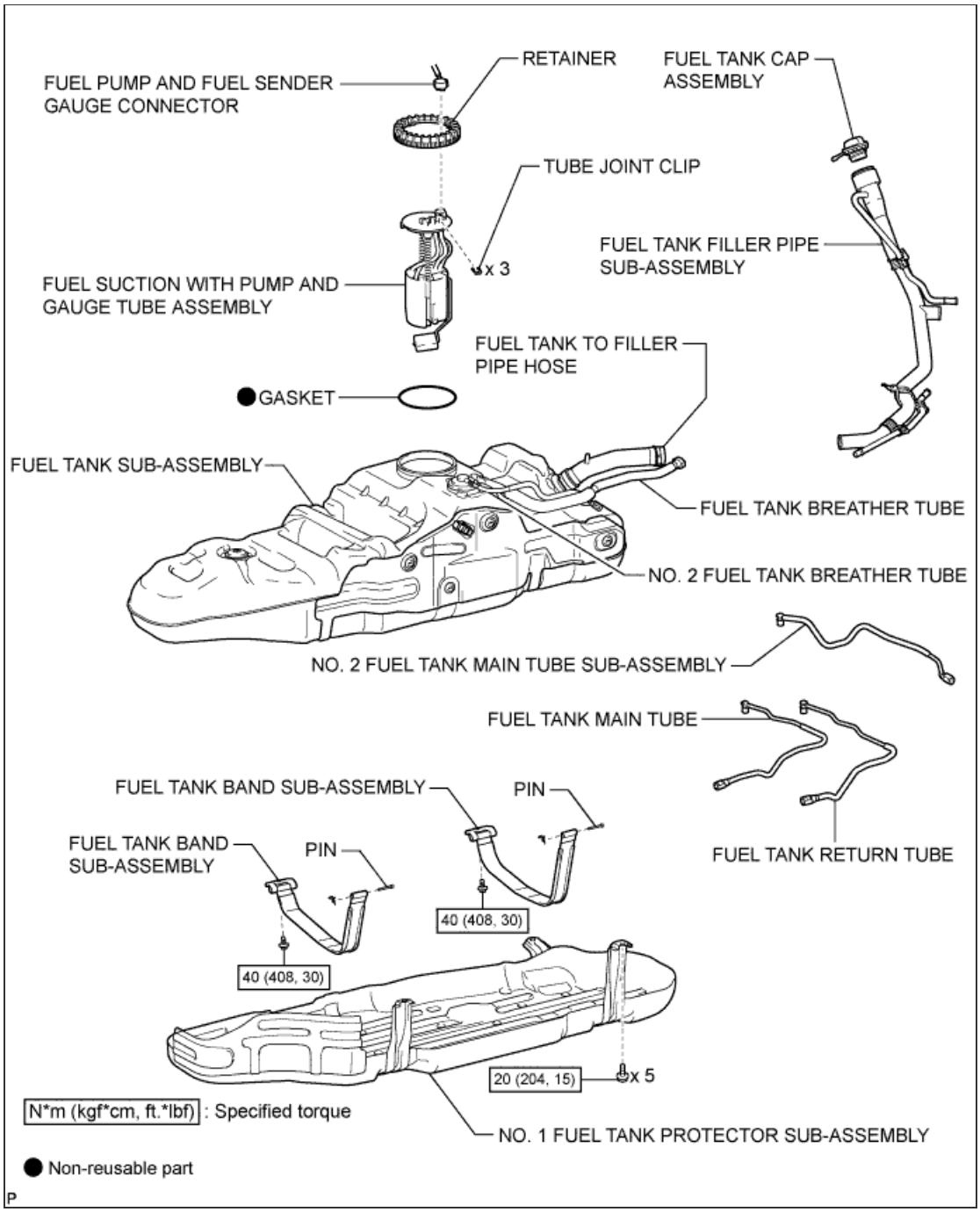


N*m (kgf*cm, ft.*lbf) : Specified torque

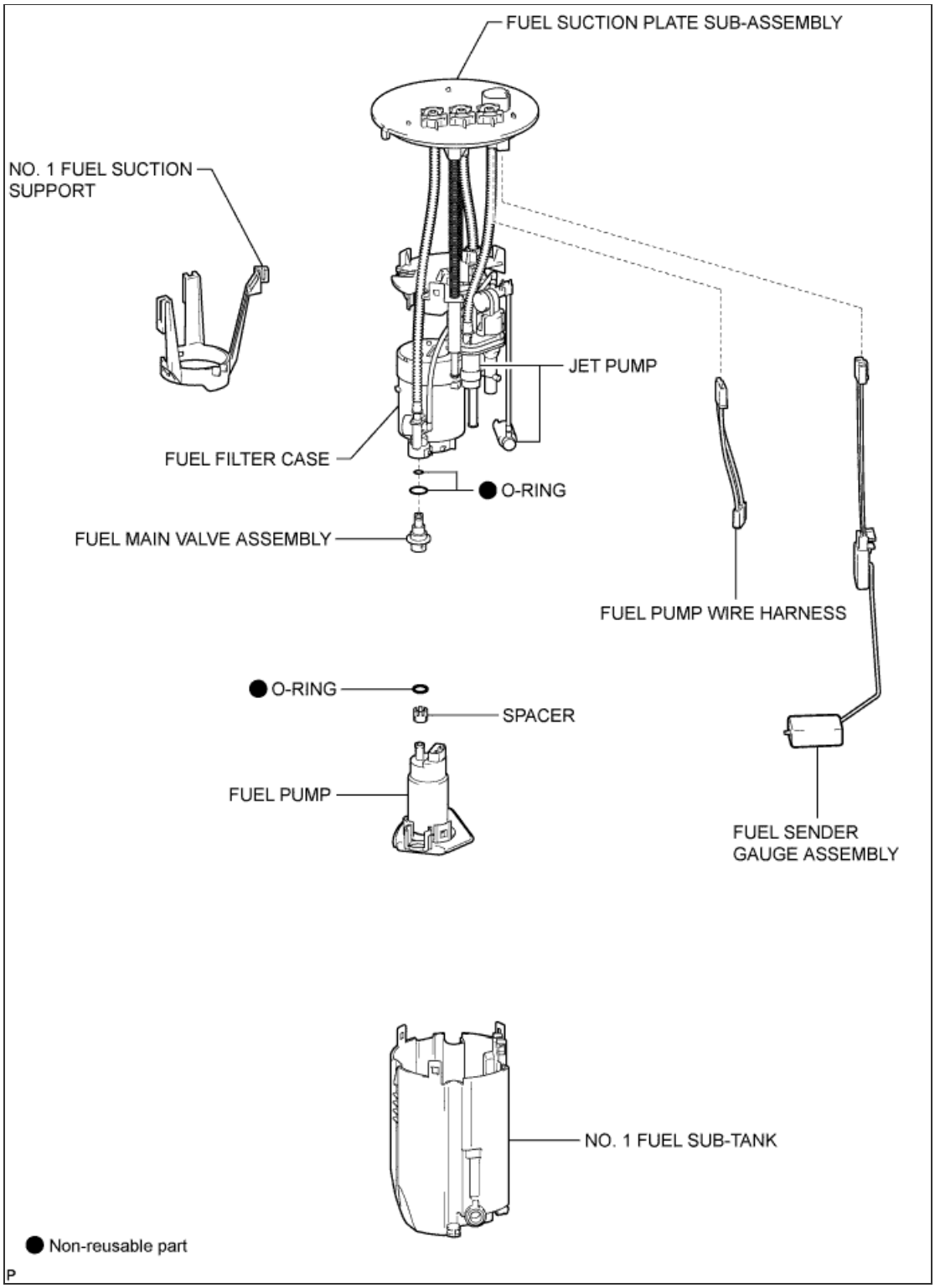
P


OUTER LAP BELT ANCHOR COVER
REAR FLOOR MAT REAR SUPPORT PLATE
SEAT BELT ANCHOR
FRONT QUARTER TRIM PANEL ASSEMBLY RH
12 (122, 9)
REAR SEAT COVER CAP
42 (428, 31)
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
REAR SEAT COVER CAP
42 (428, 31)
12 (122, 9)
SEAT BELT ANCHOR
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
42 (428, 31)
FRONT QUARTER TRIM PANEL ASSEMBLY LH
REAR STEP COVER
REAR DOOR SCUFF PLATE RH
REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)
REAR STEP COVER
AIR DUCT PLUG (w/ Rear Air Conditioning System)
REAR DOOR SCUFF PLATE LH
N*m (kgf*cm, ft.*lbf) : Specified torque
T


REAR NO. 1 SEAT PROTECTOR
REAR NO. 2 SEAT PROTECTOR
FRONT FLOOR CARPET ASSEMBLY
x 2
AIR DUCT
REAR FLOOR NO. 2 SERVICE HOLE COVER
P


FUEL PUMP AND FUEL SENDER GAUGE CONNECTOR
RETAINER
FUEL TANK CAP ASSEMBLY
TUBE JOINT CLIP
x 3
FUEL TANK FILLER PIPE SUB-ASSEMBLY
FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY
FUEL TANK TO FILLER PIPE HOSE
GASKET
FUEL TANK SUB-ASSEMBLY
FUEL TANK BREATHER TUBE
NO. 2 FUEL TANK BREATHER TUBE
NO. 2 FUEL TANK MAIN TUBE SUB-ASSEMBLY
FUEL TANK MAIN TUBE
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TANK RETURN TUBE
40 (408, 30)
40 (408, 30)
20 (204, 15)
x 5
N*m (kgf*cm, ft.*lbf) : Specified torque
NO. 1 FUEL TANK PROTECTOR SUB-ASSEMBLY
Non-reusable part

P


FUEL SUCTION PLATE SUB-ASSEMBLY
NO. 1 FUEL SUCTION SUPPORT
JET PUMP
FUEL FILTER CASE
O-RING
FUEL MAIN VALVE ASSEMBLY
FUEL PUMP WIRE HARNESS
O-RING
SPACER
FUEL PUMP
FUEL SENDER GAUGE ASSEMBLY
NO. 1 FUEL SUB-TANK
Non-reusable part
P

for Preparation Click here

1. REMOVE FUEL TANK SUB-ASSEMBLY

a. Remove the fuel tank sub-assembly (Click here).

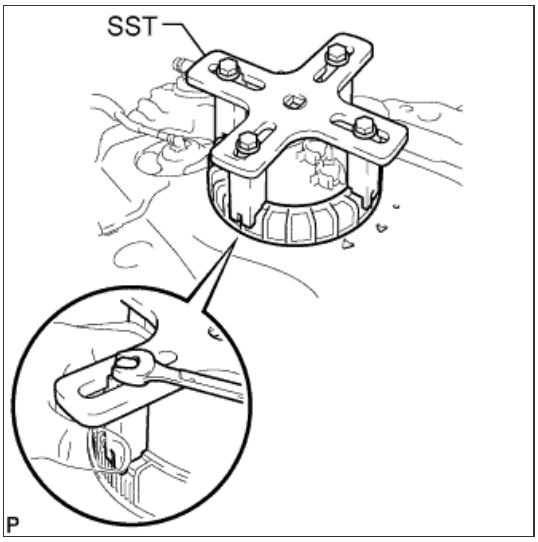
2. REMOVE FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

a. Set SST on the retainer.

SST
09808-14030

HINT:

- **Securely attach the claws of SST to the protrusion of the retainer and fix SST in place.**
- **Install SST while pressing the claws of SST against the retainer (towards the center of SST).**



b. Using SST, loosen the retainer.

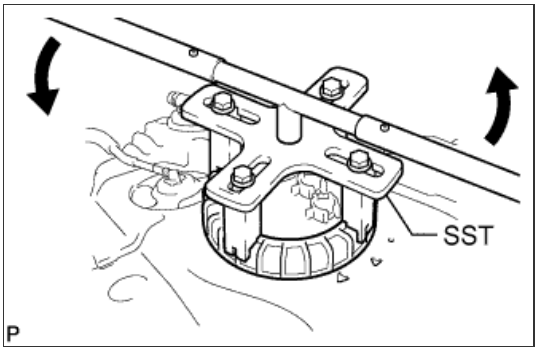
SST
09808-14030

NOTICE:

- **Do not use any tools other than those specified in this operation. Damage to the retainer or the fuel tank may result.**
- **While pressing down on SST so that the claws of SST do not slip off the protrusion of the retainer, turn the retainer counterclockwise to loosen it.**

HINT:

The protrusion of the retainer fit in the ends of SST.



Text in Illustration

➡	Turn

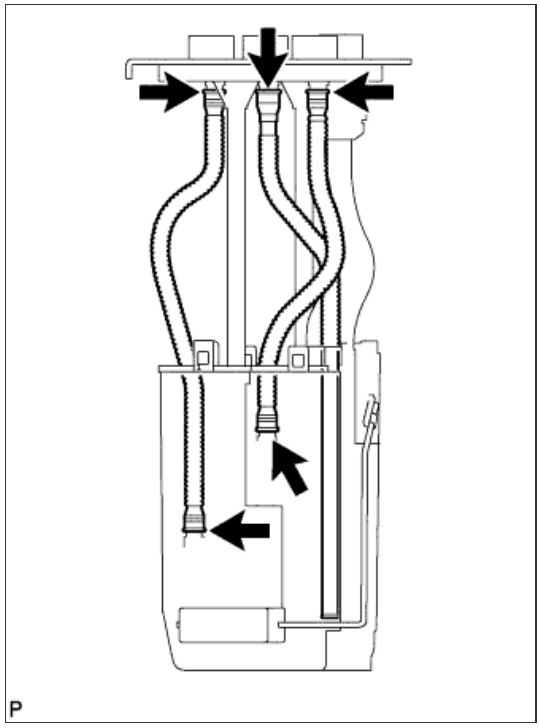
c. Remove the retainer while holding the fuel suction tube assembly by hand.

d. Remove the gasket from the fuel tank.

for Preparation Click here

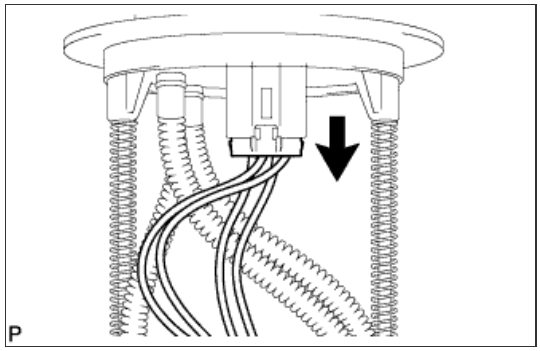
NOTICE:

Do not disconnect the hoses indicated in the illustration.

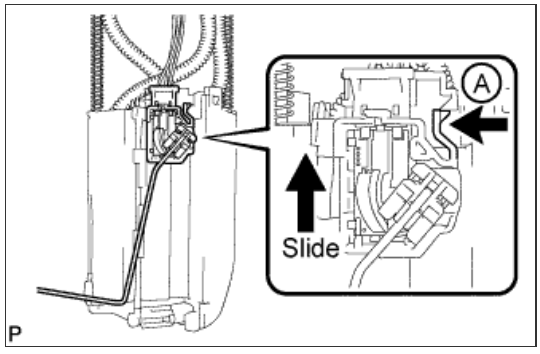


1. REMOVE FUEL SENDER GAUGE ASSEMBLY

a. Disconnect the fuel sender gauge connector.

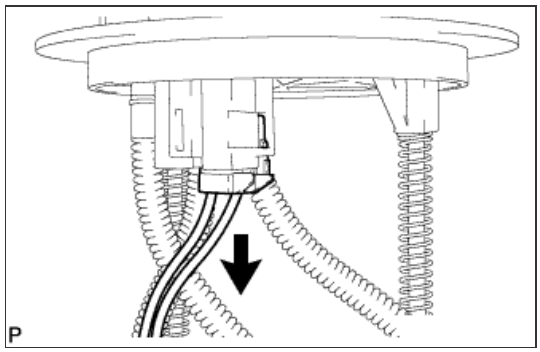


b. Press down on the sender gauge claw labeled A. Then slide the sender gauge upward to remove it.



2. REMOVE NO. 1 FUEL SUB-TANK

a. Disconnect the fuel pump connector.



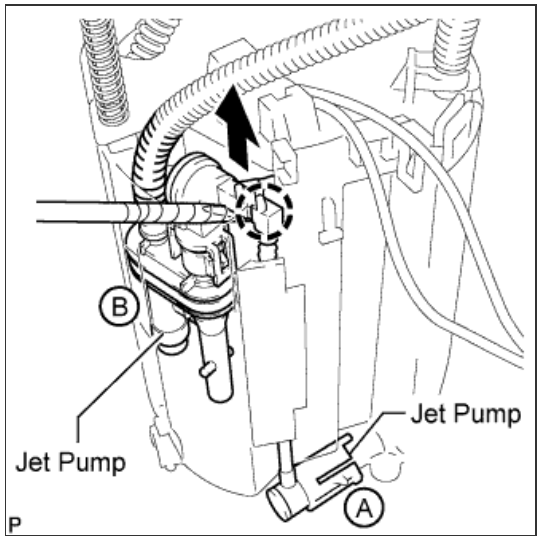
b. Disconnect the jet pump (labeled A) from the sub-tank.

c. Disconnect the jet pump (labeled B) from the sub-tank.

i. Using a small screwdriver, detach the claw from the sub-tank.

HINT:

Tape the screwdriver tip before use.



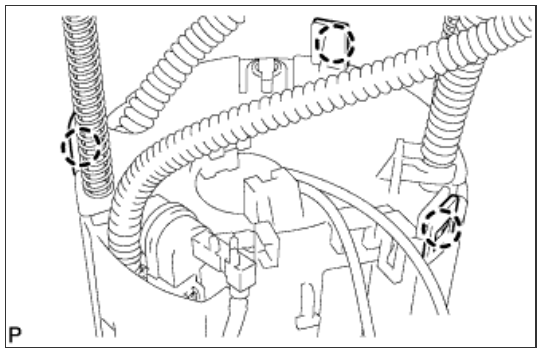
d. Using a screwdriver, detach the 3 claws from the claw holes.

NOTICE:

Do not damage the fuel sub-tank.

HINT:

Tape the screwdriver tip before use.



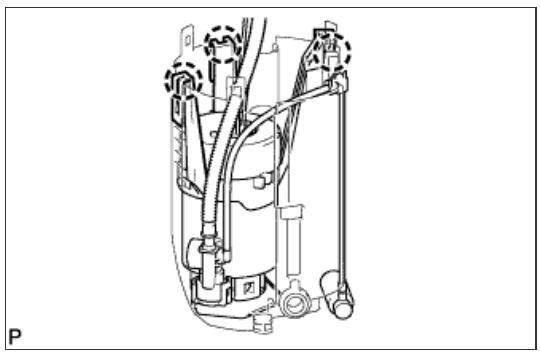
e. Using a screwdriver, detach the 3 claws from the claw holes.

NOTICE:

Do not damage the fuel sub-tank.

HINT:

Tape the screwdriver tip before use.



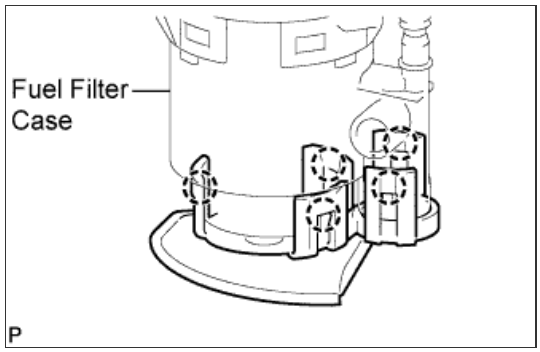
3. REMOVE FUEL PUMP

a. Using a screwdriver, detach the 5 claws from the claw holes and disconnect the

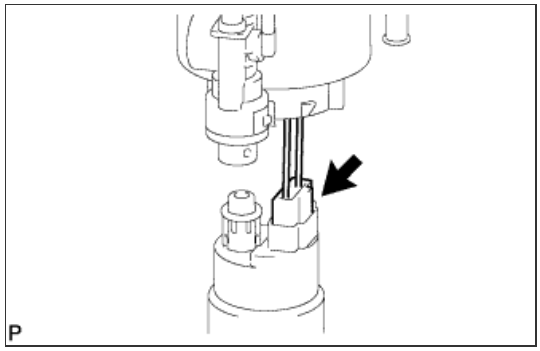
fuel pump from the fuel filter case.

HINT:

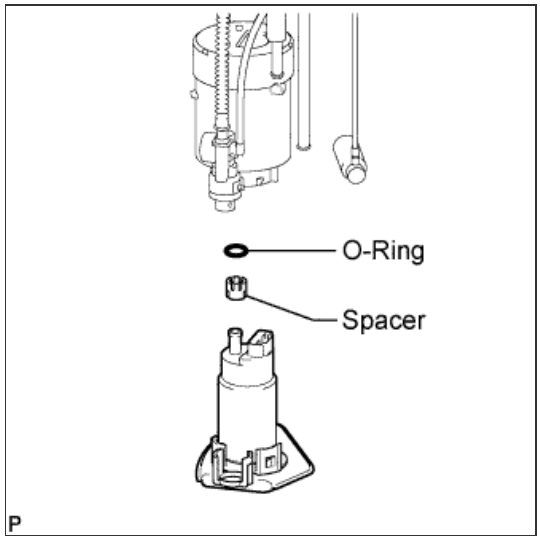
Tape the screwdriver tip before use.



b. Disconnect the fuel pump wire harness connector from the fuel pump to remove it.



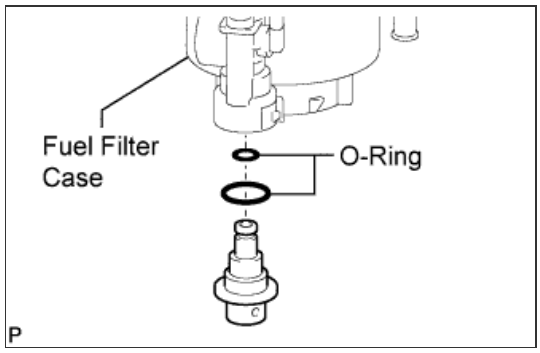
c. Remove the O-ring and spacer from the fuel pump.



4. REMOVE FUEL MAIN VALVE ASSEMBLY

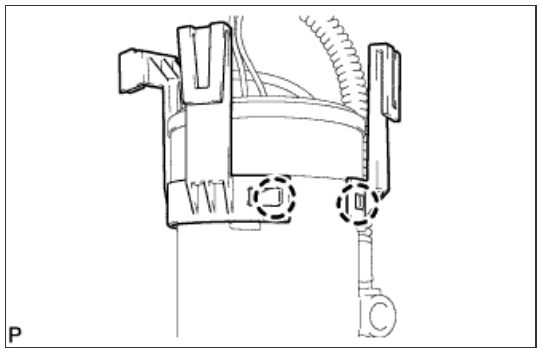
a. Remove the fuel main valve from the fuel filter case.

b. Remove the 2 O-rings from the fuel main valve.



5. REMOVE NO. 1 FUEL SUCTION SUPPORT

a. Detach the 2 claws from the claw holes to remove the fuel suction support.



for Preparation Click here

1. INSPECT FUEL PUMP

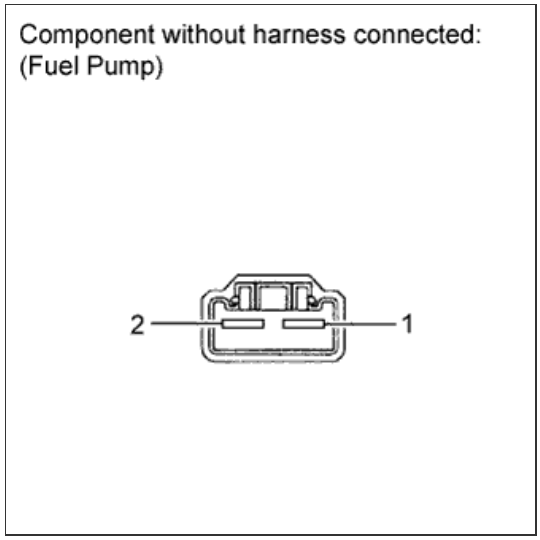
a. Inspect the resistance of the fuel pump.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	0.2 to 3.0 Ω

If the result is not as specified, replace the fuel suction with pump and gauge tube.

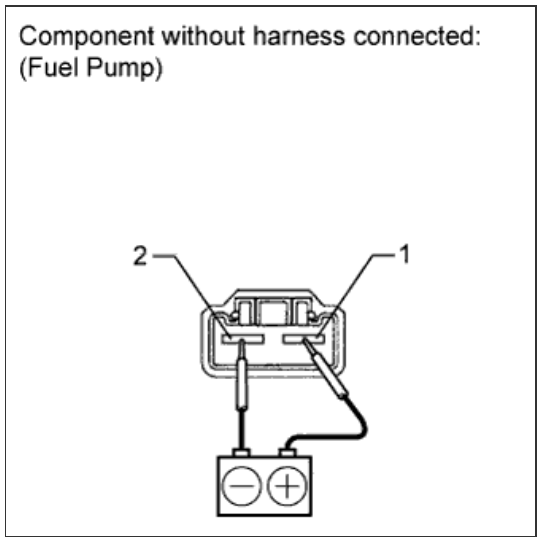


b. Inspect the operation of the fuel pump.

i. Connect the battery's positive (+) lead to terminal 1 of the connector, and the negative (-) lead to terminal 2. Check that the fuel pump operates.
If the result is not as specified, replace the fuel pump and fuel pump ECU.

NOTICE:

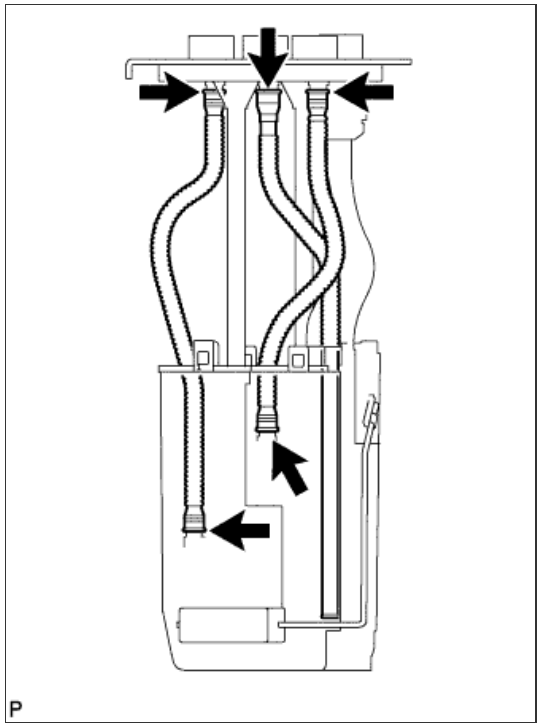
- **These tests must be performed thin 10 seconds to prevent the coil from burning out.**
- **eep the fuel pump as far a ay from the battery as possible.**
- **Al ays turn the voltage on and off on the battery side, not the fuel pump side.**
- **When the pump is locked and does not operate due to foreign matter being stuck, etc., replace the fuel pump ECU together th the fuel pump, as the fuel pump ECU may be damaged electrically.**



for Preparation Click here

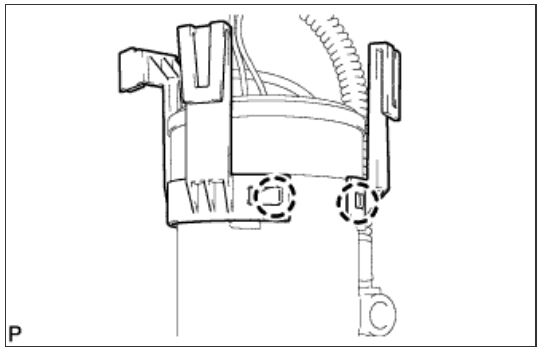
NOTICE:

Do not disconnect the hoses indicated in the illustration.



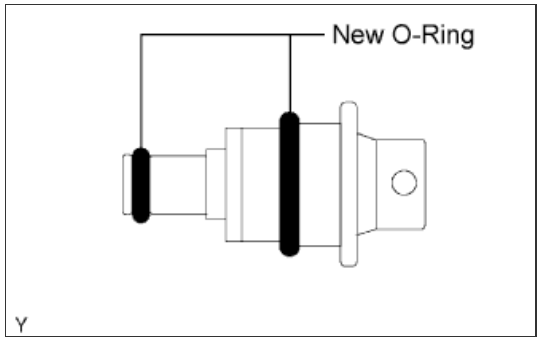
1. INSTALL NO. 1 FUEL SUCTION SUPPORT

a. Attach the 2 claws to the claw holes to install the fuel suction support.



2. INSTALL FUEL MAIN VALVE ASSEMBLY

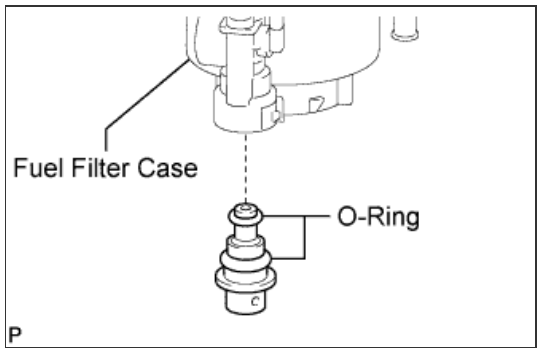
a. Apply a light coat of gasoline to 2 new O-rings, and install them onto the fuel main valve.



b. Install the fuel main valve to the fuel filter case.

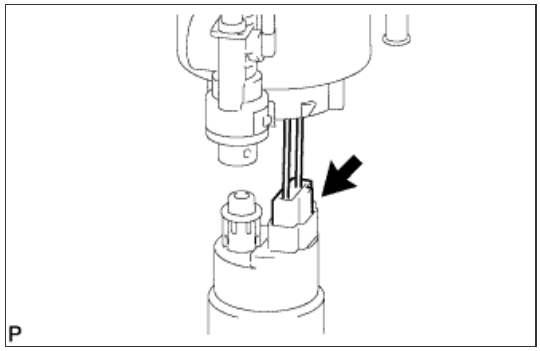
NOTICE:

Make sure the O-rings are not cut or pinched during the installation.

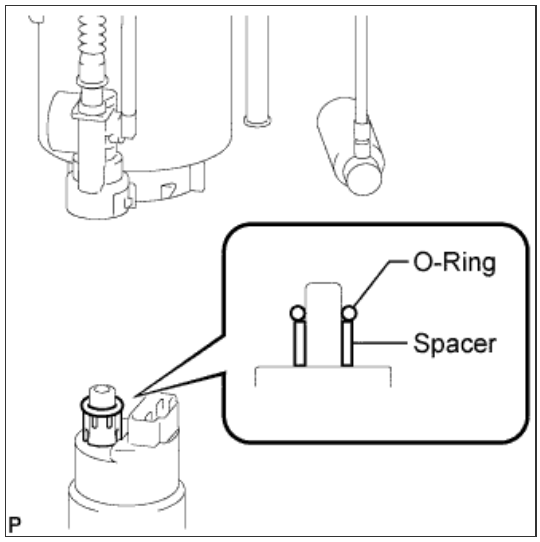


3. INSTALL FUEL PUMP

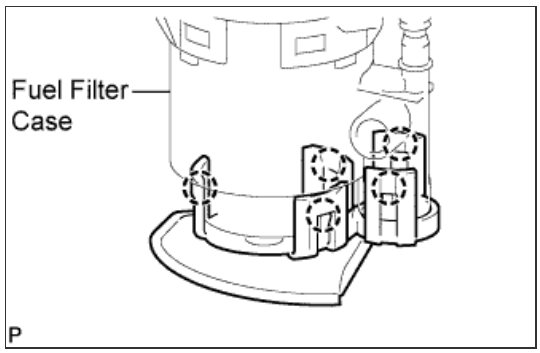
a. Connect the fuel pump wire harness connector to the fuel pump.



b. Apply a light coat of gasoline to a new O-ring. Then install the spacer and O-ring to the fuel pump.



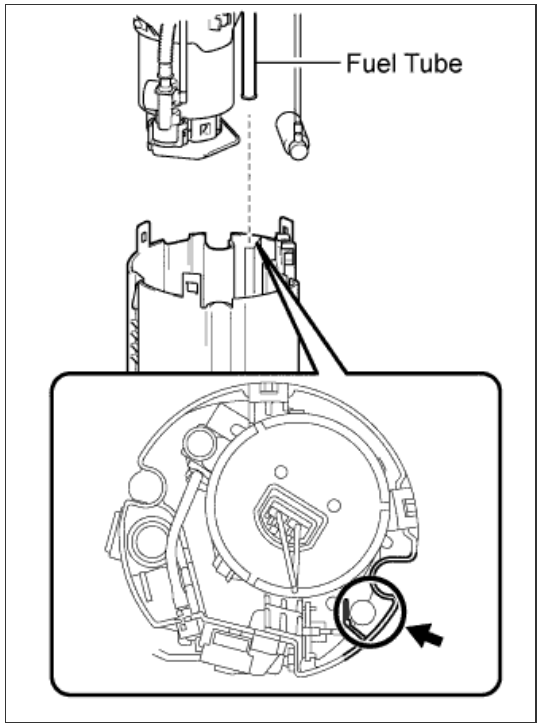
c. Attach the 5 claws to the claw holes and install the fuel pump to the fuel filter case.



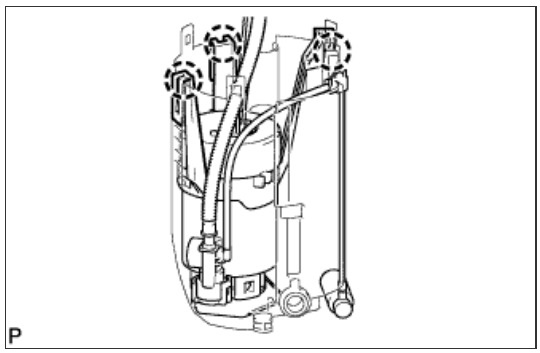
4. INSTALL NO. 1 FUEL SUB-TANK

NOTICE:

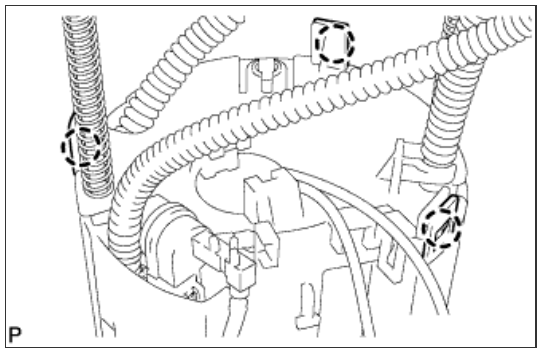
Make sure that the fuel tube passes into the section marked by the circle.



a. Attach the 3 claws to the claw holes and install the fuel sub-tank.



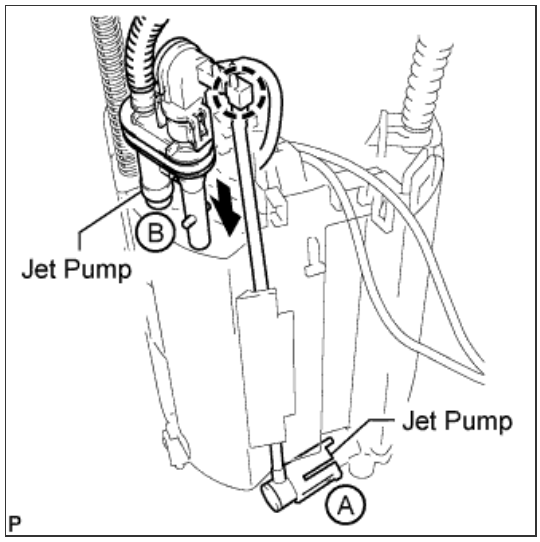
b. Attach the 3 claws to the claw holes.



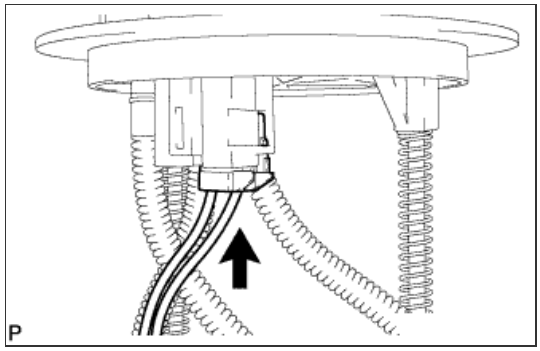
c. Connect the jet pump (labeled B) to the sub-tank.

i. Attach the claw on the end of the tube to the claw hole.

d. Connect the jet pump (labeled A) to the sub-tank.

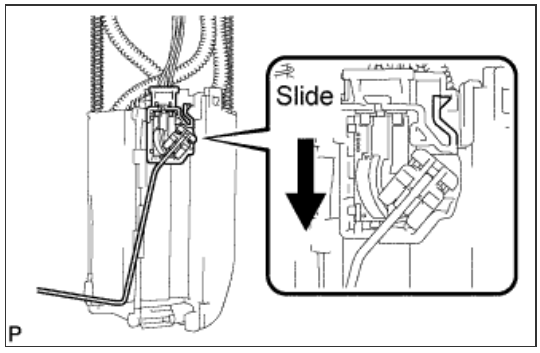


e. Connect the fuel pump connector.

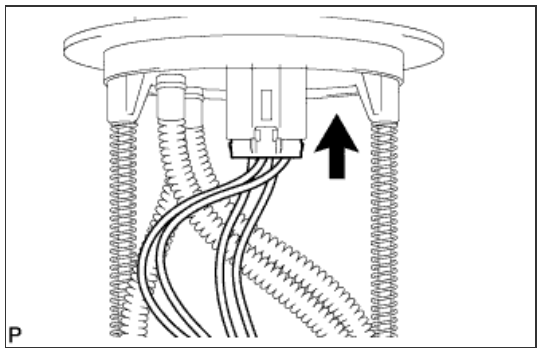


5. INSTALL FUEL SENDER GAUGE ASSEMBLY

a. Set the sender gauge to the fuel sub-tank. Then slide the sender gauge downward to install it.



b. Connect the fuel sender gauge connector.



for Preparation Click here

1. INSTALL FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

a. Apply a light coat of gasoline or grease to a new gasket, and install it to the fuel tank.

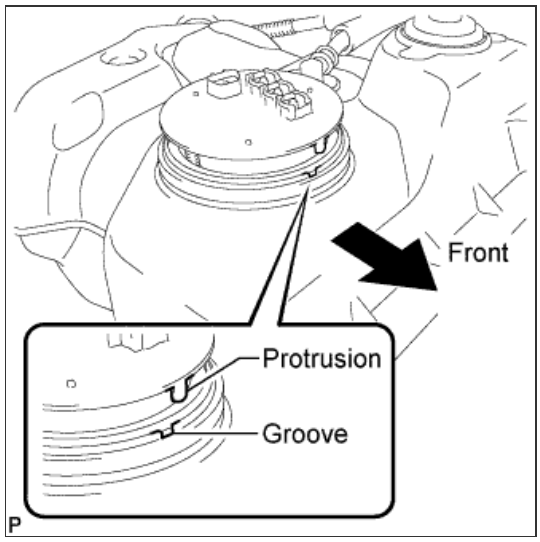
b. Install the fuel suction with pump and gauge tube into the fuel tank.

NOTICE:

Be careful not to bend the arm of the fuel sender gauge.

HINT:

Align the protrusion of the fuel suction with pump and gauge tube with the groove of the fuel tank.



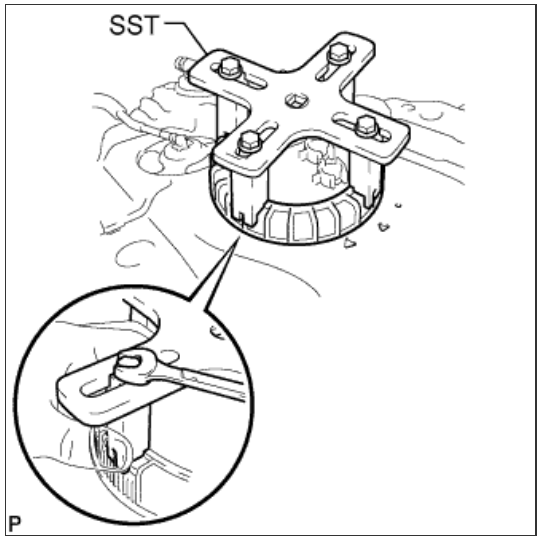
c. Put the retainer on the fuel tank. While holding the fuel suction with pump and gauge tube, tighten the retainer one complete turn by hand.

d. Set SST on the retainer.

SST
09808-14030

HINT:

- **Hold the fuel suction tube assembly upright by hand to ensure that the fuel suction tube gasket is not moved out of position.**
- **Securely attach the claws of SST to the protrusions of the retainer and fix SST in place.**
- **Install SST while pressing the claws of SST against the retainer (toward the center of SST).**

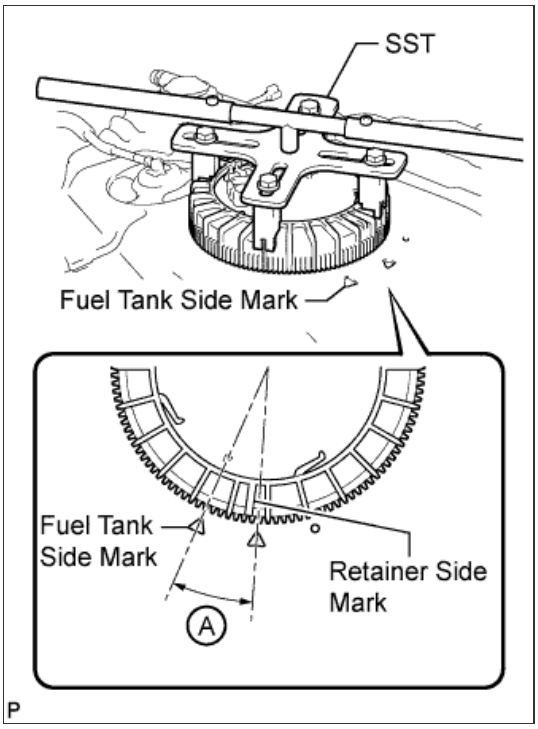


e. Using SST, tighten the retainer until the mark on the retainer is within range A on the fuel tank as shown in the illustration.

SST
09808-14030

HINT:

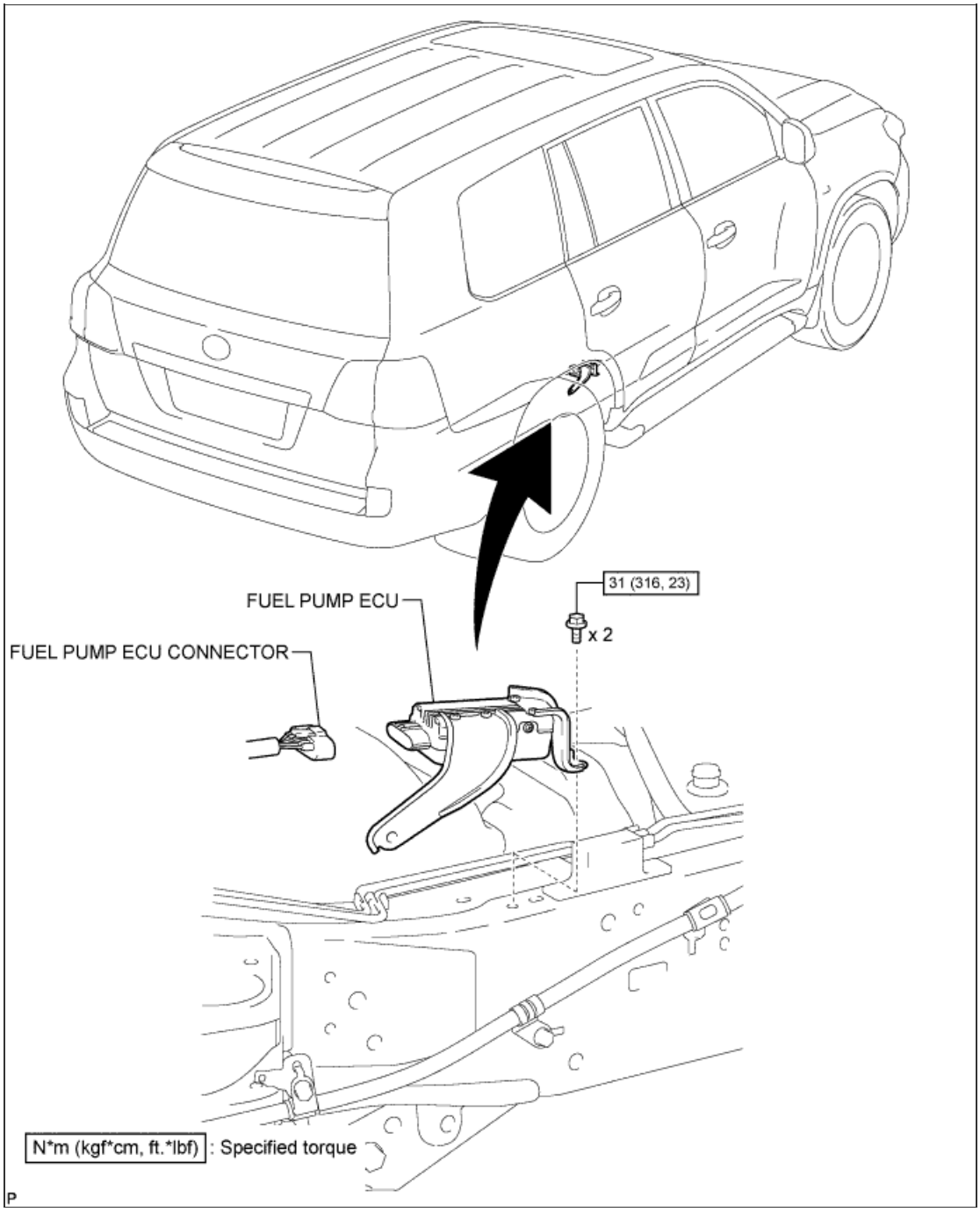
Fit the tips of SST onto the ribs of the retainer.



2. INSTALL FUEL TANK SUB-ASSEMBLY

a. Install the fuel tank sub-assembly (Click here).

for Preparation [Click here]



for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

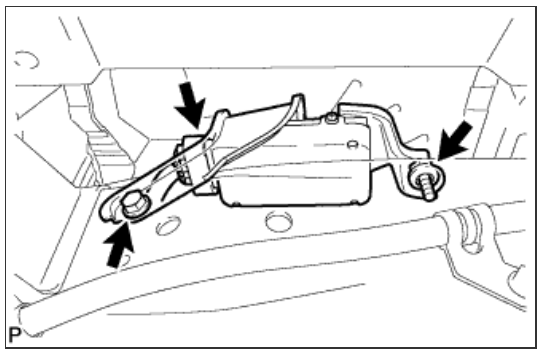
2. REMOVE FUEL PUMP ECU

a. Disconnect the ECU connector.

b. Remove the 2 bolts and ECU.

NOTICE:

Make sure the ECU is not subjected to physical shocks such as being dropped, etc.



for Preparation Click here

1. INSTALL FUEL PUMP ECU

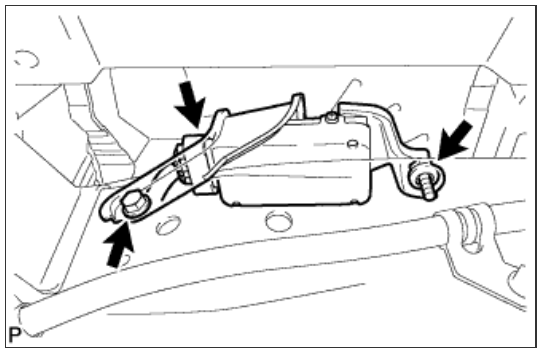
a. Install the ECU with the 2 bolts.

Torque:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

NOTICE:

Do not use the ECU if it has been subjected to physical shocks such as being dropped, etc.

b. Connect the ECU connector.

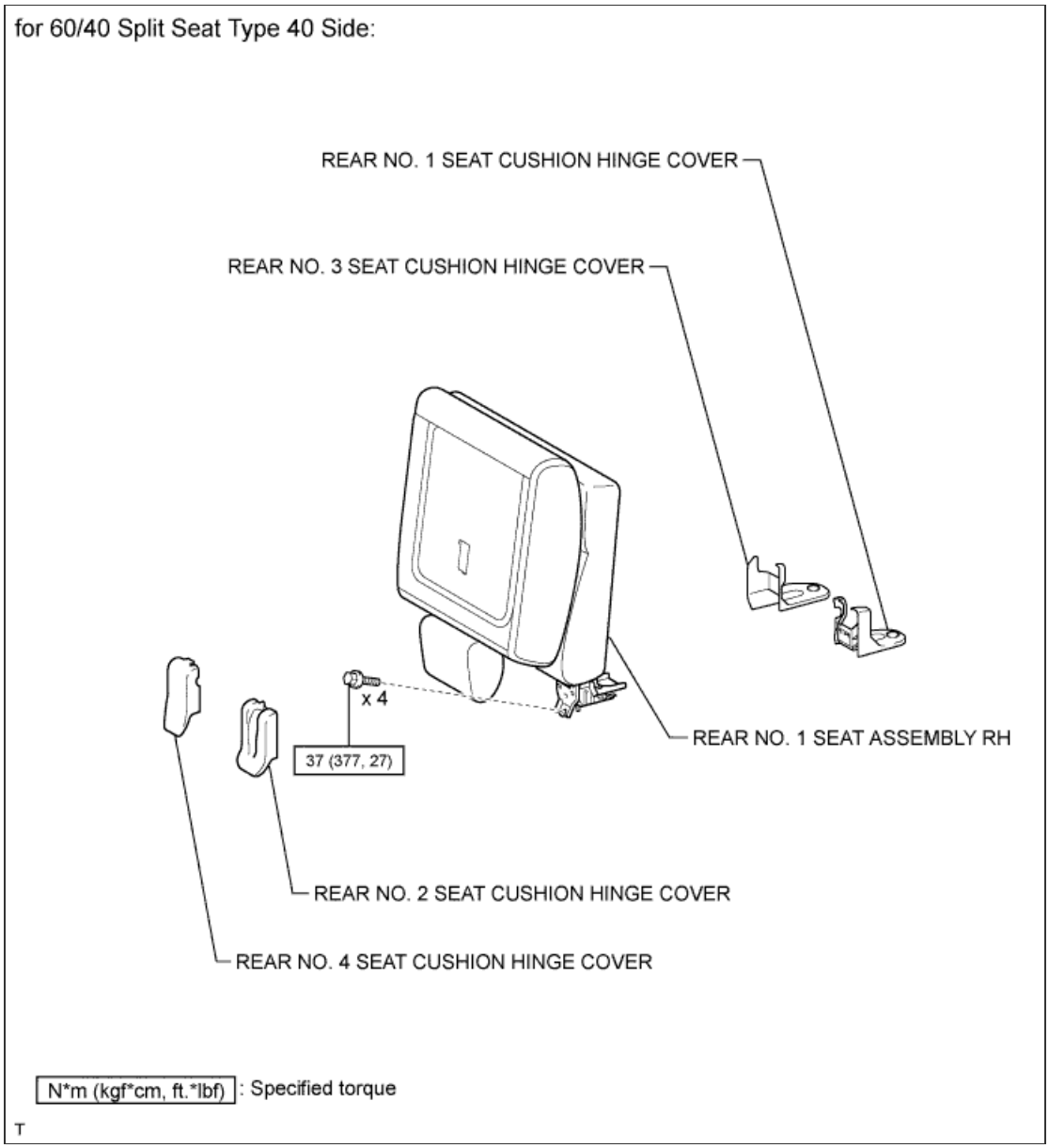


2. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

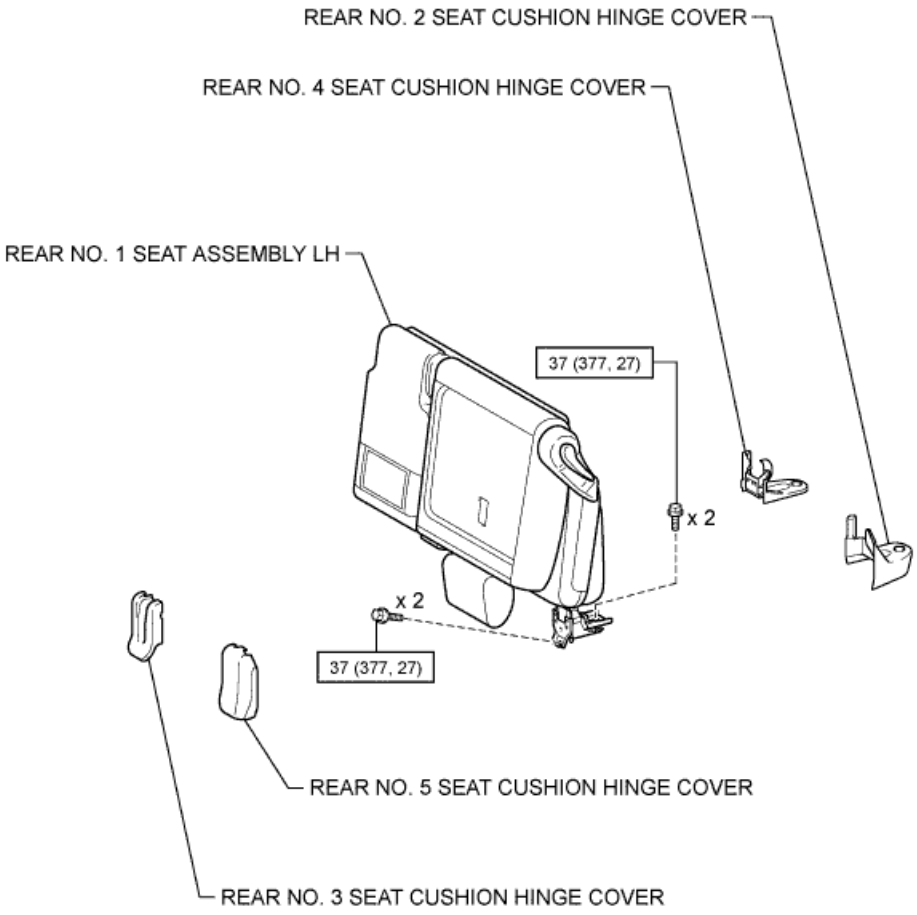
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

for Preparation Click here



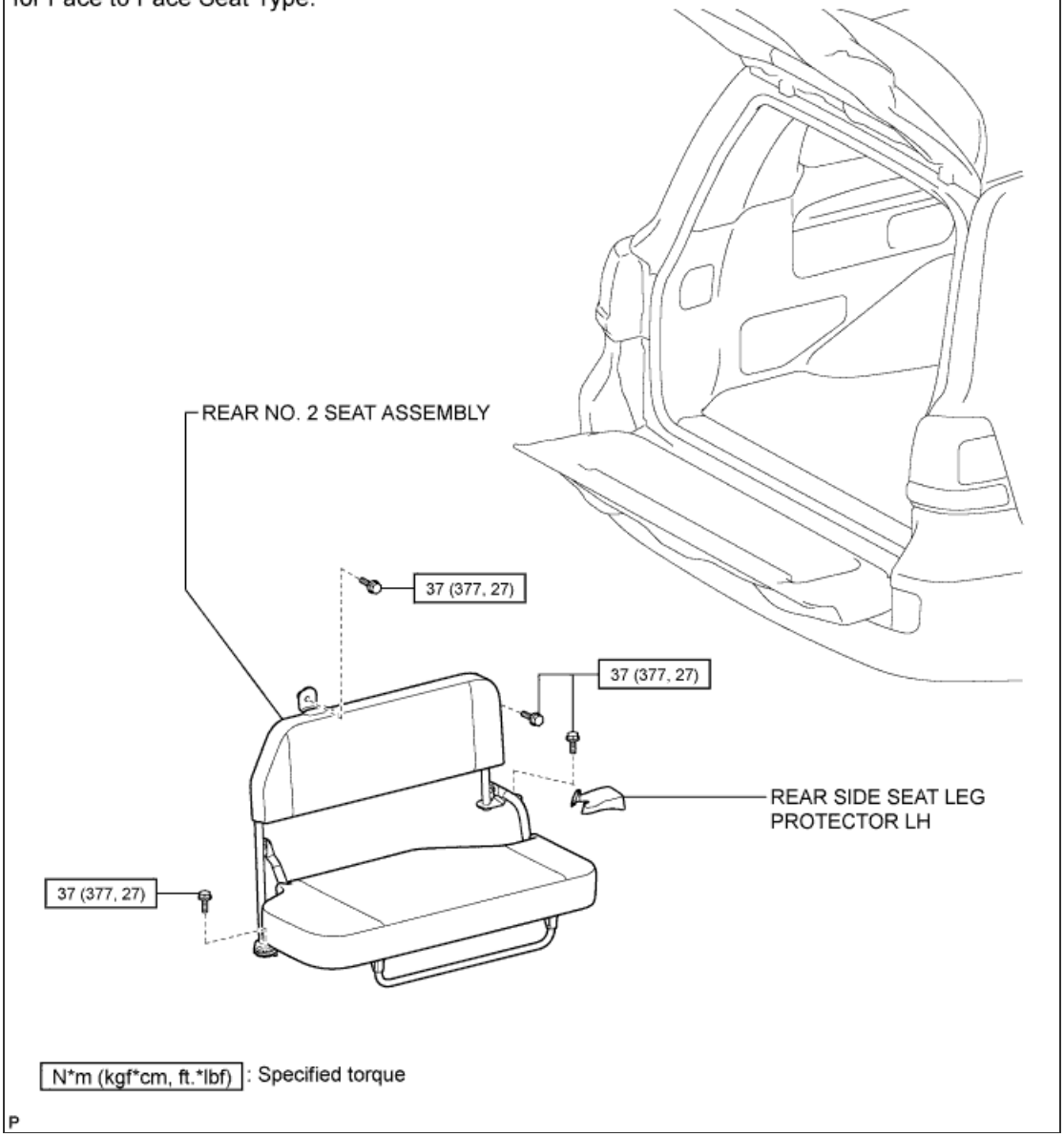
for 60/40 Split Seat Type 60 Side:



N*m (kgf*cm, ft.*lbf) : Specified torque

T

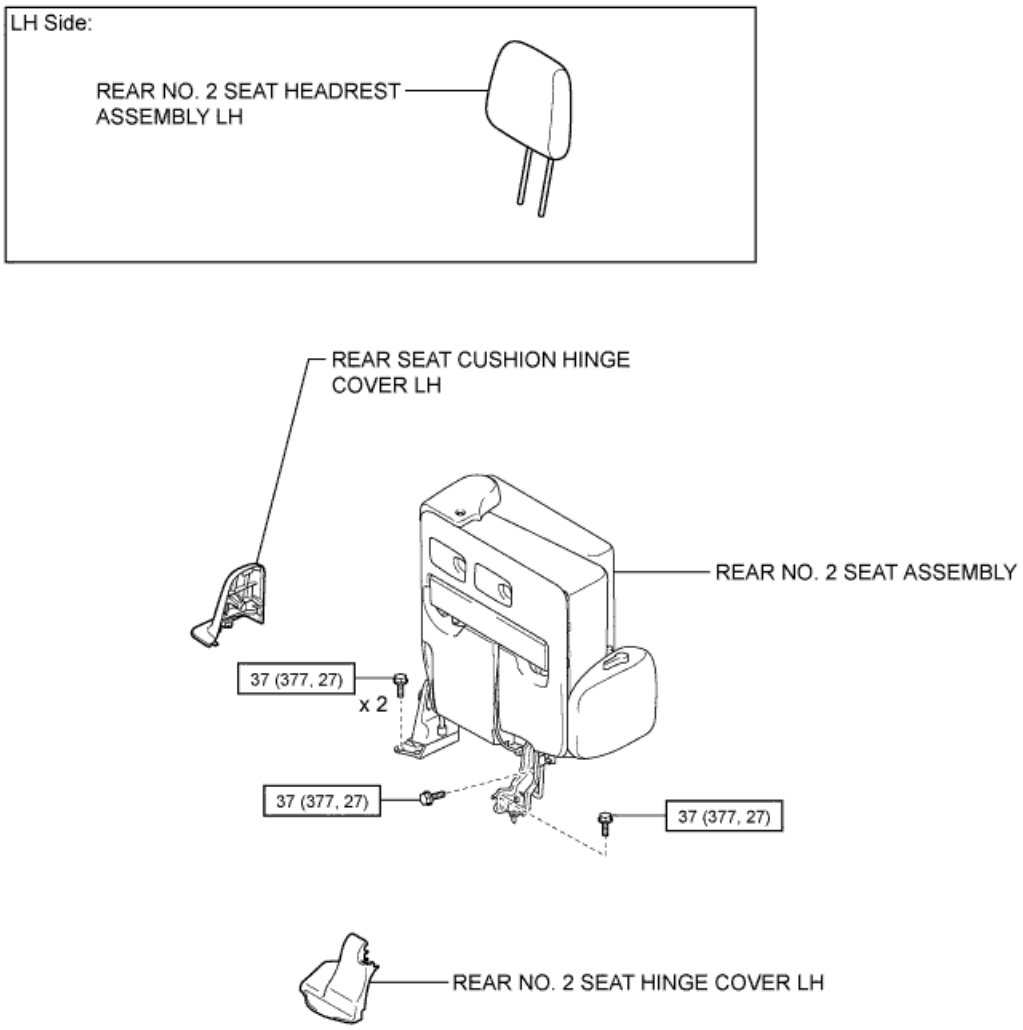
for Face to Face Seat Type:



N*m (kgf*cm, ft.*lbf) : Specified torque

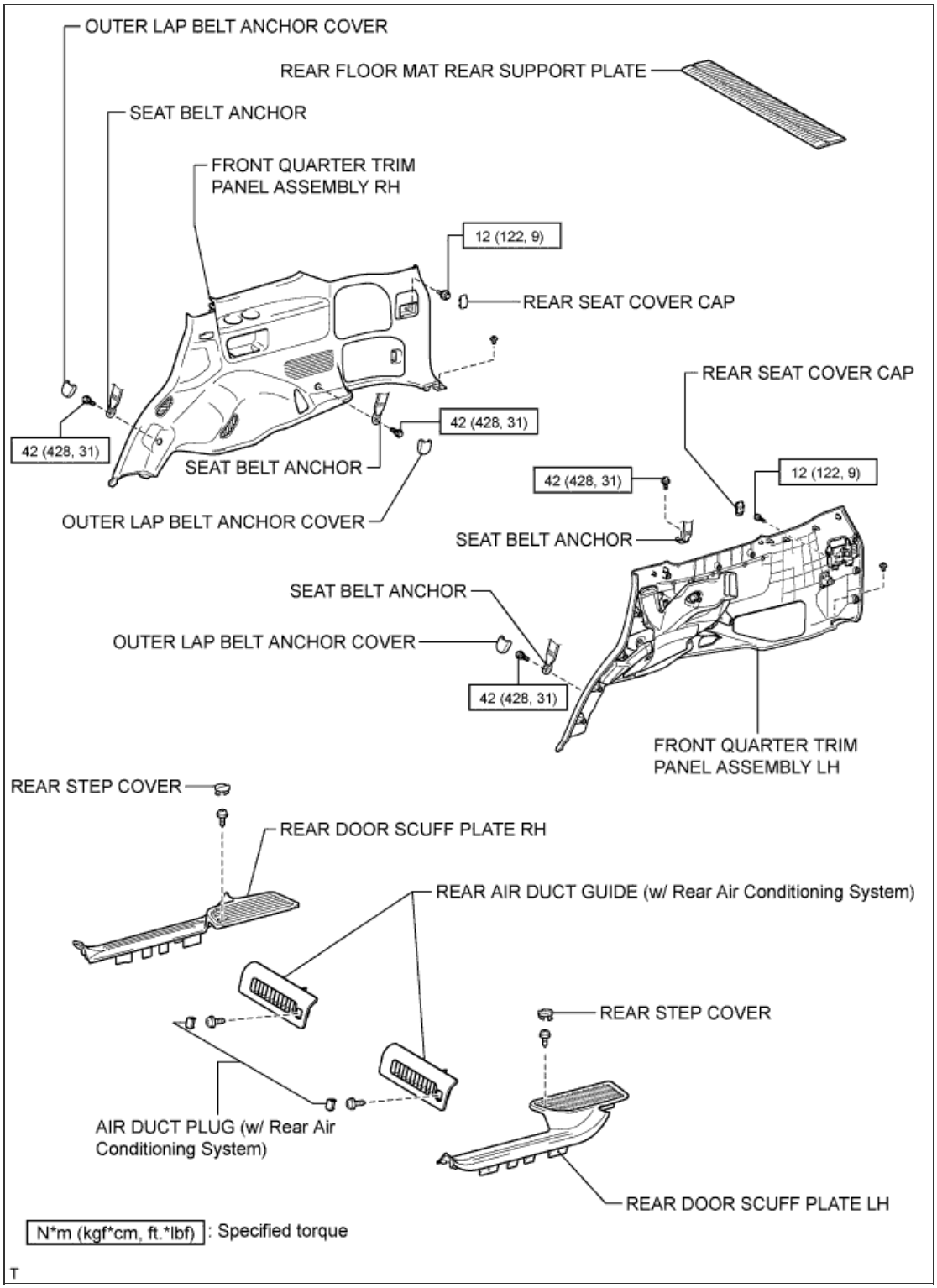
P

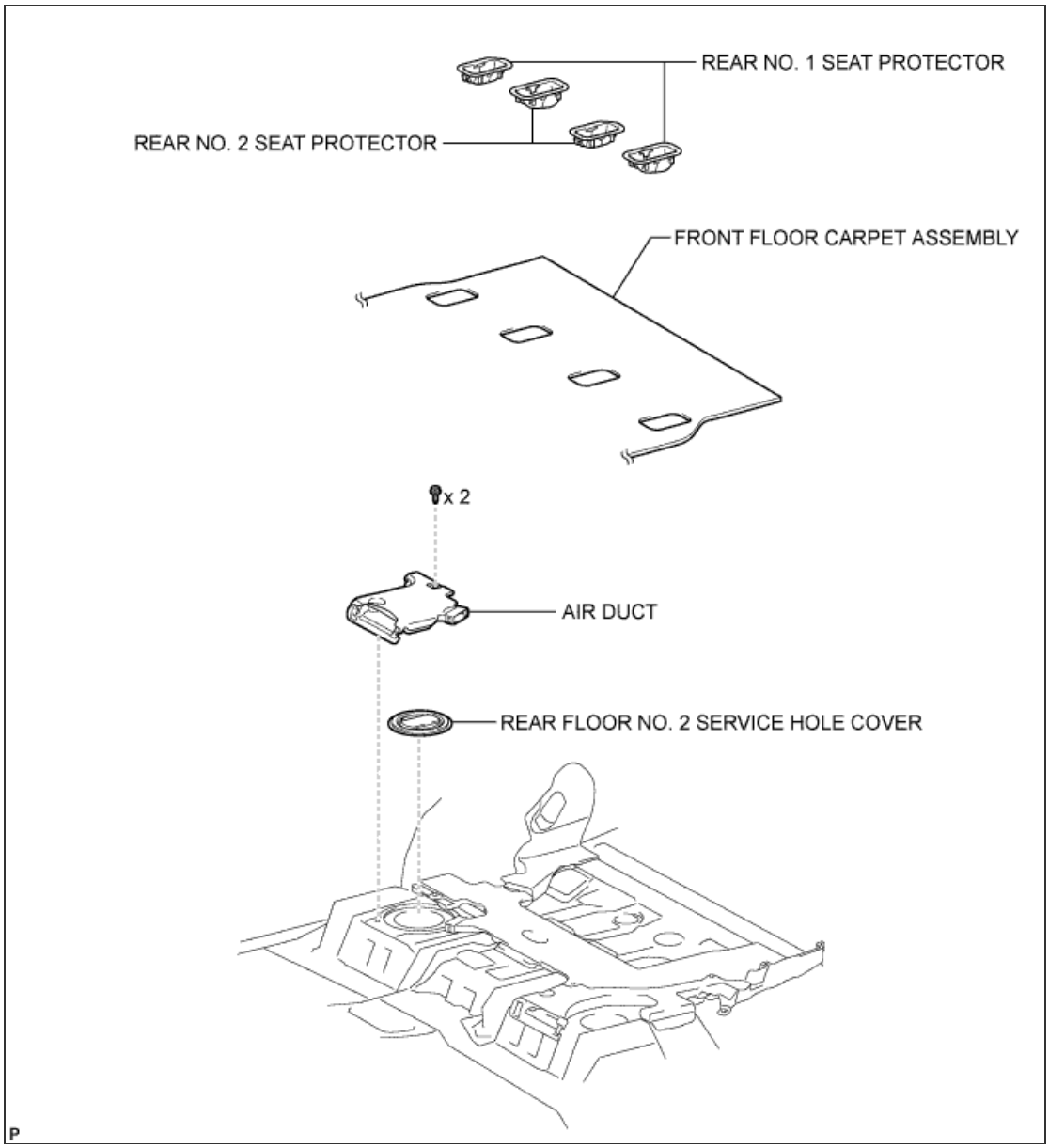
except Face to Face Seat Type:

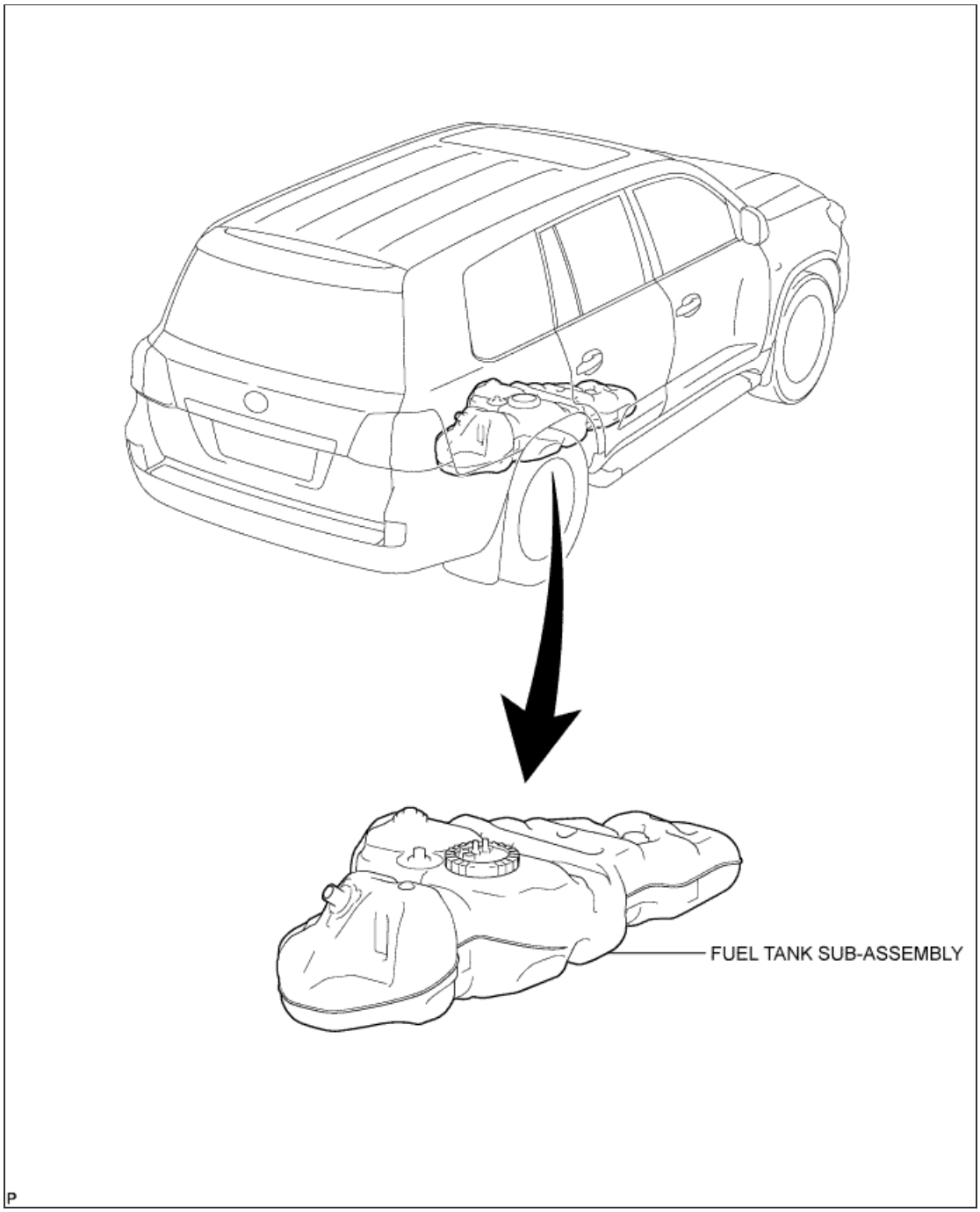


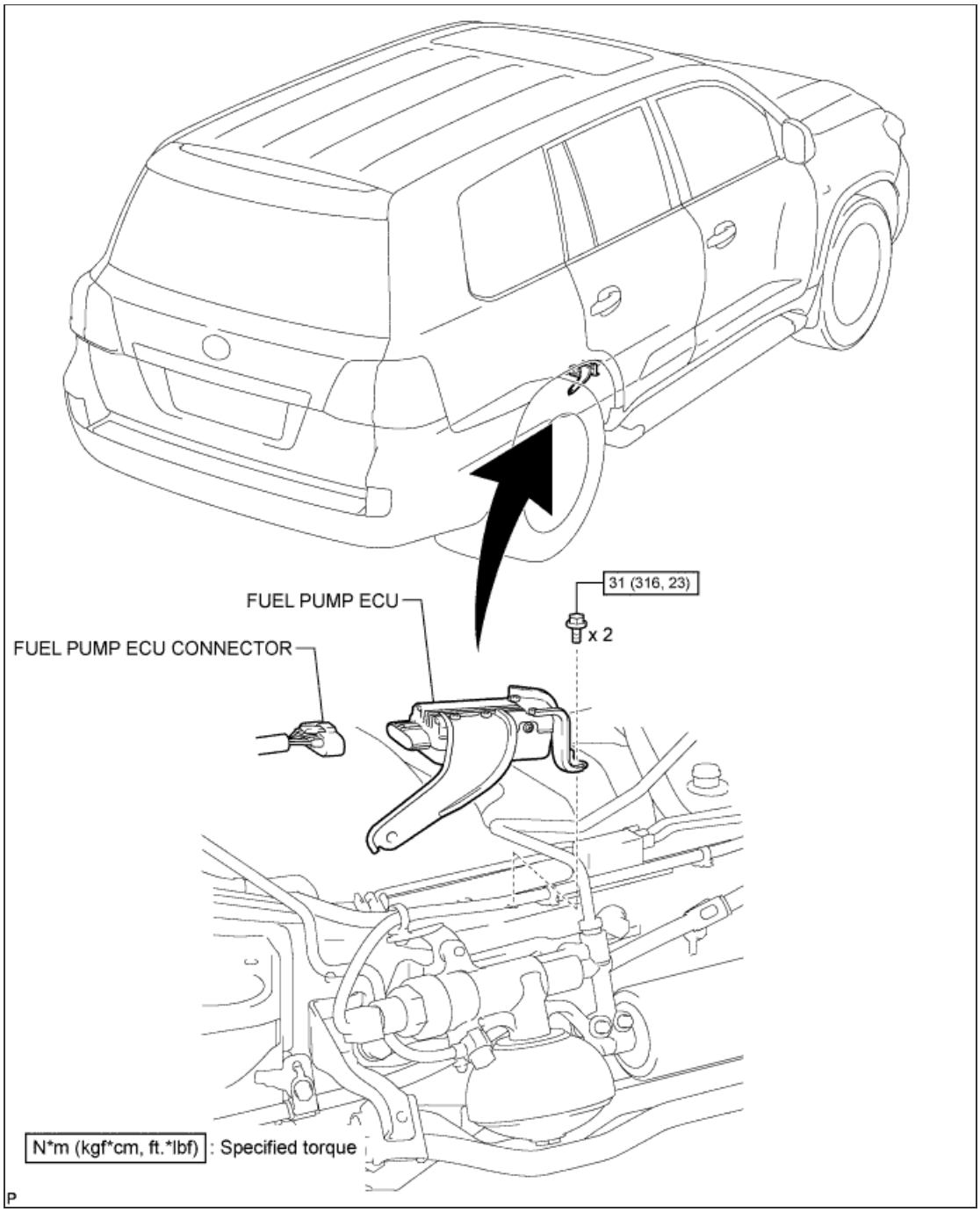
N*m (kgf*cm, ft.*lbf) : Specified torque

P


OUTER LAP BELT ANCHOR COVER
REAR FLOOR MAT REAR SUPPORT PLATE
SEAT BELT ANCHOR
FRONT QUARTER TRIM PANEL ASSEMBLY RH
12 (122, 9)
REAR SEAT COVER CAP
42 (428, 31)
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
REAR SEAT COVER CAP
42 (428, 31)
12 (122, 9)
SEAT BELT ANCHOR
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
42 (428, 31)
FRONT QUARTER TRIM PANEL ASSEMBLY LH
REAR STEP COVER
REAR DOOR SCUFF PLATE RH
REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)
REAR STEP COVER
AIR DUCT PLUG (w/ Rear Air Conditioning System)
REAR DOOR SCUFF PLATE LH
N*m (kgf*cm, ft.*lbf) : Specified torque
T


REAR NO. 1 SEAT PROTECTOR
REAR NO. 2 SEAT PROTECTOR
FRONT FLOOR CARPET ASSEMBLY
x 2
AIR DUCT
REAR FLOOR NO. 2 SERVICE HOLE COVER
P


FUEL TANK SUB-ASSEMBLY
P


FUEL PUMP ECU
FUEL PUMP ECU CONNECTOR
31 (316, 23)
x 2
N*m (kgf*cm, ft.*lbf) : Specified torque
P

for Preparation Click here

1. REMOVE FUEL TANK SUB-ASSEMBLY

a. Remove the fuel tank sub-assembly (Click here).

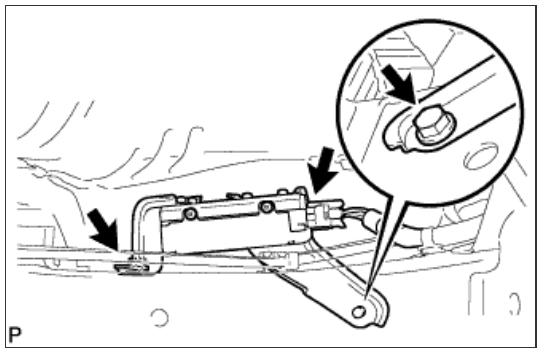
2. REMOVE FUEL PUMP CONTROL ECU ASSEMBLY

a. Disconnect the ECU connector.

b. Remove the 2 bolts and ECU.

NOTICE:

Make sure the ECU is not subjected to physical shocks such as being dropped, etc.



for Preparation Click here

1. INSTALL FUEL PUMP CONTROL ECU ASSEMBLY

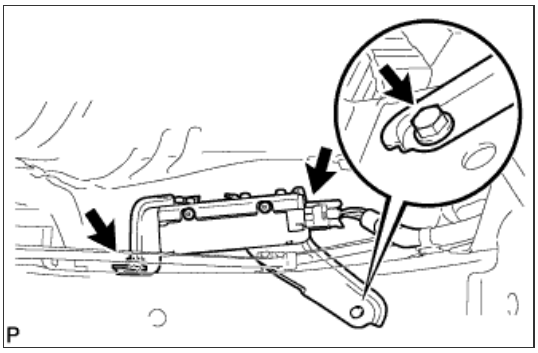
a. Install the ECU with the 2 bolts.

Torque:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

NOTICE:

Do not use the ECU if it has been subjected to physical shocks such as being dropped, etc.

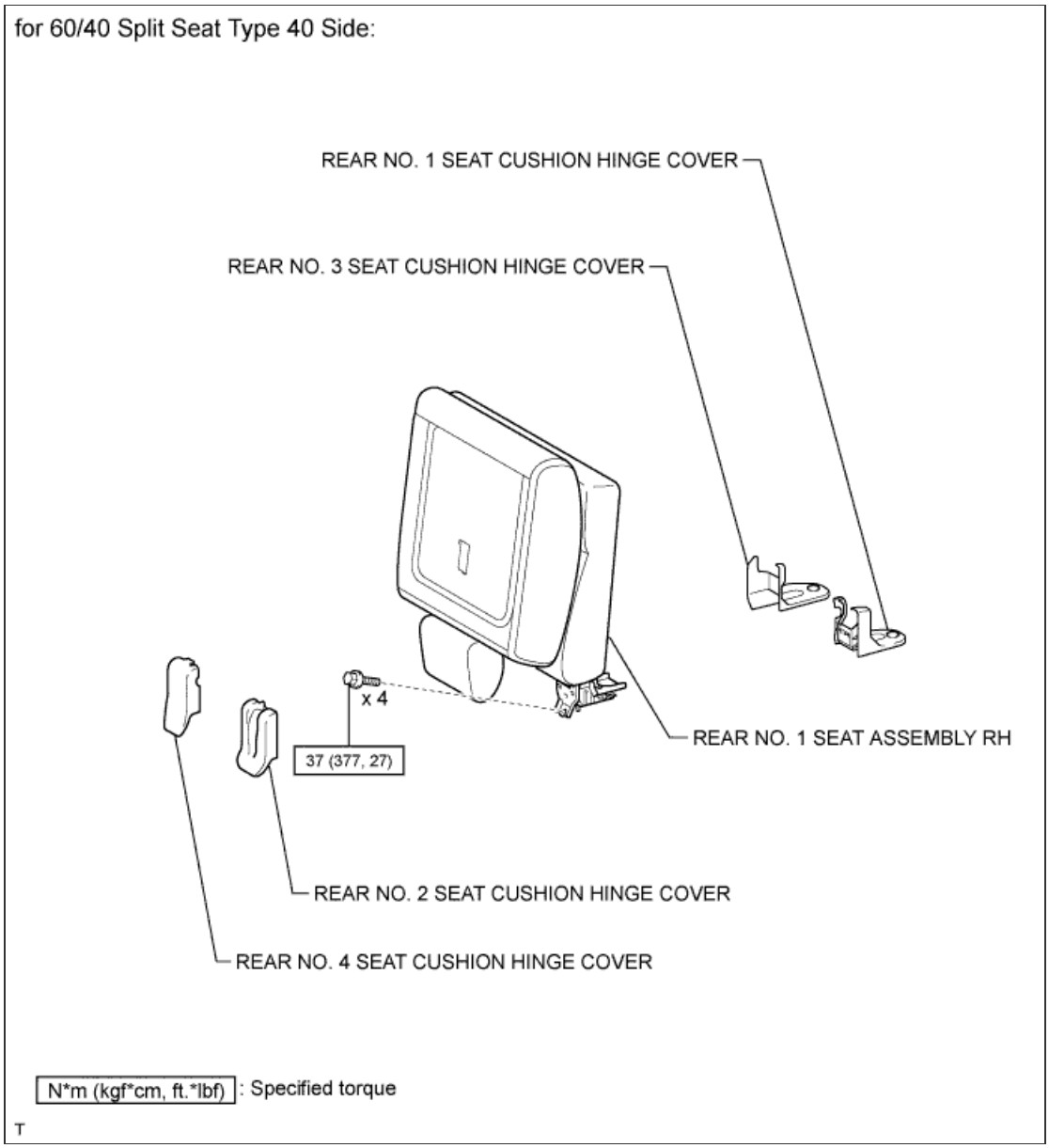
b. Connect the ECU connector.



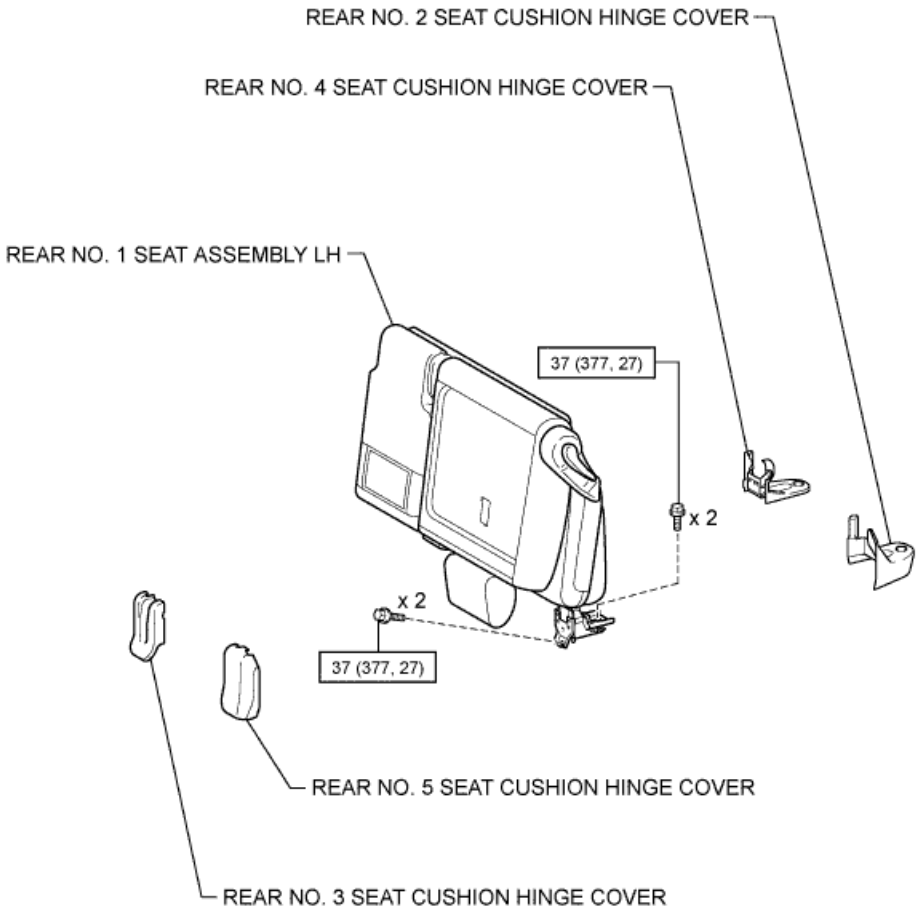
2. INSTALL FUEL TANK SUB-ASSEMBLY

a. Install the fuel tank sub-assembly (Click here).

for Preparation [Click here]



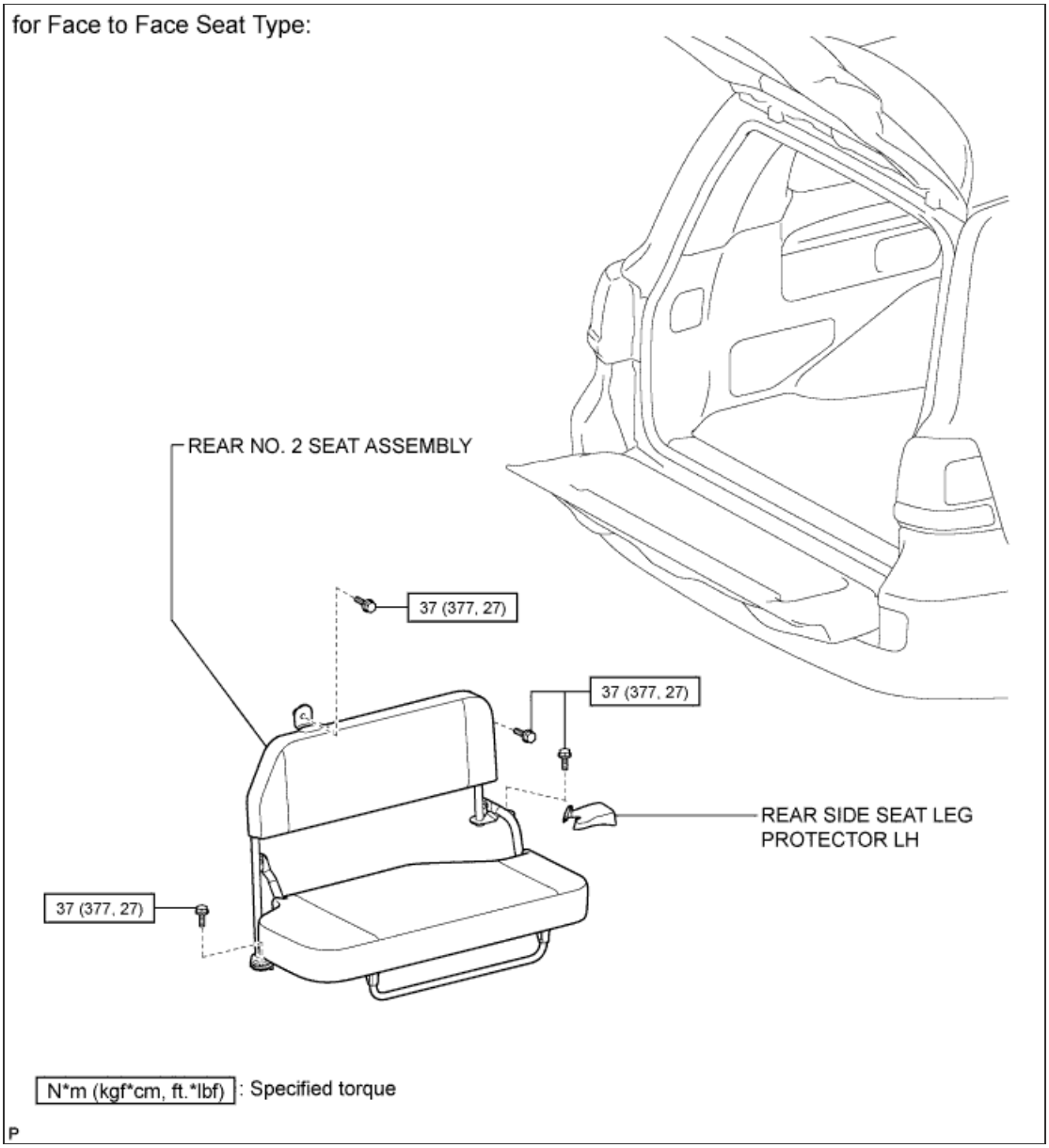
for 60/40 Split Seat Type 60 Side:



N*m (kgf*cm, ft.*lbf) : Specified torque

T

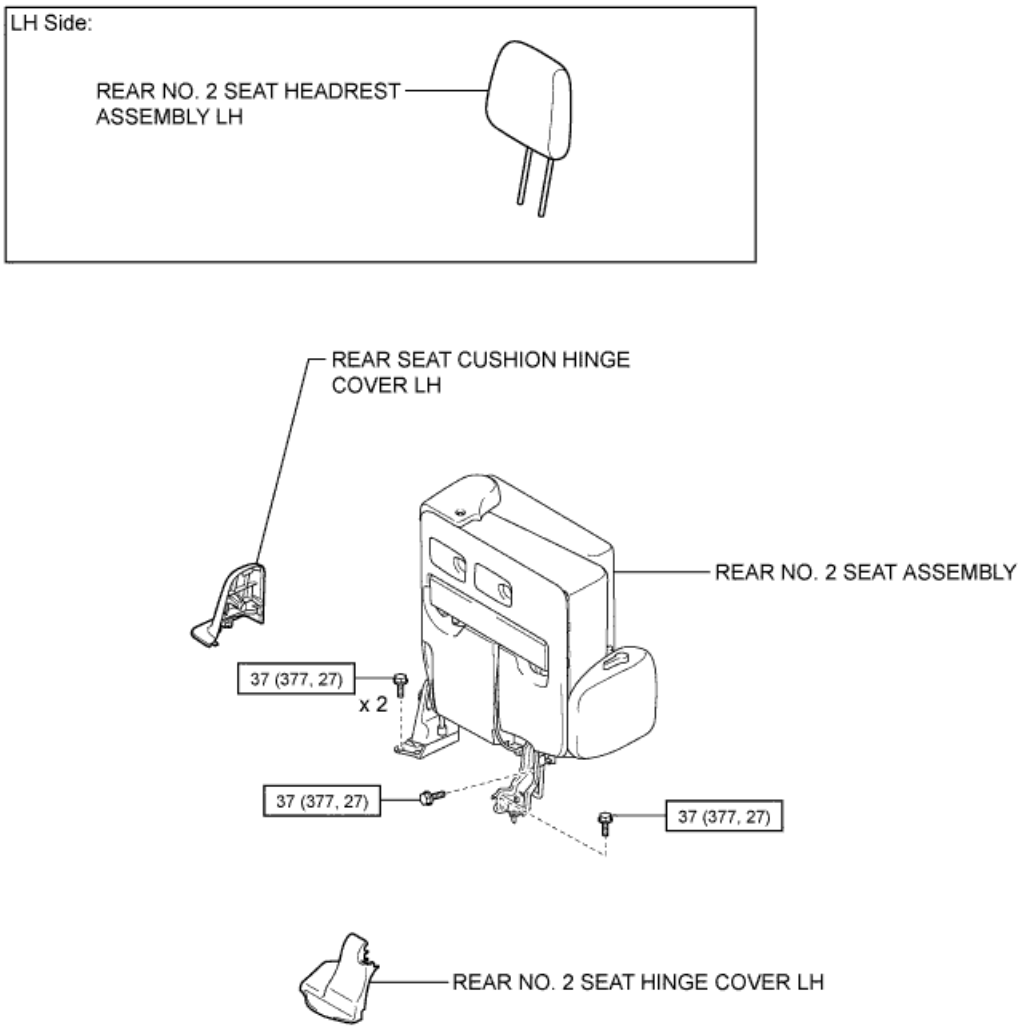
for Face to Face Seat Type:



N*m (kgf*cm, ft.*lbf) : Specified torque

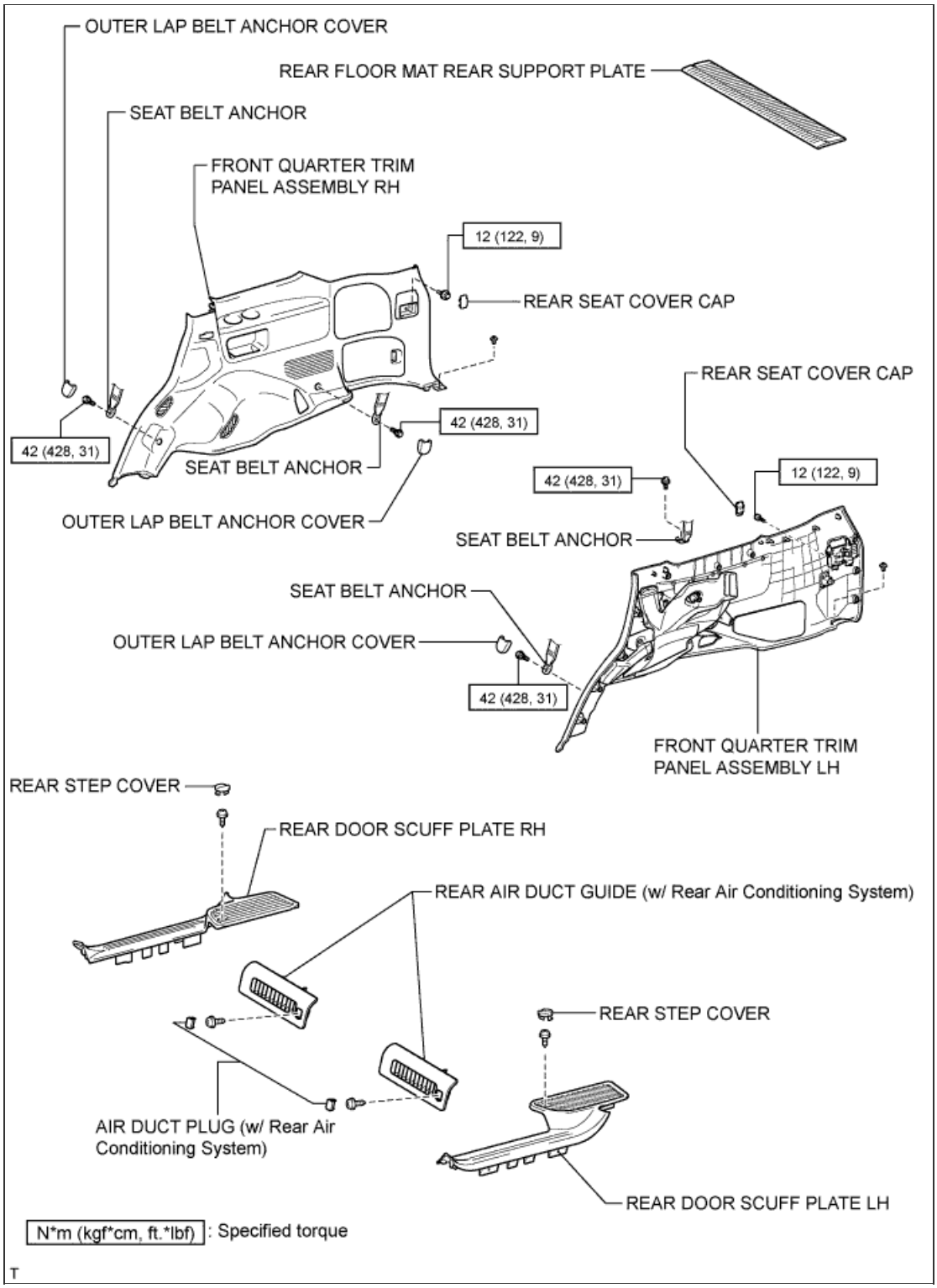
P

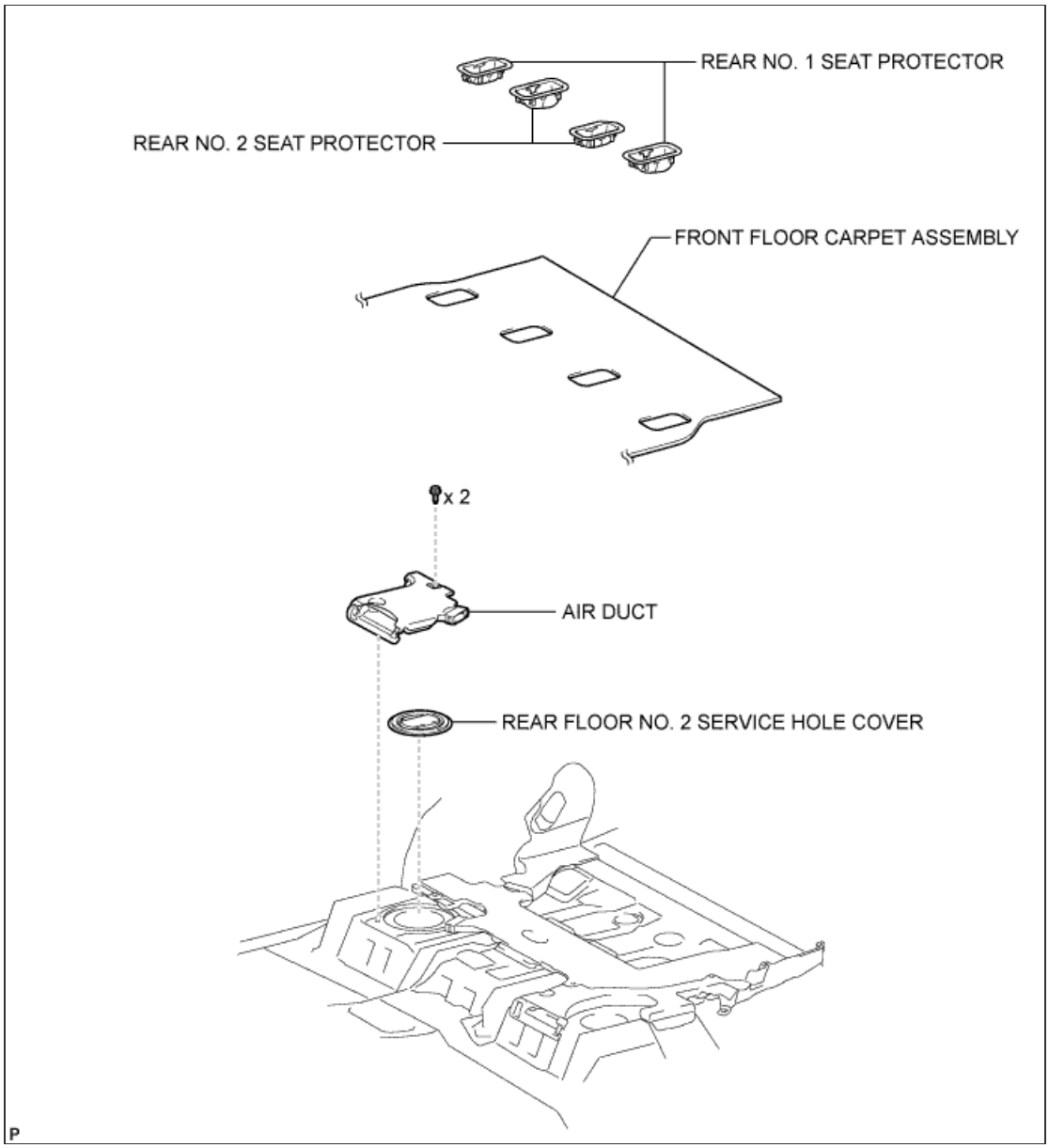
except Face to Face Seat Type:

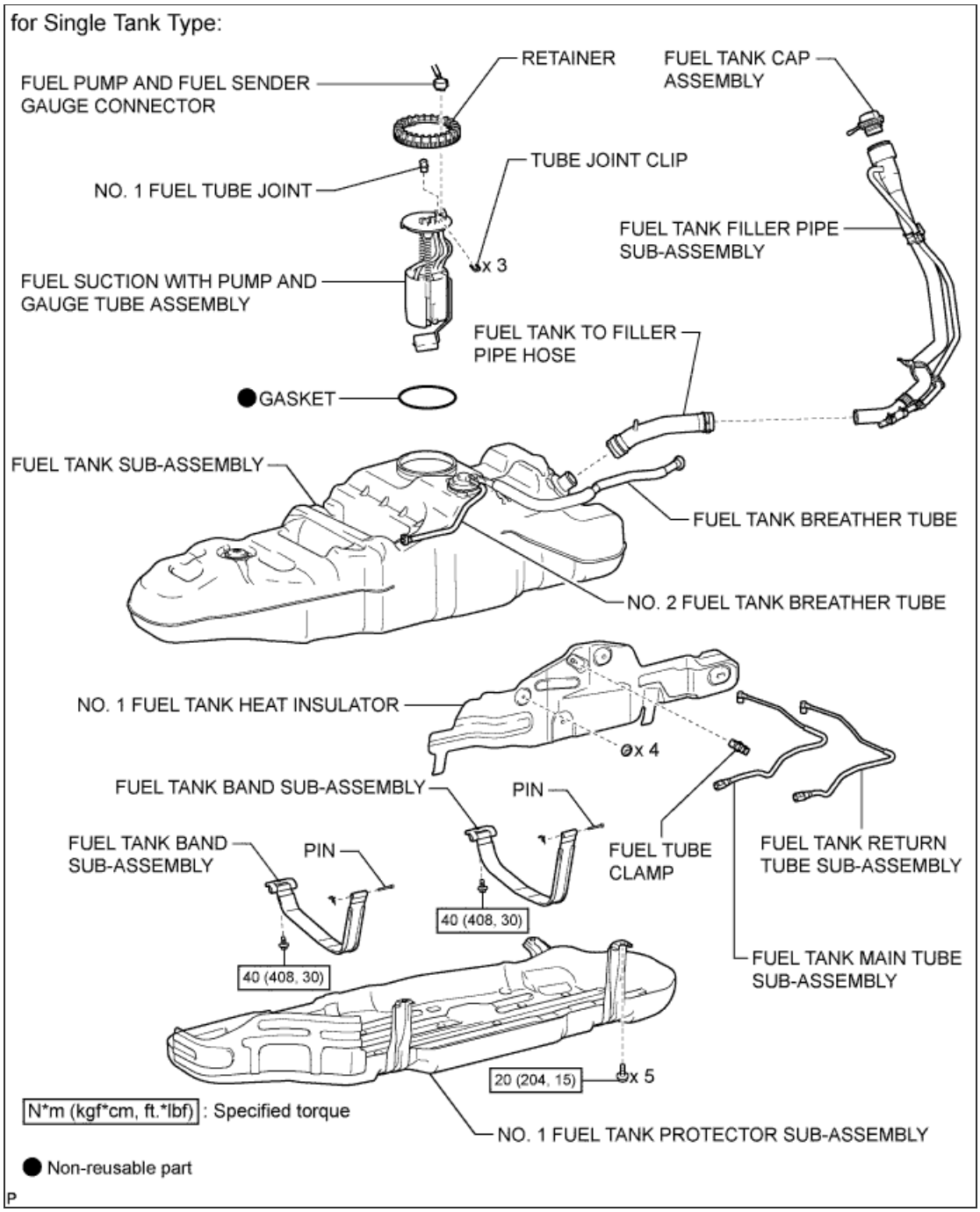


N*m (kgf*cm, ft.*lbf) : Specified torque

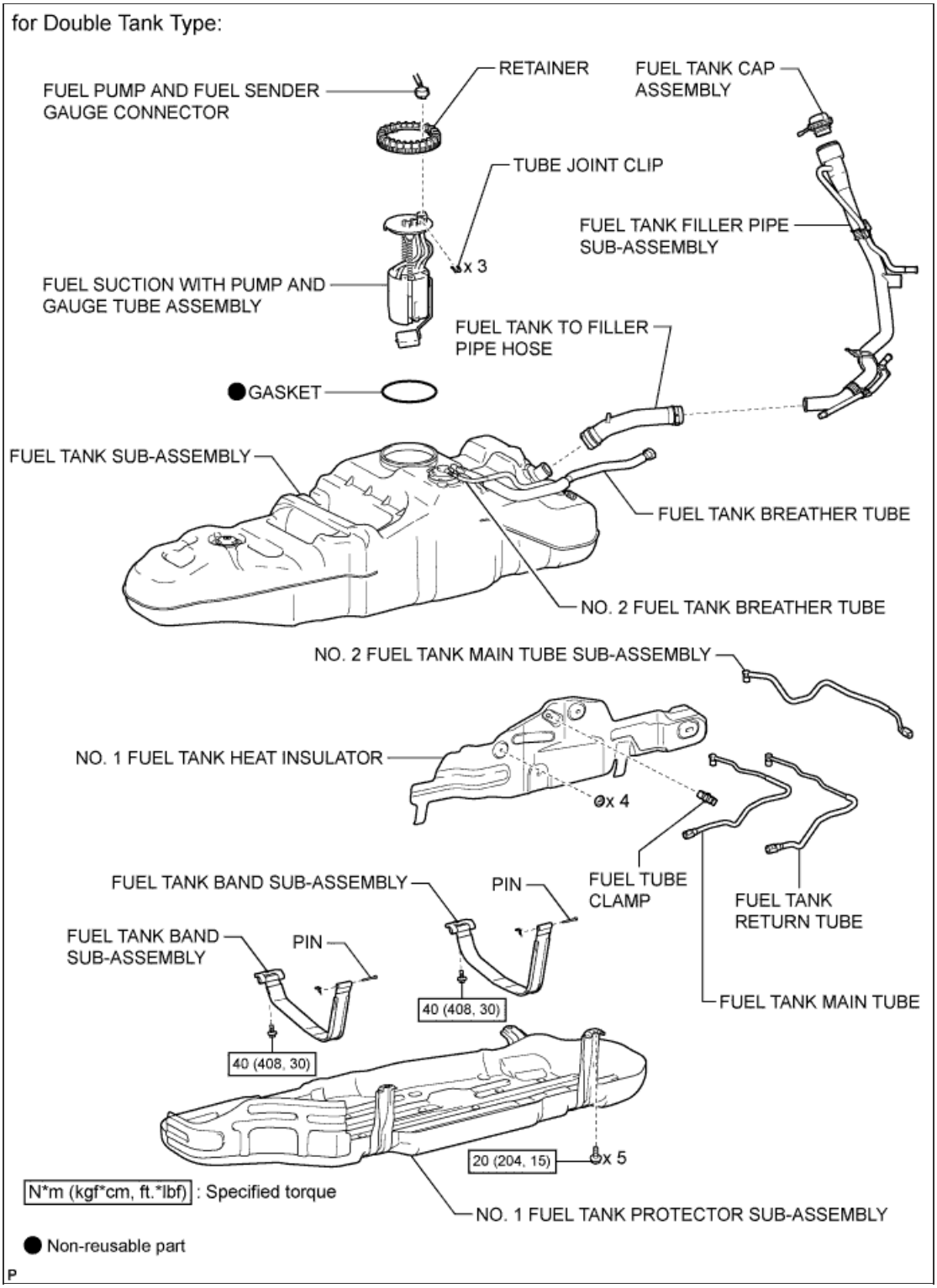
P


OUTER LAP BELT ANCHOR COVER
REAR FLOOR MAT REAR SUPPORT PLATE
SEAT BELT ANCHOR
FRONT QUARTER TRIM PANEL ASSEMBLY RH
12 (122, 9)
REAR SEAT COVER CAP
42 (428, 31)
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
REAR SEAT COVER CAP
12 (122, 9)
42 (428, 31)
SEAT BELT ANCHOR
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
42 (428, 31)
FRONT QUARTER TRIM PANEL ASSEMBLY LH
REAR STEP COVER
REAR DOOR SCUFF PLATE RH
REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)
REAR STEP COVER
AIR DUCT PLUG (w/ Rear Air Conditioning System)
REAR DOOR SCUFF PLATE LH
N*m (kgf*cm, ft.*lbf) : Specified torque
T


REAR NO. 1 SEAT PROTECTOR
REAR NO. 2 SEAT PROTECTOR
FRONT FLOOR CARPET ASSEMBLY
x 2
AIR DUCT
REAR FLOOR NO. 2 SERVICE HOLE COVER
P


for Single Tank Type:
FUEL PUMP AND FUEL SENDER GAUGE CONNECTOR
RETAINER
FUEL TANK CAP ASSEMBLY
TUBE JOINT CLIP
NO. 1 FUEL TUBE JOINT
FUEL TANK FILLER PIPE SUB-ASSEMBLY
x 3
FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY
FUEL TANK TO FILLER PIPE HOSE
GASKET
FUEL TANK SUB-ASSEMBLY
FUEL TANK BREATHER TUBE
NO. 2 FUEL TANK BREATHER TUBE
NO. 1 FUEL TANK HEAT INSULATOR
x 4
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TUBE CLAMP
FUEL TANK RETURN TUBE SUB-ASSEMBLY
40 (408, 30)
40 (408, 30)
FUEL TANK MAIN TUBE SUB-ASSEMBLY
20 (204, 15)
x 5
N*m (kgf*cm, ft.*lbf) : Specified torque
NO. 1 FUEL TANK PROTECTOR SUB-ASSEMBLY
Non-reusable part
P

for Double Tank Type:



P

for Preparation Click here

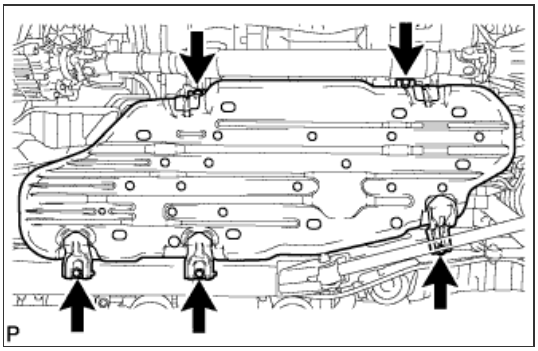
1. DISCHARGE FUEL SYSTEM PRESSURE

a. Discharge the fuel system pressure (Click here).

2. REMOVE FUEL TANK CAP ASSEMBLY

3. REMOVE NO. 1 FUEL TANK PROTECTOR SUB-ASSEMBLY

a. Remove the 5 bolts and fuel tank protector.



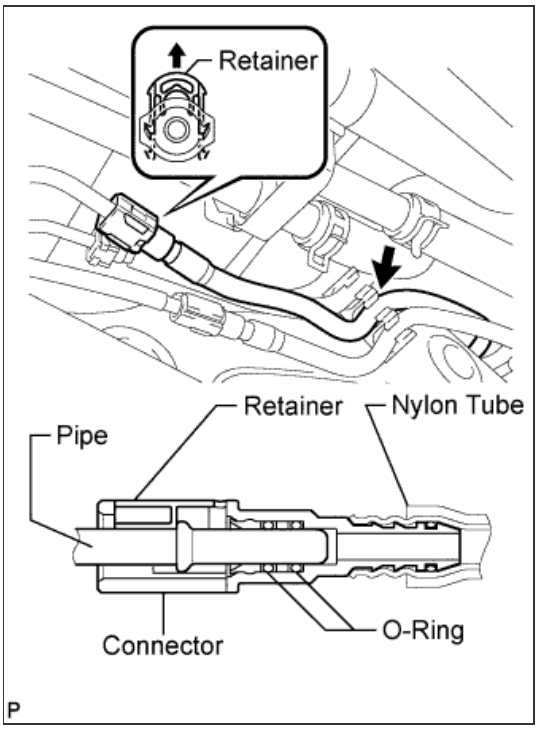
4. DISCONNECT FUEL TANK MAIN TUBE SUB-ASSEMBLY (for Single Tank Type)

a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel tank main tube.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



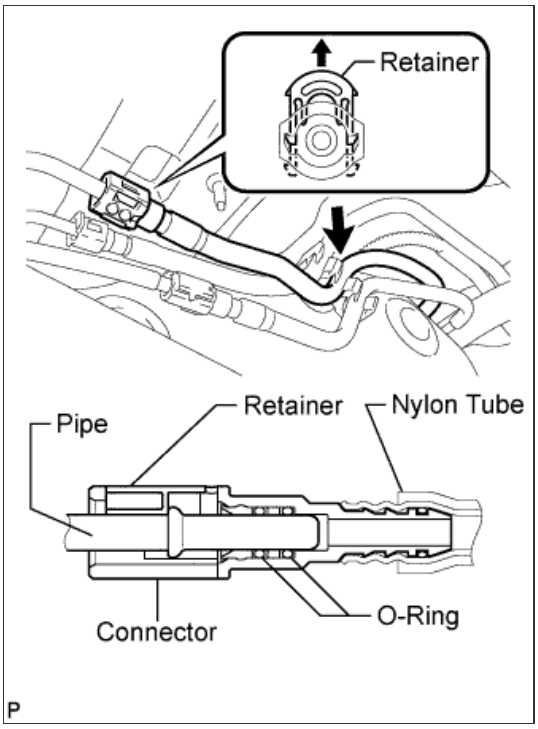
5. DISCONNECT FUEL TANK MAIN TUBE SUB-ASSEMBLY (for Double Tank Type)

a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel tank main tube.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



6. DRAIN FUEL

a. Connect the cable to the negative (-) battery terminal.

b. Connect the intelligent tester to the DLC3.

c. Turn the engine switch on (IG).

NOTICE:

Do not start the engine.

d. Turn the intelligent tester ON.

e. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Fuel Pump / Speed.

CAUTION:

- **Do not smoke or be near an open flame when working on the fuel system.**
- **Secure good ventilation.**
- **Keep gasoline away from rubber or leather parts.**

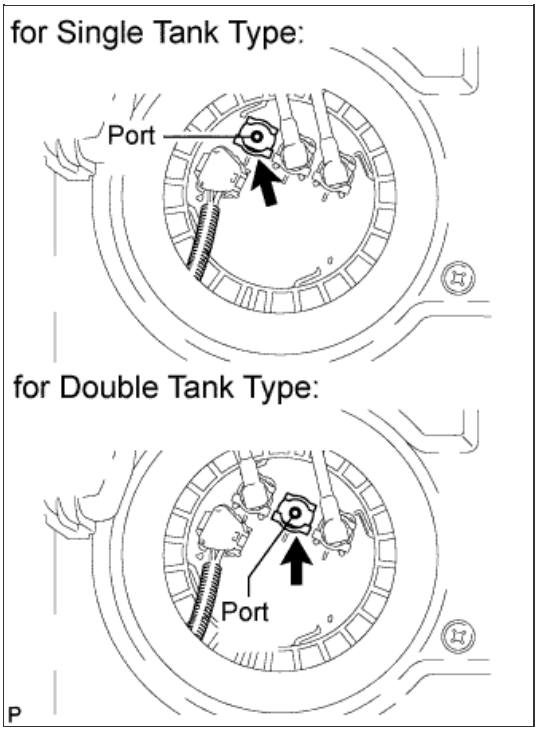
HINT:

for Single Tank Type:

If the fuel pump does not operate, remove the fuel tube joint clip and No. 1 fuel tube joint, and drain fuel from the port shown in the illustration.

for Double Tank Type:

If the fuel pump does not operate, remove the fuel tube joint clip and disconnect the fuel tank return tube, and drain fuel from the port shown in the illustration.



7. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

8. REMOVE REAR NO. 1 SEAT ASSEMBLY RH (for 60/40 Split Seat Type 40 Side)

a. Remove the rear No. 1 seat assembly RH (Click here).

9. REMOVE REAR NO. 1 SEAT ASSEMBLY LH (for 60/40 Split Seat Type 60 Side)

a. Remove the rear No. 1 seat assembly LH (Click here).

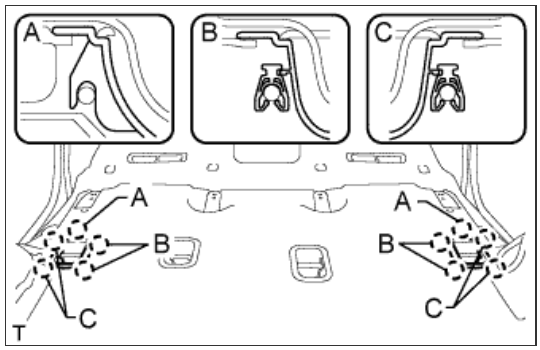
10. REMOVE REAR NO. 2 SEAT ASSEMBLY

a. for Face to Face Seat Type:
Remove the rear No. 2 seat assembly (Click here).

b. except Face to Face Seat Type:
Remove the rear No. 2 seat assembly (Click here).

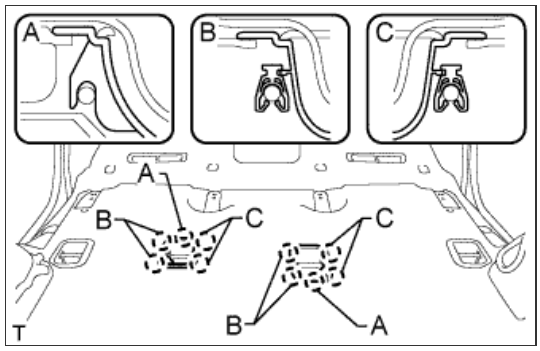
11. REMOVE REAR NO. 1 SEAT PROTECTOR

a. Detach the 10 claws and remove the 2 seat protectors.



12. REMOVE REAR NO. 2 SEAT PROTECTOR

a. Detach the 10 claws and remove the 2 seat protectors.

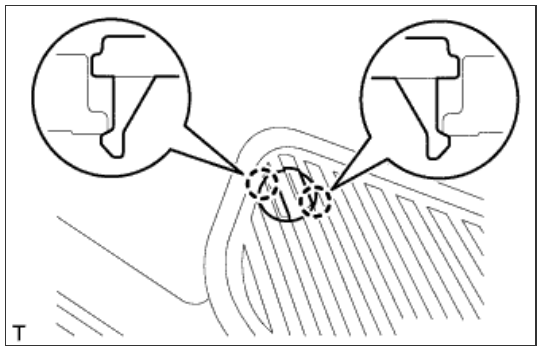


13. REMOVE REAR STEP COVER

HINT:

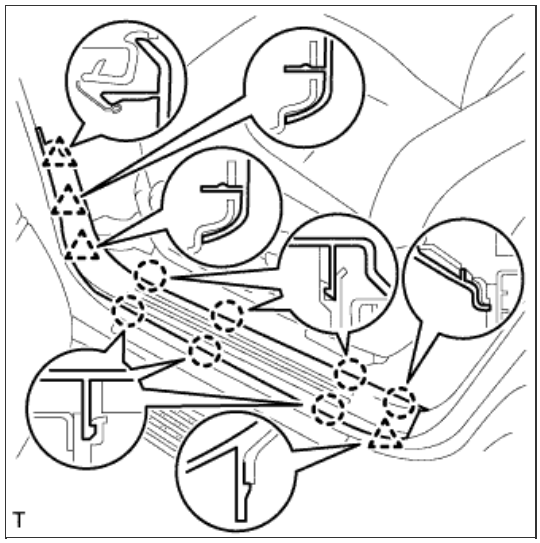
Use the same procedure to remove the step cover on the other side.

a. Detach the 2 claws and remove the step cover.



14. REMOVE REAR DOOR SCUFF PLATE LH

a. Detach the 7 claws and 4 clips, and remove the scuff plate.



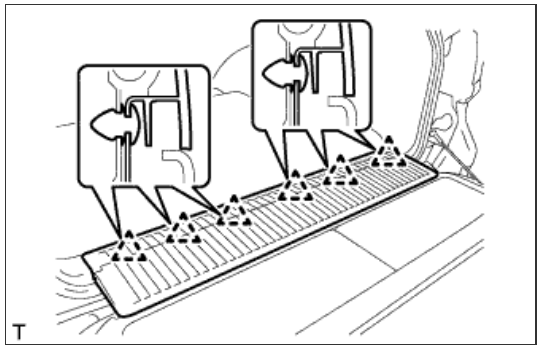
15. REMOVE REAR DOOR SCUFF PLATE RH

HINT:

Use the same procedures described for the LH side.

16. REMOVE REAR FLOOR MAT REAR SUPPORT PLATE

a. Detach the 6 clips and remove the support plate.



17. REMOVE REAR SEAT COVER CAP (w/ Rear No. 2 Seat, except Face to Face Seat Type)

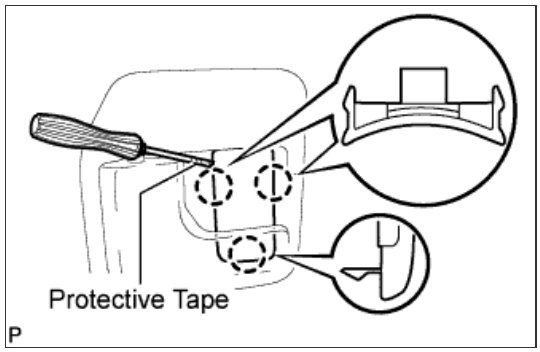
HINT:

Use the same procedure to remove the rear seat cover cap on the other side.

a. Using a screwdriver, detach the 3 claws and remove the rear seat cover cap.

HINT:

Tape the screwdriver tip before use.



18. REMOVE FRONT QUARTER TRIM PANEL ASSEMBLY LH

a. w/ Sliding Roof:
Remove the front quarter trim panel assembly LH (Click here).

b. w/o Sliding Roof:
Remove the front quarter trim panel assembly LH (Click here).

19. REMOVE FRONT QUARTER TRIM PANEL ASSEMBLY RH

a. w/ Sliding Roof:
Remove the front quarter trim panel assembly RH (Click here).

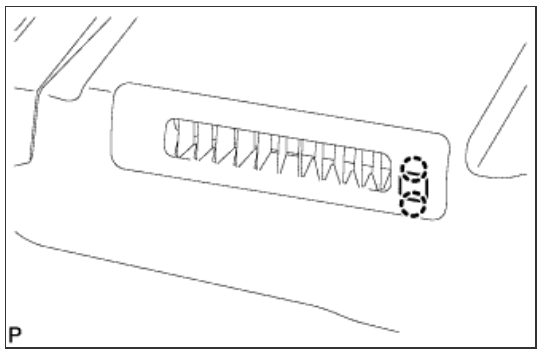
b. w/o Sliding Roof:
Remove the front quarter trim panel assembly RH (Click here).

20. REMOVE AIR DUCT PLUG (w/ Rear Air Conditioning System)

a. Detach the 2 claws and remove the plug.

HINT:

Use the same procedures for both sides.



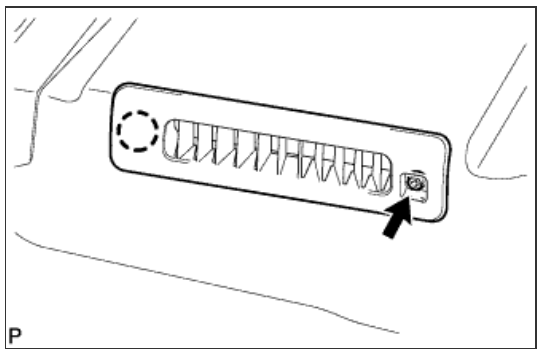
21. REMOVE REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)

a. Remove the screw.

b. Detach the claw and remove the guide.

HINT:

Use the same procedures for both sides.



22. REMOVE FRONT FLOOR CARPET ASSEMBLY

a. w/ Rear Air Conditioning System:
Turn over the floor carpet.

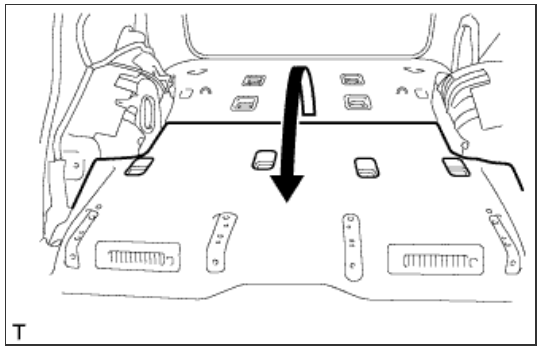
HINT:

Fold back the floor carpet so that the air duct can be removed.

b. w/o Rear Air Conditioning System:
Turn over the floor carpet.

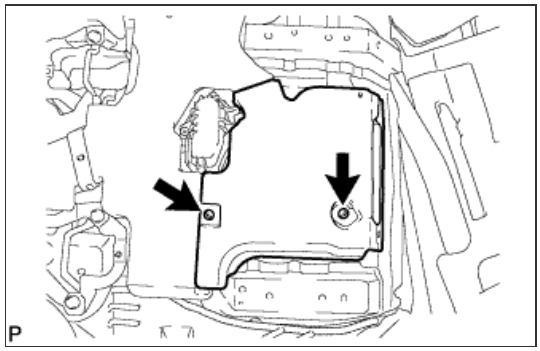
HINT:

Fold back the floor carpet so that the service hole cover can be removed.

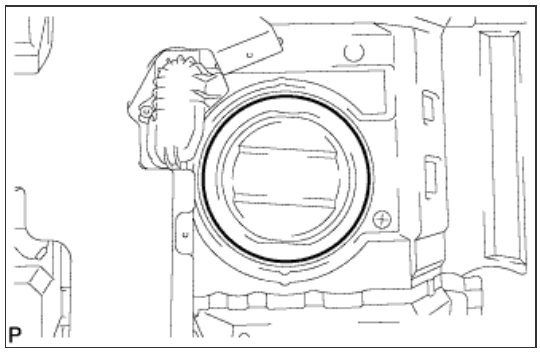


23. REMOVE REAR FLOOR NO. 2 SERVICE HOLE COVER

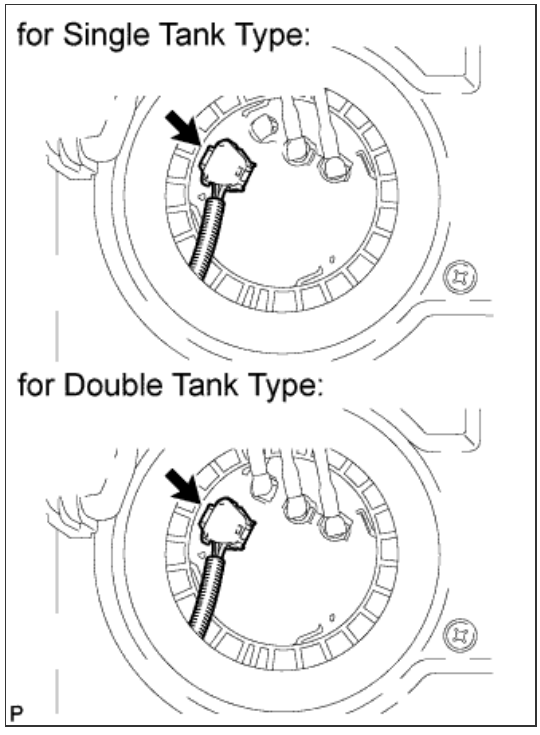
a. w/ Rear Air Conditioning System:
Remove the 2 screws and air duct.



b. Remove the service hole cover.



c. Disconnect the fuel pump and fuel sender gauge connector.



24. DISCONNECT NO. 2 FUEL TANK BREATHER TUBE (for Single Tank Type)

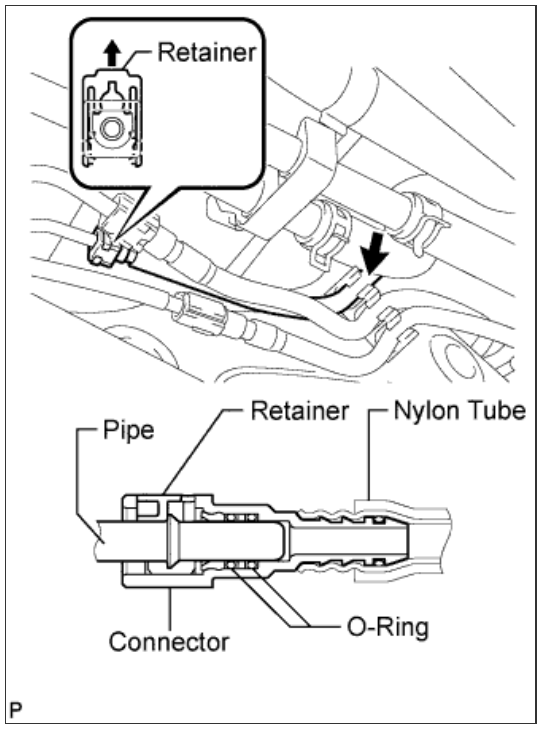
a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel tank breather tube.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**

- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



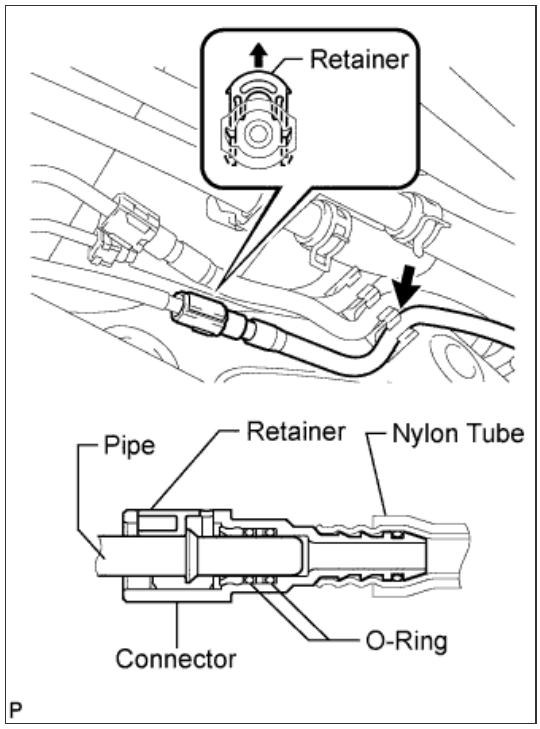
25. DISCONNECT FUEL TANK RETURN TUBE (for Single Tank Type)

a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel tank return tube.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



26. DISCONNECT FUEL TANK RETURN TUBE (for Double Tank Type)

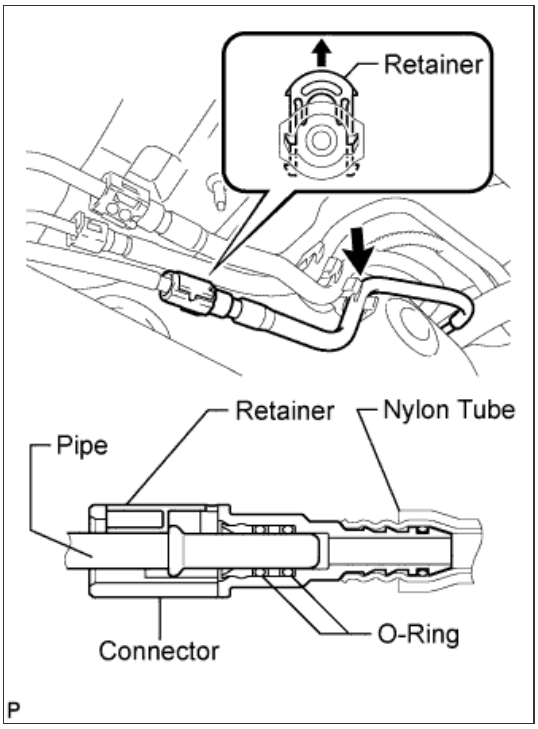
a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel tank return tube.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**

- Do not forcefully bend or twist the nylon tube.
- Check for foreign matter on the pipe seal surface. Clean if necessary.
- Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.
- If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.



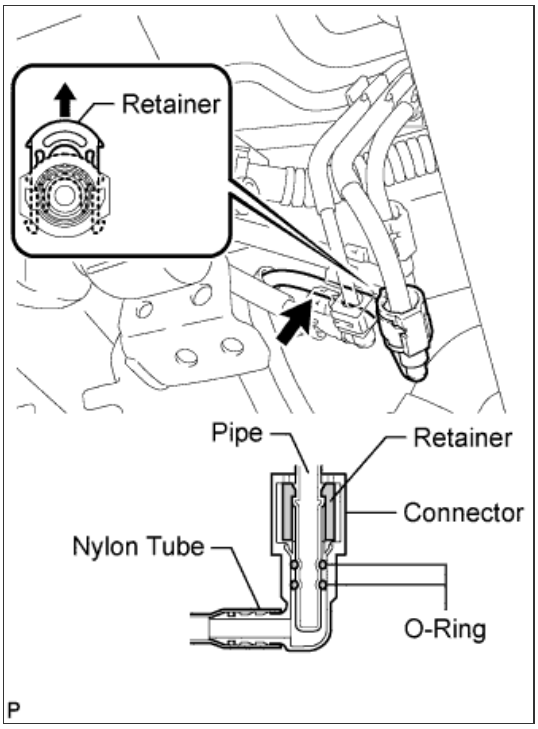
27. DISCONNECT NO. 2 FUEL MAIN TUBE SUB-ASSEMBLY (for Double Tank Type)

a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel tank main tube.

NOTICE:

- Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.
- Do not use any tools to separate the pipe and connector.
- Do not forcefully bend or twist the nylon tube.
- Check for foreign matter on the pipe seal surface. Clean if necessary.
- Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.
- If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.



28. DISCONNECT NO. 2 FUEL TANK BREATHER TUBE (for Double Tank Type)

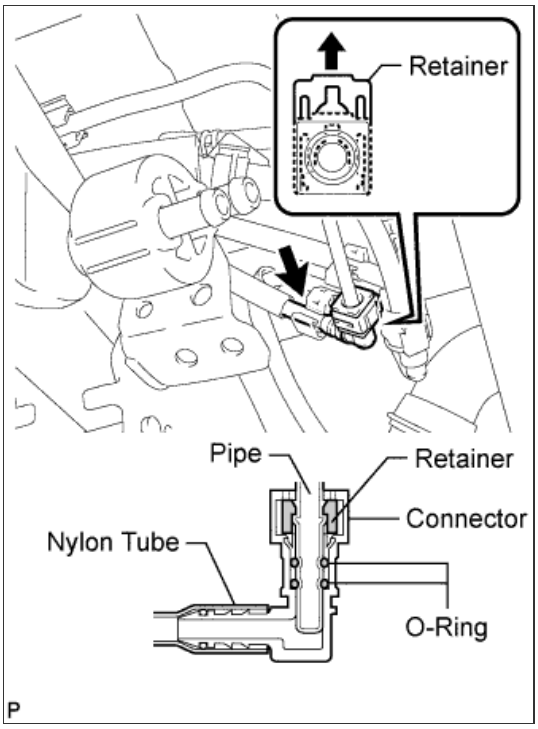
a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel tank breather tube.

NOTICE:

- Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.
- Do not use any tools to separate the pipe and connector.

- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



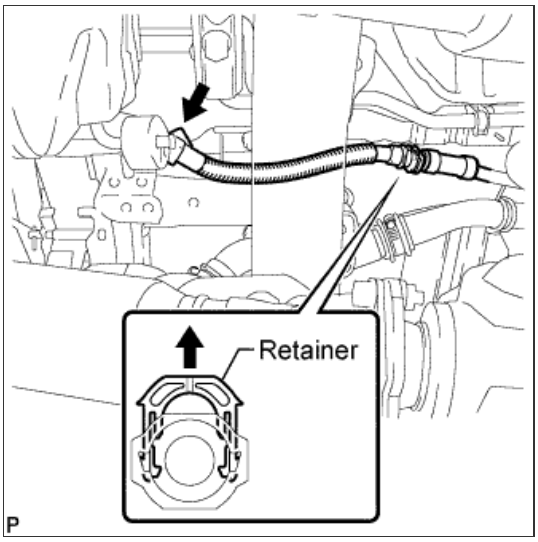
29. DISCONNECT FUEL TANK BREATHER TUBE (for Single Tank Type)

a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel tank breather tube from the filler pipe.

NOTICE:

- **Do not use any tools in this procedure.**
- **Check for any dirt and foreign matter contamination in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**



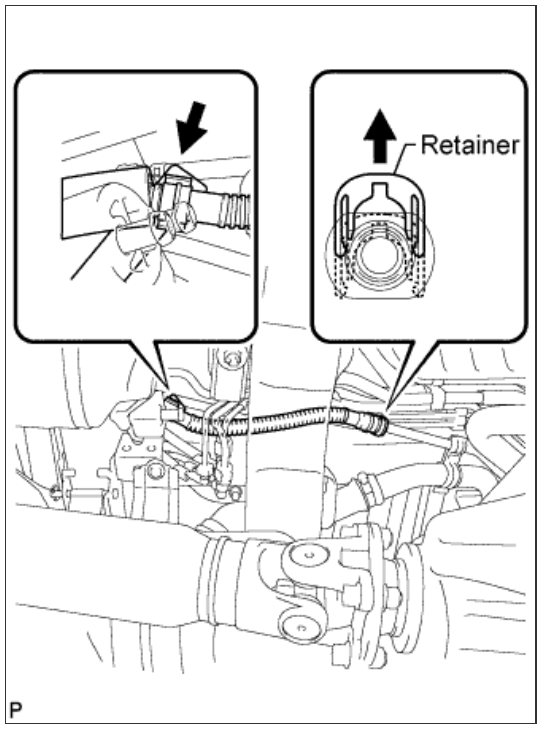
30. DISCONNECT FUEL TANK BREATHER TUBE (for Double Tank Type)

a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel tank breather tube from the filler pipe.

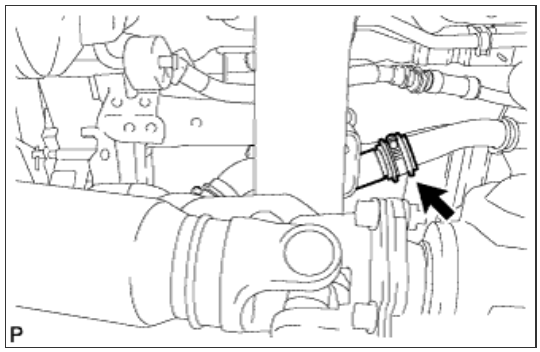
NOTICE:

- **Do not use any tools in this procedure.**
- **Check for any dirt and foreign matter contamination in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**



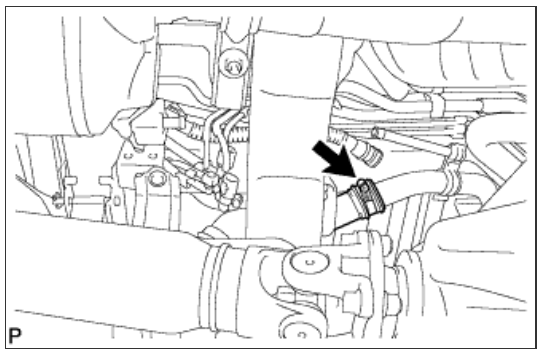
31. DISCONNECT FUEL TANK TO FILLER PIPE HOSE (for Single Tank Type)

a. Disconnect the hose from the filler pipe.



32. DISCONNECT FUEL TANK TO FILLER PIPE HOSE (for Double Tank Type)

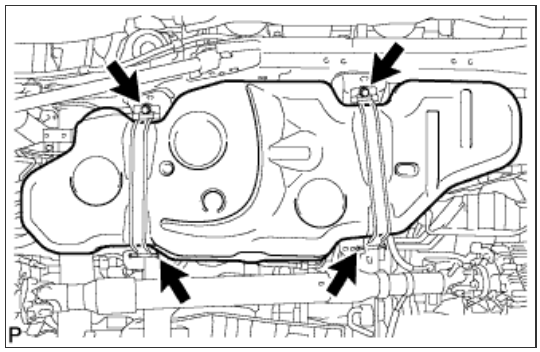
a. Disconnect the hose from the filler pipe.



33. REMOVE FUEL TANK SUB-ASSEMBLY

a. Place a transmission jack under the fuel tank.

b. Remove the 2 bolts, 2 clips, 2 pins and 2 fuel tank bands.

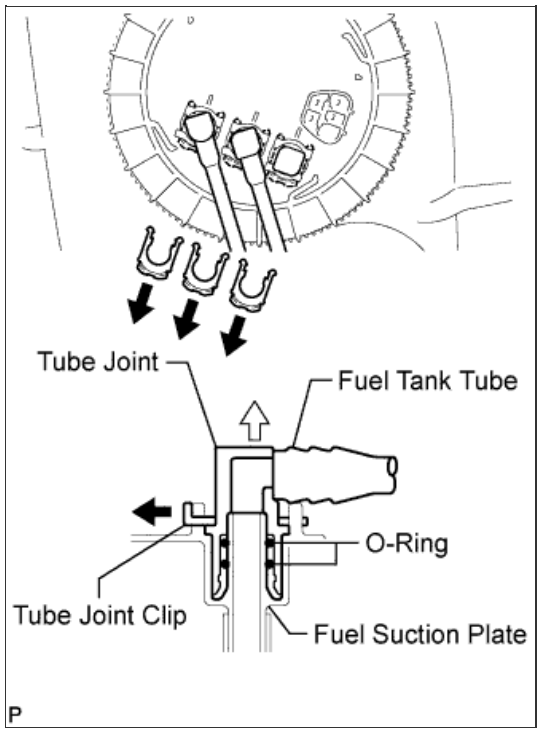


34. REMOVE FUEL TANK MAIN TUBE SUB-ASSEMBLY AND FUEL TANK RETURN TUBE SUB-ASSEMBLY (for Single Tank Type)

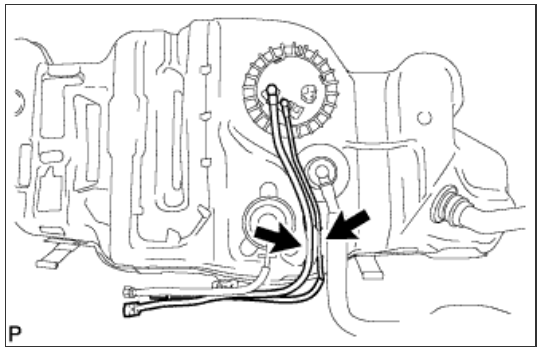
a. Remove the 3 fuel tube joint clips and pull out the 2 fuel tubes and No. 1 fuel tube joint.

NOTICE:

- **Remove any dirt and foreign matter on the fuel tube oint before performing this work.**
- **Do not allow any scratches or foreign matter on the parts when disconnecting them, as the fuel tube oint contains the O-rings that seal the plug.**
- **Perform this work by hand. Do not use any tools.**
- **Do not forcibly bend, twist or turn the nylon tube.**
- **Protect the disconnected part by covering it with a plastic bag and tape after disconnecting the fuel tubes.**



b. Remove the 2 fuel tubes from the fuel tank.



35. REMOVE FUEL TANK MAIN TUBE, FUEL TANK RETURN TUBE AND NO. 2 FUEL TANK MAIN TUBE SUB-ASSEMBLY (for Double Tank Type)

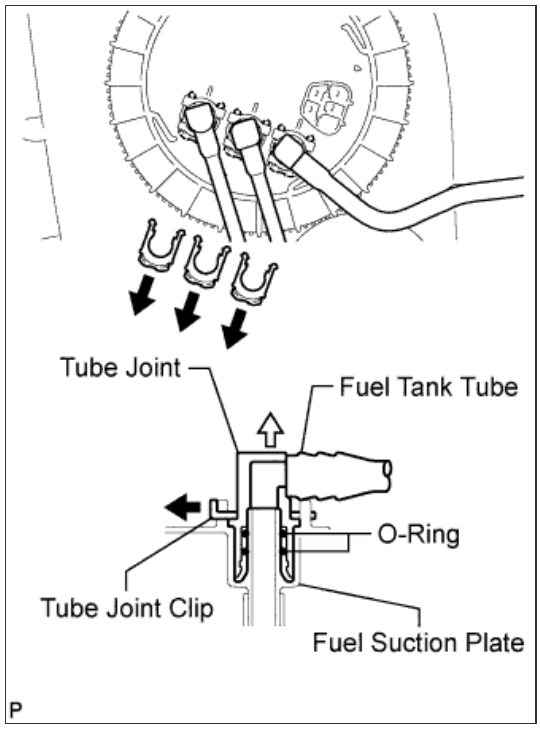
a. Remove the 3 fuel tube joint clips and pull out the 3 fuel tubes.

NOTICE:

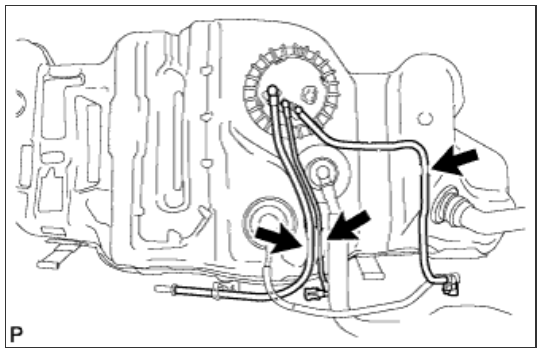
- **Remove any dirt and foreign matter on the fuel tube oint before performing this work.**
- **Do not allow any scratches or foreign matter on the parts when**

disconnecting them, as the fuel tube oint contains the O-rings that seal the plug.

- Perform this work by hand. Do not use any tools.
- Do not forcibly bend, twist or turn the nylon tube.
- Protect the disconnected part by covering it with a plastic bag and tape after disconnecting the fuel tubes.



b. Remove the 3 fuel tubes from the fuel tank.



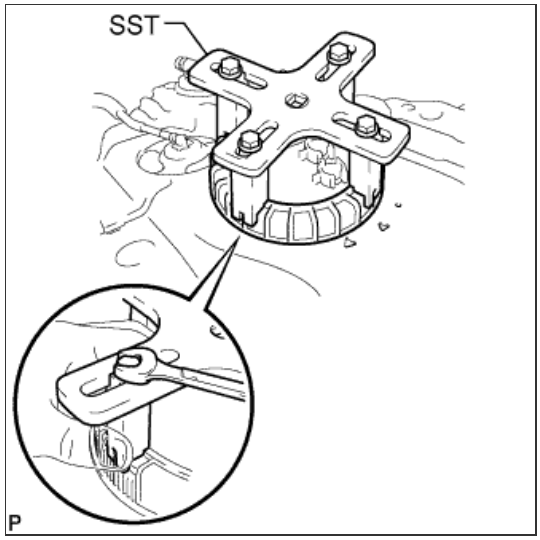
36. REMOVE FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

a. Set SST on the retainer.

SST
09808-14030

HINT:

- **Securely attach the claws of SST to the protrusion of the retainer and fix SST in place.**
- **Install SST while pressing the claws of SST against the retainer (towards the center of SST).**

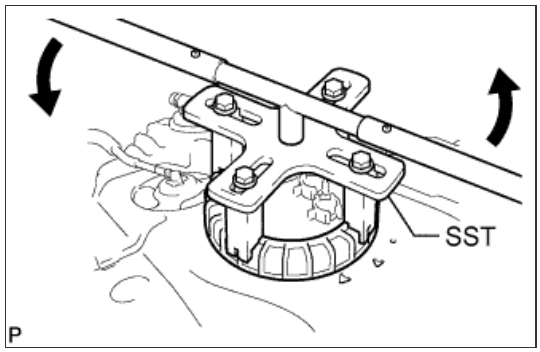


b. Using SST, loosen the retainer.

SST
09808-14030

NOTICE:

- **Do not use any tools other than those specified in this operation. Damage to the retainer or the fuel tank may result.**
- **While pressing down on SST so that the claws of SST do not slip off the protrusion of the retainer, turn the retainer counterclockwise to loosen it.**



HINT:

The protrusion of the retainer fit in the ends of SST.

Text in Illustration

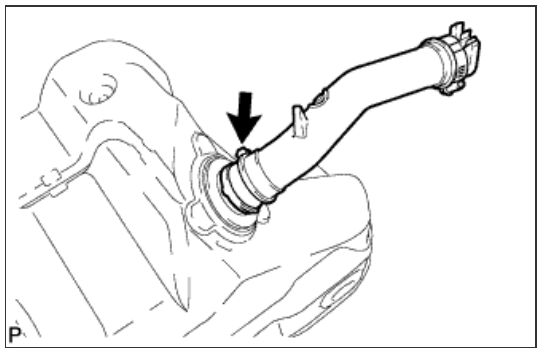
➡	Turn

c. Remove the retainer while holding the fuel suction tube assembly by hand.

d. Remove the gasket from the fuel tank.

37. REMOVE FUEL TANK TO FILLER PIPE HOSE

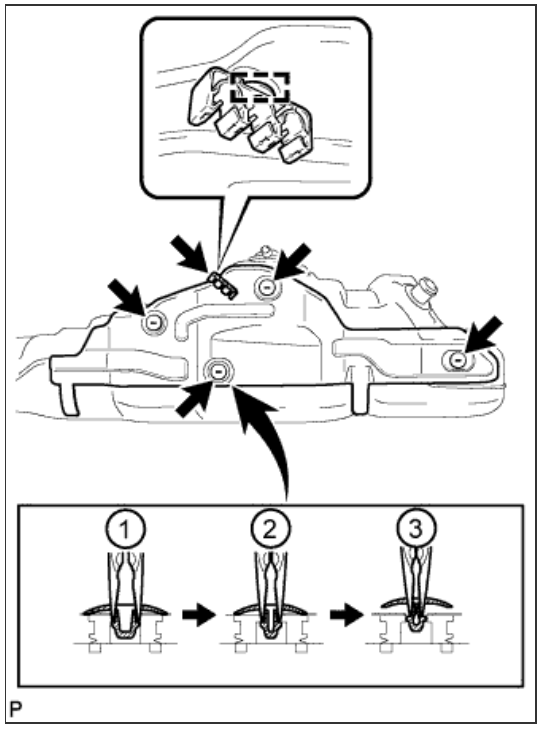
a. Remove the hose from the fuel tank.



38. REMOVE NO. 1 FUEL TANK HEAT INSULATOR

a. Remove the fuel tube clamp from the heat insulator.

b. Using needle-nose pliers, remove the 4 clips shown in the illustration and then remove the heat insulator.

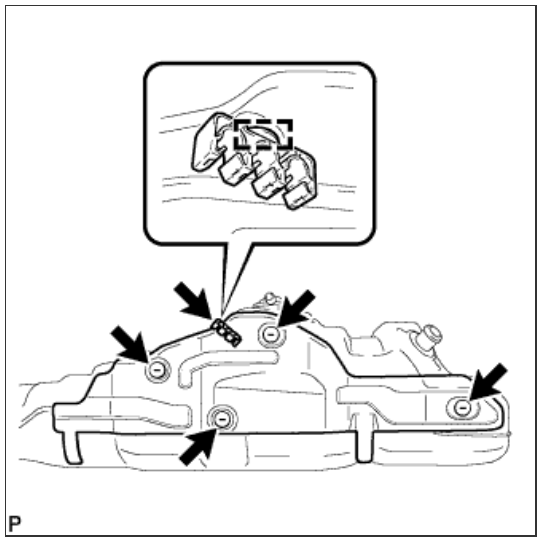


for Preparation Click here

1. INSTALL NO. 1 FUEL TANK HEAT INSULATOR

a. Install the heat insulator with the 4 clips.

b. Install the fuel tube clamp to the heat insulator.

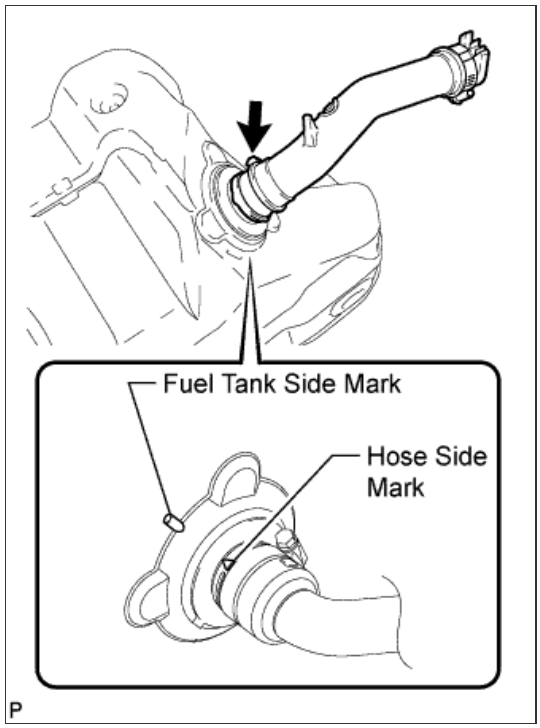


2. INSTALL FUEL TANK TO FILLER PIPE HOSE

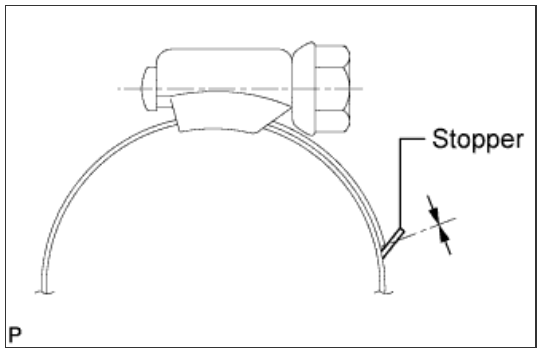
a. Install the hose to the fuel tank as shown in the illustration.

HINT:

- **Align the fuel tank side mark with the hose side mark when installing the hose.**



- **Tighten the hose clamp until the end of the hose clamp contacts the stopper as shown in the illustration.**



3. INSTALL FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

a. Apply a light coat of gasoline or grease to a new gasket, and install it to the fuel tank.

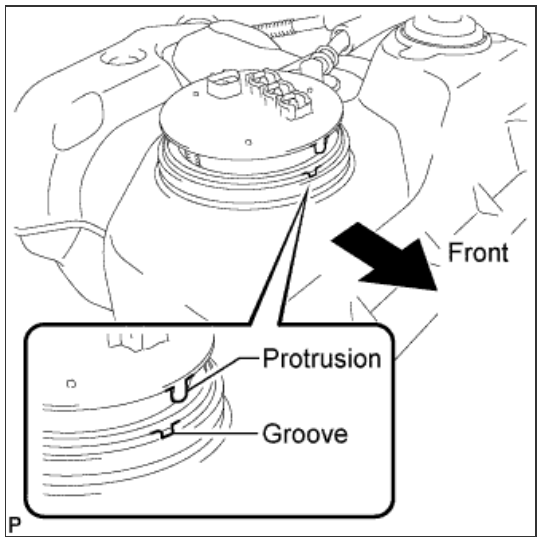
b. Install the fuel suction with pump and gauge tube into the fuel tank.

NOTICE:

Be careful not to bend the arm of the fuel sender gauge.

HINT:

Align the protrusion of the fuel suction with pump and gauge tube with the groove of the fuel tank.



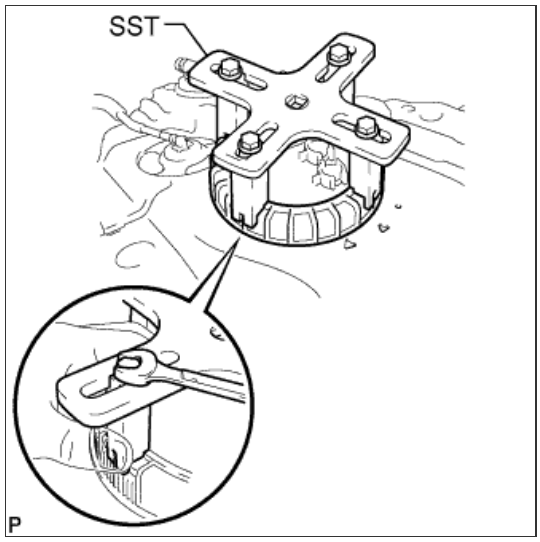
c. Put the retainer on the fuel tank. While holding the fuel suction with pump and gauge tube, tighten the retainer one complete turn by hand.

d. Set SST on the retainer.

SST
09808-14030

HINT:

- **Hold the fuel suction tube assembly upright by hand to ensure that the fuel suction tube gasket is not moved out of position.**
- **Securely attach the claws of SST to the protrusions of the retainer and fix SST in place.**
- **Install SST while pressing the claws of SST against the retainer (toward the center of SST).**

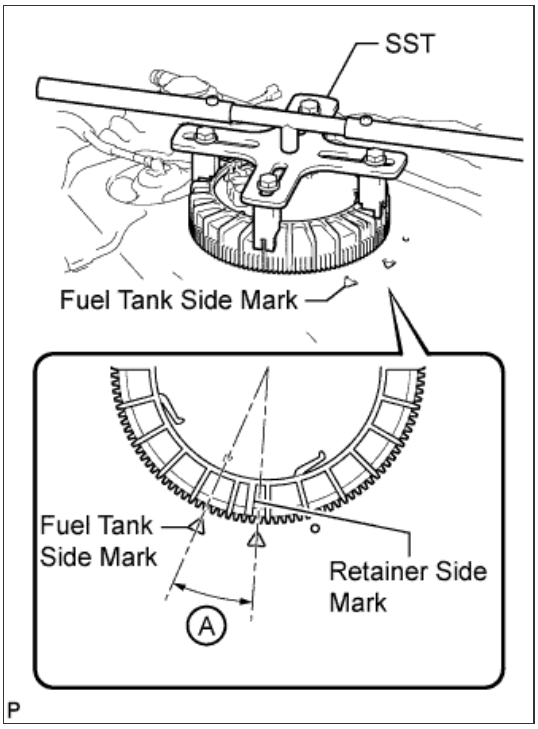


e. Using SST, tighten the retainer until the mark on the retainer is within range A on the fuel tank as shown in the illustration.

SST
09808-14030

HINT:

Fit the tips of SST onto the ribs of the retainer.

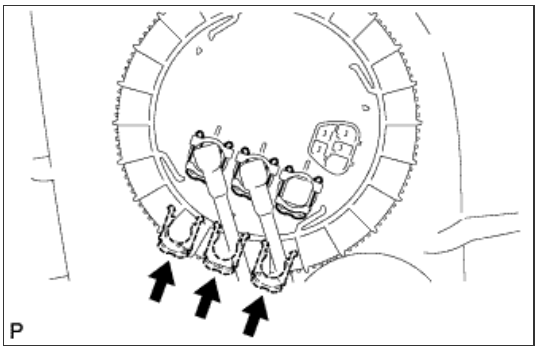


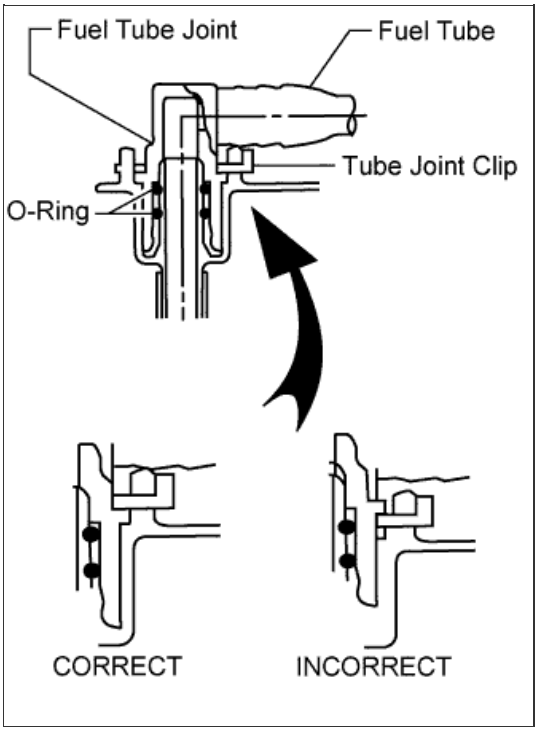
4. INSTALL FUEL TANK MAIN TUBE SUB-ASSEMBLY AND FUEL TANK RETURN TUBE SUB-ASSEMBLY (for Single Tank Type)

a. Install the 2 fuel tank tubes and No. 1 fuel tube joint with the 3 tube joint clips.

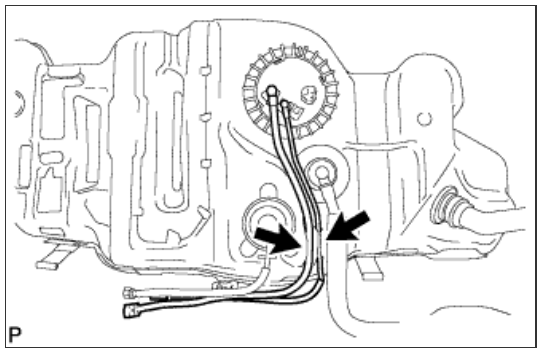
NOTICE:

- **Check that there are no scratches or foreign objects on the connecting parts.**
- **Check that the fuel tube joints are inserted securely.**
- **Check that the tube joint clips are on the collars of the fuel tube joints.**
- **After installing the tube joint clips, check that the fuel tube joints cannot be pulled off.**



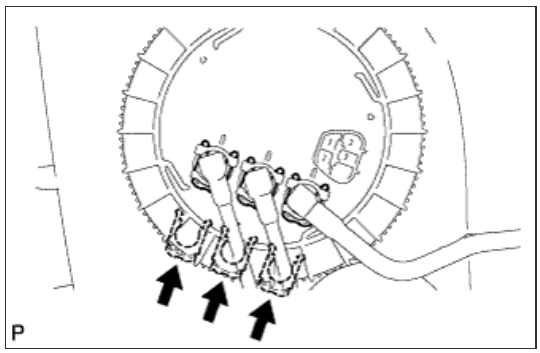


b. Install the 2 fuel tank tubes to the fuel tank.



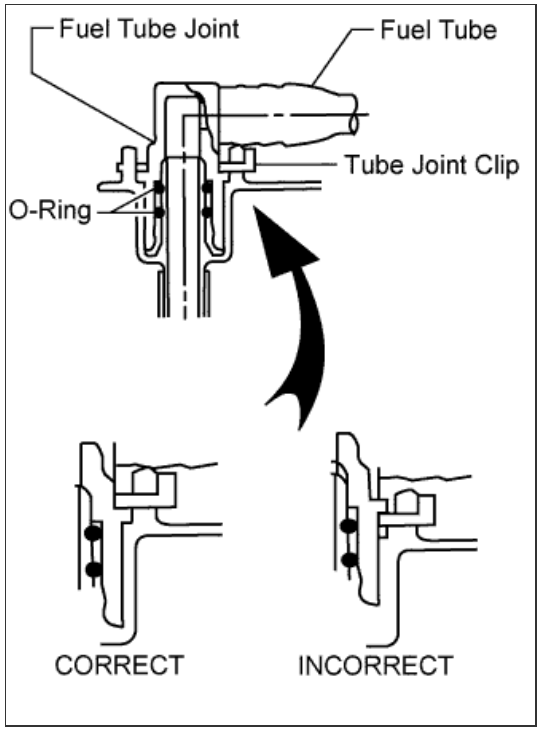
5. INSTALL FUEL TANK MAIN TUBE, FUEL TANK RETURN TUBE AND NO. 2 FUEL TANK MAIN TUBE SUB-ASSEMBLY (for Double Tank Type)

a. Install the 3 fuel tank tubes with the 3 tube joint clips.

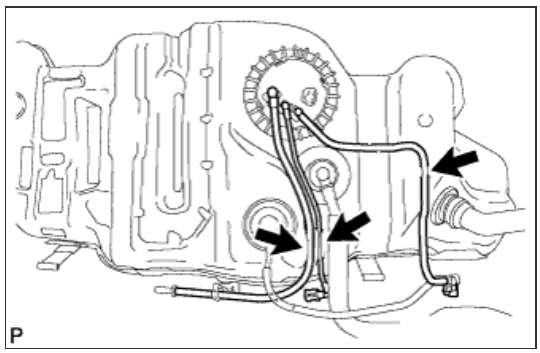


NOTICE:

- **Check that there are no scratches or foreign objects on the connecting parts.**
- **Check that the fuel tube joints are inserted securely.**
- **Check that the tube joint clips are on the collars of the fuel tube joints.**
- **After installing the tube joint clips, check that the fuel tube joints cannot be pulled off.**



b. Install the 3 fuel tank tubes to the fuel tank.



6. INSTALL FUEL TANK SUB-ASSEMBLY

a. Set the fuel tank on a transmission jack and raise the fuel tank.

NOTICE:

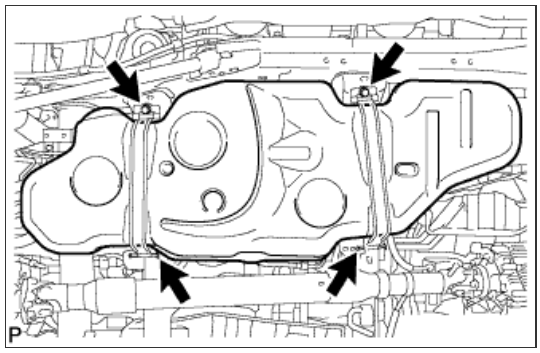
Do not allow the fuel tank to contact the vehicle, especially the differential.

b. Raise the transmission jack.

c. Install the 2 fuel tank bands with the 2 pins and 2 clips.

d. Connect the 2 fuel tank bands with the 2 bolts.

Torque:
40 N m 408 kgf cm , 30 ft. lbf

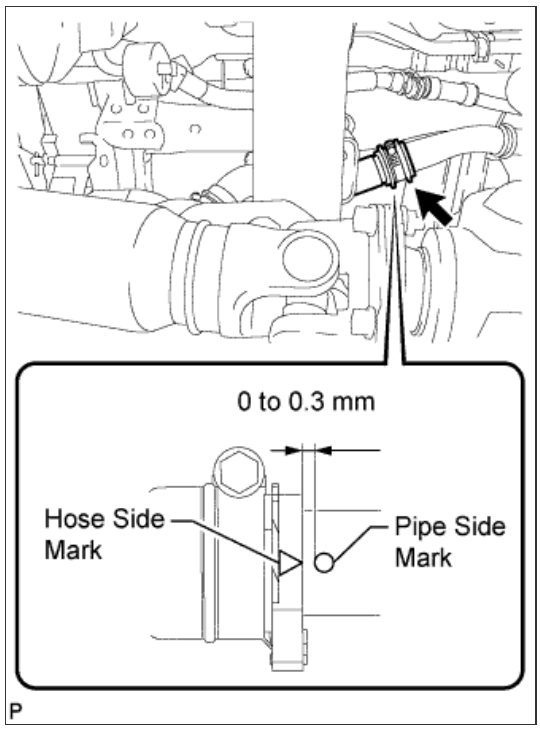


. CONNECT FUEL TANK TO FILLER PIPE HOSE (for Single Tank Type)

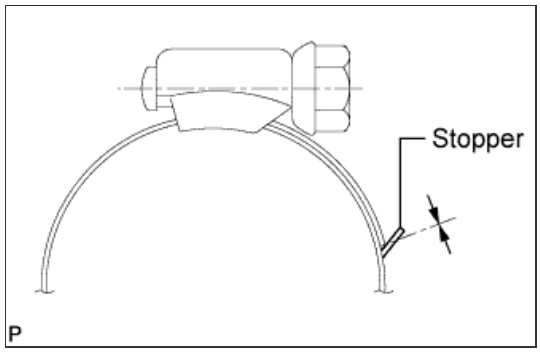
a. Connect the hose to the filler pipe as shown in the illustration.

HINT:

- **Install the hose so that the distance between the fuel tank inlet pipe side mark and fuel tank to filler pipe hose side mark is 0 to 0.3 mm (0 to 0.0118 in.) as shown in the illustration.**



- **Tighten the hose clamp until the end of the hose clamp contacts the stopper as shown in the illustration.**

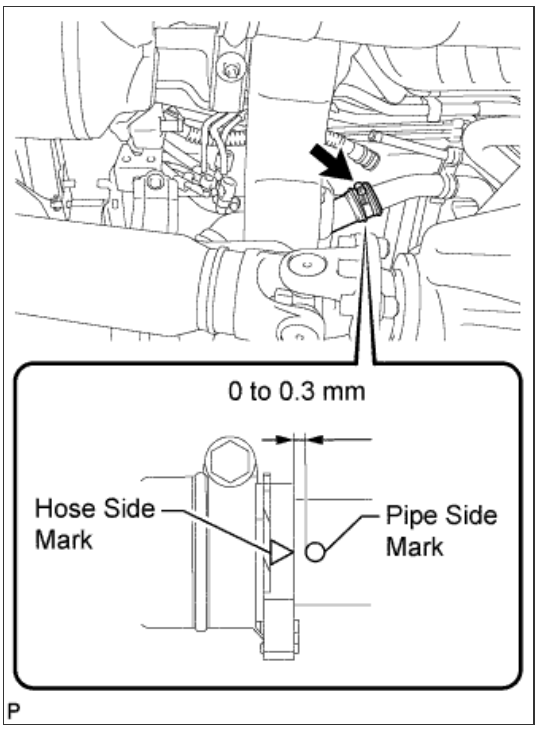


8. CONNECT FUEL TANK TO FILLER PIPE HOSE (for Double Tank Type)

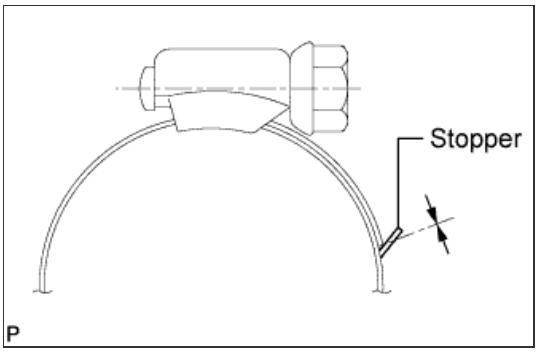
a. Connect the hose to the filler pipe as shown in the illustration.

HINT:

- **Install the hose so that the distance between the fuel tank inlet pipe side mark and fuel tank to filler pipe hose side mark is 0 to 0.3 mm (0 to 0.0118 in.) as shown in the illustration.**



- **Tighten the hose clamp until the end of the hose clamp contacts the stopper as shown in the illustration.**



9. CONNECT FUEL TANK BREATHER TUBE (for Single Tank Type)

a. Connect the fuel tank breather tube to the filler pipe and push the retainer.

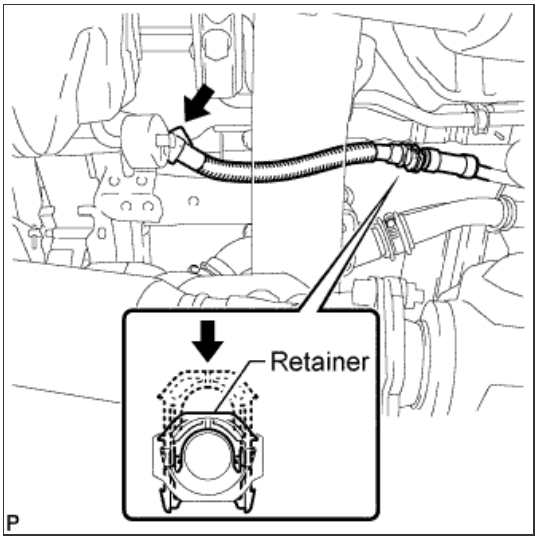
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Attach the fuel tube clamp.



10. CONNECT FUEL TANK BREATHER TUBE (for Double Tank Type)

a. Connect the fuel tank breather tube to the filler pipe and push the retainer.

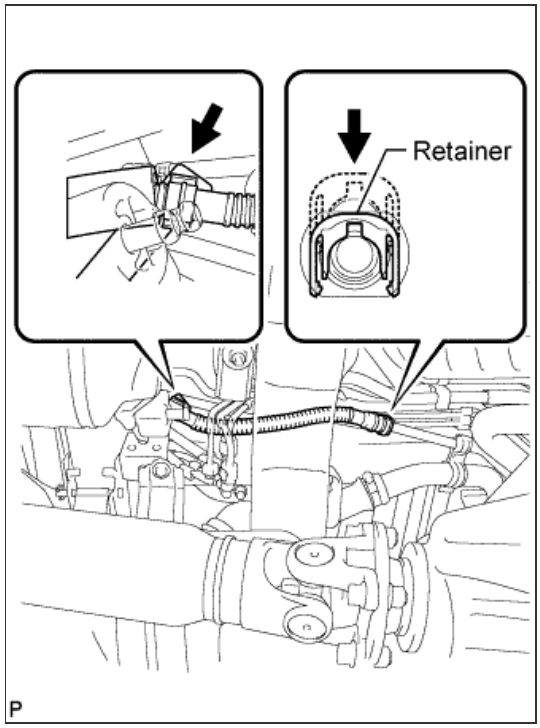
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Attach the fuel tube clamp.



11. CONNECT NO. 2 FUEL MAIN TUBE SUB-ASSEMBLY (for Double Tank Type)

a. Connect the fuel main tube and push the retainer.

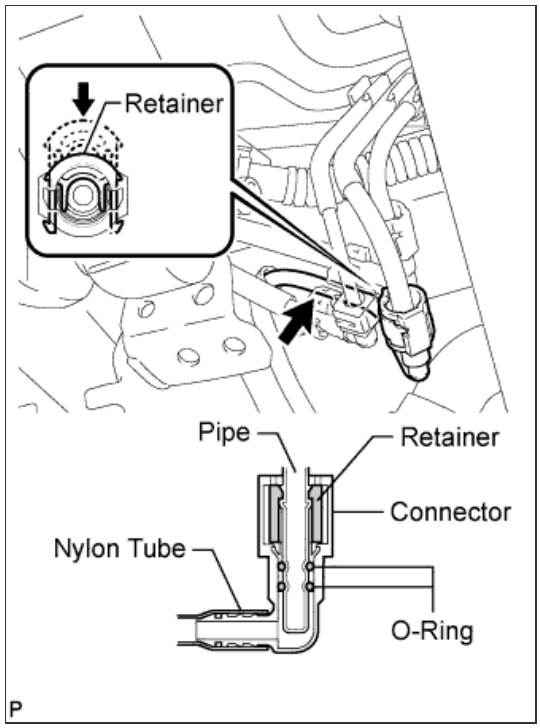
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Attach the fuel tube clamp.



12. CONNECT NO. 2 FUEL TANK BREATHER TUBE (for Double Tank Type)

a. Connect the fuel tank breather tube and push the retainer.

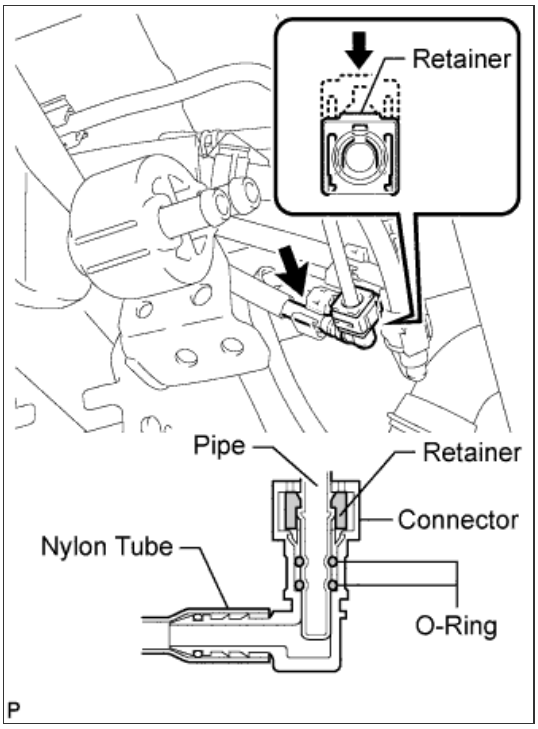
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Attach the fuel tube clamp.



13. CONNECT FUEL TANK RETURN TUBE (for Single Tank Type)

a. Connect the fuel tank return tube and push the retainer.

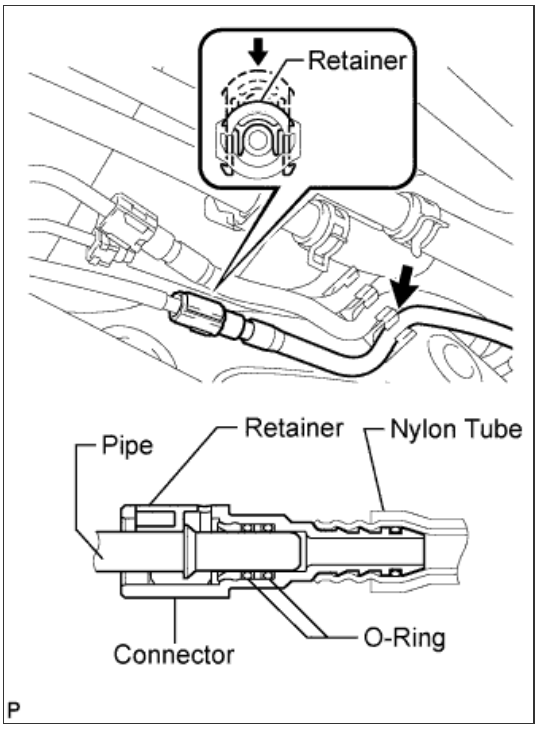
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Attach the fuel tube clamp.



14. CONNECT FUEL TANK RETURN TUBE (for Double Tank Type)

a. Connect the fuel tank return tube and push the retainer.

HINT:

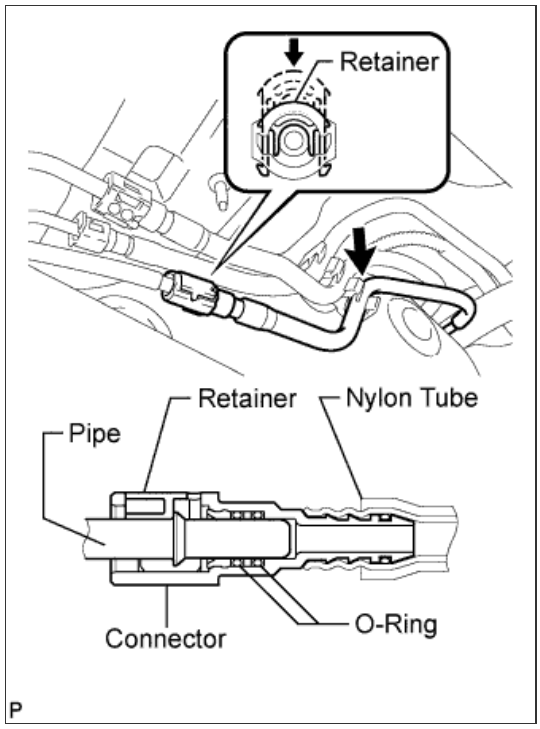
Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**

- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Attach the fuel tube clamp.



15. CONNECT NO. 2 FUEL TANK BREATHER TUBE (for Single Tank Type)

a. Connect the fuel tank breather tube and push the retainer.

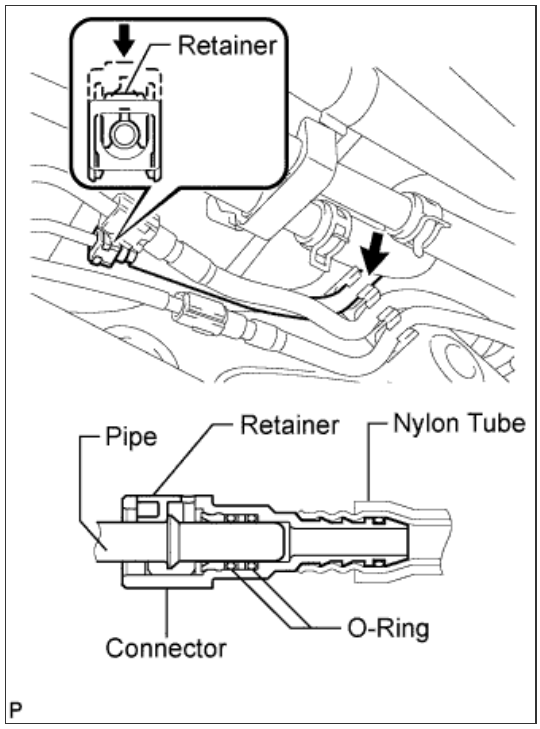
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Attach the fuel tube clamp.



16. CONNECT FUEL TANK MAIN TUBE SUB-ASSEMBLY (for Single Tank Type)

a. Connect the fuel tank main tube and push the retainer.

HINT:

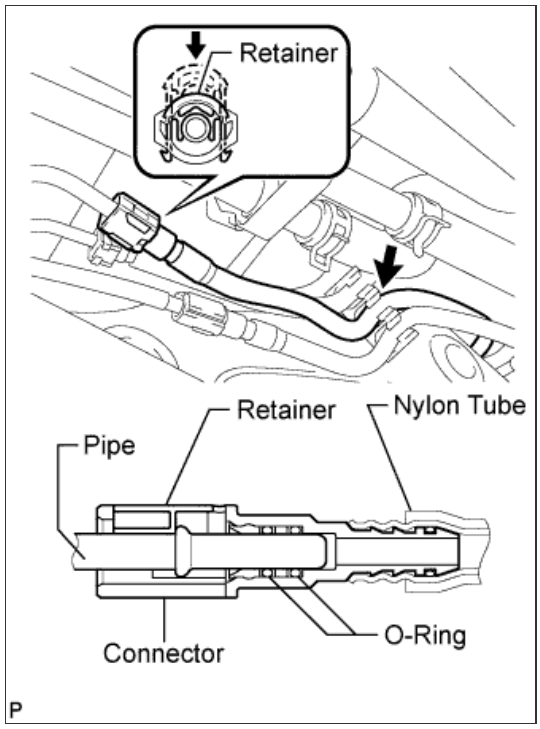
Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**

- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Attach the fuel tube clamp.



17. CONNECT FUEL TANK MAIN TUBE SUB-ASSEMBLY (for Double Tank Type)

a. Connect the fuel tank main tube and push the retainer.

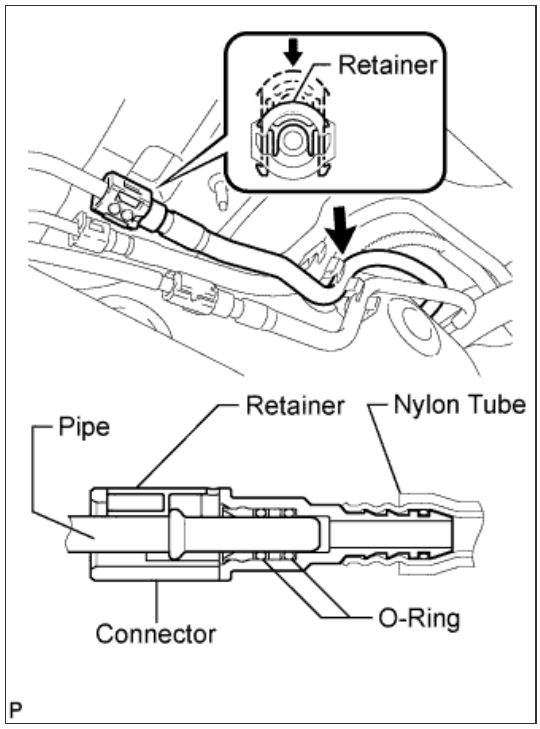
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

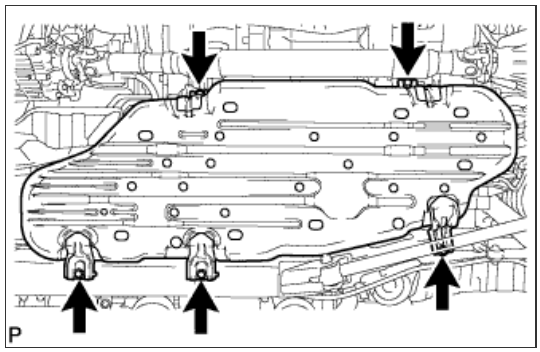
b. Attach the fuel tube clamp.



18. INSTALL NO. 1 FUEL TANK PROTECTOR SUB-ASSEMBLY

a. Install the tank protector with the 5 bolts.

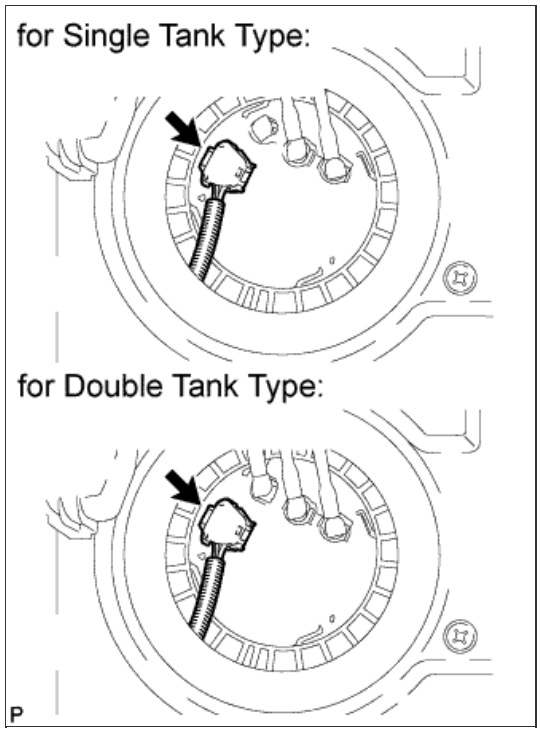
Torque:
20 N m 204 kgf cm , 15 ft. lbf



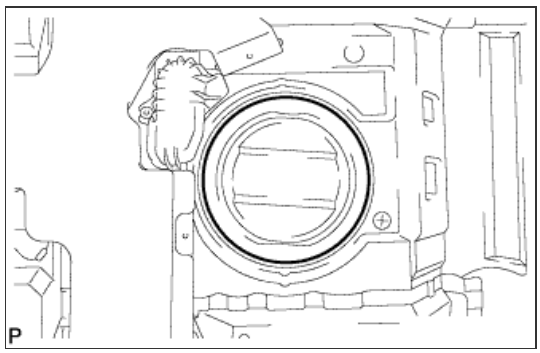
19. INSTALL FUEL TANK CAP ASSEMBLY

20. INSTALL REAR FLOOR NO. 2 SERVICE HOLE COVER

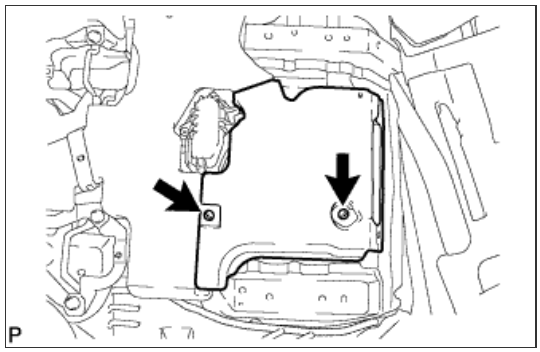
a. Connect the fuel pump and fuel sender gauge connector.



b. Install the service hole cover with new butyl tape.



c. w/ Rear Air Conditioning System:
Install the air duct and 2 screws.



21. INSTALL FRONT FLOOR CARPET ASSEMBLY

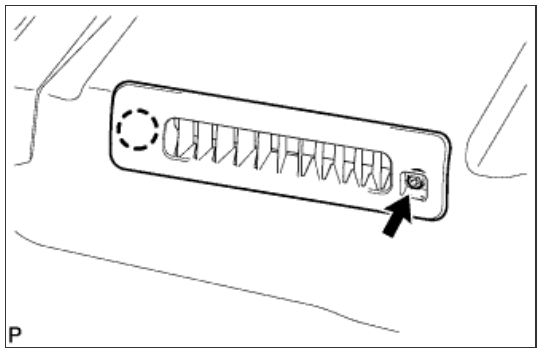
22. INSTALL REAR AIR DUCT GUIDE (w Rear Air Conditioning System)

a. Attach the claw to install the guide.

b. Install the screw.

HINT:

Use the same procedures for both sides.

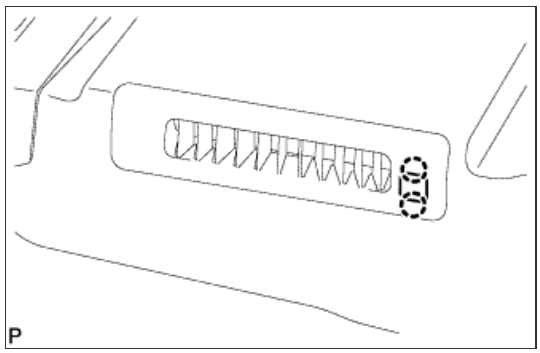


23. INSTALL AIR DUCT PLUG (w Rear Air Conditioning System)

a. Attach the 2 claws to install the plug.

HINT:

Use the same procedures for both sides.



24. INSTALL FRONT QUARTER TRIM PANEL ASSEMBLY LH

a. w/ Sliding Roof:
Install the front quarter trim panel assembly LH (Click here).

b. w/o Sliding Roof:
Install the front quarter trim panel assembly LH (Click here).

25. INSTALL FRONT QUARTER TRIM PANEL ASSEMBLY RH

a. w/ Sliding Roof:
Install the front quarter trim panel assembly RH (Click here).

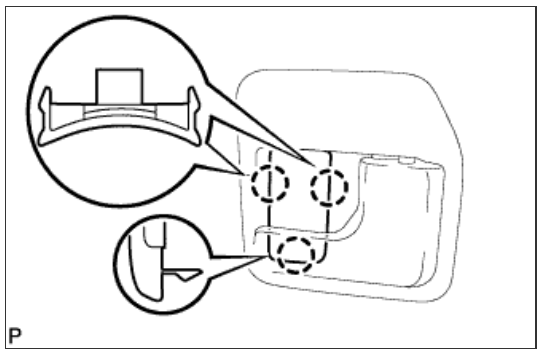
b. w/o Sliding Roof:
Install the front quarter trim panel assembly RH (Click here).

26. INSTALL REAR SEAT COVER CAP (w/ Rear No. 2 Seat, except Face to Face Seat Type)

HINT:

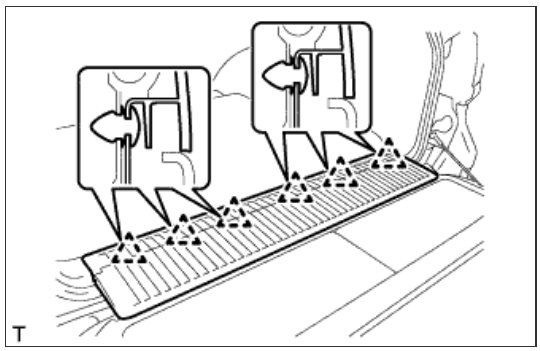
Use the same procedure to install the rear seat cover cap on the other side.

a. Attach the 3 claws to install the rear seat cover cap.



27. INSTALL REAR FLOOR MAT REAR SUPPORT PLATE

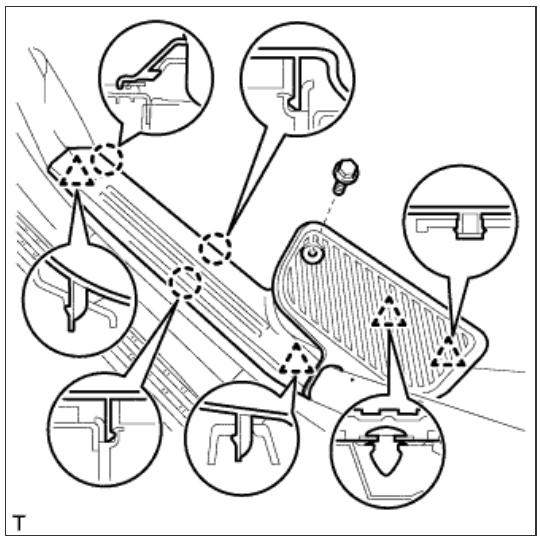
a. Attach the 6 clips to install the support plate.



28. INSTALL REAR DOOR SCUFF PLATE LH

a. Attach the 3 claws and 4 clips to install the scuff plate.

b. Install the screw.



29. INSTALL REAR DOOR SCUFF PLATE RH

HINT:

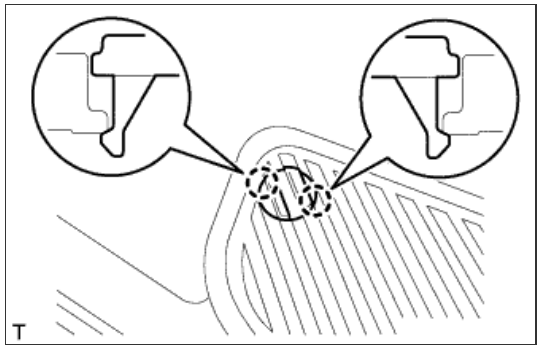
Use the same procedures described for the LH side.

30. INSTALL REAR STEP COVER

HINT:

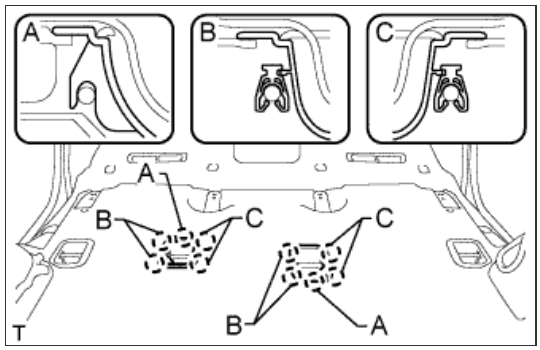
Use the same procedure to install the step cover on the other side.

a. Attach the 2 claws to install the step cover.



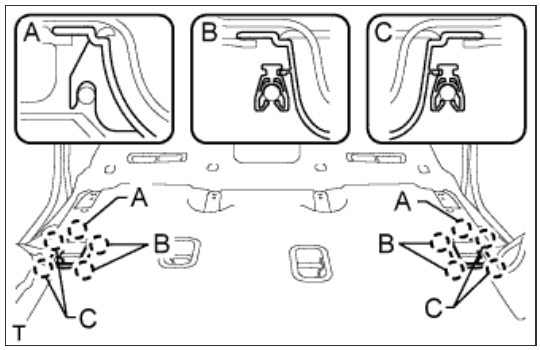
31. INSTALL REAR NO. 2 SEAT PROTECTOR

a. Attach the 10 claws to install the 2 seat protectors.



32. INSTALL REAR NO. 1 SEAT PROTECTOR

a. Attach the 10 claws to install the 2 seat protectors.



33. INSTALL REAR NO. 2 SEAT ASSEMBLY

a. for Face to Face Seat Type:
Install the rear No. 2 seat assembly (Click here).

b. except Face to Face Seat Type:
Install the rear No. 2 seat assembly (Click here).

34. INSTALL REAR NO. 1 SEAT ASSEMBLY RH (for 60 40 Split Seat Type 40 Side)

a. Install the rear No. 1 seat assembly RH (Click here).

35. INSTALL REAR NO. 1 SEAT ASSEMBLY LH (for 60 40 Split Seat Type 60 Side)

a. Install the rear No. 1 seat assembly LH (Click here).

36. CONNECT CABLE TO NEGATI BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

37. CHECK SRS WARNING LIGHT

a. Check the SRS warning light (Click here).

38. ADD FUEL

39. INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and intelligent tester N.

NOTICE:

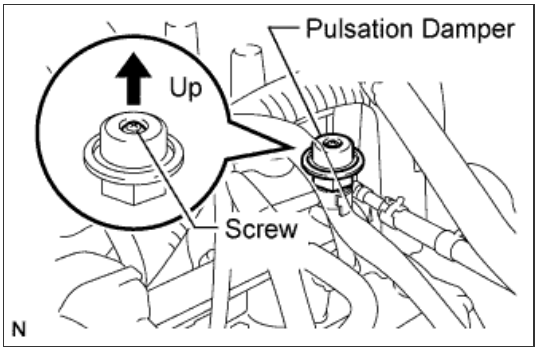
Do not start the engine.

c. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the Fuel Pump Speed Control.

d. Check that there are no fuel leaks after doing maintenance anywhere on the fuel system.

e. Check that the pulsation damper screw rises up when the fuel pump operates.
If the operation is not as specified, check the following parts:

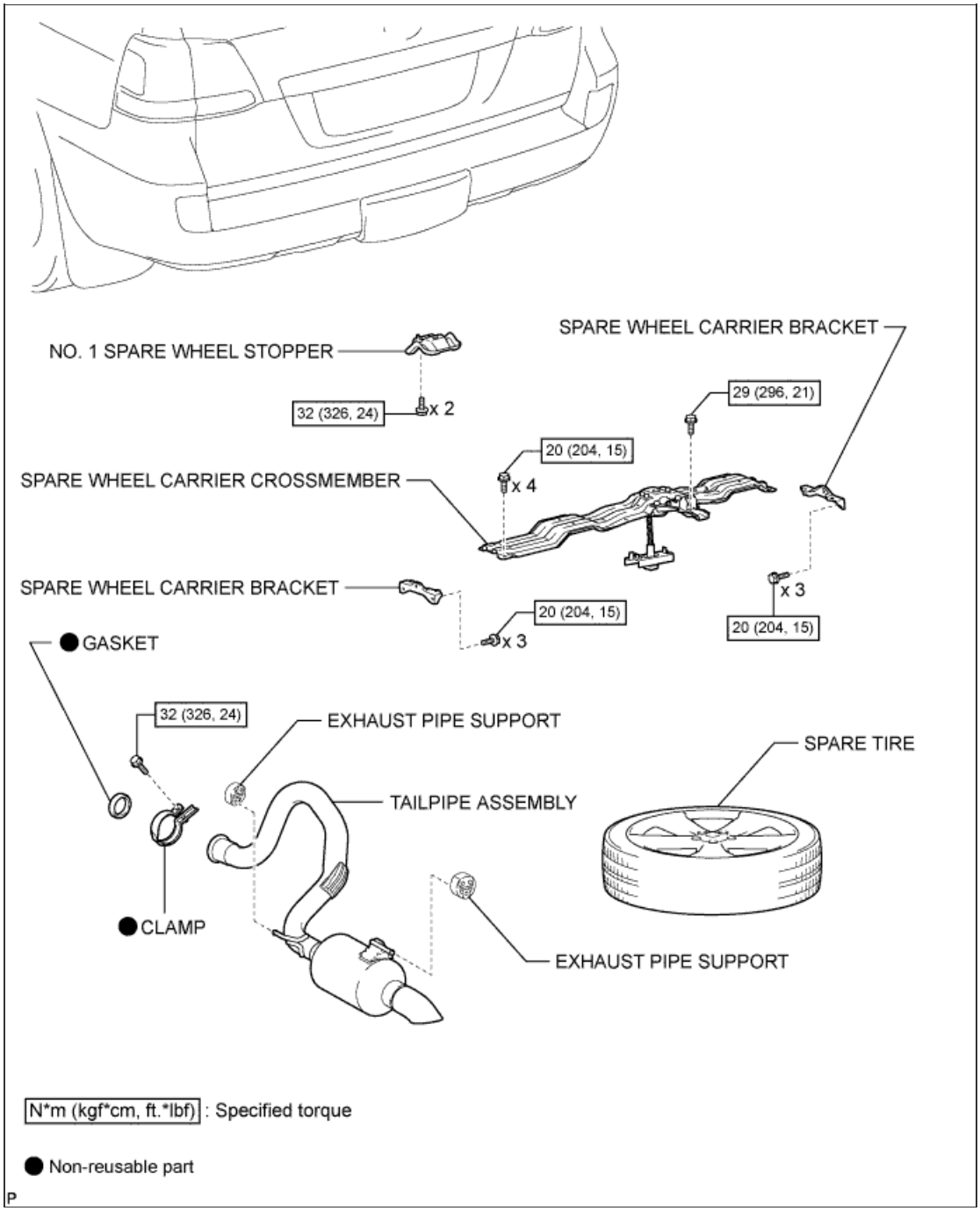
- Fusible link
- Fuses
- Circuit opening relay (C PN)
- Fuel pump
- EC
- Wiring connections

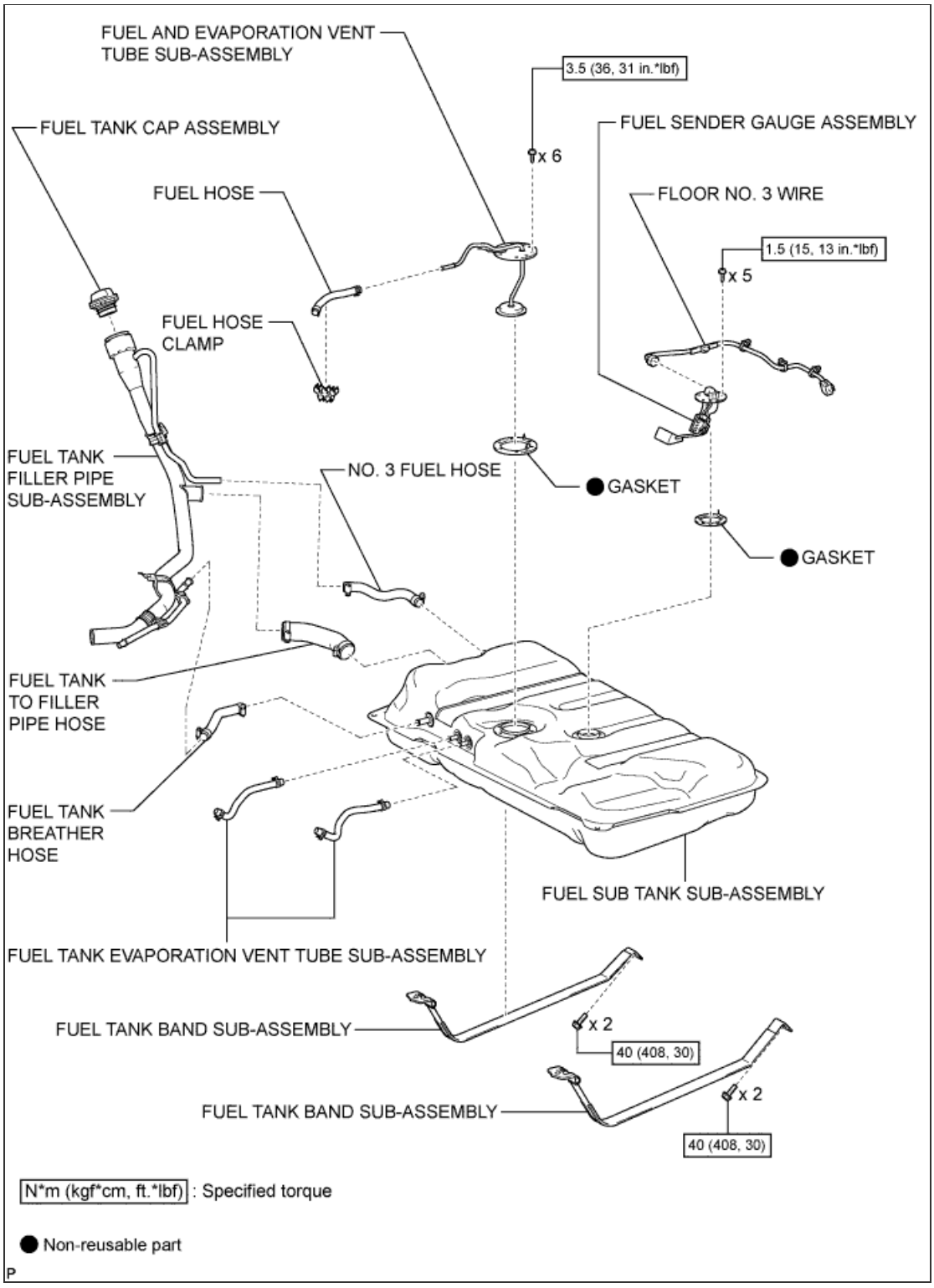


f. Turn the engine switch off.

g. Disconnect the intelligent tester from the DLC3.

for Preparation Click here




FUEL AND EVAPORATION VENT TUBE SUB-ASSEMBLY
3.5 (36, 31 in.*lbf)
FUEL TANK CAP ASSEMBLY
x 6
FUEL SENDER GAUGE ASSEMBLY
FUEL HOSE
FLOOR NO. 3 WIRE
1.5 (15, 13 in.*lbf)
x 5
FUEL HOSE CLAMP
FUEL TANK FILLER PIPE SUB-ASSEMBLY
NO. 3 FUEL HOSE
GASKET
GASKET
FUEL TANK TO FILLER PIPE HOSE
FUEL TANK BREATHER HOSE
FUEL SUB TANK SUB-ASSEMBLY
FUEL TANK EVAPORATION VENT TUBE SUB-ASSEMBLY
FUEL TANK BAND SUB-ASSEMBLY
x 2
40 (408, 30)
FUEL TANK BAND SUB-ASSEMBLY
x 2
40 (408, 30)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

a. Discharge the fuel system pressure (Click here).

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE SPARE TIRE

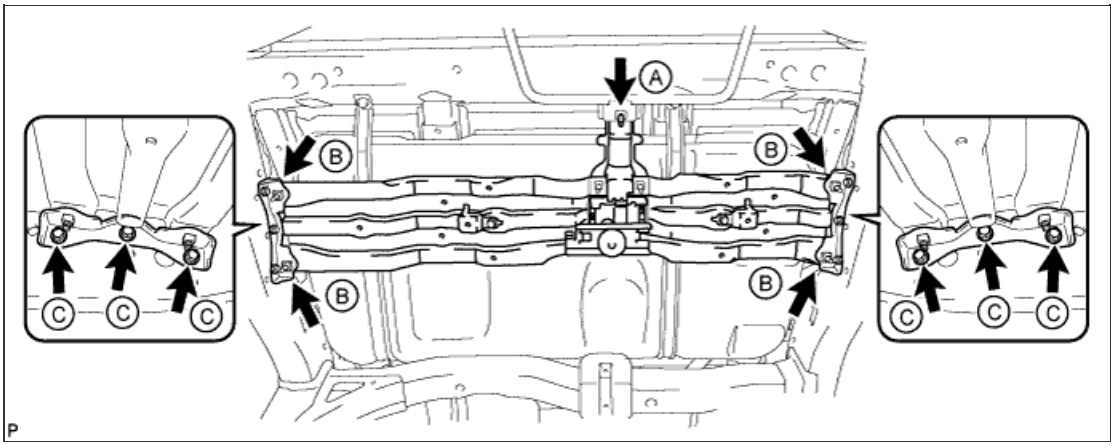
4. REMOVE TAILPIPE ASSEMBLY

a. Remove the bolt, clamp and gasket.

b. Remove the tailpipe from the 2 exhaust pipe supports.

5. REMOVE SPARE WHEEL CARRIER CROSSMEMBER AND SPARE WHEEL CARRIER BRACKET

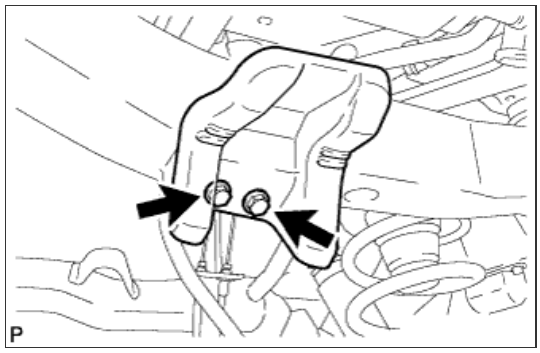
a. Remove the bolt labeled A, and then loosen the 4 bolts labeled B.



b. Slightly raise the spare wheel carrier crossmember, and then remove the 6 bolts labeled C, spare wheel carrier crossmember and 2 brackets.

6. REMOVE NO. 1 SPARE WHEEL STOPPER

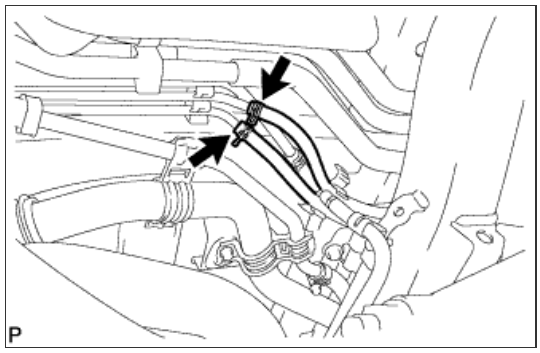
a. Remove the 2 bolts and spare wheel stopper.



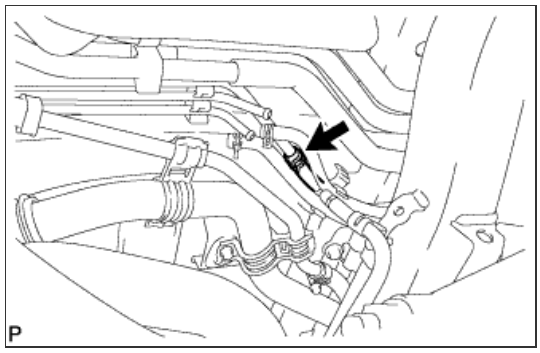
7. REMOVE FUEL TANK CAP ASSEMBLY

8. DISCONNECT FUEL TANK EVAPORATION VENT TUBE SUB-ASSEMBLY

a. Disconnect the 2 fuel tank evaporation vent tubes.

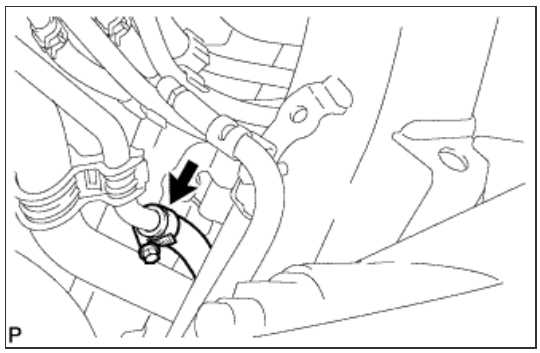


9. DISCONNECT FUEL HOSE



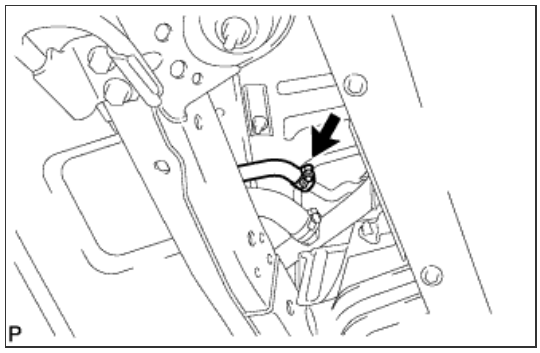
10. DISCONNECT FUEL TANK BREATHER HOSE

a. Disconnect the breather hose from the filler pipe.



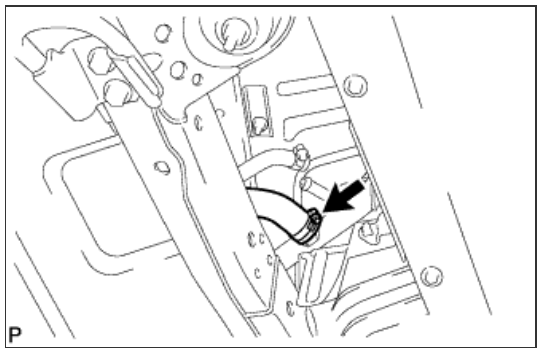
11. DISCONNECT NO. 3 FUEL HOSE

a. Disconnect the fuel hose from the filler pipe.



12. DISCONNECT FUEL TANK TO FILLER PIPE HOSE

a. Disconnect the hose from the filler pipe.

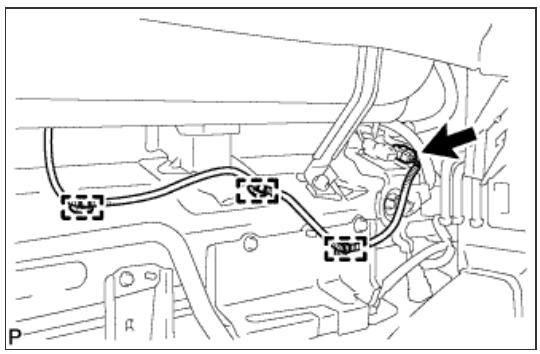


13. REMOVE FUEL SUB TANK SUB-ASSEMBLY

a. Disconnect the floor No. 3 wire connector.

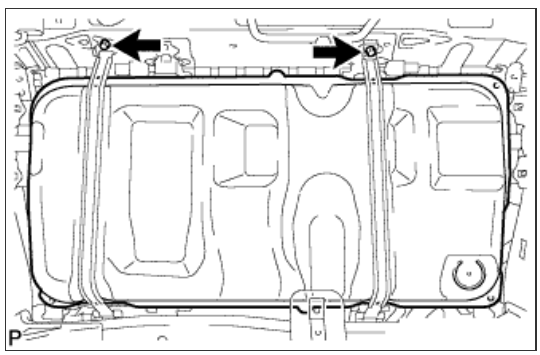
b. Using a clip remover, detach the 3 wire harness clamps.

c. Set a transmission jack underneath the fuel sub tank.



d. Remove the 2 bolts and disconnect the 2 fuel tank bands.

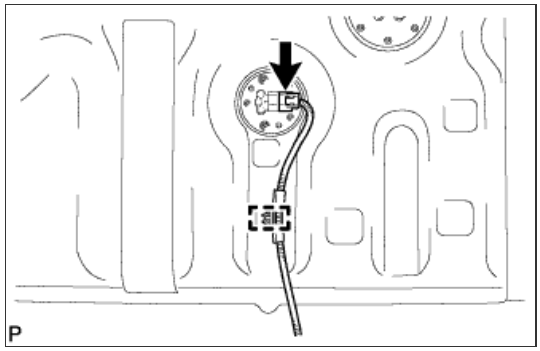
e. Remove the fuel sub tank.



14. REMOVE FLOOR NO. 3 WIRE

a. Disconnect the sender gauge connector.

b. Using a clip remover, detach the wire harness clamp.



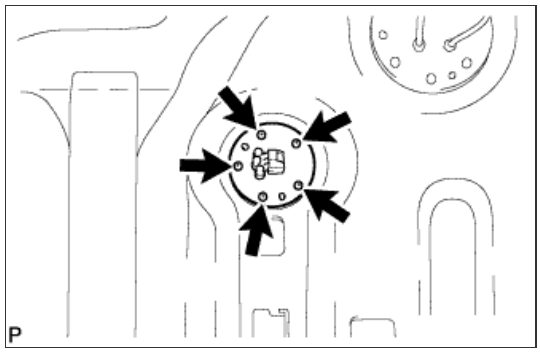
15. REMOVE FUEL SENDER GAUGE ASSEMBLY

a. Remove the 5 screws and sender gauge.

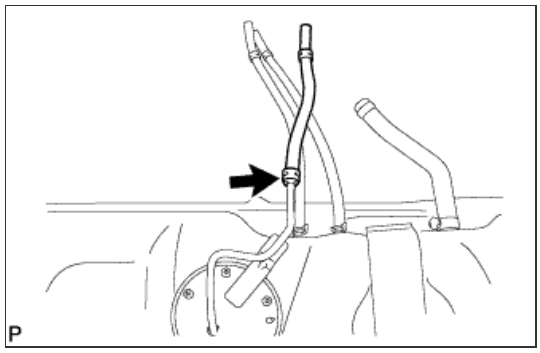
NOTICE:

Be careful not to bend the arm of the fuel sender gauge.

b. Remove the gasket from the sender gauge.

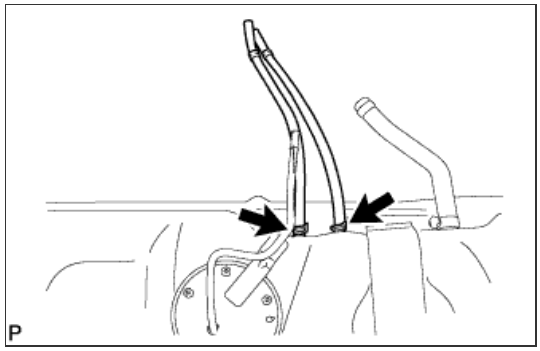


16. REMOVE FUEL HOSE



17. REMOVE FUEL TANK EVAPORATION VENT TUBE SUB-ASSEMBLY

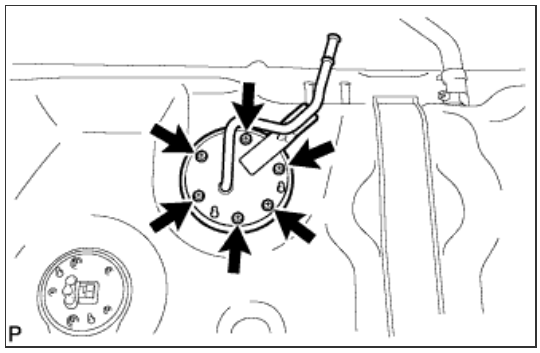
a. Remove the 2 fuel tank evaporation vent tubes.



18. REMOVE FUEL AND EVAPORATION VENT TUBE SUB-ASSEMBLY

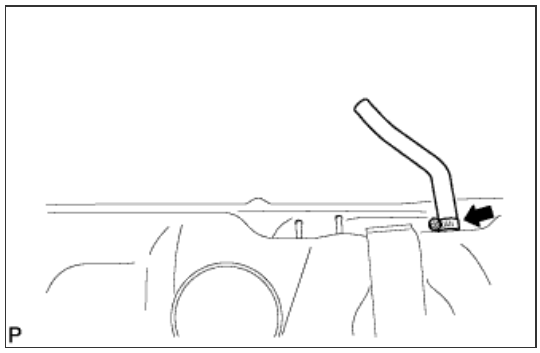
a. Remove the 6 bolts and fuel and evaporation vent tube.

b. Remove the gasket from the fuel and evaporation vent tube.



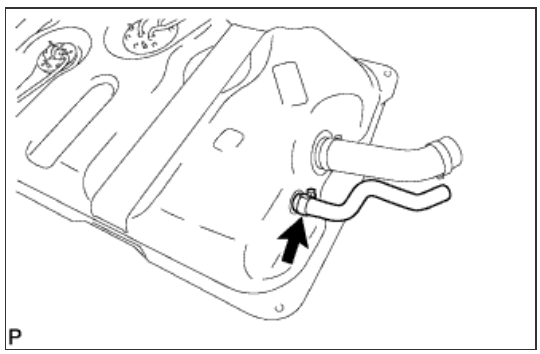
19. REMOVE FUEL TANK BREATHER HOSE

a. Remove the breather hose from the fuel sub tank.



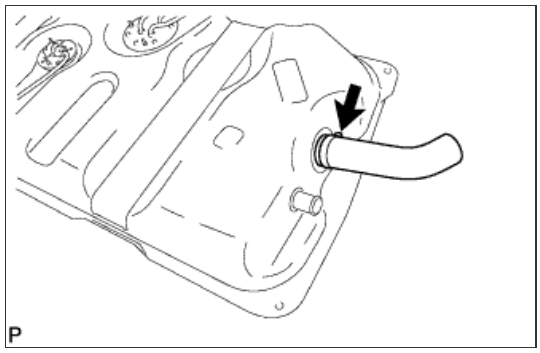
20. REMOVE NO. 3 FUEL HOSE

a. Remove the fuel hose from the fuel sub tank.



21. REMOVE FUEL TANK TO FILLER PIPE HOSE

a. Remove the hose from the fuel sub tank.


P

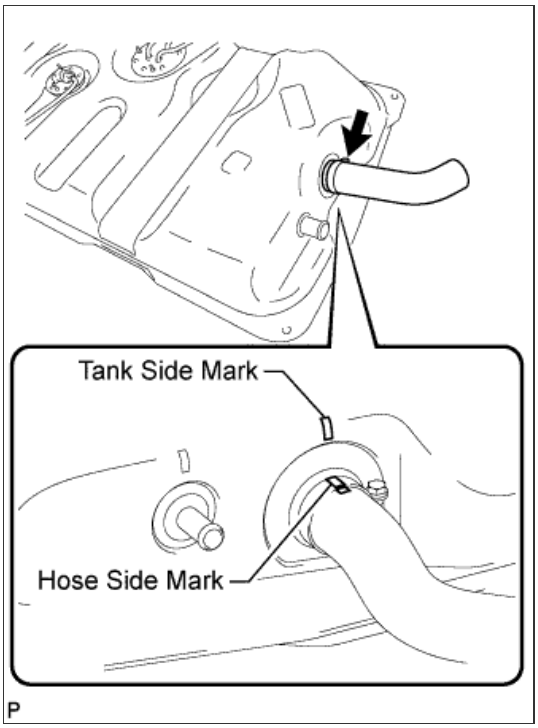
for Preparation Click here

1. INSTALL FUEL TANK TO FILLER PIPE HOSE

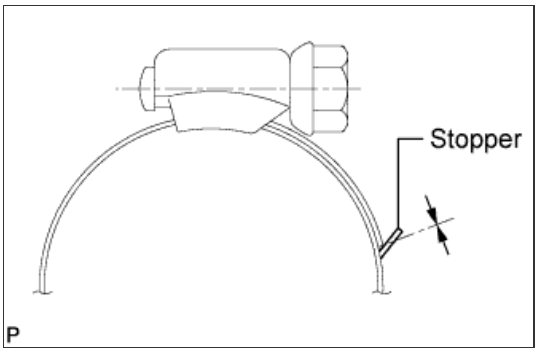
a. Install the hose to the fuel sub tank as shown in the illustration.

HINT:

- **Align the fuel sub tank side mark with the hose side mark when installing the hose.**



- **Tighten the hose clamp until the end of the hose clamp contacts the stopper as shown in the illustration.**

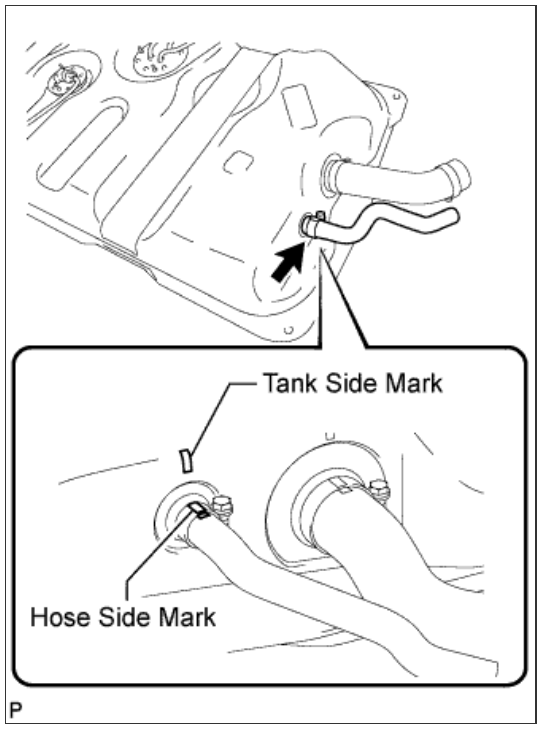


2. INSTALL NO. 3 FUEL HOSE

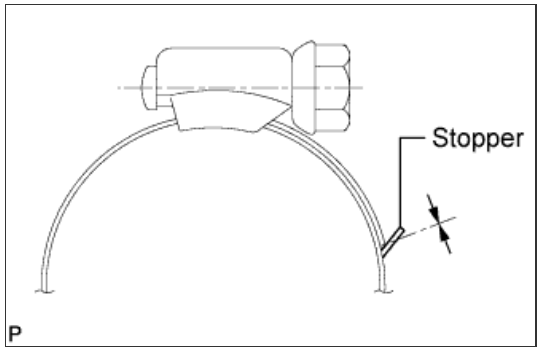
a. Install the fuel hose to the fuel sub tank as shown in the illustration.

HINT:

- **Align the fuel sub tank side mark with the hose side mark when installing the hose.**

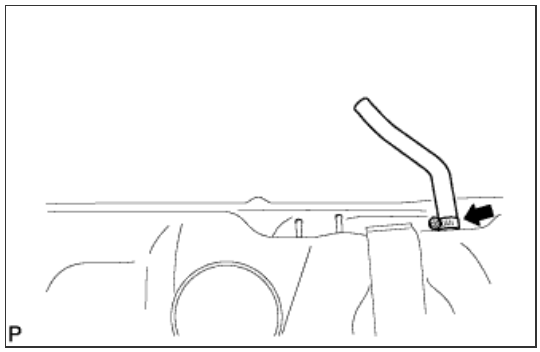


- **Tighten the hose clamp until the end of the hose clamp contacts the stopper as shown in the illustration.**



3. INSTALL FUEL TANK BREATHER HOSE

a. Install the breather hose to the fuel sub tank.

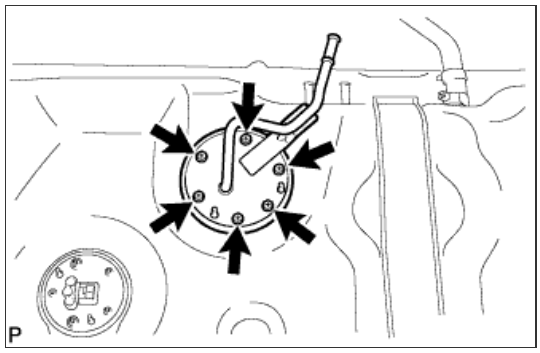


4. INSTALL FUEL AND EVAPORATION VENT TUBE SUB-ASSEMBLY

a. Install a new gasket to the fuel and evaporation vent tube.

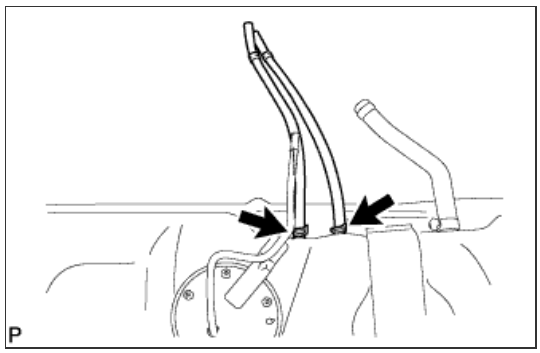
b. Install the fuel and evaporation vent tube with the 6 bolts.

Torque:
3.5 N*m 36 kgf*cm , 31 in.*lbf }

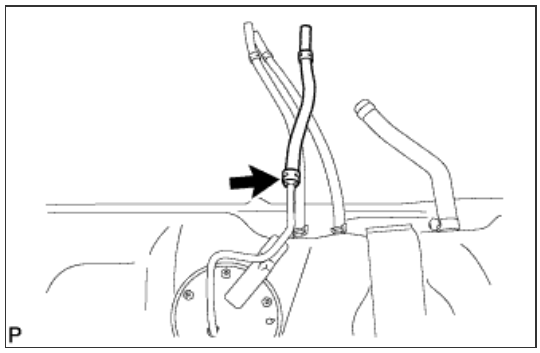


5. INSTALL FUEL TANK EVAPORATION VENT TUBE SUB-ASSEMBLY

a. Install the 2 fuel tank evaporation vent tubes.



6. INSTALL FUEL HOSE



7. INSTALL FUEL SENDER GAUGE ASSEMBLY

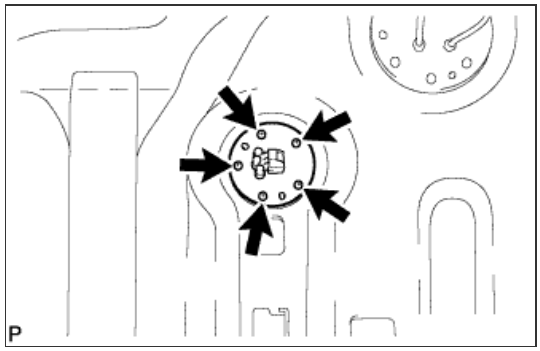
a. Install a new gasket to the sender gauge.

NOTICE:

Be careful not to bend the arm of the fuel sender gauge.

b. Install the sender gauge with the 5 screws.

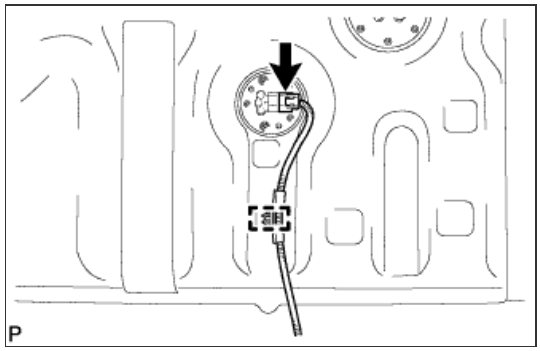
Torque:
1.5 N*m 15 kgf*cm , 13 in.*lbf }



8. INSTALL FLOOR NO. 3 WIRE

a. Attach the wire harness clamp to the fuel sub tank.

b. Connect the sender gauge connector.

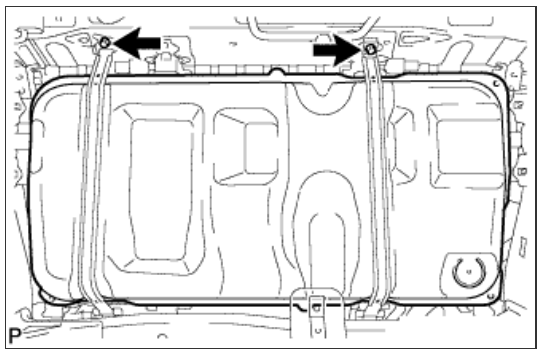


9. INSTALL FUEL SUB TANK SUB-ASSEMBLY

a. Set the fuel sub tank on a transmission jack and raise the fuel sub tank.

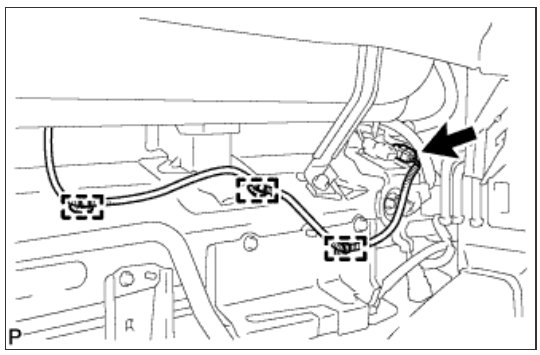
b. Connect the 2 fuel tank bands with the 2 bolts.

Torque:
40 N*m 408 kgf*cm , 30 ft.*lbf }



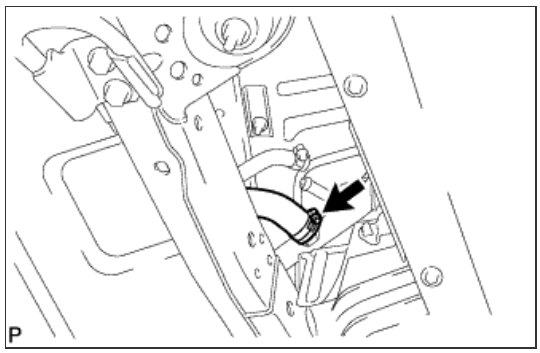
c. Connect the floor No. 3 wire connector.

d. Attach the 3 wire harness clamps.



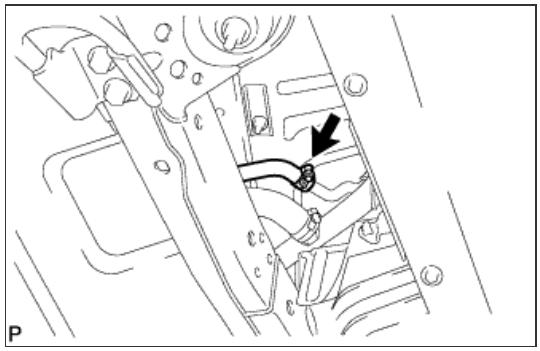
10. CONNECT FUEL TANK TO FILLER PIPE HOSE

a. Connect the hose to the filler pipe.



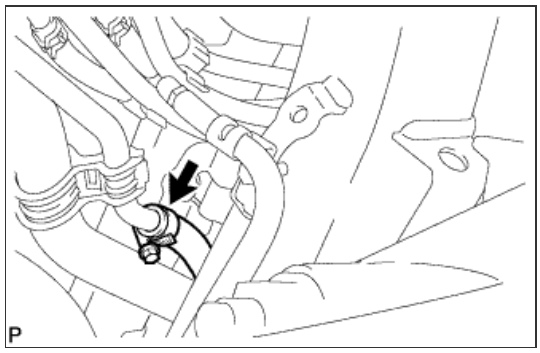
11. CONNECT NO. 3 FUEL HOSE

a. Connect the fuel hose to the filler pipe.

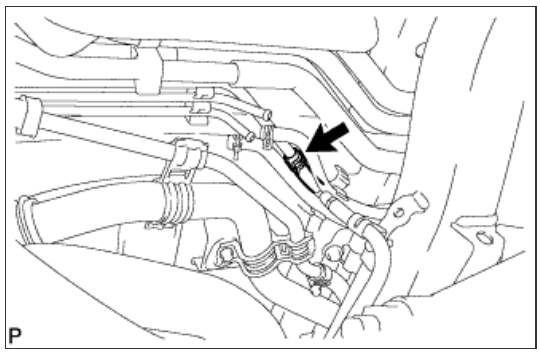


12. CONNECT FUEL TANK BREATHER HOSE

a. Connect the breather hose to the filler pipe.

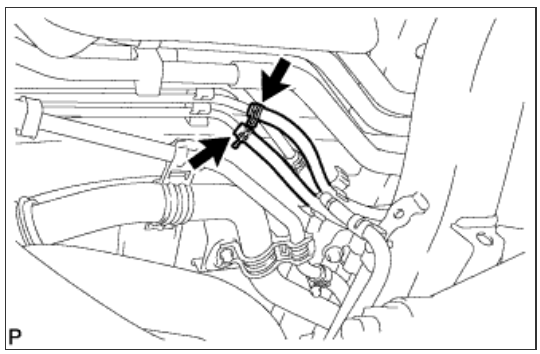


13. CONNECT FUEL HOSE



14. CONNECT FUEL TANK EVAPORATION VENT TUBE SUB-ASSEMBLY

a. Connect the 2 fuel tubes.

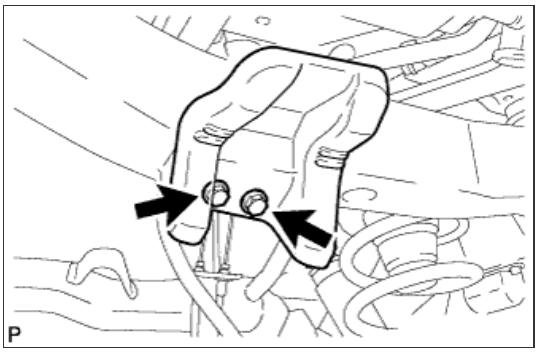


15. INSTALL FUEL TANK CAP ASSEMBLY

16. INSTALL NO. 1 SPARE WHEEL STOPPER

a. Install the spare wheel stopper with the 2 bolts.

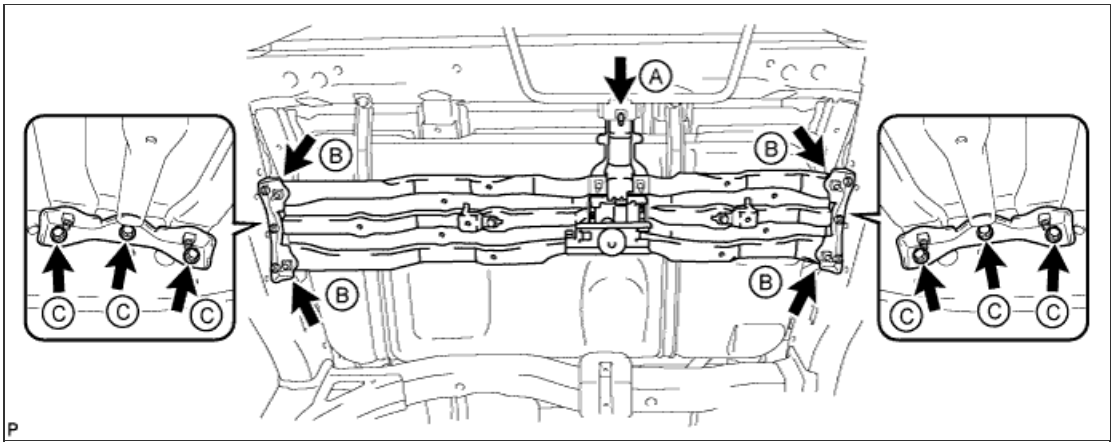
Torque:
32 N*m 326 kgf*cm , 24 ft.*lbf }



17. INSTALL SPARE WHEEL CARRIER CROSSMEMBER AND SPARE WHEEL CARRIER BRACKET

a. Install the spare wheel carrier crossmember and 2 brackets to the vehicle with the 6 bolts labeled C.

Torque:
for bolt C:
20 N*m 204 kgf*cm , 15 ft.*lbf }



b. Temporarily install the bolt labeled A, and then tighten the bolt labeled A and bolts labeled B.

Torque:
for bolt A:
29 N*m 296 kgf*cm , 21 ft.*lbf }
for bolt B:
20 N*m 204 kgf*cm , 15 ft.*lbf }

18. INSTALL TAILPIPE ASSEMBLY

a. Install the tailpipe to the 2 exhaust pipe supports.

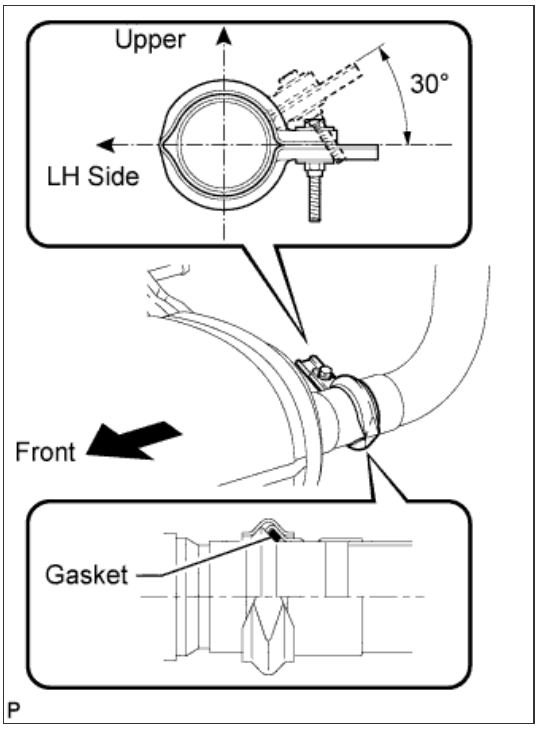
b. Install a new gasket to the center exhaust pipe.

c. Connect the tailpipe and center exhaust pipe with a new clamp.

Torque:
32 N*m 326 kgf*cm , 24 ft.*lbf }

HINT:

Install the clamp within the angle range shown in the illustration.



19. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

20. INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and intelligent tester ON.

NOTICE:

Do not start the engine.

c. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the Fuel Pump Speed Control.

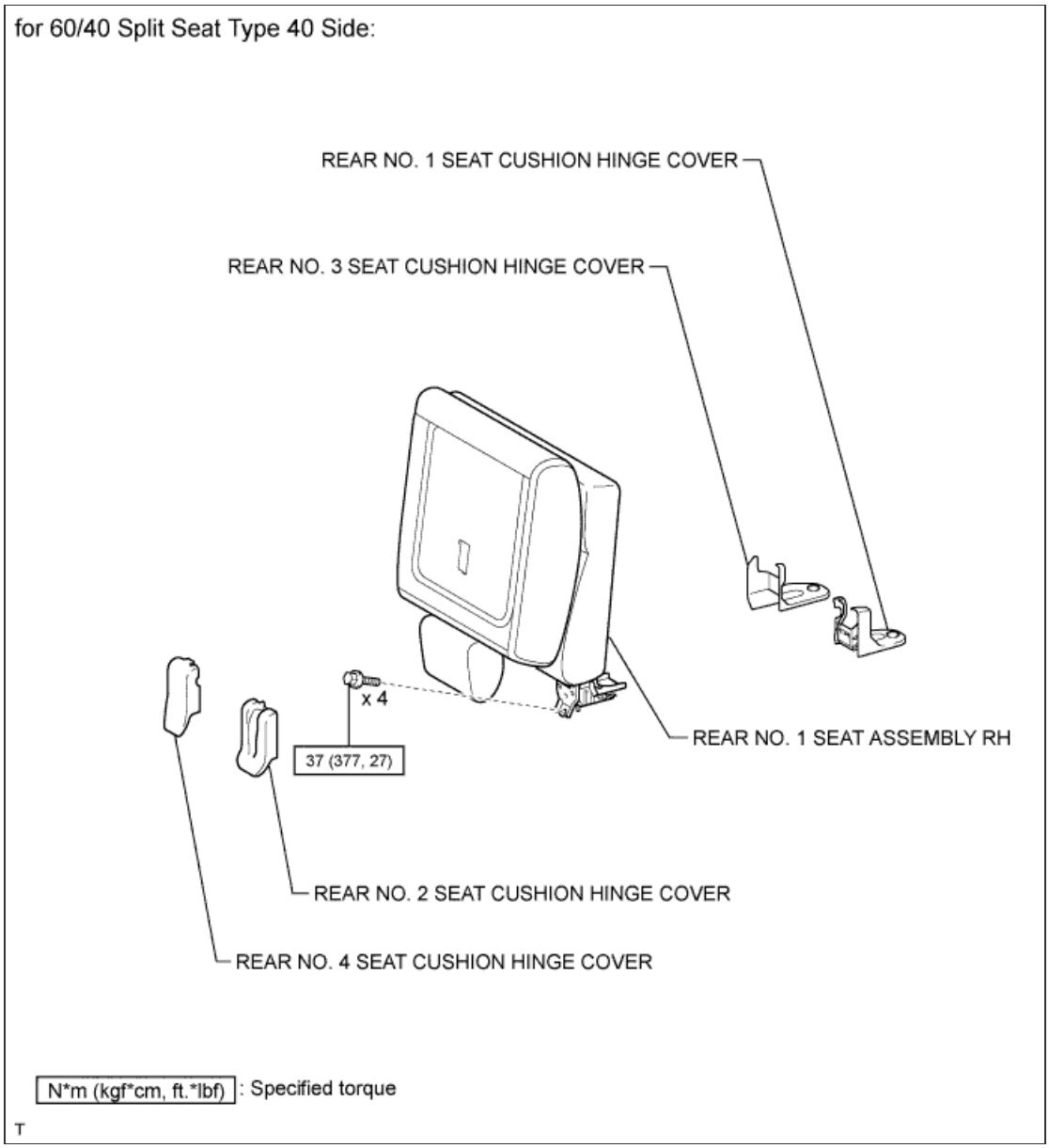
d. Check that there are no fuel leaks after doing maintenance anywhere on the fuel system.

21. INSPECT FOR EXHAUST GAS LEAK

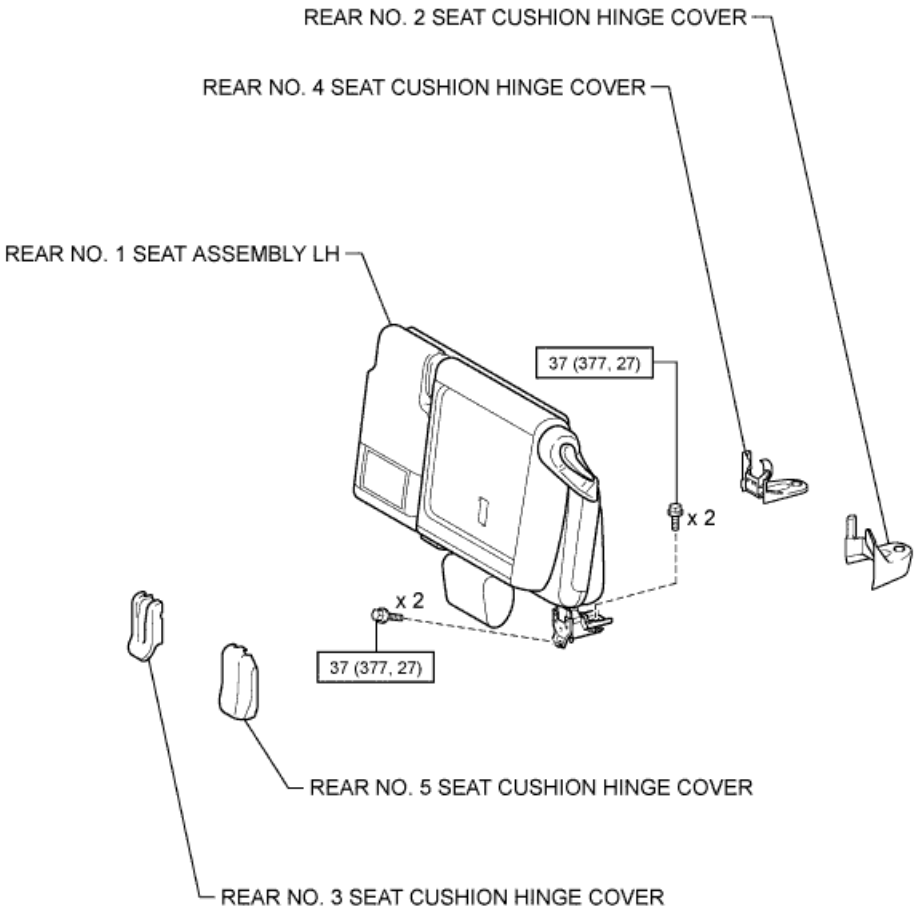
If gas is leaking, tighten the areas necessary to stop the leak. Replace damaged parts as necessary.

22. INSTALL SPARE TIRE

for Preparation Click here



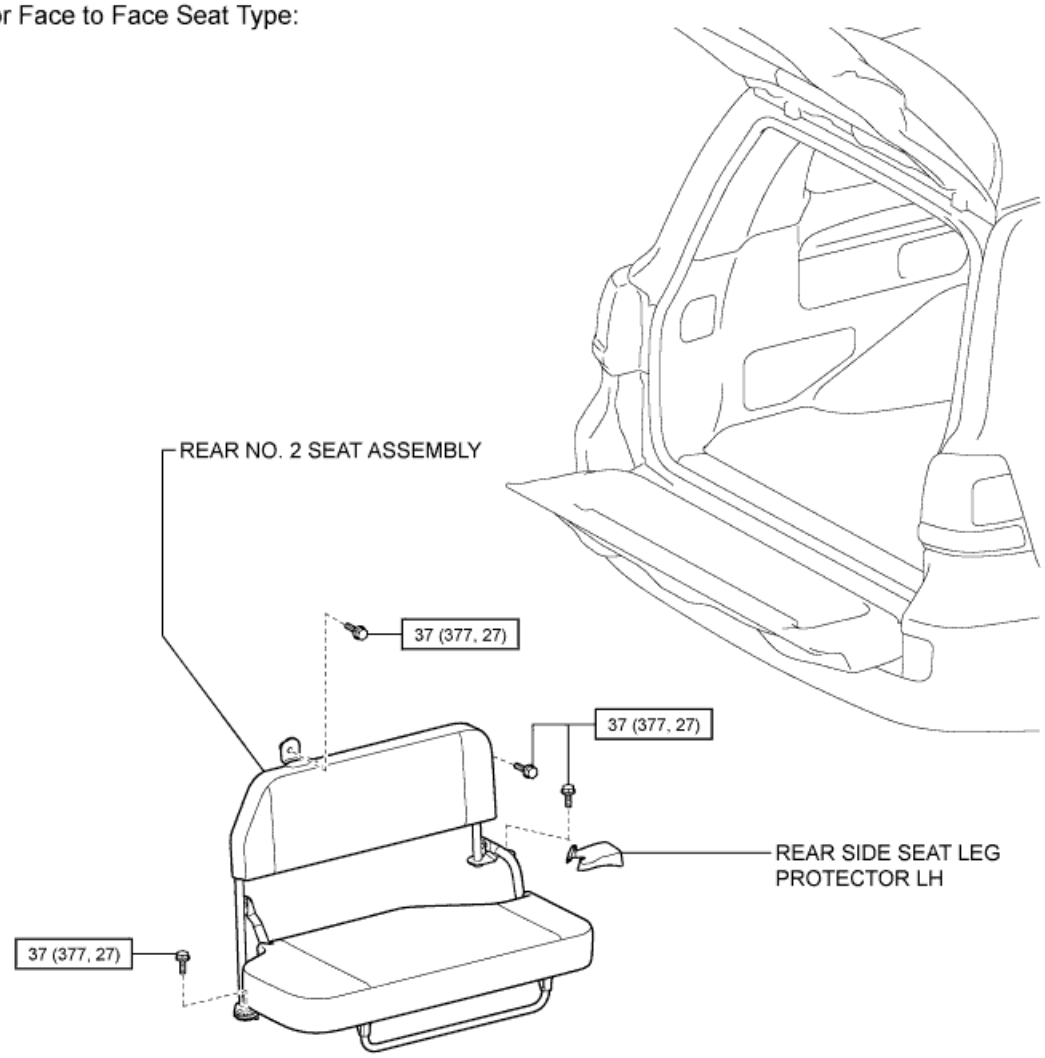
for 60/40 Split Seat Type 60 Side:



N*m (kgf*cm, ft.*lbf) : Specified torque

T

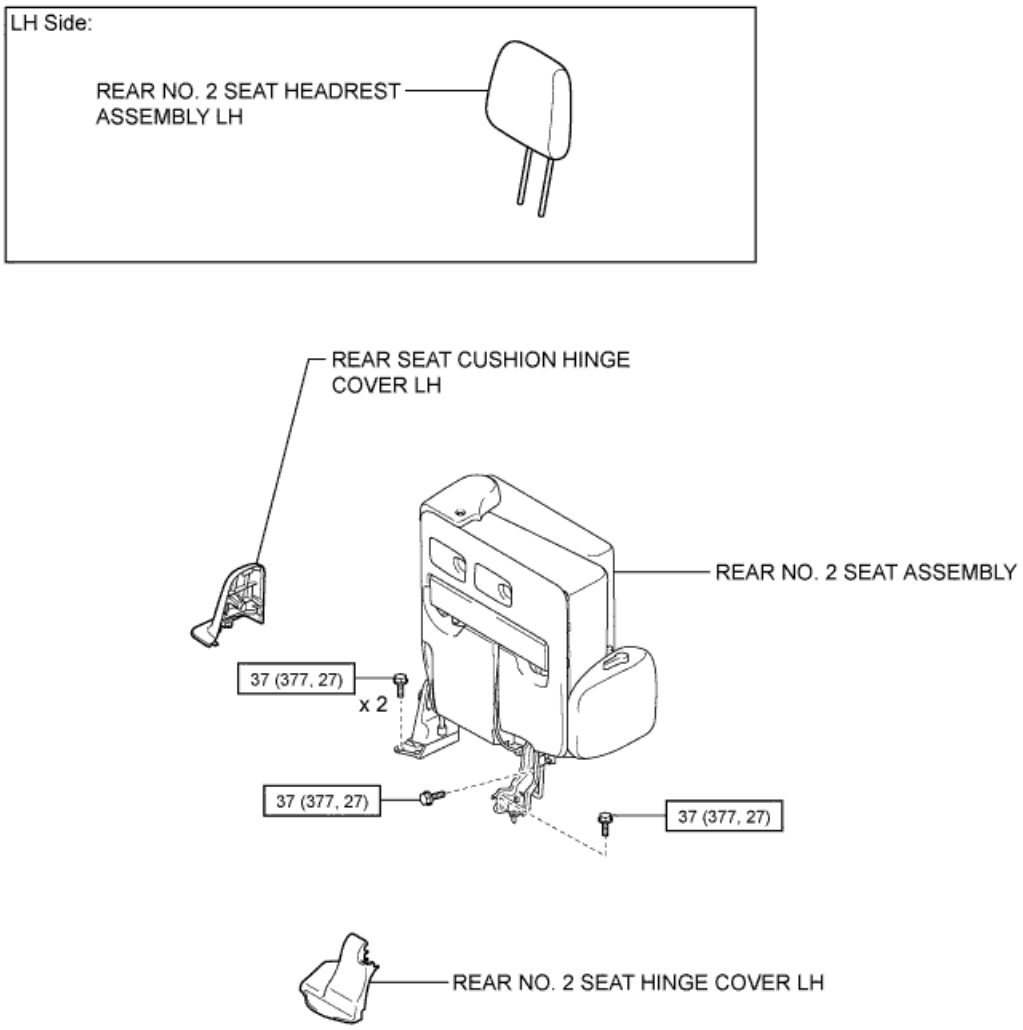
for Face to Face Seat Type:



N*m (kgf*cm, ft.*lbf) : Specified torque

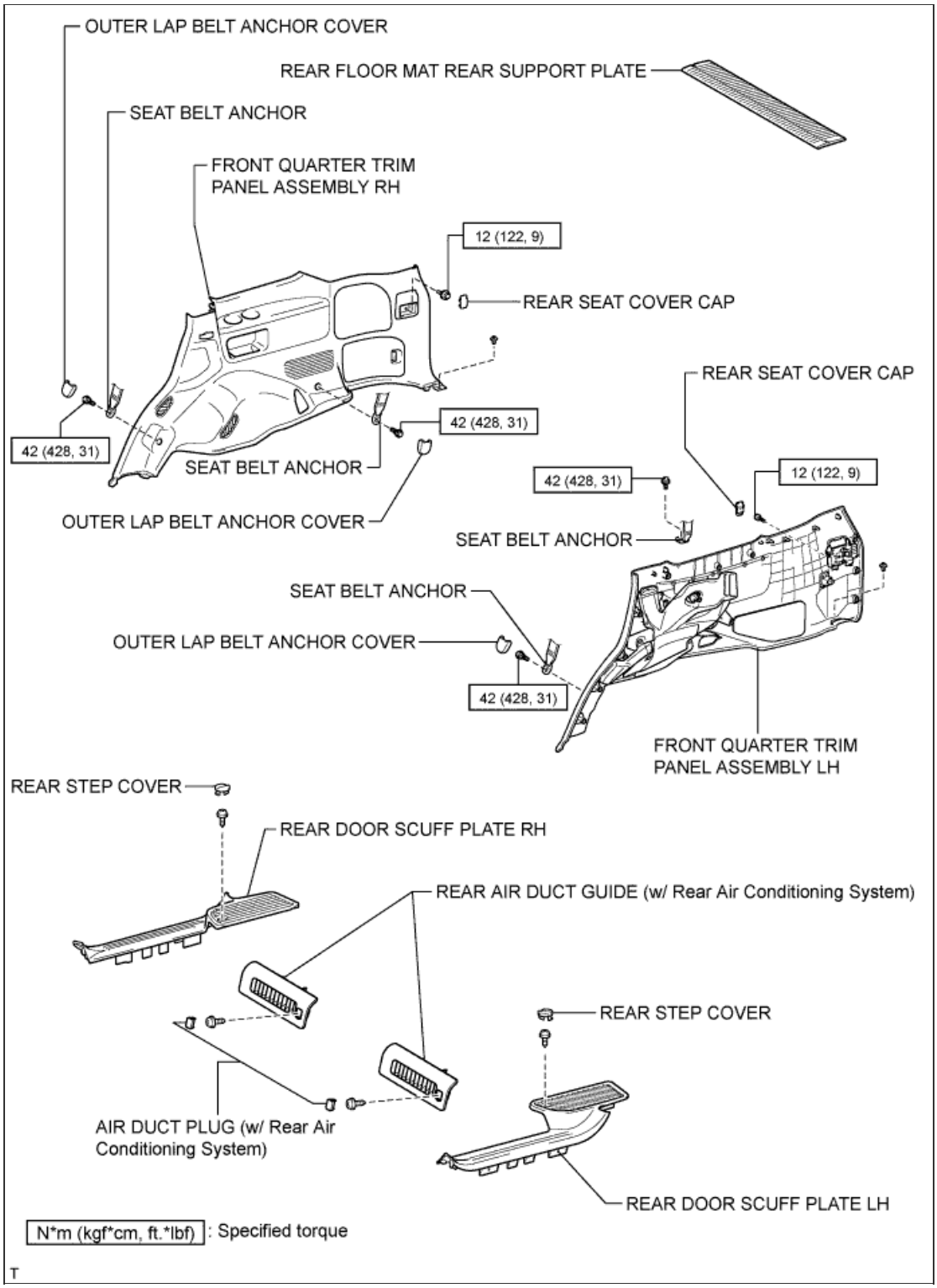
P

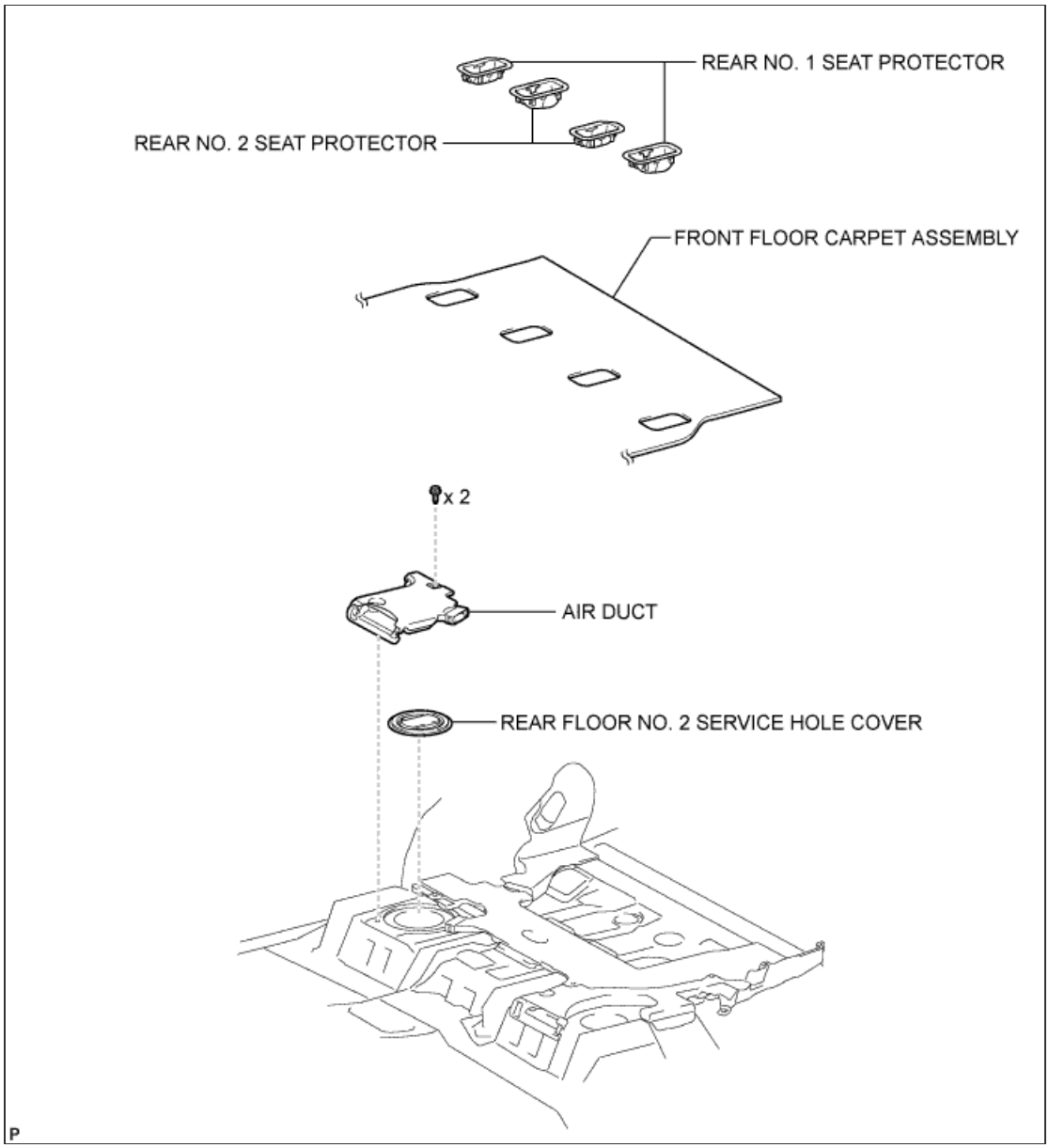
except Face to Face Seat Type:

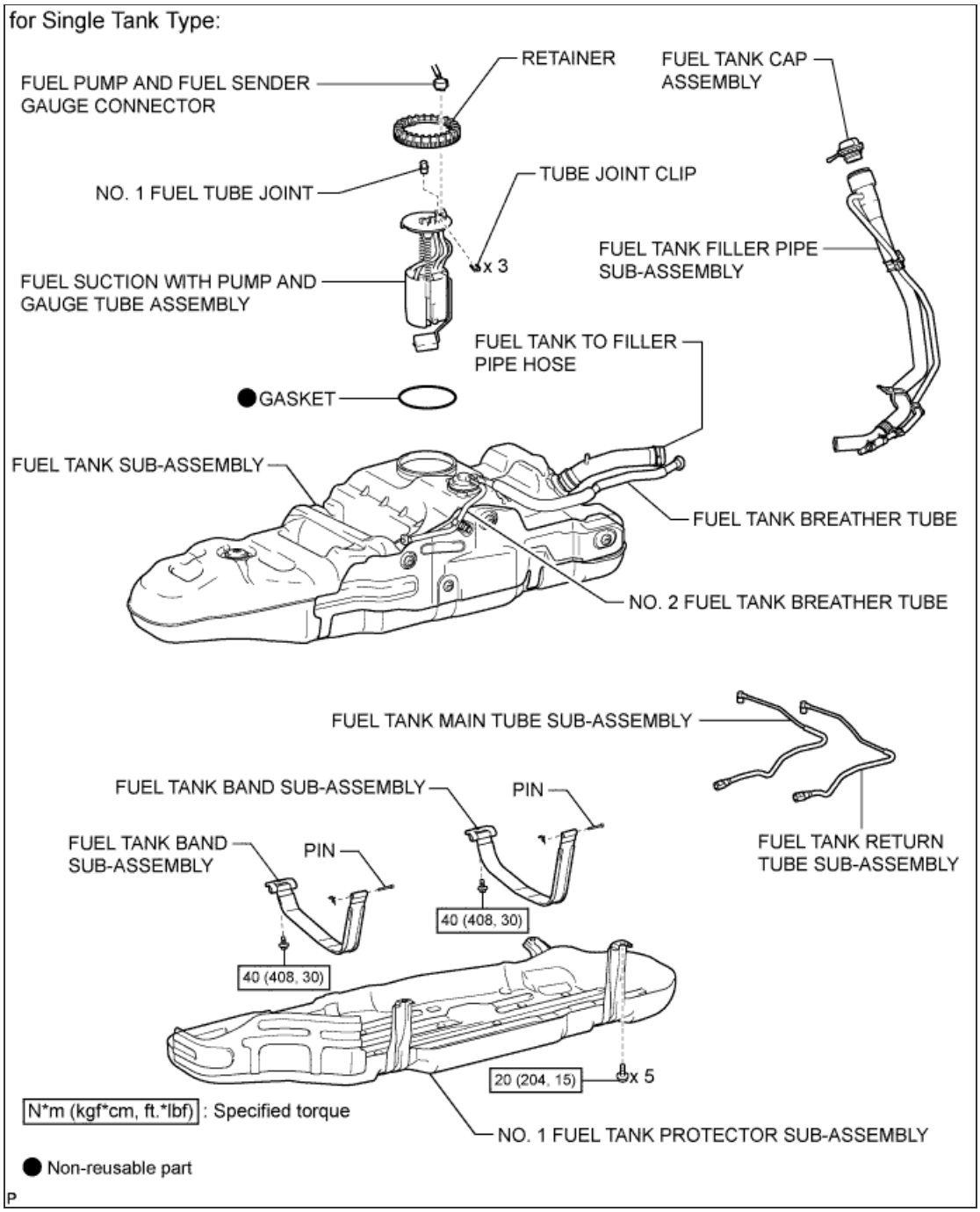


N*m (kgf*cm, ft.*lbf) : Specified torque

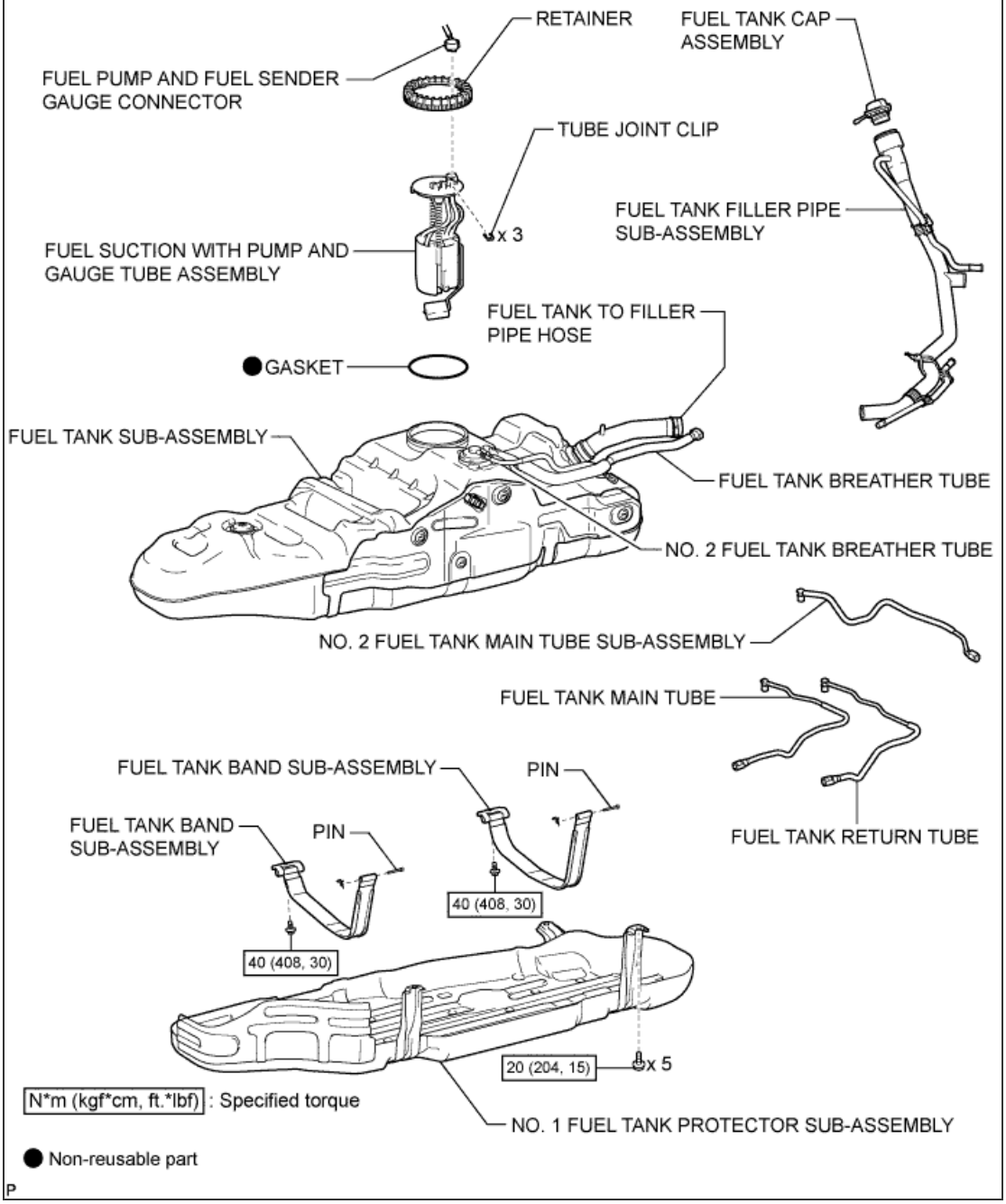
P


OUTER LAP BELT ANCHOR COVER
REAR FLOOR MAT REAR SUPPORT PLATE
SEAT BELT ANCHOR
FRONT QUARTER TRIM PANEL ASSEMBLY RH
12 (122, 9)
REAR SEAT COVER CAP
42 (428, 31)
SEAT BELT ANCHOR
42 (428, 31)
OUTER LAP BELT ANCHOR COVER
REAR SEAT COVER CAP
42 (428, 31)
12 (122, 9)
SEAT BELT ANCHOR
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
42 (428, 31)
FRONT QUARTER TRIM PANEL ASSEMBLY LH
REAR STEP COVER
REAR DOOR SCUFF PLATE RH
REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)
REAR STEP COVER
AIR DUCT PLUG (w/ Rear Air Conditioning System)
REAR DOOR SCUFF PLATE LH
N*m (kgf*cm, ft.*lbf) : Specified torque
T


REAR NO. 1 SEAT PROTECTOR
REAR NO. 2 SEAT PROTECTOR
FRONT FLOOR CARPET ASSEMBLY
x 2
AIR DUCT
REAR FLOOR NO. 2 SERVICE HOLE COVER
P

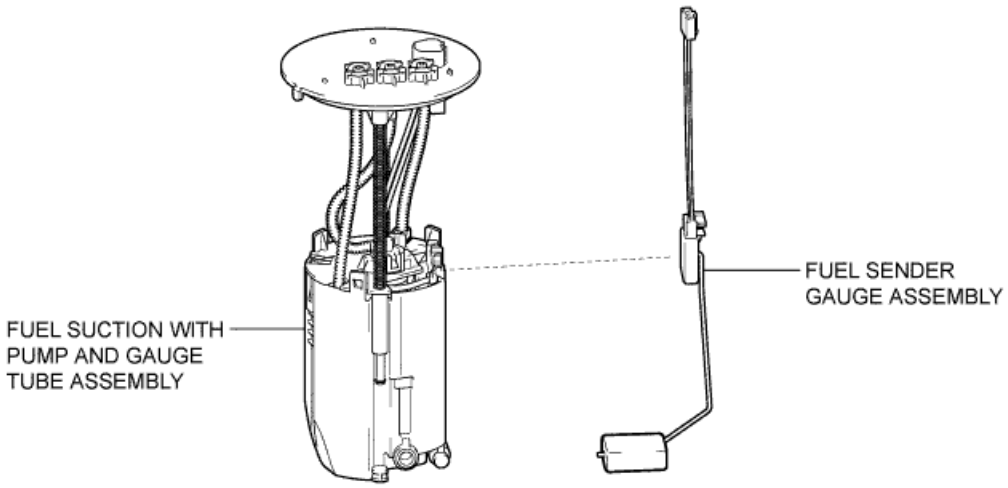

for Single Tank Type:
FUEL PUMP AND FUEL SENDER GAUGE CONNECTOR
RETAINER
FUEL TANK CAP ASSEMBLY
NO. 1 FUEL TUBE JOINT
TUBE JOINT CLIP
x 3
FUEL TANK FILLER PIPE SUB-ASSEMBLY
FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY
FUEL TANK TO FILLER PIPE HOSE
GASKET
FUEL TANK SUB-ASSEMBLY
FUEL TANK BREATHER TUBE
NO. 2 FUEL TANK BREATHER TUBE
FUEL TANK MAIN TUBE SUB-ASSEMBLY
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TANK RETURN TUBE SUB-ASSEMBLY
40 (408, 30)
40 (408, 30)
20 (204, 15)
x 5
N*m (kgf*cm, ft.*lbf) : Specified torque
NO. 1 FUEL TANK PROTECTOR SUB-ASSEMBLY
Non-reusable part
P

for Double Tank Type:

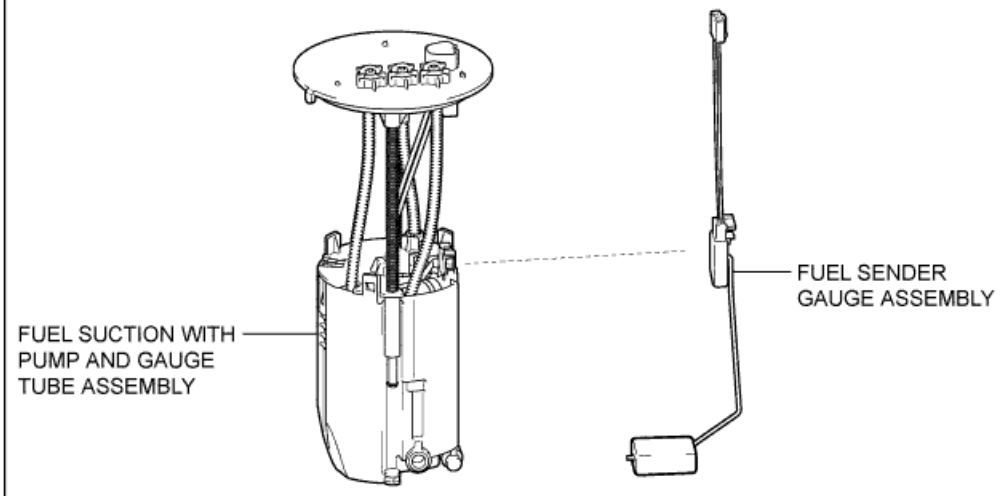


P

for Single Tank Type:



for Double Tank Type:



P

for Preparation Click here

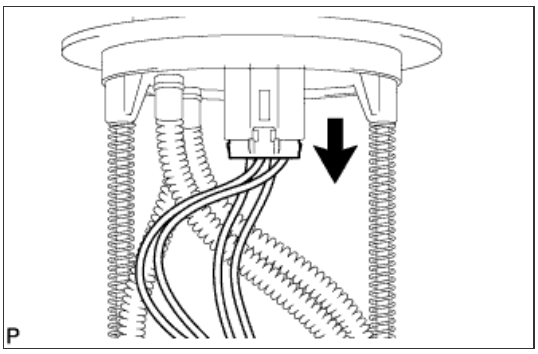
1. REMOVE FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

a. for Single Tank Type:
Remove the fuel suction with pump and gauge tube assembly (Click here).

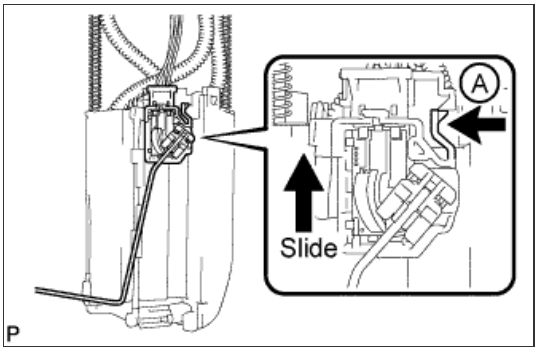
b. for Double Tank Type:
Remove the fuel suction with pump and gauge tube assembly (Click here).

2. REMOVE FUEL SENDER GAUGE ASSEMBLY

a. Disconnect the fuel sender gauge connector.



b. Press down on the sender gauge claw labeled A. Then slide the sender gauge upward to remove it.

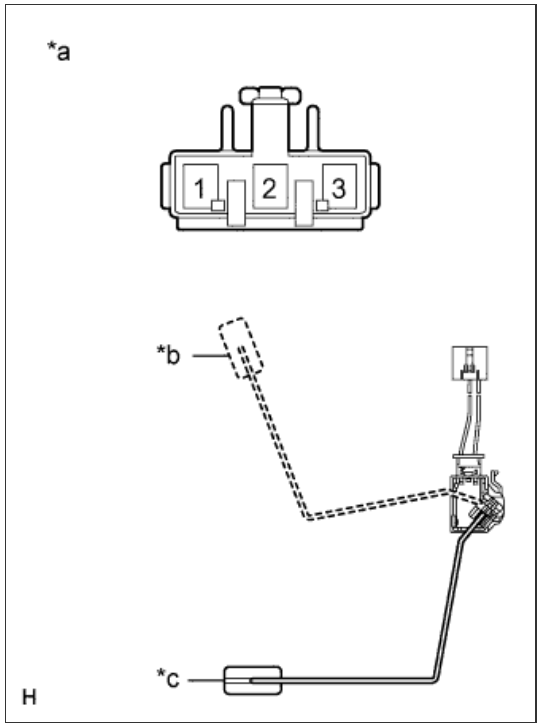


for Preparation Click here

1. INSPECT FUEL SENDER GAUGE ASSEMBLY

Text in Illustration

*a	Component without harness connected (Fuel Sender Gauge)
*b	F (Upper)
*c	E (Lower)



a. Check that the float moves smoothly between F and E.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

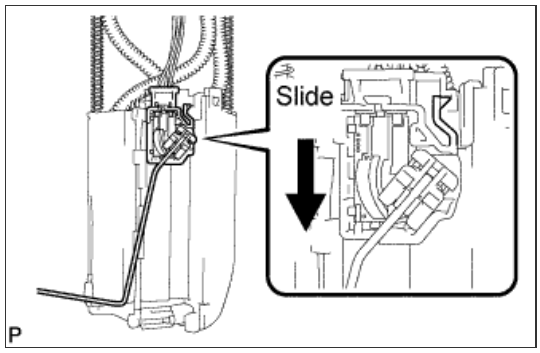
Tester Connection	Condition	Specified Condition
1 - 2	Float level is F (upper)	13.5 to 16.5 Ω
	Float level is E (lower)	405.5 to 414.5 Ω

If the result is not as specified, replace the fuel sender gauge assembly.

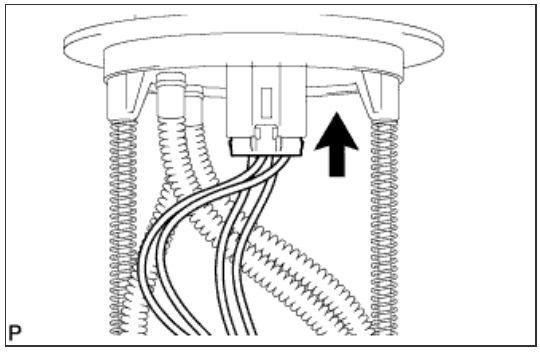
for Preparation Click here

1. INSTALL FUEL SENDER GAUGE ASSEMBLY

a. Set the sender gauge to the fuel sub-tank. Then slide the sender gauge downward to install it.



b. Connect the fuel sender gauge connector.

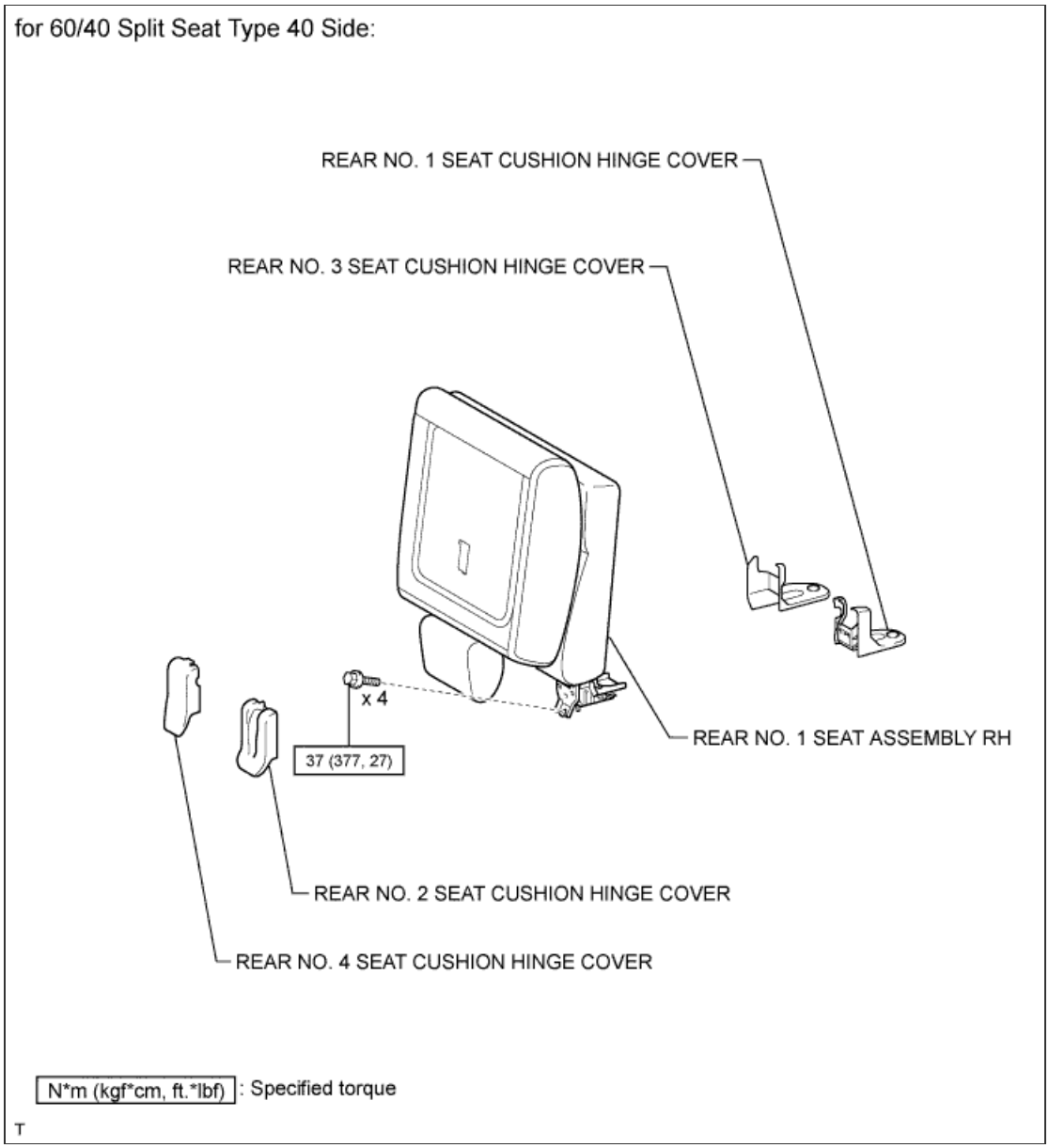


2. INSTALL FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

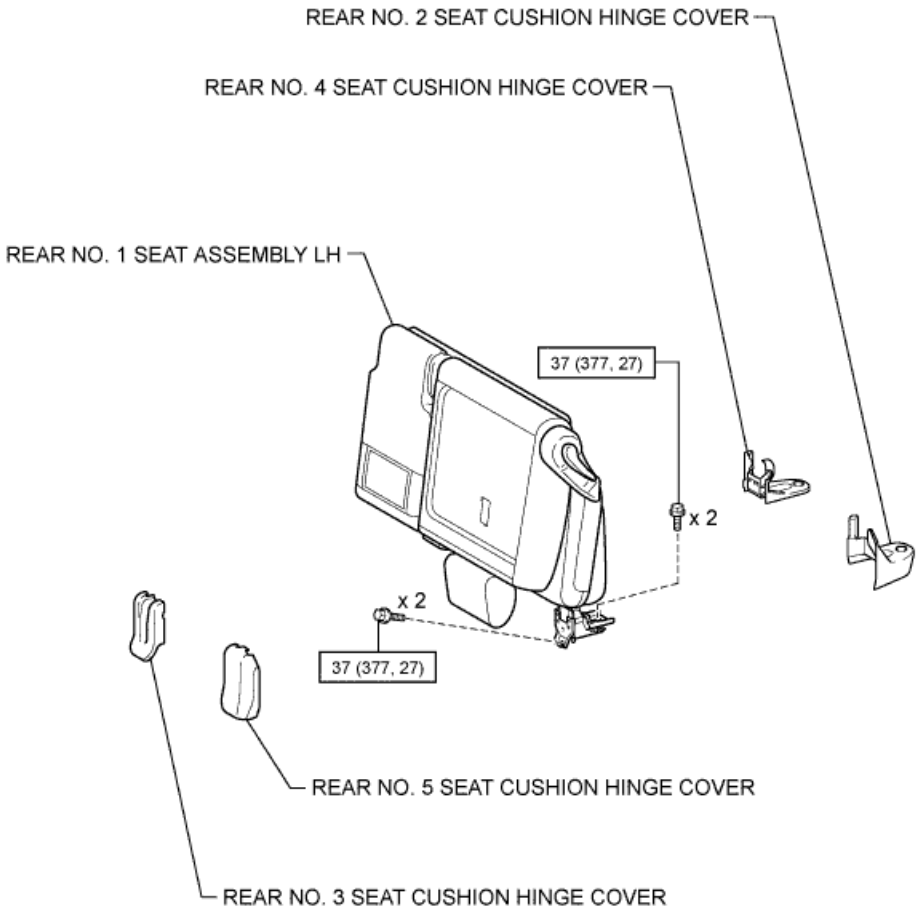
a. for Single Tank Type:
Install the fuel suction with pump and gauge tube assembly (Click here).

b. for Double Tank Type:
Install the fuel suction with pump and gauge tube assembly (Click here).

for Preparation Click here



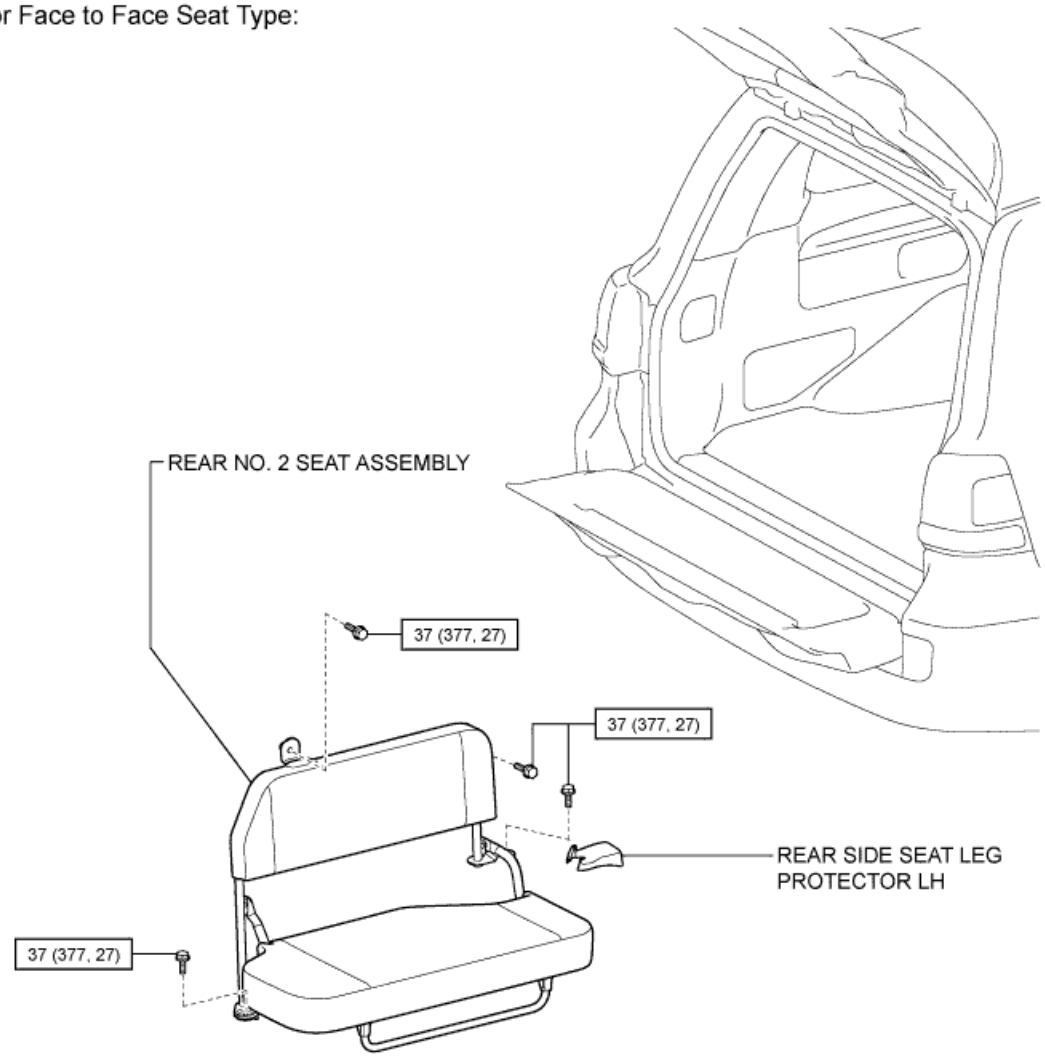
for 60/40 Split Seat Type 60 Side:



N*m (kgf*cm, ft.*lbf) : Specified torque

T

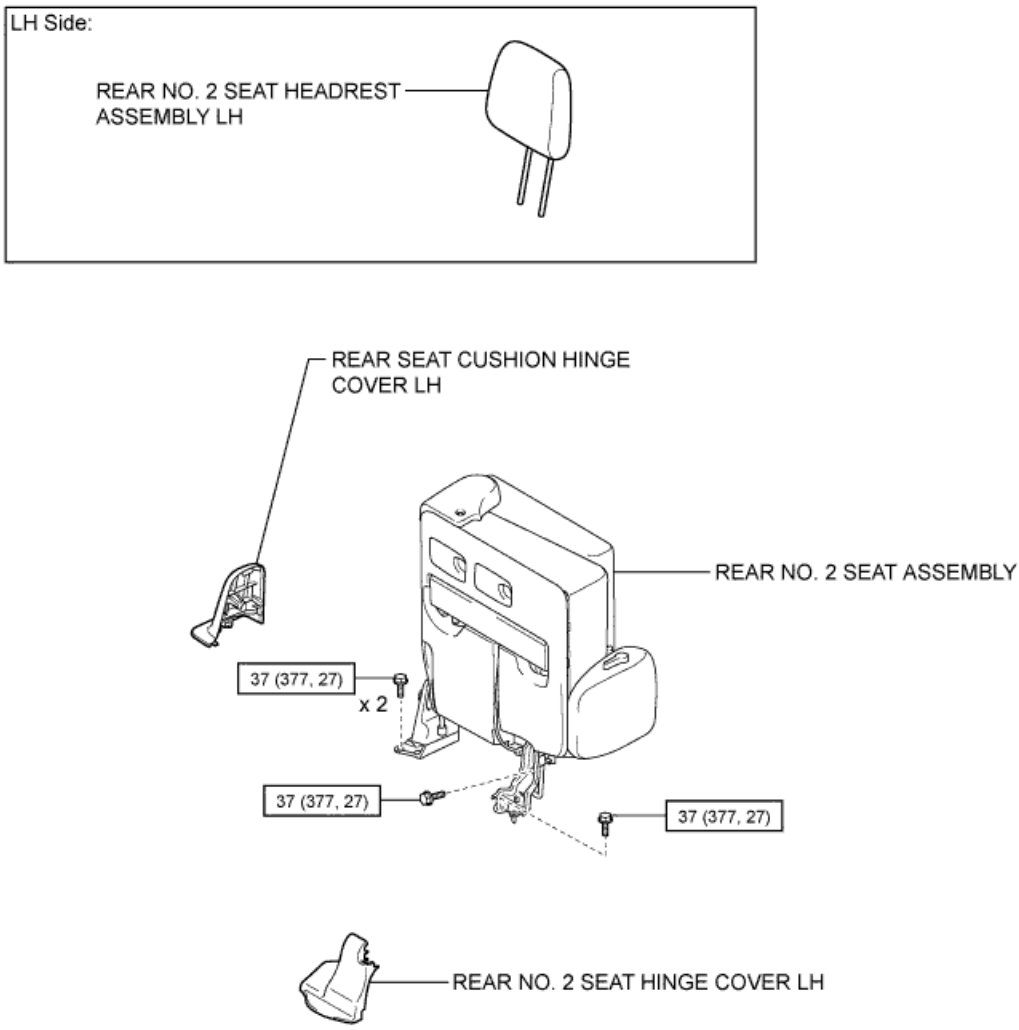
for Face to Face Seat Type:



N*m (kgf*cm, ft.*lbf) : Specified torque

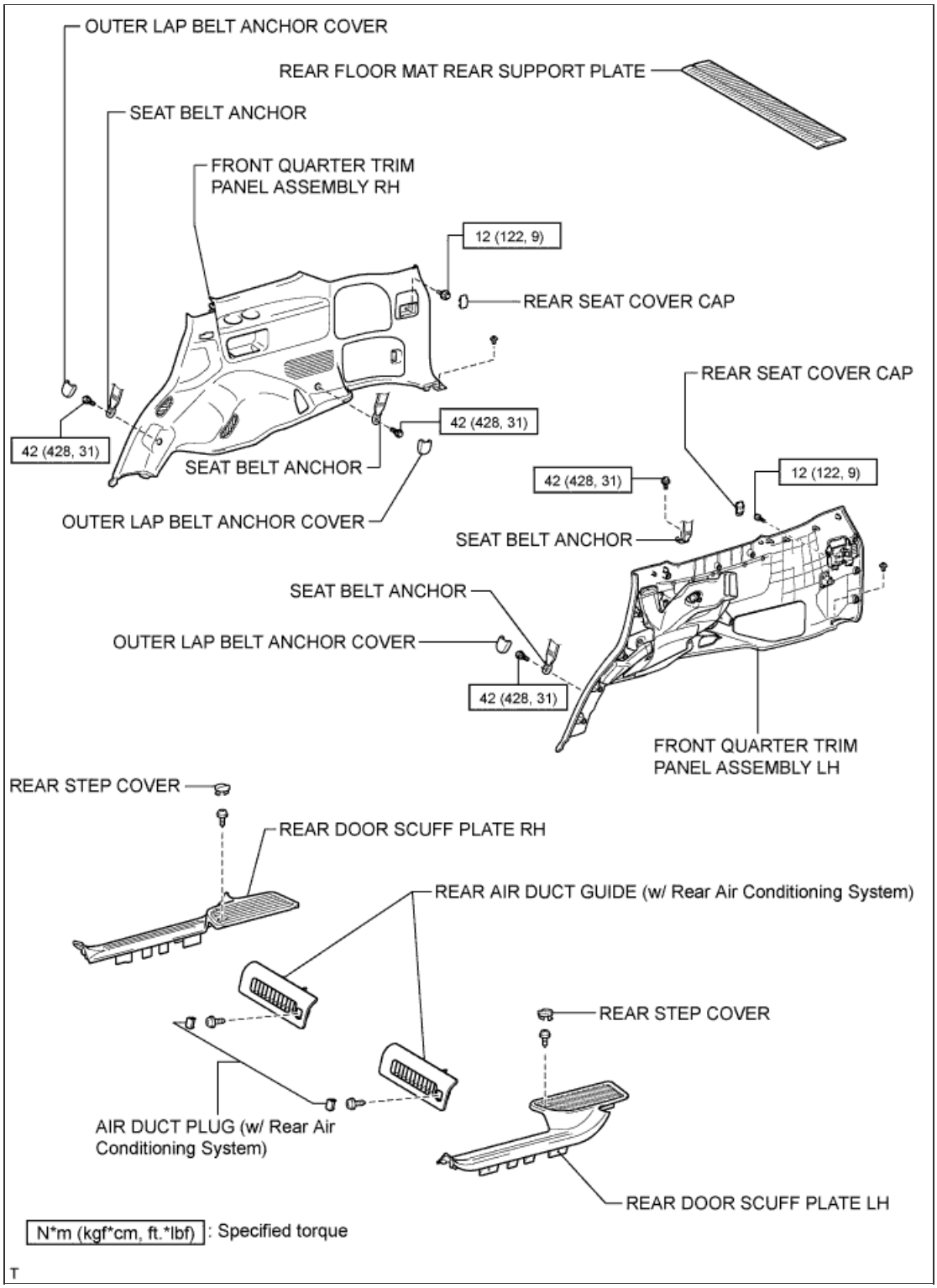
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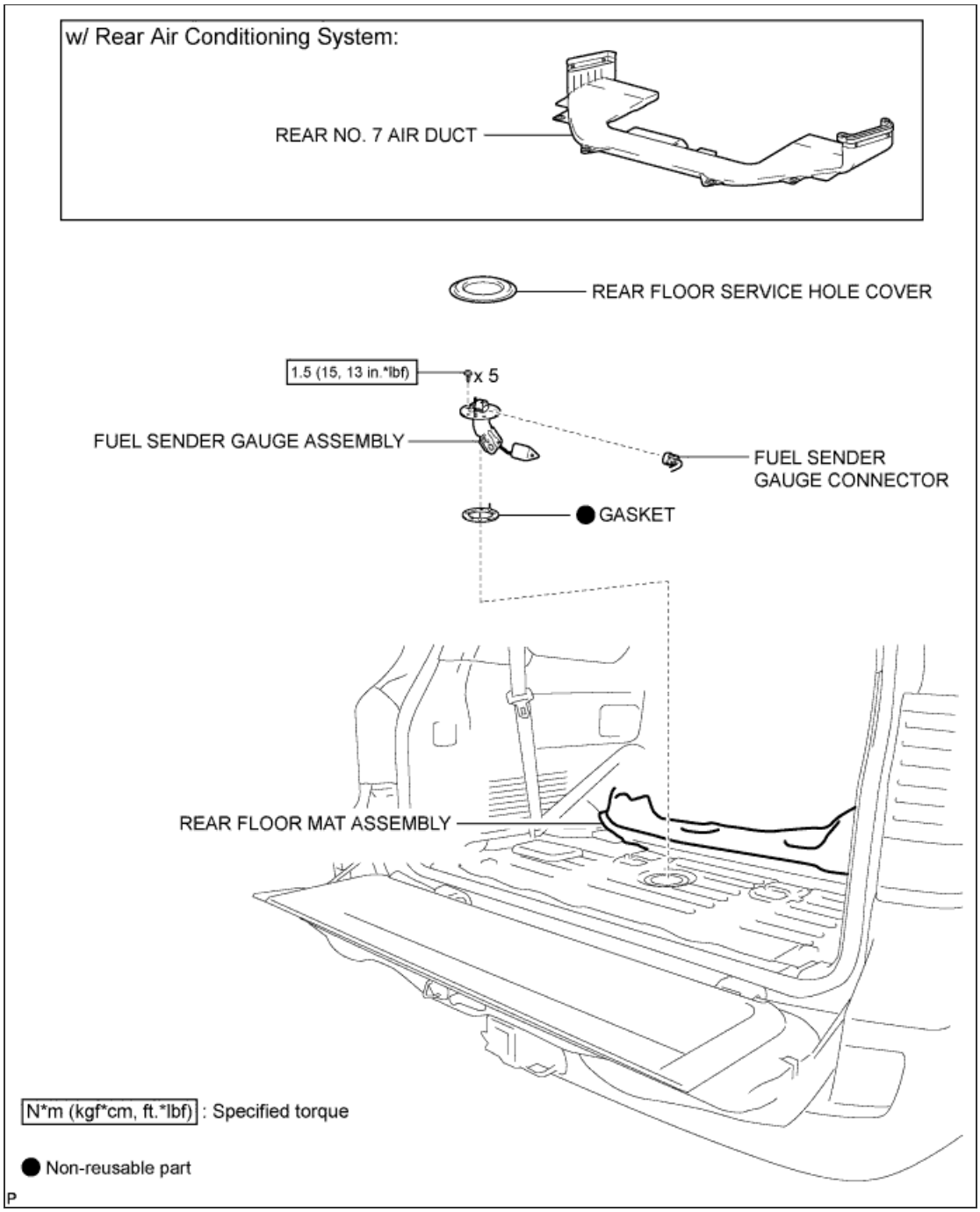
except Face to Face Seat Type:



N*m (kgf*cm, ft.*lbf) : Specified torque

P


OUTER LAP BELT ANCHOR COVER
REAR FLOOR MAT REAR SUPPORT PLATE
SEAT BELT ANCHOR
FRONT QUARTER TRIM PANEL ASSEMBLY RH
12 (122, 9)
REAR SEAT COVER CAP
42 (428, 31)
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
REAR SEAT COVER CAP
42 (428, 31)
12 (122, 9)
SEAT BELT ANCHOR
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
42 (428, 31)
FRONT QUARTER TRIM PANEL ASSEMBLY LH
REAR STEP COVER
REAR DOOR SCUFF PLATE RH
REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)
REAR STEP COVER
AIR DUCT PLUG (w/ Rear Air Conditioning System)
REAR DOOR SCUFF PLATE LH
N*m (kgf*cm, ft.*lbf) : Specified torque
T


w/ Rear Air Conditioning System:
REAR NO. 7 AIR DUCT
REAR FLOOR SERVICE HOLE COVER
1.5 (15, 13 in.*lbf)
x 5
FUEL SENDER GAUGE ASSEMBLY
FUEL SENDER GAUGE CONNECTOR
GASKET
REAR FLOOR MAT ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

FUEL SENDER GAUGE ASSEMBLY (for Fuel Sub Tank) > REMOVAL

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

2. REMOVE REAR NO. 1 SEAT ASSEMBLY RH (for 60/40 Split Seat Type 40 Side)

a. Remove the rear No. 1 seat assembly RH (Click here).

3. REMOVE REAR NO. 1 SEAT ASSEMBLY LH (for 60/40 Split Seat Type 60 Side)

a. Remove the rear No. 1 seat assembly LH (Click here).

4. REMOVE REAR NO. 2 SEAT ASSEMBLY

a. for Face to Face Seat Type:
Remove the rear No. 2 seat assembly (Click here).

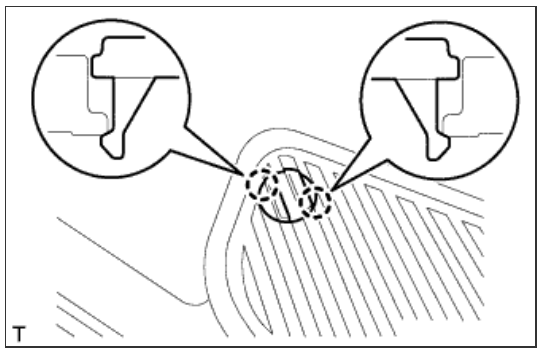
b. except Face to Face Seat Type:
Remove the rear No. 2 seat assembly (Click here).

5. REMOVE REAR STEP COVER

HINT:

Use the same proced e to remove the step cover on the other side.

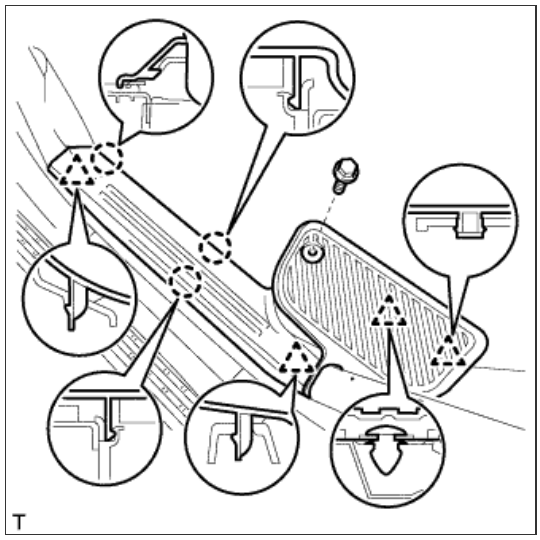
a. Detach the 2 claws and remove the step cover.



6. REMOVE REAR DOOR SCUFF PLATE LH

a. Remove the screw.

b. Detach the 3 claws and 4 clips, and remove the sc ff plate.



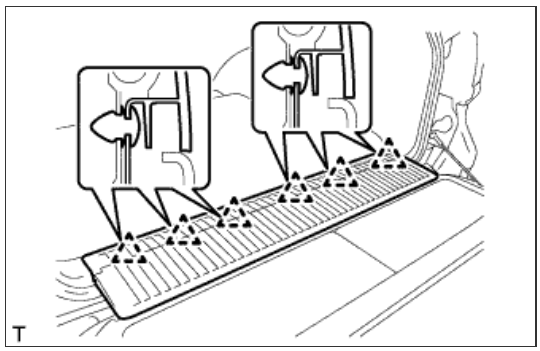
7. REMOVE REAR DOOR SCUFF PLATE RH

HINT:

Use the same procedures as described for the LH side.

8. REMOVE REAR FLOOR MAT REAR SUPPORT PLATE

a. Detach the 6 clips and remove the support plate.



9. REMOVE REAR SEAT COVER CAP (w/ Rear No. 2 Seat, except Face to Face Seat Type)

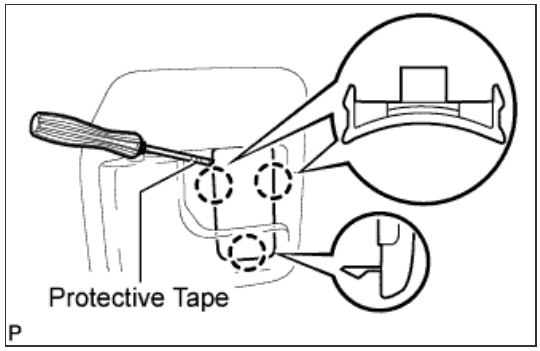
HINT:

Use the same procedure to remove the rear seat cover cap on the other side.

a. Using a screwdriver, detach the 3 claws and remove the rear seat cover cap.

HINT:

Tape the screwdriver tip before use.



10. REMOVE FRONT QUARTER TRIM PANEL ASSEMBLY LH

a. w/ Sliding Roof:
Remove the front quarter trim panel assembly LH (Click here).

b. w/o Sliding Roof:
Remove the front quarter trim panel assembly LH (Click here).

11. REMOVE FRONT QUARTER TRIM PANEL ASSEMBLY RH

a. w/ Sliding Roof:
Remove the front arter trim panel assembly RH (Click here).

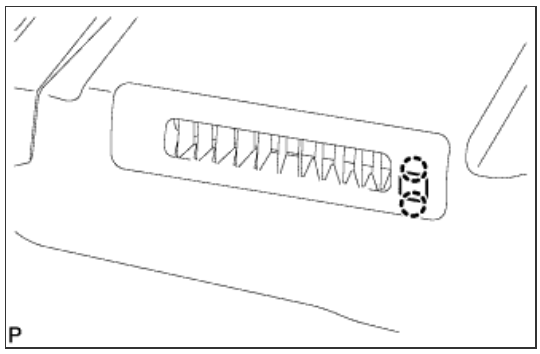
b. w/o Sliding Roof:
Remove the front arter trim panel assembly RH (Click here).

12. REMOVE AIR DUCT PLUG (w/ Rear Air Conditioning System)

a. Detach the 2 claws and remove the pl g.

HINT:

Use the same proced es for both sides.



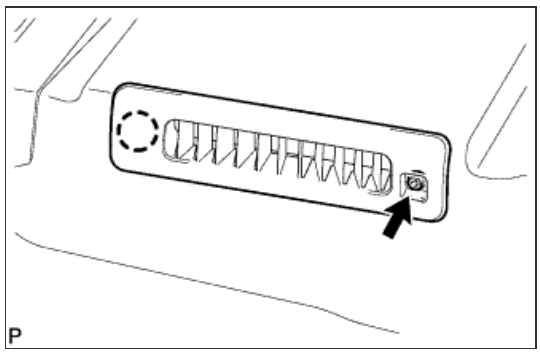
13. REMOVE REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)

a. Remove the screw.

b. Detach the claw and remove the g ide.

HINT:

Use the same proced es for both sides.



14. REMOVE REAR FLOOR MAT ASSEMBLY

a. w/ Rear Air Conditioning System:
Detach the 5 clips and fold back the floor mat toward the front of the vehicle.

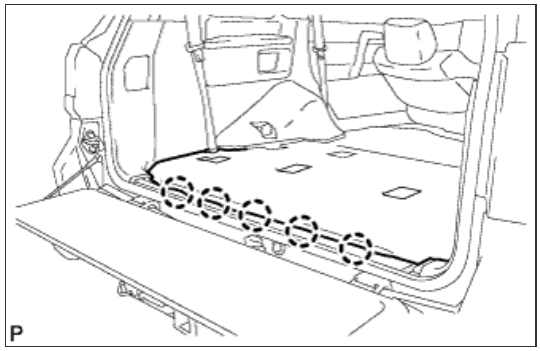
HINT:

Fold back the floor mat so that the rear No. 7 air d ct can be removed.

b. w/o Rear Air Conditioning System:
Detach the 5 clips and fold back the floor mat toward the front of the vehicle.

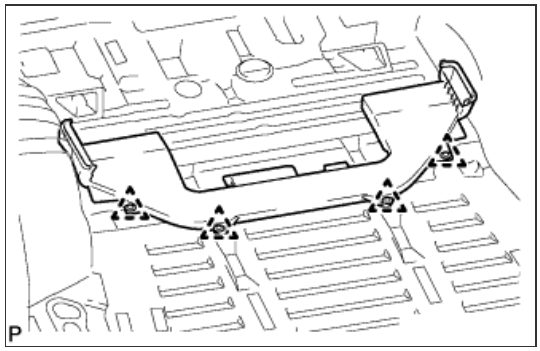
HINT:

Fold back the floor mat so that the service hole cover can be removed.

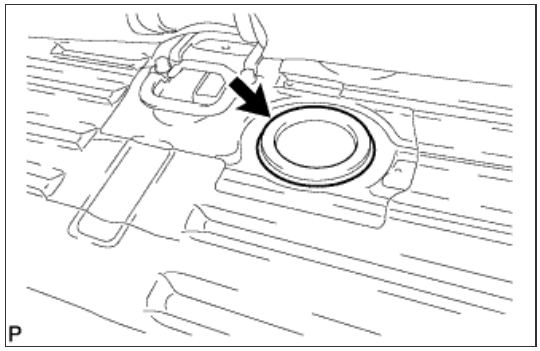


15. REMOVE REAR NO. 7 AIR DUCT (w/ Rear Air Conditioning System)

a. Detach the 4 clips and remove the air d ct.



16. REMOVE REAR FLOOR SERVICE HOLE COVER



17. REMOVE FUEL SENDER GAUGE ASSEMBLY

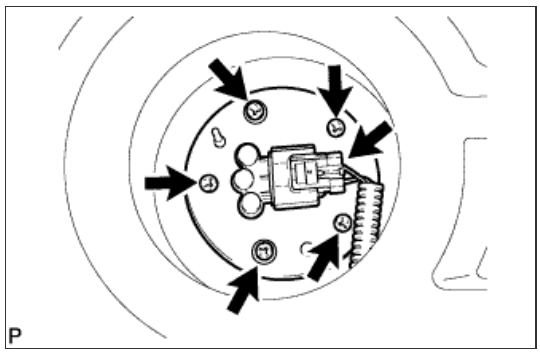
a. Disconnect the sender ga ge connector.

b. Remove the 5 screws and sender ga ge.

NOTICE:

Be caref l not to bend the arm of the f el sender ga ge.

c. Remove the gasket from the sender ga ge.



for Preparation Click here

1. INSPECT FUEL SENDER GAUGE ASSEMBLY

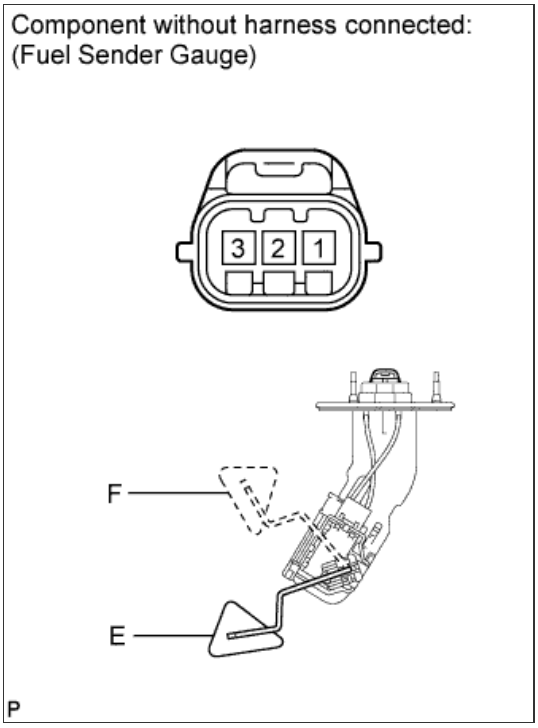
a. Check that the float moves smoothly between F and E.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
2 - 3	Float level is F (upper)	12 to 18 Ω
	Float level is E (lower)	405 to 415 Ω

If the result is not as specified, replace the fuel sender gauge assembly.



for Preparation Click here

1. INSTALL FUEL SENDER GAUGE ASSEMBLY

a. Install a new gasket to the sender gauge.

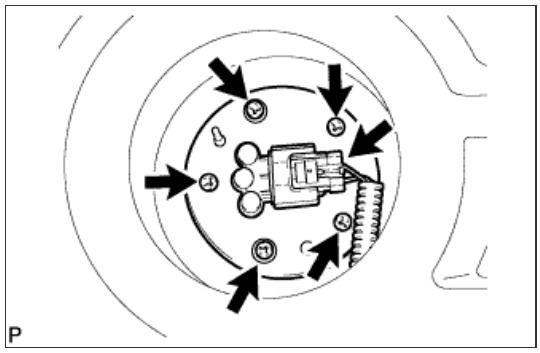
b. Install the sender gauge with the 5 screws.

Torque:
1.5 N*m{ 15 kgf*cm , 13 in.*lbf }

NOTICE:

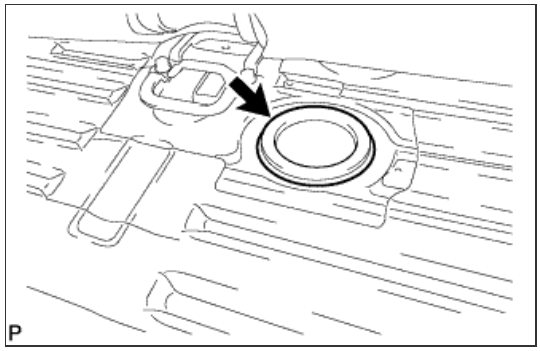
Be careful not to bend the arm of the fuel sender gauge.

c. Connect the sender gauge connector.



2. INSTALL REAR FLOOR SERVICE HOLE COVER

a. Install the service hole cover with new butyl tape.

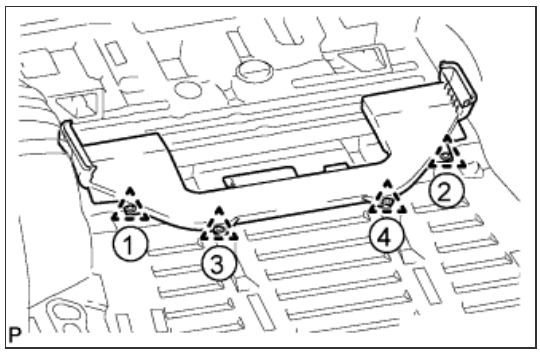


3. INSTALL REAR NO. 7 AIR DUCT (w/ Rear Air Conditioning System)

a. Attach the 4 clips to install the air duct.

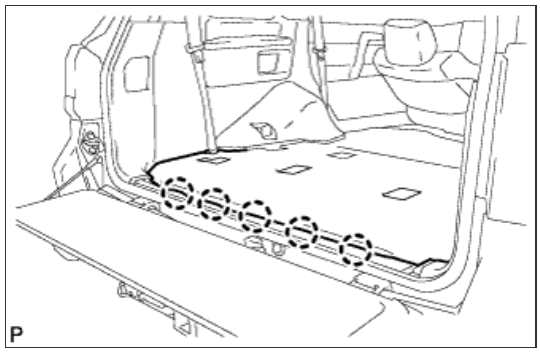
HINT:

Attach the clips in the order shown in the illustration.



4. INSTALL REAR FLOOR MAT ASSEMBLY

a. Attach the 5 clips to install the floor mat.



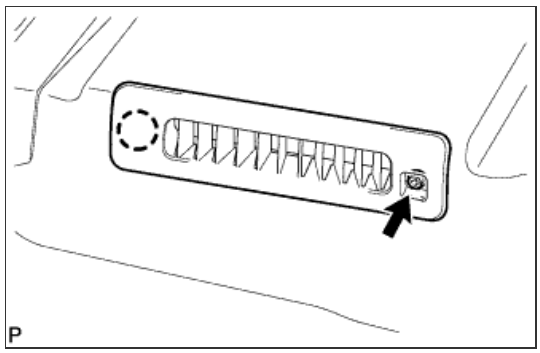
5. INSTALL REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)

a. Attach the claw to install the guide.

b. Install the screw.

HINT:

Use the same procedures for both sides.

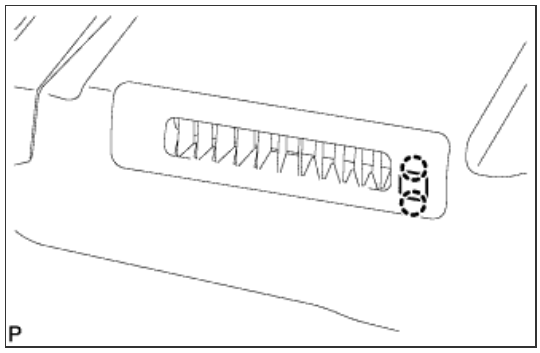


6. INSTALL AIR DUCT PLUG (w/ Rear Air Conditioning System)

a. Attach the 2 claws to install the plug.

HINT:

Use the same procedures for both sides.



7. INSTALL FRONT QUARTER TRIM PANEL ASSEMBLY LH

a. w/ Sliding Roof:
Install the front quarter trim panel assembly LH (Click here).

b. w/o Sliding Roof:
Install the front quarter trim panel assembly LH (Click here).

8. INSTALL FRONT QUARTER TRIM PANEL ASSEMBLY RH

a. w/ Sliding Roof:
Install the front quarter trim panel assembly RH (Click here).

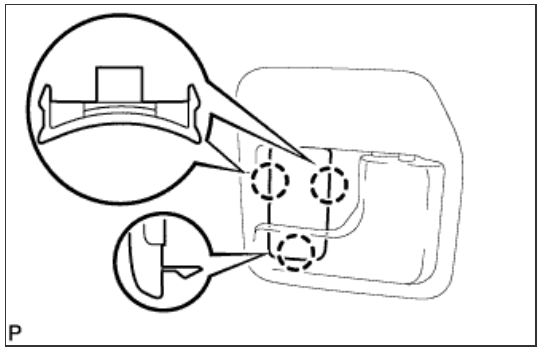
b. w/o Sliding Roof:
Install the front quarter trim panel assembly RH (Click here).

9. INSTALL REAR SEAT COVER CAP (w/ Rear No. 2 Seat, except Face to Face Seat Type)

HINT:

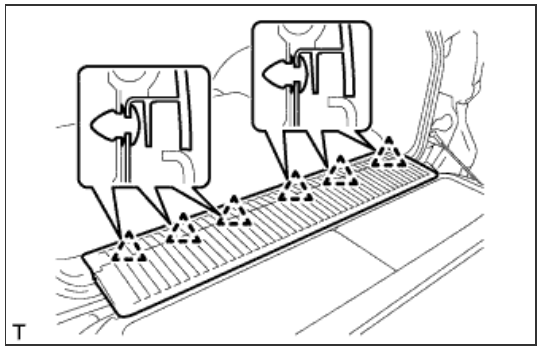
Use the same procedure to install the rear seat cover cap on the other side.

a. Attach the 3 claws to install the rear seat cover cap.



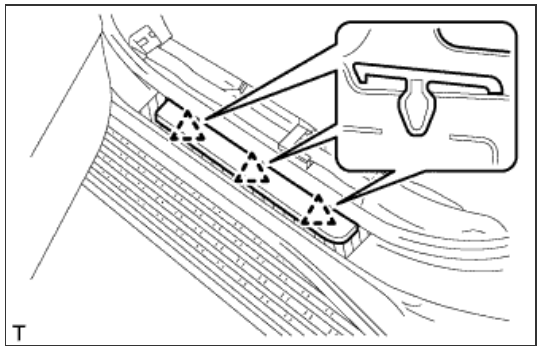
10. INSTALL REAR FLOOR MAT REAR SUPPORT PLATE

a. Attach the 6 clips to install the support plate.



11. INSTALL REAR DOOR SCUFF PLATE LH

a. Attach the 3 clips to install the rear door scuff plate outside.



12. INSTALL REAR DOOR SCUFF PLATE RH

HINT:

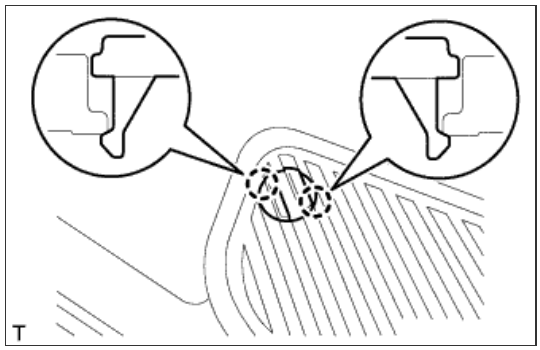
Use the same procedures described for the LH side.

13. INSTALL REAR STEP COVER

HINT:

Use the same procedure to install the step cover on the other side.

a. Attach the 2 claws to install the step cover.



14. INSTALL REAR NO. 2 SEAT ASSEMBLY

a. for Face to Face Seat Type:
Install the rear No. 2 seat assembly (Click here).

b. e cept Face to Face Seat Type:
Install the rear No. 2 seat assembly (Click here).

15. INSTALL REAR NO. 1 SEAT ASSEMBLY RH (for 60/40 Split Seat Type 40 Side)

a. Install the rear No. 1 seat assembly RH (Click here).

16. INSTALL REAR NO. 1 SEAT ASSEMBLY LH (for 60/40 Split Seat Type 60 Side)

a. Install the rear No. 1 seat assembly LH (Click here).

17. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable some systems need to be initialized after the cable is reconnected (Click here).

18. CHECK SRS WARNING LIGHT

a. Check the SRS warning light (Click here).

for Preparation Click here

1.IGNITION S ITCH EXPRESSION

HINT:

The type of ignition switch used on this model differs depending on the specifications of the vehicle. The expressions listed in the table below are used in this section.

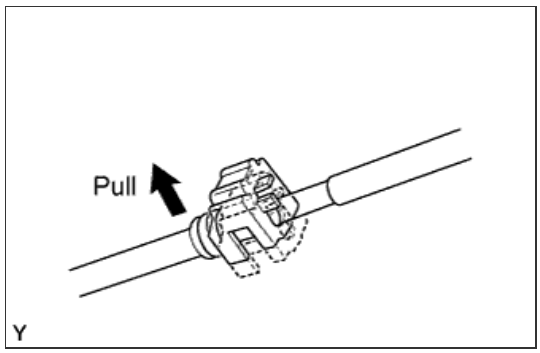
Expression	Ignition Switch (Position)	Engine Switch (Condition)
Ignition Switch off	LOCK	Off
Ignition Switch ACC	ACC	On (ACC)
Ignition Switch ON	ON	On (IG)
Engine Start	START	Start

2.FUEL SYSTEM

a. Observe these precautions when disconnecting the fuel tube connector (for quick type A).

i. Detach the lock claw by lifting up the cover, as shown in the illustration.

ii. Check for dirt or mud on the pipe and around the connector before disconnection. Clean if necessary.

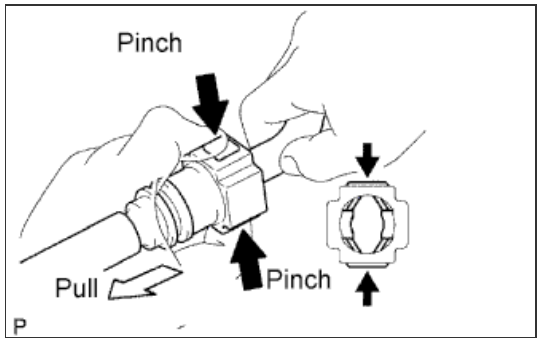


iii. Pinch the connector and disconnect the connector and pipe.
If the connector and the pipe are stuck together, pinch the connector, then push and pull the pipe to disconnect the pipe and pull it out.

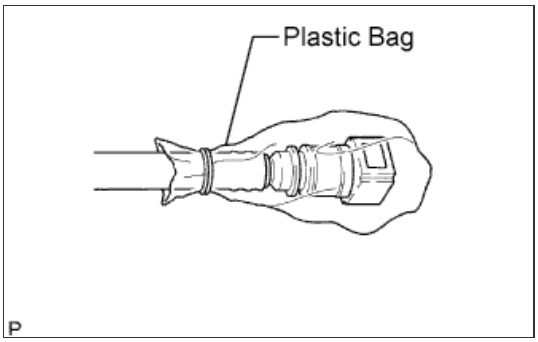
NOTICE:

Do not use any tools in this procedure.

iv. Check for dirt or mud on the seal surface of the disconnected pipe. Clean if necessary.

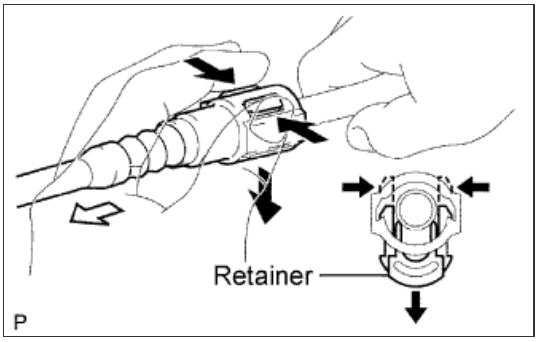


v. To protect the disconnected pipe and connector from damage and contamination, cover it with a plastic bag.



b. Observe these precautions when disconnecting the fuel tube connector (for quick type B).

i. Check that there is no damage or foreign matter on the part of the pipe that contacts the connector.



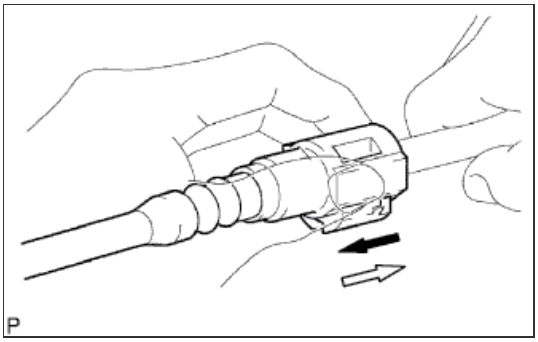
ii. Detach the 2 claws of the connector retainer. Push down on the connector and disconnect it from the pipe.

HINT:

If the connector and pipe are stuck, pinch the fuel pipe by hand, and push and pull the connector to disconnect it.

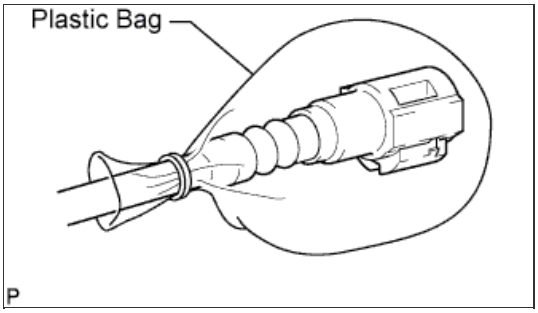
NOTICE:

Do not use any tools in this procedure.



iii. Check for foreign matter on the seal surface of the disconnected pipe. Clean it if necessary.

iv. To protect the disconnected pipe and connector from damage and foreign matter, cover it with a plastic bag.

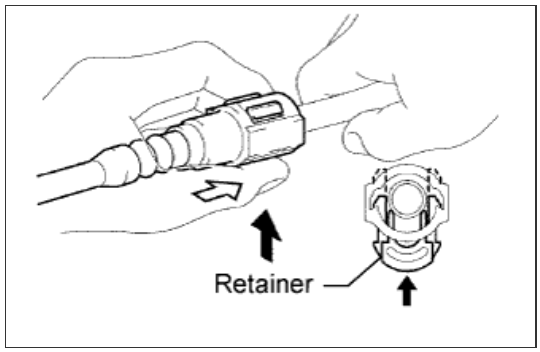


c. Observe these precautions when connecting the fuel tube connector (for quick type B).

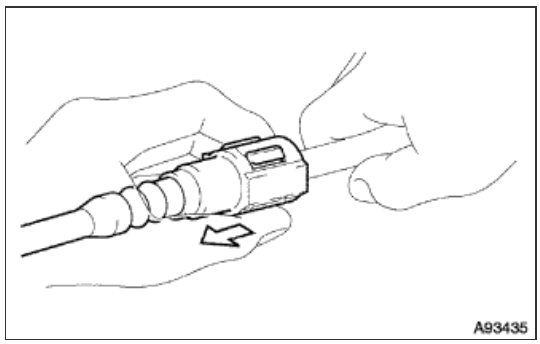
i. Check for foreign matter on the pipe and around the connector before connecting it. Clean it if necessary.

ii. Align the axis of the connector with the axis of the pipe. Push the pipe

into the connector, and push up on the retainer.



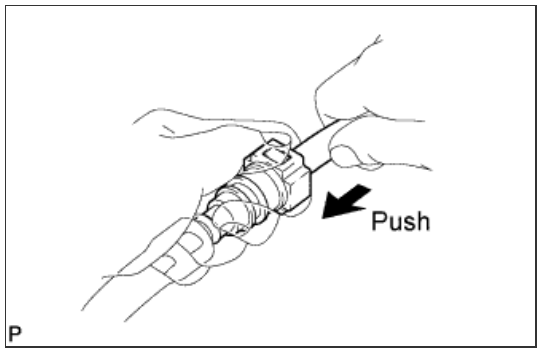
iii. After connecting the pipe and connector, try to pull them apart to confirm that they are securely connected.



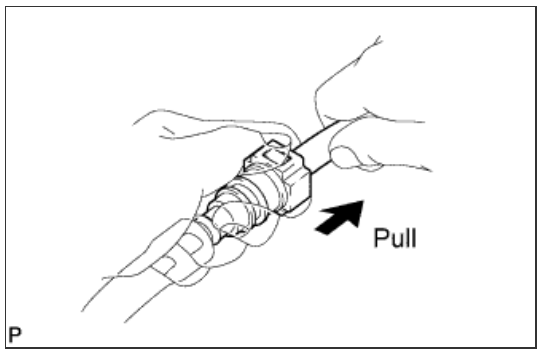
d. Observe these precautions when connecting the fuel tube connector (for quick type A).

i. Check that there is no damage or contamination in the connected part of the pipe.

ii. Align the axis of the connector with the axis of the pipe. Push the pipe into the connector until the connector makes a "click" sound. If the connection is tight, apply a small amount of fresh spindle oil or gasoline on the tip of the pipe.

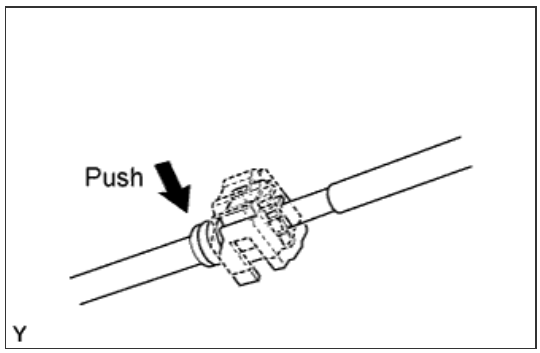


iii. After having finished the connection, try to pull apart the pipe and the connector to confirm that they are securely connected.



iv. Attach the lock claw to the connector by pushing down on the cover, as shown in the illustration.

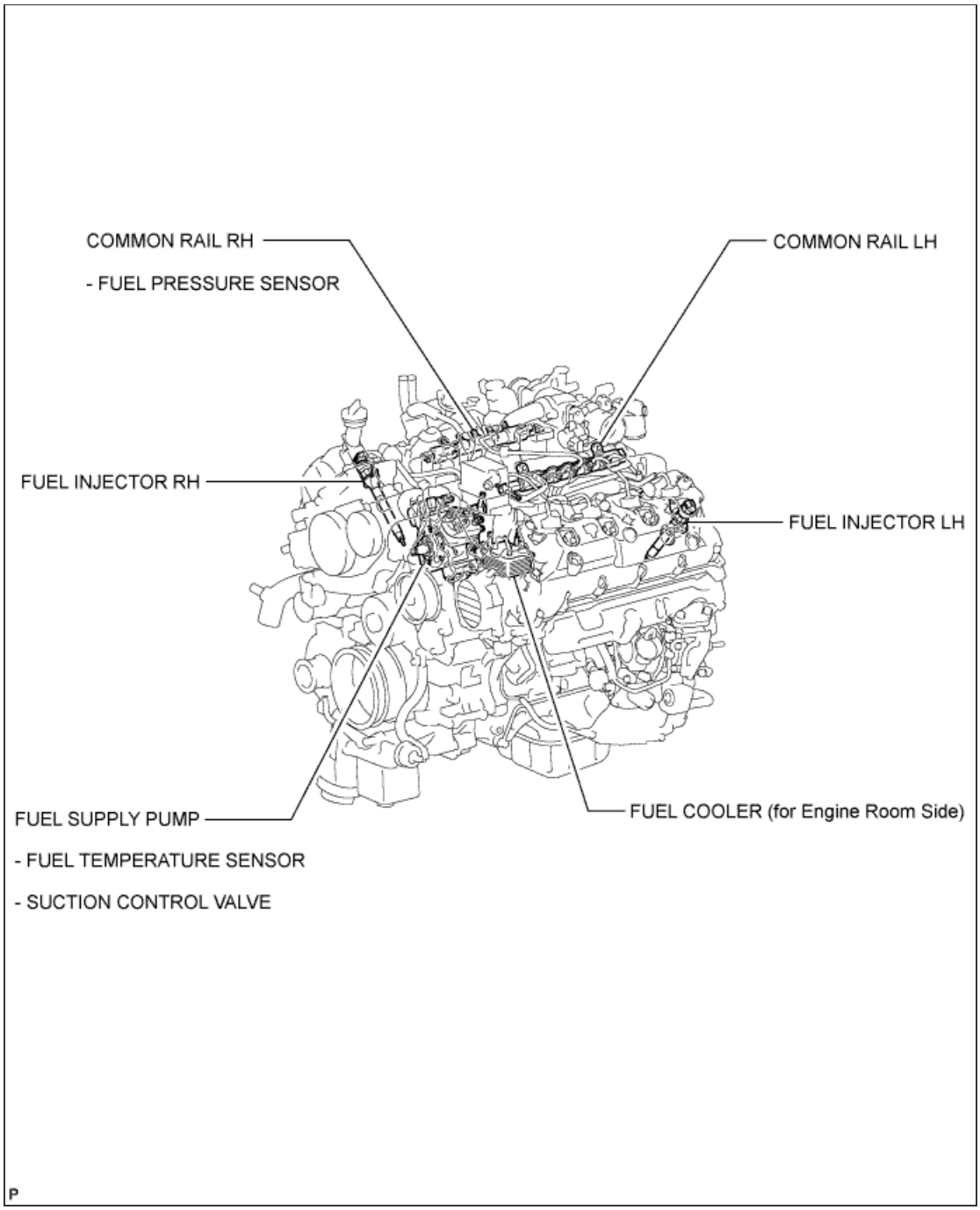
v. Check that there is no fuel leakage.



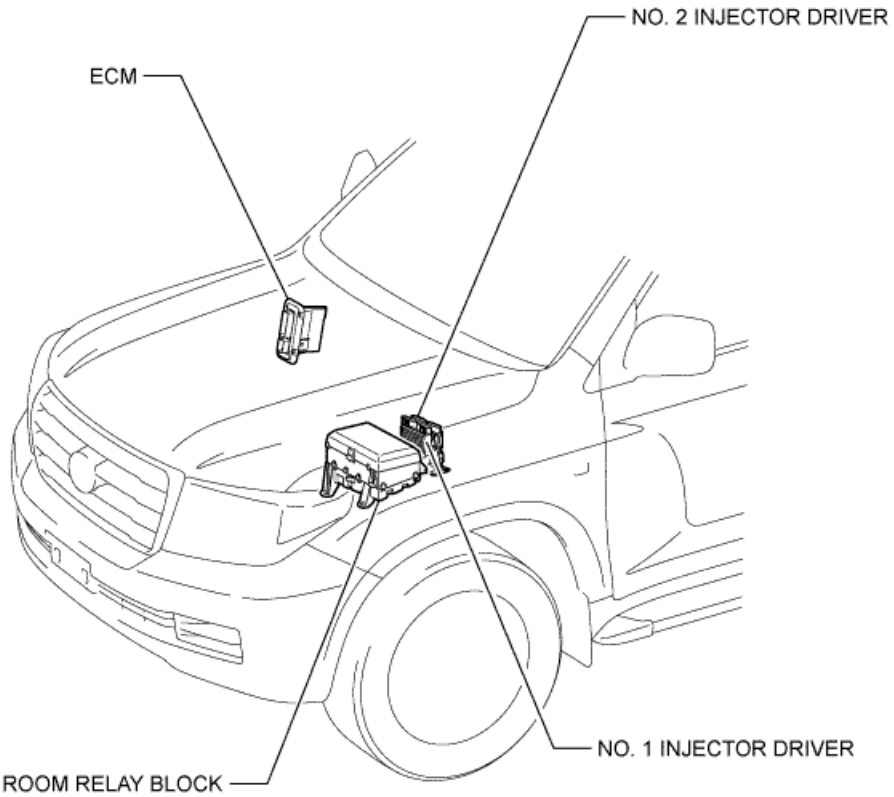
3.CHECK FOR FUEL LEAK

a. Check that there are no fuel leaks after performing maintenance anywhere on the fuel system (Click here).

for Preparation Click here



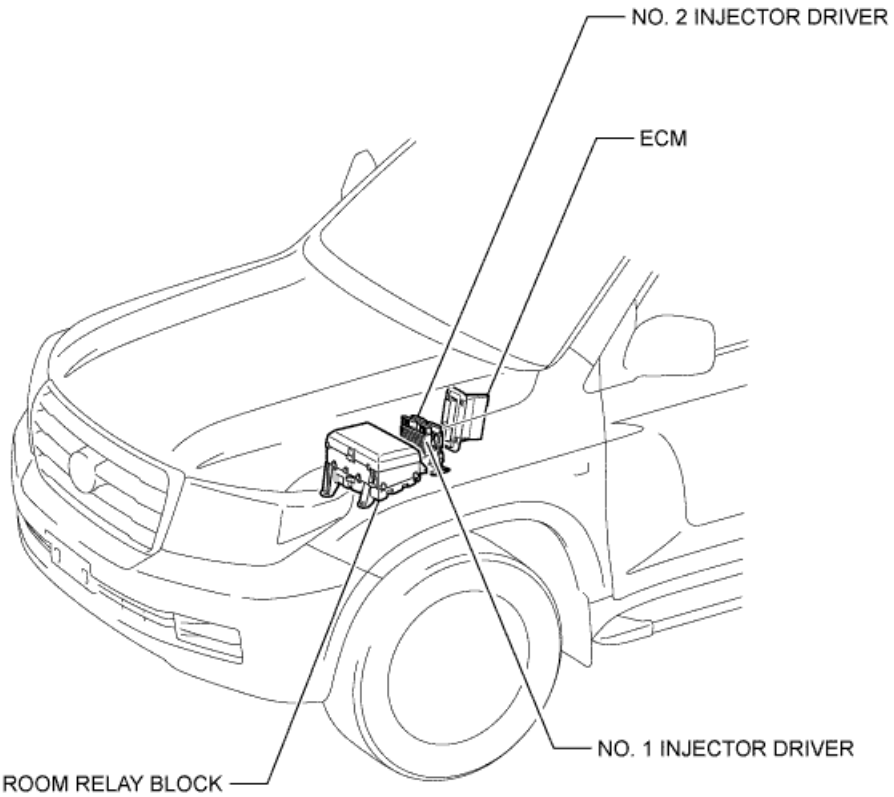
for LHD:



- INTEGRATION RELAY (EFI RELAY, EFI MAIN 2 RELAY)
- SUB PUMP RELAY (SUB PUMP)
- EDU RELAY (EDU 1)
- EDU RELAY (EDU 2)
- F/PMP FUSE

P

for RHD:

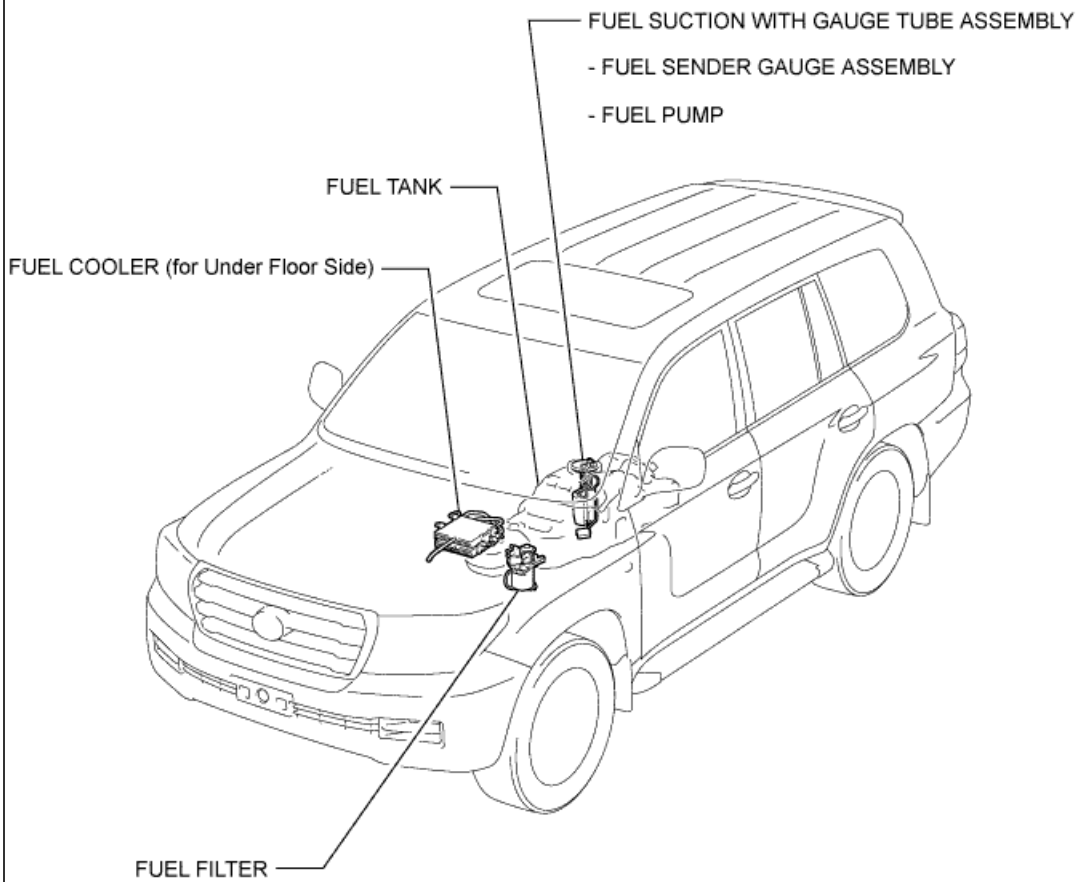


ENGINE ROOM RELAY BLOCK

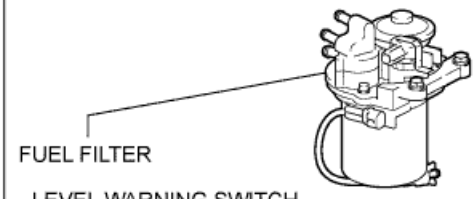
- INTEGRATION RELAY (EFI RELAY, EFI MAIN 2 RELAY)
- SUB PUMP RELAY (SUB PUMP)
- EDU RELAY (EDU 1)
- EDU RELAY (EDU 2)
- F/PMP FUSE

P

for Single Tank Type:

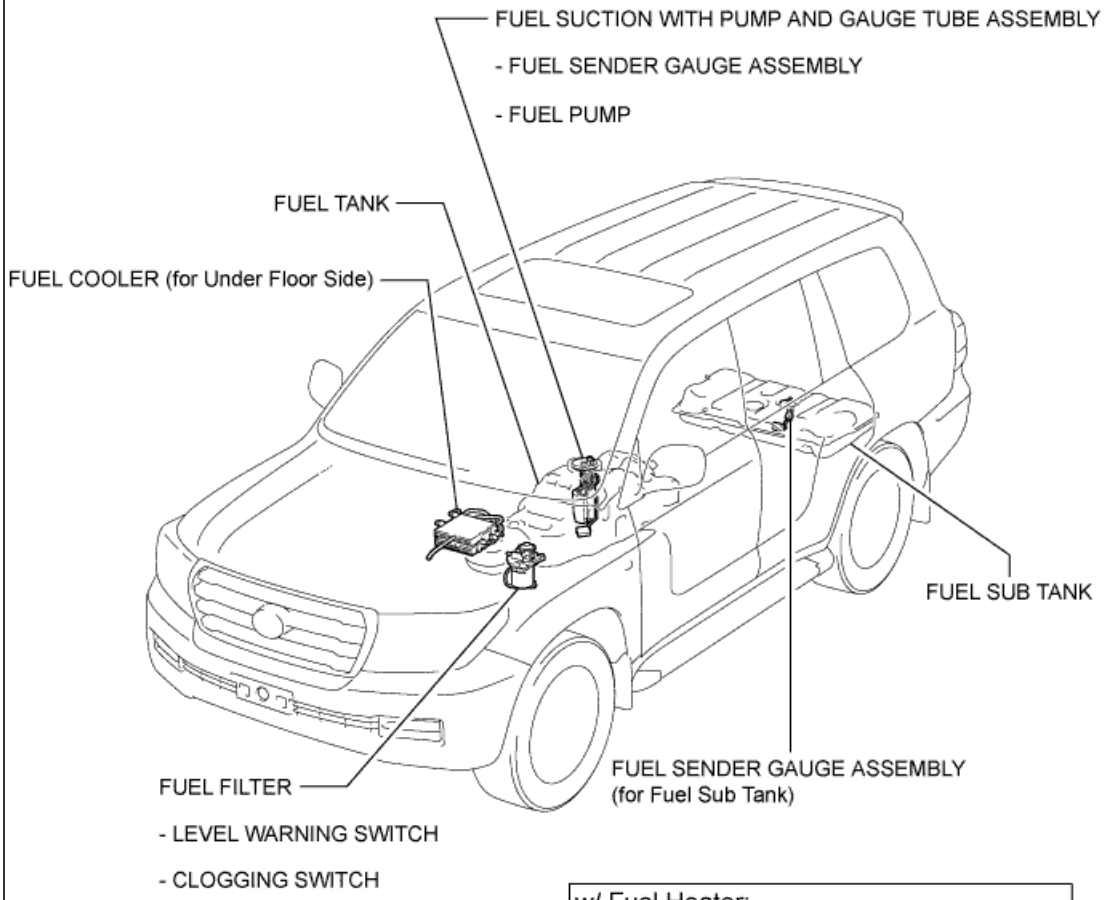


w/ Fuel Heater:

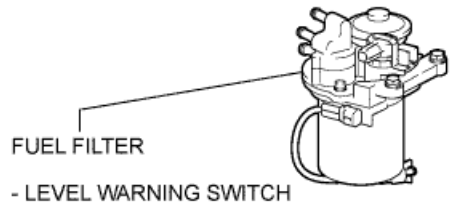


P

for Double Tank Type:



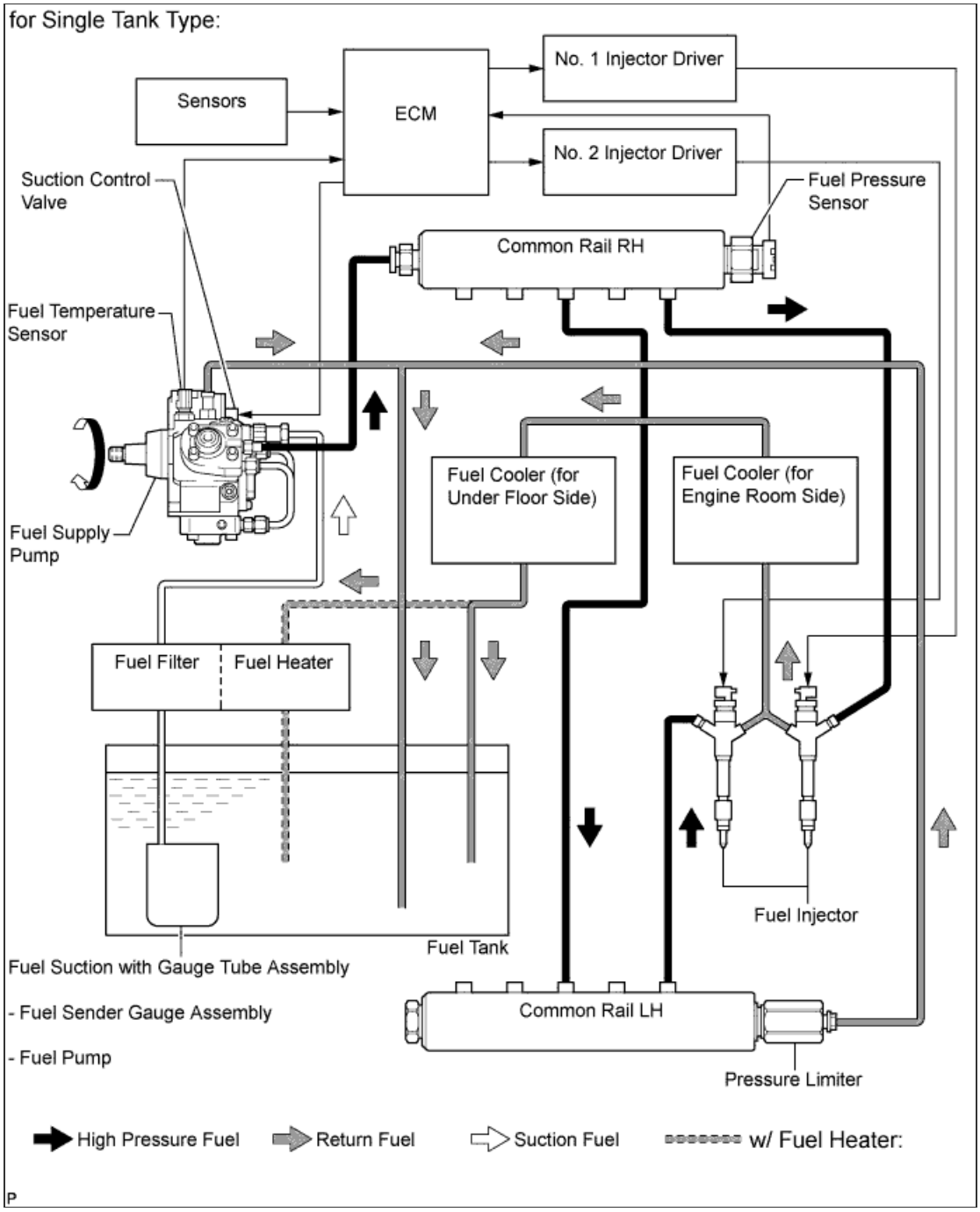
w/ Fuel Heater:

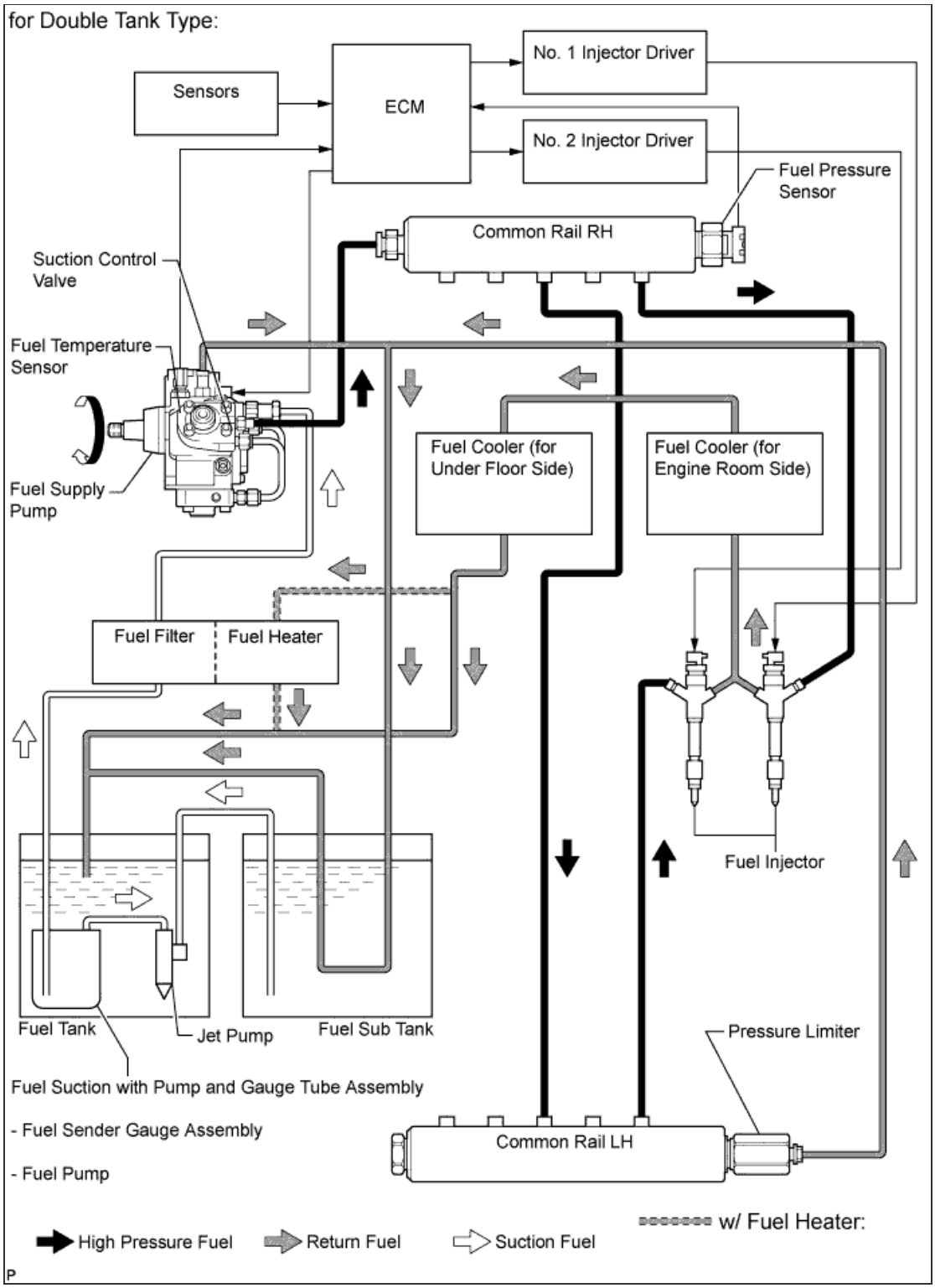


P

for Preparation Click here

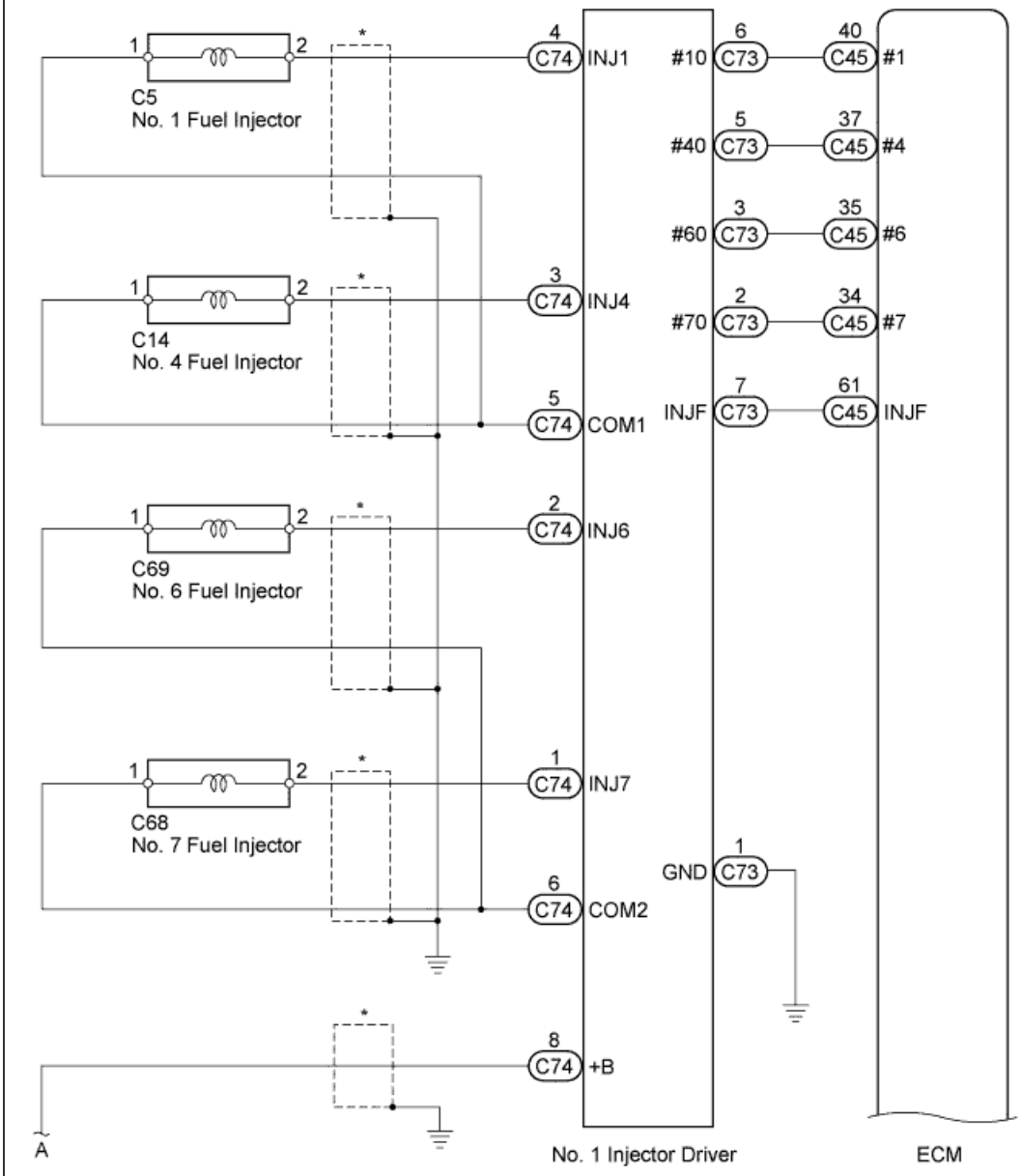
FUEL FLOW DIAGRAM





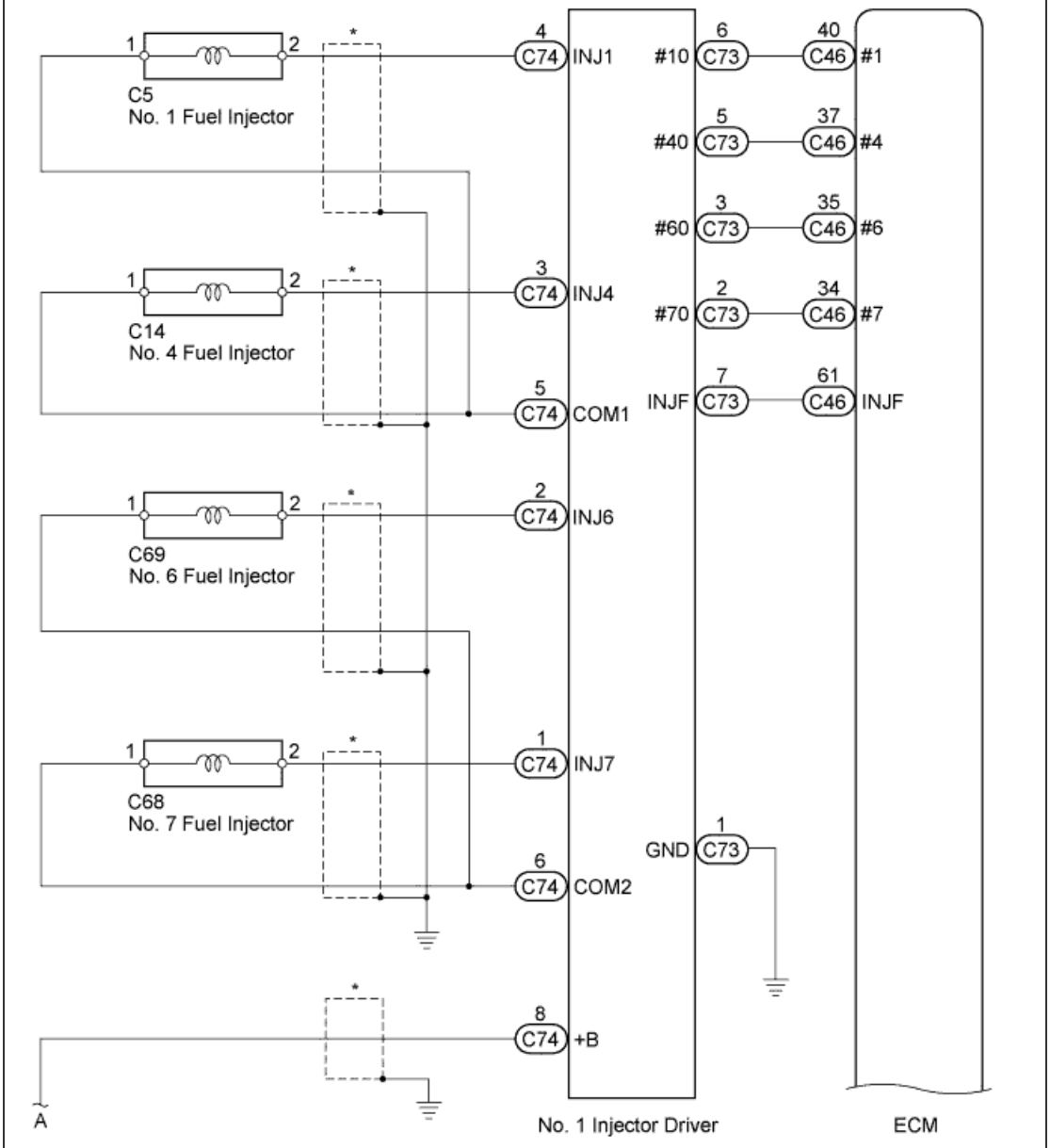
FUEL SYSTEM WIRING DIAGRAM

for LHD:

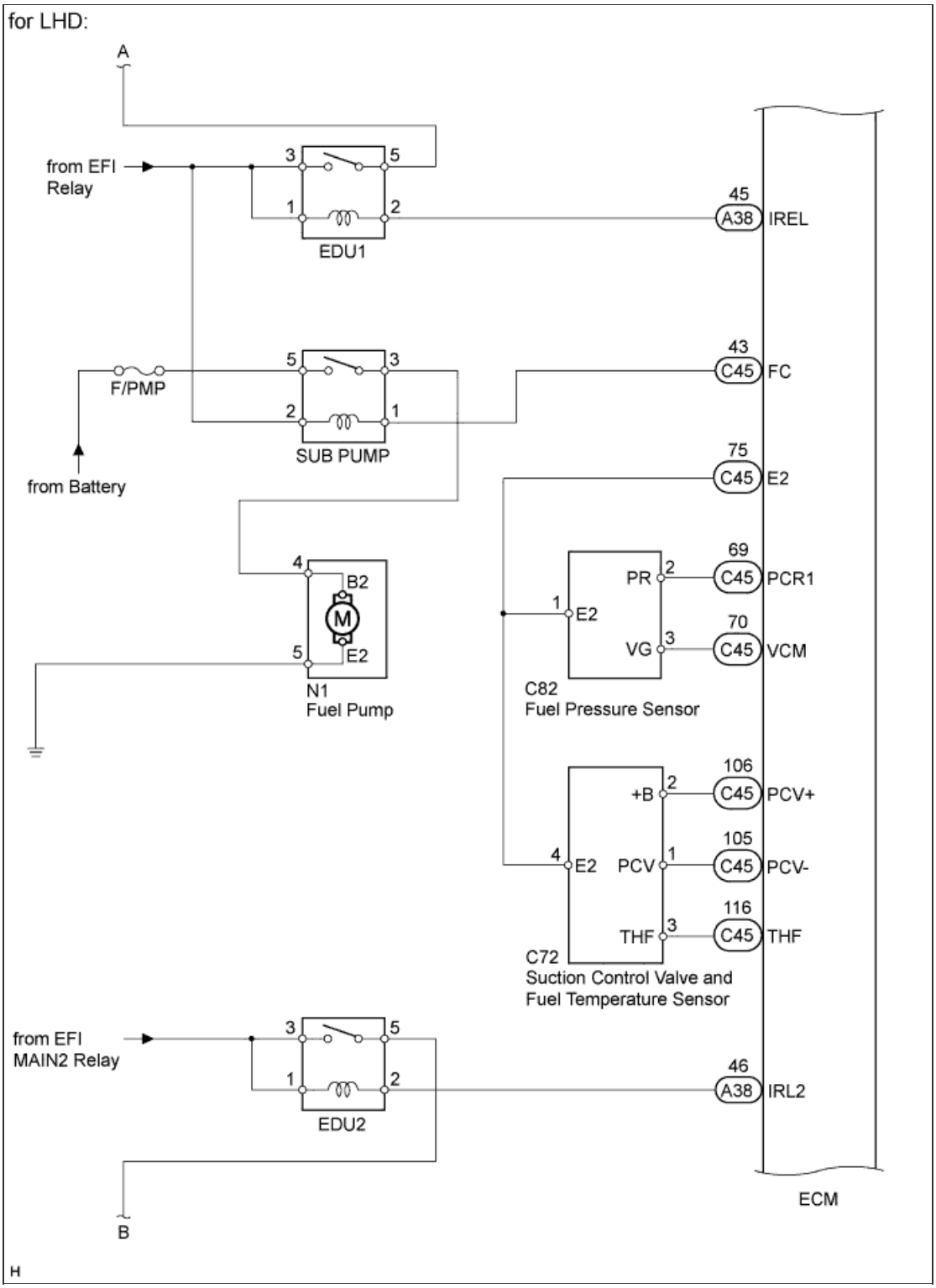

C5
No. 1 Fuel Injector
C14
No. 4 Fuel Injector
C69
No. 6 Fuel Injector
C68
No. 7 Fuel Injector
C74
INJ1
INJ4
COM1
INJ6
INJ7
COM2
+B
A
No. 1 Injector Driver
#10
#40
#60
#70
INJF
GND
C73
C45
#1
#4
#6
#7
INJF
ECM
* Shielded

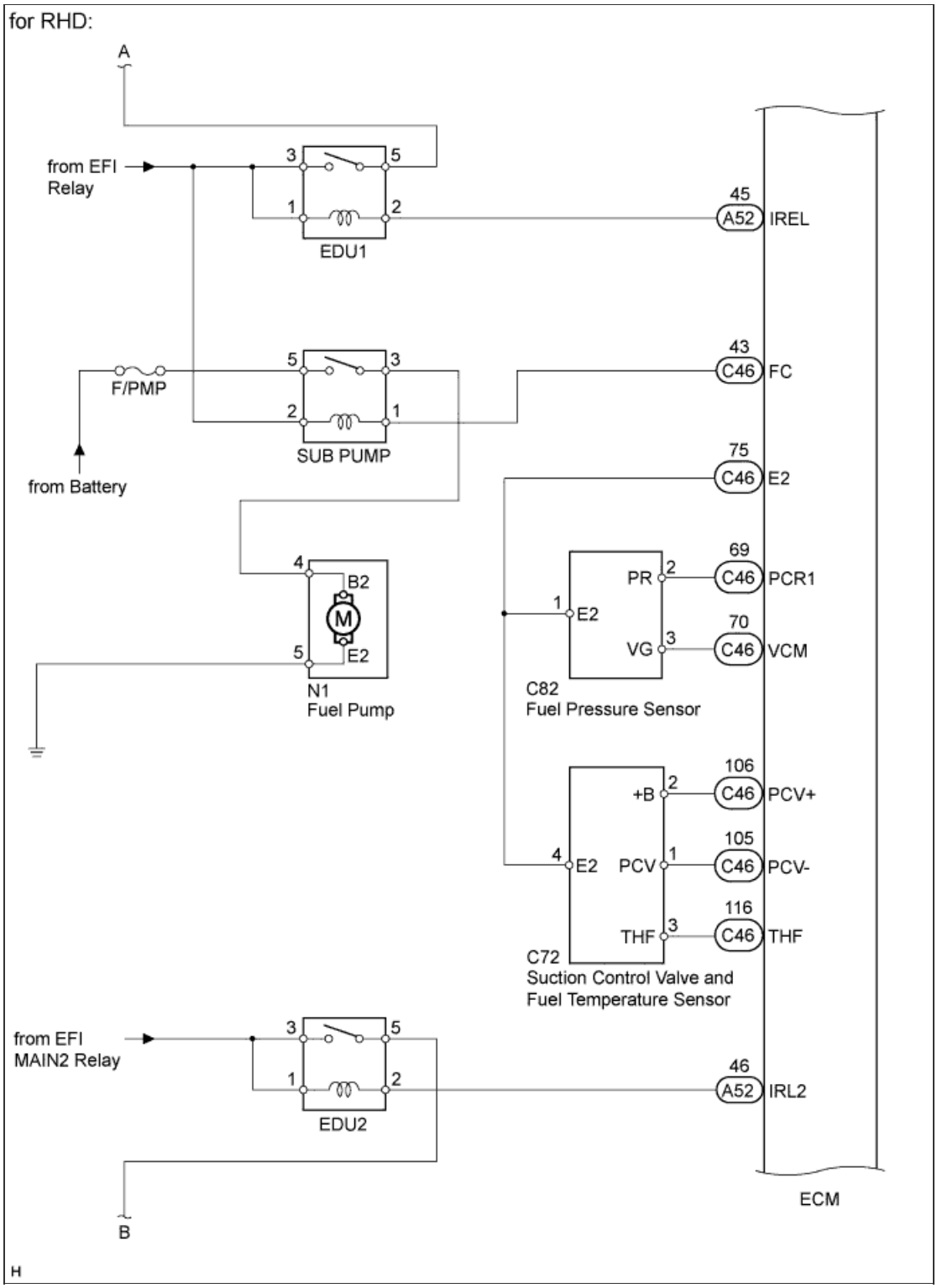
H

for RHD:

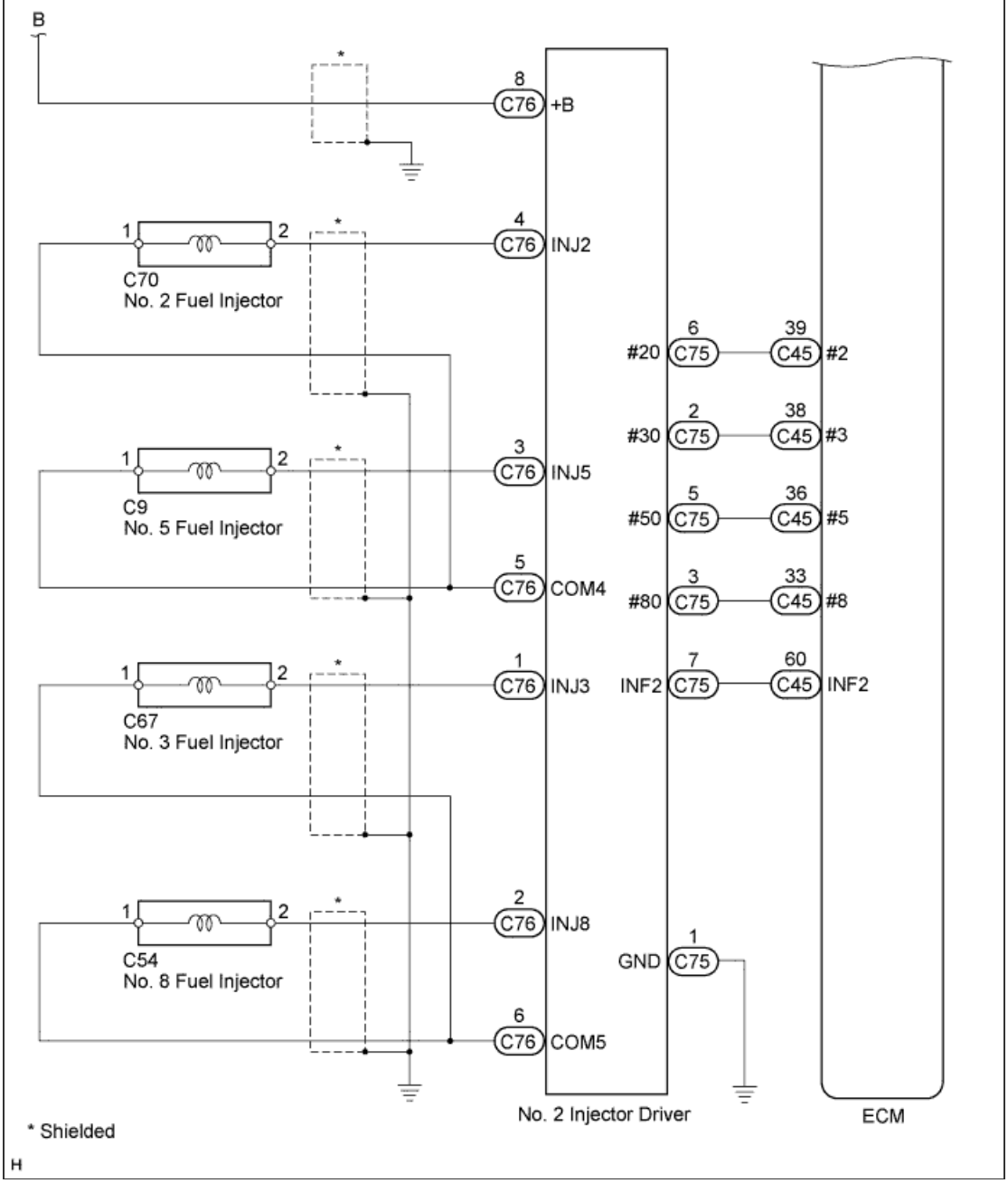

C5
No. 1 Fuel Injector
C14
No. 4 Fuel Injector
C69
No. 6 Fuel Injector
C68
No. 7 Fuel Injector
C74
INJ1
INJ4
COM1
INJ6
INJ7
COM2
+B
A
No. 1 Injector Driver
#10
#40
#60
#70
INJF
GND
C73
C46
#1
#4
#6
#7
INJF
ECM
* Shielded

H


for LHD:
A
from EFI
Relay
3
5
1
2
EDU1
45
A38
IREL
F/PMP
5
3
2
1
SUB PUMP
43
C45
FC
from Battery
75
C45
E2
4
B2
M
5
E2
N1
Fuel Pump
69
PR
2
C45
PCR1
1
E2
70
VG
3
C45
VCM
C82
Fuel Pressure Sensor
106
+B
2
C45
PCV+
4
E2
PCV
1
105
C45
PCV-
116
THF
3
C45
THF
C72
Suction Control Valve and
Fuel Temperature Sensor
from EFI
MAIN2 Relay
3
5
1
2
EDU2
46
A38
IRL2
B
ECM
H

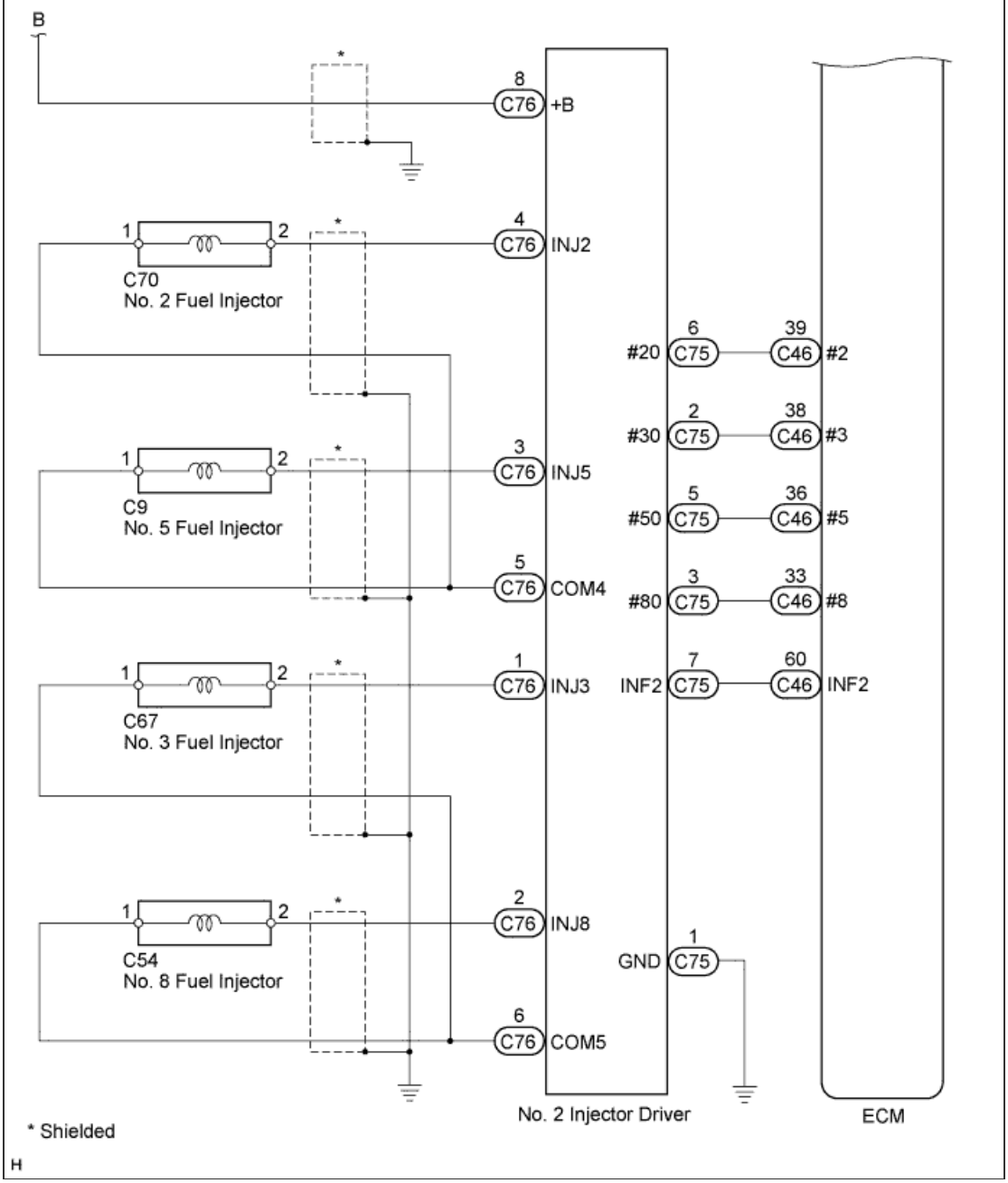

for RHD:
A
from EFI
Relay
3
5
1
2
EDU1
45
A52
IREL
F/PMP
5
3
2
1
SUB PUMP
43
C46
FC
from Battery
75
C46
E2
4
B2
M
5
E2
N1
Fuel Pump
69
PR
2
C46
PCR1
1
E2
70
VG
3
C46
VCM
C82
Fuel Pressure Sensor
106
+B
2
C46
PCV+
4
E2
PCV
1
105
C46
PCV-
116
THF
3
C46
THF
C72
Suction Control Valve and
Fuel Temperature Sensor
from EFI
MAIN2 Relay
3
5
1
2
EDU2
46
A52
IRL2
ECM
B
H

for LHD:

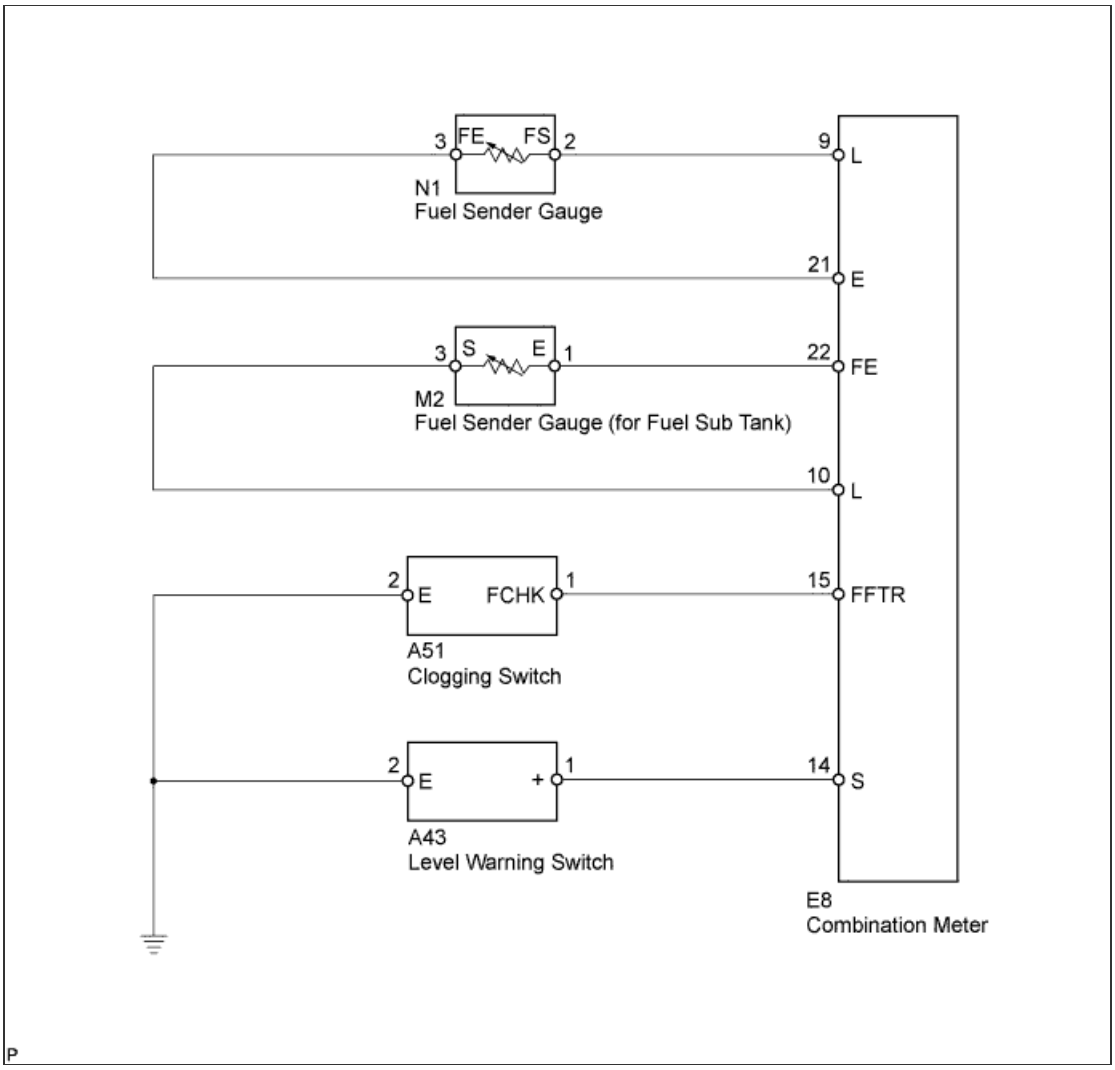

B
*
8
C76
+B
1
2
C70
No. 2 Fuel Injector
4
C76
INJ2
C9
No. 5 Fuel Injector
3
C76
INJ5
5
C76
COM4
C67
No. 3 Fuel Injector
1
C76
INJ3
C54
No. 8 Fuel Injector
2
C76
INJ8
6
C76
COM5
#20
6
C75
39
C45
#2
#30
2
C75
38
C45
#3
#50
5
C75
36
C45
#5
#80
3
C75
33
C45
#8
INF2
7
C75
60
C45
INF2
GND
1
C75
No. 2 Injector Driver
ECM
* Shielded

H

for RHD:


B
*
8
C76
+B
1
2
C70
No. 2 Fuel Injector
4
INJ2
3
INJ5
C9
No. 5 Fuel Injector
5
COM4
1
INJ3
C67
No. 3 Fuel Injector
2
INJ8
C54
No. 8 Fuel Injector
6
COM5
No. 2 Injector Driver
#20
#30
#50
#80
INF2
GND
C75
6
2
5
3
7
1
C46
39
38
36
33
60
#2
#3
#5
#8
INF2
ECM
* Shielded

H


3
FE
FS
2
N1
Fuel Sender Gauge
9
L
21
E
3
S
E
1
M2
Fuel Sender Gauge (for Fuel Sub Tank)
22
FE
10
L
2
E
FCHK
1
A51
Clogging Switch
15
FFTR
2
E
+
1
A43
Level Warning Switch
14
S
E8
Combination Meter
P

for Preparation Click here

1. INSPECT FUEL PRESSURE

a. Read Data List.

i. Warm up the engine.

ii. Turn the ignition switch off.

iii. Connect the intelligent tester to the DLC3.

iv. Turn the ignition switch to ON.

v. Turn the intelligent tester ON.

vi. Enter the following menus: Powertrain / Engine / Data List.

vii. Read the Data List.

Tester Display	Measurement Item/Range (Display)	Normal Condition
Fuel Press	Fuel pressure / Min.: 0 kPa, Max.: 250000 kPa	27000 to 37000 kPa: Idling
Target Common Rail Pressure	Target common rail pressure / Min.: 0 kPa, Max.: 250000 kPa	25000 to 180000 kPa

2. INSPECT FOR FUEL LEAK

a. Perform Active Test.

i. Connect the intelligent tester to the DLC3.

ii. Turn the ignition switch to ON.

iii. Start the engine.

iv. Turn the intelligent tester ON.

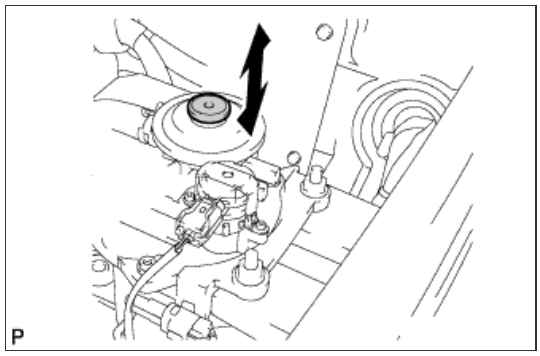
v. Enter the following menus: Powertrain / Engine / Active Test.

vi. Perform the Active Test.

Tester Display	Test Detail	Control Range	Diagnostic Note
Test the Fuel Leak	Pressurizes fuel inside common rail and checks for fuel leaks	Stop/Start	• The fuel inside the common rail is pressurized to the specified value and the engine speed increases to 2000 rpm when Start is selected. • The above conditions are preserved while Start is selected.

3. BLEED AIR FROM FUEL SYSTEM

a. Using the hand pump indicated by the arrow in the illustration, bleed the fuel system. Continue pumping until pumping becomes difficult.



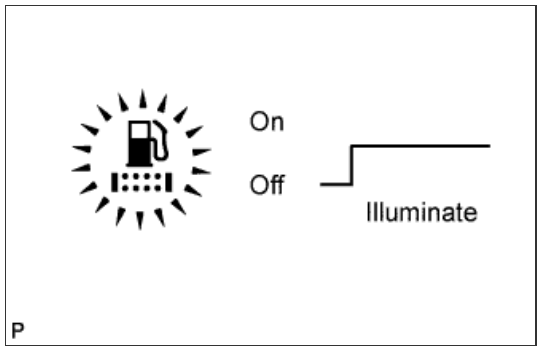
4. CHECK FUEL FILTER WARNING LIGHT AND DRAIN WATER

a. w/o Multi-information Display:

i. Check if the fuel filter warning light is illuminated.

NOTICE:

When the fuel filter warning light illuminates, the fuel filter is clogged. Replace the filter (Click here).



ii. Check if the fuel filter warning light is blinking.

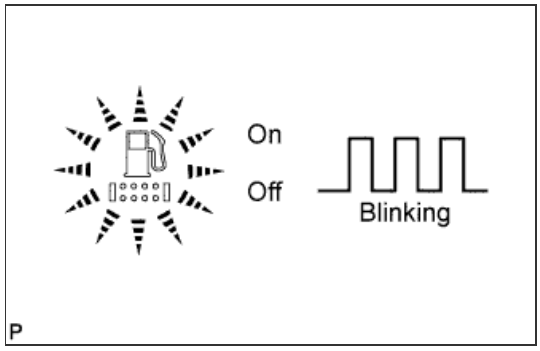
NOTICE:

When the fuel filter warning light is blinking and the buzzer sounds, immediately drain the water in the fuel filter.

b. w/ Multi-information Display:
Check the fuel filter multi-information display.

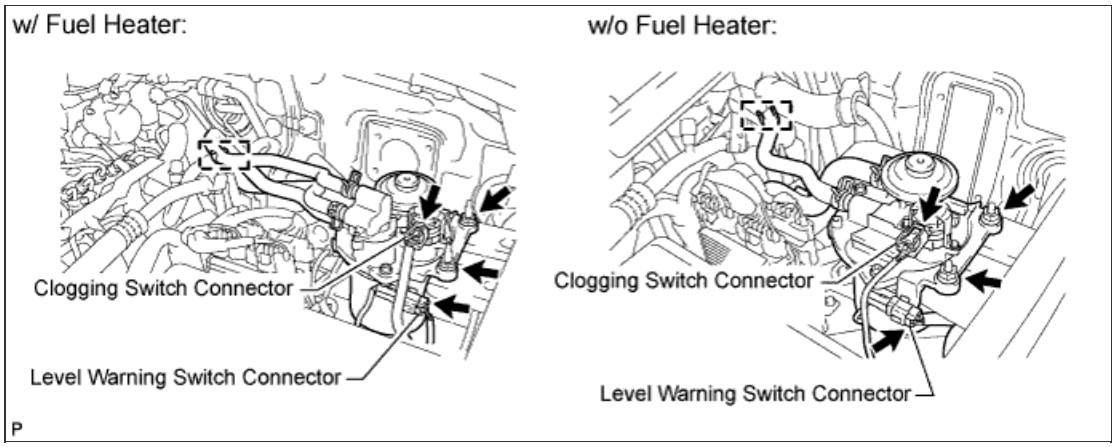
NOTICE:

When the fuel system warning is displayed on the multi-information display and the buzzer sounds, replace the fuel filter (Click here) or drain the water in the fuel filter.



c. Drain water.

i. Detach the fuel hose clamp.



ii. Disconnect the clogging switch connector and level warning switch connector.

iii. Remove the 2 nuts and lift up the fuel filter assembly.

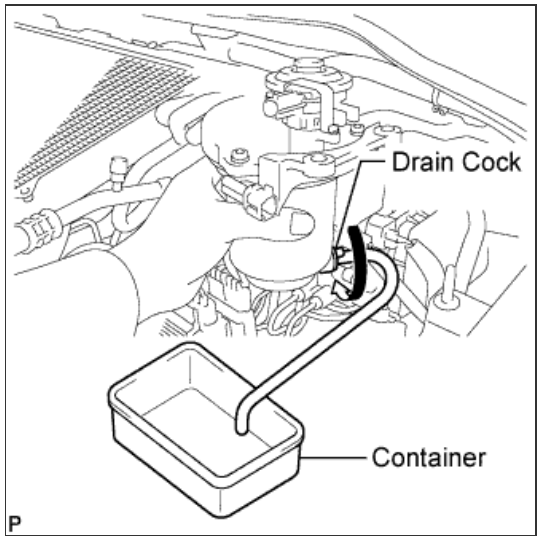
iv. Connect a hose to the drain cock. Place the other end of the hose into a container under the drain cock.

v. Loosen the drain cock to drain water.

vi. Tighten the drain cock by hand.

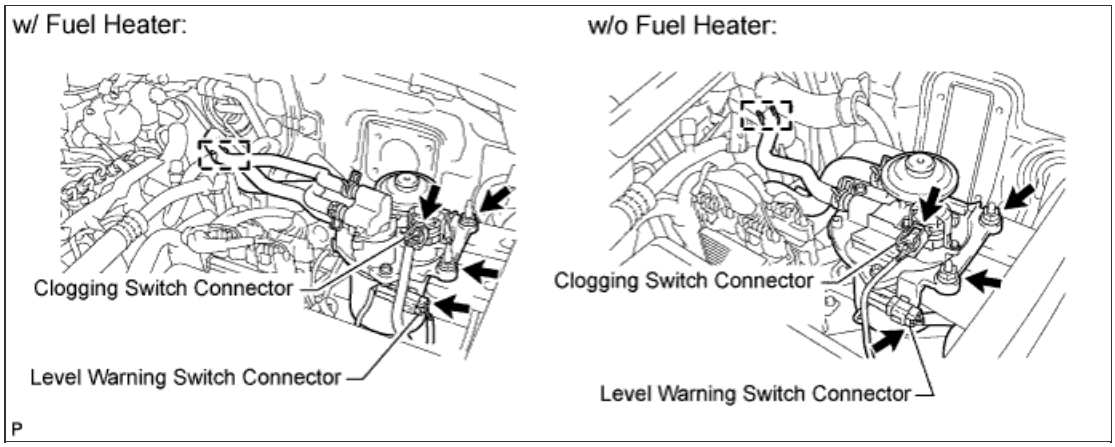
NOTICE:

Do not use any tools in this procedure.



vii. Install the fuel filter assembly with the 2 nuts.

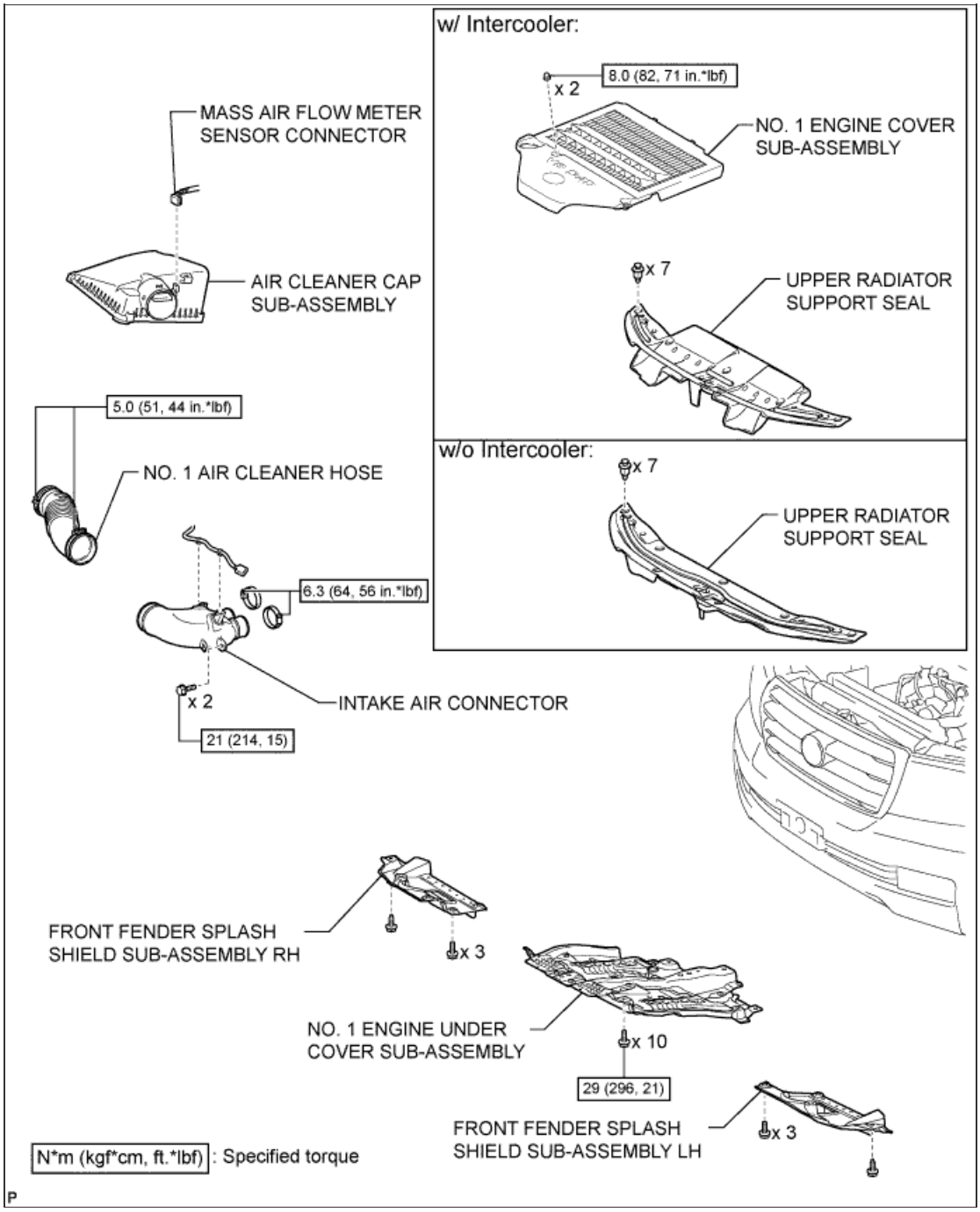
Torque:
20 N*m{ 199 kgf*cm , 14 ft.*lbf }

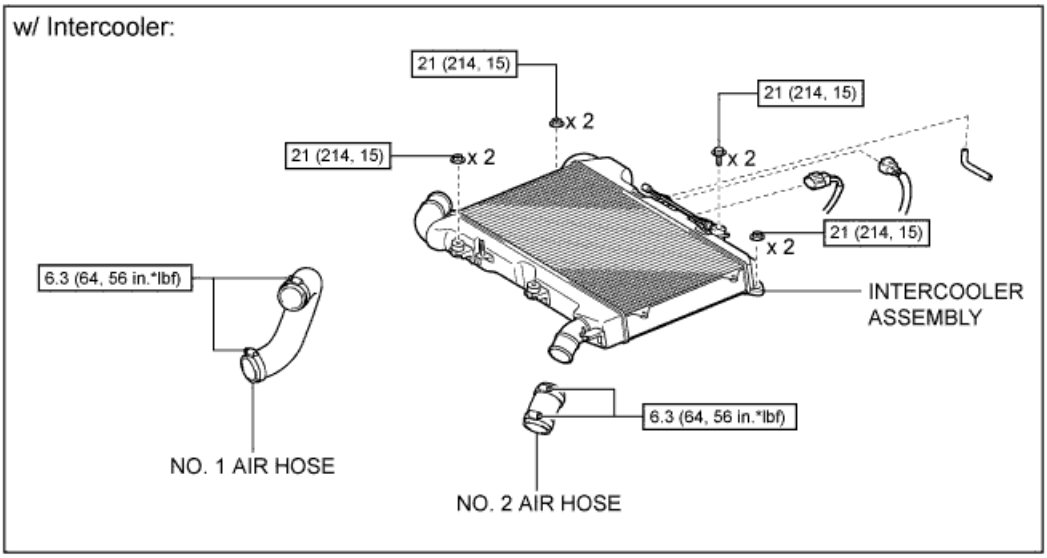


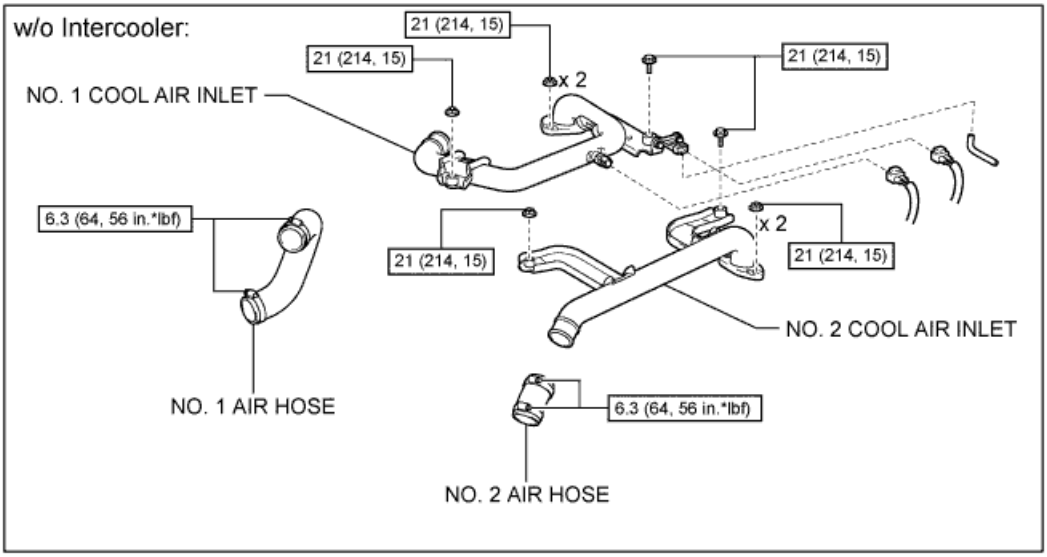
viii. Connect the clogging switch connector and level warning switch connector.

ix. Attach the fuel hose clamp.

for Preparation Click here



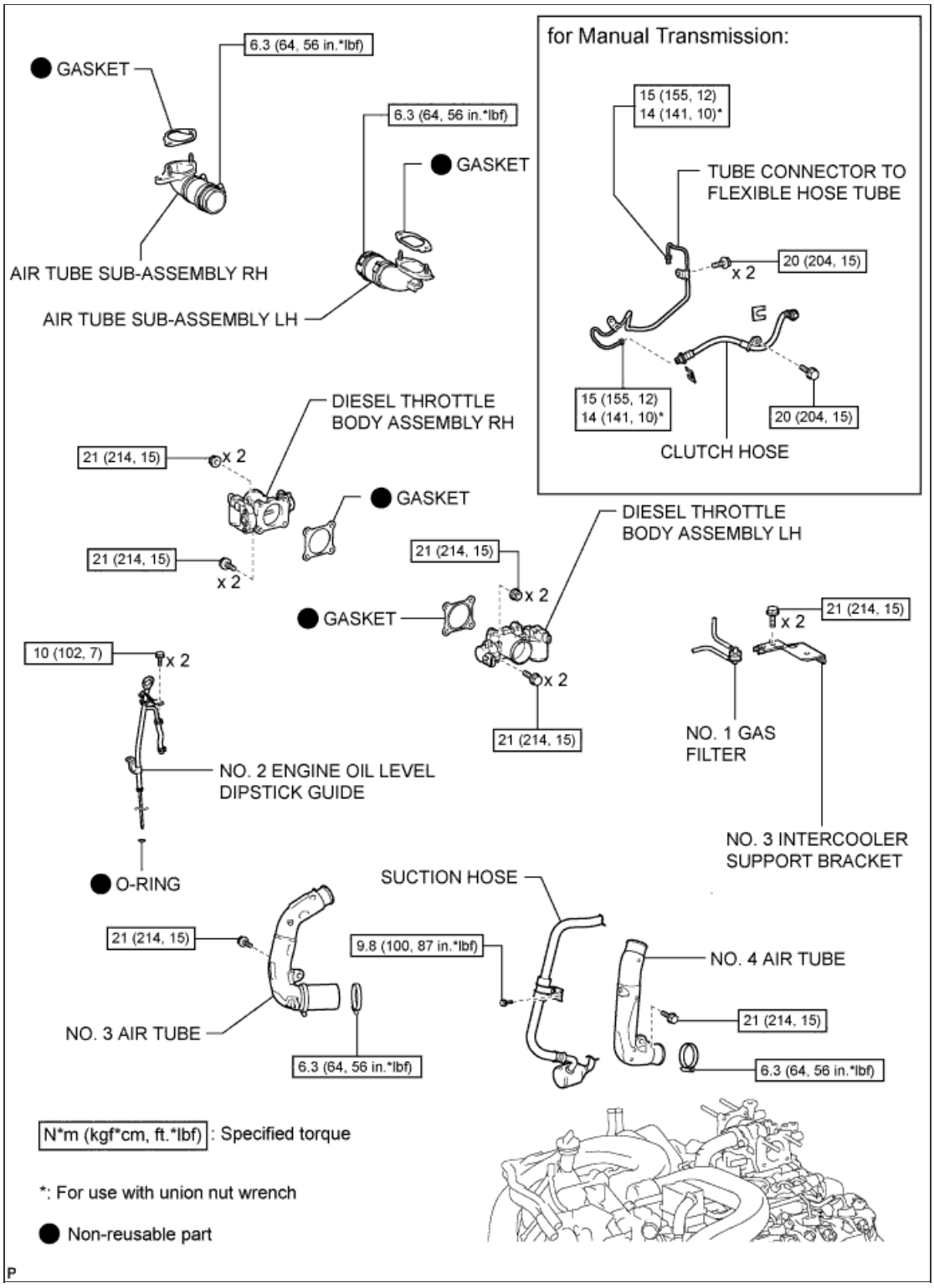


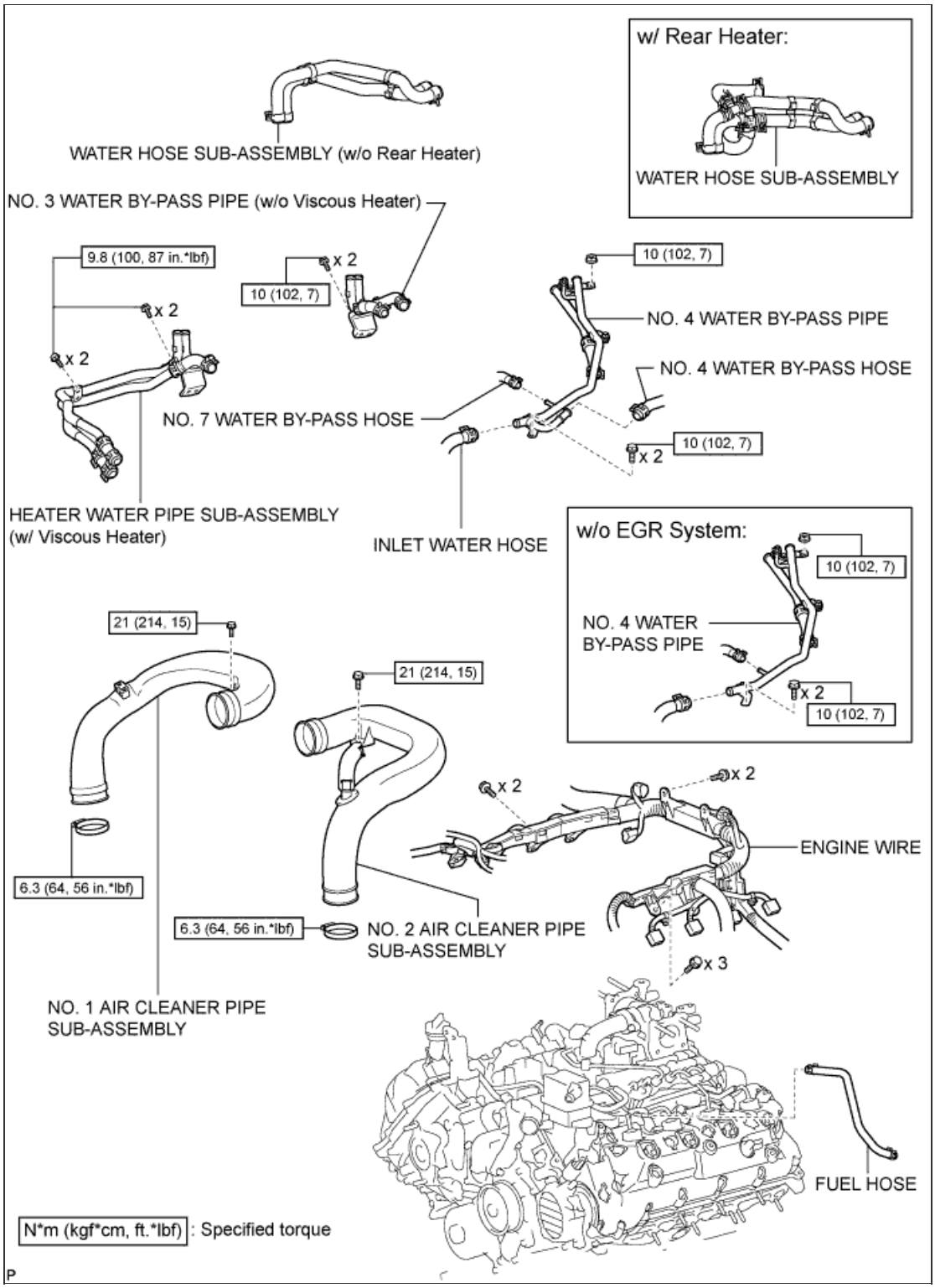


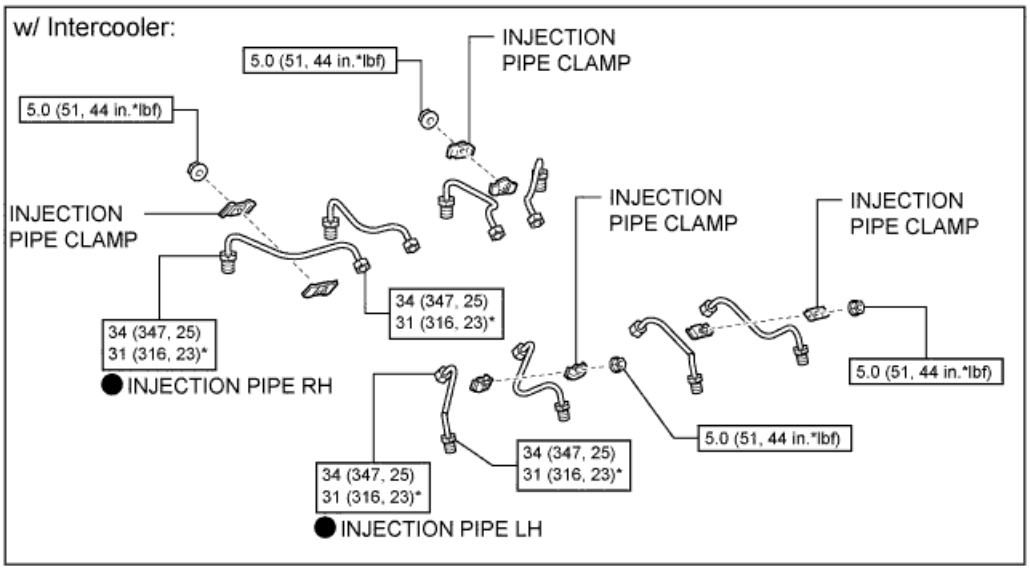


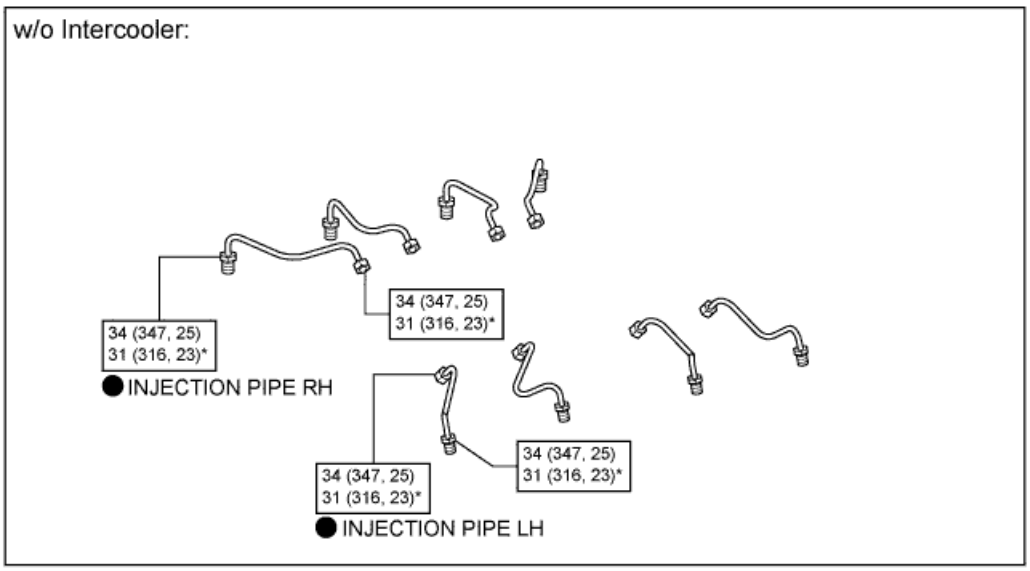
N*m (kgf*cm, ft.*lbf) : Specified torque

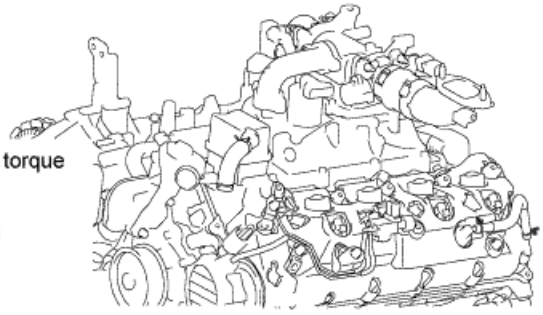
P


GASKET
6.3 (64, 56 in.*lbf)
AIR TUBE SUB-ASSEMBLY RH
6.3 (64, 56 in.*lbf)
GASKET
AIR TUBE SUB-ASSEMBLY LH
for Manual Transmission:
15 (155, 12)
14 (141, 10)*
TUBE CONNECTOR TO FLEXIBLE HOSE TUBE
20 (204, 15)
x 2
15 (155, 12)
14 (141, 10)*
20 (204, 15)
CLUTCH HOSE
DIESEL THROTTLE BODY ASSEMBLY RH
21 (214, 15)
x 2
GASKET
21 (214, 15)
x 2
21 (214, 15)
x 2
GASKET
DIESEL THROTTLE BODY ASSEMBLY LH
x 2
21 (214, 15)
21 (214, 15)
x 2
10 (102, 7)
x 2
NO. 2 ENGINE OIL LEVEL DIPSTICK GUIDE
O-RING
NO. 1 GAS FILTER
NO. 3 INTERCOOLER SUPPORT BRACKET
SUCTION HOSE
21 (214, 15)
NO. 3 AIR TUBE
6.3 (64, 56 in.*lbf)
9.8 (100, 87 in.*lbf)
NO. 4 AIR TUBE
21 (214, 15)
6.3 (64, 56 in.*lbf)
N*m (kgf*cm, ft.*lbf): Specified torque
*: For use with union nut wrench
Non-reusable part
P


w/ Rear Heater:
WATER HOSE SUB-ASSEMBLY
WATER HOSE SUB-ASSEMBLY (w/o Rear Heater)
NO. 3 WATER BY-PASS PIPE (w/o Viscous Heater)
9.8 (100, 87 in.*lbf)
x 2
x 2
10 (102, 7)
x 2
10 (102, 7)
NO. 4 WATER BY-PASS PIPE
NO. 4 WATER BY-PASS HOSE
NO. 7 WATER BY-PASS HOSE
10 (102, 7)
x 2
HEATER WATER PIPE SUB-ASSEMBLY
(w/ Viscous Heater)
INLET WATER HOSE
w/o EGR System:
10 (102, 7)
NO. 4 WATER
BY-PASS PIPE
x 2
10 (102, 7)
21 (214, 15)
21 (214, 15)
x 2
x 2
ENGINE WIRE
6.3 (64, 56 in.*lbf)
6.3 (64, 56 in.*lbf)
NO. 2 AIR CLEANER PIPE
SUB-ASSEMBLY
x 3
NO. 1 AIR CLEANER PIPE
SUB-ASSEMBLY
FUEL HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
P





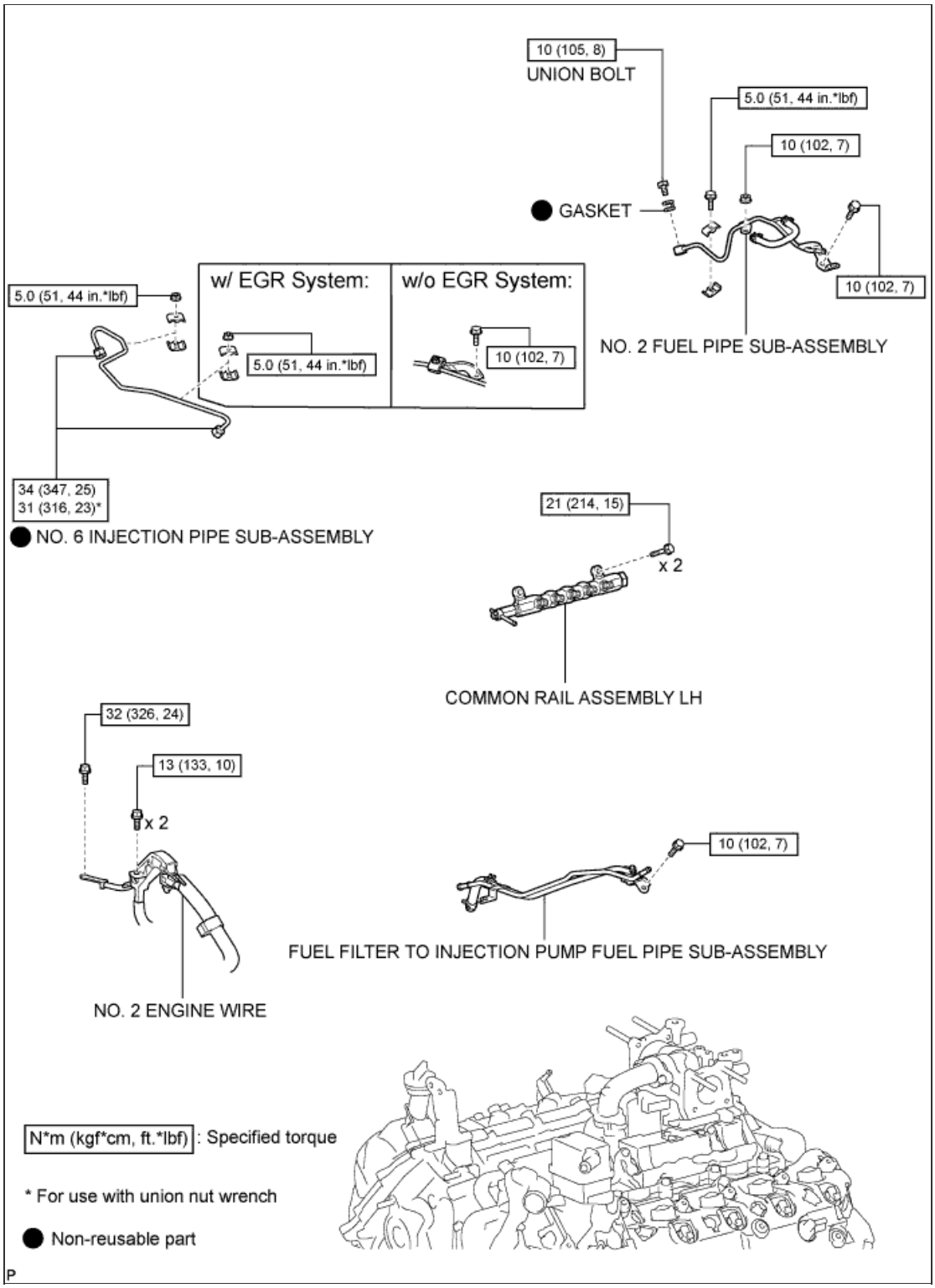


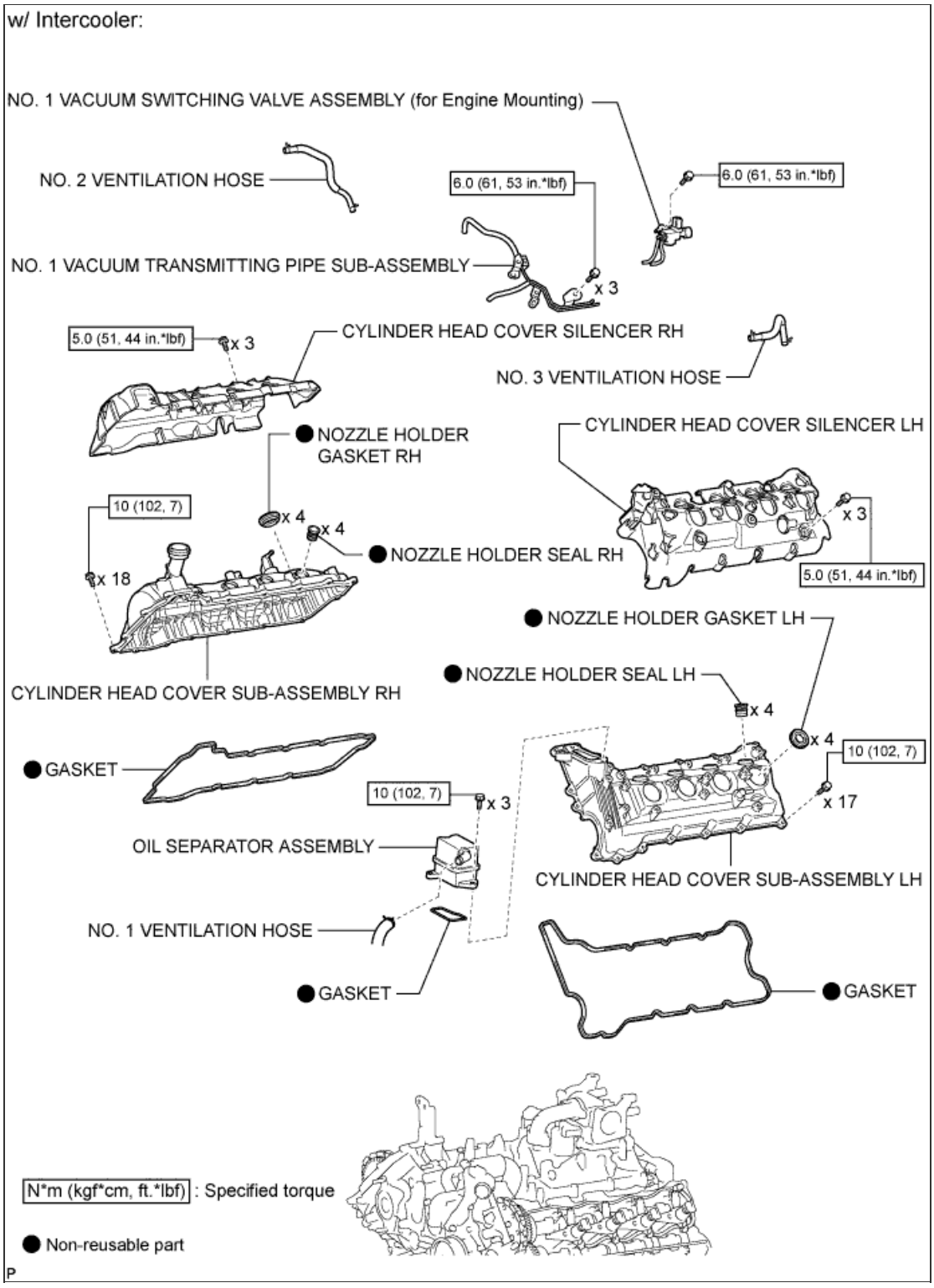
N*m (kgf*cm, ft.*lbf): Specified torque

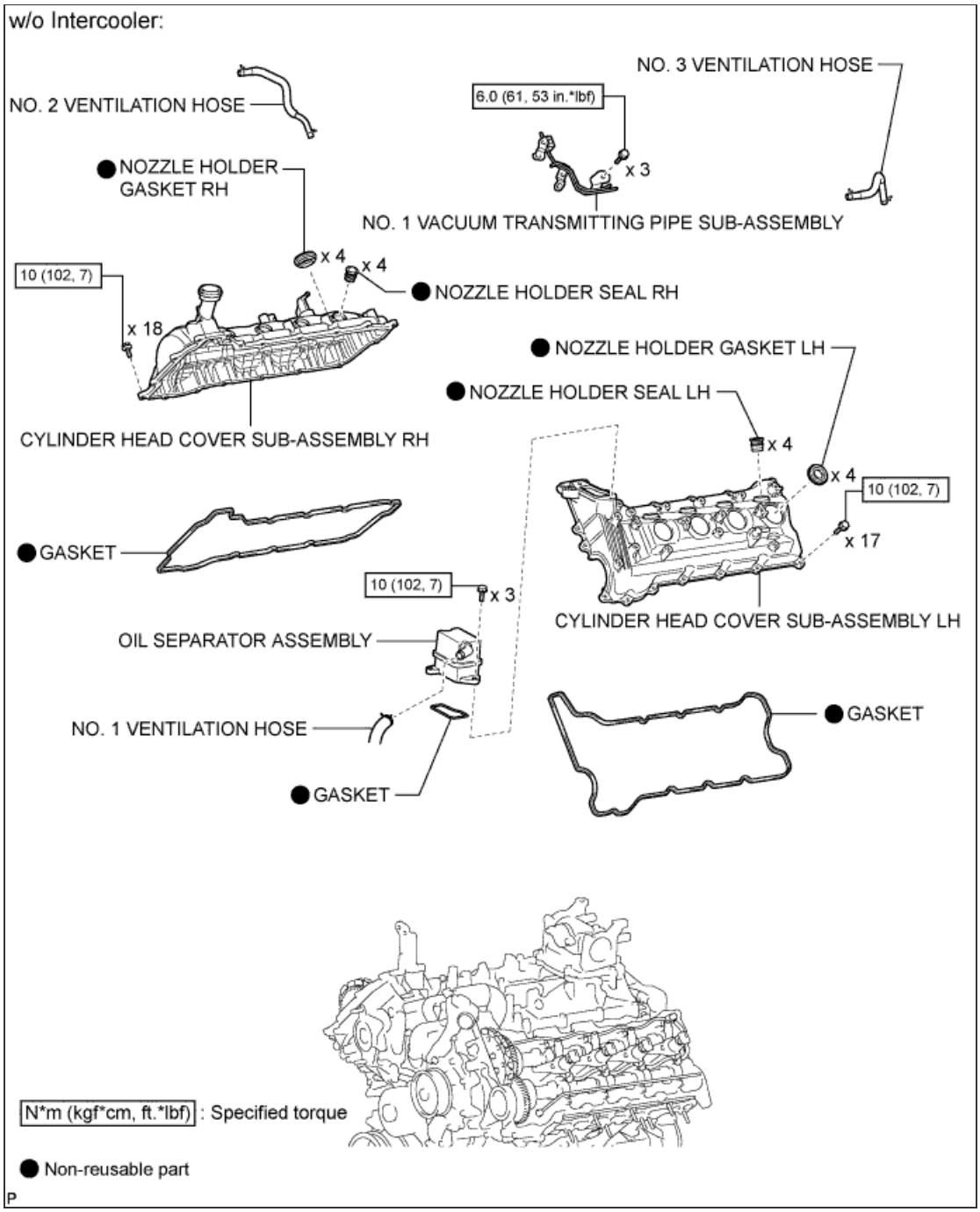
*: For use with union nut wrench

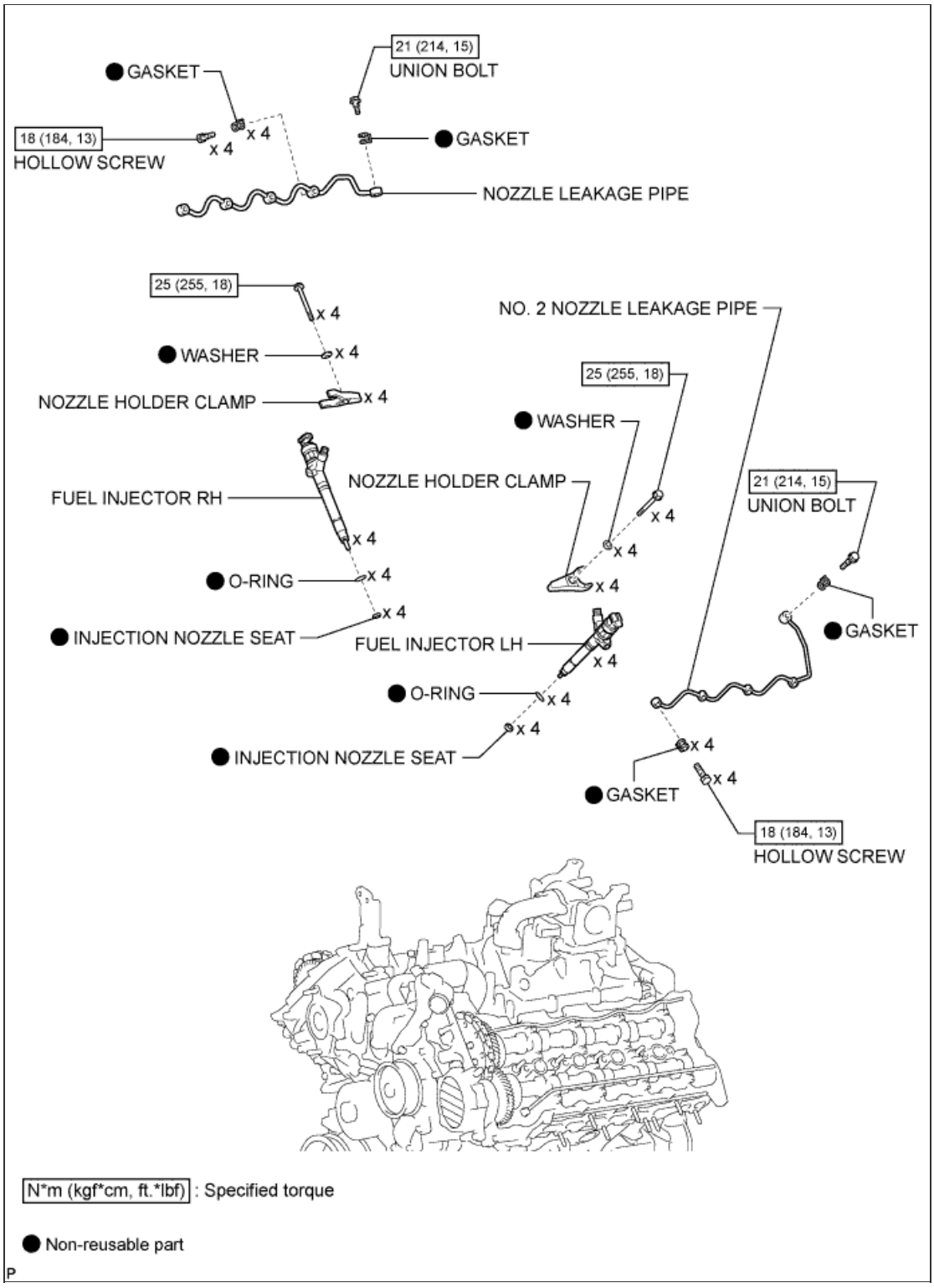
● Non-reusable part

P


10 (105, 8)
UNION BOLT
5.0 (51, 44 in.*lbf)
10 (102, 7)
GASKET
10 (102, 7)
NO. 2 FUEL PIPE SUB-ASSEMBLY
w/ EGR System:
w/o EGR System:
5.0 (51, 44 in.*lbf)
5.0 (51, 44 in.*lbf)
10 (102, 7)
34 (347, 25)
31 (316, 23)*
NO. 6 INJECTION PIPE SUB-ASSEMBLY
21 (214, 15)
x 2
COMMON RAIL ASSEMBLY LH
32 (326, 24)
13 (133, 10)
x 2
NO. 2 ENGINE WIRE
10 (102, 7)
FUEL FILTER TO INJECTION PUMP FUEL PIPE SUB-ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
* For use with union nut wrench
Non-reusable part
P


w/ Intercooler:
NO. 1 VACUUM SWITCHING VALVE ASSEMBLY (for Engine Mounting)
NO. 2 VENTILATION HOSE
6.0 (61, 53 in.*lbf)
6.0 (61, 53 in.*lbf)
NO. 1 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY
x 3
5.0 (51, 44 in.*lbf)
x 3
CYLINDER HEAD COVER SILENCER RH
NO. 3 VENTILATION HOSE
NOZZLE HOLDER GASKET RH
CYLINDER HEAD COVER SILENCER LH
10 (102, 7)
x 4
x 4
NOZZLE HOLDER SEAL RH
x 3
x 18
5.0 (51, 44 in.*lbf)
NOZZLE HOLDER GASKET LH
NOZZLE HOLDER SEAL LH
CYLINDER HEAD COVER SUB-ASSEMBLY RH
x 4
x 4
10 (102, 7)
GASKET
10 (102, 7)
x 3
x 17
OIL SEPARATOR ASSEMBLY
CYLINDER HEAD COVER SUB-ASSEMBLY LH
NO. 1 VENTILATION HOSE
GASKET
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P


w/o Intercooler:
NO. 2 VENTILATION HOSE
NO. 3 VENTILATION HOSE
6.0 (61, 53 in.*lbf)
x 3
NOZZLE HOLDER GASKET RH
NO. 1 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY
x 4
x 4
10 (102, 7)
NOZZLE HOLDER SEAL RH
x 18
NOZZLE HOLDER GASKET LH
NOZZLE HOLDER SEAL LH
CYLINDER HEAD COVER SUB-ASSEMBLY RH
x 4
x 4
10 (102, 7)
x 17
GASKET
10 (102, 7)
x 3
CYLINDER HEAD COVER SUB-ASSEMBLY LH
OIL SEPARATOR ASSEMBLY
NO. 1 VENTILATION HOSE
GASKET
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P



N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P

for Preparation Click here

NOTICE:

When replacing an injector (including interchanging injectors between cylinders), common rail, replace the corresponding injection pipes with a new one.

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

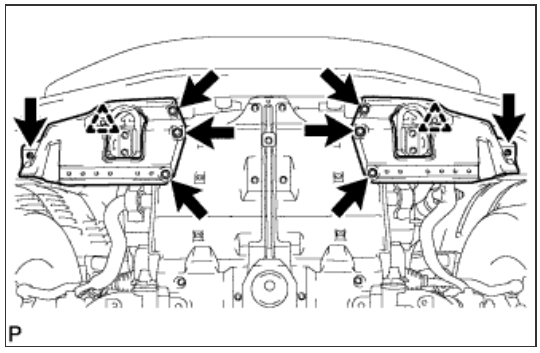
When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Disconnect the cables from the negative (-) main battery and sub-battery terminals.

2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.



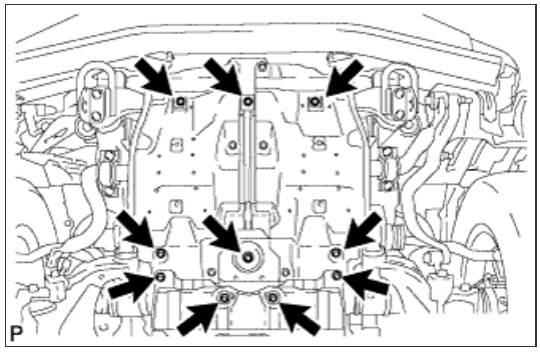
3. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.

4. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



5. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and upper radiator support seal.

6. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

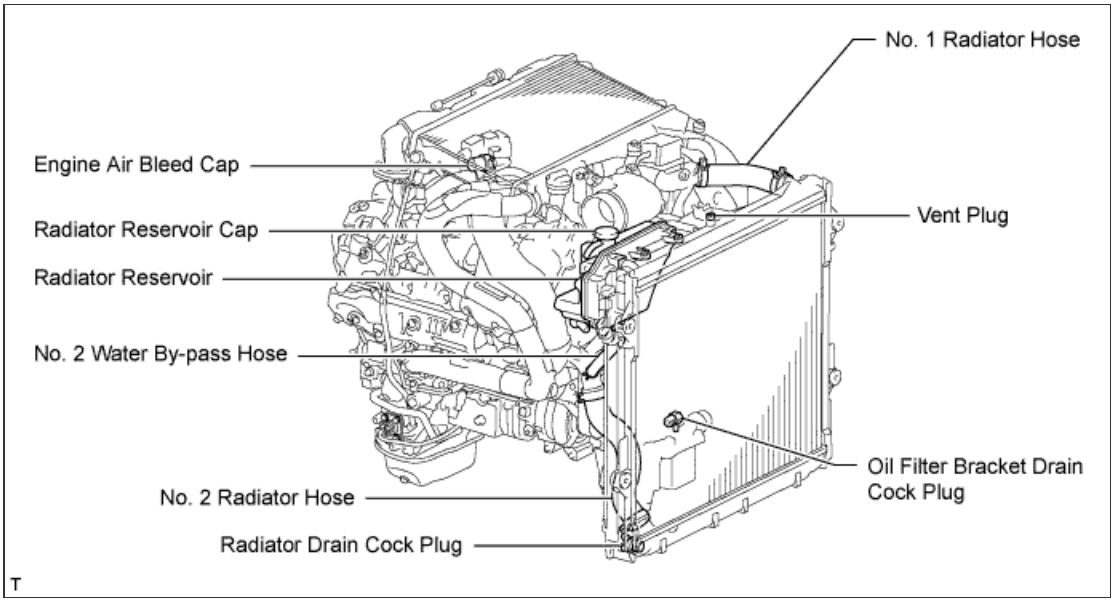
HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

a. Loosen the radiator drain cock plug.

b. Remove the radiator reservoir cap to drain the coolant in the radiator.

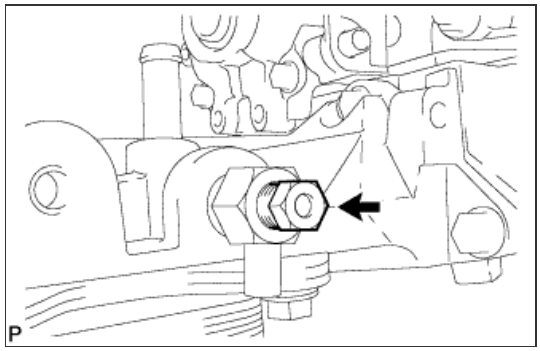
c. Loosen the oil filter bracket drain cock plug to drain the coolant in the engine.



d. ighten the radiator drain cock plug by hand.

e. ighten the oil filter bracket drain cock plug.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



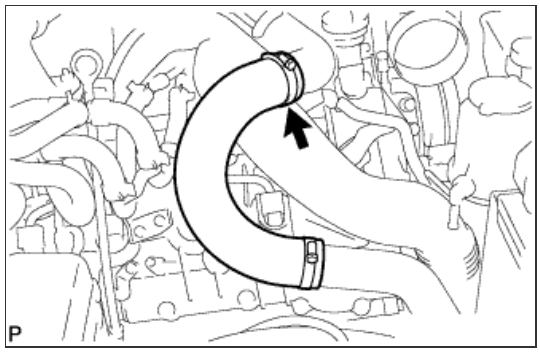
7. REMOVE INTERCOOLER ASSEMBLY (w/ Intercooler)

a. Remove the intercooler assembly (Click here).

8. REMOVE NO. 1 COOL AIR INLET (w/o Intercooler)

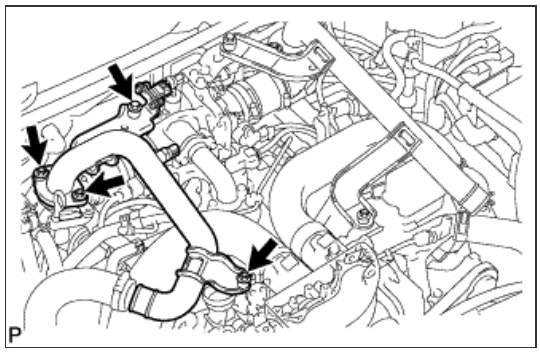
a. Loosen the No. 1 air hose clamp.

b. Disconnect the turbo pressure sensor connector, intake air temperature sensor connector and vacuum hose.



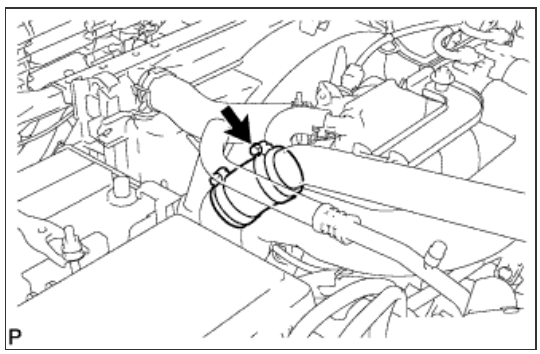
c. Remove the 3 nuts, bolt and No. 1 cool air inlet.

d. Remove the gasket from the air tube RH.



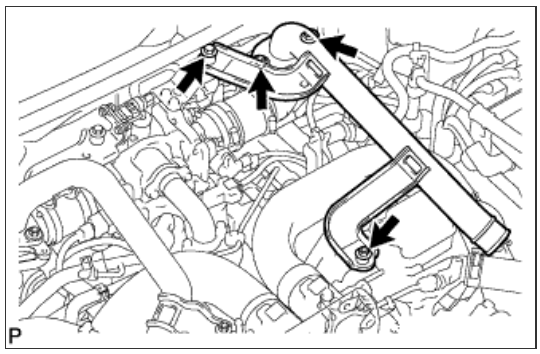
9. REMOVE NO. 2 COOL AIR INLET (w/o Intercooler)

a. Loosen the No. 2 air hose clamp.

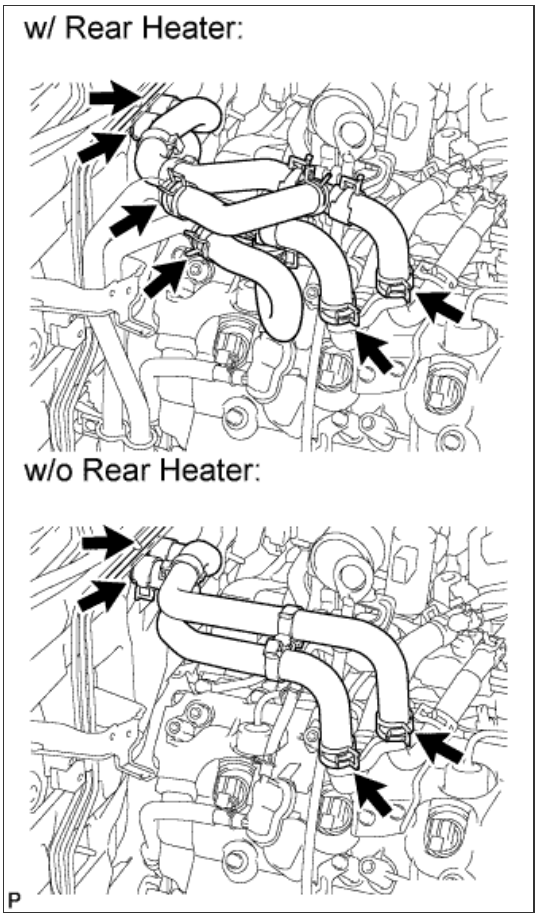


b. Remove the 3 nuts, bolt and No. 2 cool air inlet.

c. Remove the gasket from the air tube LH.

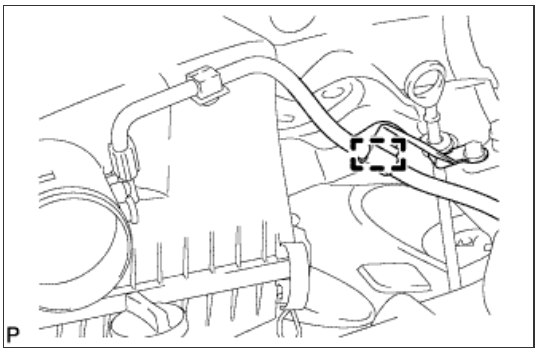


10. DISCONNECT WATER HOSE SUB-ASSEMBLY



11. REMOVE NO. 2 ENGINE OIL LEVEL DIPSTICK GUIDE

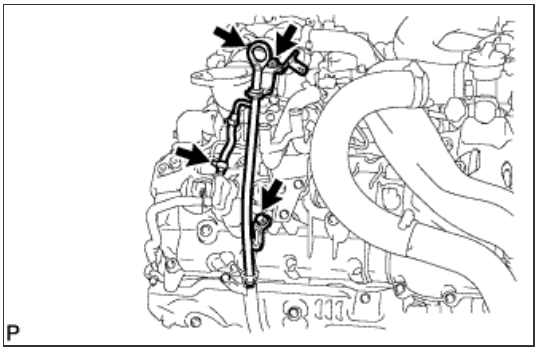
a. Disconnect the wire harness clamp from the No. 2 engine oil level dipstick guide.



b. Disconnect the ventilation hose from the cylinder head cover RH.

c. Remove the 2 bolts and No. 2 engine oil level dipstick guide.

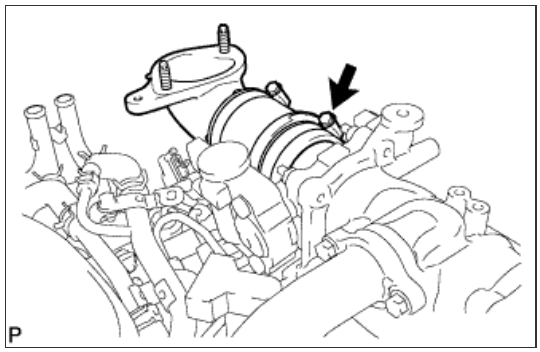
d. Remove the O-ring from the No. 2 engine oil level dipstick guide.



12. REMOVE AIR TUBE SUB-ASSEMBLY RH

a. Loosen the hose clamp.

b. Remove the air tube from the throttle body.



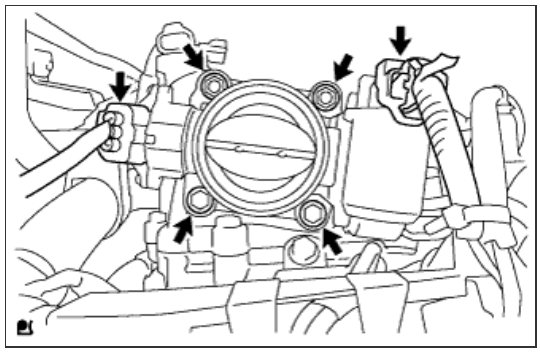
13. REMOVE DIESEL THROTTLE BODY ASSEMBLY RH

a. Disconnect the throttle position sensor connector.

b. Disconnect the throttle motor connector.

c. Remove the 2 bolts, 2 nuts and throttle body.

d. Remove the gasket from the intake pipe.



14. DRAIN CLUTCH FLUID (for Manual Tran m ion)

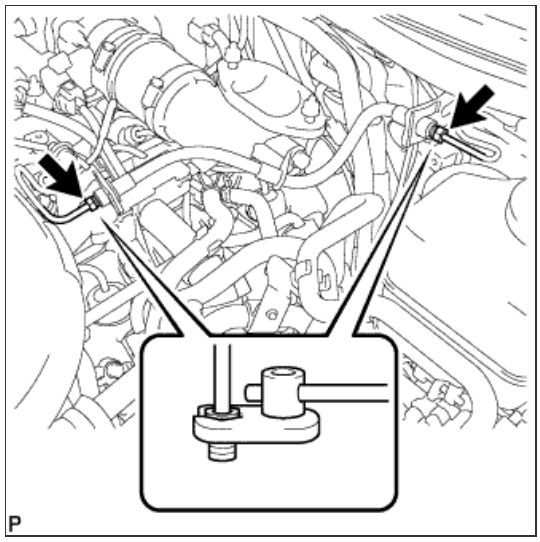
15. REMOVE CLUTCH HOSE (for Manual Tran m ion)

a. Disconnect the 2 flexible hose tubes from the clutch hose with a 10 mm union nut wrench while holding the flexible hose with a wrench.

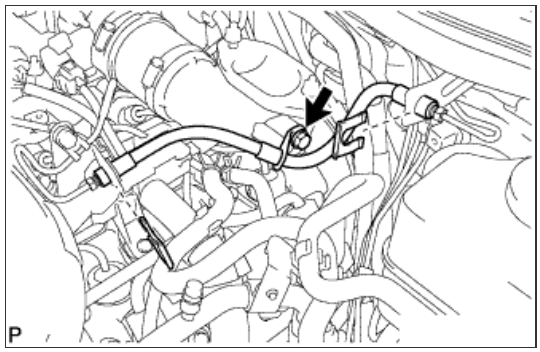
NOTICE:

- **Do not bend or damage the fle ible ho e tube .**
- **Do not allow any foreign matter uch a dirt and du t to enter the fle ible ho e tube from the connecting point.**

b. Remove the 2 clips.



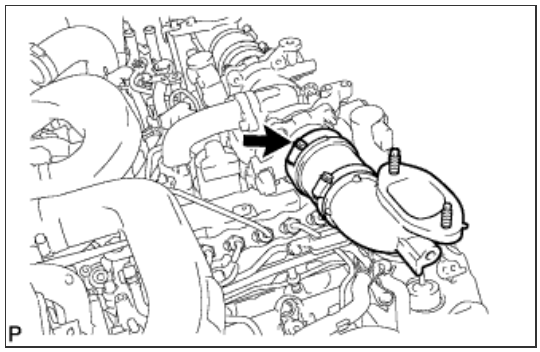
c. Remove the bolt and clutch hose.



16. REMOVE AIR TUBE SUB-ASSEMBLY LH

a. Loosen the hose clamp.

b. Remove the air tube from the throttle body.

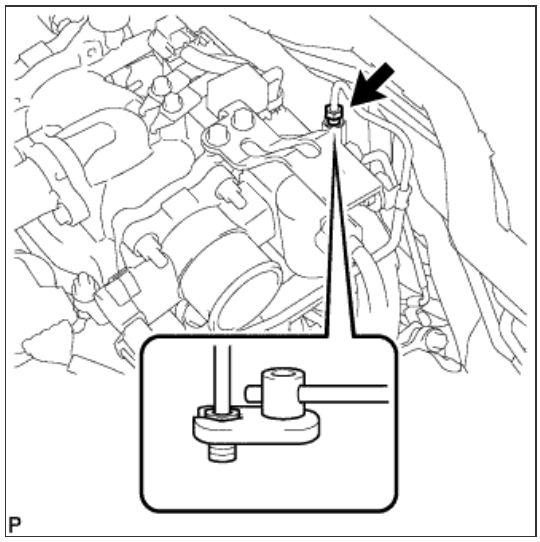


17. REMOVE TUBE CONNECTOR TO FLE IBLE HOSE TUBE (for Manual Tran m ion)

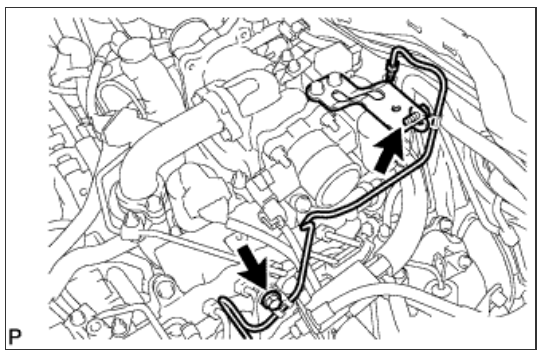
a. Using a 10 mm union nut wrench, disconnect the tube connector to flexible hose tube from the clutch tube to release cylinder 2 way.

NOTICE:

- **Do not bend or damage the fle ible ho e tube.**
- **Do not allow any foreign matter uch a dirt and du t to enter the fle ible ho e tube from the connecting point.**



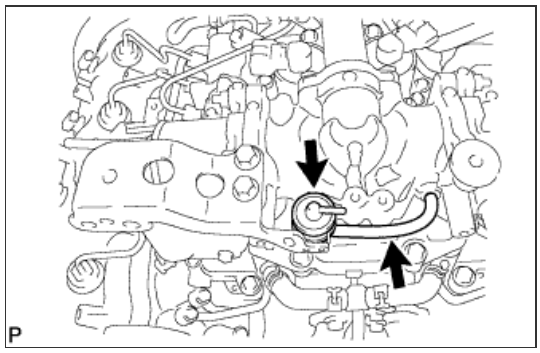
b. Remove the 2 bolts and tube connector to flexible hose tube.



18. REMOVE NO. 1 GAS FILTER

a. Disconnect the hose from the intake pipe.

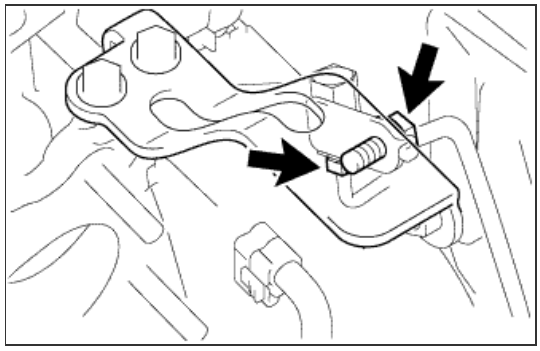
b. Remove the gas filter.



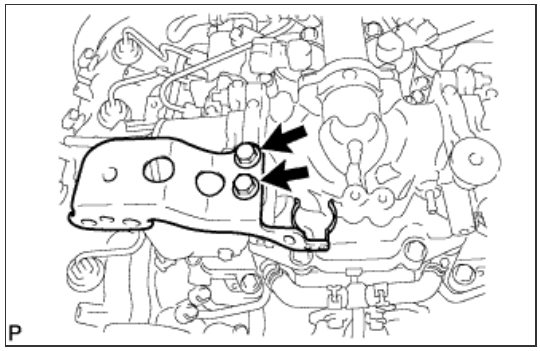
19. REMOVE NO. 3 INTERCOOLER SUPPORT BRACKET

a. for Manual ransmission:

i. Remove the bolt and disconnect the clutch tube to release cylinder 2 way from the bracket.



b. Remove the 2 bolts and bracket.



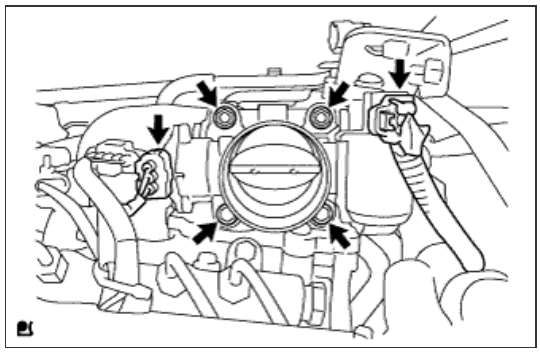
20. REMOVE DIESEL THROTTLE BODY ASSEMBLY LH

a. Disconnect the throttle position sensor connector.

b. Disconnect the throttle motor connector.

c. Remove the 2 bolts, 2 nuts and throttle body.

d. Remove the gasket from the intake pipe.

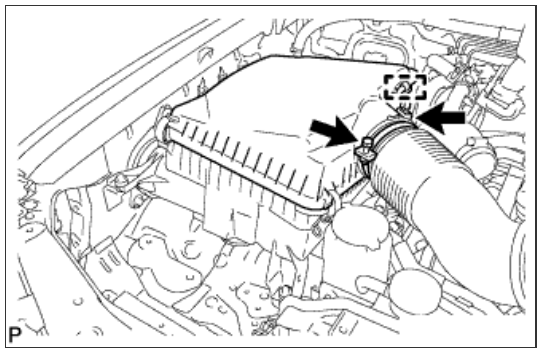


21. REMOVE AIR CLEANER CAP SUB-ASSEMBLY

a. Loosen the hose clamp.

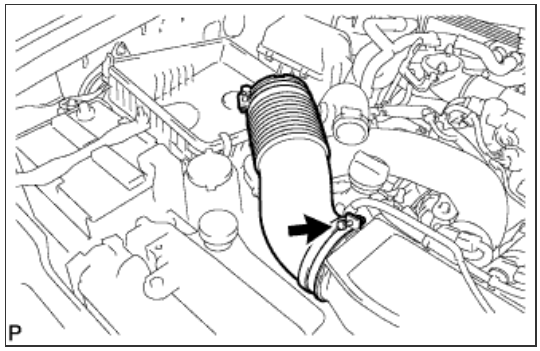
b. Disconnect the mass air flow meter connector and using a clip remover, detach the wire harness clamp from the air cleaner cap.

c. Detach the 4 clamps and remove the air cleaner cap.



22. REMOVE NO. 1 AIR CLEANER HOSE

a. Loosen the hose clamp and remove the No. 1 air cleaner hose.



23. REMOVE INTAKE AIR CONNECTOR

a. w/o Viscous Heater:

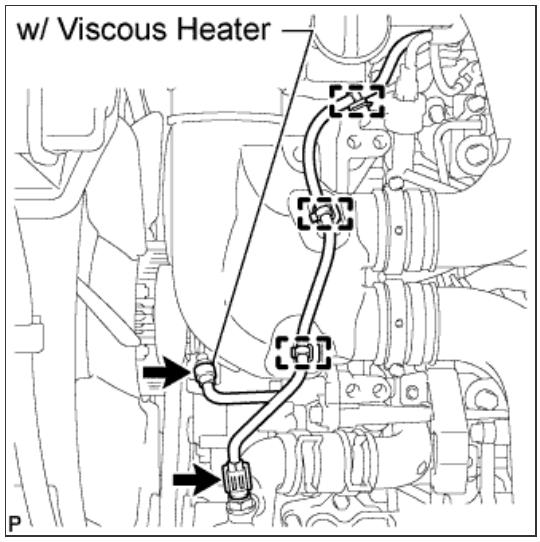
i. Disconnect the connector from the water temperature sensor.

ii. Using a clip remover, detach the 3 wire harness clamps.

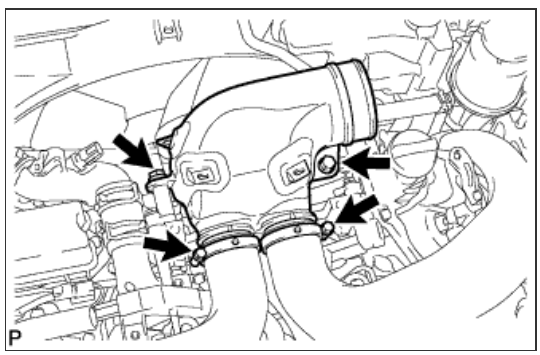
b. w/ Viscous Heater:

i. Disconnect the 2 connectors from the viscous with magnet clutch heater and water temperature sensor.

ii. Using a clip remover, detach the 3 wire harness clamps.



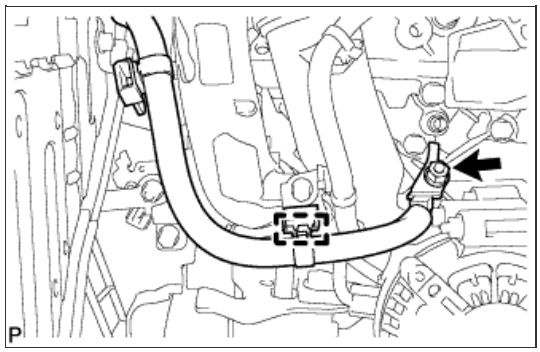
c. Loosen the 2 hose clamps and remove the 2 bolts and intake air connector.



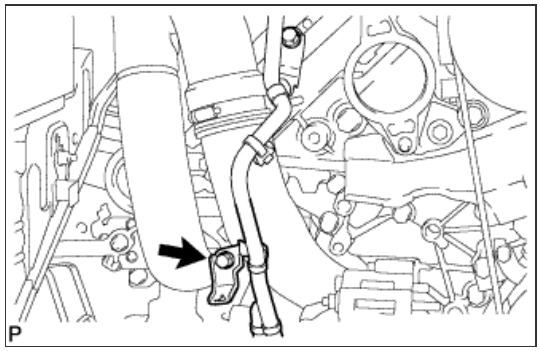
24. REMOVE NO. 3 AIR TUBE

a. Disconnect the wire harness from the clamp.

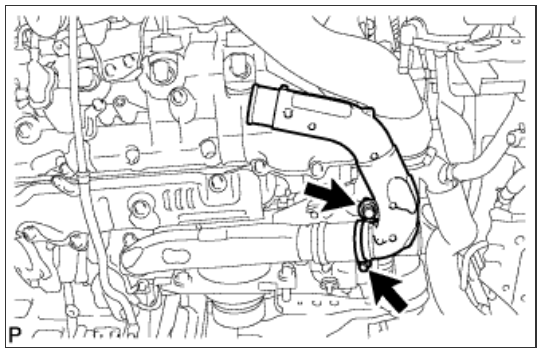
b. Remove the nut and ground wire.



c. Remove the bolt and disconnect the wire harness bracket.

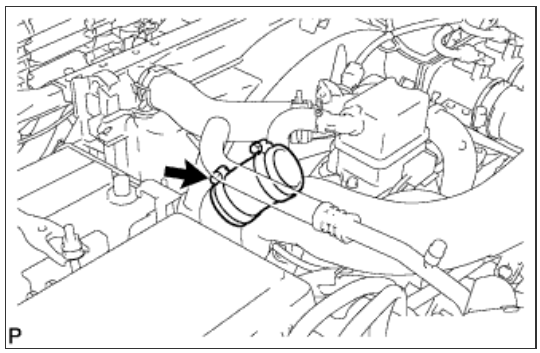


d. Loosen the hose clamp and remove the bolt and No. 3 air tube.



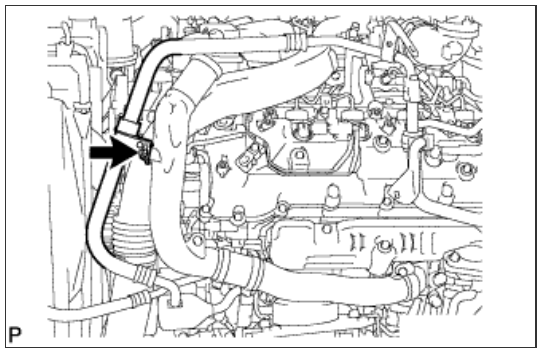
25. REMOVE NO. 2 AIR HOSE

a. Loosen the hose clamp and remove the No. 2 air hose.

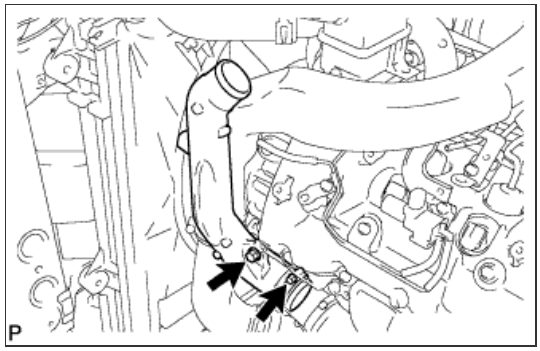


26. REMOVE NO. 4 AIR TUBE

a. Remove the bolt and disconnect the suction hose.



b. Loosen the hose clamp and remove the bolt and No. 4 air tube.

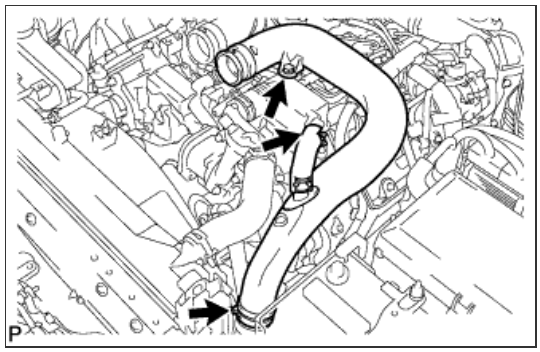


27. REMOVE NO. 2 AIR CLEANER PIPE SUB-ASSEMBLY

a. Disconnect the ventilation hose from the oil separator.

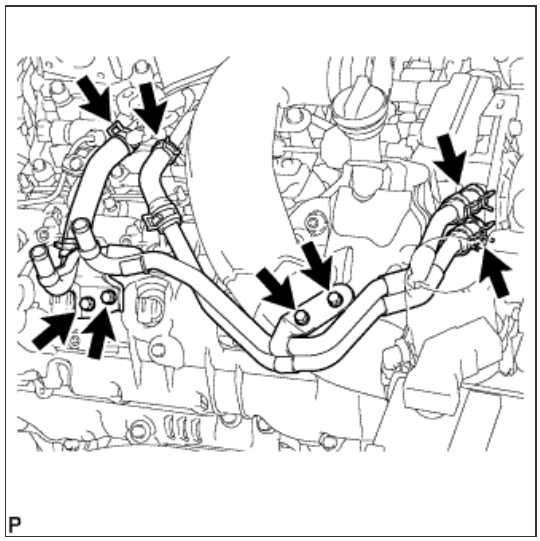
b. Loosen the hose clamp.

c. Remove the bolt and No. 2 air cleaner pipe.



28. REMOVE HEATER WATER PIPE SUB-ASSEMBLY (w/ Vi cou Heater)

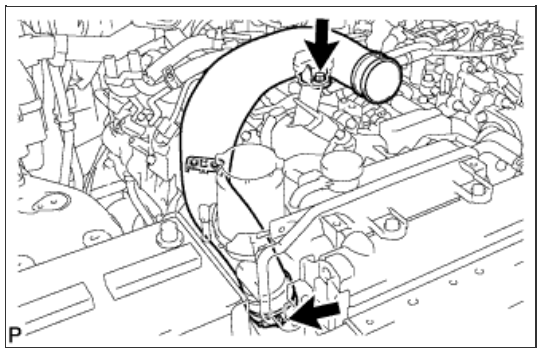
a. Remove the 4 bolts and disconnect the 4 water hose ends, and then remove the heater water pipe.



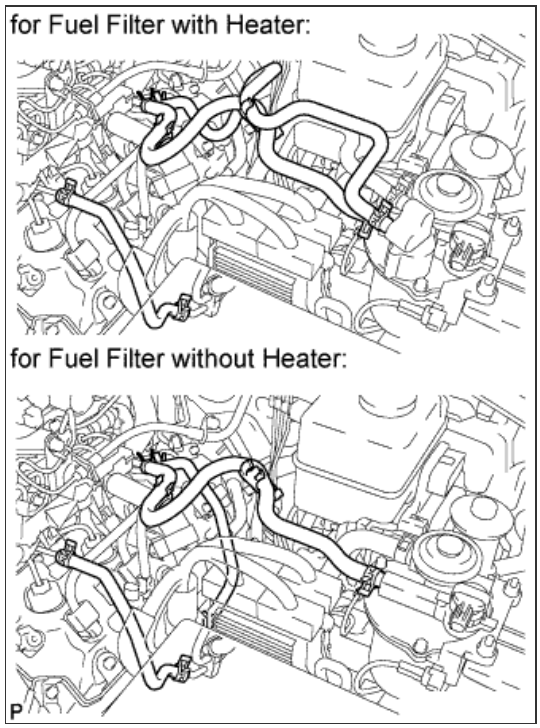
29. REMOVE NO. 1 AIR CLEANER PIPE SUB-ASSEMBLY

a. Loosen the hose clamp.

b. Remove the bolt and No. 1 air cleaner pipe.

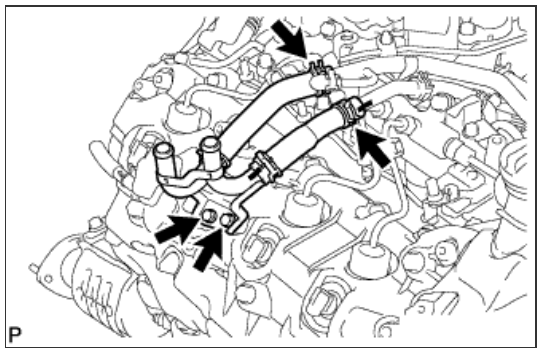


30. DISCONNECT FUEL HOSE



31. REMOVE NO. 3 WATER BY-PASS PIPE (w/o Vi cou Heater)

a. Remove the 2 bolts and disconnect the 2 water hose ends, and then remove the No. 3 water by-pass pipe.

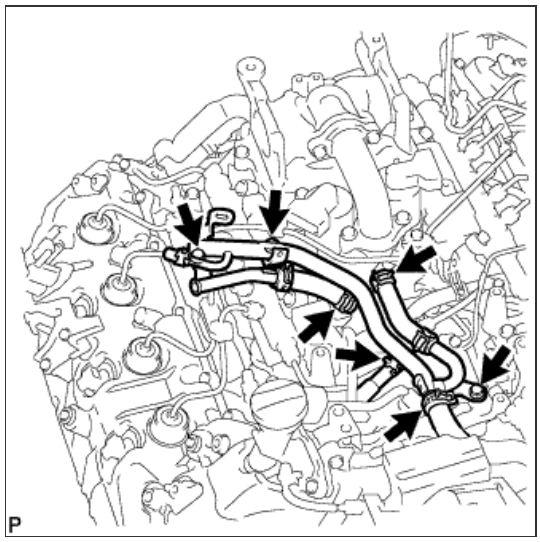


32. REMOVE NO. 4 WATER BY-PASS PIPE

a. w/ R System:

i. Remove the 2 bolts and nut.

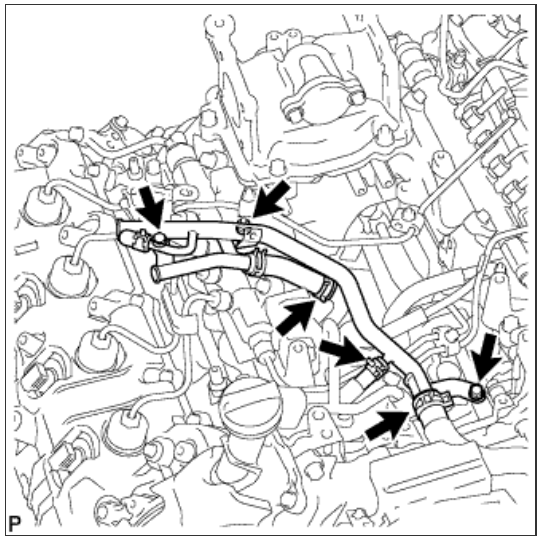
ii. Disconnect the 4 water hose ends, and then remove the No. 4 water by-pass pipe.



b. w/o R System:

i. Remove the 2 bolts and nut.

ii. Disconnect the 3 water hose ends, and then remove the No. 4 water by-pass pipe.

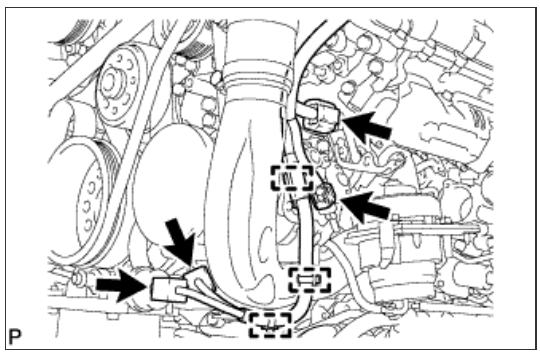


33. DISCONNECT ENGINE WIRE

a. LH Side:

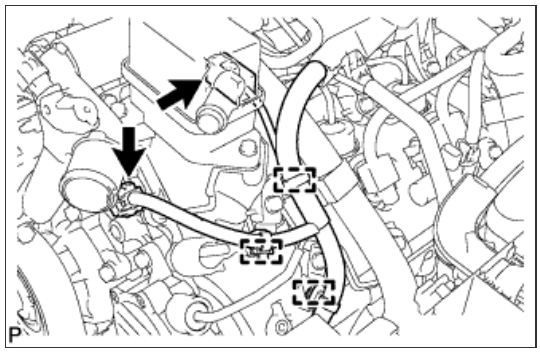
i. Disconnect the 4 connectors.

ii. Using a clip remover, detach the 3 wire harness clamps.



iii. Disconnect the 2 connectors.

iv. Using a clip remover, detach the 3 wire harness clamps.

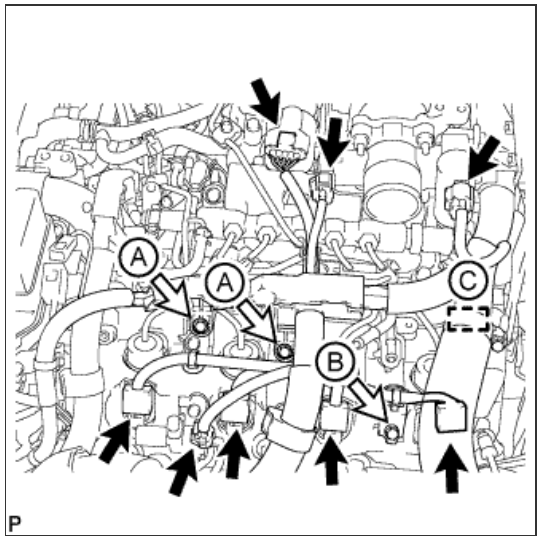


v. Disconnect the 8 connectors.

vi. Remove the bolt and engine wire harness bracket labeled B.

vii. Remove the 2 bolts and disconnect the engine wire protector labeled A.

viii. for RHD:
Disconnect the wire harness from the wire harness clamp holder labeled C.



b. RH Side:

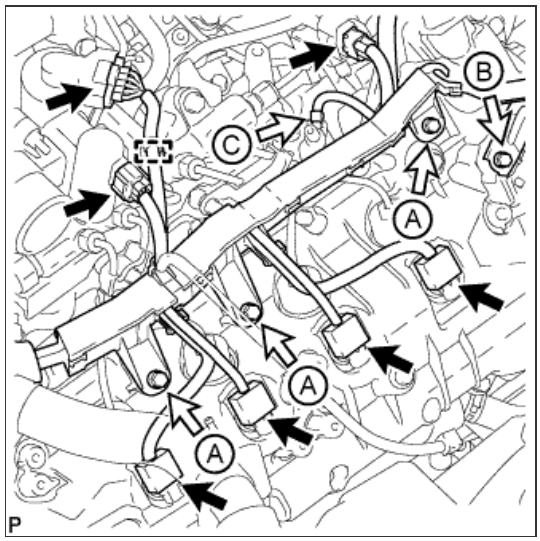
i. Disconnect the 7 connectors.

ii. Using a clip remover, detach the wire harness clamp.

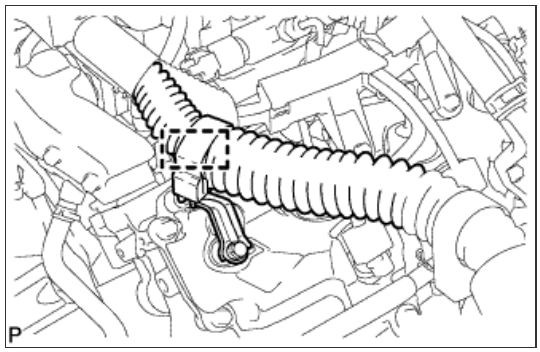
iii. Remove the 3 bolts and disconnect the wire harness protector labeled A.

iv. Remove the bolt and wire harness bracket labeled B.

v. Remove the nut and glow plug wire harness labeled C.



vi. for RHD:
Disconnect the wire harness from the wire harness clamp holder.



c. Rear Side:

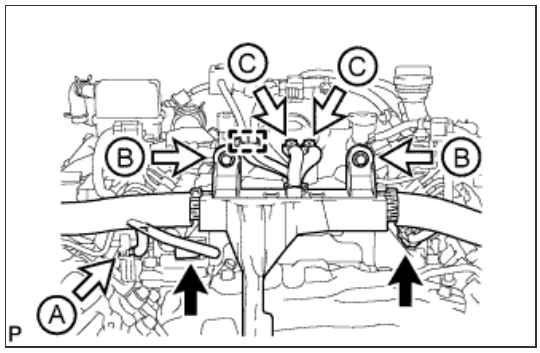
i. Using a clip remover, detach the wire harness clamp.

ii. Remove the 2 bolts and 2 ground wires labeled C.

iii. Remove the 2 bolts and disconnect the engine wire harness protector labeled B.

iv. Disconnect the 2 common rail connectors.

v. Remove the nut and disconnect the glow plug wire harness labeled A.



34. REMOVE NO. 2 FUEL PIPE SUB-ASSEMBLY

NOTICE:

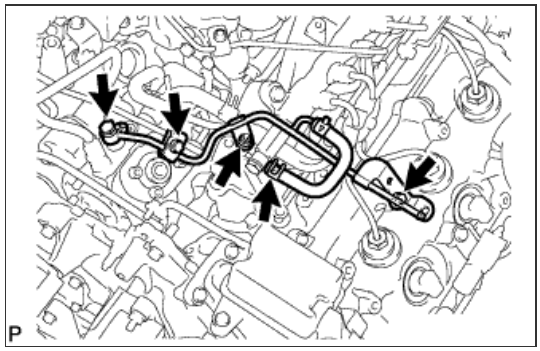
- **After removing a fuel pipe, to prevent dirt or foreign object from entering the fuel pipe end , cover the fuel pipe end with pla tic bag .**
- **After removing a fuel pipe, to prevent dirt or foreign object from entering the fuel upply pump hole, cover the hole with protective tape.**

a. Disconnect the fuel hose from the No. 5 nozzle leakage pipe.

b. Remove the bolt and No. 2 injection pipe clamp.

c. Remove the union bolt and gasket.

d. Remove the bolt, nut and No. 2 fuel pipe.



35. REMOVE NO. 6 INJECTION PIPE SUB-ASSEMBLY

NOTICE:

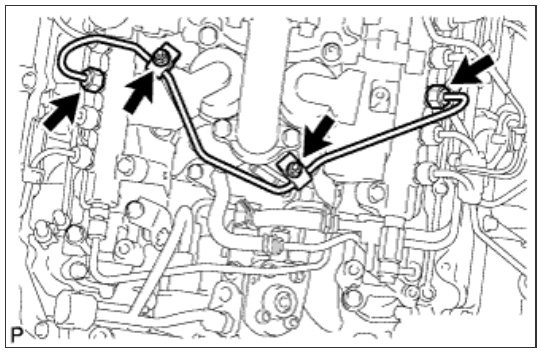
After removing an injection pipe, to prevent dirt or foreign objects from entering the common rail holes, cover the holes with protective tape.

a. w/ R System:

i. Using a union nut wrench, loosen the No. 6 injection pipe ends.

ii. Remove the 2 nuts and 2 No. 2 injection pipe clamps.

iii. Remove the No. 6 injection pipe.

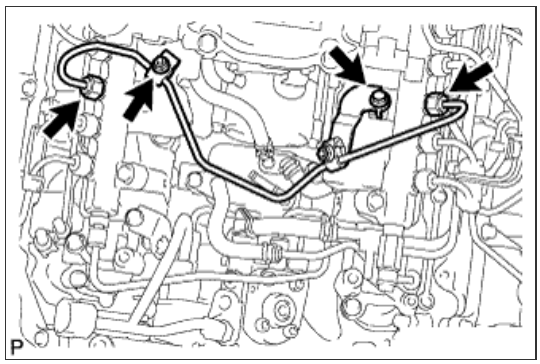


b. w/o R System:

i. Using a union nut wrench, loosen the No. 6 injection pipe ends.

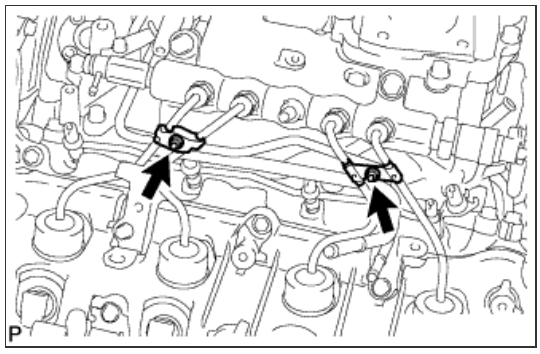
ii. Remove the nut and No. 2 injection pipe clamp.

iii. Remove the bolt and No. 6 injection pipe.



36. REMOVE INJECTION PIPE LH

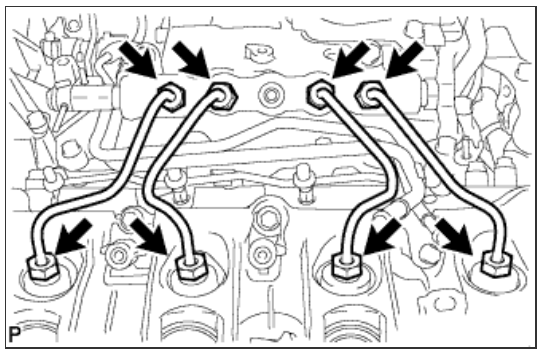
a. w/ ntercooler:
Remove the 2 nuts and 4 injection pipe clamps.



b. Using a union nut wrench, remove the 4 injection pipes.

NOTICE:

After removing an injection pipe, to prevent dirt or foreign objects from entering the common rail holes or injector holes, cover the holes with protective tape.

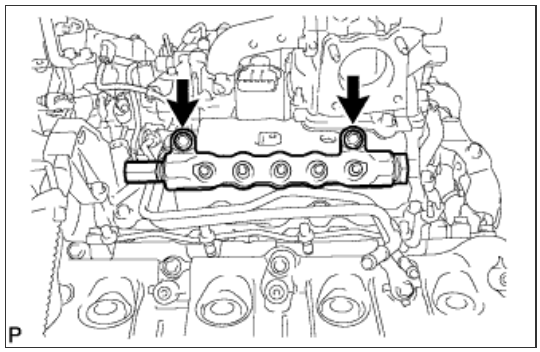


37. REMOVE COMMON RAIL ASSEMBLY LH

a. Remove the 2 bolts and common rail.

NOTICE:

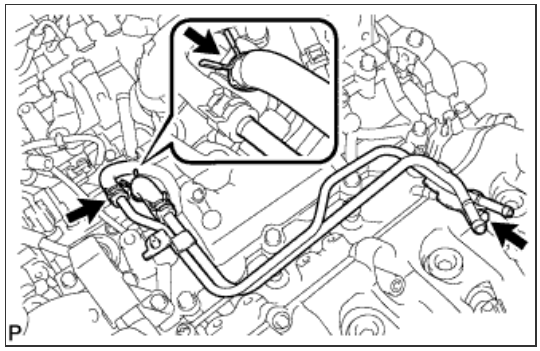
Do not remove the fuel pressure limiter from the common rail. f it is removed, replace the common rail.



38. REMOVE FUEL FILTER TO INJECTION PUMP FUEL PIPE SUB-ASSEMBLY

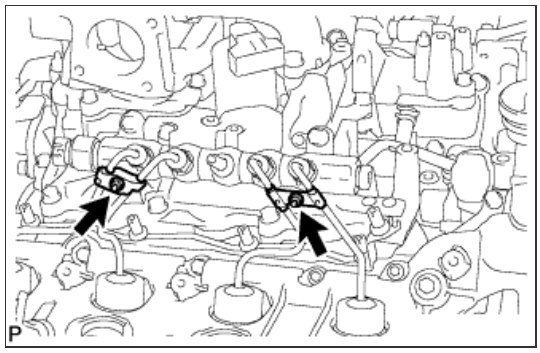
a. Disconnect the 2 hoses from the fuel pipe.

b. Remove the bolt and fuel filter to injection pump fuel pipe.



39. REMOVE INJECTION PIPE RH

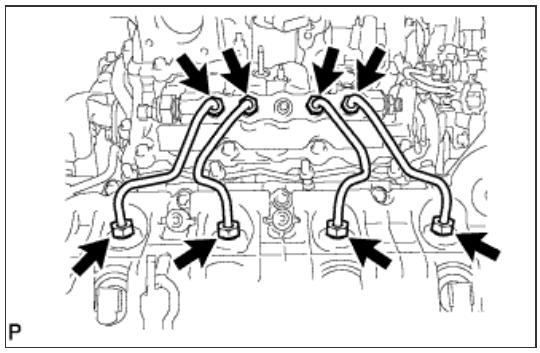
a. w/ ntercooler:
Remove the 2 nuts and 4 injection pipe clamps.



b. Using a union nut wrench, remove the 4 injection pipes.

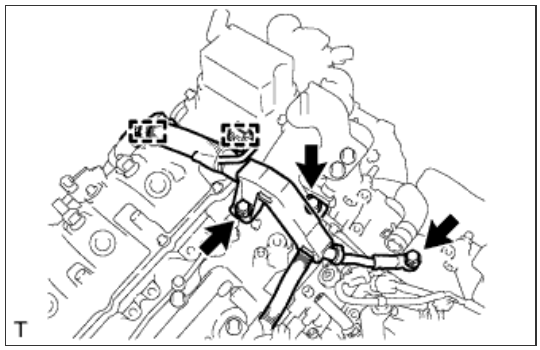
NOTICE:

After removing an injection pipe, to prevent dirt or foreign objects from entering the common rail holes or injector holes, cover the holes with protective tape.



40. DISCONNECT NO. 2 ENGINE WIRE

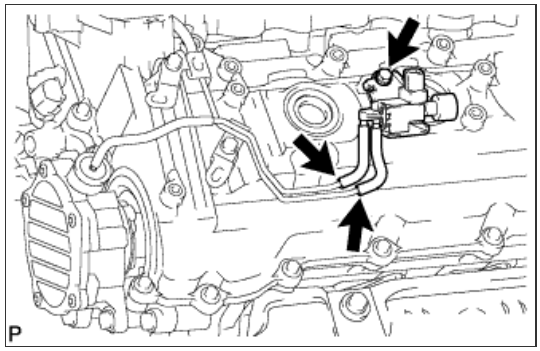
a. Remove the 3 bolts and using a clip remover, detach the 2 wire harness clamps, and then disconnect the No. 2 engine wire.



41. REMOVE NO. 1 VACUUM SWITCHING VALVE ASSEMBLY (for Engine Mounting)

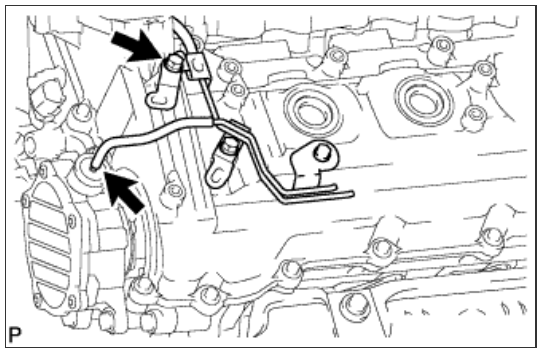
a. Disconnect the 2 vacuum hoses.

b. Remove the bolt and vacuum switching valve.

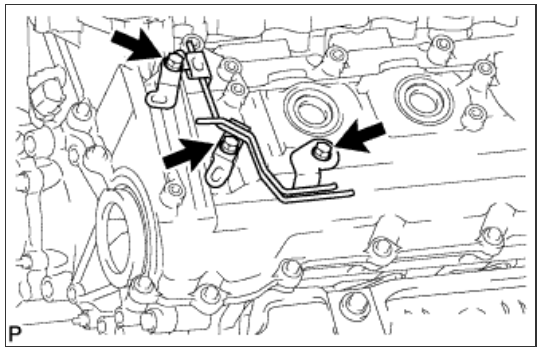


42. REMOVE NO. 1 VACUUM TRANSMITTING PIPE SUB-ASSEMBLY

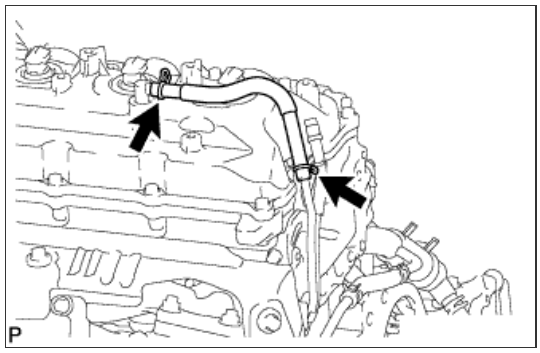
a. w/ ntercooler:
Disconnect the 2 vacuum hoses.



b. Remove the 3 bolts and vacuum transmitting pipe.

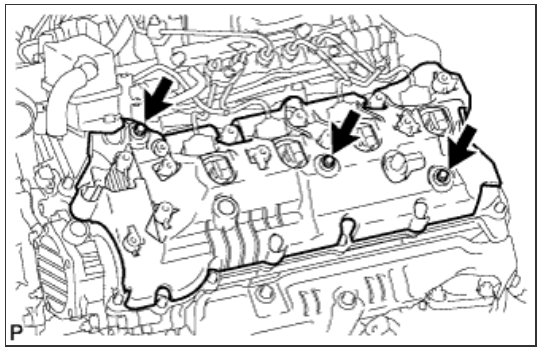


43. DISCONNECT NO. 3 VENTILATION HOSE



44. REMOVE CYLINDER HEAD COVER SILENCER LH (w/ Intercooler)

a. Remove the 3 bolts and cylinder head cover silencer.

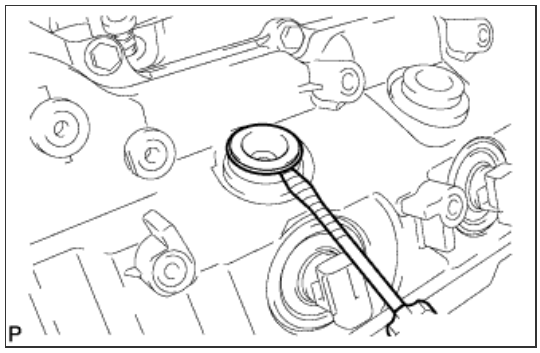


45. REMOVE NOZZLE HOLDER SEAL LH

a. Using a small screwdriver, remove the 4 holder seals by prying the portion between each holder seal and the cutout part of the cylinder head cover.

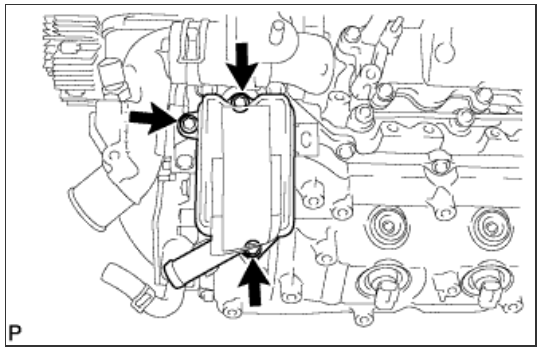
HINT:

ape the screwdriver tip before use.



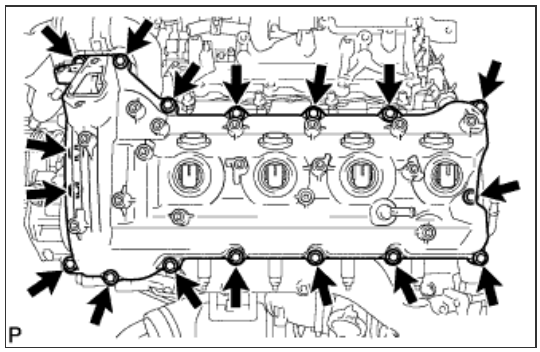
46. REMOVE OIL SEPARATOR ASSEMBLY

a. Remove the 3 bolts, oil separator and gasket.



47. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY LH

a. Remove the 17 bolts, cylinder head cover and gasket.

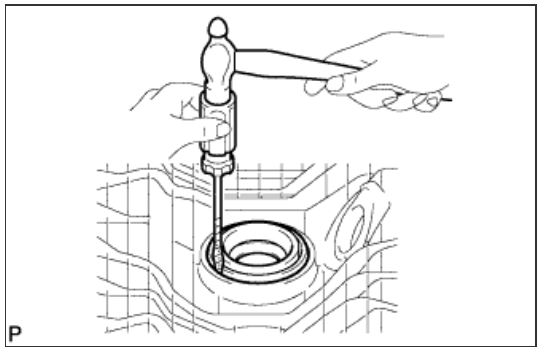


48. REMOVE NOZZLE HOLDER GASKET LH

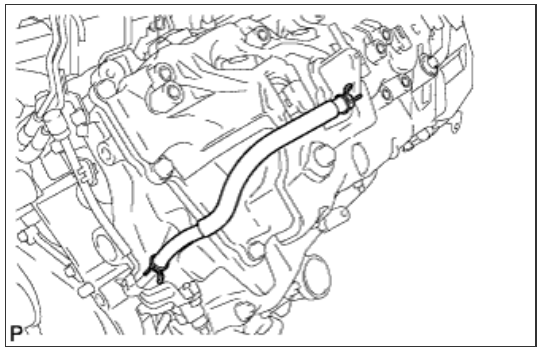
a. Using a small screwdriver and hammer, remove the 4 nozzle holder gaskets.

HINT:

ape the screwdriver tip before use.

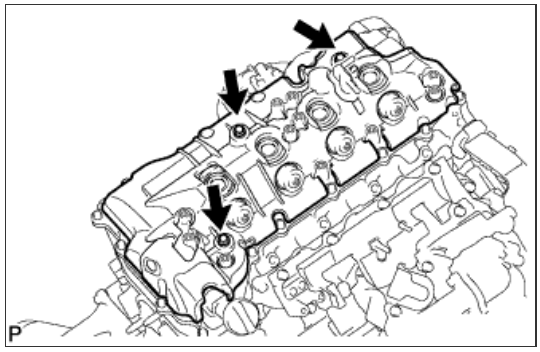


49. DISCONNECT NO. 2 VENTILATION HOSE



50. REMOVE CYLINDER HEAD COVER SILENCER RH (w/ Intercooler)

a. Remove the 3 bolts and cylinder head cover silencer.

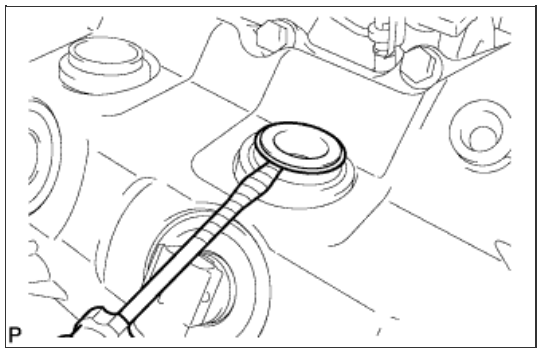


51. REMOVE NOZZLE HOLDER SEAL RH

a. Using a small screwdriver, remove the 4 holder seals by prying the portion between each holder seal and the cutout part of the cylinder head cover.

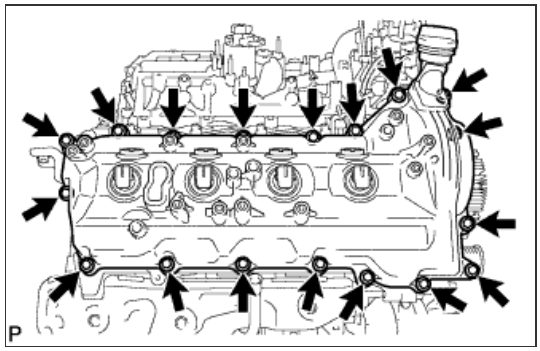
HINT:

ape the screwdriver tip before use.



52. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY RH

a. Remove the 18 bolts, cylinder head cover and gasket.

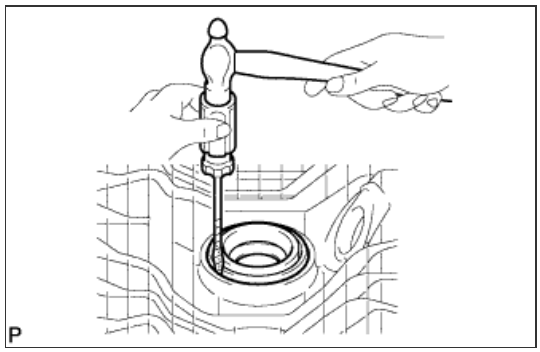


53. REMOVE NOZZLE HOLDER GASKET RH

a. Using a small screwdriver and hammer, remove the 4 nozzle holder gaskets.

HINT:

ape the screwdriver tip before use.

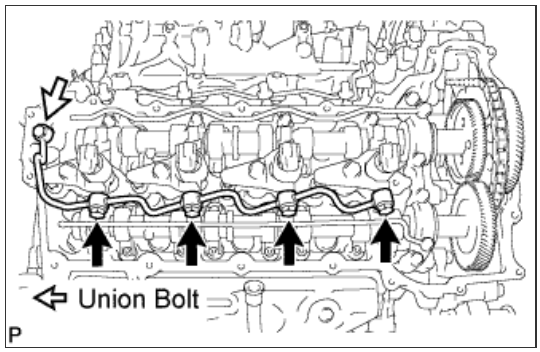


54. REMOVE FUEL INJECTOR RH

a. Remove the union bolt, 4 hollow screws, 5 gaskets and nozzle leakage pipe.

NOTICE:

- **When removing the no le leakage pipe, place a cu hion under the pipe.**
- **Be careful not to deform or cratch the union eal urface.**
- **After removing the no le leakage pipe, put it in a pla tic bag to prevent foreign matter from contaminating it injector inlet.**



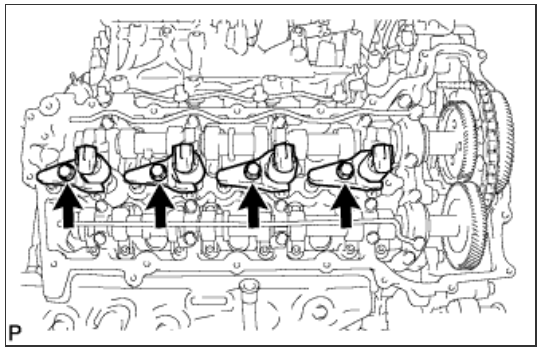
b. Remove the 4 bolts, 4 washers, 4 nozzle holder clamps and 4 injectors.

HINT:

Arrange the injectors, holder clamps, washers and bolts in the correct order.

c. Remove the O-ring from each injector.

d. Remove the 4 injection nozzle seats from the cylinder head.

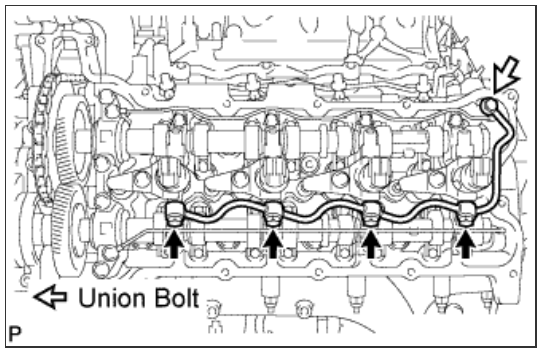


55. REMOVE FUEL INJECTOR LH

a. Remove the union bolt, 4 hollow screws, 5 gaskets and No. 2 nozzle leakage pipe.

NOTICE:

- **When removing the no le leakage pipe, place a cu hion under the pipe.**
- **Be careful not to deform or cratch the union eal urface.**
- **After removing the no le leakage pipe, put it in a pla tic bag to prevent foreign matter from contaminating it injector inlet.**



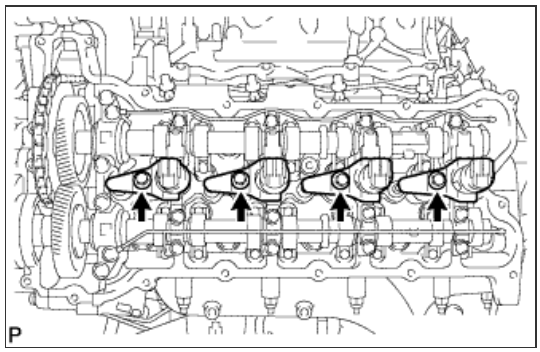
b. Remove the 4 bolts, 4 washers, 4 nozzle holder clamps and 4 injectors.

HINT:

Arrange the injectors, holder clamps, washers and bolts in the correct order.

c. Remove the O-ring from each injector.

d. Remove the 4 injection nozzle seats from the cylinder head.



for Preparation Click here

1. INSPECT FUEL INJECTOR

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	0.85 to 1.05 Ω

If the result is not as specified, replace the fuel injector.

for Preparation Click here

NOTICE:

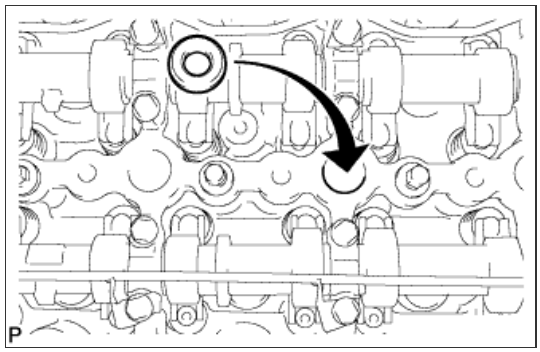
When replacing an injector (including interchanging injectors between cylinders), common rail, replace the corresponding injection pipes with a new one.

1. INSTALL FUEL INJECTOR LH

NOTICE:

Be sure to install the injector, holder clamp and bolt in their original positions.

a. Install 4 new injection nozzle seats to the cylinder head.



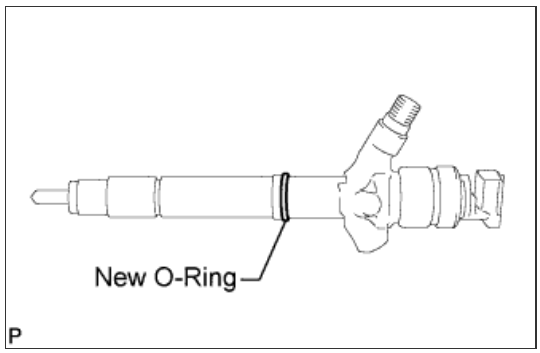
b. Apply a light amount of clean engine oil to 4 new O-rings.

c. Install the O-rings to each injector as shown in the illustration.

d. Insert the 4 injectors into the cylinder head.

NOTICE:

- **Insert the injector until it touches the nozzle seat surface.**
- **After installing the injector to the cylinder head, the O-ring may prevent the injector from fully seating. If so, pull out the injector and reinstall it.**
- **Always return an injector to the same place it was removed from.**

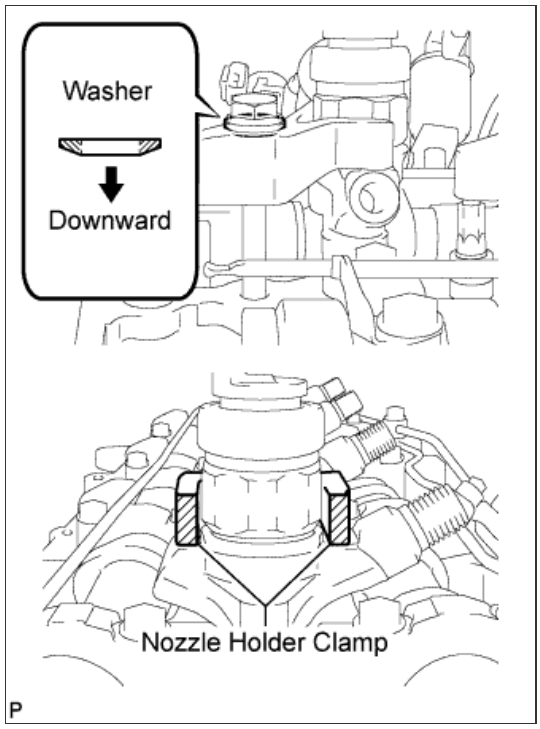


e. For an injector that has been replaced with a new injector, register the injector compensation code.

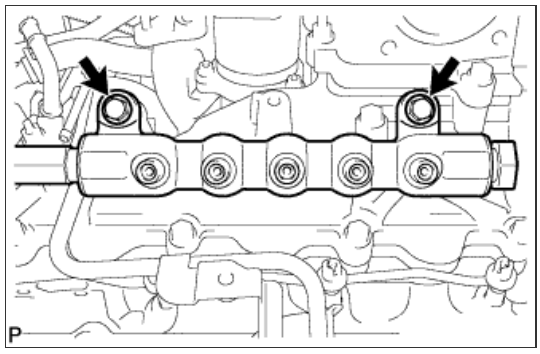
f. Temporarily install 4 new washers and the 4 nozzle clamps with the 4 clamp bolts.

NOTICE:

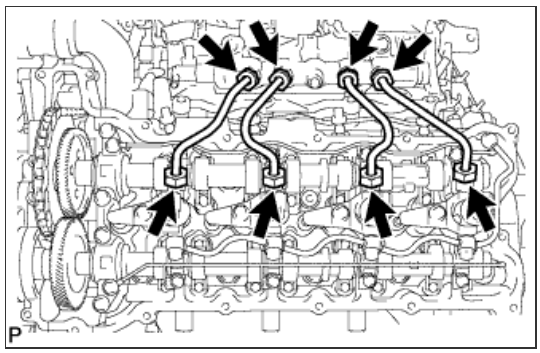
- **The fork portion of the nozzle holder clamp must be set to the injector.**
- **Before tightening the bolts, check that the nozzle holder clamp is set properly.**
- **To tighten the clamp bolts, first tighten them by hand until they cannot be turned further. Then, tighten the bolts to the specified torque in a later step.**
- **When tightening the bolts, be careful not to tilt the bolt and clamp.**
- **Do not reuse the washer.**



g. Temporarily install the common rail LH with the 2 bolts.

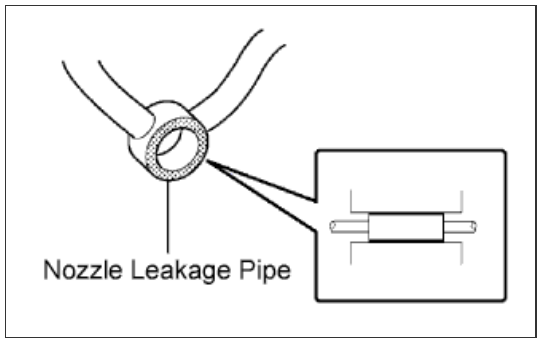


h. Temporarily install the 4 new injection pipes to the common rail and injector.



i. Check the nozzle leakage pipe. Check that there are no scratches or dents on the 5 union seal surfaces. If scratches or dents are present, replace the nozzle leakage pipe.

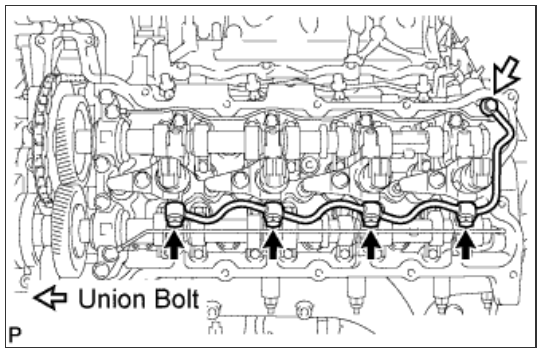
j. Set the leakage pipe and 5 new gaskets in place.



k. Temporarily install the leakage pipe with the 4 hollow screws and union bolt.

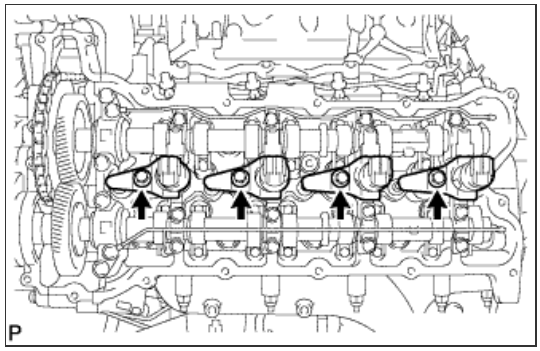
HINT:

To position the injectors, loosely tighten the 4 hollow screws and union bolt.



l. Tighten the 4 holder clamp bolts.

Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }



m. Remove the 4 injection pipes.

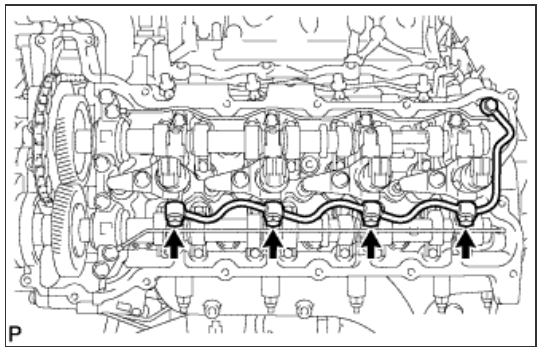
n. Remove the 2 bolts and common rail LH.

o. Tighten the 4 hollow screws.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

NOTICE:

If a hollow screw is accidentally tightened beyond the torque specification, it must be replaced together with the nozzle leakage pipe.

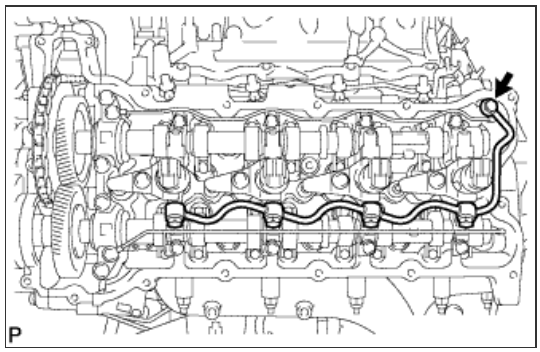


p. Tighten the union bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

NOTICE:

If a hollow screw is accidentally tightened beyond the torque specification, it must be replaced together with the nozzle leakage pipe.

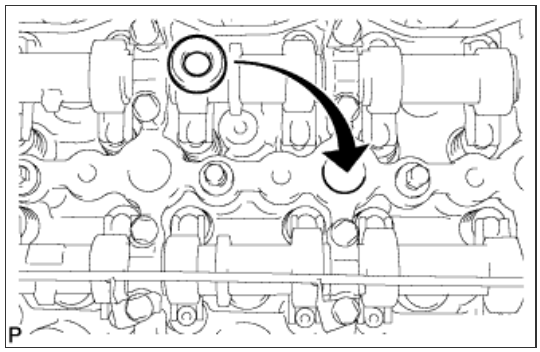


2. INSTALL FUEL INJECTOR RH

NOTICE:

Be sure to install the injector, holder clamp and bolt in their original positions.

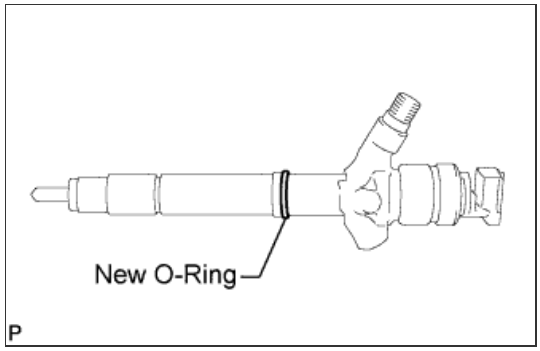
a. Install 4 new injection nozzle seats to the cylinder head.



b. Apply a light amount of clean engine oil to 4 new O-rings.

c. Install the O-rings to each injector as shown in the illustration.

d. Insert the 4 injectors into the cylinder head.

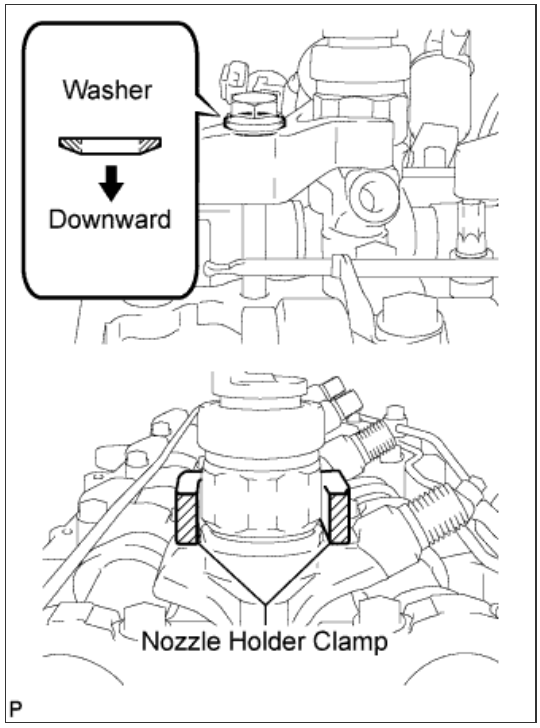


NOTICE:

- **Insert the injector until it touches the nozzle seat surface.**
- **After installing the injector to the cylinder head, the O-ring may prevent the injector from fully seating. If so, pull out the injector and reinstall it.**
- **Always return an injector to the same place it was removed from.**

e. For an injector that has been replaced with a new injector, register the injector compensation code.

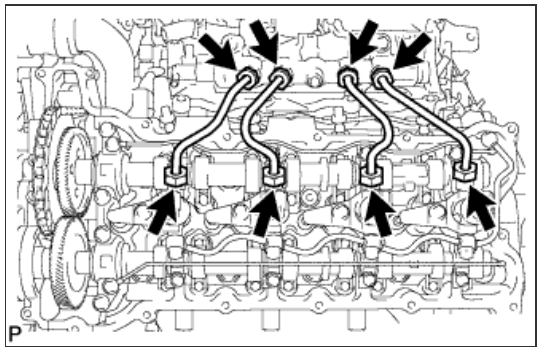
f. Temporarily install 4 new washers and the 4 nozzle clamps with the 4 clamp bolts.



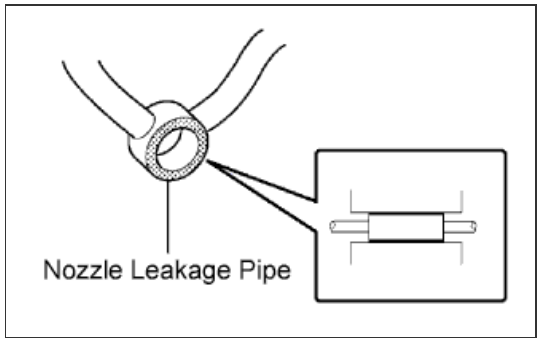
NOTICE:

- **The fork portion of the nozzle holder clamp must be set to the injector.**
- **Before tightening the bolts, check that the nozzle holder clamp is set properly.**
- **To tighten the clamp bolts, first tighten them by hand until they cannot be turned further. Then, tighten the bolts to the specified torque in a later step.**
- **When tightening the bolts, be careful not to tilt the bolt and clamp.**
- **Do not reuse the washer.**

g. Temporarily install the 4 new injection pipes to the common rail and injector.



h. Check the nozzle leakage pipe. Check that there are no scratches or dents on the 5 union seal surfaces. If scratches or dents are present, replace the nozzle leakage pipe.

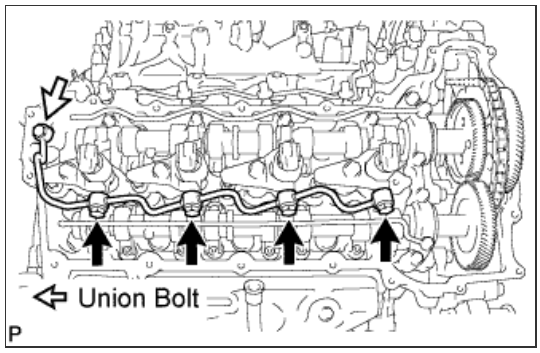


i. Set the leakage pipe and 5 new gaskets in place.

j. Temporarily install the leakage pipe with the 4 hollow screws and union bolt.

HINT:

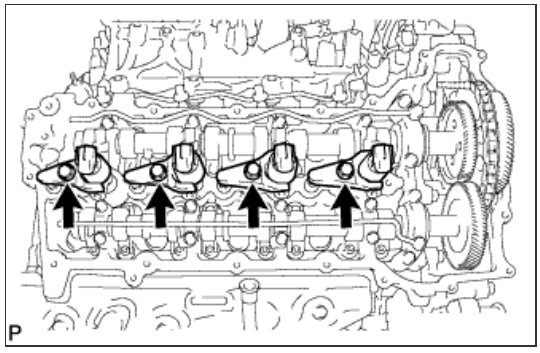
To position the injectors, loosely tighten the 4 hollow screws and union bolt.



k. Tighten the 4 holder clamp bolts.

Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }

l. Remove the 4 injection pipes.

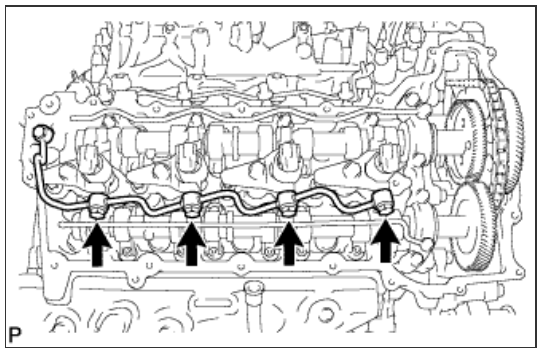


m. Tighten the 4 hollow screws.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

NOTICE:

If a hollow screw is accidentally tightened beyond the torque specification, it must be replaced together with the nozzle leakage pipe.

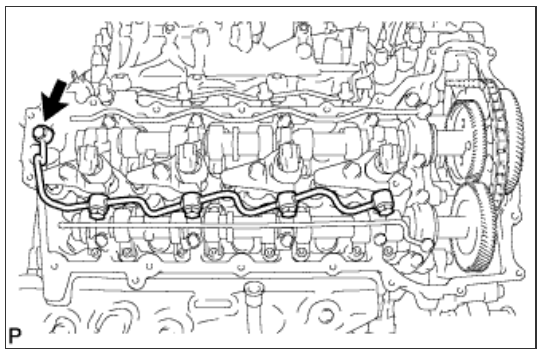


n. Tighten the union bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

NOTICE:

If a hollow screw is accidentally tightened beyond the torque specification, it must be replaced together with the nozzle leakage pipe.

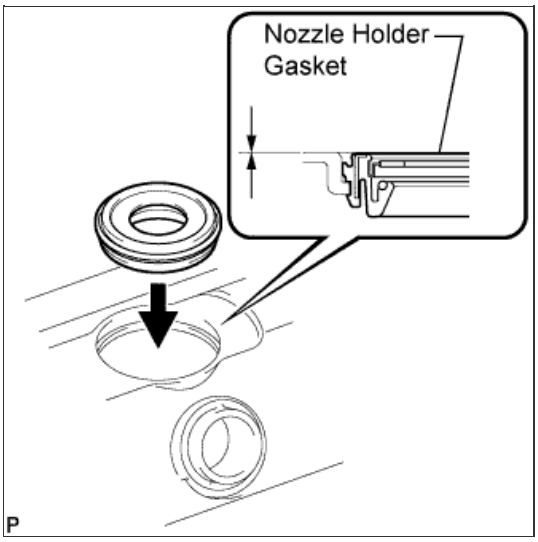


3. INSTALL NOZZLE HOLDER GASKET RH

a. Press 4 new nozzle holder gaskets into the cylinder head cover RH.

NOTICE:

After installing the nozzle holder gasket, check that it dose not protrude from the cylinder head cover.



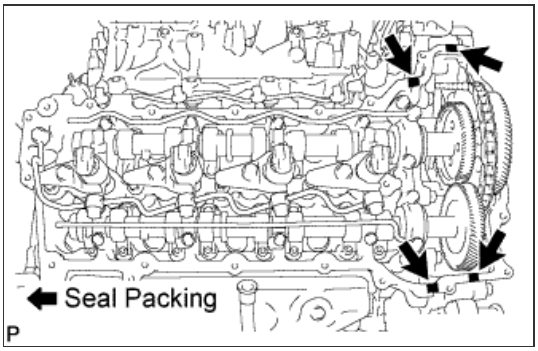
4. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY RH

a. Apply seal packing as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the cylinder head cover within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after the installation.**



b. Install a new gasket to the cylinder head cover.

NOTICE:

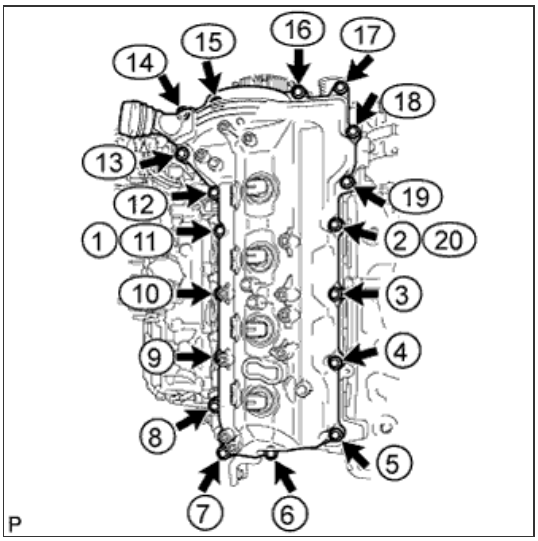
Remove any oil from the contact surface.

c. Temporarily install the cylinder head cover with the 18 bolts. Tighten the 18 bolts in the order shown in the illustration.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

HINT:

After tightening the bolts, check that the bolts at step 11 and 20 are tightened to the specified torque.



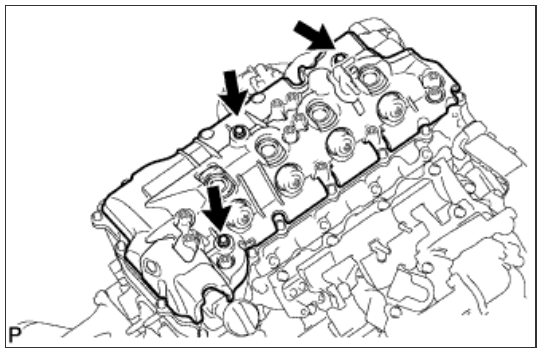
5. INSTALL NOZZLE HOLDER SEAL RH

a. Press 4 new holder seals into the cylinder head cover RH.

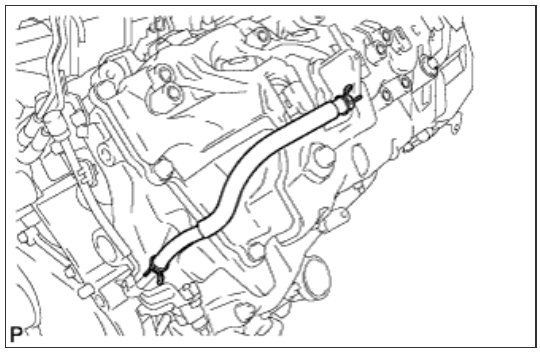
. INSTALL CYLINDER HEAD COVER SILENCER RH w Intercooler

a. Install the cylinder head cover silencer with the 3 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



7. CONNECT NO. 2 VENTILATION HOSE

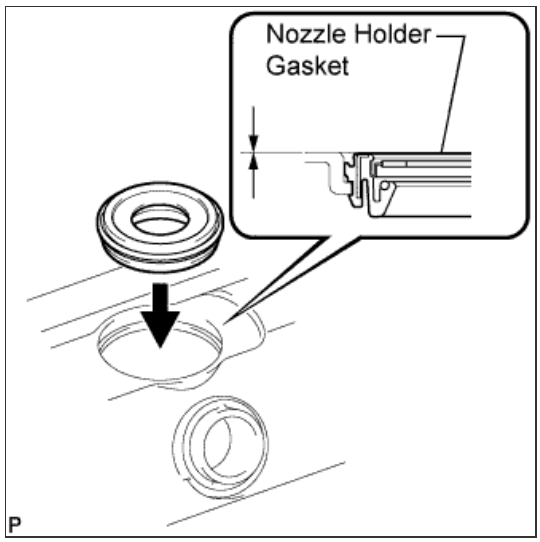


8. INSTALL NOZZLE HOLDER GASKET LH

a. Press 4 new nozzle holder gaskets into the cylinder head cover LH.

NOTICE:

After installing the nozzle holder gasket, check that it dose not protrude from the cylinder head cover.



9. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY LH

a. Apply seal packing as shown in the illustration.

Seal packing:

Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

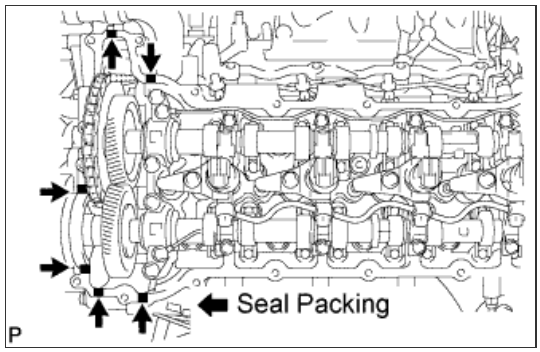
NOTICE:

- **Remove any oil from the contact surface.**
- **Install the cylinder head cover within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after the installation.**

b. Install a new gasket to the cylinder head cover.

NOTICE:

Remove any oil from the contact surface.

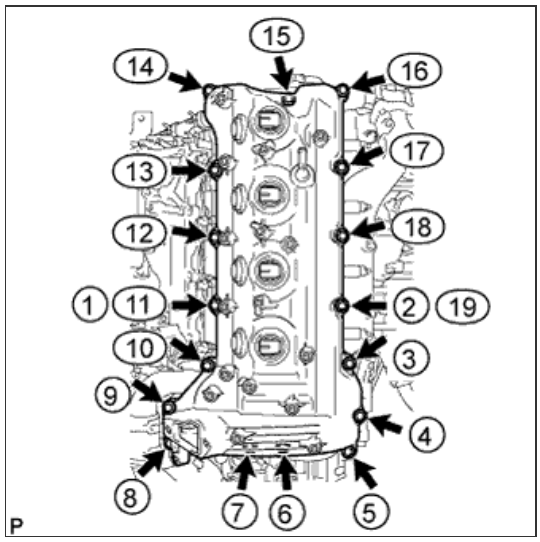


c. Temporarily install the cylinder head cover with the 17 bolts. Tighten the 17 bolts in the order shown in the illustration.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

HINT:

After tightening the bolts, check that the bolts at step 11 and 19 are tightened to the specified torque.



10. INSTALL OIL SEPARATOR ASSEMBLY

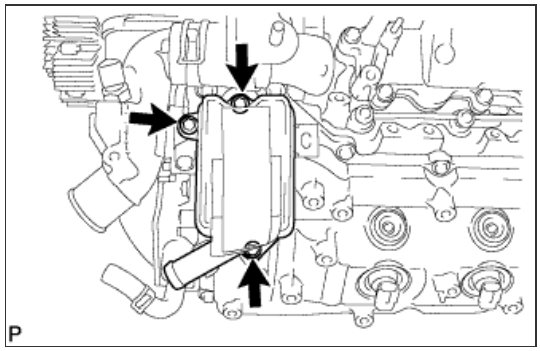
a. Install a new gasket to the oil separator.

NOTICE:

Remove any oil from the contact surface.

b. Install the oil separator with the 3 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



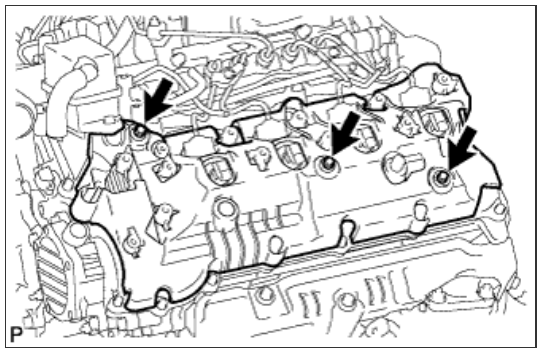
11. INSTALL NOZZLE HOLDER SEAL LH

a. Press 4 new holder seals into the cylinder head cover LH.

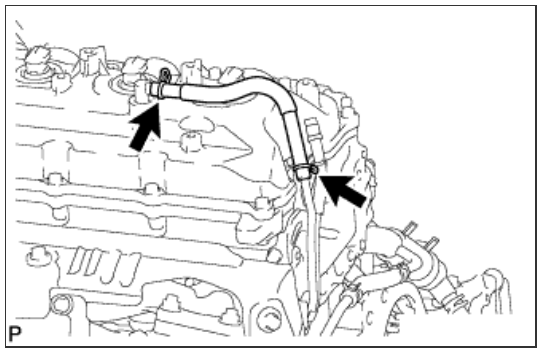
12. INSTALL CYLINDER HEAD COVER SILENCER LH (w/ Intercooler)

a. Install the cylinder head cover silencer with the 3 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



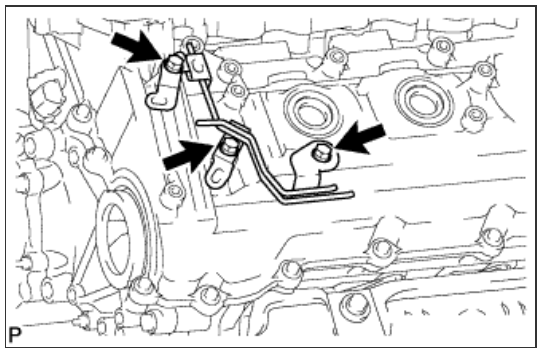
13. CONNECT NO. 3 VENTILATION HOSE



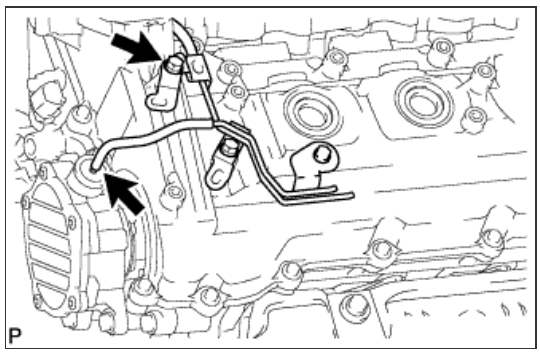
14. INSTALL NO. 1 VACUU TRANS ITTING PIPE SUB-ASSEMBLY

a. Install the vacuum transmitting pipe with the 3 bolts.

Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }



b. w/ Intercooler:
Connect the 2 vacuum hoses.



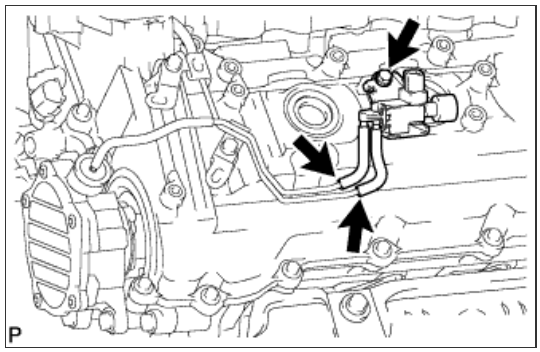
15. INSTALL NO. 1 VACUUM SWITCHING VALVE ASSEMBLY (for Engine Mounting)

a. Install vacuum switching valve with the bolt.

Torque:

.0 N*m{ 61 kgf*cm , 53 in.*lbf }

b. Connect the 2 vacuum hoses.

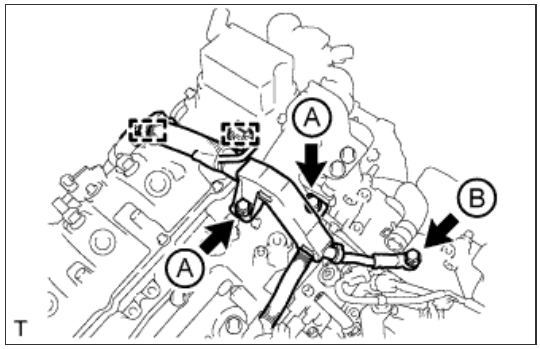


16. INSTALL NO. 2 ENGINE WIRE

a. Connect the No. 2 engine wire with the 3 bolts.

Torque:
for bolt A:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }
for bolt B:
32 N*m{ 326 kgf*cm , 24 ft.*lbf }

b. Attach the 2 wire harness clamps.



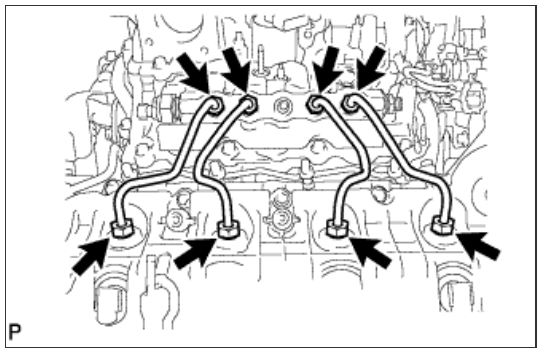
17. INSTALL INJECTION PIPE RH

a. Using a union nut wrench, install the 4 new injection pipes.

Torque:
without union nut wrench:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }
with union nut wrench:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

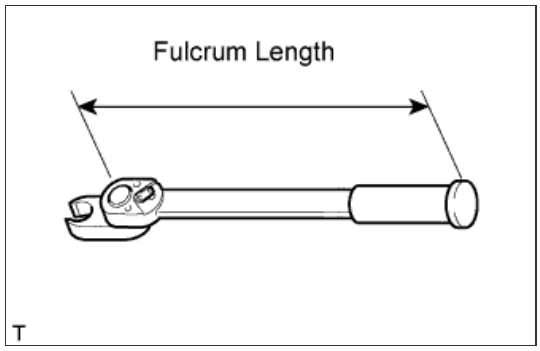
NOTICE:

Make sure there is no damage or foreign matter on the seal surfaces.



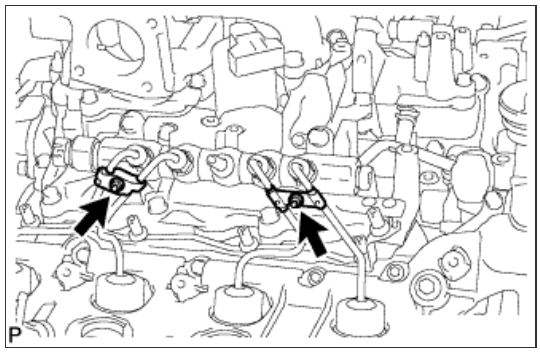
HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure the union nut wrench and the torque wrench are connected in a straight line.**



b. w/ Intercooler:
Install the 4 injection pipe clamps with the 2 nuts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

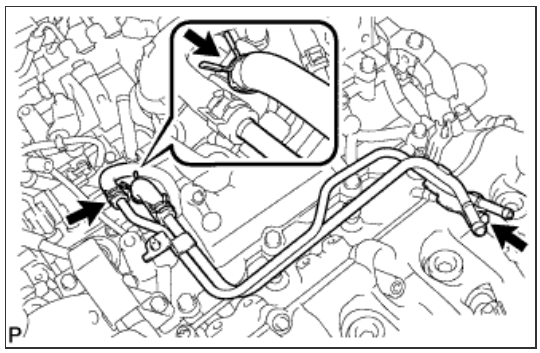


18. INSTALL FUEL FILTER TO INJECTION PUMP FUEL PIPE SUB-ASSEMBLY

a. Install the fuel filter to injection pump fuel pipe with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

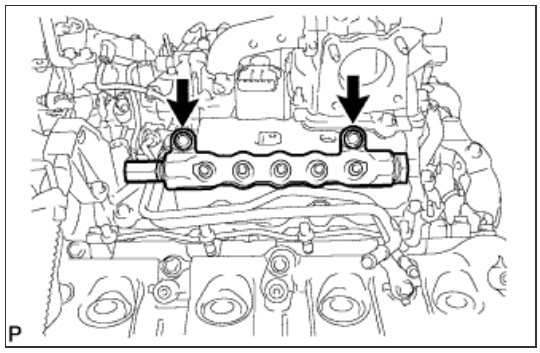
b. Connect the 2 hoses to the fuel pipe.



19. INSTALL COMMON RAIL ASSEMBLY LH

a. Install the common rail with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



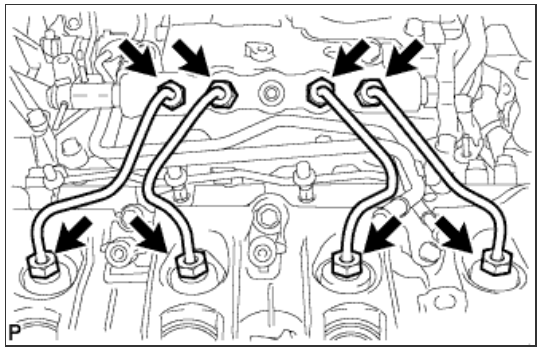
20. INSTALL INJECTION PIPE LH

a. Using a union nut wrench, install the 4 new injection pipes.

Torque:
without union nut wrench:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }
with union nut wrench:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

NOTICE:

Make sure there is no damage or foreign matter on the seal surfaces.

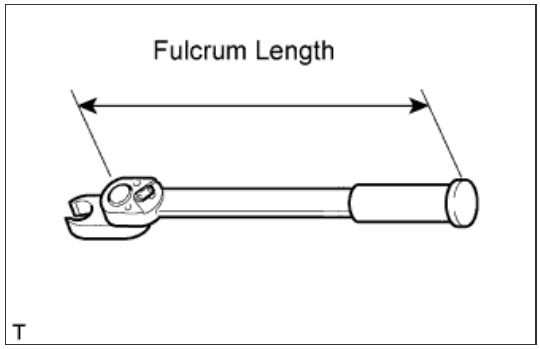


HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8**

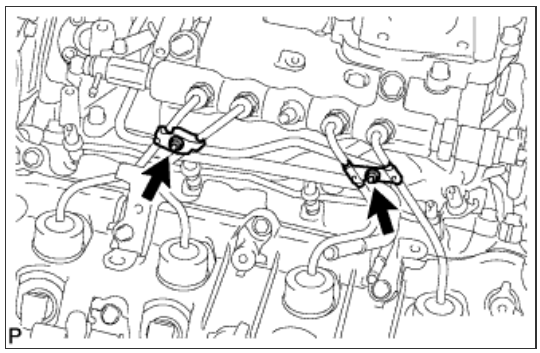
in. .

- ake sure the union nut wrench and the torque wrench are connected in a straight line.



b. w/ Intercooler:
Install the 4 injection pipe clamps with the 2 nuts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



21. INSTALL NO. 6 INJECTION PIPE SUB-ASSEMBLY

a. w/ EGR System:

i. Temporarily install a new No. 6 injection pipe to the common rail LH and RH.

NOTICE:

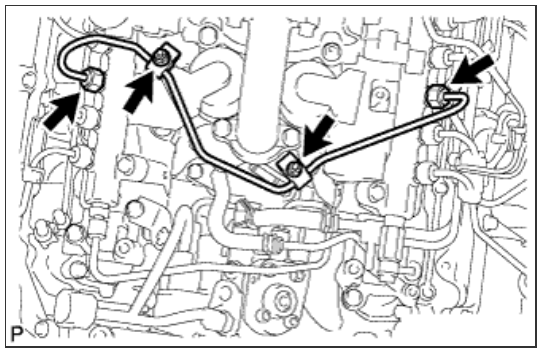
Make sure there is no damage or foreign matter on the seal surfaces.

ii. Install the 2 No. 2 injection pipe clamps with the 2 nuts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

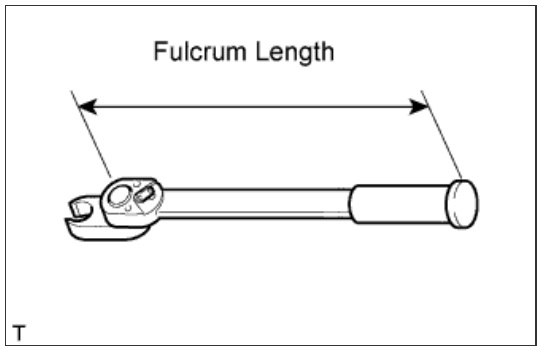
iii. Using a union nut wrench, tighten the No. 6 injection pipe ends.

Torque:
without union nut wrench:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }
with union nut wrench:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

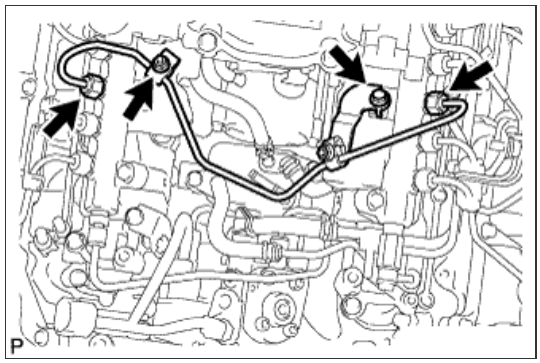


HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure the union nut wrench and the torque wrench are connected in a straight line.**



b. w/o EGR System:



i. Temporarily install a new No. 6 injection pipe to the common rail LH and RH.

NOTICE:

Make sure there is no damage or foreign matter on the seal surfaces.

ii. Install the bracket to the No. 3 intake manifold with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

iii. Install the No. 2 injection pipe clamp with the nut.

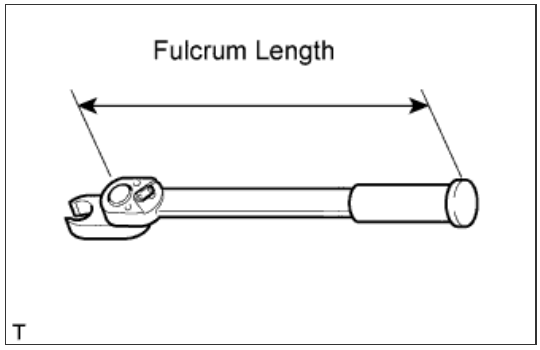
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

iv. Using a union nut wrench, tighten the No. 6 injection pipe ends.

Torque:
without union nut wrench:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }
with union nut wrench:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure the union nut wrench and the torque wrench are connected in a straight line.**

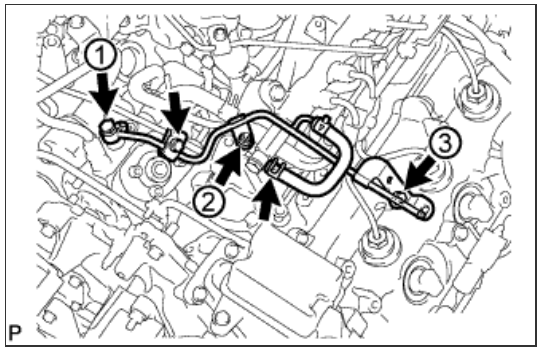


22. INSTALL NO. 2 FUEL PIPE SUB-ASSEMBLY

NOTICE:

Check for damage and foreign matter on the fuel pipe installation surface of the supply pump.

If there is foreign matter, remove it from the installation surface. If the installation surface is damaged, replace the fuel supply pump.



a. Temporarily install a new gasket and the No. 2 fuel pipe with the union bolt, nut and bolt.

b. Tighten the union bolt, nut and bolt in the order shown in the illustration.

Torque:
for union bolt:
10 N*m{ 105 kgf*cm , 8 ft.*lbf }
for bolt and nut:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

c. Install the No. 2 injection pipe clamp with the bolt.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

d. Connect the fuel hose to the No. 5 nozzle leakage pipe.

23. CONNECT ENGINE WIRE

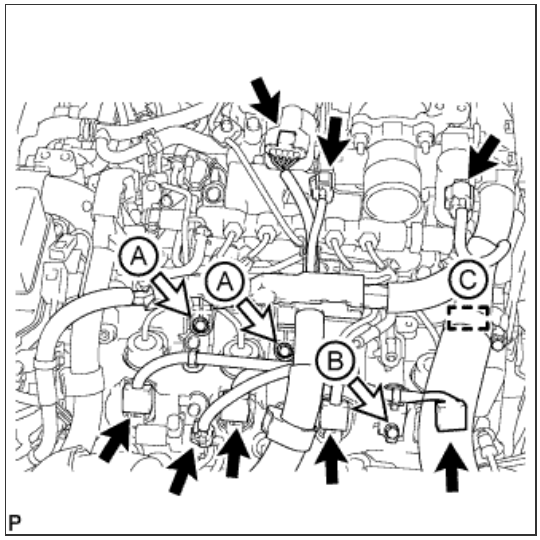
a. LH Side:

i. Install the engine wire protector with the 2 bolts labeled A.

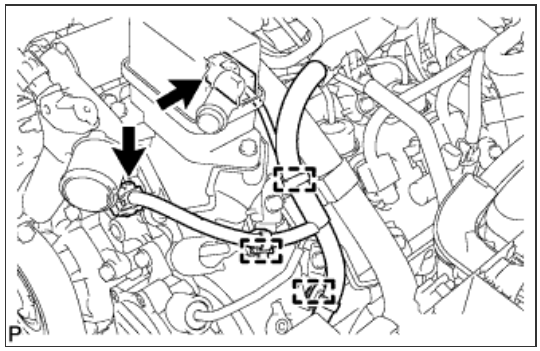
ii. Connect the 8 connectors.

iii. Install the engine wire harness bracket with the bolt labeled B.

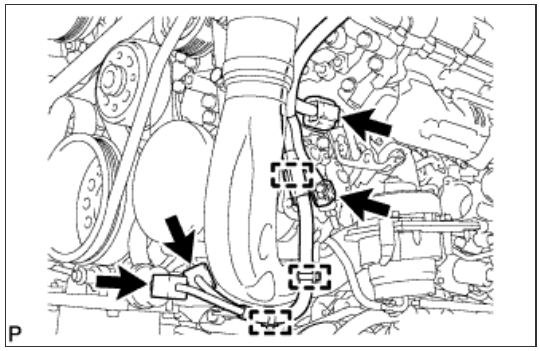
iv. for RHD:
Connect the wire harness with the wire harness clamp holder labeled C.



v. Attach the 3 wire harness clamps and connect the 2 connectors.



vi. Attach the 3 wire harness clamps and connect the 4 connectors.



b. RH Side:

i. Install the engine wire harness protector with the 3 bolts labeled A.

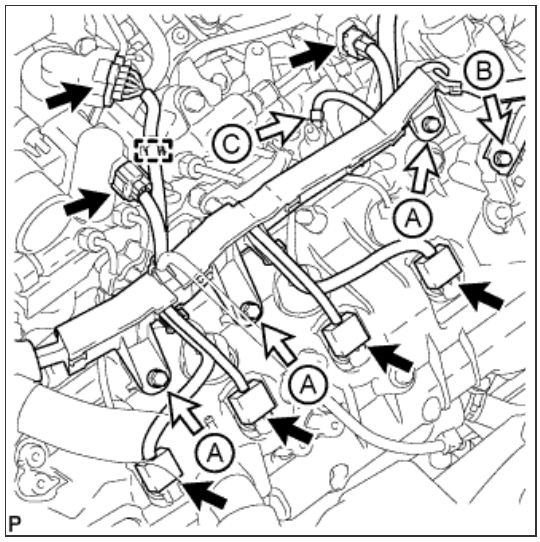
ii. Connect the 7 connectors.

iii. Attach the wire harness clamp.

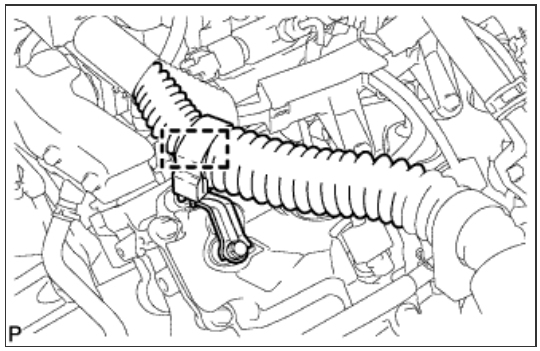
iv. Install the wire harness bracket with the bolt labeled B.

v. Install the glow plug wire harness labeled C with the nut.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }



vi. for RHD:
Connect the wire harness with the wire harness clamp holder.



c. Rear Side:

i. Install the glow plug wire harness with the nut labeled A.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }

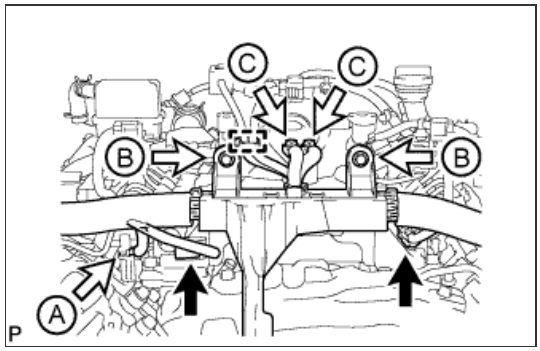
ii. Connect the 2 common rail connectors.

iii. Install the engine wire harness protector with the 2 bolts labeled B.

iv. Install the 2 ground wires with the 2 bolts labeled C.

Torque:
8.4 N*m{ 87 kgf*cm , 74 in.*lbf }

v. Attach the wire harness clamp.

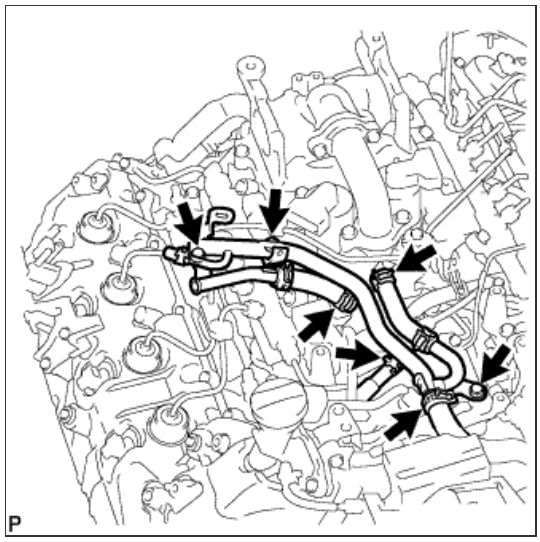


24. INSTALL NO. 4 WATER BY-PASS PIPE

a. w/ EGR System:
Connect the 4 water hose ends, and temporarily install the No. 4 water by-pass pipe with the 2 bolts and nut.

b. First tighten the 2 bolts and then tighten the nut.

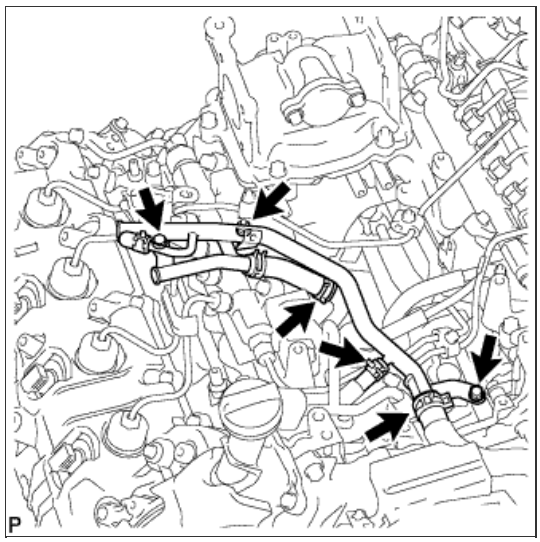
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



c. w/o EGR System:
Connect the 3 water hose ends, and temporarily install the No. 4 water by-pass pipe with the 2 bolts and nut.

d. First tighten the 2 bolts and then tighten the nut.

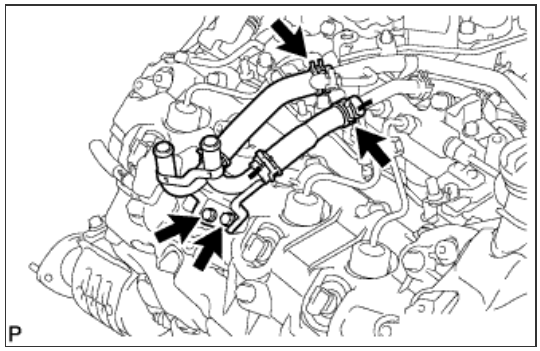
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



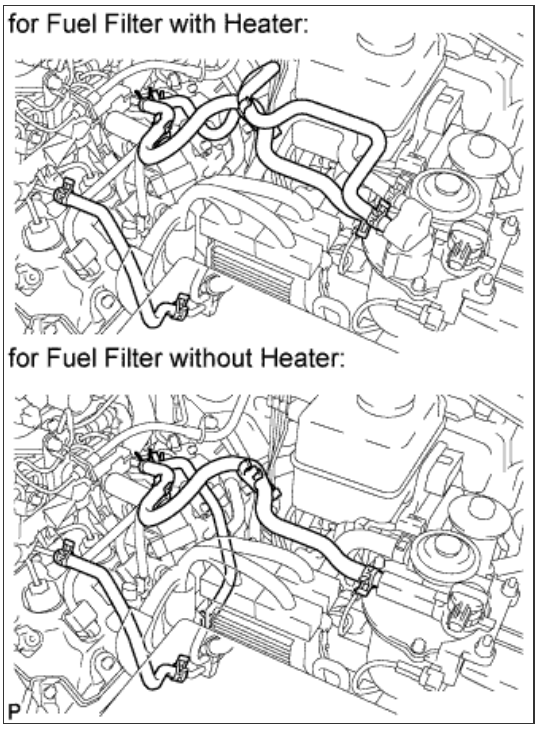
25. INSTALL NO. 3 WATER BY-PASS PIPE (w/o Viscous Heater)

a. Connect the 2 water hose ends, and install the No. 3 water by-pass pipe with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



26. CONNECT FUEL HOSE



27. INSTALL NO. 1 AIR CLEANER PIPE SUB-ASSEMBLY

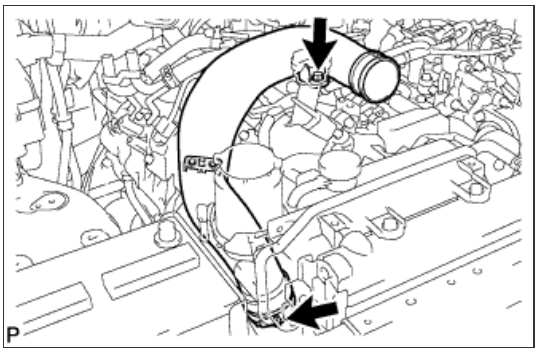
a. Connect the No. 1 air cleaner pipe to the No. 1 intake air connector pipe.

b. Install the pipe with the bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Tighten the hose clamp.

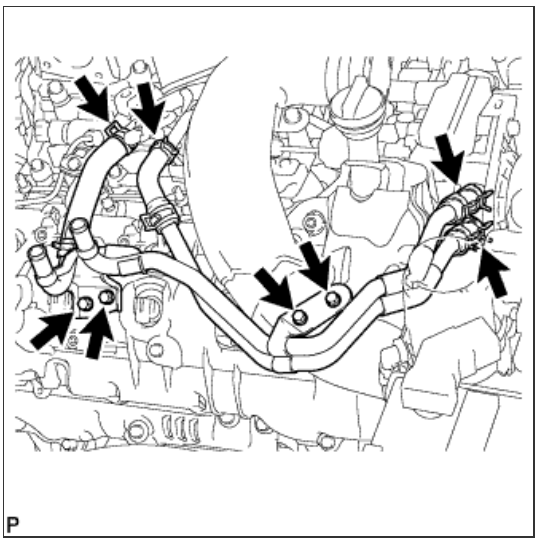
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



28. INSTALL HEATER WATER PIPE SUB-ASSEMBLY (w/ Viscous Heater)

a. Connect the 4 water hose ends, and install the water pipe with the 4 bolts.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }



29. INSTALL NO. 2 AIR CLEANER PIPE SUB-ASSEMBLY

a. Connect the No. 2 air cleaner pipe to the No. 2 intake air connector pipe.

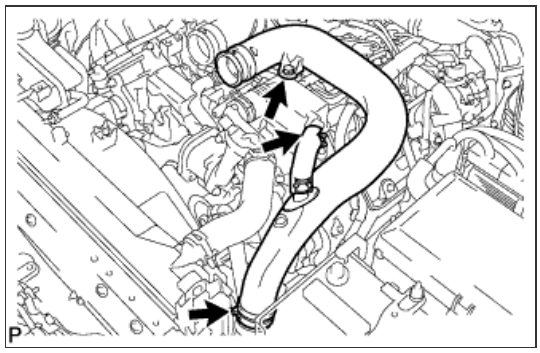
b. Connect the ventilation hose to the oil separator.

c. Install the pipe with the bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

d. Tighten the hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



30. INSTALL NO. 4 AIR TUBE

a. Install the No. 4 air tube with the bolt.

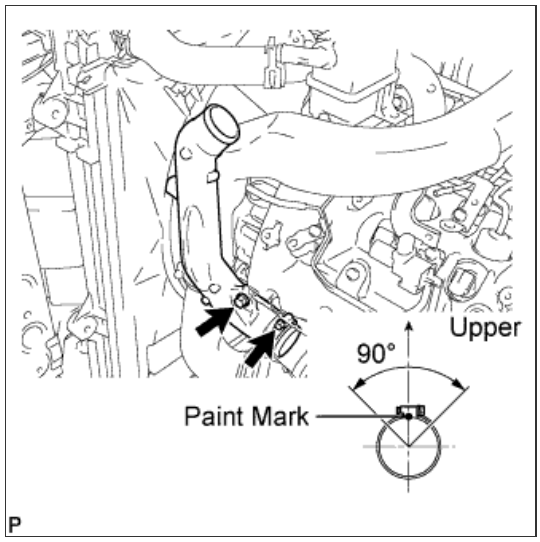
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

b. Tighten the hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

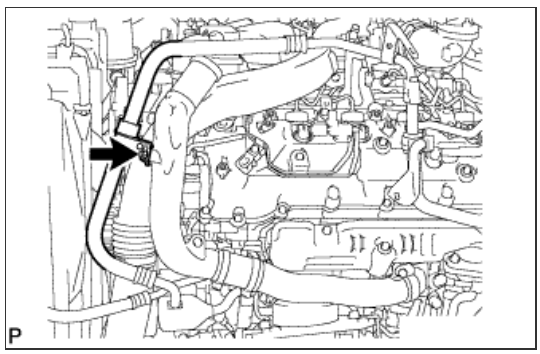
HINT:

Make sure the direction of the hose clamp is as shown in the illustration.



c. Install the suction hose with the bolt.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }



31. INSTALL NO. 2 AIR HOSE

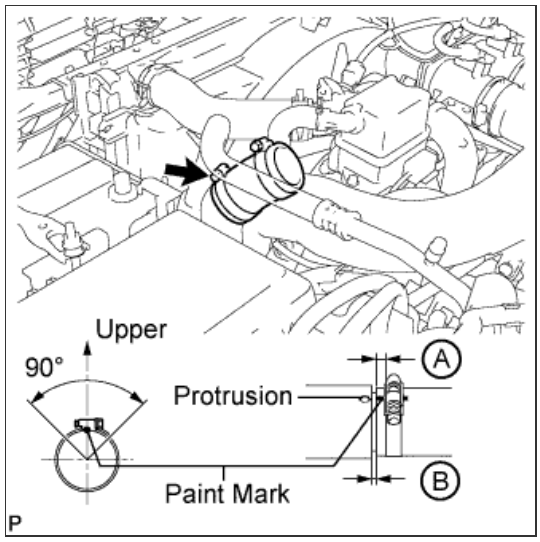
a. Connect the No. 2 air hose with the hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion and push in the air hose so that distance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that distance A is 2 to 6 mm (0.0787 to 0.236 in.).**

- **ake sure the direction of the hose clamp is as shown in the illustration.**



32. INSTALL NO. 3 AIR TUBE

a. Install the No. 3 air tube with the bolt.

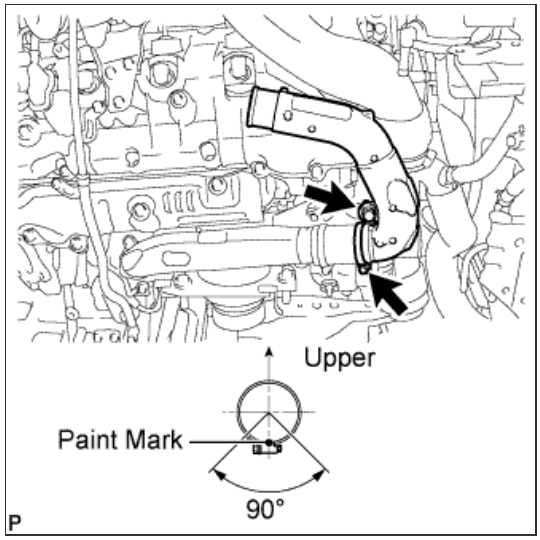
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

b. Tighten the hose clamp.

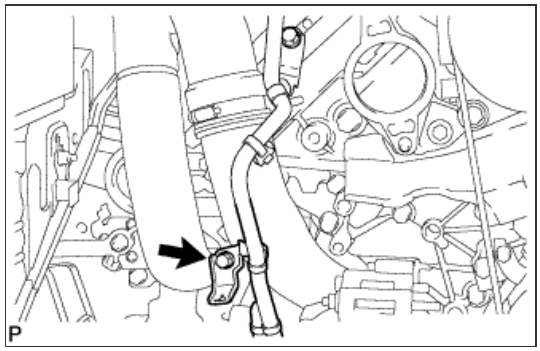
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

Make sure the direction of the hose clamp is as shown in the illustration.

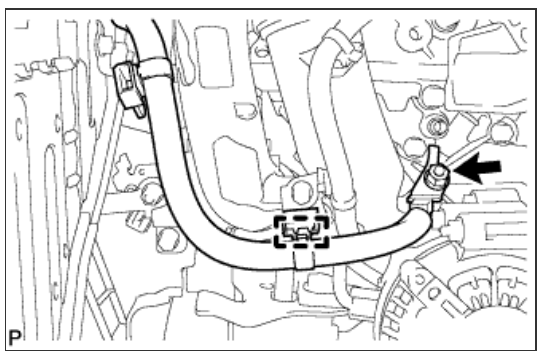


c. Install the wire harness bracket with the bolt.



d. Install the ground wire with the nut, and attach the wire harness clamp.

Torque:
8.4 N*m{ 87 kgf*cm , 74 in.*lbf }



33. INSTALL INTAKE AIR CONNECTOR

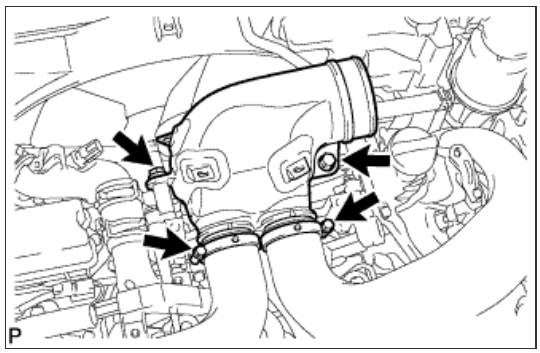
a. Connect the intake air connector to the No. 1 and No. 2 air cleaner pipes.

b. Install the connector with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Tighten the 2 hose clamps.

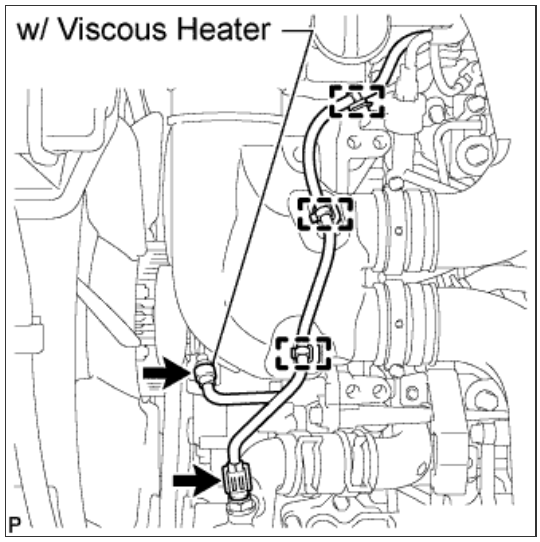
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



d. Attach the 3 wire harness clamps.

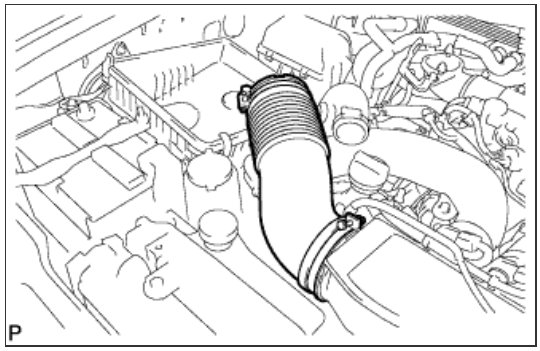
e. w/o Viscous Heater:
Connect the connector to the water temperature sensor.

f. w/ Viscous Heater:
Connect the 2 connectors to the water temperature sensor and viscous with magnet clutch heater.



34. TEMPORARILY INSTALL NO. 1 AIR CLEANER HOSE

a. Temporarily install the air cleaner hose to the intake air connector.

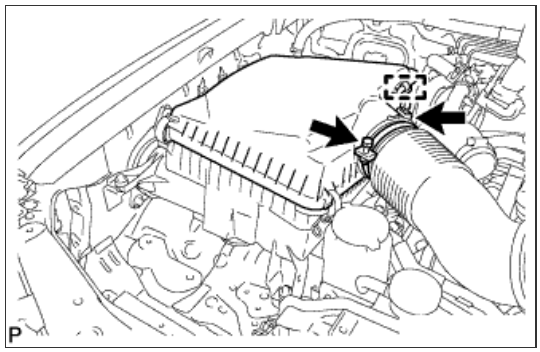


35. INSTALL AIR CLEANER CAP SUB-ASSEMBLY

a. Connect the air cleaner cap to the air cleaner hose, and install the air cleaner cap with the 4 clamps.

b. Connect the mass air flow meter connector and attach the wire harness clamp to the air cleaner cap.

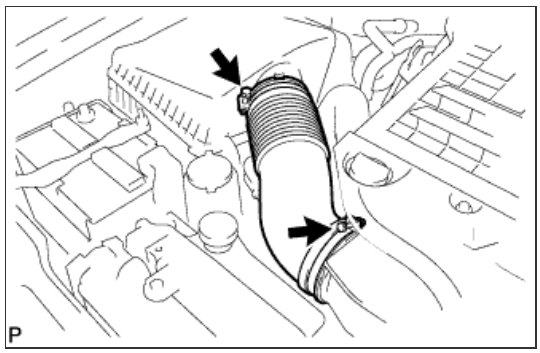
c. Attach the wire harness clamp.



d. Align the protrusion of air cleaner cap and concave portion of air cleaner hose.

e. Tighten the 2 hose clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



36. INSTALL DIESEL THROTTLE BODY ASSEMBLY LH

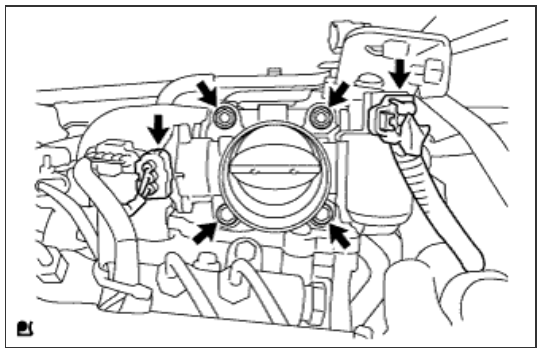
a. Install a new gasket to the intake pipe.

b. Install the throttle body with the 2 bolts and 2 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Connect the throttle position sensor connector.

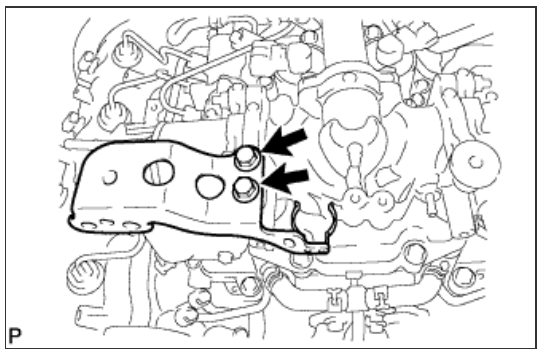
d. Connect the throttle motor connector.



37. INSTALL NO. 3 INTERCOOLER SUPPORT BRACKET

a. Install the bracket with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



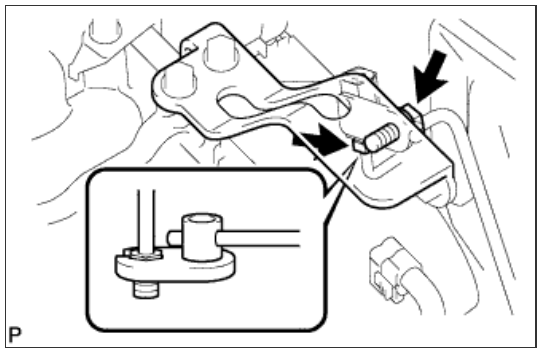
b. for Manual Transmission:

i. Connect the clutch tube to release cylinder 2 way with the bolt.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

ii. Check that the union nut is tightened to the specified torque.

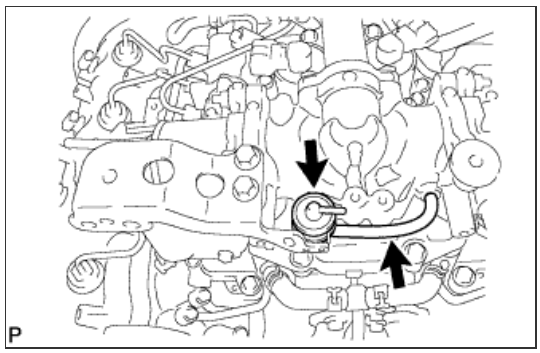
Torque:
without union nut wrench:
15 N*m{ 154 kgf*cm , 11 ft.*lbf }
with union nut wrench:
14 N*m{ 141 kgf*cm , 10 ft.*lbf }



38. INSTALL NO. 1 GAS FILTER

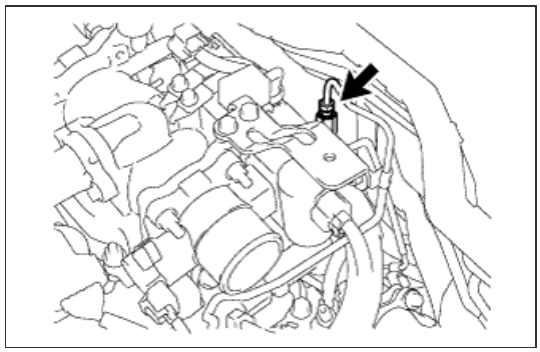
a. Install the gas filter.

b. Connect the hose to the intake pipe.



39. INSTALL TUBE CONNECTOR TO FLEXIBLE HOSE TUBE (for Manual Transmission)

a. Temporarily install the flare nut of the tube connector to fle ible hose tube to the clutch tube to release cylinder 2 way by hand.



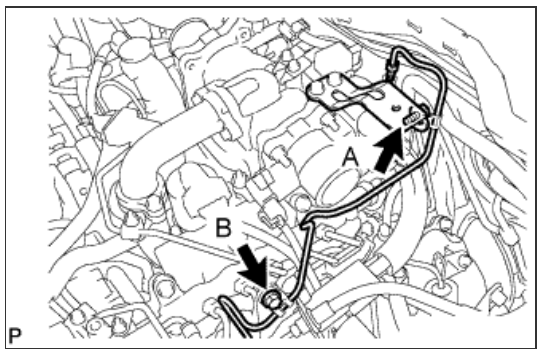
b. Temporarily install the tube connector to fle ible hose tube with the 2 bolts.

c. Tighten the bolt labeled A.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

NOTICE:

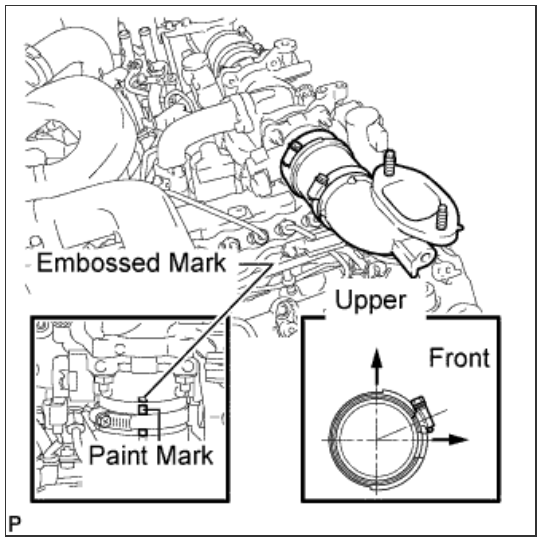
Tighten the bolt labeled B after installing the clutch hose.



40. INSTALL AIR TUBE SUB-ASSEMBLY LH

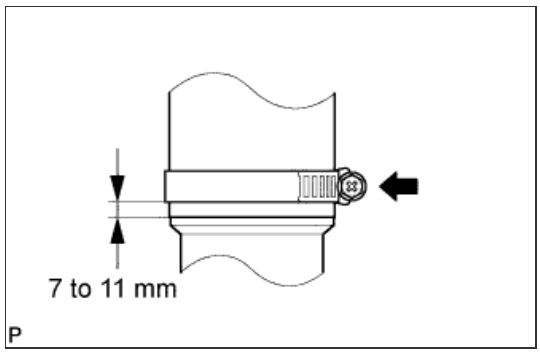
a. Install the air tube to the throttle body.

b. Align the embossed mark of the throttle body with the paint mark of the No. 4 air hose.



c. Tighten the hose clamp so that it is 7 to 11 mm (0.276 to 0.433 in.) from the end of the hose as shown in the illustration.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



41. INSTALL CLUTCH HOSE (for Manual Transmission)

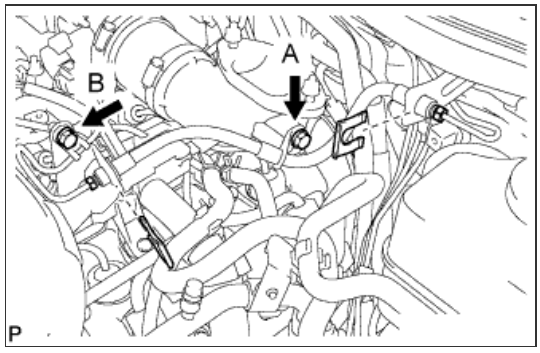
a. Connect the clutch hose to the air tube with the bolt labeled A.

b. Temporarily install the clutch hose to the clutch master cylinder tube to fle ible hose tube and tube connector to fle ible hose tube, and fi it in place with the 2 clips.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

c. Tighten the bolt labeled B.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }



d. Tighten the fle ible hose tube.

NOTICE:

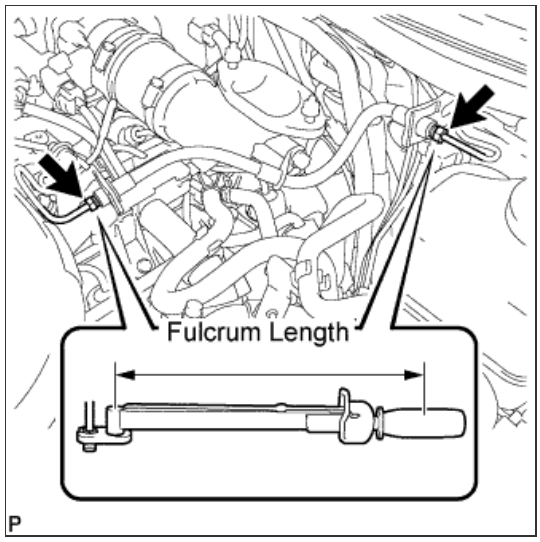
- **Do not bend or damage the flexible hose tube.**
- **Do not allow any foreign matter such as dirt and dust to enter the flexible hose tube from the connecting points.**

HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.). If using a torque wrench with a length that is not 30 cm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the "without SST" torque specification (Click here).**
- **Make sure union nut wrench and the wrench are connected in a straight line.**

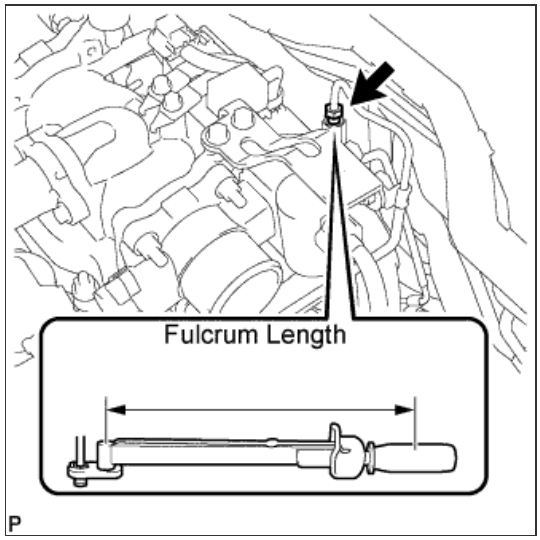
i. Using a 10 mm union nut wrench, tighten the 2 flare nuts of the fle ible hose tube.

Torque:
without union nut wrench:
15 N*m{ 154 kgf*cm , 11 ft.*lbf }
with union nut wrench:
14 N*m{ 141 kgf*cm , 10 ft.*lbf }



ii. Using a 10 mm union nut wrench, tighten the flare nut of the fle ible hose tube.

Torque:
without union nut wrench:
15 N*m{ 154 kgf*cm , 11 ft.*lbf }
with union nut wrench:
14 N*m{ 141 kgf*cm , 10 ft.*lbf }



42. INSTALL DIESEL THROTTLE BODY ASSEMBLY RH

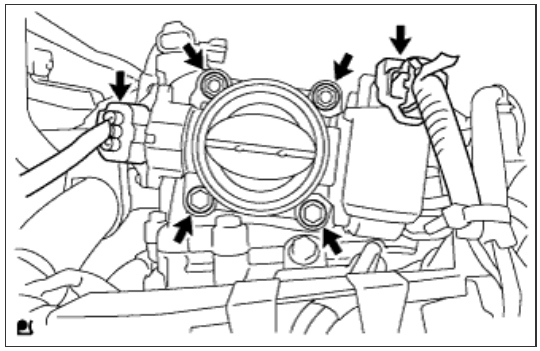
a. Install a new gasket to the intake pipe.

b. Install the throttle body with the 2 bolts and 2 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Connect the throttle position sensor connector.

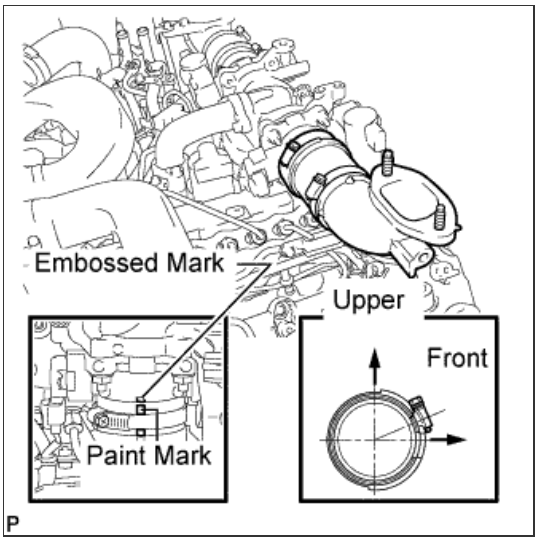
d. Connect the throttle motor connector.



43. INSTALL AIR TUBE SUB-ASSEMBLY RH

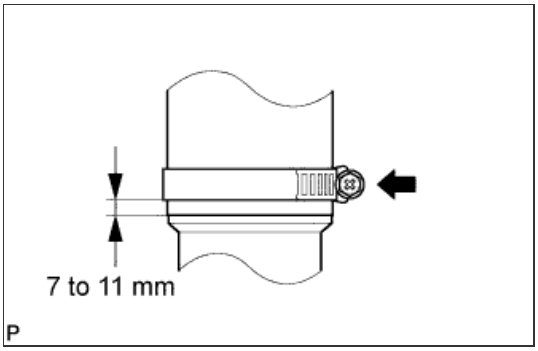
a. Install the air tube to the throttle body.

b. Align the embossed mark of the throttle body with the paint mark of the No. 4 air hose.



c. Tighten the hose clamp so that it is 7 to 11 mm (0.276 to 0.433 in.) from the end of the hose as shown in the illustration.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



44. INSTALL NO. 2 ENGINE OIL LEVEL DIPSTICK GUIDE

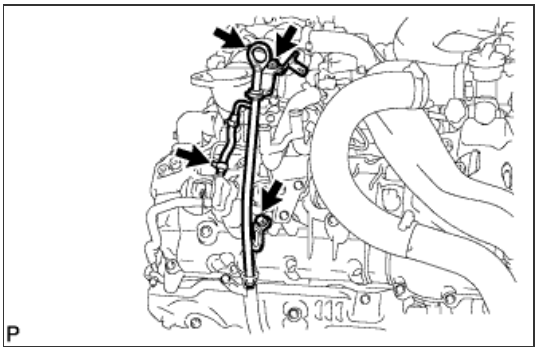
a. Apply a light coat of engine oil to a new O-ring.

b. Install the O-ring to the No. 2 engine oil level dipstick guide.

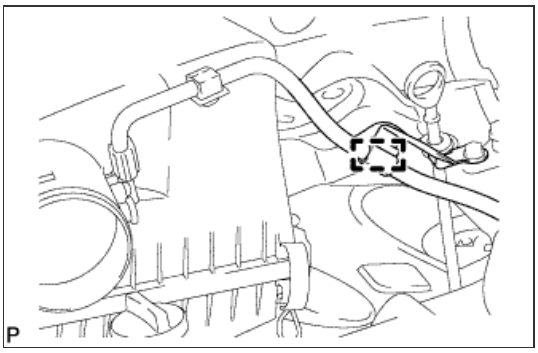
c. Install the No. 2 engine oil level dipstick guide with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

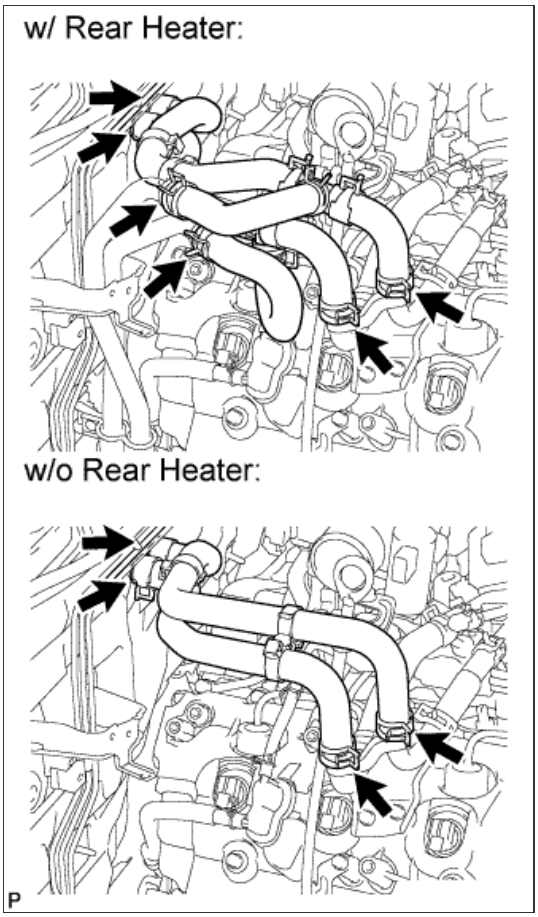
d. Connect the ventilation hose to the cylinder head cover RH.



e. Connect the wire harness clamp to the No. 2 engine oil level dipstick guide bracket.



45. CONNECT WATER HOSE SUB-ASSEMBLY

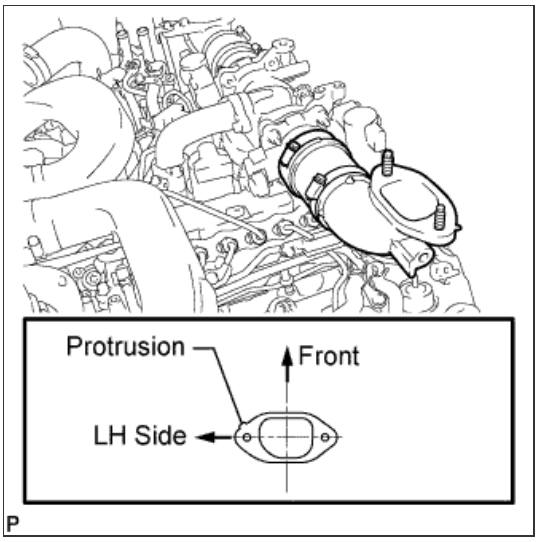


4 . INSTALL NO. 2 COOL AIR INLET (w/o Intercooler)

a. Install a new gasket to the air tube LH.

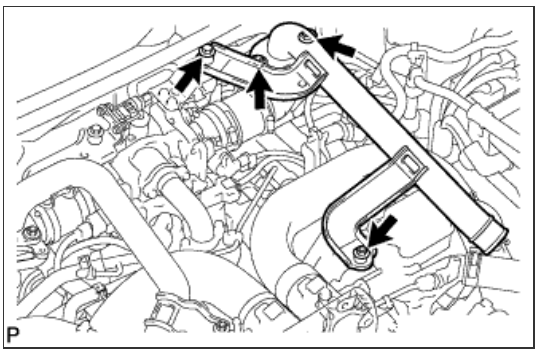
HINT:

Install the gasket with the protrusion facing as shown in the illustration.



b. Install the No. 2 cool air inlet with the 3 nuts and bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



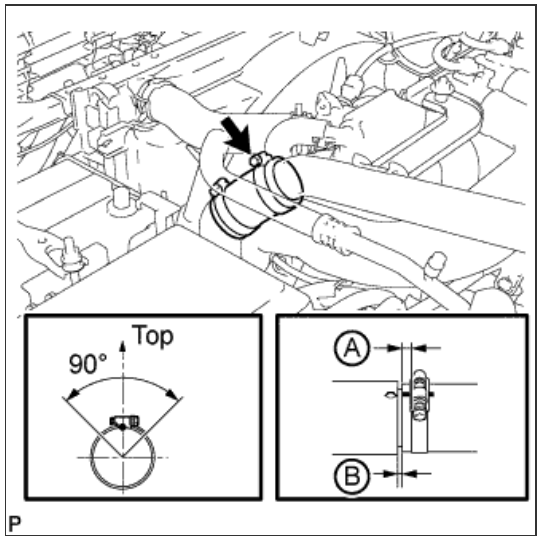
c. Connect the No. 2 air hose to the No. 2 cool air inlet.

d. Tighten the No. 2 air hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion and push on the air hose so that distance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that distance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make sure the direction of the hose clamp is as shown in the illustration.**

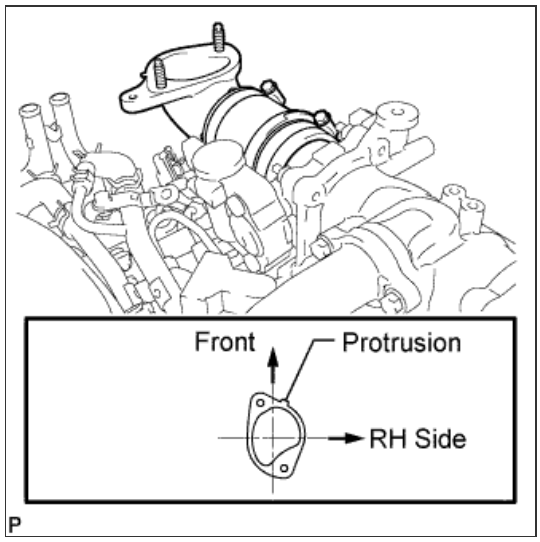


47. INSTALL NO. 1 COOL AIR INLET (w/o Intercooler)

a. Install a new gasket to the air tube RH.

HINT:

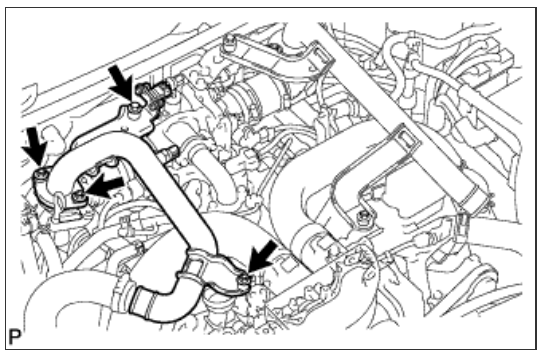
Install the gasket with the protrusion facing as shown in the illustration.



b. Install the No. 1 cool air inlet with the 3 nuts and bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Connect the vacuum hose, intake air temperature sensor connector and turbo pressure sensor connector.



d. Connect the No. 1 air hose to the No. 1 cool air inlet.

e. Tighten the No. 1 air hose clamp.

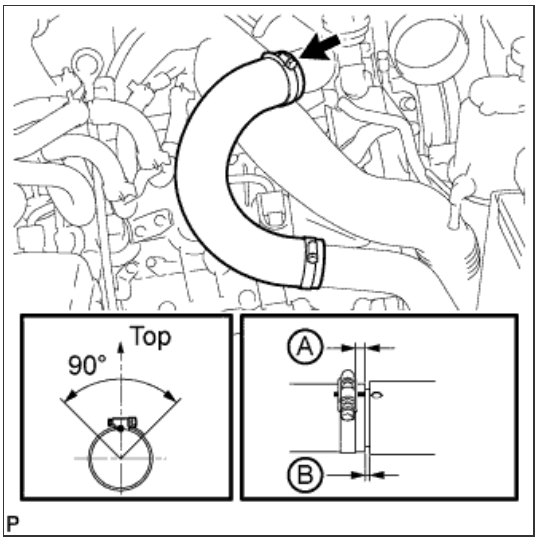
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion and push on the air hose so that distance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that distance A is 2 to 6 mm (0.0787 to**

0.236 in.).

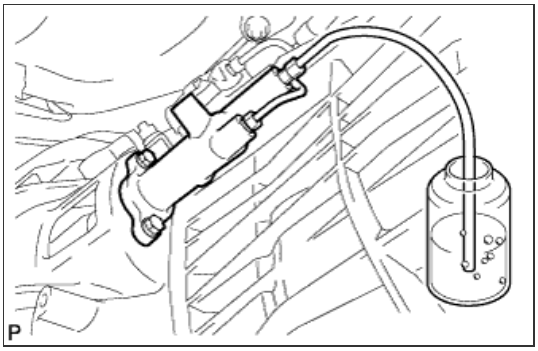
- **Make sure the direction of the hose clamp is as shown in the illustration.**



48. INSTALL INTERCOOLER ASSEMBLY (w/ Intercooler)

a. Install the intercooler assembly (Click here).

49. BLEED CLUTCH LINE (for Manual Transmission)



a. Remove the release cylinder bleeder plug cap.

b. Connect a vinyl tube to the bleeder plug.

c. Depress the clutch pedal several times, and then loosen the bleeder plug while the pedal is depressed.

d. When fluid no longer comes out, tighten the bleeder plug, and then release the clutch pedal.

e. Repeat the previous 2 steps until all the air in the fluid is completely bled.

f. Tighten the bleeder plug.

Torque:
11 N*m{ 110 kgf*cm , 8 ft.*lbf }

g. Install the bleeder plug cap.

h. Check that all the air has been bled from the clutch line.

50. INSPECT FOR CLUTCH FLUID LEAK (for Manual Transmission)

51. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

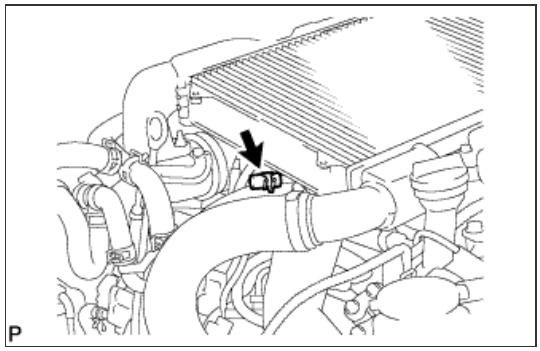
a. Connect the cables to the negative (-) main battery and sub-battery terminals.

52. REGISTER INJECTOR COMPENSATION CODE

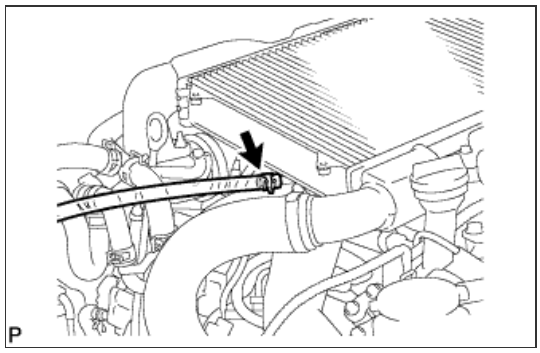
a. Register the injector compensation code (Click here).

53. ADD ENGINE COOLANT

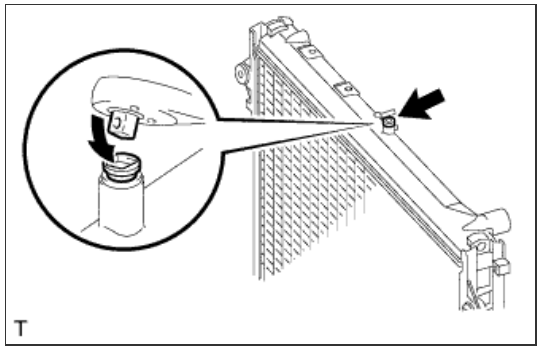
a. Remove the engine air bleed cap.



b. Connect a clear hose to the engine air bleed pipe.



c. Using a wrench, remove the vent plug.



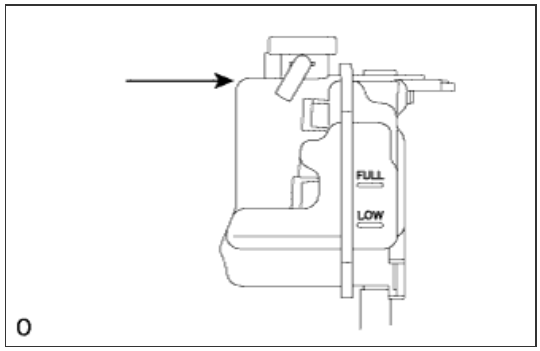
d. Fill the radiator with TOYOTA SLLC to the radiator reservoir filler neck.

HINT:

Pour TOYOTA SLLC until it spills out of the engine air bleed pipe.

Standard Capacity (for Automatic Transmission):

Item	Specified Condition
Front heater only	14.8 liters (15.6 US qts, 13.0 Imp. qts)
Front heater and rear heater	17.6 liters (18.6 US qts, 15.5 Imp. qts)
Front heater with viscous heater	15.2 liters (16.1 US qts, 13.4 Imp. qts)
Front heater and rear heater with viscous heater	18.0 liters (19.0 US qts, 15.4 Imp. qts)



Standard capacity (for Manual Transmission):
15.4 liters (16.3 US qts, 13.6 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical

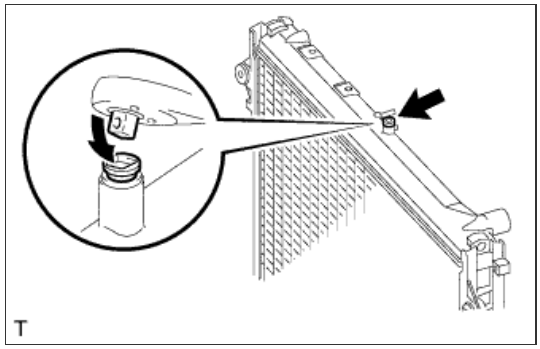
problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

e. Install the vent plug.

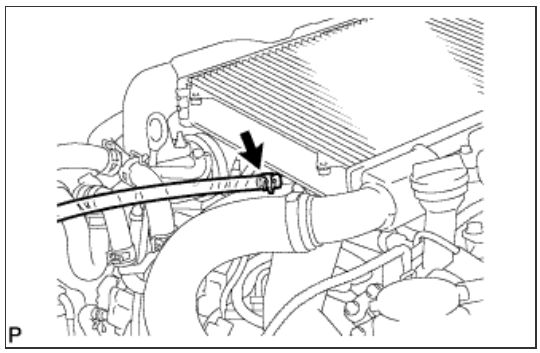
Torque:
2.0 N*m{ 20 kgf*cm , 18 in.*lbf }

NOTICE:

Do not tighten the plug to 5.0 N*m (51 kgf*cm, 44 in.*lbf) or more, as the plug will be damaged.



f. Disconnect the clear hose from the engine air bleed pipe.



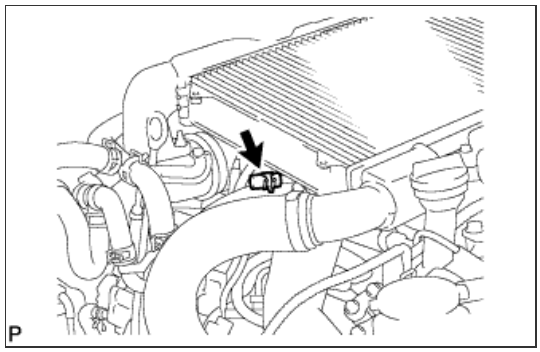
g. Install the engine air bleed cap when coolant comes out.

h. Install the radiator reservoir cap.

i. Start the engine.

NOTICE:

Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the FULL line.



j. Maintain an engine speed of 3000 rpm for appro imately 10 minutes so that the thermostat opens and air bleeding is performed.

CAUTION:

When pressing the radiator hoses:

- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the radiator fan**

NOTICE:

- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**

HINT:

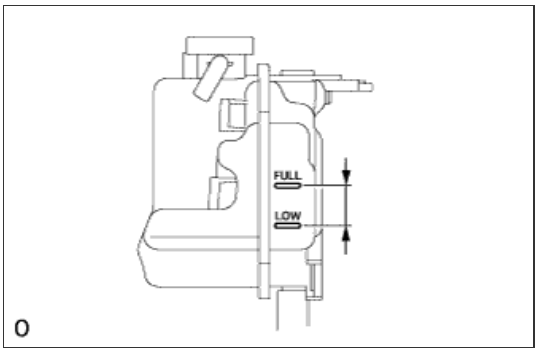
The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

k. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

l. Check that the coolant level is between the FULL and LOW lines.
If the coolant level is above the FULL line, drain coolant so that the coolant level is between the FULL and LOW lines.



54. INSPECT FOR ENGINE COOLANT LEAKS

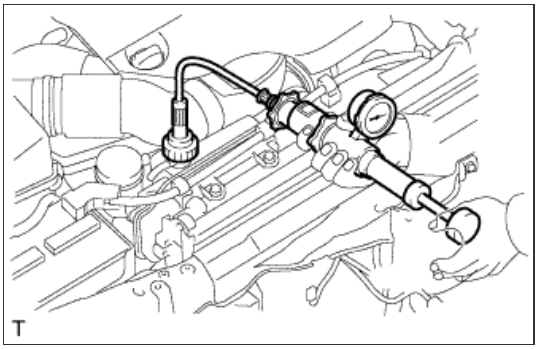
CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester to the radiator reservoir.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 17.8 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks.
If no e ternal leaks are found, check the cylinder block and cylinder head.



55. INSPECT FOR FUEL LEAK

a. Perform Active Test.

i. Connect the intelligent tester to the DLC3.

ii. Turn the ignition switch to ON.

iii. Start the engine.

iv. Turn the intelligent tester ON.

v. Enter the following menus: Powertrain / Engine / Active Test.

vi. Perform the Active Test.

Tester Display	Test Detail	Control Range	Diagnostic Note
Test the Fuel Leak	Pressurizes fuel inside common rail and checks for fuel leaks	Stop/Start	• The fuel inside the common rail is pressurized to the specified value and the engine speed increases to 2000 rpm when Start is selected. • The above conditions are preserved while Start is selected.

5 . INSPECT FOR OIL LEAK

a. Warm up the engine and check for an engine oil leak.

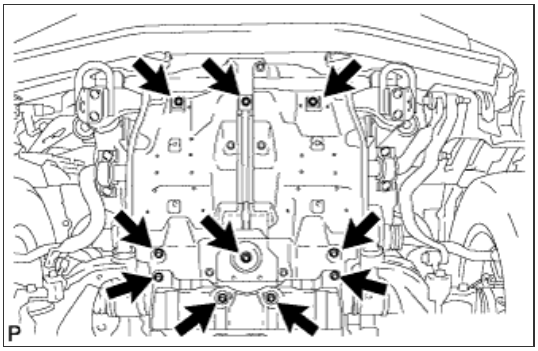
57. INSTALL UPPER RADIATOR SUPPORT SEAL

a. Install the upper radiator support seal with the 7 clips.

58. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

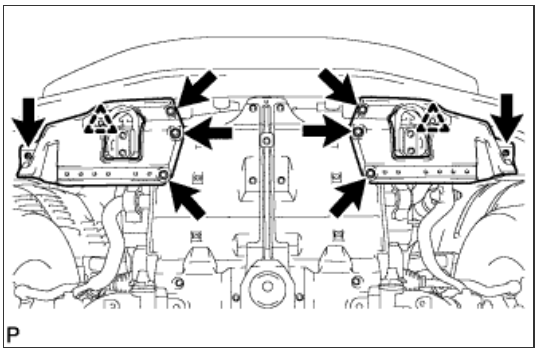
a. Install the engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



59. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

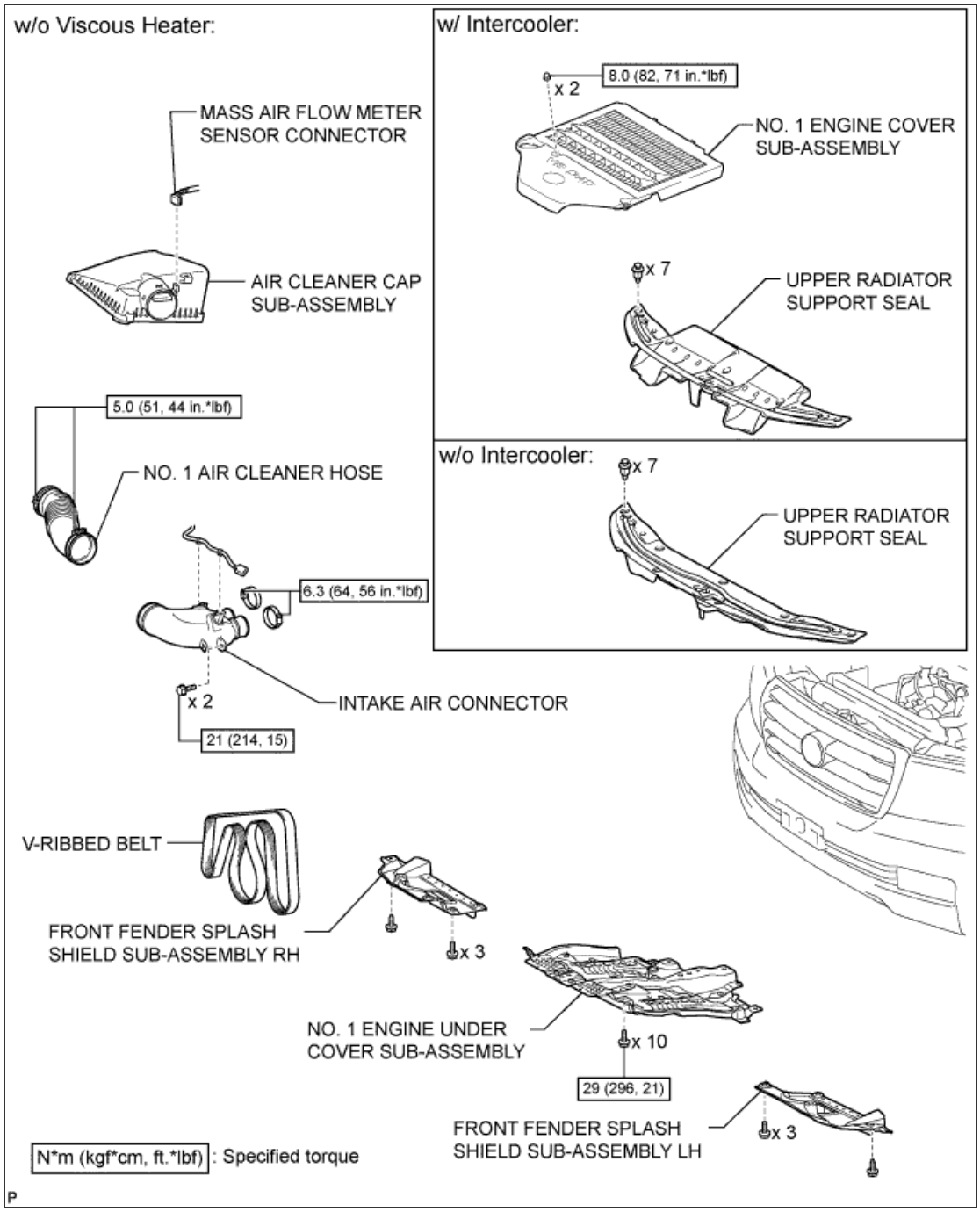
a. Install the splash shield with the clip, and then install the 3 bolts and screw.

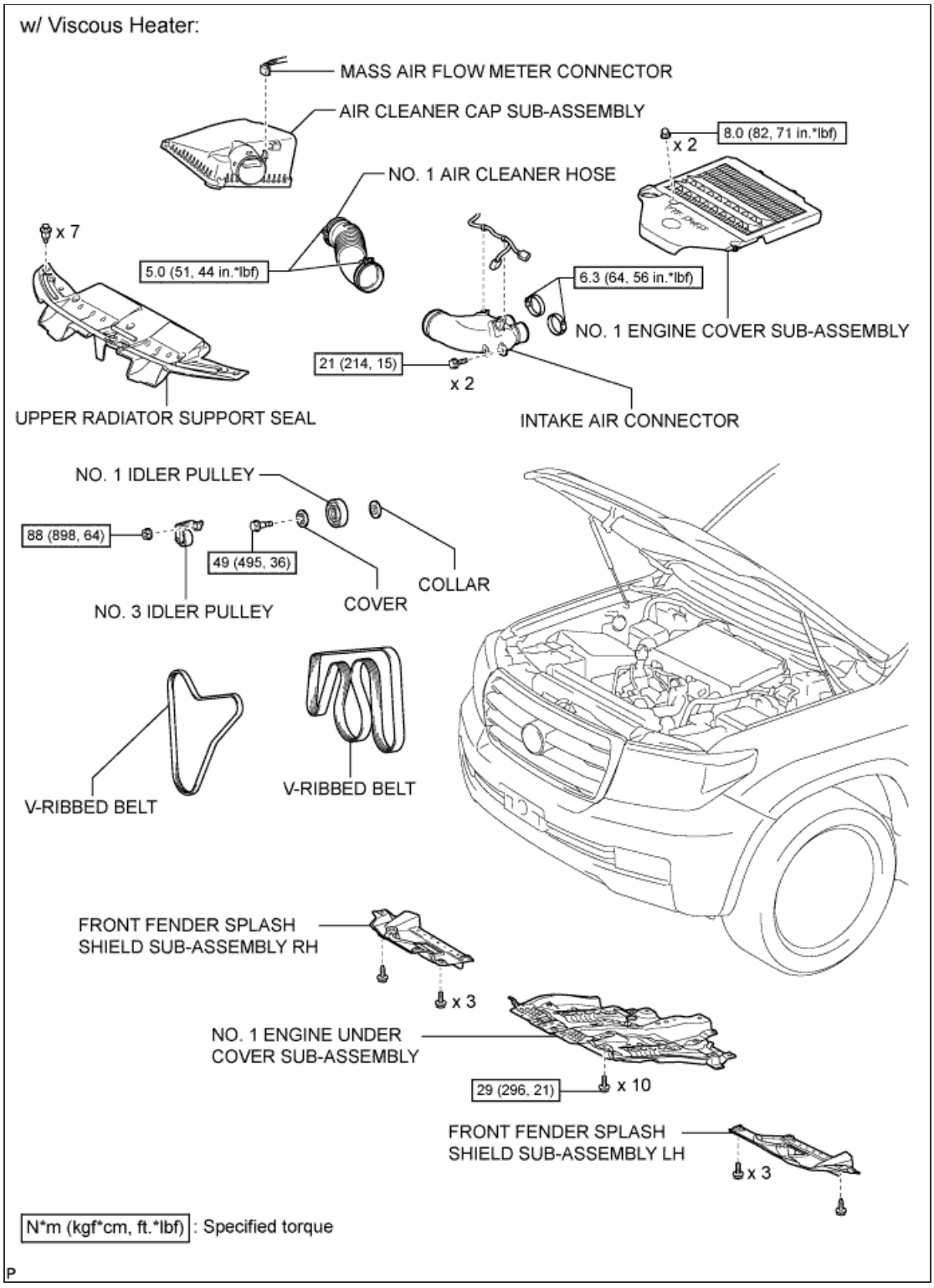


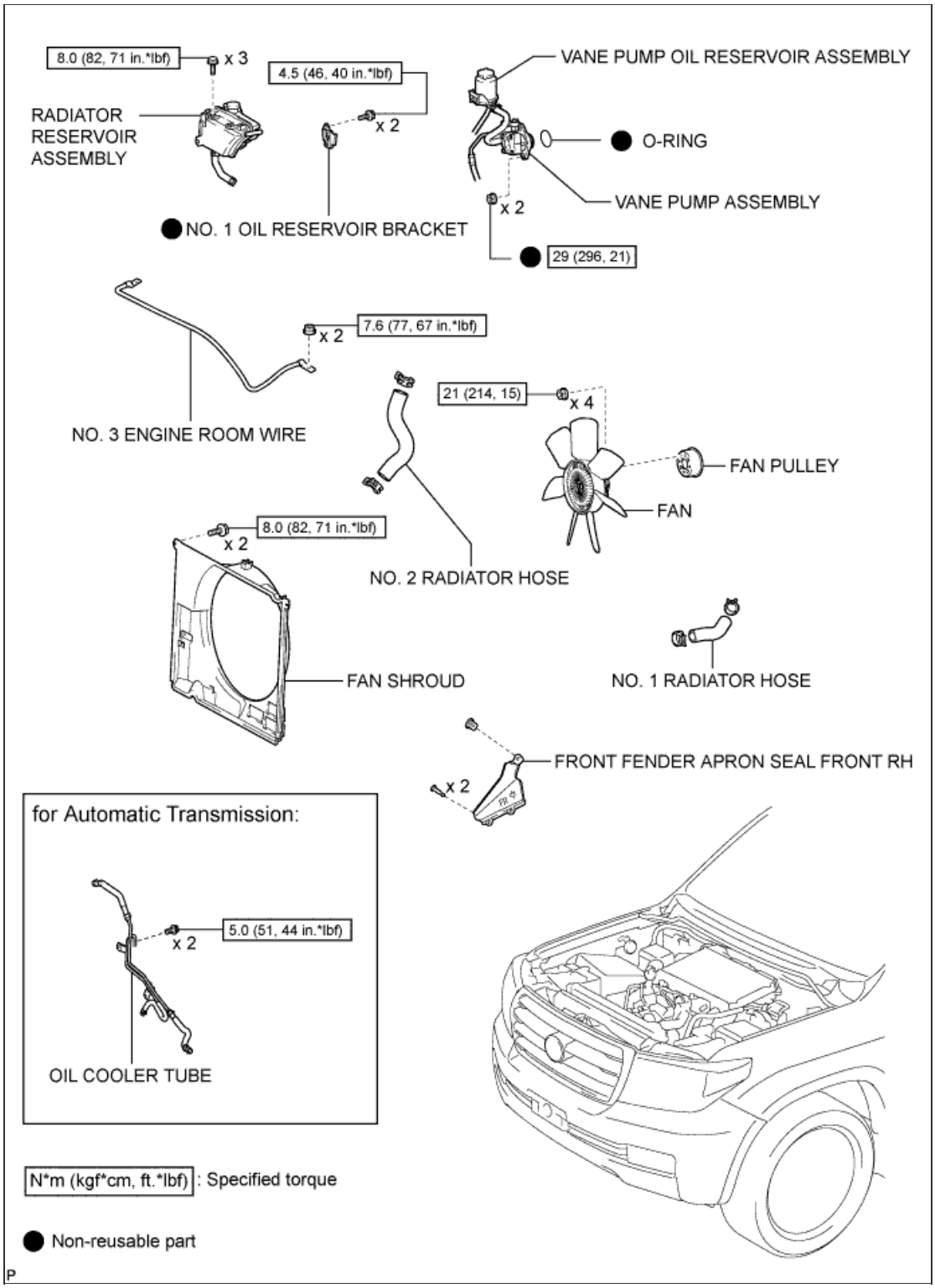
60. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Install the splash shield with the clip, and then install the 3 bolts and screw.

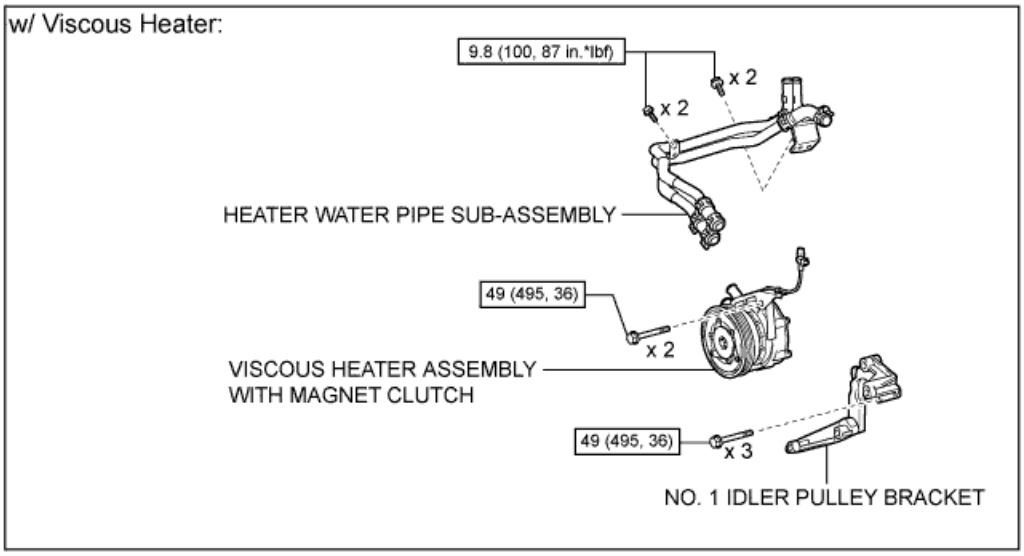
for Preparation Click here

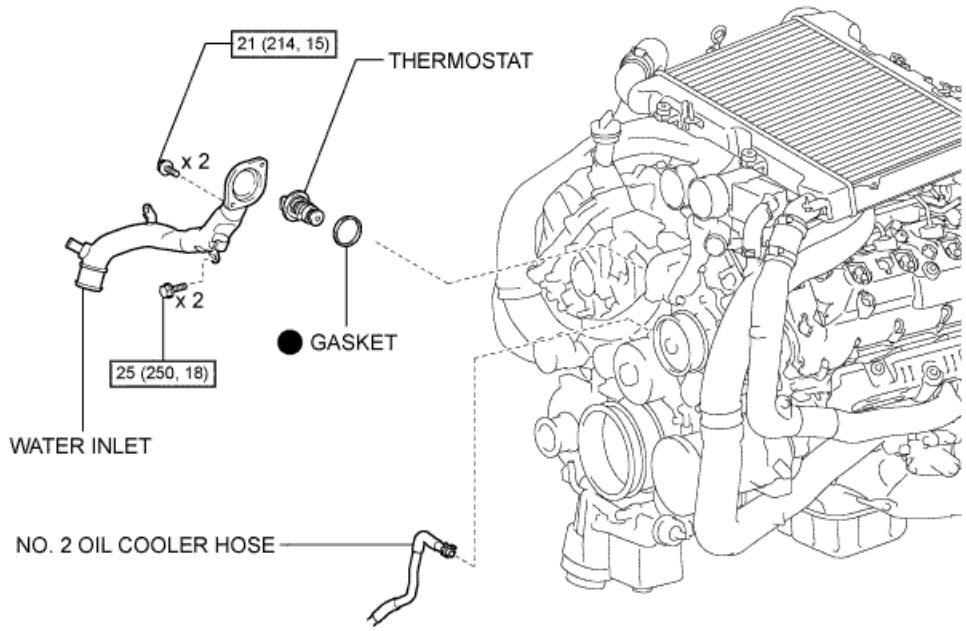



w/ Viscous Heater:
MASS AIR FLOW METER CONNECTOR
AIR CLEANER CAP SUB-ASSEMBLY
8.0 (82, 71 in.*lbf)
x 2
NO. 1 AIR CLEANER HOSE
x 7
5.0 (51, 44 in.*lbf)
6.3 (64, 56 in.*lbf)
NO. 1 ENGINE COVER SUB-ASSEMBLY
21 (214, 15)
x 2
UPPER RADIATOR SUPPORT SEAL
INTAKE AIR CONNECTOR
NO. 1 IDLER PULLEY
88 (898, 64)
49 (495, 36)
COLLAR
COVER
NO. 3 IDLER PULLEY
V-RIBBED BELT
V-RIBBED BELT
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH
x 3
NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY
29 (296, 21)
x 10
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH
x 3
N*m (kgf*cm, ft.*lbf) : Specified torque
P


8.0 (82, 71 in.*lbf)
x 3
4.5 (46, 40 in.*lbf)
x 2
RADIATOR RESERVOIR ASSEMBLY
NO. 1 OIL RESERVOIR BRACKET
VANE PUMP OIL RESERVOIR ASSEMBLY
O-RING
VANE PUMP ASSEMBLY
x 2
29 (296, 21)
7.6 (77, 67 in.*lbf)
x 2
NO. 3 ENGINE ROOM WIRE
21 (214, 15)
x 4
FAN PULLEY
FAN
8.0 (82, 71 in.*lbf)
x 2
NO. 2 RADIATOR HOSE
FAN SHROUD
NO. 1 RADIATOR HOSE
FRONT FENDER APRON SEAL FRONT RH
x 2
for Automatic Transmission:
5.0 (51, 44 in.*lbf)
x 2
OIL COOLER TUBE
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P

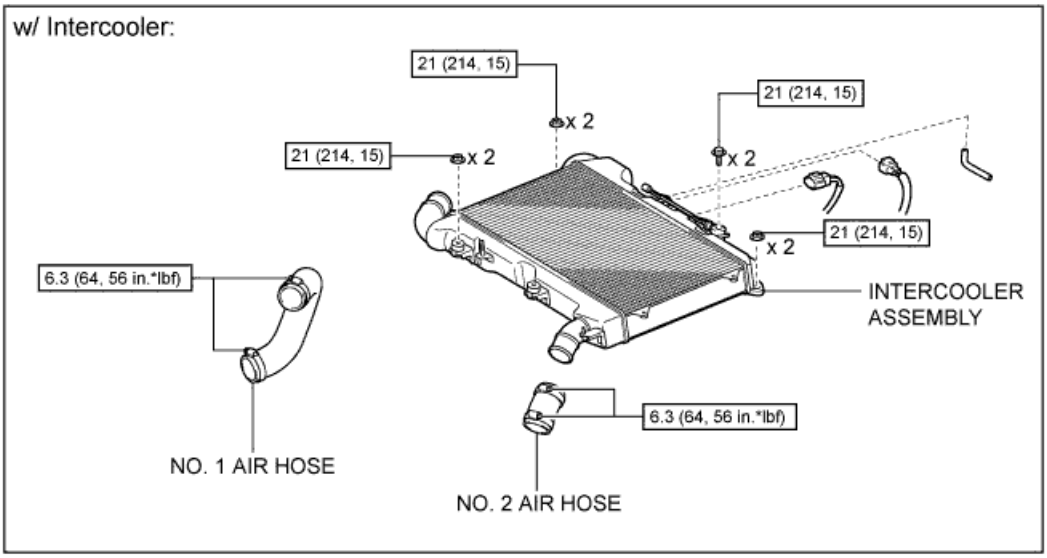


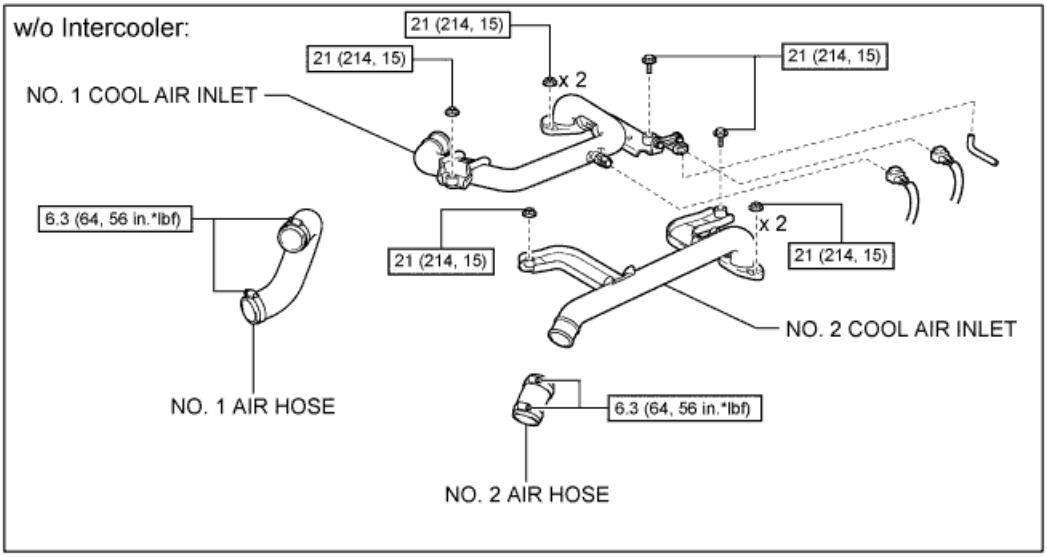


N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P

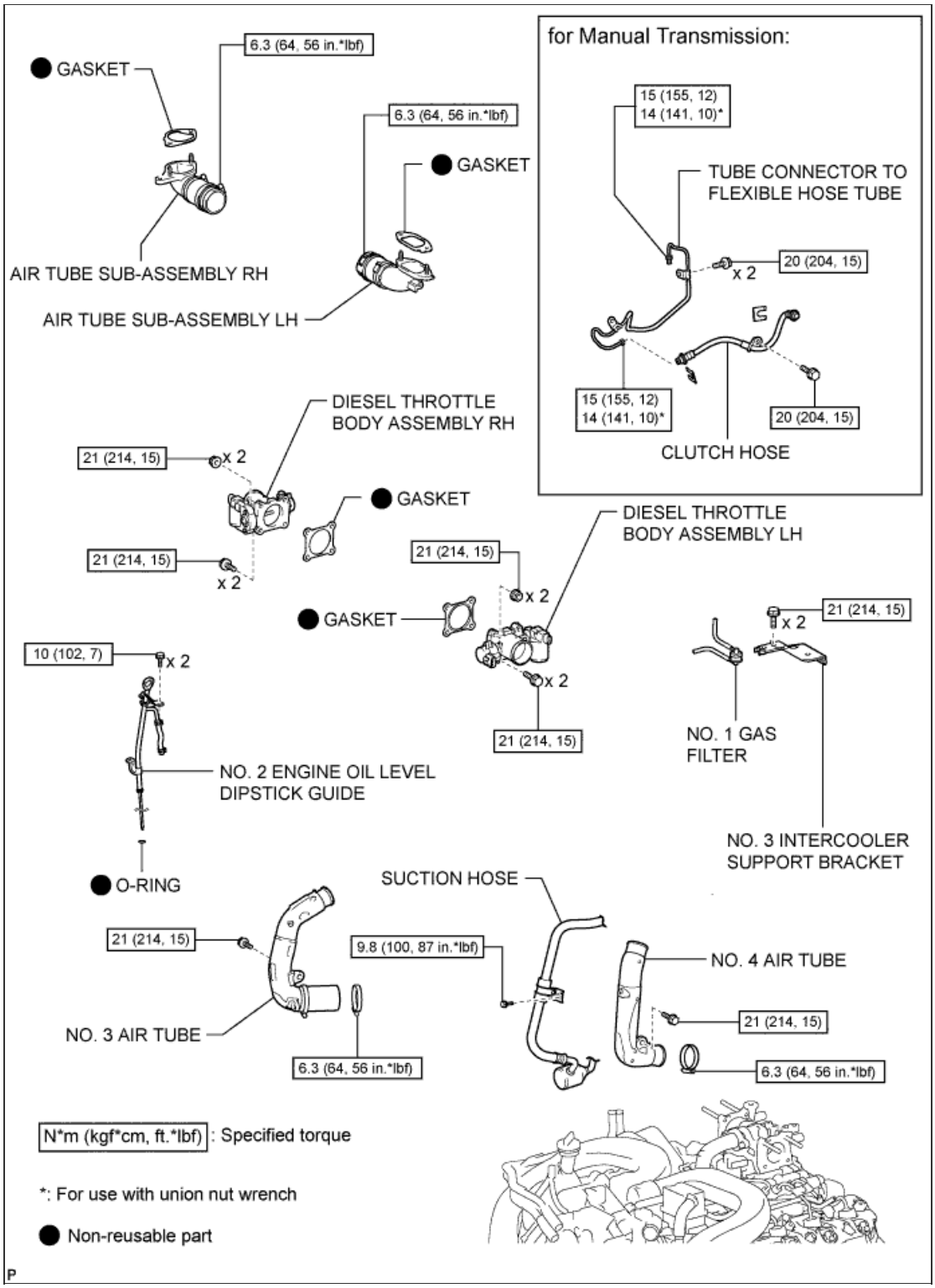


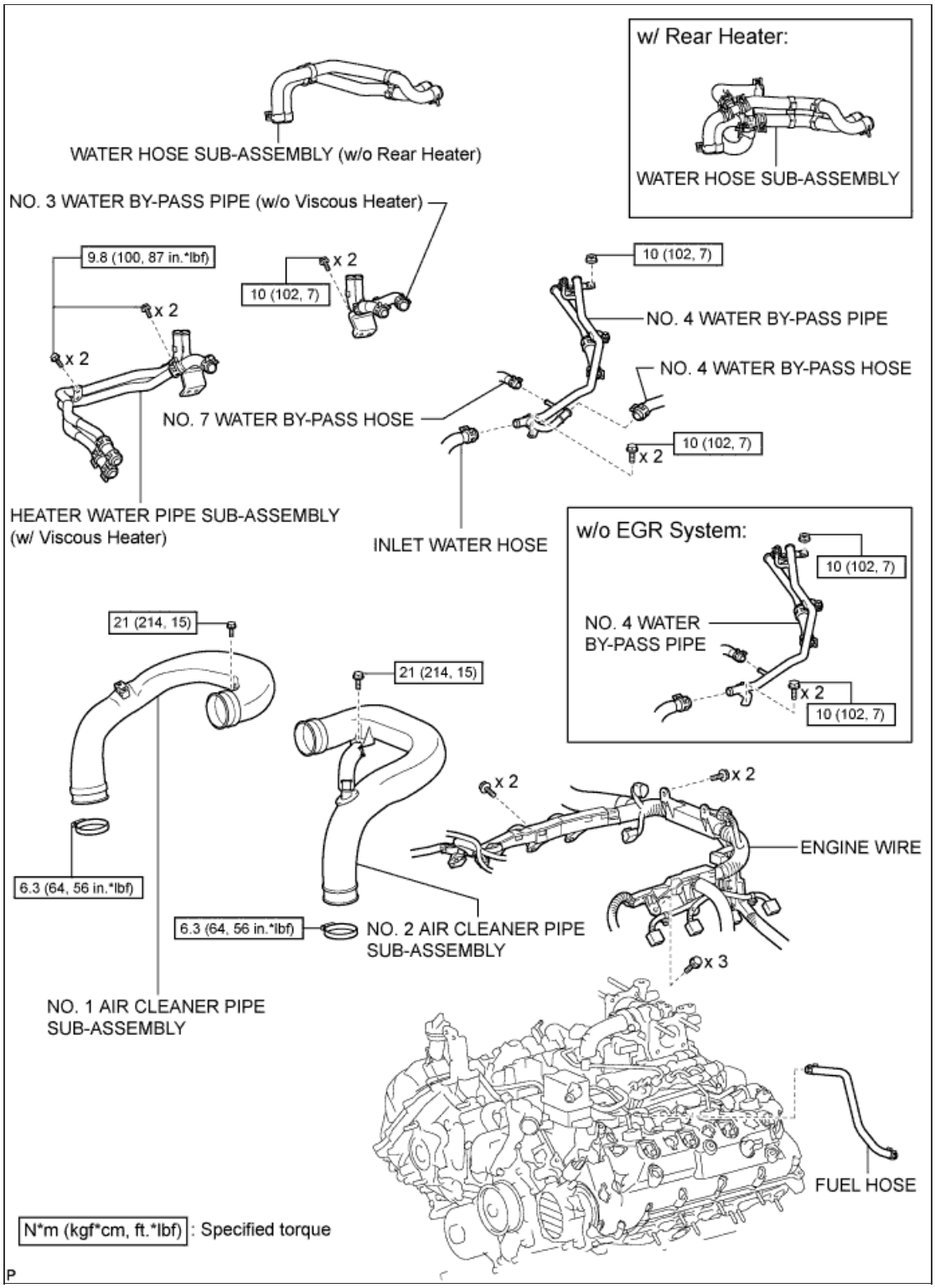


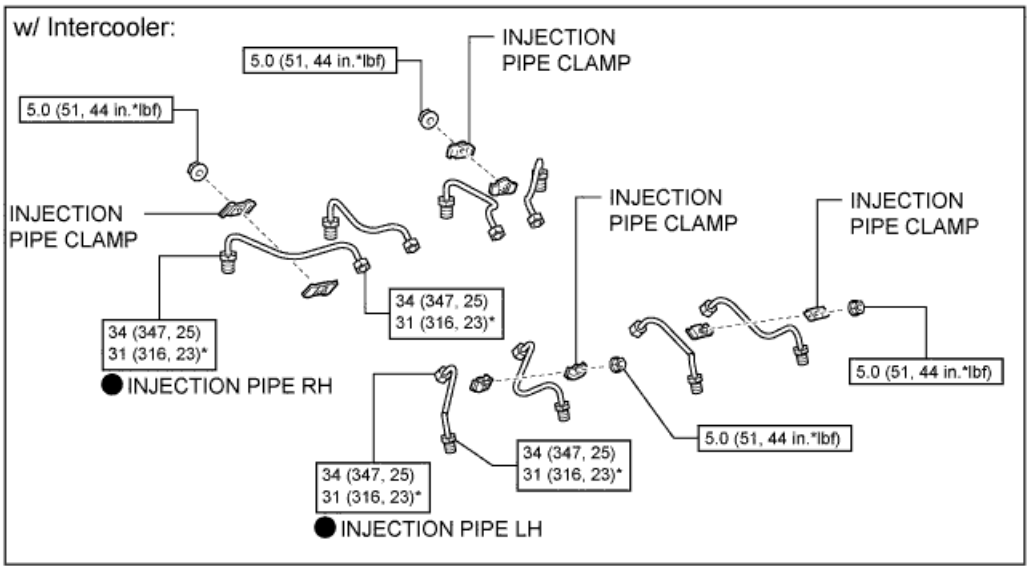


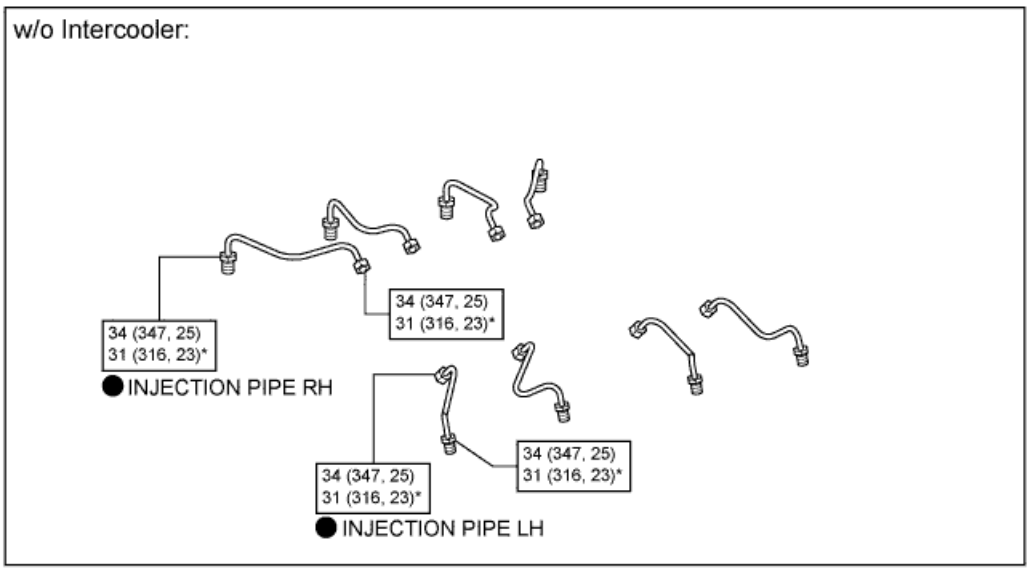
N*m (kgf*cm, ft.*lbf) : Specified torque

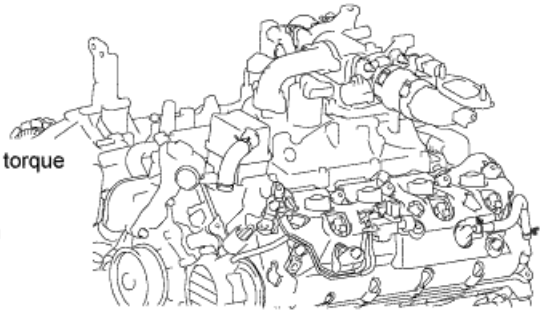
P


GASKET
6.3 (64, 56 in.*lbf)
AIR TUBE SUB-ASSEMBLY RH
6.3 (64, 56 in.*lbf)
GASKET
AIR TUBE SUB-ASSEMBLY LH
for Manual Transmission:
15 (155, 12)
14 (141, 10)*
TUBE CONNECTOR TO FLEXIBLE HOSE TUBE
20 (204, 15)
x 2
15 (155, 12)
14 (141, 10)*
20 (204, 15)
CLUTCH HOSE
DIESEL THROTTLE BODY ASSEMBLY RH
21 (214, 15)
x 2
GASKET
21 (214, 15)
x 2
21 (214, 15)
x 2
GASKET
DIESEL THROTTLE BODY ASSEMBLY LH
x 2
21 (214, 15)
21 (214, 15)
x 2
10 (102, 7)
x 2
NO. 2 ENGINE OIL LEVEL DIPSTICK GUIDE
O-RING
NO. 1 GAS FILTER
NO. 3 INTERCOOLER SUPPORT BRACKET
SUCTION HOSE
21 (214, 15)
NO. 3 AIR TUBE
6.3 (64, 56 in.*lbf)
9.8 (100, 87 in.*lbf)
NO. 4 AIR TUBE
21 (214, 15)
6.3 (64, 56 in.*lbf)
N*m (kgf*cm, ft.*lbf): Specified torque
*: For use with union nut wrench
Non-reusable part
P


w/ Rear Heater:
WATER HOSE SUB-ASSEMBLY
WATER HOSE SUB-ASSEMBLY (w/o Rear Heater)
NO. 3 WATER BY-PASS PIPE (w/o Viscous Heater)
9.8 (100, 87 in.*lbf)
x 2
x 2
10 (102, 7)
x 2
HEATER WATER PIPE SUB-ASSEMBLY
(w/ Viscous Heater)
NO. 7 WATER BY-PASS HOSE
10 (102, 7)
NO. 4 WATER BY-PASS PIPE
NO. 4 WATER BY-PASS HOSE
10 (102, 7)
x 2
INLET WATER HOSE
w/o EGR System:
10 (102, 7)
NO. 4 WATER
BY-PASS PIPE
x 2
10 (102, 7)
21 (214, 15)
21 (214, 15)
x 2
x 2
ENGINE WIRE
6.3 (64, 56 in.*lbf)
6.3 (64, 56 in.*lbf)
NO. 2 AIR CLEANER PIPE
SUB-ASSEMBLY
x 3
NO. 1 AIR CLEANER PIPE
SUB-ASSEMBLY
FUEL HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
P





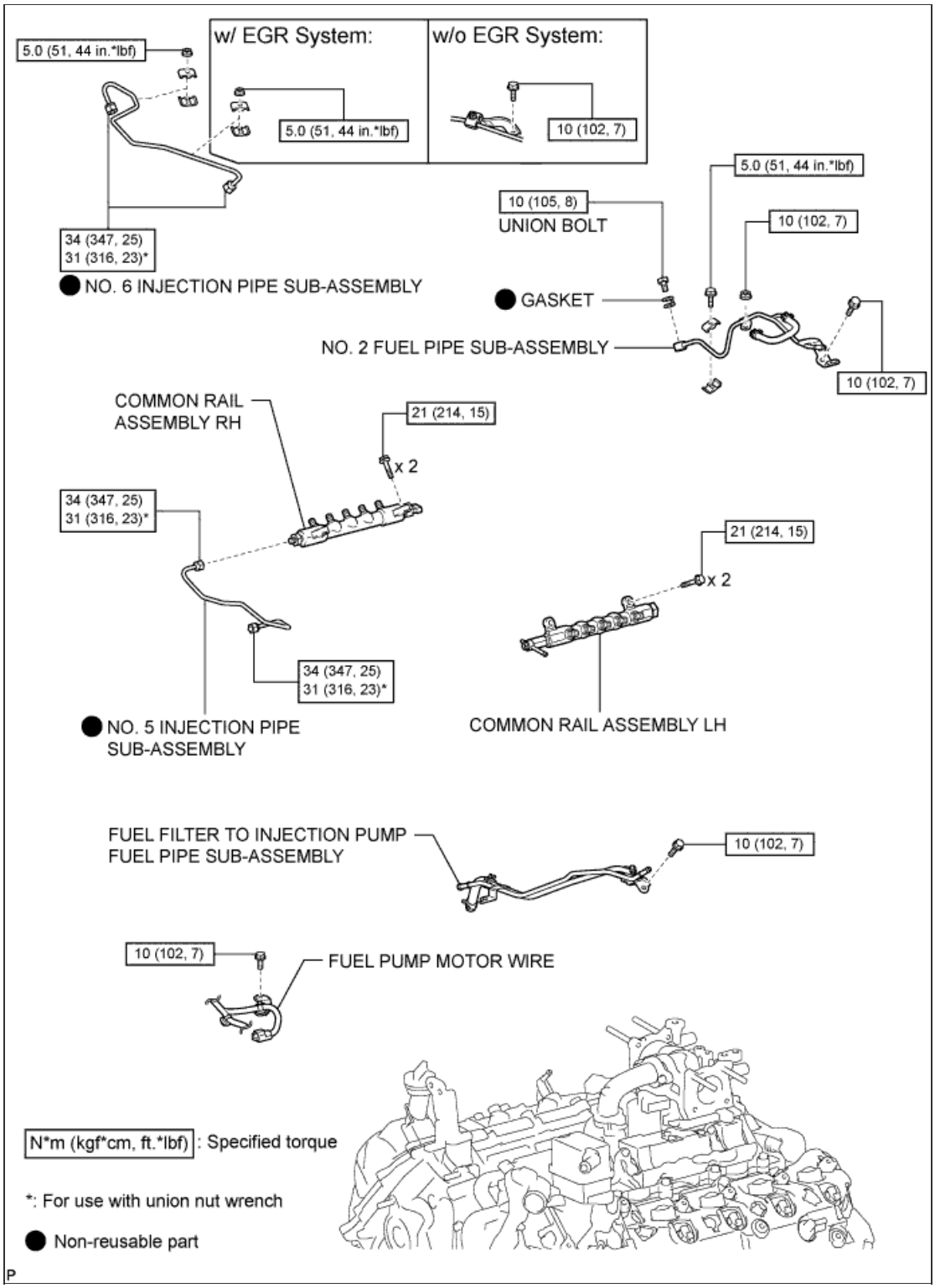


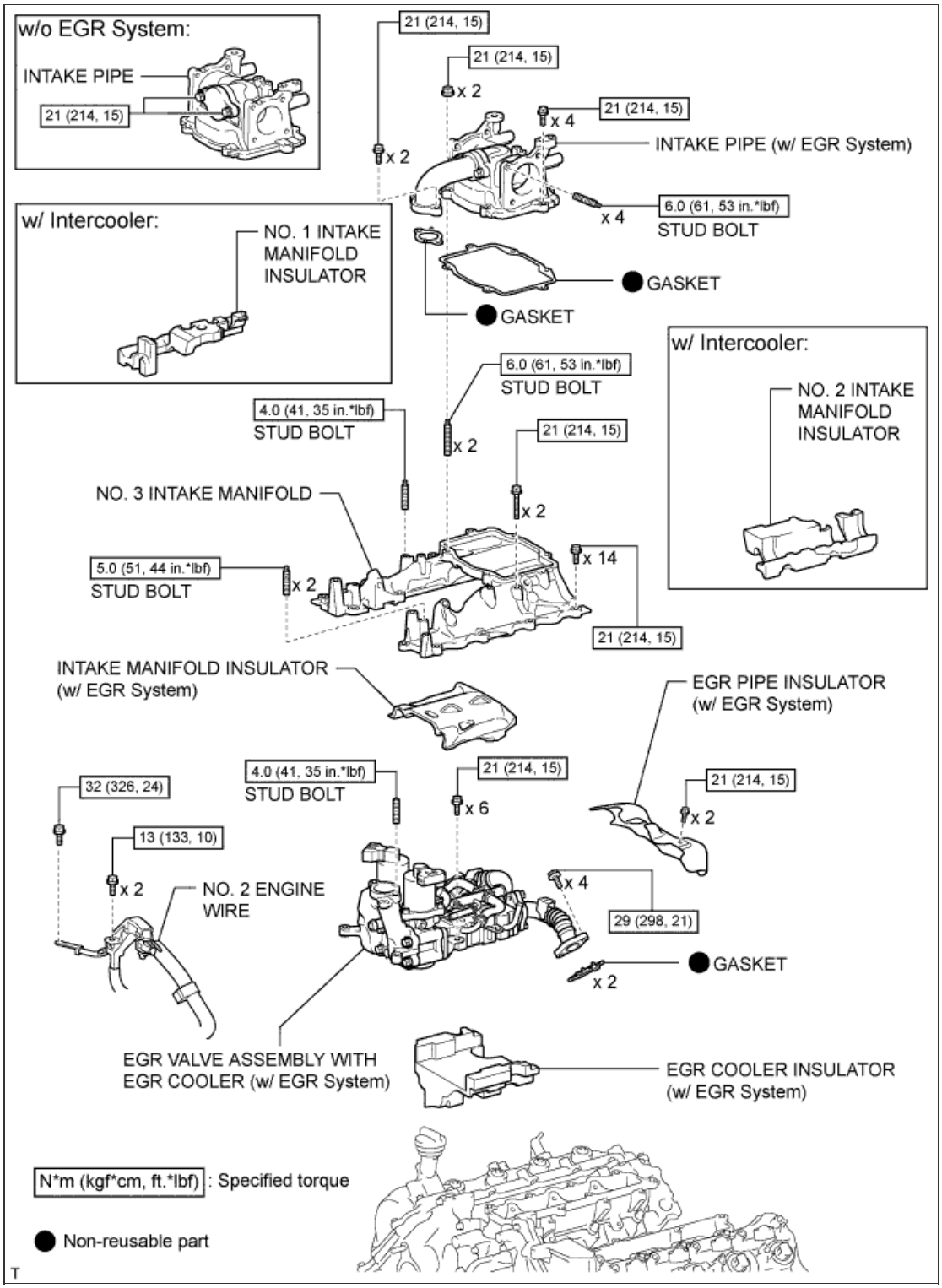
N*m (kgf*cm, ft.*lbf): Specified torque

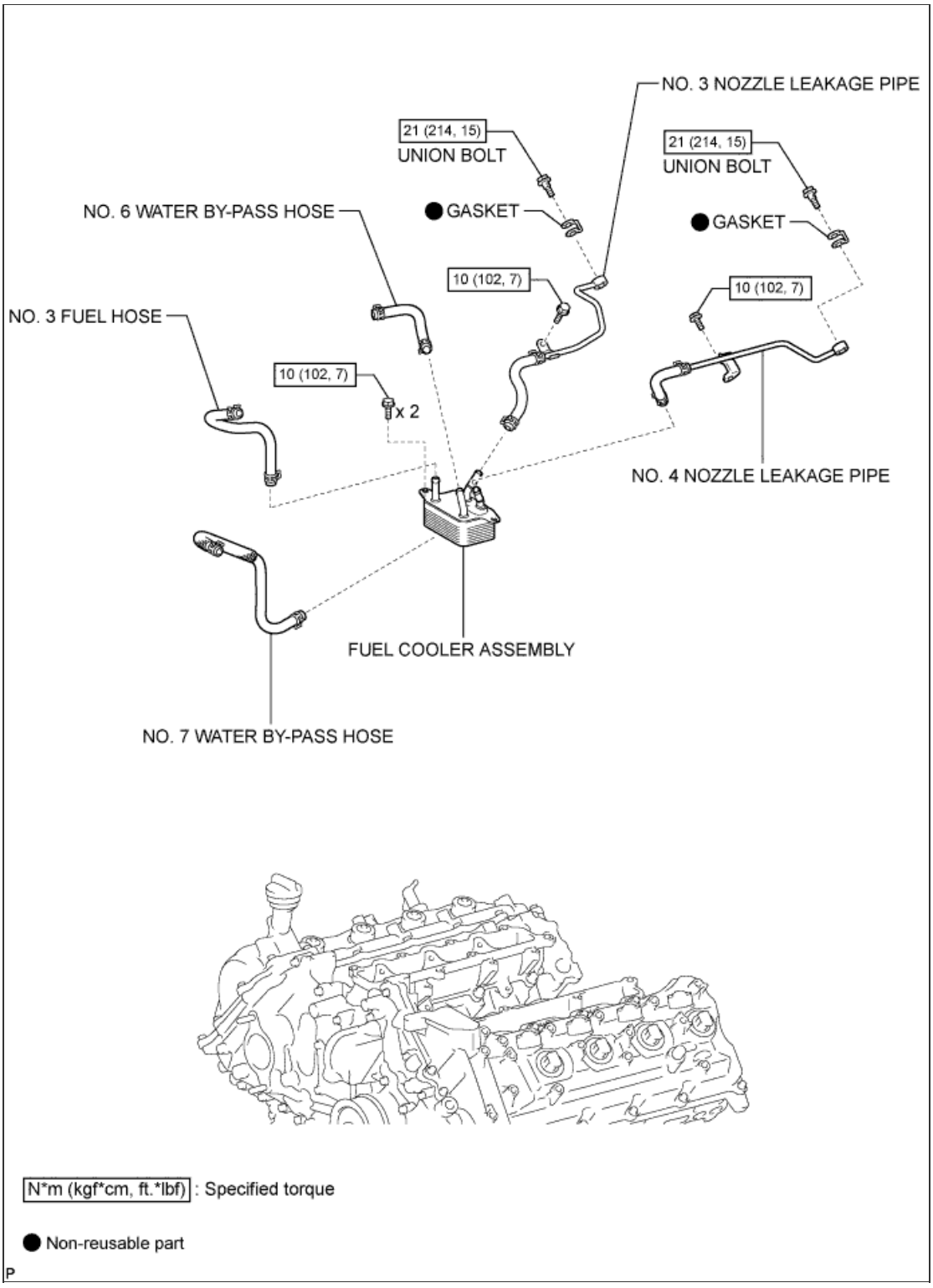
*: For use with union nut wrench

● Non-reusable part

P


w/ EGR System:
w/o EGR System:
5.0 (51, 44 in.*lbf)
5.0 (51, 44 in.*lbf)
10 (102, 7)
5.0 (51, 44 in.*lbf)
10 (105, 8)
UNION BOLT
10 (102, 7)
34 (347, 25)
31 (316, 23)*
NO. 6 INJECTION PIPE SUB-ASSEMBLY
GASKET
NO. 2 FUEL PIPE SUB-ASSEMBLY
10 (102, 7)
COMMON RAIL ASSEMBLY RH
21 (214, 15)
x 2
34 (347, 25)
31 (316, 23)*
21 (214, 15)
x 2
34 (347, 25)
31 (316, 23)*
NO. 5 INJECTION PIPE SUB-ASSEMBLY
COMMON RAIL ASSEMBLY LH
FUEL FILTER TO INJECTION PUMP FUEL PIPE SUB-ASSEMBLY
10 (102, 7)
10 (102, 7)
FUEL PUMP MOTOR WIRE
N*m (kgf*cm, ft.*lbf) : Specified torque
*: For use with union nut wrench
Non-reusable part
P

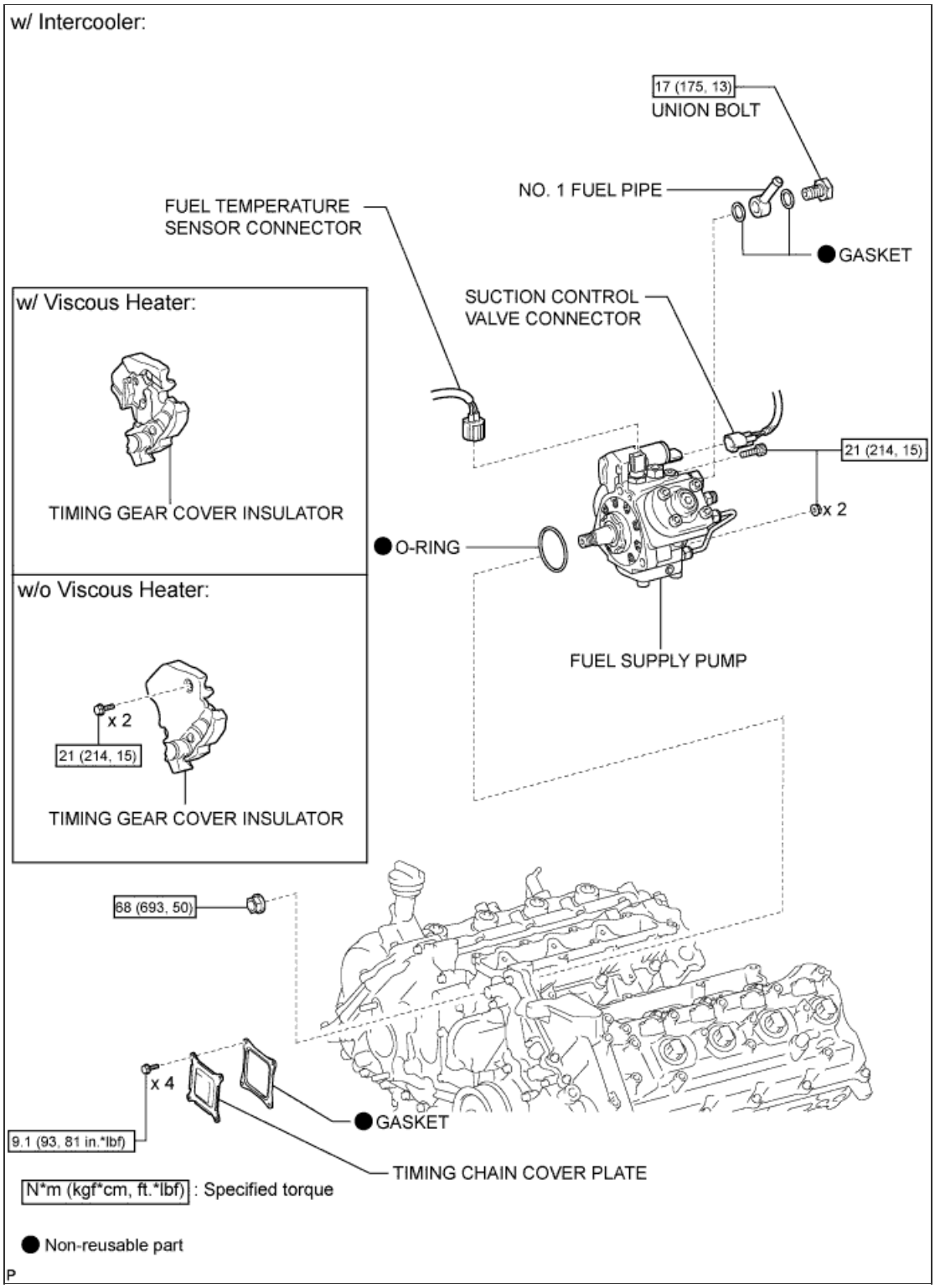

w/o EGR System:
INTAKE PIPE
21 (214, 15)
w/ Intercooler:
NO. 1 INTAKE MANIFOLD INSULATOR
21 (214, 15)
21 (214, 15)
x 2
x 4
21 (214, 15)
INTAKE PIPE (w/ EGR System)
x 2
6.0 (61, 53 in.*lbf)
STUD BOLT
x 4
GASKET
GASKET
w/ Intercooler:
NO. 2 INTAKE MANIFOLD INSULATOR
6.0 (61, 53 in.*lbf)
STUD BOLT
4.0 (41, 35 in.*lbf)
STUD BOLT
x 2
21 (214, 15)
x 2
NO. 3 INTAKE MANIFOLD
5.0 (51, 44 in.*lbf)
STUD BOLT
x 2
x 14
21 (214, 15)
INTAKE MANIFOLD INSULATOR
(w/ EGR System)
EGR PIPE INSULATOR
(w/ EGR System)
32 (326, 24)
4.0 (41, 35 in.*lbf)
STUD BOLT
21 (214, 15)
x 6
21 (214, 15)
x 2
13 (133, 10)
x 2
NO. 2 ENGINE WIRE
x 4
29 (298, 21)
GASKET
x 2
EGR VALVE ASSEMBLY WITH
EGR COOLER (w/ EGR System)
EGR COOLER INSULATOR
(w/ EGR System)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
T

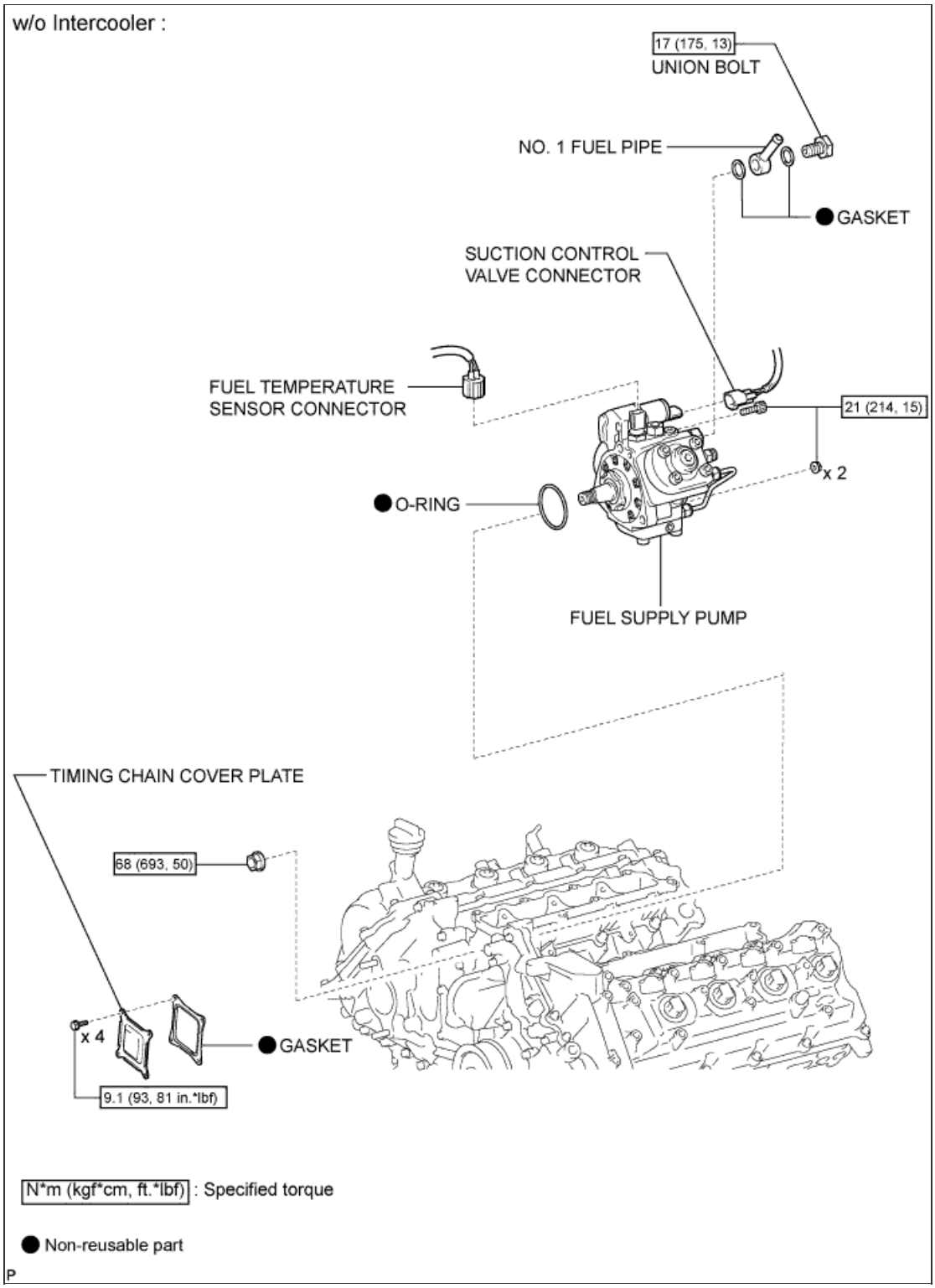


N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P


w/ Intercooler:
17 (175, 13)
UNION BOLT
NO. 1 FUEL PIPE
FUEL TEMPERATURE SENSOR CONNECTOR
GASKET
w/ Viscous Heater:
SUCTION CONTROL VALVE CONNECTOR
21 (214, 15)
x 2
TIMING GEAR COVER INSULATOR
O-RING
w/o Viscous Heater:
FUEL SUPPLY PUMP
x 2
21 (214, 15)
TIMING GEAR COVER INSULATOR
68 (693, 50)
x 4
GASKET
9.1 (93, 81 in.*lbf)
TIMING CHAIN COVER PLATE
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P


w/o Intercooler :
17 (175, 13)
UNION BOLT
NO. 1 FUEL PIPE
GASKET
SUCTION CONTROL
VALVE CONNECTOR
FUEL TEMPERATURE
SENSOR CONNECTOR
21 (214, 15)
x 2
O-RING
FUEL SUPPLY PUMP
TIMING CHAIN COVER PLATE
68 (693, 50)
x 4
GASKET
9.1 (93, 81 in.*lbf)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Disconnect the cables from the negative (-) main battery and sub-battery terminals.

2. REMOVE THERMOSTAT

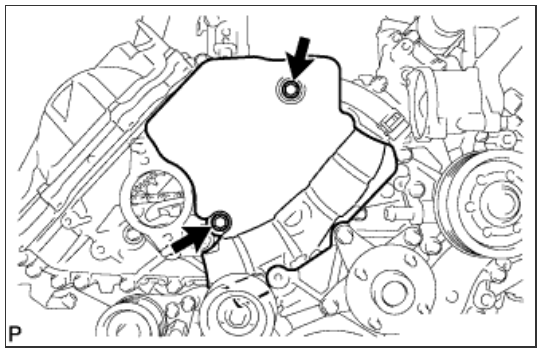
a. Remove the thermostat (Click here).

3. REMOVE FUEL COOLER ASSEMBLY

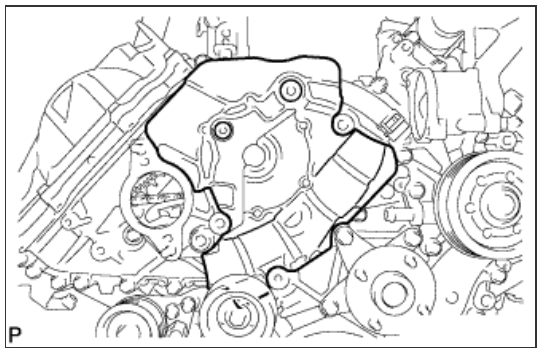
a. Remove the fuel cooler assembly (Click here).

4. REMOVE TIMING GEAR COVER INSULATOR (w/ Intercooler)

a. w/o Viscous eater:
Remove the 2 bolts and timing gear cover insulator.

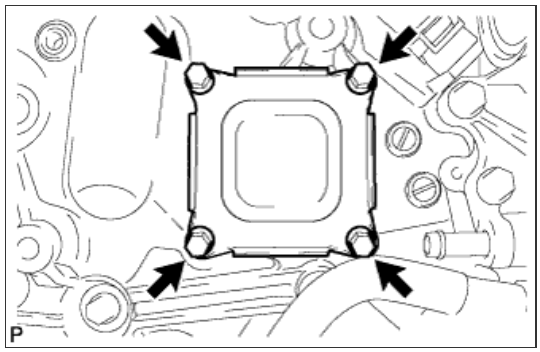


b. w/ Viscous eater:
Remove the timing gear cover insulator.



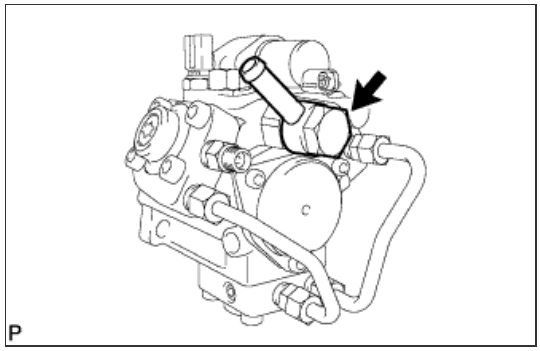
5. REMOVE TIMING CHAIN COVER PLATE

a. Remove the 4 bolts, cover plate and gasket.



6. REMOVE NO. 1 FUEL PIPE

a. Remove the union bolt, fuel pipe and 2 gaskets.



7. REMOVE FUEL SUPPLY PUMP

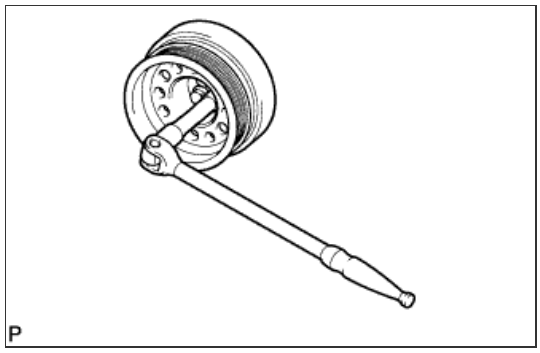
a. Using a wrench, hold the crankshaft.

NOTICE:

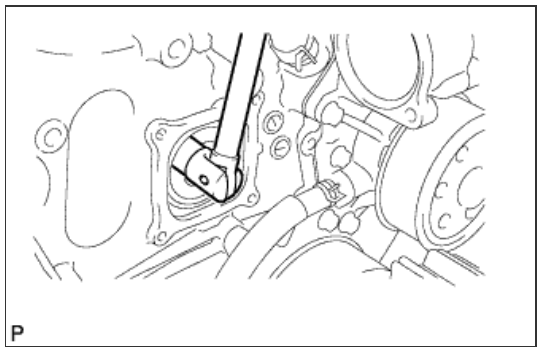
Do not turn the crankshaft counterclockwise.

If it is turned counterclockwise, check that the crankshaft pulley set bolt is not loose. If loose, tighten the bolt (Click here).

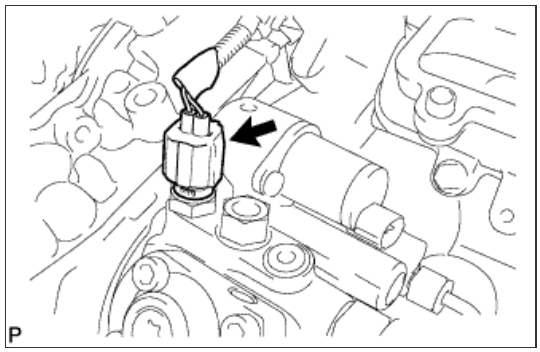
Torque:
108 N*m{ 1101 kgf*cm , 80 ft.*lbf } or more



b. Remove the set nut.

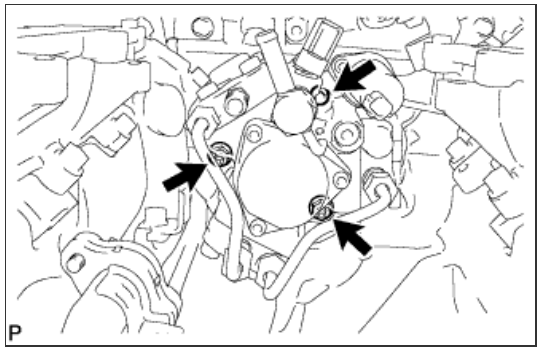


c. Disconnect the fuel temperature sensor connector.



d. Using a 6 mm hexagon wrench, remove the bolt.

e. Loosen the 2 nuts.



f. Disconnect the pump from the supply pump drive gear.

i. Install SST (No. 1 adapter) to the timing chain cover.

SST

09950-50013 (09951-05010, 09952-05010, 09953-05020, 09954-05031, 09955-05010)

NOTICE:

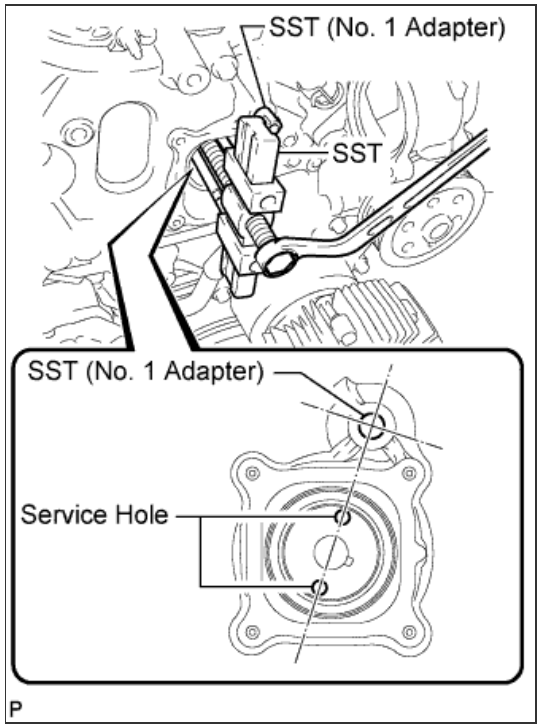
Do not use any tools in this procedure.

ii. Rotate the supply pump gear so that the service holes are aligned with SST (No. 1 adapter) as shown in the illustration.

iii. Using SST, disconnect the pump from the supply pump drive gear.

NOTICE:

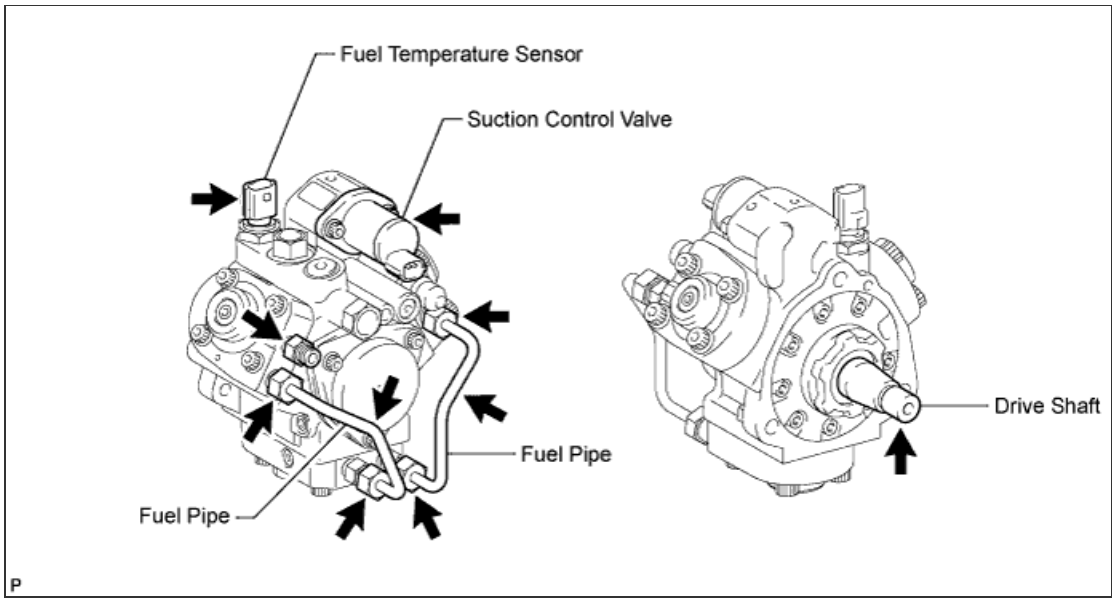
- **When removing or installing SST, do not push the supply pump gear.**
- **Apply lubricant to the threads and tip of SST (center bolt) before using it.**



g. Remove the 2 nuts.

NOTICE:

- **Do not hold the supply pump by the parts indicated by the arrows in the illustration, as this may result in deformation, damage, and fuel leakage.**



- **The pump must be kept horizontal.**

h. Remove the O-ring from the supply pump.

for Preparation Click here

1. INSPECT FUEL SUPPLY PUMP

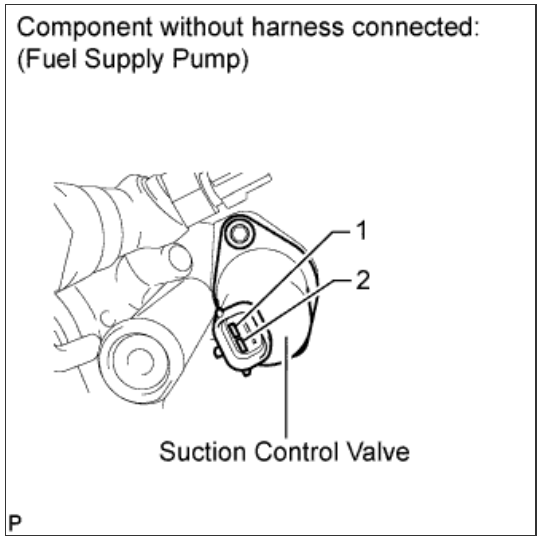
a. Inspect the suction control valve.

i. esure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	1.9 to 2.3 Ω

If the result is not as specified, replace the fuel supply pump.



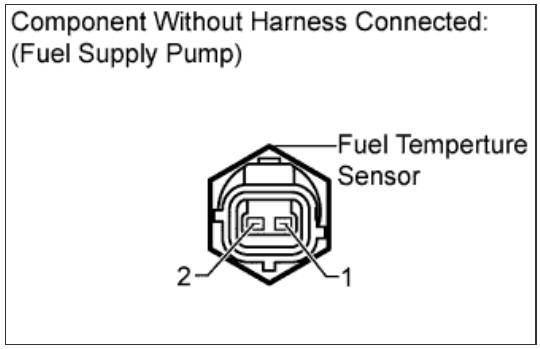
2. INSPECT FUEL TEMPERATURE SENSOR

a. esure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	2.32 to 2.59 Ω

If the result is not as specified, replace the supply pump.



for Preparation Click here

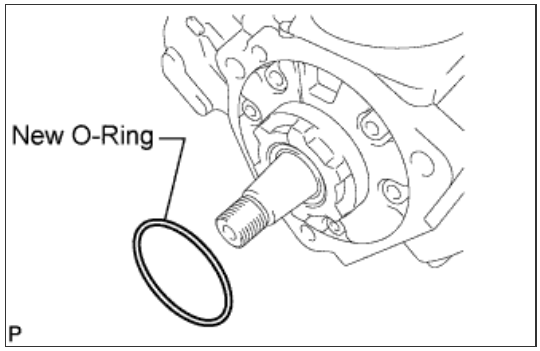
1. INSTALL FUEL SUPPLY PUMP

NOTICE:

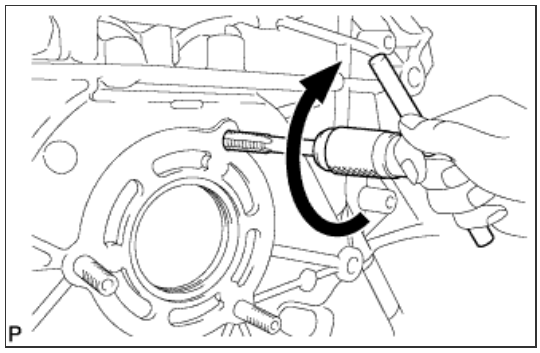
Do not push the supply pump drive gear.

a. Install a new O-ring to the supply pump.

b. Apply a light coat of engine oil to the O-ring.

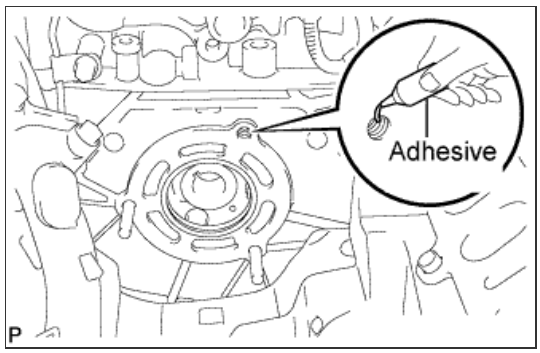


c. Using an mm x 1.25 pitch tap, remove the adhesive from the timing gear case side bolt hole.

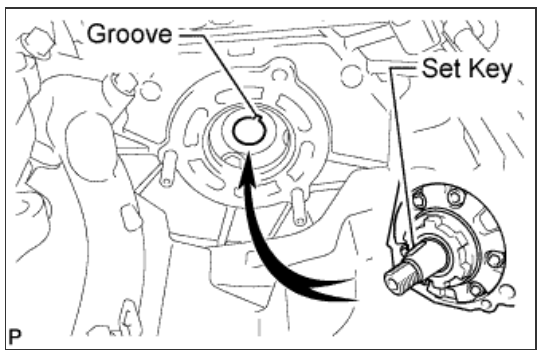


d. Apply adhesive to 2 or more threads as shown in the illustration.

Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent

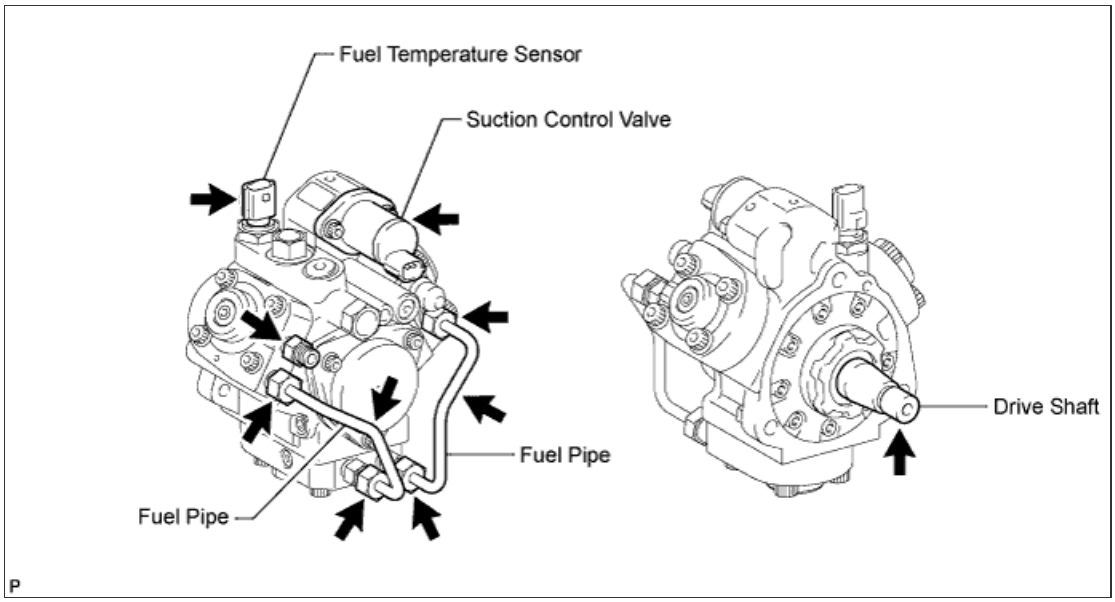


e. Align the set key on the drive shaft with the groove of the supply pump drive gear.

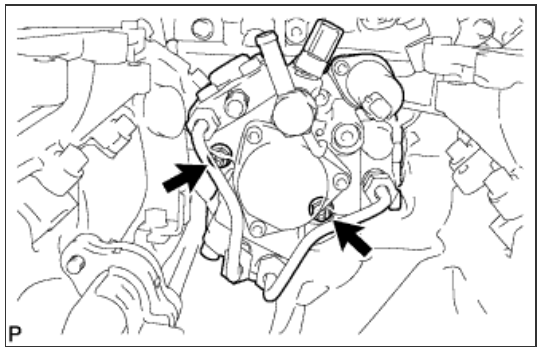


NOTICE:

Do not hold the supply pump by the parts indicated by the arrows in the illustration, as this may result in deformation, damage, and fuel leakage.



f. emporarily install the fuel supply pump with the 2 nuts.

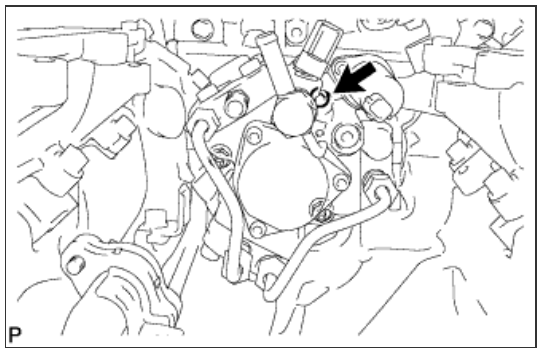


g. Using a 6 mm hexagon wrench, install the bolt.

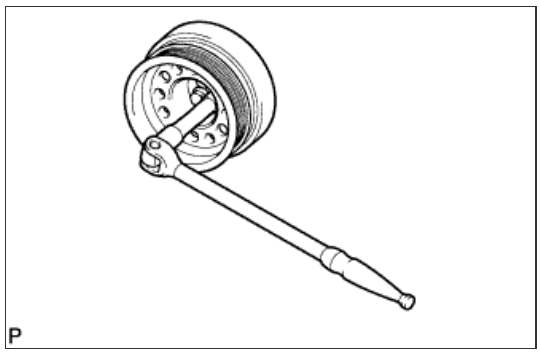
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

h. hten the 2 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



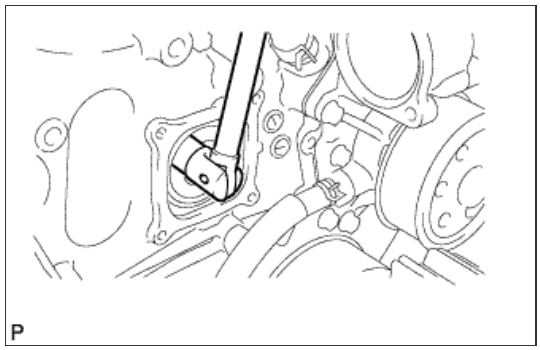
i. Using a wrench, hold the crankshaft.



. Install the set nut.

Torque:
68 N*m{ 693 kgf*cm , 50 ft.*lbf }

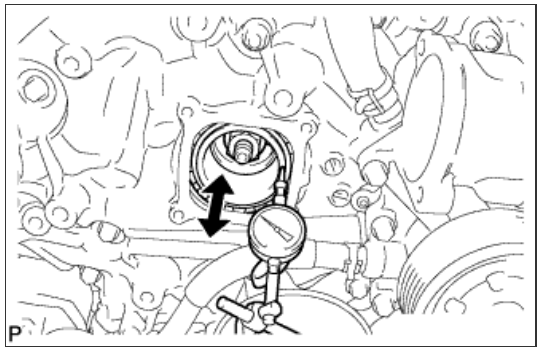
k. urn the crankshaft 2 times, and check that there are no problems.



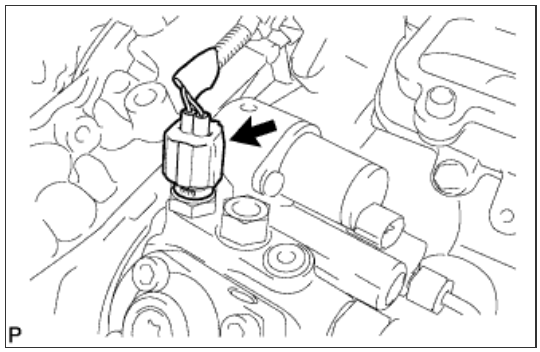
l. Using a dial indicator, check the thrust clearance of the supply pump drive shaft while moving the pump drive shaft gear back and forth.

Standard thrust clearance:
0.05 to 0.30 mm (0.00197 to 0.0118 in.)

If the clearance is not within the specified range, disassemble and reassemble the supply pump and pump drive shaft gear. hen repeat the step above.



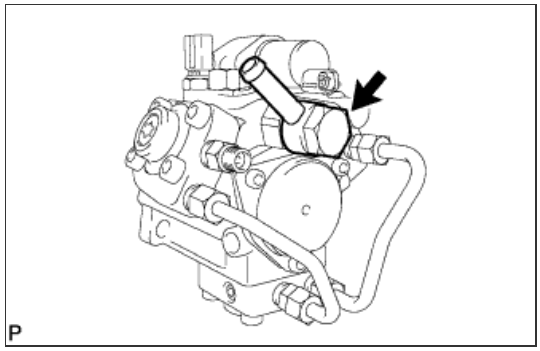
m. Connect the fuel temperature sensor connector.



2. INSTALL NO. 1 FUEL PIPE

a. Install 2 new gaskets and the No. 1 fuel pipe with the union bolt.

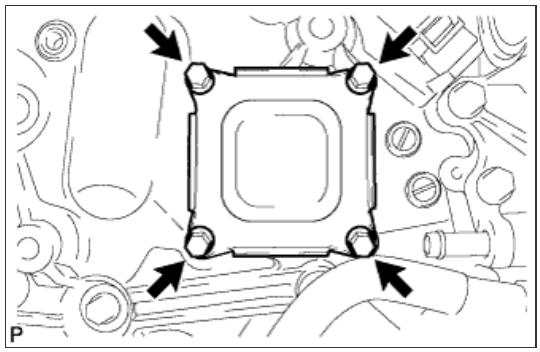
Torque:
17 N*m{ 175 kgf*cm , 13 ft.*lbf }



3. INSTALL TIMING CHAIN COVER PLATE

a. Install a new gasket and the cover plate with the 4 bolts.

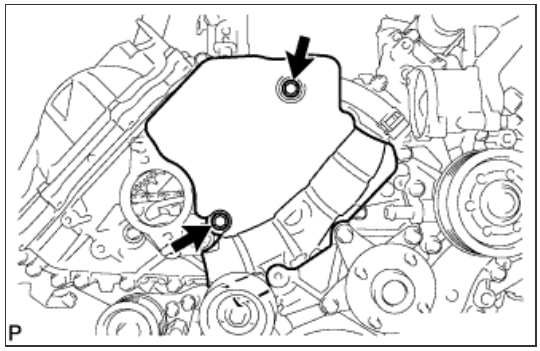
Torque:
9.1 N*m{ 93 kgf*cm , 81 in.*lbf }



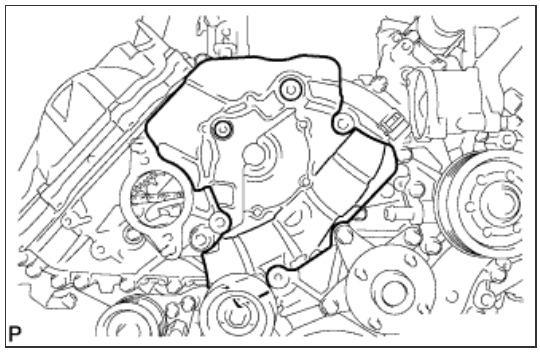
4. INSTALL TIMING GEAR COVER INSULATOR (w/ Intercooler)

a. w/o Viscous Heater:
Install the timing gear cover insulator with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



b. w/ Viscous Heater:
Install the timing gear cover insulator.



5. INSTALL FUEL COOLER ASSEMBLY

a. Install the fuel cooler assembly (Click here).

6. INSTALL THERMOSTAT

a. Install the thermostat (Click here).

7. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

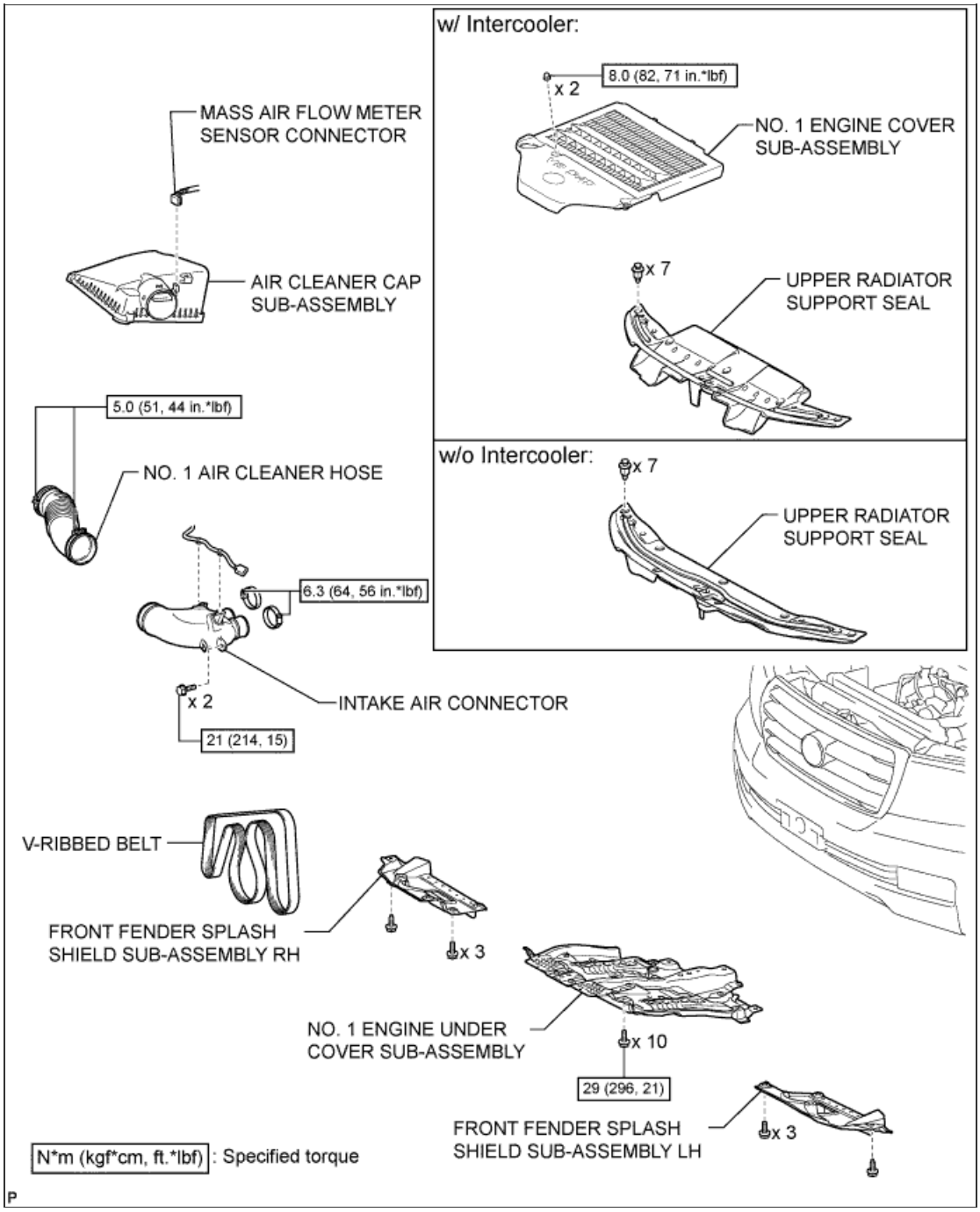
When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

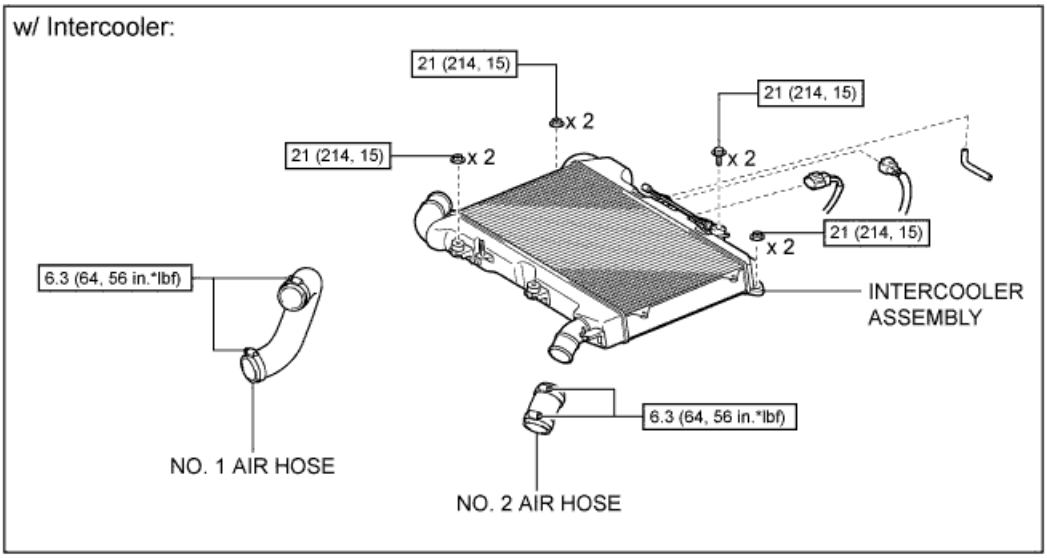
a. Connect the cables to the negative (-) main battery and sub-battery terminals.

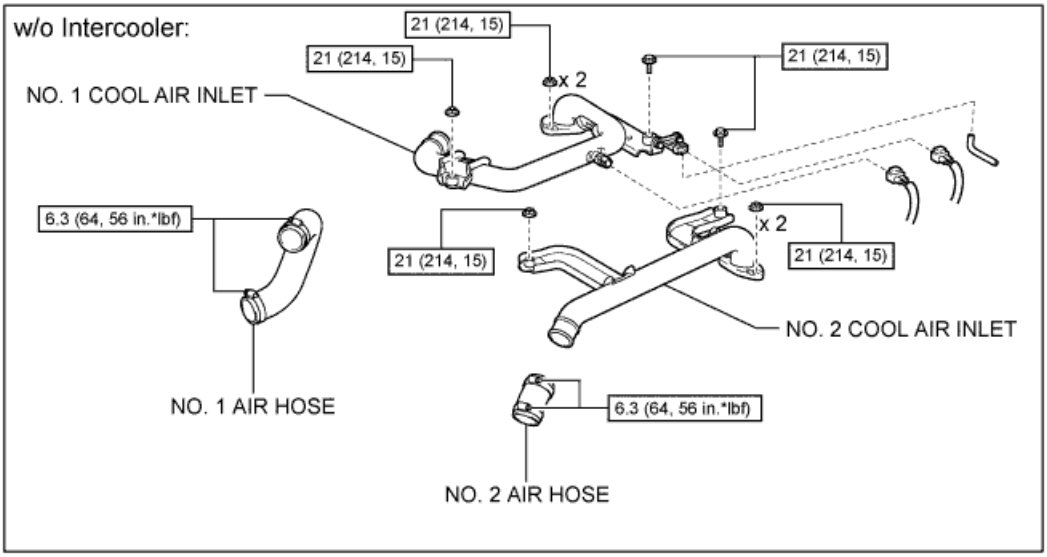
8. FUEL SUPPLY PUMP INITIALIZATION

a. Initialize the fuel supply pump (Click here).

for Preparation [Click here]



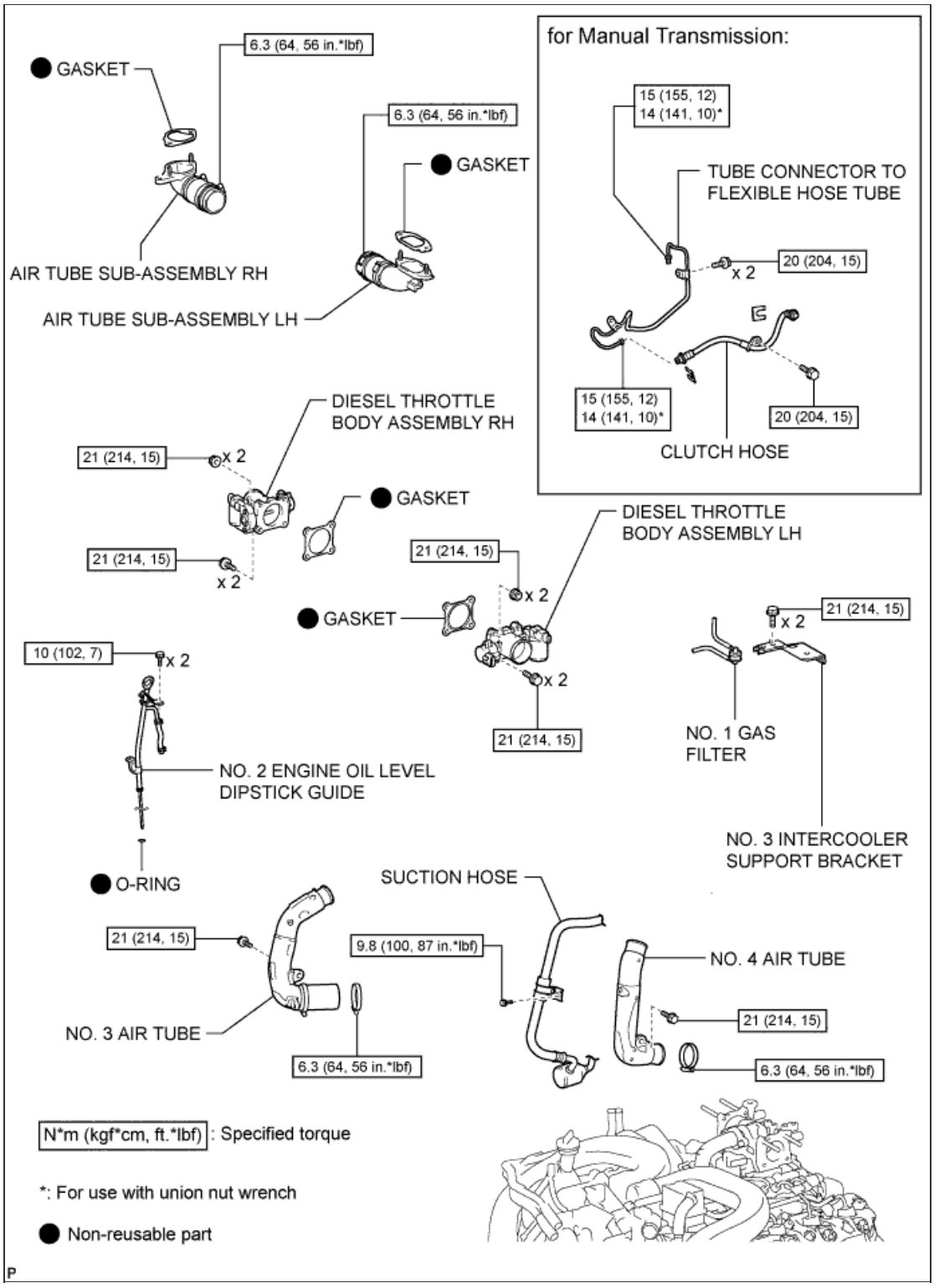


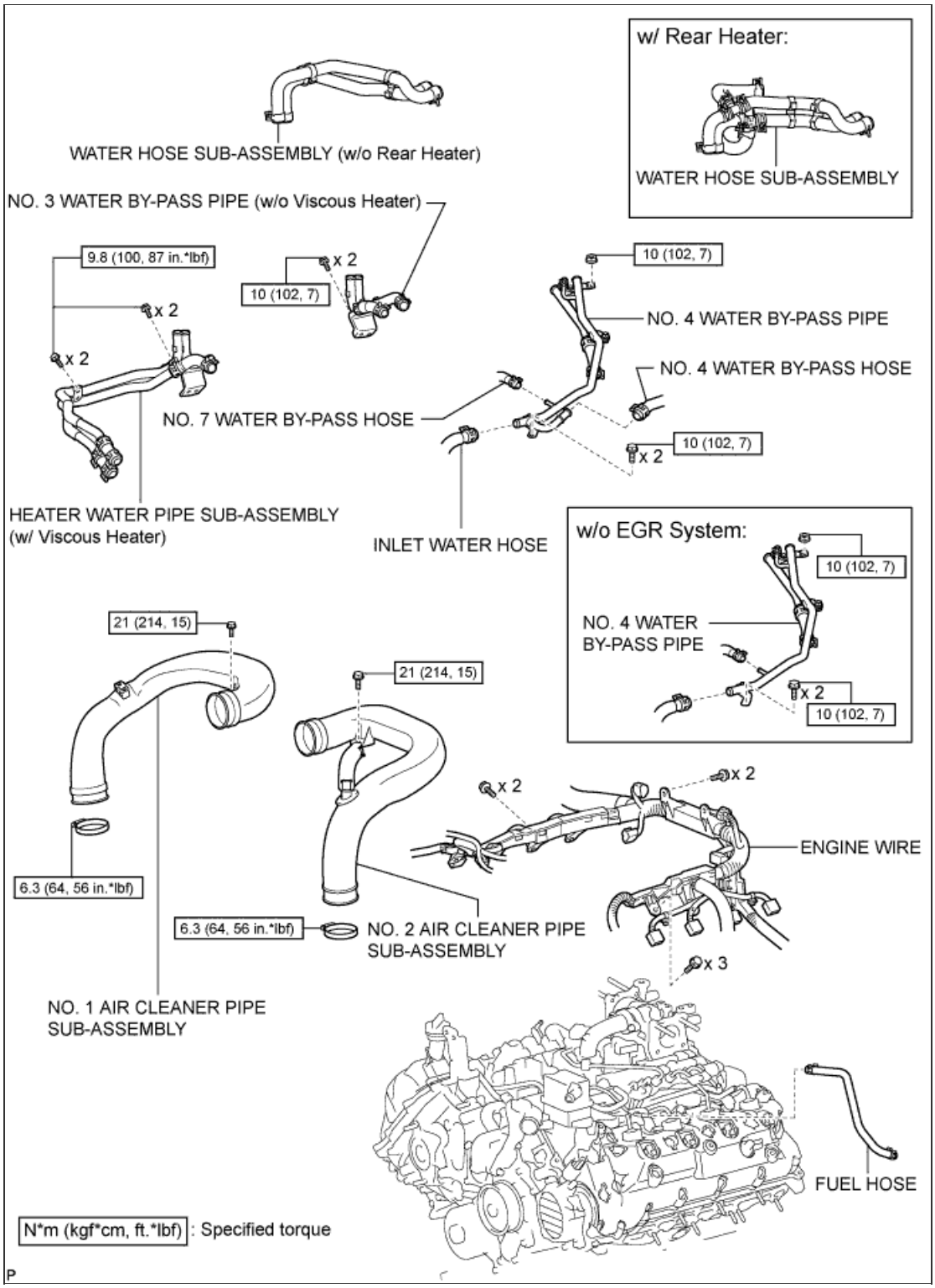


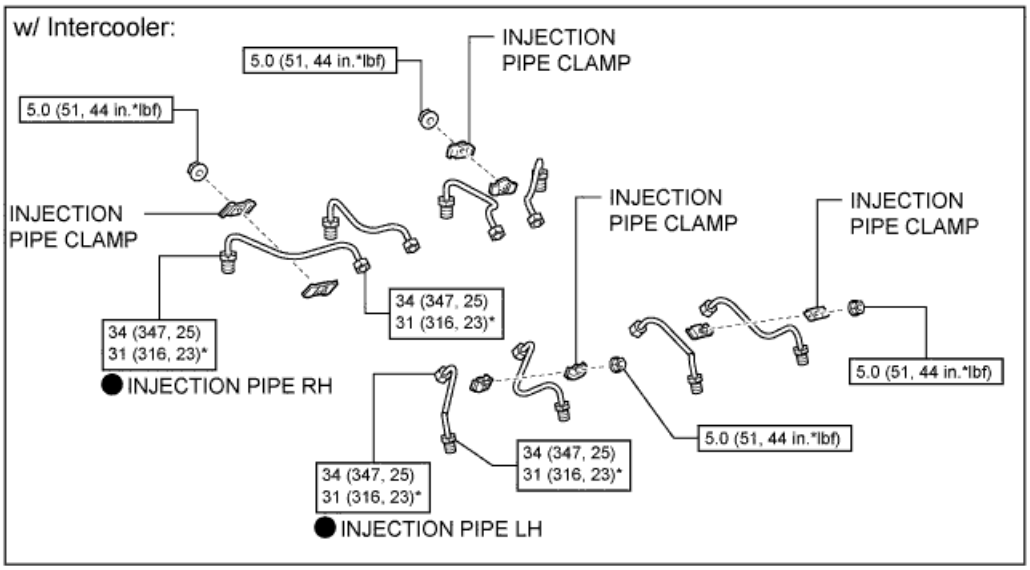


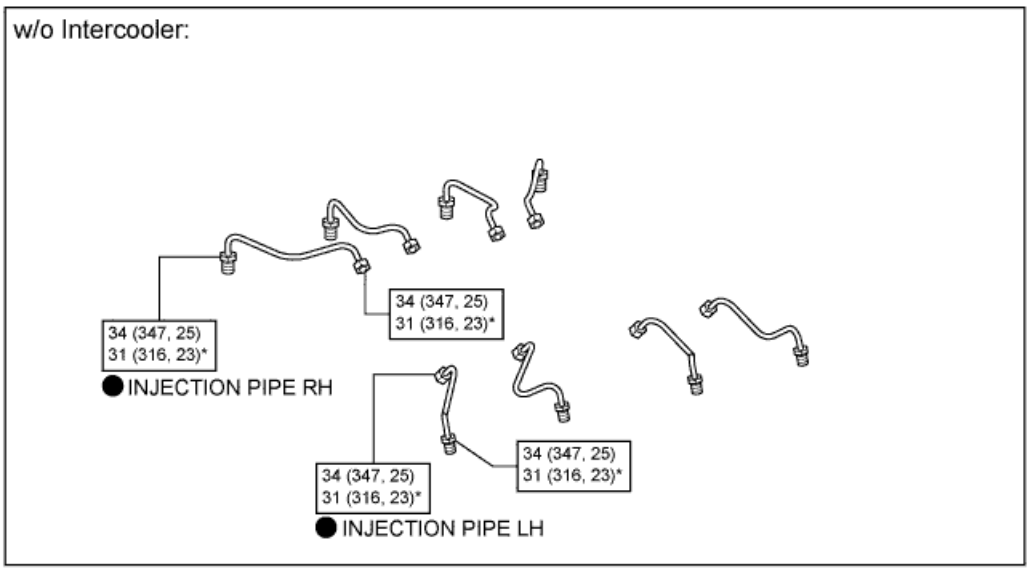
N*m (kgf*cm, ft.*lbf) : Specified torque

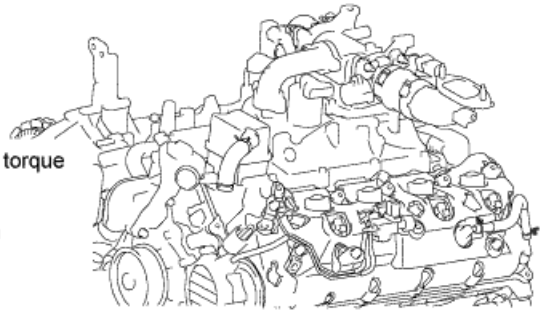
P


GASKET
6.3 (64, 56 in.*lbf)
AIR TUBE SUB-ASSEMBLY RH
6.3 (64, 56 in.*lbf)
GASKET
AIR TUBE SUB-ASSEMBLY LH
for Manual Transmission:
15 (155, 12)
14 (141, 10)*
TUBE CONNECTOR TO FLEXIBLE HOSE TUBE
20 (204, 15)
x 2
15 (155, 12)
14 (141, 10)*
20 (204, 15)
CLUTCH HOSE
DIESEL THROTTLE BODY ASSEMBLY RH
21 (214, 15)
x 2
GASKET
21 (214, 15)
x 2
21 (214, 15)
x 2
GASKET
DIESEL THROTTLE BODY ASSEMBLY LH
x 2
21 (214, 15)
21 (214, 15)
x 2
NO. 1 GAS FILTER
10 (102, 7)
x 2
NO. 2 ENGINE OIL LEVEL DIPSTICK GUIDE
O-RING
NO. 3 INTERCOOLER SUPPORT BRACKET
SUCTION HOSE
21 (214, 15)
NO. 3 AIR TUBE
6.3 (64, 56 in.*lbf)
9.8 (100, 87 in.*lbf)
NO. 4 AIR TUBE
21 (214, 15)
6.3 (64, 56 in.*lbf)
N*m (kgf*cm, ft.*lbf): Specified torque
*: For use with union nut wrench
Non-reusable part
P


w/ Rear Heater:
WATER HOSE SUB-ASSEMBLY
WATER HOSE SUB-ASSEMBLY (w/o Rear Heater)
NO. 3 WATER BY-PASS PIPE (w/o Viscous Heater)
9.8 (100, 87 in.*lbf)
x 2
x 2
10 (102, 7)
x 2
HEATER WATER PIPE SUB-ASSEMBLY
(w/ Viscous Heater)
NO. 7 WATER BY-PASS HOSE
10 (102, 7)
NO. 4 WATER BY-PASS PIPE
NO. 4 WATER BY-PASS HOSE
10 (102, 7)
x 2
INLET WATER HOSE
w/o EGR System:
10 (102, 7)
NO. 4 WATER
BY-PASS PIPE
x 2
10 (102, 7)
21 (214, 15)
21 (214, 15)
x 2
x 2
ENGINE WIRE
6.3 (64, 56 in.*lbf)
6.3 (64, 56 in.*lbf)
NO. 2 AIR CLEANER PIPE
SUB-ASSEMBLY
x 3
NO. 1 AIR CLEANER PIPE
SUB-ASSEMBLY
FUEL HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
P





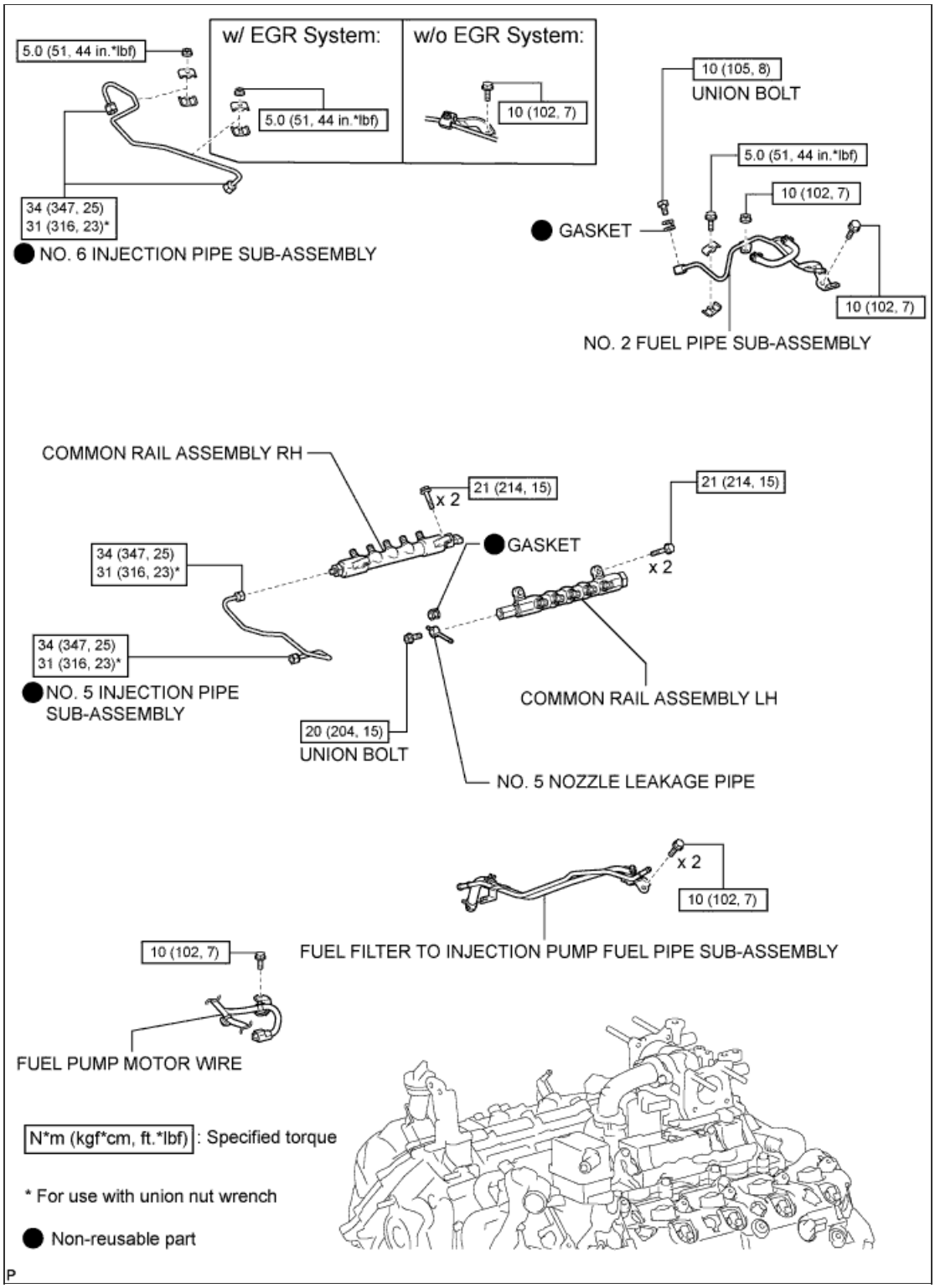


N*m (kgf*cm, ft.*lbf): Specified torque

*: For use with union nut wrench

● Non-reusable part

P


5.0 (51, 44 in.*lbf)
w/ EGR System:
5.0 (51, 44 in.*lbf)
w/o EGR System:
10 (102, 7)
34 (347, 25)
31 (316, 23)*
NO. 6 INJECTION PIPE SUB-ASSEMBLY
10 (105, 8)
UNION BOLT
5.0 (51, 44 in.*lbf)
10 (102, 7)
GASKET
10 (102, 7)
NO. 2 FUEL PIPE SUB-ASSEMBLY
COMMON RAIL ASSEMBLY RH
x 2
21 (214, 15)
21 (214, 15)
GASKET
x 2
34 (347, 25)
31 (316, 23)*
34 (347, 25)
31 (316, 23)*
NO. 5 INJECTION PIPE
SUB-ASSEMBLY
COMMON RAIL ASSEMBLY LH
20 (204, 15)
UNION BOLT
NO. 5 NOZZLE LEAKAGE PIPE
x 2
10 (102, 7)
FUEL FILTER TO INJECTION PUMP FUEL PIPE SUB-ASSEMBLY
10 (102, 7)
FUEL PUMP MOTOR WIRE
N*m (kgf*cm, ft.*lbf) : Specified torque
* For use with union nut wrench
Non-reusable part
P

for Preparation Click here

NOTICE:

When replacing an injector (including interchanging injectors between cylinders), common rail, replace the corresponding injection pipes with a new one.

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 9 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

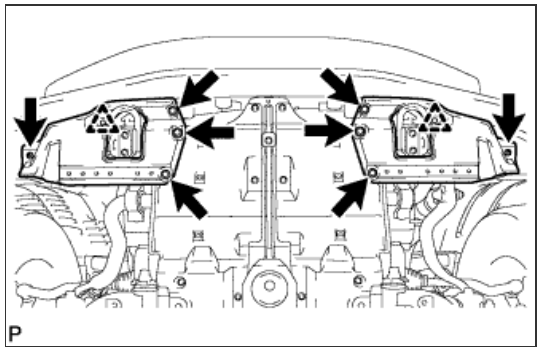
When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Disconnect the cables from the negative (-) main battery and sub-battery terminals.

2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.



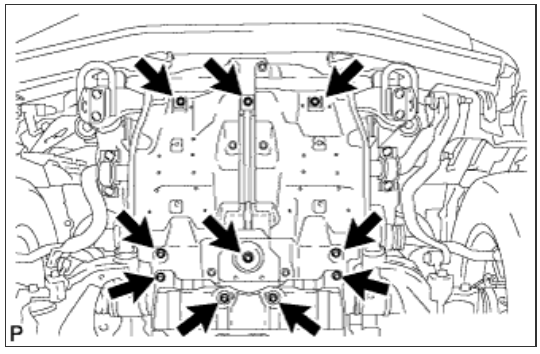
3. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.

4. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 1 bolts and under cover.



5. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and upper radiator support seal.

6. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

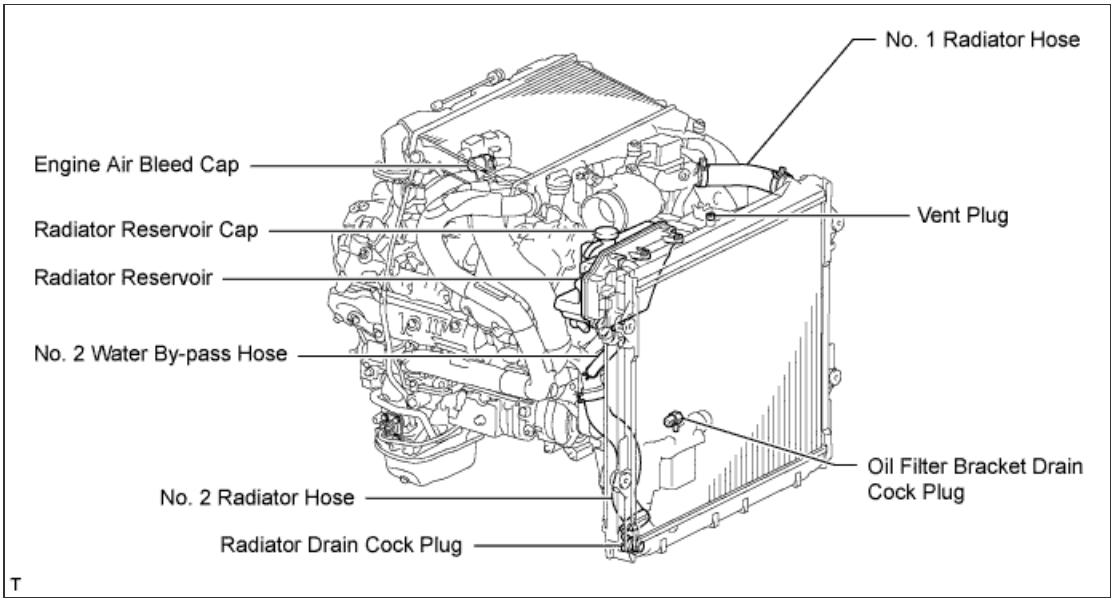
HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

a. Loosen the radiator drain cock plug.

b. Remove the radiator reservoir cap to drain the coolant in the radiator.

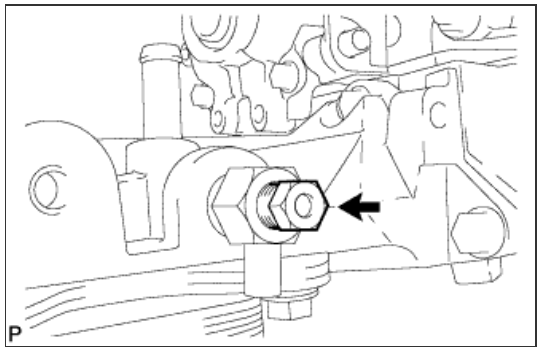
c. Loosen the oil filter bracket drain cock plug to drain the coolant in the engine.



d. ighten the radiator drain cock plug by hand.

e. ighten the oil filter bracket drain cock plug.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



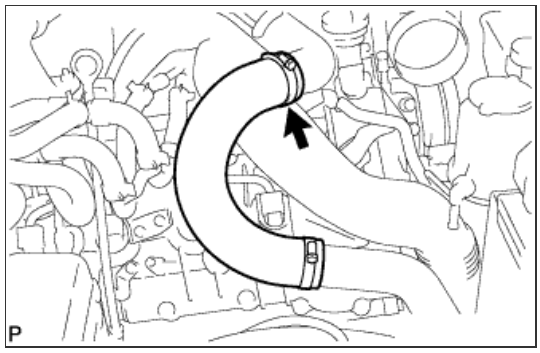
7. REMOVE INTERCOOLER ASSEMBLY (w/ Intercooler)

a. Remove the intercooler assembly (Click here).

8. REMOVE NO. 1 COOL AIR INLET (w/o Intercooler)

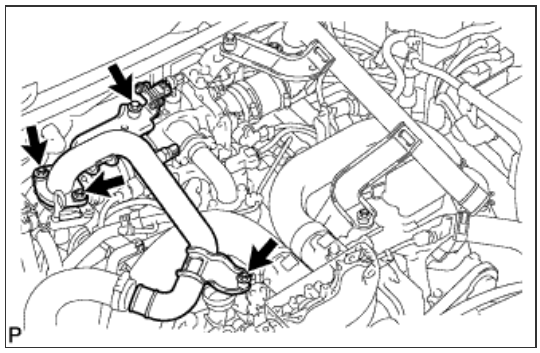
a. Loosen the No. 1 air hose clamp.

b. Disconnect the turbo pressure sensor connector, intake air temperature sensor connector and vacuum hose.



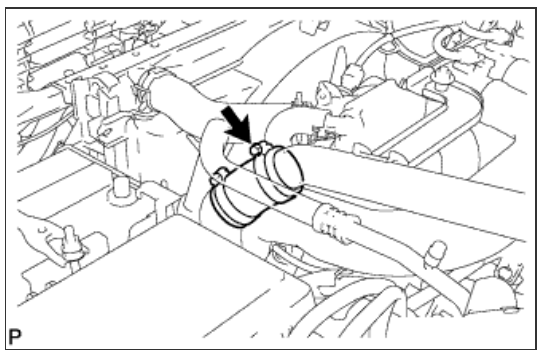
c. Remove the 3 nuts, bolt and No. 1 cool air inlet.

d. Remove the gasket from the air tube RH.



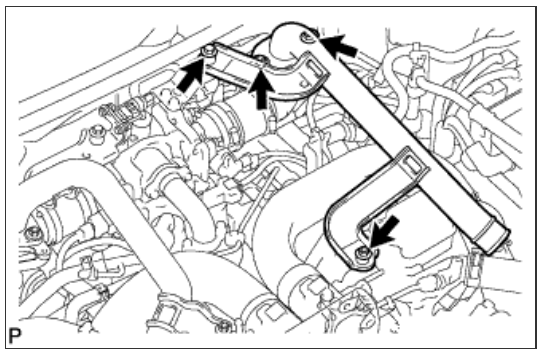
9. REMOVE NO. 2 COOL AIR INLET (w/o Intercooler)

a. Loosen the No. 2 air hose clamp.

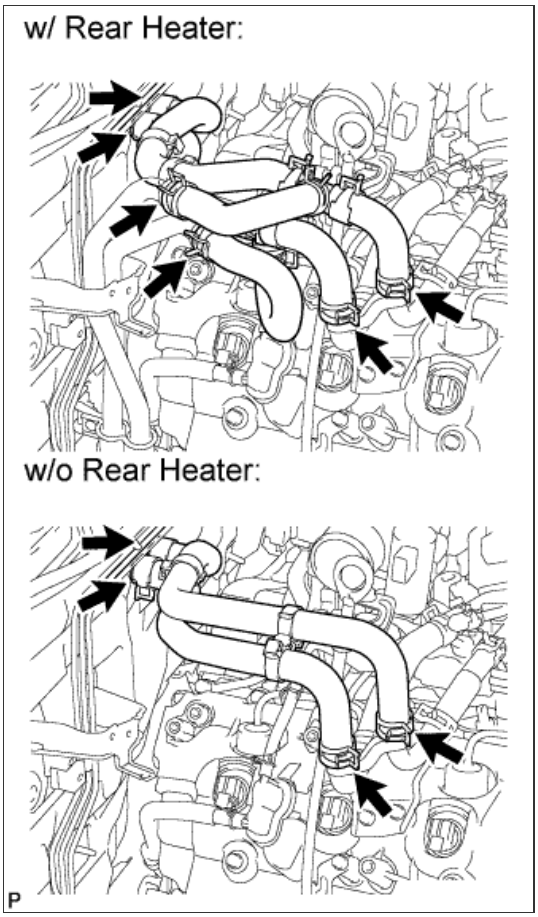


b. Remove the 3 nuts, bolt and No. 2 cool air inlet.

c. Remove the gasket from the air tube LH.

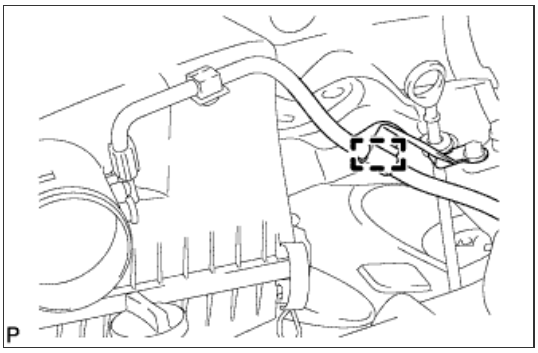


10. DISCONNECT WATER HOSE SUB-ASSEMBLY



11. REMOVE NO. 2 ENGINE OIL LEVEL DIPSTICK GUIDE

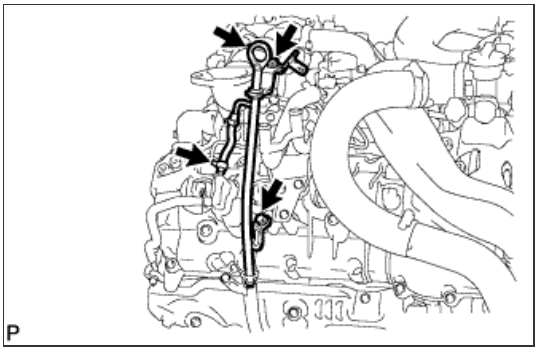
a. Disconnect the wire harness clamp from the No. 2 engine oil level dipstick guide.



b. Disconnect the ventilation hose from the cylinder head cover RH.

c. Remove the 2 bolts and No. 2 engine oil level dipstick guide.

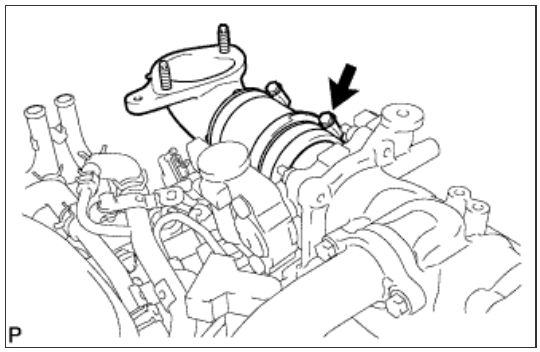
d. Remove the O-ring from the No. 2 engine oil level dipstick guide.



12. REMOVE AIR TUBE SUB-ASSEMBLY RH

a. Loosen the hose clamp.

b. Remove the air tube from the throttle body.



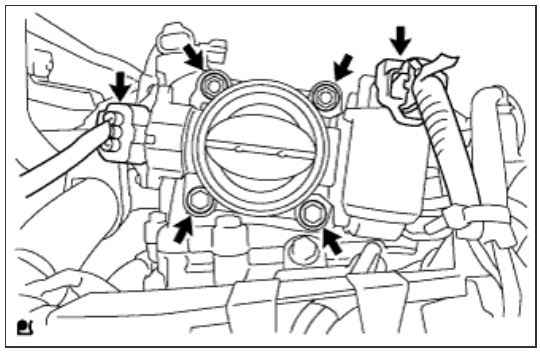
13. REMOVE DIESEL THROTTLE BODY ASSEMBLY RH

a. Disconnect the throttle position sensor connector.

b. Disconnect the throttle motor connector.

c. Remove the 2 bolts, 2 nuts and throttle body.

d. Remove the gasket from the intake pipe.



14. DRAIN CLUTCH FLUID (for Manual Transmission)

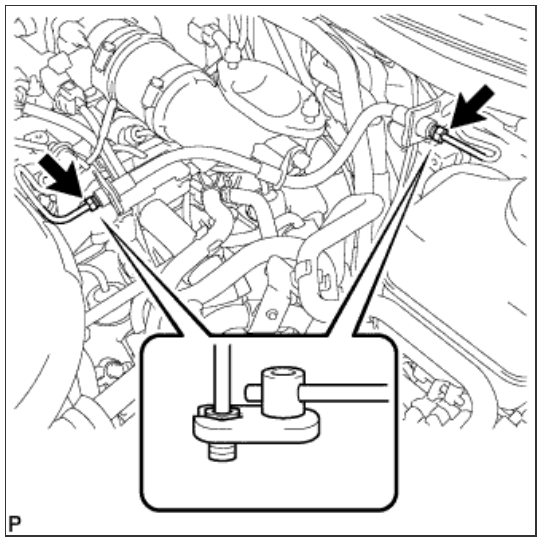
15. REMOVE CLUTCH HOSE (for Manual Transmission)

a. Disconnect the 2 flexible hose tubes from the clutch hose with a 1 mm union nut wrench while holding the flexible hose with a wrench.

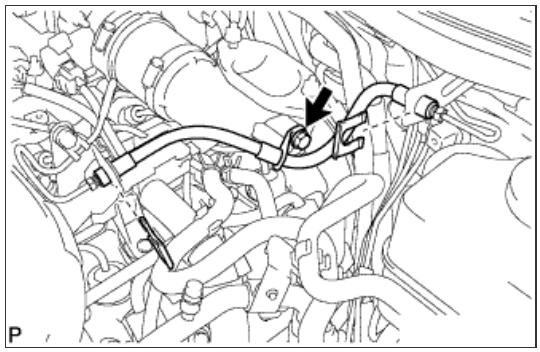
NOTICE:

- **Do not bend or damage the flexible hose tubes.**
- **Do not allow any foreign matter such as dirt and dust to enter the flexible hose tubes from the connecting point.**

b. Remove the 2 clips.



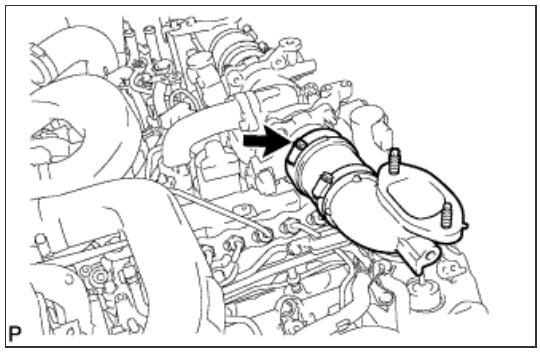
c. Remove the bolt and clutch hose.



16. REMOVE AIR TUBE SUB-ASSEMBLY LH

a. Loosen the hose clamp.

b. Remove the air tube from the throttle body.

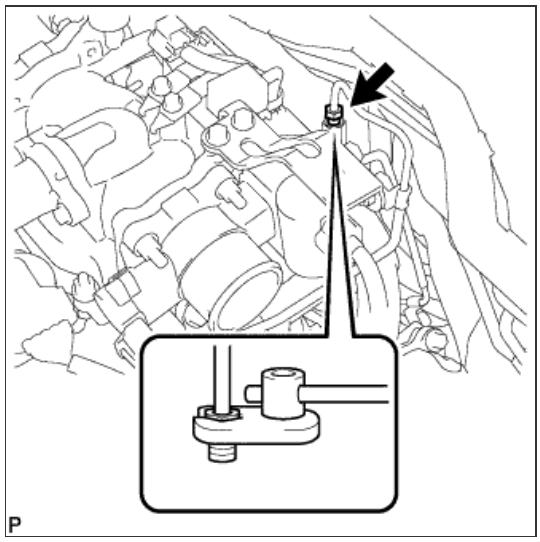


17. REMOVE TUBE CONNECTOR TO FLEXIBLE HOSE TUBE (for Manual Transmission)

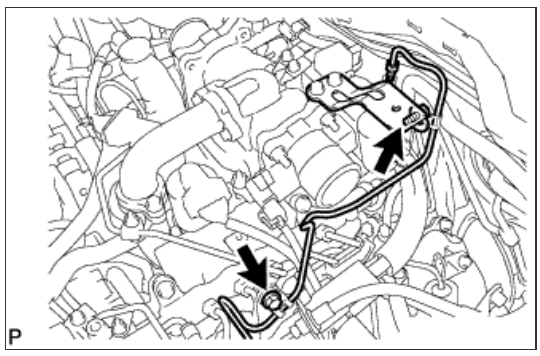
a. Using a 1 mm union nut wrench, disconnect the tube connector to flexible hose tube from the clutch tube to release cylinder 2 way.

NOTICE:

- **Do not bend or damage the flexible hose tube.**
- **Do not allow any foreign matter such as dirt and dust to enter the flexible hose tube from the connecting point.**



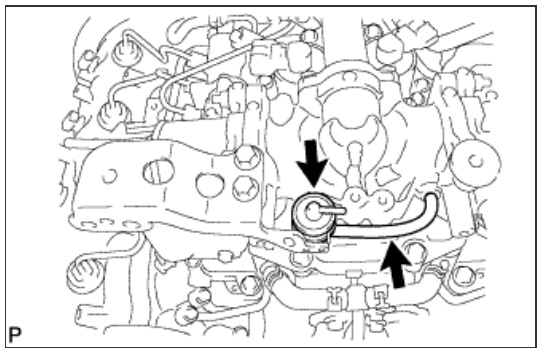
b. Remove the 2 bolts and tube connector to flexible hose tube.



18. REMOVE NO. 1 GAS FILTER

a. Disconnect the hose from the intake pipe.

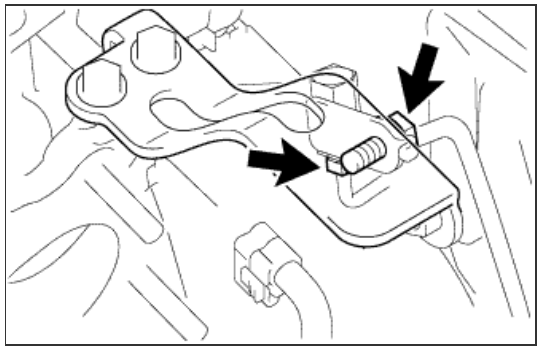
b. Remove the gas filter.



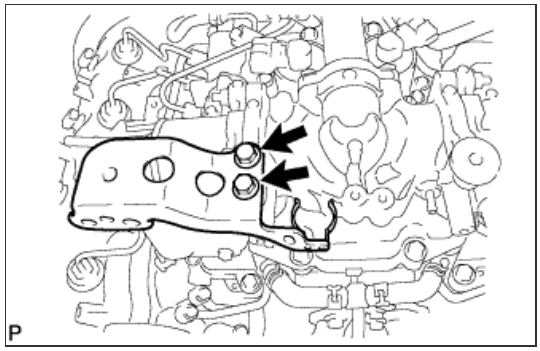
19. REMOVE NO. 3 INTERCOOLER SUPPORT BRACKET

a. for Manual ransmission:

i. Remove the bolt and disconnect the clutch tube to release cylinder 2 way from the bracket.



b. Remove the 2 bolts and bracket.



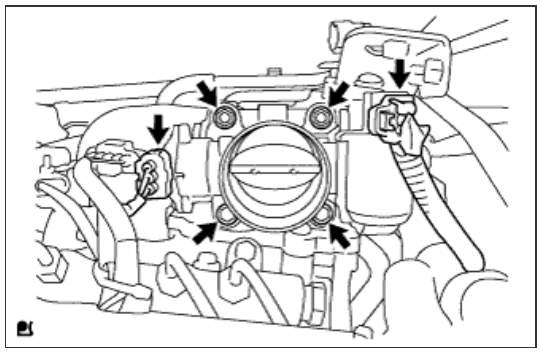
20. REMOVE DIESEL THROTTLE BODY ASSEMBLY LH

a. Disconnect the throttle position sensor connector.

b. Disconnect the throttle motor connector.

c. Remove the 2 bolts, 2 nuts and throttle body.

d. Remove the gasket from the intake pipe.

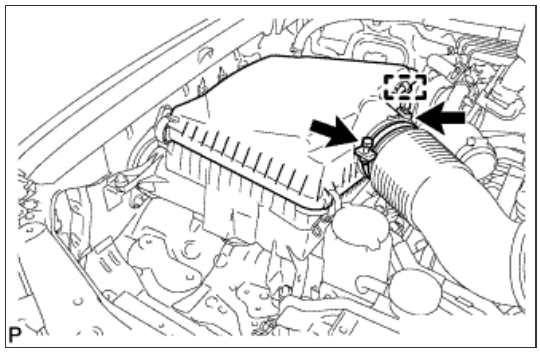


21. REMOVE AIR CLEANER CAP SUB-ASSEMBLY

a. Loosen the hose clamp.

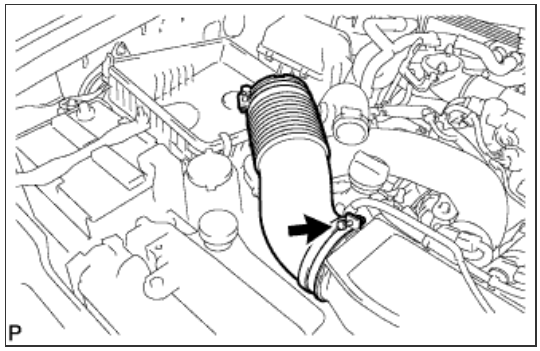
b. Disconnect the mass air flow meter connector and using a clip remover, detach the wire harness clamp from the air cleaner cap.

c. Detach the 4 clamps and remove the air cleaner cap.



22. REMOVE NO. 1 AIR CLEANER HOSE

a. Loosen the hose clamp and remove the No. 1 air cleaner hose.



23. REMOVE INTAKE AIR CONNECTOR

a. w/o Viscous Heater:

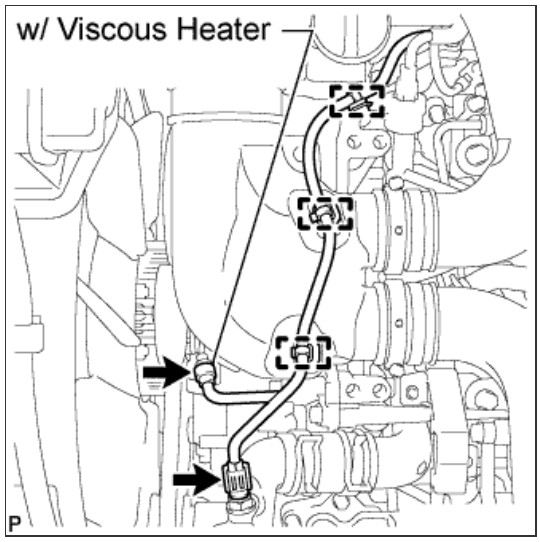
i. Disconnect the connector from the water temperature sensor.

ii. Using a clip remover, detach the 3 wire harness clamps.

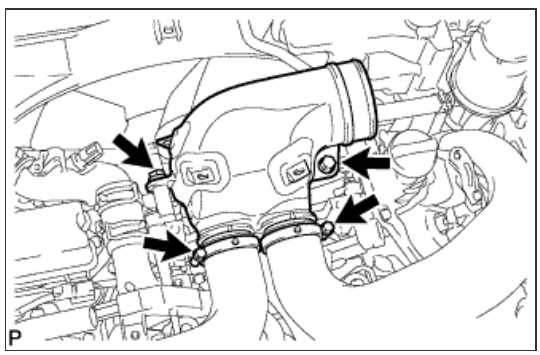
b. w/ Viscous Heater:

i. Disconnect the 2 connectors from the viscous with magnet clutch heater and water temperature sensor.

ii. Using a clip remover, detach the 3 wire harness clamps.



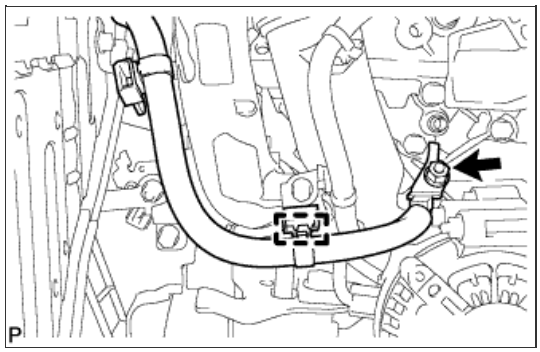
c. Loosen the 2 hose clamps and remove the 2 bolts and intake air connector.



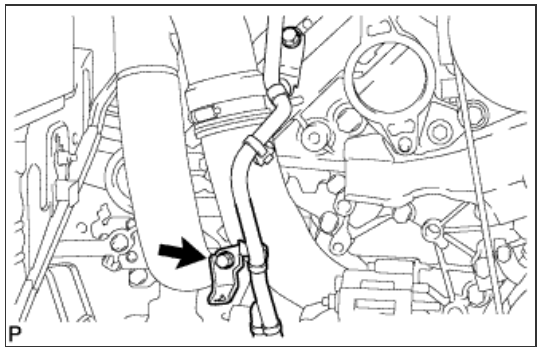
24. REMOVE NO. 3 AIR TUBE

a. Disconnect the wire harness from the clamp.

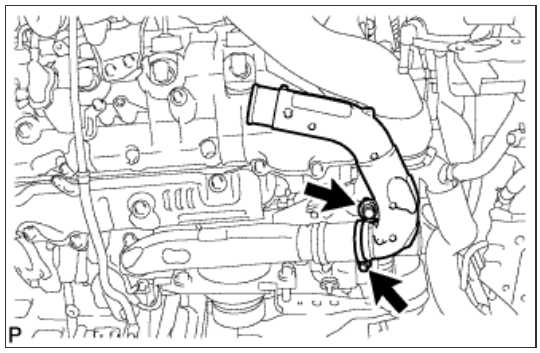
b. Remove the nut and ground wire.



c. Remove the bolt and disconnect the wire harness bracket.

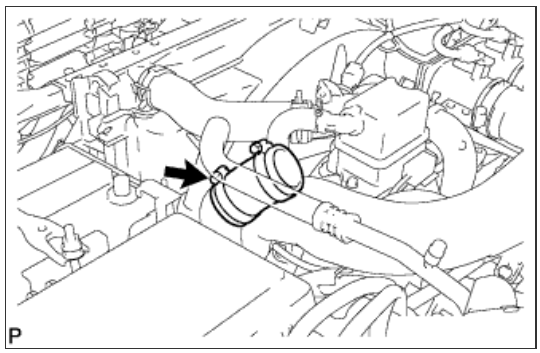


d. Loosen the hose clamp and remove the bolt and No. 3 air tube.



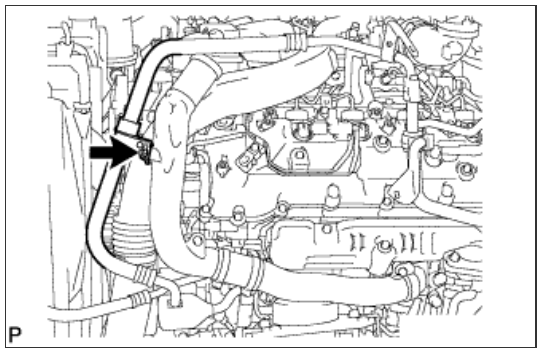
25. REMOVE NO. 2 AIR HOSE

a. Loosen the hose clamp and remove the No. 2 air hose.

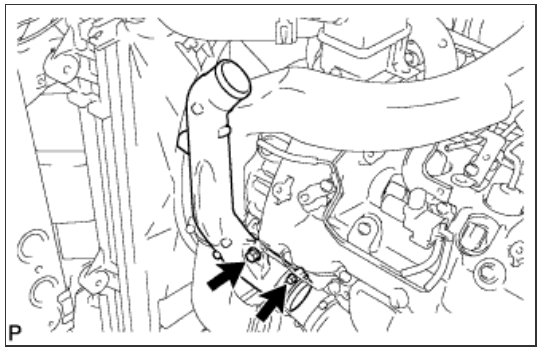


26. REMOVE NO. 4 AIR TUBE

a. Remove the bolt and disconnect the suction hose.



b. Loosen the hose clamp and remove the bolt and No. 4 air tube.

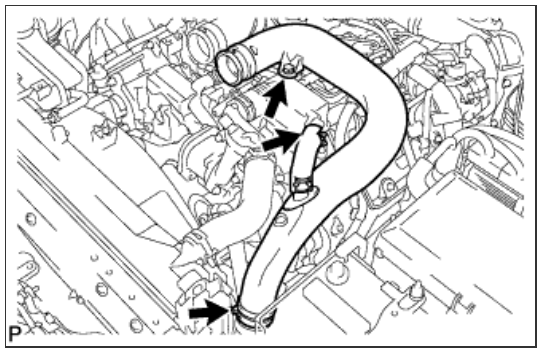


27. REMOVE NO. 2 AIR CLEANER PIPE SUB-ASSEMBLY

a. Disconnect the ventilation hose from the oil separator.

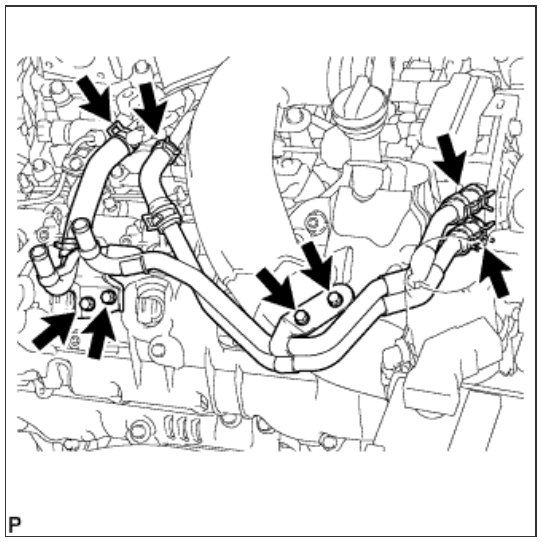
b. Loosen the hose clamp.

c. Remove the bolt and No. 2 air cleaner pipe.



28. REMOVE HEATER WATER PIPE SUB-ASSEMBLY (w/ Viscous Heater)

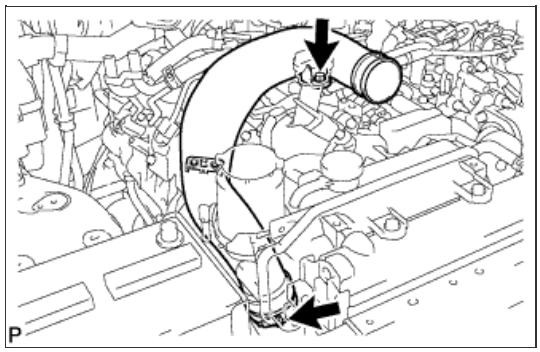
a. Remove the 4 bolts and disconnect the 4 water hose ends, and then remove the heater water pipe.



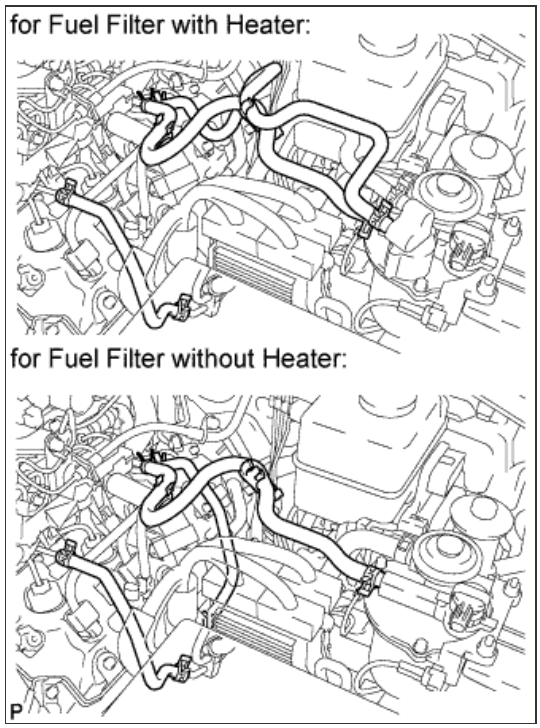
29. REMOVE NO. 1 AIR CLEANER PIPE SUB-ASSEMBLY

a. Loosen the hose clamp.

b. Remove the bolt and No. 1 air cleaner pipe.

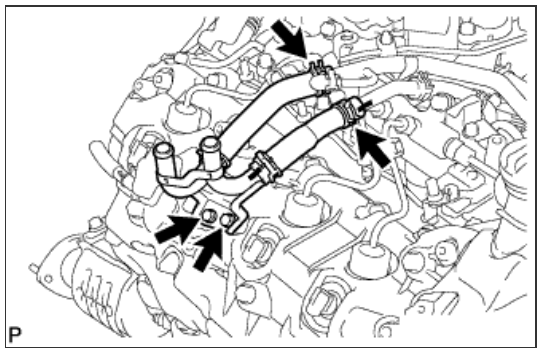


30. DISCONNECT FUEL HOSE



31. REMOVE NO. 3 WATER BY-PASS PIPE (w/o Viscous Heater)

a. Remove the 2 bolts and disconnect the 2 water hose ends, and then remove the No. 3 water by-pass pipe.

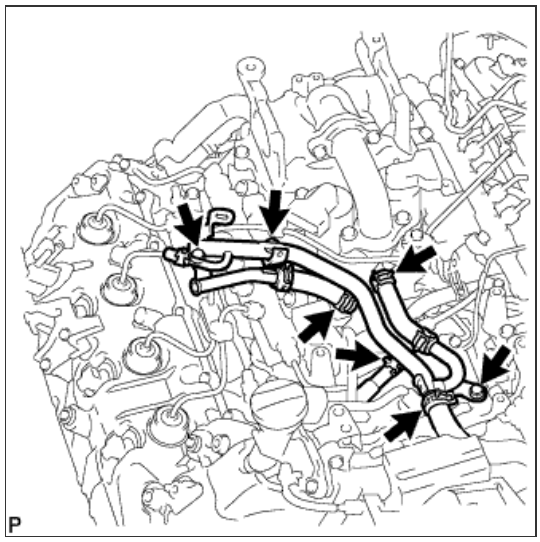


32. REMOVE NO. 4 WATER BY-PASS PIPE

a. w/ System:

i. Remove the 2 bolts and nut.

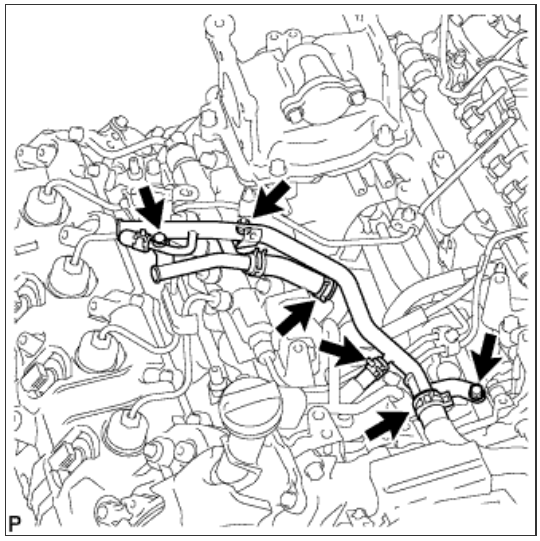
ii. Disconnect the 4 water hose ends, and then remove the No. 4 water by-pass pipe.



b. w/o System:

i. Remove the 2 bolts and nut.

ii. Disconnect the 3 water hose ends, and then remove the No. 4 water by-pass pipe.

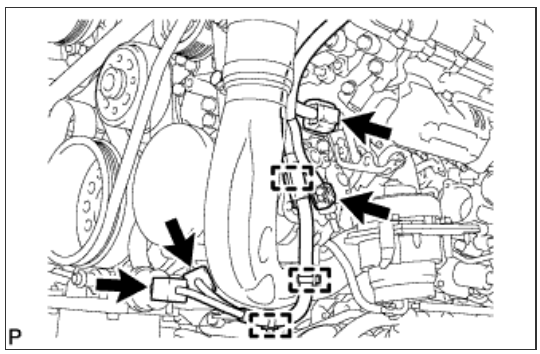


33. DISCONNECT ENGINE WIRE

a. LH Side:

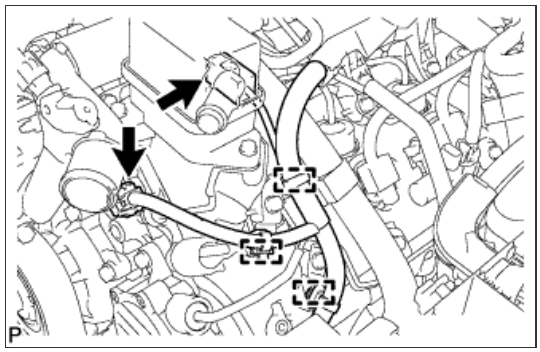
i. Disconnect the 4 connectors.

ii. Using a clip remover, detach the 3 wire harness clamps.



iii. Disconnect the 2 connectors.

iv. Using a clip remover, detach the 3 wire harness clamps.

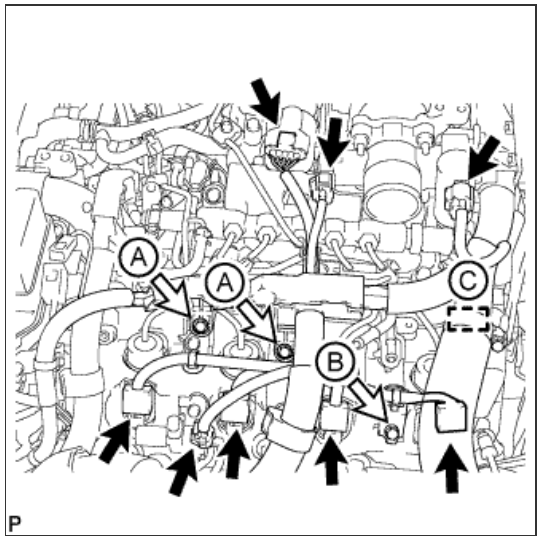


. Disconnect the 8 connectors.

i. Remove the bolt and engine wire harness bracket labeled B.

ii. Remove the 2 bolts and disconnect the engine wire protector labeled A.

iii. for RHD:
Disconnect the wire harness from the wire harness clamp holder labeled C.



b. RH Side:

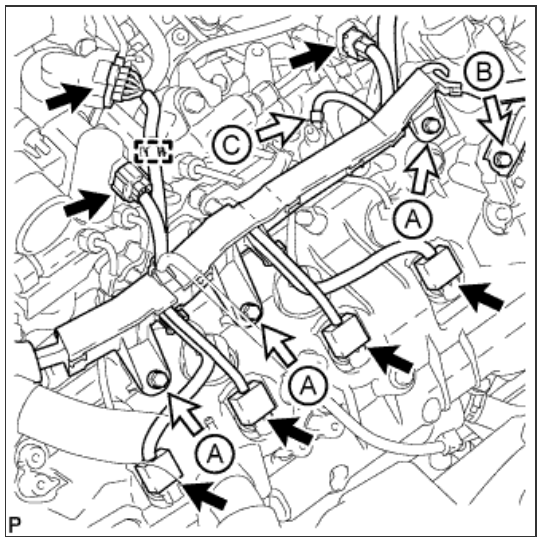
i. Disconnect the 7 connectors.

ii. Using a clip remover, detach the wire harness clamp.

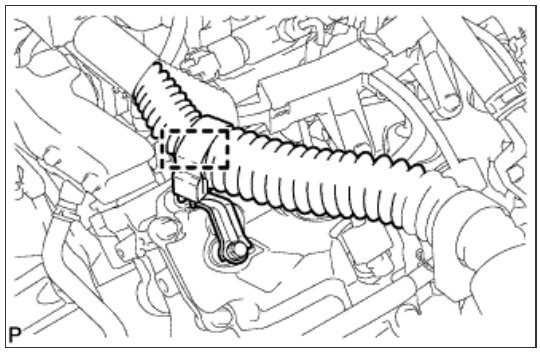
iii. Remove the 3 bolts and disconnect the wire harness protector labeled A.

i . Remove the bolt and wire harness bracket labeled B.

. Remove the nut and glow plug wire harness labeled C.



i. for RHD:
Disconnect the wire harness from the wire harness clamp holder.



c. Rear Side:

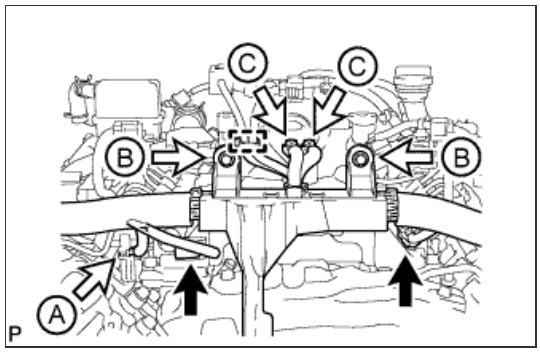
i. Using a clip remover, detach the wire harness clamp.

ii. Remove the 2 bolts and 2 ground wires labeled C.

iii. Remove the 2 bolts and disconnect the engine wire harness protector labeled B.

i . Disconnect the 2 common rail connectors.

. Remove the nut and disconnect the glow plug wire harness labeled A.



34. REMOVE NO. 2 FUEL PIPE SUB-ASSEMBLY

NOTICE:

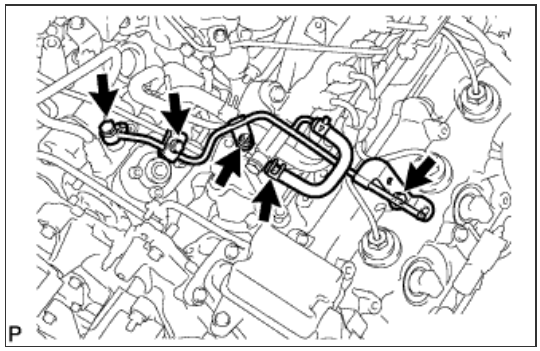
- **After removing a fuel pipe, to prevent dirt or foreign objects from entering the fuel pipe ends, cover the fuel pipe ends with plastic bags.**
- **After removing a fuel pipe, to prevent dirt or foreign objects from entering the fuel supply pump hole, cover the hole with protective tape.**

a. Disconnect the fuel hose from the No. 5 nozzle leakage pipe.

b. Remove the bolt and No. 2 injection pipe clamp.

c. Remove the union bolt and gasket.

d. Remove the bolt, nut and No. 2 fuel pipe.



35. REMOVE NO. 6 INJECTION PIPE SUB-ASSEMBLY

NOTICE:

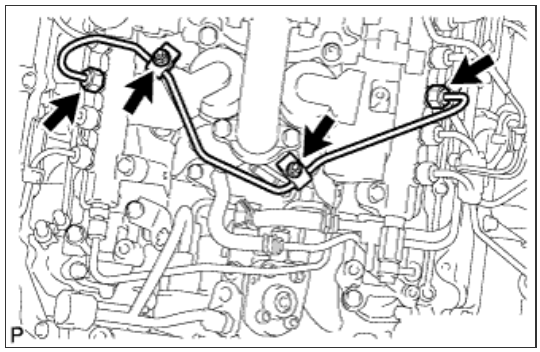
After removing an injection pipe, to prevent dirt or foreign objects from entering the common rail holes, cover the holes with protective tape.

a. w/ System:

i. Using a union nut wrench, loosen the No. 6 injection pipe ends.

ii. Remove the 2 nuts and 2 No. 2 injection pipe clamps.

iii. Remove the No. 6 injection pipe.

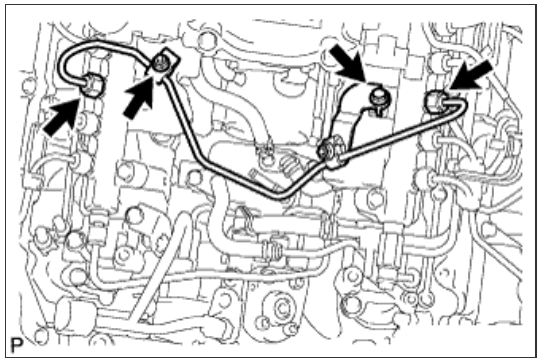


b. w/o System:

i. Using a union nut wrench, loosen the No. 6 injection pipe ends.

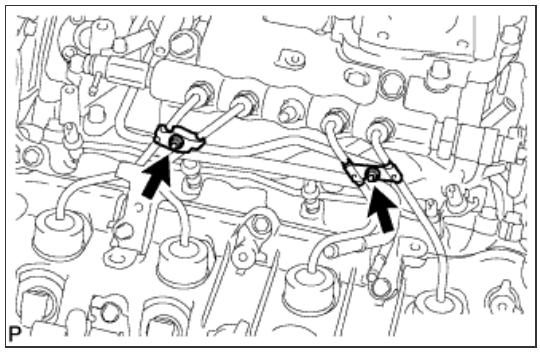
ii. Remove the nut and No. 2 injection pipe clamp.

iii. Remove the bolt and No. 6 injection pipe.



36. REMOVE INJECTION PIPE LH

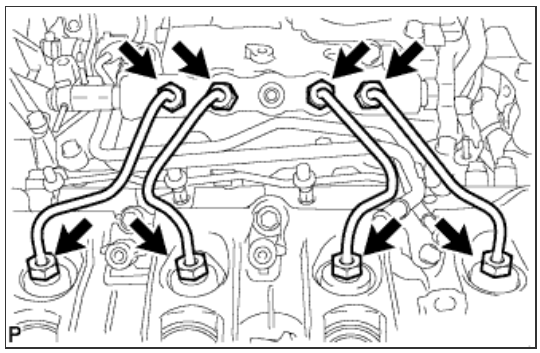
a. w/ ntercooler:
Remove the 2 nuts and 4 injection pipe clamps.



b. Using a union nut wrench, remove the 4 injection pipes.

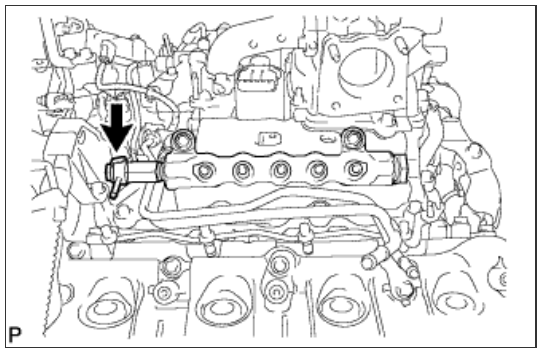
NOTICE:

After removing an injection pipe, to prevent dirt or foreign objects from entering the common rail holes or injector holes, cover the holes with protective tape.



37. REMOVE NO. 5 NOZZLE LEAKAGE PIPE

a. Remove the union bolt, gasket and No. 5 nozzle leakage pipe.

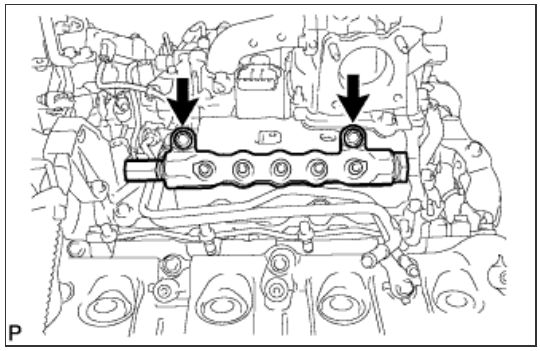


38. REMOVE COMMON RAIL ASSEMBLY LH

a. Remove the 2 bolts and common rail.

NOTICE:

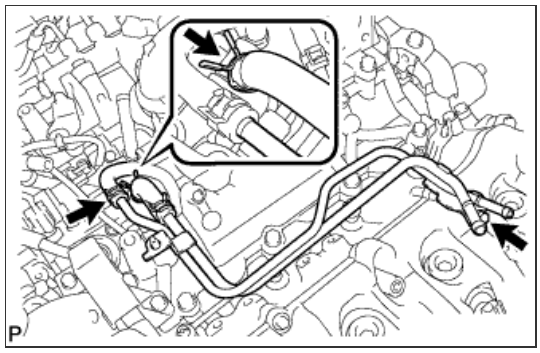
Do not remove the fuel pressure limiter from the common rail. it is removed, replace the common rail.



39. REMOVE FUEL FILTER TO INJECTION PUMP FUEL PIPE SUB-ASSEMBLY

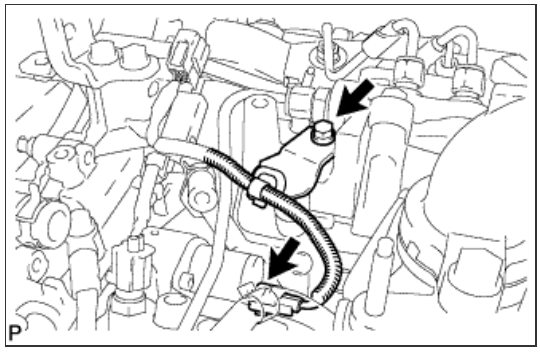
a. Disconnect the 2 hoses from the fuel pipe.

b. Remove the bolt and fuel filter to injection pump fuel pipe.



40. DISCONNECT FUEL PUMP MOTOR WIRE

a. Remove the bolt and disconnect the connector from the fuel supply pump.

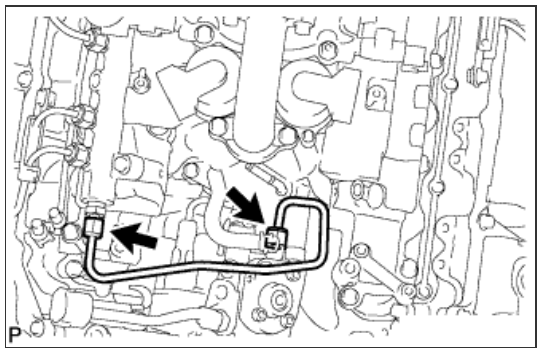


41. REMOVE NO. 5 INJECTION PIPE SUB-ASSEMBLY

a. Using a union nut wrench, remove the No. 5 injection pipe.

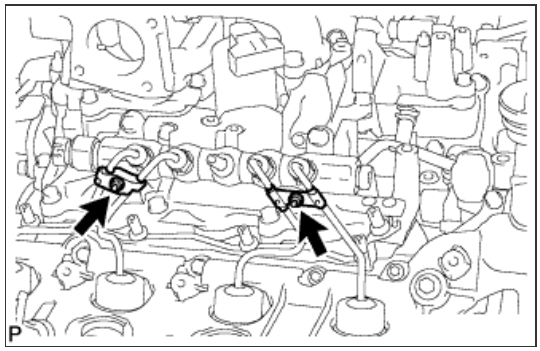
NOTICE:

After removing an injection pipe, to prevent dirt or foreign objects from entering the common rail hole or injection pump hole, cover the holes with protective tape.



42. REMOVE INJECTION PIPE RH

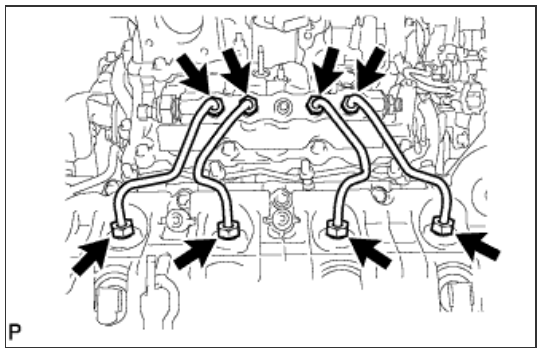
a. w/ ntercooler:
Remove the 2 nuts and 4 injection pipe clamps.



b. Using a union nut wrench, remove the 4 injection pipes.

NOTICE:

After removing an injection pipe, to prevent dirt or foreign objects from entering the common rail holes or injector holes, cover the holes with protective tape.

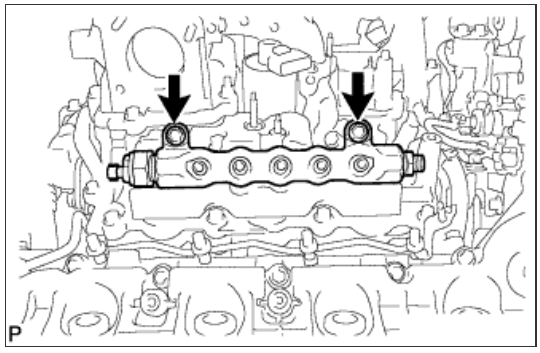


43. REMOVE COMMON RAIL ASSEMBLY RH

a. Remove the 2 bolts and common rail.

NOTICE:

Do not remove the fuel pressure sensor from the common rail. it is removed, replace the common rail.



for Preparation Click here

1. INSPECT COMMON RAIL ASSEMBLY RH

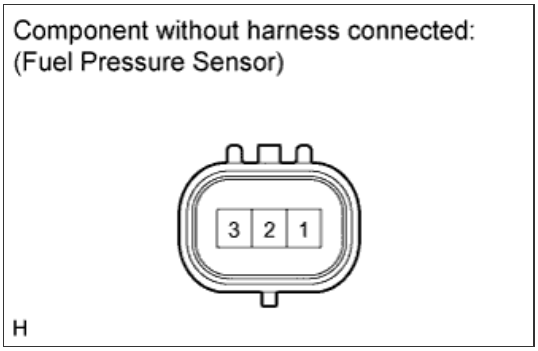
a. Inspect the fuel pressure sensor.

i. esure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	25°C (77°F)	16.4 kΩ or less
2 - 3	25°C (77°F)	3 kΩ or less

If the result is not as specified, replace the common rail assembly RH.



for Preparation Click here

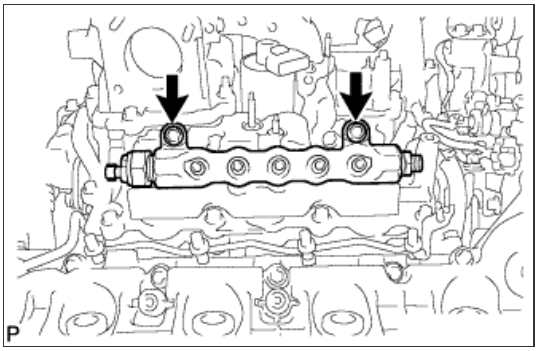
NOTICE:

When replacing an injector (including interchanging injectors between cylinders), common rail, replace the corresponding injection pipes with a new one.

1. INSTALL COMMON RAIL ASSEMBLY RH

a. Install the common rail with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



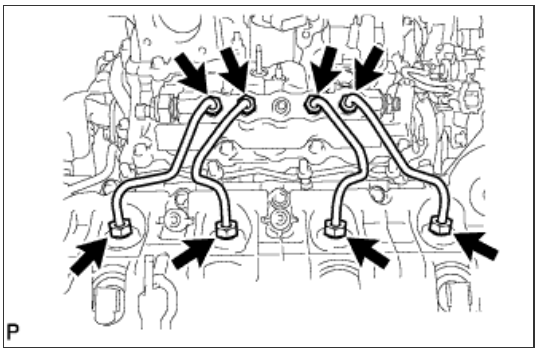
2. INSTALL INJECTION PIPE RH

a. Using a union nut wrench, install the 4 new injection pipes.

Torque:
without union nut wrench:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }
with union nut wrench:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

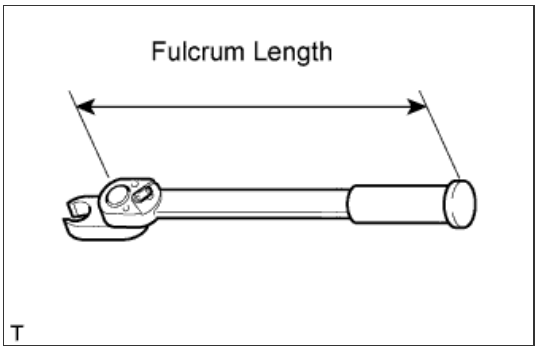
NOTICE:

Make sure there is no damage or foreign matter on the seal surfaces.



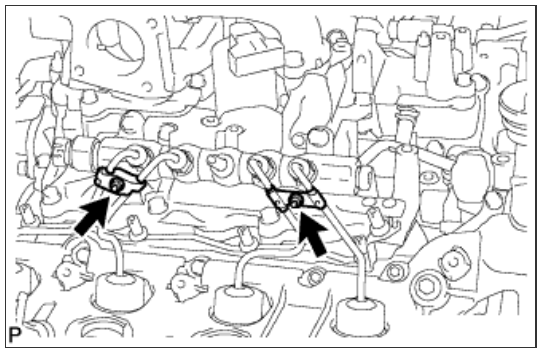
HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure the union nut wrench and the torque wrench are connected in a straight line.**



b. w/ Intercooler:
Install the 4 injection pipe clamps with the 2 nuts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

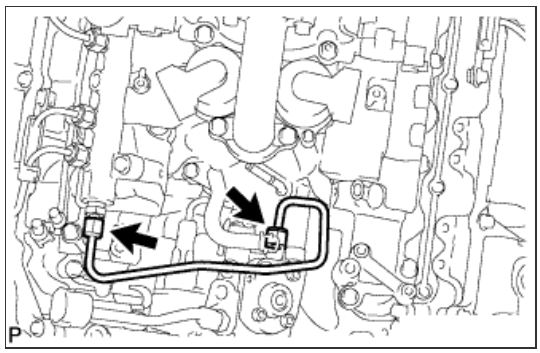


3. INSTALL NO. 5 INJECTION PIPE SUB-ASSEMBLY

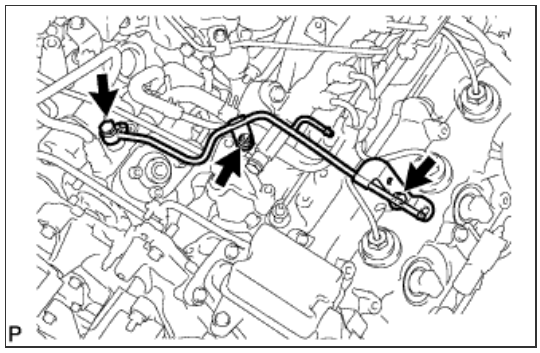
a. Temporarily install a new No. 5 injection pipe by hand.

NOTICE:

Make sure there is no damage or foreign matter on the seal surfaces.

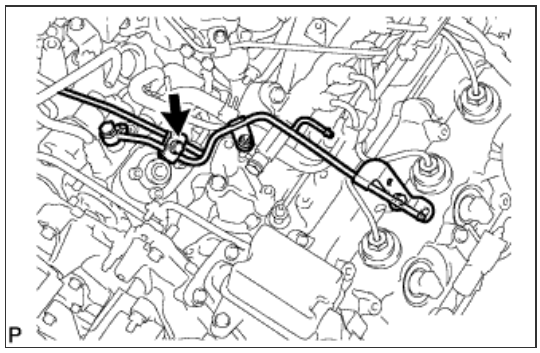


b. Temporarily install the used gasket and No. 2 fuel pipe with the nut, bolt and union bolt.



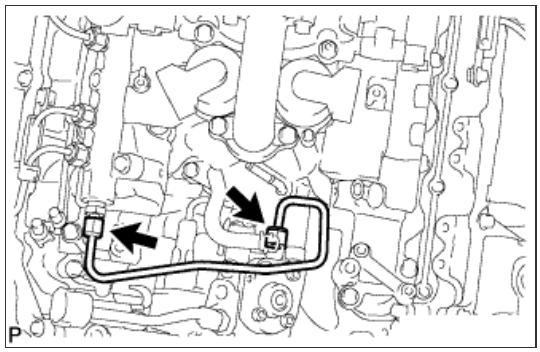
c. Temporarily install the No. 2 injection pipe clamp with the bolt.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



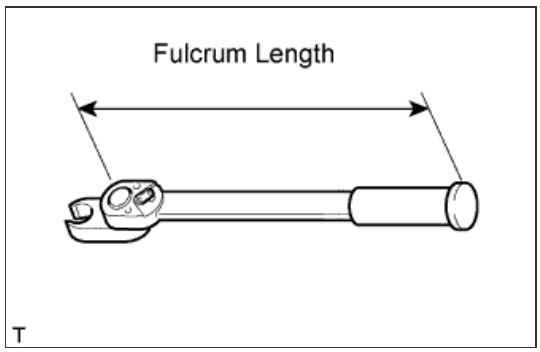
d. Using a union nut wrench, tighten the No. 5 injection pipe ends.

Torque:
without union nut wrench:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }
with union nut wrench:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

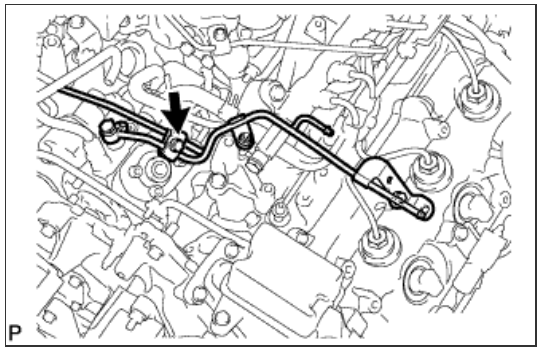


HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure the union nut wrench and the torque wrench are connected in a straight line.**

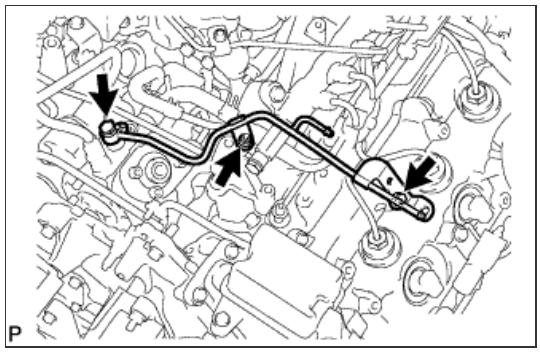


e. Remove the bolt and No. 2 injection pipe clamp.



f. Remove the union bolt and gasket.

g. Remove the bolt, nut and No. 2 fuel pipe.

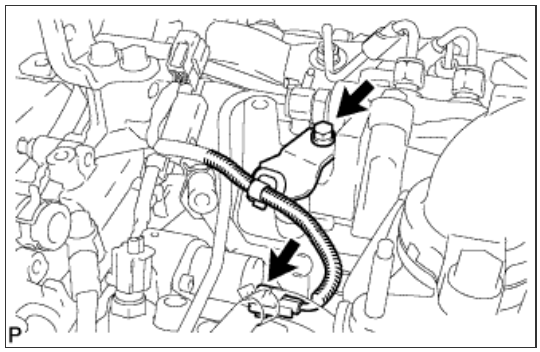


4. CONNECT FUEL PUMP MOTOR WIRE

a. Install the fuel pump motor wire bracket to the No. 3 intake manifold with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Connect the connector to the fuel supply pump.

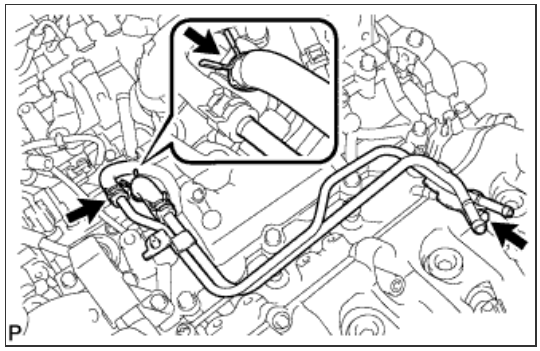


5. INSTALL FUEL FILTER TO INJECTION PUMP FUEL PIPE SUB-ASSEMBLY

a. Install the fuel filter to injection pump fuel pipe with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

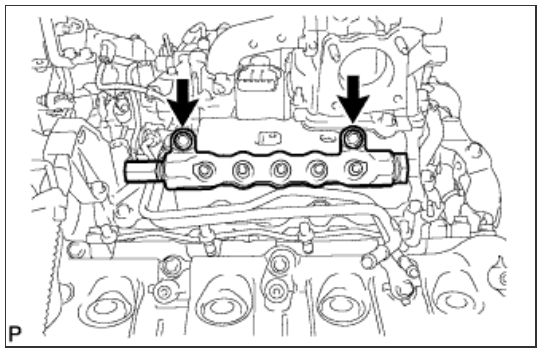
b. Connect the 2 hoses to the fuel pipe.



6. INSTALL COMMON RAIL ASSEMBLY LH

a. Install the common rail with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



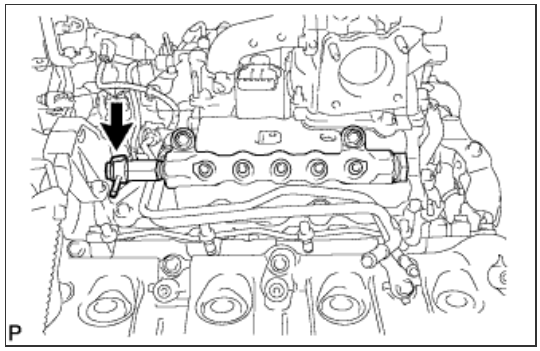
7. INSTALL NO. 5 NOZZLE LEAKAGE PIPE

a. Install a new gasket and the leakage pipe with the union bolt.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

NOTICE:

Make sure there is no foreign matter or damage on the seal surface.



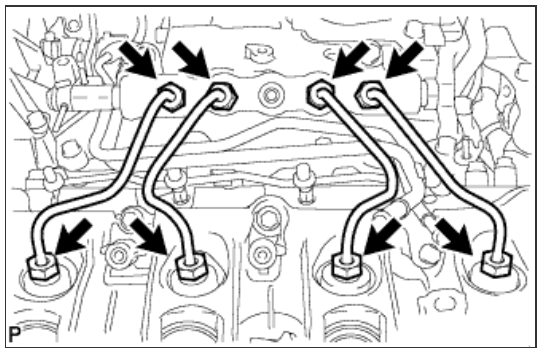
8. INSTALL INJECTION PIPE LH

a. Using a union nut wrench, install the 4 new injection pipes.

Torque:
without union nut wrench:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }
with union nut wrench:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

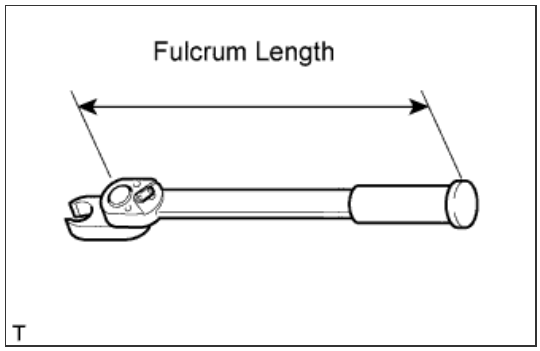
NOTICE:

Make sure there is no damage or foreign matter on the seal surfaces.



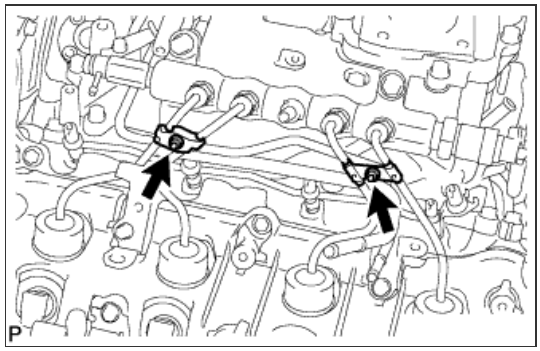
HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure the union nut wrench and the torque wrench are connected in a straight line.**



b. w/ Intercooler:
Install the 4 injection pipe clamps with the 2 nuts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



. INSTALL NO. 6 INJECTION PIPE SUB-ASSEMBLY

a. w/ EGR System:

i. Temporarily install a new No. 6 injection pipe to the common rail LH and RH.

NOTICE:

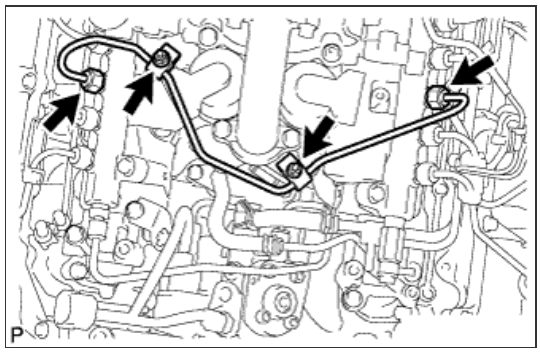
Make sure there is no damage or foreign matter on the seal surfaces.

ii. Install the 2 No. 2 injection pipe clamps with the 2 nuts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

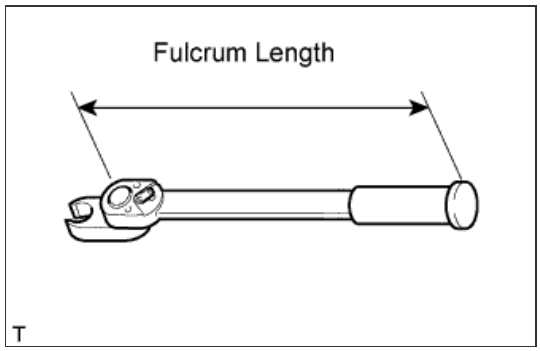
iii. Using a union nut wrench, tighten the No. 6 injection pipe ends.

Torque:
without union nut wrench:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }
with union nut wrench:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

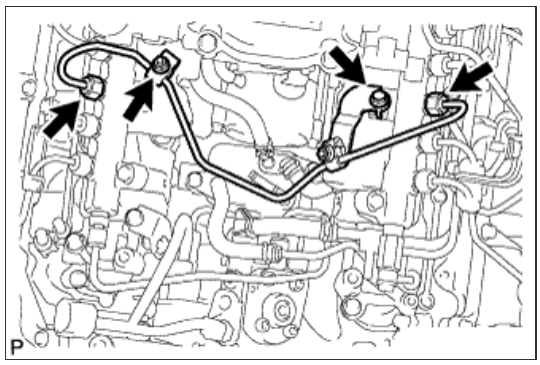


HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure the union nut wrench and the torque wrench are connected in a straight line.**



b. w/o EGR System:



i. Temporarily install a new No. 6 injection pipe to the common rail LH and RH.

NOTICE:

Make sure there is no damage or foreign matter on the seal surfaces.

ii. Install the bracket to the No. 3 intake manifold with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

iii. Install the No. 2 injection pipe clamp with the nut.

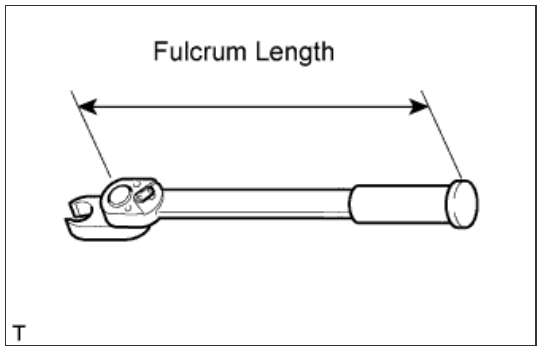
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

i . Using a union nut wrench, tighten the No. 6 injection pipe ends.

Torque:
without union nut wrench:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }
with union nut wrench:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure the union nut wrench and the torque wrench are connected in a straight line.**



10. INSTALL NO. 2 FUEL PIPE SUB-ASSEMBLY

NOTICE:

Check for damage and foreign matter on the fuel pipe installation surface of the supply pump.

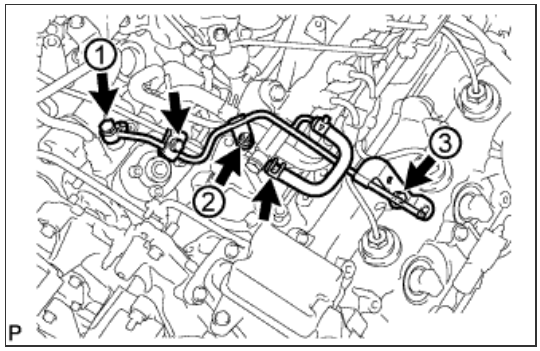
If there is foreign matter, remove it from the installation surface. If the installation surface is damaged, replace the fuel supply pump.

a. Temporarily install a new gasket and the No. 2 fuel pipe with the union

bolt, nut and bolt.

b. Tighten the union bolt, nut and bolt in the order shown in the illustration.

Torque:
for union bolt:
10 N*m{ 105 kgf*cm , 8 ft.*lbf }
for bolt and nut:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



c. Install the No. 2 injection pipe clamp with the bolt.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

d. Connect the fuel hose to the No. 5 nozzle leakage pipe.

11. CONNECT ENGINE WIRE

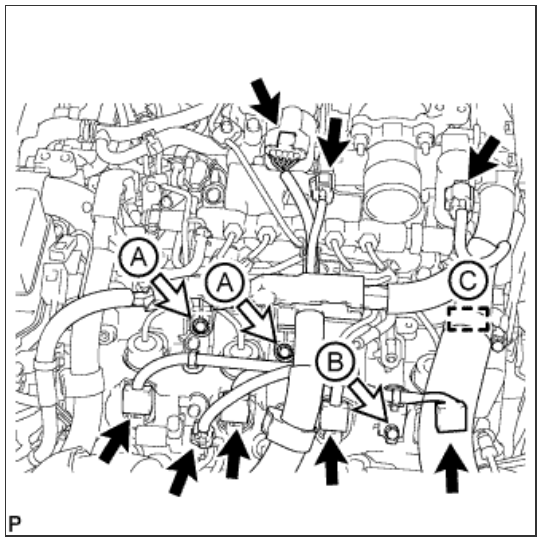
a. LH Side:

i. Install the engine wire protector with the 2 bolts labeled A.

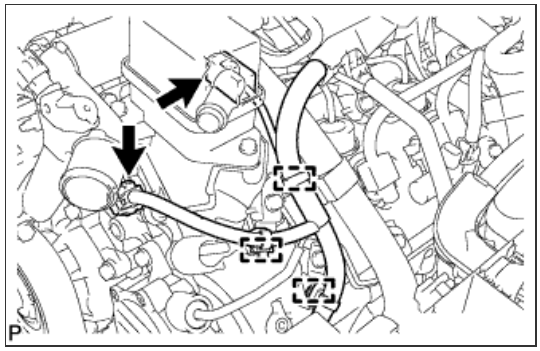
ii. Connect the 8 connectors.

iii. Install the engine wire harness bracket with the bolt labeled

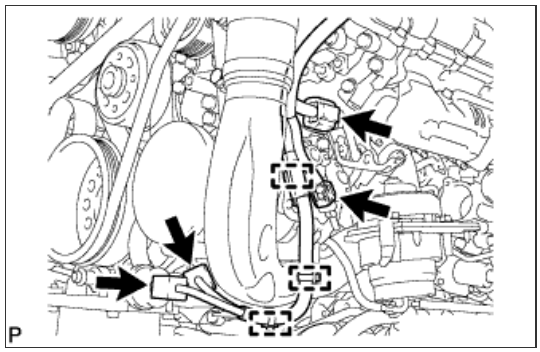
i . r RHD:
Connect the wire harness with the wire harness clamp holder labeled C.



. Attach the 3 wire harness clamps and connect the 2 connectors.



i. Attach the 3 wire harness clamps and connect the 4 connectors.



b. RH Side:

i. Install the engine wire harness protector with the 3 bolts labeled A.

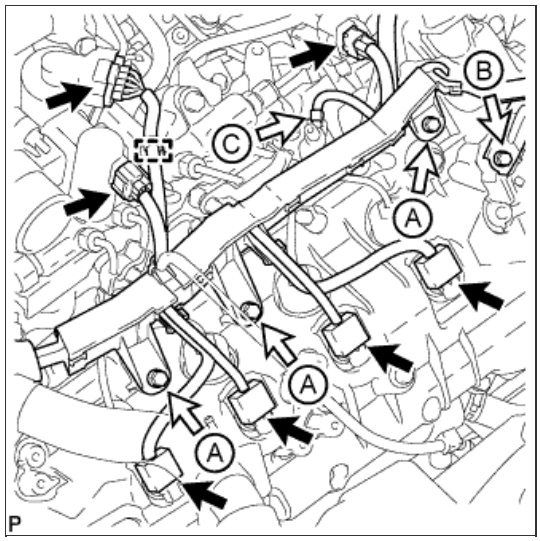
ii. Connect the 7 connectors.

iii. Attach the wire harness clamp.

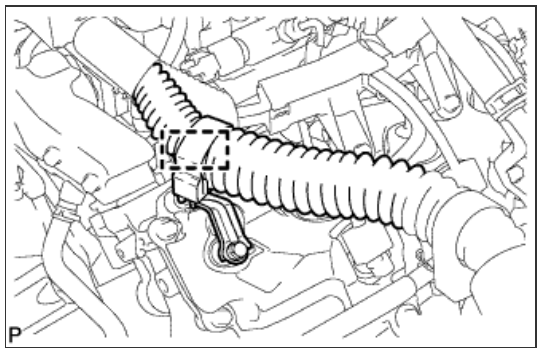
i . Install the wire harness bracket with the bolt labeled

. nstall the glow plug wire harness labeled C with the nut.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }



i. for RHD:
Connect the wire harness with the wire harness clamp holder.



c. Rear Side:

i. Install the glow plug wire harness with the nut labeled A.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }

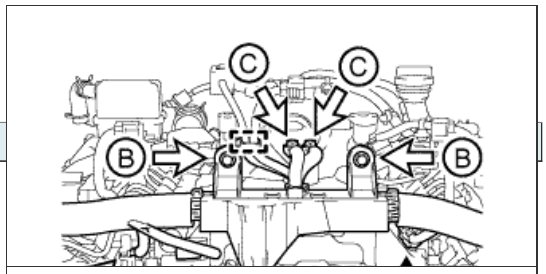
ii. Connect the 2 common rail connectors.

iii. Install the engine wire harness protector with the 2 bolts labeled

i . nstall the 2 ground wires with the 2 bolts labeled C.

Torque:
8.4 N*m{ 87 kgf*cm , 74 in.*lbf }

. Attach the wire harness clamp.

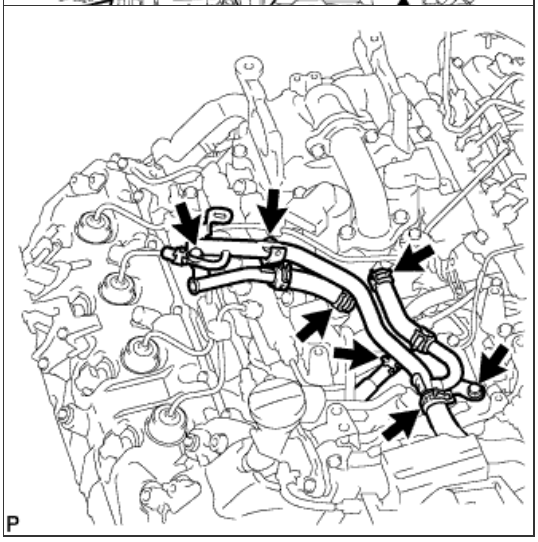


12. INSTALL NO. 4 WATER BY-PASS PIPE

a. w/ EGR System:
Connect the 4 water hose ends, and temporarily install the No. 4 water by-pass pipe with the 2 bolts and nut.

b. First tighten the 2 bolts and then tighten the nut.

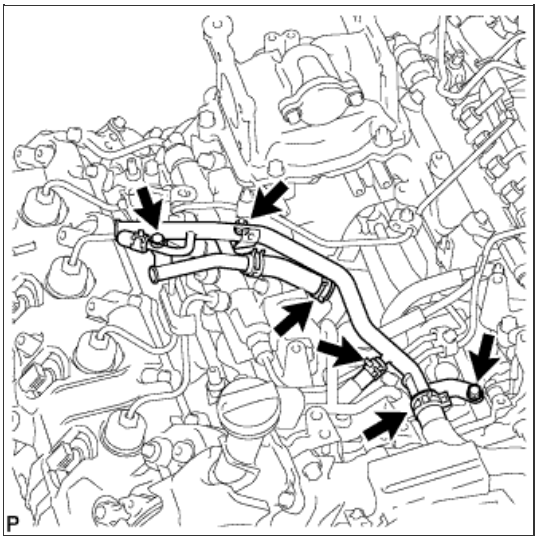
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



c. w/o EGR System:
Connect the 3 water hose ends, and temporarily install the No. 4 water by-pass pipe with the 2 bolts and nut.

d. First tighten the 2 bolts and then tighten the nut.

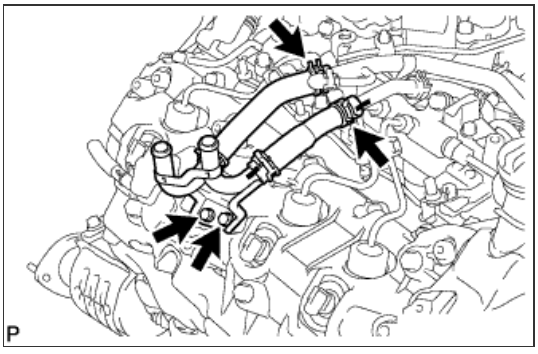
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



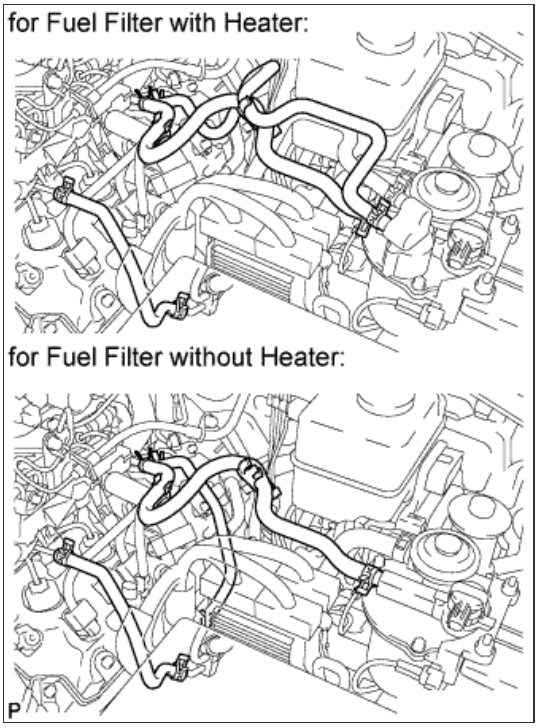
13. INSTALL NO. 3 WATER BY-PASS PIPE (w/o Viscous Heater)

a. Connect the 2 water hose ends, and install the No. 3 water by-pass pipe with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



14. CONNECT FUEL HOSE



15. INSTALL NO. 1 AIR CLEANER PIPE SUB-ASSEMBLY

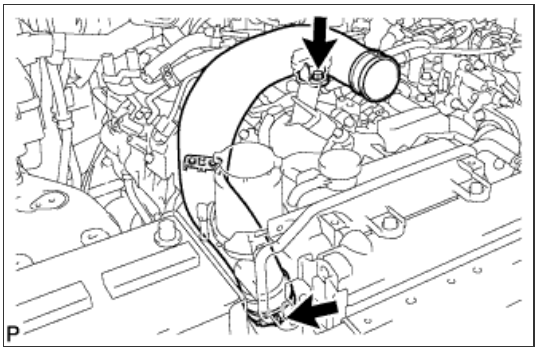
a. Connect the No. air cleaner pipe to the No. intake air connector pipe.

b. Install the pipe with the bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Tighten the hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



16. INSTALL HEATER WATER PIPE SUB-ASSEMBLY (w/ Viscous Heater)

a. Connect the 4 water hose ends, and install the water pipe with the 4 bolts.

Torque:
.8 N*m{ 100 kgf*cm , 87 in.*lbf }



17. INSTALL NO. 2 AIR CLEANER PIPE SUB-ASSEMBLY

a. Connect the No. 2 air cleaner pipe to the No. 2 intake air connector pipe.

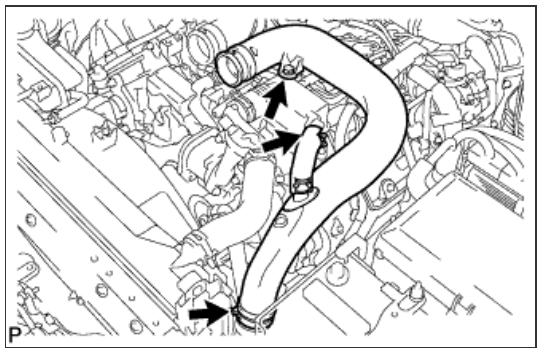
b. Connect the ventilation hose to the oil separator.

c. Install the pipe with the bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

d. Tighten the hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



18. INSTALL NO. 4 AIR TUBE

a. Install the No. 4 air tube with the bolt.

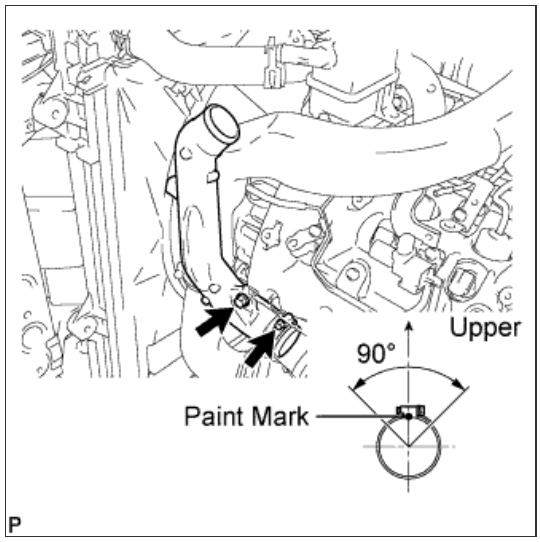
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

b. Tighten the hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

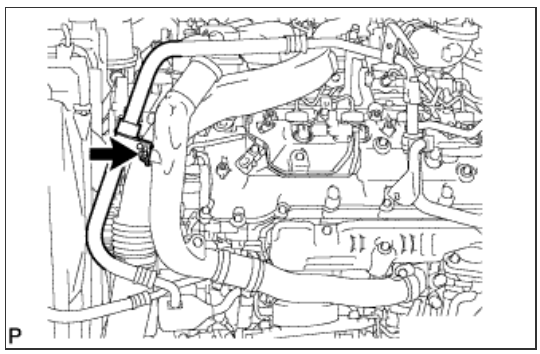
HINT:

Make sure the direction of the hose clamp is as shown in the illustration.



c. Install the suction hose with the bolt.

Torque:
.8 N*m{ 100 kgf*cm , 87 in.*lbf }



1 . INSTALL NO. 2 AIR HOSE

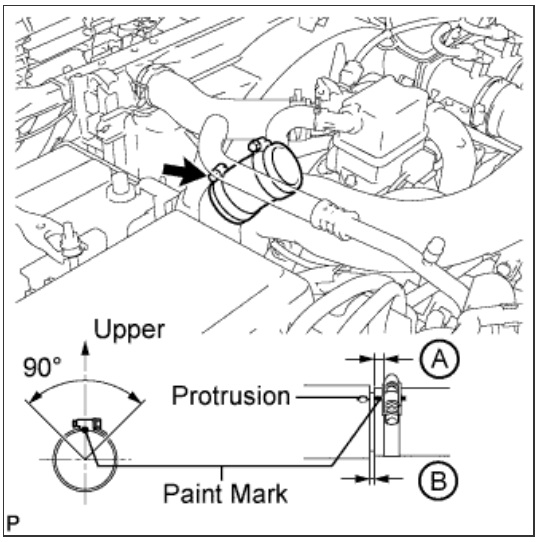
a. Connect the No. 2 air hose with the hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion and push in the air hose so that distance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that distance A is 2 to 6 mm (0.0787 to 0.236 in.).**

- **Make sure the direction of the hose clamp is as shown in the illustration.**



20. INSTALL NO. 3 AIR TUBE

a. Install the No. 3 air tube with the bolt.

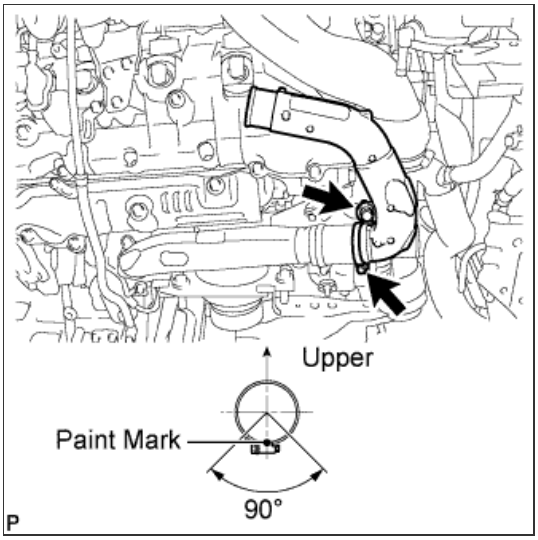
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

b. Tighten the hose clamp.

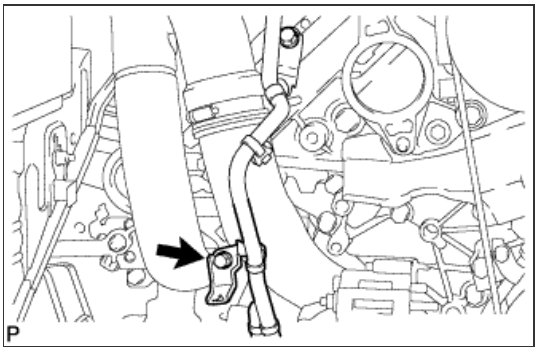
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

Make sure the direction of the hose clamp is as shown in the illustration.

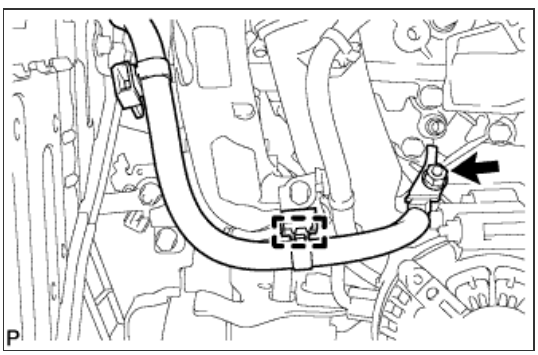


c. Install the wire harness bracket with the bolt.



d. Install the ground wire with the nut, and attach the wire harness clamp.

Torque:
8.4 N*m{ 87 kgf*cm , 74 in.*lbf }



21. INSTALL INTAKE AIR CONNECTOR

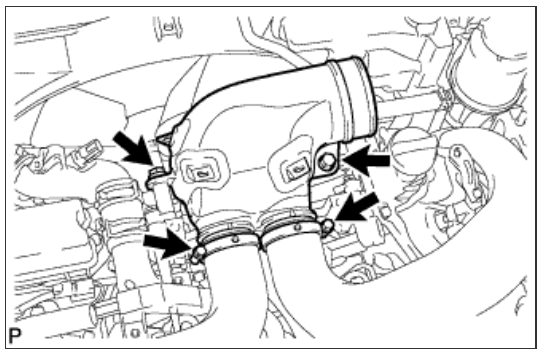
a. Connect the intake air connector to the No. and No. 2 air cleaner pipes.

b. Install the connector with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Tighten the 2 hose clamps.

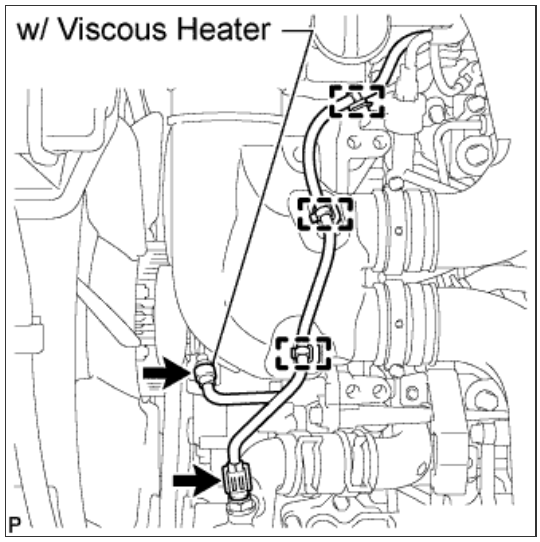
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



d. Attach the 3 wire harness clamps.

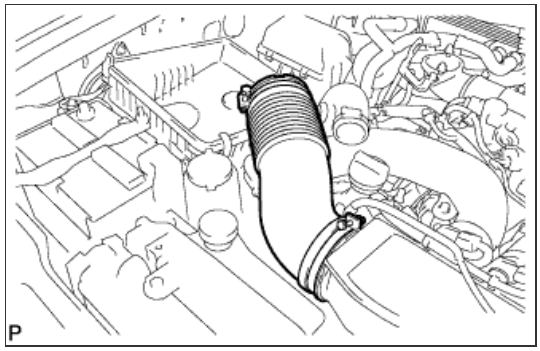
e. w/o Viscous Heater:
Connect the connector to the water temperature sensor.

f. w/ Viscous Heater:
Connect the 2 connectors to the water temperature sensor and viscous with magnet clutch heater.



22. TEMPORARILY INSTALL NO. 1 AIR CLEANER HOSE

a. Temporarily install the air cleaner hose to the intake air connector.

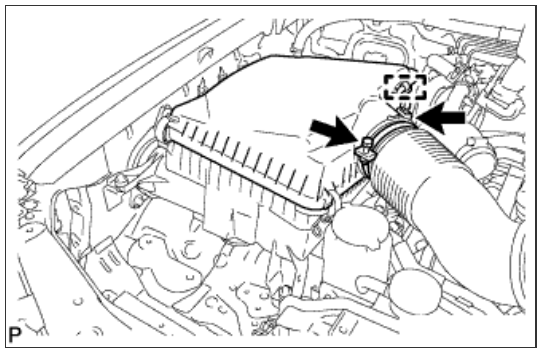


23. INSTALL AIR CLEANER CAP SUB-ASSEMBLY

a. Connect the air cleaner cap to the air cleaner hose, and install the air cleaner cap with the 4 clamps.

b. Connect the mass air flow meter connector and attach the wire harness clamp to the air cleaner cap.

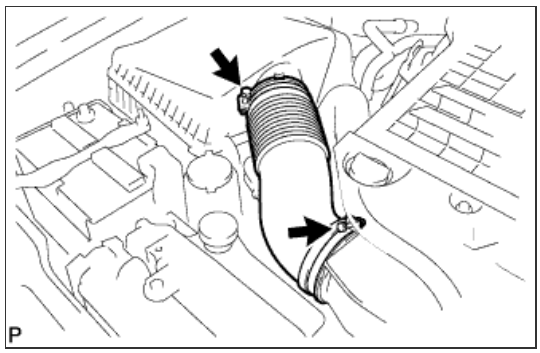
c. Attach the wire harness clamp.



d. Align the protrusion of air cleaner cap and concave portion of air cleaner hose.

e. Tighten the 2 hose clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



24. INSTALL IESEL THROTTLE BO Y ASSEMBLY LH

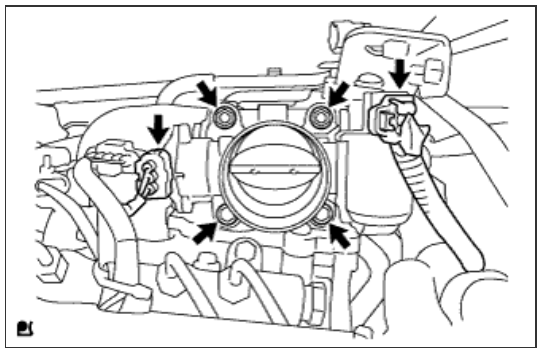
a. Install a new gasket to the intake pipe.

b. Install the throttle body with the 2 bolts and 2 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Connect the throttle position sensor connector.

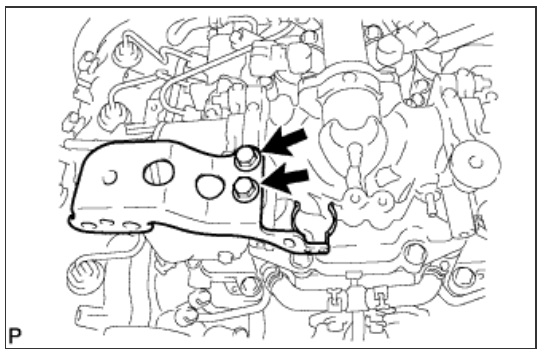
d. Connect the throttle motor connector.



25. INSTALL NO. 3 INTERCOOLER SUPPORT BRACKET

a. Install the bracket with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



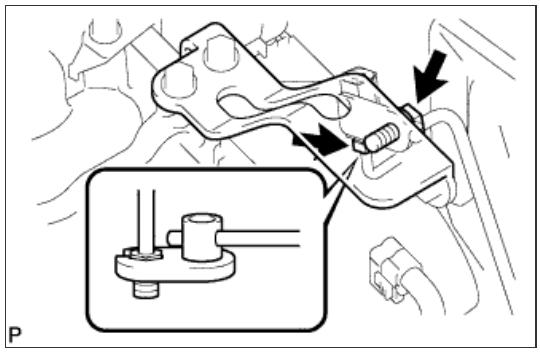
b. for Manual Transmission:

i. Connect the clutch tube to release cylinder 2 way with the bolt.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

ii. Check that the union nut is tightened to the specified torque.

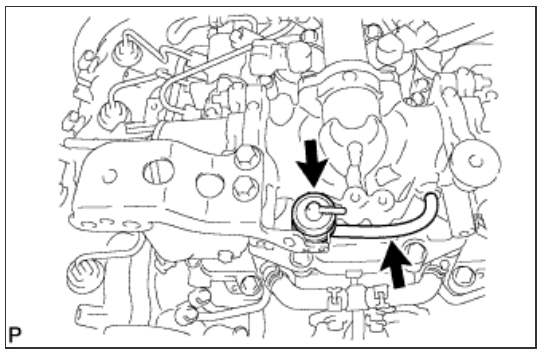
Torque:
without union nut wrench:
15 N*m{ 154 kgf*cm , 11 ft.*lbf }
with union nut wrench:
14 N*m{ 141 kgf*cm , 10 ft.*lbf }



26. INSTALL NO. 1 GAS FILTER

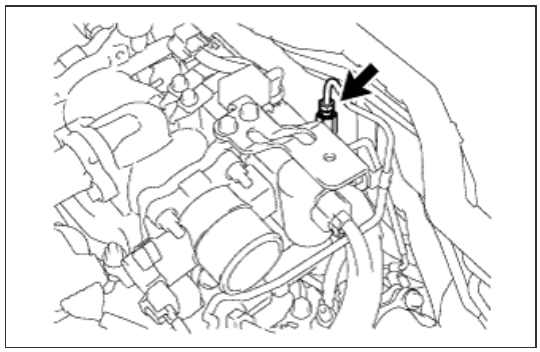
a. Install the gas filter.

b. Connect the hose to the intake pipe.



27. INSTALL TUBE CONNECTOR TO FLE IBLE HOSE TUBE (for Manual Transmission)

a. Temporarily install the flare nut of the tube connector to flexible hose tube to the clutch tube to release cylinder 2 way by hand.



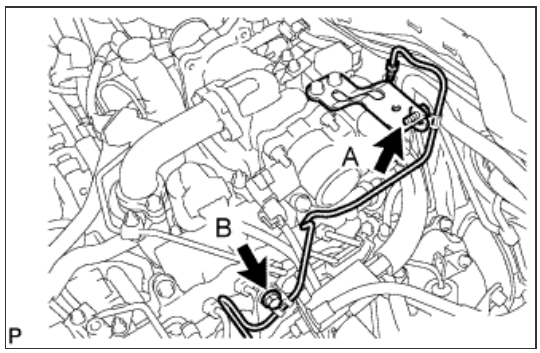
b. Temporarily install the tube connector to flexible hose tube with the 2 bolts.

c. Tighten the bolt labeled A.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

NOTICE:

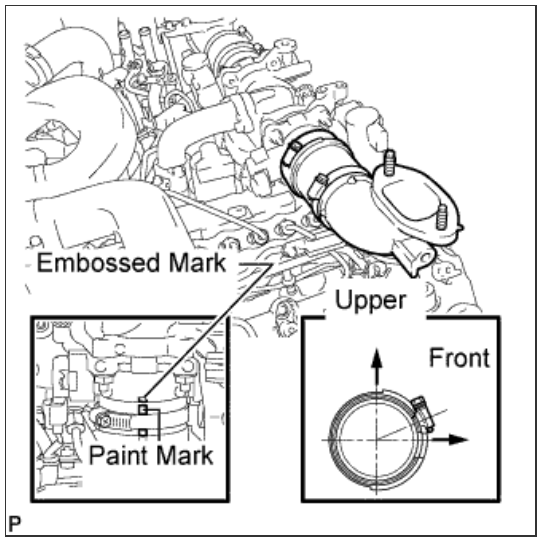
Tighten the bolt labeled after installing the clutch hose.



28. INSTALL AIR TUBE SUB-ASSEMBLY LH

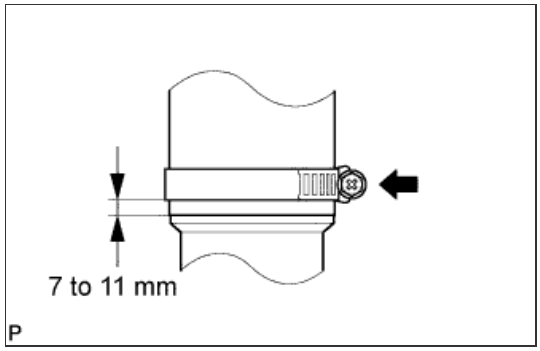
a. Install the air tube to the throttle body.

b. Align the embossed mark of the throttle body with the paint mark of the No. 4 air hose.



c. Tighten the hose clamp so that it is 7 to mm (0.276 to 0.433 in.) from the end of the hose as shown in the illustration.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



2 . INSTALL CLUTCH HOSE (for Manual Transmission)

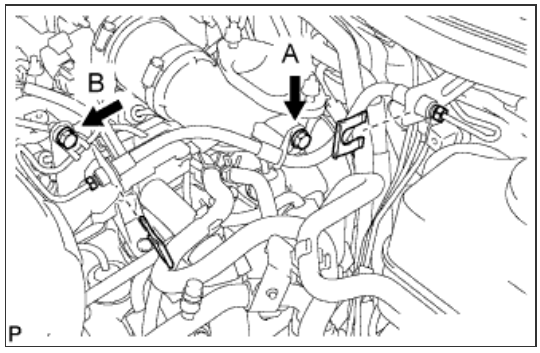
a. Connect the clutch hose to the air tube with the bolt labeled A.

b. Temporarily install the clutch hose to the clutch master cylinder tube to flexible hose tube and tube connector to flexible hose tube, and fix it in place with the 2 clips.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

c. Tighten the bolt labeled

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }



d. ighten the flexible hose tube.

NOTICE:

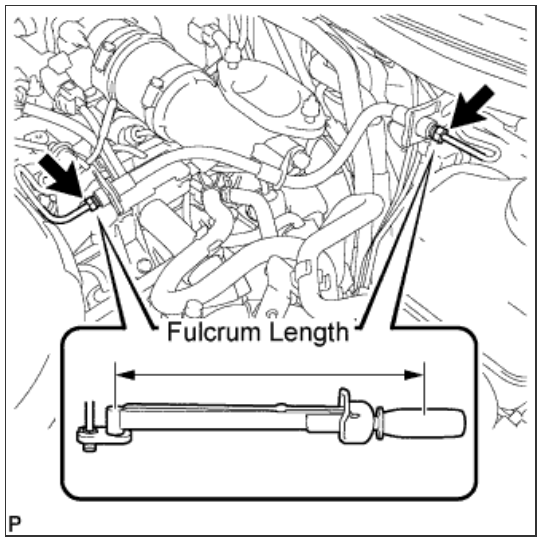
- **o not bend or damage the fle ible hose tube.**
- **o not allow an foreign matter such as dirt and dust to enter the fle ible hose tube from the connecting points.**

HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.). If using a torque wrench with a length that is not 30 cm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the without SST torque specification (Click here).**
- **Make sure union nut wrench and the wrench are connected in a straight line.**

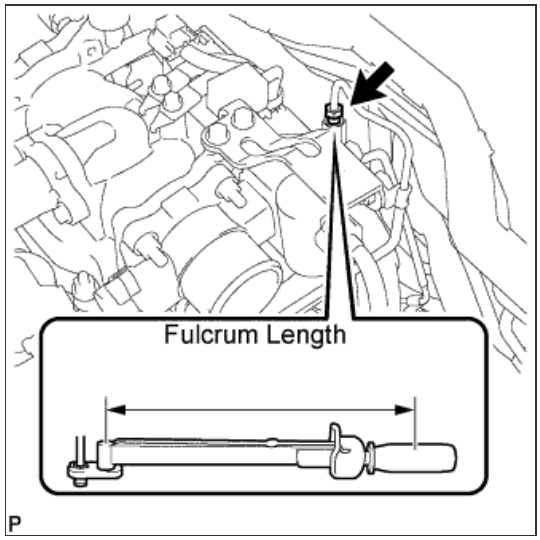
i. Using a mm union nut wrench, tighten the 2 flare nuts of the flexible hose tube.

Torque:
without union nut wrench:
15 N*m{ 154 kgf*cm , 11 ft.*lbf }
with union nut wrench:
14 N*m{ 141 kgf*cm , 10 ft.*lbf }



ii. Using a mm union nut wrench, tighten the flare nut of the flexible hose tube.

Torque:
without union nut wrench:
15 N*m{ 154 kgf*cm , 11 ft.*lbf }
with union nut wrench:
14 N*m{ 141 kgf*cm , 10 ft.*lbf }



30. INSTALL IESEL THROTTLE BO Y ASSEMBLY RH

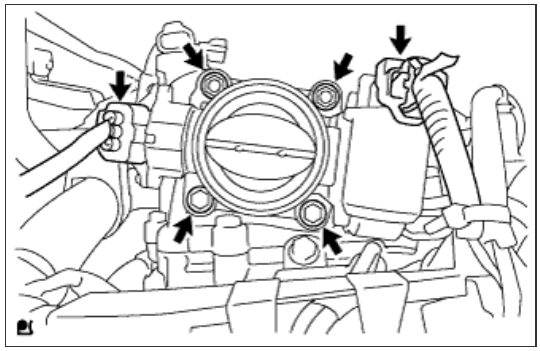
a. Install a new gasket to the intake pipe.

b. Install the throttle body with the 2 bolts and 2 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Connect the throttle position sensor connector.

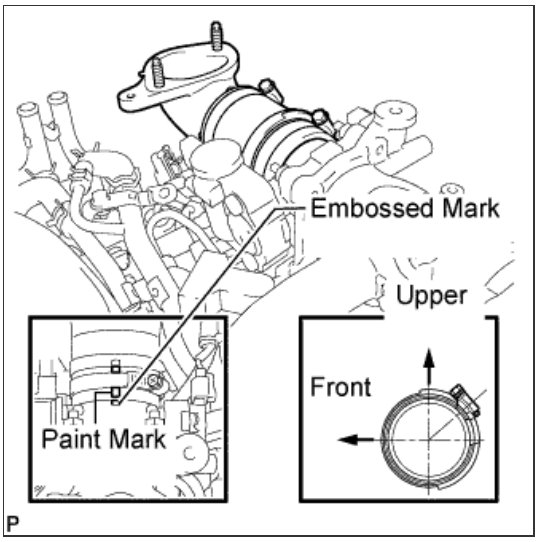
d. Connect the throttle motor connector.



31. INSTALL AIR TUBE SUB-ASSEMBLY RH

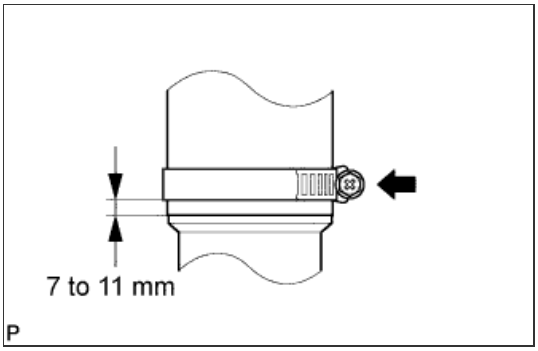
a. Install the air tube to the throttle body.

b. Align the embossed mark of the throttle body with the paint mark of the No. 4 air hose.



c. Tighten the hose clamp so that it is 7 to mm (0.276 to 0.433 in.) from the end of the hose as shown in the illustration.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



32. INSTALL NO. 2 ENGINE OIL LEVEL IPSTICK GUI E

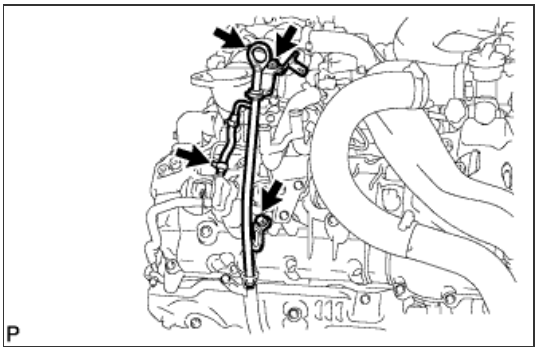
a. Apply a light coat of engine oil to a new O-ring.

b. Install the O-ring to the No. 2 engine oil level dipstick guide.

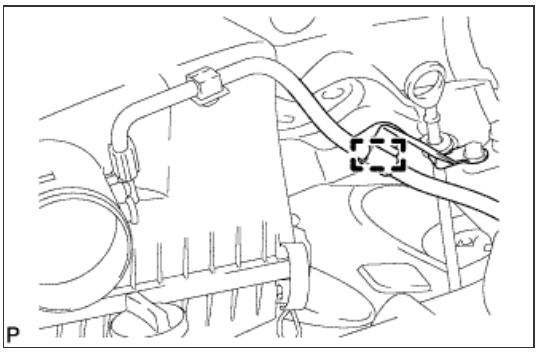
c. Install the No. 2 engine oil level dipstick guide with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

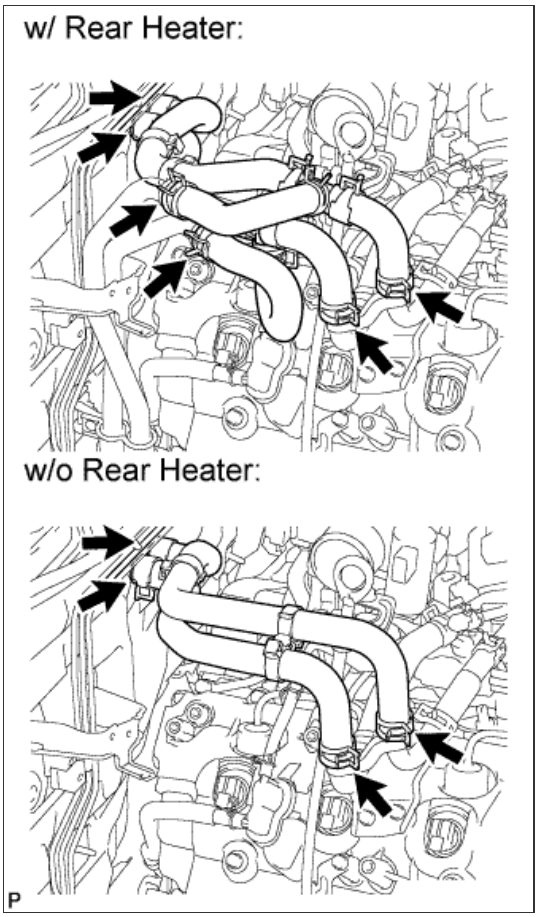
d. Connect the ventilation hose to the cylinder head cover RH.



e. Connect the wire harness clamp to the No. 2 engine oil level dipstick guide bracket.



33. CONNECT WATER HOSE SUB-ASSEMBLY

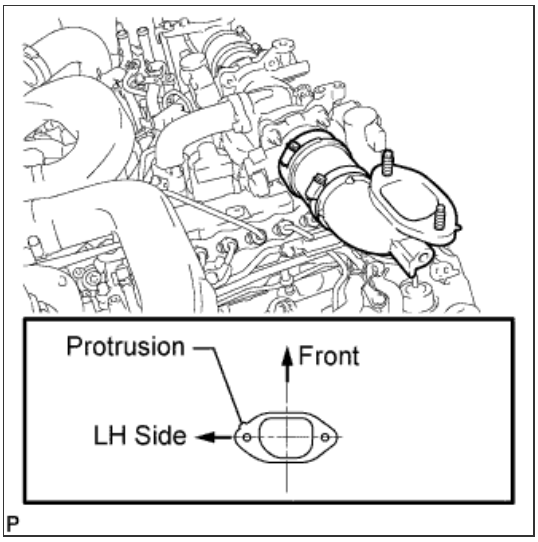


34. INSTALL NO. 2 COOL AIR INLET (w/o Intercooler)

a. Install a new gasket to the air tube LH.

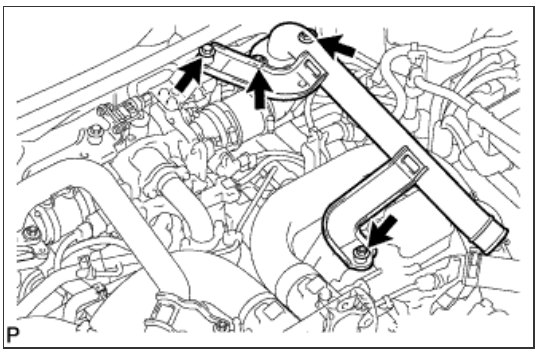
HINT:

Install the gasket with the protrusion facing as shown in the illustration.



b. Install the No. 2 cool air inlet with the 3 nuts and bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



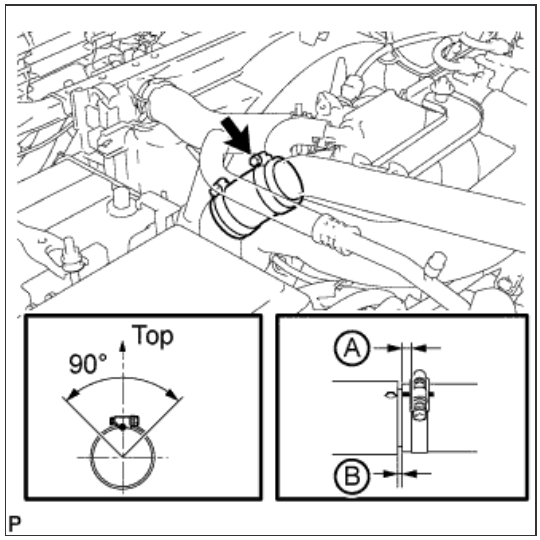
c. Connect the No. 2 air hose to the No. 2 cool air inlet.

d. Tighten the No. 2 air hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion and push on the air hose so that distance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that distance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make sure the direction of the hose clamp is as shown in the illustration.**

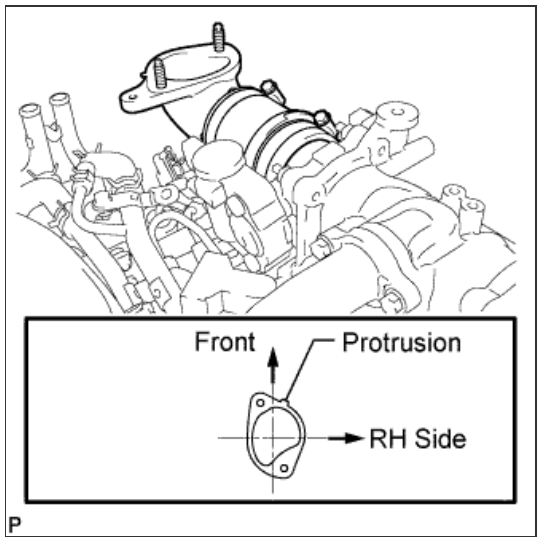


35. INSTALL NO. 1 COOL AIR INLET (w/o Intercooler)

a. Install a new gasket to the air tube RH.

HINT:

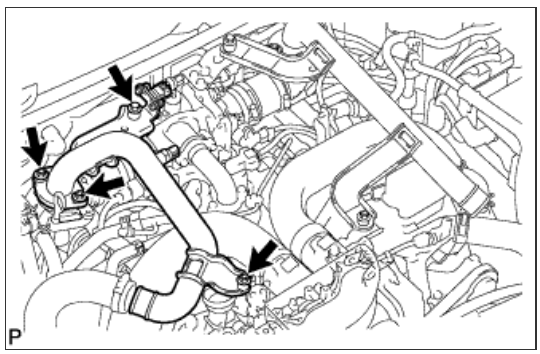
Install the gasket with the protrusion facing as shown in the illustration.



b. Install the No. cool air inlet with the 3 nuts and bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Connect the vacuum hose, intake air temperature sensor connector and turbo pressure sensor connector.



d. Connect the No. air hose to the No. cool air inlet.

e. Tighten the No. air hose clamp.

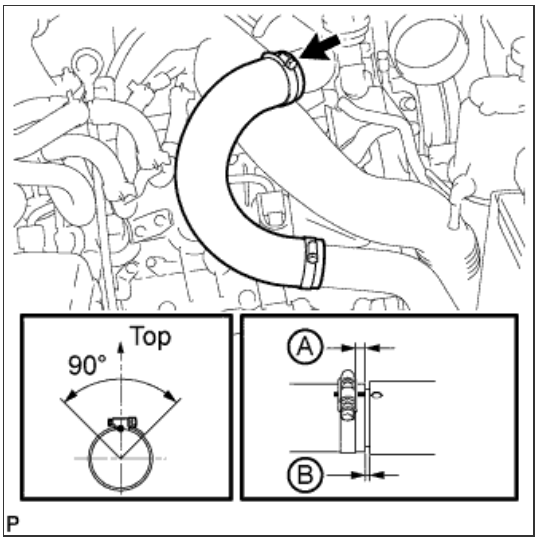
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion and push on the air hose so that distance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that distance A is 2 to 6 mm (0.0787 to**

0.236 in.).

- **Make sure the direction of the hose clamp is as shown in the illustration.**



36. INSTALL INTERCOOLER ASSEMBLY (w/ Intercooler)

a. Install the intercooler assembly (Click here).

37. BLEE CLUTCH LINE (for Manual Transmission)

a. Remove the release cylinder bleeder plug cap.

b. Connect a vinyl tube to the bleeder plug.

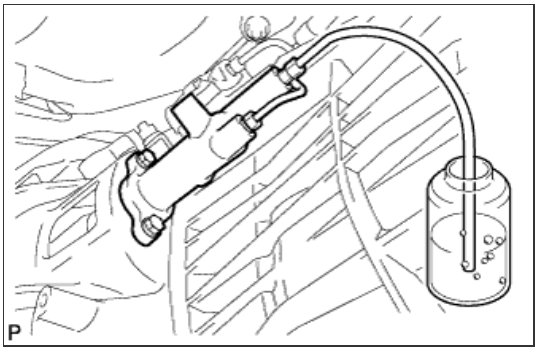
c. Depress the clutch pedal several times, and then loosen the bleeder plug while the pedal is depressed.

d. When fluid no longer comes out, tighten the bleeder plug, and then release the clutch pedal.

e. Repeat the previous 2 steps until all the air in the fluid is completely bled.

f. Tighten the bleeder plug.

Torque:
11 N*m{ 110 kgf*cm , 8 ft.*lbf }



g. Install the bleeder plug cap.

h. Check that all the air has been bled from the clutch line.

38. INSPECT FOR CLUTCH FLUI LEAK (for Manual Transmission)

39. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

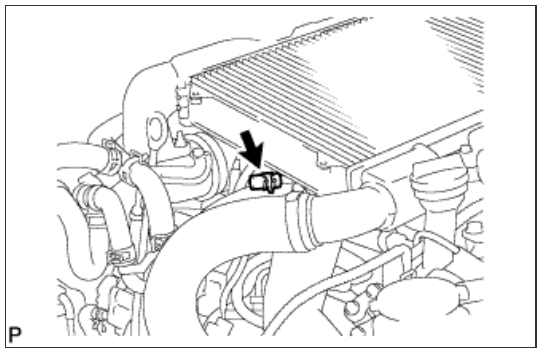
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

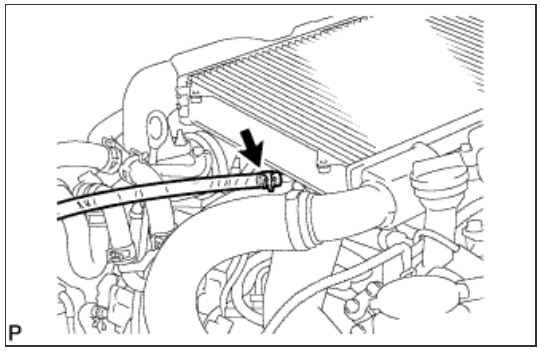
a. Connect the cables to the negative (-) main battery and sub-battery terminals.

40. A ENGINE COOLANT

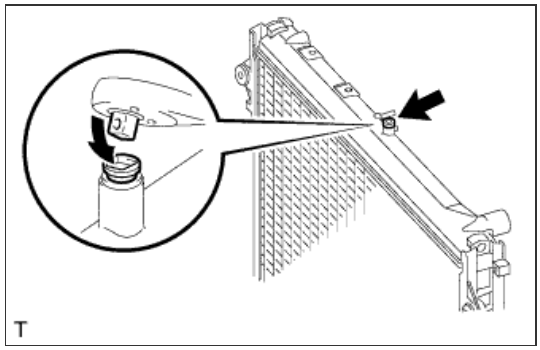
a. Remove the engine air bleed cap.



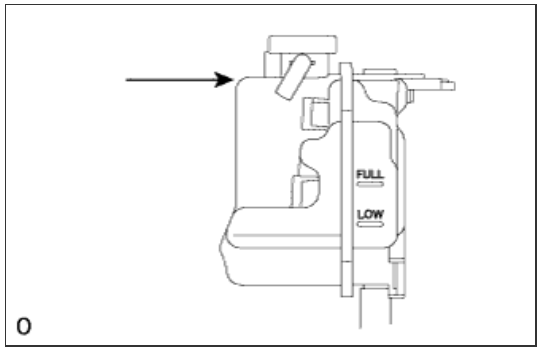
b. Connect a clear hose to the engine air bleed pipe.



c. Using a wrench, remove the vent plug.



d. Fill the radiator with TOYOTA SLLC to the radiator reservoir filler neck.



HINT:

r TOYOTA SLLC until it spills out of the engine air bleed pipe.

Standard Capacit (for Automatic Transmission):

Item	Specified Condition
Front heater only	liters (US qts, p. qts)
Front heater and rear heater	liters (US qts, p. qts)
Front heater with viscous heater	liters (US qts, p. qts)
Front heater and rear heater with viscous heater	liters (US qts, p. qts)

Standard capacit (for Manual Transmission):
15.4 liters (16.3 US qts, 13.6 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

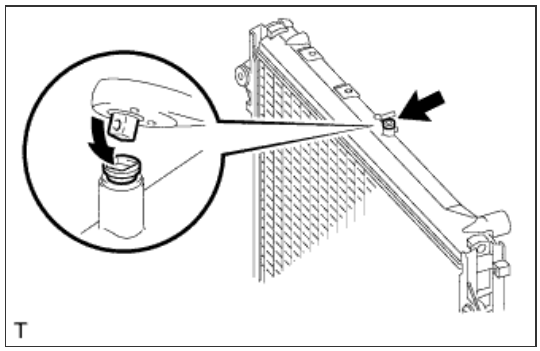
TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

e. Install the vent plug.

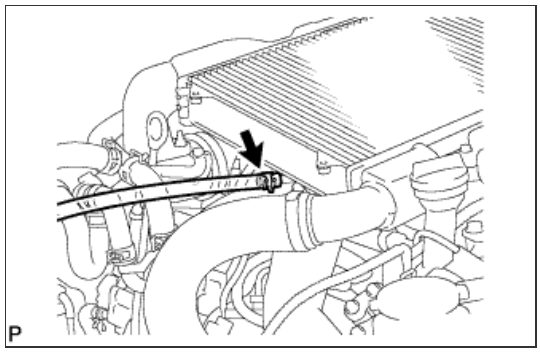
Torque:
2.0 N*m{ 20 kgf*cm , 18 in.*lbf }

NOTICE:

Do not tighten the plug to 5.0 N*m (5 kgf*cm, 44 in.*lbf) or more, as the plug will be damaged.



f. Disconnect the clear hose from the engine air bleed pipe.



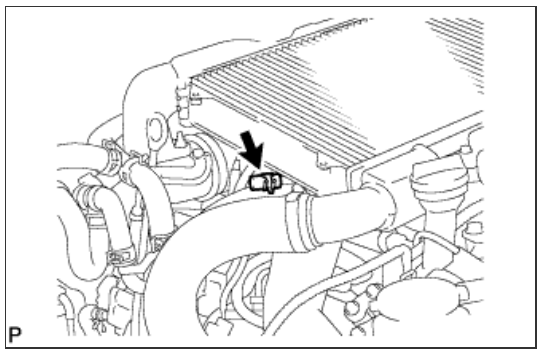
g. Install the engine air bleed cap when coolant comes out.

h. Install the radiator reservoir cap.

i. Start the engine.

NOTICE:

Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the FULL line.



. Maintain an engine speed of 3000 rpm for approximately minutes so that the thermostat opens and air bleeding is performed.

CAUTION:

When pressing the radiator hoses:

- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep our hands awa from the radiator fan**

NOTICE:

- **Pa attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormall high temperature.**
- **If there is not enough coolant, the engine ma burn out or overheat.**

HINT:

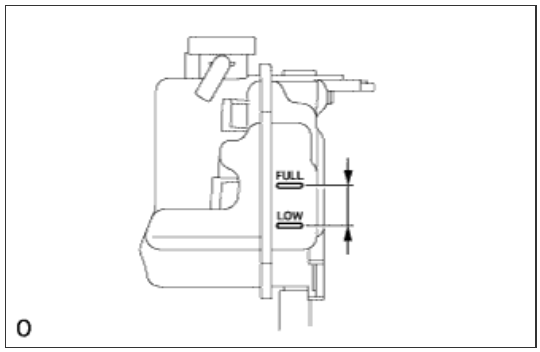
The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

k. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. ressurized, hot engine coolant and steam may be released and cause serious burns.

l. Check that the coolant level is between the FULL and LOW lines.
If the coolant level is above the FULL line, drain coolant so that the coolant level is between the FULL and LOW lines.



41. INSPECT FOR FUEL LEAK

a. erform Active Test.

i. Connect the intelligent tester to the DLC3.

ii. Turn the ignition switch to ON.

iii. Start the engine.

iv. Turn the intelligent tester ON.

v. Enter the following menus: ertrain / Engine / Active Test.

vi. erform the Active Test.

Tester Display	Test Detail	Control Range	Diagnostic Note
Test the Fuel Leak	ressurizes fuel inside common rail and checks for fuel leaks	Stop/Start	• The fuel inside the common rail is pressurized to the specified value and the engine speed increases to 2000 rpm when Start is selected. • The above conditions are preserved while Start is selected.

42. CHECK FOR ENGINE COOLANT LEAKS

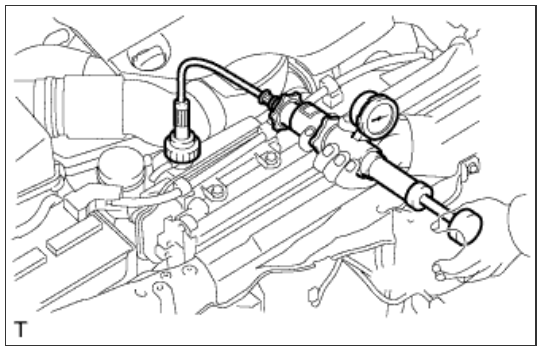
CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. ressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester to the radiator reservoir.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to a (kgf/cm^2, psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks.
If no external leaks are found, check the cylinder block and cylinder head.



43. INSPECT FOR OIL LEAK

a. Warm up the engine and check for an engine oil leak.

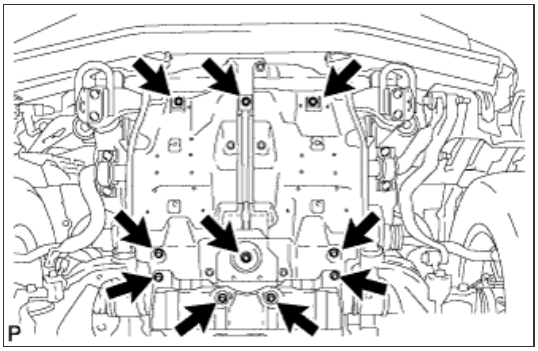
44. INSTALL UPPER RA IATOR SUPPORT SEAL

a. Install the upper radiator support seal with the 7 clips.

45. INSTALL NO. 1 ENGINE UN ER COVER SUB-ASSEMBLY

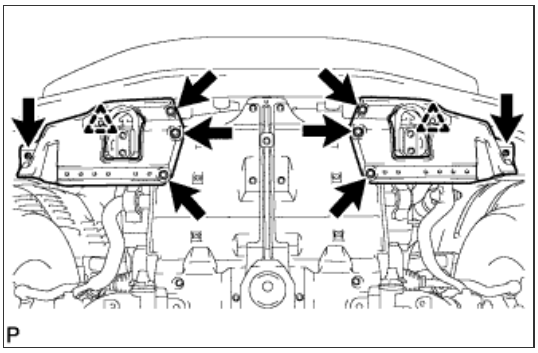
a. Install the engine under cover with the bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



46. INSTALL FRONT FEN ER SPLASH SHIEL SUB-ASSEMBLY RH

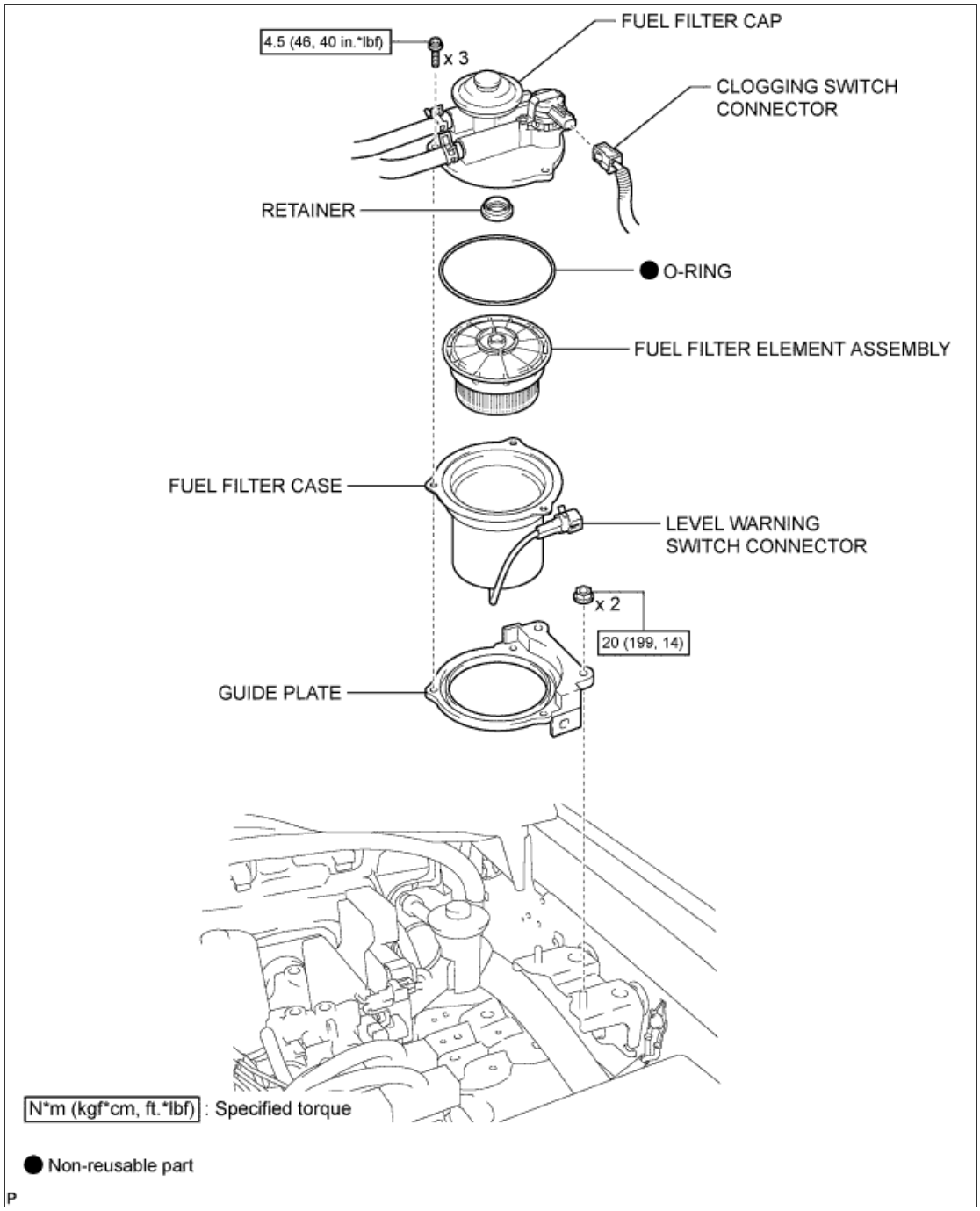
a. Install the splash shield with the clip, and then install the 3 bolts and screw.

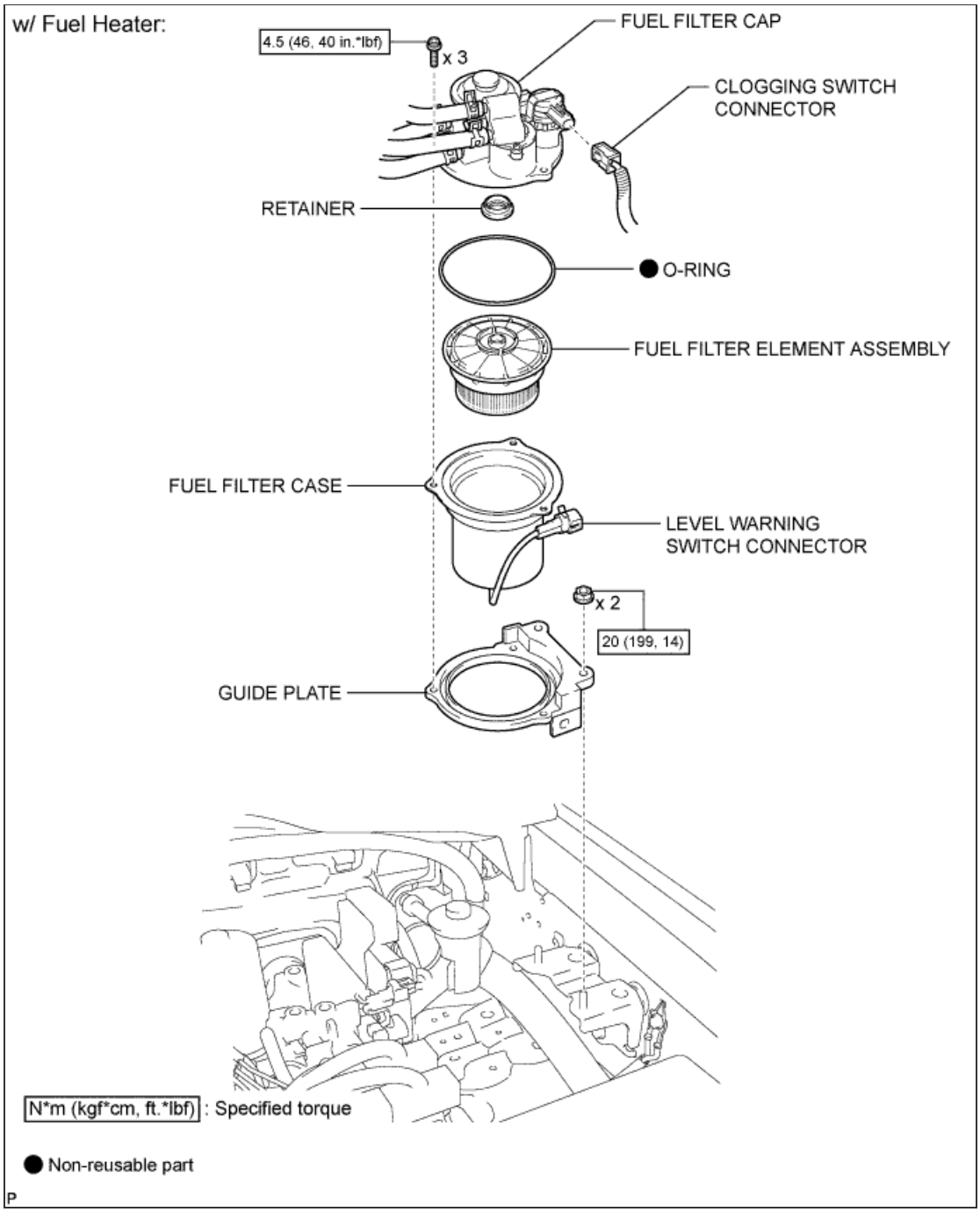


47. INSTALL FRONT FEN ER SPLASH SHIEL SUB-ASSEMBLY LH

a. Install the splash shield with the clip, and then install the 3 bolts and screw.

for Preparation Click here




w/ Fuel Heater:
4.5 (46, 40 in.*lbf)
x 3
FUEL FILTER CAP
CLOGGING SWITCH CONNECTOR
RETAINER
O-RING
FUEL FILTER ELEMENT ASSEMBLY
FUEL FILTER CASE
LEVEL WARNING SWITCH CONNECTOR
x 2
20 (199, 14)
GUIDE PLATE
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

for Preparation Click here

1. INSPECT FUEL FILTER ASSEMBLY

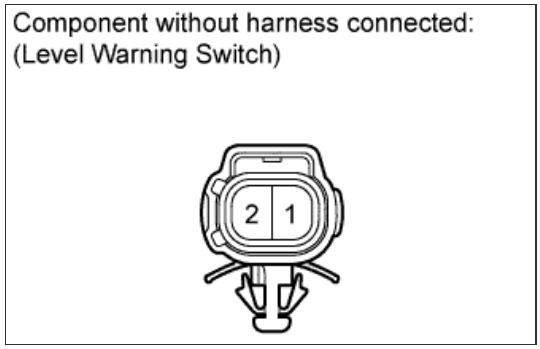
a. Inspect the level warning switch.

i. esure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	Float upper end position	Below 1 Ω
1 - 2	Float lower end position	1 Ω higher

If the result is not as specified, replace the fuel filter asse ly.



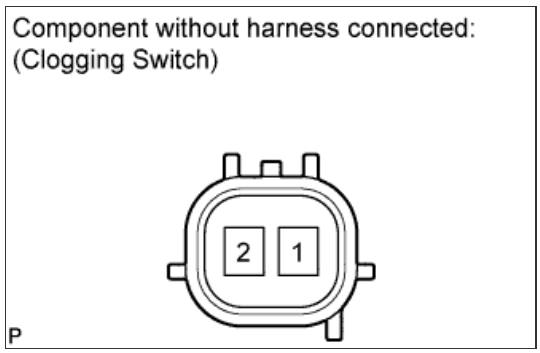
b. Inspect the clogging switch.

i. esure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20	low 1 Ω e

If the result is not as specified, replace the fuel filter asse ly.



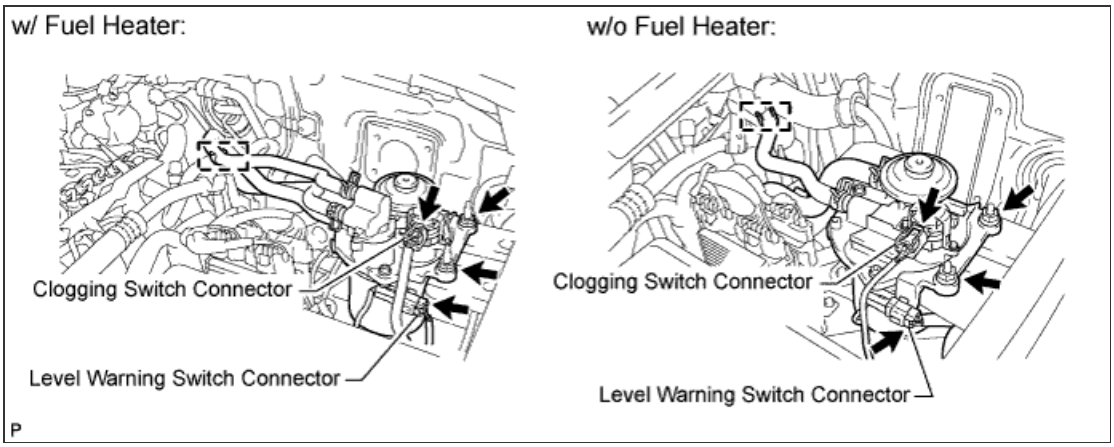
for Preparation Click here

HINT:

When replacing the filter, use T genuine parts or equivalent parts.

1. DRAIN FUEL FROM FUEL FILTER

a. Detach the fuel hose clamp.



b. Disconnect the clogging switch connector and level warning switch connector.

c. Remove the 2 nuts and lift up the fuel filter assembly.

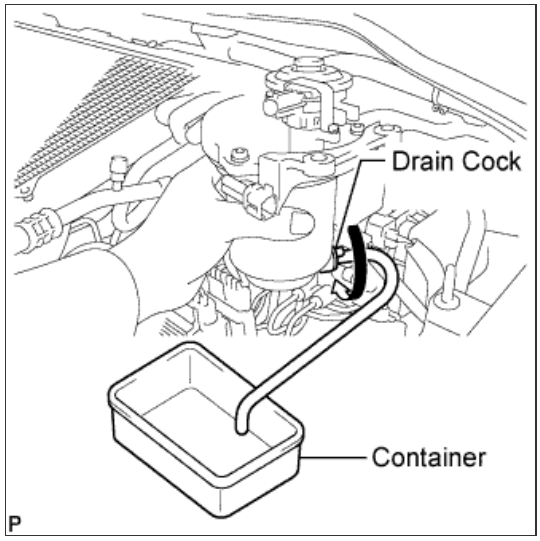
d. Connect a hose to the drain cock. Place the other end of the hose into a container under the drain cock.

e. Loosen the drain cock to drain fuel.

f. Tighten the drain cock by hand.

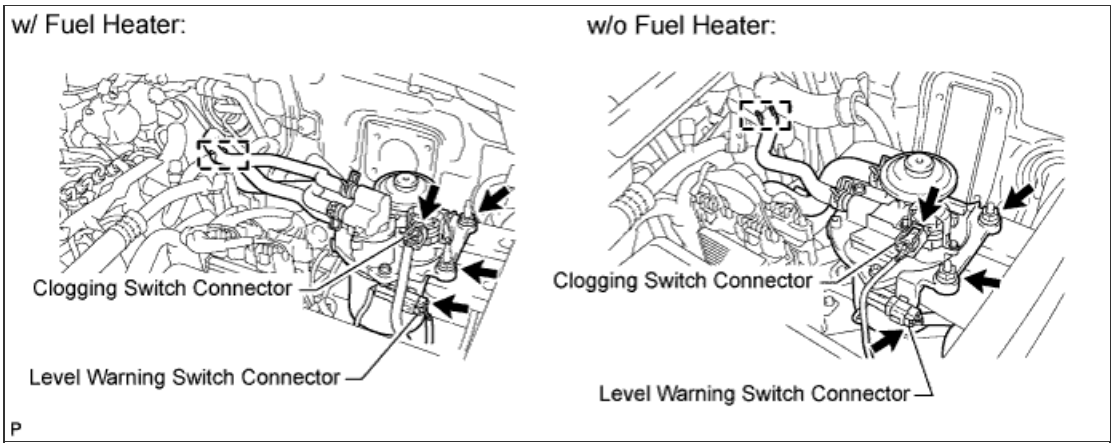
NOTICE:

Do not use any tools in this procedure.



g. Install the fuel filter assembly with the 2 nuts.

Torque:
20 N*m{ 199 kgf*cm , 14 ft.*lbf }

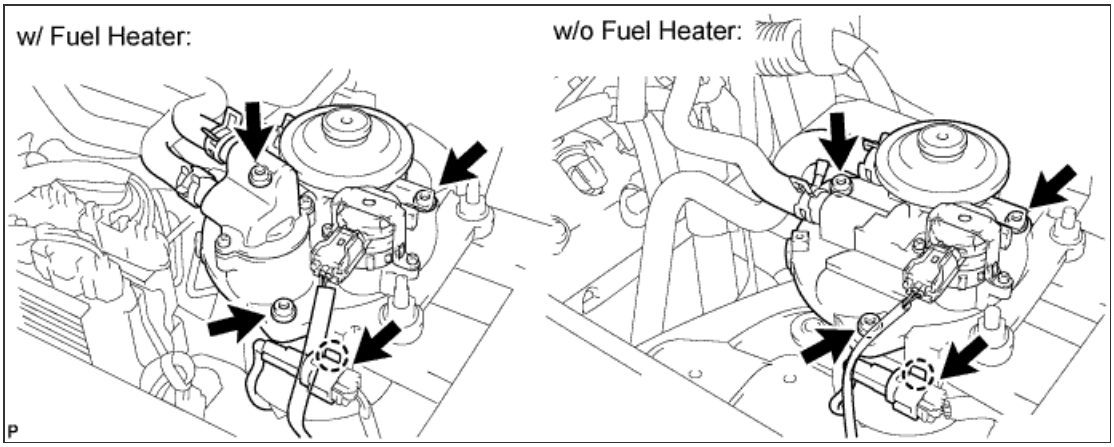


h. Connect the clogging switch connector and level warning switch connector.

i. Attach the fuel hose clamp.

2. REMOVE FUEL FILTER ELEMENT A EMBLY

a. Disconnect the level warning switch connector, and detach the level warning switch connector clamp.



b. Using a 5 mm hexagon socket wrench, remove the 3 bolts and disconnect the fuel filter cap.

c. Remove the fuel filter case and element assembly.

d. Remove the ring and retainer.

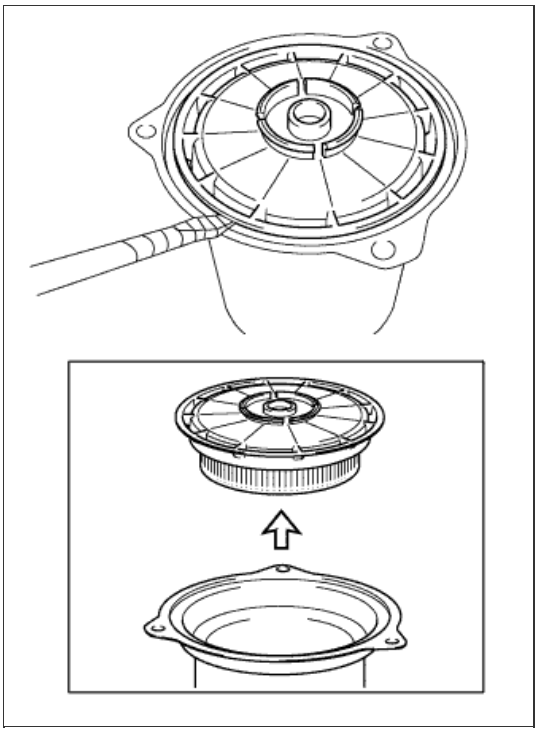
e. Using a screwdriver, remove the fuel filter element from the case.

NOTICE:

Do not damage the fuel filter element and case.

HINT:

Tape the screwdriver tip before use.



3. IN TALL FUEL FILTER ELEMENT A EMBLY

a. Clean the fuel filter case.

NOTICE:

When replacing the fuel filter, clean the fuel filter case and remove dirt completely.

b. Install the fuel filter element to the case.

NOTICE:

Make sure that there is no foreign matter on the areas of the case shown in the illustration.

c. Install the retainer.

d. Install a new ring.

NOTICE:

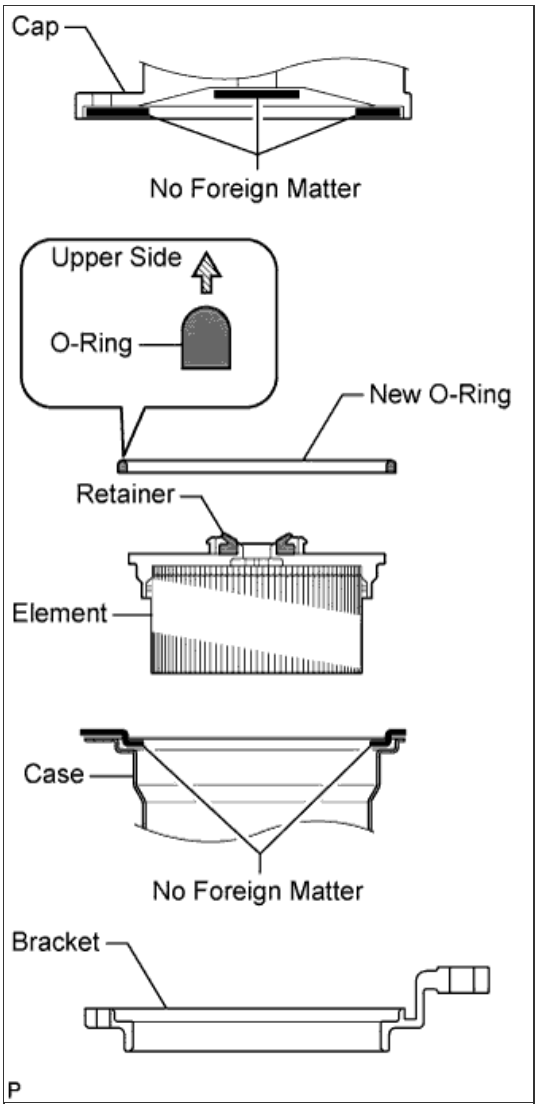
Make sure the rounded side of the ring faces upward as shown in the illustration.

e. Install the fuel filter case and element assembly to the bracket.

f. Set the fuel filter cap on the case.

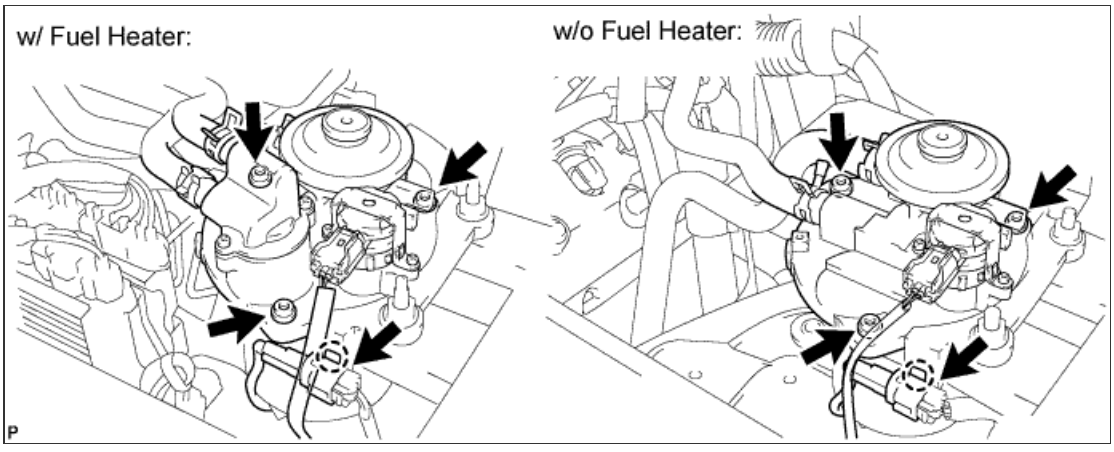
NOTICE:

- **Make sure that there is no foreign matter on the areas of the cap shown in the illustration.**
- **Do not turn the cap as the O-ring will be damaged.**



g. Using a 5 mm hexagon socket wrench, install the fuel filter cap with the 3 bolts.

Torque:
4.5 N*m{ 46 kgf*cm , 40 in.*lbf }



h. Further tighten the first bolt tightened above so that its torque value is slightly more than the torque specification.

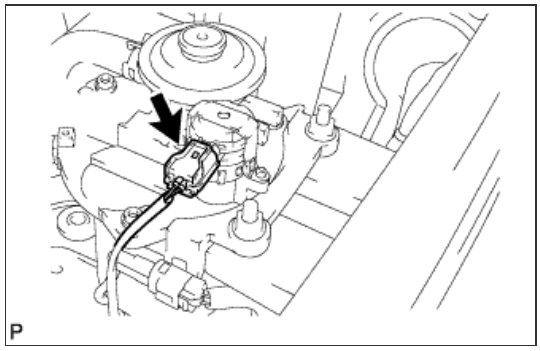
i. Attach the level warning switch connector clamp and connect the level warning switch connector.

4. RE ET FUEL TEM WARNING LIGHT

a. Disconnect the clogging switch connector.

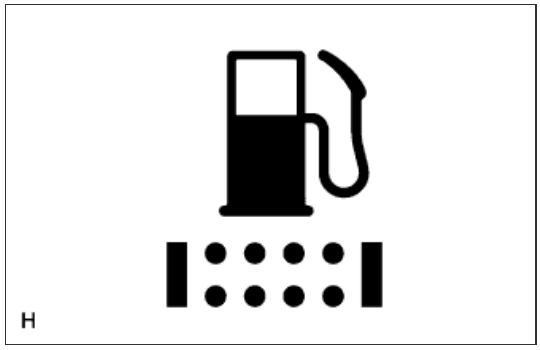
b. Turn the ignition switch to

c. er turning the ignition switch to connect the clogging switch connector within 3 to 60 seconds.



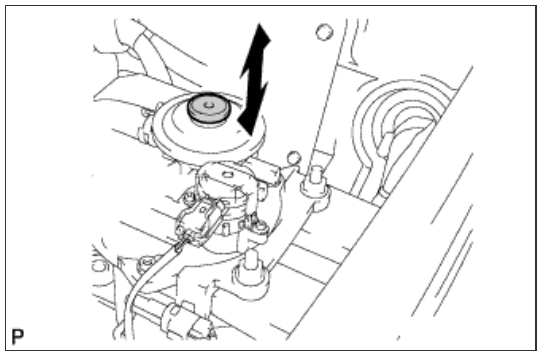
d. w/o Multi-information Display:
Check that the fuel system warning light on the combination meter turns off.

e. w/ Multi-information Display:
Check that the fuel system warning on the multi-information display turns off.



5. BLEED AIR FROM FUEL TEM

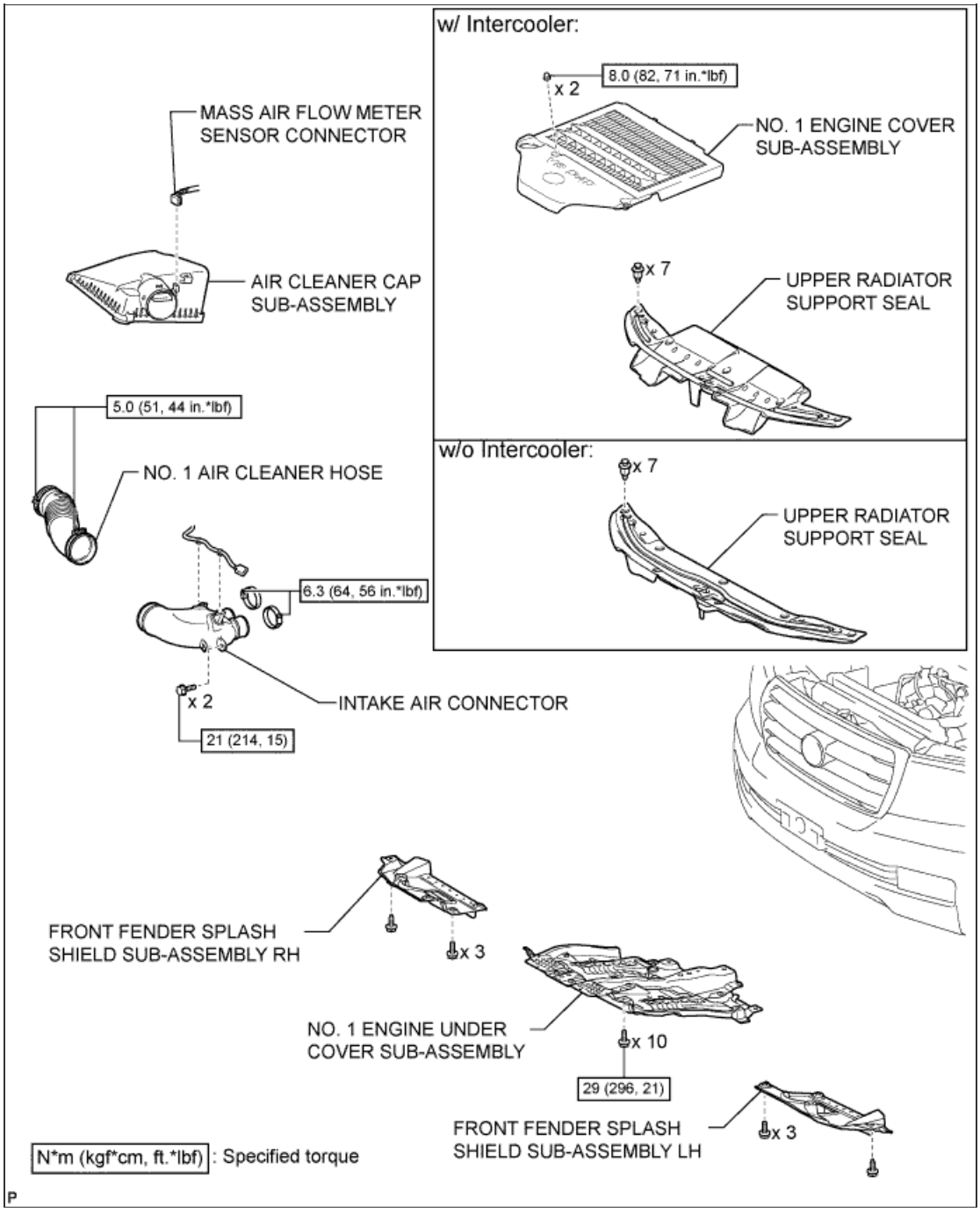
a. Using the hand pump, bleed air from the fuel system until pumping becomes difficult.

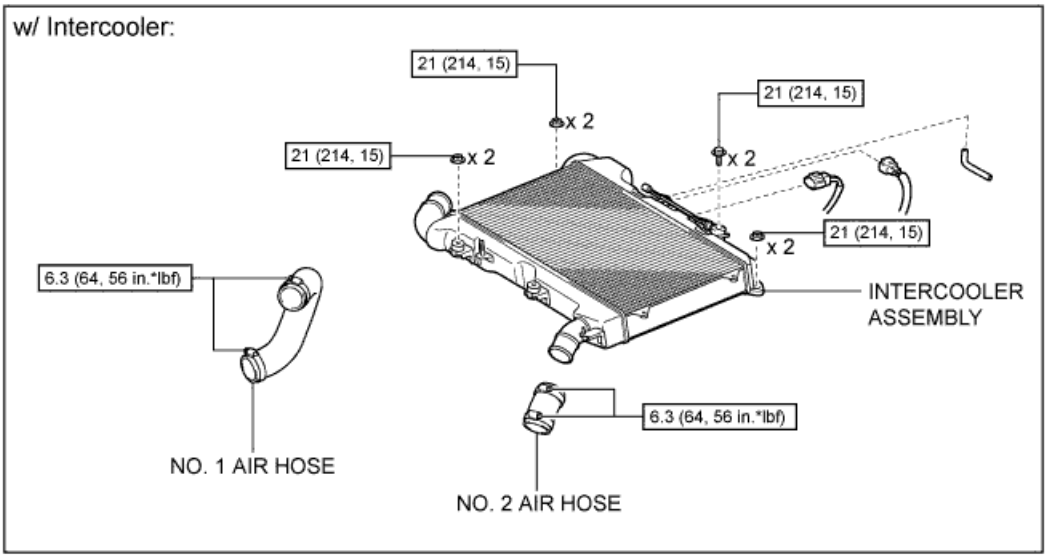


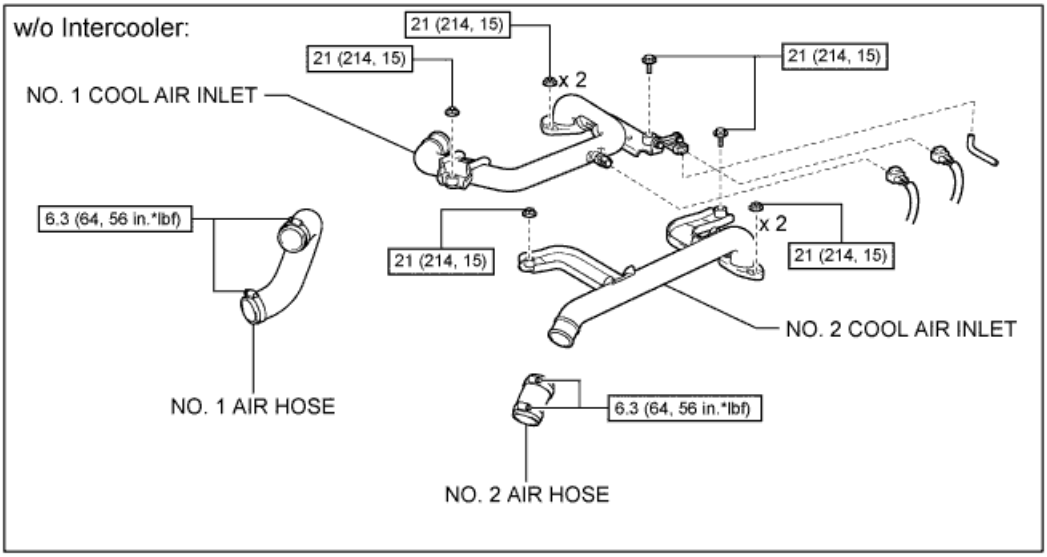
6. IN PECT FOR FUEL LEAK

a. Start the engine. Check that leaking sounds, sucking sounds or other unusual sounds cannot be heard.

for Preparation Click here



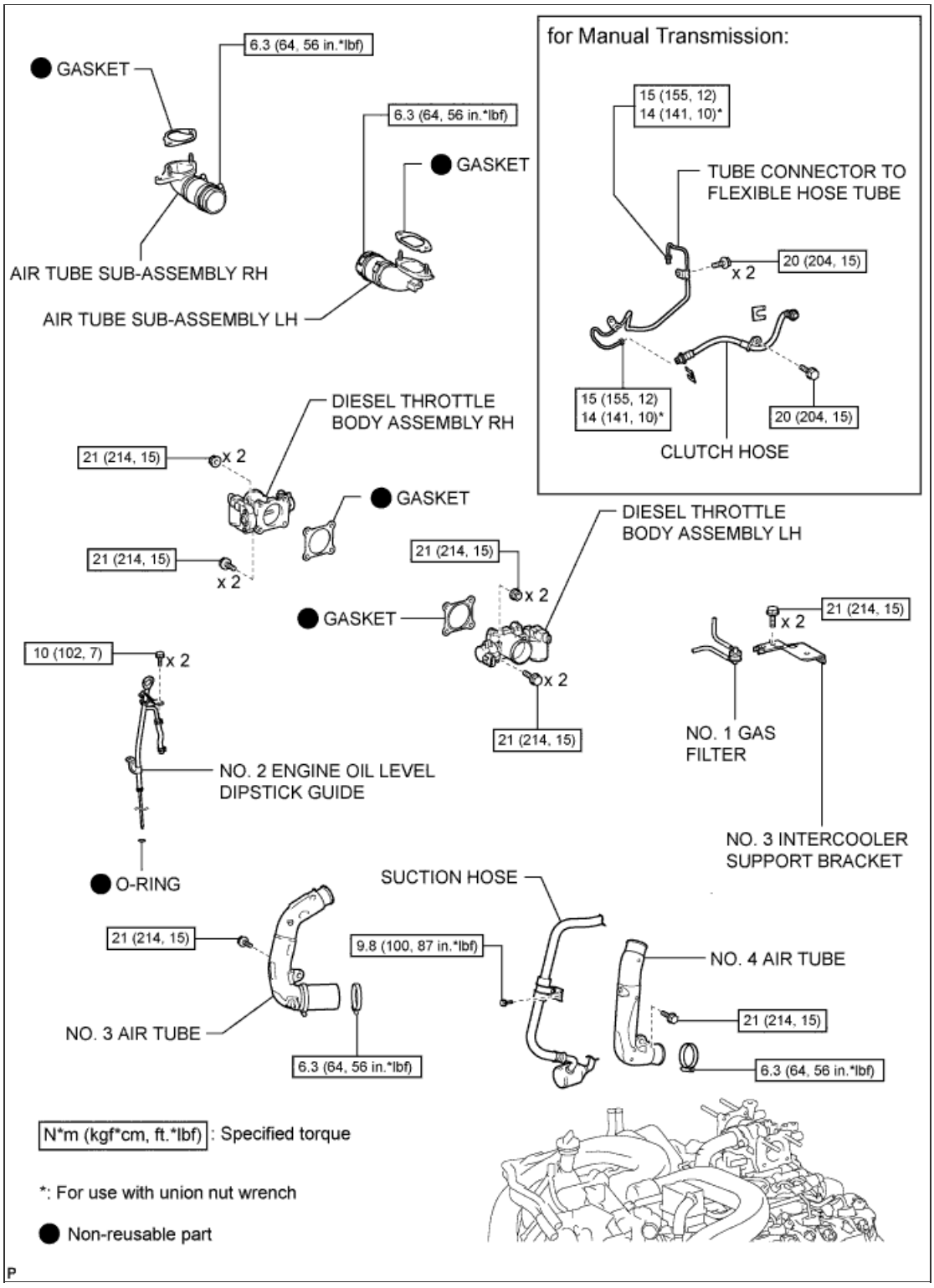


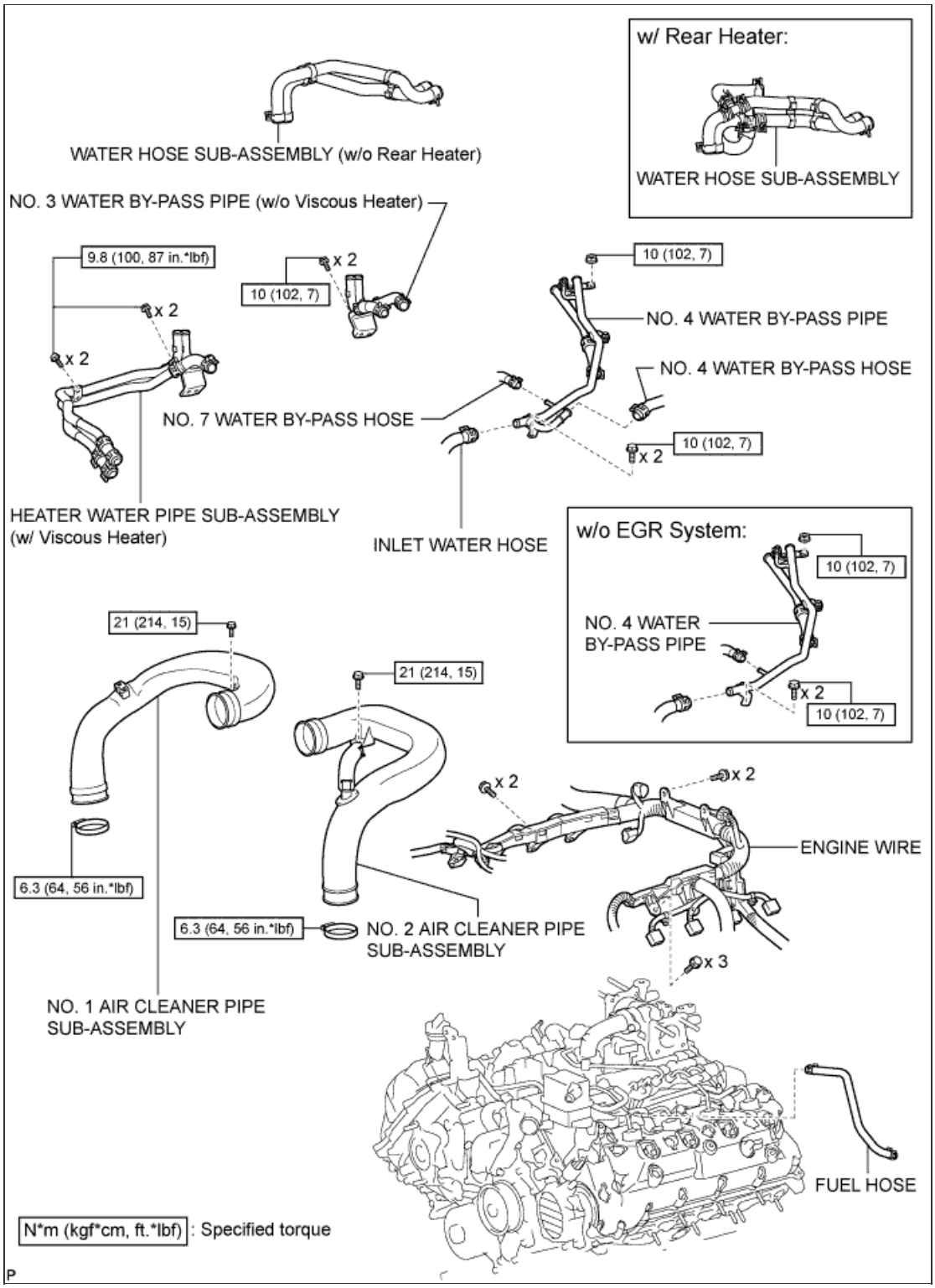


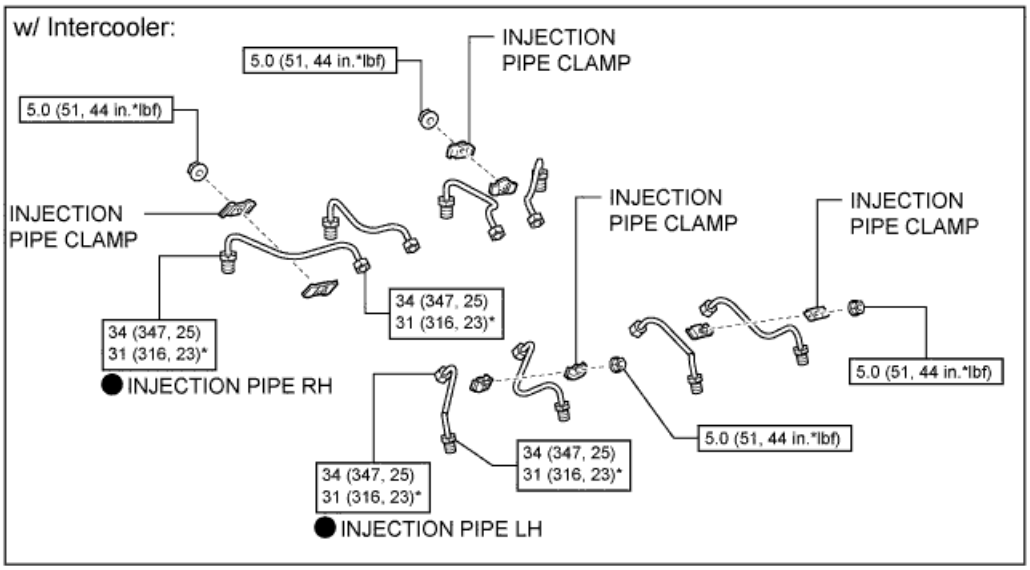


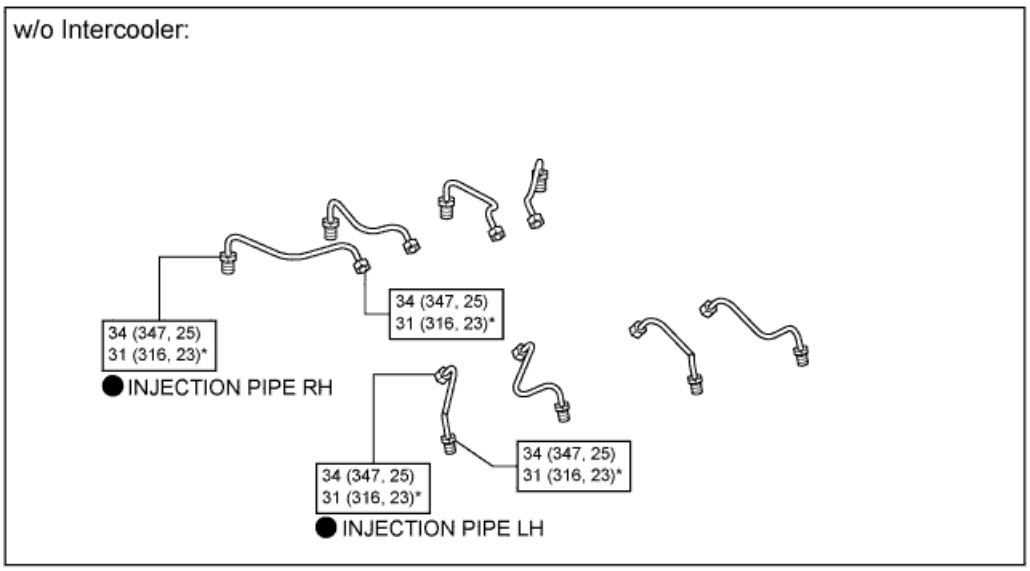
N*m (kgf*cm, ft.*lbf) : Specified torque

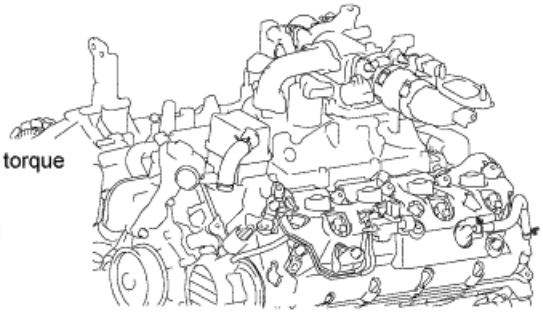
P


GASKET
6.3 (64, 56 in.*lbf)
AIR TUBE SUB-ASSEMBLY RH
6.3 (64, 56 in.*lbf)
GASKET
AIR TUBE SUB-ASSEMBLY LH
for Manual Transmission:
15 (155, 12)
14 (141, 10)*
TUBE CONNECTOR TO FLEXIBLE HOSE TUBE
20 (204, 15)
x 2
15 (155, 12)
14 (141, 10)*
20 (204, 15)
CLUTCH HOSE
DIESEL THROTTLE BODY ASSEMBLY RH
21 (214, 15)
x 2
GASKET
21 (214, 15)
x 2
21 (214, 15)
x 2
GASKET
DIESEL THROTTLE BODY ASSEMBLY LH
x 2
21 (214, 15)
21 (214, 15)
x 2
10 (102, 7)
x 2
NO. 2 ENGINE OIL LEVEL DIPSTICK GUIDE
NO. 1 GAS FILTER
NO. 3 INTERCOOLER SUPPORT BRACKET
O-RING
SUCTION HOSE
21 (214, 15)
9.8 (100, 87 in.*lbf)
NO. 4 AIR TUBE
NO. 3 AIR TUBE
21 (214, 15)
6.3 (64, 56 in.*lbf)
6.3 (64, 56 in.*lbf)
N*m (kgf*cm, ft.*lbf): Specified torque
*: For use with union nut wrench
Non-reusable part
P


w/ Rear Heater:
WATER HOSE SUB-ASSEMBLY
WATER HOSE SUB-ASSEMBLY (w/o Rear Heater)
NO. 3 WATER BY-PASS PIPE (w/o Viscous Heater)
9.8 (100, 87 in.*lbf)
x 2
x 2
10 (102, 7)
x 2
HEATER WATER PIPE SUB-ASSEMBLY
(w/ Viscous Heater)
NO. 7 WATER BY-PASS HOSE
10 (102, 7)
NO. 4 WATER BY-PASS PIPE
NO. 4 WATER BY-PASS HOSE
10 (102, 7)
x 2
INLET WATER HOSE
w/o EGR System:
10 (102, 7)
NO. 4 WATER
BY-PASS PIPE
x 2
10 (102, 7)
21 (214, 15)
21 (214, 15)
x 2
x 2
ENGINE WIRE
6.3 (64, 56 in.*lbf)
6.3 (64, 56 in.*lbf)
NO. 2 AIR CLEANER PIPE
SUB-ASSEMBLY
x 3
NO. 1 AIR CLEANER PIPE
SUB-ASSEMBLY
FUEL HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
P





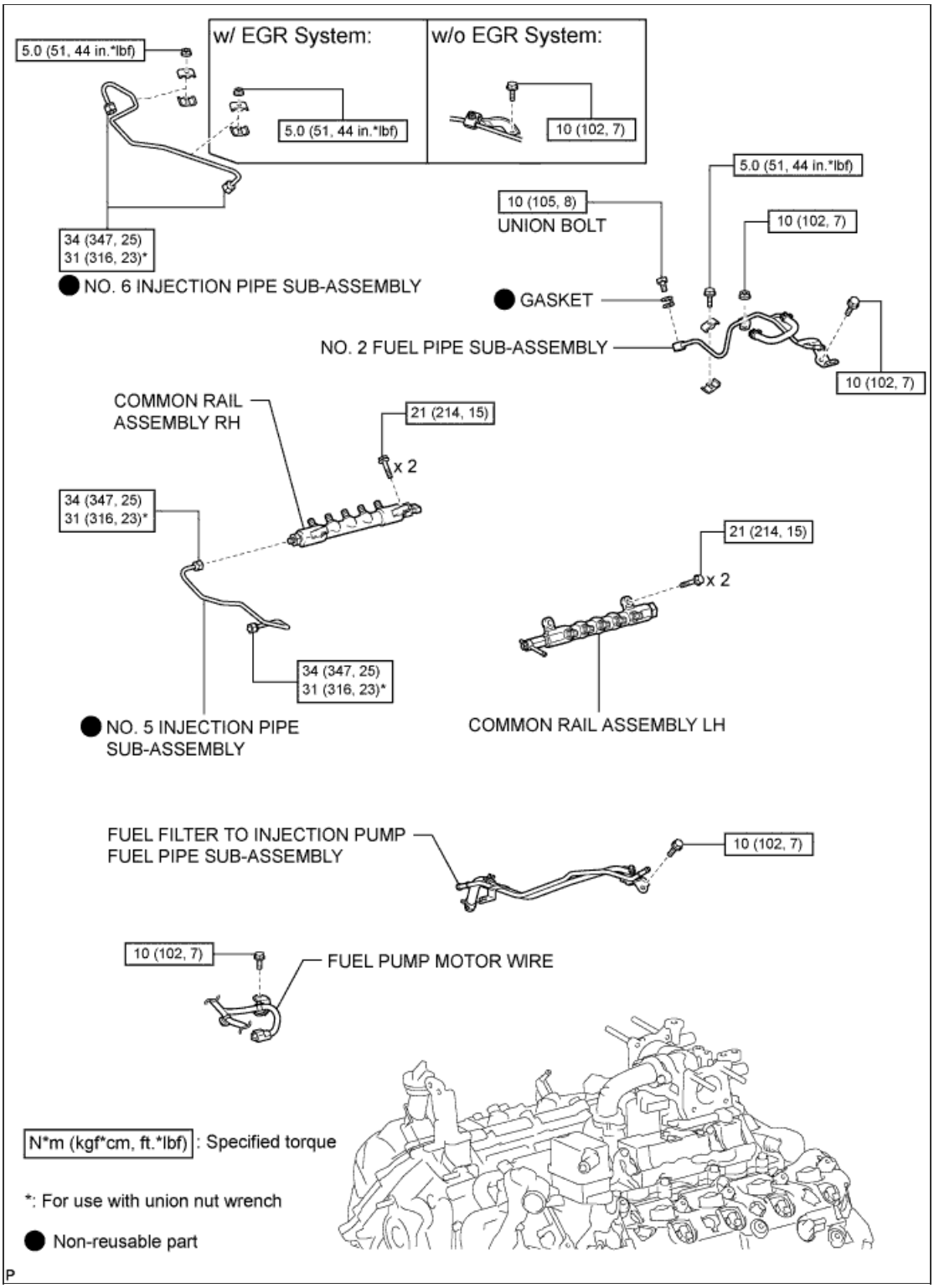


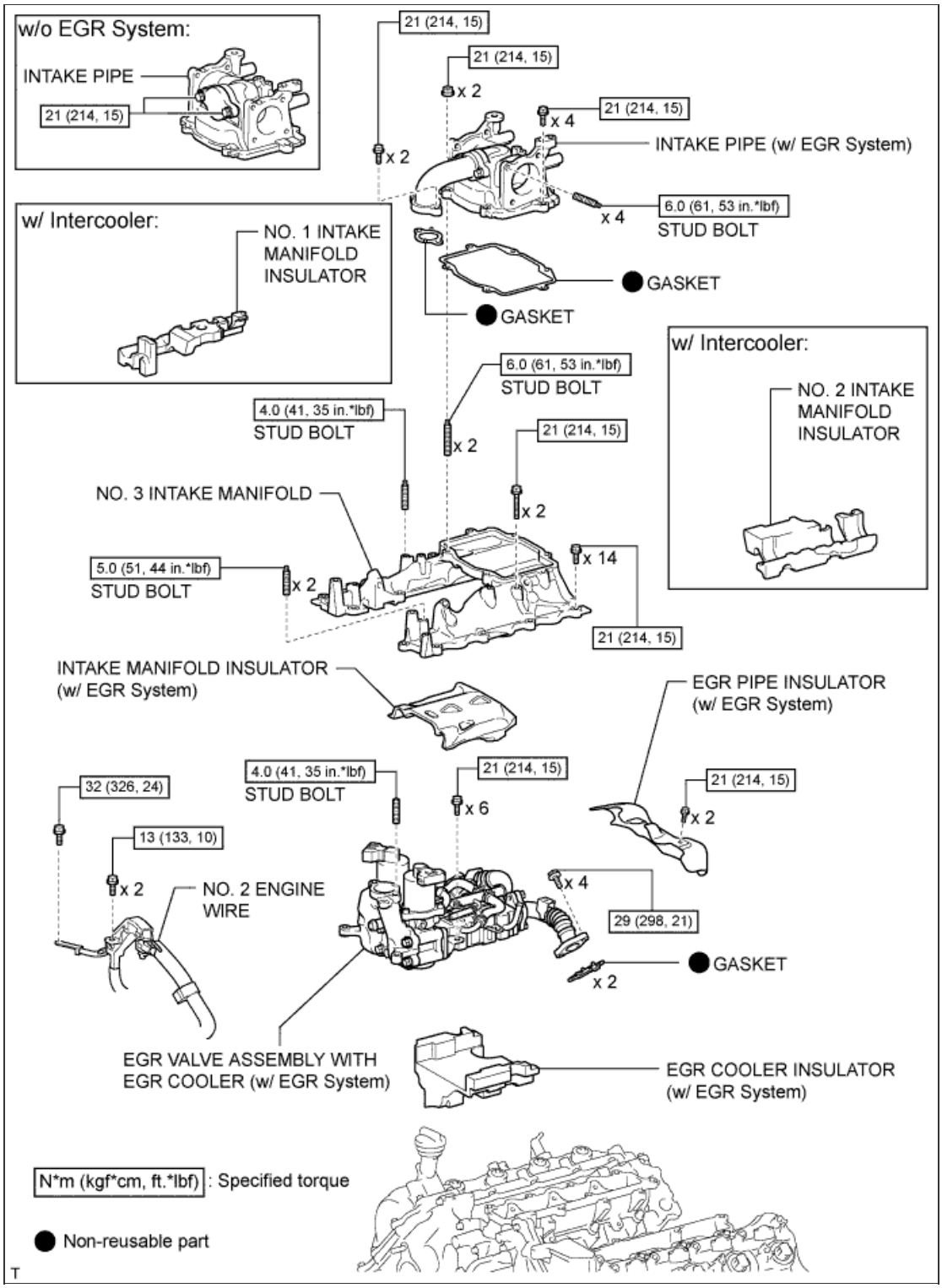
N*m (kgf*cm, ft.*lbf): Specified torque

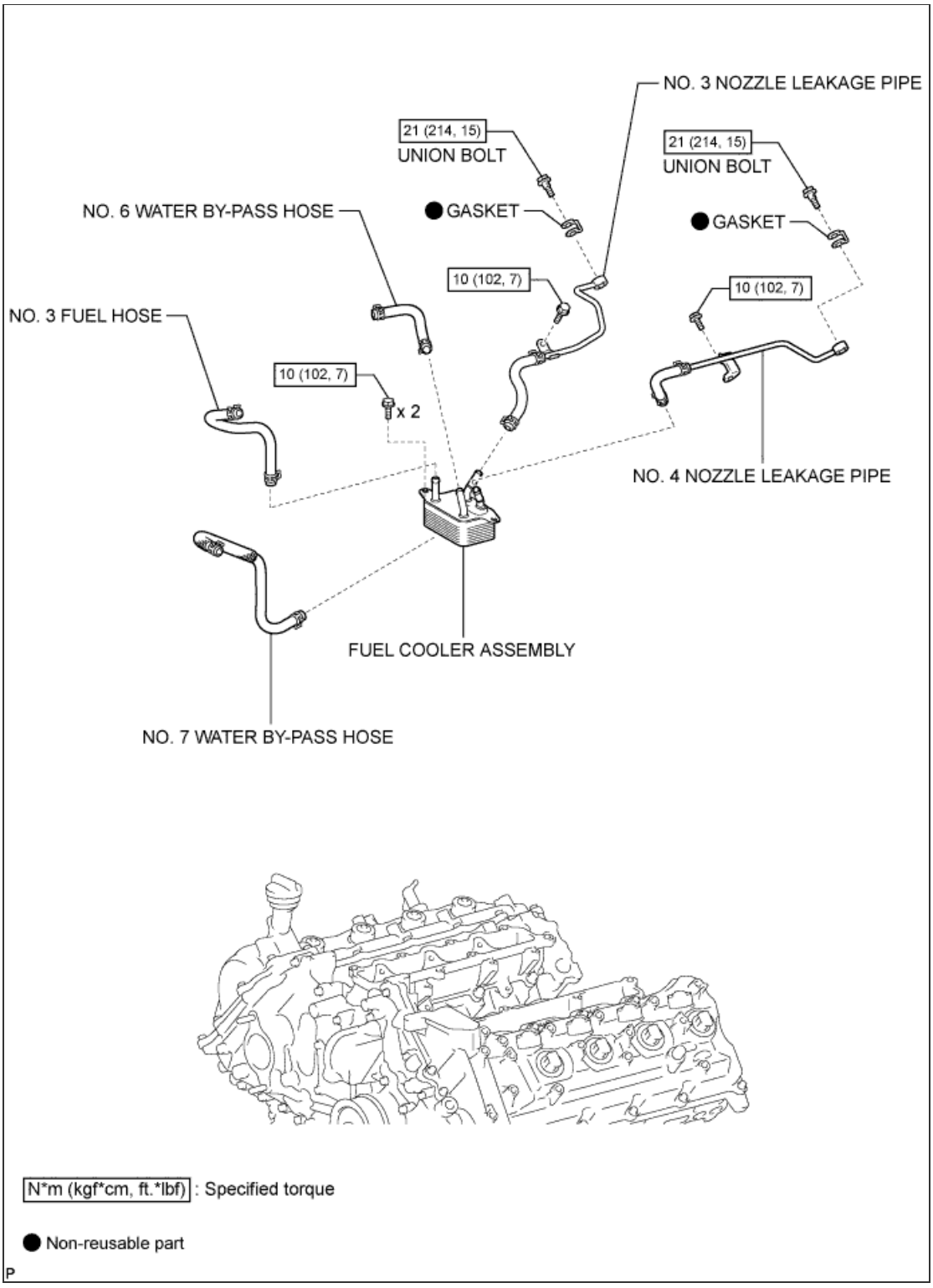
*: For use with union nut wrench

● Non-reusable part

P


w/ EGR System:
w/o EGR System:
5.0 (51, 44 in.*lbf)
5.0 (51, 44 in.*lbf)
10 (102, 7)
5.0 (51, 44 in.*lbf)
10 (105, 8)
UNION BOLT
10 (102, 7)
34 (347, 25)
31 (316, 23)*
NO. 6 INJECTION PIPE SUB-ASSEMBLY
GASKET
NO. 2 FUEL PIPE SUB-ASSEMBLY
10 (102, 7)
COMMON RAIL ASSEMBLY RH
21 (214, 15)
x 2
34 (347, 25)
31 (316, 23)*
21 (214, 15)
x 2
34 (347, 25)
31 (316, 23)*
NO. 5 INJECTION PIPE SUB-ASSEMBLY
COMMON RAIL ASSEMBLY LH
FUEL FILTER TO INJECTION PUMP FUEL PIPE SUB-ASSEMBLY
10 (102, 7)
10 (102, 7)
FUEL PUMP MOTOR WIRE
N*m (kgf*cm, ft.*lbf) : Specified torque
*: For use with union nut wrench
Non-reusable part
P


w/o EGR System:
INTAKE PIPE
21 (214, 15)
w/ Intercooler:
NO. 1 INTAKE MANIFOLD INSULATOR
21 (214, 15)
21 (214, 15)
x 2
x 4
21 (214, 15)
INTAKE PIPE (w/ EGR System)
x 2
6.0 (61, 53 in.*lbf)
STUD BOLT
x 4
GASKET
GASKET
w/ Intercooler:
NO. 2 INTAKE MANIFOLD INSULATOR
6.0 (61, 53 in.*lbf)
STUD BOLT
4.0 (41, 35 in.*lbf)
STUD BOLT
x 2
21 (214, 15)
x 2
NO. 3 INTAKE MANIFOLD
5.0 (51, 44 in.*lbf)
STUD BOLT
x 2
x 14
21 (214, 15)
INTAKE MANIFOLD INSULATOR
(w/ EGR System)
EGR PIPE INSULATOR
(w/ EGR System)
32 (326, 24)
4.0 (41, 35 in.*lbf)
STUD BOLT
21 (214, 15)
x 6
21 (214, 15)
x 2
13 (133, 10)
x 2
NO. 2 ENGINE WIRE
x 4
29 (298, 21)
GASKET
x 2
EGR VALVE ASSEMBLY WITH
EGR COOLER (w/ EGR System)
EGR COOLER INSULATOR
(w/ EGR System)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
T



N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

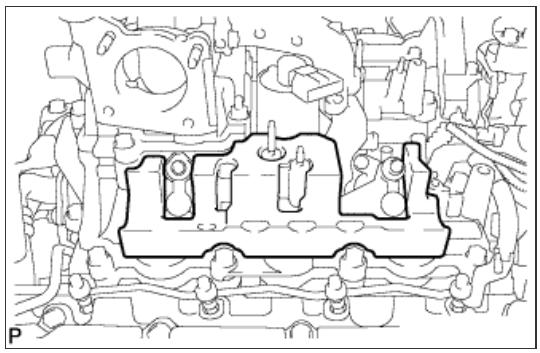
P

for Preparation Click here

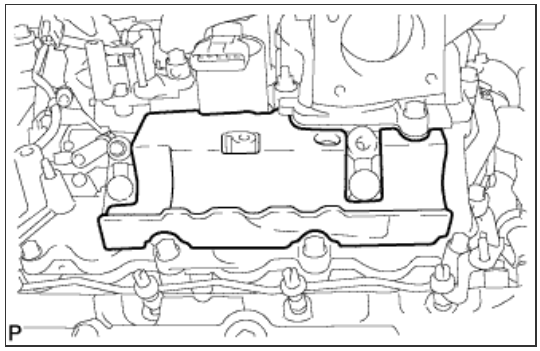
1. REMOVE COMMON RAIL ASSEMBLY LH AND RH

a. Remove the common rail assembly LH and RH (Click here).

2. REMOVE NO. 1 INTAKE MANIFOLD INSULATOR (w/ Intercooler)

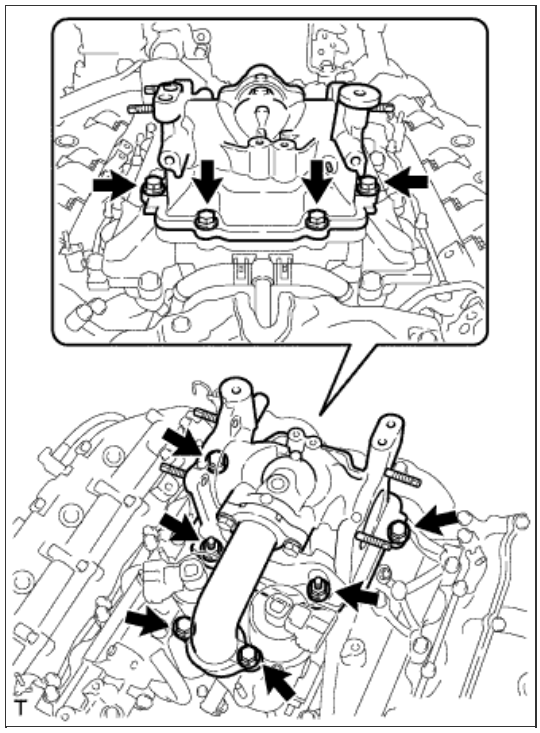


3. REMOVE NO. 2 INTAKE MANIFOLD INSULATOR (w/ Intercooler)

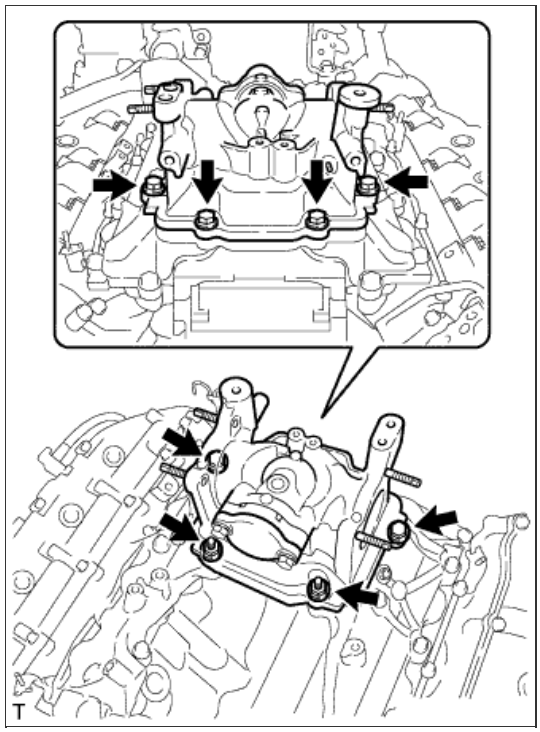


4. REMOVE INTAKE PIPE

a. w E R System
Remove the 2 nuts, 6 bolts, intake pipe and 2 gaskets.

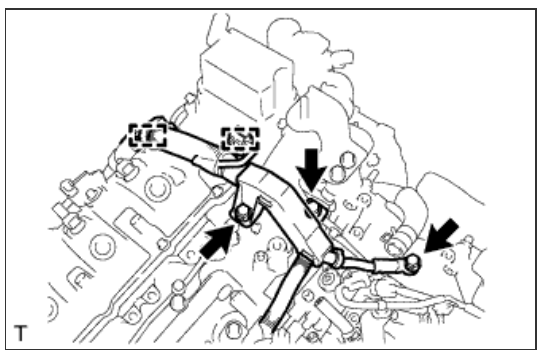


b. w o E R System
Remove the 2 nuts, 4 bolts, intake pipe and gasket.



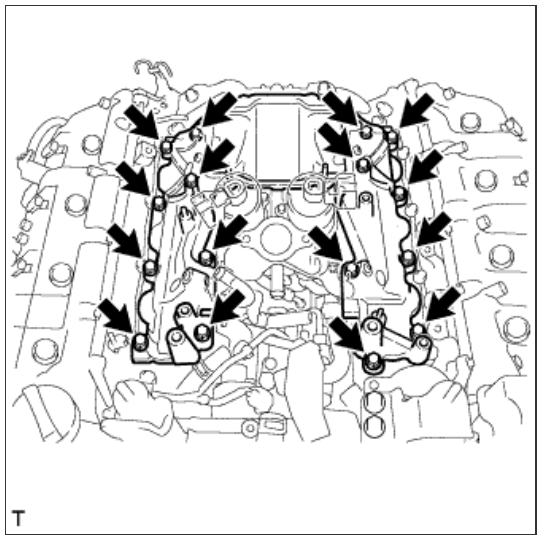
5. DISCONNECT NO. 2 ENGINE WIRE

a. Remove the 3 bolts and using a clip remover, detach the 2 wire harness clamps, and then disconnect the No. 2 engine wire.

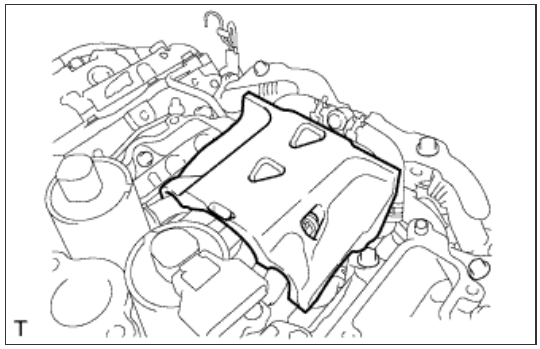


6. REMOVE NO. 3 INTAKE MANIFOLD

a. Remove the 16 bolts, No. 3 intake manifold and 2 gaskets.

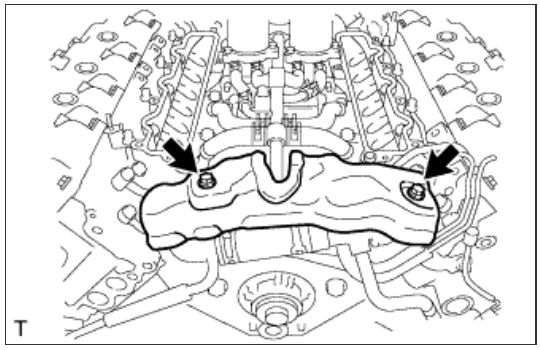


7. REMOVE INTAKE MANIFOLD INSULATOR (w/ EGR System)



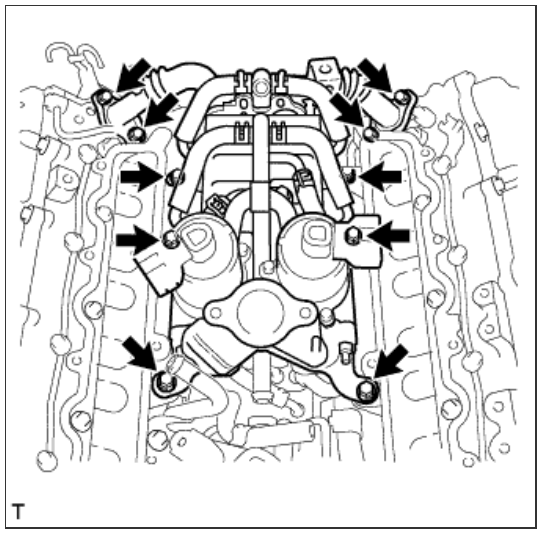
8. REMOVE EGR PIPE INSULATOR (w/ EGR System)

a. Remove the 2 bolts and E R pipe insulator.

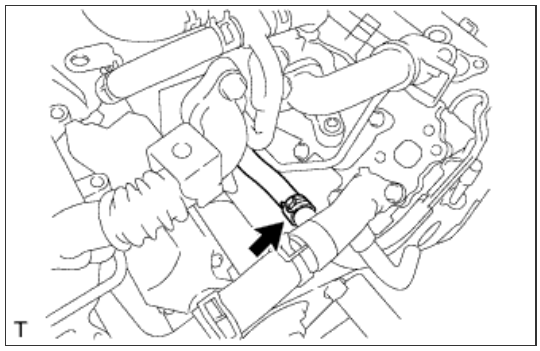


9. REMOVE EGR VALVE ASSEMBLY WITH EGR COOLER (w/ EGR System)

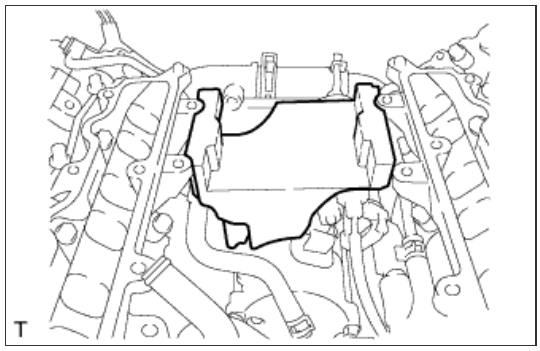
a. Remove the 10 bolts, E R valve with E R cooler and 2 gaskets.



b. Disconnect the No. 5 water by-pass hose from the water by-pass outlet.



10. REMOVE EGR COOLER INSULATOR (w/ EGR System)



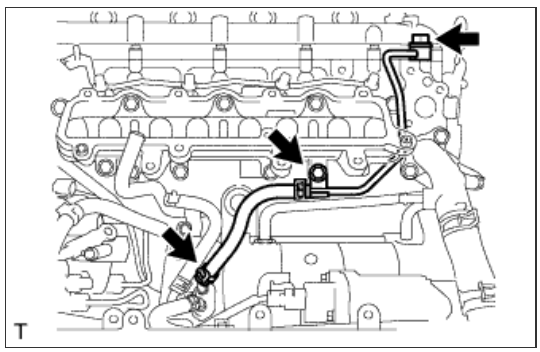
11. REMOVE NO. 3 NOZZLE LEAKAGE PIPE

a. Disconnect the No. 1 fuel hose from the fuel cooler.

b. Remove the union bolt, bolt, No. 3 nozzle leakage pipe and gasket.

NOTICE:

After removing the nozzle leakage pipe, to prevent dirt or foreign objects from entering the nozzle leakage pipe, cover the nozzle leakage pipe ends with plastic bags.



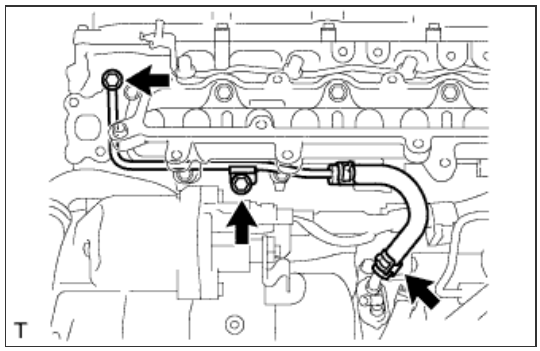
12. REMOVE NO. 4 NOZZLE LEAKAGE PIPE

a. Disconnect the No. 2 fuel hose from the fuel cooler.

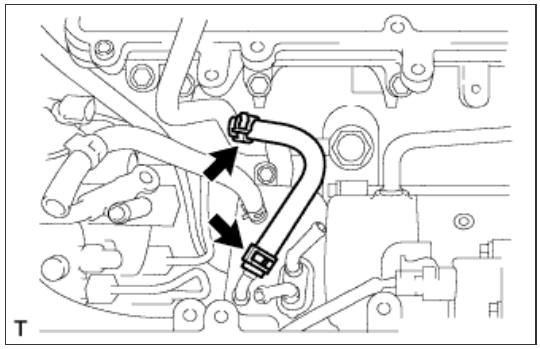
b. Remove the union bolt, bolt, No. 4 nozzle leakage pipe and gasket.

NOTICE:

After removing the nozzle leakage pipe, to prevent dirt or foreign objects from entering the nozzle leakage pipe, cover the nozzle leakage pipe ends with plastic bags.

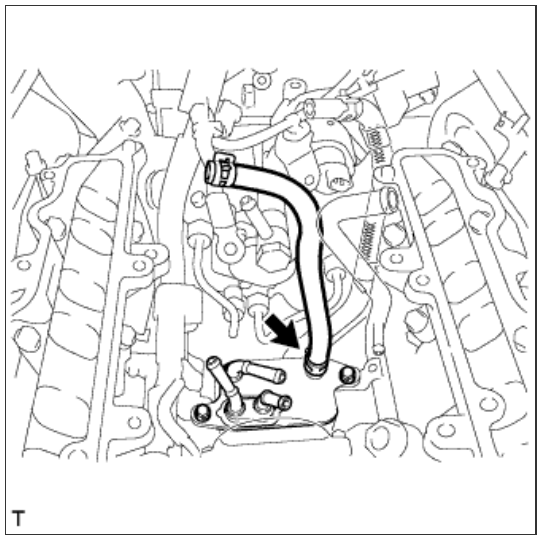


13. DISCONNECT NO. 6 WATER BY-PASS HOSE



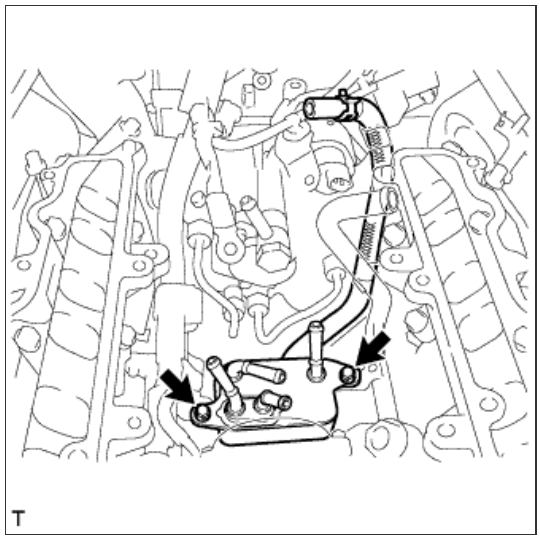
14. DISCONNECT NO. 3 FUEL HOSE

a. Disconnect the fuel hose from the fuel cooler.



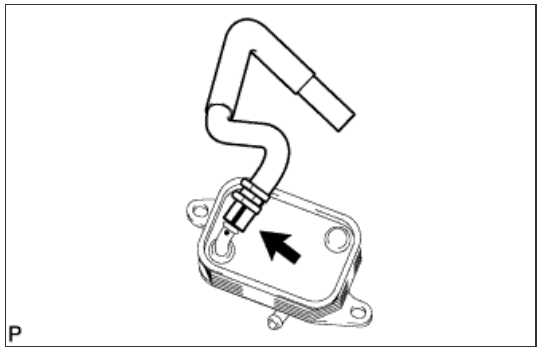
15. REMOVE FUEL COOLER ASSEMBLY

a. Remove the 2 bolts and fuel cooler.



16. DISCONNECT NO. 7 WATER BY-PASS HOSE

a. Disconnect the water by-pass hose from the fuel cooler.



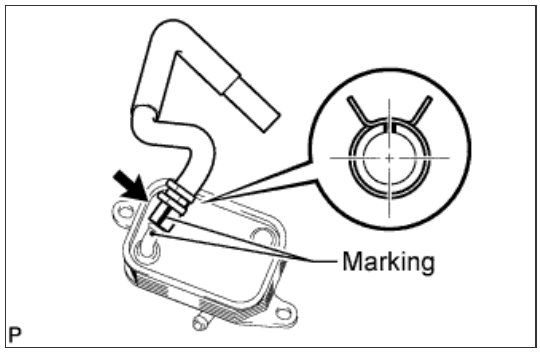
for Preparation Click here

1. CONNECT NO. 7 WATER BY-PASS HOSE

a. Connect the water by-pass hose to the fuel cooler.

HINT:

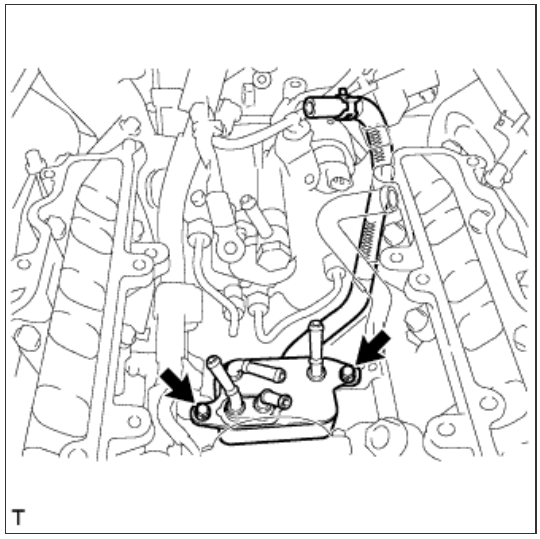
- **Align the alignment marks and connect the hose.**
- **Align the pinching portion of the clamp with the hose alignment mark and connect the hose.**



2. INSTALL FUEL COOLER ASSEMBLY

a. Install the fuel cooler with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

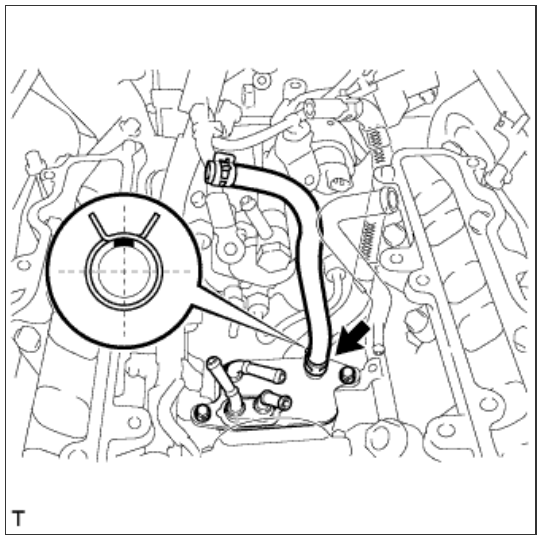


3. CONNECT NO. 3 FUEL HOSE

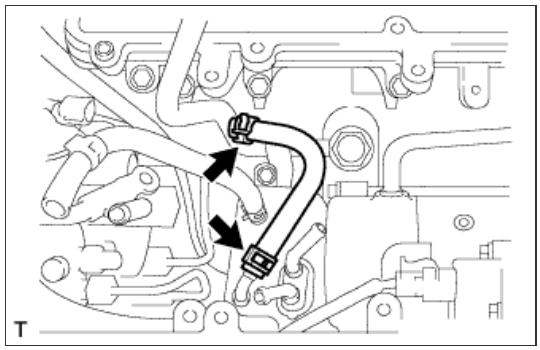
a. Connect the fuel hose to the fuel cooler.

HINT:

- **Align the alignment marks and connect the hose.**
- **Align the pinching portion of the clamp with the hose alignment mark and connect the hose.**



4. CONNECT NO. 6 WATER BY-PASS HOSE



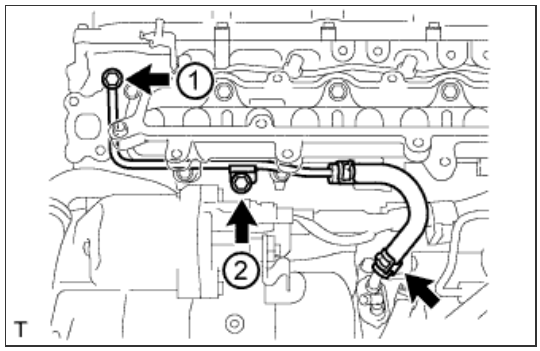
5. INSTALL NO. 4 NOZZLE LEAKAGE PIPE

a. Temporarily install a new gasket and the No. 4 nozzle leakage pipe with the union bolt and bolt.

b. Tighten the union bolt and bolt in the order shown in the illustration.

Torque:
for union bolt:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

c. Connect the No. 2 fuel hose to the fuel cooler.



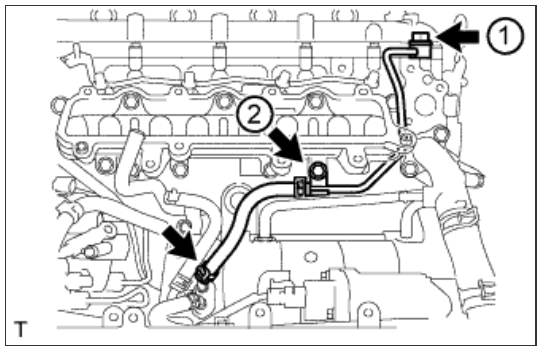
6. INSTALL NO. 3 NOZZLE LEAKAGE PIPE

a. Temporarily install a new gasket and the No. 3 nozzle leakage pipe with the union bolt and bolt.

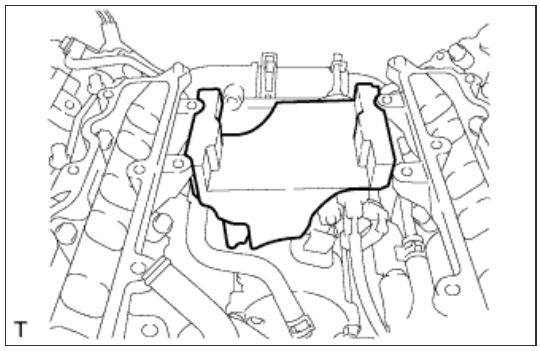
b. Tighten the union bolt and bolt in the order shown in the illustration.

Torque:
for union bolt:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

c. Connect the No. 1 fuel hose to the fuel cooler.

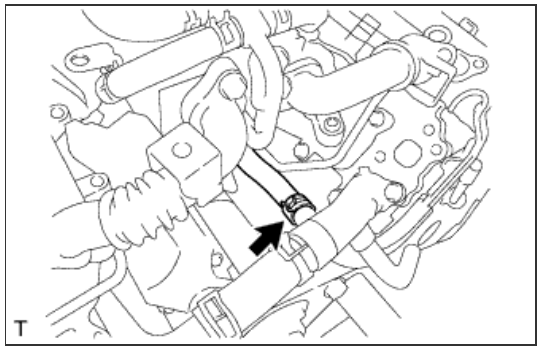


7. INSTALL EGR COOLER INSULATOR (w/ EGR System)



8. INSTALL EGR VALVE ASSEMBLY WITH EGR COOLER (w/ EGR System)

a. Connect the No. 5 water by-pass hose to the water by-pass outlet.

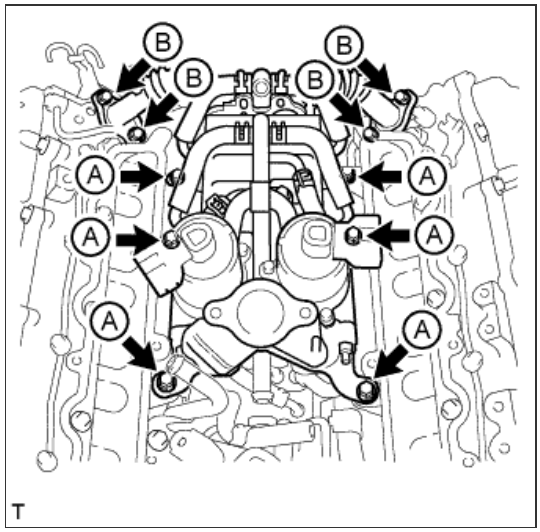


b. Install 2 new gaskets and the E valve with E cooler with the 6 bolts labeled A and 4 bolts labeled B shown in the illustration.

Torque:
for bolt A:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for bolt B:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

HINT:

The gasket claws should face toward the No. 1 and No. 2 E pipes.



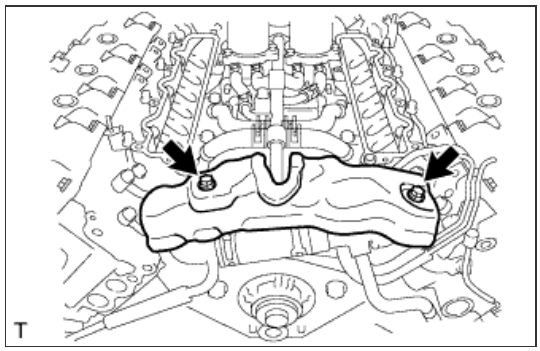
9. INSTALL EGR PIPE INSULATOR (w/ EGR System)

a. Install the E pipe insulator with the 2 bolts.

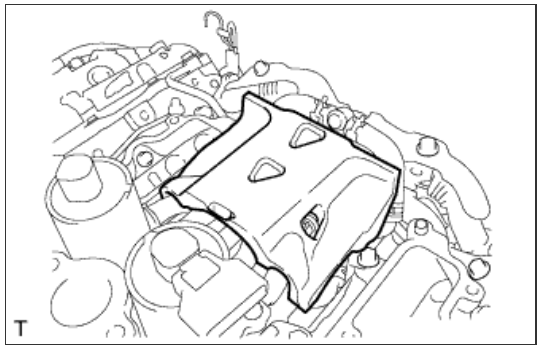
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

NOTICE:

If the No. 1 and No. 2 E pipe insulator installation stay is deformed or the bolt holes of the E pipe insulator do not align replace the No. 1 and No. 2 E pipes as a set.



10. INSTALL INTAKE MANIFOLD INSULATOR (w/ EGR System)



11. INSTALL NO. 3 INTAKE MANIFOLD

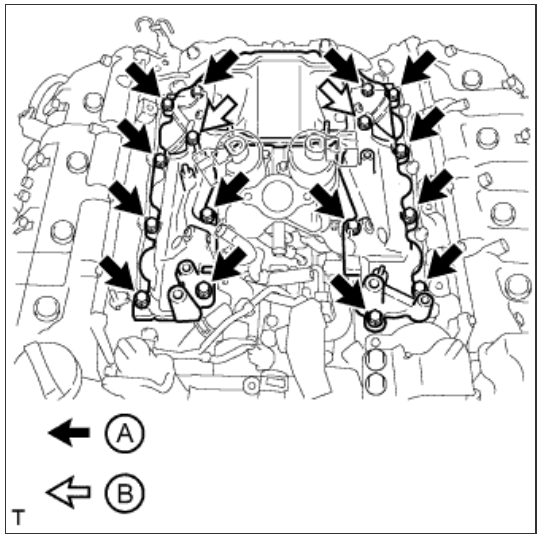
a. Set 2 new gaskets to the No. 1 and No. 2 intake manifolds.

b. Install the No. 3 intake manifold with the 16 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

Bolt Length

Item	Length
Bolt A	25 mm (0.984 in.)
Bolt B	70 mm (2.76 in.)

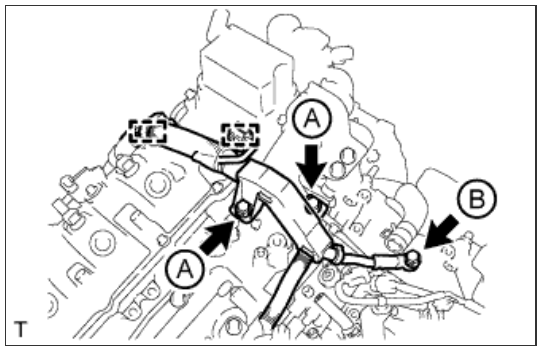


12. CONNECT NO. 2 ENGINE WIRE

a. Connect the No. 2 engine wire with the 3 bolts.

Torque:
for bolt A:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }
for bolt B:
32 N*m{ 326 kgf*cm , 24 ft.*lbf }

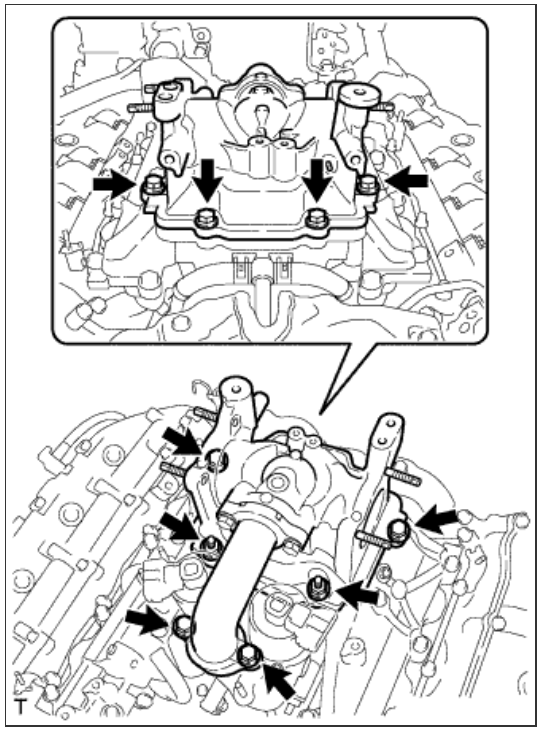
b. Attach the 2 wire harness clamps.



13. INSTALL INTAKE PIPE

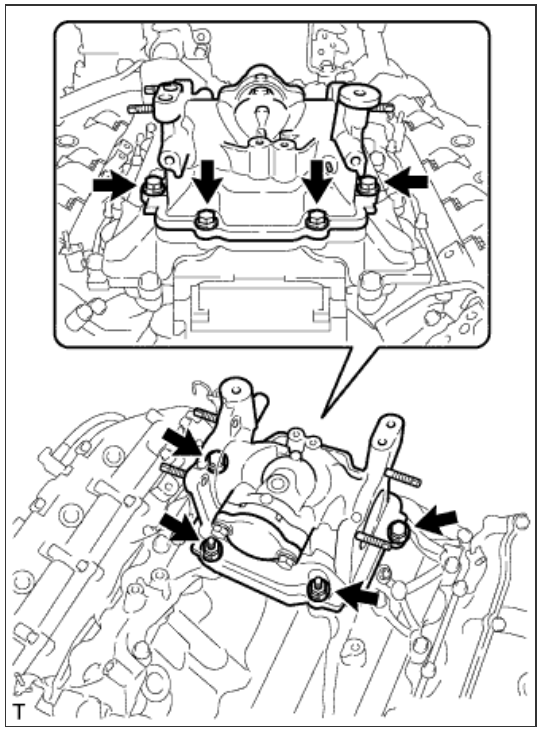
a. w/ E System:
Install 2 new gaskets and the intake pipe with the 6 bolts and 2 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

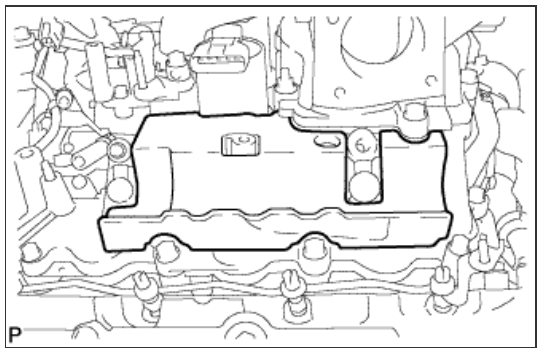


b. w/o E System:
Install a new gasket and the intake pipe with the 4 bolts and 2 nuts.

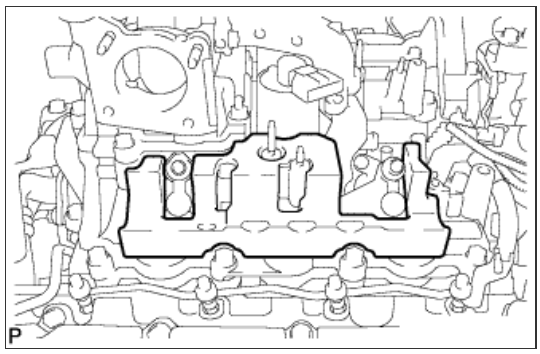
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



14. INSTALL NO. 2 INTAKE MANIFOLD INSULATOR (w/ Intercooler)



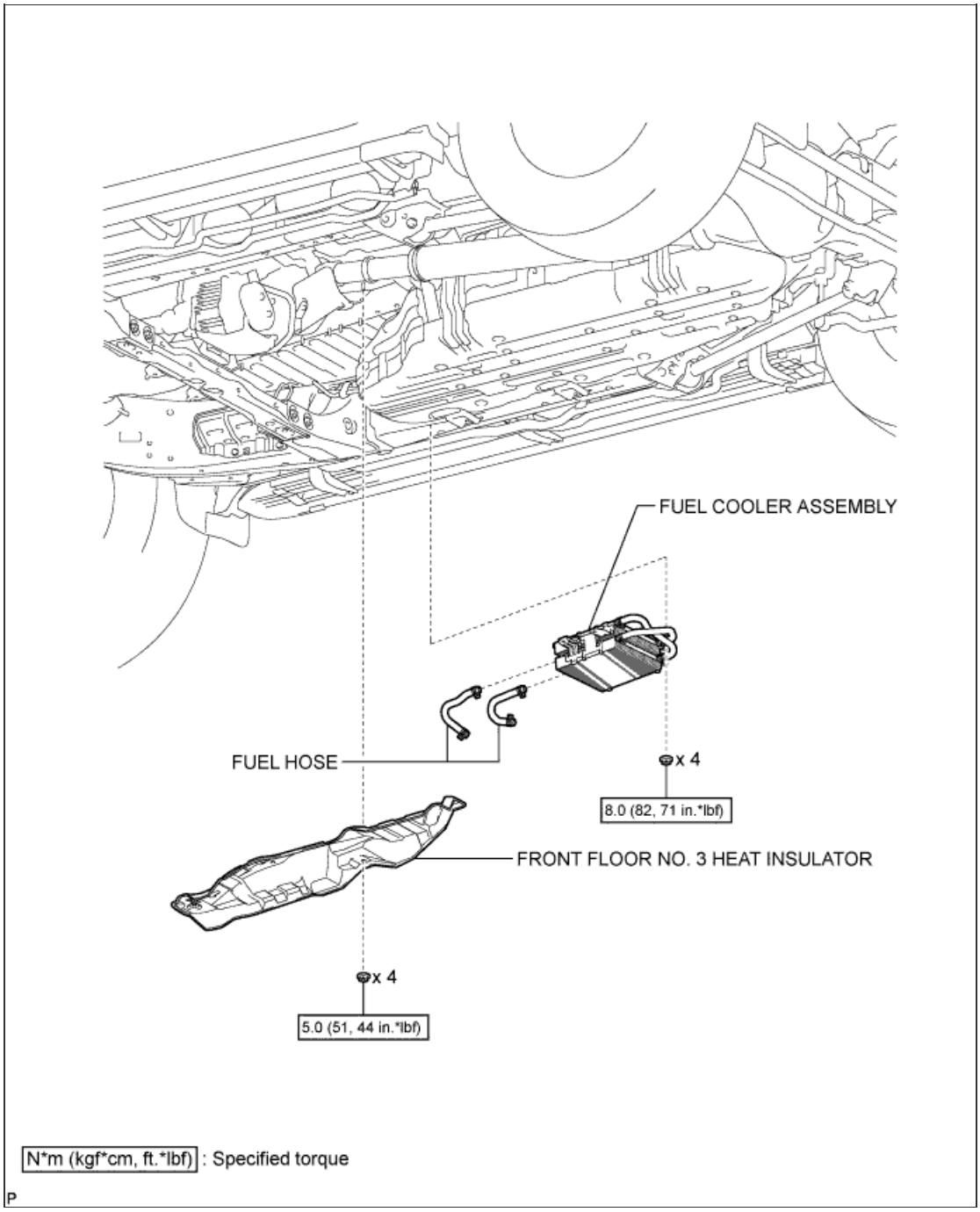
15. INSTALL NO. 1 INTAKE MANIFOLD INSULATOR (w/ Intercooler)



16. INSTALL COMMON RAIL ASSEMBLY LH AND RH

a. Install the common rail assembly LH and RH (Click here).

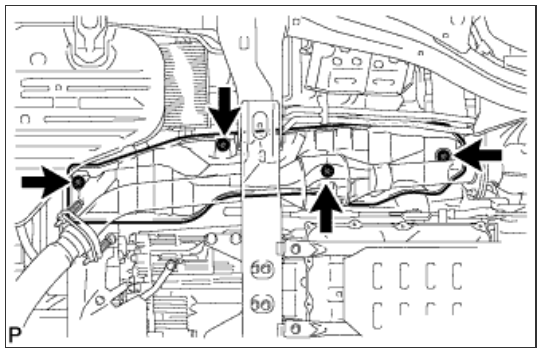
for Preparation Click here



for Preparation Click here

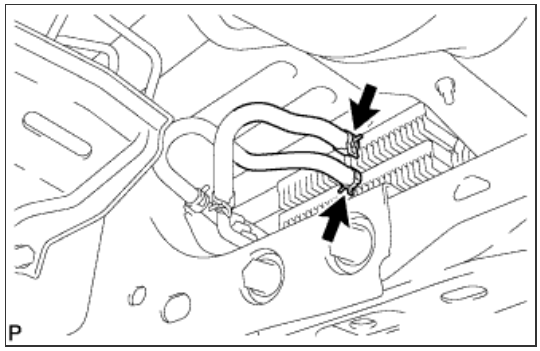
1. REMOVE FRONT FLOOR NO. 3 HEAT INSULATOR

a. Remove the 4 nuts and floor heat insulator.

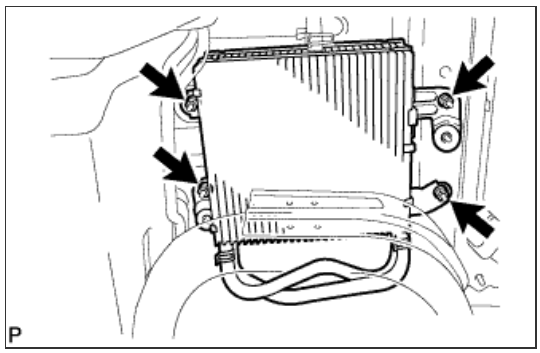


2. REMOVE FUEL COOLER ASSEMBLY

a. Disconnect the fuel hoses from the fuel cooler.



b. Remove the 4 nuts and fuel cooler.

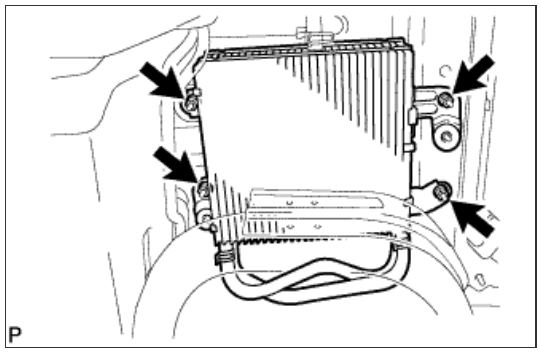


for Preparation Click here

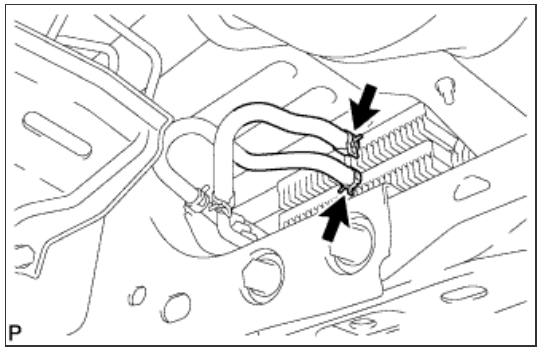
1. INSTALL FUEL COOLER ASSEMBLY

a. Install the fuel cooler with the 4 nuts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }



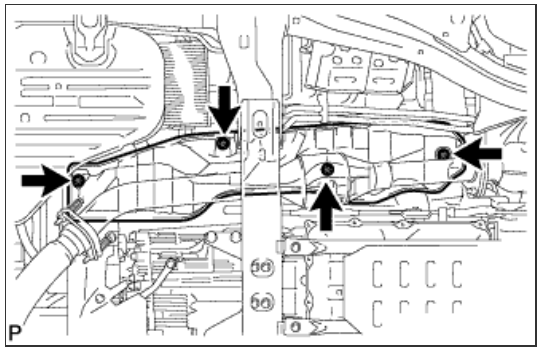
b. Connect the fuel hoses to the fuel cooler.



2. INSTALL FRONT FLOOR NO. 3 HEAT INSULATOR

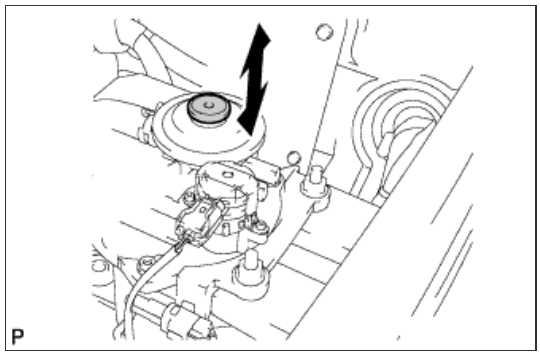
a. Install the floor heat insulator with the 4 nuts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



3. BLEED AIR FROM FUEL SYSTEM

a. Using the hand pump indicated by the arrow in the illustration, bleed the fuel system. Continue pumping until pumping becomes difficult.



4. INSPECT FOR FUEL LEAK

a. Perform Active Test.

i. Connect the intelligent tester to the DLC3.

ii. Turn the ignition switch to ON.

iii. Start the engine.

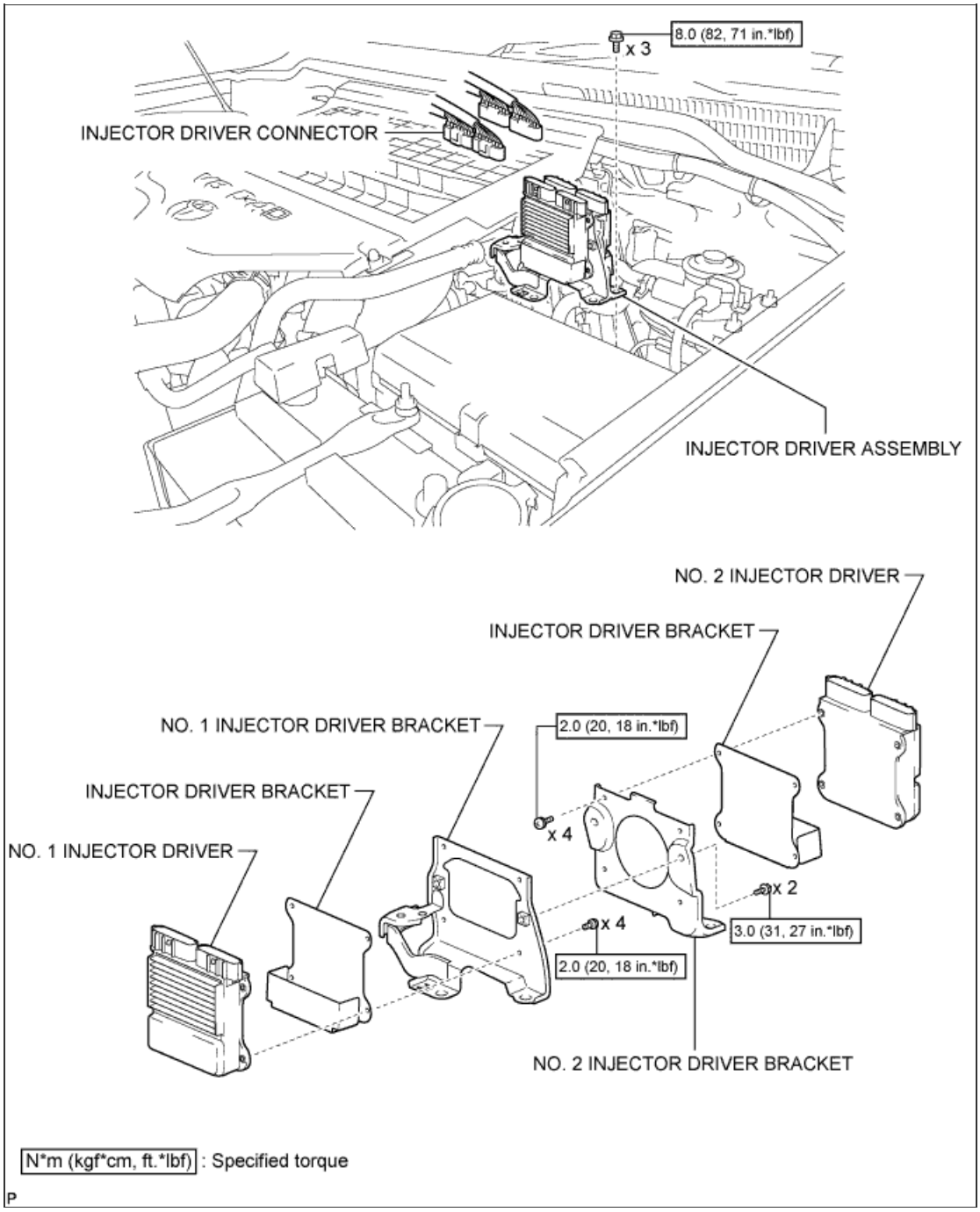
iv. Turn the intelligent tester ON.

v. Enter the following menus: Powertrain / Engine / Active Test.

vi. Perform the Active Test.

Tester Display	Test Detail	Control Range	Diagnostic Note
Test the Fuel Leak	Pressurizes fuel inside common rail and checks for fuel leaks	Stop/Start	• The fuel inside the common rail is pressurized to the specified value and the engine speed increases to rpm when Start is selected. • The above conditions are preserved while Start is selected.

for Preparation [Click here]



for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

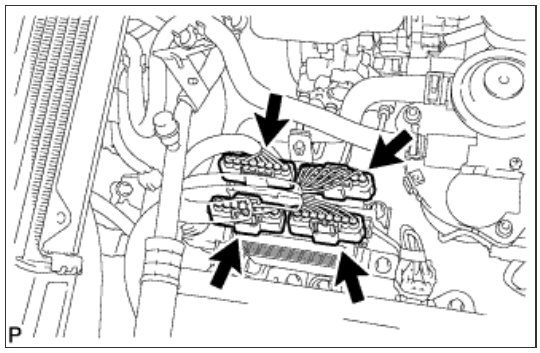
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Disconnect the cables from the negative (-) main battery and sub-battery terminals.

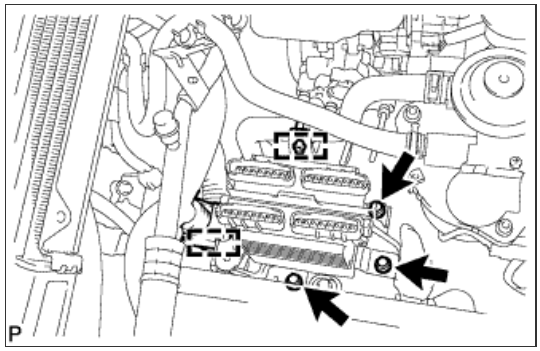
2. REMOVE INJECTOR DRIVER

a. Disconnect the 4 in ector driver connectors.

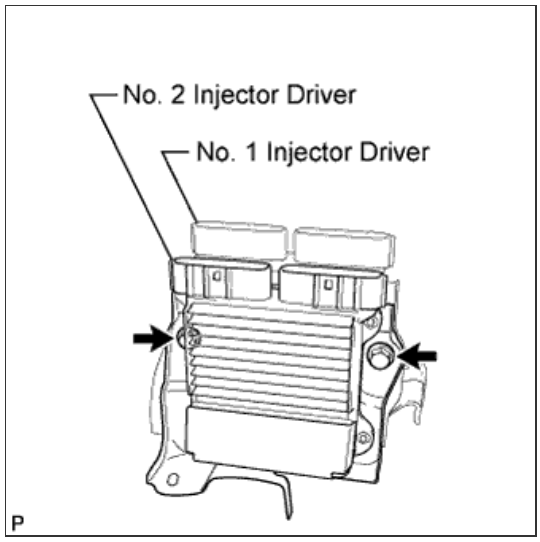


b. Detach the fuel hose clamp and wire harness clamp.

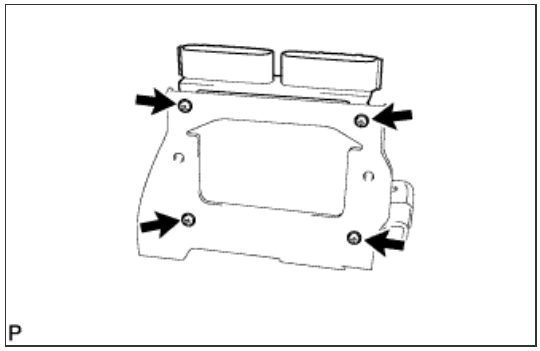
c. Remove the 3 bolts and in ector driver assembly.



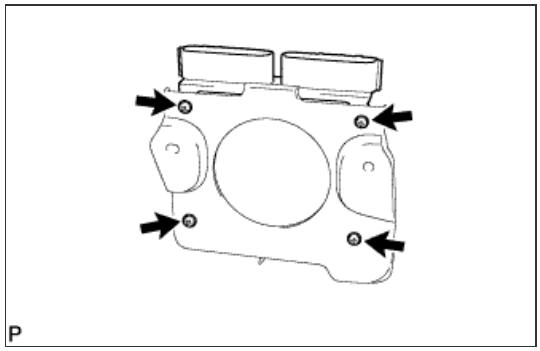
d. Remove the 2 bolts, No. 2 in ector driver and No. 2 in ector driver bracket from the No. 1 in ector driver bracket.



e. Remove the 4 screws, No. 1 in ector driver bracket, No. 1 in ector driver and in ector driver bracket.



f. Remove the 4 screws, No. 2 in ector driver bracket, No. 2 in ector driver and in ector driver bracket.



for Preparation Click here

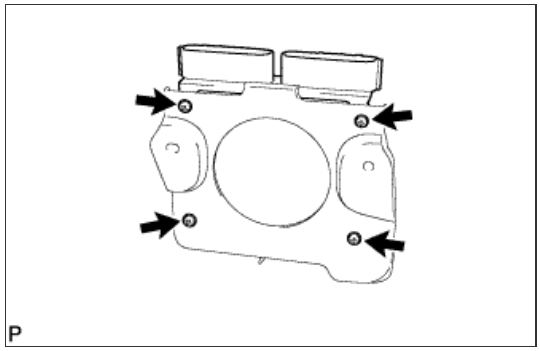
1. INSTALL INJECTOR DRIVER

NOTICE:

Be careful not to drop or strike the in ector driver.

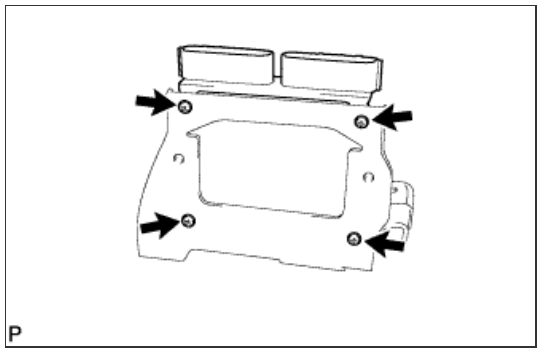
a. nstall the No. 2 in ector driver and in ector driver bracket to the No. 2 in ector driver bracket with the screws.

Torque:
2.0 N*m{ 20 kgf*cm , 18 in.*lbf }



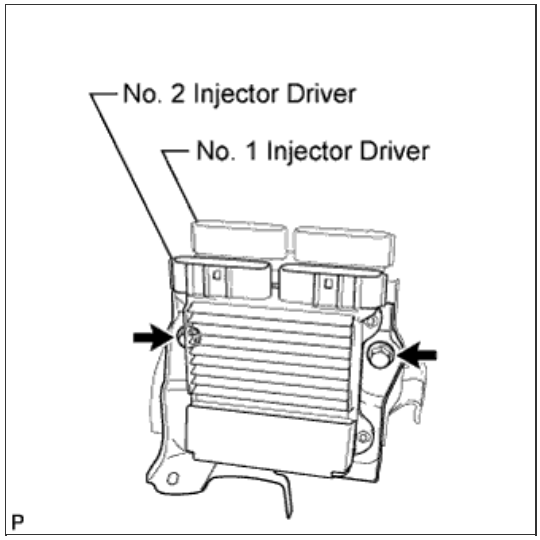
b. nstall the No. 1 in ector driver and in ector driver bracket to the No. 1 in ector driver bracket with the screws.

Torque:
2.0 N*m{ 20 kgf*cm , 18 in.*lbf }



c. nstall the No. 2 in ector driver bracket to the No. 1 in ector driver bracket with the 2 bolts.

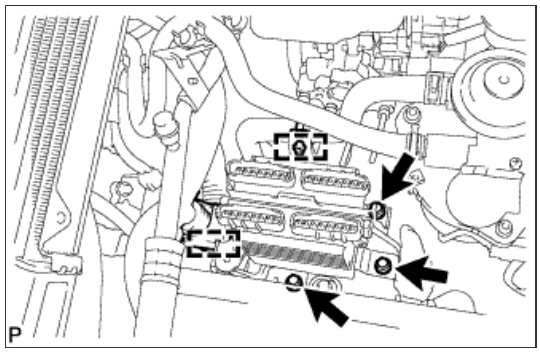
Torque:
3.0 N*m{ 31 kgf*cm , 27 in.*lbf }



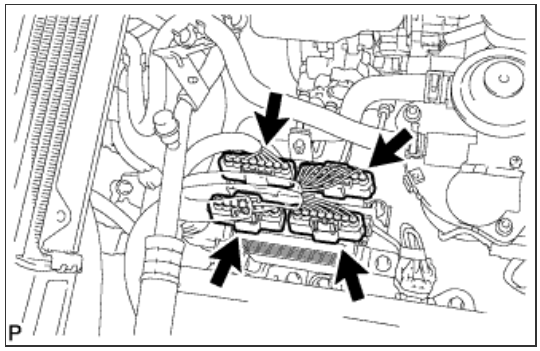
d. nstall the in ector driver assembly with the 3 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

e. Attach the fuel hose clamp and wire harness clamp.



f. Connect the in ector driver connectors.



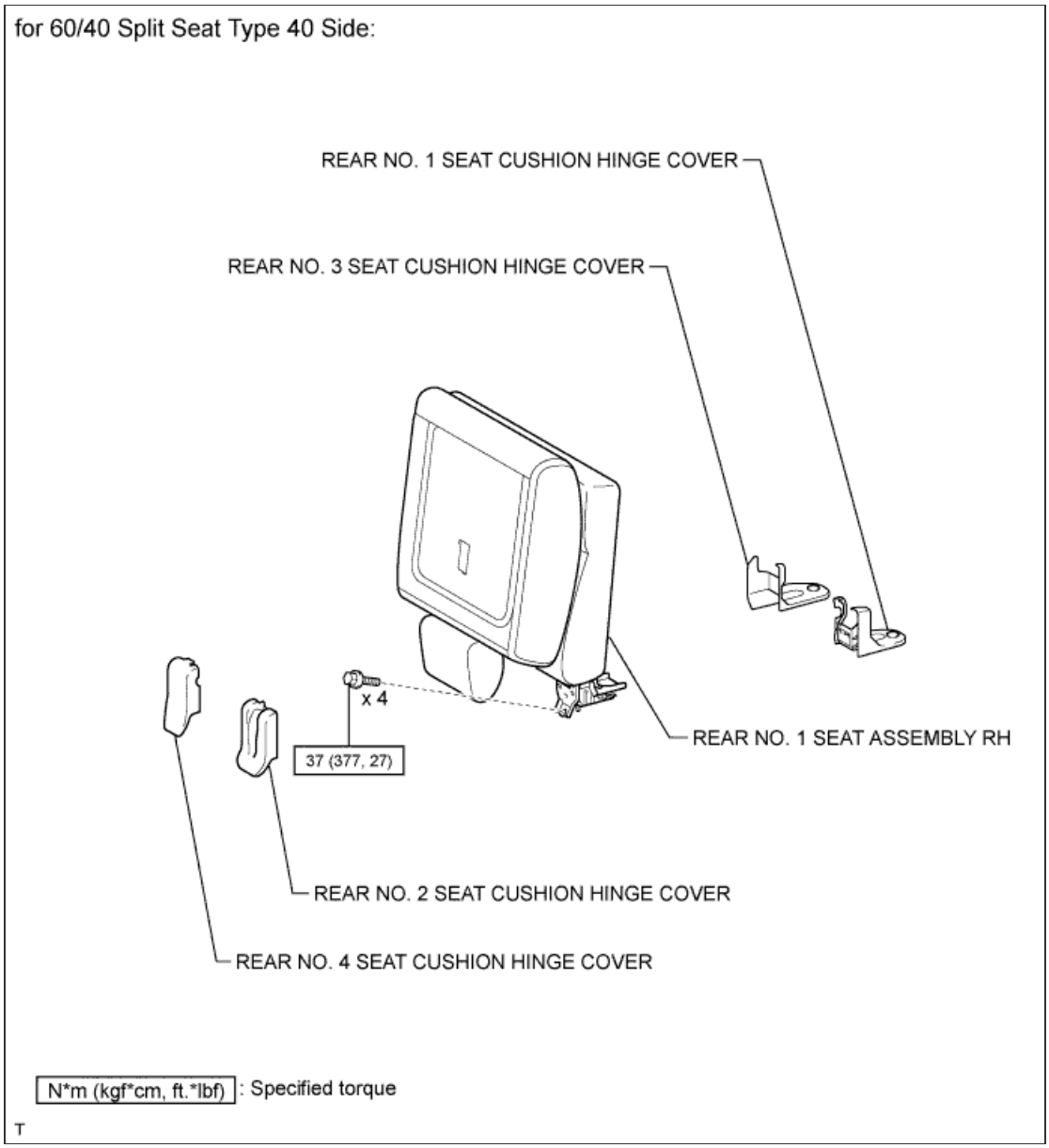
2. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

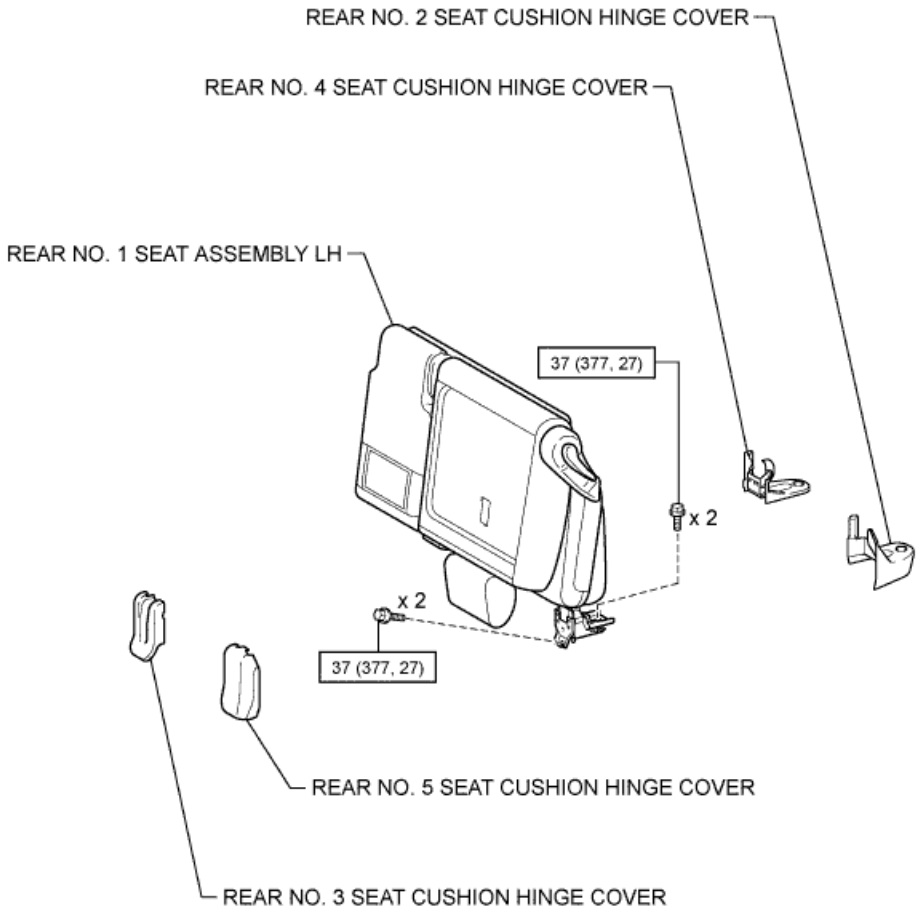
en disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Connect the cables to the negative (-) main battery and sub-battery terminals.

for Preparation [Click here]



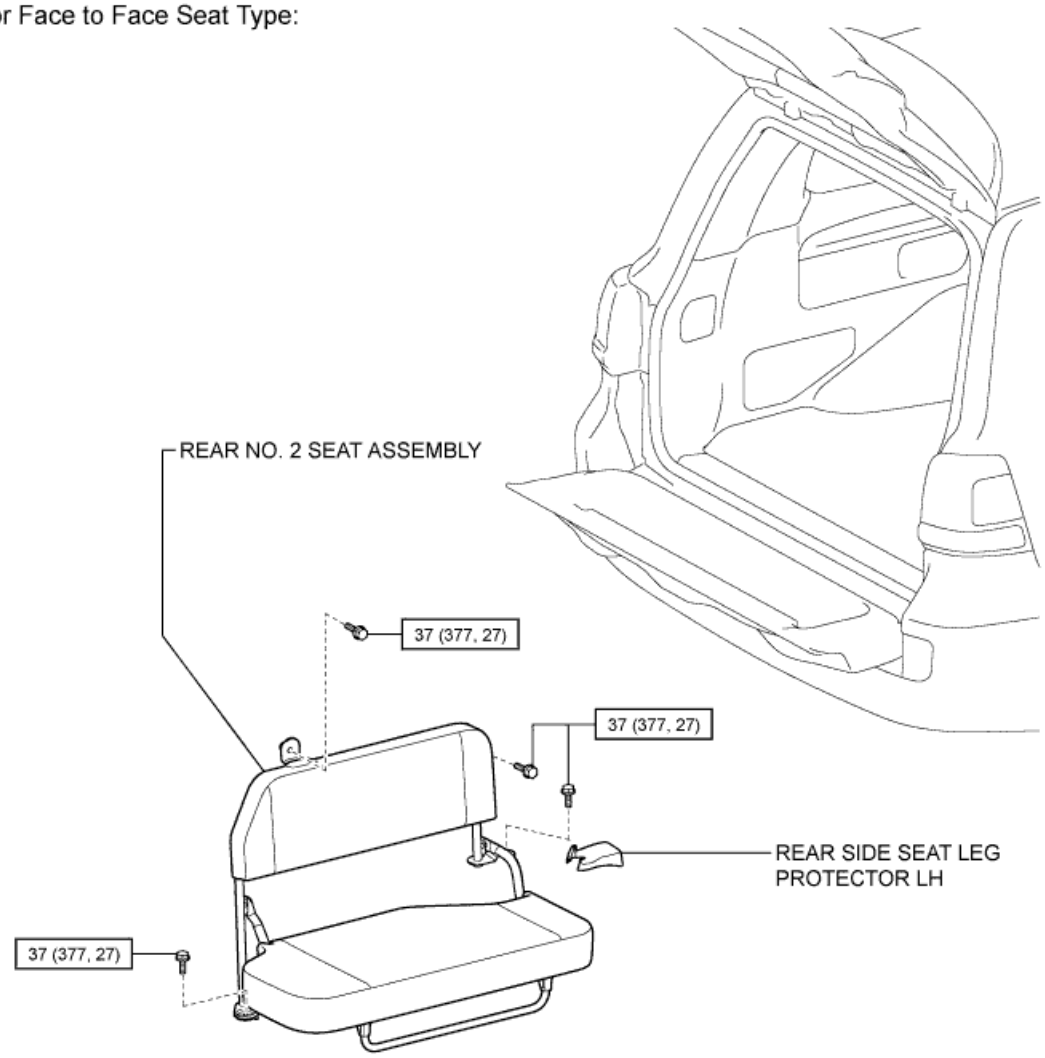
for 60/40 Split Seat Type 60 Side:



N*m (kgf*cm, ft.*lbf) : Specified torque

T

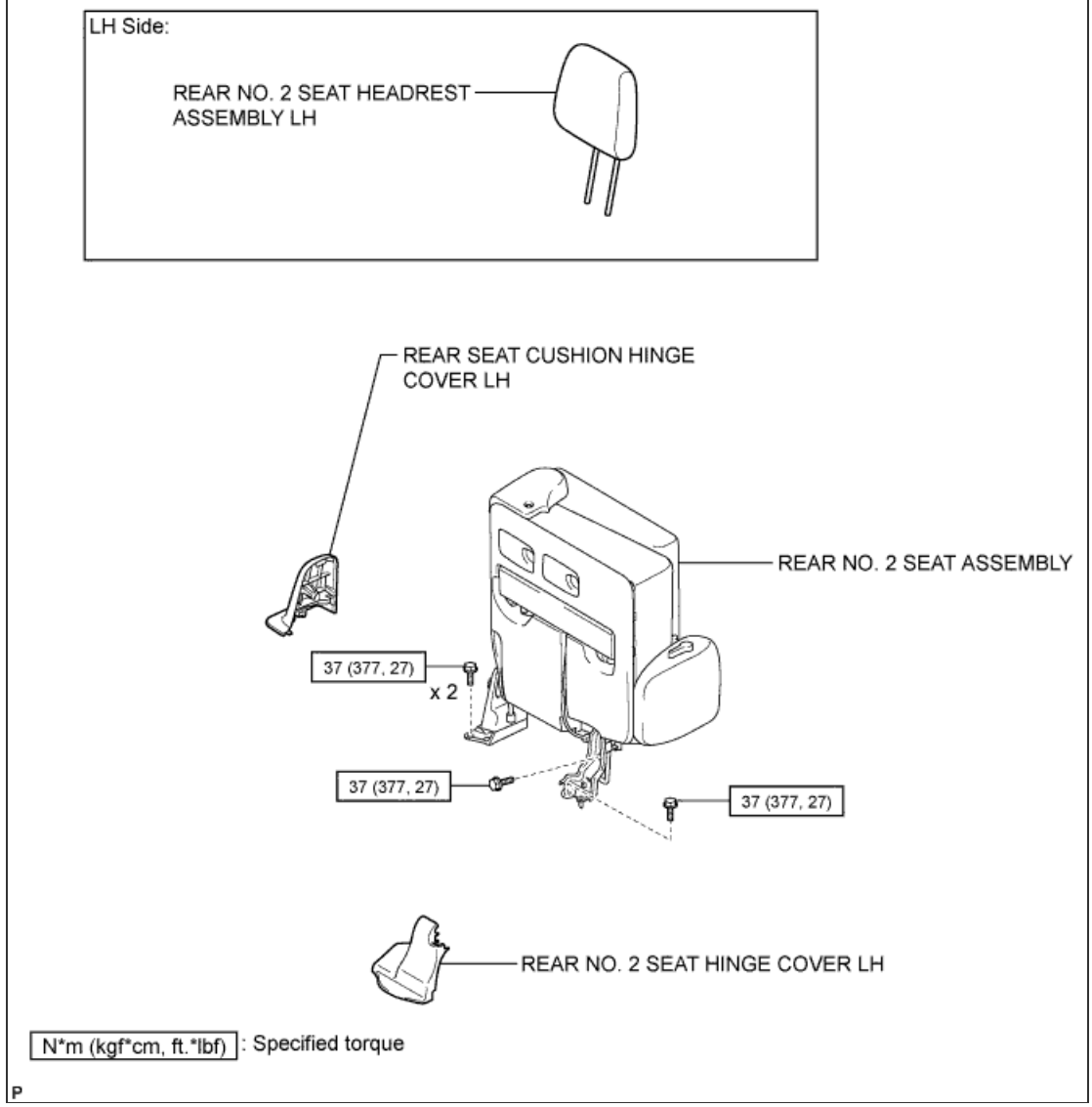
for Face to Face Seat Type:



N*m (kgf*cm, ft.*lbf) : Specified torque

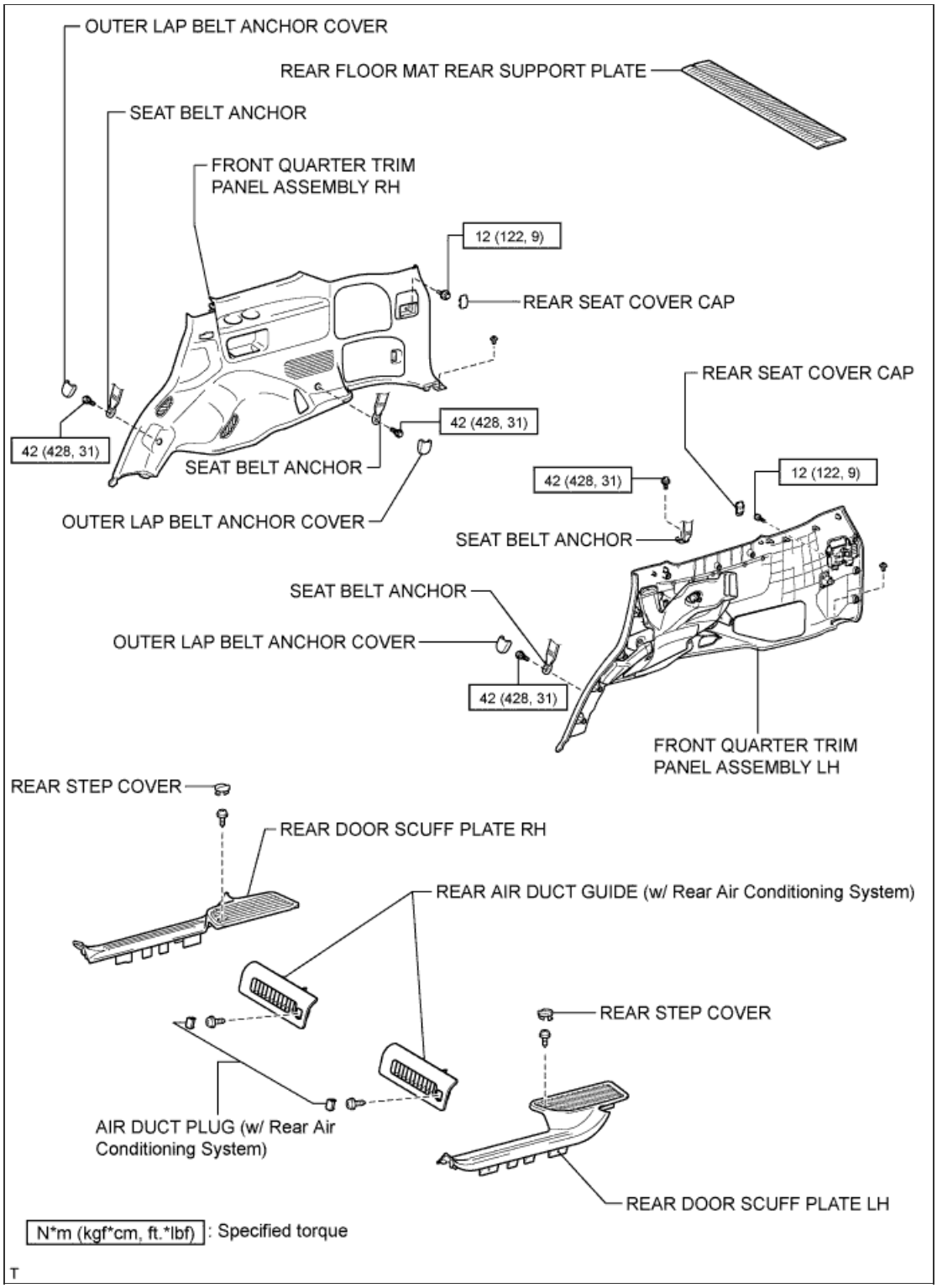
P

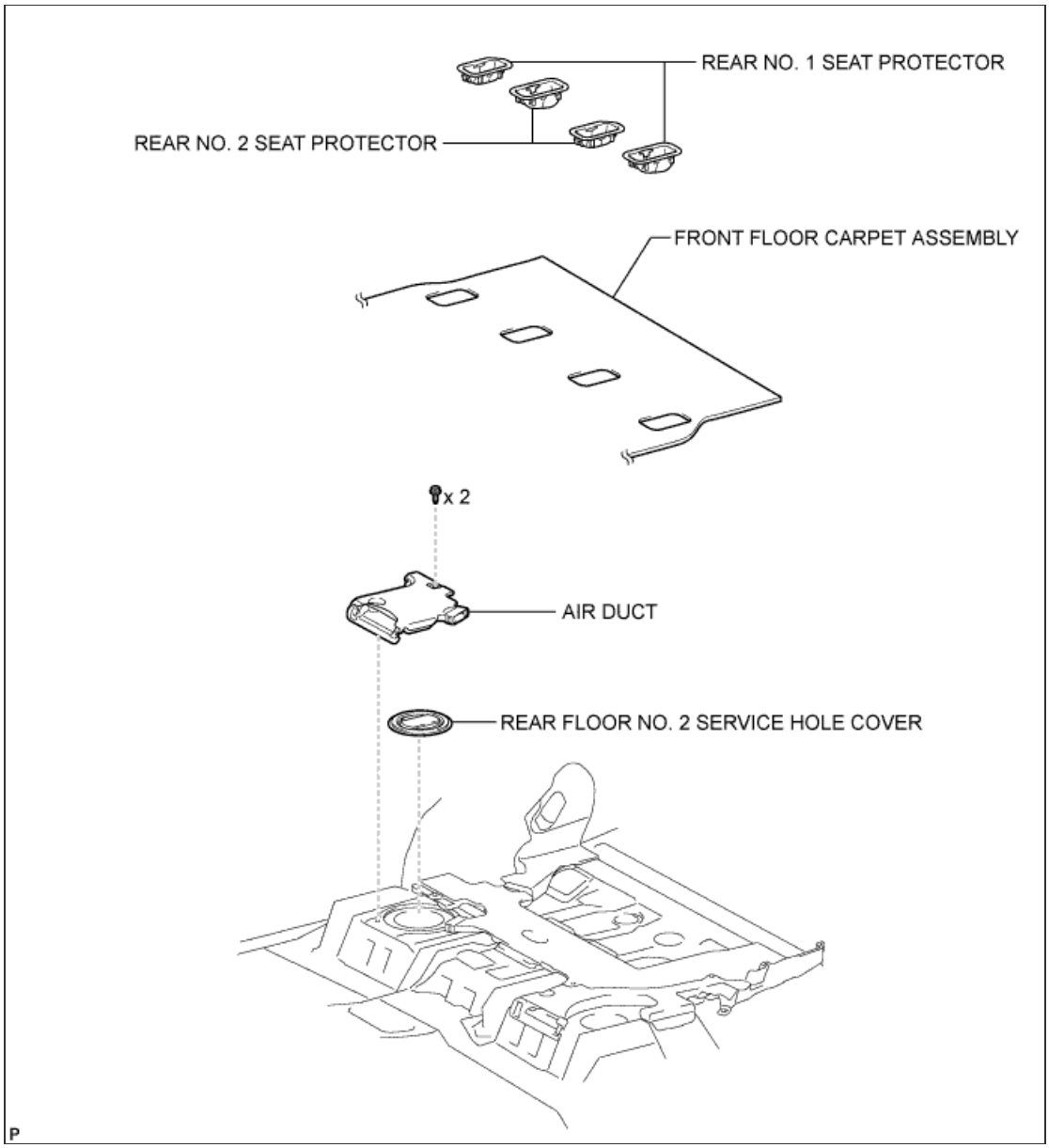
except Face to Face Seat Type:

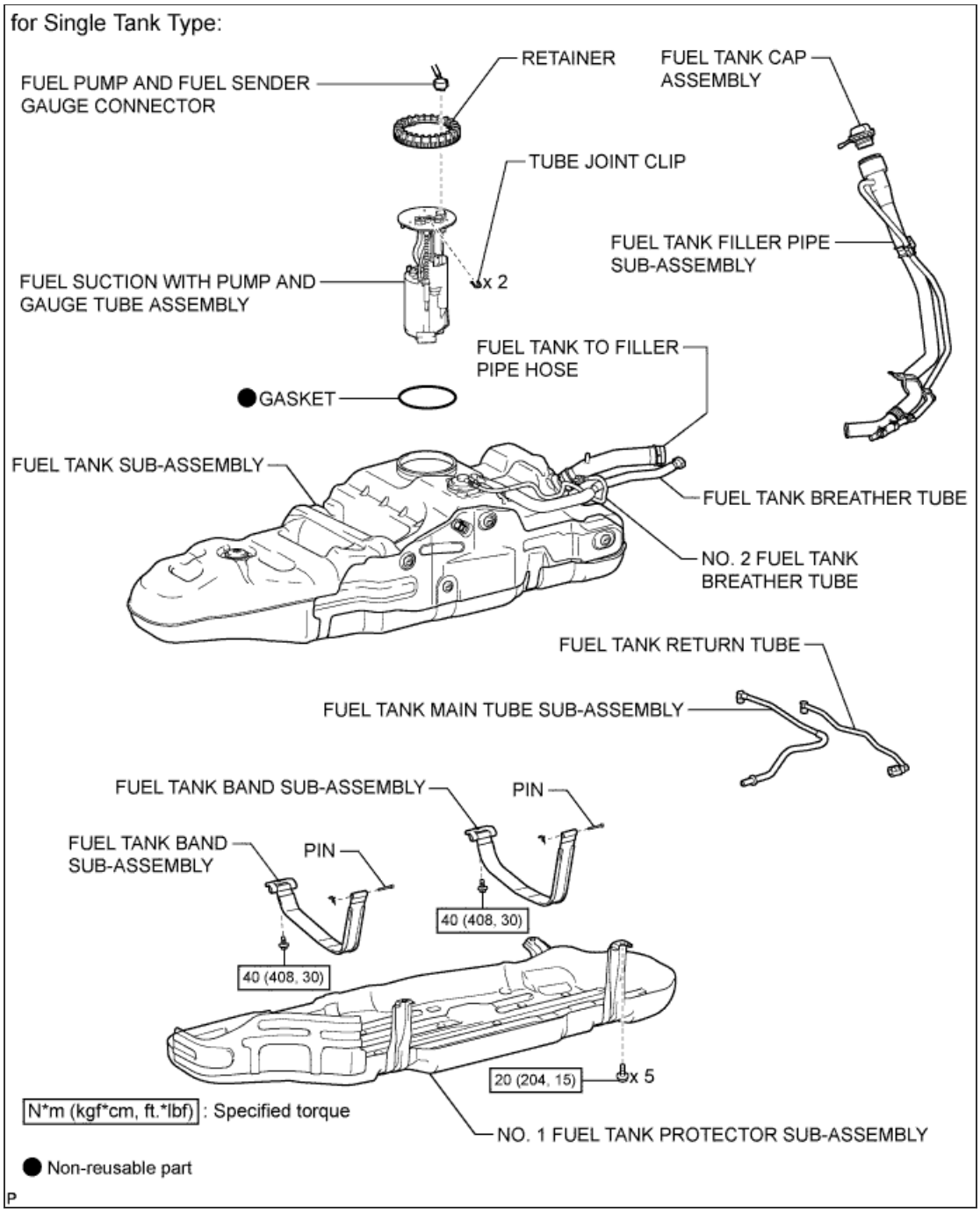


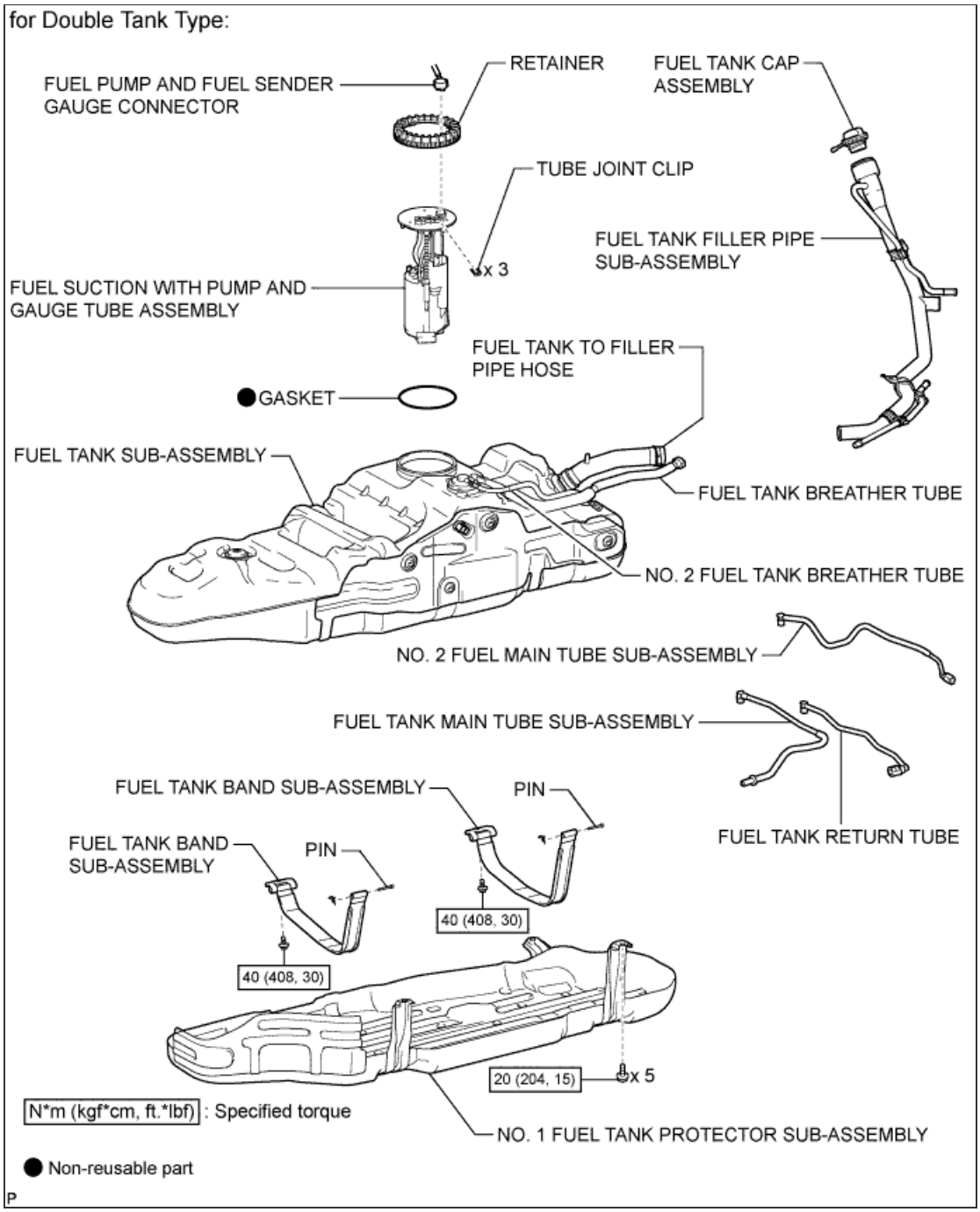
N*m (kgf*cm, ft.*lbf) : Specified torque

P

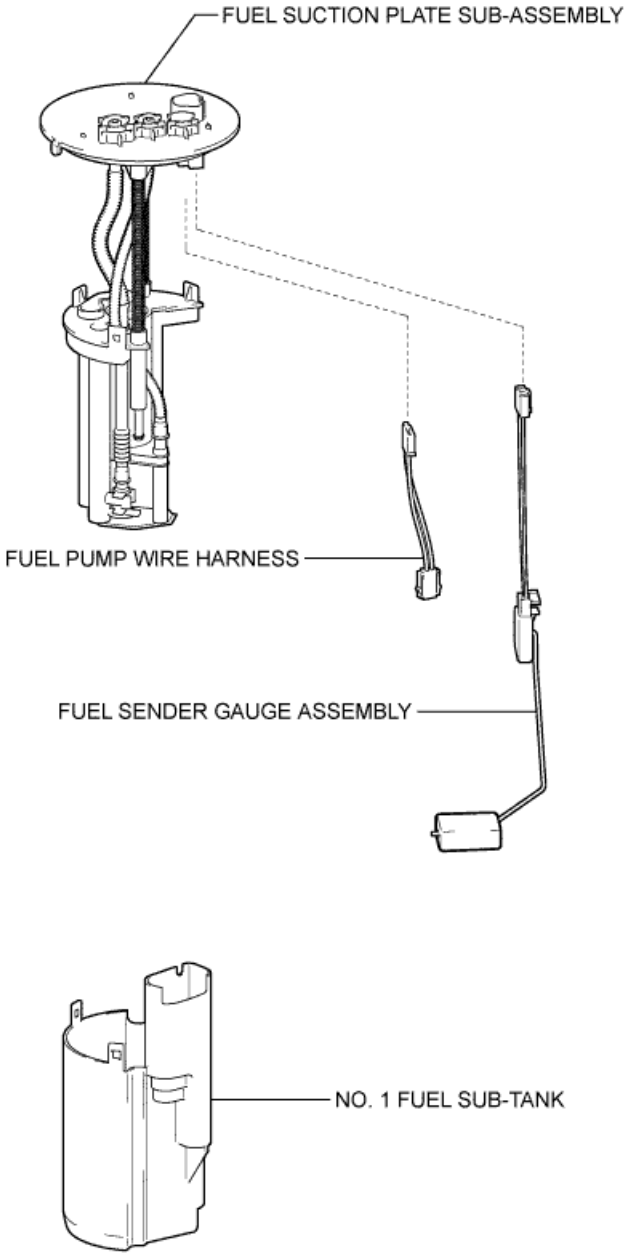

OUTER LAP BELT ANCHOR COVER
REAR FLOOR MAT REAR SUPPORT PLATE
SEAT BELT ANCHOR
FRONT QUARTER TRIM PANEL ASSEMBLY RH
12 (122, 9)
REAR SEAT COVER CAP
42 (428, 31)
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
REAR SEAT COVER CAP
42 (428, 31)
12 (122, 9)
SEAT BELT ANCHOR
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
42 (428, 31)
FRONT QUARTER TRIM PANEL ASSEMBLY LH
REAR STEP COVER
REAR DOOR SCUFF PLATE RH
REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)
REAR STEP COVER
AIR DUCT PLUG (w/ Rear Air Conditioning System)
REAR DOOR SCUFF PLATE LH
N*m (kgf*cm, ft.*lbf) : Specified torque
T


REAR NO. 1 SEAT PROTECTOR
REAR NO. 2 SEAT PROTECTOR
FRONT FLOOR CARPET ASSEMBLY
x 2
AIR DUCT
REAR FLOOR NO. 2 SERVICE HOLE COVER
P


for Single Tank Type:
FUEL PUMP AND FUEL SENDER GAUGE CONNECTOR
RETAINER
FUEL TANK CAP ASSEMBLY
TUBE JOINT CLIP
FUEL TANK FILLER PIPE SUB-ASSEMBLY
FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY
x 2
FUEL TANK TO FILLER PIPE HOSE
GASKET
FUEL TANK SUB-ASSEMBLY
FUEL TANK BREATHER TUBE
NO. 2 FUEL TANK BREATHER TUBE
FUEL TANK RETURN TUBE
FUEL TANK MAIN TUBE SUB-ASSEMBLY
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TANK BAND SUB-ASSEMBLY
PIN
40 (408, 30)
40 (408, 30)
20 (204, 15)
x 5
N*m (kgf*cm, ft.*lbf) : Specified torque
NO. 1 FUEL TANK PROTECTOR SUB-ASSEMBLY
Non-reusable part
P

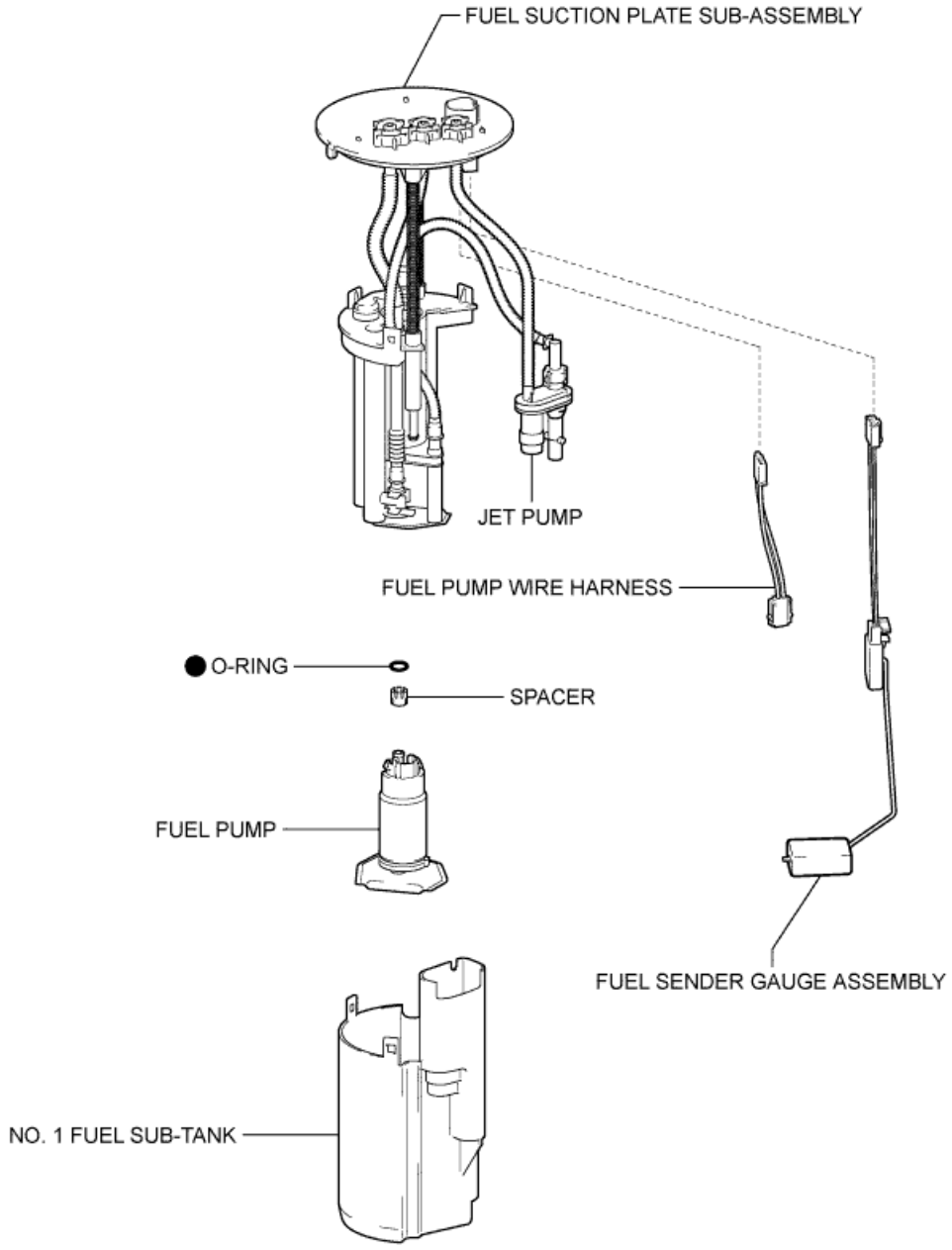

for Double Tank Type:
FUEL PUMP AND FUEL SENDER GAUGE CONNECTOR
RETAINER
FUEL TANK CAP ASSEMBLY
TUBE JOINT CLIP
x 3
FUEL TANK FILLER PIPE SUB-ASSEMBLY
FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY
FUEL TANK TO FILLER PIPE HOSE
GASKET
FUEL TANK SUB-ASSEMBLY
FUEL TANK BREATHER TUBE
NO. 2 FUEL TANK BREATHER TUBE
NO. 2 FUEL MAIN TUBE SUB-ASSEMBLY
FUEL TANK MAIN TUBE SUB-ASSEMBLY
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TANK RETURN TUBE
FUEL TANK BAND SUB-ASSEMBLY
PIN
40 (408, 30)
40 (408, 30)
20 (204, 15)
x 5
N*m (kgf*cm, ft.*lbf) : Specified torque
NO. 1 FUEL TANK PROTECTOR SUB-ASSEMBLY
Non-reusable part
P

for Single Tank Type:



P

for Double Tank Type:



● Non-reusable part

P

for Preparation Click here

1. REMOVE FUEL TANK SUB-ASSEMBLY

a. Remove the fuel tank sub-assembly (Cl he e).

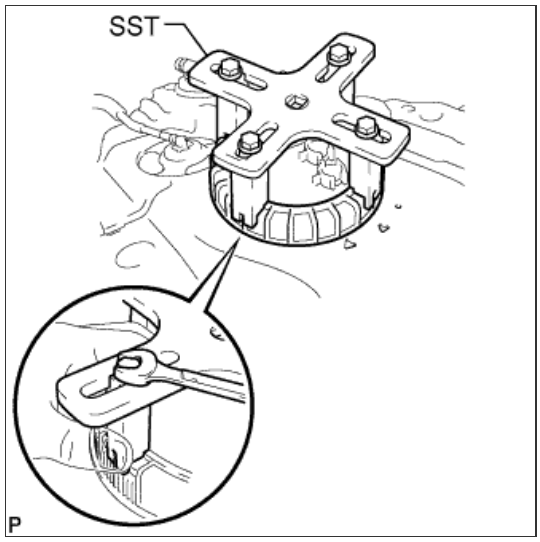
2. REMOVE FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

a. Set SST on the eta e

SST
09808-14030

HINT:

- **Securely attach the claws of SST to the protrusion of the retainer and fix SST in place.**
- **Install SST while pressing the claws of SST against the retainer (towards the center of SST).**

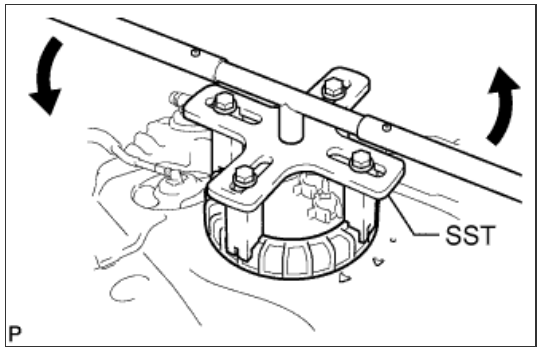


b. SST, loosen the eta e

SST
09808-14030

Text in Illustration

➡	u



NOTICE:

- **Do not use any tools other than those specified in this operation. Damage to the retainer or the fuel tank may result.**
- **While pressing down on SST so that the claws of SST do not slip off the protrusion of the retainer, turn the retainer counterclockwise to loosen it.**

HINT:

he p ot us on of the eta e f t the ends of SST.

c. Remove the eta e

d. Remove the eta e wh le hold the fuel suct on tube assembly by hand.

NOTICE:

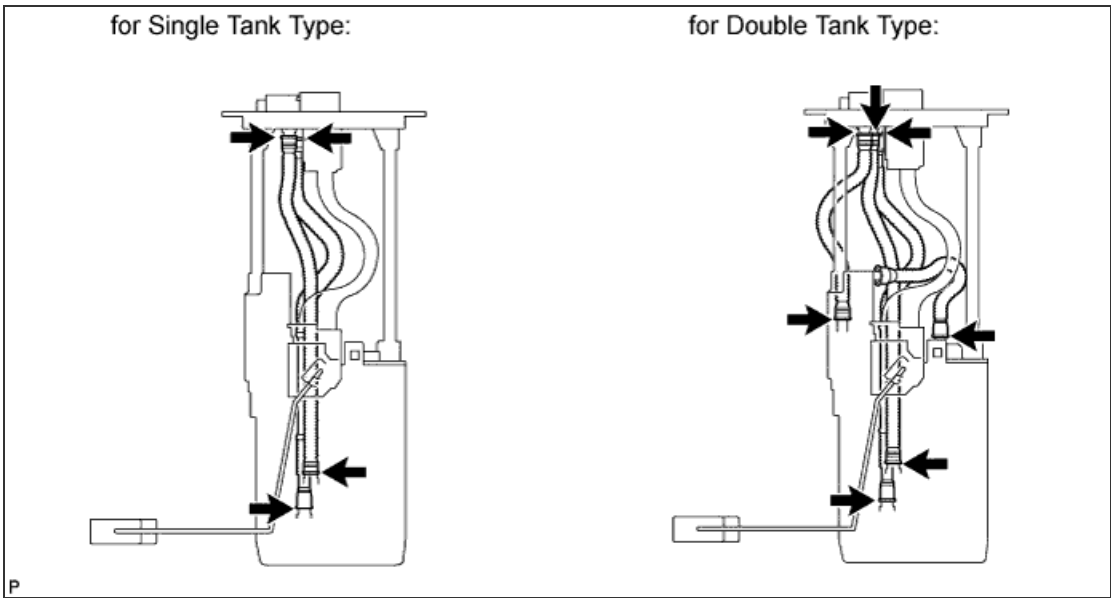
Be ca eful not to bend the a m of the fuel sende gauge.

e. Remove the gasket f om the fuel tank.

for Preparation Click here

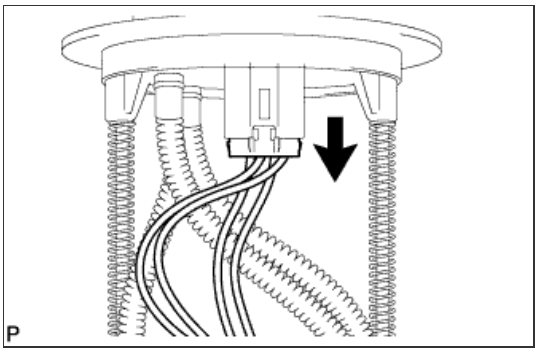
NOTICE:

Do not disconnect the hoses indicated in the illustration.

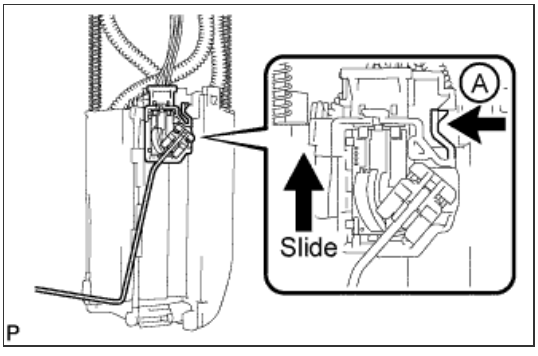


1. REMOVE FUEL SENDER GAUGE ASSEMBLY

a. Disconnect the fuel sender gauge connector.



b. Press down on the sender gauge claw labeled Then slide the sender gauge upward to remove it.



2. REMOVE NO. 1 FUEL SUB-TANK (for Single Tank Type)

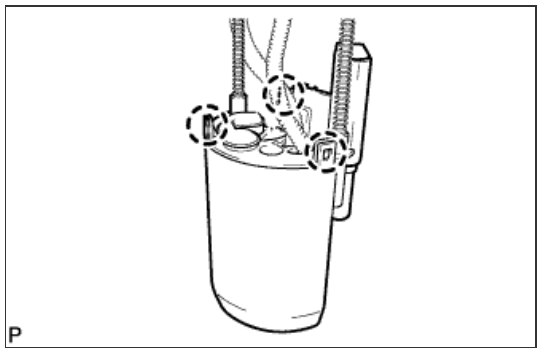
a. Using a screwdriver, detach the 3 claws from the claw holes to remove the fuel sub-tank.

NOTICE:

Do not damage the fuel sub-tank.

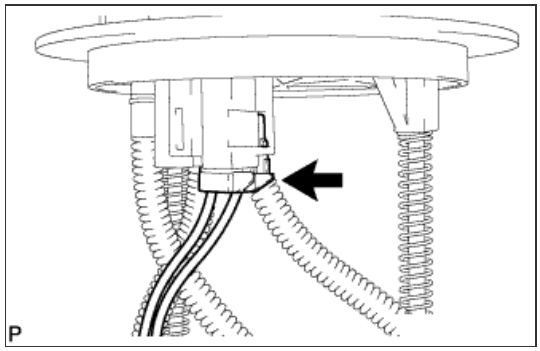
HINT:

Tape the screwdriver tip before use.



3. REMOVE NO. 1 FUEL SUB-TANK (for Double Tank Type)

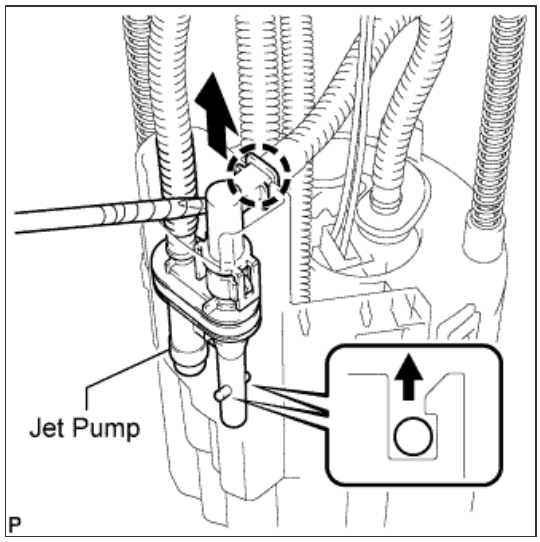
a. Disconnect the fuel pump connector.



b. Using a small screwdriver, detach the claw from the sub-tank.

HINT:

Tape the screwdriver tip before use.



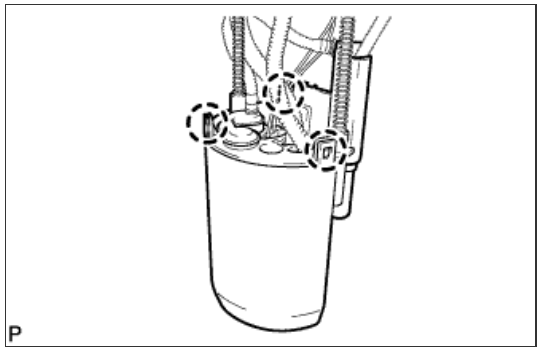
c. Using a screwdriver, detach the 3 claws from the claw holes to remove the fuel sub-tank.

NOTICE:

Do not damage the fuel sub-tank.

HINT:

Tape the screwdriver tip before use.

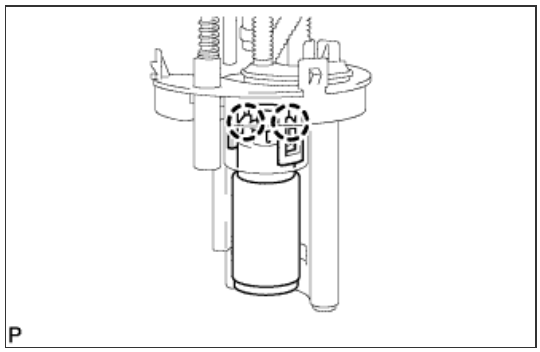


4. REMOVE FUEL PUMP (for Double Tank Type)

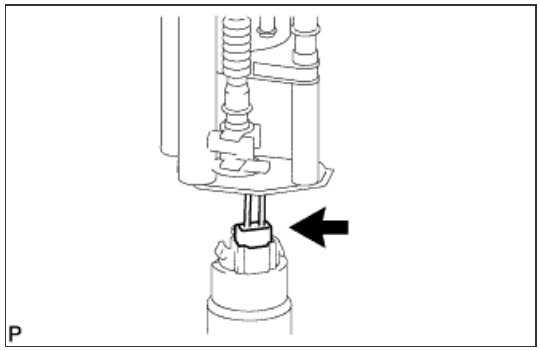
a. Using a screwdriver, detach the 2 claws from the claw holes and remove the fuel pump.

HINT:

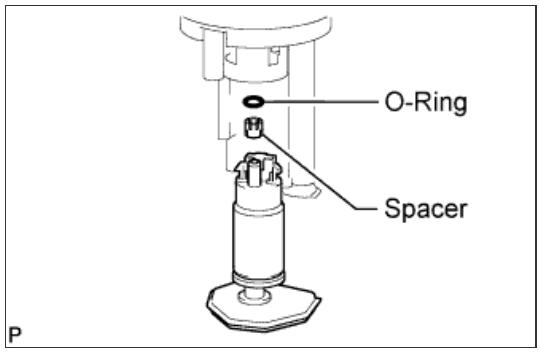
Tape the screwdriver tip before use.



b. Disconnect the fuel pump wire harness connector from the fuel pump.



c. Remove the O-ring and spacer from the fuel pump.



for Preparation Click here

1. INSPECT FUEL PUMP

a. Inspect the resistance of the fuel pump.

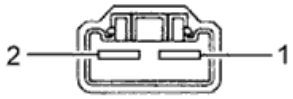
i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20	to 3.0 Ω

If the result is not as specified, replace the fuel pump.

Component without harness connected:
(Fuel Pump)



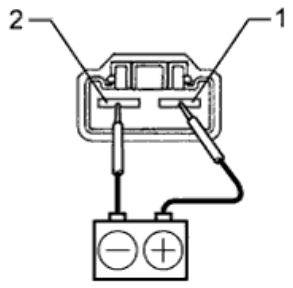
b. Inspect the operation of the fuel pump.

i. Connect the battery s positive (+) lead to terminal 1 of the connector, and the negative (-) lead to terminal 2. Check that the fuel pump operates.
If the result is not as specified, replace the fuel pump and fuel pump ECU.

NOTICE:

- **These tests st be perfor ed within 1 seconds to prevent the coil fro burning out.**
- **Keep the fuel pu p as far away fro the battery as possible.**
- **l ays turn the voltage on and off on the battery side, not the fuel pu p side.**

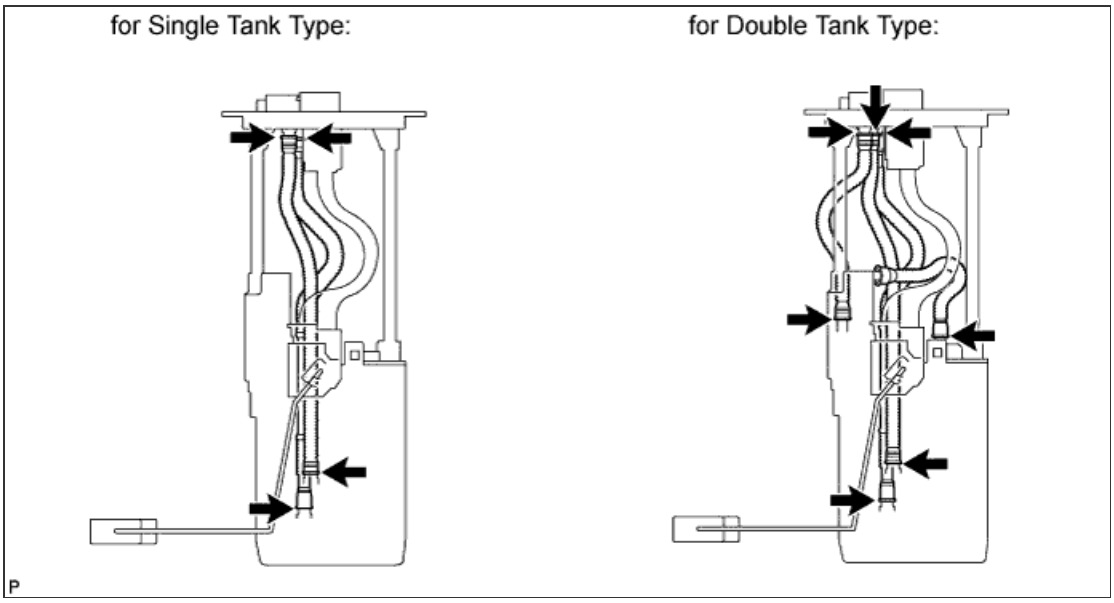
Component without harness connected:
(Fuel Pump)



for Preparation Click here

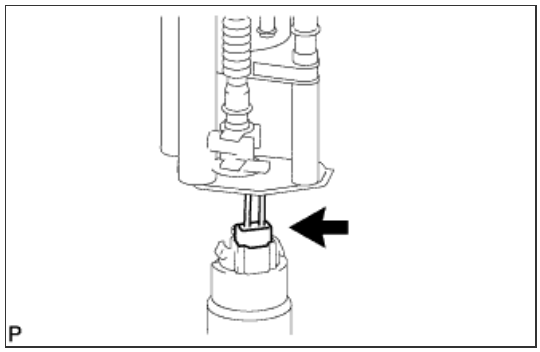
NOTICE:

Do not disconnect the hoses indicated in the illustration.

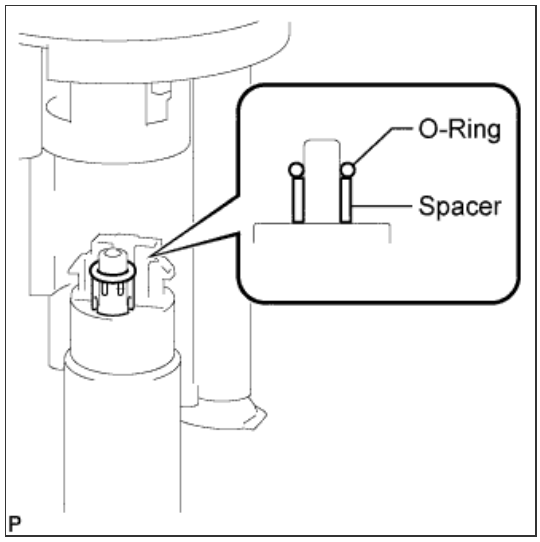


1. INSTALL FUEL PUMP (for Double Tank Type)

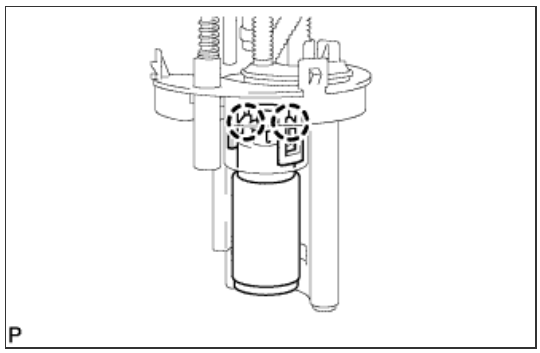
a. Connect the fuel pump wire harness connector to the fuel pump.



b. a light coat of gasoline to a new O-ring. Then install the spacer and O-ring to the fuel pump.

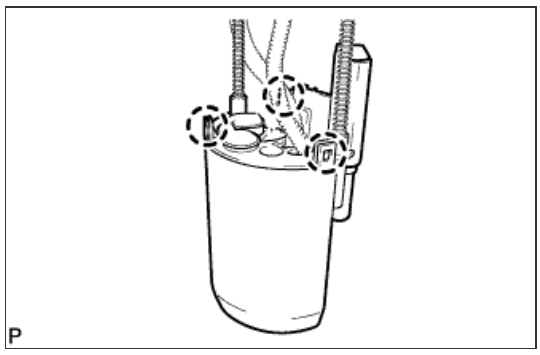


c. ttach the 2 claws to the claw holes to install the fuel pump.



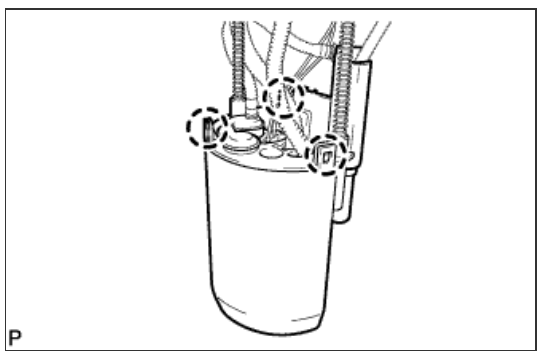
2. INSTALL NO. 1 FUEL SUB-TANK (for Single Tank Type)

a. ttach the 3 claws to the claw holes to install the fuel sub-tank.



3. INSTALL NO. 1 FUEL SUB-TANK (for Double Tank Type)

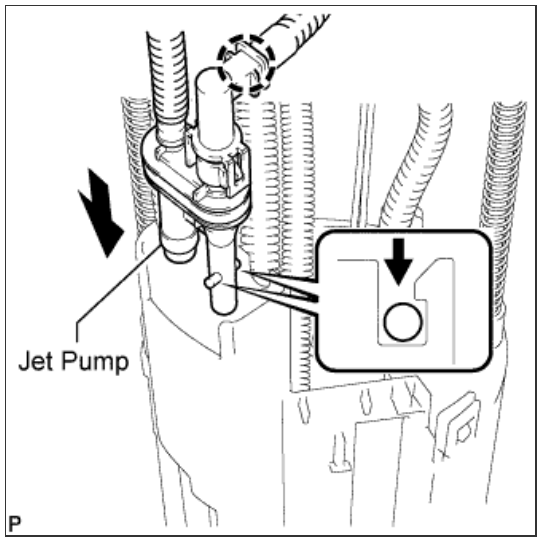
a. ttach the 3 claws to the claw holes to install the fuel sub-tank.



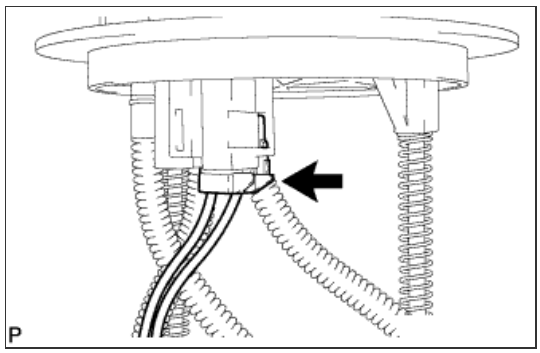
b. ttach the jet pump to the sub-tank.

HINT:

Make sure the 2 protrusions of the jet pump are properly installed into the sub-tank.

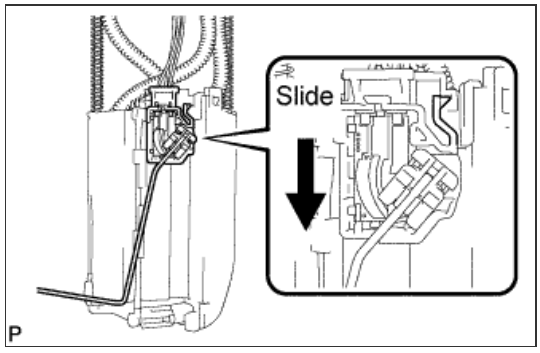


c. Connect the fuel pump connector.

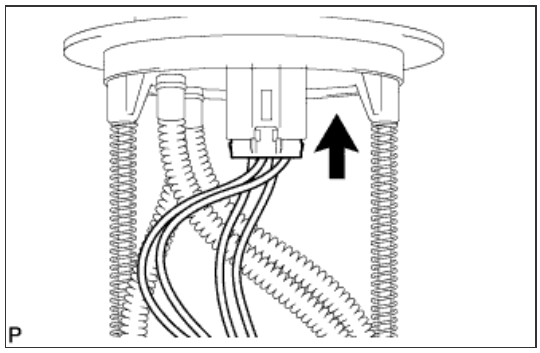


4. INSTALL FUEL SENDER GAUGE ASSEMBLY

a. Set the sender gauge to the fuel sub-tank. Then slide the sender gauge downward to install it.



b. Connect the fuel sender gauge connector.



for Preparation Click here

1. INSTALL FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

a. Apply a light coat of gasoline or grease to a new gasket, and install it to the fuel tank.

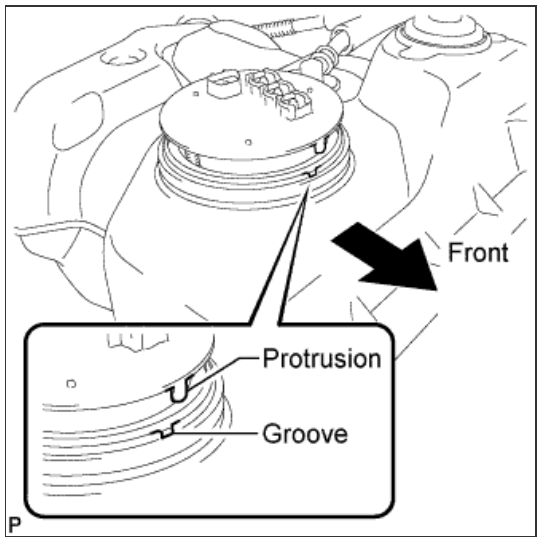
b. Install the fuel suction with pump and gauge tube into the fuel tank.

NOTICE:

Be careful not to bend the arm of the fuel sender gauge.

HINT:

Align the protrusion of the fuel suction with pump and gauge tube with the groove of the fuel tank.



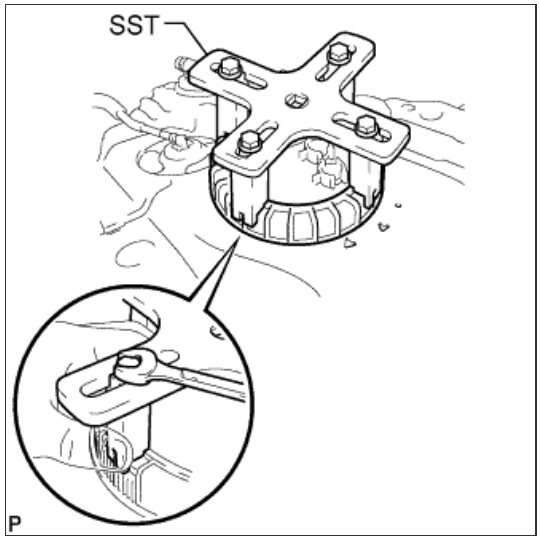
c. Put the retainer on the fuel tank. While holding the fuel suction with pump and gauge tube, tighten the retainer one complete turn by hand.

d. Set SST on the retainer.

SST
09808-14030

HINT:

- **Hold the fuel suction tube assembly upright by hand to ensure that the fuel suction tube gasket is not moved out of position.**
- **Securely attach the claws of SST to the protrusions of the retainer and fix SST in place.**
- **Install SST while pressing the claws of SST against the retainer (toward the center of SST).**

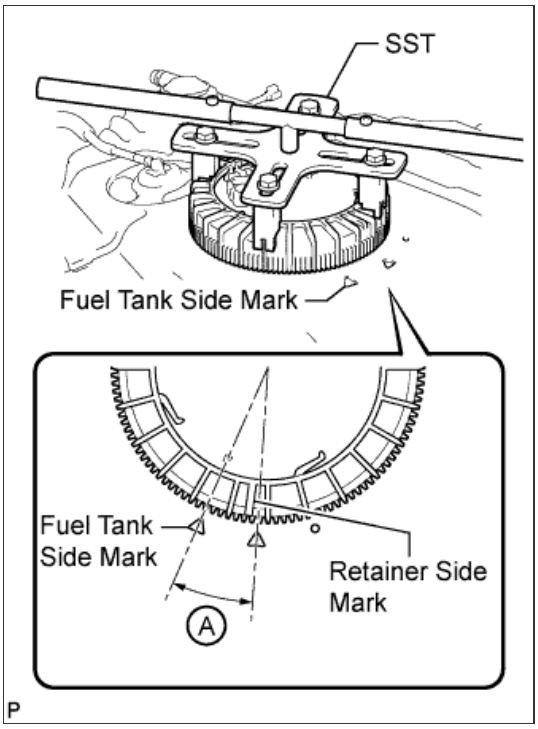


e. Using SST, tighten the retainer until the mark on the retainer is within range A on the fuel tank as shown in the illustration.

SST
09808-14030

HINT:

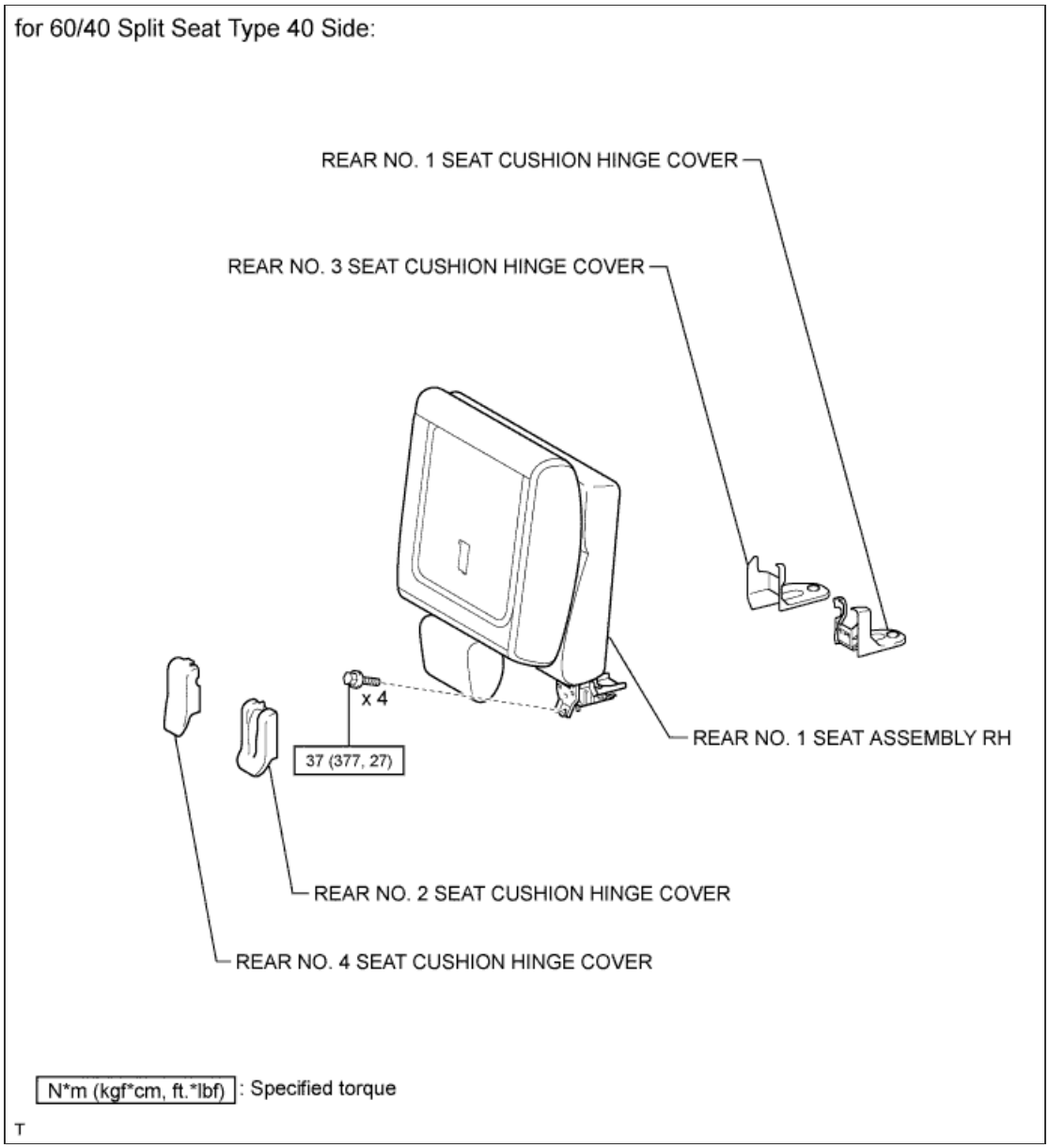
Fit the tips of SST onto the ribs of the retainer.



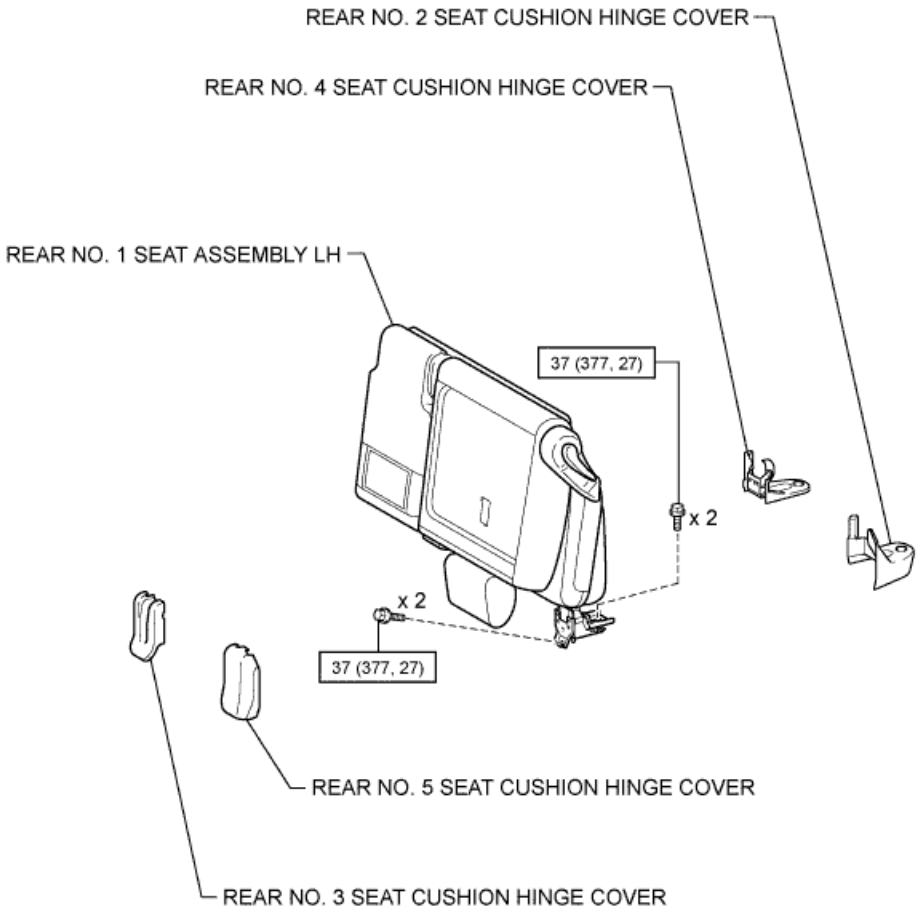
2. INSTALL FUEL TANK SUB-ASSEMBLY

a. Install the fuel tank sub-assembly (Click here).

for Preparation [Click here]



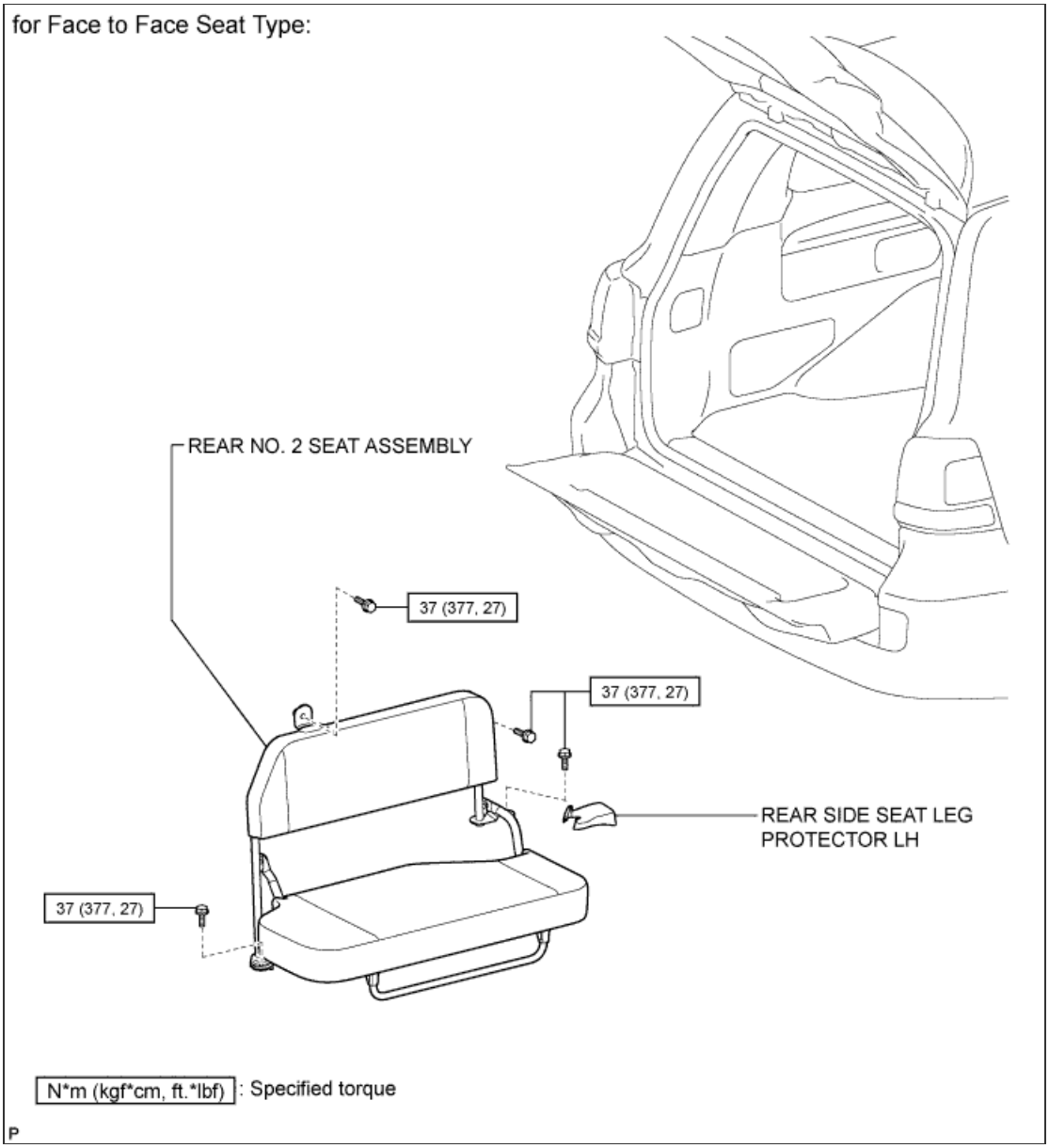
for 60/40 Split Seat Type 60 Side:



N*m (kgf*cm, ft.*lbf) : Specified torque

T

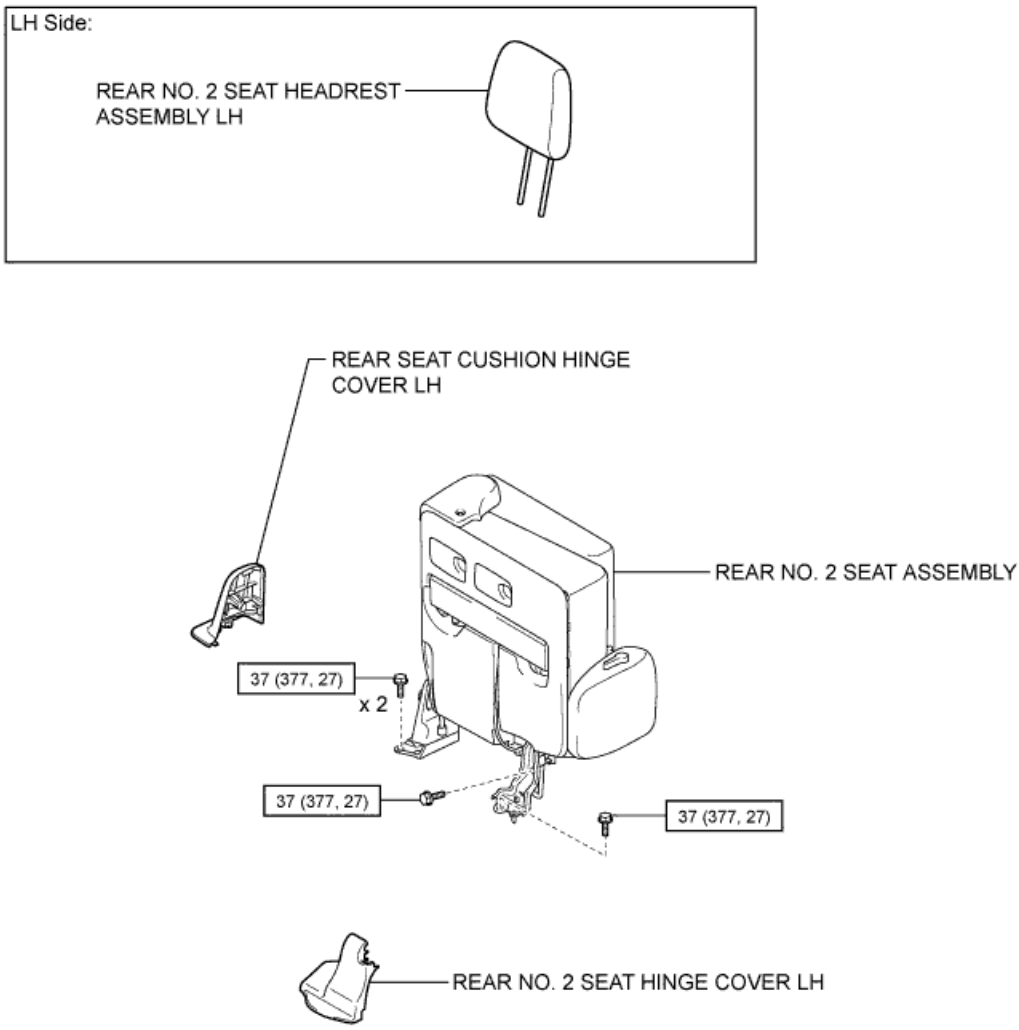
for Face to Face Seat Type:



N*m (kgf*cm, ft.*lbf) : Specified torque

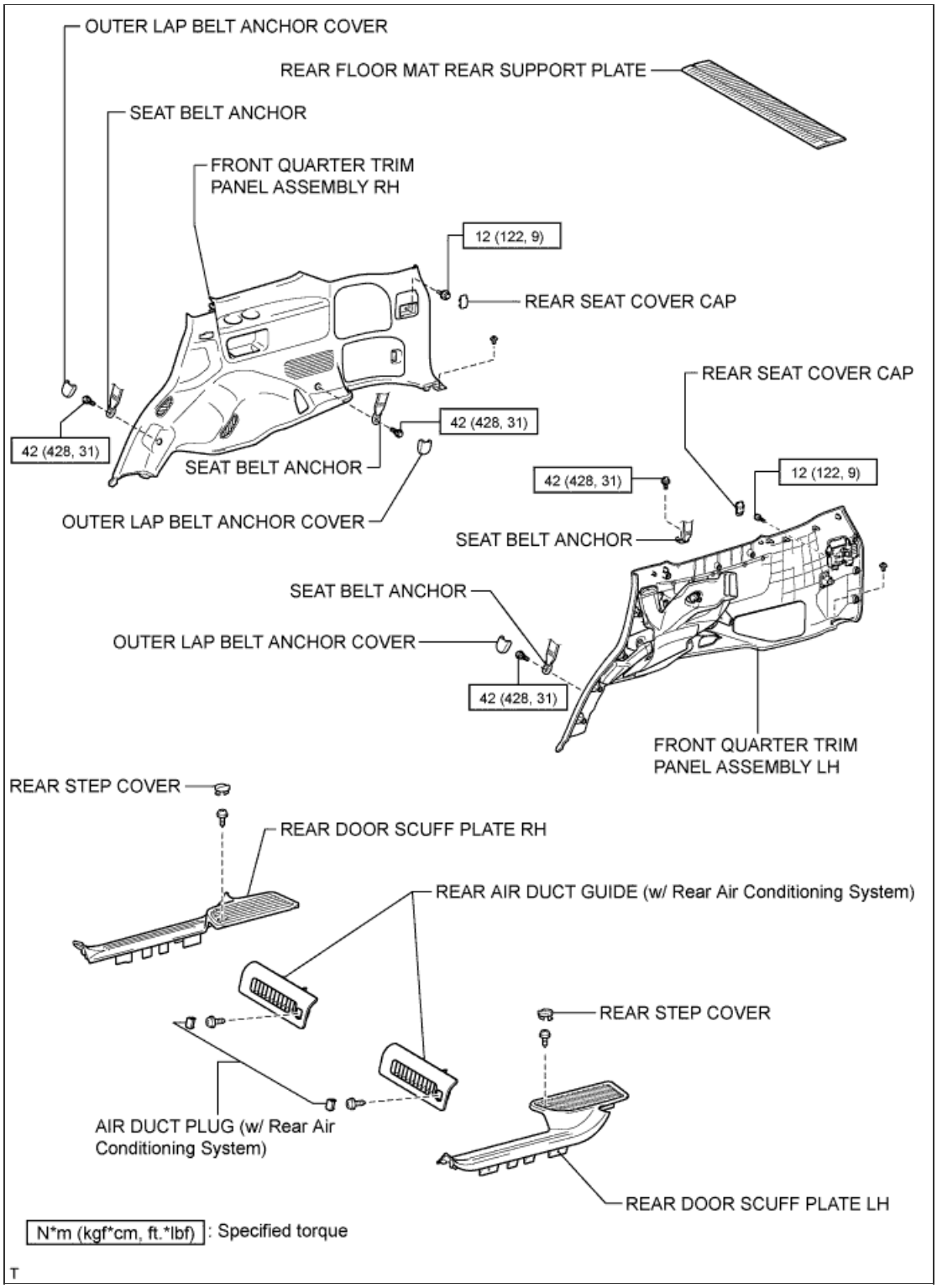
P

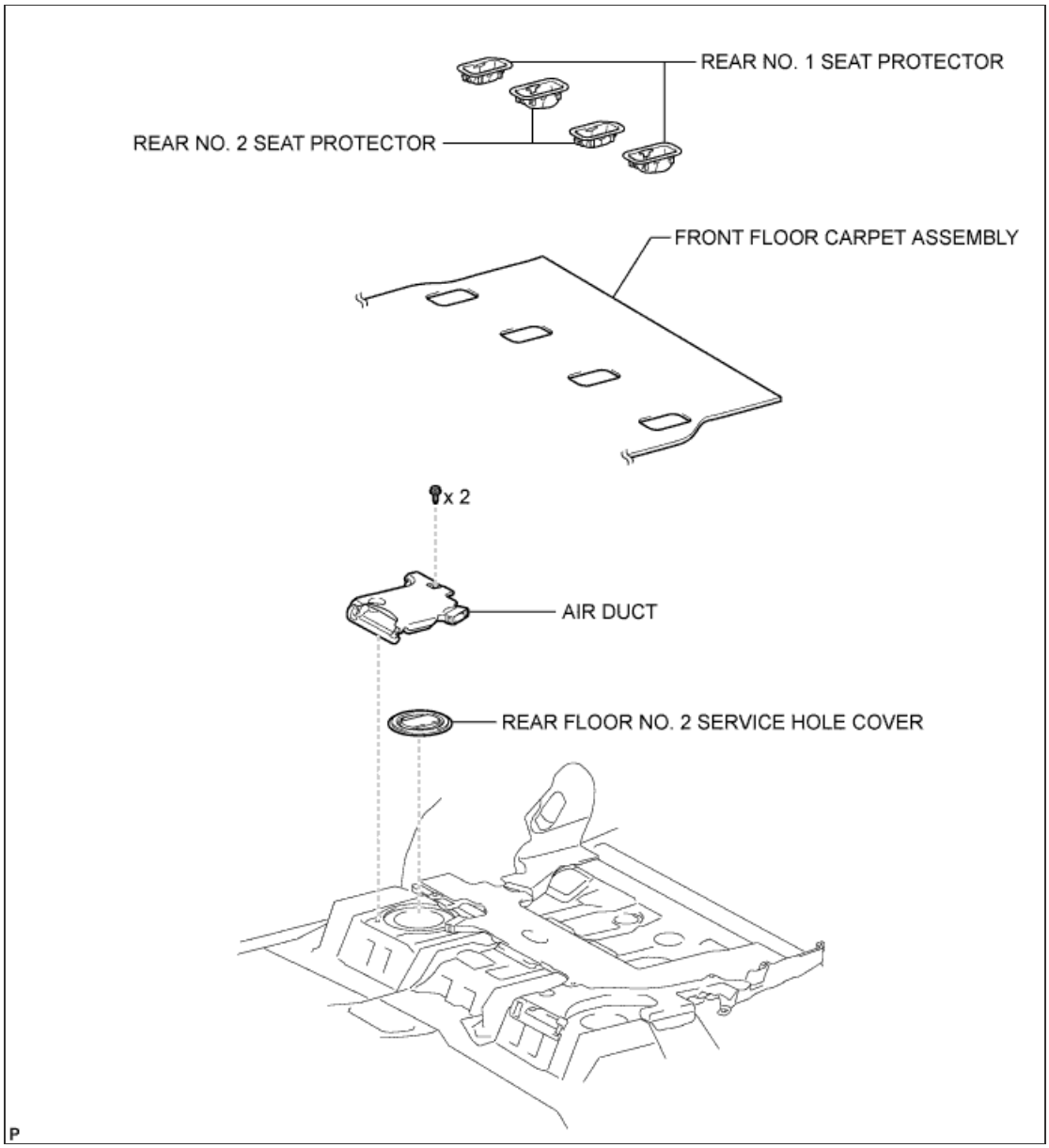
except Face to Face Seat Type:

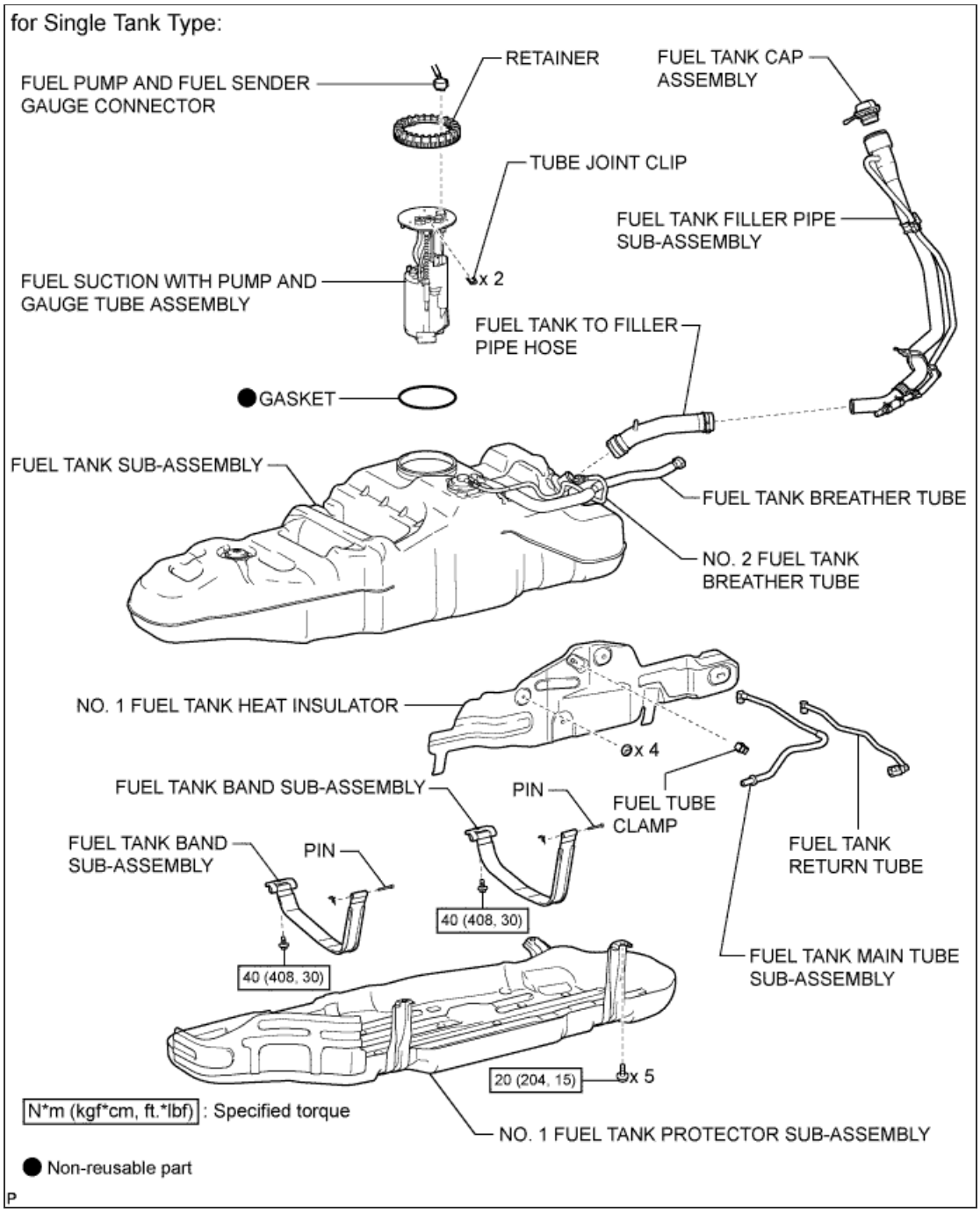


N*m (kgf*cm, ft.*lbf) : Specified torque

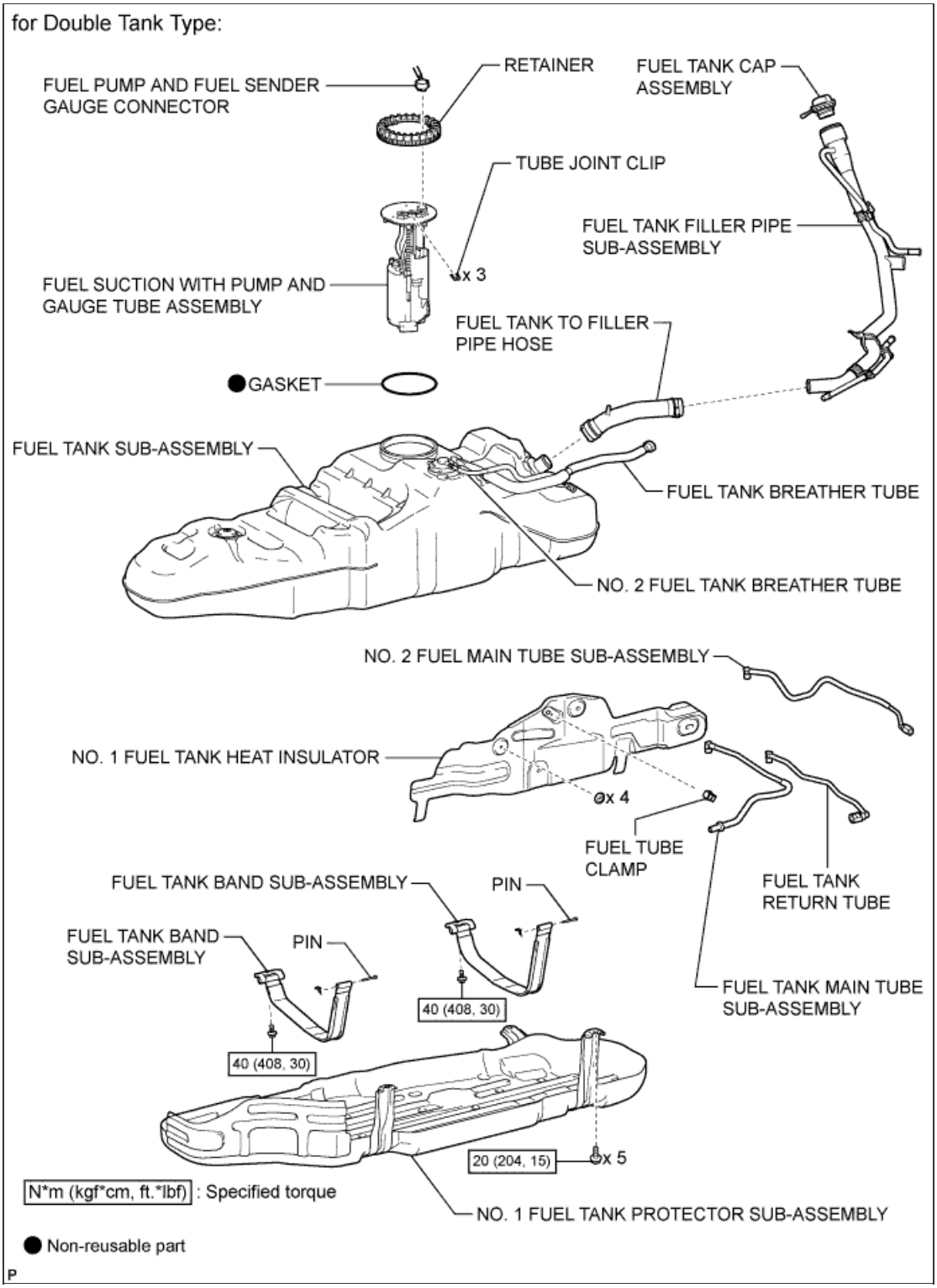
P


OUTER LAP BELT ANCHOR COVER
REAR FLOOR MAT REAR SUPPORT PLATE
SEAT BELT ANCHOR
FRONT QUARTER TRIM PANEL ASSEMBLY RH
12 (122, 9)
REAR SEAT COVER CAP
42 (428, 31)
SEAT BELT ANCHOR
42 (428, 31)
OUTER LAP BELT ANCHOR COVER
REAR SEAT COVER CAP
42 (428, 31)
12 (122, 9)
SEAT BELT ANCHOR
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
42 (428, 31)
FRONT QUARTER TRIM PANEL ASSEMBLY LH
REAR STEP COVER
REAR DOOR SCUFF PLATE RH
REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)
REAR STEP COVER
AIR DUCT PLUG (w/ Rear Air Conditioning System)
REAR DOOR SCUFF PLATE LH
N*m (kgf*cm, ft.*lbf) : Specified torque
T


REAR NO. 1 SEAT PROTECTOR
REAR NO. 2 SEAT PROTECTOR
FRONT FLOOR CARPET ASSEMBLY
x 2
AIR DUCT
REAR FLOOR NO. 2 SERVICE HOLE COVER
P


for Single Tank Type:
FUEL PUMP AND FUEL SENDER GAUGE CONNECTOR
RETAINER
FUEL TANK CAP ASSEMBLY
TUBE JOINT CLIP
FUEL TANK FILLER PIPE SUB-ASSEMBLY
FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY
x 2
FUEL TANK TO FILLER PIPE HOSE
GASKET
FUEL TANK SUB-ASSEMBLY
FUEL TANK BREATHER TUBE
NO. 2 FUEL TANK BREATHER TUBE
NO. 1 FUEL TANK HEAT INSULATOR
x 4
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TUBE CLAMP
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TANK RETURN TUBE
40 (408, 30)
40 (408, 30)
FUEL TANK MAIN TUBE SUB-ASSEMBLY
20 (204, 15)
x 5
N*m (kgf*cm, ft.*lbf) : Specified torque
NO. 1 FUEL TANK PROTECTOR SUB-ASSEMBLY
Non-reusable part
P

for Double Tank Type:



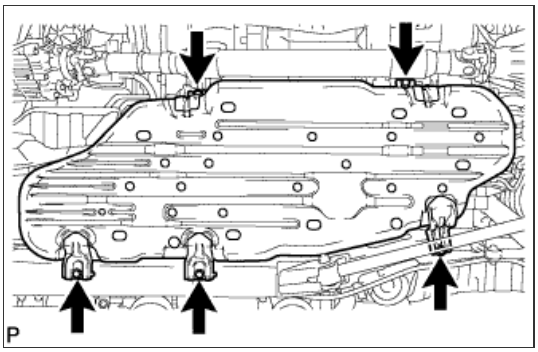
P

for Preparation Click here

1. REMOVE FUEL TANK CAP ASSEMBLY

2. REMOVE NO. 1 FUEL TANK PROTECTOR SUB-ASSEMBLY

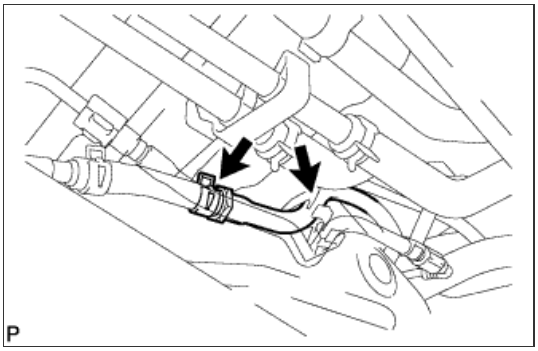
a. Remove the 5 bolts and fuel tank protector.



3. DISCONNECT FUEL TANK MAIN TUBE SUB-ASSEMBLY

a. Detach the fuel tube clamp.

b. Disconnect the fuel tank main tube.



4. DRAIN FUEL

a. for Double Tank Type:

i. Connect the intelligent tester to the DLC3.

ii. Turn the ignition switch to ON.

NOTICE:

Do not start the engine.

iii. Turn the intelligent tester ON.

iv. Enter the following menus: Powertrain / Engine / Active Test / Activate the Intank Fuel Pump Relay.

CAUTION:

- **Do not smoke or be near an open flame when working on the fuel system.**
- **Secure good ventilation.**

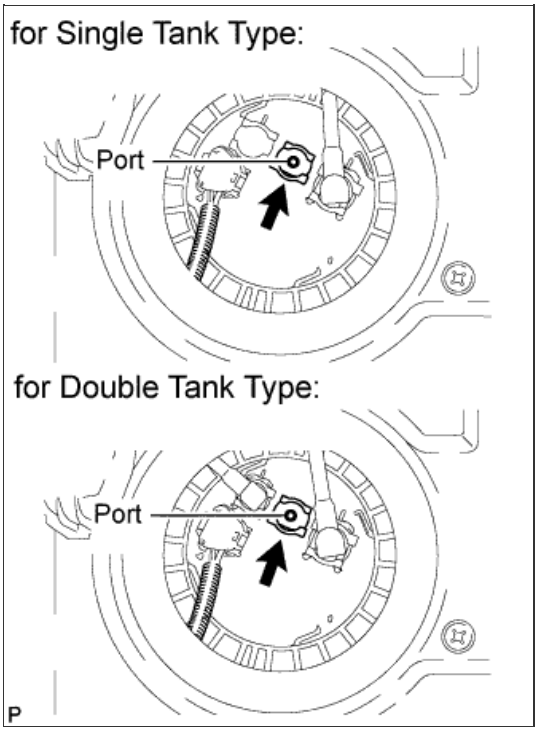
HINT:

for Single Tank Type:

Remove the fuel tube joint clip and disconnect the fuel tank return tube, and drain fuel from the port shown in the illustration.

for Double Tank Type:

If the fuel pump does not operate, remove the fuel tube joint clip and disconnect the fuel tank return tube, and drain fuel from the port shown in the illustration.



5. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Disconnect the cables from the negative (-) main battery and sub-battery terminals.

6. REMOVE REAR NO. 1 SEAT ASSEMBLY RH (for 60/40 Split Seat Type 40 Side)

a. Remove the rear No. 1 seat assembly RH (Click here).

7. REMOVE REAR NO. 1 SEAT ASSEMBLY LH (for 60/40 Split Seat Type 60 Side)

a. Remove the rear No. 1 seat assembly LH (Click here).

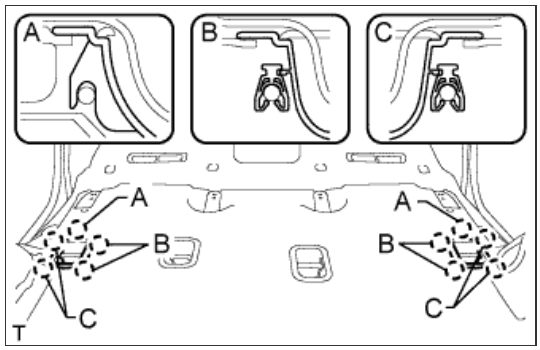
8. REMOVE REAR NO. 2 SEAT ASSEMBLY

a. for Face to Face Seat Type:
Remove the rear No. 2 seat assembly (Click here).

b. except Face to Face Seat Type:
Remove the rear No. 2 seat assembly (Click here).

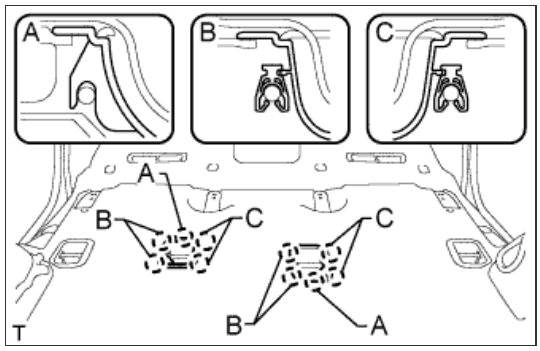
9. REMOVE REAR NO. 1 SEAT PROTECTOR

a. Detach the 10 claws and remove the 2 seat protectors.



10. REMOVE REAR NO. 2 SEAT PROTECTOR

a. Detach the 10 claws and remove the 2 seat protectors.

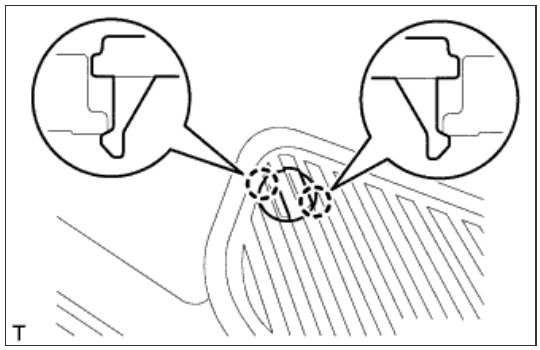


11. REMOVE REAR STEP COVER

HINT:

Use the same procedure to remove the step cover on the other side.

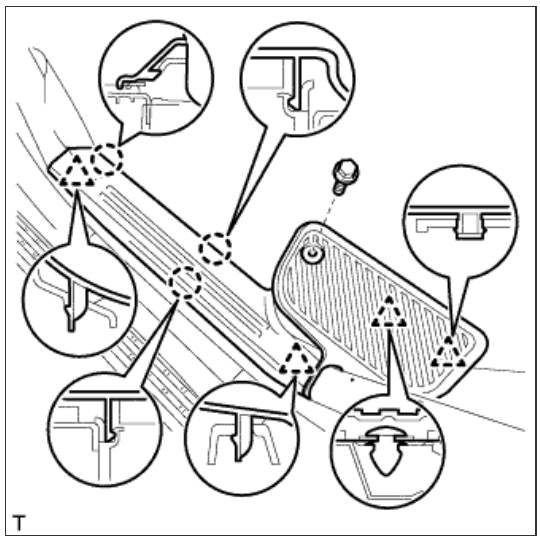
a. Detach the 2 claws and remove the step cover.



12. REMOVE REAR DOOR SCUFF PLATE LH

a. Remove the screw.

b. Detach the 3 claws and 4 clips, and remove the scuff plate.



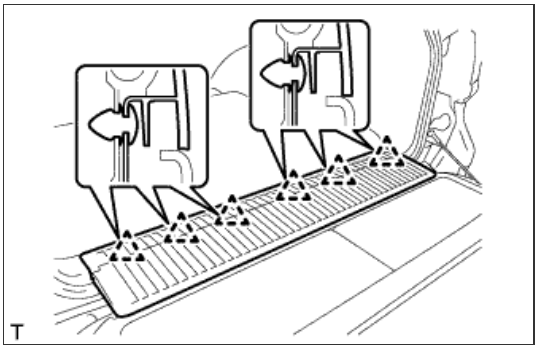
13. REMOVE REAR DOOR SCUFF PLATE RH

HINT:

Use the same procedures described for the LH side.

14. REMOVE REAR FLOOR MAT REAR SUPPORT PLATE

a. Detach the 6 clips and remove the support plate.



15. REMOVE REAR SEAT COVER CAP (w/ Rear No. 2 Seat, except Face to Face Seat Type)

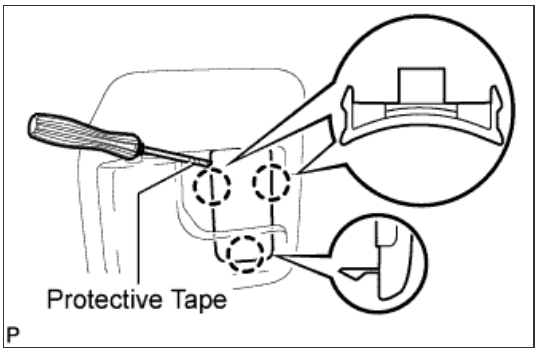
HINT:

Use the same procedure to remove the rear seat cover cap on the other side.

a. Using a screwdriver, detach the 3 claws and remove the rear seat cover cap.

HINT:

Tape the screwdriver tip before use.



16. REMOVE FRONT QUARTER TRIM PANEL ASSEMBLY LH

a. w/ Sliding Roof:
Remove the front quarter trim panel assembly LH (Click here).

b. w/o Sliding Roof:
Remove the front quarter trim panel assembly LH (Click here).

17. REMOVE FRONT QUARTER TRIM PANEL ASSEMBLY RH

a. w/ Sliding Roof:
Remove the front quarter trim panel assembly RH (Click here).

b. w/o Sliding Roof:
Remove the front quarter trim panel assembly RH (Click here).

18. REMOVE AIR DUCT PLUG (w/ Rear Air Conditioning System)

a. for Standard:
Remove the front fender splash shield (Click here).

b. w/ Winch:
Remove the front fender splash shield (Click here).

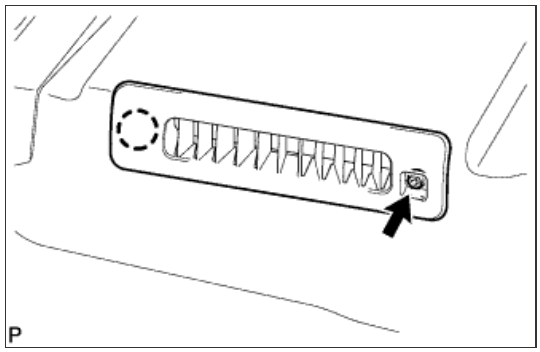
19. REMOVE REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)

a. Remove the screw.

b. Detach the claw and remove the guide.

HINT:

Use the same procedures for both sides.



20. REMOVE FRONT FLOOR CARPET ASSEMBLY

a. w/ Rear Air Conditioning System:
Fold back the floor carpet.

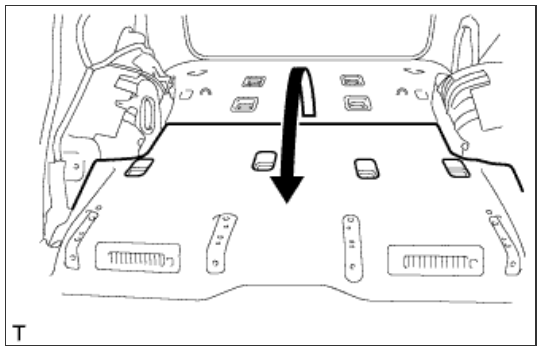
HINT:

Fold back the floor carpet so that the air duct can be removed.

b. w/o Rear Air Conditioning System:
Fold back the floor carpet.

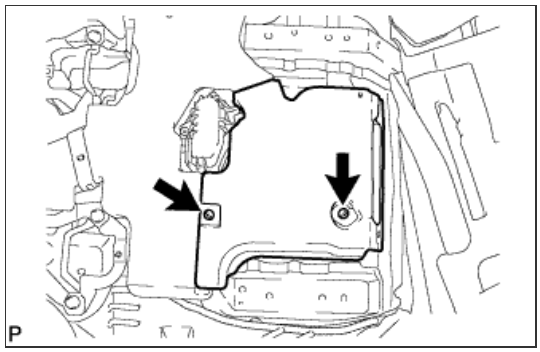
HINT:

Fold back the floor carpet so that the service hole cover can be removed.

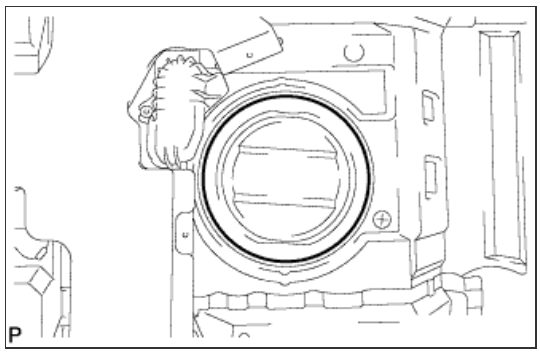


21. REMOVE REAR FLOOR NO. 2 SERVICE HOLE COVER

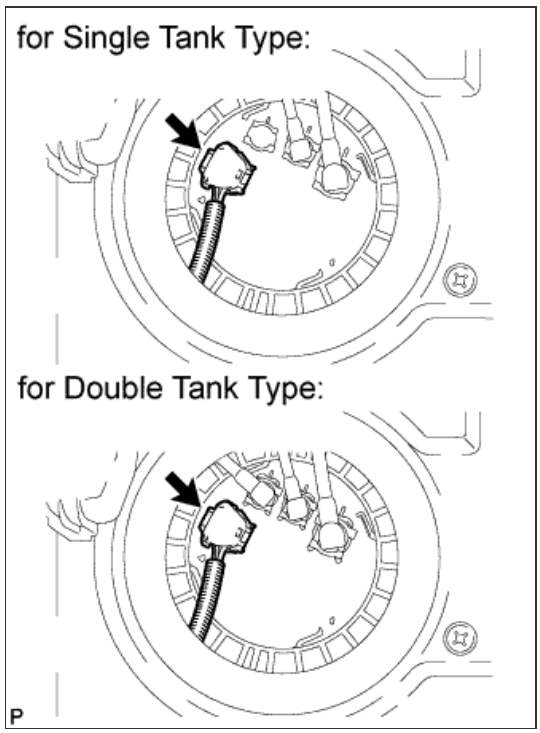
a. w/ Rear Air Conditioning System:
Remove the 2 screws and air duct.



b. Remove the service hole cover.



c. Disconnect the fuel pump and fuel sender gauge connector.



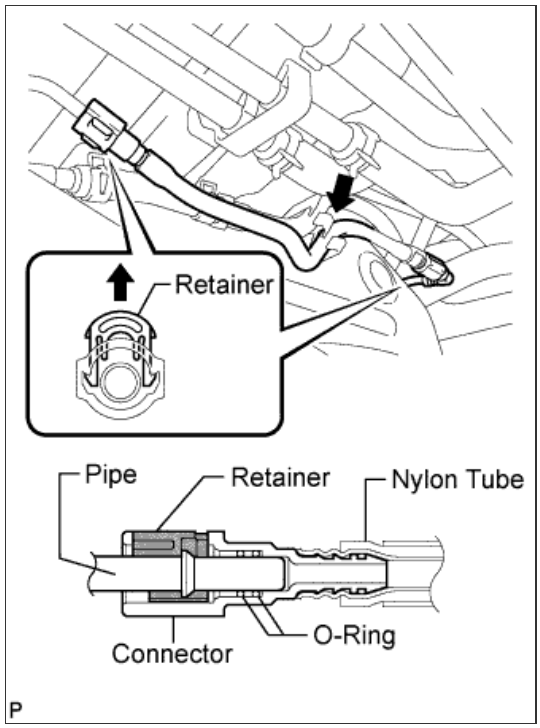
22. DISCONNECT FUEL TANK RETURN TUBE

a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect both ends of the fuel tank return tube.

NOTICE:

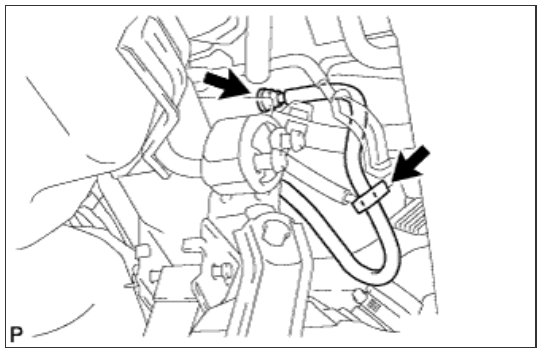
- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



23. DISCONNECT NO. 2 FUEL TANK BREATHER TUBE (for Single Tank Type)

a. Detach the fuel tube clamp.

b. Disconnect the No. 2 fuel tank breather tube from the body.



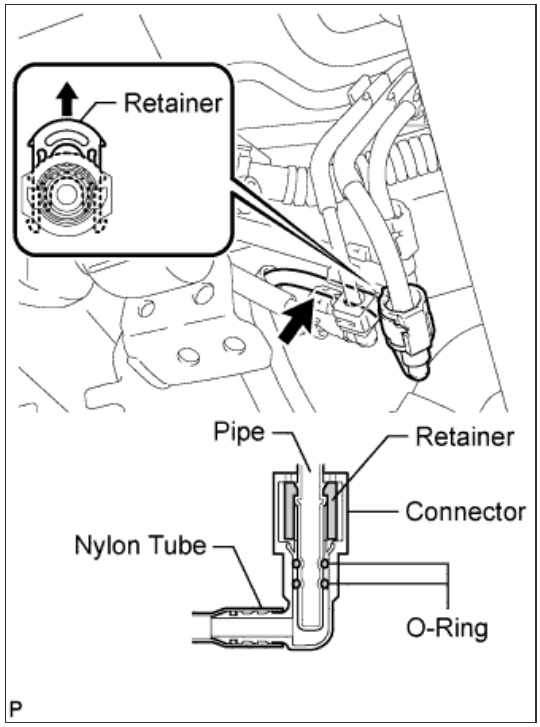
24. DISCONNECT NO. 2 FUEL MAIN TUBE SUB-ASSEMBLY (for Double Tank Type)

a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel main tube.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



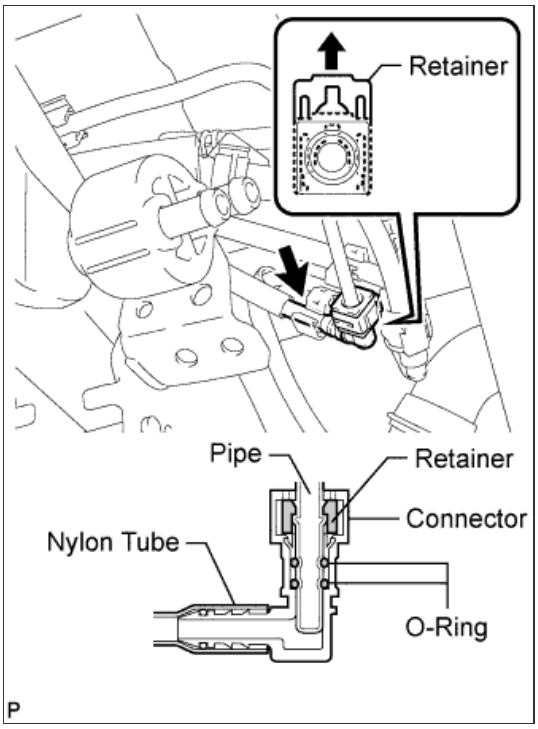
25. DISCONNECT NO. 2 FUEL TANK BREATHER TUBE (for Double Tank Type)

a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel tank breather tube.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



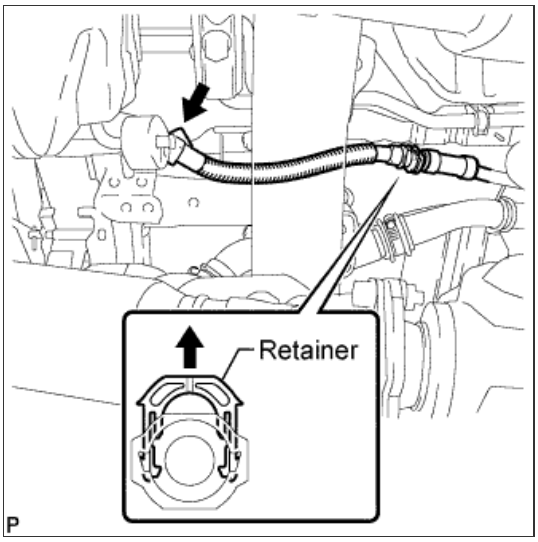
26. DISCONNECT FUEL TANK BREATHER TUBE (for Single Tank Type)

a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel tank breather tube.

NOTICE:

- **Do not use any tools in this procedure.**
- **Check for any dirt and foreign matter contamination in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-rings or cause leaks in the seal between the pipe and connector.**



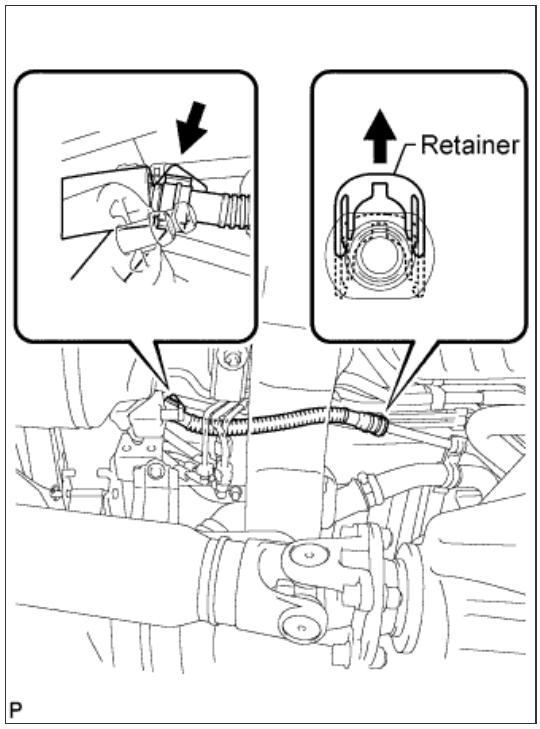
27. DISCONNECT FUEL TANK BREATHER TUBE (for Double Tank Type)

a. Detach the fuel tube clamp.

b. Pull up the retainer and disconnect the fuel tank breather tube.

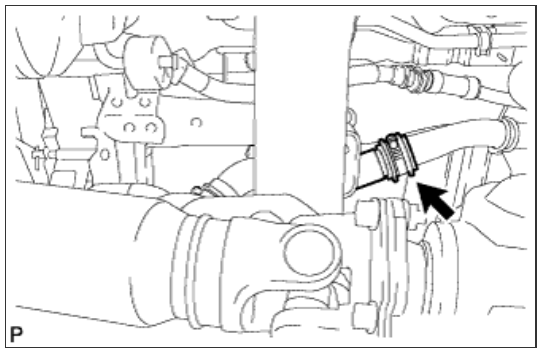
NOTICE:

- **Do not use any tools in this procedure.**
- **Check for any dirt and foreign matter contamination in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-rings or cause leaks in the seal between the pipe and connector.**



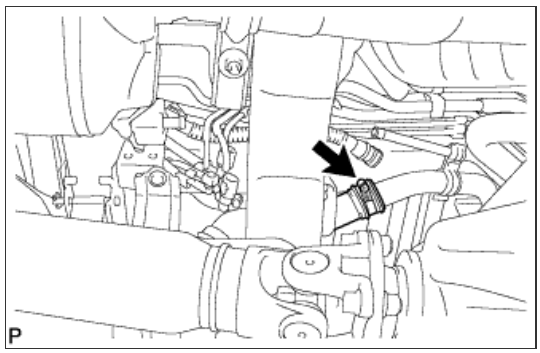
28. DISCONNECT FUEL TANK TO FILLER PIPE HOSE (for Single Tank Type)

a. Disconnect the hose from the filler pipe.



29. DISCONNECT FUEL TANK TO FILLER PIPE HOSE (for Double Tank Type)

a. Disconnect the hose from the filler pipe.

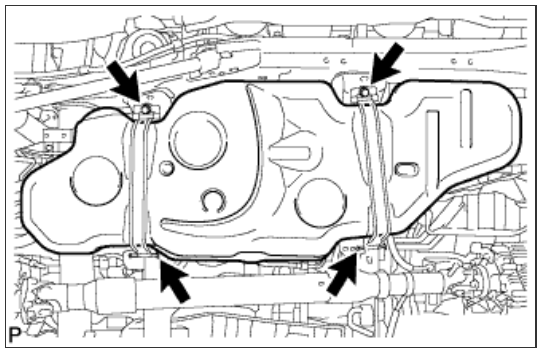


30. REMOVE FUEL TANK SUB-ASSEMBLY

a. Place a transmission jack under the fuel tank.

b. Remove the 2 bolts, 2 clips, 2 pins and 2 fuel tank bands.

c. Lower the transmission jack to remove the fuel tank from the vehicle.



NOTICE:

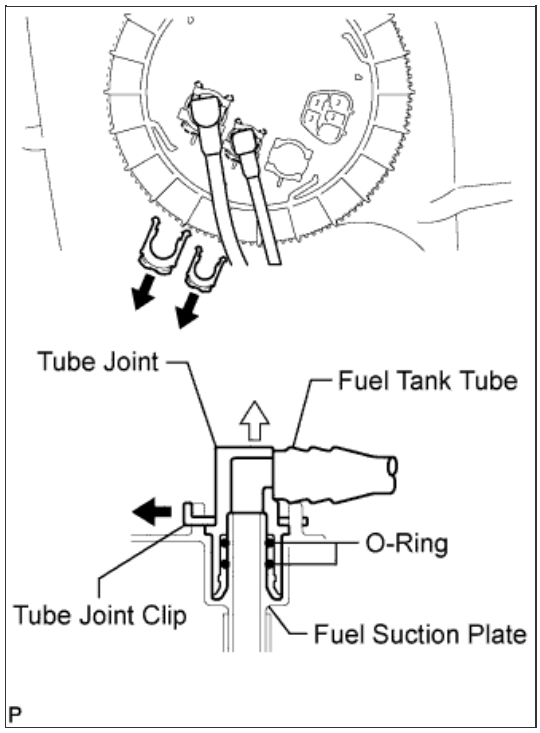
Do not allow the fuel tank to contact the vehicle, especially the differential.

HINT:

Lower the transmission jack slowly.

31. REMOVE FUEL TANK MAIN TUBE SUB-ASSEMBLY AND FUEL TANK RETURN TUBE (for Single Tank Type)

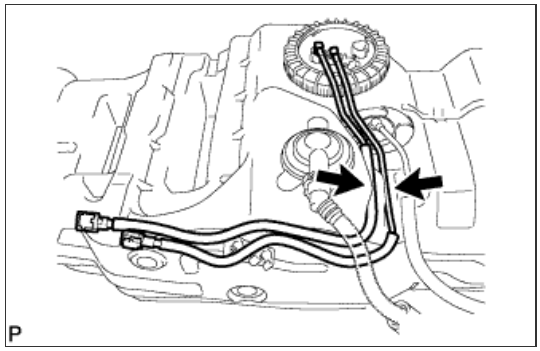
a. Remove the 2 fuel tube joint clips and pull out the 2 fuel tubes.



NOTICE:

- **Remove any dirt and foreign matter on the fuel tube joint before performing this work.**
- **Do not allow any scratches or foreign matter on the parts when disconnecting them, as the fuel tube joint contains the O-rings that seal the plug.**
- **Perform this work by hand. Do not use any tools.**
- **Do not forcibly bend, twist or turn the nylon tube.**
- **Protect the disconnected part by covering it with a plastic bag and tape after disconnecting the fuel tubes.**

b. Remove the 2 fuel tubes from the fuel tank.



32. REMOVE FUEL TANK MAIN TUBE SUB-ASSEMBLY, FUEL TANK RETURN TUBE AND NO. 2 FUEL MAIN TUBE SUB-ASSEMBLY (for Double Tank Type)

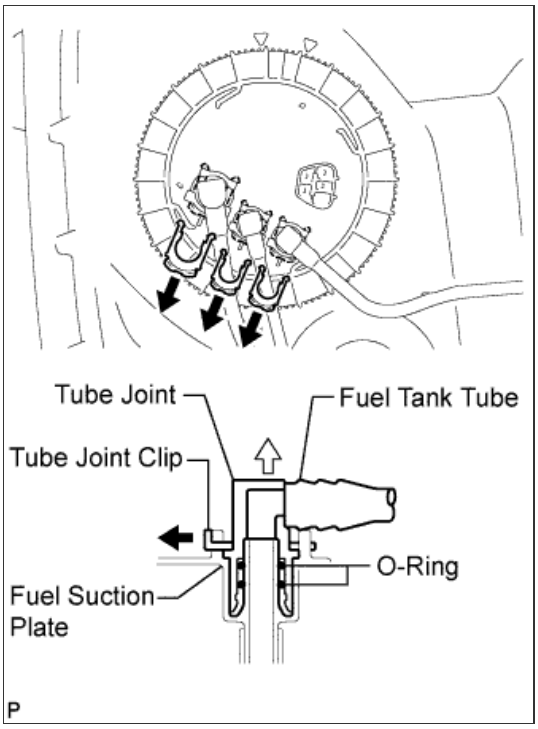
a. Remove the 3 fuel tube joint clips and pull out the 3 fuel tubes.

NOTICE:

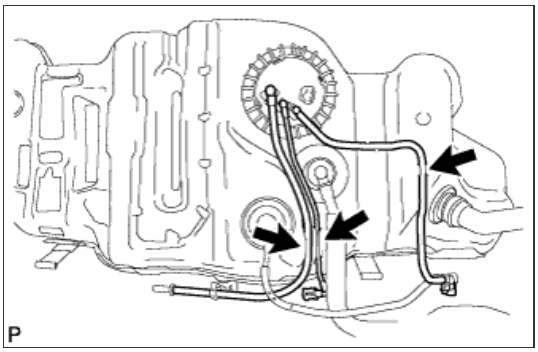
- **Remove any dirt and foreign matter on the fuel tube joint before performing this work.**
- **Do not allow any scratches or foreign matter on the parts when**

disconnecting them, as the fuel tube joint contains the O-rings that seal the plug.

- Perform this work by hand. Do not use any tools.
- Do not forcibly bend, twist or turn the nylon tube.
- Protect the disconnected part by covering it with a plastic bag and tape after disconnecting the fuel tubes.



b. Remove the 3 fuel tubes from the fuel tank.



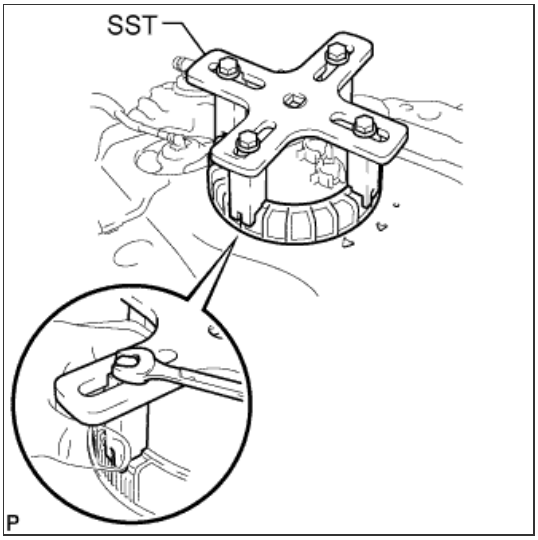
33. REMOVE FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

a. Set SST on the retainer.

SST
09808-14030

HINT:

- **Securely attach the claws of SST to the protrusion of the retainer and fix SST in place.**
- **Install SST while pressing the claws of SST against the retainer (towards the center of SST).**

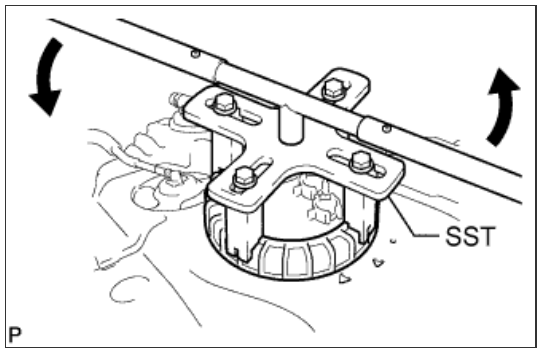


b. Using SST, loosen the retainer.

SST
09808-14030

Text in Illustration

➡	Turn



NOTICE:

- **Do not use any tools other than those specified in this operation. Damage to the retainer or the fuel tank may result.**
- **While pressing down on SST so that the claws of SST do not slip off the protrusion of the retainer, turn the retainer counterclockwise to loosen it.**

HINT:

The protrusion of the retainer fit in the ends of SST.

c. Remove the retainer.

d. Remove the retainer while holding the fuel suction tube assembly by hand.

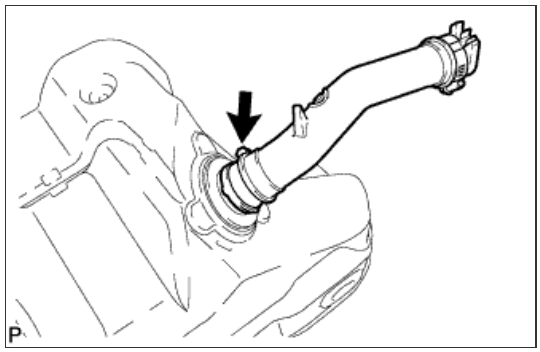
NOTICE:

Be careful not to bend the arm of the fuel sender gauge.

e. Remove the gasket from the fuel tank.

34. REMOVE FUEL TANK TO FILLER PIPE HOSE

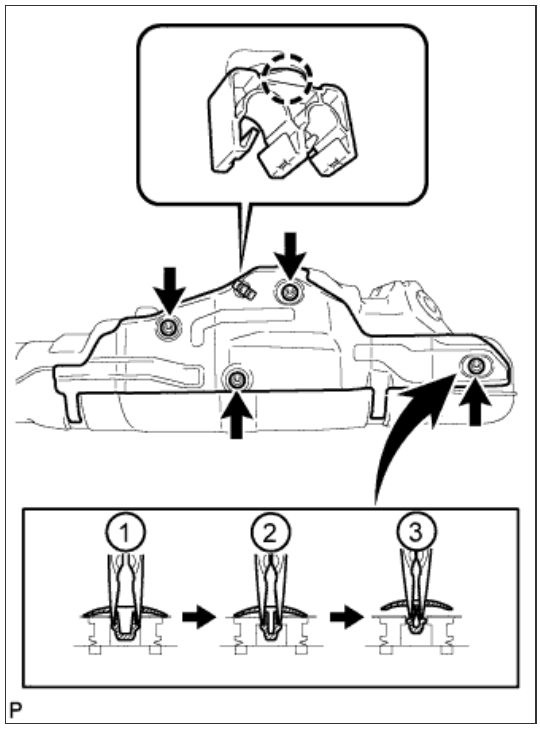
a. Remove the hose from the fuel tank.



35. REMOVE NO. 1 FUEL TANK HEAT INSULATOR

a. Remove the fuel tube clamp from the heat insulator.

b. Using needle-nose pliers, remove the 4 clips shown in the illustration and then remove the heat insulator.

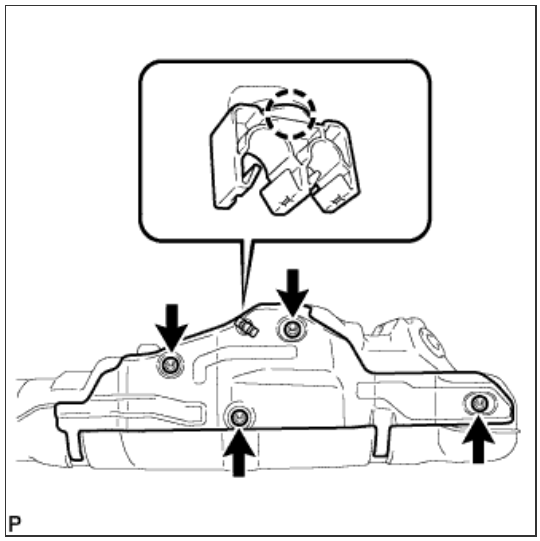

1
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1. INSTALL NO. 1 FUEL TANK HEAT INSULATOR

a. Install the heat insulator with the 4 clips.

b. Install the fuel tube clamp to the heat insulator.

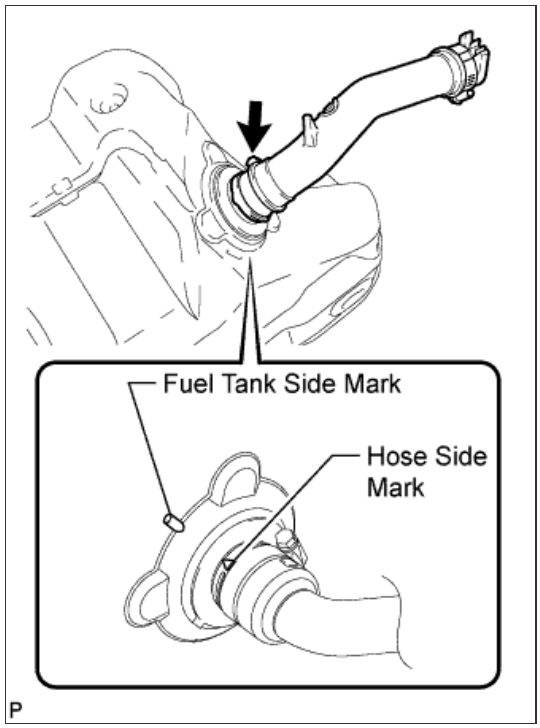


2. INSTALL FUEL TANK TO FILLER PIPE HOSE

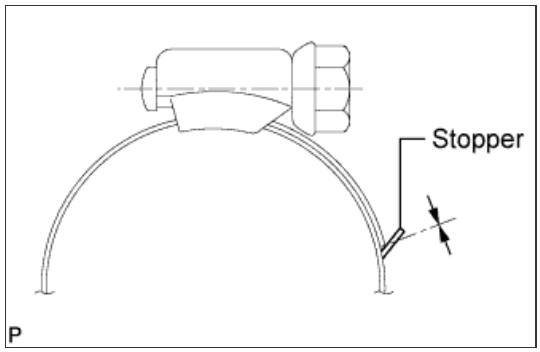
a. Install the fuel tank to filler pipe hose to the fuel tank as shown in the illustration.

HINT:

- **Align the fuel tank side mark with the hose side mark when installing the hose.**



- **Tighten the hose clamp until the end of the hose clamp contacts the stopper as shown in the illustration.**



3. INSTALL FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

a. Apply a light coat of gasoline or grease to a new gasket, and install it to the fuel tank.

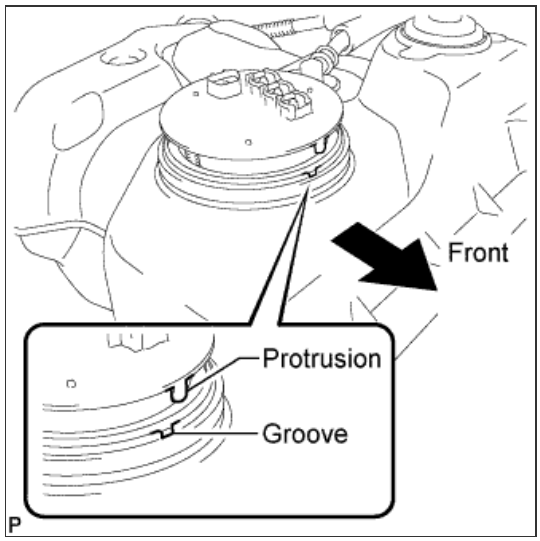
b. Install the fuel suction with pump and gauge tube into the fuel tank.

NOTICE:

Be careful not to bend the arm of the fuel sender gauge.

HINT:

Align the protrusion of the fuel suction with pump and gauge tube with the groove of the fuel tank.



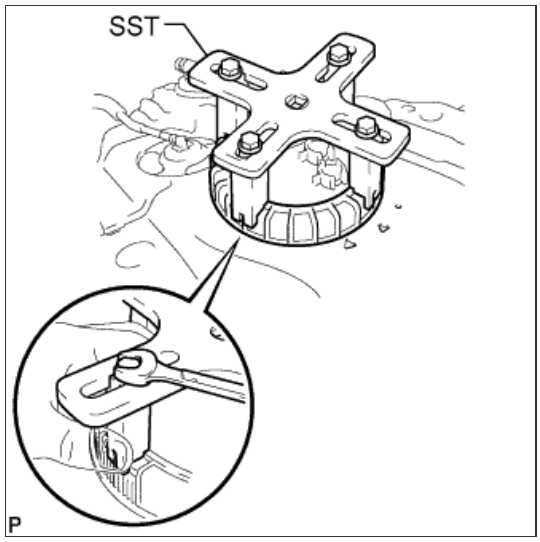
c. Put the retainer on the fuel tank. While holding the fuel suction with pump and gauge tube, tighten the retainer one complete turn by hand.

d. Set SST on the retainer.

SST
09808-14030

HINT:

- **Hold the fuel suction tube assembly upright by hand to ensure that the fuel suction tube gasket is not moved out of position.**
- **Securely attach the claws of SST to the protrusions of the retainer and fix SST in place.**
- **Install SST while pressing the claws of SST against the retainer (toward the center of SST).**

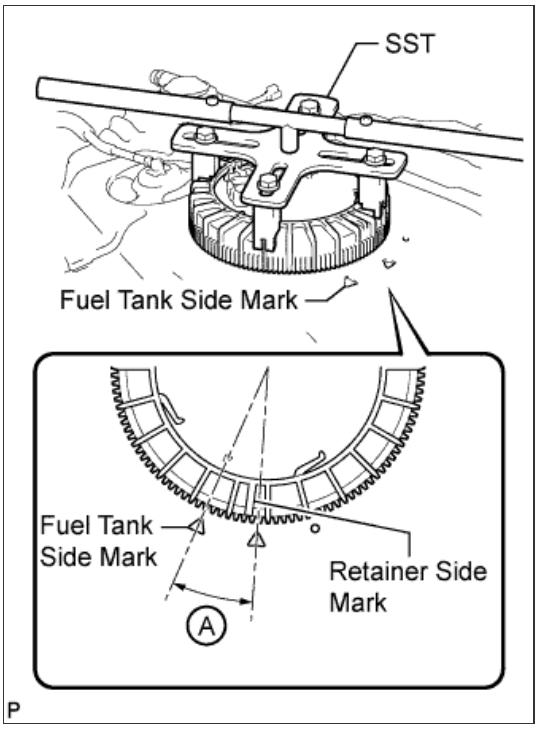


e. Using SST, tighten the retainer until the mark on the retainer is within range A on the fuel tank as shown in the illustration.

SST
09808-14030

HINT:

Fit the tips of SST onto the ribs of the retainer.

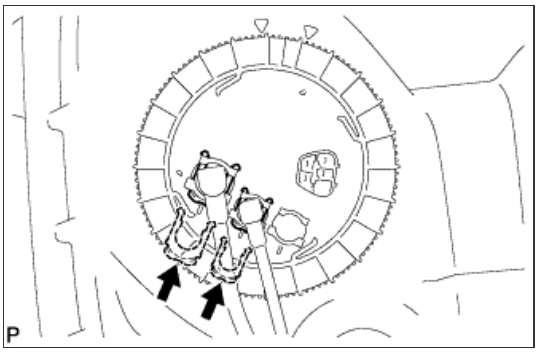


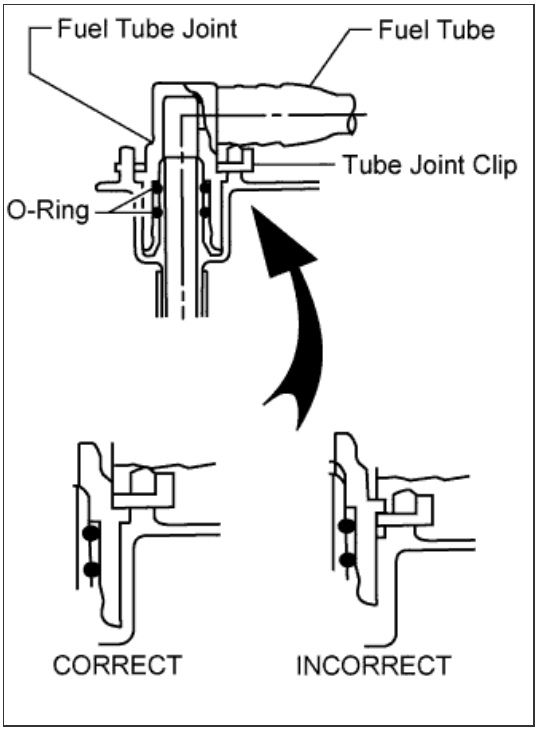
4. INSTALL FUEL TANK MAIN TUBE SUB-ASSEMBLY AND FUEL TANK RETURN TUBE (for Single Tank Type)

a. Install the 2 fuel tank tubes with the 2 tube joint clips.

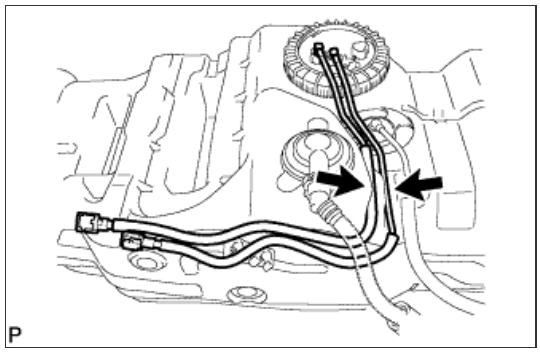
NOTICE:

- **Check that there are no scratches or foreign objects on the connecting parts.**
- **Check that the fuel tube joints are inserted securely.**
- **Check that the tube joint clips are on the collars of the fuel tube joints.**
- **After installing the tube joint clips, check that the fuel tube joints cannot be pulled off.**





b. Install the 2 fuel tubes to the fuel tank.

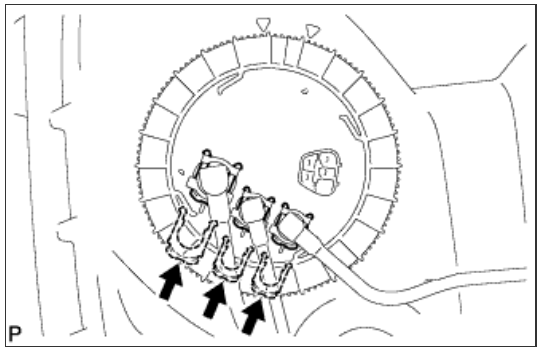


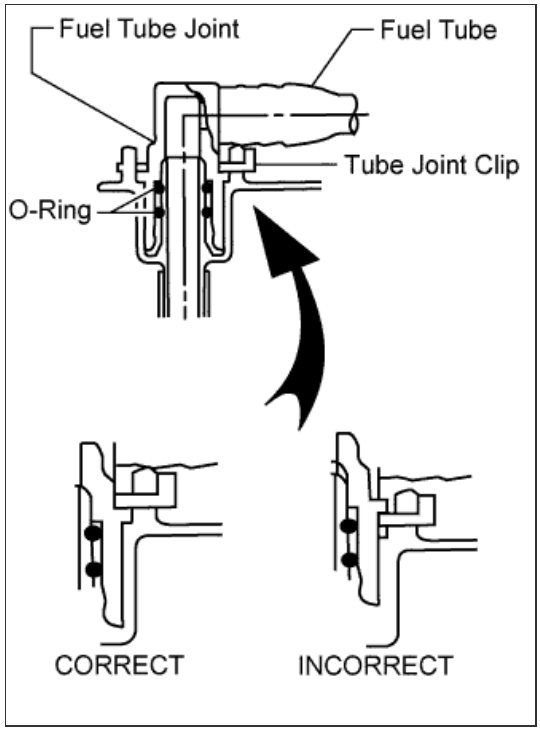
5. INSTALL FUEL TANK MAIN TUBE SUB-ASSEMBLY, FUEL TANK RETURN TUBE AND NO. 2 FUEL MAIN TUBE SUB-ASSEMBLY (for Double Tank Type)

a. Install the 3 fuel tank tubes with the 3 tube joint clips.

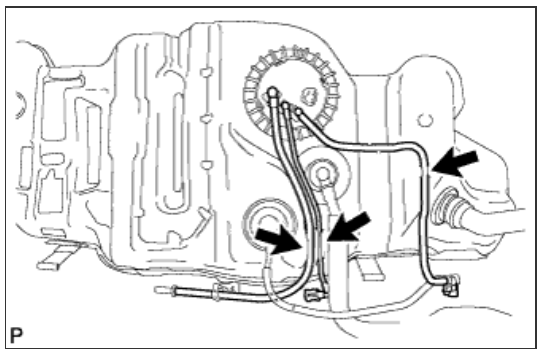
NOTICE:

- **Check that there are no scratches or foreign objects on the connecting parts.**
- **Check that the fuel tube joints are inserted securely.**
- **Check that the tube joint clips are on the collars of the fuel tube joints.**
- **After installing the tube joint clips, check that the fuel tube joints cannot be pulled off.**





b. Install the 3 fuel tubes to the fuel tank.



6. INSTALL FUEL TANK SUB-ASSEMBLY

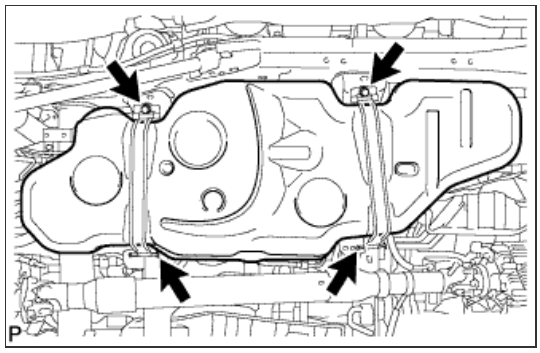
a. Set the fuel tank on a transmission jack.

b. Raise the transmission jack.

c. Install the 2 fuel tank bands with the 2 pins and 2 clips.

d. onect the 2 fuel tank bands with the 2 bolts.

Tor ue:
40 N m 408 kgf cm , 30 ft. lbf

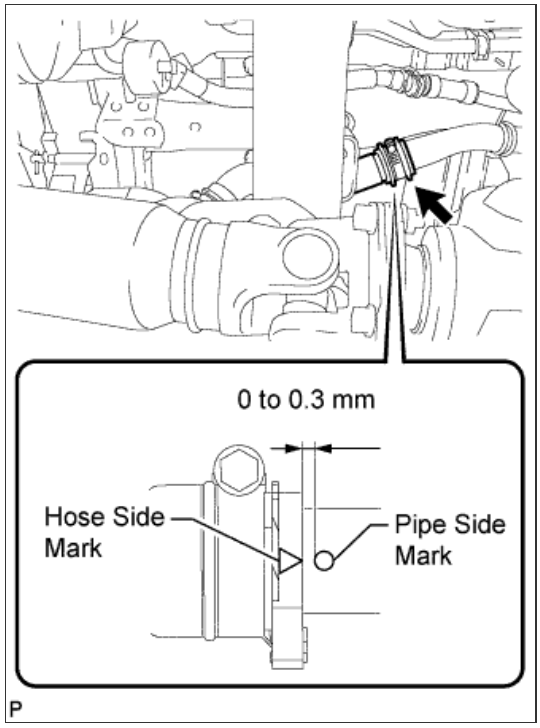


. CONNECT FUEL TANK TO FILLER PIPE HOSE (for Single Tank Type)

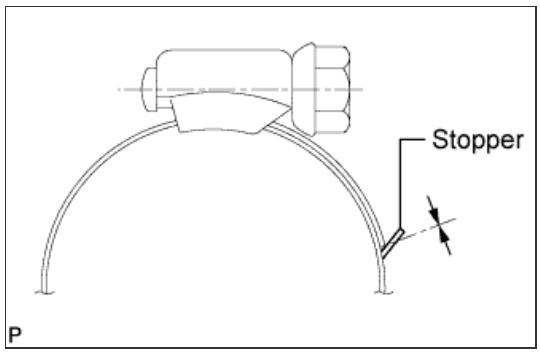
a. Connect the hose to the fuel tank filler pipe as shown in the illustration.

HINT:

- **Install the hose so that the distance between the fuel tank inlet pipe side mark and fuel tank to filler pipe hose side mark is 0 to 0.3 mm (0 to 0.0118 in.) as shown in the illustration.**



- **Tighten the hose clamp until the end of the hose clamp contacts the stopper as shown in the illustration.**

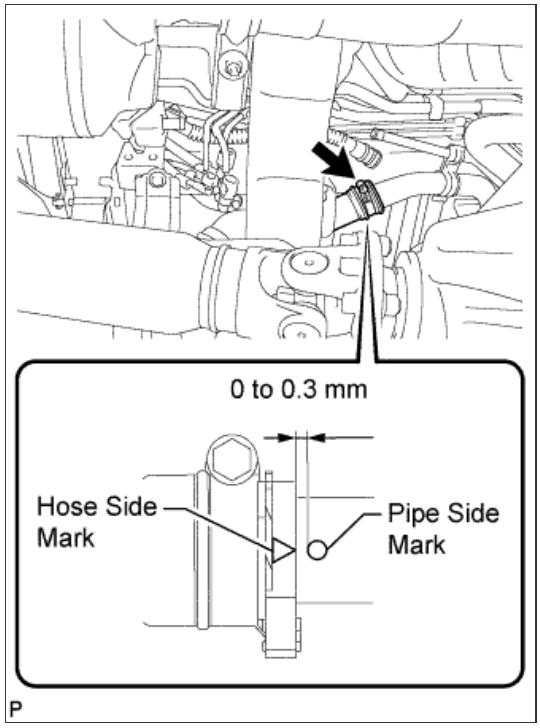


8. CONNECT FUEL TANK TO FILLER PIPE HOSE (for Double Tank Type)

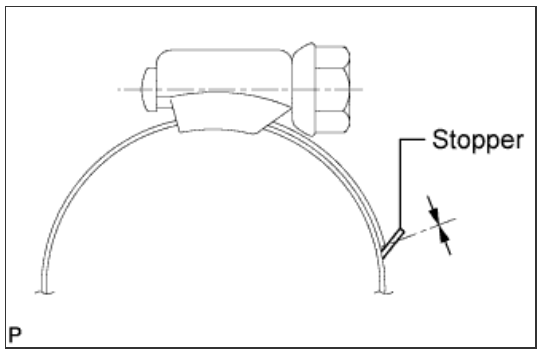
a. Connect the hose to the fuel tank filler pipe as shown in the illustration.

HINT:

- **Install the hose so that the distance between the fuel tank inlet pipe side mark and fuel tank to filler pipe hose side mark is 0 to 0.3 mm (0 to 0.0118 in.) as shown in the illustration.**



- **Tighten the hose clamp until the end of the hose clamp contacts the stopper as shown in the illustration.**



9. CONNECT FUEL TANK BREATHER TUBE (for Single Tank Type)

a. Connect the fuel tank breather tube to the filler pipe and push the retainer.

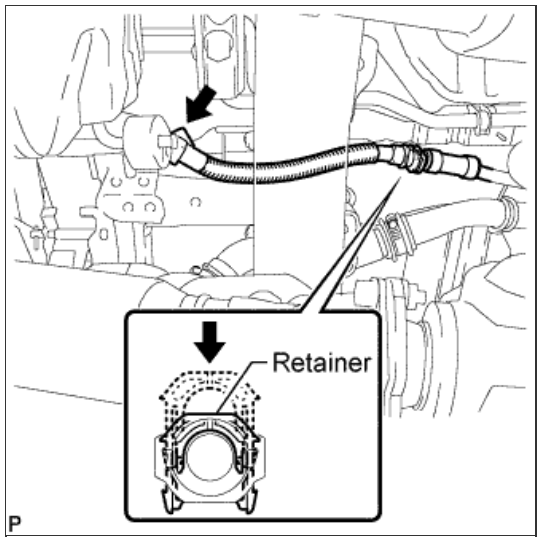
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Attach the fuel tube clamp.



10. CONNECT FUEL TANK BREATHER TUBE (for Double Tank Type)

a. Connect the fuel tank breather tube to the filler pipe and push the retainer.

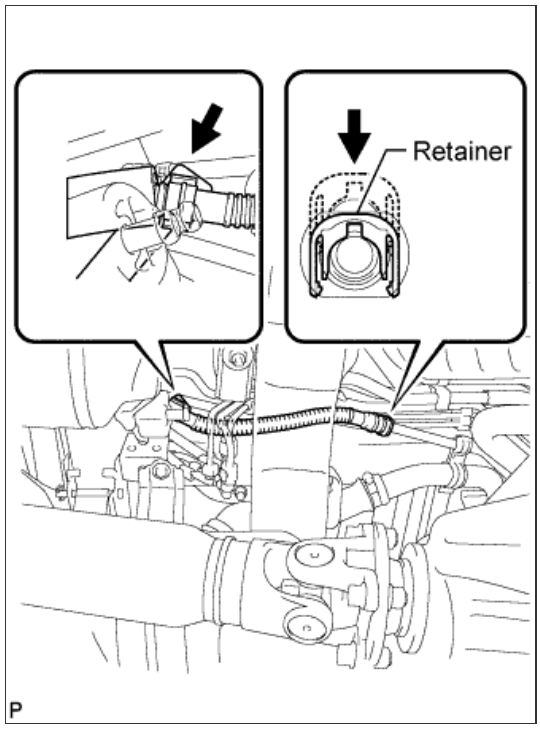
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Attach the fuel tube clamp.



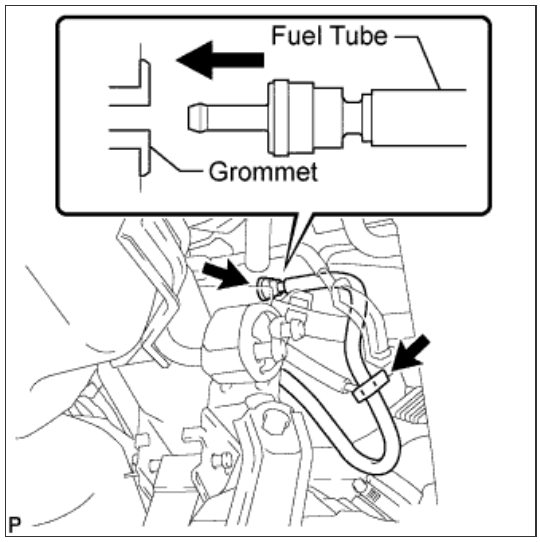
11. CONNECT NO. 2 FUEL TANK BREATHER TUBE (for Single Tank Type)

a. Connect the No. 2 fuel tank breather tube to the body.

HINT:

Make sure the No. 2 fuel tank breather tube is securely inserted into the grommet.

b. Attach the fuel tube clamp.



12. CONNECT NO. 2 FUEL TANK BREATHER TUBE (for Double Tank Type)

a. Connect the fuel tank breather tube and push the retainer.

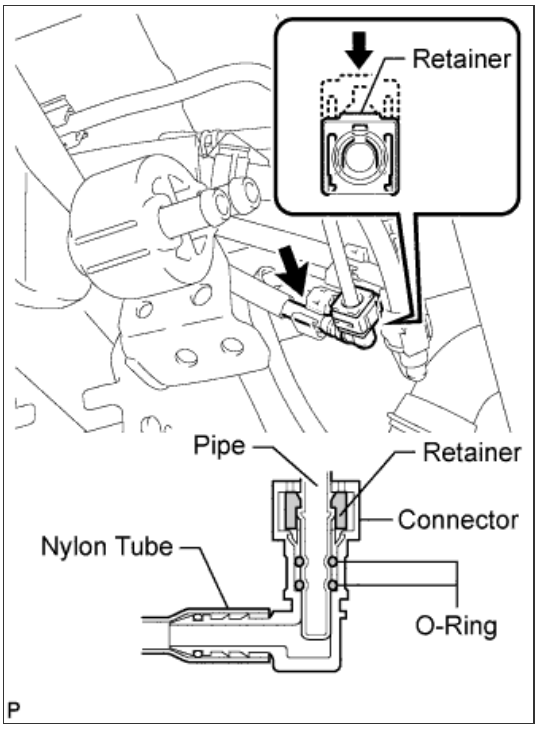
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

b. Attach the fuel tube clamp.



13. CONNECT NO. 2 FUEL MAIN TUBE SUB-ASSEMBLY (for Double Tank Type)

a. Connect the No. 2 fuel main tube and push the retainer.

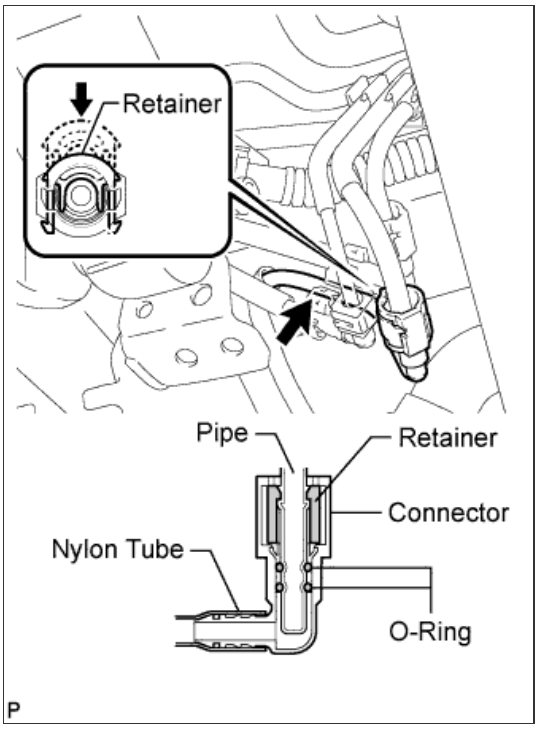
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

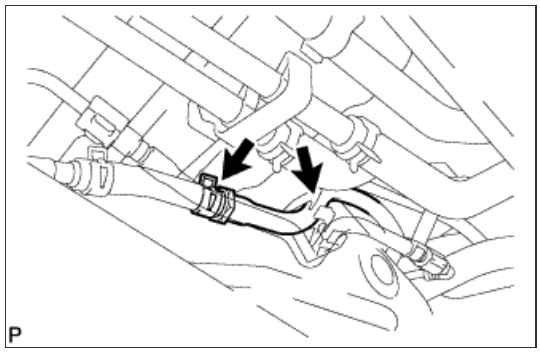
b. Attach the fuel tube clamp.



14. CONNECT FUEL TANK MAIN TUBE SUB-ASSEMBLY

a. Connect the fuel tank main tube.

b. Attach the fuel tube clamp.



15. CONNECT FUEL TANK RETURN TUBE

a. Connect both ends of the fuel tank return tube and push the retainer.

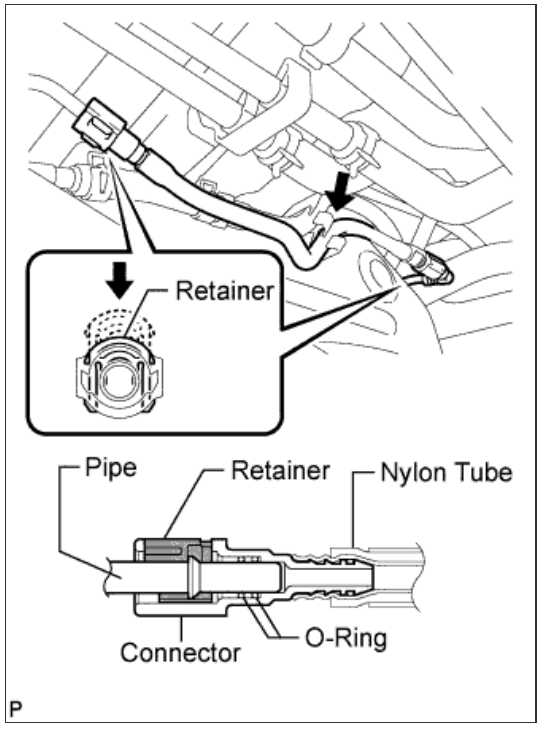
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before installing the tube connectors to the pipes, check if there is any damage or foreign matter in the connectors.**
- **After the connection, check if the connectors and pipes are securely connected by trying to pull them apart.**

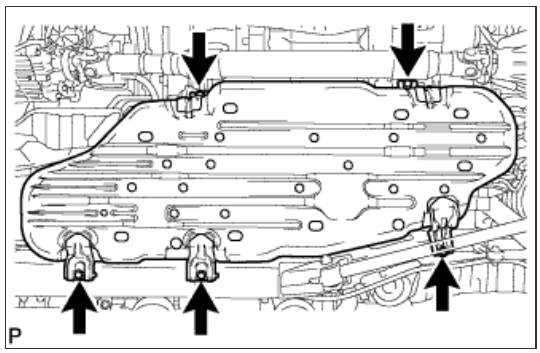
b. Attach the fuel tube clamp.



16. INSTALL NO. 1 FUEL TANK PROTECTOR SUB-ASSEMBLY

a. Install the tank protector with the 5 bolts.

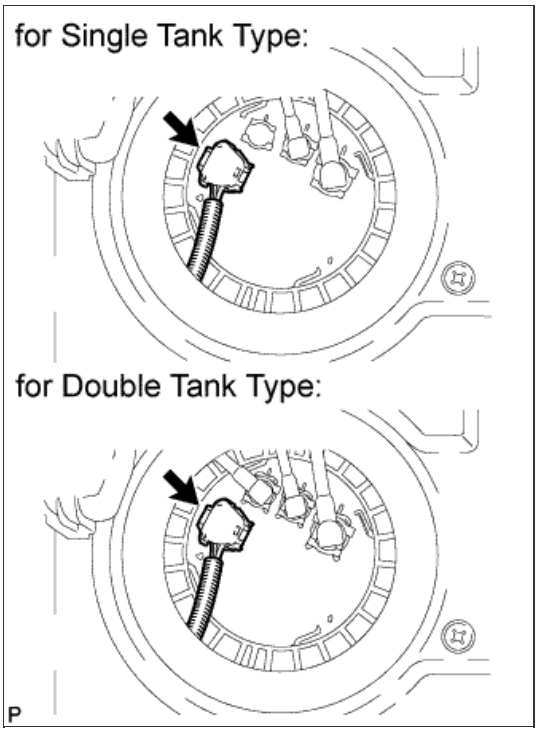
Tor ue:
20 N m 204 kgf cm , 15 ft. lbf



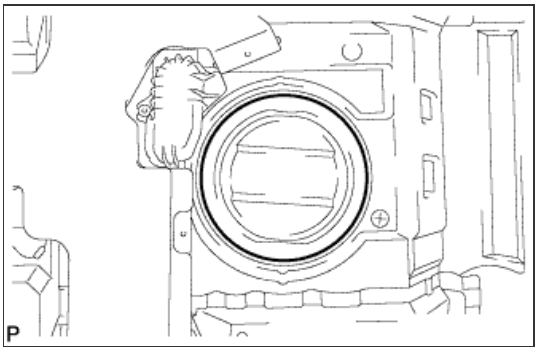
17. INSTALL FUEL TANK CAP ASSEMBLY

18. INSTALL REAR FLOOR NO. 2 SER ICE HOLE CO B

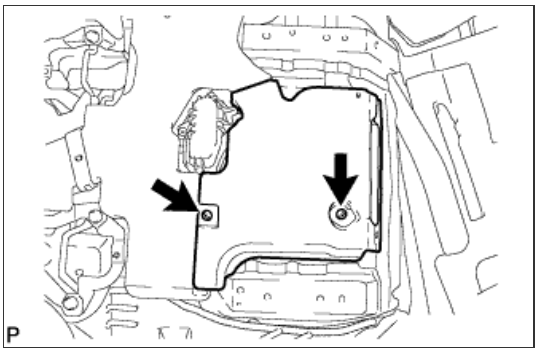
a. Connect the fuel pump and fuel sender gauge connector.



b. Install the service hole cover with new butyl tape.



c. w/ Rear Air Conditioning System:
Install the air duct and 2 screws.



19. INSTALL FRONT FLOOR CARPET ASSEMBLY

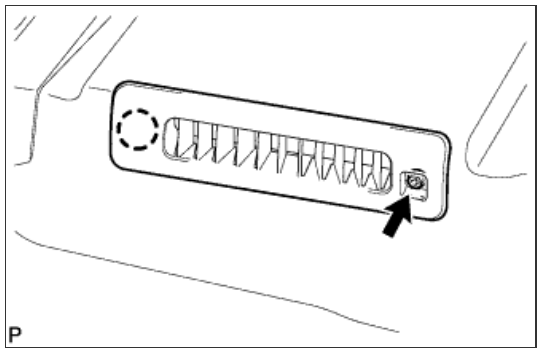
20. INSTALL REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)

a. Attach the claw to install the guide.

b. Install the screw.

HINT:

Use the same procedures for both sides.

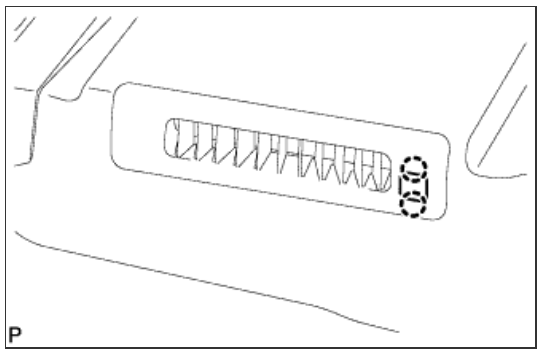


21. INSTALL AIR DUCT PLUG (w/ Rear Air Conditioning System)

a. Attach the 2 claws to install the plug.

HINT:

Use the same procedures for both sides.



22. INSTALL FRONT QUARTER TRIM PANEL ASSEMBLY LH

a. w/ Sliding Roof:
Install the front quarter trim panel assembly LH (Click here).

b. w/o Sliding Roof:
Install the front quarter trim panel assembly LH (Click here).

23. INSTALL FRONT QUARTER TRIM PANEL ASSEMBLY RH

a. w/ Sliding Roof:
Install the front quarter trim panel assembly RH (Click here).

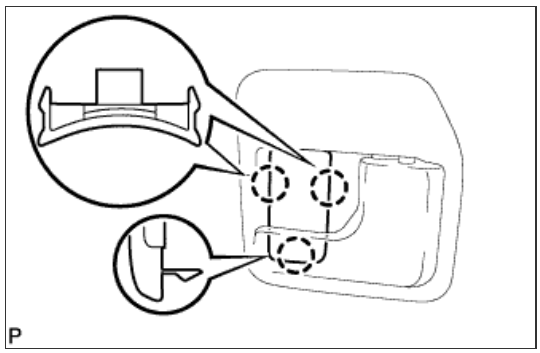
b. w/o Sliding Roof:
Install the front quarter trim panel assembly RH (Click here).

24. INSTALL REAR SEAT COVER CAP (w/ Rear No. 2 Seat, except Face to Face Seat Type)

HINT:

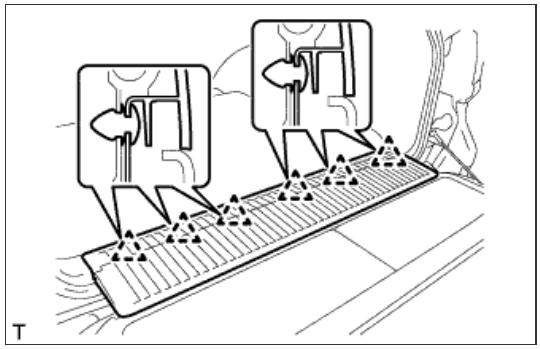
Use the same procedure to install the rear seat cover cap on the other side.

a. Attach the 3 claws to install the rear seat cover cap.



25. INSTALL REAR FLOOR MAT REAR SUPPORT PLATE

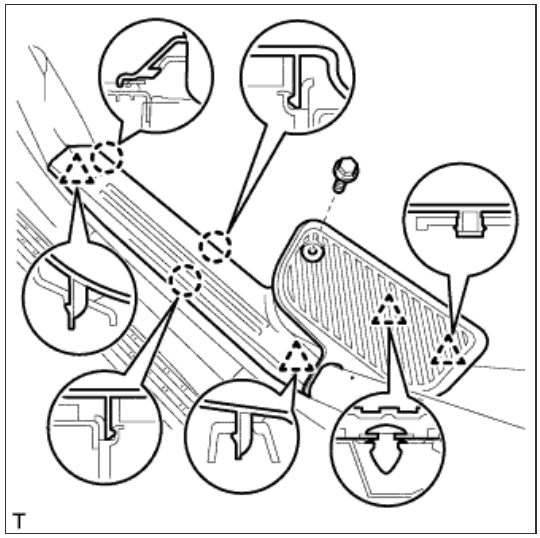
a. Attach the 6 clips to install the support plate.



26. INSTALL REAR DOOR SCUFF PLATE LH

a. Attach the 3 claws and 4 clips to install the scuff plate.

b. Install the screw.



27. INSTALL REAR DOOR SCUFF PLATE RH

HINT:

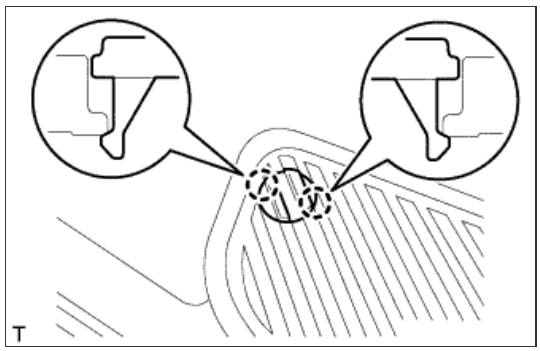
Use the same procedures described for the LH side.

28. INSTALL REAR STEP CO ER

HINT:

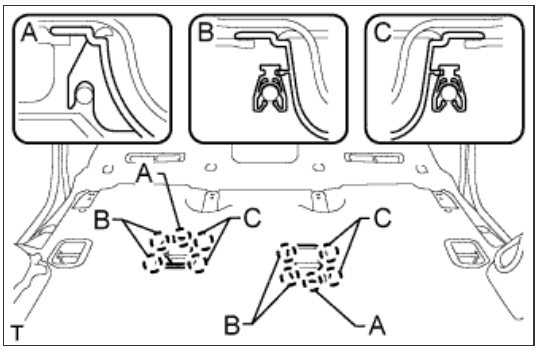
Use the same procedure to install the step cover on the other side.

a. Attach the 2 claws to install the step cover.



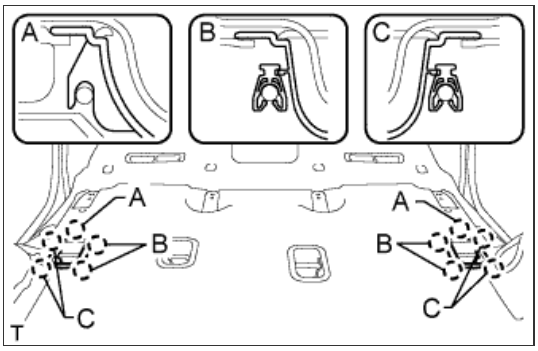
29. INSTALL REAR NO. 2 SEAT PROTECTOR

a. Attach the 10 claws to install the 2 seat protectors.



30. INSTALL REAR NO. 1 SEAT PROTECTOR

a. Attach the 10 claws to install the 2 seat protectors.



31. INSTALL REAR NO. 2 SEAT ASSEMBLY

a. for Face to Face Seat Type:
Install the rear No. 2 seat assembly (Click here).

b. except Face to Face Seat Type:
Install the rear No. 2 seat assembly (Click here).

32. INSTALL REAR NO. 1 SEAT ASSEMBLY RH (for 60/40 Split Seat Type 40 Side)

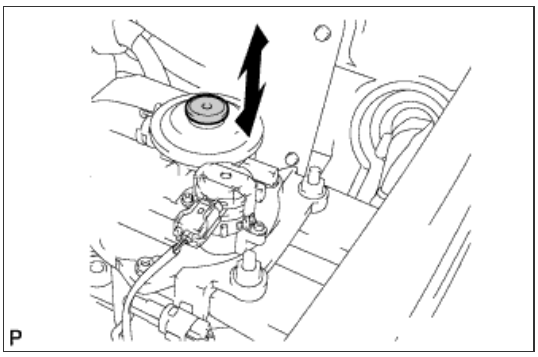
a. Install the rear No. 1 seat assembly RH (Click here).

33. INSTALL REAR NO. 1 SEAT ASSEMBLY LH (for 60/40 Split Seat Type 60 Side)

a. Install the rear No. 1 seat assembly LH (Click here).

34. BLEED AIR FROM FUEL SYSTEM

a. Using the hand pump indicated by the arrow in the illustration, bleed the fuel system. Continue pumping until pumping becomes difficult.



35. CONNECT CABLE TO NEGATI BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Connect the cables to the negative (-) main battery and sub-battery terminals.

36. CHECK SRS WARNING LIGHT

a. Check the SRS warning light (Click here).

37. ADD FUEL

38. INSPECT FOR FUEL LEAK

a. Perform Active Test.

i. Connect the intelligent tester to the DLC3.

ii. Turn the ignition switch to ON.

iii. Start the engine.

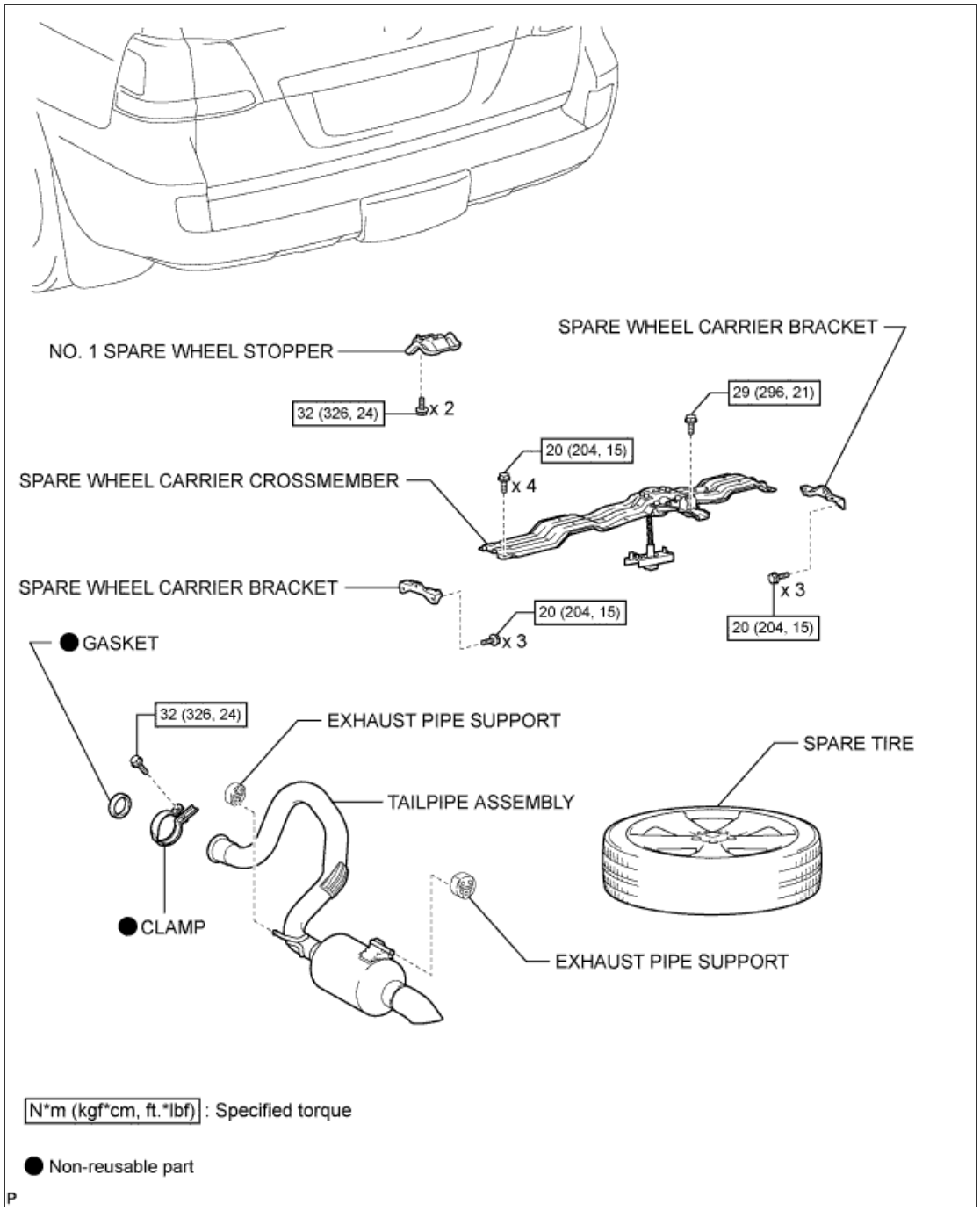
iv. Turn the intelligent tester ON.

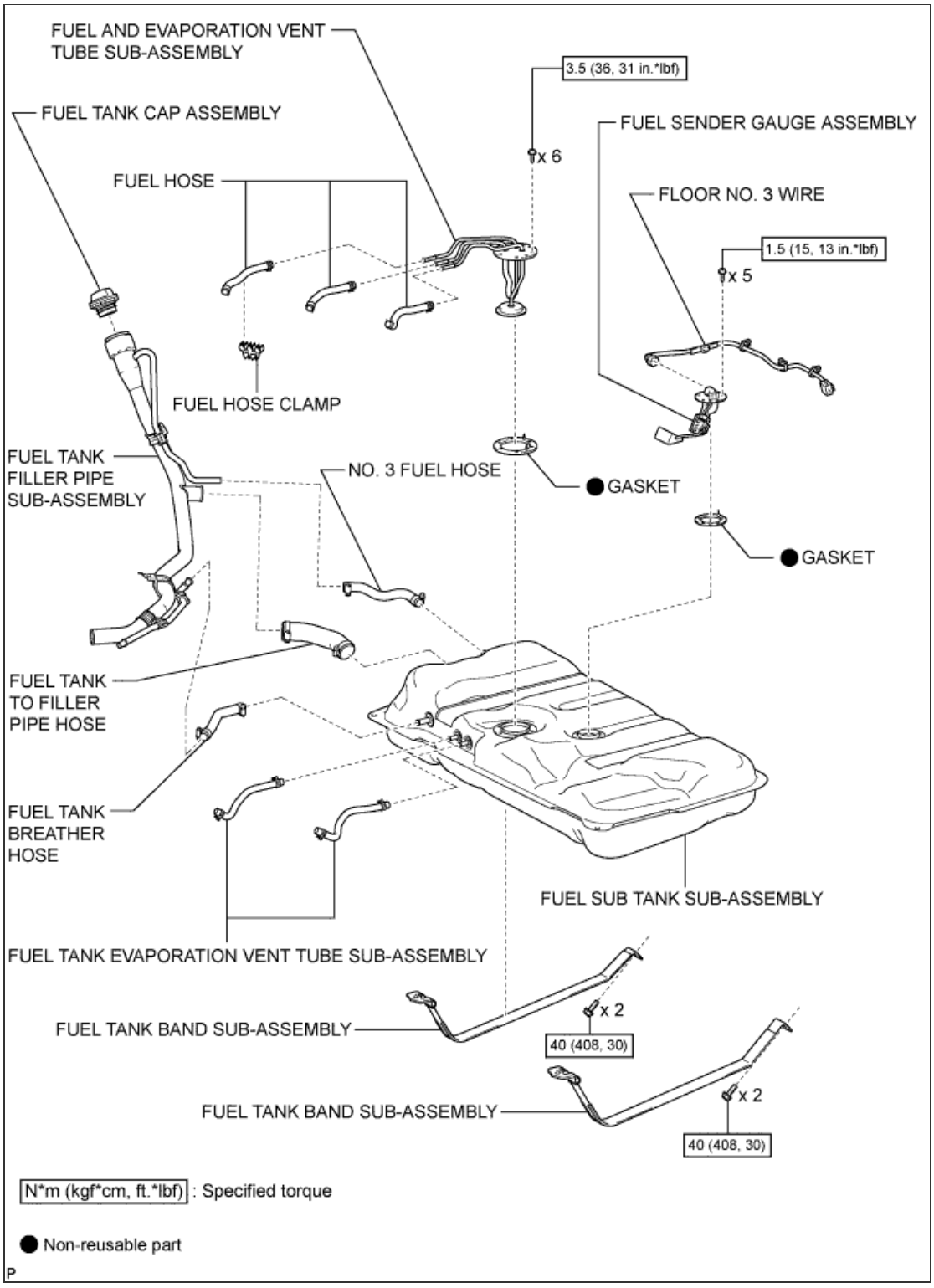
v. Enter the following menus: Powertrain / Engine / Active Test.

vi. Perform the Active Test.

Tester Display	Test Detail	Control Range	Diagnostic Note
Test the Fuel Leak	Pressurizes fuel inside common rail and checks for fuel leaks	Stop/Start	• The fuel inside the common rail is pressurized to the specified value and the engine speed increases to 2000 rpm when Start is selected. • The above conditions are preserved while Start is selected.

for Preparation Click here




FUEL AND EVAPORATION VENT TUBE SUB-ASSEMBLY
3.5 (36, 31 in.*lbf)
FUEL TANK CAP ASSEMBLY
FUEL SENDER GAUGE ASSEMBLY
x 6
FUEL HOSE
FLOOR NO. 3 WIRE
1.5 (15, 13 in.*lbf)
x 5
FUEL HOSE CLAMP
FUEL TANK FILLER PIPE SUB-ASSEMBLY
NO. 3 FUEL HOSE
GASKET
GASKET
FUEL TANK TO FILLER PIPE HOSE
FUEL TANK BREATHER HOSE
FUEL SUB TANK SUB-ASSEMBLY
FUEL TANK EVAPORATION VENT TUBE SUB-ASSEMBLY
FUEL TANK BAND SUB-ASSEMBLY
x 2
40 (408, 30)
FUEL TANK BAND SUB-ASSEMBLY
x 2
40 (408, 30)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Disconnect the cables from the negative (-) main battery and sub-battery terminals.

2. REMOVE SPARE TIRE

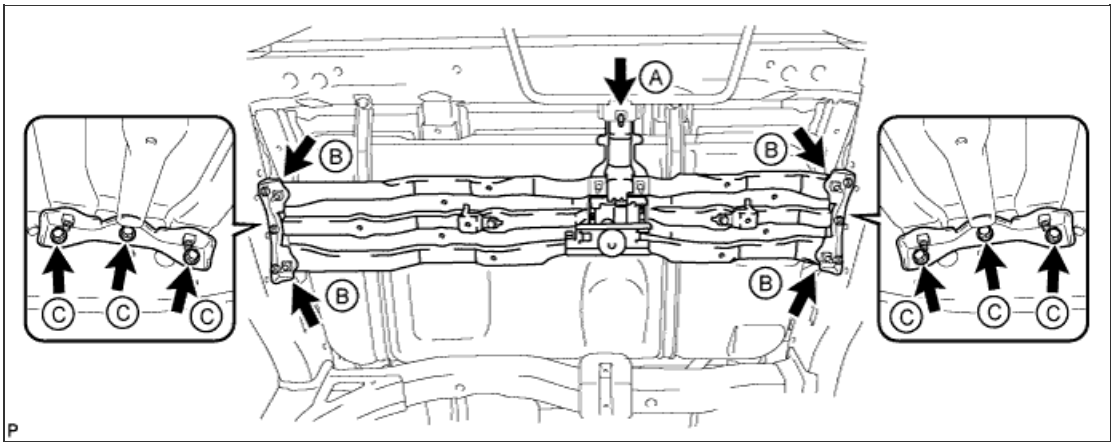
3. REMOVE TAILPIPE ASSEMBLY

a. Remove the bolt, clamp and gasket.

b. Disconnect the tailpipe from the 2 exhaust pipe supports.

4. REMOVE SPARE WHEEL CARRIER CROSSMEMBER AND SPARE WHEEL CARRIER BRACKET

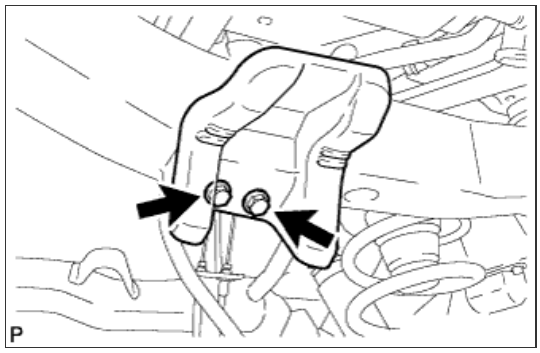
a. Remove the bolt labeled A, and then loosen the 4 bolts labeled B.



b. Slightly raise the spare wheel carrier crossmember, and then remove the 6 bolts labeled C, spare wheel carrier crossmember and 2 brackets.

5. REMOVE NO. 1 SPARE WHEEL STOPPER

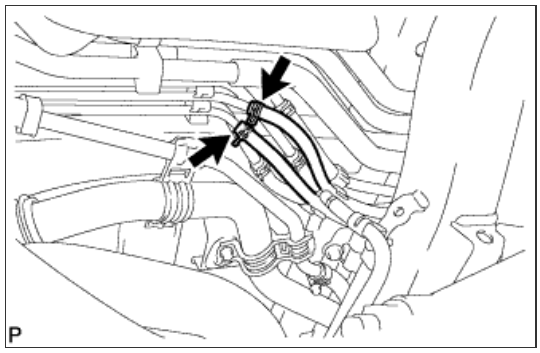
a. Remove the 2 bolts and spare wheel stopper.



6. REMOVE FUEL TANK CAP ASSEMBLY

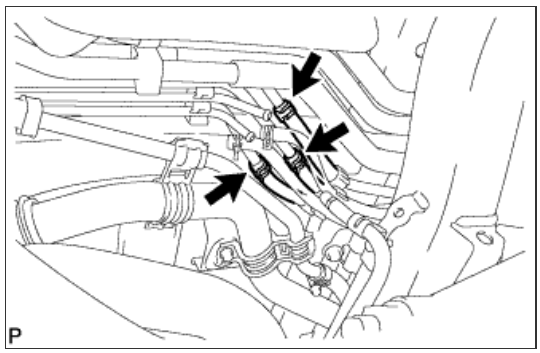
7. DISCONNECT FUEL TANK EVAPORATION VENT TUBE SUB-ASSEMBLY

a. Disconnect the 2 fuel tank evaporation vent tubes.



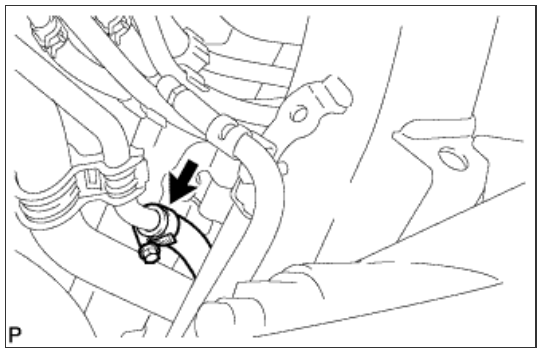
8. DISCONNECT FUEL HOSE

a. Disconnect the 3 fuel hoses.



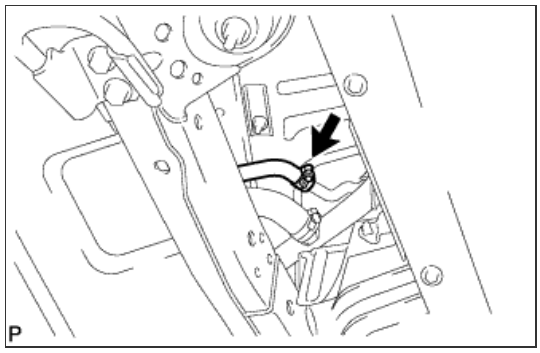
9. DISCONNECT FUEL TANK BREATHER HOSE

a. Disconnect the breather hose from the filler pipe.



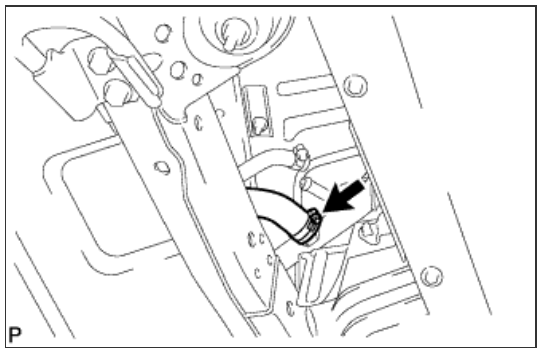
10. DISCONNECT NO. 3 FUEL HOSE

a. Disconnect the fuel hose from the filler pipe.



11. DISCONNECT FUEL TANK TO FILLER PIPE HOSE

a. Disconnect the hose from the filler pipe.



12. REMOVE FUEL SUB TANK SUB-ASSEMBLY

a. Disconnect the floor No. 3 wire connector.

b. Using a clip remover, detach the 3 wire harness clamps.

c. Place a transmission jack under the fuel sub tank.

. Remove the 2 bolts and disconnect the 2 fuel tank bands.

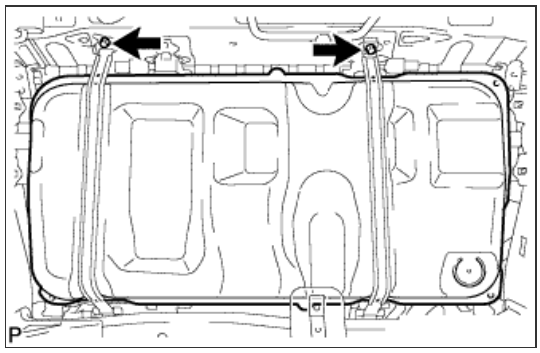
e. Lower the transmission jack to remove the fuel sub tank from the vehicle.

NOTICE:

Do not allow the fuel sub tank to contact the vehicle, especially the differential.

HINT:

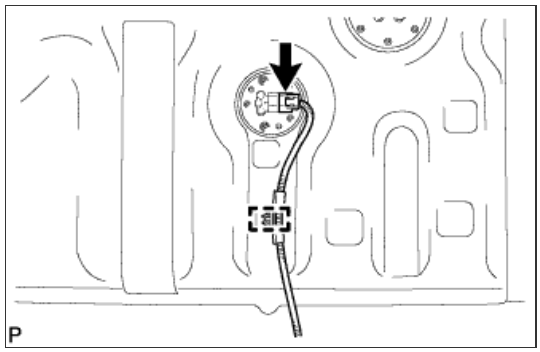
Lower the transmission jack slowly.



13. REMOVE FLOOR NO. 3 WIRE

a. Disconnect the sender gauge connector.

b. Using a clip remover, detach the wire harness clamp.



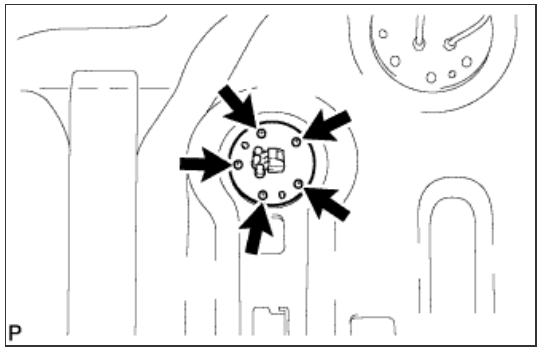
14. REMOVE FUEL SENDER GAUGE ASSEMBLY

a. Remove the 5 screws and sender gauge.

NOTICE:

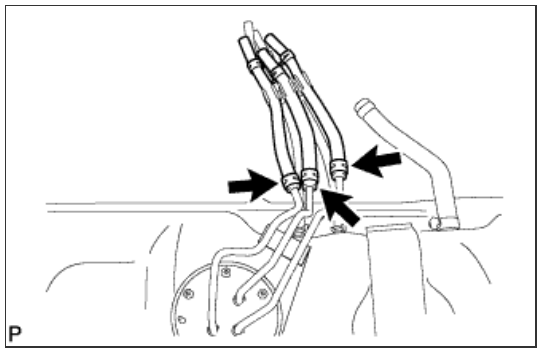
Be careful not to bend the arm of the fuel sender gauge.

b. Remove the gasket from the sender gauge.



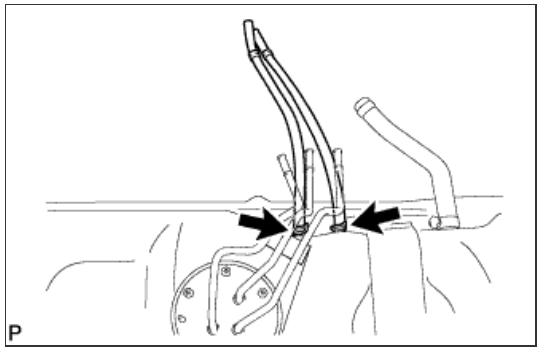
15. REMOVE FUEL HOSE

a. Remove the 3 fuel hoses.



16. REMOVE FUEL TANK EVAPORATION VENT TUBE SUB-ASSEMBLY

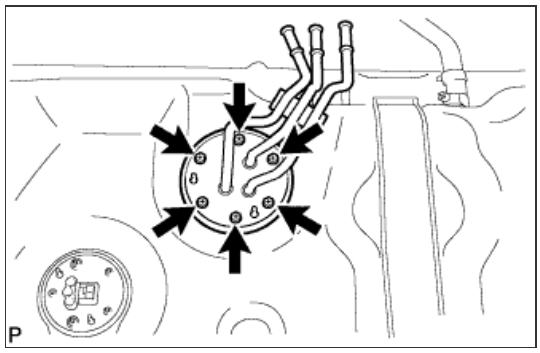
a. Remove the 2 fuel tank evaporation vent tubes.



17. REMOVE FUEL AND EVAPORATION VENT TUBE SUB-ASSEMBLY

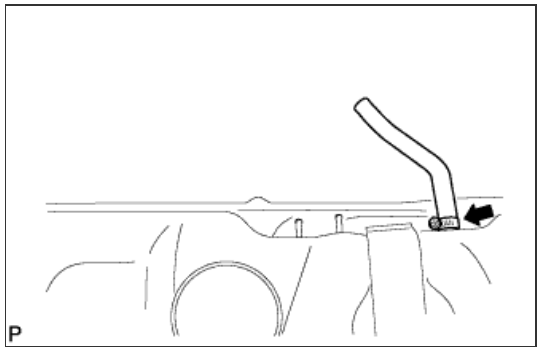
a. Remove the 6 bolts and fuel and evaporation vent tube.

b. Remove the gasket from the fuel and evaporation vent tube.



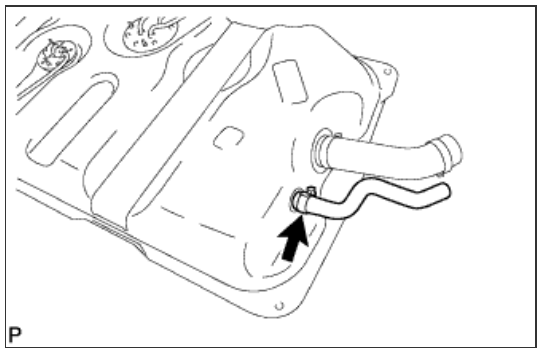
18. REMOVE FUEL TANK BREATHER HOSE

a. Remove the breather hose from the fuel sub tank.



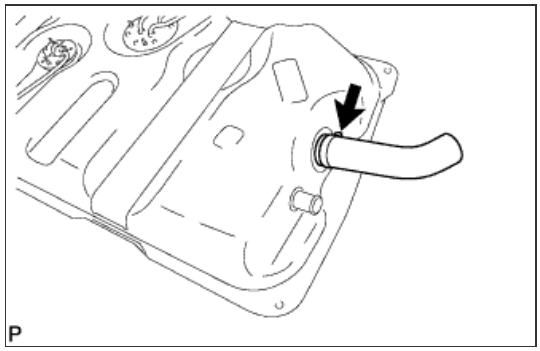
19. REMOVE NO. 3 FUEL HOSE

a. Remove the fuel hose from the fuel sub tank.



20. REMOVE FUEL TANK TO FILLER PIPE HOSE

a. Remove the hose from the fuel sub tank.



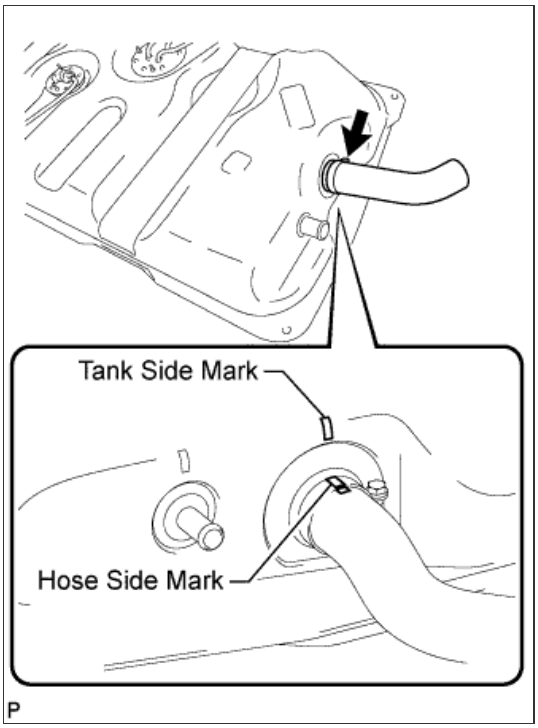
for Preparation Click here

1. INSTALL FUEL TANK TO FILLER PIPE HOSE

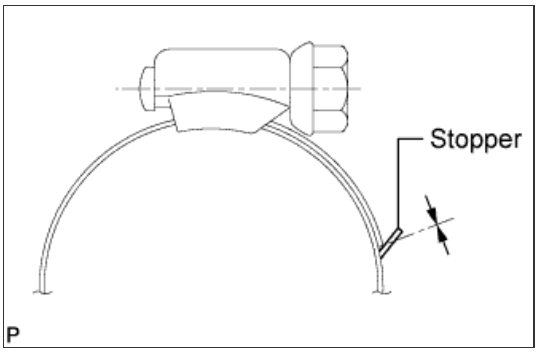
a. Install the hose to the fuel sub tank as shown in the illustration.

HINT:

- **Align the fuel sub tank side mark with the hose side mark when installing the hose.**



- **Tighten the hose clamp until the end of the hose clamp contacts the stopper as shown in the illustration.**

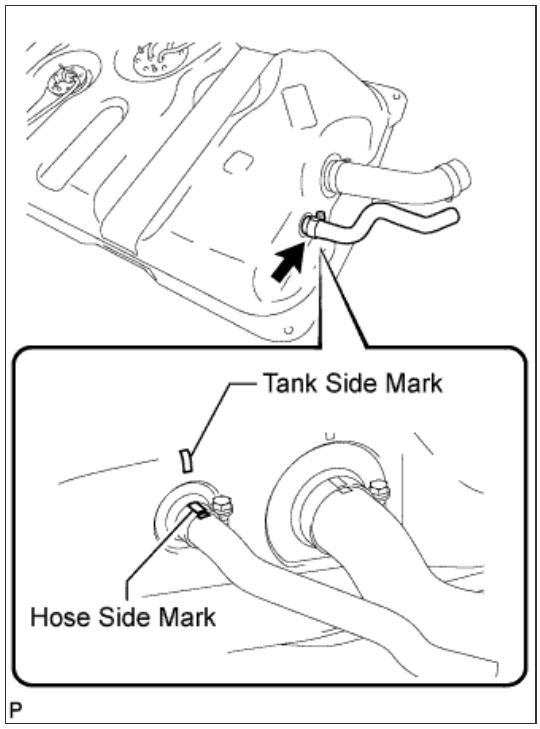


2. INSTALL NO. 3 FUEL HOSE

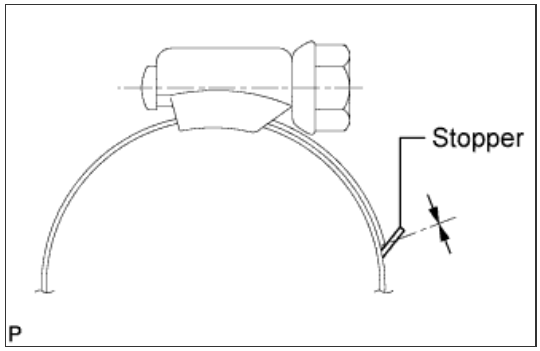
a. Install the fuel hose to the fuel sub tank as shown in the illustration.

HINT:

- **Align the fuel sub tank side mark with the hose side mark when installing the hose.**

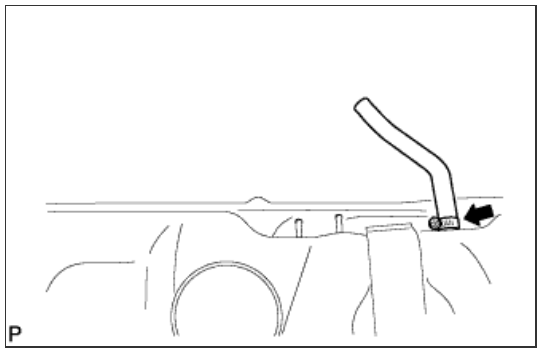


- **Tighten the hose clamp until the end of the hose clamp contacts the stopper as shown in the illustration.**



3. INSTALL FUEL TANK BREATHER HOSE

a. Install the breather hose to the fuel sub tank.

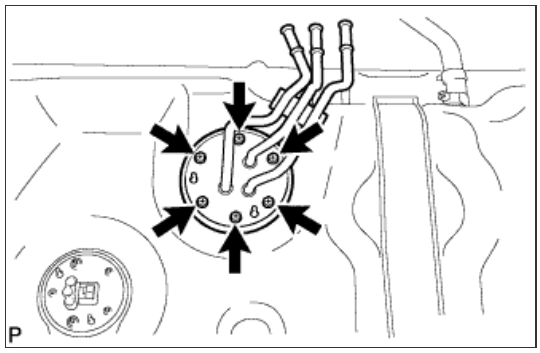


4. INSTALL FUEL AND EVAPORATION VENT TUBE SUB-ASSEMBLY

a. Install a new gasket to the fuel and evaporation vent tube.

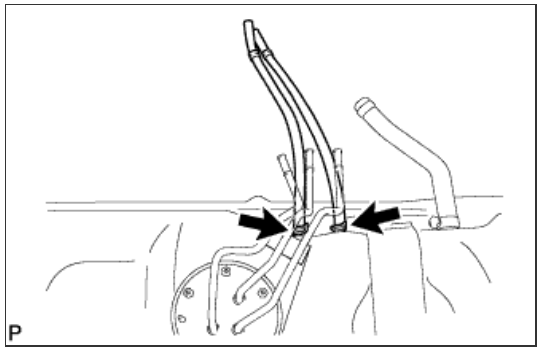
b. Install the fuel and evaporation vent tube with the 6 bolts.

Torque:
3.5 N*m 36 kgf*cm , 31 in.*lbf }



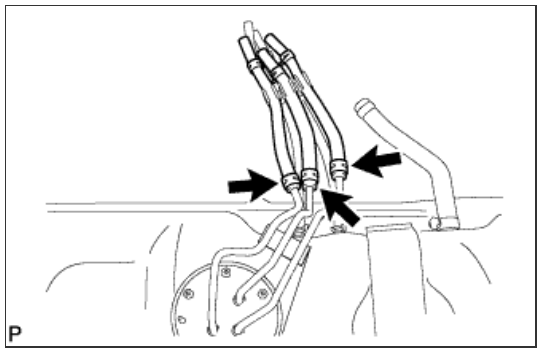
5. INSTALL FUEL TANK EVAPORATION VENT TUBE SUB-ASSEMBLY

a. Install the 2 fuel tank evaporation vent tubes.



6. INSTALL FUEL HOSE

a. Install the 3 fuel hoses.



7. INSTALL FUEL SENDER GAUGE ASSEMBLY

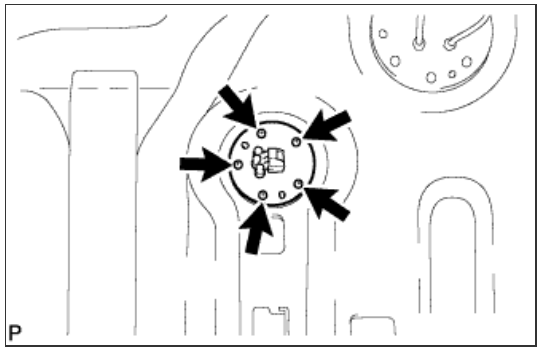
a. Install a new gasket to the sender gauge.

NOTICE:

Be careful not to bend the arm of the fuel sender gauge.

b. Install the sender gauge with the 5 screws.

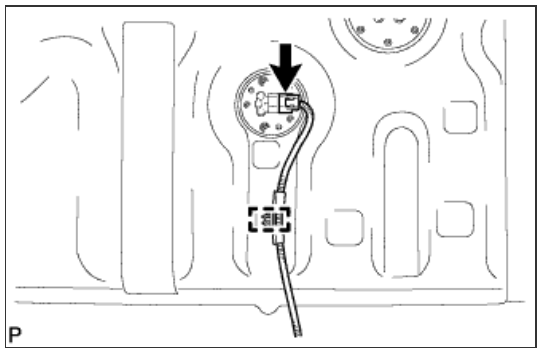
Torque:
1.5 N*m 15 kgf*cm , 13 in.*lbf }



8. INSTALL FLOOR NO. 3 WIRE

a. Attach the wire harness clamp to the fuel sub tank.

b. Connect the sender gauge connector.



9. INSTALL FUEL SUB TANK SUB-ASSEMBLY

a. Set the fuel sub tank on a transmission jack and raise the fuel sub tank.

NOTICE:

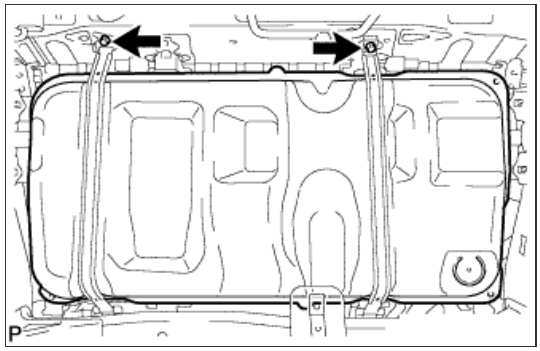
Do not allow the fuel sub tank to contact the vehicle, especially the differential.

b. Connect the 2 fuel tank bands with the 2 bolts.

Torque:
4 N*m 4 8 kgf*cm , 3 ft.*lbf }

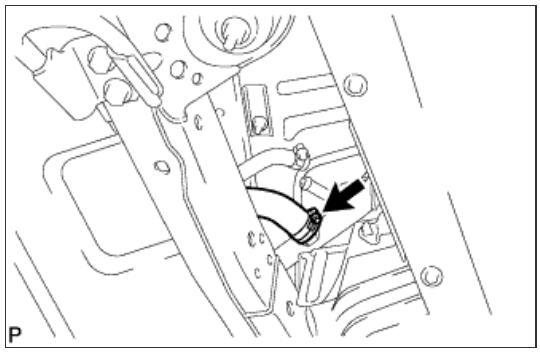
c. Connect the floor No. 3 wire connector.

d. Attach the 3 wire harness clamps.



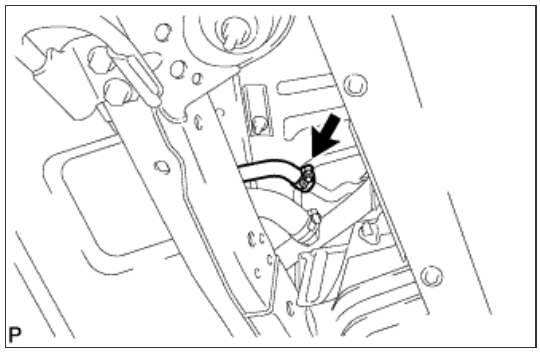
1 . CONNECT FUEL TANK TO FILLER PIPE HOSE

a. Connect the hose to the filler pipe.



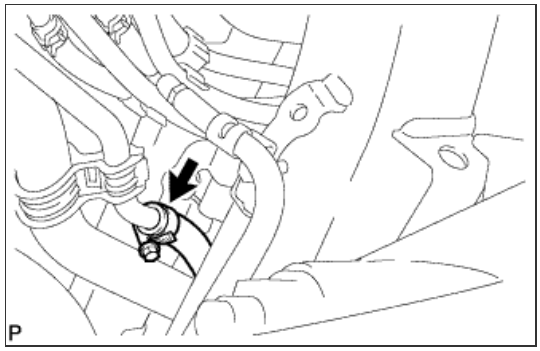
11. CONNECT NO. 3 FUEL HOSE

a. Connect the fuel hose to the filler pipe.



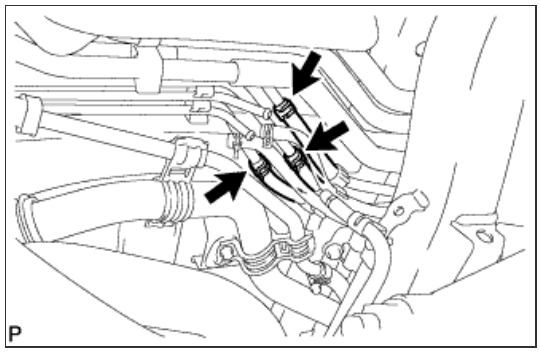
12. CONNECT FUEL TANK BREATHER HOSE

a. Connect the breather hose to the filler pipe.



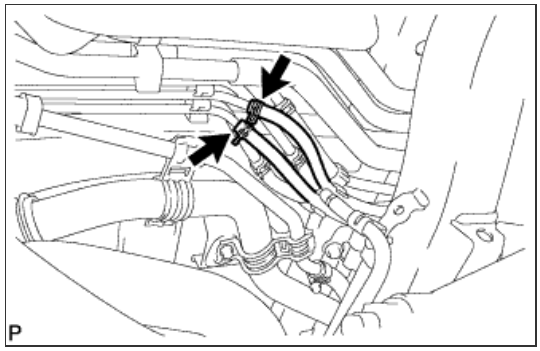
13. CONNECT FUEL HOSE

a. Connect the 3 fuel hoses.



14. CONNECT FUEL TANK EVAPORATION VENT TUBE

a. Connect the 2 fuel evaporation vent tubes.

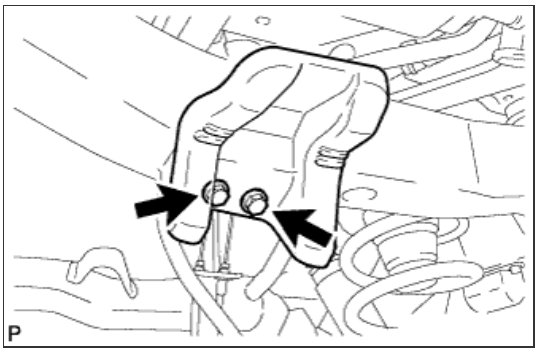


15. INSTALL FUEL TANK CAP ASSEMBLY

16. INSTALL NO. 1 SPARE WHEEL STOPPER

a. Install the spare wheel stopper with the 2 bolts.

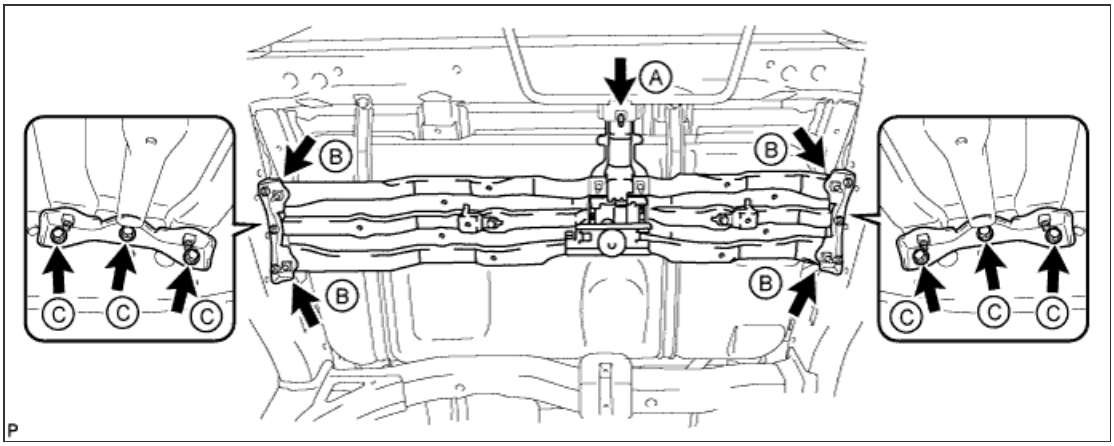
Torque:
32 N*m 326 kgf*cm , 24 ft.*lbf }



17. INSTALL SPARE WHEEL CARRIER CROSSMEMBER AND SPARE WHEEL CARRIER BRACKET

a. Install the spare wheel carrier crossmember and 2 brackets to the vehicle body with the 6 bolts labeled C.

Torque:
for bolt C:
2 N*m 2 4 kgf*cm , 15 ft.*lbf }



b. Temporarily install the bolt labeled A, and then tighten the bolt labeled A and bolts labeled B.

Torque:
for bolt A:
29 N*m 296 kgf*cm , 21 ft.*lbf }
for bolt B:
2 N*m 2 4 kgf*cm , 15 ft.*lbf }

18. INSTALL TAILPIPE ASSEMBLY

a. Connect the tailpipe to the 2 exhaust pipe supports.

b. Set a new gasket to the center exhaust pipe.

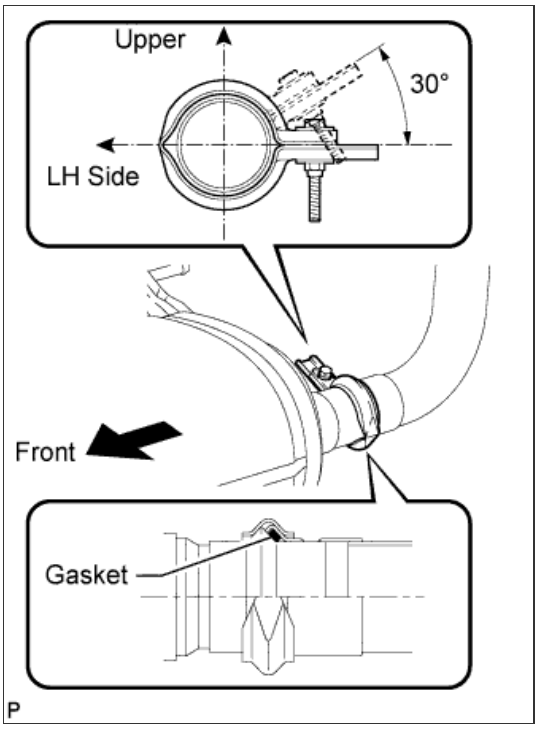
c. Connect the tailpipe to the center exhaust pipe with a new clamp.

HINT:

Install the clamp within the angle range shown in the illustration.

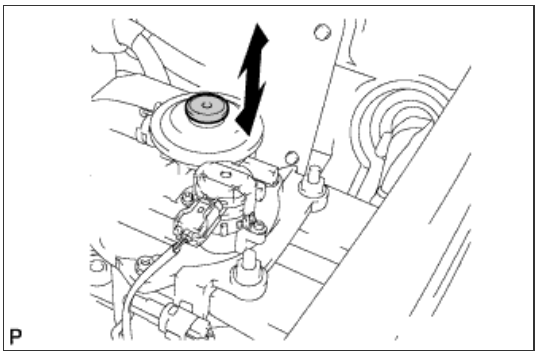
d. Tighten the bolt.

Torque:
32 N*m 326 kgf*cm , 24 ft.*lbf }



19. BLEED AIR FROM FUEL SYSTEM

a. Using the hand pump indicated by the arrow in the illustration, bleed the fuel system. Continue pumping until pumping becomes difficult.



2 . CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Connect the cables to the negative (-) main battery and sub-battery terminals.

21. INSPECT FOR FUEL LEAK

a. Perform Active Test.

i. Connect the intelligent tester to the DLC3.

ii. Turn the ignition switch to ON.

iii. Start the engine.

iv. Turn the intelligent tester ON.

v. nter the following menus: Powertrain / ngine / Active Test.

vi. Perform the Active Test.

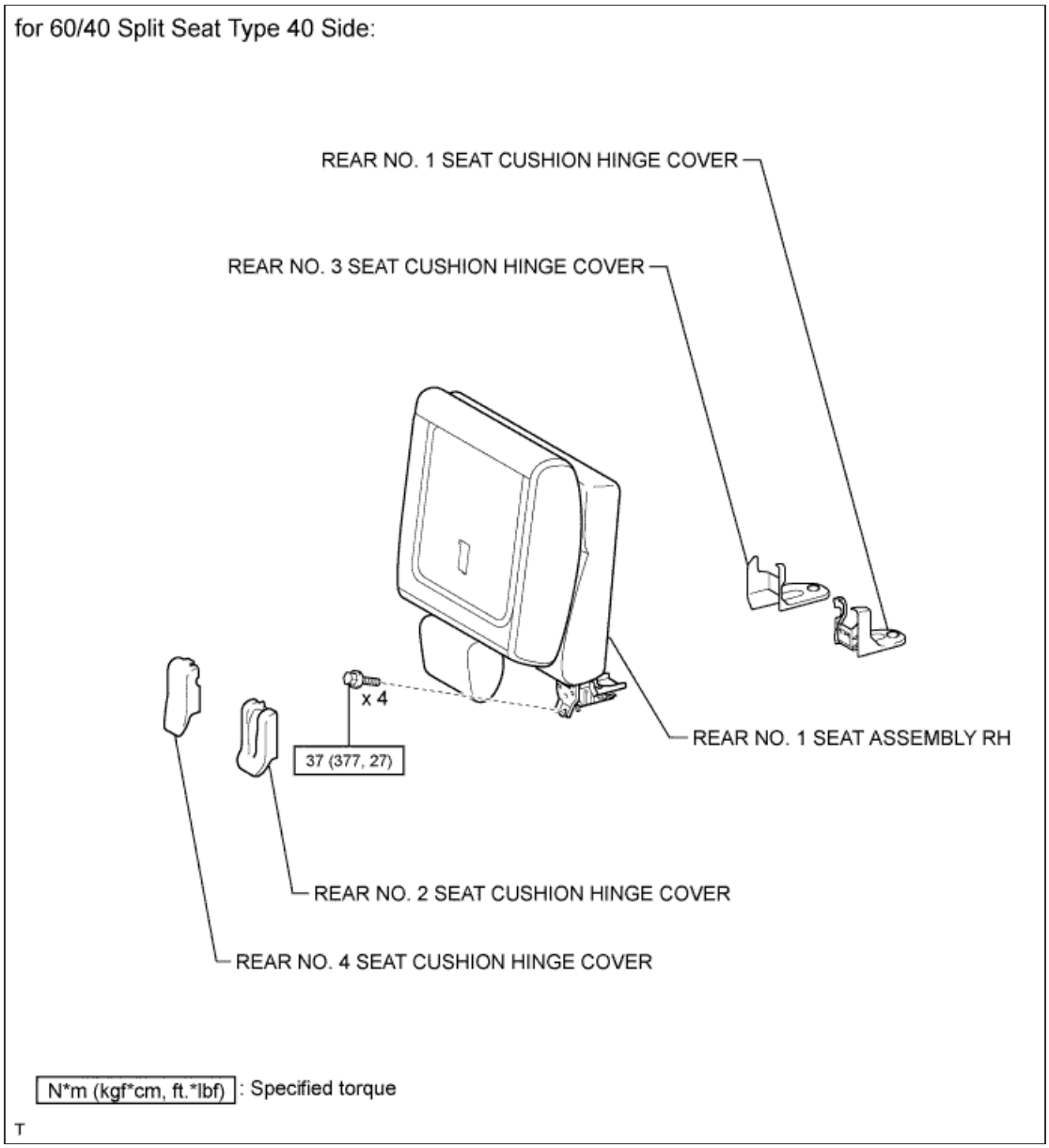
Tester Display	Test Detail	Control Range	Diagnostic Note

Test the Fuel Leak	Pressurizes fuel inside common rail and checks for fuel leaks	Stop/Start	• The fuel inside the common rail is pressurized to the specified value and the engine speed increases to 2000 rpm when Start is selected. • The above conditions are preserved while Start is selected.

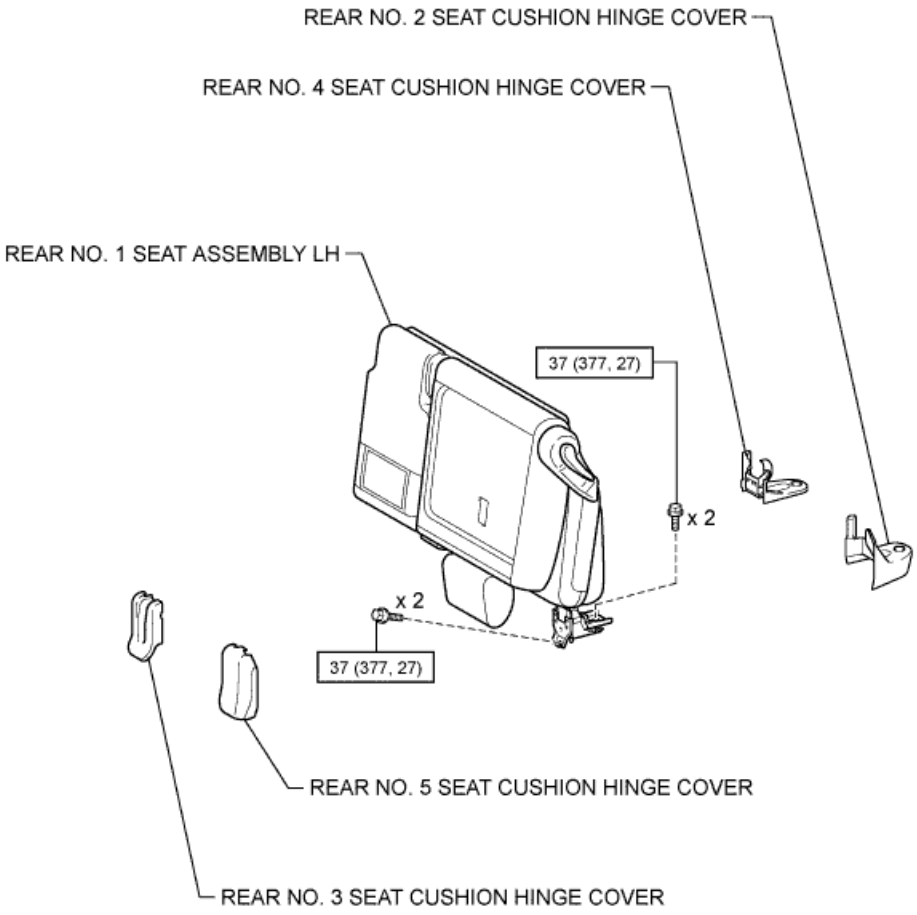
22. INSPECT FOR EXHAUST GAS LEAK

23. INSTALL SPARE TIRE

for Preparation Click here



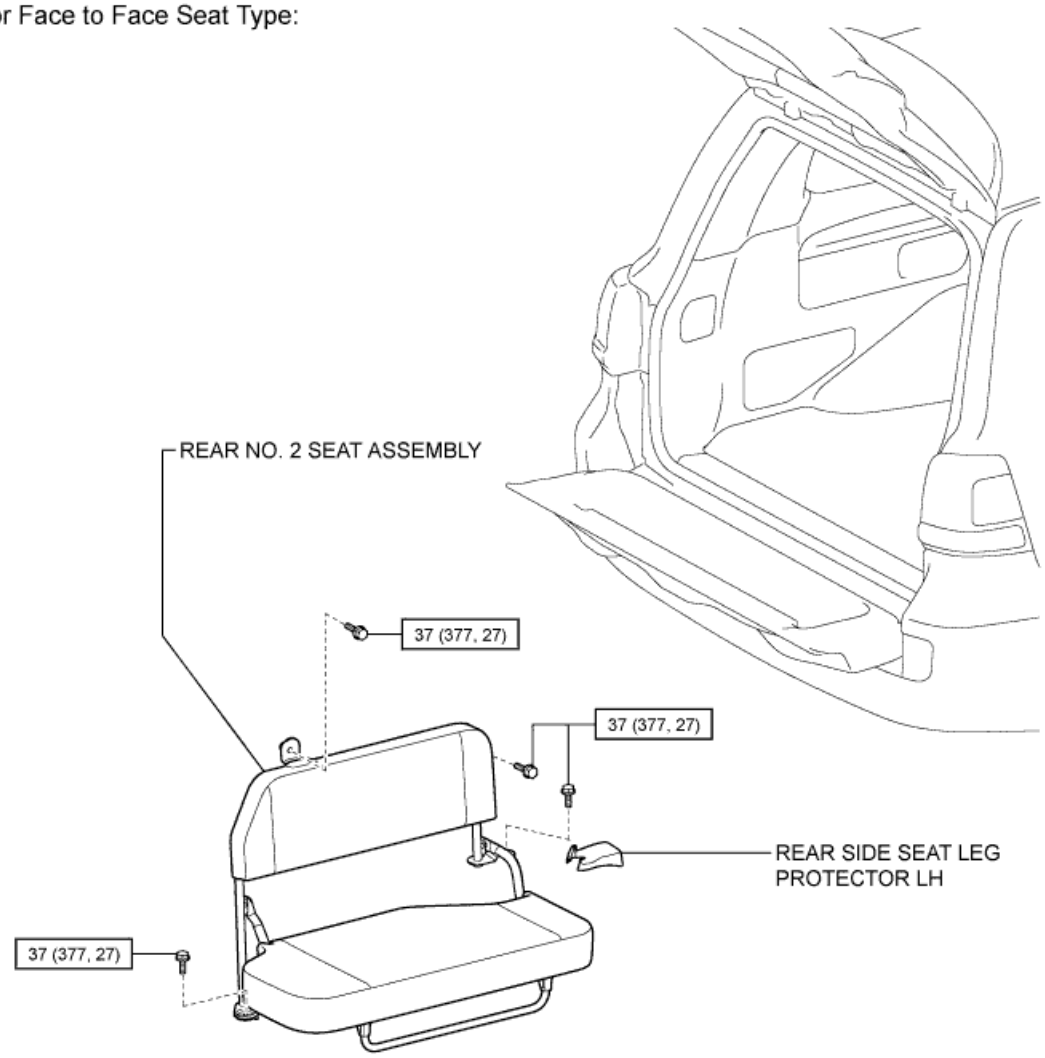
for 60/40 Split Seat Type 60 Side:



N*m (kgf*cm, ft.*lbf) : Specified torque

T

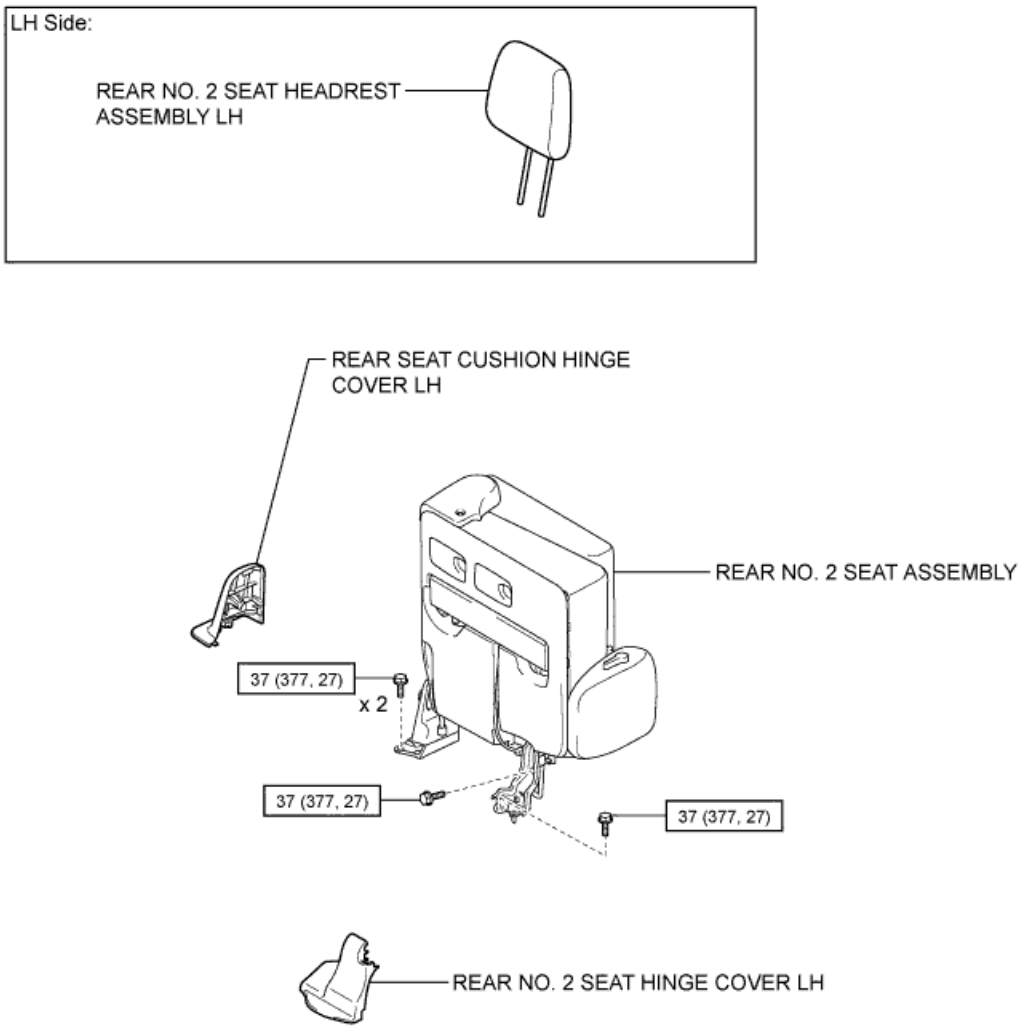
for Face to Face Seat Type:



N*m (kgf*cm, ft.*lbf) : Specified torque

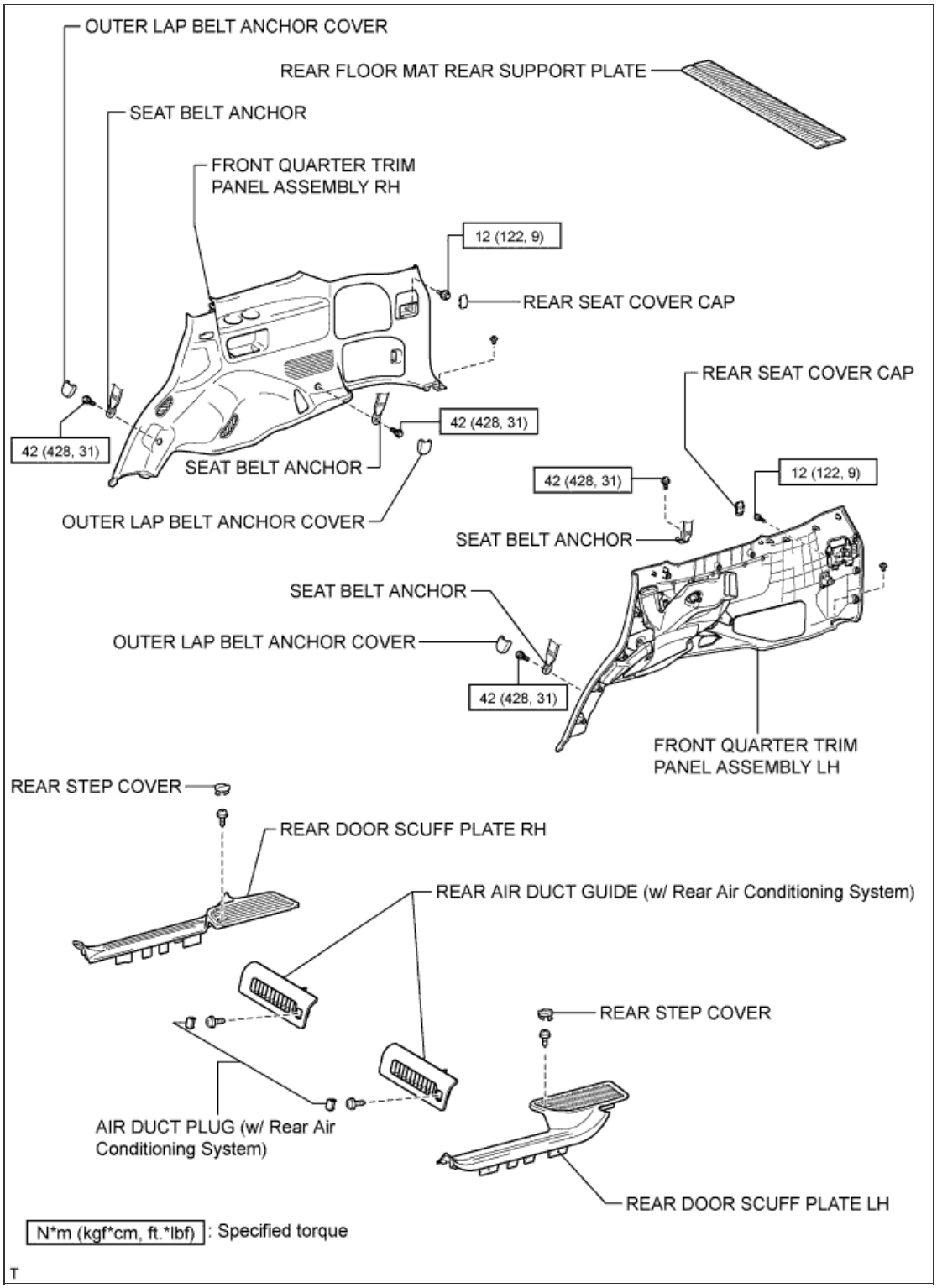
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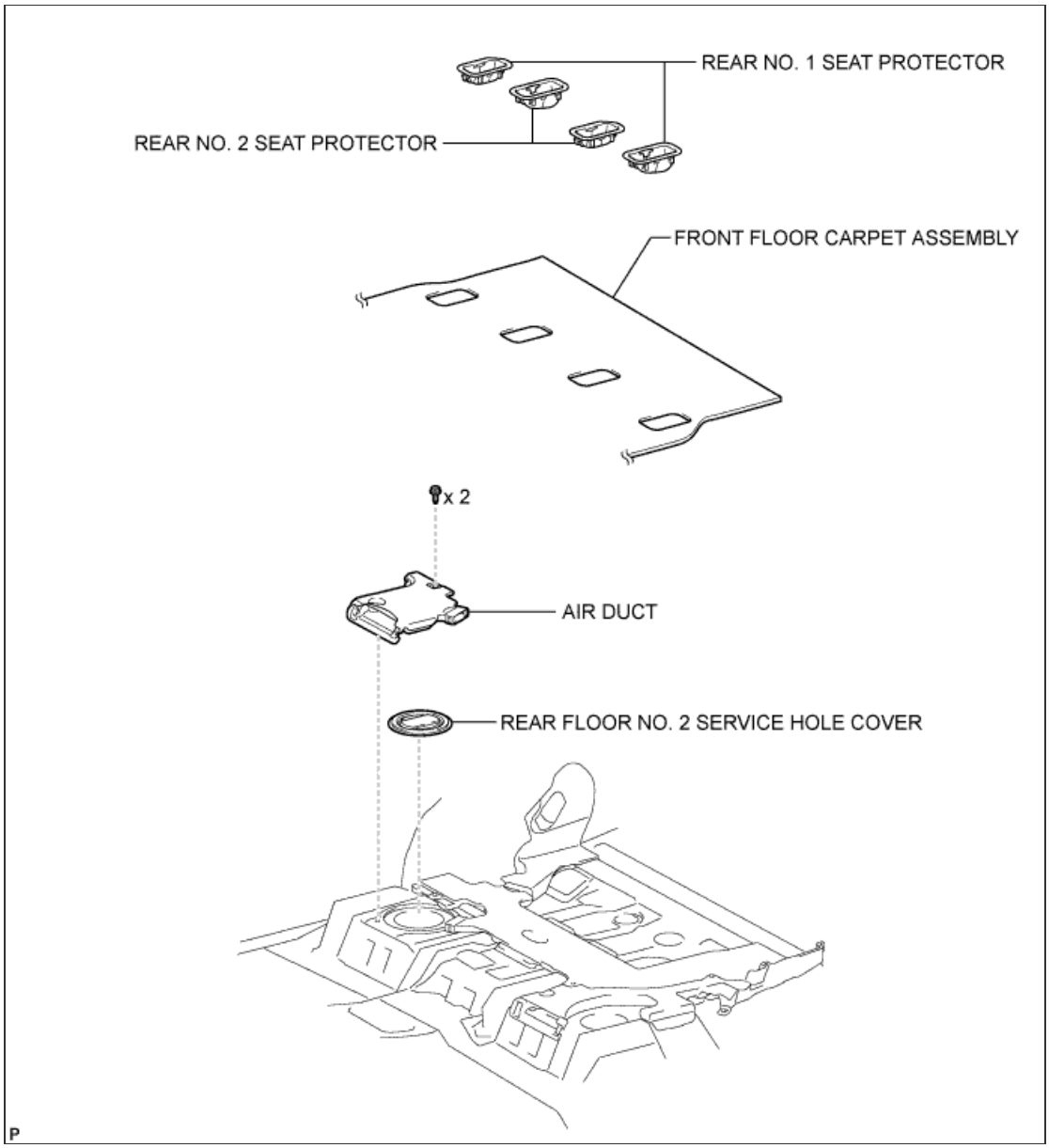
except Face to Face Seat Type:

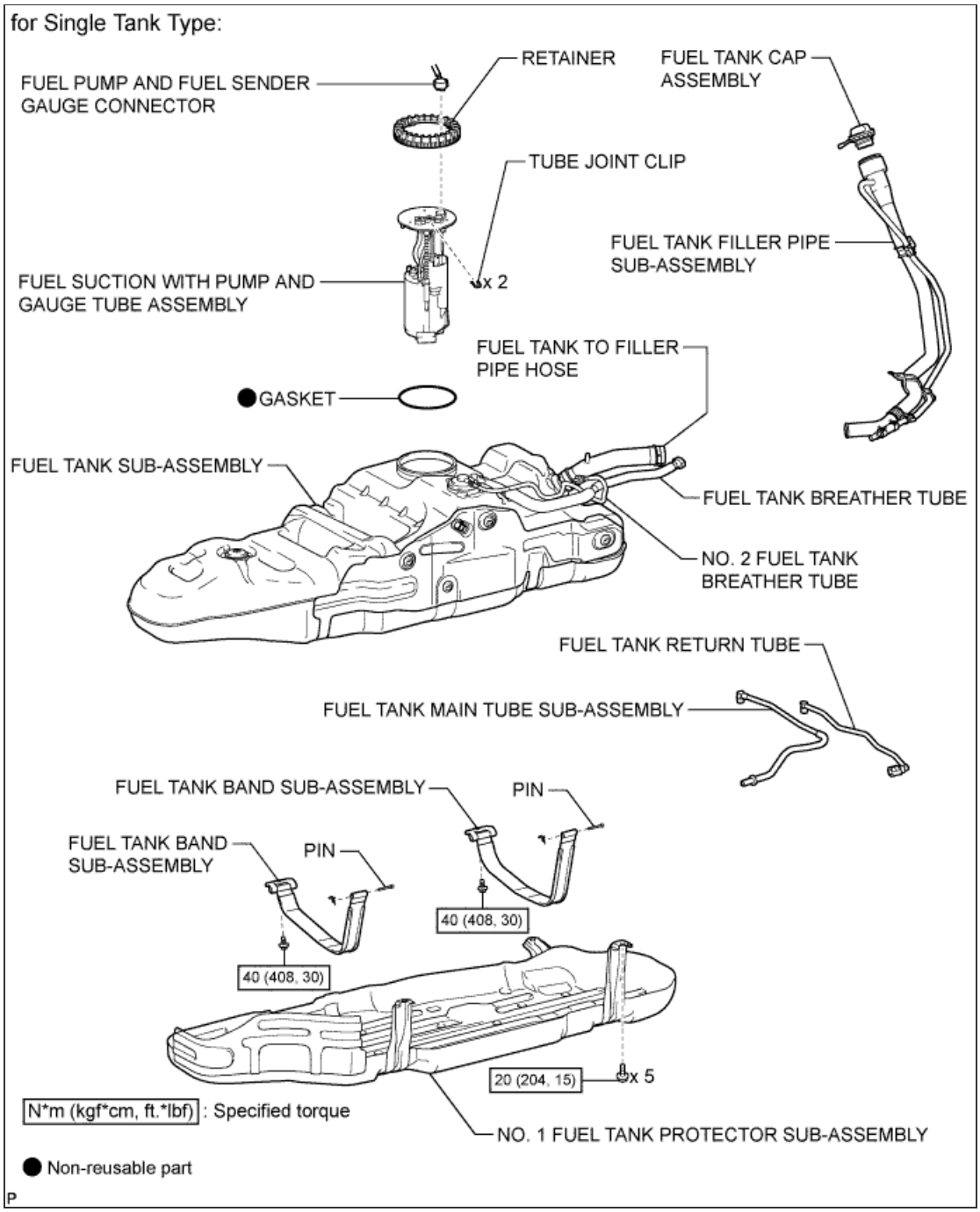


N*m (kgf*cm, ft.*lbf) : Specified torque

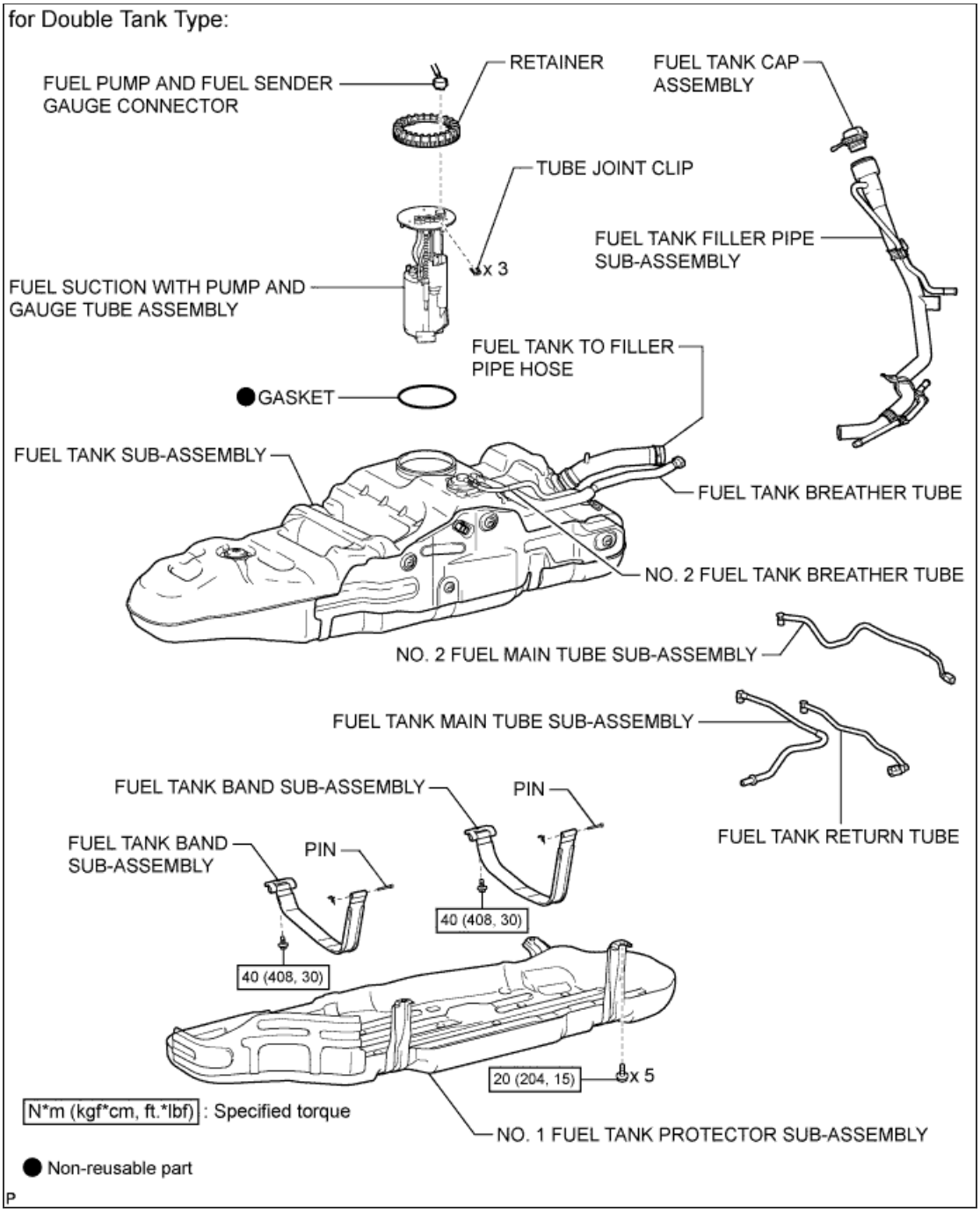
P


OUTER LAP BELT ANCHOR COVER
REAR FLOOR MAT REAR SUPPORT PLATE
SEAT BELT ANCHOR
FRONT QUARTER TRIM PANEL ASSEMBLY RH
12 (122, 9)
REAR SEAT COVER CAP
42 (428, 31)
SEAT BELT ANCHOR
42 (428, 31)
OUTER LAP BELT ANCHOR COVER
REAR SEAT COVER CAP
42 (428, 31)
12 (122, 9)
SEAT BELT ANCHOR
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
42 (428, 31)
FRONT QUARTER TRIM PANEL ASSEMBLY LH
REAR STEP COVER
REAR DOOR SCUFF PLATE RH
REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)
REAR STEP COVER
AIR DUCT PLUG (w/ Rear Air Conditioning System)
REAR DOOR SCUFF PLATE LH
N*m (kgf*cm, ft.*lbf) : Specified torque
T


REAR NO. 1 SEAT PROTECTOR
REAR NO. 2 SEAT PROTECTOR
FRONT FLOOR CARPET ASSEMBLY
x 2
AIR DUCT
REAR FLOOR NO. 2 SERVICE HOLE COVER
P

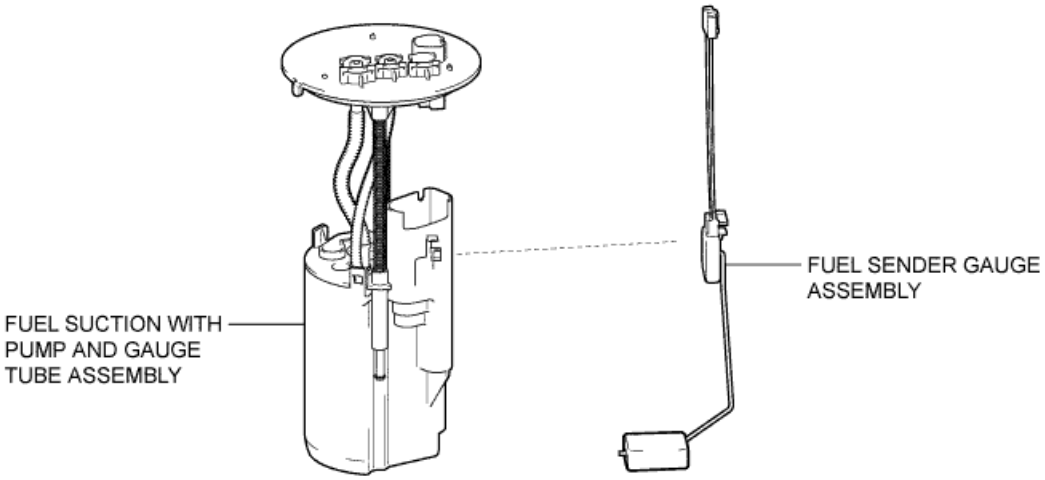

for Single Tank Type:
FUEL PUMP AND FUEL SENDER GAUGE CONNECTOR
RETAINER
FUEL TANK CAP ASSEMBLY
TUBE JOINT CLIP
FUEL TANK FILLER PIPE SUB-ASSEMBLY
FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY
x 2
FUEL TANK TO FILLER PIPE HOSE
GASKET
FUEL TANK SUB-ASSEMBLY
FUEL TANK BREATHER TUBE
NO. 2 FUEL TANK BREATHER TUBE
FUEL TANK RETURN TUBE
FUEL TANK MAIN TUBE SUB-ASSEMBLY
FUEL TANK BAND SUB-ASSEMBLY
PIN
FUEL TANK BAND SUB-ASSEMBLY
PIN
40 (408, 30)
40 (408, 30)
20 (204, 15)
x 5
N*m (kgf*cm, ft.*lbf) : Specified torque
NO. 1 FUEL TANK PROTECTOR SUB-ASSEMBLY
Non-reusable part
P

for Double Tank Type:

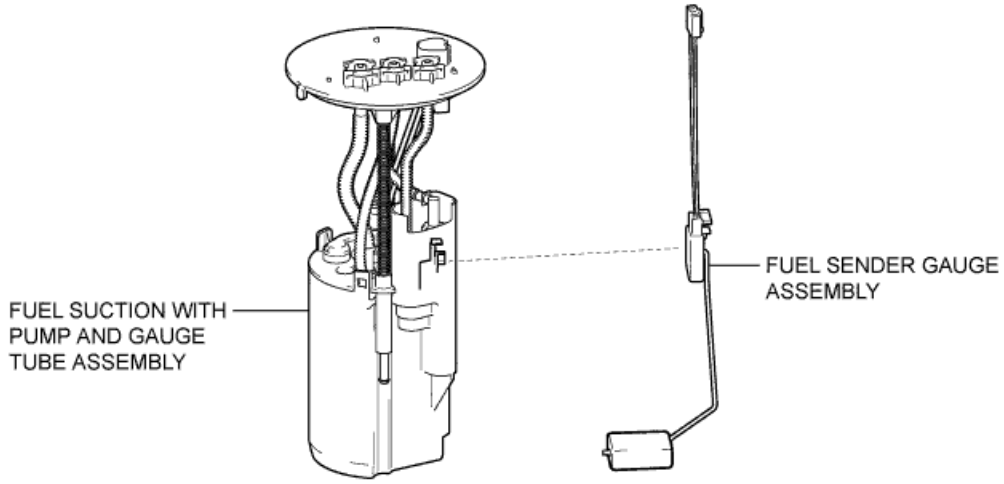


P

for Single Tank Type:



for Double Tank Type:



P

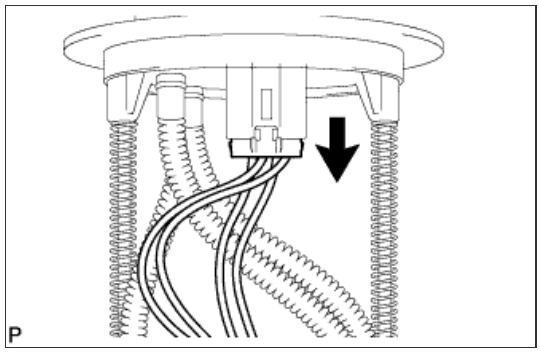
for Preparation Click here

1. REMOVE FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

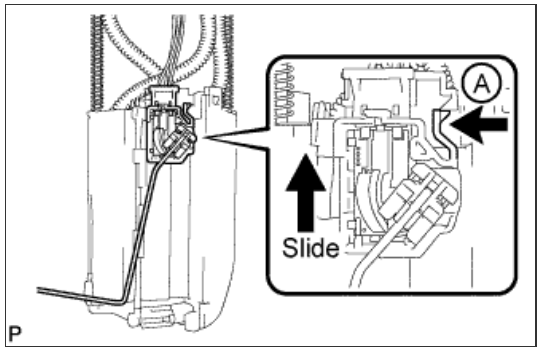
a. Remove the fuel suction with pump and gauge tube assembly (Click he e

2. REMOVE FUEL SENDER GAUGE ASSEMBLY

a. isconnect the fuel sende gauge connecto



b. se down on the sende gauge claw labeled A. Then slide the sende gauge upwa d to emove it.

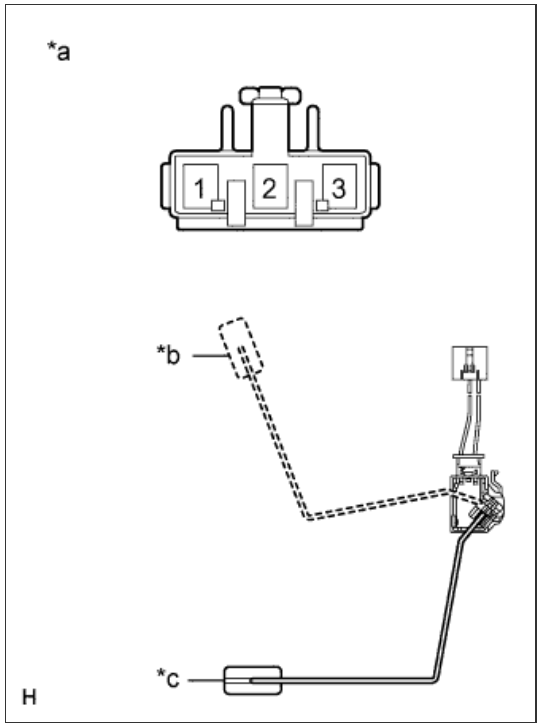


for Preparation Click here

1. INSPECT FUEL SENDER GAUGE ASSEMBLY

Text in Illustration

*a	Component without harness connected (Fuel Sender Gauge)
*b	F (Upper)
*c	E (Lower)



a. Check that the float moves smoothly between F and E.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

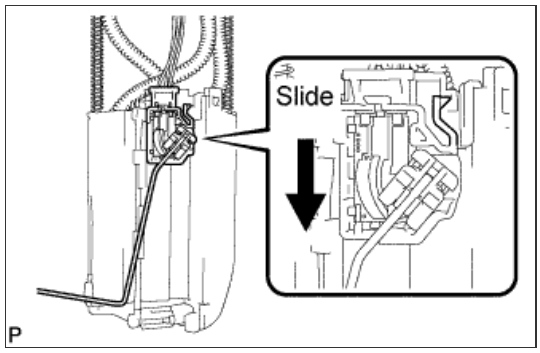
Tester Connection	Condition	Specified Condition
1 - 2	Float level is F (upper)	13.5 to 16.5 Ω
	Float level is E (lower)	405.5 to 414.5 Ω

If the result is not as specified, replace the fuel sender gauge assembly.

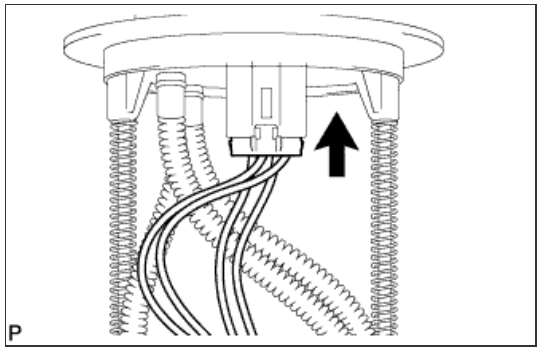
for Preparation Click here

1. INSTALL FUEL SENDER GAUGE ASSEMBLY

a. Set the sender gauge to the fuel sub-tank. Then slide the sender gauge downward to install it.



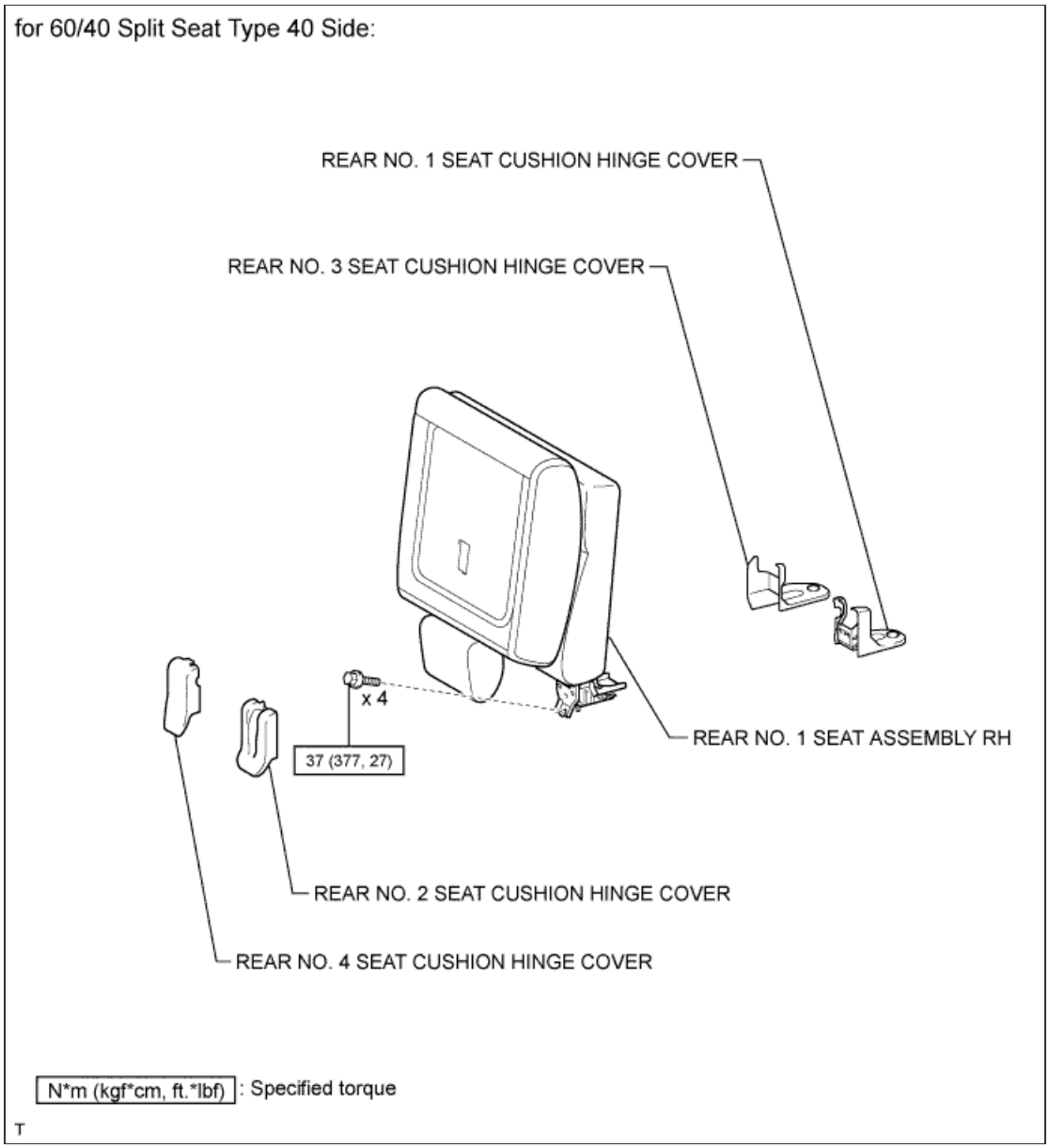
b. Connect the fuel sender gauge connector.



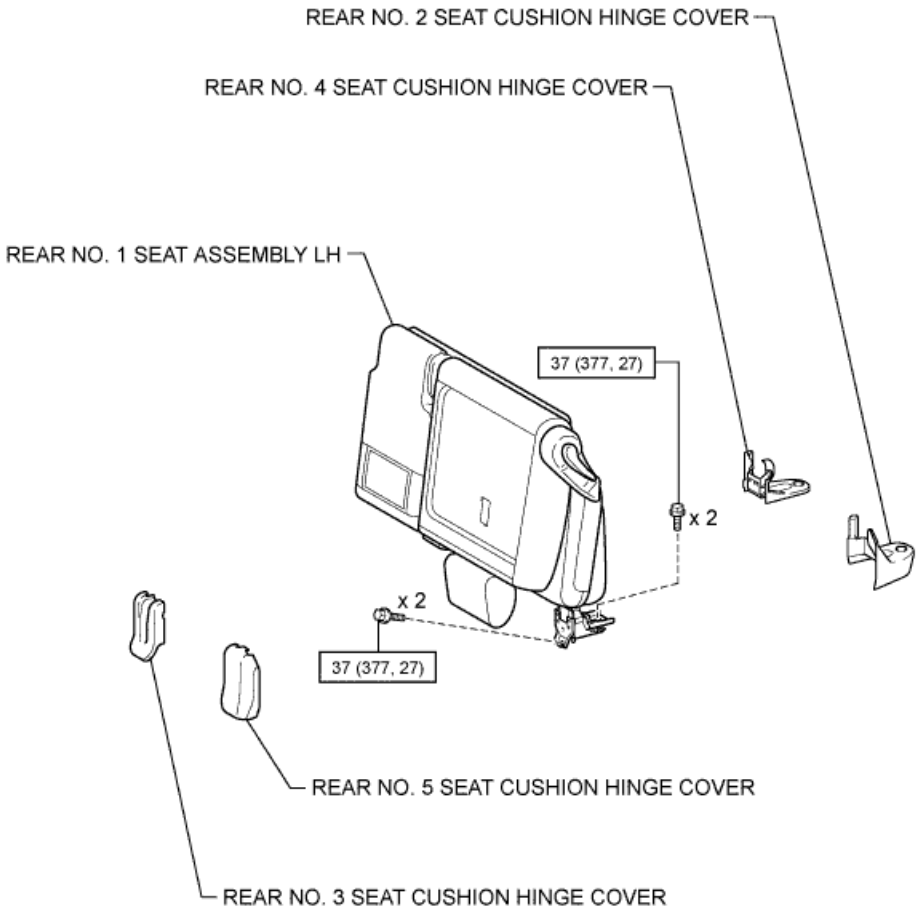
2. INSTALL FUEL SUCTION WITH PUMP AND GAUGE TUBE ASSEMBLY

a. Install the fuel suction with pump and gauge tube assembly (Click here).

for Preparation Click here



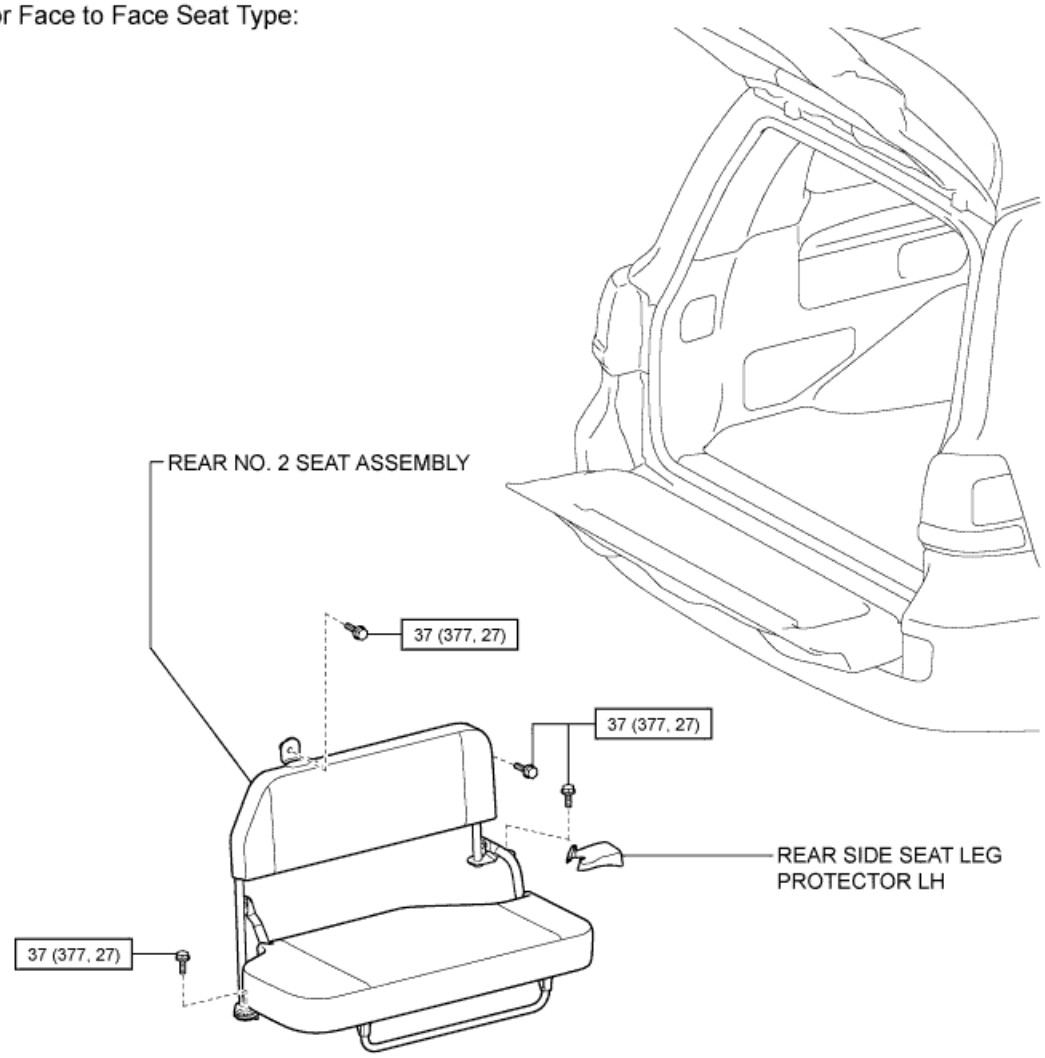
for 60/40 Split Seat Type 60 Side:



N*m (kgf*cm, ft.*lbf) : Specified torque

T

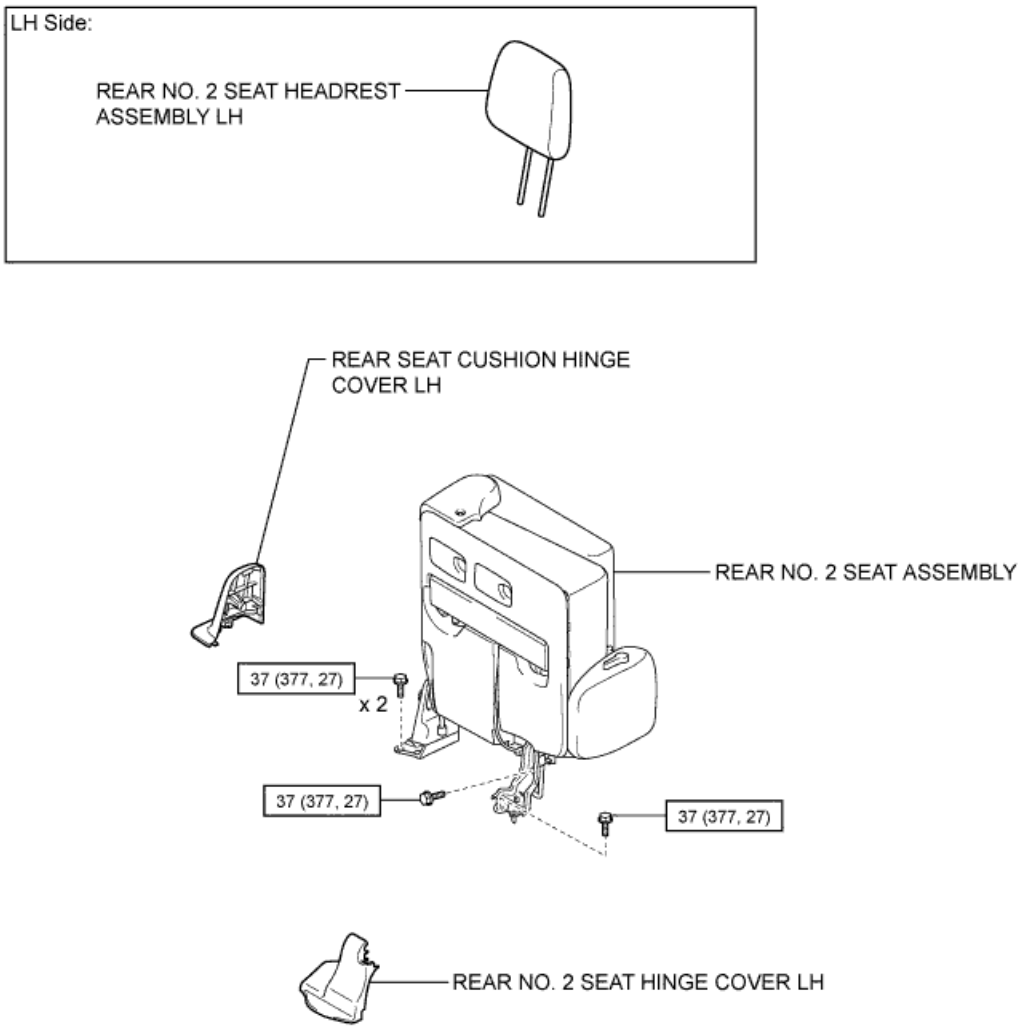
for Face to Face Seat Type:



N*m (kgf*cm, ft.*lbf) : Specified torque

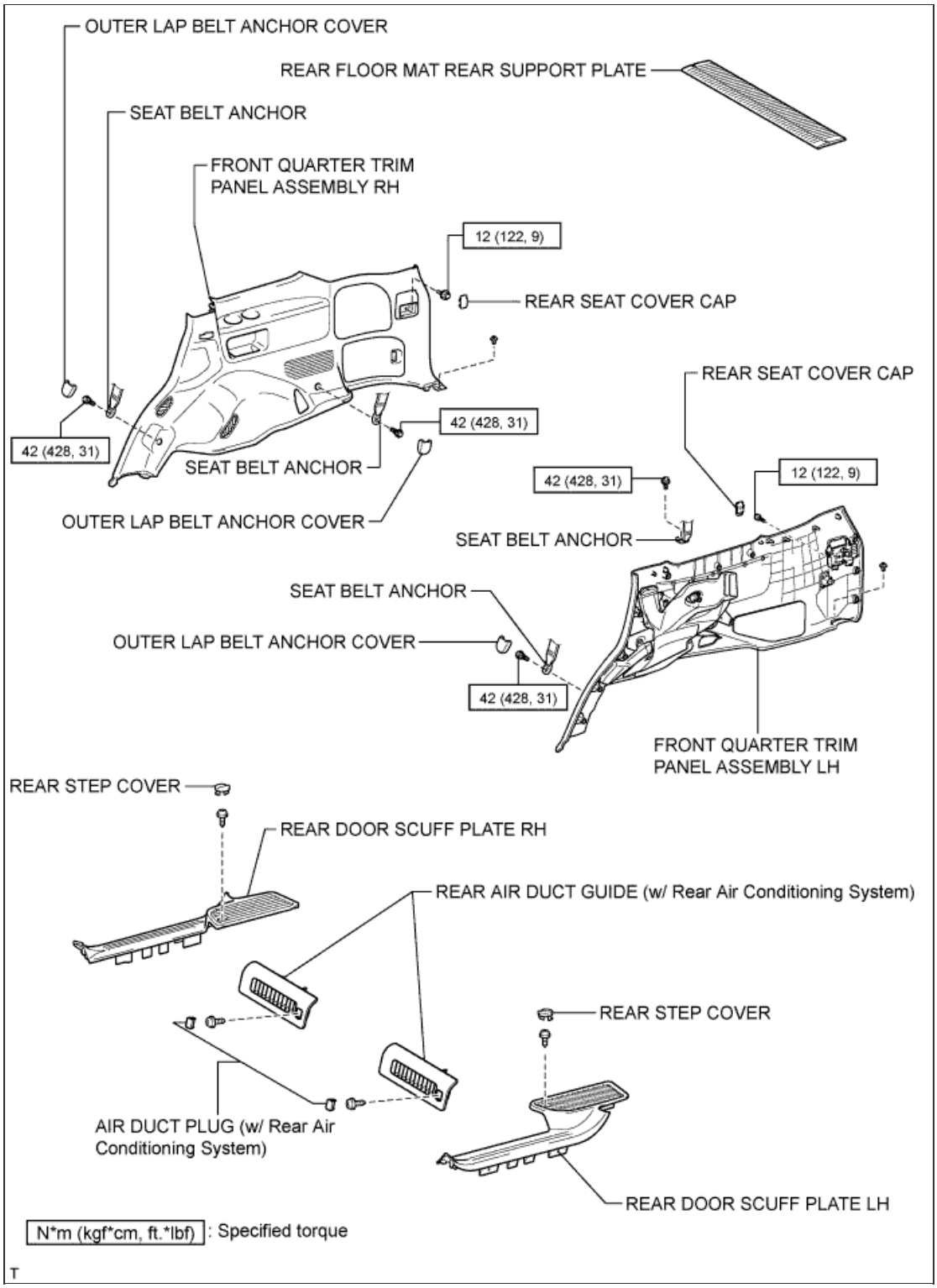
P

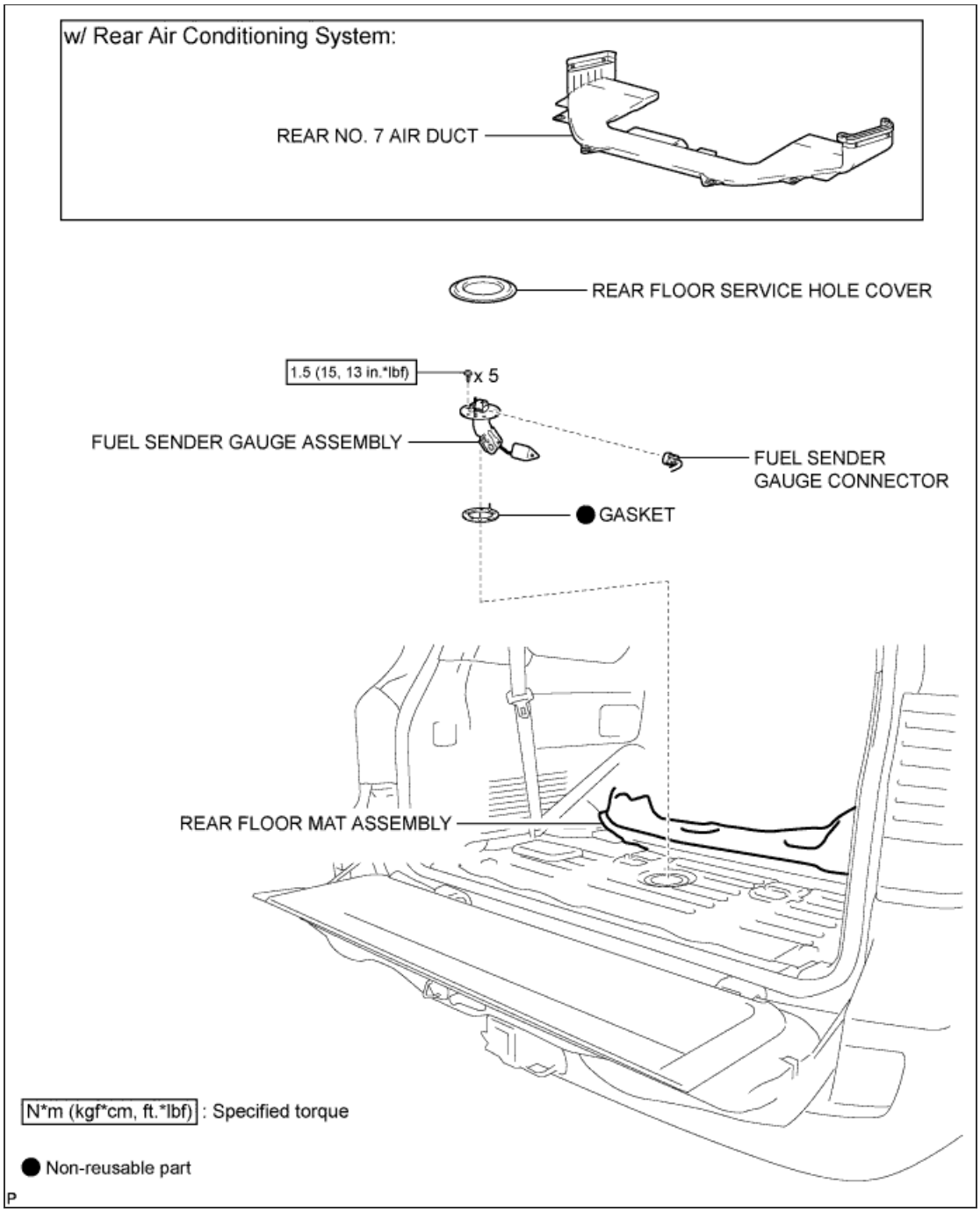
except Face to Face Seat Type:



N*m (kgf*cm, ft.*lbf) : Specified torque

P


OUTER LAP BELT ANCHOR COVER
REAR FLOOR MAT REAR SUPPORT PLATE
SEAT BELT ANCHOR
FRONT QUARTER TRIM PANEL ASSEMBLY RH
12 (122, 9)
REAR SEAT COVER CAP
42 (428, 31)
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
REAR SEAT COVER CAP
42 (428, 31)
12 (122, 9)
SEAT BELT ANCHOR
SEAT BELT ANCHOR
OUTER LAP BELT ANCHOR COVER
42 (428, 31)
FRONT QUARTER TRIM PANEL ASSEMBLY LH
REAR STEP COVER
REAR DOOR SCUFF PLATE RH
REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)
REAR STEP COVER
AIR DUCT PLUG (w/ Rear Air Conditioning System)
REAR DOOR SCUFF PLATE LH
N*m (kgf*cm, ft.*lbf) : Specified torque
T


w/ Rear Air Conditioning System:
REAR NO. 7 AIR DUCT
REAR FLOOR SERVICE HOLE COVER
1.5 (15, 13 in.*lbf)
x 5
FUEL SENDER GAUGE ASSEMBLY
FUEL SENDER GAUGE CONNECTOR
● GASKET
REAR FLOOR MAT ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
P

FUEL SENDER GAUGE ASSEMBLY (for Fuel Sub Tank) > REMOVAL

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Disconnect the cables from the negative (-) main battery and sub-battery terminals.

2. REMOVE REAR NO. 1 SEAT ASSEMBLY RH (for 60/40 Split Seat Type 40 Side)

a. Remove the rear No. 1 seat assembly RH (Click here).

3. REMOVE REAR NO. 1 SEAT ASSEMBLY LH (for 60/40 Split Seat Type 60 Side)

a. Remove the rear No. 1 seat assembly LH (Click here).

4. REMOVE REAR NO. 2 SEAT ASSEMBLY

a. for Face to Face Seat Type:
Remove the rear No. 2 seat assembly (Click here).

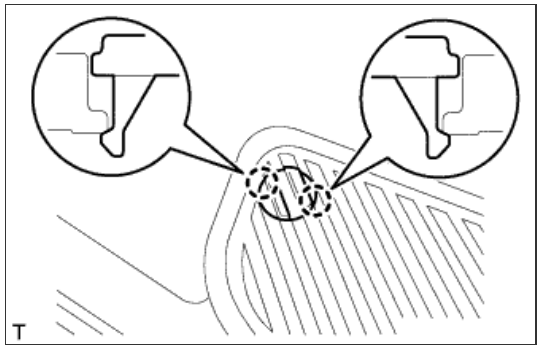
b. except Face to Face Seat Type:
Remove the rear No. 2 seat assembly (Click here).

5. REMOVE REAR STEP COVER

HINT:

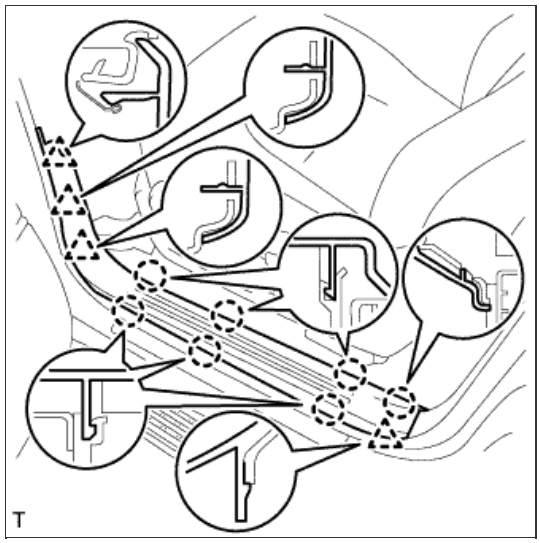
Use the same procedure to remove the step cover on the other side.

a. Detach the 2 claws and remove the step cover.



6. REMOVE REAR DOOR SCUFF PLATE LH

a. Detach the 7 claws and 4 clips, and remove the scuff plate.



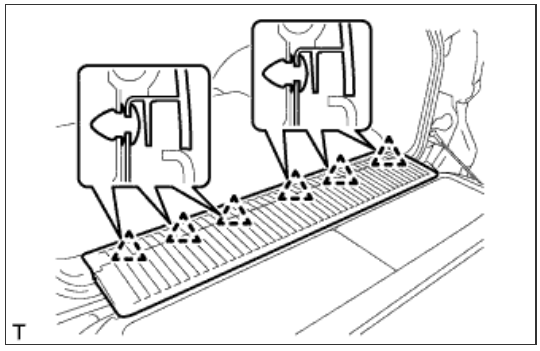
7. REMOVE REAR DOOR SCUFF PLATE RH

HINT:

Use the same procedures described for the LH side.

8. REMOVE REAR FLOOR MAT REAR SUPPORT PLATE

a. Detach the 6 clips and remove the support plate.



9. REMOVE REAR SEAT COVER CAP (w/ Rear No. 2 Seat, except Face to Face Seat Type)

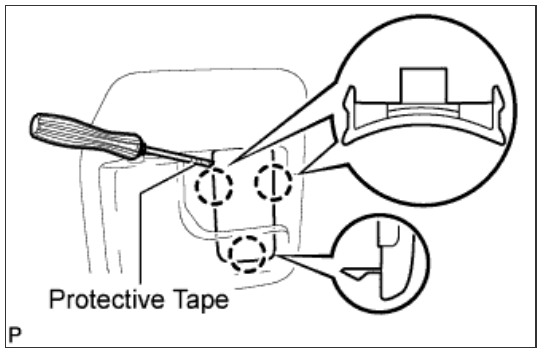
HINT:

Use the same procedure to remove the rear seat cover cap on the other side.

a. Using a screwdriver, detach the 3 claws and remove the rear seat cover cap.

HINT:

Tape the screwdriver tip before use.



10. REMOVE FRONT QUARTER TRIM PANEL ASSEMBLY LH

a. w/ Sliding Roof:
Remove the front quarter trim panel assembly LH (Click here).

b. w/o Sliding Roof:
Remove the front quarter trim panel assembly LH (Click here).

11. REMOVE FRONT QUARTER TRIM PANEL ASSEMBLY RH

a. w/ Sliding Roof:
Remove the front quarter trim panel assembly RH (Click here).

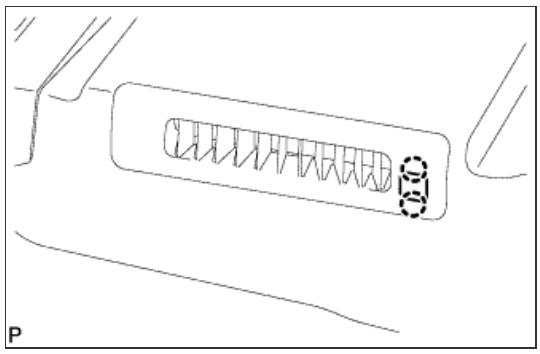
b. w/o Sliding Roof:
Remove the front quarter trim panel assembly RH (Click here).

12. REMOVE AIR DUCT PLUG (w/ Rear Air Conditioning System)

a. Detach the 2 claws and remove the plug.

HINT:

Use the same procedures for both sides.



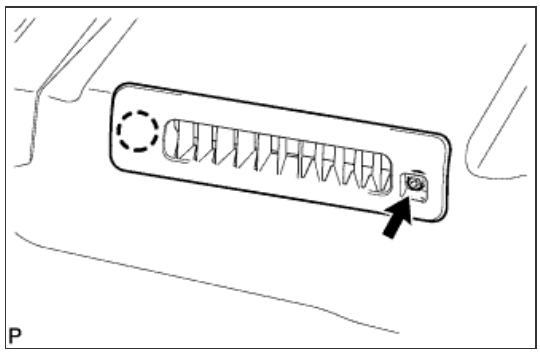
13. REMOVE REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)

a. Remove the screw.

b. Detach the claw and remove the guide.

HINT:

Use the same procedures for both sides.



14. SEPARATE REAR FLOOR MAT ASSEMBLY

a. w/ Rear Air Conditioning System:
Detach the 5 clips and fold back the floor mat toward the front of the vehicle.

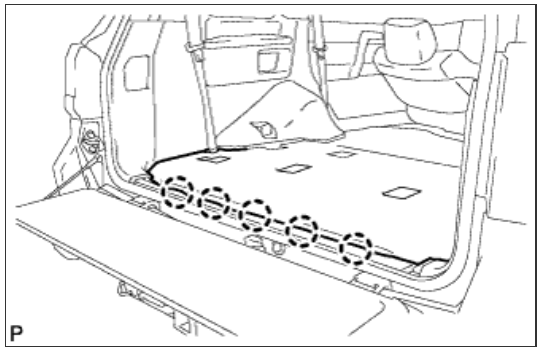
HINT:

Fold back the floor mat so that the rear No. 7 air duct can be removed.

b. w/o Rear Air Conditioning System:
Detach the 5 clips and fold back the floor mat toward the front of the vehicle.

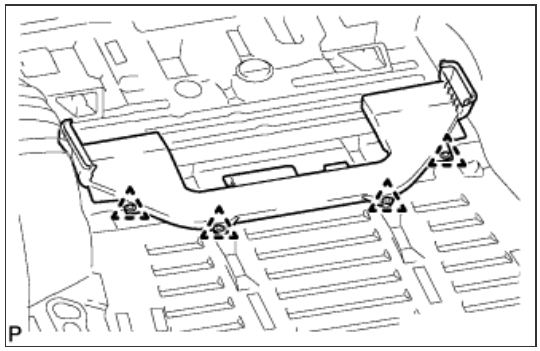
HINT:

Fold back the floor mat so that the service hole cover can be removed.

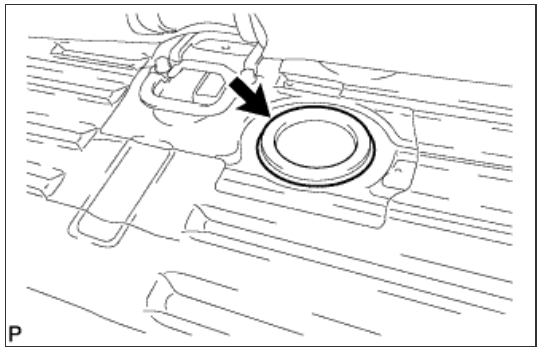


15. REMOVE REAR NO. 7 AIR DUCT (w/ Rear Air Conditioning System)

a. Detach the 4 clips and remove the air duct.



16. REMOVE REAR FLOOR SERVICE HOLE COVER



17. REMOVE FUEL SENDER GAUGE ASSEMBLY

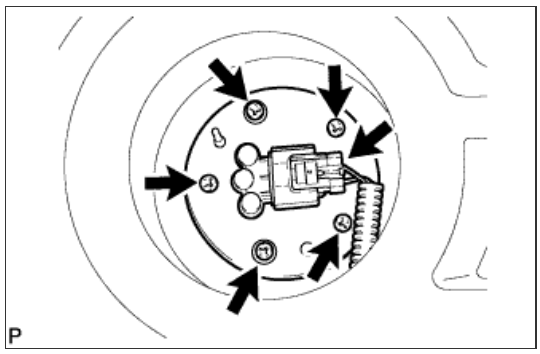
a. Disconnect the sender gauge connector.

b. Remove the 5 screws and sender gauge.

NOTICE:

Be careful not to bend the arm of the fuel sender gauge.

c. Remove the gasket from the sender gauge.



for Preparation Click here

1. INSPECT FUEL SENDER GAUGE ASSEMBLY

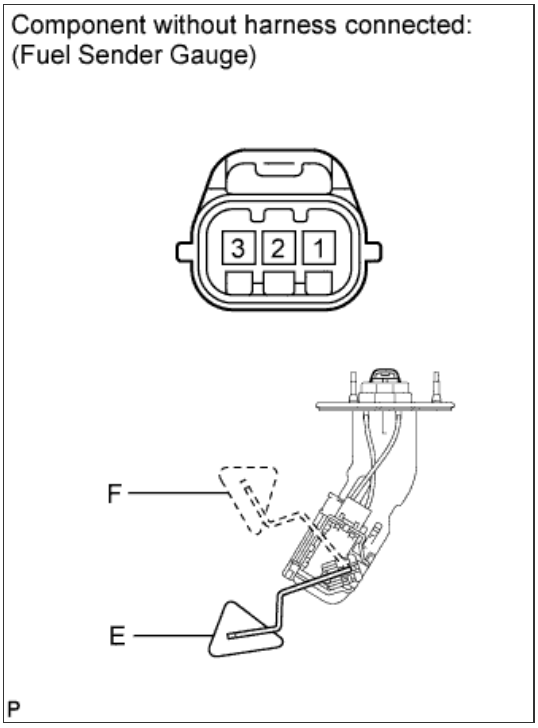
a. Check that the float moves smoothly between F and E.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
2 - 3	Float level is F (upper)	12 to 18 Ω
	Float level is E (lower)	405 to 415 Ω

If the result is not as specified, replace the fuel sender gauge assembly.



for Preparation Click here

1. INSTALL FUEL SENDER GAUGE ASSEMBLY

a. Install a new gasket to the sender gauge.

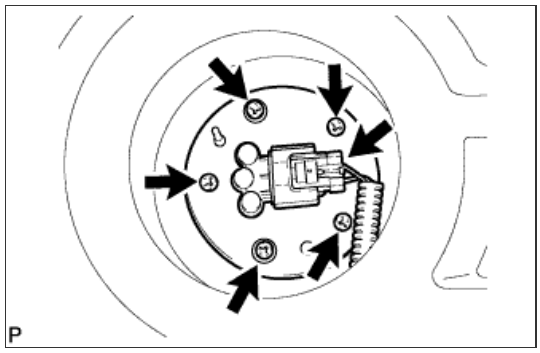
b. Install the sender gauge with the 5 screws.

Torque:
1.5 N*m{ 15 kgf*cm , 13 in.*lbf }

NOTICE:

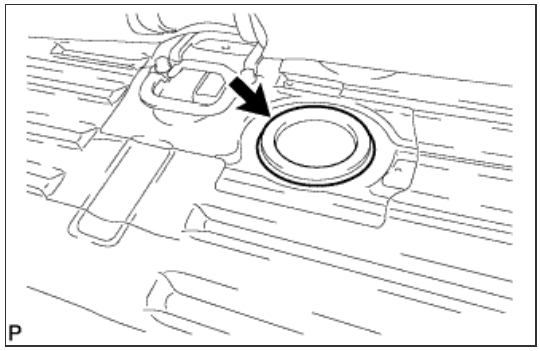
Be careful not to bend the arm of the fuel sender gauge.

c. Connect the sender gauge connector.



2. INSTALL REAR FLOOR SERVICE HOLE COVER

a. Install the service hole cover with new butyl tape.

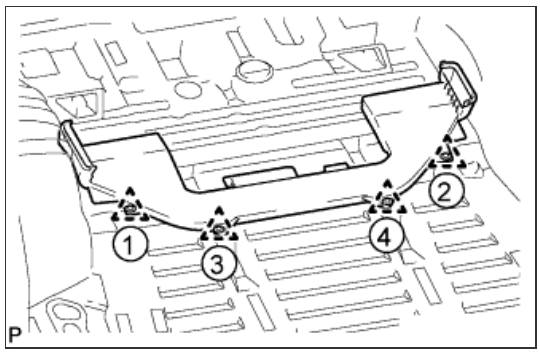


3. INSTALL REAR NO. 7 AIR DUCT (w/ Rear Air Conditioning System)

a. Attach the 4 clips to install the air duct.

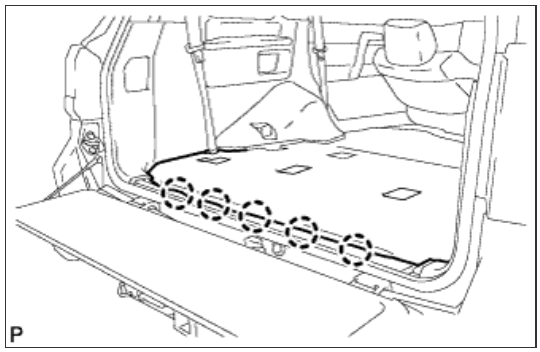
HINT:

Attach the clips in the order shown in the illustration.



4. INSTALL REAR FLOOR MAT ASSEMBLY

a. Attach the 5 clips to install the floor mat.



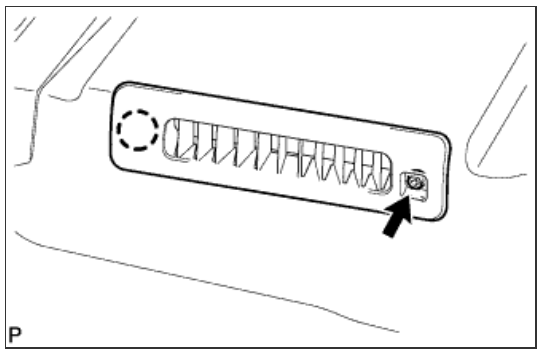
5. INSTALL REAR AIR DUCT GUIDE (w/ Rear Air Conditioning System)

a. Attach the claw to install the guide.

b. Install the screw.

HINT:

Use the same procedures for both sides.

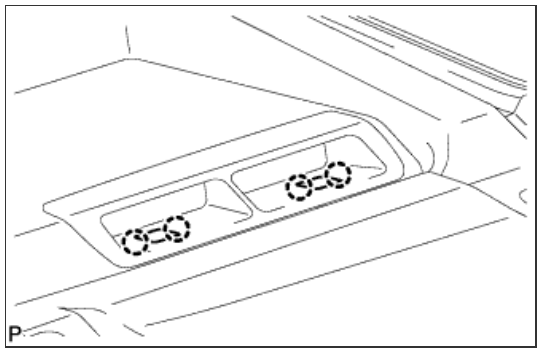


6. INSTALL AIR DUCT PLUG (w/ Rear Air Conditioning System)

a. Attach the 4 claws to install the 2 plugs.

HINT:

Use the same procedures for both sides.



7. INSTALL FRONT QUARTER TRIM PANEL ASSEMBLY LH

a. w/ Sliding Roof:
Install the front quarter trim panel assembly LH (Click here).

b. w/o Sliding Roof:
Install the front quarter trim panel assembly LH (Click here).

8. INSTALL FRONT QUARTER TRIM PANEL ASSEMBLY RH

a. w/ Sliding Roof:
Install the front quarter trim panel assembly RH (Click here).

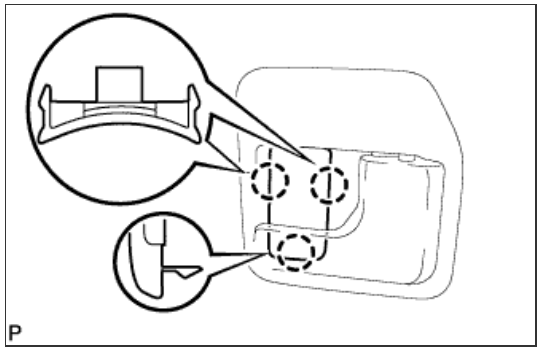
b. w/o Sliding Roof:
Install the front quarter trim panel assembly RH (Click here).

9. INSTALL REAR SEAT COVER CAP (w/ Rear No. 2 Seat, except Face to Face Seat Type)

HINT:

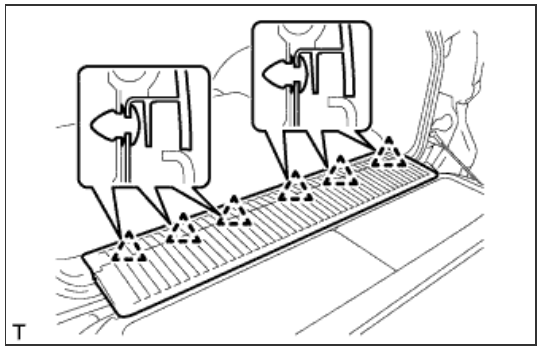
Use the same procedure to install the rear seat cover cap on the other side.

a. Attach the 3 claws to install the rear seat cover cap.



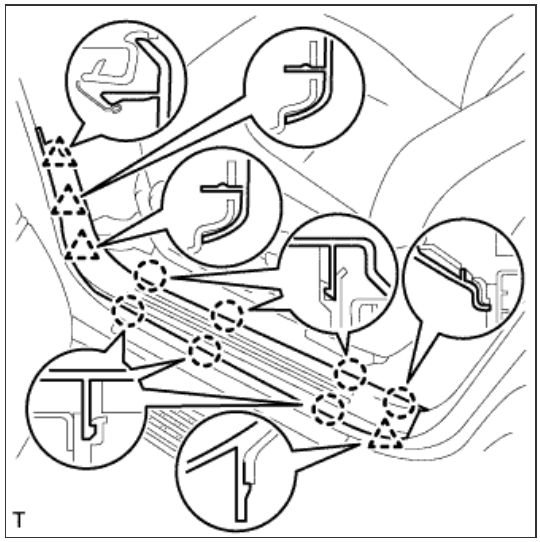
10. INSTALL REAR FLOOR MAT REAR SUPPORT PLATE

a. Attach the 6 clips to install the support plate.



11. INSTALL REAR DOOR SCUFF PLATE LH

a. Attach the 7 claws and 4 clips to install the scuff plate.



12. INSTALL REAR DOOR SCUFF PLATE RH

HINT:

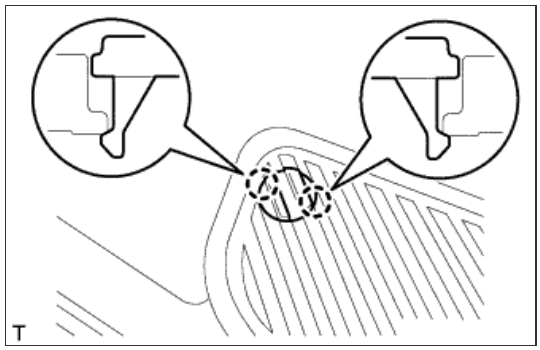
Use the same procedures described for the LH side.

13. INSTALL REAR STEP COVER

HINT:

Use the same procedure to install the step cover on the other side.

a. Attach the 2 claws to install the step cover.



14. INSTALL REAR NO. 2 SEAT ASSEMBLY

a. for Face to Face Seat Type:
Install the rear No. 2 seat assembly (Click here).

b. except Face to Face Seat Type:
Install the rear No. 2 seat assembly (Click here).

15. INSTALL REAR NO. 1 SEAT ASSEMBLY RH (for 60/40 Split Seat Type 40 Side)

a. Install the rear No. 1 seat assembly RH (Click here).

16. INSTALL REAR NO. 1 SEAT ASSEMBLY LH (for 60/40 Split Seat Type 60 Side)

a. Install the rear No. 1 seat assembly LH (Click here).

17. INSTALL CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Connect the cables to the negative (-) main battery and sub-battery terminals.

18. CHECK SRS WARNING LIGHT

a. Check the SRS warning light (Click here).

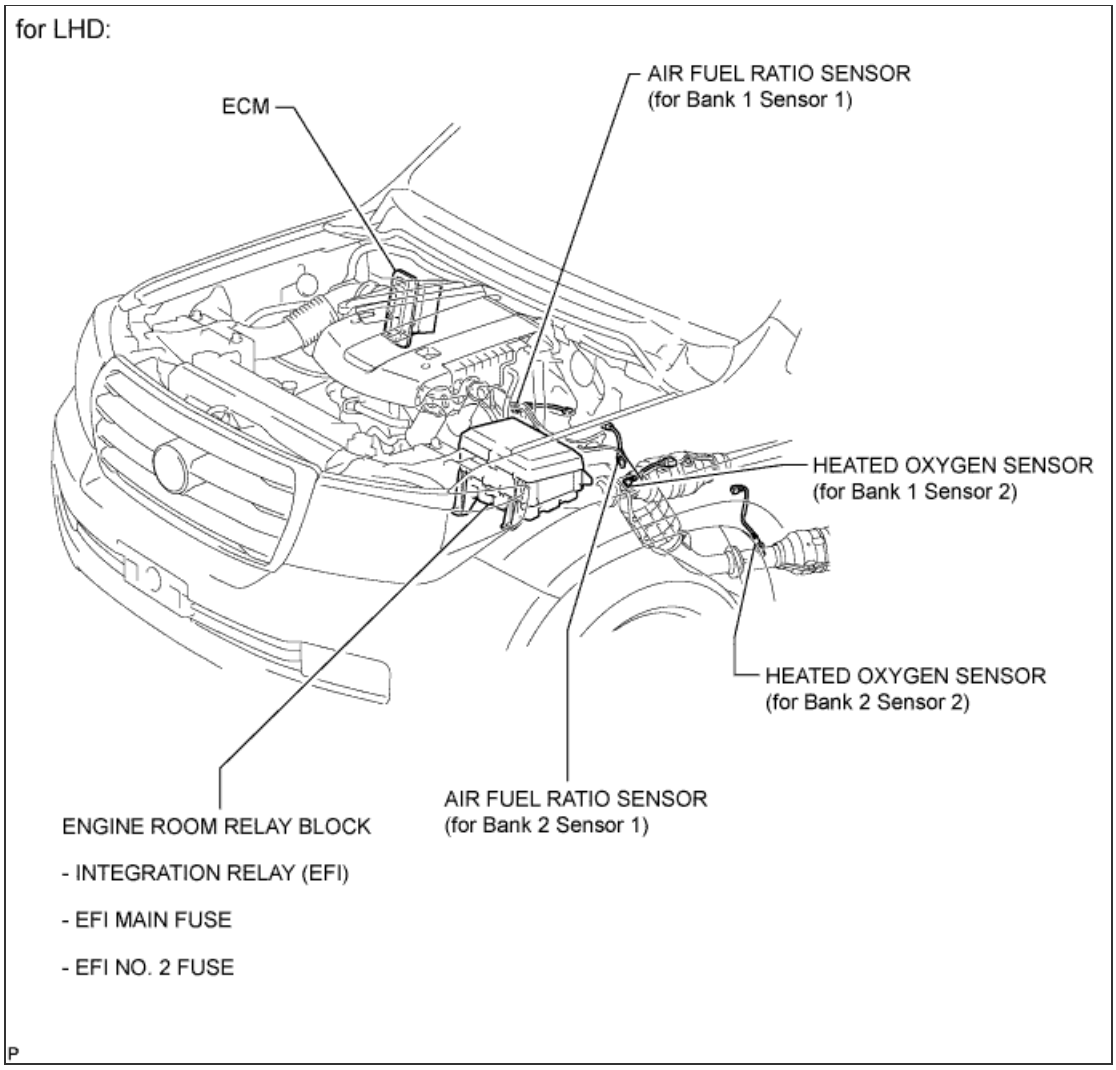
for Preparation Click here

1.AIR INDUCTION SYSTEM

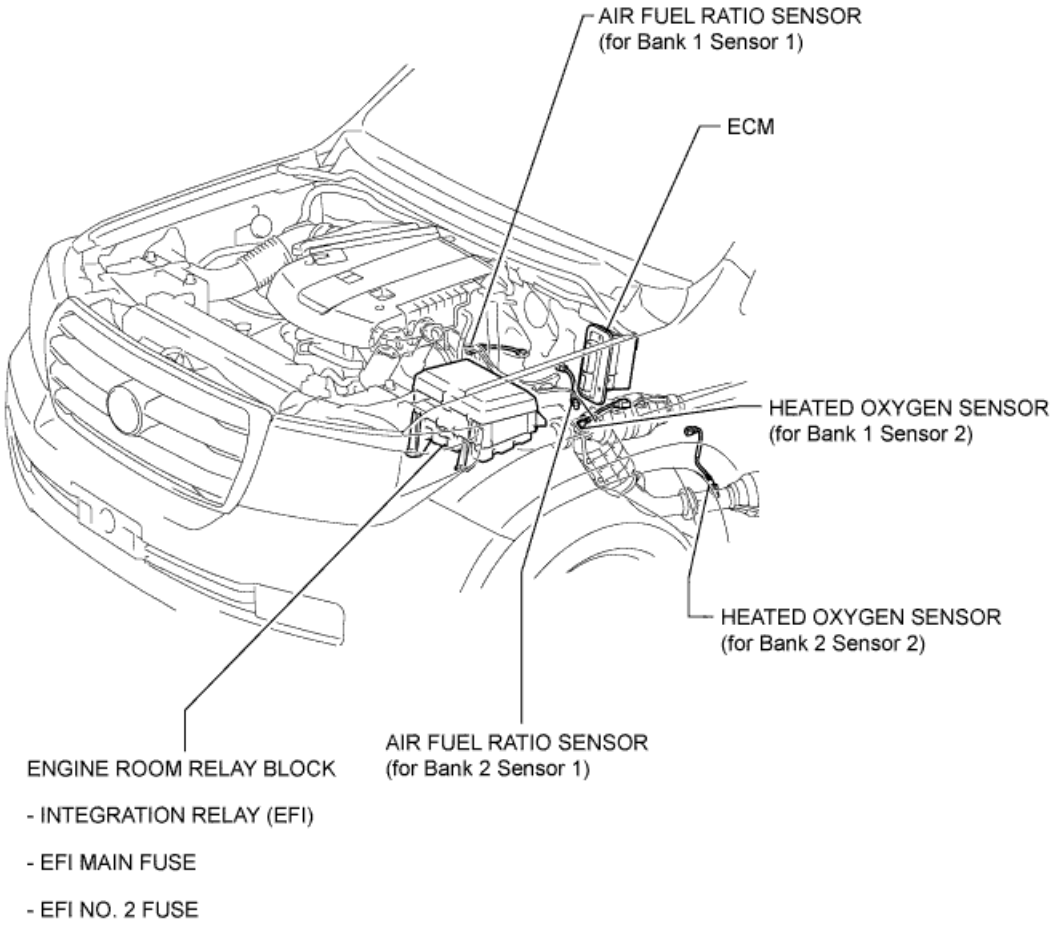
a. Separation of the engine oil dipstick, oil filler cap, PCV hose, etc. may cause the engine to be out of tune.

b. Disconnection, looseness or cracks in the parts of the air induction system between the throttle body and cylinder head will result in air suction and cause the engine to be out of tune.

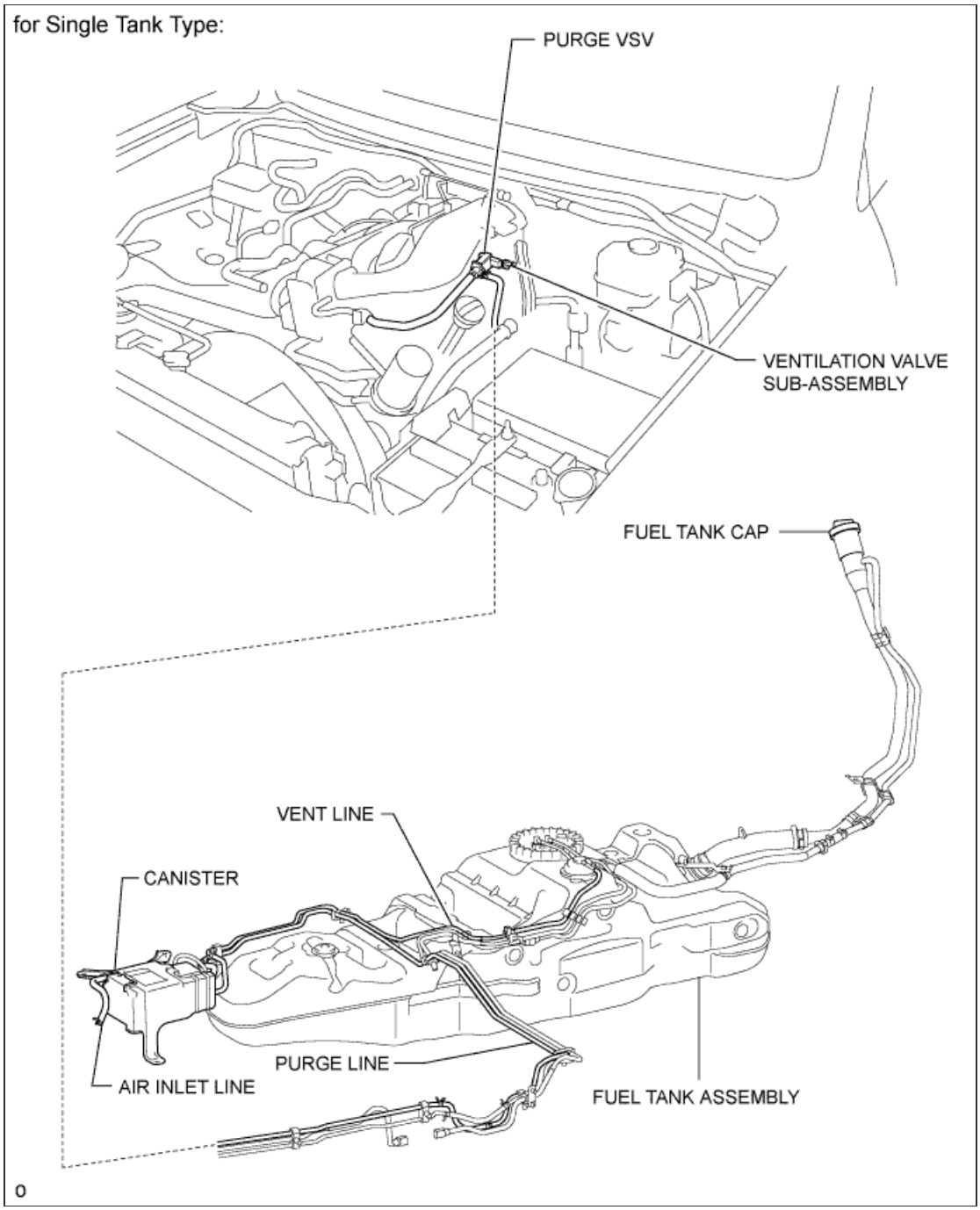
for Preparation Click here



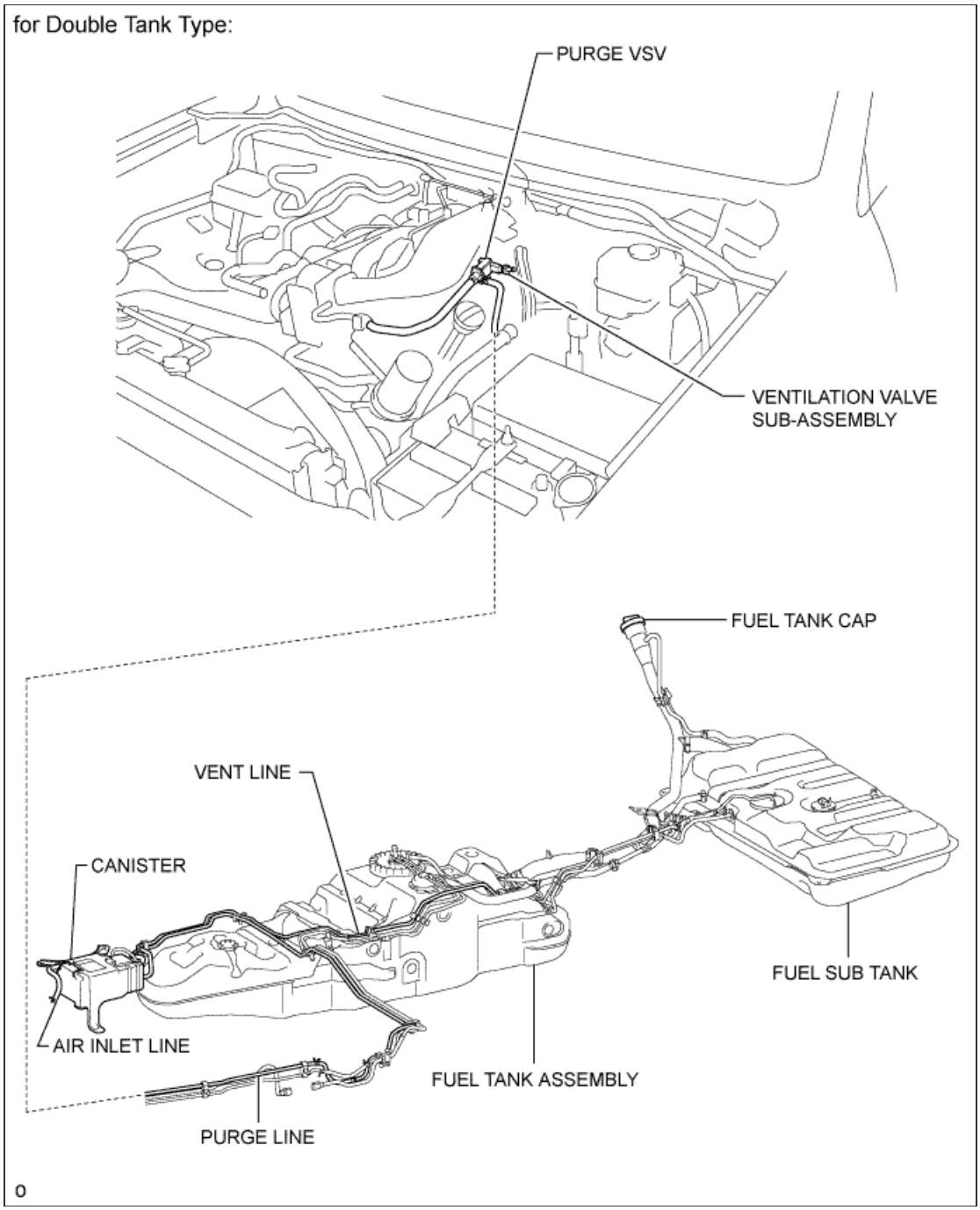
for RHD:


AIR FUEL RATIO SENSOR
(for Bank 1 Sensor 1)
ECM
HEATED OXYGEN SENSOR
(for Bank 1 Sensor 2)
HEATED OXYGEN SENSOR
(for Bank 2 Sensor 2)
AIR FUEL RATIO SENSOR
(for Bank 2 Sensor 1)
ENGINE ROOM RELAY BLOCK
- INTEGRATION RELAY (EFI)
- EFI MAIN FUSE
- EFI NO. 2 FUSE

P


for Single Tank Type:
PURGE VSV
VENTILATION VALVE
SUB-ASSEMBLY
FUEL TANK CAP
VENT LINE
CANISTER
PURGE LINE
AIR INLET LINE
FUEL TANK ASSEMBLY
o

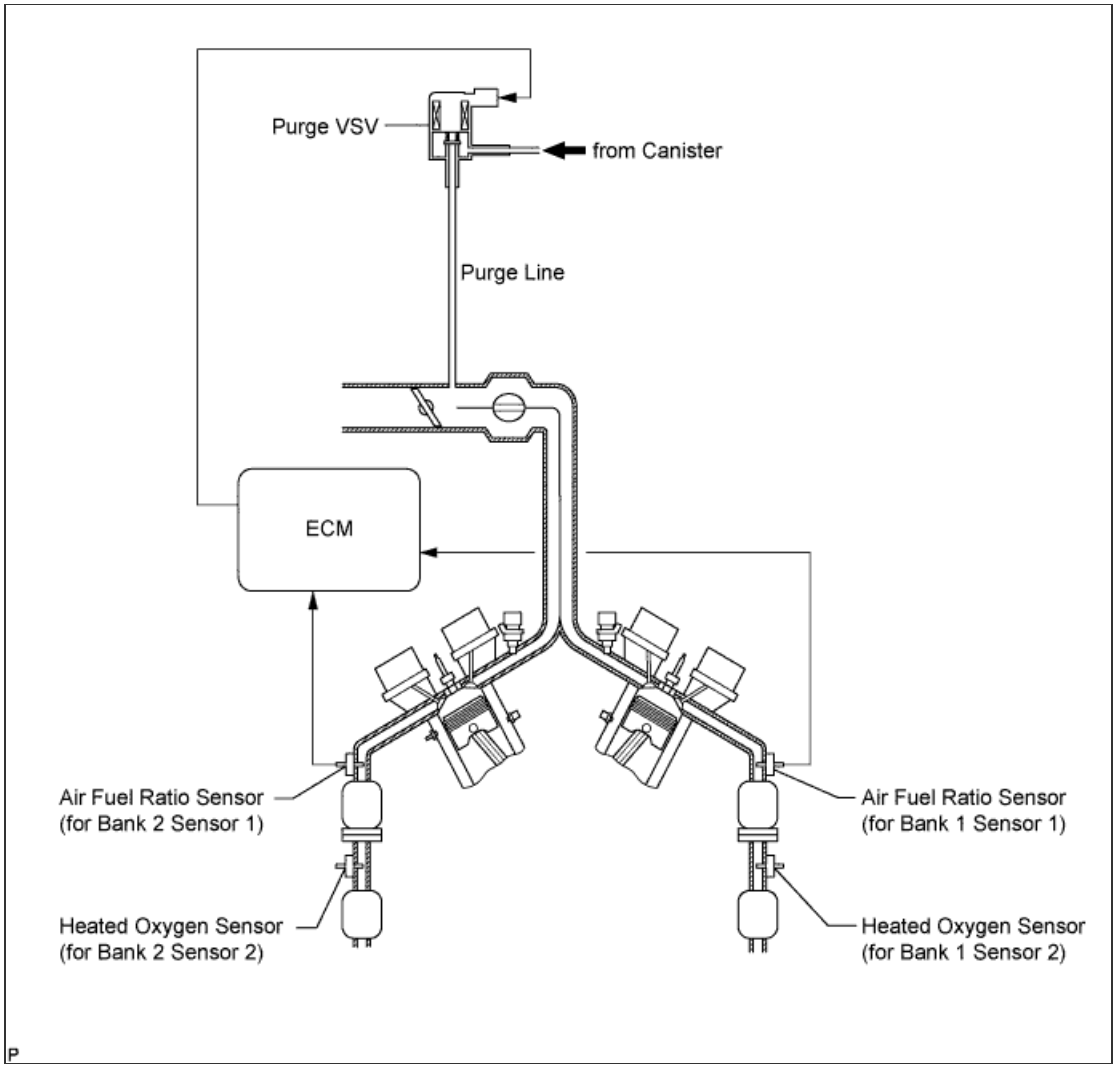
for Double Tank Type:



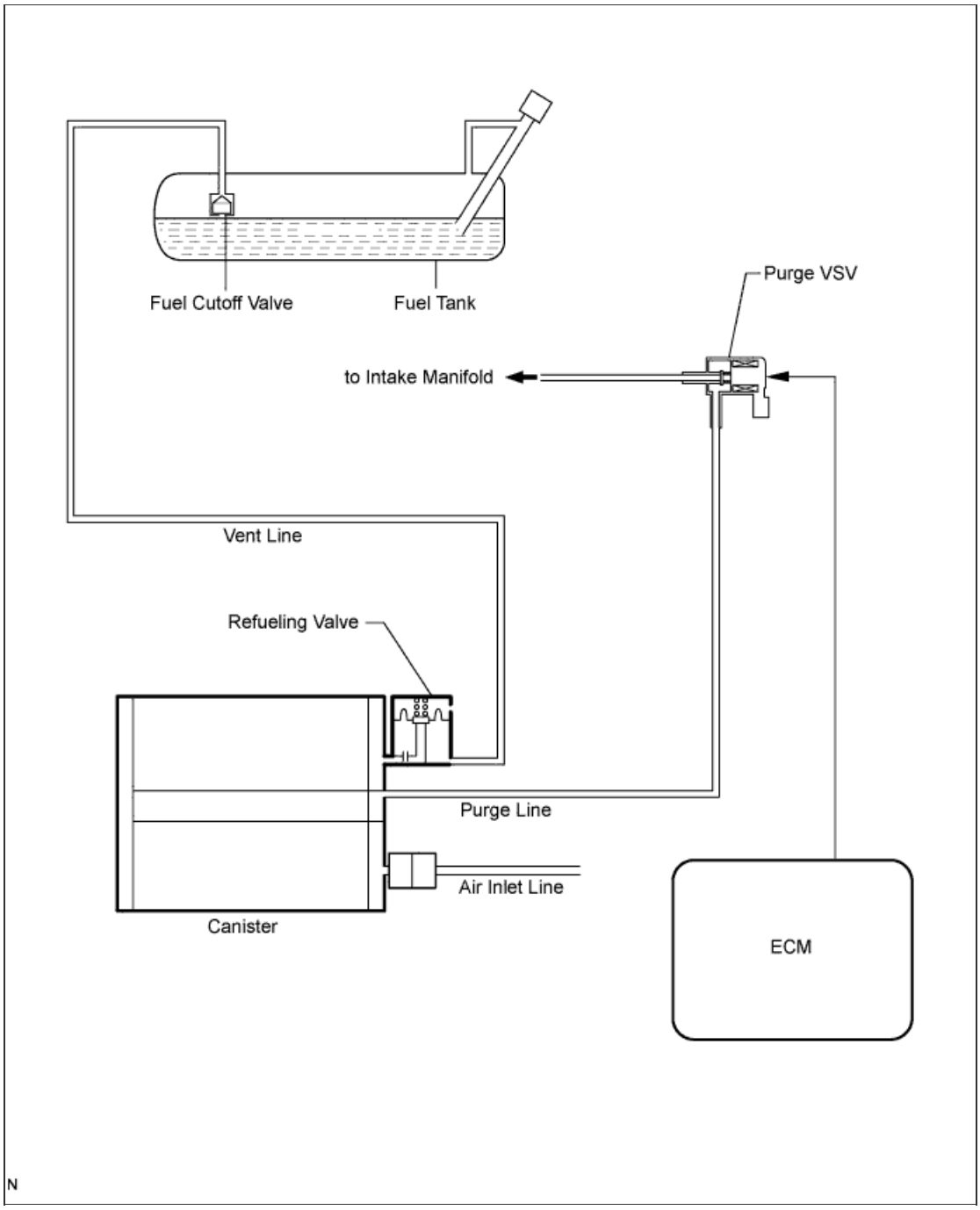
o

for Preparation Click here

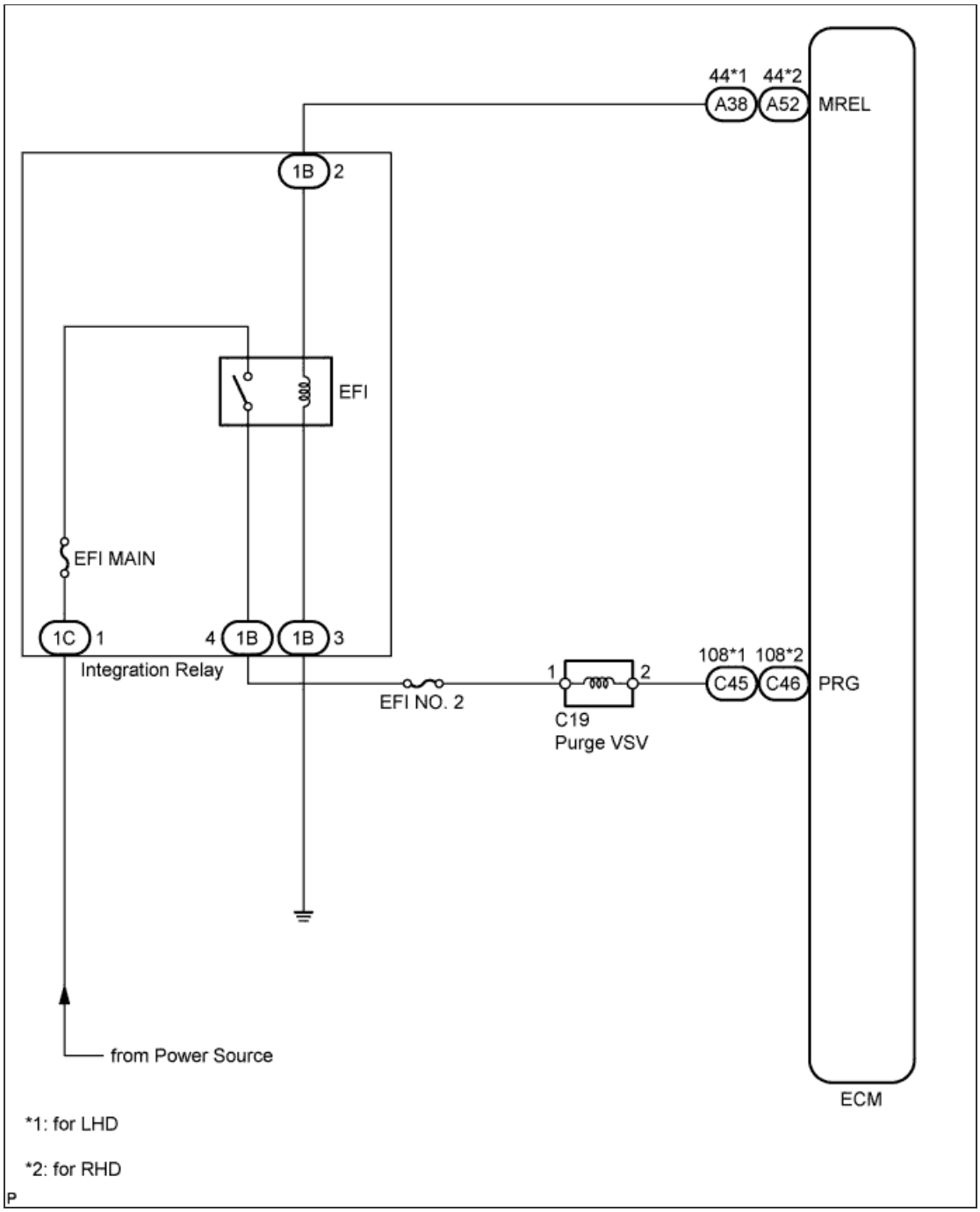
EMISSION CONTROL SYSTEM DIAGRAM



E AP CONTROL SYSTEM DIAGRAM



EVAP SYSTEM WIRING DIAGRAM


44*1
44*2
A38
A52
MREL
1B
2
EFI
EFI MAIN
1C
1
4
1B
1B
3
Integration Relay
EFI NO. 2
1
2
C19
Purge VSV
108*1
108*2
C45
C46
PRG
ECM
from Power Source
*1: for LHD
*2: for RHD
P

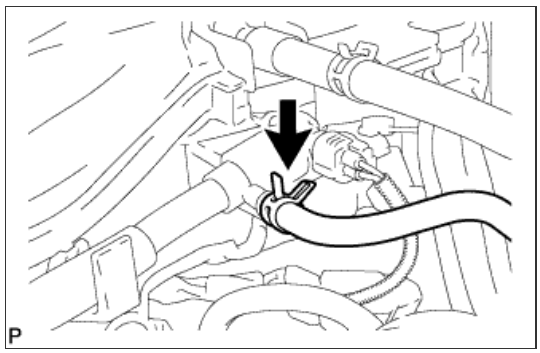
for Preparation Click here

1. CHECK PURGE VSV

a. Connect the intelligent tester to the DLC3.

b. Remove the V-bank cover (Click here).

c. Disconnect the hose (connected to the canister) from the purge VSV.



d. Start the engine and turn the tester main switch on.

e. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the VSV for EVAP Control.

Standard:

Tester Operation	Specified Condition
EVAP VSV: OFF	Purge VSV has no suction
EVAP VSV: O	rge VSV has suction

f. Connect the hose (connected to the canister) to the purge VSV.

g. Install the V-bank cover (Click here).

2. INSPECT FUEL CUT-OFF RPM

a. Start and warm up the engine.

b. Increase the engine speed to at least 3500 rpm.

c. Use a sound scope to check for injector operation noise.

d. Check that when the accelerator pedal is released, injector operation noise stops momentarily and then resumes.
If the result is not as specified, check the injector, wiring and ECM.

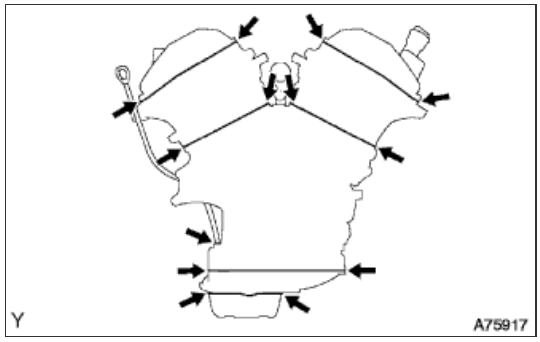
3. VISUALLY INSPECT HOSES, CONNECTIONS AND GASKETS

a. Check that there are no cracks, leaks or damage.

NOTICE:

- **Detachment or other problems with the engine oil dipstick, filler cap, ventilation hose and other components may cause the engine to run improperly.**
- **Air suction caused by disconnections, looseness or cracks in the parts of the air induction system between the throttle body and cylinder head will cause engine failure or engine malfunctions.**

If the result is not as specified, replace parts as necessary.



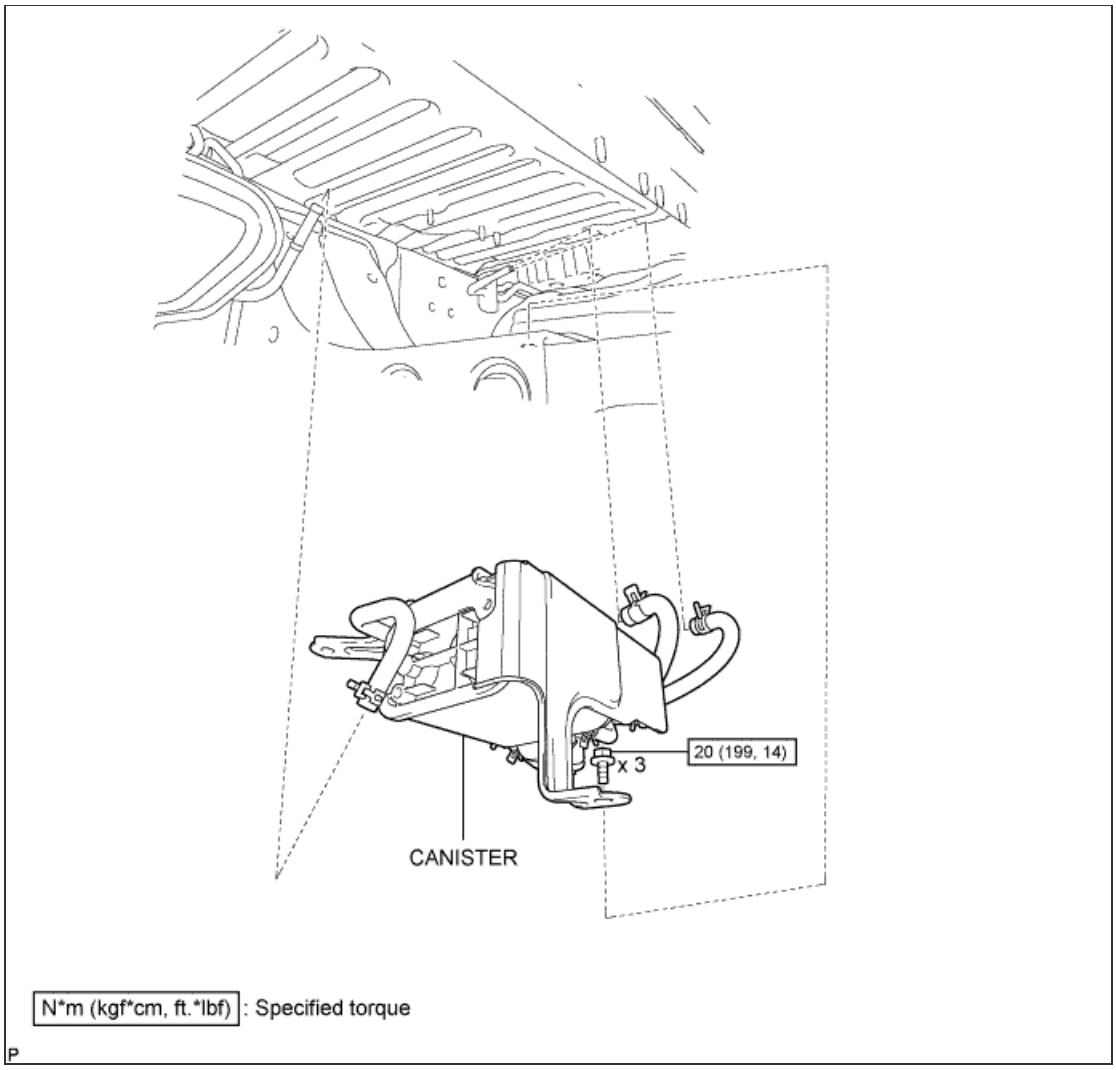
4. CHECK HOSES AND CONNECTORS

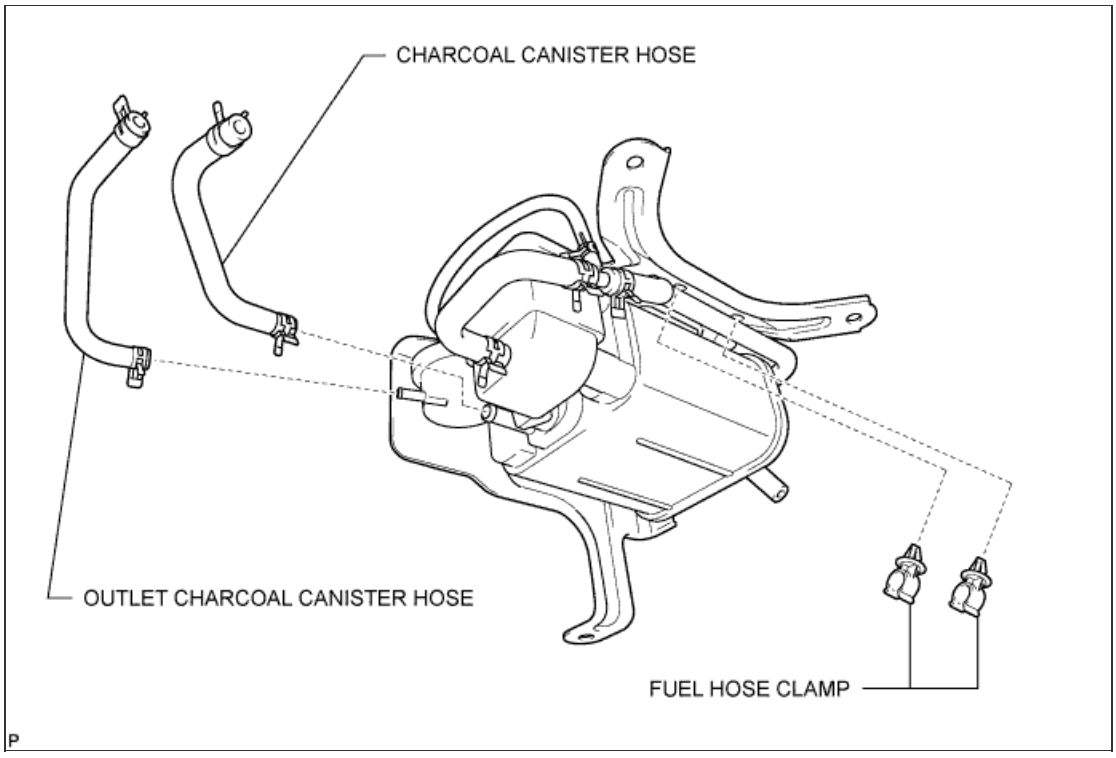
a. Visually check for loose connections, sharp bends or damage.

5. CHECK FUEL TANK ASSEMBLY

a. Visually check for deformation, cracks or fuel leakage.

for Preparation Click here

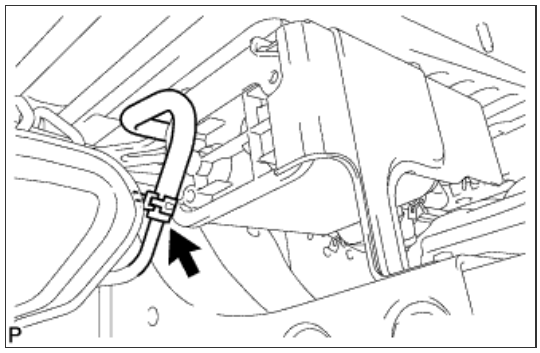



CHARCOAL CANISTER HOSE
OUTLET CHARCOAL CANISTER HOSE
FUEL HOSE CLAMP
P

for Preparation Click here

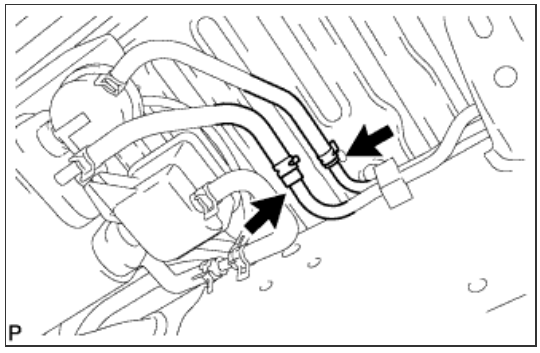
1. REMOVE CANISTER

a. Disconnect the hose.



b. Disconnect the charcoal canister hose.

c. Disconnect the outlet charcoal canister hose.

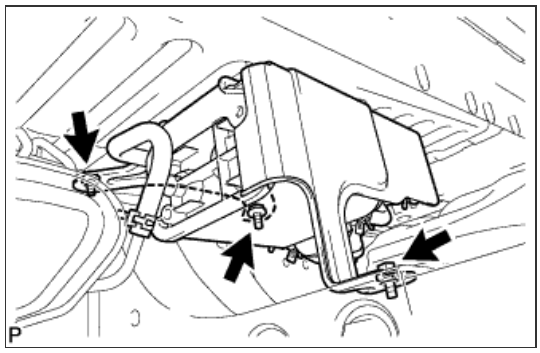


d. Remove the 3 bolts and canister.

e. Remove the 2 fuel hose clamps from the canister.

f. Remove the charcoal canister hose.

. Remove the outlet charcoal canister hose.



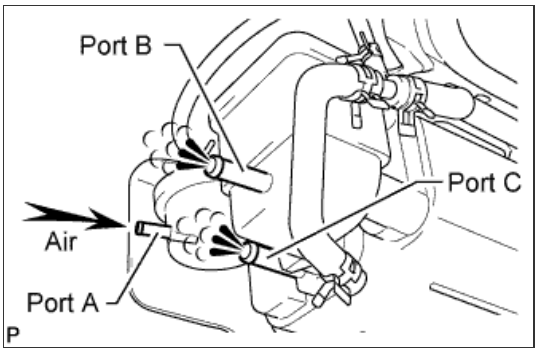
for Preparation Click here

1. INSPECT CHARCOAL CANISTER

a. Visually check the canister for cracks or damage.

Blow compressed air of 4.9 kPa (50 gf/cm ^{2}, 0.71 psi) into port A and check that air flows without resistance from port B and port C.
If the result is not as specified, replace the canister.

c. Apply a vacuum of 1.96 kPa (20 gf/cm^2, 0.28 psi) to port A. Check that the vacuum does not decrease when ports B and C are closed, and check that the vacuum does not decrease when port B is released.
If the result is not as specified, replace the canister.

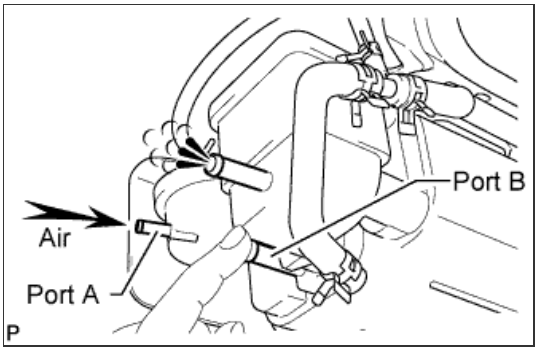


2. CLEAN FILTER IN CANISTER

a. Clean the filter by blowing compressed air of 4.9 kPa (50 gf/cm ^{2}, 0.71 psi) into port A while holding port B closed.

NOTICE:

Do not attempt to wash the canister.



for Preparation Click here

1. INSTALL CANISTER ASSEMBLY

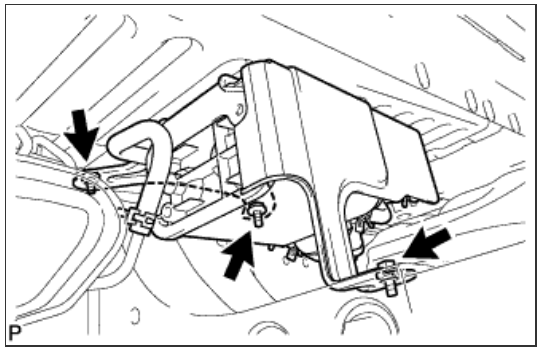
a. Install the outlet charcoal canister hose to the canister.

b. Install the charcoal canister hose to the canister.

c. Install the 2 fuel hose clamps to the canister.

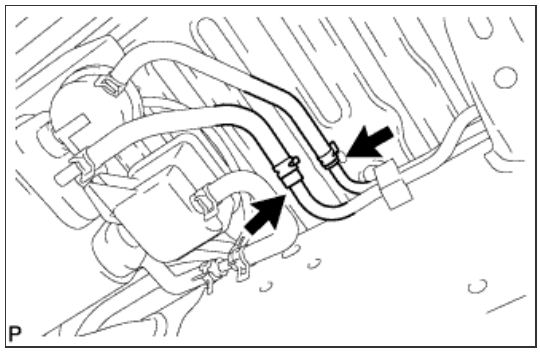
d. Install the canister with the 3 bolts.

Torque:
20 N*m{ 199 kgf*cm , 14 ft.*lbf }

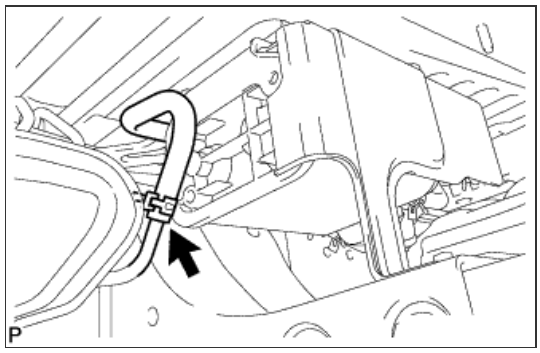


e. Connect the outlet charcoal canister hose.

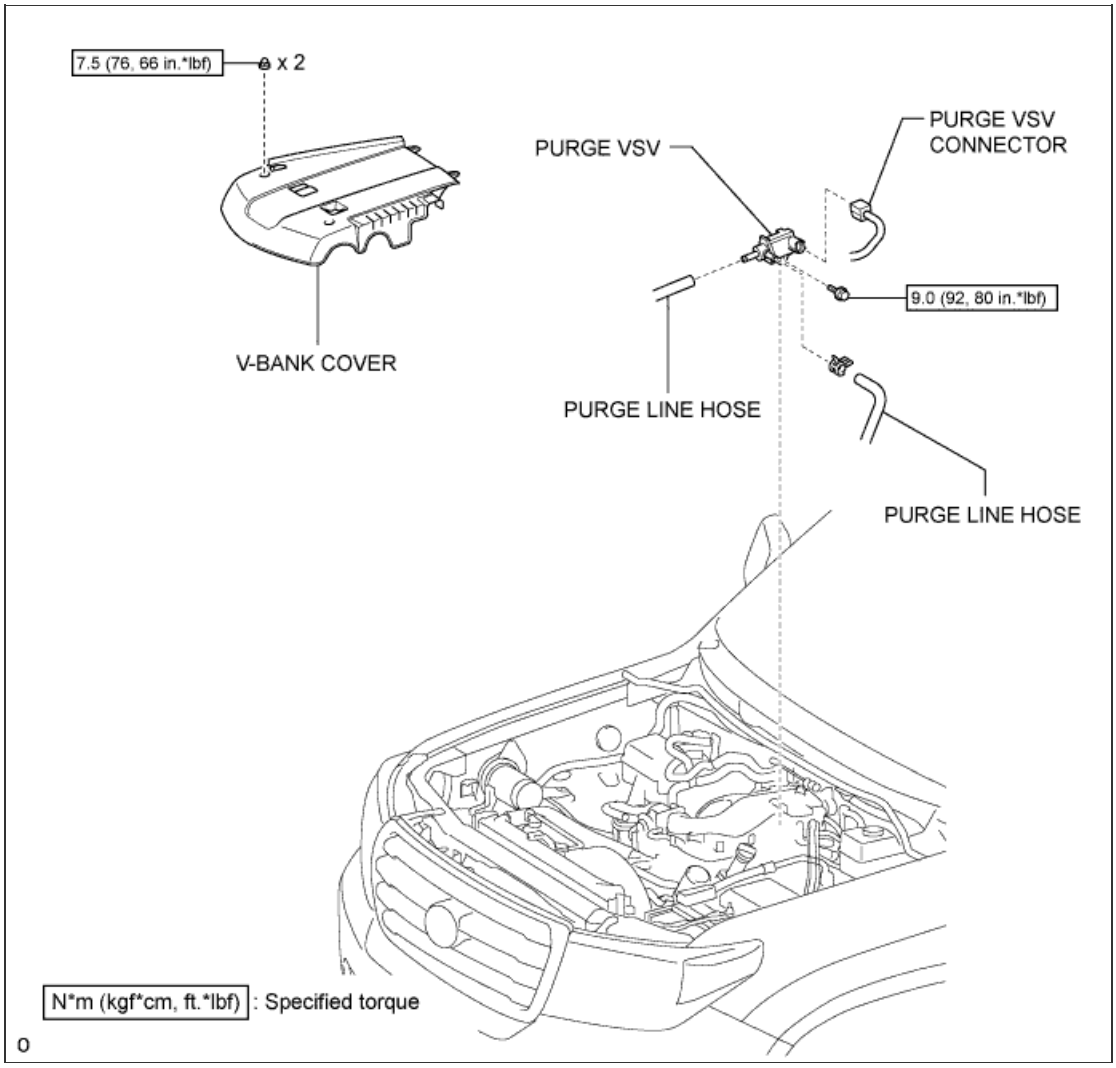
f. Connect the charcoal canister hose.



g. Connect the hose.



for Preparation Click here



PURGE VALVE > REMOVAL

for Preparation Click here

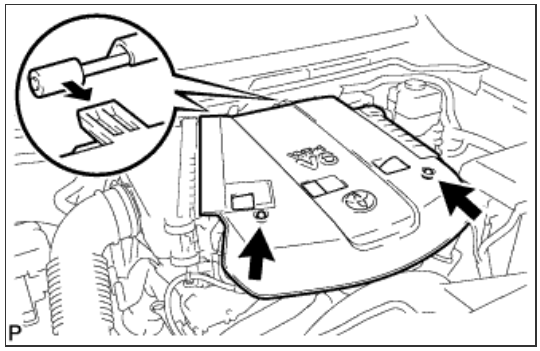
1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

2. REMOVE V-BANK COVER

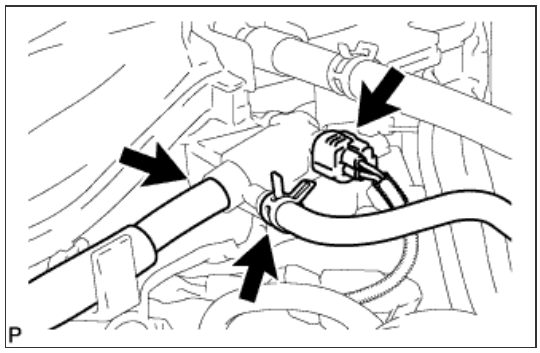
a. Remove the 2 nuts and V-bank cover.



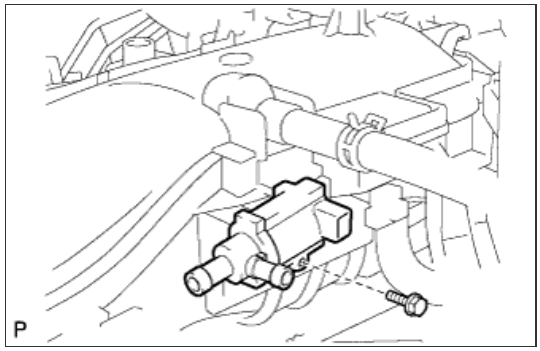
3. REMOVE PURGE VSV

a. Disconnect the purge VSV connector.

b. Disconnect the 2 purge line hoses.



c. Remove the bolt and purge VSV.



for Preparation Click here

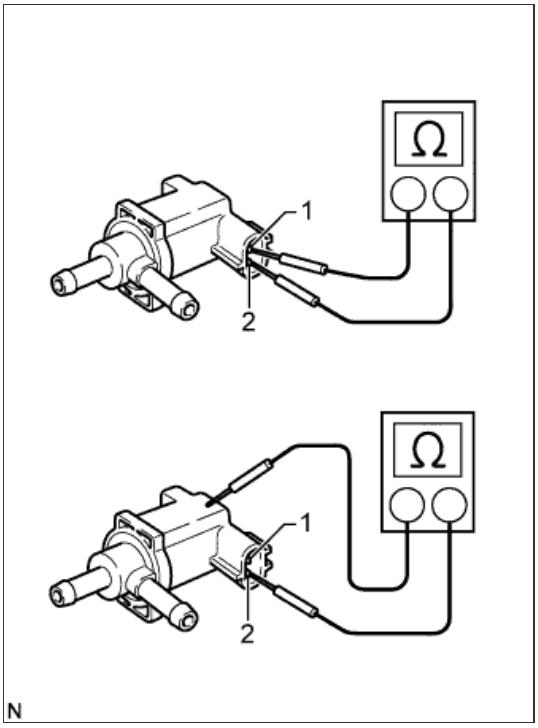
1. INSPECT PURGE VSV

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

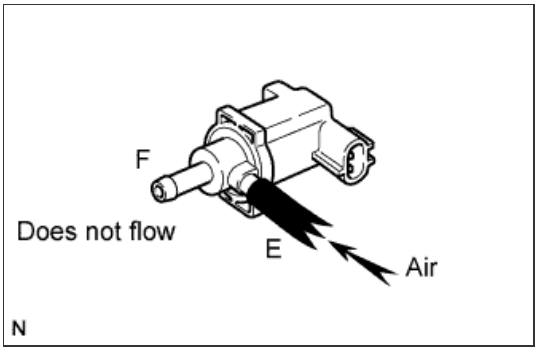
Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	26 to 30 Ω
1 - Body ground	Always	10 MΩ or higher
2 - Body ground		

If the result is not as specified, replace the purge VSV.



b. Check operation of purge VSV.

i. Check that air does not flow from port F when air is applied to port E.

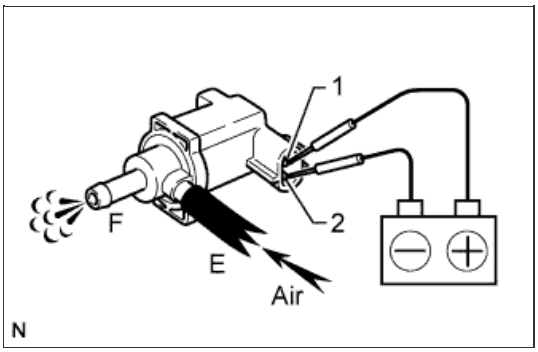


ii. Apply battery voltage to the connector, and check the VSV operation.

O :

Measurement Condition	Specified Condition
Battery positive (+) → Terminal 1 Battery negative (-) → Terminal 2	Air flows from port E to port F

If the result is not as specified, replace the purge VSV.

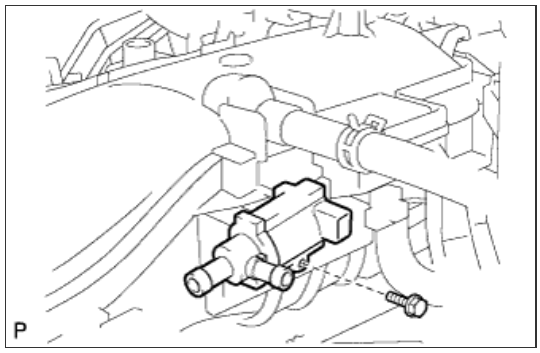


for Preparation Click here

1. INSTALL PURGE VSV

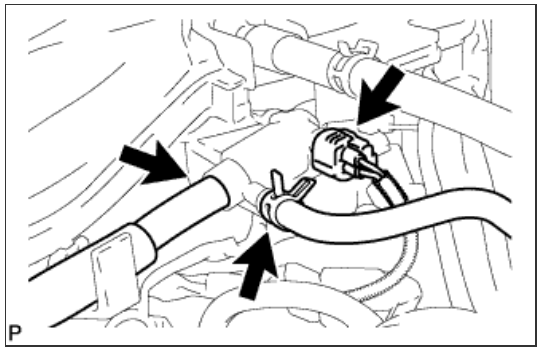
a. Install the purge VSV with the bolt.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



b. Connect the 2 purge line hoses.

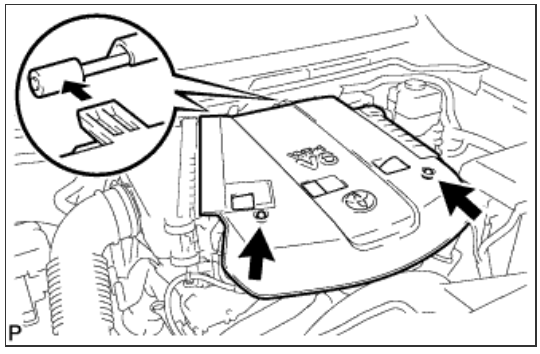
c. Connect the purge VSV connector.



2. INSTALL V-BANK COVER

a. Install the V-bank cover with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



3. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

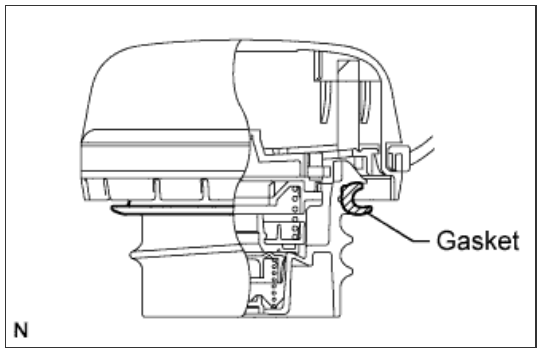
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

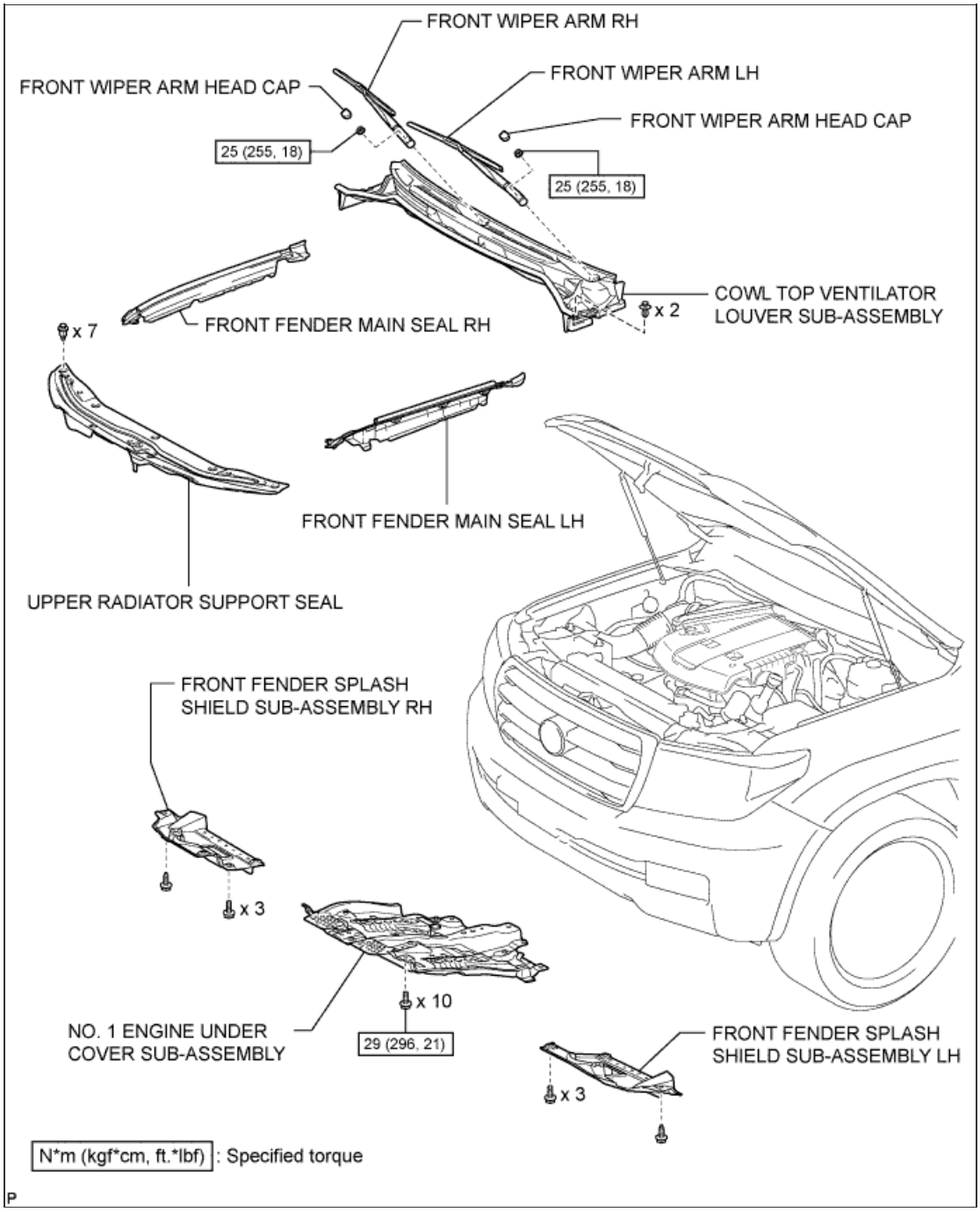
for Preparation Click here

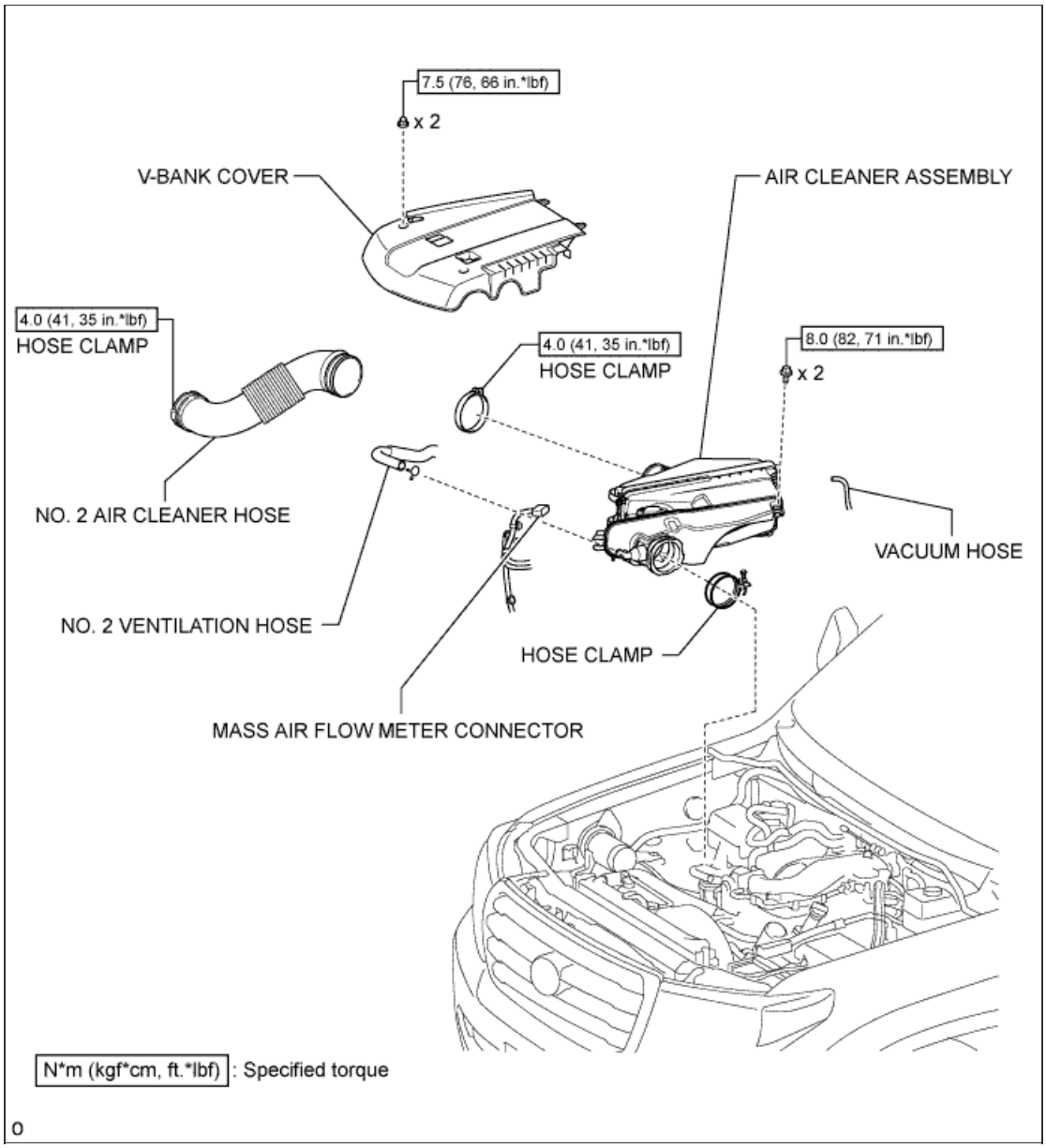
1. INSPECT FUEL TANK CAP ASSEMBLY

a. Visually check if the cap and/or gasket are deformed or damaged.
If necessary, replace the cap assembly or gasket.

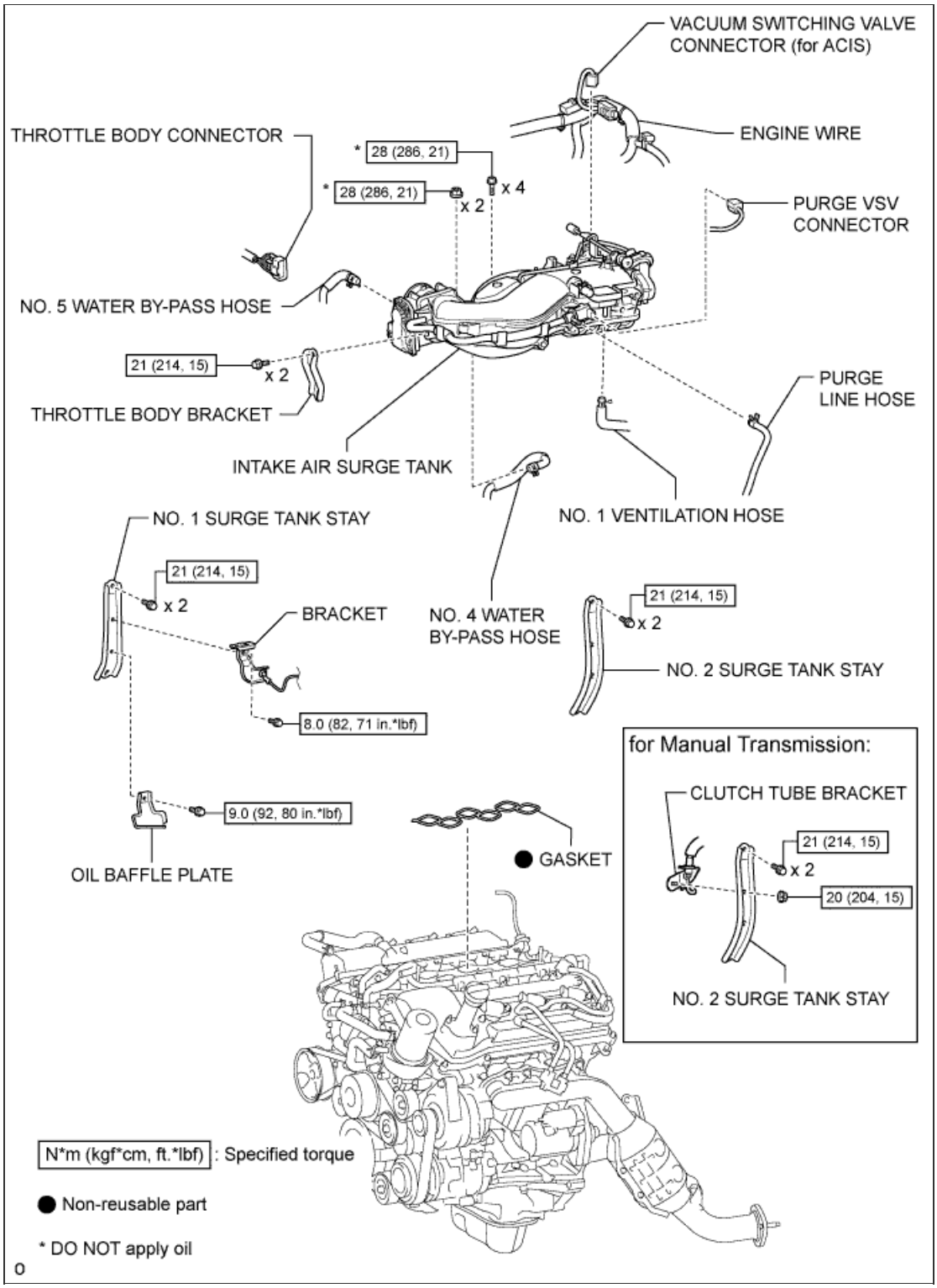


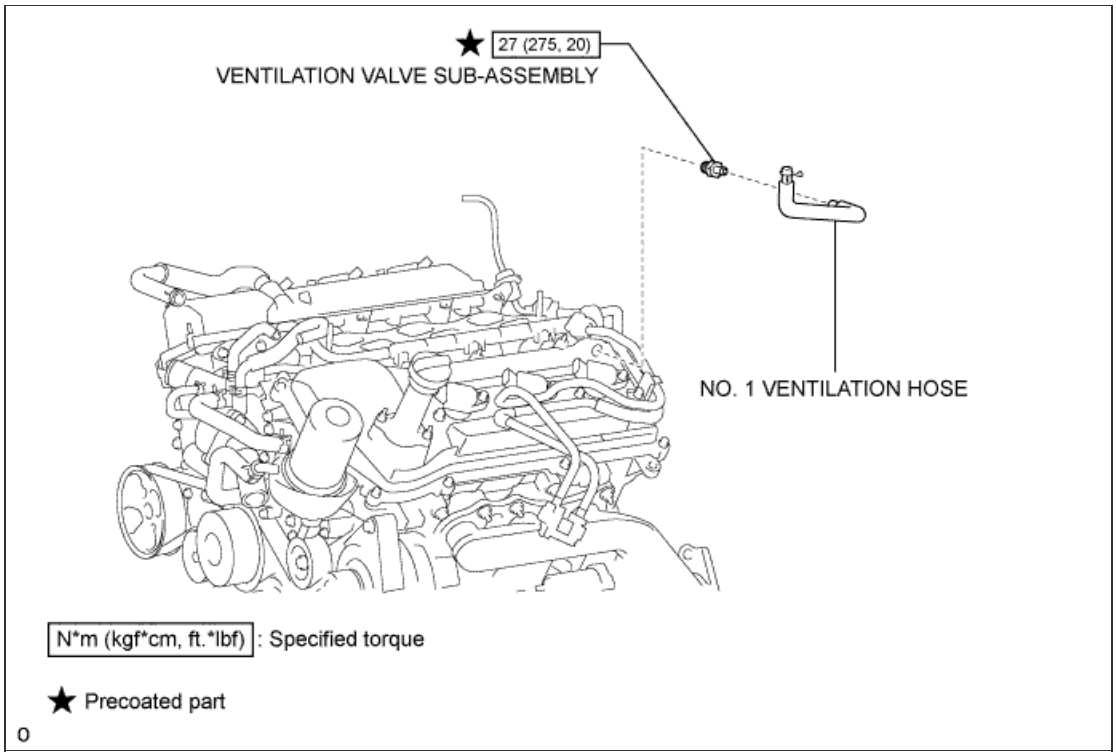
for Preparation Click here




7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER
AIR CLEANER ASSEMBLY
4.0 (41, 35 in.*lbf)
HOSE CLAMP
4.0 (41, 35 in.*lbf)
HOSE CLAMP
8.0 (82, 71 in.*lbf)
x 2
NO. 2 AIR CLEANER HOSE
VACUUM HOSE
NO. 2 VENTILATION HOSE
HOSE CLAMP
MASS AIR FLOW METER CONNECTOR
N*m (kgf*cm, ft.*lbf) : Specified torque

0


VACUUM SWITCHING VALVE CONNECTOR (for ACIS)
ENGINE WIRE
THROTTLE BODY CONNECTOR
* 28 (286, 21)
* 28 (286, 21)
x 2
x 4
PURGE VSV CONNECTOR
NO. 5 WATER BY-PASS HOSE
21 (214, 15)
x 2
THROTTLE BODY BRACKET
PURGE LINE HOSE
INTAKE AIR SURGE TANK
NO. 1 VENTILATION HOSE
NO. 1 SURGE TANK STAY
21 (214, 15)
x 2
BRACKET
NO. 4 WATER BY-PASS HOSE
21 (214, 15)
x 2
NO. 2 SURGE TANK STAY
8.0 (82, 71 in.*lbf)
for Manual Transmission:
CLUTCH TUBE BRACKET
21 (214, 15)
x 2
20 (204, 15)
NO. 2 SURGE TANK STAY
9.0 (92, 80 in.*lbf)
OIL BAFFLE PLATE
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
* DO NOT apply oil


★ 27 (275, 20)
VENTILATION VALVE SUB-ASSEMBLY
NO. 1 VENTILATION HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
★ Precoated part

for Preparation Click here

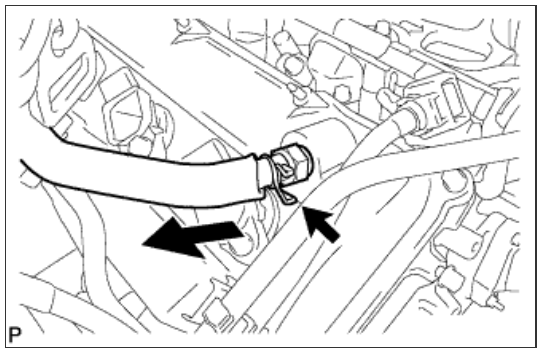
1. REMOVE INTAKE AIR SURGE TANK

a. Remove the intake air surge tank (Click here).

2. REMOVE VENTILATION VALVE SUB-ASSEMBLY

a. Loosen the hose clamp and disconnect the ventilation hose from the valve.

b. Remove the valve.



for Preparation Click here

1. INSPECT VENTILATION VALVE SUB-ASSEMBLY

a. Install a clean hose to the ventilation valve.

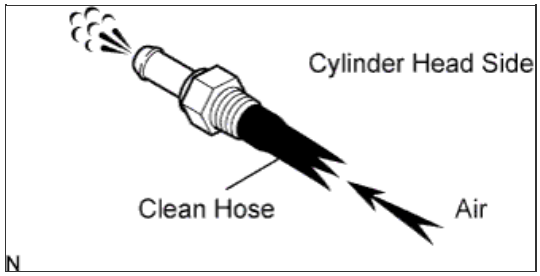
b. Check the ventilation valve operation.

i. Blow air into the cylinder head side, and check that air passes through easily.

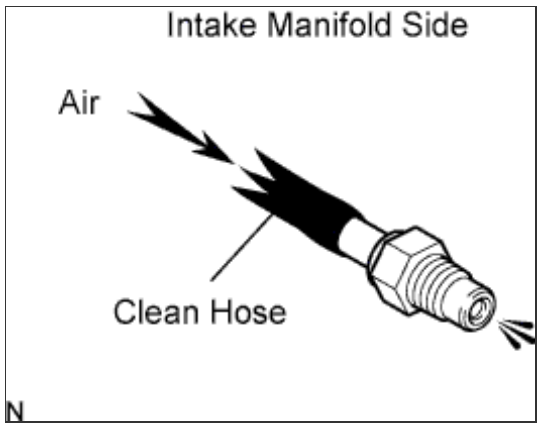
CAUTION:

Do not suck air through the valve.

Petroleum substances inside the valve are hazardous to your health.



ii. Blow air into the intake manifold side, and check that air passes through with difficulty.
If the result is not as specified, replace the ventilation valve.



c. Remove the clean hose from the ventilation valve.

for Preparation Click here

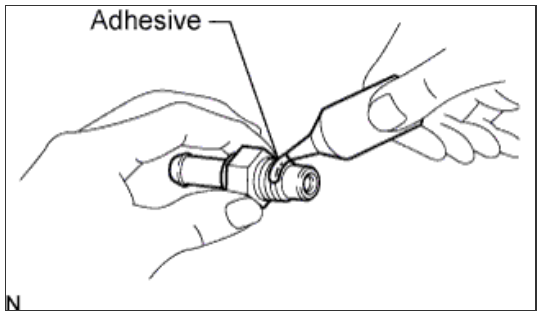
1. INSTALL VENTILATION VALVE SUB-ASSEMBLY

a. Apply adhesive to 2 or 3 threads of the ventilation valve.

Adhesive:
Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent

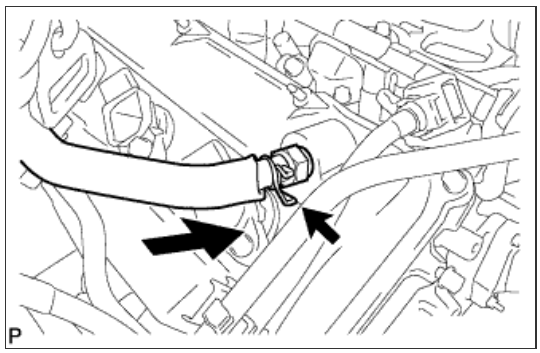
b. Install the ventilation valve.

Torque:
27 N*m{ 275 kgf*cm , 20 ft.*lbf }



c. Connect the ventilation hose to the valve.

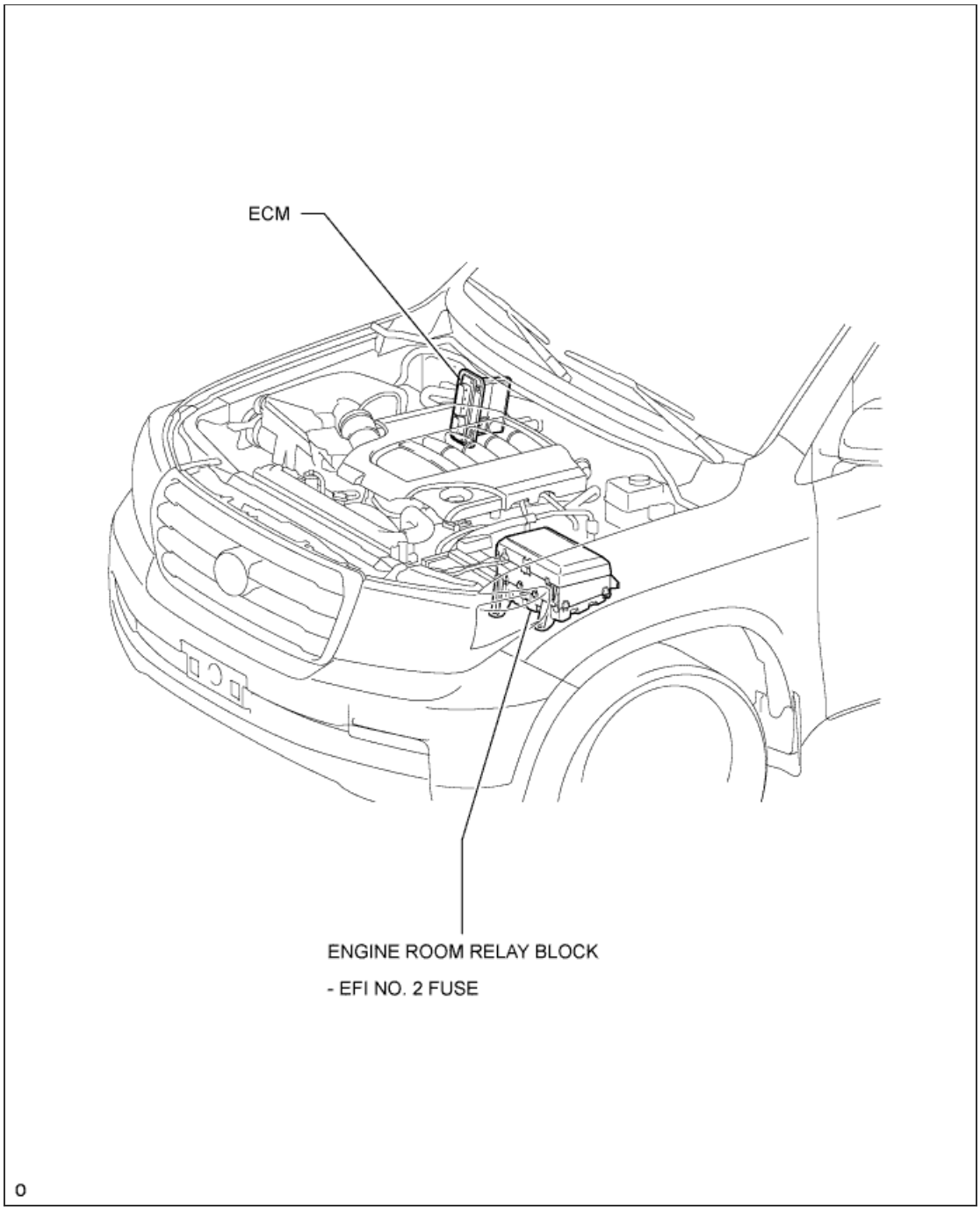
d. Secure the hose with the clamp.

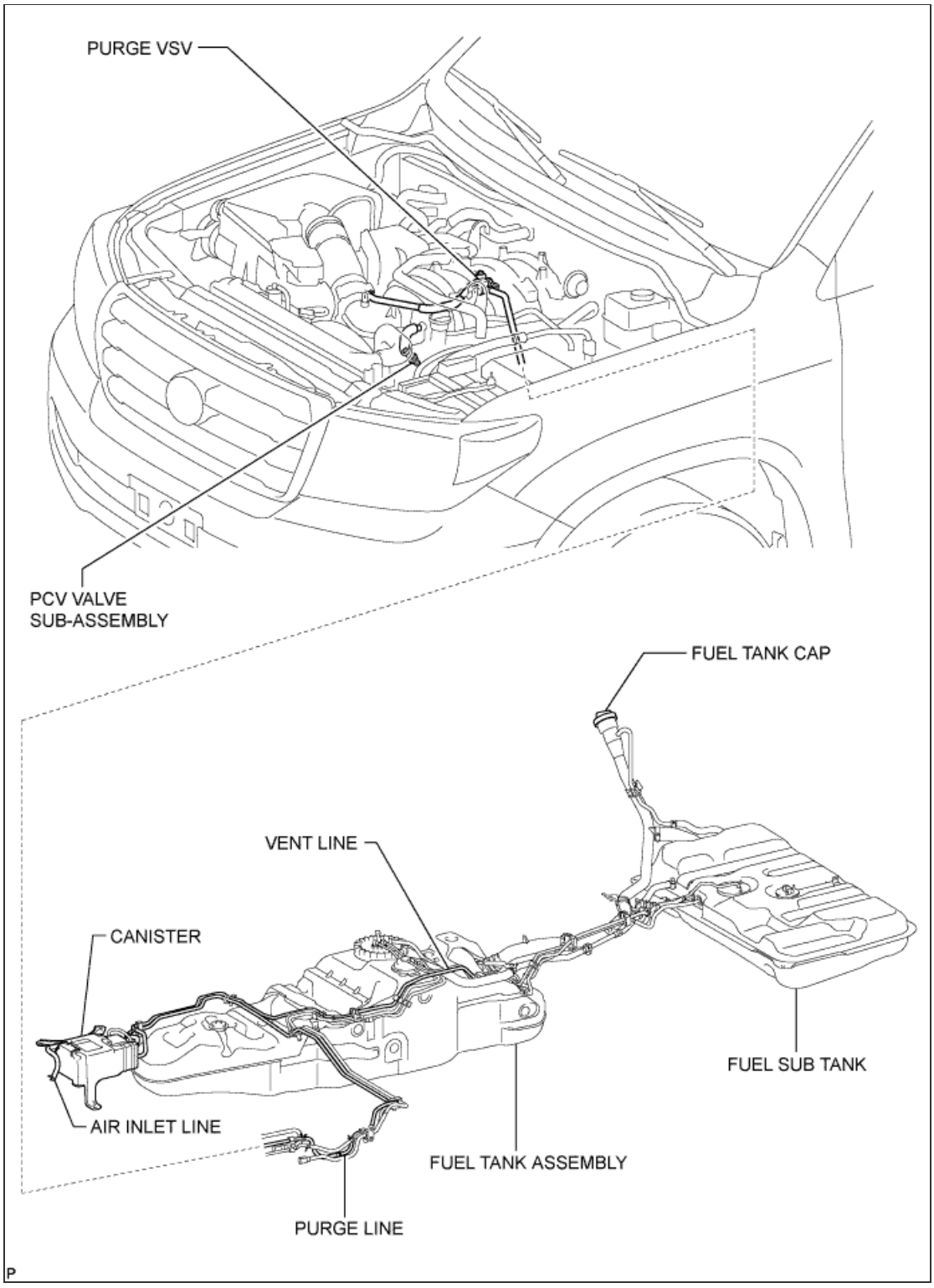


2. INSTALL INTAKE AIR SURGE TANK

a. Install the intake air surge tank (Click here).

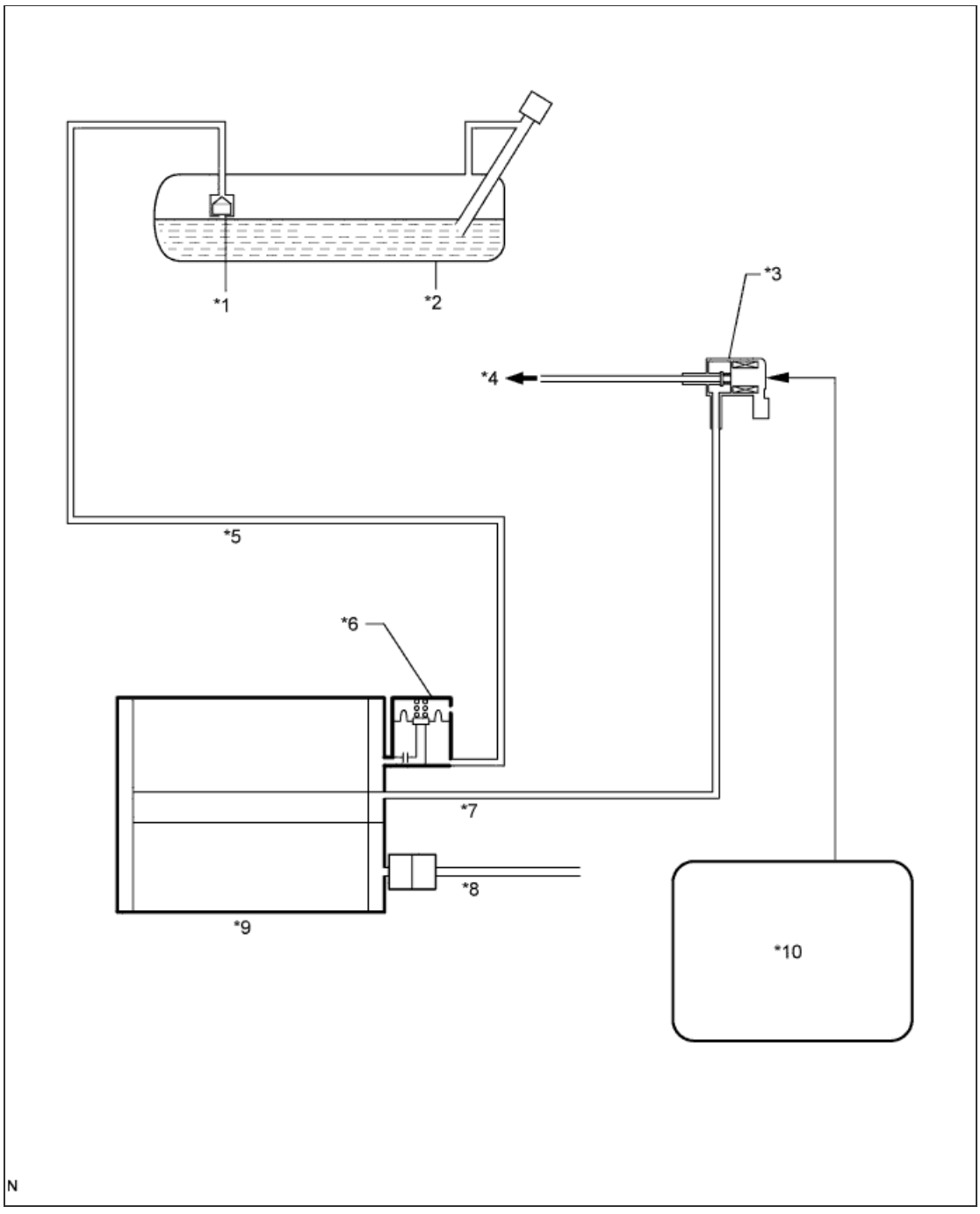
for Preparation Click here




PURGE VSV
PCV VALVE
SUB-ASSEMBLY
FUEL TANK CAP
VENT LINE
CANISTER
FUEL SUB TANK
AIR INLET LINE
FUEL TANK ASSEMBLY
PURGE LINE
P

for Preparation Click here

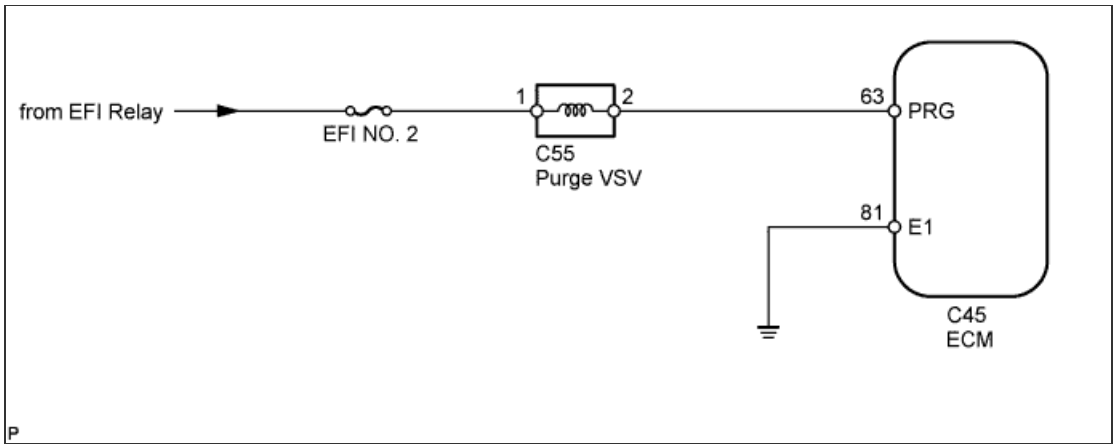
EVAP CONTROL SYSTEM DIAGRAM



Text in Illustration

*1	Fuel Cutoff Valve	*2	Fuel Tank
*3	Purge VSV	*4	to Intake Manifold
*5	Vent Line	*6	Refueling Valve
*7	Purge Line	*8	Air Inlet Line
*9	Canister	*10	ECM

EVAP SYSTEM WIRING DIAGRAM


from EFI Relay
EFI NO. 2
1
2
C55
Purge VSV
63
PRG
81
E1
C45
ECM
P

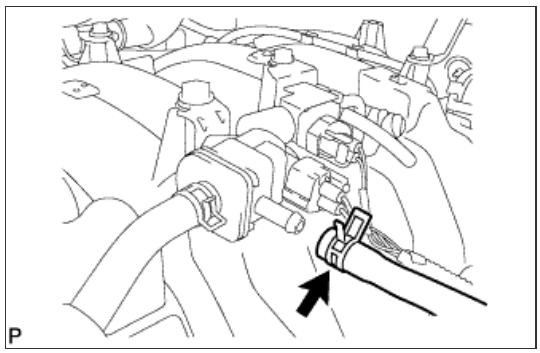
for Preparation Click here

1. CHECK PURGE VSV

a. Connect the intelligent tester to the DLC3.

b. Remove the V-bank cover (Click here).

c. Disconnect the hose (connected to the canister) from the purge VSV.



d. Start the engine and turn the intelligent tester main switch on.

e. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the VSV for Evap Control.

OK:

Tester Operation	Specified Condition
Activate the VSV for Evap Control: OFF	Purge VSV has no suction
Activate the VSV for Evap Control: O	rge VSV has suction

f. Connect the hose (connected to the canister) to the purge VSV.

g. Install the V-bank cover (Click here).

2. INSPECT FUEL CUT-OFF RPM

a. Start and warm up the engine.

b. Open the throttle valve and keep the engine speed at 3000 rpm.

c. Use a sound scope to check for injector operating noise.

d. Check that when the accelerator pedal is released, the injector operation noise stops momentaril and then resumes.
If the result is as not specified, check the injector, wiring and ECM.

3. VISUALLY INSPECT HOSES, CONNECTIONS AND GASKETS

a. Check that there are no cracks, leaks or damage.

HINT:

Separation of the engine oil dipstick, oil filler cap, ventilation hose, etc. ma cause an engine failure or engine malfunctions.
Disconnection, looseness or cracks in the parts of the air induction s stem between the throttle bod and c linder head will allow air suction and cause an engine failure or engine malfunctions.

NOTICE:

- **Detachment or other problems with the engine oil dipstick, filler cap, ventilation hose and other components may cause the engine to run improperly.**
- **Disconnection, looseness or cracks in the parts of the air induction system between the throttle body and cylinder head will allow air suction and cause an engine failure or engine malfunctions.**

If the result is not as specified, replace parts as necessar .

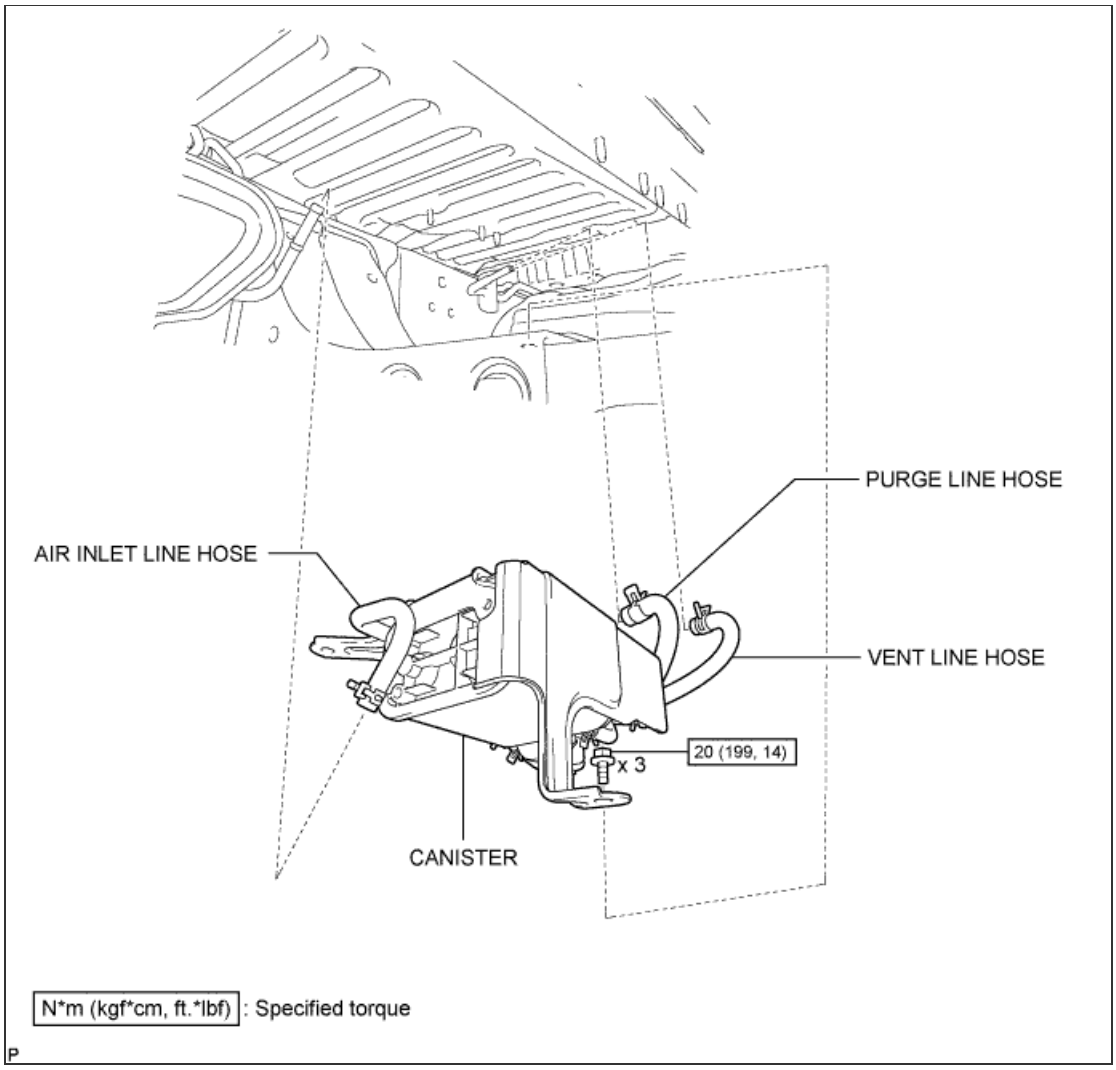
4. CHECK HOSES AND CONNECTORS

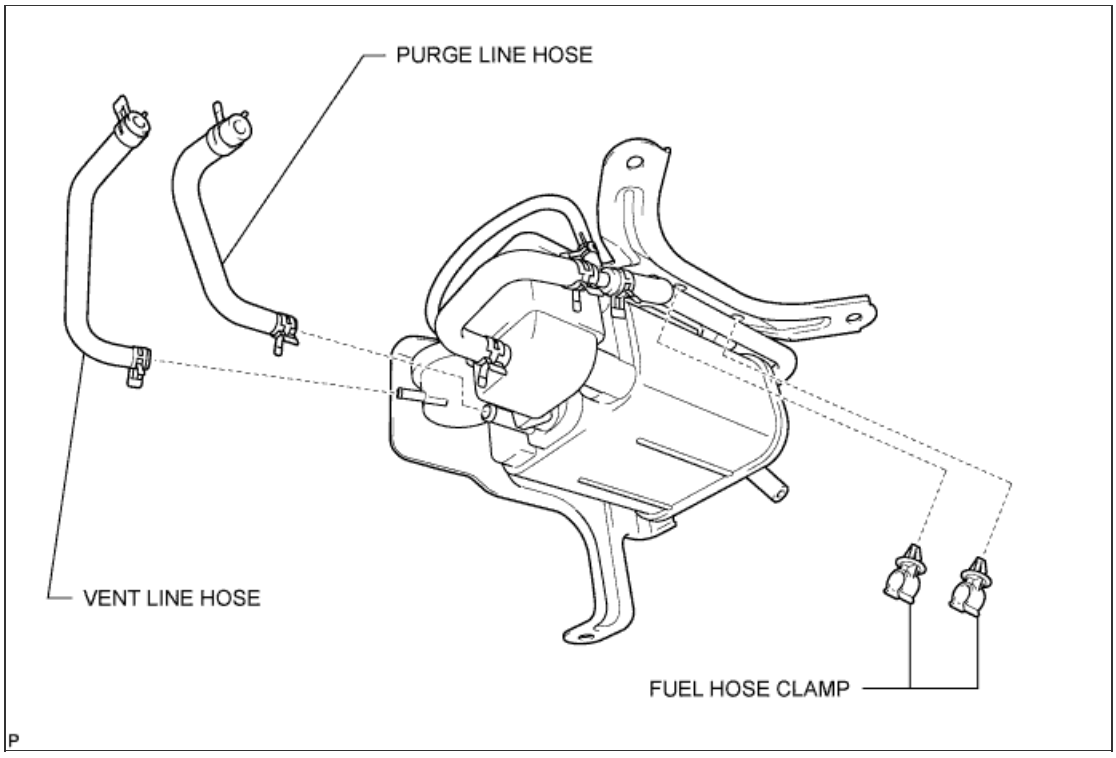
a. Visuall check for loose connections, sharp bends or damage.

5. CHECK FUEL TANK ASSEM LY

a. Visuall check for deformation, cracks or fuel leakage.

for Preparation Click here

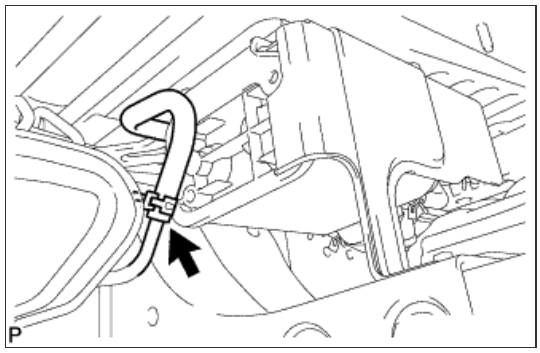



PURGE LINE HOSE
VENT LINE HOSE
FUEL HOSE CLAMP
P

for Preparation Click here

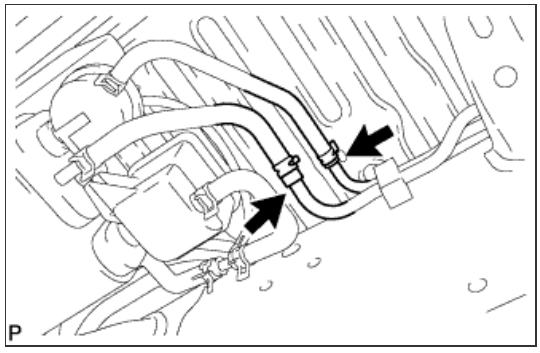
1. REMOVE CANISTER

a. Disconnect the air inlet line hose.



b. Disconnect the vent line hose.

c. Disconnect the purge line hose.

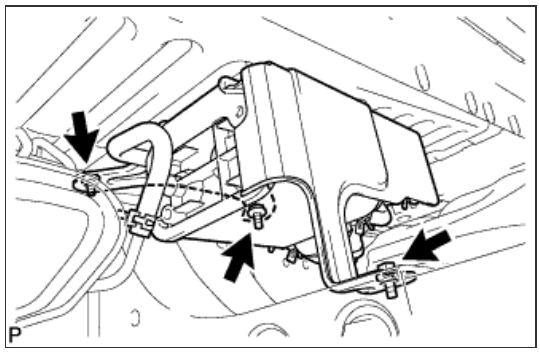


d. Remove the 3 bolts and canister.

e. Remove the 2 fuel hose clamps from the canister.

f. Remove the purge line hose.

. Remove the vent line hose.



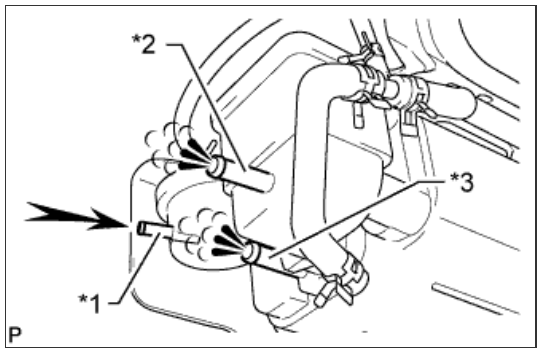
for Preparation Click here

1. INSPECT CANISTER

a. Visually check the canister for cracks or damage.

Text in Illustration

*1	Port A
*2	Port B
*3	Port C
➡	Air



b. Blow compressed air of 4.9 kPa (50 gf/cm^2, 0.71 psi) into port A and check that air flows without resistance from port B and port C.
If the result is not as specified, replace the canister.

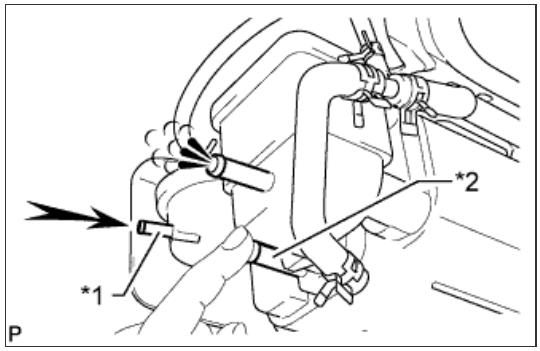
c. Apply a vacuum of 1.96 kPa (20 gf/cm^2, 0.28 psi) to port A. Check that the vacuum does not decrease when ports B and C are closed, and check that the vacuum does not decrease when port B is released.
If the result is not as specified, replace the canister.

2. CLEAN FILTER IN CANISTER

a. Clean the filter by blowing compressed air of 4.9 kPa (50 gf/cm^2, 0.71 psi) into port A while holding port B closed.

Text in Illustration

*1	Port A
*2	Port B
➡	Air



NOTICE:

Do not attempt to wash the canister.

for Preparation Click here

1. INSTALL CANISTER

a. Install the vent line hose to the canister.

b. Install the purge line hose to the canister.

c. Install the 2 fuel hose clamps to the canister.

d. Install the canister with the 3 bolts.

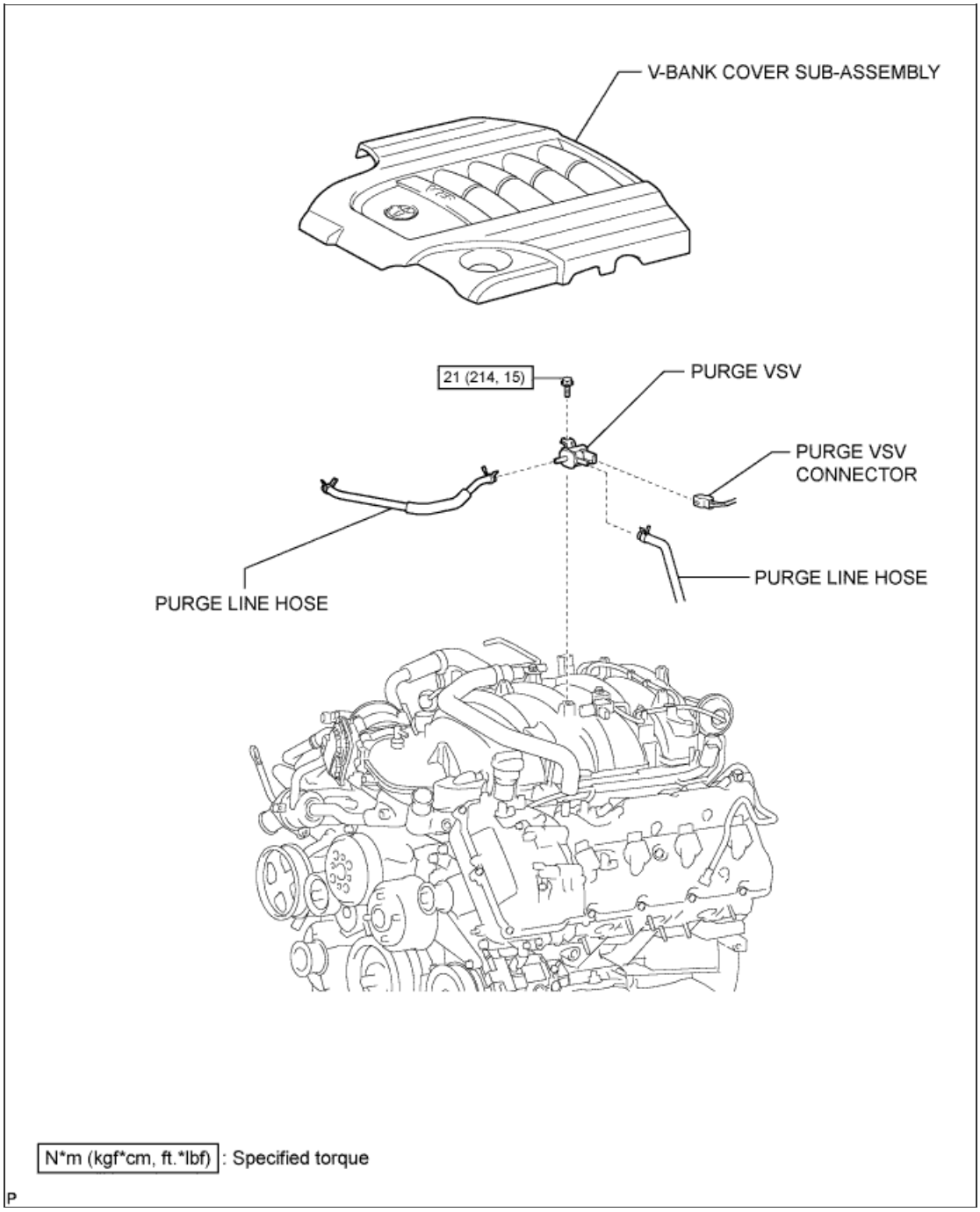
Torque:
20 N 1 kgf*cm , 14 ft.*lbf }

e. Connect the vent line hose.

f. Connect the purge line hose.

g. Connect the air inlet line hose.

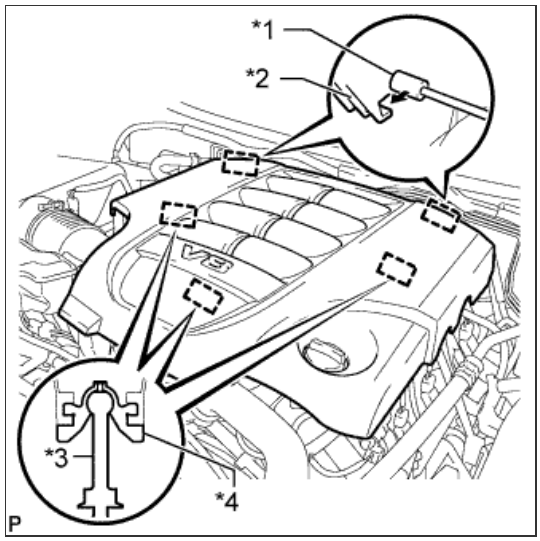
for Preparation Click here



for Preparation Click here

1. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Raise the front of the V-bank cover to detach the 3 pins. Then remove the 2 V-bank cover hooks from the bracket, and remove the V-bank cover.



Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet

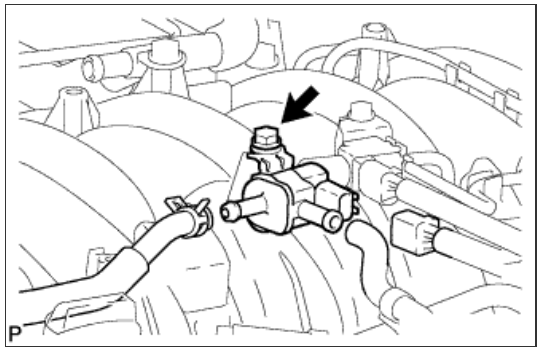
2. DISCONNECT PURGE LINE HOSE

a. Disconnect the 2 purge line hoses.

3. REMOVE PURGE VSV

a. Disconnect the purge VSV connector.

b. Remove the bolt and purge VSV.



for Preparation Click here

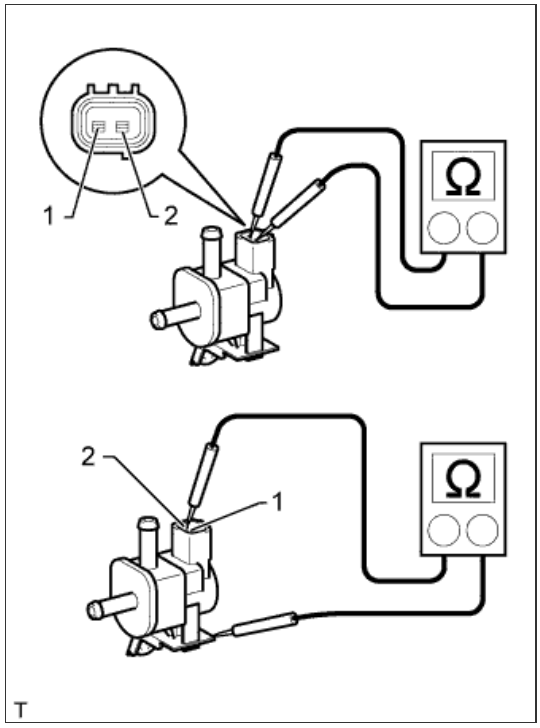
1. INSPECT PURGE VSV

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	23 to 26 Ω
1 - VSV body ground	Always	10 kΩ or higher
2 - VSV body ground		10 kΩ or higher

If the result is not as specified, replace the purge VSV.

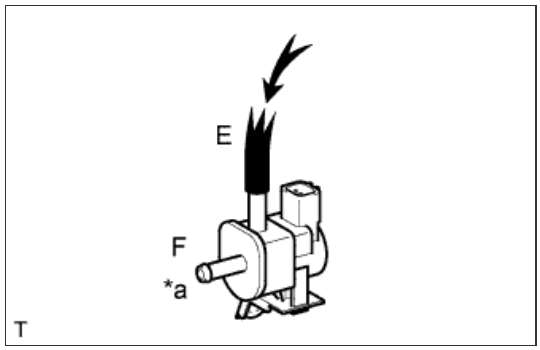


b. Check the operation of the purge VSV.

i. Check that air does not flow from port F when air is applied to port E.

Te t in Illustration

a	Does not flow
➡	Air



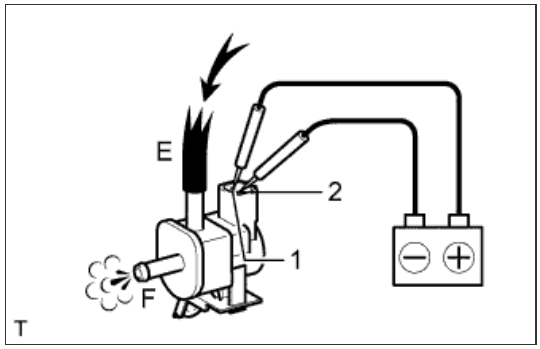
ii. Apply battery voltage to the connector, and check the VSV operation.

OK:

Measurement Condition	Specified Condition
Battery positive ( ) → Terminal 1 Battery negative (-) → Terminal 2	Air flows from port E to port F

Te t in Illustration

➡	Air



If the result is not as specified, replace the purge VSV.

for Preparation Click here

1. INSTALL PURGE VSV

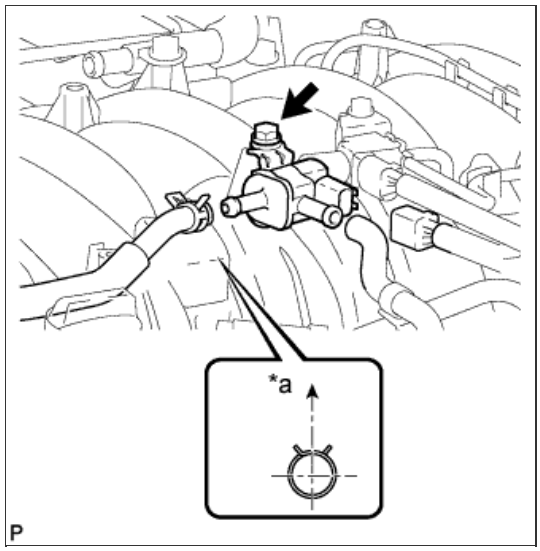
a. Install the purge VSV with the bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

b. Connect the purge VSV connector.

Text in Illustration

*a	Upper



2. CONNECT PURGE LINE HOSE

a. Connect the 2 purge line hoses.

HINT:

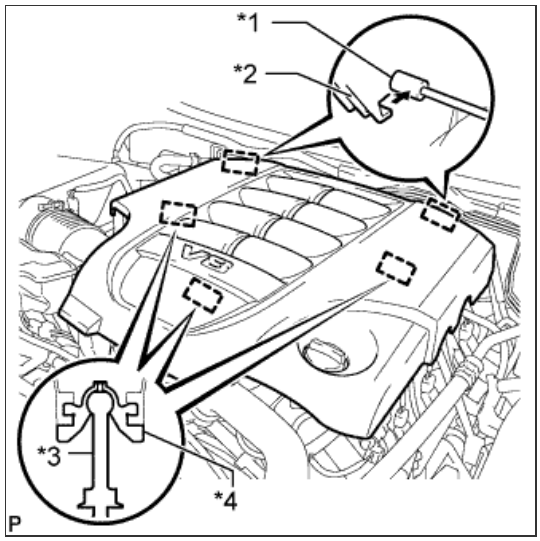
Turn the claw of the clip to the upper side.

3. INSTALL V NK COVER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket. Then align the 3 V-bank cover grommets with the 3 pins, and press down on the V-bank cover to attach the pins.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet



for Preparation Click here

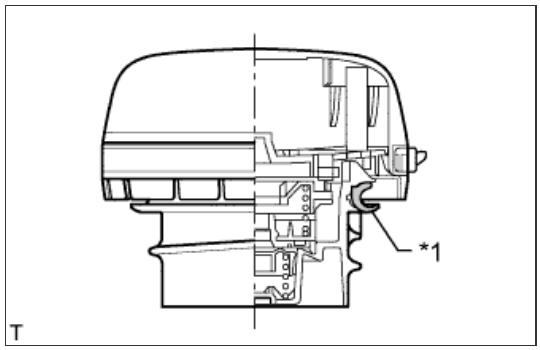
1. INSPECT FUEL TANK CAP ASSEMBLY

a. Visually check if the cap and/or gasket are deformed or damaged.

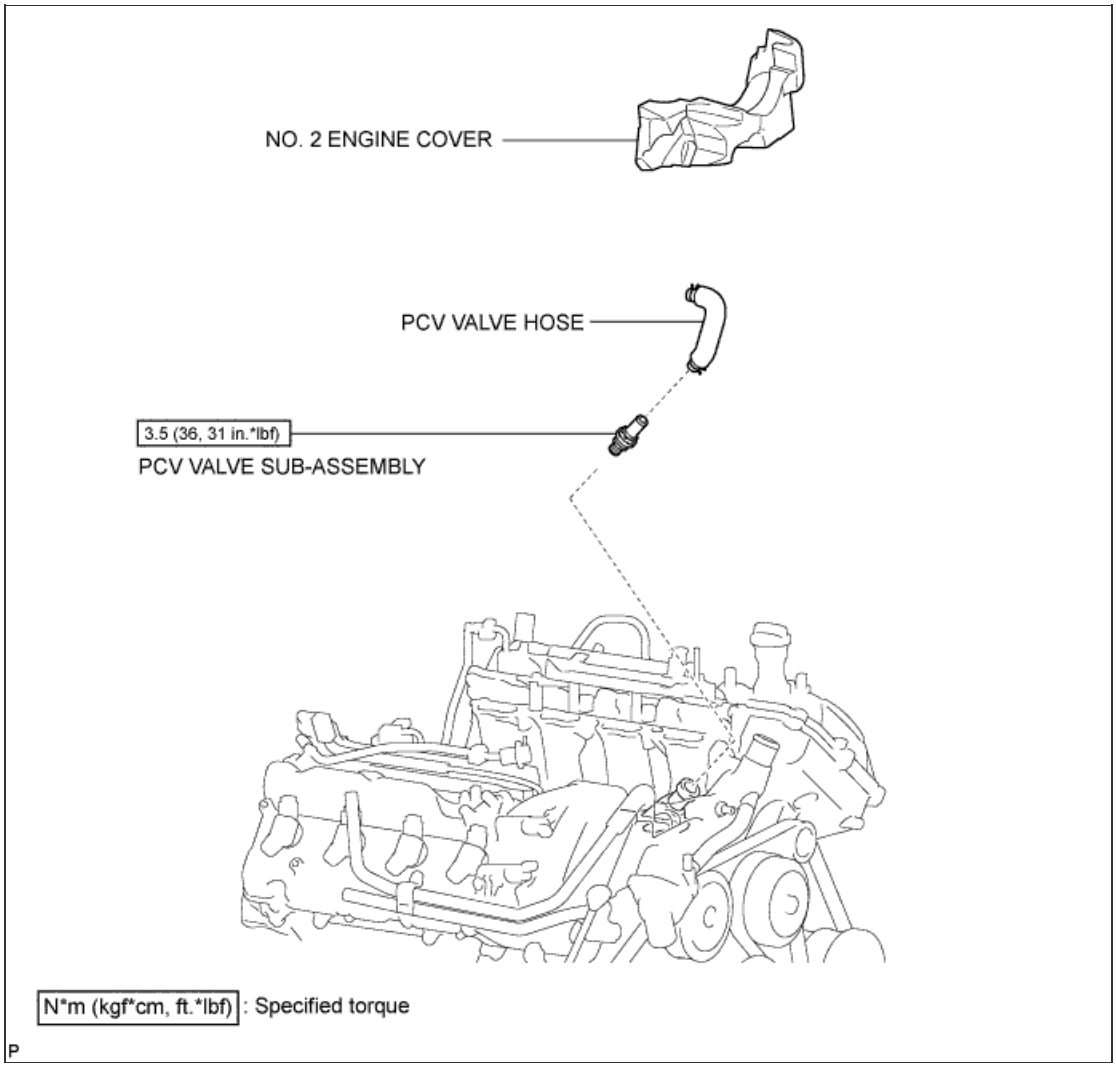
Text in Illustration

*1	Gasket

If the result is not as specified, replace the fuel tank cap assembly.



for Preparation Click here

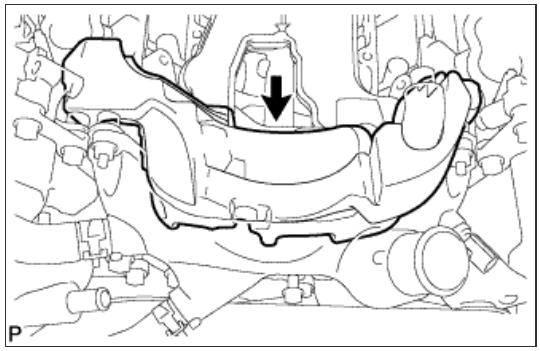


for Preparation Click here

1. REMOVE INTAKE MANIFOLD

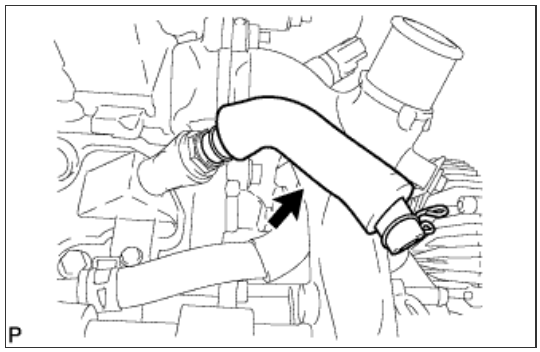
(Click here)

2. REMOVE NO. 2 ENGINE COVER



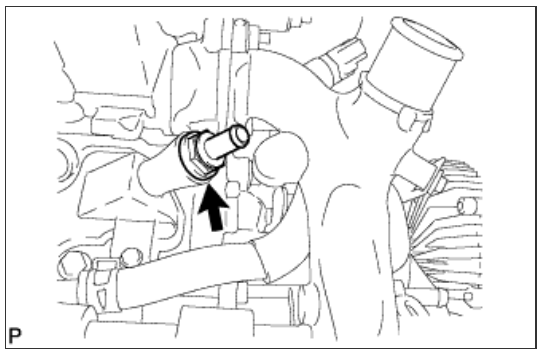
3. REMOVE PCV VALVE HOSE

a. Remove the hose from the PCV valve.



4. REMOVE PCV VALVE SUB-ASSEMBLY

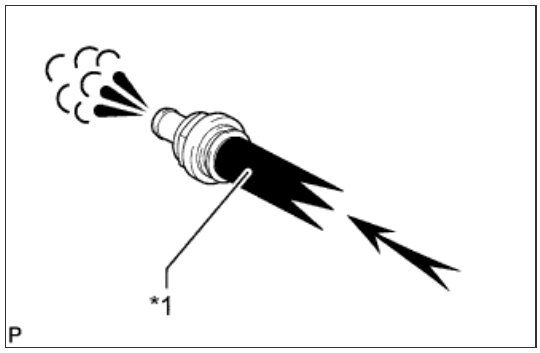
a. Remove the PCV valve.



for Preparation Click here

1. INSPECT PCV VALVE SUB-ASSEMBLY

a. Install a clean hose to the PCV valve.



b. Check the PCV valve operation.

i. Blow air into the cylinder head side, and check that air passes through easily.

Text in Illustration

*1	Clean Hose
➡	Air

CAUTION:

Do not suck air through the valve.

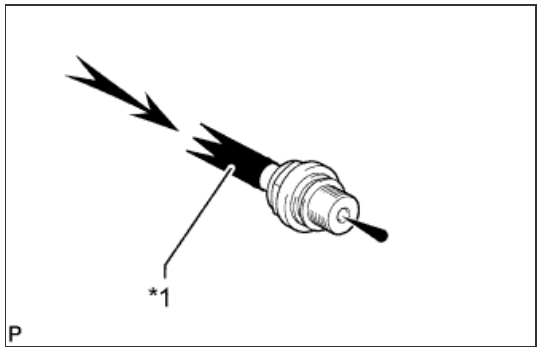
Petroleum substances inside the valve are hazardous to your health.

ii. Blow air into the intake manifold side, and check that air passes through with difficulty.

Text in Illustration

*1	Clean Hose
➡	Air

If the result is not as specified, replace the PCV valve sub-assembly.



c. Remove the hose from the PCV valve.

for Preparation Click here

1. INSTALL PCV VALVE SUB-ASSEMBLY

a. Apply a light coat of engine oil to the O-ring of the valve.

Text in Illustration

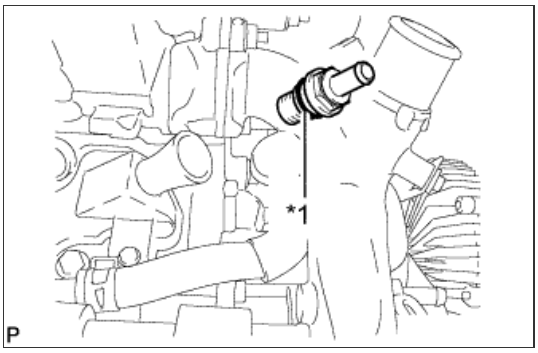
*1	O-Ring

HINT:

When reusing the PCV valve, inspect the O-ring. If the O-ring has scratches or cuts, replace the PCV valve.

b. Install the PCV valve.

Torque:
3.5 N*m{ 36 kgf*cm , 31 in.*lbf }



2. INSTALL PCV VALVE HOSE

a. Install the hose to the PCV valve.

3. INSTALL NO. 2 ENGINE COVER

4. INSTALL INTAKE MANIFOLD

(Click here)

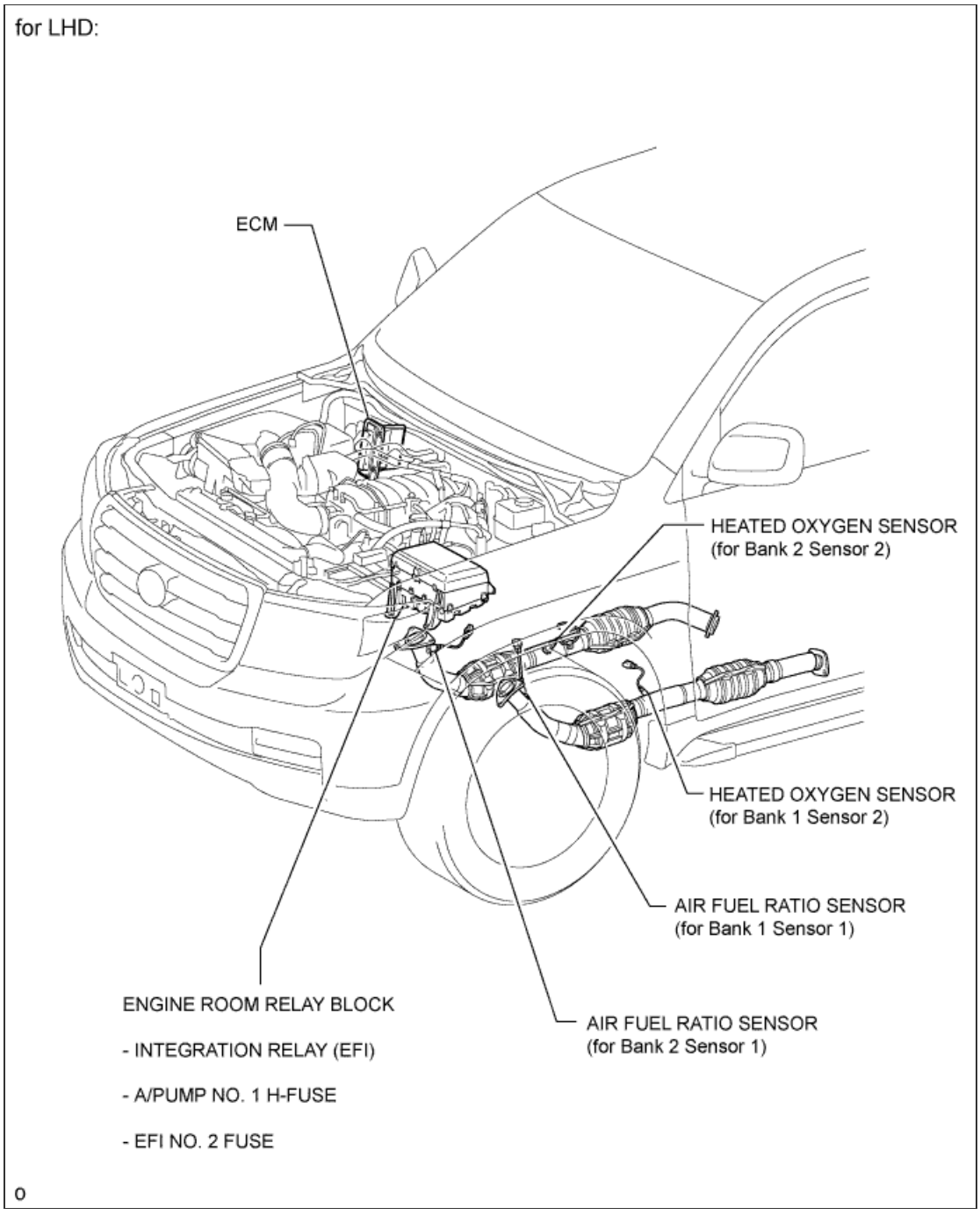
for reparation Click here

1.AIR INDUCTION SYSTEM

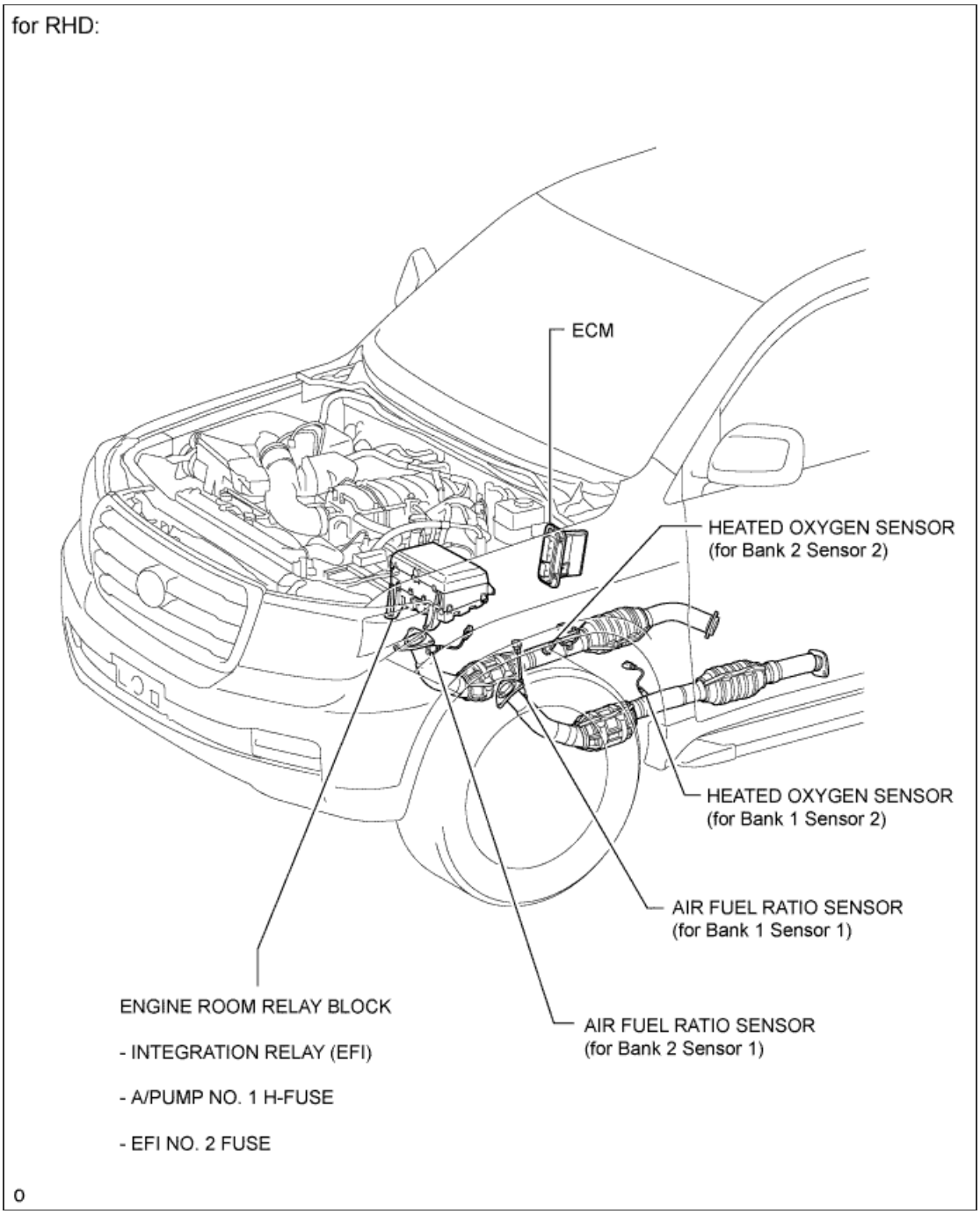
a. Removal of the engine oil dipstick, oil filler cap, PCV hose, etc. may damage the engine.

b. Disconnection, looseness or cracks in the parts of the air induction system between the throttle body and cylinder head may result in air suction and damage the engine.

for re aration Click here

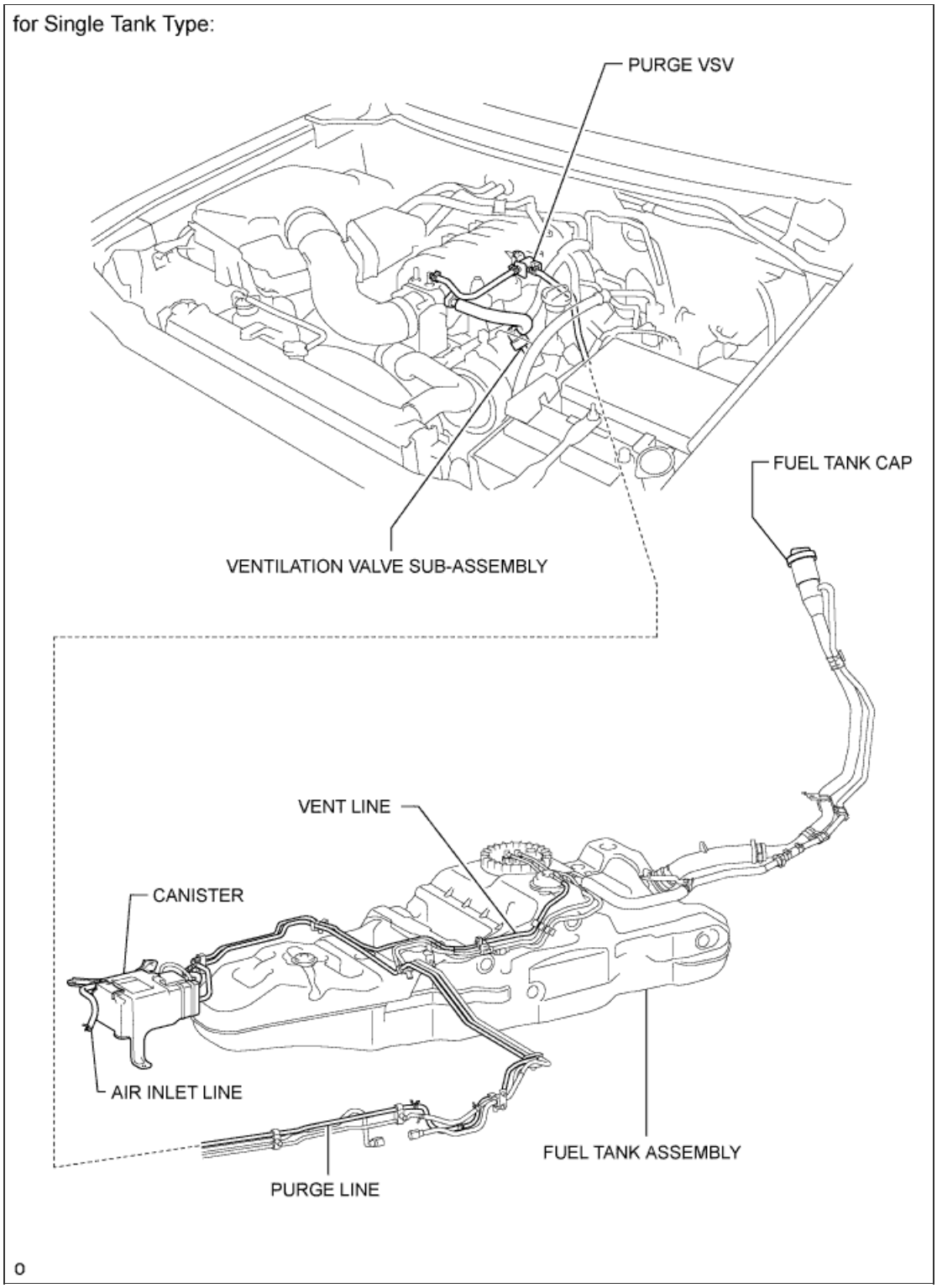


for RHD:


ECM
HEATED OXYGEN SENSOR
(for Bank 2 Sensor 2)
HEATED OXYGEN SENSOR
(for Bank 1 Sensor 2)
AIR FUEL RATIO SENSOR
(for Bank 1 Sensor 1)
AIR FUEL RATIO SENSOR
(for Bank 2 Sensor 1)
ENGINE ROOM RELAY BLOCK
- INTEGRATION RELAY (EFI)
- A/PUMP NO. 1 H-FUSE
- EFI NO. 2 FUSE

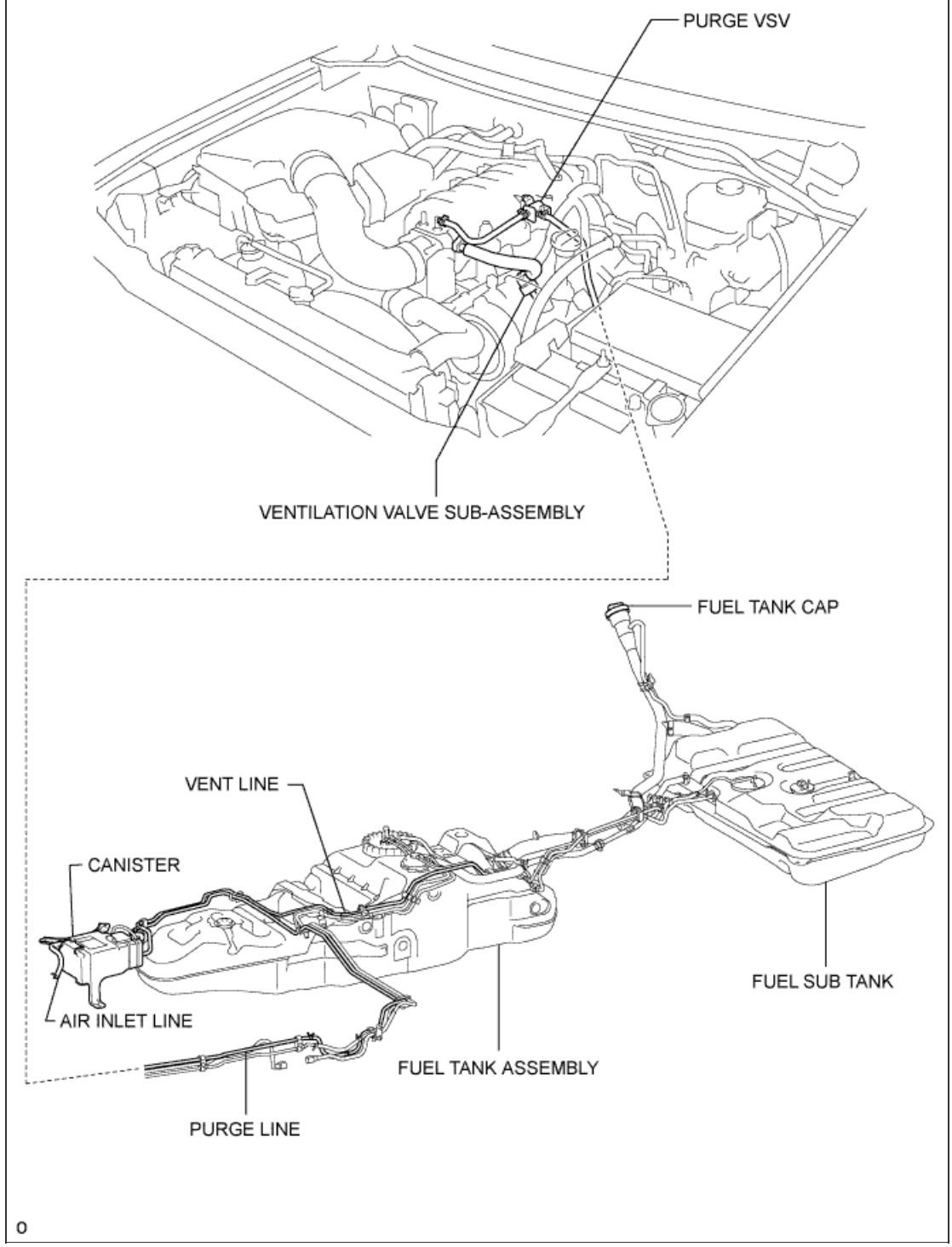
o

for Single Tank Type:



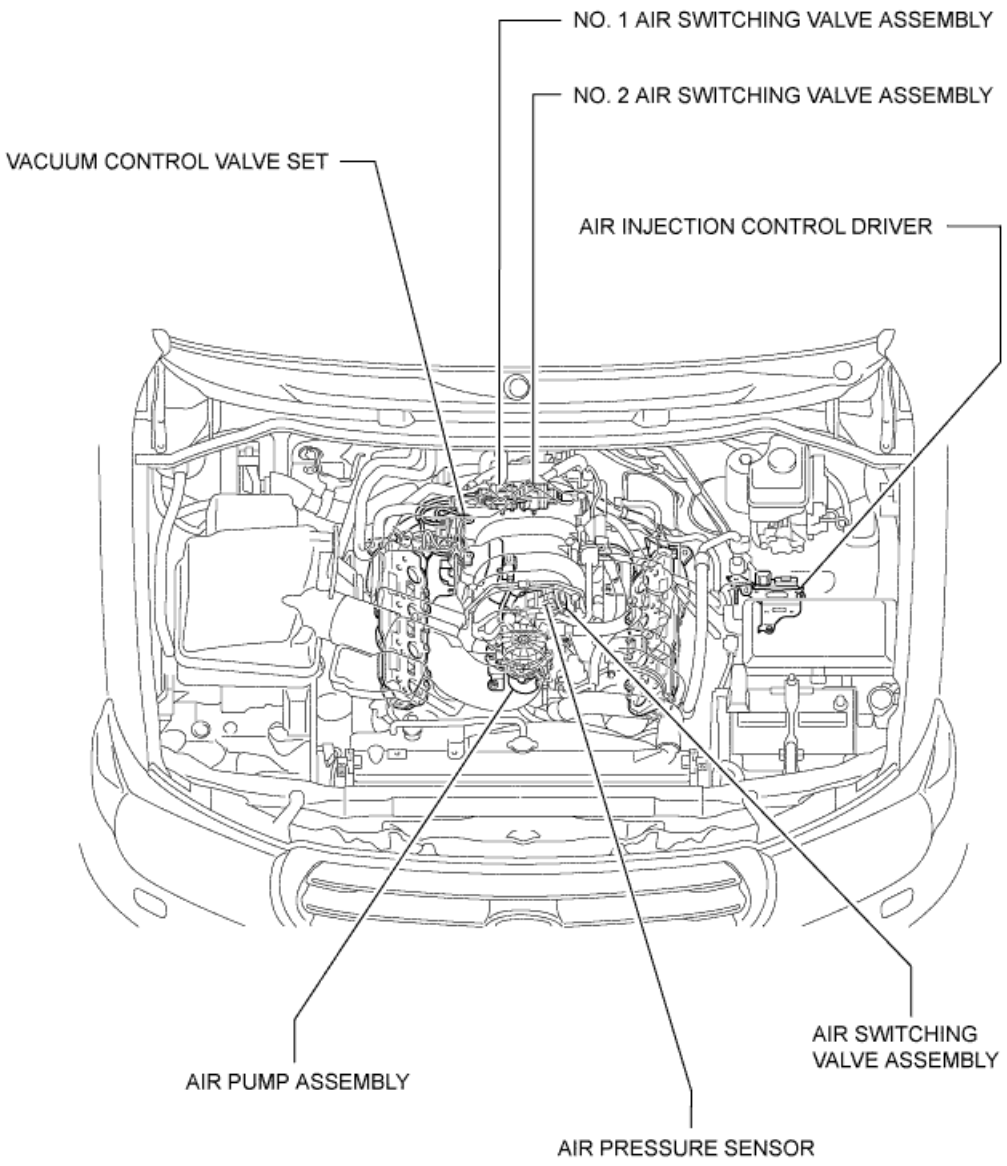
o

for Double Tank Type:



o

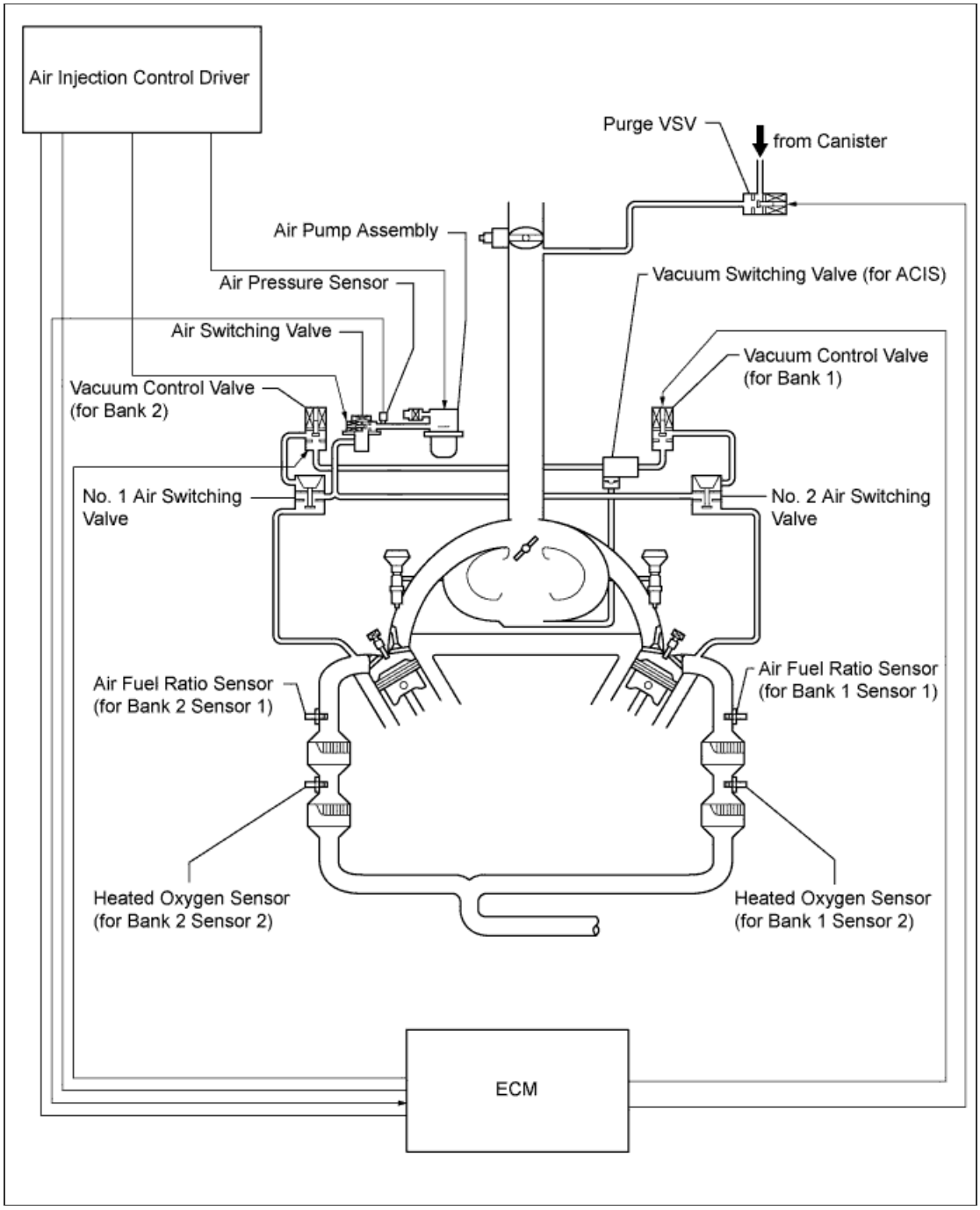
w/ Secondary Air Injection System:

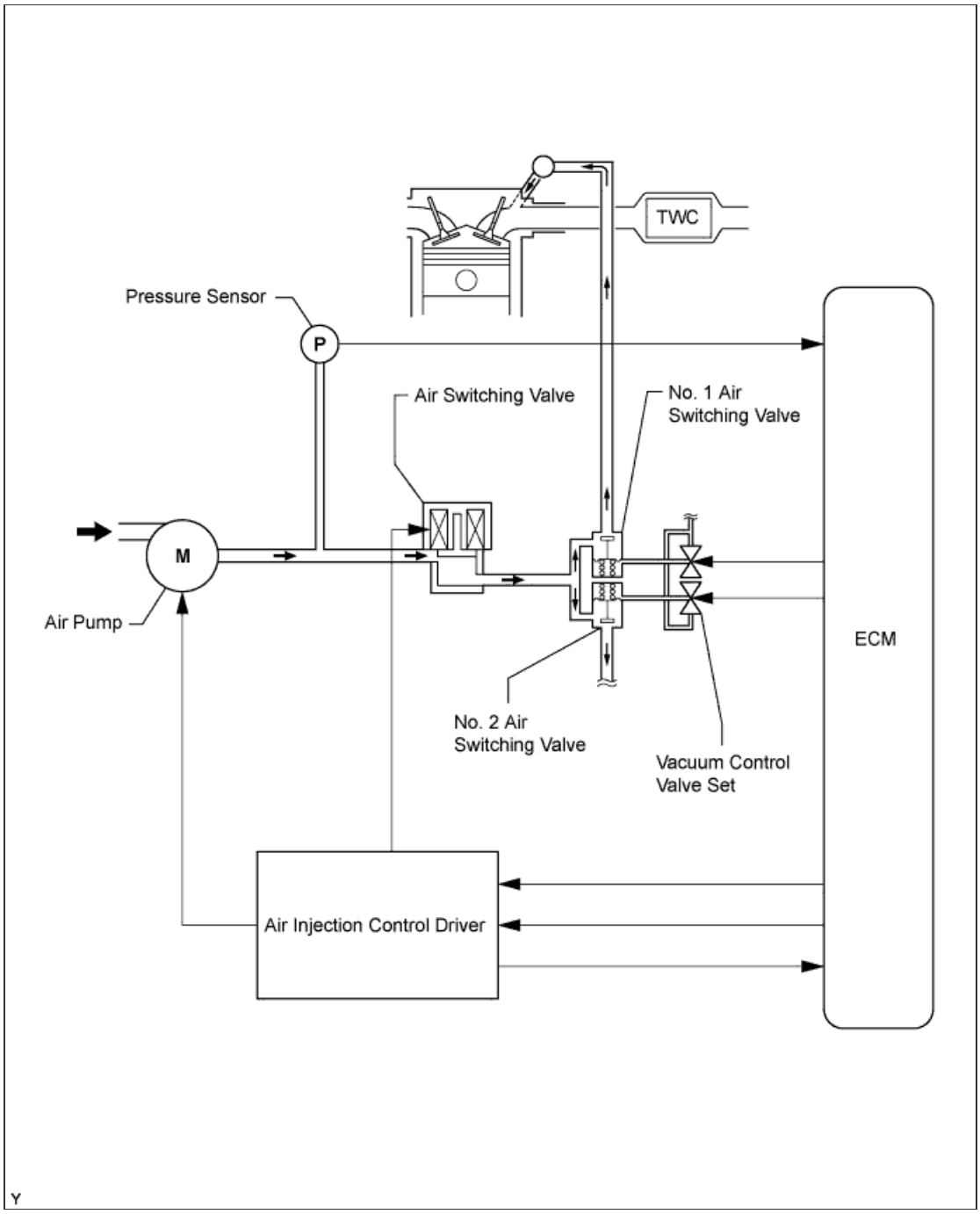


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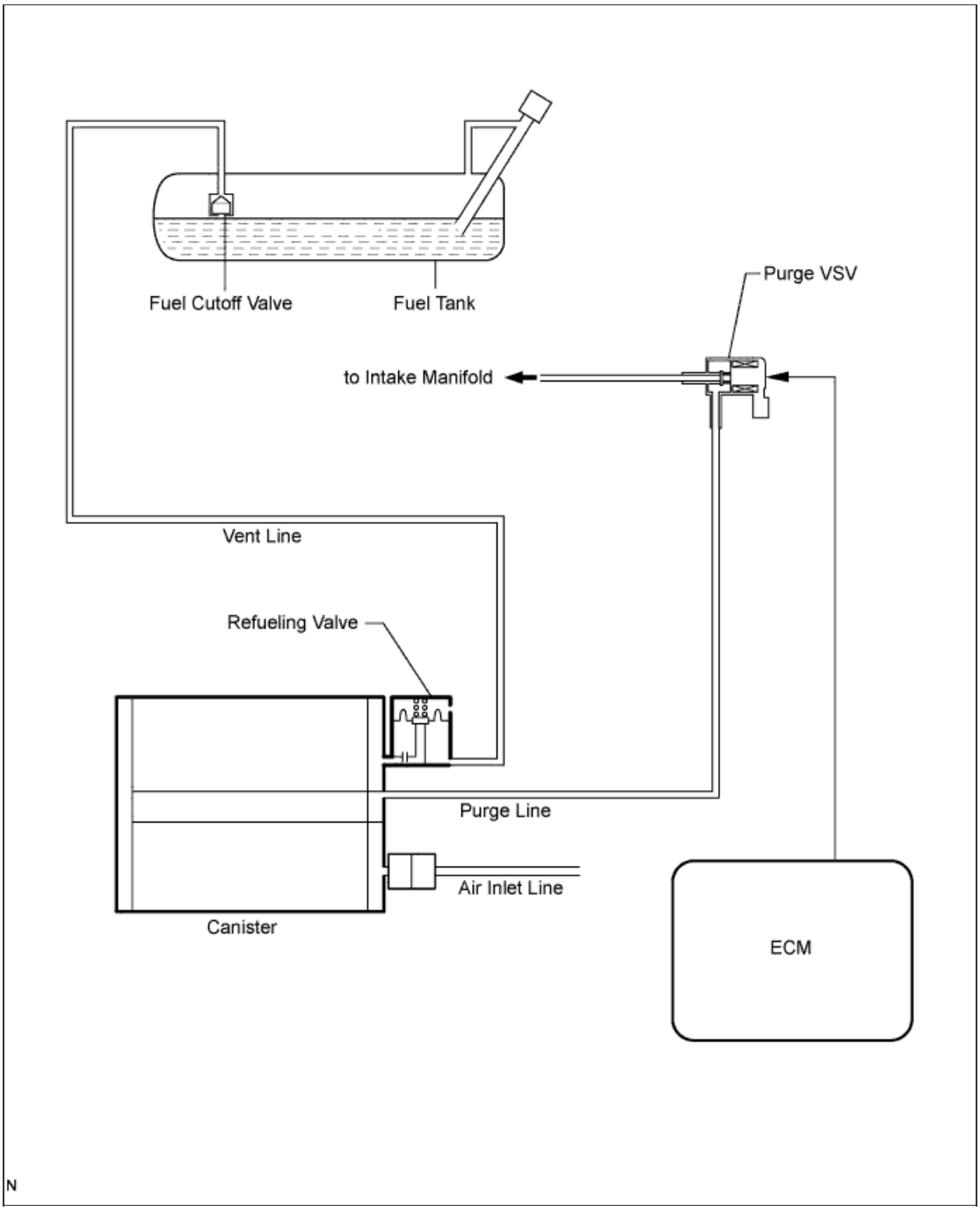
for reparation Click here

SECONDARY AIR INJECTION CONTROL SYSTEM DIAGRAM

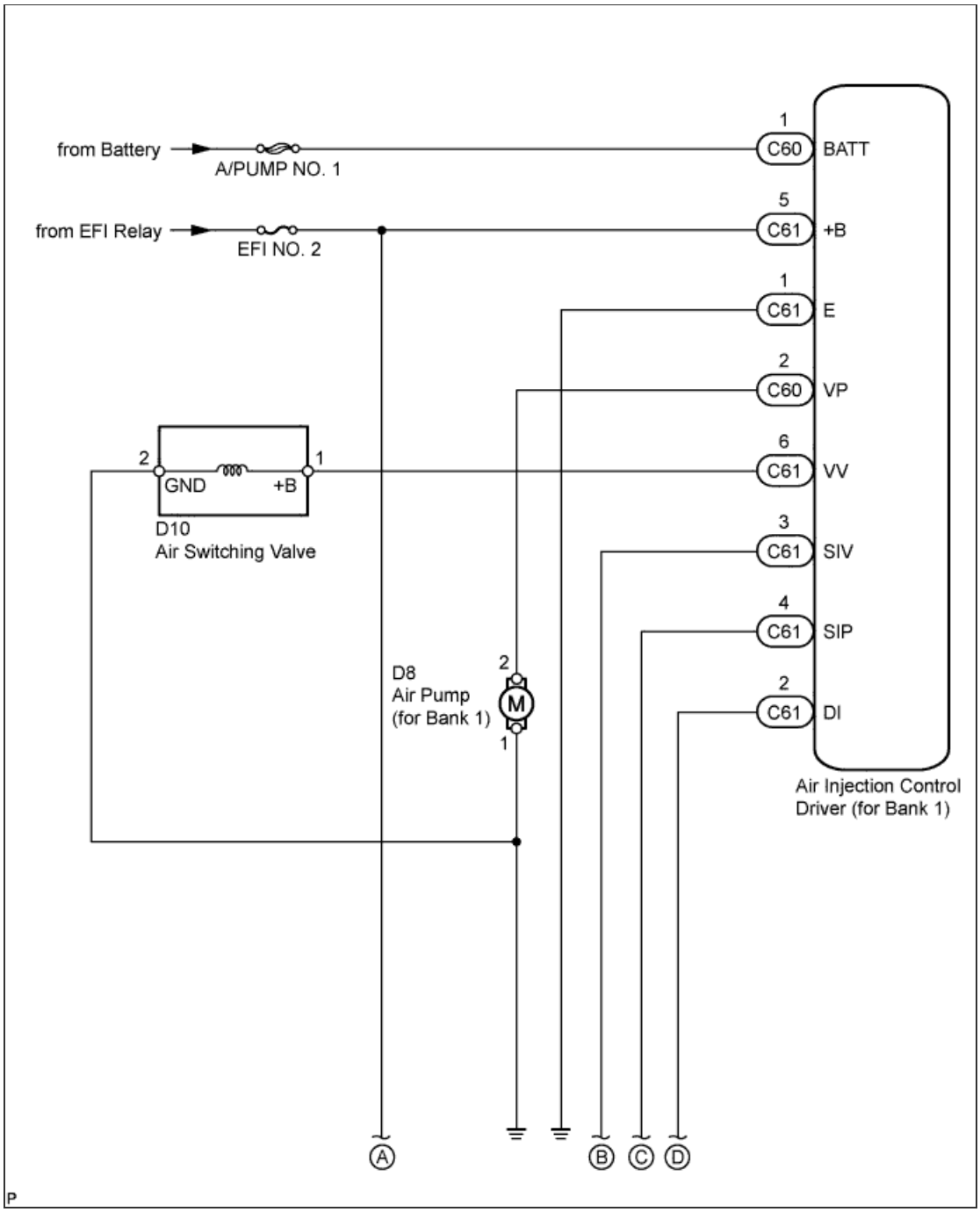




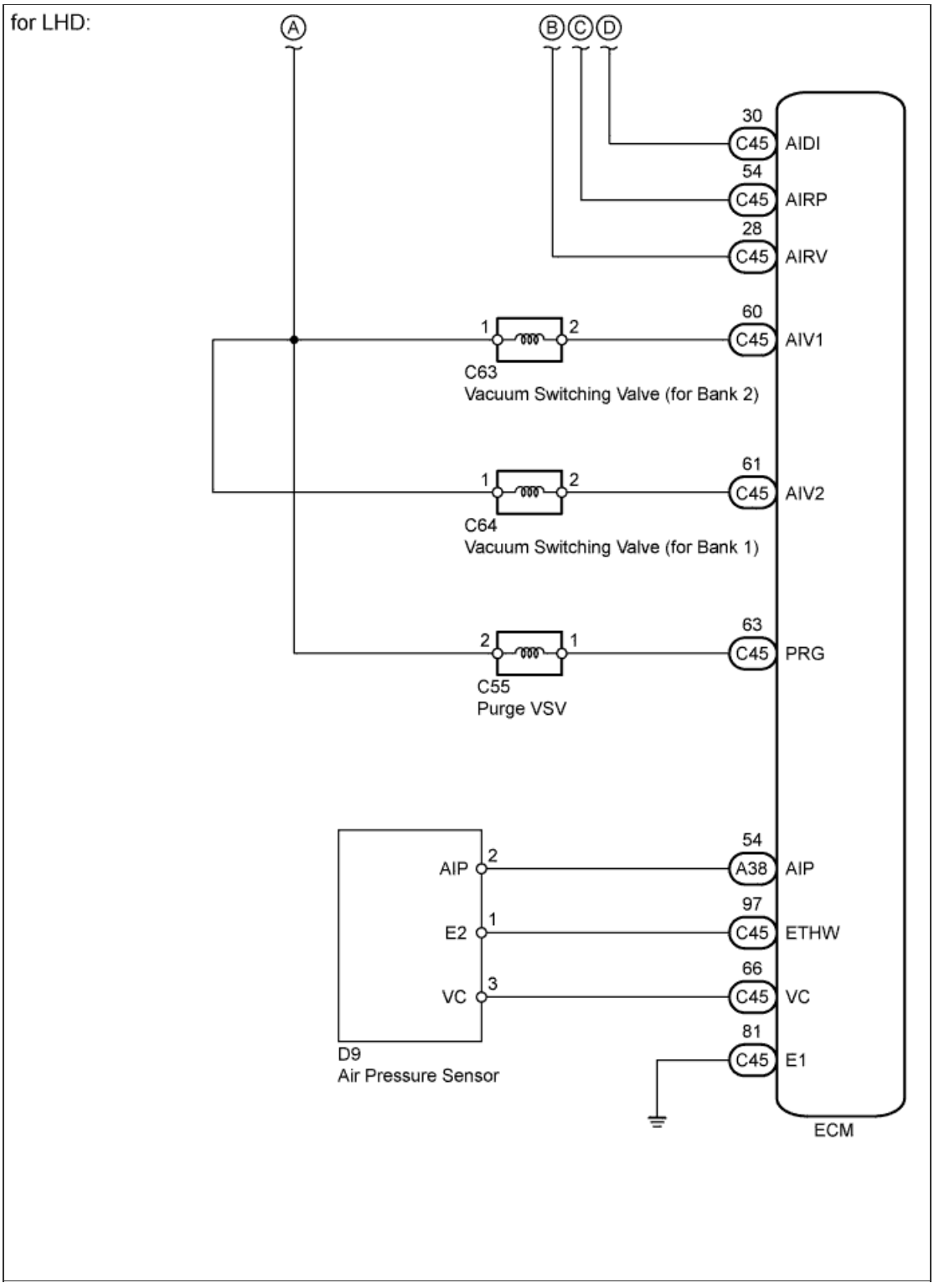
EVA CONTROL SYSTEM DIAGRAM



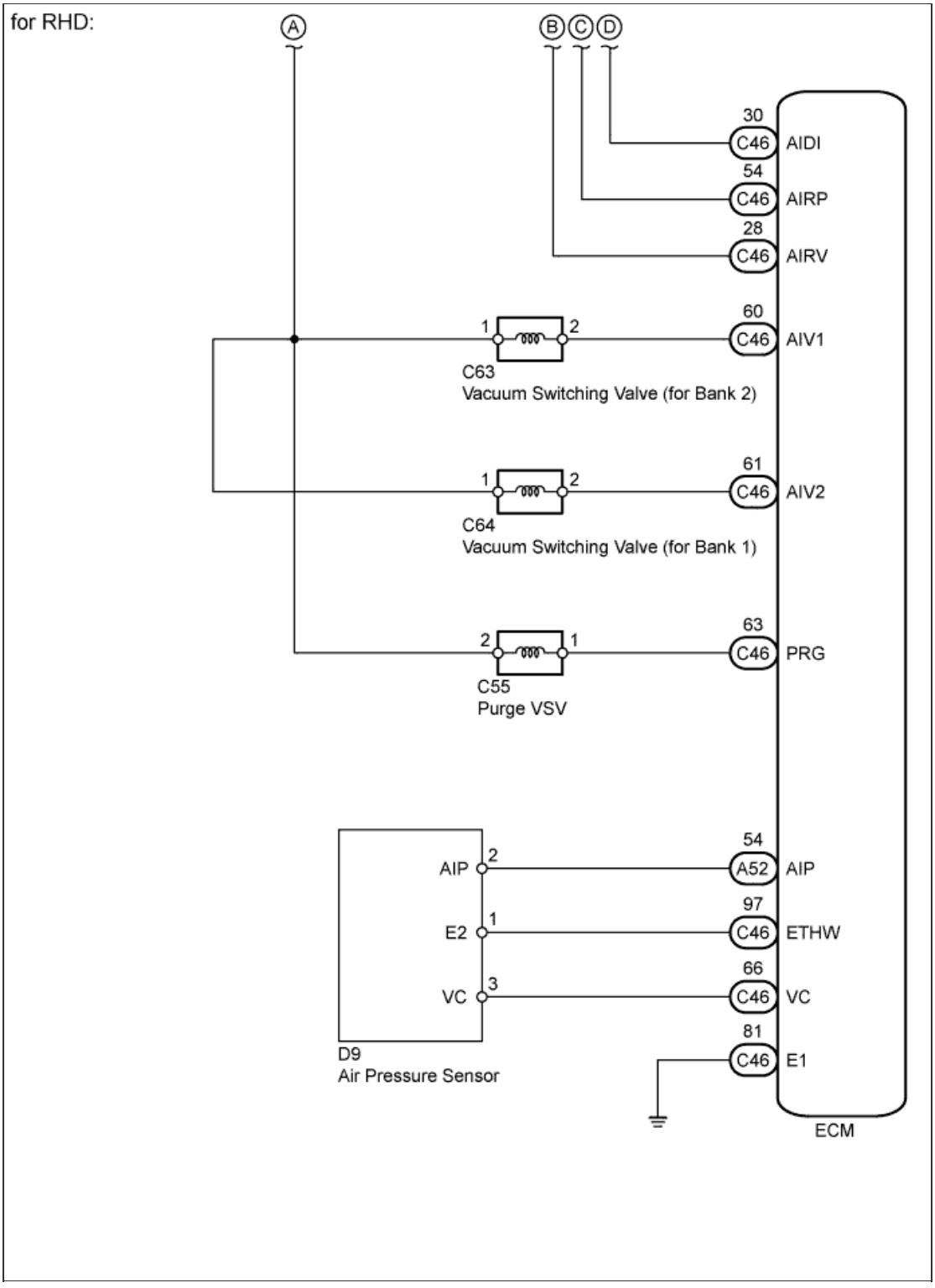
SECONDARY AIR INJECTION SYSTEM WIRING DIAGRAM


from Battery
A/PUMP NO. 1
from EFI Relay
EFI NO. 2
1
C60
BATT
5
C61
+B
1
C61
E
2
C60
VP
6
C61
VV
3
C61
SIV
4
C61
SIP
2
C61
DI
Air Injection Control
Driver (for Bank 1)
2
GND
+B
1
D10
Air Switching Valve
D8
Air Pump
(for Bank 1)
2
M
1
A
B
C
D
P

for LHD:


A
B
C
D
30
C45
AIDI
54
C45
AIRP
28
C45
AIRV
60
C45
AIV1
1
2
C63
Vacuum Switching Valve (for Bank 2)
61
C45
AIV2
1
2
C64
Vacuum Switching Valve (for Bank 1)
63
C45
PRG
2
1
C55
Purge VSV
54
A38
AIP
AIP
2
97
C45
ETHW
E2
1
66
C45
VC
VC
3
81
C45
E1
D9
Air Pressure Sensor
ECM

for RHD:


A
B
C
D
30
C46
AIDI
54
C46
AIRP
28
C46
AIRV
60
C46
AIV1
1
2
C63
Vacuum Switching Valve (for Bank 2)
61
C46
AIV2
1
2
C64
Vacuum Switching Valve (for Bank 1)
63
C46
PRG
2
1
C55
Purge VSV
54
A52
AIP
AIP
2
97
C46
ETHW
E2
1
66
C46
VC
VC
3
81
C46
E1
D9
Air Pressure Sensor
ECM

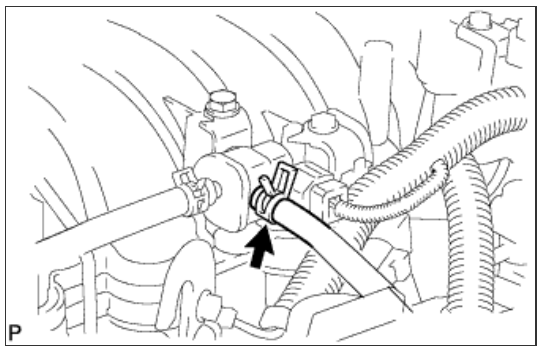
for Preparation Click here

1. CHECK PURGE VSV

a. Connect the intelligent tester to the DLC3.

b. Remove the V-bank cover (Click here).

c. Disconnect the hose (connected to the canister) from the purge VSV.



d. Start the engine and turn the tester main switch ON.

e. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the VSV for EVAP Control.

OK:

Tester Operation	Specified Condition
EVAP VSV: OFF	Purge VSV has no suction
EVAP VSV: ON	Purge VSV has suction

f. Connect the hose (connected to the canister) to the purge VSV.

g. Install the V-bank cover (Click here).

2. INSPECT FUEL CUT-OFF RPM

a. Start and warm up the engine.

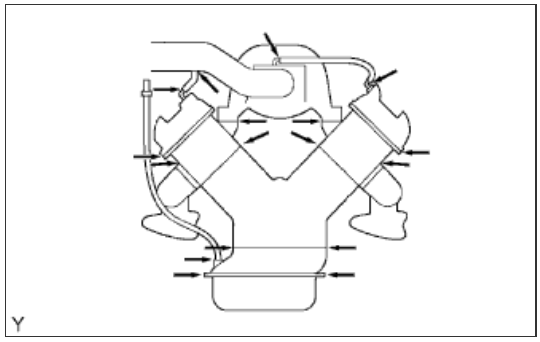
b. Open the throttle valve and keep the engine speed at 3000 rpm.

c. Use a sound scope to check for injector operating noise.

d. Check that when the accelerator pedal is released, injector operation noise stops momentaril and then resumes.
If the result is not as specified, check the injector, wiring and ECM.

3. VISUALLY INSPECT HOSES, CONNECTIONS AND GASKETS

a. Check that there are no cracks, leaks or damage.



HINT:

Separation of the engine oil dipstick, oil filler cap, ventilation hose, etc. ma cause an engine failure or engine malfunctions. Disconnection, looseness or cracks in the parts of the air induction s stem between the throttle bod and c linder head will allow air suction and cause an engine failure or engine malfunctions.

NOTICE:

- **Detachment or other problems with the engine oil dipstick, filler cap, ventilation hose and other components may cause the engine to run improperly.**
- **Disconnection, looseness or cracks in the parts of the air induction system between the throttle body and cylinder head will allow air suction and cause an engine failure or engine failure malfunctions.**

If the result is not as specified, replace parts as necessar .

4. CHECK HOSES AND CONNECTORS

a. Visuall check for loose connections, sharp bends or damage.

5. CHECK FUEL TANK ASSEMBLY

a. Visuall check for deformation, cracks or fuel leakage.

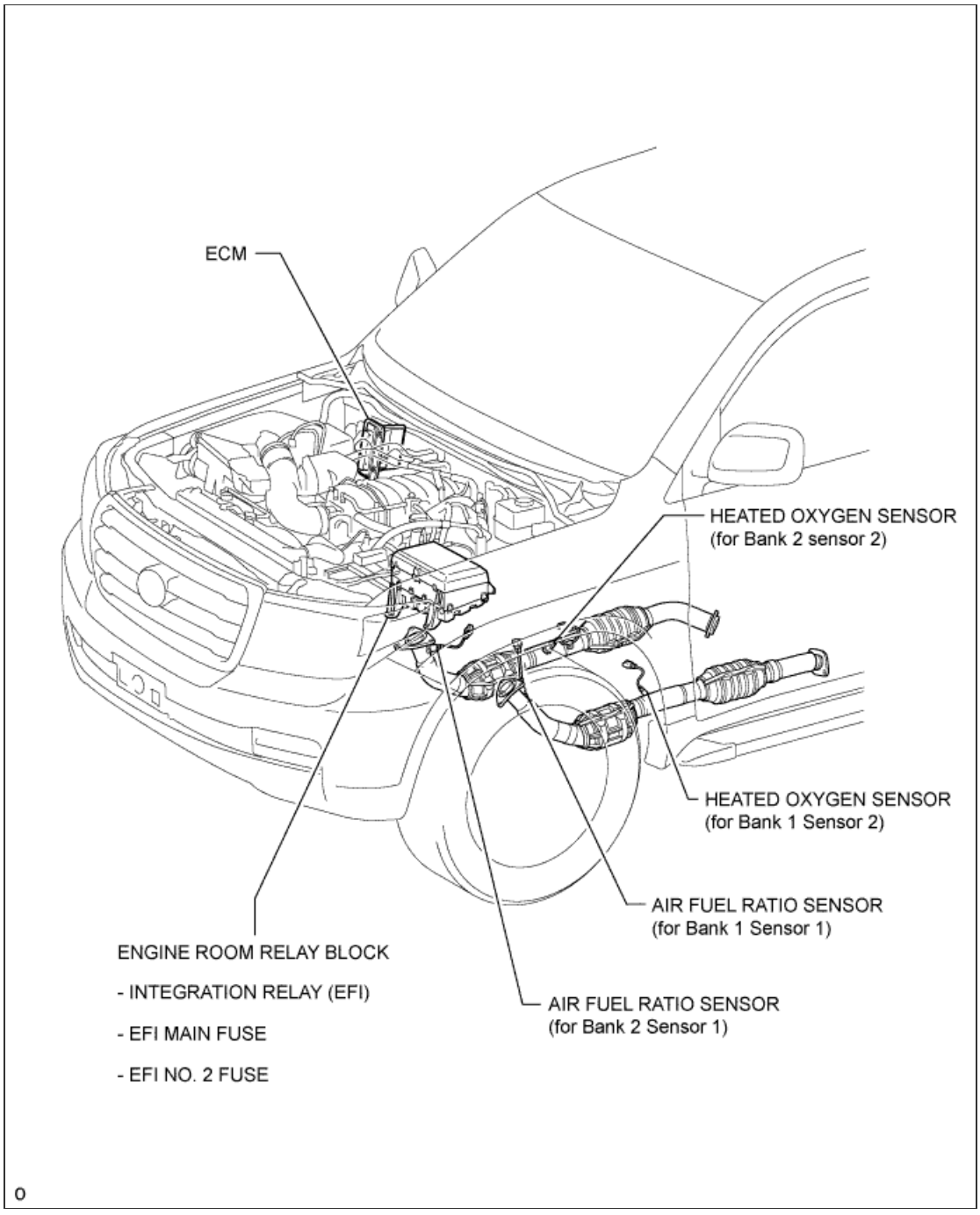
for reparation Click here

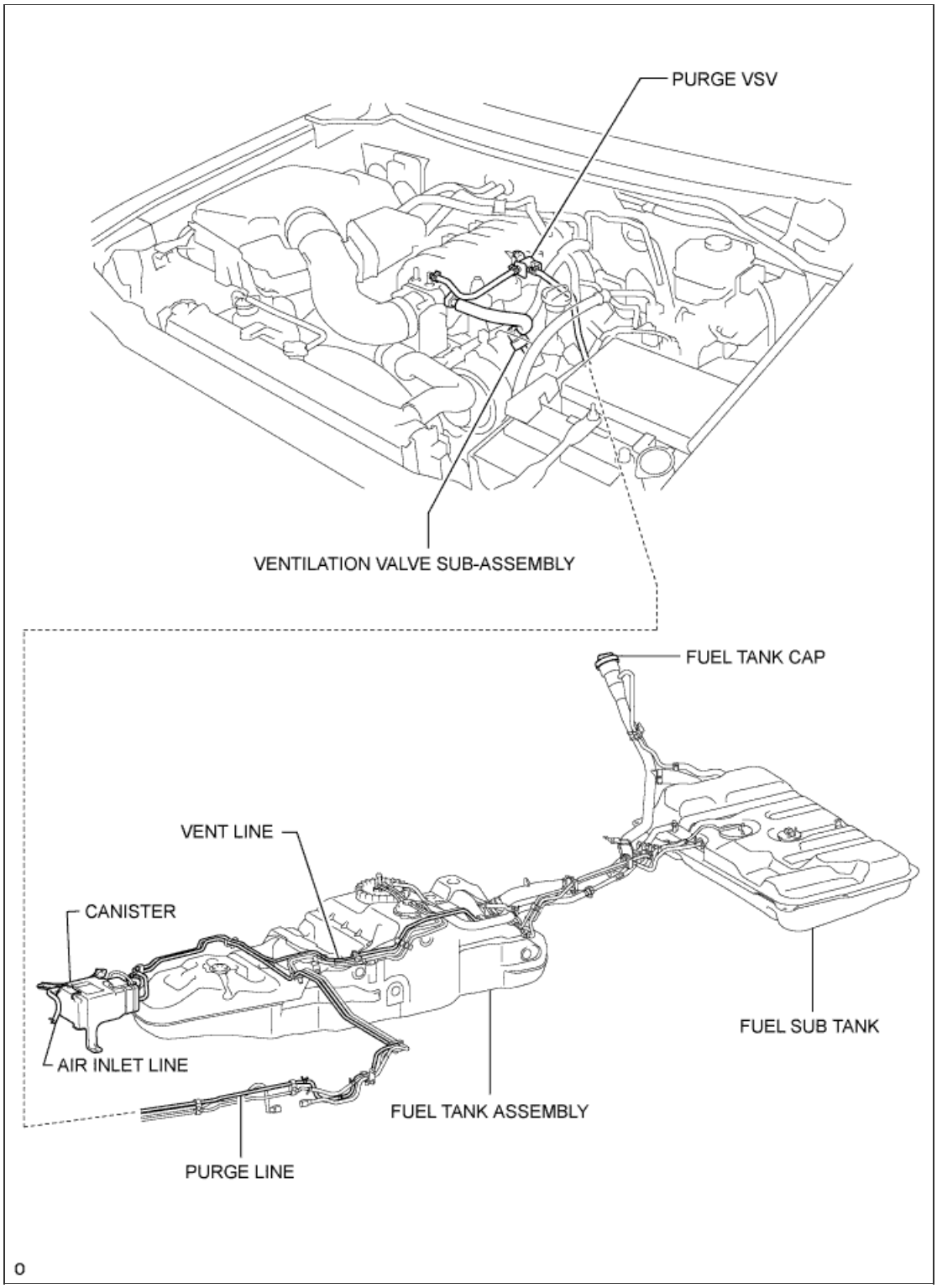
1.AIR INDUCTION SYSTEM

a. Removal of the engine oil dipstick, oil filler cap, PCV hose, etc. may damage the engine.

b. Disconnection, looseness or cracks in the parts of the air induction system between the throttle body and cylinder head may result in air suction and damage the engine.

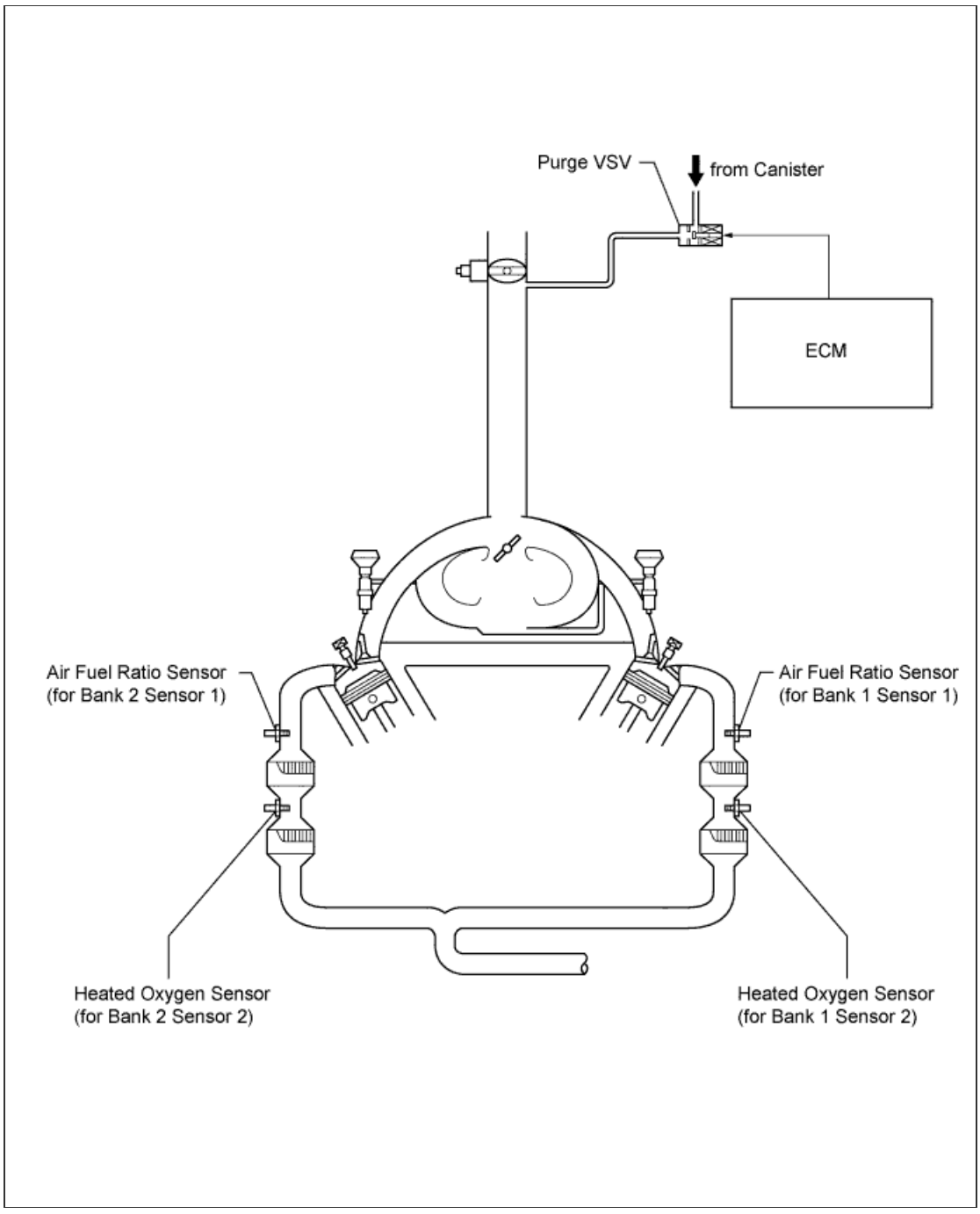
for re aration Click here



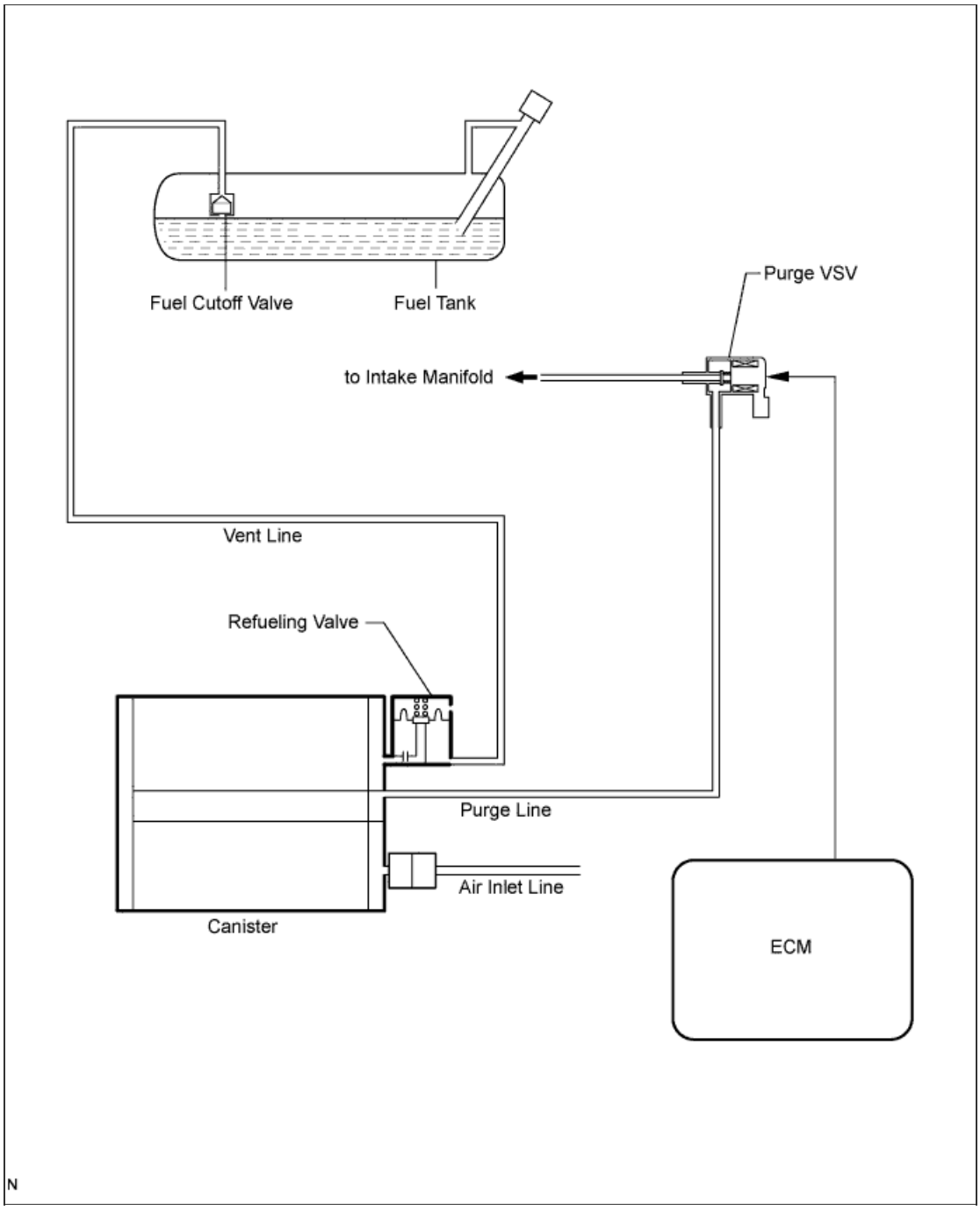

PURGE VSV
VENTILATION VALVE SUB-ASSEMBLY
FUEL TANK CAP
VENT LINE
CANISTER
AIR INLET LINE
FUEL SUB TANK
FUEL TANK ASSEMBLY
PURGE LINE

for reparation Click here

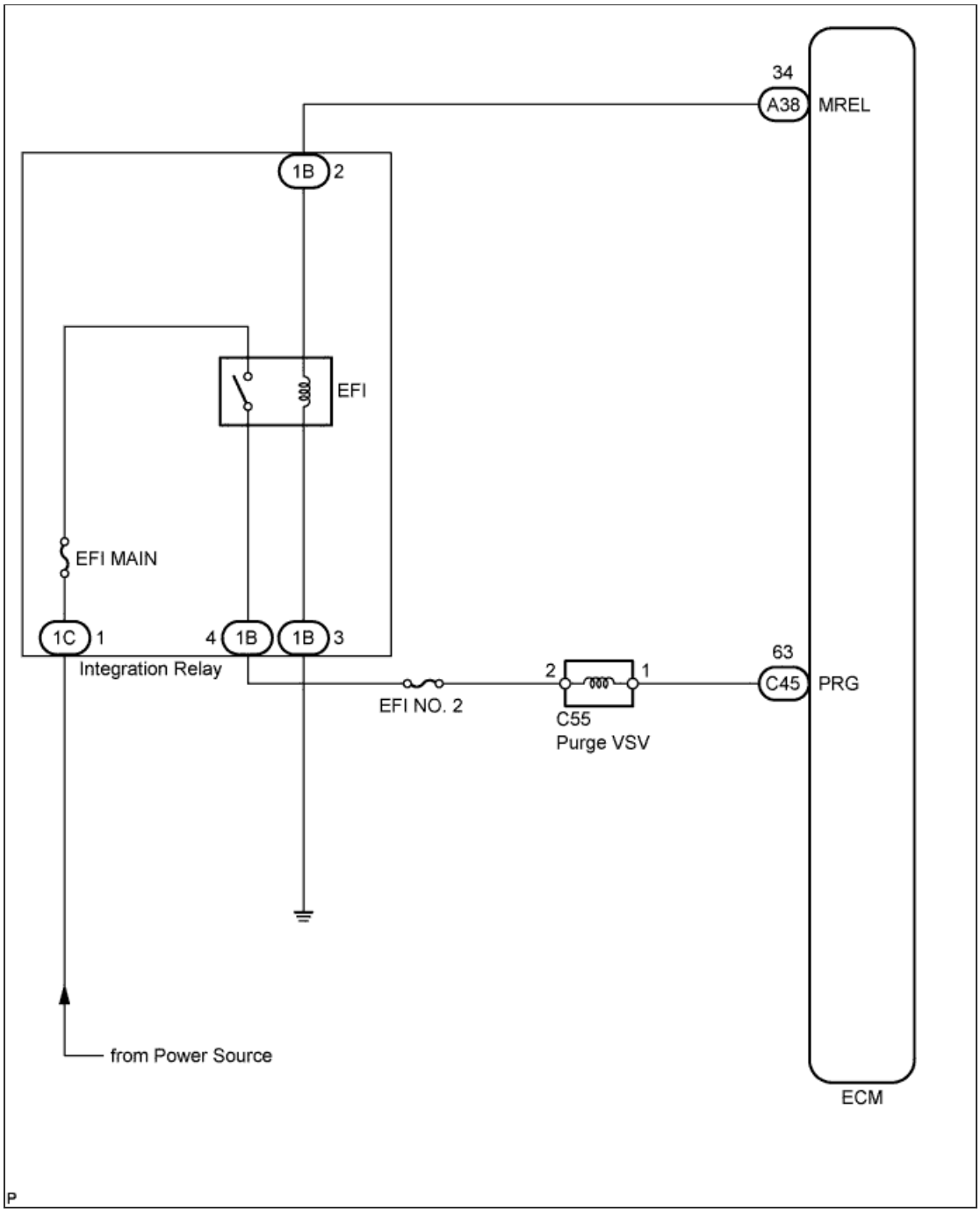
EMISSION CONTROL SYSTEM DIAGRAM



EVA CONTROL SYSTEM DIAGRAM



EVA SYSTEM WIRING DIAGRAM


34
A38
MREL
1B
2
EFI
EFI MAIN
1C
1
4
1B
1B
3
Integration Relay
EFI NO. 2
2
1
C55
Purge VSV
63
C45
PRG
ECM
from Power Source
P

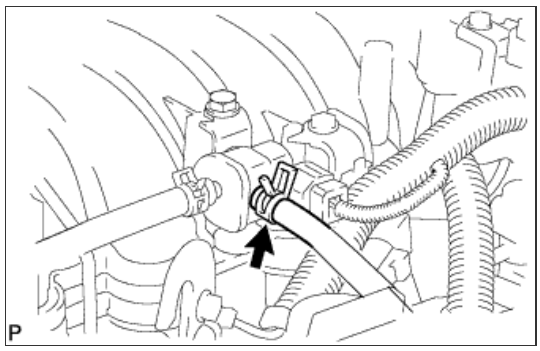
for Preparation Click here

1. CHECK PURGE VSV

a. Connect the intelligent tester to the DLC3.

b. Remove the V-bank cover (Click here).

c. Disconnect the hose (connected to the canister) from the purge VSV.



d. Start the engine and turn the tester main switch ON.

e. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the VSV for EVAP Control.

OK:

Tester Operation	Specified Condition
EVAP VSV: OFF	Purge VSV has no suction
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2. INSPECT FUEL CUT-OFF RPM

a. Start and warm up the engine.

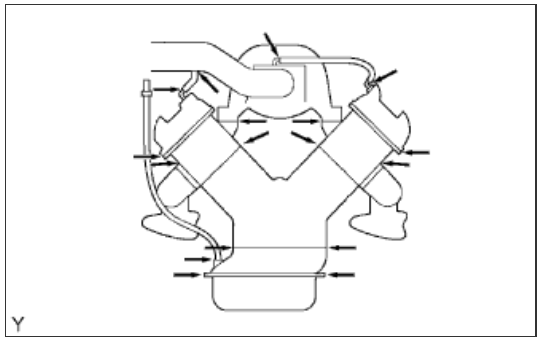
b. Open the throttle valve and keep the engine speed at 3000 rpm.

c. Use a sound scope to check for injector operating noise.

d. Check that when the accelerator pedal is released, injector operation noise stops momentaril and then resumes.
If the result is not as specified, check the injector, wiring and ECM.

3. VISUALLY INSPECT HOSES, CONNECTIONS AND GASKETS

a. Check that there are no cracks, leaks or damage.



HINT:

Separation of the engine oil dipstick, oil filler cap, ventilation hose, etc. ma cause an engine failure or engine malfunctions. Disconnection, looseness or cracks in the parts of the air induction s stem between the throttle bod and c linder head will allow air suction and cause an engine failure or engine malfunctions.

NOTICE:

- **Detachment or other problems with the engine oil dipstick, filler cap, ventilation hose and other components may cause the engine to run improperly.**
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If the result is not as specified, replace parts as necessar .

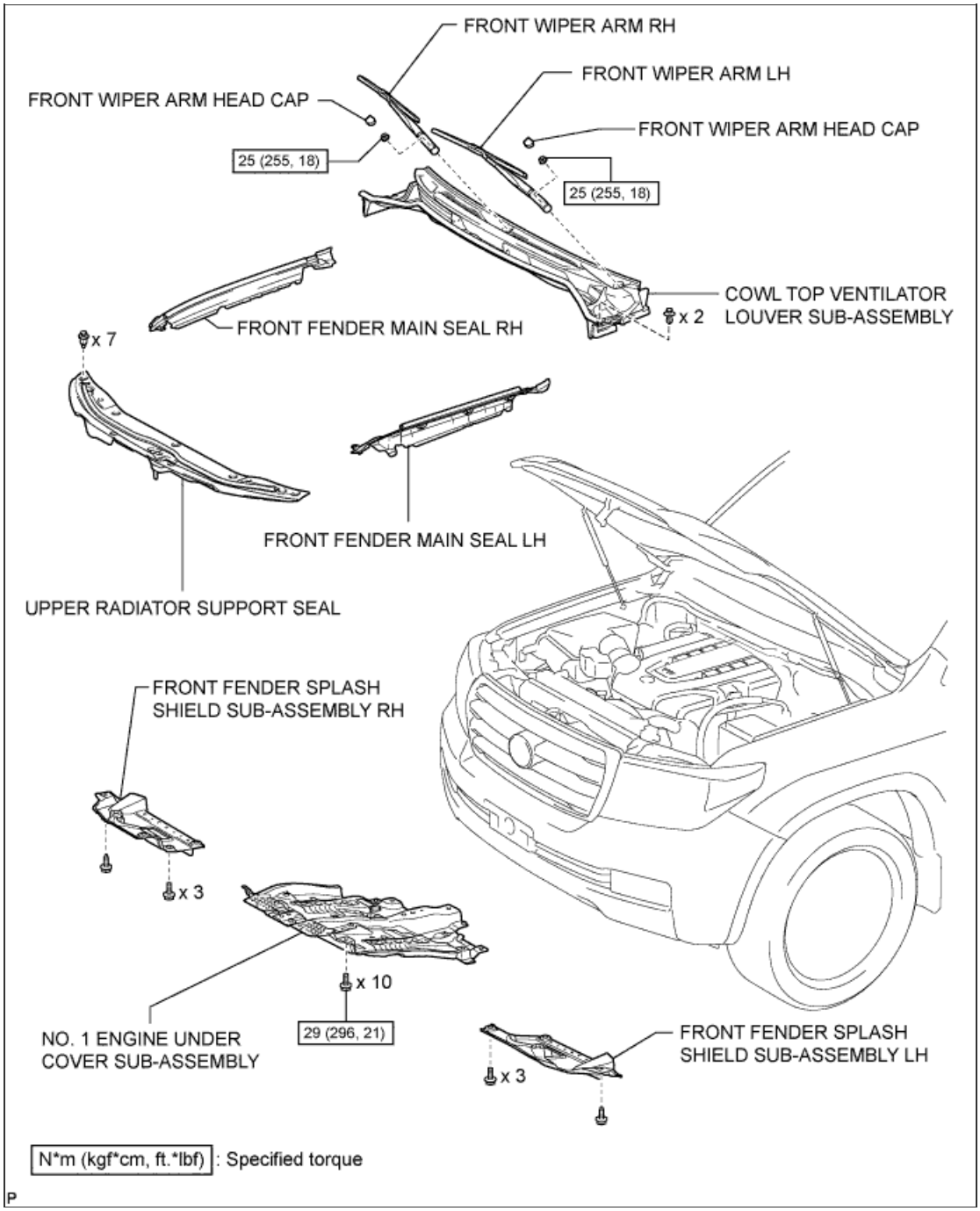
4. CHECK HOSES AND CONNECTORS

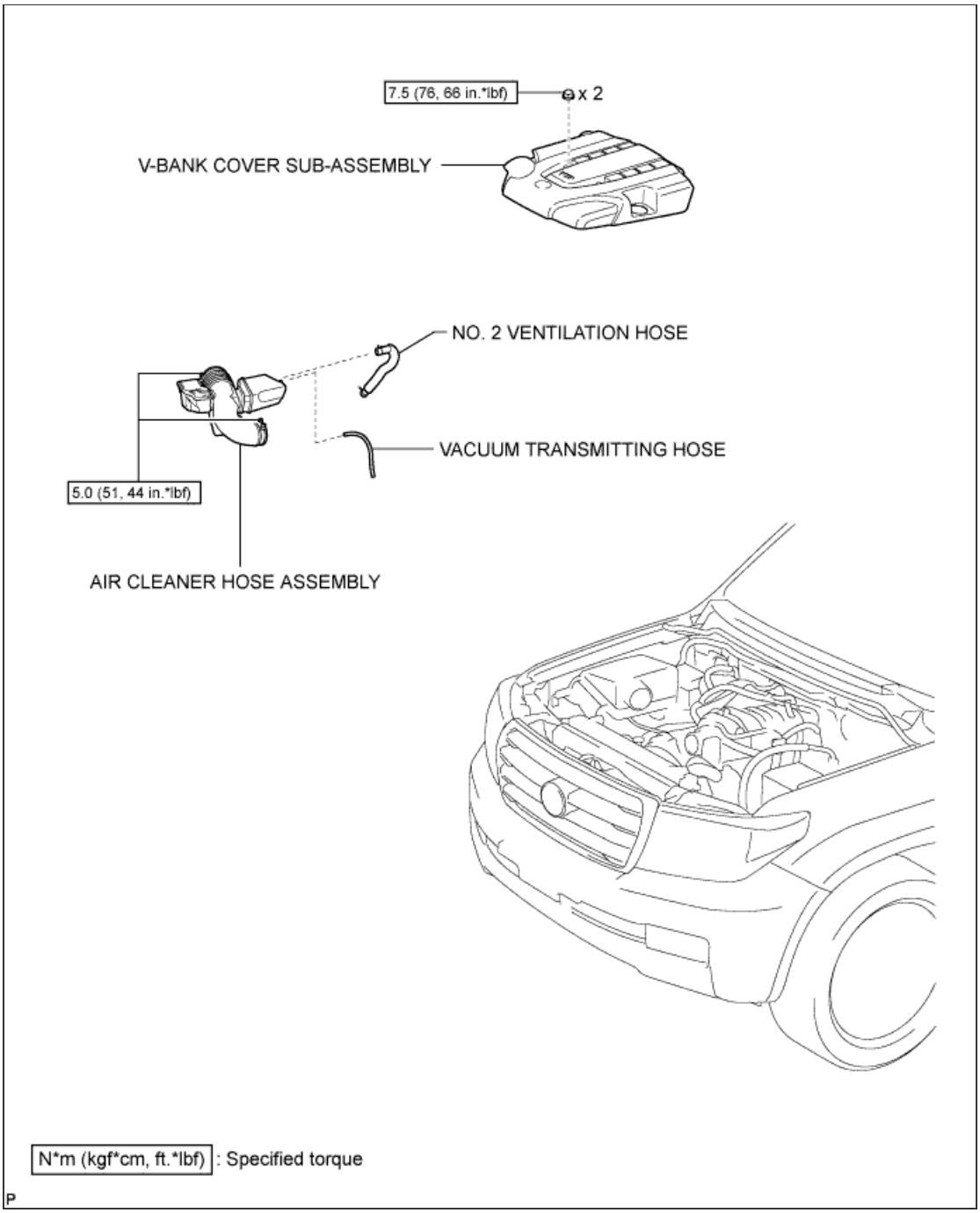
a. Visuall check for loose connections, sharp bends or damage.

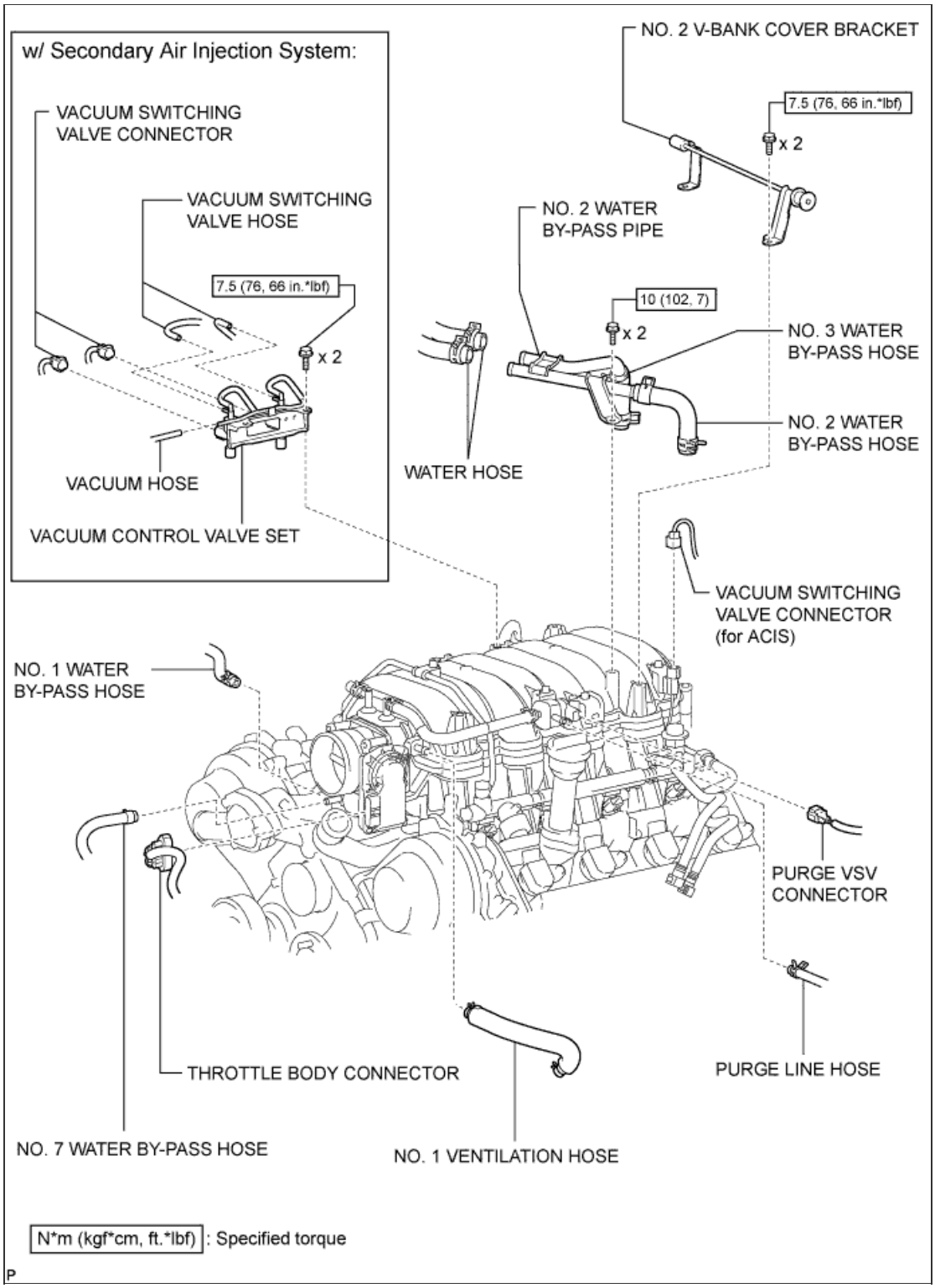
5. CHECK FUEL TANK ASSEMBLY

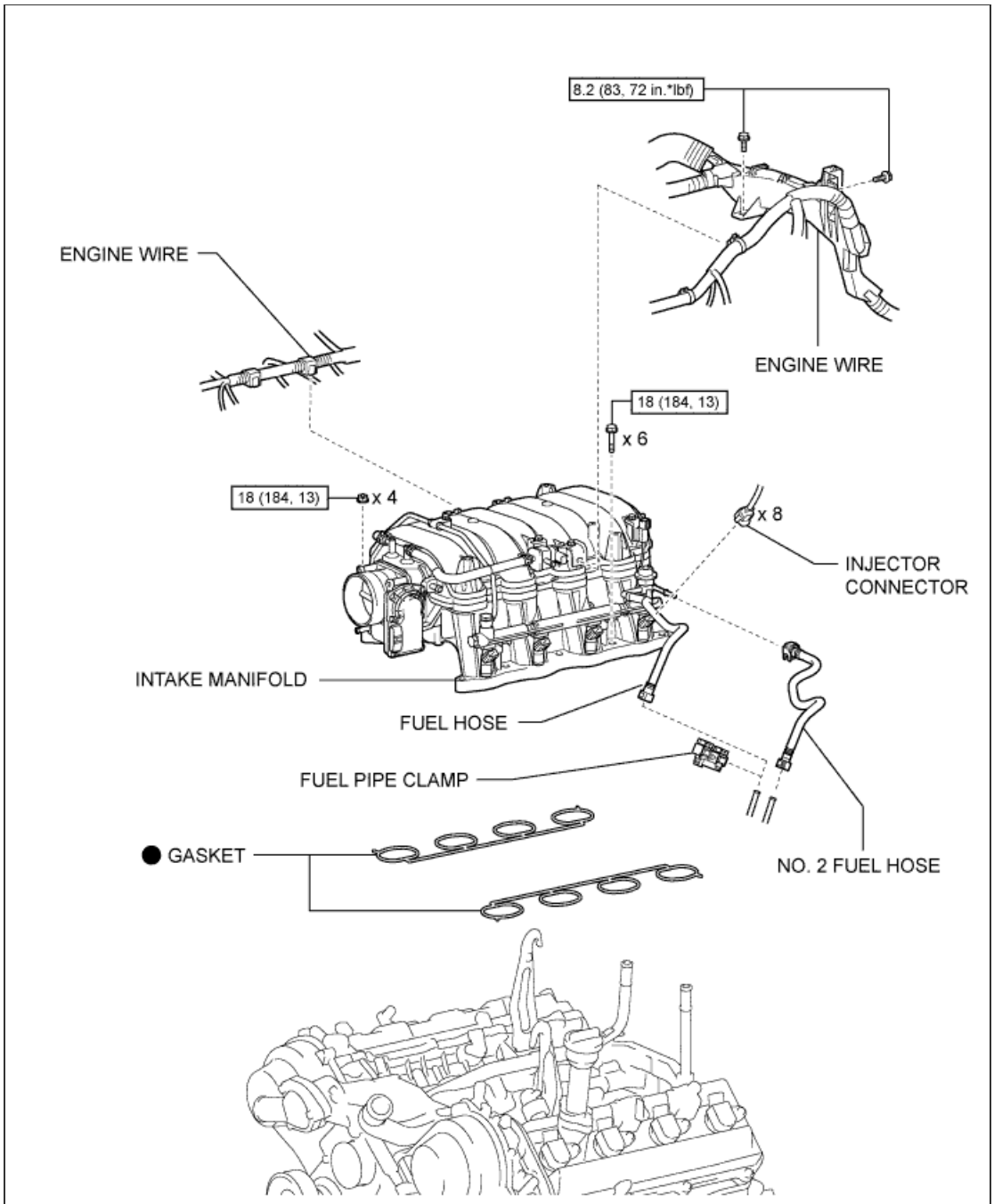
a. Visuall check for deformation, cracks or fuel leakage.

for Preparation Click here




7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER SUB-ASSEMBLY
NO. 2 VENTILATION HOSE
VACUUM TRANSMITTING HOSE
5.0 (51, 44 in.*lbf)
AIR CLEANER HOSE ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
P

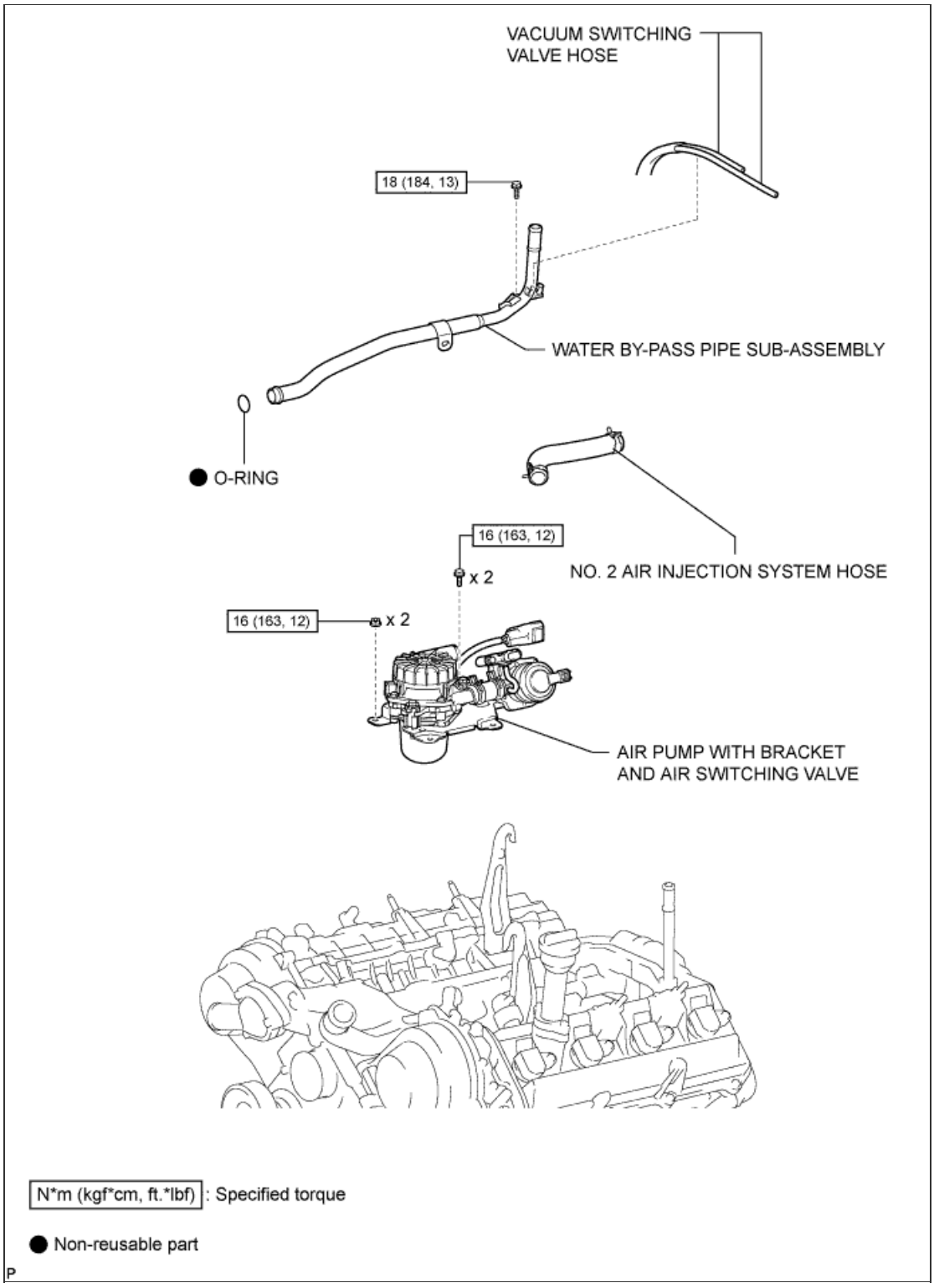

w/ Secondary Air Injection System:
VACUUM SWITCHING VALVE CONNECTOR
VACUUM SWITCHING VALVE HOSE
7.5 (76, 66 in.*lbf)
x 2
VACUUM HOSE
VACUUM CONTROL VALVE SET
NO. 2 V-BANK COVER BRACKET
7.5 (76, 66 in.*lbf)
x 2
NO. 2 WATER BY-PASS PIPE
10 (102, 7)
x 2
NO. 3 WATER BY-PASS HOSE
NO. 2 WATER BY-PASS HOSE
WATER HOSE
VACUUM SWITCHING VALVE CONNECTOR (for ACIS)
NO. 1 WATER BY-PASS HOSE
PURGE VSV CONNECTOR
THROTTLE BODY CONNECTOR
PURGE LINE HOSE
NO. 7 WATER BY-PASS HOSE
NO. 1 VENTILATION HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
P



N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

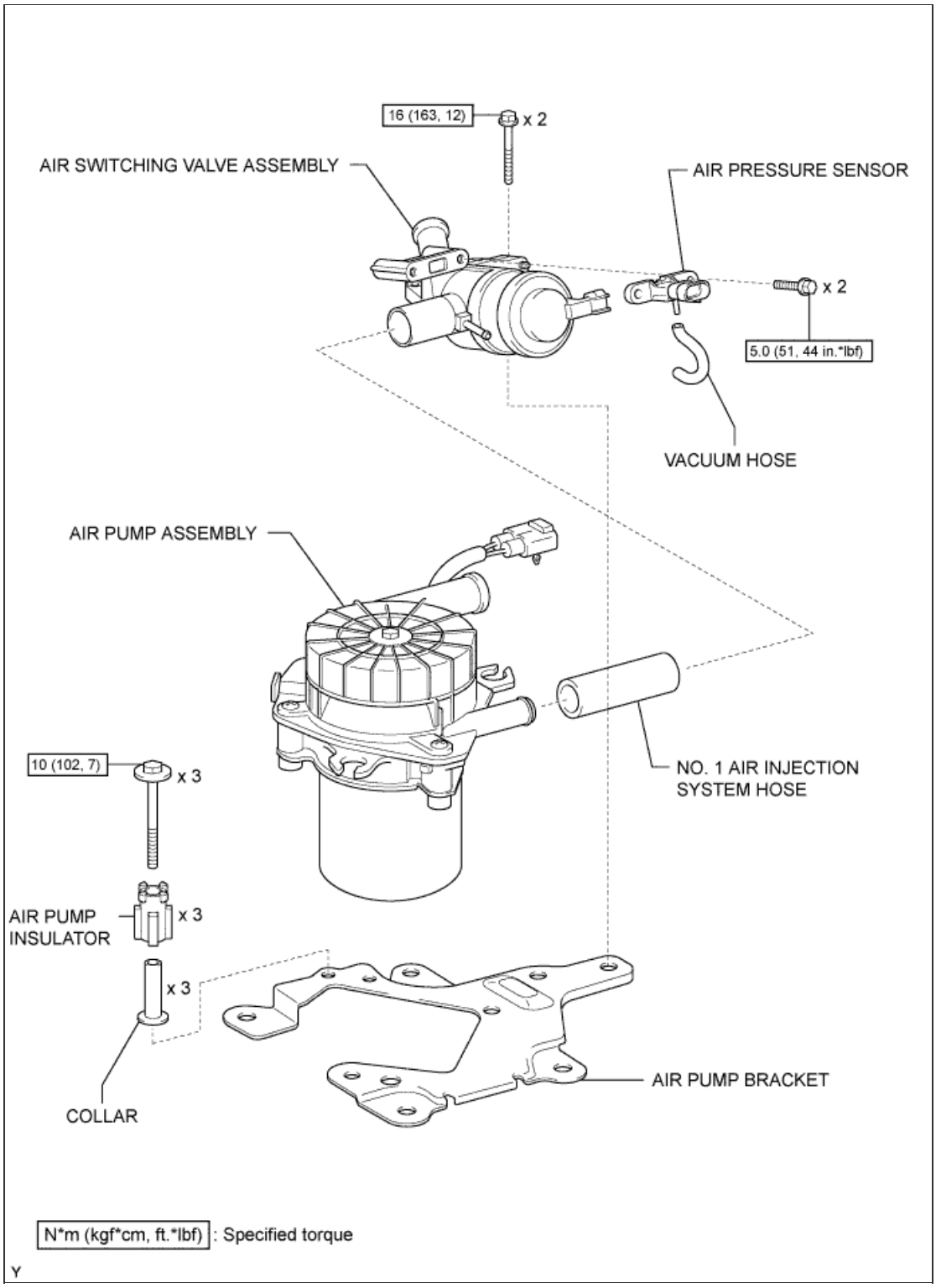
P



N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P


16 (163, 12)
x 2
AIR SWITCHING VALVE ASSEMBLY
AIR PRESSURE SENSOR
x 2
5.0 (51, 44 in.*lbf)
VACUUM HOSE
AIR PUMP ASSEMBLY
NO. 1 AIR INJECTION SYSTEM HOSE
10 (102, 7)
x 3
AIR PUMP INSULATOR
x 3
x 3
COLLAR
AIR PUMP BRACKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Y

for Preparation Click here

1. REMOVE INTAKE MANIFOLD

a. Remove the intake manifold (Click here).

2. REMOVE WATER BY-PASS PIPE SUB-ASSEMBLY

a. Disconnect the connector.

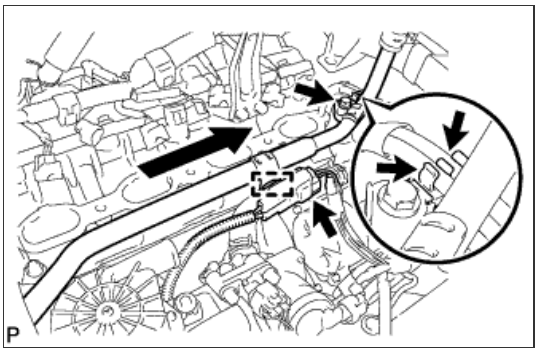
b. Disconnect the wire harness clamp from the water by-pass pipe.

c. Disconnect the 2 vacuum switching valve hoses from the water by-pass pipe clamp.

d. Remove the bolt.

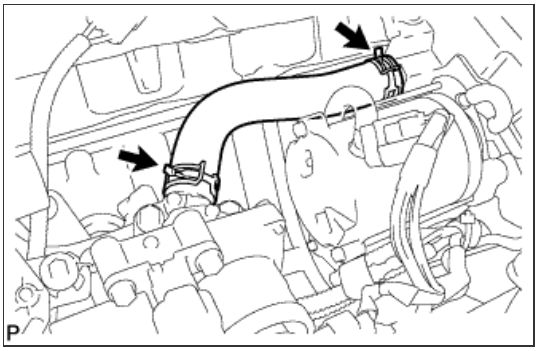
e. Pull out the water by-pass pipe.

f. Remove the O-ring from the water by-pass pipe.



3. REMOVE NO. 2 AIR INJECTION SYSTEM HOSE

a. Remove the No. 2 air injection system hose from the rear water by-pass joint and air switching valve.

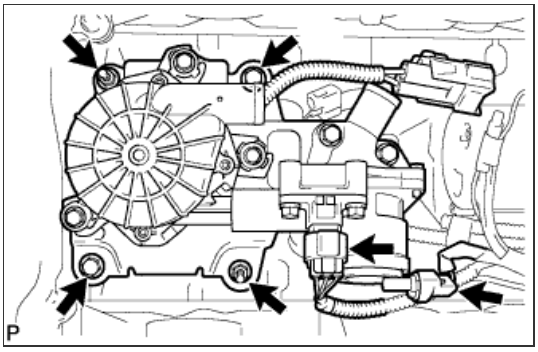


4. REMOVE AIR PUMP WITH BRACKET AND AIR SWITCHING VALVE

a. Disconnect the air switching valve connector.

b. Disconnect the air pressure sensor connector.

c. Remove the 2 bolts, 2 nuts and air pump with bracket.



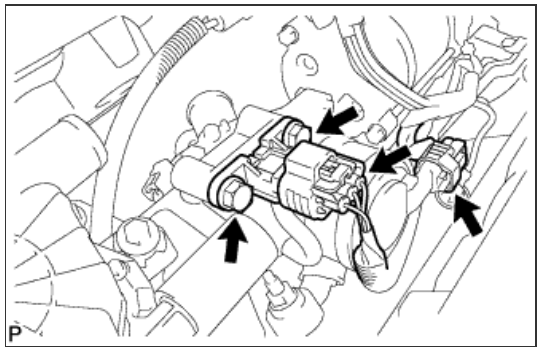
5. REMOVE AIR SWITCHING VALVE ASSEMBLY

a. Disconnect the air pressure sensor connector.

b. Disconnect the air switching valve connector.

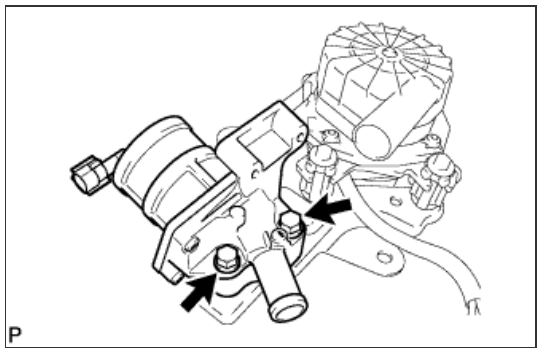
c. Remove the vacuum hose from the air pressure sensor and air switching valve.

d. Remove the 2 bolts and air pressure sensor from the air switching valve.



e. Remove the 2 bolts and air switching valve from the air pump bracket.

f. Remove the air switching valve from the No. 1 air injection system hose.



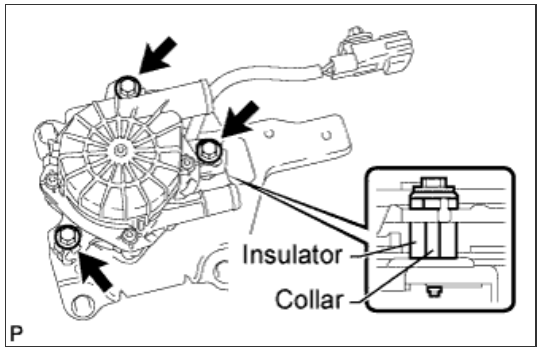
6. REMOVE NO. 1 AIR INJECTION SYSTEM HOSE

a. Remove the hose from the air pump assembly.

7. REMOVE AIR PUMP ASSEMBLY

a. Remove the air hose.

b. Remove the 3 bolts, 3 collars, 3 insulators and air pump.



for Preparation Click here

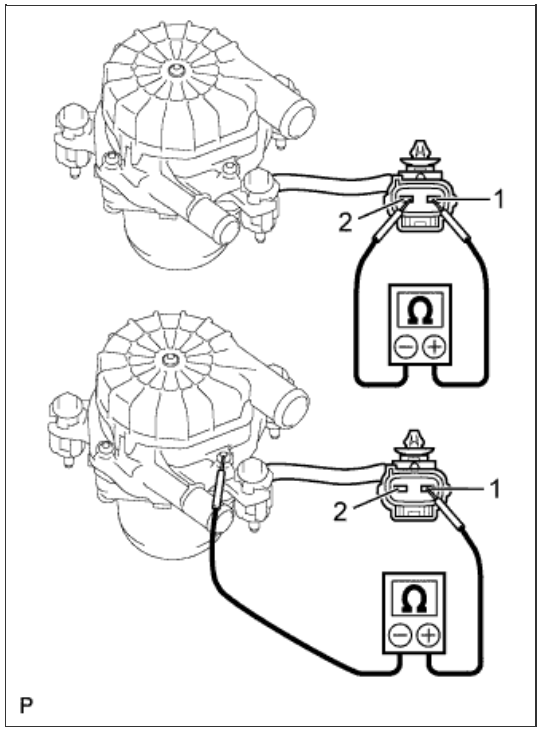
1. INSPECT AIR PUMP

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

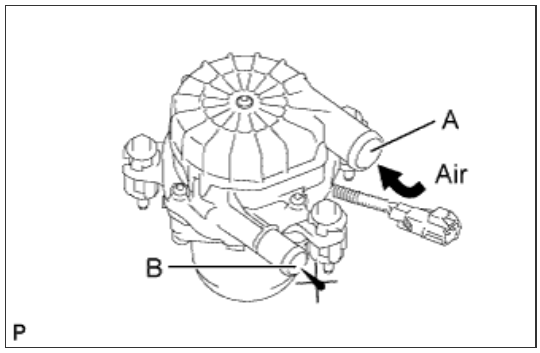
Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	0.4 to 1.0 Ω
1 - Body ground	Always	10 kΩ or higher
2 - Body ground		

If the result is not as specified, replace the air pump.



b. Check operation of the air pump.

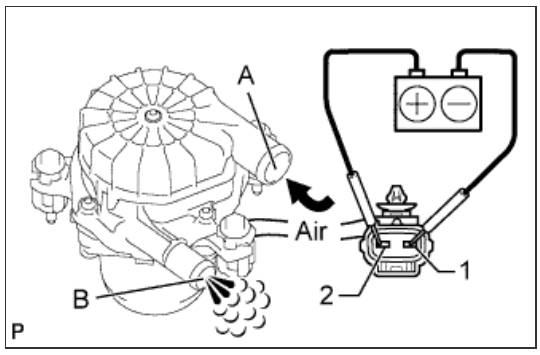
i. Check that air does not flow from port A to port B.
If the result is not as specified, replace the air pump.



ii. Apply battery voltage to the connector, and check the air pump operation.

NOTICE:

- **Do not operate the air pump continuously for 2 minutes or more.**
- **When operating the air pump, wait 5 minutes until the pump has cooled down between each operation. If the pump has not cooled down sufficiently, the motor will burn out.**



OK:

Measurement Condition	Specified Condition
Battery positive ( ) → Terminal 1 Battery negative (-) → Terminal 5	Air flows from port A to port B

If the result is not as specified, replace the air pump.

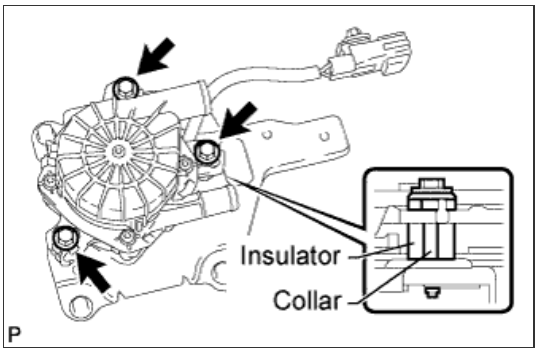
for Preparation Click here

1. INSTALL AIR PUMP ASSEMBLY

a. Install the air pump, 3 insulators and 3 collars with the 3 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Install the air hose.



2. INSTALL NO. 1 AIR INJECTION SYSTEM HOSE

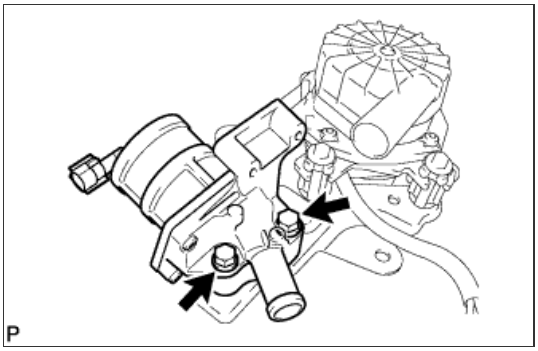
a. Install the hose to the air pump assembly.

3. INSTALL AIR SWITCHING VALVE ASSEMBLY

a. Install the air switching valve to the No. 1 air injection system hose.

b. Install the air switching valve to the air pump bracket with the 2 bolts.

Torque:
16 N*m{ 163 kgf*cm , 12 ft.*lbf }



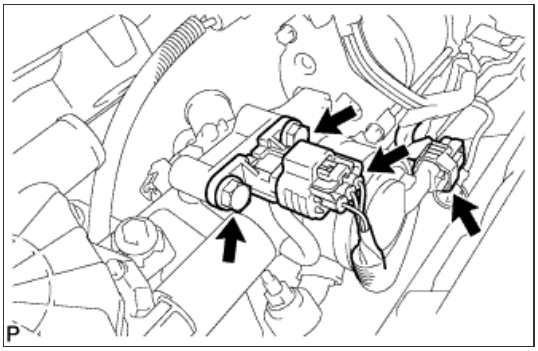
c. Install the air pressure sensor to the air switching valve with the 2 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

d. Install the vacuum hose to the air pressure sensor and air switching valve.

e. Connect the air pressure sensor connector.

f. Connect the air switching valve connector.



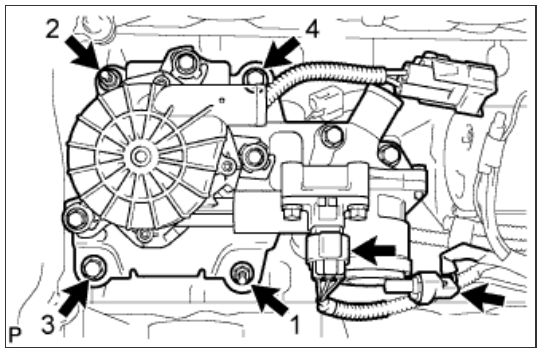
4. INSTALL AIR PUMP WITH BRACKET AND AIR SWITCHING VALVE

a. Install the air pump with bracket with the 2 bolts and 2 nuts in the order shown in the illustration.

Torque:
16 N*m{ 163 kgf*cm , 12 ft.*lbf }

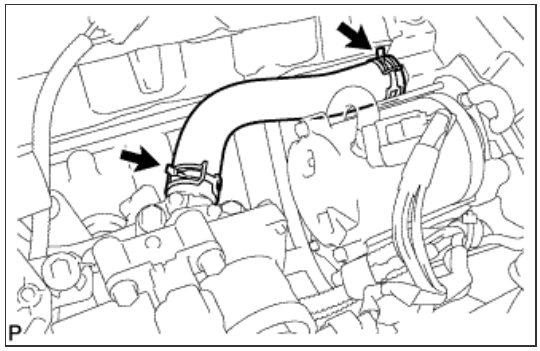
b. Connect the pressure sensor connector.

c. Connect the air switching valve connector.



5. INSTALL NO. 2 AIR INJECTION SYSTEM HOSE

a. Install the hose.



6. INSTALL WATER BY-PASS PIPE SUB-ASSEMBLY

a. Apply soapy water to the O-ring.

b. Install a new O-ring to the water by-pass pipe.

c. Push in the water by-pass pipe.

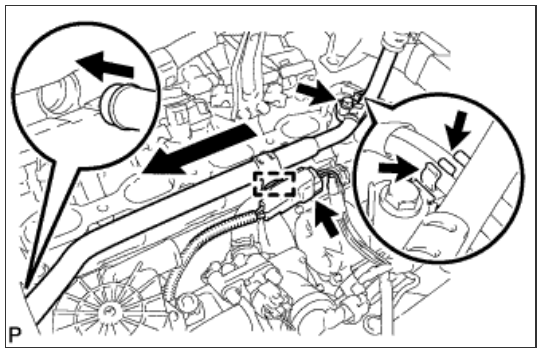
d. Install the water by-pass pipe with the bolt.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

e. Connect the 2 vacuum switching valve hoses to the water by-pass pipe clamp.

f. Connect the wire harness clamp.

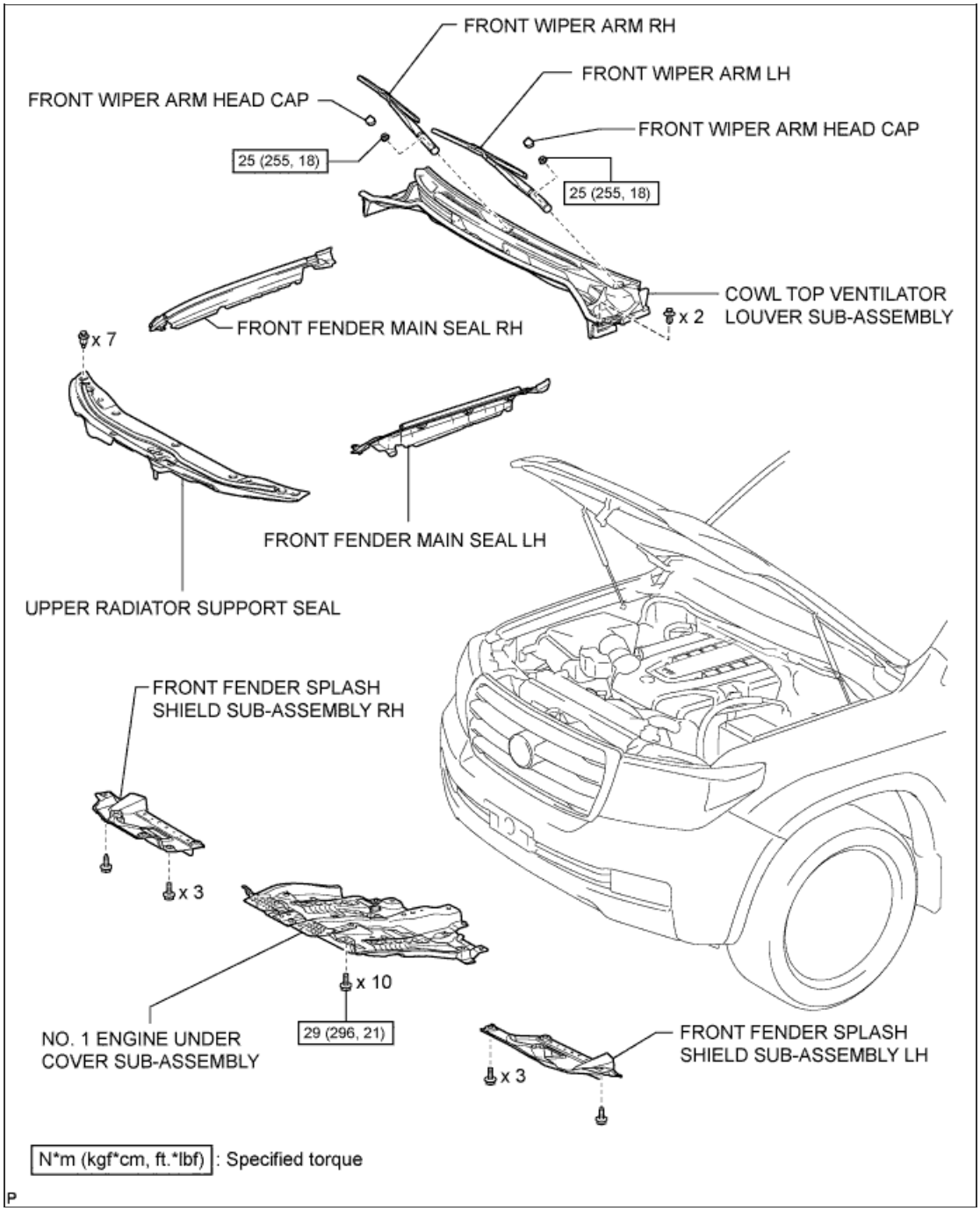
g. Connect the connector.

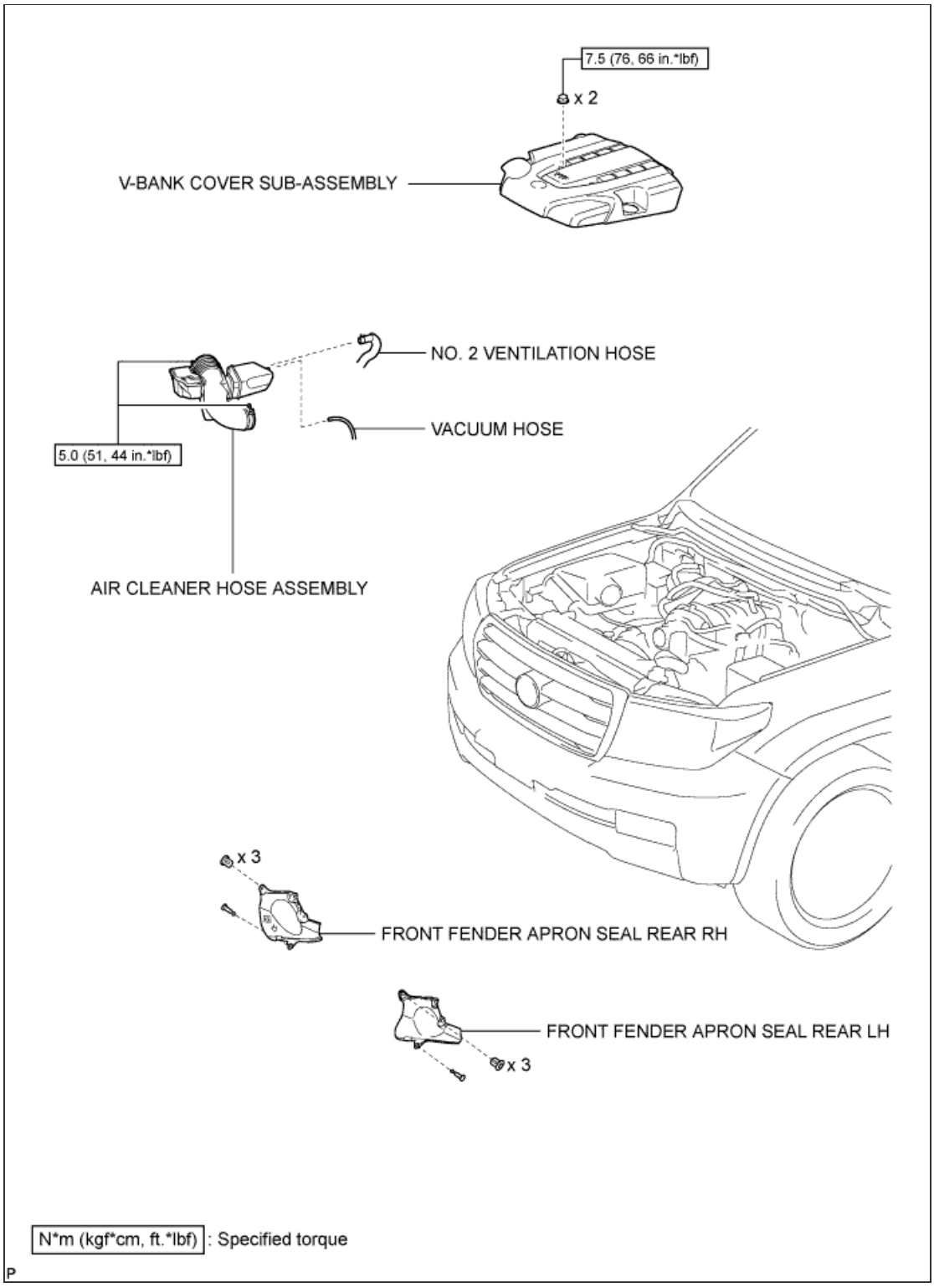


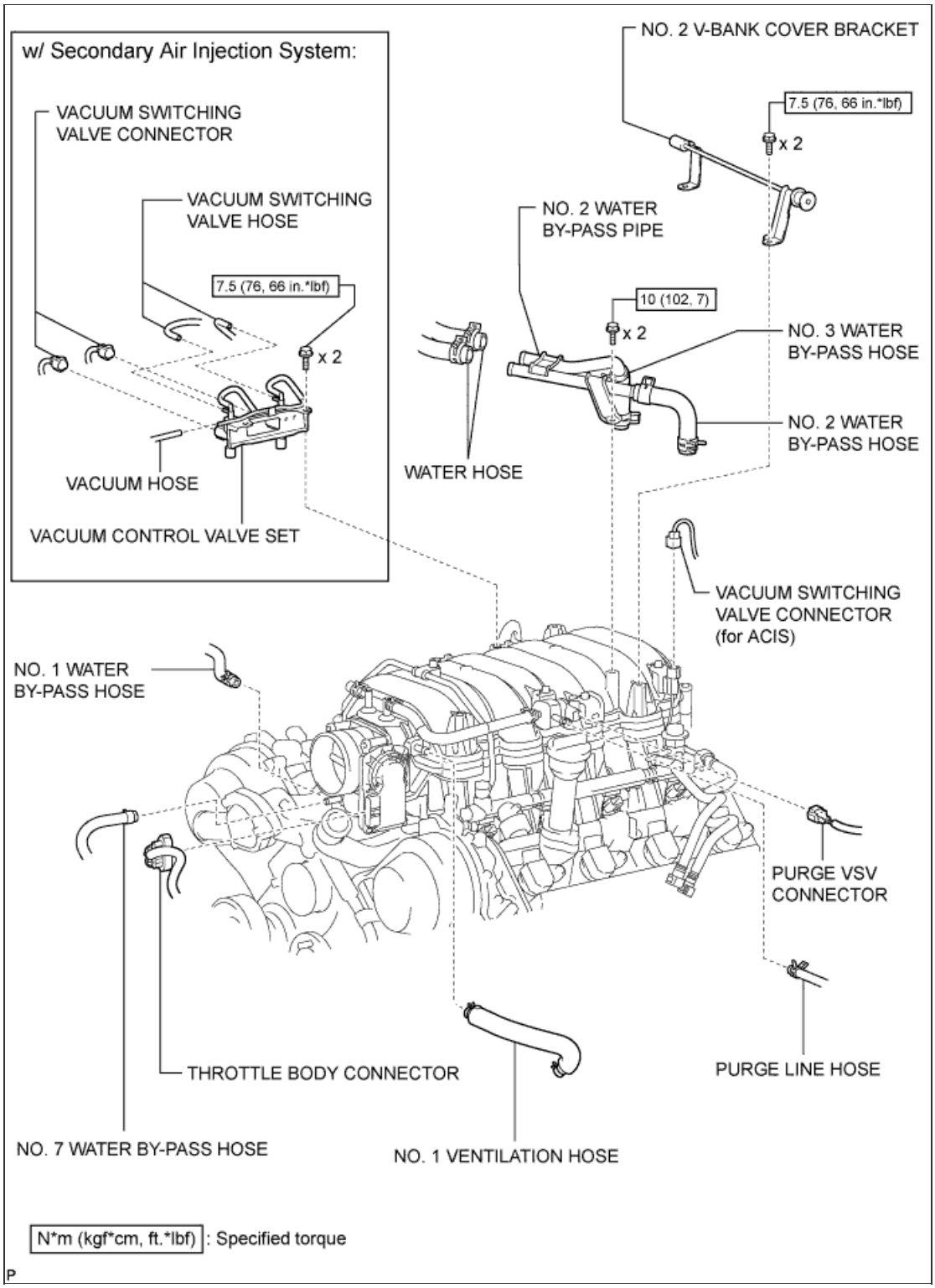
7. INSTALL INTAKE MANIFOLD

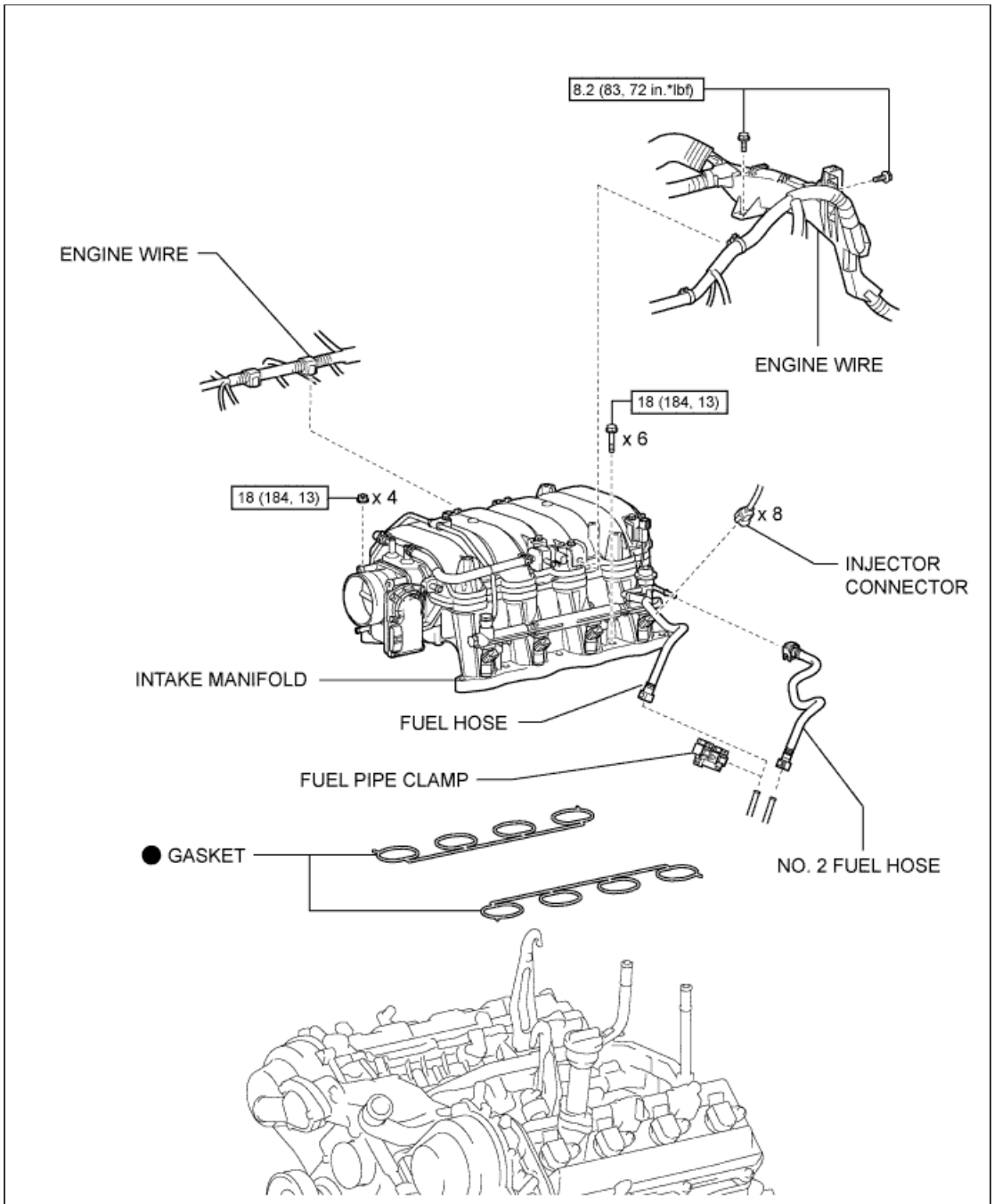
a. Install the intake mani old (Click here).

for reparation Click ere




7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER SUB-ASSEMBLY
NO. 2 VENTILATION HOSE
VACUUM HOSE
5.0 (51, 44 in.*lbf)
AIR CLEANER HOSE ASSEMBLY
x 3
FRONT FENDER APRON SEAL REAR RH
FRONT FENDER APRON SEAL REAR LH
x 3
N*m (kgf*cm, ft.*lbf) : Specified torque
P

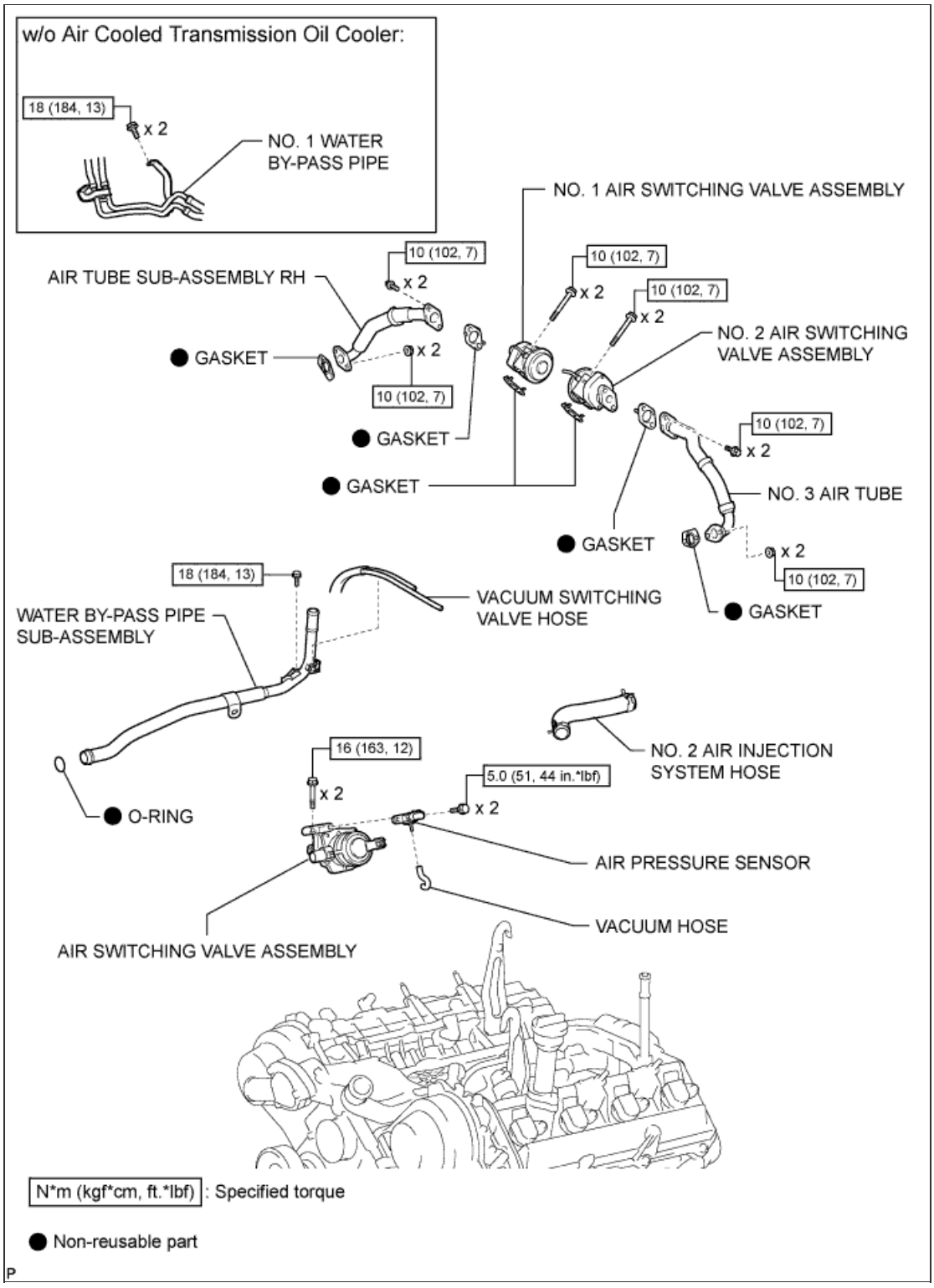

w/ Secondary Air Injection System:
VACUUM SWITCHING VALVE CONNECTOR
VACUUM SWITCHING VALVE HOSE
7.5 (76, 66 in.*lbf)
x 2
VACUUM HOSE
VACUUM CONTROL VALVE SET
NO. 2 V-BANK COVER BRACKET
7.5 (76, 66 in.*lbf)
x 2
NO. 2 WATER BY-PASS PIPE
10 (102, 7)
x 2
NO. 3 WATER BY-PASS HOSE
NO. 2 WATER BY-PASS HOSE
WATER HOSE
VACUUM SWITCHING VALVE CONNECTOR (for ACIS)
NO. 1 WATER BY-PASS HOSE
PURGE VSV CONNECTOR
THROTTLE BODY CONNECTOR
PURGE LINE HOSE
NO. 7 WATER BY-PASS HOSE
NO. 1 VENTILATION HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
P



N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P


w/o Air Cooled Transmission Oil Cooler:
18 (184, 13)
x 2
NO. 1 WATER BY-PASS PIPE
NO. 1 AIR SWITCHING VALVE ASSEMBLY
AIR TUBE SUB-ASSEMBLY RH
10 (102, 7)
x 2
GASKET
NO. 2 AIR SWITCHING VALVE ASSEMBLY
NO. 3 AIR TUBE
WATER BY-PASS PIPE SUB-ASSEMBLY
VACUUM SWITCHING VALVE HOSE
O-RING
16 (163, 12)
5.0 (51, 44 in.*lbf)
NO. 2 AIR INJECTION SYSTEM HOSE
AIR PRESSURE SENSOR
VACUUM HOSE
AIR SWITCHING VALVE ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

for Preparation Click here

1. CHECK AIR PRESSURE SENSOR

a. Remove the intake manifold (Click here).

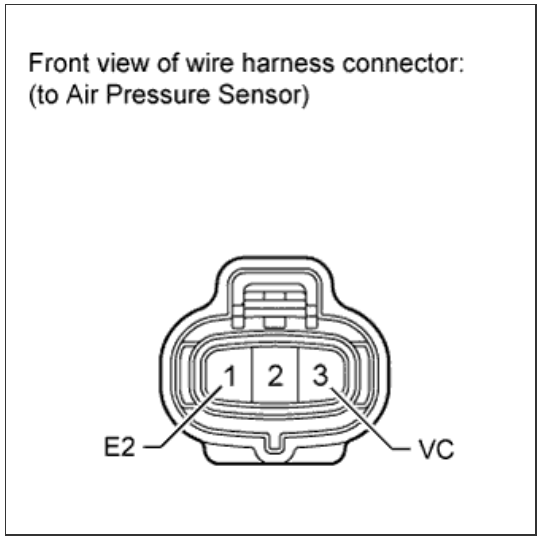
b. Disconnect the air pressure sensor connector.

c. Turn the engine switch on (IG).

d. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
3 (VC) - 1 (E2)	Engine switch on (IG)	4.5 to 5.5 V

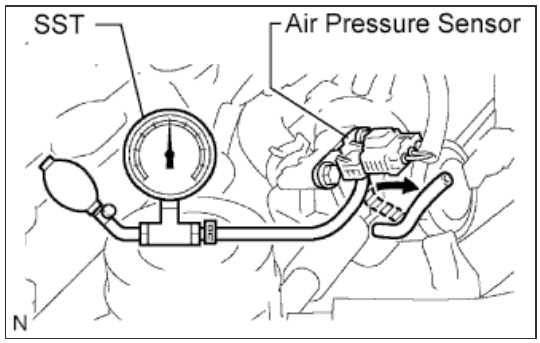


e. Turn the engine switch off.

f. Connect the air pressure sensor connector.

g. Connect SST (turbocharger pressure gauge) to the air pressure sensor as shown in the illustration.

SST
09992-00242



h. Connect the intelligent tester to the DLC3.

i. Turn the engine switch on (IG).

j. Turn the tester main switch on.

k. Enter the following menus: Powertrain / Engine and ECT / Data List / Air pump pressure (absolute).

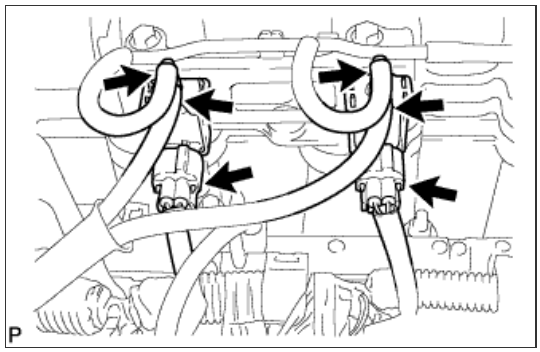
OK:
Pressure fluctuates in response to the pressure applied with pressure gauge.

l. Check that the pressure displayed on the intelligent tester fluctuates when applying pressure to the pressure sensor with the pressure gauge.

2. CHECK VACUUM CONTROL VALVE SET

a. Disconnect the 2 connectors.

b. Disconnect the 2 vacuum switching valve hoses and 2 vacuum hoses from the VSV.

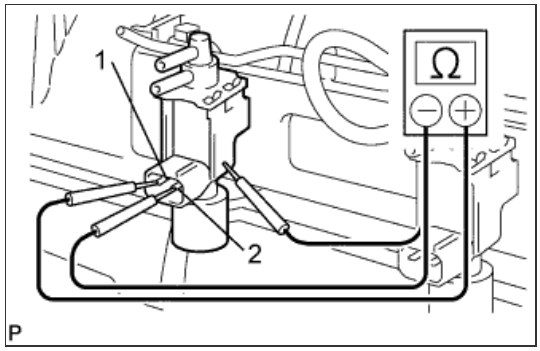


c. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

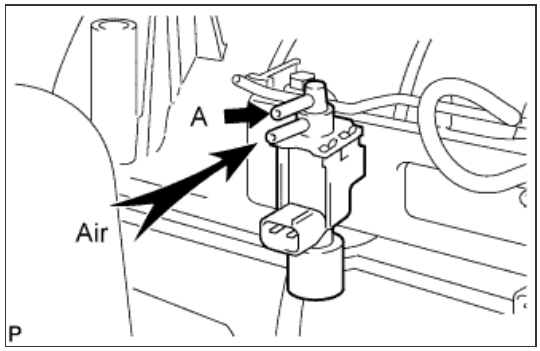
Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	33 to 39 Ω
1 - Body ground	Always	1 MΩ or higher
2 - Body ground		1 MΩ or higher

If the resistance is not as specified replace the VSV.



d. Apply air to the port as shown in the illustration.

e. Check that air does not flow from port A.
If the result is not as specified replace the VSV.



f. Apply positive battery voltage to the terminals apply air to the port and check that air flows from the port shown in the illustration.
If the result is not as specified replace the VSV.

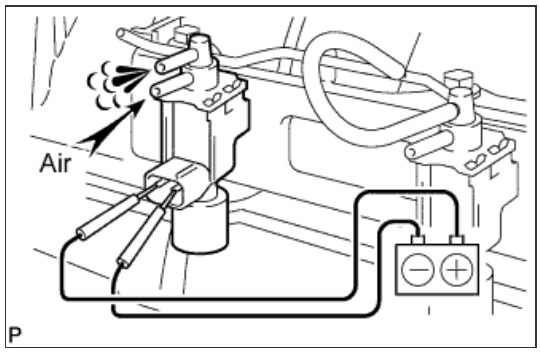
g. Connect the 2 vacuum switching valve hoses and 2 vacuum hoses to the VSV.

NOTICE:

Be sure to connect the vacuum hoses correctly.

h. Connect the 2 VSV connectors.

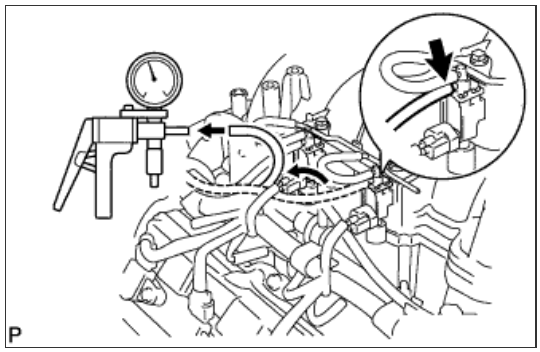
i. Perform the "Check Vacuum Switching Valve" procedures above on the other VSV.



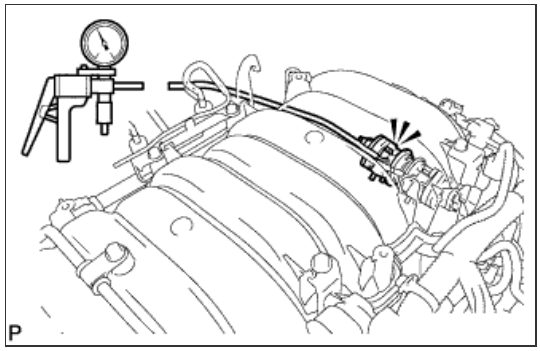
3. CHECK NO. 1 AIR SWITCHING VALVE ASSEMBLY

a. Disconnect the vacuum switching valve hose from the VSV for the air injection system.

b. Apply vacuum of 60 kPa (450 mmHg 1 . in.Hg) to the vacuum switching valve hose and check that the vacuum does not decrease.
If the operation is not as specified replace the No. 1 air switching valve assembly.



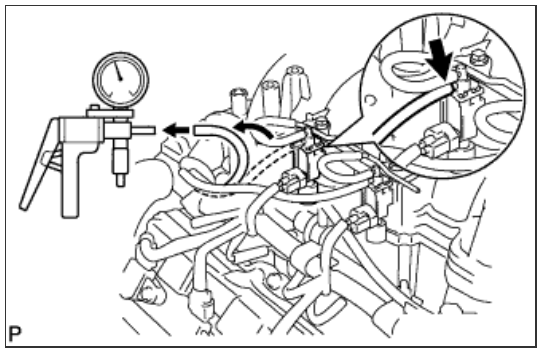
c. Release the vacuum and check that the operation sound is emitted from the No. 1 air switching valve assembly.
If the operation is not as specified replace the No. 1 air switching valve assembly.



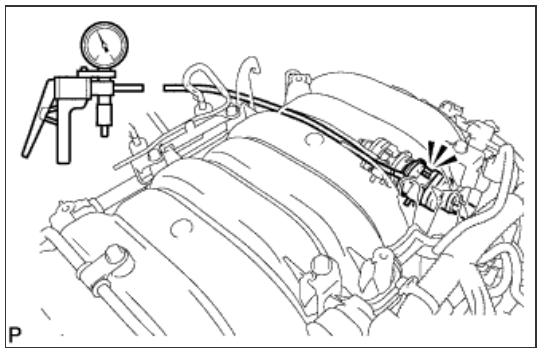
4. CHECK NO. 2 AIR SWITCHING VALVE ASSEMBLY

a. Disconnect the vacuum switching valve hose from the VSV for the air injection system.

b. Apply vacuum of 60 kPa (450 mmHg 1 . in.Hg) to the vacuum switching valve hose and check that the vacuum does not decrease.
If the operation is not as specified replace the No. 2 air switching valve assembly.



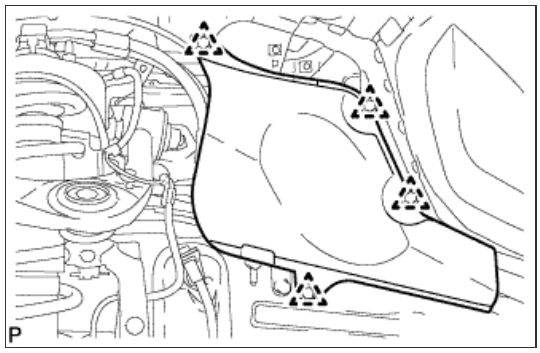
c. Release the vacuum and check that the operation sound is emitted from the No. 2 air switching valve assembly.
If the operation is not as specified replace the No. 2 air switching valve assembly.



for Preparation Click here

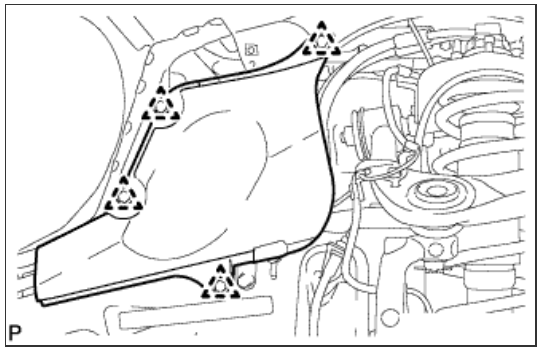
1. REMOVE FRONT FENDER APRON SEAL REAR LH

a. Using a clip remover, remove the 4 clips and fender apron seal.



2. REMOVE FRONT FENDER APRON SEAL REAR RH

a. Using a clip remover, remove the 4 clips and fender apron seal.



3. REMOVE INTAKE MANIFOLD

a. Remove the intake manifold (Click here).

4. REMOVE WATER BY-PASS PIPE SUB-ASSEMBLY

a. Disconnect the connector.

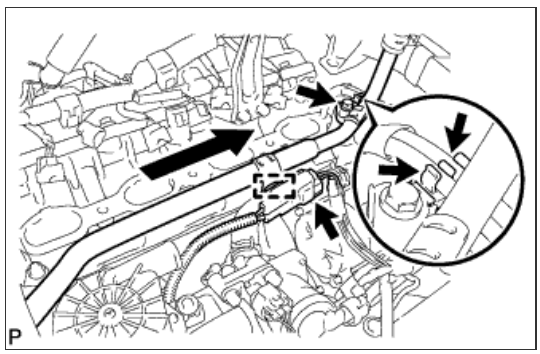
b. Disconnect the wire harness clamp from the water by-pass pipe.

c. Disconnect the 2 vacuum switching valve hoses from the water by-pass pipe clamp.

d. Remove the bolt.

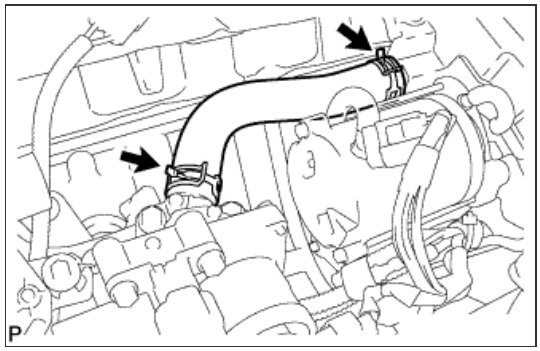
e. Pull out the water by-pass pipe.

f. Remove the O-ring from the water by-pass pipe.



5. REMOVE NO. 2 AIR INJECTION SYSTEM HOSE

a. Remove the No. 2 air injection system hose from the rear water by-pass joint and air switching valve.



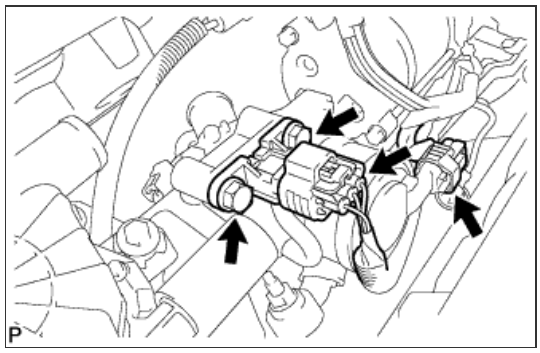
6. REMOVE AIR SWITCHING VALVE ASSEMBLY

a. Disconnect the air pressure sensor connector.

b. Disconnect the air switching valve connector.

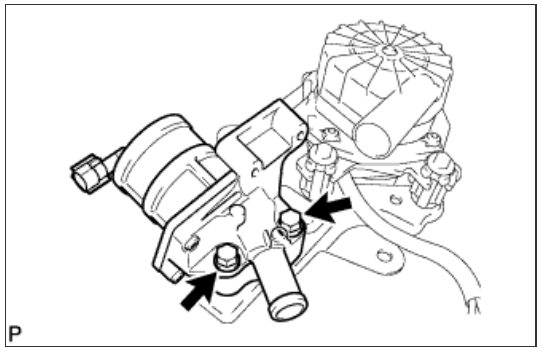
c. Remove the vacuum hose from the air pressure sensor and air switching valve.

d. Remove the 2 bolts and air pressure sensor from the air switching valve.



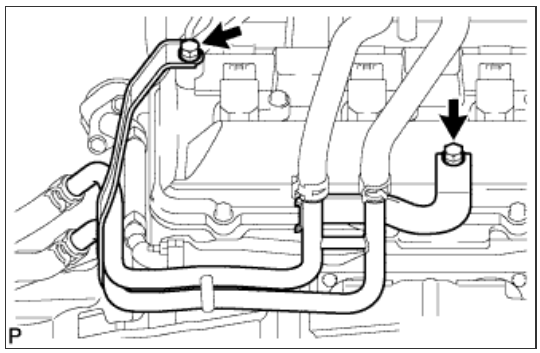
e. Remove the 2 bolts and air switching valve from the air pump bracket.

f. Remove the air switching valve from the No. 1 air injection system hose.



7. DISCONNECT NO. 1 WATER BY-PASS PIPE (w/o Air Cooled Transmission Oil Cooler)

a. Remove the 2 bolts and disconnect the water by-pass pipe from the cylinder head cover RH.

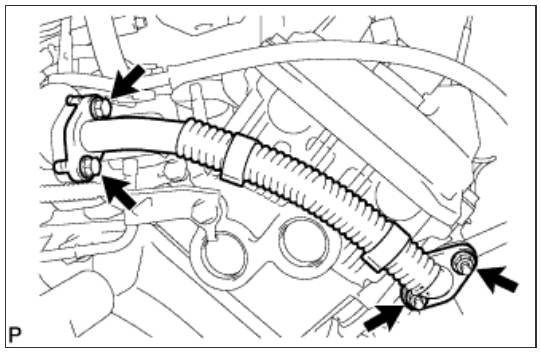


8. REMOVE AIR TUBE SUB-ASSEMBLY RH

a. Remove the 2 bolts, 2 nuts and air tube sub-assembly.

a. Remove the 2 bolts, 2 nuts and air tube sub-assembly.

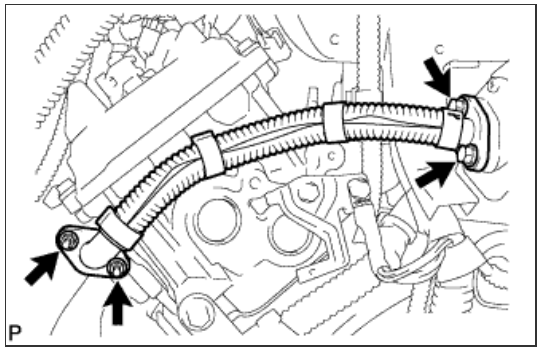
b. Remove the 2 gaskets.



9. REMOVE NO. 3 AIR TUBE

a. Remove the 2 bolts, 2 nuts and No. 3 air tube.

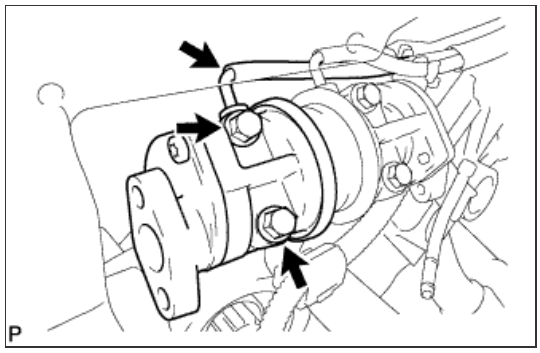
b. Remove the 2 gaskets.



10. REMOVE NO. 2 AIR SWITCHING VALVE ASSEMBLY

a. Remove the vacuum switching valve hose from the No. 2 air switching valve.

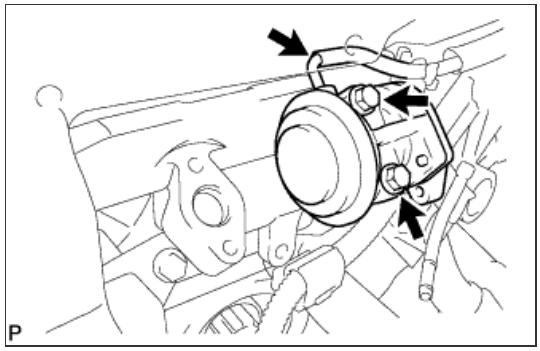
b. Remove the 2 bolts, gasket and No. 2 air switching valve from the rear water by-pass joint.



11. REMOVE NO. 1 AIR SWITCHING VALVE ASSEMBLY

a. Remove the vacuum switching valve hose from the No. 1 air switching valve.

b. Remove the 2 bolts, gasket and No. 1 air switching valve from the rear water by-pass joint.



for Preparation Click here

1. INSPECT AIR SWITCHING VALVE ASSEMBLY

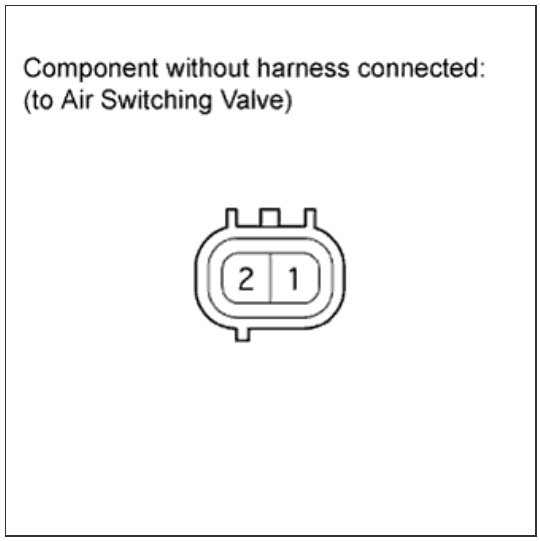
a. Measure the resistance of the valve.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

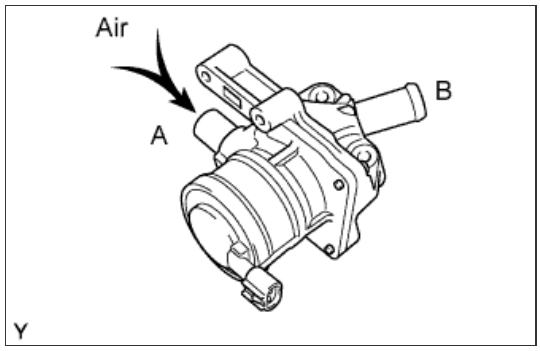
Tester Connection	Condition	Specified Condition
1- 2	20°C (68°F)	4.5 to 5.5 Ω
1 - Body ground	Always	1 MΩ or higher
2 - Body ground	Always	1 MΩ or higher

If the result is not as specified, replace the air switching valve assembly.



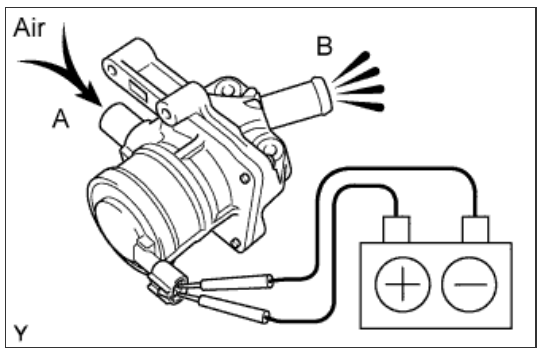
b. Check the valve operation.

i. Blow air into port A and check that air is not discharged from port B.



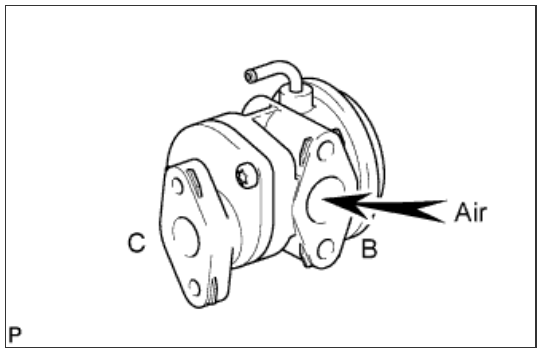
ii. Apply battery voltage across the terminals.

iii. Blow air into port A and check that air is discharged from port B.
If the result is not as specified, replace the air switching valve assembly.

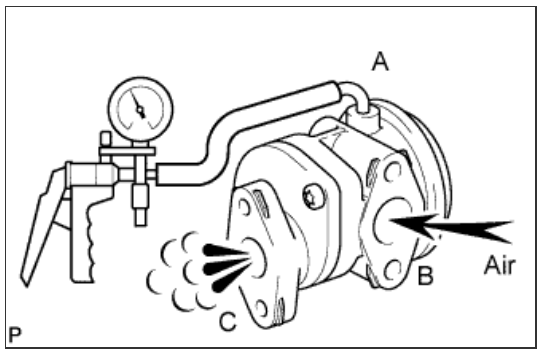


2. INSPECT NO. 1 AIR SWITCHING VALVE ASSEMBLY

a. Blow air into port B and check that air is not discharged from port C.

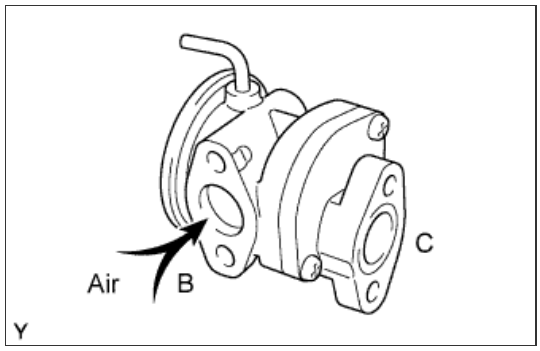


b. Apply vacuum of 33 kPa (250 mmHg, 9.83 in.Hg) to port A, blow air into port B and check that air is discharged from port C.
If the result is not as specified, replace the No. 1 air switching valve assembly.

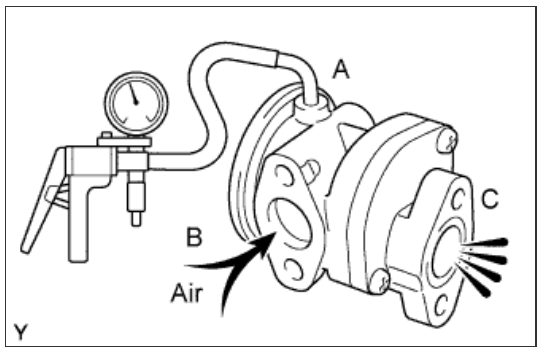


3. INSPECT NO. 2 AIR SWITCHING VALVE ASSEMBLY

a. Blow air into port B and check that air is not discharged from port C.



b. Apply vacuum of 33 kPa (250 mmHg, 9.83 in.Hg) to port A, blow air into port B and check that air is discharged from port C.
If the result is not as specified, replace the No. 2 air switching valve assembly.



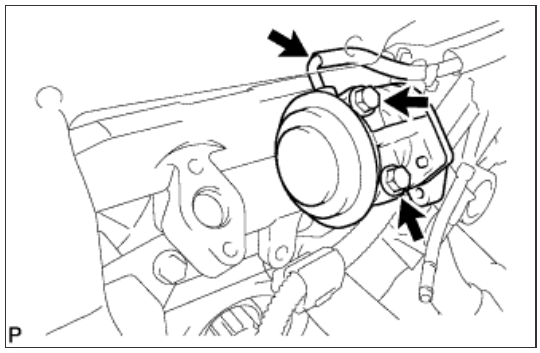
for Preparation Click here

1. INSTALL NO. 1 AIR SWITCHING VALVE ASSEMBLY

a. Install a new gasket and the No. 1 air switching valve to the rear water by-pass joint with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Connect the vacuum switching valve hose to the No. 1 air switching valve.

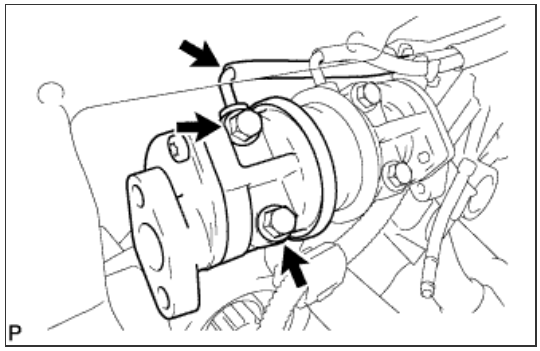


2. INSTALL NO. 2 AIR SWITCHING VALVE ASSEMBLY

a. Install a new gasket and the No. 2 air switching valve to the rear water by-pass joint with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Connect the vacuum switching valve hose to the No. 2 air switching valve.



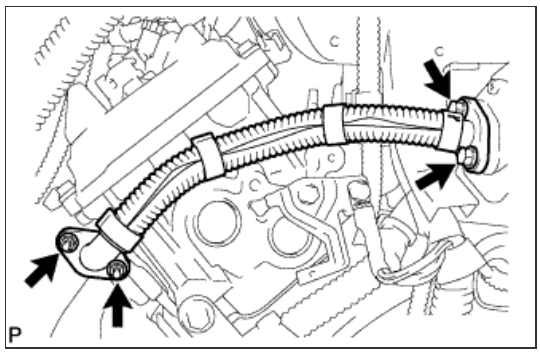
3. INSTALL NO. 3 AIR TUBE

a. Install a new gasket and connect the No. 3 air tube to the exhaust manifold with the 2 nuts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Install a new gasket and connect the No. 3 air tube to the No. 2 air switching valve with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



4. INSTALL AIR TUBE SUB-ASSEMBLY RH

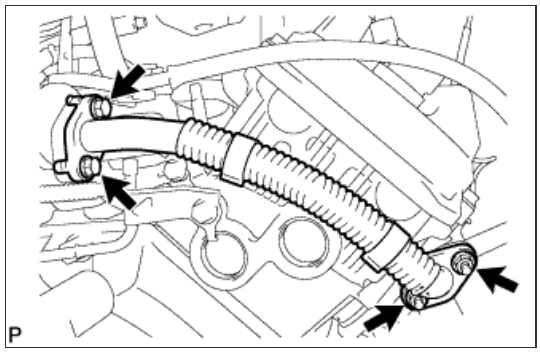
a. Install a new gasket and connect the air tube to the exhaust manifold with the 2 nuts.

Torque:

10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Install a new gasket and connect the air tube to the No. 1 air switching valve with the 2 bolts.

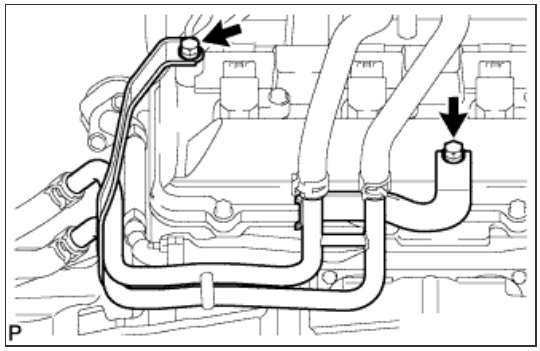
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



5. CONNECT NO. 1 WATER BY-PASS PIPE (w/o Air Cooled Transmission Oil Cooler)

a. Connect the water by-pass pipe to the cylinder head cover RH with the 2 bolts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

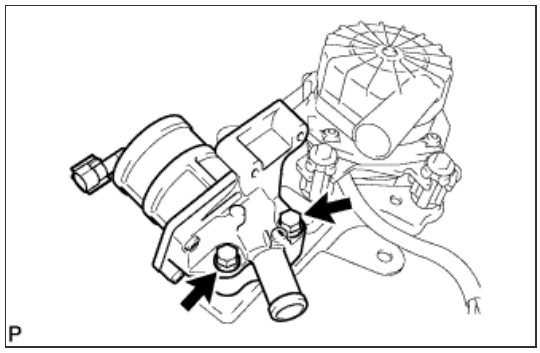


6. INSTALL AIR SWITCHING VALVE ASSEMBLY

a. Install the air switching valve to the No. 1 air injection system hose.

b. Install the air switching valve to the air pump bracket with the 2 bolts.

Torque:
16 N*m{ 163 kgf*cm , 12 ft.*lbf }



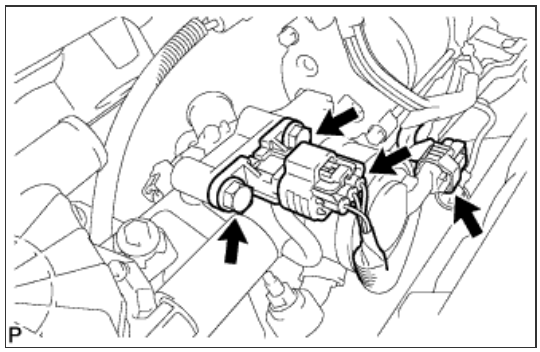
c. Install the air pressure sensor to the air switching valve with the 2 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

d. Install the vacuum hose to the air pressure sensor and air switching valve.

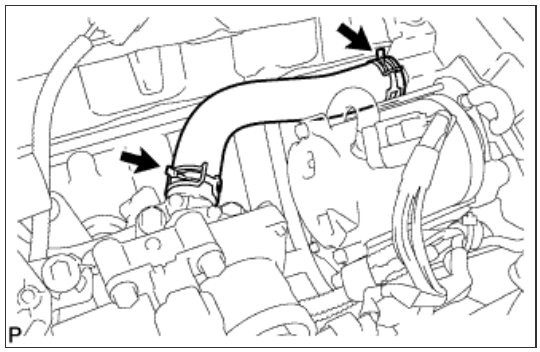
e. Connect the air pressure sensor connector.

f. Connect the air switching valve connector.



7. INSTALL NO. 2 AIR INJECTION SYSTEM HOSE

a. Install the hose.



8. INSTALL WATER BY-PASS PIPE SUB-ASSEMBLY

a. Apply soapy water to the O-ring.

b. Install a new O-ring to the water by-pass pipe.

c. Push in the water by-pass pipe.

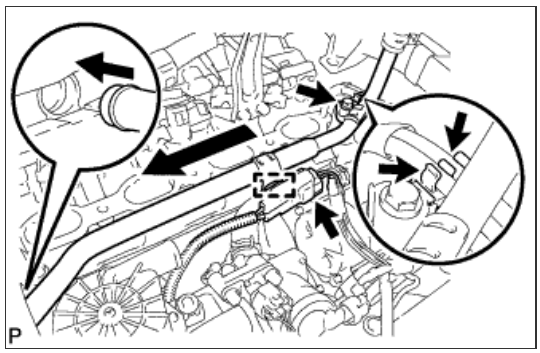
d. Install the water by-pass pipe with the bolt.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

e. Connect the 2 vacuum switching valve hoses to the water by-pass pipe clamp.

f. Connect the wire harness clamp.

g. Connect the connector.

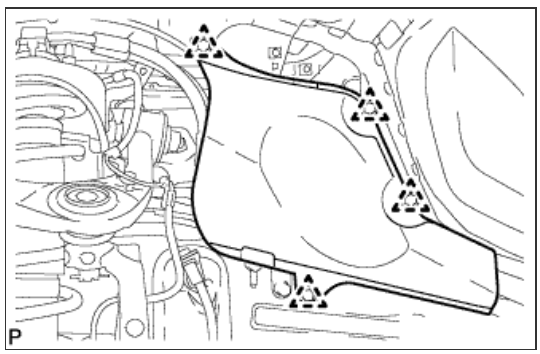


9. INSTALL INTAKE MANIFOLD

a. Install the intake manifold (Click here).

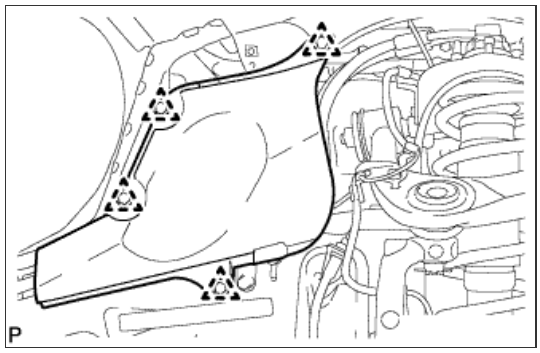
10. INSTALL FRONT FENDER APRON SEAL REAR LH

a. Install the fender apron seal with the 4 clips.

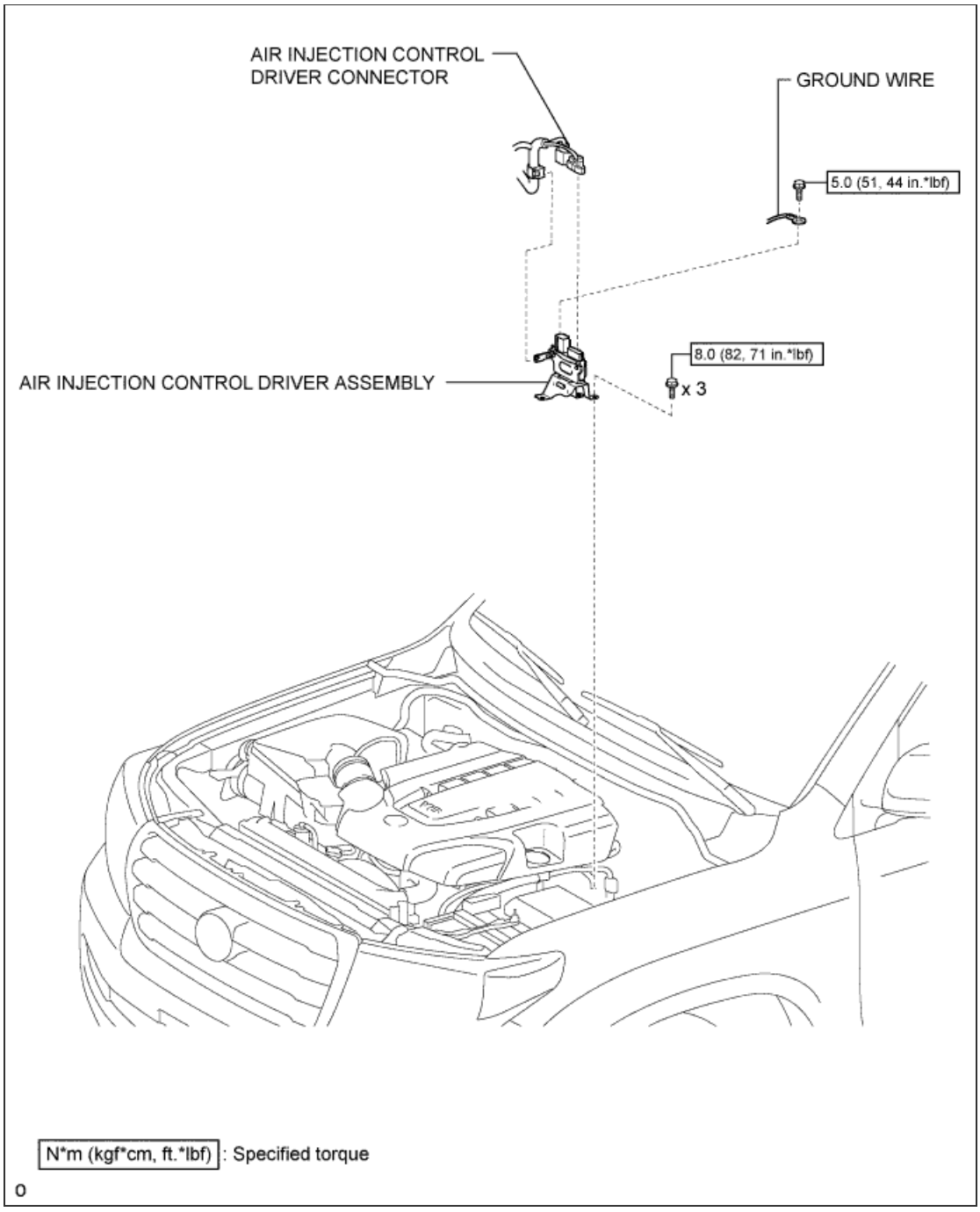


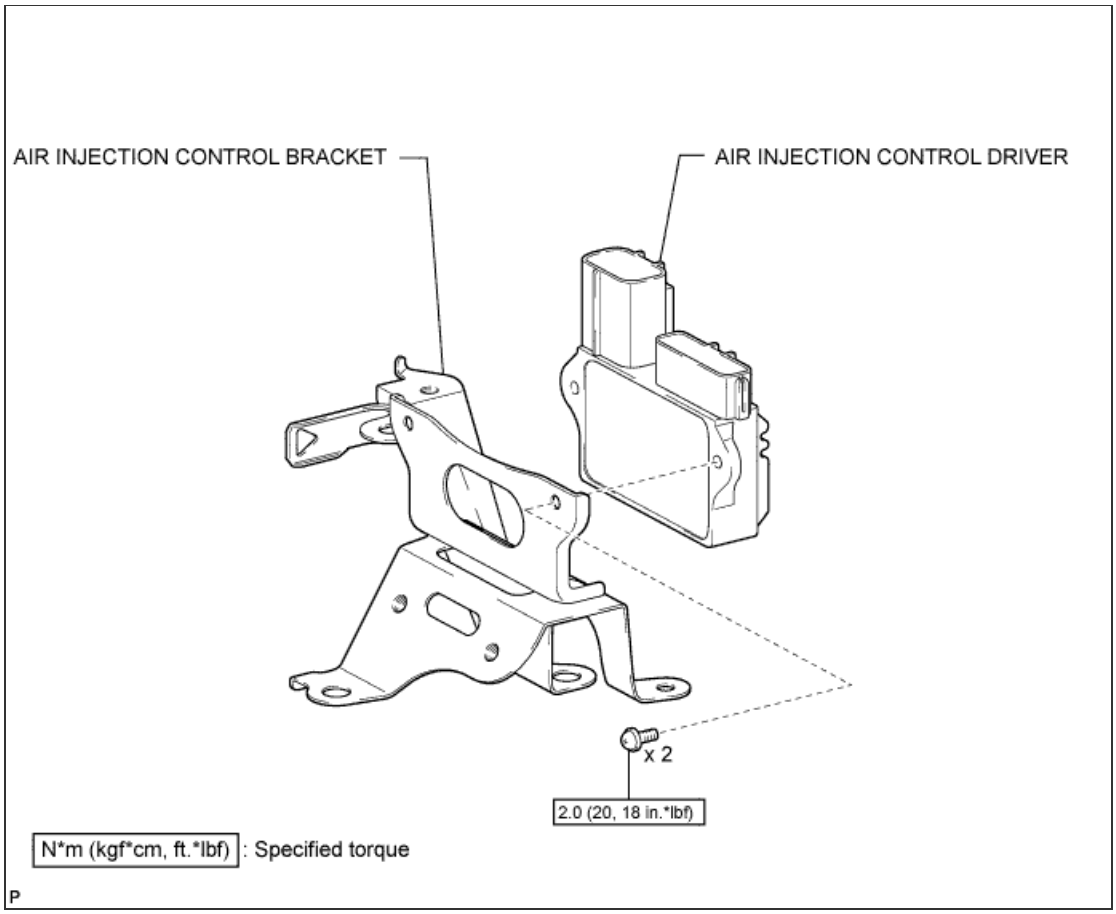
11. INSTALL FRONT FENDER APRON SEAL REAR RH

a. Install the fender apron seal with the 4 clips.


P

for Preparation Click here




AIR INJECTION CONTROL BRACKET
AIR INJECTION CONTROL DRIVER
x 2
2.0 (20, 18 in.*lbf)
N*m (kgf*cm, ft.*lbf) : Specified torque
P

for Preparation Click here

1. DISCONNECT CABLE ROM NEGATIVE BATTER TERMINAL

NOTICE:

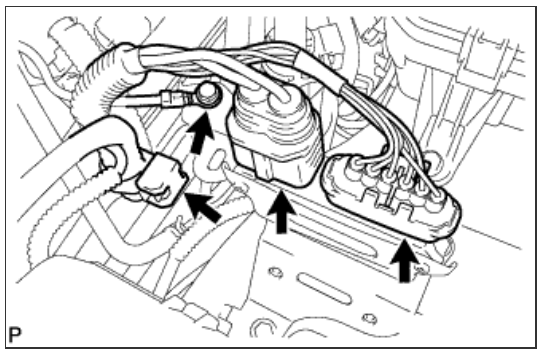
When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

2. REMOVE AIR INJECTION CONTROL DRIVER ASSEMBL

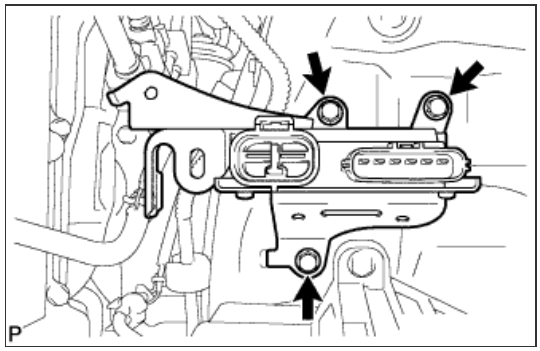
a. Disconnect the 2 air injection control driver connectors.

b. Remove the bolt and disconnect the wire harness.

c. Disconnect the wire harness clamp.



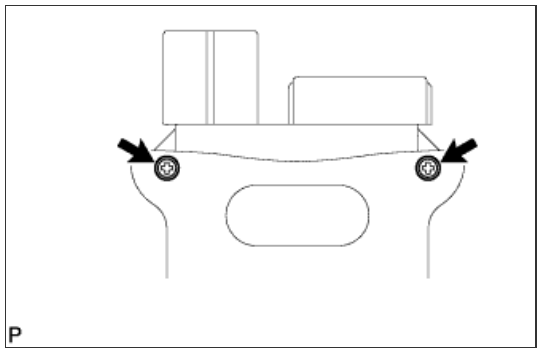
d. Remove the 3 bolts and air injection control driver assembly.



for reparation Clic ere

1. REMOVE AIR INJECTION CONTROL DRIVER

a. Remove the 2 screws and air injection control driver.

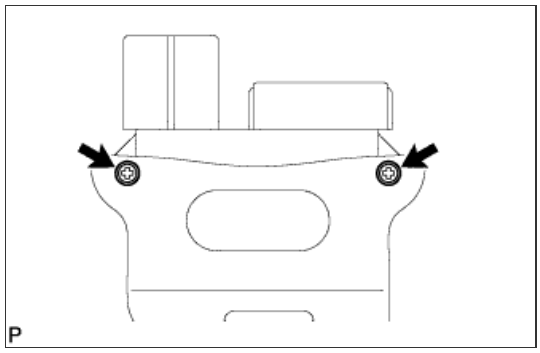


for Preparation Click here

1. INSTALL AIR INJECTION CONTROL DRIVER

a. Install the air injection control driver with the 2 screws.

Torque:
2.0 N*m{ 20 kgf*cm , 18 in.*lbf }

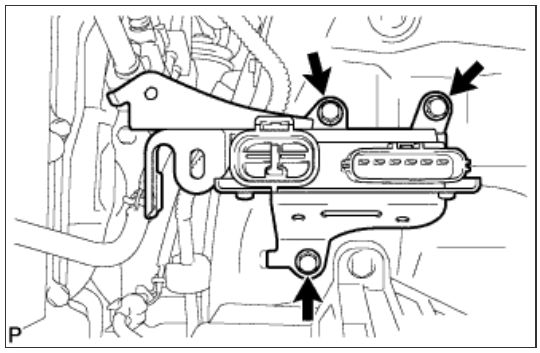


for Preparation Click here

1. INSTALL AIR INJECTION CONTROL DRIVER ASSEMBLY

a. Install the air injection control driver assembly with the 3 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

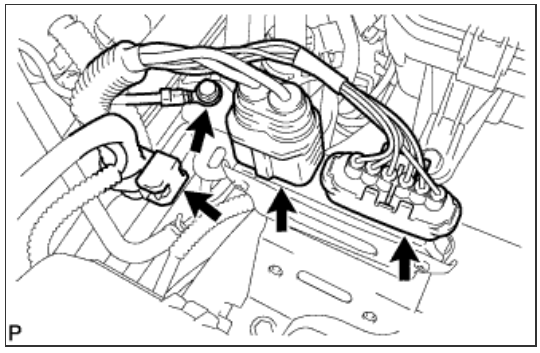


b. Connect the wire harness clamp.

c. Connect the wire harness with the bolt.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

d. Connect the 2 air injection control driver connectors

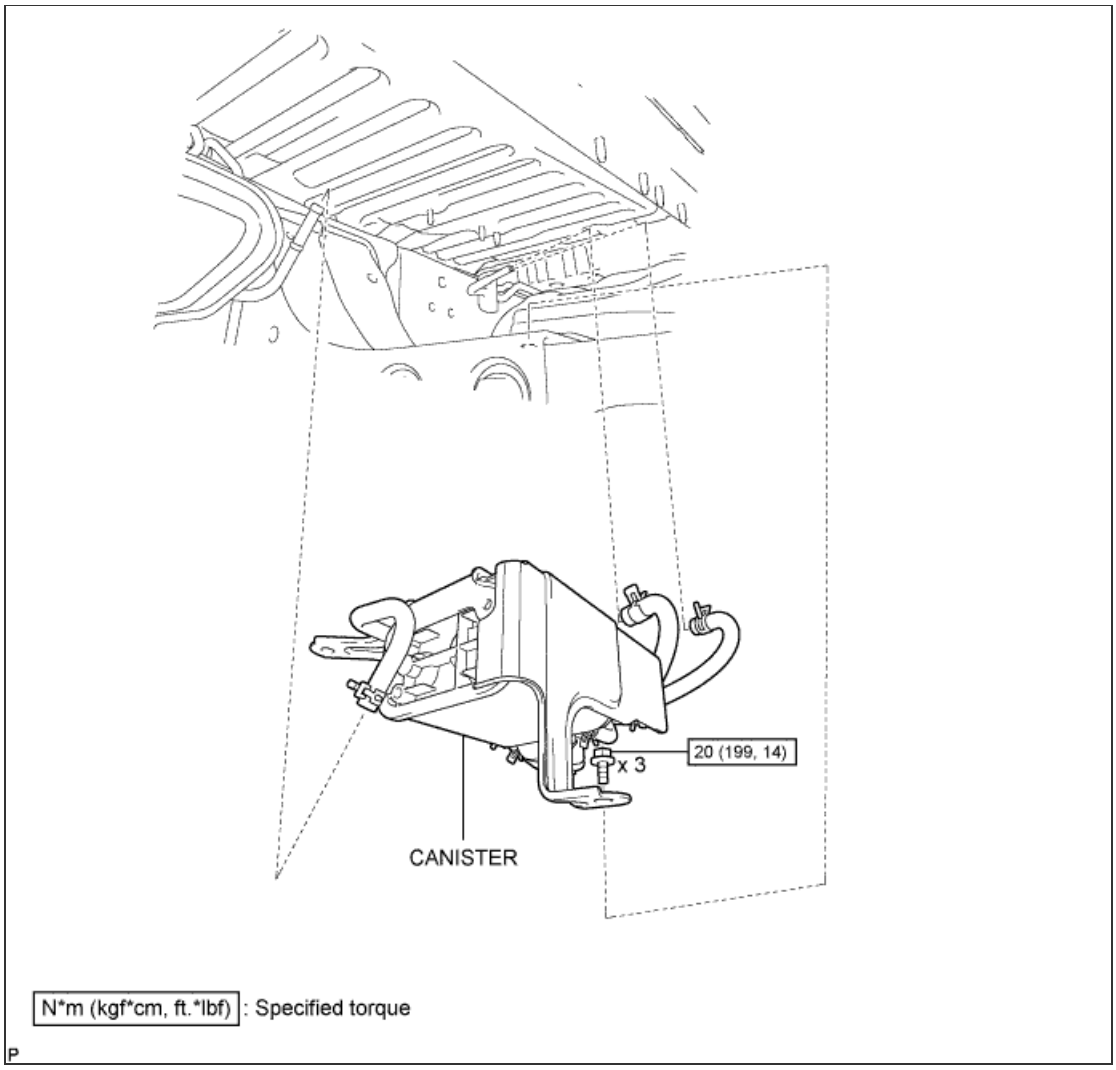


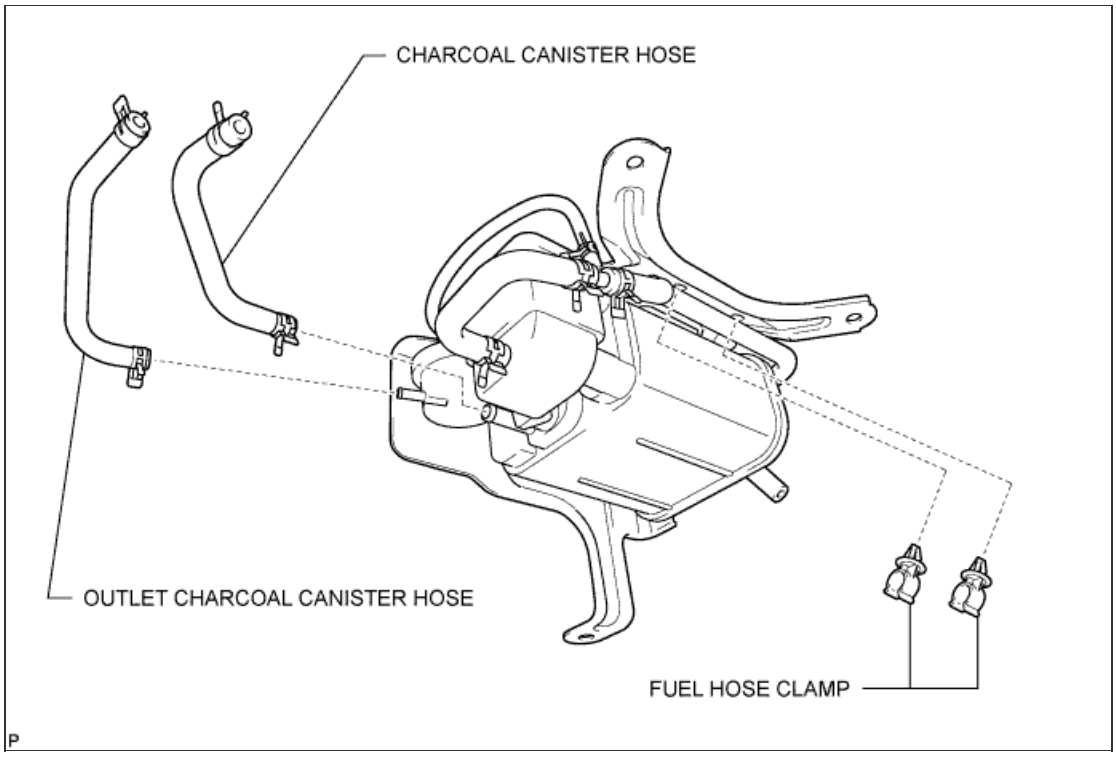
2. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

hen disconnectin the cable, some systems need to be initiali ed a ter the cable is reconnected (Click here).

for Preparation Click here

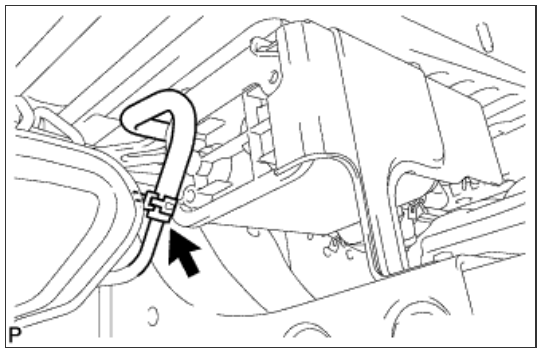



CHARCOAL CANISTER HOSE
OUTLET CHARCOAL CANISTER HOSE
FUEL HOSE CLAMP
P

for Preparation Click here

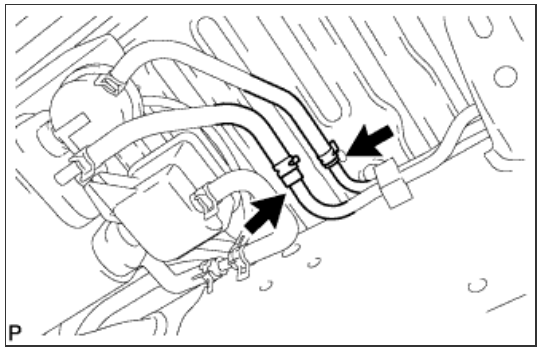
1. REMOVE CANISTER

a. Disconnect the hose.



b. Disconnect the charcoal canister hose.

c. Disconnect the outlet charcoal canister hose.

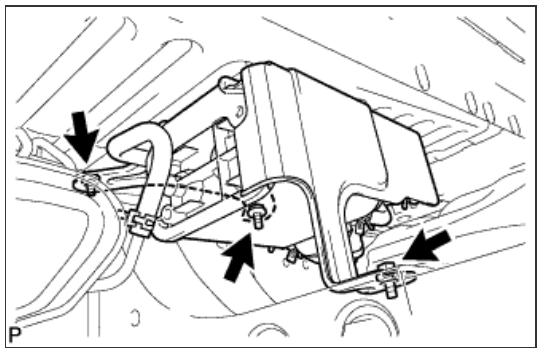


d. Remove the 3 bolts and canister.

e. Remove the 2 fuel hose clamps from the canister.

f. Remove the charcoal canister hose.

. Remove the outlet charcoal canister hose.



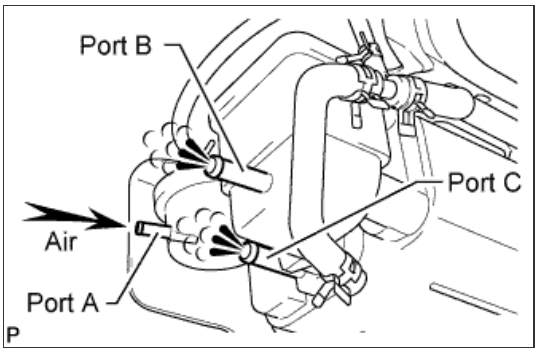
for Preparation Click here

1. INSPECT CANISTER

a. Visually check the canister for cracks or damage.

b. Blow compressed air of 4.9 kPa (50 gf/cm ^{2}, 0.71 psi) into port A and check that air flows without resistance from port B and port C.
If the result is not as specified, replace the canister.

c. Apply a vacuum of 1.96 kPa (20 gf/cm^2, 0.28 psi) to port A. Check that the vacuum does not decrease when ports B and C are closed, and check that the vacuum does not decrease when port B is released.
If the result is not as specified, replace the canister.

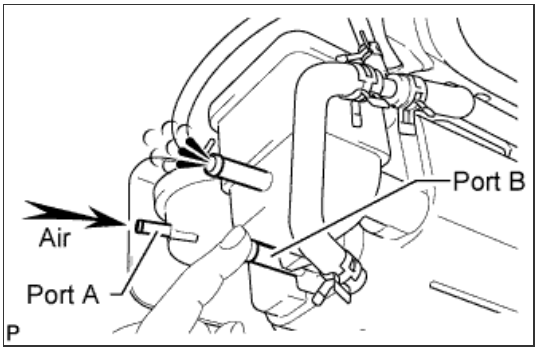


2. CLEAN FILTER IN CANISTER

a. Clean the filter by blowing compressed air of 4.9 kPa (50 gf/cm ^{2}, 0.71 psi) into port A while holding port B closed.

NOTICE:

Do not attempt to wash the canister.



for Preparation Click here

1. INSTALL CANISTER

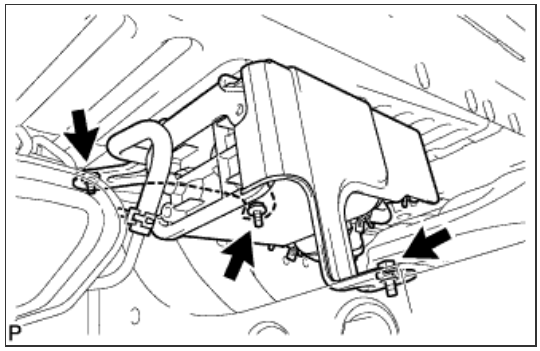
a. Install the outlet charcoal canister hose to the canister.

b. Install the charcoal canister hose to the canister.

c. Install the 2 fuel hose clamps to the canister.

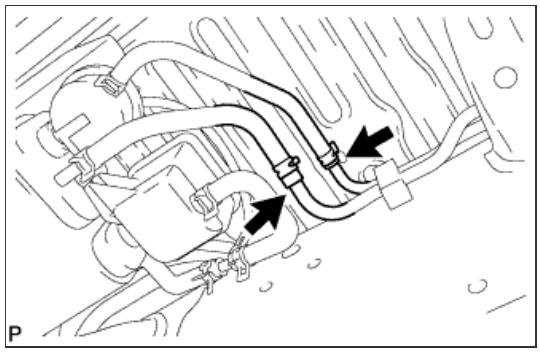
d. Install the canister with the 3 bolts.

Torque:
20 N*m{ 1 kgf*cm , 14 ft.*lbf }

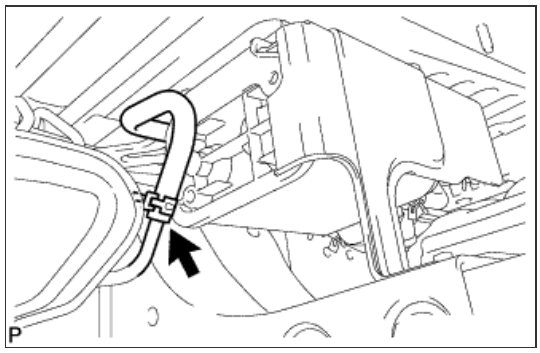


e. Connect the outlet charcoal canister hose.

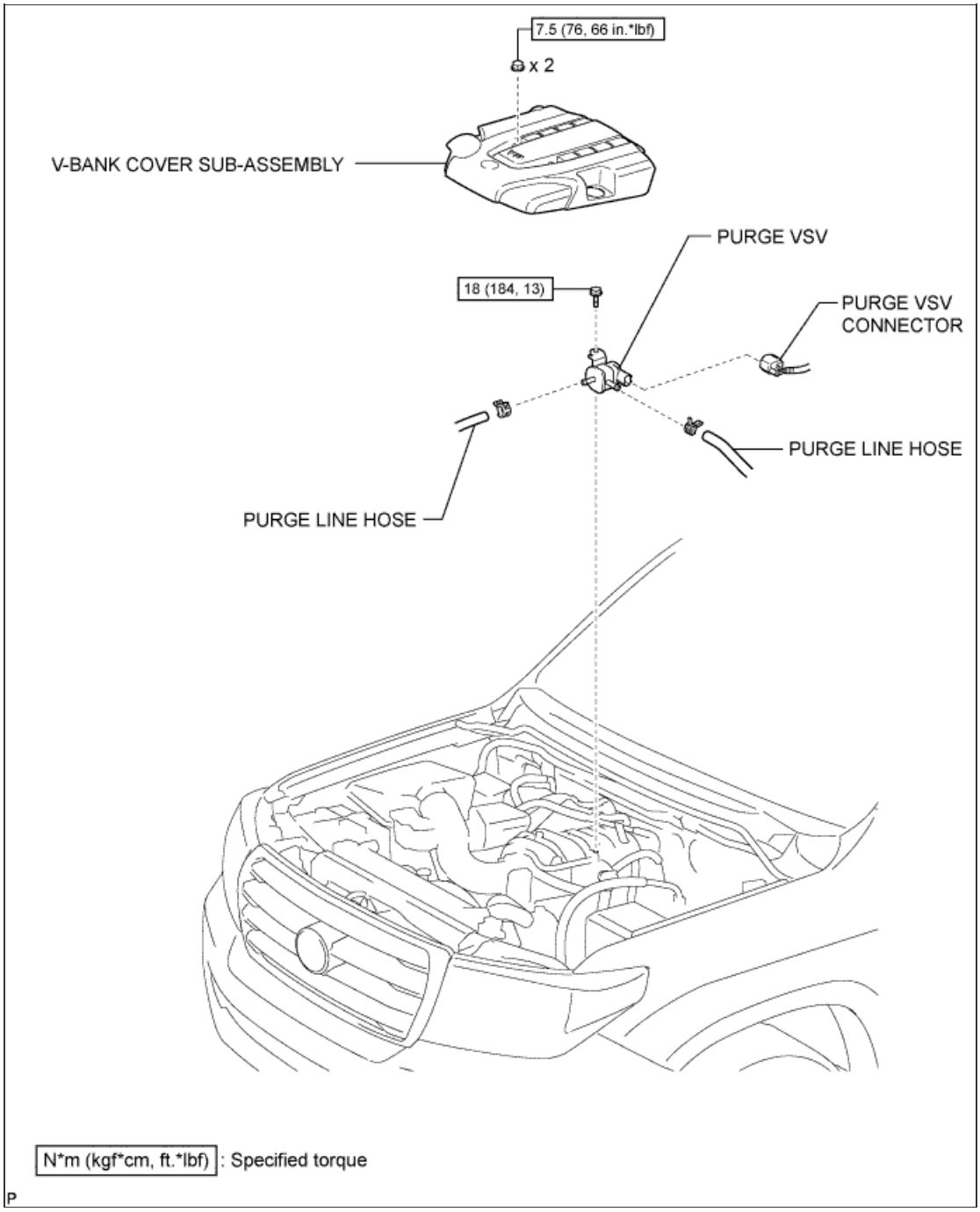
f. Connect the charcoal canister hose.



g. Connect the hose.



for Preparation Click here



for Preparation Click here

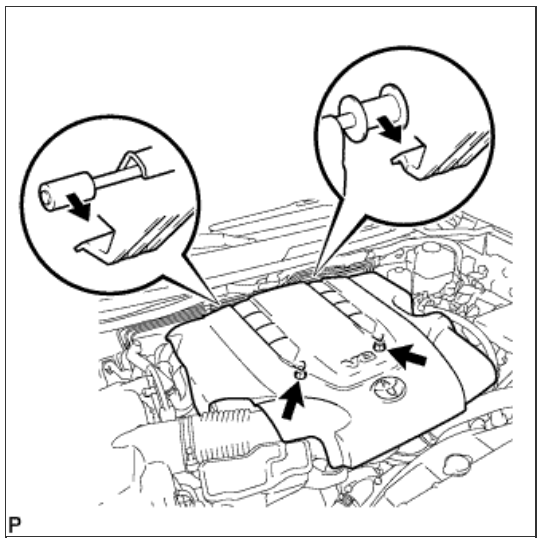
1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

2. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Remove the 2 nuts and V-bank cove

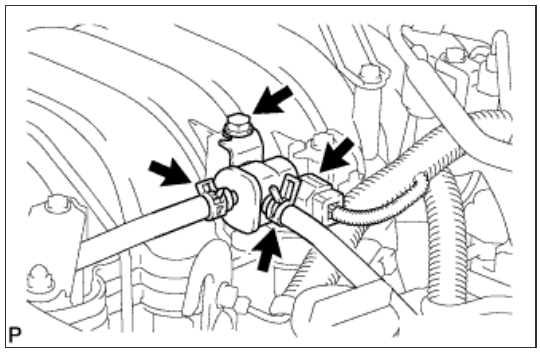


3. REMOVE PURGE VSV

a. isconnect the pu ge VSV connecto

b. isconnect the 2 pu ge line hoses.

c. emove the bolt and pu ge VSV.



for Preparation Click here

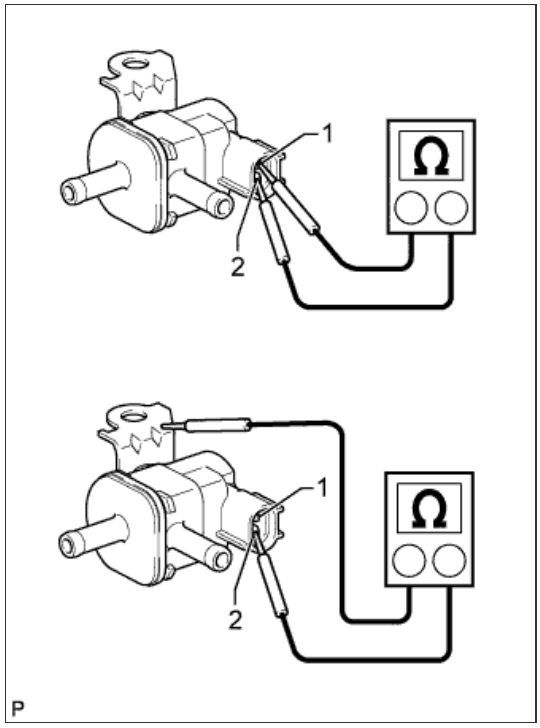
1. INSPECT PURGE VSV

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

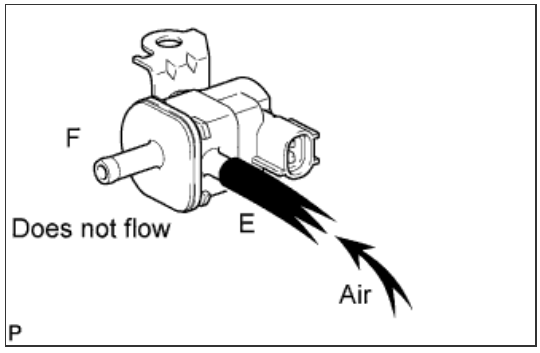
Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	23 to 26 Ω
1 - Body ground	Always	10 MΩ or higher
2 - Body ground		

If the result is not as specified, replace the purge VSV.



b. Check operation of purge VSV.

i. Check that air does not flow from port F when air is applied to port E.

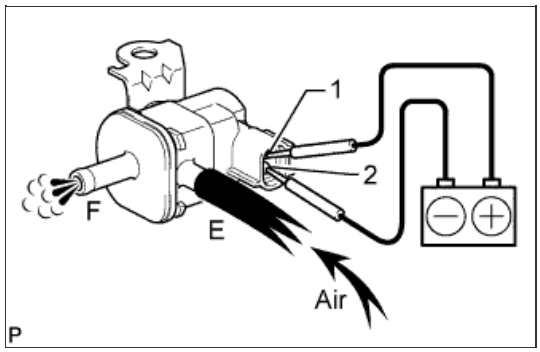


ii. Apply battery voltage to the connector, and check the VSV operation.

OK:

Measurement Condition	Specified Condition
Battery positive (+) → Terminal 1 Battery negative (-) → Terminal 2	Air flows from port E to port F

If the result is not as specified, replace the purge VSV.



for Preparation Click here

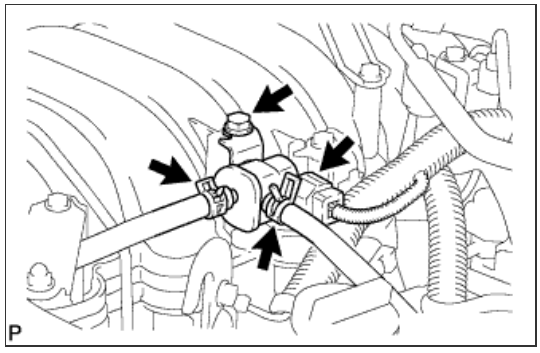
1. INSTALL PURGE VSV

a. Install the purge VSV with the bolt.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

b. Connect the purge line hoses.

c. Connect the purge VSV connector.

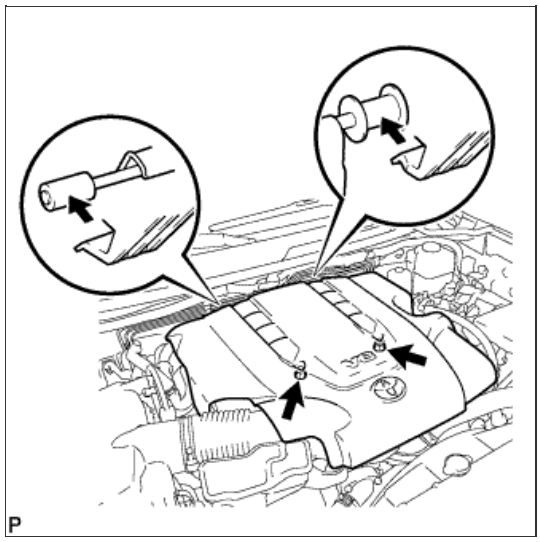


2. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the V-bank cover hook sub to the bracket.

b. Install the V-bank cover with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



3. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

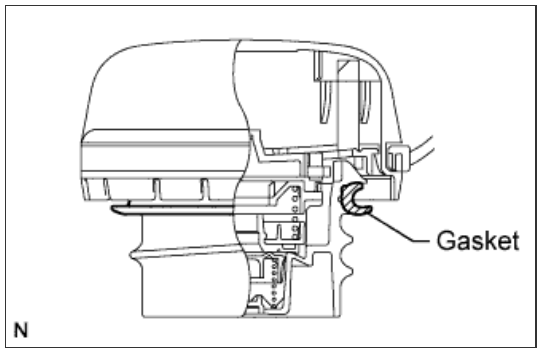
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

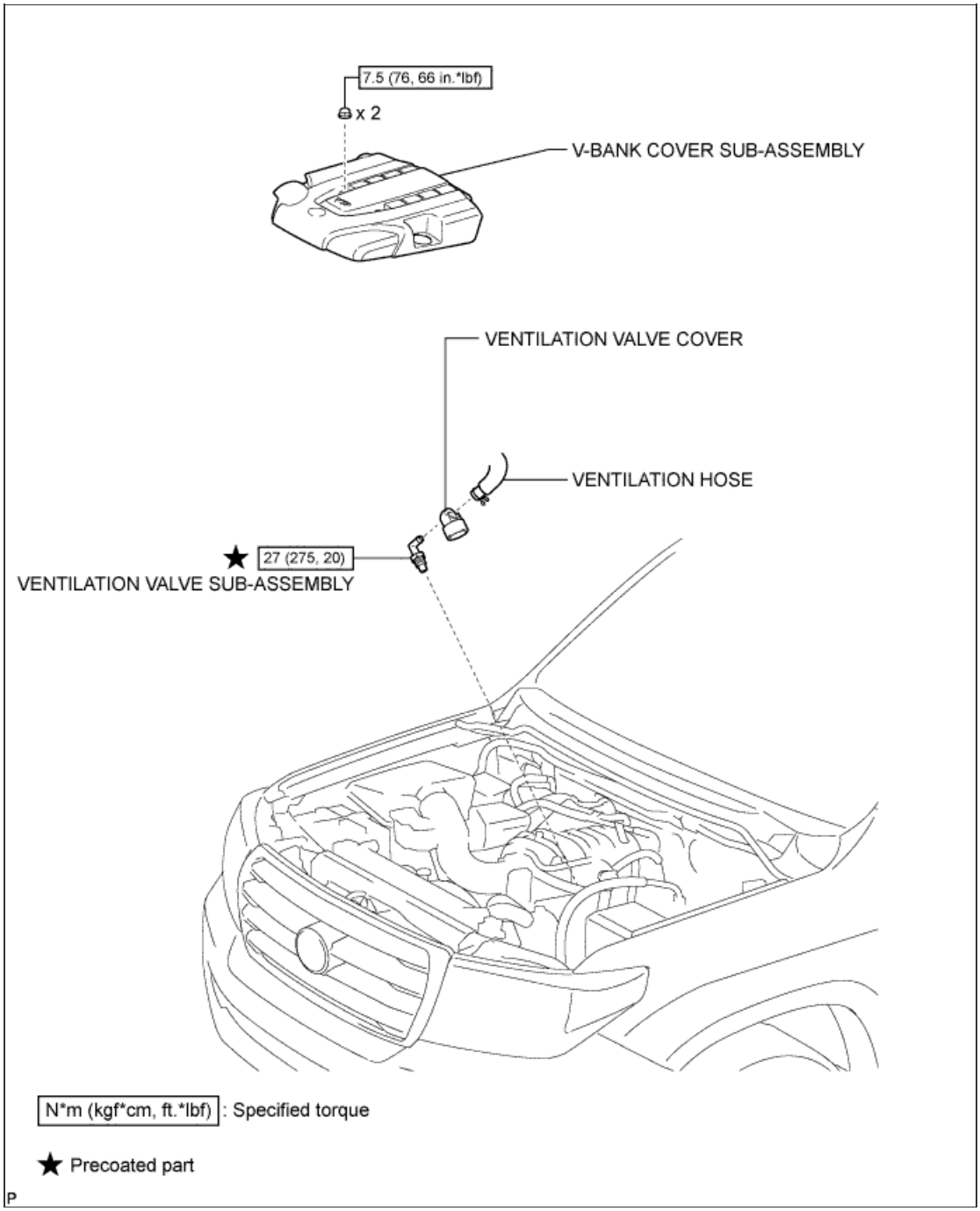
for Preparation Click here

1. INSPECT FUEL TANK CAP ASSEMBLY

a. Visually check if the cap and/or gasket are deformed or damaged.
If necessary, replace the cap assembly or gasket.



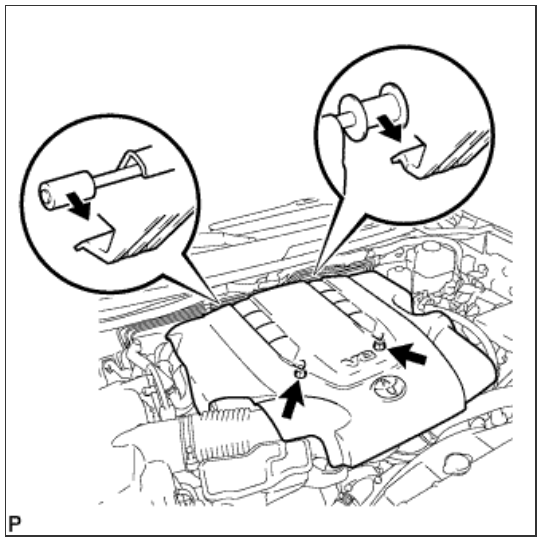
for Preparation [Click here]



for Preparation Click here

1. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Remove the 2 nuts and V-bank cover.



2. DISCONNECT VENTILATION HOSE

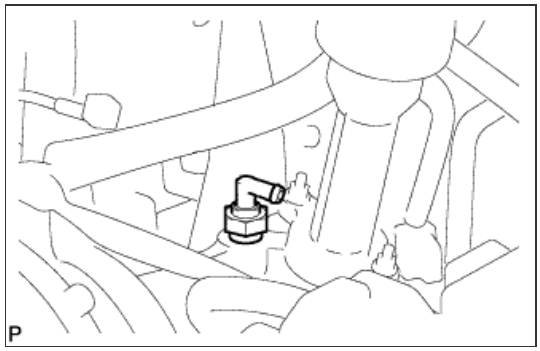
a. Disconnect the ventilation hose from the ventilation valve.

3. REMOVE VENTILATION VALVE COVER

a. Remove the ventilation valve cover from the ventilation valve.

4. REMOVE VENTILATION VALVE SUB-ASSEMBLY

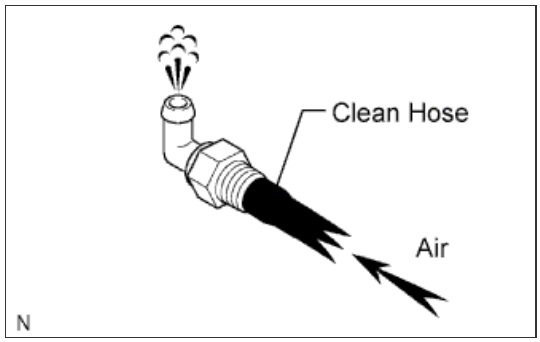
a. Remove the ventilation valve from the cylinder head cover sub-assembly LH.



for Preparation Click here

1. INSPECT VENTILATION VALVE SUB-ASSEMBLY

a. Install a clean hose to the ventilation valve.



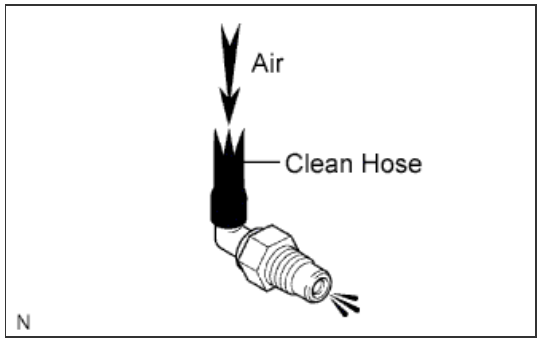
b. Inspect the ventilation valve operation.

i. Blow air into the cylinder head side, and check that air passes through smoothly.

CAUTION:

Do not suck air through the valve. Petroleum substances inside the valve are harmful.

ii. Blow air into the intake manifold side, and check that air does not pass through smoothly.
If the result is not as specified, replace the ventilation valve.



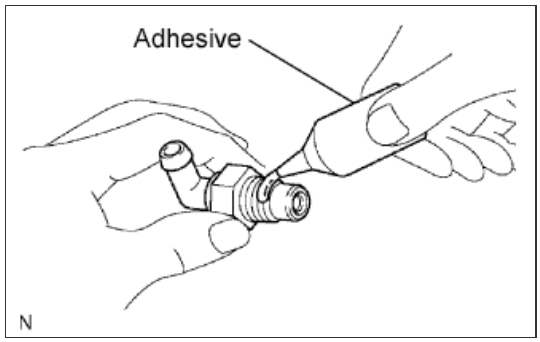
c. Remove the hose from the ventilation valve.

for Preparation Click here

1. INSTALL VENTILATION VALVE SUB-ASSEMBLY

a. Apply adhesive to 2 or 3 threads of the ventilation valve.

Adhesive:
Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent

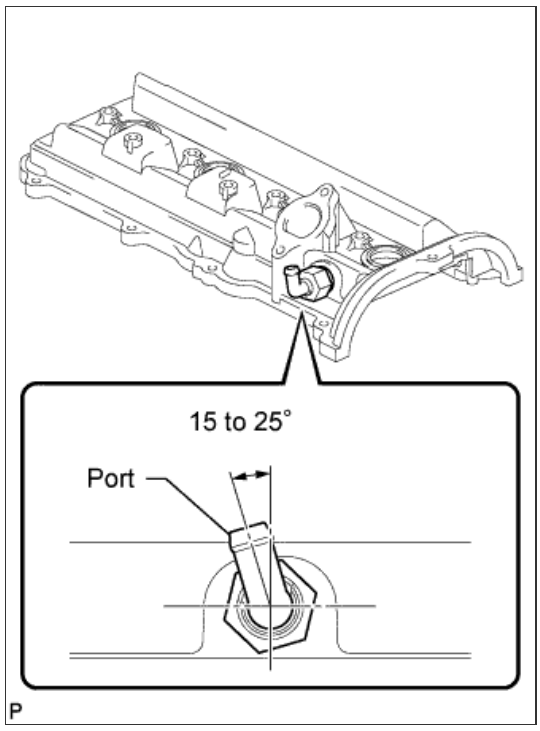


b. Install the ventilation valve to the cylinder head cover sub-assembly LH.

Torque:
27 N*m{ 275 kgf*cm , 20 ft.*lbf }

HINT:

After applying the specified torque, rotate the ventilation valve clockwise until the port facing in the direction indicated in the illustration.



2. INSTALL VENTILATION VALVE COVER

a. Install the ventilation valve cover to the ventilation valve.

3. CONNECT VENTILATION HOSE

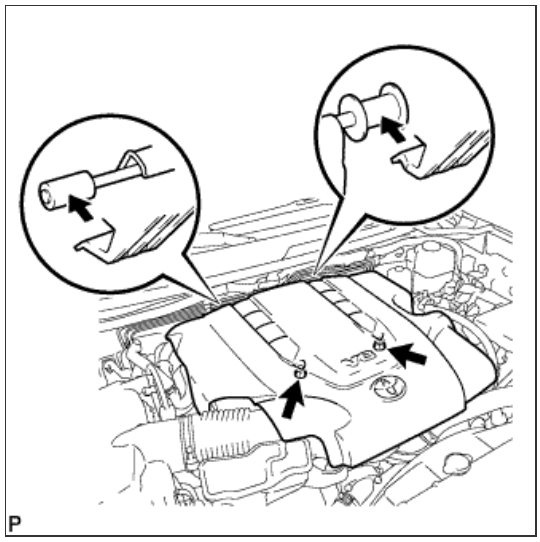
a. Connect the ventilation hose to the ventilation valve.

4. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 -bank cover hooks to the bracket.

b. Install the -bank cover with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



for Preparation Click here

1.IGNITION SWITCH EXPRESSION

HINT:

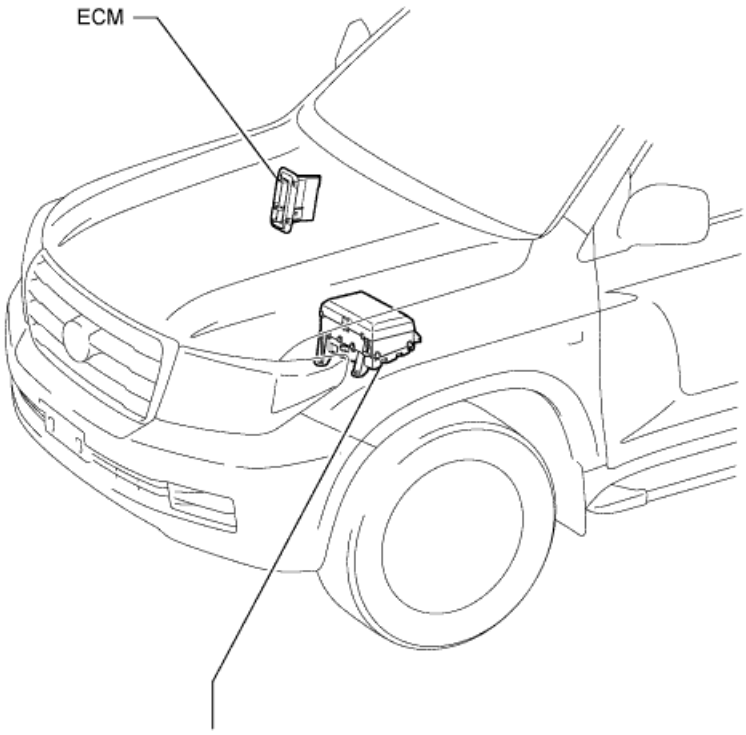
The type of ignition switch used on this model differs depending on the specifications of the vehicle. The e pressions listed in the table below are used in this section.

E pression	Ignition Switch (Position)	Engine Switch (ondition)
Ignition Switch off	LO	ff
Ignition Switch A		n (A
gnition Switch ON	ON	On (IG)
Engine Start	START	Start

for Preparation Click here

w/ EGR System:

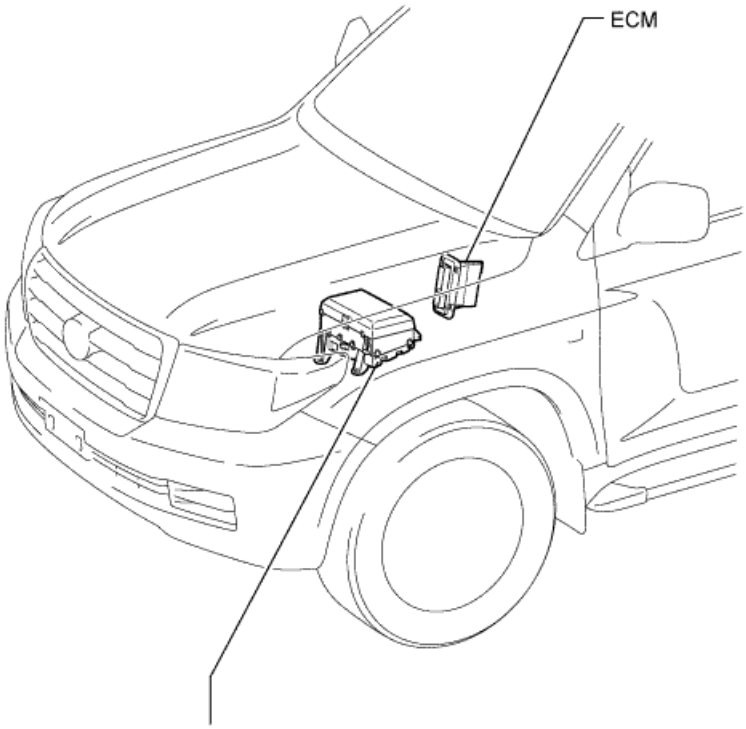
for LHD:



P

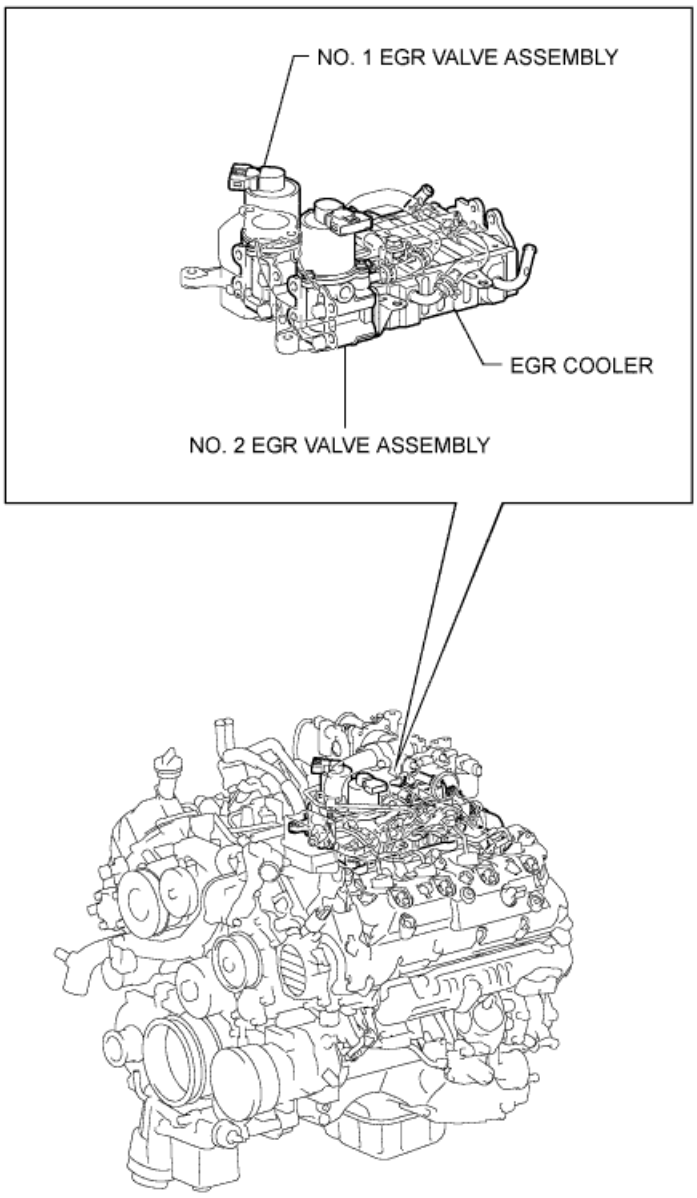
w/ EGR System:

for RHD:



P

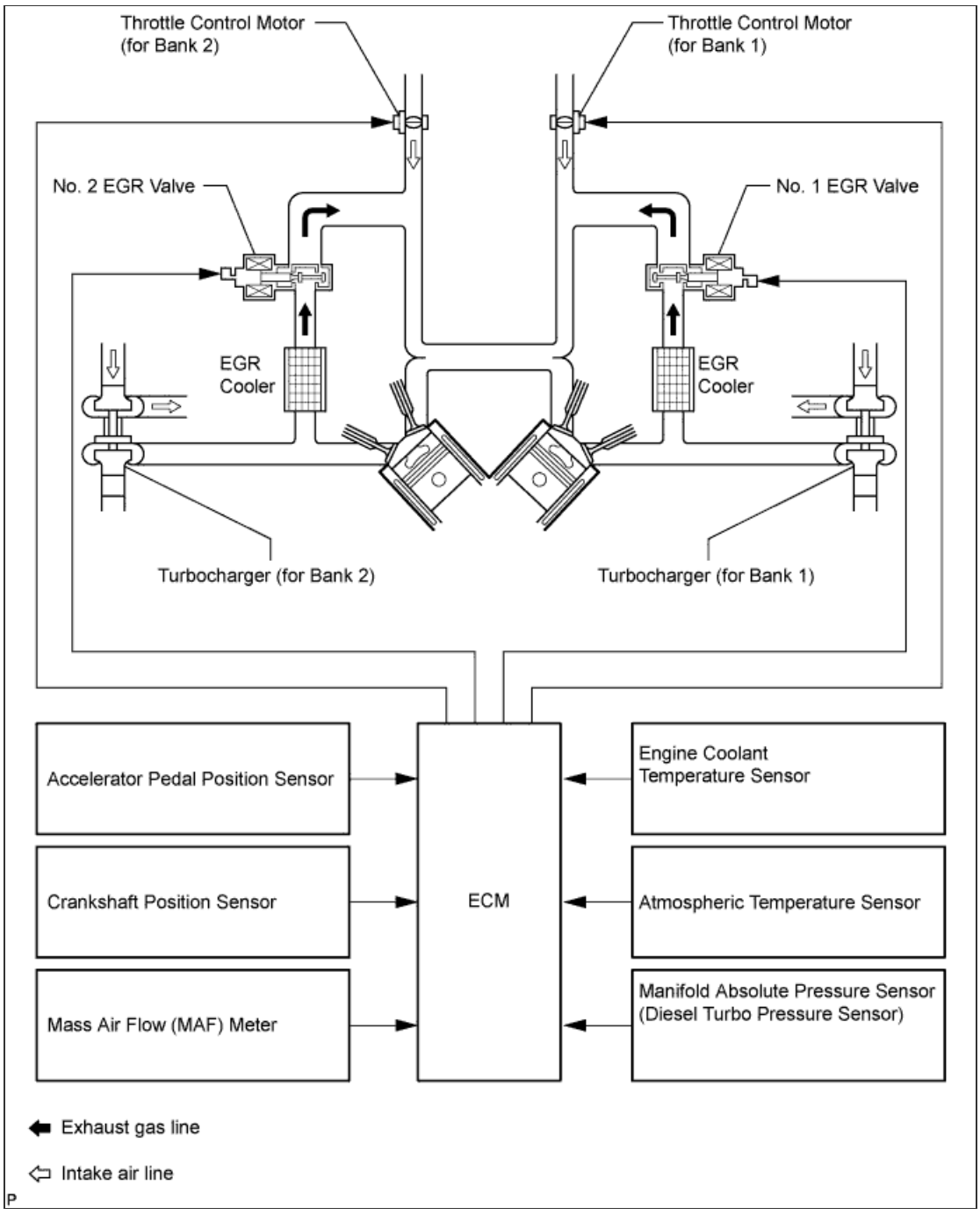
w/ EGR System:



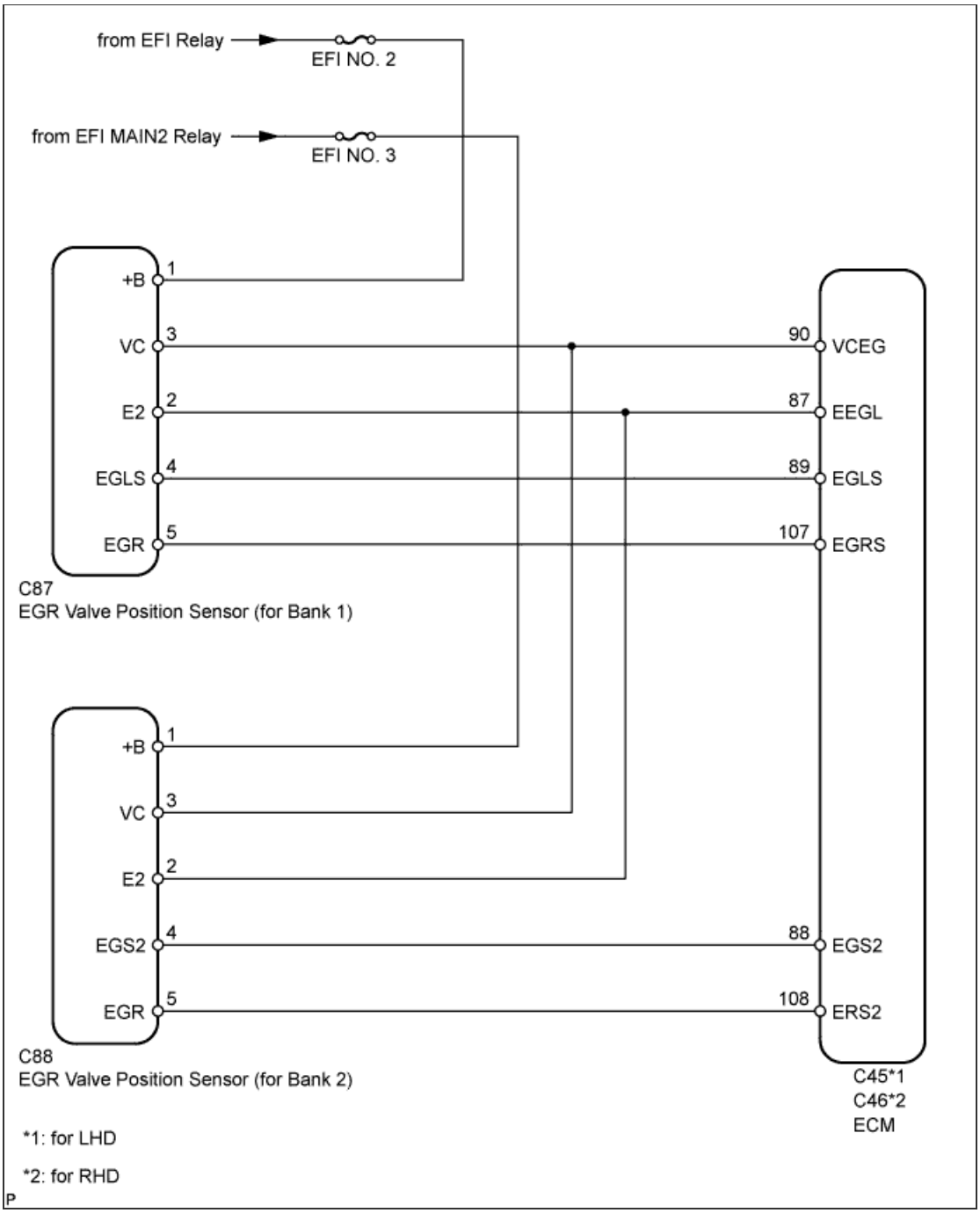
P

for Preparation Click here

EGR FLOW DIAGRAM (EGR System)



EMISSION CONTROL SYSTEM WIRING DIAGRAM (EGR System)


from EFI Relay
EFI NO. 2
from EFI MAIN2 Relay
EFI NO. 3
+B
1
VC
3
E2
2
EGLS
4
EGR
5
C87
EGR Valve Position Sensor (for Bank 1)
+B
1
VC
3
E2
2
EGS2
4
EGR
5
C88
EGR Valve Position Sensor (for Bank 2)
90
VCEG
87
EEGL
89
EGLS
107
EGRS
88
EGS2
108
ERS2
C45*1
C46*2
ECM
*1: for LHD
*2: for RHD
P

for Preparation Click here

HINT:

In a malfunction where the EGR system is always on, black or white smoke may be emitted from the exhaust pipe.

1. CHECK SEATING OF EGR VALVE (w/ EGR System)

a. Start the engine, and then check that the engine starts and runs at idle.

2. CHECK ENGINE CONDITION (w/ EGR System)

a. Connect the intelligent tester to the DLC3.

b. Start the engine, then run it at idle.

c. Turn the intelligent tester on.

d. Warm up the engine.

HINT:

The coolant temperature should be between 75°C (167°F) and 90°C (194°F).

e. Enter the following menus: Powertrain / Engine / Data List / Actual EGR Valve Pos. or Actual EGR Valve Pos. #2.

f. Check that the value of the EGR angle is within the specification.

Standard Percentage:

Engine Condition	EGR Valve Opening Angle Expressed as Percentage
During idling	0 to 80%

If the result is not as specified, refer to the EGR valve inspection procedures (Click here).

g. Turn the ignition switch off.

3. CHECK EGR VALVE OPERATION (w/ EGR System)

a. Turn the ignition switch to ON.

b. Turn the intelligent tester on.

c. Enter the following menus: Powertrain / Engine / Active Test / Control the EGR step position or Control the EGR step position #2.

d. Check the Data List / EGR Lift Sensor Output, Actual EGR Valve Pos. or Actual EGR Valve Pos. #2 reading.

HINT:

Make sure the EGR valve opening angle changes according to the Active Test operation.

Standard Percentage:

Control Range Condition	Specified Condition
Active Test performed (Set EGR position to 100%)	EGR Valve Angle: 73 to 100%
Active Test performed (Set EGR position to 0%)	EGR Valve Angle: 0 to 27%

If the result is not as specified, refer to DTC P0400 (Click here).

4. CHECK MAF AMOUNT (w/ EGR System)

a. Start the engine, then run it at idle.

b. Warm up the engine.

HINT:

The coolant temperature should be between 75°C (167°F) and 90°C (194°F).

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain / Engine / Data List / MAF.

e. Check the MAF reading.

f. Enter the following menus: Powertrain / Engine / Active Test / Control the EGR step position or Control the EGR step position #2.

HINT:

- **In the Active Test, the EGR valve of bank 1 and bank 2 cannot be operated at the same time.**
- **In the Active Test, the change in the MAF amount is difficult to check because the EGR valve can only be operated one bank at a time. Therefore, use the value below as a reference and check that the MAF amount changes.**

Standard (Reference):

Engine Condition	Active Test Condition	MAF Reading
Idling	Active Test performed (Set EGR position to 0%)	Air flow amount changes (Approximately 7.8 to 26.5 g/sec.)

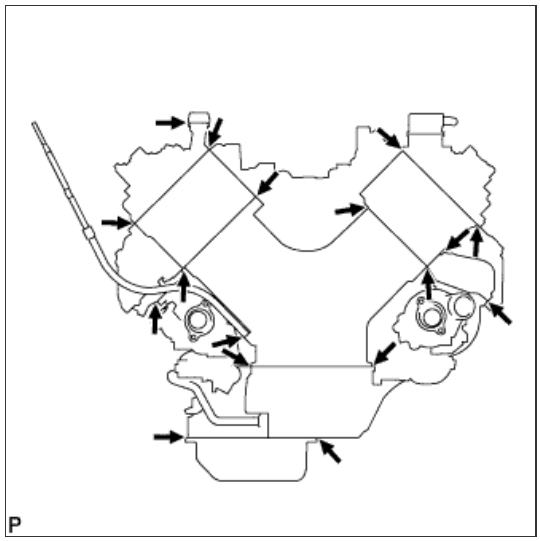
5. VISUALLY INSPECT HOSES, CONNECTIONS AND GASKETS

a. Visually check that the hoses, connections and gaskets have no cracks, leaks or damage.

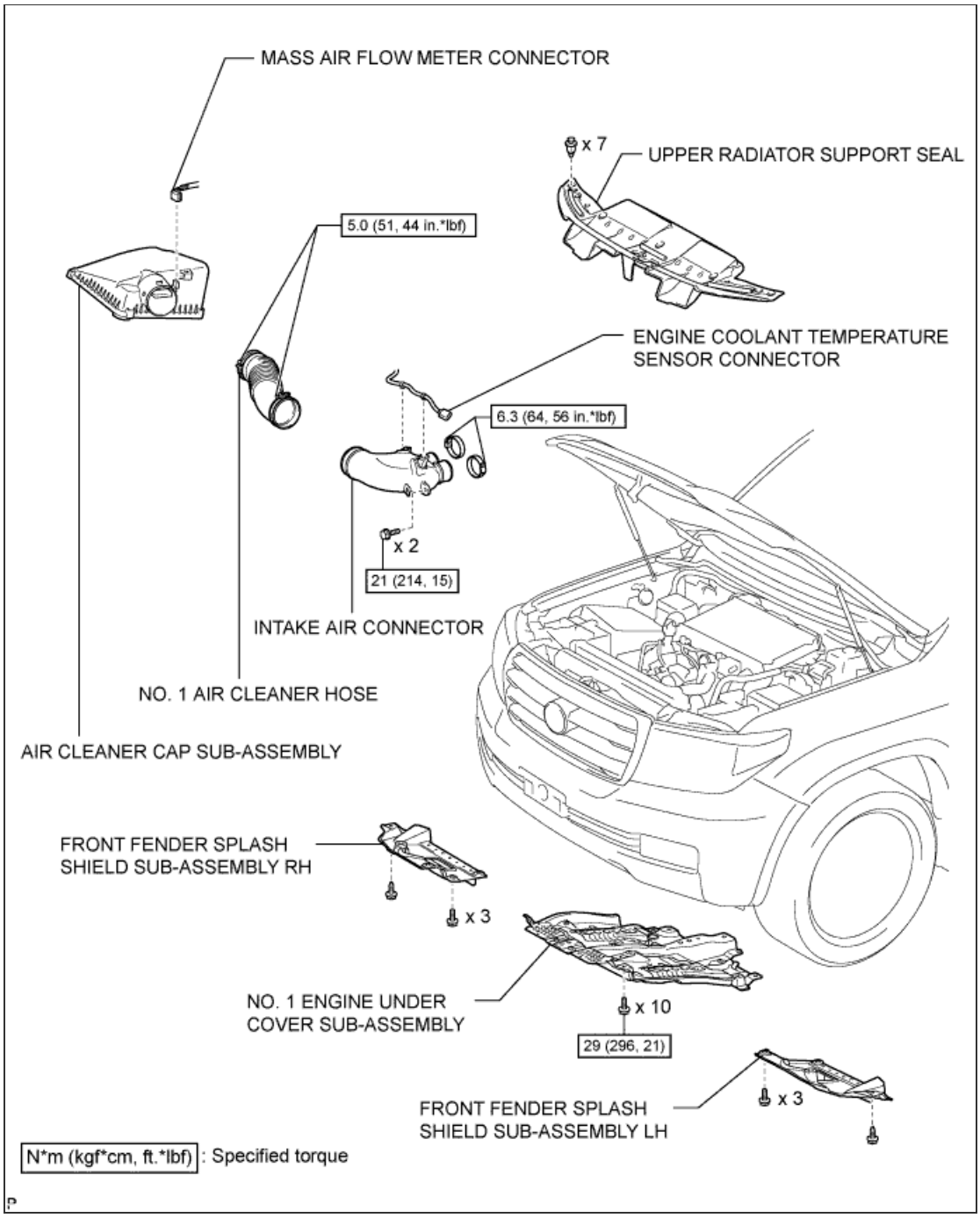
NOTICE:

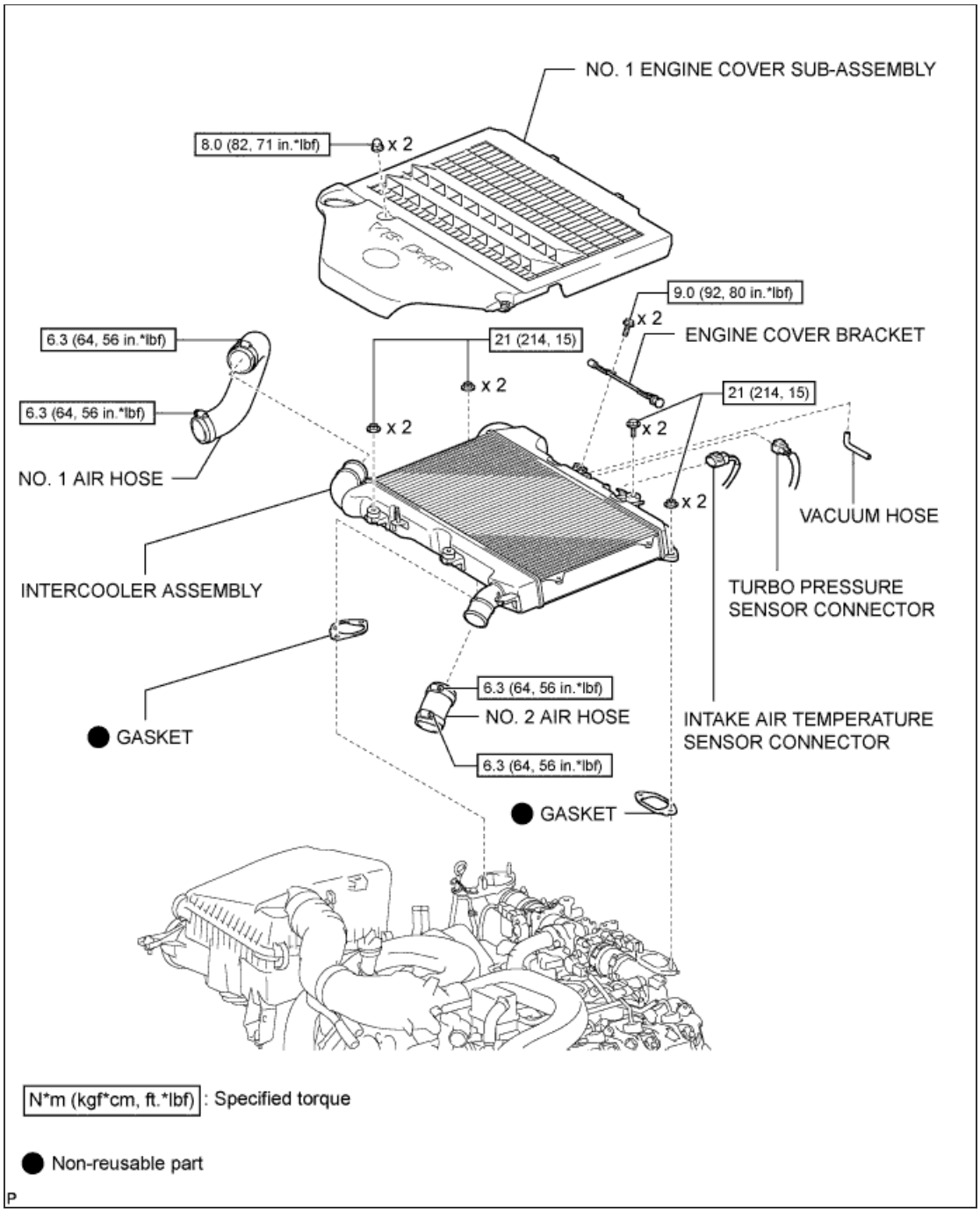
- **Detachment or other problems with the engine oil dipstick, filler cap, PCV hose and other components may cause the engine to run improperly.**
- **Air suction caused by disconnections, looseness or cracks in the parts of the air induction system between the throttle body and cylinder head will cause engine failure or engine malfunctions.**

If the result is not as specified, replace parts as necessary.

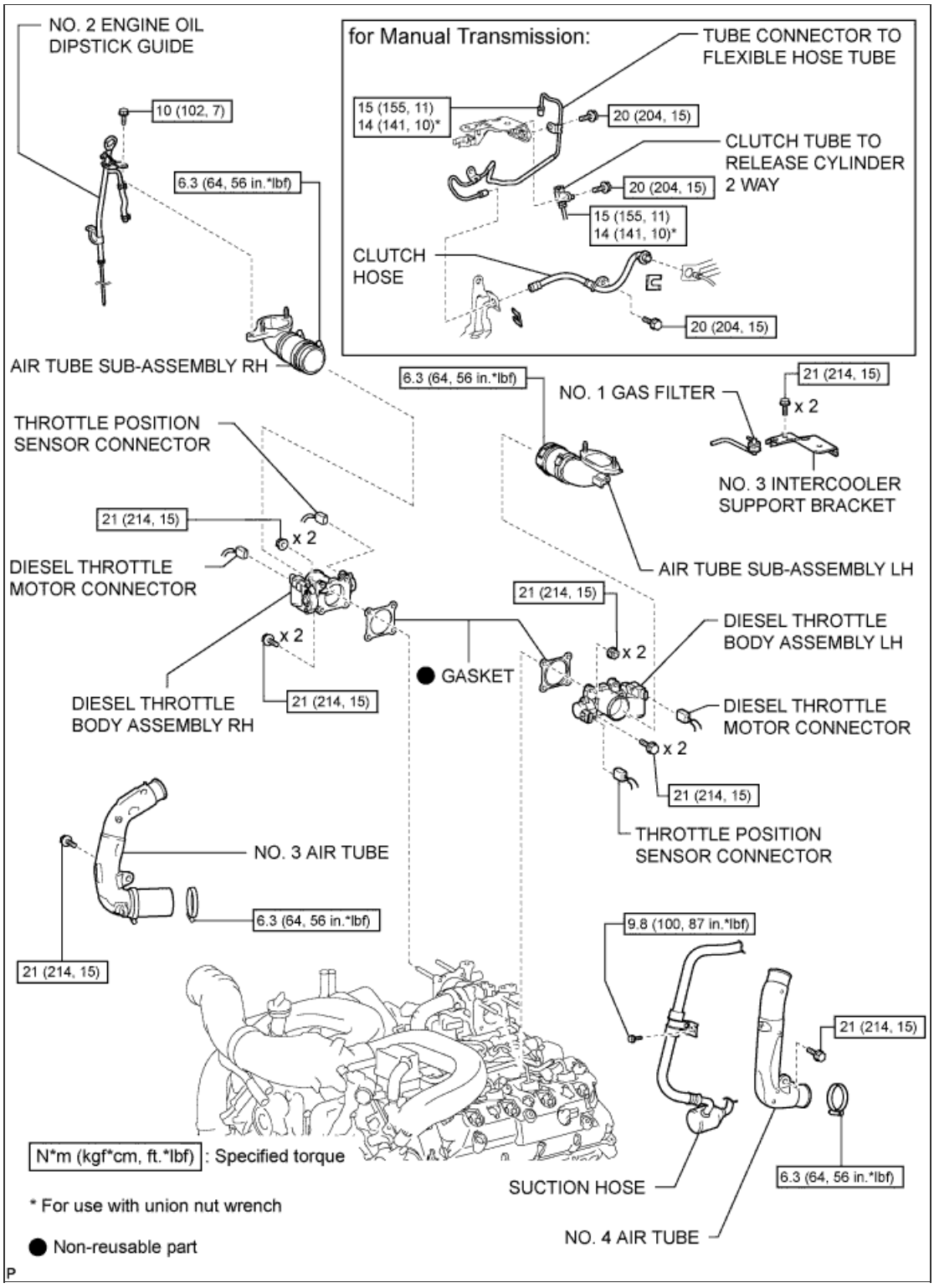


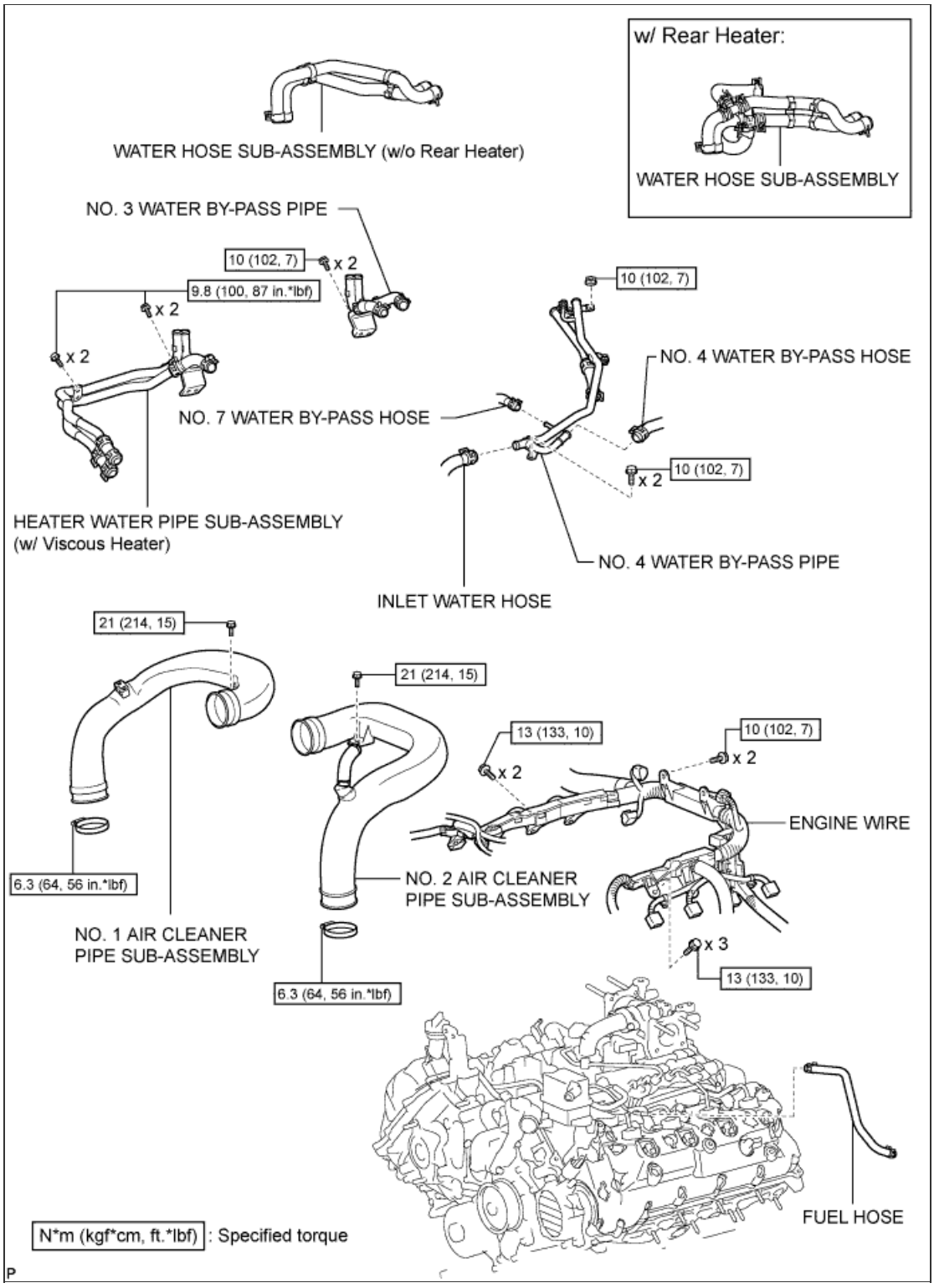
for Preparation Click here

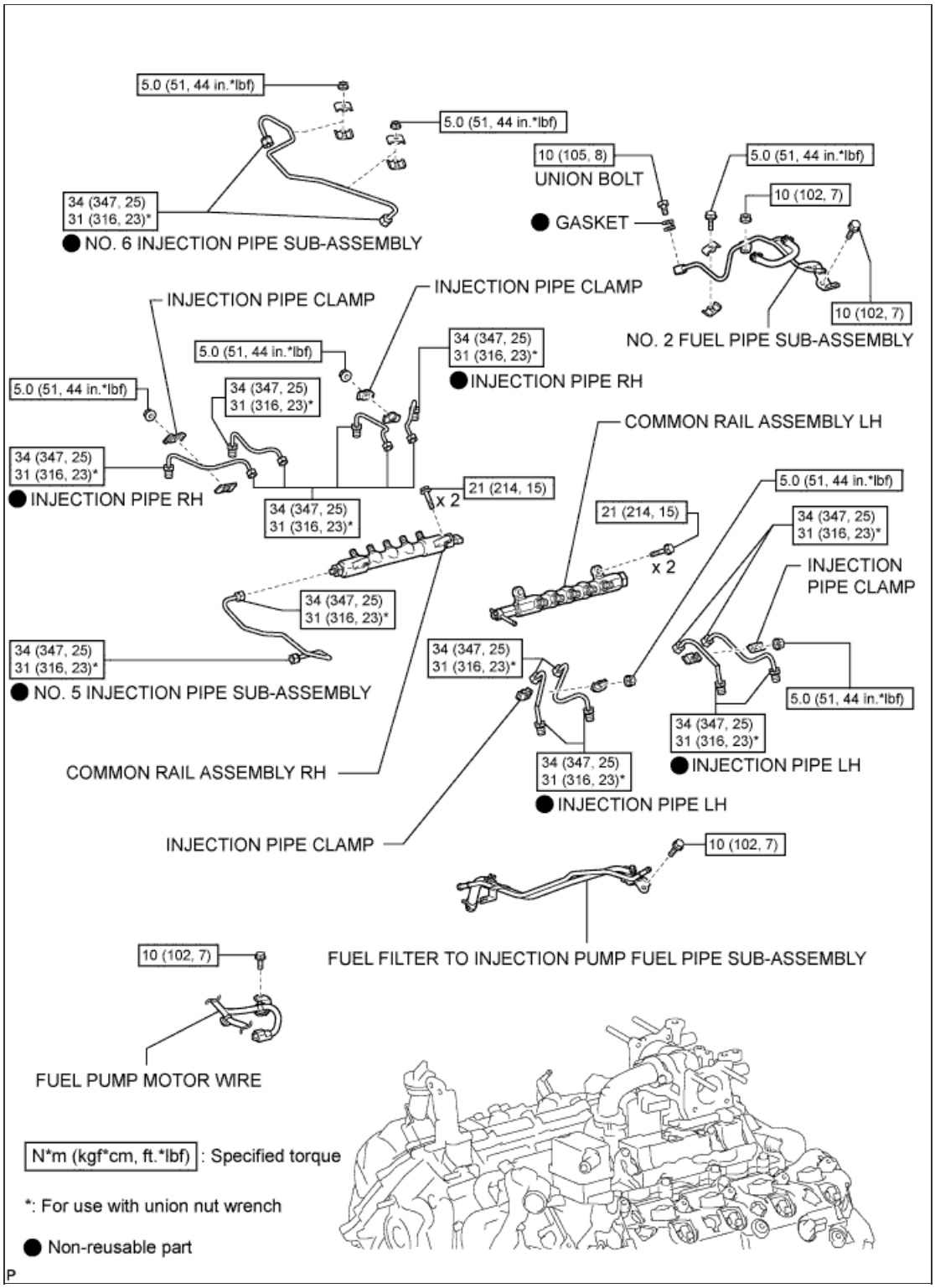


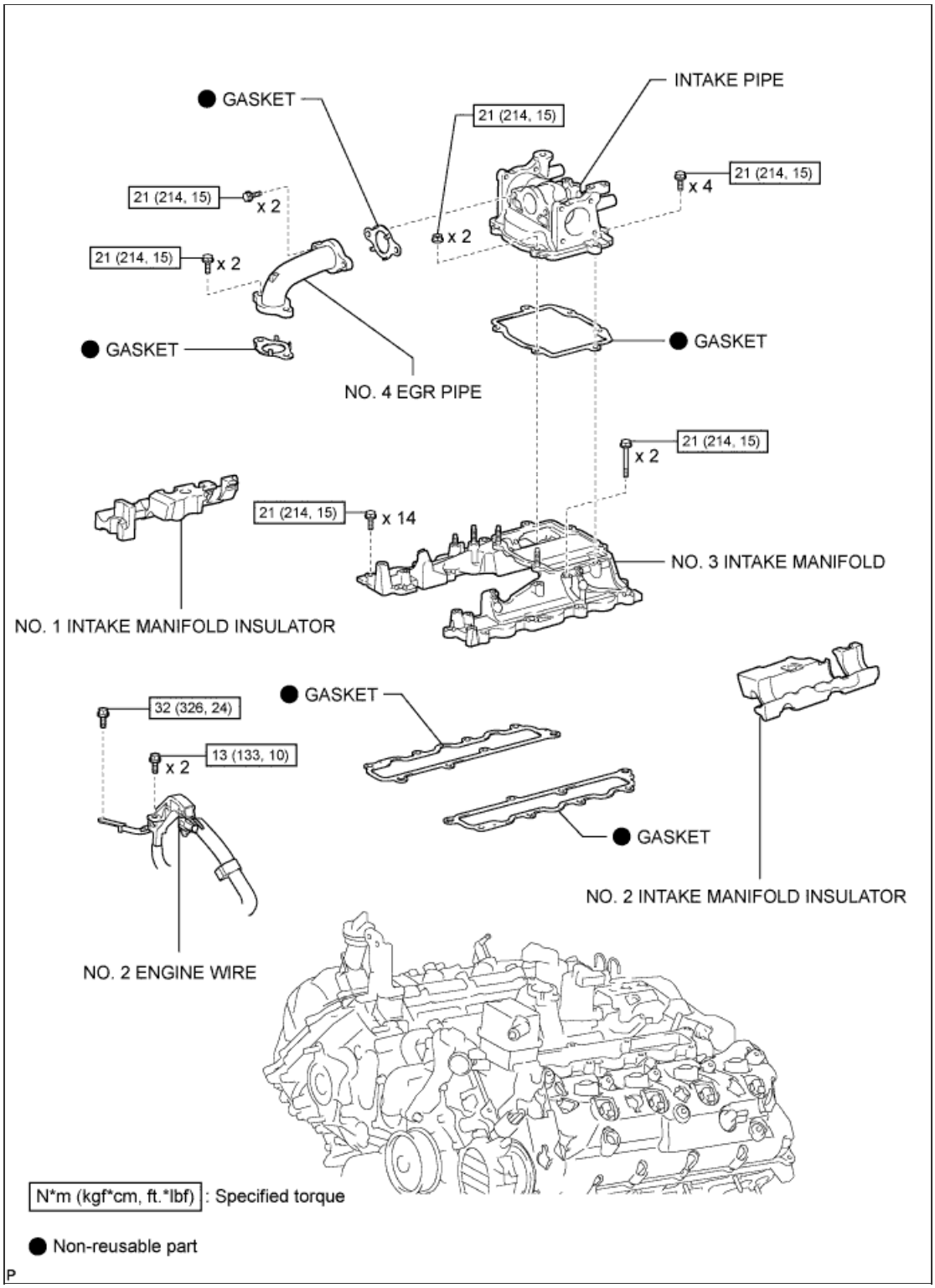

NO. 1 ENGINE COVER SUB-ASSEMBLY
8.0 (82, 71 in.*lbf)
x 2
9.0 (92, 80 in.*lbf)
x 2
ENGINE COVER BRACKET
6.3 (64, 56 in.*lbf)
6.3 (64, 56 in.*lbf)
NO. 1 AIR HOSE
21 (214, 15)
x 2
x 2
21 (214, 15)
x 2
x 2
VACUUM HOSE
INTERCOOLER ASSEMBLY
TURBO PRESSURE SENSOR CONNECTOR
GASKET
6.3 (64, 56 in.*lbf)
NO. 2 AIR HOSE
6.3 (64, 56 in.*lbf)
INTAKE AIR TEMPERATURE SENSOR CONNECTOR
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P

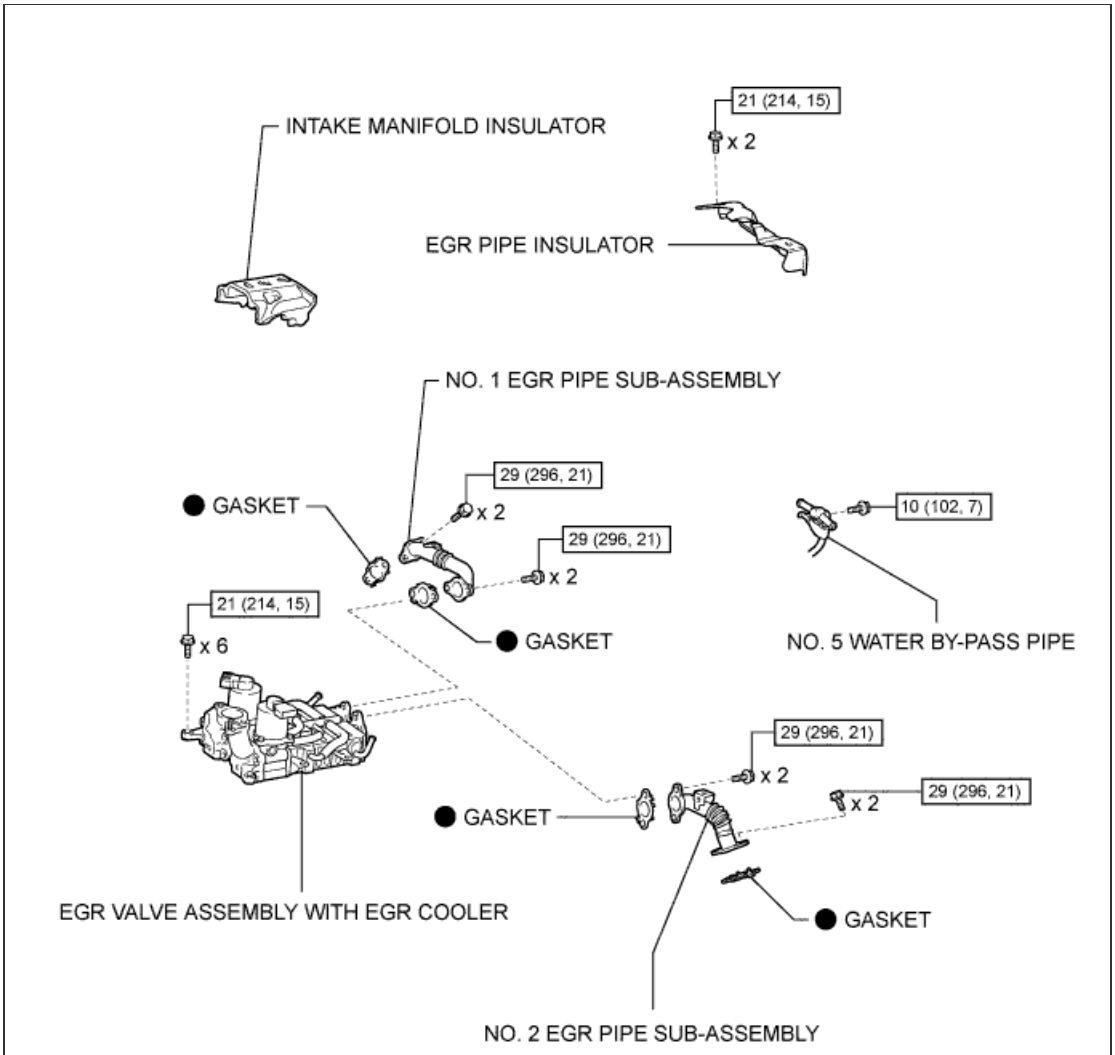

NO. 2 ENGINE OIL DIPSTICK GUIDE
10 (102, 7)
6.3 (64, 56 in.*lbf)
AIR TUBE SUB-ASSEMBLY RH
for Manual Transmission:
TUBE CONNECTOR TO FLEXIBLE HOSE TUBE
15 (155, 11) 14 (141, 10)*
20 (204, 15)
CLUTCH TUBE TO RELEASE CYLINDER 2 WAY
20 (204, 15)
15 (155, 11) 14 (141, 10)*
CLUTCH HOSE
20 (204, 15)
6.3 (64, 56 in.*lbf)
NO. 1 GAS FILTER
21 (214, 15)
x 2
NO. 3 INTERCOOLER SUPPORT BRACKET
THROTTLE POSITION SENSOR CONNECTOR
21 (214, 15)
x 2
DIESEL THROTTLE MOTOR CONNECTOR
AIR TUBE SUB-ASSEMBLY LH
21 (214, 15)
x 2
DIESEL THROTTLE BODY ASSEMBLY LH
x 2
GASKET
DIESEL THROTTLE BODY ASSEMBLY RH
21 (214, 15)
DIESEL THROTTLE MOTOR CONNECTOR
x 2
21 (214, 15)
THROTTLE POSITION SENSOR CONNECTOR
NO. 3 AIR TUBE
6.3 (64, 56 in.*lbf)
21 (214, 15)
9.8 (100, 87 in.*lbf)
21 (214, 15)
6.3 (64, 56 in.*lbf)
SUCTION HOSE
NO. 4 AIR TUBE
N*m (kgf*cm, ft.*lbf) : Specified torque
* For use with union nut wrench
Non-reusable part
P

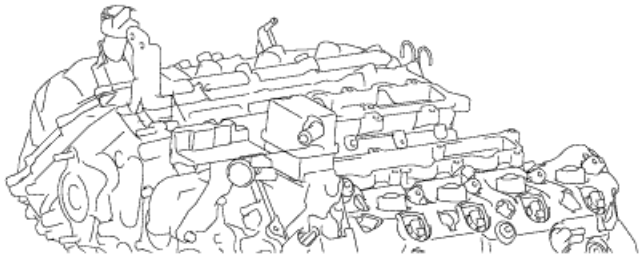

w/ Rear Heater:
WATER HOSE SUB-ASSEMBLY
WATER HOSE SUB-ASSEMBLY (w/o Rear Heater)
NO. 3 WATER BY-PASS PIPE
10 (102, 7)
x 2
9.8 (100, 87 in.*lbf)
x 2
x 2
NO. 7 WATER BY-PASS HOSE
HEATER WATER PIPE SUB-ASSEMBLY
(w/ Viscous Heater)
10 (102, 7)
NO. 4 WATER BY-PASS HOSE
x 2
10 (102, 7)
NO. 4 WATER BY-PASS PIPE
INLET WATER HOSE
21 (214, 15)
21 (214, 15)
13 (133, 10)
x 2
10 (102, 7)
x 2
ENGINE WIRE
6.3 (64, 56 in.*lbf)
NO. 2 AIR CLEANER
PIPE SUB-ASSEMBLY
NO. 1 AIR CLEANER
PIPE SUB-ASSEMBLY
x 3
13 (133, 10)
6.3 (64, 56 in.*lbf)
FUEL HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
P


5.0 (51, 44 in.*lbf)
5.0 (51, 44 in.*lbf)
34 (347, 25)
31 (316, 23)*
NO. 6 INJECTION PIPE SUB-ASSEMBLY
10 (105, 8)
UNION BOLT
GASKET
5.0 (51, 44 in.*lbf)
10 (102, 7)
10 (102, 7)
NO. 2 FUEL PIPE SUB-ASSEMBLY
INJECTION PIPE CLAMP
INJECTION PIPE CLAMP
5.0 (51, 44 in.*lbf)
34 (347, 25)
31 (316, 23)*
INJECTION PIPE RH
5.0 (51, 44 in.*lbf)
34 (347, 25)
31 (316, 23)*
34 (347, 25)
31 (316, 23)*
INJECTION PIPE RH
34 (347, 25)
31 (316, 23)*
x 2
21 (214, 15)
COMMON RAIL ASSEMBLY LH
21 (214, 15)
x 2
5.0 (51, 44 in.*lbf)
34 (347, 25)
31 (316, 23)*
INJECTION
PIPE CLAMP
34 (347, 25)
31 (316, 23)*
34 (347, 25)
31 (316, 23)*
NO. 5 INJECTION PIPE SUB-ASSEMBLY
34 (347, 25)
31 (316, 23)*
5.0 (51, 44 in.*lbf)
34 (347, 25)
31 (316, 23)*
INJECTION PIPE LH
COMMON RAIL ASSEMBLY RH
34 (347, 25)
31 (316, 23)*
INJECTION PIPE LH
INJECTION PIPE CLAMP
10 (102, 7)
FUEL FILTER TO INJECTION PUMP FUEL PIPE SUB-ASSEMBLY
10 (102, 7)
FUEL PUMP MOTOR WIRE
N*m (kgf*cm, ft.*lbf) : Specified torque
*: For use with union nut wrench
Non-reusable part
P


GASKET
21 (214, 15)
INTAKE PIPE
21 (214, 15) x 2
21 (214, 15) x 4
21 (214, 15) x 2
x 2
GASKET
GASKET
NO. 4 EGR PIPE
21 (214, 15) x 2
21 (214, 15) x 14
NO. 3 INTAKE MANIFOLD
NO. 1 INTAKE MANIFOLD INSULATOR
GASKET
32 (326, 24)
13 (133, 10) x 2
GASKET
NO. 2 INTAKE MANIFOLD INSULATOR
NO. 2 ENGINE WIRE
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P

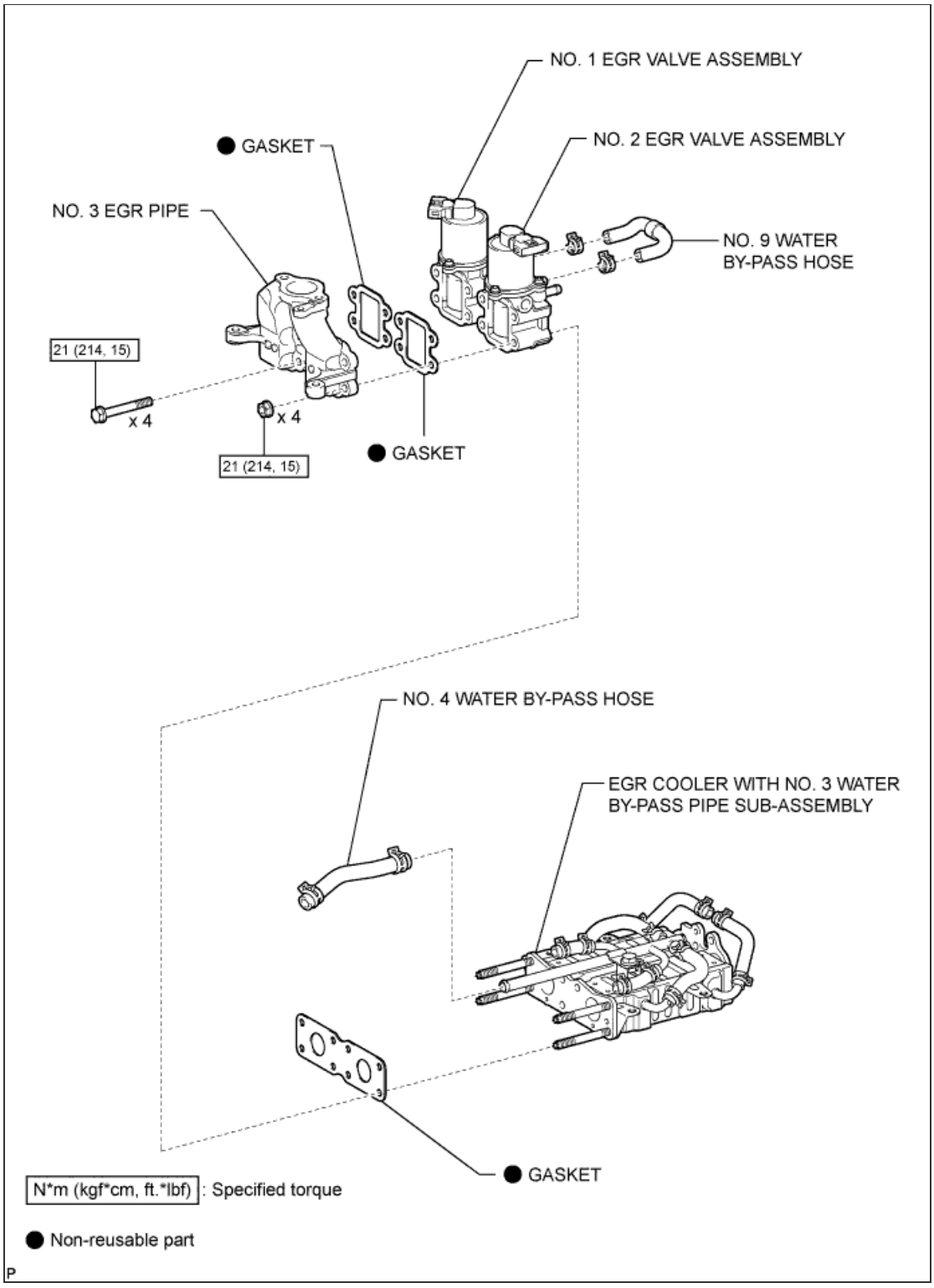




N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P


NO. 1 EGR VALVE ASSEMBLY
GASKET
NO. 2 EGR VALVE ASSEMBLY
NO. 3 EGR PIPE
NO. 9 WATER BY-PASS HOSE
21 (214, 15)
x 4
x 4
21 (214, 15)
GASKET
NO. 4 WATER BY-PASS HOSE
EGR COOLER WITH NO. 3 WATER BY-PASS PIPE SUB-ASSEMBLY
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

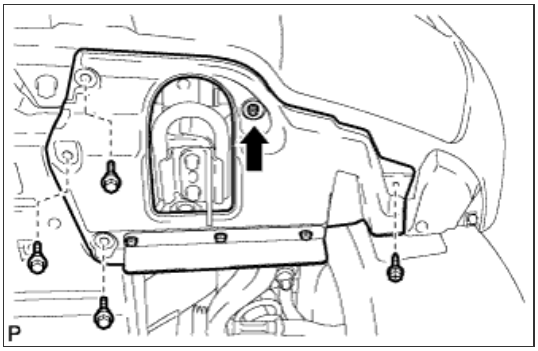
When disconnect the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Disconnect the cables from the negative (-) main battery and sub-battery terminals.

2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



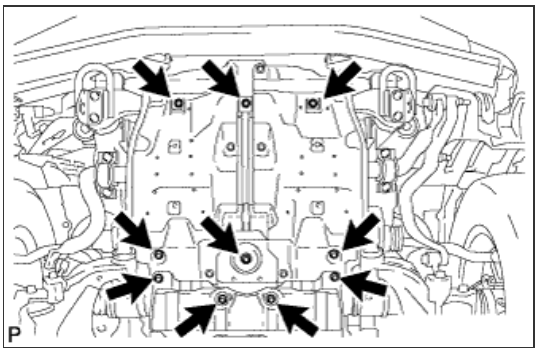
3. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

4. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



5. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and upper radiator support seal.

6. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

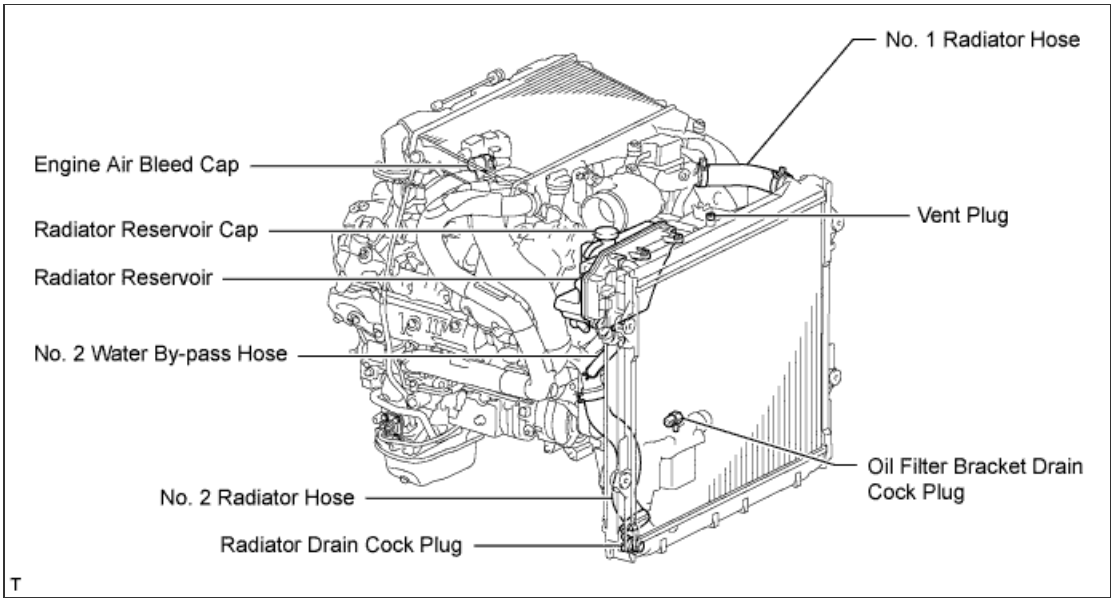
HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

a. Loosen the radiator drain cock plug.

b. Remove the radiator reservoir cap to drain the coolant in the radiator.

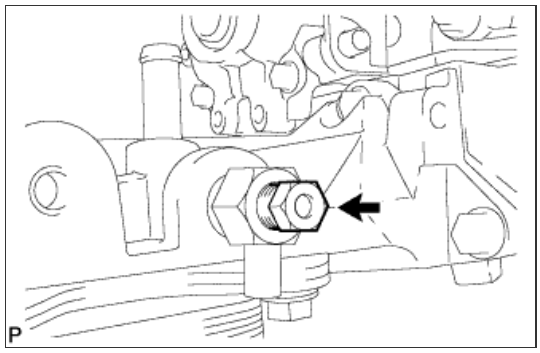
c. Loosen the oil filter bracket drain cock plug to drain the coolant in the engine.



d. Tighten the radiator drain cock plug by hand.

e. Tighten the oil filter bracket drain cock plug.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }

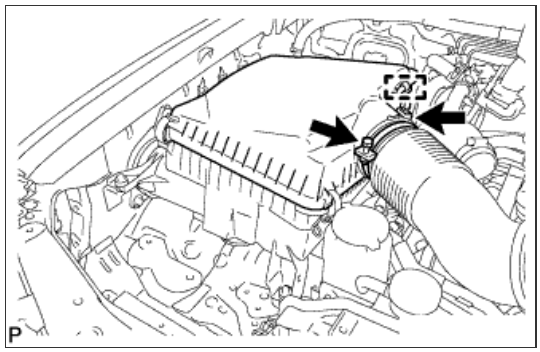


7. REMOVE AIR CLEANER CAP SUB-ASSEMBLY

a. Loosen the hose clamp.

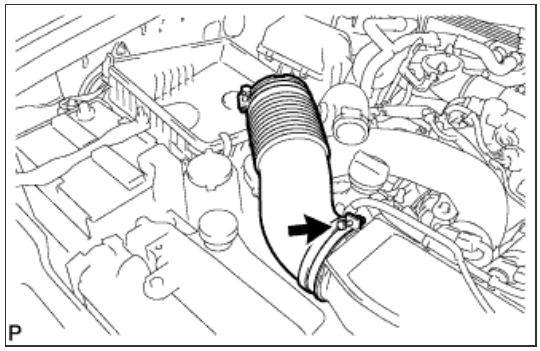
b. Disconnect the mass air flow meter connector and using a clip remover, detach the wire harness clamp from the air cleaner cap.

c. Detach the 4 clamps and remove the air cleaner cap.



8. REMOVE NO. 1 AIR CLEANER HOSE

a. Loosen the hose clamp and remove the No. 1 air cleaner hose.



9. REMOVE INTAKE AIR CONNECTOR

a. w/o Viscous Heater:

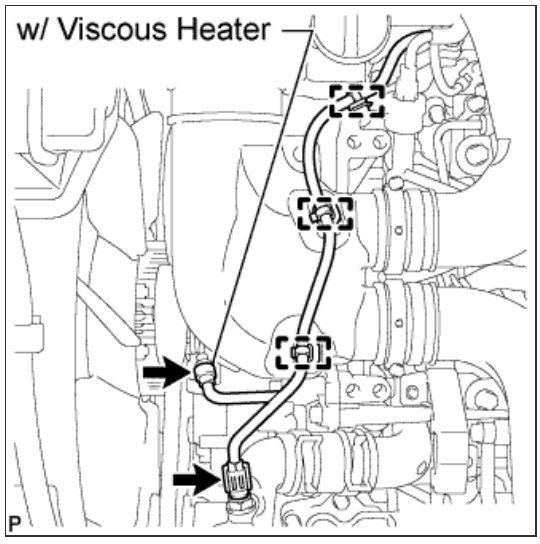
i. Disconnect the connector from the water temperature sensor.

ii. Using a clip remover, detach the 3 wire harness clamps.

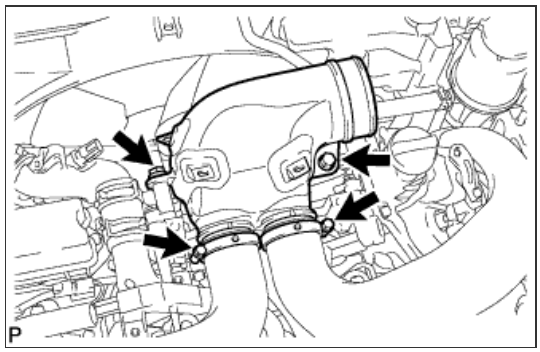
b. w/ Viscous Heater:

i. Disconnect the 2 connectors from the viscous with magnet clutch heater and water temperature sensor.

ii. Using a clip remover, detach the 3 wire harness clamps.



c. Loosen the 2 hose clamps and remove the 2 bolts and intake air connector.

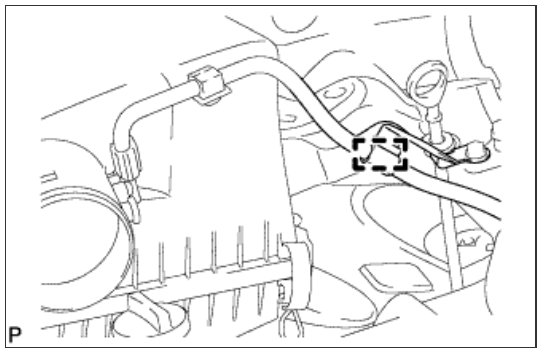


10. REMOVE INTERCOOLER ASSEMBLY

a. Remove the intercooler assembly (Click here).

11. REMOVE NO. 2 ENGINE OIL DIPSTICK GUIDE

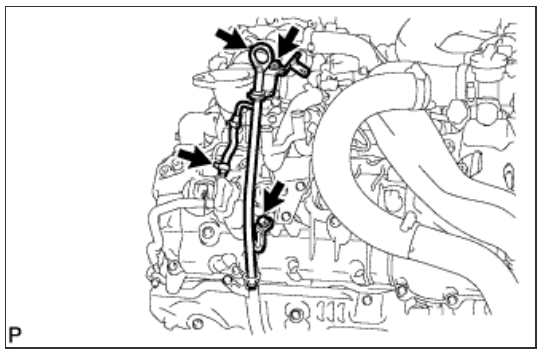
a. Disconnect the wire harness clamp from the No. 2 engine oil level dipstick guide.



b. Disconnect the ventilation hose from the cylinder head cover RH.

c. Remove the 2 bolts and No. 2 engine oil level dipstick guide.

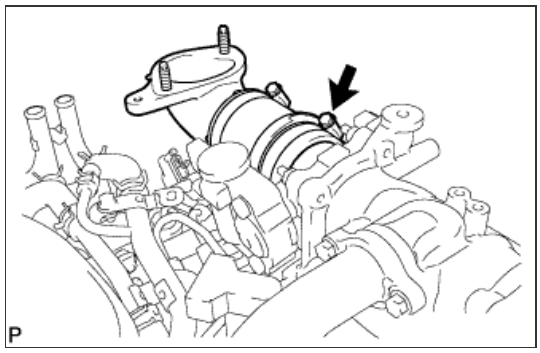
d. Remove the O-ring from the No. 2 engine oil level dipstick guide.



12. REMOVE AIR TUBE SUB-ASSEMBLY RH

a. Loosen the hose clamp.

b. Remove the air tube from the throttle body.



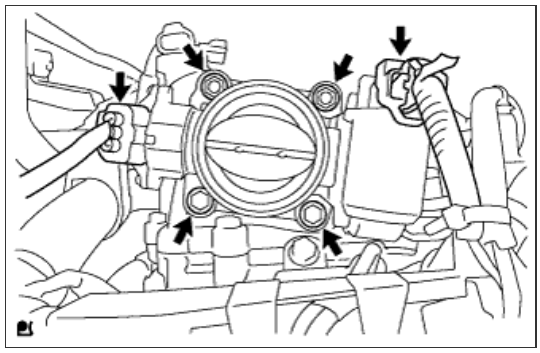
13. REMOVE DIESEL THROTTLE BODY ASSEMBLY RH

a. Disconnect the throttle position sensor connector.

b. Disconnect the throttle motor connector.

c. Remove the 2 bolts, 2 nuts and throttle body.

d. Remove the gasket from the intake pipe.



14. DRAIN CLUTCH FLUID (for Manual Transmission)

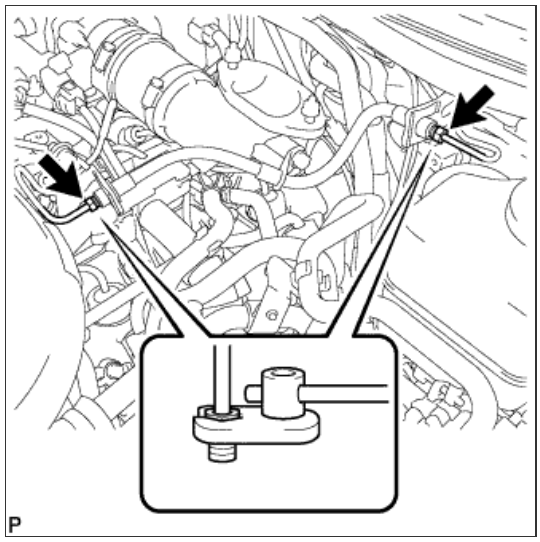
15. REMOVE CLUTCH HOSE (for Manual Transmission)

a. Disconnect the 2 flexible hose tubes from the clutch hose with a 10 mm union nut wrench while holding the flexible hose with a wrench.

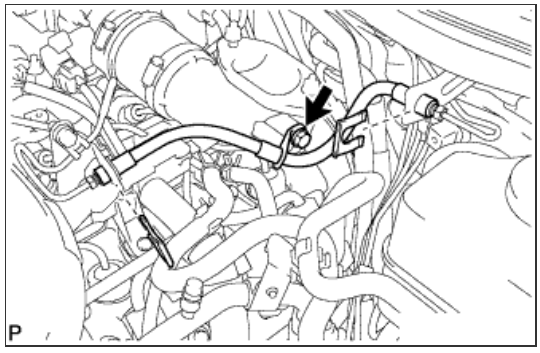
NOTICE:

- **Do not bend or damage the flexible hose tubes.**
- **Do not allow any foreign matter such as dirt and dust to enter the flexible hose tubes from the connecting point.**

b. Remove the 2 clips.



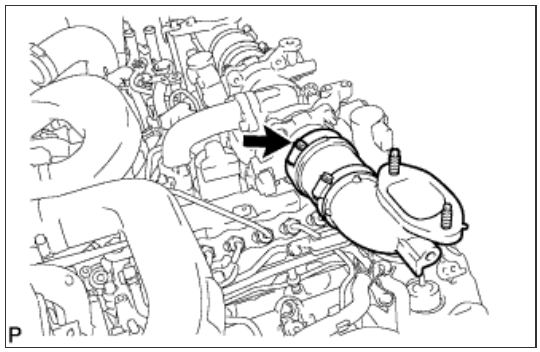
c. Remove the bolt and clutch hose.



16. REMOVE AIR TUBE SUB-ASSEMBLY LH

a. Loosen the hose clamp.

b. Remove the air tube from the throttle body.

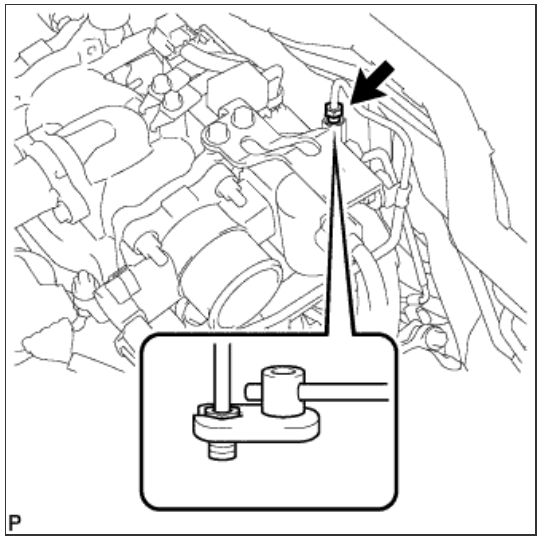


17. REMOVE TUBE CONNECTOR TO FLEXIBLE HOSE TUBE (for Manual Transaxle)

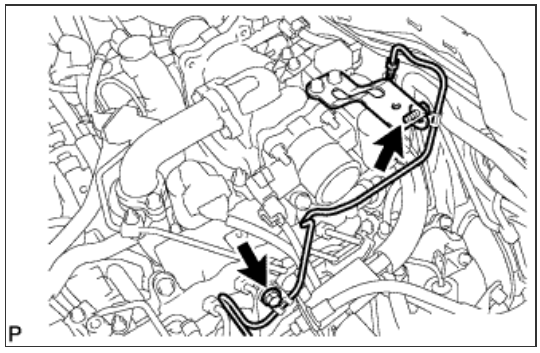
a. Using a 10 mm union nut wrench, disconnect the tube connector to flexible hose tube from the clutch tube to release cylinder 2 way.

NOTICE:

- **Do not bend or damage the flexible hose tube.**
- **Do not allow any foreign matter such as dirt and dust to enter the flexible hose tube from the connecting point.**



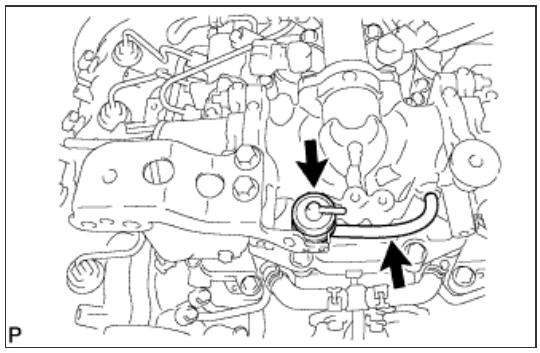
b. Remove the 2 bolts and tube connector to flexible hose tube.



18. REMOVE NO. 1 GAS FILTER

a. Disconnect the hose from the intake pipe.

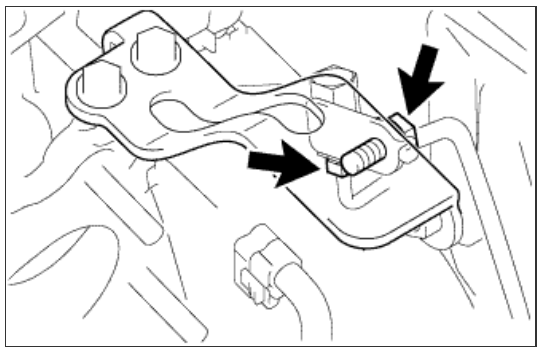
b. Remove the gas filter.



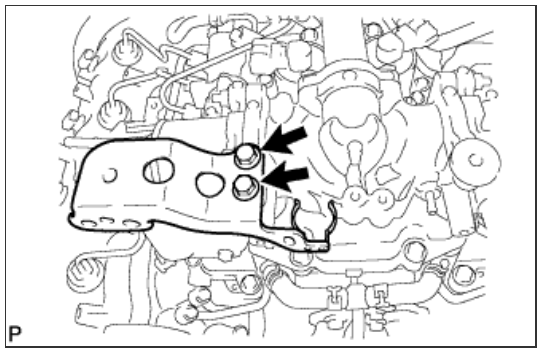
19. REMOVE NO. 3 INTERCOOLER SUPPORT BRACKET

a. for Manual Transmission:

i. Remove the bolt and disconnect the clutch tube to release cylinder 2 way from the bracket.



b. Remove the 2 bolts and bracket.



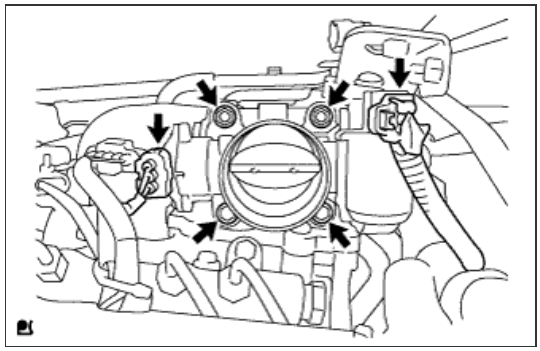
20. REMOVE DIESEL THROTTLE BODY ASSEMBLY LH

a. Disconnect the throttle position sensor connector.

b. Disconnect the throttle motor connector.

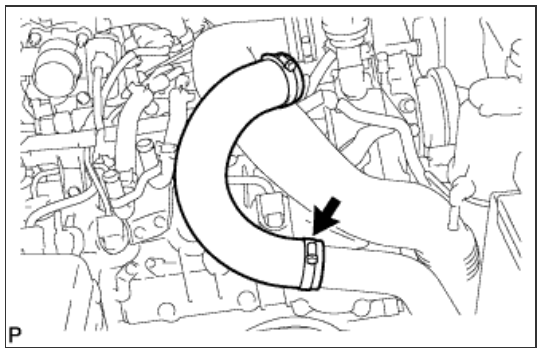
c. Remove the 2 bolts, 2 nuts and throttle body.

d. Remove the gasket from the intake pipe.



21. REMOVE NO. 1 AIR HOSE

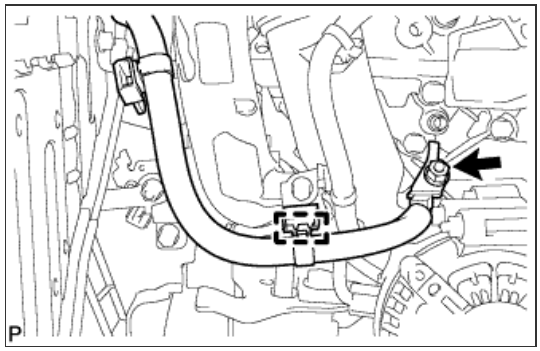
a. Loosen the hose clamp and remove the No. 1 air hose.



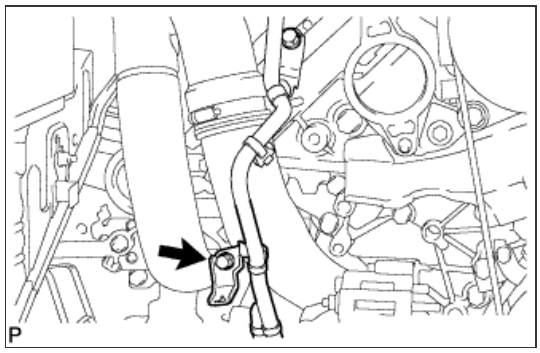
22. REMOVE NO. 3 AIR TUBE

a. Disconnect the wire harness from the clamp.

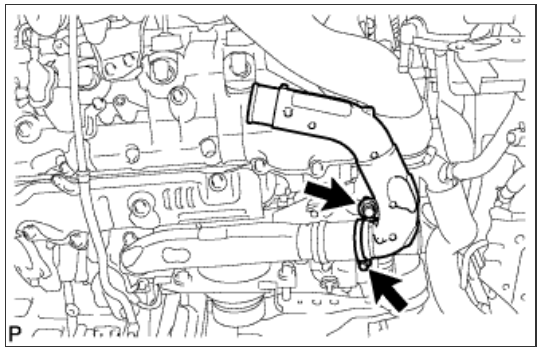
b. Remove the nut and ground wire.



c. Remove the bolt and disconnect the wire harness bracket.

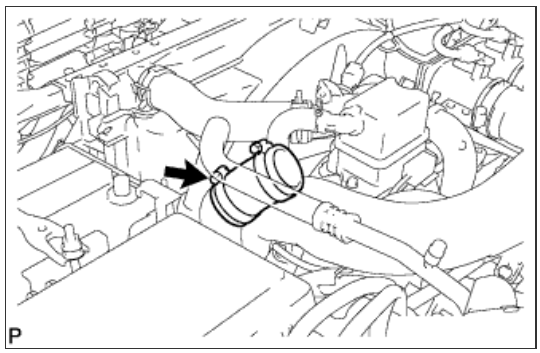


d. Loosen the hose clamp and remove the bolt and No. 3 air tube.



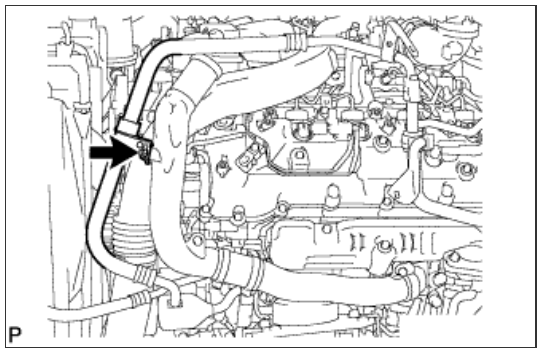
23. REMOVE NO. 2 AIR HOSE

a. Loosen the hose clamp and remove the No. 2 air hose.

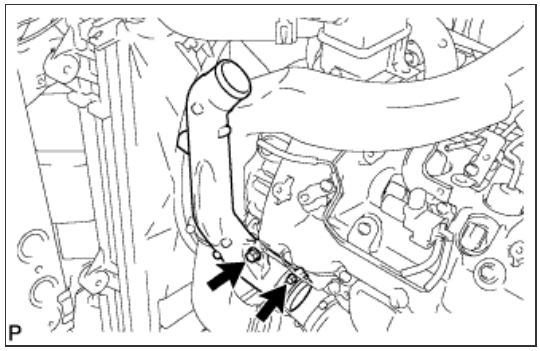


24. REMOVE NO. 4 AIR TUBE

a. Remove the bolt and disconnect the suction hose.



b. Loosen the hose clamp and remove the bolt and No. 4 air tube.

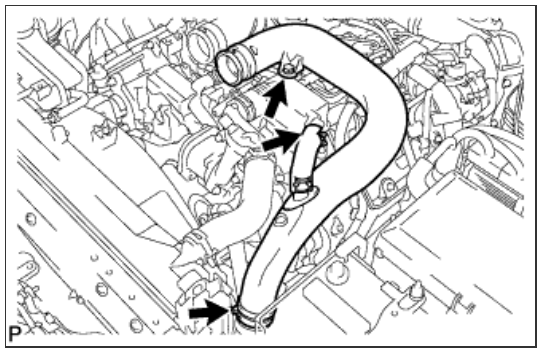


25. REMOVE NO. 2 AIR CLEANER PIPE SUB-ASSEMBLY

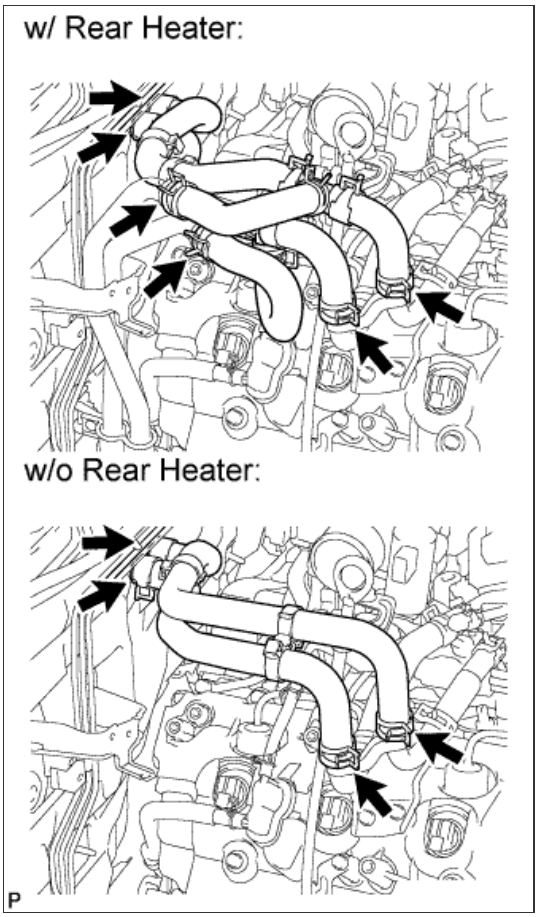
a. Disconnect the ventilation hose from the oil separator.

b. Loosen the hose clamp.

c. Remove the bolt and No. 2 air cleaner pipe.



26. DISCONNECT WATER HOSE SUB-ASSEMBLY



27. REMOVE HEATER WATER PIPE SUB-ASSEMBLY (w/ Viscous Heater)

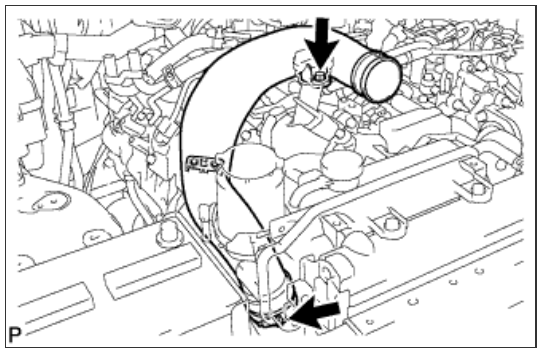
a. Remove the 4 bolts and disconnect the 4 water hose ends, and then remove the heater water pipe.



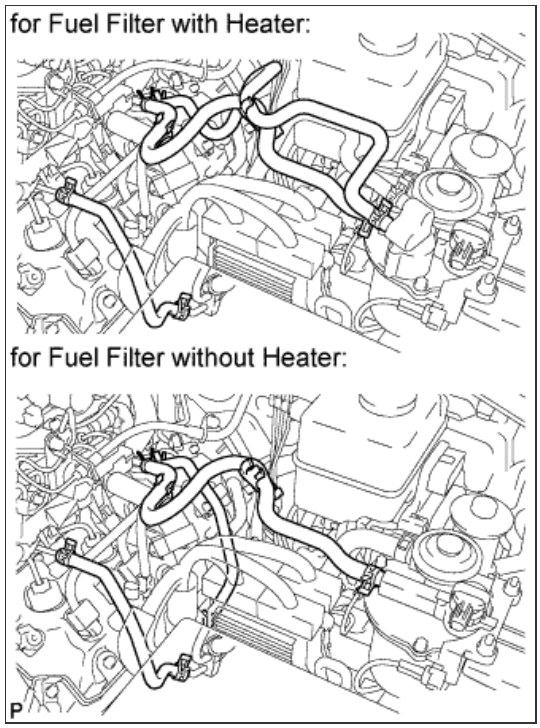
28. REMOVE NO. 1 AIR CLEANER PIPE SUB-ASSEMBLY

a. Loosen the hose clamp.

b. Remove the bolt and No. 1 air cleaner pipe.

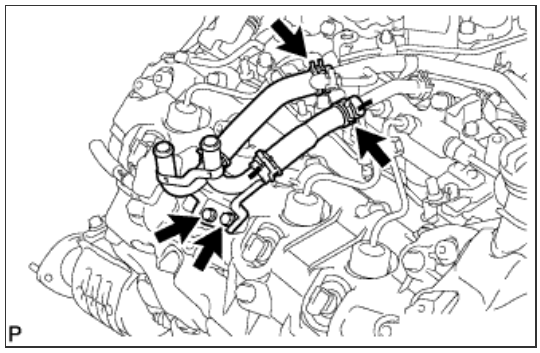


29. REMOVE FUEL HOSE



30. REMOVE NO. 3 WATER BY-PASS PIPE (w/o Viscous Heater)

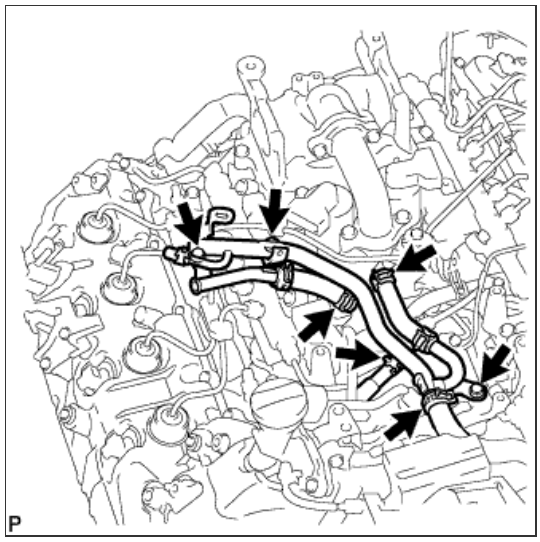
a. Remove the 2 bolts and disconnect the 2 water hose ends, and then remove the No. 3 water by-pass pipe.



31. REMOVE NO. 4 WATER BY-PASS PIPE

a. Remove the 2 bolts and nut.

b. Disconnect the 4 water hose ends, then remove the No. 4 water by-pass pipe.

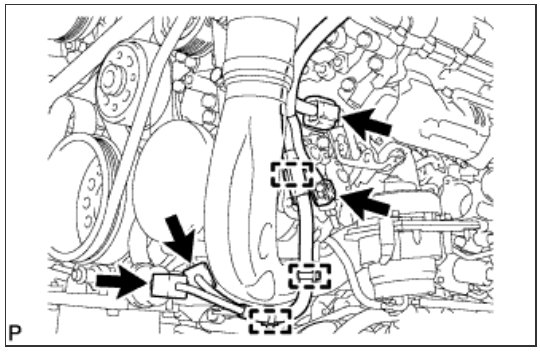


32. DISCONNECT ENGINE WIRE

a. LH Side:

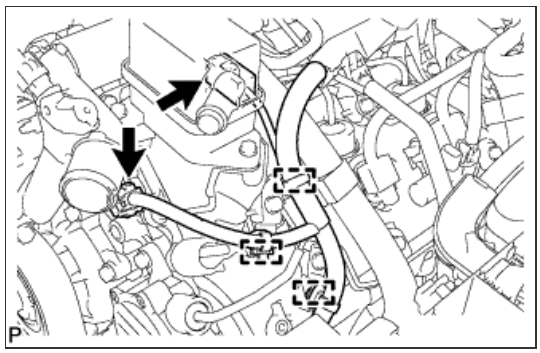
i. Disconnect the 4 connectors.

ii. Using a clip remover, detach the 3 wire harness clamps.



iii. Disconnect the 2 connectors.

iv. Using a clip remover, detach the 3 wire harness clamps.

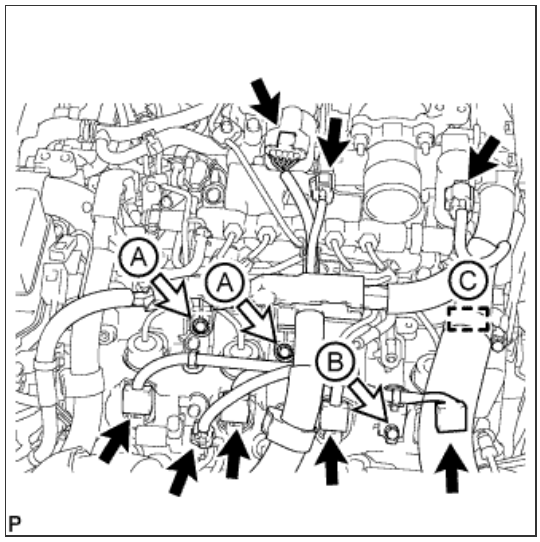


v. Disconnect the 8 connectors.

vi. Remove the bolt and engine wire harness bracket labeled B.

vii. Remove the 2 bolts and disconnect the engine wire protector labeled
.

viii. for RHD:
Disconnect the wire harness from the wire harness clamp holder labeled C.



b. RH Side:

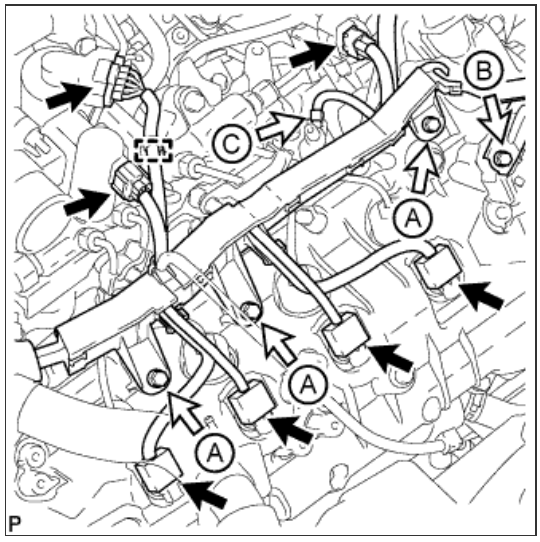
i. Disconnect the 7 connectors.

ii. Using a clip remover, detach the wire harness clamp.

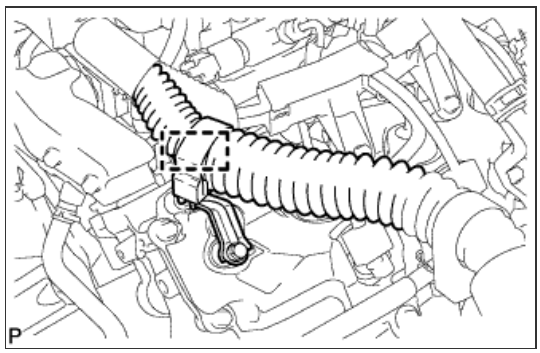
iii. Remove the 3 bolts and disconnect the wire harness protector labeled .

i . Remove the bolt and wire harness bracket labeled B.

. Remove the nut and glow plug wire harness labeled C.



i. for RHD:
Disconnect the wire harness from the wire harness clamp holder.



c. Rear Side:

i. Using a clip remover, detach the wire harness clamp.

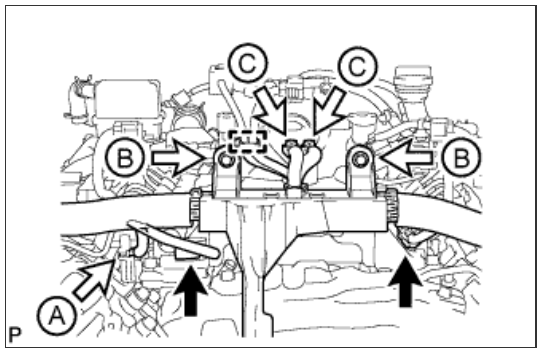
ii. Remove the 2 bolts and 2 ground wires labeled C.

iii. Remove the 2 bolts and disconnect the engine wire harness protector

labeled B.

i . Disconnect the 2 common rail connectors.

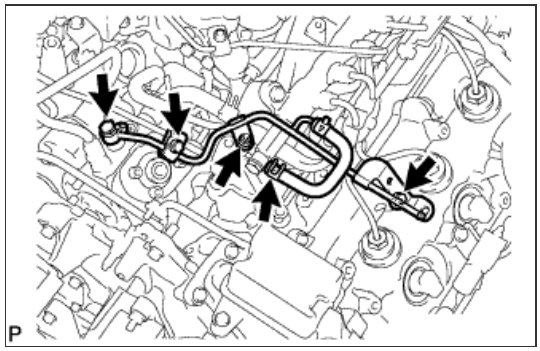
. Remove the nut and disconnect the glow plug wire harness labeled .



33. REMOVE NO. 2 FUEL PIPE SUB-ASSEMBLY

NOTICE:

- **After removing a fuel pipe, to prevent dirt or foreign objects from entering the fuel pipe ends, cover the fuel pipe ends with plastic bags.**
- **After removing a fuel pipe, to prevent dirt or foreign objects from entering the fuel supply pump hole, cover the hole with protective tape.**



a. Disconnect the fuel hose from the No. 5 nozzle leakage pipe.

b. Remove the bolt and No. 2 injection pipe clamp.

c. Remove the union bolt and gasket.

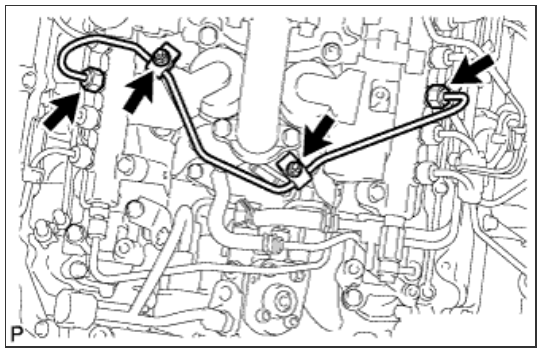
d. Remove the bolt, nut and No. 2 fuel pipe.

34. REMOVE NO. 6 INJECTION PIPE SUB-ASSEMBLY

NOTICE:

fter removing an injection pipe, to prevent dirt or foreign objects from entering the common rail holes, cover the holes with protective tape.

a. w/ EGR System:

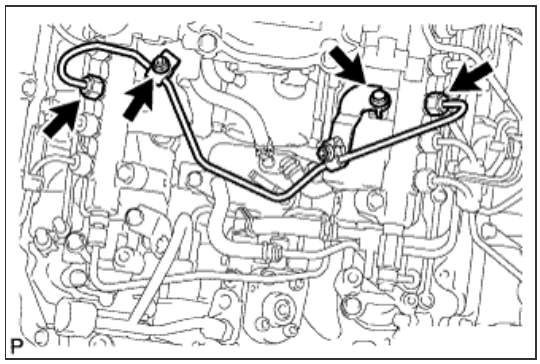


i. Using a union nut wrench, loosen the No. 6 injection pipe ends.

ii. Remove the 2 nuts and 2 No. 2 injection pipe clamps.

iii. Remove the No. 6 injection pipe.

b. w/o EGR System:



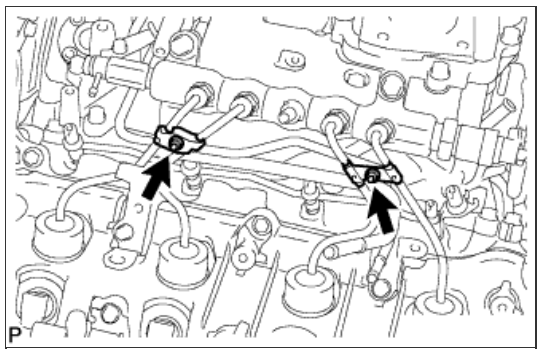
i. Using a union nut wrench, loosen the No. 6 injection pipe ends.

ii. Remove the nut and No. 2 injection pipe clamp.

iii. Remove the bolt and No. 6 injection pipe.

35. REMOVE INJECTION PIPE LH

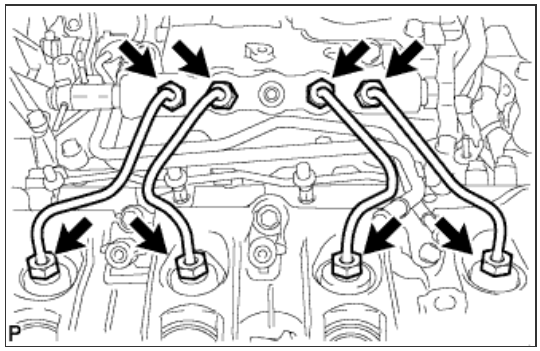
a. w/ ntercooler:
Remove the 2 nuts and 4 injection pipe clamps.



b. Using a union nut wrench, remove the 4 injection pipes.

NOTICE:

fter removing an injection pipe, to prevent dirt or foreign objects from entering the common rail holes or injector holes, cover the holes with protective tape.

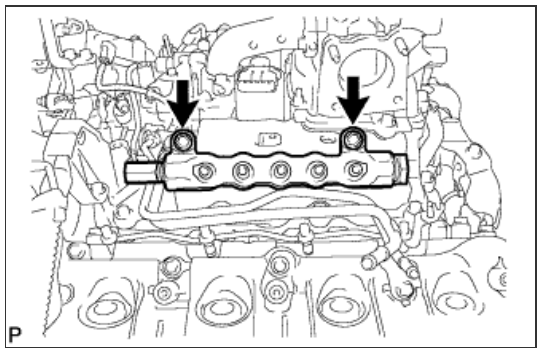


36. REMOVE COMMON RAIL ASSEMBLY LH

a. Remove the 2 bolts and common rail.

NOTICE:

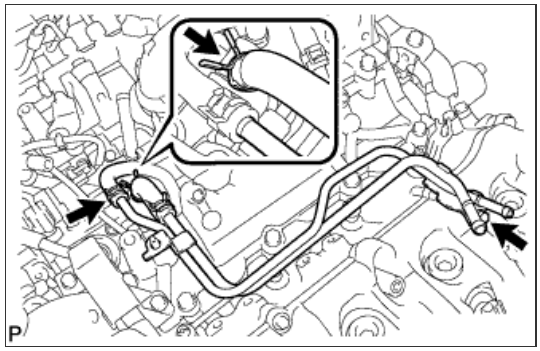
Do not remove the fuel pressure limiter from the common rail. f it is removed, replace the common rail.



37. REMOVE FUEL FILTER TO INJECTION PUMP FUEL PIPE SUB-ASSEMBLY

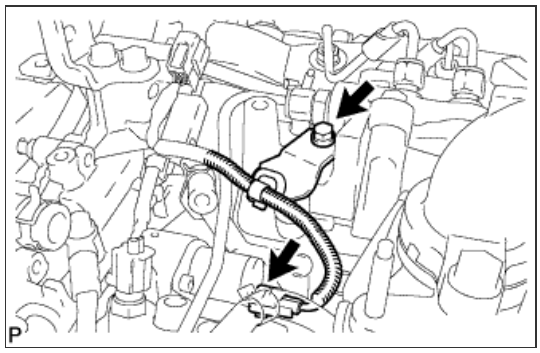
a. Disconnect the 2 hoses from the fuel pipe.

b. Remove the bolt and fuel filter to injection pump fuel pipe.



38. DISCONNECT FUEL PUMP MOTOR WIRE

a. Remove the bolt and disconnect the connector from the fuel supply pump.

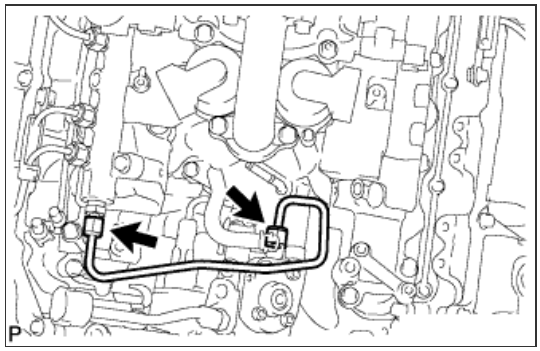


39. REMOVE NO. 5 INJECTION PIPE SUB-ASSEMBLY

a. Using a union nut wrench, remove the No. 5 injection pipe.

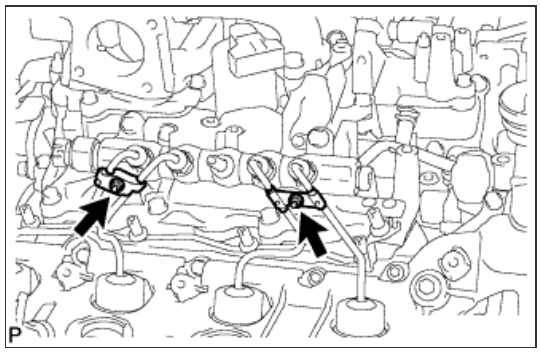
NOTICE:

fter removing an injection pipe, to prevent dirt or foreign objects from entering the common rail hole or injection pump hole, cover the holes with protective tape.



40. REMOVE INJECTION PIPE RH

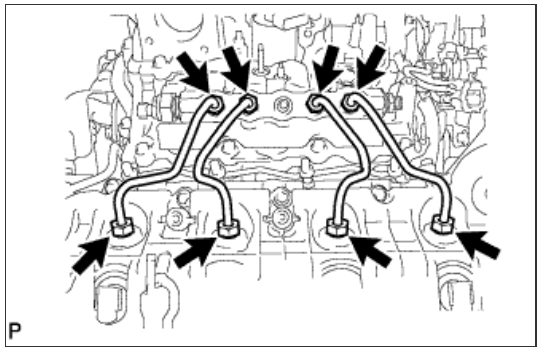
a. w/ ntercooler:
Remove the 2 nuts and 4 injection pipe clamps.



b. Using a union nut wrench, remove the 4 injection pipes.

NOTICE:

fter removing an injection pipe, to prevent dirt or foreign objects from entering the common rail holes or injector holes, cover the holes with protective tape.

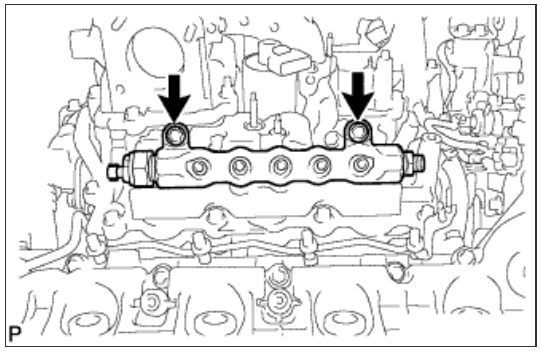


41. REMOVE COMMON RAIL ASSEMBLY RH

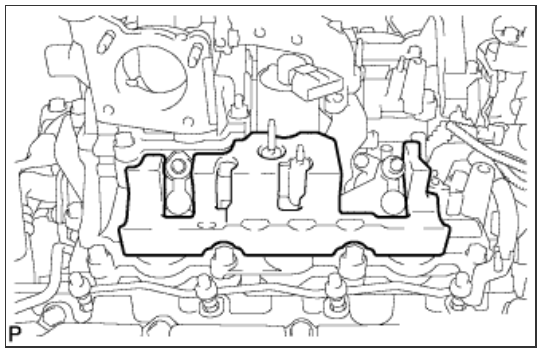
a. Remove the 2 bolts and common rail.

NOTICE:

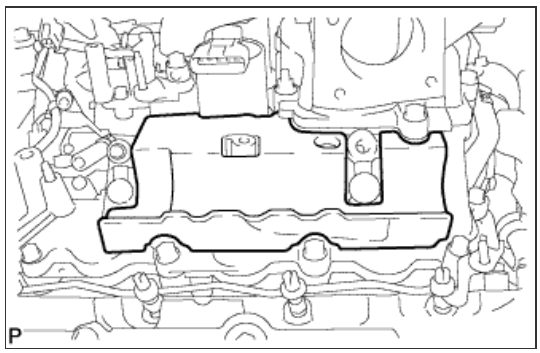
Do not remove the fuel pressure sensor from the common rail. f it is removed, replace the common rail.



42. REMOVE NO. 1 INTAKE MANIFOLD INSULATOR

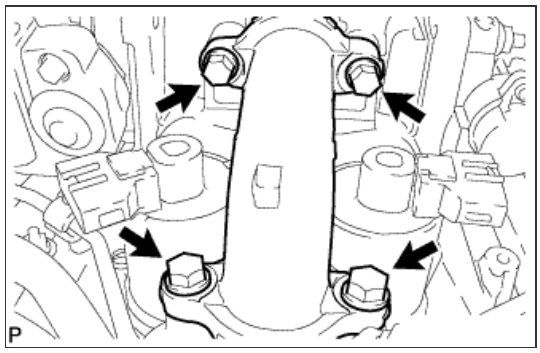


43. REMOVE NO. 2 INTAKE MANIFOLD INSULATOR



44. REMOVE NO. 4 EGR PIPE

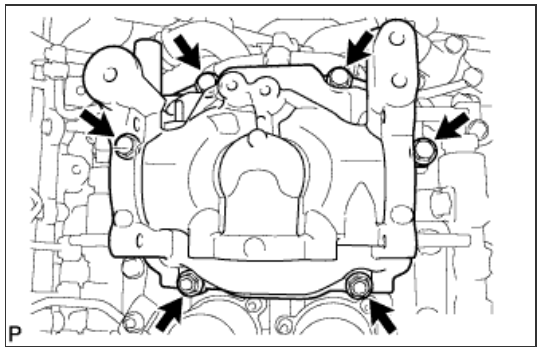
a. Remove the 4 bolts, EGR pipe and 2 gaskets.



45. REMOVE INTAKE PIPE

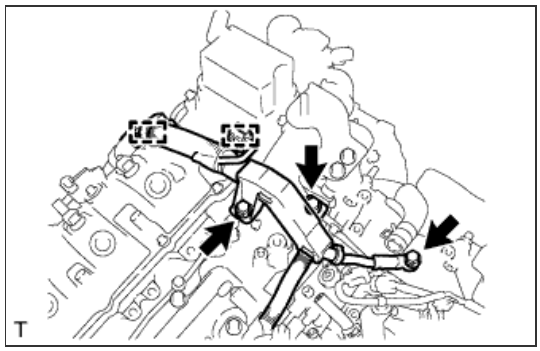
a. Remove the 4 bolts, 2 nuts and intake pipe.

b. Remove the gasket.



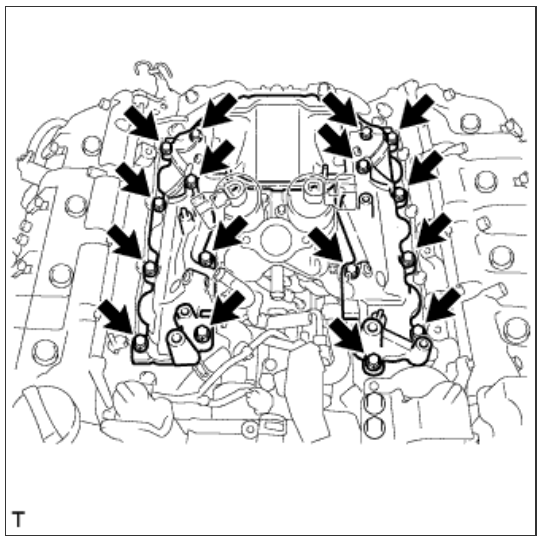
46. DISCONNECT NO. 2 ENGINE WIRE

a. Remove the 3 bolts and using a clip remover, detach the 2 wire harness clamps, and then disconnect the No. 2 engine wire.

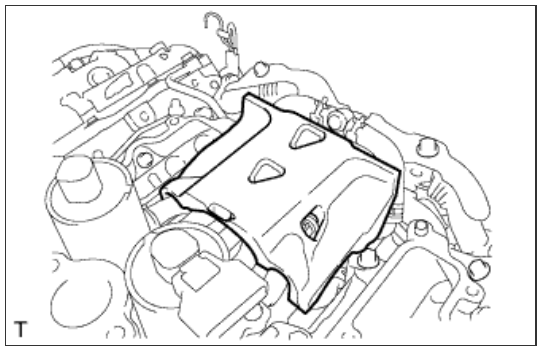


47. REMOVE NO. 3 INTAKE MANIFOLD

a. Remove the 16 bolts, No. 3 intake manifold and 2 gaskets.

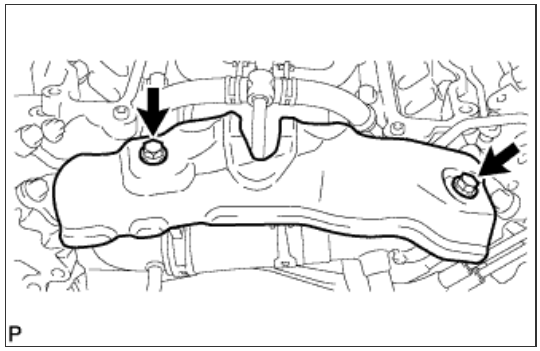


48. REMOVE INTAKE MANIFOLD INSULATOR



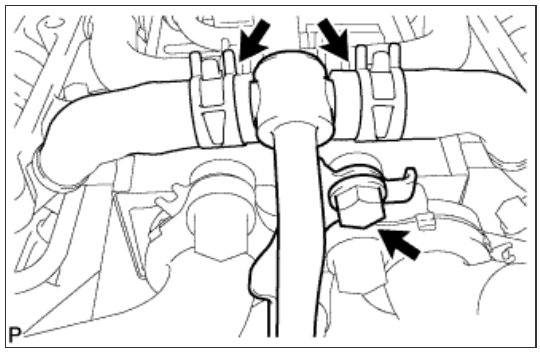
49. REMOVE EGR PIPE INSULATOR

a. Remove the 2 bolts and insulator.



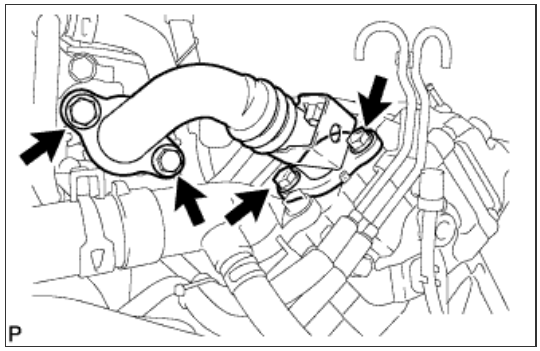
50. DISCONNECT NO. 5 WATER BY-PASS PIPE

a. Remove the bolt and disconnect the 2 hoses to disconnect the water by-pass pipe.



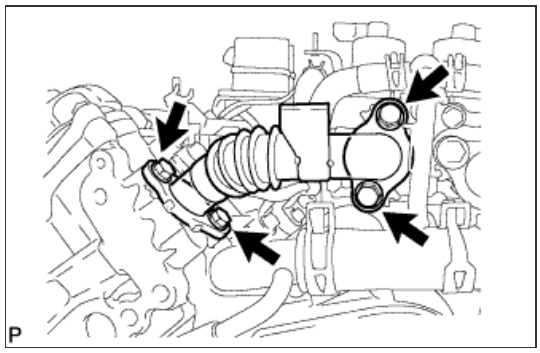
51. REMOVE NO. 1 EGR PIPE SUB-ASSEMBLY

a. Remove the 4 bolts, EGR pipe and 2 gaskets.



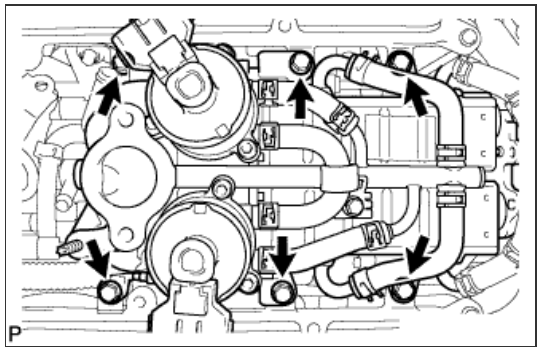
52. REMOVE NO. 2 EGR PIPE SUB-ASSEMBLY

a. Remove the 4 bolts, EGR pipe and 2 gaskets.



53. REMOVE EGR VALVE ASSEMBLY WITH EGR COOLER

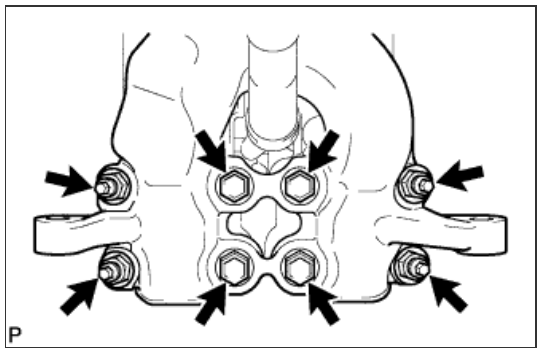
a. Remove the 6 bolts and EGR valve with EGR cooler.



54. REMOVE NO. 3 EGR PIPE

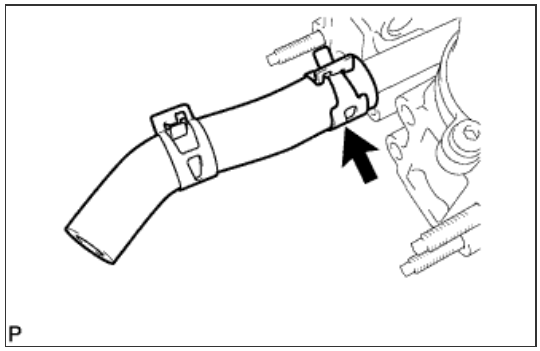
a. Remove the 4 nuts, 4 bolts and pipe.

b. Remove the 2 gaskets.



55. REMOVE NO. 4 WATER BY-PASS HOSE

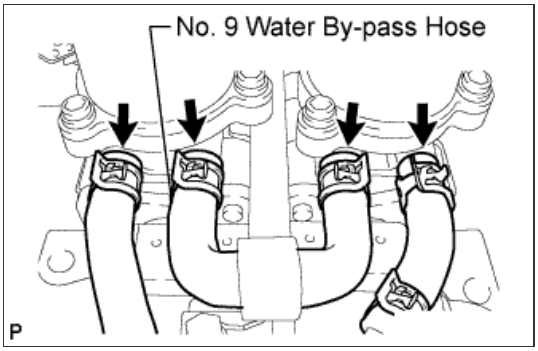
a. Remove the No. 4 water by-pass hose from the No. 3 water by-pass pipe.



56. REMOVE NO. 9 WATER BY-PASS HOSE AND WATER HOSE

a. Remove the No. 9 water by-pass hose.

b. Disconnect the 2 water hoses.



57. REMOVE NO. 1 EGR VALVE ASSEMBLY

58. REMOVE NO. 2 EGR VALVE ASSEMBLY

59. REMOVE EGR COOLER GASKET

for Preparation Click here

1. INSPECT EGR VALVE ASSEMBLY

a. Check the EGR valve position sensor.

i. Measure the resistance according to the value(s) in the table below.

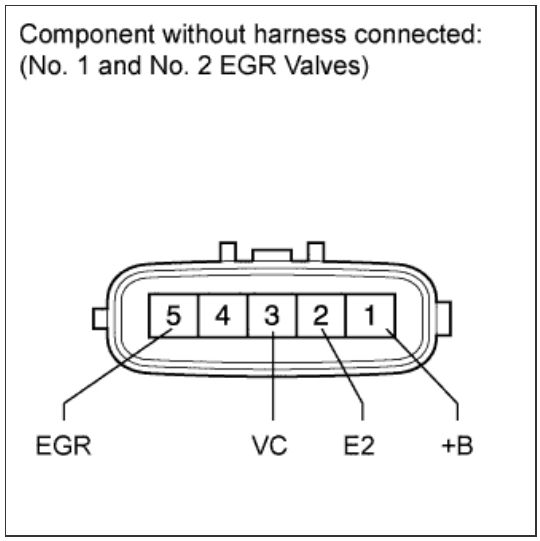
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (+B) - 5 (EGR)	20°C (68°F)	6.5 to 7.5 Ω
3 (VC) - 2 (E2)	Always	2.45 to 4.55 kΩ

HINT:

The temperature indicated under "Condition" is the temperature of the EGR valve assembly.

If the result is not as specified, replace the EGR valve assembly.



for Preparation Click here

1. INSTALL EGR COOLER GASKET

a. Install a new gasket.

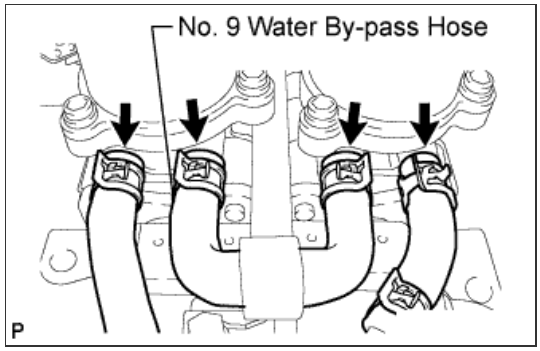
2. INSTALL NO. 2 EGR VALVE ASSEMBLY

3. INSTALL NO. 1 EGR VALVE ASSEMBLY

4. INSTALL NO. 9 WATER BY-PASS HOSE AND WATER HOSE

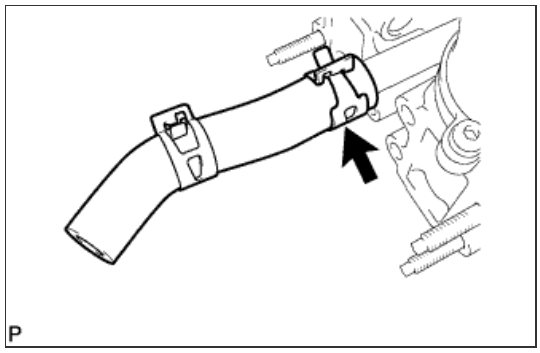
a. Connect the 2 water hoses.

b. Install the No. 9 water by-pass hose.



5. INSTALL NO. 4 WATER BY-PASS HOSE

a. Install the No. 4 water by-pass hose to the No. 3 water by-pass pipe.

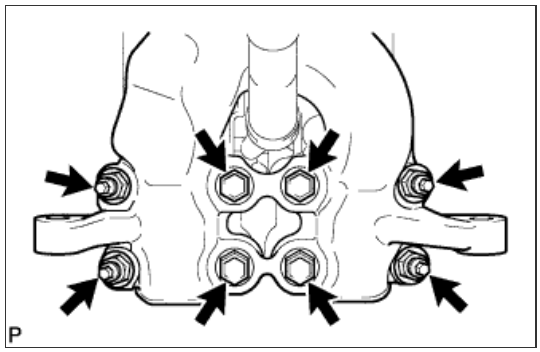


6. INSTALL NO. 3 EGR PIPE

a. Install 2 new gaskets.

b. Install the pipe with the 4 nuts and 4 bolts.

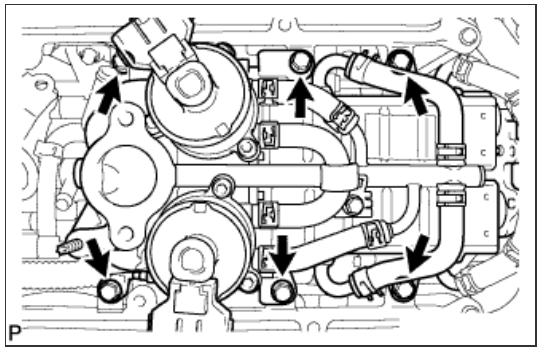
Tor e
21 N*m{ 214 kgf*cm , 15 ft.*lbf



7. INSTALL EGR VALVE ASSEMBLY WITH EGR COOLER

a. Install the EGR valve with EGR cooler with the 6 bolts.

Tor e
21 N*m{ 214 kgf*cm , 15 ft.*lbf



. INSTALL NO. 2 EGR PIPE S B-ASSEMBLY

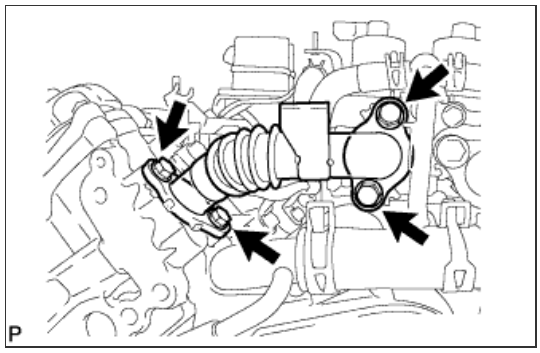
a. Install 2 new gaskets to the pipe.

b. Install the pipe with the 4 bolts.

Tor e
29 N*m{ 296 kgf*cm , 21 ft.*lbf

NOTICE

- **Press own the cooler si by han while tightening the bolts on the cylin ehea is e**
- **If the ins lator installation stay is torme , replace the No. 2 EGR pipe.**
- **If the clearance between the hea an flange is 1 mm (0.0394 in.) or more, replace the No. 2 EGR pipe.**



9. INSTALL NO. 1 EGR PIPE S B-ASSEMBLY

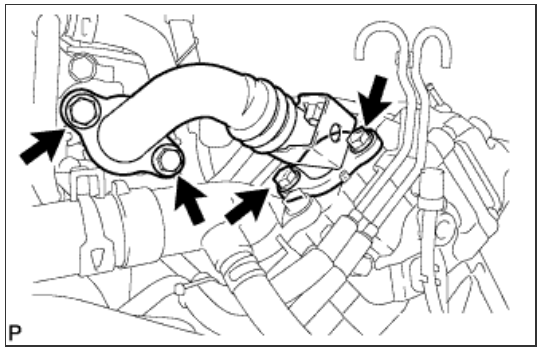
a. Install 2 new gaskets to the pipe.

b. Install the pipe with the 4 bolts.

Tor e
29 N*m{ 296 kgf*cm , 21 ft.*lbf

NOTICE

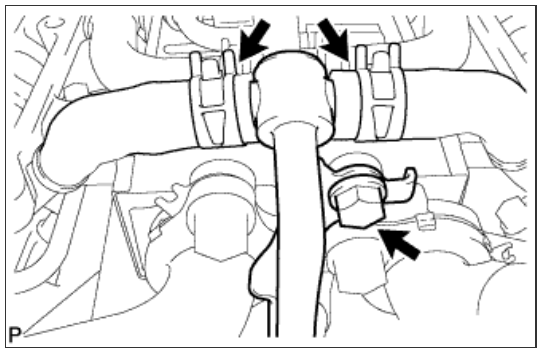
- **Press own the cooler si by han while tightening the bolts on the cylin ehea is e**
- **If the ins lator installation stay is torme , replace the No. 1 EGR pipe.**
- **If the clearance between the hea an flange is 1 mm (0.0394 in.) or more, replace the No. 1 EGR pipe.**



10. CONNECT NO. 5 WATER BY-PASS PIPE

a. Connect the 2 hoses and install the bolt to connect the water by-pass pipe.

Tor e
10 N*m{ 102 kgf*cm , 7 ft.*lbf



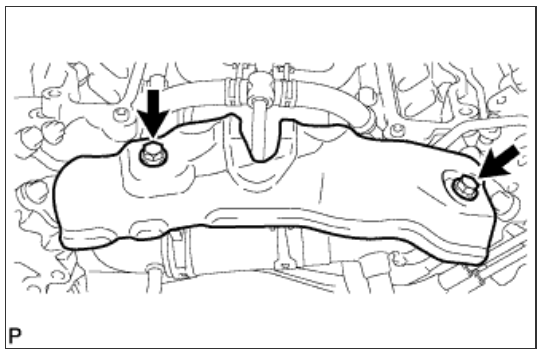
11. INSTALL EGR PIPE INS LATOR

a. Install the insulator with the 2 bolts.

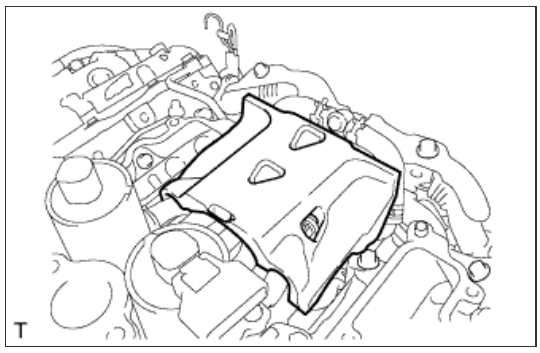
Tor e
21 N*m{ 214 kgf*cm , 15 ft.*lbf

NOTICE

If the insulator installation stay for the No. 1 and No. 2 EGR pipe is deformed, or the bolt holes do not align, replace the No. 1 and No. 2 EGR pipe.



12. INSTALL INTAKE MANI OLD INS LATOR



13. INSTALL NO. 3 INTAKE MANI OLD

a. Set 2 new gaskets to the No. 1 and No. 2 intake manifolds.

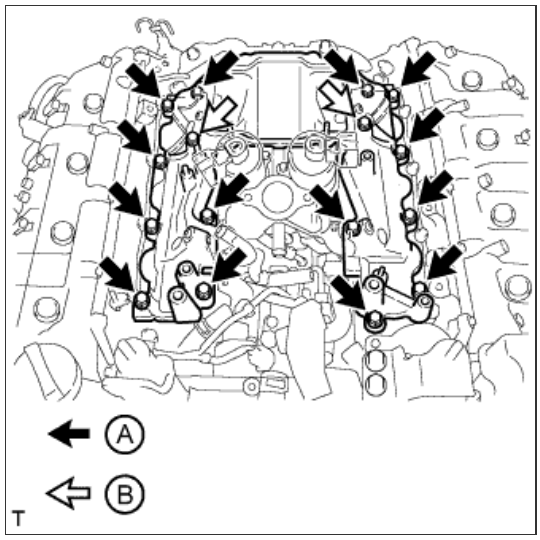
b. Install the No. 3 intake manifold with the 16 bolts.

Tor e
21 N*m{ 214 kgf*cm , 15 ft.*lbf

Bolt Length

Item	Length
Bolt A	25 mm (0.984 in.)

Bolt B	70 mm (2.76 in.)

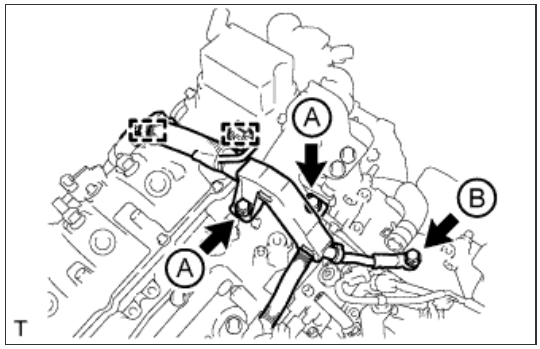


14. CONNECT NO. 2 ENGINE WIRE

a. Connect the No. 2 engine wire with the 3 bolts.

Tor e
for bolt A
13 N*m{ 133 kgf*cm , 10 ft.*lbf
for bolt B
32 N*m{ 326 kgf*cm , 24 ft.*lbf

b. Attach the 2 wire harness clamps.

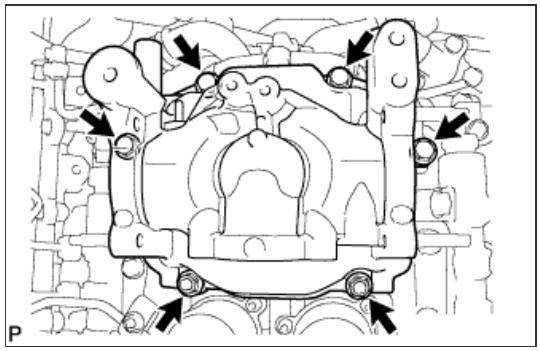


15. INSTALL INTAKE PIPE

a. Install a new gasket.

b. Install the pipe with the 4 bolts and 2 nuts.

Tor e
21 N*m{ 214 kgf*cm , 15 ft.*lbf

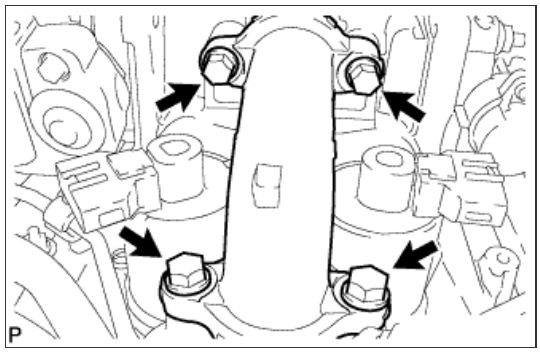


16. INSTALL NO. 4 EGR PIPE

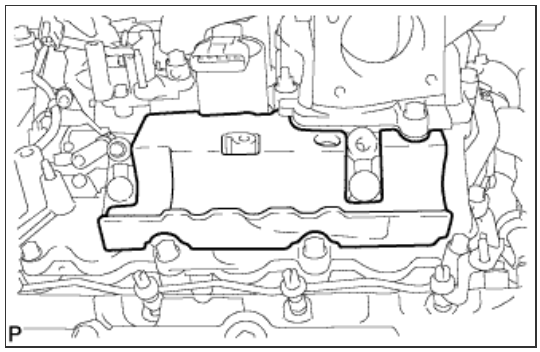
a. Install 2 new gaskets to the pipe.

b. Install the pipe with the 4 bolts.

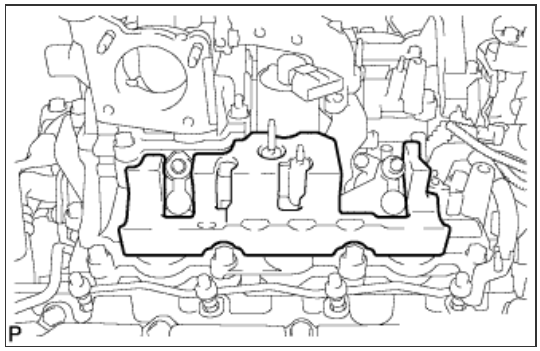
Tor e
21 N*m{ 214 kgf*cm , 15 ft.*lbf



17. INSTALL NO. 2 INTAKE MANI OLD INS LATOR



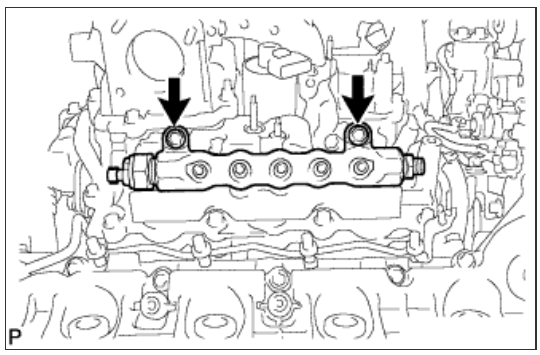
18. INSTALL NO. 1 INTAKE MANI OLD INS LATOR



19. INSTALL COMMON RAIL ASSEMBLY RH

a. Install the common rail with the 2 bolts.

Tor e
21 N*m{ 214 kgf*cm , 15 ft.*lbf



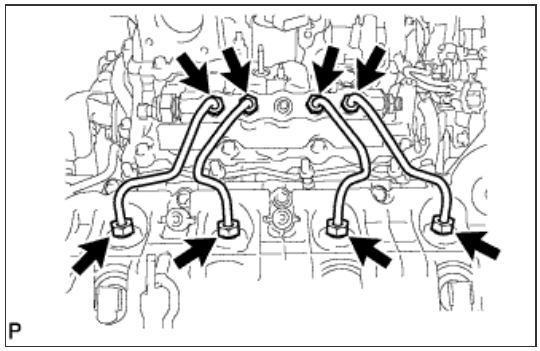
20. INSTALL INJECTION PIPE RH

a. Using a union nut wrench, install the 4 new injection pipes.

Tor e
witho t nion n t wrench
34 N*m{ 347 kgf*cm , 25 ft.*lbf
with nion n t wrench
31 N*m{ 316 kgf*cm , 23 ft.*lbf

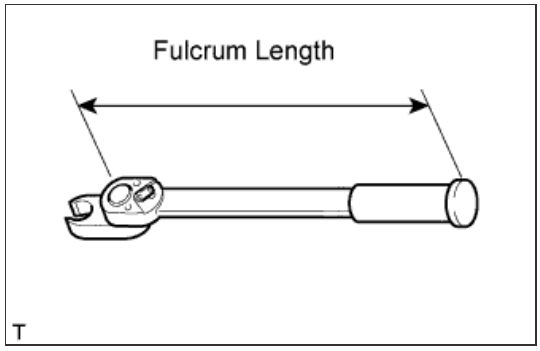
NOTICE

Make sure there is no damage or foreign matter on the seal surfaces.



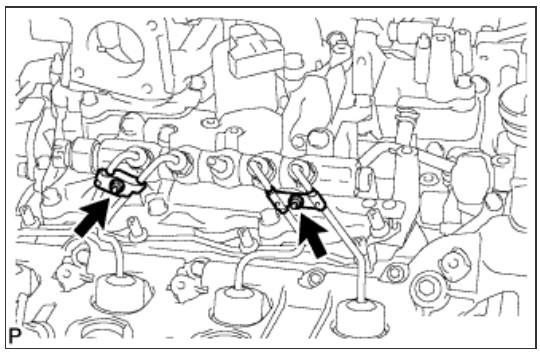
HINT

- **se a tor e wrench with a f lcr m length of 30 cm (11.8 in.).**
- **Make s re the nion n t wrench an he tor e wrench are connecte in a straight line.**



b. w/ Intercooler:
Install the 4 injection pipe clamps with the 2 nuts.

Tor e
5.0 N*m{ 51 kgf*cm , 44 in.*lbf

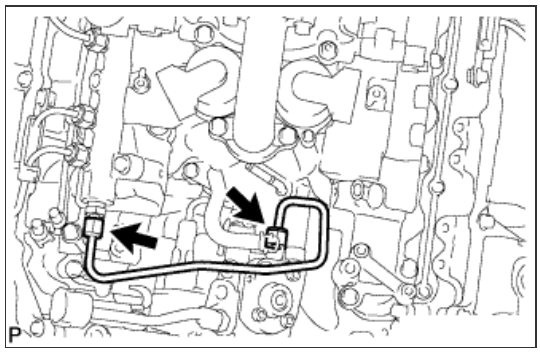


21. INSTALL NO. 5 INJECTION PIPE S B-ASSEMBLY

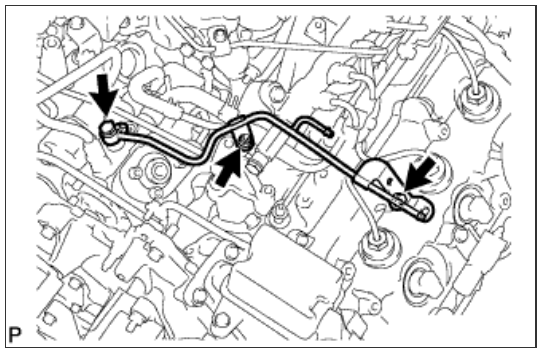
a. Temporarily install a new No. 5 injection pipe by hand.

NOTICE

Make sure there is no damage or foreign matter on the seal surfaces.

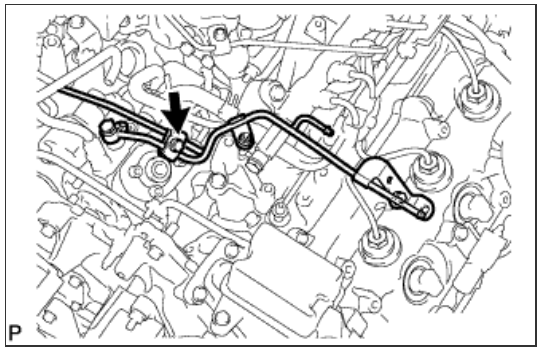


b. Temporarily install the used gasket and No. 2 fuel pipe with the nut, bolt and union bolt.



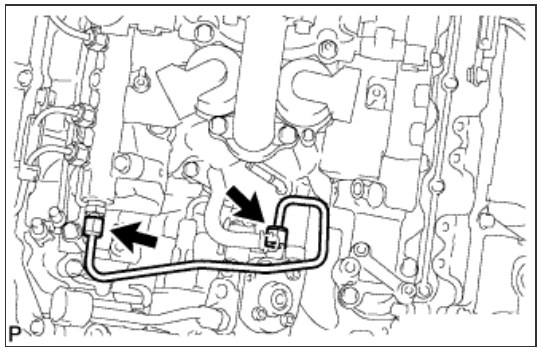
c. Temporarily install the No. 2 injection pipe clamp with the bolt.

Tor e
5.0 N*m{ 51 kgf*cm , 44 in.*lbf



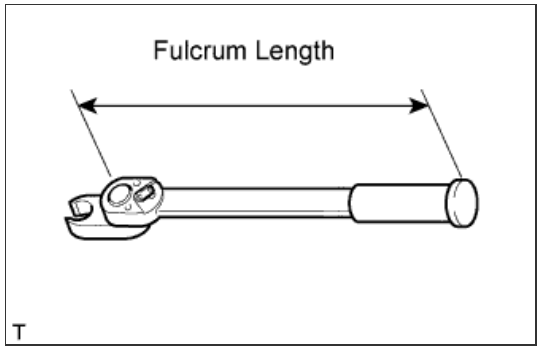
. Using a union nut wrench, tighten the No. 5 injection pipe ends.

Tor e
witho t nion n t wrench
34 N*m{ 347 kgf*cm , 25 ft.*lbf
with nion n t wrench
31 N*m{ 316 kgf*cm , 23 ft.*lbf

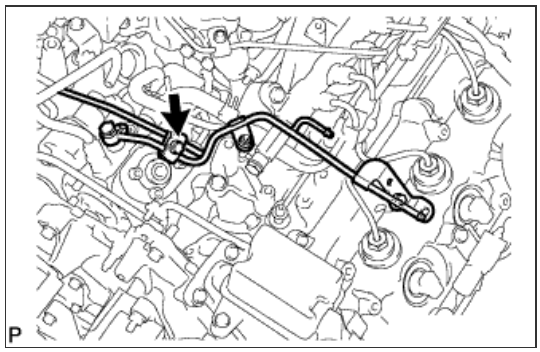


HINT

- **se a tor e wrench with a f lcr m length of 30 cm (11.8 in.).**
- **Make s re the nion n t wrench an he tor e wrench are connecte in a straight line.**

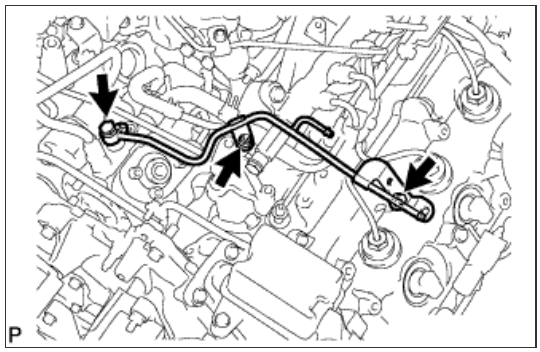


e. Remove the bolt and No. 2 injection pipe clamp.



f. Remove the union bolt and gasket.

g. Remove the bolt, nut and No. 2 fuel pipe.

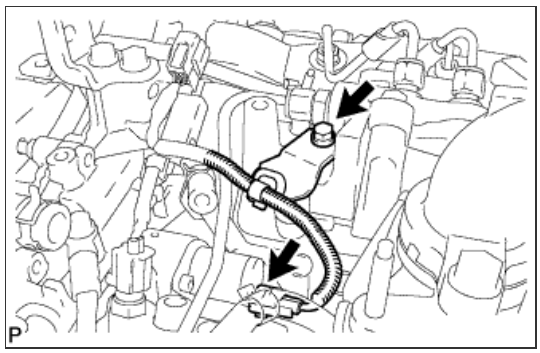


22. CONNECT EL P MP MOTOR WIRE

a. Install the fuel pump motor wire bracket to the No. 3 intake manifold with the bolt.

Tor e
10 N*m{ 102 kgf*cm , 7 ft.*lbf

b. Connect the connector to the fuel supply pump.

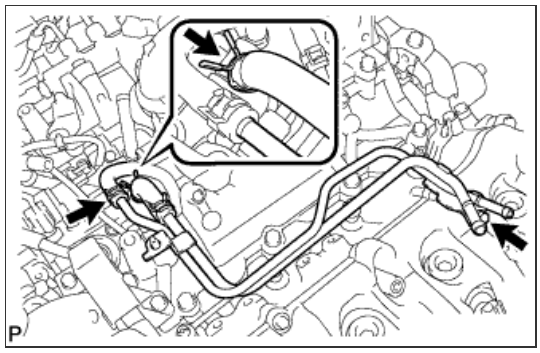


23. INSTALL EL ILTER TO INJECTION P MP EL PIPE S B-ASSEMBLY

a. Install the fuel filter to injection pump fuel pipe with the bolt.

Tor e
10 N*m{ 102 kgf*cm , 7 ft.*lbf

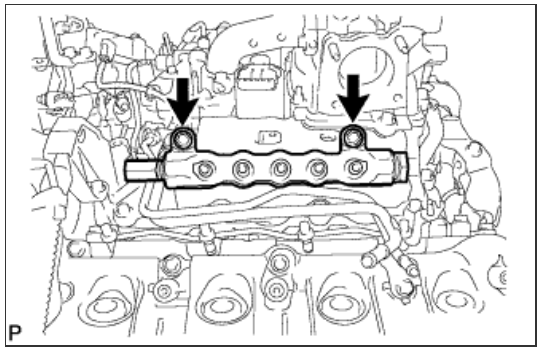
b. Connect the 2 hoses to the fuel pipe.



24. INSTALL COMMON RAIL ASSEMBLY LH

a. Install the common rail with the 2 bolts.

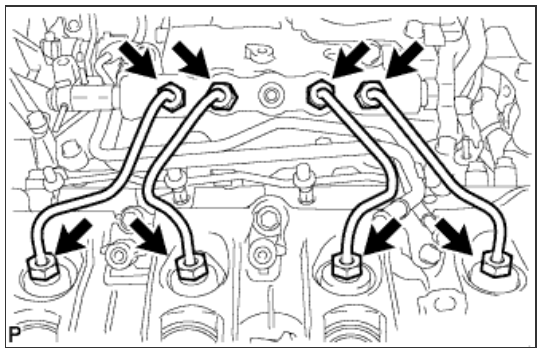
Tor e
21 N*m{ 214 kgf*cm , 15 ft.*lbf



25. INSTALL INJECTION PIPE LH

a. Using a union nut wrench, install the 4 new injection pipes.

Tor e
witho t nion n t wrench
34 N*m{ 347 kgf*cm , 25 ft.*lbf
with nion n t wrench
31 N*m{ 316 kgf*cm , 23 ft.*lbf

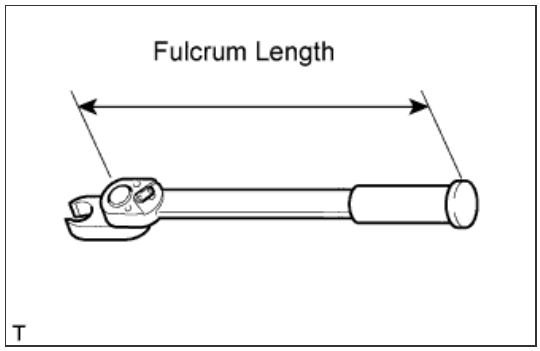


NOTICE

ake sure there is no damage or foreign matter on the seal surfaces.

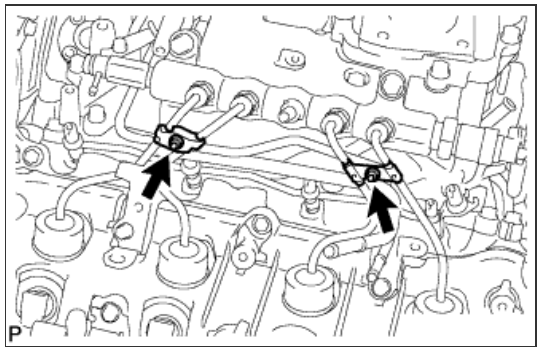
HINT

- **se a tor e wrench with a f lcr m length of 30 cm (11.8 in.).**
- **Make s re the nion n t wrench an lle tor e wrench are connecte in a straight line.**



b. w/ Intercooler:
Install the 4 injection pipe clamps with the 2 nuts.

Tor e
5.0 N*m{ 51 kgf*cm , 44 in.*lbf



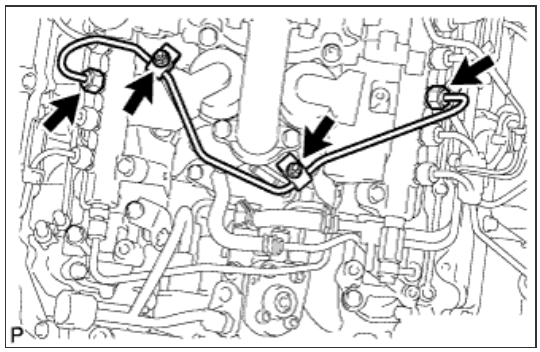
26. INSTALL NO. 6 INJECTION PIPE S B-ASSEMBLY

a. w/ EGR System:

i. Temporarily install a new No. 6 injection pipe to the common rail LH and RH.

NOTICE

Make sure there is no damage or foreign matter on the seal surfaces.



ii. Install the 2 No. 2 injection pipe clamps with the 2 nuts.

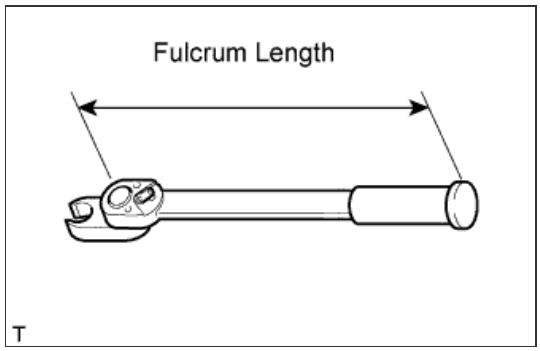
Tor e
5.0 N*m{ 51 kgf*cm , 44 in.*lbf

iii. Using a union nut wrench, tighten the No. 6 injection pipe ends.

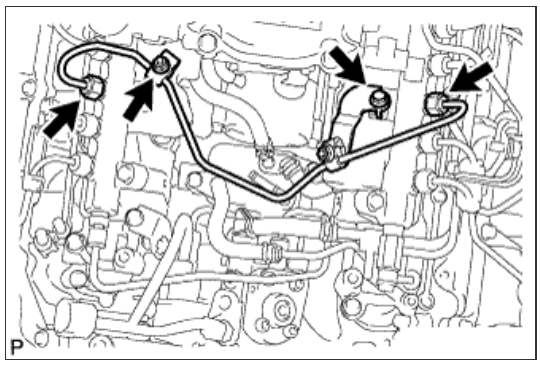
Tor e
witho t nion n t wrench
34 N*m{ 347 kgf*cm , 25 ft.*lbf
with nion n t wrench
31 N*m{ 316 kgf*cm , 23 ft.*lbf

HINT

- **se a tor e wrench with a f lcr m length of 30 cm (11.8 in.).**
- **Make s re the nion n t wrench an he tor e wrench are connecte in a straight line.**



b. w/o EGR System:



i. Temporarily install a new No. 6 injection pipe to the common rail LH and RH.

NOTICE

Make sure there is no damage or foreign matter on the seal surfaces.

ii. Install the bracket to the No. 3 intake manifold with the bolt.

Tor e
10 N*m{ 102 kgf*cm , 7 ft.*lbf

iii. Install the No. 2 injection pipe clamp with the nut.

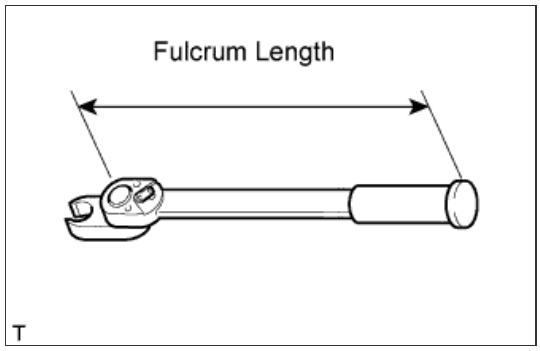
Tor e
5.0 N*m{ 51 kgf*cm , 44 in.*lbf

iv. Using a union nut wrench, tighten the No. 6 injection pipe ends.

Tor e
witho t nion n t wrench
34 N*m{ 347 kgf*cm , 25 ft.*lbf
with nion n t wrench
31 N*m{ 316 kgf*cm , 23 ft.*lbf

HINT

- **se a tor e wrench with a f lcr m length of 30 cm (11.8 in.).**
- **Make s re the nion n t wrench an he tor e wrench are connecte in a straight line.**



27. INSTALL NO. 2 EL PIPE S B-ASSEMBLY

NOTICE

Check for damage and foreign matter on the fuel pipe installation surface of the supply pump.

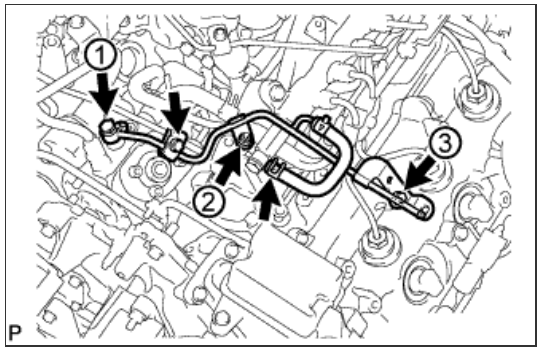
If there is foreign matter, remove it from the installation surface. If the installation surface is damaged, replace the fuel supply pump.

a. Temporarily install a new gasket and the No. 2 fuel pipe with the union

bolt, nut and bolt.

b. Tighten the union bolt, nut and bolt in the order shown in the illustration.

Tor e
for nion bolt
10 N*m{ 105 kgf*cm , 8 ft.*lbf
for bolt an n t
10 N*m{ 102 kgf*cm , 7 ft.*lbf



c. Install the No. 2 injection pipe clamp with the bolt.

Tor e
5.0 N*m{ 51 kgf*cm , 44 in.*lbf

. Connect the fuel hose to the No. 5 nozzle leakage pipe.

28. CONNECT ENGINE WIRE

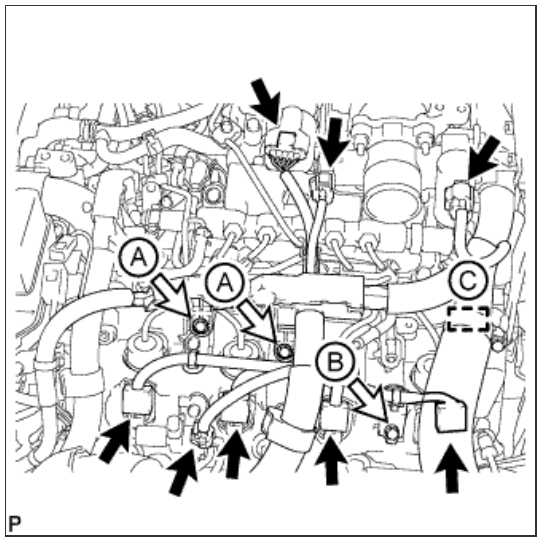
a. LH Side:

i. Install the engine wire protector with the 2 bolts labeled A.

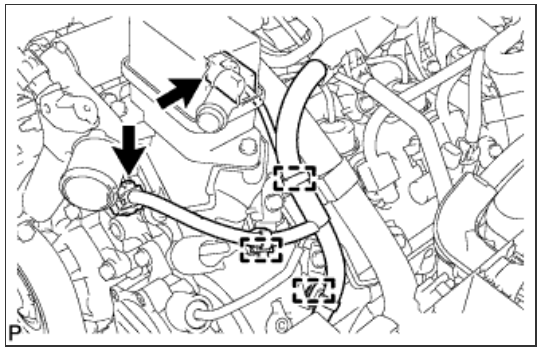
ii. Connect the 8 connectors.

iii. Install the engine wire harness bracket with the bolt labeled B.

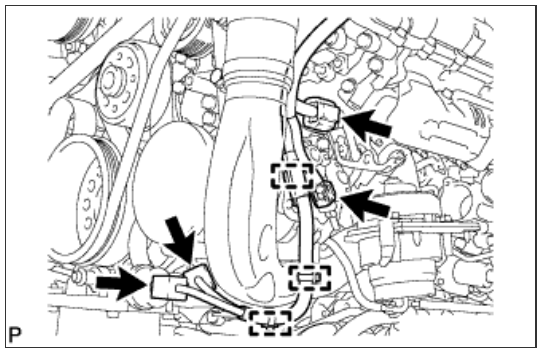
iv. for RHD:
Connect the wire harness with the wire harness clamp holder labeled C.



v. Attach the 3 wire harness clamps and connect the 2 connectors.



vi. Attach the 3 wire harness clamps and connect the 4 connectors.



b. RH Side:

i. Install the engine wire harness protector with the 3 bolts labeled A.

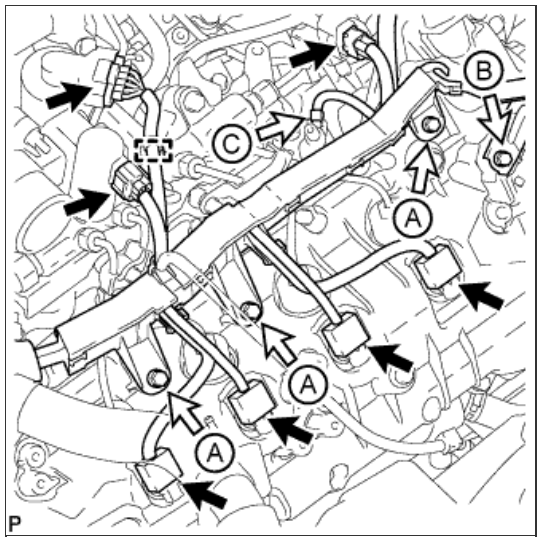
ii. Connect the 7 connectors.

iii. Attach the wire harness clamp.

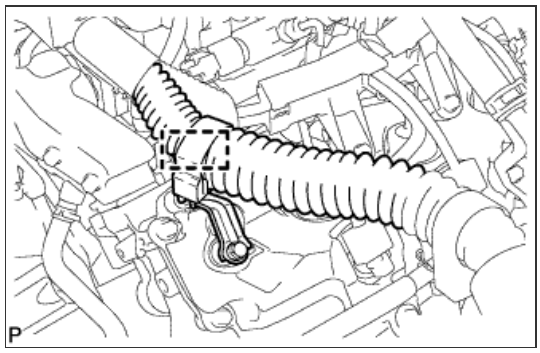
iv. Install the wire harness bracket with the bolt labeled B.

v. Install the glow plug wire harness labeled C with the nut.

Tor e
4.0 N*m{ 41 kgf*cm , 35 in.*lbf



i. for RHD:
Connect the wire harness with the wire harness clamp holder.



c. Rear Side:

i. Install the glow plug wire harness with the nut labeled A.

Tor e
4.0 N*m{ 41 kgf*cm , 35 in.*lbf

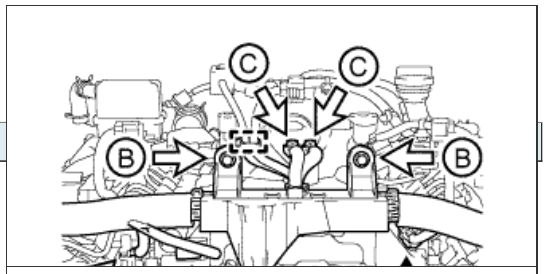
ii. Connect the 2 common rail connectors.

iii. Install the engine wire harness protector with the 2 bolts labeled B.

iv. Install the 2 ground wires with the 2 bolts labeled C.

Tor e
.4 N*m{ 87 kgf*cm , 74 in.*lbf

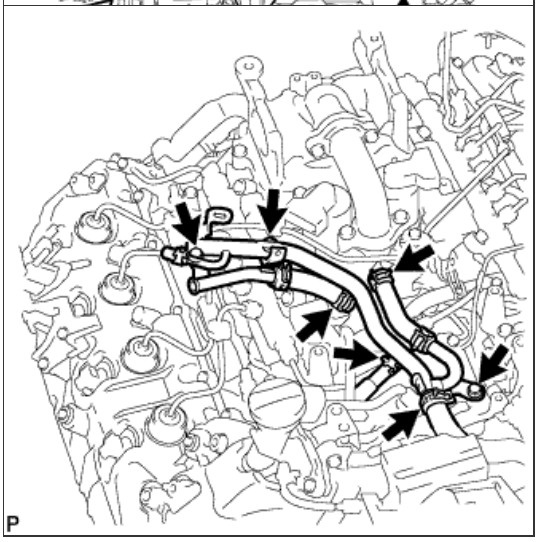
v. Attach the wire harness clamp.



29. INSTALL NO. 4 WATER BY-PASS PIPE

a. Connect the 4 water hose ends, and install the No. 4 water by-pass pipe with the 2 bolts and nut.

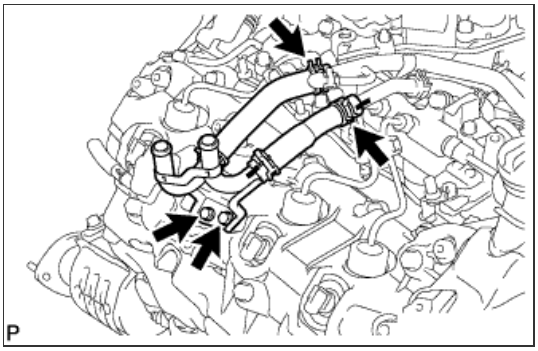
Tor e
10 N*m{ 102 kgf*cm , 7 ft.*lbf



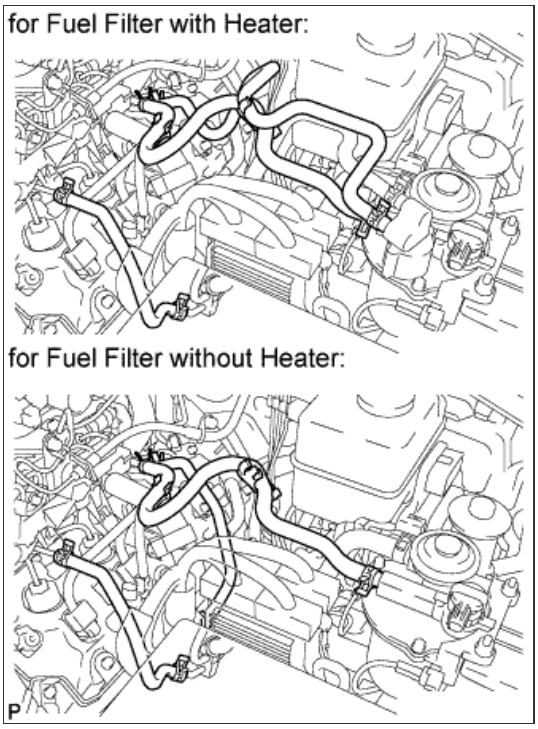
30. INSTALL NO. 3 WATER BY-PASS PIPE

a. Connect the 2 water hose ends, and install the No. 3 water by-pass pipe with the 2 bolts.

Tor e
10 N*m{ 102 kgf*cm , 7 ft.*lbf



31. CONNECT EL HOSE



32. INSTALL NO. 1 AIR CLEANER PIPE S B-ASSEMBLY

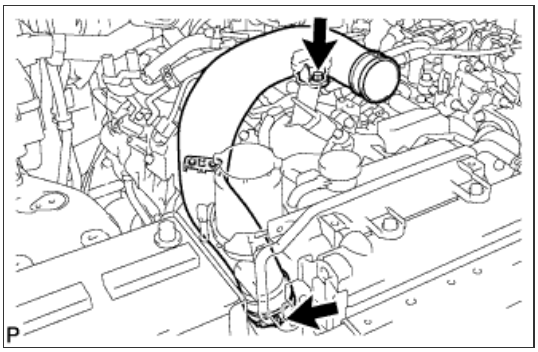
a. Connect the No. 1 air cleaner pipe to the No. 1 intake air connector pipe.

b. Install the pipe with the bolt.

Tor e
21 N*m{ 214 kgf*cm , 15 ft.*lbf

c. Tighten the hose clamp.

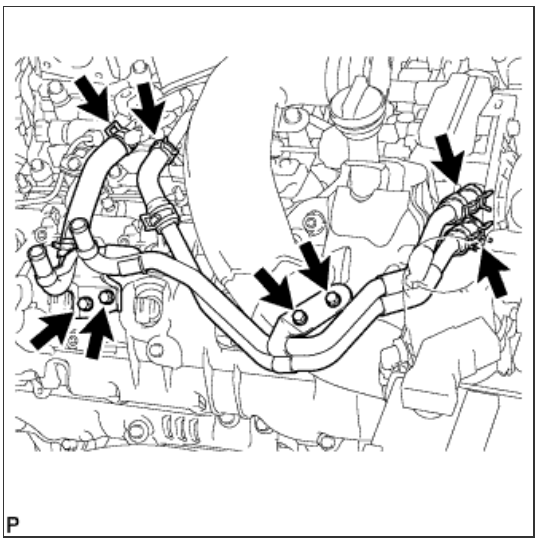
Tor e
.3 N*m{ 64 kgf*cm , 56 in.*lbf



33. INSTALL HEATER WATER PIPE S B-ASSEMBLY (w/ Visco s Heater)

a. Connect the 4 water hose ends, and install the water pipe with the 4 bolts.

Tor e
9.8 N*m{ 100 kgf*cm , 87 in.*lbf



34. INSTALL NO. 2 AIR CLEANER PIPE

a. Connect the No. 2 air cleaner pipe to the No. 2 intake air connector pipe.

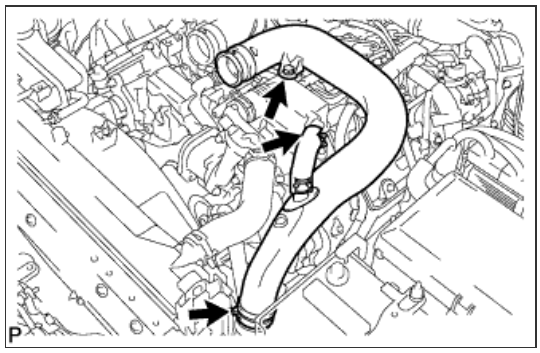
b. Connect the ventilation hose to the oil separator.

c. Install the pipe with the bolt.

Tor e
21 N*m{ 214 kgf*cm , 15 ft.*lbf

. Tighten the hose clamp.

Tor e
.3 N*m{ 64 kgf*cm , 56 in.*lbf



35. INSTALL NO. 4 AIR T BE

a. Install the No. 4 air tube with the bolt.

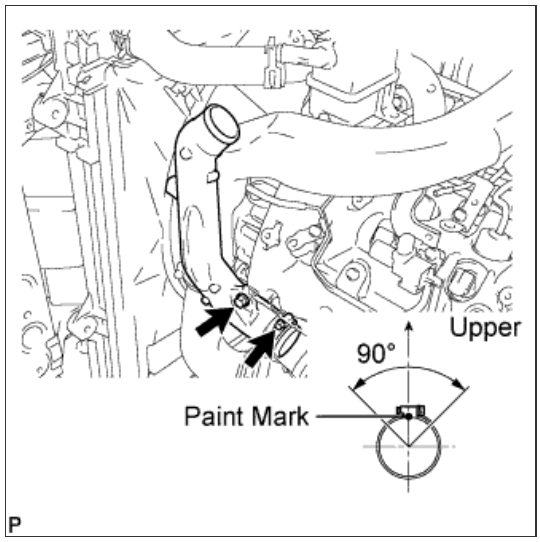
Tor e
21 N*m{ 214 kgf*cm , 15 ft.*lbf

b. Tighten the hose clamp.

Tor e
.3 N*m{ 64 kgf*cm , 56 in.*lbf

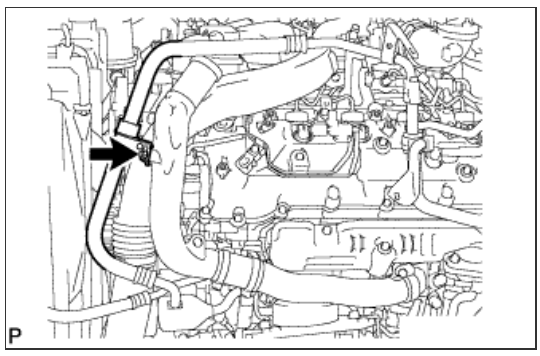
HINT

Make sure the direction of the hose clamp is as shown in the illustration.



c. Install the suction hose with the bolt.

Tor e
9.8 N*m{ 100 kgf*cm , 87 in.*lbf



36. INSTALL NO. 2 AIR HOSE

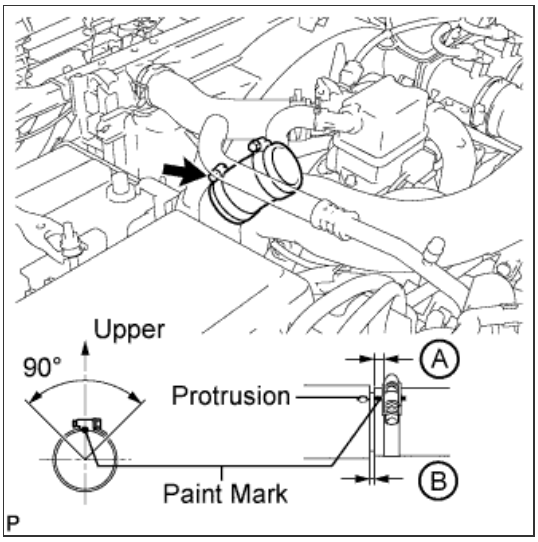
a. Connect the No. 2 air hose with the hose clamp.

Tor e
.3 N*m{ 64 kgf*cm , 56 in.*lbf

HINT

- **Align the paint mark of the air hose with the protr sion an p sh in the air hose so that istance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that istance A is 2 to 6 mm (0.0787 to 0.236 in.).**

- **Make s re the irection of the hose clamp is as shown in the ill stration.**



37. INSTALL NO. 3 AIR T BE

a. Install the No. 3 air tube with the bolt.

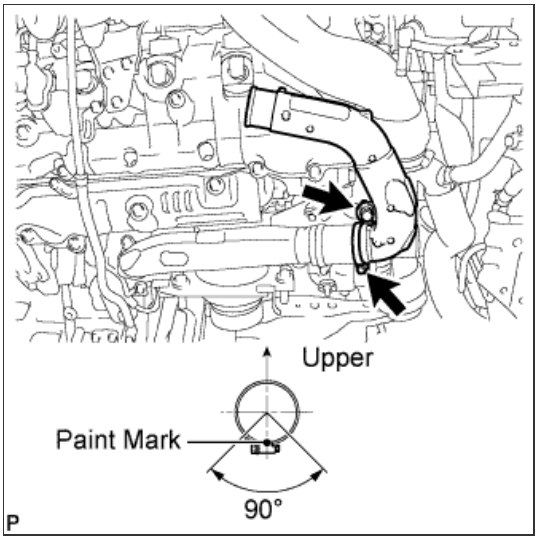
Tor e
21 N*m{ 214 kgf*cm , 15 ft.*lbf

b. Tighten the hose clamp.

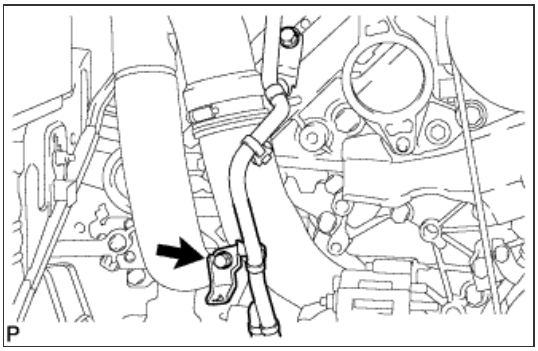
Tor e
.3 N*m{ 64 kgf*cm , 56 in.*lbf

HINT

Make sure the direction of the hose clamp is as shown in the illustration.

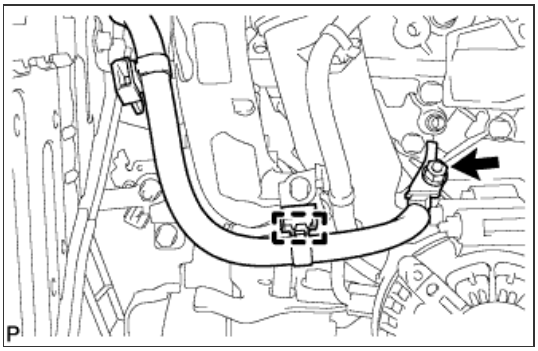


c. Install the wire harness bracket with the bolt.



. Install the ground wire with the nut, and attach the wire harness clamp.

Tor e
.4 N*m{ 87 kgf*cm , 74 in.*lbf



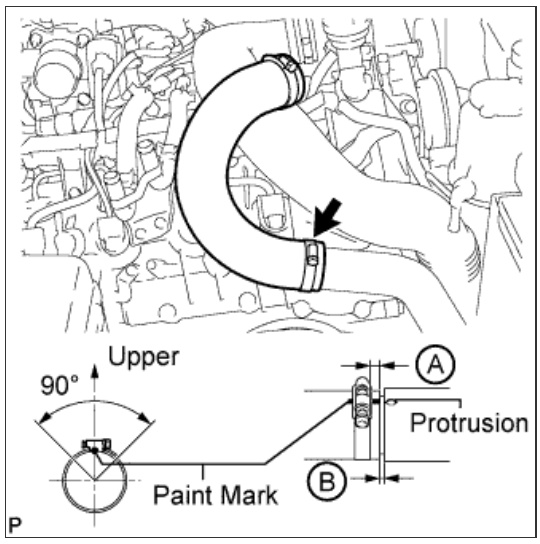
38. INSTALL NO. 1 AIR HOSE

a. Connect the No. 1 air hose with the hose clamp.

Tor e
.3 N*m{ 64 kgf*cm , 56 in.*lbf

HINT

- **Align the paint mark of the air hose with the protr sion an p sh in the air hose so that istance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that istance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make s re the irection of the hose clamp is as shown in the ill stration.**



39. INSTALL INTAKE AIR CONNECTOR

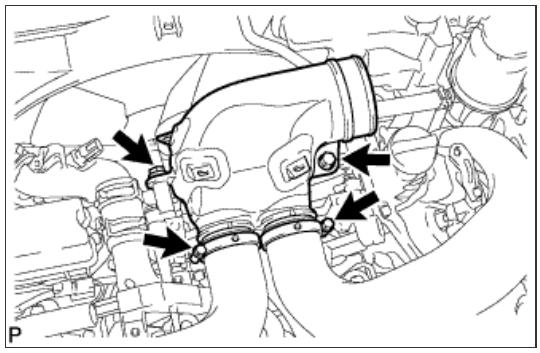
a. Connect the intake air connector to the No. 1 and No. 2 air cleaner pipes.

b. Install the connector with the 2 bolts.

Tor e
21 N*m{ 214 kgf*cm , 15 ft.*lbf

c. Tighten the 2 hose clamps.

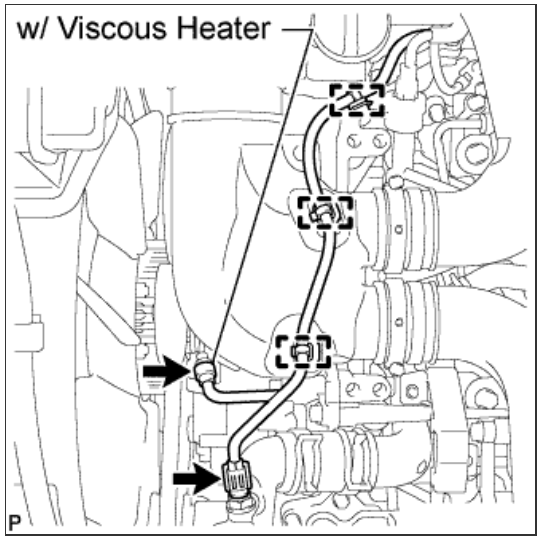
Tor e
.3 N*m{ 64 kgf*cm , 56 in.*lbf



. Attach the 3 wire harness clamps.

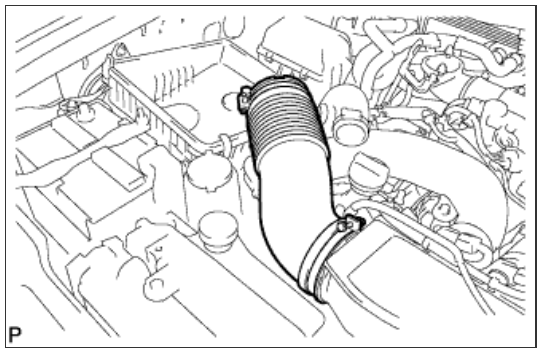
e. w/o Viscous Heater:
Connect the connector to the water temperature sensor.

f. w/ Viscous Heater:
Connect the 2 connectors to the water temperature sensor and viscous with magnet clutch heater.



40. TEMPORARILY INSTALL NO. 1 AIR CLEANER HOSE

a. Temporarily install the air cleaner hose to the intake air connector.

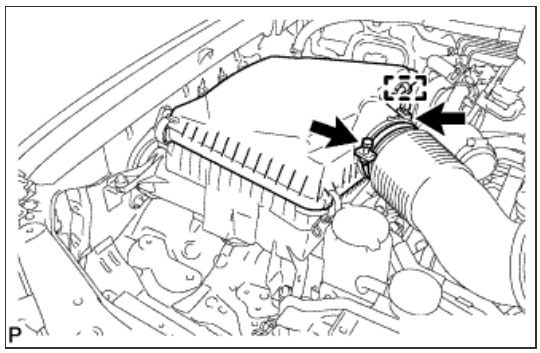


41. INSTALL AIR CLEANER CAP S B-ASSEMBLY

a. Connect the air cleaner cap to the air cleaner hose, and install the air cleaner cap with the 4 clamps.

b. Connect the mass air flow meter connector and attach the wire harness clamp to the air cleaner cap.

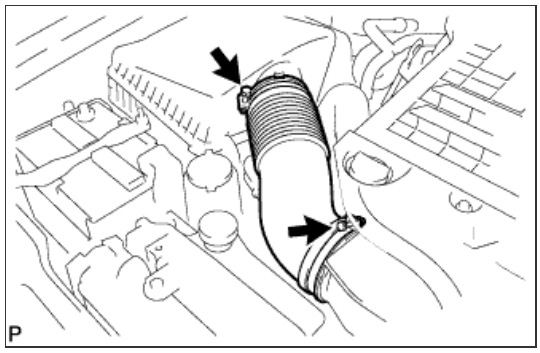
c. Attach the wire harness clamp.



. Align the protrusion of air cleaner cap and concave portion of air cleaner hose.

e. Tighten the 2 hose clamps.

Tor e
5.0 N*m{ 51 kgf*cm , 44 in.*lbf



42. INSTALL DIESEL THROTTLE BODY ASSEMBLY LH

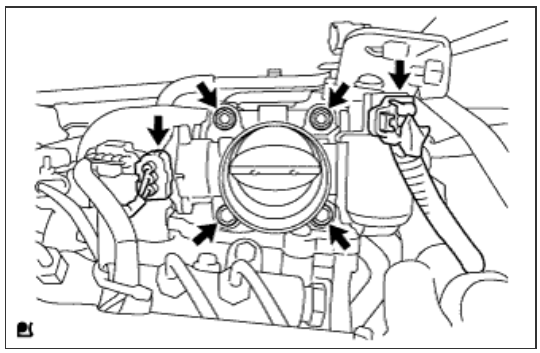
a. Install a new gasket to the intake pipe.

b. Install the throttle body with the 2 bolts and 2 nuts.

Tor e
21 N*m{ 214 kgf*cm , 15 ft.*lbf

c. Connect the throttle position sensor connector.

. Connect the throttle motor connector.

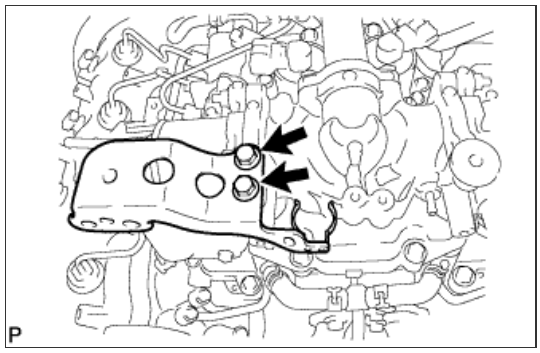


43. INSTALL NO. 3 INTERCOOLER S PIPE BRACKET

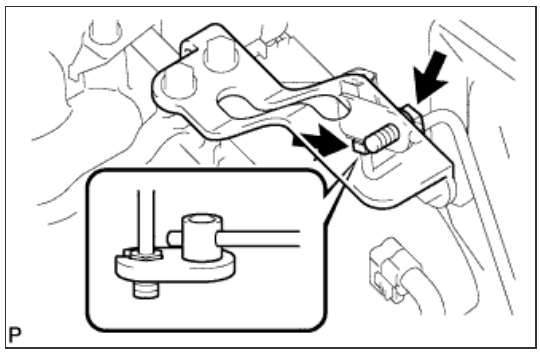
a. Install the bracket with the 2 bolts.

Tor e

21 N*m{ 214 kgf*cm , 15 ft.*lbf



b. for anual Transmission:



i. Connect the clutch tube to release cylinder 2 way with the bolt.

Tor e
20 N*m{ 204 kgf*cm , 15 ft.*lbf

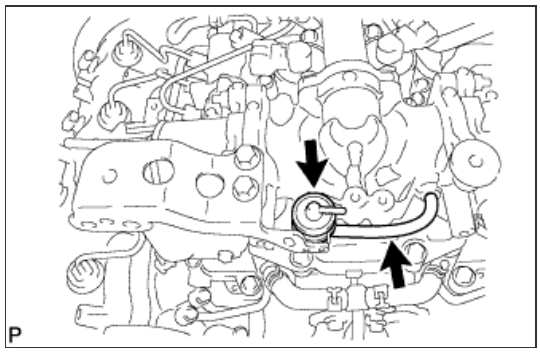
ii. Check that the union nut is tightened to the specified torque.

Tor e
witho t nion n t wrench
15 N*m{ 154 kgf*cm , 11 ft.*lbf
with nion n t wrench
14 N*m{ 141 kgf*cm , 10 ft.*lbf

44. INSTALL NO. 1 GAS ILTER

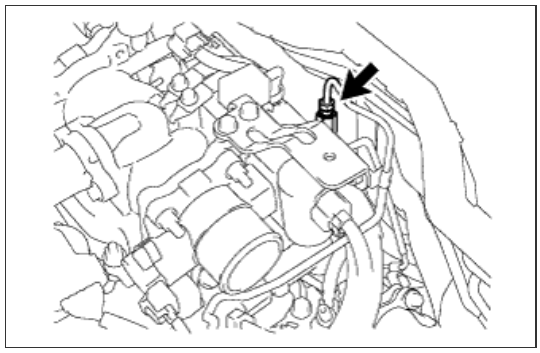
a. Install the gas filter.

b. Connect the hose to the intake pipe.



45. INSTALL T BE CONNECTOR TO LEXIBLE HOSE T BE (for Man al Transmission)

a. Temporarily install the flare nut of the tube connector to flexible hose tube to the clutch tube to release cylinder 2 way by hand.



b. Temporarily install the tube connector to flexible hose tube with the 2 bolts.

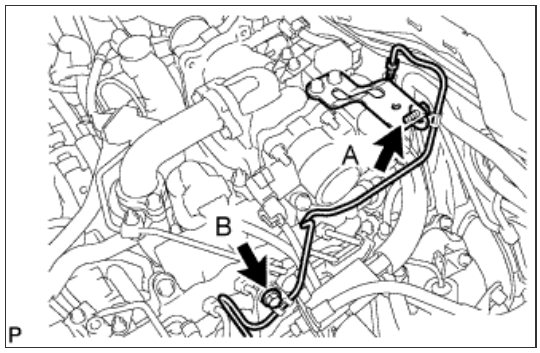
c. Tighten the bolt labeled A.

Tor e

20 N*m{ 204 kgf*cm , 15 ft.*lbf

NOTICE

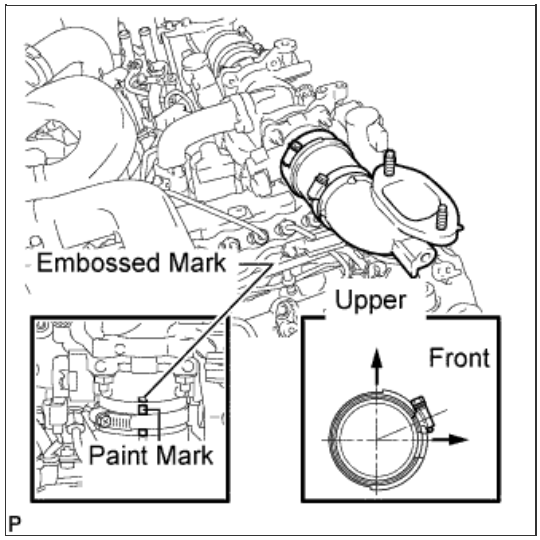
Tighten the bolt labeled B after installing the clutch hose.



46. INSTALL AIR T BE S B-ASSEMBLY LH

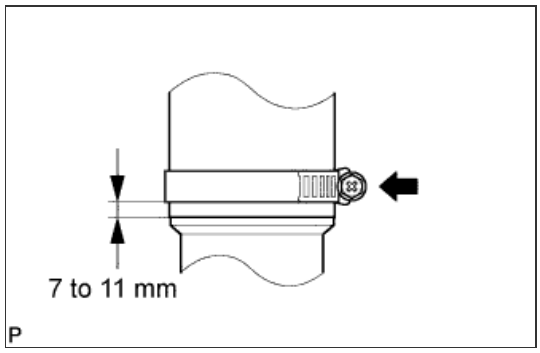
a. Install the air tube to the throttle body.

b. Align the embossed mark of the throttle body with the paint mark of the No. 4 air hose.



c. Tighten the hose clamp so that it is 7 to 11 mm (0.276 to 0.433 in.) from the end of the hose as shown in the illustration.

Tor e
.3 N*m{ 64 kgf*cm , 56 in.*lbf



47. INSTALL CL TCH HOSE (for Man al Transmission)

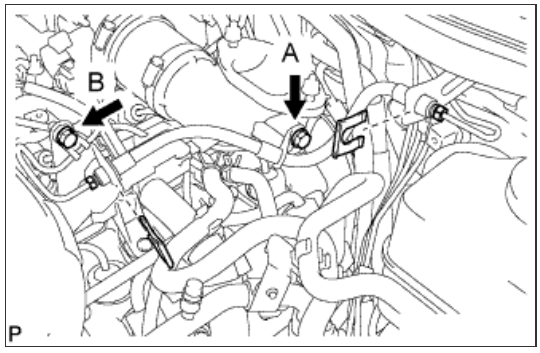
a. Connect the clutch hose to the air tube with the bolt labeled A.

b. Temporarily install the clutch hose to the clutch master cylinder tube to flexible hose tube and tube connector to flexible hose tube, and fix it in place with the 2 clips.

Tor e
20 N*m{ 204 kgf*cm , 15 ft.*lbf

c. Tighten the bolt labeled B.

Tor e
20 N*m{ 204 kgf*cm , 15 ft.*lbf



. Tighten the flexible hose tube.

NOTICE

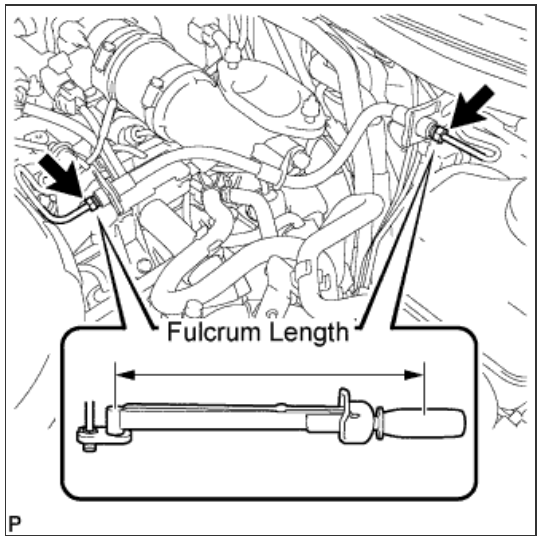
- **Do not ben or amage the fle ible hose tube.**
- **Do not allow any foreign matter such as irt an ust to enter the fle ible hose tube from the connecting points.**

HINT

- **se a tor e wrench with a fulcrum length of 30 cm (11.8 in.). If using a tor e wrench with a length that is not 30 cm (11.8 in.), calculate the tor e specification for the tor e wrench an SST base on the "without SST" tor e specification (Click here).**
- **Make sure union nut wrench an he wrench are connecte in a straight line.**

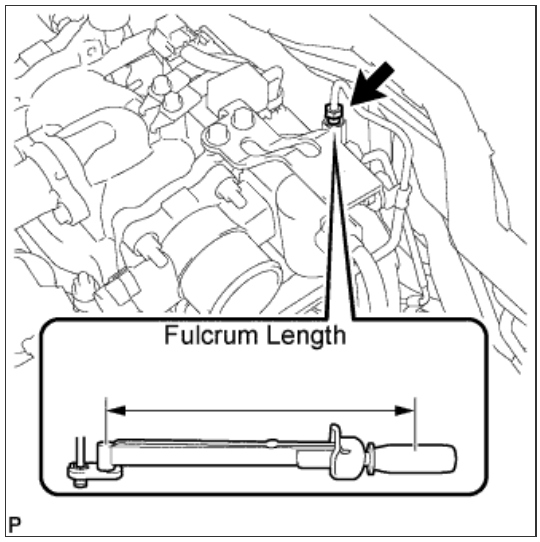
i. Using a 10 mm union nut wrench, tighten the 2 flare nuts of the flexible hose tube.

Tor e
without union nut wrench
15 N*m{ 154 kgf*cm , 11 ft.*lbf
with union nut wrench
14 N*m{ 141 kgf*cm , 10 ft.*lbf



ii. Using a 10 mm union nut wrench, tighten the flare nut of the flexible hose tube.

Tor e
without union nut wrench
15 N*m{ 154 kgf*cm , 11 ft.*lbf
with union nut wrench
14 N*m{ 141 kgf*cm , 10 ft.*lbf



48. INSTALL DIESEL THROTTLE BODY ASSEMBLY RH

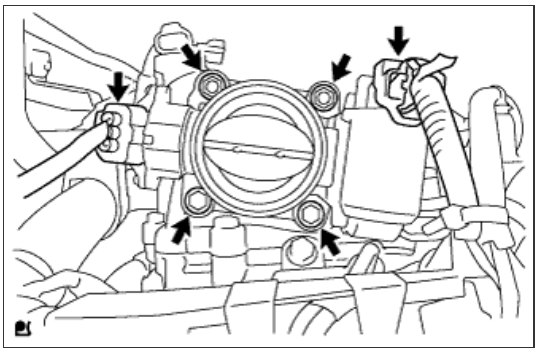
a. Install a new gasket to the intake pipe.

b. Install the throttle body with the 2 bolts and 2 nuts.

Tor e
21 N*m{ 214 kgf*cm , 15 ft.*lbf

c. Connect the throttle position sensor connector.

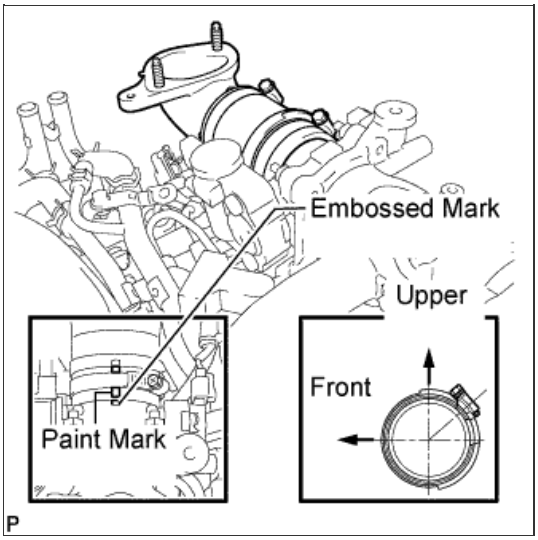
. Connect the throttle motor connector.



49. INSTALL AIR T BE S B-ASSEMBLY RH

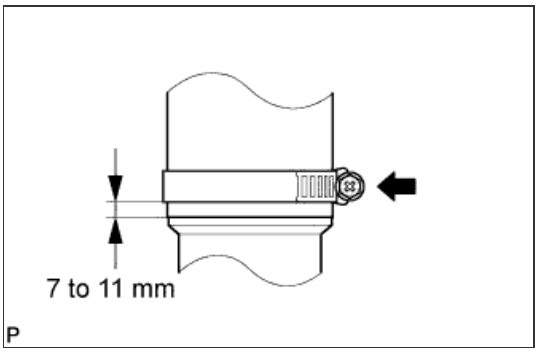
a. Install the air tube to the throttle body.

b. Align the embossed mark of the throttle body with the paint mark of the No. 4 air hose.



c. Tighten the hose clamp so that it is 7 to 11 mm (0.276 to 0.433 in.) from the end of the hose as shown in the illustration.

Tor e
.3 N*m{ 64 kgf*cm , 56 in.*lbf



50. INSTALL NO. 2 ENGINE OIL LEVEL DIPSTICK G IDE

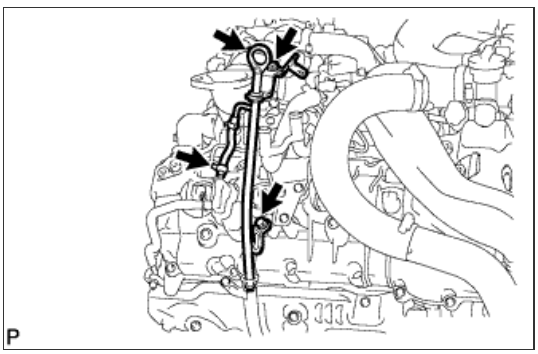
a. Apply a light coat of engine oil to a new O-ring.

b. Install the O-ring to the No. 2 engine oil level dipstick guide.

c. Install the No. 2 engine oil level dipstick guide with the 2 bolts.

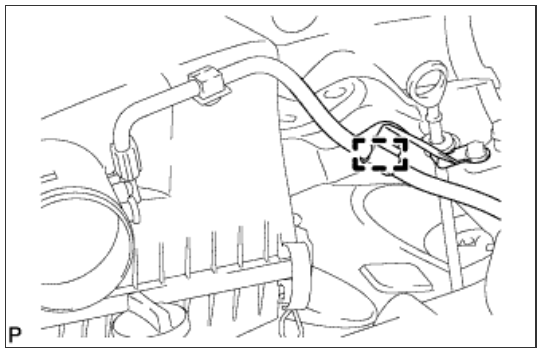
Tor e
10 N*m{ 102 kgf*cm , 7 ft.*lbf

. Connect the ventilation hose to the cylinder head cover RH.

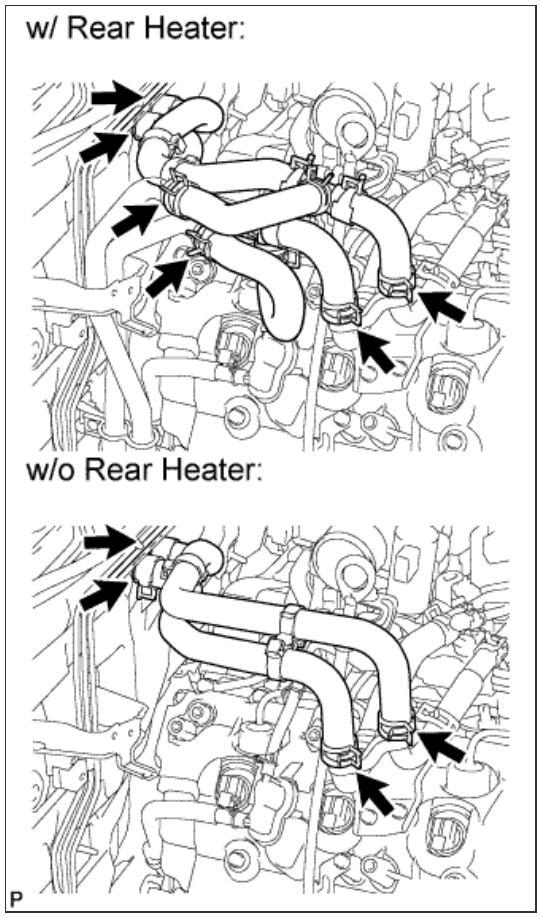


e. Connect the wire harness clamp to the No. 2 engine oil level dipstick guide

bracket.



51. CONNECT WATER HOSE S B-ASSEMBLY



52. INSTALL INTERCOOLER ASSEMBLY

a. Install the intercooler assembly (Click here).

53. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

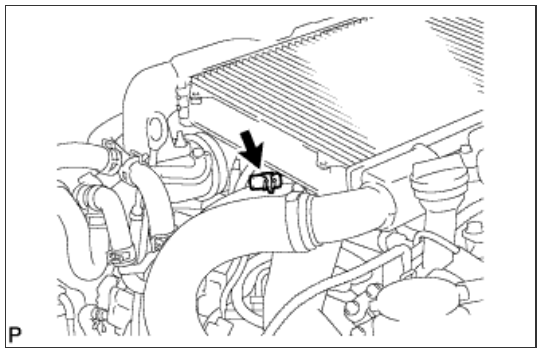
NOTICE

When disconnect the cable, some systems need to be initialized after the cable is reconnected (Click here).

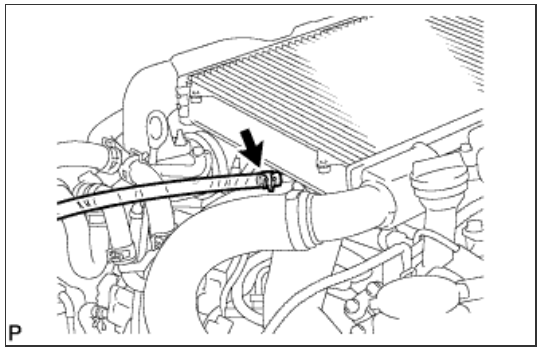
a. Connect the cables to the negative (-) main battery and sub-battery terminals.

54. ADD ENGINE COOLANT

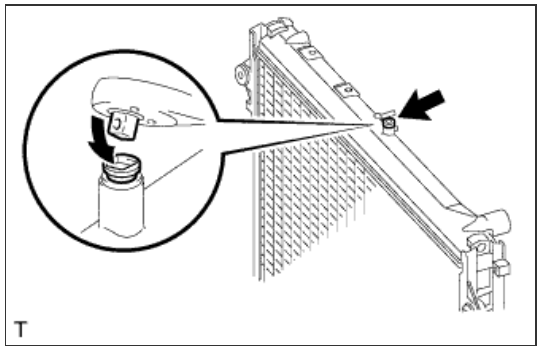
a. Remove the engine air bleed cap.



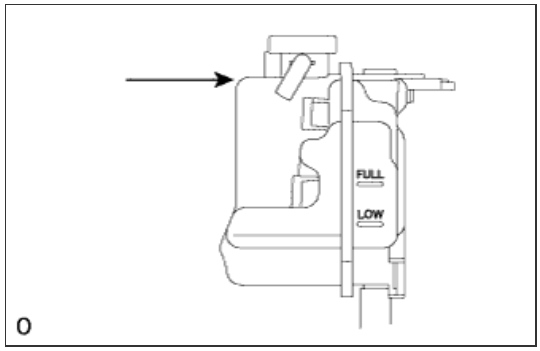
b. Connect a clear hose to the engine air bleed pipe.



c. Using a wrench, remove the vent plug.



. ill the radiator with T A STLLC to the radiator reservoir filler neck.



HINT

Pour TOYOTA SLLC until it spills out of the engine air bleed pipe.

Stan ar Capacity (for Automatic Transmission)

Item	Specified Condition
Front heater only	14.8 liters (15.6 US qts, 13.0 Imp. qts)
Front heater and rear heater	17.6 liters (18.6 US qts, 15.5 Imp. qts)
Front heater with viscous heater	15.2 liters (16.1 US qts, 13.4 Imp. qts)
Front heater and rear heater with viscous heater	18.0 liters (19.0 US qts, 15.4 Imp. qts)

Stan ar capacity (for Manual Transmission)
15.4 liters (16.3 S ts, 13.6 Imp. ts)

NOTICE

Do not substitute plain water for engine coolant.

HINT:

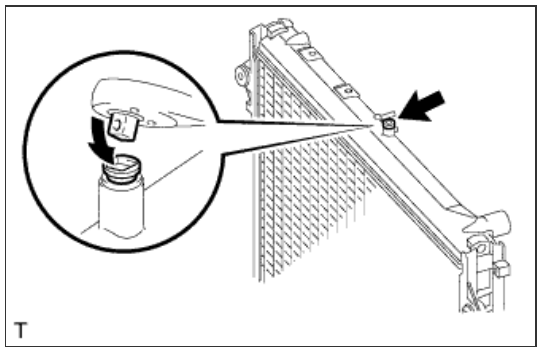
TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

e. Install the vent plug.

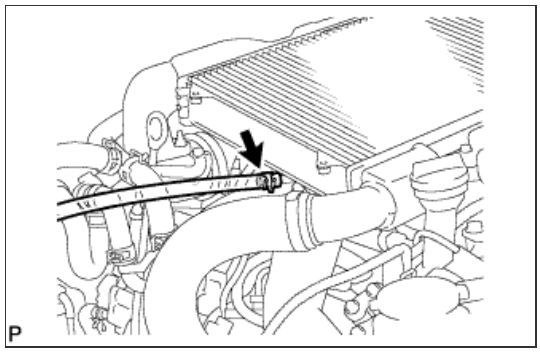
Torque:
2.0 N*m{ 20 kgf*cm , 18 in.*lbf }

NOTICE:

Do not tighten the plug to 5.0 N*m (51 kgf*cm, 44 in.*lbf) or more, as the plug will be damaged.



f. Disconnect the clear hose from the engine air bleed pipe.



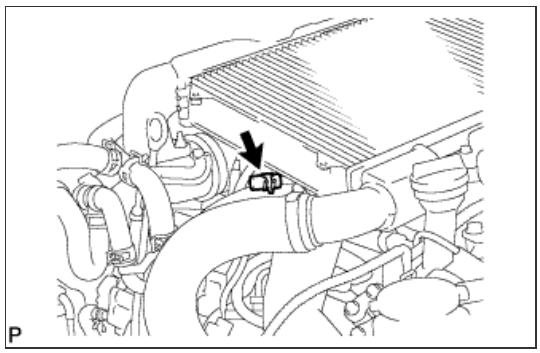
g. Install the engine air bleed cap when coolant comes out.

h. Install the radiator reservoir cap.

i. Start the engine.

NOTICE:

Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the FULL line.



j. Maintain an engine speed of 3000 rpm for approximately 10 minutes so that the thermostat opens and air bleeding is performed.

CAUTION:

When pressing the radiator hoses:

- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the radiator fan**

NOTICE:

- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**

HINT:

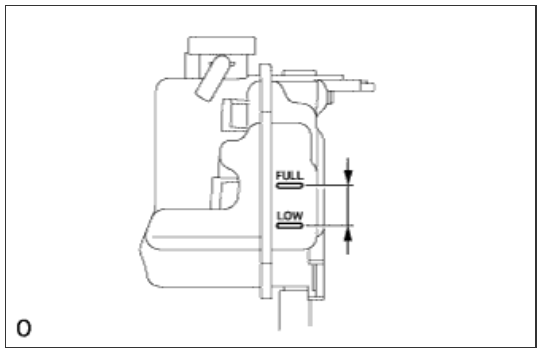
The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

k. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

l. Check that the coolant level is between the FULL and LOW lines.
If the coolant level is above the FULL line, drain coolant so that the coolant level is between the FULL and LOW lines.



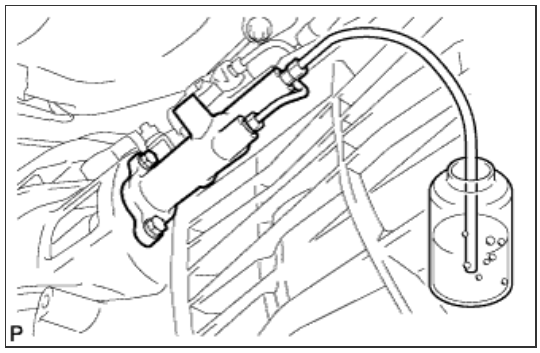
55. ADD CL TCH L ID

56. ILL BRAKE L ID RESERVOIR (for Manual Transmission)

a. Check the fluid level.
If the brake fluid level is low, check for leaks and inspect the disc brake pad. If necessary, refill the reservoir with brake fluid after repair or replacement.

Brake flui :
SAE J1703 or FMVSS No. 116 DOT 3

57. BLEED CLUTCH LINE (for Manual Transmission)



a. Remove the release cylinder bleeder plug cap.

b. Connect a vinyl tube to the bleeder plug.

c. Depress the clutch pedal several times, and then loosen the bleeder plug while the pedal is depressed.

d. When fluid no longer comes out, tighten the bleeder plug, and then release the clutch pedal.

e. Repeat the previous 2 steps until all the air in the fluid is completely bled.

f. Tighten the bleeder plug.

Torque:
11 N*m{ 110 kgf*cm , 8 ft.*lbf }

g. Install the bleeder plug cap.

h. Check that all the air has been bled from the clutch line.

58. CHECK FLUID LEVEL IN RESERVOIR (for Manual Transmission)

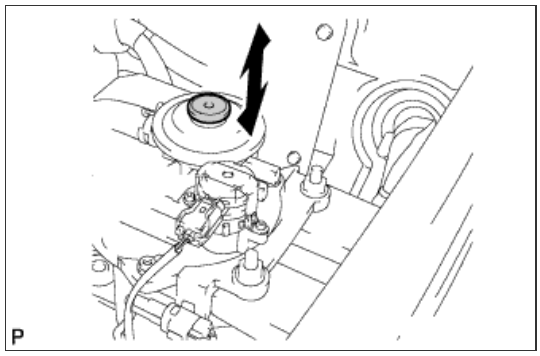
a. Check the fluid level.
If the brake fluid level is low, check for leaks and inspect the disc brake pad. If necessary, refill the reservoir with brake fluid after repair or replacement.

Brake fluid:
SAE J1703 or FMVSS No. 116 DOT 3

59. INSPECT FOR CLUTCH FLUID LEAK (for Manual Transmission)

60. BLEED AIR FROM FUEL SYSTEM

a. Using the hand pump, bleed air from the fuel system until pumping becomes difficult.



61. INSPECT OR LEAK

a. Perform Active Test.

i. Connect the intelligent tester to the DLC3.

ii. Turn the ignition switch to ON.

iii. Start the engine.

iv. Turn the intelligent tester ON.

v. Enter the following menus: Powertrain / Engine / Active Test.

vi. Perform the Active Test.

Tester Display	Test Detail	Control Range	Diagnostic Note
Test the Fuel Leak	Pressurizes fuel inside common rail and checks for fuel leaks	Stop/Start	• The fuel inside the common rail is pressurized to the specified value and the engine speed increases to 2000 rpm when Start is selected. • The above conditions are preserved while Start is selected.

62. INSPECT OR COOLANT LEAK

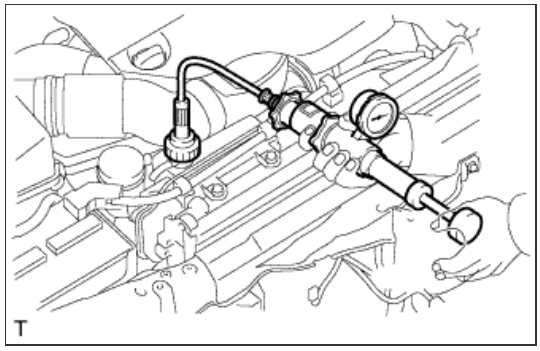
CA TION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester to the radiator reservoir.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 17.8 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks.
If no external leaks are found, check the cylinder block and cylinder head.



63. INSPECT OR OIL LEAK

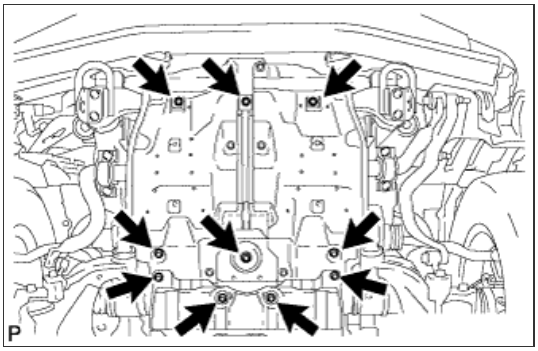
64. INSTALL PPER RADIATOR S PPORT SEAL

a. Install the upper radiator support seal with the 7 clips.

65. INSTALL NO. 1 ENGINE NDER COVER S B-ASSEMBLY

a. Install the engine under cover with the 10 bolts.

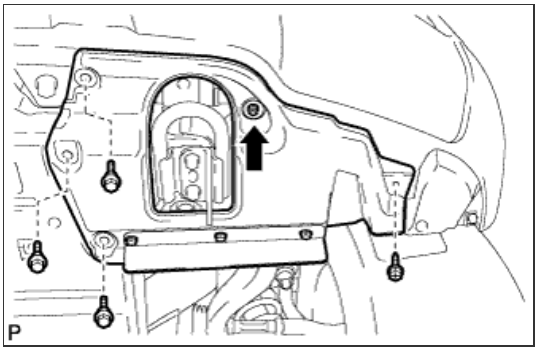
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



66. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.

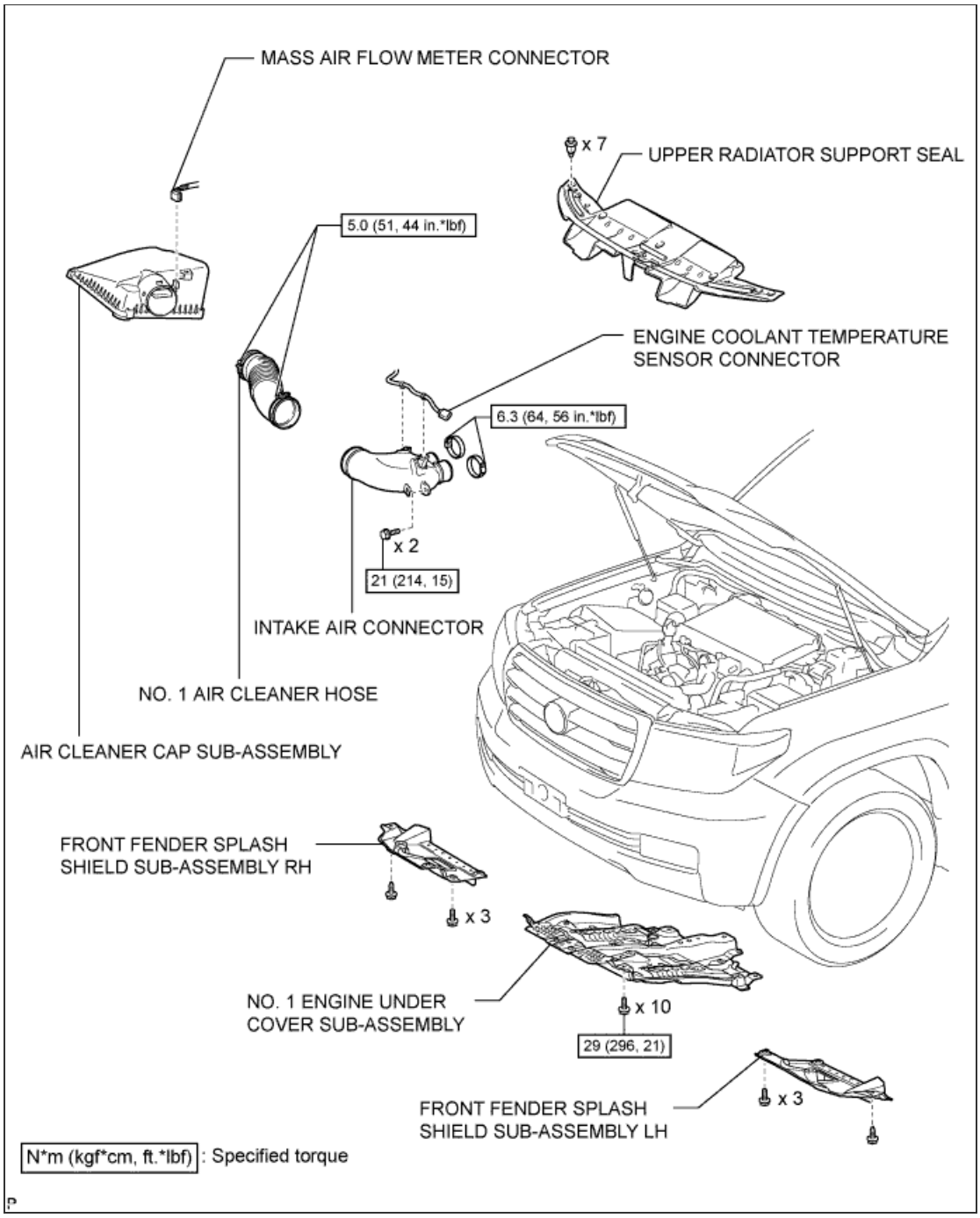


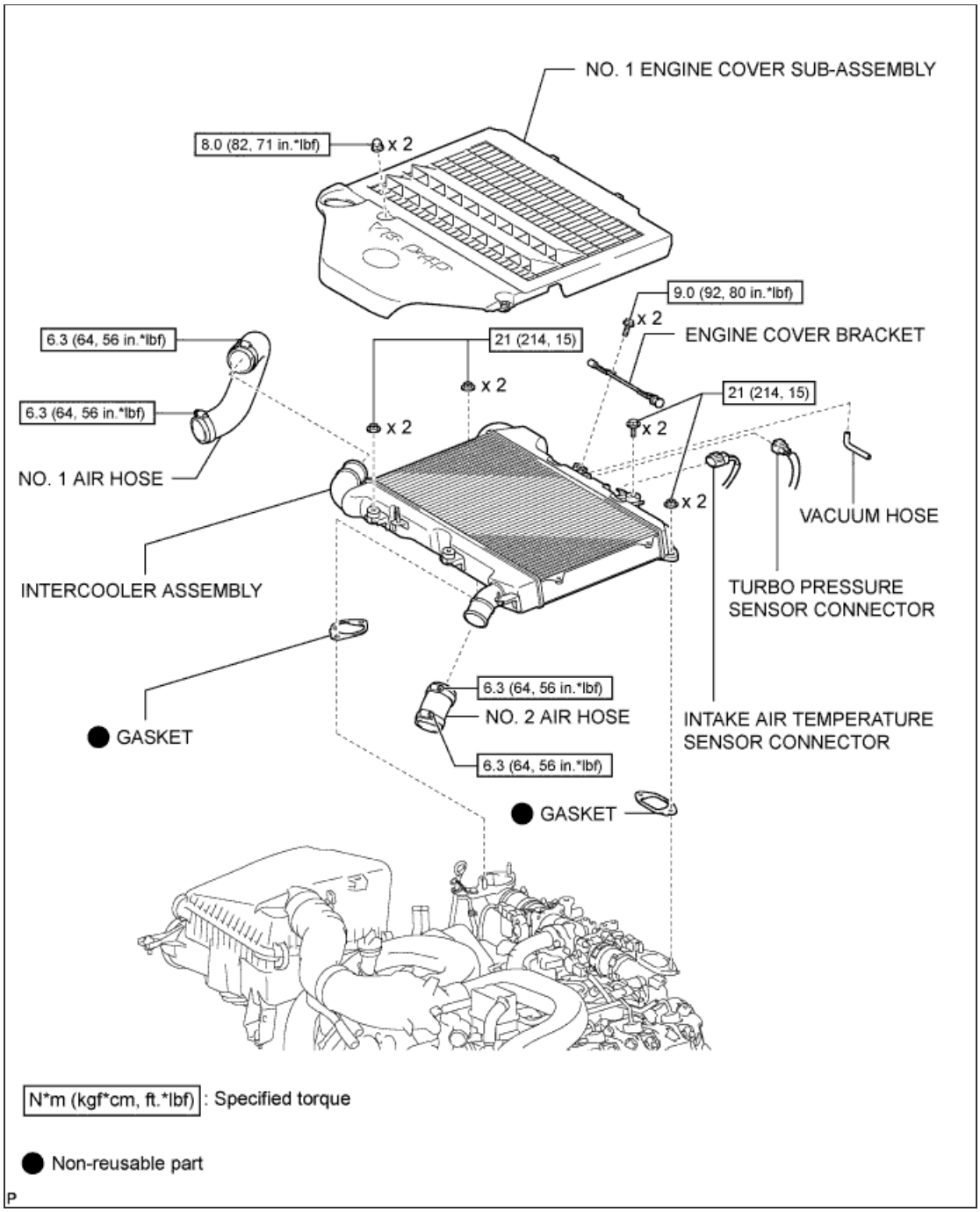
67. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

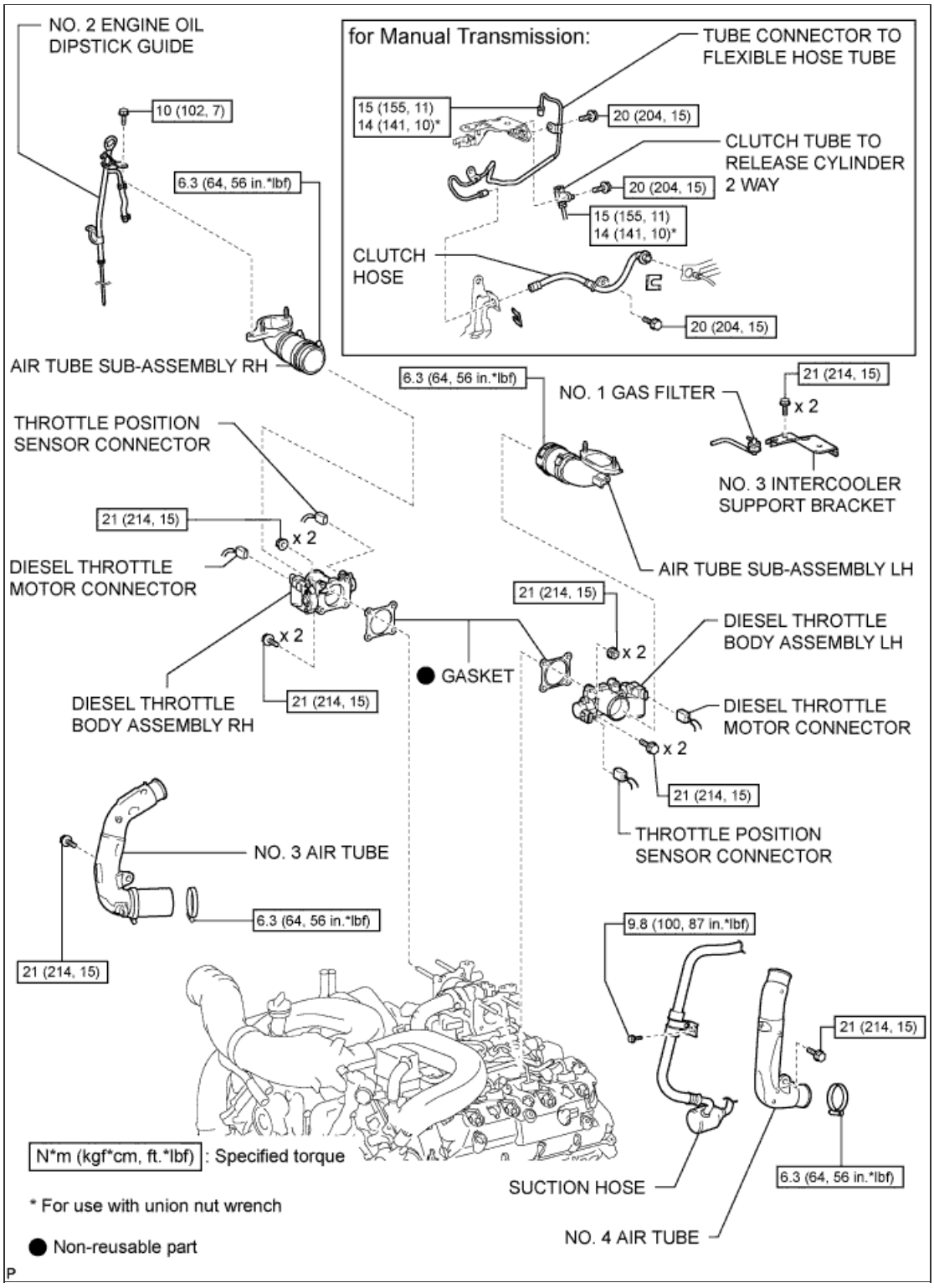
Use the same procedures described for the LH side.

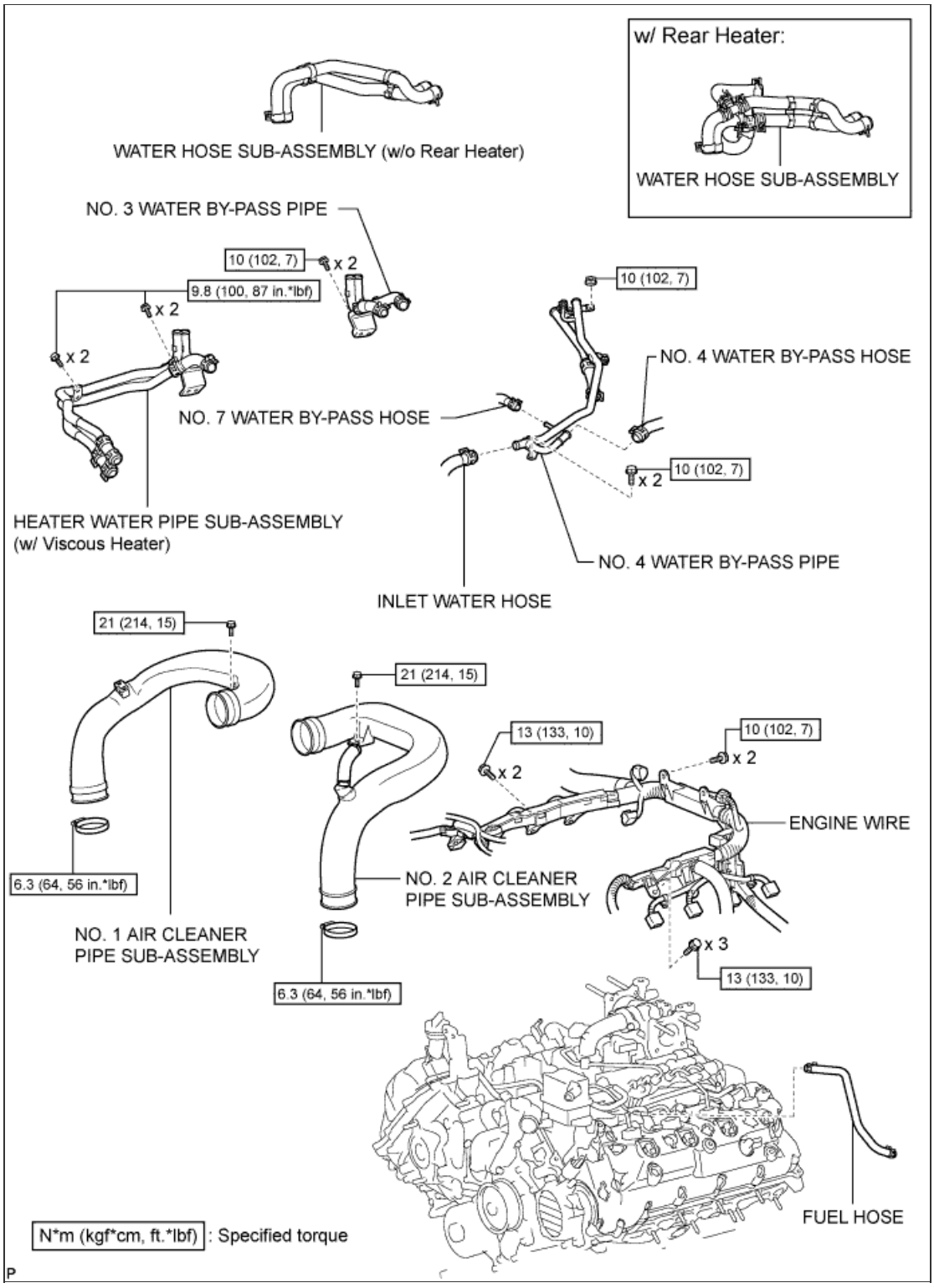
for Preparation Click here

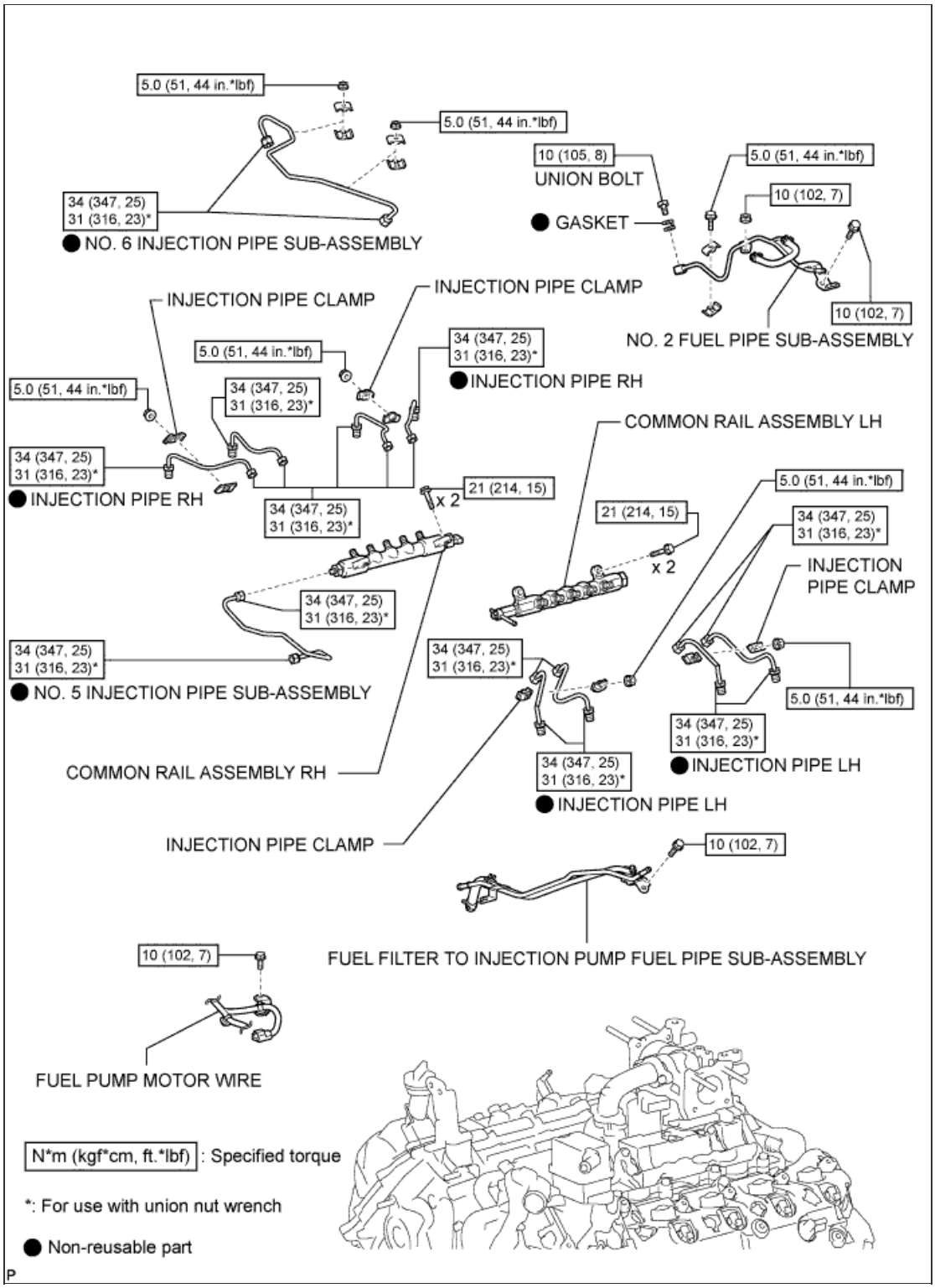


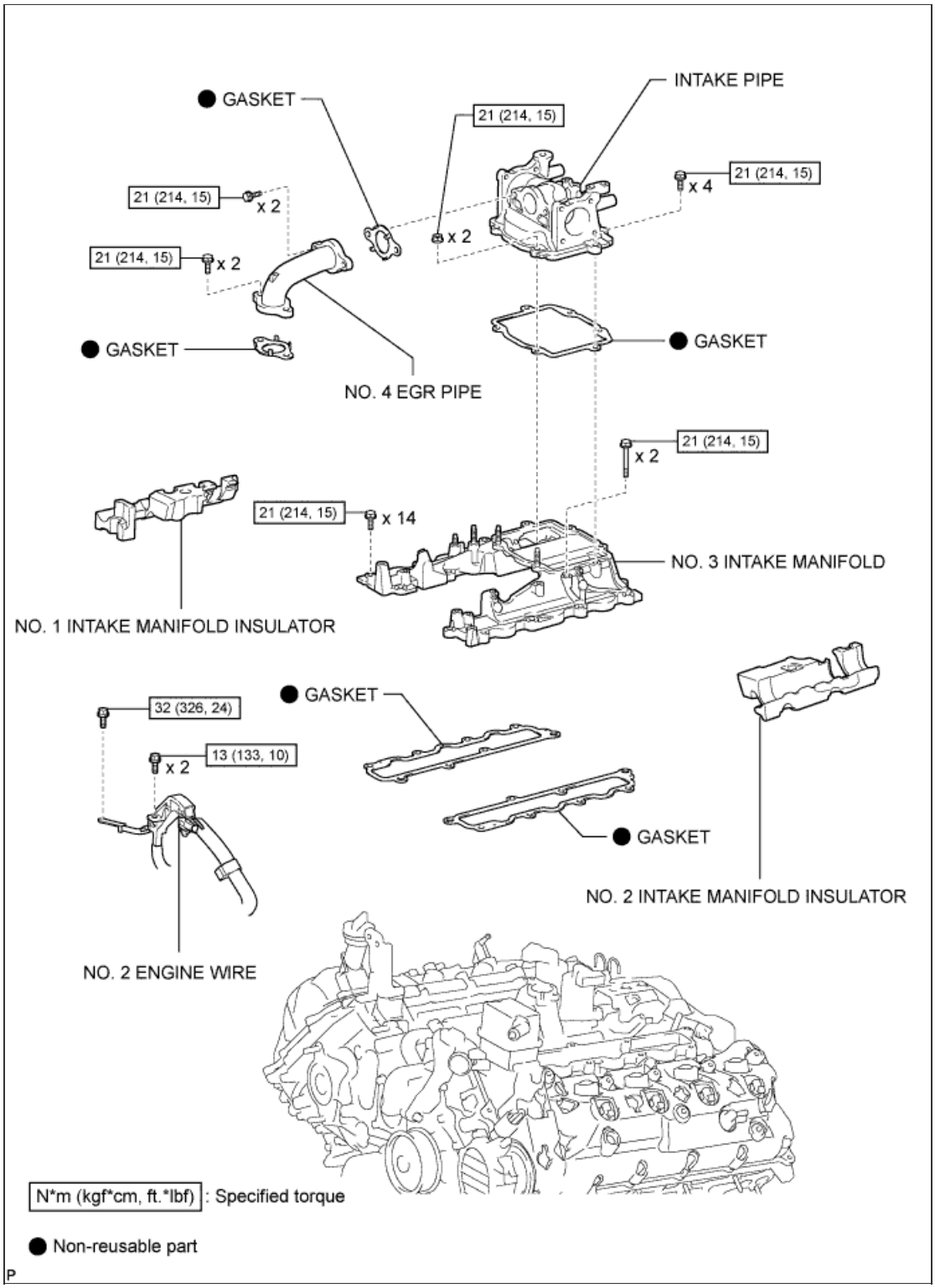

NO. 1 ENGINE COVER SUB-ASSEMBLY
8.0 (82, 71 in.*lbf)
x 2
9.0 (92, 80 in.*lbf)
x 2
ENGINE COVER BRACKET
6.3 (64, 56 in.*lbf)
6.3 (64, 56 in.*lbf)
NO. 1 AIR HOSE
21 (214, 15)
x 2
x 2
21 (214, 15)
x 2
x 2
VACUUM HOSE
INTERCOOLER ASSEMBLY
TURBO PRESSURE SENSOR CONNECTOR
GASKET
6.3 (64, 56 in.*lbf)
NO. 2 AIR HOSE
6.3 (64, 56 in.*lbf)
INTAKE AIR TEMPERATURE SENSOR CONNECTOR
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P

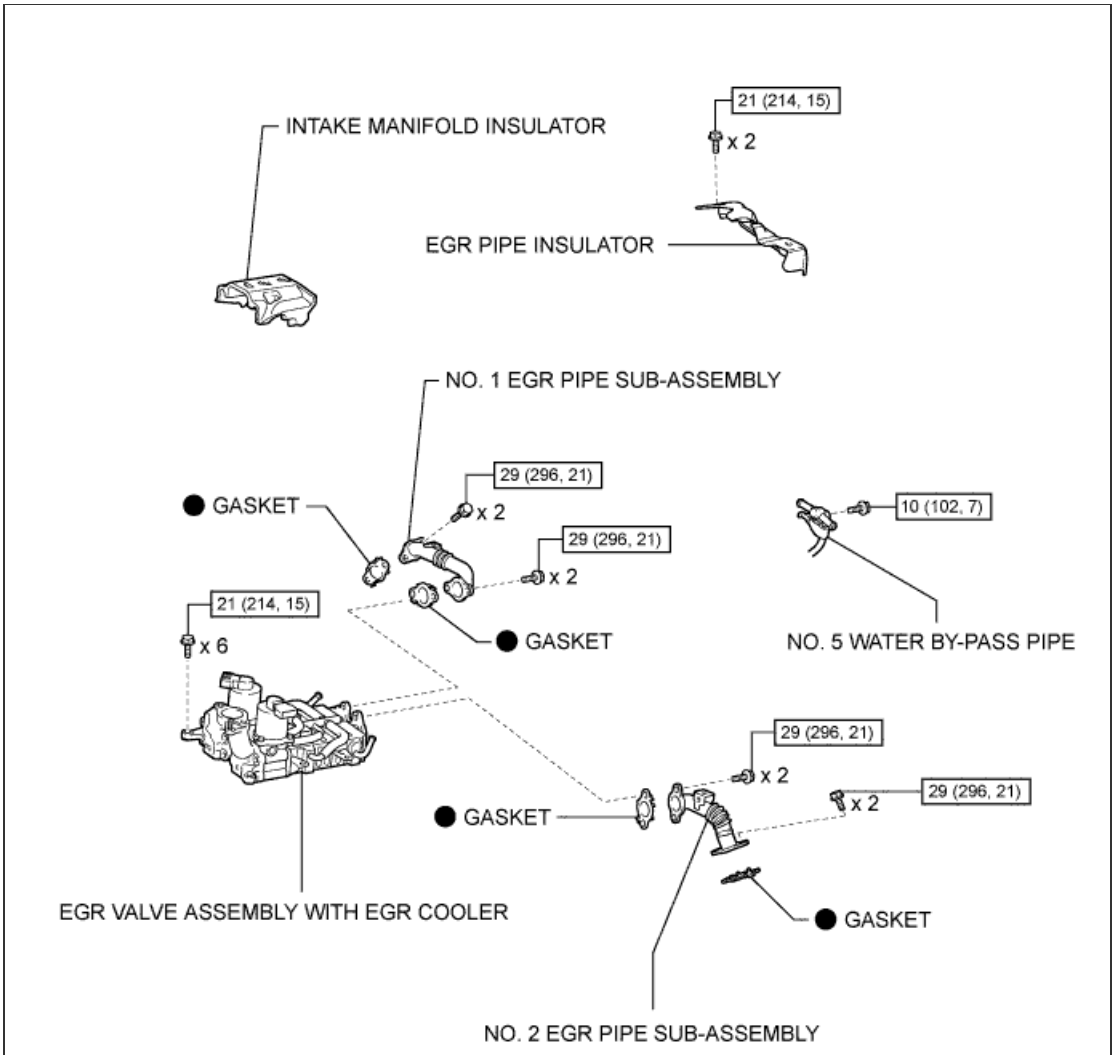

NO. 2 ENGINE OIL DIPSTICK GUIDE
10 (102, 7)
6.3 (64, 56 in.*lbf)
AIR TUBE SUB-ASSEMBLY RH
for Manual Transmission:
TUBE CONNECTOR TO FLEXIBLE HOSE TUBE
15 (155, 11) 14 (141, 10)*
20 (204, 15)
CLUTCH TUBE TO RELEASE CYLINDER 2 WAY
20 (204, 15)
15 (155, 11) 14 (141, 10)*
CLUTCH HOSE
20 (204, 15)
6.3 (64, 56 in.*lbf)
NO. 1 GAS FILTER
21 (214, 15)
x 2
NO. 3 INTERCOOLER SUPPORT BRACKET
THROTTLE POSITION SENSOR CONNECTOR
21 (214, 15)
x 2
DIESEL THROTTLE MOTOR CONNECTOR
AIR TUBE SUB-ASSEMBLY LH
21 (214, 15)
x 2
DIESEL THROTTLE BODY ASSEMBLY LH
x 2
GASKET
DIESEL THROTTLE BODY ASSEMBLY RH
21 (214, 15)
DIESEL THROTTLE MOTOR CONNECTOR
x 2
21 (214, 15)
THROTTLE POSITION SENSOR CONNECTOR
NO. 3 AIR TUBE
6.3 (64, 56 in.*lbf)
21 (214, 15)
9.8 (100, 87 in.*lbf)
21 (214, 15)
6.3 (64, 56 in.*lbf)
SUCTION HOSE
NO. 4 AIR TUBE
N*m (kgf*cm, ft.*lbf) : Specified torque
* For use with union nut wrench
Non-reusable part
P

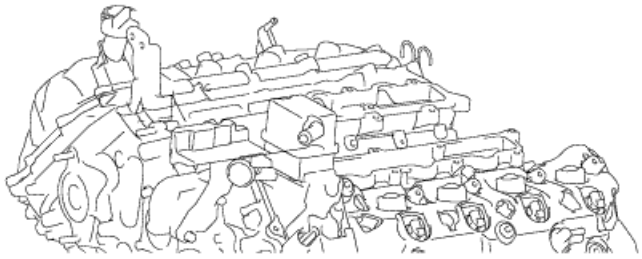

w/ Rear Heater:
WATER HOSE SUB-ASSEMBLY
WATER HOSE SUB-ASSEMBLY (w/o Rear Heater)
NO. 3 WATER BY-PASS PIPE
10 (102, 7)
x 2
9.8 (100, 87 in.*lbf)
x 2
x 2
NO. 7 WATER BY-PASS HOSE
HEATER WATER PIPE SUB-ASSEMBLY
(w/ Viscous Heater)
10 (102, 7)
NO. 4 WATER BY-PASS HOSE
x 2
10 (102, 7)
NO. 4 WATER BY-PASS PIPE
INLET WATER HOSE
21 (214, 15)
21 (214, 15)
13 (133, 10)
x 2
10 (102, 7)
x 2
ENGINE WIRE
6.3 (64, 56 in.*lbf)
NO. 2 AIR CLEANER
PIPE SUB-ASSEMBLY
NO. 1 AIR CLEANER
PIPE SUB-ASSEMBLY
x 3
13 (133, 10)
6.3 (64, 56 in.*lbf)
FUEL HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
P


5.0 (51, 44 in.*lbf)
5.0 (51, 44 in.*lbf)
34 (347, 25)
31 (316, 23)*
NO. 6 INJECTION PIPE SUB-ASSEMBLY
10 (105, 8)
UNION BOLT
GASKET
5.0 (51, 44 in.*lbf)
10 (102, 7)
10 (102, 7)
NO. 2 FUEL PIPE SUB-ASSEMBLY
INJECTION PIPE CLAMP
INJECTION PIPE CLAMP
5.0 (51, 44 in.*lbf)
34 (347, 25)
31 (316, 23)*
INJECTION PIPE RH
5.0 (51, 44 in.*lbf)
34 (347, 25)
31 (316, 23)*
34 (347, 25)
31 (316, 23)*
INJECTION PIPE RH
34 (347, 25)
31 (316, 23)*
x 2
21 (214, 15)
COMMON RAIL ASSEMBLY LH
21 (214, 15)
x 2
5.0 (51, 44 in.*lbf)
34 (347, 25)
31 (316, 23)*
INJECTION
PIPE CLAMP
34 (347, 25)
31 (316, 23)*
34 (347, 25)
31 (316, 23)*
NO. 5 INJECTION PIPE SUB-ASSEMBLY
34 (347, 25)
31 (316, 23)*
5.0 (51, 44 in.*lbf)
34 (347, 25)
31 (316, 23)*
INJECTION PIPE LH
COMMON RAIL ASSEMBLY RH
34 (347, 25)
31 (316, 23)*
INJECTION PIPE LH
INJECTION PIPE CLAMP
10 (102, 7)
FUEL FILTER TO INJECTION PUMP FUEL PIPE SUB-ASSEMBLY
10 (102, 7)
FUEL PUMP MOTOR WIRE
N*m (kgf*cm, ft.*lbf) : Specified torque
*: For use with union nut wrench
Non-reusable part
P


GASKET
21 (214, 15)
INTAKE PIPE
21 (214, 15) x 2
21 (214, 15) x 4
21 (214, 15) x 2
x 2
GASKET
GASKET
NO. 4 EGR PIPE
21 (214, 15) x 2
21 (214, 15) x 14
NO. 3 INTAKE MANIFOLD
NO. 1 INTAKE MANIFOLD INSULATOR
GASKET
32 (326, 24)
13 (133, 10) x 2
GASKET
NO. 2 INTAKE MANIFOLD INSULATOR
NO. 2 ENGINE WIRE
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P

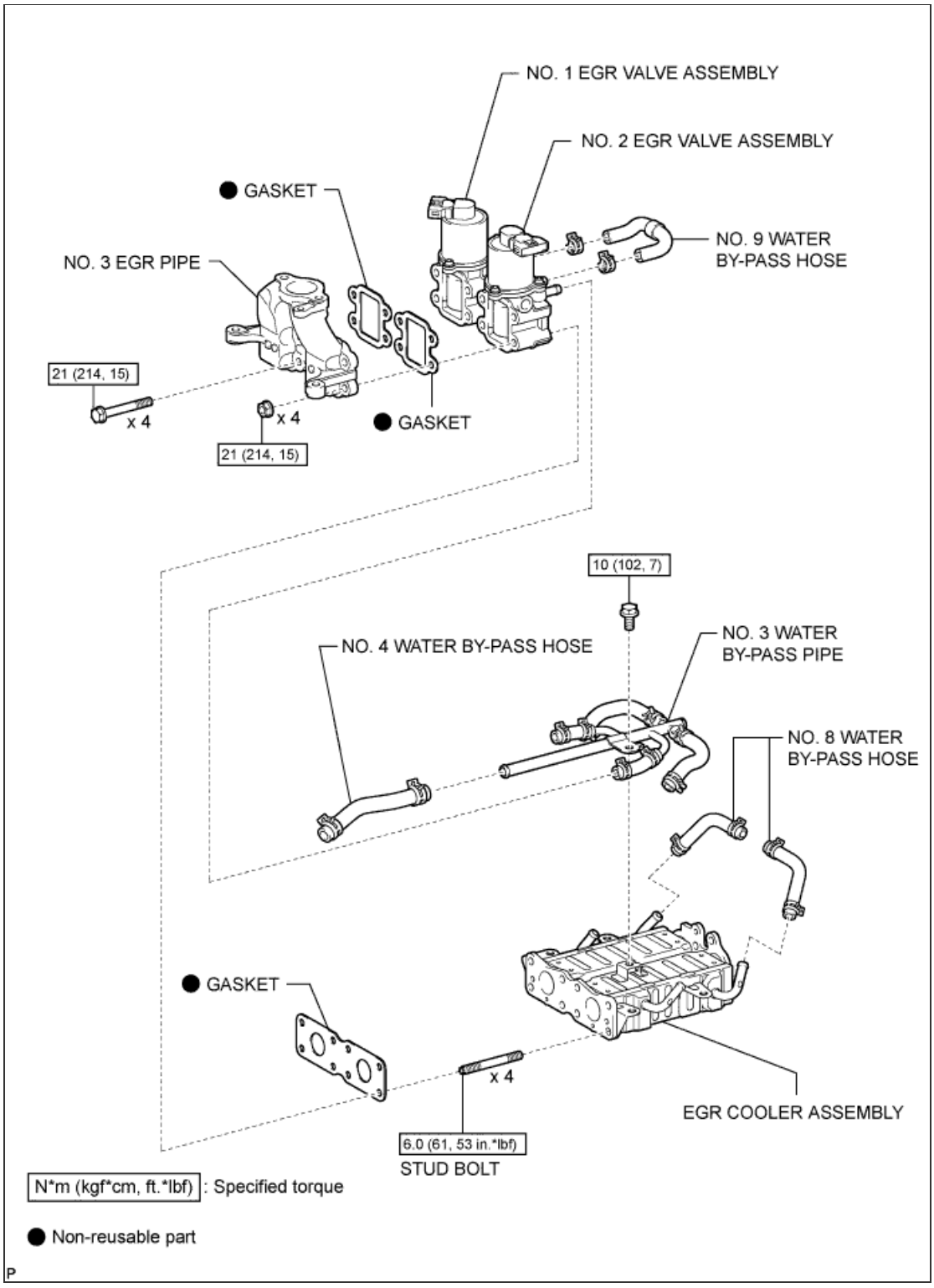




N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P


NO. 1 EGR VALVE ASSEMBLY
NO. 2 EGR VALVE ASSEMBLY
GASKET
NO. 9 WATER BY-PASS HOSE
NO. 3 EGR PIPE
21 (214, 15)
x 4
x 4
GASKET
21 (214, 15)
10 (102, 7)
NO. 4 WATER BY-PASS HOSE
NO. 3 WATER BY-PASS PIPE
NO. 8 WATER BY-PASS HOSE
GASKET
x 4
EGR COOLER ASSEMBLY
6.0 (61, 53 in.*lbf)
STUD BOLT
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

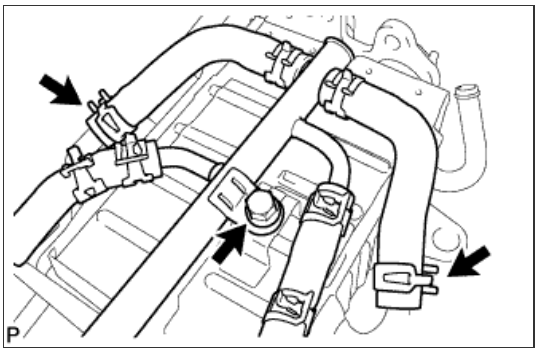
for Preparation Click here

1. REMOVE NO. 1 AND NO. 2 EGR VALVE ASSEMBLIES

a. Remove the No. 1 and No. 2 EGR valve assemblies (Click here).

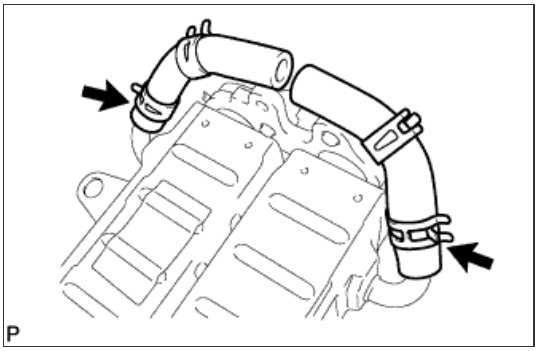
2. REMOVE NO. 3 WATER BY-PASS PIPE

a. Remove the bolt and disconnect the 2 hoses to remove the water by-pass pipe.



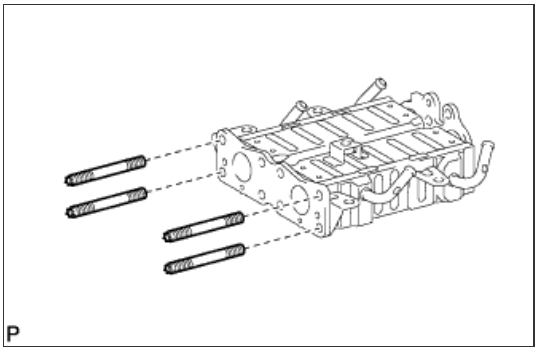
3. REMOVE NO. 8 WATER BY-PASS HOSE

a. Remove the 2 hoses.



4. REMOVE STUD BOLT

a. Using an E6 "TORX" socket wrench, remove the 4 stud bolts from the EGR cooler.

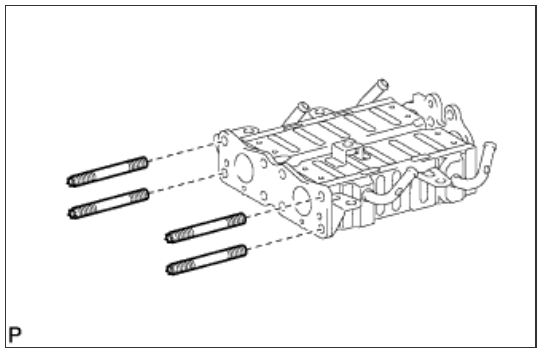


for Preparation Click here

1. INSTALL STUD BOLT

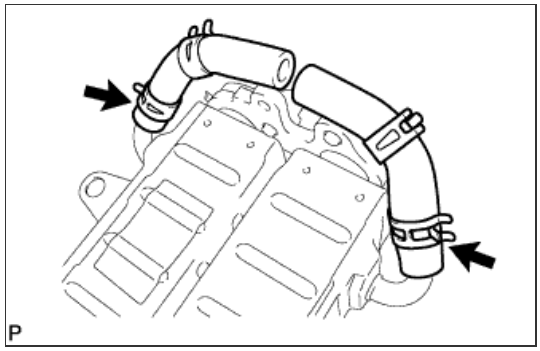
a. Using an E6 "TORX" socket wrench, install the 4 stud bolts to the EGR cooler.

Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }



2. INSTALL NO. 8 WATER BY-PASS HOSE

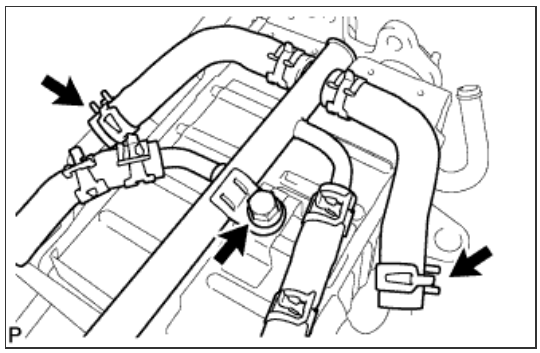
a. Install the 2 hoses.



3. INSTALL NO. 3 WATER BY-PASS PIPE

a. Connect the 2 hoses and install the water by-pass pipe with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



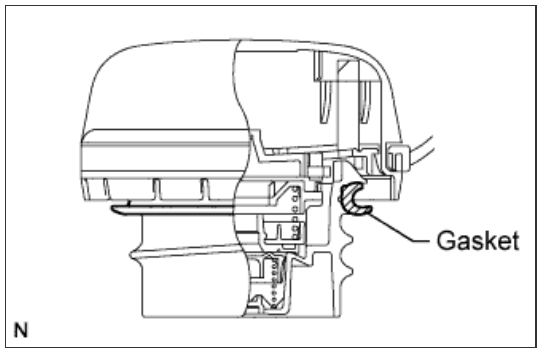
4. INSTALL NO. 1 AND NO. 2 EGR VALVE ASSEMBLIES

a. Install the No. 1 and No. 2 EGR valve assemblies (Click here).

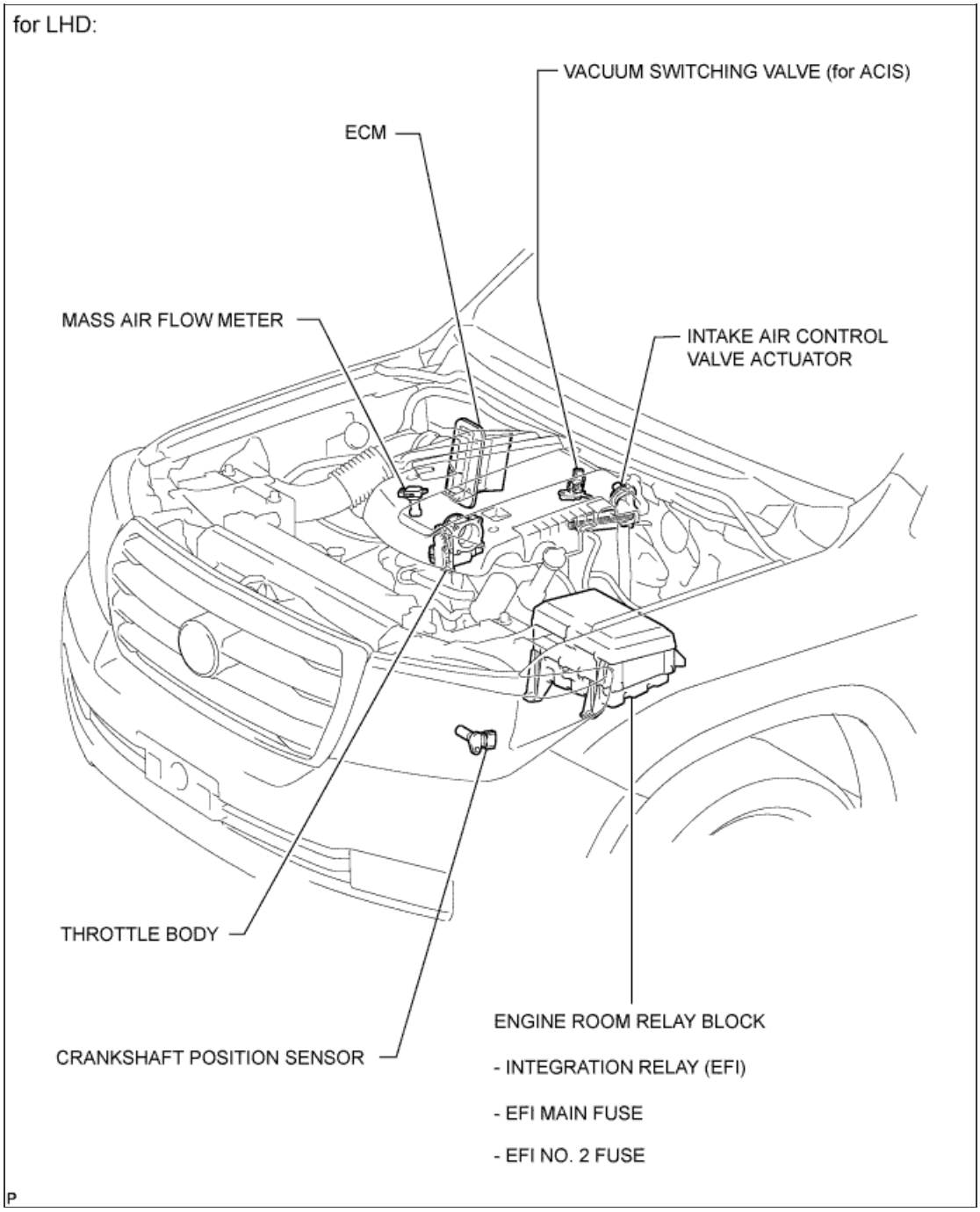
for Preparation Click here

1. INSPECT FUEL TANK CAP ASSEMBLY

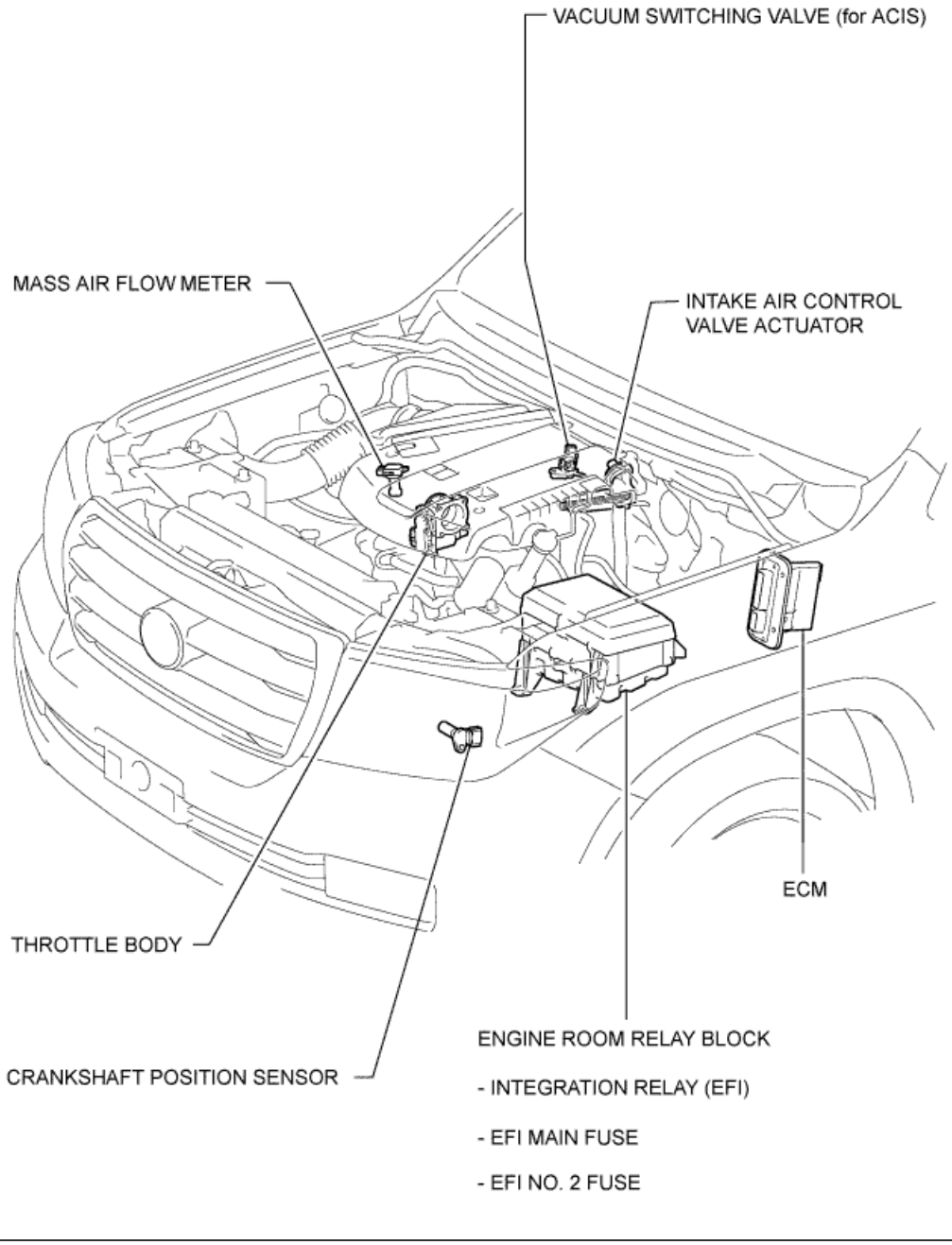
a. Visually check that the cap and gasket are not deformed or damaged.
If the result is not as specified, replace the fuel tank cap assembly or gasket.



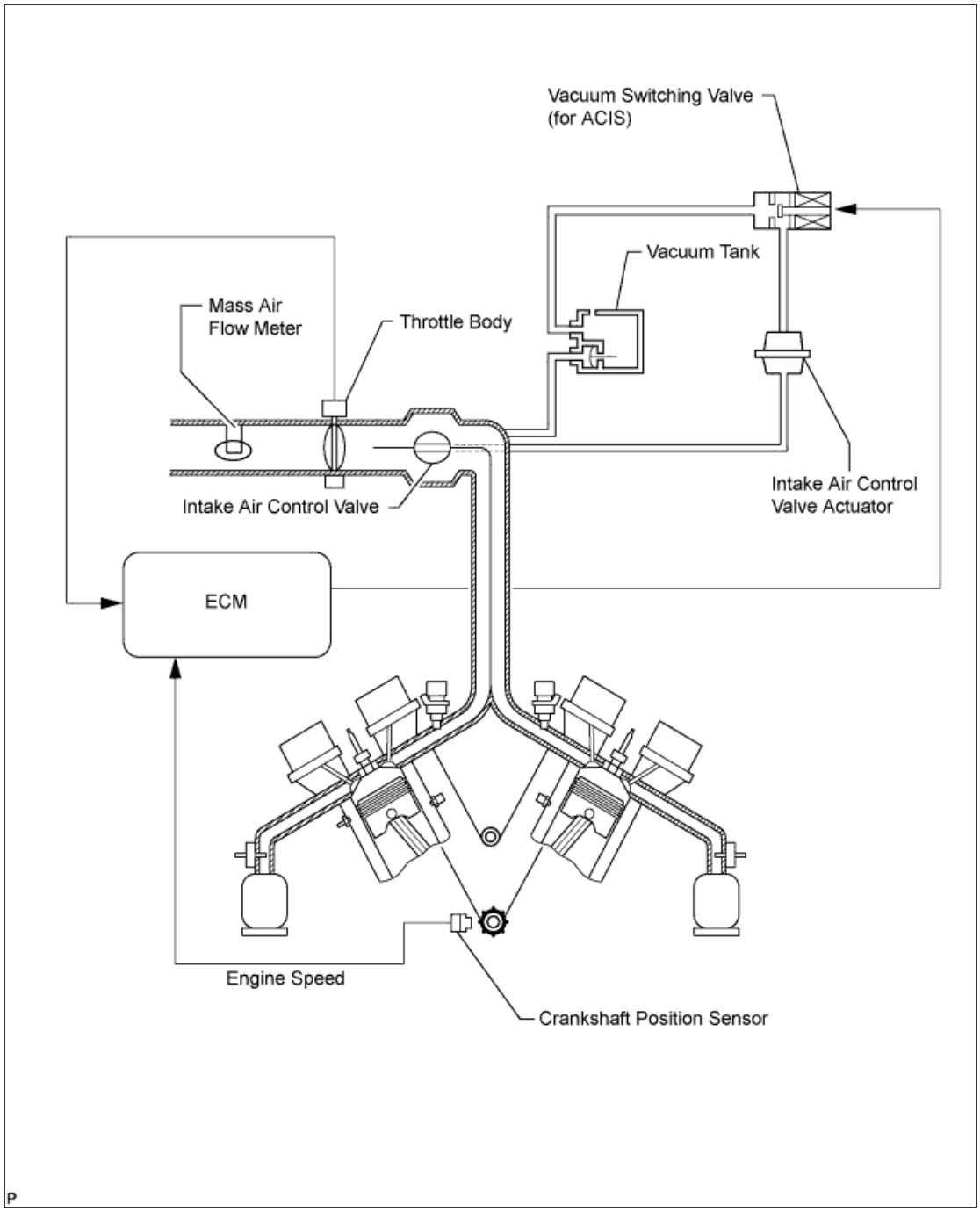
for Preparation Click here

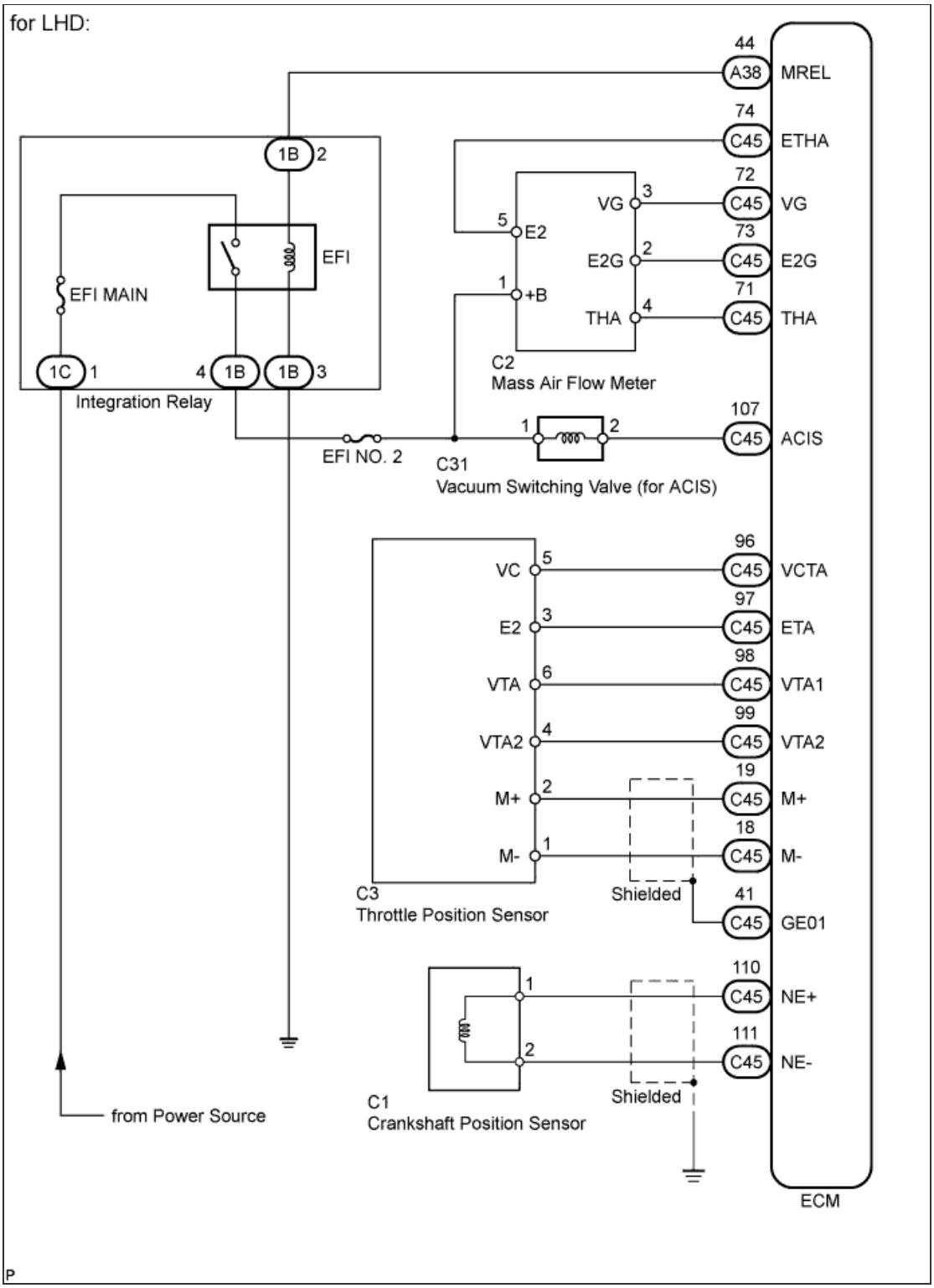


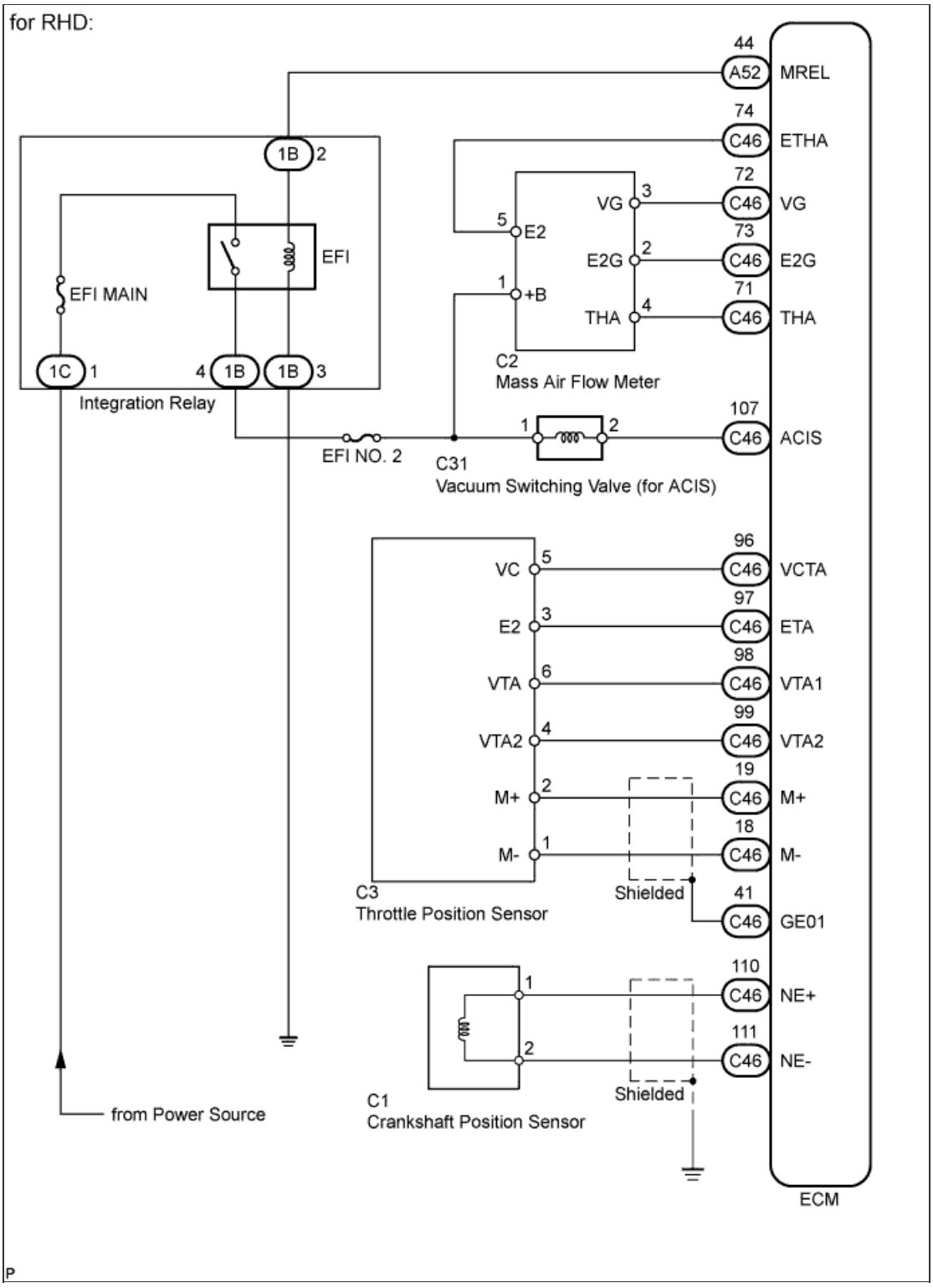
for RHD:


VACUUM SWITCHING VALVE (for ACIS)
MASS AIR FLOW METER
INTAKE AIR CONTROL VALVE ACTUATOR
ECM
THROTTLE BODY
ENGINE ROOM RELAY BLOCK
- INTEGRATION RELAY (EFI)
- EFI MAIN FUSE
- EFI NO. 2 FUSE
CRANKSHAFT POSITION SENSOR
P

for Preparation Click here

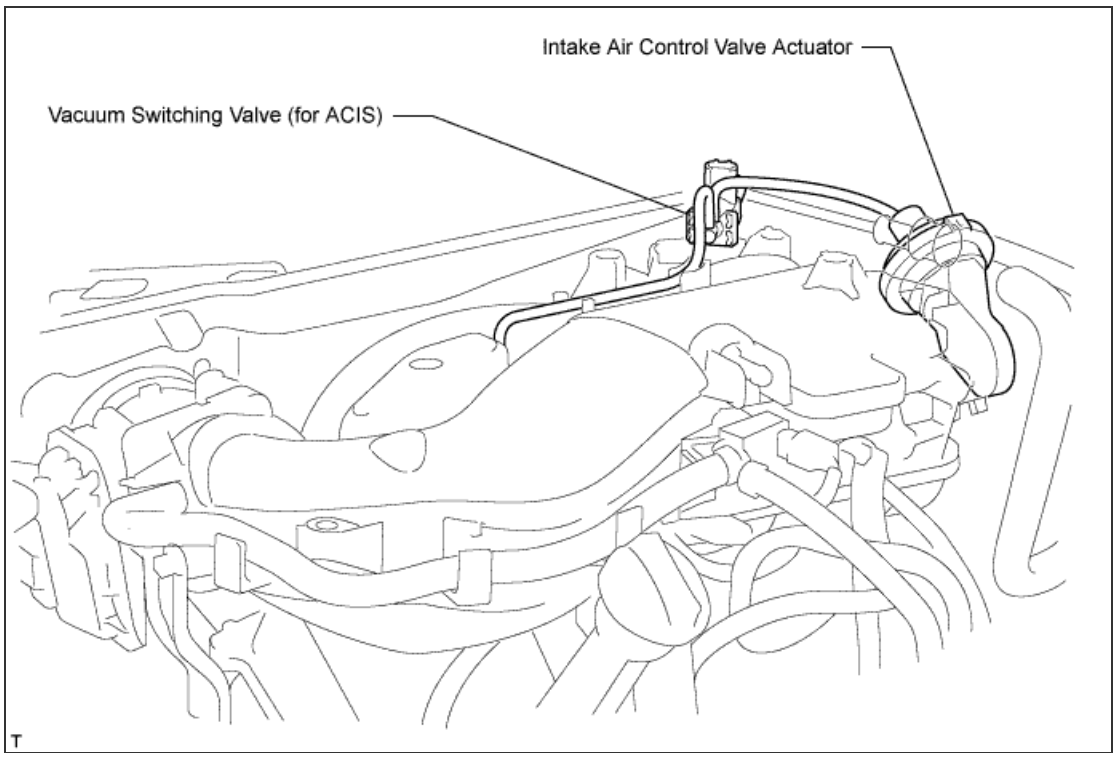



for LHD:
44
A38
MREL
74
C45
ETHA
72
C45
VG
73
C45
E2G
71
C45
THA
1B 2
EFI
EFI MAIN
1C 1
4 1B
1B 3
Integration Relay
5 E2
1 +B
VG 3
E2G 2
THA 4
C2
Mass Air Flow Meter
107
C45
ACIS
EFI NO. 2
C31
Vacuum Switching Valve (for ACIS)
96
C45
VCTA
97
C45
ETA
98
C45
VTA1
99
C45
VTA2
19
C45
M+
18
C45
M-
VC 5
E2 3
VTA 6
VTA2 4
M+ 2
M- 1
C3
Throttle Position Sensor
Shielded
41
C45
GE01
110
C45
NE+
111
C45
NE-
1
2
C1
Crankshaft Position Sensor
Shielded
from Power Source
ECM
P


for RHD:
44
A52
MREL
74
C46
ETHA
72
C46
VG
73
C46
E2G
71
C46
THA
1B 2
EFI
EFI MAIN
1C 1
4 1B
1B 3
Integration Relay
5 E2
1 +B
VG 3
E2G 2
THA 4
C2
Mass Air Flow Meter
107
C46
ACIS
EFI NO. 2
C31
Vacuum Switching Valve (for ACIS)
96
C46
VCTA
97
C46
ETA
98
C46
VTA1
99
C46
VTA2
19
C46
M+
18
C46
M-
VC 5
E2 3
VTA 6
VTA2 4
M+ 2
M- 1
C3
Throttle Position Sensor
Shielded
41
C46
GE01
110
C46
NE+
111
C46
NE-
1
2
C1
Crankshaft Position Sensor
Shielded
from Power Source
ECM
P

for Preparation Click here

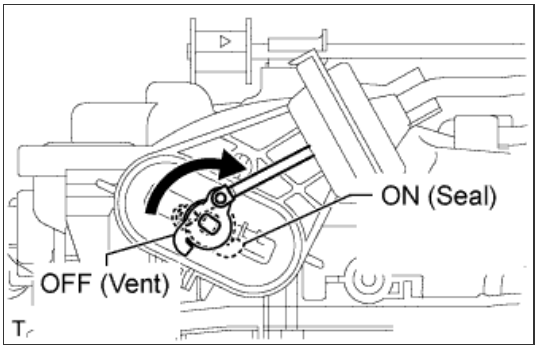
1. CHECK INTAKE AIR CONTROL FUNCTION



a. Remove the V-bank cover.

b. Start the engine.

c. Check that the VSV (for ACIS) is ON (seal) under either of the following conditions below.



- Depressing the accelerator pedal to a throttle valve opening angle of 60°.
- Racing the engine above 4700 rpm.

NOTICE:

Do not increase the engine speed to 5400 rpm or more.

d. Check that the VSV (for ACIS) is OFF (vent) under either of the following conditions below.

- The engine is idling.
- Releasing the accelerator pedal while under the VSV (for ACIS) ON condition.

e. Connect the intelligent tester to the DLC3.

f. Perform the Active Test, and then check that the actuator rod operates.
If the result is not as specified, inspect the intake air control valve, vacuum tank and VSV (for ACIS) for normal operation. Replace malfunctioning parts as necessary.

g. Install the V-bank cover.

2. CHECK INTAKE AIR CONTROL VALVE OPERATION

a. Remove the V-bank cover.

b. Using a 3-way connector, connect a vacuum gauge to the actuator hose.

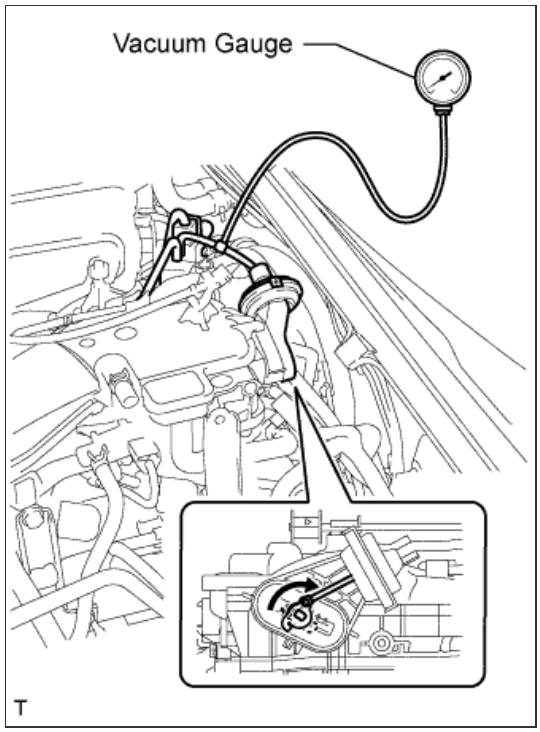
c. Start the engine.

d. While the engine is idling, check that the vacuum gauge needle momentarily fluctuates up to approximately 40 kPa (299 mmHg, 11.8 in.Hg) (the actuator rod is pulled out).

e. Fully depress the accelerator pedal, and check that the vacuum gauge needle points to 0 kPa (0 mmHg, 0 in.Hg) (the actuator rod is returned).

f. Remove the vacuum gauge, and connect the vacuum hose to the actuator.

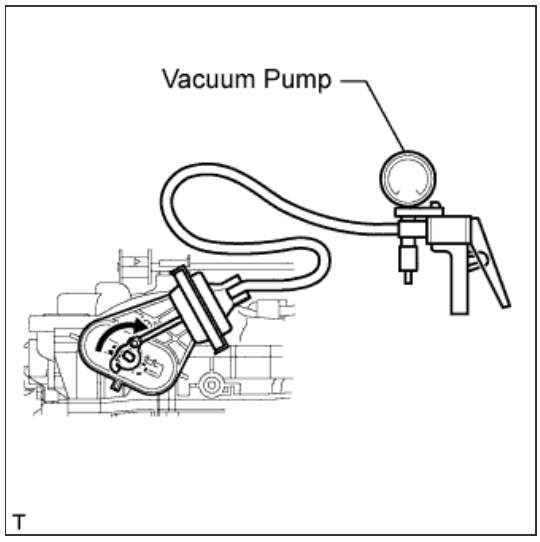
g. Install the V-bank cover.



3. INSPECT INTAKE AIR CONTROL VALVE

a. Inspect the diaphragm.

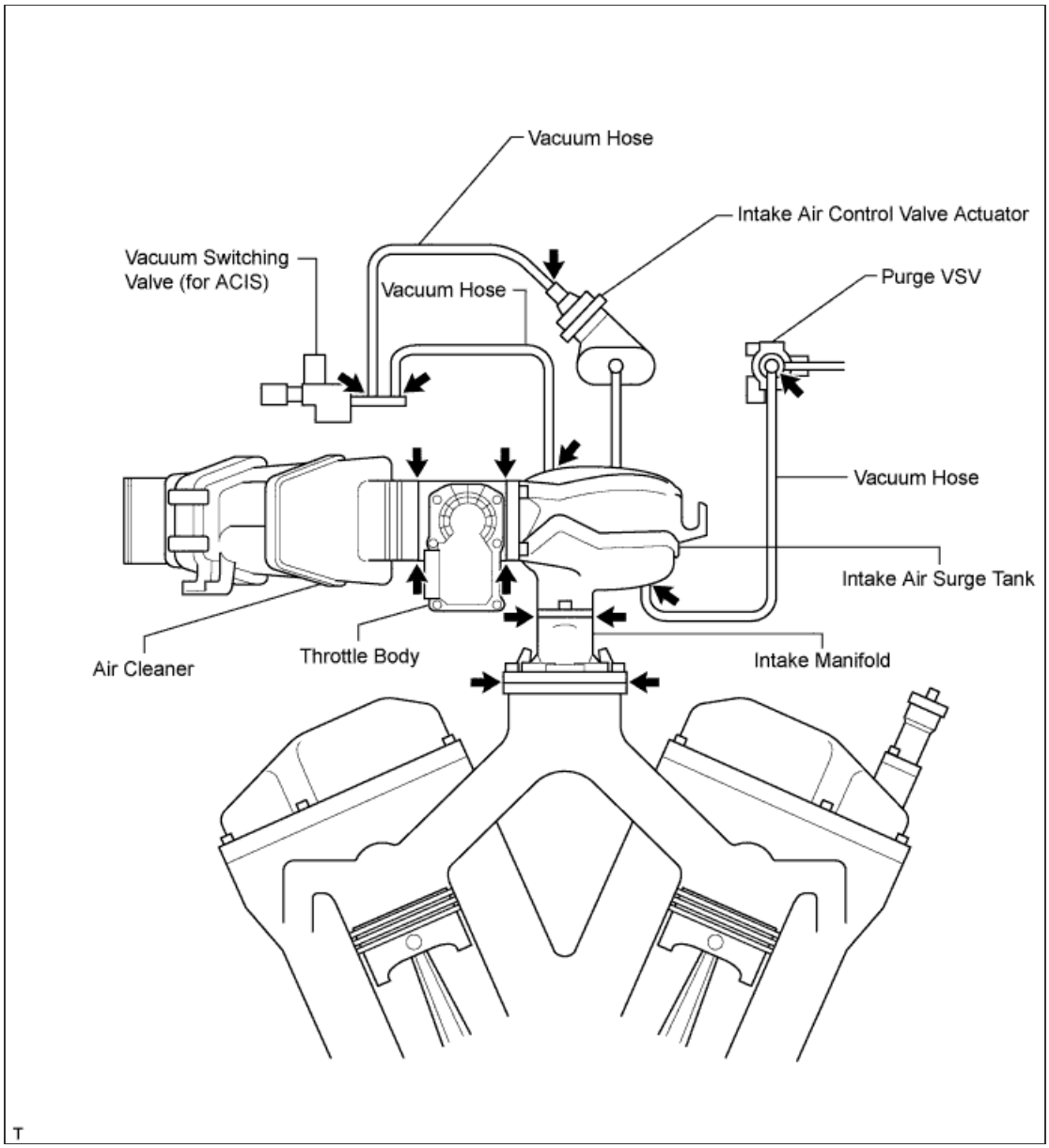
i. Using a vacuum pump, apply a vacuum of 27 kPa (200 mmHg, 7.85 in.Hg). Check that the lever moves.
If the result is not as specified, replace the intake air surge tank.



4. CHECK AIR INDUCTION SYSTEM

HINT:

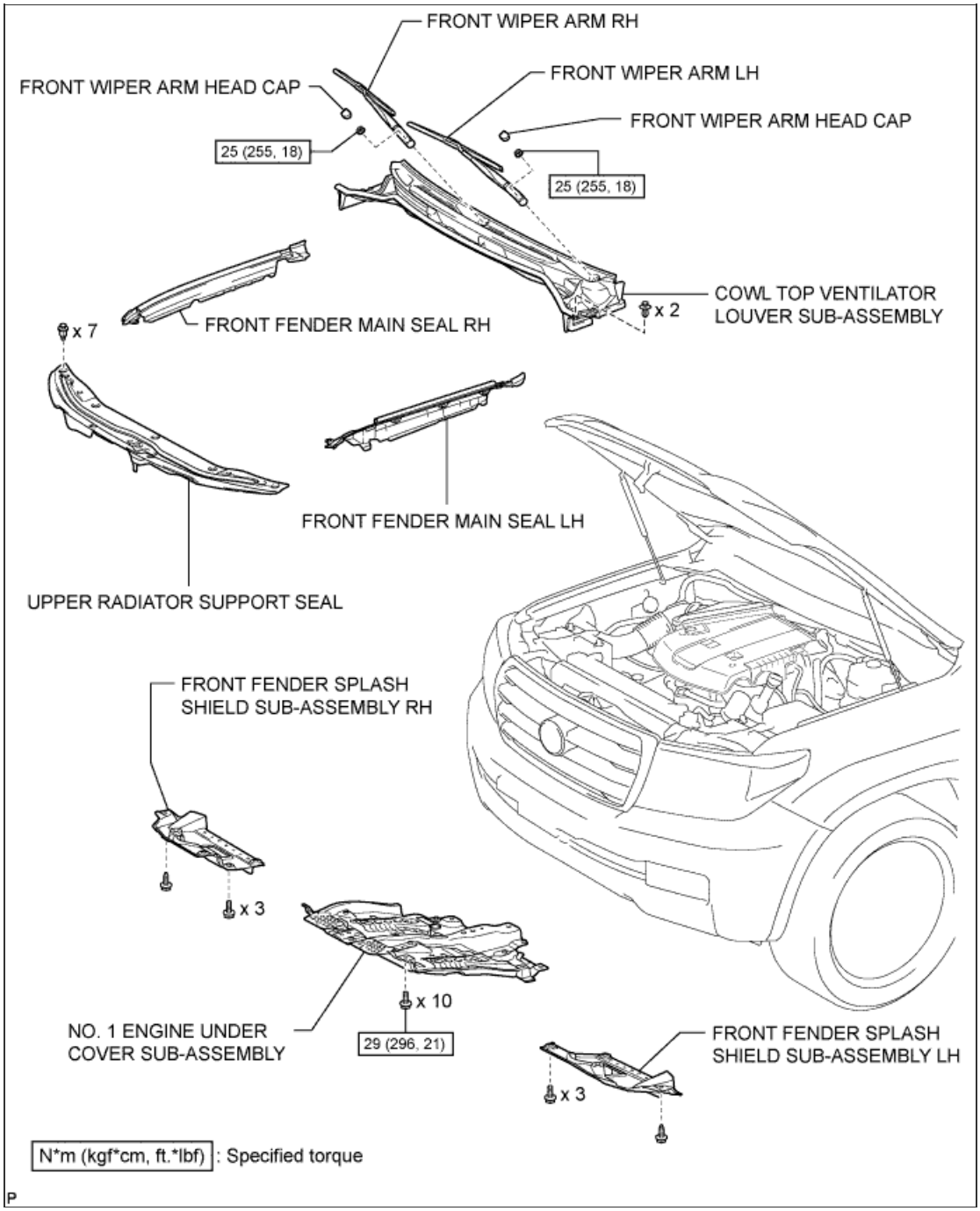
The illustration shows the areas that may draw in secondary air, which could lead to idling problems.

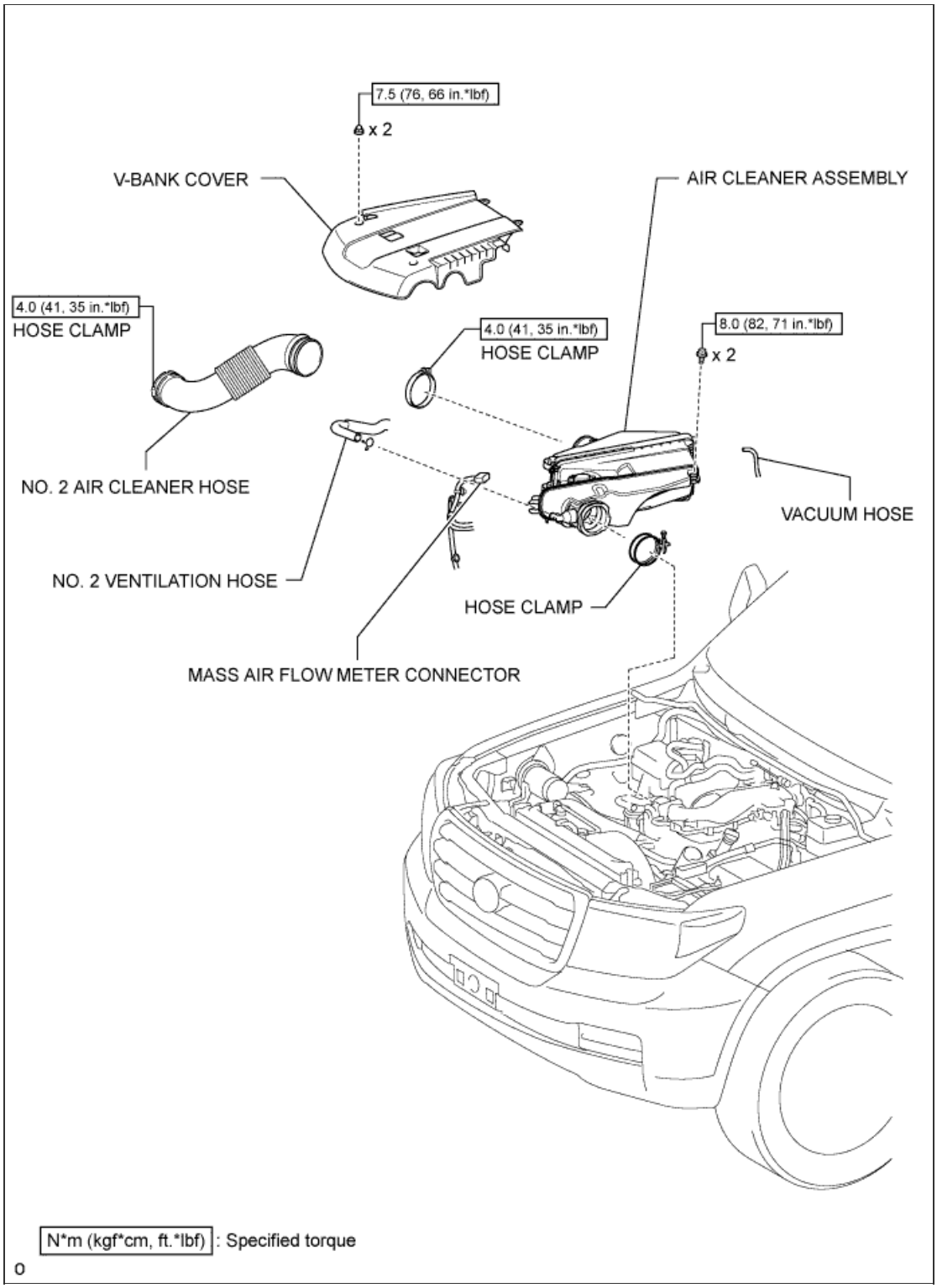


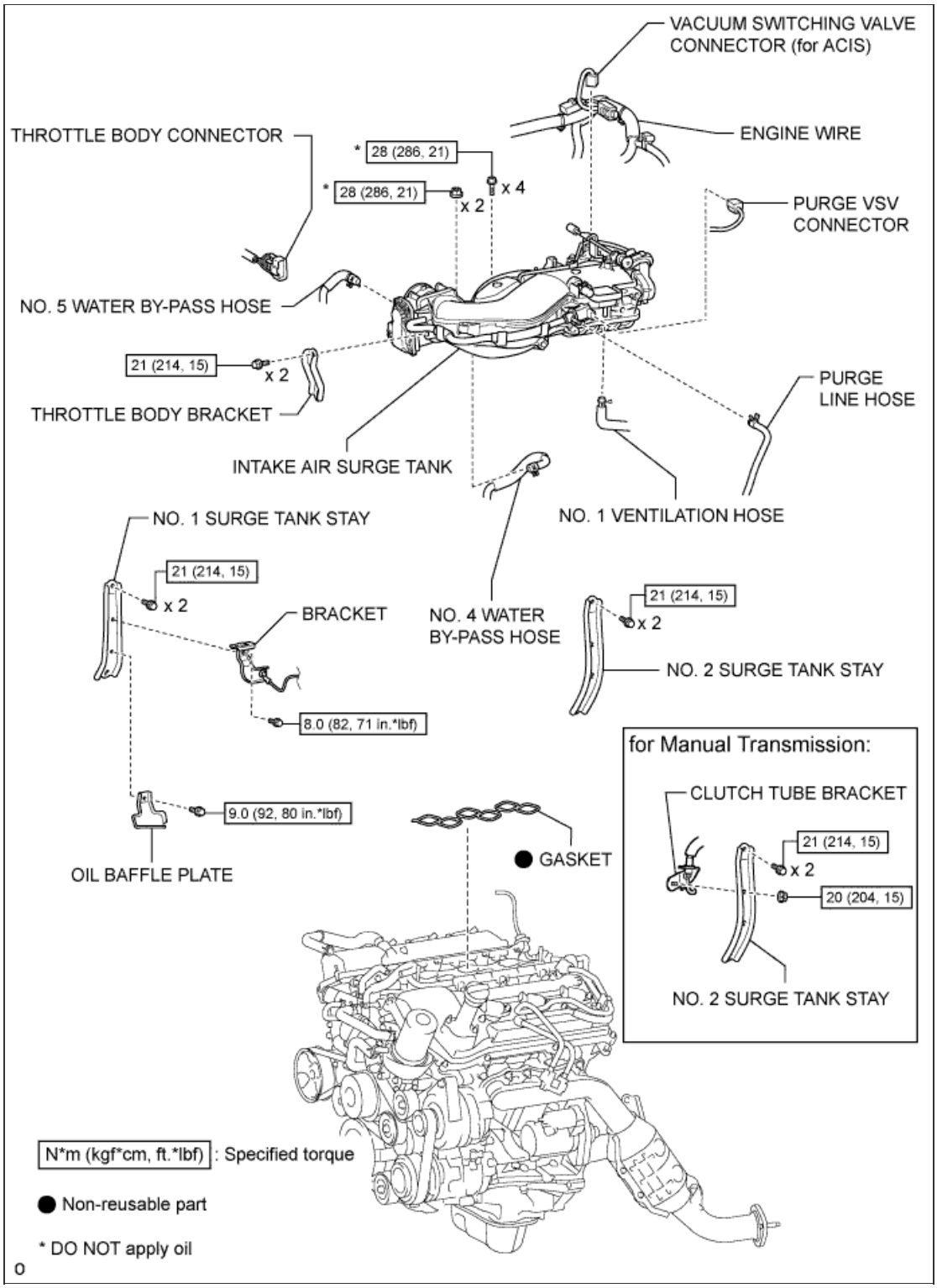
a. Check that the hoses are installed correctly.

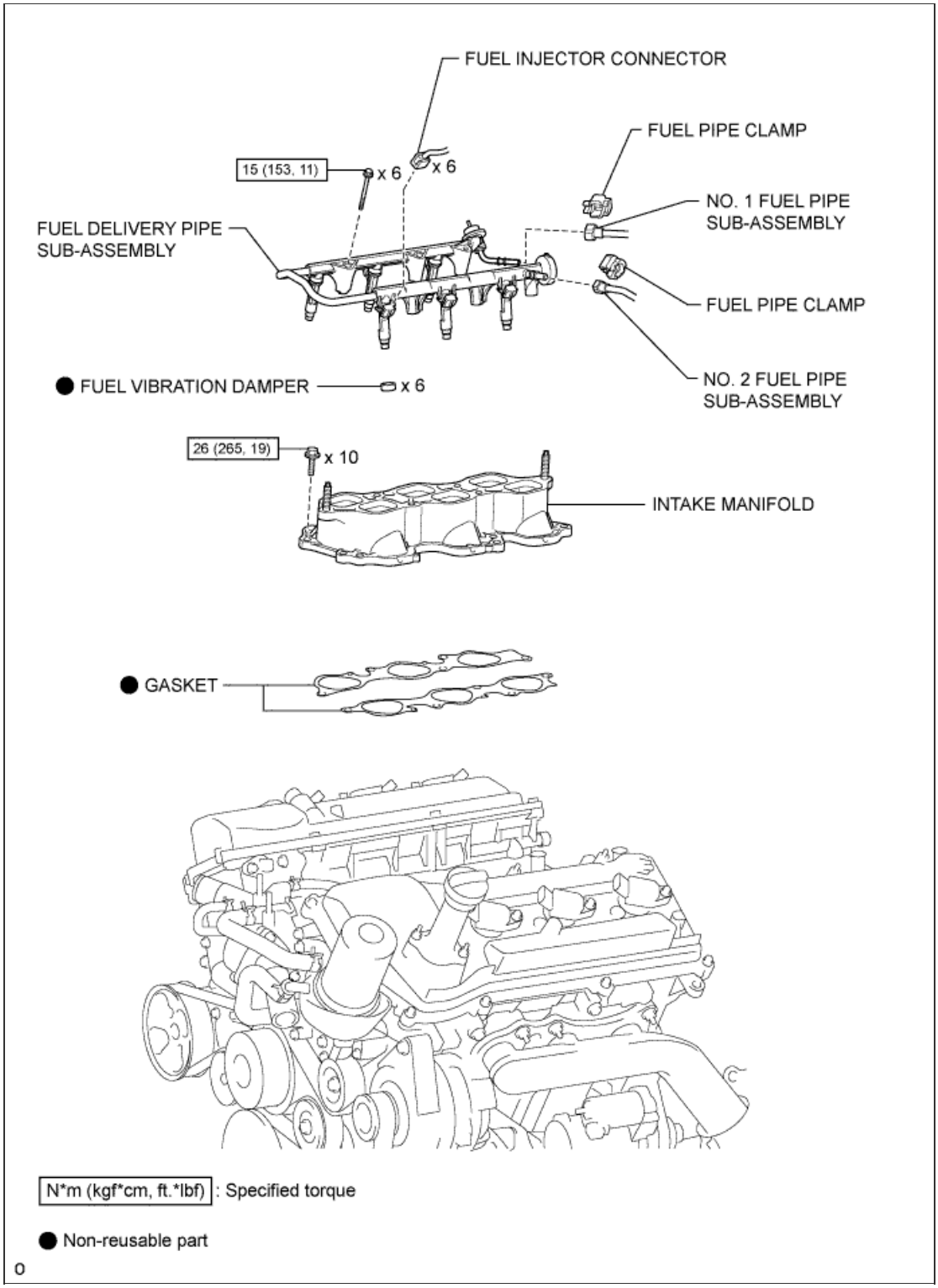
b. Check for cracks, etc. in the hoses.

for Preparation Click here




7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER
AIR CLEANER ASSEMBLY
4.0 (41, 35 in.*lbf)
HOSE CLAMP
4.0 (41, 35 in.*lbf)
HOSE CLAMP
8.0 (82, 71 in.*lbf)
x 2
NO. 2 AIR CLEANER HOSE
VACUUM HOSE
NO. 2 VENTILATION HOSE
HOSE CLAMP
MASS AIR FLOW METER CONNECTOR
N*m (kgf*cm, ft.*lbf) : Specified torque
o


VACUUM SWITCHING VALVE CONNECTOR (for ACIS)
ENGINE WIRE
THROTTLE BODY CONNECTOR
* 28 (286, 21)
* 28 (286, 21)
x 2
x 4
PURGE VSV CONNECTOR
NO. 5 WATER BY-PASS HOSE
21 (214, 15)
x 2
THROTTLE BODY BRACKET
PURGE LINE HOSE
INTAKE AIR SURGE TANK
NO. 1 VENTILATION HOSE
NO. 1 SURGE TANK STAY
21 (214, 15)
x 2
BRACKET
NO. 4 WATER BY-PASS HOSE
21 (214, 15)
x 2
NO. 2 SURGE TANK STAY
8.0 (82, 71 in.*lbf)
for Manual Transmission:
CLUTCH TUBE BRACKET
21 (214, 15)
x 2
20 (204, 15)
NO. 2 SURGE TANK STAY
9.0 (92, 80 in.*lbf)
OIL BAFFLE PLATE
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
* DO NOT apply oil



N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

o

for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

a. Discharge the fuel system pressure (Click here).

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

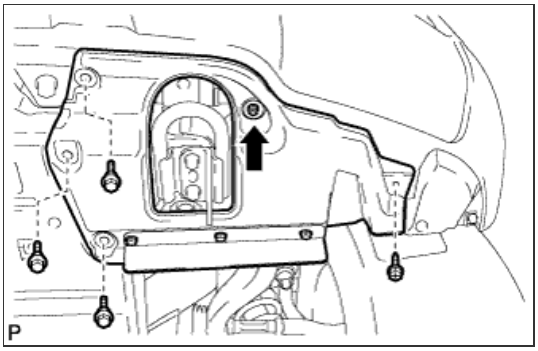
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



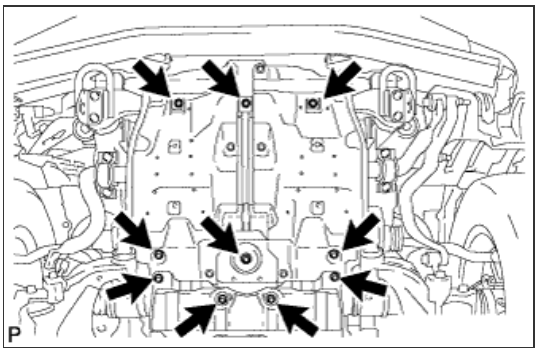
4. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

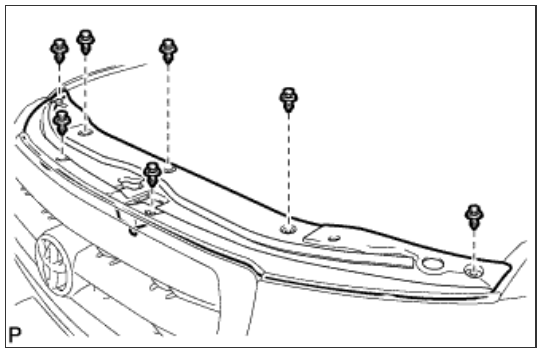
5. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



6. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and radiator support seal.



7. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug and 2 cylinder block drain cock plugs.

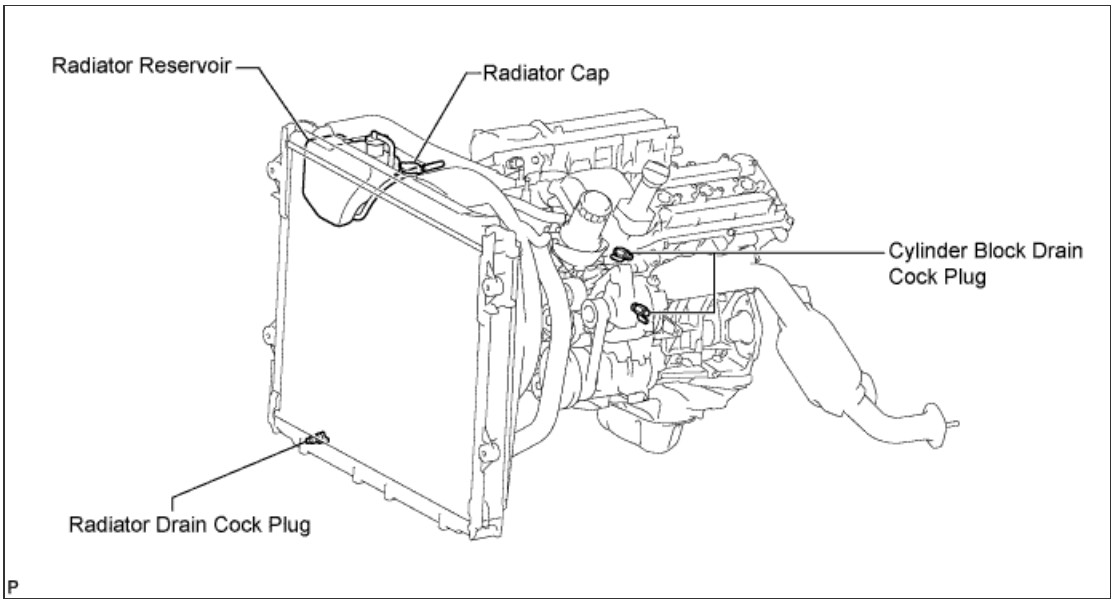
b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Tighten the 2 cylinder block drain cock plugs.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



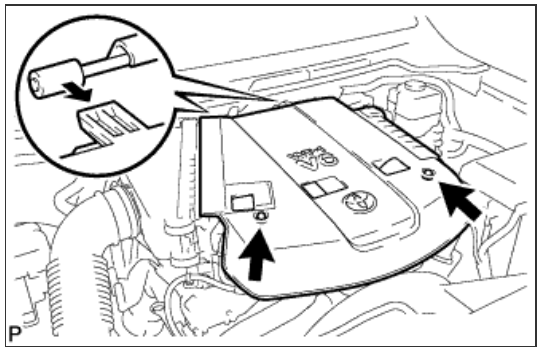
d. Tighten the radiator drain cock plug by hand.

8. REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Remove the cowl top ventilator louver (Click here).

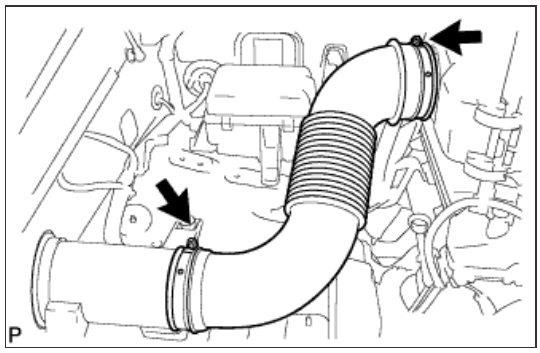
9. REMOVE V-BANK COVER

a. Remove the 2 nuts and V-bank cover.



10. REMOVE NO. 2 AIR CLEANER HOSE

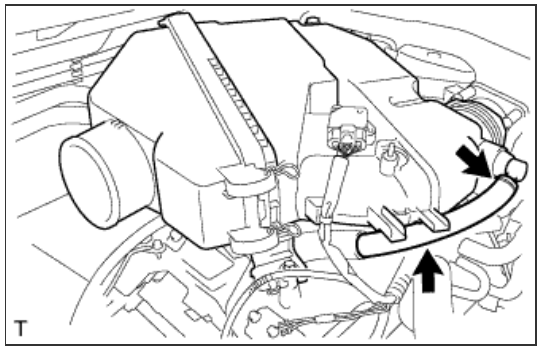
a. Loosen the 2 hose clamps and remove the air cleaner hose.



11. REMOVE AIR CLEANER ASSEMBLY

a. Disconnect the No. 2 ventilation hose.

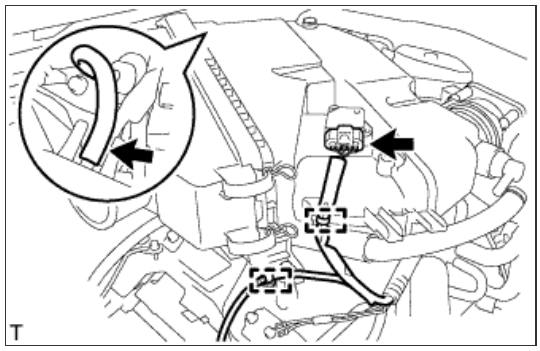
b. Detach the hose clamp.



c. Disconnect the vacuum hose.

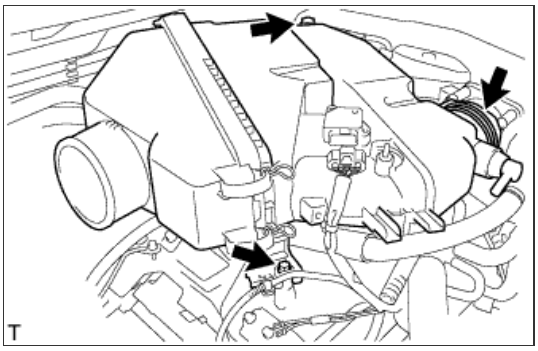
d. Disconnect the MAF meter connector.

e. Using a clip remover, detach the 2 wire harness clamps.



f. Loosen the hose clamp.

g. Remove the 2 bolts and air cleaner assembly.

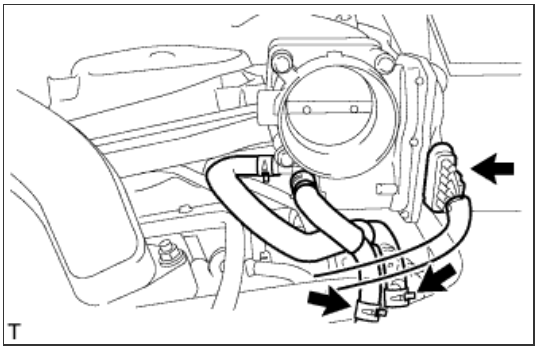


12. REMOVE INTAKE AIR SURGE TANK

a. Disconnect the throttle body connector.

b. Disconnect the No. 4 water by-pass hose.

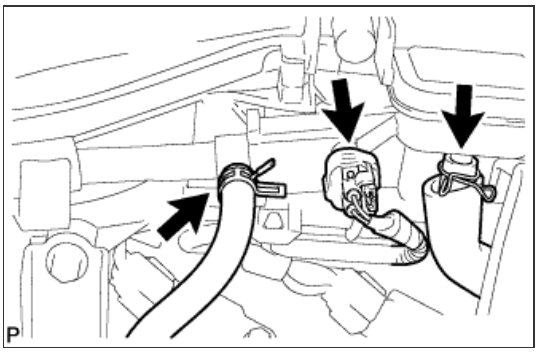
c. Disconnect the No. 5 water by-pass hose.



d. Disconnect the purge line hose.

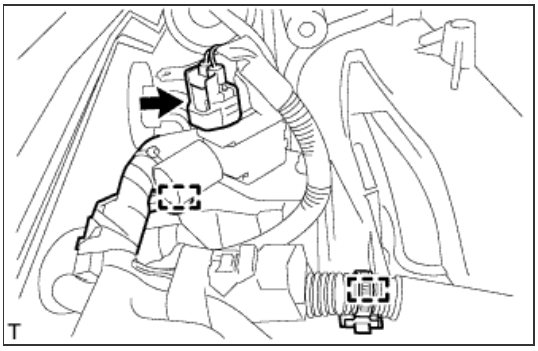
e. Disconnect the purge VSV connector.

f. Disconnect the No. 1 ventilation hose.

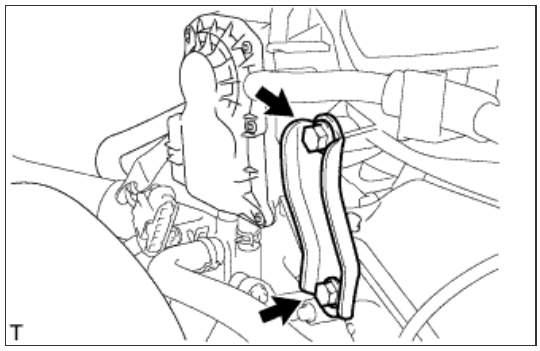


g. Disconnect the vacuum switching valve (for ACIS) connector.

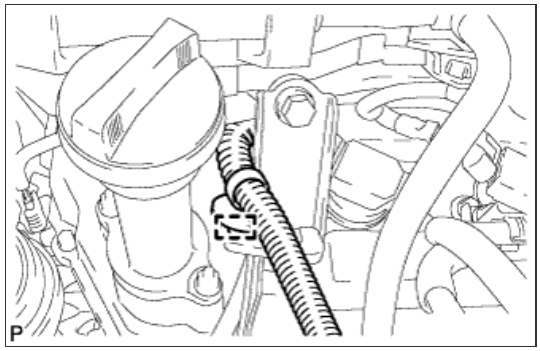
h. Using a clip remover, detach the 2 wire harness clamps.



i. Remove the 2 bolts and throttle body bracket.

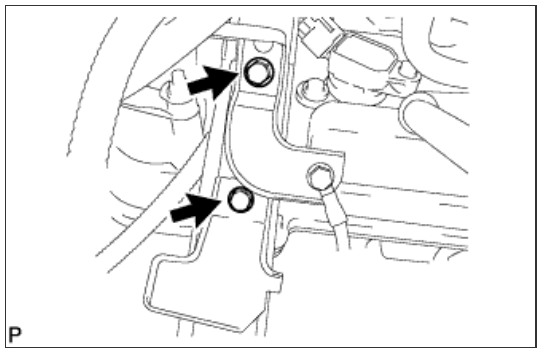


j. Using a clip remover, detach the wire harness clamp.

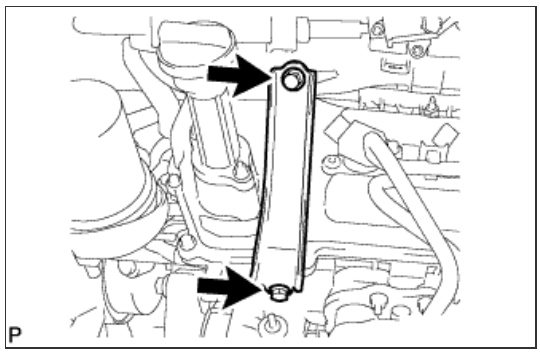


k. Remove the bolt and bracket from the No. 1 surge tank stay.

l. Remove the bolt and oil baffle plate.

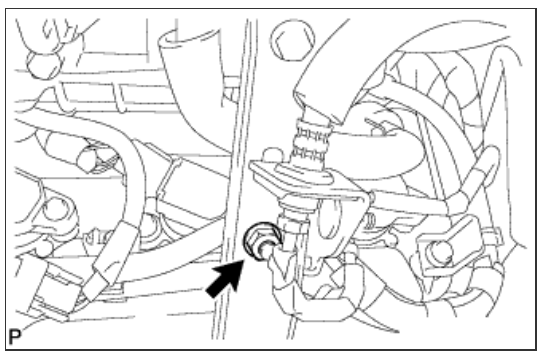


m. Remove the 2 bolts and No. 1 surge tank stay.

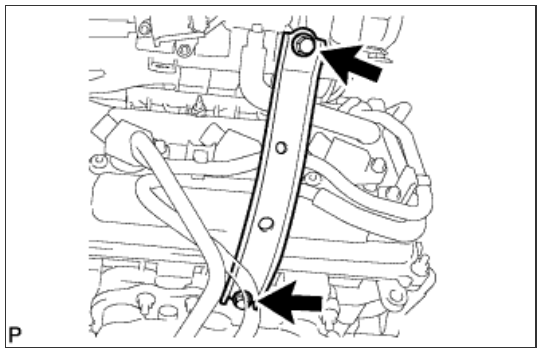


n. for Manual Transmission:

i. Remove the nut.

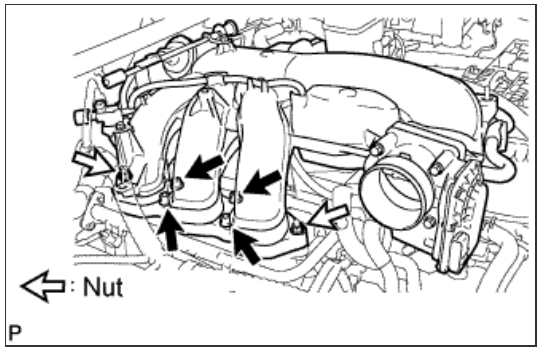


o. Remove the 2 bolts and No. 2 surge tank stay.



p. Remove the 2 nuts.

q. Using an 8 mm hexagon wrench, remove the 4 bolts. Then remove the intake air surge tank and gasket.



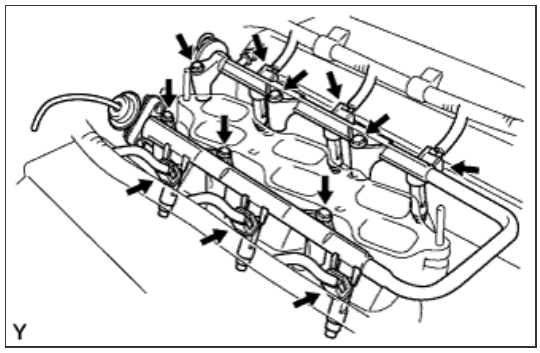
13. REMOVE FUEL DELIVERY PIPE SUB-ASSEMBLY

a. Disconnect the 6 fuel injector connectors.

b. Remove the 6 bolts and fuel delivery pipe together with the 6 fuel injectors.

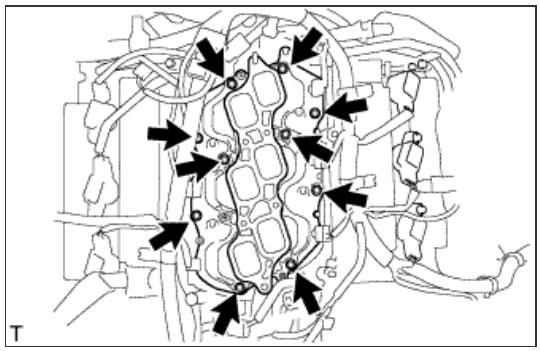
NOTICE:

Be careful not to drop the injectors when removing the fuel delivery pipe.



14. REMOVE INTAKE MANIFOLD

a. Remove the 10 bolts, intake manifold and 2 gaskets.



for Preparation Click here

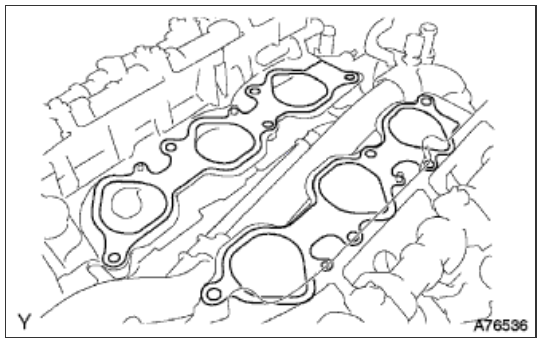
1. INSTALL INTAKE MANIFOLD

a. Set a new gasket on each cylinder head.

NOTICE:

- **Align the port holes of the gasket and cylinder head.**
- **Be careful of the installation direction.**

b. Set the intake manifold on the cylinder heads.

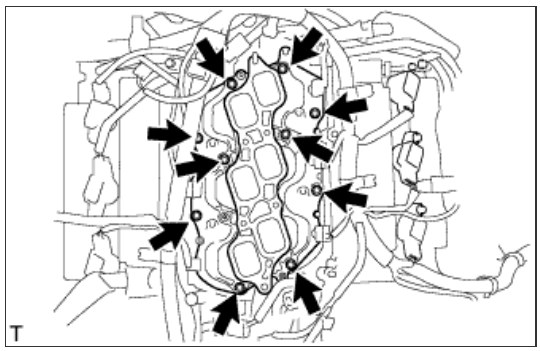


c. Install and uniformly tighten the 10 bolts in several passes.

Torque:
26 N*m{ 265 kgf*cm , 19 ft.*lbf }

HINT:

Tighten the inner installation bolts of the intake manifold before tightening the outer bolts.



2. INSTALL FUEL DELIVERY PIPE SUB-ASSEMBLY

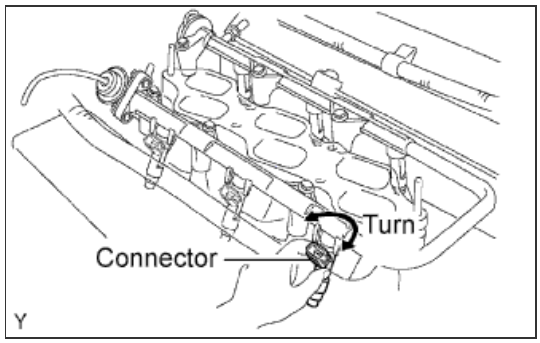
a. Place the fuel delivery pipe together with the 6 fuel injectors on the intake manifold.

b. Temporarily install the 6 bolts, which are used to hold the fuel delivery pipe, to the intake manifold.

c. Check that the fuel injectors rotate smoothly.

HINT:

If the fuel injectors do not rotate smoothly, replace the O-ring of any injector that does not rotate smoothly.



d. Position the fuel injector connectors facing outward.

e. Tighten the 6 bolts, which are used to hold the fuel delivery pipe, to the intake manifold.

Torque:
15 N*m{ 153 kgf*cm , 11 ft.*lbf }

f. Connect the 6 fuel injector connectors.

3. INSTALL INTAKE AIR SURGE TANK

NOTICE:
Do not apply oil to the bolts and nuts listed below: :

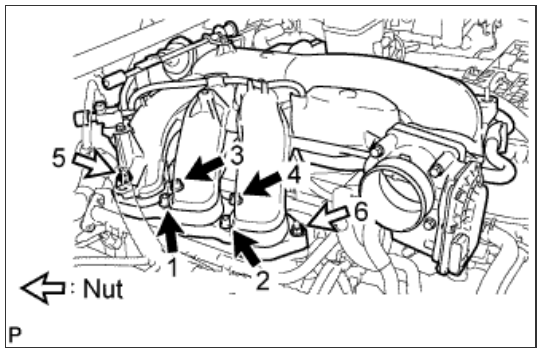
Oil Application Prohibited Bolt/Nut

Bolt for surge tank and intake manifold
Nut for surge tank and intake manifold

a. Install a new gasket to the intake air surge tank.

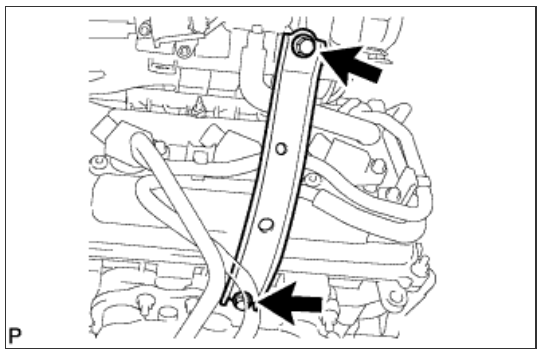
b. Using an 8 mm hexagon wrench, install the intake air surge tank with the 4 bolts and 2 nuts in the order shown in the illustration.

Torque:
28 N*m{ 286 kgf*cm , 21 ft.*lbf }



c. Install the No. 2 surge tank stay with the 2 bolts.

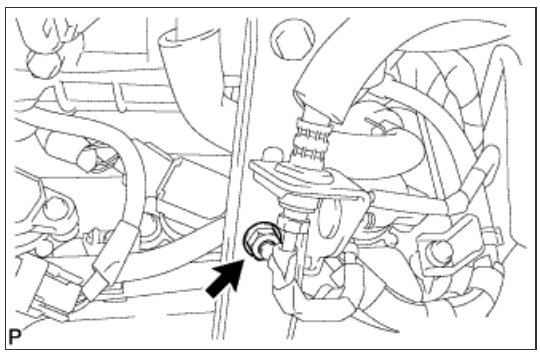
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



d. for Manual Transmission:

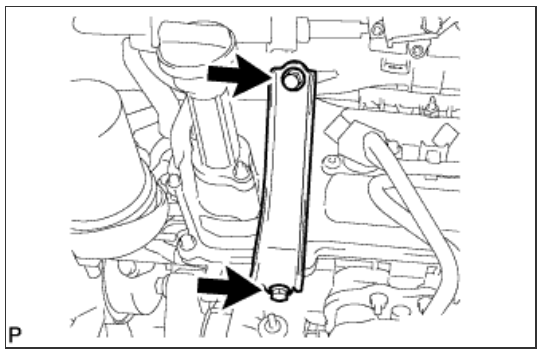
i. Install the bracket to the No. 2 surge tank stay with the nut.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }



e. Install the No. 1 surge tank stay with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



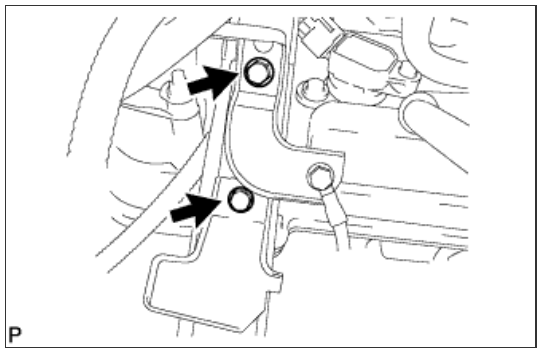
f. Install the oil baffle plate with the bolt.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }

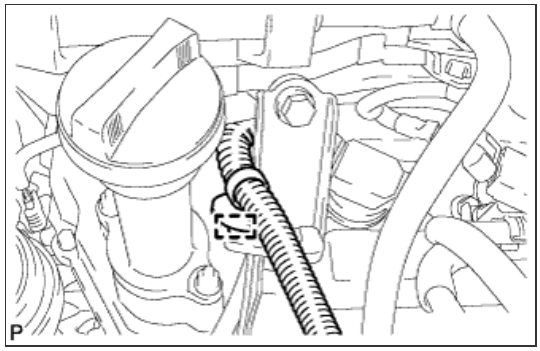
g. Install the bracket to the No. 1 surge tank stay with the bolt.

Torque:

8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

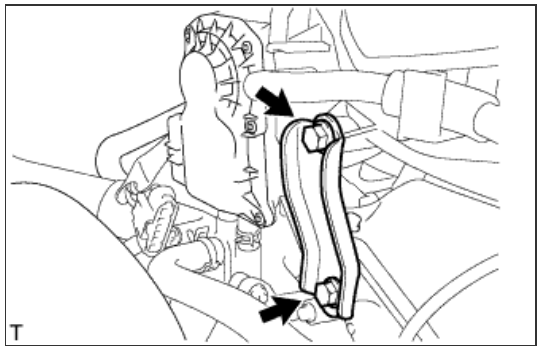


h. Attach the wire harness clamp.



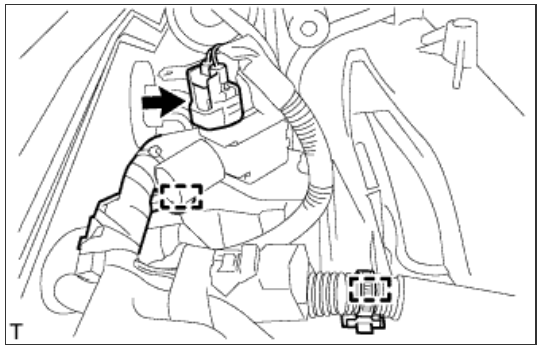
i. Install the throttle body bracket with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



j. Connect the vacuum switching valve (for ACIS) connector.

k. Attach the 2 wire harness clamps.



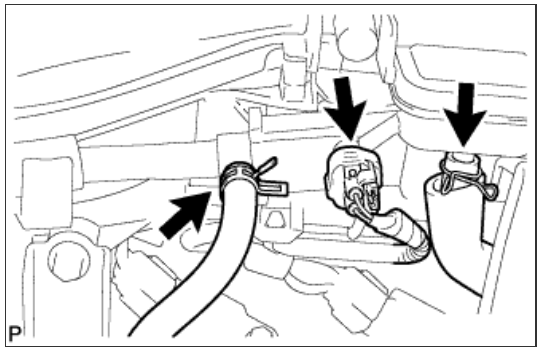
l. Connect the No. 1 ventilation hose.

m. Connect the purge VSV connector.

n. Connect the purge line hose.

HINT:

Connect the hose so that the direction of the hose clamp is as indicated in the illustration.

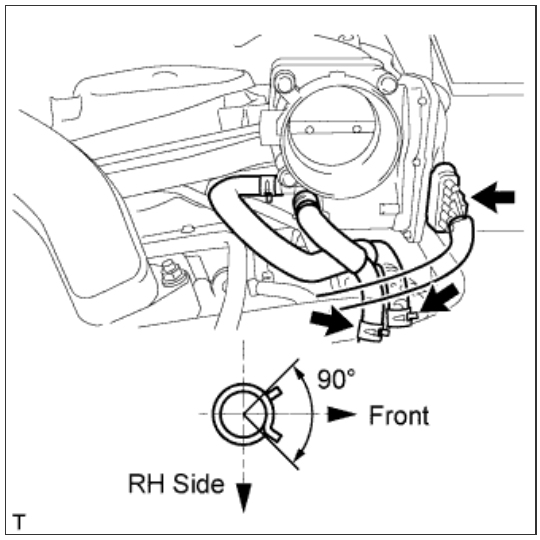


o. Connect the No. 4 and No. 5 water by-pass hose.

HINT:

Connect the hoses so that the direction of the hose clamps is as shown in the illustration.

p. Connect the throttle body connector.



4. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner assembly with the 2 bolts.

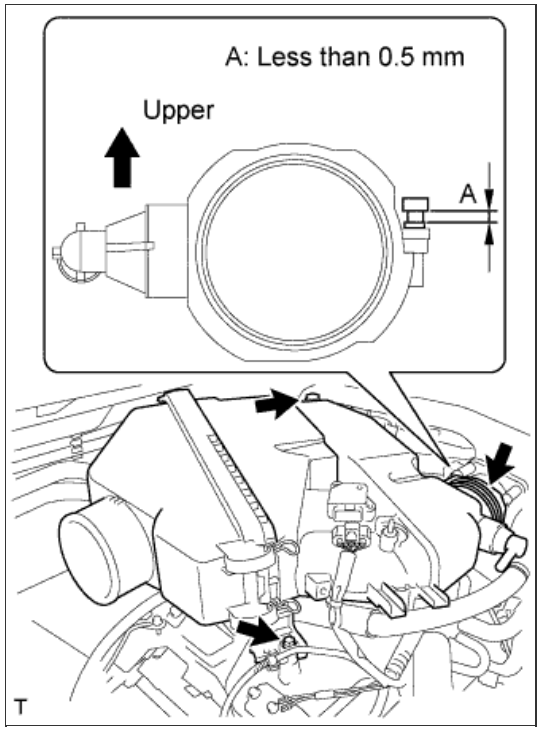
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

b. Tighten the hose clamp.

HINT:

Tighten the hose clamp until it reaches the specified protrusion height labeled A shown in the illustration.

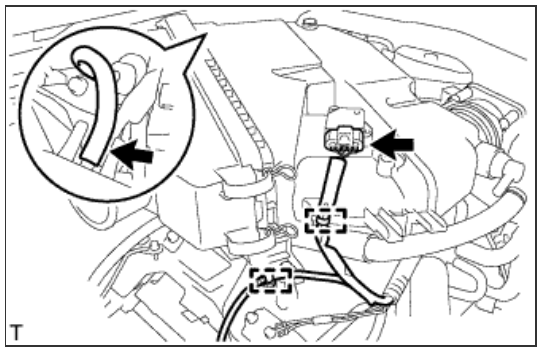
Standard protrusion height:
Less than 0.5 mm (0.0197 in.)



c. Connect the MAF meter connector.

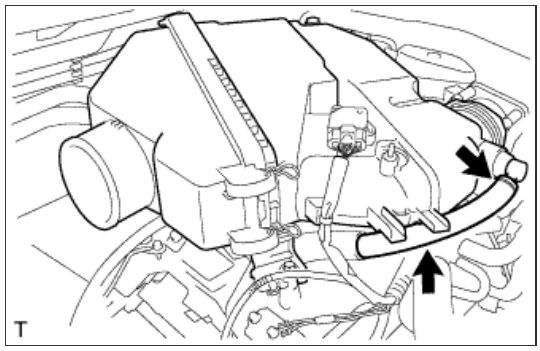
d. Attach the 2 wire harness clamps.

e. Connect the vacuum hose.



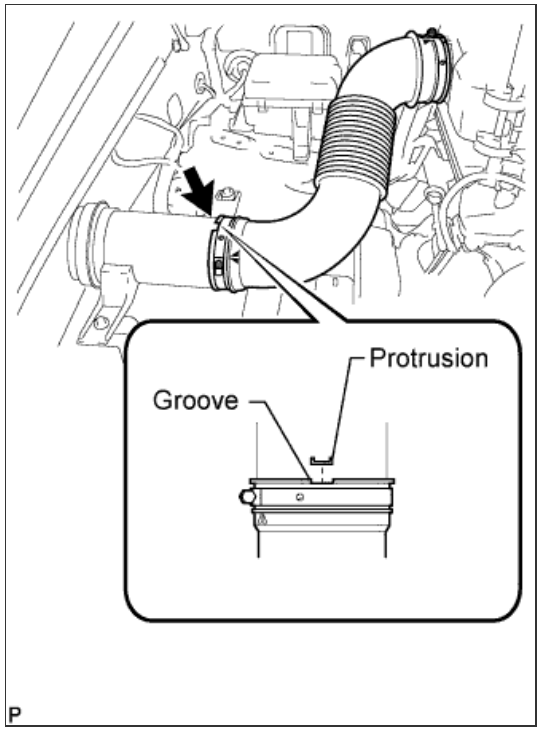
f. Attach the hose clamp.

g. Connect the No. 2 ventilation hose.



5. INSTALL NO. 2 AIR CLEANER HOSE

a. Align the protrusion of the pre-cleaner with the groove of the No. 2 air cleaner hose as shown in the illustration.

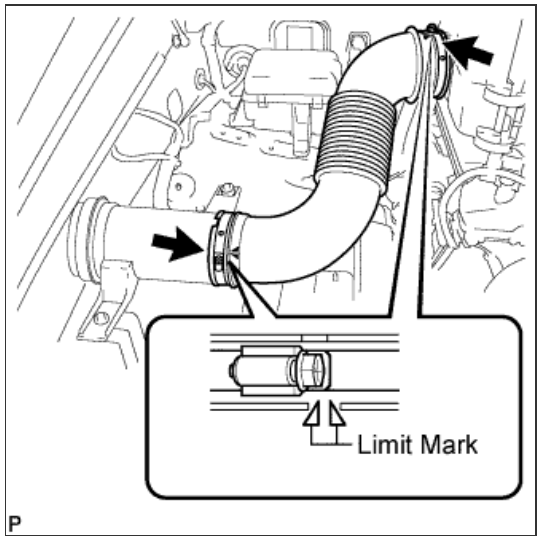


b. Tighten the 2 hose clamps.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }

HINT:

Tighten the clamp until the end of the clamp band is within both limit marks.



6. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

7. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item		Specified condition
for Automatic transmission	w/o Rear Heater	11.2 liters (11.8 US qts, 9.9 Imp. qts)
	w/ Rear Heater	14.4 liters (15.2 US qts, 12.7 Imp. qts)
for Manual transmission	w/o Rear Heater	12.0 liters (12.7 US qts, 10.6 Imp. qts)
	w/ Rear Heater	14.6 liters (15.4 US qts, 12.8 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

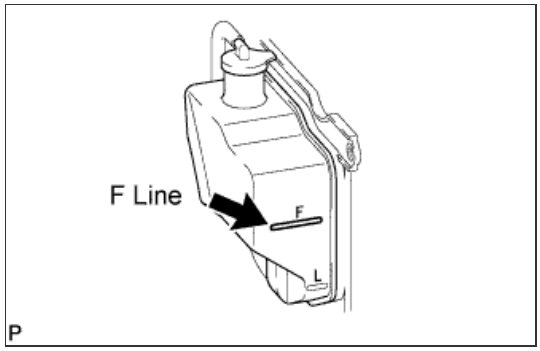
TO OTA vehicles are filled with TO OTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TO OTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.



f. Set the air conditioning as follows while warming up the engine.

Item	Condition
Fan speed	Any setting except off
Temperature	Toward WARM
Air conditioning switch	Off

g. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

h. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

i. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

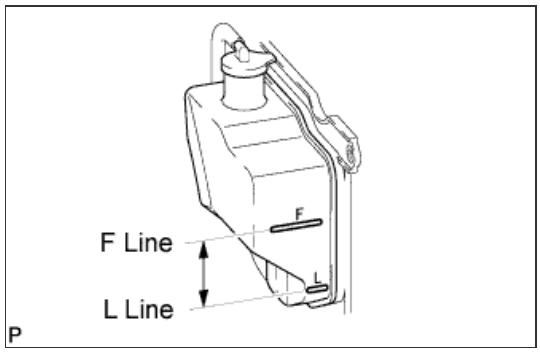
- **Wear protective gloves. Heat areas on the parts may injure your hands.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the fan.**

j. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

k. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.



8. INSPECT FOR COOLANT LEAK

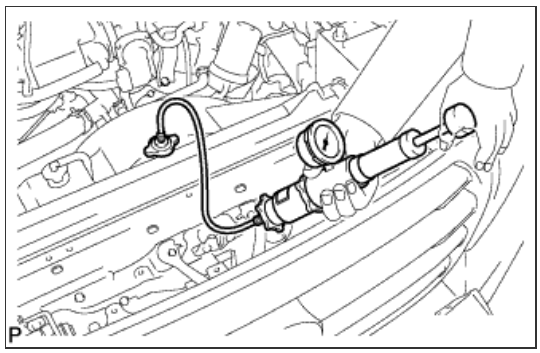
CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 12 kPa (1. kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



9. INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the DLC .

b. Turn the ignition switch to ON.

NOTICE:

Do not start the engine.

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the Fuel Pump Speed Control.

e. Check fuel pump operation.

i. Check for pressure in the fuel inlet tube from the fuel line. Check that the sound of fuel flowing in the fuel tank can be heard.
If there is no sound, check the integration relay, fuel pump, ECM and wiring connector.

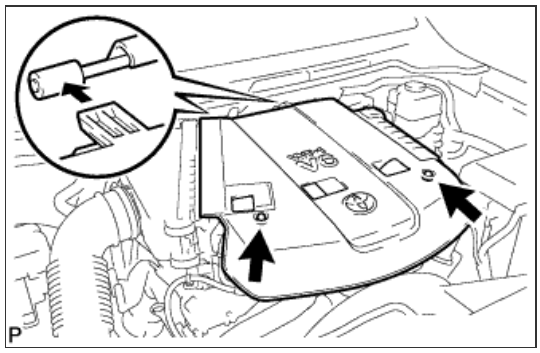
f. Check for fuel leak.

i. Check that there are no fuel leaks after performing maintenance anywhere on the system.
If there are fuel leaks, repair or replace parts as necessary.

10. INSTALL V-BANK COVER

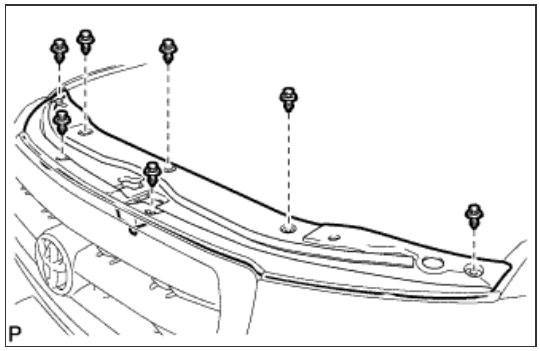
a. Install the V-bank cover with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



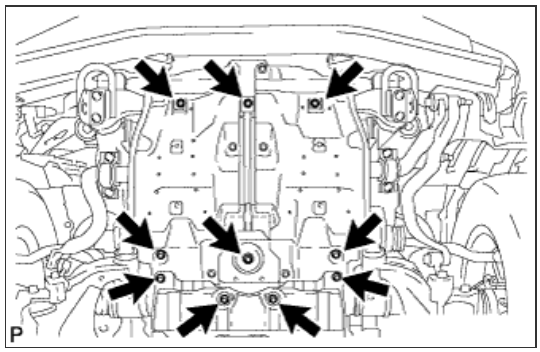
11. INSTALL UPPER RADIATOR SUPPORT SEAL

a. Install the radiator support seal with the 7 clips.



12. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

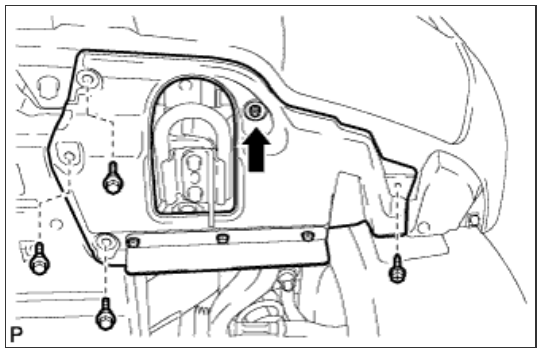
a. Install the under cover with the 10 bolts.



13. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the bolts and screw.



14. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

15. INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

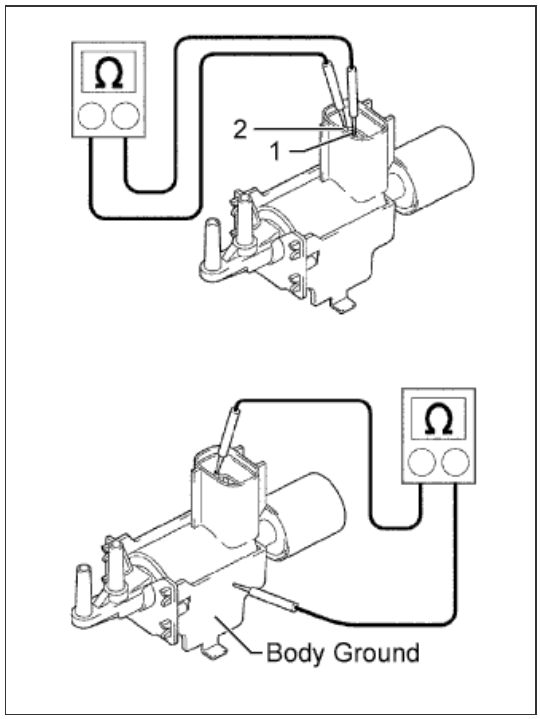
a. Install the cowl top ventilator louver (Click here).

for Preparation Click here

1. INSPECT VACUUM SWITCHING VALVE ASSEMBLY (for ACIS)

a. Disconnect the VSV connector.

b. Measure the resistance according to the value(s) in the table below.



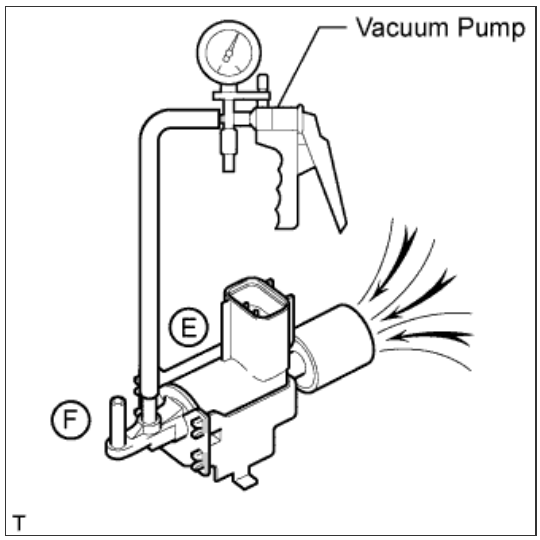
Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	37 to 44 Ω
1 - Body ground	Always	1 MΩ or higher
2 - Body ground		

If the result is not as specified, replace the vacuum switching valve assembly.

c. Check the VSV operation.

i. When applying vacuum to port E, check that air is sucked into the filter.



ii. Apply battery voltage to the connector, and check the VSV operation.

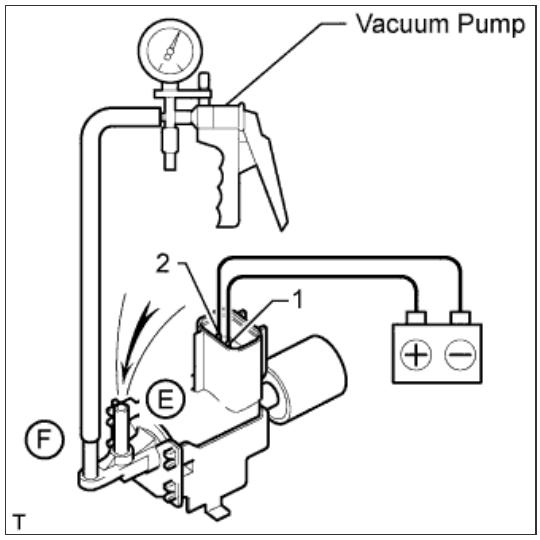
OK:

Measurement Condition	Specified Condition
Battery positive (+) →	When applying vacuum

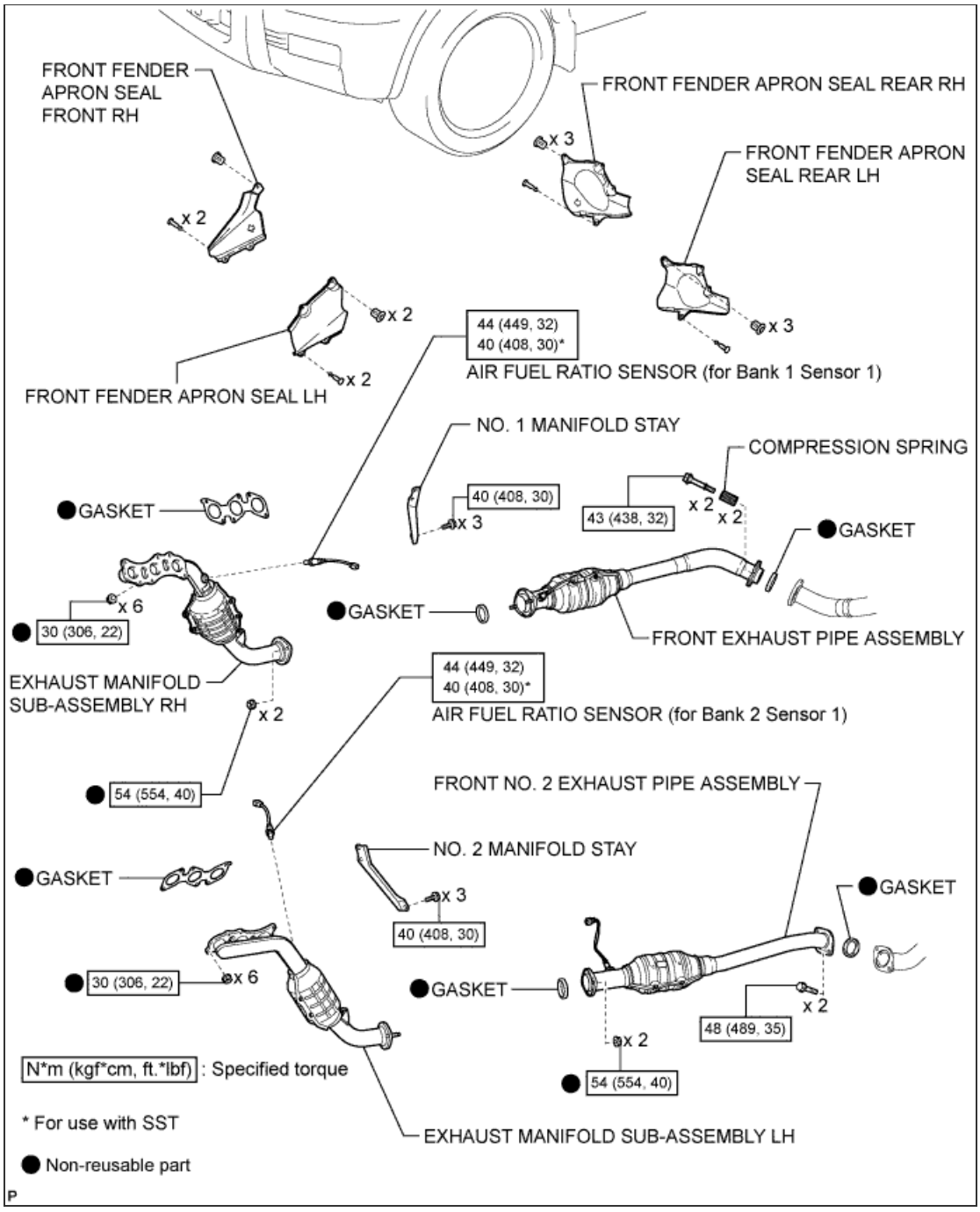
Terminal 1 Battery negative (-) → Terminal 2	to port F, check that air is sucked into port E

If the result is not as specified, replace the vacuum switching valve assembly.

d. Connect the VSV connector.



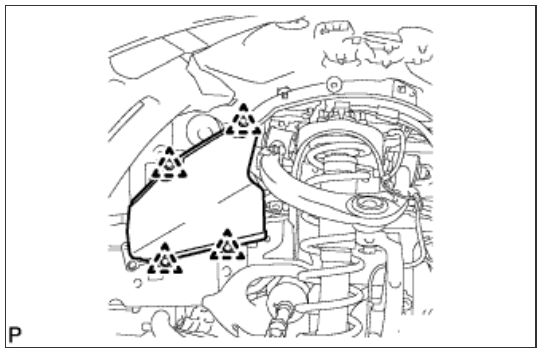
for Preparation Click here



for Preparation Click here

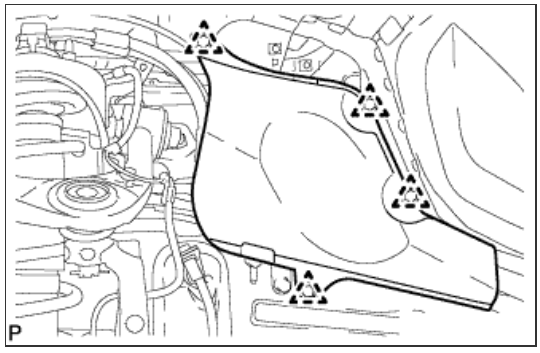
1. REMOVE FRONT FENDER APRON SEAL LH

a. Using a clip remover, remove the 4 clips and fender apron seal.



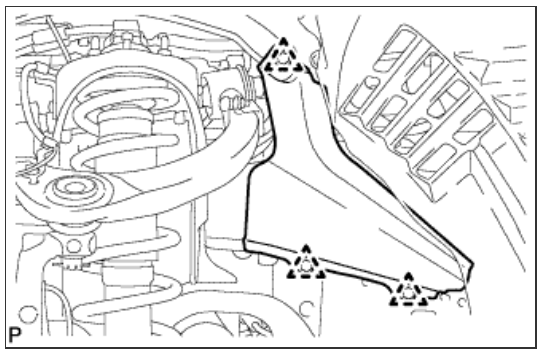
2. REMOVE FRONT FENDER APRON SEAL REAR LH

a. Using a clip remover, remove the 4 clips and fender apron seal.



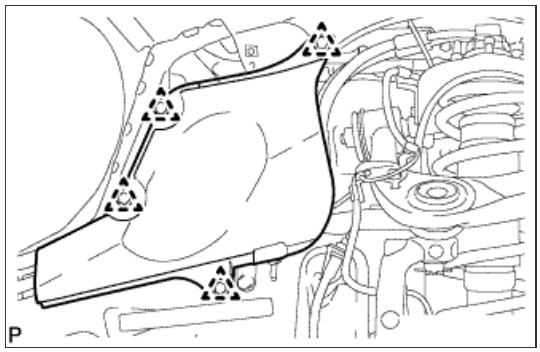
3. REMOVE FRONT FENDER APRON SEAL FRONT RH

a. Using a clip remover, remove the 3 clips and fender apron seal.



4. REMOVE FRONT FENDER APRON SEAL REAR RH

a. Using a clip remover, remove the 4 clips and fender apron seal.



5. REMOVE FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Disconnect the heated oxygen sensor connector.

b. Remove the 2 bolts from the center exhaust pipe.

c. Remove the 2 bolts, 2 nuts and front No. 2 exhaust pipe.

d. Remove the 2 gaskets from the front No. 2 exhaust pipe.

6. REMOVE FRONT EXHAUST PIPE ASSEMBLY

a. Disconnect the heated oxygen sensor connector.

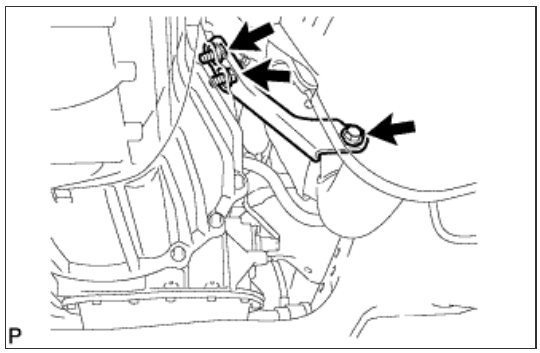
b. Remove the 2 bolts with the 2 compression springs from the center exhaust pipe.

c. Remove the 2 nuts and front exhaust pipe.

d. Remove the 2 gaskets from the front exhaust pipe.

7. REMOVE NO. 1 MANIFOLD STAY

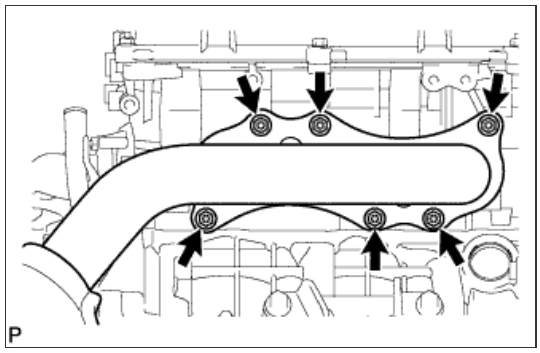
a. Remove the 3 bolts and No. 1 manifold stay.



8. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY RH

a. Disconnect the air fuel ratio sensor connector.

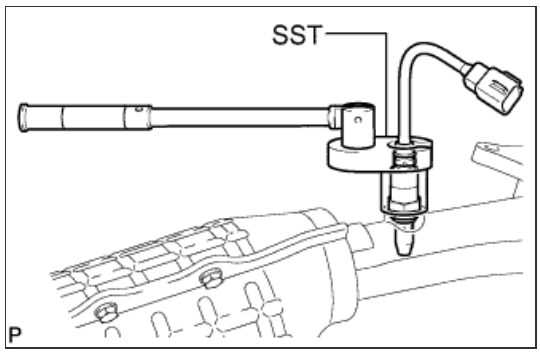
b. Remove the 6 nuts, exhaust manifold and gasket from the cylinder head RH.



9. REMOVE AIR FUEL RATIO SENSOR (for Bank 1 Sensor 1)

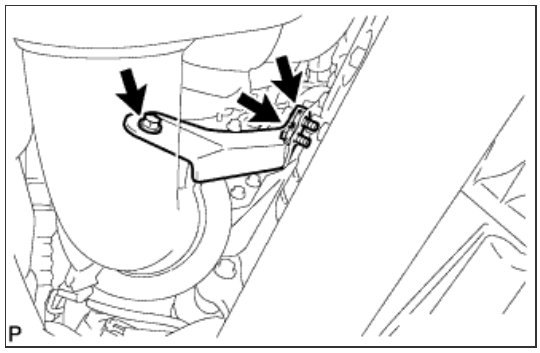
a. Using SST, remove the sensor.

SST
09224-00010



10. REMOVE NO. 2 MANIFOLD STAY

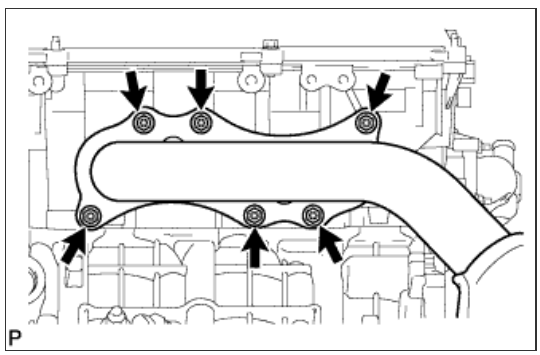
a. Remove the 3 bolts and No. 2 manifold stay.



11. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY LH

a. Disconnect the air fuel ratio sensor connector.

b. Remove the 6 nuts, exhaust manifold and gasket from the cylinder head LH.

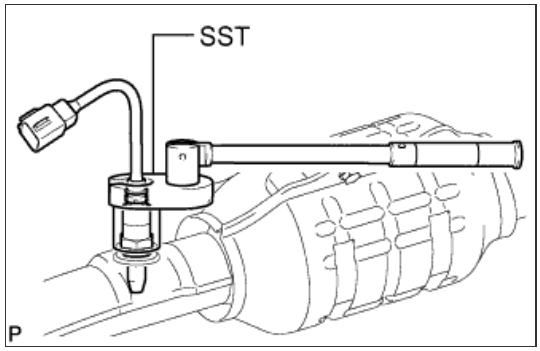


12. REMOVE AIR FUEL RATIO SENSOR (for Bank 2 Sensor 1)

a. Using SST, remove the sensor.

SST

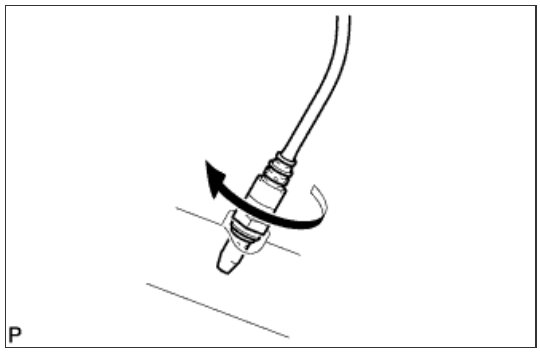
09224-00010



for Preparation Click here

1. INSTALL AIR FUEL RATIO SENSOR (for Bank 2 Sensor 1)

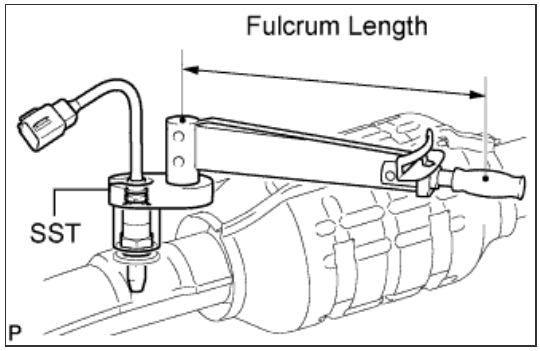
a. Temporarily install the sensor to the exhaust manifold by hand.



b. Using SST, tighten the sensor.

SST
09224-00010

Torque:
without SST:
44 N*m{ 449 kgf*cm , 32 ft.*lbf }
with SST:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }



HINT:

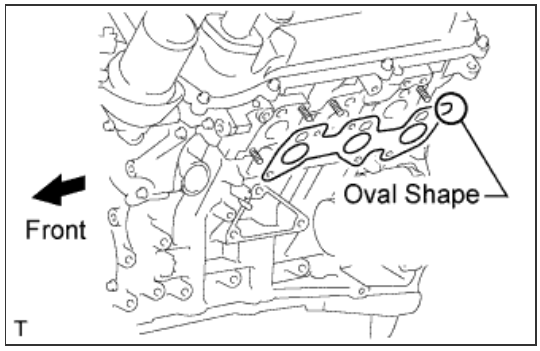
- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.). If using a torque wrench with a length that is not 30 cm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the "without SST" torque specification (Click here).**
- **Make sure SST and the wrench are connected in a straight line.**

2. INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY LH

a. Set a new gasket to the cylinder head LH with the oval shape facing rearward.

NOTICE:

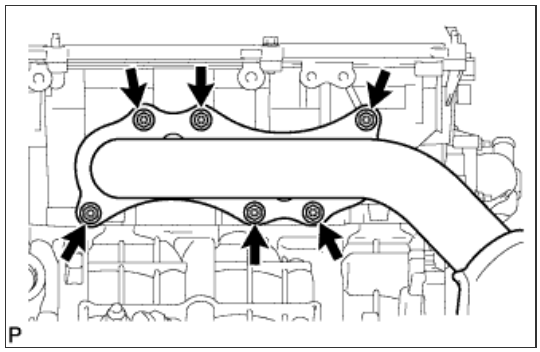
Be careful of the installation direction.



b. Install the exhaust manifold with 6 new nuts.

Torque:
30 N*m{ 306 kgf*cm , 22 ft.*lbf }

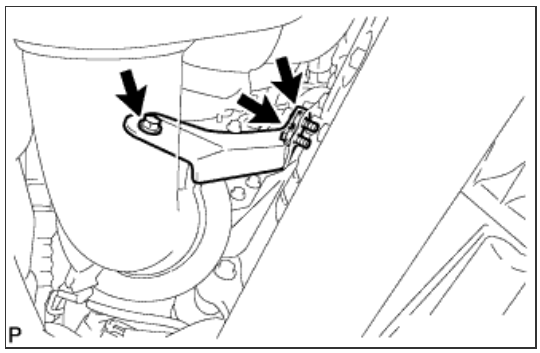
c. Connect the air fuel ratio sensor connector.



3. INSTALL NO. 2 MANIFOLD STAY

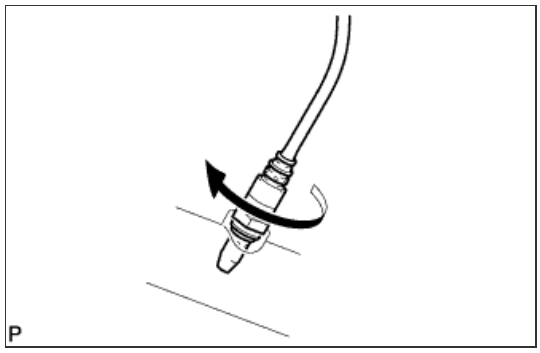
a. Install the No. 2 manifold stay with the 3 bolts.

Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }



4. INSTALL AIR FUEL RATIO SENSOR (for Bank 1 Sensor 1)

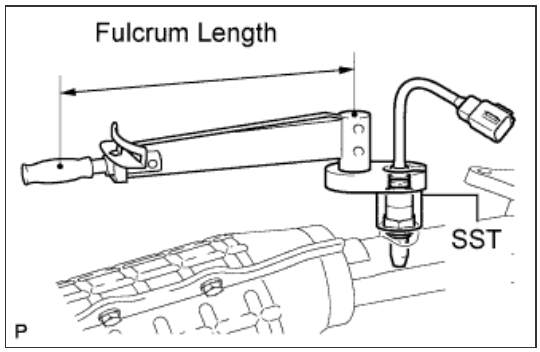
a. Temporarily install the sensor to the exhaust manifold by hand.



b. Using SST, tighten the sensor.

SST
09224-00010

Torque:
without SST:
44 N*m{ 449 kgf*cm , 32 ft.*lbf }
with SST:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }



HINT:

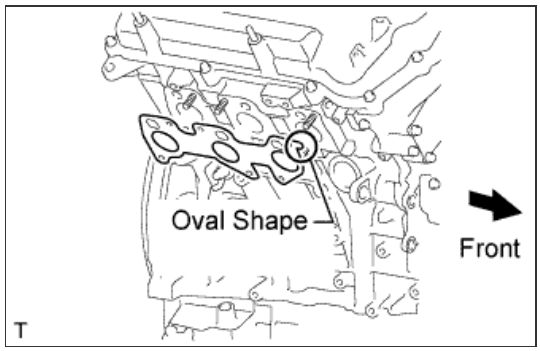
- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.). If using a torque wrench with a length that is not 30 cm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the "without SST" torque specification (Click here).**
- **Make sure SST and the wrench are connected in a straight line.**

5. INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY RH

a. Set a new gasket to the cylinder head RH with the oval shape facing forward.

NOTICE:

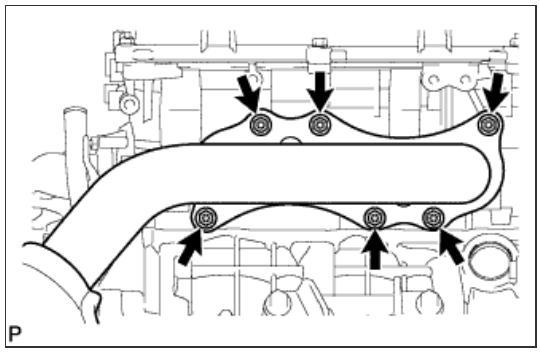
Be careful of the installation direction.



b. Install the exhaust manifold with 6 new nuts.

Torque:
30 N*m{ 306 kgf*cm , 22 ft.*lbf }

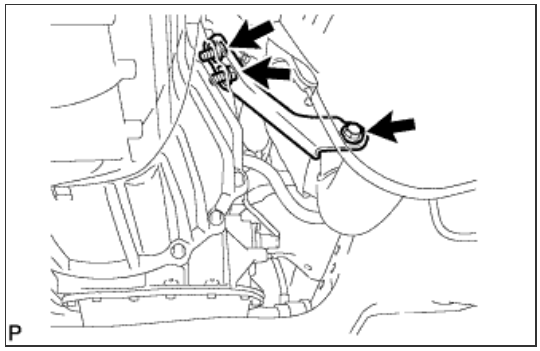
c. Connect the air fuel ratio sensor connector.



6. INSTALL NO. 1 MANIFOLD STAY

a. Install the No. 1 manifold stay with the 3 bolts.

Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }



7. INSTALL FRONT EXHAUST PIPE ASSEMBLY

a. Install 2 new gaskets to the front exhaust pipe.

b. Install the front exhaust pipe to the exhaust manifold RH with 2 new nuts.

Torque:
54 N*m{ 554 kgf*cm , 40 ft.*lbf }

c. Install the 2 compression springs and 2 bolts to the center exhaust pipe.

Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }

d. Connect the heated oxygen sensor connector.

8. INSTALL FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Install 2 new gaskets to the front No. 2 exhaust pipe.

b. Install the front No. 2 exhaust pipe to the exhaust manifold LH with 2 new nuts.

Torque:

54 N*m{ 554 kgf*cm , 40 ft.*lbf }

c. Install the 2 bolts to the center exhaust pipe.

Torque:
48 N*m{ 489 kgf*cm , 35 ft.*lbf }

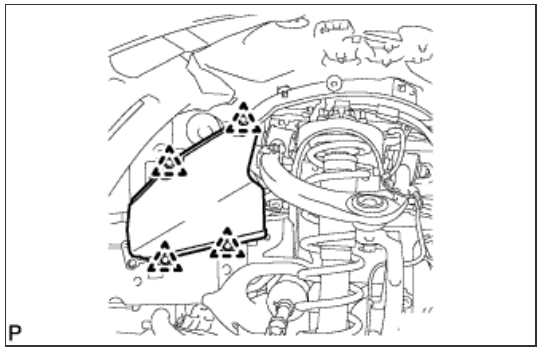
d. Connect the heated oxygen sensor connector.

9. INSPECT FOR EXHAUST GAS LEAK

If gas is leaking, tighten the areas necessary to stop the leak. Replace damaged parts as necessary.

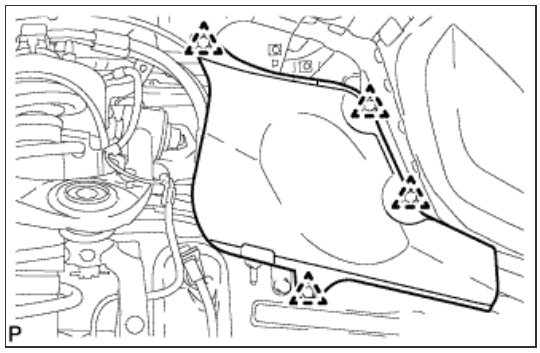
10. INSTALL FRONT FENDER APRON SEAL LH

a. Install the fender apron seal with the 4 clips.



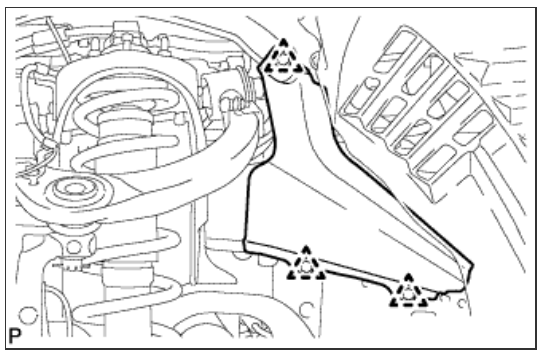
11. INSTALL FRONT FENDER APRON SEAL REAR LH

a. Install the fender apron seal with the 4 clips.



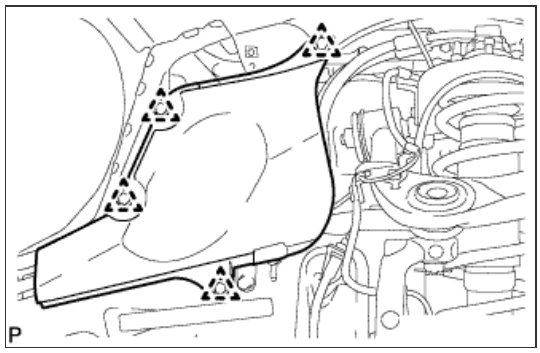
12. INSTALL FRONT FENDER APRON SEAL FRONT RH

a. Install the fender apron seal with the 3 clips.

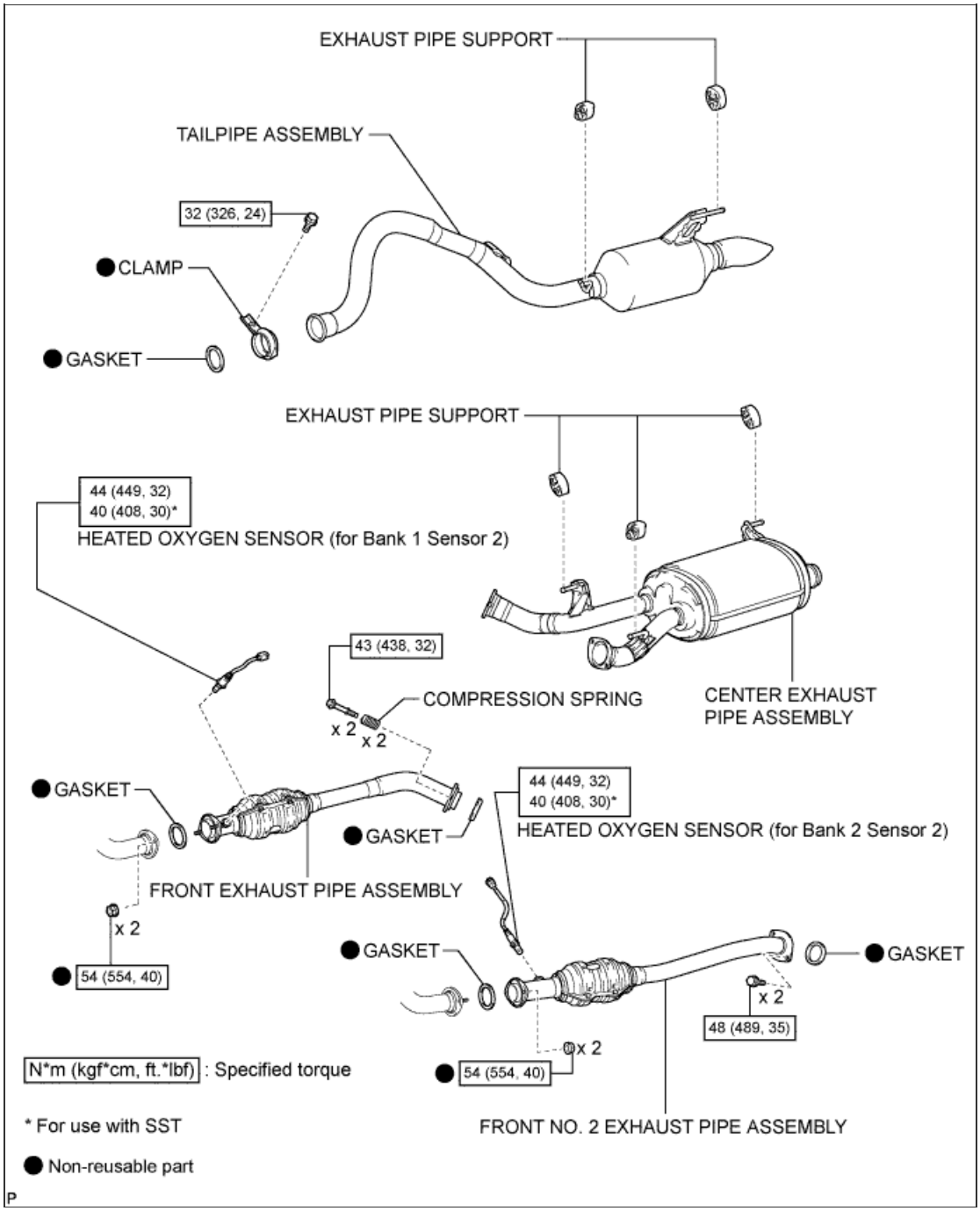


13. INSTALL FRONT FENDER APRON SEAL REAR RH

a. Install the fender apron seal with the 4 clips.



for Preparation Click here



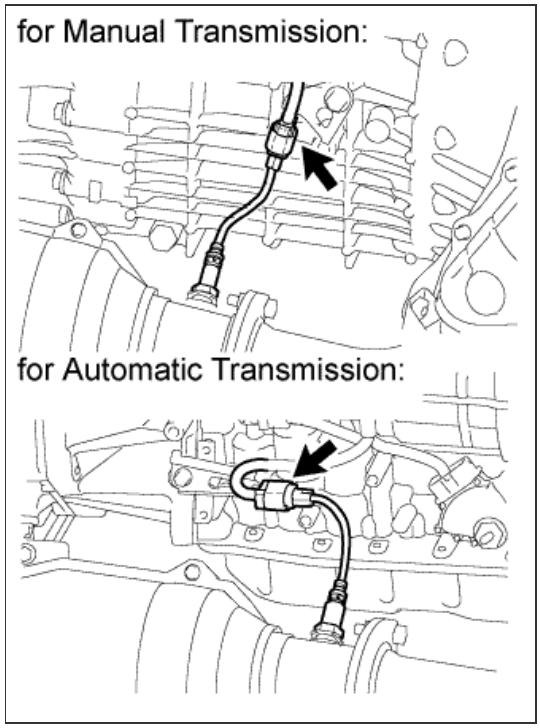
for Preparation Click here

CAUTION:

- **Wear protective gloves when removing the exhaust pipe.**
- **The exhaust pipe is extremely hot immediately after the engine has stopped.**
- **Confirm that the exhaust pipe has cooled down before removing it.**

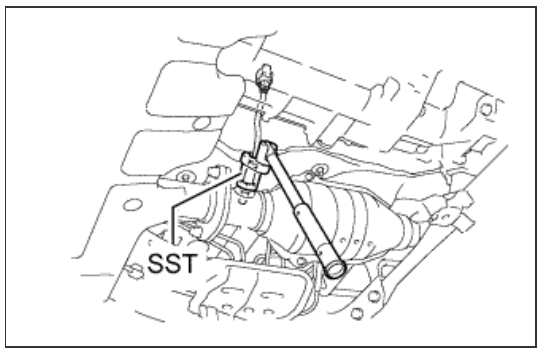
1. REMOVE HEATED OXYGEN SENSOR (for Bank 1 Sensor 2)

a. Disconnect the sensor connector.



b. Using SST, remove the sensor.

SST
09224-00010



2. REMOVE TAILPIPE ASSEMBLY

a. Remove the bolt, clamp and gasket.

b. Remove the tailpipe from the 2 exhaust pipe supports.

3. REMOVE CENTER EXHAUST PIPE ASSEMBLY

a. Remove the 4 bolts and 2 compression springs.

b. Remove the center exhaust pipe from the 3 exhaust pipe supports.

c. Remove the 2 gaskets from the front exhaust pipe and front No. 2 exhaust pipe.

4. REMOVE FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Disconnect the heated oxygen sensor connector.

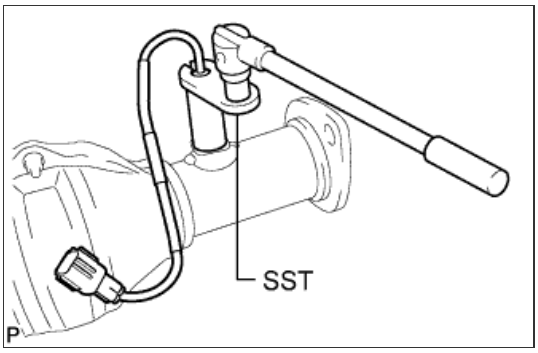
b. Remove the 2 nuts and front exhaust pipe.

c. Remove the gasket from the front exhaust pipe.

5. REMOVE HEATED OXYGEN SENSOR (for Bank 2 Sensor 2)

a. Using SST, remove the sensor.

SST
09224-00010



6. REMOVE FRONT EXHAUST PIPE ASSEMBLY

a. Disconnect the heated oxygen sensor connector.

b. Remove the 2 nuts and front exhaust pipe.

c. Remove the gasket from the front exhaust pipe.

for Preparation Click here

1. INSTALL FRONT EXHAUST PIPE ASSEMBLY

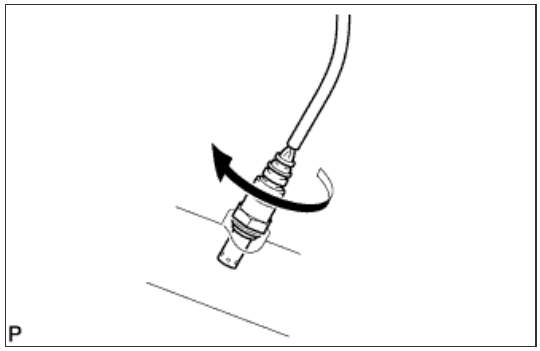
a. Install a new gasket and the front exhaust pipe to the exhaust manifold R with 2 new nuts.

Torque:
54 N*m{ 554 kgf*cm , 40 ft.*lbf }

b. Connect the heated oxygen sensor connector.

2. INSTALL HEATED OXYGEN SENSOR (for Bank 2 Sensor 2)

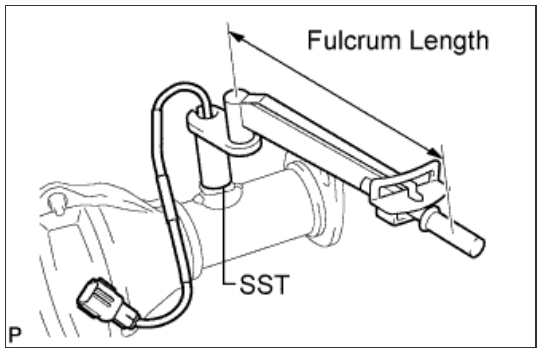
a. Temporarily install the sensor to the exhaust pipe by hand.



b. Using SST, tighten the sensor.

SST
09224-00010

Torque:
without SST:
44 N*m{ 449 kgf*cm , 32 ft.*lbf }
with SST:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }



HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.). If using a torque wrench with a length that is not 30 cm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the without SST torque specification (Click here).**
- **Make sure SST and the wrench are connected in a straight line.**

3. INSTALL FRONT NO. 2 EXHAUST PIPE ASSEMBLY

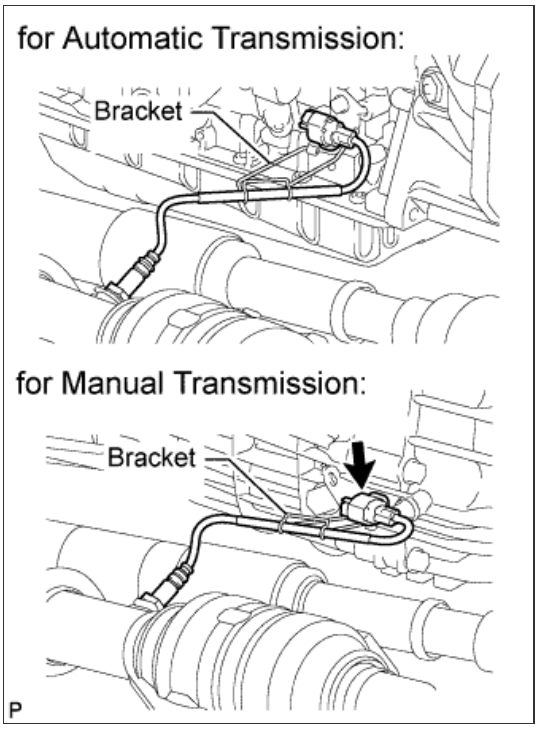
a. Install a new gasket and the front No. 2 exhaust pipe to the exhaust manifold L with 2 new nuts.

Torque:
54 N*m{ 554 kgf*cm , 40 ft.*lbf }

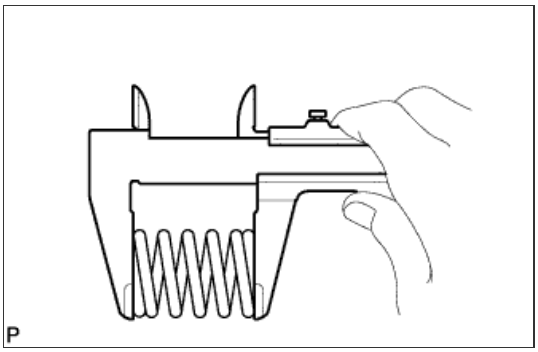
b. Connect the heated oxygen sensor connector.

HINT:

ook the wire harness to the bracket.



4. INSTALL CENTER EXHAUST PIPE ASSEMBLY



a. Check the free length.

i. Using a vernier caliper, measure the free length of the compression spring.

Minimum free length:
43 mm (1.693 in.)

If the free length is less than the minimum, replace the compression spring.

b. Connect the center exhaust pipe to the 3 exhaust pipe supports.

c. Install 2 new gaskets to the front exhaust pipe and front No. 2 exhaust pipe.

d. Install the center exhaust pipe with the 4 bolts and 2 compression springs.

Torque:
for center exhaust pipe and front exhaust pipe:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }
for center exhaust pipe and front No. 2 exhaust pipe:
48 N*m{ 489 kgf*cm , 35 ft.*lbf }

5. INSTALL TAILPIPE ASSEMBLY

a. Install the tailpipe to the 2 exhaust pipe supports.

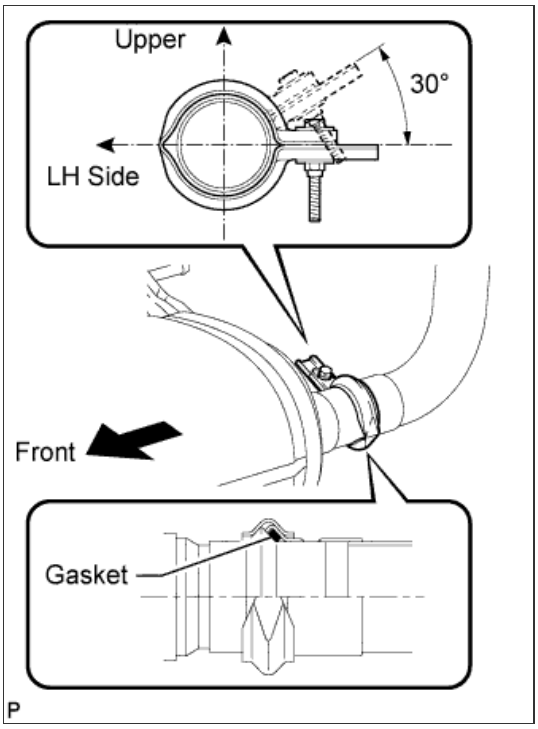
b. Set a new gasket to the center exhaust pipe.

c. Connect the tailpipe to the center pipe with a new clamp.

Torque:
32 N*m{ 326 kgf*cm , 24 ft.*lbf }

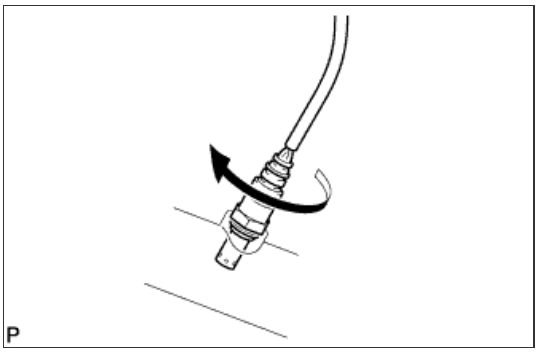
HINT:

Install the clamp within the angle range shown in the illustration.



6. INSTALL HEATED OXYGEN SENSOR (for Bank 1 Sensor 2)

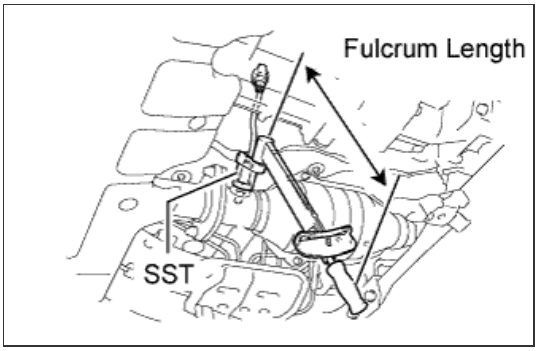
a. Temporarily install the sensor to the exhaust pipe by hand.



b. Using SST, tighten the sensor.

SST
09224-00010

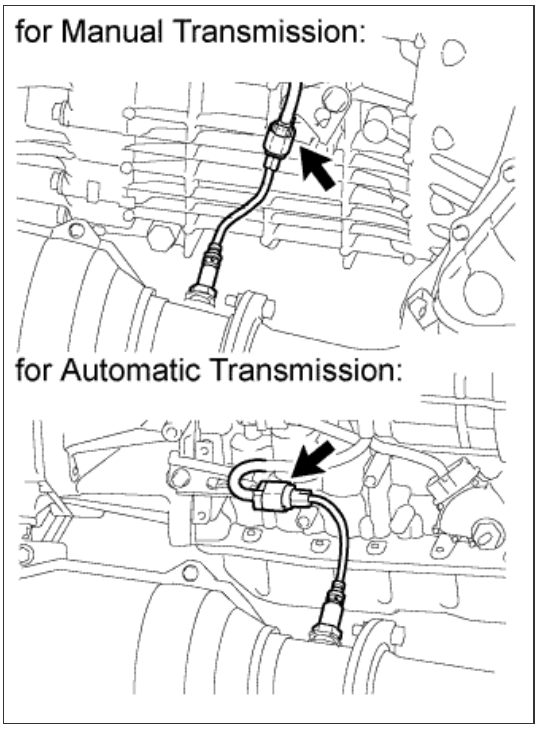
Torque:
without SST:
44 N*m{ 449 kgf*cm , 32 ft.*lbf }
with SST:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }



HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.). If using a torque wrench with a length that is not 30 cm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the without SST torque specification (Click here).**
- **Make sure SST and the wrench are connected in a straight line.**

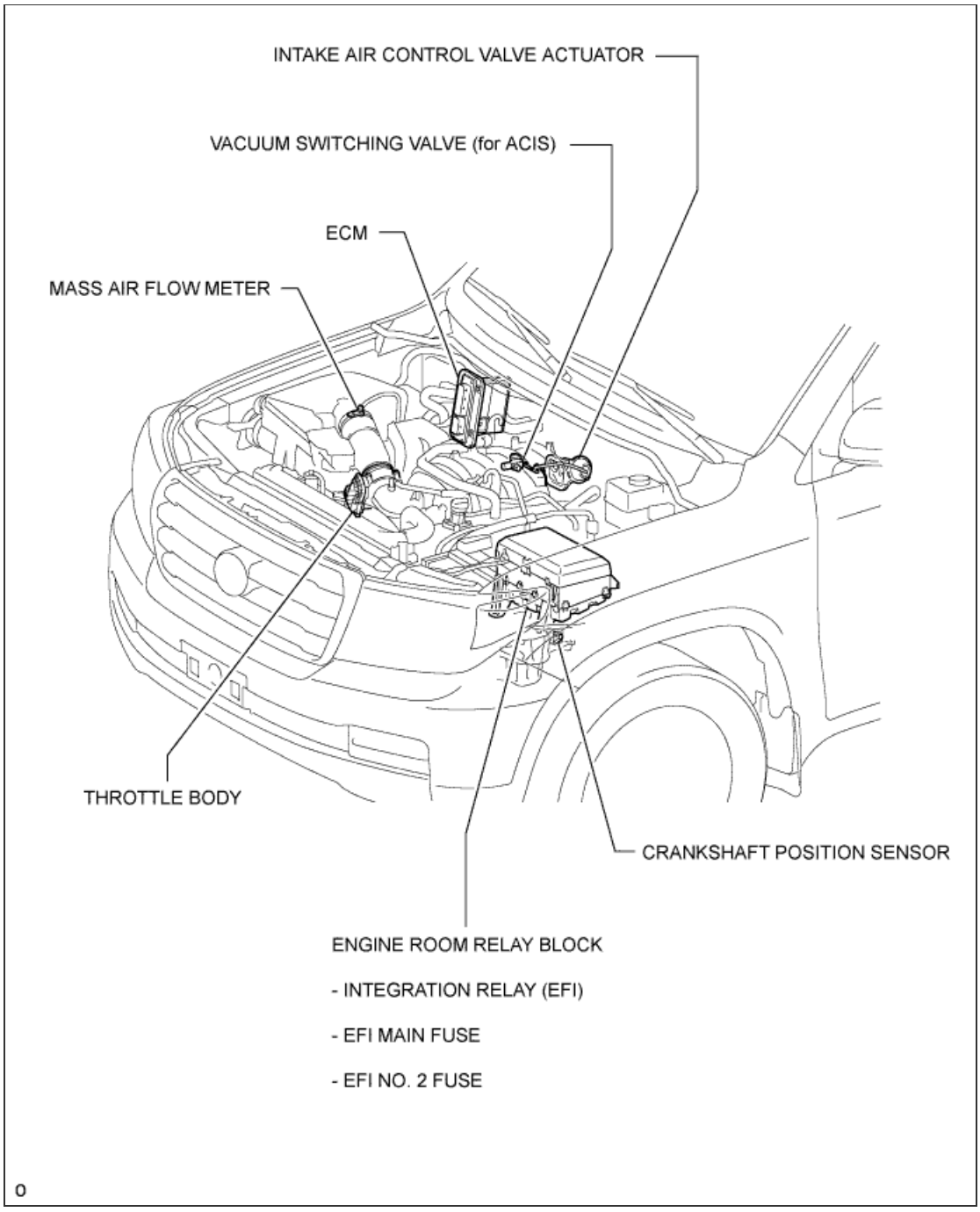
c. Connect the sensor connector.



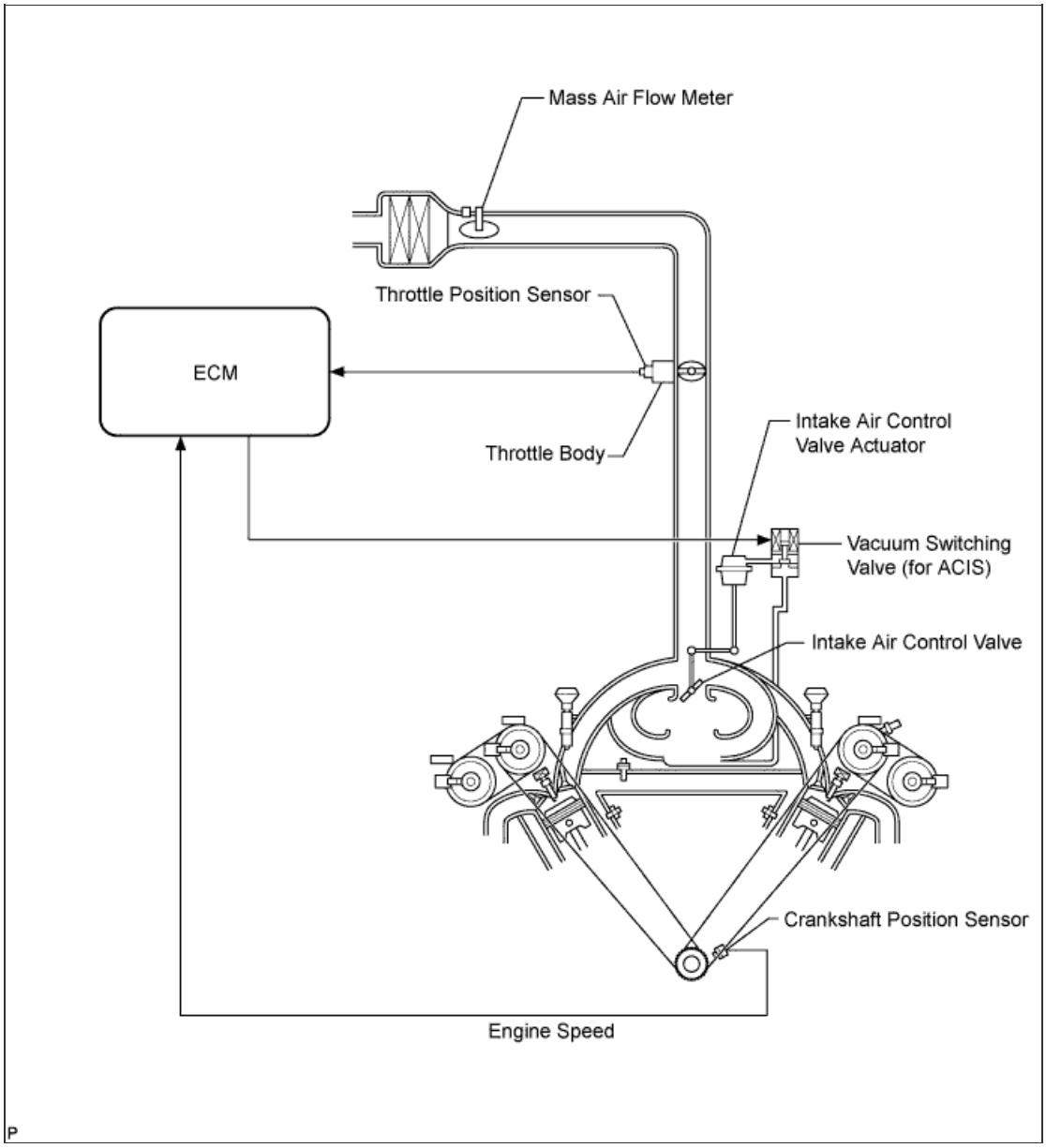
7. INSPECT FOR EXHAUST GAS LEAK

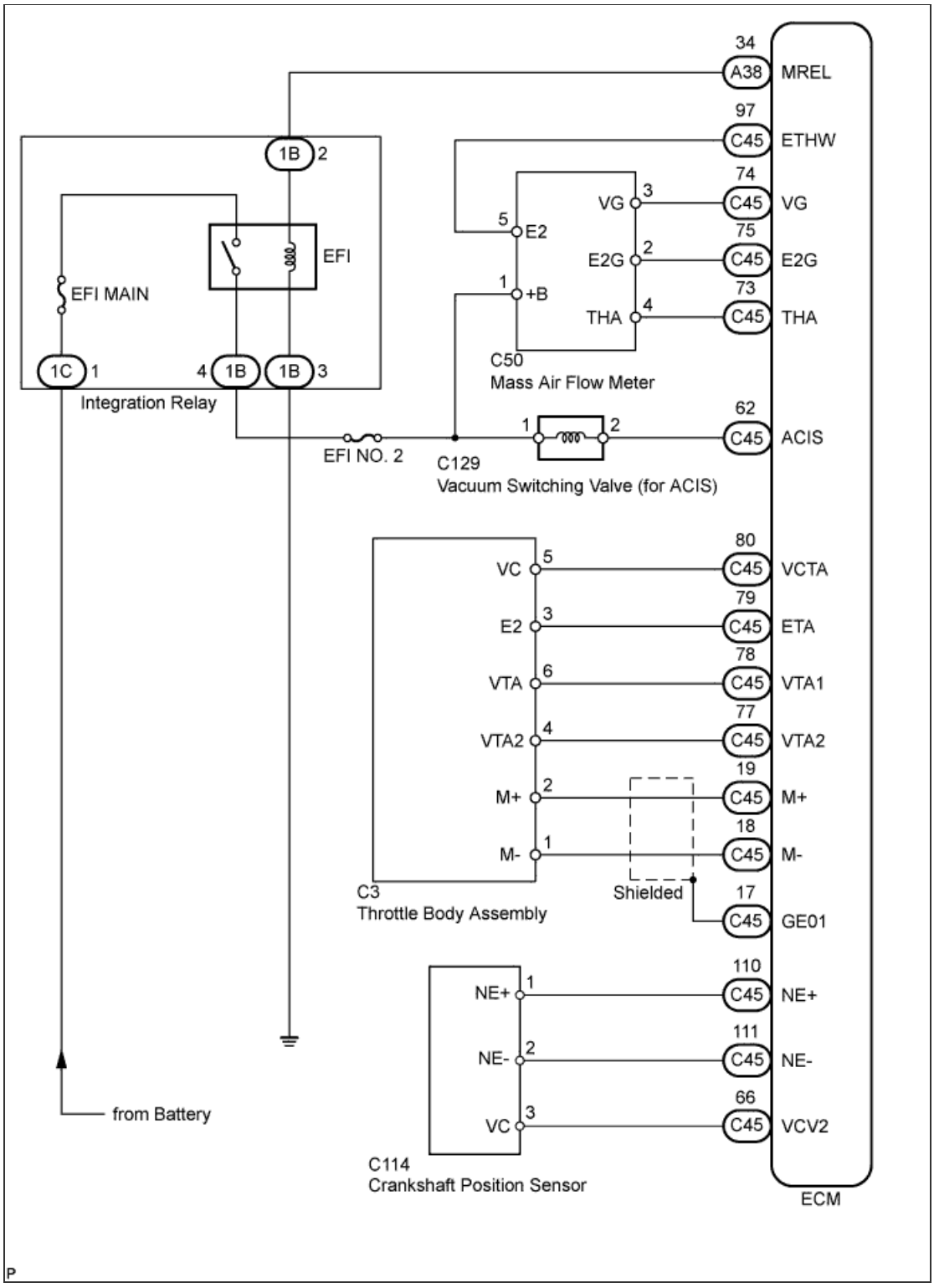
If gas is leaking, tighten the areas necessary to stop the leak. Replace damaged parts as necessary.

for Preparation Click here



for Preparation Click here




34
A38
MREL
97
C45
ETHW
74
C45
VG
75
C45
E2G
73
C45
THA
62
C45
ACIS
80
C45
VCTA
79
C45
ETA
78
C45
VTA1
77
C45
VTA2
19
C45
M+
18
C45
M-
17
C45
GE01
110
C45
NE+
111
C45
NE-
66
C45
VCV2
ECM
1B 2
EFI
EFI MAIN
1C 1
4 1B
1B 3
Integration Relay
EFI NO. 2
5 E2
1 +B
VG 3
E2G 2
THA 4
C50
Mass Air Flow Meter
1 2
C129
Vacuum Switching Valve (for ACIS)
VC 5
E2 3
VTA 6
VTA2 4
M+ 2
M- 1
C3
Throttle Body Assembly
Shielded
NE+ 1
NE- 2
VC 3
C114
Crankshaft Position Sensor
from Battery
P

for Preparation Click here

1. INSPECT INTAKE AIR CONTROL VALVE

a. Remove the V-bank cover.

b. Start the engine.

c. Check that the VSV (for ACIS) is ON (seal) under both of the following conditions:

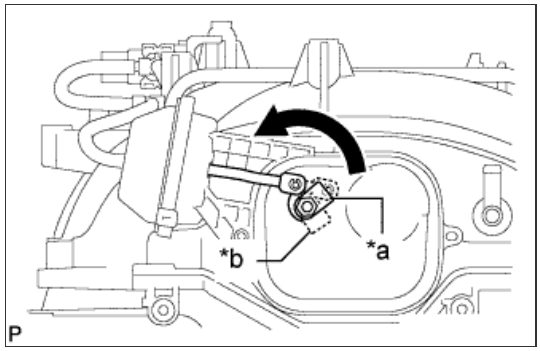
- Depressing the accelerator pedal to a achieve throttle valve opening angle of 50° or more.
- Racing the engine to 4700 rpm or less.

NOTICE:

Do not increase the engine speed to 5400 rpm or more.

d. Check that the VSV (for ACIS) is OFF (vent) under the following conditions:

- After releasing the accelerator pedal while under the VSV (for ACIS) ON condition.
- The engine is idling.



Text in Illustration

*a	ON (Seal)
*b	OFF (Vent)

e. Connect the intelligent tester to the DLC3.

f. Perform the Active Test, and then check that the actuator rod operates.
If the result is not as specified, inspect the intake air control valve, vacuum tank and VSV (for ACIS) for normal operation. Replace malfunctioning parts as necessary.

g. Install the V-bank cover.

2. CHECK INTAKE AIR CONTROL VALVE OPERATION

a. Remove the V-bank cover.

b. Using a 3-way connector, connect a vacuum gauge to the actuator hose.

Text in Illustration

*1	Vacuum Gauge

c. Start the engine.

d. While the engine is idling, check that the vacuum gauge indicates 0 kPa (0 mmHg, 0 in.Hg) and the rod is at the OFF position

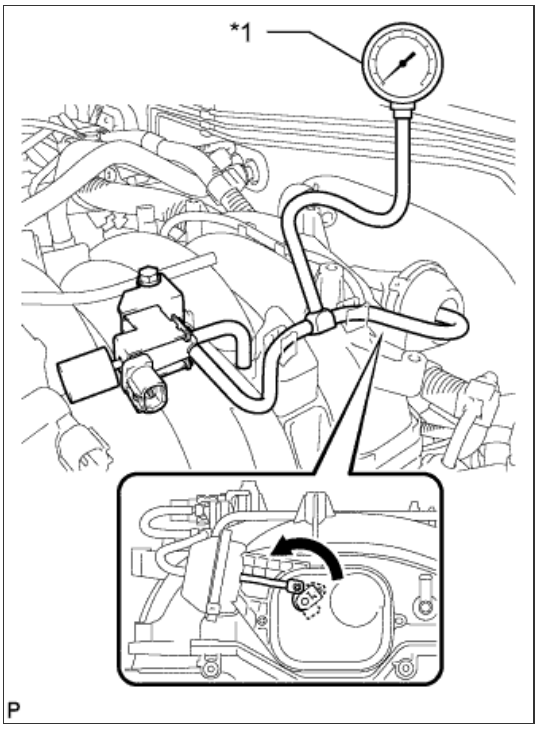
e. Fully depress the accelerator pedal quickly. Check that the VSV (for ACIS) turns ON and the rod moves in the ON direction.

NOTICE:

Make sure to fully depress and release the accelerator pedal within 1 second.

f. Remove the vacuum gauge, and connect the vacuum hose to the actuator.

g. Install the V-bank cover.



3. INSPECT INTAKE AIR CONTROL VALVE

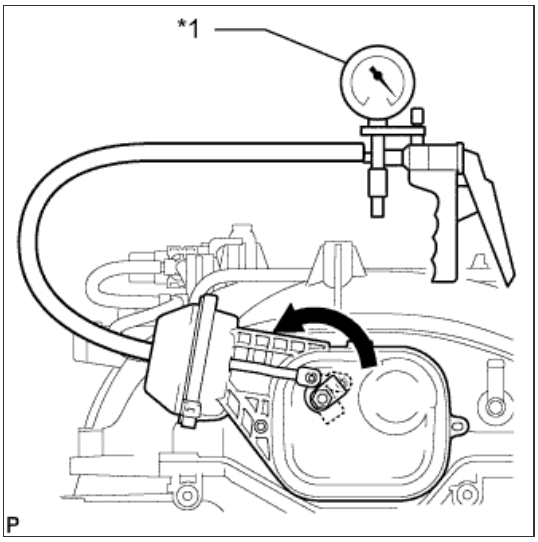
a. Inspect the diaphragm.

i. Using a vacuum pump, apply a vacuum of 7 kPa (00 mmHg, 7.85 in.Hg). Check that the lever moves.

Text in Illustration

*1	Vacuum Pump

If the result is not as specified, replace the intake air surge tank.



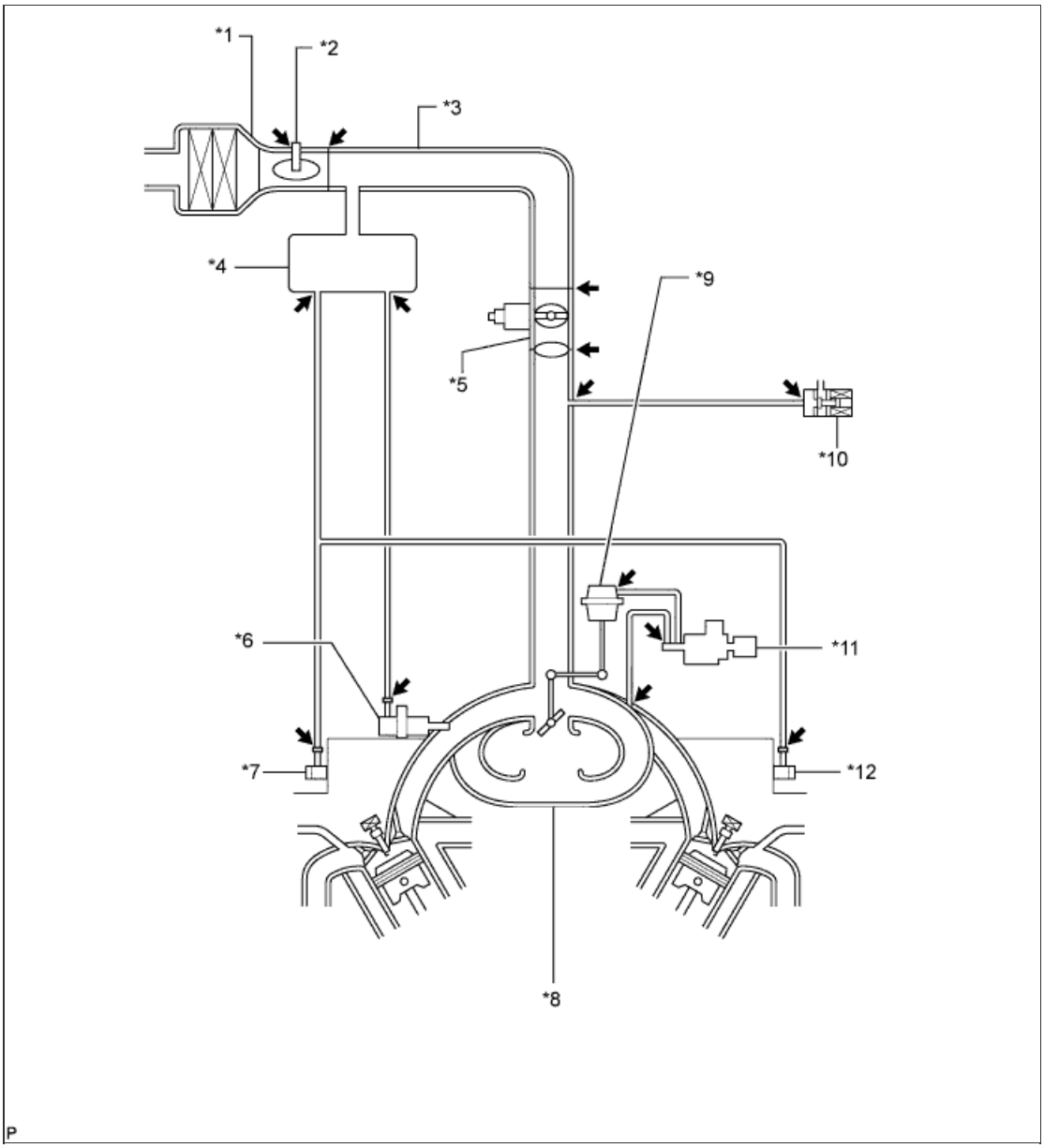
4. CHECK AIR INDUCTION SYSTEM

HINT:

The illustration shows the areas that may draw in secondary air, which could lead to idling problems.

a. Check that the hoses are installed correctly.

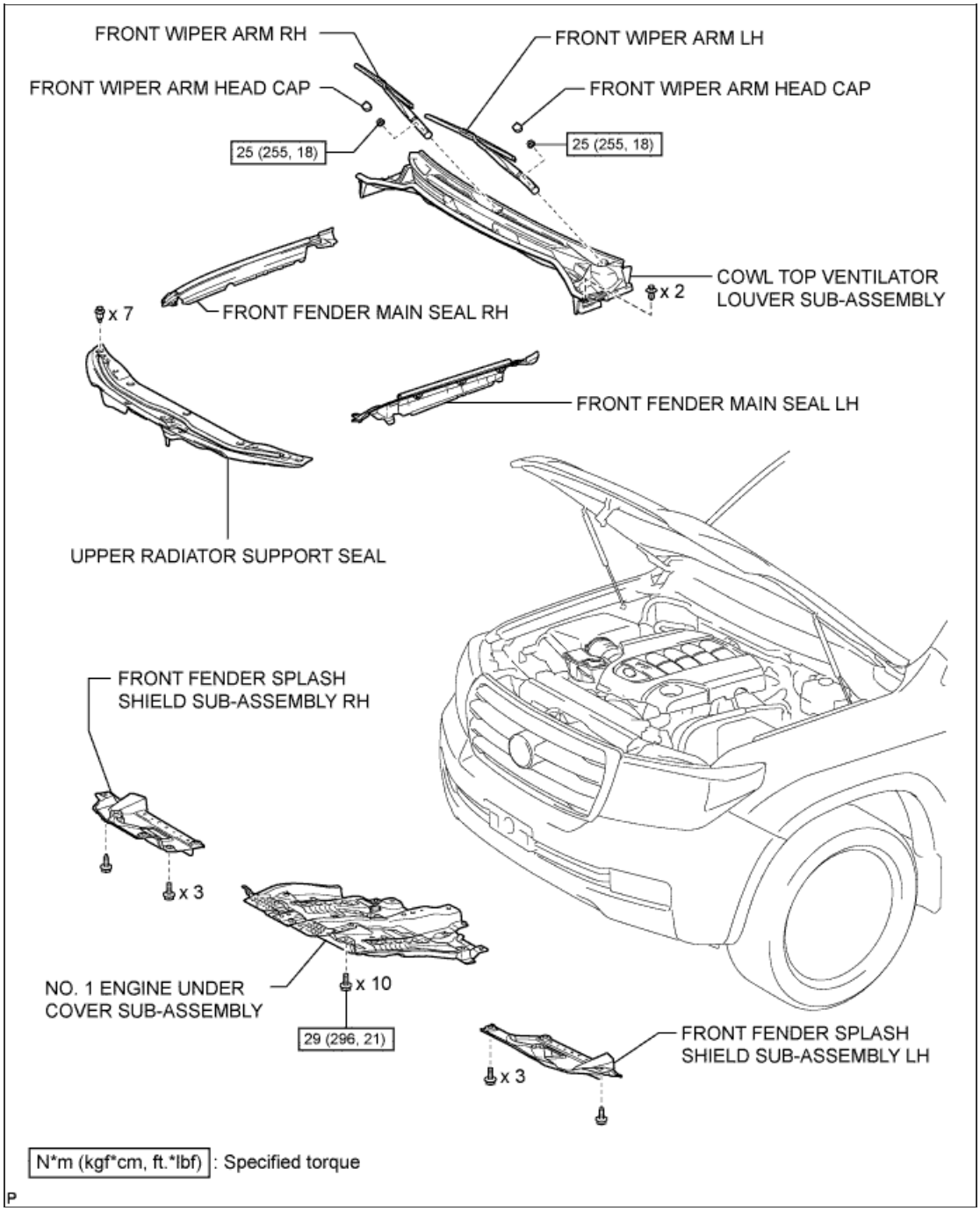
b. Check for cracks, etc. in the hoses.

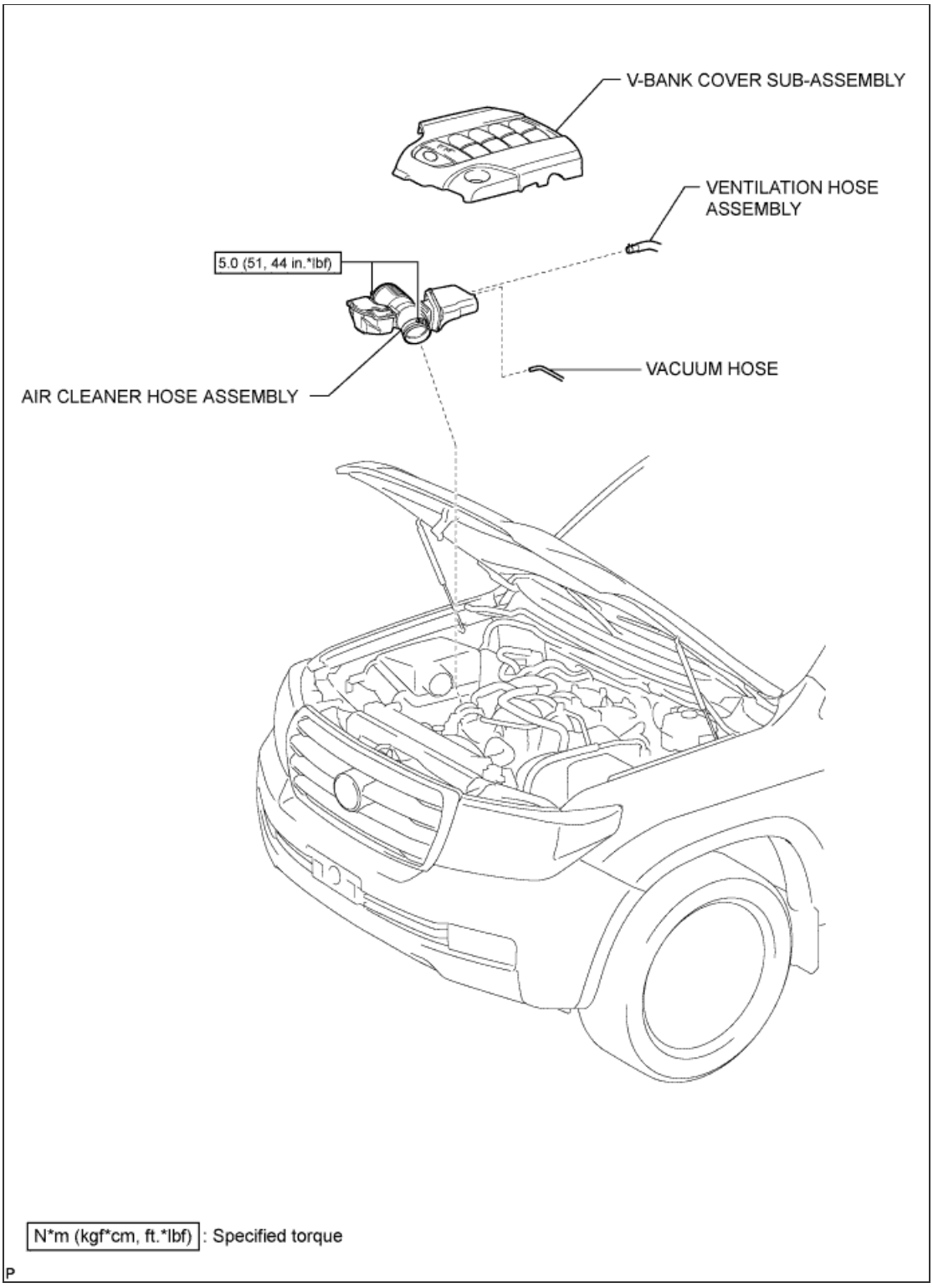


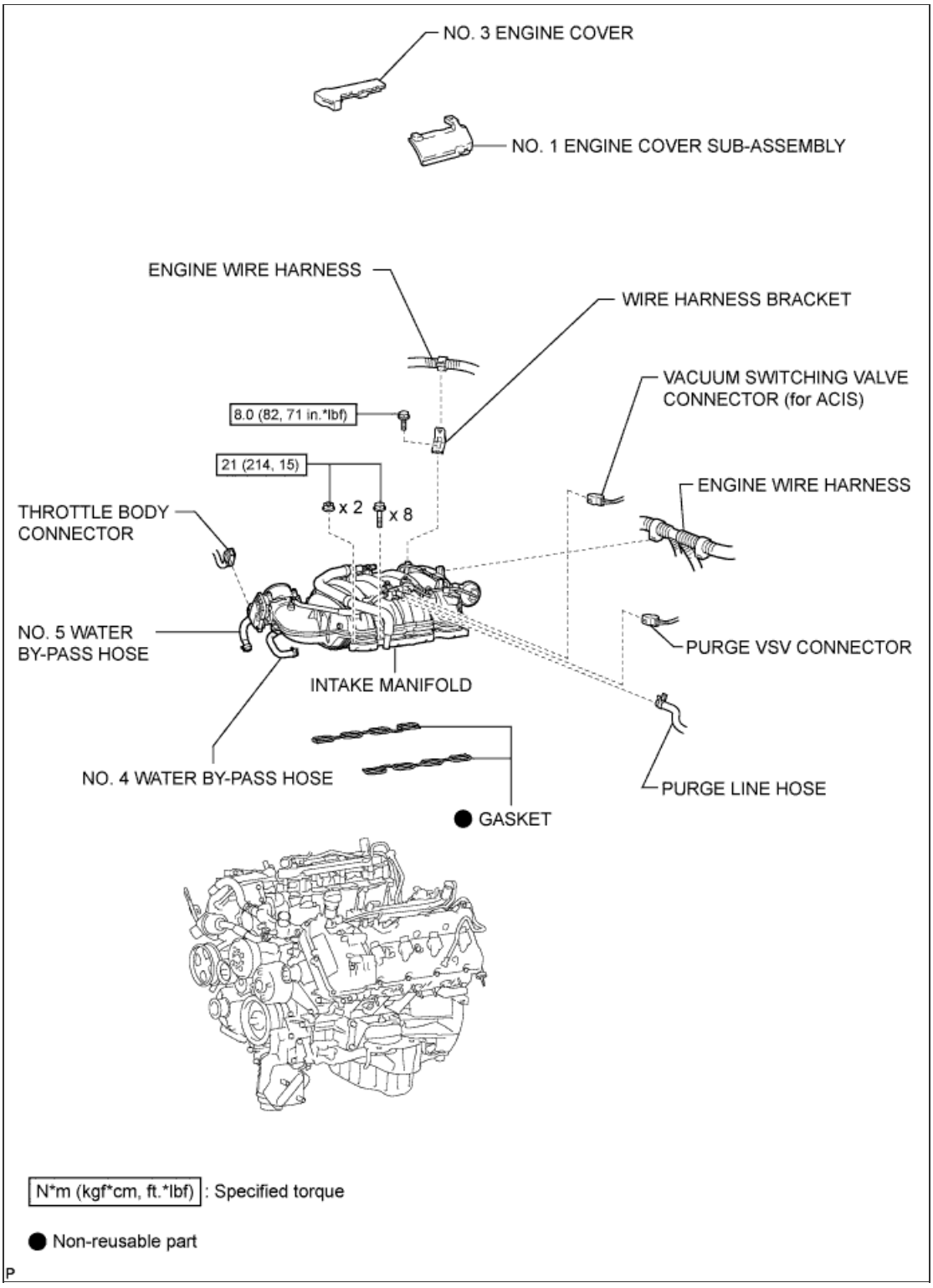
Text in Illustration

*1	Air Cleaner	*	ass Air Flow Meter
*3	Air Cleaner Hose	*4	Resonator
*5	Throttle Body	*	Fuel Pressure Regulator
*7	Ventilation Pipe	*8	Intake Manifold
*	Intake Air Control Valve Actuator (for ACIS)	*10	Purge VSV
*11	Vacuum Switching Valve (for ACIS)	*1	Ventilation Pipe

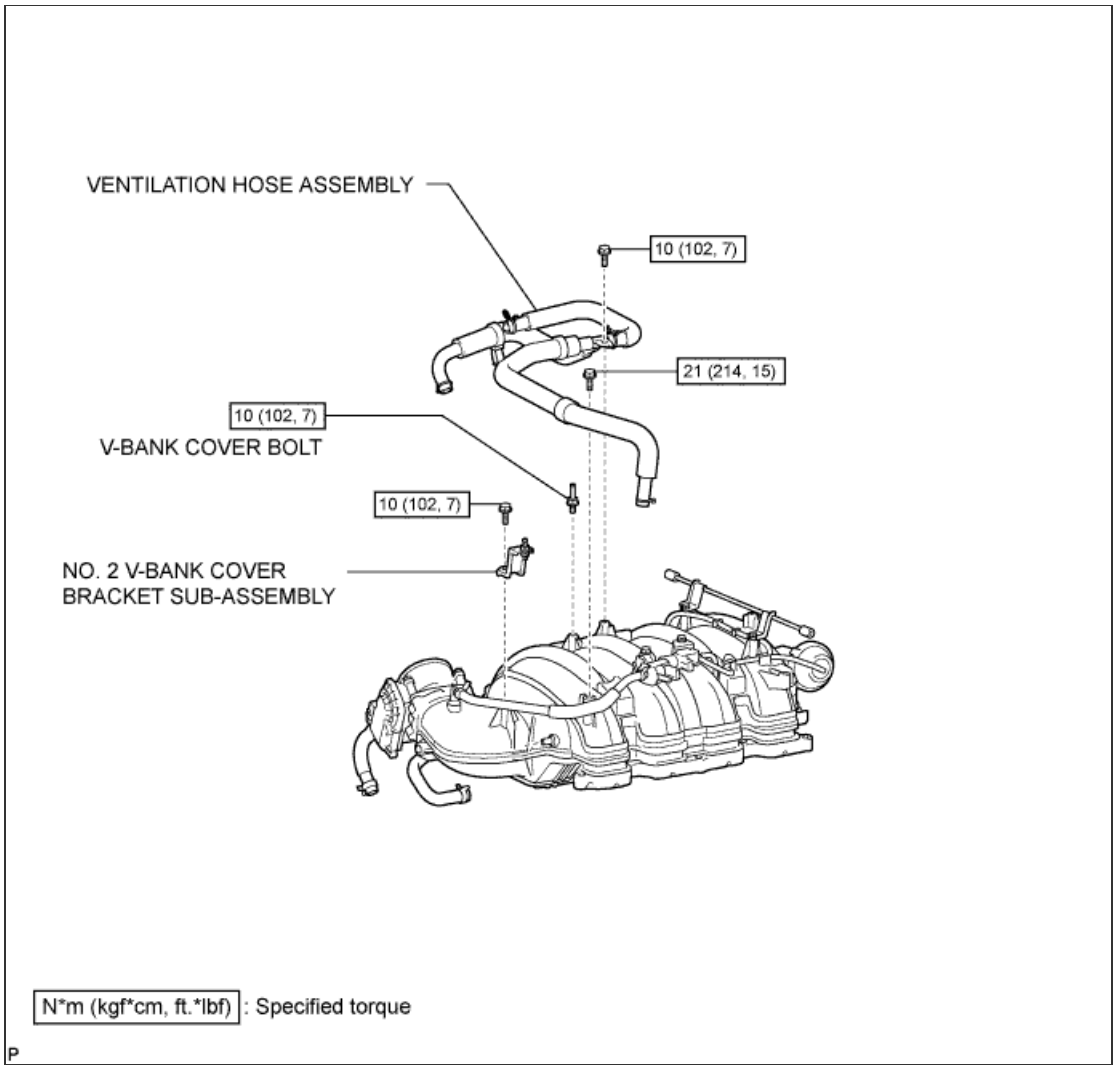
for Preparation [Click here]

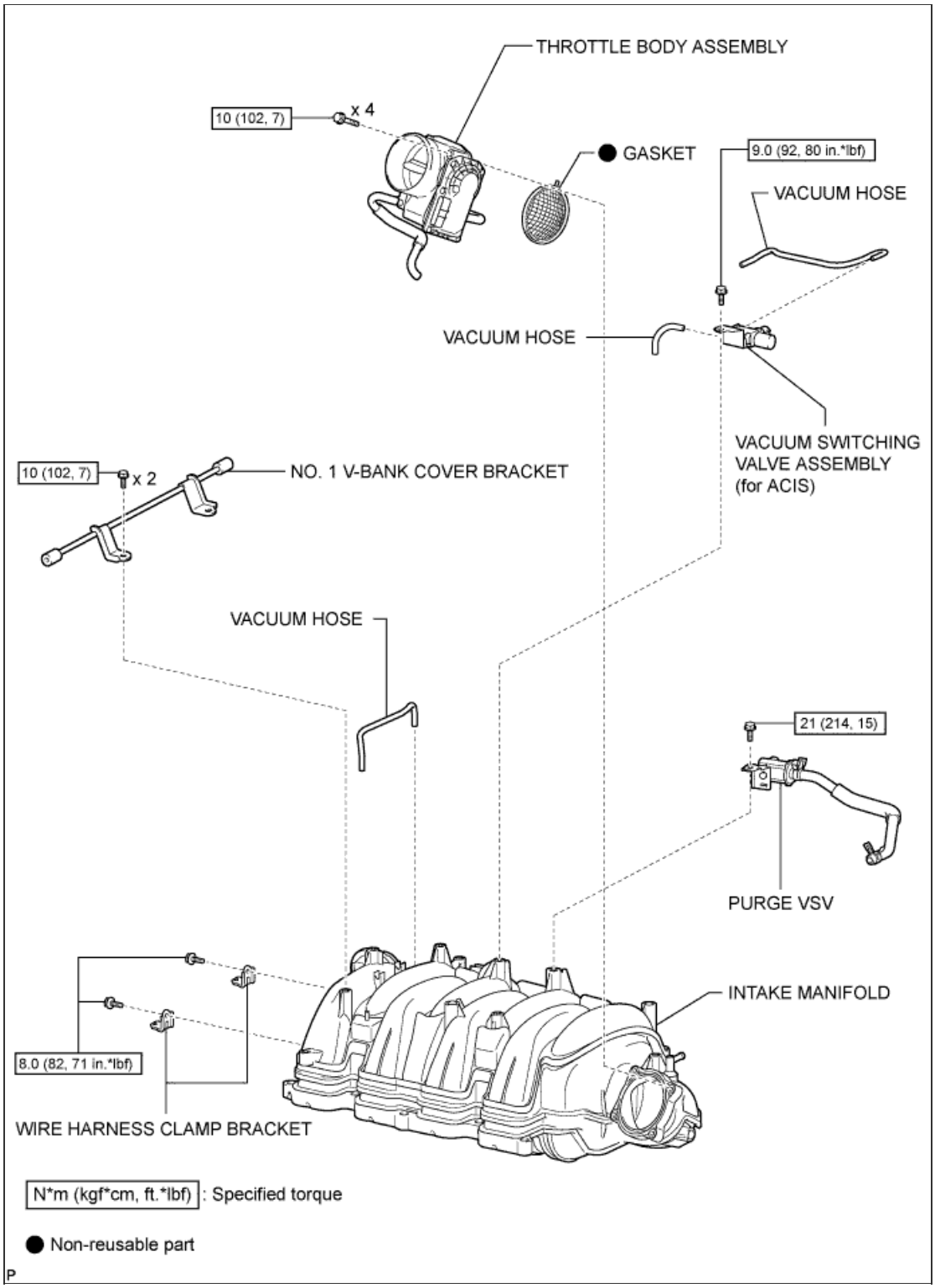



V-BANK COVER SUB-ASSEMBLY
VENTILATION HOSE ASSEMBLY
5.0 (51, 44 in.*lbf)
VACUUM HOSE
AIR CLEANER HOSE ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
P


NO. 3 ENGINE COVER
NO. 1 ENGINE COVER SUB-ASSEMBLY
ENGINE WIRE HARNESS
WIRE HARNESS BRACKET
VACUUM SWITCHING VALVE CONNECTOR (for ACIS)
8.0 (82, 71 in.*lbf)
21 (214, 15)
x 2
x 8
ENGINE WIRE HARNESS
THROTTLE BODY CONNECTOR
NO. 5 WATER BY-PASS HOSE
INTAKE MANIFOLD
PURGE VSV CONNECTOR
NO. 4 WATER BY-PASS HOSE
PURGE LINE HOSE
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P


VENTILATION HOSE ASSEMBLY
10 (102, 7)
21 (214, 15)
10 (102, 7)
V-BANK COVER BOLT
10 (102, 7)
NO. 2 V-BANK COVER
BRACKET SUB-ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
P


THROTTLE BODY ASSEMBLY
10 (102, 7)
x 4
GASKET
9.0 (92, 80 in.*lbf)
VACUUM HOSE
VACUUM HOSE
VACUUM SWITCHING VALVE ASSEMBLY (for ACIS)
10 (102, 7)
x 2
NO. 1 V-BANK COVER BRACKET
VACUUM HOSE
21 (214, 15)
PURGE VSV
INTAKE MANIFOLD
8.0 (82, 71 in.*lbf)
WIRE HARNESS CLAMP BRACKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

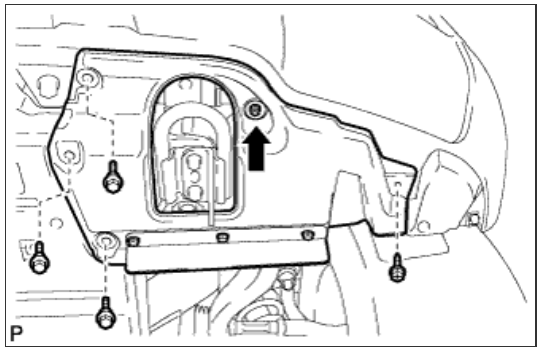
2. REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

(Click here)

3. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



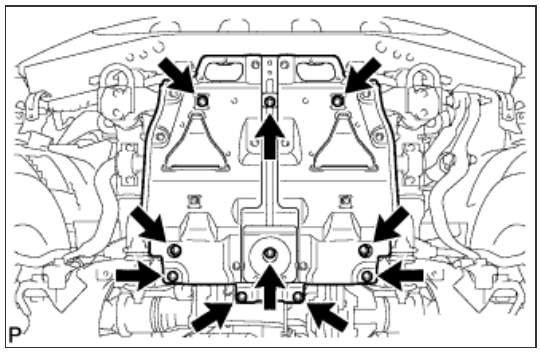
4. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

5. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and No. 1 engine under cover.



6. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug.

HINT:

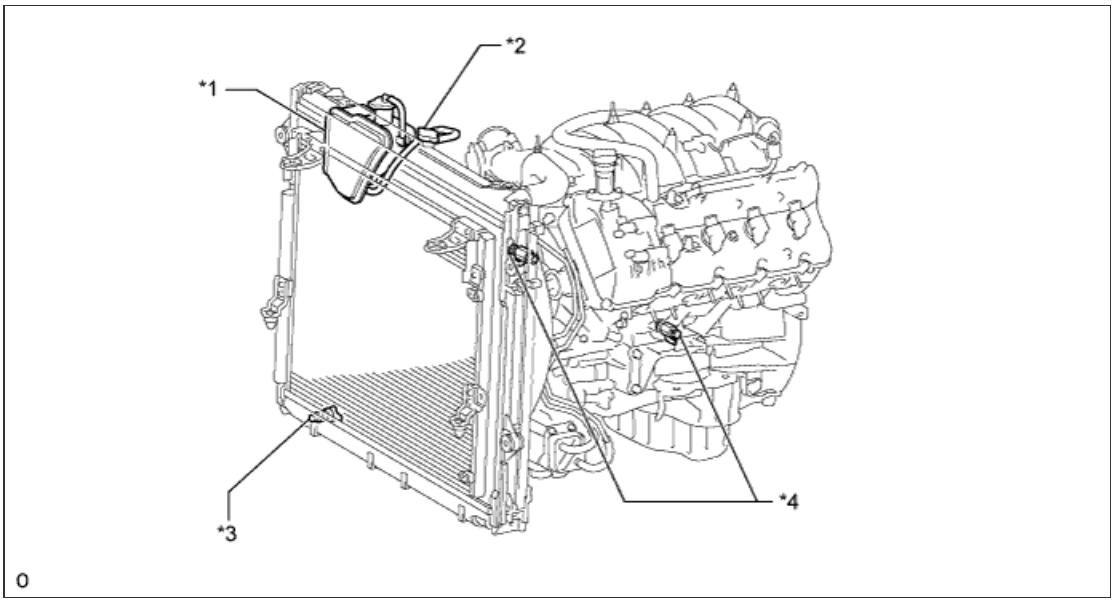
Collect the coolant in a container and dispose of it according to the regulations in your area.

b. Remove the radiator cap. Then drain the coolant from the radiator.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

d. Tighten the 2 cylinder block drain cock plugs.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



Text in Illustration

*1	Radiator Reservoir	*2	Radiator Cap
*3	Radiator Drain Cock Plug	*4	Cylinder Block Drain Cock Plug

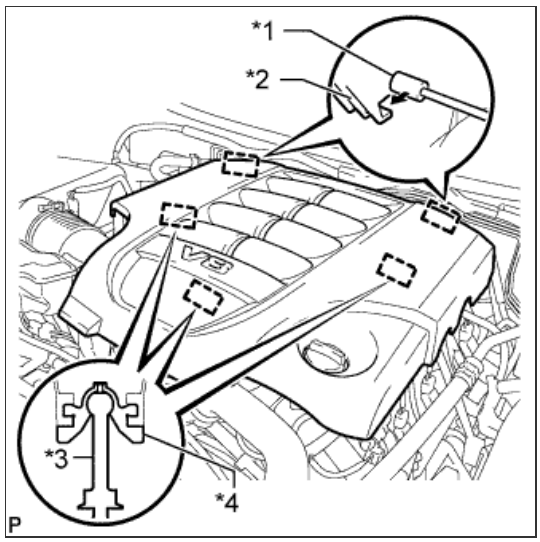
e. Tighten the radiator drain cock plug by hand.

7. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Raise the front of the V-bank cover to detach the 3 pins. Then remove the 2 V-bank cover hooks from the bracket, and remove the V-bank cover.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet

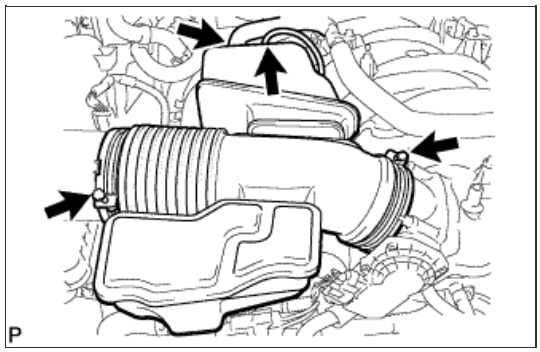


8. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum hose and No. 2 ventilation hose.

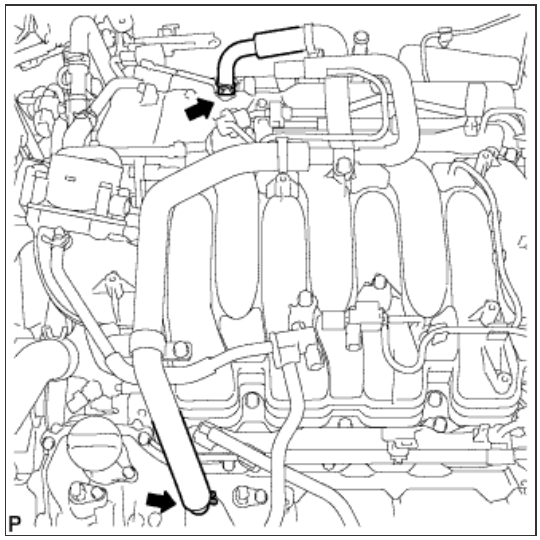
b. Loosen the 2 hose clamps.

c. Remove the air cleaner hose.



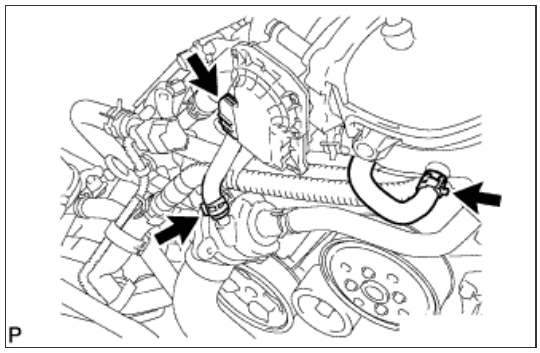
9. REMOVE INTAKE MANIFOLD

a. Disconnect the ventilation hose from the ventilation pipe of the cylinder head cover LH and RH.

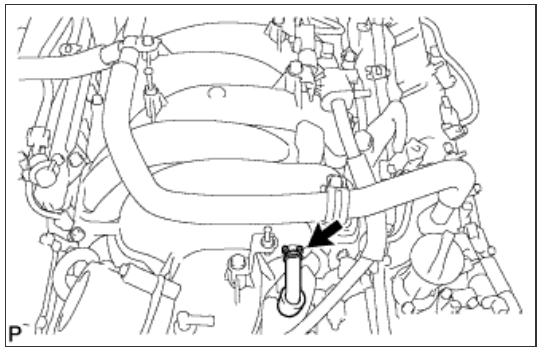


b. Disconnect the 2 water by-pass hoses.

c. Disconnect the throttle body connector.



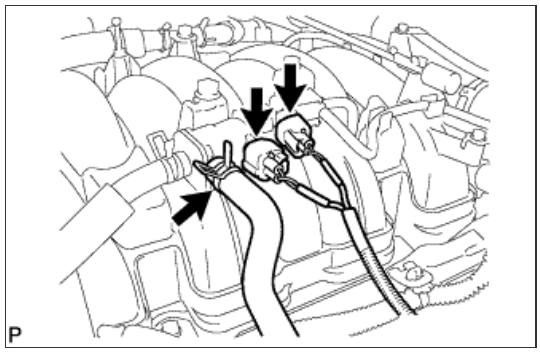
d. Disconnect the No. 1 ventilation hose.



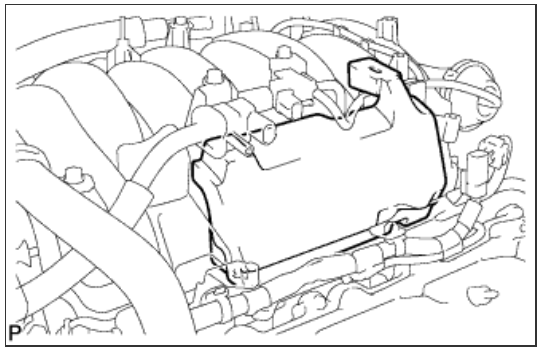
e. Disconnect the purge VSV connector.

f. Disconnect the purge line hose from the purge VSV.

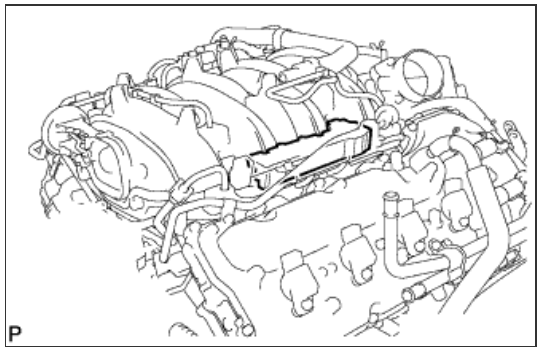
g. Disconnect the vacuum switching valve connector (for ACIS).



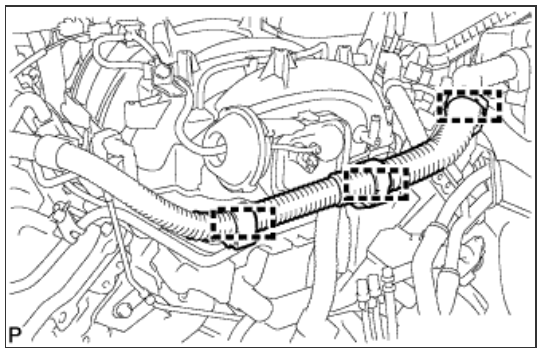
h. Remove the No. 1 engine cover sub-assembly.



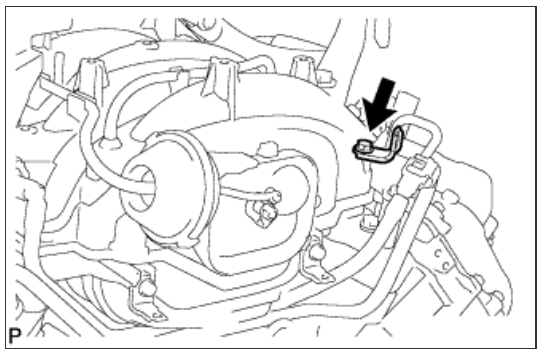
i. Remove the No. 3 engine cover.



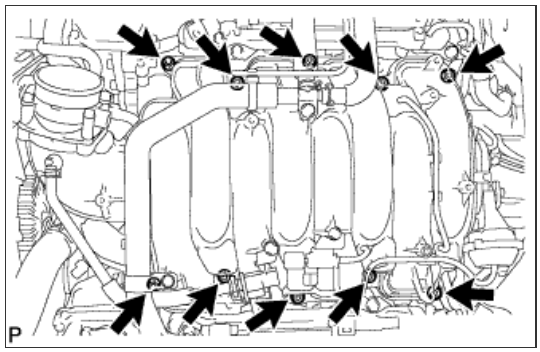
j. Disconnect the 3 wire clamps from the 3 wire brackets.



k. Remove the bolt and wire bracket from the intake manifold.

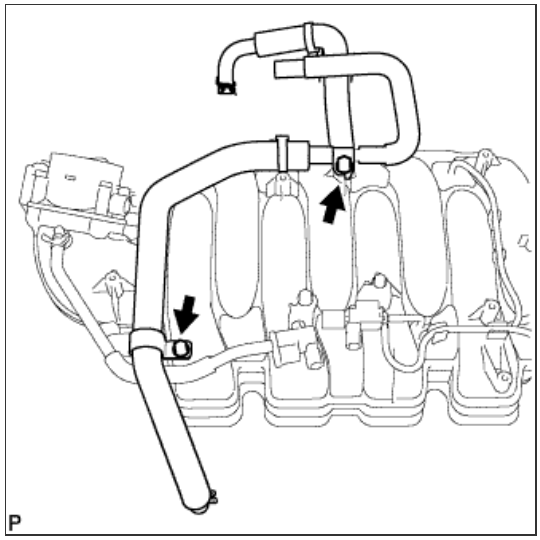


l. Remove the 2 nuts, 8 bolts, intake manifold and 2 gaskets.



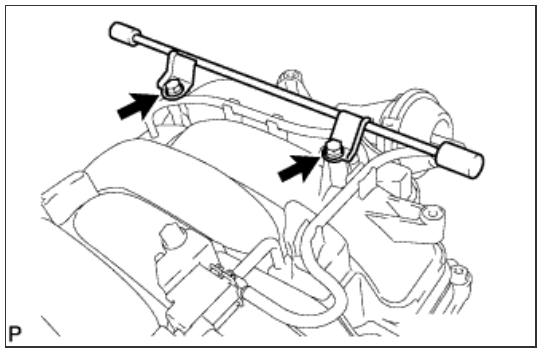
10. REMOVE VENTILATION HOSE ASSEMBLY

a. Remove the 2 bolts and ventilation hose from the intake manifold.



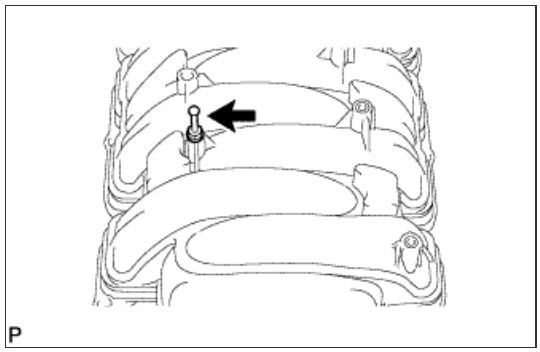
11. REMOVE NO. 1 V-BANK COVER BRACKET

a. Remove the 2 bolts and bracket.



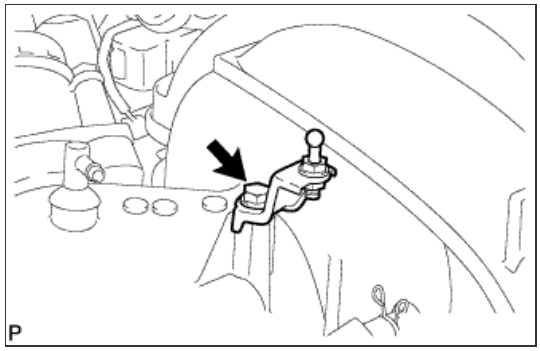
12. REMOVE V-BANK COVER BOLT

a. Remove the cover bolt from the intake manifold.



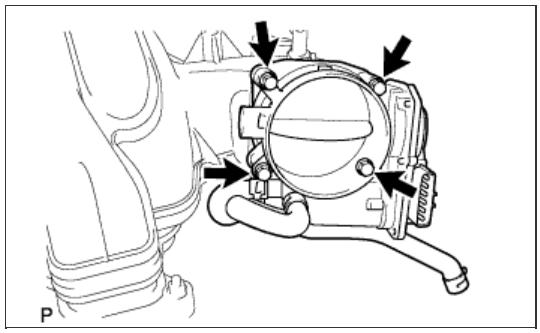
13. REMOVE NO. 2 V-BANK COVER BRACKET SUB-ASSEMBLY

a. Remove the bolt and bracket.



14. REMOVE THROTTLE BODY ASSEMBLY

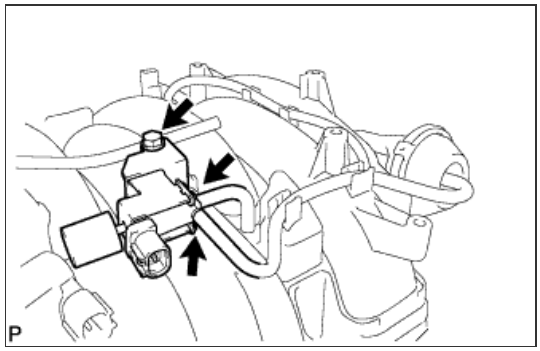
a. Remove the 4 bolts, throttle body and gasket.



15. REMOVE VACUUM SWITCHING VALVE ASSEMBLY (for ACIS)

a. Disconnect the 2 vacuum hoses from the vacuum switching valve.

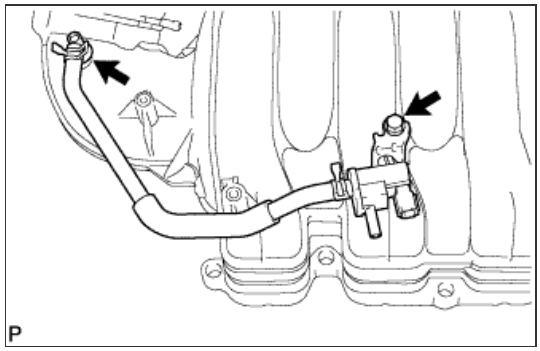
b. Remove the bolt and vacuum switching valve.



16. REMOVE PURGE VSV

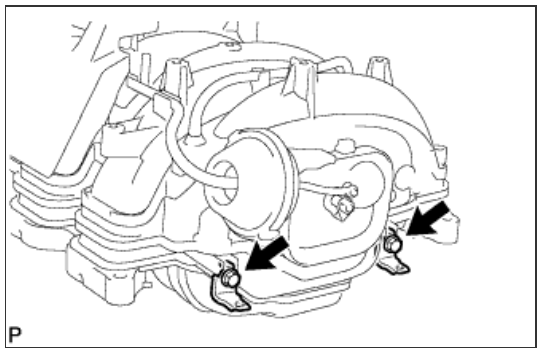
a. Disconnect the purge line hose from the intake manifold.

b. Remove the bolt and purge VSV.



17. REMOVE WIRE HARNESS CLAMP BRACKET

a. Remove the 2 bolts and 2 wire harness clamp brackets.



for Preparation Click here

1. INSTALL WIRE HARNESS CLAMP BRACKET

a. Install the 2 wire harness clamp brackets with the 2 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

2. INSTALL PURGE VSV

a. Connect the purge line hose to the intake manifold.

b. Install the purge VSV to the intake manifold with the bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

3. INSTALL VACUUM SWITCHING VALVE ASSEMBLY (for ACIS)

a. Install the vacuum switching valve to the intake manifold with the bolt.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }

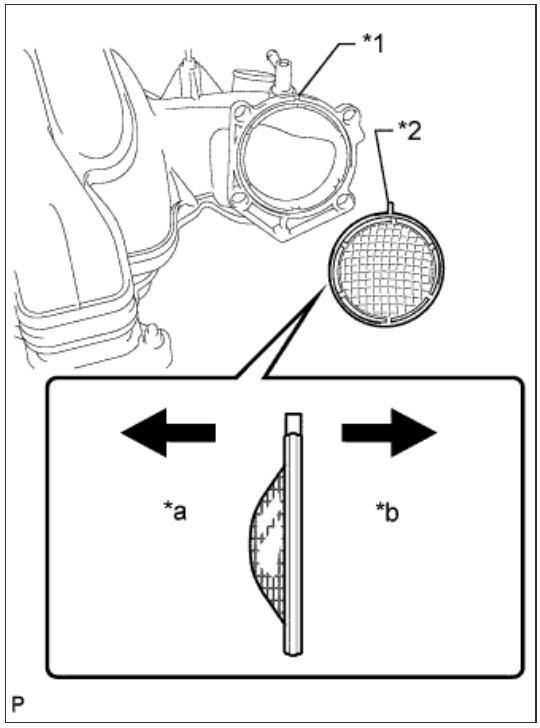
b. Connect the 2 vacuum hoses to the vacuum switching valve.

4. INSTALL THROTTLE BODY ASSEMBLY

a. Align the protrusion of a new gasket with the groove of the intake manifold, and install the gasket.

Text in Illustration

*1	Groove
*2	Protrusion
*a	Surge Tank Side
*b	Throttle Body Side



b. Install the throttle body with the 4 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

5. INSTALL NO. 2 V-BANK COVER BRACKET SUB-ASSEMBLY

a. Install the bracket with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

6. INSTALL V-BANK COVER BOLT

a. Install the cover bolt to the intake manifold.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

7. INSTALL NO. 1 V-BANK COVER BRACKET

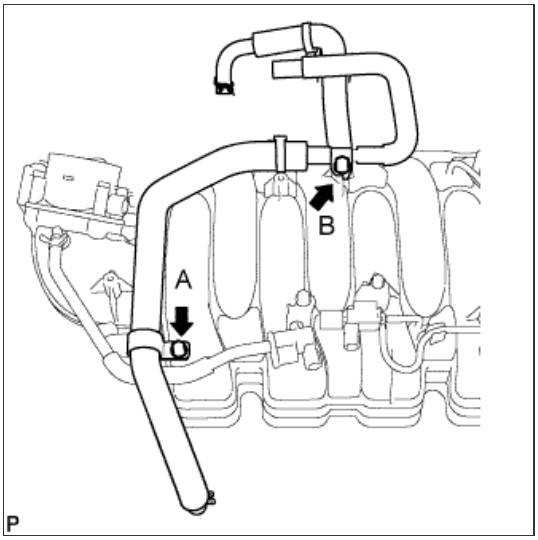
a. Install the bracket with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

8. INSTALL VENTILATION HOSE ASSEMBLY

a. Install the ventilation hose to the intake manifold with the 2 bolts.

Torque:
for bolt A:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for bolt B:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



9. INSTALL INTAKE MANIFOLD

a. Place 2 new gaskets on the intake manifold.

Text in Illustration

*1	Gasket

b. Place the intake manifold on the cylinder head.

c. Install and uniformly tighten the 8 bolts and 2 nuts in several steps.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

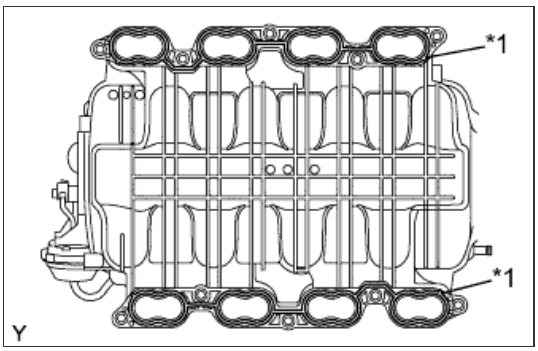
d. Install the wire bracket to the intake manifold with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

e. Connect the 3 wire clamps to the 3 wire brackets.

f. Install the No. 3 engine cover.

g. Install the No. 1 engine cover sub-assembly.



h. Connect the purge VSV connector.

i. Connect the purge line hose to the purge VSV.

j. Connect the vacuum switching valve connector (for ACIS).

k. Connect the No. 1 ventilation hose.

l. Connect the 2 water by-pass hoses.

m. Connect the throttle body connector.

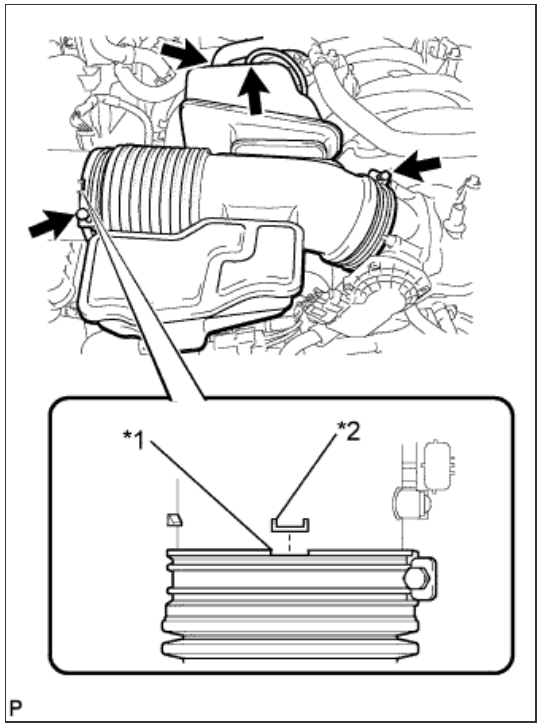
n. Connect the ventilation hose to the ventilation pipe of the cylinder head cover LH and RH.

10. INSTALL AIR CLEANER HOSE ASSEMBLY

a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

Text in Illustration

*1	Groove
*2	Protrusion



b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum hose.

d. Connect the No. 2 ventilation hose.

11. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item	Specified Condition
with rear heater	16.2 liters (17.1 US qts, 14.3 Imp. qts)
without rear heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the radiator inlet hose by hand, and checking when the engine coolant starts to flow inside the hose.

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

h. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the fan.**

i. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

j. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.

12. INSPECT FOR COOLANT LEAK

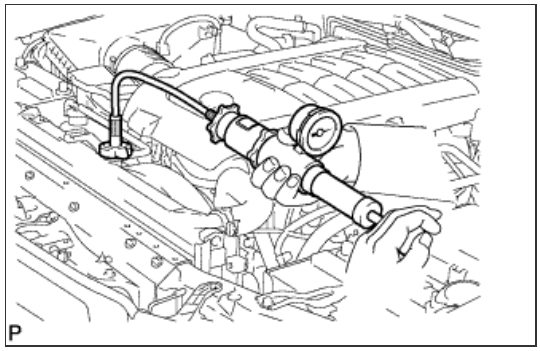
CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.

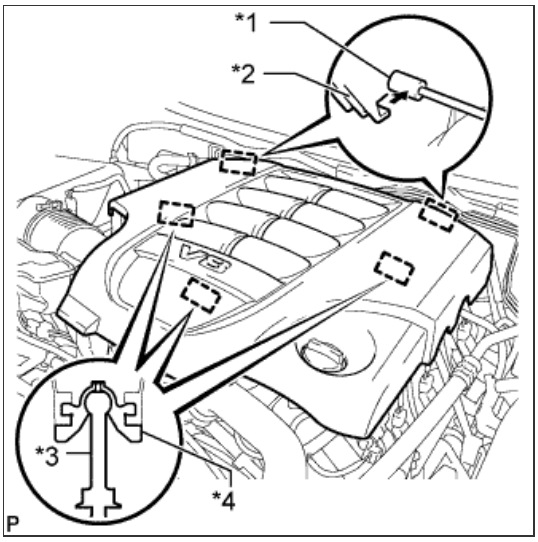


13. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket. Then align the 3 V-bank cover grommets with the 3 pins, and press down on the V-bank cover to attach the pins.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet



14. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

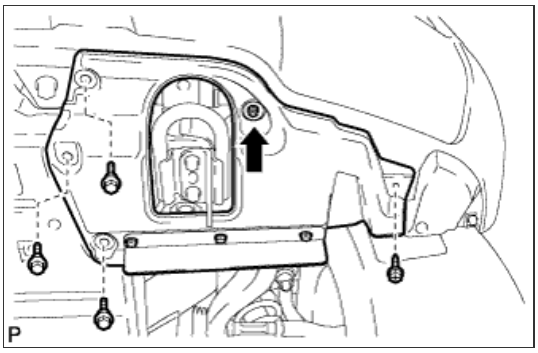
a. Install the No. 1 engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

15. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



16. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

17. INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Install the cowl top ventilator louver (Click here).

18. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

19. CHECK THROTTLE BODY ASSEMBLY

a. Check the throttle control motor operating sounds.

i. Turn the engine switch on (IG).

ii. When depressing the accelerator pedal, check the operating sound of the running motor. Make sure that no friction noises are emitted from the motor. If friction noise exists, replace the throttle body.

b. Check the throttle position sensor.

i. Connect the intelligent tester to the DLC3.

ii. Turn the engine switch on (IG).

iii. Turn the intelligent tester main switch on.

iv. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Throttle Sensor Volt %.

v. Depress the accelerator pedal. When the throttle valve is fully opened, check that the value of "Throttle Sensor Volt %" is within the specification.

Standard throttle valve opening percentage:
60% or more

HINT:

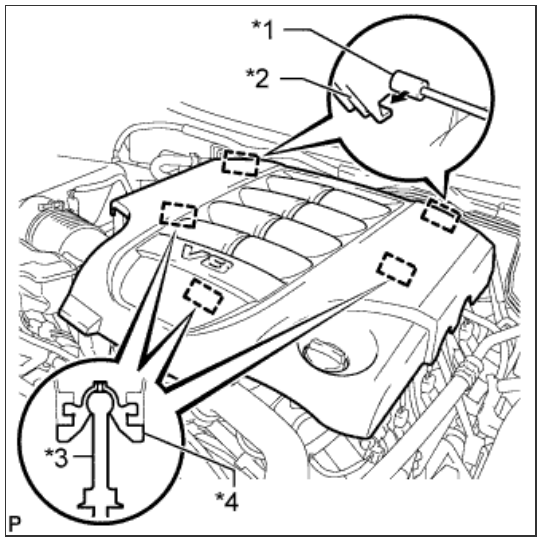
When checking the standard throttle valve opening percentage, the shift lever should be in N.

If the percentage is less than 60%, replace the throttle body.

for Preparation Click here

1. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Raise the front of the V-bank cover to detach the 3 pins. Then remove the 2 V-bank cover hooks from the bracket, and remove the V-bank cover.



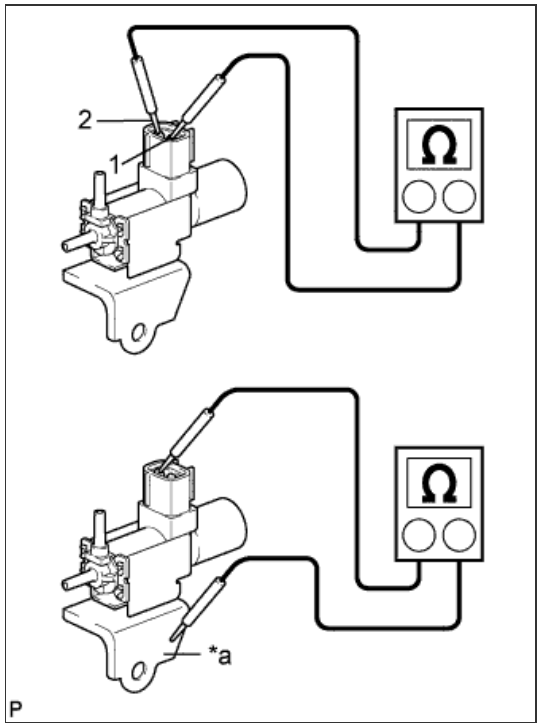
Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet

2. INSPECT VACUUM SWITCHING VALVE ASSEMBLY (for ACIS)

a. Disconnect the vacuum switching valve connector.

b. Measure the resistance according to the value(s) in the table below.



Text in Illustration

*a	Body Ground

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	37 to 44 Ω
1 - Body ground	lways	1 MΩ or higher
2 - Body ground		

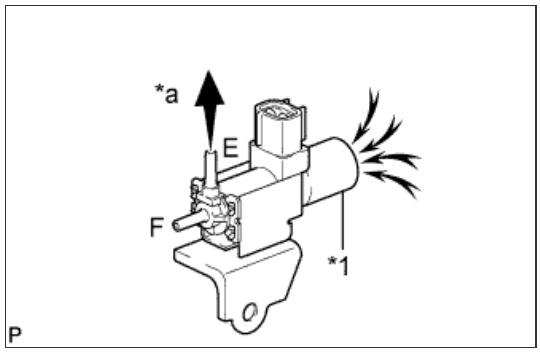
f the result is not as specified, replace the vacuum switching valve assembly.

c. When applying vacuum to port , check that air is sucked into the filter.

Text in Illustration

*1	Filter
*a	Vacuum

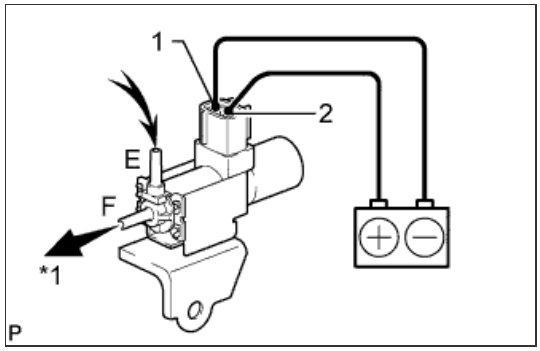
f the result is not as specified, replace the vacuum switching valve assembly.



d. pply battery voltage to the connector, and check the VSV operation.

OK:

Measurement Condition	Specified Condition
Battery positive (+) → Terminal 1 Battery negative (-) → Terminal 2	ir is sucked into port when a vacuum is applied to port F



Text in Illustration

*a	Vacuum

f the result is not as specified, replace the vacuum switching valve assembly.

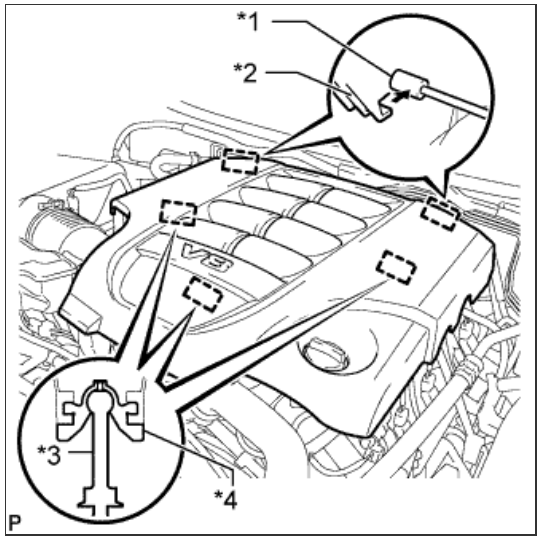
e. Connect the vacuum switching valve connector.

3. INSTALL V-BANK COVER SUB-ASSEMBLY

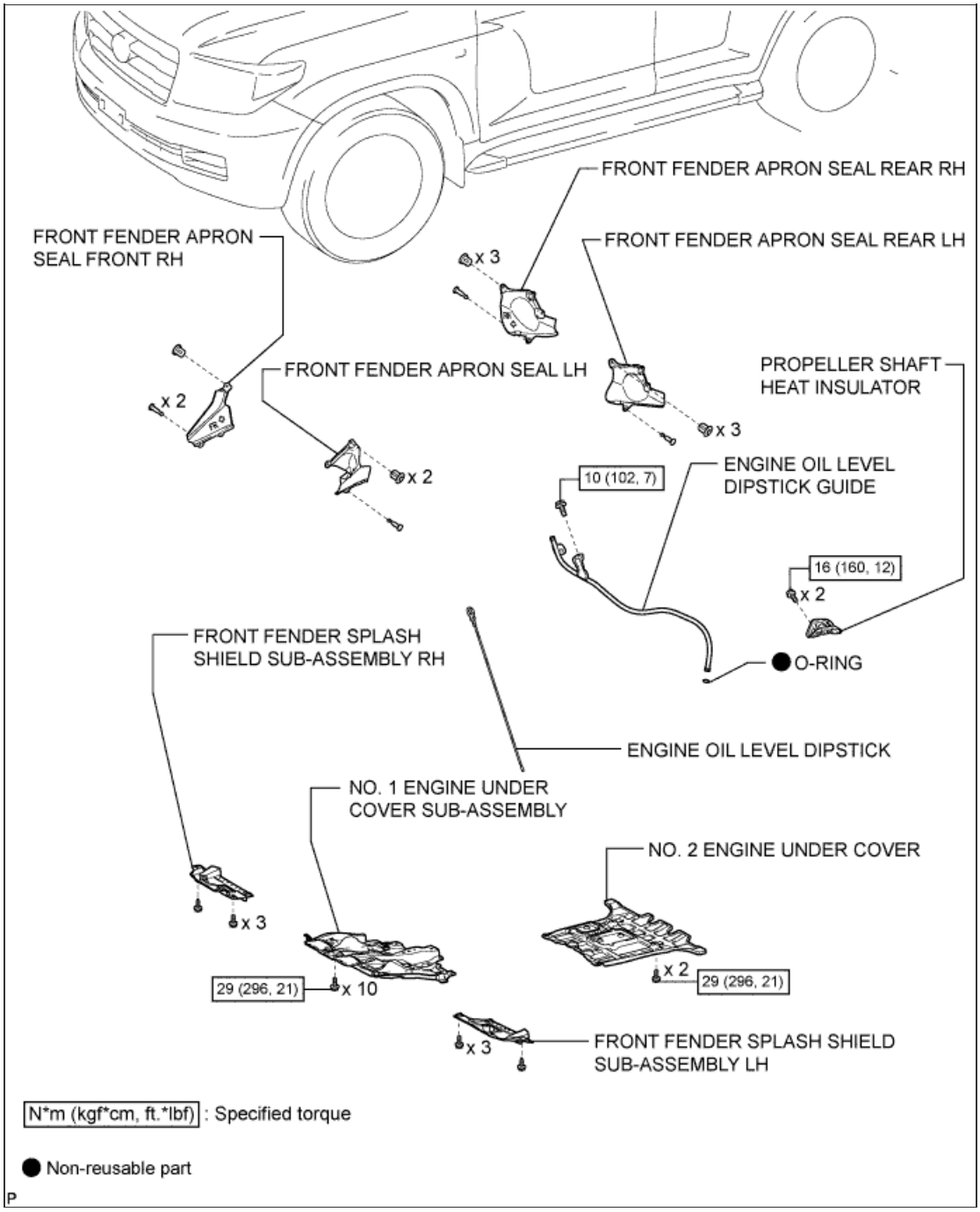
a. ttach the 2 V-bank cover hooks to the bracket. Then align the 3 V-bank cover grommets with the 3 pins, and press down on the V-bank cover to attach the pins.

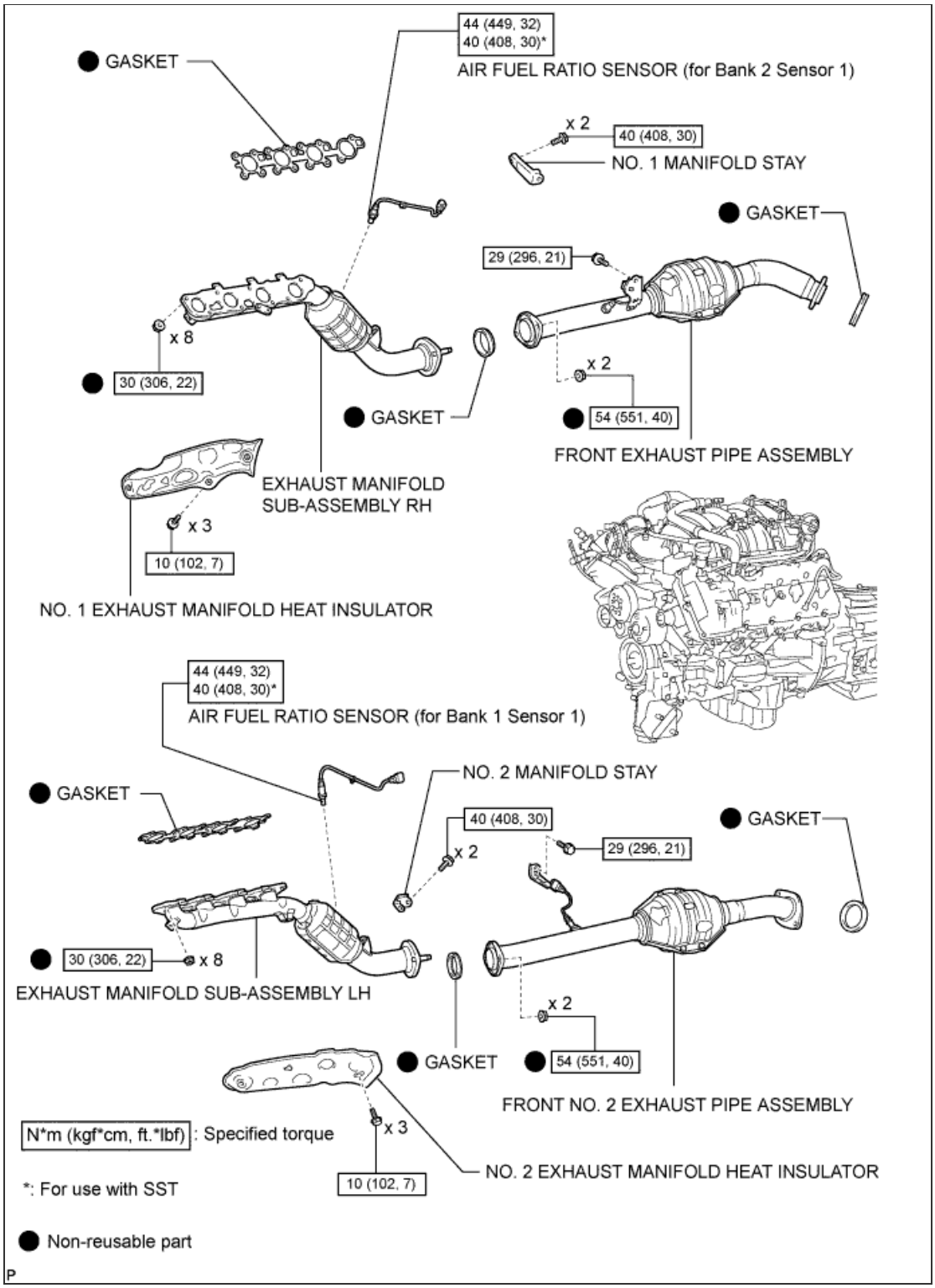
Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet



for Preparation Click here



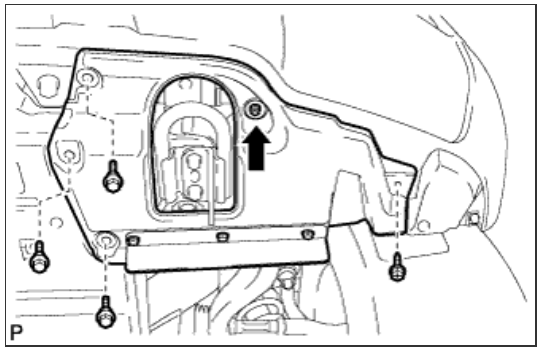

GASKET
44 (449, 32)
40 (408, 30)*
AIR FUEL RATIO SENSOR (for Bank 2 Sensor 1)
x 2
40 (408, 30)
NO. 1 MANIFOLD STAY
GASKET
29 (296, 21)
x 8
30 (306, 22)
GASKET
x 2
54 (551, 40)
FRONT EXHAUST PIPE ASSEMBLY
EXHAUST MANIFOLD
SUB-ASSEMBLY RH
x 3
10 (102, 7)
NO. 1 EXHAUST MANIFOLD HEAT INSULATOR
44 (449, 32)
40 (408, 30)*
AIR FUEL RATIO SENSOR (for Bank 1 Sensor 1)
NO. 2 MANIFOLD STAY
GASKET
40 (408, 30)
x 2
29 (296, 21)
GASKET
30 (306, 22)
x 8
EXHAUST MANIFOLD SUB-ASSEMBLY LH
x 2
GASKET
54 (551, 40)
FRONT NO. 2 EXHAUST PIPE ASSEMBLY
x 3
10 (102, 7)
NO. 2 EXHAUST MANIFOLD HEAT INSULATOR
N*m (kgf*cm, ft.*lbf) : Specified torque
*: For use with SST
Non-reusable part
P

for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



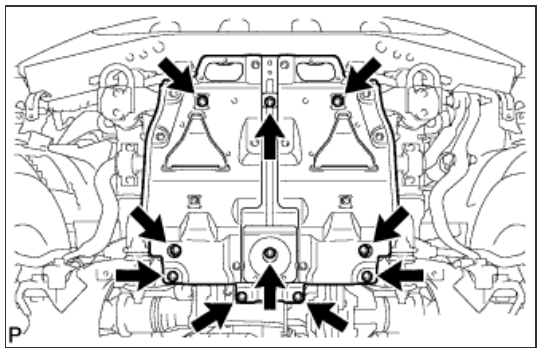
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

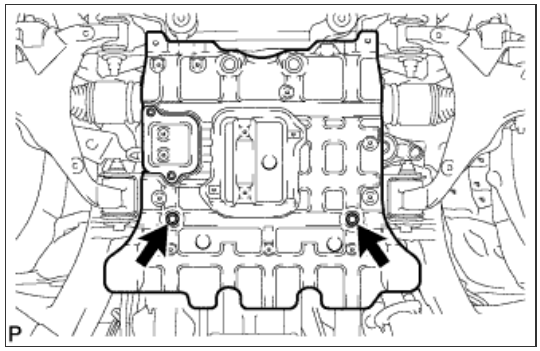
3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and No. 1 engine under cover.



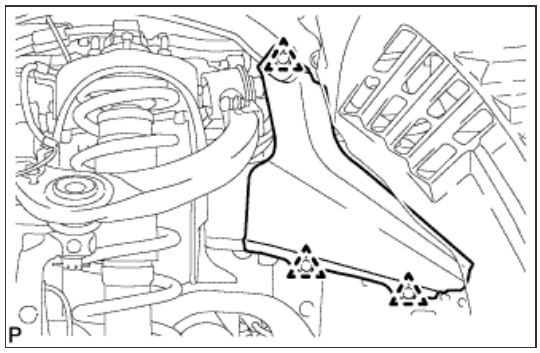
4. REMOVE NO. 2 ENGINE UNDER COVER

a. Remove the 2 bolts and No. 2 engine under cover.



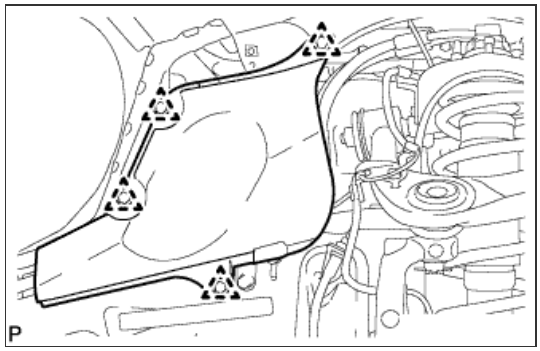
5. REMOVE FRONT FENDER APRON SEAL FRONT RH

a. Using a clip remover, remove the 3 clips and fender apron seal.



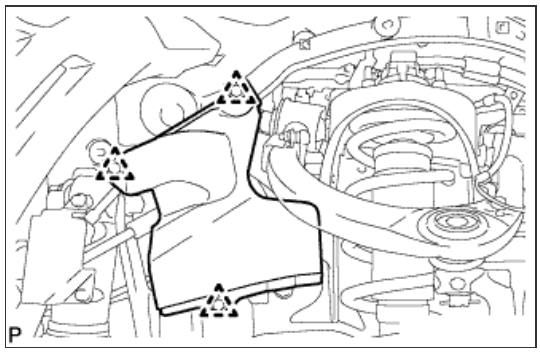
6. REMOVE FRONT FENDER APRON SEAL REAR RH

a. Using a clip remover, remove the 4 clips and fender apron seal.



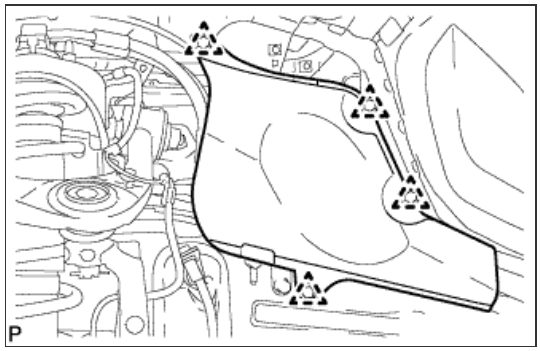
7. REMOVE FRONT FENDER APRON SEAL LH

a. Using a clip remover, remove the 3 clips and fender apron seal.



8. REMOVE FRONT FENDER APRON SEAL REAR LH

a. Using a clip remover, remove the 4 clips and fender apron seal.



9. REMOVE ENGINE OIL LEVEL DIPSTICK GUIDE

a. Apply a light coat of engine oil to a new O-ring.

b. Install the O-ring to the guide.

c. Install the dipstick guide with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

d. Install the dipstick.

e. Connect the wire harness clamp.

10. REMOVE TAILPIPE ASSEMBLY

a. Remove the bolt, clamp and gasket.

b. Remove the tailpipe from the 2 exhaust pipe supports.

c. Remove the bolt and clamp, and then disconnect the tailpipe from the center exhaust pipe.

11. REMOVE CENTER EXHAUST PIPE ASSEMBLY

a. Remove the 4 bolts.

b. Remove the center exhaust pipe from the 3 exhaust pipe supports.

c. Remove the 2 gaskets from the front exhaust pipe and front No. 2 exhaust pipe.

12. REMOVE FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Disconnect the heated oxygen sensor connector.

b. Remove the bolt and disconnect the wire harness clamp bracket of the oxygen sensor from the transmission.

c. Remove the 2 nuts, front No. 2 exhaust pipe and gasket from the exhaust manifold LH.

13. REMOVE FRONT EXHAUST PIPE ASSEMBLY

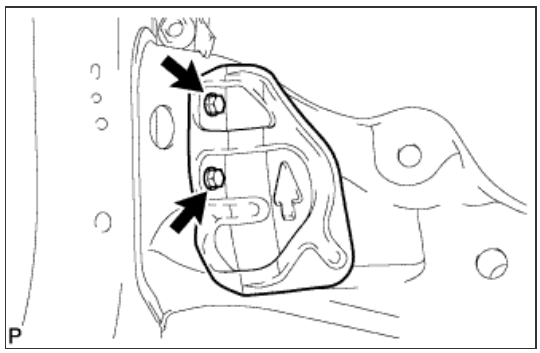
a. Disconnect the heated oxygen sensor connector.

b. Remove the bolt and disconnect the wire harness clamp bracket of the oxygen sensor from the transmission.

c. Remove the 2 nuts, front exhaust pipe and gasket from the exhaust manifold RH.

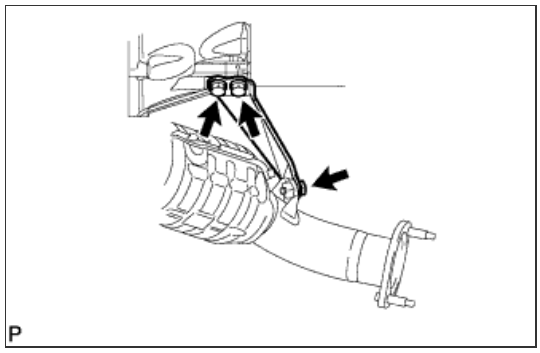
14. REMOVE PROPELLER SHAFT HEAT INSULATOR

a. Remove the 2 bolts and heat insulator.



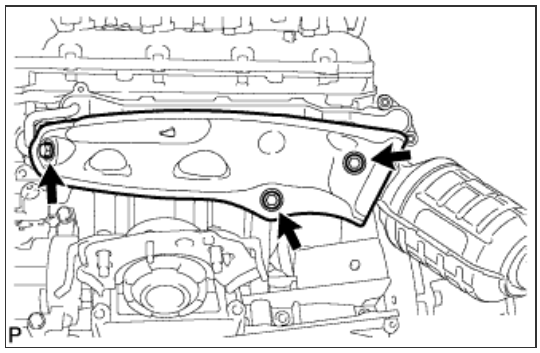
15. REMOVE NO. 2 MANIFOLD STAY

a. Remove the 3 bolts and manifold stay.



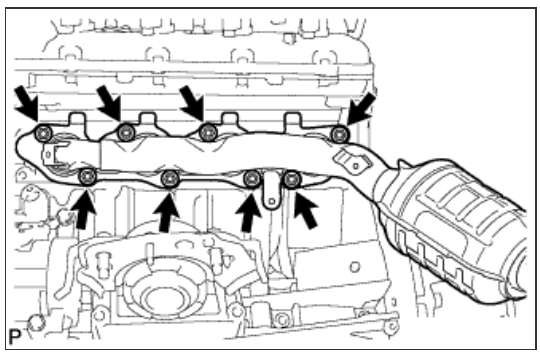
16. REMOVE NO. 2 EXHAUST MANIFOLD HEAT INSULATOR

a. Remove the 3 bolts and heat insulator.



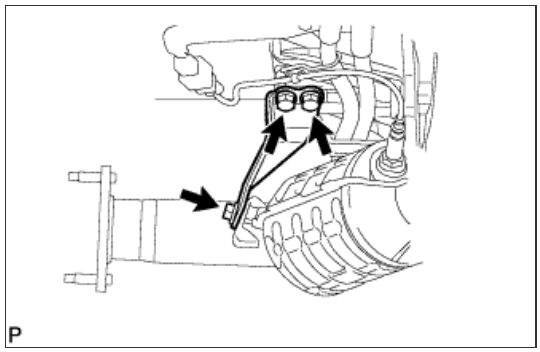
17. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY LH

a. Remove the 8 nuts, exhaust manifold and gasket.



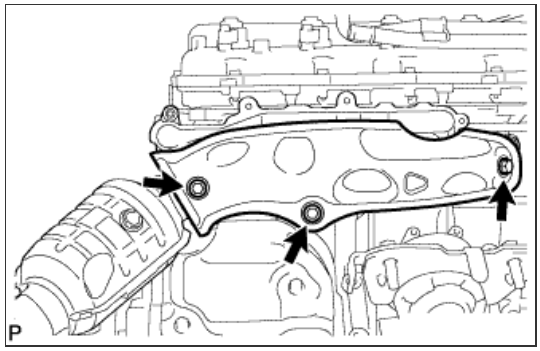
18. REMOVE NO. 1 MANIFOLD STAY

a. Remove the 3 bolts and manifold stay.



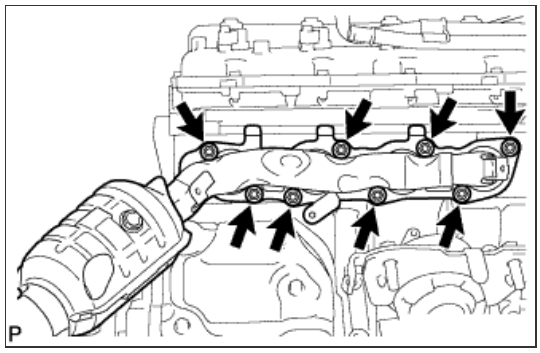
19. REMOVE NO. 1 EXHAUST MANIFOLD HEAT INSULATOR

a. Remove the 3 bolts and heat insulator.



20. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY RH

a. Remove the 8 nuts, exhaust manifold and gasket.



for Preparation Click here

1. INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY RH

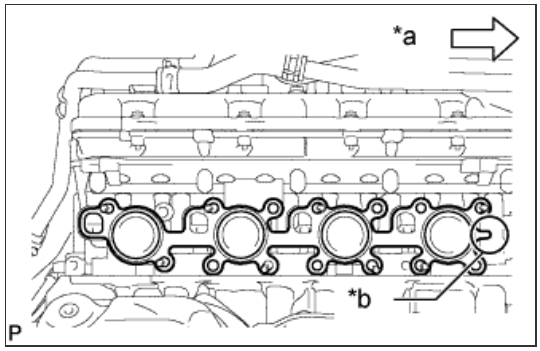
a. Install a new gasket to the cylinder head.

HINT:

Install the exhaust manifold gasket with the gasket tab facing toward the front of the engine.

Text in Illustration

*a	Front
*b	Tab



b. Install the exhaust manifold with 8 new nuts.

Torque:
30 N*m{ 306 kgf*cm , 22 ft.*lbf }

2. INSTALL NO. 1 EXHAUST MANIFOLD HEAT INSULATOR

a. Install the heat insulator with the 3 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

3. INSTALL NO. 1 MANIFOLD STAY

a. Install the manifold stay with the 3 bolts.

Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

4. INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY LH

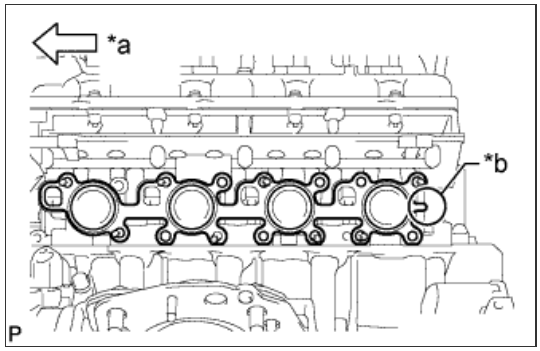
a. Install a new gasket to the cylinder head.

HINT:

Install the exhaust manifold gasket with the gasket tab facing toward the rear of the engine.

Text in Illustration

*a	Front
*b	Tab



b. Install the exhaust manifold with 8 new nuts.

Torque:
30 N*m{ 306 kgf*cm , 22 ft.*lbf }

5. INSTALL NO. 2 EXHAUST MANIFOLD HEAT INSULATOR

a. Install the heat insulator with the 3 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

6. INSTALL NO. 2 MANIFOLD STAY

a. Install the manifold stay with the 3 bolts.

Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

7. INSTALL PROPELLER SHAFT HEAT INSULATOR

a. Install the heat insulator with the 2 bolts.

Torque:
16 N*m{ 160 kgf*cm , 12 ft.*lbf }

8. INSTALL FRONT EXHAUST PIPE ASSEMBLY

a. Install a new gasket and the front exhaust pipe to the exhaust manifold RH with 2 new nuts.

Torque:
54 N*m{ 551 kgf*cm , 40 ft.*lbf }

b. Install the wire harness clamp bracket of the oxygen sensor to the transmission with the bolt.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

c. Connect the heated oxygen sensor connector.

9. INSTALL FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Install a new gasket and the front No. 2 exhaust pipe to the exhaust manifold LH with 2 new nuts.

Torque:
54 N*m{ 551 kgf*cm , 40 ft.*lbf }

b. Install the wire harness clamp bracket of the oxygen sensor to the transmission with the bolt.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

c. Connect the heated oxygen sensor connector.

10. INSTALL CENTER EXHAUST PIPE ASSEMBLY

a. Install 2 new gaskets to the front exhaust pipe and front No. 2 exhaust pipe.

b. Install the center exhaust pipe to the 3 exhaust pipe supports, and then install the 4 bolts.

Torque:
48 N*m{ 489 kgf*cm , 35 ft.*lbf }

11. INSTALL TAILPIPE ASSEMBLY

a. Install the tailpipe to the 2 exhaust pipe supports.

b. Install a new gasket to the center exhaust pipe.

c. Connect the tailpipe to the center exhaust pipe.

d. Attach a new clamp to the tailpipe and center exhaust pipe. Then install the bolt to the clamp.

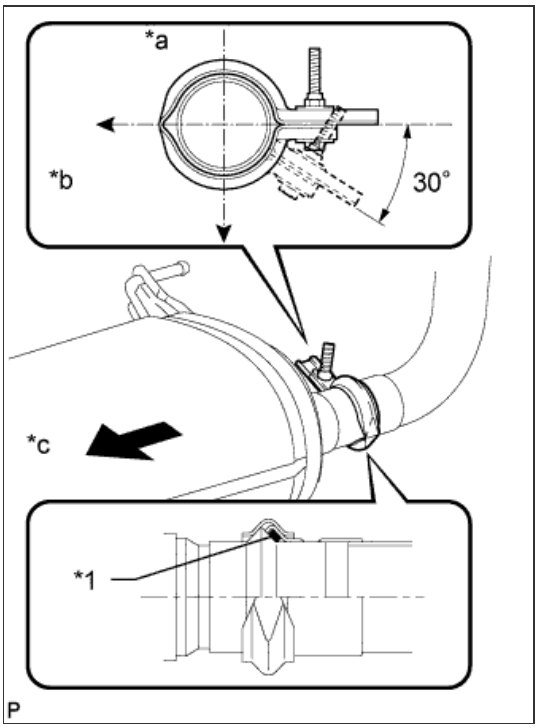
Torque:
32 N*m{ 326 kgf*cm , 24 ft.*lbf }

Text in Illustration

*1	Gasket
*a	Top
*b	LH Side
*c	Front

HINT:

Install the clamp within the angle range shown in the illustration.



12. INSTALL ENGINE OIL LEVEL DIPSTICK GUIDE

a. Apply a light coat of engine oil to a new O-ring.

b. Install the O-ring to the guide.

c. Install the dipstick guide with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

d. Install the dipstick.

e. Connect the wire harness clamp.

13. INSPECT FOR EXHAUST GAS LEAK

If gas is leaking, tighten the areas necessary to stop the leak. Replace damaged parts as necessary.

14. INSTALL FRONT FENDER APRON SEAL LH

a. Install the fender apron seal with the 3 clips.

15. INSTALL FRONT FENDER APRON SEAL REAR LH

a. Install the fender apron seal with the 4 clips.

16. INSTALL FRONT FENDER APRON SEAL FRONT RH

a. Install the fender apron seal with the 3 clips.

17. INSTALL FRONT FENDER APRON SEAL REAR RH

a. Install the fender apron seal with the 4 clips.

18. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

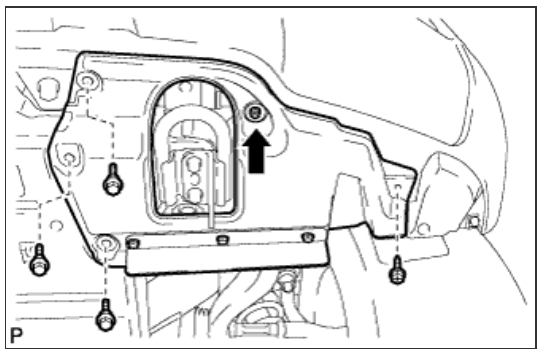
a. Install the No. 1 engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

19. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



20. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

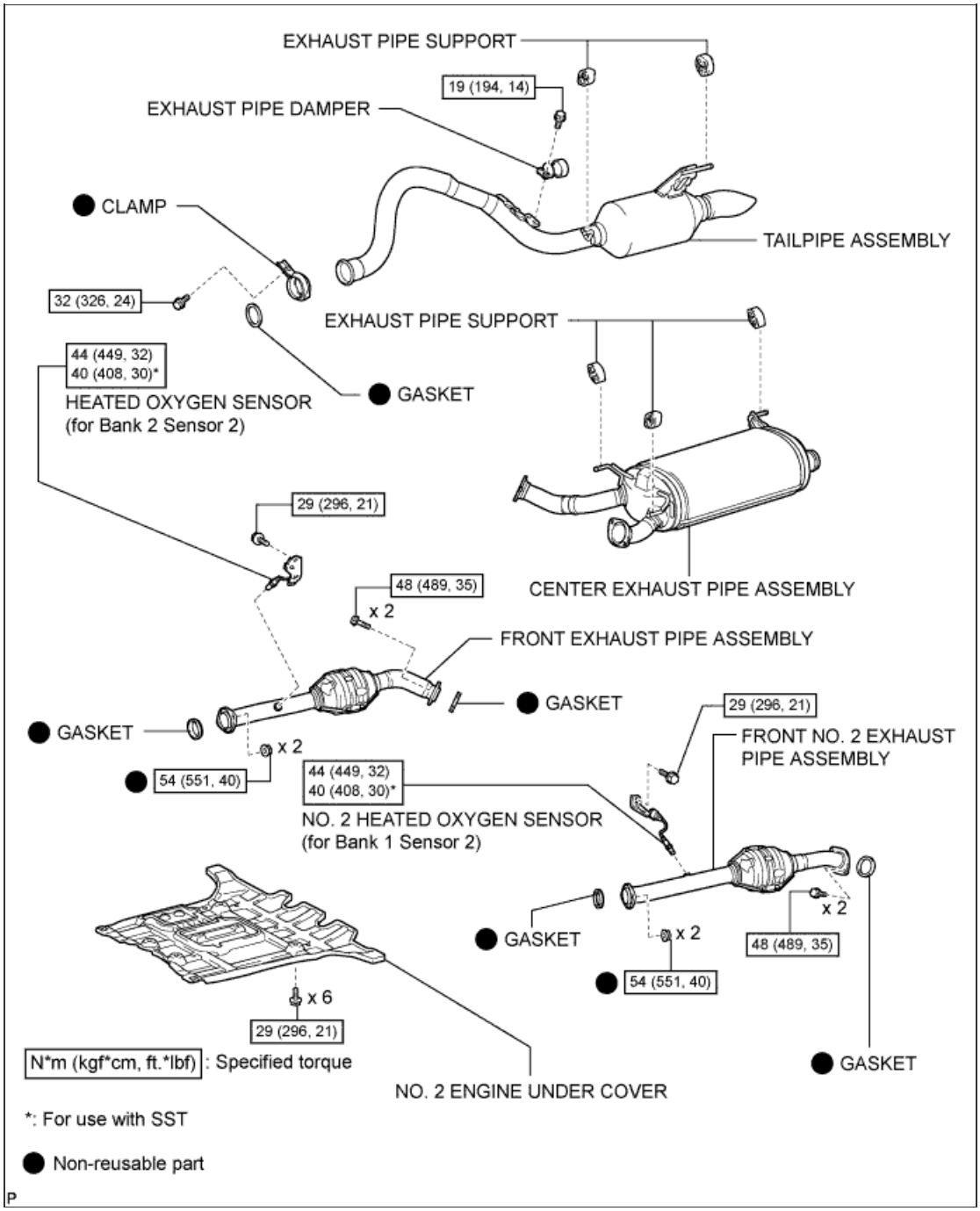
Use the same procedures described for the LH side.

21. INSTALL NO. 2 ENGINE UNDER COVER

a. Install the No. 2 engine under cover with the 2 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

for Preparation Click here



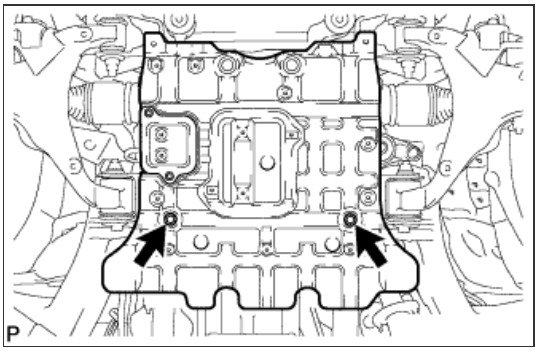
for Preparation Click here

CAUTION:

- **Wear protective gloves when removing the exhaust pipe.**
- **The exhaust pipe is extremely hot immediately after the engine has stopped.**
- **Confirm that the exhaust pipe has cooled down before removing it.**

1. REMOVE NO. 2 ENGINE UNDER COVER

a. Remove the 2 bolts and No. 2 engine under cover.



2. REMOVE TAILPIPE ASSEMBLY

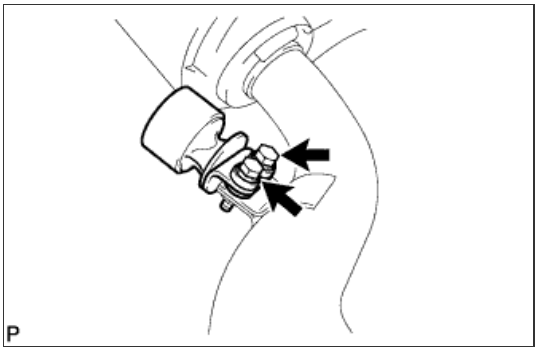
a. Remove the bolt, clamp and gasket.

b. Remove the tailpipe from the 2 exhaust pipe supports.

c. Remove the bolt and clamp, and then disconnect the tailpipe from the center exhaust pipe.

3. REMOVE EXHAUST PIPE DAMPER

a. Remove the 2 bolts and exhaust pipe damper from the tailpipe.



4. REMOVE CENTER EXHAUST PIPE ASSEMBLY

a. Remove the 4 bolts.

b. Remove the center exhaust pipe from the 3 exhaust pipe supports.

c. Remove the 2 gaskets from the front exhaust pipe and front No. 2 exhaust pipe.

5. REMOVE FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Disconnect the heated oxygen sensor connector.

b. Remove the bolt and disconnect the wire harness clamp bracket of the oxygen sensor from the transmission.

c. Remove the 2 nuts, front No. 2 exhaust pipe and gasket from the exhaust manifold LH.

6. REMOVE FRONT EXHAUST PIPE ASSEMBLY

a. Disconnect the heated oxygen sensor connector.

b. Remove the bolt and disconnect the wire harness clamp bracket of the oxygen sensor from the transmission.

c. Remove the 2 nuts, front exhaust pipe and gasket from the exhaust manifold RH.

7. REMOVE NO. 2 HEATED OXYGEN SENSOR (for Bank 1 Sensor 2)

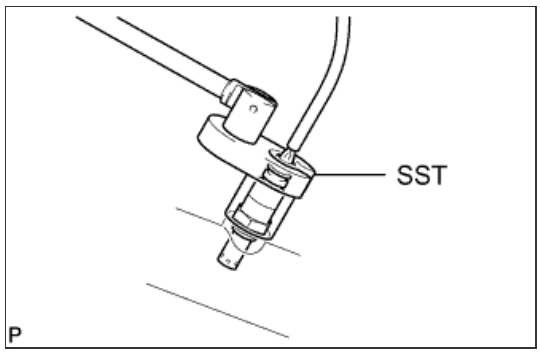
a. Using SST, remove the sensor.

SST
09224-00010

8. REMOVE HEATED OXYGEN SENSOR (for Bank 2 Sensor 2)

a. Using SST, remove the sensor.

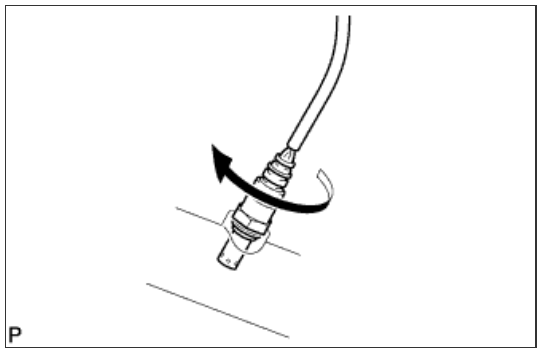
SST
09224-00010



for Preparation Click here

1. INSTALL NO. 2 HEATED OXYGEN SENSOR (for Bank 1 Sensor 2)

a. Temporarily install the sensor to the exhaust pipe by hand.



b. Using SST, tighten the sensor.

SST
09224-00010

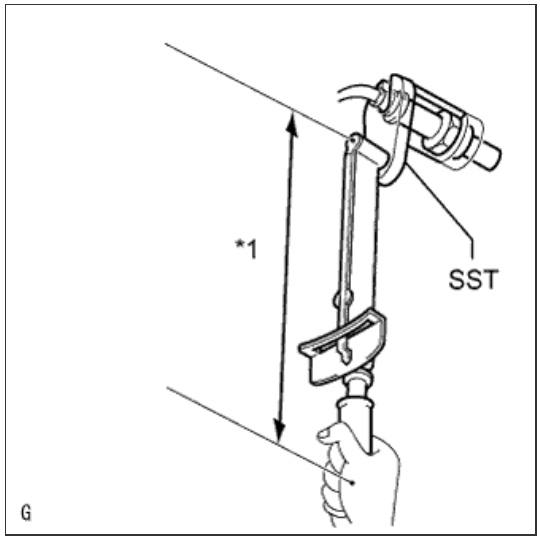
Torque:
without SST:
44 N*m{ 449 kgf*cm , 32 ft.*lbf }
with SST:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

Text in Illustration

*1	Fulcrum Length

HINT:

- **Use a torque wrench with a fulcrum length of 300 mm (11.8 in.). If using a torque wrench with a length that is not 300 mm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the "without SST" torque specification (Click here).**
- **Make sure SST and the wrench are connected in a straight line.**



2. INSTALL HEATED OXYGEN SENSOR (for Bank 2 Sensor 2)

a. Temporarily install the sensor to the exhaust pipe by hand.

b. Using SST, tighten the sensor.

SST
09224-00010

Torque:
without SST:
44 N*m{ 449 kgf*cm , 32 ft.*lbf }
with SST:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

Text in Illustration

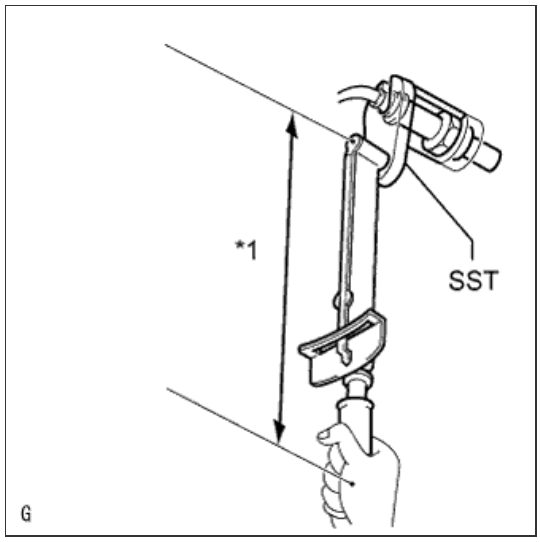
*1	Fulcrum Length

HINT:

- **Use a torque wrench with a fulcrum length of 300 mm (11.8 in.).**

If using a torque wrench with a length that is not 300 mm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the "without SST" torque specification (Click here).

- **Make sure SST and the wrench are connected in a straight line.**



3. INSTALL FRONT EXHAUST PIPE ASSEMBLY

a. Install a new gasket and the front exhaust pipe to the exhaust manifold RH with 2 new nuts.

Torque:
54 N*m{ 551 kgf*cm , 40 ft.*lbf }

b. Install the wire harness clamp bracket of the oxygen sensor to the transmission with the bolt.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

c. Connect the heated oxygen sensor connector.

4. INSTALL FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Install a new gasket and the front No. 2 exhaust pipe to the exhaust manifold LH with 2 new nuts.

Torque:
54 N*m{ 551 kgf*cm , 40 ft.*lbf }

b. Install the wire harness clamp bracket of the oxygen sensor to the transmission with the bolt.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

c. Connect the heated oxygen sensor connector.

5. INSTALL CENTER EXHAUST PIPE ASSEMBLY

a. Install 2 new gaskets to the front exhaust pipe and front No. 2 exhaust pipe.

b. Install the center exhaust pipe to the 3 exhaust pipe supports, and then install the 4 bolts.

Torque:
48 N*m{ 489 kgf*cm , 35 ft.*lbf }

6. INSTALL EXHAUST PIPE DAMPER

a. Install the exhaust pipe damper to the tailpipe with the 2 bolts.

Torque:
19 N*m{ 194 kgf*cm , 14 ft.*lbf }

7. INSTALL TAILPIPE ASSEMBLY

a. Install the tailpipe to the 2 exhaust pipe supports.

b. Install a new gasket to the center exhaust pipe.

c. Connect the tailpipe to the center exhaust pipe.

d. Attach a new clamp to the tailpipe and center exhaust pipe. Then install the bolt to the clamp.

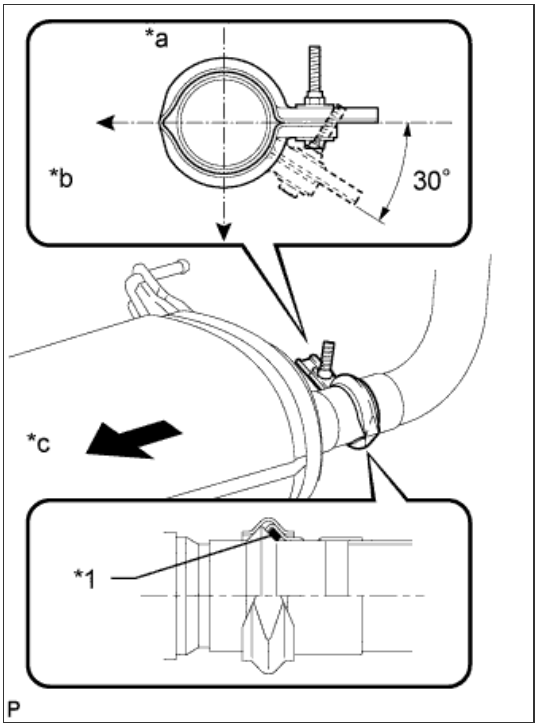
Torque:
32 N*m{ 326 kgf*cm , 24 ft.*lbf }

Text in Illustration

*1	aket
*a	Top
*b	LH Side
*c	Front

HINT:

Install the clamp within the angle range shown in the illustration.



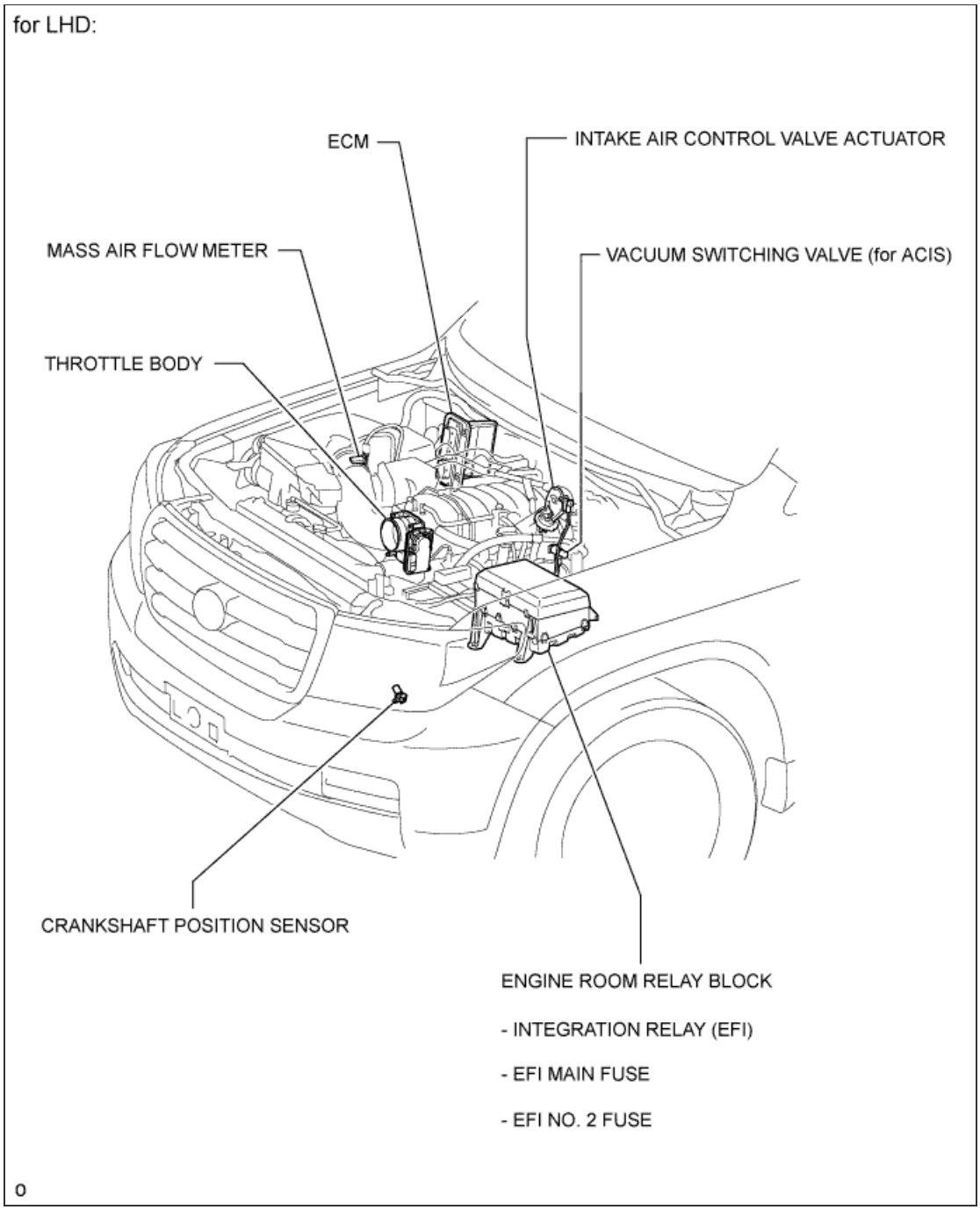
8. INSPECT FOR EXHAUST GAS LEAK

9. INSTALL NO. 2 ENGINE UNDER COVER

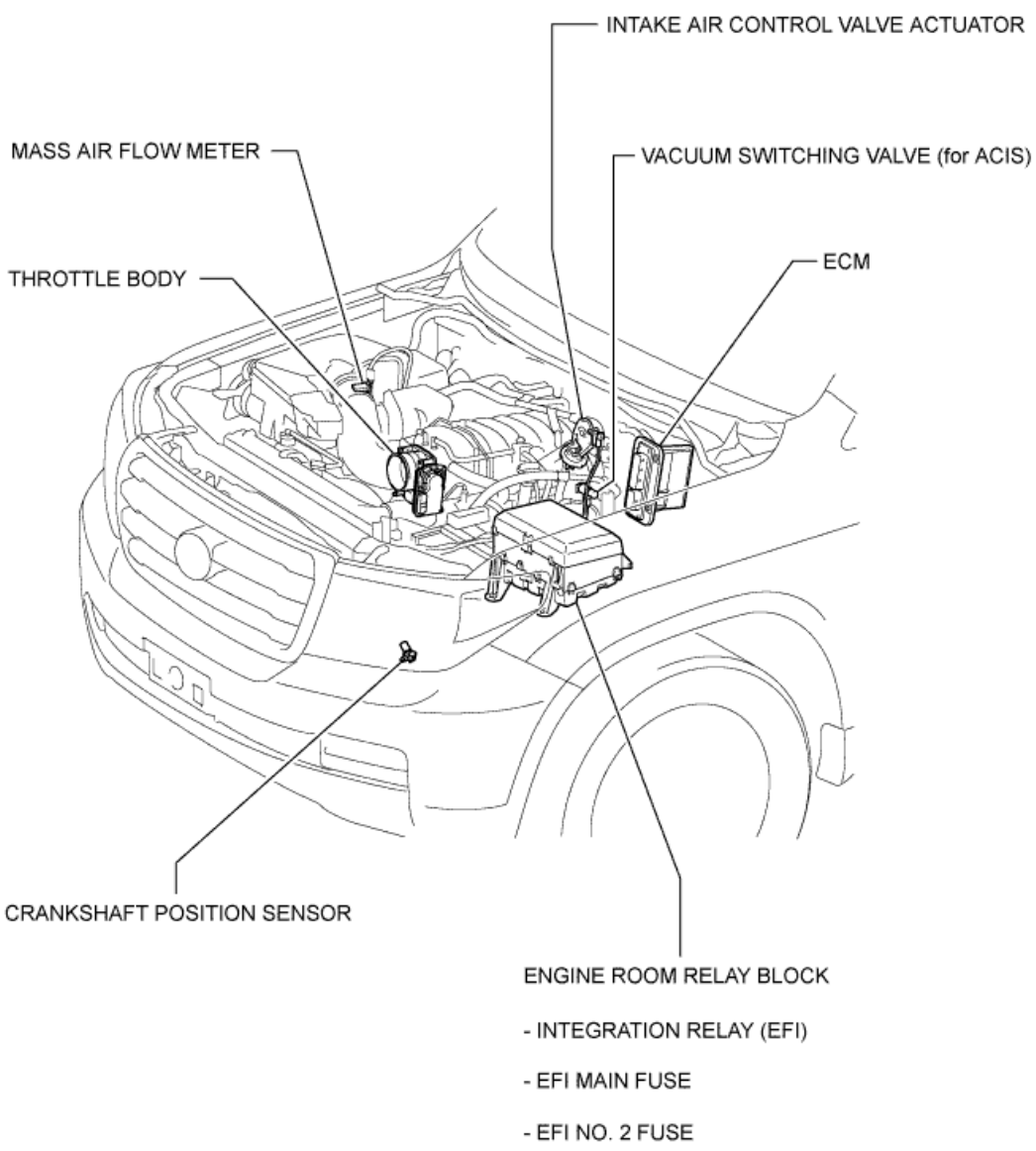
a. Install the No. 2 engine under co er with the 2 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

for Preparation Click here

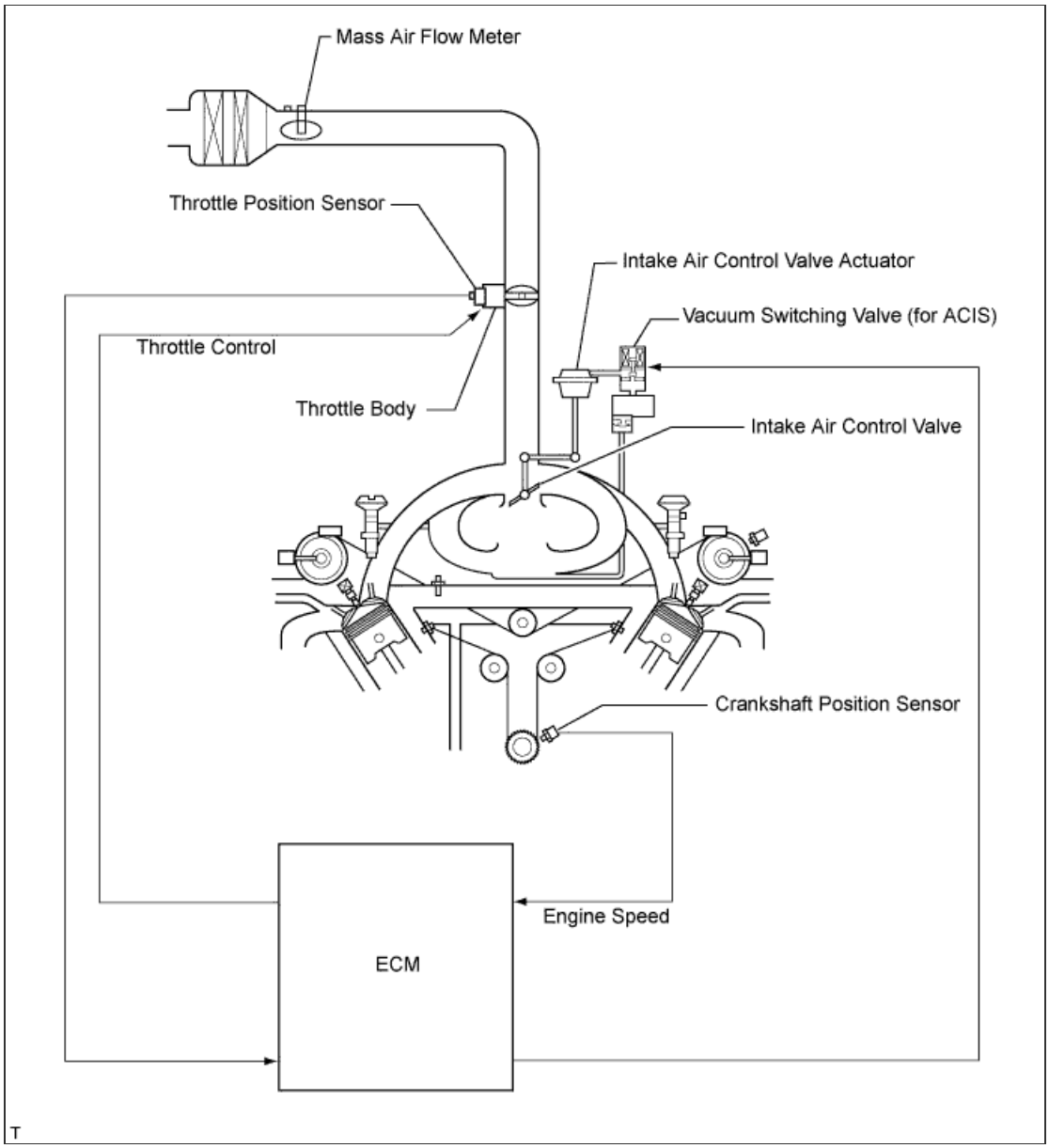


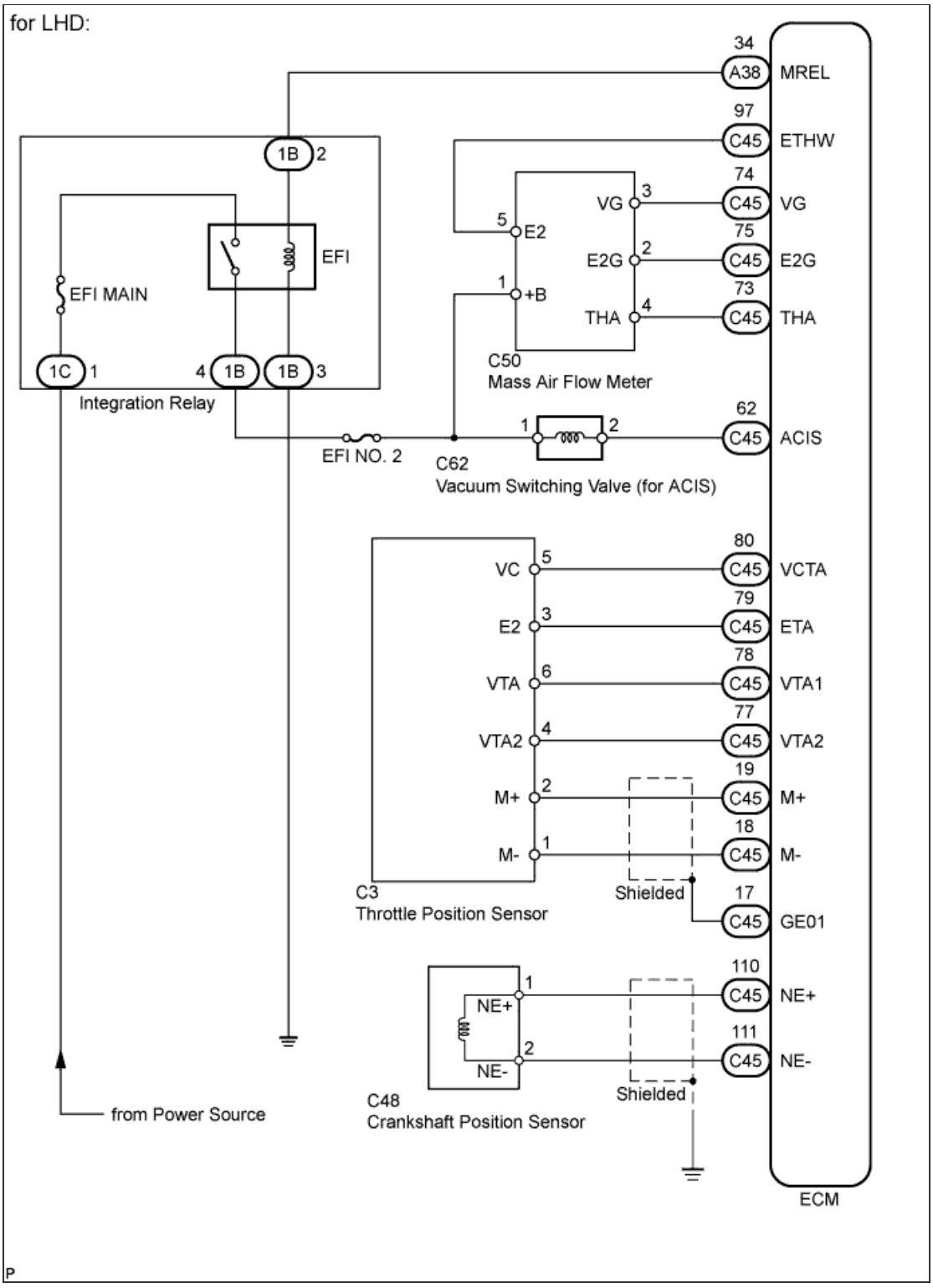
for RHD:

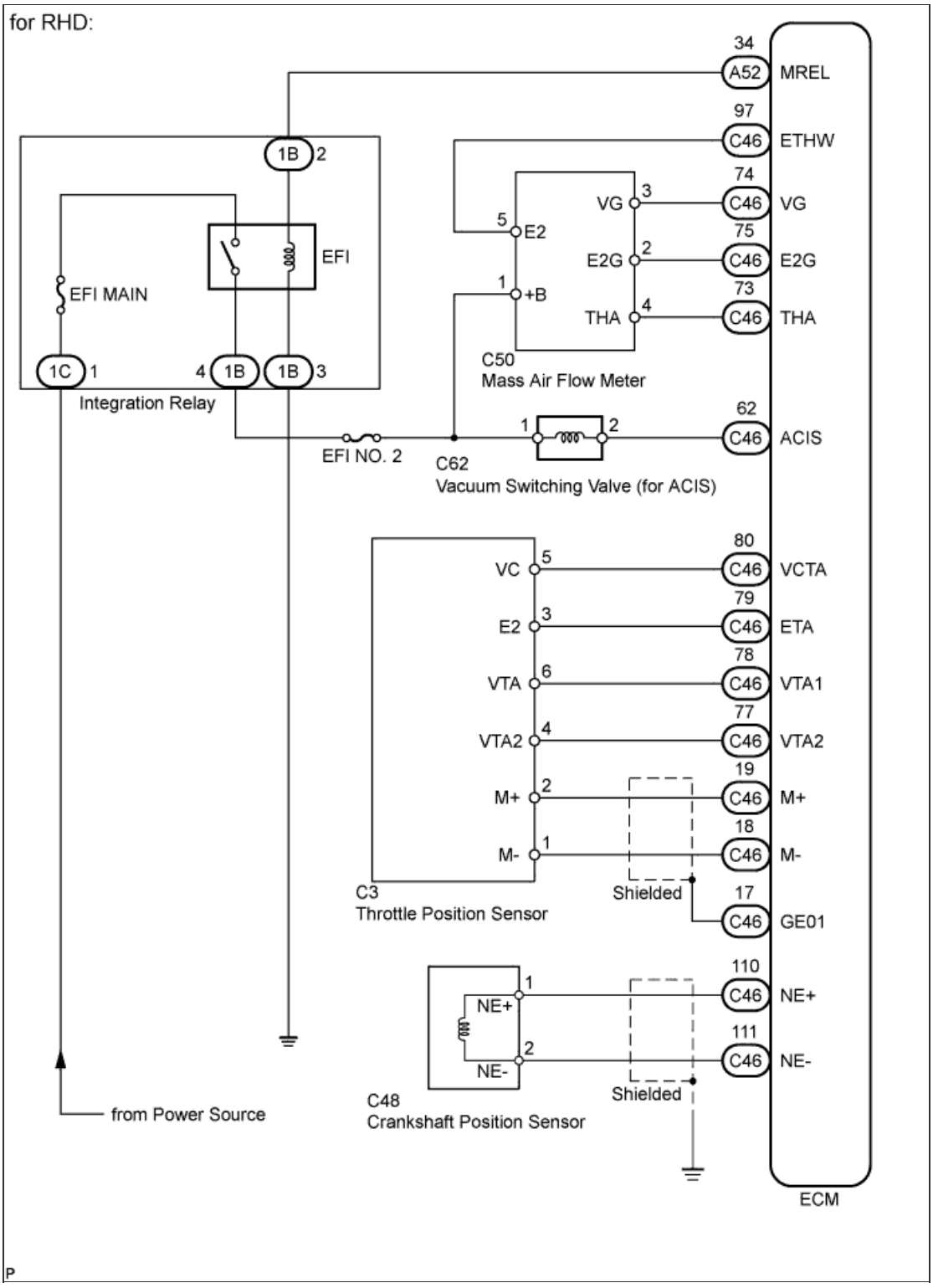

INTAKE AIR CONTROL VALVE ACTUATOR
MASS AIR FLOW METER
VACUUM SWITCHING VALVE (for ACIS)
THROTTLE BODY
ECM
CRANKSHAFT POSITION SENSOR
ENGINE ROOM RELAY BLOCK
- INTEGRATION RELAY (EFI)
- EFI MAIN FUSE
- EFI NO. 2 FUSE

o

for Preparation Click here




for LHD:
34
A38
MREL
97
C45
ETHW
74
C45
VG
75
C45
E2G
73
C45
THA
62
C45
ACIS
80
C45
VCTA
79
C45
ETA
78
C45
VTA1
77
C45
VTA2
19
C45
M+
18
C45
M-
17
C45
GE01
110
C45
NE+
111
C45
NE-
ECM
1B 2
EFI
EFI MAIN
1C 1
4 1B
1B 3
Integration Relay
EFI NO. 2
5 E2
VG 3
E2G 2
1 +B
THA 4
C50
Mass Air Flow Meter
1 2
C62
Vacuum Switching Valve (for ACIS)
VC 5
E2 3
VTA 6
VTA2 4
M+ 2
M- 1
C3
Throttle Position Sensor
Shielded
1 NE+
2 NE-
C48
Crankshaft Position Sensor
Shielded
from Power Source
P

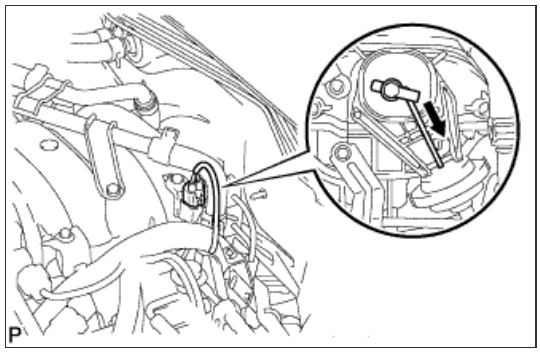

for RHD:
34
A52
MREL
97
C46
ETHW
74
C46
VG
75
C46
E2G
73
C46
THA
62
C46
ACIS
80
C46
VCTA
79
C46
ETA
78
C46
VTA1
77
C46
VTA2
19
C46
M+
18
C46
M-
17
C46
GE01
110
C46
NE+
111
C46
NE-
ECM
1B 2
EFI
EFI MAIN
1C 1
4 1B
1B 3
Integration Relay
EFI NO. 2
5 E2
1 +B
VG 3
E2G 2
THA 4
C50
Mass Air Flow Meter
C62
Vacuum Switching Valve (for ACIS)
VC 5
E2 3
VTA 6
VTA2 4
M+ 2
M- 1
C3
Throttle Position Sensor
Shielded
NE+ 1
NE- 2
C48
Crankshaft Position Sensor
Shielded
from Power Source
P

for Preparation Click here

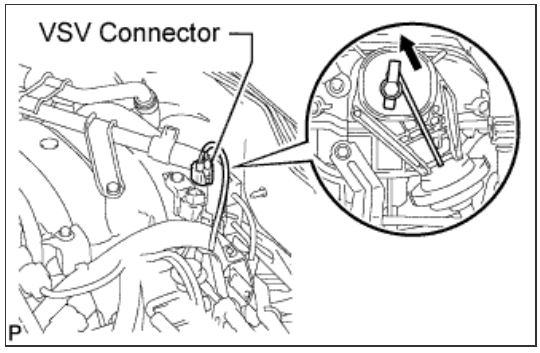
1. INSPECT INTAKE AIR CONTROL VALVE OPERATION

a. Start the engine.

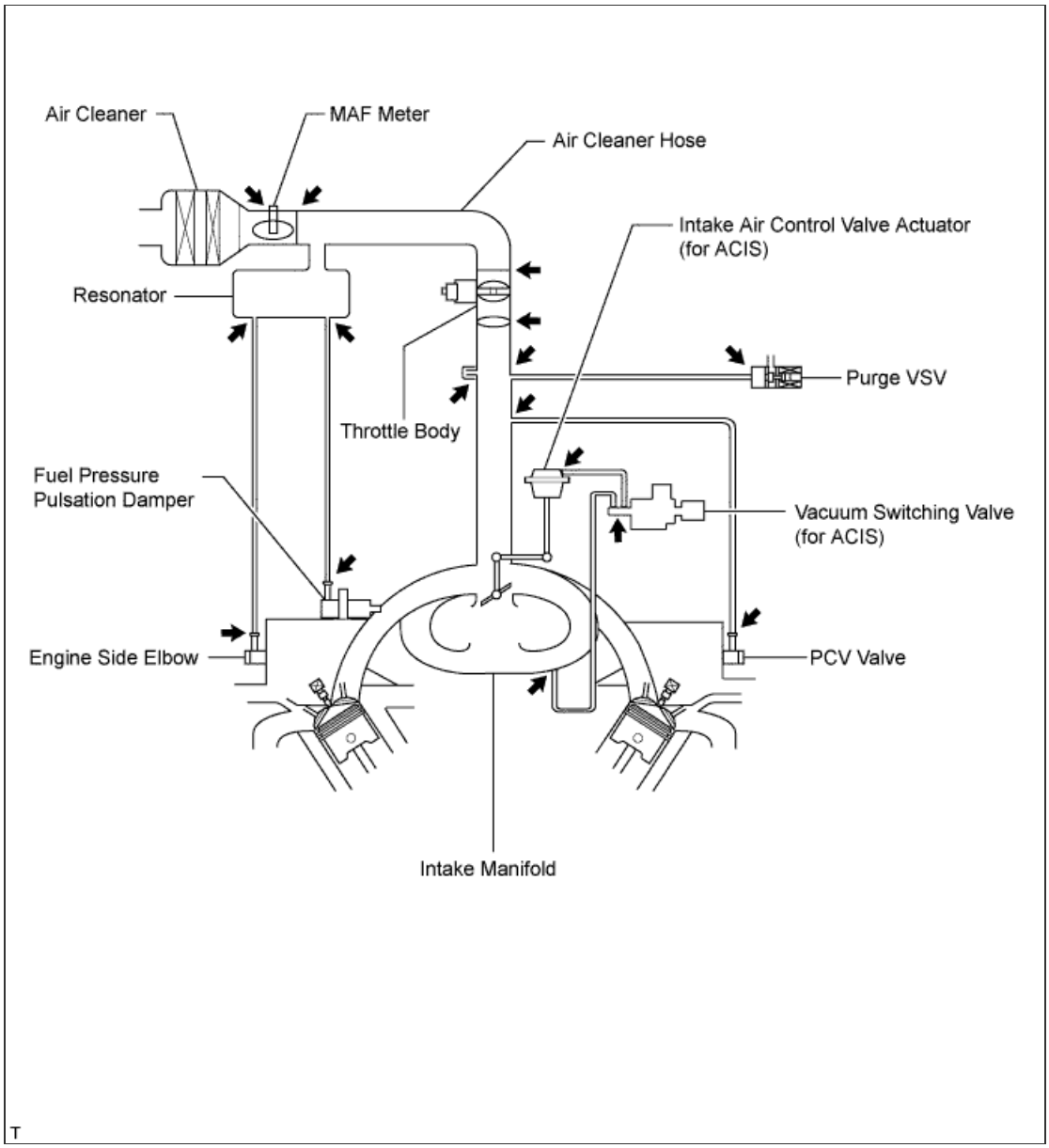
b. While the engine is idling, check that the actuator rod moves as shown in the illustration.



c. Disconnect the VSV connector, and check that the actuator rod returns.
If the result is not as specified, inspect the intake air control valve, VSV and ECM.



2. CHECK AIR INDUCTION SYSTEM



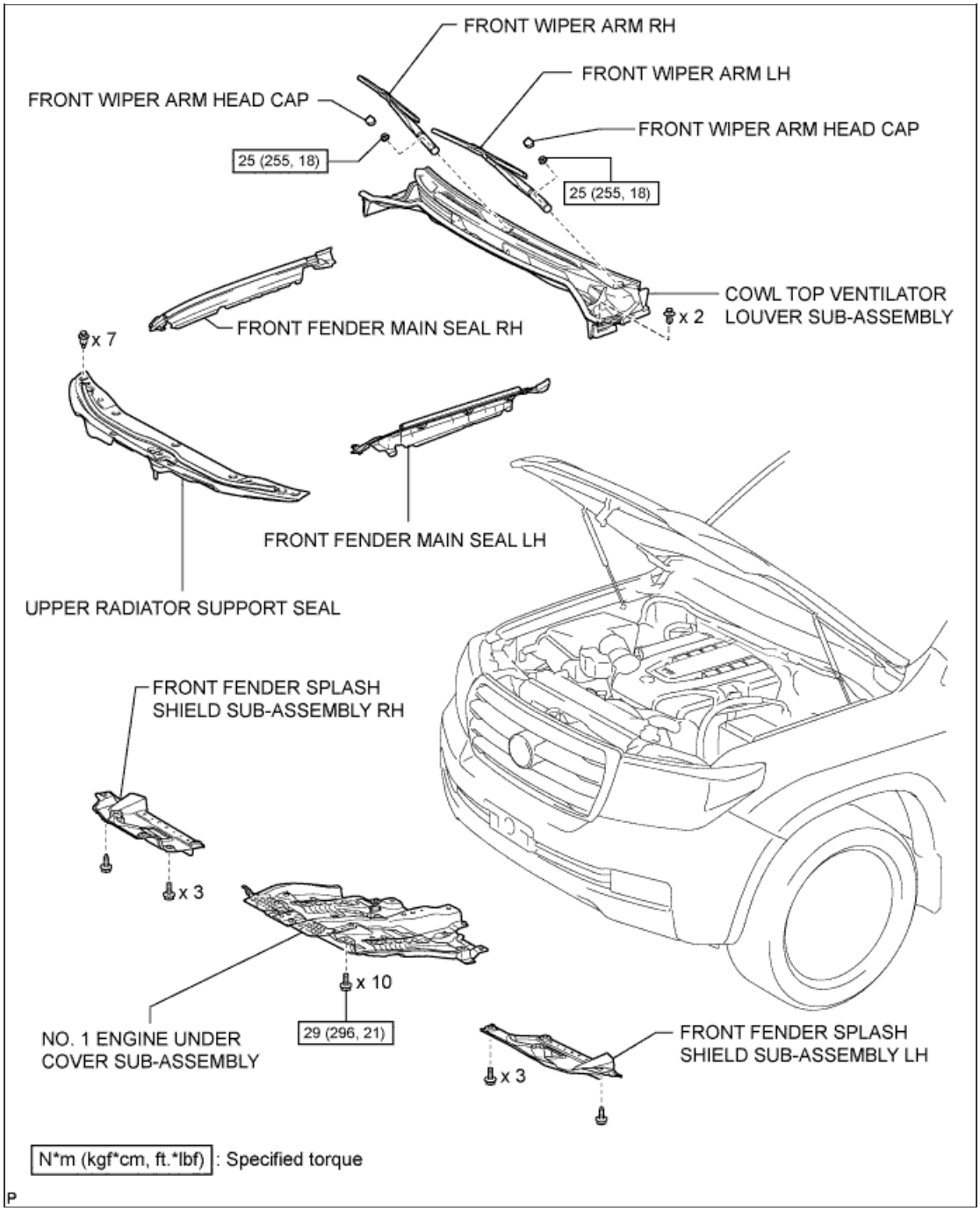
HINT:

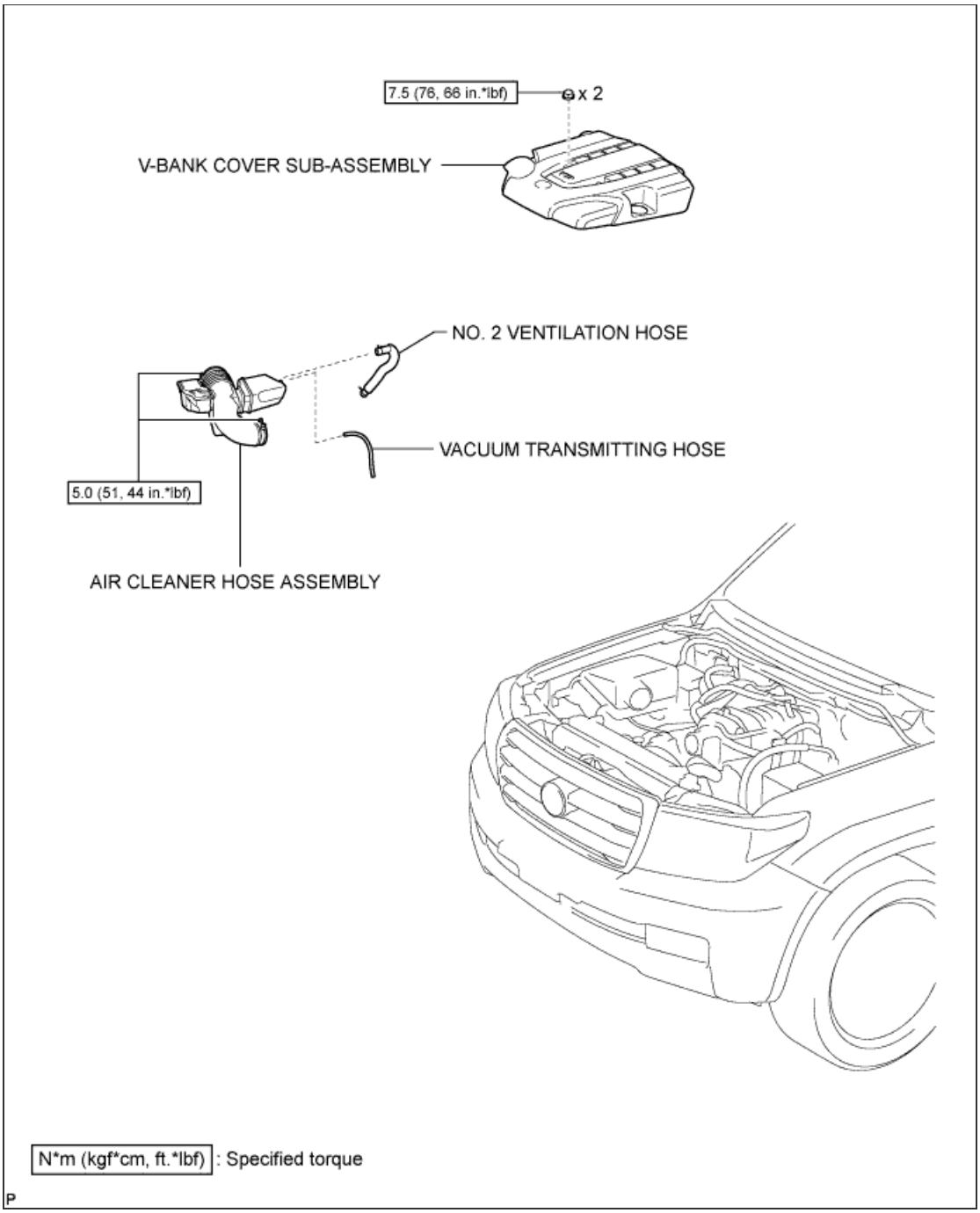
The illustration shows the areas that may draw in secondary air, which could lead to idling problems.

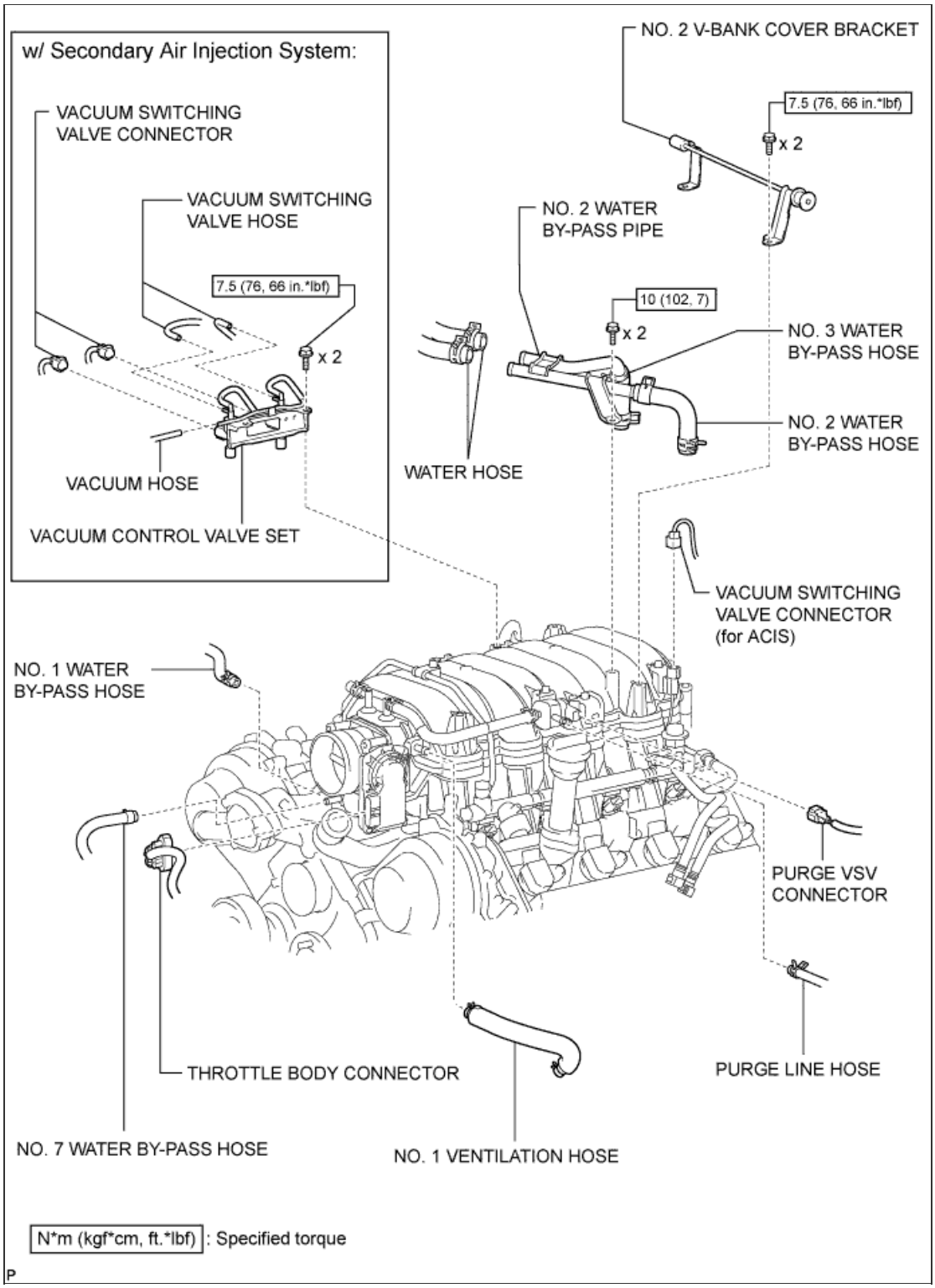
a. Check that the hoses are installed correctly.

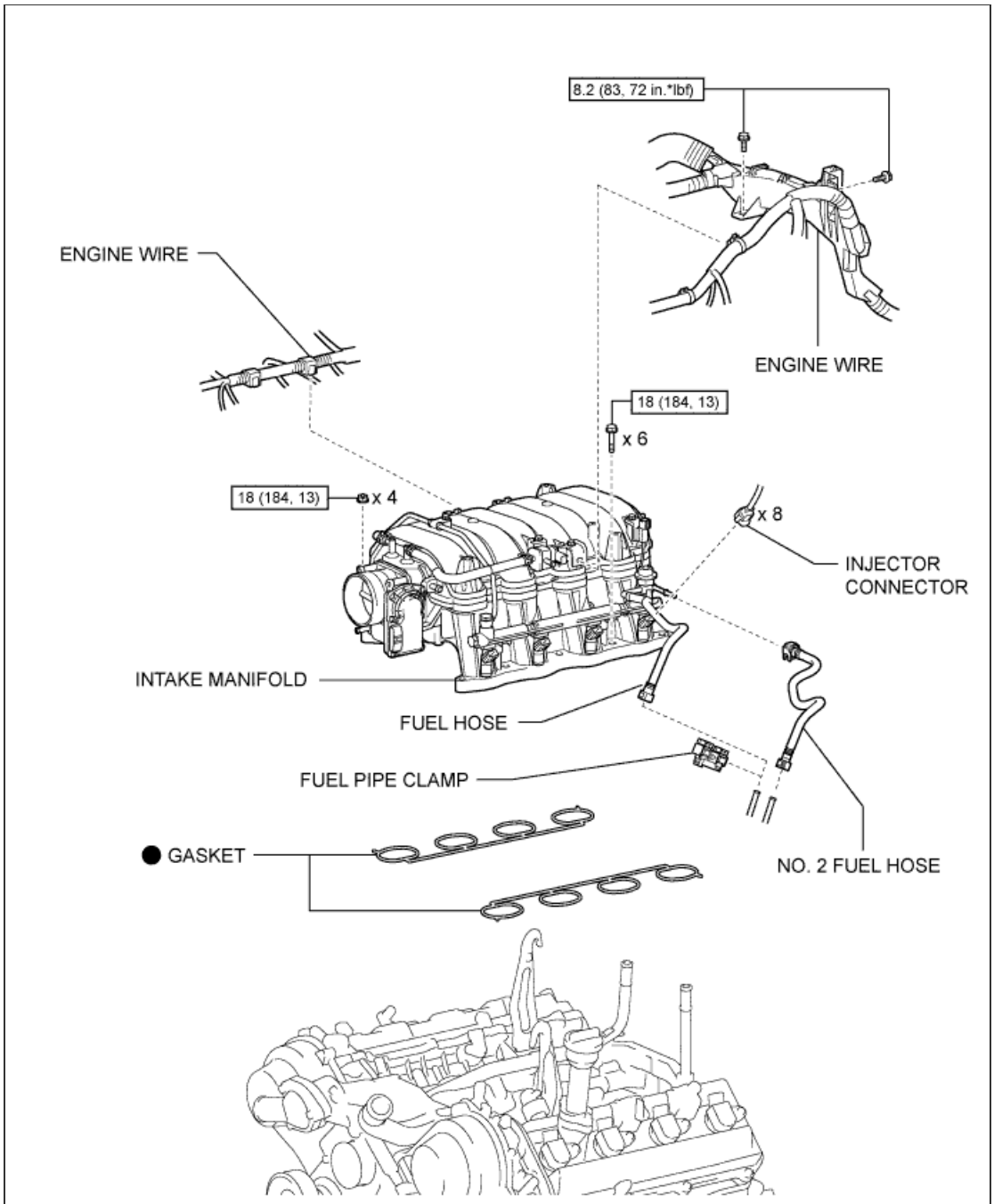
b. Check for cracks, etc. in the hoses.

for Preparation Click here




7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER SUB-ASSEMBLY
NO. 2 VENTILATION HOSE
VACUUM TRANSMITTING HOSE
5.0 (51, 44 in.*lbf)
AIR CLEANER HOSE ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
P

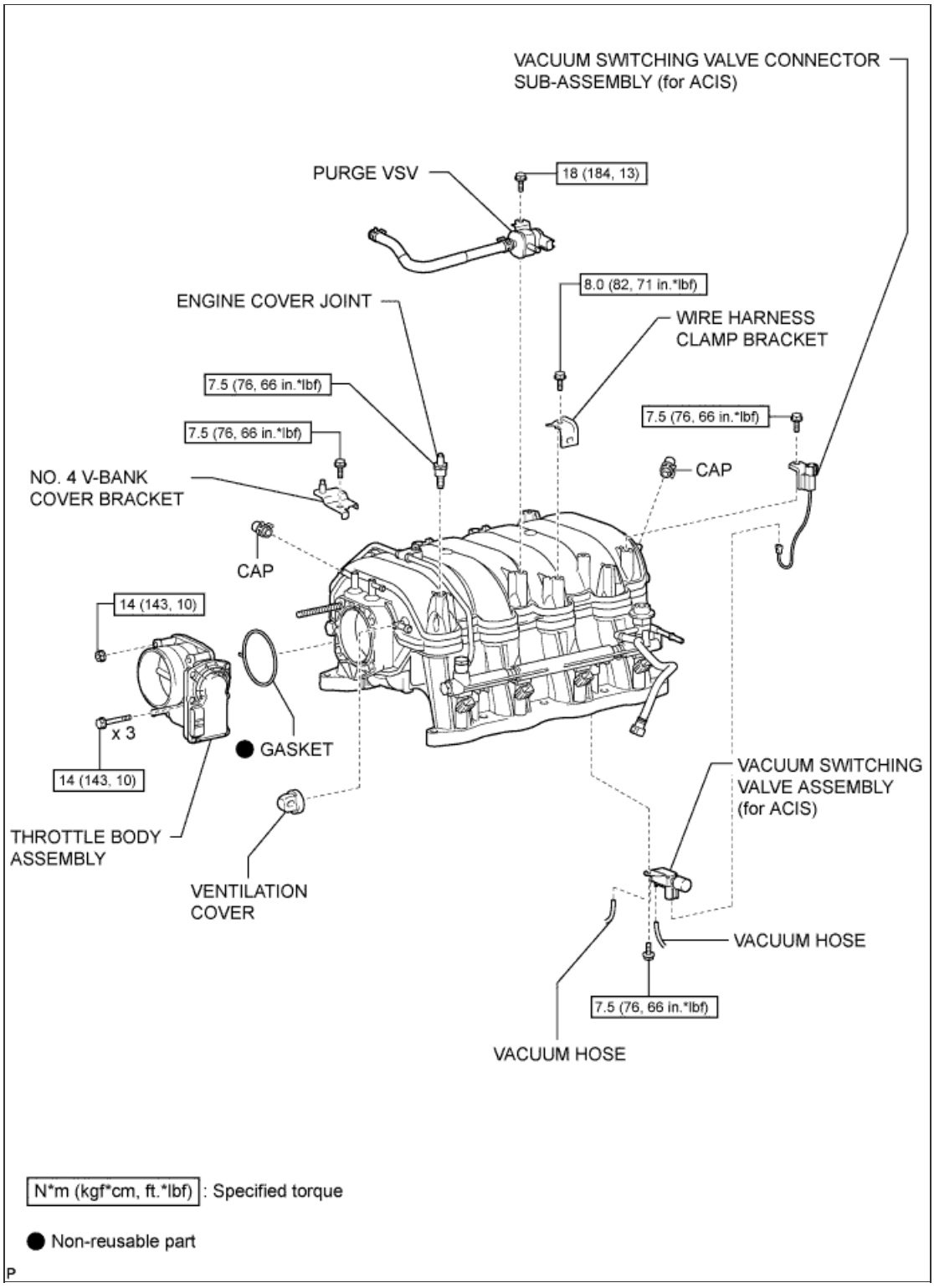

w/ Secondary Air Injection System:
VACUUM SWITCHING VALVE CONNECTOR
VACUUM SWITCHING VALVE HOSE
7.5 (76, 66 in.*lbf)
x 2
VACUUM HOSE
VACUUM CONTROL VALVE SET
NO. 2 V-BANK COVER BRACKET
7.5 (76, 66 in.*lbf)
x 2
NO. 2 WATER BY-PASS PIPE
10 (102, 7)
x 2
NO. 3 WATER BY-PASS HOSE
NO. 2 WATER BY-PASS HOSE
WATER HOSE
VACUUM SWITCHING VALVE CONNECTOR (for ACIS)
NO. 1 WATER BY-PASS HOSE
PURGE VSV CONNECTOR
THROTTLE BODY CONNECTOR
PURGE LINE HOSE
NO. 7 WATER BY-PASS HOSE
NO. 1 VENTILATION HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
P

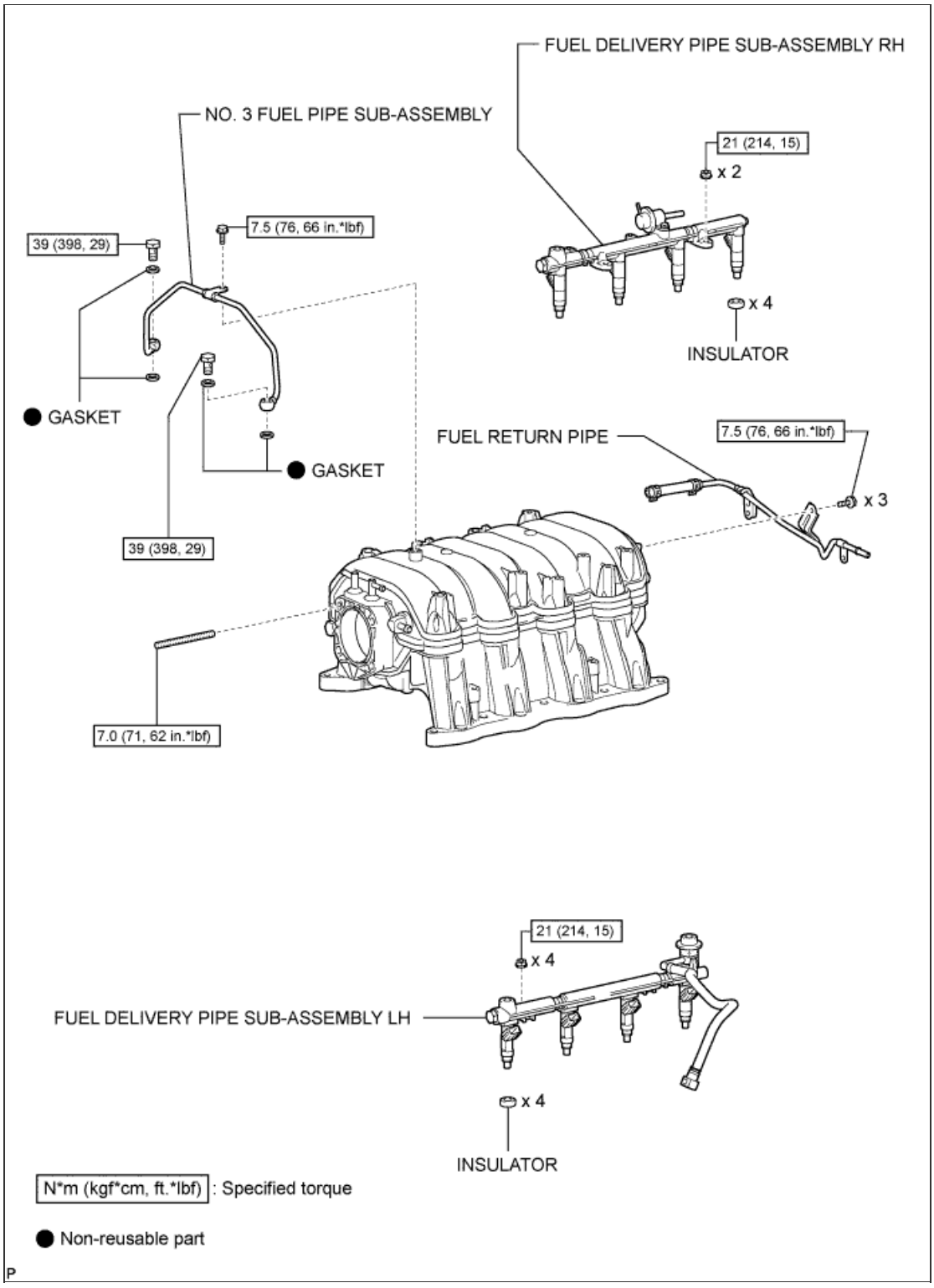


N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P


VACUUM SWITCHING VALVE CONNECTOR SUB-ASSEMBLY (for ACIS)
PURGE VSV
18 (184, 13)
8.0 (82, 71 in.*lbf)
ENGINE COVER JOINT
WIRE HARNESS CLAMP BRACKET
7.5 (76, 66 in.*lbf)
7.5 (76, 66 in.*lbf)
7.5 (76, 66 in.*lbf)
NO. 4 V-BANK COVER BRACKET
CAP
CAP
14 (143, 10)
x 3
14 (143, 10)
GASKET
THROTTLE BODY ASSEMBLY
VENTILATION COVER
VACUUM SWITCHING VALVE ASSEMBLY (for ACIS)
VACUUM HOSE
7.5 (76, 66 in.*lbf)
VACUUM HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P


FUEL DELIVERY PIPE SUB-ASSEMBLY RH
NO. 3 FUEL PIPE SUB-ASSEMBLY
21 (214, 15)
x 2
39 (398, 29)
7.5 (76, 66 in.*lbf)
x 4
INSULATOR
GASKET
GASKET
FUEL RETURN PIPE
7.5 (76, 66 in.*lbf)
x 3
39 (398, 29)
7.0 (71, 62 in.*lbf)
21 (214, 15)
x 4
FUEL DELIVERY PIPE SUB-ASSEMBLY LH
x 4
INSULATOR
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

a. Discharge the fuel system pressure (Click here).

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnect the cable, some systems need to be initialized after the cable is reconnected (Click here).

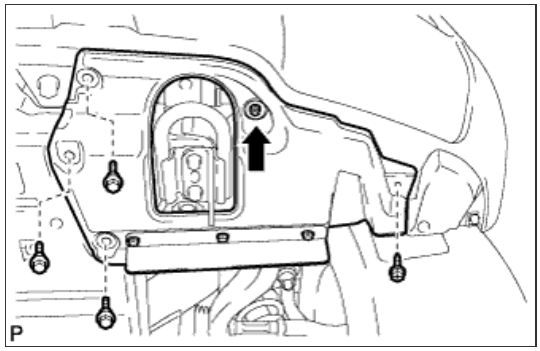
3. REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Remove the cowl top ventilator louver sub-assembly (Click here).

4. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



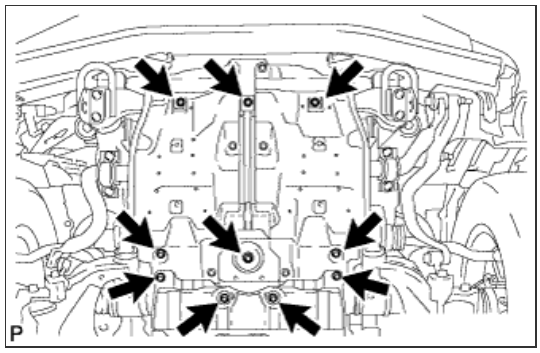
5. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

6. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

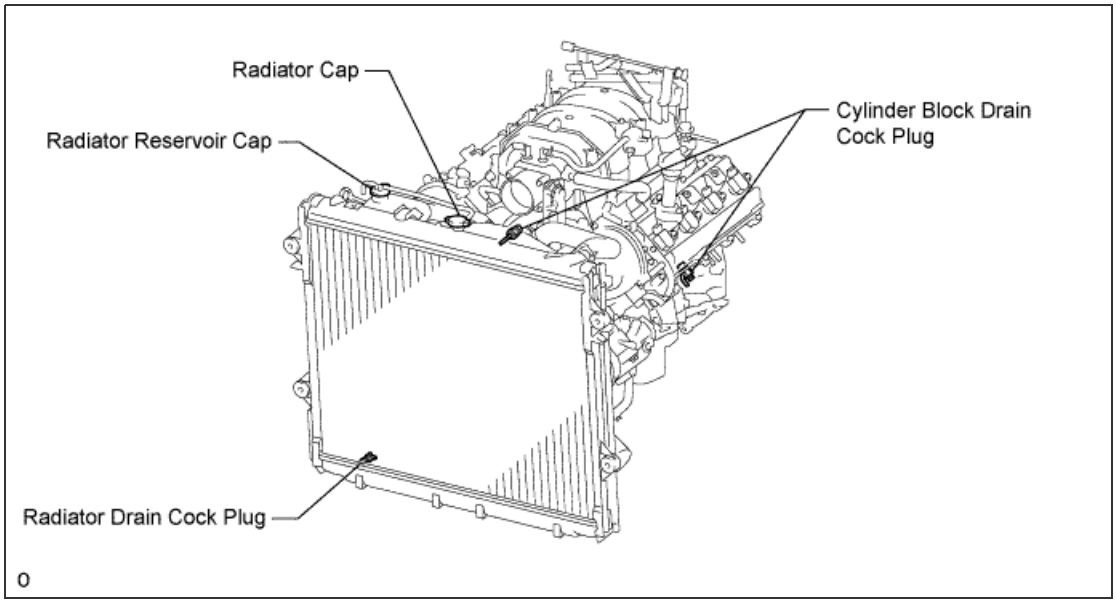
a. Remove the 10 bolts and No. 1 engine under cover.



7. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.



a. Loosen the radiator drain cock plug.

b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

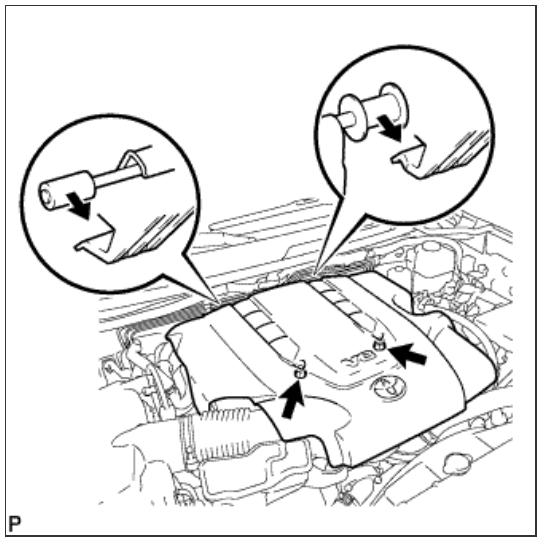
d. Tighten the 2 cylinder block drain cock plugs.

Torque:
13 N*m{ 130 kgf*cm , 9 ft.*lbf }

e. Tighten the radiator drain cock plug by hand.

8. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Remove the 2 nuts and V-bank cover.

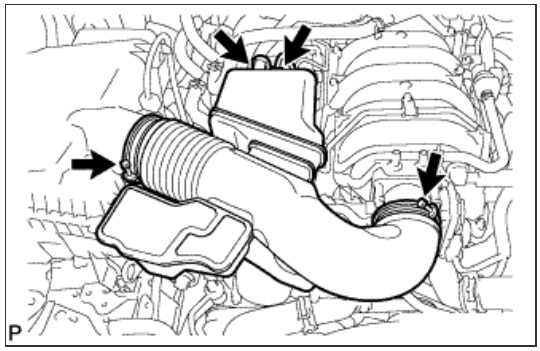


9. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum transmitting hose and No. 2 ventilation hose.

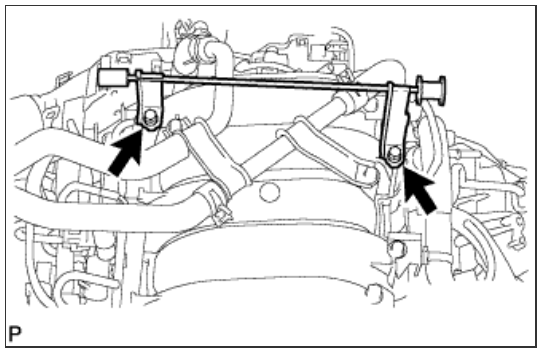
b. Loosen the 2 hose clamps.

c. Remove the air cleaner hose.



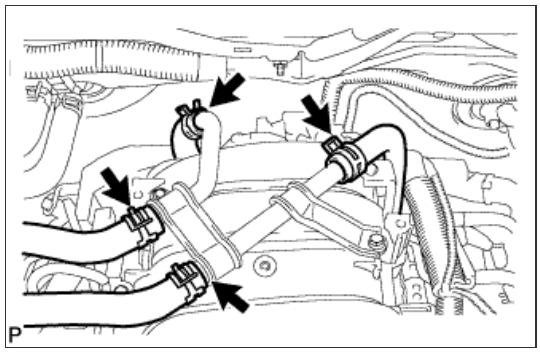
10. REMOVE NO. 2 V-BANK COVER BRACKET

a. Remove the 2 bolts and bracket.



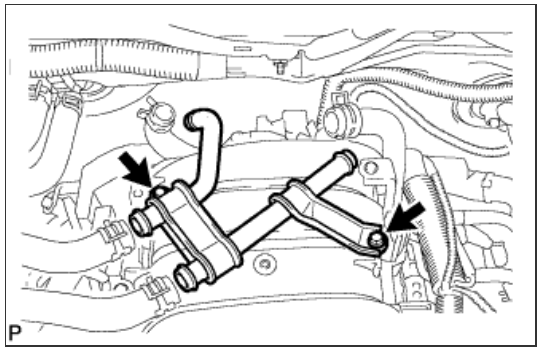
11. REMOVE NO. 2 WATER BY-PASS PIPE

a. Disconnect the 4 water hoses from the No. 2 water by-pass pipe.



b. Remove the 2 bolts.

c. Remove the No. 2 water by-pass pipe.



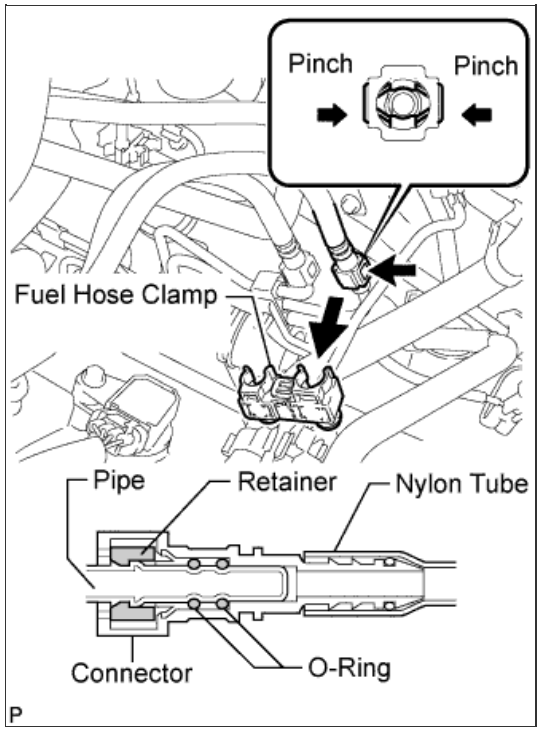
12. DISCONNECT FUEL HOSE

a. Remove the fuel hose clamp.

b. Pinch and pull the fuel hose connector to disconnect the connector from the fuel pipe.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



13. REMOVE NO. 2 FUEL HOSE

a. for engine side:

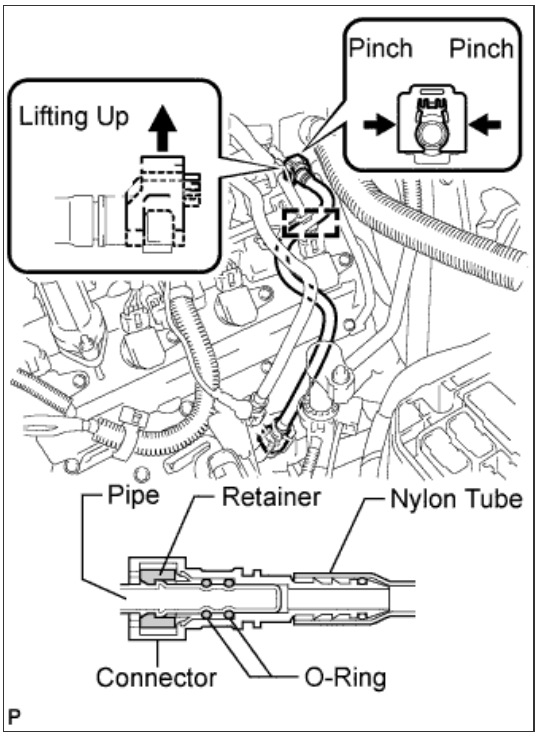
i. Detach the fuel hose clamp.

ii. Detach the lock claw by lifting up the cover, as shown in the illustration.

iii. Pinch and pull the No. 2 fuel hose connector to disconnect the connector from the No. 3 fuel pipe.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**

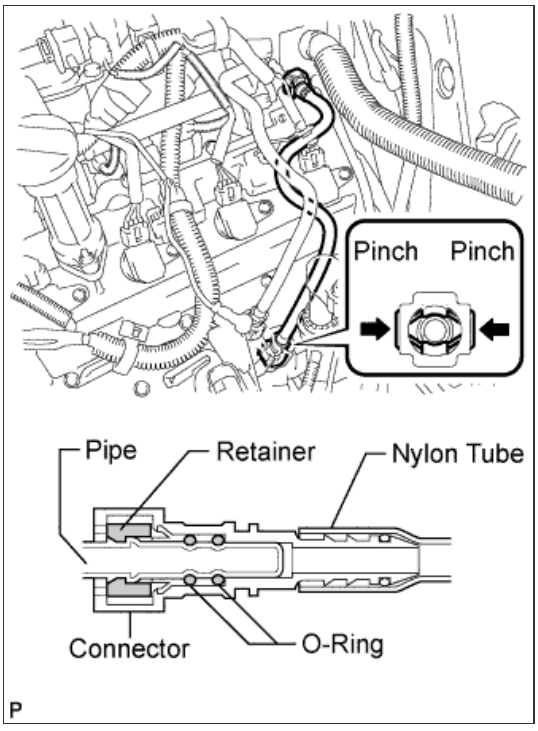


b. for body side:

i. Pinch and pull the No. 2 fuel hose connector to disconnect the connector from the fuel pipe.

NOTICE:

- **Check for foreign matter in the pipe and around the connector. Clean if necessary. Foreign matter may damage the O-ring or cause leaks in the seal between the pipe and connector.**
- **Do not use any tools to separate the pipe and connector.**
- **Do not forcefully bend or twist the nylon tube.**
- **Check for foreign matter on the pipe seal surface. Clean if necessary.**
- **Put the pipe and connector ends in plastic bags to prevent damage and foreign matter contamination.**
- **If the pipe and connector are stuck together, pinch the connector between your fingers and turn it carefully to disconnect it.**



14. REMOVE NO. 2 VENTILATION HOSE

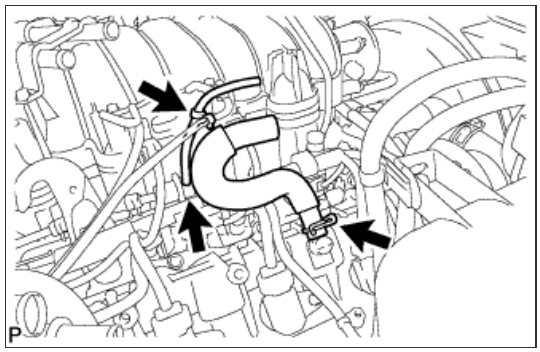
a. w/ Secondary Air Injection System:

i. Remove the No. 2 ventilation hose from the cylinder head cover.

ii. Remove the clamp.

iii. Remove the vacuum transmitting hose from the fuel pressure

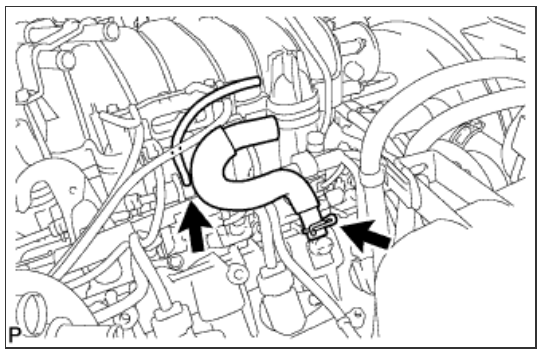
regulator.



b. w/o Secondary Air Injection System:

i. Remove the No. 2 ventilation hose from the cylinder head cover.

ii. Remove the vacuum transmitting hose from the fuel pressure regulator.

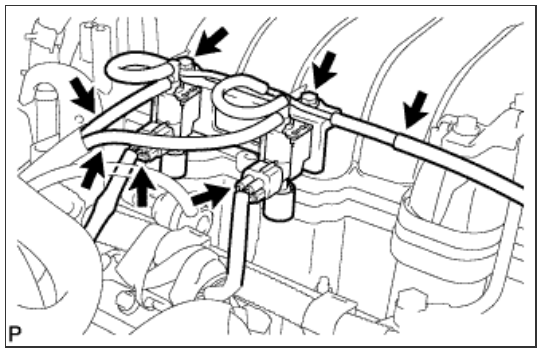


15. REMOVE VACUUM CONTROL VALVE SET (w/ Secondary Air Injection System

a. Disconnect the 2 VSV connectors.

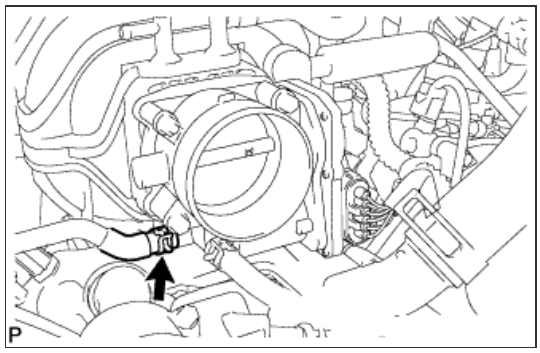
b. Disconnect the 3 vacuum hoses.

c. Remove the 2 bolts and vacuum control valve set.



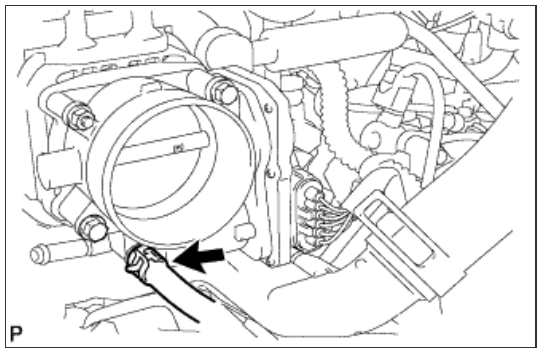
16. DISCONNECT NO. 1 WATER BY-PASS HOSE

a. Disconnect the No. 1 water by-pass hose from the throttle body.



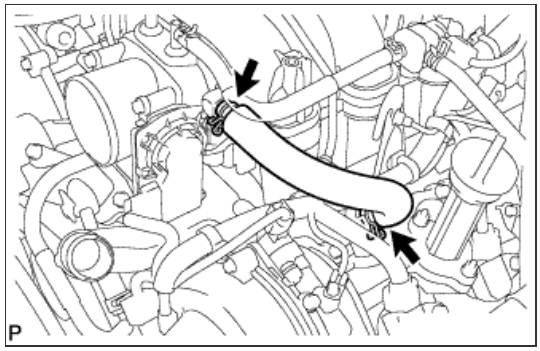
17. DISCONNECT NO. 7 WATER BY-PASS HOSE

a. Disconnect the No. 7 water by-pass hose from the throttle body.



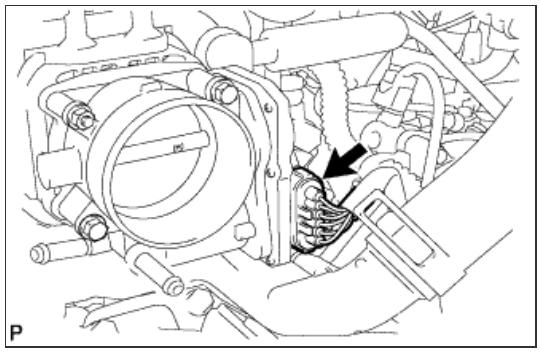
18. REMOVE NO. 1 VENTILATION HOSE

a. Remove the No. 1 ventilation hose from the intake manifold and ventilation valve.



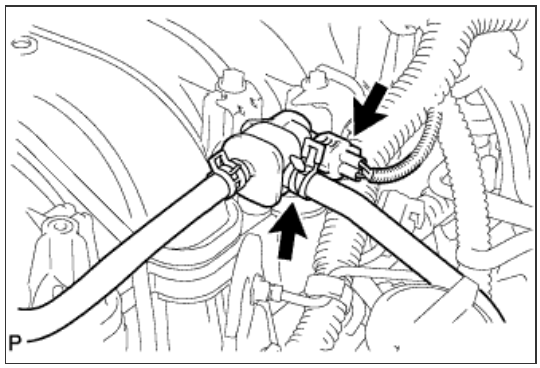
19. REMOVE INTAKE MANIFOLD

a. Disconnect the throttle position sensor and control motor connector.



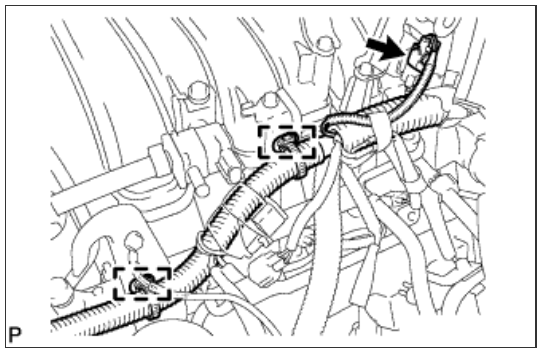
b. Disconnect the purge VSV connector.

c. Disconnect the purge line hose from the purge VSV.



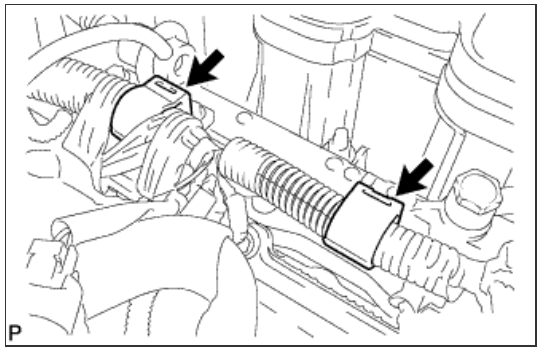
d. Disconnect the VSV connector (for ACIS).

e. Disconnect the 2 wire clamps from the wire bracket and engine hanger.

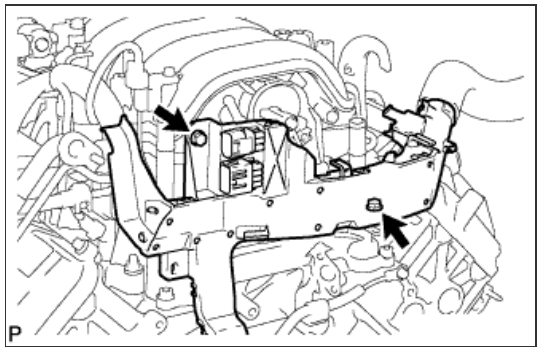


f. Disconnect the 2 wire clamps from the wire clamp brackets on the delivery pipe RH.

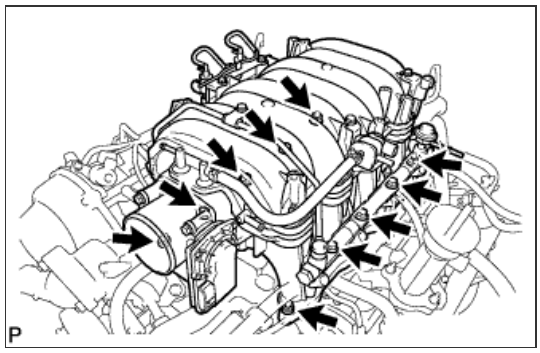
g. Disconnect the 8 injector connectors.



h. Remove the 2 bolts and disconnect the engine wire protector.



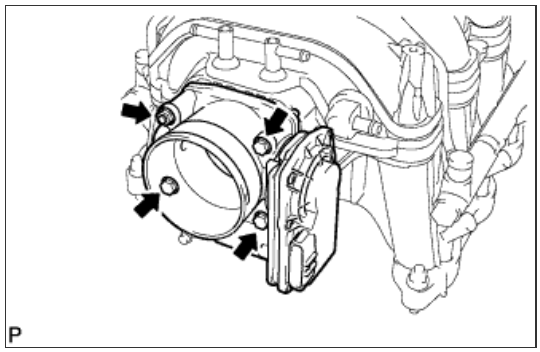
i. Remove the 6 bolts, 4 nuts, intake manifold and 2 gaskets.



20. REMOVE THROTTLE BODY ASSEMBLY

a. Remove the nut, 3 bolts, throttle body and gasket.

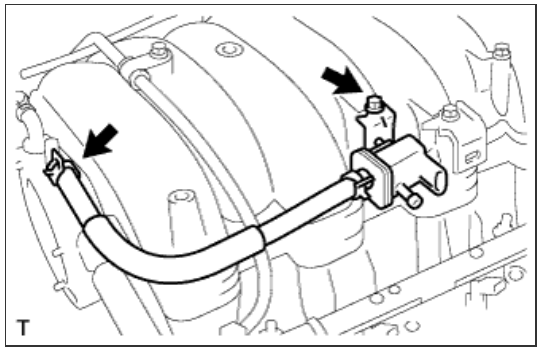
b. Remove the stud bolt.



21. REMOVE PURGE VSV

a. Disconnect the purge line hose from the intake manifold.

b. Remove the bolt and purge VSV.

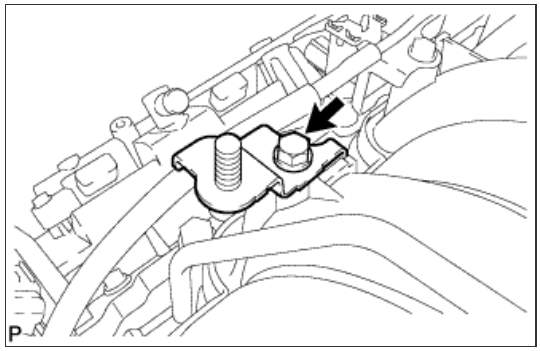


22. REMOVE WIRE HARNESS CLAMP BRACKET

a. Remove the bolt and bracket.

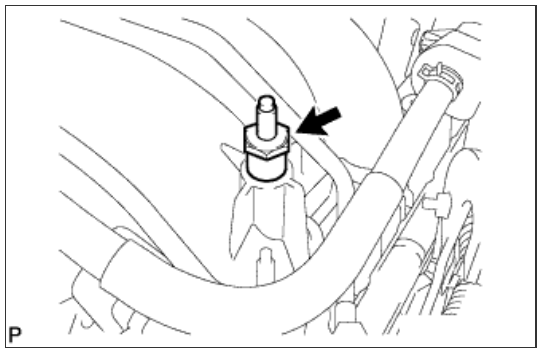
23. REMOVE NO. 4 V-BANK COVER BRACKET

a. Remove the bolt and bracket.



24. REMOVE ENGINE COVER OINT

a. Remove the joint from the intake manifold.



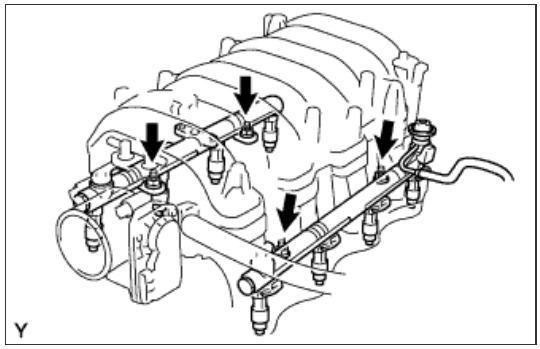
25. REMOVE FUEL DELIVERY PIPE SUB-ASSEMBLY

a. Remove the 4 nuts holding the delivery pipes to the intake manifold.

b. Remove the 2 delivery pipes from the intake manifold.

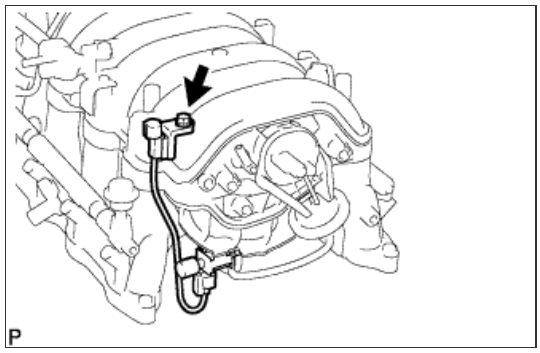
NOTICE:

Be careful not to drop the injectors when removing the delivery pipes.



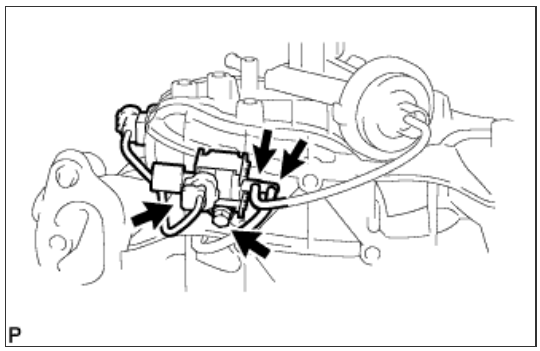
26. REMOVE VACUUM SWITCHING VALVE ASSEMBLY (for ACIS

a. Remove the bolt.



b. Disconnect the 2 vacuum hoses and VSV connector.

c. Remove the bolt and VSV.



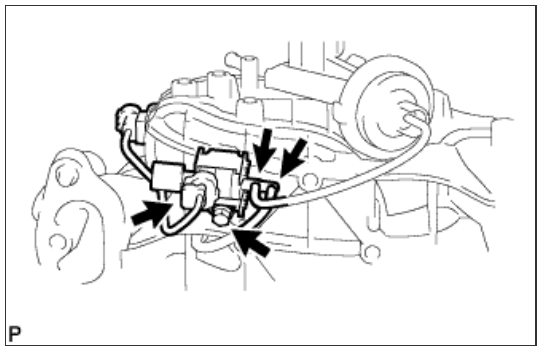
for Preparation Click here

1. INSTALL VACUUM SWITCHING VALVE ASSEMBLY (for ACIS)

a. Install the VSV with the bolt.

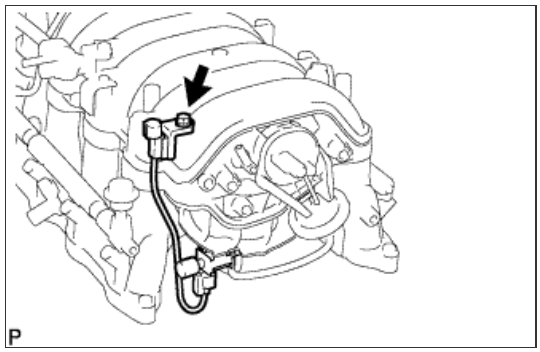
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

b. Connect the VSV connector and 2 vacuum hoses.



c. Connect the VSV connector with the bolt.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



2. INSTALL FUEL DELIVERY PIPE SUB-ASSEMBLY

NOTICE:

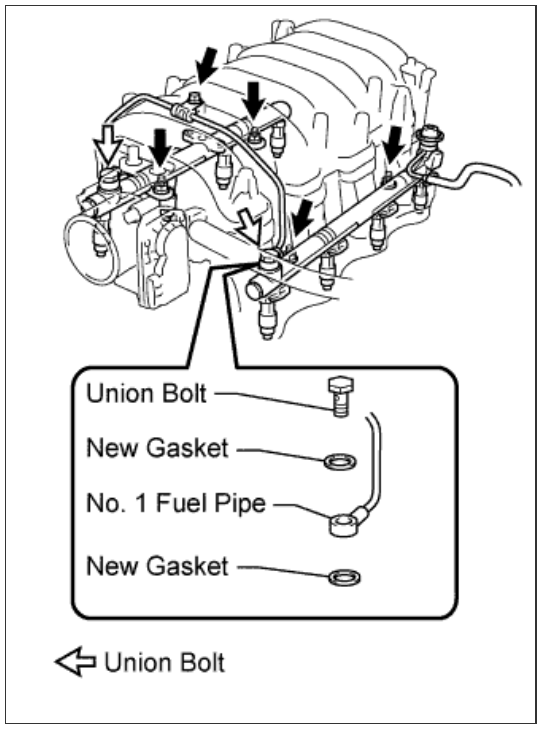
Be careful not to drop the injectors when installing the delivery pipes.

a. Place the 2 delivery pipes and injector assemblies on the lower intake manifold.

b. Temporarily install the 4 nuts.

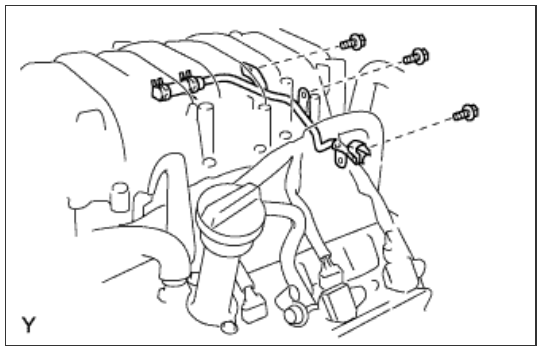
c. Install the No. 1 fuel pipe and 4 new gaskets with the bolt and 2 union bolts.

Torque:
for union bolt:
39 N*m{ 398 kgf*cm , 29 ft.*lbf }
for bolt:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

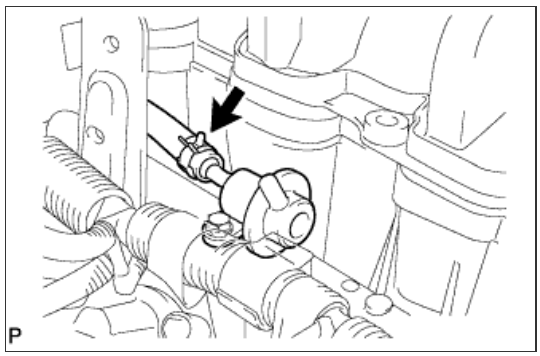


d. Connect the No. 3 fuel pipe with the 3 bolts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



e. Connect the fuel return hose to the fuel pressure regulator.



f. Check that the injectors rotate smoothly.

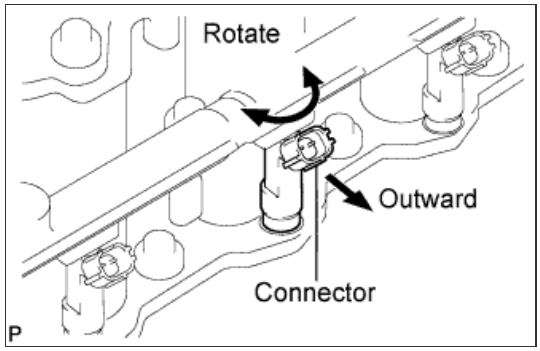
HINT:

If the injectors do not rotate smoothly, a probable cause is incorrect installation of the O-rings. Replace the O-ring of any injector that does not rotate smoothly.

g. Position the injector connectors outward.

h. Tighten the 4 nuts holding the delivery pipes to the lower intake manifold.

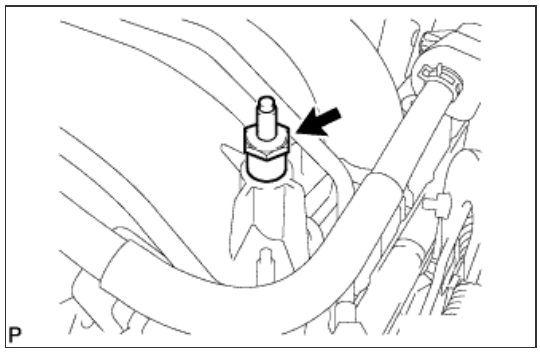
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



3. INSTALL ENGINE COVER JOINT

a. Install the joint to the intake manifold.

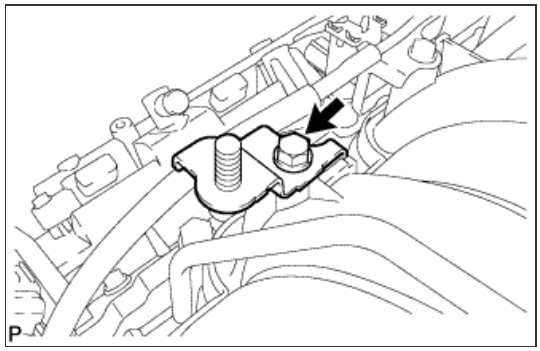
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



4. INSTALL NO. 4 V-BANK COVER BRACKET

a. Install the bracket with the bolt.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



5. INSTALL WIRE HARNESS CLAMP BRACKET

a. Install the bracket with the bolt.

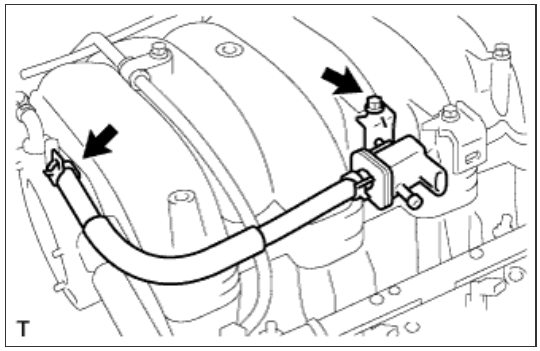
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

6. INSTALL PURGE VSV

a. Install the VSV to the intake manifold with the bolt.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

b. Connect the purge line hose to the intake manifold.

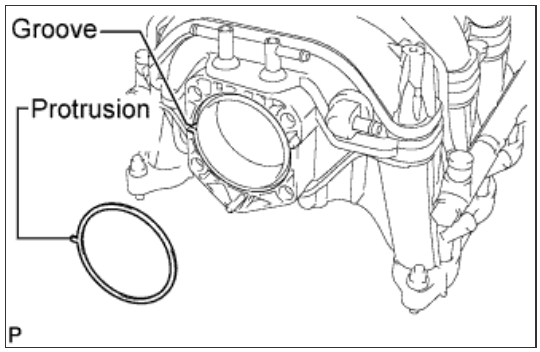


7. INSTALL THROTTLE BODY ASSEMBLY

a. Align the protrusion of a new gasket with the groove of the intake manifold, and install the gasket.

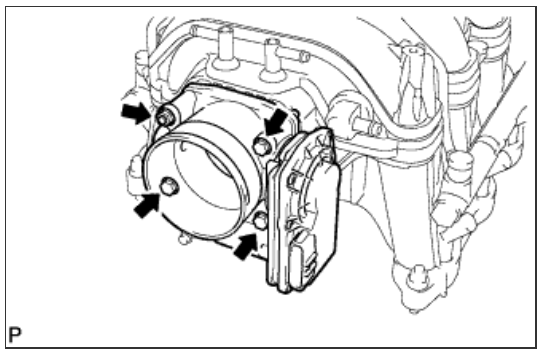
b. Install the stud bolt.

Torque:
7.0 N*m{ 71 kgf*cm , 62 in.*lbf }



c. Install the throttle body with the nut and 3 bolts.

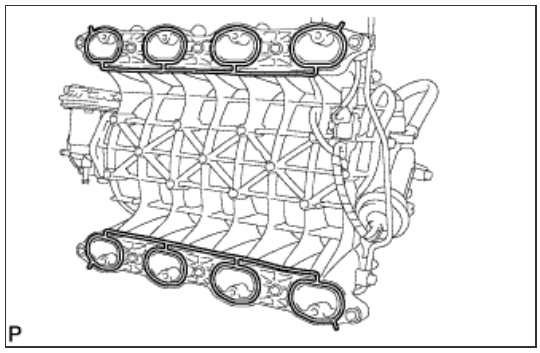
Torque:
14 N*m{ 143 kgf*cm , 10 ft.*lbf }



8. INSTALL INTAKE MANIFOLD

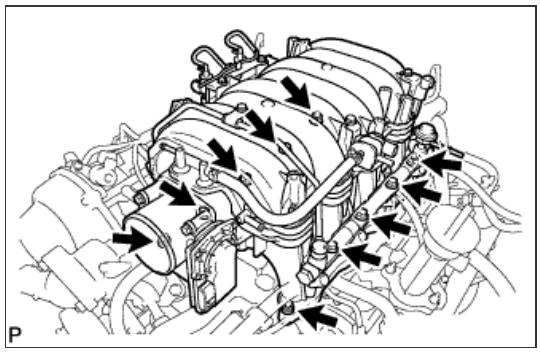
a. Place 2 new gaskets on the intake manifold.

b. Place the intake manifold on the cylinder heads.



c. Install and uniformly tighten the 6 bolts and 4 nuts in several steps.

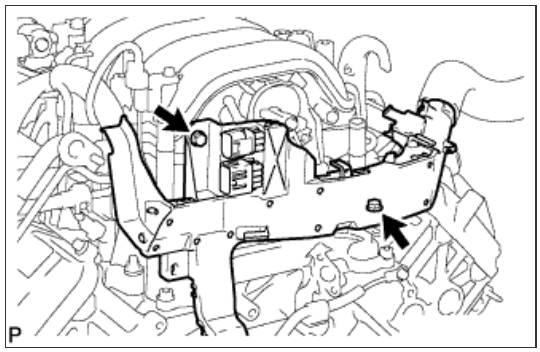
Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }



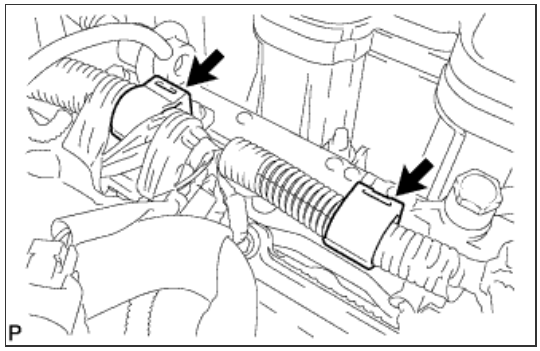
d. Install the engine wire protector with the 2 bolts.

Torque:
8.2 N*m{ 83 kgf*cm , 72 in.*lbf }

e. Connect the 8 injector connectors.

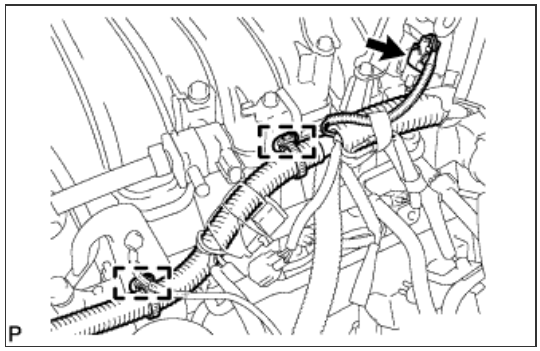


f. Connect the 2 wire clamps to the wire clamp brackets on the delivery pipe.



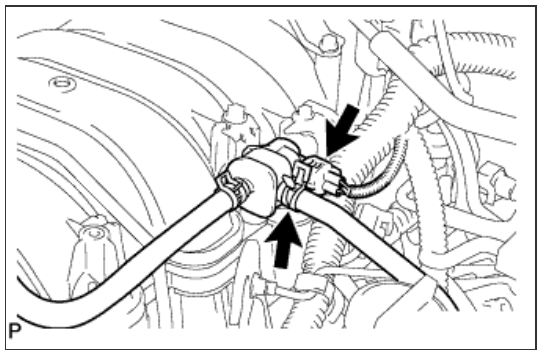
g. Attach the 2 clamps to connect the engine wire to the wire bracket and engine hanger.

h. Connect the VSV connector (for ACIS).

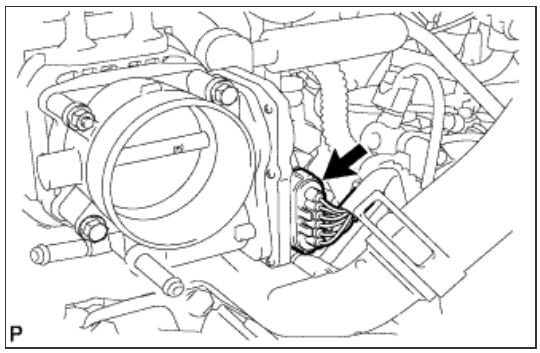


i. Connect the purge line hose to the purge VSV.

j. Connect the purge VSV connector.

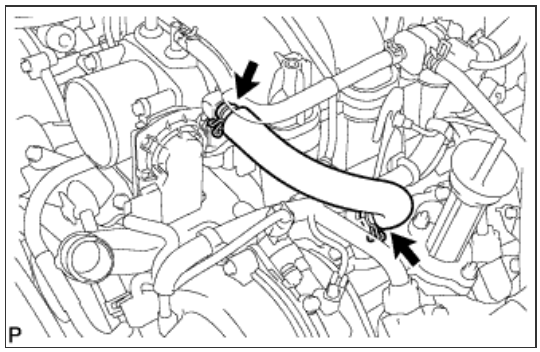


k. Connect the throttle position sensor and control motor connector.



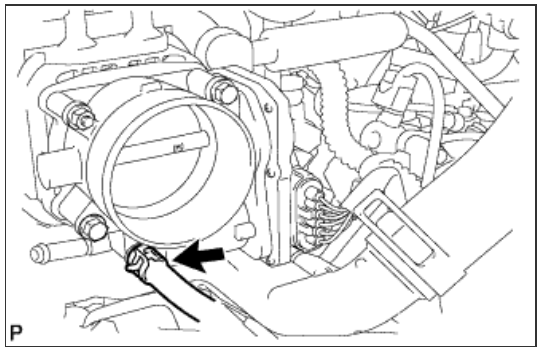
9. INSTALL NO. 1 VENTILATION HOSE

a. Install the No. 1 ventilation hose to the intake manifold and ventilation valve.



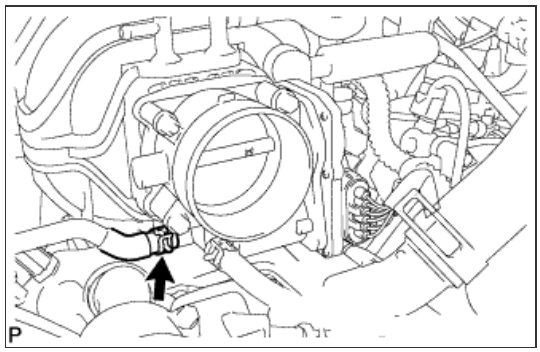
10. CONNECT NO. 7 WATER BY-PASS HOSE

a. Connect the No. 7 water by-pass hose to the throttle body.



11. CONNECT NO. 1 WATER BY-PASS HOSE

a. Connect the No. 1 water by-pass hose to the throttle body.



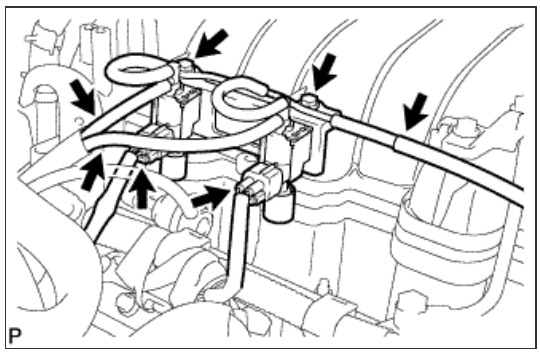
12. INSTALL VACUUM CONTROL VALVE SET (w/ Secondary Air Injection Sy tem)

a. Install the vacuum control valve set with the 2 bolts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

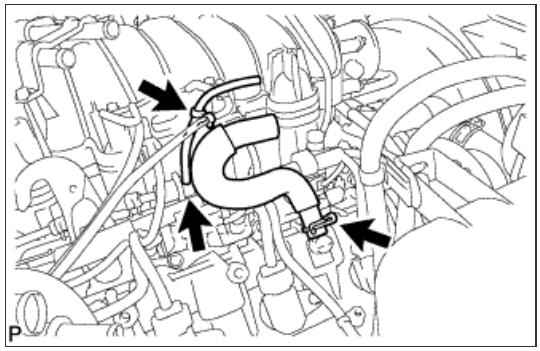
b. Connect the 3 vacuum hoses.

c. Connect the 2 VSV connectors.



13. INSTALL NO. 2 VENTILATION HOSE

a. w/ Secondary Air Injection System:

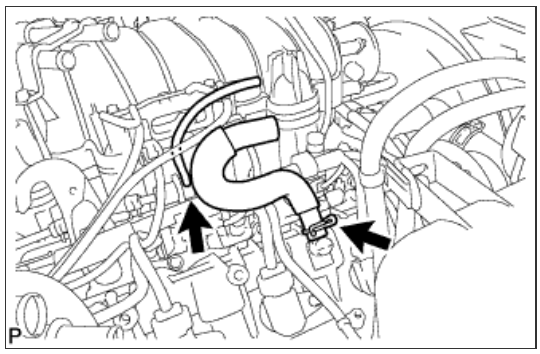


i. Install the vacuum transmitting hose to the fuel pressure regulator.

ii. Install the clamp.

iii. Install the No. 2 ventilation hose to the cylinder head cover.

b. w/o Secondary Air Injection System:



i. Install the vacuum transmitting hose to the fuel pressure regulator.

ii. Install the No. 2 ventilation hose to the cylinder head cover.

14. INSTALL NO. 2 FUEL HOSE

a. for engine side:

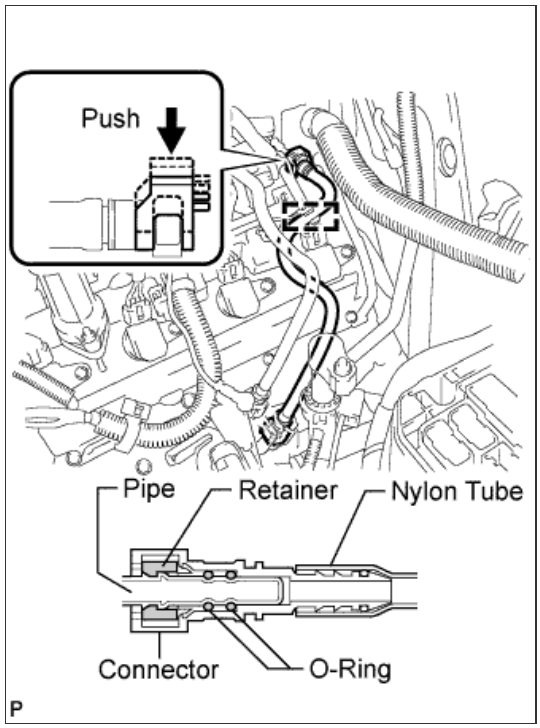
i. Connect the fuel hose to the No. 3 fuel pipe.

HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before in talling the tube connector to the pipe , check if there i any damage or foreign matter in the connector .**
- **After the connection, check if the connector and pipe are ecurely connected by trying to pull them apart.**



ii. Attach the lock claws to the connector by pushing down on the cover, as shown in the illustration.

iii. Attach the fuel hose clamp.

b. for body side:

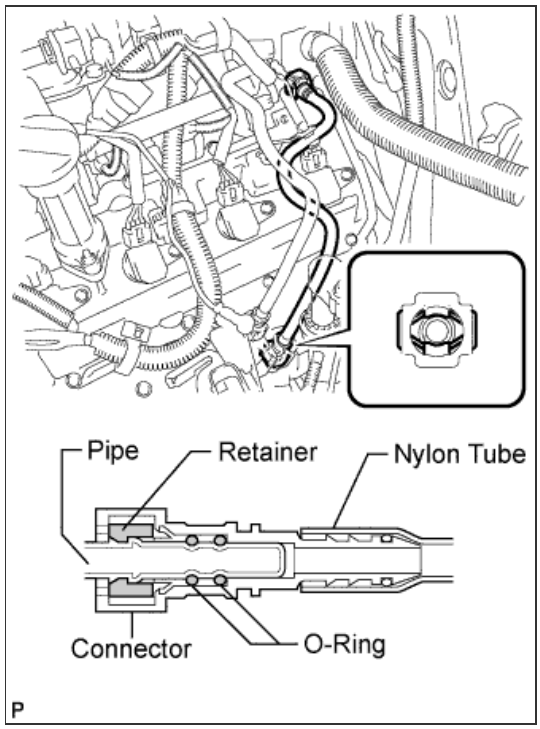
i. Connect the fuel hose to the fuel pipe.

HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before in talling the tube connector to the pipe , check if there i any damage or foreign matter in the connector .**
- **After the connection, check if the connector and pipe are ecurely connected by trying to pull them apart.**



15. CONNECT FUEL HOSE

a. Connect the fuel hose.

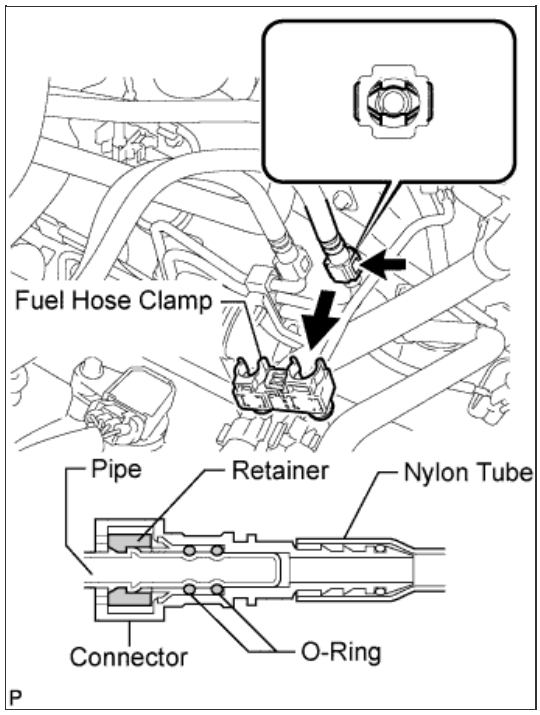
HINT:

Push the parts together firmly until a "click" sound is heard.

NOTICE:

- **Before in talling the tube connector to the pipe , check if there i any damage or foreign matter in the connector .**
- **After the connection, check if the connector and pipe are ecurely connected by trying to pull them apart.**

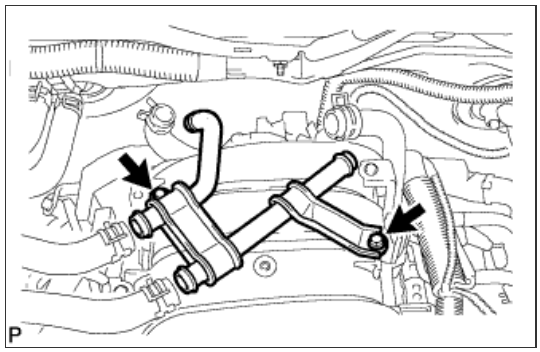
b. Install the fuel hose clamp.



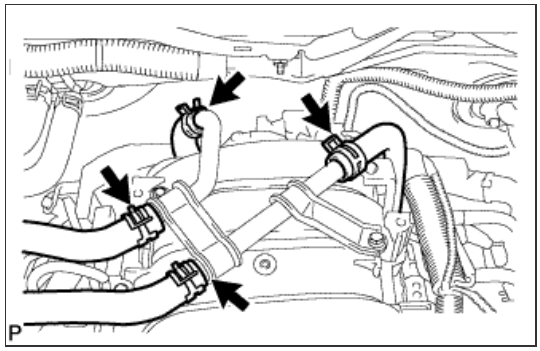
16. INSTALL NO. 2 WATER BY-PASS PIPE

a. Install the No. 2 water by-pass pipe with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



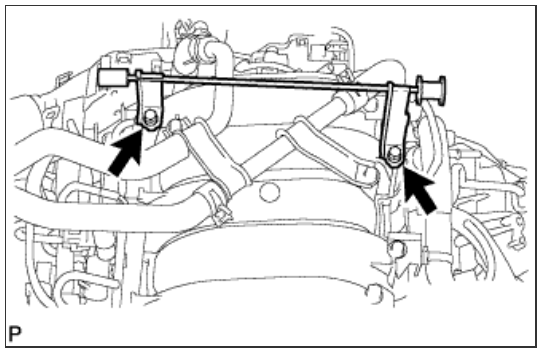
b. Connect the 4 water hoses.



17. INSTALL NO. 2 V-BANK COVER BRACKET

a. Install the bracket with the 2 bolts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



18. INSTALL AIR CLEANER HOSE ASSEMBLY

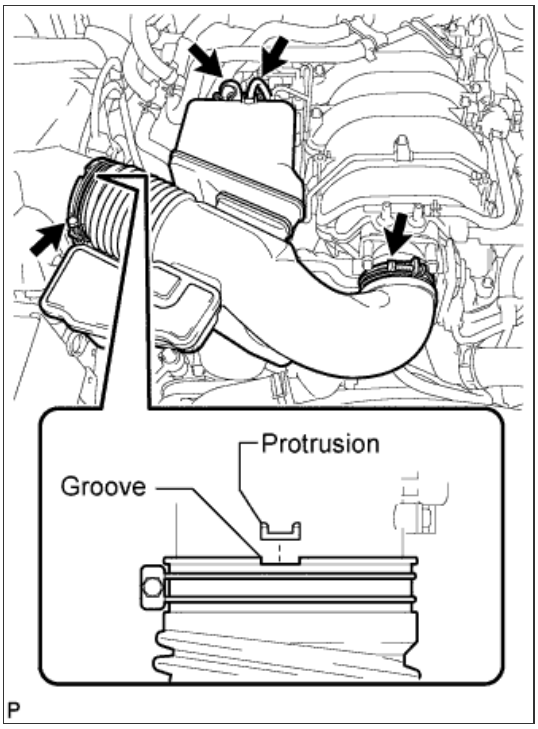
a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum transmitting hose.

d. Connect the No. 2 ventilation hose.



19. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

20. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item		Specified Condition
w/o Transmission oil cooler	w/o Rear Heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)
	w/ Rear Heater	16.3 liters (17.2 US qts, 14.3 Imp. qts)
w/ Transmission oil cooler	w/o Rear Heater	14.1 liters (14.9 US qts, 12.4 Imp. qts)
	w/ Rear Heater	16.9 liters (17.9 US qts, 14.9 Imp. qts)

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

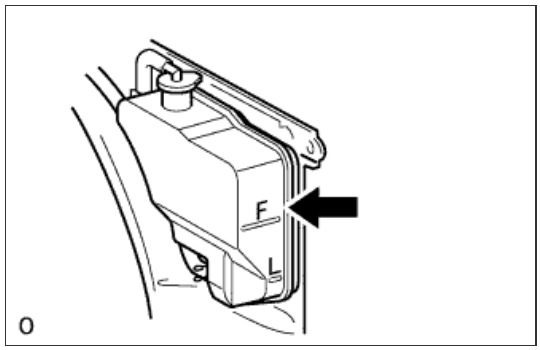
b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the radiator reservoir cap.

d. Press the inlet and outlet radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.



NOTICE:

Switch off the A/C.

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make ure that the radiator re er oir till ha ome coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make ure that the needle doe not how an abnormally high temperature.**
- **If there i not enough coolant, the engine may burn out or o erheat.**
- **Immediately after tarting the engine, if the radiator re er oir doe not ha e any coolant, perform the following: 1) top the engine, 2) wait until the coolant ha cooled down, and 3) add coolant until the coolant i filled to the F line.**
- **Run the engine at 2000 rpm until the coolant le el ha tabilized.**

h. Press the inlet and outlet radiator hoses several times by hand to bleed air.

CAUTION:

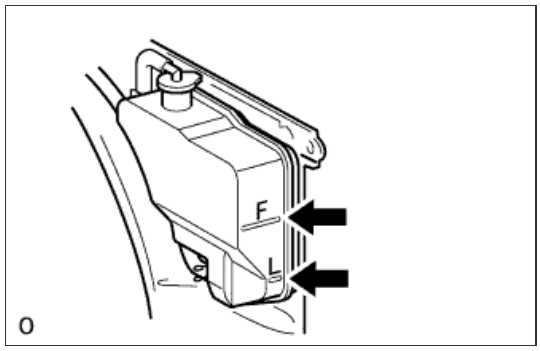
- **Wear protecti e glo e .**
- **Be careful a the radiator ho e are hot.**
- **Keep your hand away from the cooling fan.**

i. Stop the engine, and wait until the engine coolant cools down to the ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

j. Check that the coolant level is between the F and L lines. If the coolant level is below the L line, repeat all of the procedures above. If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.

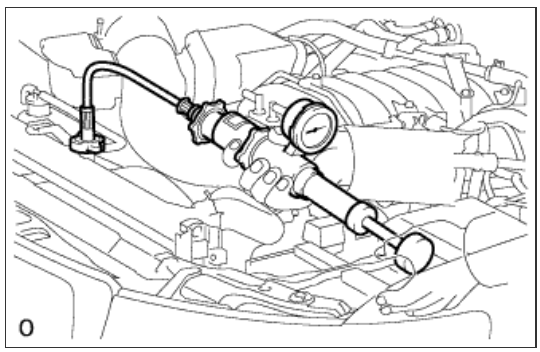


21. INSPECT FOR COOLANT LEAK

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



22. INSPECT FOR FUEL LEAK

a. Connect the intelligent tester to the DLC3.

b. Turn the engine switch on (IG) and intelligent tester ON.

NOTICE:

Do not start the engine.

c. nter the following menus: Powertrain / ngine and CT / Active Test / Activate the Fuel Pump Speed Control.

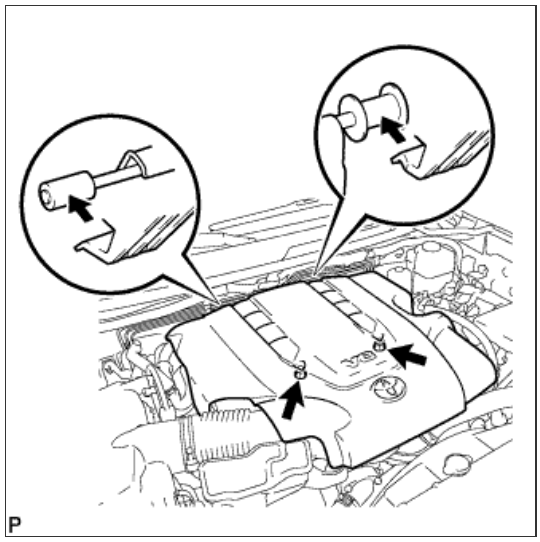
d. Check that there are no fuel leaks after doing maintenance anywhere on the fuel system.

23. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket.

b. Install the V-bank cover with the 2 nuts.

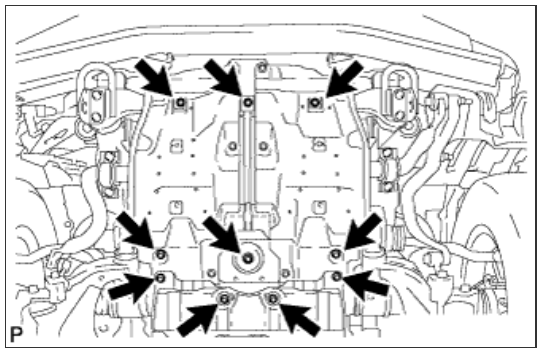
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



24. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the No. 1 engine under cover with the 10 bolts.

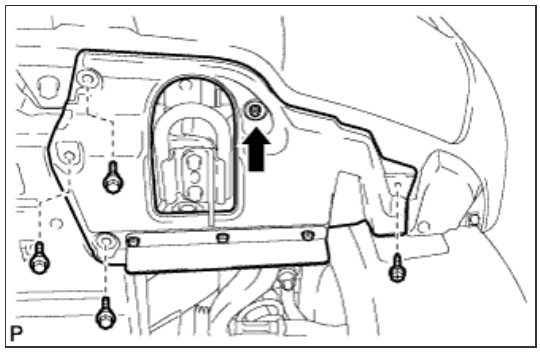
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



25. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



26. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

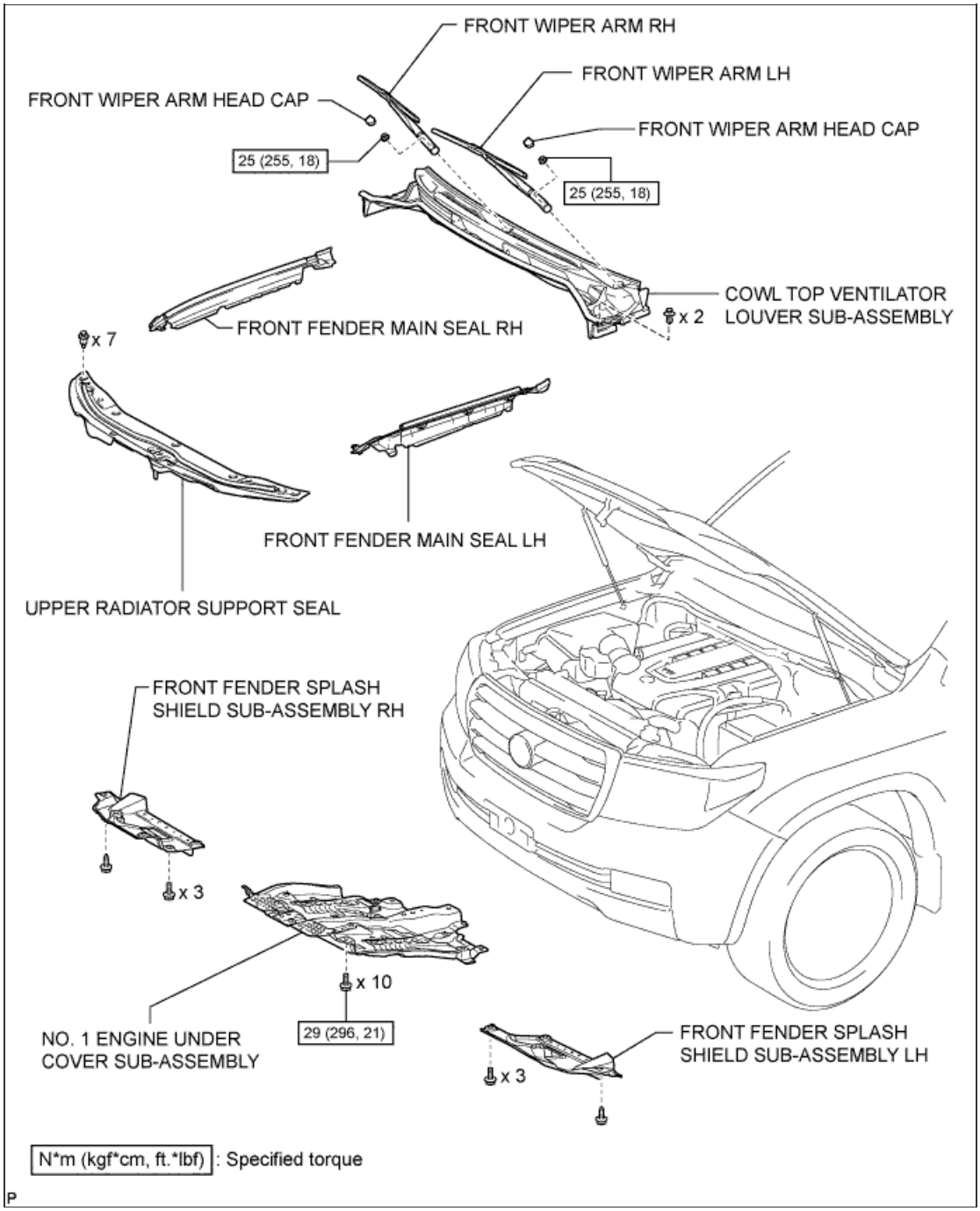
HINT:

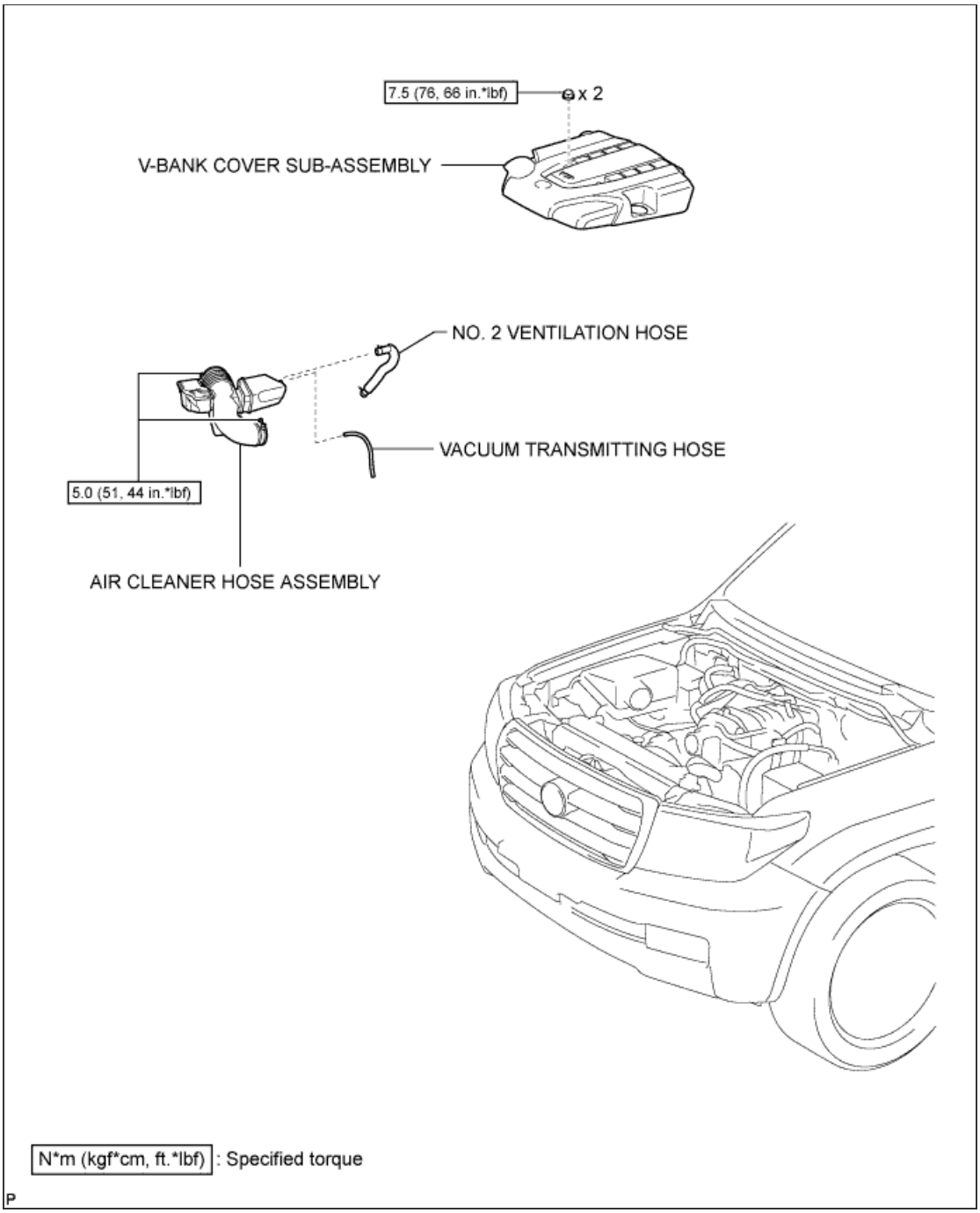
se the same procedures described for the side.

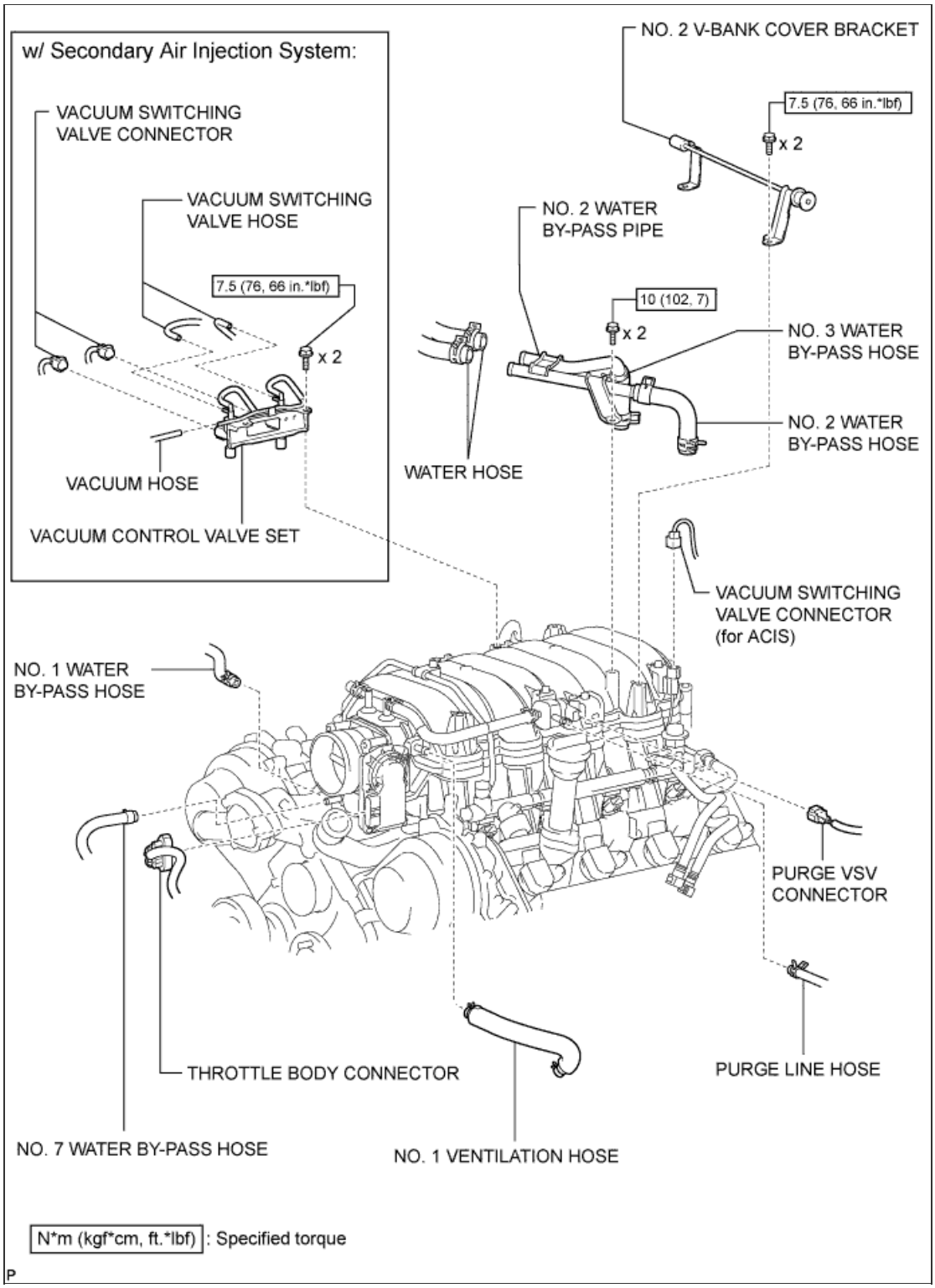
27. INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

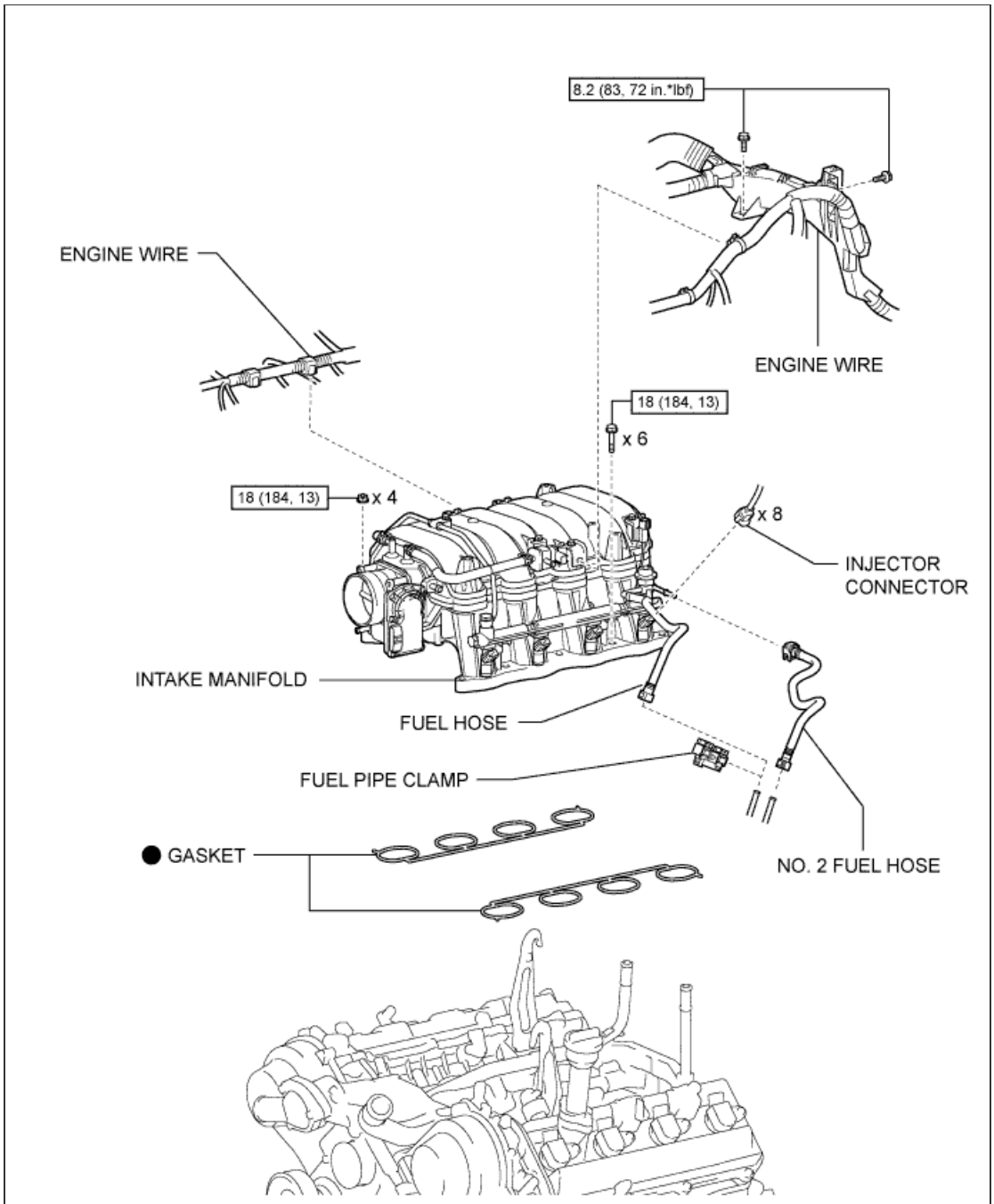
a. Install the cowl top ventilator louver (Click here).

for Preparation Click here




7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER SUB-ASSEMBLY
NO. 2 VENTILATION HOSE
VACUUM TRANSMITTING HOSE
5.0 (51, 44 in.*lbf)
AIR CLEANER HOSE ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
P

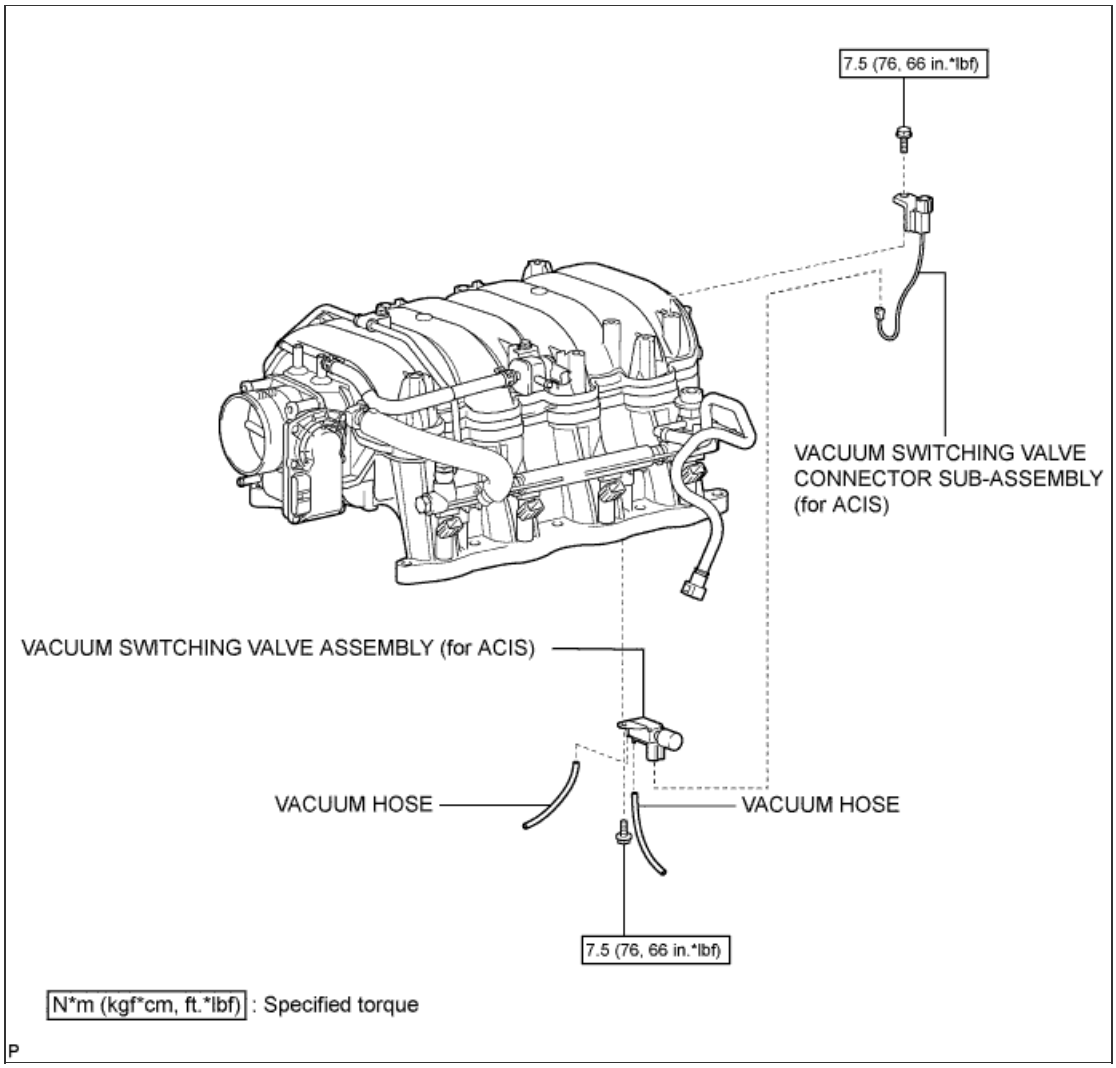

w/ Secondary Air Injection System:
VACUUM SWITCHING VALVE CONNECTOR
VACUUM SWITCHING VALVE HOSE
7.5 (76, 66 in.*lbf)
x 2
VACUUM HOSE
VACUUM CONTROL VALVE SET
NO. 2 V-BANK COVER BRACKET
7.5 (76, 66 in.*lbf)
x 2
NO. 2 WATER BY-PASS PIPE
10 (102, 7)
x 2
NO. 3 WATER BY-PASS HOSE
NO. 2 WATER BY-PASS HOSE
WATER HOSE
VACUUM SWITCHING VALVE CONNECTOR (for ACIS)
NO. 1 WATER BY-PASS HOSE
PURGE VSV CONNECTOR
THROTTLE BODY CONNECTOR
PURGE LINE HOSE
NO. 7 WATER BY-PASS HOSE
NO. 1 VENTILATION HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
P



N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P


7.5 (76, 66 in.*lbf)
VACUUM SWITCHING VALVE CONNECTOR SUB-ASSEMBLY (for ACIS)
VACUUM SWITCHING VALVE ASSEMBLY (for ACIS)
VACUUM HOSE
VACUUM HOSE
7.5 (76, 66 in.*lbf)
N*m (kgf*cm, ft.*lbf) : Specified torque
P

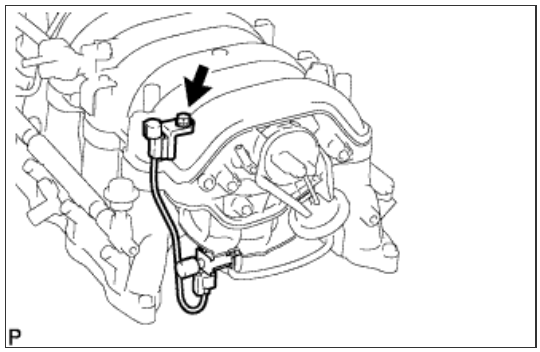
for Preparation Click here

1. REMOVE INTAKE MANIFOL

a. Remove the intake manifold (Click here).

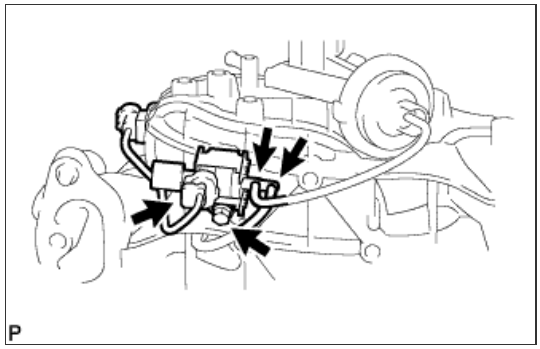
2. REMOVE VACUUM SWITCHING VALVE ASSEMBLY (for ACIS)

a. Remove the bolt.



b. Disconnect the 2 vacuum hoses and VSV connector.

c. Remove the bolt and VSV.

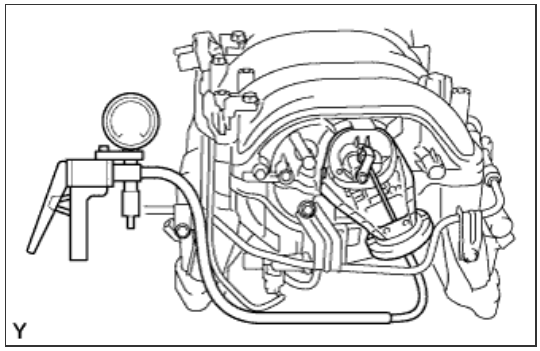


for Preparation Click here

1. INSPECT INTAKE AIR CONTROL VALVE

a. Apply 40 kPa (300 mmHg, 11.8 in.Hg) of vacuum to the actuator and check that the actuator rod moves.

b. One minute after applying vacuum in the above step, check that the actuator rod does not return.
If the result is not as specified, replace the intake manifold.



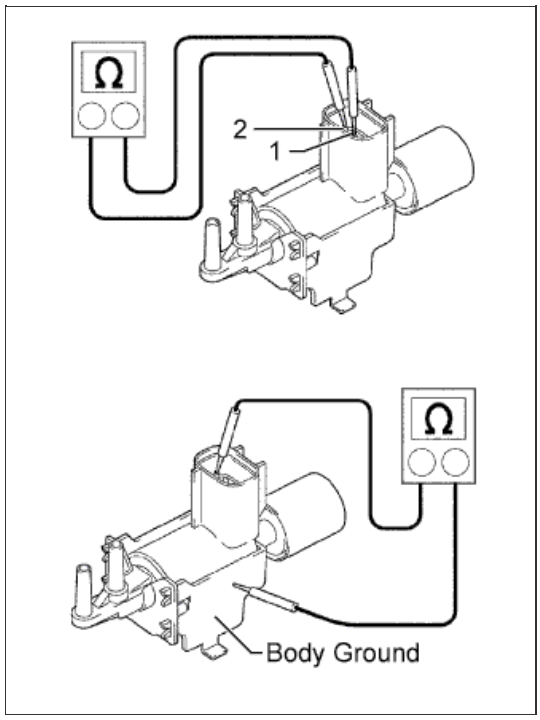
2. INSPECT VACUUM SWITCHING VALVE ASSEMBLY (for ACIS)

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

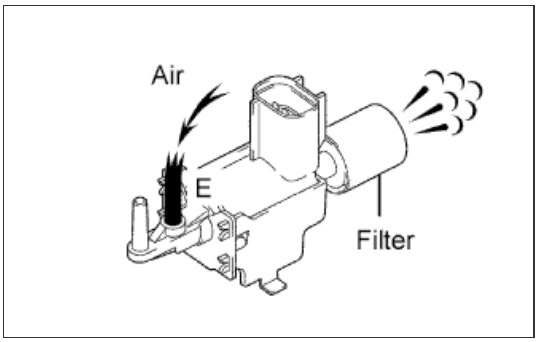
Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	33 to 39 Ω
1 - Body ground	Always	1 MΩ or higher
2 - Body ground		

If the result is not as specified, replace the vacuum switching valve assembly.



b. Check the VSV operation.

i. Check that air flows from port E to the filter.

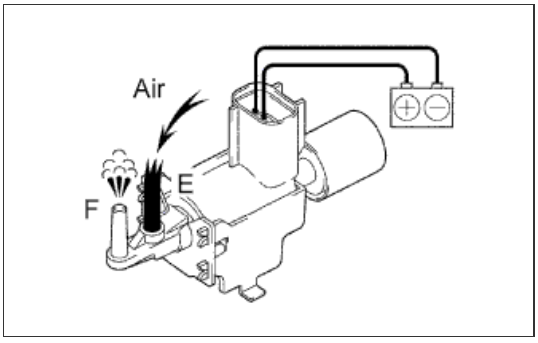


ii. Apply battery voltage to the connector, and check the VSV operation.

OK:

Measurement Condition	Specified Condition
Battery positive (+) → Terminal 1 Battery negative (-) → Terminal 2	Check that air flows from port E to F

If the result is not as specified, replace the vacuum switching valve assembly.



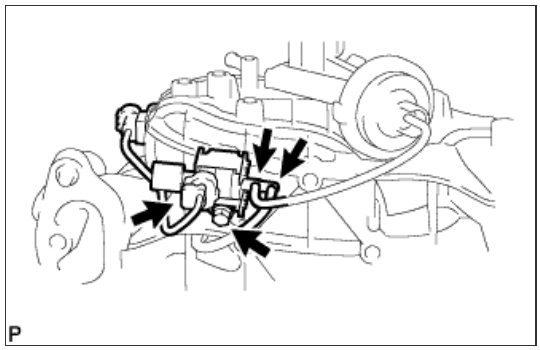
for Preparation Click here

1. INSTALL VACUUM SWITCHING VALVE ASSEMBLY (for ACIS)

a. Install the VSV with the bolt.

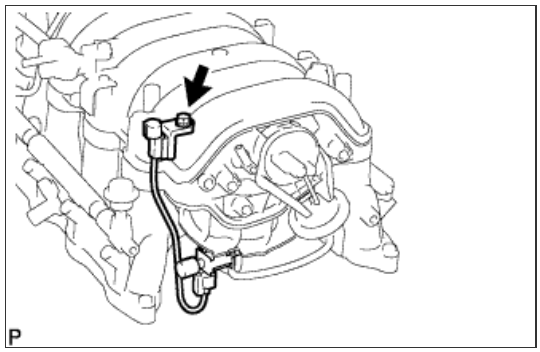
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

b. Connect the VSV connector and 2 vacuum hoses.



c. Connect the VSV connector with the bolt.

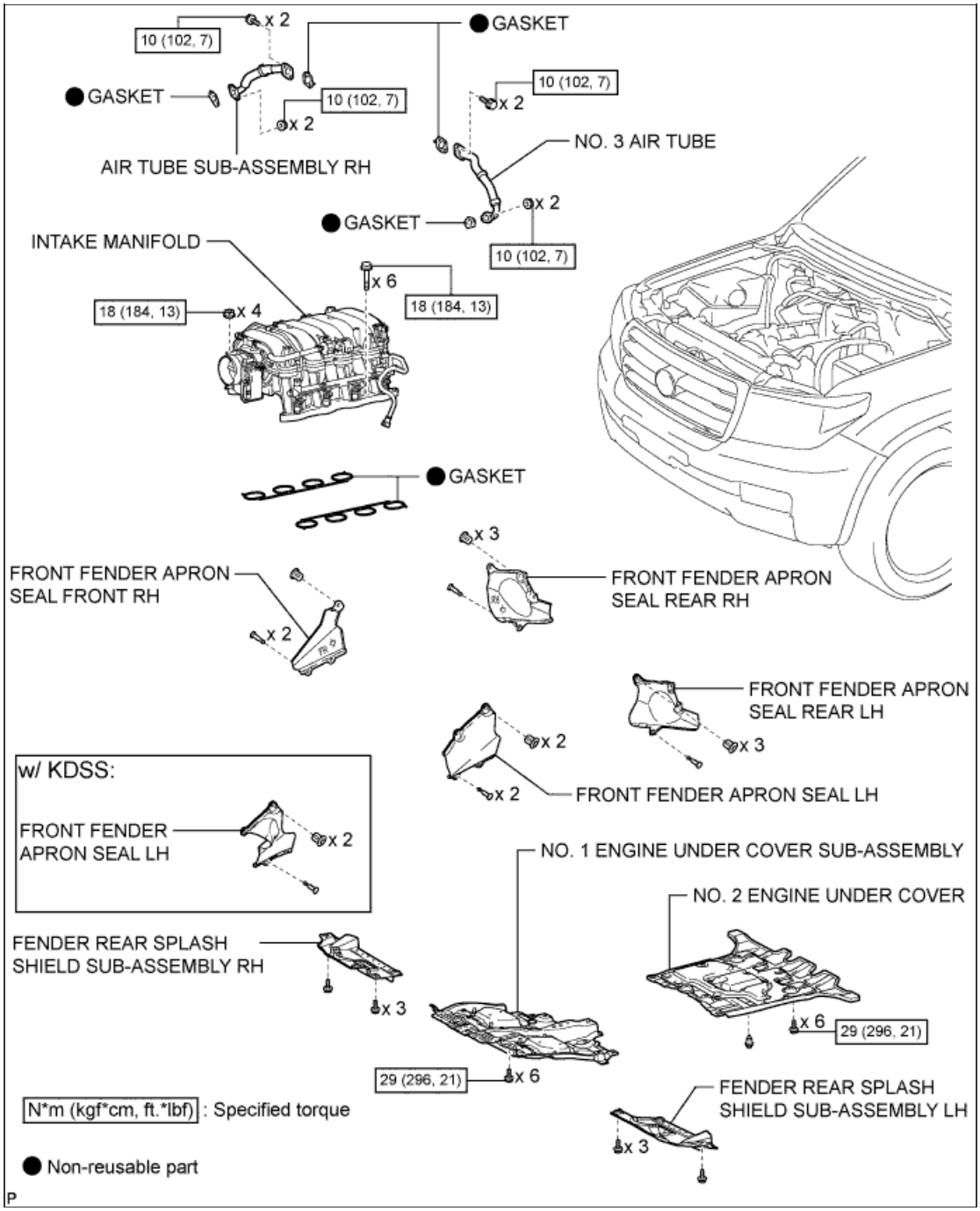
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

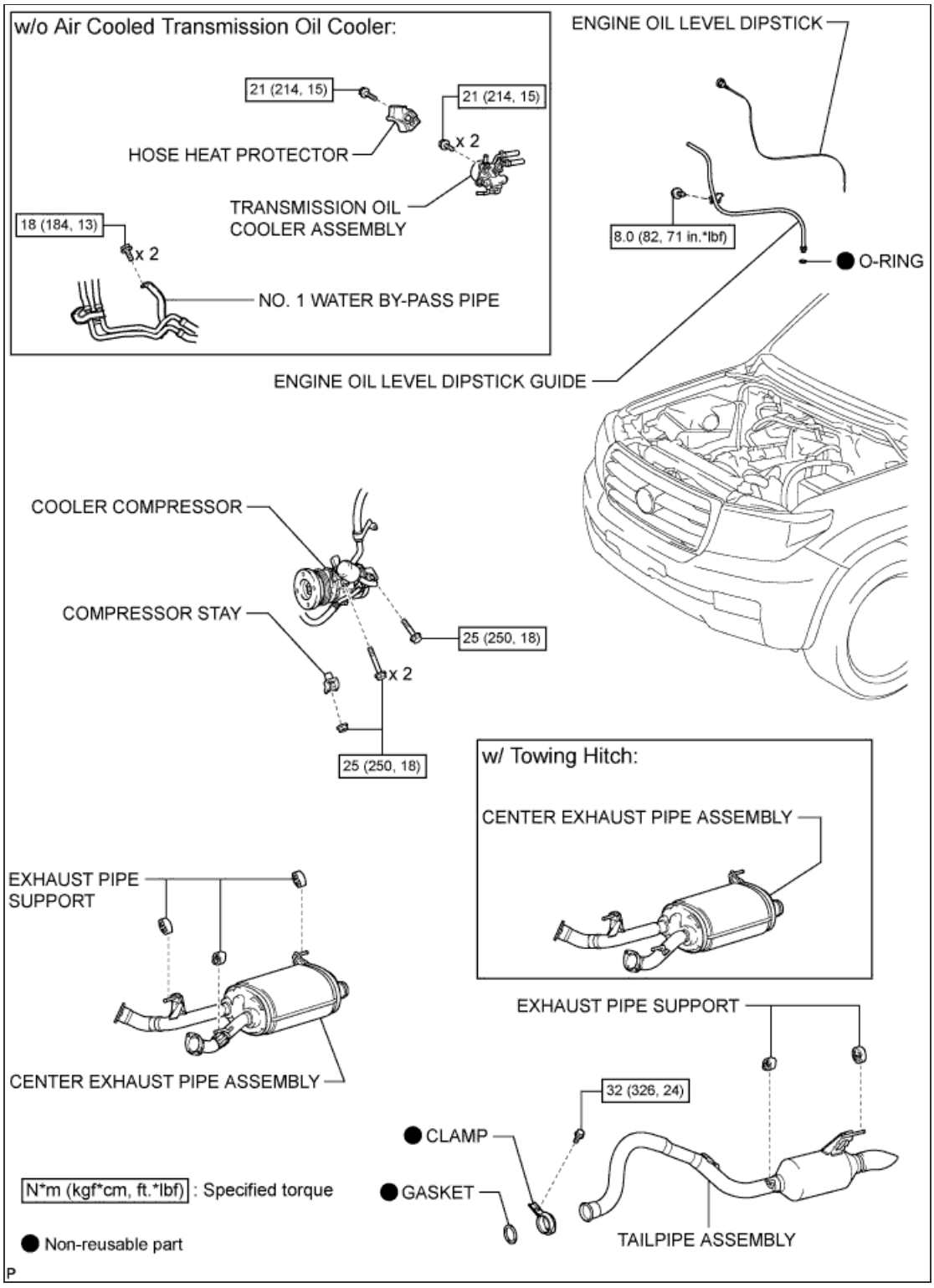


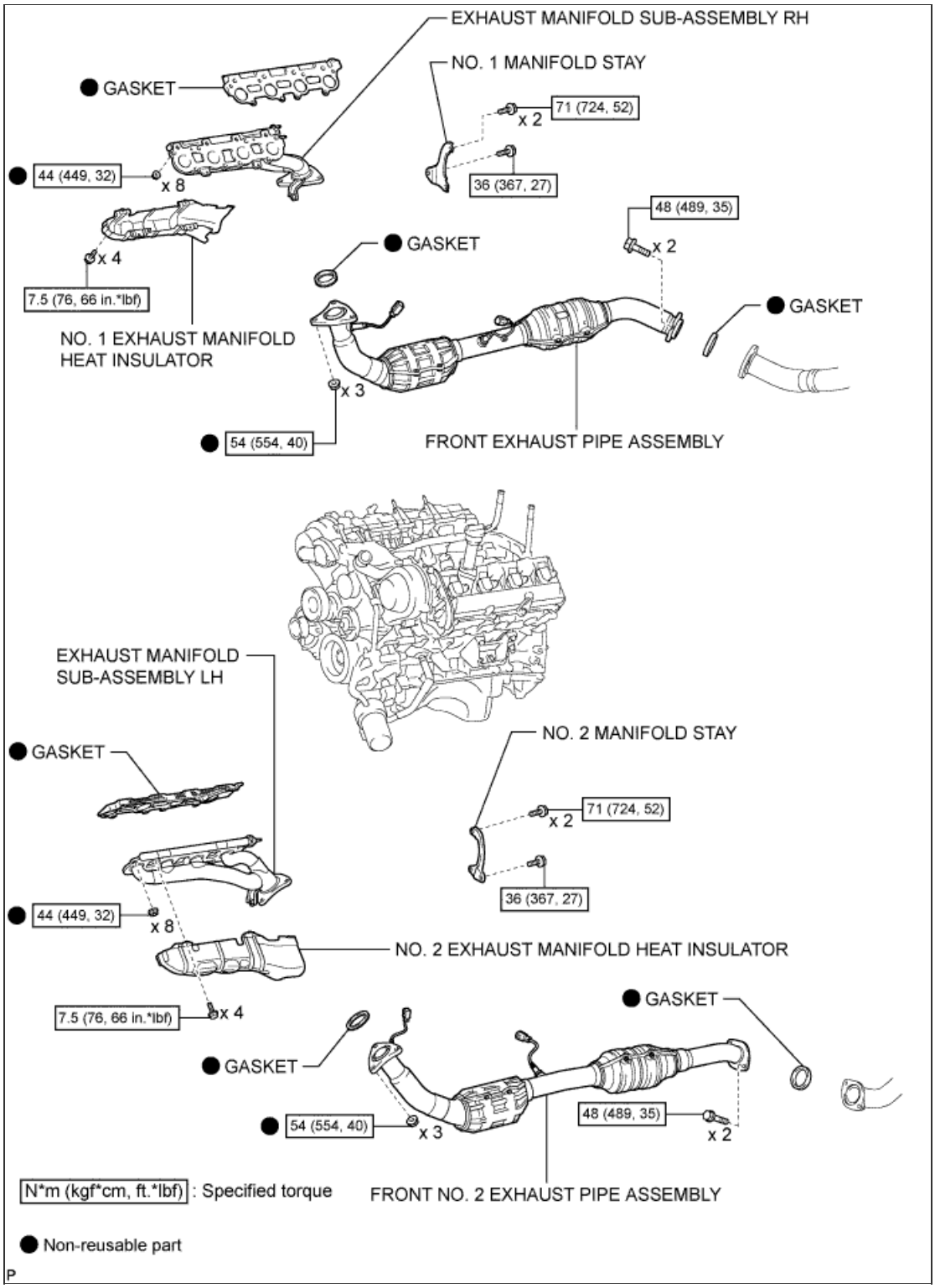
2. INSTALL INTAKE MANIFOLD

a. Install the intake manifold (Click here).

for Preparation ick ere




w/o Air Cooled Transmission Oil Cooler:
21 (214, 15)
21 (214, 15)
HOSE HEAT PROTECTOR
x 2
TRANSMISSION OIL COOLER ASSEMBLY
18 (184, 13)
x 2
NO. 1 WATER BY-PASS PIPE
ENGINE OIL LEVEL DIPSTICK
8.0 (82, 71 in.*lbf)
O-RING
ENGINE OIL LEVEL DIPSTICK GUIDE
COOLER COMPRESSOR
COMPRESSOR STAY
25 (250, 18)
x 2
25 (250, 18)
w/ Towing Hitch:
CENTER EXHAUST PIPE ASSEMBLY
EXHAUST PIPE SUPPORT
CENTER EXHAUST PIPE ASSEMBLY
EXHAUST PIPE SUPPORT
32 (326, 24)
CLAMP
GASKET
TAILPIPE ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P


EXHAUST MANIFOLD SUB-ASSEMBLY RH
NO. 1 MANIFOLD STAY
GASKET
71 (724, 52)
x 2
44 (449, 32)
x 8
36 (367, 27)
48 (489, 35)
x 4
GASKET
x 2
GASKET
7.5 (76, 66 in.*lbf)
NO. 1 EXHAUST MANIFOLD HEAT INSULATOR
x 3
54 (554, 40)
FRONT EXHAUST PIPE ASSEMBLY
EXHAUST MANIFOLD SUB-ASSEMBLY LH
GASKET
NO. 2 MANIFOLD STAY
71 (724, 52)
x 2
36 (367, 27)
44 (449, 32)
x 8
NO. 2 EXHAUST MANIFOLD HEAT INSULATOR
7.5 (76, 66 in.*lbf)
x 4
GASKET
GASKET
54 (554, 40)
x 3
48 (489, 35)
x 2
N*m (kgf*cm, ft.*lbf) : Specified torque
FRONT NO. 2 EXHAUST PIPE ASSEMBLY
Non-reusable part

P

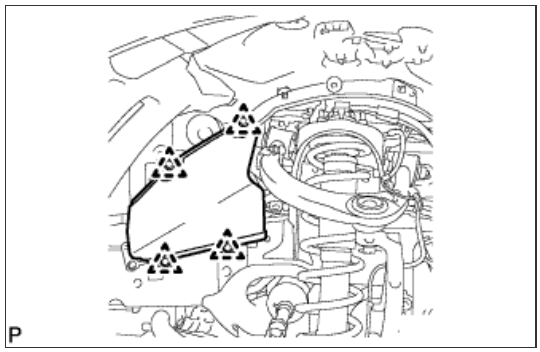
for Preparation Click here

1. REMOVE INTAKE MANIFOLD

a. Remove the intake manifold (Click here).

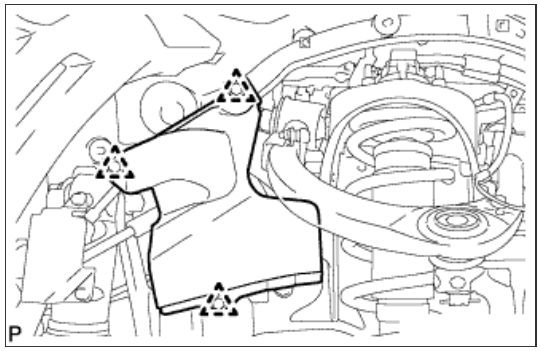
2. REMOVE FRONT FENDER APRON SEAL LH

a. Using a clip remover, remove the 4 clips and fender apron seal.



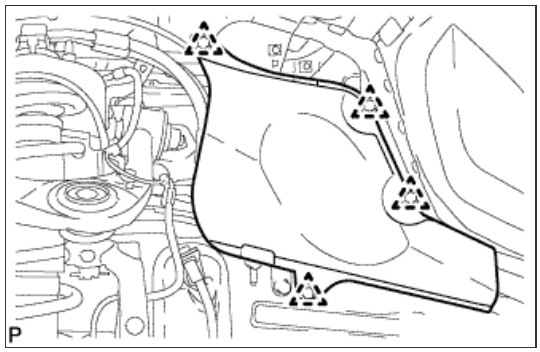
3. REMOVE FRONT FENDER APRON SEAL LH (w/ KDSS)

a. Using a clip remover, remove the 3 clips and fender apron seal.



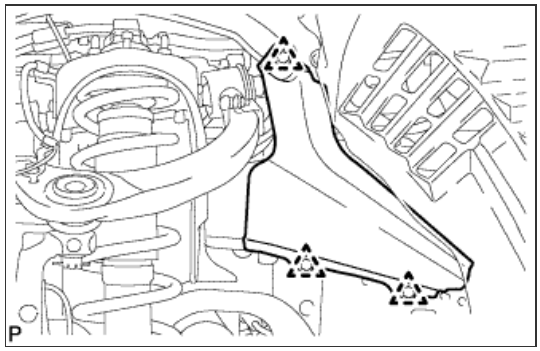
4. REMOVE FRONT FENDER APRON SEAL REAR LH

a. Using a clip remover, remove the 4 clips and fender apron seal.



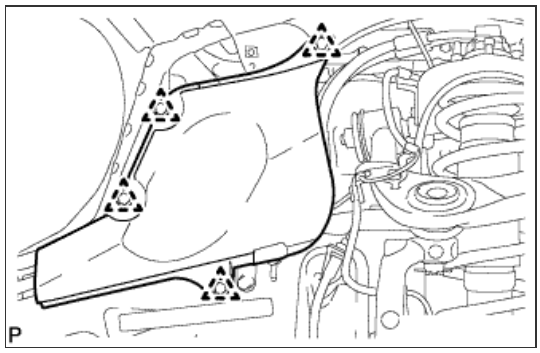
5. REMOVE FRONT FENDER APRON SEAL FRONT RH

a. Using a clip remover, remove the 3 clips and fender apron seal.



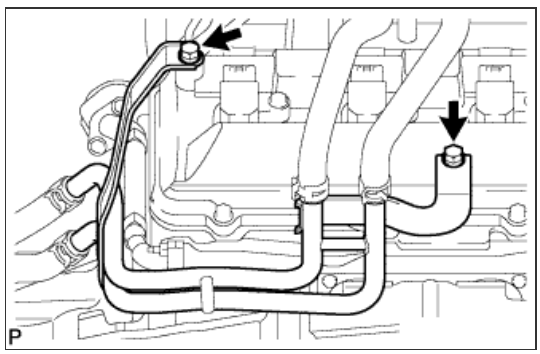
6. REMOVE FRONT FENDER APRON SEAL REAR RH

a. Using a clip remover, remove the 4 clips and fender apron seal.



7. DISCONNECT NO. 1 WATER BY-PASS PIPE (w/o Air Cooled Transmission Oil Cooler)

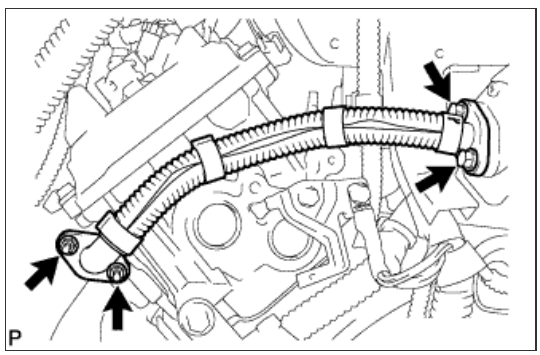
a. Remove the 2 bolts and disconnect the water by-pass pipe from the cylinder head cover RH.



8. REMOVE NO. 3 AIR TUBE

a. Remove the 2 bolts, 2 nuts and No. 3 air tube.

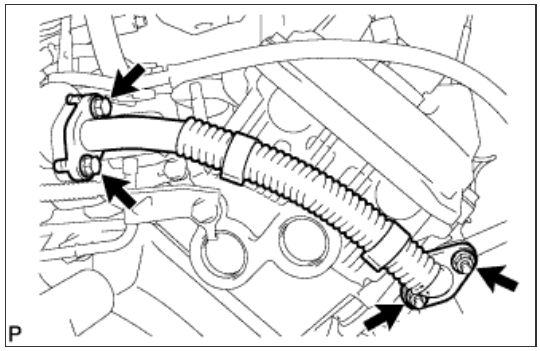
b. Remove the 2 gaskets.



9. REMOVE AIR TUBE SUB-ASSEMBLY RH

a. Remove the 2 bolts, 2 nuts and air tube sub-assembly.

b. Remove the 2 gaskets.

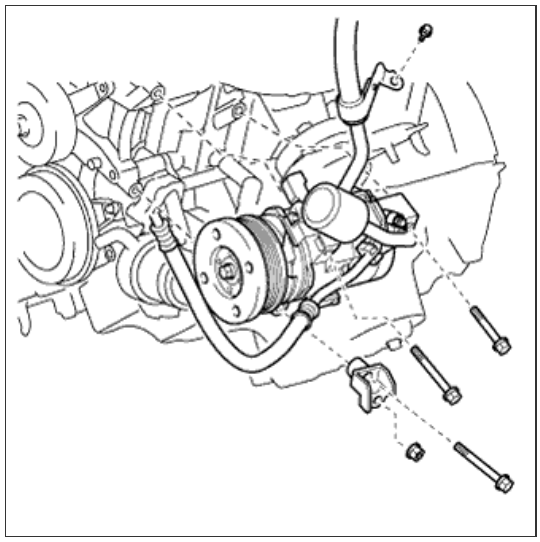


10. DISCONNECT COOLER COMPRESSOR

a. Disconnect the connector.

b. Remove the bolt. Then disconnect the cooler refrigerant suction hose from the cylinder head cover.

c. Remove the 3 bolts, nut and No. 1 compressor stay and disconnect the cooler compressor.

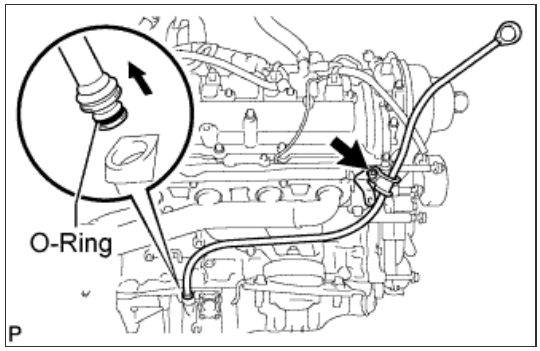


11. REMOVE ENGINE OIL LEVEL DIPSTICK GUIDE

a. Remove the dipstick.

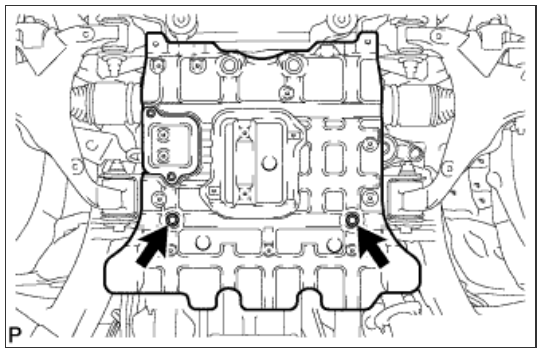
b. Remove the bolt and dipstick guide.

c. Remove the O-ring from the dipstick guide.



12. REMOVE NO. 2 ENGINE UNDER COVER

a. Remove the 2 bolts and No. 2 engine under cover.



13. REMOVE TAILPIPE ASSEMBLY

a. Remove the bolt, clamp and gasket.

b. Remove the tailpipe from the 2 exhaust pipe supports.

14. REMOVE CENTER EXHAUST PIPE ASSEMBLY

a. Remove the 4 bolts.

b. Remove the center exhaust pipe from the 3 exhaust pipe supports.

c. Remove the 2 gaskets from the front exhaust pipe and front No. 2 exhaust pipe.

15. REMOVE FRONT EXHAUST PIPE ASSEMBLY

a. Disconnect the air fuel ratio sensor connector.

b. Disconnect the heated oxygen sensor connector.

c. Detach the heated oxygen sensor wire clamp.

d. Remove the 3 nuts, front exhaust pipe and gasket.

16. REMOVE FRONT NO. 2 EXHAUST PIPE ASSEMBLY

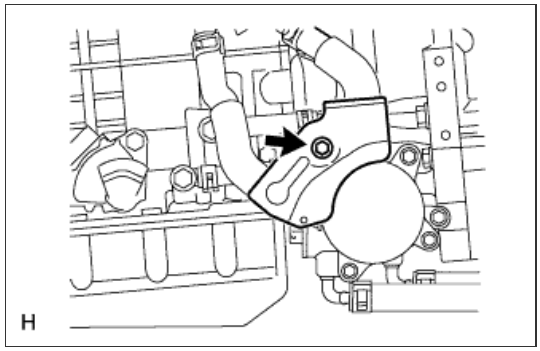
a. Disconnect the air fuel ratio sensor connector.

b. Disconnect the heated oxygen sensor connector.

c. Remove the 3 nuts, front No. 2 exhaust pipe and gasket.

17. DISCONNECT TRANSMISSION OIL COOLER ASSEMBLY (w/o Air Cooled Transmission Oil Cooler)

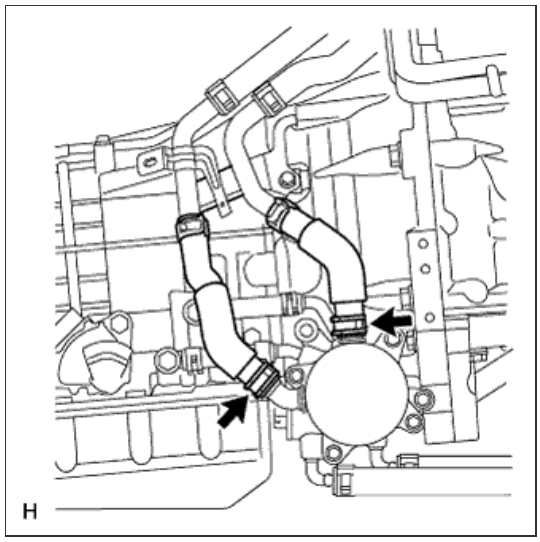
a. Remove the bolt and hose heat protector.



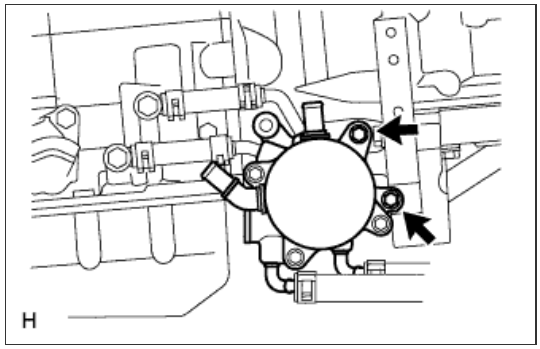
b. Disconnect the 2 water bypass hoses from the transmission oil cooler.

NOTICE:

Use a container to catch any coolant which flows out of the water by-pass hoses.

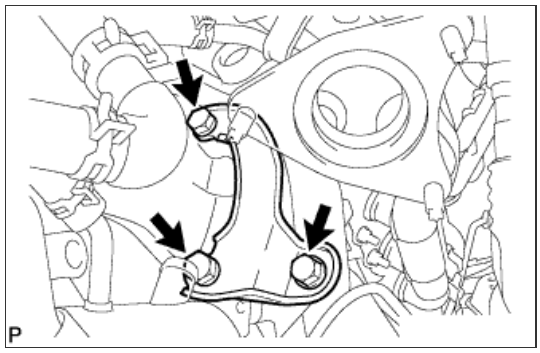


c. Remove the 2 bolts and disconnect the transmission oil cooler.



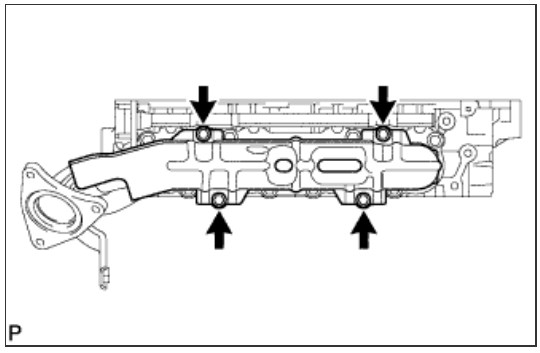
18. REMOVE NO. 1 MANIFOLD STAY

a. Remove the 3 bolts and manifold stay.



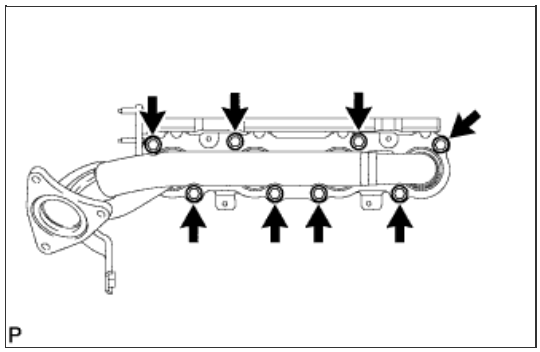
19. REMOVE NO. 1 EXHAUST MANIFOLD HEAT INSULATOR

a. Remove the 4 bolts and heat insulator.

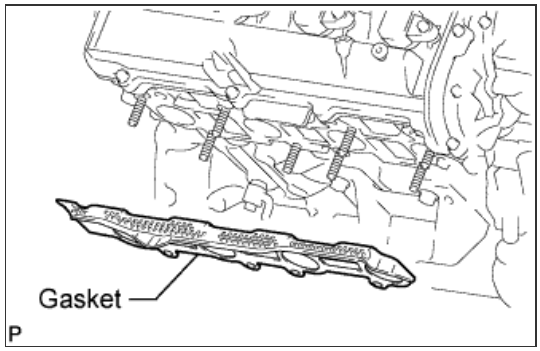


20. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY RH

a. Remove the 8 nuts and exhaust manifold.

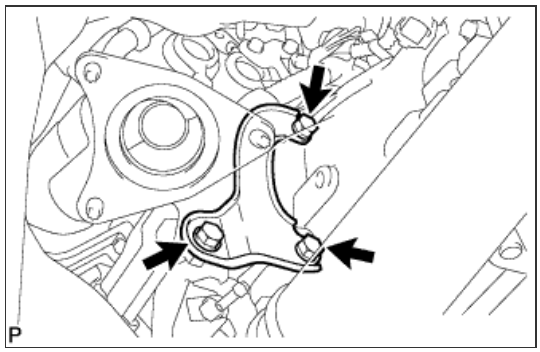


b. Remove the gasket from the cylinder head RH.



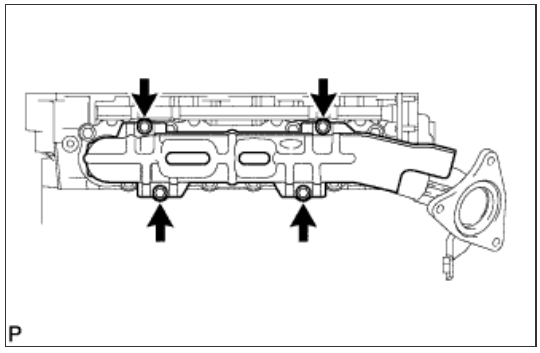
21. REMOVE NO. 2 MANIFOLD STAY

a. Remove the 3 bolts and manifold stay.



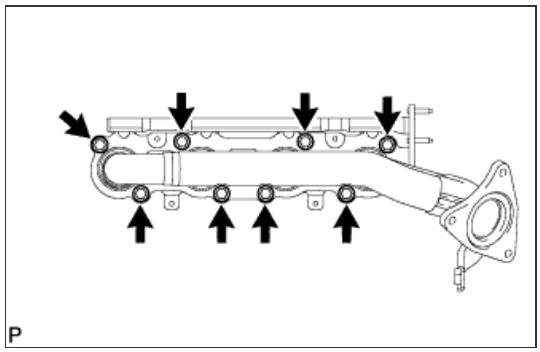
22. REMOVE NO. 2 EXHAUST MANIFOLD HEAT INSULATOR

a. Remove the 4 bolts and heat insulator.

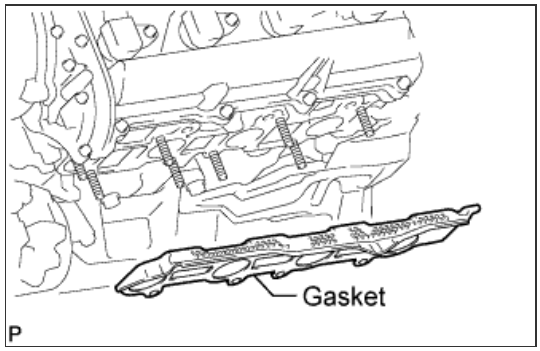


23. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY LH

a. Remove the 8 nuts and exhaust manifold.



b. Remove the gasket from the cylinder head LH.



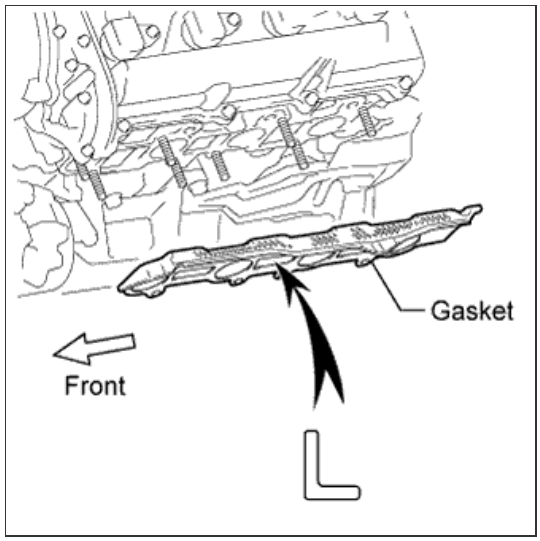
for Preparation Click here

1. INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY LH

a. Place a new gasket on the cylinder head with the "L" mark facing the manifold side.

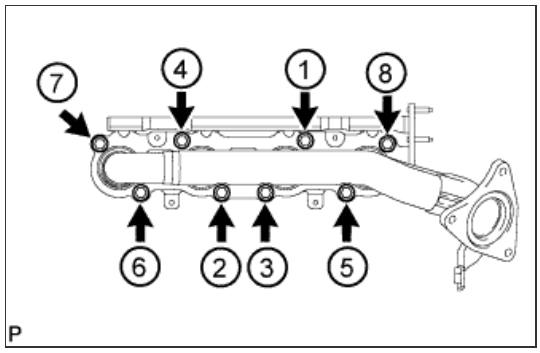
NOTICE:

Be careful of the installation direction.



b. Temporarily install the exhaust manifold with 8 new nuts, and then uniformly tighten the nuts in several steps, in the sequence shown in the illustration.

Torque:
44 N*m{ 449 kgf*cm , 32 ft.*lbf }

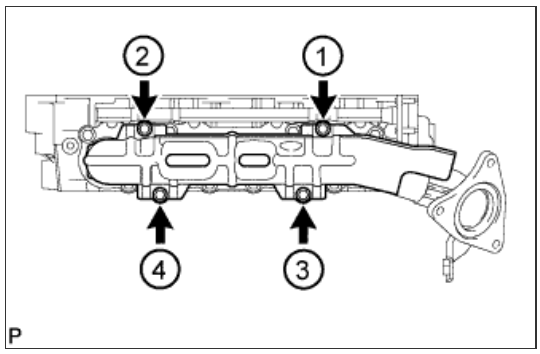


2. INSTALL NO. 2 EXHAUST MANIFOLD HEAT INSULATOR

a. Temporarily install the heat insulator with the 4 bolts.

b. Uniformly tighten the 4 bolts in several steps, in the sequence shown in the illustration.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

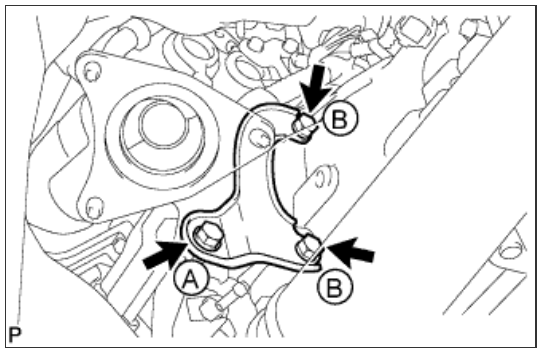


3. INSTALL NO. 2 MANIFOLD STAY

a. Install the manifold stay with the 3 bolts.

a. Install the manifold stay with the 3 bolts.

Torque:
for bolt A:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }
for bolt B:
71 N*m{ 724 kgf*cm , 52 ft.*lbf }

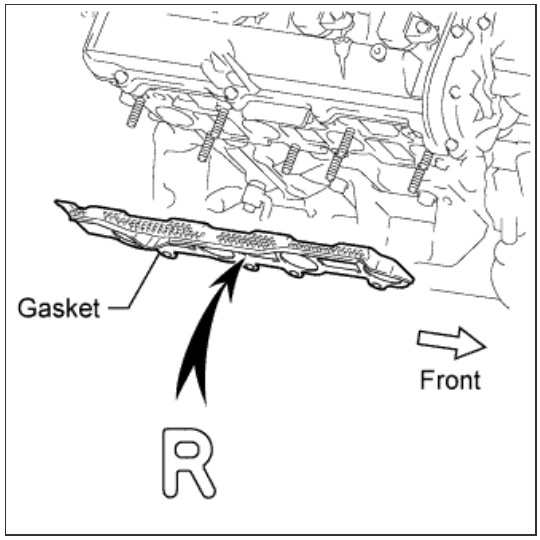


4. INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY RH

a. Place a new gasket on the cylinder head with the "R" mark facing the manifold side.

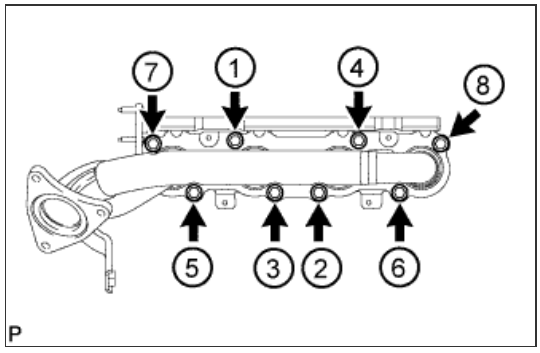
NOTICE:

Be careful of the installation direction.



b. Temporarily install the exhaust manifold with 8 new nuts, and then uniformly tighten the nuts in several steps, in the sequence shown in the illustration.

Torque:
44 N*m{ 429 kgf*cm , 32 ft.*lbf }

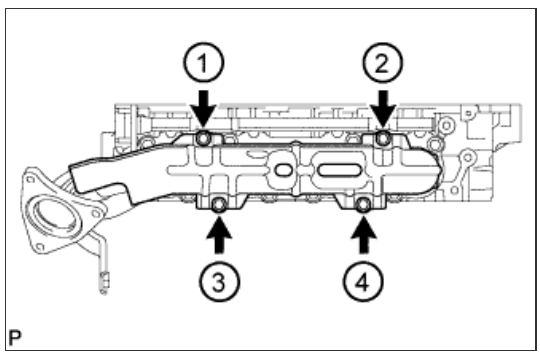


5. INSTALL NO. 1 EXHAUST MANIFOLD HEAT INSULATOR

a. Temporarily install the heat insulator with the 4 bolts.

b. Uniformly tighten the 4 bolts in several steps, in the sequence shown in the illustration.

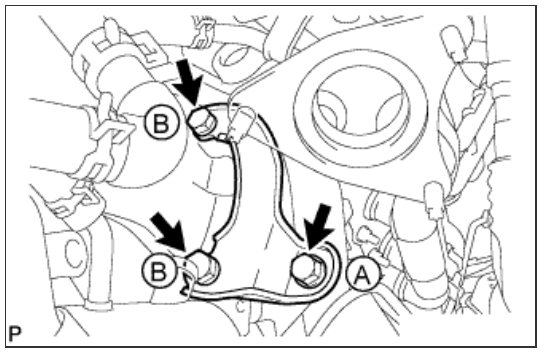
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



6. INSTALL NO. 1 MANIFOLD STAY

a. Install the manifold stay with the 3 bolts.

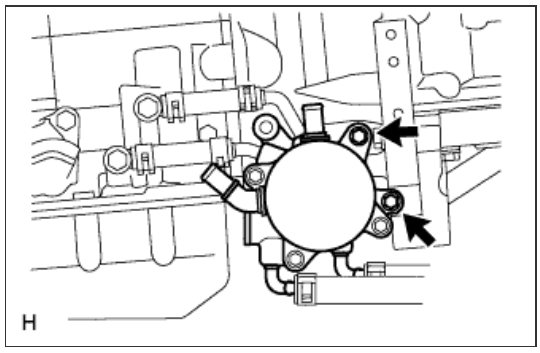
Torque:
for bolt A:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }
for bolt B:
71 N*m{ 724 kgf*cm , 52 ft.*lbf }



7. CONNECT TRANSMISSION OIL COOLER ASSEMBLY (w/o Air Cooled Transmission Oil Cooler)

a. Connect the transmission oil cooler with the 2 bolts.

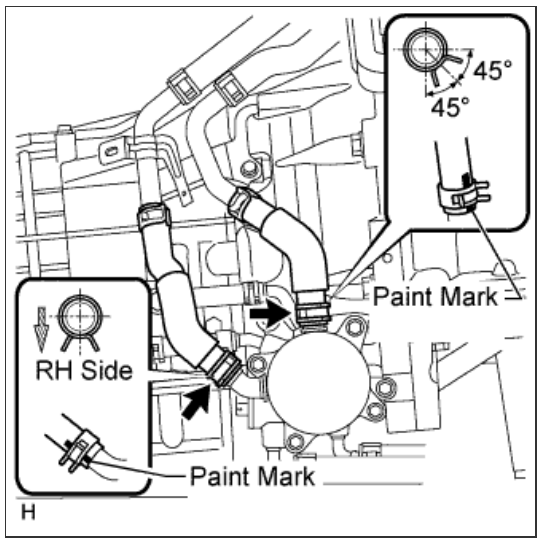
Torque:
21 N*m{ 214 kgf*cm , 1 ft.*lbf }



b. Connect the 2 water bypass hoses to the transmission oil cooler.

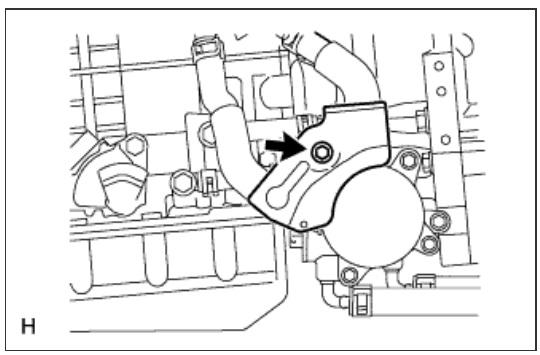
NOTICE:

Make sure the pinching portion of each clip is facing the direction shown in the illustration.



c. Install the hose heat protector with the bolt.

Torque:
21 N*m{ 214 kgf*cm , 1 ft.*lbf }



8. INSTALL FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Install a new gasket and the front No. 2 exhaust pipe to the exhaust manifold LH with 3 new nuts.

Torque:
54 N*m{ 554 kgf*cm , 40 ft.*lbf }

b. Connect the air fuel ratio sensor connector.

c. Connect the heated oxygen sensor connector.

9. INSTALL FRONT EXHAUST PIPE ASSEMBLY

a. Install a new gasket and the front exhaust pipe to the exhaust manifold with 3 new nuts.

Torque:
54 N*m{ 554 kgf*cm , 40 ft.*lbf }

b. Connect the air fuel ratio sensor connector.

c. Connect the heated oxygen sensor connector.

d. Attach the heated oxygen sensor wire clamp.

1 INSTALL CENTER EXHAUST PIPE ASSEMBLY

a. Install the center exhaust pipe to the 3 exhaust pipe supports.

b. Install 2 new gaskets to the front exhaust pipe and front No. 2 exhaust pipe.

c. Install the 4 bolts.

Torque:
48 N*m{ 489 kgf*cm , 35 ft.*lbf }

11. INSTALL TAILPIPE ASSEMBLY

a. Install the tailpipe to the 2 exhaust pipe supports.

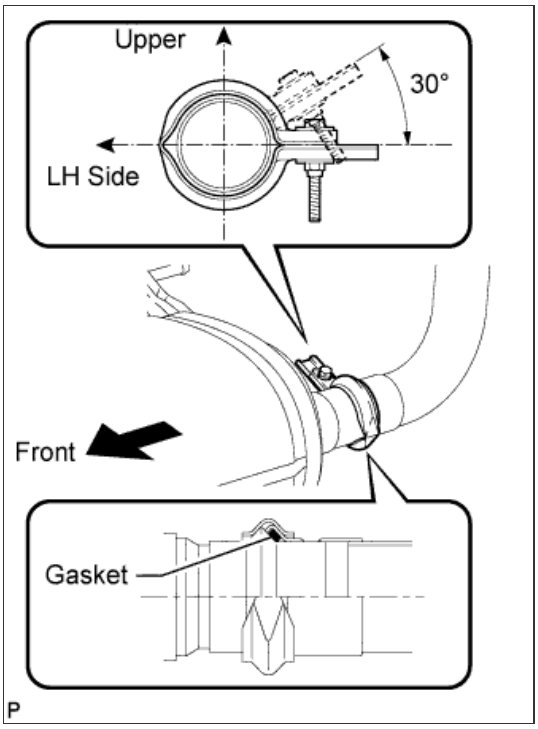
b. Install a new gasket to the center exhaust pipe.

c. Connect the tailpipe and center exhaust pipe with a new clamp.

Torque:
32 N*m{ 326 kgf*cm , 24 ft.*lbf }

HINT:

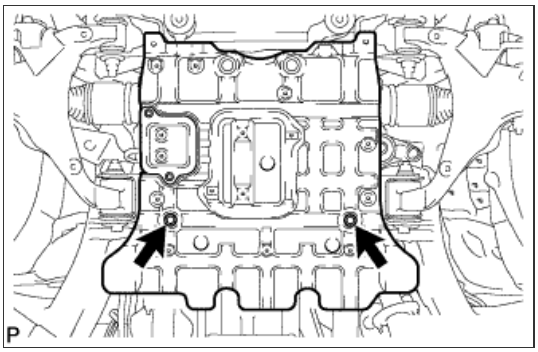
Install the clamp within the angle range shown in the illustration.



12. INSTALL NO. 2 EN INE UNDER CO ER

a. Install the No. 2 engine under cover with the 2 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



13. INSTALL EN INE OIL LEVEL DIPSTIC IDE

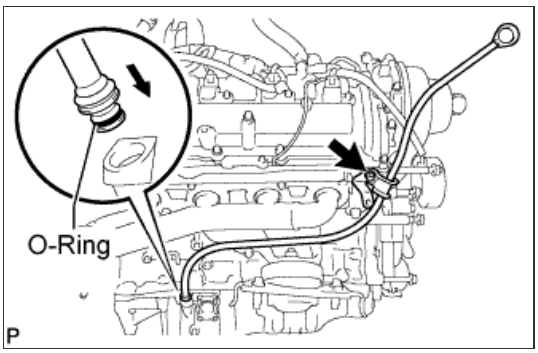
a. Apply a light coat of engine oil to a new O-ring.

b. Install a new O-ring to the guide.

c. Install the dipstick guide with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

d. Install the dipstick.



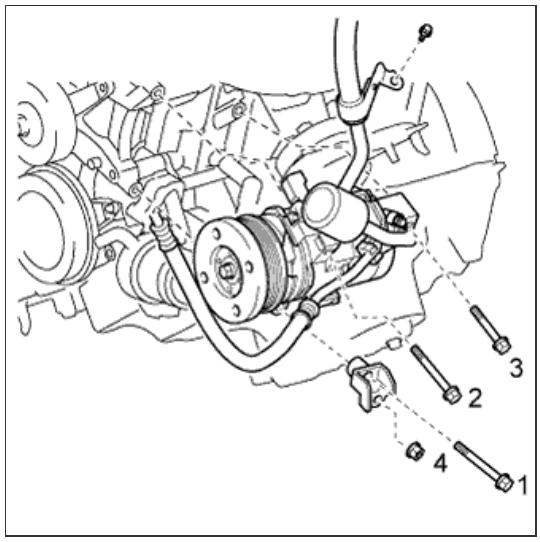
14. CONNECT COOLER COMPRESSOR

a. Connect the compressor. Then install it and the No. 1 compressor stay with the nut and 3 bolts.

Torque:
for bolt:
45 N*m{ 459 kgf*cm , 33 ft.*lbf }
for nut:
25 N*m{ 250 kgf*cm , 1 ft.*lbf }

HINT:

Tighten the bolts in the order shown in the illustration to install the cooler compressor.



b. Install the cooler refrigerant suction hose with the bolt.

Torque:
9.8 N*m{ 1 kgf*cm , 87 in.*lbf }

c. Connect the connector.

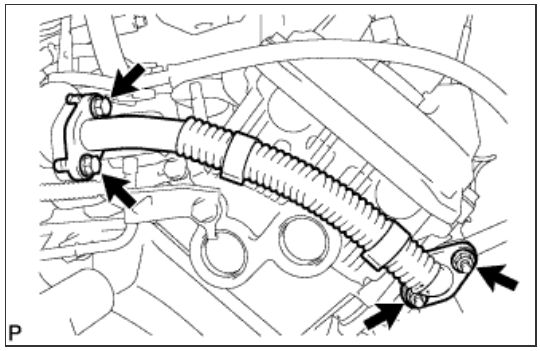
1 INSTALL AIR TUBE SUB-ASSEMBLY RH

a. Install a new gasket and connect the air tube to the exhaust manifold with the 2 nuts.

Torque:
1 N*m{ 1 2kgf*cm , 7 ft.*lbf }

b. Install a new gasket and connect the air tube to the No. 1 air switching valve with the 2 bolts.

Torque:
1 N*m{ 1 2kgf*cm , 7 ft.*lbf }



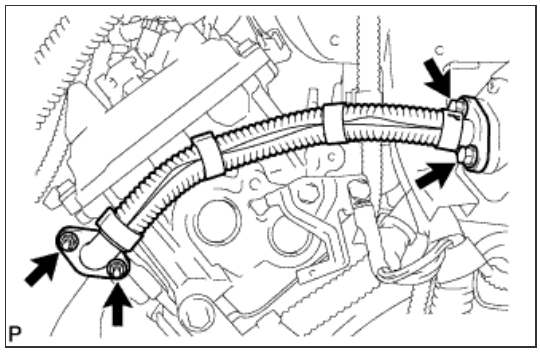
1 INSTALL NO. 3 AIR TUBE

a. Install a new gasket and connect the No. 3 air tube to the exhaust manifold with the 2 nuts.

Torque:
1 N*m{ 1 2kgf*cm , 7 ft.*lbf }

b. Install a new gasket and connect the No. 3 air tube to the No. 2 air switching valve with the 2 bolts.

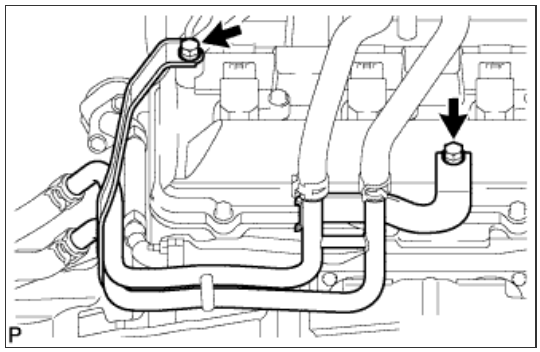
Torque:
1 N*m{ 1 2kgf*cm , 7 ft.*lbf }



17. CONNECT NO. 1 WATER BY-PASS PIPE (w/o Air Cooled Transmission Oil Cooler)

a. Connect the water by-pass pipe to the cylinder head cover RH with the 2 bolts.

Torque:
1 N*m{ 1 4 kgf*cm , 13 ft.*lbf }



1 INSTALL INTAKE MANIFOLD

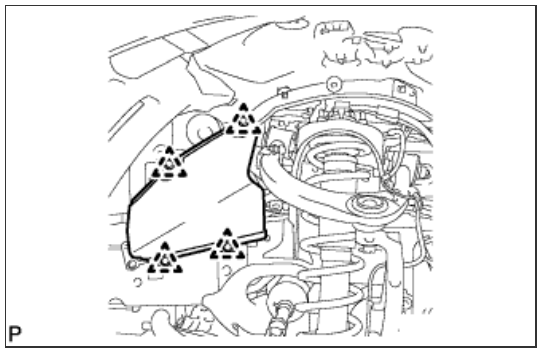
a. Install the intake manifold (Click here).

19. INSPECT FOR EXHAUST AS LEAK

If gas is leaking, tighten the areas necessary to stop the leak. Replace damaged parts as necessary.

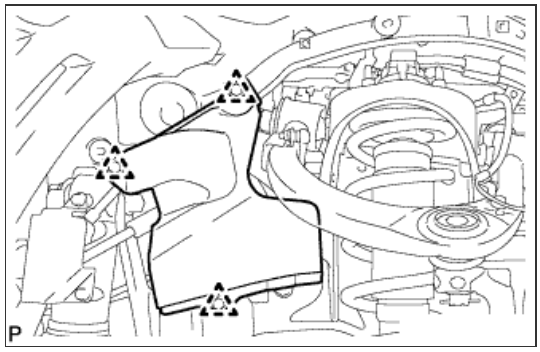
20. INSTALL FRONT FENDER APRON SEAL LH

a. Install the fender apron seal with the 4 clips.



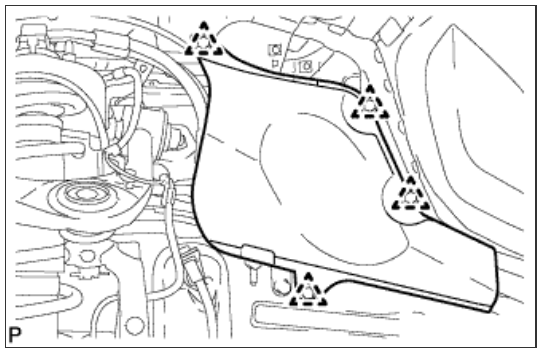
21. INSTALL FRONT FENDER APRON SEAL LH (w/ DSS)

a. Install the fender apron seal with the 3 clips.



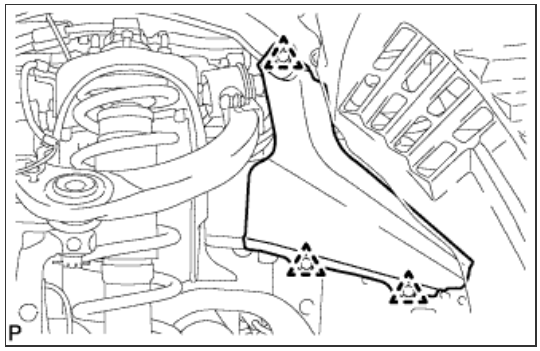
22. INSTALL FRONT FENDER APRON SEAL REAR LH

a. Install the fender apron seal with the 4 clips.



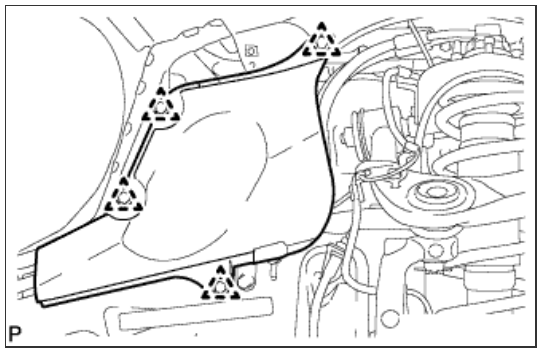
23. INSTALL FRONT FENDER APRON SEAL FRONT RH

a. Install the fender apron seal with the 3 clips.

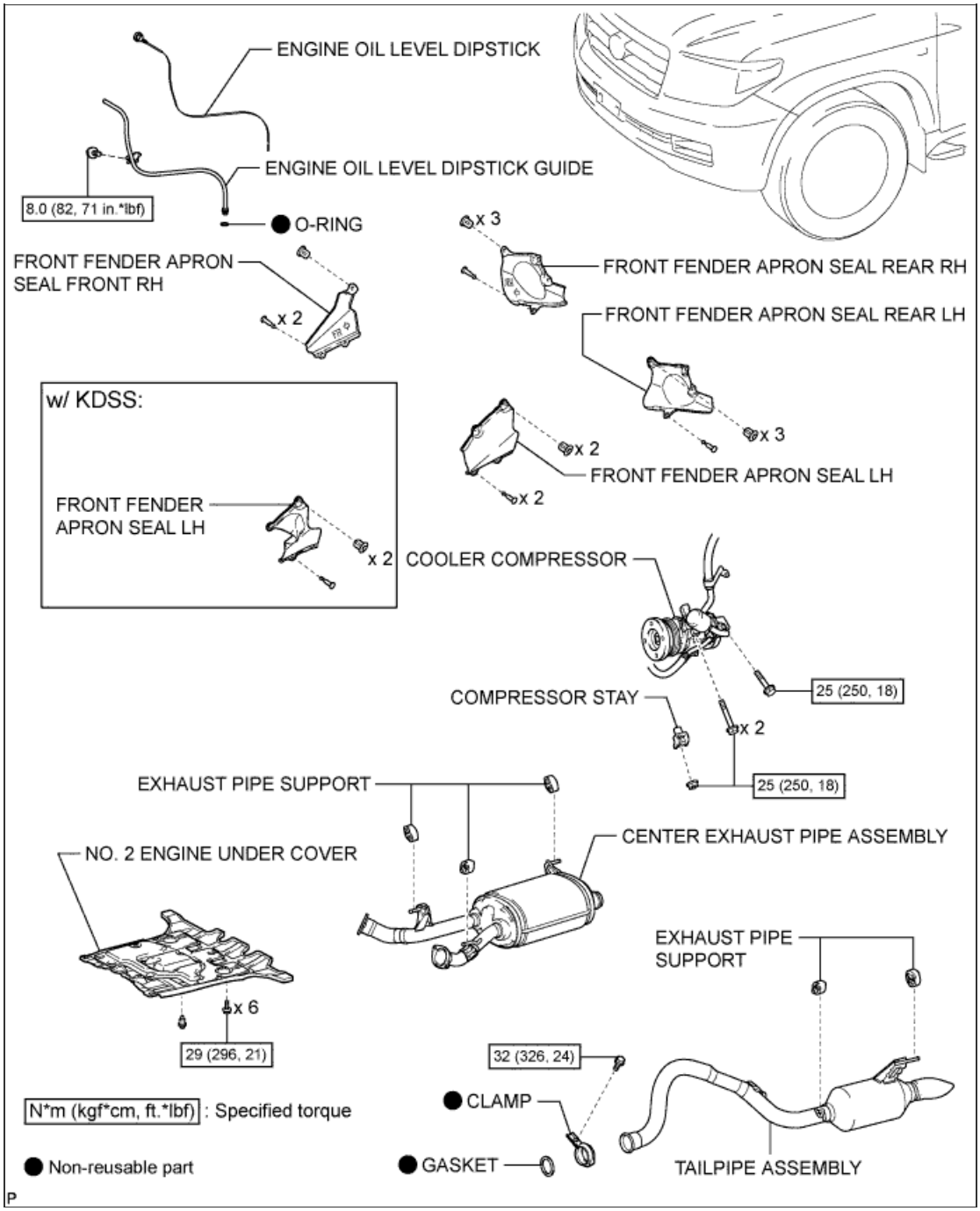


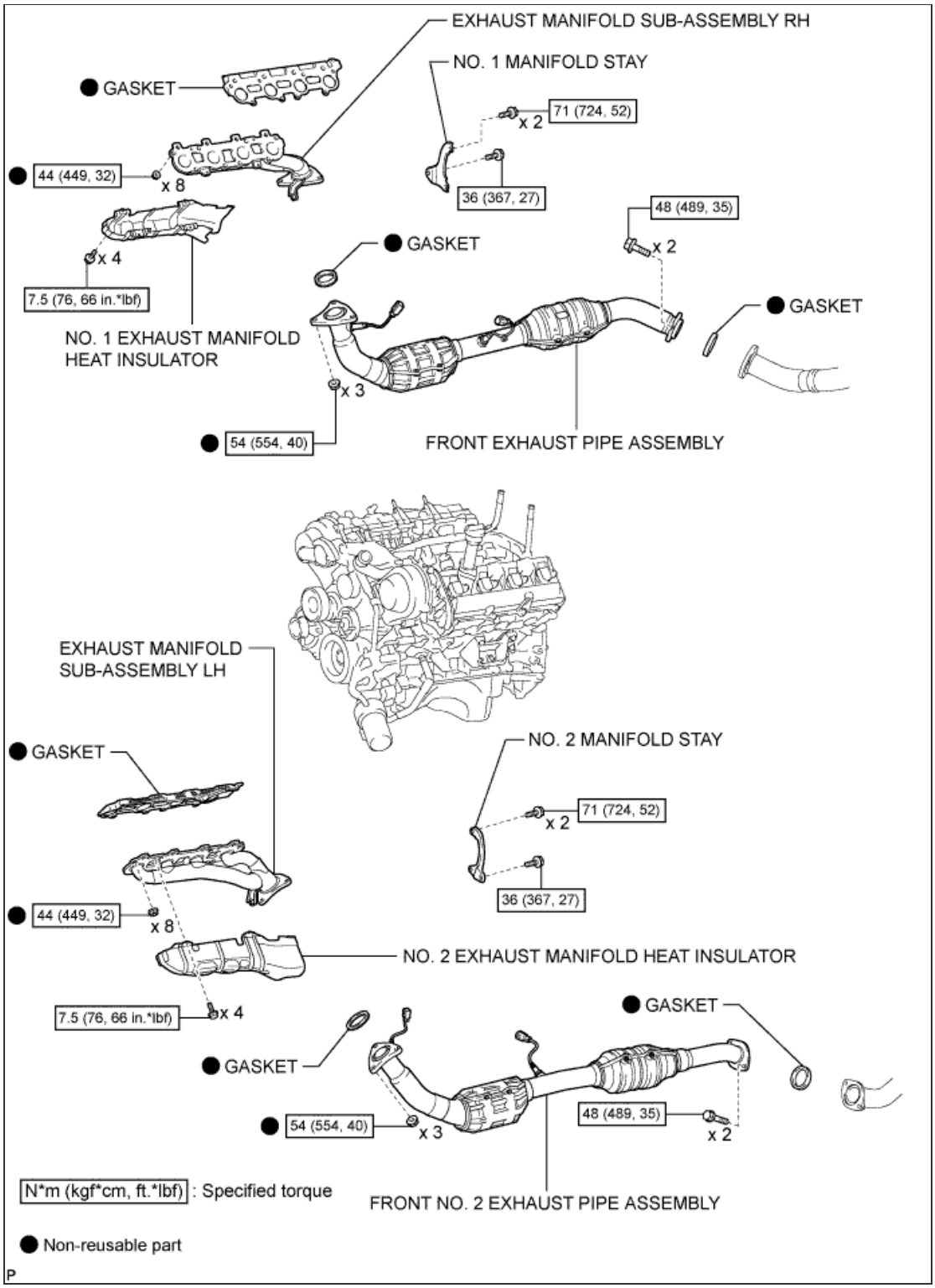
24. INSTALL FRONT FENDER APRON SEAL REAR RH

a. Install the fender apron seal with the 4 clips.



for Preparation ick ere

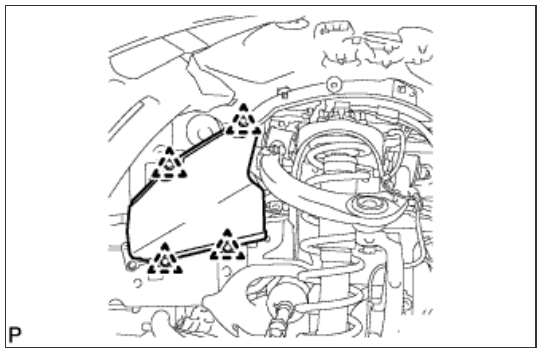



EXHAUST MANIFOLD SUB-ASSEMBLY RH
NO. 1 MANIFOLD STAY
GASKET
71 (724, 52)
x 2
44 (449, 32)
x 8
36 (367, 27)
48 (489, 35)
x 2
x 4
GASKET
7.5 (76, 66 in.*lbf)
GASKET
NO. 1 EXHAUST MANIFOLD
HEAT INSULATOR
x 3
54 (554, 40)
FRONT EXHAUST PIPE ASSEMBLY
EXHAUST MANIFOLD
SUB-ASSEMBLY LH
GASKET
NO. 2 MANIFOLD STAY
71 (724, 52)
x 2
36 (367, 27)
44 (449, 32)
x 8
NO. 2 EXHAUST MANIFOLD HEAT INSULATOR
7.5 (76, 66 in.*lbf)
x 4
GASKET
GASKET
54 (554, 40)
x 3
48 (489, 35)
x 2
N*m (kgf*cm, ft.*lbf) : Specified torque
FRONT NO. 2 EXHAUST PIPE ASSEMBLY
Non-reusable part
P

for Preparation Click here

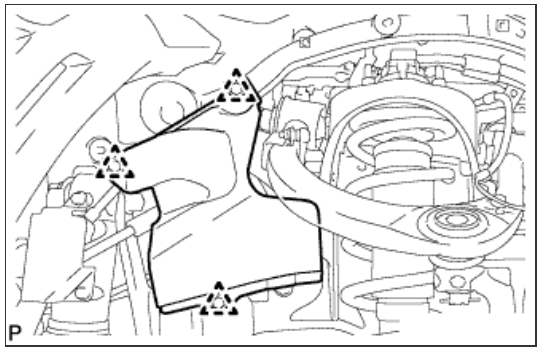
1. REMOVE FRONT FENDER APRON SEAL LH

a. Using a clip remover, remove the 4 clips and fender apron seal.



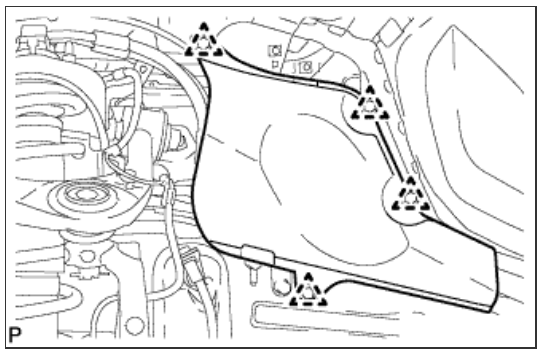
2. REMOVE FRONT FENDER APRON SEAL LH (w/ KDSS)

a. Using a clip remover, remove the 3 clips and fender apron seal.



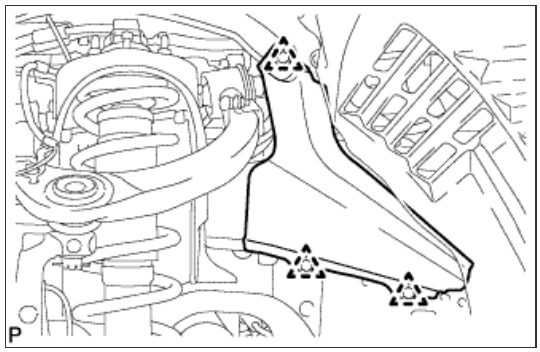
3. REMOVE FRONT FENDER APRON SEAL REAR LH

a. Using a clip remover, remove the 4 clips and fender apron seal.



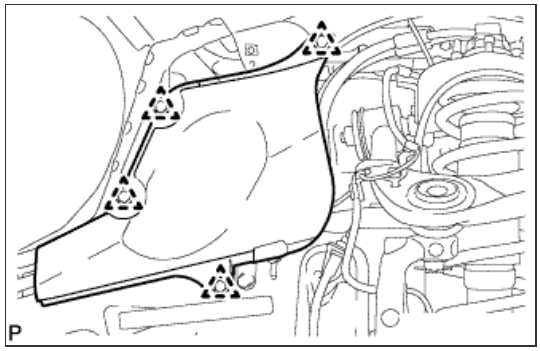
4. REMOVE FRONT FENDER APRON SEAL FRONT RH

a. Using a clip remover, remove the 3 clips and fender apron seal.



5. REMOVE FRONT FENDER APRON SEAL REAR RH

a. Using a clip remover, remove the 4 clips and fender apron seal.

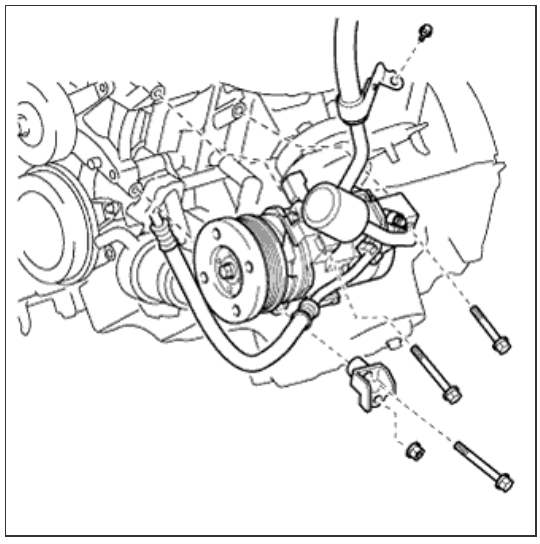


6. DISCONNECT COOLER COMPRESSOR

a. Disconnect the connector.

b. Remove the bolt. Then disconnect the cooler refrigerant suction hose from the cylinder head cover.

c. Remove the 3 bolts, nut and No. 1 compressor stay and disconnect the cooler compressor.

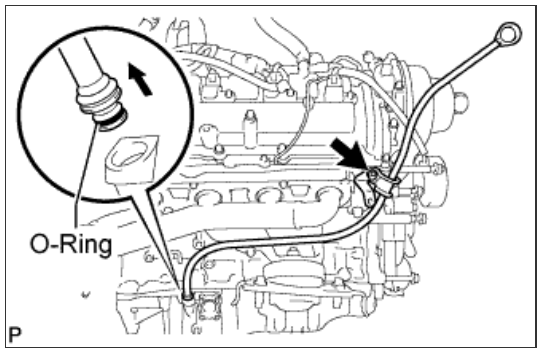


7. REMOVE ENGINE OIL LEVEL DIPSTICK GUIDE

a. Remove the dipstick.

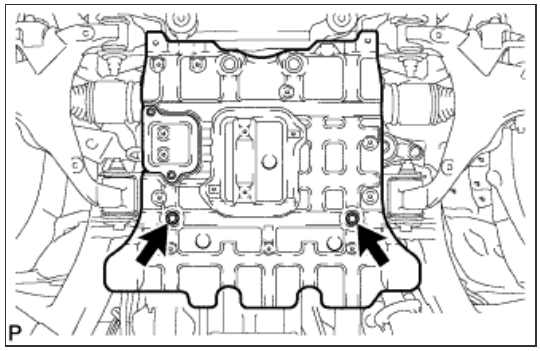
b. Remove the bolt and dipstick guide.

c. Remove the O-ring from the dipstick guide.



8. REMOVE NO. 2 ENGINE UNDER COVER

a. Remove the 2 bolts and No. 2 engine under cover.



9. REMOVE TAILPIPE ASSEMBLY

a. Remove the bolt, clamp and gasket.

b. Remove the tailpipe from the 2 exhaust pipe supports.

10. REMOVE CENTER EXHAUST PIPE ASSEMBLY

a. Remove the 4 bolts.

b. Remove the center exhaust pipe from the 3 exhaust pipe supports.

c. Remove the 2 gaskets from the front exhaust pipe and front No. 2 exhaust pipe.

11. REMOVE FRONT EXHAUST PIPE ASSEMBLY

a. Disconnect the air fuel ratio sensor connector.

b. Disconnect the heated oxygen sensor connector.

c. Detach the heated oxygen sensor wire clamp.

d. Remove the 3 nuts, front exhaust pipe and gasket.

12. REMOVE FRONT NO. 2 EXHAUST PIPE ASSEMBLY

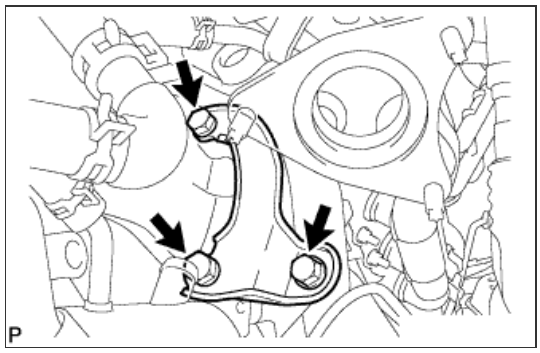
a. Disconnect the air fuel ratio sensor connector.

b. Disconnect the heated oxygen sensor connector.

c. Remove the 3 nuts, front No. 2 exhaust pipe and gasket.

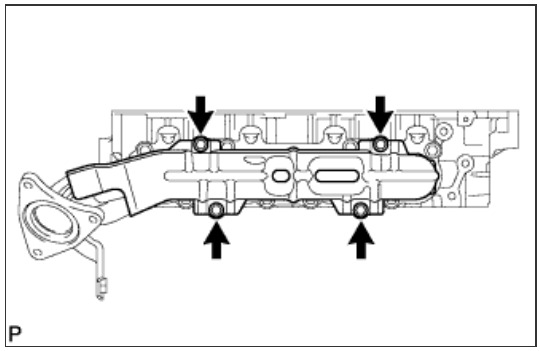
13. REMOVE NO. 1 MANIFOLD STAY

a. Remove the 3 bolts and manifold stay.



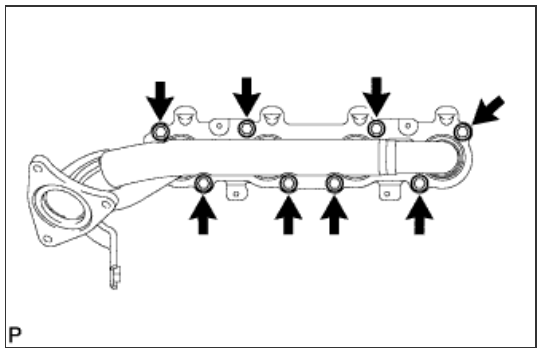
14. REMOVE NO. 1 EXHAUST MANIFOLD HEAT INSULATOR

a. Remove the 4 bolts and heat insulator.

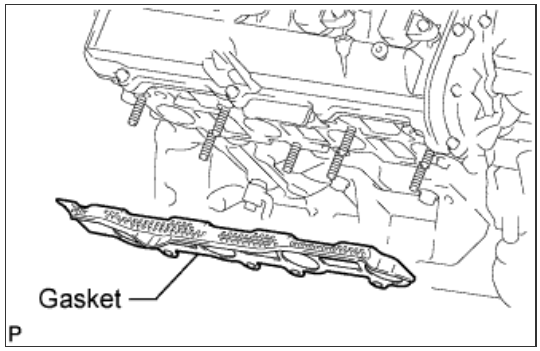


15. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY RH

a. Remove the 8 nuts and exhaust manifold.

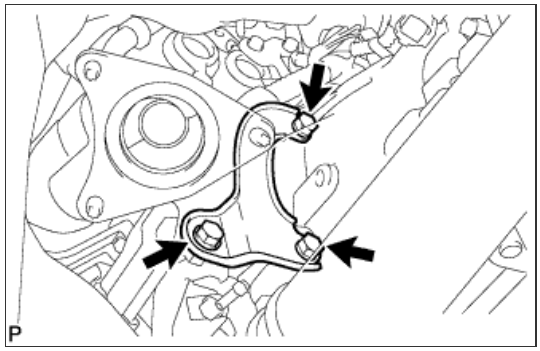


b. Remove the gasket from the cylinder head RH.



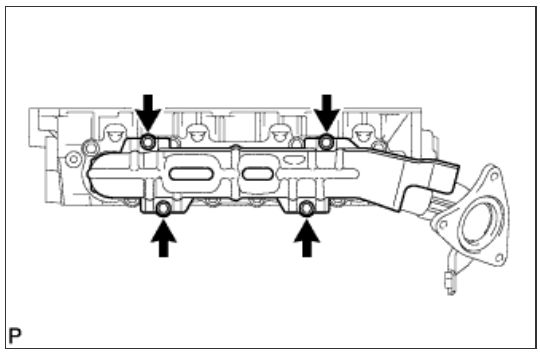
16. REMOVE NO. 2 MANIFOLD STAY

a. Remove the 3 bolts and manifold stay.



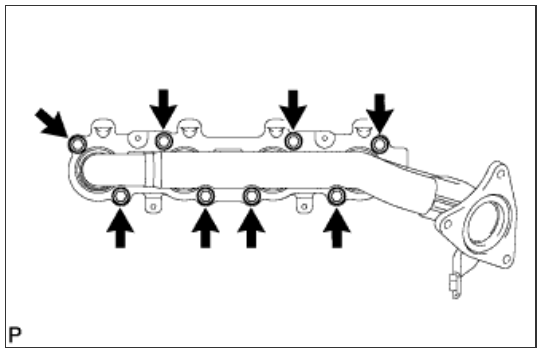
17. REMOVE NO. 2 EXHAUST MANIFOLD HEAT INSULATOR

a. Remove the 4 bolts and heat insulator.

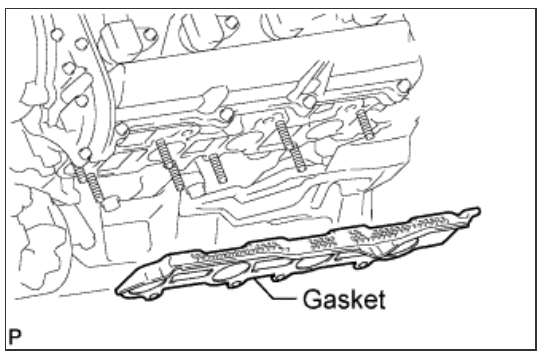


18. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY LH

a. Remove the 8 nuts and exhaust manifold.



b. Remove the gasket from the cylinder head LH.



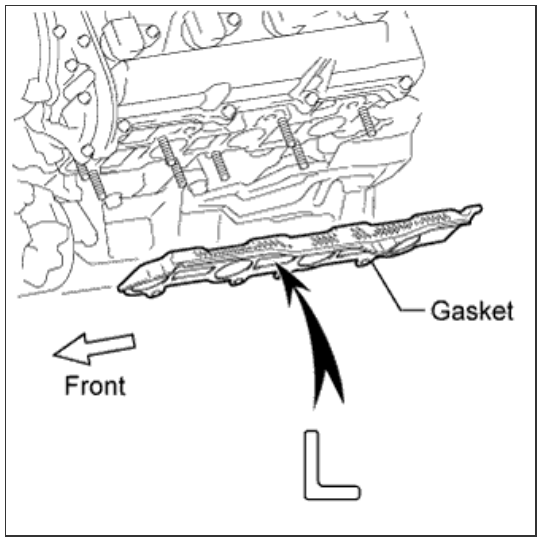
for Preparation Click here

1. INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY LH

a. Place a new gasket on the cylinder head with the "L" mark facing the manifold side.

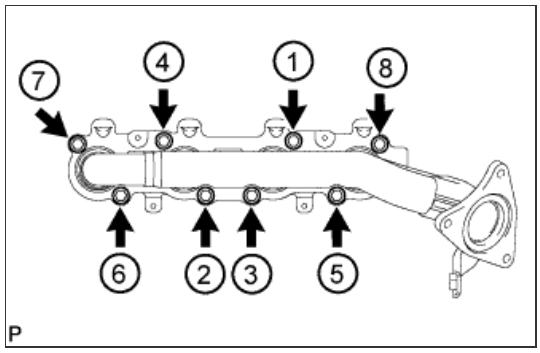
NOTICE:

Be careful of the installation direction.



b. Temporarily install the exhaust manifold with 8 new nuts, and then uniformly tighten the nuts in several steps, in the sequence shown in the illustration.

Torque:
44 N*m{ 449 kgf*cm , 32 ft.*lbf }

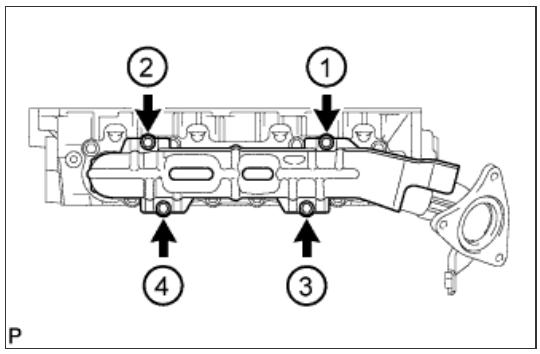


2. INSTALL NO. 2 EXHAUST MANIFOLD HEAT INSULATOR

a. Temporarily install the heat insulator with the 4 bolts.

b. Uniformly tighten the 4 bolts in several steps, in the sequence shown in the illustration.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

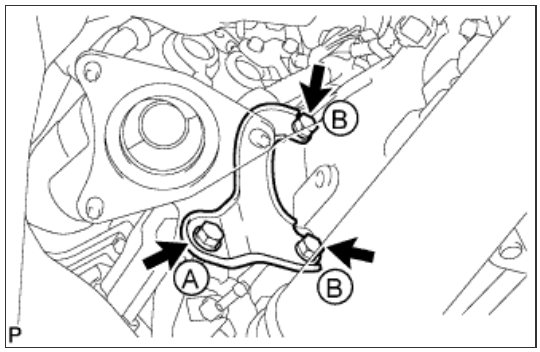


3. INSTALL NO. 2 MANIFOLD STAY

a. Install the manifold stay with the 3 bolts.

a. Install the manifold stay with the 3 bolts.

Torque:
for bolt A:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }
for bolt B:
71 N*m{ 724 kgf*cm , 52 ft.*lbf }

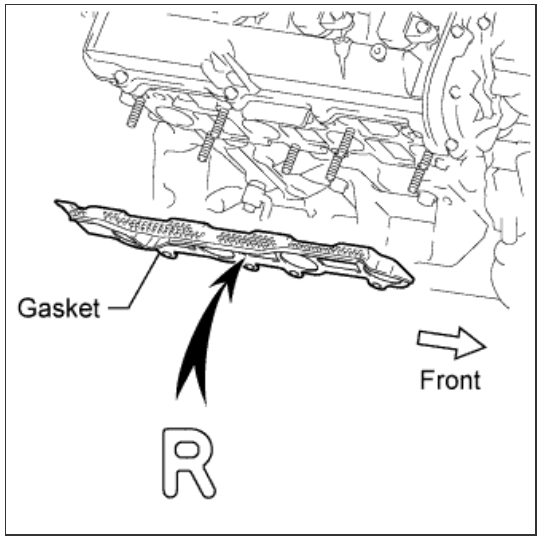


4. INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY RH

a. Place a new gasket on the cylinder head with the "R" mark facing the manifold side.

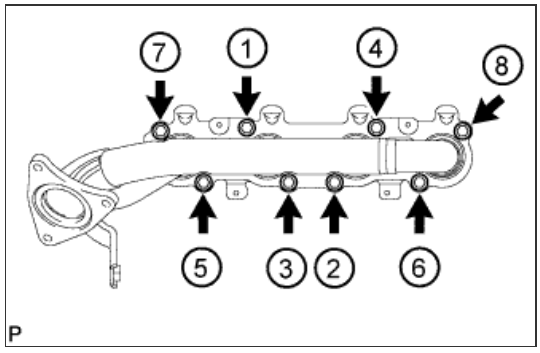
NOTICE:

Be careful of the installation direction.



b. Temporarily install the exhaust manifold with 8 new nuts, and then uniformly tighten the nuts in several steps, in the sequence shown in the illustration.

Torque:
44 N*m{ 429 kgf*cm , 32 ft.*lbf }

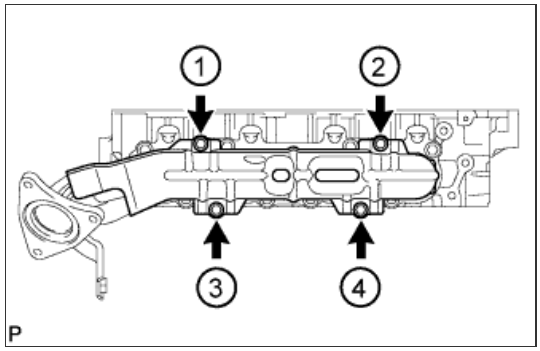


5. INSTALL NO. 1 EXHAUST MANIFOLD HEAT INSULATOR

a. Temporarily install the heat insulator with the 4 bolts.

b. Uniformly tighten the 4 bolts in several steps, in the sequence shown in the illustration.

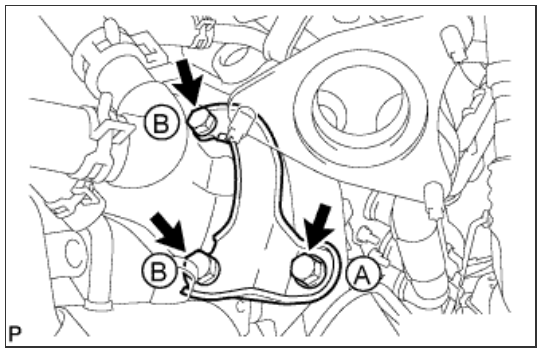
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



6. INSTALL NO. 1 MANIFOLD STAY

a. Install the manifold stay with the 3 bolts.

Torque:
for bolt A:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }
for bolt B:
71 N*m{ 724 kgf*cm , 52 ft.*lbf }



7. INSTALL FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Install a new gasket and the front No. 2 exhaust pipe to the exhaust manifold LH with 3 new nuts.

Torque:
54 N*m{ 554 kgf*cm , 40 ft.*lbf }

b. Connect the air fuel ratio sensor connector.

c. Connect the heated oxygen sensor connector.

8. INSTALL FRONT EXHAUST PIPE ASSEMBLY

a. Install a new gasket and the front exhaust pipe to the exhaust manifold with 3 new nuts.

Torque:
54 N*m{ 554 kgf*cm , 40 ft.*lbf }

b. Connect the air fuel ratio sensor connector.

c. Connect the heated oxygen sensor connector.

d. Attach the heated oxygen sensor wire clamp.

9. INSTALL CENTER EXHAUST PIPE ASSEMBLY

a. Install the center exhaust pipe to the 3 exhaust pipe supports.

b. Install 2 new gaskets to the front exhaust pipe and front No. 2 exhaust pipe.

c. Install the 4 bolts.

Torque:
48 N*m{ 489 kgf*cm , 35 ft.*lbf }

1 INSTALL TAILPIPE ASSEMBLY

a. Install the tailpipe to the 2 exhaust pipe supports.

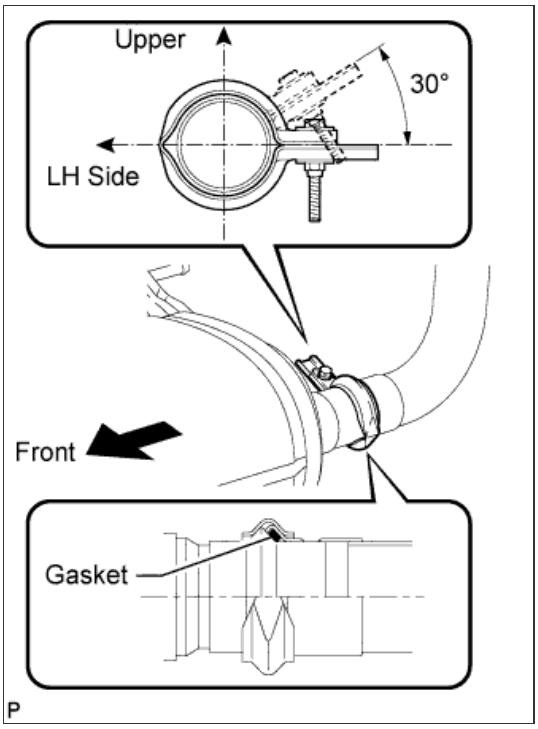
b. Install a new gasket to the center exhaust pipe.

c. Connect the tailpipe and center exhaust pipe with a new clamp.

Torque:
32 N*m{ 326 kgf*cm , 24 ft.*lbf }

HINT:

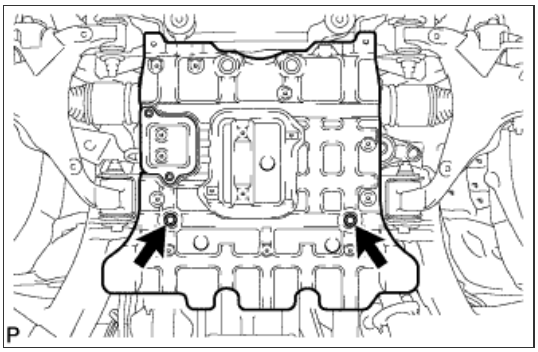
Install the clamp within the angle range shown in the illustration.



11. INSTALL NO. 2 ENGINE UNDER COVER

a. Install the No. 2 engine under cover with the 2 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



12. INSTALL ENGINE OIL LEVEL DIPSTICK GUIDE

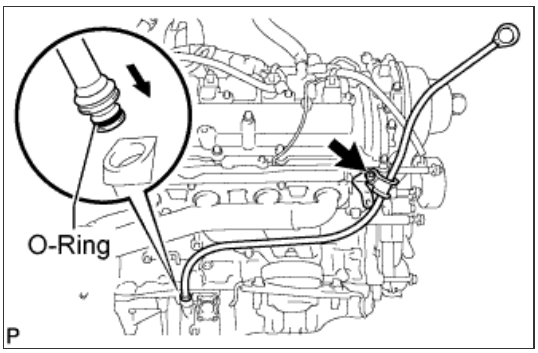
a. Apply a light coat of engine oil to a new O-ring.

b. Install a new O-ring to the guide.

c. Install the dipstick guide with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

d. Install the dipstick.



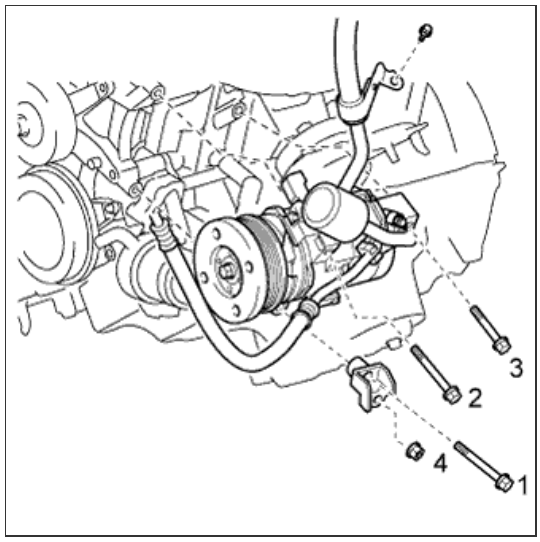
13. CONNECT COOLER COMPRESSOR

a. Connect the compressor. Then install it and the No. 1 compressor stay with the nut and 3 bolts.

Torque:
for bolt:
45 N*m{ 459 kgf*cm , 33 ft.*lbf }
for nut:
25 N*m{ 250 kgf*cm , 1 ft.*lbf }

HINT:

Tighten the bolts in the order shown in the illustration to install the cooler compressor.



b. Install the cooler refrigerant suction hose with the bolt.

Torque:
9.8 N*m{ 1 kgf*cm , 87 in.*lbf }

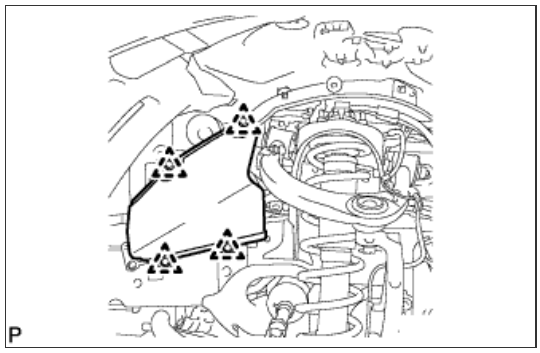
c. Connect the connector.

14. INSPECT FOR EXHAUST AS LEAK

If gas is leaking, tighten the areas necessary to stop the leak. Replace damaged parts as necessary.

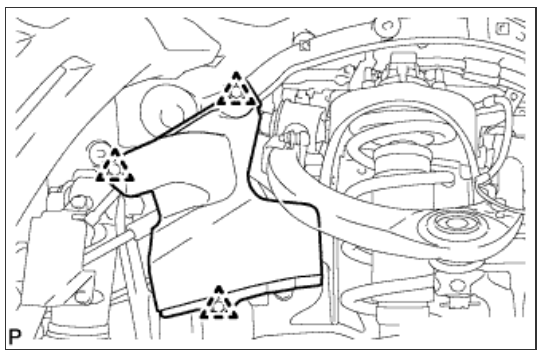
1 INSTALL FRONT FENDER APRON SEAL LH

a. Install the fender apron seal with the 4 clips.



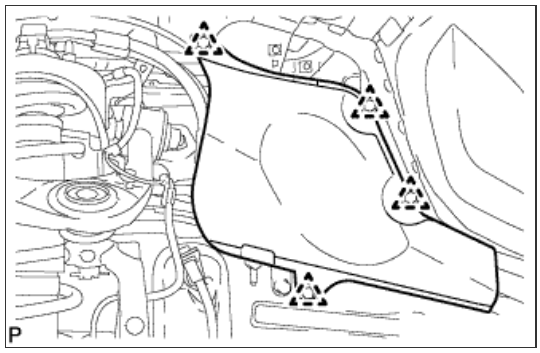
1 INSTALL FRONT FENDER APRON SEAL LH (w/ DSS)

a. Install the fender apron seal with the 3 clips.



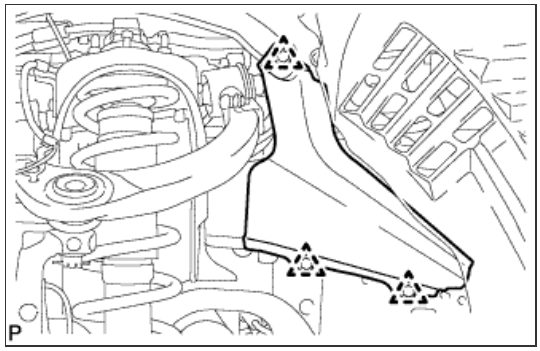
17. INSTALL FRONT FENDER APRON SEAL REAR LH

a. Install the fender apron seal with the 4 clips.



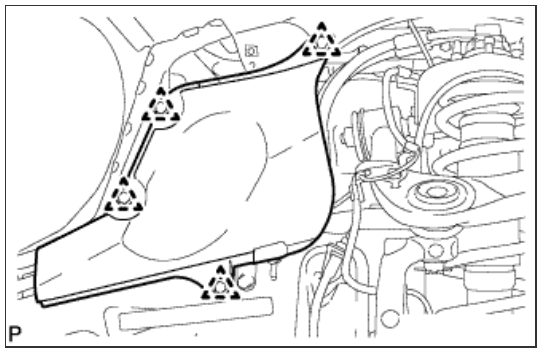
1 INSTALL FRONT FENDER APRON SEAL FRONT RH

a. Install the fender apron seal with the 3 clips.

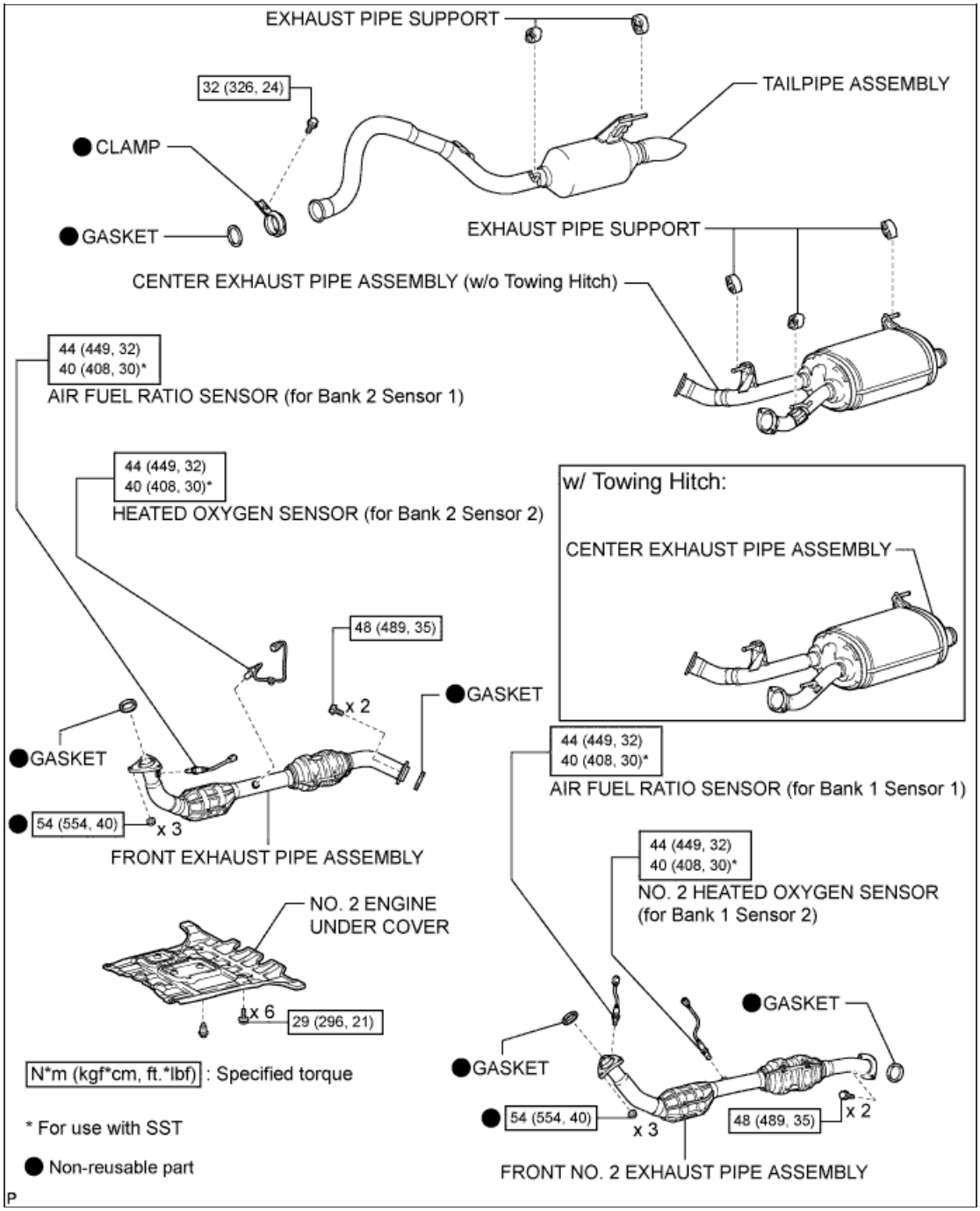


19. INSTALL FRONT FENDER APRON SEAL REAR RH

a. Install the fender apron seal with the 4 clips.



for Preparation Click here



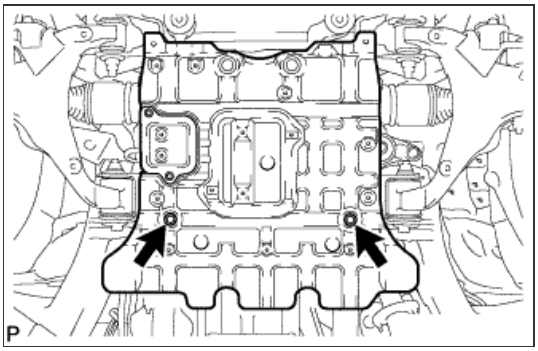
for Preparation Click here

CAUTION:

- **Wear protective gloves when removing the exhaust pipe.**
- **The exhaust pipe is extremely hot immediately after the engine has stopped.**
- **Confirm that the exhaust pipe has cooled down before removing it.**

1. REMOVE NO. 2 ENGINE UNDER COVER

a. Remove the 2 bolts and No. 2 engine under cover.



2. REMOVE TAILPIPE ASSEMBLY

a. Remove the bolt, clamp and gasket.

b. Remove the tailpipe from the 2 exhaust pipe supports.

3. REMOVE CENTER EXHAUST PIPE ASSEMBLY

a. Remove the 4 bolts.

b. Remove the center exhaust pipe from the 3 exhaust pipe supports.

c. Remove the 2 gaskets from the front exhaust pipe and front No. 2 exhaust pipe.

4. REMOVE FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Disconnect the air fuel ratio sensor connector.

b. Disconnect the heated oxygen sensor connector.

c. Remove the 3 nuts, front No. 2 exhaust pipe and gasket.

5. REMOVE FRONT EXHAUST PIPE ASSEMBLY

a. Disconnect the air fuel ratio sensor connector.

b. Disconnect the heated oxygen sensor connector.

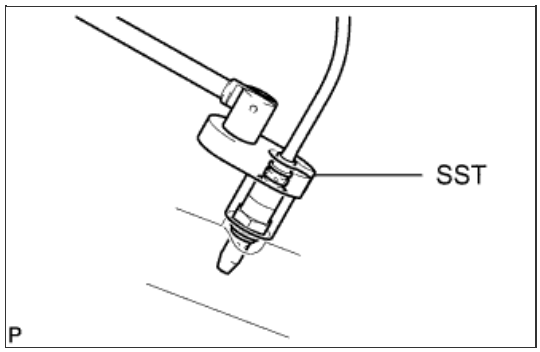
c. Detach the heated oxygen sensor wire clamp.

d. Remove the 3 nuts, front exhaust pipe and gasket.

6. REMOVE AIR FUEL RATIO SENSOR (for Bank 1 Sensor 1)

a. Using SST, remove the sensor.

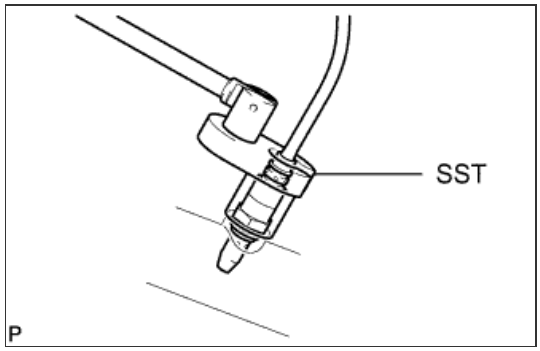
SST
09224-00010



7. REMOVE AIR FUEL RATIO SENSOR (for Bank 2 Sensor 1)

a. Using SST, remove the sensor.

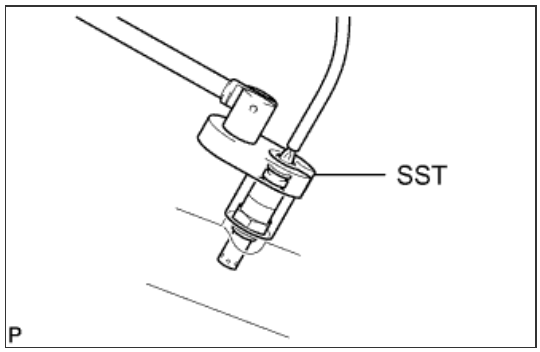
SST
09224-00010



8. REMOVE NO. 2 HEATED OXYGEN SENSOR (for Bank 1 Sensor 2)

a. Using SST, remove the sensor.

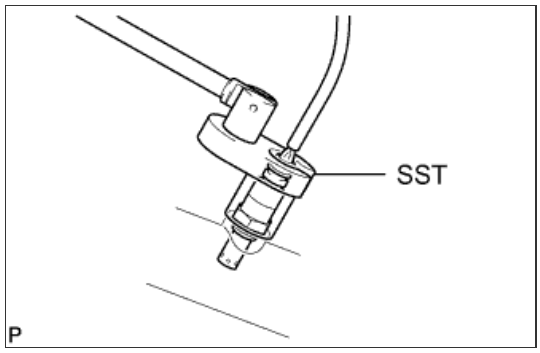
SST
09224-00010



9. REMOVE HEATED OXYGEN SENSOR (for Bank 2 Sensor 2)

a. Using SST, remove the sensor.

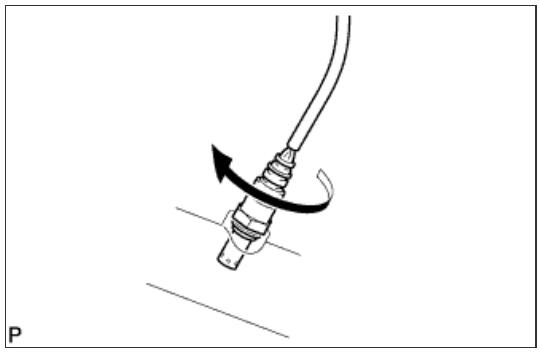
SST
09224-00010


SST
P

for Preparation Click here

1. INSTALL AIR FUEL RATIO SENSOR (for Bank 1 Sensor 1)

a. Temporarily install the sensor to the exhaust pipe by hand.



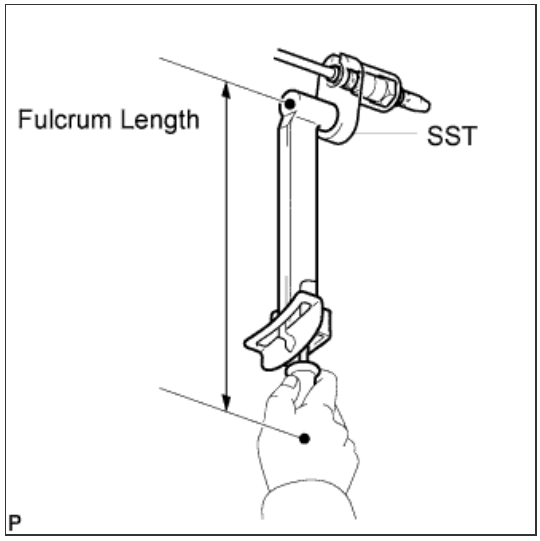
b. Using SST, tighten the sensor.

SST
09224-00010

Torque:
without SST:
44 N*m{ 449 kgf*cm , 32 ft.*lbf }
with SST:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

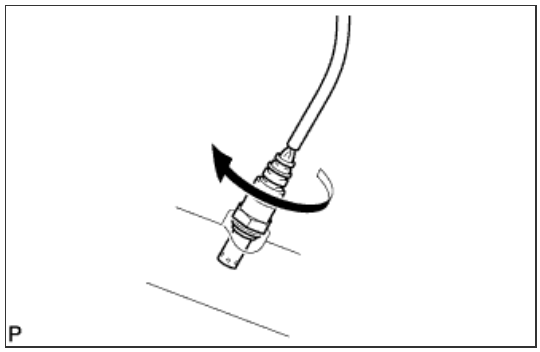
HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.). If using a torque wrench with a length that is not 30 cm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the "without SST" torque specification (Click here).**
- **Make sure SST and the wrench are connected in a straight line.**



2. INSTALL AIR FUEL RATIO SENSOR (for Bank 2 Sensor 1)

a. Temporarily install the sensor to the exhaust pipe by hand.



b. Using SST, tighten the sensor.

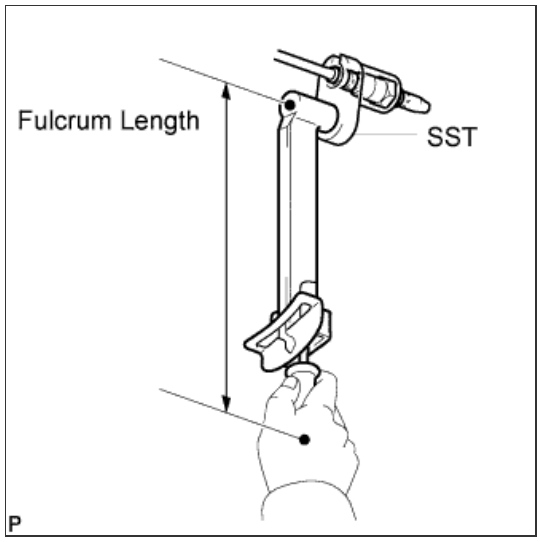
SST
09224-00010

Torque:
without SST:

44 N*m{ 449 kgf*cm , 32 ft.*lbf }
with SST:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

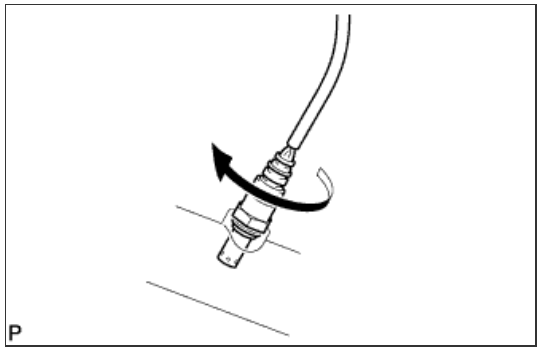
HINT:

- Use a torque wrench with a fulcrum length of 30 cm (11.8 in.). If using a torque wrench with a length that is not 30 cm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the "without SST" torque specification (Click here).
- Make sure SST and the wrench are connected in a straight line.



3. INSTALL NO. 2 HEATED OXYGEN SENSOR (for Bank 1 Sensor 2)

a. Temporarily install the sensor to the exhaust pipe by hand.



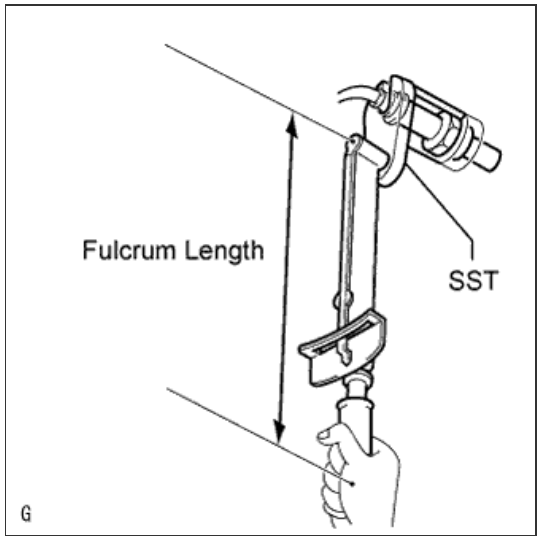
b. Using SST, tighten the sensor.

SST
09224-00010

Torque:
without SST:
44 N*m{ 449 kgf*cm , 32 ft.*lbf }
with SST:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

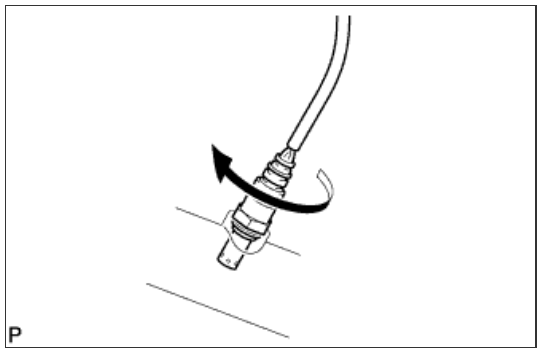
HINT:

- Use a torque wrench with a fulcrum length of 30 cm (11.8 in.). If using a torque wrench with a length that is not 30 cm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the "without SST" torque specification (Click here).
- Make sure SST and the wrench are connected in a straight line.



4. INSTALL HEATED OXYGEN SENSOR (for Bank 2 Sensor 2)

a. Temporarily install the sensor to the exhaust pipe by hand.



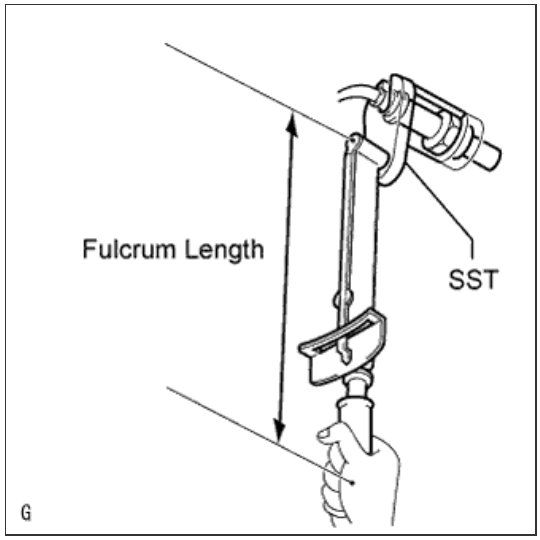
b. Using SST, tighten the sensor.

SST
09224-00010

Torque:
without SST:
44 N*m{ 449 kgf*cm , 32 ft.*lbf }
with SST:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.). If using a torque wrench with a length that is not 30 cm (11.8 in.), calculate the torque specification for the torque wrench and SST based on the "without SST" torque specification (Click here).**
- **Make sure SST and the wrench are connected in a straight line.**



5. INSTALL FRONT EXHAUST PIPE ASSEMBLY

a. Install a new gasket and the front exhaust pipe to the exhaust manifold with 3 new nuts.

Torque:
54 N*m{ 554 kgf*cm , 40 ft.*lbf }

b. Conne the air fuel ratio sensor onne dr.

c. Conne the heated oxygen sensor onne dr.

d. Atta h the heated oxygen sensor wire lamp.

6. INSTALL FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Install a new gasket and the front No. 2 exhaust pipe to the exhaust manifold LH with 3 new nuts.

Torque:
54 N*m{ 554 kgf*cm , 40 ft.*lbf }

b. Conne the air fuel ratio sensor onne dr.

c. Conne the heated oxygen sensor onne dr.

7. INSTALL CENTER EXHAUST PIPE ASSEMBLY

a. Install the enter exhaust pipe to the 3 exhaust pipe supports.

b. Install 2 new gaskets to the front exhaust pipe and front No. 2 exhaust pipe.

c. Install the 4 bolts.

Torque:
48 N*m{ 489 kgf*cm , 35 ft.*lbf }

8. INSTALL TAILPIPE ASSEMBLY

a. Install the tailpipe to the 2 exhaust pipe supports.

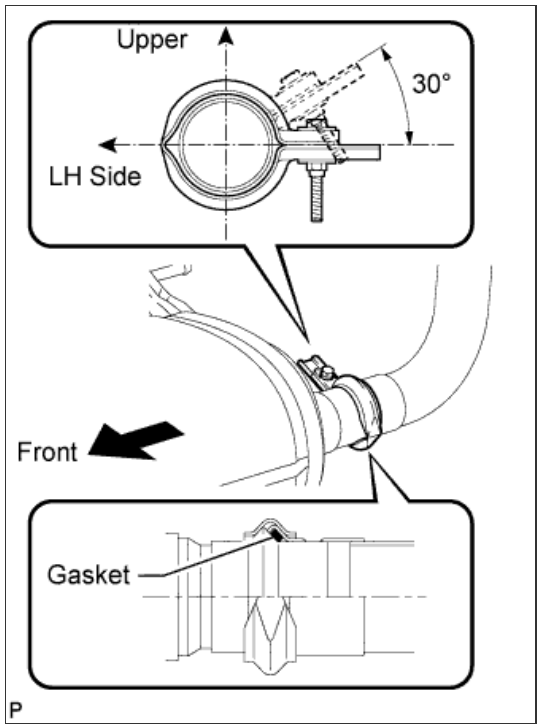
b. Install a new gasket to the enter exhaust pipe.

c. Conne the tailpipe and enter exhaust pipe with a new lamp.

Torque:
32 N*m{ 326 kgf*cm , 24 ft.*lbf }

HINT:

Install the lamp within the angle range shown in the illustration.



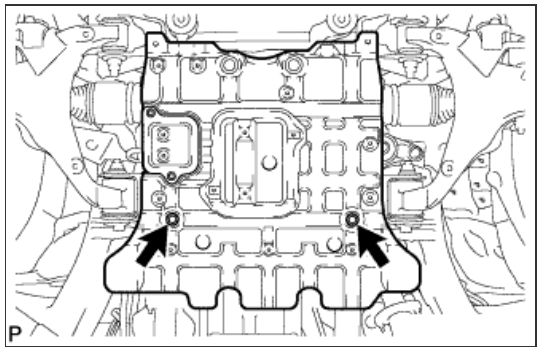
9. INSPECT FOR EXHAUST GAS LEAK

If gas is leaking, tighten the areas ne essary to stop the leak. Repla e damaged parts as ne essary.

10. INSTALL NO. 2 ENGINE UNDER COVER

a. Install the No. 2 engine under over with the 2 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



for Preparation Click here

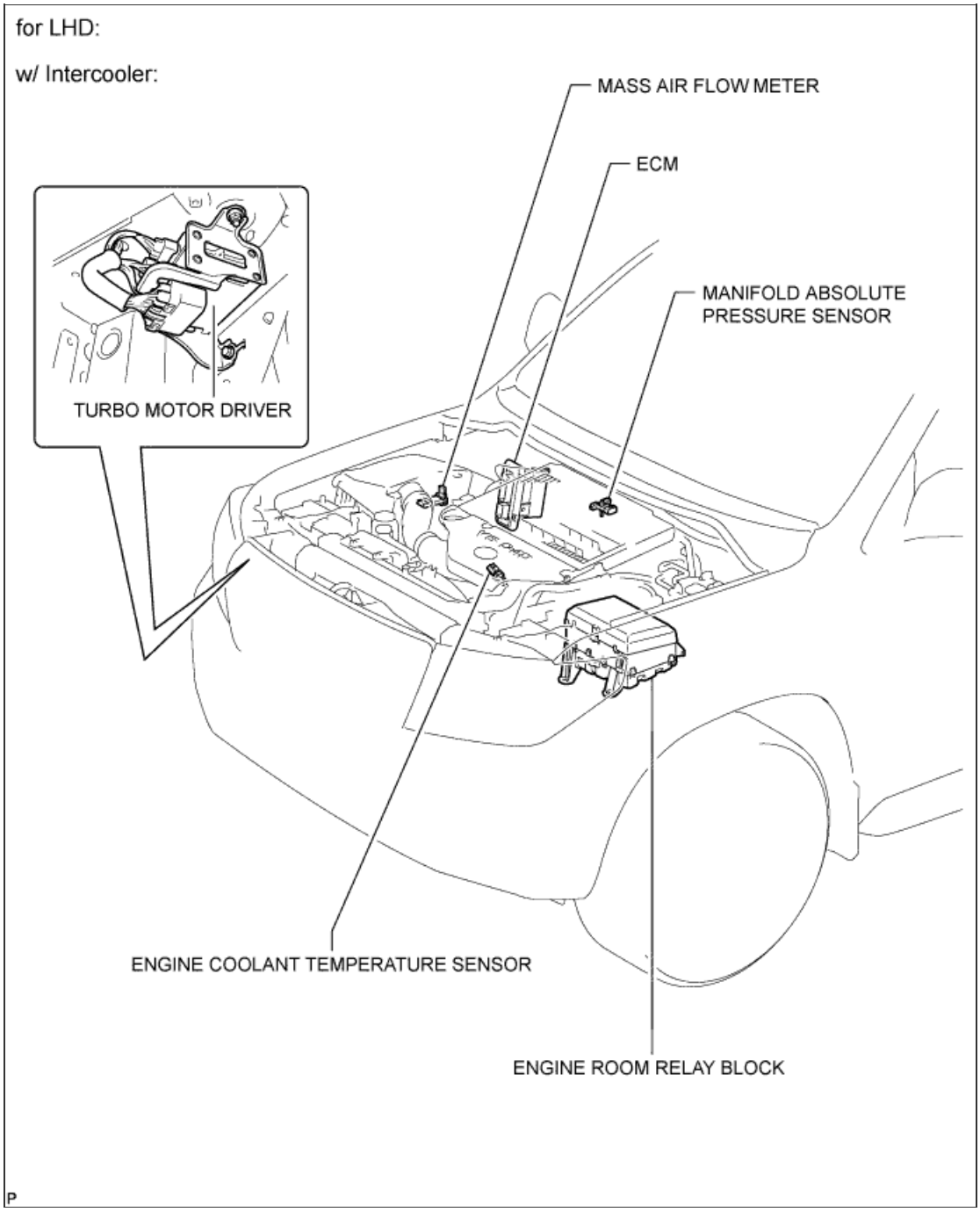
1.IGNITION SWITCH EXPRESSION

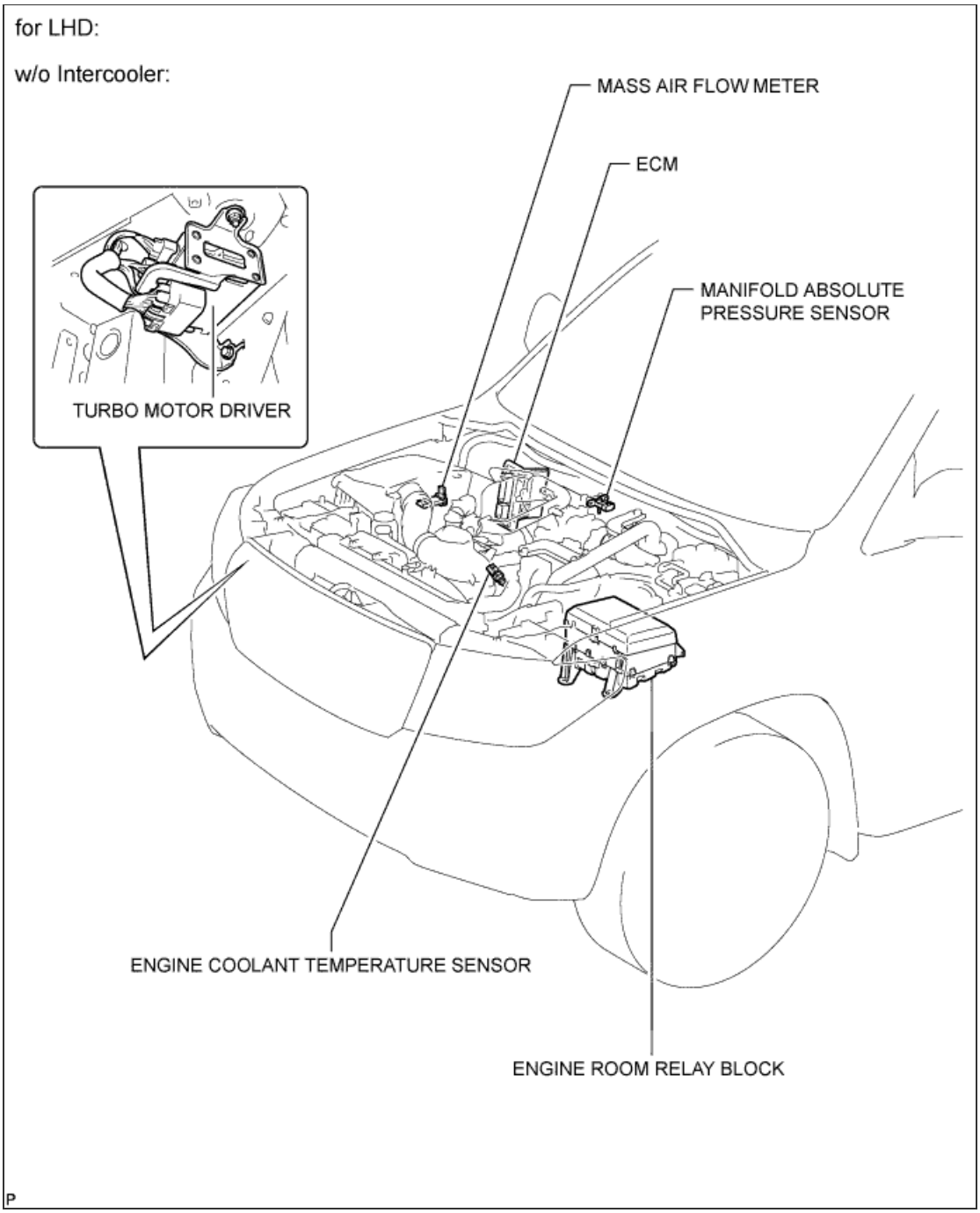
HINT:

The type of ignition switch used on this model differs depending on the specifications of the vehicle. The e pressions listed in the table below are used in this section.

E pression	Ignition Switch (Position)	Engine Switch (ondition)
Ignition Switch off	LO	ff
Ignition Switch A		n (A
gnition Switch ON	ON	On (IG)
Engine Start	START	Start

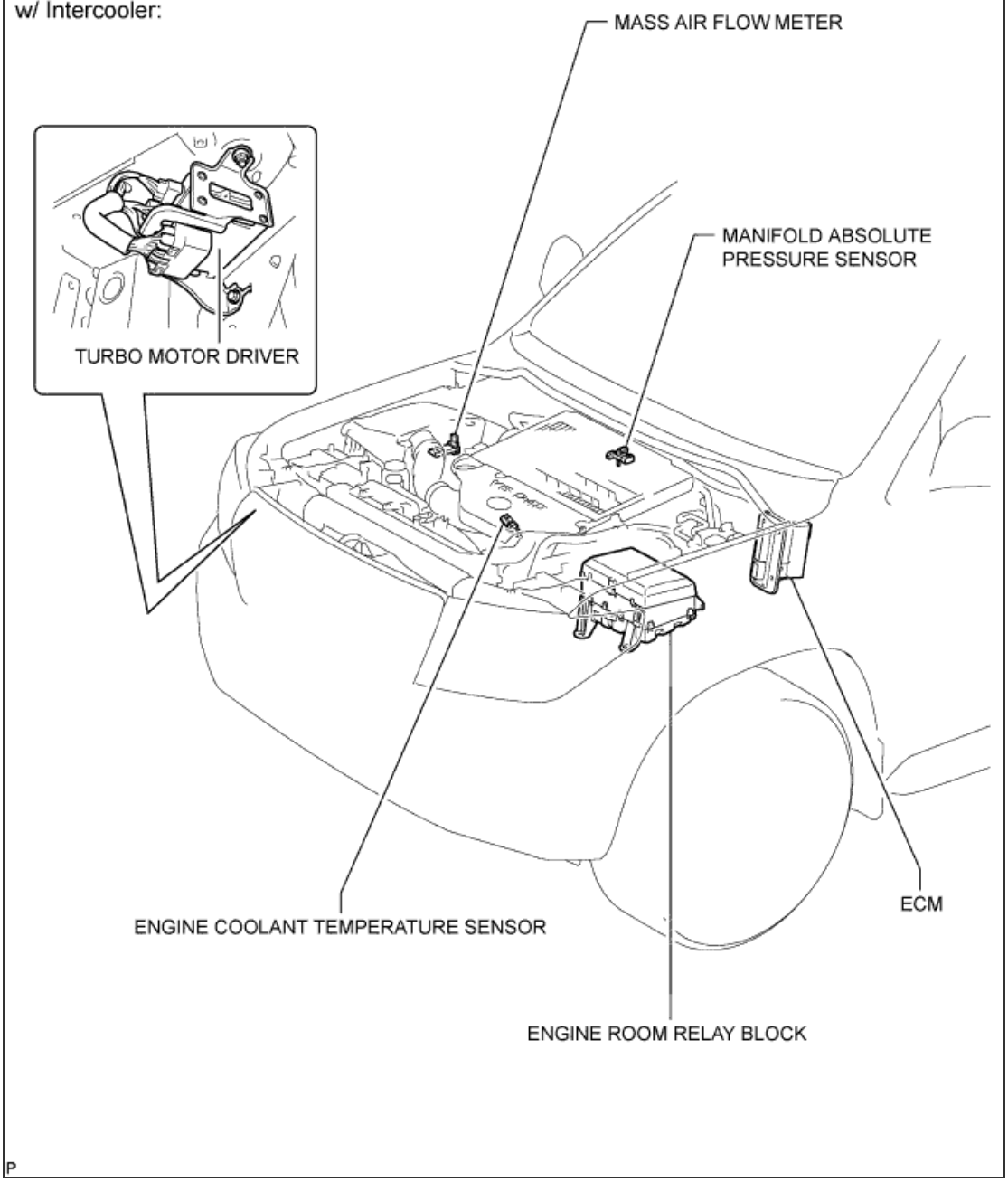
for Preparation Click here



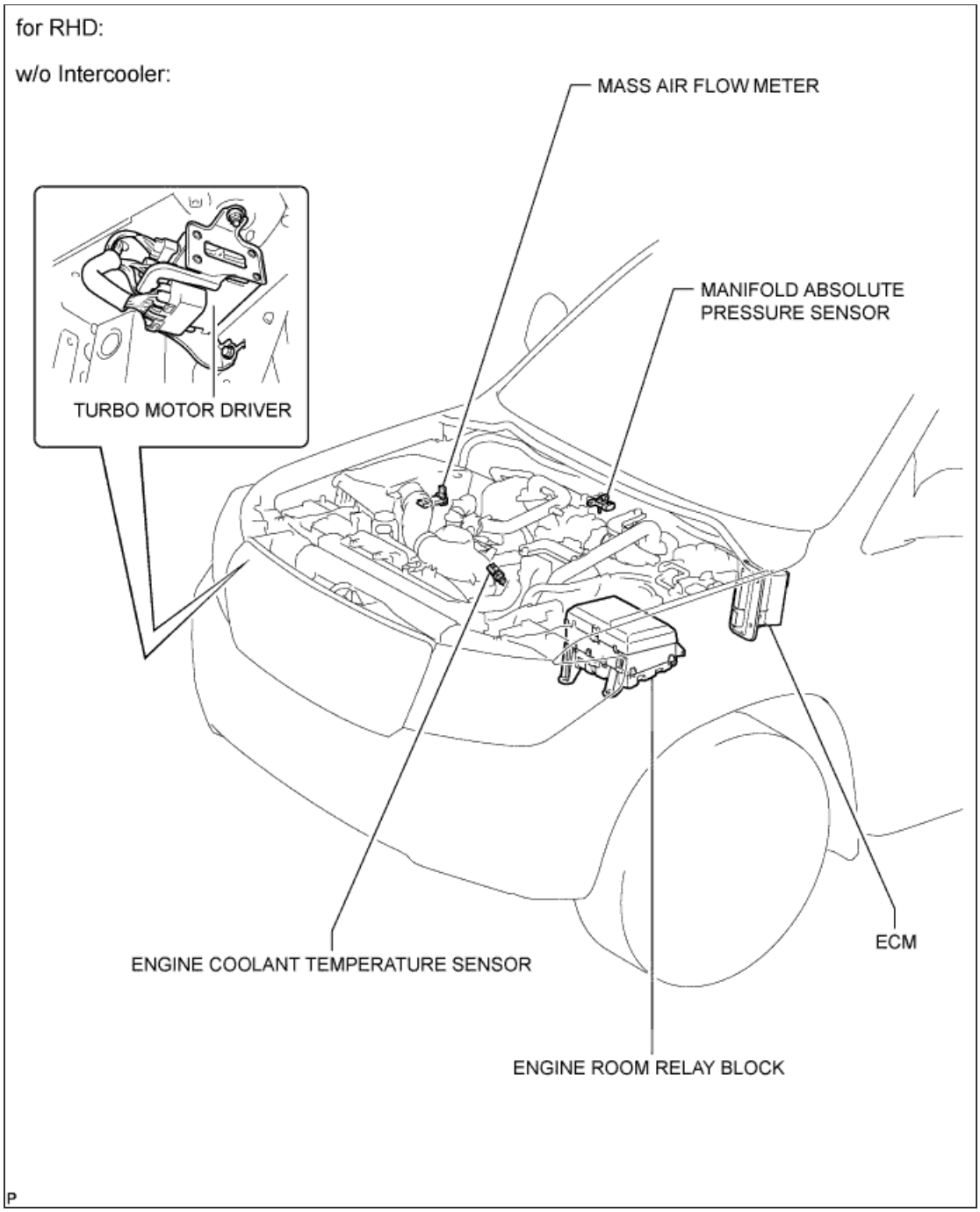

for LHD:
w/o Intercooler:
MASS AIR FLOW METER
ECM
MANIFOLD ABSOLUTE PRESSURE SENSOR
TURBO MOTOR DRIVER
ENGINE COOLANT TEMPERATURE SENSOR
ENGINE ROOM RELAY BLOCK
P

for RHD:

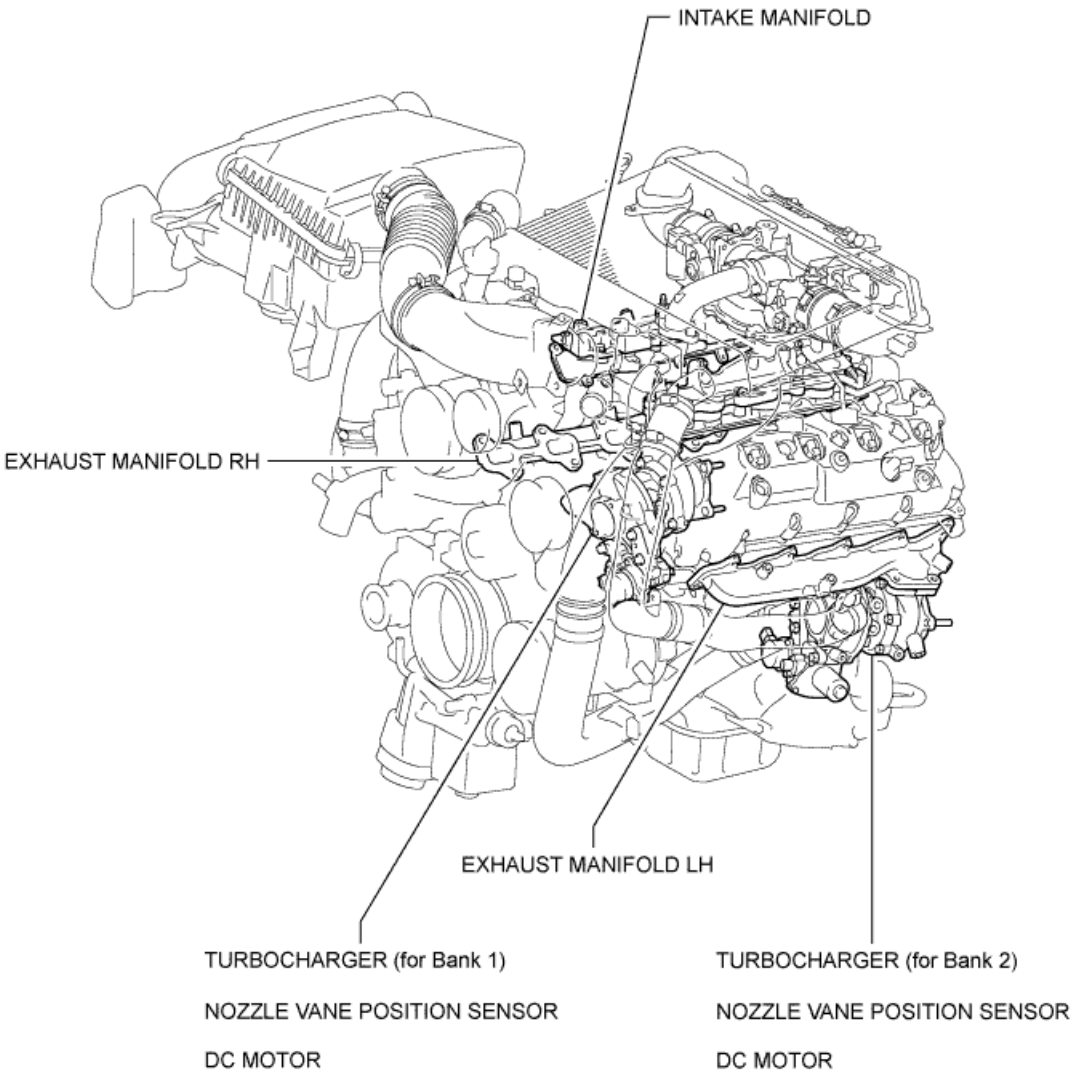
w/ Intercooler:



P

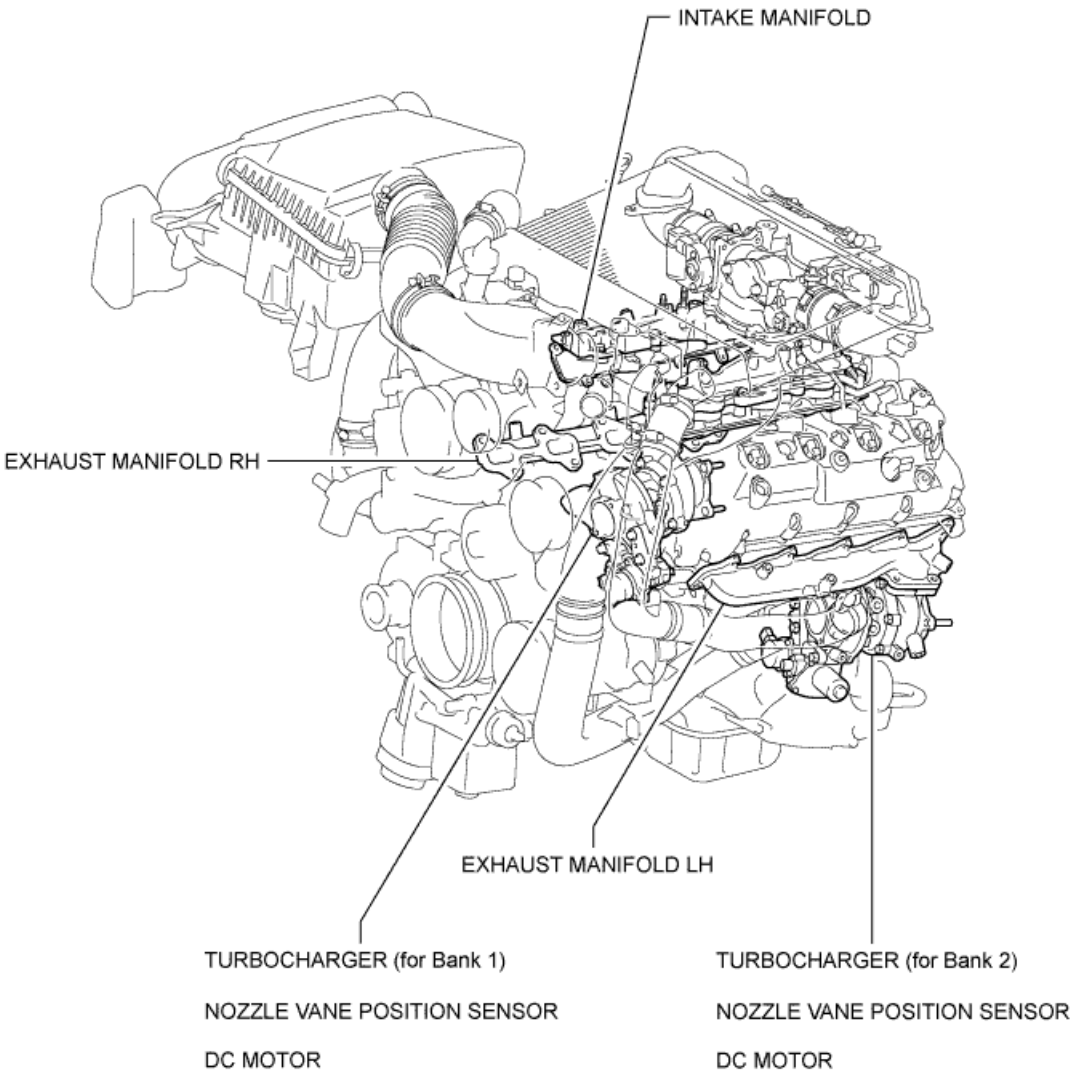

for RHD:
w/o Intercooler:
MASS AIR FLOW METER
MANIFOLD ABSOLUTE PRESSURE SENSOR
TURBO MOTOR DRIVER
ECM
ENGINE COOLANT TEMPERATURE SENSOR
ENGINE ROOM RELAY BLOCK
P

w/ EGR System:



P

w/o EGR System:



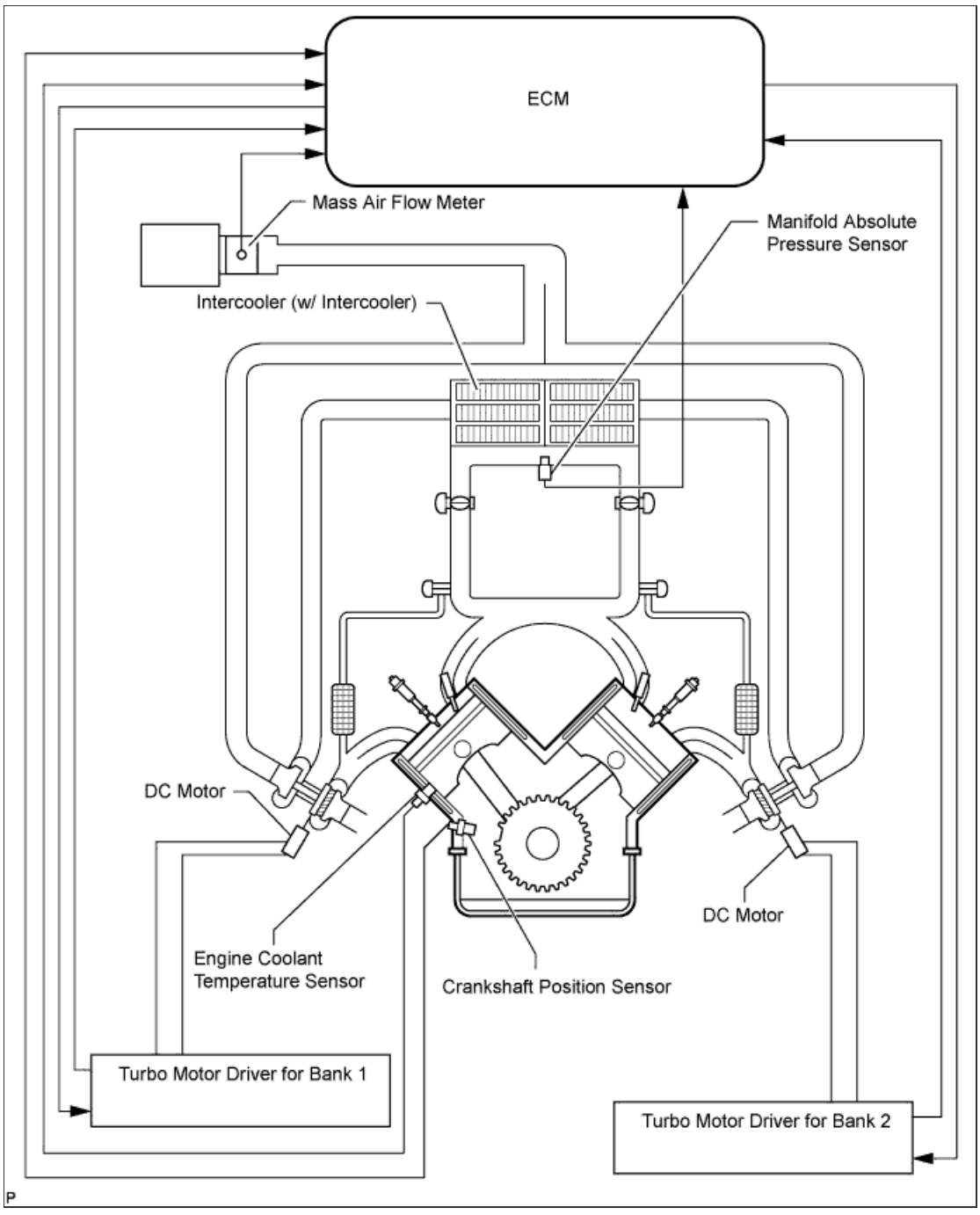
P

for Preparation Click here

TURBOCHARGER SYSTEM ILLUSTRATION

- The turbocharger system is comprised of the Variable Nozzle (VN) type turbocharger, turbo motor driver and ECM.
- The turbocharger has a nozzle vane which opens and closes to control the volume of the exhaust gas flowing into the turbine. This, in turn, controls the boost pressure. When the nozzle vane moves towards the closing direction, the pressure increases. When the vane moves towards the opening direction, the pressure decreases.
- The turbocharger actuator on the compressor housing side activates the nozzle vane. The nozzle vane position sensor on the actuator detects the opening angle of the nozzle vane. The turbo motor driver receives an opening angle request from the ECM and a nozzle vane position sensor signal. Based on these signals, the turbo motor driver operates the DC motor and controls the turbocharger opening angle. The turbo motor driver sends the status as a turbo driver status signal to the ECM.

- The ECM sends a target nozzle vane position signal to the turbo motor driver to obtain the nozzle vane position for optimal pressure in accordance with the driving conditions.



for Preparation Click here

1. CHECK INTAKE AIR CONTROL SYSTEM

a. Check for leakage or clogging between the air cleaner housing and inlet turbocharger and between the outlet turbocharger and cylinder head.

Condition	Operation
Clogged air cleaner	Replace element
Hoses collapsed or deformed	Repair or replace
Leakage from connections	Check each connection and repair
Cracks in components	Check and replace

2. CHECK EXHAUST SYSTEM

a. Check for leakage or clogging between the cylinder head and turbocharger inlet and between the turbocharger outlet and exhaust pipe.

Condition	Operation
Deformed components	Repair or replace
Foreign material in passages	Remove
Leakage from components	Repair or replace
Cracks in components	Check and replace

3. CHECK AIR INDUCTION SYSTEM

HINT:

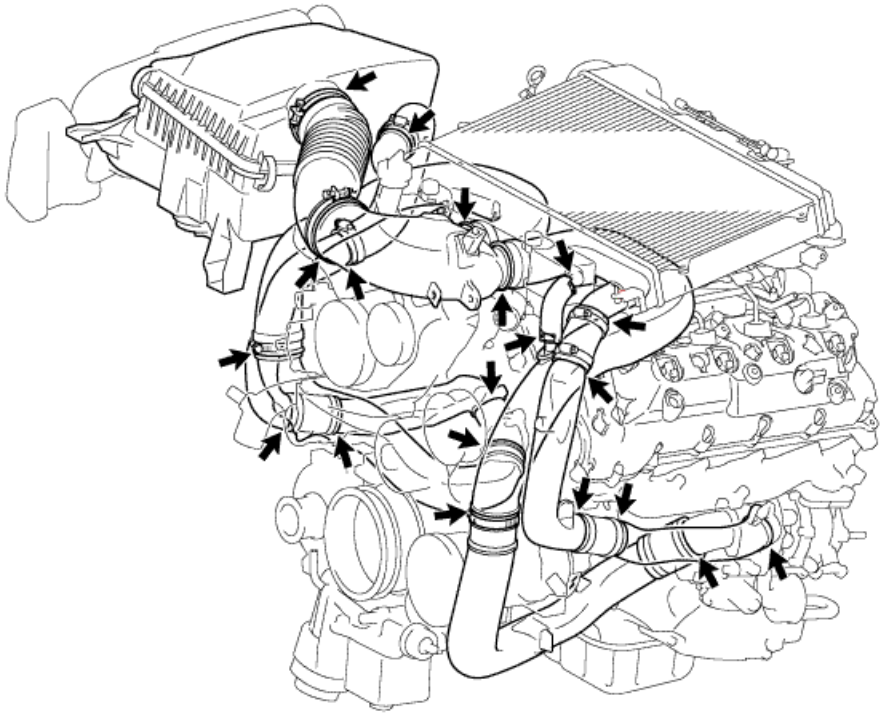
The illustration shows the areas that may draw in secondary air, which could lead to idling problems.

a. Check that the hoses, gaskets and O-rings are installed correctly.

b. Check for cracks, etc. in the hoses, gaskets and O-rings.

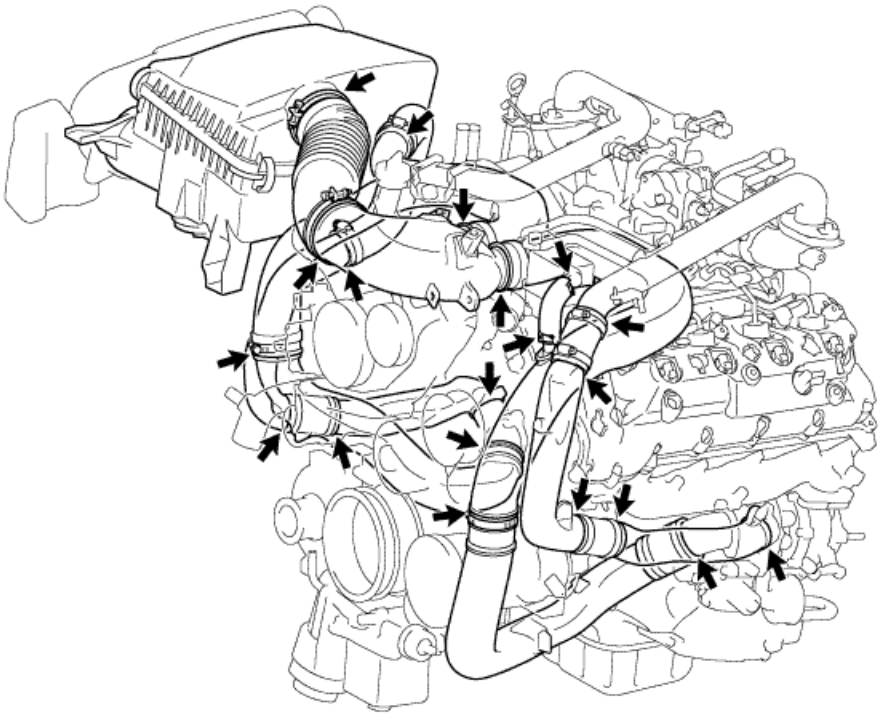
- for V-bank Outside Area:

w/ Intercooler:



P

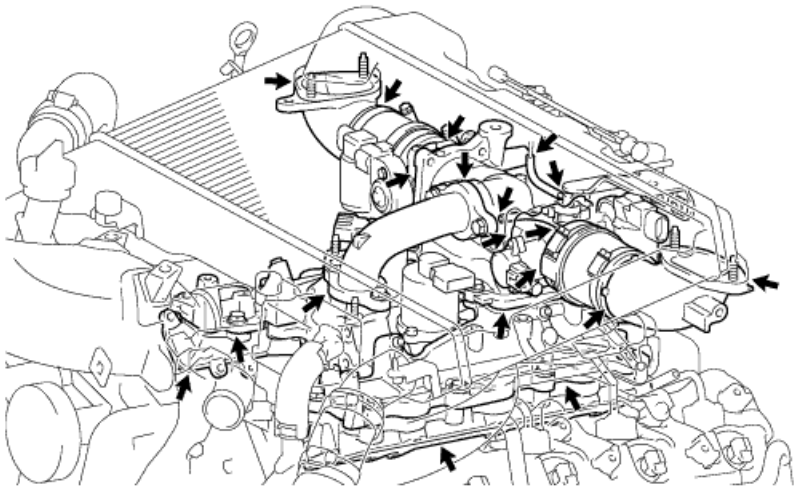
w/o Intercooler:



P

- for V-bank inside Area:

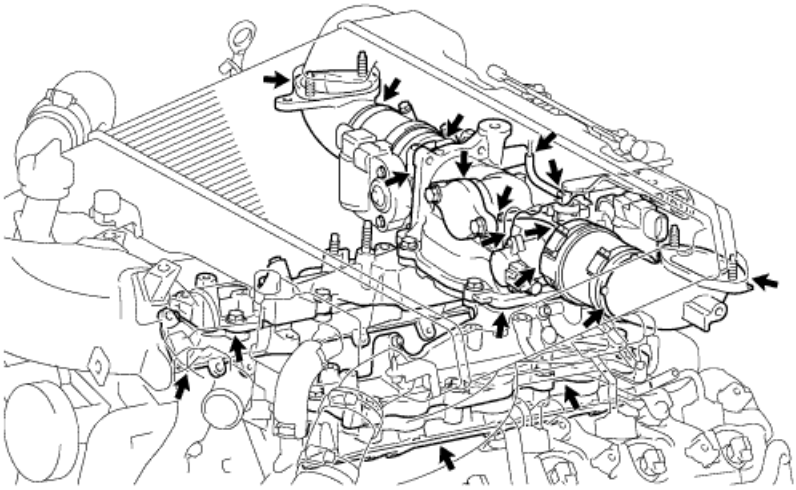
w/ EGR System:



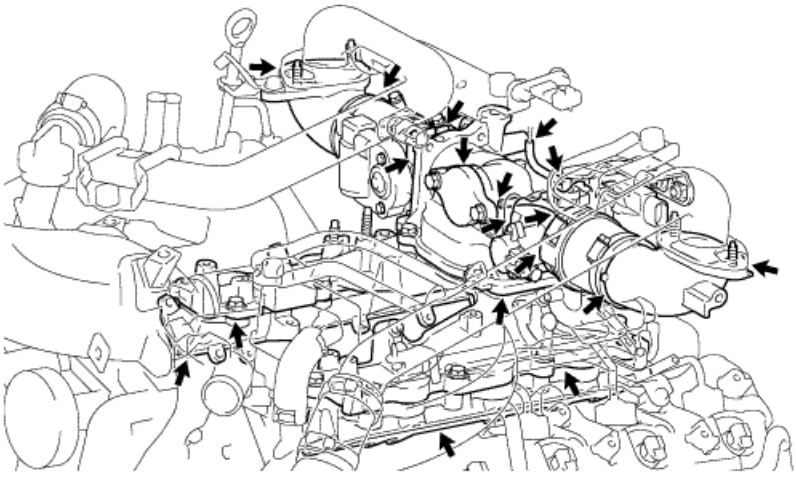
P

w/o EGR System:

w/ Intercooler:



w/o Intercooler:



P

4. CHECK BOOST PRESSURE

a. Connect the intelligent tester to the DLC3.

b. Start the engine and turn the tester on.

c. Warm up the engine.

HINT:

Be sure to perform the inspection when the engine coolant temperature is between 75 and 90°C (167 and 194°F).

d. Enter the following menus: Powertrain / Engine / Data List / All Data.

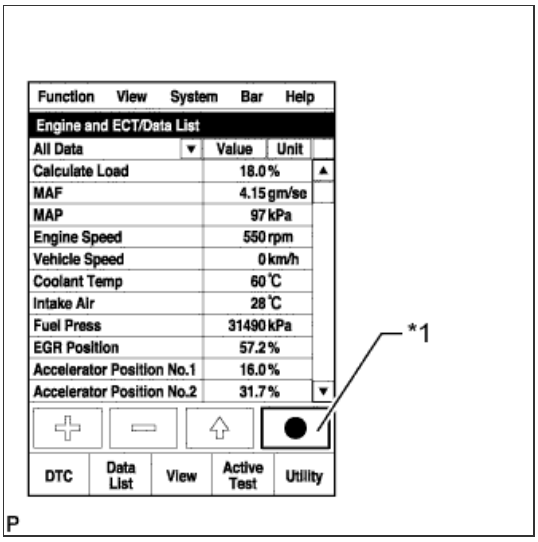
Text in Illustration

*1	Snapshot Record Button

Take a snapshot of the Data List items with the intelligent tester shown in the illustration.

e. **HINT:**

- **Graphs can be displayed by transferring the stored snapshot from the tester to a PC. Intelligent Viewer must be installed on the PC.**
- **The condition of the turbocharger can be determined by fully depressing the accelerator pedal while driving at 15 km/h (9 mph) in 2nd gear to accelerate the vehicle (obey all laws and regulations, and pay attention to driving conditions while driving the vehicle), and then comparing MAP with Target Booster Pressure at an engine speed of 3000 rpm.**



f. Compare MAP with Target Booster Pressure.

Standard:
MAP is within 35 kPa of Target Booster Pressure when accelerating with accelerator pedal fully depressed.

HINT:

- **The specification above denotes the difference between the absolute pressure values.**
- **The inspection above is only for vehicles equipped with a manual transmission.**
- **If the driving inspection using the intelligent tester above cannot be performed (e.g. due to road conditions), perform the following inspection.**

i. Warm up the engine.

HINT:

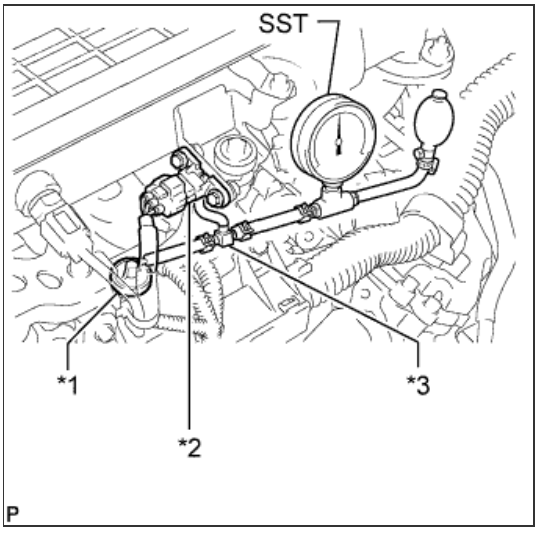
Be sure to perform the inspection when the engine coolant temperature is between 75 and 90°C (167 and 194°F).

ii. Using a 3-way connector, connect SST (turbocharger pressure gauge) between the diesel turbo pressure sensor (manifold absolute pressure sensor) and the gas filter.

SST
09992-00242

Text in Illustration

*1	Gas Filter
*2	Diesel Turbo Pressure Sensor
*3	3-Way Connector



iii. Fully apply the parking brake and chock the 4 wheels.

iv. for Manual Transmission:
While depressing the clutch pedal, fully depress the accelerator pedal. Measure the boost pressure at maximum engine speed (4700 to 4900 rpm).

v. for Automatic Transmission:
Move the shift lever to P or N, and then fully depress the accelerator pedal. Measure the boost pressure at maximum engine speed (4700 to 4900 rpm).

Standard Pressure (Gauge Pressure):
30 to 60 kPa (0.30 to 0.61 kgf/cm^2, 4.3 to 8.7 psi)

If the pressure is lower than the standard, the following problems may be present.

- The intake system or exhaust system has leakage or blockage.
- The turbocharger sub-assembly or turbo motor driver is malfunctioning.
- The EGR valve does not close.
- The diesel throttle body does not open.
- The vacuum hose connected to the diesel turbo pressure sensor (manifold absolute pressure sensor) is cracked or disconnected.

- The mass air flow meter is malfunctioning.
- A fuel injector is malfunctioning.

If the pressure is higher than the standard, check the turbocharger and/or boost control components (turbo motor driver, pressure sensor, vacuum hose, wire harness, etc.).

g. Chart showing the suspected trouble areas when the pressure is lower than the standard.

HINT:

- **○: If a problem listed in the leftmost column of the chart exists, or if the part in the leftmost column of the chart has a malfunction, the value of the Data List item in the uppermost row of the chart will meet the conditions shown in the row labeled "Value which represents a malfunction".**
- **The values in the chart are applicable when the engine coolant temperature is between 75 and 90°C (167 and 194°F).**
- **The values in the chart are for vehicles equipped with a manual transmission. For vehicles with an automatic transmission, use these values as a reference only as they may differ from the actual values.**
- **The values in the chart are valid in an area with an absolute atmospheric pressure higher than 95 kPa. (Standard atmospheric pressure is 101 kPa. Atmospheric pressure decreases by 1 kPa for every 100 m increase in altitude, and is also affected by the current weather conditions.)**
- **When the altitude increases, atmospheric pressure and MAP decrease.**

Item	MAP (Absolute pressure inside intake manifold)	MAF (Intake air flow rate)	Accel Position	Actual Throttle Position (#2)	Actual EGR Valve Pos. (#2)	EGR Close Lrn. Status (#2) (EGR valve fully closed position learning status)	Fuel Pressure	Injection Feedback Val #1 (to #4)
Values taken from an actual normal vehicle *1	-	228 g/sec.	99% or more	0%	0%	OK	-	-3 to +3 mm^3/st
Values which represent a malfunction *1	MAP is below Target Booster Pressure by 35 kPa or more	MAF is less than 190 g/sec.	Accel Position is not fully depressed position *2	Actual Throttle Position (#2) is not within 10% of Target Throttle Position (#2)	Actual EGR Valve Pos. (#2) is more than 10% *3	NG (Determined after performing learning)	Fuel Pressure is below Target Common Rail Pressure by 10 MPa or more (Check while condition steady)	Outside of above range
Turbocharger	○	○	-	-	-	-	-	-
EGR valve does not close or has problem with movement	○	○	-	-	○ (Problem with EGR valve movement) *4	○ (EGR valve does not close) *4	-	-
Problem with diesel throttle movement	○ (Intake airflow decreases)	○	-	○	-	-	-	-
Accelerator pedal cannot be fully depressed or problem with accelerator pedal position sensor exists	-	○	○	-	-	-	-	-
Intake air system leakage or blockage	○	○	-	-	-	-	-	-
Exhaust gas leakage before turbocharger or blockage	○	○	-	-	-	-	-	-
Manifold								

absolute pressure sensor	○	○	-	-	-	-	-	-
Manifold absolute pressure sensor hose is disconnected	○	○	-	-	-	-	-	-
Mass air flow meter sub-assembly	-	○	-	-	-	-	-	-
Fuel system (injector, supply pump or common rail)	○	○	-	-	-	-	○ (Fuel injector leakage, decrease in pressure discharge valve relief pressure or valve is stuck)	○ *5

HINT:

- ***1: These values are measured when the transmission is in 2nd gear, the accelerator pedal is fully depressed, the vehicle is accelerating, and the engine speed is 3000 rpm.**
- ***2: The Accel Position is the accelerator opening angle (%) for engine control use. The value indicates around 100% when the accelerator pedal is fully depressed. If the value does not indicate around 100% when the accelerator pedal is fully depressed, the accelerator pedal position sensor circuit or the pedal itself is malfunctioning. When the MIL is illuminated, even with the accelerator pedal fully depressed and an Accel Position of below 70%, it means the fail-safe is restricting the accelerator.**
- ***3: Check that the Actual EGR Valve Pos. is always following the Target EGR Position value (e.g. the Actual EGR Valve Pos. is around fully closed position when the Target EGR Position value indicates 0%). The EGR valve may be malfunctioning if the value is stuck or does not fluctuate smoothly. However, in some cases the EGR valve may be malfunctioning even if the Actual EGR Valve Pos. value is normal. Inspect the EGR valve for any defects (deposits, valve stuck, poor movement, etc.) if necessary.**
- ***4: DTC P0400 (for bank 1) or P1248 (for bank 2) may be stored at this time. If the actual EGR valve position follows the target EGR valve position slowly, a feeling of hesitation may occur.**
- ***5: If Injection Feedback Val # of a cylinder is not within -3 to +3 mm ^{3}/st, the corresponding cylinder may have a malfunction (injector or compression). However, in some cases the cylinder may be malfunctioning even if the value is within -3 to +3 mm^3/st because these values are injection volume correction values calculated by the ECM at the engine idling and not correction values for the high engine load condition related to the boost pressure control and engine output performance.**

5. CHECK TURBOCHARGER SUB-ASSEMBLY

CAUTION:

- **Wear protective gloves to prevent injuries and burns when checking the turbocharger.**
- **The engine compartment becomes hot when the engine is running.**

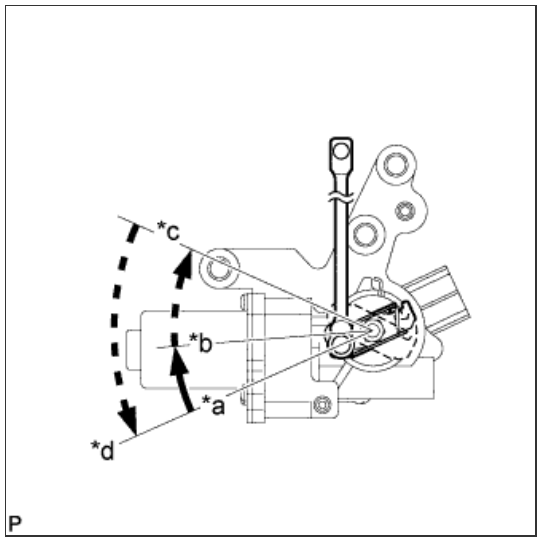
a. Make sure that the connector is properly connected.

b. Check the motor movement when turning the ignition switch to ON, when starting the engine, and then when turning the ignition switch off.

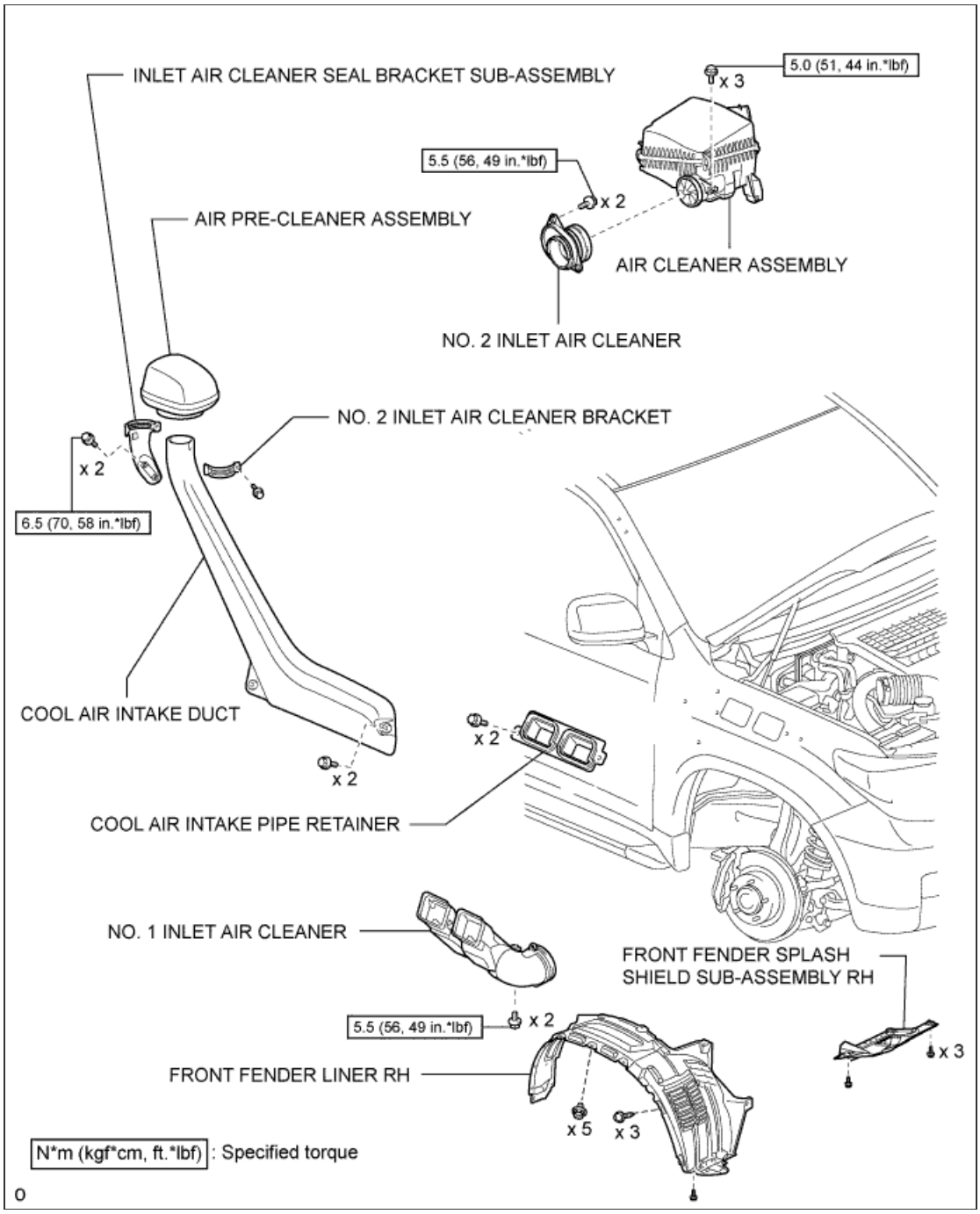
Text in Illustration

*a	Ignition switch ON
*b	Engine idling
*c	*b → *c → *d: Turn the ignition switch off at idling
*d	Ignition switch off

If the result is not as specified, check the ECM and/or turbo motor driver (Click hereand Click here).


*c
*b
*a
*d
P

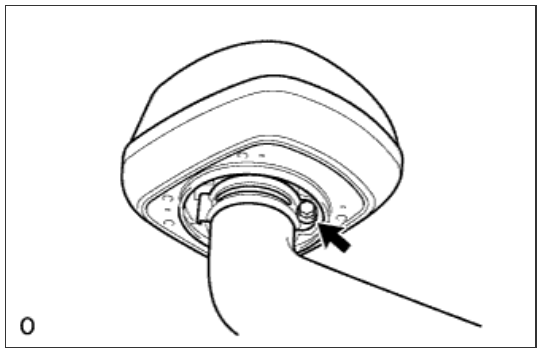
for Preparation Click here



for Preparation Click here

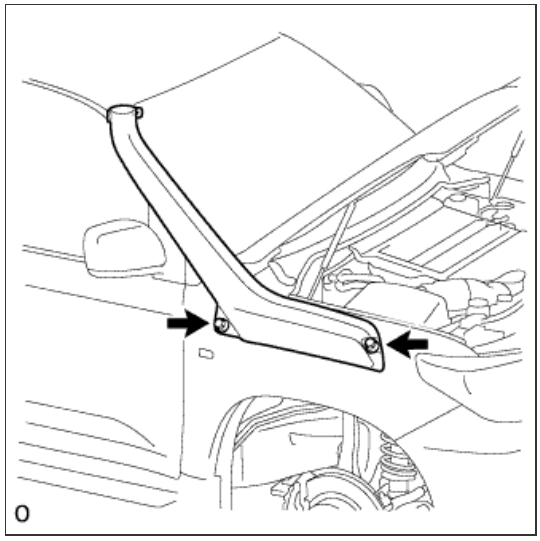
1. REMOVE AIR PRE-CLEANER ASSEMBLY

a. Remove the bolt, air pre-cleaner and No. 2 inlet air cleaner bracket.



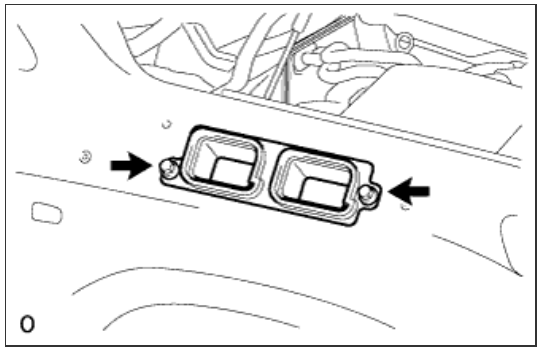
2. REMOVE COOL AIR INTAKE DUCT

a. Remove the 2 bolts and cool air intake duct.



3. REMOVE COOL AIR INTAKE PIPE RETAINER

a. Remove the 2 bolts and cool air intake pipe retainer.



4. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.

5. REMOVE FRONT FENDER LINER RH

a. Remove the screw and disconnect the liner from the front bumper cover.

b. Using a T30 "TORX" socket, remove the 3 screws.

c. Remove the 5 clips.

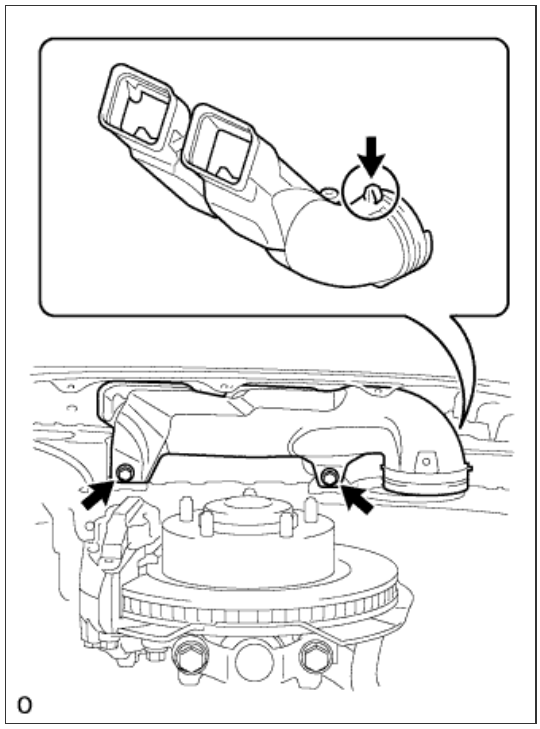
HINT:

It is not necessary to fully remove the fender liner. Partially remove it so that the air pump can be removed.

6. REMOVE NO. 1 INLET AIR CLEANER

a. Remove the 2 bolts.

b. Detach the claw shown in the illustration, and then remove the No. 1 inlet air cleaner.



7. REMOVE AIR CLEANER ASSEMBLY

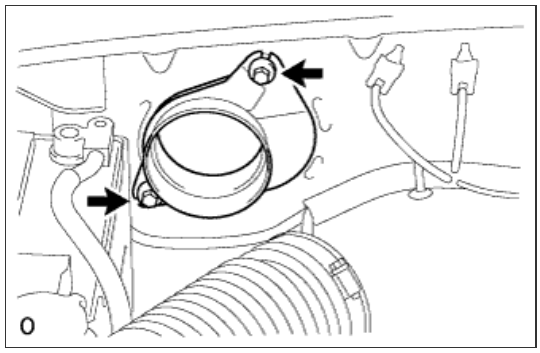
a. Disconnect the mass air flow meter connector and using a clip remover, detach the wire harness clamp from the air cleaner cap.

b. Using a clip remover, detach the wire harness clamp from the air cleaner case.

c. Remove the 3 bolts and air cleaner case.

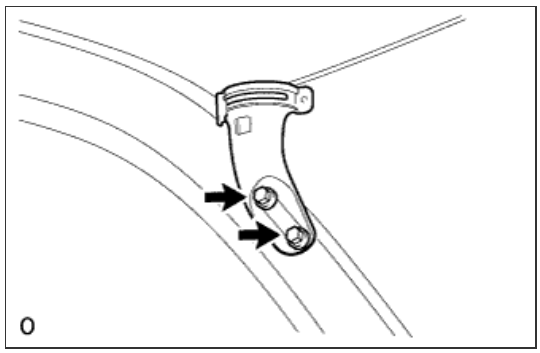
8. REMOVE NO. 2 INLET AIR CLEANER

a. Remove the 2 bolts and inlet air cleaner.



9. REMOVE INLET AIR CLEANER SEAL BRACKET SUB-ASSEMBLY

a. Remove the 2 bolts and inlet air cleaner seal bracket.

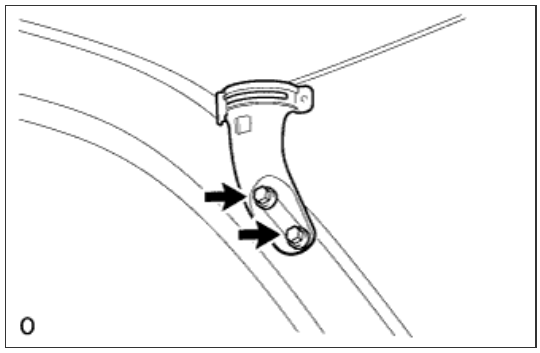


for Preparation Click here

1. INSTALL INLET AIR CLEANER SEAL BRACKET SUB-ASSEMBLY

a. Install the inlet air cleaner seal bracket with the 2 bolts.

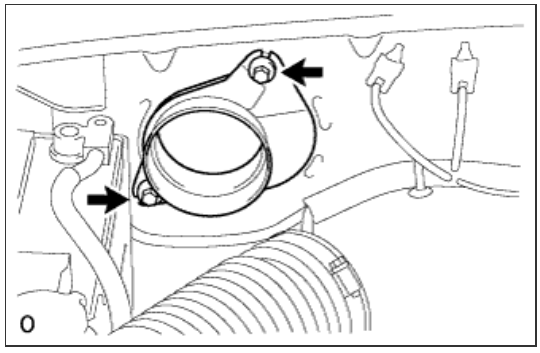
Torque:
6.5 N*m{ 70 kgf*cm , 58 in.*lbf }



2. INSTALL NO. 2 INLET AIR CLEANER

a. Install the No. 2 inlet air cleaner with the 2 bolts.

Torque:
5.5 N*m{ 56 kgf*cm , 49 in.*lbf }



3. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner case with the 3 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

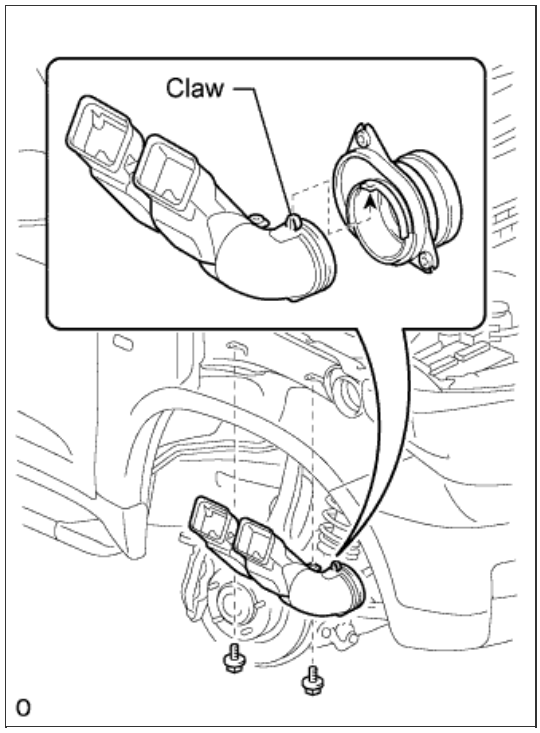
b. Attach the wire harness clamp to the air cleaner case.

c. Connect the mass air flow meter connector and attach the wire harness clamp to the air cleaner cap.

4. INSTALL NO. 1 INLET AIR CLEANER

a. Attach the claw of the No. 1 inlet air cleaner to the No. 2 inlet air cleaner, and install the No. 1 inlet air cleaner with the 2 bolts.

Torque:
5.5 N*m{ 56 kgf*cm , 49 in.*lbf }



5. INSTALL FRONT FENDER LINER R

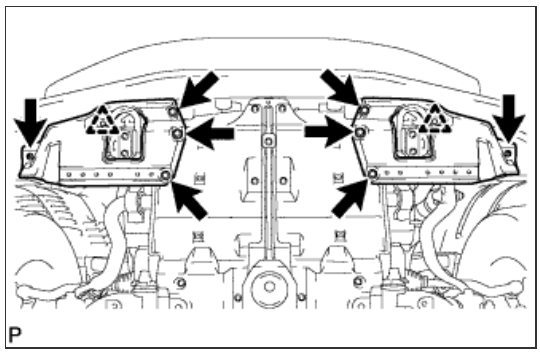
a. Install the fender liner with the 5 clips.

b. Using a T30 "TOR socket, install the 3 screws.

c. Connect the liner to the front bumper cover with the screw.

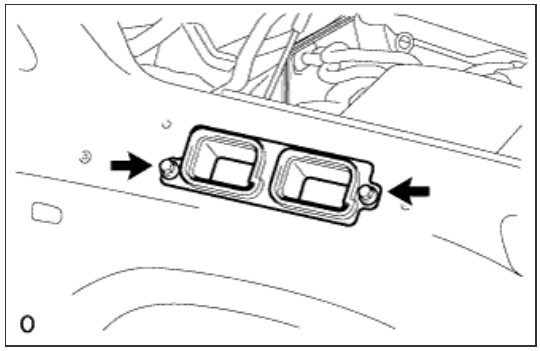
6. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY R

a. Install the splash shield with the clip, and then install the 3 bolts and screw.



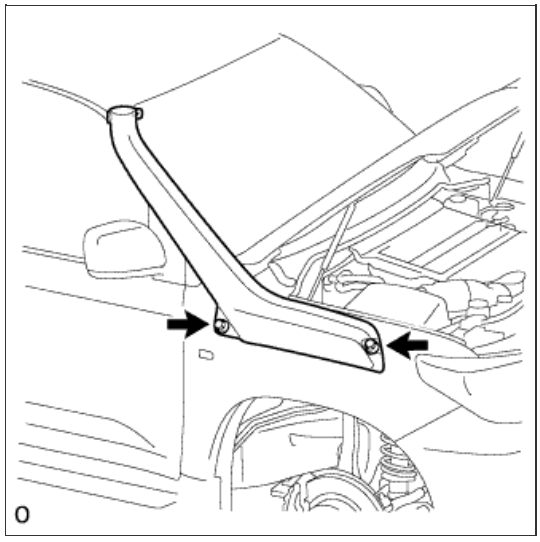
7. INSTALL COOL AIR INTAKE PIPE RETAINER

a. Install the cool air intake pipe retainer with the 2 bolts.



8. INSTALL COOL AIR INTAKE DUCT

a. Install the cool air intake duct with the 2 bolts.



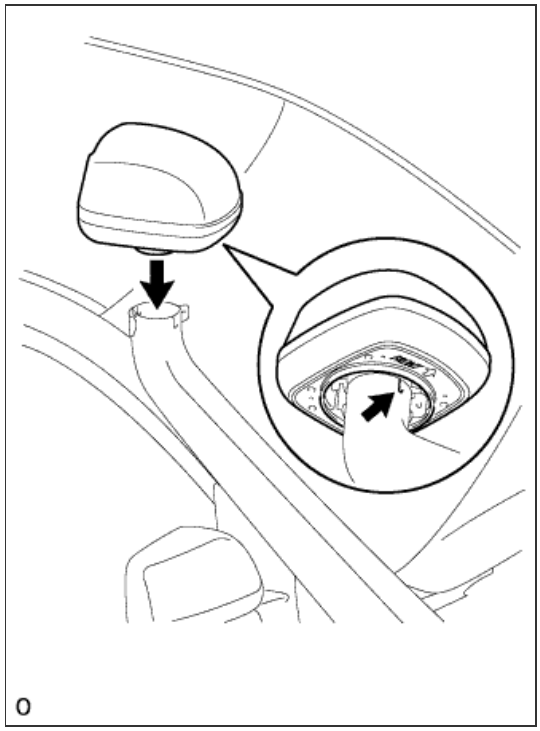
9. INSTALL AIR PRE-CLEANER ASSEMBLY

a. Temporarily install the No. 2 inlet air cleaner bracket to the inlet air cleaner seal bracket with the bolt.

b. Install the air pre-cleaner to the cool air intake duct.

HINT:

Fit the air pre-cleaner into the groove of the cool air intake duct with the side stamped "FRONT" facing forward.

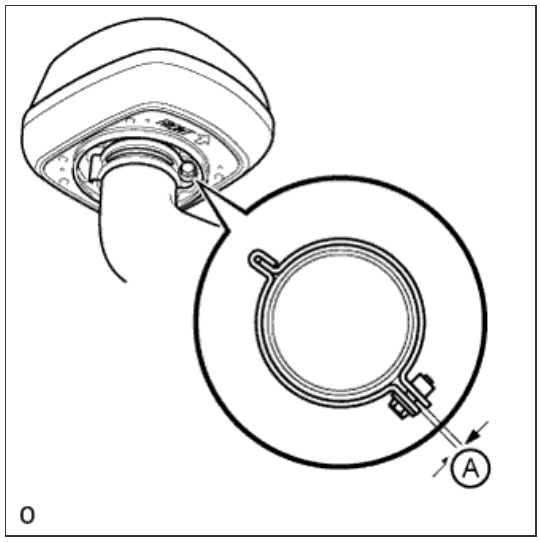


c. Tighten the bolt of the inlet air cleaner bracket.

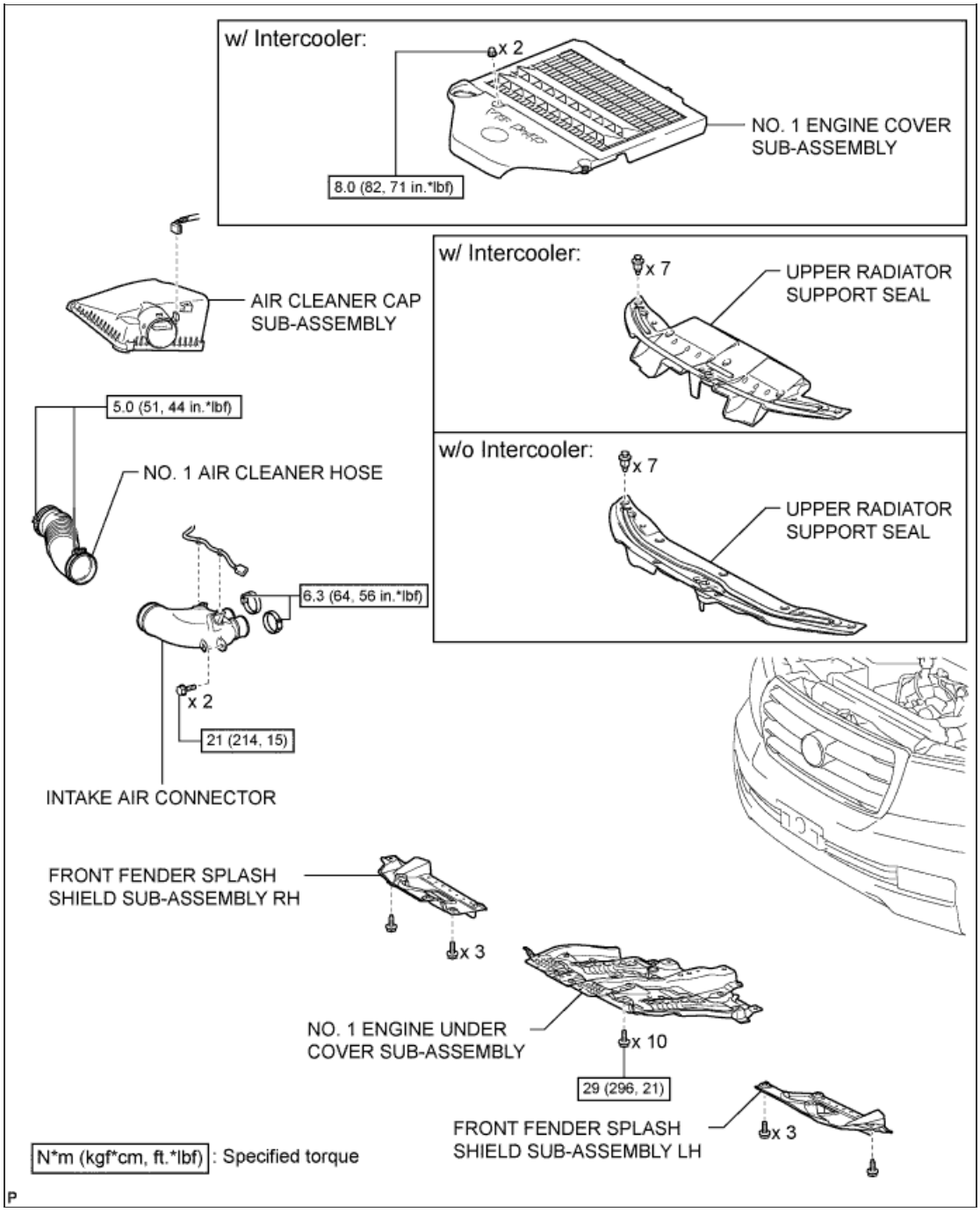
HINT:

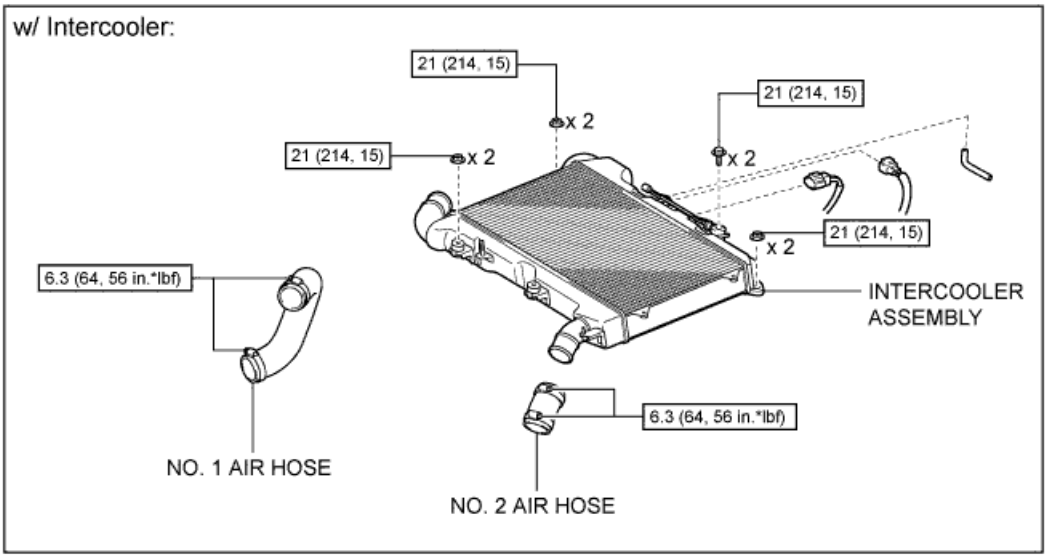
hen tightening bolt, make sure that the clearance labeled A in the illustration os as specified.

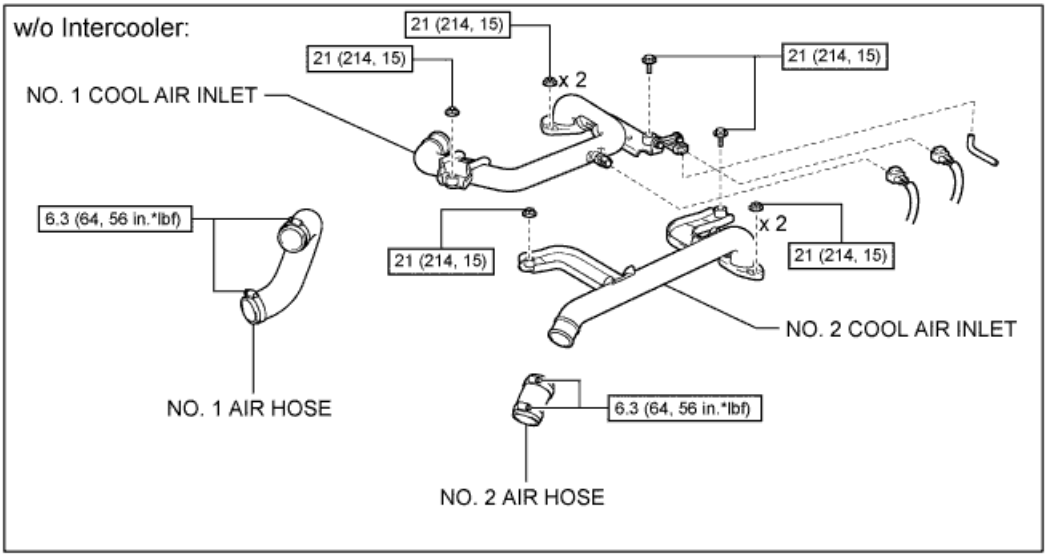
Standard clearance:
0 to 5 mm (0 to 1.97 in.)


A

for Preparation Click here



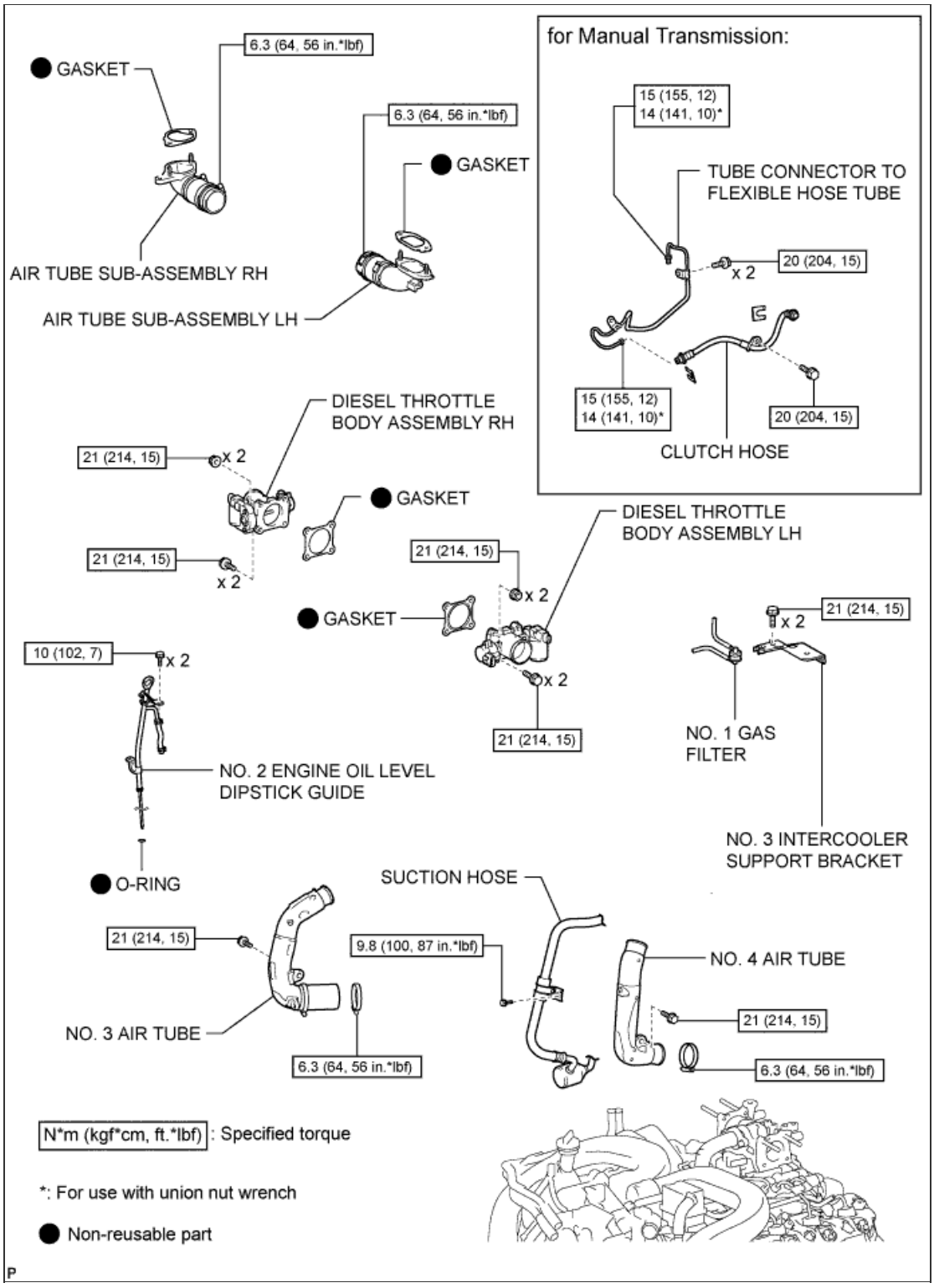


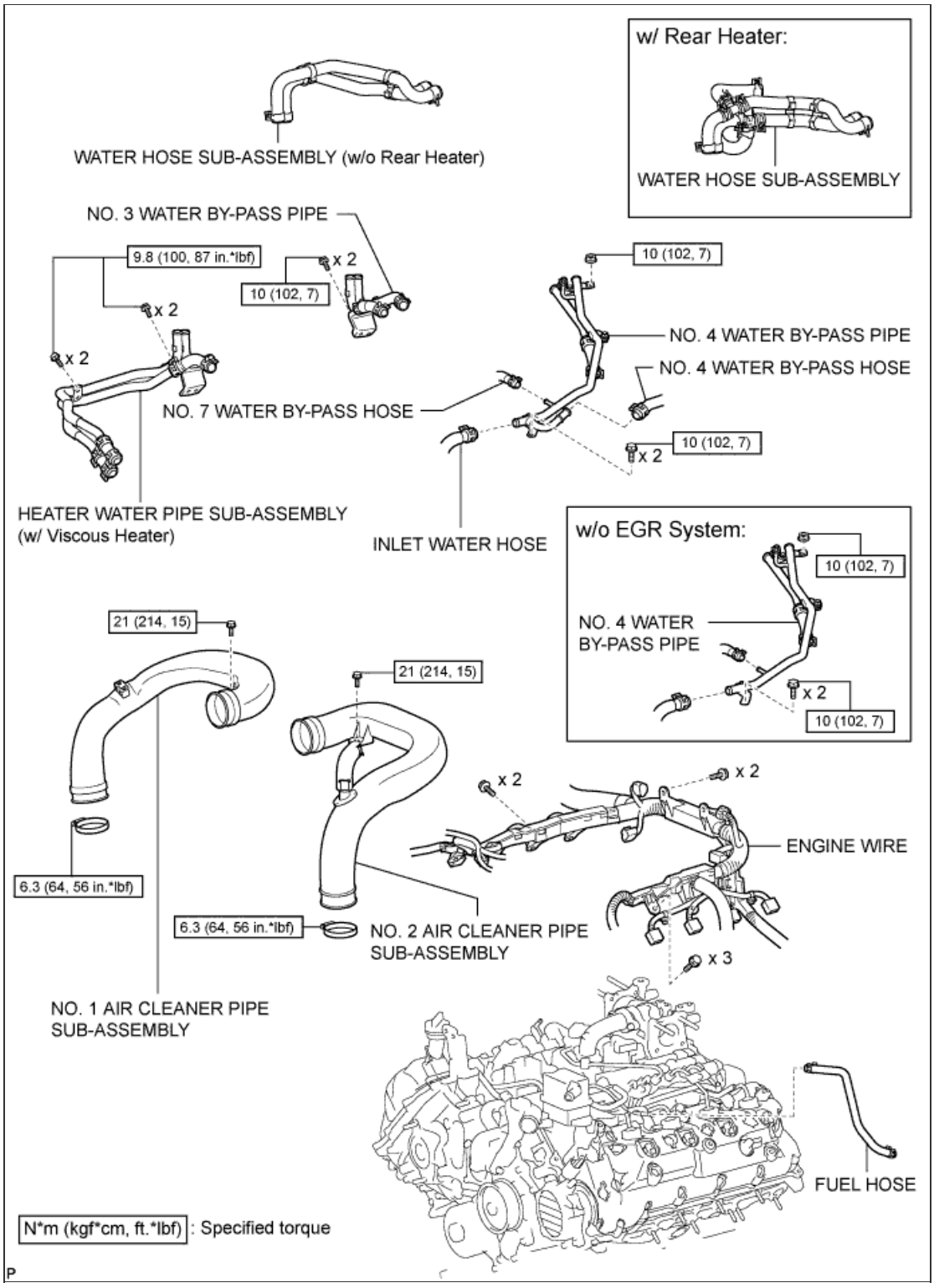


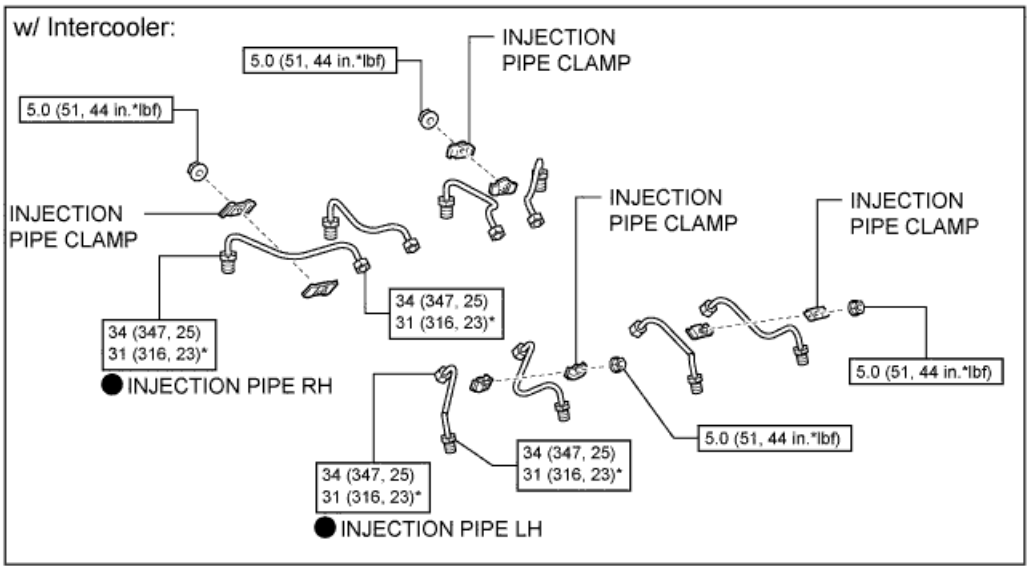


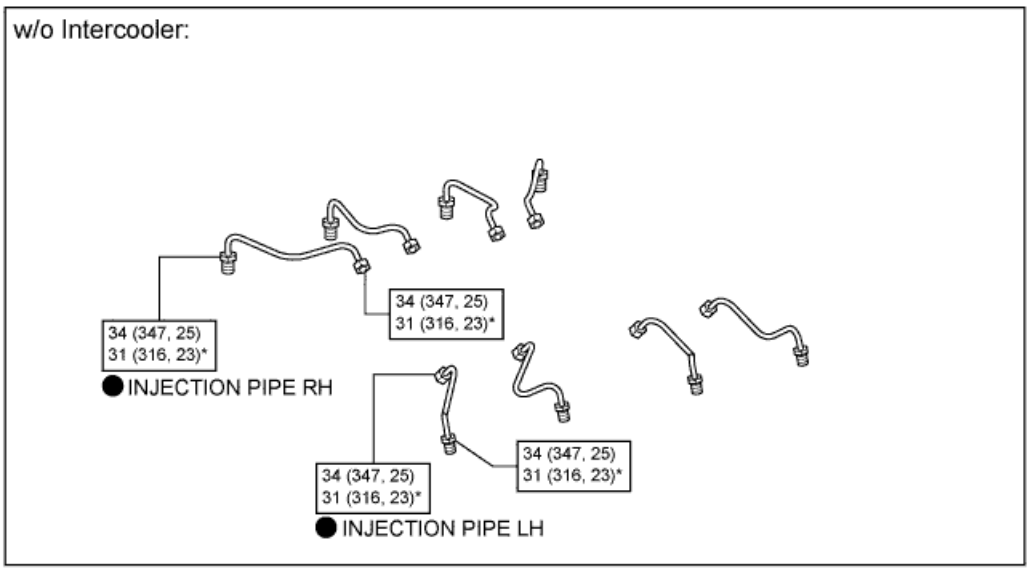
N*m (kgf*cm, ft.*lbf) : Specified torque

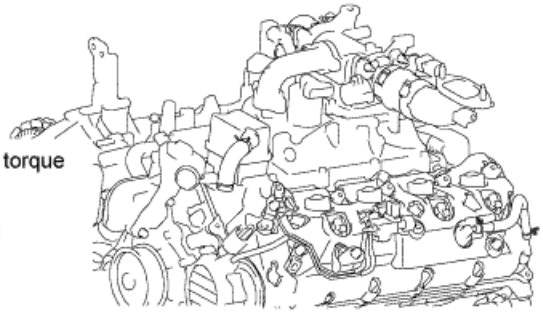
P


GASKET
6.3 (64, 56 in.*lbf)
AIR TUBE SUB-ASSEMBLY RH
6.3 (64, 56 in.*lbf)
GASKET
AIR TUBE SUB-ASSEMBLY LH
for Manual Transmission:
15 (155, 12)
14 (141, 10)*
TUBE CONNECTOR TO FLEXIBLE HOSE TUBE
20 (204, 15)
x 2
15 (155, 12)
14 (141, 10)*
20 (204, 15)
CLUTCH HOSE
DIESEL THROTTLE BODY ASSEMBLY RH
21 (214, 15)
x 2
GASKET
21 (214, 15)
x 2
21 (214, 15)
x 2
GASKET
DIESEL THROTTLE BODY ASSEMBLY LH
x 2
21 (214, 15)
21 (214, 15)
x 2
10 (102, 7)
x 2
NO. 2 ENGINE OIL LEVEL DIPSTICK GUIDE
NO. 1 GAS FILTER
NO. 3 INTERCOOLER SUPPORT BRACKET
O-RING
SUCTION HOSE
21 (214, 15)
9.8 (100, 87 in.*lbf)
NO. 4 AIR TUBE
NO. 3 AIR TUBE
21 (214, 15)
6.3 (64, 56 in.*lbf)
6.3 (64, 56 in.*lbf)
N*m (kgf*cm, ft.*lbf): Specified torque
*: For use with union nut wrench
Non-reusable part
P


w/ Rear Heater:
WATER HOSE SUB-ASSEMBLY (w/o Rear Heater)
WATER HOSE SUB-ASSEMBLY
NO. 3 WATER BY-PASS PIPE
9.8 (100, 87 in.*lbf)
x 2
10 (102, 7)
x 2
x 2
10 (102, 7)
NO. 4 WATER BY-PASS PIPE
NO. 4 WATER BY-PASS HOSE
NO. 7 WATER BY-PASS HOSE
10 (102, 7)
x 2
HEATER WATER PIPE SUB-ASSEMBLY
(w/ Viscous Heater)
INLET WATER HOSE
w/o EGR System:
10 (102, 7)
NO. 4 WATER
BY-PASS PIPE
x 2
10 (102, 7)
21 (214, 15)
21 (214, 15)
x 2
x 2
ENGINE WIRE
6.3 (64, 56 in.*lbf)
6.3 (64, 56 in.*lbf)
NO. 2 AIR CLEANER PIPE
SUB-ASSEMBLY
x 3
NO. 1 AIR CLEANER PIPE
SUB-ASSEMBLY
FUEL HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
P





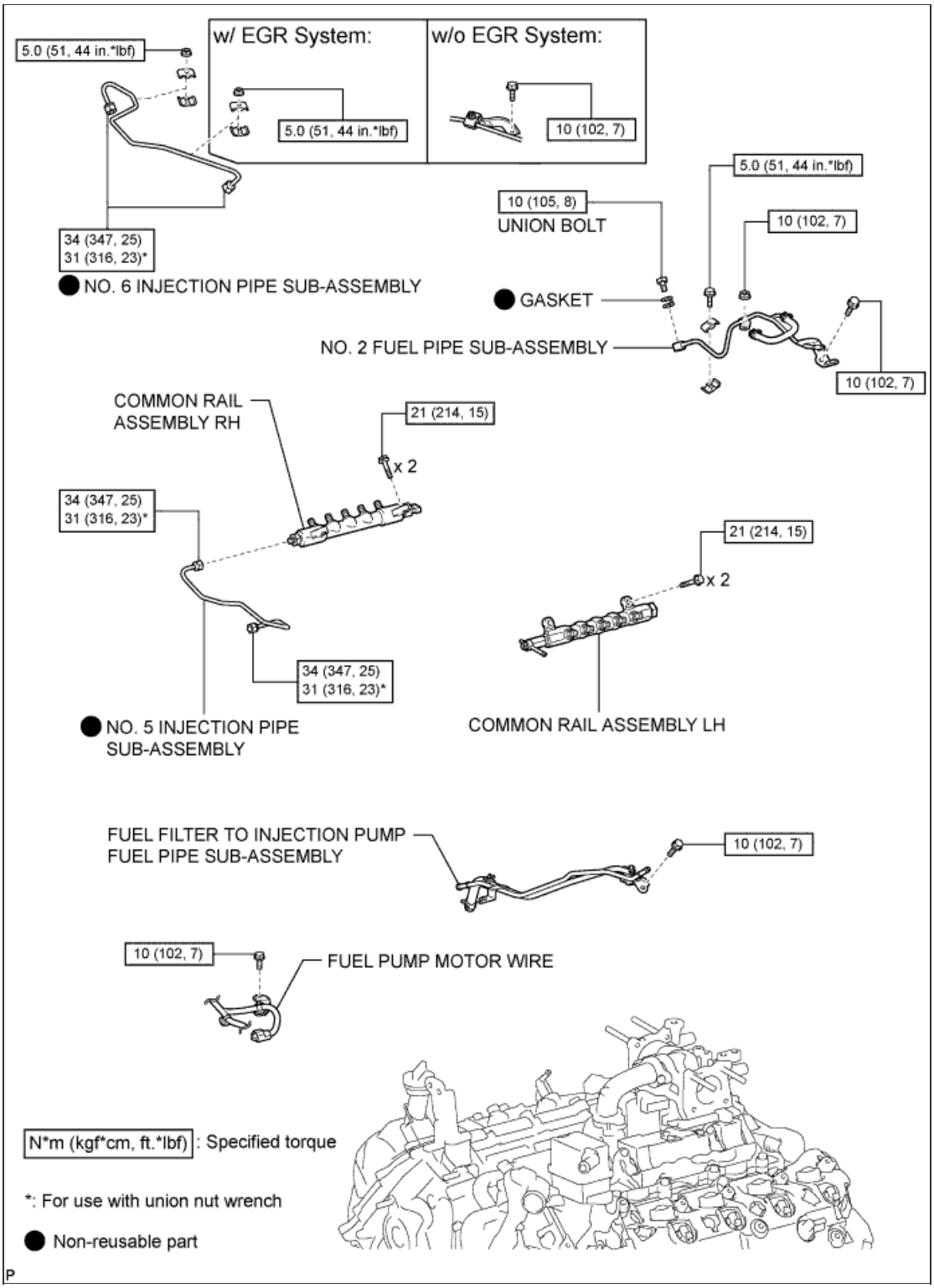


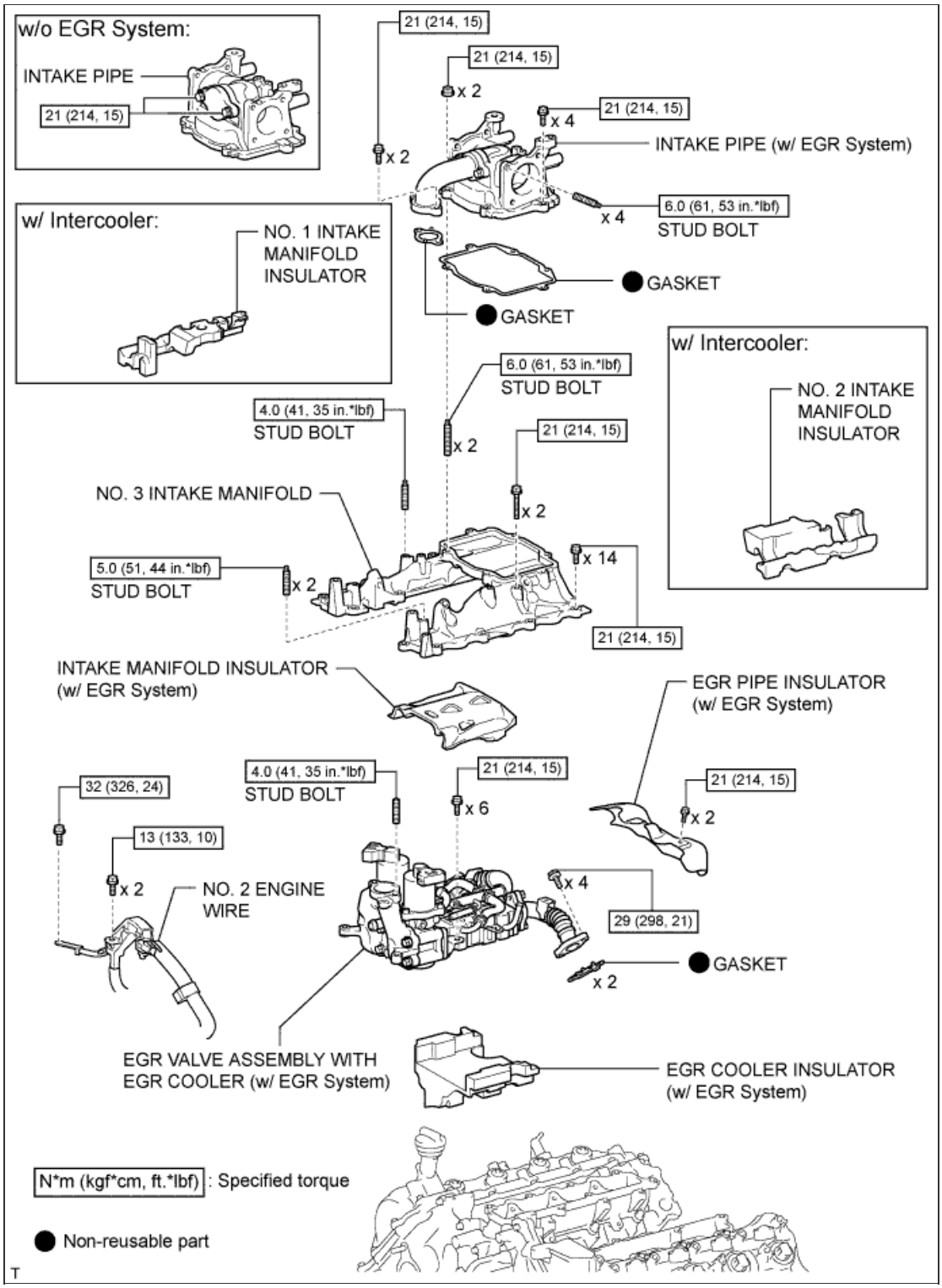
N*m (kgf*cm, ft.*lbf): Specified torque

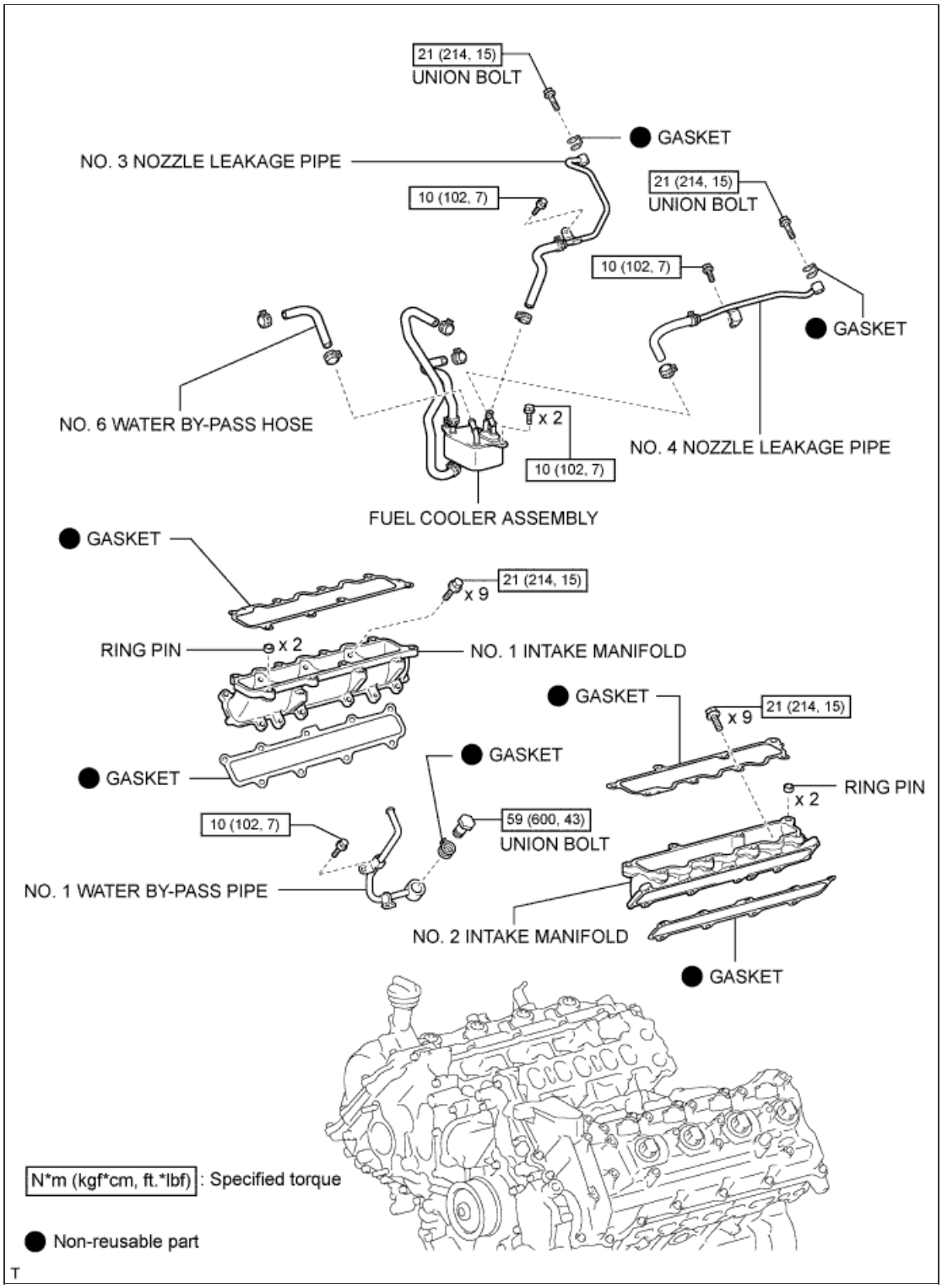
*: For use with union nut wrench

● Non-reusable part

P


w/ EGR System:
w/o EGR System:
5.0 (51, 44 in.*lbf)
5.0 (51, 44 in.*lbf)
10 (102, 7)
5.0 (51, 44 in.*lbf)
10 (105, 8)
UNION BOLT
10 (102, 7)
34 (347, 25)
31 (316, 23)*
NO. 6 INJECTION PIPE SUB-ASSEMBLY
GASKET
NO. 2 FUEL PIPE SUB-ASSEMBLY
10 (102, 7)
COMMON RAIL ASSEMBLY RH
21 (214, 15)
x 2
34 (347, 25)
31 (316, 23)*
21 (214, 15)
x 2
34 (347, 25)
31 (316, 23)*
NO. 5 INJECTION PIPE SUB-ASSEMBLY
COMMON RAIL ASSEMBLY LH
FUEL FILTER TO INJECTION PUMP FUEL PIPE SUB-ASSEMBLY
10 (102, 7)
10 (102, 7)
FUEL PUMP MOTOR WIRE
N*m (kgf*cm, ft.*lbf) : Specified torque
*: For use with union nut wrench
Non-reusable part
P


w/o EGR System:
INTAKE PIPE
21 (214, 15)
w/ Intercooler:
NO. 1 INTAKE MANIFOLD INSULATOR
21 (214, 15)
21 (214, 15)
x 2
x 4
21 (214, 15)
INTAKE PIPE (w/ EGR System)
x 2
6.0 (61, 53 in.*lbf)
STUD BOLT
x 4
GASKET
GASKET
w/ Intercooler:
NO. 2 INTAKE MANIFOLD INSULATOR
6.0 (61, 53 in.*lbf)
STUD BOLT
4.0 (41, 35 in.*lbf)
STUD BOLT
x 2
21 (214, 15)
x 2
NO. 3 INTAKE MANIFOLD
5.0 (51, 44 in.*lbf)
STUD BOLT
x 2
x 14
21 (214, 15)
INTAKE MANIFOLD INSULATOR
(w/ EGR System)
EGR PIPE INSULATOR
(w/ EGR System)
32 (326, 24)
4.0 (41, 35 in.*lbf)
STUD BOLT
21 (214, 15)
x 6
21 (214, 15)
x 2
13 (133, 10)
x 2
NO. 2 ENGINE WIRE
x 4
29 (298, 21)
GASKET
x 2
EGR VALVE ASSEMBLY WITH
EGR COOLER (w/ EGR System)
EGR COOLER INSULATOR
(w/ EGR System)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
T


21 (214, 15)
UNION BOLT
GASKET
NO. 3 NOZZLE LEAKAGE PIPE
10 (102, 7)
21 (214, 15)
UNION BOLT
10 (102, 7)
GASKET
NO. 6 WATER BY-PASS HOSE
x 2
10 (102, 7)
NO. 4 NOZZLE LEAKAGE PIPE
FUEL COOLER ASSEMBLY
GASKET
21 (214, 15)
x 9
RING PIN
x 2
NO. 1 INTAKE MANIFOLD
GASKET
GASKET
21 (214, 15)
x 9
GASKET
RING PIN
x 2
10 (102, 7)
59 (600, 43)
UNION BOLT
NO. 1 WATER BY-PASS PIPE
NO. 2 INTAKE MANIFOLD
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

T

for Preparation Click here

NOTICE:

When replacing the injectors (including shuffling the injectors between the cylinders), common rail, cylinder head, or intake manifold, it is necessary to replace the injection pipes with new ones.

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

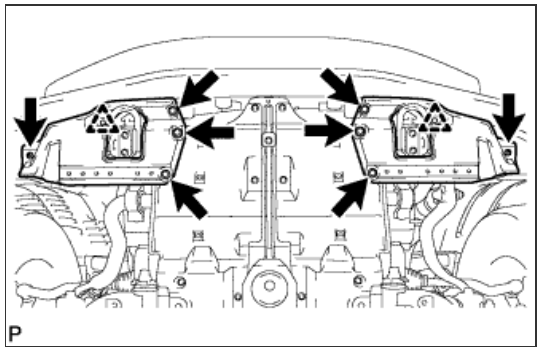
When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Disconnect the cables from the negative (-) main battery and sub-battery terminals.

2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.



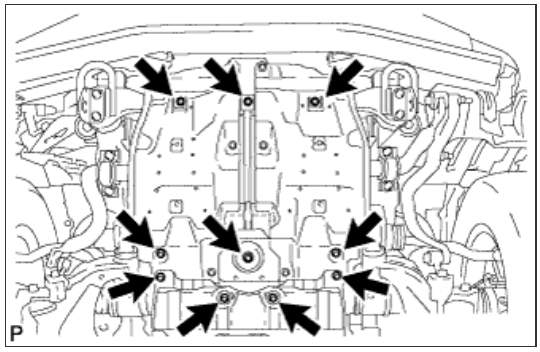
3. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.

4. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



5. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and upper radiator support seal.

6. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

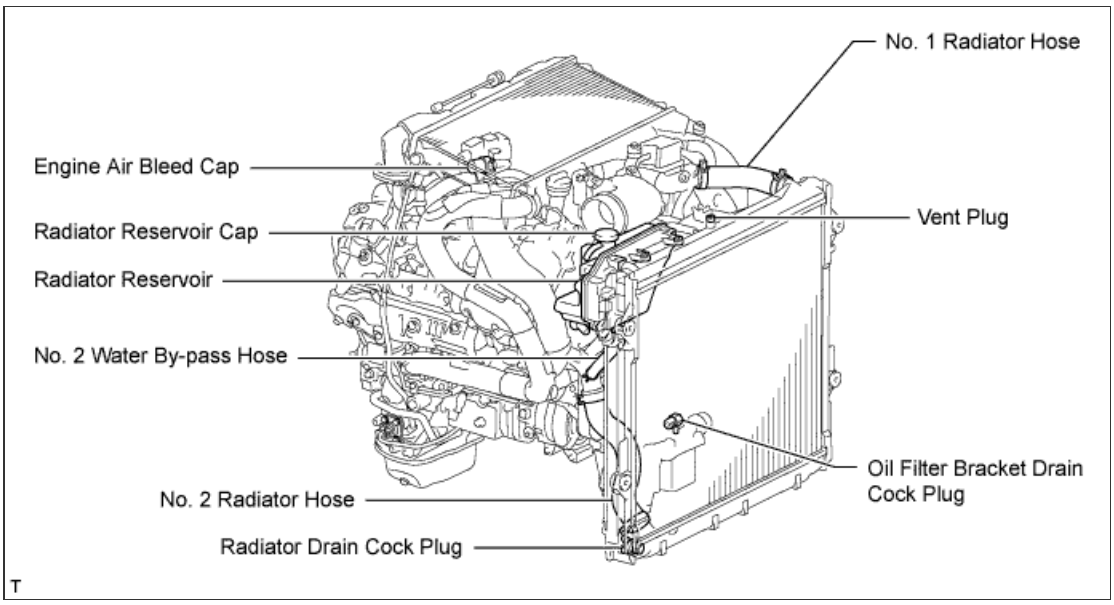
HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

a. Loosen the radiator drain cock plug.

b. Remove the radiator reservoir cap to drain the coolant in the radiator.

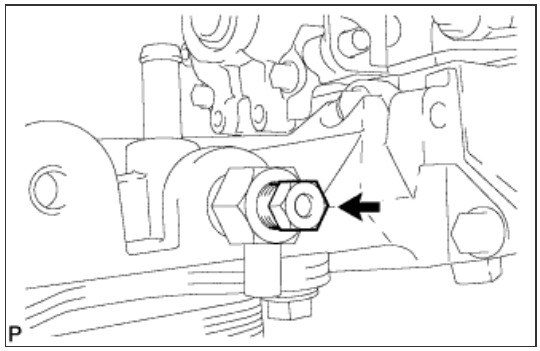
c. Loosen the oil filter bracket drain cock plug to drain the coolant in the engine.



d. Tighten the radiator drain cock plug by hand.

e. Tighten the oil filter bracket drain cock plug.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }

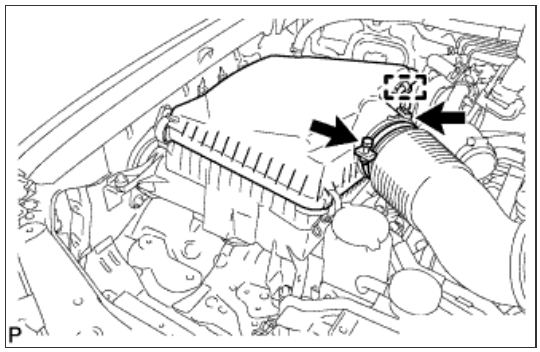


7. REMOVE AIR CLEANER CAP SUB-ASSEMBLY

a. Loosen the hose clamp.

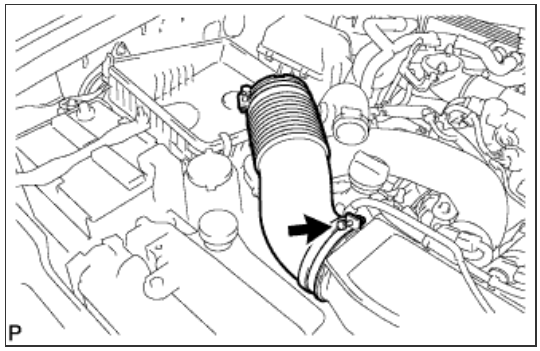
b. Disconnect the mass air flow meter connector and using a clip remover, detach the wire harness clamp from the air cleaner cap.

c. Detach the 4 clamps and remove the air cleaner cap.



8. REMOVE NO. 1 AIR CLEANER HOSE

a. Loosen the hose clamp and remove the No. 1 air cleaner hose.



9. REMOVE INTAKE AIR CONNECTOR

a. w/o Viscous Heater:

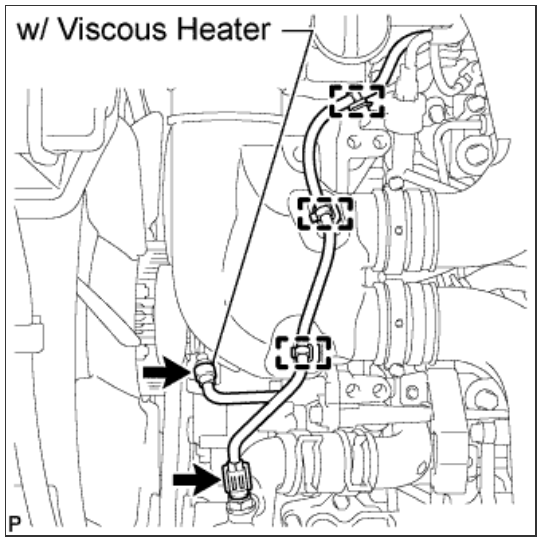
i. Disconnect the connector from the water temperature sensor.

ii. Using a clip remover, detach the 3 wire harness clamps.

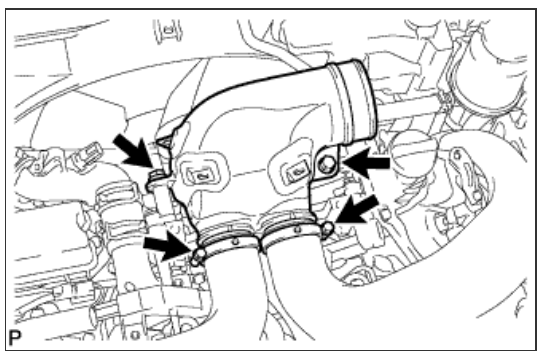
b. w/ Viscous Heater:

i. Disconnect the 2 connectors from the viscous with magnet clutch heater and water temperature sensor.

ii. Using a clip remover, detach the 3 wire harness clamps.



c. Loosen the 2 hose clamps and remove the 2 bolts and intake air connector.



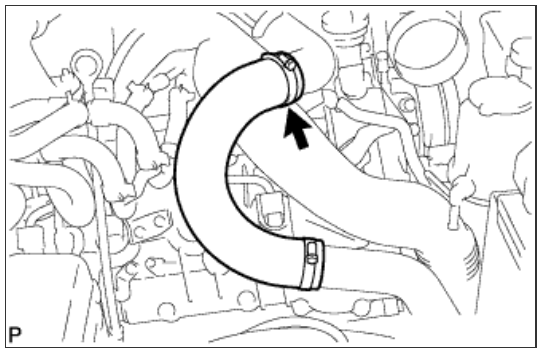
10. REMOVE INTERCOOLER ASSEMBLY (w/ Intercooler

a. Remove the intercooler assembly (Click here).

11. REMOVE NO. 1 COOL AIR INLET (w/o Intercooler

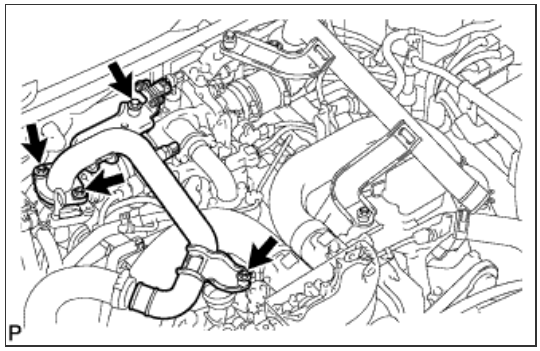
a. Loosen the No. 1 air hose clamp.

b. Disconnect the turbo pressure sensor connector, intake air temperature sensor connector and vacuum hose.



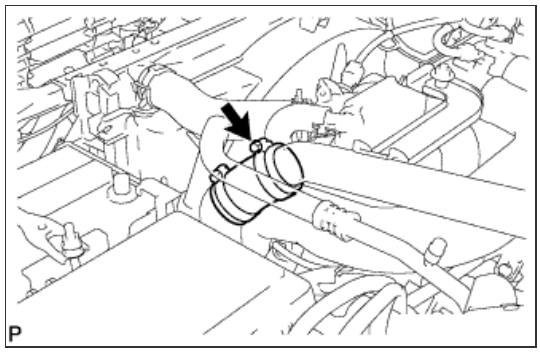
c. Remove the 3 nuts, bolt and No. 1 cool air inlet.

d. Remove the gasket from the air tube RH.



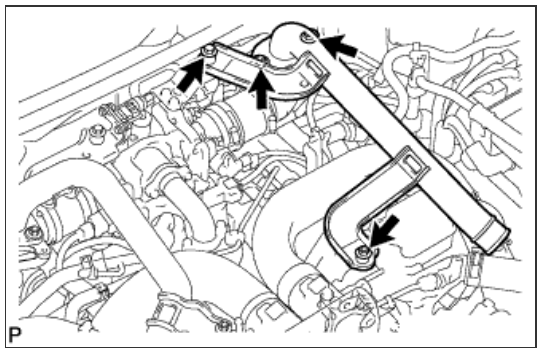
12. REMOVE NO. 2 COOL AIR INLET (w/o Intercooler

a. Loosen the No. 2 air hose clamp.



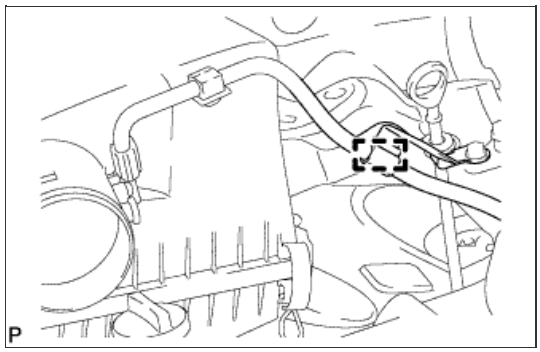
b. Remove the 3 nuts, bolt and No. 2 cool air inlet.

c. Remove the gasket from the air tube LH.



13. REMOVE NO. 2 ENGINE OIL LEVEL DIPSTICK GUIDE

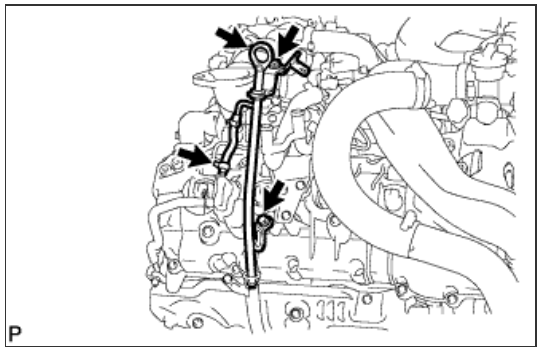
a. Disconnect the wire harness clamp from the No. 2 engine oil level dipstick guide.



b. Disconnect the ventilation hose from the cylinder head cover RH.

c. Remove the 2 bolts and No. 2 engine oil level dipstick guide.

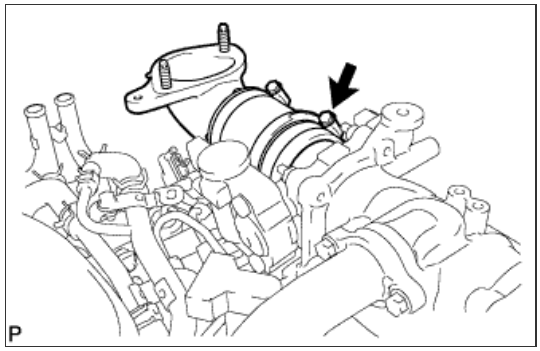
d. Remove the -ring from the No. 2 engine oil level dipstick guide.



14. REMOVE AIR TUBE SUB-ASSEMBLY RH

a. Loosen the hose clamp.

b. Remove the air tube from the throttle body.



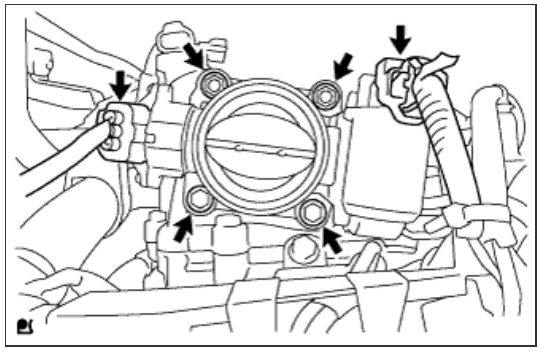
15. REMOVE DIESEL THROTTLE BODY ASSEMBLY RH

a. Disconnect the throttle position sensor connector.

b. Disconnect the throttle motor connector.

c. Remove the 2 bolts, 2 nuts and throttle body.

d. Remove the gasket from the intake pipe.



16. DRAIN CLUTCH FLUID (for Manual Transmission

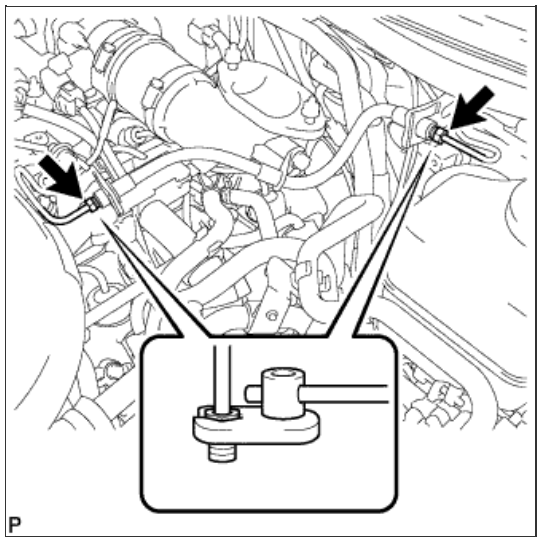
17. REMOVE CLUTCH HOSE (for Manual Transmission

a. Disconnect the 2 flexible hose tubes from the clutch hose with a 10 mm union nut wrench while holding the flexible hose with a wrench.

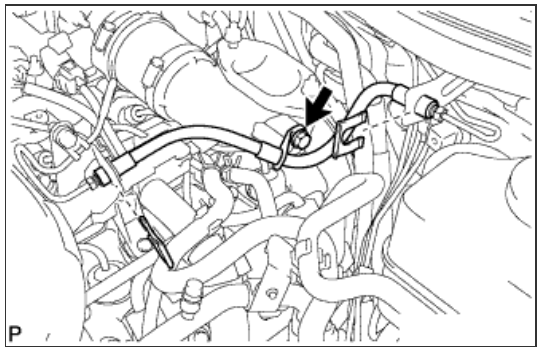
NOTICE:

- **Do not bend or damage the flexible hose tubes.**
- **Do not allow any foreign matter such as dirt and dust to enter the flexible hose tubes from the connecting point.**

b. Remove the 2 clips.



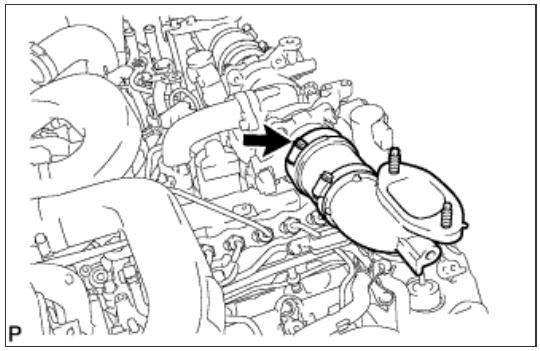
c. Remove the bolt and clutch hose.



18. REMOVE AIR TUBE SUB-ASSEMBLY LH

a. Loosen the hose clamp.

b. Remove the air tube from the throttle body.

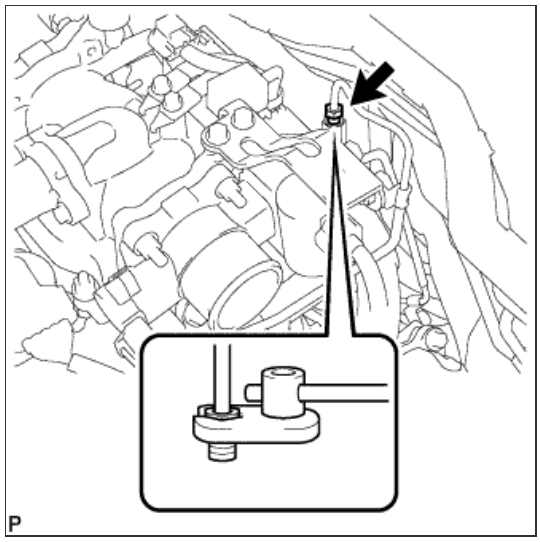


19. REMOVE TUBE CONNECTOR TO FLE BLE HOSE TUBE (for Manual Transmission

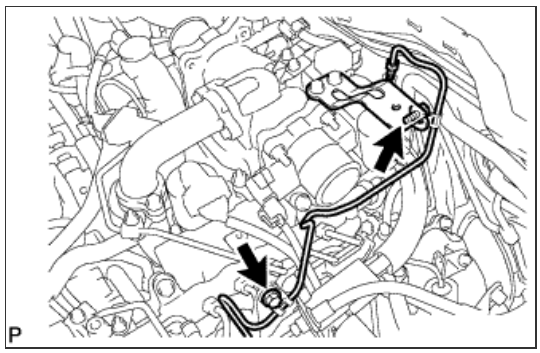
a. Using a 10 mm union nut wrench, disconnect the tube connector to flexible hose tube from the clutch tube to release cylinder 2 way.

NOTICE:

- **Do not bend or damage the flexible hose tube.**
- **Do not allow any foreign matter such as dirt and dust to enter the flexible hose tube from the connecting point.**



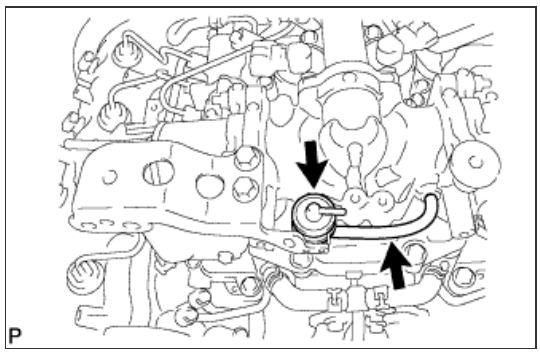
b. Remove the 2 bolts and tube connector to flexible hose tube.



20. REMOVE NO. 1 GAS FILTER

a. Disconnect the hose from the intake pipe.

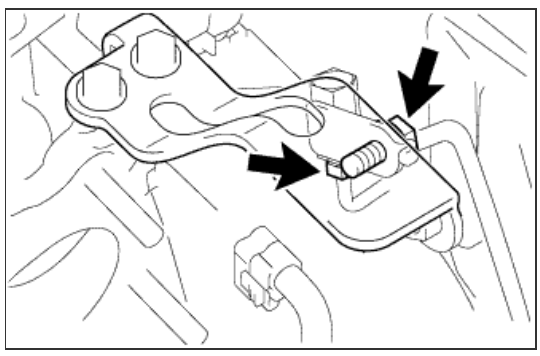
b. Remove the gas filter.



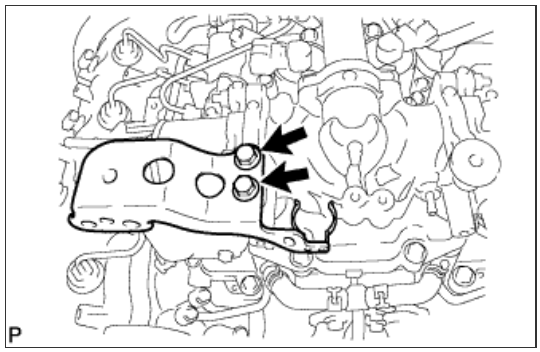
21. REMOVE NO. 3 INTERCOOLER SUPPORT BRACKET

a. for anual Transmission:

i. Remove the bolt and disconnect the clutch tube to release cylinder 2 way from the bracket.



b. Remove the 2 bolts and bracket.



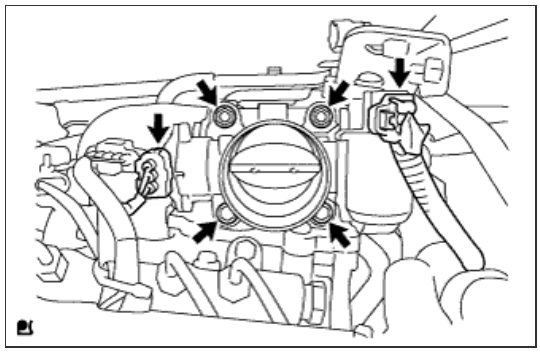
22. REMOVE DIESEL THROTTLE BODY ASSEMBLY LH

a. Disconnect the throttle position sensor connector.

b. Disconnect the throttle motor connector.

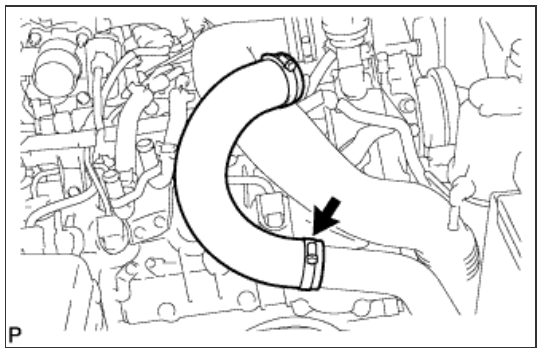
c. Remove the 2 bolts, 2 nuts and throttle body.

d. Remove the gasket from the intake pipe.



23. REMOVE NO. 1 AIR HOSE

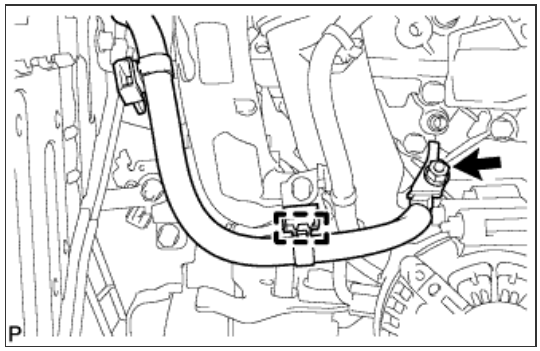
a. Loosen the hose clamp and remove the No. 1 air hose.



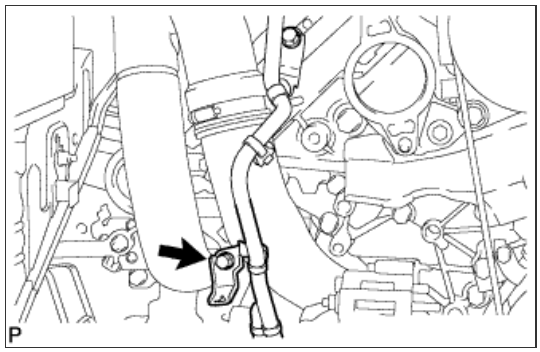
24. REMOVE NO. 3 AIR TUBE

a. Disconnect the wire harness from the clamp.

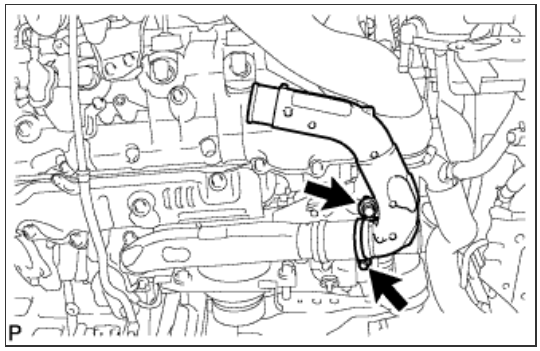
b. Remove the nut and ground wire.



c. Remove the bolt and disconnect the wire harness bracket.

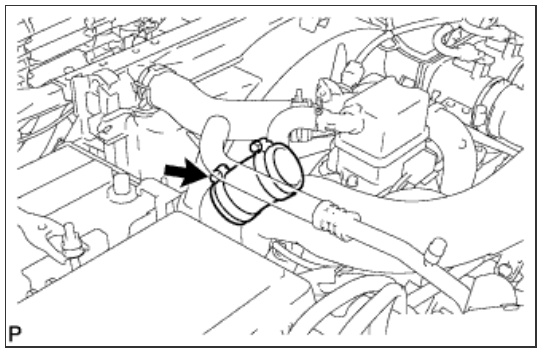


d. Loosen the hose clamp and remove the bolt and No. 3 air tube.



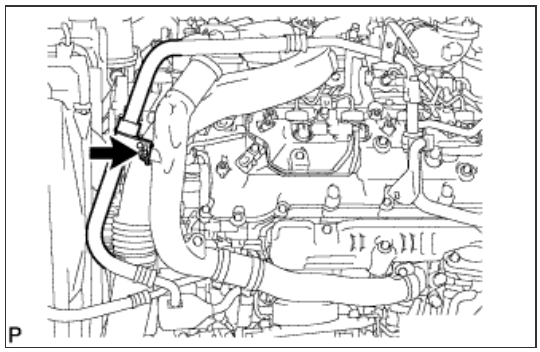
25. REMOVE NO. 2 AIR HOSE

a. Loosen the hose clamp and remove the No. 2 air hose.

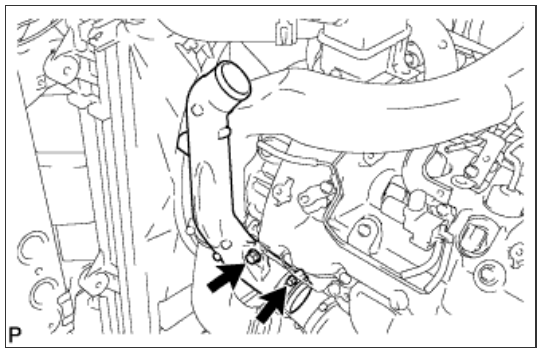


26. REMOVE NO. 4 AIR TUBE

a. Remove the bolt and disconnect the suction hose.



b. Loosen the hose clamp and remove the bolt and No. 4 air tube.

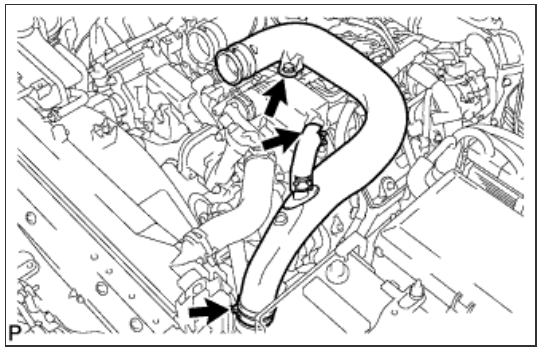


27. REMOVE NO. 2 AIR CLEANER PIPE SUB-ASSEMBLY

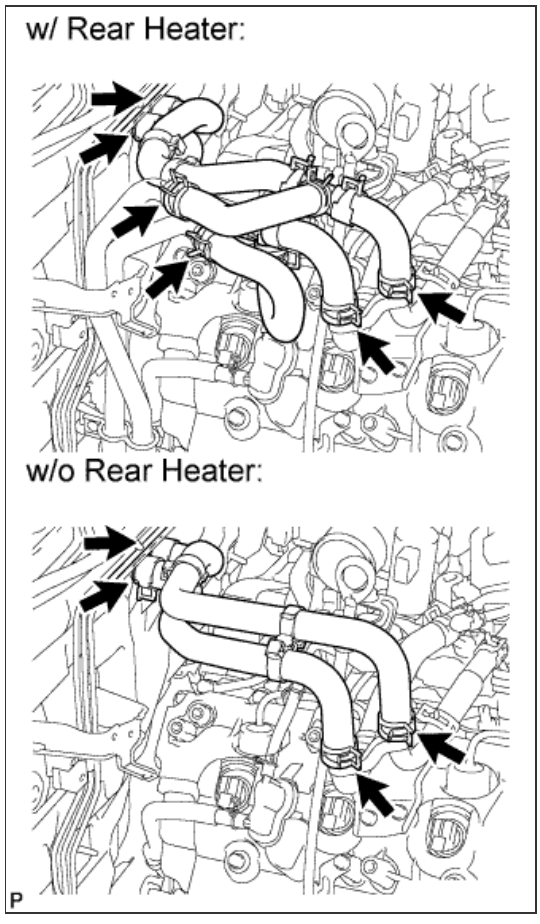
a. Disconnect the ventilation hose from the oil separator.

b. Loosen the hose clamp.

c. Remove the bolt and No. 2 air cleaner pipe.

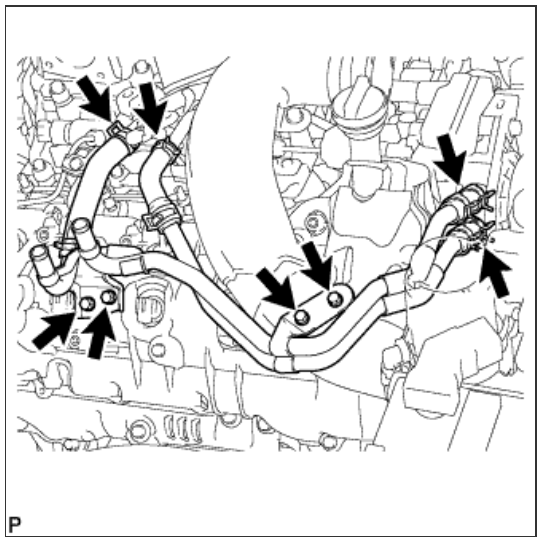


28. DISCONNECT WATER HOSE SUB-ASSEMBLY



29. REMOVE HEATER WATER PIPE SUB-ASSEMBLY (w/ Viscous Heater

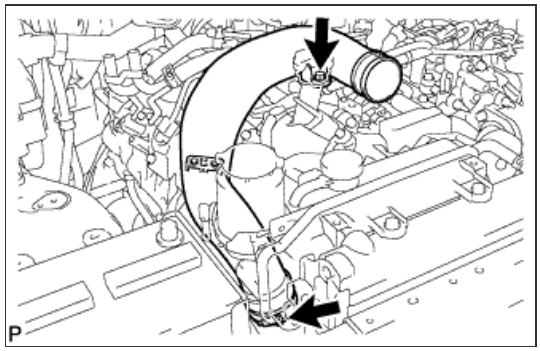
a. Remove the 4 bolts and disconnect the 4 water hose ends, and then remove the heater water pipe.



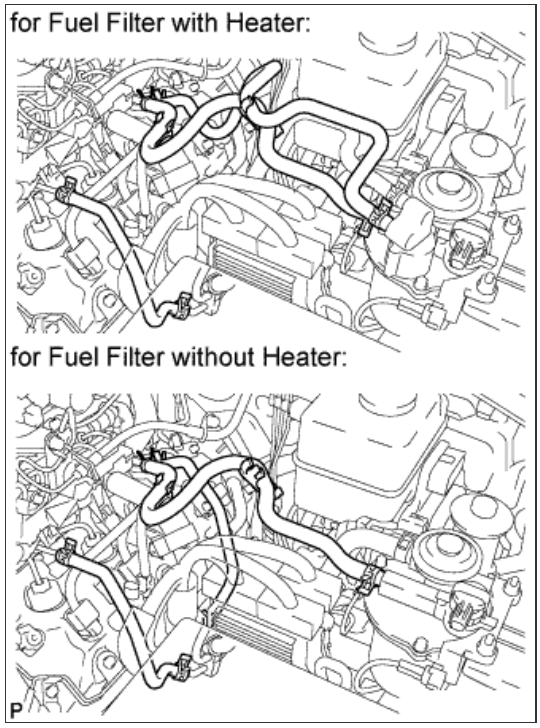
30. REMOVE NO. 1 AIR CLEANER PIPE SUB-ASSEMBLY

a. Loosen the hose clamp.

b. Remove the bolt and No. 1 air cleaner pipe.

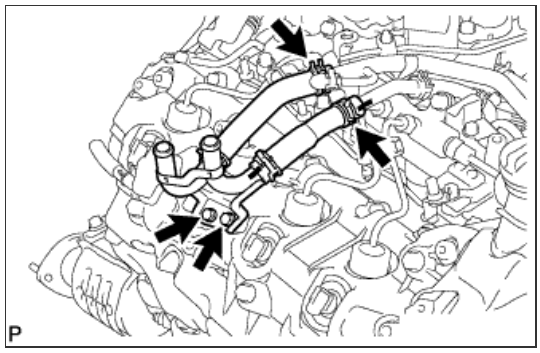


31. DISCONNECT FUEL HOSE



32. REMOVE NO. 3 WATER BY-PASS PIPE (w/o Viscous Heater

a. Remove the 2 bolts and disconnect the 2 water hose ends, and then remove the No. 3 water by-pass pipe.

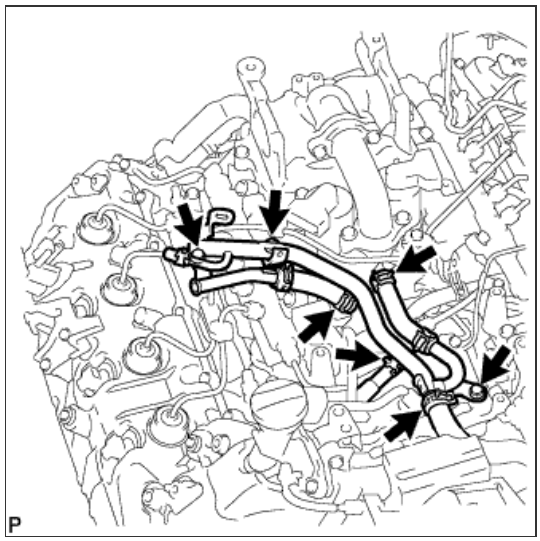


33. REMOVE NO. 4 WATER BY-PASS PIPE

a. w/ R System:

i. Remove the 2 bolts and nut.

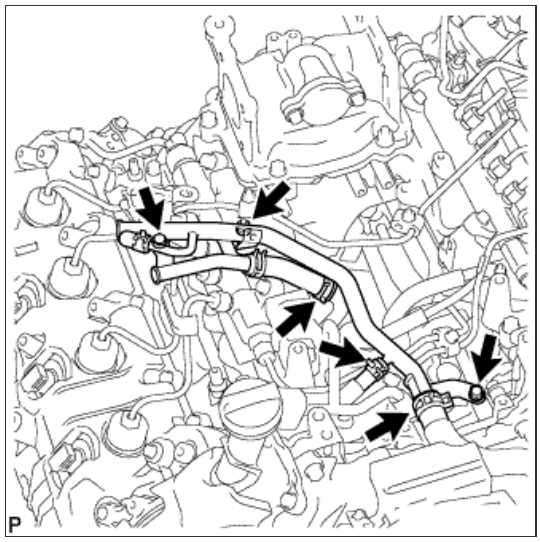
ii. Disconnect the 4 water hose ends, and then remove the No. 4 water by-pass pipe.



b. w/o R System:

i. Remove the 2 bolts and nut.

ii. Disconnect the 3 water hose ends, and then remove the No. 4 water by-pass pipe.

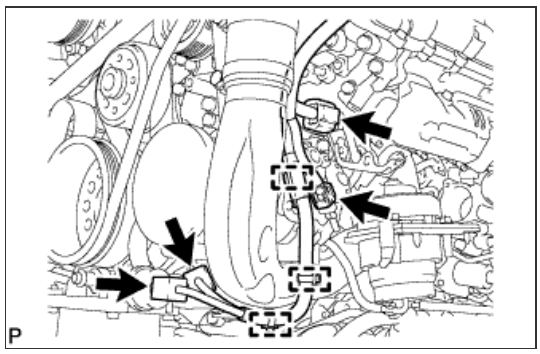


34. DISCONNECT ENGINE WIRE

a. LH Side:

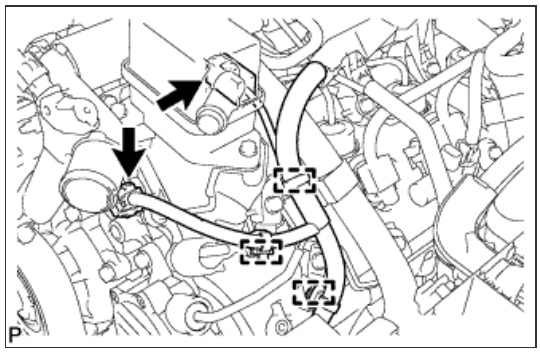
i. Disconnect the 4 connectors.

ii. Using a clip remover, detach the 3 wire harness clamps.



iii. Disconnect the 2 connectors.

i . Using a clip remover, detach the 3 wire harness clamps.

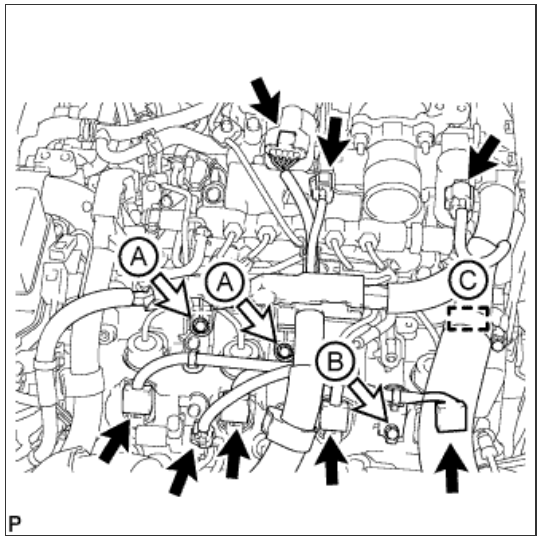


. Disconnect the 8 connectors.

.i Remove the bolt and engine wire harness bracket labeled B.

ii Remove the 2 bolts and disconnect the engine wire protector labeled A.

iii for RHD:
Disconnect the wire harness from the wire harness clamp holder labeled C.



b. RH Side:

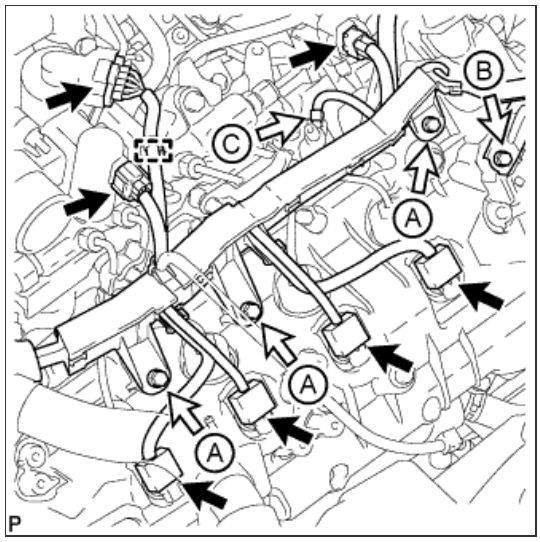
i. Disconnect the 7 connectors.

ii. Using a clip remover, detach the wire harness clamp.

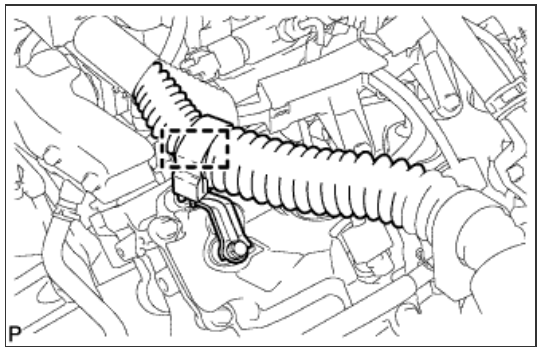
iii. Remove the 3 bolts and disconnect the wire harness protector labeled A.

i . Remove the bolt and wire harness bracket labeled B.

. Remove the nut and glow plug wire harness labeled C.



.i for RHD:
Disconnect the wire harness from the wire harness clamp holder.



c. Rear Side:

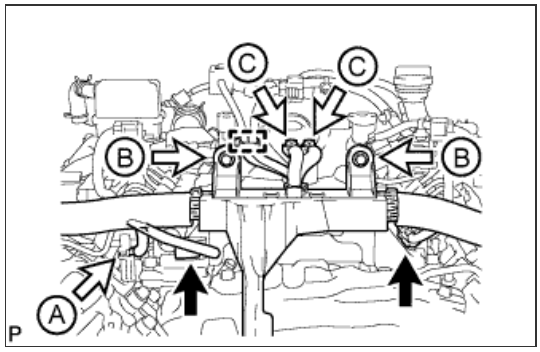
i. Using a clip remover, detach the wire harness clamp.

ii. Remove the 2 bolts and 2 ground wires labeled C.

iii. Remove the 2 bolts and disconnect the engine wire harness protector labeled B.

i . Disconnect the 2 common rail connectors.

. Remove the nut and disconnect the glow plug wire harness labeled A.



35. REMOVE NO. 2 FUEL PIPE SUB-ASSEMBLY

NOTICE:

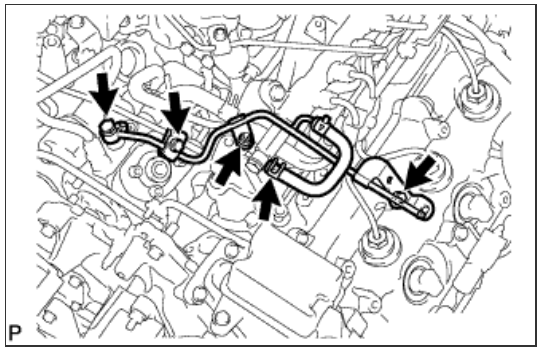
- **After remo ig a fuel pipe, to pre entdirt or foreign objects from entering the fuel pipe ends, co erhe fuel pipe ends with plastic bags.**
- **After remo ig a fuel pipe, to pre entdirt or foreign objects from entering the fuel supply pump hole, co erhe hole with protecti e tape.**

a. Disconnect the fuel hose from the No. 5 nozzle leakage pipe.

b. Remove the bolt and No. 2 injection pipe clamp.

c. Remove the union bolt and gasket.

d. Remove the bolt, nut and No. 2 fuel pipe.



36. REMOVE NO. 6 INJECTION PIPE SUB-ASSEMBLY

NOTICE:

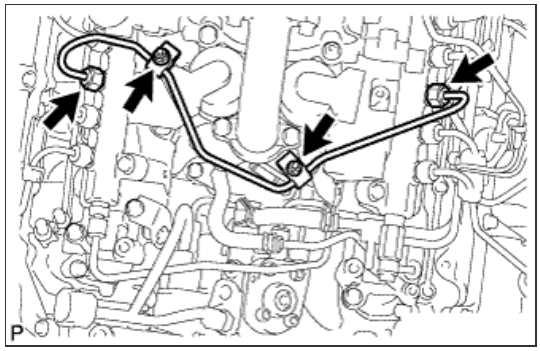
After removing an injection pipe, to prevent dirt or foreign objects from entering the common rail holes, cover the holes with protective tape.

a. w/ EGR System:

i. Using a union nut wrench, loosen the No. 6 injection pipe ends.

ii. Remove the 2 nuts and 2 No. 2 injection pipe clamps.

iii. Remove the No. 6 injection pipe.

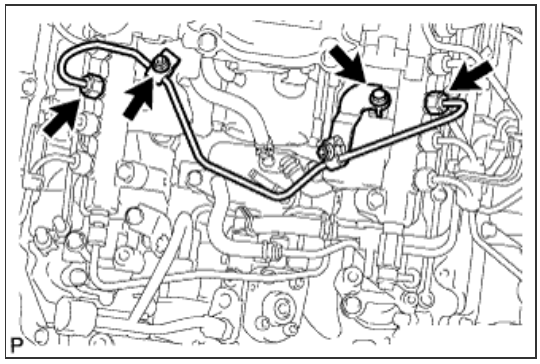


b. w/o EGR System:

i. Using a union nut wrench, loosen the No. 6 injection pipe ends.

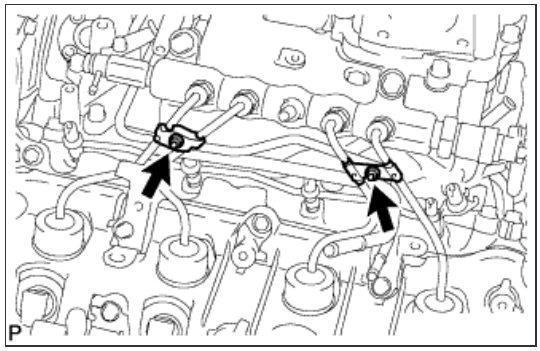
ii. Remove the nut and No. 2 injection pipe clamp.

iii. Remove the bolt and No. 6 injection pipe.



37. REMOVE INJECTION PIPE LH

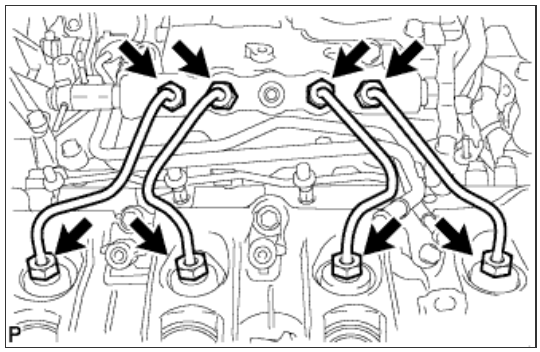
a. w/ Intercooler:
Remove the 2 nuts and 4 injection pipe clamps.



b. Using a union nut wrench, remove the 4 injection pipes.

NOTICE:

After removing an injection pipe, to prevent dirt or foreign objects from entering the common rail holes or injector holes, cover the holes with protective tape.

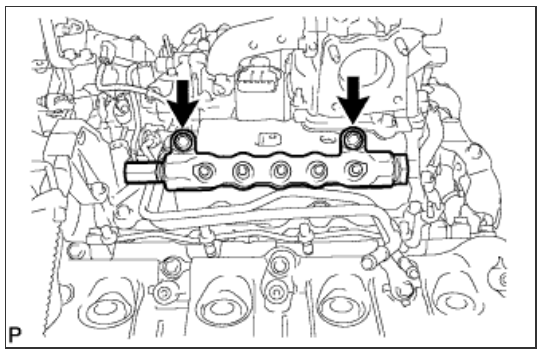


38. REMOVE COMMON RAIL ASSEMBLY LH

a. Remove the 2 bolts and common rail.

NOTICE:

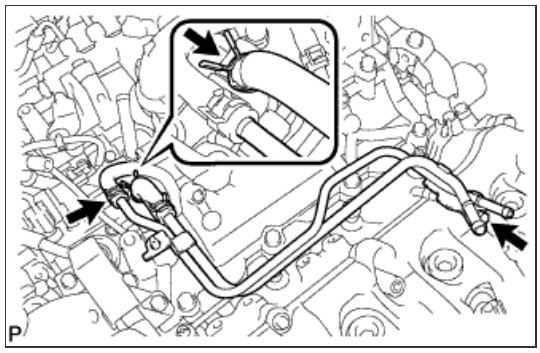
Do not remove the fuel pressure limiter from the common rail. If it is removed, replace the common rail.



39. REMOVE FUEL FILTER TO INJECTION PUMP FUEL PIPE SUB-ASSEMBLY

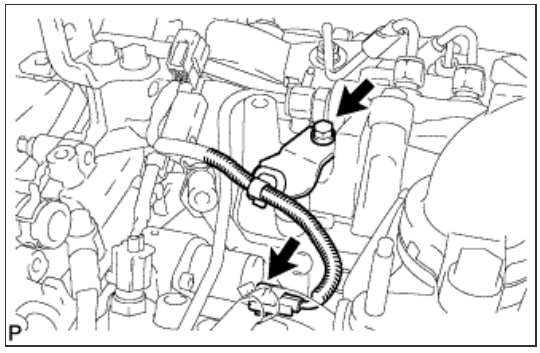
a. Disconnect the 2 hoses from the fuel pipe.

b. Remove the bolt and fuel filter to injection pump fuel pipe.



40. DISCONNECT FUEL PUMP MOTOR WIRE

a. Remove the bolt and disconnect the connector from the fuel supply pump.

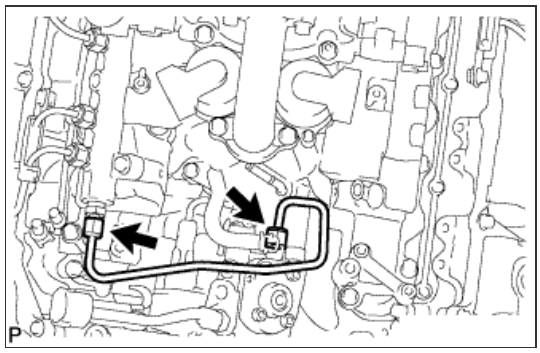


41. REMOVE NO. 5 INJECTION PIPE SUB-ASSEMBLY

a. Using a union nut wrench, remove the No. 5 injection pipe.

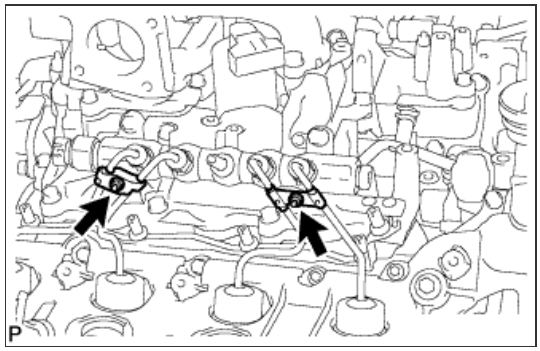
NOTICE:

After removing an injection pipe, to prevent dirt or foreign objects from entering the common rail hole or injection pump hole, cover the holes with protective tape.



42. REMOVE INJECTION PIPE RH

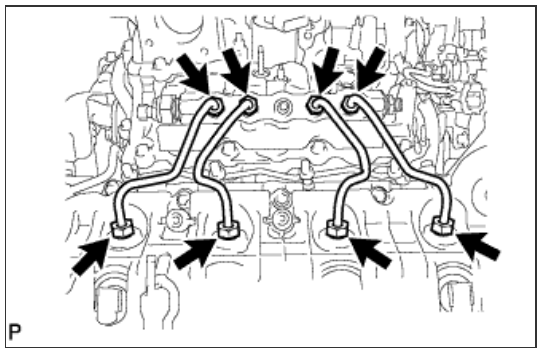
a. w/ Intercooler:
Remove the 2 nuts and 4 injection pipe clamps.



b. Using a union nut wrench, remove the 4 injection pipes.

NOTICE:

After removing an injection pipe, to prevent dirt or foreign objects from entering the common rail holes or injector holes, cover the holes with protective tape.

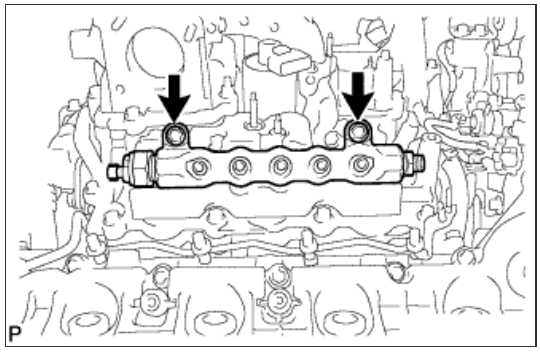


43. REMOVE COMMON RAIL ASSEMBLY RH

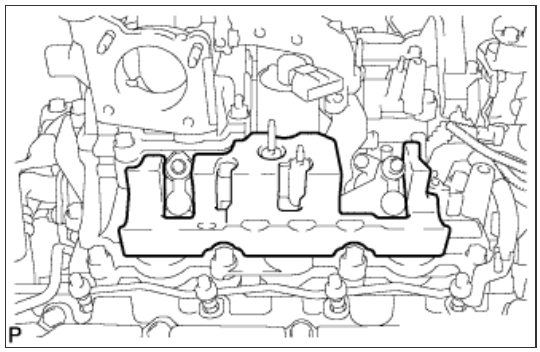
a. Remove the 2 bolts and common rail.

NOTICE:

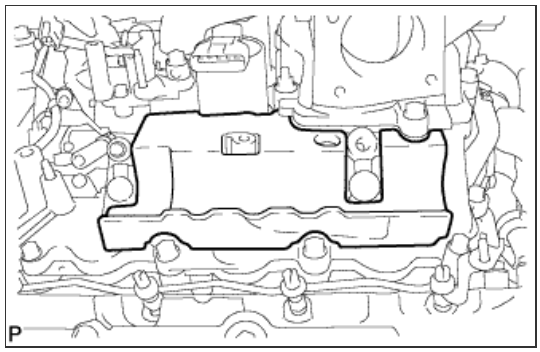
Do not remove the fuel pressure sensor from the common rail. If it is removed, replace the common rail.



44. REMOVE NO. 1 INTAKE MANIFOLD INSULATOR (w/ Intercooler

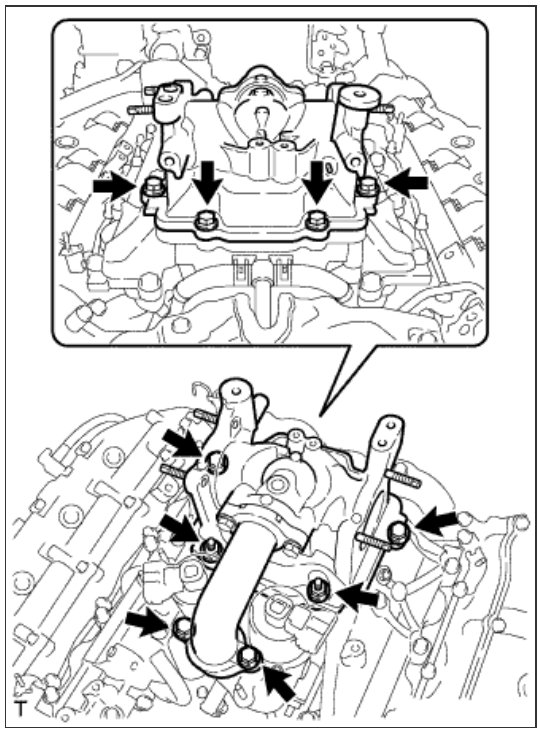


45. REMOVE NO. 2 INTAKE MANIFOLD INSULATOR (w/ Intercooler

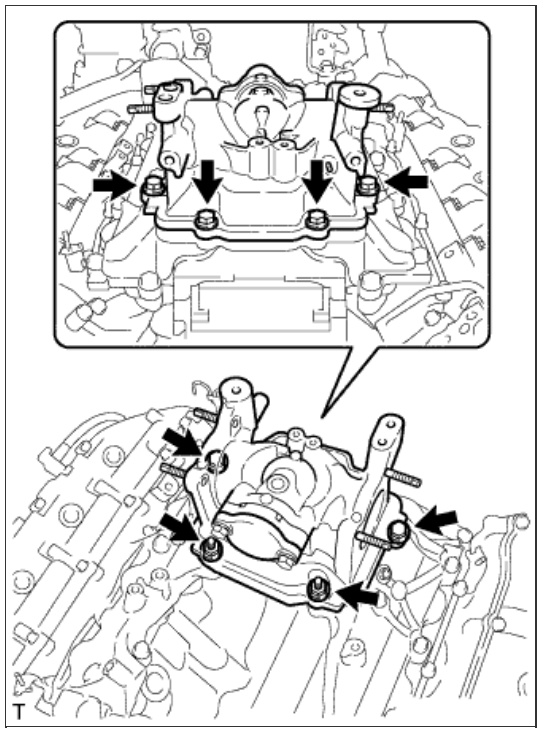


46. REMOVE INTAKE PIPE

a. w/ R System:
Remove the 2 nuts, 6 bolts, intake pipe and 2 gaskets.

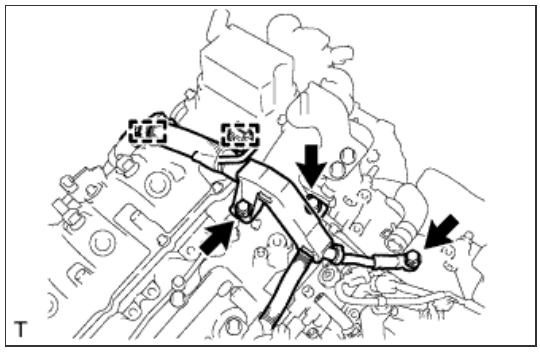


b. w/o R System:
Remove the 2 nuts, 4 bolts, intake pipe and gasket.



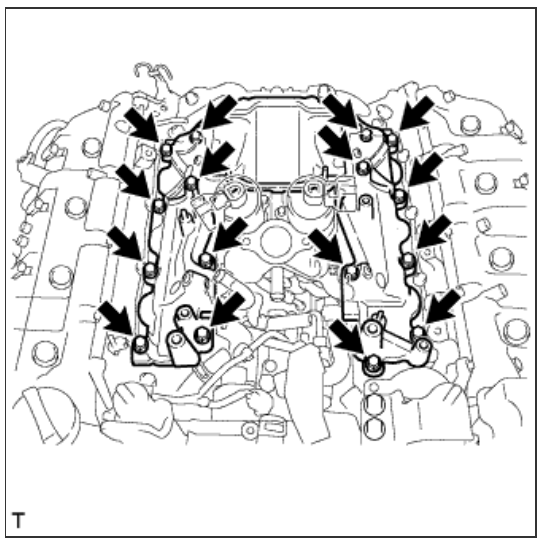
47. DISCONNECT NO. 2 ENGINE WIRE

a. Remove the 3 bolts and using a clip remover, detach the 2 wire harness clamps, and then disconnect the No. 2 engine wire.

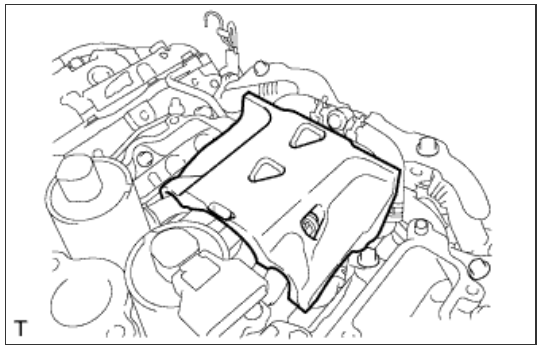


48. REMOVE NO. 3 INTAKE MANIFOLD

a. Remove the 16 bolts, No. 3 intake manifold and 2 gaskets.

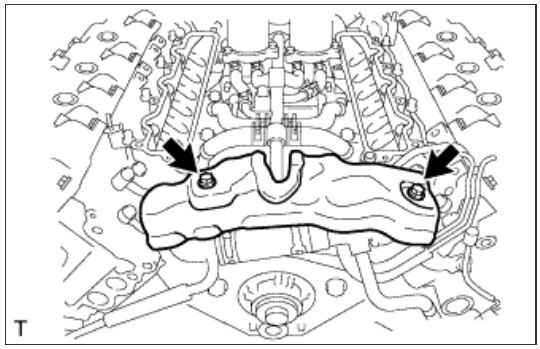


49. REMOVE INTAKE MANIFOLD INSULATOR (w/ EGR System



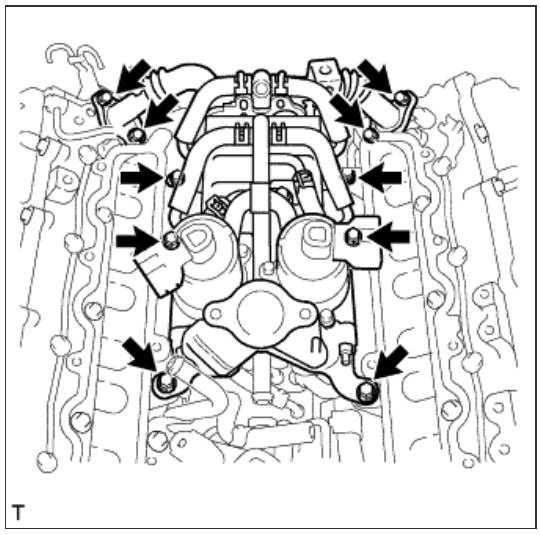
50. REMOVE EGR PIPE INSULATOR (w/ EGR System

a. Remove the 2 bolts and R pipe insulator.

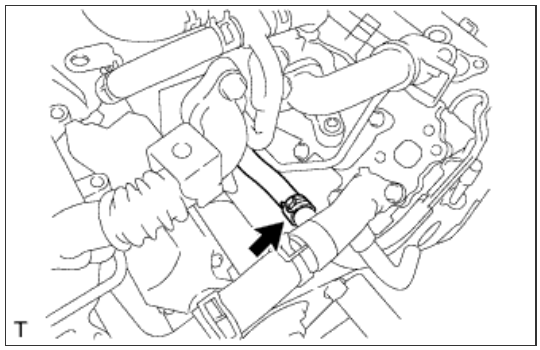


51. REMOVE EGR VALVE ASSEMBLY WITH EGR COOLER (w/ EGR System

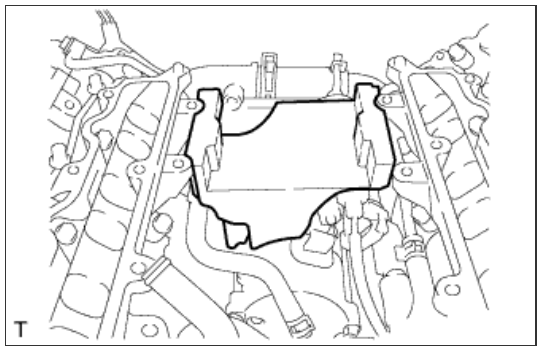
a. Remove the 10 bolts, R valve with R cooler and 2 gaskets.



b. Disconnect the No. 5 water by-pass hose from the water by-pass outlet.



52. REMOVE EGR COOLER INSULATOR (w/ EGR System



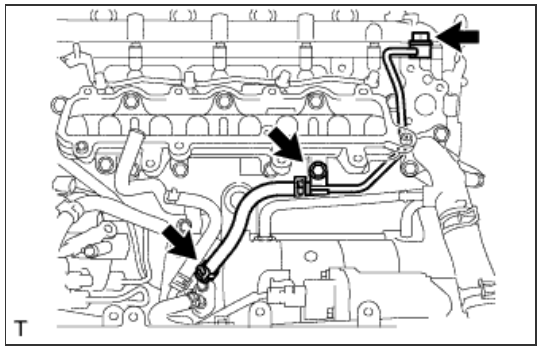
53. REMOVE NO. 3 NO LE LEAKGE PIPE

a. Disconnect the No. 1 fuel hose from the fuel cooler.

b. Remove the union bolt, bolt, No. 3 nozzle leakage pipe and gasket.

NOTICE:

After removing the nozzle leakage pipe, to prevent dirt or foreign objects from entering the nozzle leakage pipe, cover the nozzle leakage pipe ends with plastic bags.



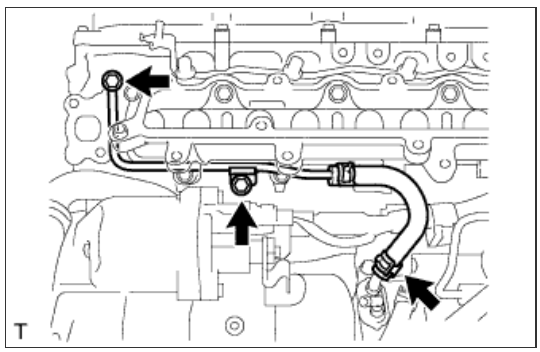
54. REMOVE NO. 4 NO LE LEAKGE PIPE

a. Disconnect the No. 2 fuel hose from the fuel cooler.

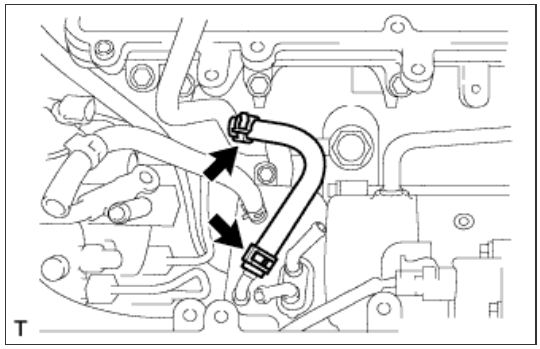
b. Remove the union bolt, bolt, No. 4 nozzle leakage pipe and gasket.

NOTICE:

After removing the nozzle leakage pipe, to prevent dirt or foreign objects from entering the nozzle leakage pipe, cover the nozzle leakage pipe ends with plastic bags.

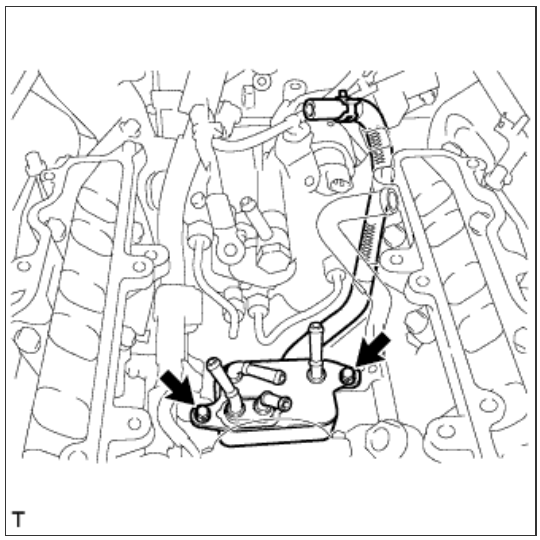


55. DISCONNECT NO. 6 WATER BY-PASS HOSE



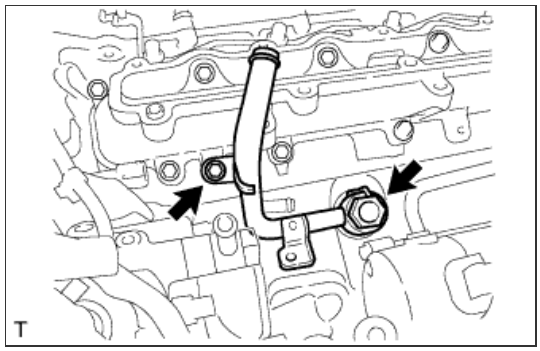
56. REMOVE FUEL COOLER ASSEMBLY

a. Remove the 2 bolts and fuel cooler.



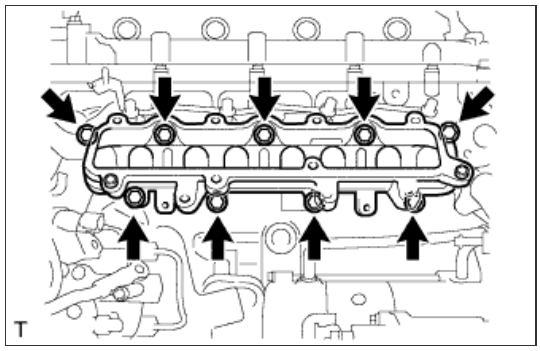
57. REMOVE NO. 1 WATER BY-PASS PIPE

a. Remove the union bolt, bolt, No. 1 water by-pass pipe and gasket.



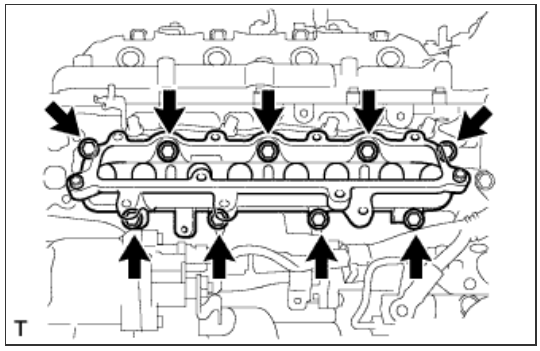
58. REMOVE NO. 1 INTAKE MANIFOLD

a. Remove the 9 bolts, No. 1 intake manifold and gasket.



59. REMOVE NO. 2 INTAKE MANIFOLD

a. Remove the 9 bolts, No. 2 intake manifold and gasket.



60. REPLACE STUD BOLT

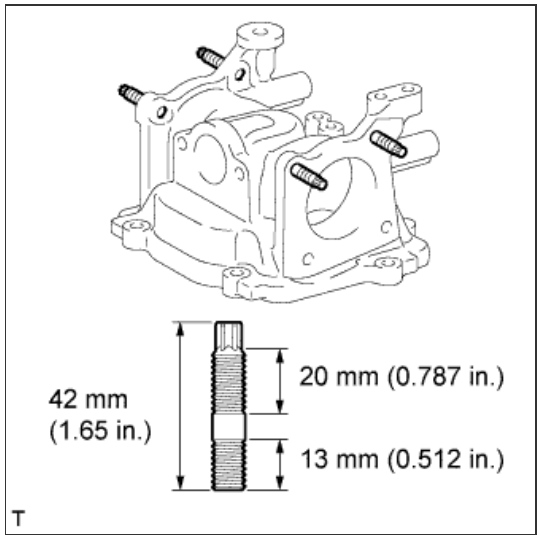
HINT:

If a stud bolt is deformed or the threads are damaged, replace it.

a. The stud bolt of the intake pipe.

i. Using an E8 "TORX" wrench, replace the stud bolts.

Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }



b. The stud bolt of the No. 3 intake manifold.

i. Using an E8 "TORX" wrench, replace the stud bolts labeled A.

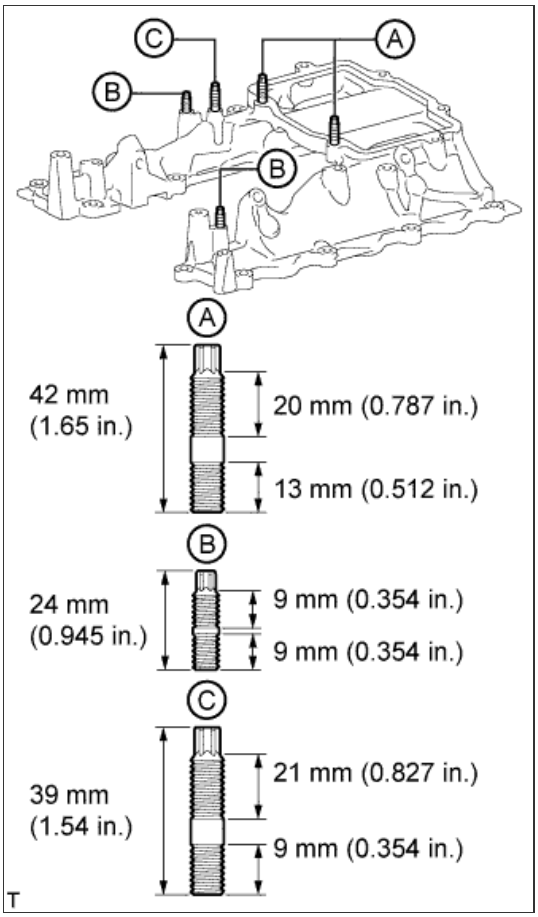
Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }

ii. Using an E6 "TORX" wrench, replace the stud bolts labeled B.

Torque:
4.5 N*m{ 46 kgf*cm , 40 in.*lbf }

iii. Using an TORX" wrench, replace the stud bolt labeled C.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }



for Preparation Click here

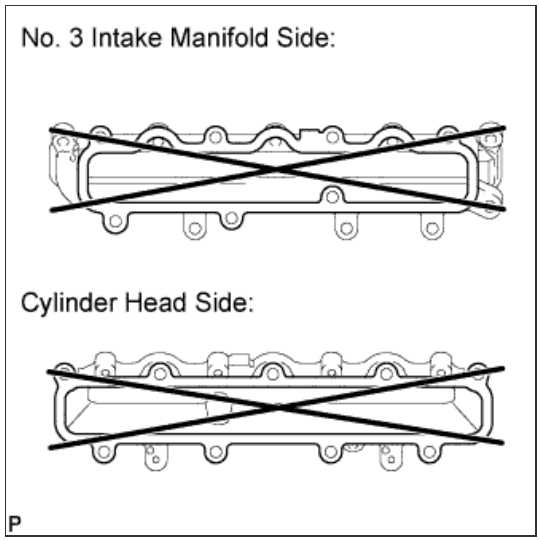
1. INSPECT NO. 1 INTAKE MANIFOLD FOR FLATNESS

a. Using a precision straightedge and feeler gauge, measure the warpage of the contact surface between the No. 1 and No. 3 intake manifold, and the No. 1 intake manifold and cylinder head.

Ma imum Warpage:

tem	Specified Condition
No. 3 intake manifold	0.10 mm (0.00394 in.)
Cylinder head	0.10 mm (0.00394 in.)

f the warpage is more than the maximum, replace the No. 1 intake manifold.



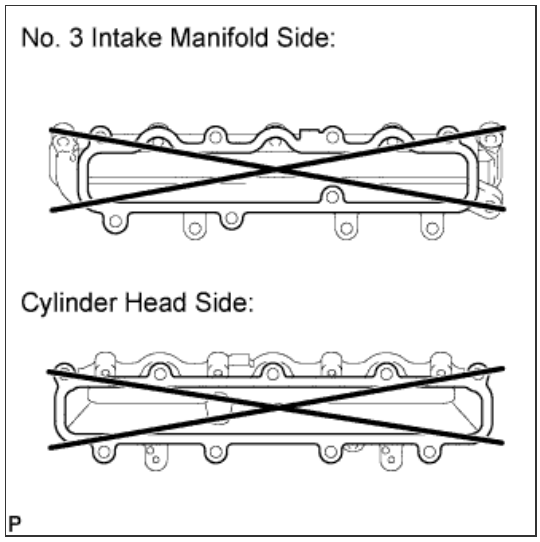
2. INSPECT NO. 2 INTAKE MANIFOLD FOR FLATNESS

a. Using a precision straightedge and feeler gauge, measure the warpage of the contact surface between the No. 2 and No. 3 intake manifold, and the No. 2 intake manifold and cylinder head.

Ma imum Warpage:

tem	Specified Condition
No. 3 intake manifold	0.10 mm (0.00394 in.)
Cylinder head	0.10 mm (0.00394 in.)

f the warpage is more than the maximum, replace the No. 2 intake manifold.



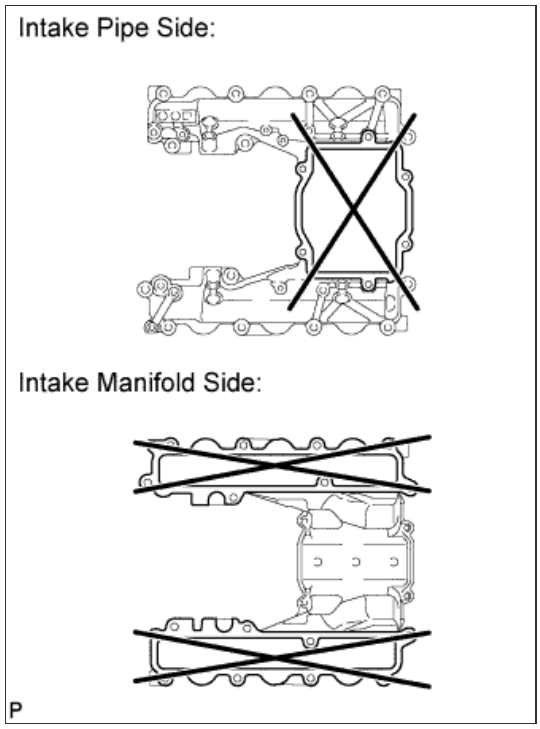
3. INSPECT NO. 3 INTAKE MANIFOLD FOR FLATNESS

a. Using a precision straightedge and feeler gauge, measure the warpage of the contact surface between the No. 3 and No. 1 intake manifold, the No. 3 and No. 2 intake manifold, and the No. 3 intake manifold and intake pipe.

Ma imum Warpage:

tem	Specified Condition
ntake pipe	0.10 mm (0.00394 in.)
No. 2 and No. 3 intake manifold	0.15 mm (0.00591 in.)

f the warpage is more than the maximum, replace the No. 3 intake manifold.



for Preparation Click here

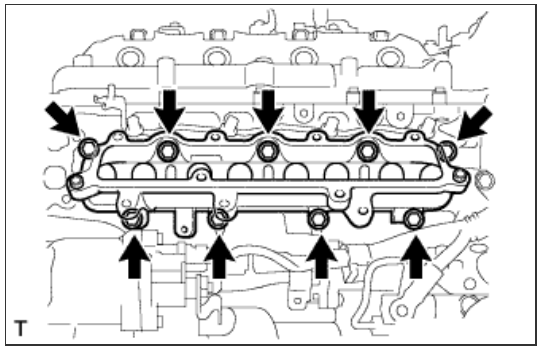
NOTICE:

When replacing the injectors (including shuffling the injectors between the cylinders), common rail, cylinder head, or intake manifold, it is necessary to replace the injection pipes with new ones.

1. INSTALL NO. 2 INTAKE MANIFOLD

a. Install a new gasket and the No. 2 intake manifold with the 9 bolts.

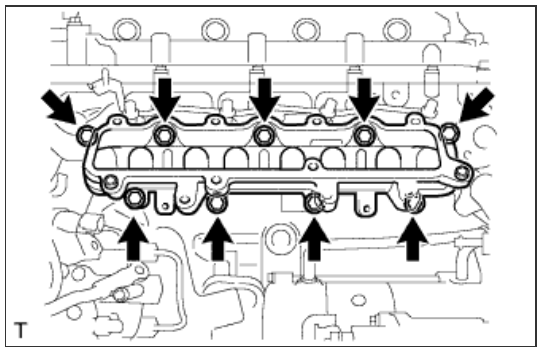
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



2. INSTALL NO. 1 INTAKE MANIFOLD

a. Install a new gasket and the No. 1 intake manifold with the 9 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

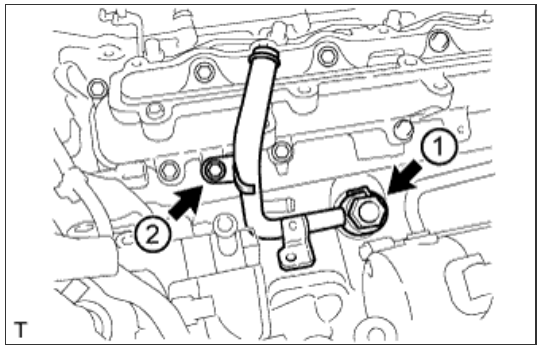


3. INSTALL NO. 1 WATER BY-PASS PIPE

a. Temporarily install a new gasket and the No. 1 water by-pass pipe with the union bolt and bolt.

b. Tighten the union bolt and bolt in the order shown in the illustration.

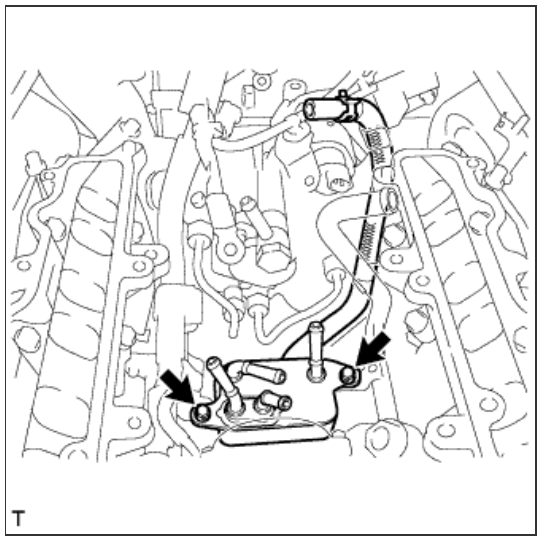
Torque:
for union bolt:
59 N*m{ 600 kgf*cm , 43 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



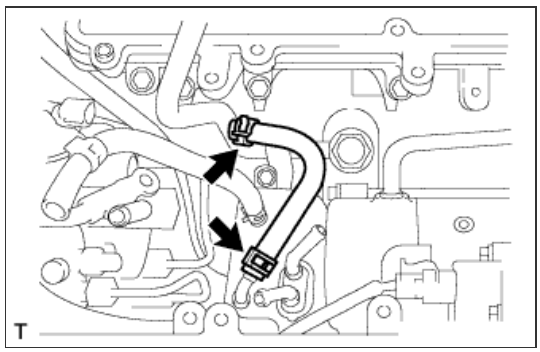
4. INSTALL FUEL COOLER ASSEMBLY

a. Install the fuel cooler with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



5. CONNECT NO. 6 WATER BY-PASS HOSE



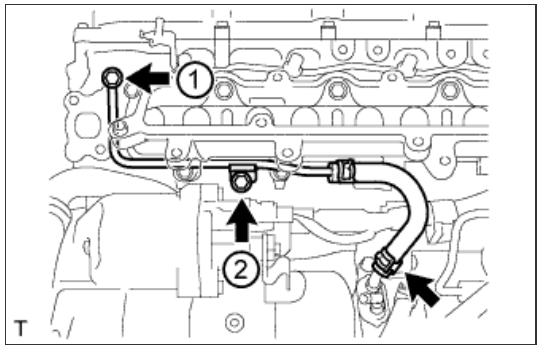
6. INSTALL NO. 4 NO LE LEAKAGE PIPE

a. Temporarily install a new gasket and the No. 4 nozzle leakage pipe with the union bolt and bolt.

b. Tighten the union bolt and bolt in the order shown in the illustration.

Torque:
for union bolt:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

c. Connect the No. 2 fuel hose to the fuel cooler.



7. INSTALL NO. 3 NO LE LEAKAGE PIPE

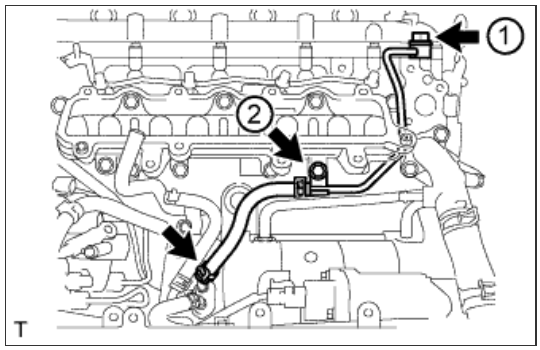
a. Temporarily install a new gasket and the No. 3 nozzle leakage pipe with the union bolt and bolt.

b. Tighten the union bolt and bolt in the order shown in the illustration.

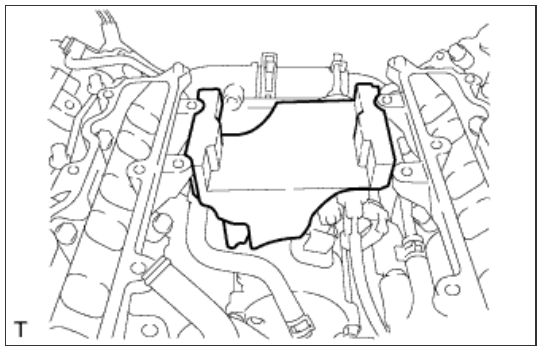
Torque:
for union bolt:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

c. Connect the No. 1 fuel hose to the fuel cooler.

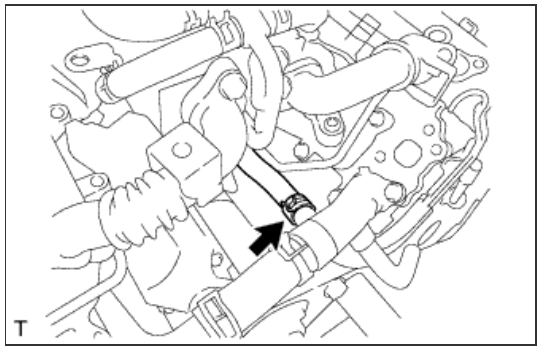


8. INSTALL EGR COOLER INSULATOR (w/ EGR System)



9. INSTALL EGR VALVE ASSEMBLY WITH EGR COOLER (w/ EGR System)

a. Connect the No. 5 water by-pass hose to the water by-pass outlet.

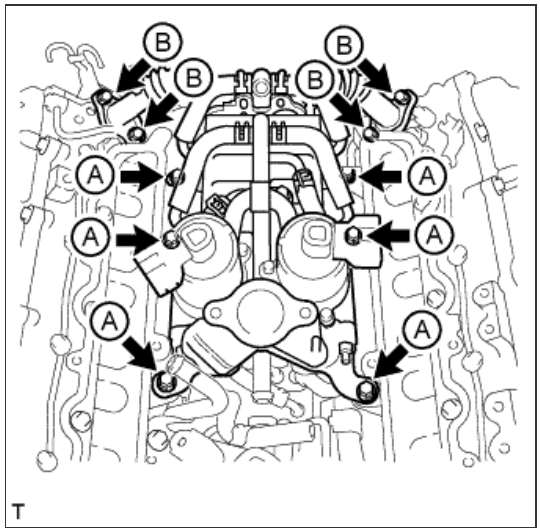


b. Install 2 new gaskets and the EGR valve with EGR cooler with the 6 bolts labeled A and 4 bolts labeled B shown in the illustration.

Torque:
for bolt A:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for bolt B:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

HINT:

The gasket claws should face toward the No. 1 and No. 2 EGR pipes.



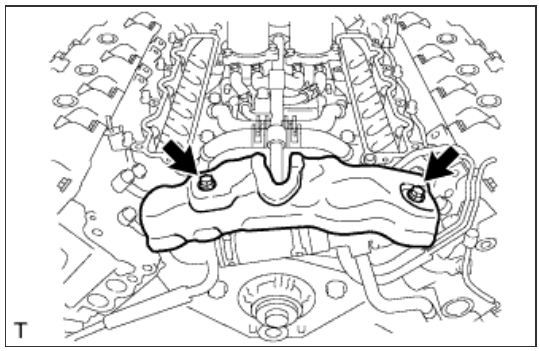
10. INSTALL EGR PIPE INSULATOR (w/ EGR System)

a. Install the EGR pipe insulator with the 2 bolts.

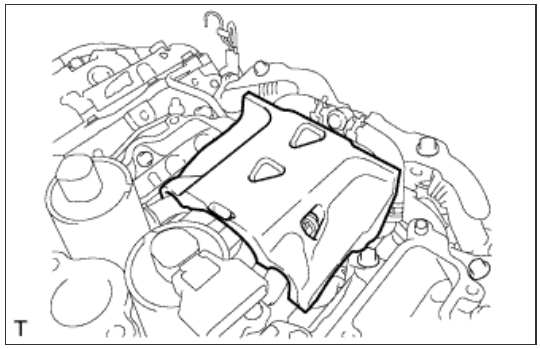
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

NOTICE:

If the No. 1 and No. 2 EGR pipe insulator installation stay is deformed, or the bolt holes of the EGR pipe insulator do not align, replace the No. 1 and No. 2 EGR pipes as a set.



11. INSTALL INTAKE MANIFOLD INSULATOR (w/ EGR System)



12. INSTALL NO. 3 INTAKE MANIFOLD

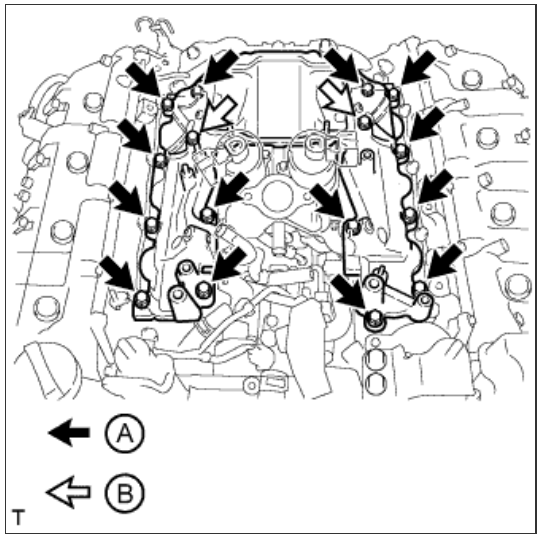
a. Set 2 new gaskets to the No. 1 and No. 2 intake manifolds.

b. Install the No. 3 intake manifold with the 16 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

Bolt Length

Item	Length
Bolt A	25 mm (0.984 in.)
Bolt B	70 mm (2.76 in.)

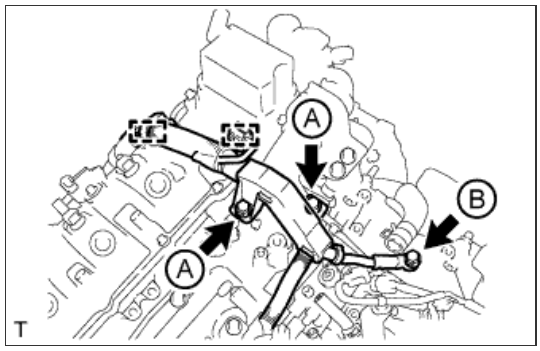


13. CONNECT NO. 2 ENGINE WIRE

a. Connect the No. 2 engine wire with the 3 bolts.

Torque:
for bolt A:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }
for bolt B:
32 N*m{ 326 kgf*cm , 24 ft.*lbf }

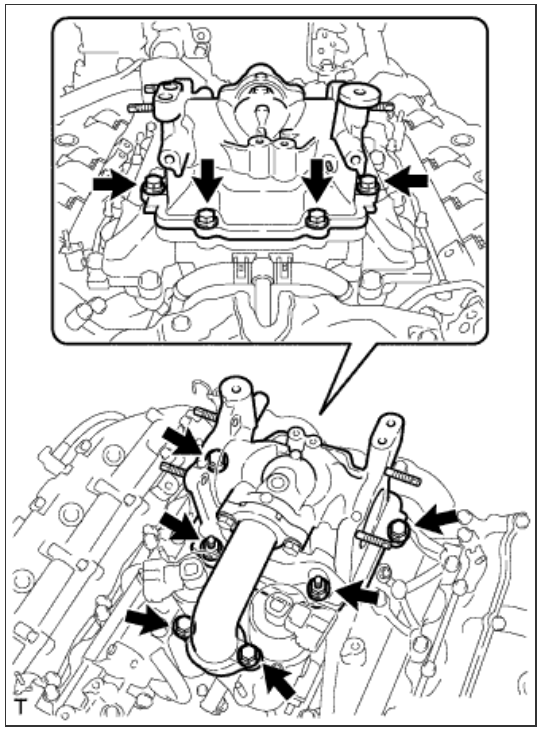
b. Attach the 2 wire harness clamps.



14. INSTALL INTAKE PIPE

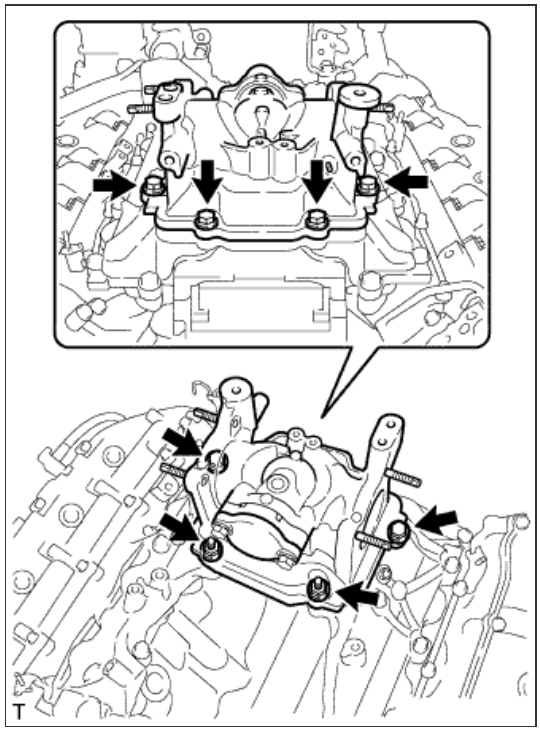
a. w/ EGR System:
Install 2 new gaskets and the intake pipe with the 6 bolts and 2 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

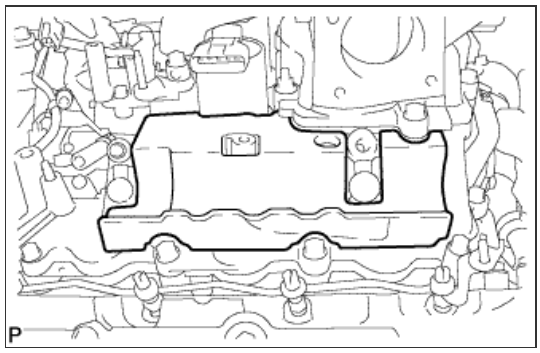


b. w/o EGR System:
Install a new gasket and the intake pipe with the 4 bolts and 2 nuts.

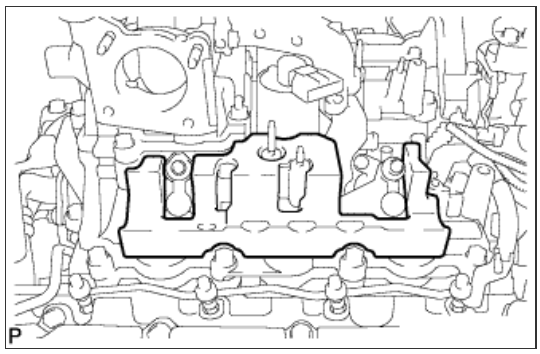
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



15. INSTALL NO. 2 INTAKE MANIFOLD INSULATOR (w/ Intercooler)



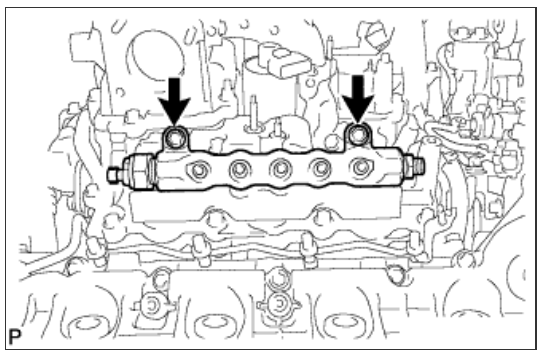
16. INSTALL NO. 1 INTAKE MANIFOLD INSULATOR (w/ Intercooler)



17. INSTALL COMMON RAIL ASSEMBLY RH

a. Install the common rail with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



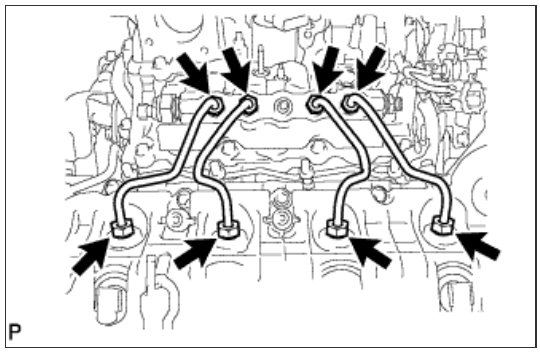
18. INSTALL INJECTION PIPE RH

a. Using a union nut wrench, install the 4 new injection pipes.

Torque:
without union nut wrench:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }
with union nut wrench:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

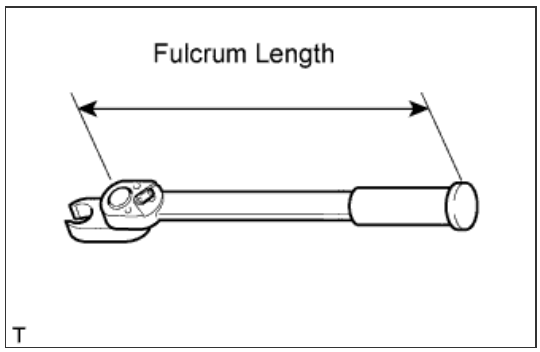
NOTICE:

Make sure there is no damage or foreign matter on the seal surfaces.



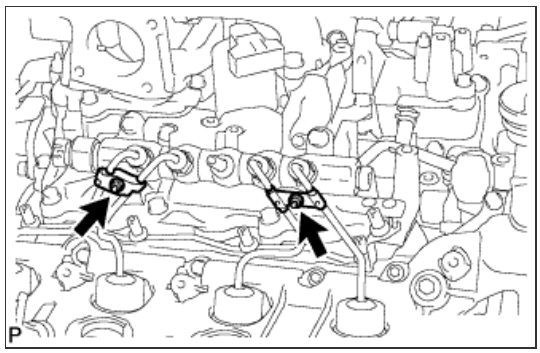
HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure the union nut wrench an the torque wrench are connecte in a straight line.**



b. w/ Intercooler:
Install the 4 injection pipe clamps with the 2 nuts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

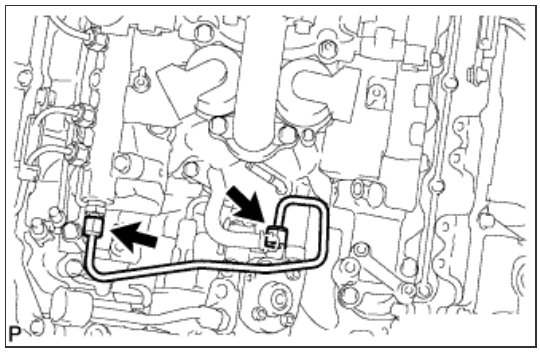


19. INSTALL NO. 5 INJECTION PIPE SUB-ASSEMBLY

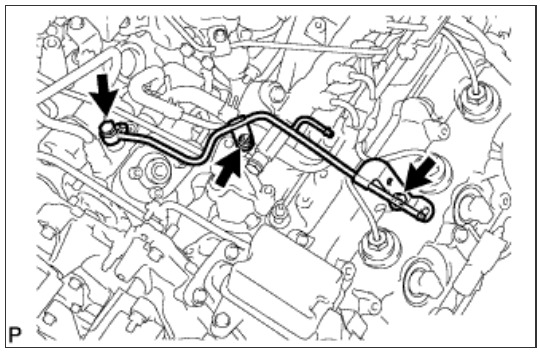
a. Temporarily install a new No. 5 injection pipe by hand.

NOTICE:

Make sure there is no damage or foreign matter on the seal surfaces.

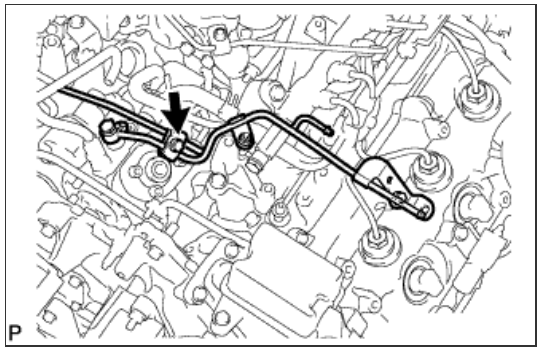


b. Temporarily install the used gasket and No. 2 fuel pipe with the nut, bolt and union bolt.



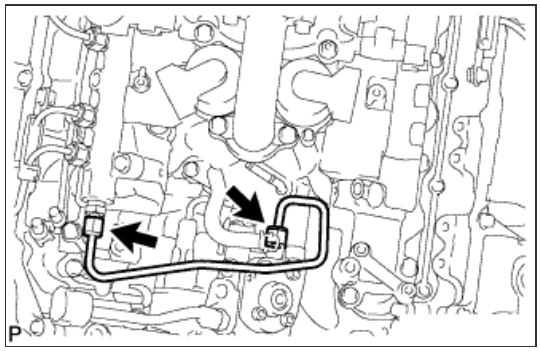
c. Temporarily install the No. 2 injection pipe clamp with the bolt.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



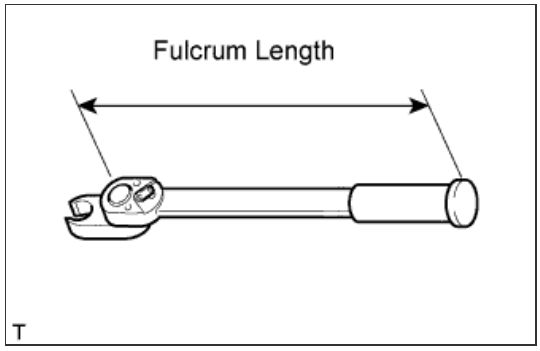
.Using a union nut wrench, tighten the No. 5 injection pipe ends.

Torque:
without union nut wrench:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }
with union nut wrench:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

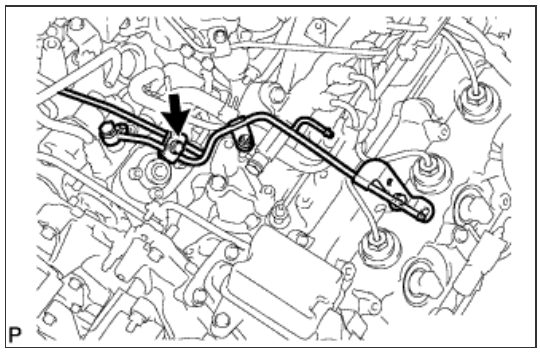


HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure the union nut wrench an the torque wrench are connecte in a straight line.**

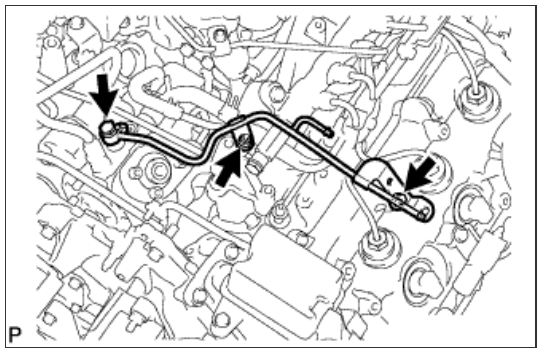


e. Remove the bolt and No. 2 injection pipe clamp.



f. Remove the union bolt and gasket.

g. Remove the bolt, nut and No. 2 fuel pipe.

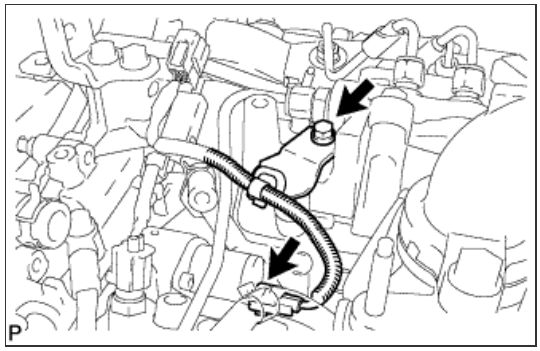


20. CONNECT FUEL PUMP MOTOR WIRE

a. Install the fuel pump motor wire bracket to the No. 3 intake manifold with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Connect the connector to the fuel supply pump.

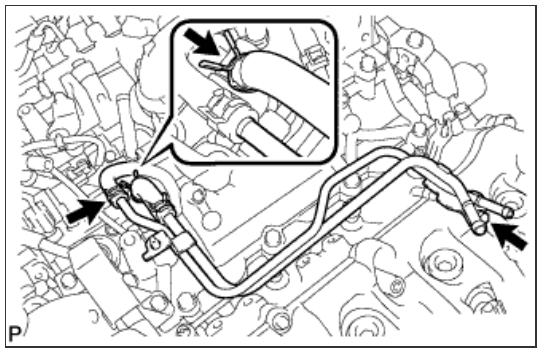


21. INSTALL FUEL FILTER TO INJECTION PUMP FUEL PIPE SUB-ASSEMBLY

a. Install the fuel filter to injection pump fuel pipe with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

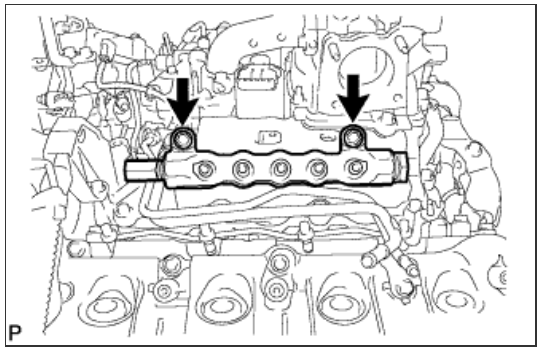
b. Connect the 2 hoses to the fuel pipe.



22. INSTALL COMMON RAIL ASSEMBLY LH

a. Install the common rail with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



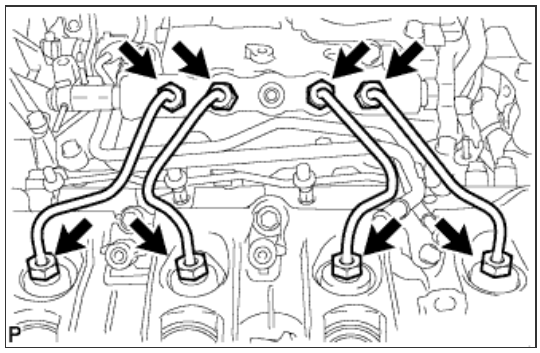
23. INSTALL INJECTION PIPE LH

a. Using a union nut wrench, install the 4 new injection pipes.

Torque:
without union nut wrench:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }
with union nut wrench:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

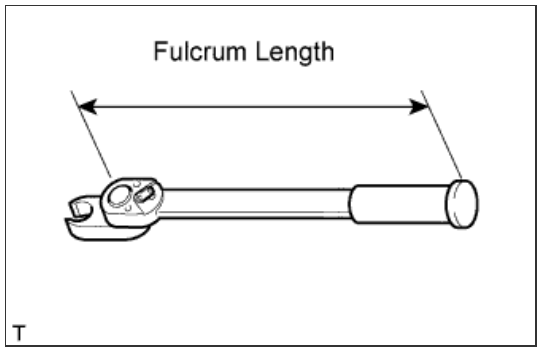
NOTICE:

Make sure there is no damage or foreign matter on the seal surfaces.



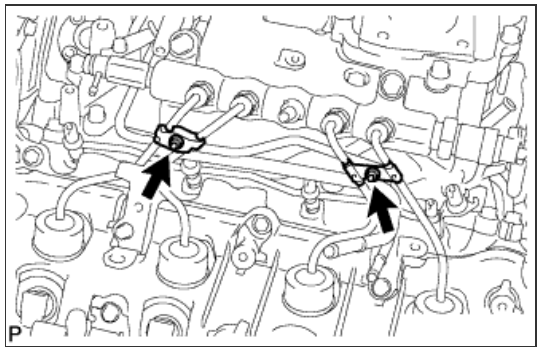
HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure the union nut wrench an the torque wrench are connecte in a straight line.**



b. w/ Intercooler:
Install the 4 injection pipe clamps with the 2 nuts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



24. CONNECT NO. 6 INJECTION PIPE SUB-ASSEMBLY

a. w/ EGR System:

i. Temporarily install a new No. 6 injection pipe to the common rail LH and RH.

NOTICE:

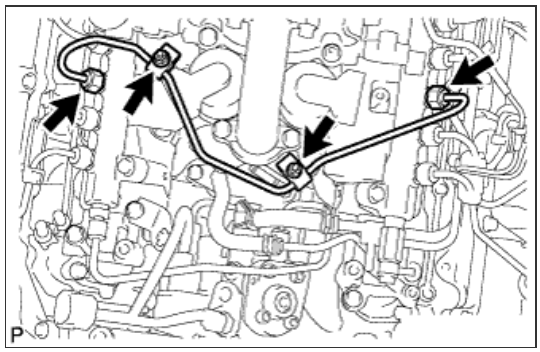
Make sure there is no damage or foreign matter on the seal surfaces.

ii. Install the 2 No. 2 injection pipe clamps with the 2 nuts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

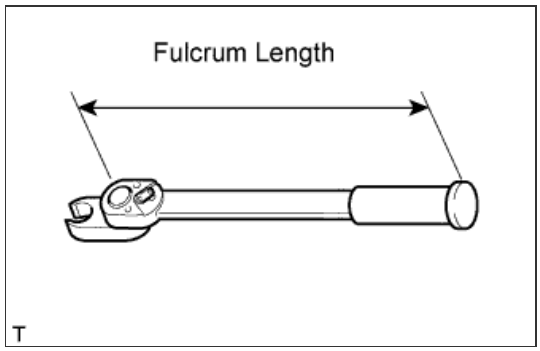
iii. Using a union nut wrench, tighten the No. 6 injection pipe ends.

Torque:
without union nut wrench:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }
with union nut wrench:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

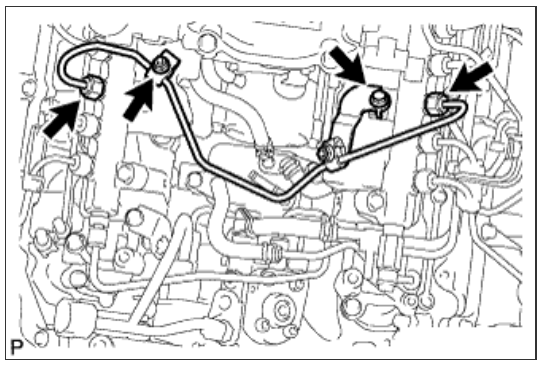


HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure the union nut wrench an the torque wrench are connecte in a straight line.**



b. w/o EGR System:



i. Temporarily install a new No. 6 injection pipe to the common rail LH and RH.

NOTICE:

Make sure there is no damage or foreign matter on the seal surfaces.

ii. Install the bracket to the No. 3 intake manifold with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

iii. Install the No. 2 injection pipe clamp with the nut.

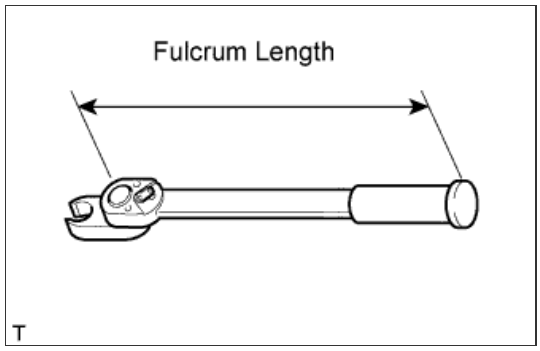
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

i .Using a union nut wrench, tighten the No. 6 injection pipe ends.

Torque:
without union nut wrench:
34 N*m{ 347 kgf*cm , 25 ft.*lbf }
with union nut wrench:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.).**
- **Make sure the union nut wrench an the torque wrench are connecte in a straight line.**



25. INSTALL NO. 2 FUEL PIPE SUB-ASSEMBLY

NOTICE:

Check for damage and foreign matter on the fuel pipe installation surface of the supply pump.

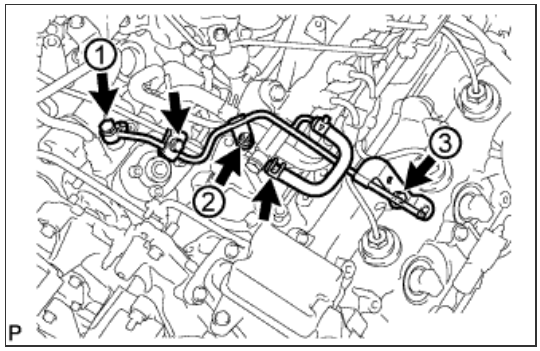
If there is foreign matter, remove it from the installation surface. If the installation surface is damaged, replace the fuel supply pump.

a. Temporarily install a new gasket and the No. 2 fuel pipe with the union

bolt, nut and bolt.

b. Tighten the union bolt, nut and bolt in the order shown in the illustration.

Torque:
for union bolt:
10 N*m{ 105 kgf*cm , 8 ft.*lbf }
for bolt an nut:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



c. Install the No. 2 injection pipe clamp with the bolt.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

.Connect the fuel hose to the No. 5 nozzle leakage pipe.

26. CONNECT ENGINE WIRE

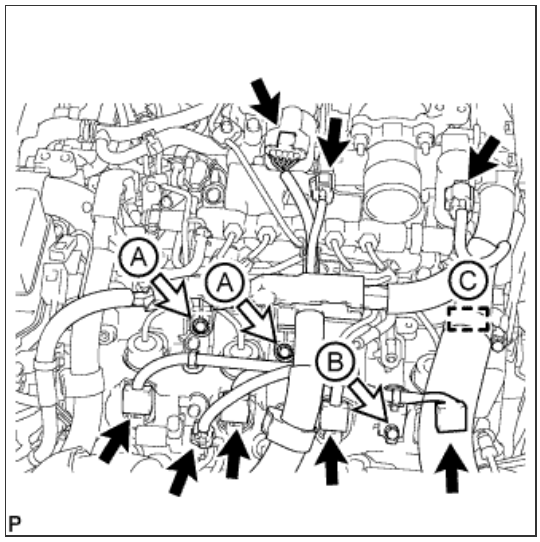
a. LH Side:

i. Install the engine wire protector with the 2 bolts labeled A.

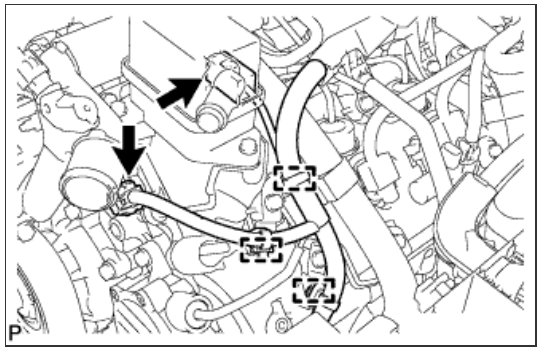
ii. Connect the 8 connectors.

iii. Install the engine wire harness bracket with the bolt labeled B.

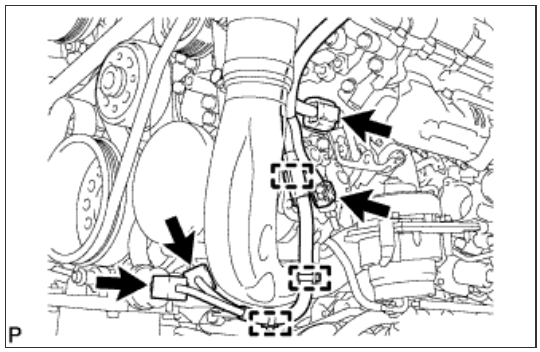
i .for RHD:
Connect the wire harness with the wire harness clamp holder labeled C.



.Attach the 3 wire harness clamps and connect the 2 connectors.



i. Attach the 3 wire harness clamps and connect the 4 connectors.



b. RH Side:

i. Install the engine wire harness protector with the 3 bolts labeled A.

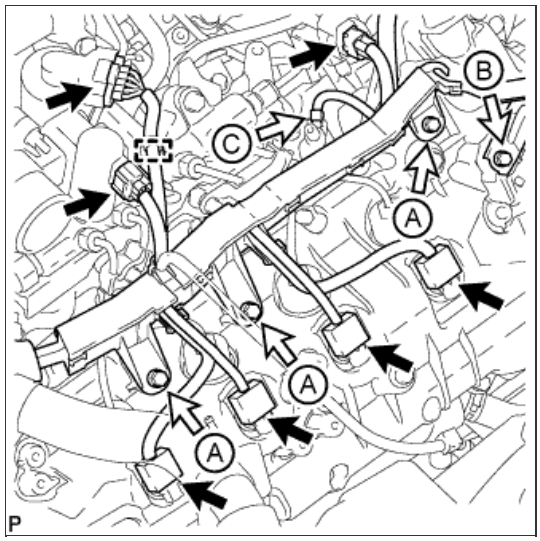
ii. Connect the 7 connectors.

iii. Attach the wire harness clamp.

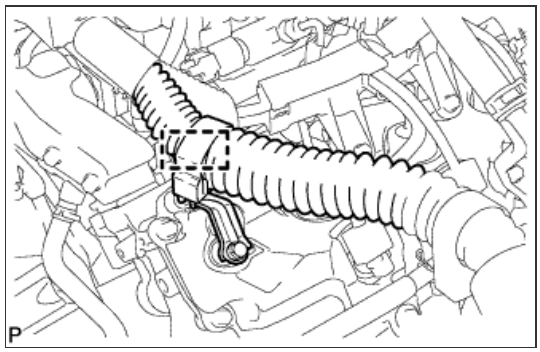
i .Install the wire harness bracket with the bolt labeled B.

.Install the glow plug wire harness labeled C with the nut.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }



i. for RHD:
Connect the wire harness with the wire harness clamp holder.



c. Rear Side:

i. Install the glow plug wire harness with the nut labeled A.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }

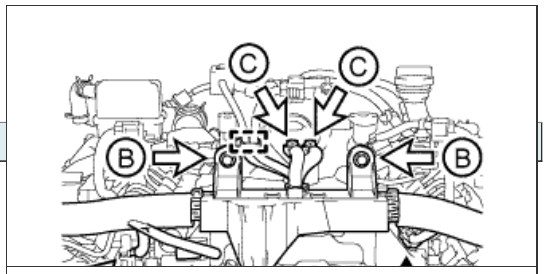
ii. Connect the 2 common rail connectors.

iii. Install the engine wire harness protector with the 2 bolts labeled B.

i .Install the 2 ground wires with the 2 bolts labeled C.

Torque:
8.4 N*m{ 87 kgf*cm , 74 in.*lbf }

.Attach the wire harness clamp.

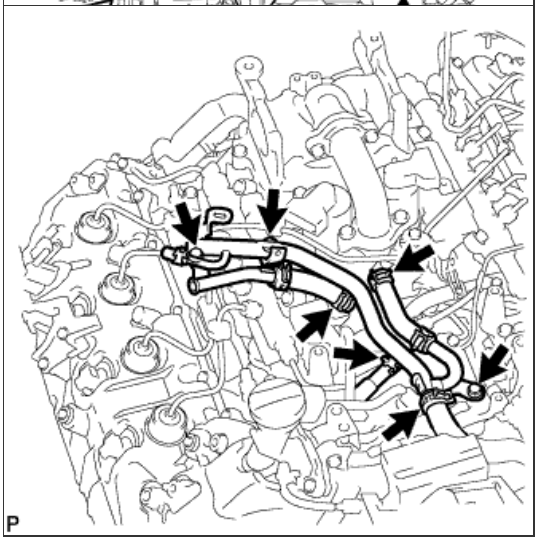


27. INSTALL NO. 4 WATER BY-PASS PIPE

a. w/ EGR System:
Connect the 4 water hose ends, and temporarily install the No. 4 water by-pass pipe with the 2 bolts and nut.

b. First tighten the 2 bolts and then tighten the nut.

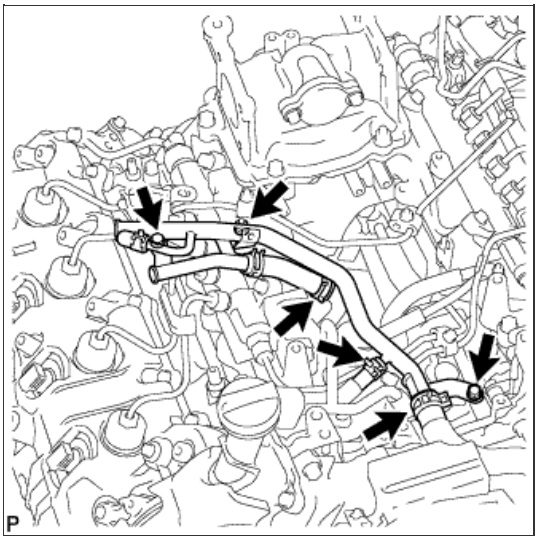
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



c. w/o EGR System:
Connect the 3 water hose ends, and temporarily install the No. 4 water by-pass pipe with the 2 bolts and nut.

.First tighten the 2 bolts and then tighten the nut.

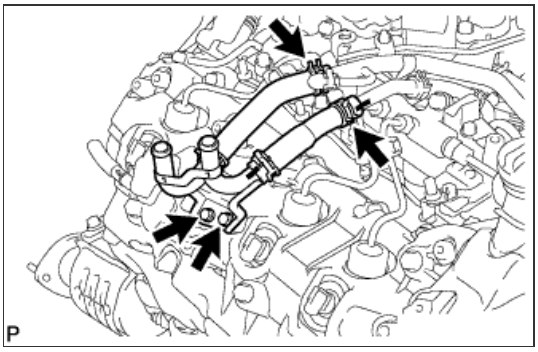
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



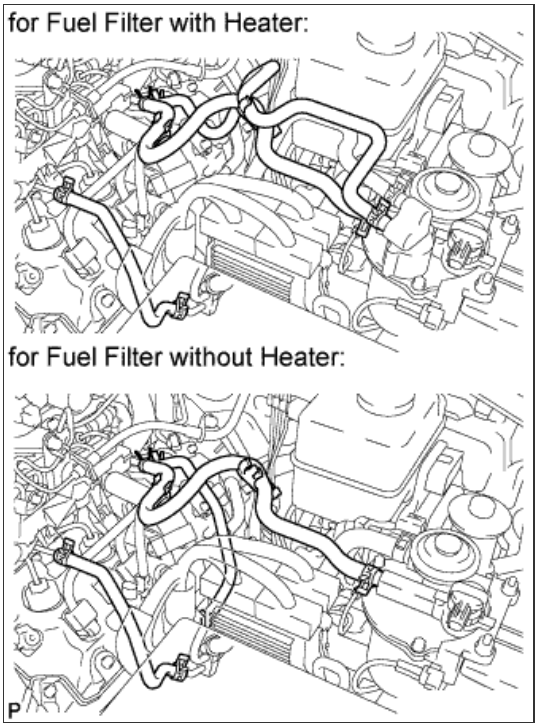
28. INSTALL NO. 3 WATER BY-PASS PIPE (w/o Viscous Heater)

a. Connect the 2 water hose ends, and install the No. 3 water by-pass pipe with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



29. CONNECT FUEL HOSE



30. INSTALL NO. 1 AIR CLEANER PIPE SUB-ASSEMBLY

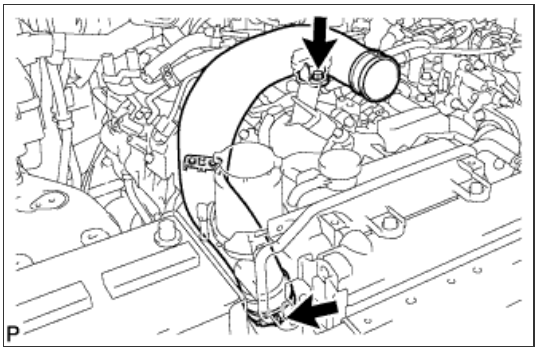
a. Connect the No. 1 air cleaner pipe to the No. 1 intake air connector pipe.

b. Install the pipe with the bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Tighten the hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



31. INSTALL HEATER WATER PIPE SUB-ASSEMBLY (w/ Viscous Heater)

a. Connect the 4 water hose ends, and install the water pipe with the 4 bolts.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }



32. INSTALL NO. 2 AIR CLEANER PIPE SUB-ASSEMBLY

a. Connect the No. 2 air cleaner pipe to the No. 2 intake air connector pipe.

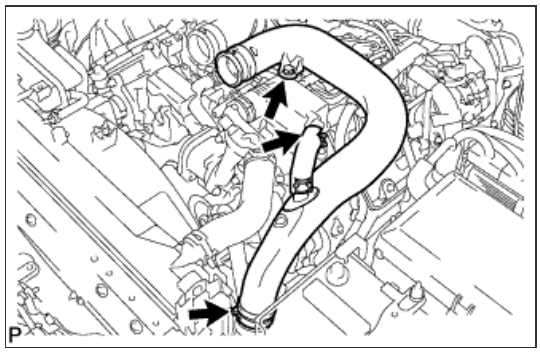
b. Connect the ventilation hose to the oil separator.

c. Install the pipe with the bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

.Tighten the hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



33. INSTALL NO. 4 AIR TUBE

a. Install the No. 4 air tube with the bolt.

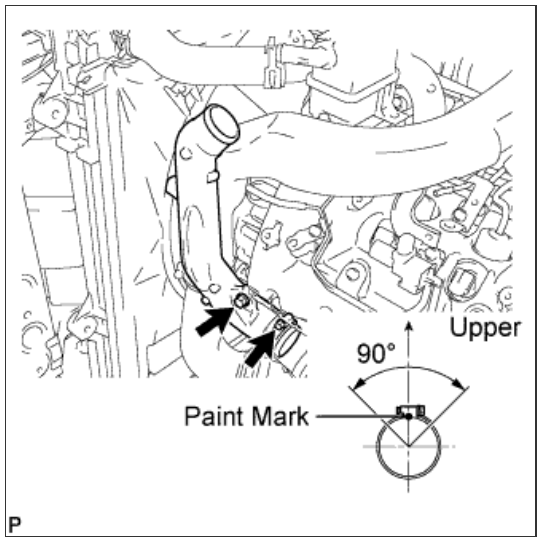
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

b. Tighten the hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

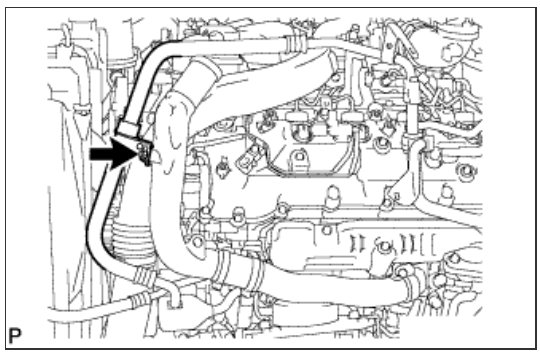
HINT:

Make sure the direction of the hose clamp is as shown in the illustration.



c. Install the suction hose with the bolt.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }



34. INSTALL NO. 2 AIR HOSE

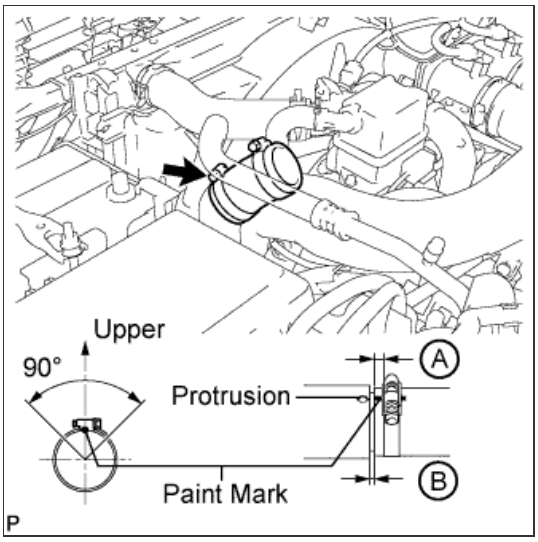
a. Connect the No. 2 air hose with the hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion an push in the air hose so that istance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that istance A is 2 to 6 mm (0.0787 to 0.236 in.).**

- **Make sure the irection of the hose clamp is as shown in the illustration.**



35. INSTALL NO. 3 AIR TUBE

a. Install the No. 3 air tube with the bolt.

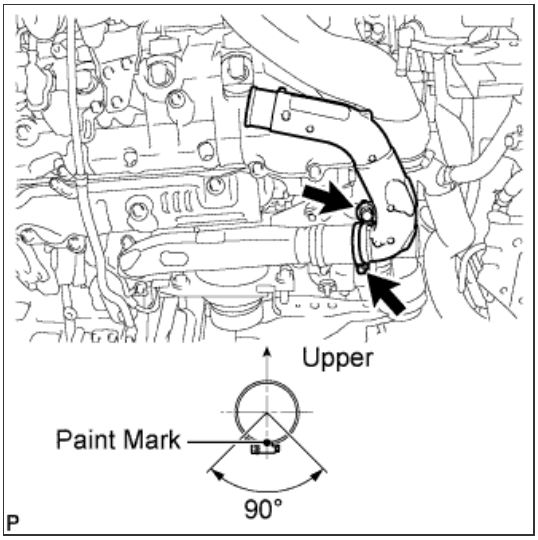
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

b. Tighten the hose clamp.

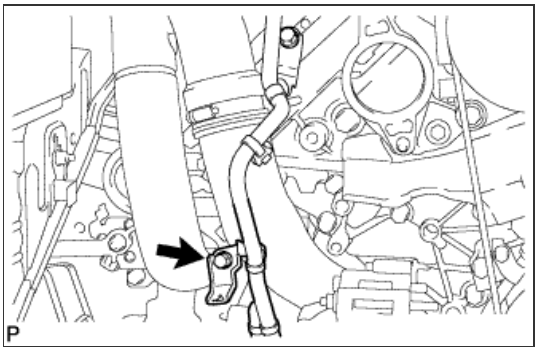
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

Make sure the direction of the hose clamp is as shown in the illustration.

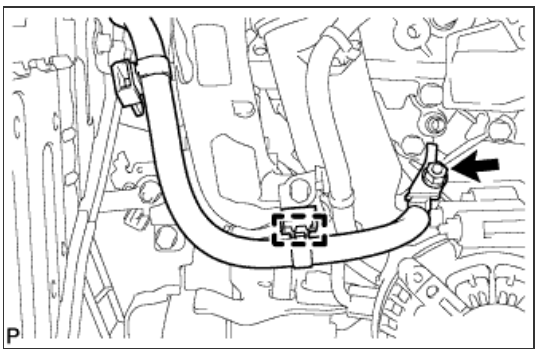


c. Install the wire harness bracket with the bolt.



.Install the ground wire with the nut, and attach the wire harness clamp.

Torque:
8.4 N*m{ 87 kgf*cm , 74 in.*lbf }



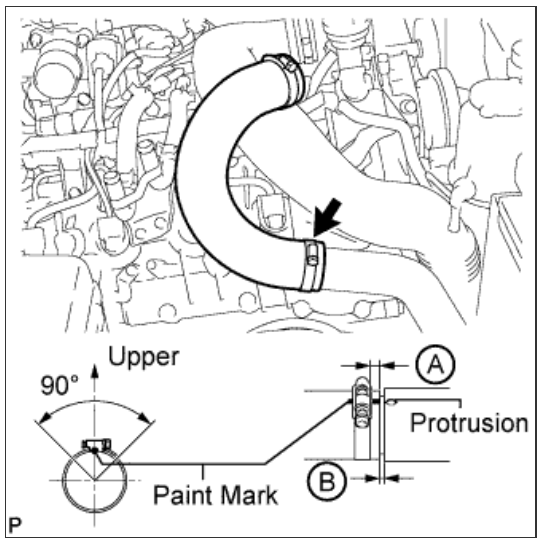
36. INSTALL NO. 1 AIR HOSE

a. Connect the No. 1 air hose with the hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion an push in the air hose so that istance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that istance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make sure the irection of the hose clamp is as shown in the illustration.**



37. INSTALL INTAKE AIR CONNECTOR

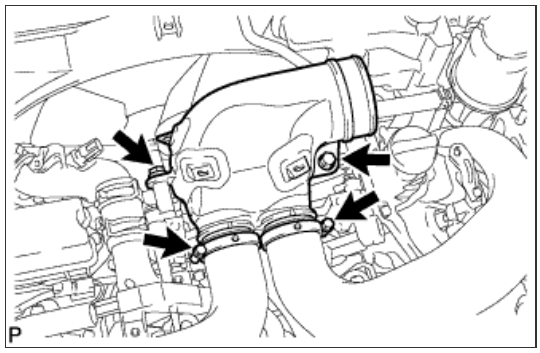
a. Connect the intake air connector to the No. 1 and No. 2 air cleaner pipes.

b. Install the connector with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Tighten the 2 hose clamps.

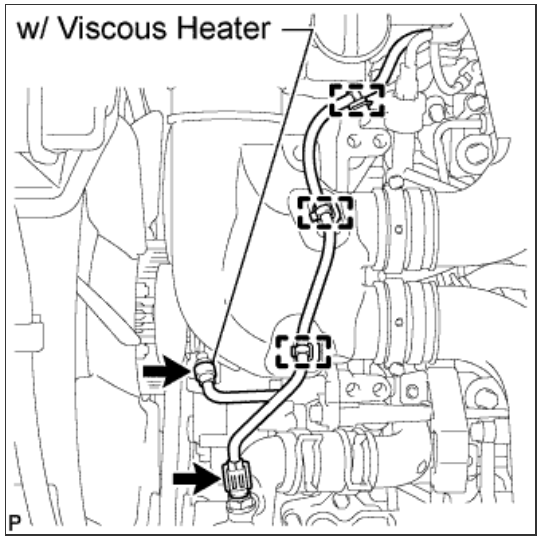
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



.Attach the 3 wire harness clamps.

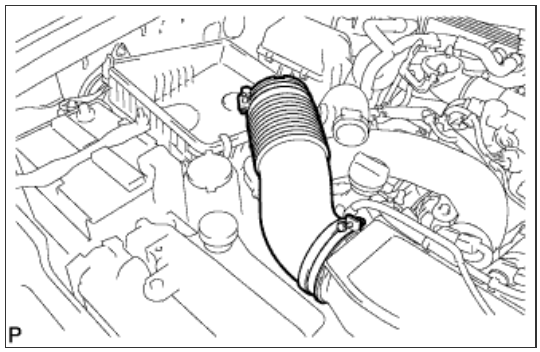
e. w/o Viscous Heater:
Connect the connector to the water temperature sensor.

f. w/ Viscous Heater:
Connect the 2 connectors to the water temperature sensor and viscous with magnet clutch heater.



38. TEMPORARILY INSTALL NO. 1 AIR CLEANER HOSE

a. Temporarily install the air cleaner hose to the intake air connector.

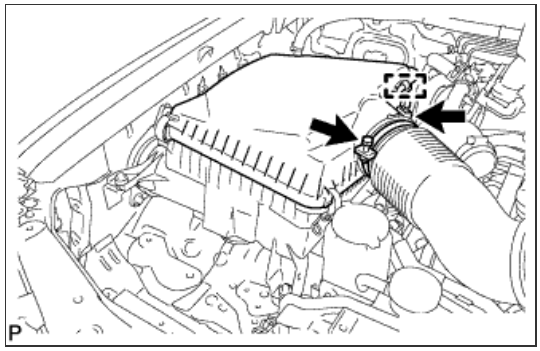


39. INSTALL AIR CLEANER CAP SUB-ASSEMBLY

a. Connect the air cleaner cap to the air cleaner hose, and install the air cleaner cap with the 4 clamps.

b. Connect the mass air flow meter connector and attach the wire harness clamp to the air cleaner cap.

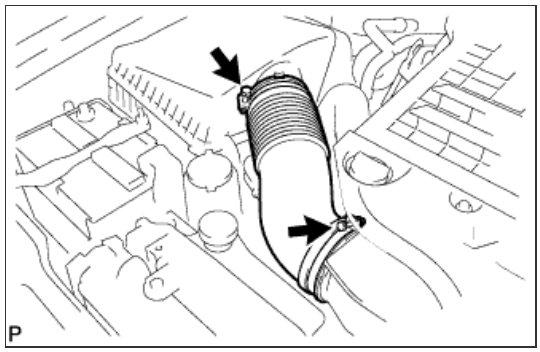
c. Attach the wire harness clamp.



.Align the protrusion of air cleaner cap and concave portion of air cleaner hose.

e. Tighten the 2 hose clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



40. INSTALL DIESEL THROTTLE BODY ASSEMBLY LH

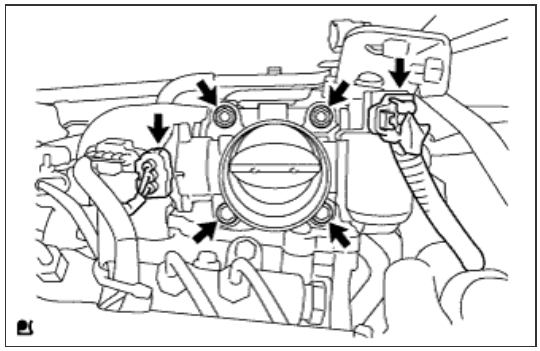
a. Install a new gasket to the intake pipe.

b. Install the throttle body with the 2 bolts and 2 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Connect the throttle position sensor connector.

.Connect the throttle motor connector.

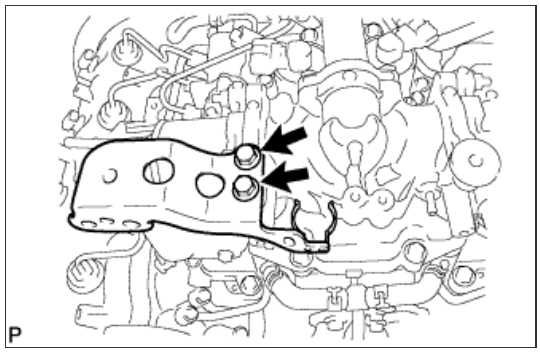


41. INSTALL NO. 3 INTERCOOLER SUPPORT BRACKET

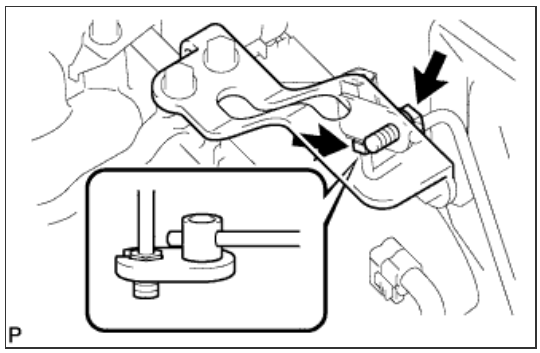
a. Install the bracket with the 2 bolts.

Torque:

21 N*m{ 214 kgf*cm , 15 ft.*lbf }



b. for Manual Transmission:



i. Connect the clutch tube to release cylinder 2 way with the bolt.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

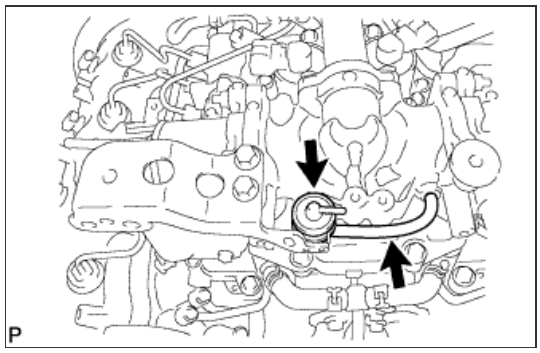
ii. Check that the union nut is tightened to the specified torque.

Torque:
without union nut wrench:
15 N*m{ 154 kgf*cm , 11 ft.*lbf }
with union nut wrench:
14 N*m{ 141 kgf*cm , 10 ft.*lbf }

42. INSTALL NO. 1 GAS FILTER

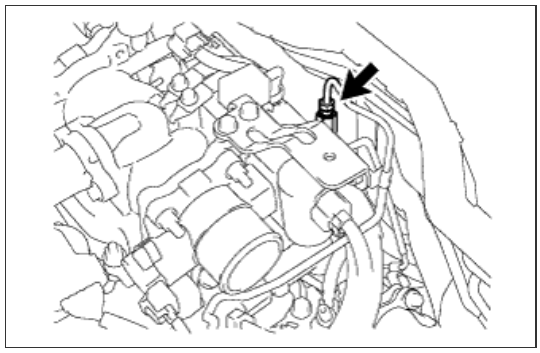
a. Install the gas filter.

b. Connect the hose to the intake pipe.



43. INSTALL TUBE CONNECTOR TO FLEXIBLE HOSE TUBE (for Manual Transmission)

a. Temporarily install the flare nut of the tube connector to flexible hose tube to the clutch tube to release cylinder 2 way by hand.



b. Temporarily install the tube connector to flexible hose tube with the 2 bolts.

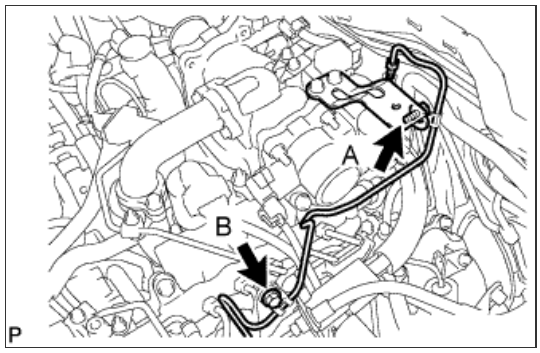
c. Tighten the bolt labeled A.

Torque:

20 N*m{ 204 kgf*cm , 15 ft.*lbf }

NOTICE:

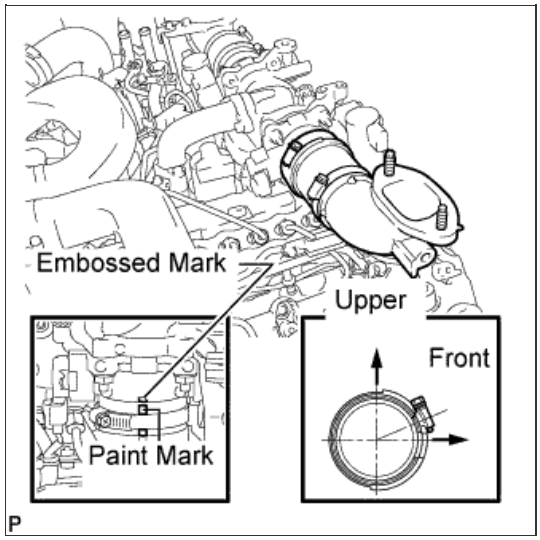
Tighten the bolt labeled B after installing the clutch hose.



44. INSTALL AIR TUBE SUB-ASSEMBLY LH

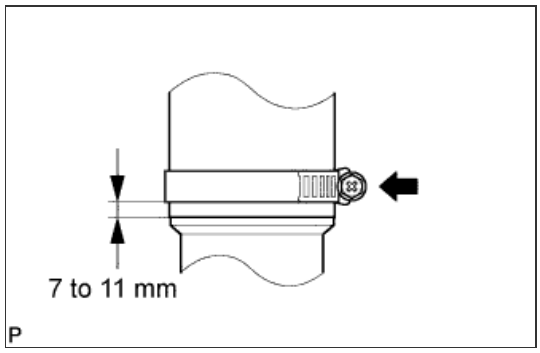
a. Install the air tube to the throttle body.

b. Align the embossed mark of the throttle body with the paint mark of the No. 4 air hose.



c. Tighten the hose clamp so that it is 7 to 11 mm (0.276 to 0.433 in.) from the end of the hose as shown in the illustration.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



45. INSTALL CLUTCH HOSE (for Manual Transmission)

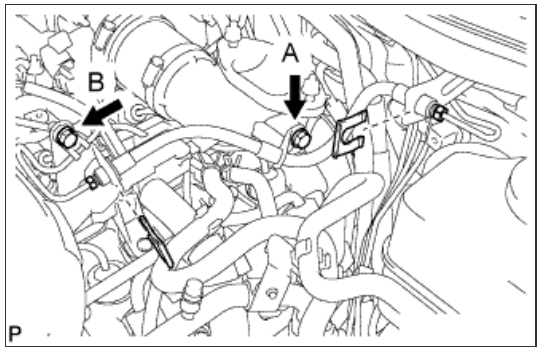
a. Connect the clutch hose to the air tube with the bolt labeled A.

b. Temporarily install the clutch hose to the clutch master cylinder tube to flexible hose tube and tube connector to flexible hose tube, and fix it in place with the 2 clips.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

c. Tighten the bolt labeled B.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }



.Tighten the flexible hose tube.

NOTICE:

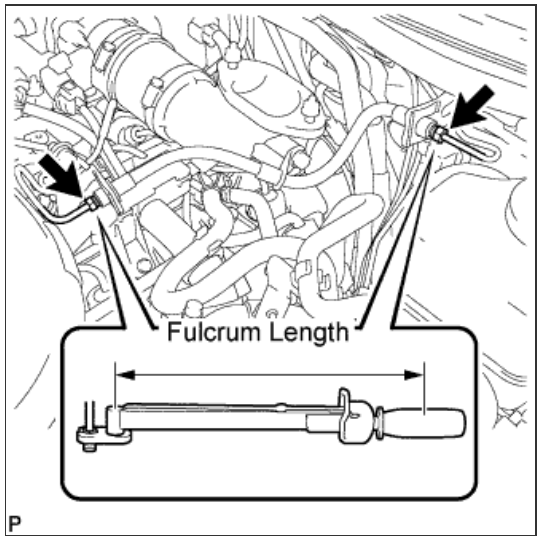
- **Do not ben or amage the flexible hose tube.**
- **Do not allow any foreign matter such as irt an ust to enter the flexible hose tube from the connecting points.**

HINT:

- **Use a torque wrench with a fulcrum length of 30 cm (11.8 in.). If using a torque wrench with a length that is not 30 cm (11.8 in.), calculate the torque specification for the torque wrench an SST base on the ithout SST" torque specification (Click here).**
- **Make sure union nut wrench an the wrench are connecte in a straight line.**

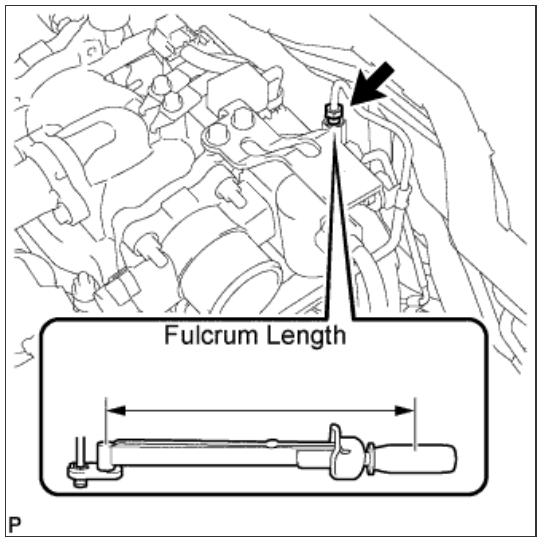
i. Using a 10 mm union nut wrench, tighten the 2 flare nuts of the flexible hose tube.

Torque:
without union nut wrench:
15 N*m{ 154 kgf*cm , 11 ft.*lbf }
with union nut wrench:
14 N*m{ 141 kgf*cm , 10 ft.*lbf }



ii. Using a 10 mm union nut wrench, tighten the flare nut of the flexible hose tube.

Torque:
without union nut wrench:
15 N*m{ 154 kgf*cm , 11 ft.*lbf }
with union nut wrench:
14 N*m{ 141 kgf*cm , 10 ft.*lbf }



46. INSTALL DIESEL THROTTLE BODY ASSEMBLY RH

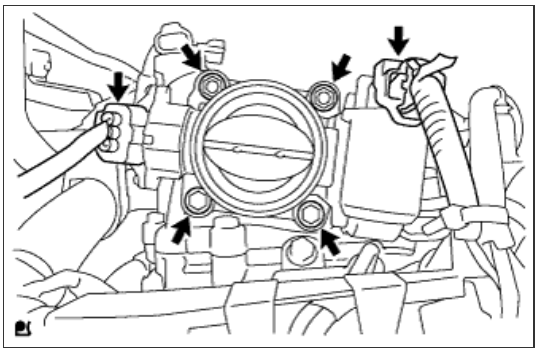
a. Install a new gasket to the intake pipe.

b. Install the throttle body with the 2 bolts and 2 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Connect the throttle position sensor connector.

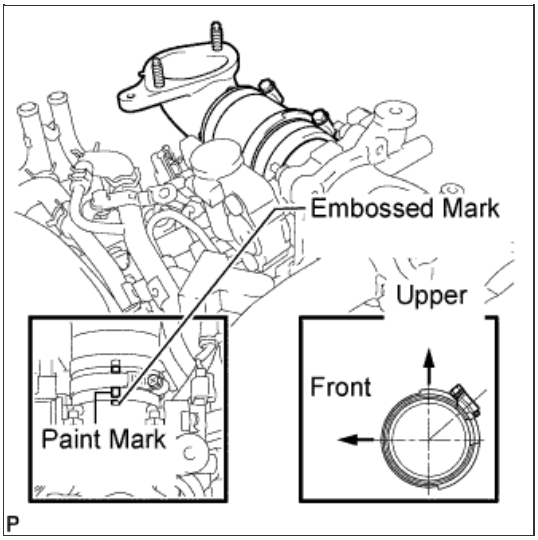
. Connect the throttle motor connector.



47. INSTALL AIR TUBE SUB-ASSEMBLY RH

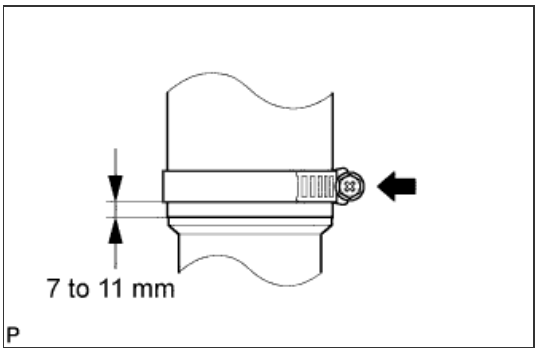
a. Install the air tube to the throttle body.

b. Align the embossed mark of the throttle body with the paint mark of the No. 4 air hose.



c. Tighten the hose clamp so that it is 7 to 11 mm (0.276 to 0.433 in.) from the end of the hose as shown in the illustration.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



48. INSTALL NO. 2 ENGINE OIL LEVEL DIPSTICK GUIDE

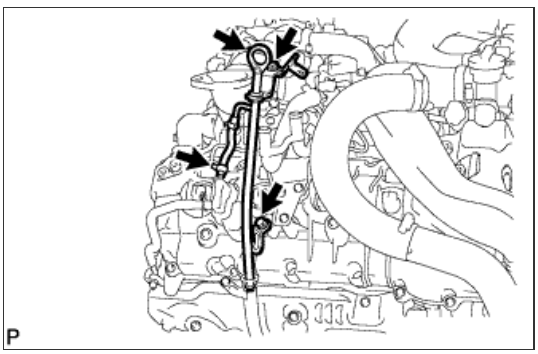
a. Apply a light coat of engine oil to a new -ring.

b. Install the -ring to the No. 2 engine oil level dipstick guide.

c. Install the No. 2 engine oil level dipstick guide with the 2 bolts.

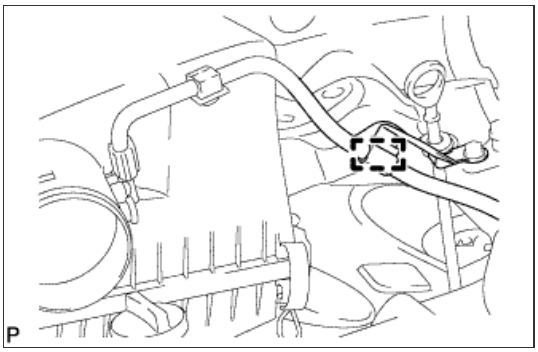
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

. Connect the ventilation hose to the cylinder head cover RH.

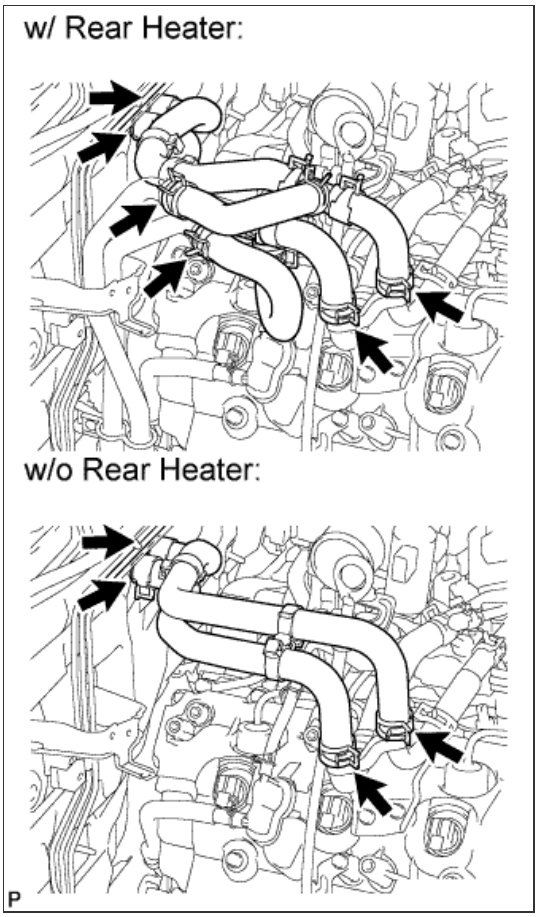


e. Connect the wire harness clamp to the No. 2 engine oil level dipstick guide

bracket.



49. CONNECT WATER HOSE SUB-ASSEMBLY

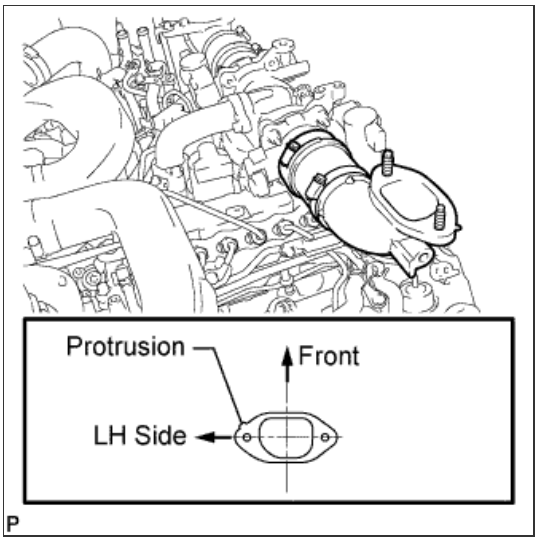


50. INSTALL NO. 2 COOL AIR INLET (w/o Intercooler)

a. Install a new gasket to the air tube LH.

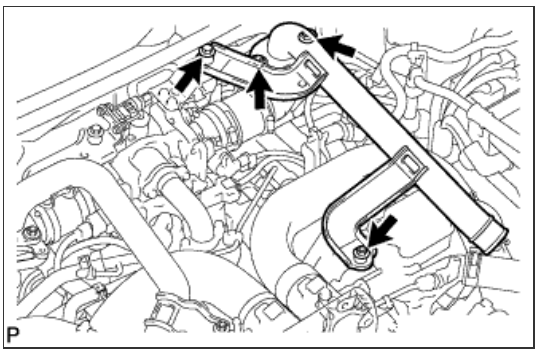
HINT:

Install the gasket with the protrusion facing as shown in the illustration.



b. Install the No. 2 cool air inlet with the 3 nuts and bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



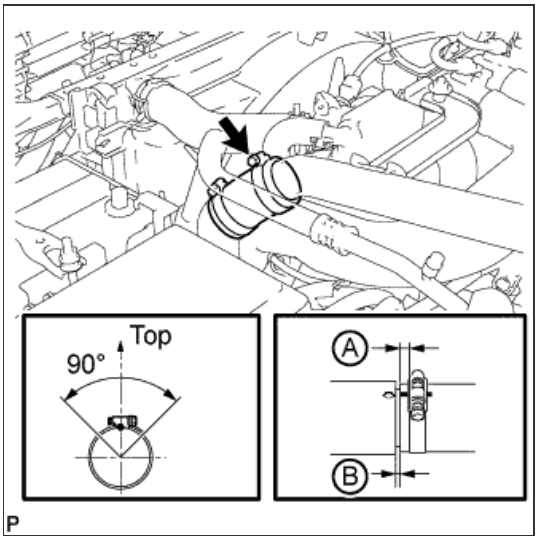
c. Connect the No. 2 air hose to the No. 2 cool air inlet.

. Tighten the No. 2 air hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion an push on the air hose so that istance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that istance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make sure the irection of the hose clamp is as shown in the illustration.**

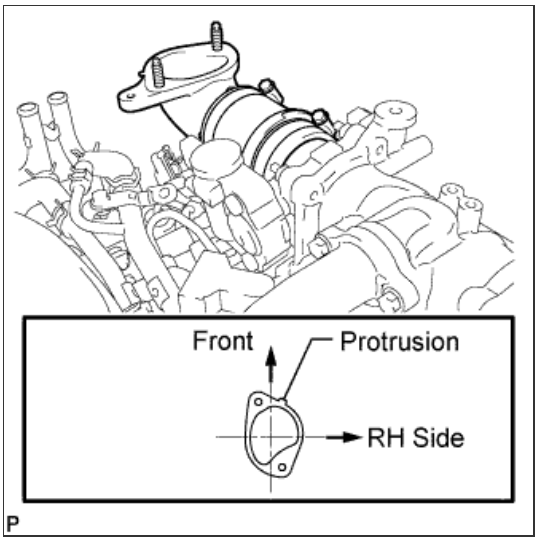


51. INSTALL NO. 1 COOL AIR INLET (w/o Intercooler)

a. Install a new gasket to the air tube RH.

HINT:

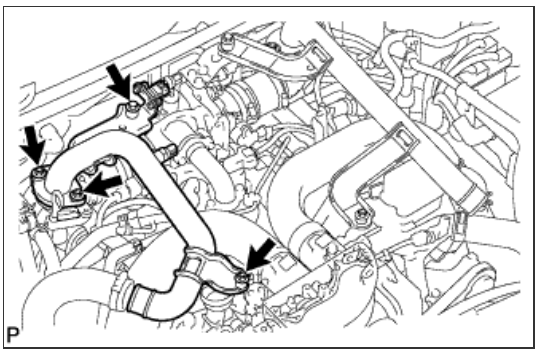
Install the gasket with the protrusion facing as shown in the illustration.



b. Install the No. 1 cool air inlet with the 3 nuts and bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Connect the vacuum hose, intake air temperature sensor connector and turbo pressure sensor connector.



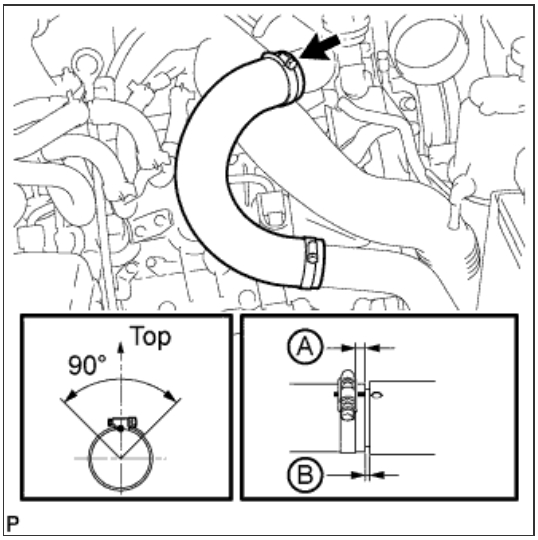
. Connect the No. 1 air hose to the No. 1 cool air inlet.

e. Tighten the No. 1 air hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion an push on the air hose so that istance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that istance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make sure the irection of the hose clamp is as shown in the illustration.**



52. INSTALL INTERCOOLER ASSEMBLY (w/ Intercooler)

a. Install the intercooler assembly (Click here).

53. BLEED CLUTCH LINE

a. Remove the release cylinder bleeder plug cap.

b. Connect a vinyl tube to the bleeder plug.

c. Depress the clutch pedal several times, and then loosen the bleeder plug while the pedal is depressed.

. When fluid no longer comes out, tighten the bleeder plug, and then release the clutch pedal.

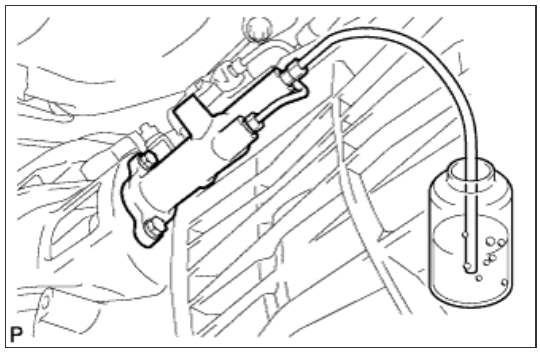
e. Repeat the previous 2 steps until all the air in the fluid is completely bled.

f. Tighten the bleeder plug.

Torque:
11 N*m{ 110 kgf*cm , 8 ft.*lbf }

g. Install the bleeder plug cap.

h. Check that all the air has been bled from the clutch line.



54. CHECK FOR CLUTCH FLUID LEAK

55. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

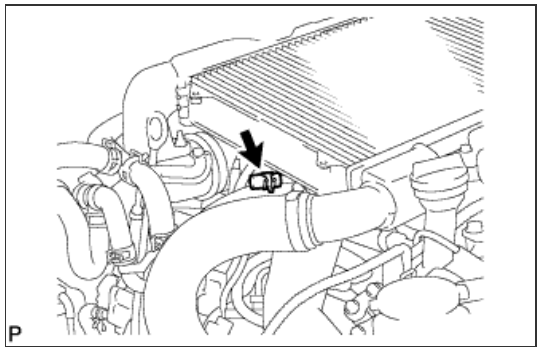
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

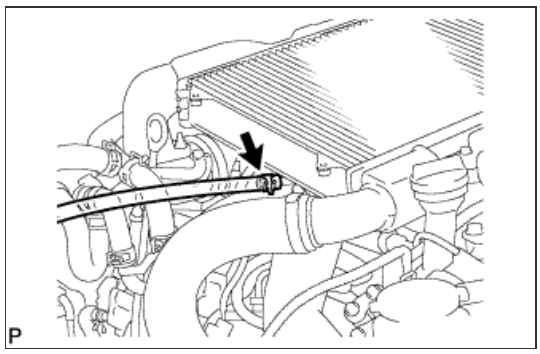
a. Connect the cables to the negative (-) main battery and sub-battery terminals.

56. ADD ENGINE COOLANT

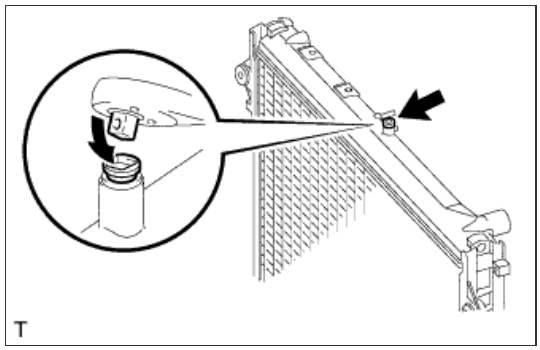
a. Remove the engine air bleed cap.



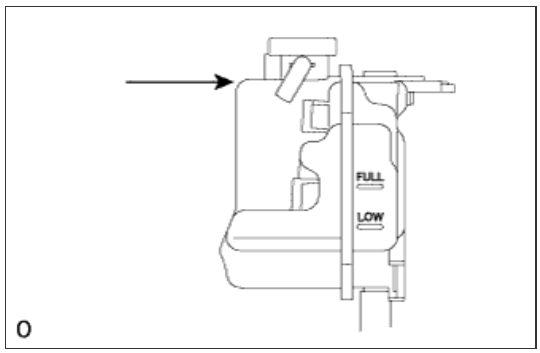
b. Connect a clear hose to the engine air bleed pipe.



c. Using a wrench, remove the vent plug.



. Fill the radiator with T TA SLLC to the radiator reservoir filler neck.



HINT:

our T TA SLLC until it spills out of the engine air bleed pipe.

Stan ar Capacity (for Automatic Transmission):

Item	Specified Condition
Front heater only	14.8 liters (15.6 US qts, 13.0 Imp. qts)
Front heater and rear heater	17.6 liters (18.6 US qts, 15.5 Imp. qts)
Front heater with viscous heater	15.2 liters (16.1 US qts, 13.4 Imp. qts)
Front heater and rear heater with viscous heater	18.0 liters (19.0 US qts, 15.4 Imp. qts)

Stan ar capacity (for Manual Transmission):
15.4 liters (16.3 US qts, 13.6 Imp. qts)

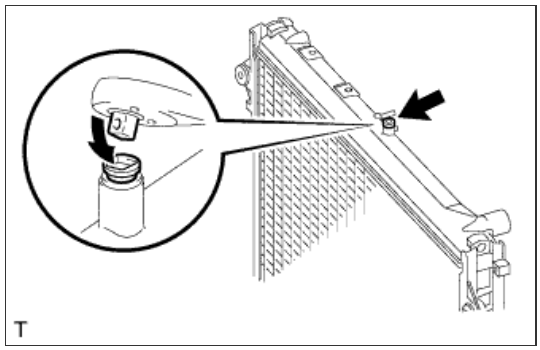
NOTICE:

Do not substitute plain water for engine coolant.

HINT:

T TA vehicles are filled with T TA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use T TA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

e. Install the vent plug.

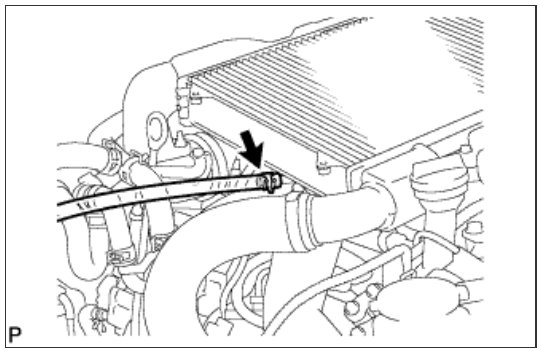


Torque:
2.0 N*m{ 20 kgf*cm , 18 in.*lbf }

NOTICE:

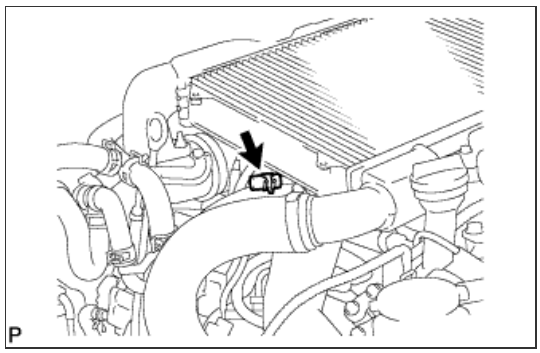
Do not tighten the plug to 5.0 N*m (51 kgf*cm, 44 in.*lbf) or more, as the plug will be damaged.

f. Disconnect the clear hose from the engine air bleed pipe.



g. Install the engine air bleed cap when coolant comes out.

h. Install the radiator reservoir cap.



i. Start the engine.

NOTICE:

Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the FULL line.

.Maintain an engine speed of 3000 rpm for approximately 10 minutes so that the thermostat opens and air bleeding is performed.

CAUTION:

When pressing the ra iator hoses:

- **Wear protecti e glo es.**
- **Be careful as the ra iator hoses are hot.**
- **Keep your han away from the ra iator fan**

NOTICE:

- **Pay attention to the nee le of the water temperature meter. Make sure that the nee le oes not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or o erheat.**

HINT:

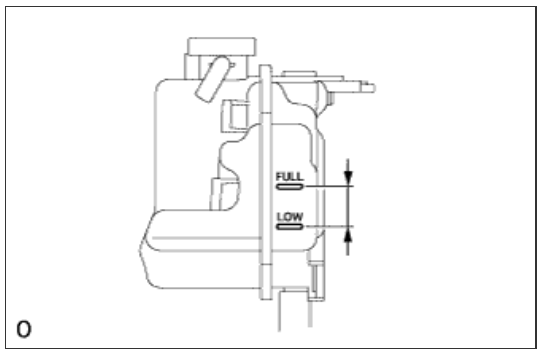
The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

k. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. ressurized, hot engine coolant and steam may be released and cause serious burns.

l. Check that the coolant level is between the FULL and L Wines.
If the coolant level is above the FULL line, drain coolant so that the coolant level is between the FULL and L Wines.



57. INSPECT FOR FUEL LEAK

a. erform Active Test.

i. Connect the intelligent tester to the DLC3.

ii. Turn the ignition switch to N.

iii. Start the engine.

i .Turn the intelligent tester N.

.Enter the following menus: owertrain / Engine / Active Test.

i. erform the Active Test.

Tester Display	Test Detail	Control Range	Diagnostic Note
Test the Fuel Leak	essurizes fuel inside common rail and checks for fuel leaks	Stop/Start	• The fuel inside the common rail is pressurized to the specified value and the engine speed increases to 2000 rpm when Start is selected. • The above conditions are preserved while Start is selected.

58. CHECK FOR ENGINE COOLANT LEAK

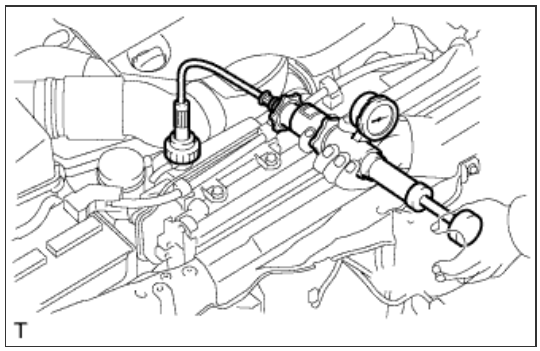
CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. ressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester to the radiator reservoir.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 k a1(.3 kgf/cm^2, 17.8 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks.
If no external leaks are found, check the cylinder block and cylinder head.



59. INSPECT FOR OIL LEAK

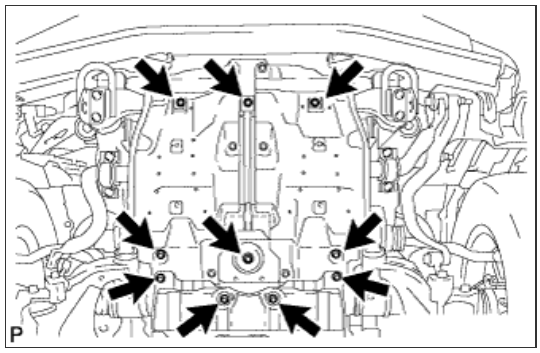
60. INSTALL UPPER RADIATOR SUPPORT SEAL

a. Install the upper radiator support seal with the 7 clips.

61. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

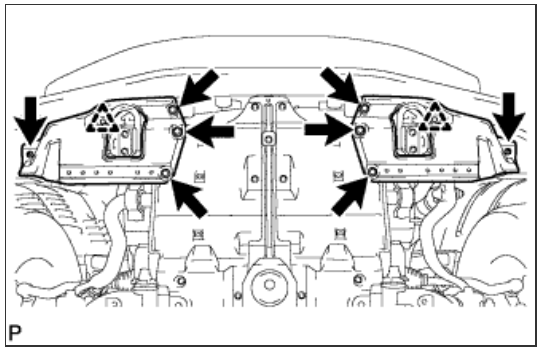
a. Install the engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



62. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

a. Install the splash shield with the clip, and then install the 3 bolts and screw.



63. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Install the splash shield with the clip, and then install the 3 bolts and screw.

for Preparation Click here

1.MAINTENANCE PRECAUTION

a. Do not stop the engine immediately after pulling a trailer, driving at a high speed, or driving uphill. Let the engine idle for 20 to 120 seconds before turning the engine switch off. According to the driving conditions, vary the idling time.

b. Avoid quick acceleration or quickly increasing the engine speed immediately after starting a cold engine.

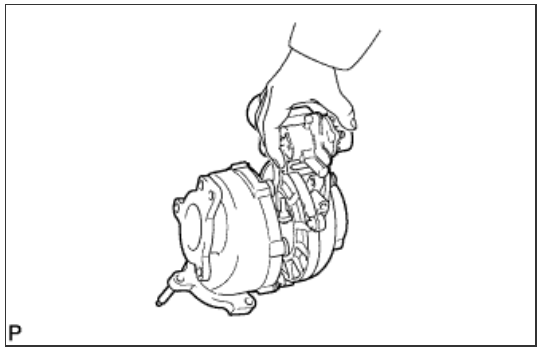
c. If the turbocharger is found to be defective, it must be replaced. Also, inspect the source of the trouble including the conditions under which the turbocharger was used. Repair or replace the following as necessary:

i. Engine oil (level and quality)

ii. Oil lines leading to the turbocharger

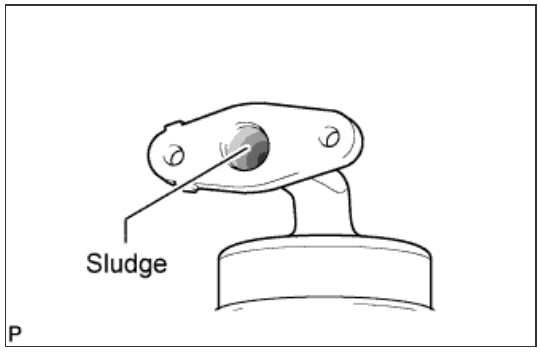
d. Be careful when removing and installing the turbocharger. Do not drop, strike, or grasp easily deformed assembly parts such as the DC motor or push rod during removal and installation.

e. Before removal, cover both the intake and exhaust ports and the oil inlet to prevent dirt or foreign objects from entering.



f. If replacing the turbocharger, check for accumulation of sludge particles in the oil pipe. If necessary, replace the No. 1 turbo oil pipe.

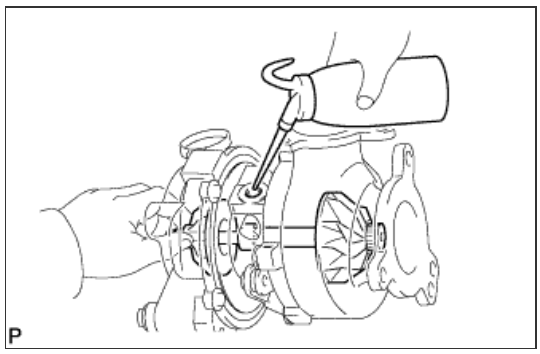
g. If replacing the bolts or nuts, use TOYOTA genuine parts to prevent breakage or deformation.



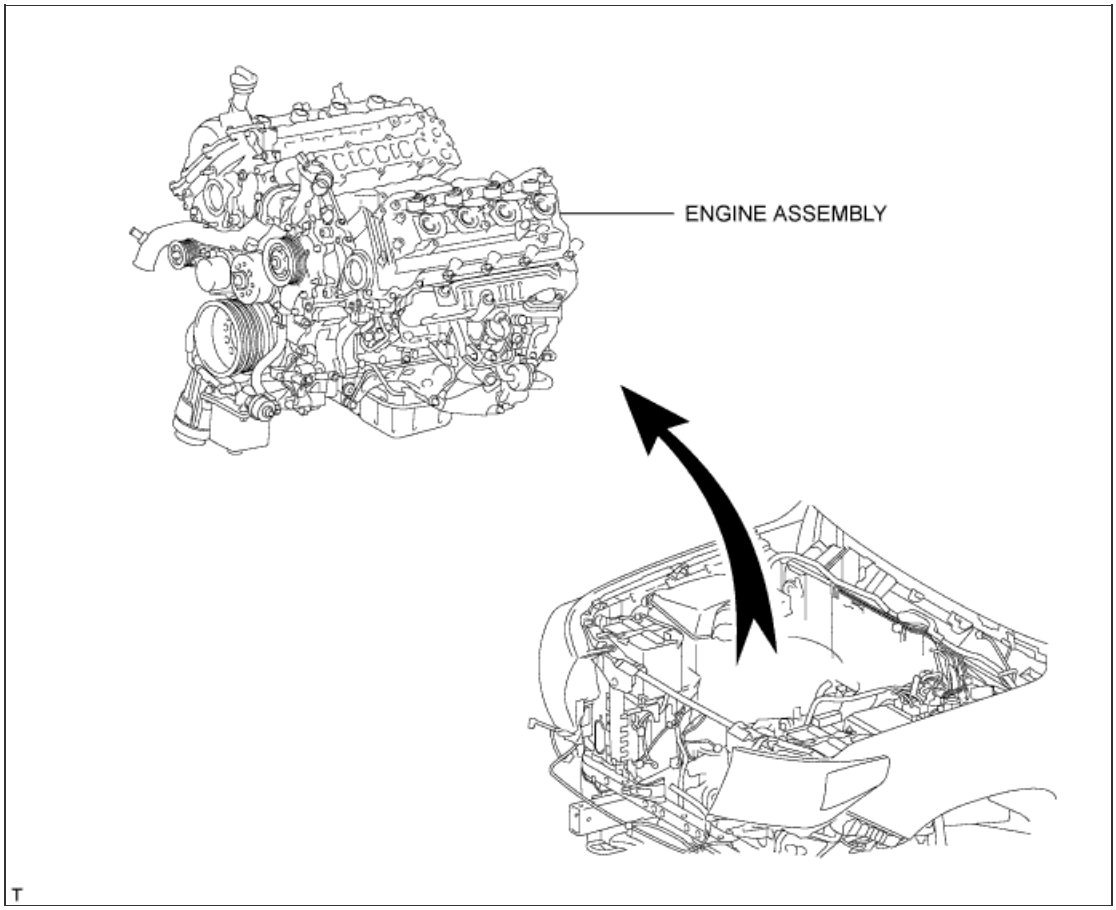
h. If replacing the turbocharger, put 20 cc (1.2 cu. in.) of fresh oil into the inlet turbocharger oil hole and turn the turbine wheel by hand to spread oil over the bearing.

i. If overhauling or replacing the engine, cut the fuel supply after reassembly and crank the engine for 30 seconds to distribute oil throughout the engine. Then reconnect the fuel supply and allow the engine to idle for 60 seconds.

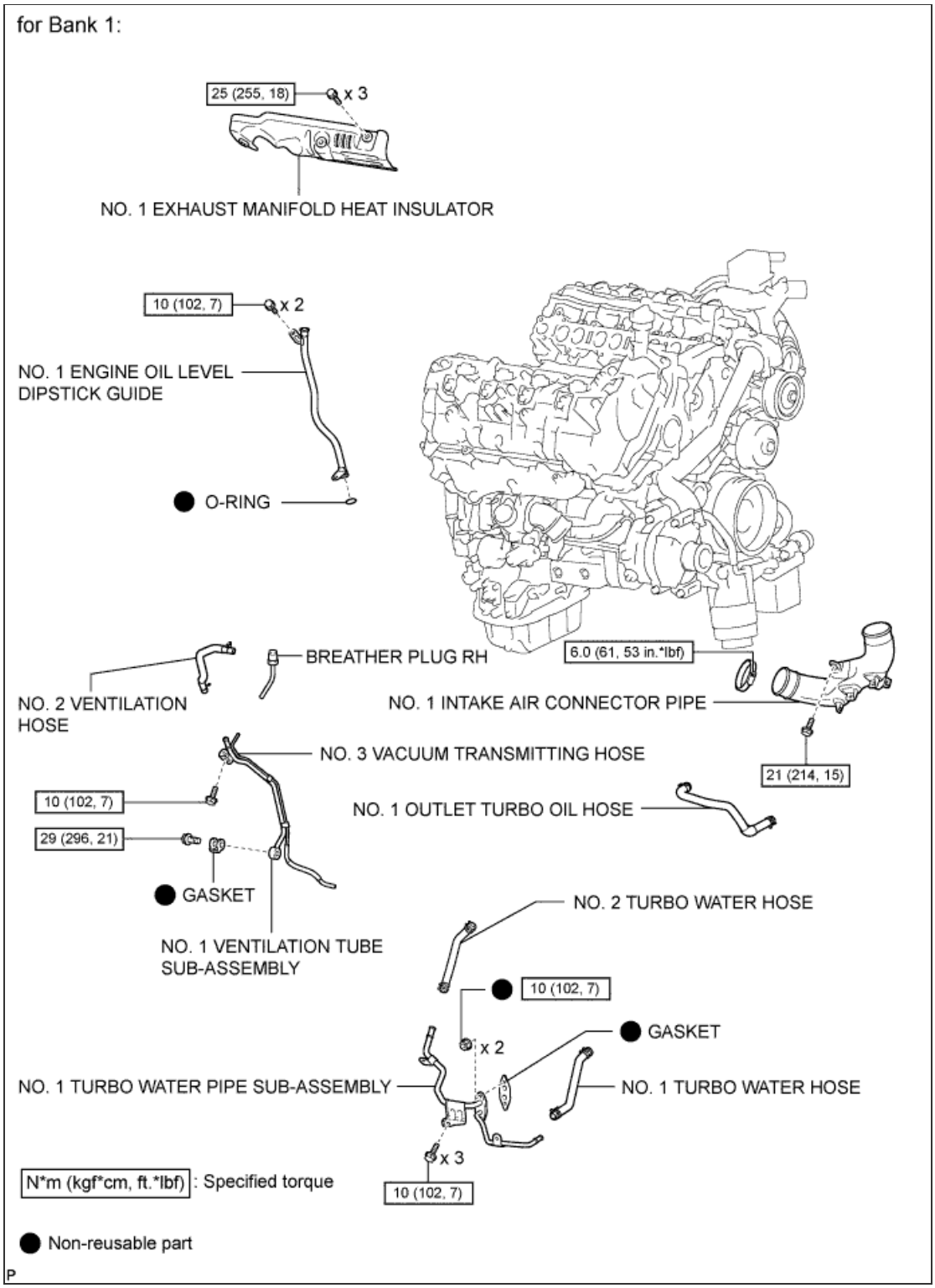
j. Since the turbine wheel runs at an extremely high speed, if the engine is running without the air cleaner, air cleaner cap and hose, the turbine wheel will be damaged due to entry of foreign particles.



for Preparation Click here

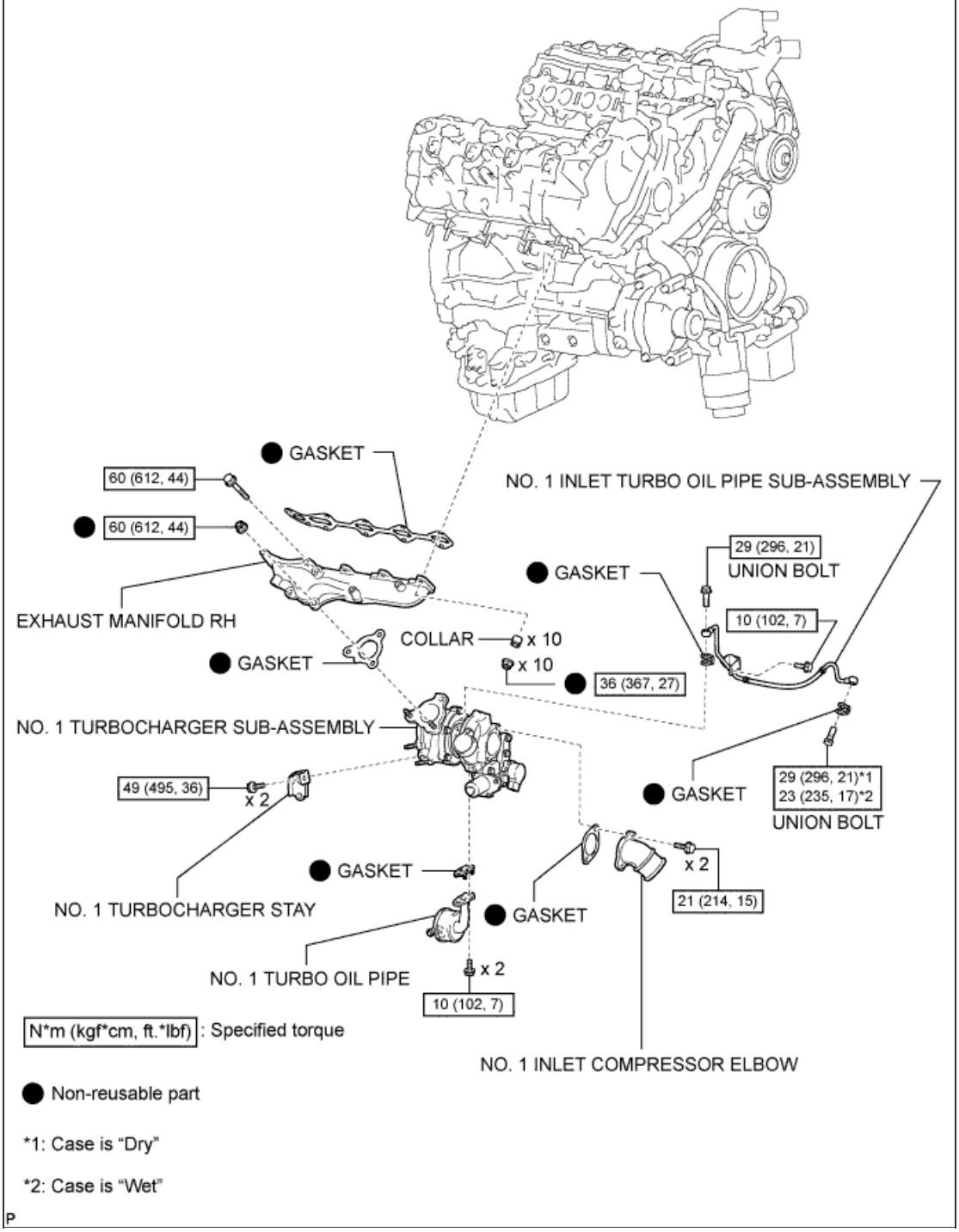


for Bank 1:


25 (255, 18)
x 3
NO. 1 EXHAUST MANIFOLD HEAT INSULATOR
10 (102, 7)
x 2
NO. 1 ENGINE OIL LEVEL DIPSTICK GUIDE
O-RING
BREATHER PLUG RH
6.0 (61, 53 in.*lbf)
NO. 2 VENTILATION HOSE
NO. 1 INTAKE AIR CONNECTOR PIPE
NO. 3 VACUUM TRANSMITTING HOSE
21 (214, 15)
10 (102, 7)
NO. 1 OUTLET TURBO OIL HOSE
29 (296, 21)
GASKET
NO. 1 VENTILATION TUBE SUB-ASSEMBLY
NO. 2 TURBO WATER HOSE
10 (102, 7)
GASKET
x 2
NO. 1 TURBO WATER PIPE SUB-ASSEMBLY
NO. 1 TURBO WATER HOSE
x 3
10 (102, 7)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P

for Bank 1:



N*m (kgf*cm, ft.*lbf) : Specified torque

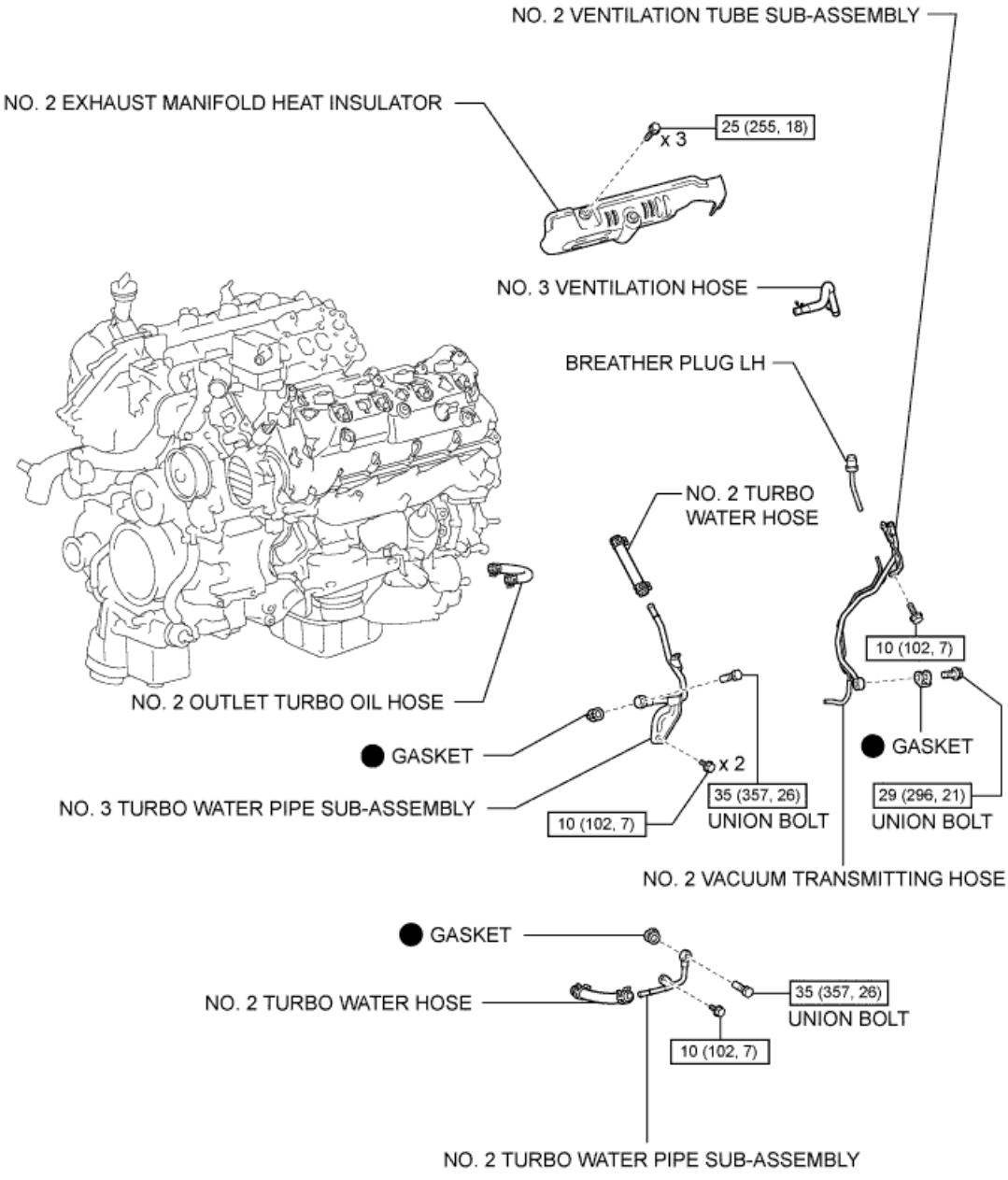
● Non-reusable part

*1: Case is “Dry”

*2: Case is “Wet”

P

for Bank 2:

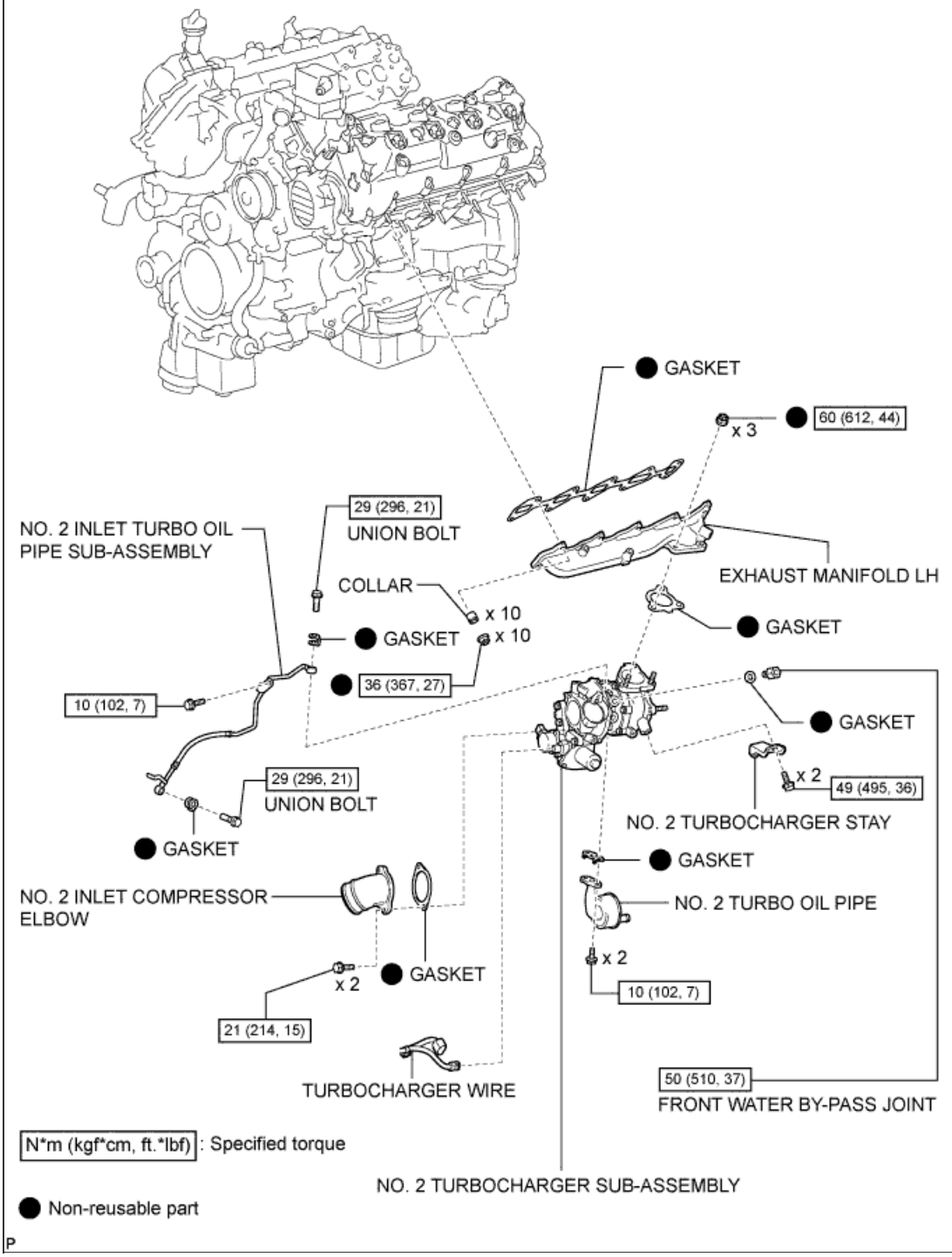


N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

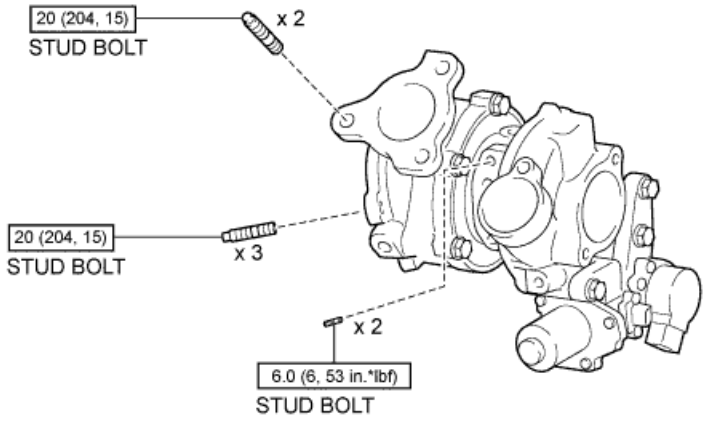
P

for Bank 2:


GASKET
60 (612, 44)
x 3
29 (296, 21)
UNION BOLT
NO. 2 INLET TURBO OIL PIPE SUB-ASSEMBLY
COLLAR
x 10
x 10
GASKET
36 (367, 27)
EXHAUST MANIFOLD LH
GASKET
10 (102, 7)
GASKET
29 (296, 21)
UNION BOLT
x 2
49 (495, 36)
NO. 2 TURBOCHARGER STAY
GASKET
GASKET
NO. 2 INLET COMPRESSOR ELBOW
NO. 2 TURBO OIL PIPE
x 2
GASKET
x 2
10 (102, 7)
21 (214, 15)
TURBOCHARGER WIRE
50 (510, 37)
FRONT WATER BY-PASS JOINT
N*m (kgf*cm, ft.*lbf) : Specified torque
NO. 2 TURBOCHARGER SUB-ASSEMBLY
Non-reusable part

P

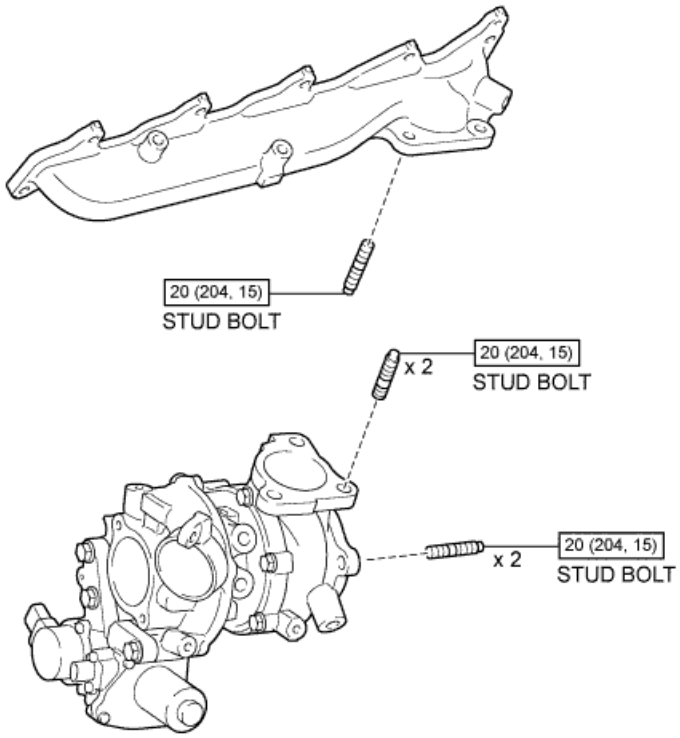
for Bank 1:



N*m (kgf*cm, ft.*lbf): Specified torque

T

for Bank 2:



N*m (kgf*cm, ft.*lbf): Specified torque

T

for Preparation Click here

This section should be used as a guide for troubleshooting when the turbocharger is suspected as the cause of a problem.

OUTLINE OF TURBOCHARGER FAILURE

a. State of Turbocharger Failure Repair:
It is well known that turbocharger malfunctions cause many symptoms as shown below. However, the mechanisms resulting in these symptoms that indicate turbocharger malfunctions are not well understood. As a result, many unnecessary turbocharger replacements and other repairs are being performed due to lack of knowledge about the turbocharger and turbocharger failure. Therefore, knowing the facts regarding turbocharger malfunctions is useful for making effective repairs and saving time.

b. Turbocharger Failure Classification

Symptom		Symptom Description	See page
Noise	Whistling noise	Continuous high pitch noise proportional to engine speed	• "NOISE" listed below • Flowchart "Turbocharger Noise" (Click here)
	Whining noise	Relatively low pitch noise compared to whistling noise	
Oil leak	External oil leak	Oil leak on surface of turbocharger visible from outside of turbocharger	• "OIL LEAK AND WHITE SMOKE" listed below • Flowchart "Turbocharger Oil Leak and White Smoke" (Click here)
	Internal oil leak	Oil leak from inside of bearing housing to inside of either compressor housing or turbine housing through seal ring	
White smoke	Oil smoke	Oil smoke is emitted from exhaust pipe	
	Unburned fuel smoke	Unburned fuel smoke is emitted from exhaust pipe	
Black smoke		Black smoke is emitted from exhaust pipe	• "BLACK SMOKE" listed below • Flowchart "Black Smoke Emitted" (Click here)
Lack of power or hesitation		Vehicle does not reach target speed	• "LACK OF POWER AND HESITATION" listed below • Flowchart "Lack of Power or Hesitation" (Click here)
		Poor acceleration	
		Shock during acceleration	
MIL turns on (DTC)	P0046	Control Solenoid Circuit Range / Performance	Diagnostic Trouble Code Chart (Click here)
	P0047	Boost Control "A" Circuit Low	
	P0048	Boost Control "A" Circuit High	
	P004C	Boost control solenoid "B" circuit low	
	P004D	Boost control solenoid "B" circuit high	
	P00AF	Boost control "A" module performance	
	P00B0	Boost control "B" module performance	
	P0299	Underboost	
	P1251	Overboost Condition (Too High)	
	P1258	Position sensor circuit range/performance bank 2 sensor 1	
	P1259	Position sensor low bank 2 sensor 1	
	P1260	Position sensor high bank 2	

	sensor 1
P1262	Position sensor low bank 2 sensor 2
P1263	Position sensor high bank 2 sensor 2
P2563	Position Sensor "A" Circuit Range/Performance
P2564	Position Sensor "A" Circuit Low
P2565	Position Sensor "A" Circuit High
P2588	Position Sensor "B" Circuit Low
P2589	Position Sensor "B" Circuit High

HINT:

This table shows only typical problems related to the turbocharger.

NOISE

Description

Probable Cause	Probable Failed Component
Turbine shaft imbalance	Turbocharger
Leakage from intake line	Intake line
Gear noise (Mistaken for turbocharger noise)	• Gear inside engine • Transmission gear

HINT:

It is easy to confirm whether the turbocharger is the cause of the noise or not, and confirming this before inspecting the turbocharger or removing it from the engine is an effective way to reduce troubleshooting time.

a. Connect the intelligent tester to the DLC3.

HINT:

The software version installed on the intelligent tester must be V2009.2 or later.

b. Start the engine and warm it up.

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine / Active Test / Activate the VN Turbo Open.

HINT:

This Active Test function operates both the turbocharger actuators (bank 1 and bank 2) at the same time.

e. Perform the Active Test and rev the engine up several times.

f. Check whether the noise is reduced or not compared with the noise under the condition that the Active Test is not performed.

Result

Result	Cause of Noise
The noise is reduced (or disappears)	Turbocharger
The noise does not change	Not turbocharger (other parts)

HINT:

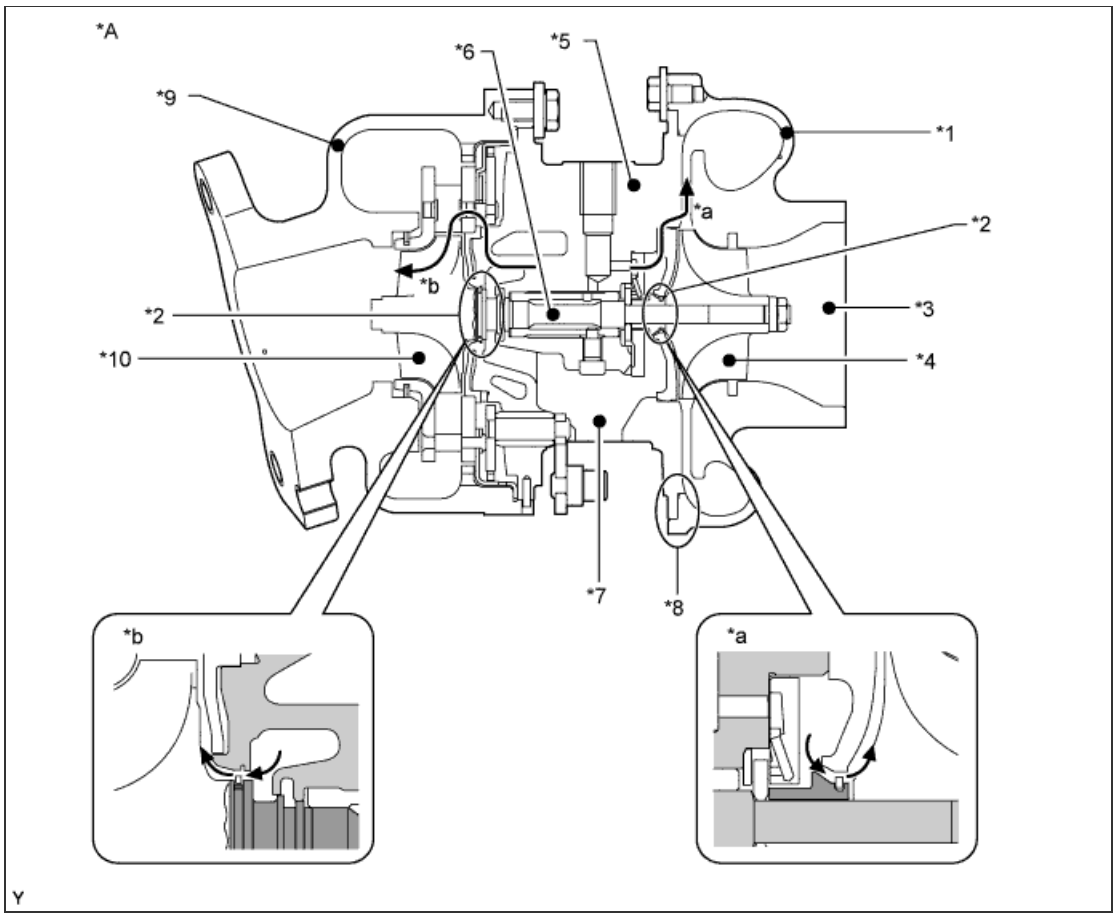
Refer to the flowchart "Turbocharger Noise" (Click here).

OIL LEAK AND WHITE SMOKE

Description

Oil Leak Type	Description	Main Trouble Area
Internal oil	• Oil leak from bearing housing to either compressor housing (intake side) or turbine housing (exhaust side) through seal rings.	• Compressor side seal ring • Turbine side seal ring • Clogging of oil drain

leak (White smoke)	• This type of oil leak is not visible from outside of turbocharger. • If oil leak occurs from turbine side seal, large amount of white smoke is emitted from exhaust pipe.	• Shaft breakage • Shaft or bearing seizure • Compressor impeller damage
External oil leak	• Oil leak from inside of turbocharger to outside of turbocharger. • Includes oil leaks visible from outside of turbocharger.	• FIPG sealing part • Oil pipe flange • Oil pipe union • Hose connection of intake pipe



Text in Illustration

*A	DC Motor Type Turbocharger (No. 1)	-	-
*1	Compressor Housing	*2	Seal Ring
*3	Compressor Inlet	*4	Compressor Impeller
*5	Bearing Housing	*6	Turbine Shaft
*7	Oil Drain (Outlet)	*8	FIPG Sealing Part
*9	Turbine Housing	*10	Turbine Wheel
*a	Internal oil leak to compressor housing	*b	Internal oil leak to turbine housing

HINT:

- **Above illustration is an example.**
- **When there is an internal oil leak, white smoke is emitted from the exhaust pipe and oil is consumed excessively. However, the cause of white smoke or excessive oil consumption can vary. Therefore, do not assume that the turbocharger is the cause of the failure when there is white smoke emission or excessive oil consumption.**
- **When there is an external oil leak, the sources of the oil leak are limited to the points mentioned in the table above. If oil leaks from a FIPG sealing part, replace the turbocharger. If oil leaks from an oil pipe flange or a hose connection, do not replace the turbocharger, but confirm and repair the flange or hose.**
- **Refer to the flowchart "Turbocharger Oil Leak and White Smoke" (Click here).**

BLACK SMOKE

a. Malfunctions are classified into 2 types as shown below.

Description

Malfunction	Main Fault
Intake air volume shortage	Insufficient mass air flow due to, for example, excessively low boost pressure, which results in fuel injection volume being relatively excessive with respect to mass air flow.
Excessive injection volume	Excessive injection volume or incorrect injection timing due to fuel system trouble.

b. Main Components Related to Black Smoke:

Possible Faulty Component	Main Fault
Turbocharger	Abnormally low boost pressure
Intake system	Leakage between turbocharger and intake manifold
Fuel system	• Excessive fuel injection volume • Incorrect fuel injection timing
EGR valve	Stuck or does not close completely
Diesel throttle	Stuck or does not move smoothly

HINT:

The components listed above are only the main ones. Not all the components potentially related to black smoke are listed. For details regarding the troubleshooting of black smoke, refer to the flowchart "Black Smoke Emitted" (Click here).

c. Relation between Turbocharger and Black Smoke:
If the boost pressure is lower than normal due to a turbocharger failure, black smoke may occur due to a lack of mass air flow. However, abnormally low boost pressure can be caused by the failure of various components such as intake lines, the EGR valve, etc. Therefore, do not assume that the turbocharger is the cause of abnormally low boost pressure, but check all the components possibly related to abnormally low boost pressure. Components related to abnormal boost pressure are shown in a chart listed in the On-vehicle Inspection for Intake System (Click here). For simple and effective troubleshooting, refer to the chart before starting troubleshooting.

LACK OF POWER AND HESITATION

a. Malfunctions are classified into 2 types as shown below.

Description

Malfunction	Main Fault
Intake air volume shortage	Insufficient mass air flow due to, for example, excessively low boost pressure, which results in fuel injection volume being restricted.
Abnormal injection volume	Abnormal injection volume or timing due to fuel system trouble.

b. Main Components Related to Lack of Power and Hesitation:

Possible Faulty Component	Main Fault
Turbocharger	• Abnormal boost pressure • VN does not move smoothly
Intake system	• Leakage between turbocharger and intake manifold • Clogging or blockage of intake line
Fuel system	• Abnormal injection volume • Incorrect fuel injection timing
EGR valve	Stuck or does not close completely
Diesel throttle	Stuck or does not move smoothly
Exhaust system	Clogging of exhaust line

HINT:

- **The components listed above are only the main ones. Not all the components potentially related to lack of power and hesitation are listed. For details regarding the troubleshooting of lack of power and hesitation, refer to the flowchart "Lack of Power or Hesitation" (Click here).**
- **If obvious malfunction (lack of power) has not been reproduced, perform test driving another vehicle, which is the same model and has the same engine, and compare the engine conditions and performance. If a great difference does not present in engine performance, explain to the customer that lack of power the customer mentioned is not abnormal.**

c. Relation between Turbocharger and Abnormal Boost Pressure:
If the boost pressure is lower than normal due to a turbocharger failure, lack of power could occur due to an intake air volume shortage. However, abnormal boost pressure can be caused by the failure of various components such as intake lines, the EGR valve, etc. Therefore, do not assume that the turbocharger is the cause of abnormal boost pressure, but check all the components possibly related to abnormal boost pressure. Components related to abnormal boost pressure are shown in a chart listed in the On-vehicle Inspection for Intake System

(Click here). For simple and effective troubleshooting, refer to the chart before starting troubleshooting.

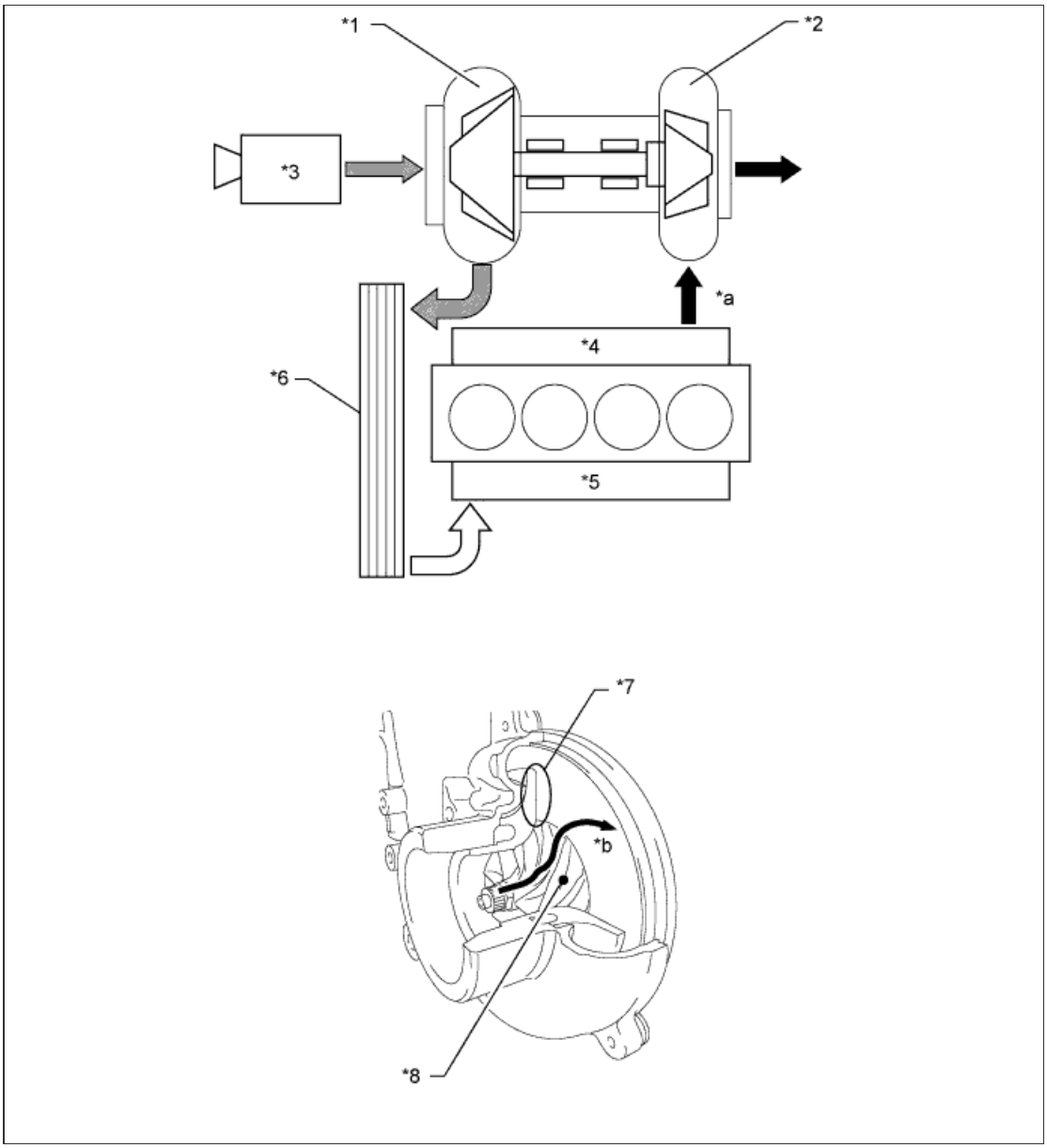
MIL TURNS ON

If a DTC related to a turbocharger malfunction is stored, refer to the troubleshooting section for each DTC (Click here).

BRIEF OUTLINE OF TURBOCHARGER OPERATION AND CONSTRUCTION

a. A turbocharger is a component used to supply a larger air volume to the cylinders by recovering exhaust gas energy using a turbine coaxially connected to a compressor.

b. Principle of Turbocharging:
Boost pressure is proportional to turbocharger speed, because the intake air is accelerated by centrifugal force generated by the rotation of the compressor and the increased kinetic energy, i.e. the velocity of the intake air, is converted to pressure energy by the diffuser located around the outlet of the compressor impeller. The compressor is driven by the turbine connected coaxially by the turbine shaft. The turbine is driven by exhaust gas energy. Therefore, when the turbocharger begins boosting the intake air, a larger air volume is supplied to the cylinders and more fuel can be injected. As a result, more exhaust energy will be available and the turbocharger boost increases.



Text in Illustration

*1	Compressor	*2	Turbine
*3	Air Cleaner	*4	Exhaust Manifold
*5	Intake Manifold	*6	Intercooler (w/ Intercooler)
*7	Diffuser	*8	Compressor

*a	See HINT below	*b	Intake air flow

HINT:

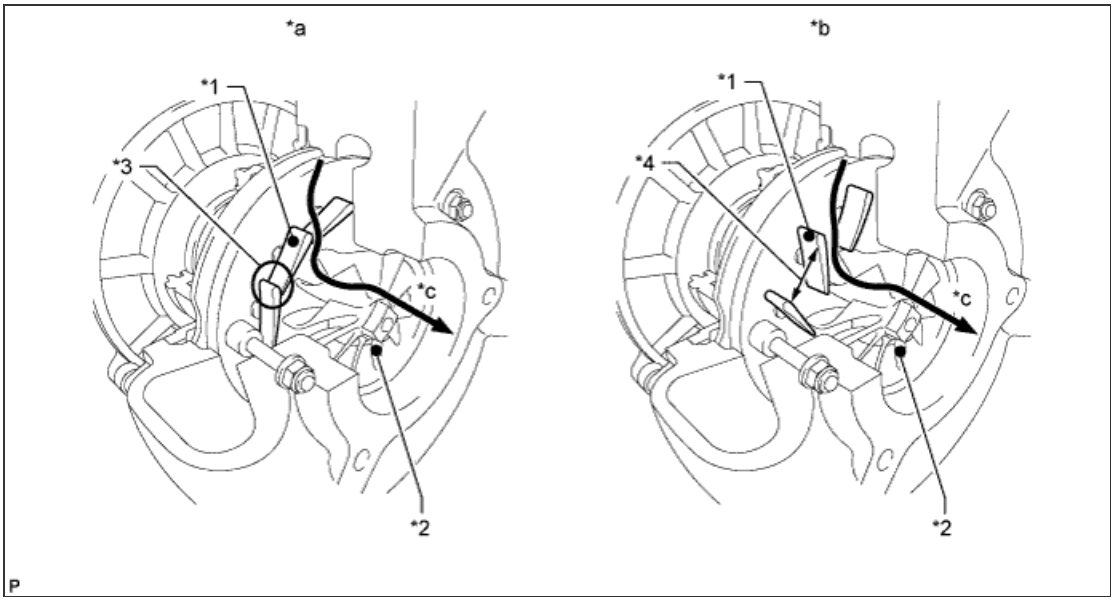
- ***a: If sufficient exhaust gas energy is not available, the turbocharger cannot generate the required boost pressure even when the turbocharger does not have a malfunction.**
- **Considering the fact that the turbocharger is driven by exhaust gas energy, if sufficient exhaust gas is not available due to abnormal injection volume, etc., the required boost pressure will not be available even when the turbocharger does not have a malfunction. Therefore, when boost pressure is abnormally low, checking all the related components using the correct troubleshooting procedure is necessary for simple and effective repair.**

c. Boost Pressure Control:

The amount of energy the turbine can obtain from the exhaust gas is proportional to the expansion ratio, which is defined as the ratio of the turbine inlet exhaust gas pressure to the pressure at the turbine outlet.

To control boost pressure, a Variable Nozzle (VN) is used just upstream of the turbine wheel inlet, and controls the expansion ratio. If the VN is closed, the gap between neighboring vanes is narrowed and the turbine inlet exhaust gas pressure, and correspondingly the expansion ratio, increases. Therefore, when the VN is closed, the turbine receives more energy, and the turbine speed and boost pressure increase. On the other hand, if the VN is opened, the turbine inlet exhaust gas pressure decreases, and the turbine speed and boost pressure decrease.

The VN is actuated by a DC motor. The ECM controls the VN opening angle through the turbo motor driver in accordance with the engine condition. When a high engine power is required, the actuation rod is moved by the actuator to close the VN and boost pressure increases.



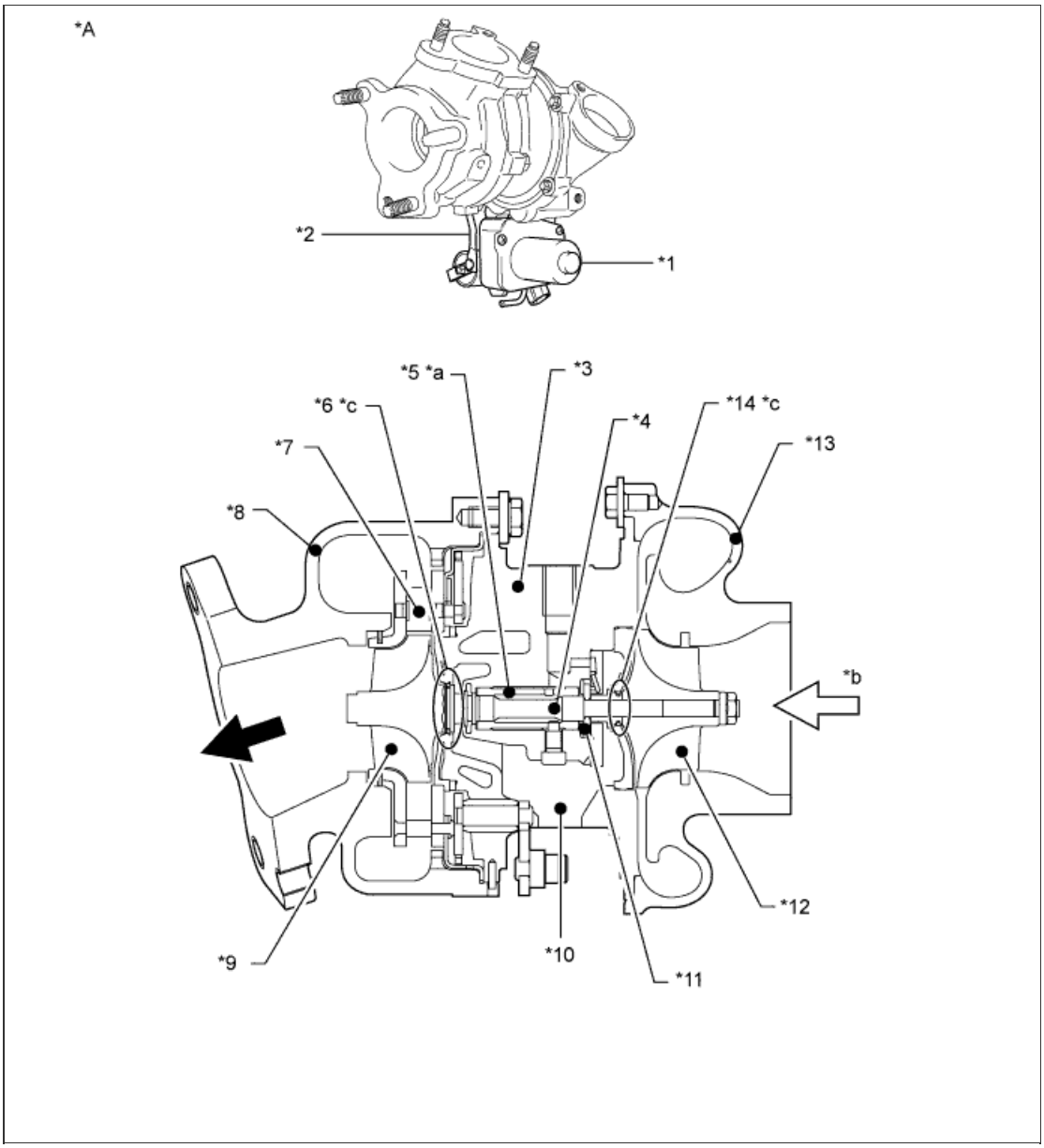
Text in Illustration

*1	VN (Variable Nozzle)	*2	Turbine Wheel
*3	Narrow Gap	*4	Wide Gap
*a	VN Closed	*b	VN Opened
*c	Exhaust Gas Flow	-	-

HINT:

If the VN becomes stuck open, the necessary boost pressure will not be available. If the VN becomes stuck closed, overboost will occur.

d. Mechanical Construction of Turbocharger:



Text in Illustration

➡	Exhaust Gas Flow	⇨	Intake Air Flow
*A	DC Motor Type Turbocharger (No. 1)	-	-
*1	VN Actuator (DC Motor)	*2	VN Actuating Rod
*3	Bearing Housing	*4	Turbine Shaft
*5	Radial Bearing	*6	Turbine Side Seal Ring
*7	VN (Variable Nozzle)	*8	Turbine Housing
*9	Turbine Wheel	*10	Oil Drain
*11	Thrust Bearing	*12	Compressor Impeller
*13	Compressor Housing	*14	Compressor Side Seal Ring
*a	See HINT below	*b	See HINT below
*c	See HINT below	-	-

HINT:

- **Above illustration is an example.**
- ***a: The clearances of the radial bearing and thrust bearing are on the order of 100 µm, and for the accurate measurement of these clearances, an accurate process and accurate tools are essential.**
- ***b: A certain amount of oil mist from PCV gas is contained in the intake air. Therefore, a certain amount of oil at the inlet of the compressor is normal, and is not an oil leak.**
- ***c: The seal rings are C-shaped rings just like piston rings, and have a gap. Therefore, complete sealing is impossible**

by the seal rings alone. The oil is sealed in with the aid of the boost pressure in the compressor housing, and the exhaust gas pressure in the turbine housing. These pressures prevent oil from exiting the bearing housing through the gap of the seal rings. Therefore, if the turbine shaft is inclined from the horizontal, oil may flow out through the gap of a seal ring. This should not be interpreted as an oil leak due to seal ring failure.

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Disconnect the cables from the negative (-) main battery and sub-battery terminals.

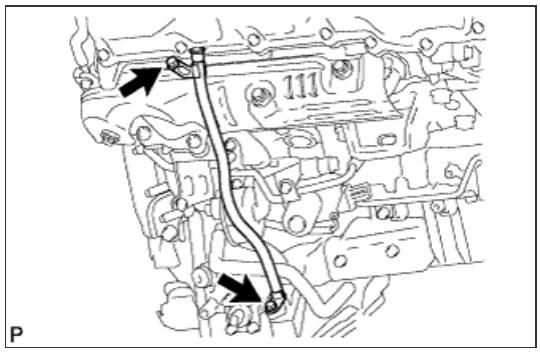
2. REMOVE ENGINE ASSEMBLY

a. Remove the engine assembly from the vehicle (Click here).

3. REMOVE NO. 1 ENGINE OIL LEVEL DIPSTICK GUIDE (for Bank 1)

a. Remove the 2 bolts and No. 1 engine oil level dipstick guide.

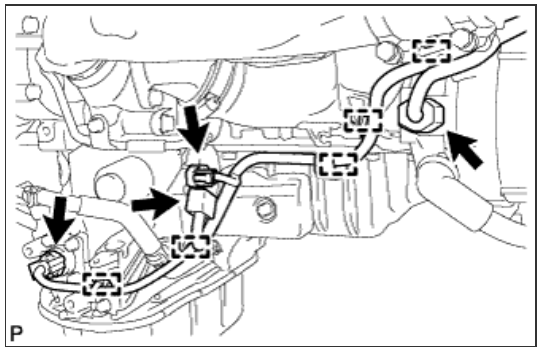
b. Remove the O-ring from the No. 1 engine oil level dipstick.



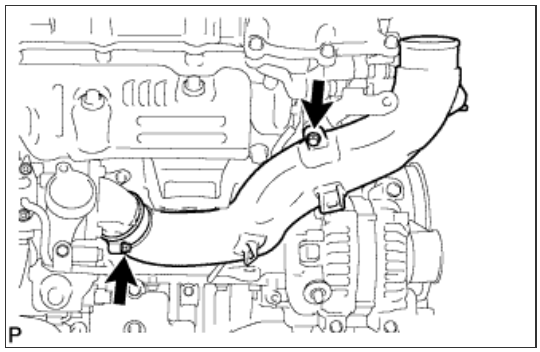
4. REMOVE NO. 1 INTAKE AIR CONNECTOR PIPE (for Bank 1)

a. Disconnect the 4 connectors.

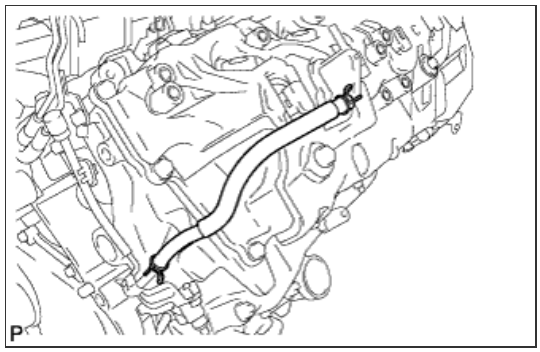
b. Using a clip remover, detach the 5 wire harness clamps.



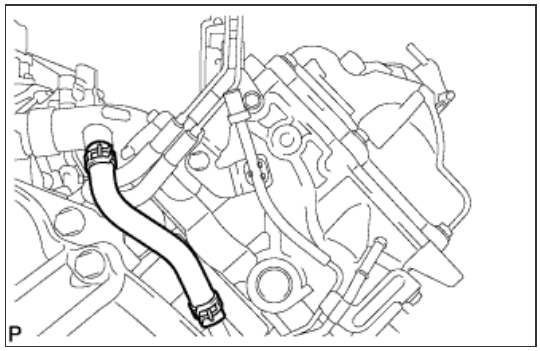
c. Loosen the hose clamp, and remove the bolt and No. 1 intake air connector pipe.



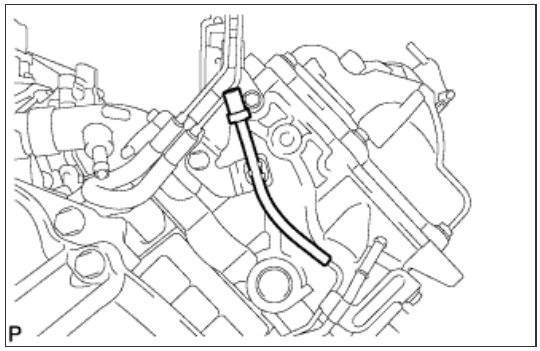
5. DISCONNECT NO. 2 VENTILATION HOSE (for Bank 1)



6. DISCONNECT NO. 2 TURBO WATER HOSE (for Bank 1)

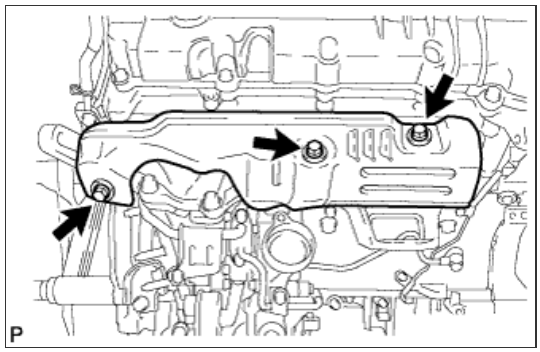


7. DISCONNECT BREATHER PLUG RH (for Bank 1)

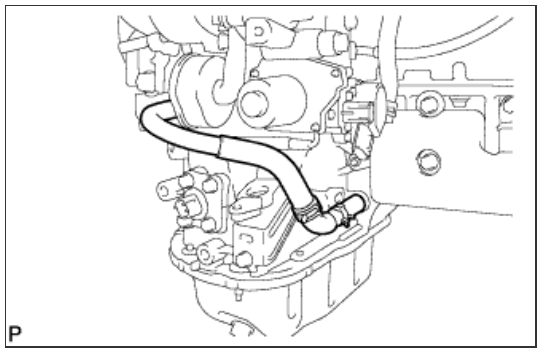


8. REMOVE NO. 1 EXHAUST MANIFOLD HEAT INSULATOR (for Bank 1)

a. Remove the 3 bolts and No. 1 exhaust manifold heat insulator.



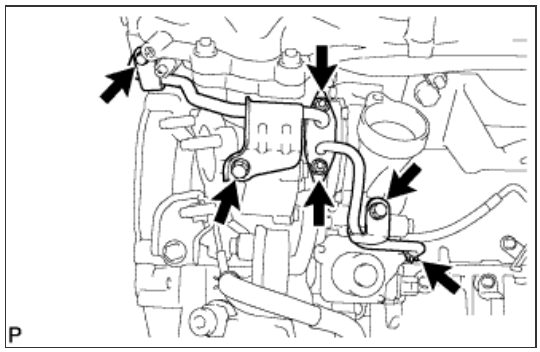
9. DISCONNECT NO. 1 OUTLET TURBO OIL HOSE (for Bank 1)



10. REMOVE NO. 1 TURBO WATER PIPE SUB-ASSEMBLY (for Bank 1)

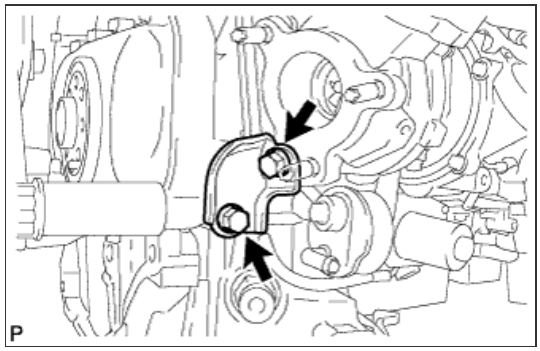
a. Disconnect the water hose.

b. Remove the 3 bolts, 2 nuts, No. 1 turbo water pipe and gasket.



11. REMOVE NO. 1 TURBOCHARGER STAY (for Bank 1)

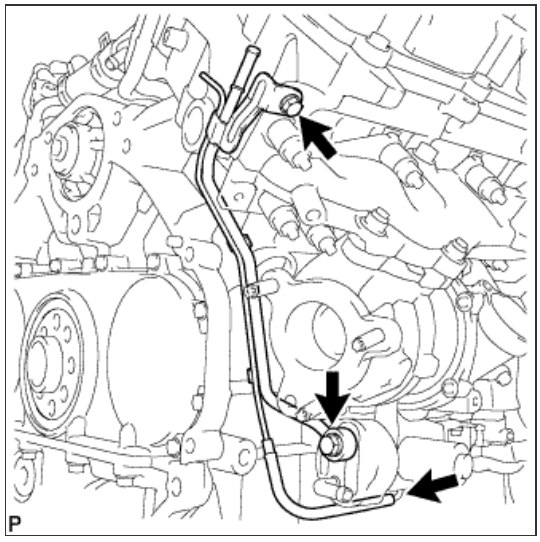
a. Remove the 2 bolts and No. 1 turbocharger stay.



12. REMOVE NO. 1 VENTILATION TUBE SUB-ASSEMBLY (for Bank 1)

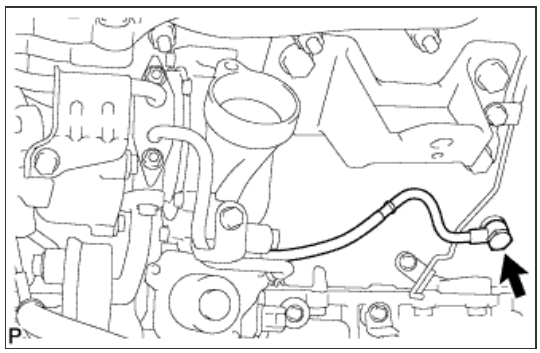
a. Disconnect the vacuum hose.

b. Remove the union bolt, bolt, No. 1 ventilation tube and gasket.

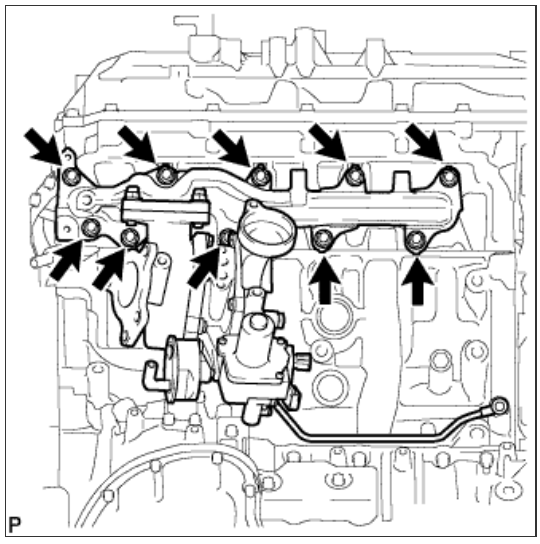


13. REMOVE NO. 1 TURBOCHARGER SUB-ASSEMBLY WITH EXHAUST MANIFOLD RH (for Bank 1)

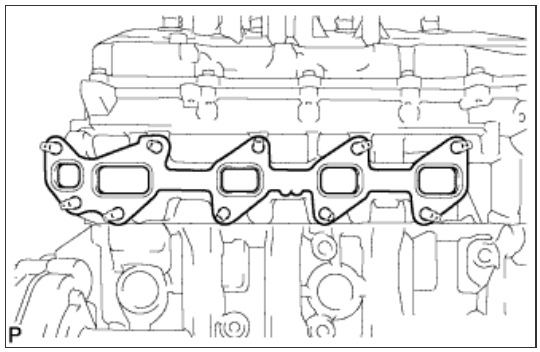
a. Remove the union bolt and gasket, and disconnect the No. 1 inlet turbo oil pipe from the cylinder block.



b. Remove the 10 nuts, 10 collars and No. 1 turbocharger with exhaust manifold RH.

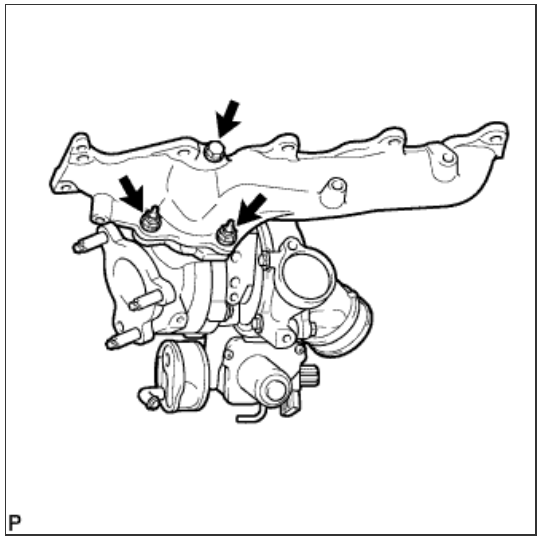


c. Remove the gasket.



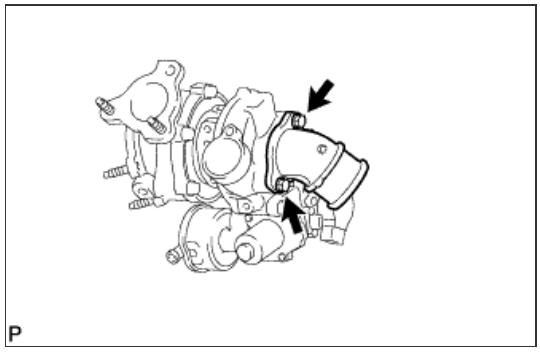
d. Remove the 2 nuts and bolt, and separate the No. 1 turbocharger and exhaust manifold RH.

e. Remove the gasket from the No. 1 turbocharger.



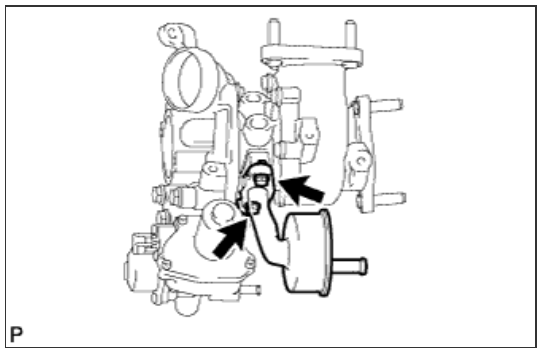
14. REMOVE NO. 1 INLET COMPRESSOR ELBOW (for Bank 1)

a. Remove the 2 bolts, No. 1 inlet compressor elbow and gasket.



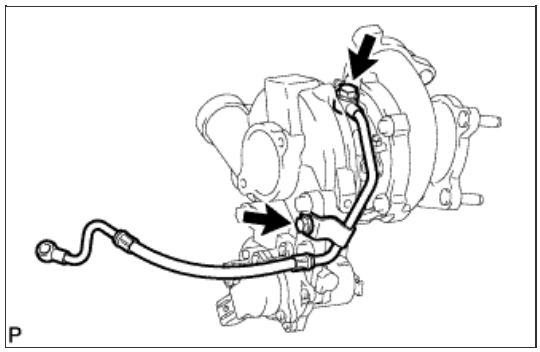
15. REMOVE NO. 1 TURBO OIL PIPE (for Bank 1)

a. Remove the 2 bolts, No. 1 turbo oil pipe and gasket.

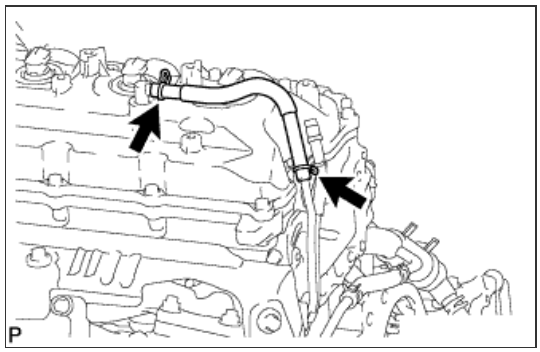


16. REMOVE NO. 1 INLET TURBO OIL PIPE SUB-ASSEMBLY (for Bank 1)

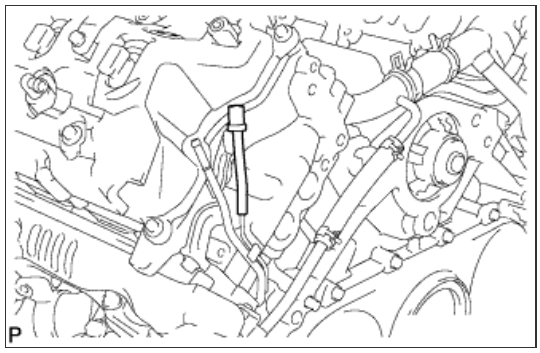
a. Remove the union bolt, bolt, No. 1 inlet turbo oil pipe and gasket.



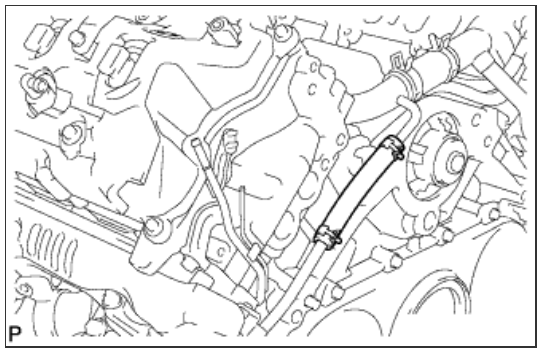
17. DISCONNECT NO. 3 VENTILATION HOSE (for Bank 2)



18. DISCONNECT BREATHER PLUG LH (for Bank 2)

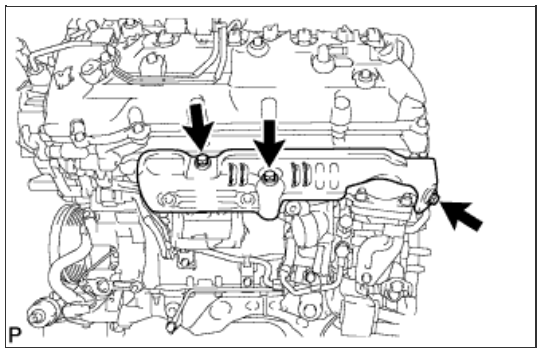


19. DISCONNECT NO. 2 TURBO WATER HOSE (for Bank 2)



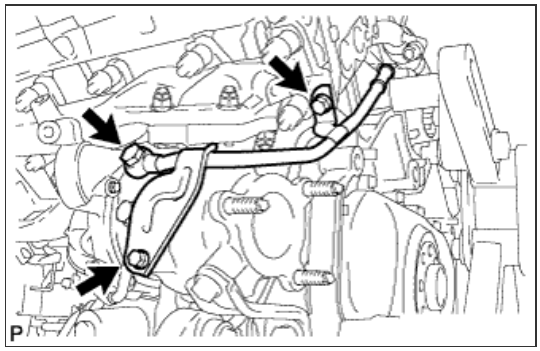
20. REMOVE NO. 2 EXHAUST MANIFOLD HEAT INSULATOR (for Bank 2)

a. Remove the 3 bolts and No. 2 exhaust manifold heat insulator.



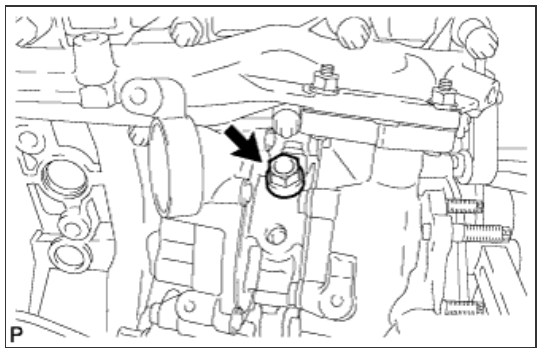
21. REMOVE NO. 3 TURBO WATER PIPE SUB-ASSEMBLY (for Bank 2)

a. Remove the 2 bolts, union bolt, No. 3 turbo water pipe and gasket.



22. REMOVE FRONT WATER BY-PASS JOINT (for Bank 2)

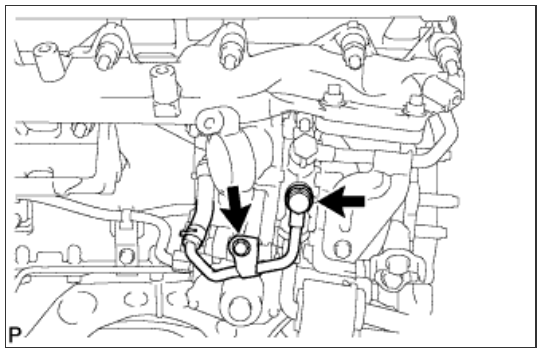
a. Remove the front water by-pass joint and gasket.



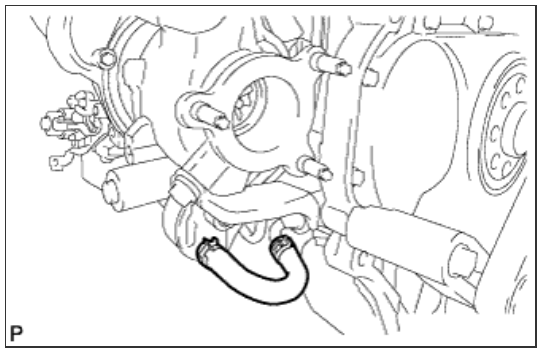
23. REMOVE NO. 2 TURBO WATER PIPE SUB-ASSEMBLY (for Bank 2)

a. Disconnect the water hose.

b. Remove the union bolt, bolt, No. 2 turbo water pipe and gasket.

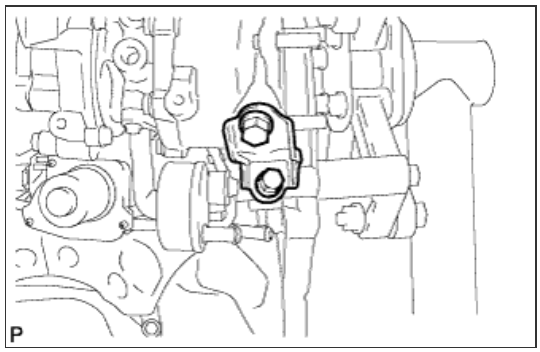


24. DISCONNECT NO. 2 OUTLET TURBO OIL HOSE (for Bank 2)



25. REMOVE NO. 2 TURBOCHARGER STAY (for Bank 2)

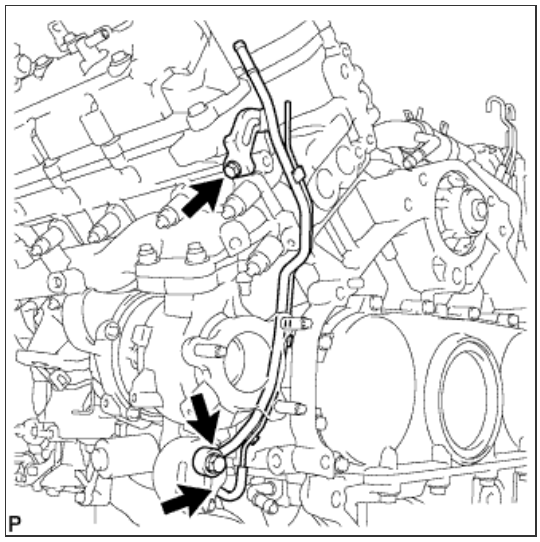
a. Remove the 2 bolts and No. 2 turbocharger stay.



26. REMOVE NO. 2 VENTILATION TUBE SUB-ASSEMBLY (for Bank 2)

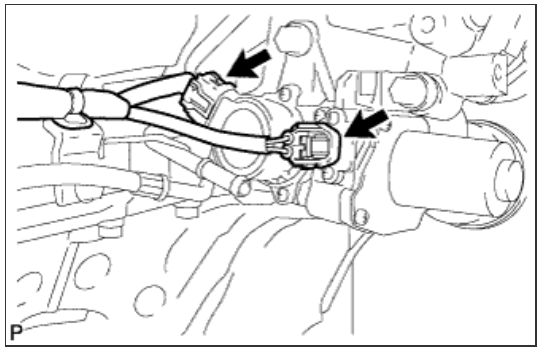
a. Disconnect the No. 2 vacuum transmitting hose.

b. Remove the union bolt, bolt, No. 2 ventilation tube and gasket.

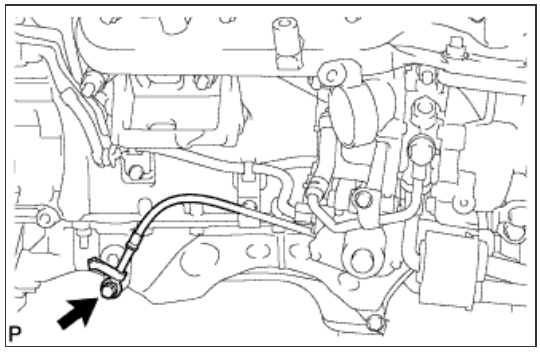


27. REMOVE NO. 2 TURBOCHARGER SUB-ASSEMBLY WITH EXHAUST MANIFOLD LH (for Bank 2)

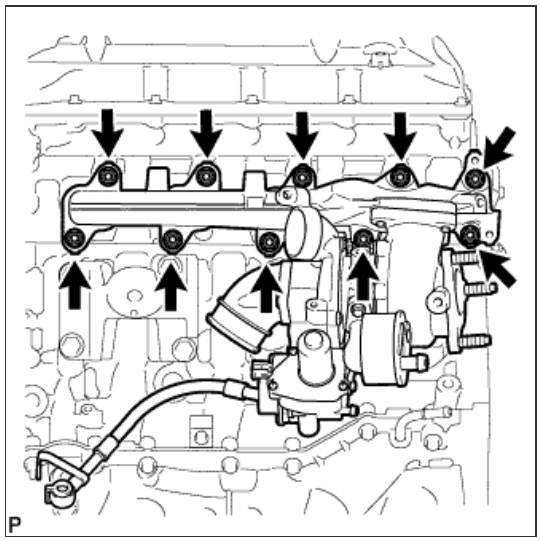
a. Disconnect the 2 connectors from the turbocharger.



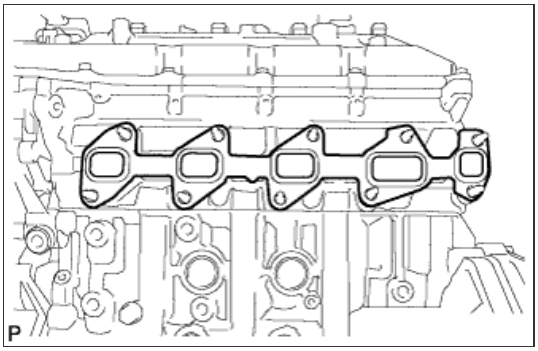
b. Remove the union bolt and gasket, and disconnect the No. 2 inlet turbo oil pipe.



c. Remove the 10 nuts, 10 collars and No. 2 turbocharger with exhaust manifold LH.

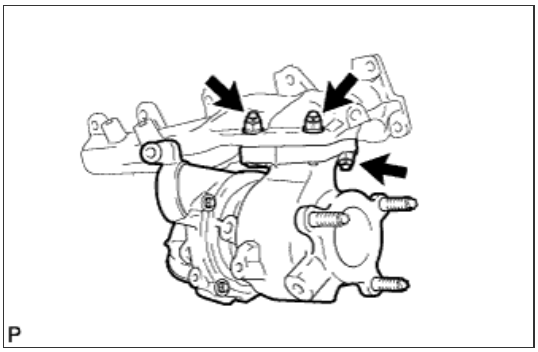


d. Remove the gasket.



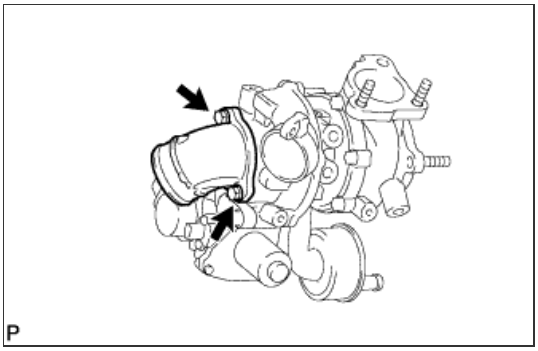
e. Remove the 3 nuts, and separate the No. 2 turbocharger and exhaust manifold LH.

f. Remove the gasket from the turbocharger.



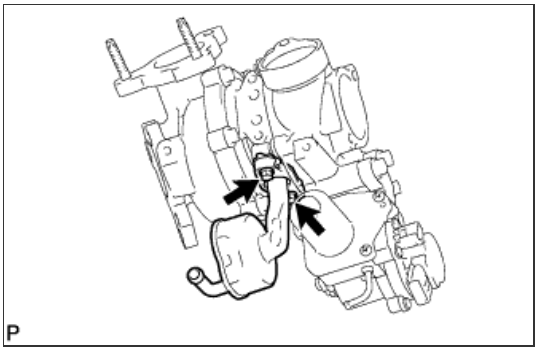
28. REMOVE NO. 2 INLET COMPRESSOR ELBOW (for Bank 2)

a. Remove the 2 bolts, No. 2 inlet compressor elbow and gasket.



29. REMOVE NO. 2 TURBO OIL PIPE (for Bank 2)

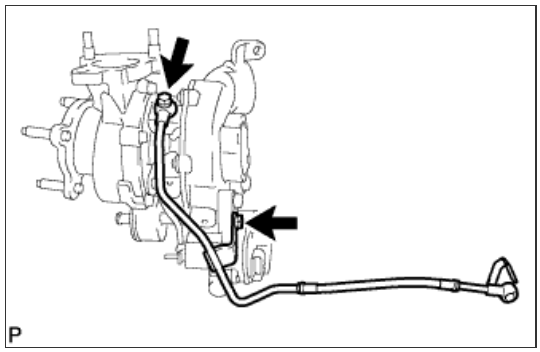
a. Remove the 2 bolts, No. 2 turbo oil pipe and gasket.



30. REMOVE NO. 2 INLET TURBO OIL PIPE SUB-ASSEMBLY (for Bank 2)

a. Remove the union bolt, bolt, No. 2 inlet turbo oil pipe and gasket.

a. Remove the union bolt, bolt, No. 2 inlet turbo oil pipe and gasket.



31. REPLACE STUD BOLT

HINT:

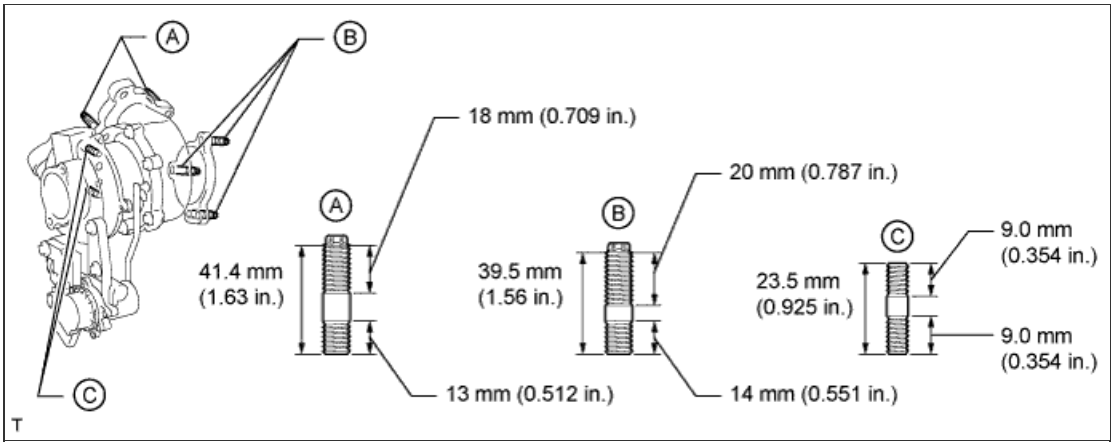
If a stud bolt is deformed or the threads are damaged, replace it.

a. for No. 1 Turbocharger:
Using an E10 "TORX" wrench, replace the stud bolts labeled A and B shown in the illustration below.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

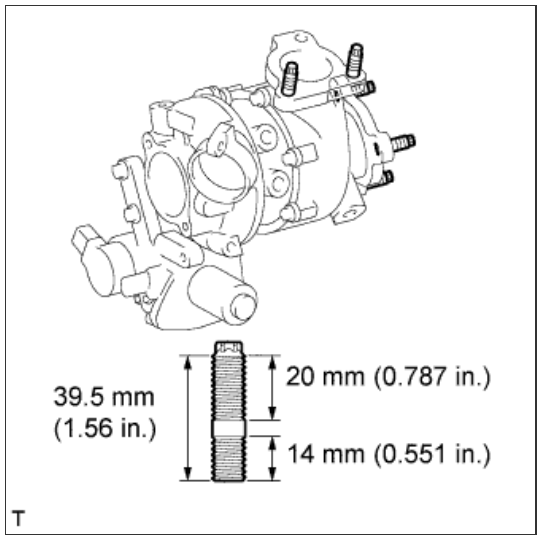
b. for No. 1 Turbocharger:
Replace the stud bolts labeled C shown in the illustration below.

Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }



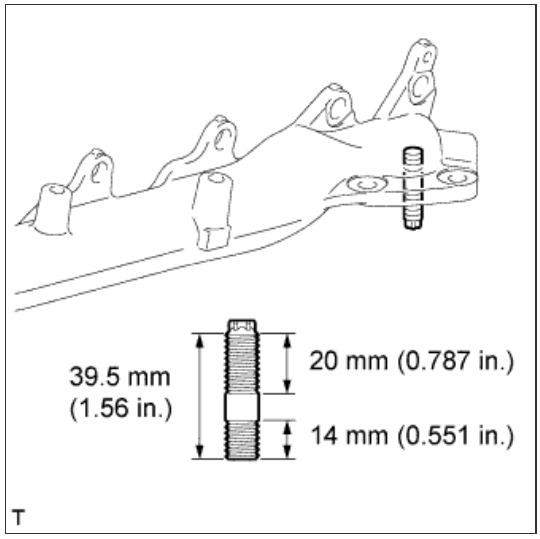
c. for No. 2 Turbocharger:
Using an E10 "TORX" wrench, replace the stud bolt.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }



d. for Exhaust Manifold RH:
Using an E10 "TORX" wrench, replace the stud bolt.

Torque:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }



for Preparation Click here

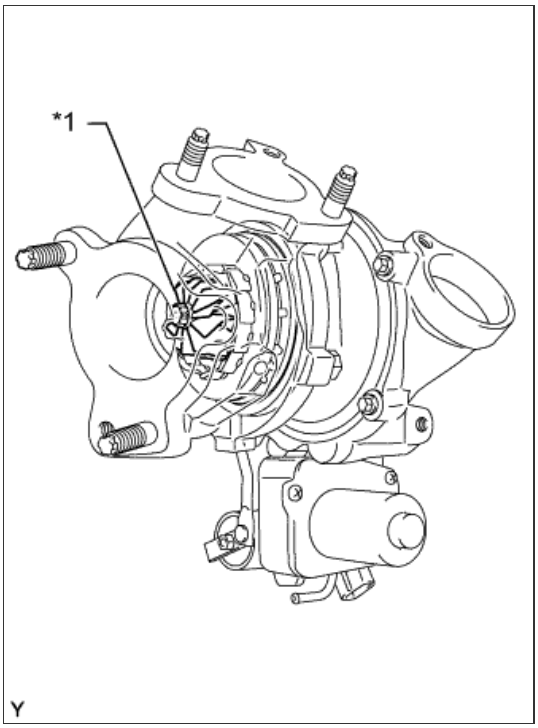
1. VISUALLY CHECK TURBOCHARGER SUB-ASSEMBLY

a. Check for deformation and cracks in the turbine wheel on the exhaust side.

Text in Illustration

*1	Turbine Wheel

If the turbine wheel is cracked or deformed, replace the turbocharger sub-assembly.



2. INSPECT AXIAL PLAY OF TURBINE SHAFT

a. Using a dial indicator, insert the needle of the dial indicator into the exhaust side of the turbine shaft.

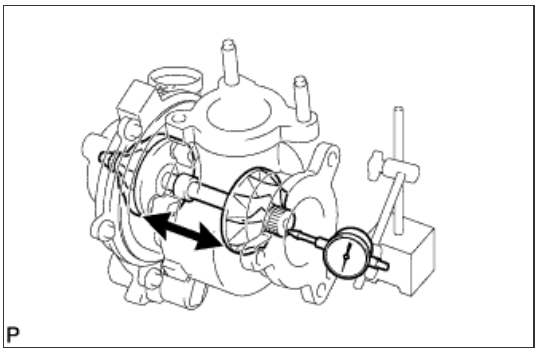
b. Move the turbine shaft in an axial direction and measure the axial play of the turbine shaft.

NOTICE:

Turbocharger sub-assembly and dial indicators are surely fixed when performing measurement.

Maximum axial play:
0.09 mm (0.00354 in.)

If the axial play is more than the maximum, replace the turbocharger sub-assembly.



3. INSPECT RADIAL PLAY OF TURBINE SHAFT

a. Connect a lever probe to a dial indicator.

*1	Lever Probe
*a	Air Intake Side
*b	Lift Up

*c *d	Not Cut for Balancing Upward

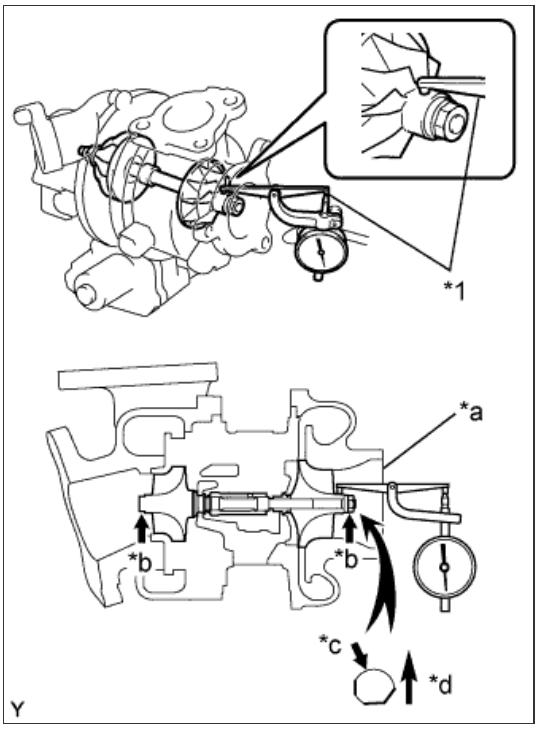
b. Rotate the turbine shaft so that a part that has not been cut for shaft balancing is facing upwards on the air intake side.

c. Place the lever probe against the shaft at the position shown in the illustration.

d. Lift up the both sides of the turbine shaft, move it in a radial direction and measure the radial play of the turbine shaft.

Maximum radial play:
0.16 mm (0.00630 in.)

If the radial play is more than the maximum, replace the turbocharger sub-assembly.



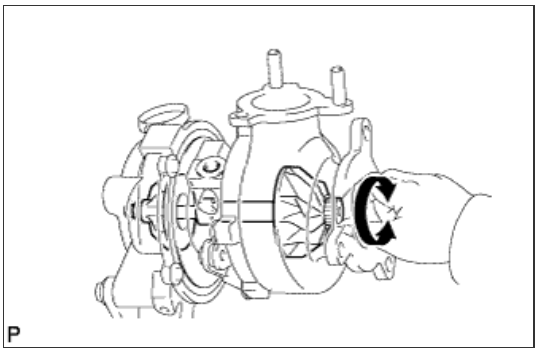
4. CHECK TURBINE SHAFT ROTATION

a. Rotate the turbine wheel on the exhaust side with your finger and check that it rotates smoothly.

HINT:

Even if it takes effort a little to rotate the turbine wheel, this is not a problem.

If the turbine wheel does not rotate smoothly, replace the turbocharger sub-assembly.

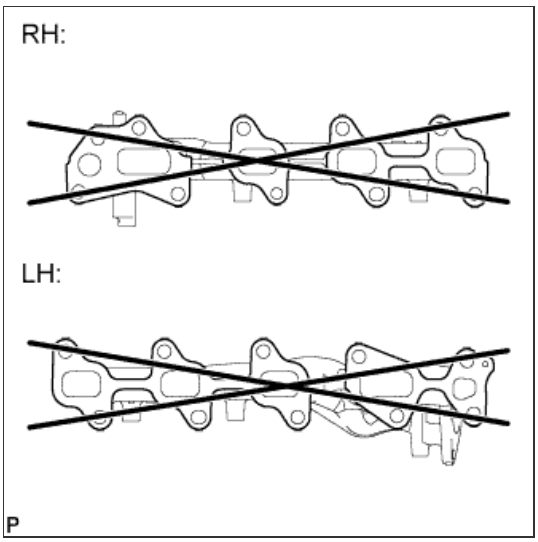


5. INSPECT EXHAUST MANIFOLD RH AND LH

a. Using a precision straightedge and feeler gauge, measure the warpage of the contact surface between the exhaust manifold and cylinder head.

Maximum warpage:
0.80 mm (0.0315 in.)

If the warpage is more than the maximum, replace the exhaust manifold.



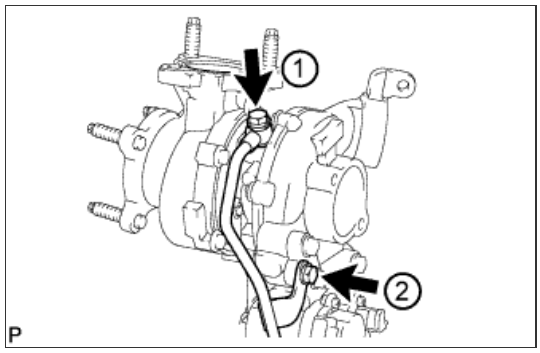
for Preparation Click here

1. INSTALL NO. 2 INLET TURBO OIL PIPE SUB-ASSEMBLY (for Bank 2)

a. Temporarily install a new gasket and the No. 2 inlet turbo oil pipe with the union bolt and bolt.

b. Tighten the union bolt and bolt in the order shown in the illustration.

Torque:
for union bolt:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



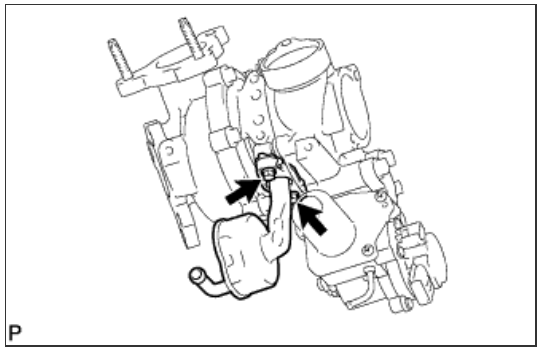
2. INSTALL NO. 2 TURBO OIL PIPE (for Bank 2)

a. Install a new gasket and the No. 2 turbo oil pipe with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

HINT:

The gasket claws should face the pipe.



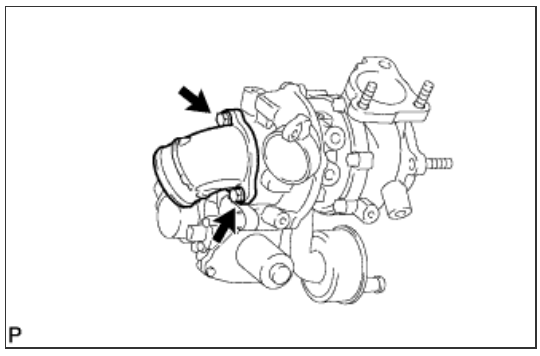
3. INSTALL NO. 2 INLET COMPRESSOR ELBOW (for Bank 2)

a. Install a new gasket and the No. 2 inlet compressor elbow with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

HINT:

Install the No. 2 inlet compressor elbow with the "L" mark facing toward the outside of the vehicle.



4. INSTALL NO. 2 TURBOCHARGER SUB-ASSEMBLY WITH EXHAUST MANIFOLD LH (for Bank 2)

a. Set a new gasket to the No. 2 turbocharger.

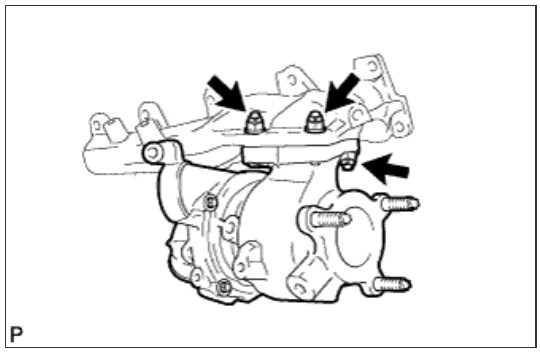
b. Install the exhaust manifold LH to the No. 2 turbocharger with 3 new nuts.

Torque:

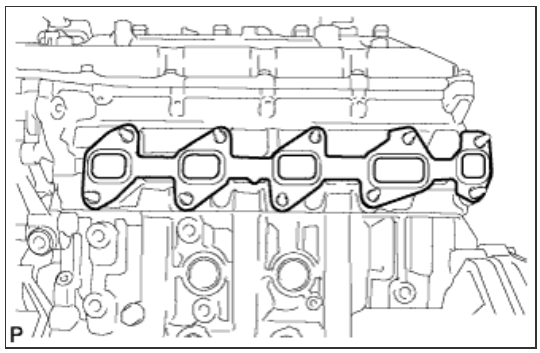
60 N*m{ 612 kgf*cm , 44 ft.*lbf }

HINT:

The gasket claw should face toward the outside of the vehicle.



c. Set a new gasket to the cylinder head LH.

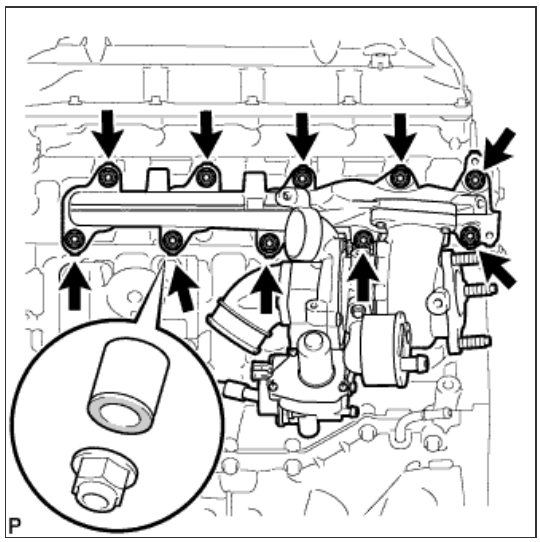


d. Install the No. 2 turbocharger with exhaust manifold LH and 10 collars to the cylinder head LH with 10 new nuts.

Torque:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }

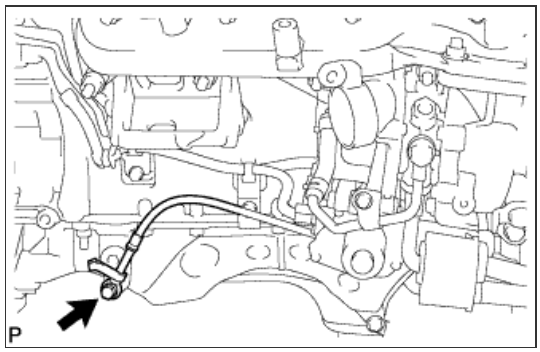
HINT:

Install the collars with the colored side facing the nuts.

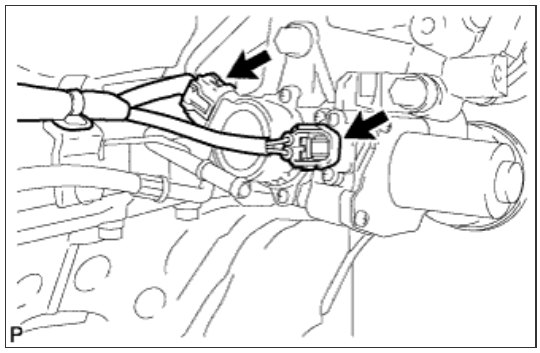


e. Install a new gasket and the No. 2 inlet turbo oil pipe to the No. 1 oil pan with the union bolt.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



f. Connect the 2 connectors to the turbocharger.



5. INSTALL NO. 2 VENTILATION TUBE SUB-ASSEMBLY (for Bank 2)

a. Temporarily install a new gasket and the No. 2 ventilation tube with the union bolt and bolt.

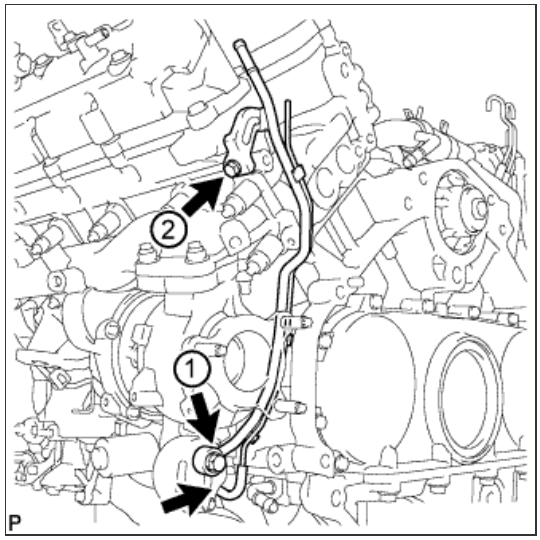
b. Tighten the union bolt and bolt in the order shown in the illustration.

Torque:
for union bolt:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

NOTICE:

Clean and remove any oil labeled 1shown in the illustration.

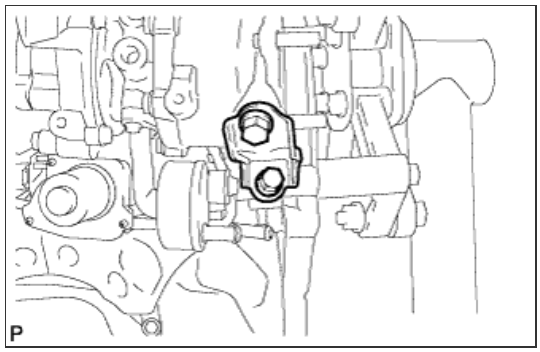
c. Connect the No. 2 vacuum transmitting hose.



6. INSTALL NO. 2 TURBOCHARGER STAY (for Bank 2)

a. Install the No. 2 turbocharger stay with the 2 bolts.

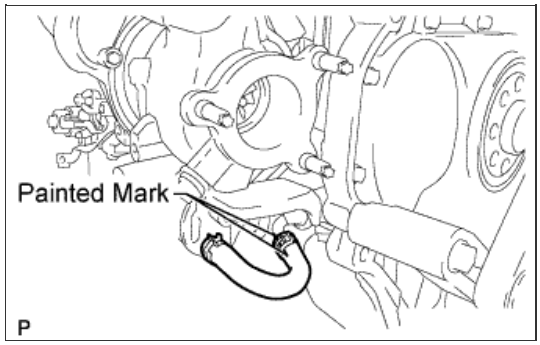
Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }



7. CONNECT NO. 2 OUTLET TURBO OIL HOSE (for Bank 2)

HINT:

Align the white paint marks on the oil hose and pipe, and connect the hose.



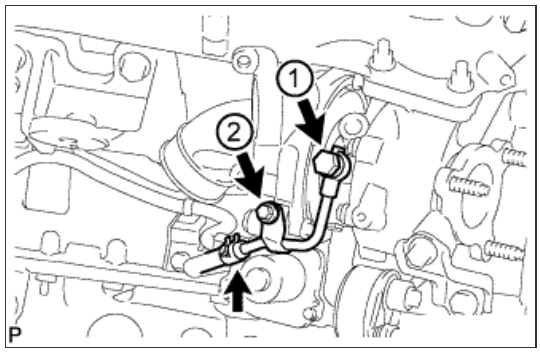
8. INSTALL NO. 2 TURBO WATER PIPE SUB-ASSEMBLY (for Bank 2)

a. Temporarily install a new gasket and the No. 2 turbo water pipe with the union bolt and bolt.

b. Tighten the union bolt and bolt in the order shown in the illustration.

Torque:
for union bolt:
35 N*m{ 357 kgf*cm , 26 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

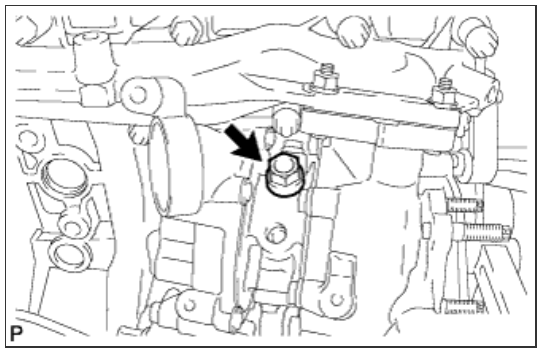
c. Connect the water hose to the pipe.



9. INSTALL FRONT WATER BY-PASS JOINT (for Bank 2)

a. Install a new gasket and the front water by-pass joint.

Torque:
50 N*m{ 510 kgf*cm , 37 ft.*lbf }

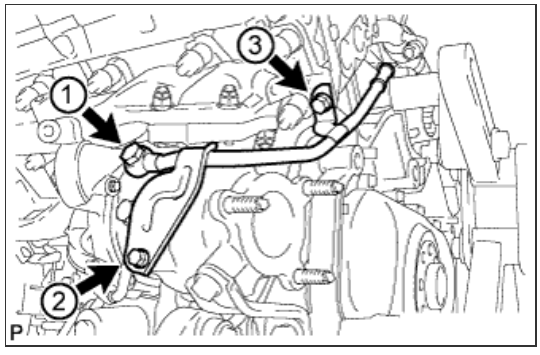


10. INSTALL NO. 3 TURBO WATER PIPE SUB-ASSEMBLY (for Bank 2)

a. Temporarily install a new gasket and the No. 3 turbo water pipe with the union bolt and 2 bolts.

b. Tighten the union bolt and 2 bolts in the order shown in the illustration.

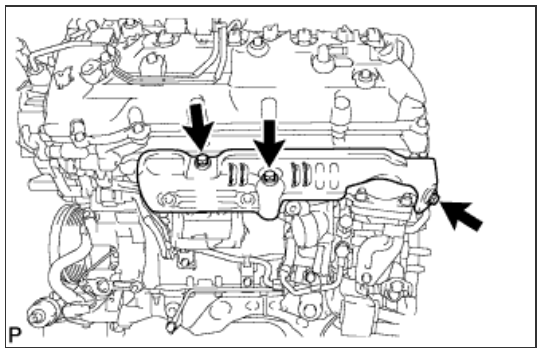
Torque:
for union bolt:
35 N*m{ 357 kgf*cm , 26 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



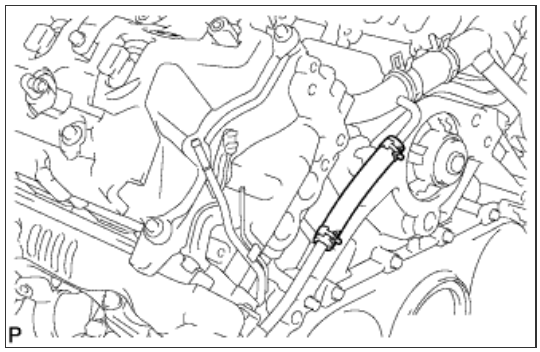
11. INSTALL NO. 2 EXHAUST MANIFOLD HEAT INSULATOR (for Bank 2)

a. Install the No. 2 exhaust manifold heat insulator with the 3 bolts.

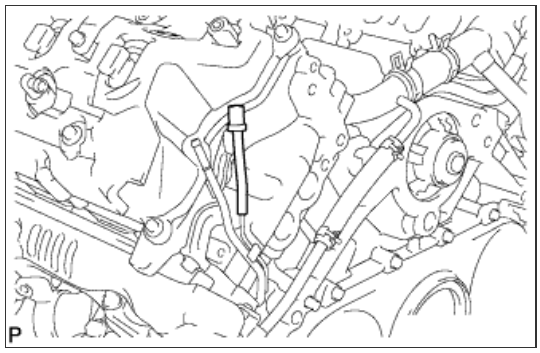
Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }



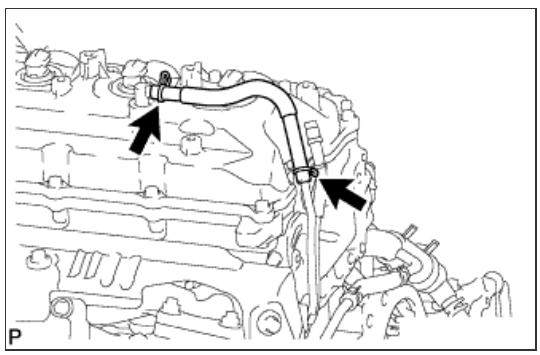
12. CONNECT NO. 2 TURBO WATER HOSE (for Bank 2)



13. CONNECT BREATHER PLUG LH (for Bank 2)



14. CONNECT NO. 3 VENTILATION HOSE (for Bank 2)

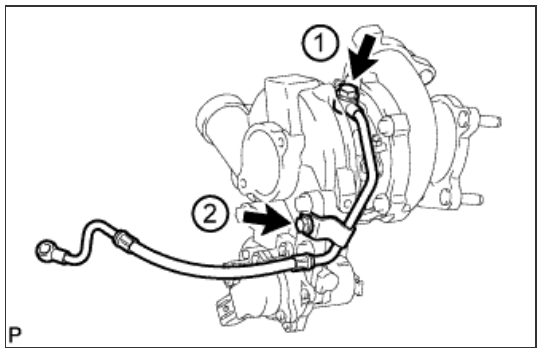


15. INSTALL NO. 1 INLET TURBO OIL PIPE SUB-ASSEMBLY (for Bank 1)

a. Temporarily install a new gasket and the No. 1 inlet turbo oil pipe with the union bolt and bolt.

b. Tighten the union bolt and bolt in the order shown in the illustration.

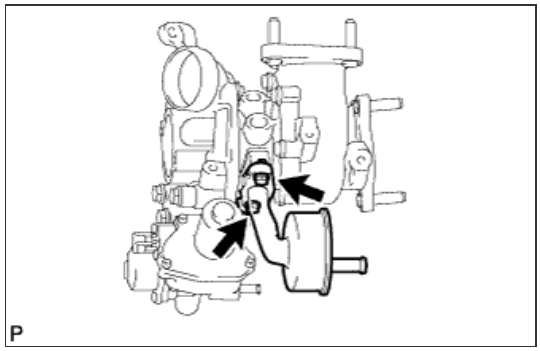
Torque:
for union bolt:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



16. INSTALL NO. 1 TURBO OIL PIPE (for Bank 1)

a. Install a new gasket and the No. 1 turbo oil pipe with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



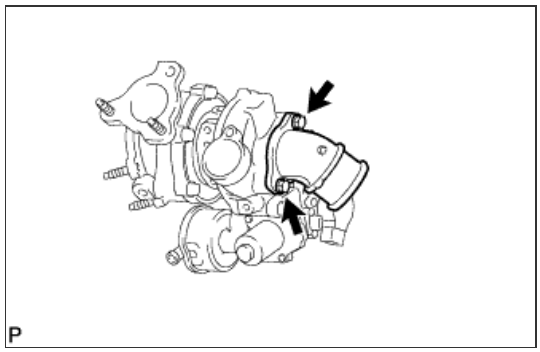
17. INSTALL NO. 1 INLET COMPRESSOR ELBOW (for Bank 1)

a. Install a new gasket and the No. 1 inlet compressor elbow with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

HINT:

Install the No. 1 inlet compressor elbow with the "R" mark facing toward the outside of the vehicle.

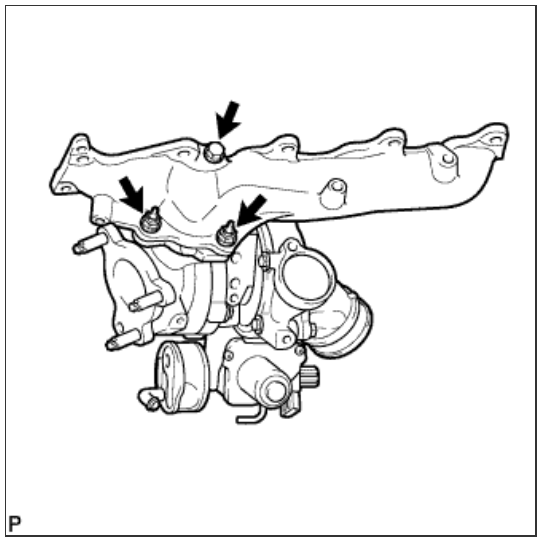


18. INSTALL NO. 1 TURBOCHARGER SUB-ASSEMBLY WITH EXHAUST MANIFOLD RH (for Bank 1)

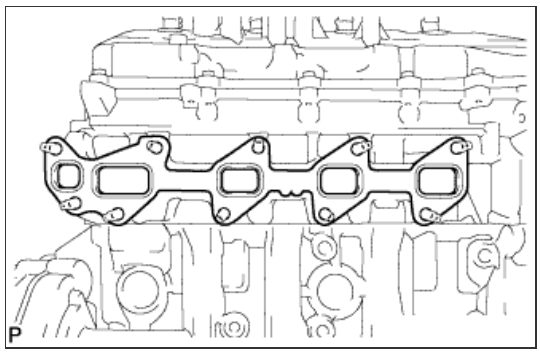
a. Set a new gasket to the No. 1 turbocharger.

b. Install the exhaust manifold RH to the No. 1 turbocharger with 2 new nuts and the bolt.

Torque:
60 N*m{ 612 kgf*cm , 44 ft.*lbf }



c. Set a new gasket to the cylinder head RH.

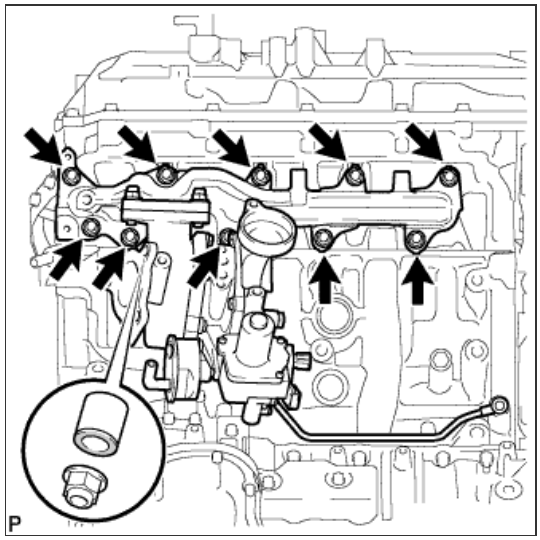


d. Install the No. 1 turbocharger with exhaust manifold RH to the cylinder head RH with the 10 collars and 10 new nuts.

Torque:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }

HINT:

Install the collars with the colored side facing the nuts.

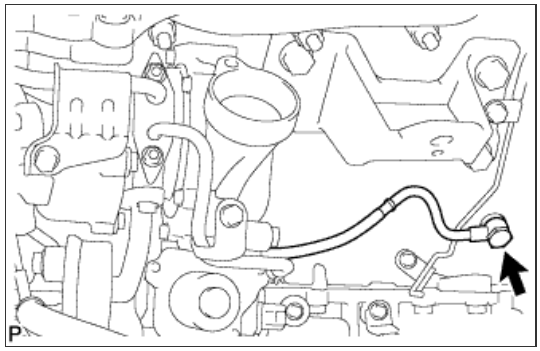


e. Install a new gasket and the No. 1 inlet turbo oil pipe to the cylinder block with the union bolt.

Torque:
Case i dry:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }
Case i et
23 N*m{ 235 kgf*cm , 17 ft.*lbf }

NOTICE:

- **The ca e i dry" when there i olutel no engine oil on the union bolt and c lider block bolt hole.**
- **The ca e i et hen the engine oil on the union bolt and c lider block bolt hole.**



19. INSTALL NO. 1 VENTILATION TUBE SUB-ASSEMBLY (for Bank 1)

a. Temporarily install a new gasket and the No. 1 ventilation tube with the union bolt and bolt.

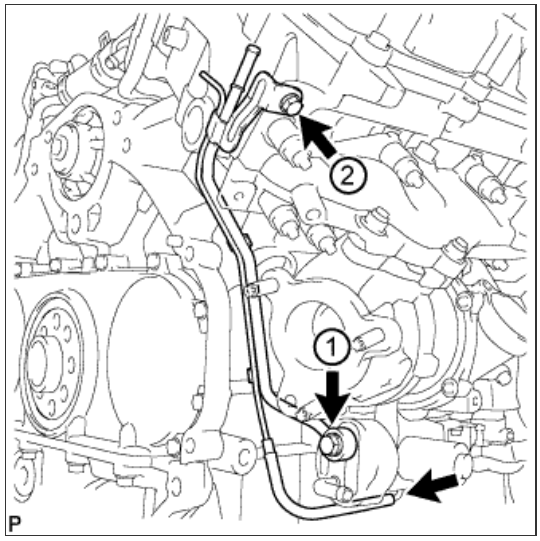
b. Tighten the union bolt and bolt in the order shown in the illustration.

Torque:
for union bolt:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }
for bolt:
10 N*m{ 102 kgf*cm , 7 in.*lbf }

NOTICE:

Clean and remove any oil labeled 1 shown in the illustration.

c. Connect the vacuum hose.

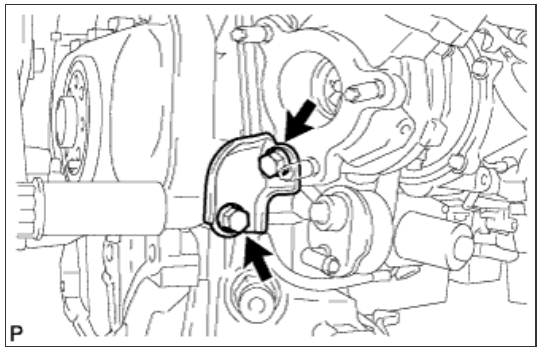


20. INSTALL NO. 1 TURBOCHARGER STAY (for Bank 1)

a. Temporarily install the No. 1 turbocharger stay with the 2 bolts.

b. Tighten the 2 bolts.

Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }

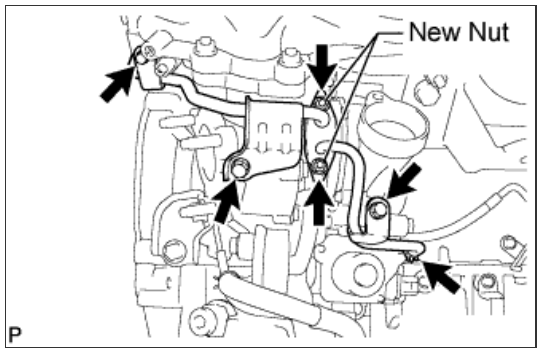


21. INSTALL NO. 1 TURBO WATER PIPE SUB-ASSEMBLY (for Bank 1)

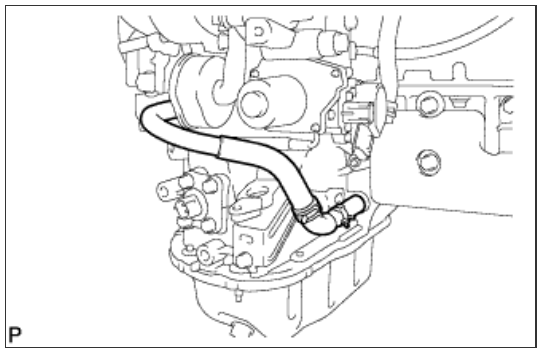
a. Install a new gasket and the No. 1 turbo water pipe with 2 new nuts and 3 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Connect the water hose.



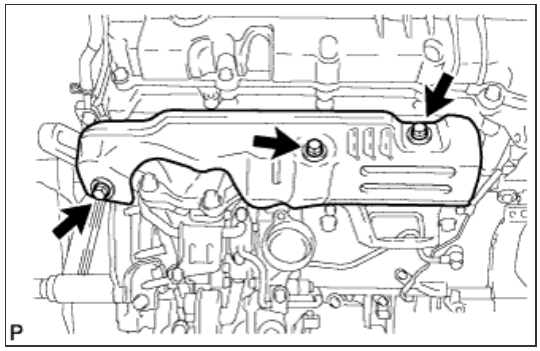
22. CONNECT NO. 1 OUTLET TURBO OIL HOSE (for Bank 1)



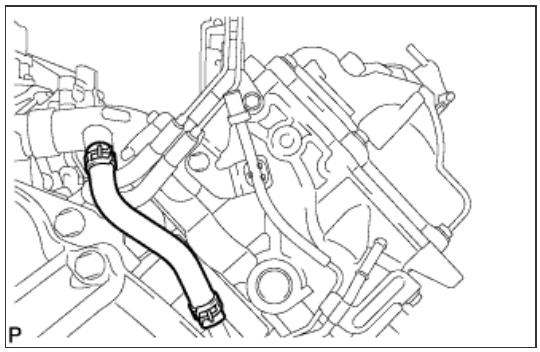
23. INSTALL NO. 1 EXHAUST MANIFOLD HEAT INSULATOR (for Bank 1)

a. Install the No. 1 exhaust manifold heat insulator with the 3 bolts.

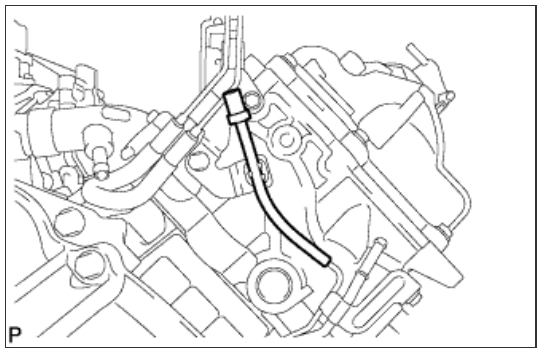
Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }



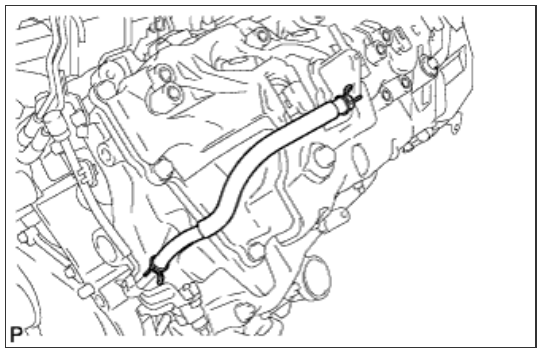
24. CONNECT NO. 2 TURBO WATER HOSE (for Bank 1)



25. CONNECT BREATHER PLUG RH (for Bank 1)



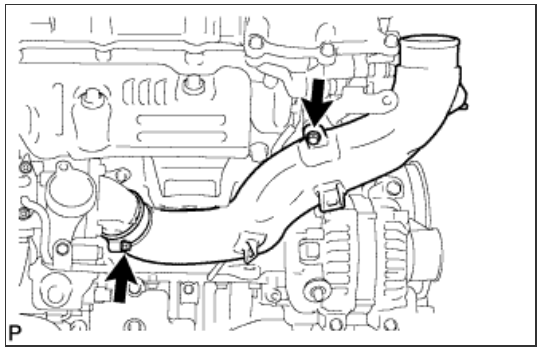
26. CONNECT NO. 2 VENTILATION HOSE (for Bank 1)



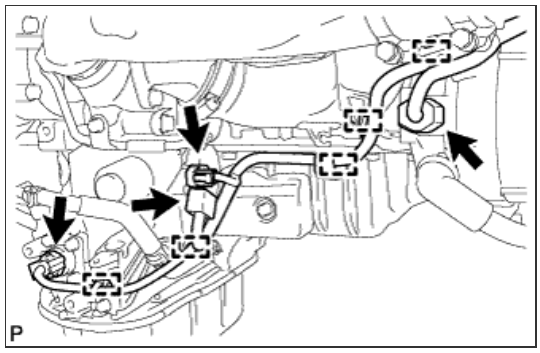
27. INSTALL NO. 1 INTA E AIR CONNECTOR PIPE (for Bank 1)

a. Install the No. 1 intake air connector pipe with the bolt. Then tighten the hose clamp.

Torque:
for bolt:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for clamp:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }



b. Connect the 4 connectors and attach the 5 wire harness clamps.

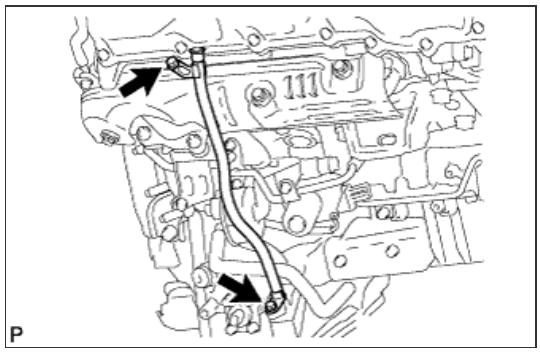


28. INSTALL NO. 1 ENGINE OIL LEVEL DIPSTIC GUIDE (for Bank 1)

a. Apply a light coat of engine oil to a new O-ring and install it to the No. 1 engine oil level dipstick guide.

b. Install the No. 1 engine oil level dipstick guide with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



29. INSTALL ENGINE ASSEMBLY

a. Install the engine assembly to the vehicle (Click here).

30. INSPECT FOR OIL LEA

a. Warm up the engine and check for an engine oil leak.

31. INSPECT FOR COOLANT LEA

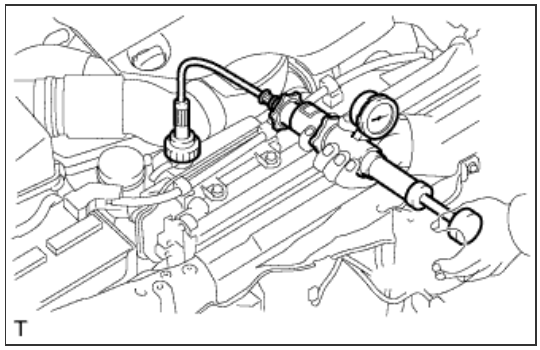
CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester to the radiator reservoir.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 17.8 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks.
If no external leaks are found, check the cylinder block and cylinder head.



32. CHEC ENGINE OIL LEVEL

a. Warm up the engine, stop the engine and wait 5 minutes. The engine oil level should be between the dipstick low level mark and full level mark.
If low, check for leakage and add oil up to the full level mark.

NOTICE:

Do not fill engine oil above the full level mark.

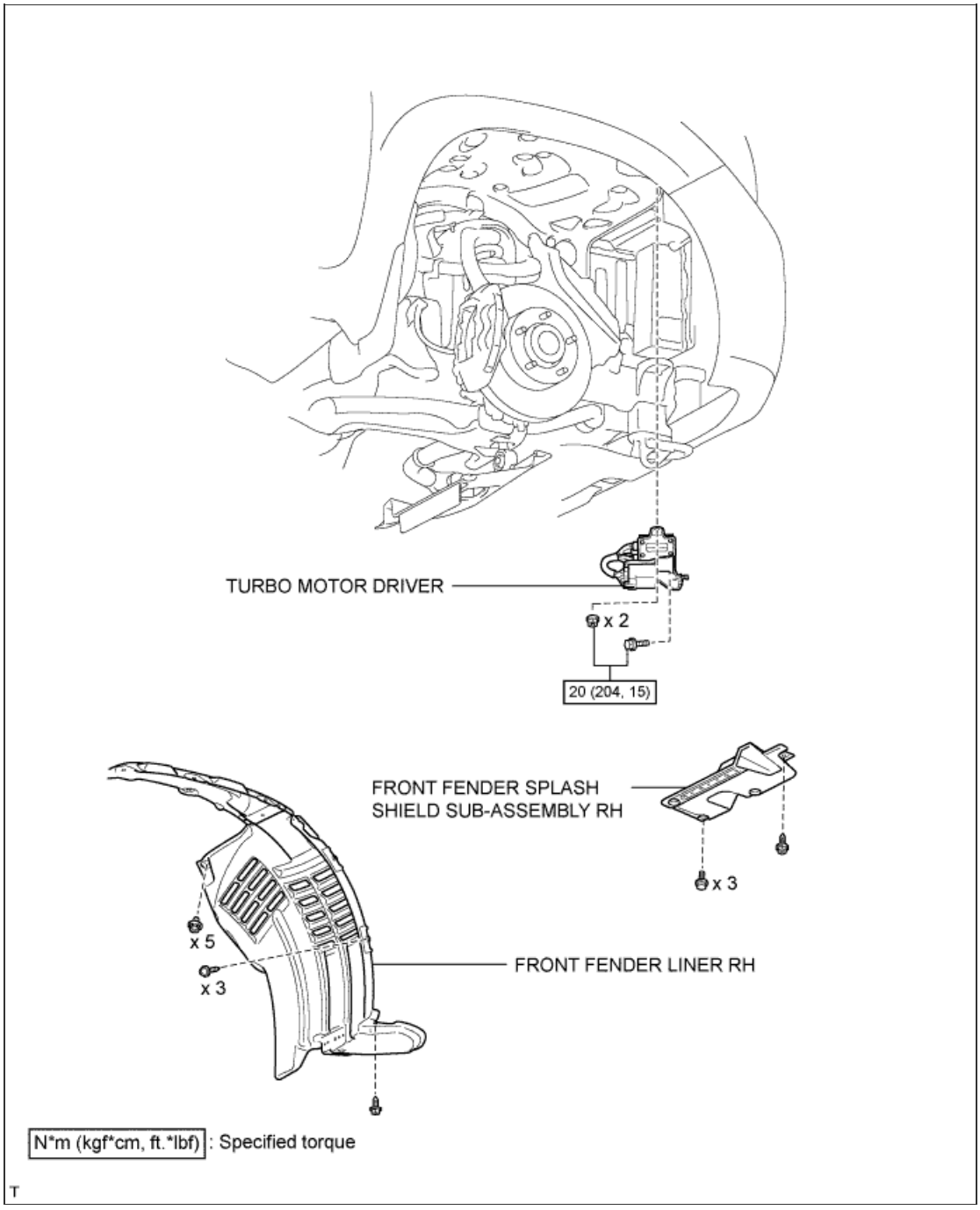
33. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

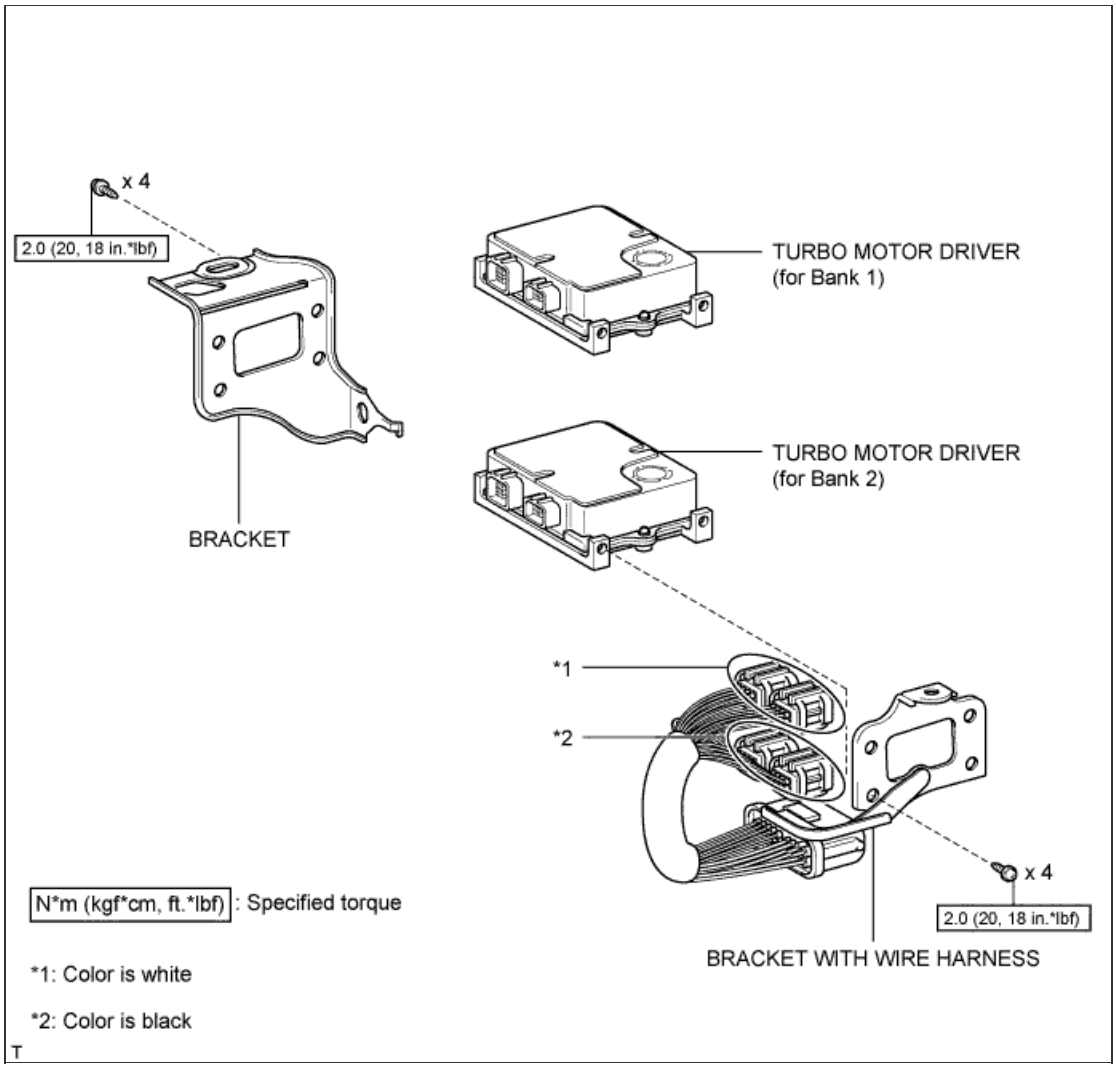
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Connect the cables to negative (-) main battery and sub-battery terminals.

for Preparation Click here




x 4
2.0 (20, 18 in.*lbf)
BRACKET
TURBO MOTOR DRIVER
(for Bank 1)
TURBO MOTOR DRIVER
(for Bank 2)
*1
*2
x 4
2.0 (20, 18 in.*lbf)
BRACKET WITH WIRE HARNESS
N*m (kgf*cm, ft.*lbf) : Specified torque
*1: Color is white
*2: Color is black

T

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Disconnect the cables from the negative (-) main battery and sub-battery terminals.

2. REMOVE FRONT FENDER SPLASH SHIELD SUB ASSEMBLY RH

a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.

3. REMOVE FRONT FENDER LINER RH

a. Remove the screw and disconnect the liner from the front bumper cover.

b. Using a T30 "TORX" socket, remove the 3 screws.

c. Remove the 5 clips.

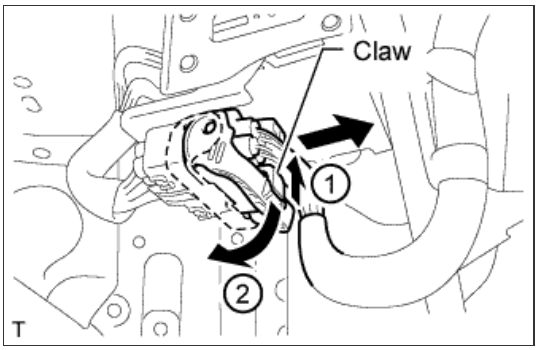
HINT:

It is not necessary to fully remove the fender liner. Partially remove it so that the air pump can be removed.

4. REMOVE TURBO MOTOR DRIVER

a. Disconnect the connector.

i. Disconnect the connector as follows: (1) push the claw upward, and (2) move the lock lever to release the lock.

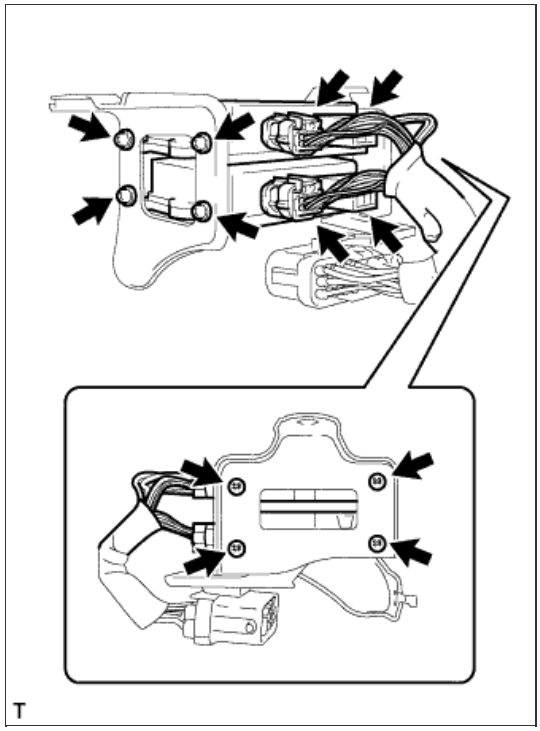


b. Remove 2 nuts, bolt and turbo motor driver.



c. Disconnect the 4 connectors from the turbo motor driver.

d. Remove the 8 screws and 2 turbo motor drivers from the brackets.



for Preparation Click here

1. INSTALL TURBO MOTOR DRIVER

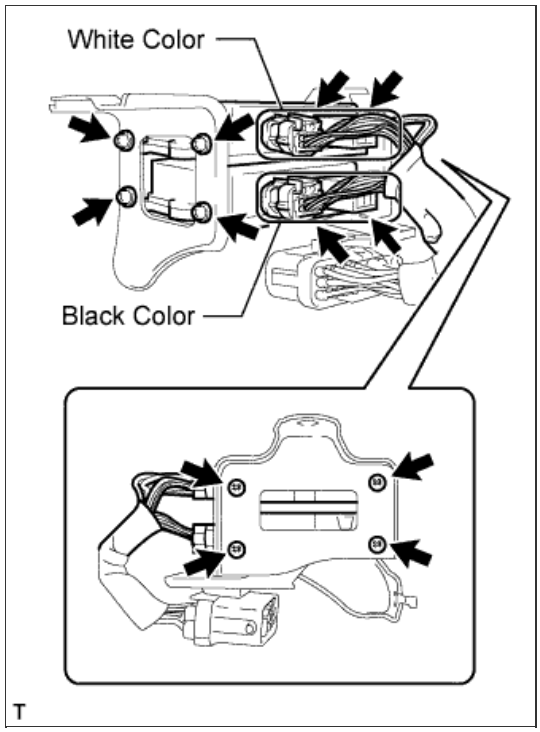
a. Install the 2 turbo motor drivers to the brackets with the 8 screws.

Torque:
2.0 N*m{ 20 kgf*cm , 18 in.*lbf }

b. Connect the 4 connectors to the turbo motor driver.

NOTICE:

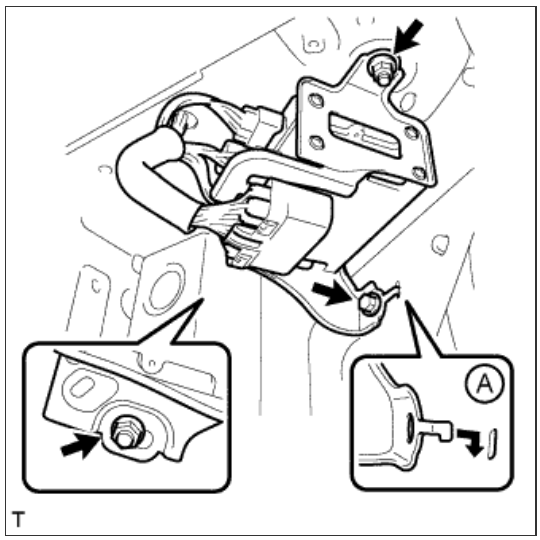
- **Mach the 10 pin and 4 pin connector colors when connecting them to the turbo motor driver.**
- **Make sure to connect the white connectors to the upper side and the black connectors to the lower side.**



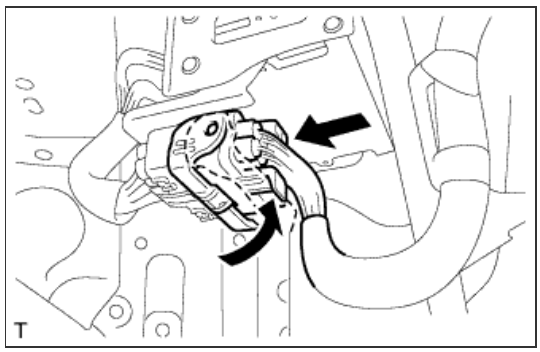
c. Insert the bracket tab into the slot labeled A and insert the 2 stud bolts into the bracket hole as shown in illustration.

d. Install the 2 nuts and bolt.

Torque:
20 N*m{ 199 kgf*cm , 14 ft.*lbf }



e. Connect the connector. Then move the lock lever as shown in the illustration to lock the connectors.



2. INSTALL FRONT FENDER LINER RH

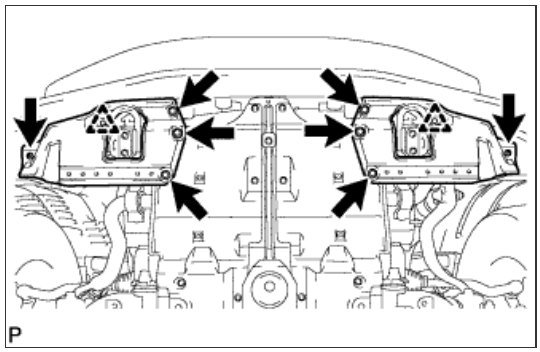
a. Install the fender liner with the 5 clips.

b. Using a T30 "TORX" socket, install the 3 screws.

c. Connect the liner to the front bumper cover with the screw.

3. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

a. Install the splash shield with the clip, and then install the 3 bolts and screw.



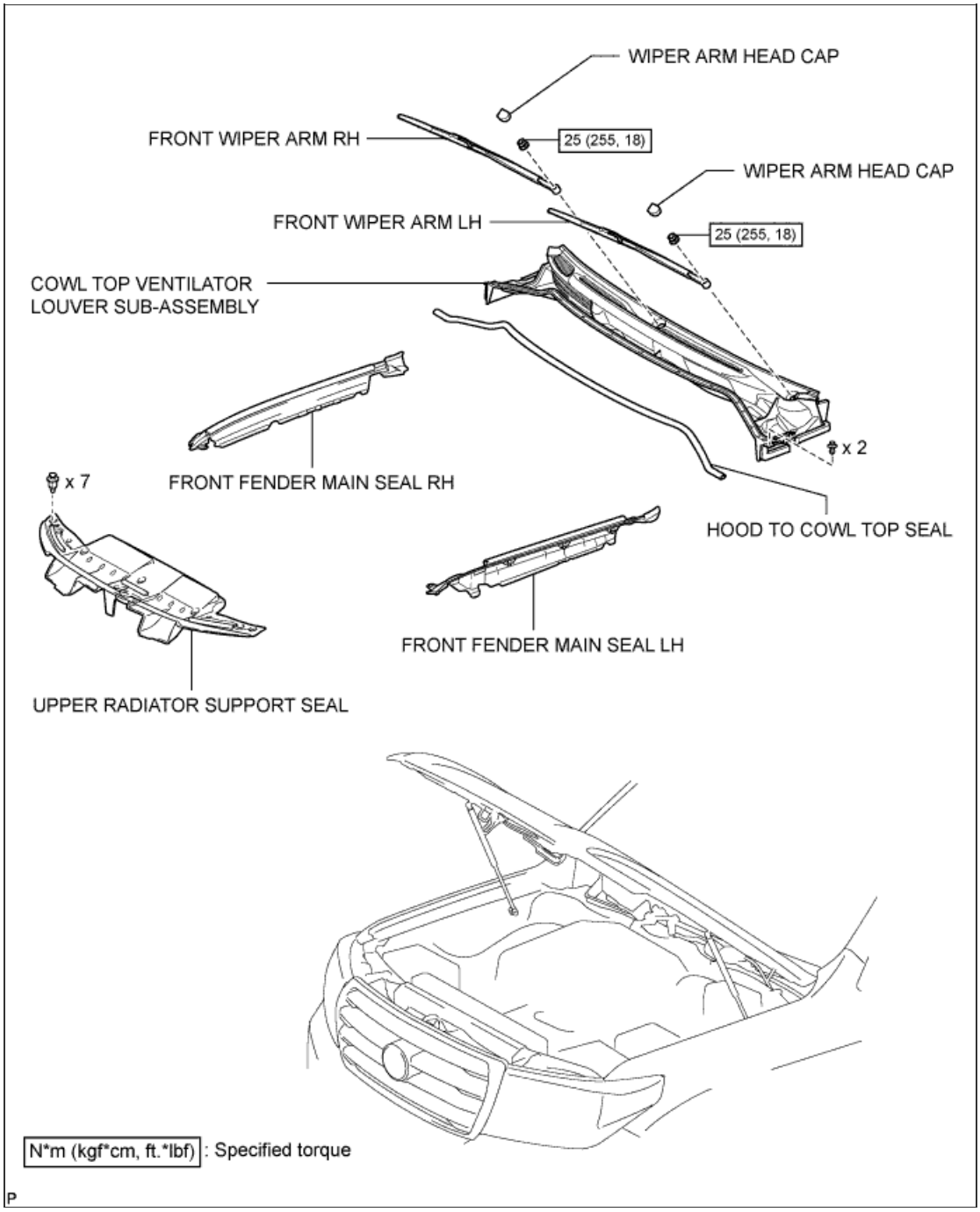
4. CONNECT CABLE TO NEGATIVE NEGATIVE BATTERY TERMINAL

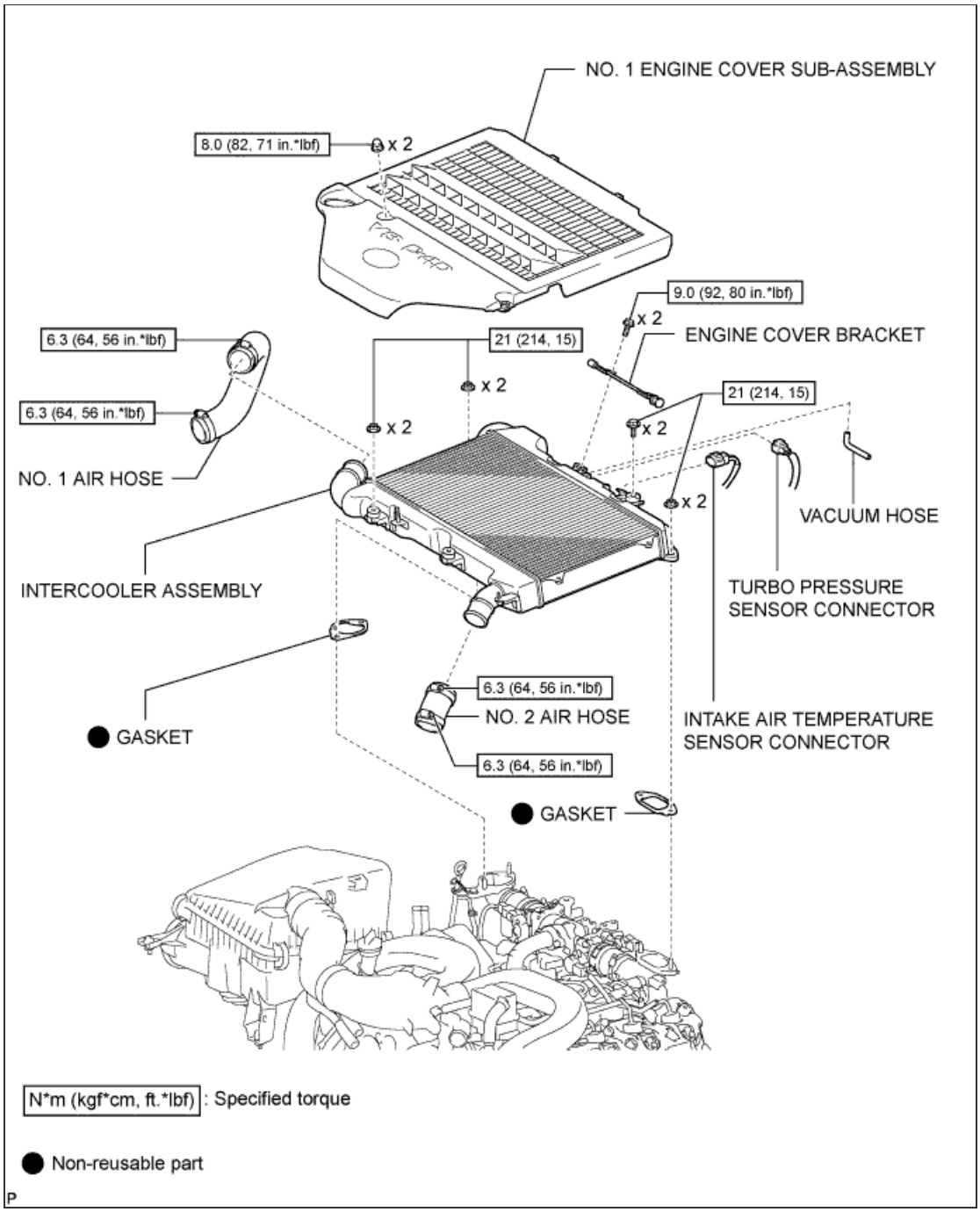
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Connect the cables to the negative (-) main battery and sub-battery terminals.

for Preparation [Click here]




NO. 1 ENGINE COVER SUB-ASSEMBLY
8.0 (82, 71 in.*lbf)
x 2
9.0 (92, 80 in.*lbf)
x 2
ENGINE COVER BRACKET
6.3 (64, 56 in.*lbf)
6.3 (64, 56 in.*lbf)
NO. 1 AIR HOSE
21 (214, 15)
x 2
x 2
21 (214, 15)
x 2
x 2
VACUUM HOSE
INTERCOOLER ASSEMBLY
TURBO PRESSURE SENSOR CONNECTOR
GASKET
6.3 (64, 56 in.*lbf)
NO. 2 AIR HOSE
6.3 (64, 56 in.*lbf)
INTAKE AIR TEMPERATURE SENSOR CONNECTOR
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

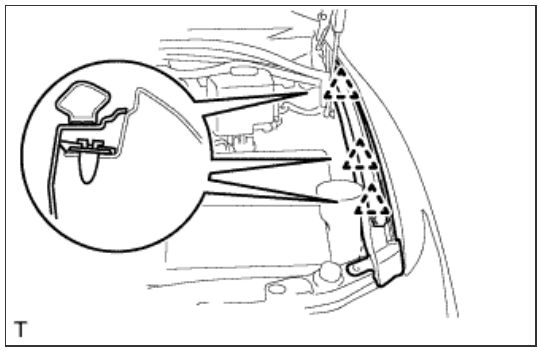
for Preparation Click here

1. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and upper radiator support seal.

2. REMOVE FRONT FENDER MAIN SEAL LH

a. Using a clip remover, detach the 3 clips and remove the fender main seal.



3. REMOVE FRONT FENDER MAIN SEAL RH

HINT:

Use the same procedures described for the LH side.

4. REMOVE FRONT WIPER ARM LH

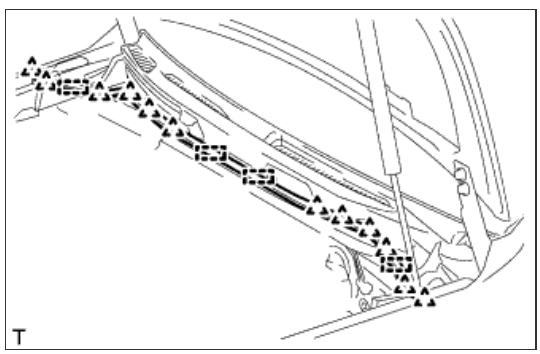
a. Remove the nut, wiper arm and blade.

5. REMOVE FRONT WIPER ARM RH

a. Remove the nut, wiper arm and blade.

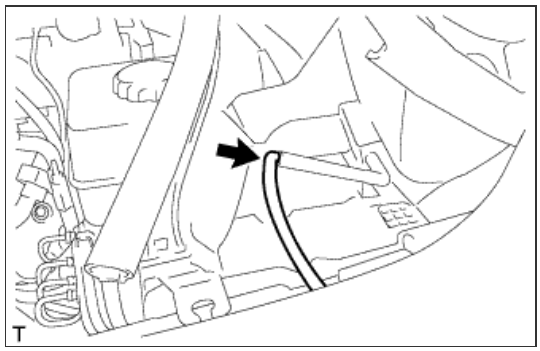
6. REMOVE HOOD TO COWL TOP SEAL

a. Using a clip remover, detach the 12 clips, 4 clamps and remove the hood to cowl top seal.



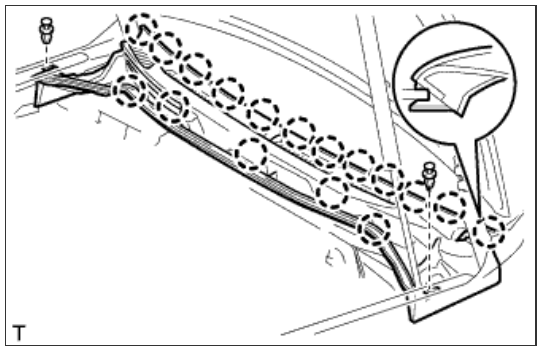
7. REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Remove the washer hose.



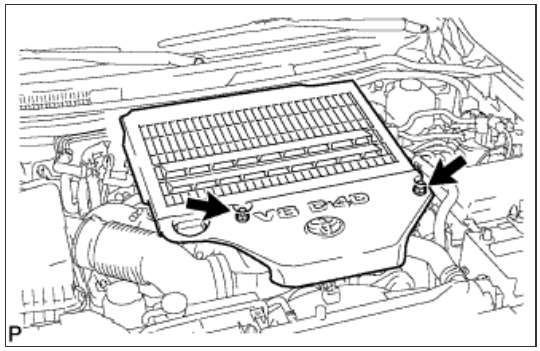
b. Remove the 2 clips.

c. Detach the 17 claws and remove the cowl top ventilator louver sub-assembly.



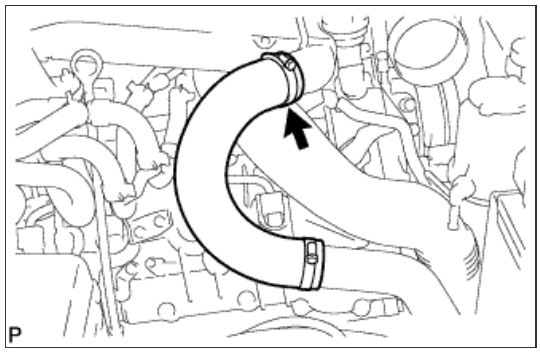
8. REMOVE NO. 1 ENGINE COVER SUB-ASSEMBLY

a. Remove the 2 nuts and No. 1 engine cover.

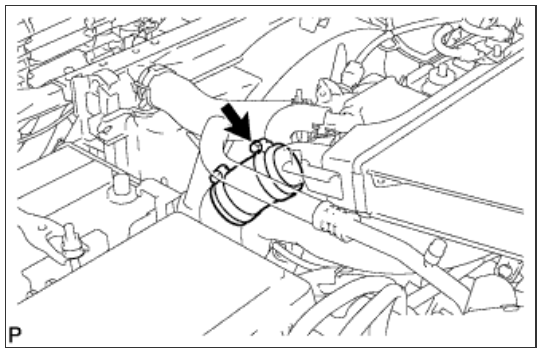


9. REMOVE INTERCOOLER ASSEMBLY

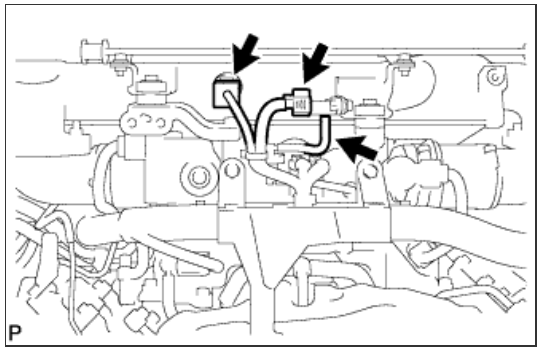
a. Loosen the No. 1 air hose clamp.



b. Loosen the No. 2 air hose clamp.



c. Disconnect the turbo pressure sensor connector, intake air temperature sensor connector and vacuum hose.



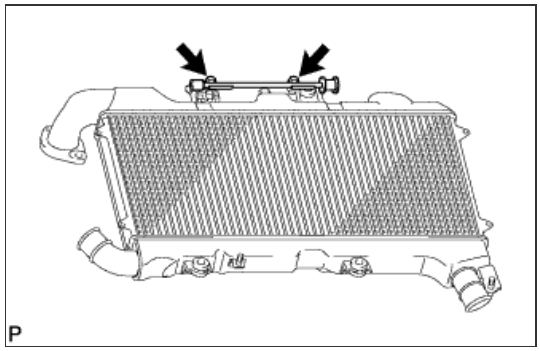
d. Remove the 6 nuts, 2 bolts and intercooler.

e. Remove the 2 gaskets from the air tube LH and RH.



10. REMOVE ENGINE COVER BRACKET

a. Remove the 2 bolts and engine cover bracket.

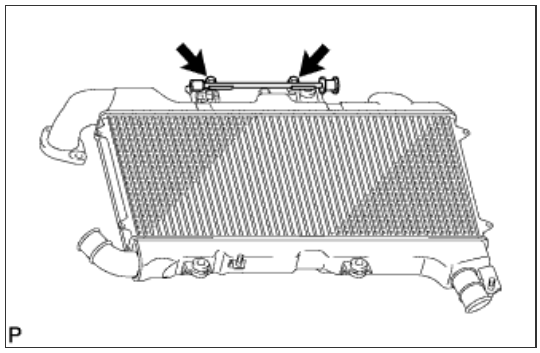


for Preparation Click here

1. INSTALL ENGINE COVER BRACKET

a. Install the engine cover bracket with the 2 bolts.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }

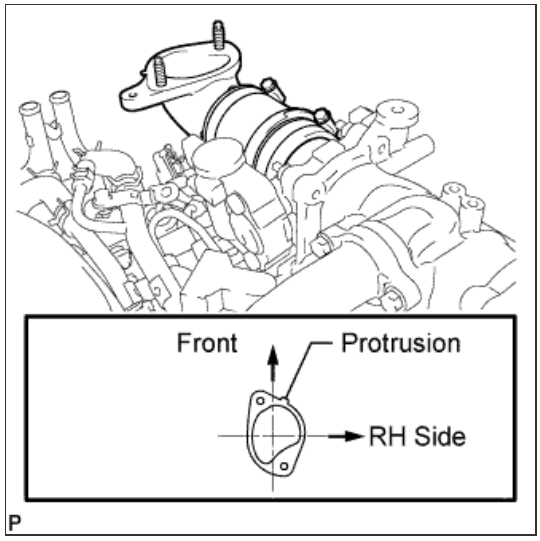


2. INSTALL INTERCOOLER ASSEMBLY

a. Install a new gasket to the air tube RH.

HINT:

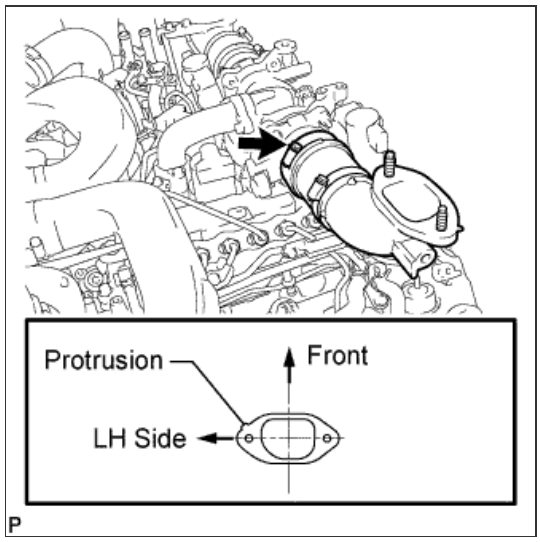
Install the gasket with the protrusion facing as shown in the illustration.



b. Install a new gasket to the air tube LH.

HINT:

Install the gasket with the protrusion facing as shown in the illustration.



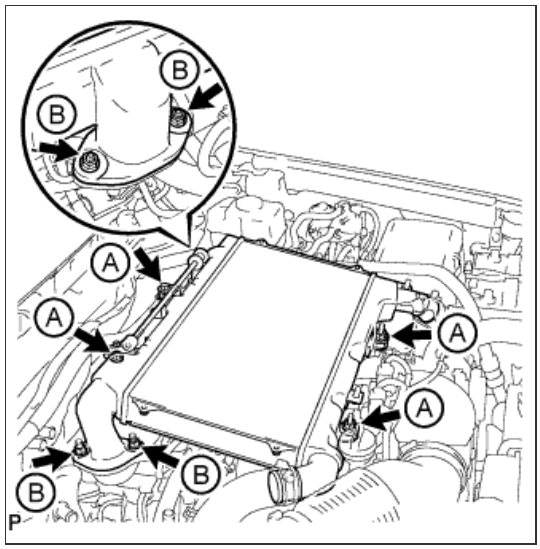
c. Align the No. 1 and No. 2 air hoses and intercooler pipes and connect them, and install the intercooler with the 2 bolts and 2 nuts labeled A in the illustration.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

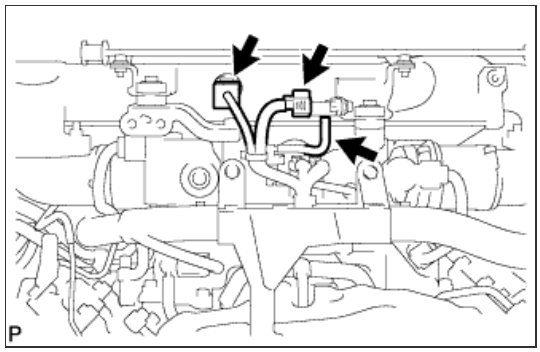
. Temporarily install the 4 nuts labeled B in the illustration.

e. Tighten the air tube LH and RH with the 4 nuts labeled B shown in the illustration.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



f. Connect the vacuum hose, intake air temperature sensor connector and turbo pressure sensor connector.

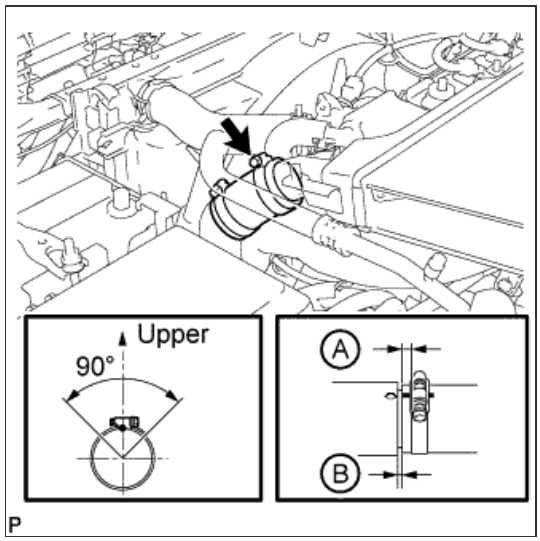


g. Tighten the clamp of the No. 2 air hose.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion an push in the air hose so that istance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that istance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make sure the irection of the hose clamp is as shown in the illustration.**

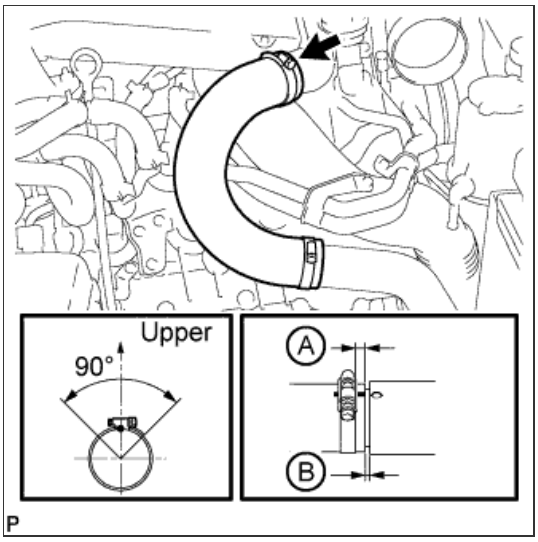


h. Tighten the clamp of the No. 1 air hose.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

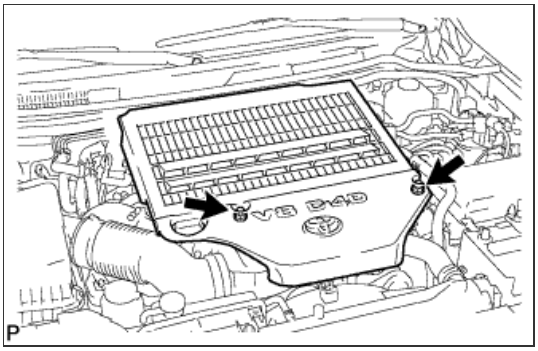
- **Align the paint mark of the air hose with the protrusion an push in the air hose so that istance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that istance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make sure the irection of the hose clamp is as shown in the illustration.**



3. INSTALL NO. 1 ENGINE COVER SUB-ASSEMBLY

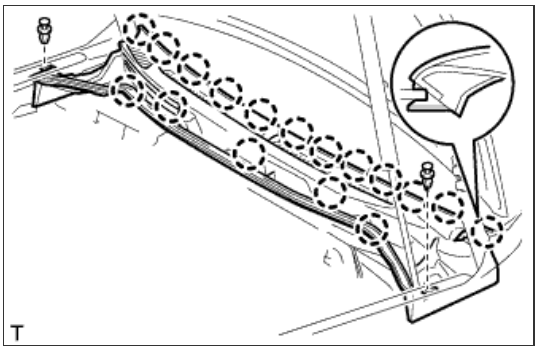
a. Install the engine cover with the 2 nuts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }



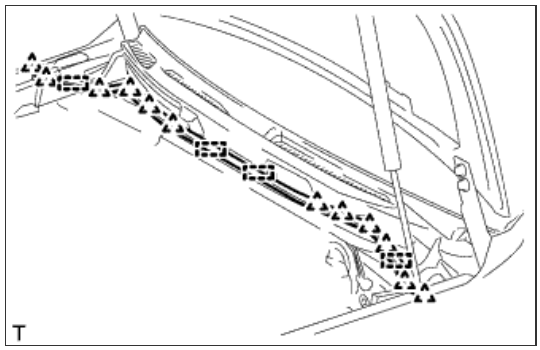
4. INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

a. Push the ventilator louver in the direction indicated by the arrow in the illustration to attach the 17 claws and 2 clips and install the ventilator louver.

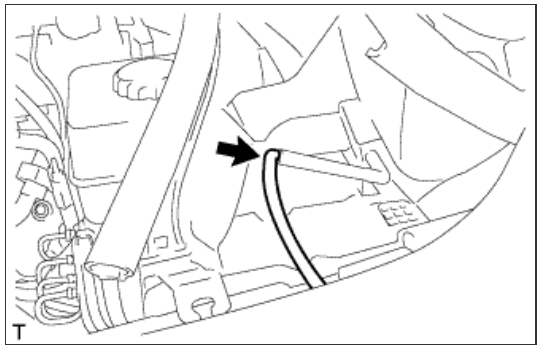


5. INSTALL HOOD TO COWL TOP SEAL

a. Attach the 12 clips and 4 clamps to install the hood to cowl top seal.

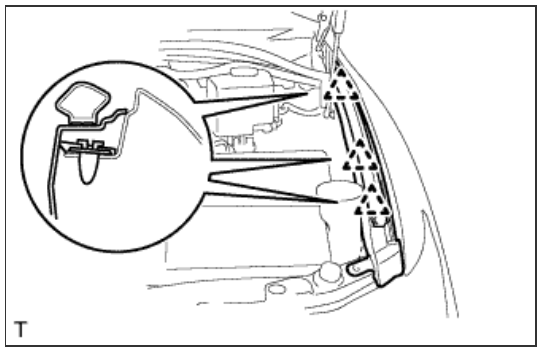


b. Install the washer hose.



6. INSTALL FRONT FENDER MAIN SEAL LH

a. Attach the 3 clips to install the fender main seal.



7. INSTALL FRONT FENDER MAIN SEAL RH

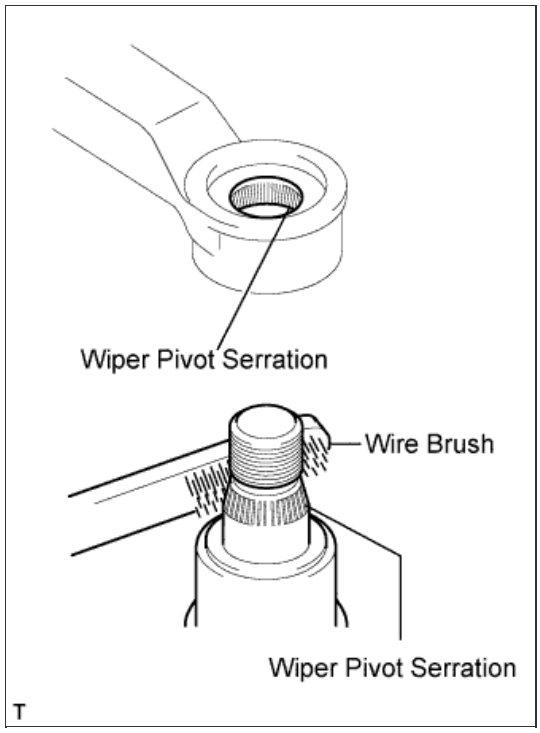
HINT:

Use the same procedures described for the LH side.

8. INSTALL FRONT WIPER ARM LH

a. Stop the wiper motor at the automatic stop position.

b. Clean the wiper pivot serration with a wire brush.



c. Install the wiper arm and blade with the nut. Make sure that the wiper arm and blade comes to the position shown in the illustration.

Stan ar Measurement:

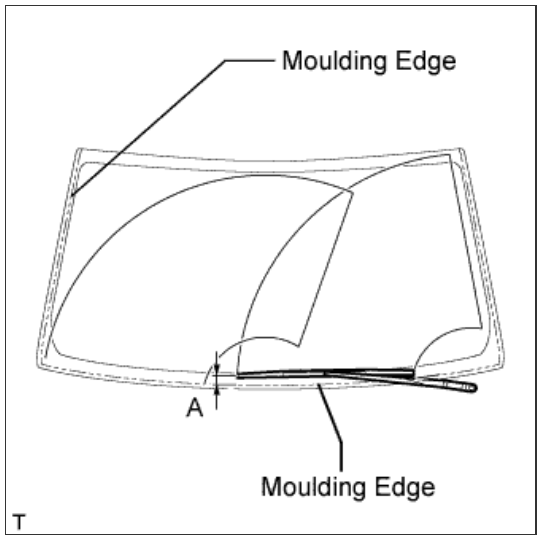
Position	Specified Condition
A	16.8 to 36.8 mm (0.661 to 1.45 in.)

Torque:

25 N*m{ 255 kgf*cm , 18 ft.*lbf }

HINT:

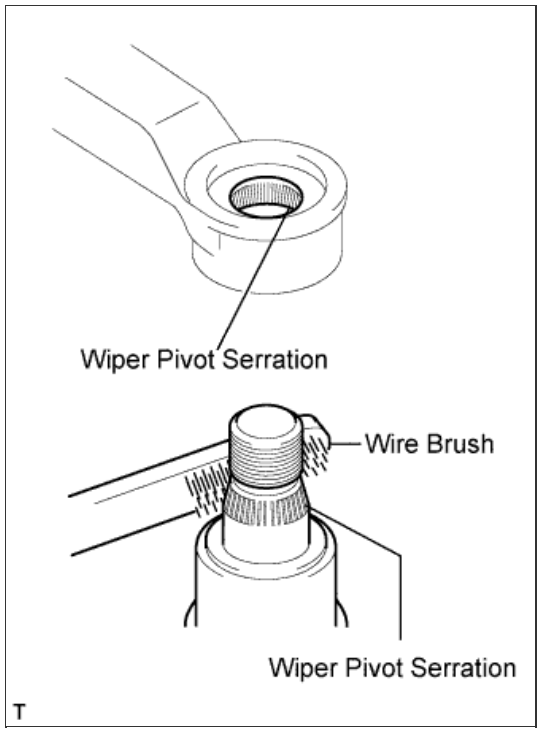
Hold down the wiper arm hinge with your hand while tightening the nut.



9. INSTALL FRONT WIPER ARM RH

a. Stop the wiper motor at the automatic stop position.

b. Clean the wiper pivot serration with a wire brush.



c. Install the wiper arm and blade with the nut. Make sure that the wiper arm and blade comes to the position shown in the illustration.

Stan ar Measurement:

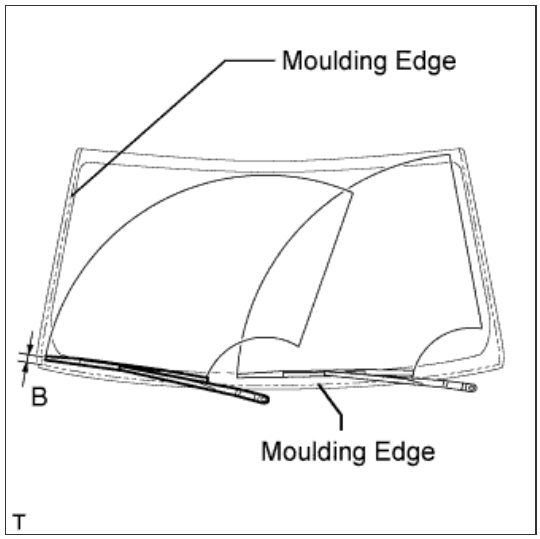
Position	Specified Condition
B	20.0 to 40.0 mm (0.787 to 1.57 in.)

Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }

HINT:

Hold down the wiper arm hinge with your hand while tightening the nut.

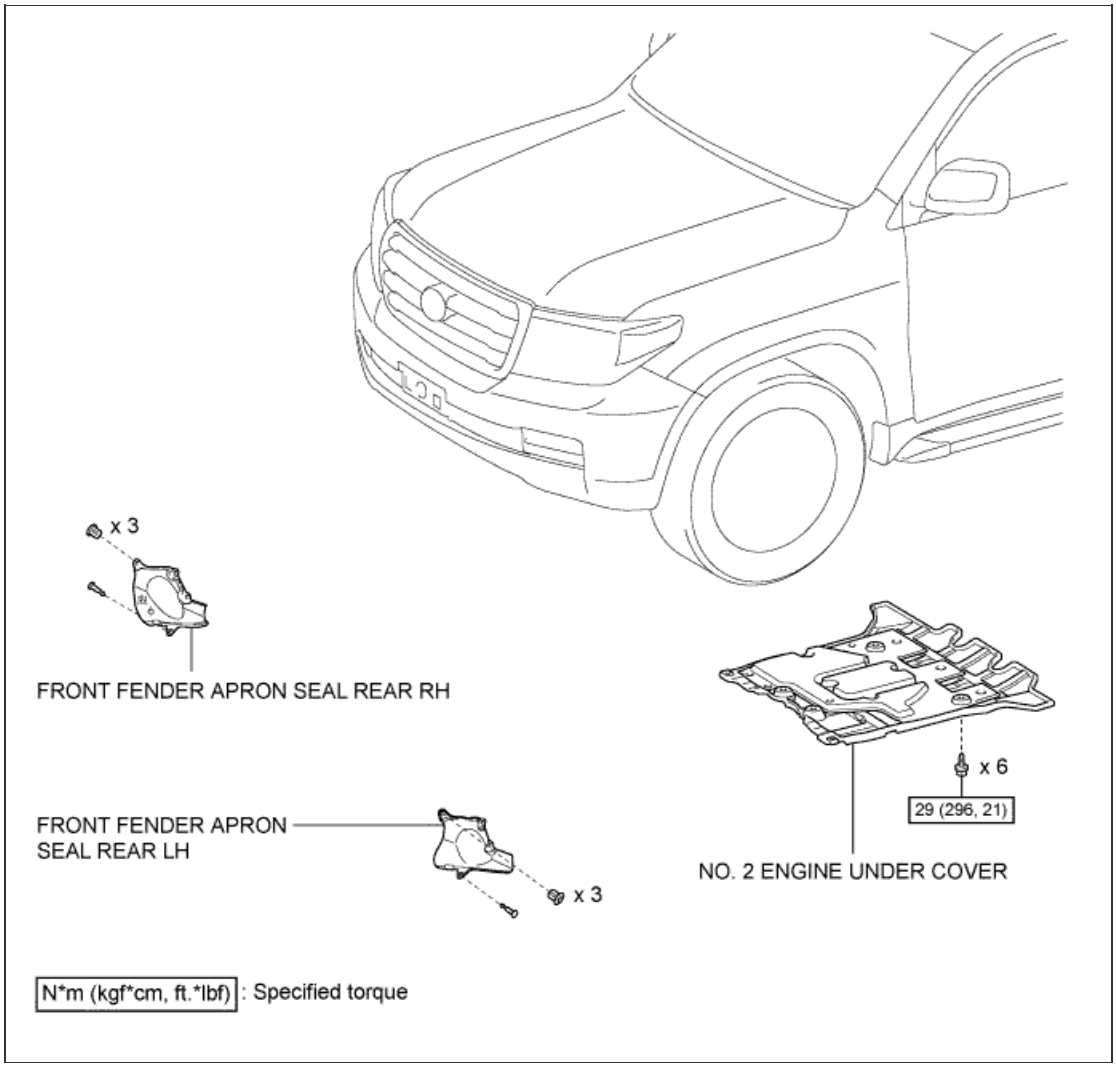
- Operate the front wipers while spraying washer fluid on the windshield glass. Make sure that the front wipers function properly and there is no interference with the vehicle body.

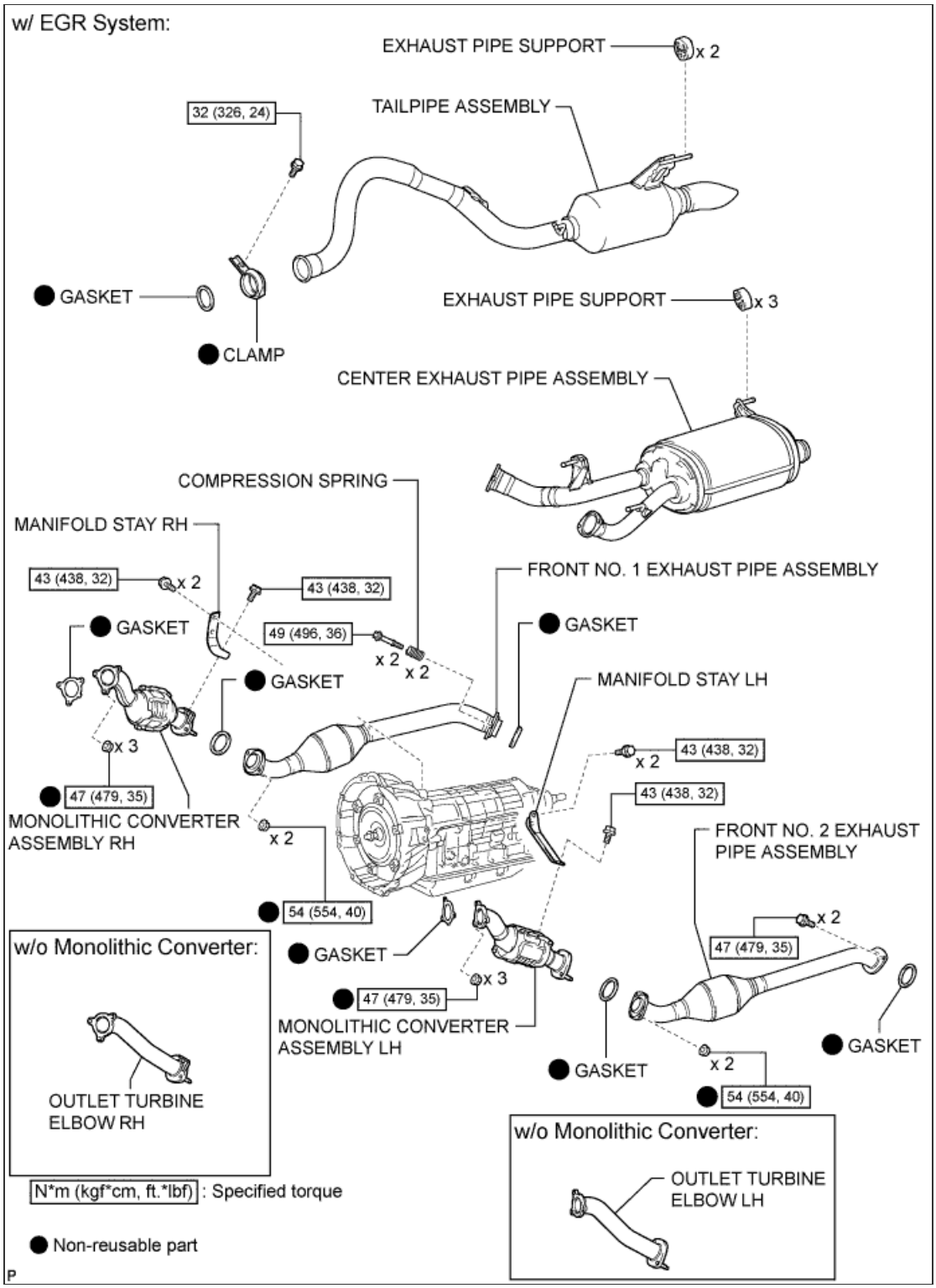


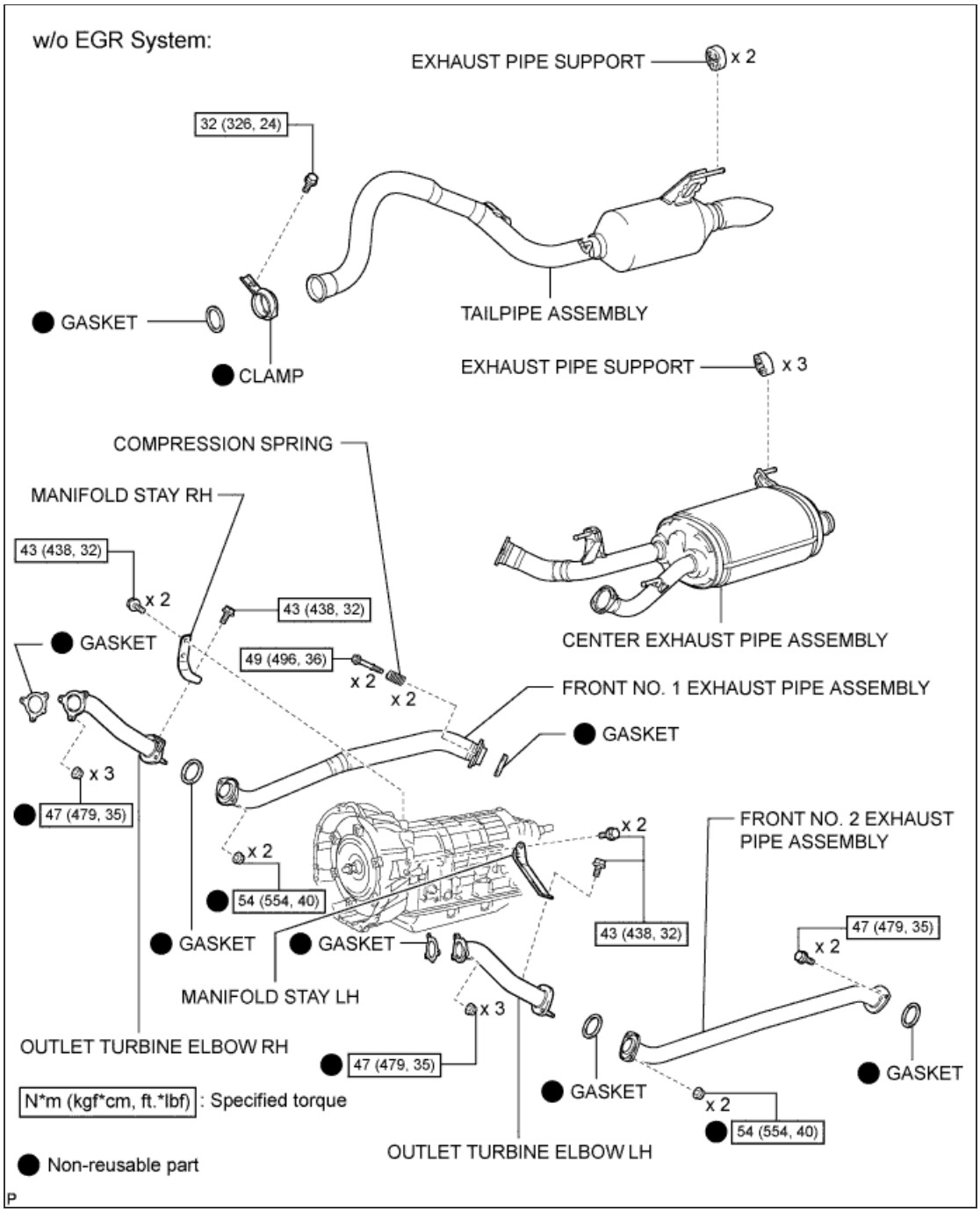
10. INSTALL UPPER RADIATOR SUPPORT SEAL

a. Install the upper radiator support seal with the 7 clips.

for Preparation Click here




w/ EGR System:
EXHAUST PIPE SUPPORT
x 2
TAILPIPE ASSEMBLY
32 (326, 24)
GASKET
CLAMP
EXHAUST PIPE SUPPORT
x 3
CENTER EXHAUST PIPE ASSEMBLY
COMPRESSION SPRING
MANIFOLD STAY RH
43 (438, 32)
x 2
43 (438, 32)
FRONT NO. 1 EXHAUST PIPE ASSEMBLY
GASKET
49 (496, 36)
x 2
x 2
GASKET
GASKET
MANIFOLD STAY LH
x 3
43 (438, 32)
x 2
47 (479, 35)
MONOLITHIC CONVERTER ASSEMBLY RH
43 (438, 32)
x 2
FRONT NO. 2 EXHAUST PIPE ASSEMBLY
54 (554, 40)
GASKET
x 2
47 (479, 35)
w/o Monolithic Converter:
x 3
47 (479, 35)
MONOLITHIC CONVERTER ASSEMBLY LH
GASKET
GASKET
x 2
54 (554, 40)
OUTLET TURBINE ELBOW RH
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
w/o Monolithic Converter:
OUTLET TURBINE ELBOW LH
P


w/o EGR System:
EXHAUST PIPE SUPPORT
x 2
32 (326, 24)
TAILPIPE ASSEMBLY
GASKET
CLAMP
EXHAUST PIPE SUPPORT
x 3
COMPRESSION SPRING
MANIFOLD STAY RH
43 (438, 32)
x 2
43 (438, 32)
CENTER EXHAUST PIPE ASSEMBLY
GASKET
49 (496, 36)
x 2
x 2
FRONT NO. 1 EXHAUST PIPE ASSEMBLY
GASKET
x 3
47 (479, 35)
x 2
54 (554, 40)
x 2
FRONT NO. 2 EXHAUST PIPE ASSEMBLY
43 (438, 32)
47 (479, 35)
x 2
GASKET
GASKET
MANIFOLD STAY LH
x 3
OUTLET TURBINE ELBOW RH
47 (479, 35)
GASKET
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
x 2
54 (554, 40)
OUTLET TURBINE ELBOW LH
Non-reusable part
P

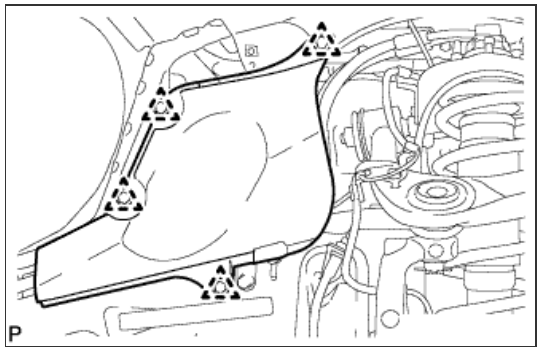
for Preparation Click here

CAUTION:

- **Wear protective gloves and protective glasses when removing the exhaust pipe.**
- **The exhaust pipe is extremely hot immediately after the engine has stopped.**
- **Confirm that the exhaust pipe has cooled down before removing it.**

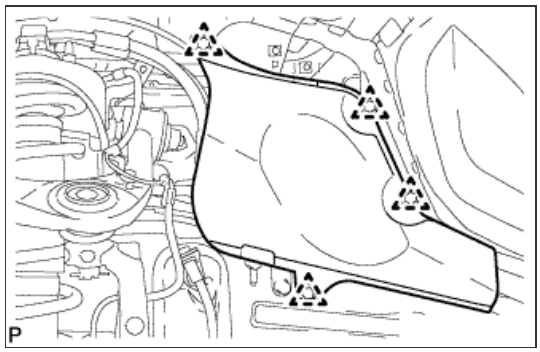
1. REMOVE FRONT FENDER APRON SEAL REAR RH

a. Using a clip remover, remove the 4 clips and fender apron seal.



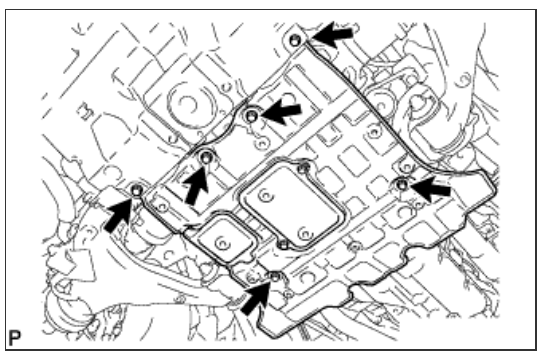
2. REMOVE FRONT FENDER APRON SEAL REAR LH

a. Using a clip remover, remove the 4 clips and fender apron seal.



3. REMOVE NO. 2 ENGINE UNDER COVER

a. Remove the bolts and under cover.



4. REMOVE TAILPIPE ASSEMBLY

a. Remove the bolt, clamp and gasket.

b. Disconnect the tailpipe from the 2 exhaust pipe supports.

5. REMOVE CENTER EXHAUST PIPE ASSEMBLY

a. Remove the 4 bolts and 2 compression springs.

b. Disconnect the center exhaust pipe from the 3 exhaust pipe supports.

c. Remove the gasket from the front exhaust pipe.

6. REMOVE FRONT NO. 1 EXHAUST PIPE ASSEMBLY

a. Remove the 2 nuts and front exhaust pipe.

b. Remove the gasket.

7. REMOVE FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Remove the 2 nuts, 2 bolts and front exhaust pipe.

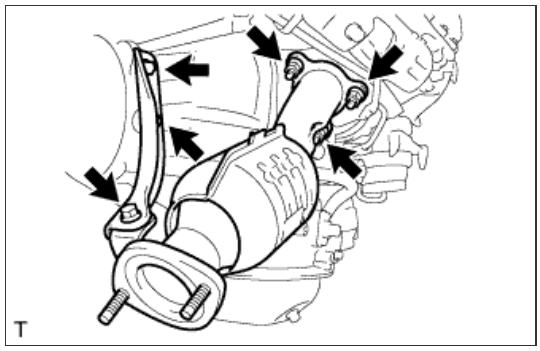
b. Remove the gasket.

8. REMOVE MONOLITHIC CONVERTER ASSEMBLY RH (w/ Monolithic Converter)

a. Remove the 3 bolts and manifold stay RH.

b. Remove the 3 nuts and monolithic converter RH.

c. Remove the gasket from the turbocharger.

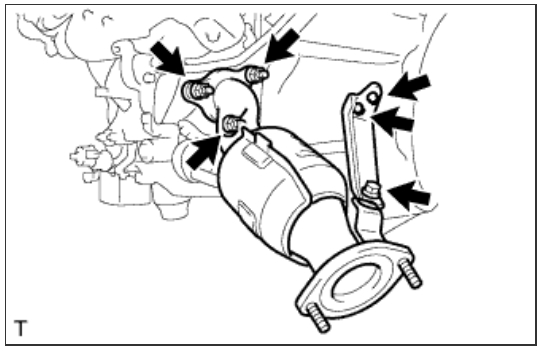


9. REMOVE MONOLITHIC CONVERTER ASSEMBLY LH (w/ Monolithic Converter)

a. Remove the 3 bolts and manifold stay LH.

b. Remove the 3 nuts and monolithic converter LH.

c. Remove the gasket from the turbocharger.

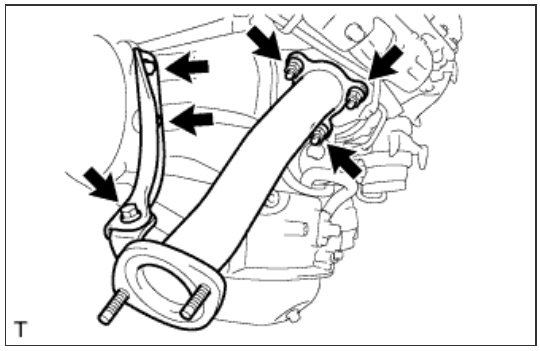


10. REMOVE OUTLET TURBINE ELBOW RH (w/o Monolithic Converter)

a. Remove the 3 bolts and manifold stay RH.

b. Remove the 3 nuts and outlet turbine elbow RH.

c. Remove the gasket from the turbocharger.

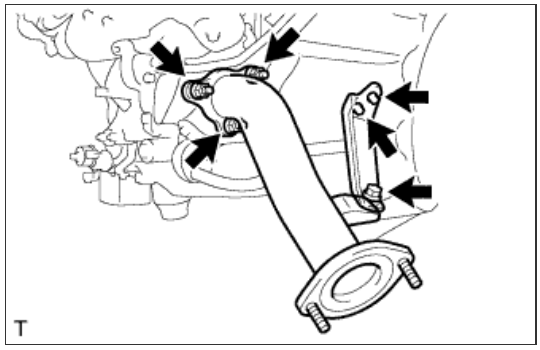


11. REMOVE OUTLET TURBINE ELBOW LH (w/o Monolithic Converter)

a. Remove the 3 bolts and manifold stay LH.

b. Remove the 3 nuts and outlet turbine elbow LH.

c. Remove the gasket from the turbocharger.



for Preparation Click here

CAUTION:

- **Wear protective gloves and protective glasses when installing the exhaust pipe.**
- **The exhaust pipe is extremely hot immediately after the engine has stopped.**
- **Confirm that the exhaust pipe has cooled down before removing it.**

1. INSTALL OUTLET TURBINE ELBOW LH (w/o Monolithic Converter)

a. Set a new gasket to the turbocharger.

b. Temporarily install the outlet turbine elbow LH with 3 new nuts.

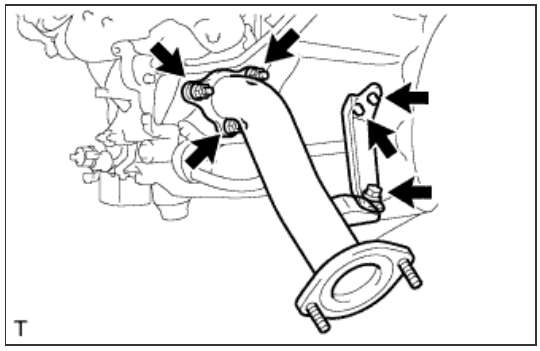
c. Temporarily install the manifold stay LH with the 3 bolts.

d. Tighten the 3 nuts of the outlet turbine elbow LH.

Torque:
47 N*m{ 479 kgf*cm , 35 ft.*lbf }

e. Tighten the 3 bolts of the manifold stay LH.

Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }



2. INSTALL OUTLET TURBINE ELBOW RH (w/o Monolithic Converter)

a. Set a new gasket to the turbocharger.

b. Temporarily install the outlet turbine elbow RH with 3 new nuts.

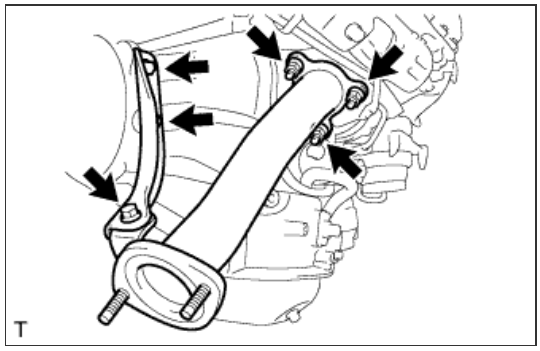
c. Temporarily install the manifold stay RH with the 3 bolts.

d. Tighten the 3 nuts of the outlet turbine elbow RH.

Torque:
47 N*m{ 479 kgf*cm , 35 ft.*lbf }

e. Tighten the 3 bolts of the manifold stay RH.

Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }



3. INSTALL MONOLITHIC CONVERTER ASSEMBLY LH (w/ Monolithic Converter)

a. Set a new gasket to the turbocharger.

b. Temporarily install the monolithic converter LH with 3 new nuts.

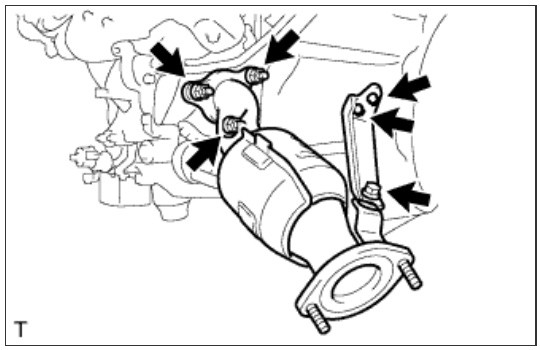
c. Temporarily install the manifold stay LH with the 3 bolts.

d. Tighten the 3 nuts of the monolithic converter LH.

Torque:
47 N*m{ 479 kgf*cm , 35 ft.*lbf }

e. Tighten the 3 bolts of the manifold stay LH.

Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }



4. INSTALL MONOLITHIC CONVERTER ASSEMBLY RH (w/ Monolithic Converter)

a. Set a new gasket to the turbocharger.

b. Temporarily install the monolithic converter RH with 3 new nuts.

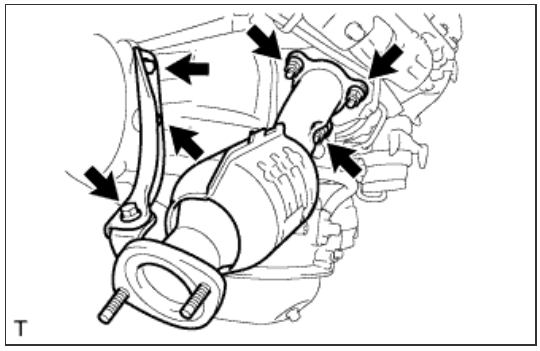
c. Temporarily install the manifold stay RH with the 3 bolts.

d. Tighten the 3 nuts of the monolithic converter RH.

Torque:
47 N*m{ 479 kgf*cm , 35 ft.*lbf }

e. Tighten the 3 bolts of the manifold stay RH.

Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }



5. INSTALL FRONT NO. 2 EXHAUST PIPE ASSEMBLY

a. Install a new gasket and the front No. 2 exhaust pipe to the monolithic converter/outlet turbine elbow with 2 new nuts.

Torque:
54 N*m{ 554 kgf*cm , 40 ft.*lbf }

. INSTALL FRONT NO. 1 EXHAUST PIPE ASSEMBLY

a. Install a new gasket and the front No. 1 exhaust pipe to the converter/outlet turbine elbow with 2 new nuts.

Torque:
54 N*m{ 554 kgf*cm , 40 ft.*lbf }

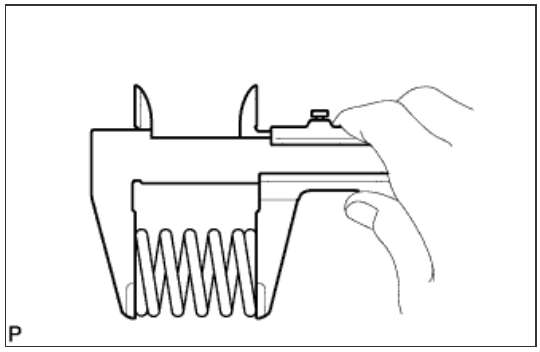
7. INSTALL CENTER EXHAUST PIPE ASSEMBLY

a. Check the free length.

i. Using a vernier caliper, measure the free length of the compression spring.

Free length:
43 mm (1. 9 in.)

If the free length is less that the minimum, replace the compression spring.



b. Connect the center exhaust pipe to the 3 exhaust pipe supports.

c. Set 2 new gaskets to the front No. 1 and No. 2 exhaust pipes.

d. Install the center exhaust pipe with the 4 bolts and 2 compression springs.

Torque:
for center exhaust pipe and front No. 1 exhaust pipe:
49 N*m{ 49 kgf*cm , 3 ft.*lbf }
for center exhaust pipe and front No. 2 exhaust pipe:
48 N*m{ 489 kgf*cm , 35 ft.*lbf }

8. INSTALL TAILPIPE ASSEMBLY

a. Connect the tailpipe to the 2 exhaust pipe supports.

b. Set a new gasket to the center exhaust pipe.

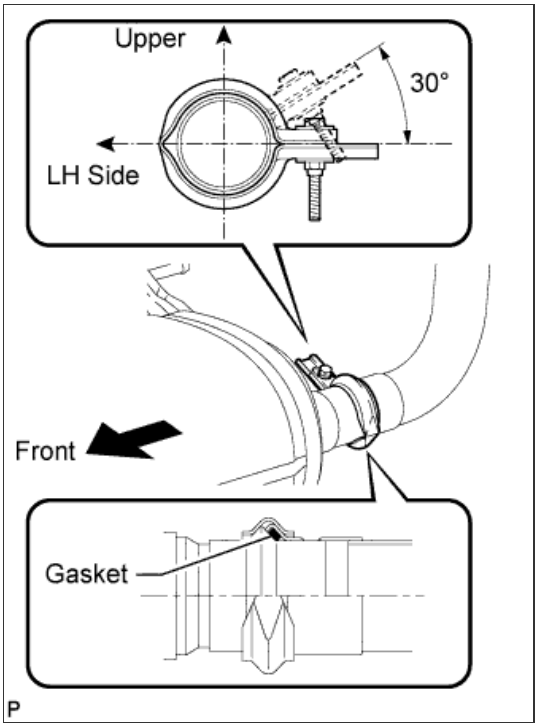
c. Connect the tailpipe to the center exhaust pipe with a new clamp.

HINT:

Install the clamp within the angle range shown in the illustration.

d. Tighten the bolt.

Torque:
32 N*m{ 32 kgf*cm , 24 ft.*lbf }

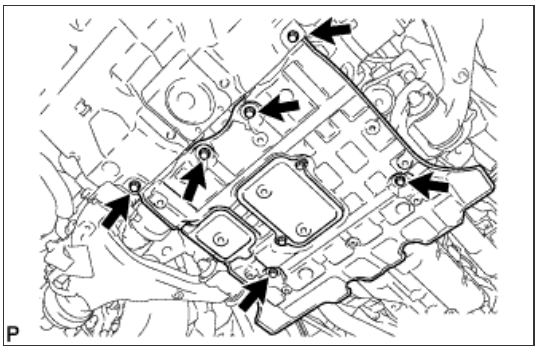


9. INSPECT FOR EXHAUST AS LEAK

10. INSTALL NO. 2 EN INE UNDER COVER

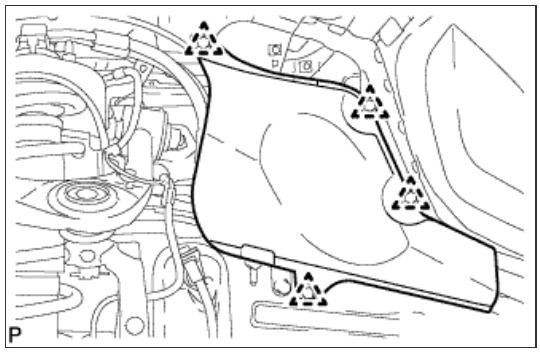
a. Install the under cover the with the 6 bolts.

Torque:
29 N*m{ 29 kgf*cm , 21 ft.*lbf }



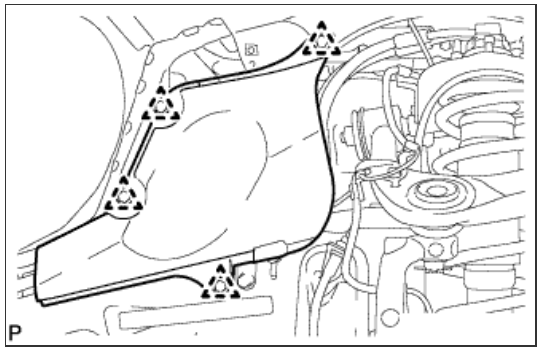
11. INSTALL FRONT FENDER APRON SEAL REAR LH

a. Install the fender apron seal with the 4 clips.



12. INSTALL FRONT FENDER APRON SEAL REAR RH

a. Install the fender apron seal with the 4 clips.



for Preparation Click here

1. INSPECT FOR COOLANT LEAK

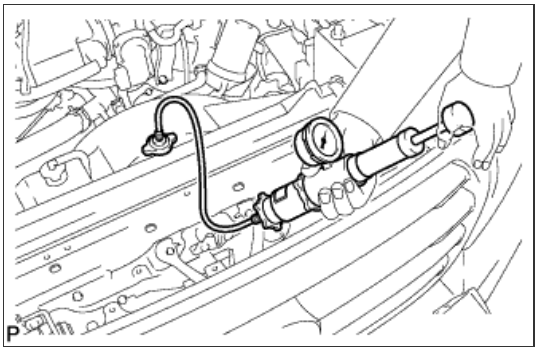
CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.

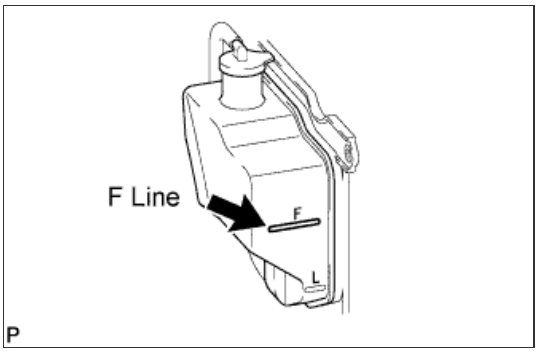


2. CHECK ENGINE COOLANT LEVEL IN RESERVOIR

a. Check that the engine coolant level is between the L and F lines when the engine is cold.
If the engine coolant is low, check for leaks and add "TO OTA Super Long Life Coolant" or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite and non-borate coolant with long-life hybrid organic acid technology to the F line.

NOTICE:

Do not substitute plain water for engine coolant.



3. CHECK ENGINE COOLANT ALITY

a. Remove the radiator cap.

CAUTION:

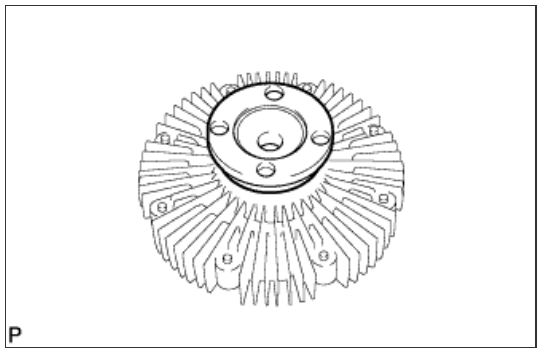
Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

b. Check if there are any excessive deposits of rust or scales around the radiator cap and radiator filler hole. Also, the coolant should be free of oil.
If excessively dirty, clean the coolant passage and replace the coolant.

c. Install the radiator cap.

4. INSPECT FLUID COUPLING ASSEMBLY

a. Check the fluid coupling for damage or silicon oil leaks.
If necessary, replace the fluid coupling.

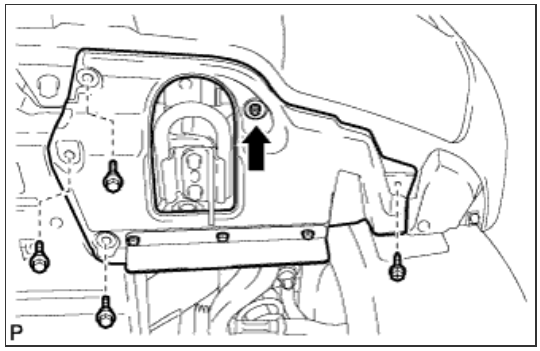

P

for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



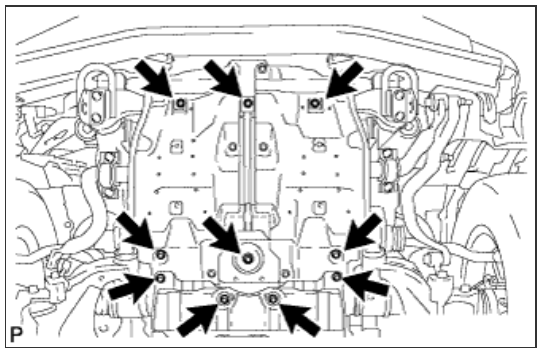
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

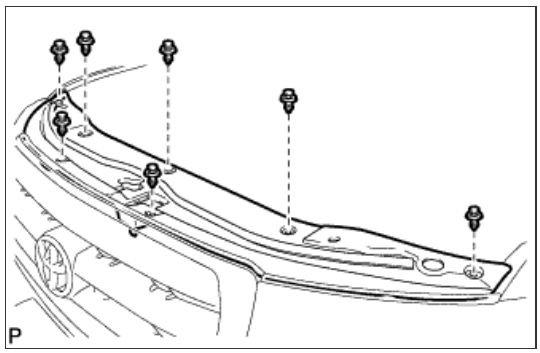
3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



4. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and radiator support seal.



5. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug and 2 cylinder block drain cock plugs.

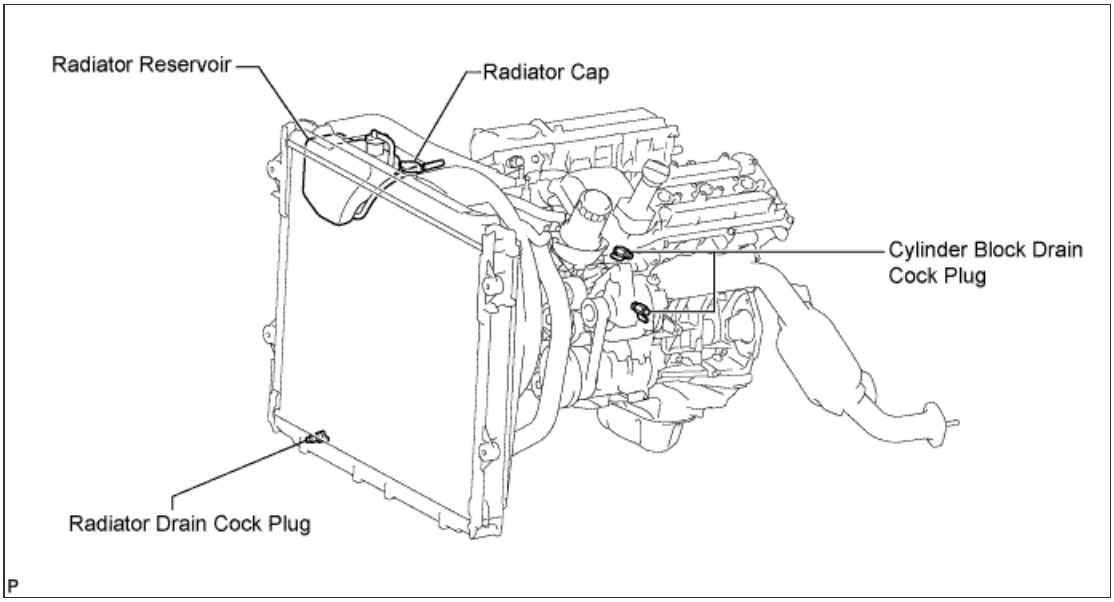
b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Tighten the 2 cylinder block drain cock plugs.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



d. Tighten the radiator drain cock plug by hand.

6. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item		Specified condition
for Automatic transmission	w/o Rear Heater	11.2 liters (11.8 US qts, . Imp. qts)
	w/ Rear Heater	14.4 liters (15.2 US qts, 12.7 Imp. qts)
for anual transmission	w/o Rear Heater	12.0 liters (12.7 US qts, 10.6 Imp. qts)
	w/ Rear Heater	14.6 liters (15.4 US qts, 12.8 Imp. qts)

NOTICE:

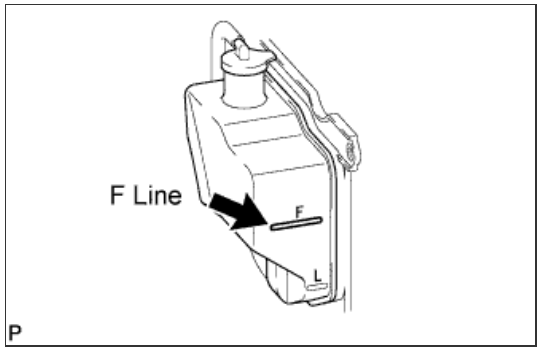
Do not substitute plain water for engine coolant.

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical

problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.



c. Install the reservoir cap.

d. Press the o. 1 and o. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Set the air conditioning as follows while warming up the engine.

Item	Condition
Fan speed	Any setting except off
Temperature	Toward WAR
Air conditioning switch	Off

g. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the o. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

h. aintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

i. Press the o. 1 and o. 2 radiator hoses several times by hand to bleed air.

CAUTION:

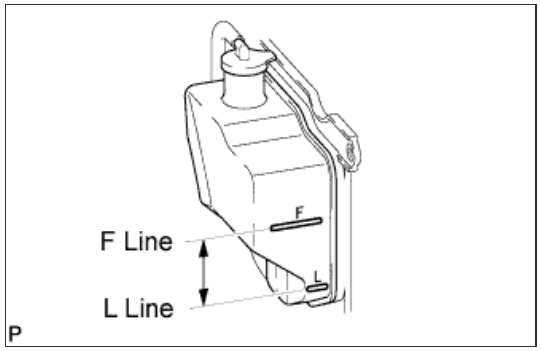
- **Wear protective gloves. Heat areas on the parts may injure your hands.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the fan.**

j. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

k. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.



7. INSPECT FOR ENGINE COOLANT LEAK

CAUTION:

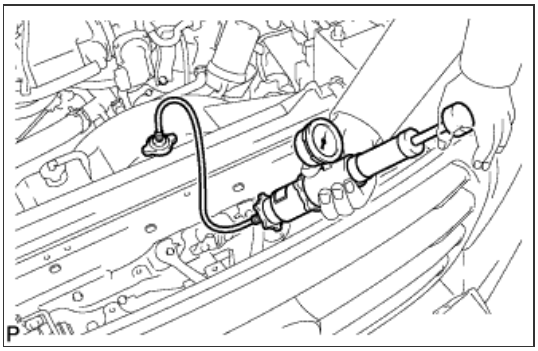
Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause

serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

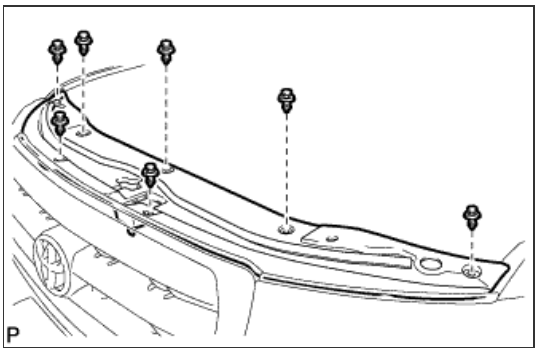
b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



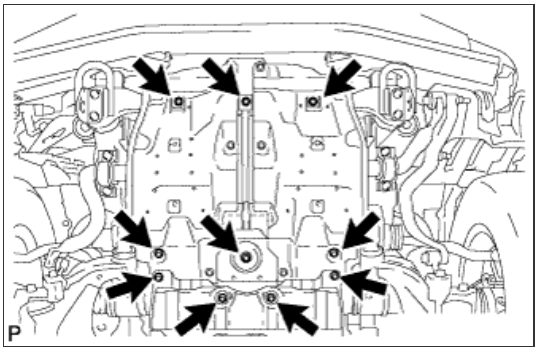
8. INSTALL UPPER RADIATOR SUPPORT SEAL

a. Install the radiator support seal with the 7 clips.



9. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the under cover with the 10 bolts.



10. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

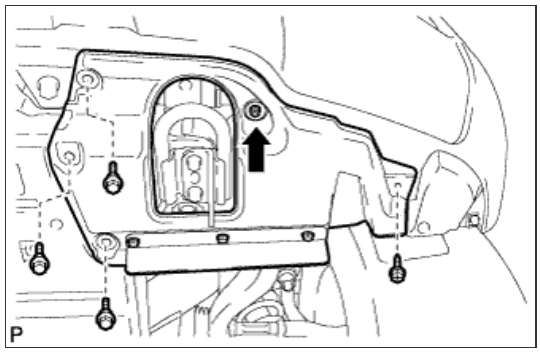
HINT:

Use the same procedures described for the LH side.

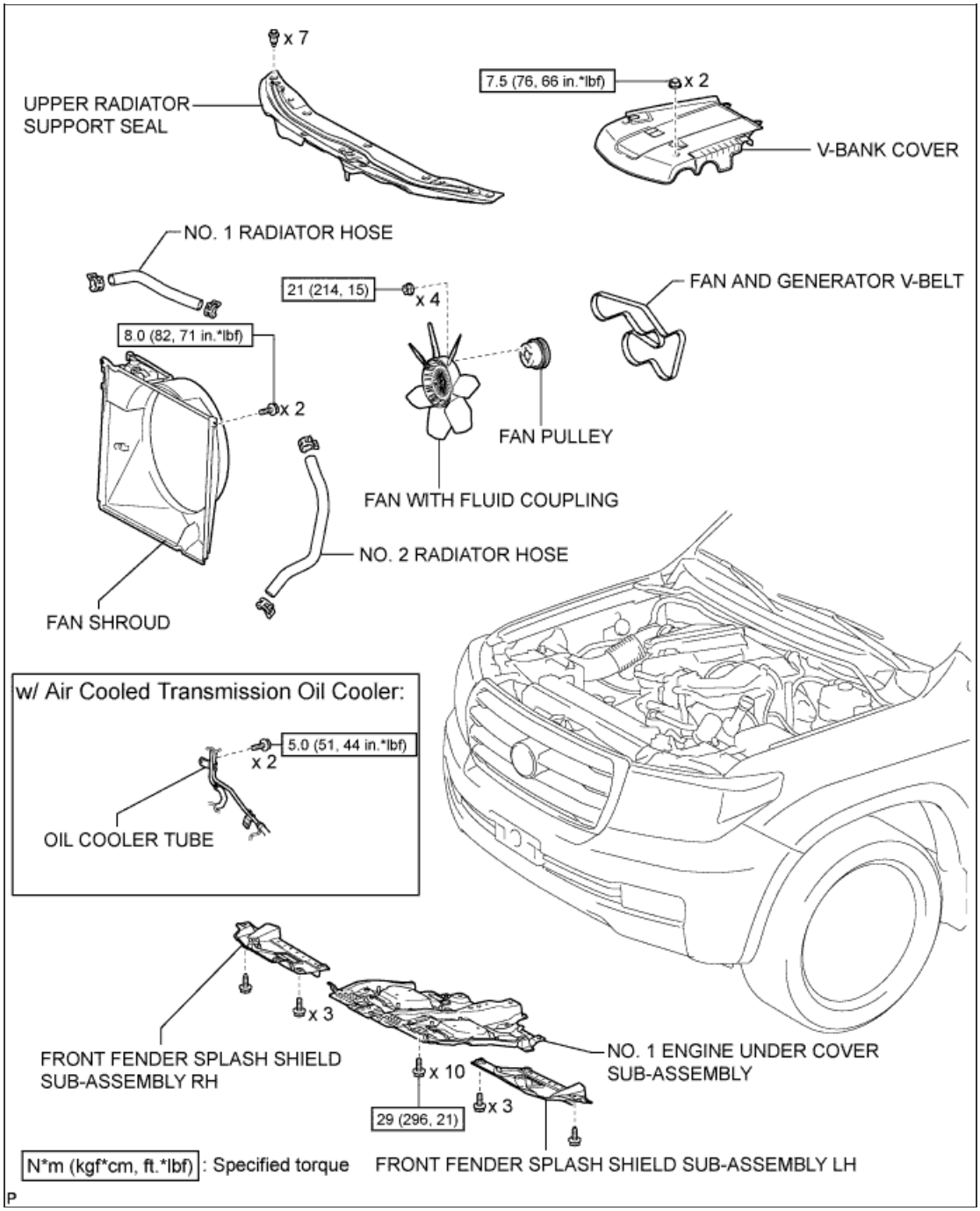
11. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

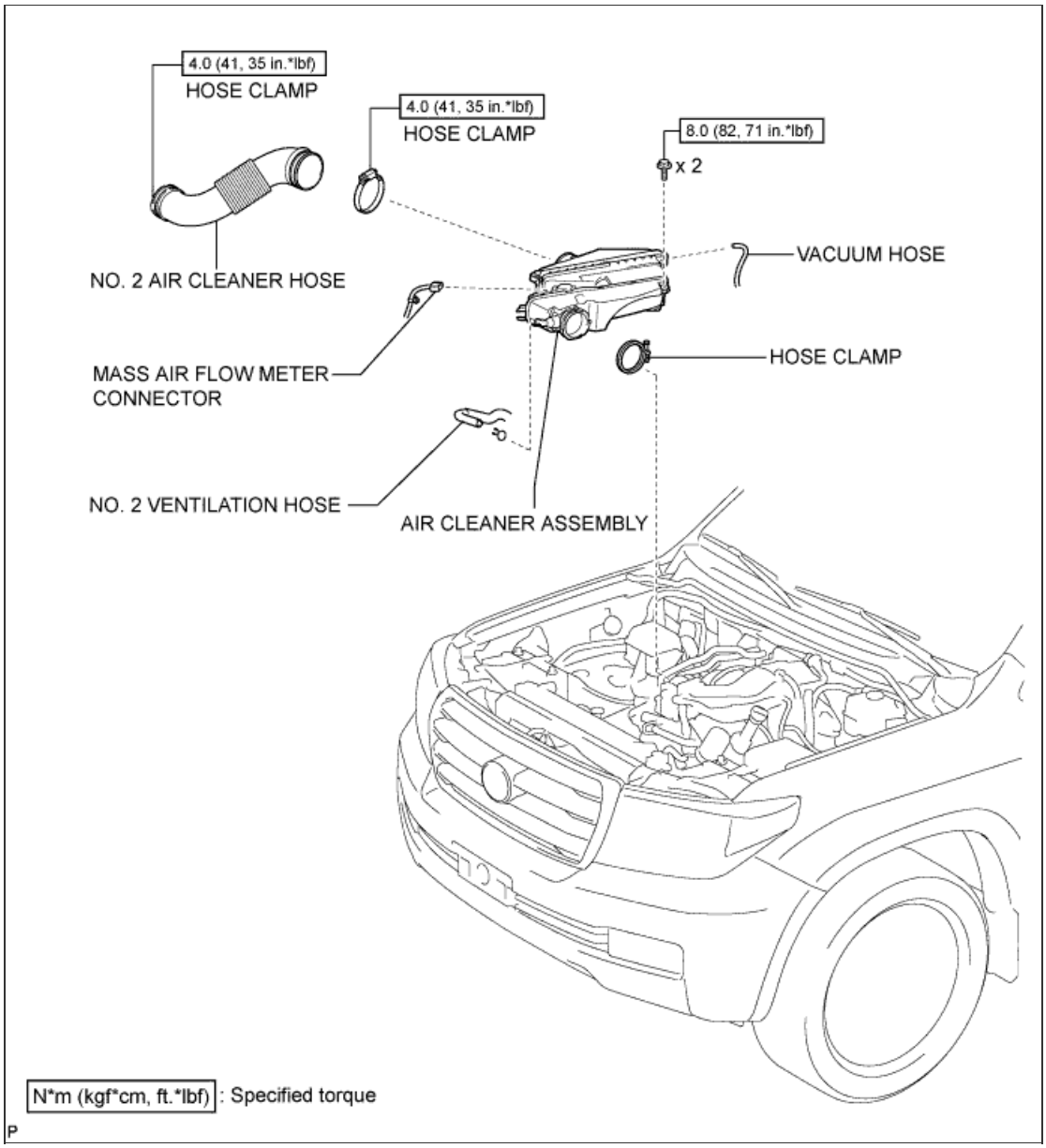
a. Remove the 3 bolts and screw.

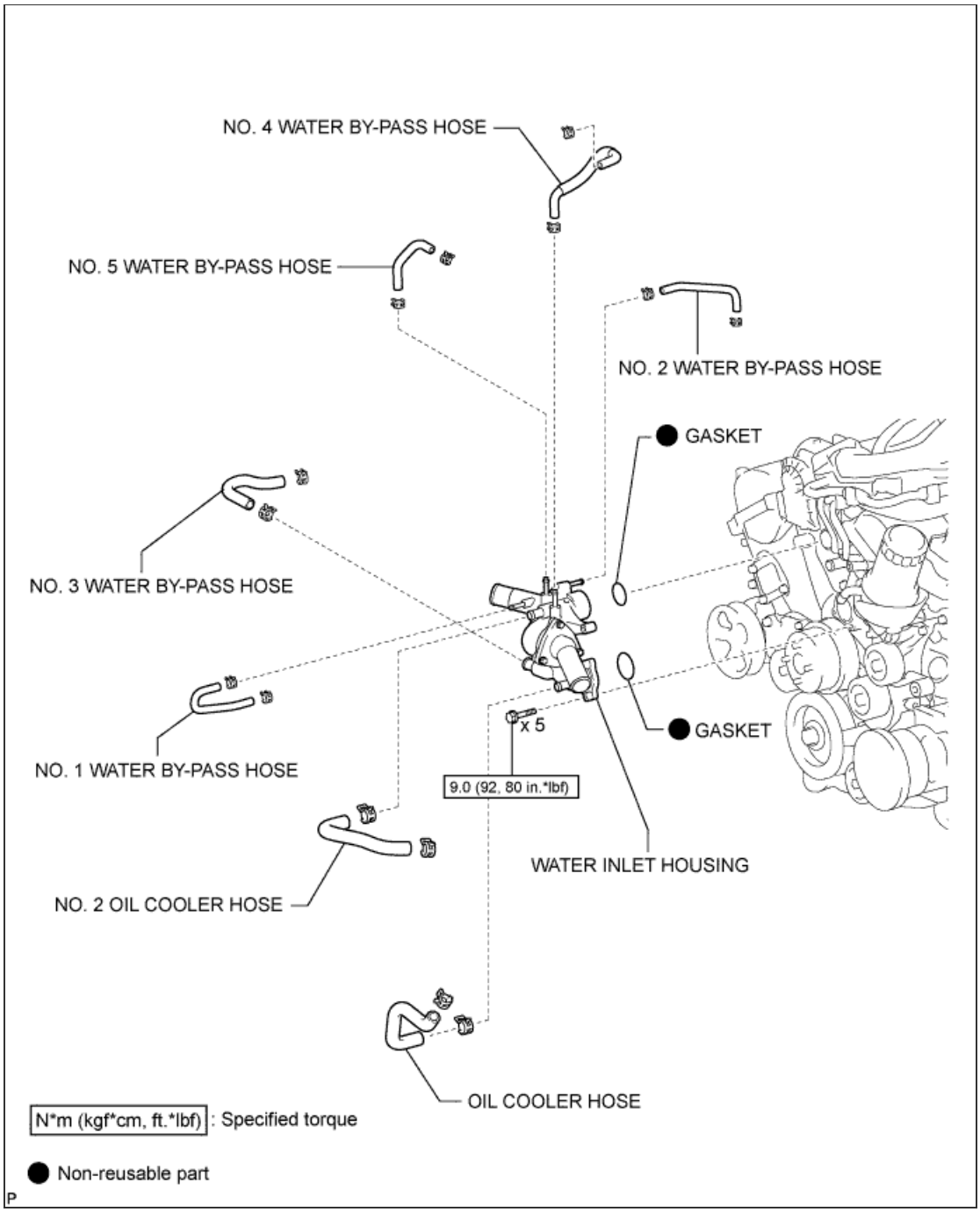
b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.

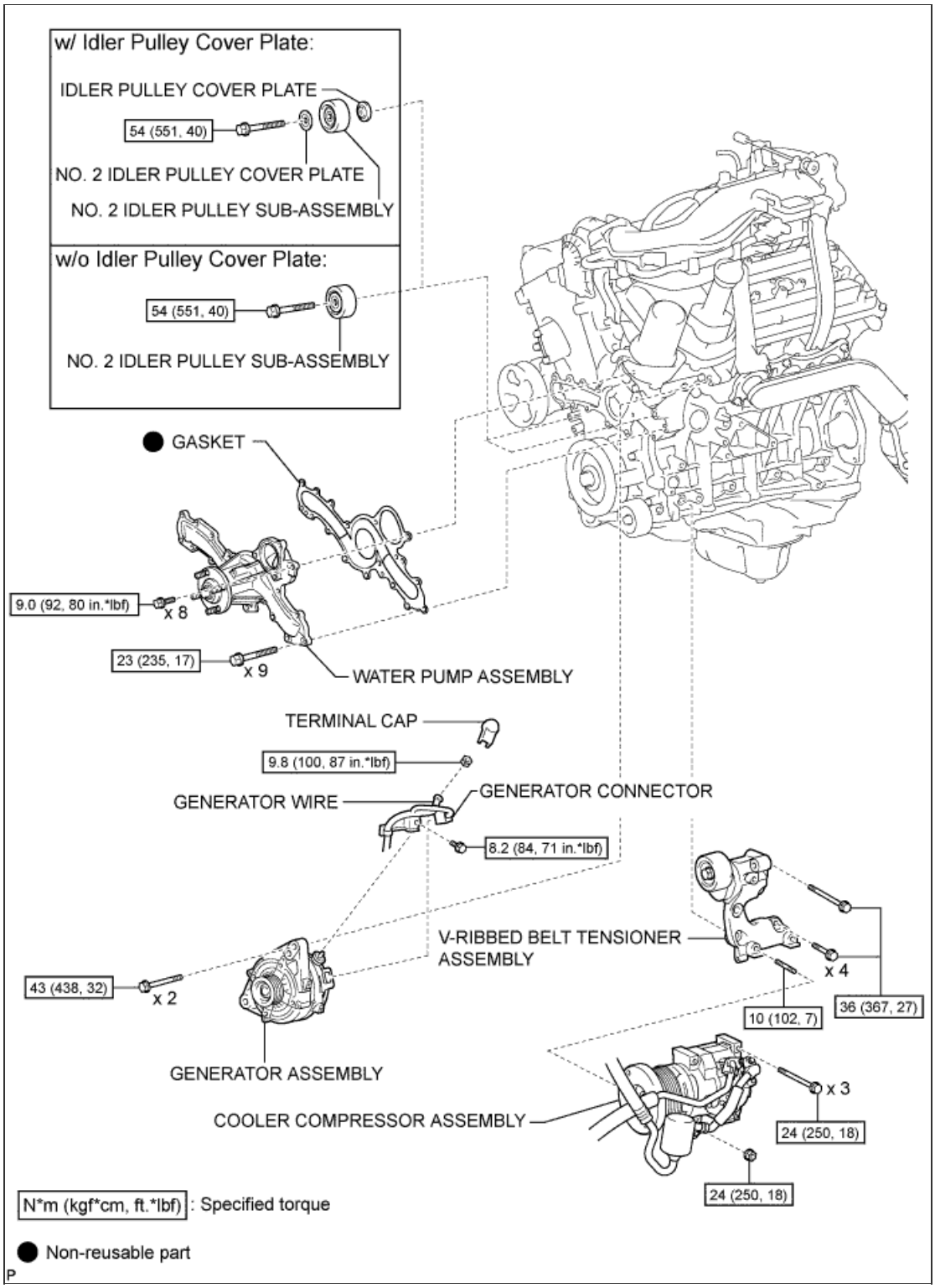

P

for Preparation [Click here]




4.0 (41, 35 in.*lbf)
HOSE CLAMP
4.0 (41, 35 in.*lbf)
HOSE CLAMP
8.0 (82, 71 in.*lbf)
x 2
VACUUM HOSE
NO. 2 AIR CLEANER HOSE
MASS AIR FLOW METER CONNECTOR
HOSE CLAMP
NO. 2 VENTILATION HOSE
AIR CLEANER ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
P


NO. 4 WATER BY-PASS HOSE
NO. 5 WATER BY-PASS HOSE
NO. 2 WATER BY-PASS HOSE
GASKET
NO. 3 WATER BY-PASS HOSE
x 5
GASKET
NO. 1 WATER BY-PASS HOSE
9.0 (92, 80 in.*lbf)
WATER INLET HOUSING
NO. 2 OIL COOLER HOSE
OIL COOLER HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P


w/ Idler Pulley Cover Plate:
IDLER PULLEY COVER PLATE
54 (551, 40)
NO. 2 IDLER PULLEY COVER PLATE
NO. 2 IDLER PULLEY SUB-ASSEMBLY
w/o Idler Pulley Cover Plate:
54 (551, 40)
NO. 2 IDLER PULLEY SUB-ASSEMBLY
GASKET
9.0 (92, 80 in.*lbf)
x 8
23 (235, 17)
x 9
WATER PUMP ASSEMBLY
TERMINAL CAP
9.8 (100, 87 in.*lbf)
GENERATOR WIRE
GENERATOR CONNECTOR
8.2 (84, 71 in.*lbf)
V-RIBBED BELT TENSIONER ASSEMBLY
x 4
10 (102, 7)
36 (367, 27)
43 (438, 32)
x 2
GENERATOR ASSEMBLY
COOLER COMPRESSOR ASSEMBLY
x 3
24 (250, 18)
24 (250, 18)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

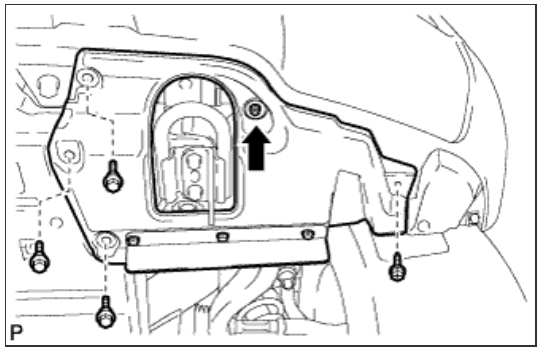
P

for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



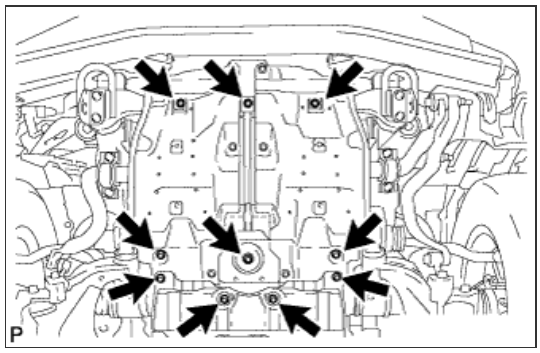
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

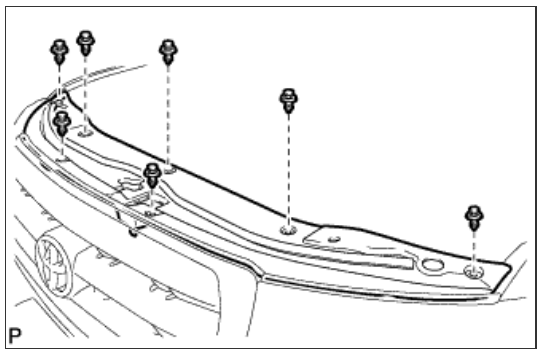
3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



4. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and radiator support seal.



5. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug and 2 cylinder block drain cock plugs.

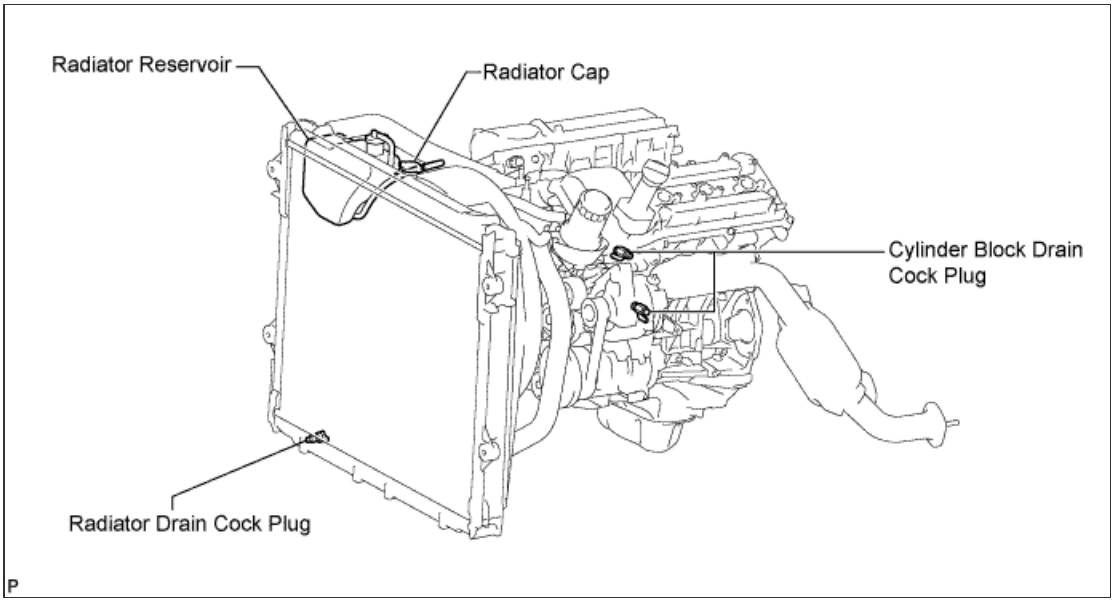
b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Tighten the 2 cylinder block drain cock plugs.

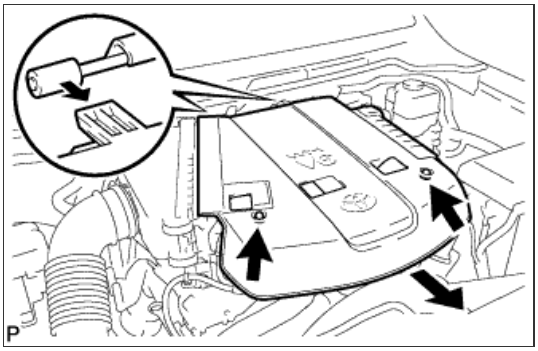
Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



d. Tighten the radiator drain cock plug by hand.

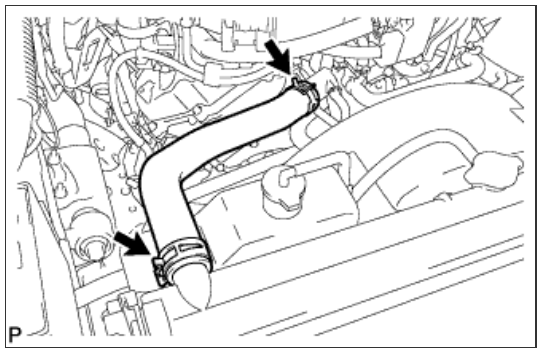
6. REMOVE V-BANK COVER

a. Remove the 2 cap nuts and V-bank cover.



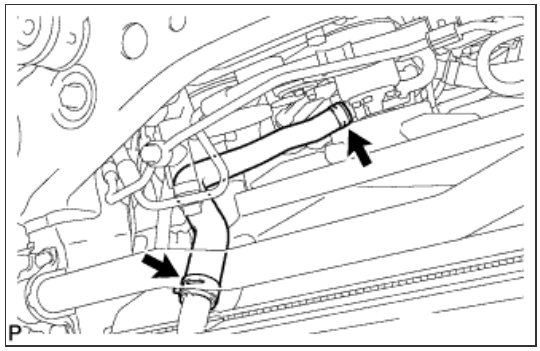
7. REMOVE NO. 1 RADIATOR HOSE

a. Remove the radiator hose.



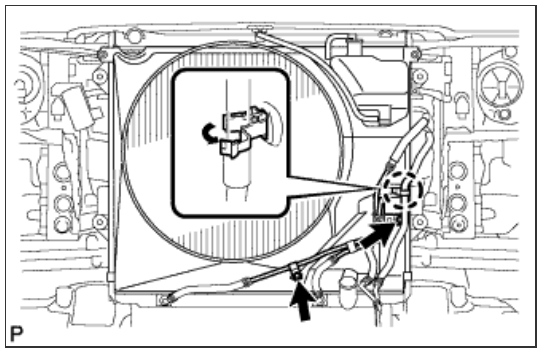
8. REMOVE NO. 2 RADIATOR HOSE

a. Remove the radiator hose.



9. DISCONNECT OIL COOLER TUBE (w/ Air Cooled Transmission Oil Cooler)

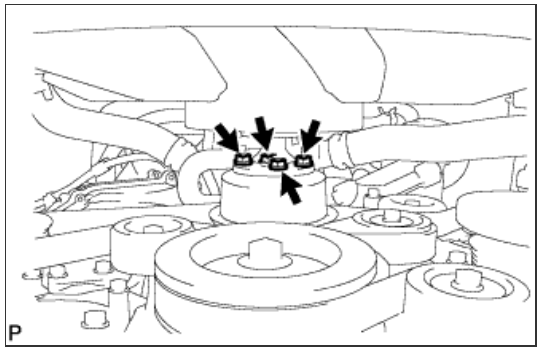
a. Detach the claw to open the flexible hose clamp, and then remove the 2 bolts to disconnect the oil cooler tube from the fan shroud.



10. REMOVE FAN SHROUD

a. Loosen the 4 nuts holding the fluid coupling fan.

b. Remove the fan and generator V-belt (Click here).



c. Disconnect the reservoir hose from the upper side of the radiator tank.

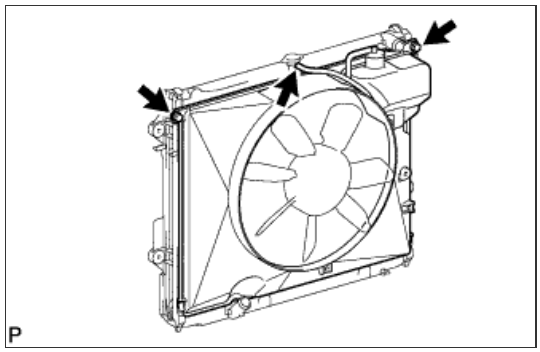
d. Remove the 2 bolts holding the fan shroud.

e. Remove the 4 nuts of the fluid coupling fan, and then remove the shroud together with the coupling fan.

NOTICE:

Be careful not to damage the radiator core.

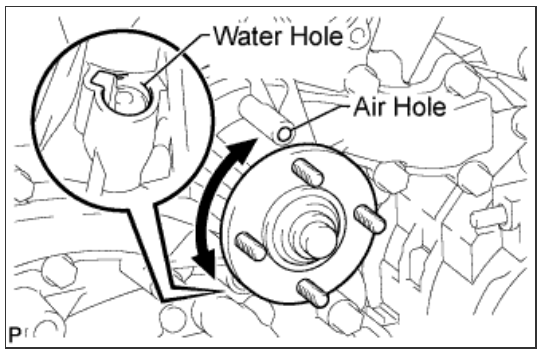
f. Remove the fan pulley from the water pump.



11. INSPECT WATER PUMP ASSEMBLY

a. Visually check the air hole and water hole for coolant leakage.
If leakage is found, replace the water pump assembly.

b. Turn the pulley and check that the water pump bearing moves smoothly and quietly.
If necessary, replace the water pump assembly.



12. INSTALL FAN SHROUD

a. Install the fan pulley to the water pump.

b. Place the shroud together with the coupling fan between the radiator and engine.

NOTICE:

Be careful not to damage the radiator core.

c. Temporarily install the fluid coupling fan to the water pump with the 4 nuts. Tighten the nuts as much as possible by hand.

d. Attach the claws of the shroud to the radiator as shown in the illustration.

e. Install the shroud with the 2 bolts.

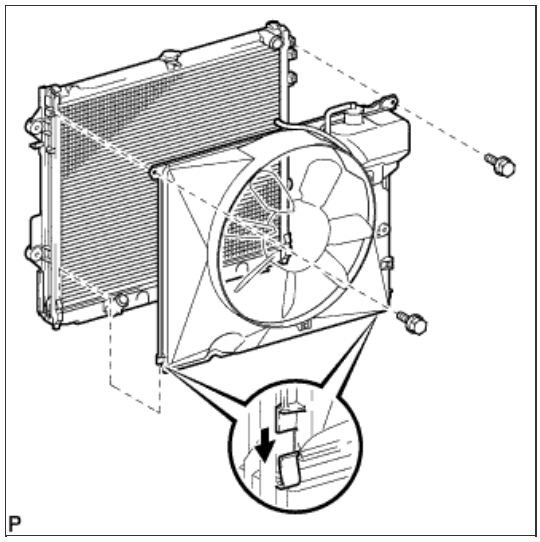
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

f. Connect the reservoir hose to upper side of the radiator tank upper.

g. Install the fan and generator V-belt (Click here).

h. Tighten the 4 nuts of the fluid coupling fan.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

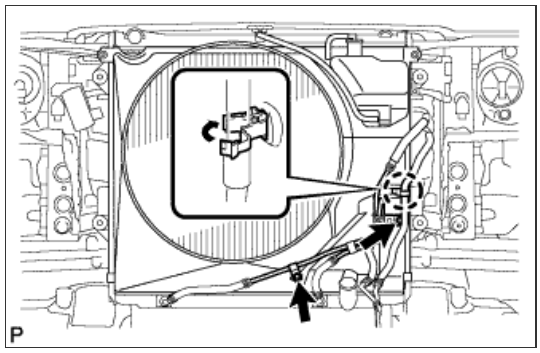


13. CONNECT OIL COOLER TUBE (w/ Air Cooled Transmission Oil Cooler)

a. Connect the oil cooler tube with the 2 bolts, and attach the claw to close the

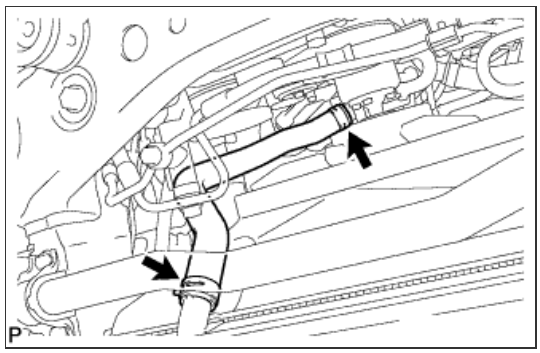
flexible hose clamp.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



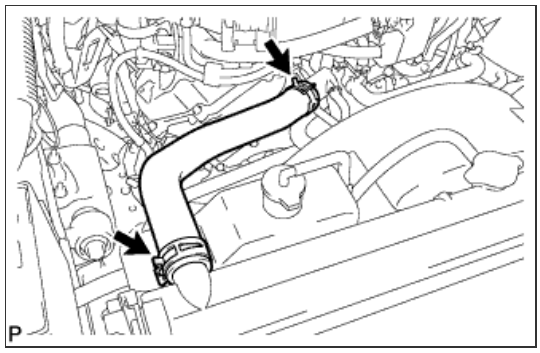
14. INSTALL NO. 2 RADIATOR HOSE

a. Install the radiator hose.



15. INSTALL NO. 1 RADIATOR HOSE

a. Install the radiator hose.



16. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item		Specified condition
for Automatic transmission	w/o Rear Heater	11.2 liters (11.8 US ts, 9.9 Imp. ts)
	w/ Rear Heater	14.4 liters (15.2 US ts, 12.7 Imp. ts)
for Manual transmission	w/o Rear Heater	12.0 liters (12.7 US ts, 10.6 Imp. ts)
	w/ Rear Heater	14.6 liters (15.4 US ts, 12.8 Imp. ts)

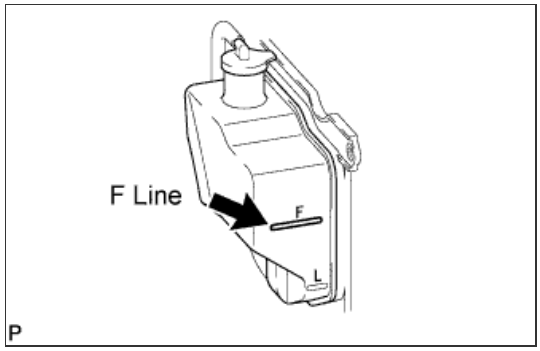
NOTICE:

Do not substitute plain water for engine coolant.

HINT:

TO TA vehicles are filled with TO TA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TO TA SLLC or similar high uality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.



c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Set the air conditioning as follows while warming up the engine.

Item	Condition
Fan speed	Any setting except off
Temperature	Toward RM
Air conditioning switch	Off

g. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

h. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

i. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

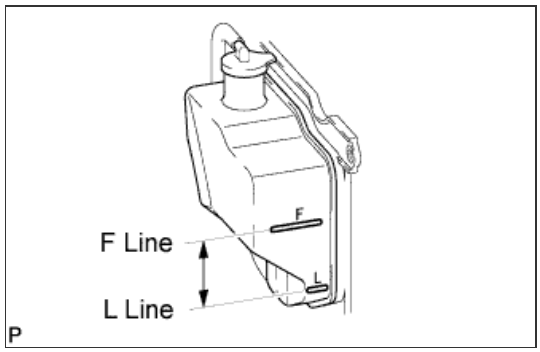
- **Wear protective gloves. Heat areas on the parts may injure your hands.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the fan.**

j. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

k. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.



17. INSPECT FOR COOLANT LEAK

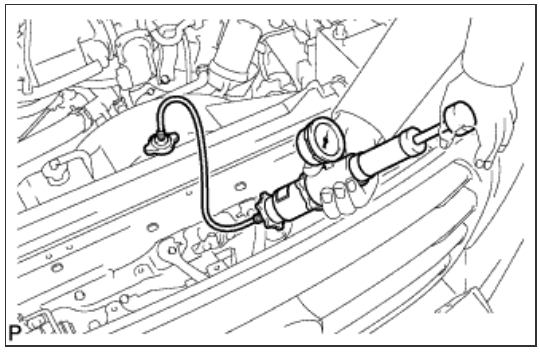
CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

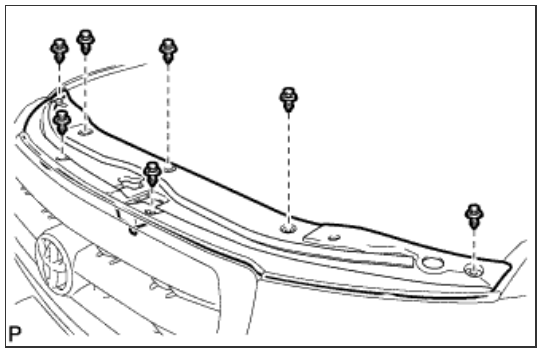
b. arm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



18. INSTALL UPPER RADIATOR SUPPORT SEAL

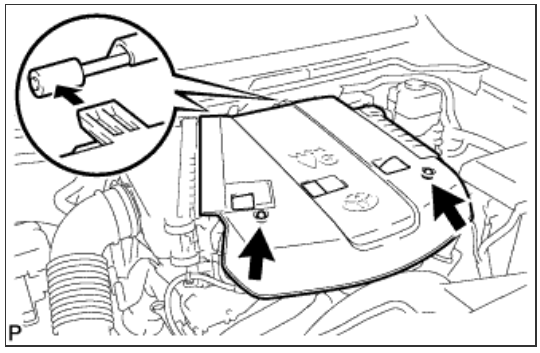
a. Install the radiator support seal with the 7 clips.



19. INSTALL V-BANK COVER

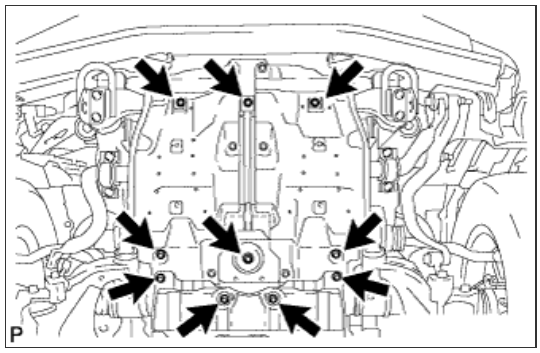
a. Install the V-bank cover with the 2 cap nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



20. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the under cover with the 10 bolts.



21. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

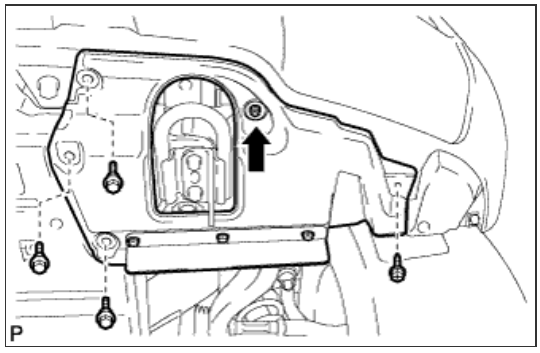
HINT:

Use the same procedures described for the LH side.

22. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.

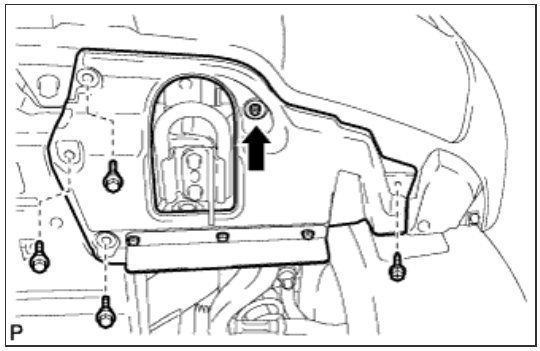


for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



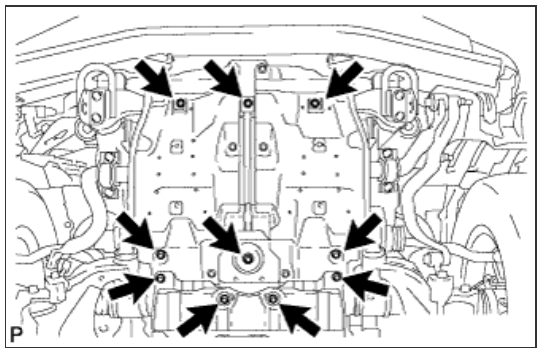
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

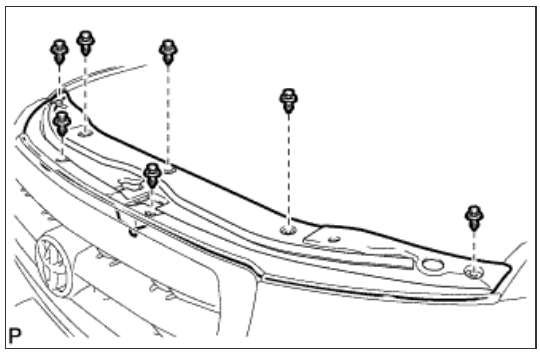
3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



4. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and radiator support seal.



5. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug and 2 cylinder block drain cock plugs.

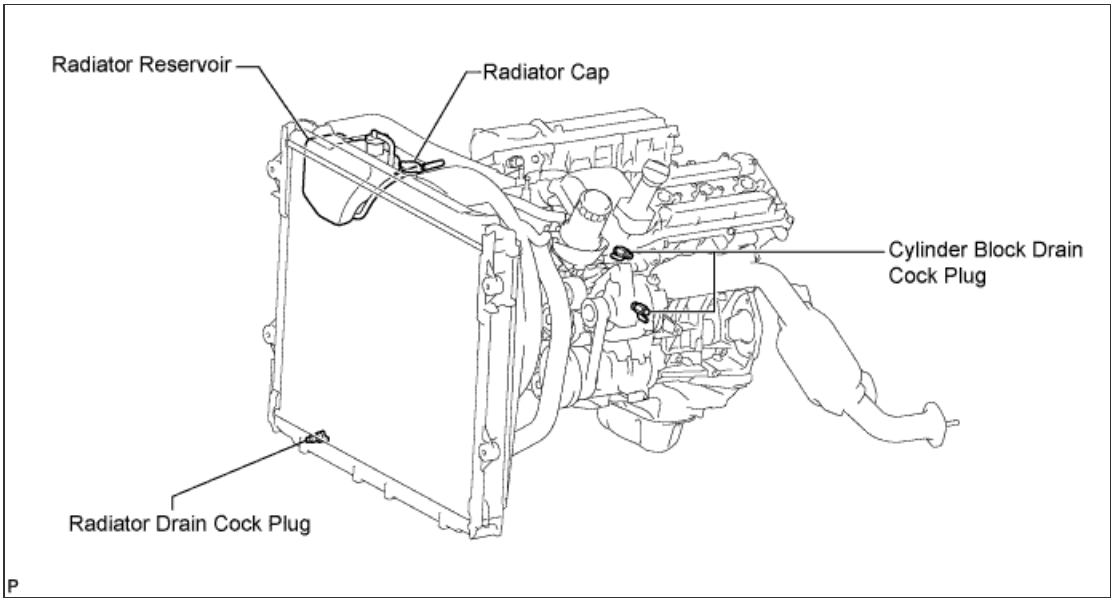
b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Tighten the 2 cylinder block drain cock plugs.

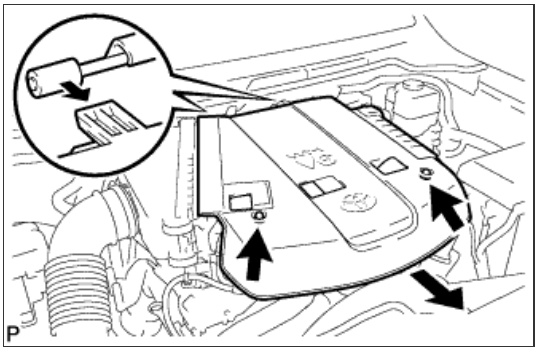
Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



d. Tighten the radiator drain cock plug by hand.

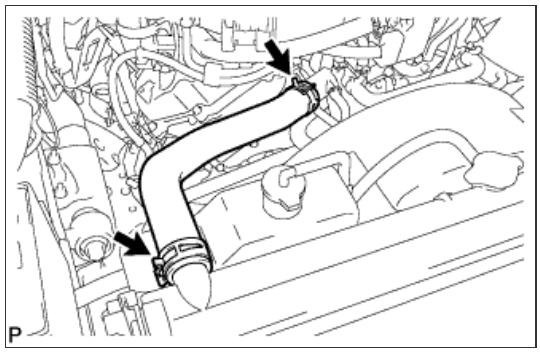
6. REMOVE V-BANK COVER

a. Remove the 2 cap nuts and V-bank cover.



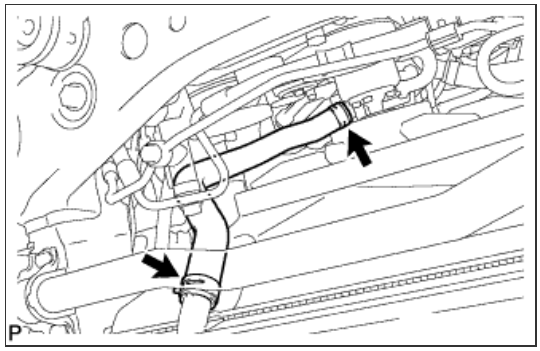
7. REMOVE NO. 1 RADIATOR HOSE

a. Remove the radiator hose.



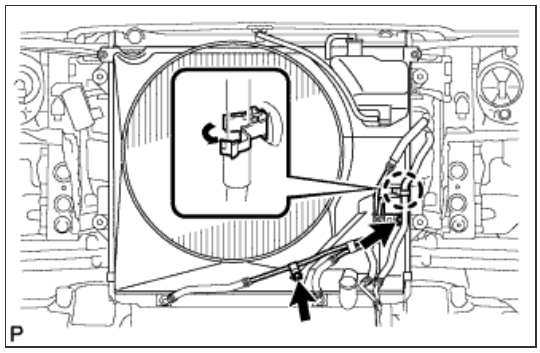
8. REMOVE NO. 2 RADIATOR HOSE

a. Remove the radiator hose.



9. DISCONNECT OIL COOLER TUBE (w/ Air Cooled Transmission Oil Cooler)

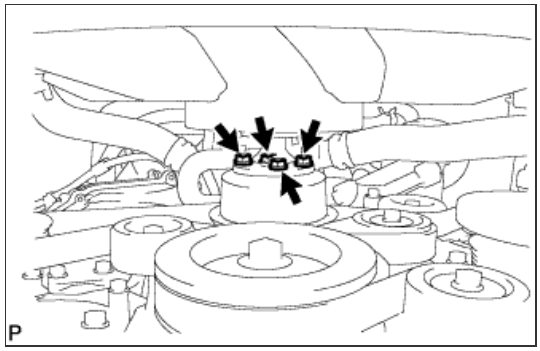
a. Detach the claw to open the flexible hose clamp, and then remove the 2 bolts to disconnect the oil cooler tube from the fan shroud.



10. REMOVE FAN SHROUD

a. Loosen the 4 nuts holding the fluid coupling fan.

b. Remove the fan and generator V-belt (Click here).



c. Disconnect the reservoir hose from the upper side of the radiator tank.

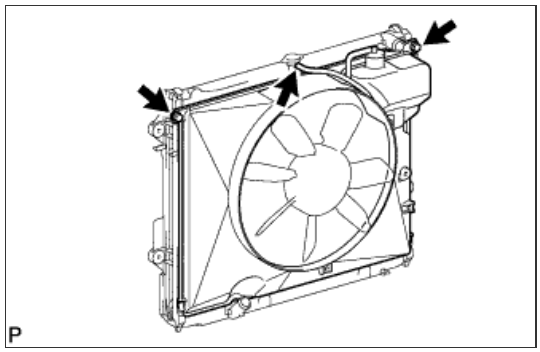
d. Remove the 2 bolts holding the fan shroud.

e. Remove the 4 nuts of the fluid coupling fan, and then remove the shroud together with the coupling fan.

NOTICE:

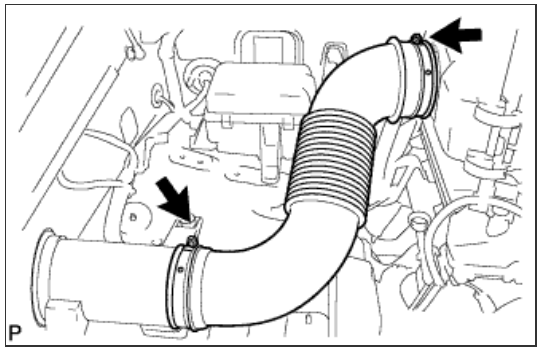
Be careful not to damage the radiator core.

f. Remove the fan pulley from the water pump.



11. REMOVE NO. 2 AIR CLEANER HOSE

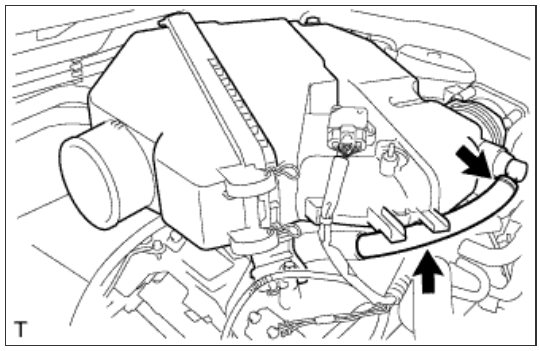
a. Loosen the 2 hose clamps and remove the air cleaner hose.



12. REMOVE AIR CLEANER ASSEMBLY

a. Disconnect the No. 2 ventilation hose.

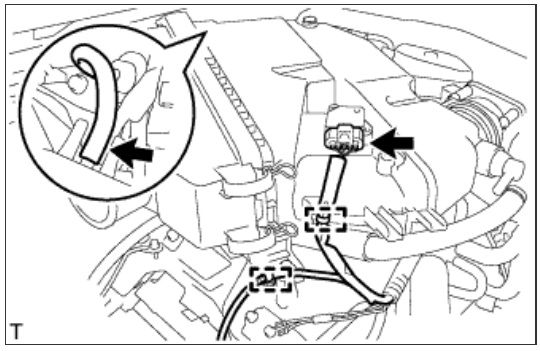
b. Detach the hose clamp.



c. Disconnect the vacuum hose.

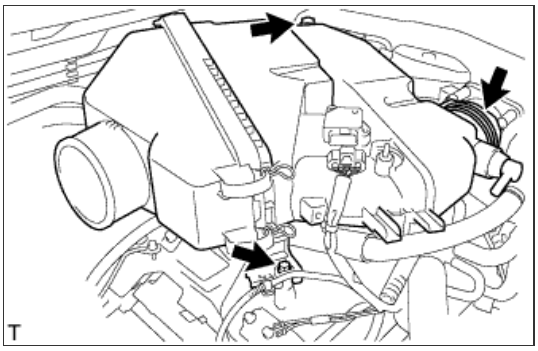
d. Disconnect the MAF meter connector.

e. Using a clip remover, detach the 2 wire harness clamps.



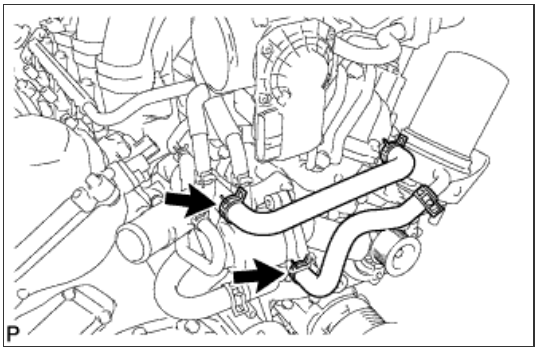
f. Loosen the hose clamp.

g. Remove the 2 bolts and air cleaner assembly.

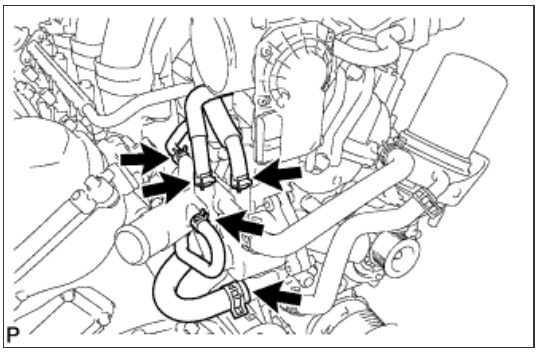


13. REMOVE WATER INLET HOUSING

a. Disconnect the 2 oil cooler hoses.



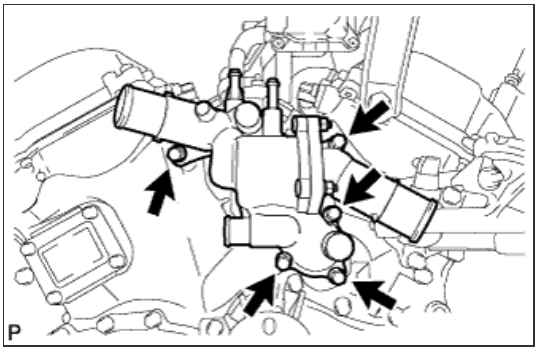
b. Disconnect the 5 water by-pass hoses.



c. Remove the 5 bolts and water inlet.

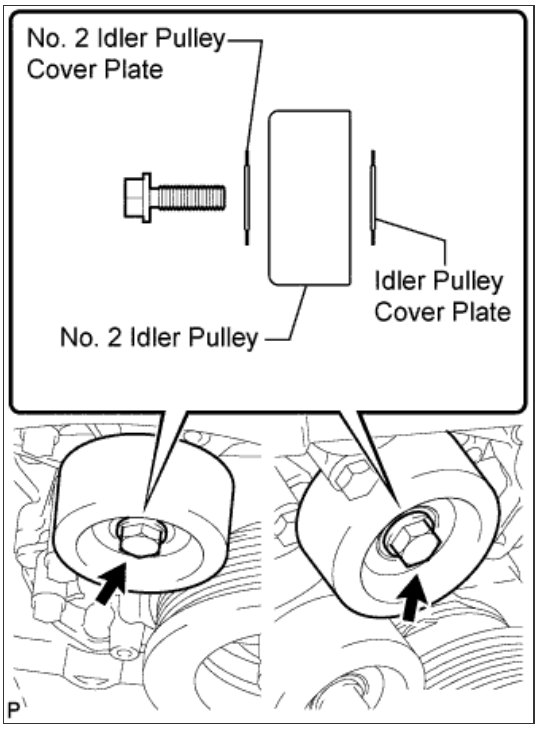
d. Remove the gasket from the water outlet pipe.

e. Remove the gasket from the water pump.

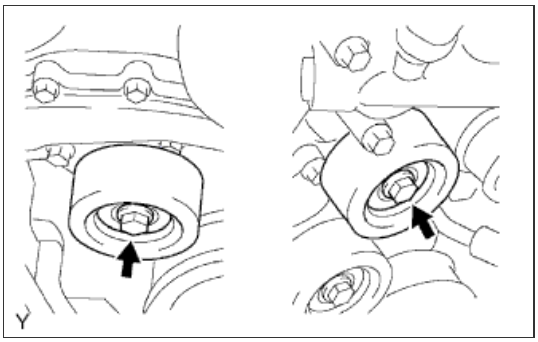


14. REMOVE NO. 2 IDLER PULLEY SUB-ASSEMBLY

a. w/ Pulley Cover Plate:
Remove the 2 bolts, 2 No. 2 idler pulley cover plate, 2 idler pulley and 2 idler pulley cover plate.

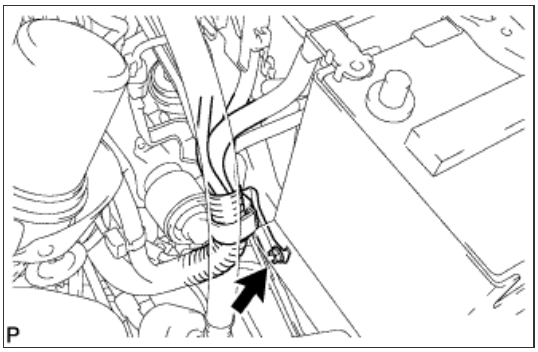


b. w/o Pulley Cover Plate:
Remove the 2 bolts and 2 No. 2 idler pulleys.



15. REMOVE GENERATOR ASSEMBLY

a. Remove the nut and disconnect the wire harness clamp bracket.



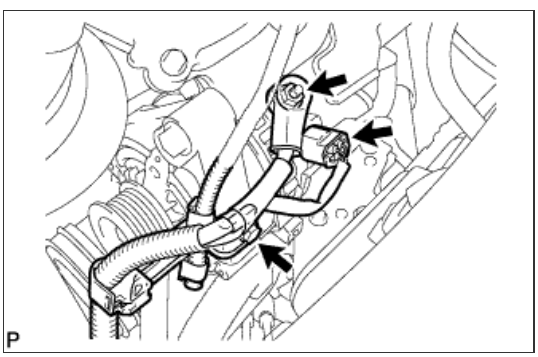
b. Disconnect the generator connector.

c. Remove the terminal cap.

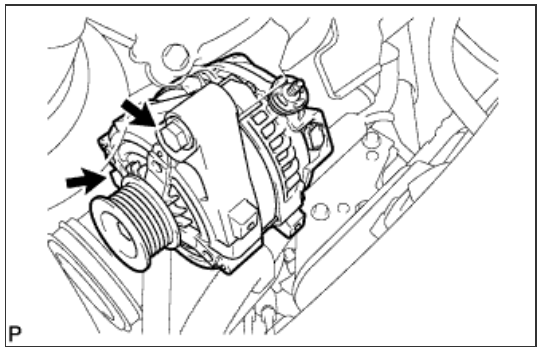
d. Remove the nut and disconnect the generator wire.

e. Remove the wire harness clamp.

f. Remove the bolt and disconnect the wire harness clamp bracket.



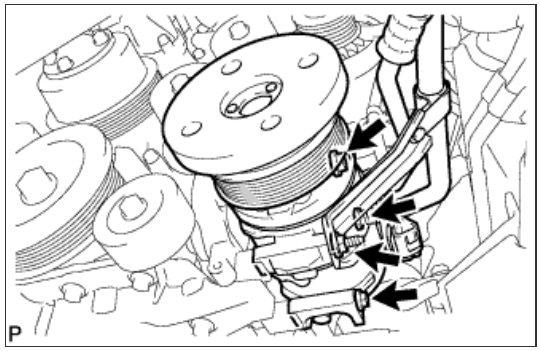
g. Remove the 2 bolts and generator.



16. DISCONNECT COOLER COMPRESSOR ASSEMBLY

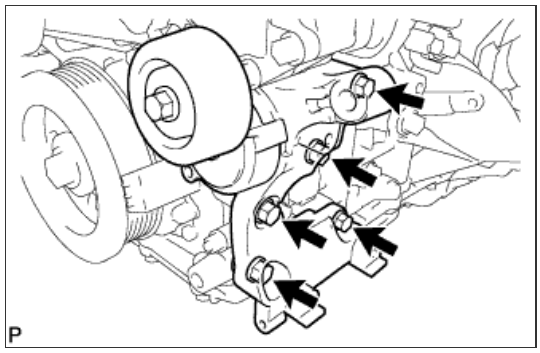
a. Disconnect the cooler compressor connector.

b. Remove the nut, 3 bolts and stud bolt, and disconnect the cooler compressor.



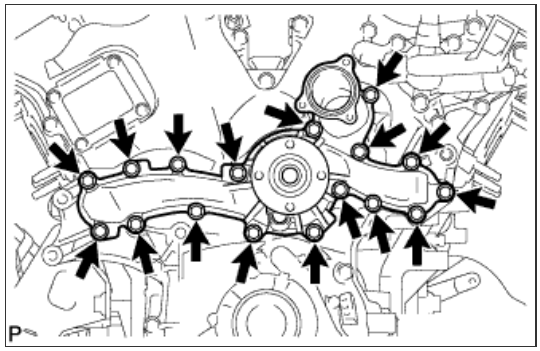
17. REMOVE V-RIBBED BELT TENSIONER ASSEMBLY

a. Remove the 5 bolts and V-ribbed belt tensioner.



18. REMOVE WATER PUMP ASSEMBLY

a. Remove the 17 bolts, water pump and gasket.

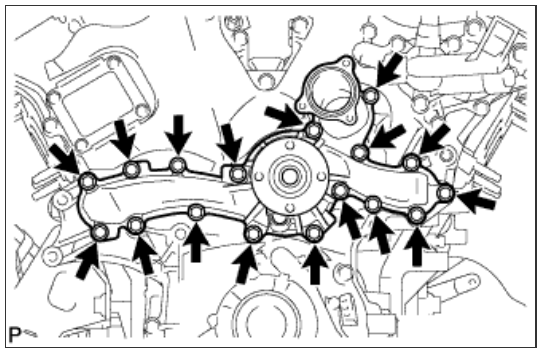


for Preparation Click here

1. INSTALL WATER PUMP ASSEMBLY

a. Install a new gasket and the water pump with the 17 bolts.

Torque:
for 10 mm head:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }
for 12 mm head:
23 N*m{ 235 kgf*cm , 17 ft.*lbf }



2. INSTALL V-RIBBED BELT TENSIONER ASSEMBLY

a. Temporarily install the V-ribbed belt tensioner with the 5 bolts.

b. Tighten bolt 1 and 2 in numerical order.

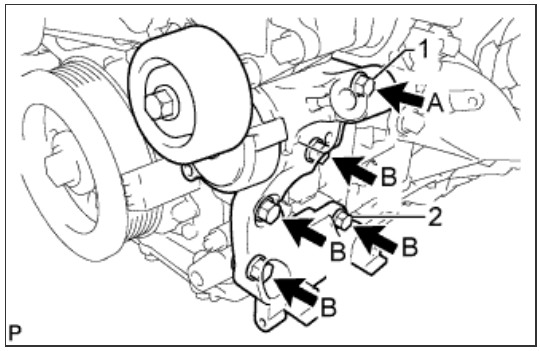
Torque:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }

c. Tighten the other bolts.

Torque:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }

Standard Bolt:

Item	Length
A	70 mm (2.76 in.)
B	33 mm (1.30 in.)



3. CONNECT COOLER COMPRESSOR ASSEMBLY

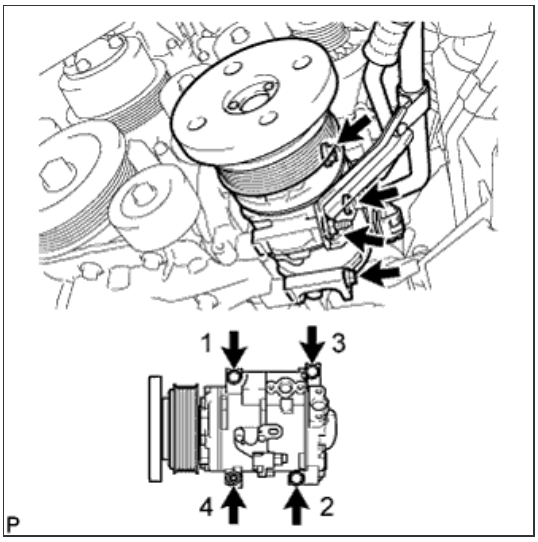
a. Fix the cooler compressor in place with the stud bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Install the cooler compressor with the nut and 3 bolts in several steps in the sequence shown in the illustration.

Torque:
24 N*m{ 250 kgf*cm , 18 ft.*lbf }

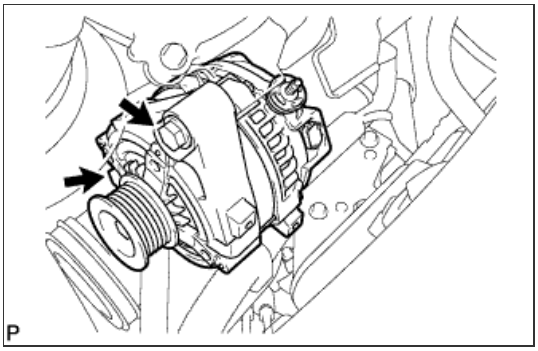
c. Connect the cooler compressor connector.



4. INSTALL GENERATOR ASSEMBLY

a. Install the generator with the 2 bolts.

Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }



b. Connect the wire harness clamp bracket with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

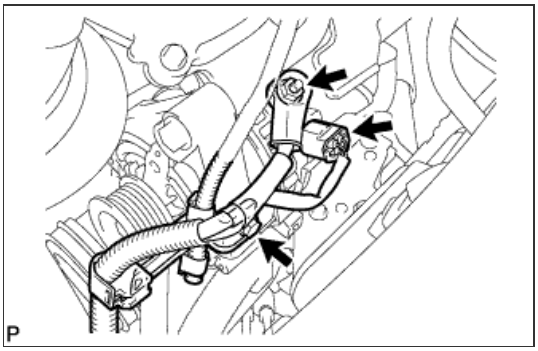
c. Install the wire harness clamp to the bracket.

d. Connect the generator wire with the nut.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }

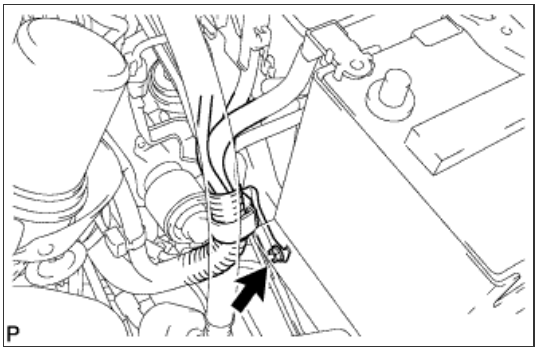
e. Install the terminal cap.

f. Connect the generator connector.

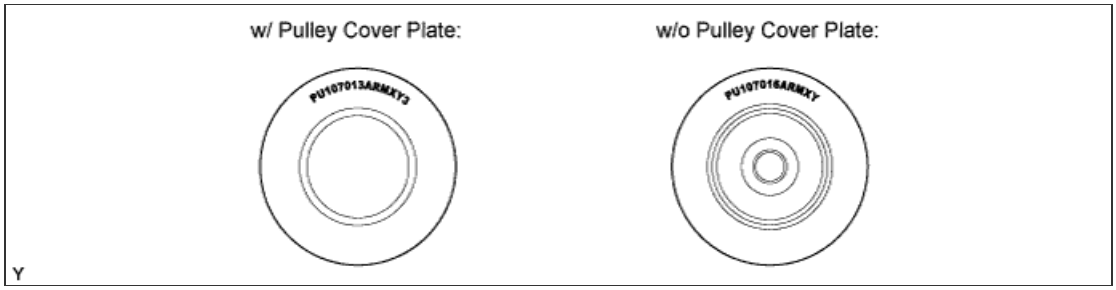


g. Connect the wire harness clamp bracket with the nut.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }



5. INSTALL NO. 2 IDLER PULLEY SUB-ASSEMBLY



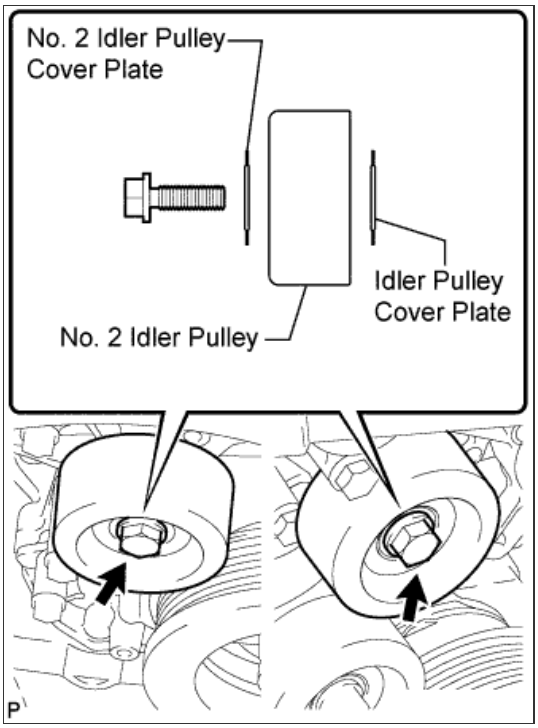
a. w/ Pulley Cover Plate:

i. Install the idler pulley cover plate, idler pulley and No. 2 idler pulley cover plate with the bolt.

Torque:
54 N*m{ 551 kgf*cm , 40 ft.*lbf }

NOTICE:

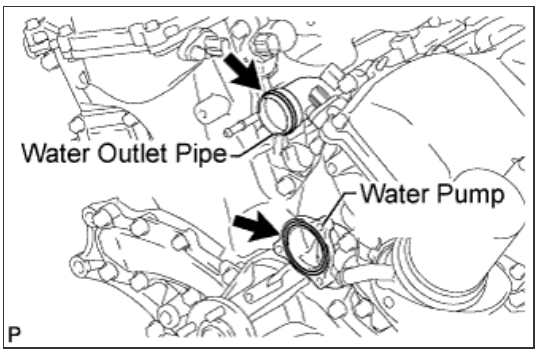
If it is necessary to replace the pulley or either plate, replace the No. 2 idler pulley cover plate, No. 2 idler pulley and idler pulley cover plate as a set with new parts.



b. w/o Pulley Cover Plate:
Install the 2 No. 2 idler pulleys with the 2 bolts.

Torque:
54 N*m{ 551 kgf*cm , 40 ft.*lbf }

6. INSTALL WATER INLET HOUSING



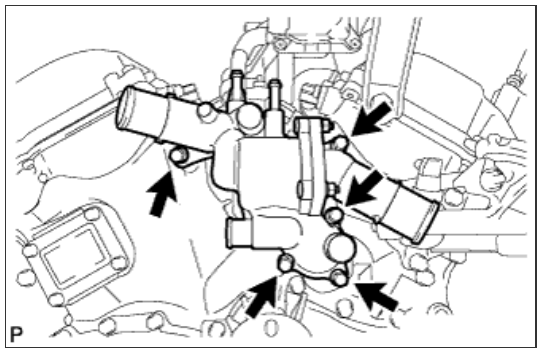
a. Install a new gasket to the water outlet pipe.

b. Install a new gasket to the water pump.

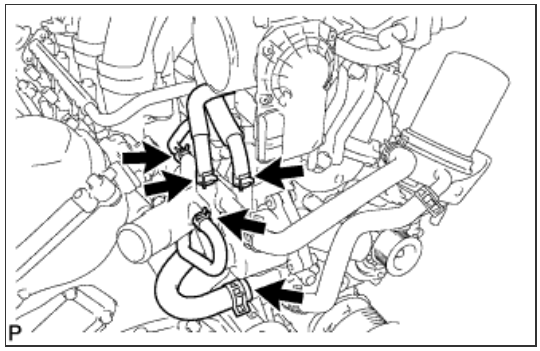
c. Apply soapy water to the gasket of the water outlet pipe.

d. Install the water inlet with the 5 bolts.

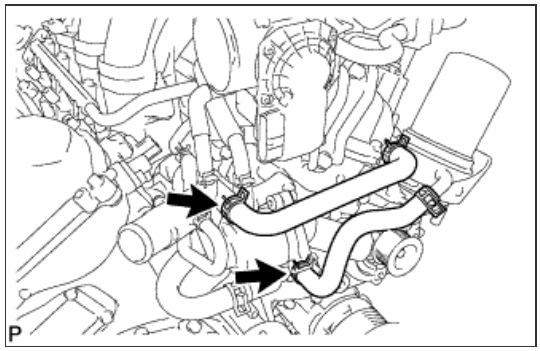
Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



e. Connect the 5 water by-pass hoses.



f. Connect the 2 oil cooler hoses.



7. INSTALL FAN SHROUD

a. Install the fan pulley to the water pump.

b. Place the shroud together with the coupling fan between the radiator and engine.

NOTICE:

Be careful not to damage the radiator core.

c. Temporarily install the fluid coupling fan to the water pump with the 4 nuts. Tighten the nuts as much as possible by hand.

d. Attach the claws of the shroud to the radiator as shown in the illustration.

e. Install the shroud with the 2 bolts.

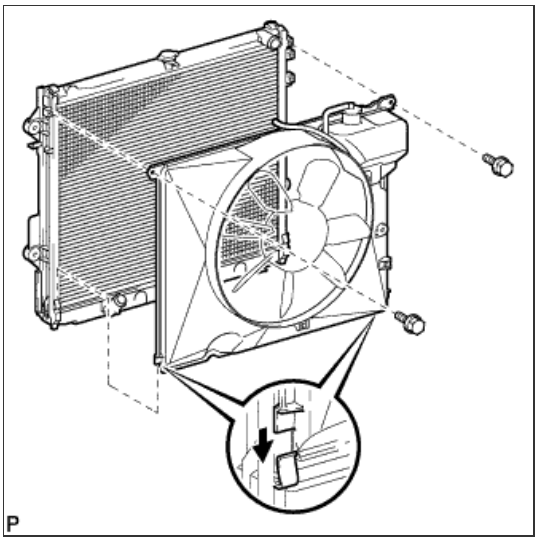
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

f. Connect the reservoir hose to upper side of the radiator tank upper.

g. Install the fan and generator V-belt (Click here).

h. Tighten the 4 nuts of the fluid coupling fan.

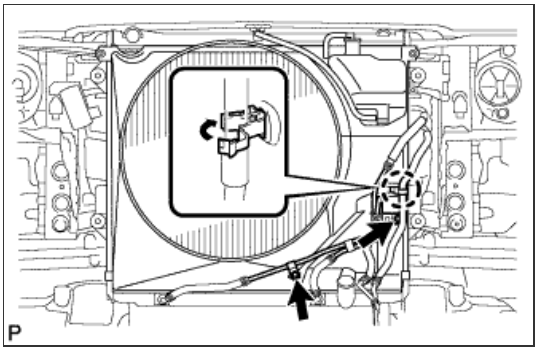
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



8. CONNECT OIL COOLER TUBE (w/ Air Cooled Transmission Oil Cooler)

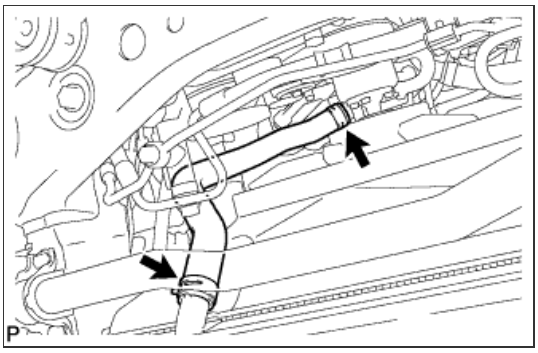
a. Connect the oil cooler tube with the 2 bolts, and attach the claw to close the flexible hose clamp.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



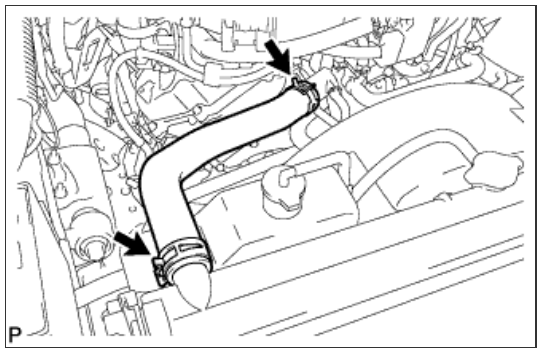
9. INSTALL NO. 2 RADIATOR HOSE

a. Install the radiator hose.



10. INSTALL NO. 1 RADIATOR HOSE

a. Install the radiator hose.



11. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner assembly with the 2 bolts.

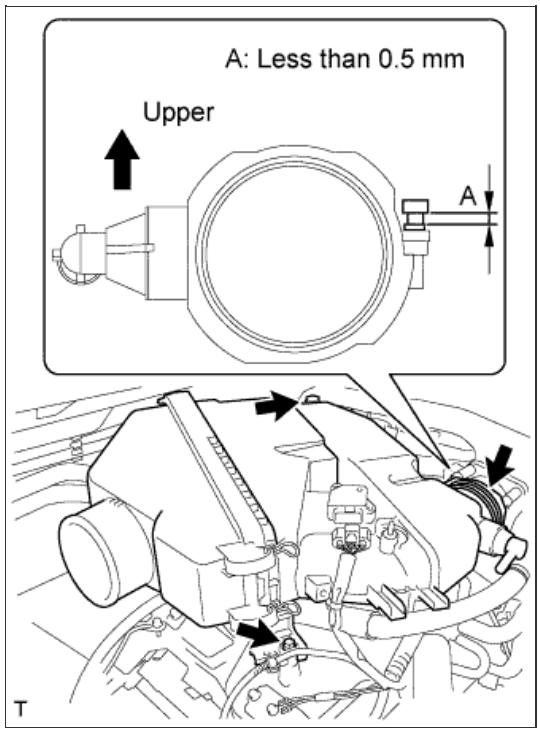
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

b. Tighten the hose clamp.

HINT:

Tighten the hose clamp until it reaches the specified protrusion height labeled A shown in the illustration.

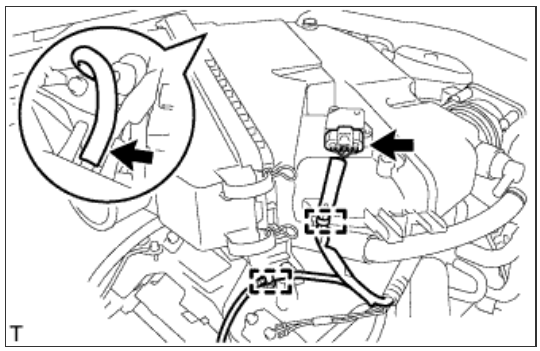
Standard protrusion height:
Less than 0.5 mm (0.0197 in.)



c. Connect the MAF meter connector.

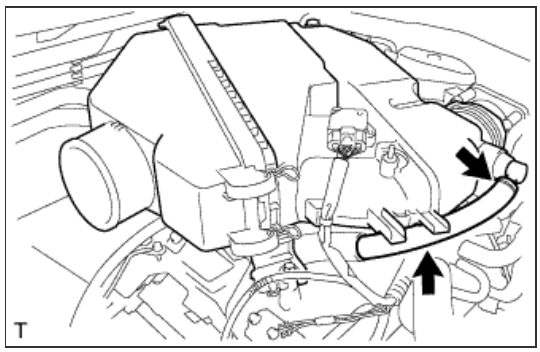
d. Attach the 2 wire harness clamps.

e. Connect the vacuum hose.



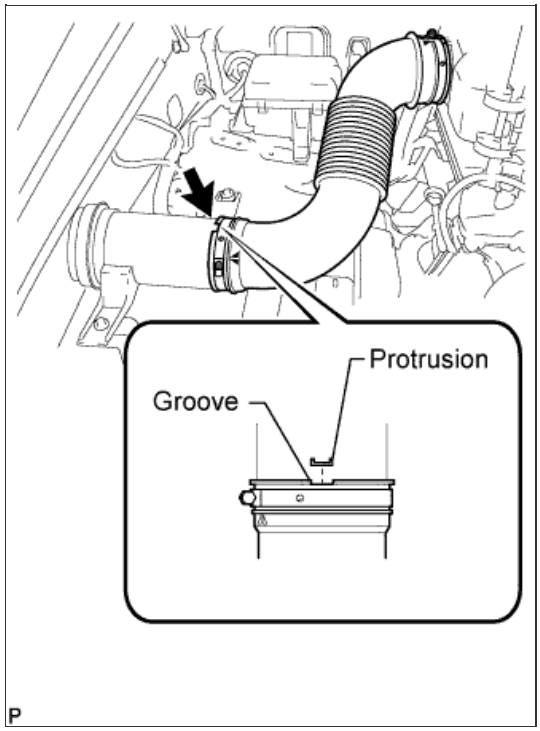
f. Attach the hose clamp.

g. Connect the No. 2 ventilation hose.



12. INSTALL NO. 2 AIR CLEANER HOSE

a. Align the protrusion of the pre-cleaner with the groove of the No. 2 air cleaner hose as shown in the illustration.

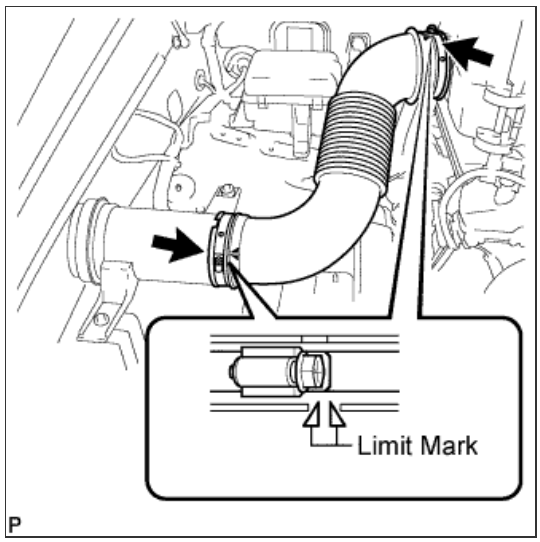


b. Tighten the 2 hose clamps.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }

HINT:

Tighten the clamp until the end of the clamp band is within both limit marks.



13. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacit :

Item		Specified condition
for Automatic transmission	w/o Rear Heater	11.2 liters (11.8 US qts, 9.9 Imp. qts)
	w/ Rear Heater	14.4 liters (15.2 US qts, 12.7 Imp. qts)
for Manual transmission	w/o Rear Heater	12.0 liters (12.7 US qts, 10.6 Imp. qts)
	w/ Rear Heater	14.6 liters (15.4 US qts, 12.8 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

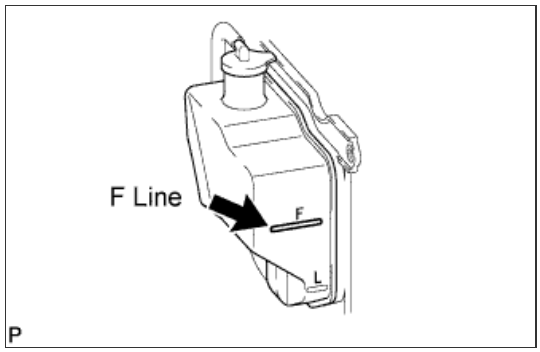
TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.



f. Set the air conditioning as follows while warming up the engine.

Item	Condition
Fan speed	Any setting except off
Temperature	Toward WARM
Air conditioning switch	Off

g. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

h. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pa attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormall high temperature.**
- **If there is not enough coolant, the engine ma burn out or overheat.**
- **Immediatel after starting the engine, if the radiator reservoir does not have an coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

i. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

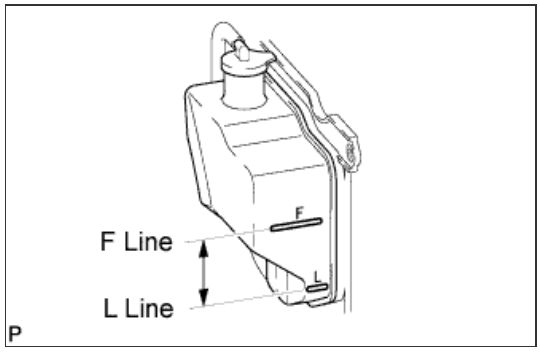
- **Wear protective gloves. Heat areas on the parts ma injure our hands.**
- **Be careful as the radiator hoses are hot.**
- **eep our hands awa from the fan.**

j. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

k. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.



14. INSPECT FOR COOLANT LEA

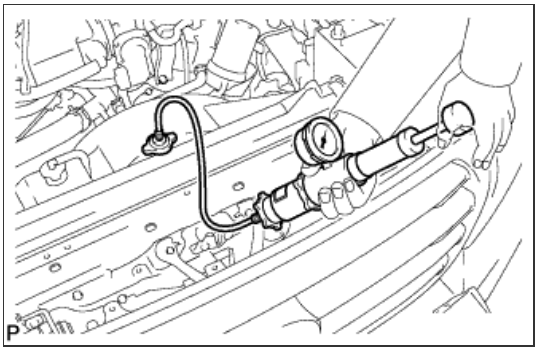
CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

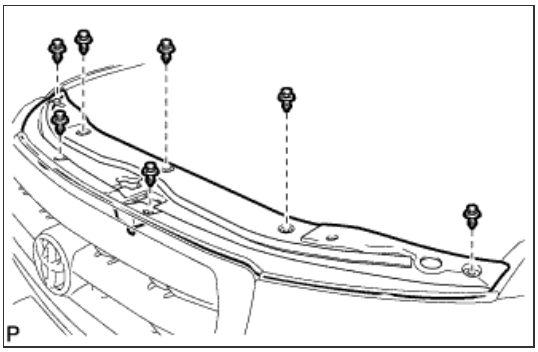
b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



15. INSTALL UPPER RADIATOR SUPPORT SEAL

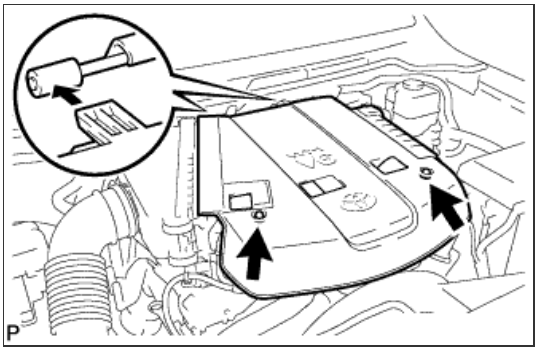
a. Install the radiator support seal with the 7 clips.



16. INSTALL V-BAN COVER

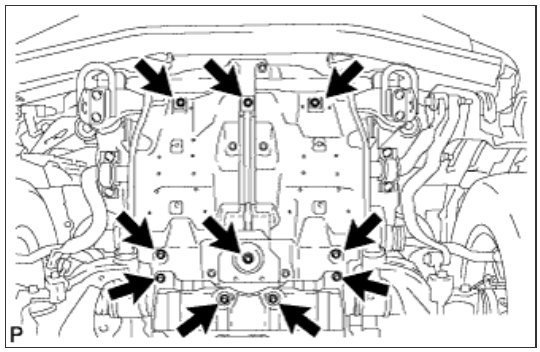
a. Install the V-bank cover with the 2 cap nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



17. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the under cover with the 10 bolts.



18. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

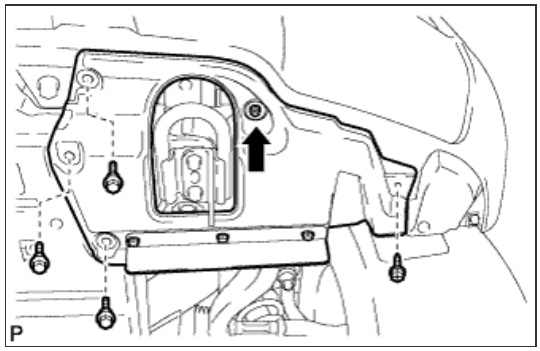
HINT:

Use the same procedures described for the LH side.

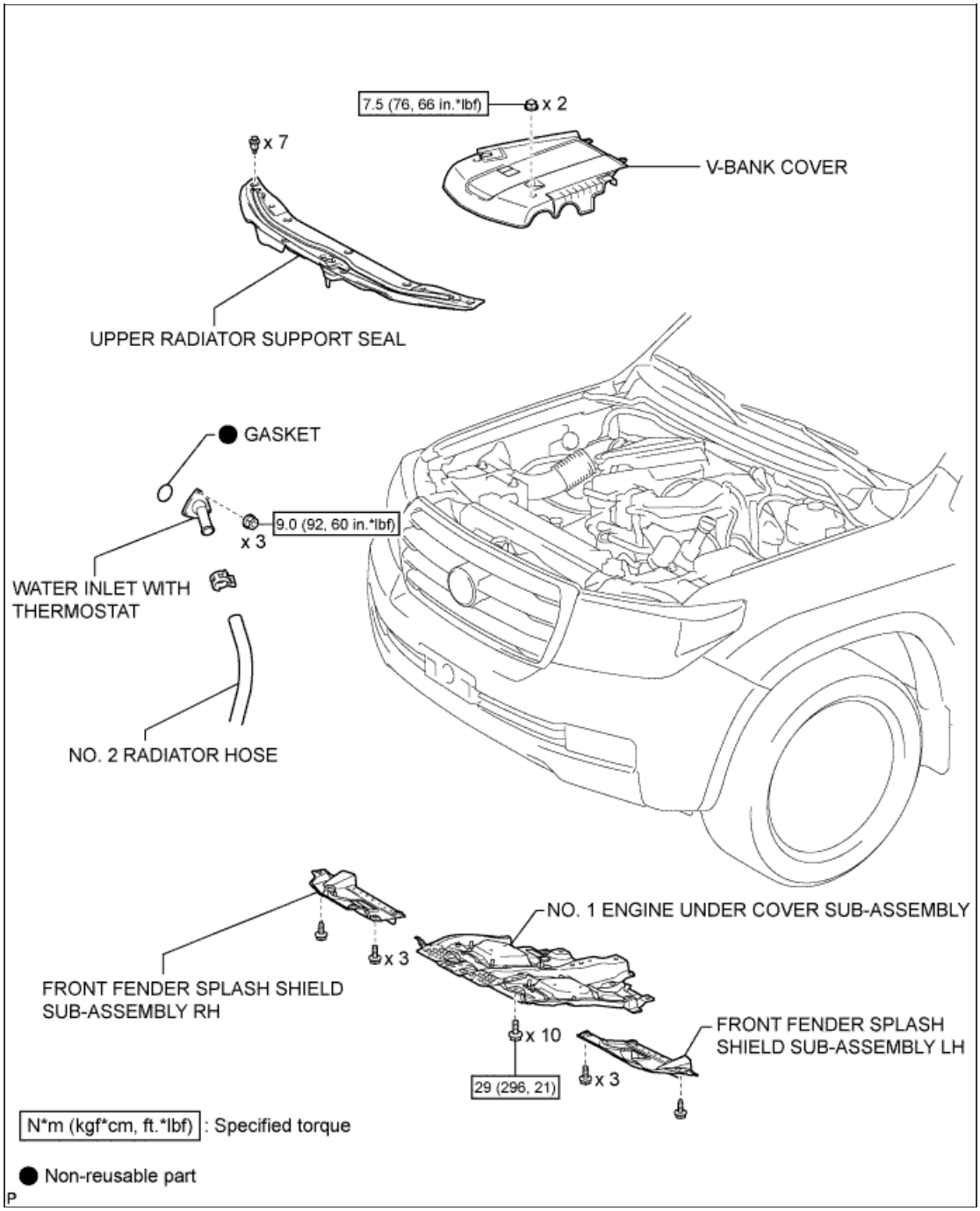
19. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



for Preparation [Click here]

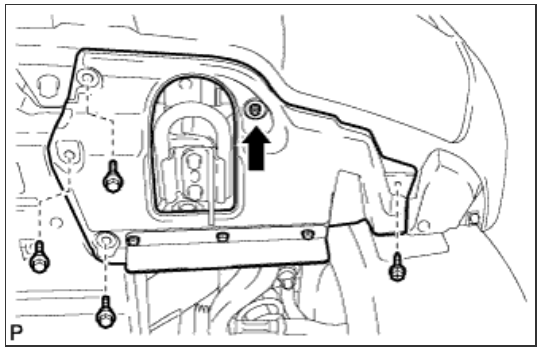


for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



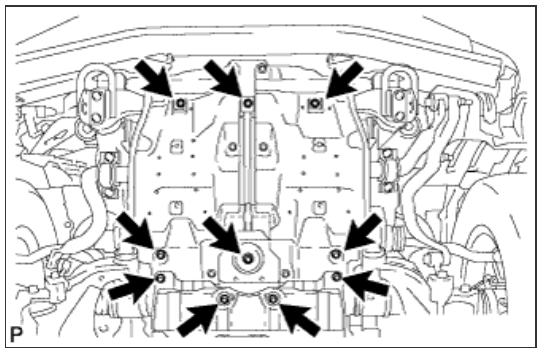
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

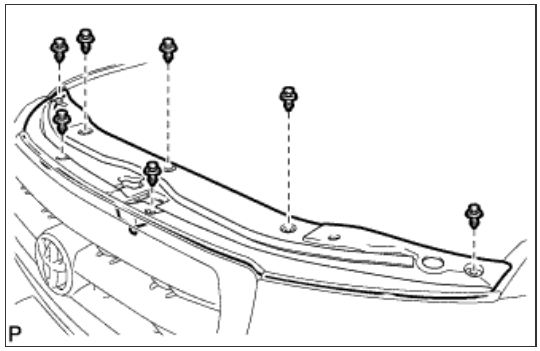
3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



4. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and radiator support seal.



5. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug and 2 cylinder block drain cock plugs.

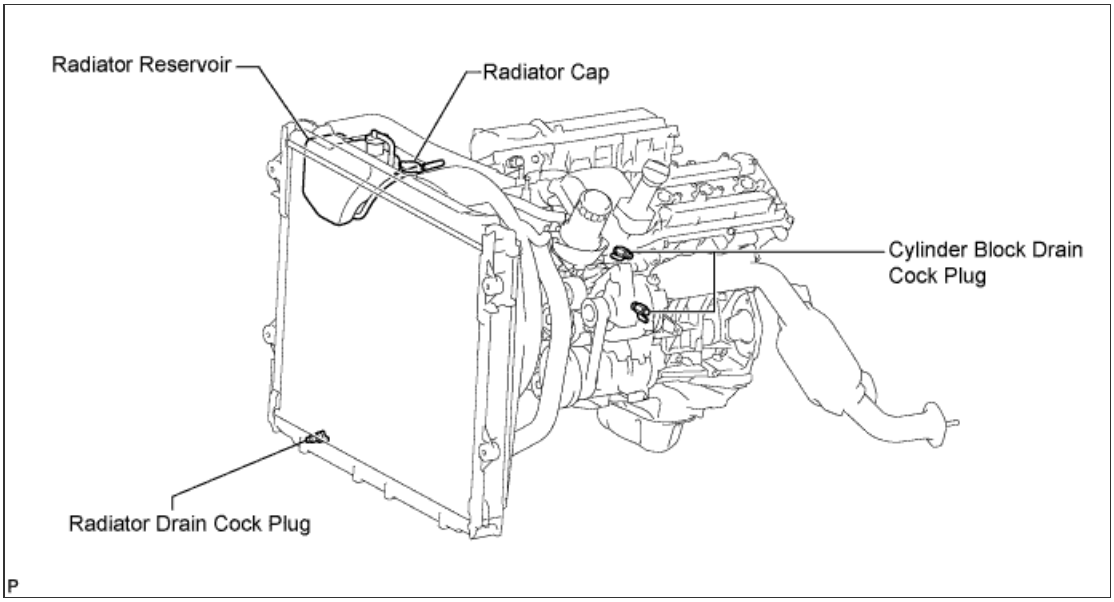
b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Tighten the 2 cylinder block drain cock plugs.

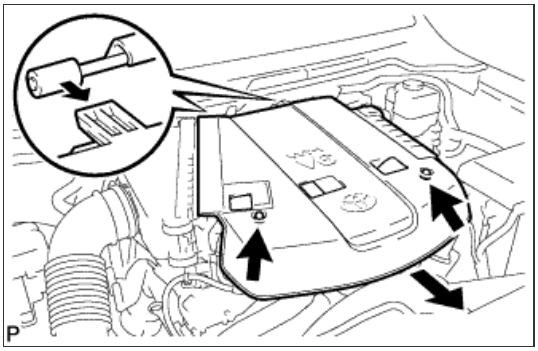
Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



d. Tighten the radiator drain cock plug by hand.

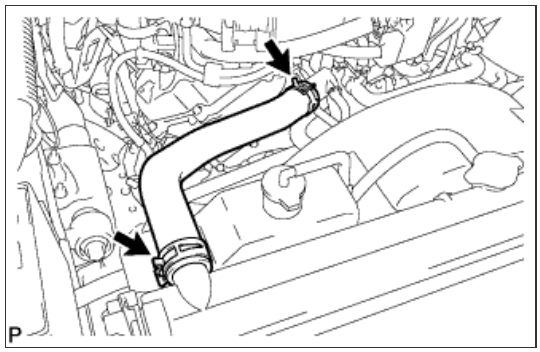
6. REMOVE V-BANK COVER

a. Remove the 2 cap nuts and V-bank cover.



7. REMOVE NO. 2 RADIATOR HOSE

a. Remove the radiator hose.

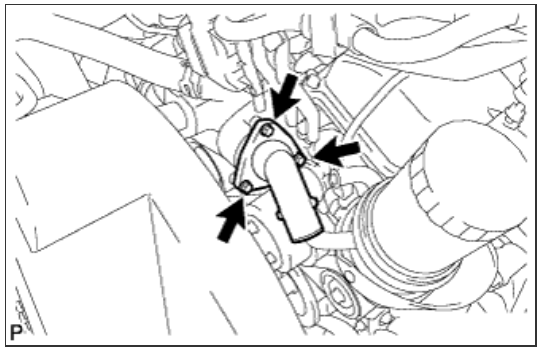


8. REMOVE WATER INLET WITH THERMOSTAT

HINT:

If the thermostat was not installed, cooling efficiency would decrease. Even if the engine tends to overheat, do not remove the thermostat.

a. Remove the 3 nuts, water inlet with thermostat and gasket.

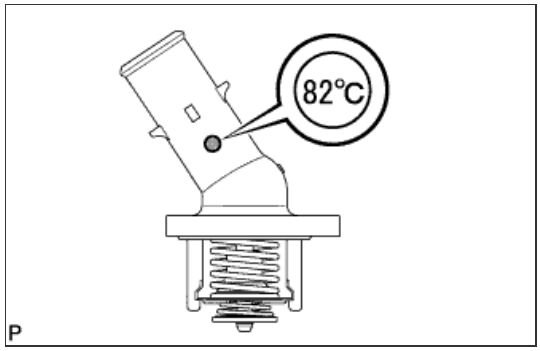


for Preparation Click here

1. INSPECT WATER INLET WITH THERMOSTAT

HINT:

The valve opening temperature is inscribed on the thermostat.

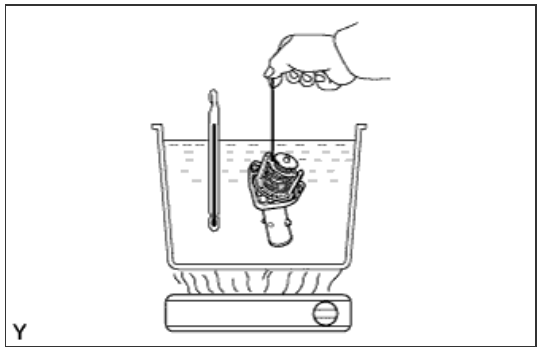


a. Immerse the thermostat in water, then gradually heat the water.

b. Check the valve opening temperature of the thermostat.

Standard valve opening temperature:
80 to 84°C (176 to 183°F)

If the valve opening temperature is not as specified, replace the water inlet with thermostat.

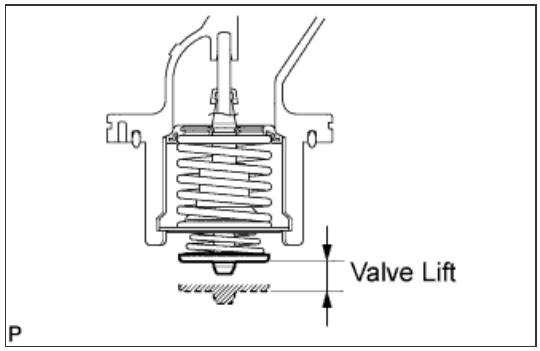


c. Check the valve lift.

Standard valve lift:
8.0 mm (0.315 in.) or more at 95°C (203°F)

If the valve lift is not as specified, replace the water inlet with thermostat.

d. Check that the valve is fully closed when the water inlet with thermostat is at a low temperature (below 77 C (171 .
If not fully closed, replace the thermostat.

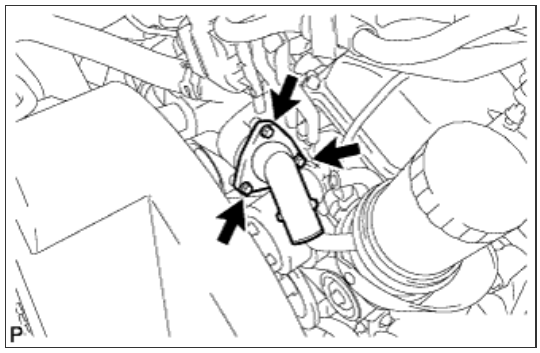


for Preparation Click here

1. INSTALL WATER INLET WITH THERMOSTAT

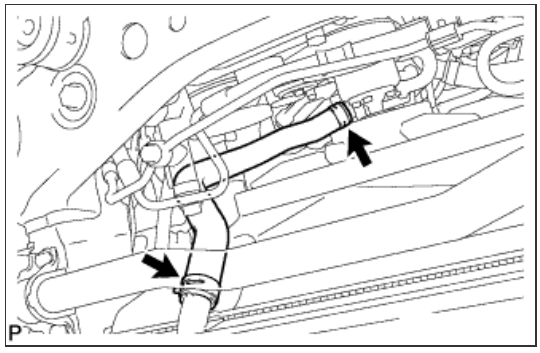
a. Install a new gasket and the water inlet with thermostat with the 3 nuts.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



2. INSTALL NO. 2 RADIATOR HOSE

a. Install the radiator hose.



3. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item		Specified condition
for Automatic transmission	w/o Rear Heater	11.2 liters (11.8 US qts, 9.9 Imp. qts)
	w/ Rear Heater	14.4 liters (15.2 US qts, 12.7 Imp. qts)
for Manual transmission	w/o Rear Heater	12.0 liters (12.7 US qts, 10.6 Imp. qts)
	w/ Rear Heater	14.6 liters (15.4 US qts, 12.8 Imp. qts)

NOTICE:

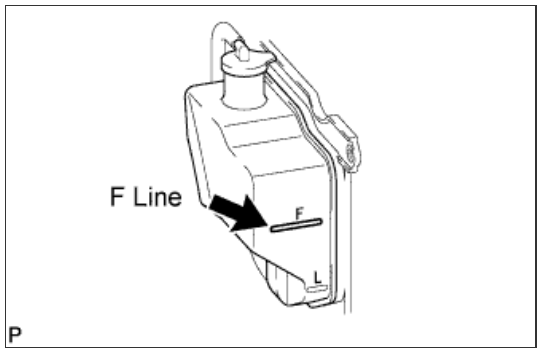
Do not substitute plain water for engine coolant.

HINT:

TO A ehicles are filled with TO A SLL at the factor . In order to a oid damage to the engine cooling s stem and other technical problems, onl use TO A SLL or similar high qualit eth lene gl col based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life h brid organic acid technolog (coolant with long-life h brid organic acid technolog consists of a combination of low

phosphates and organic acids).

b. Slowl pour coolant into the radiator reser oir until it reaches the F line.



c. Install the reser oir cap.

d. Press the No. 1 and No. 2 radiator hoses se eral times b hand, and then check the coolant le el. If the coolant le el is low, add coolant.

e. Install the radiator cap.

f. Set the air conditioning as follows while warming up the engine.

Item	ondition
Fan speed	An etting except off
Temperature	Toward WARM
Air conditioning switch	Off

g. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed b pressing the No. 2 radiator hose b hand, and checking when the engine coolant starts to flow inside the hose.

h. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the line.**
- **Run the engine at 2000 rpm until the coolant level has stabili d.**

i. Press the No. 1 and No. 2 radiator hoses se eral times b hand to bleed air.

CA TION:

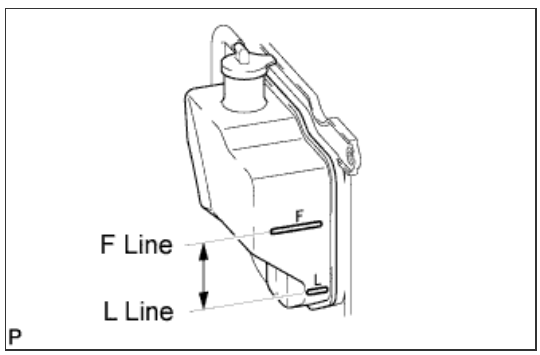
- **Wear protective gloves. Heat areas on the parts may injure your hands.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the fan.**

j. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CA TION:

Do not remo e the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam ma be released and cause serious burns.

k. heck that the coolant le el is between the F and L lines.
If the coolant le el is below the L line, repeat all of the procedures abo e.
If the coolant le el is abo e the F line, drain coolant so that the coolant le el is between the F and L lines.



4. INSPECT OR ENGINE COOLANT LEA

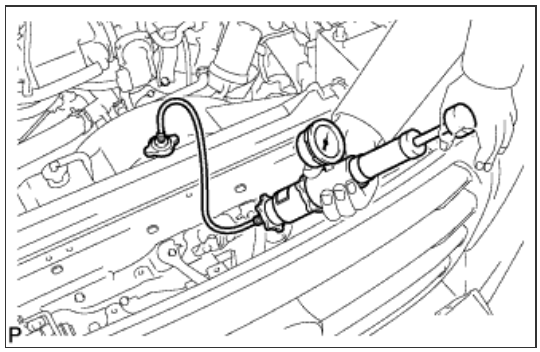
CA TION:

Do not remo e the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam ma be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

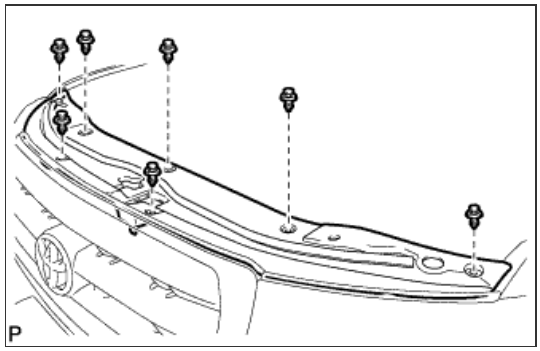
b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, c inder block and head.



5. INSTALL PPER RADIATOR S PPORT SEAL

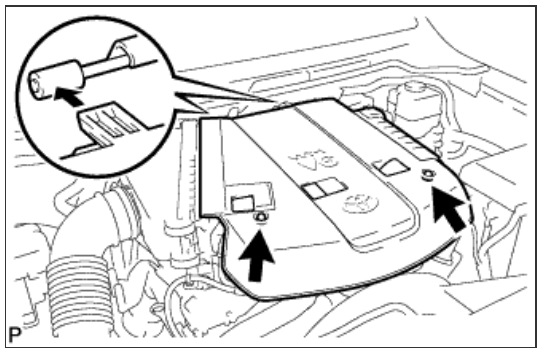
a. Install the radiator support seal with the 7 clips.



6. INSTALL V-BANK CO ER

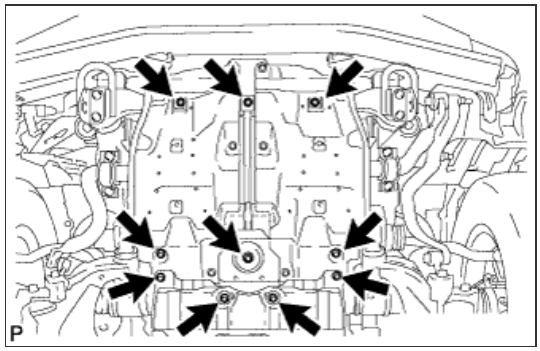
a. Install the V-bank co er with the 2 cap nuts.

Torque:
.5 N*m{ kgf*cm , 66 in.*lbf }



. INSTALL NO. 1 ENGINE DER CO ER S ASSEM L

a. Install the under co er with the 10 bolts.



8. INSTALL FRONT FENDER SPLASH SHIELD ASSEMBLY RH

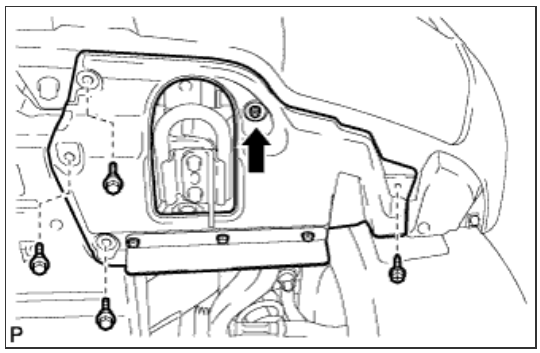
HINT:

Use the same procedures described for the LH side.

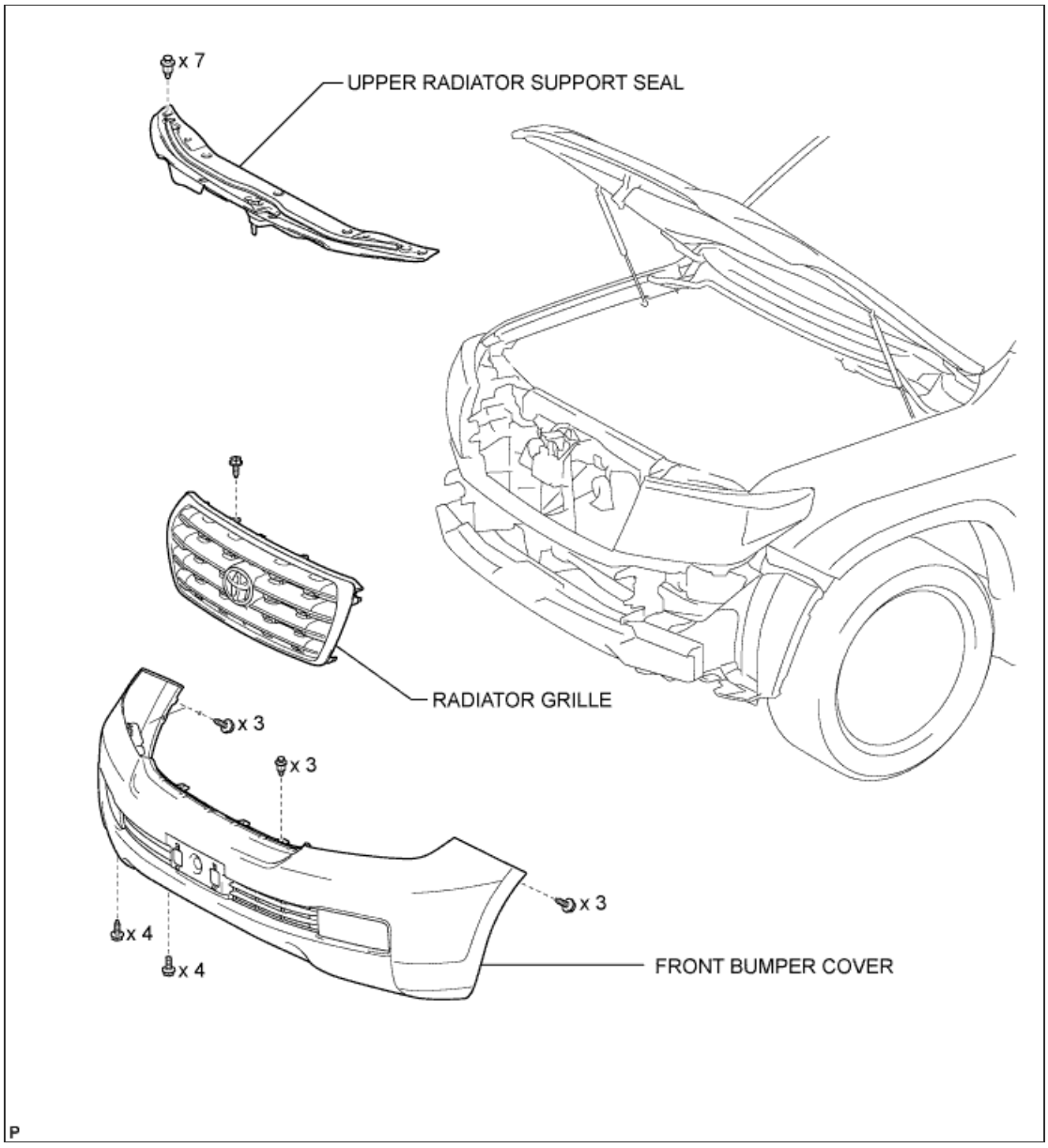
9. INSTALL FRONT FENDER SPLASH SHIELD ASSEMBLY LH

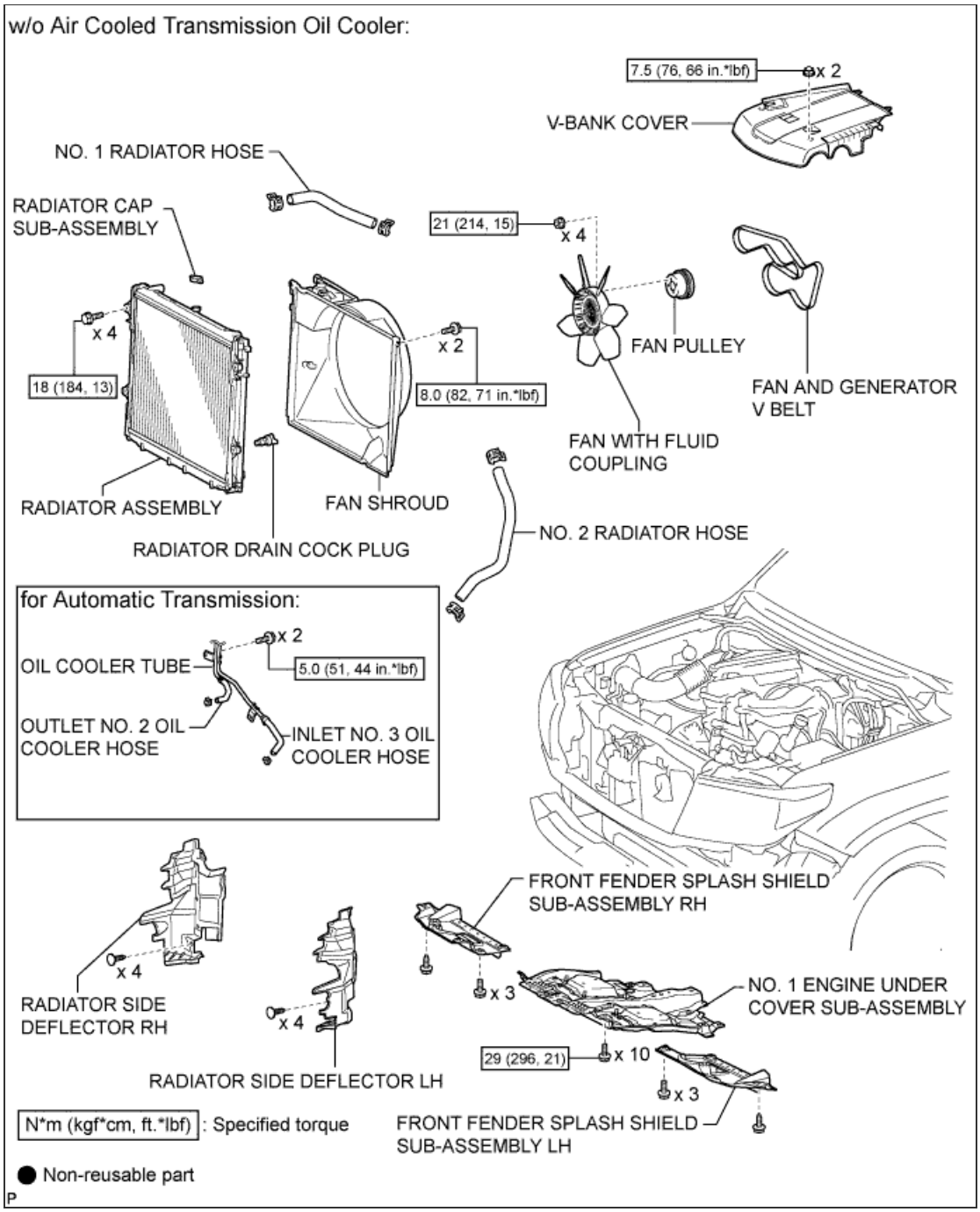
a. Remove the 3 bolts and screw.

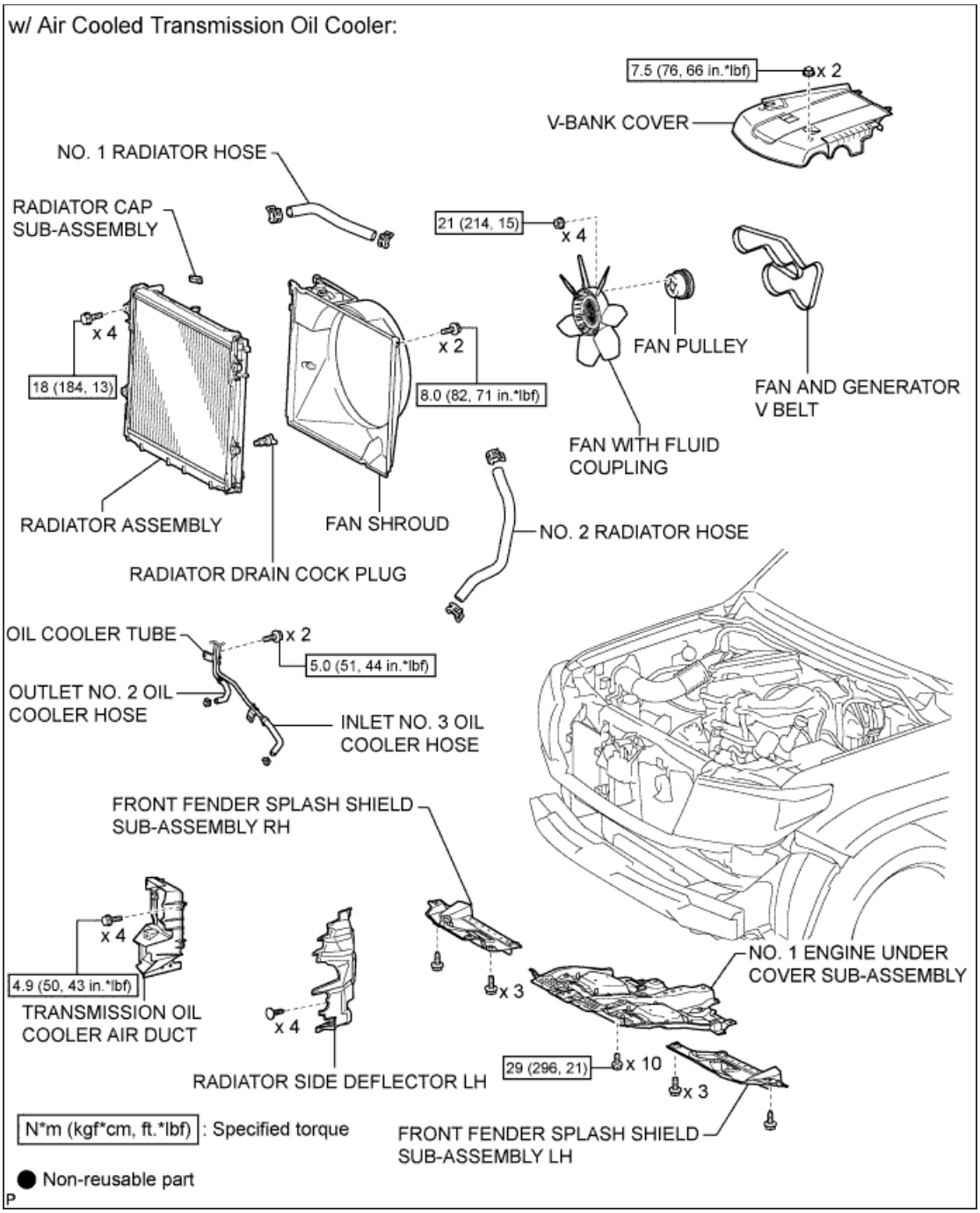
b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



for Preparation Click here




w/o Air Cooled Transmission Oil Cooler:
7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER
NO. 1 RADIATOR HOSE
RADIATOR CAP SUB-ASSEMBLY
21 (214, 15)
x 4
FAN PULLEY
FAN AND GENERATOR V BELT
x 4
18 (184, 13)
x 2
8.0 (82, 71 in.*lbf)
FAN WITH FLUID COUPLING
RADIATOR ASSEMBLY
FAN SHROUD
RADIATOR DRAIN COCK PLUG
NO. 2 RADIATOR HOSE
for Automatic Transmission:
x 2
OIL COOLER TUBE
5.0 (51, 44 in.*lbf)
OUTLET NO. 2 OIL COOLER HOSE
INLET NO. 3 OIL COOLER HOSE
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH
x 4
RADIATOR SIDE DEFLECTOR RH
x 4
x 3
NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY
29 (296, 21)
x 10
x 3
RADIATOR SIDE DEFLECTOR LH
N*m (kgf*cm, ft.*lbf) : Specified torque
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH
● Non-reusable part
P

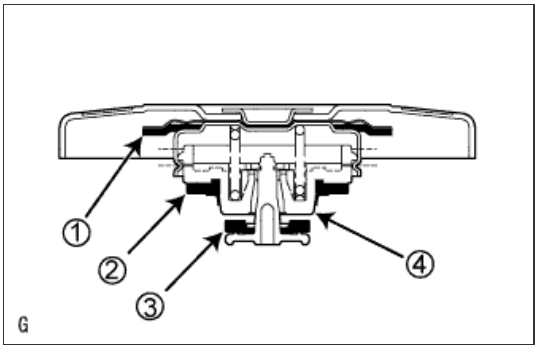

w/ Air Cooled Transmission Oil Cooler:
7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER
NO. 1 RADIATOR HOSE
RADIATOR CAP SUB-ASSEMBLY
21 (214, 15)
x 4
FAN PULLEY
FAN AND GENERATOR V BELT
x 4
18 (184, 13)
x 2
8.0 (82, 71 in.*lbf)
FAN WITH FLUID COUPLING
RADIATOR ASSEMBLY
FAN SHROUD
NO. 2 RADIATOR HOSE
RADIATOR DRAIN COCK PLUG
OIL COOLER TUBE
x 2
5.0 (51, 44 in.*lbf)
OUTLET NO. 2 OIL COOLER HOSE
INLET NO. 3 OIL COOLER HOSE
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH
x 4
4.9 (50, 43 in.*lbf)
TRANSMISSION OIL COOLER AIR DUCT
x 4
x 3
NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY
RADIATOR SIDE DEFLECTOR LH
29 (296, 21)
x 10
x 3
N*m (kgf*cm, ft.*lbf) : Specified torque
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH
● Non-reusable part
P

for Preparation Click here

1. INSPECT RADIATOR CAP SUB-ASSEMBLY

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.



a. Measure the valve opening pressure.

i. If there are water stains or foreign matter on rubber packing 1, 2 or 3, clean it by using water and finger scouring.

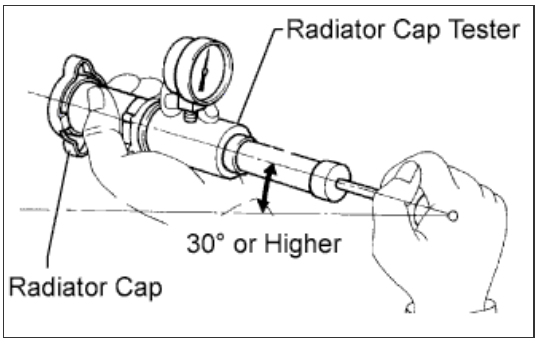
ii. Check that rubber packing 1, 2 and 3 are not deformed, cracked or swollen.

iii. Check that rubber packing 3 and 4 are not stuck together.

iv. Apply engine coolant to rubber packing 2 and 3.

v. Prepare a radiator cap tester, and tilt it more than 30°.

vi. Pump the cap tester several times, and check the maximum pressure*.



Pumping speed:
1 pump per second

HINT:

*: Even if the cap cannot maintain the maximum pressure, it is not a defect.

Standard Judgment Criterion:

Item	Specified Condition
Standard value (for brand-new cap)	30 to 123 kPa (1.0 to 1.3 kgf/cm^2, 13.5 to 18 psi)
Minimum standard value (after using cap)	7 kPa (0.8 kgf/cm^2, 11.4 psi)

If the maximum pressure is less than the minimum standard value, replace the radiator cap sub-assembly.

2. INSPECT FINS FOR BLOCKAGE

a. Check that the fins of the radiator core are not blocked with leaves, dirt, or insects.
If the fins are blocked, wash them with water or a steam cleaner.

NOTICE:

- **If the distance between the steam cleaner and core is too close, the fins may be damaged.**
- **Keep the following injection distance.**

Standard Injection Distance:

Injection Distance	Injection Pressure

300 mm (11.8 in.)	2 42 to 4 03 kPa (30.0 to 50.0 kgf/cm^2, 427 to 711 psi)
500 mm (1 .7 in.)	4 03 to 7845 kPa (50.0 to 80.0 kgf/cm^2, 711 to 1138 psi)

- **If the fins are bent, straighten them with a screwdriver or pliers.**
- **Never apply water directly onto the electric components.**

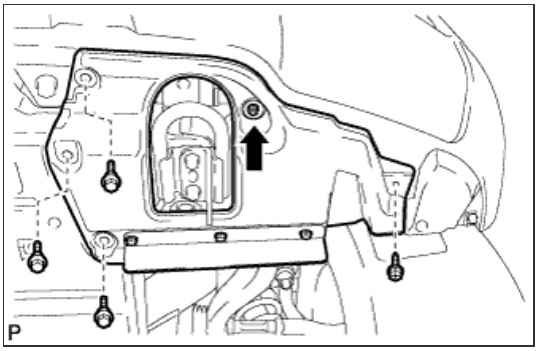
b. Dry the fins with compressed air.

for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



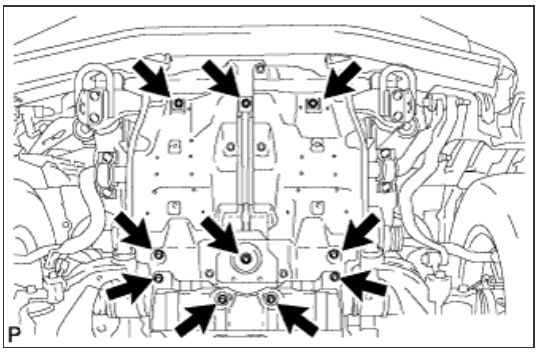
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

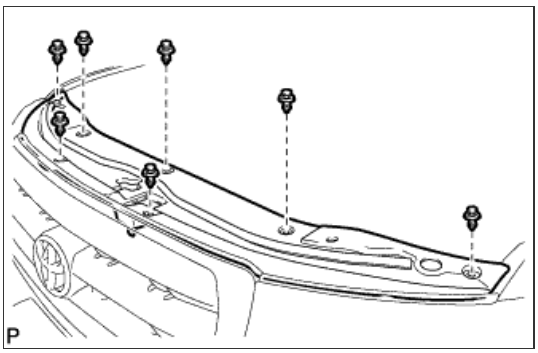
3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



4. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and radiator support seal.



5. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug and 2 cylinder block drain cock plugs.

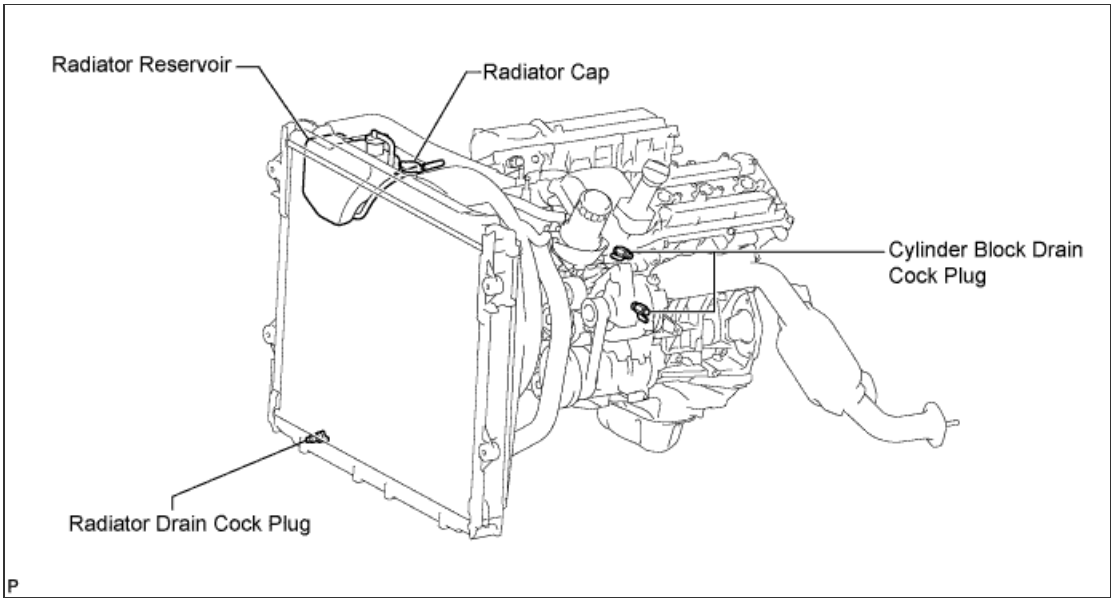
b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Tighten the 2 cylinder block drain cock plugs.

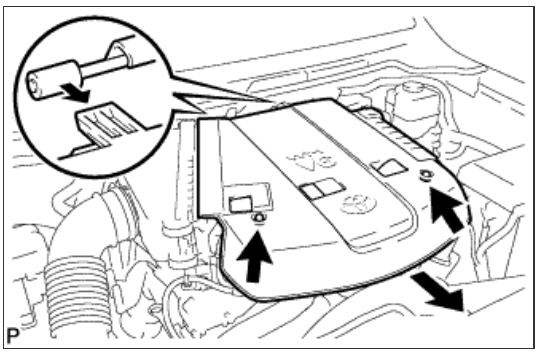
Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



d. Tighten the radiator drain cock plug by hand.

6. REMOVE V-BANK COVER

a. Remove the 2 cap nuts and V-bank cover.



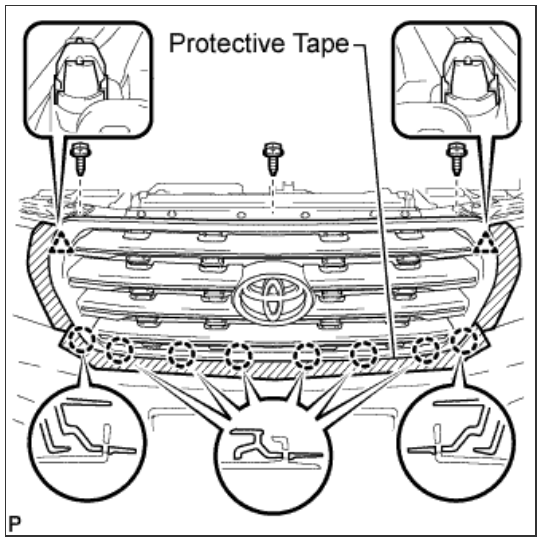
7. REMOVE FRONT BUMPER WINCH COVER SUB-ASSEMBLY Winch

REMOVE RADIATOR GRILLE

a. Put protective tape around the radiator grille.

b. Remove the 3 screws.

c. Detach the 2 clips and 8 claws, and remove the radiator grille.

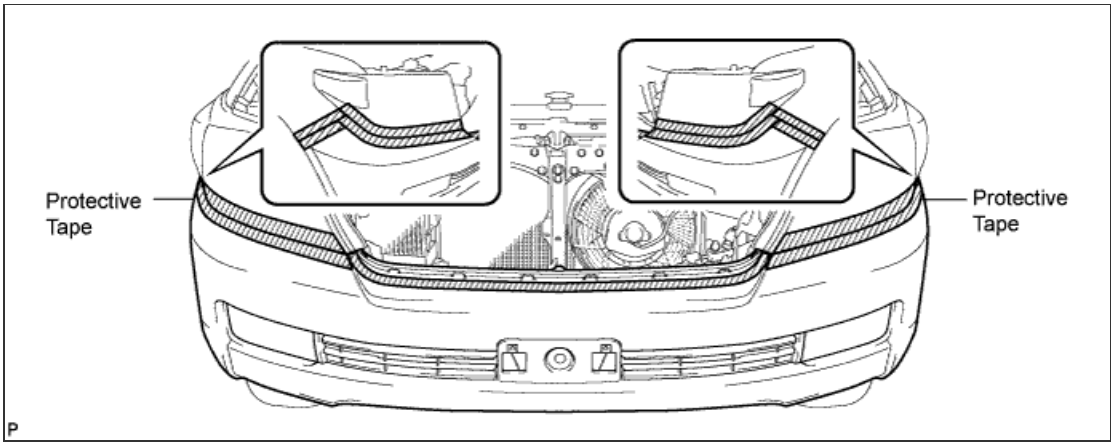


REMOVE FRONT BUMPER COVER

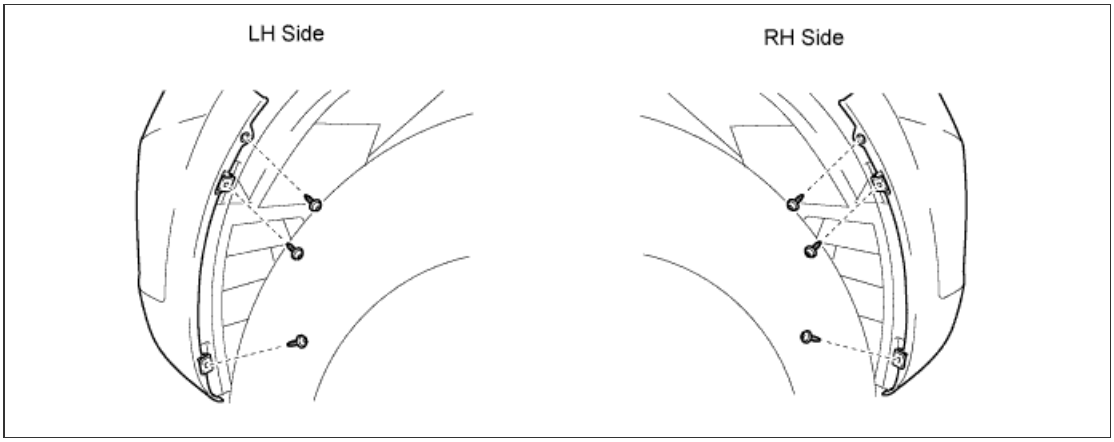
HINT:

For the front bumper cover with garnish, use the procedures described below.

a. Put protective tape around the bumper cover.



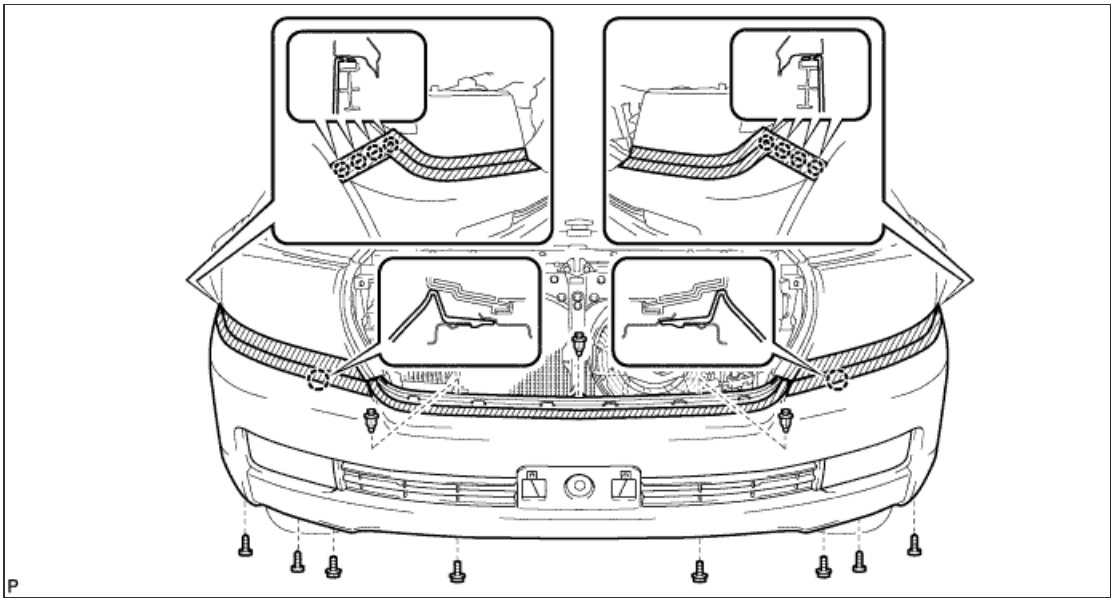
b. Using a T30 "TOR " socket, remove the 6 screws.



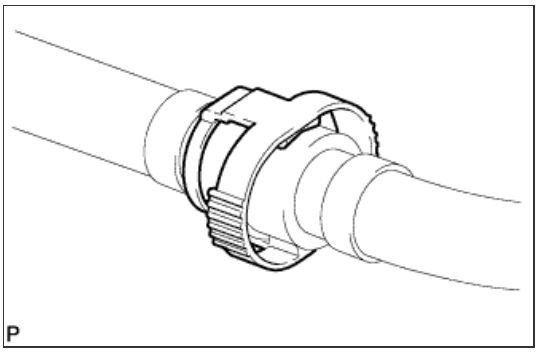
c. Remove the 3 clips, 4 screws and 4 bolts.

d. w/o TO OTA Parking Assist-sensor System, w/o Fog Light:
Detach the 10 claws and remove the bumper cover.

e. w/ TO OTA Parking Assist-sensor System or w/ Fog Light:
Detach the 10 claws, disconnect the No. 4 engine room wire connector and remove the bumper cover.

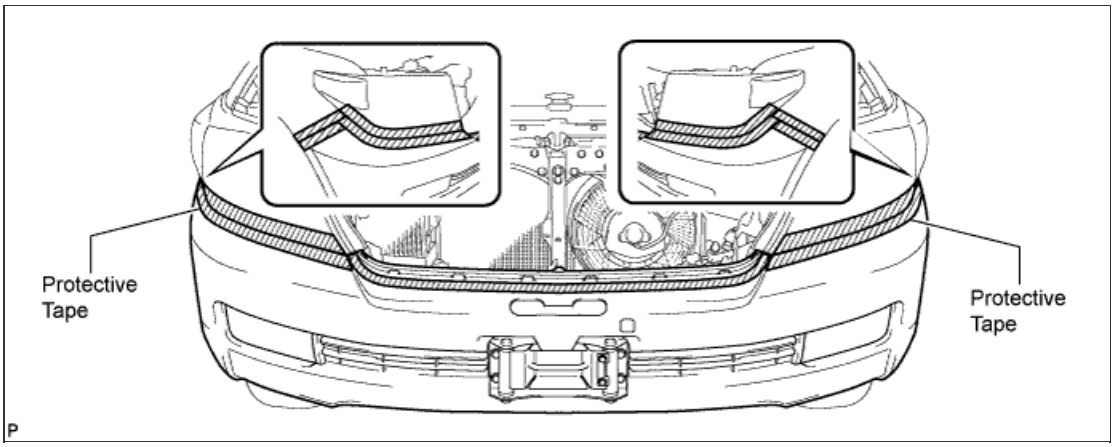


f. w/ Headlight Cleaner System:
Disconnect the headlight cleaner hose and remove the bumper cover.

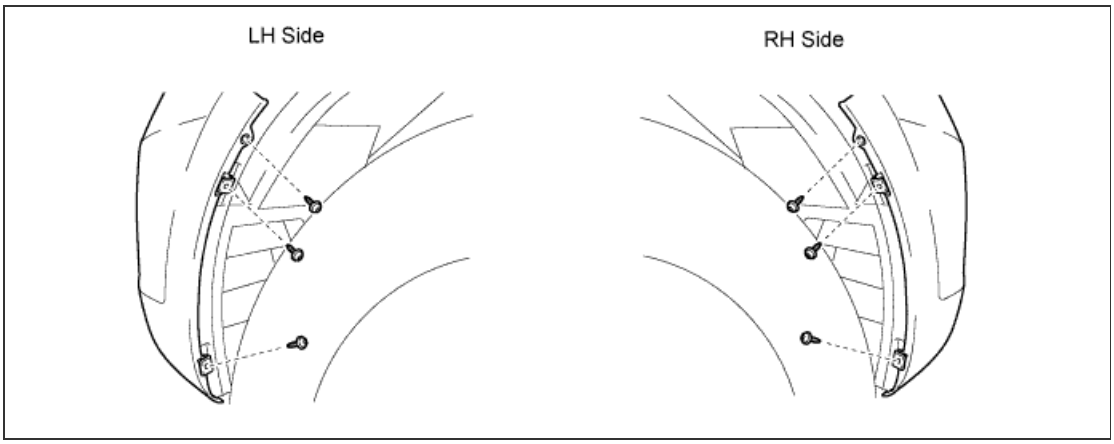


10. REMOVE FRONT BUMPER COVER Winch

a. Put protective tape around the bumper cover.



b. Using a T30 "TOR " socket, remove the 6 screws.

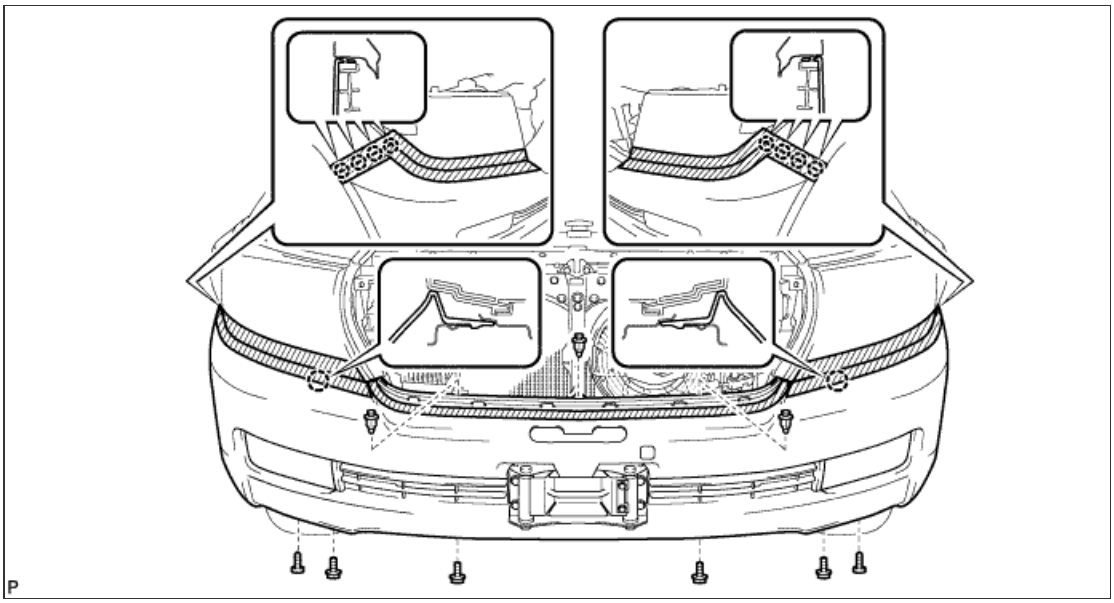


c. Remove the 3 clips, 4 screws and 4 bolts.

d. Detach the 10 claws.

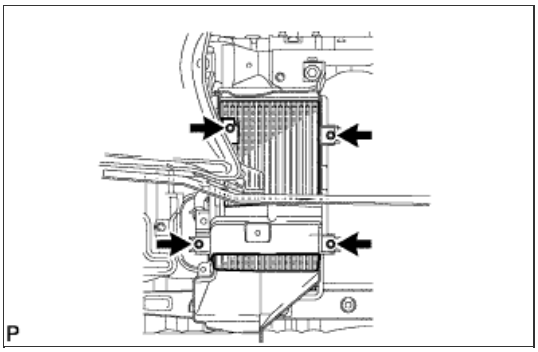
e. w/o TO OTA Parking Assist-sensor System, w/o Fog Light:
Disconnect the winch control wire connector and remove the bumper cover.

f. w/ TO OTA Parking Assist-sensor System or w/ Fog Light:
Disconnect the No. 4 engine room wire connector and winch control wire connector and remove the bumper cover.



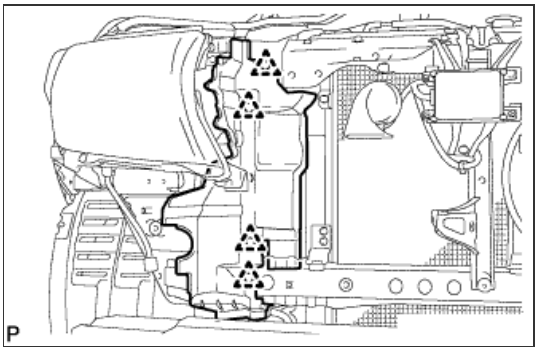
11. REMOVE TRANSMISSION OIL COOLER AIR DUCT Air Cooled Tran mi ion Oil Cooler

a. Remove the 4 bolts and oil cooler air duct.



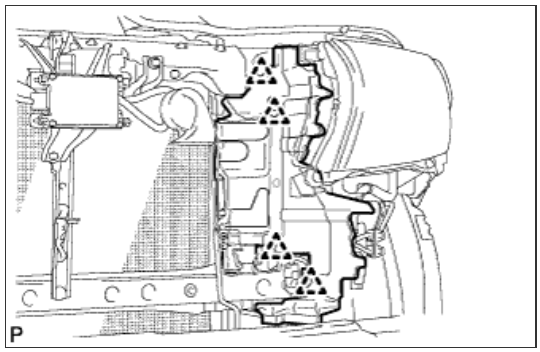
12. REMOVE RADIATOR SIDE DEFLECTOR RH o Air Cooled Tran mi ion Oil Cooler

a. Using a clip remover, remove the 4 clips and move the side deflector so that the radiator can be removed in the step below.



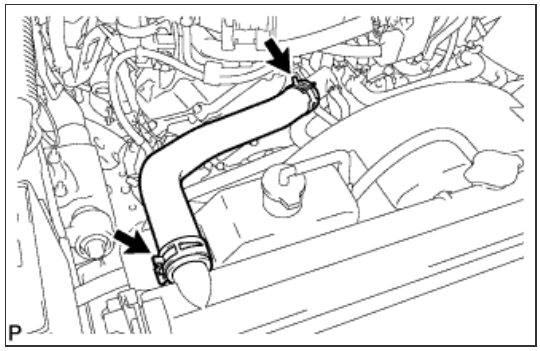
13. REMOVE RADIATOR SIDE DEFLECTOR LH

a. Using a clip remover, remove the 4 clips and move the side deflector so that the radiator can be removed in the step below.



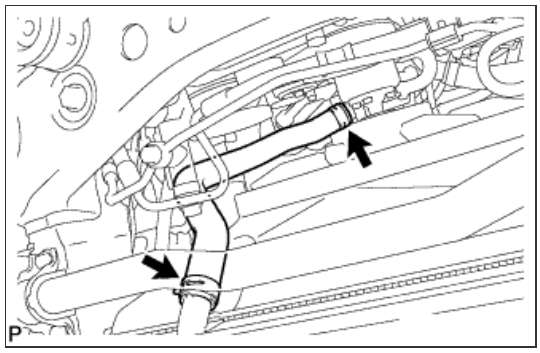
14. REMOVE NO. 1 RADIATOR HOSE

a. Remove the radiator hose.



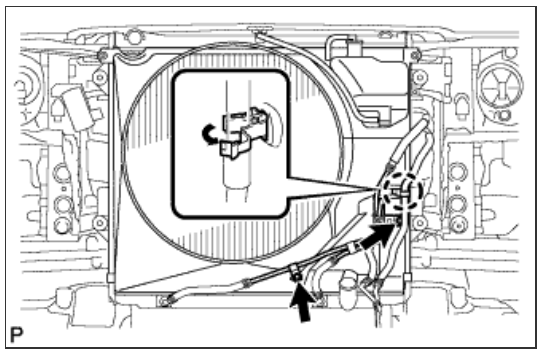
15. REMOVE NO. 2 RADIATOR HOSE

a. Remove the radiator hose.



16. DISCONNECT OIL COOLER TUBE Air Cooled Tran mi iOil Cooler

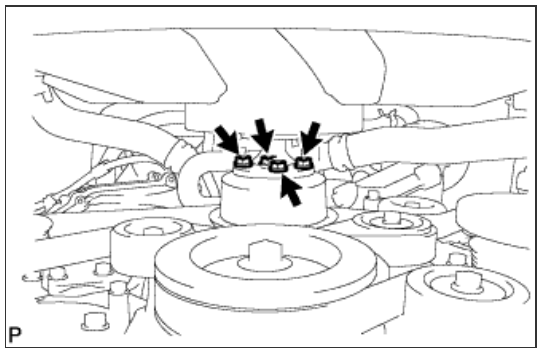
a. Detach the claw to open the fle ible hose clamp, and then remove the 2 bolts to disconnect the oil cooler tube from the fan shroud.



17. REMOVE FAN SHROUD

a. Loosen the 4 nuts holding the fluid coupling fan.

b. Remove the fan and generator V-belt (Click here).



c. Disconnect the reservoir hose from the upper side of the radiator tank.

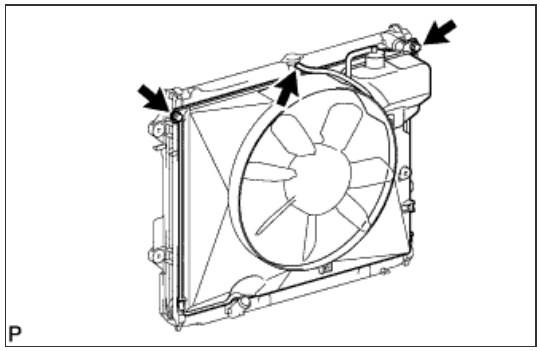
d. Remove the 2 bolts holding the fan shroud.

e. Remove the 4 nuts of the fluid coupling fan, and then remove the shroud together with the coupling fan.

NOTICE:

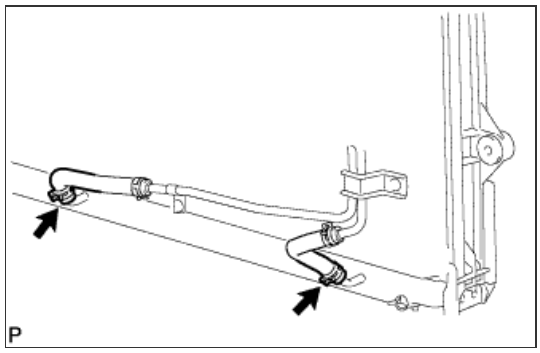
Be careful not to damage the radiator core.

f. Remove the fan pulley from the water pump.



18. DISCONNECT INLET NO. 3 OIL COOLER HOSE for Automatic Tran mi ion

a. Disconnect the oil cooler hose.

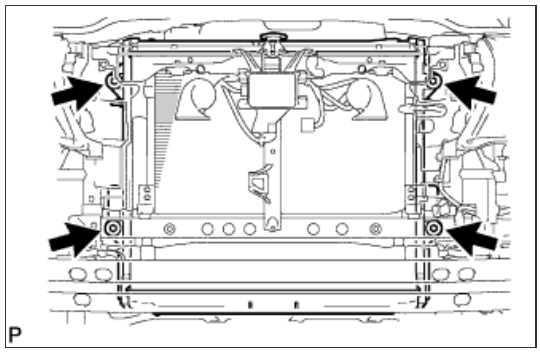


1 DISCONNECT OUTLET NO. 2 OIL COOLER HOSE for Automatic Tran mi ion

a. Disconnect the oil cooler hose.

20. REMOVE RADIATOR ASSEMBLY

a. Remove the 4 bolts and radiator.


P

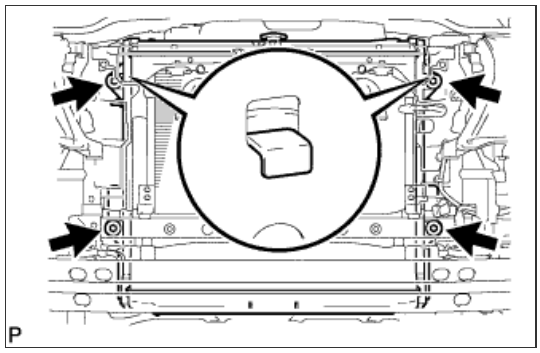
for Preparation Click here

1. INSTALL RADIATOR ASSEMBLY

a. Set the radiator bracket hooks into the radiator support holes.

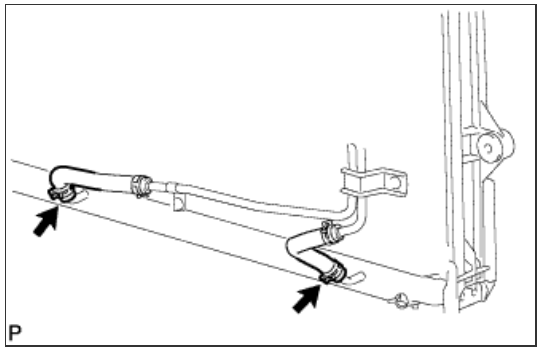
b. Install the radiator with the 4 bolts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }



2. CONNECT OUTLET NO. 2 OIL COOLER HOSE (for Automatic Transmission)

a. Connect the cooler hose.



3. CONNECT INLET NO. 3 OIL COOLER HOSE (for Automatic Transmission)

a. Connect the cooler hose.

4. INSTALL AN SHROUD

a. Install the fan pulley to the water pump.

b. Place the shroud together with the coupling fan between the radiator and engine.

NOTICE:

Be careful not to damage the radiator core.

c. Temporarily install the fluid coupling fan to the water pump with the 4 nuts. Tighten the nuts as much as possible by hand.

d. Attach the claws of the shroud to the radiator as shown in the illustration.

e. Install the shroud with the 2 bolts.

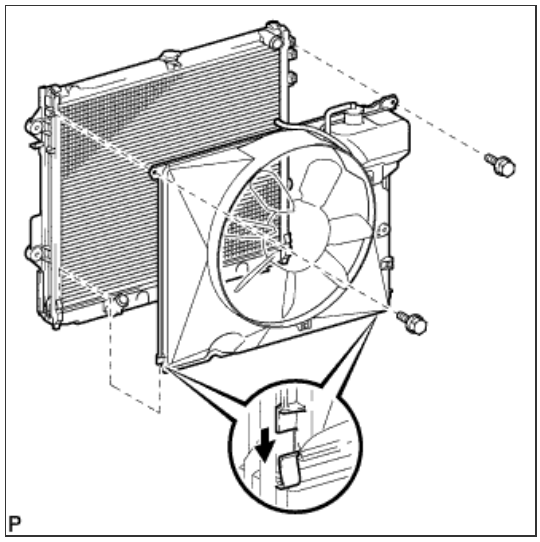
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

f. Connect the reservoir hose to upper side of the radiator tank upper.

g. Install the fan and generator V-belt (Click here).

h. Tighten the 4 nuts of the fluid coupling fan.

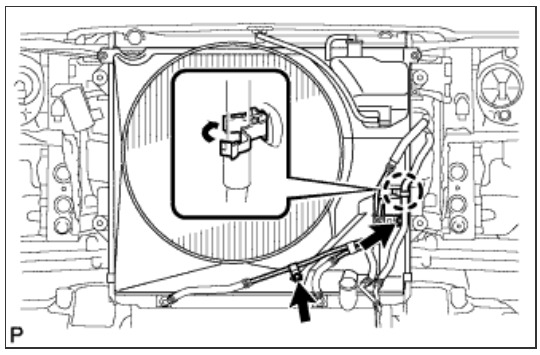
Torque:
21 N*m{ 214 kgf*cm , 1 ft.*lbf }



. CONNECT OIL COOLER TUBE (Air Cooled Transmission Oil Cooler)

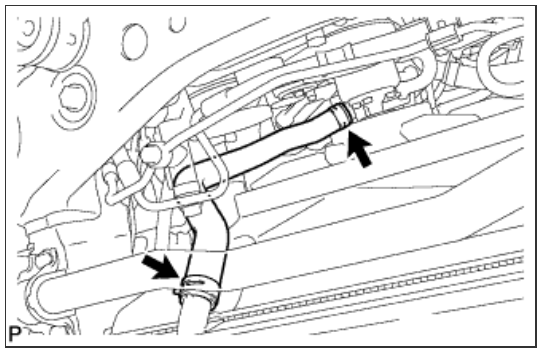
a. Connect the oil cooler tube with the 2 bolts, and attach the claw to close the flexible hose clamp.

Torque:
.0 N*m{ 1kgf*cm , 44 in.*lbf }



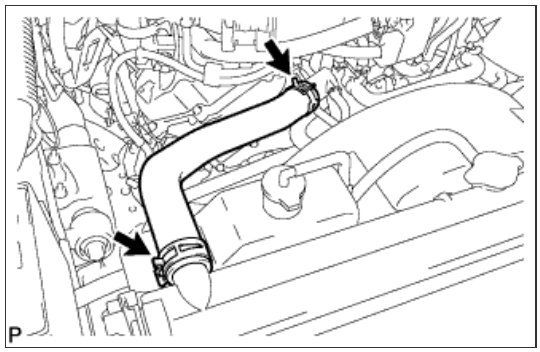
. INSTALL NO. 2 RADIATOR HOSE

a. Install the radiator hose.



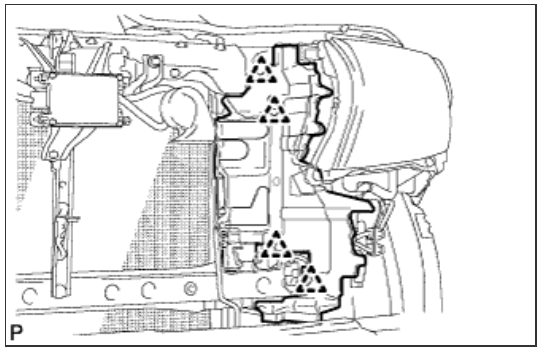
7. INSTALL NO. 1 RADIATOR HOSE

a. Install the radiator hose.



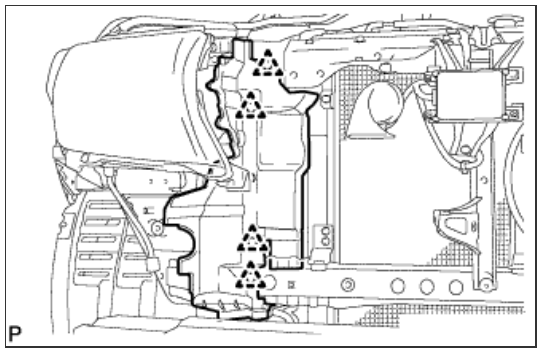
8. INSTALL RADIATOR SIDE DE LECTOR LH

a. Install the deflector with the 4 clips.



9. INSTALL RADIATOR SIDE DE LECTOR RH (o Air Cooled Transmission Oil Cooler)

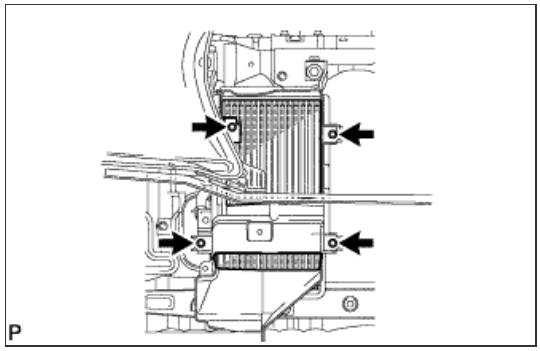
a. Install the deflector with the 4 clips.



10. INSTALL TRANSMISSION OIL COOLER AIR DUCT (Air Cooled Transmission Oil Cooler)

a. Install the oil cooler air duct with the 4 bolts.

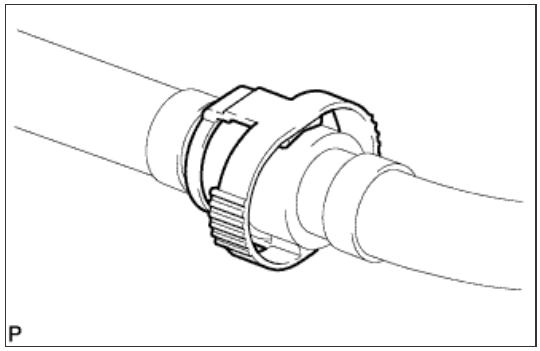
Torque:
4.9 N*m{ kgf*cm , 43 in.*lbf }



11. INSTALL RONT BUMPER CO ER

HINT:

For the front bumper cover with garnish, use the procedures described below.

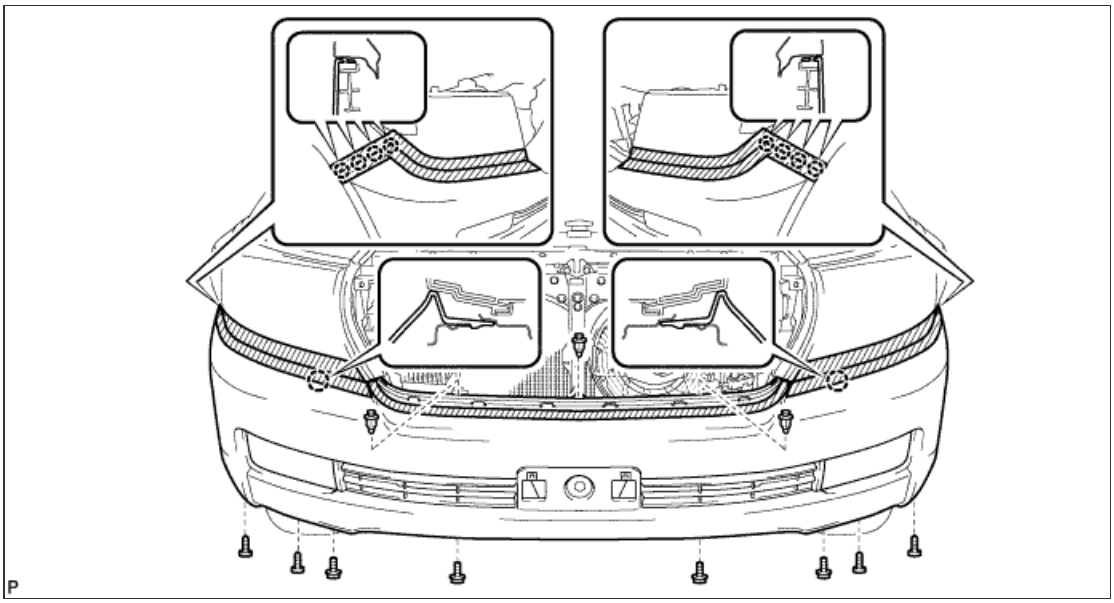


a. w/ Headlight Cleaner System:
Connect the headlight cleaner hose.

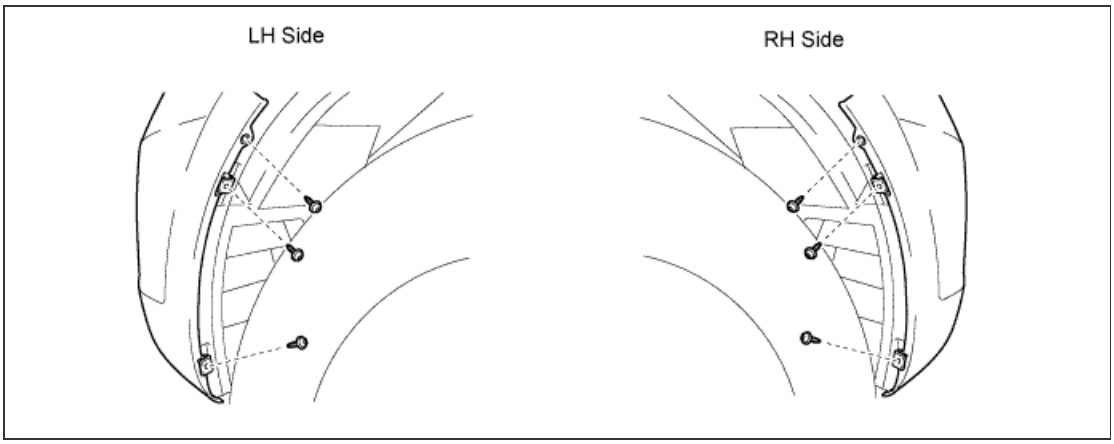
b. w/o TOYOTA Parking Assist-sensor System, w/o Fog Light:
Attach the 10 claws to install the bumper cover.

c. w/ TOYOTA Parking Assist-sensor System or w/ Fog Light:
Connect the No. 4 engine room wire connector and attach the 10 claws to install the bumper cover.

d. Install the 3 clips, 4 screws and 4 bolts.



e. Using a T30 "TORX" socket, install the 6 screws.

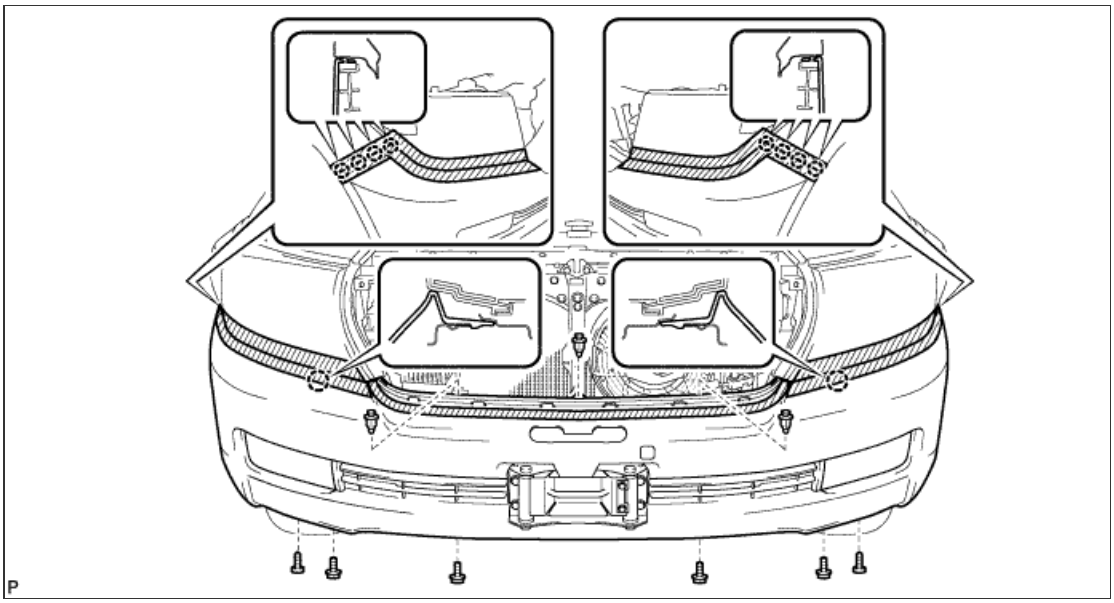


12. INSTALL RONT BUMPER CO ER (Winch)

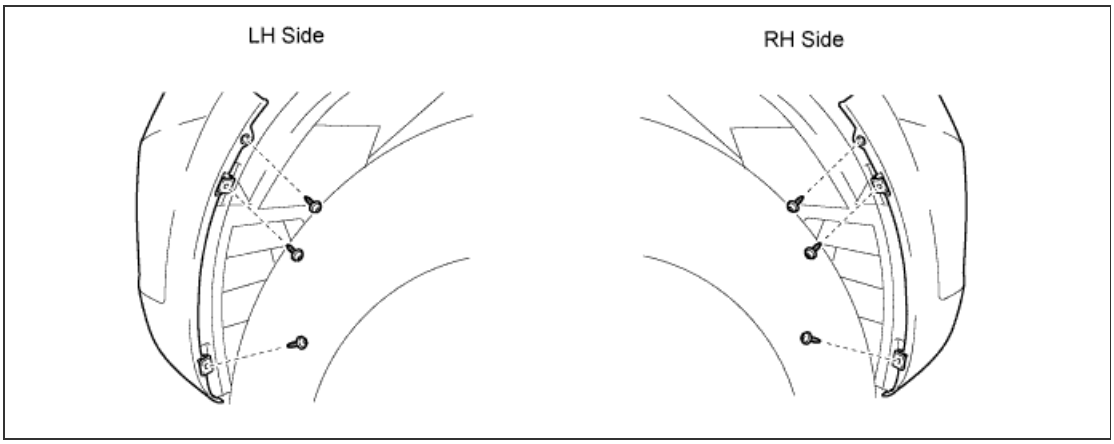
a. w/o TOYOTA Parking Assist-sensor System, w/o Fog Light:
Connect the winch control wire connector and attach the 10 claws to install the bumper cover.

b. w/ TOYOTA Parking Assist-sensor System or w/ Fog Light:
Connect the No. 4 engine room wire connector and winch control wire connector, and attach the 10 claws to install the bumper cover.

c. Install the 3 clips, 4 screws and 4 bolts.



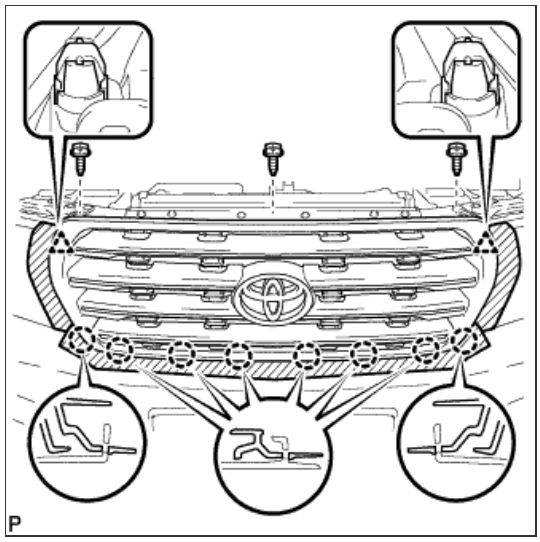
d. Using a T30 "TORX" socket, install the 6 screws.



13. INSTALL RADIATOR GRILLE

a. Attach the 2 clips and 8 claws to install the radiator grille.

b. Install the 3 screws.



14. INSTALL RONT BUMPER WINCH CO ER SUB-ASSEMBLY (Winch)

1 . ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacit :

Item		Specified condition
for Automatic transmission	w/o Rear Heater	11.2 liters (11.8 US qts, 9.9 Imp. qts)
	w/ Rear Heater	14.4 liters (15.2 US qts, 12.7 Imp. qts)
for Manual transmission	w/o Rear Heater	12.0 liters (12.7 US qts, 10.6 Imp. qts)
	w/ Rear Heater	14.6 liters (15.4 US qts, 12.8 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

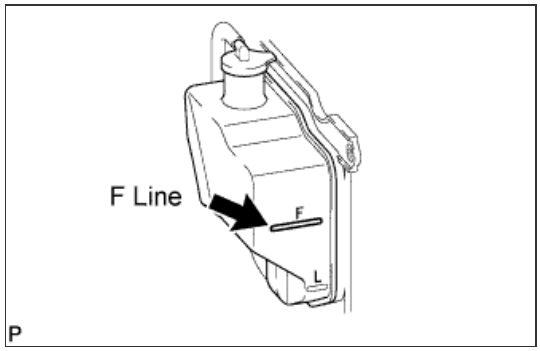
c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Set the air conditioning as follows while warming up the engine.

Item	Condition
Fan speed	Any setting except off
Temperature	Toward WARM
Air conditioning switch	Off



g. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

h. aintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pa attention to the needle of the ater temperature meter. Make sure that the needle does not sho an abnormall high temperature.**
- **If there is not enough coolant, the engine ma burn out or overheat.**
- **Immediatel after starting the engine, if the radiator reservoir does not have an coolant, perform the follo ing: 1) stop the engine, 2) ait until the coolant has cooled do n, and 3) add coolant until the coolant is filled to the line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

i. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

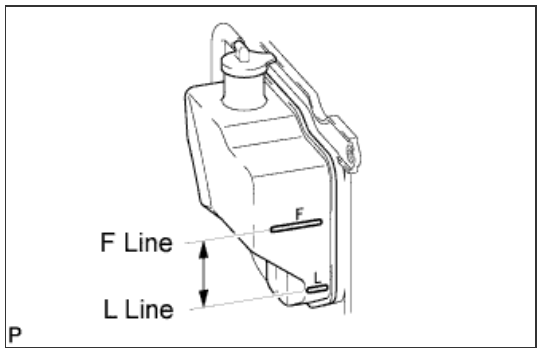
- **Wear protective gloves. Heat areas on the parts ma injure our hands.**
- **Be careful as the radiator hoses are hot.**
- **eep our hands a a from the fan.**

j. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

k. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.



1 . INSPECT R COOLANT LEA

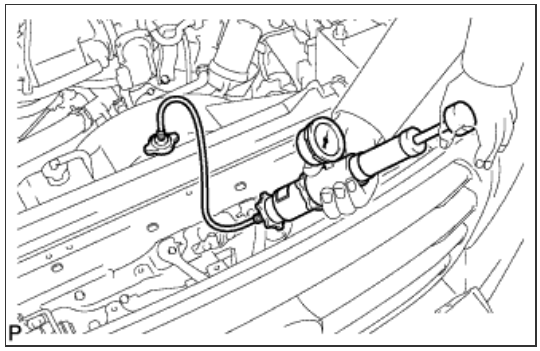
CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

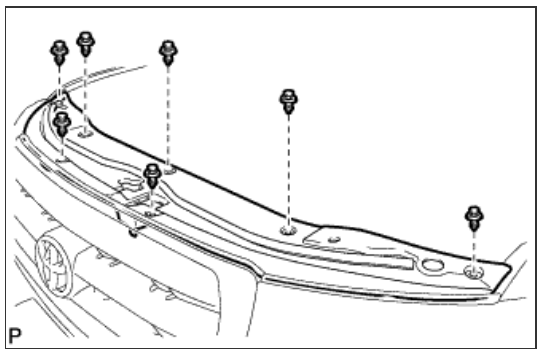
b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



17. INSTALL UPPER RADIATOR SUPPORT SEAL

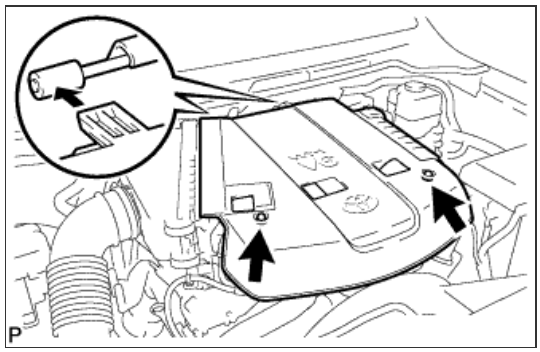
a. Install the radiator support seal with the 7 clips.



18. INSTALL V-BAN CO ER

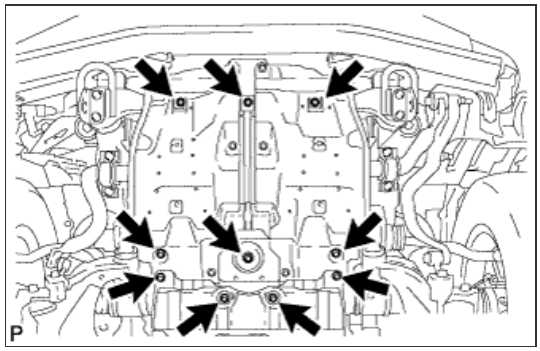
a. Install the V-bank cover with the 2 cap nuts.

Torque:
7. N*m{ 7 kgf*cm , in.*lbf }



19. INSTALL NO. 1 ENGINE UNDER CO ER SUB-ASSEMBLY

a. Install the under cover with the 10 bolts.



20. INSTALL RONT ENDER SPLASH SHIELD SUB-ASSEMBLY RH

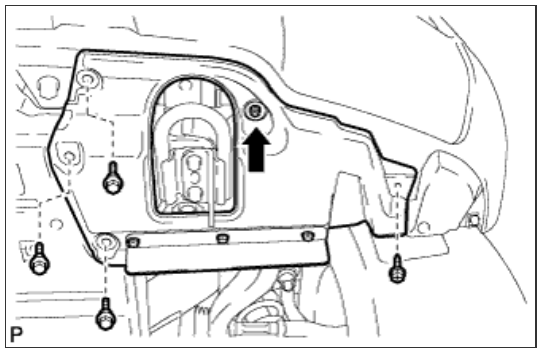
HINT:

Use the same procedures described for the LH side.

21. INSTALL RONT ENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.


P

for Preparation Click here

1. INSPECT FOR COOLANT LEAK

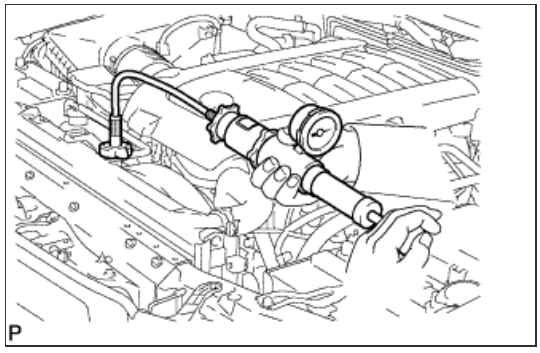
CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



2. INSPECT ENGINE COOLANT LEVEL IN RESERVOIR

a. Check that the engine coolant level is between the L and F lines when the engine is cold.
If the engine coolant is below the L line, check for leaks and add "TO OTA Super Long Life Coolant" or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite and non-borate coolant with long-life hybrid organic acid technology to the F line.

NOTICE:

Do not substitute plain water for engine coolant.

3. INSPECT ENGINE COOLANT ALITY

a. Remove the radiator cap.

CAUTION:

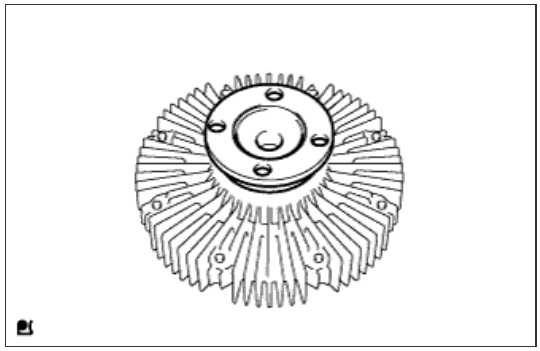
Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

b. Check if there are any excessive deposits of rust or scales around the radiator cap and radiator filler hole. Also, the coolant should be free of oil.
If excessively dirty, clean the coolant passage and replace the coolant.

c. Install the radiator cap.

4. INSPECT FLUID COUPLING ASSEMBLY

a. Check the fluid coupling for damage or silicon oil leaks.
If necessary, replace the fluid coupling.

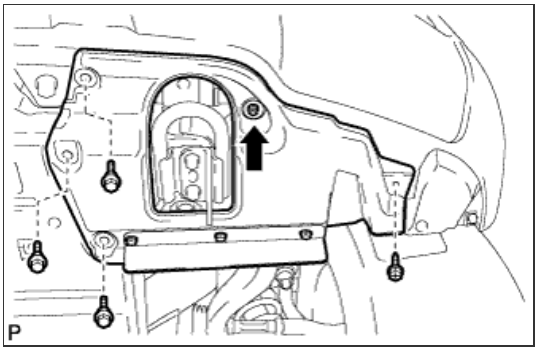


for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



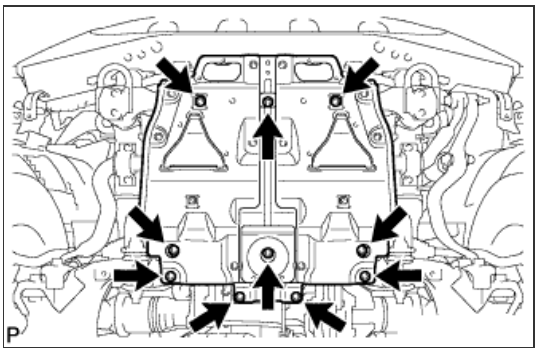
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and No. 1 engine under cover.



4. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

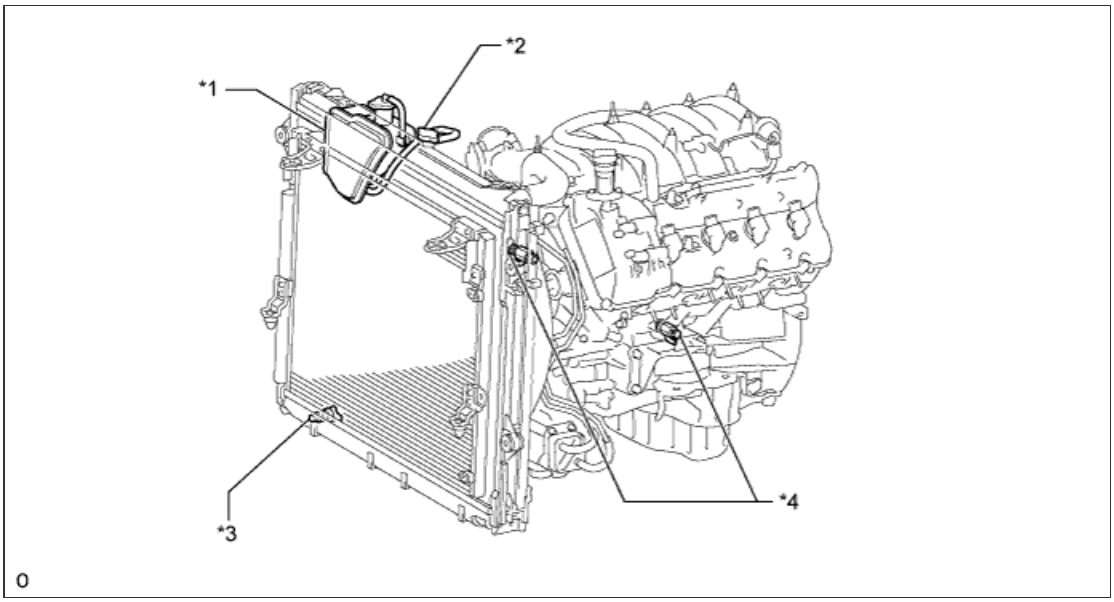
b. Remove the radiator cap. Then drain the coolant from the radiator.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

d. Tighten the 2 cylinder block drain cock plugs.

Torque:

13 N*m{ 133 kgf*cm , 1 ft.*lbf }



Text in Illustration

*1	Radiator Reservoir	*2	Radiator Cap
*3	Radiator Drain Cock Plug	*4	Cylinder Block Drain Cock Plug

e. Tighten the radiator drain cock plug by hand.

. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacit :

Item	Specified Condition
with rear heater	16.2 liters (17.1 US qts, 14.3 Imp. qts)
without rear heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

TO TA vehicles are filled with TO TA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TO TA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the radiator inlet hose by hand, and checking when the engine coolant starts to flow inside the hose.

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**

- Pa attention to the needle of the ater temperature meter. Make sure that the needle does not sho an abnormall high temperature.
- If there is not enough coolant, the engine ma burn out or overheat.
- Immediatel after starting the engine, if the radiator reservoir does not have an coolant, perform the follo ing: 1 stop the engine, 2) ait until the coolant has cooled do n, and 3) add coolant until the coolant is filled to the F line.
- Run the engine at 2000 rpm until the coolant level has stabili ed.

h. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep our hands a a from the fan.**

i. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

j. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.

. INSPECT FOR COOLANT LEAK

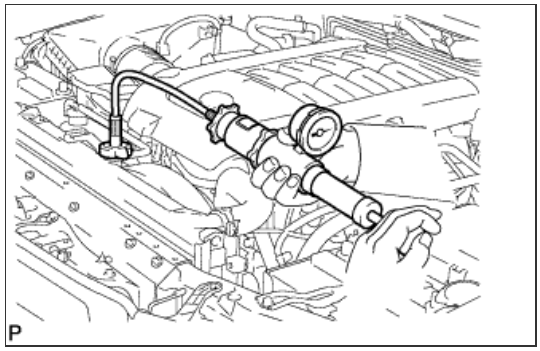
CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

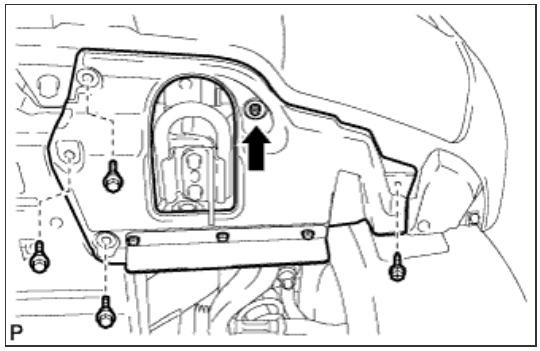
a. Install the No. 1 engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.

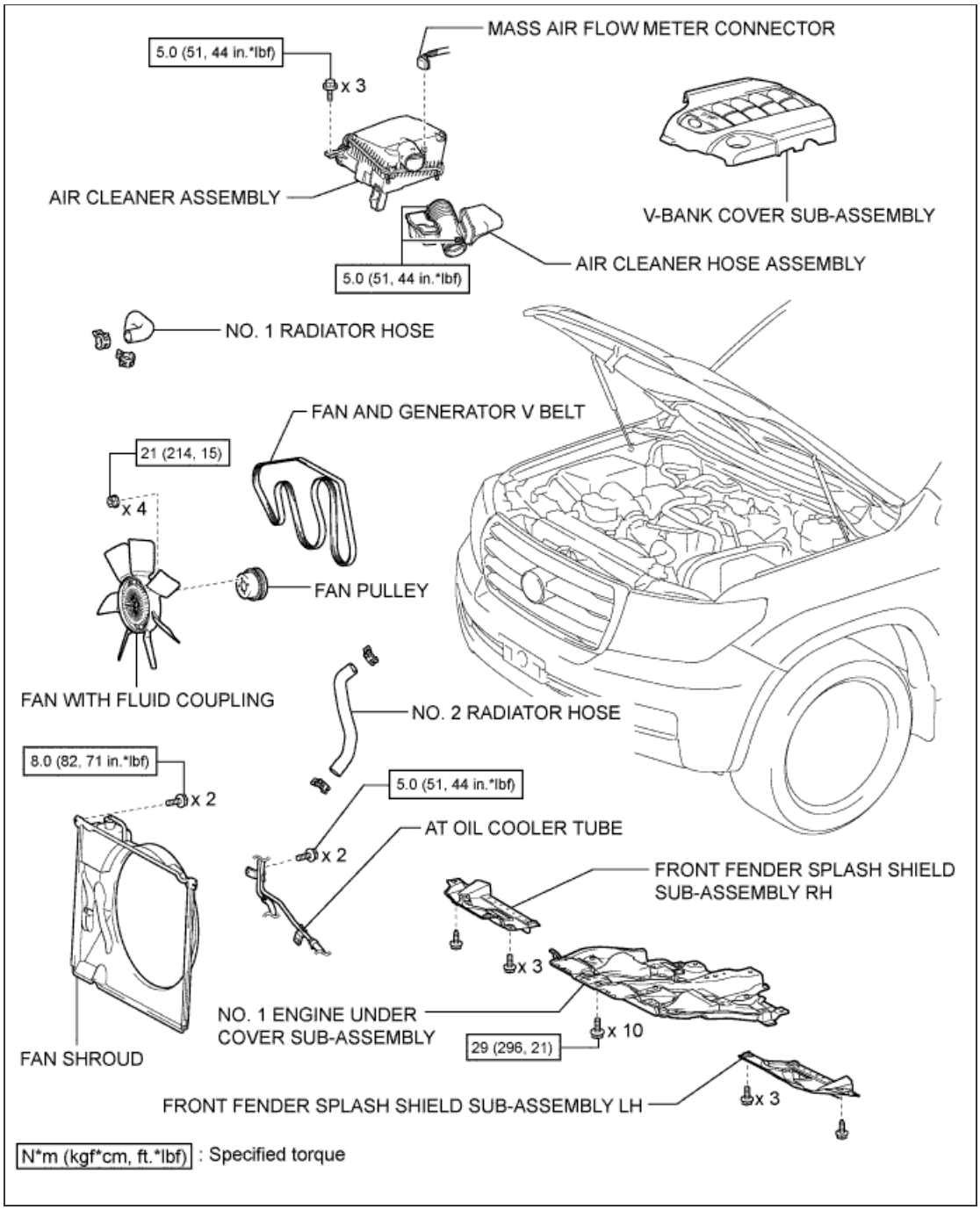


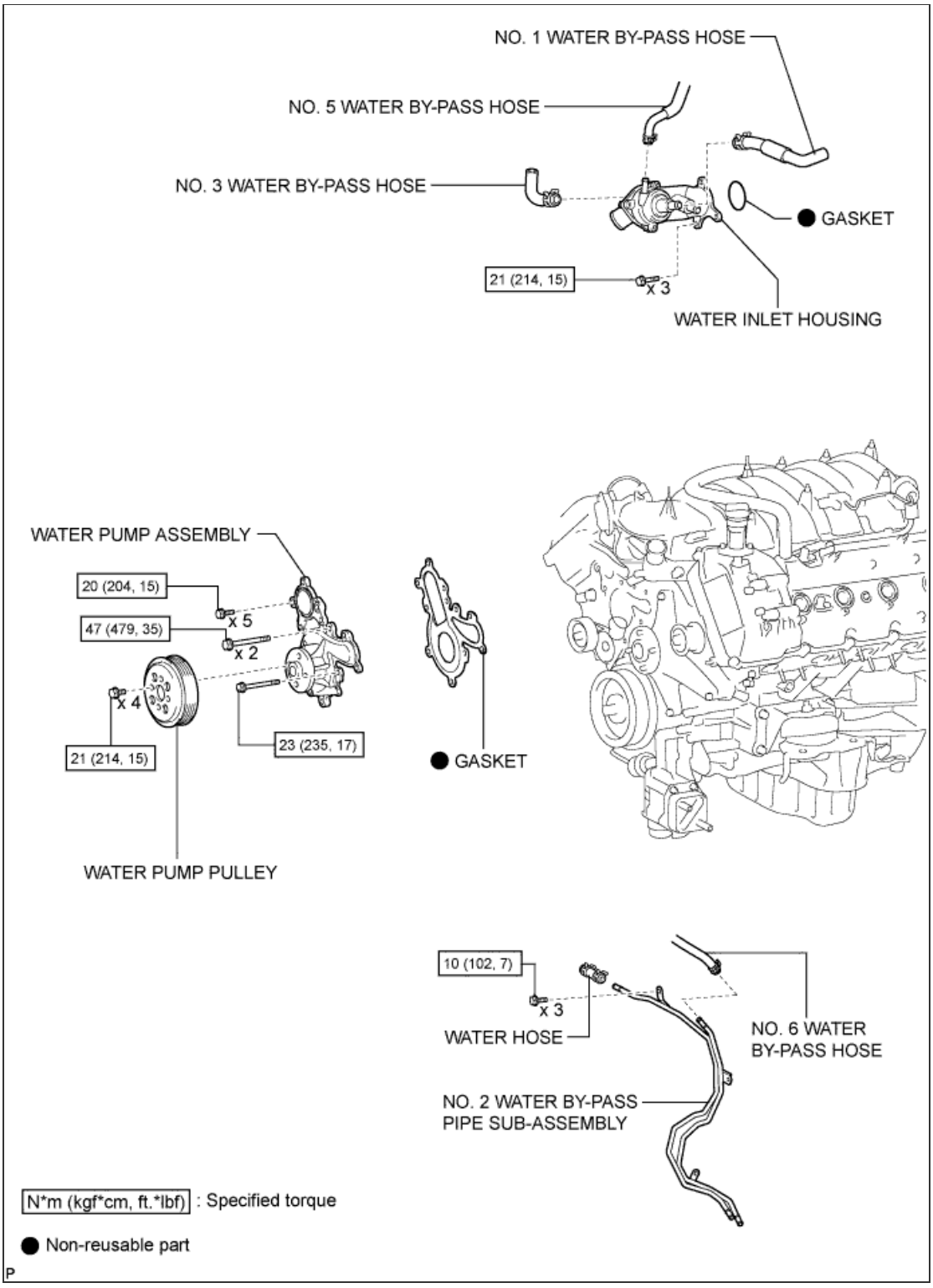
. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

for Preparation Click here

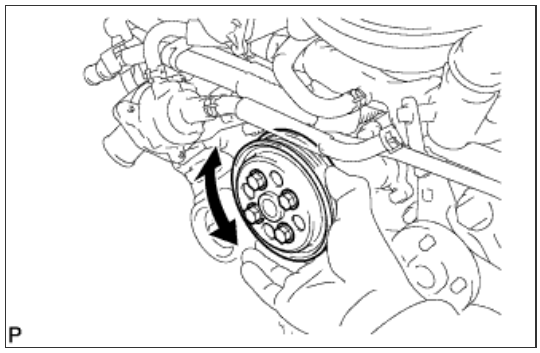



NO. 1 WATER BY-PASS HOSE
NO. 5 WATER BY-PASS HOSE
NO. 3 WATER BY-PASS HOSE
GASKET
21 (214, 15)
x 3
WATER INLET HOUSING
WATER PUMP ASSEMBLY
20 (204, 15)
x 5
47 (479, 35)
x 2
x 4
21 (214, 15)
23 (235, 17)
WATER PUMP PULLEY
GASKET
10 (102, 7)
x 3
WATER HOSE
NO. 6 WATER BY-PASS HOSE
NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

for Preparation Click here

1. INSPECT WATER PUMP ASSEMBLY

a. Turn the pulley and check that the water pump bearing moves smoothly and quietly.
If necessary, replace the water pump.

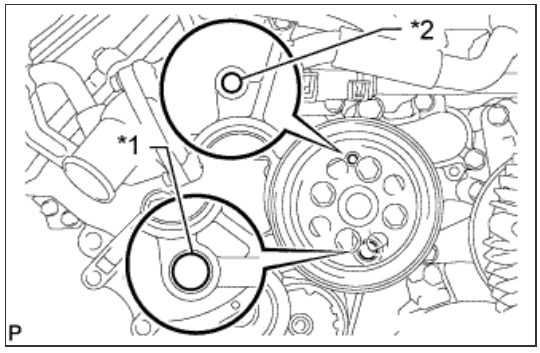


b. Visually check the air hole and drain hole for coolant leakage.

Text in Illustration

*1	Drain Hole
*2	Air Hole

If leakage is found, replace the water pump.

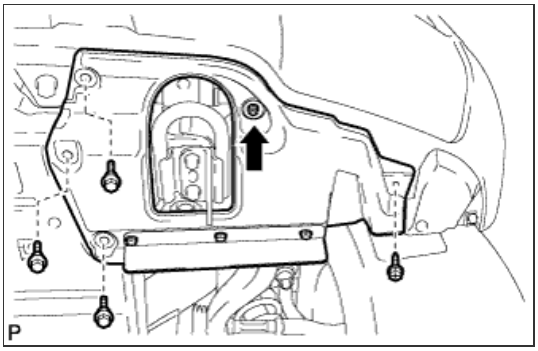


for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



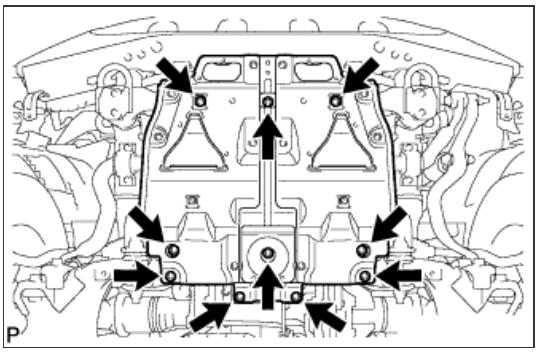
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and No. 1 engine under cover.



4. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

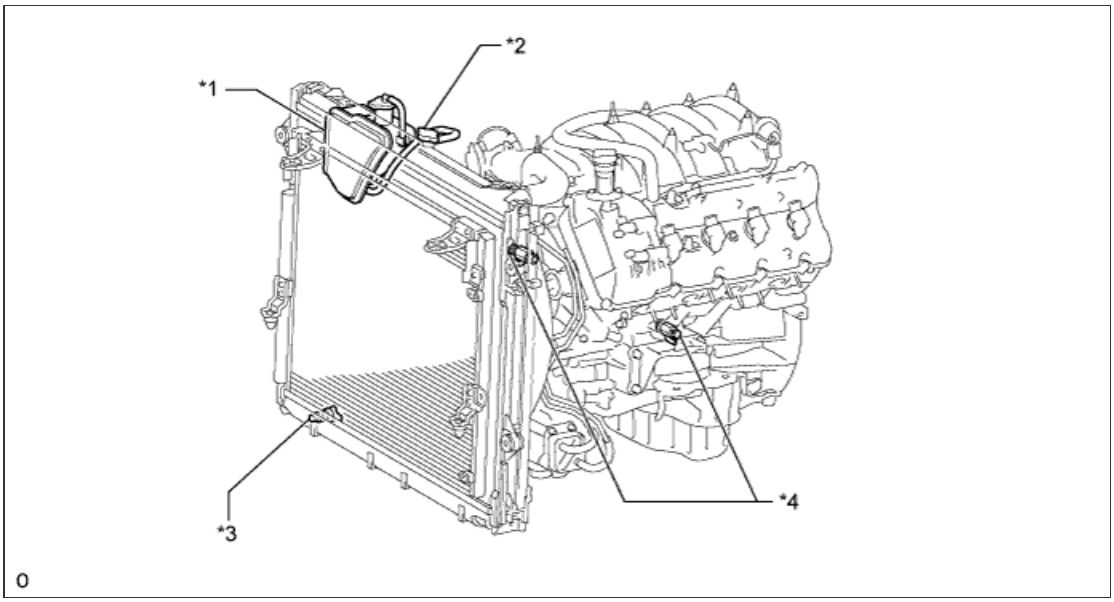
b. Remove the radiator cap. Then drain the coolant from the radiator.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

d. Tighten the 2 cylinder block drain cock plugs.

Torque:

13 N*m{ 133 kgf*cm , 10 ft.*lbf }



Text in Illu tration

*1	Radiator Reservoir	*2	Radiator Cap
*3	Radiator Drain Cock Plug	*4	Cylinder Block Drain Cock Plug

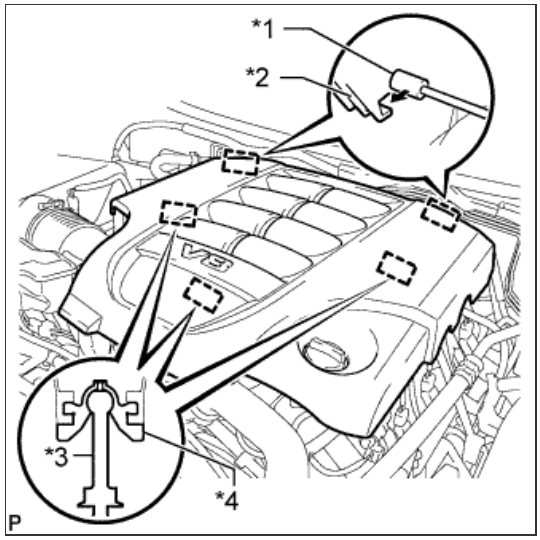
e. Tighten the radiator drain cock plug by hand.

REMOVE V-BANK COVER SUB-ASSEMBLY

a. Raise the front of the V-bank cover to detach the 3 pins. Then remove the 2 V-bank cover hooks from the bracket, and remove the V-bank cover.

Text in Illu tration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet

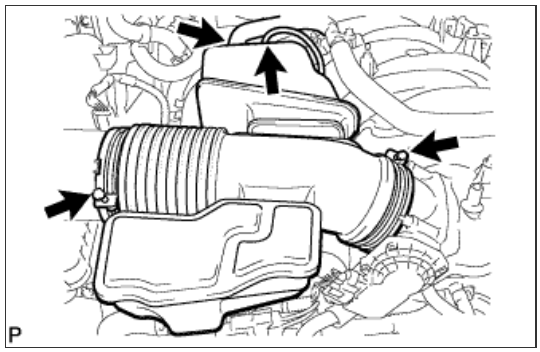


REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum hose and No. 2 ventilation hose.

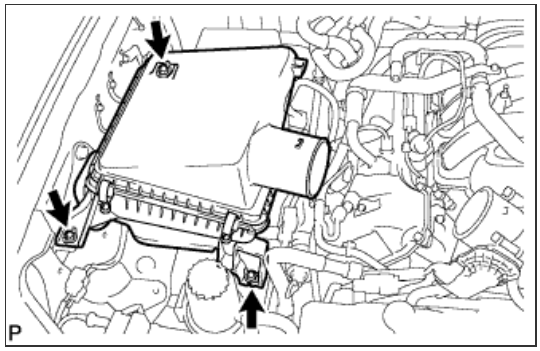
b. Loosen the 2 hose clamps.

c. Remove the air cleaner hose.



7. REMOVE AIR CLEANER ASSEMBLY

a. Remove the 3 bolts and air cleaner.



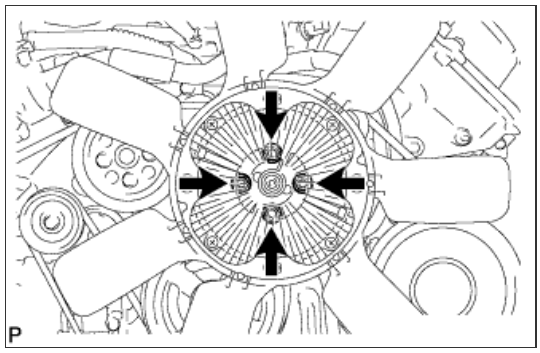
8. REMOVE NO. 1 RADIATOR HOSE

9. REMOVE NO. 2 RADIATOR HOSE

10. REMOVE FAN SHROUD

a. Loosen the 4 nuts holding the fluid coupling fan.

b. Remove the fan and generator V-belt (Click here).



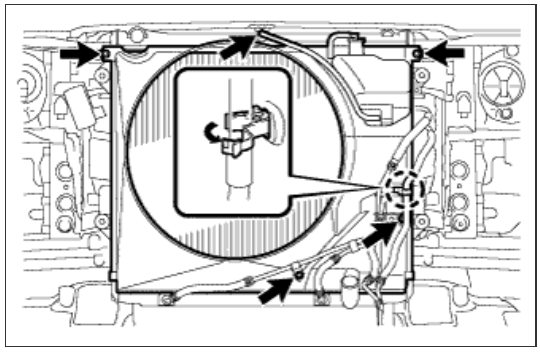
c. Disconnect the reservoir hose from the upper radiator tank.

d. Detach the claw to open the flexible hose clamp.

e. Remove the 2 bolts and disconnect the oil cooler tube from the fan shroud.

f. Remove the 2 bolts holding the fan shroud.

g. Remove the 4 nuts of the fluid coupling fan, and then remove the shroud together with the coupling fan.



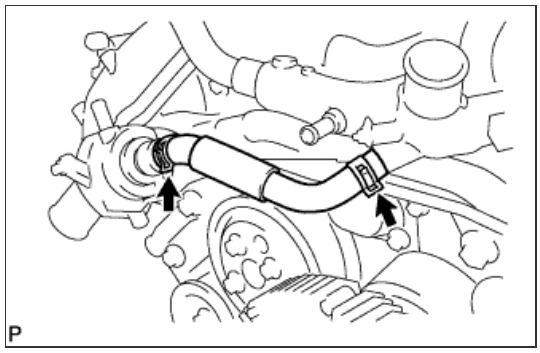
NOTICE:

Be careful not to damage the radiator core.

h. Remove the fan pulley.

11. REMOVE NO. 1 WATER BY-PASS HOSE

a. Remove the No. 1 water by-pass hose by disconnecting the hose from the water inlet housing and front water by-pass oint.

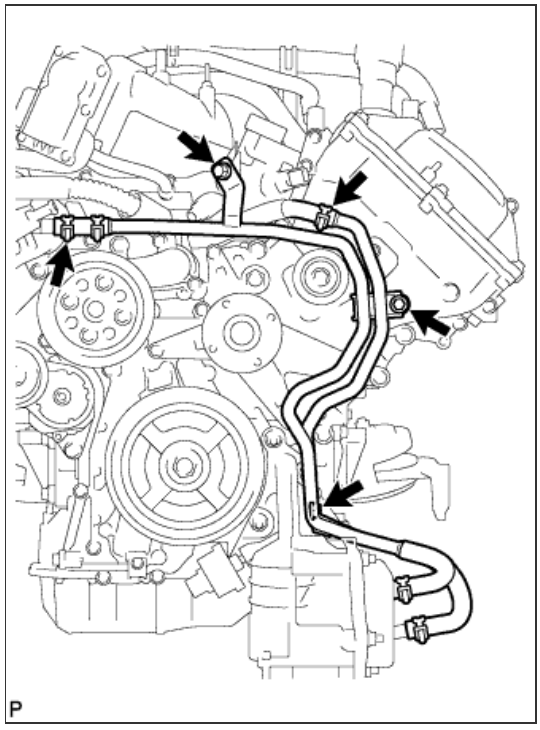


12. DISCONNECT NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY

a. Disconnect the No. 6 water by-pass hose.

b. Remove the 3 bolts.

c. Disconnect the water by-pass pipe with water hose.

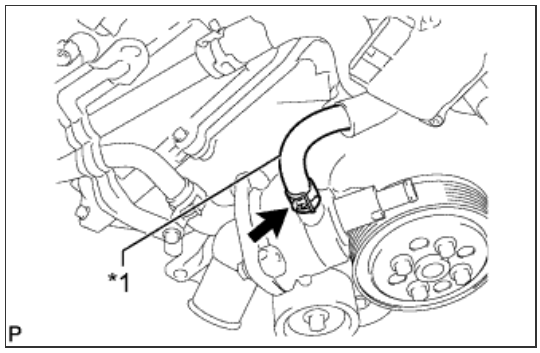


13. REMOVE WATER INLET HOUSING

a. Disconnect the No. 5 water by-pass hose.

Text in Illu tration

*1	No. 5 Water By-pass Hose

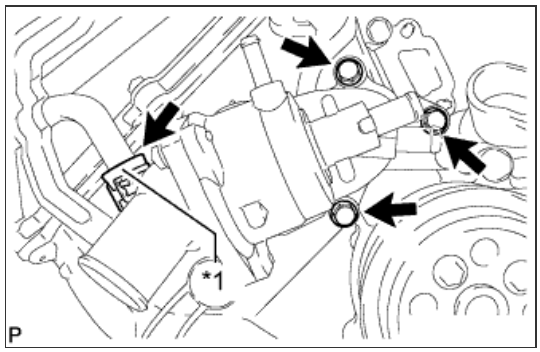


b. Disconnect the No. 3 water by-pass hose and remove the 3 bolts and water inlet housing.

Text in Illu tration

*1	No. 3 Water By-pass Hose

c. Remove the gasket from the water pump.

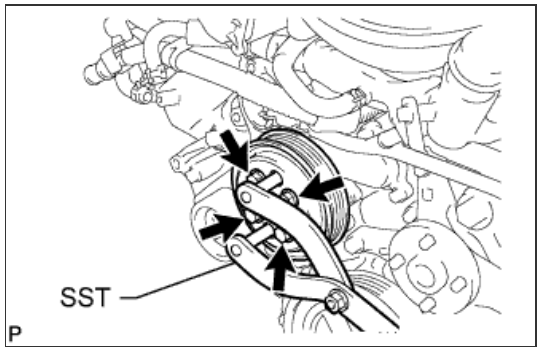


14. REMOVE WATER PUMP PULLEY

a. Using SST, hold the water pump pulley.

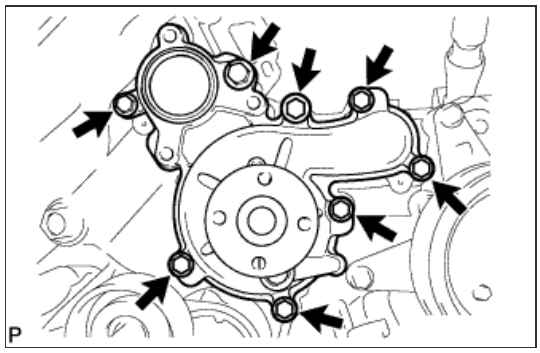
SST
099 -10010 (099 2-01000, 099 3-01000)

b. Remove the 4 bolts and water pump pulley.



1 REMOVE WATER PUMP ASSEMBLY

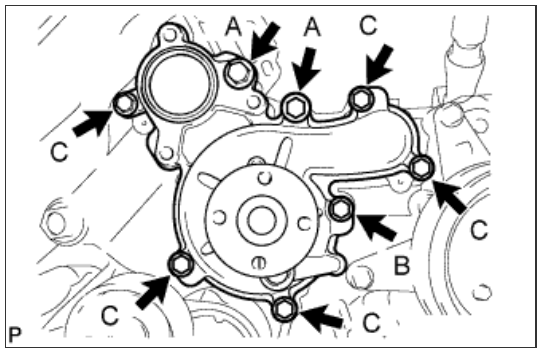
a. Remove the 8 bolts, water pump and gasket.



for Preparation Click here

1. INSTALL WATER PUMP ASSEMBLY

a. Install a new gasket and the water pump with the 8 bolts shown in the illustration.



Torque:
for bolt A:
47 N*m{ 479 kgf*cm , 35 ft.*lbf }
for bolt B:
23 N*m{ 235 kgf*cm , 17 ft.*lbf }
for bolt C:
20 N*m{ 204 kgf*cm , 15 ft.*lbf }

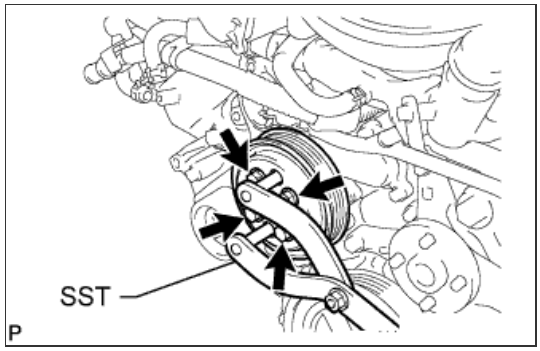
Standard Bolt:

Item	Length	Thread Diameter
Bolt A	80 mm (3.15 in.)	10 mm (0.394 in.)
Bolt B	70 mm (2.76 in.)	8 mm (0.315 in.)
Bolt C	25 mm (0.984 in.)	8 mm (0.315 in.)

2. INSTALL WATER PUMP PULLEY

a. Temporarily install the pulley with the 4 bolts.

b. Using SST, hold the pulley and tighten the 4 bolts.



SST
09960-10010 (09962-01000, 09963-01000)

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

3. INSTALL WATER INLET HOUSING

a. Install a new gasket to the water pump.

b. Install the water inlet housing with the 3 bolts and connect the No. 3 water by pass hose.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

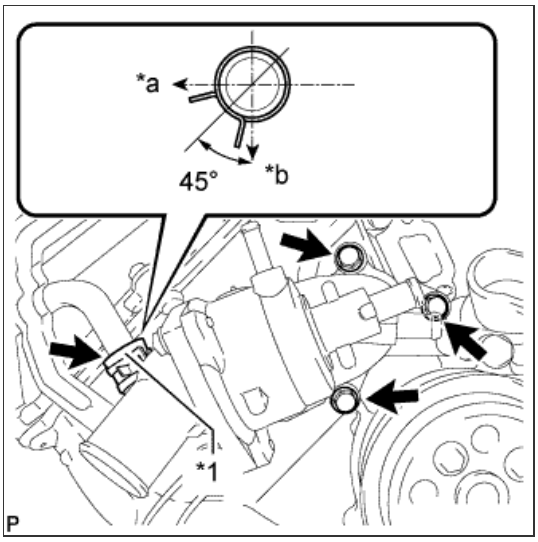
Text in Illustration

*1	No. 3 Water By pass Hose
*a	RH Side
*b	Front

HINT:

Install the hose so that the direction o the hose clamp is as indicated in the

illustration.



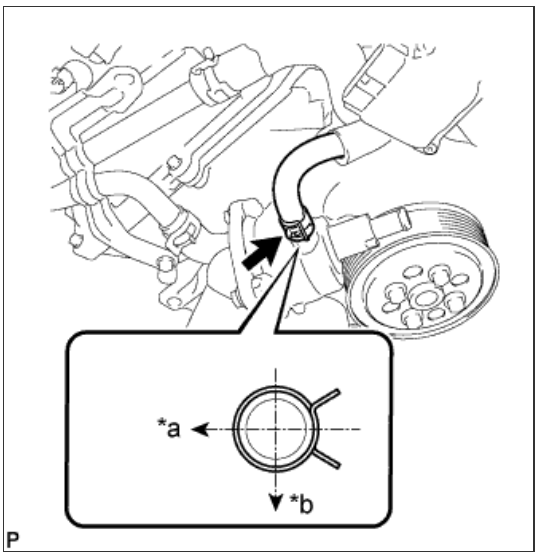
c. Connect the No. 5 water by pass hose.

Text in Illustration

*a	RH Side
*b	Front

HINT:

Install the hose so that the direction o the hose clamp is as indicated in the illustration.



4. CONNECT NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY

a. Connect the water by pass pipe with water hose.

Text in Illustration

*a	Upper
*b	Front

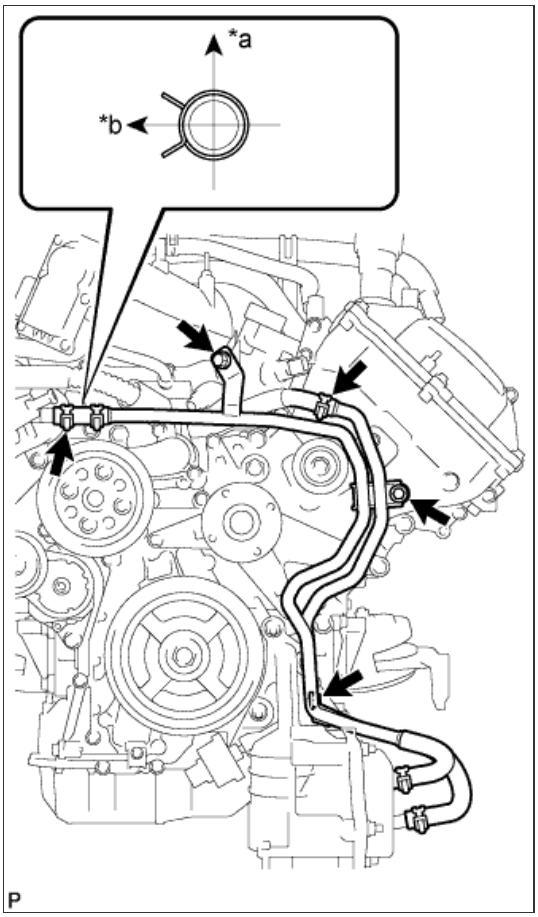
HINT:

Install the hose so that the direction o the hose clamp is as indicated in the illustration.

b. Install the 3 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

c. Connect the No. 6 water by pass hose.



5. INSTALL NO. 1 WATER BY-PASS HOSE

a. Install the No. 1 water by pass hose by connecting the hose to the water inlet housing and front water by pass joint.

6. INSTALL FAN SHROUD

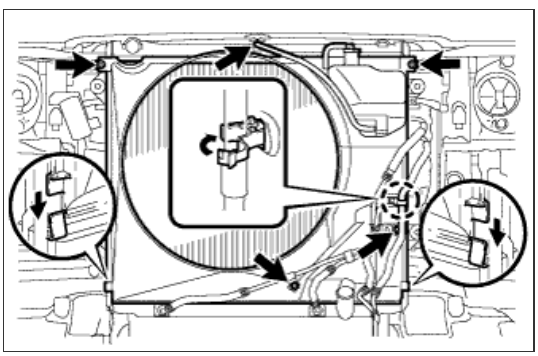
a. Install the fan pulley.

b. Place the shroud together with the coupling fan between the radiator and engine.

NOTICE:

Be careful not to damage the radiator core.

c. Temporarily install the fluid coupling and the fluid coupling bracket with the 4 nuts. Tighten the nuts as much as possible by hand.



d. Attach the claws of the shroud to the radiator as shown in the illustration.

e. Install the shroud with the 2 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

f. Connect the oil cooler tube to the fan shroud with the 2 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

g. Pass the hose through the flexible hose clamp and close the clamp as shown in the illustration.

h. Connect the reservoir hose to the upper radiator tank.

i. Install the fan and generator V belt (Click here).

j. Tighten the 4 nuts of the fluid coupling fan

Torque:

21 N*m{ 214 kgf*cm , 15 ft.*lbf }

7. INSTALL NO. 1 RADIATOR HOSE

8. INSTALL NO. 2 RADIATOR HOSE

9. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner with the 3 bolts.

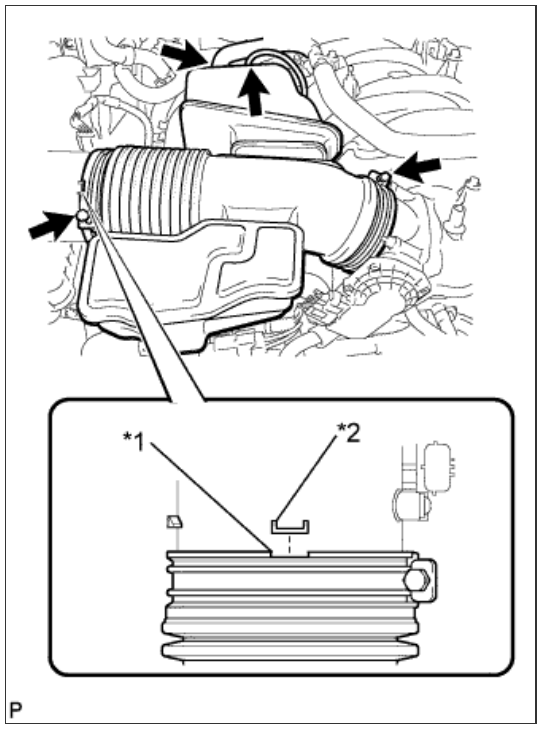
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

10. INSTALL AIR CLEANER HOSE ASSEMBLY

a. Install the air cleaner hose so that the protrusion o lte air cleaner cap aligns with the groo e o lte hose as shown in the illustration.

Text in Illustration

*1	roo e
*2	Protrusion



b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the auum hose.

d. Connect the No. 2 entilation hose.

11. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item	Speci ied Condition
with rear heater	16.2 liters (17.1 US qts, 14.3 Imp. qts)
without rear heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)

NOTICE:

Do not substitute plain water or engine coolant.

HINT:

TO TA ehicles are illed with TO TA SLLC at the atory. In order to a oid damage to the engine cooling system and other technical problems, only use TO TA SLLC or similar high quality ethylene glycol based non sicate, non amine, non itrite, non borate coolant with long ile hybrid organic acid technology (coolant with long ile hybrid organic acid technology consists o a combination o dw phosphates and organic acids).

b. Slowly pour coolant into the radiator reser oir until it reaches the F line.

c. Install the reser oir cap.

d. Press the No. 1 and No. 2 radiator hoses se eral times by hand, and then check the coolant le el. I hte coolant le el is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be con irmed by pressing the radiator inlet hose by hand, and checking when the engine coolant starts to dw inside the hose.

g. intain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

h. Press the No. 1 and No. 2 radiator hoses se eral times by hand to bleed air.

CAUTION:

- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the fan.**

i. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remo e the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

j. Check that the coolant le el is between the F and L lines.
I hte coolant le el is below the L line, repeat all o hte procedures abo e.
I hte coolant le el is abo e the F line, drain coolant so that the coolant le el is between the F and L lines.

12. INSPECT FOR COOLANT LEAK

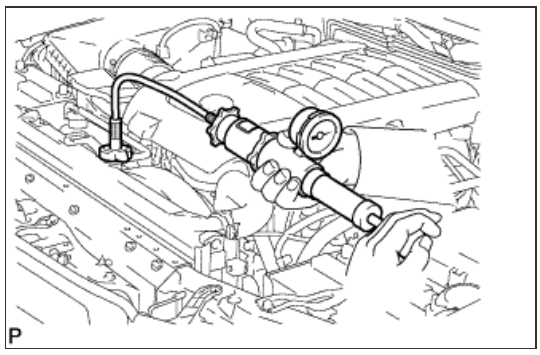
CAUTION:

Do not remo e the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kg cm^2, 18 psi), and check that the pressure does not drop.
I hte pressure drops, check the hoses, radiator and water pump or leaks. I o e ernal leaks are ound, check the heater core, cylinder block and head.



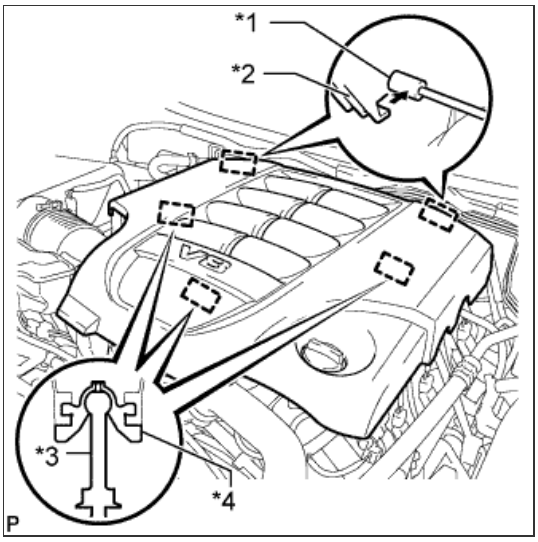
13. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 V bank co er hooks to the bracket. Then align the 3 V bank co er grommets with the 3 pins, and press down on the V bank co er to attach the pins.

Text in Illustration

*1	Bracket

*2	Hook
*3	Pin
*4	rommet



14. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

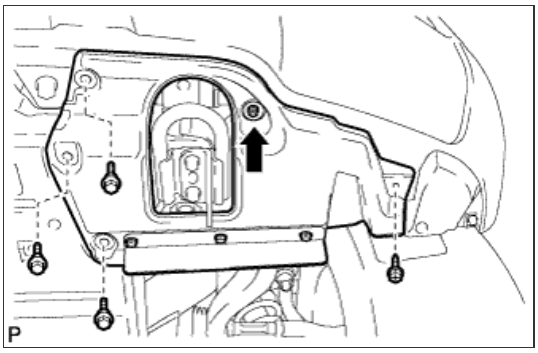
a. Install the No. 1 engine under co er with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

15. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the ender splash shield.

b. Install the 3 bolts and screw.

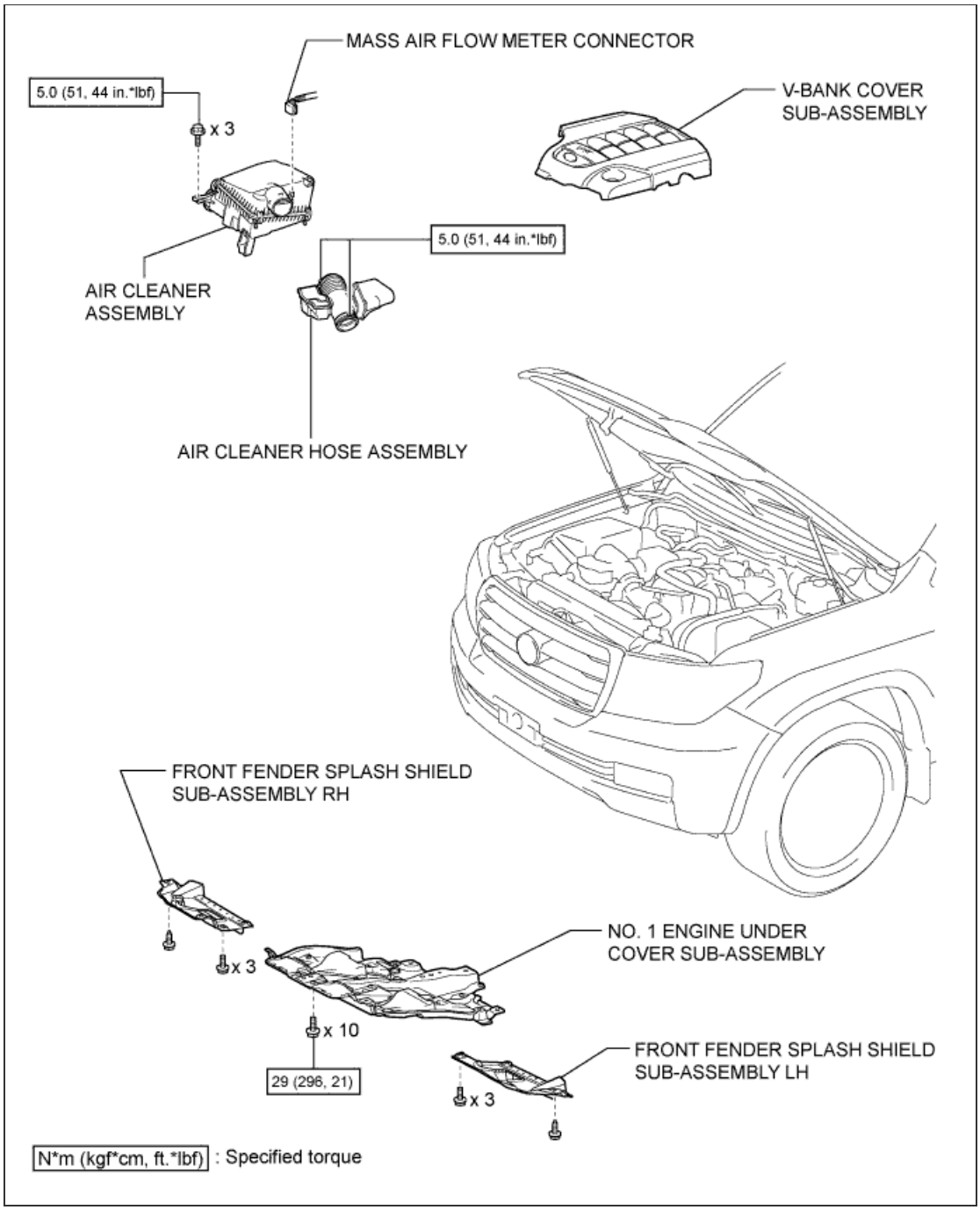


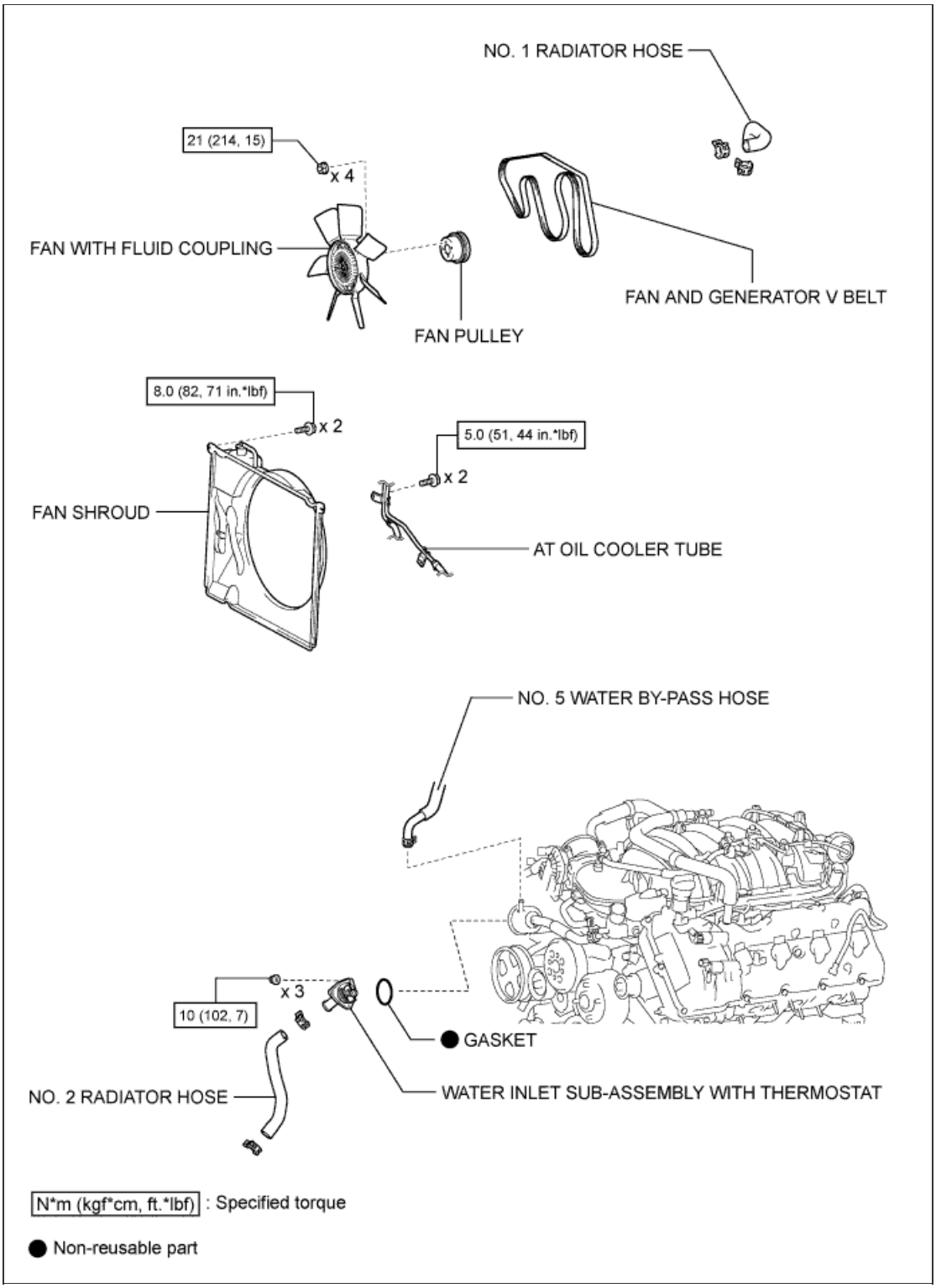
16. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described or the LH side.

for Preparation Click here




NO. 1 RADIATOR HOSE
21 (214, 15)
x 4
FAN WITH FLUID COUPLING
FAN PULLEY
FAN AND GENERATOR V BELT
8.0 (82, 71 in.*lbf)
x 2
FAN SHROUD
5.0 (51, 44 in.*lbf)
x 2
AT OIL COOLER TUBE
NO. 5 WATER BY-PASS HOSE
x 3
10 (102, 7)
GASKET
NO. 2 RADIATOR HOSE
WATER INLET SUB-ASSEMBLY WITH THERMOSTAT
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

for Preparation Click here

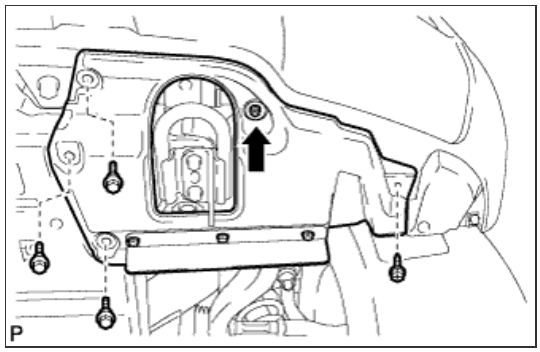
HINT:

If the thermostat is not installed, cooling efficiency decreases. Even if the engine tends to overheat, do not remove the thermostat.

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



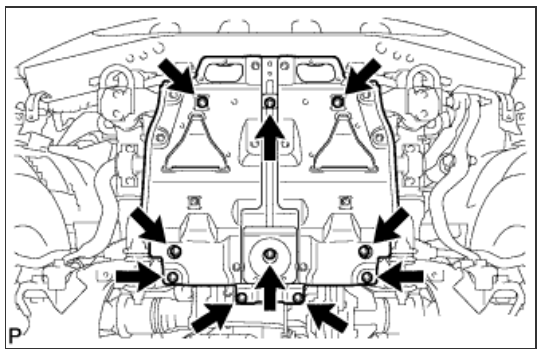
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and No. 1 engine under cover.



4. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug.

HINT:

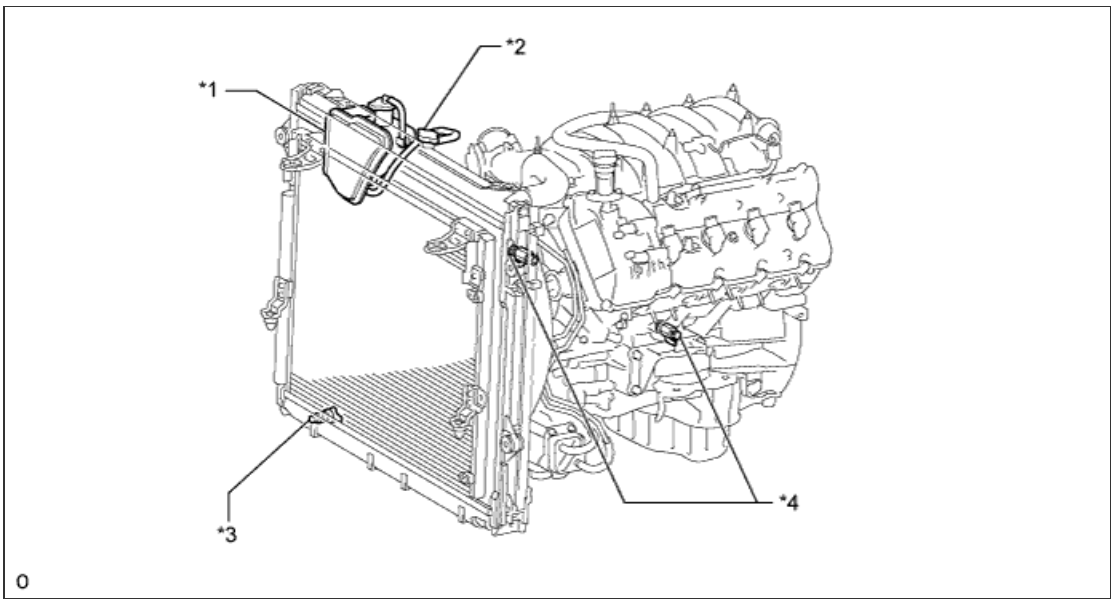
Collect the coolant in a container and dispose of it according to the regulations in your area.

b. Remove the radiator cap. Then drain the coolant from the radiator.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

d. Tighten the 2 cylinder block drain cock plugs.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



Text in Illustration

*1	Radiator Reservoir	*2	Radiator Cap
*3	Radiator Drain Cock Plug	*4	Cylinder Block Drain Cock Plug

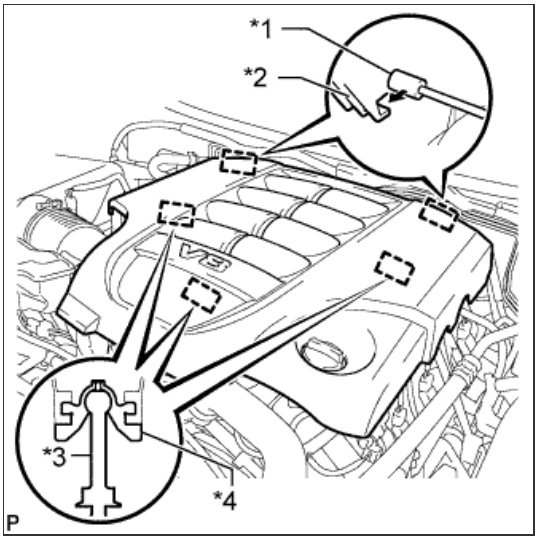
e. Tighten the radiator drain cock plug by hand.

. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Raise the front of the V bank cover to detach the 3 pins. Then remove the 2 V bank cover hooks from the bracket, and remove the V bank cover.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet

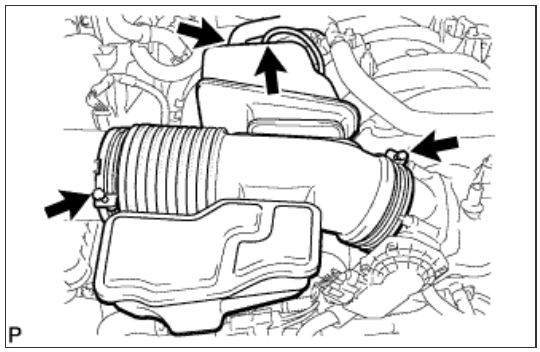


6. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum hose and No. 2 ventilation hose.

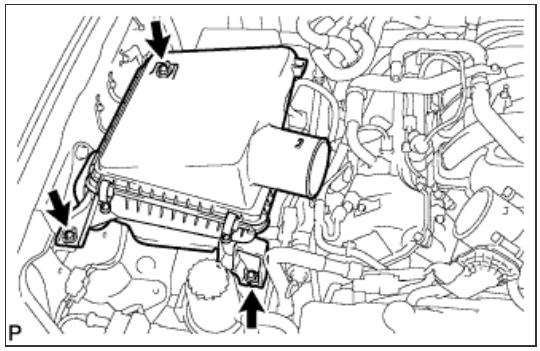
b. Loosen the 2 hose clamps.

c. Remove the air cleaner hose.



7. REMOVE AIR CLEANER ASSEMBLY

a. Remove the 3 bolts and air cleaner.



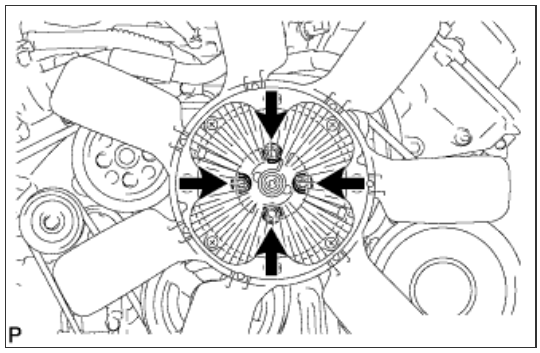
8. REMOVE NO. 1 RADIATOR HOSE

9. REMOVE NO. 2 RADIATOR HOSE

10. REMOVE FAN SHROUD

a. Loosen the 4 nuts holding the fluid coupling fan.

b. Remove the fan and generator V belt (Click here).



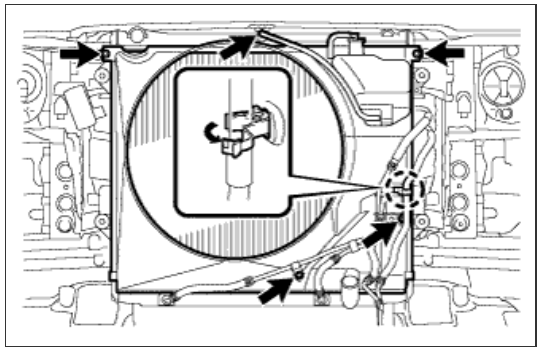
c. Disconnect the reservoir hose from the upper radiator tank.

d. Detach the claw to open the flexible hose clamp.

e. Remove the 2 bolts and disconnect the oil cooler tube from the fan shroud.

f. Remove the 2 bolts holding the fan shroud.

g. Remove the 4 nuts of the fluid coupling fan, and then remove the shroud together with the coupling fan.



NOTICE:

Be careful not to damage the radiator core.

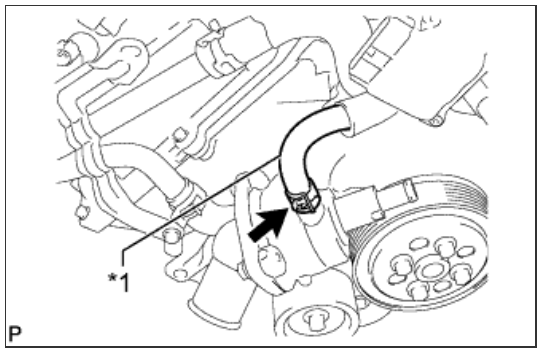
h. Remove the fan pulley.

11. REMOVE WATER INLET SUB-ASSEMBLY WITH THERMOSTAT

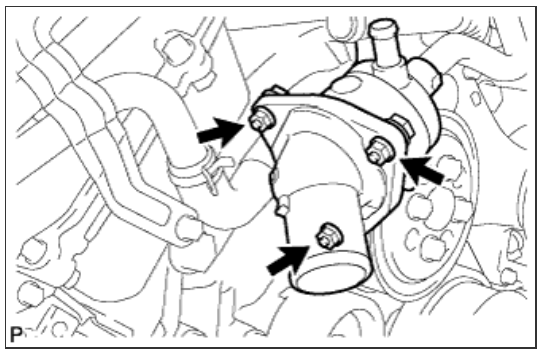
a. Disconnect the No. 5 water by pass hose.

Text in Illustration

*1	No. 5 Water By pass Hose



b. Remove the 3 nuts, water inlet with thermostat and gasket.

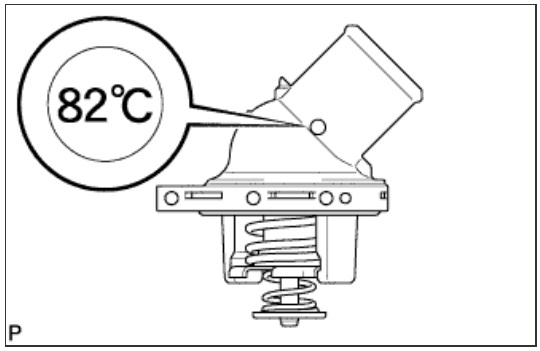


for Preparation Click here

1. INSPECT WATER INLET SUB-ASSEMBLY WITH THERMOSTAT

HINT:

The valve opening temperature is stamped on the water inlet with thermostat.

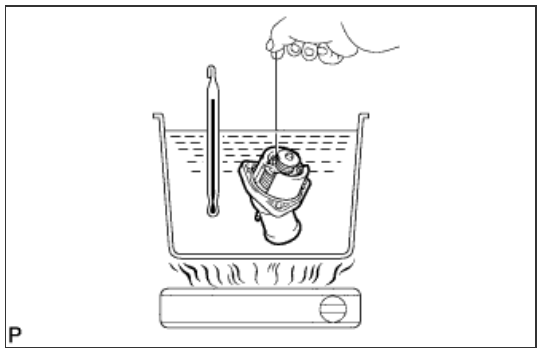


a. Immerse the water inlet with thermostat in water and gradually heat the water.

b. Check the valve opening temperature.

Standard valve opening temperature:
80 to 84°C (176 to 183°F)

If the valve opening temperature is not within the specified range, replace the water inlet with thermostat.



c. Check the valve lift.

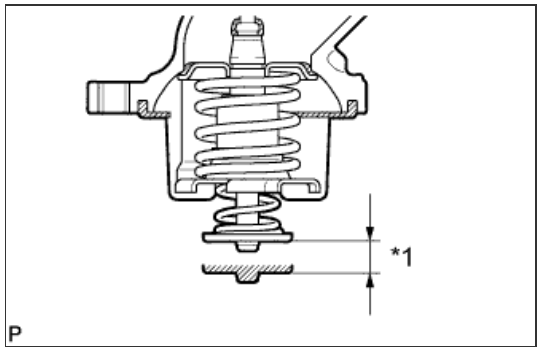
Standard valve lift:
10.0 mm (0.394 in.) or more at 95°C (03°F)

Text in Illustration

	alve Lift

If the valve lift is not as specified, replace the water inlet with thermostat.

d. Check that the valve is fully closed when the water inlet with thermostat is at a low temperature (below 77°C (171°F)).
If it is not fully closed, replace the water inlet with thermostat.



for Preparation Click here

1. INSTALL WATER INLET SUB-ASSEMBLY WITH THERMOSTAT

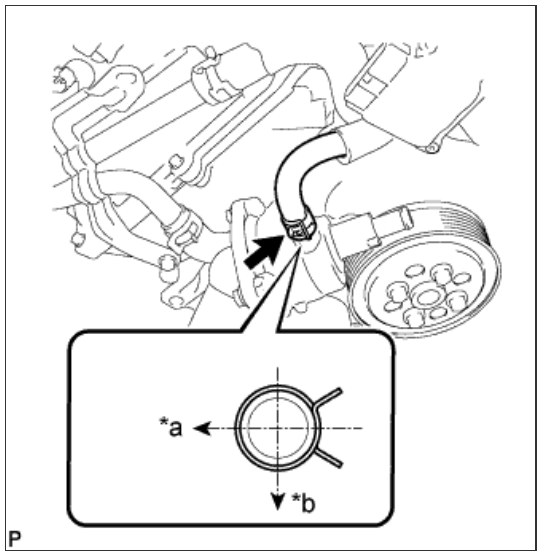
a. Install a new gasket and the water inlet with thermostat with the 3 nuts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Connect the No. 5 water by-pass hose.

Text in Illustration

*a	RH Side
*b	Front



HINT:

Install the hose so that the direction of the hose clamp is as indicated in the illustration.

2. INSTALL FAN SHROUD

a. Install the fan pulley.

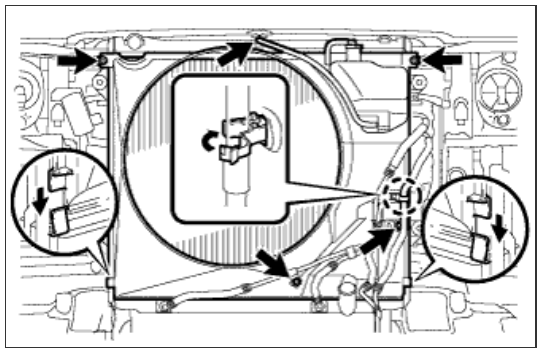
b. Place the shroud together with the coupling fan between the radiator and engine.

NOTICE:

Be careful not to damage the radiator core.

c. Temporarily install the fluid coupling fan to the fluid coupling bracket with the 4 nuts. Tighten the nuts as much as possible by hand.

d. Attach the claws of the shroud to the radiator as shown in the illustration.



e. Install the shroud with the 2 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

f. Connect the oil cooler tube to the fan shroud with the 2 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

g. Pass the hose through the flexible hose clamp and close the clamp as shown in the illustration.

h. Connect the reservoir hose to the upper radiator tank.

i. Install the fan and generator V-belt (Click here).

j. Tighten the 4 nuts of the fluid coupling fan.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

3. INSTALL NO. 2 RADIATOR HOSE

4. INSTALL NO. 1 RADIATOR HOSE

5. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner with the 3 bolts.

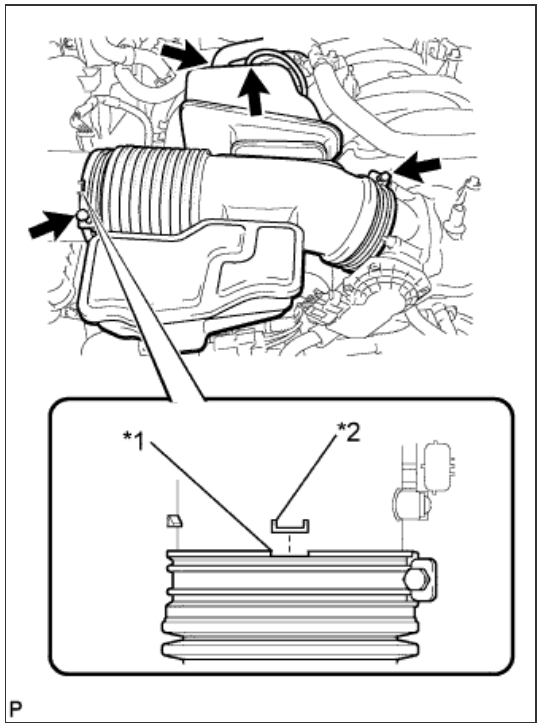
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

. INSTALL AIRCLEANER HOSE ASSEMBLY

a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

Text in Illustration

*1	Groove
*2	Protrusion



b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum hose.

d. Connect the No. 2 ventilation hose.

7. ADD EN INECOOLANT

a. Add engine coolant.

Standard Capacity:

Item	Specified Condition
with rear heater	16.2 liters (17.1 US qts, 14.3 Imp. qts)
without rear heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the radiator inlet hose by hand, and checking when the engine coolant starts to flow inside the hose.

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

h. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the fan.**

i. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

j. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.

8. INSPECT FOR COOLANT LEAK

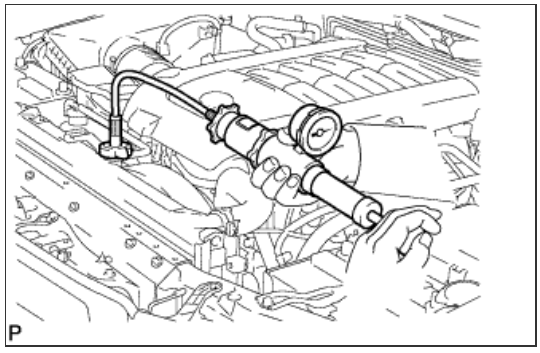
CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



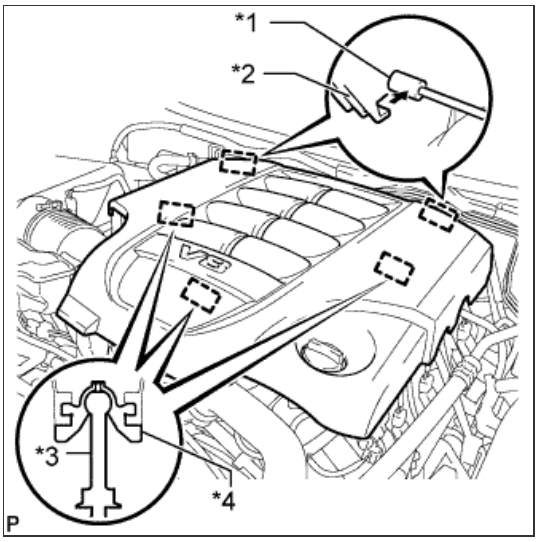
. INSTALL -BANK CO ER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket. Then align the 3 V-bank cover grommets with the 3 pins, and press down on the V-bank cover to attach the pins.

Text in Illustration

*1	Bracket
*2	Hook

*3	Pin
*4	Grommet



10. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

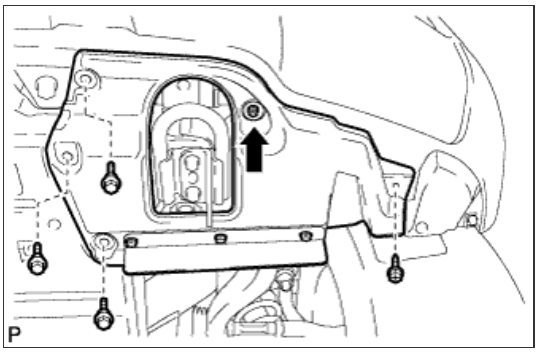
a. Install the No. 1 engine under cover with the 10 bolts.

Torque:
2 Nm{ 2 kgf*cm , 21 ft.*lbf }

11. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.

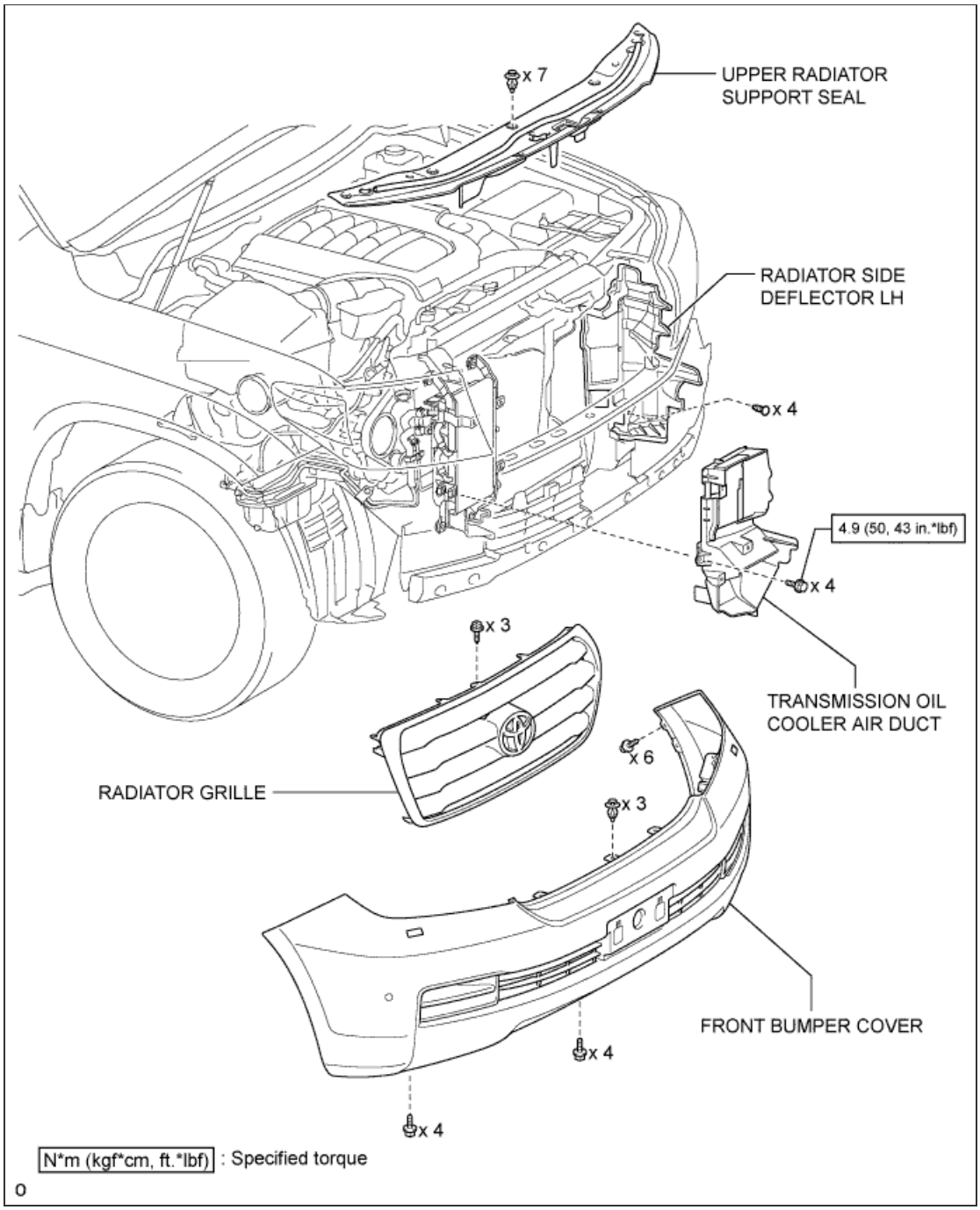


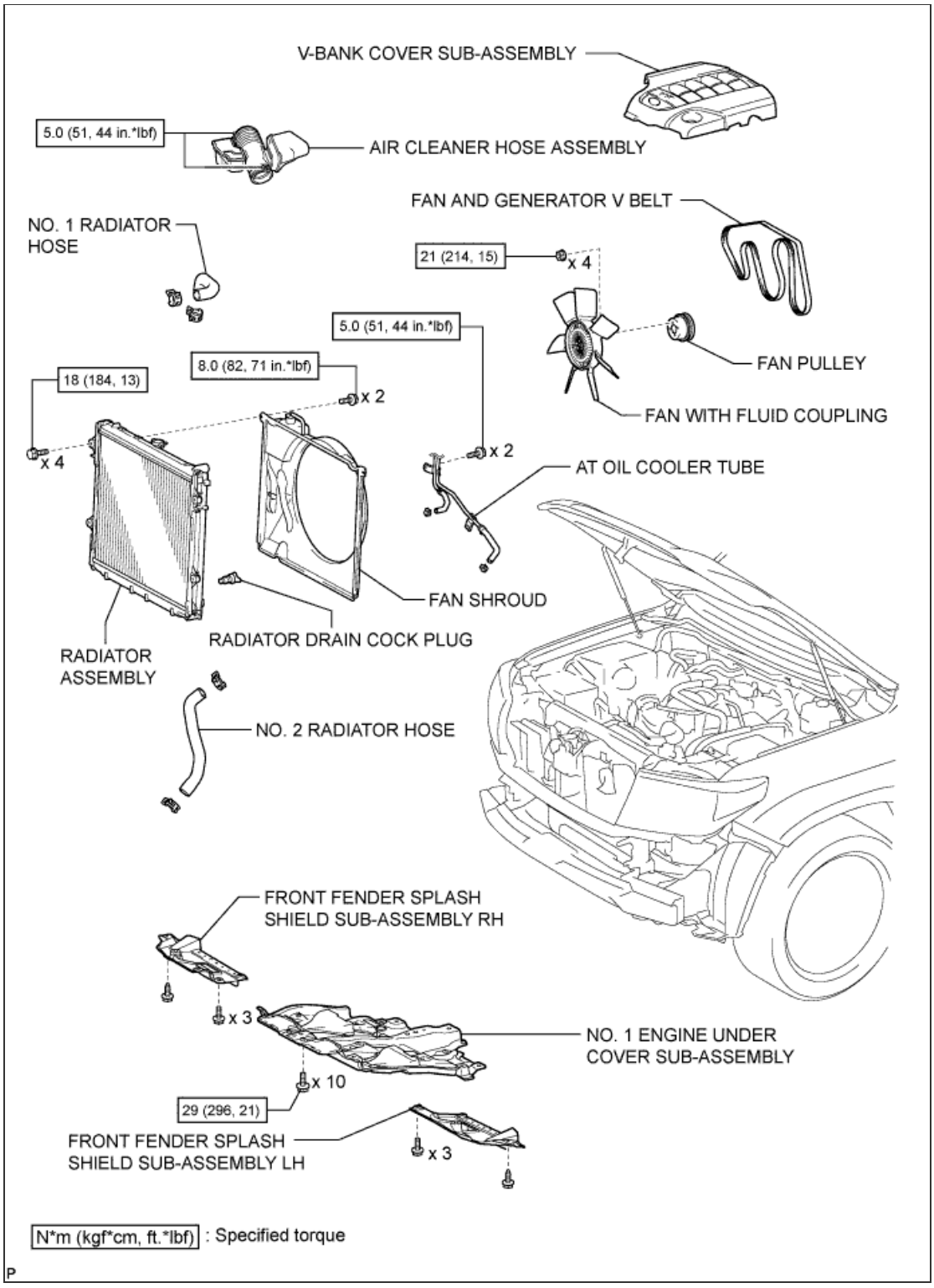
12. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

for Preparation Click here



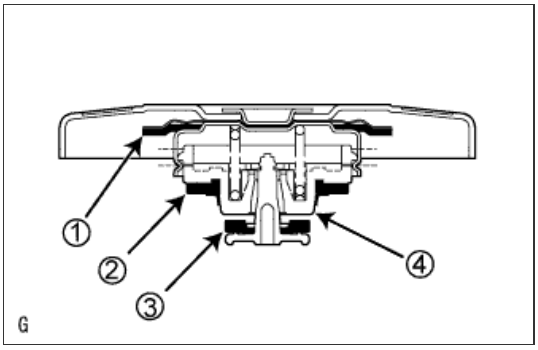

V-BANK COVER SUB-ASSEMBLY
5.0 (51, 44 in.*lbf)
AIR CLEANER HOSE ASSEMBLY
FAN AND GENERATOR V BELT
NO. 1 RADIATOR HOSE
21 (214, 15)
x 4
5.0 (51, 44 in.*lbf)
FAN PULLEY
8.0 (82, 71 in.*lbf)
18 (184, 13)
x 2
FAN WITH FLUID COUPLING
x 4
x 2
AT OIL COOLER TUBE
FAN SHROUD
RADIATOR DRAIN COCK PLUG
RADIATOR ASSEMBLY
NO. 2 RADIATOR HOSE
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH
x 3
NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY
x 10
29 (296, 21)
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH
x 3
N*m (kgf*cm, ft.*lbf) : Specified torque
P

for Preparation Click here

1. INSPECT RADIATOR CAP SUB-ASSEMBLY

CAUTION:

To avoid the danger of being burned, do not remove the radiator cap while the engine and radiator are still hot, as fluid and steam can be blown out under pressure.



a. Measure the valve opening pressure.

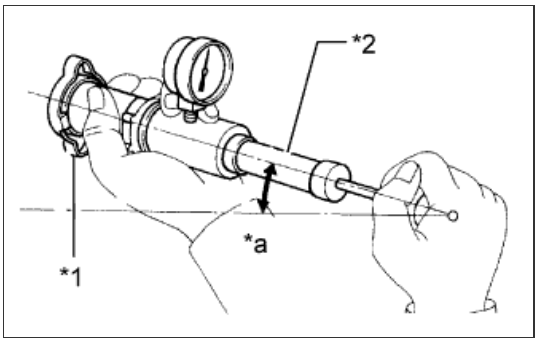
i. If there are water stains or foreign matter on rubber packing 1, 2 or 3, clean it by using water and finger scouring.

ii. Check that rubber packing 1, 2 and 3 are not deformed, cracked or swollen.

iii. Check that rubber packing 3 and 4 are not stuck together.

iv. Apply engine coolant to rubber packing 2 and 3.

v. Prepare a radiator cap tester, and tilt it more than 30°.



Text in Illustration

*1	Radiator Cap
*2	Radiator Cap Tester
*a	30° or more

vi. Pump the cap tester several times, and check the maximum pressure*.

Pumping speed:
1 pump per second

HINT:

*: Even if the cap cannot maintain the maximum pressure, it is not a defect.

Standard Judgment Criterion:

Item	Specified Condition
Standard value (for brand-new cap)	3 to 123 kPa (1.0 to 1.3 kgf/cm^2, 13.5 to 17.8 psi)
Minimum standard value (after using cap)	7 kPa (0.8 kgf/cm^2, 11.4 psi)

If the maximum pressure is less than the minimum standard value, replace the radiator cap sub-assembly.

2. INSPECT FINS FOR BLOCKAGE

a. Check that the radiator and condenser are not blocked with leaves, dirt, or insects. Clean the hose connections.
If the fins are blocked, wash them with water or a steam cleaner.

NOTICE:

- **If the distance between the steam cleaner and core is too close, the fins may be damaged.**

- **Keep the following injection distance.**

  Standard Injection Distance:

Injection Condition	Injection Pressure
300 mm (11.8 in.)	2 42 to 4 03 kPa (30.0 to 50.0 kgf/cm^2, 427 to 711 psi)
500 mm (1 .7 in.)	4 03 to 7845 kPa (50.0 to 80.0 kgf/cm^2, 711 to 1138 psi)

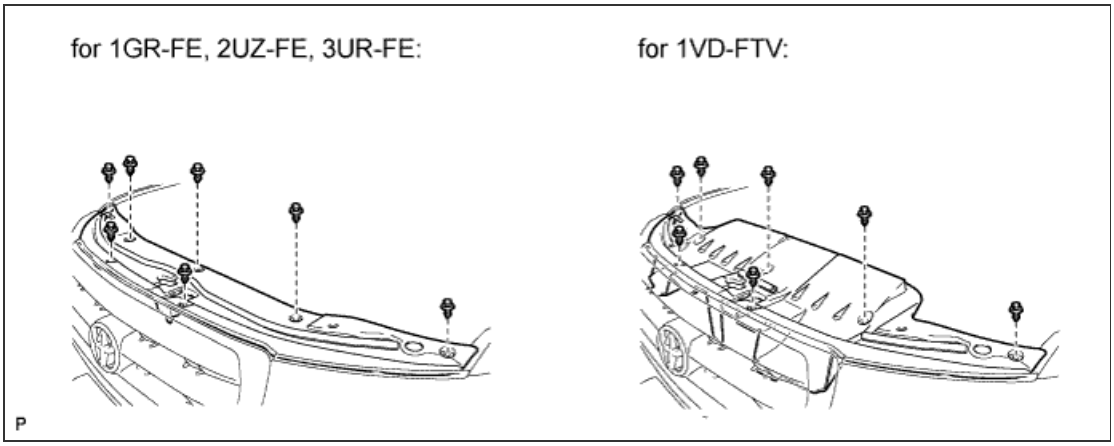
- **If the fins are bent, straighten them with a screwdriver or pliers.**
- **Never apply water directly onto the electric components.**

b. Dry the fins with compressed air.

for Preparation Click here

1. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and radiator support seal.

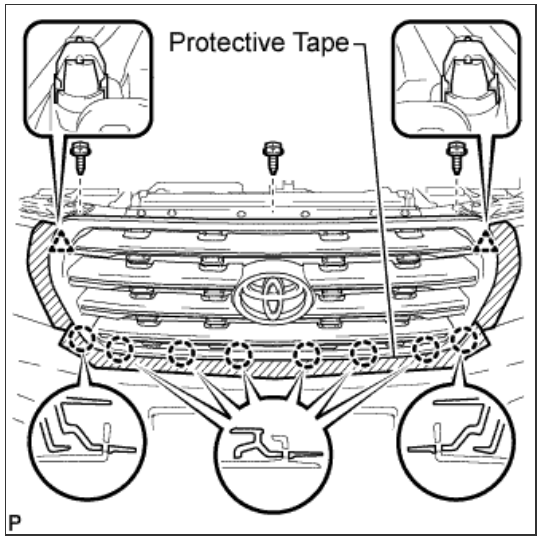


2. REMOVE RADIATOR GRILLE

a. Put protective tape around the radiator grille.

b. Remove the 3 screws.

c. Detach the 2 clips and 8 claws, and remove the radiator grille.

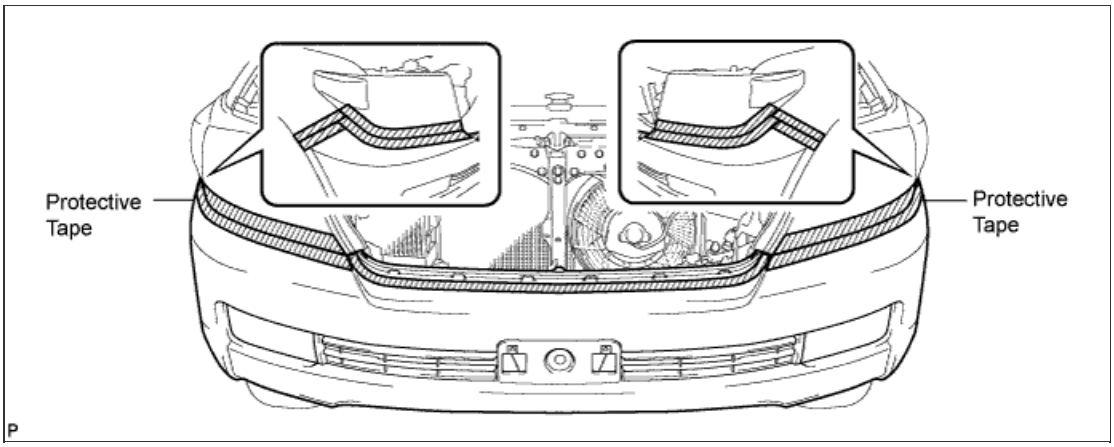


3. REMOVE FRONT BUMPER COVER

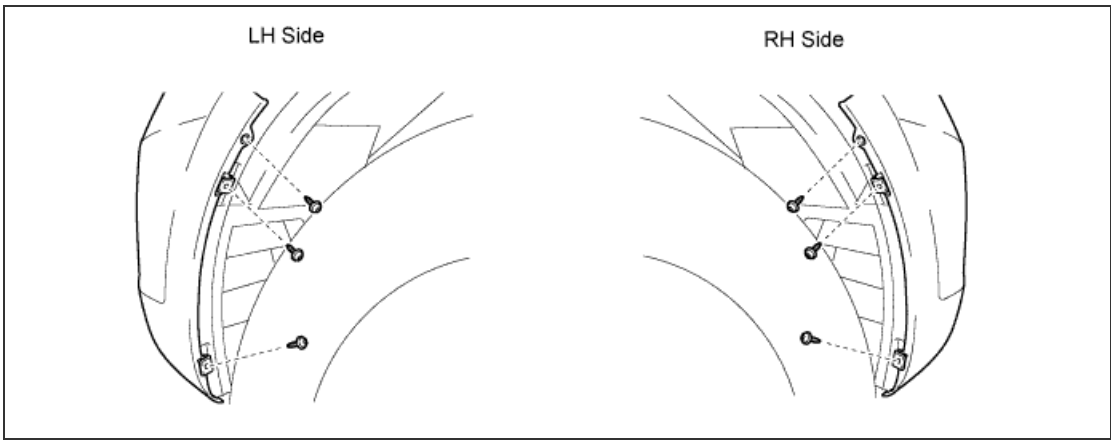
HINT:

For the front bumper cover with garnish, use the procedures described below.

a. Put protective tape around the bumper cover.



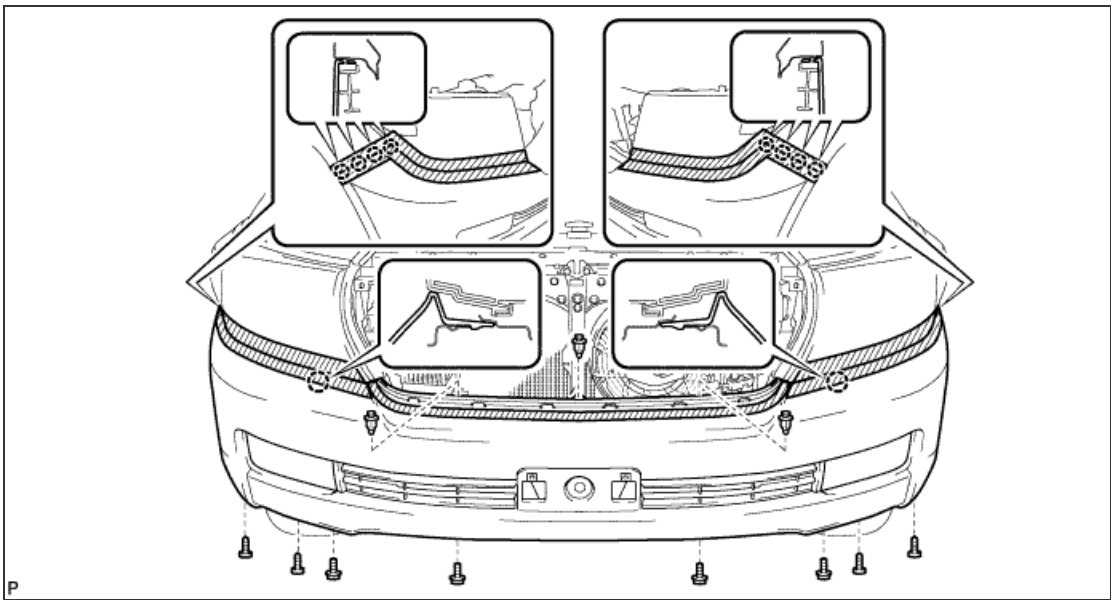
b. Using a T30 "TORX" socket, remove the 6 screws.



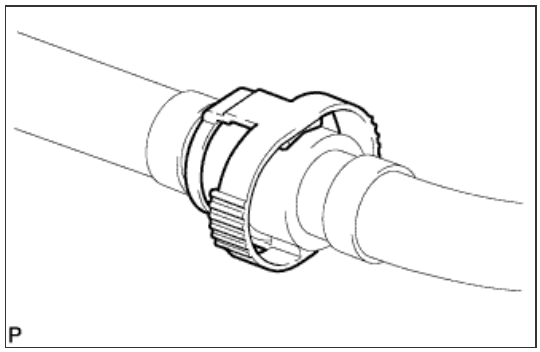
c. Remove the 3 clips, 4 screws and 4 bolts.

d. w/o TOYOTA Parking Assist-sensor System, w/o Fog Light:
Detach the 10 claws and remove the bumper cover.

e. w/ TOYOTA Parking Assist-sensor System or w/ Fog Light:
Detach the 10 claws, disconnect the No. 4 engine room wire connector and remove the bumper cover.

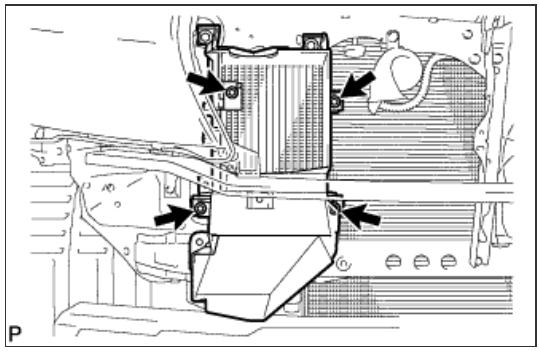


f. w/ Headlight Cleaner System:
Disconnect the headlight cleaner hose and remove the bumper cover.



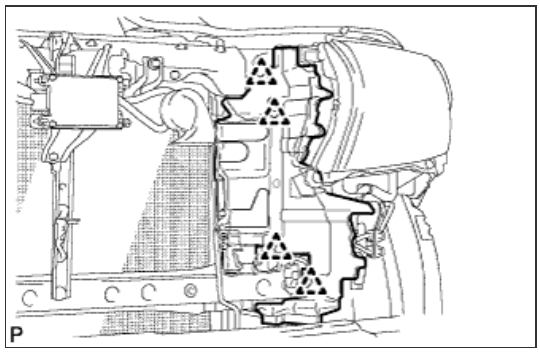
4. REMOVE TRANSMISSION OIL COOLER AIR DUCT

a. Remove the 4 bolts and oil cooler air duct.



5. DISCONNECT RADIATOR SIDE DEFLECTOR LH

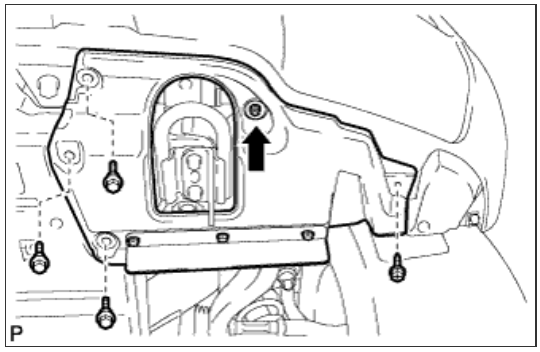
a. Using a clip remover, remove the 4 clips and disconnect the side deflector.



6. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



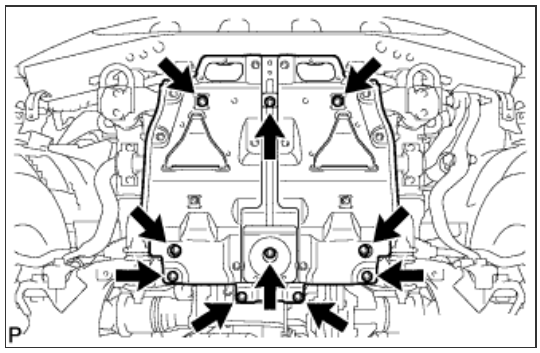
7. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

8. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and No. 1 engine under cover.



9. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug.

HINT:

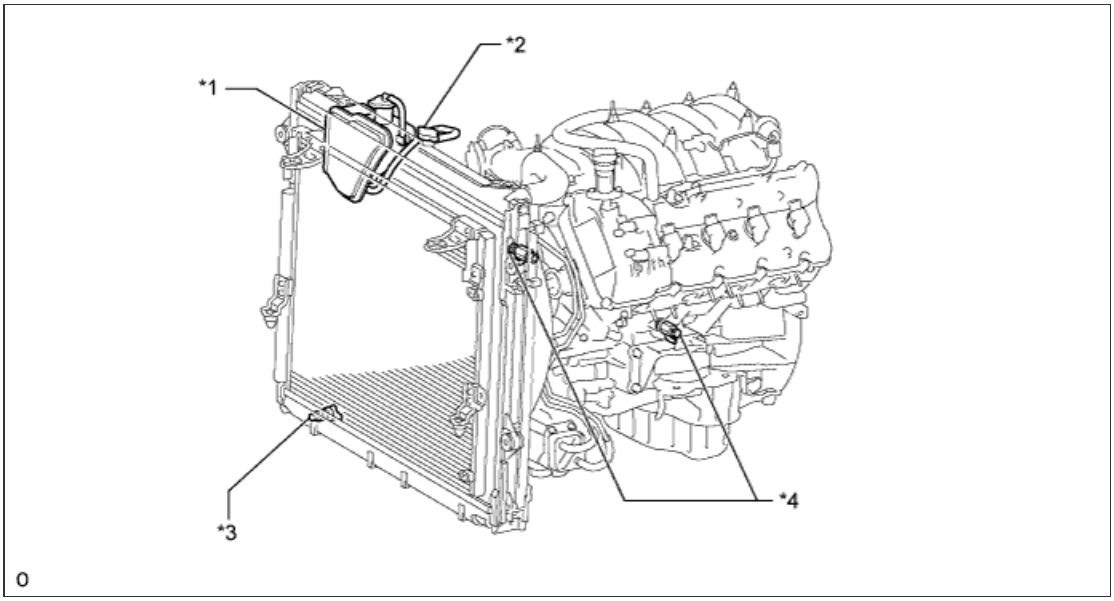
Collect the coolant in a container and dispose of it according to the regulations in your area.

b. Remove the radiator cap. Then drain the coolant from the radiator.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

d. Tighten the 2 cylinder block drain cock plugs.

Torque:
13 N 133 k f c 10 ft. lbf }



Text in Illu tration

*1	Radiator Reservoir	*2	Radiator Cap
*3	Radiator Drain Cock Plug	*4	Cylinder Block Drain Cock Plug

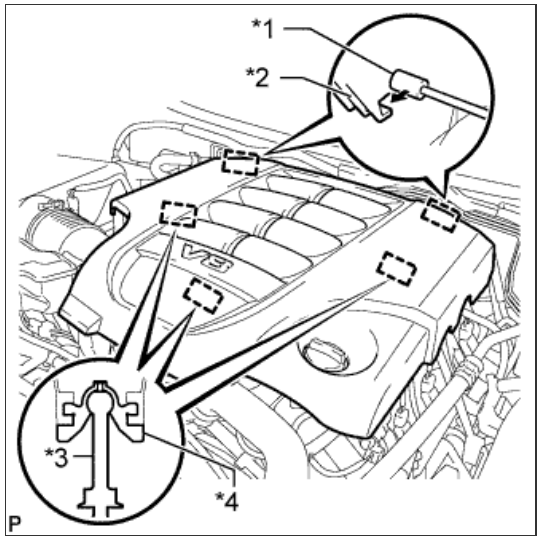
e. Tighten the radiator drain cock plug by hand.

10. REMOVE V-BAN COVER SUB-ASSEMBLY

a. Raise the front of the V-bank cover to detach the 3 pins. Then remove the 2 V-bank cover hooks from the bracket, and remove the V-bank cover.

Text in Illu tration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet

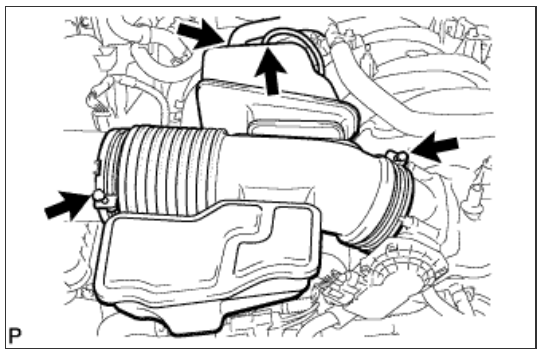


11. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum hose and No. 2 ventilation hose.

b. Loosen the 2 hose clamps.

c. Remove the air cleaner hose.



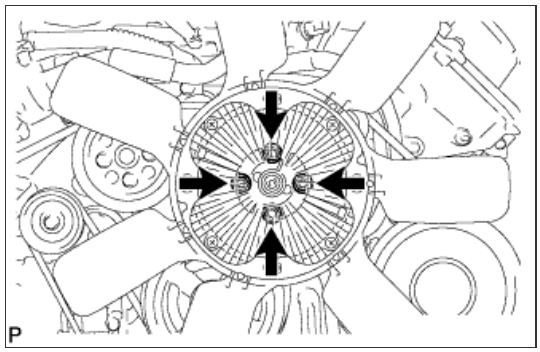
12. REMOVE NO. 1 RADIATOR HOSE

13. REMOVE NO. 2 RADIATOR HOSE

14. REMOVE FAN SHROUD

a. Loosen the 4 nuts holding the fluid coupling fan.

b. Remove the fan and generator V-belt (Click here).



c. Disconnect the reservoir hose from the upper radiator tank.

d. Detach the claw to open the flexible hose clamp.

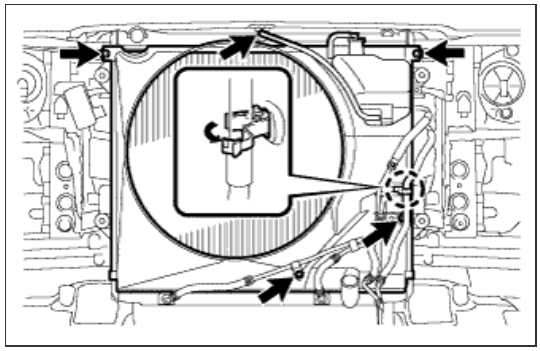
e. Remove the 2 bolts and disconnect the oil cooler tube from the fan shroud.

f. Remove the 2 bolts holding the fan shroud.

.Remove the 4 nuts of the fluid coupling fan, and then remove the shroud together with the coupling fan.

NOTICE:

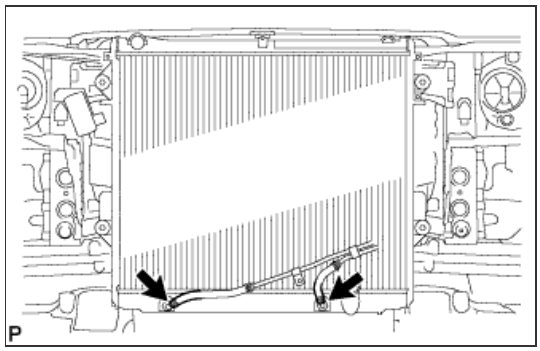
Be careful not to damage the radiator core.



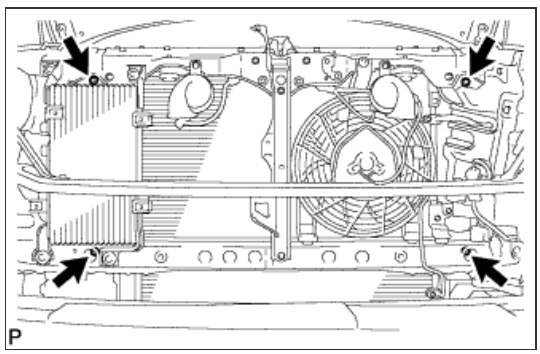
h. Remove the fan pulley.

15. REMOVE RADIATOR ASSEMBLY

a. Disconnect the 2 oil cooler hoses.

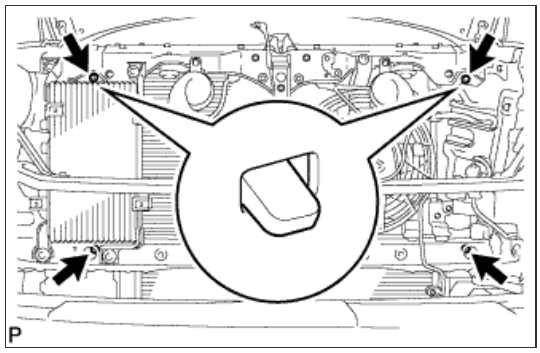


b. Remove the 4 bolts and radiator.



for Preparation Click here

1. INSTALL RADIATOR ASSEMBLY



a. Set the radiator bracket hooks to the radiator support holes.

b. Install the radiator with the 4 bolts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

c. Connect the 2 oil cooler hoses.

2. INSTALL FAN SHROUD

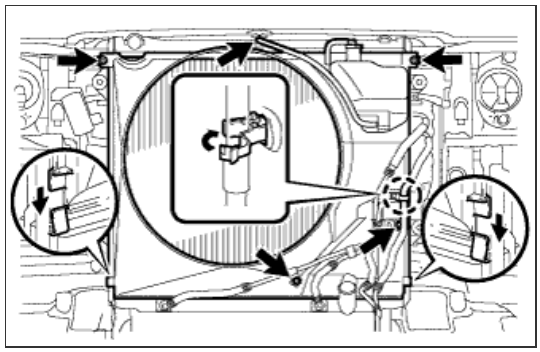
a. Install the fan pulley.

b. Place the shroud together with the coupling fan between the radiator and engine.

NOTICE:

Be careful not to damage the radiator core.

c. Temporarily install the fluid coupling fan to the fluid coupling bracket with the 4 nuts. Tighten the nuts as much as possible by hand.



d. Attach the claws of the shroud to the radiator as shown in the illustration.

e. Install the shroud with the 2 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

f. Connect the oil cooler tube to the fan shroud with the 2 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

g. Pass the hose through the flexible hose clamp and close the clamp as shown in the illustration.

h. Connect the reservoir hose to the upper radiator tank.

i. Install the fan and generator V-belt (Click here).

. Tighten the 4 nuts of the fluid coupling fan.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

3. INSTALL NO. 2 RADIATOR HOSE

4. INSTALL NO. 1 RADIATOR HOSE

5. INSTALL AIR CLEANER HOSE ASSEMBLY

a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

Text in Illu tration

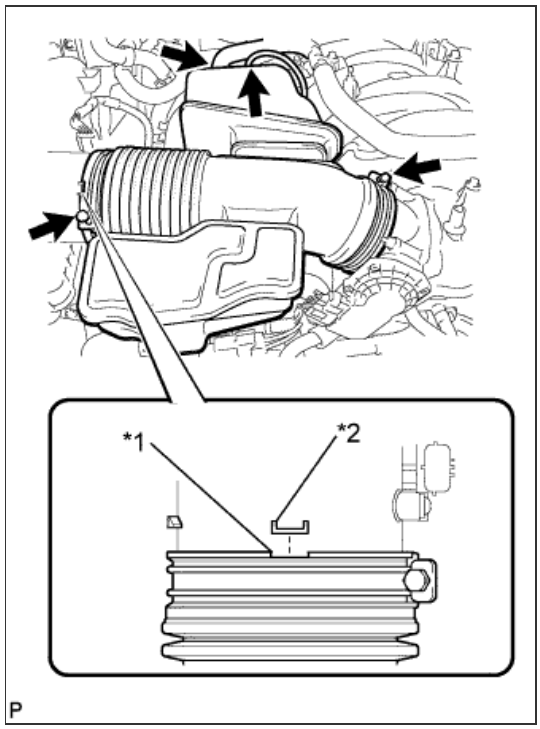
*1	Groove
*2	Protrusion

b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum hose.

d. Connect the No. 2 ventilation hose.

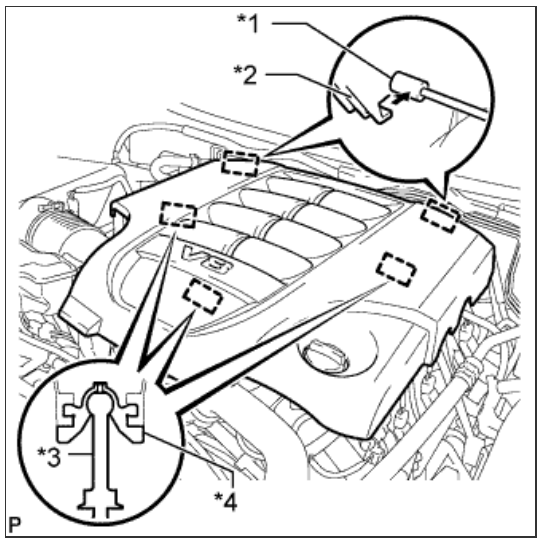


6. INSTALL V BANK COVER SUB ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket. Then align the 3 V-bank cover grommets with the 3 pins, and press down on the V-bank cover to attach the pins.

Text in Illu tration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet



7. ADD EN INE COOLANT

a. Add engine coolant.

Standard Capacity:

Item	Specified Condition
with rear heater	16.2 liters (17.1 US qts, 14.3 Imp. qts)
without rear heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

TO TA vehicles are filled with TO TA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical

problems, only use TO TA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the radiator inlet hose by hand, and checking when the engine coolant starts to flow inside the hose.

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make ure that the radiator re ervoir till ha ome coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make ure that the needle doe not how an abnormally high temperature.**
- **If there i not enough coolant, the engine may burn out or overheat.**
- **Immediately after tarting the engine, if the radiator re ervoir doe not have any coolant, perform the following: 1) top the engine, 2) wait until the coolant ha cooled down, and 3) add coolant until the coolant i filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level ha tabilized.**

h. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

- **Wear protective glove .**
- **Be careful a the radiator ho e are hot.**
- **Keep your hand away from the fan.**

i. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.

8. INSPECT FOR COOLANT LEAK

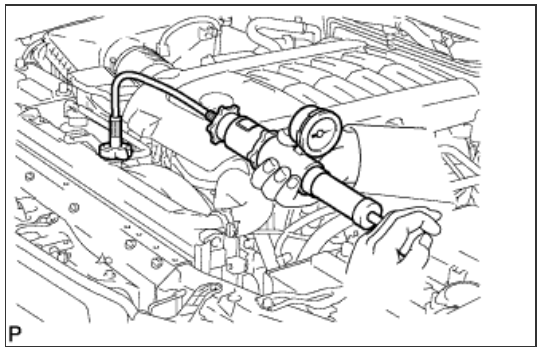
CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



9. INSTALL NO. 1 EN INE UNDER COVER SUB ASSEMBLY

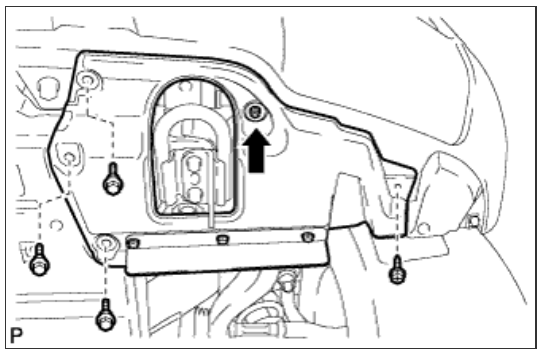
a. Install the No. 1 engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

10. INSTALL FRONT FENDER SPLASH SHIELD SUB ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



11. INSTALL FRONT FENDER SPLASH SHIELD SUB ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

12. CONNECT RADIATOR SIDE DEFLECTOR LH

a. Connect the deflector with the 4 clips.

13. INSTALL TRANSMISSION OIL COOLER AIR DUCT

a. Install the oil cooler air duct with the 4 bolts.

Torque:
4.9 N*m{ 50 kgf*cm , 43 in.*lbf }

14. INSTALL FRONT BUMPER COVER

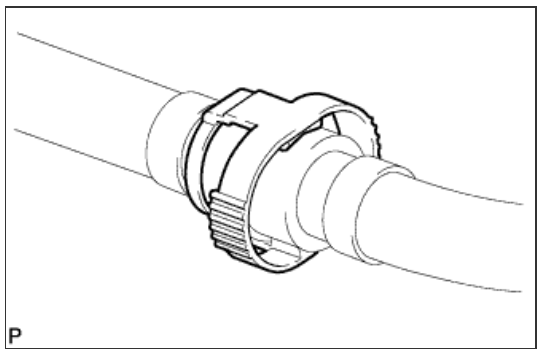
HINT:

For the front bumper cover with garnish, use the procedures described below.

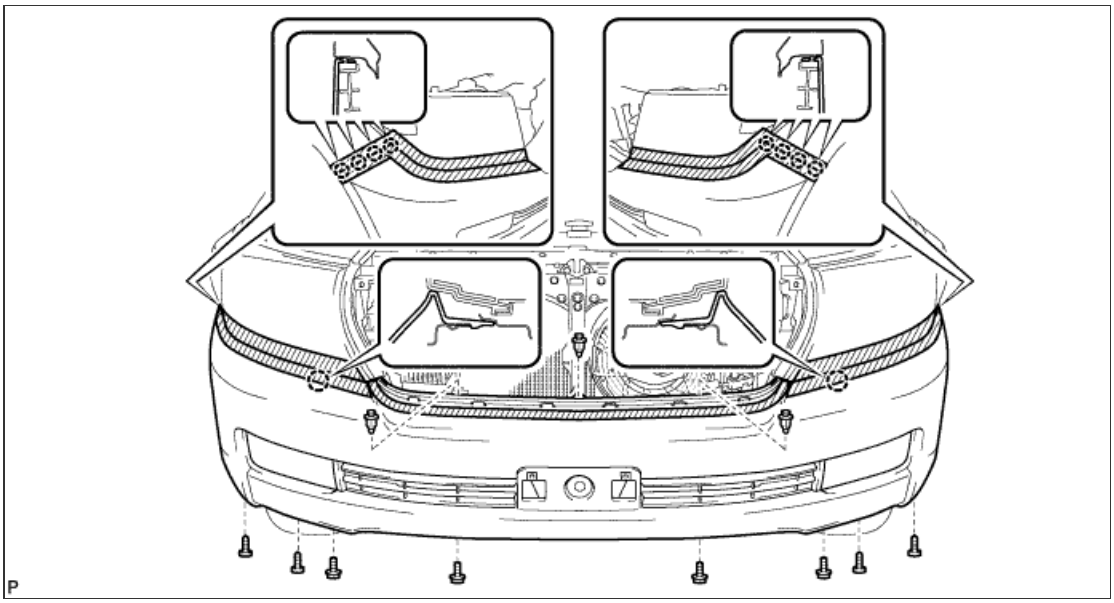
a. w/ Headlight Cleaner System:
Connect the headlight cleaner hose.

b. w/o TO TA Parking Assist-sensor System, w/o Fog Light:
Attach the 10 claws to install the bumper cover.

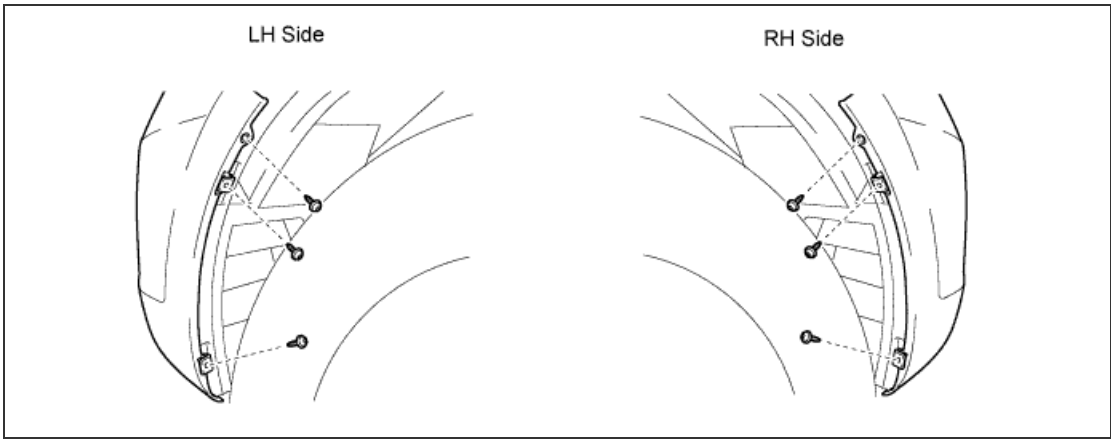
c. w/ TO TA Parking Assist-sensor System or w/ Fog Light:
Connect the No. 4 engine room wire connector and attach the 10 claws to install the bumper cover.



d. Install the 3 clips, 4 screws and 4 bolts.



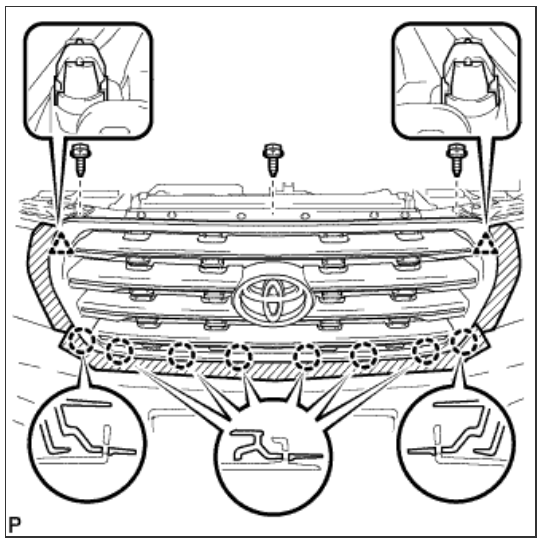
e. Using a T30 "TO socket, install the 6 screws.



15. INSTALL RADIATOR RILLE

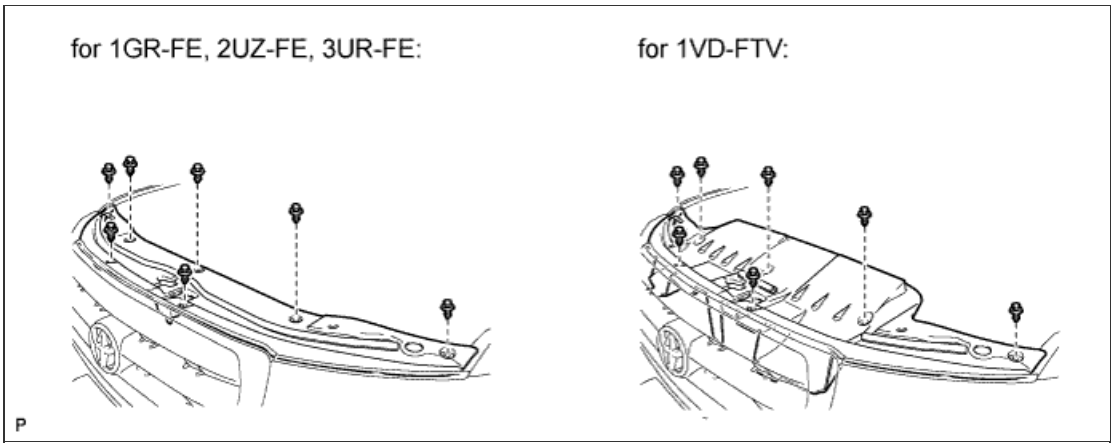
a. Attach the 2 clips and 8 claws to install the radiator grille.

b. Install the 3 screws.



16. INSTALL UPPER RADIATOR SUPPORT SEAL

a. Install the radiator support seal with the 7 clips.



for Preparation Click here

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

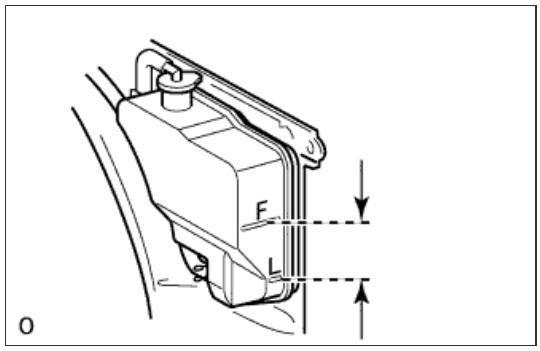
1. CHECK ENGINE COOLANT LEVEL

a. Check that the engine coolant level is between the L and F lines when the engine is cold.
If the engine coolant is low, check for leaks and add "TOYOTA Super Long Life Coolant" or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite and non-borate coolant with long-life hybrid organic acid technology to the F line.

NOTICE:

Do not substitute plain water for engine coolant.

b. Remove the radiator cap, and check that the coolant level is up to the radiator filler hole.



2. INSPECT ENGINE COOLANT UALITY

a. Remove the radiator cap.

b. Check if there are any excessive deposits of rust or scales around the radiator cap and radiator filler hole. Also, the coolant should be free of oil.
If excessively dirty, clean the coolant passage and replace the coolant.

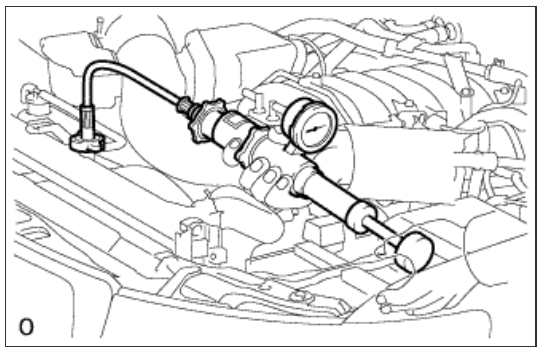
c. Install the radiator cap.

3. INSPECT FOR COOLANT LEAK

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.

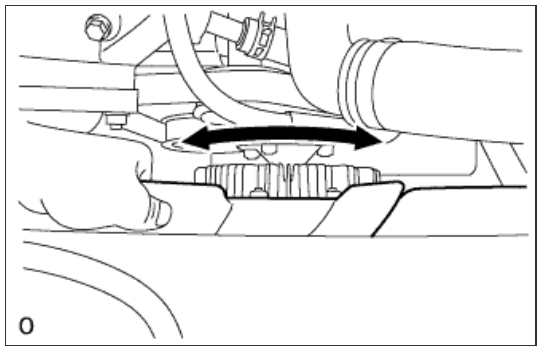


4. INSPECT FLUID COUPLING ASSEMBLY

a. Check the turning smoothness of the fluid coupling.
If necessary, replace the fluid coupling assembly.

b. Check that the fluid coupling is not damaged and that no silicon oil leaks.

If necessary, replace the fluid coupling assembly.



for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

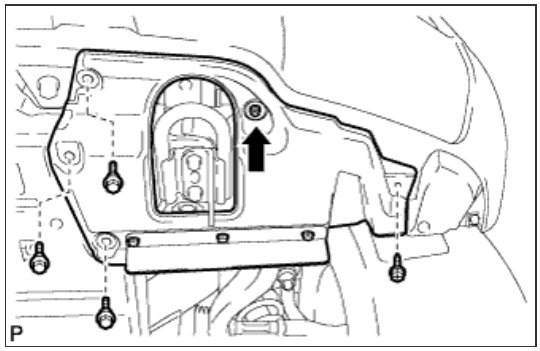
HINT:

Use the same procedures described for the LH side.

2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

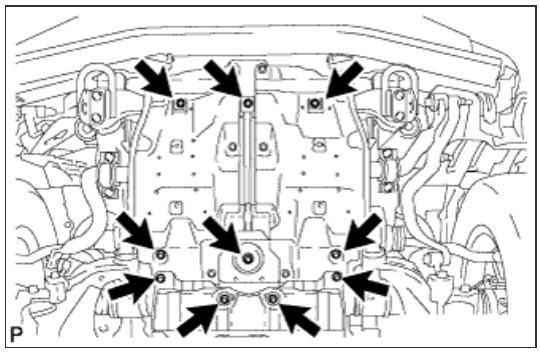
a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



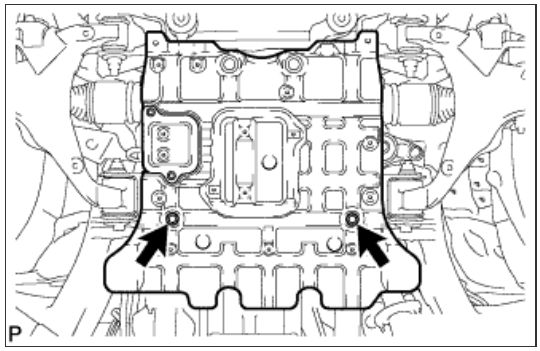
3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and No. 1 engine under cover.



4. REMOVE NO. 2 ENGINE UNDER COVER

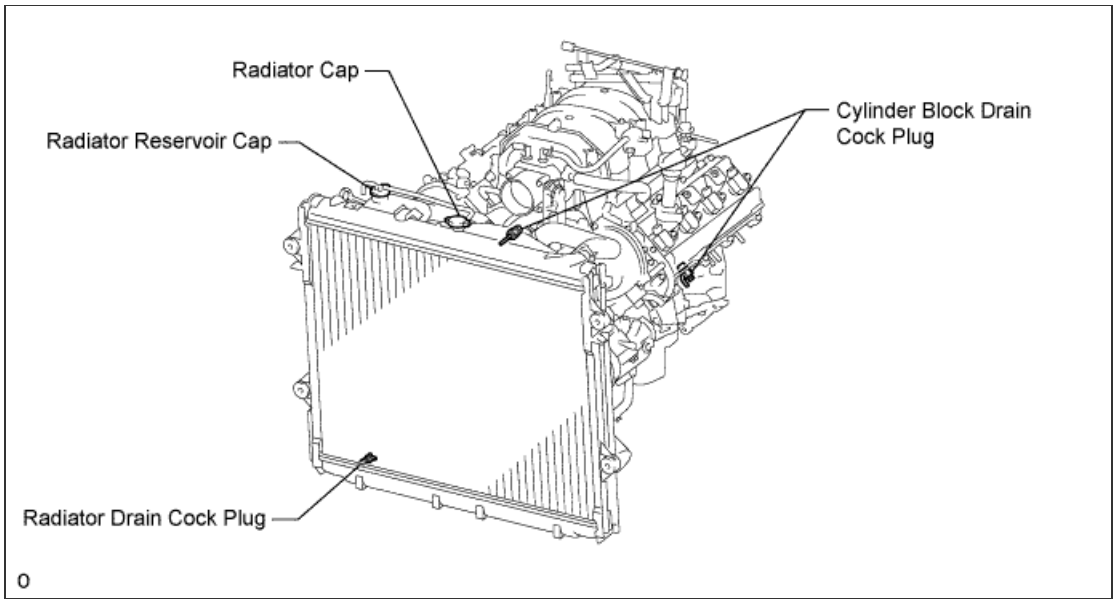
a. Remove the 2 bolts and No. 2 engine under cover.



5. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.



a. Loosen the radiator drain cock plug.

b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

d. Tighten the 2 cylinder block drain cock plugs.

Torque:
13 N*m{ 130 kgf*cm , 9 ft.*lbf }

e. Tighten the radiator drain cock plug by hand.

6. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacit :

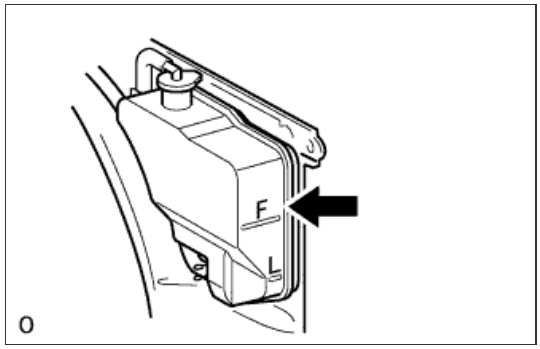
Item		Specified Condition
w/o Transmission oil cooler	w/o Rear Heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)
	w/ Rear Heater	16.3 liters (17.2 US qts, 14.3 Imp. qts)
w/ Transmission oil cooler	w/o Rear Heater	14.1 liters (14.9 US qts, 12.4 Imp. qts)
	w/ Rear Heater	16.9 liters (17.9 US qts, 14.9 Imp. qts)

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical

problems, only use T TA SLLC or similar high quality ethylene glycol based non silicate, non amine, non nitrite, non borate coolant with long life hybrid organic acid technology (coolant with long life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the line.



c. Install the radiator reservoir cap.

d. Press the inlet and outlet radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.

NOTICE:

Switch off the A/C.

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

h. Press the inlet and outlet radiator hoses several times by hand to bleed air.

CAUTION:

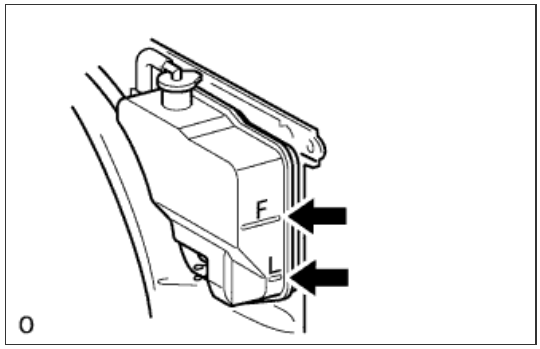
- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the cooling fan.**

i. Stop the engine, and wait until the engine coolant cools down to the ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

j. Check that the coolant level is between the and L lines. If the coolant level is below the L line, repeat all of the procedures above. If the coolant level is above the line, drain coolant so that the coolant level is between the and L lines.

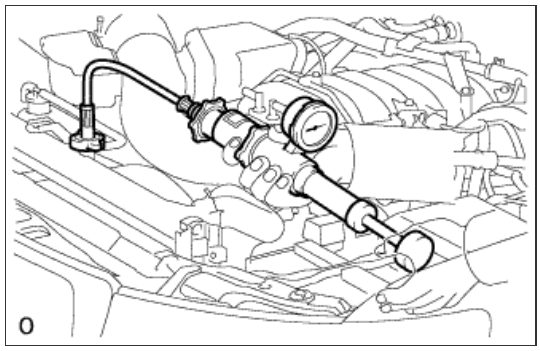


7. INSPECT FOR COOLANT LEAK

a. ill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

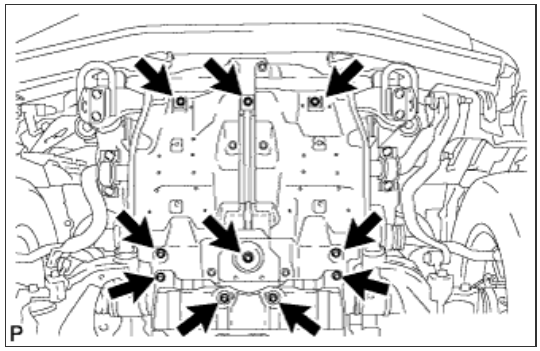
c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the No. 1 engine under cover with the 10 bolts.

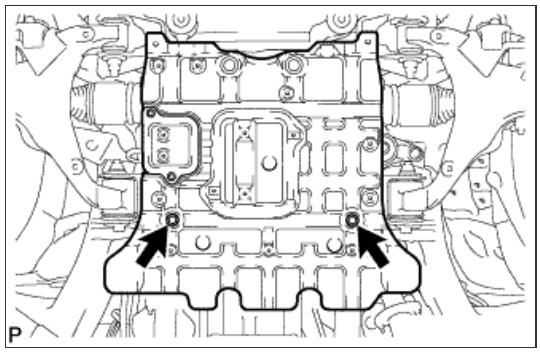
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



9. INSTALL NO. 2 ENGINE UNDER COVER

a. Install the No. 2 engine under cover with the 2 bolts.

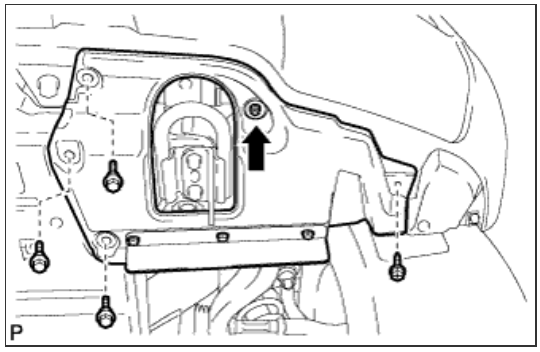
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



10. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



11. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

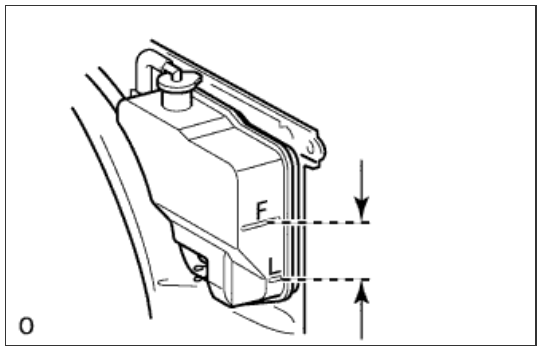
12. INSPECT ENGINE COOLANT LEVEL

a. Check that the engine coolant level is between the L and lines when the engine is cold.
If the engine coolant is low, check for leaks and add "T TA Super Long Life Coolant" or similar high quality ethylene glycol based non silicate, non amine, non nitrite and non borate coolant with long life hybrid organic acid technology to the line.

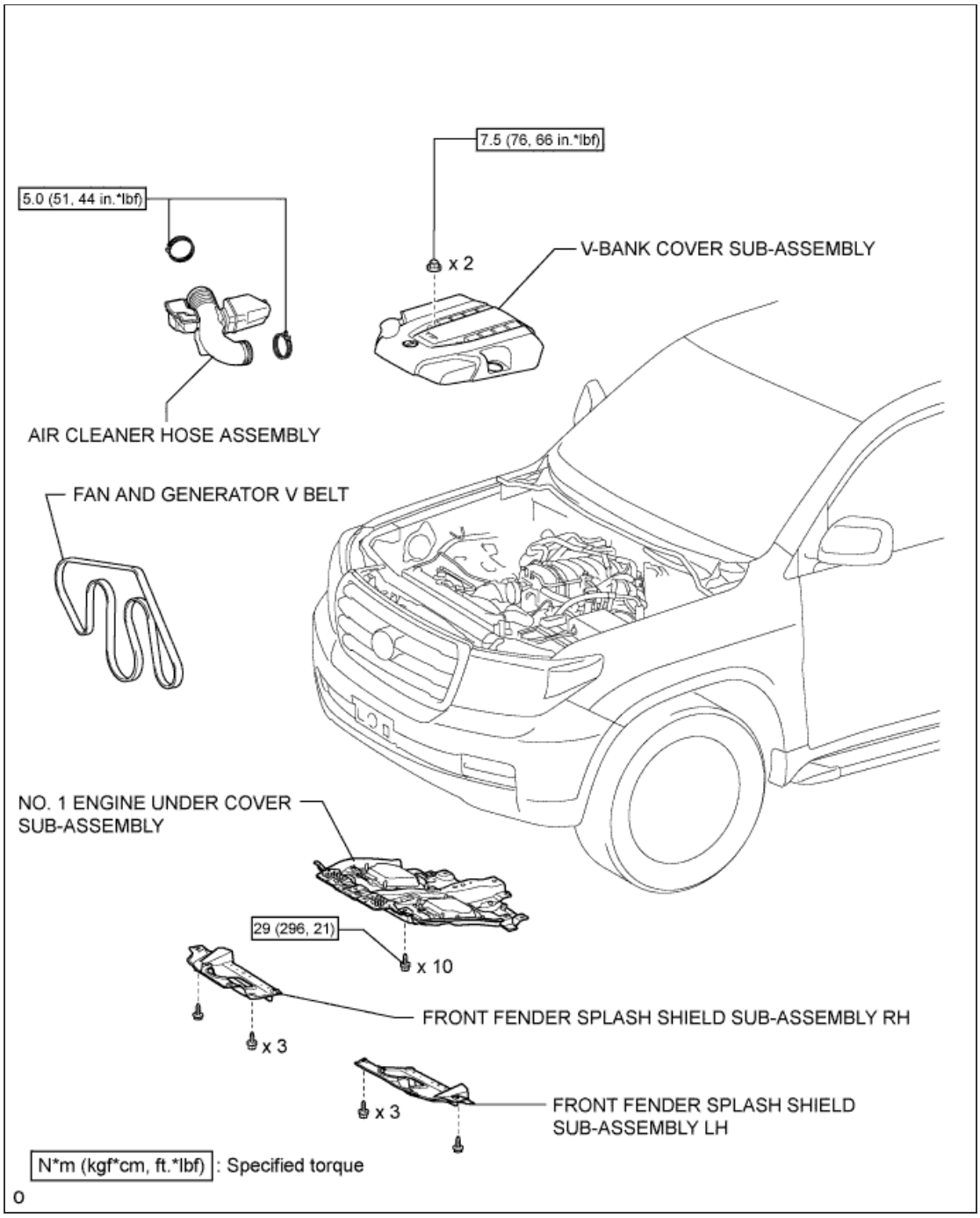
NOTICE:

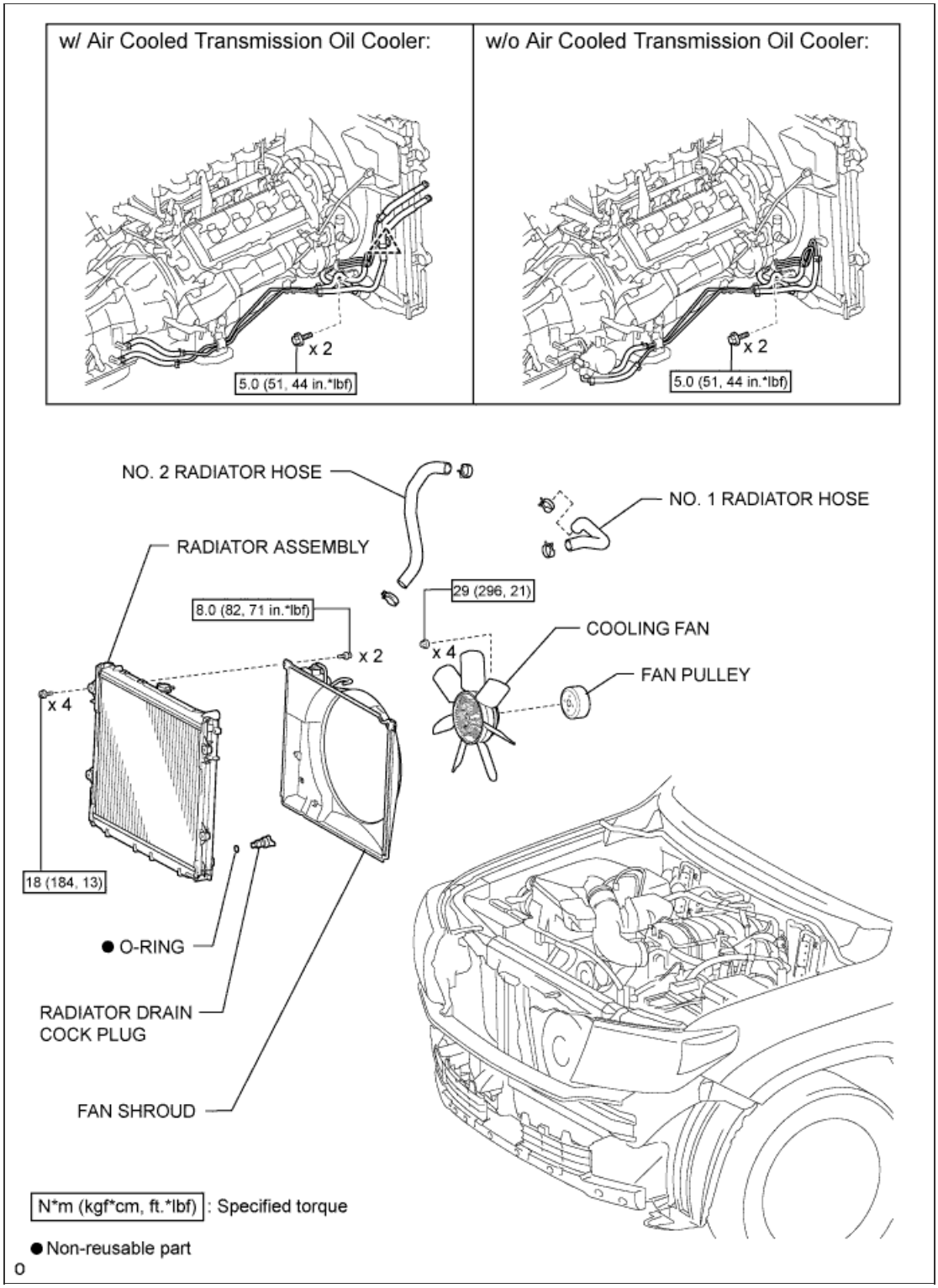
Do not substitute plain water for engine coolant.

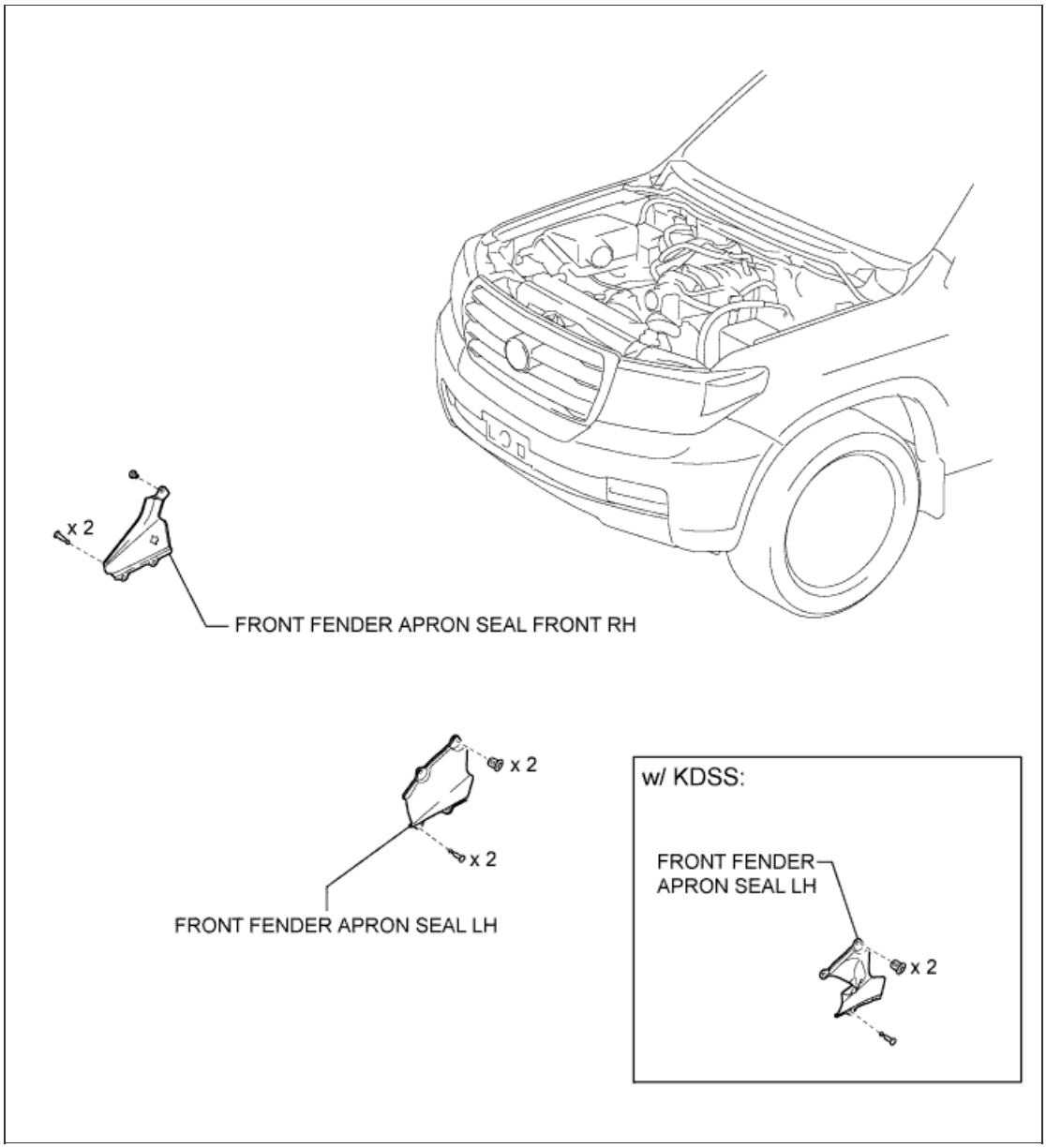
b. Remove the radiator cap, and check that the coolant level is up to the radiator filler hole.

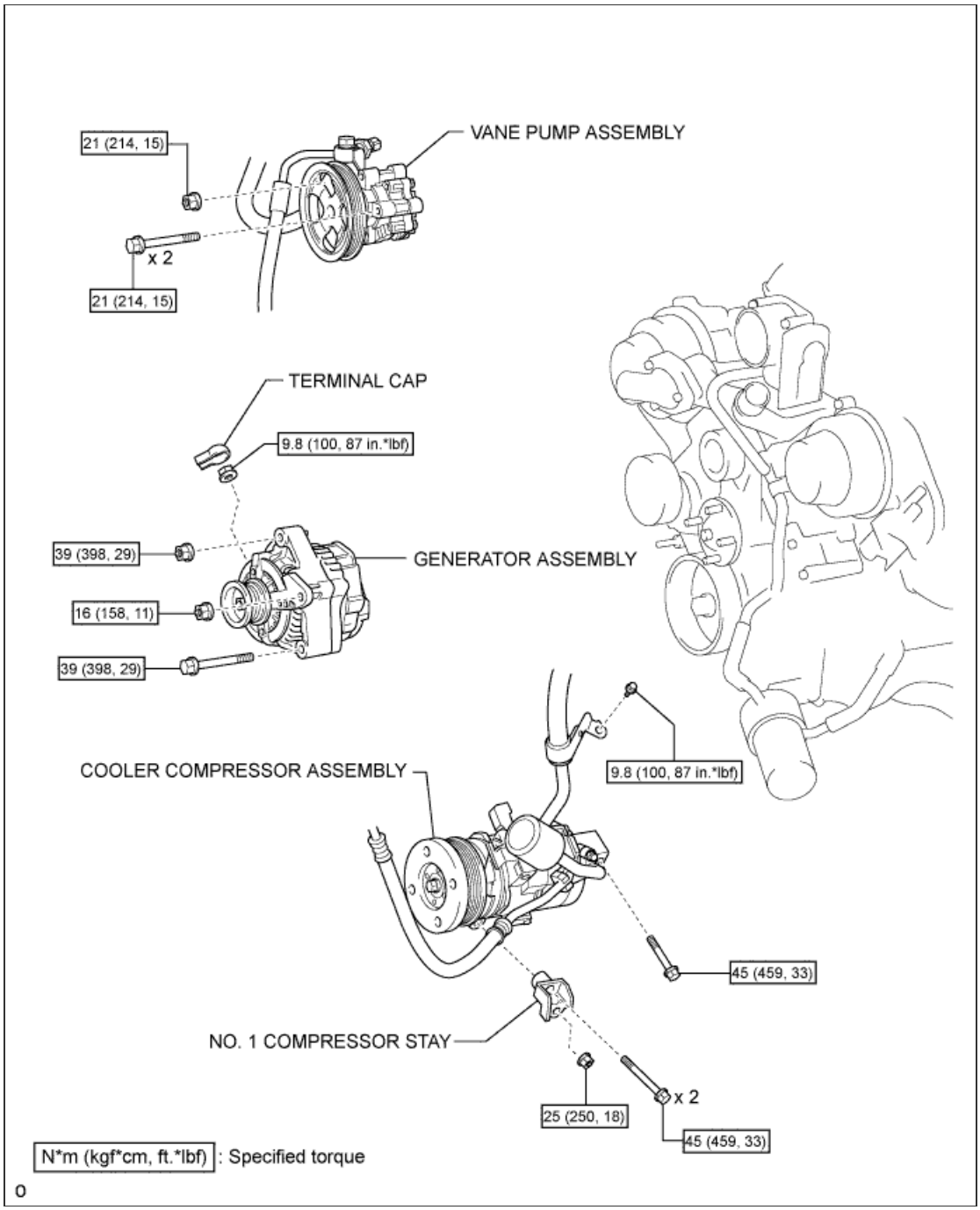


for Preparation Click here

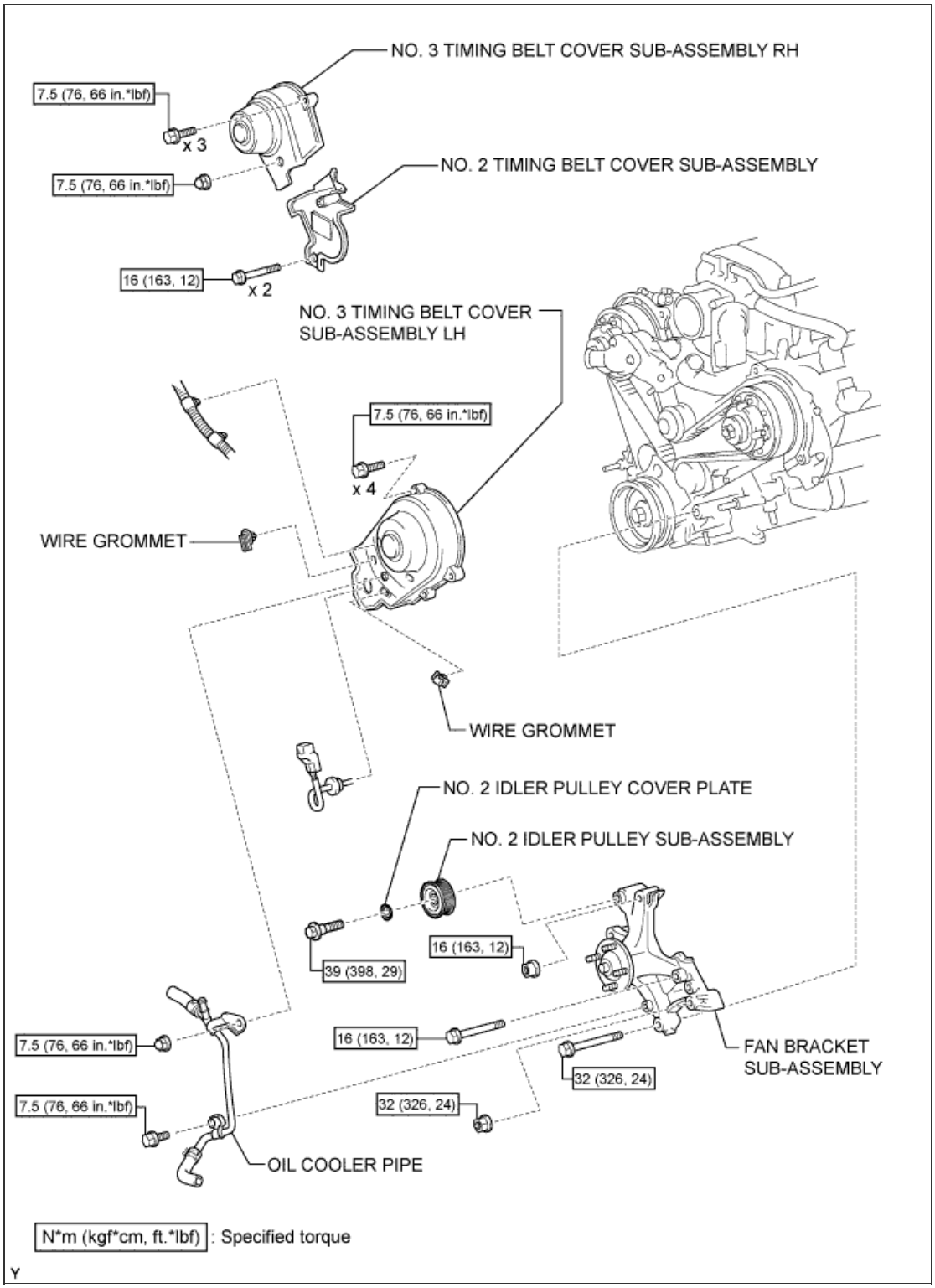


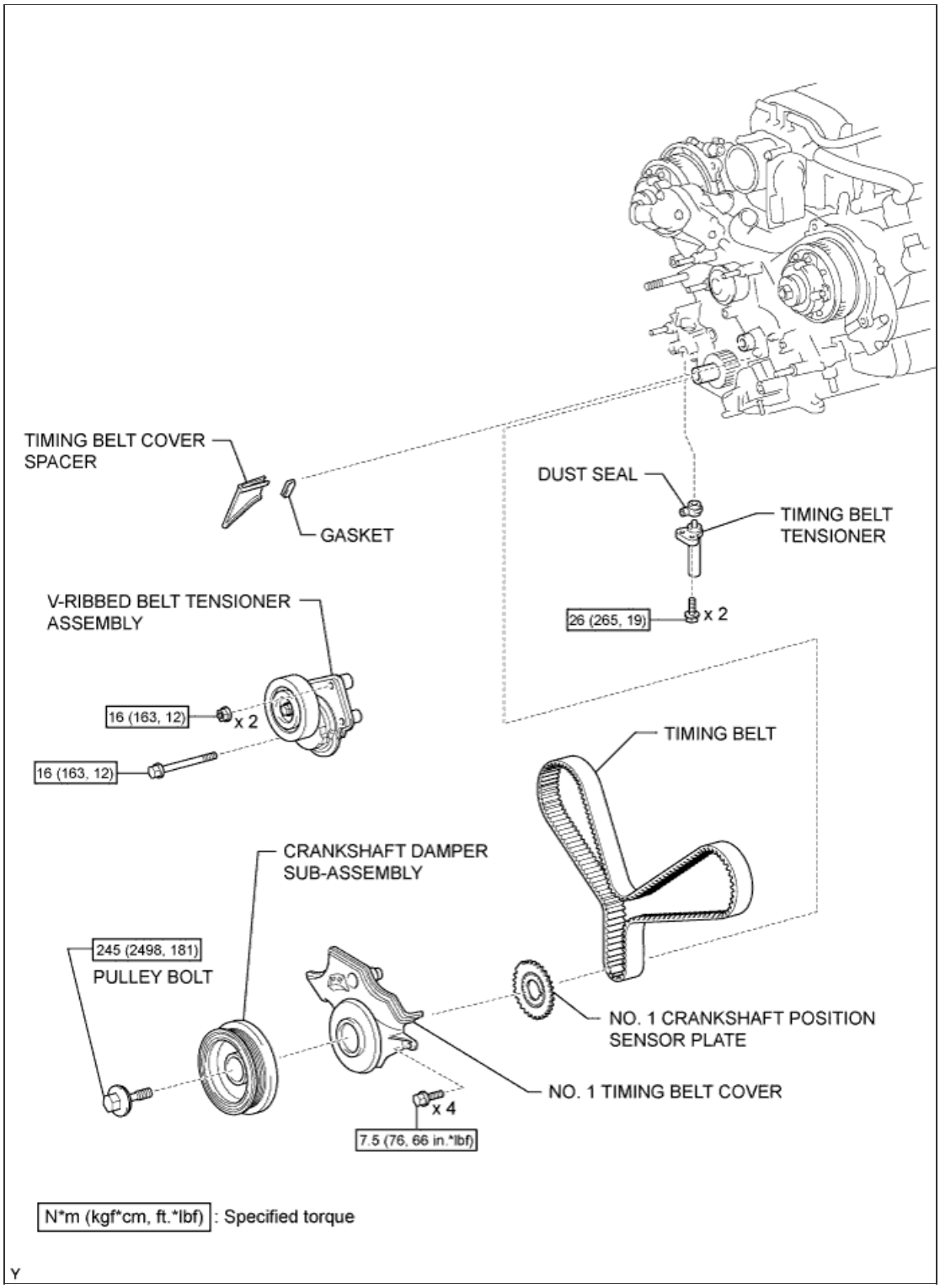

w/ Air Cooled Transmission Oil Cooler:
x 2
5.0 (51, 44 in.*lbf)
w/o Air Cooled Transmission Oil Cooler:
x 2
5.0 (51, 44 in.*lbf)
NO. 2 RADIATOR HOSE
NO. 1 RADIATOR HOSE
RADIATOR ASSEMBLY
29 (296, 21)
8.0 (82, 71 in.*lbf)
COOLING FAN
x 2
x 4
FAN PULLEY
x 4
18 (184, 13)
● O-RING
RADIATOR DRAIN COCK PLUG
FAN SHROUD
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part


x 2
FRONT FENDER APRON SEAL FRONT RH
x 2
x 2
FRONT FENDER APRON SEAL LH
w/ KDSS:
FRONT FENDER APRON SEAL LH
x 2

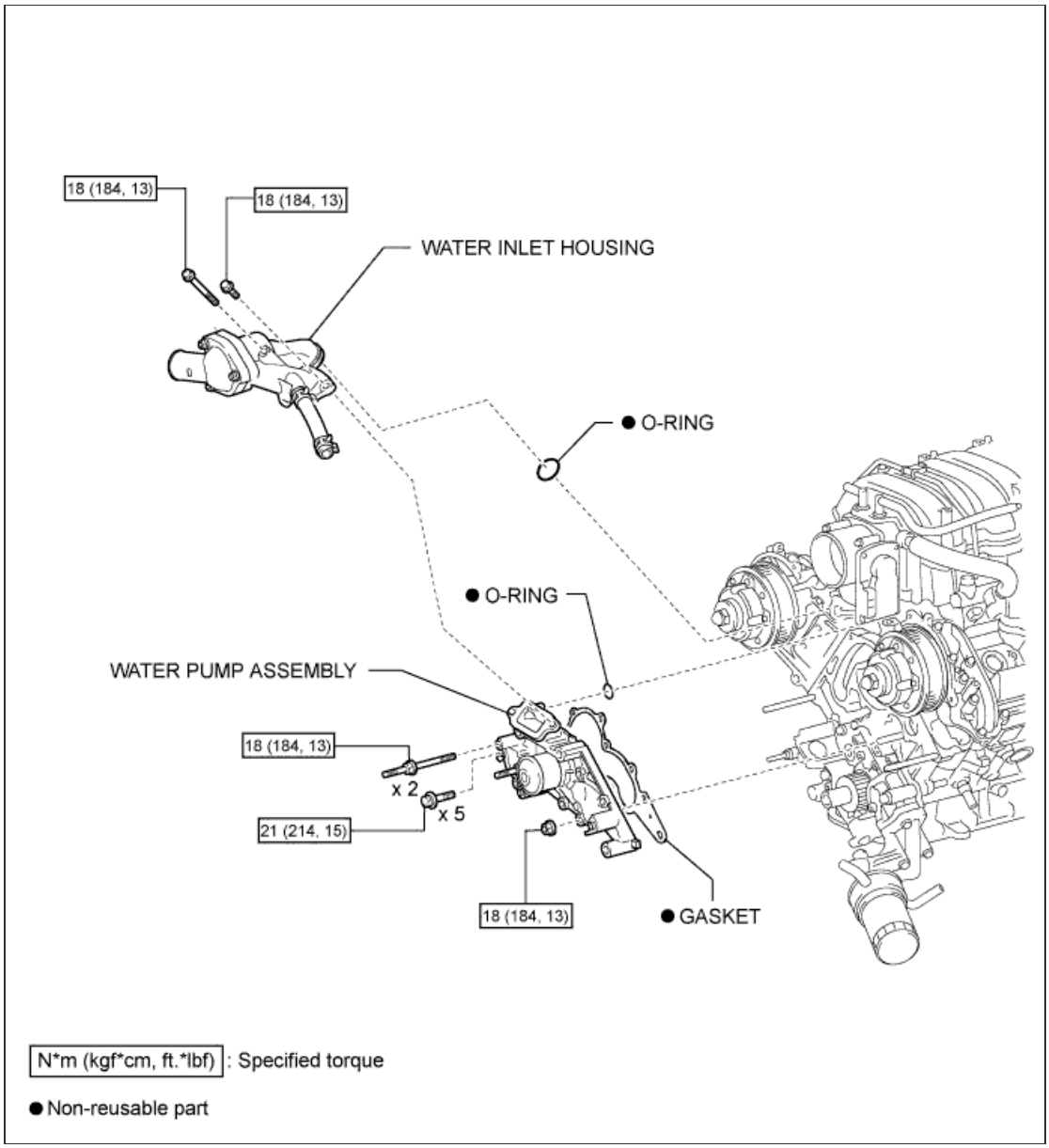

21 (214, 15)
VANE PUMP ASSEMBLY
x 2
21 (214, 15)
TERMINAL CAP
9.8 (100, 87 in.*lbf)
39 (398, 29)
GENERATOR ASSEMBLY
16 (158, 11)
39 (398, 29)
COOLER COMPRESSOR ASSEMBLY
9.8 (100, 87 in.*lbf)
45 (459, 33)
NO. 1 COMPRESSOR STAY
25 (250, 18)
x 2
45 (459, 33)
N*m (kgf*cm, ft.*lbf) : Specified torque

o


NO. 3 TIMING BELT COVER SUB-ASSEMBLY RH
7.5 (76, 66 in.*lbf)
x 3
NO. 2 TIMING BELT COVER SUB-ASSEMBLY
7.5 (76, 66 in.*lbf)
16 (163, 12)
x 2
NO. 3 TIMING BELT COVER SUB-ASSEMBLY LH
7.5 (76, 66 in.*lbf)
x 4
WIRE GROMMET
WIRE GROMMET
NO. 2 IDLER PULLEY COVER PLATE
NO. 2 IDLER PULLEY SUB-ASSEMBLY
39 (398, 29)
16 (163, 12)
7.5 (76, 66 in.*lbf)
16 (163, 12)
32 (326, 24)
FAN BRACKET SUB-ASSEMBLY
7.5 (76, 66 in.*lbf)
32 (326, 24)
OIL COOLER PIPE
N*m (kgf*cm, ft.*lbf) : Specified torque
Y


TIMING BELT COVER
SPACER
GASKET
DUST SEAL
TIMING BELT
TENSIONER
26 (265, 19)
x 2
V-RIBBED BELT TENSIONER
ASSEMBLY
16 (163, 12)
x 2
16 (163, 12)
TIMING BELT
CRANKSHAFT DAMPER
SUB-ASSEMBLY
245 (2498, 181)
PULLEY BOLT
NO. 1 CRANKSHAFT POSITION
SENSOR PLATE
NO. 1 TIMING BELT COVER
x 4
7.5 (76, 66 in.*lbf)
N*m (kgf*cm, ft.*lbf) : Specified torque

Y


18 (184, 13)
18 (184, 13)
WATER INLET HOUSING
● O-RING
● O-RING
WATER PUMP ASSEMBLY
18 (184, 13)
x 2
x 5
21 (214, 15)
18 (184, 13)
● GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

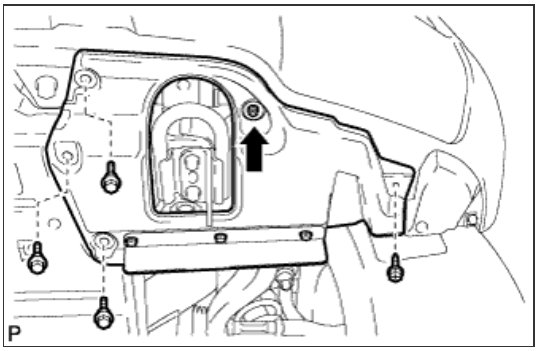
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



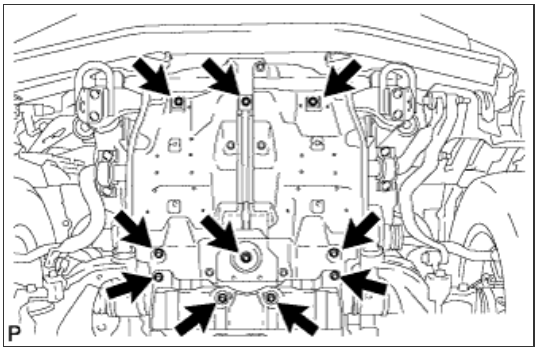
3. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

4. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

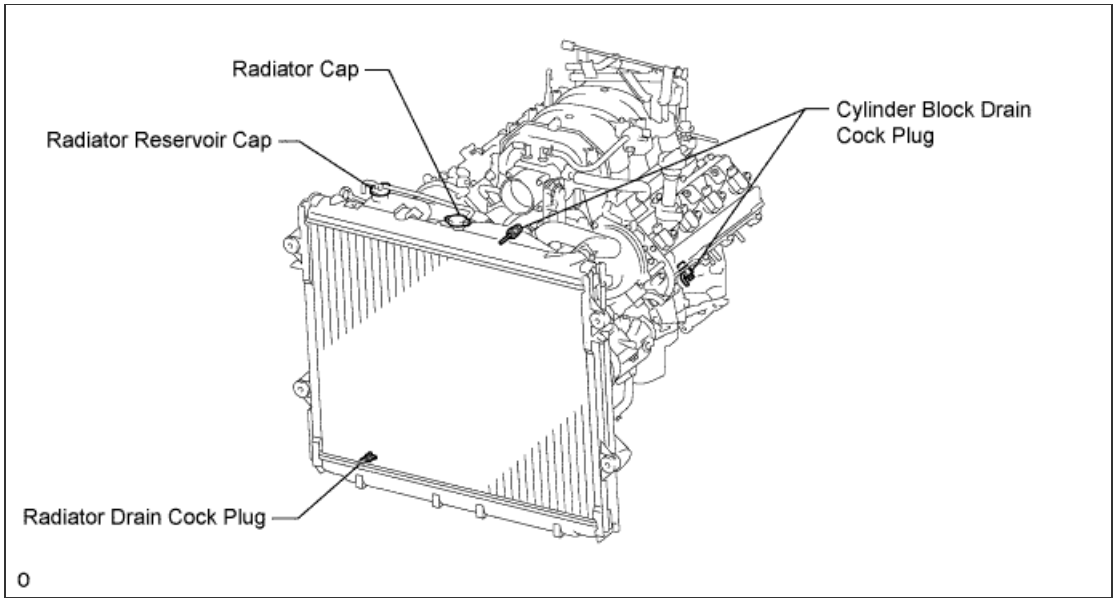
a. Remove the 10 bolts and No. 1 engine under cover.



5. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.



a. Loosen the radiator drain cock plug.

b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

d. Tighten the 2 cylinder block drain cock plugs.

Torque:
13 N*m{ 130 kgf*cm , 9 ft.*lbf }

e. Tighten the radiator drain cock plug by hand.

6. REMOVE TIMING BELT

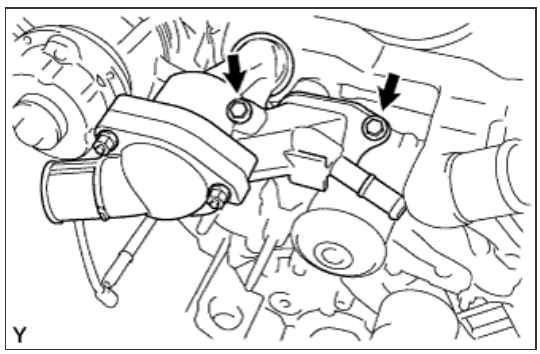
a. For the timing belt, refer to the following procedures (Click here).

7. REMOVE WATER INLET HOUSING

a. Remove the 2 bolts holding the water inlet housing to the water pump.

b. Disconnect the water inlet housing from the front water by-pass oint and water pump. Then remove the water inlet and inlet housing assembly.

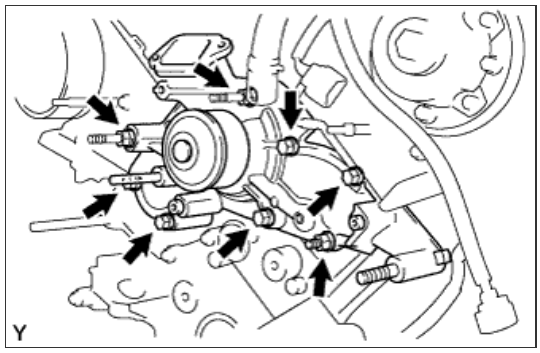
c. Remove the O-ring from the water inlet housing.



8. REMOVE WATER PUMP ASSEMBLY

a. Remove the 5 bolts, 2 stud bolts, nut, water pump and gasket.

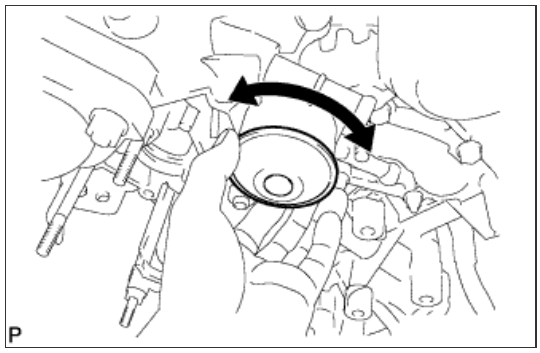
b. Remove the O-ring from the water by-pass pipe.



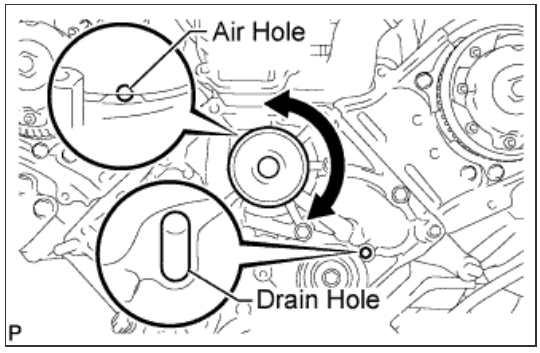
for Preparation Click here

1. INSPECT WATER PUMP ASSEMBLY

a. Turn the pulley and check that the water pump bearing moves smoothly and quietly.
If necessary, replace the water pump assembly.



b. Visually check the air hole and drain hole for coolant leakage.
If leakage is found, replace the water pump assembly and timing belt.



for Preparation Click here

1. INSTALL WATER PUMP ASSEMBLY

a. Apply soapy water to a new O-ring.

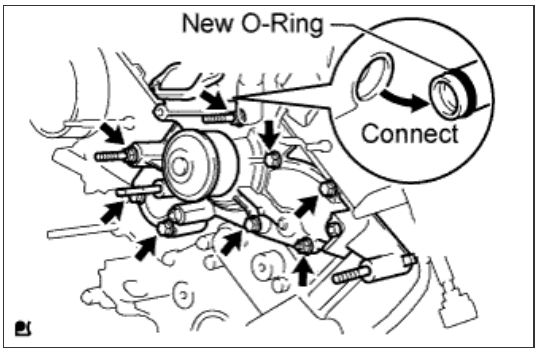
b. Install the O-ring to the water by-pass pipe end.

c. Install a new gasket to the cylinder block.

d. Connect the water pump to the water by-pass pipe end.

e. Temporarily install the water pump with the 5 bolts, 2 stud bolts and nut. Uniformly tighten the bolts, stud bolts and nut in several passes.

Torque:
for bolt:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for stud bolt, nut:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }



2. INSTALL WATER INLET HOUSING

a. Apply soapy water to a new O-ring and install it to the water inlet housing.

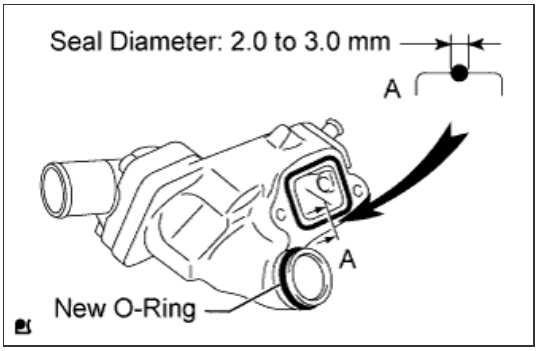
b. Apply seal packing in a continuous line to the places shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing 1282B, Three Bond 1282B or equivalent

Standard seal diameter:
2.0 to 3.0 mm (0.0787 to 0.118 in.)

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the water inlet housing within 3 minutes after applying seal packing.**

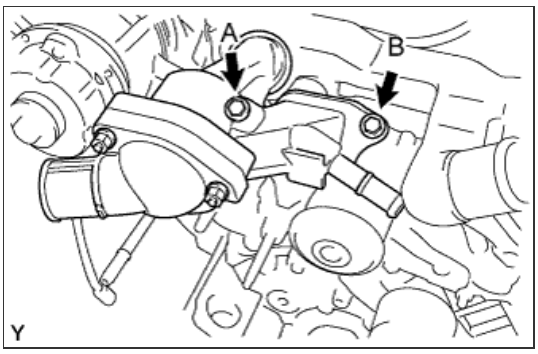


c. Temporarily install the water inlet housing with the 2 bolts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

Bolt Length:

Item	Length
Bolt A	77 mm (3.03 in.)
Bolt B	22 mm (0.866 in.)



3. INSTALL TIMING BELT

a. For the timing belt, refer to the following procedures (Click here).

4. ADD ENGINE COOLANT

a. Add engine coolant.

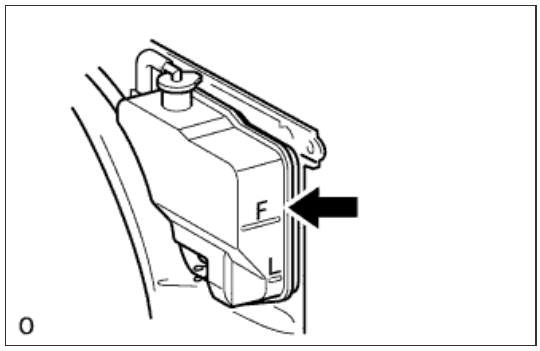
Standard Capacity:

Item		Specified Condition
w/o Transmission oil cooler	w/o Rear Heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)
	w/ Rear Heater	16.3 liters (17.2 US qts, 14.3 Imp. qts)
w/ Transmission oil cooler	w/o Rear Heater	14.1 liters (14.9 US qts, 12.4 Imp. qts)
	w/ Rear Heater	16.9 liters (17.9 US qts, 14.9 Imp. qts)

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.



c. Install the radiator reservoir cap.

d. Press the inlet and outlet radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.

NOTICE:

Switch off the A/C.

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

h. Press the inlet and outlet radiator hoses several times by hand to bleed air.

CAUTION:

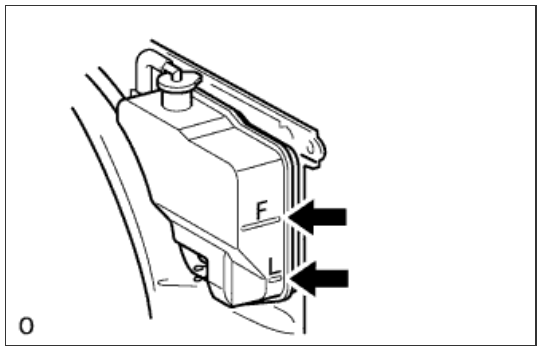
- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the cooling fan.**

i. Stop the engine, and wait until the engine coolant cools down to the ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

j. Check that the coolant level is between the F and L lines. If the coolant level is below the L line, repeat all of the procedures above. If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.



5. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

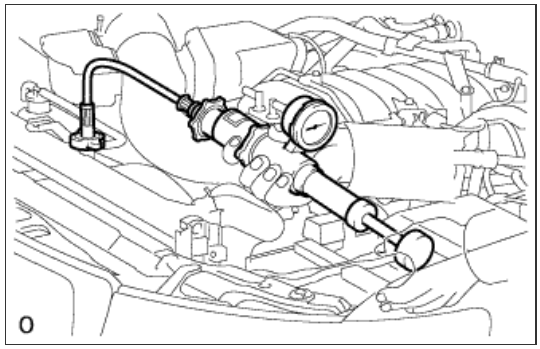
When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

6. INSPECT FOR COOLANT LEAK

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

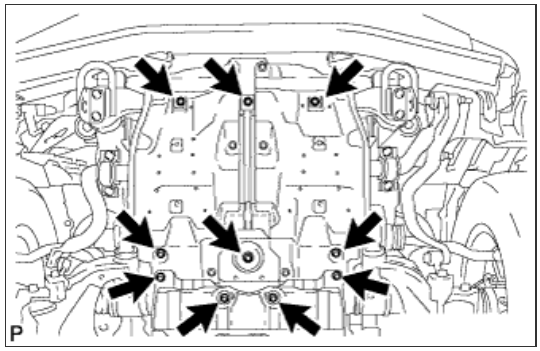
c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



7. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the No. 1 engine under cover with the 10 bolts.

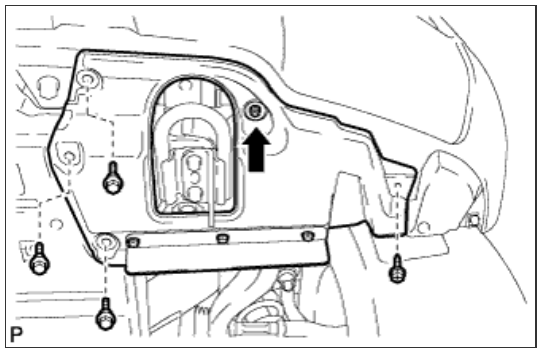
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



8. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



9. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

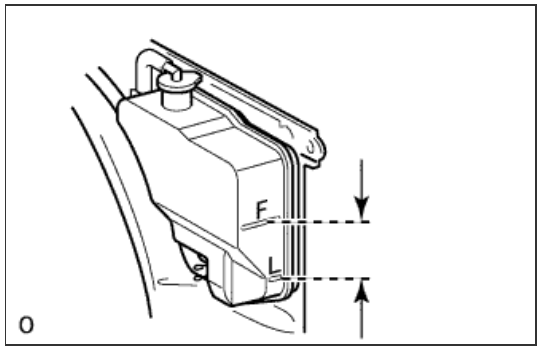
10. INSPECT ENGINE COOLANT LEVEL

a. Check that the engine coolant level is between the L and F lines when the engine is cold.
If the engine coolant is low, check for leaks and add "TOYOTA Super Long Life Coolant" or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite and non-borate coolant with long-life hybrid organic acid technology to the F line.

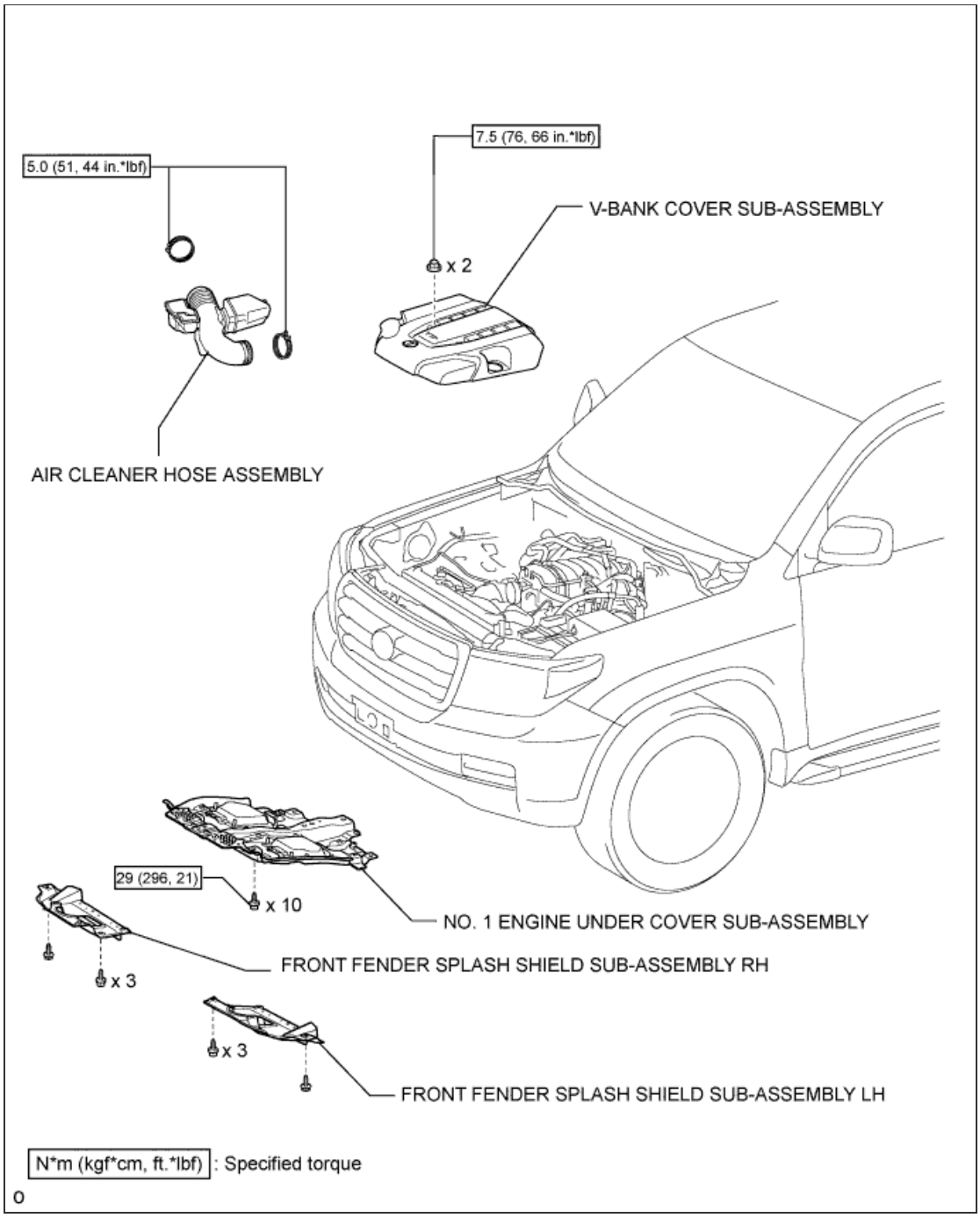
NOTICE:

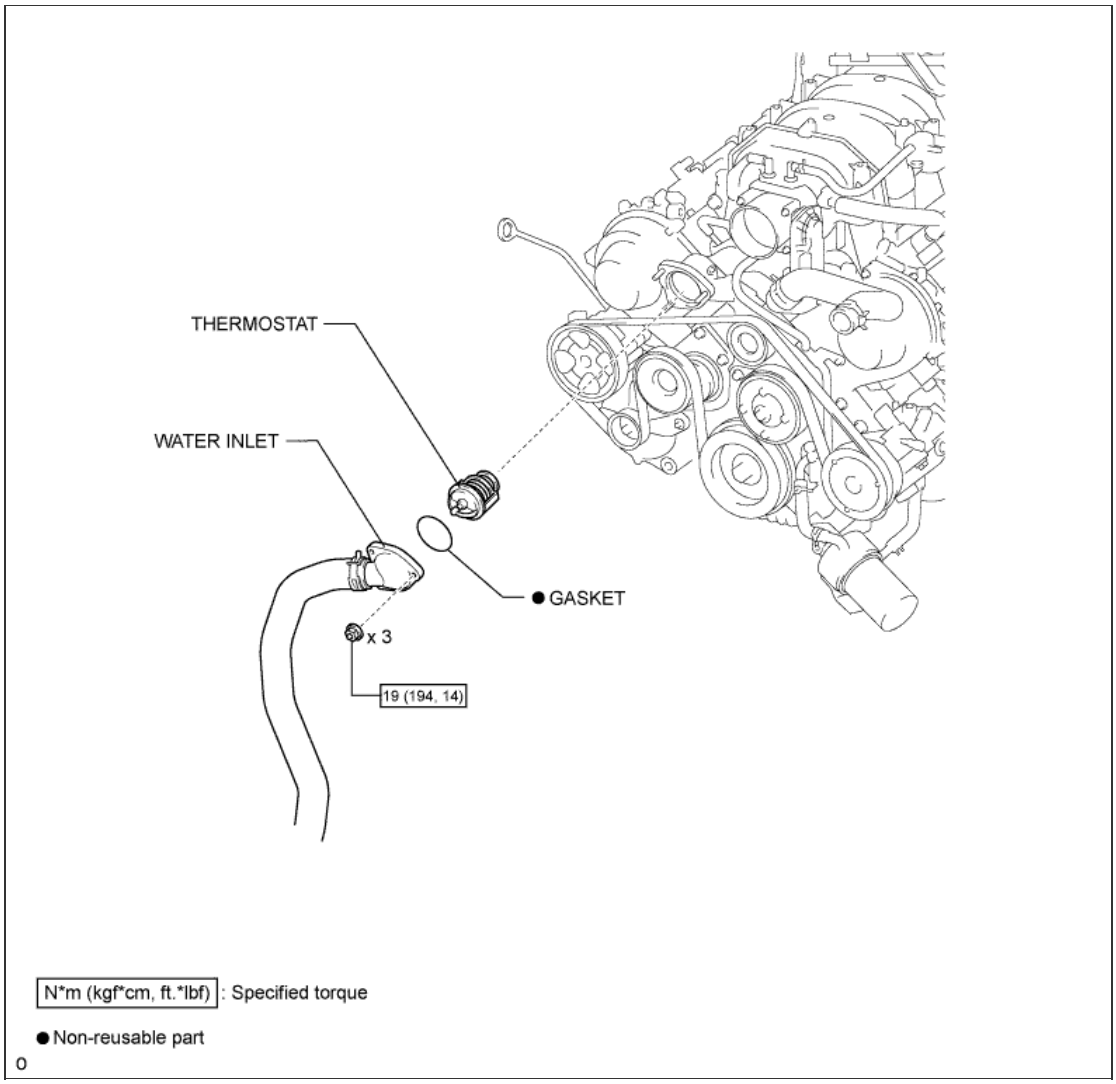
Do not substitute plain water for engine coolant.

b. Remove the radiator cap, and check that the coolant level is up to the radiator filler hole.



for Preparation [Click here]





N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

o

for Preparation Click here

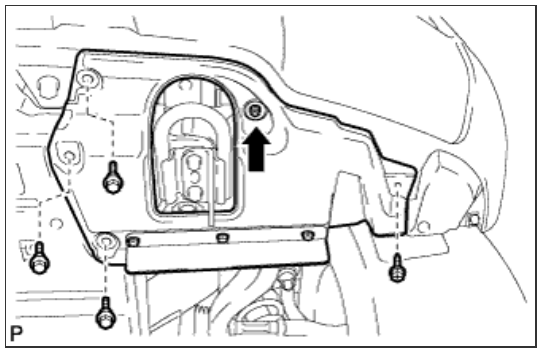
HINT:

If the thermostat is not installed, cooling efficiency decreases. Do not remove the thermostat as this will cause the engine to overheat easily.

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



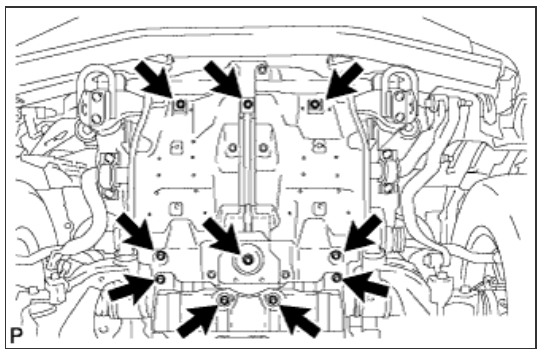
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

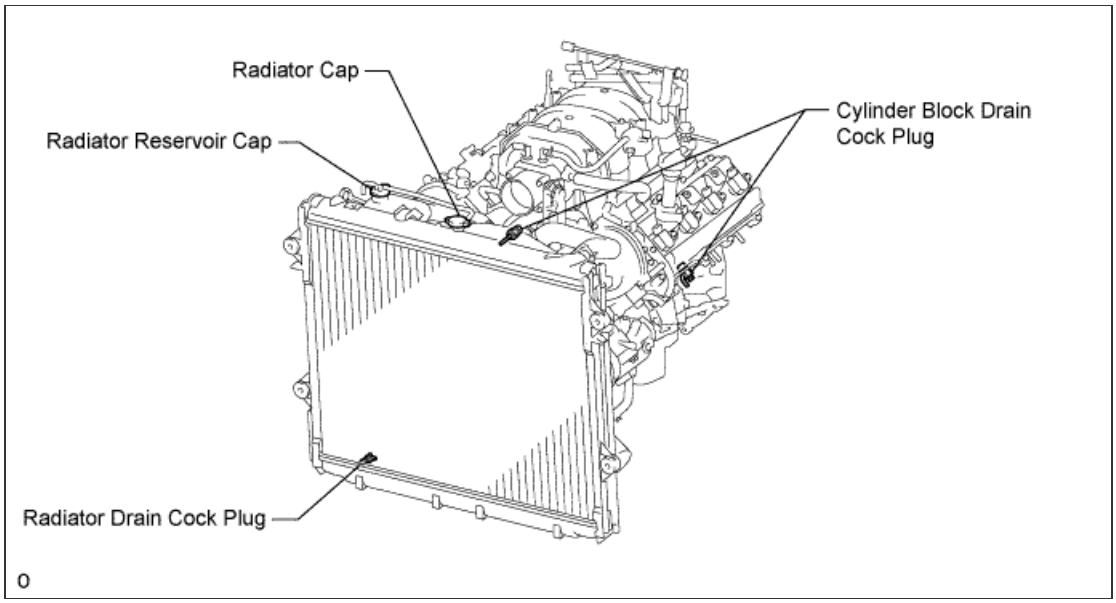
a. Remove the 10 bolts and No. 1 engine under cover.



4. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.



a. Loosen the radiator drain cock plug.

b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

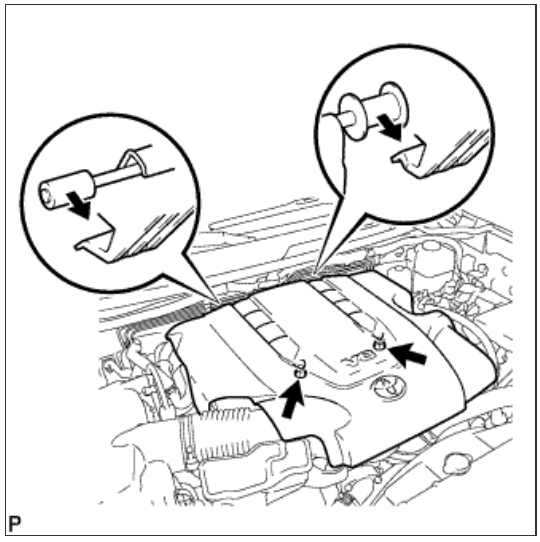
d. Tighten the 2 cylinder block drain cock plugs.

Torque:
13 N*m{ 130 kgf*cm , 9 ft.*lbf }

e. Tighten the radiator drain cock plug by hand.

5. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Remove the 2 nuts and V-bank cover.

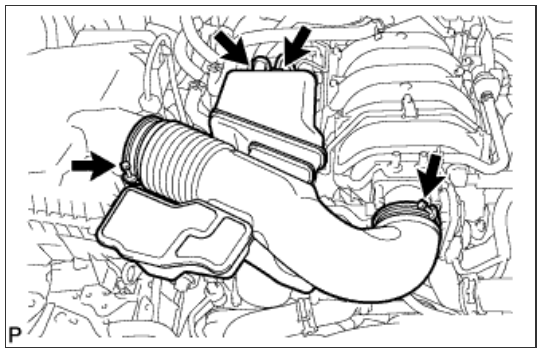


6. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum transmitting hose and No. 2 ventilation hose.

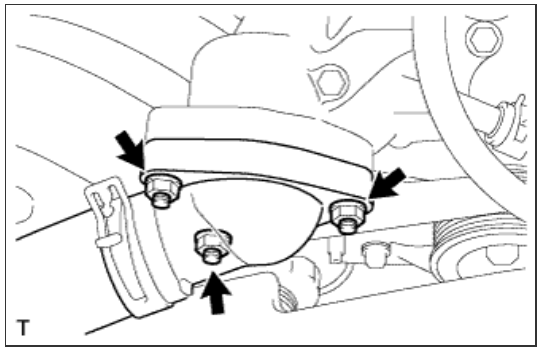
b. Loosen the 2 hose clamps.

c. Remove the air cleaner hose.



7. DISCONNECT WATER INLET

a. Remove the 3 nuts, and disconnect the water inlet from the water inlet housing.



8. REMOVE THERMOSTAT

a. Remove the thermostat.

b. Remove the gasket from the thermostat.

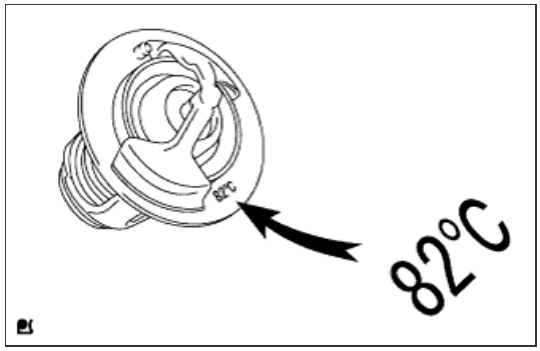
for Preparation Click here

1. INSPECT THERMOSTAT

HINT:

The valve opening temperature is inscribed on the thermostat.

a. Check that the valve is fully closed when the thermostat is at a low temperature (below 77 C (171 .
If not fully closed, replace the thermostat.

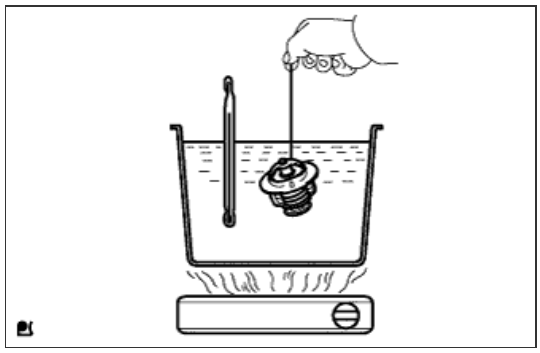


b. Immerse the thermostat in water, then gradually heat the water.

c. Check the valve opening temperature of the thermostat.

Standard valve opening temperature:
80 to 84°C (176 to 183°F)

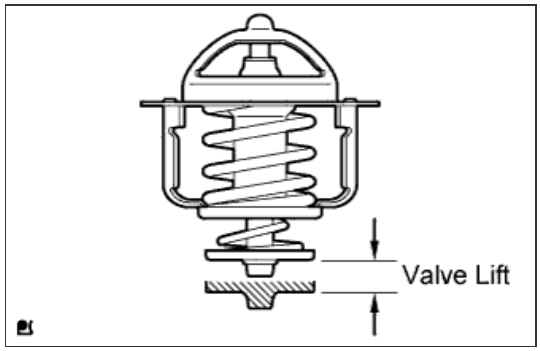
If the valve opening temperature is not as specified, replace the thermostat.



d. Check the valve lift.

Standard valve lift:
10.0 to 11.3 mm (0.394 to 0.445 in.) or more at 95°C (203°F)

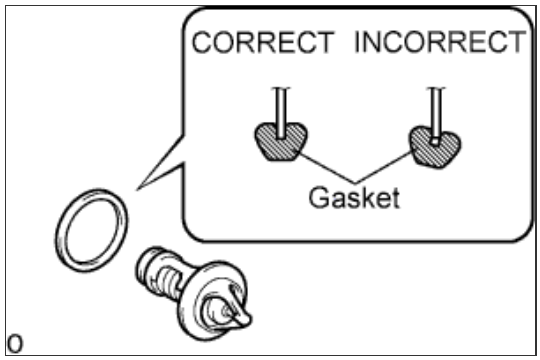
If the valve lift is not as specified, replace the thermostat.



for Preparation Click here

1. INSTALL THERMOSTAT

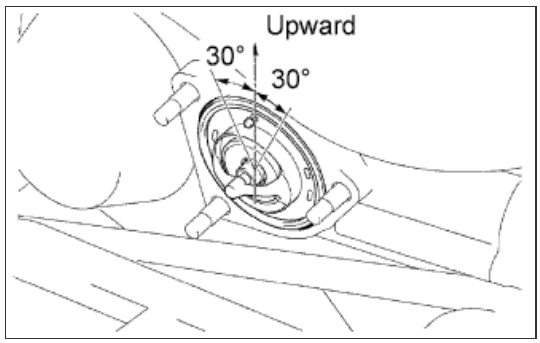
a. Install a new gasket to the thermostat.



b. Insert the thermostat into the water inlet housing with the jiggle valve facing straight upward.

HINT:

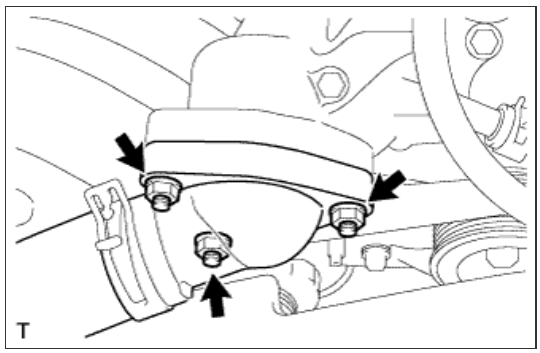
The jiggle valve may be set within 30° of either side of the prescribed position.



2. CONNECT WATER INLET

a. Connect the water inlet with the 3 nuts.

Torque:
19 N*m{ 194 kgf*cm , 14 ft.*lbf }



3. INSTALL AIR CLEANER HOSE ASSEMBLY

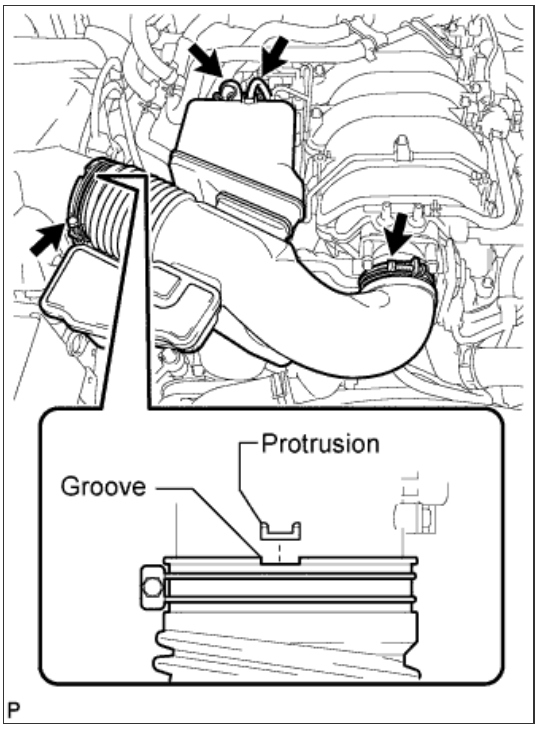
a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum transmitting hose.

d. Connect the No. 2 ventilation hose.

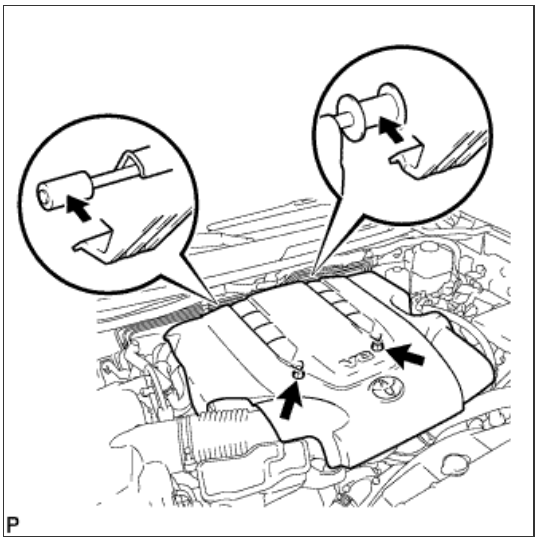


4. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket.

b. Install the V-bank cover with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



5. ADD ENGINE COOLANT

a. Add engine coolant.

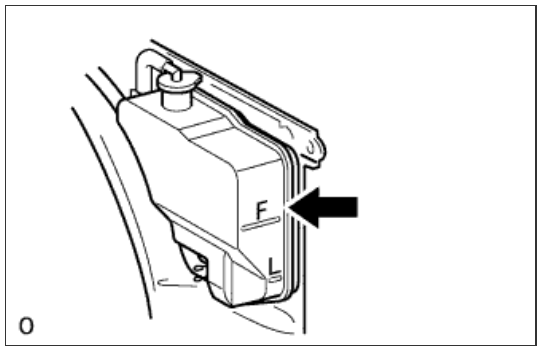
Standard Capacity:

Item		Specified Condition
w/o Transmission oil cooler	w/o Rear Heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)
	w/ Rear Heater	16.3 liters (17.2 US qts, 14.3 Imp. qts)
w/ Transmission oil cooler	w/o Rear Heater	14.1 liters (14.9 US qts, 12.4 Imp. qts)
	w/ Rear Heater	16.9 liters (17.9 US qts, 14.9 Imp. qts)

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.



c. Install the radiator reservoir cap.

d. Press the inlet and outlet radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.

NOTICE:

Switch off the A/C.

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1 stop the engine, 2 wait until the coolant has cooled down, and 3 add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

h. Press the inlet and outlet radiator hoses several times by hand to bleed air.

CAUTION:

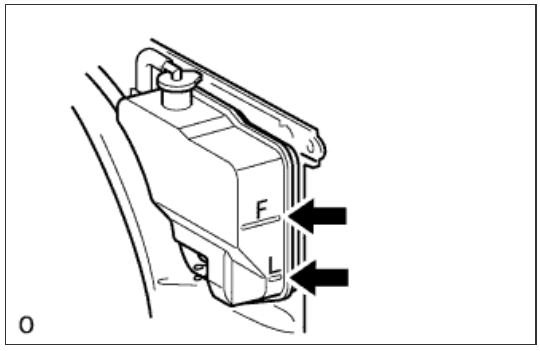
- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the cooling fan.**

i. Stop the engine, and wait until the engine coolant cools down to the ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

j. Check that the coolant level is between the F and L lines. If the coolant level is below the L line, repeat all of the procedures above. If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.



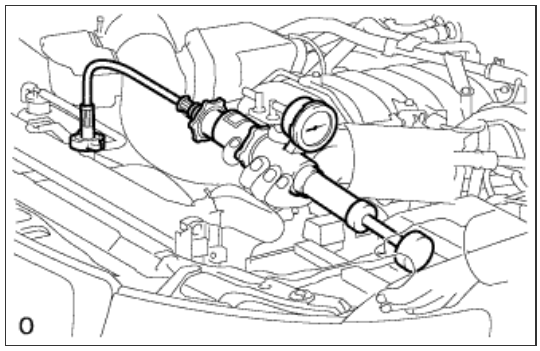
6. INSPECT FOR COOLANT LEAK

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123

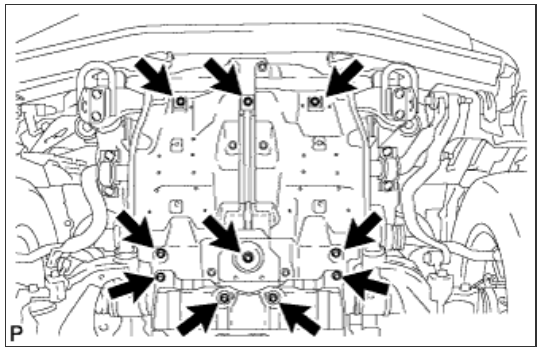
kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



7. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the No. 1 engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

9. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

HINT:

Use the same procedures described for the LH side.

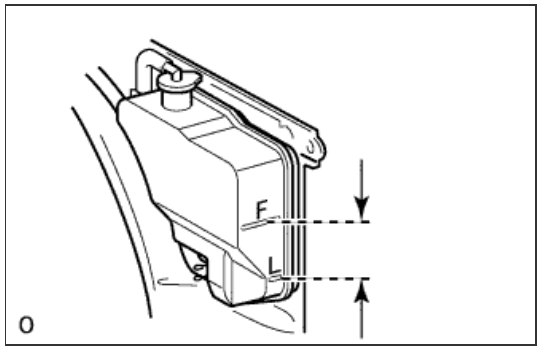
10. INSPECT ENGINE COOLANT LEVEL

a. Check that the engine coolant level is between the L and F lines when the engine is cold.
If the engine coolant is low, check for leaks and add "TOYOTA Super Long Life Coolant" or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite and non-borate coolant with long-life hybrid organic acid technology to the F line.

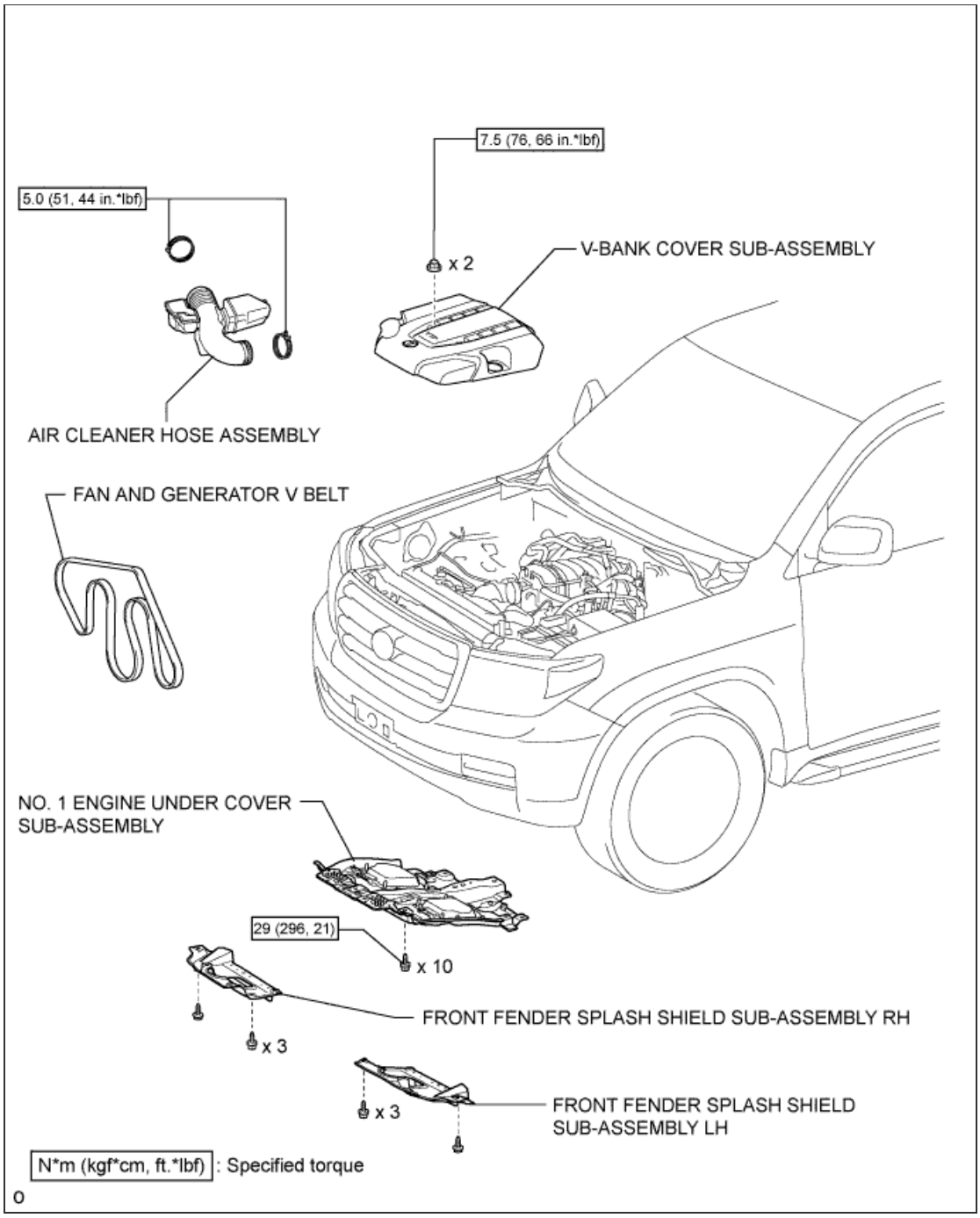
NOTICE:

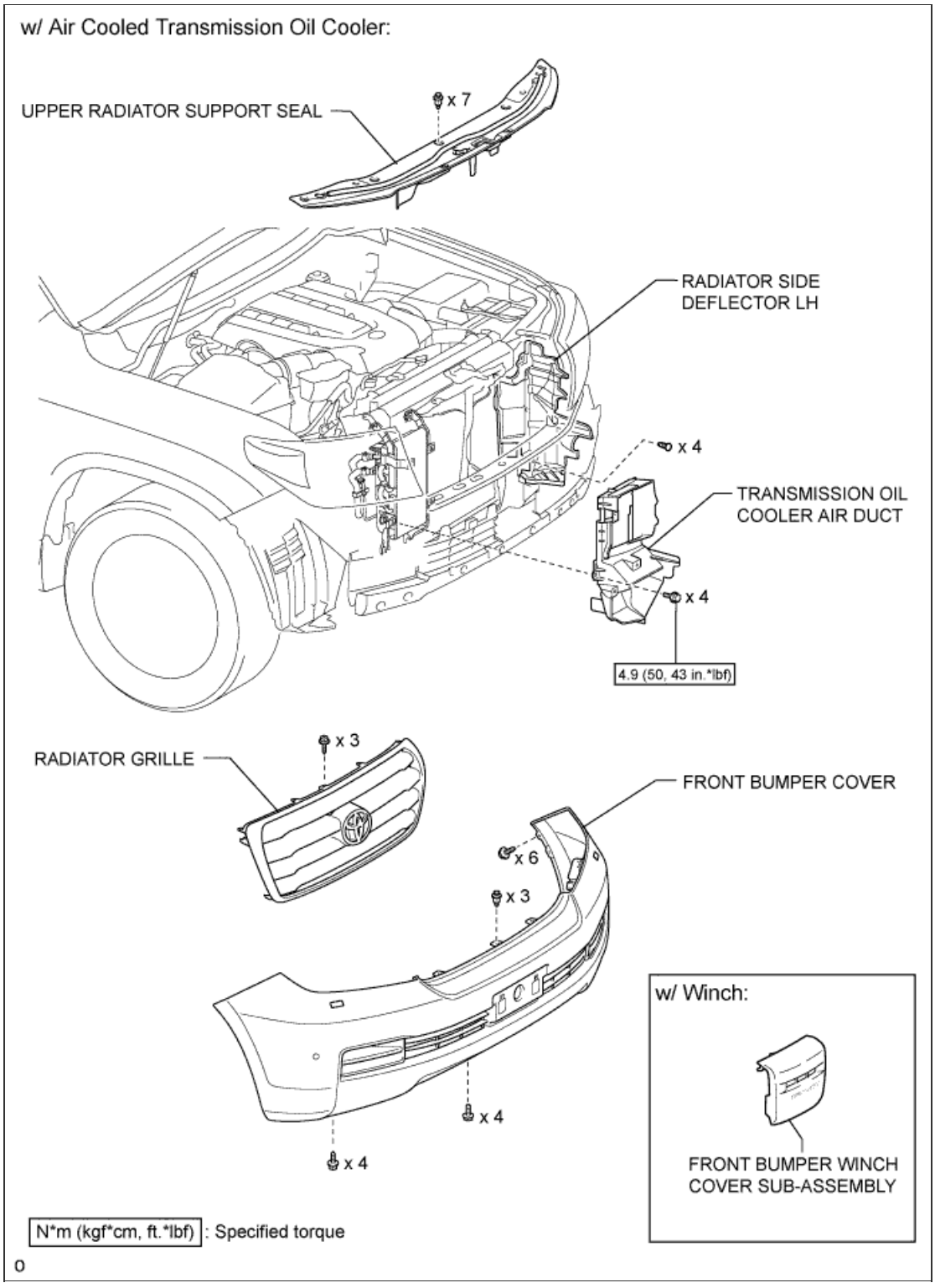
Do not substitute plain water for engine coolant.

b. Remove the radiator cap, and check that the coolant level is up to the radiator filler hole.



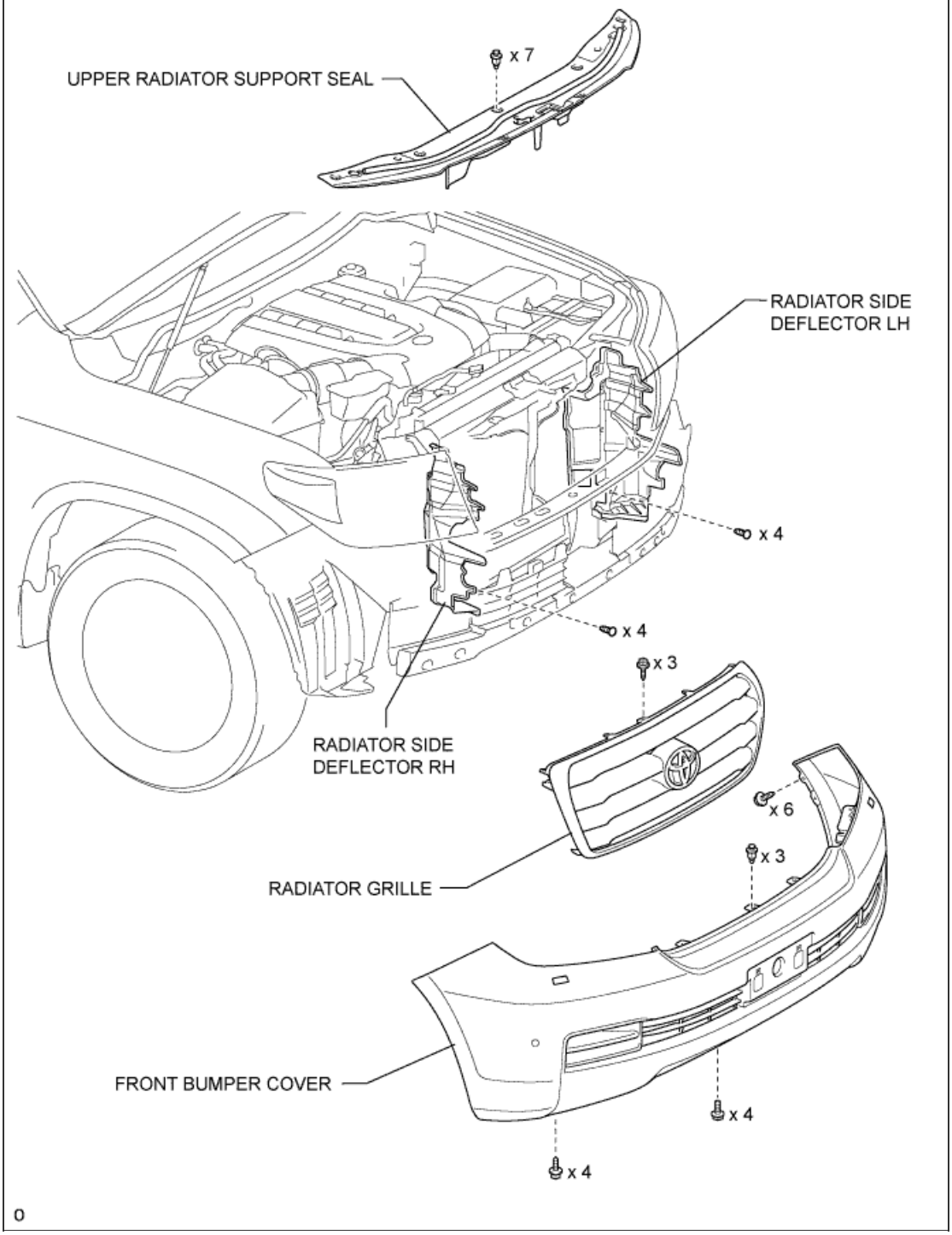
for Preparation [Click here]



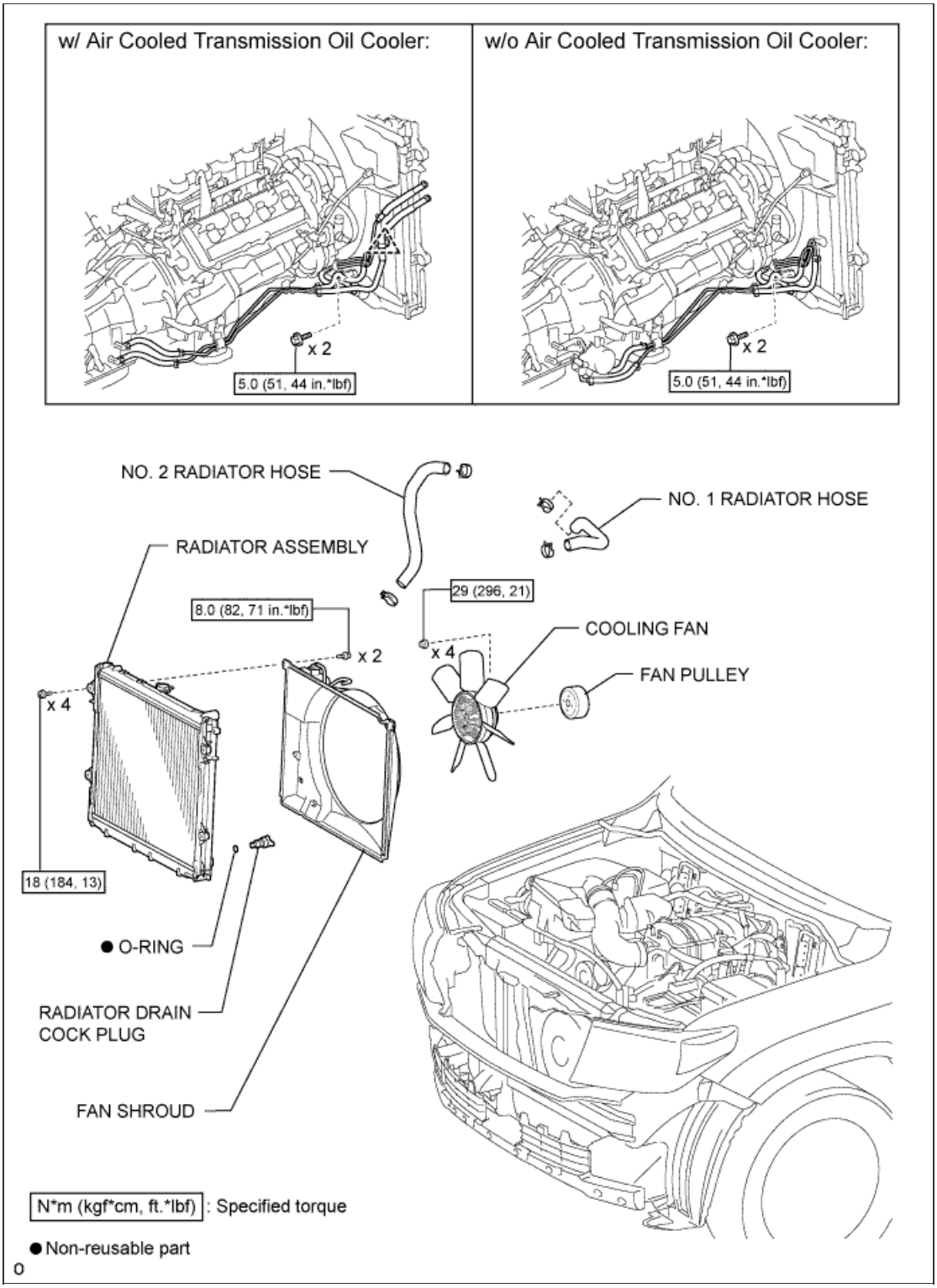

w/ Air Cooled Transmission Oil Cooler:
UPPER RADIATOR SUPPORT SEAL
x 7
RADIATOR SIDE DEFLECTOR LH
x 4
TRANSMISSION OIL COOLER AIR DUCT
x 4
4.9 (50, 43 in.*lbf)
RADIATOR GRILLE
x 3
FRONT BUMPER COVER
x 6
x 3
x 4
x 4
w/ Winch:
FRONT BUMPER WINCH COVER SUB-ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque

o

w/o Air Cooled Transmission Oil Cooler:



o


w/ Air Cooled Transmission Oil Cooler:
x 2
5.0 (51, 44 in.*lbf)
w/o Air Cooled Transmission Oil Cooler:
x 2
5.0 (51, 44 in.*lbf)
NO. 2 RADIATOR HOSE
NO. 1 RADIATOR HOSE
RADIATOR ASSEMBLY
29 (296, 21)
8.0 (82, 71 in.*lbf)
COOLING FAN
x 2
x 4
x 4
FAN PULLEY
18 (184, 13)
● O-RING
RADIATOR DRAIN COCK PLUG
FAN SHROUD
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part

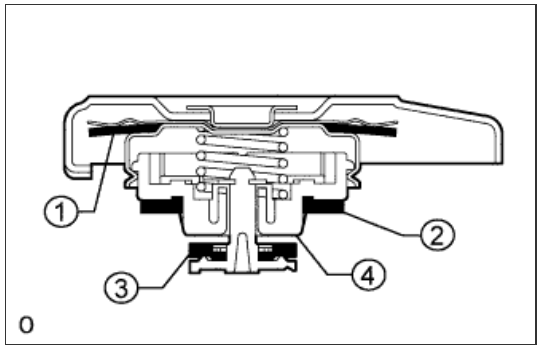
for Preparation Click here

1. INSPECT RADIATOR CAP SUB-ASSEMBLY

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Visually check the radiator cap.

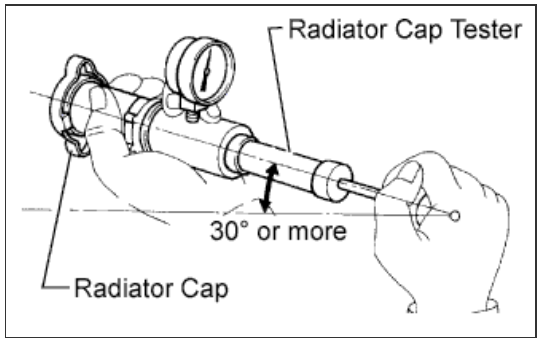


i. If there are water stains or foreign matter on rubber packing 1, 2 or 3, clean it with water and finger scouring.

ii. Check that rubber packing 1, 2 or 3 is not deformed, cracked or swollen.

iii. Check that rubber packing 3 and 4 are not stuck together.

b. Measure the valve opening pressure.



i. Apply engine coolant to rubber packing 2 and 3 before using a radiator cap tester.

ii. When using the cap tester, tilt it more than 30°.

iii. Pump the cap tester several times, and check the maximum pressure.

Pumping speed:
1 pump per second

HINT:

Even if the cap cannot maintain the maximum pressure, it is not a defect.

Standard udgment Criterion:

Item	Specified Condition
Standard (for brand-new cap)	93 to 123 kPa (1.0 to 1.3 kgf/cm^2, 13.5 to 18 psi)
Minimum (after using cap)	79 kPa (0.8 kgf/cm^2, 11.4 psi)

If the maximum pressure is less than the minimum standard value, replace the radiator cap sub-assembly.

2. INSPECT FINS FOR BLOCKAGE

a. Check that the radiator and condenser are not blocked with leaves, dirt, or insects. Clean the hose connections.
If the fins are blocked, wash them with water or a steam cleaner.

NOTICE:

- **If the distance between the steam cleaner and core is too close, the fins may be damaged.**
- **Keep the following in ection distance.**

Standard In ection Distance:

In ection Distance	In ection Pressure

300 mm (11.8 in.)	2942 to 4903 kPa (30.0 to 50.0 kgf/cm^2, 427 to 711 psi)
500 mm (19.7 in.)	4903 to 7845 kPa (50.0 to 80.0 kgf/cm^2, 711 to 1138 psi)

- **If the fins are bent, straighten them with a screwdriver or pliers.**
- **Never apply water directly onto the electric components.**

b. Dry the fins with compressed air.

for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

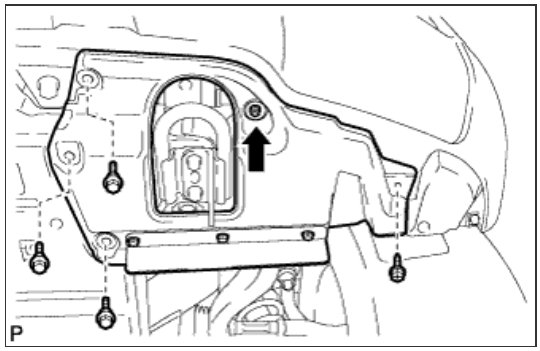
HINT:

Use the same procedures described for the LH side.

2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

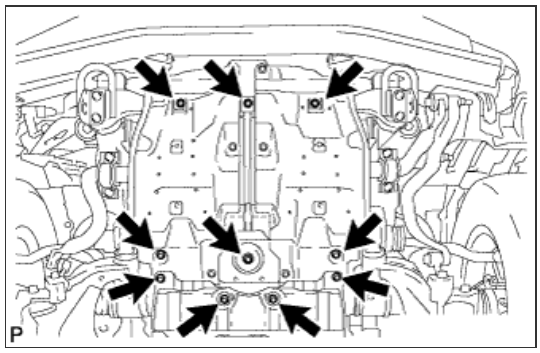
a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

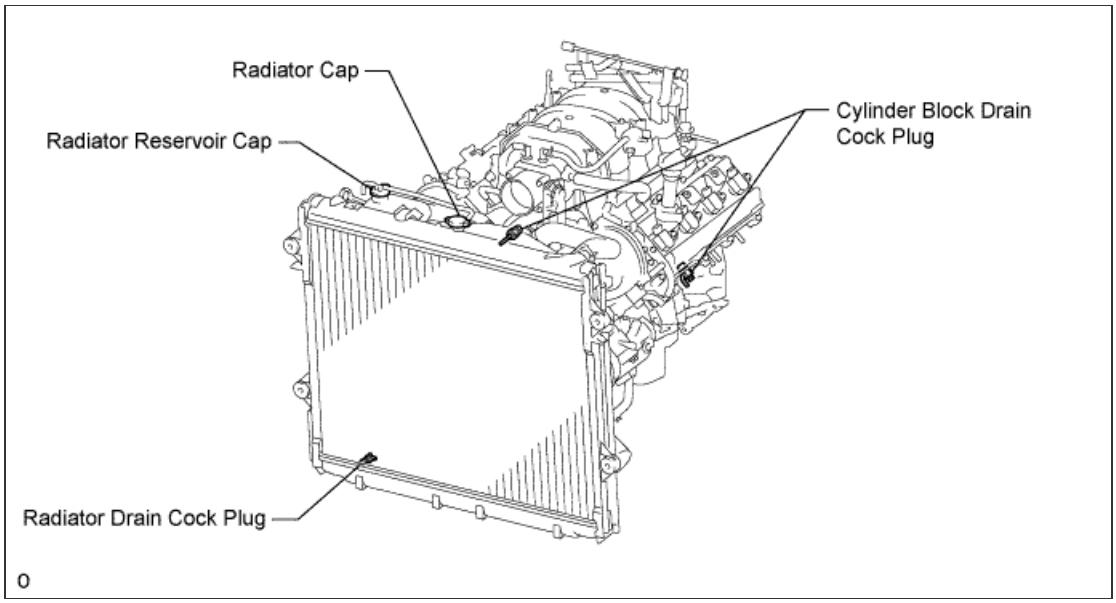
a. Remove the 10 bolts and No. 1 engine under cover.



4. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.



a. Loosen the radiator drain cock plug.

b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

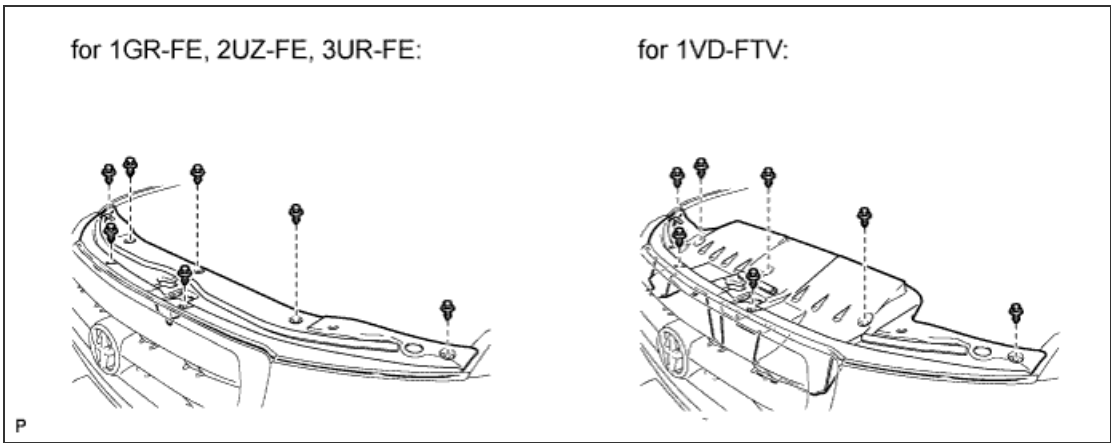
d. Tighten the 2 cylinder block drain cock plugs.

Torque:
13 N*m{ 130 kgf*cm , 9 ft.*lbf }

e. Tighten the radiator drain cock plug by hand.

5. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and radiator support seal.



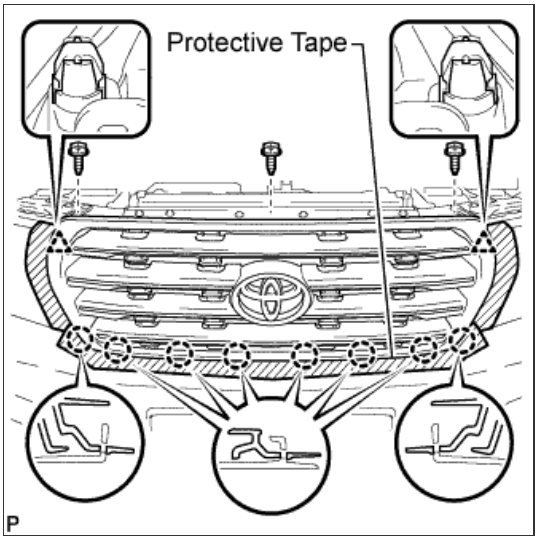
6. REMOVE FRONT BUMPER WINCH COVER SUB-ASSEMBLY (w/ Winch)

7. REMOVE RADIATOR GRILLE

a. Put protective tape around the radiator grille.

b. Remove the 3 screws.

c. Detach the 2 clips and 8 claws, and remove the radiator grille.



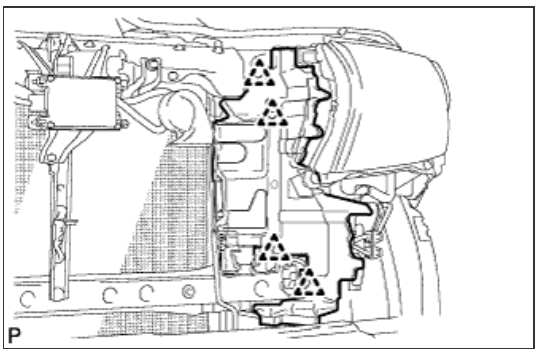
8. REMOVE FRONT BUMPER COVER

a. for Standard Type:
Refer to the following procedures (Click here).

b. w/ Winch Type:
Refer to the following procedures (Click here).

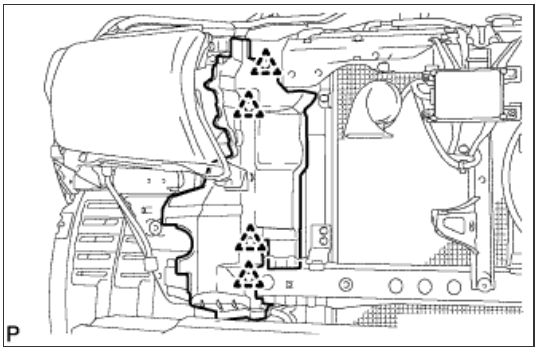
9. DISCONNECT RADIATOR SIDE DEFLECTOR LH

a. Using a clip remover, remove the 4 clips and disconnect the side deflector.



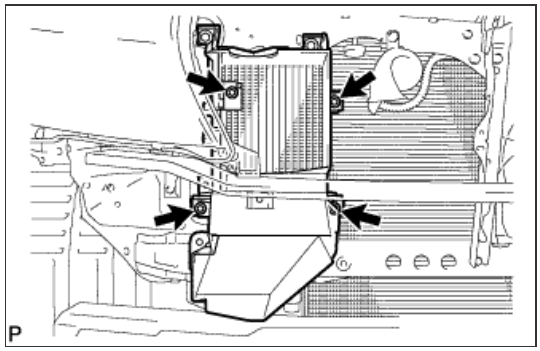
10. DISCONNECT RADIATOR SIDE DEFLECTOR RH (w/o Air Cooled Transmission Oil Cooler)

a. Using a clip remover, remove the 4 clips and disconnect the side deflector.



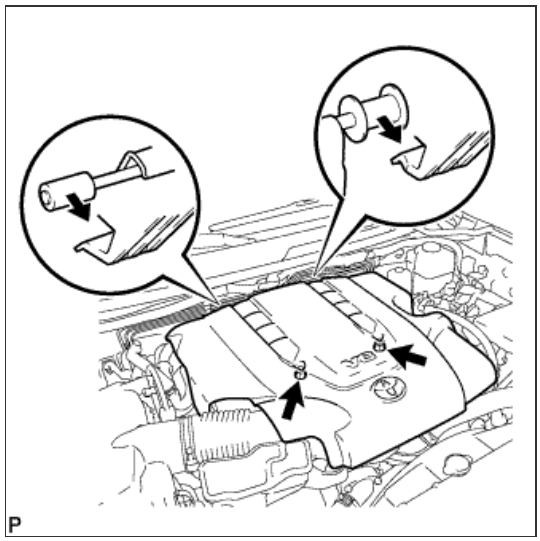
11. REMOVE TRANSMISSION OIL COOLER AIR DUCT (w/ Air Cooled Transmission Oil Cooler)

a. Remove the 4 bolts and oil cooler air duct.



12. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Remove the 2 nuts and V-bank cover.

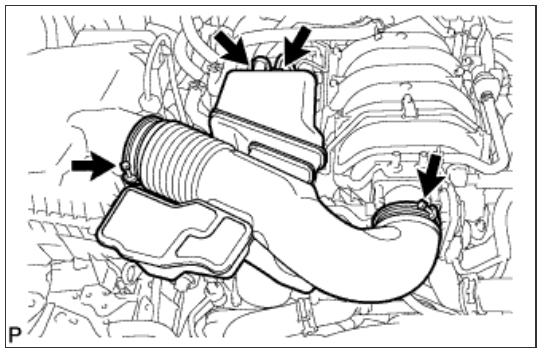


13. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum transmitting hose and No. 2 ventilation hose.

b. Loosen the 2 hose clamps.

c. Remove the air cleaner hose.

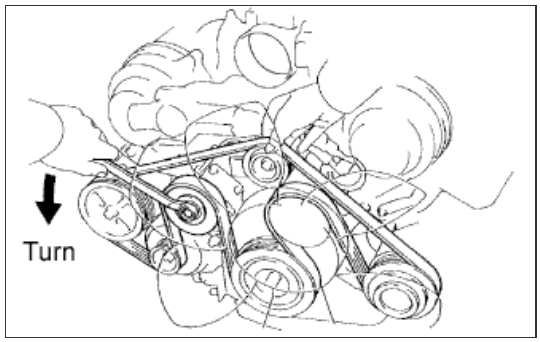


14. REMOVE FAN & GENERATOR V BELT

a. Loosen the belt tension by turning the belt tensioner counterclockwise, and then remove the fan and generator V belt.

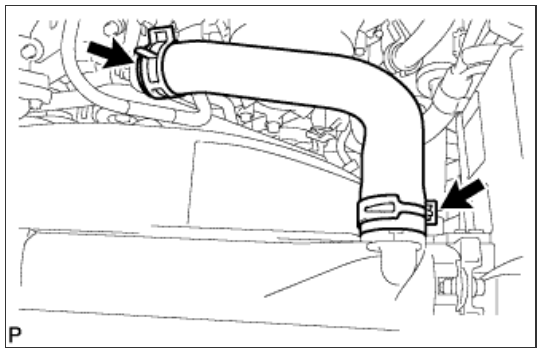
HINT:

The pulley bolt for the belt tensioner has left-hand thread.



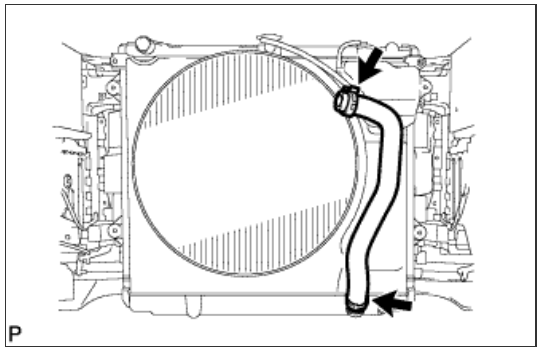
15. REMOVE NO. 1 RADIATOR HOSE

a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to remove the radiator hose.



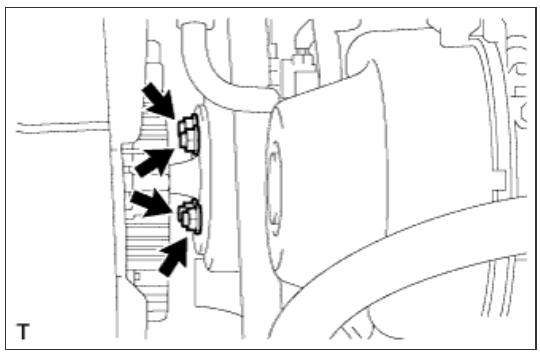
16. REMOVE NO. 2 RADIATOR HOSE

a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to remove the radiator hose.



17. REMOVE FAN SHROUD

a. Loosen the 4 nuts holding the cooling fan.



b. Disconnect the reservoir hose from the upper side of the radiator tank.

c. w/ Air Cooled Transmission Oil Cooler:

Detach the claw to open the flexible hose clamp.

d. Remove the 2 bolts and disconnect the oil cooler tube from the fan shroud.

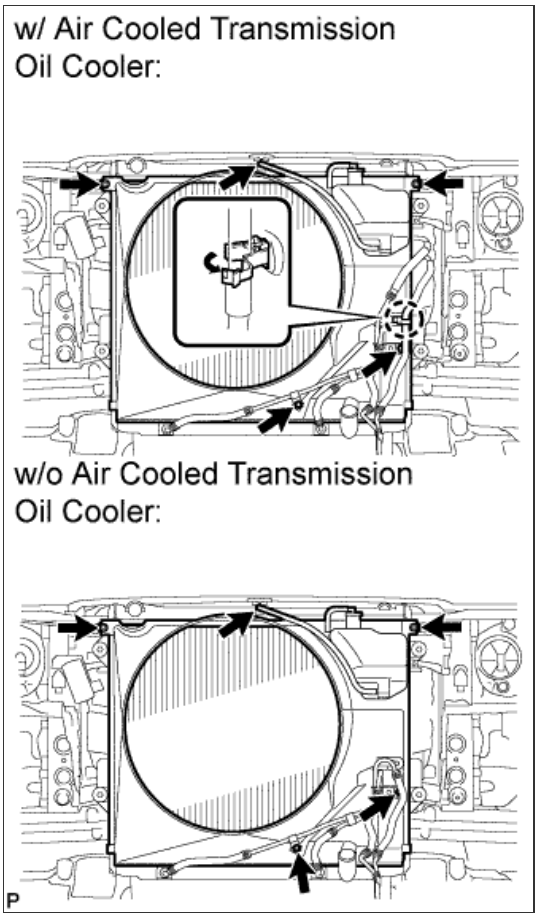
e. Remove the 2 bolts holding the fan shroud.

f. Remove the 4 nuts of the cooling fan, and then remove the shroud together with the cooling fan.

NOTICE:

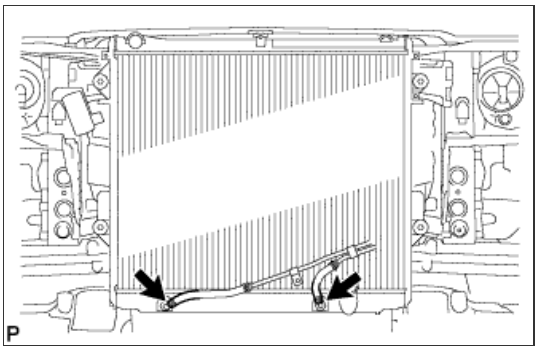
Be careful not to damage the radiator core.

g. Remove the fan pulley from the water pump.

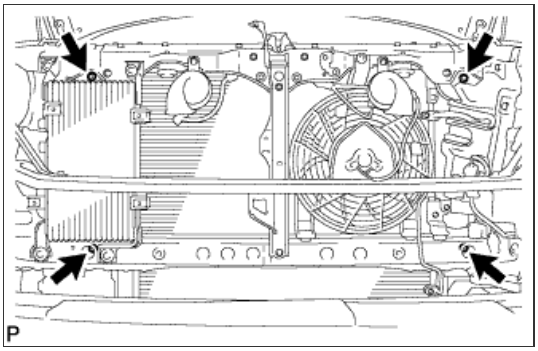


18. REMOVE RADIATOR ASSEMBLY

a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to disconnect the 2 oil cooler hoses.



b. Remove the 4 bolts and radiator.



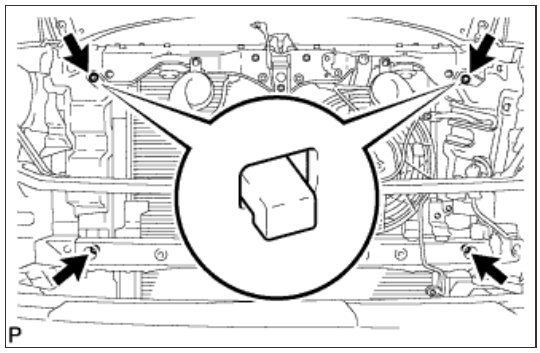
for Preparation Click here

1. INSTALL RADIATOR ASSEMBLY

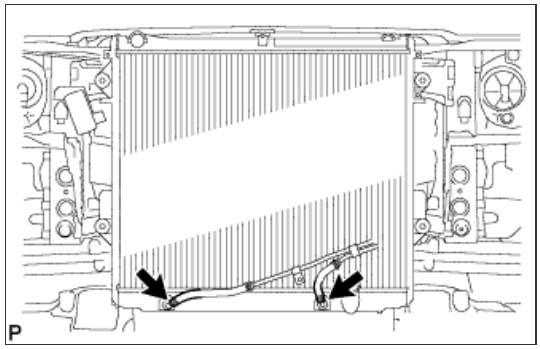
a. Set the radiator bracket hooks to the radiator support holes.

b. Install the radiator with the 4 bolts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }



c. Connect the 2 oil cooler hoses.



2. INSTALL FAN SHROUD

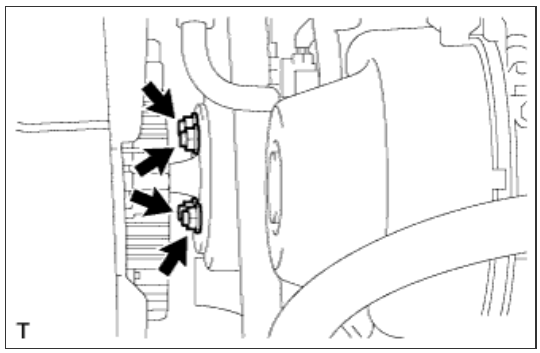
a. Install the fan pulley to the water pump.

b. Place the shroud together with the cooling fan between the radiator and engine.

NOTICE:

Be careful not to damage the radiator core.

c. Temporarily install the cooling fan to the water pump with the 4 nuts. Tighten the nuts as much as possible by hand.



d. Attach the claws of the shroud to the radiator as shown in the illustration.

e. Install the shroud with the 2 bolts.

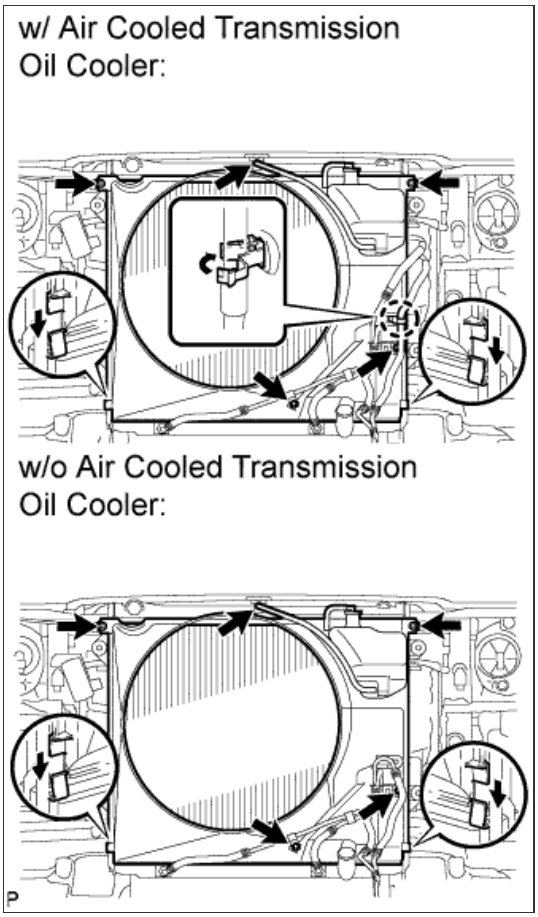
Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

f. Connect the oil cooler tube to the fan shroud with the 2 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

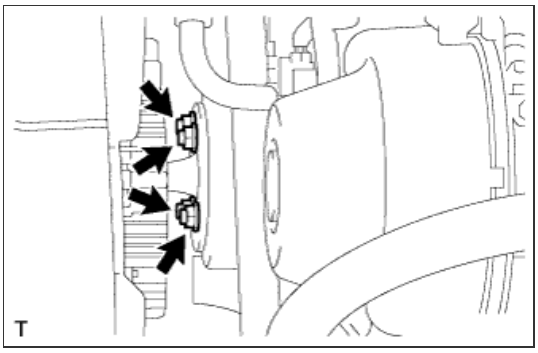
g. w/ Air Cooled Transmission Oil Cooler:
Pass the hose through the flexible hose clamp and close the clamp as shown in the illustration.

h. Connect the reservoir hose to the upper side of the radiator tank.



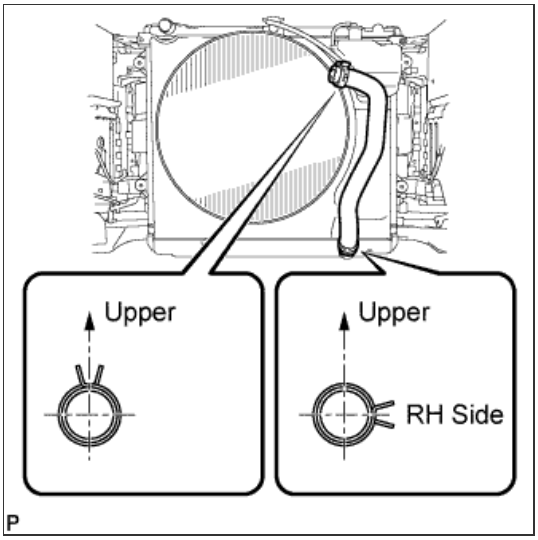
i. Tighten the 4 nuts of the cooling fan.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



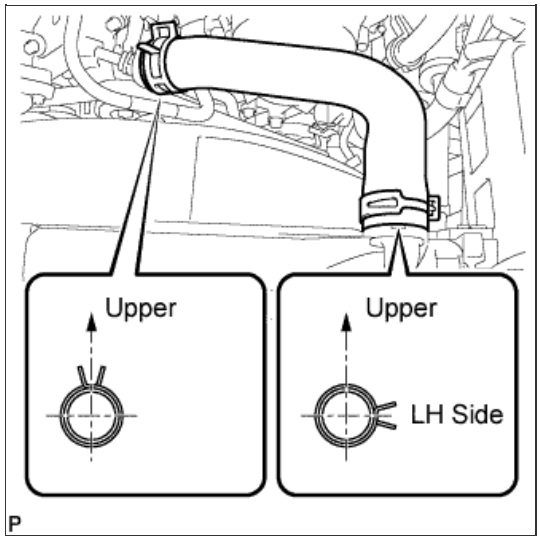
3. INSTALL NO. 2 RADIATOR HOSE

a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to install the radiator hose.



4. INSTALL NO. 1 RADIATOR HOSE

a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to install the radiator hose.

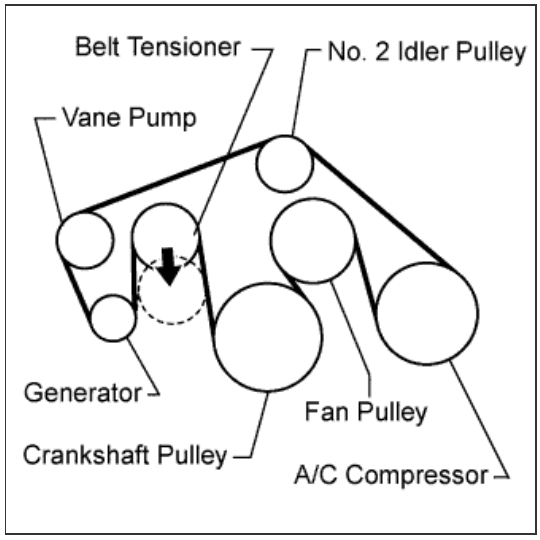


5. INSTALL FAN & GENERATOR V BELT

a. Set the V belt onto every part except the belt tensioner, as shown in the illustration.

b. Loosen the V belt by turning the belt tensioner counterclockwise.

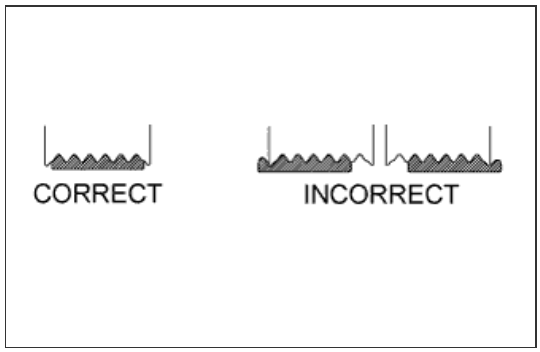
c. Set the V belt to the belt tensioner.



d. Check that the belt fits properly in the ribbed grooves.

HINT:

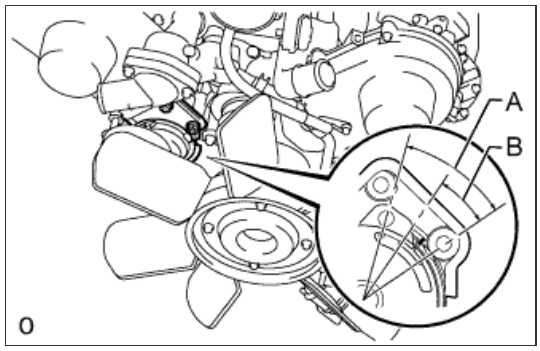
Make sure to check by hand that the belt has not slipped out of the grooves on the bottom of the pulley.



e. Check that the arrow on the belt tensioner is within area "A".
If the arrow is outside area "A", replace the fan and generator V belt.

HINT:

When a new belt is installed, the arrow should be within area "B". If not, the fan and generator V belt is not installed correctly.



6. INSTALL AIR CLEANER HOSE ASSEMBLY

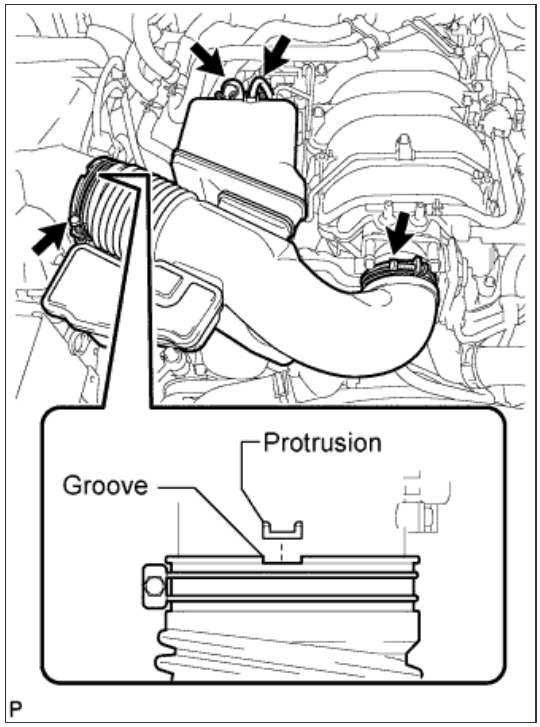
a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum transmitting hose.

d. Connect the No. 2 ventilation hose.



7. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item		Specified Condition
w/o Transmission oil cooler	w/o Rear Heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)
	w/ Rear Heater	16.3 liters (17.2 US qts, 14.3 Imp. qts)
w/ Transmission oil cooler	w/o Rear Heater	14.1 liters (14.9 US qts, 12.4 Imp. qts)
	w/ Rear Heater	16.9 liters (17.9 US qts, 14.9 Imp. qts)

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

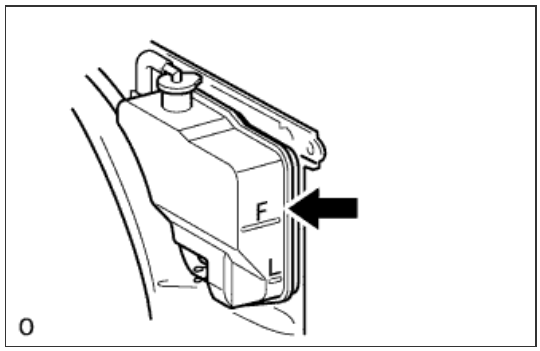
b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the radiator reservoir cap.

d. Press the inlet and outlet radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.



NOTICE:

Switch off the A/C.

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

h. Press the inlet and outlet radiator hoses several times by hand to bleed air.

CAUTION:

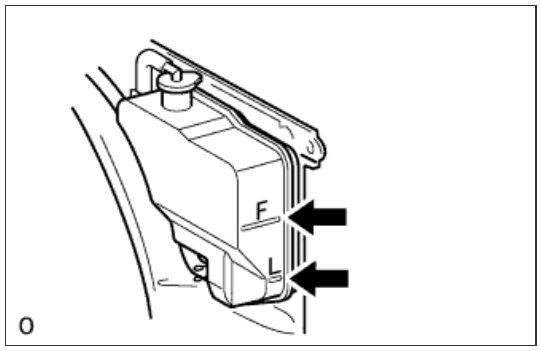
- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the cooling fan.**

i. Stop the engine, and wait until the engine coolant cools down to the ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

j. Check that the coolant level is between the F and L lines. If the coolant level is below the L line, repeat all of the procedures above. If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.

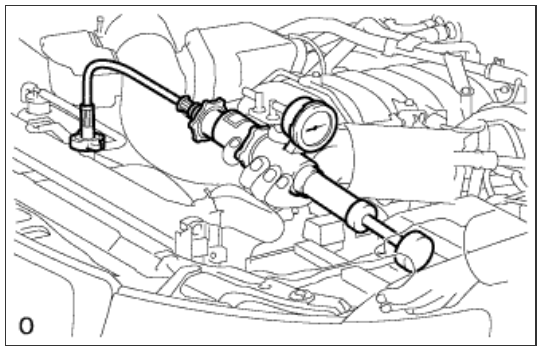


8. INSPECT FOR COOLANT LEAK

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

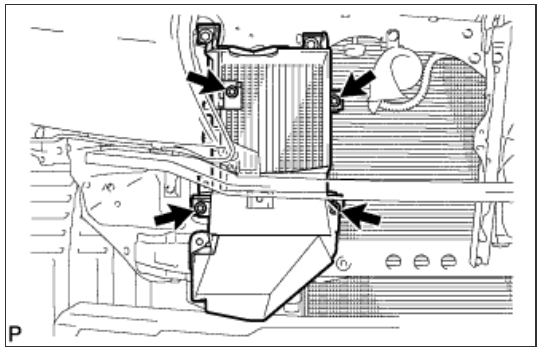
c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



9. INSTALL TRANSMISSION OIL COOLER AIR DUCT (w/ Air Cooled Transmission Oil Cooler)

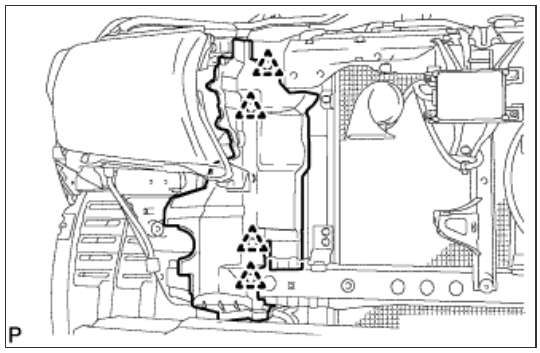
a. Install the oil cooler air duct with the 4 bolts.

Torque:
4.9 N*m{ 50 kgf*cm , 43 in.*lbf }



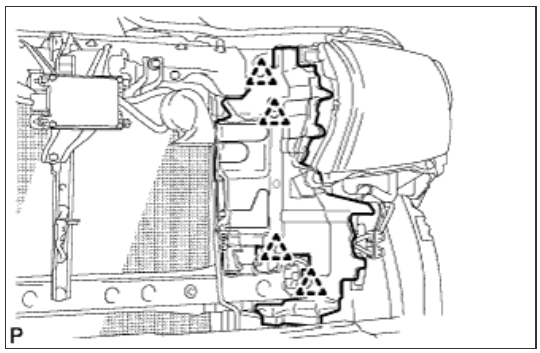
10. CONNECT RADIATOR SIDE DEFLECTOR RH (w/o Air Cooled Transmission Oil Cooler)

a. Connect the deflector with the 4 clips.



11. CONNECT RADIATOR SIDE DEFLECTOR LH

a. Connect the deflector with the 4 clips.



12. INSTALL FRONT BUMPER COVER

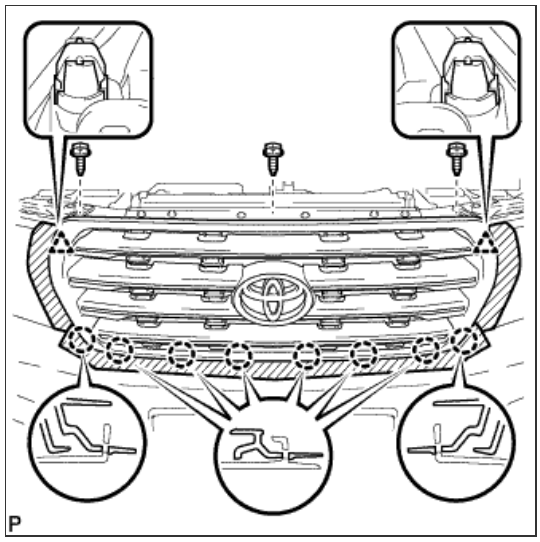
a. for Standard Type:
Refer to the following procedures (Click here).

b. w/ Winch Type:
Refer to the following procedures. (Click here).

13. INSTALL RADIATOR GRILLE

a. Attach the 2 clips and 8 claws to install the radiator grille.

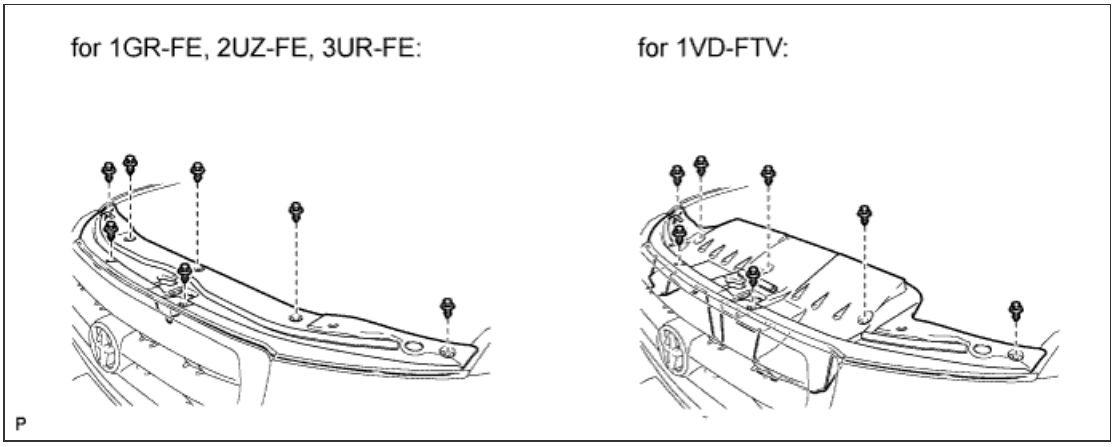
b. Install the 3 screws.



14. INSTALL FRONT BUMPER WINCH COVER SUB-ASSEMBLY (w/ Winch)

15. INSTALL UPPER RADIATOR SUPPORT SEAL

a. Install the radiator support seal with the 7 clips.

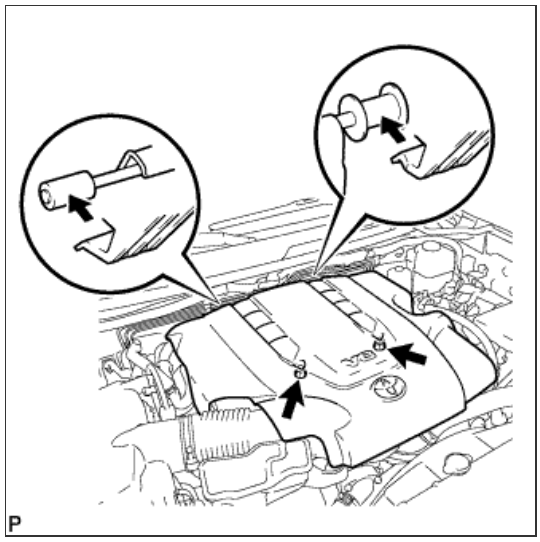


16. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket.

b. Install the V-bank cover with the 2 nuts.

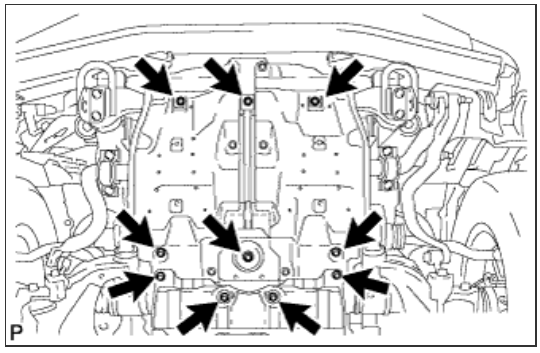
Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



17. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the No. 1 engine under cover with the 10 bolts.

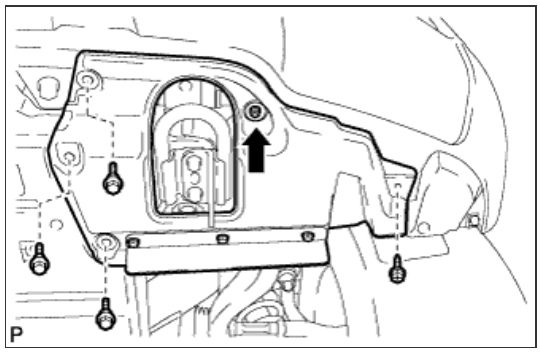
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



18. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



19. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

20. INSPECT ENGINE COOLANT LEVEL

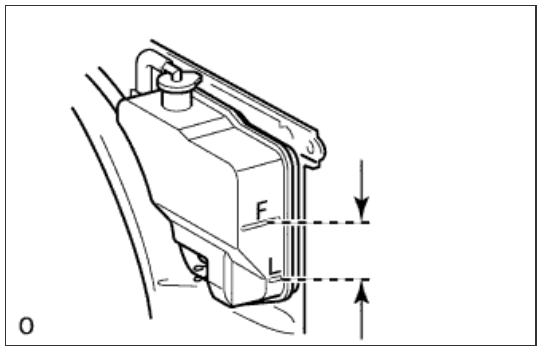
a. Check that the engine coolant level is between the L and F lines when the engine is cold.
If the engine coolant is low, check for leaks and add "TOYOTA Super Long Life

Coolant" or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite and non-borate coolant with long-life hybrid organic acid technology to the F line.

NOTICE:

Do not substitute plain water for engine coolant.

b. Remove the radiator cap, and check that the coolant level is up to the radiator filler hole.



for Preparation Click here

1. INSPECT FOR COOLANT LEAK

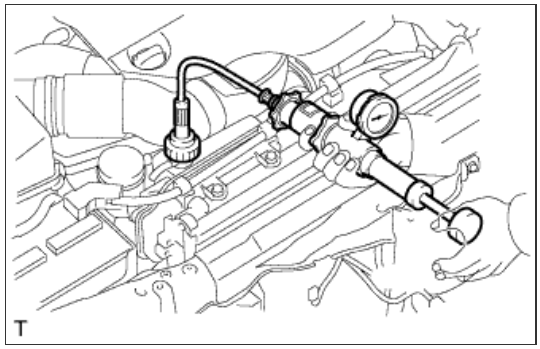
CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester to the radiator reservoir.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 17.8 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks.
If no external leaks are found, check the cylinder block and cylinder head.

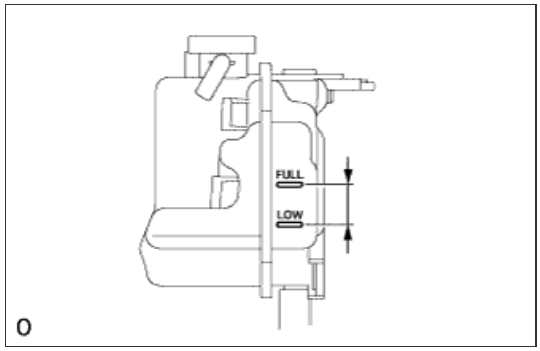


2. CHECK ENGINE COOLANT LEVEL IN RESERVOIR

a. Check that the engine coolant level is between the LOW and FULL lines when the engine is cold.
If the engine coolant is low, check for leaks and add "TOYOTA Super Long Life Coolant (SLLC)" or similar high ality ethylene glycol based non-silicate, non-amine, non-nitrite and non-borate coolant with long-life hybrid organic acid technology to the FULL line.

NOTICE:

Do not substitute plain water for engine coolant.



3. CHECK ENGINE COOLANT ALITY

a. Remove the radiator reservoir cap.

CAUTION:

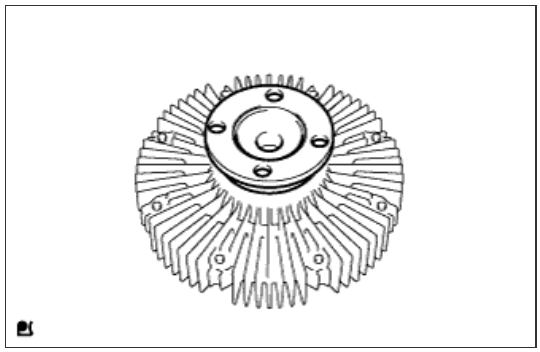
Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

b. Check if there are excessive deposits of rust or scales around the radiator reservoir cap and radiator filler hole. Also, the coolant should be free of oil.
If excessively dirty, replace the coolant.

c. Install the radiator reservoir cap.

4. INSPECT FLUID COUPLING ASSEMBLY

a. Check that the fluid coupling is not damaged and that no silicon oil leaks.
If necessary, replace the fluid coupling assembly.

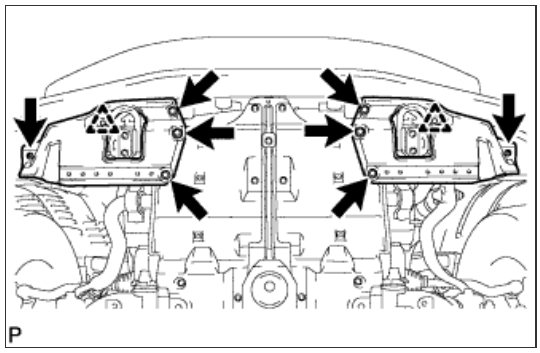


for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.



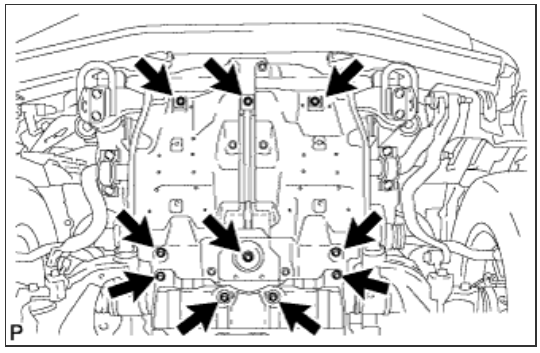
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.

3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



4. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and upper radiator support seal.

5. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

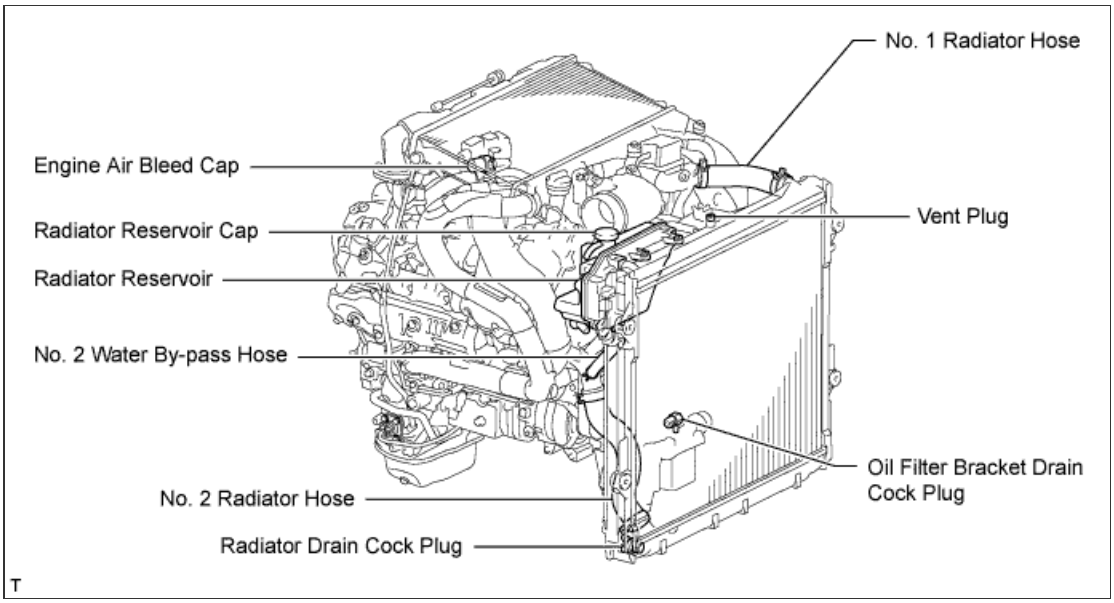
HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

a. Loosen the radiator drain cock plug.

b. Remove the radiator reservoir cap to drain the coolant in the radiator.

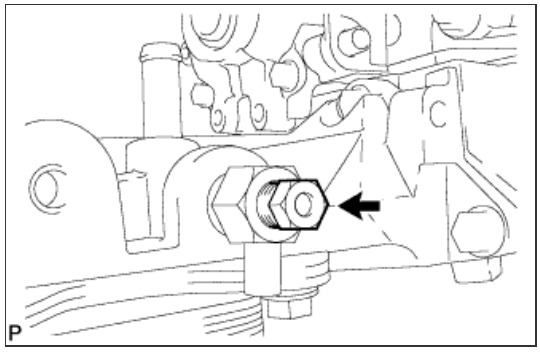
c. Loosen the oil filter bracket drain cock plug to drain the coolant in the engine.



d. Tighten the radiator drain cock plug by hand.

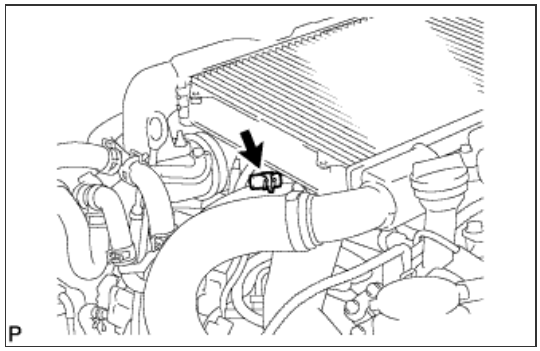
e. Tighten the oil filter bracket drain cock plug.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }

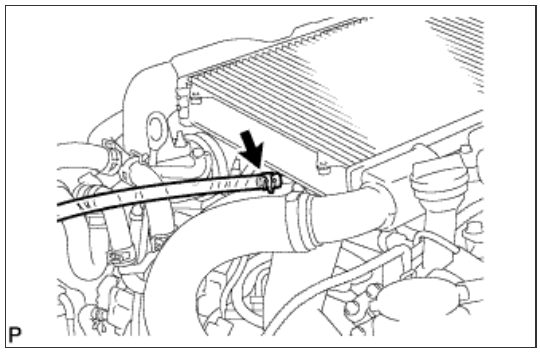


6. ADD ENGINE COOLANT

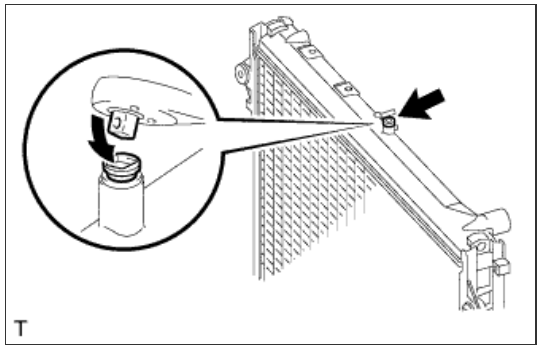
a. Remove the engine air bleed cap.



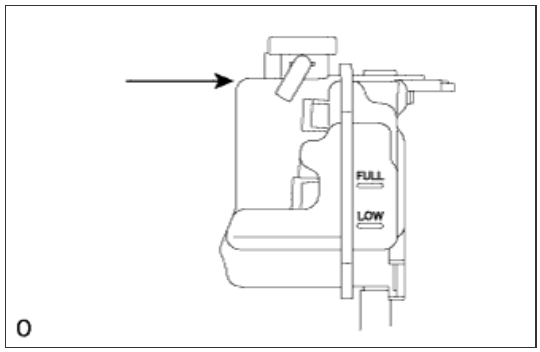
b. Connect a clear hose to the engine air bleed pipe.



c. Using a wrench, remove the vent plug.



d. Fill the radiator with TOYOTA SLLC to the radiator reservoir filler neck.



HINT:

Pour TOYOTA SLLC until it spills out of the engine air bleed pipe.

Standard Capacity (for Automatic Transmission):

Item	Specified Condition
Front heater only	14.8 liters (15.6 US qts, 13.0 Imp. qts)
Front heater and rear heater	17.6 liters (18.6 US qts, 15.5 Imp. qts)
Front heater with viscous heater	15.2 liters (16.1 US qts, 13.4 Imp. qts)
Front heater and rear heater with viscous heater	18.0 liters (19.0 US qts, 15.4 Imp. qts)

Standard capacity (for Manual Transmission):
15.4 liters (16.3 US qts, 13.6 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

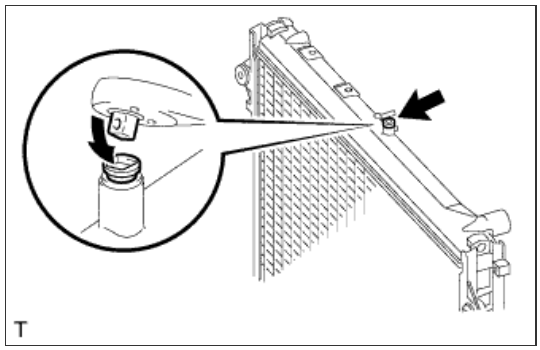
TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

e. Install the vent plug.

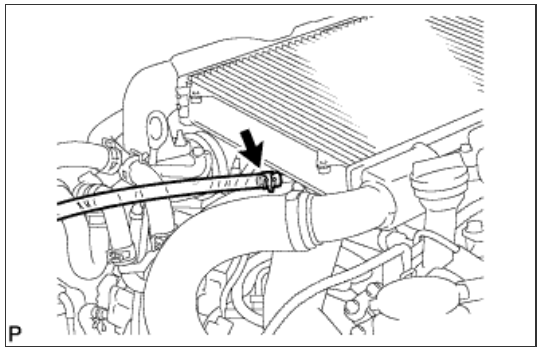
Torque:
2.0 N*m{ 20 kgf*cm , 18 in.*lbf }

NOTICE:

Do not tighten the plug to 5.0 N*m (51 kgf*cm, 44 in.*lbf) or more, as the plug will be damaged.



f. Disconnect the clear hose from the engine air bleed pipe.



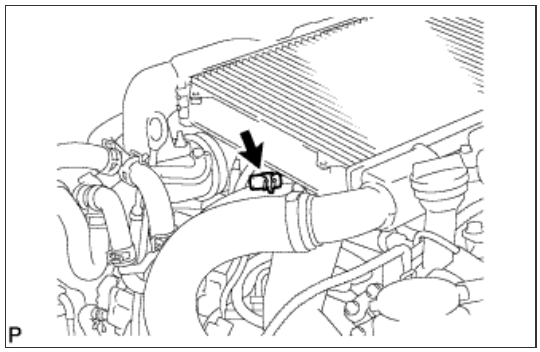
g. Install the engine air bleed cap when coolant comes out.

h. Install the radiator reservoir cap.

i. Start the engine.

NOTICE:

Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the FULL line.



j. Maintain an engine speed of 3000 rpm for approximately 10 minutes so that the thermostat opens and air bleeding is performed.

CAUTION:

When pressing the radiator hoses:

- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the radiator fan**

NOTICE:

- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**

HINT:

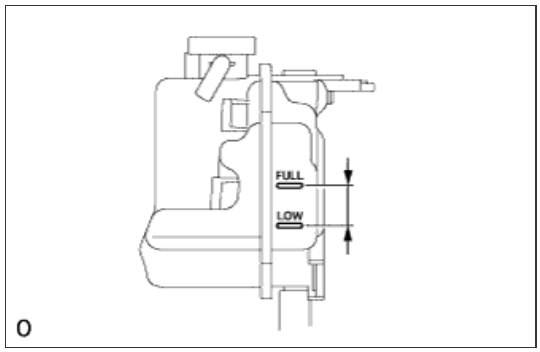
The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

k. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

l. Check that the coolant level is between the FULL and LOW lines.
If the coolant level is above the FULL line, drain coolant so that the coolant level is between the FULL and LOW lines.



7. INSPECT FOR COOLANT LEAK

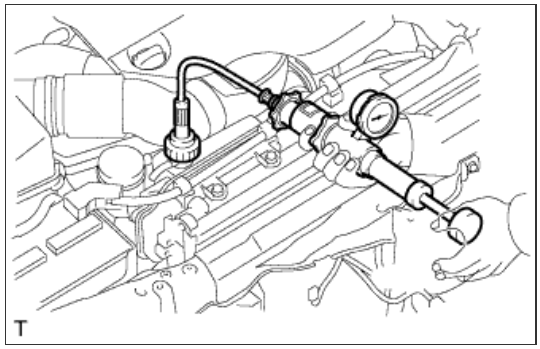
CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester to the radiator reservoir.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 17.8 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks.
If no external leaks are found, check the cylinder block and cylinder head.



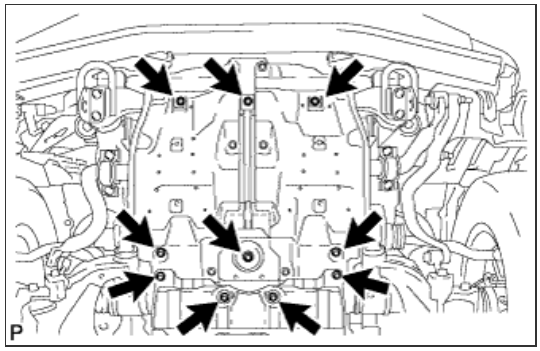
8. INSTALL UPPER RADIATOR SUPPORT SEAL

a. Install the upper radiator support seal with the 7 clips.

9. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

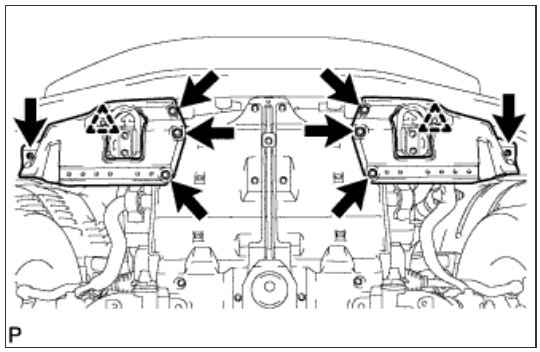
a. Install the engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



10. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

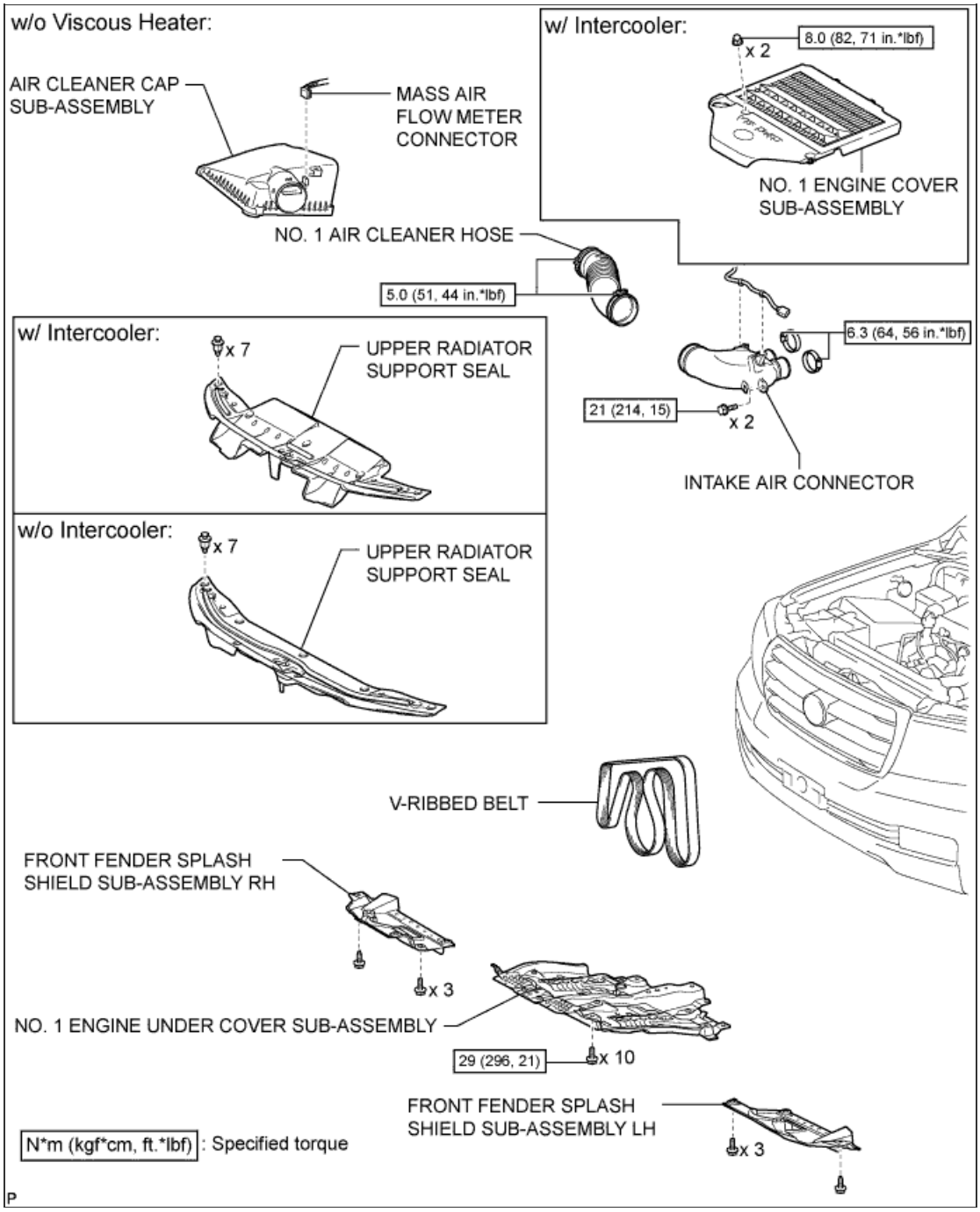
a. Install the splash shield with the clip, and then install the 3 bolts and screw.



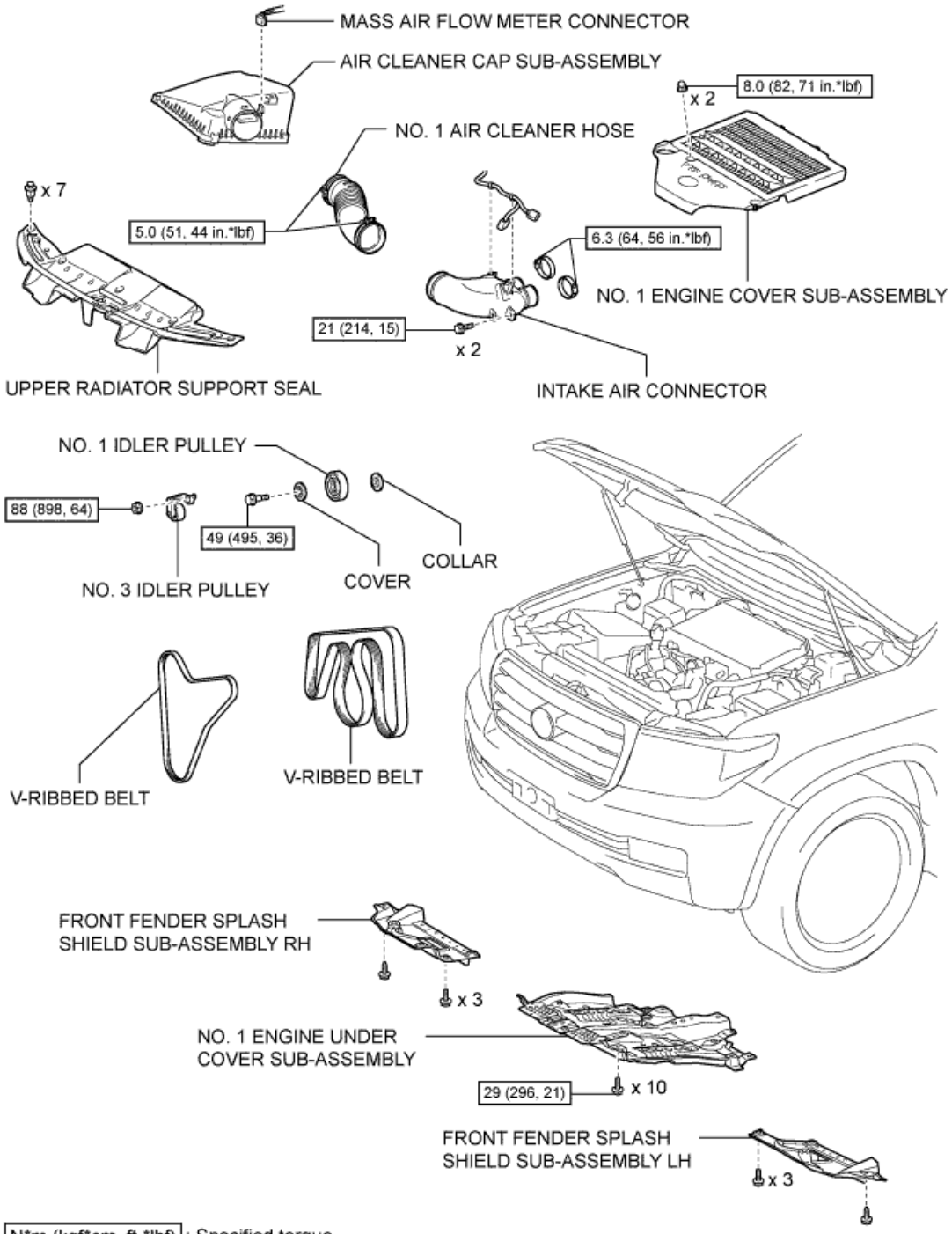
11. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Install the splash shield with the clip, and then install the 3 bolts and screw.

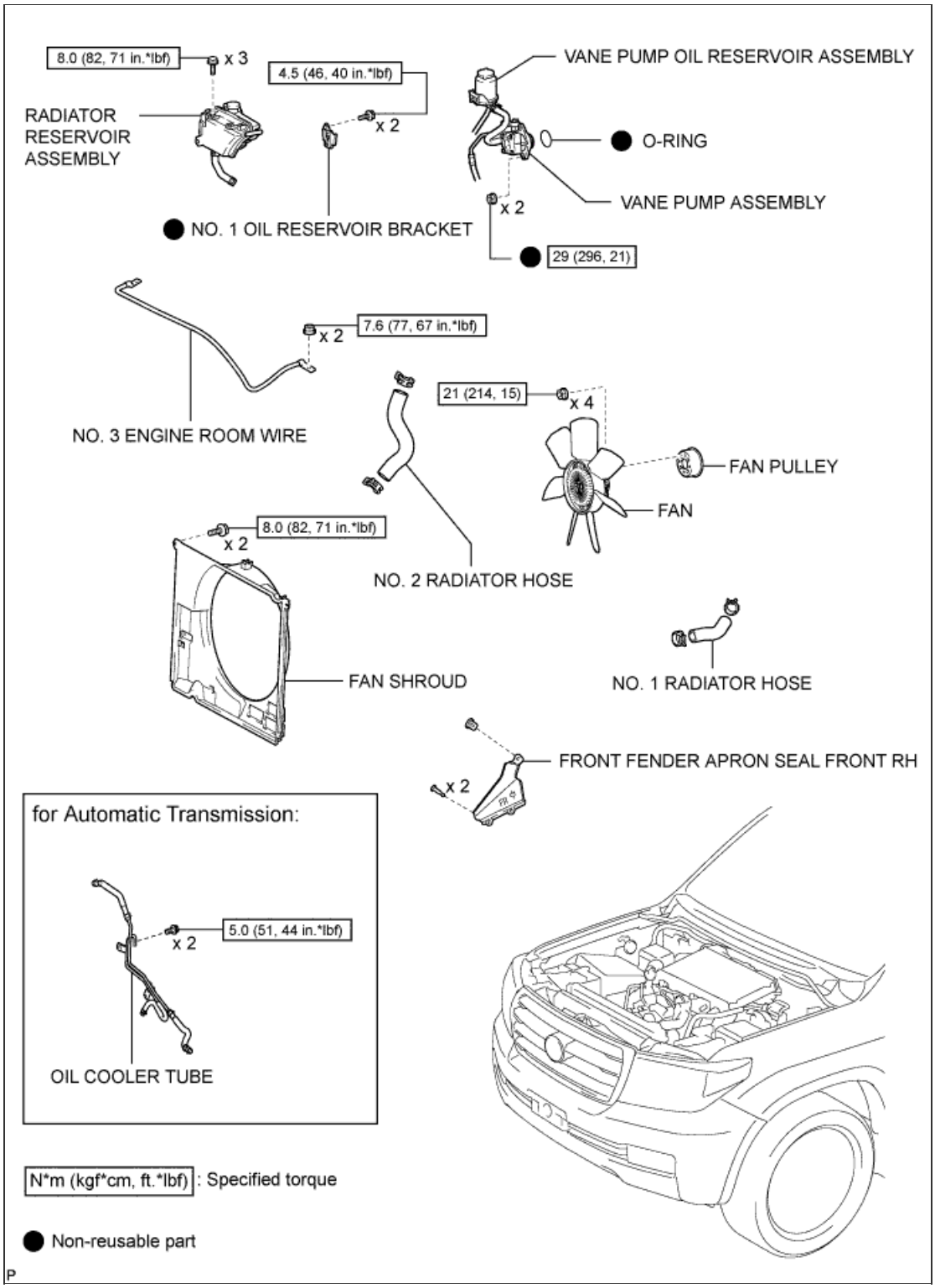
for Preparation [Click here]

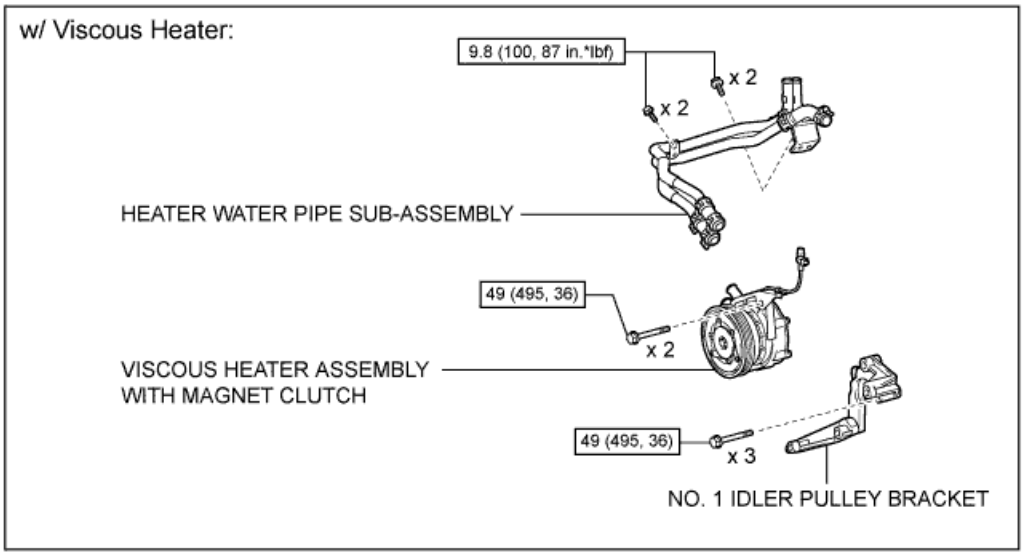


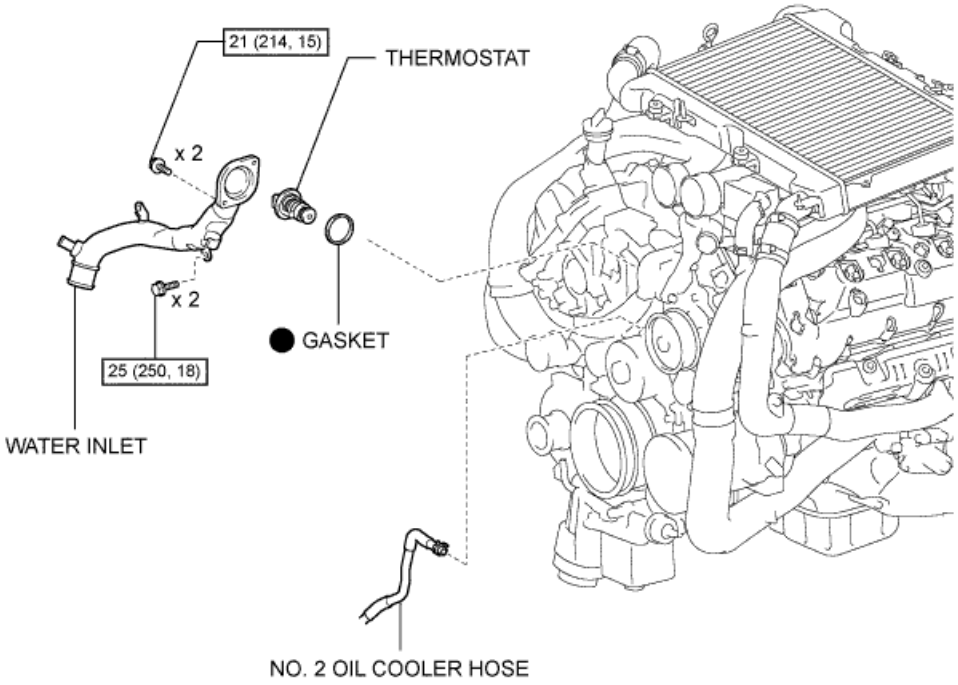
w/ Viscous Heater:



P


8.0 (82, 71 in.*lbf)
x 3
4.5 (46, 40 in.*lbf)
x 2
RADIATOR RESERVOIR ASSEMBLY
NO. 1 OIL RESERVOIR BRACKET
VANE PUMP OIL RESERVOIR ASSEMBLY
O-RING
VANE PUMP ASSEMBLY
x 2
29 (296, 21)
x 2
7.6 (77, 67 in.*lbf)
NO. 3 ENGINE ROOM WIRE
21 (214, 15)
x 4
FAN PULLEY
FAN
8.0 (82, 71 in.*lbf)
x 2
NO. 2 RADIATOR HOSE
FAN SHROUD
NO. 1 RADIATOR HOSE
FRONT FENDER APRON SEAL FRONT RH
x 2
for Automatic Transmission:
x 2
5.0 (51, 44 in.*lbf)
OIL COOLER TUBE
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

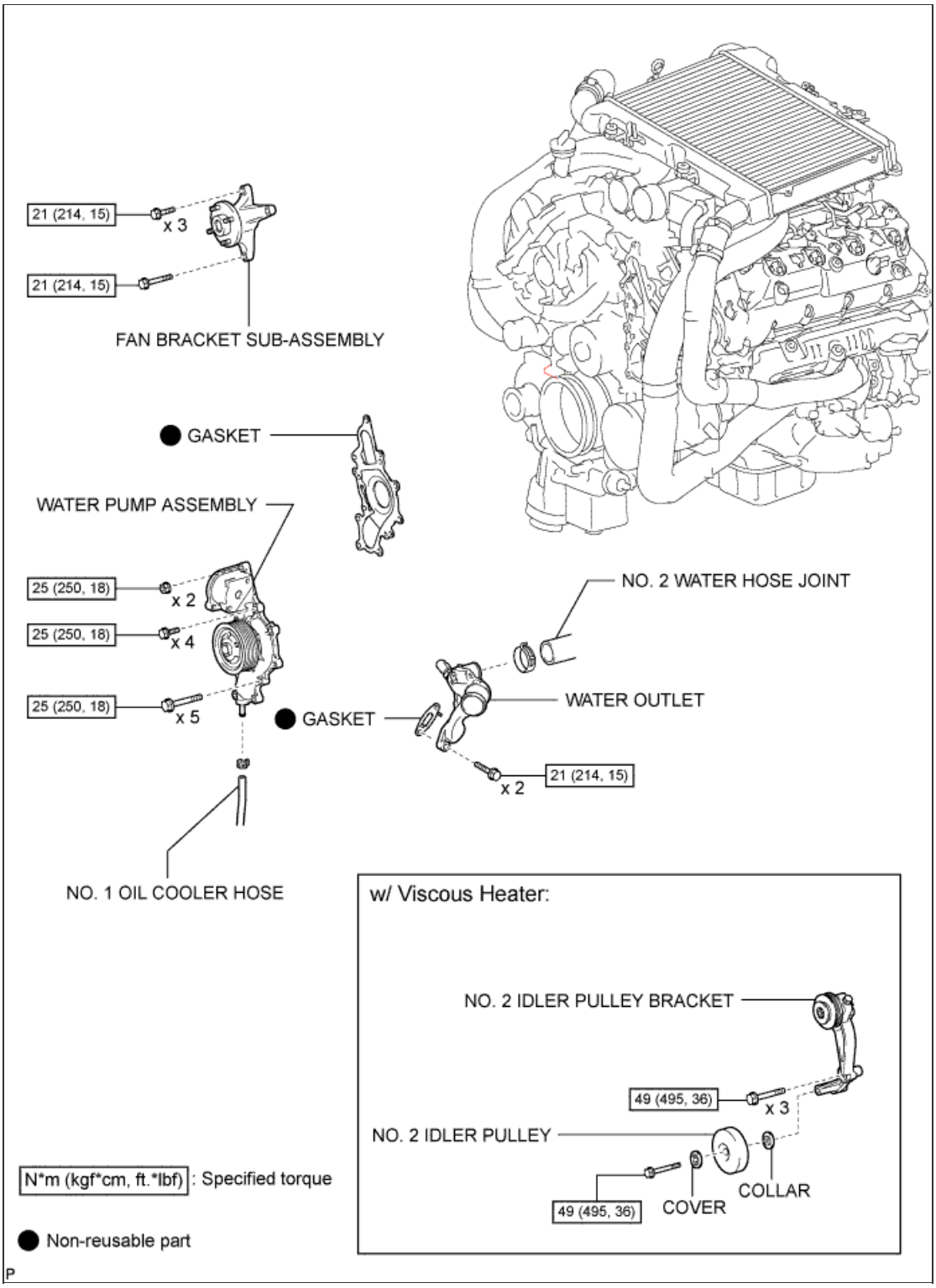




N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P

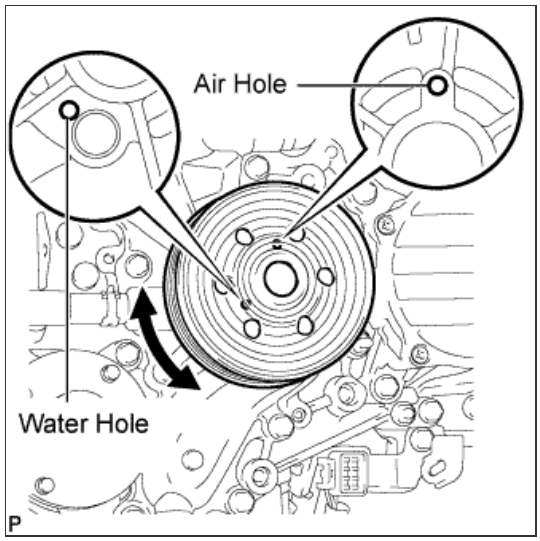

21 (214, 15)
x 3
21 (214, 15)
FAN BRACKET SUB-ASSEMBLY
GASKET
WATER PUMP ASSEMBLY
25 (250, 18)
x 2
25 (250, 18)
x 4
25 (250, 18)
x 5
NO. 1 OIL COOLER HOSE
NO. 2 WATER HOSE JOINT
WATER OUTLET
GASKET
x 2
21 (214, 15)
w/ Viscous Heater:
NO. 2 IDLER PULLEY BRACKET
49 (495, 36)
x 3
NO. 2 IDLER PULLEY
COLLAR
COVER
49 (495, 36)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

for Preparation Click here

1. INSPECT WATER PUMP ASSEMBLY

a. Visually check the water hole and air hole for coolant leakage.
If leakage is found, replace the water pump assembly.

b. Turn the pulley, and check that the pump bearing moves smoothly and quietly.
If it moves roughly or noisily, replace the water pump assembly.



for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Disconnect the cables from the negative (-) main battery and sub-battery terminals.

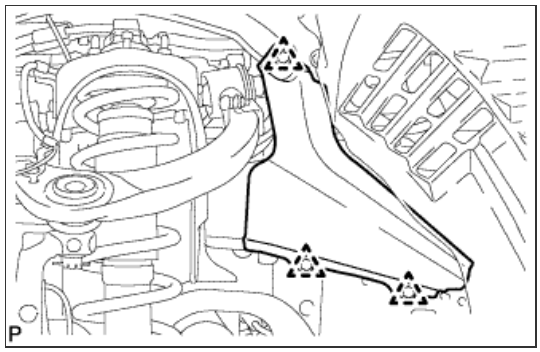
2. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and upper radiator support seal.

3. REMOVE FRONT WHEEL RH

4. REMOVE FRONT FENDER APRON SEAL FRONT RH

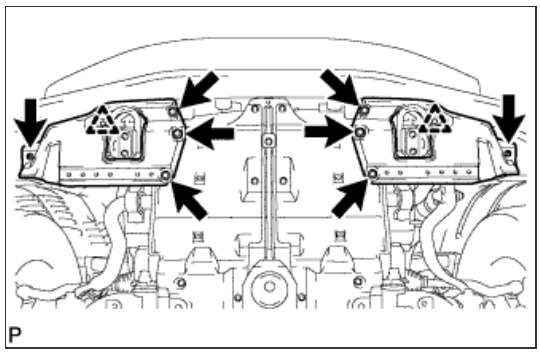
a. Remove the 3 clips and front fender apron seal front RH.



5. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.



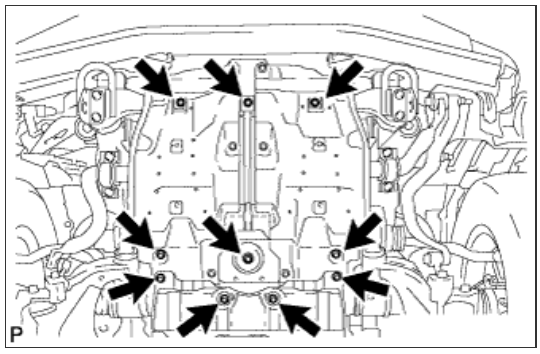
6. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.

7. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



8. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

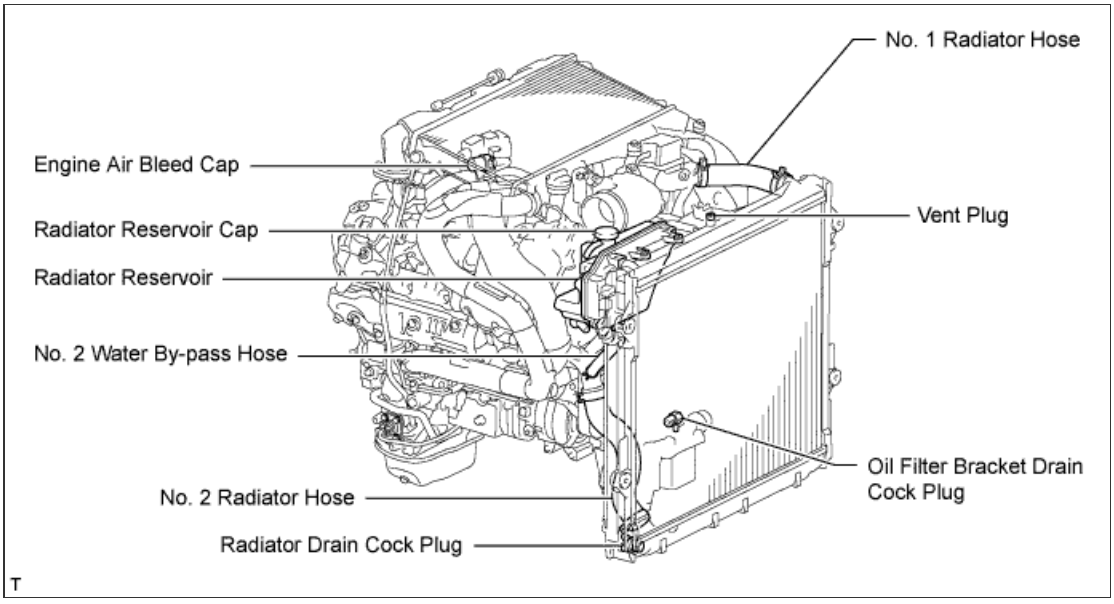
HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

a. Loosen the radiator drain cock plug.

b. Remove the radiator reservoir cap to drain the coolant in the radiator.

c. Loosen the oil filter bracket drain cock plug to drain the coolant in the engine.

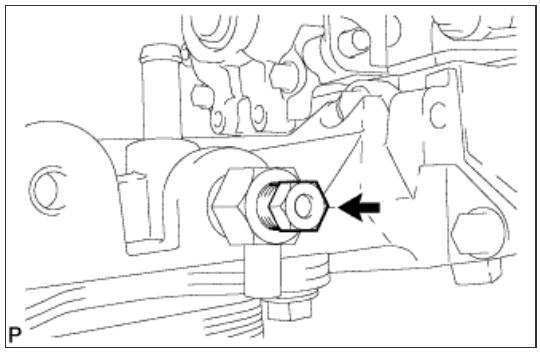


d. ighten the radiator drain cock plug by hand.

e. ighten the oil filter bracket drain cock plug.

Torque:

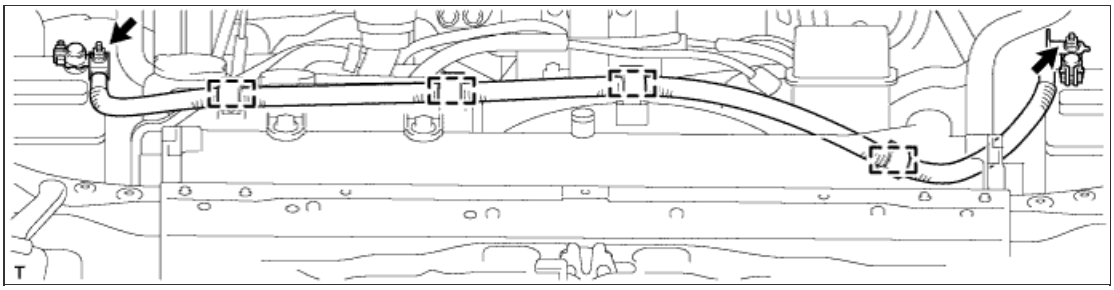
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



9. REMOVE NO. 3 ENGINE ROOM WIRE

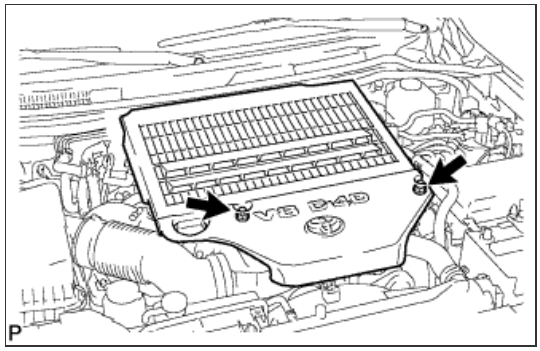
a. Disconnect the 4 wire harness clamps.

b. Remove the 2 nuts and No. 3 engine room wire.



10. REMOVE NO. 1 ENGINE COVER SUB-ASSEMBLY (w/ Intercooler

a. Remove the 2 nuts and No. 1 engine cover.

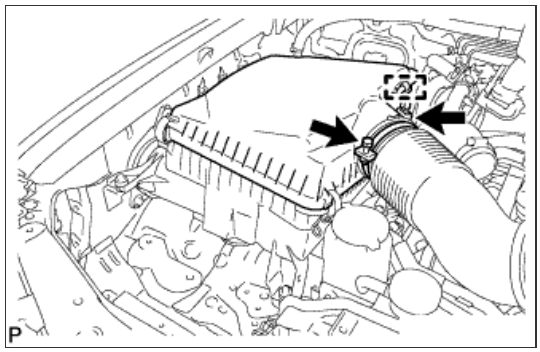


11. REMOVE AIR CLEANER CAP SUB-ASSEMBLY

a. Loosen the hose clamp.

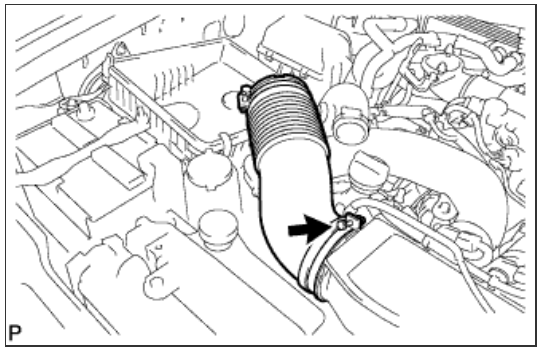
b. Disconnect the mass air flow meter connector and using a clip remover, detach the wire harness clamp from the air cleaner cap.

c. Detach the 4 clamps and remove the air cleaner cap.



12. REMOVE NO. 1 AIR CLEANER HOSE

a. Loosen the hose clamp and remove the No. 1 air cleaner hose.



13. REMOVE INTAKE AIR CONNECTOR

a. w/o Viscous Heater:

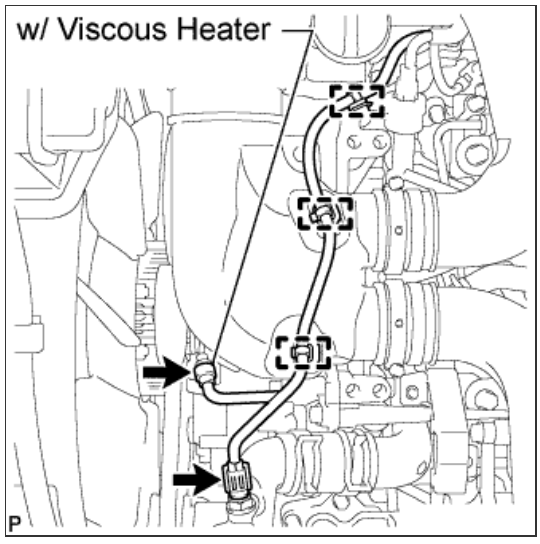
   i. Disconnect the connector from the water temperature sensor.

   ii. Using a clip remover, detach the 3 wire harness clamps.

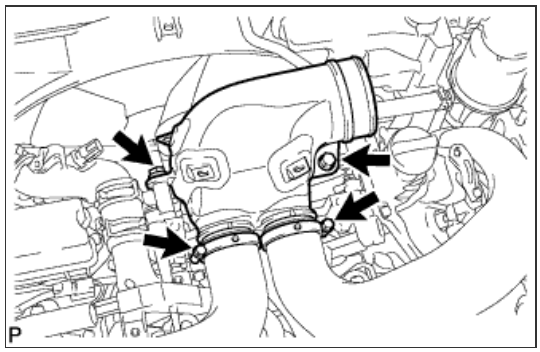
b. w/ Viscous Heater:

   i. Disconnect the 2 connectors from the viscous with magnet clutch heater and water temperature sensor.

   ii. Using a clip remover, detach the 3 wire harness clamps.

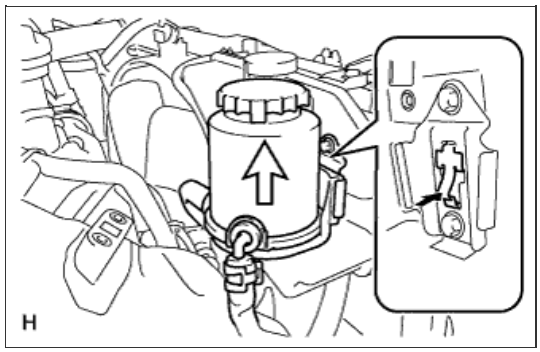


c. Loosen the 2 hose clamps and remove the 2 bolts and intake air connector.



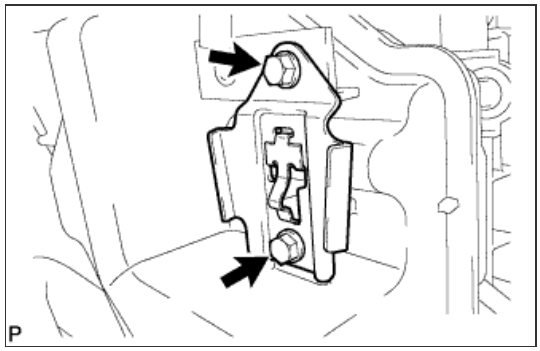
14. REMOVE VANE PUMP OIL RESERVOIR ASSEMBLY

a. Insert a screwdriver between the reservoir and oil reservoir bracket, push the claw, and then disconnect the reservoir by pulling it upwards.



15. REMOVE NO. 1 OIL RESERVOIR BRACKET

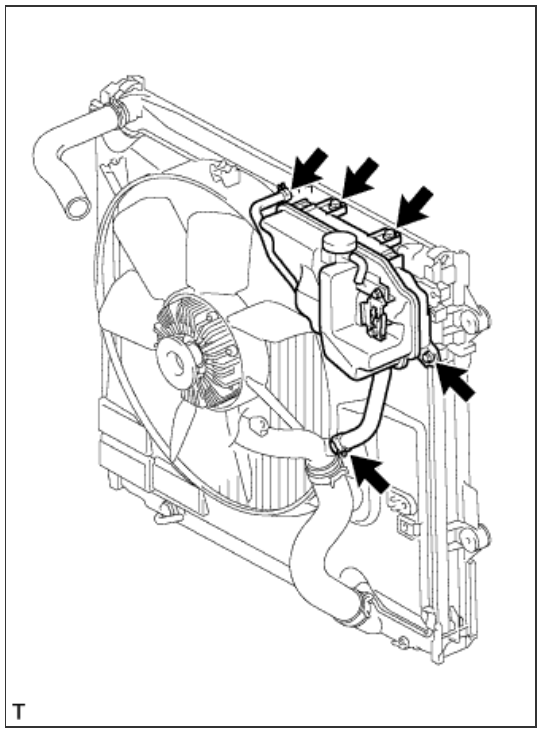
a. Remove the 2 bolts and bracket.



16. REMOVE RADIATOR RESERVOIR ASSEMBLY

a. Disconnect the 2 hoses.

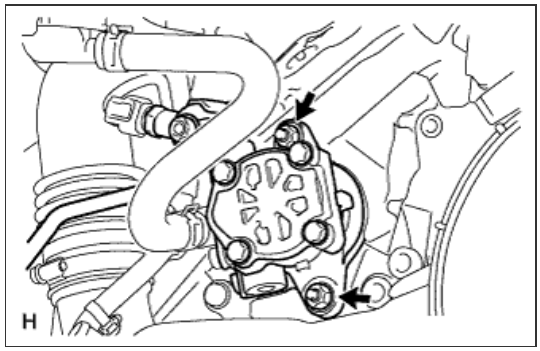
b. Remove the 3 bolts and radiator reservoir.



17. REMOVE VANE PUMP ASSEMBLY

a. Remove the 2 nuts and vane pump.

b. Remove the O-ring from the vane pump.



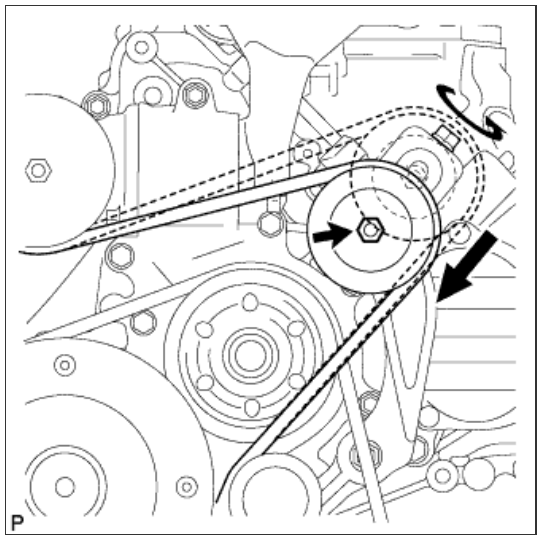
18. DISCONNECT NO. 1 RADIATOR HOSE

19. DISCONNECT NO. 2 RADIATOR HOSE

20. REMOVE V-RIBBED BELT (w/ Viscous Heater

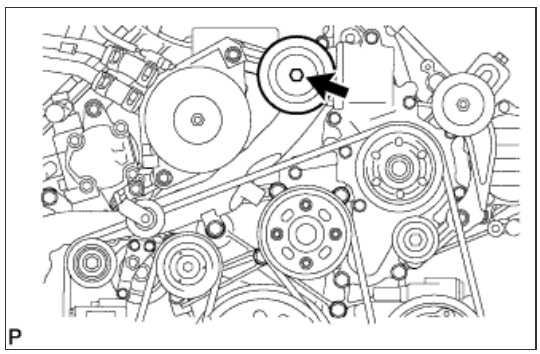
a. Loosen the lock nut and turn the bolt counterclockwise.

b. Remove the V-ribbed belt.



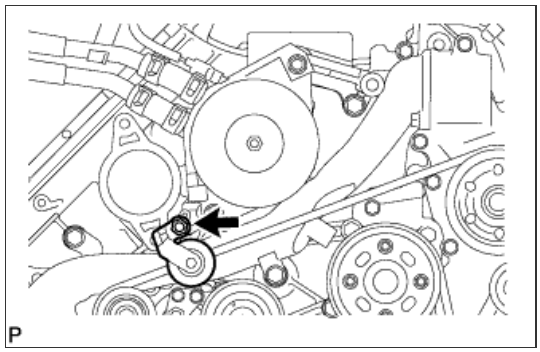
21. REMOVE NO. 1 IDLER PULLEY (w/ Viscous Heater

a. Remove the bolt, cover, No. 1 idler pulley and collar.



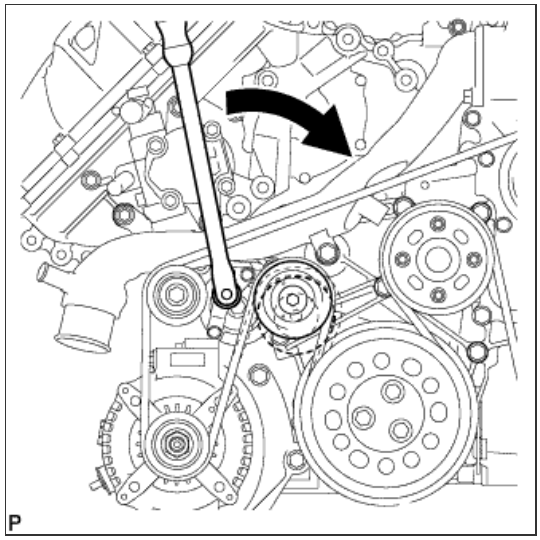
22. REMOVE NO. 3 IDLER PULLEY (w/ Viscous Heater

a. Remove the nut and No. 3 idler pulley.



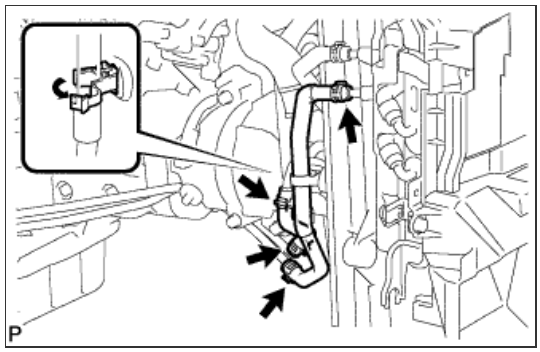
23. REMOVE V-RIBBED BELT

a. Using a wrench to the V-ribbed belt tensioner bracket, turn the wrench clockwise and remove the V-ribbed belt.

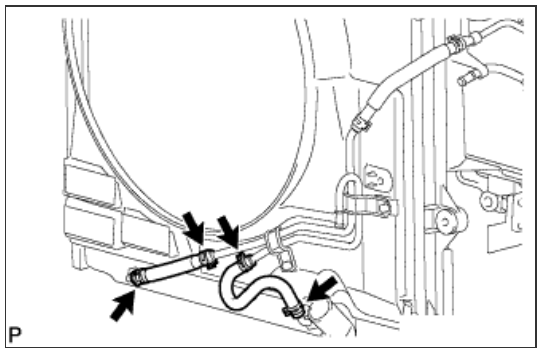


24. REMOVE OIL COOLER TUBE (for Automatic Transmission

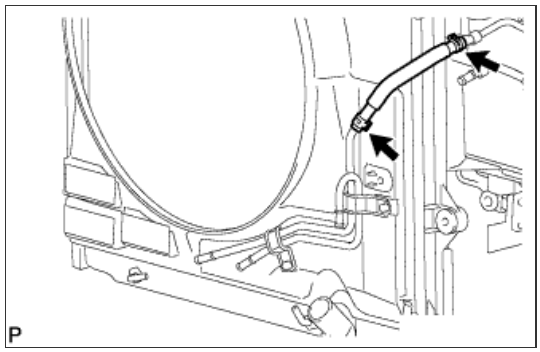
a. Disconnect the inlet and outlet No. 1 oil cooler hose.



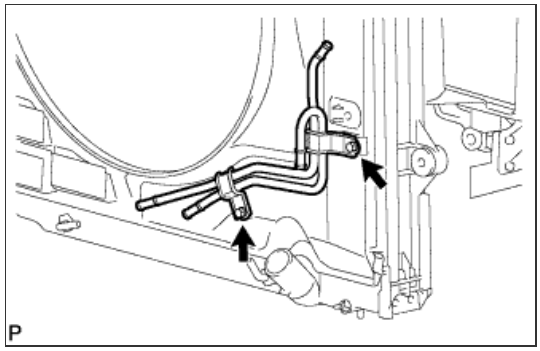
b. Disconnect the inlet No. 2 and No. 3 oil cooler hoses.



c. Disconnect the inlet No. 4 oil cooler hose.

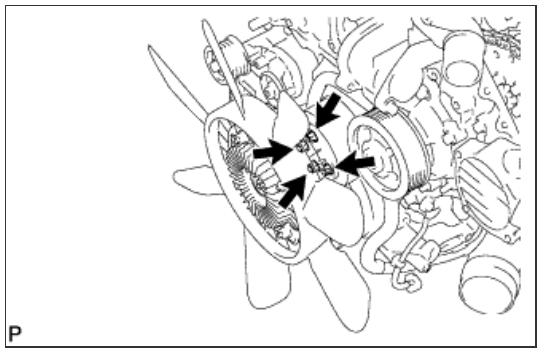


d. Remove the 2 bolts and transmission oil cooler tube.

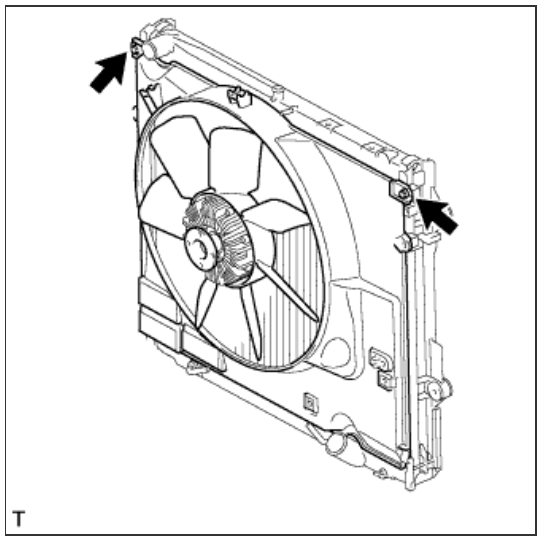


25. REMOVE FAN SHROUD WITH FAN

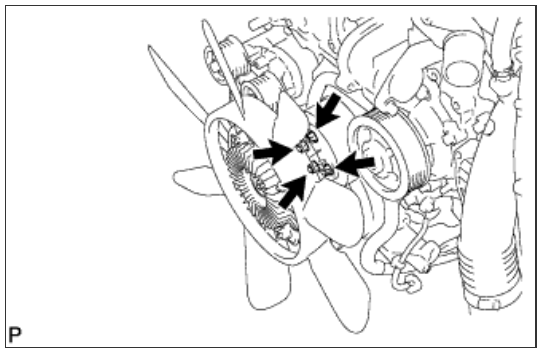
a. Loosen the 4 nuts holding the fluid coupling fan.



b. Remove the 2 bolts holding the fan shroud.



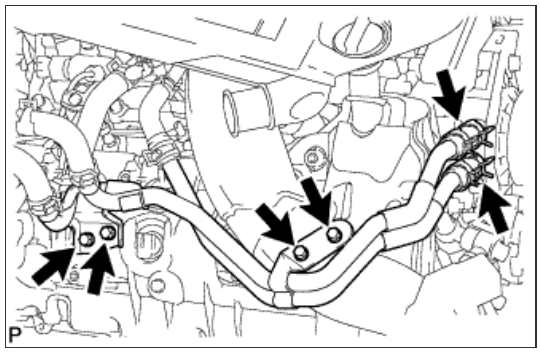
c. Remove the 4 nuts of the fluid coupling fan, and then remove the shroud together with the fluid coupling fan.



26. REMOVE FAN PULLEY

27. REMOVE HEATER WATER PIPE SUB-ASSEMBLY (w/ Viscous Heater

a. Remove the 4 bolts and disconnect the heater water pipe from the viscous heater with magnet clutch.



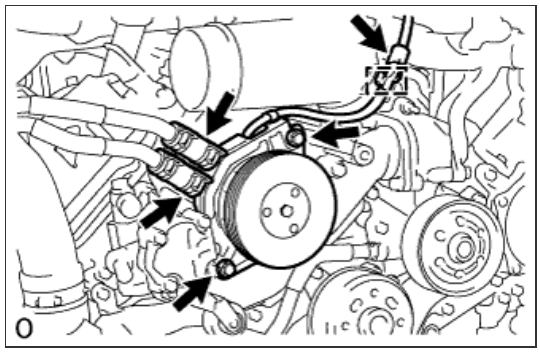
28. REMOVE VISCOUS WITH MAGNET CLUTCH HEATER ASSEMBLY (w/ Viscous Heater

a. Disconnect the connector and detach the clamp.

b. Using pliers, grip the claws of the clips and slide the 2 clips.

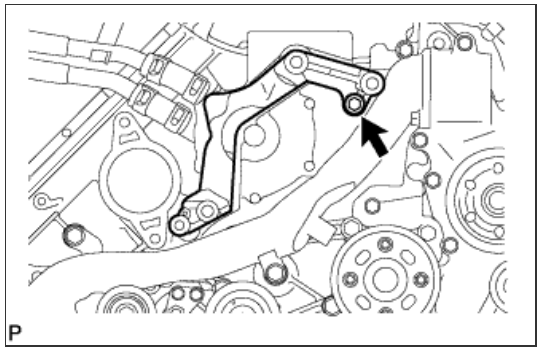
c. Disconnect the 2 heater hoses.

d. Remove the 2 bolts and heater assembly.



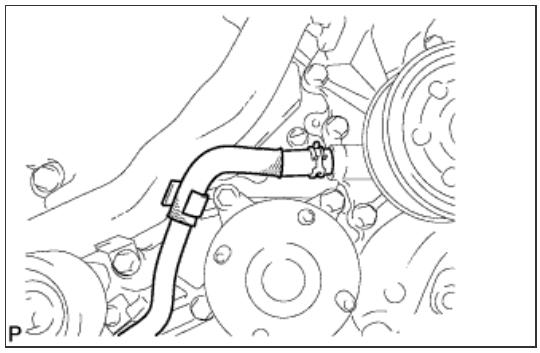
29. REMOVE NO. 1 IDLER PULLEY BRACKET (w/ Viscous Heater

a. Remove the bolt and No. 1 idler pulley bracket.

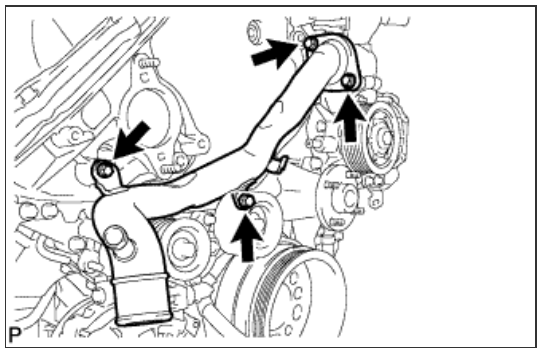


30. REMOVE WATER INLET

a. Disconnect the No. 2 oil cooler hose from the water pump and clamp.



b. Remove the 4 bolts and water inlet.



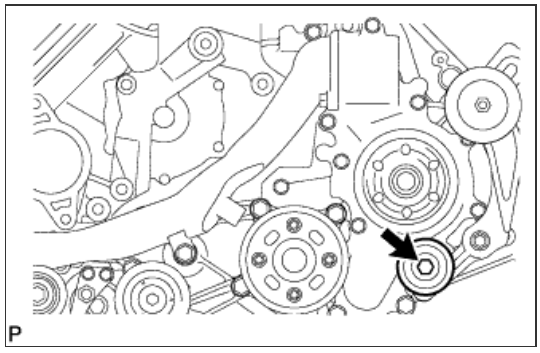
31. REMOVE THERMOSTAT

a. Remove the thermostat.

b. Remove the gasket from the thermostat.

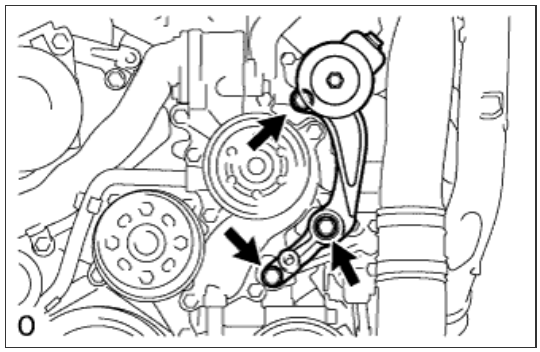
32. REMOVE NO. 2 IDLER PULLEY (w/ Viscous Heater

a. Remove the bolt, cover, No. 2 idler pulley and collar.

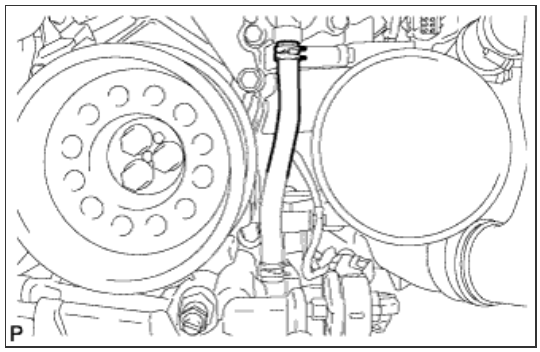


33. REMOVE NO. 2 IDLER PULLEY BRACKET (w/ Viscous Heater

a. Remove the 3 bolts and idler pulley bracket.

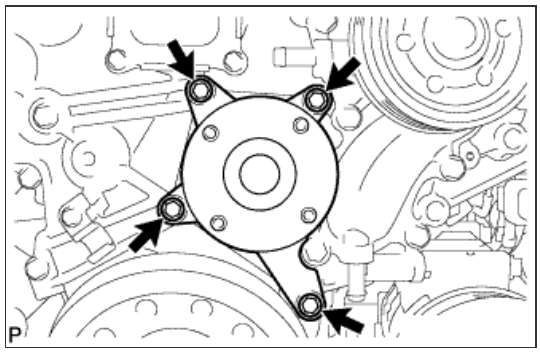


34. DISCONNECT NO. 1 OIL COOLER HOSE



35. REMOVE FAN BRACKET SUB-ASSEMBLY

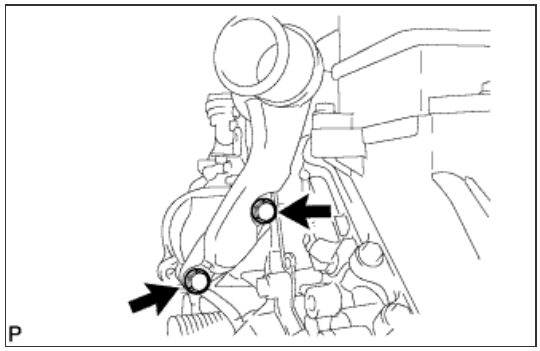
a. Remove the 4 bolts and fan bracket.



36. REMOVE WATER OUTLET

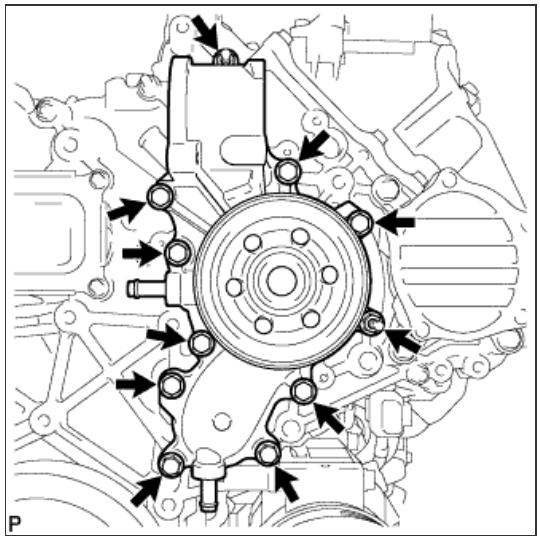
a. Disconnect the engine coolant temperature sensor connector.

b. Remove the 2 bolts, disconnect the water outlet from the No. 2 water hose joint, and remove the water outlet and gasket.



37. REMOVE WATER PUMP ASSEMBLY

a. Remove the 9 bolts, 2 nuts, water pump and gasket.



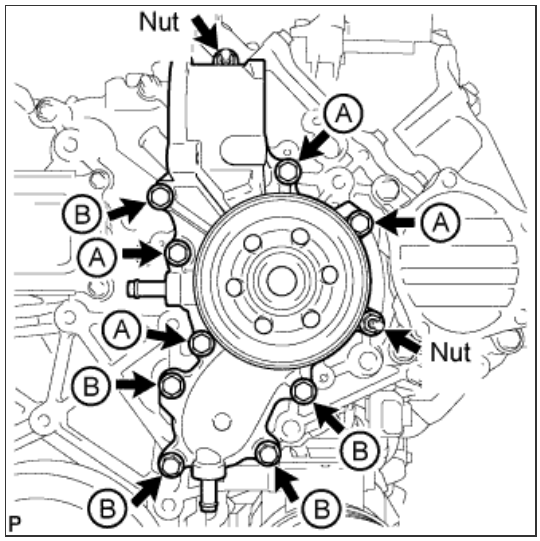
for Preparation [Click here]

1. INSTALL WATER PUMP ASSEMBLY

a. Temporarily install a new gasket and the water pump with the 9 bolts and 2 nuts.

Bolt Length

Item	Length
Bolt A	30 mm (1.18 in.)
Bolt B	80 mm (3.15 in.)

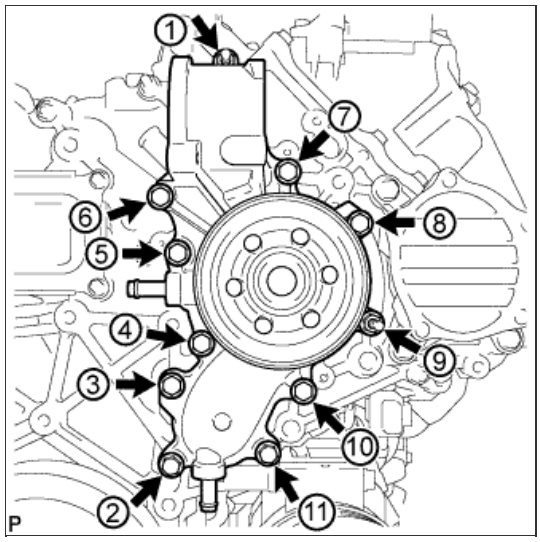


b. Uniformly tighten the 9 bolts and 2 nuts of the water pump in the order shown in the illustration.

Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }

NOTICE:

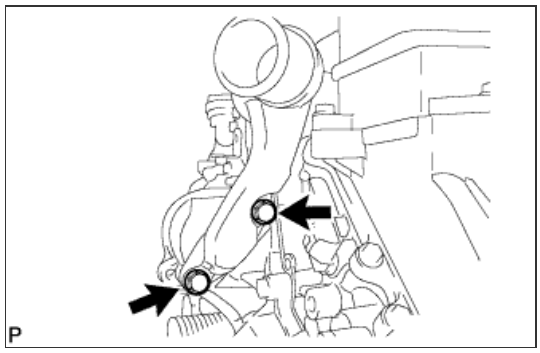
After installing all of the bolts and nuts, check that all of the bolts and nuts are tightened to the torque specification.



2. INSTALL WATER OUTLET

a. Connect the water outlet to the No. 2 water hose joint, and install a new gasket and the water outlet with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



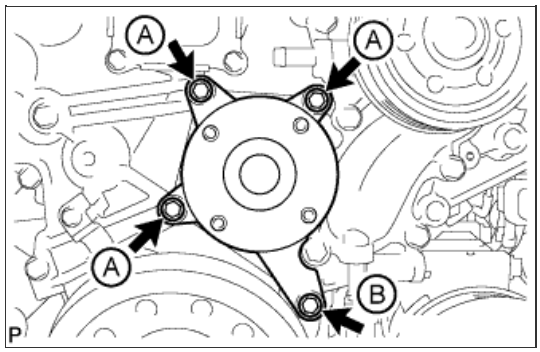
3. INSTALL FAN BRACKET SUB-ASSEMBLY

a. Install the fan bracket with the 4 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

Bolt Length

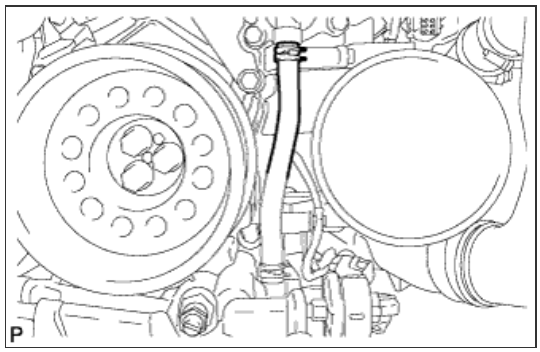
Item	Length
Bolt A	30 mm (1.18 in.)
Bolt B	80 mm (3.15 in.)



4. INSTALL NO. 1 OIL COOLER HOSE

NOTICE:

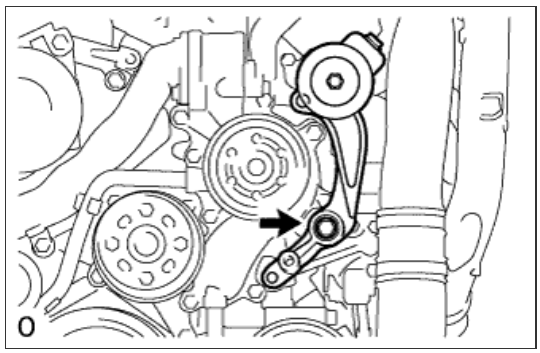
Make sure that there is clearance between the oil cooler hose and crankshaft pulley.



5. INSTALL NO. 2 IDLER PULLEY BRACKET (w/ Viscous Heater)

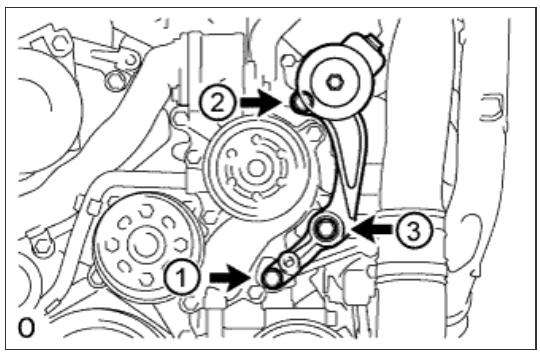
a. Temporarily install the No. 2 idler pulley bracket with the bolt.

b. Temporarily install the 2 bolts to the No. 2 idler pulley bracket bolt hole.



c. Uniformly tighten the 3 bolts of the No. 2 idler pulley bracket in the order shown in the illustration.

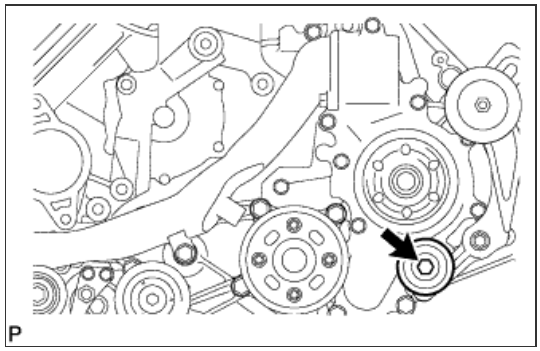
Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }



6. INSTALL NO. 2 IDLER PULLEY (w/ Viscous Heater)

a. Install the collar, No. 2 idler pulley and cover with the bolt.

Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }



7. INSTALL THERMOSTAT

a. Install a new gasket to the thermostat.

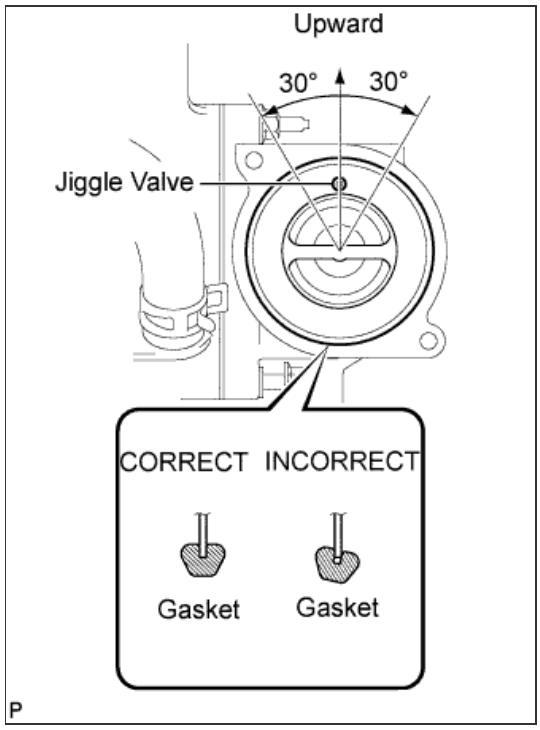
NOTICE:

When installing the gasket to the thermostat, be careful not to deform the gasket. Make sure that the groove of the gasket is properly installed onto the thermostat, as shown in the illustration.

b. Insert the thermostat into the water pump with the jiggle valve facing straight upward.

HINT:

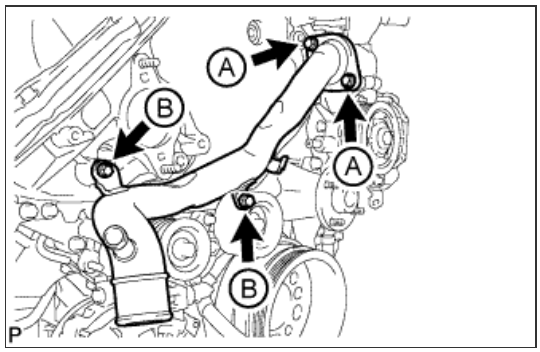
The jiggle valve may be set within 30° of either side of the prescribed position.



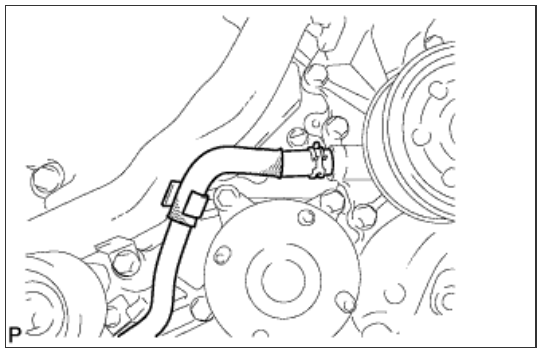
8. INSTALL WATER INLET

a. Install the water inlet with the 4 bolts.

Torque:
for bolt A:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for bolt B:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }



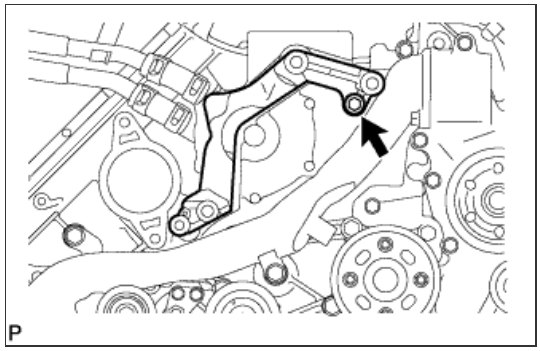
b. Connect the No. 2 oil cooler hose to the clamp and water pump.



9. INSTALL NO. 1 IDLER PULLEY BRACKET (w/ Viscous Heater)

a. Install the No. 1 idler pulley bracket with the bolt.

Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }



10. INSTALL VISCOUS WITH MAGNET CLUTCH HEATER ASSEMBLY (w/ Viscous Heater)

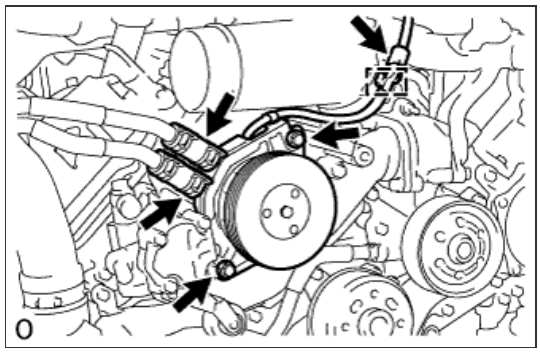
a. Install the heater assembly with the 2 bolts.

Torque:
48.5 N*m{ 495 kgf*cm , 36 ft.*lbf }

b. Connect the 2 heater hoses.

c. Using pliers, grip the claws of the clips and slide the 2 clips.

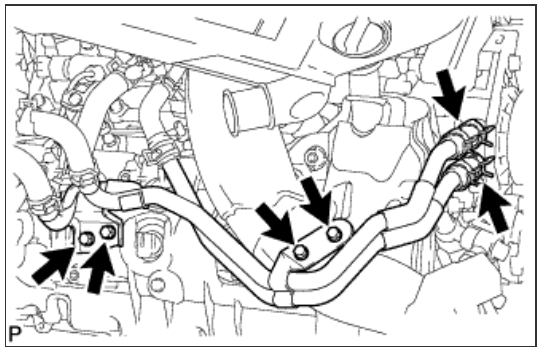
. Connect the connector and attach the clamp.



11. INSTALL HEATER WATER PIPE SUB-ASSEMBLY (w/ Viscous Heater)

a. Connect the heater water pipe to the viscous heater with magnet clutch, and install the 4 bolts.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }



12. INSTALL FAN PULLEY

13. INSTALL FAN SHROUD WITH FAN

a. Install the shroud together with the fluid coupling fan between the radiator and engine components.

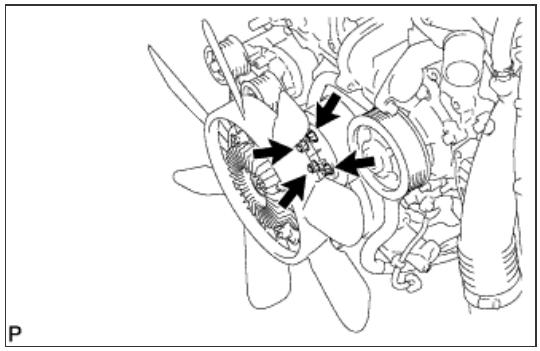
NOTICE:

Be careful not to damage the radiator core.

b. Temporarily install the fluid coupling fan to the fan bracket with the 4 nuts.

HINT:

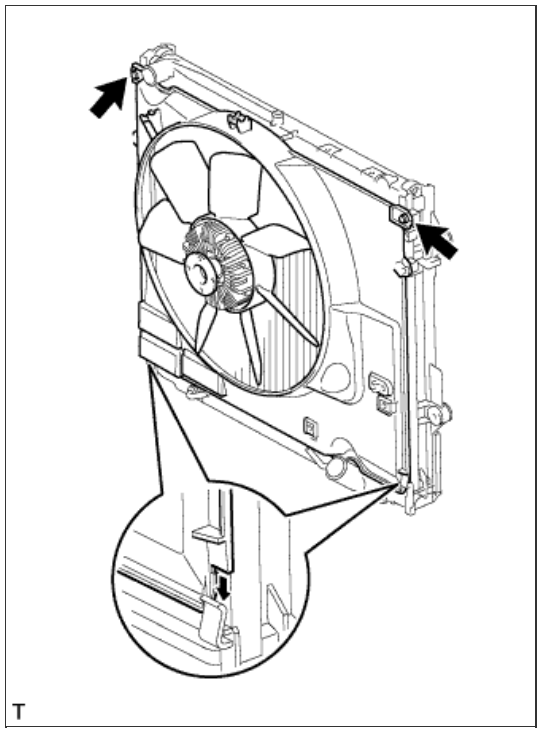
Tighten the nuts as much as possible by hand.



c. Attach the shroud claws to the radiator.

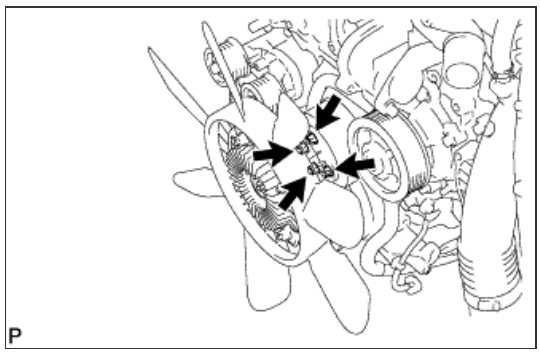
. Install the shroud with the 2 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }



e. Tighten the 4 nuts of the fluid coupling fan.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

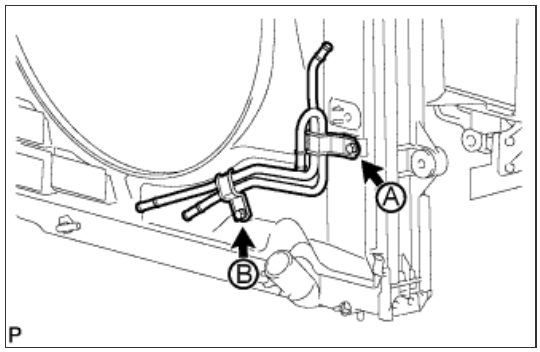


14. INSTALL OIL COOLER TUBE (for Automatic Transmission)

a. Temporarily install the oil cooler tube to the fan shroud with the bolt labeled A.

Install the bolt labeled B. Then tighten the bolt labeled A to the specified torque.

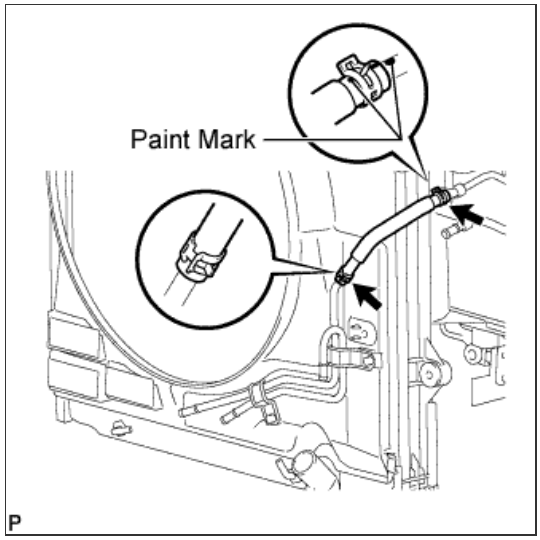
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



b. Connect the inlet No. 4 oil cooler hose as shown in the illustration.

NOTICE:

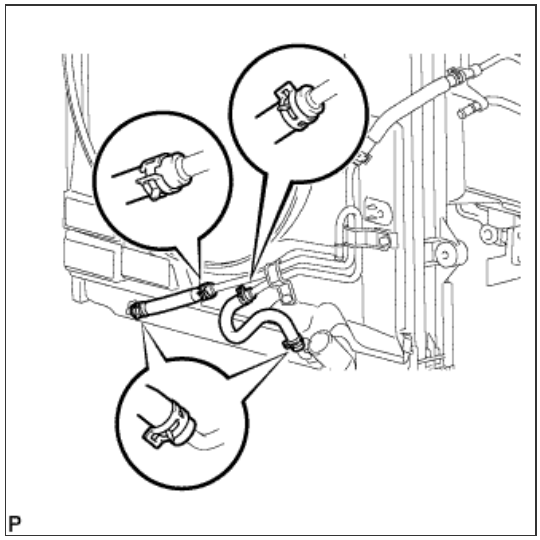
Make sure the pinching portion of each clip is facing the direction shown in the illustration.



c. Connect the inlet No. 2 and No. 3 oil cooler hoses as shown in the illustration.

NOTICE:

Make sure the pinching portion of each clip is facing the direction shown in the illustration.

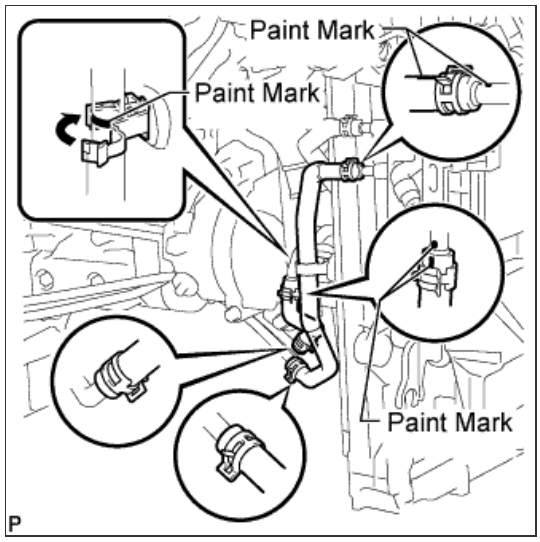


. Connect the inlet and outlet No. 1 oil cooler hoses as shown in the illustration.

NOTICE:

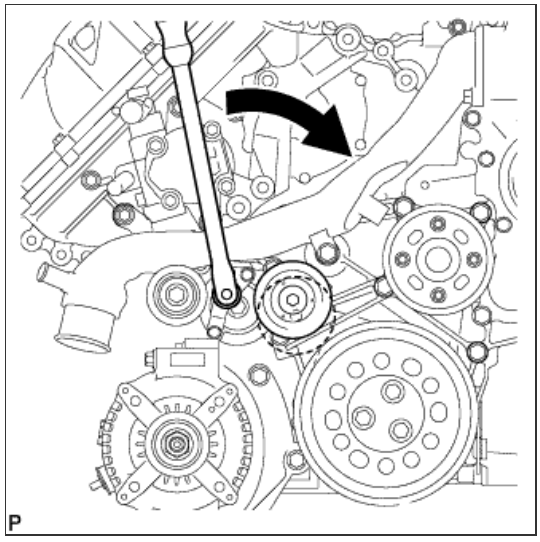
Make sure the pinching portion of each clip is facing the direction shown in the illustration.

e. Pass the hose through the flexible hose clamp and close the clamp shown in the illustration.

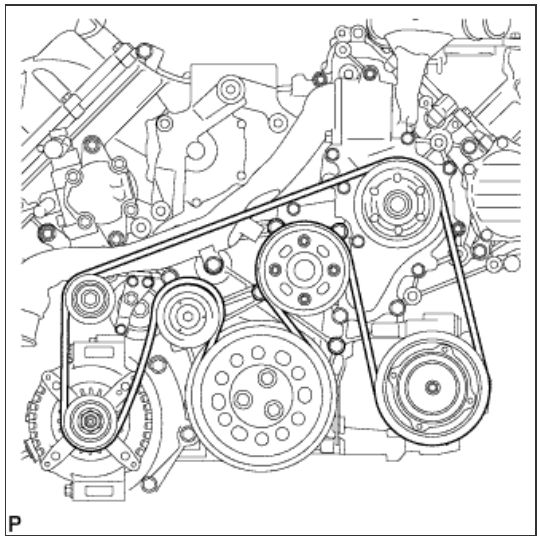


15. INSTALL V-RIBBED BELT

a. Attach a wrench to the V-ribbed belt tensioner bracket and turn the wrench clockwise.



b. Install the V-ribbed belt as shown in the illustration.

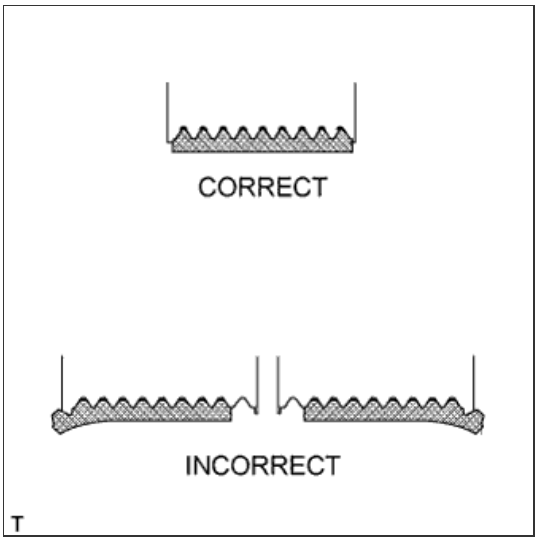


c. Check that the belt fits properly in the ribbed grooves.

HINT:

Check with your hand to confirm that the belt has not slipped out of the groove on the bottom of the pulley.

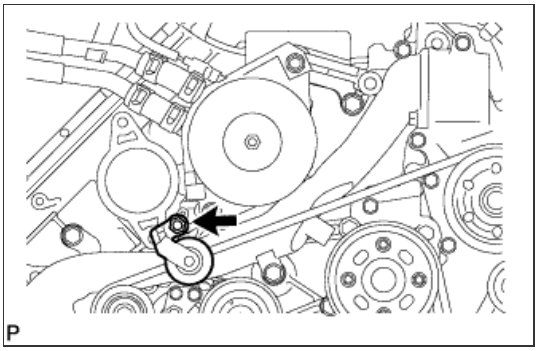
If it has slipped out, replace the V-ribbed belt. Install a new V-ribbed belt.



16. INSTALL NO. 3 IDLER PULLEY (w/ Viscous Heater)

a. Align the No. 3 idler pulley bracket knock pin and No. 1 idler pulley bracket knock pin hole and install the No. 3 idler pulley with the nut.

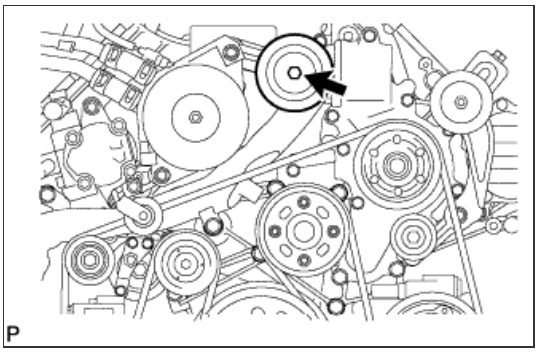
Torque:
88 N*m{ 898 kgf*cm , 64 ft.*lbf }



17. INSTALL NO. 1 IDLER PULLEY (w/ Viscous Heater)

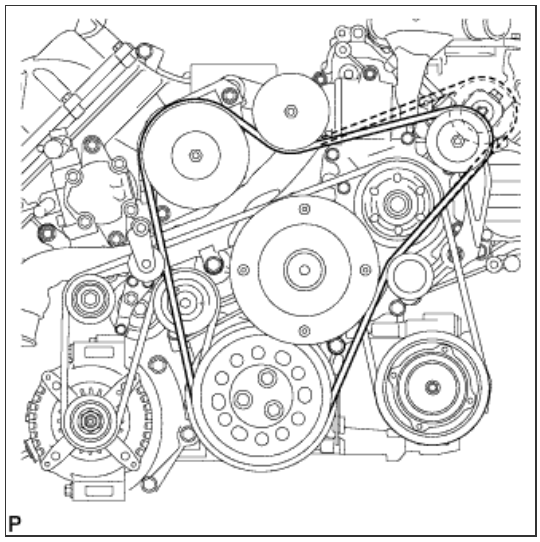
a. Install the collar, No. 1 idler pulley and cover with the bolt.

Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }

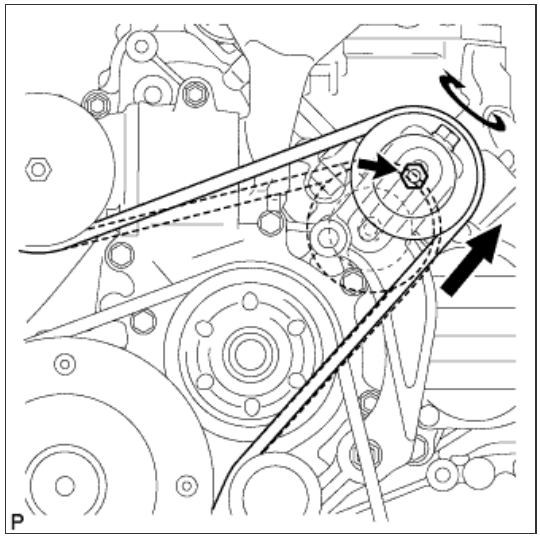


18. INSTALL V-RIBBED BELT (w/ Viscous Heater)

a. Install the V-ribbed belt as shown in the illustration.



b. Temporarily install the lock nut, and turn the bolt clockwise.



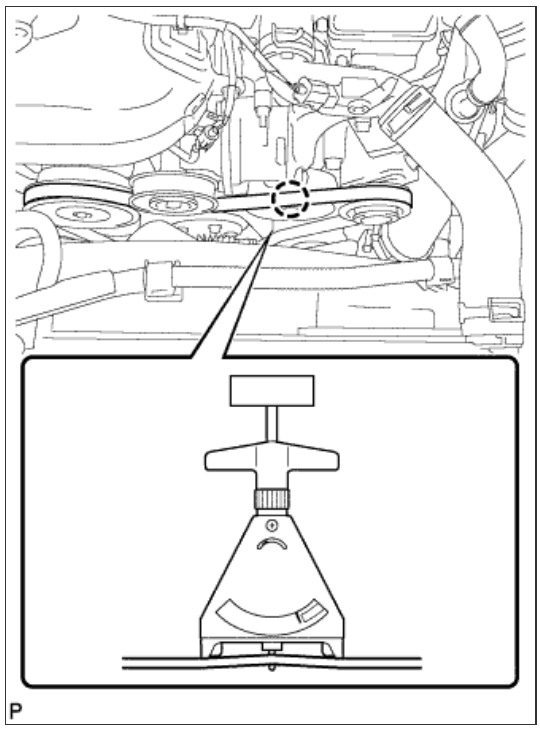
c. Using a belt tension gauge, adjust belt tension.

Stan ar Belt Tension:

Item	Specified Condition
New belt	400 to 650 N (41 to 66 kgf, 89.9 to 146.1 lbf)
Used belt	300 to 500 N (31 to 51 kgf, 67.4 to 112.4 lbf)

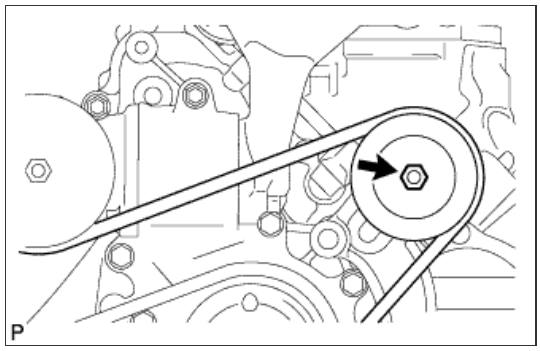
HINT:

- **A new belt is a belt which has been use for less than 5 minutes on a running engine.**
- **A use belt is a belt which has been use on a running engine for 5 minutes or more.**
- **After installing a new belt, run the engine for appro imately 5 minutes an then recheck the tension.**



. Tighten the nut.

Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

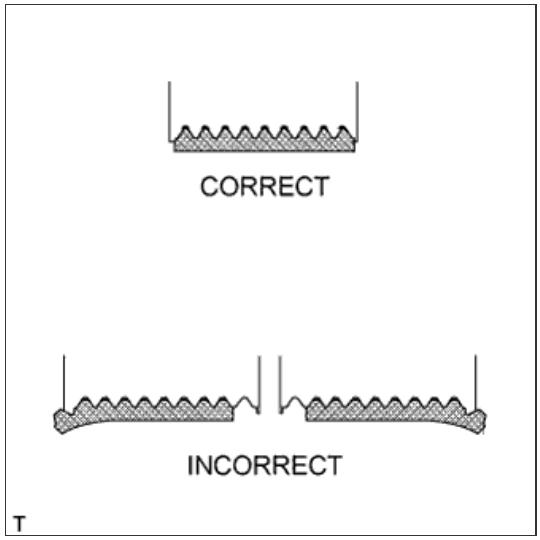


e. Check that the belt fits properly in the ribbed grooves.

HINT:

Check with your hand to confirm that the belt has not slipped out of the groove on the bottom of the pulley.

If it has slipped out, replace the V-ribbed belt. Install a new V-ribbed belt.



19. CONNECT NO. 2 RADIATOR HOSE

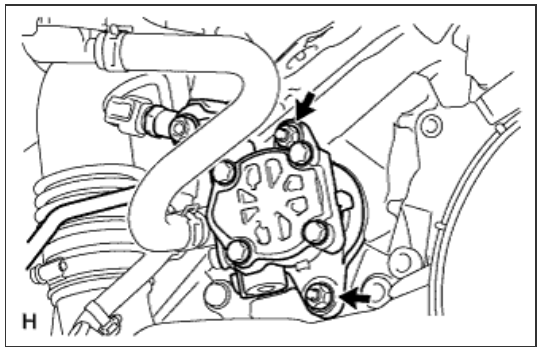
20. CONNECT NO. 1 RADIATOR HOSE

21. INSTALL VANE PUMP ASSEMBLY

a. Apply a light coat of engine oil to a new O-ring, and install it to the vane pump.

b. Install the vane pump with 2 new nuts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



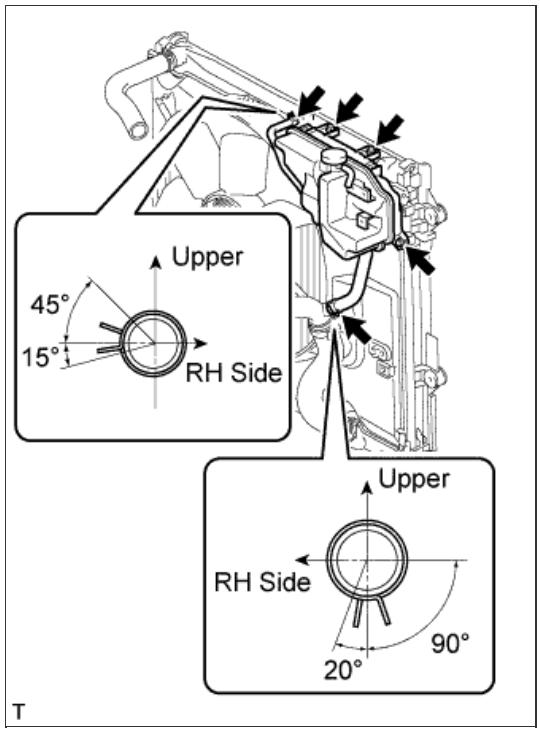
22. INSTALL RADIATOR RESERVOIR ASSEMBLY

a. Install the radiator reservoir with the 3 bolts.

b. Connect the 2 hoses to the upper radiator tank and water inlet.

HINT:

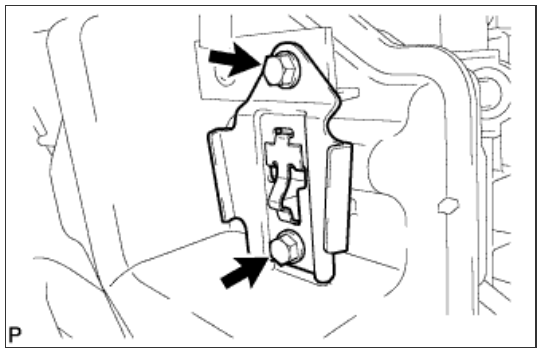
Make sure the directions of the hose clamps are as shown in the illustration.



23. INSTALL NO. 1 OIL RESERVOIR BRACKET

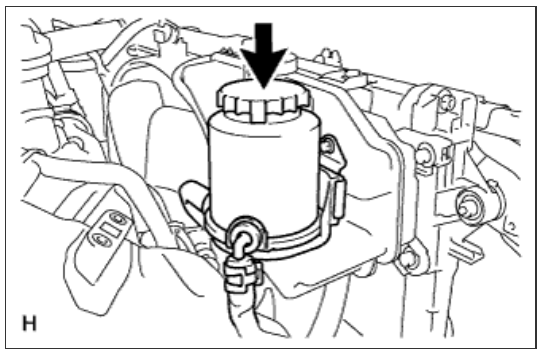
a. Install a new bracket with the 2 bolts.

Torque:
4.5 N*m{ 46 kgf*cm , 40 in.*lbf }



24. INSTALL VANE PUMP OIL RESERVOIR ASSEMBLY

a. Install the vane pump oil reservoir to the bracket.



25. INSTALL INTAKE AIR CONNECTOR

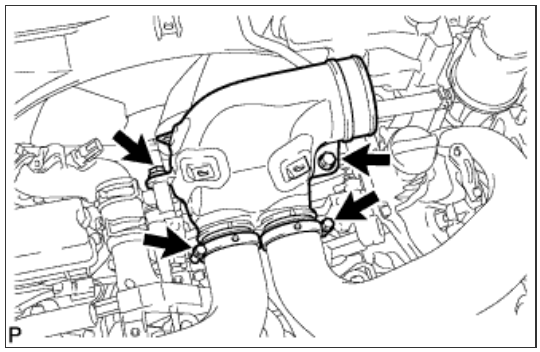
a. Connect the intake air connector to the No. 1 and No. 2 air cleaner pipes.

b. Install the connector with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Tighten the 2 hose clamps.

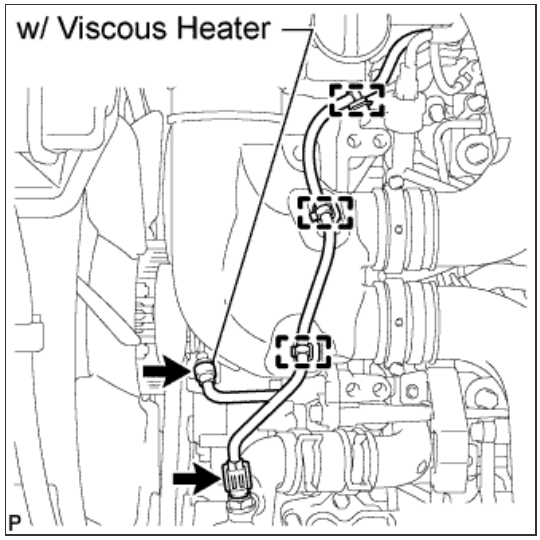
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



. Attach the 3 wire harness clamps.

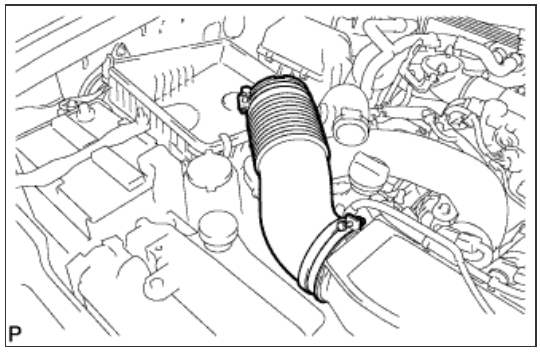
e. w/o Viscous Heater:
Connect the connector to the water temperature sensor.

f. w/ Viscous Heater:
Connect the 2 connectors to the water temperature sensor and viscous with magnet clutch heater.



26. TEMPORARILY INSTALL NO. 1 AIR CLEANER HOSE

a. Temporarily install the air cleaner hose to the intake air connector.

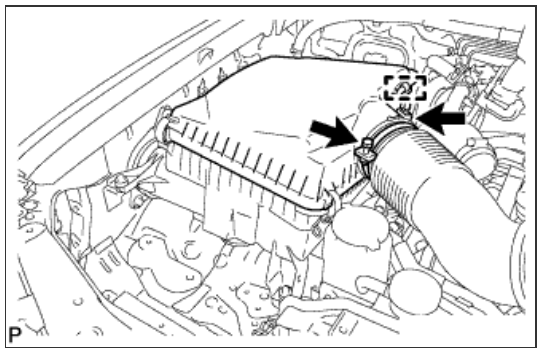


27. INSTALL AIR CLEANER CAP SUB-ASSEMBLY

a. Connect the air cleaner cap to the air cleaner hose, and install the air cleaner cap with the 4 clamps.

b. Connect the mass air flow meter connector and attach the wire harness clamp to the air cleaner cap.

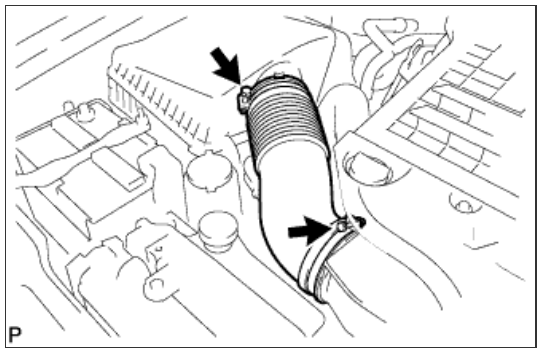
c. Attach the wire harness clamp.



. Align the protrusion of air cleaner cap and concave portion of air cleaner hose.

e. Tighten the 2 hose clamps.

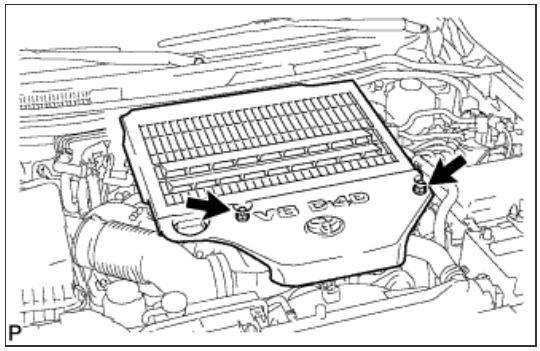
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



28. INSTALL NO. 1 ENGINE COVER SUB-ASSEMBLY (w/ Intercooler)

a. Install the engine cover with the 2 nuts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

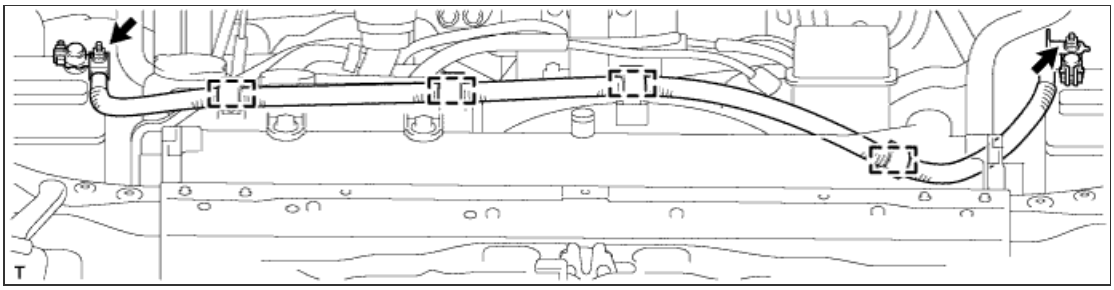


29. INSTALL NO. 3 ENGINE ROOM WIRE

a. Install the No. 3 engine room wire to the main battery and sub-battery positive terminals with the 2 nuts.

Torque:
7.6 N*m{ 77 kgf*cm , 67 in.*lbf }

b. Connect the No. 3 engine room wire with the 4 clamps.



30. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

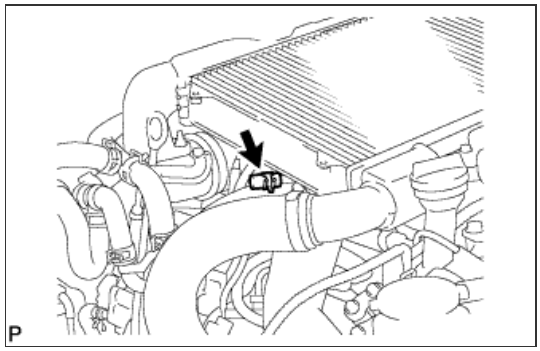
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

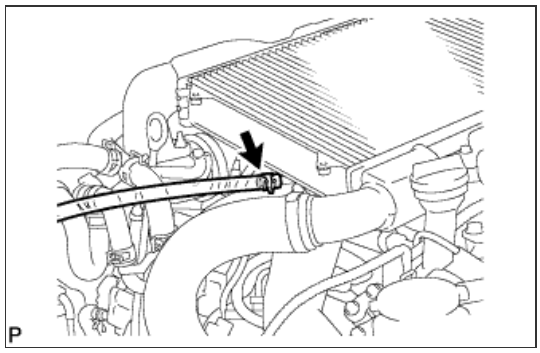
a. Connect the cables to negative (-) main battery and sub-battery terminals.

31. ADD ENGINE COOLANT

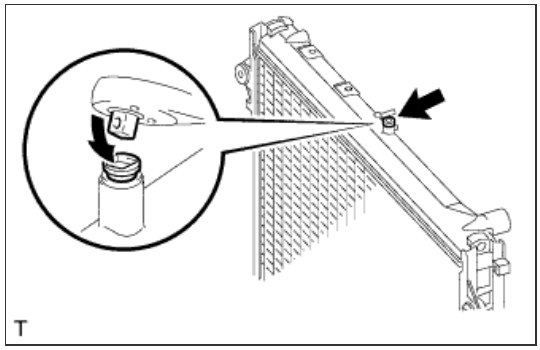
a. Remove the engine air bleed cap.



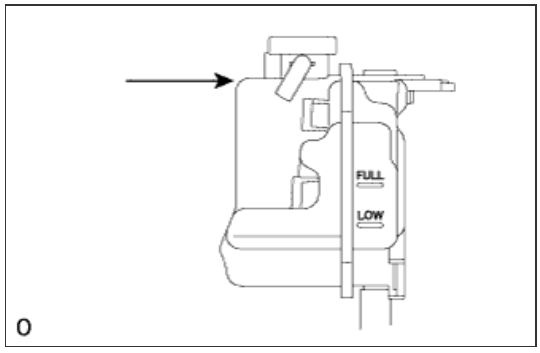
b. Connect a clear hose to the engine air bleed pipe.



c. Using a wrench, remove the vent plug.



. Fill the radiator with TOYOTA SLLC to the radiator reservoir filler neck.



HINT:

Pour TOYOTA SLLC until it spills out of the engine air bleed pipe.

Stan ar Capacity (for Automatic Transmission):

Item	Specified Condition
Front heater only	14.8 liters (15.6 US qts, 13.0 Imp. qts)
Front heater and rear heater	17.6 liters (18.6 US qts, 15.5 Imp. qts)
Front heater with viscous heater	15.2 liters (16.1 US qts, 13.4 Imp. qts)
Front heater and rear heater with viscous heater	18.0 liters (19.0 US qts, 15.4 Imp. qts)

Stan ar capacity (for Manual Transmission):
15.4 liters (16.3 US qts, 13.6 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low

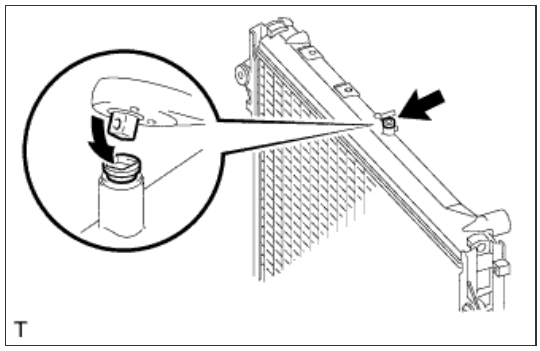
phosphates and organic acids).

e. Install the vent plug.

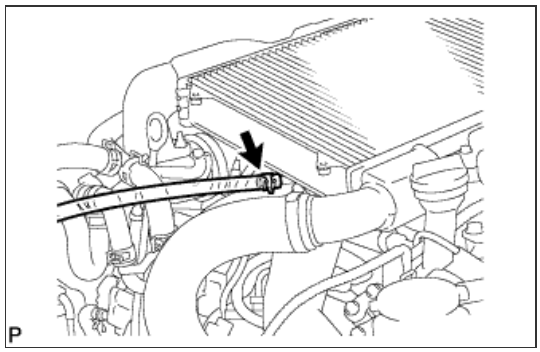
Torque:
2.0 N*m{ 20 kgf*cm , 18 in.*lbf }

NOTICE:

Do not tighten the plug to 5.0 N*m (51 kgf*cm, 44 in.*lbf) or more, as the plug will be damaged.



f. Disconnect the clear hose from the engine air bleed pipe.



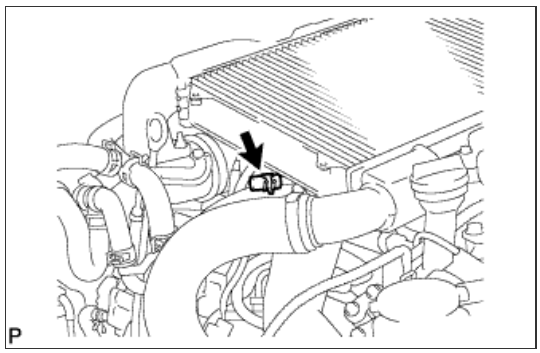
g. Install the engine air bleed cap when coolant comes out.

h. Install the radiator reservoir cap.

i. Start the engine.

NOTICE:

Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the FULL line.



j. Maintain an engine speed of 3000 rpm for approximately 10 minutes so that the thermostat opens and air bleeding is performed.

CAUTION:

When pressing the ra iator hoses:

- **Wear protective gloves.**
- **Be careful as the ra iator hoses are hot.**
- **Keep your han s away from the ra iator fan**

NOTICE:

- **Pay attention to the nee le of the water temperature meter. Make sure that the nee le oes not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**

HINT:

The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

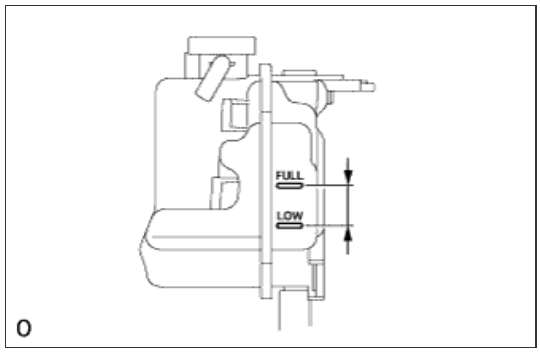
k. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

l. Check that the coolant level is between the FULL and LOW lines.
If the coolant level is above the FULL line, drain coolant so that the coolant level

is between the FULL and LOW lines.



32. INSPECT FOR ENGINE COOLANT LEAK

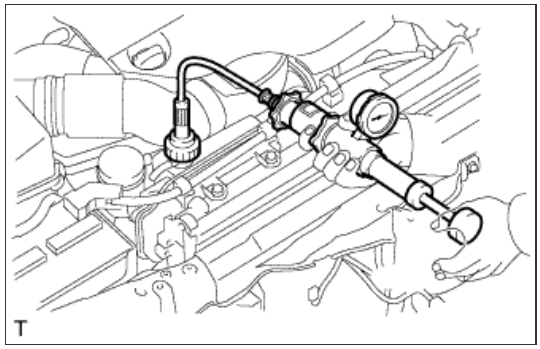
CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester to the radiator reservoir.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 17.8 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks.
If no external leaks are found, check the cylinder block and cylinder head.



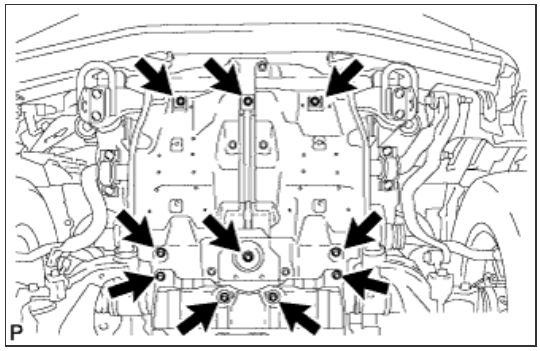
33. INSTALL UPPER RADIATOR SUPPORT SEAL

a. Install the upper radiator support seal with the 7 clips.

34. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

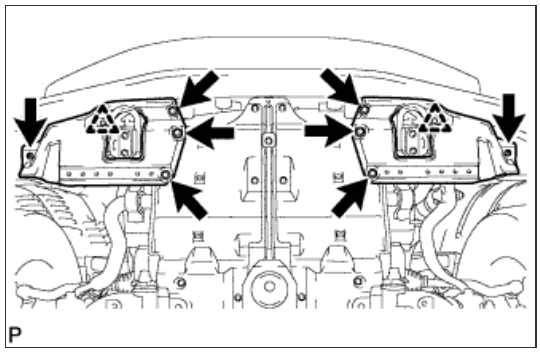
a. Install the engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



35. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

a. Install the splash shield with the clip, and then install the 3 bolts and screw.

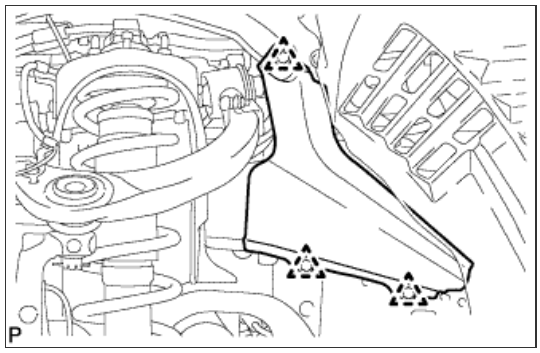


36. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Install the splash shield with the clip, and then install the 3 bolts and screw.

37. INSTALL FRONT FENDER APRON SEAL FRONT RH

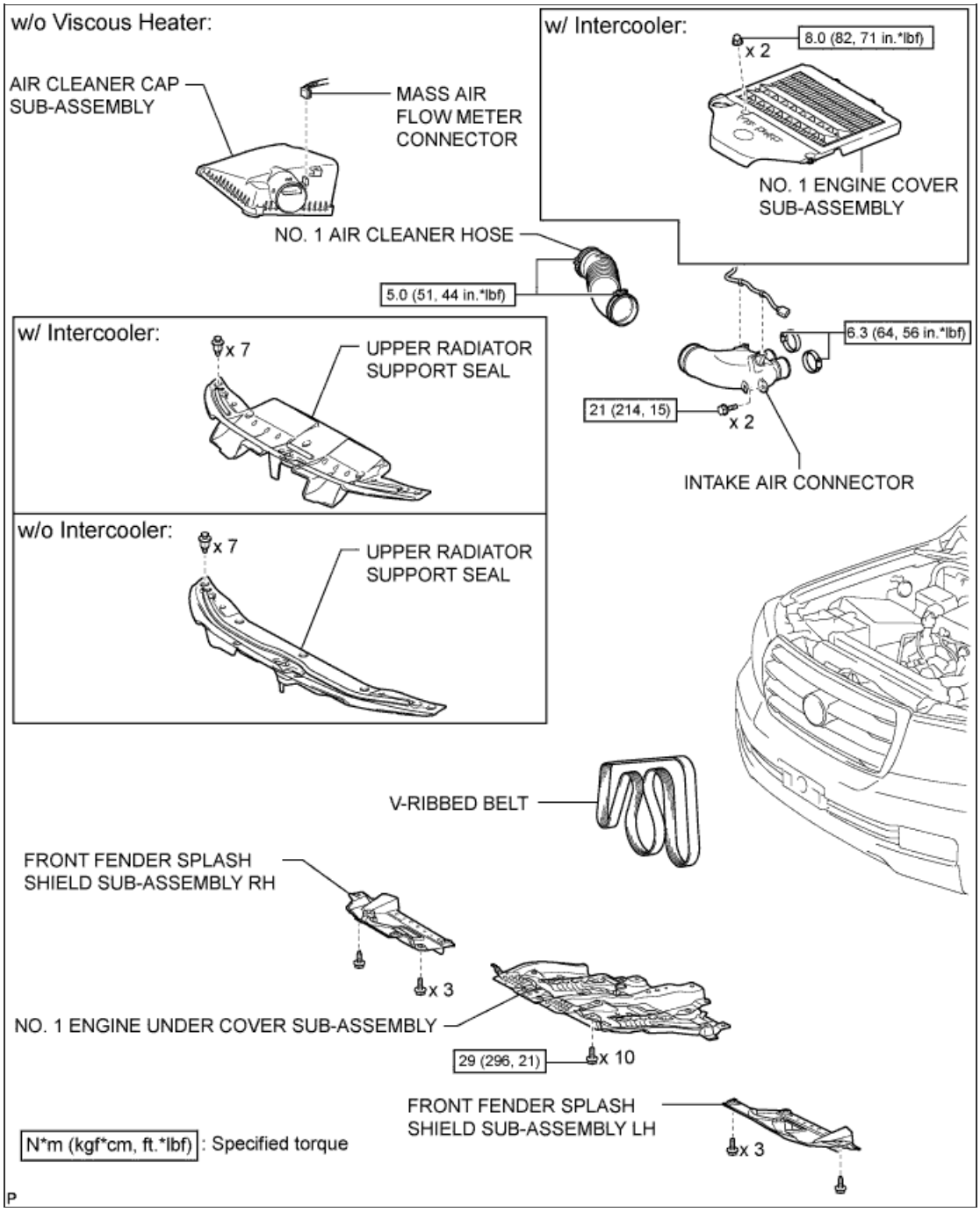
a. Install the front fender apron seal front RH with the 3 clips.



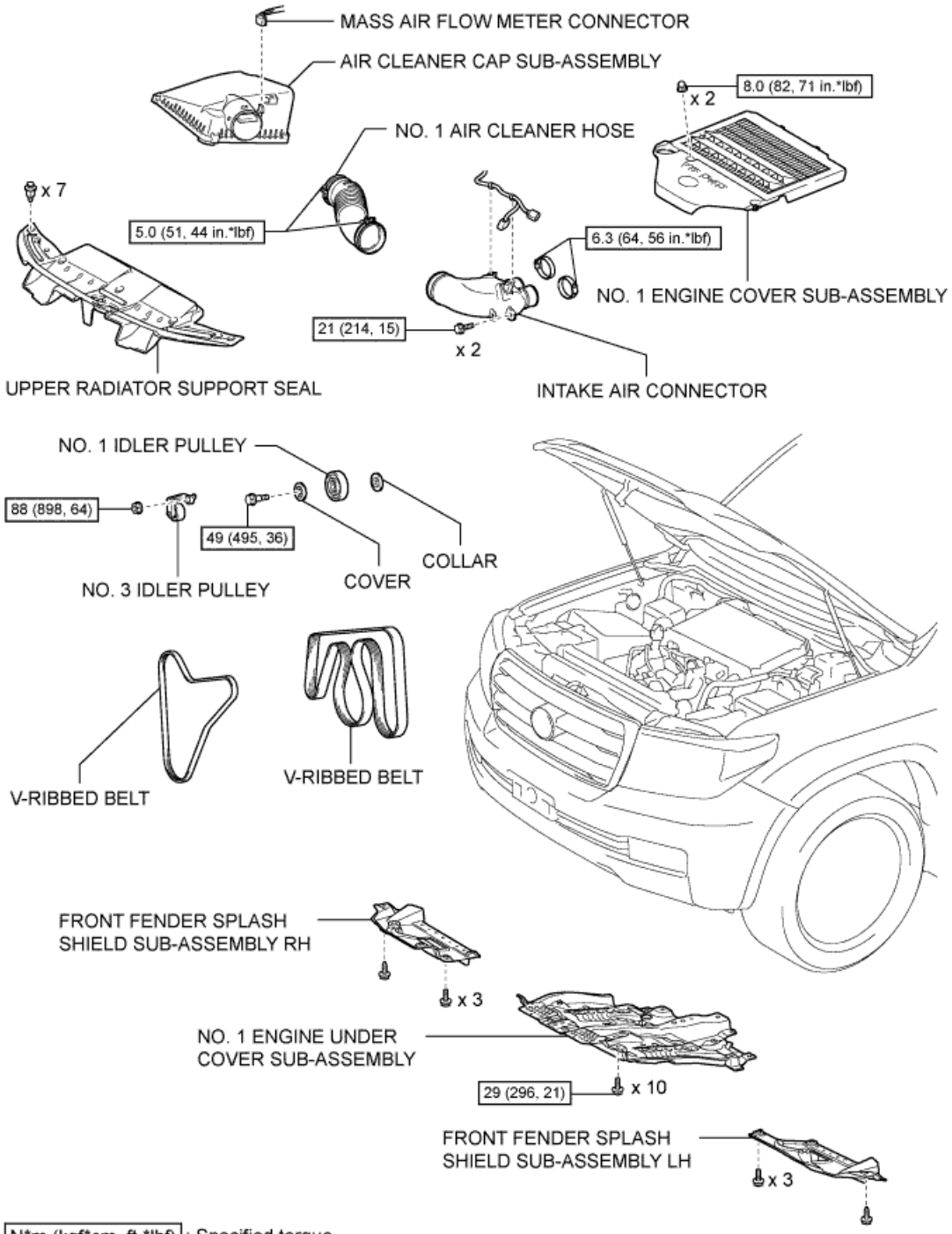
38. INSTALL FRONT WHEEL RH

Torque:
for Aluminum Wheel:
131 N*m{ 1336 kgf*cm , 97 ft.*lbf }
for Steel Wheel:
209 N*m{ 2131 kgf*cm , 154 ft.*lbf }

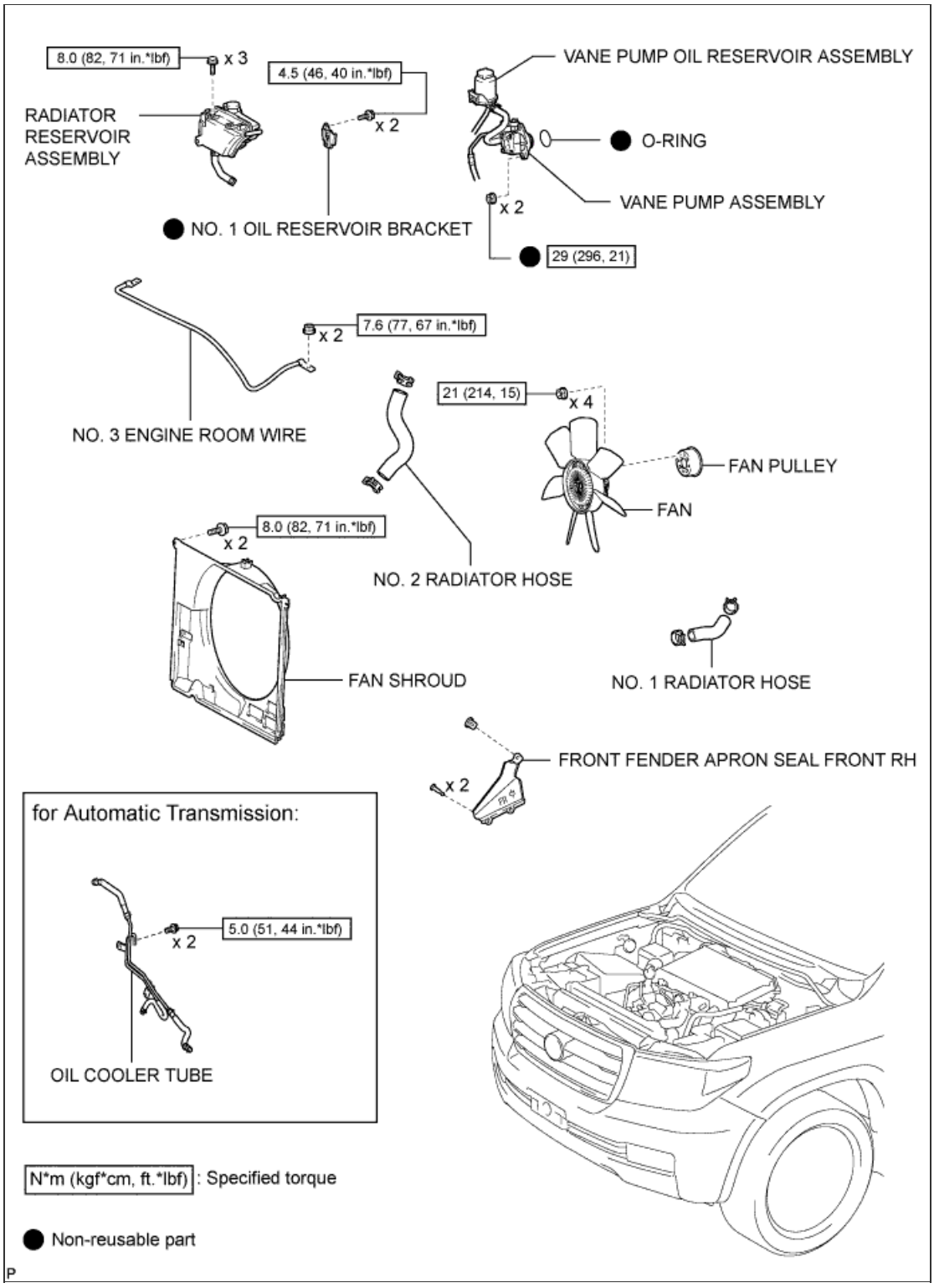
for Preparation Click here

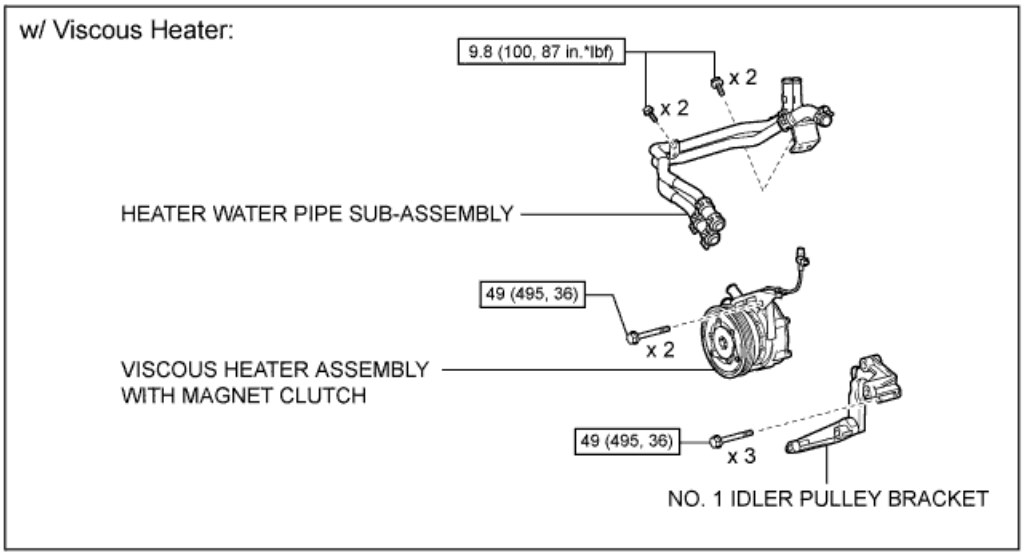


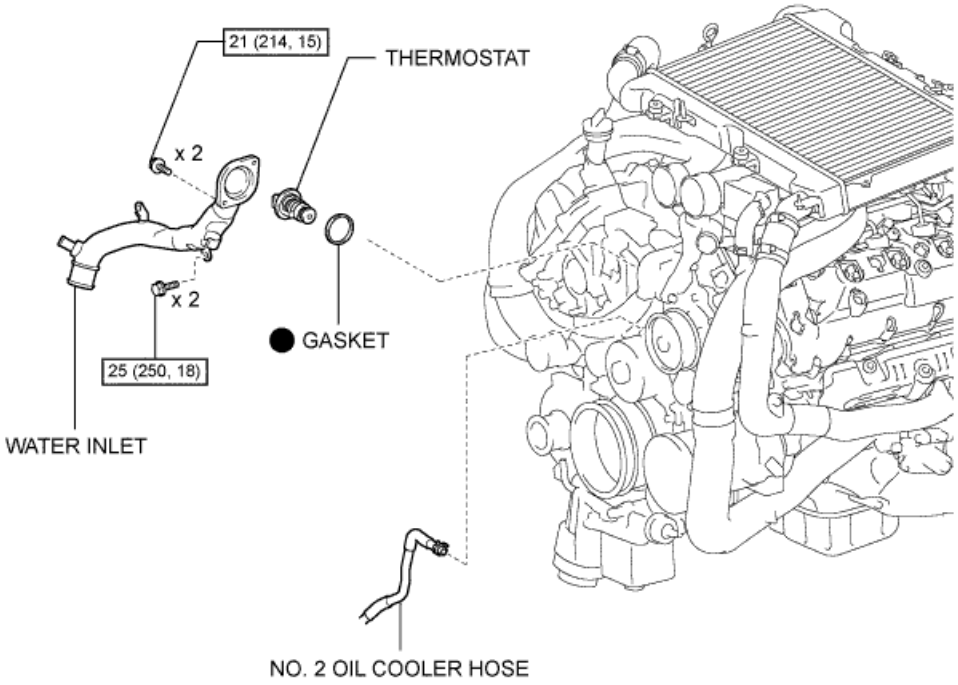
w/ Viscous Heater:



P


8.0 (82, 71 in.*lbf)
x 3
4.5 (46, 40 in.*lbf)
x 2
RADIATOR RESERVOIR ASSEMBLY
NO. 1 OIL RESERVOIR BRACKET
VANE PUMP OIL RESERVOIR ASSEMBLY
O-RING
VANE PUMP ASSEMBLY
x 2
29 (296, 21)
x 2
7.6 (77, 67 in.*lbf)
NO. 3 ENGINE ROOM WIRE
21 (214, 15)
x 4
FAN PULLEY
FAN
8.0 (82, 71 in.*lbf)
x 2
NO. 2 RADIATOR HOSE
FAN SHROUD
NO. 1 RADIATOR HOSE
FRONT FENDER APRON SEAL FRONT RH
x 2
for Automatic Transmission:
x 2
5.0 (51, 44 in.*lbf)
OIL COOLER TUBE
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P





N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Disconnect the cables from the negative (-) main battery and sub-battery terminals.

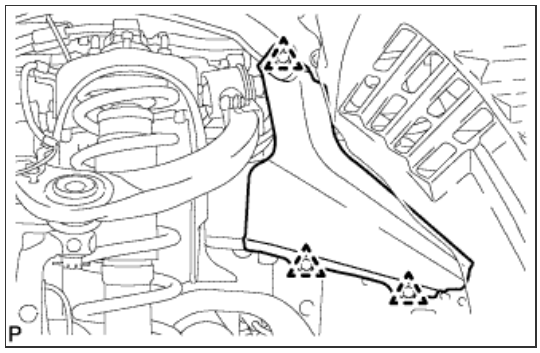
2. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and upper radiator support seal.

3. REMOVE FRONT WHEEL RH

4. REMOVE FRONT FENDER APRON SEAL FRONT RH

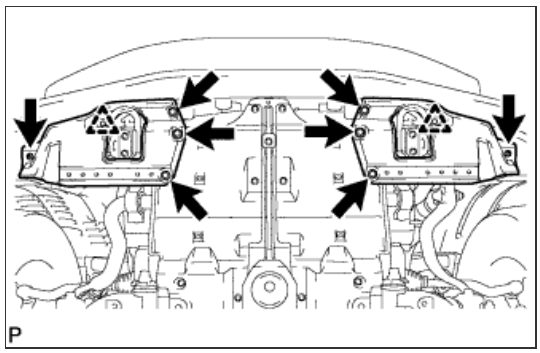
a. Remove the 3 clips and front fender apron seal front RH.



5. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.



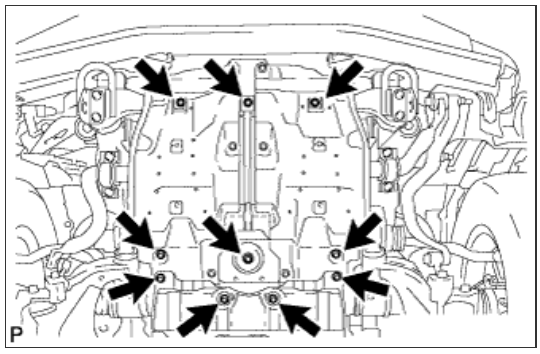
6. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.

7. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



8. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

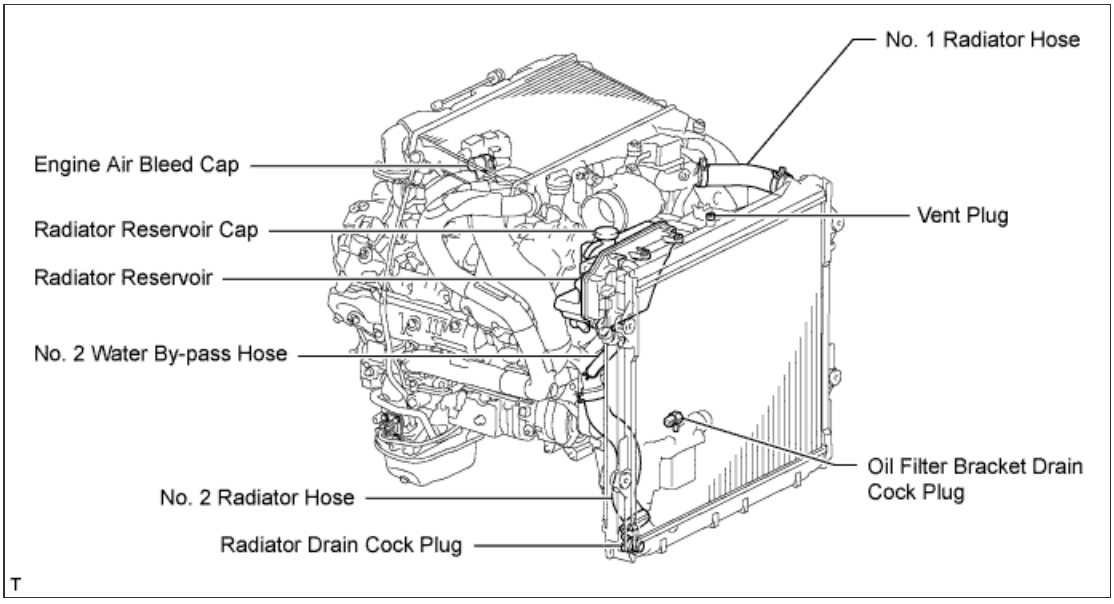
HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

a. Loosen the radiator drain cock plug.

b. Remove the radiator reservoir cap to drain the coolant in the radiator.

c. Loosen the oil filter bracket drain cock plug to drain the coolant in the engine.

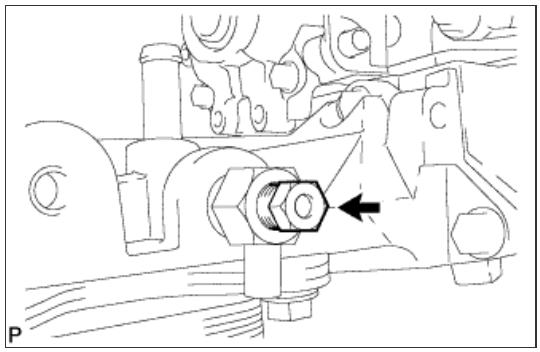


d. ighten the radiator drain cock plug by hand.

e. ighten the oil filter bracket drain cock plug.

Torque:

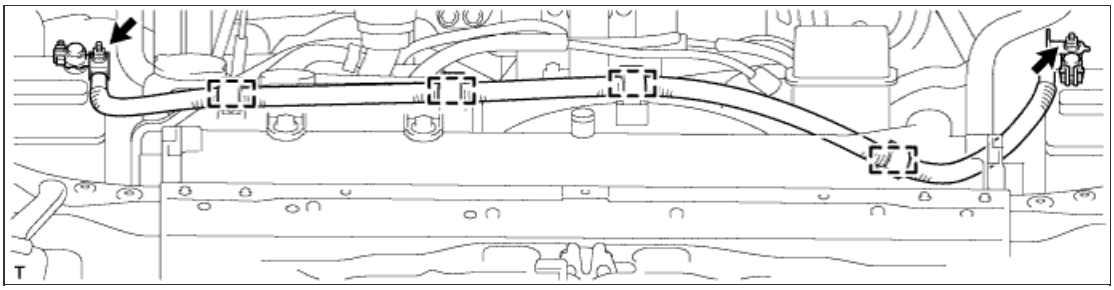
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



9. REMOVE NO. 3 ENGINE ROOM WIRE

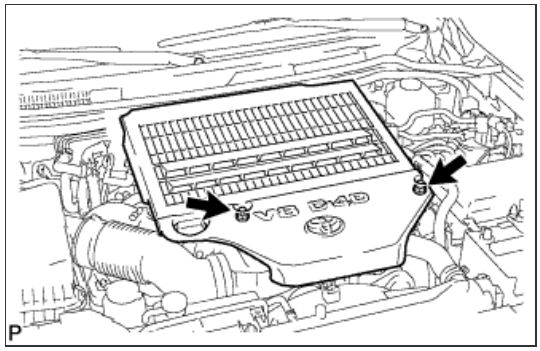
a. Disconnect the 4 wire harness clamps.

b. Remove the 2 nuts and No. 3 engine room wire.



10. REMOVE NO. 1 ENGINE COVER SUB-ASSEMBLY (w/ Intercooler

a. Remove the 2 nuts and No. 1 engine cover.

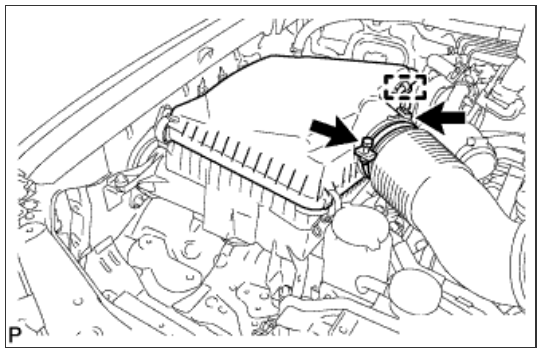


11. REMOVE AIR CLEANER CAP SUB-ASSEMBLY

a. Loosen the hose clamp.

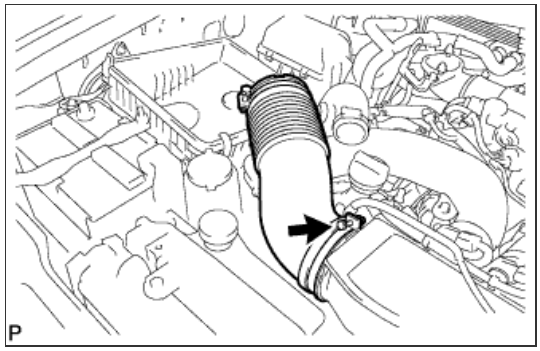
b. Disconnect the mass air flow meter connector and using a clip remover, detach the wire harness clamp from the air cleaner cap.

c. Detach the 4 clamps and remove the air cleaner cap.



12. REMOVE NO. 1 AIR CLEANER HOSE

a. Loosen the hose clamp and remove the No. 1 air cleaner hose.



13. REMOVE INTAKE AIR CONNECTOR

a. w/o Viscous Heater:

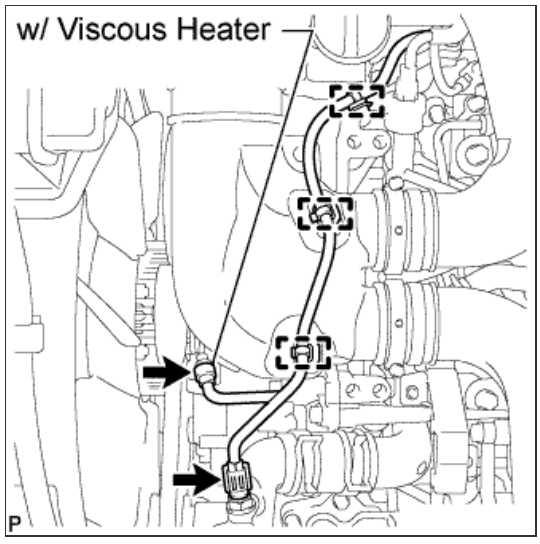
i. Disconnect the connector from the water temperature sensor.

ii. Using a clip remover, detach the 3 wire harness clamps.

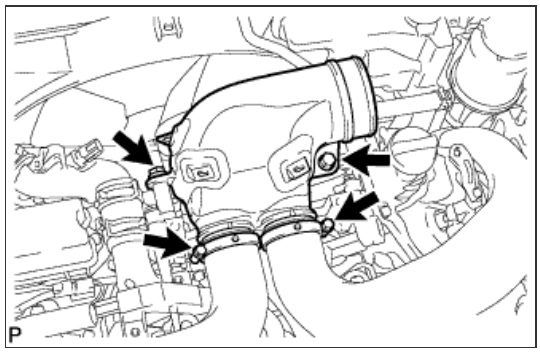
b. w/ Viscous Heater:

i. Disconnect the 2 connectors from the viscous with magnet clutch heater and water temperature sensor.

ii. Using a clip remover, detach the 3 wire harness clamps.

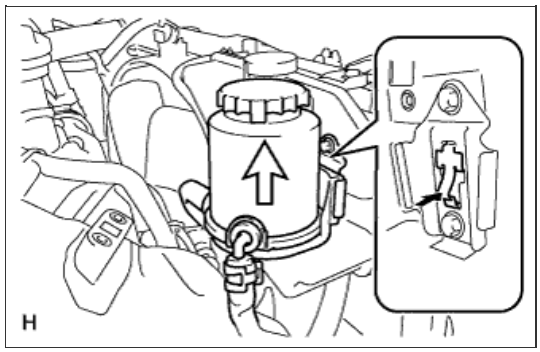


c. Loosen the 2 hose clamps and remove the 2 bolts and intake air connector.



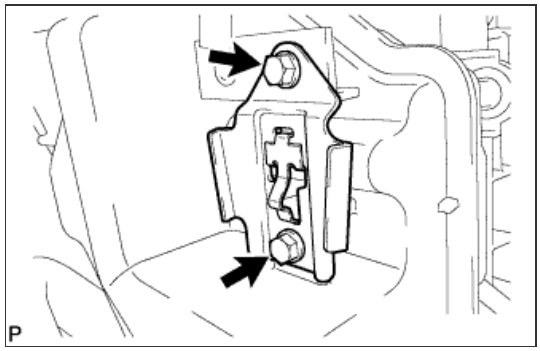
14. REMOVE VANE PUMP OIL RESERVOIR ASSEMBLY

a. Insert a screwdriver between the reservoir and oil reservoir bracket, push the claw, and then disconnect the reservoir by pulling it upwards.



15. REMOVE NO. 1 OIL RESERVOIR BRACKET

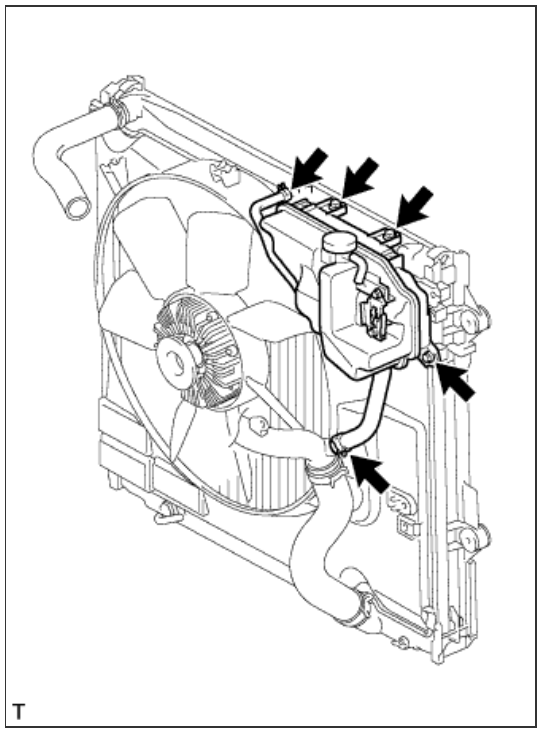
a. Remove the 2 bolts and bracket.



16. REMOVE RADIATOR RESERVOIR ASSEMBLY

a. Disconnect the 2 hoses.

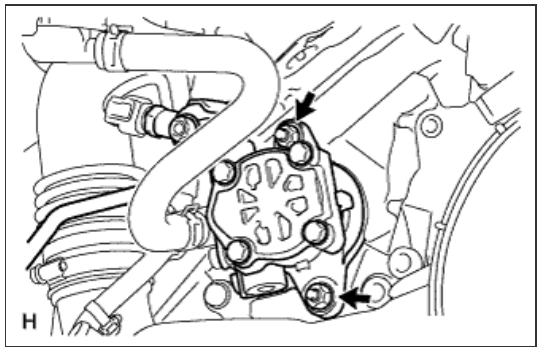
b. Remove the 3 bolts and radiator reservoir.



17. REMOVE VANE PUMP ASSEMBLY

a. Remove the 2 nuts and vane pump.

b. Remove the O-ring from the vane pump.



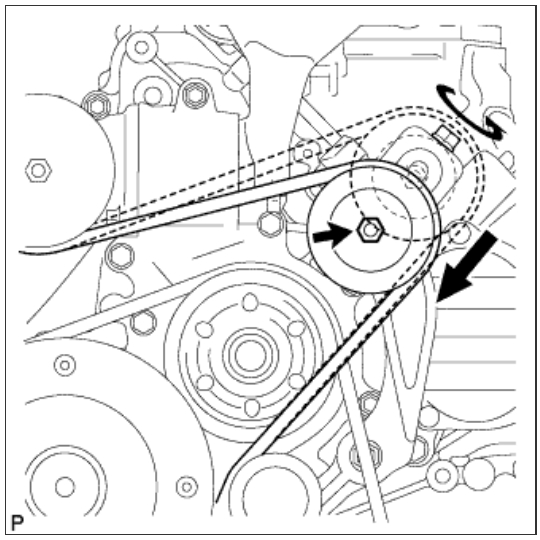
18. DISCONNECT NO. 1 RADIATOR HOSE

19. DISCONNECT NO. 2 RADIATOR HOSE

20. REMOVE V-RIBBED BELT (w/ Viscous Heater

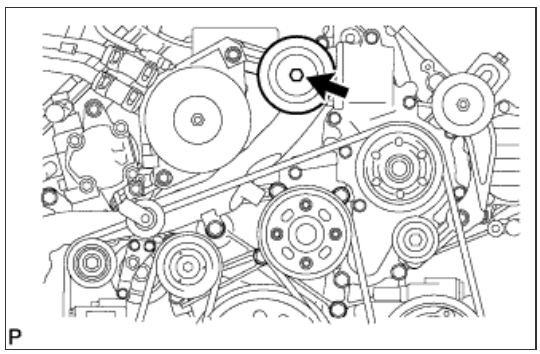
a. Loosen the lock nut and turn the bolt counterclockwise.

b. Remove the V-ribbed belt.



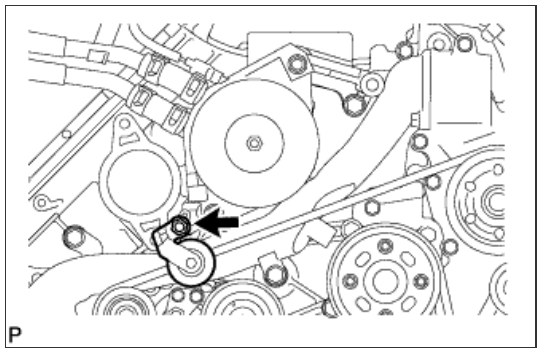
21. REMOVE NO. 1 IDLER PULLEY (w/ Viscous Heater

a. Remove the bolt, cover, No. 1 idler pulley and collar.



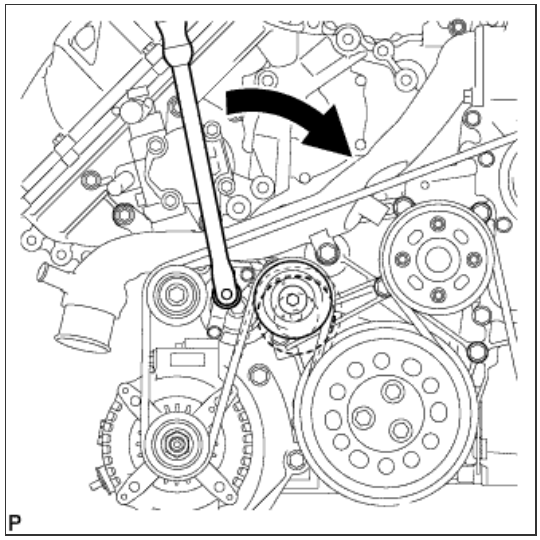
22. REMOVE NO. 3 IDLER PULLEY (w/ Viscous Heater

a. Remove the nut and No. 3 idler pulley.



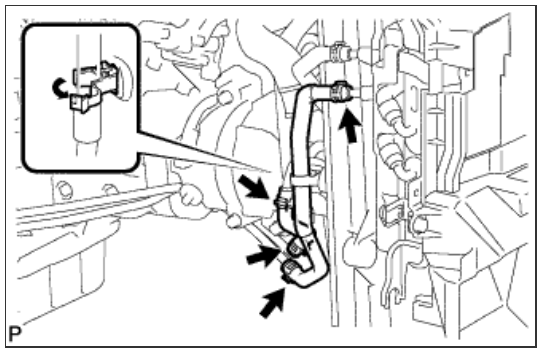
23. REMOVE V-RIBBED BELT

a. Using a wrench to the V-ribbed belt tensioner bracket, turn the wrench clockwise and remove the V-ribbed belt.

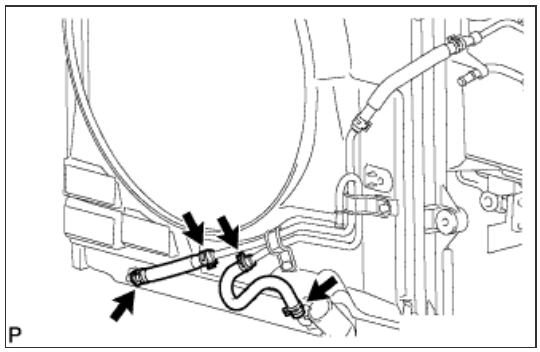


24. REMOVE OIL COOLER TUBE (for Automatic Transmission

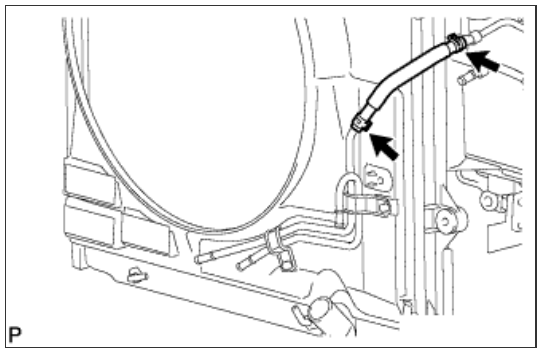
a. Disconnect the inlet and outlet No. 1 oil cooler hose.



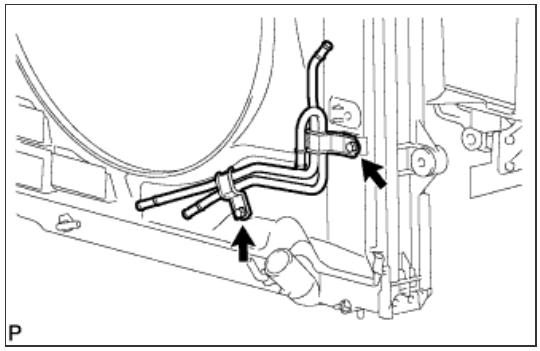
b. Disconnect the inlet No. 2 and No. 3 oil cooler hoses.



c. Disconnect the inlet No. 4 oil cooler hose.

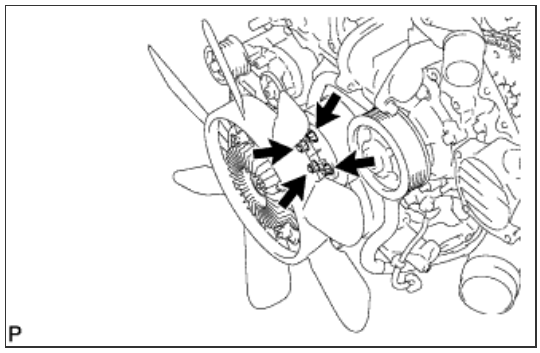


d. Remove the 2 bolts and transmission oil cooler tube.

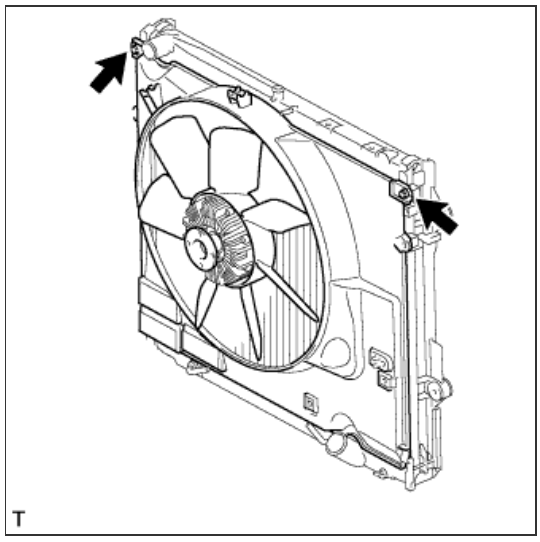


25. REMOVE FAN SHROUD WITH FAN

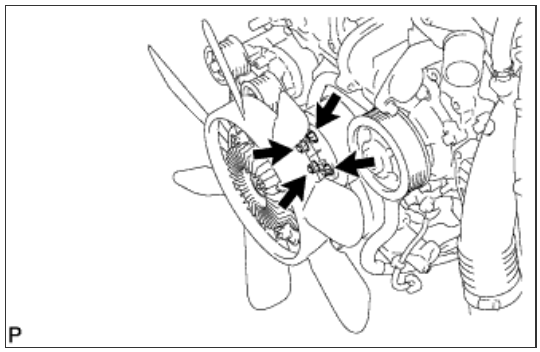
a. Loosen the 4 nuts holding the fluid coupling fan.



b. Remove the 2 bolts holding the fan shroud.



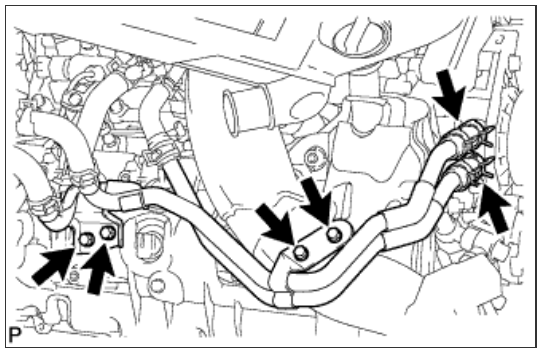
c. Remove the 4 nuts of the fluid coupling fan, and then remove the shroud together with the fluid coupling fan.



26. REMOVE FAN PULLEY

27. REMOVE HEATER WATER PIPE SUB-ASSEMBLY (w/ Viscous Heater

a. Remove the 4 bolts and disconnect the heater water pipe from the viscous heater with magnet clutch.



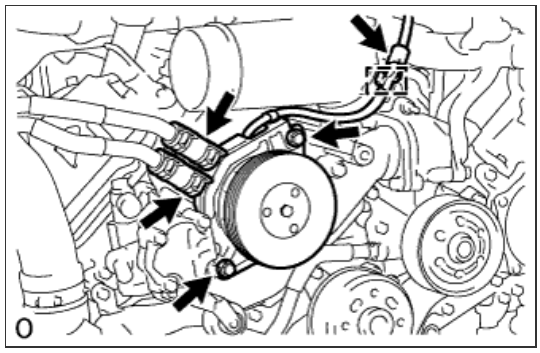
28. REMOVE VISCOUS WITH MAGNET CLUTCH HEATER ASSEMBLY (w/ Viscous Heater

a. Disconnect the connector and detach the clamp.

b. Using pliers, grip the claws of the clips and slide the 2 clips.

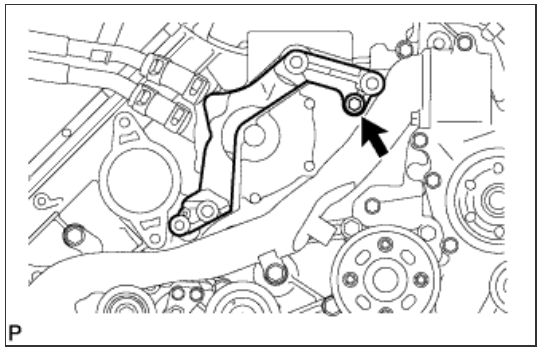
c. Disconnect the 2 heater hoses.

d. Remove the 2 bolts and heater assembly.



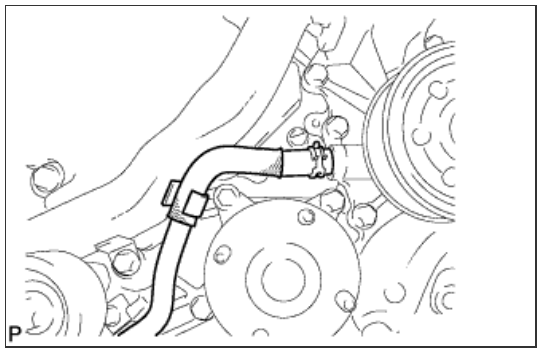
29. REMOVE NO. 1 IDLER PULLEY BRACKET (w/ Viscous Heater

a. Remove the bolt and No. 1 idler pulley bracket.

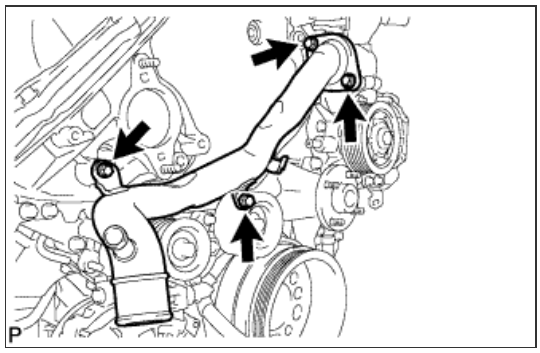


30. REMOVE WATER INLET

a. Disconnect the No. 2 oil cooler hose from the water pump and clamp.



b. Remove the 4 bolts and water inlet.



31. REMOVE THERMOSTAT

a. Remove the thermostat.

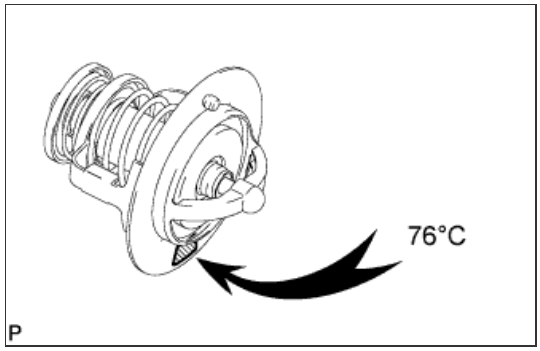
b. Remove the gasket from the thermostat.

for Preparation Click here

1. INSPECT THERMOSTAT

HINT:

The valve opening temperature is inscribed on the thermostat.

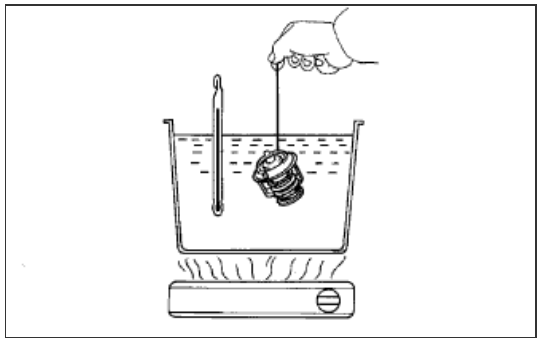


a. Immerse the thermostat in water and then gradually heat the water.

b. Check the valve opening temperature.

Valve opening temperature:
74 to 78°C (165 to 172°F)

If the valve opening temperature is not within the specified range, replace the thermostat.



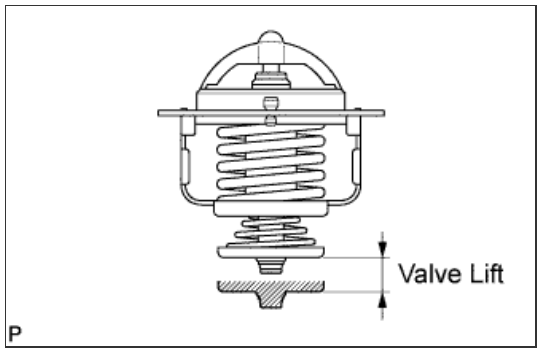
c. Check the valve lift.

Valve lift:
10 mm (0.394 in.) or more at 90°C (194°F)

If the valve lift is not as specified, replace the thermostat.

d. Check that the valve is fully closed when the thermostat is at low temperatures (below 40°C (104°F)).

If not fully closed, replace the thermostat.



for Preparation Click here

1. INSTALL THERMOSTAT

a. Install a new gasket to the thermostat.

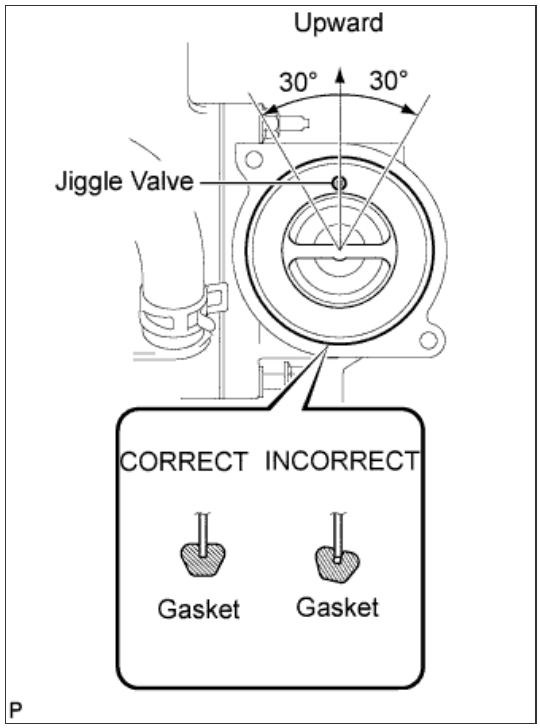
NOTICE:

When installing the gasket to the thermostat, be careful not to deform the gasket. Make sure that the groove of the gasket is properly installed onto the thermostat, as shown in the illustration.

b. Insert the thermostat into the water pump with the jiggle valve facing straight upward.

HINT:

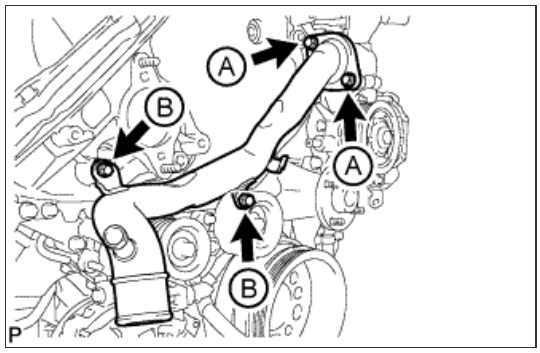
The jiggle valve may be set within 30° of either side of the prescribed position.



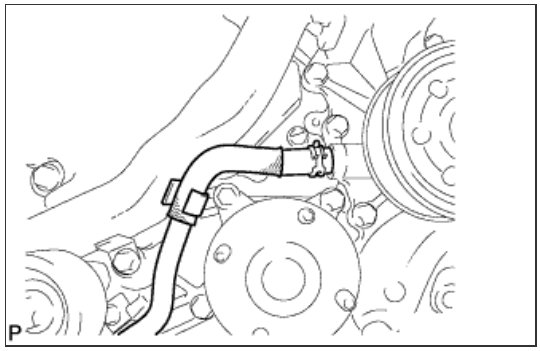
2. INSTALL WATER INLET

a. Install the water inlet with the 4 bolts.

Torque:
for bolt A:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for bolt B:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }



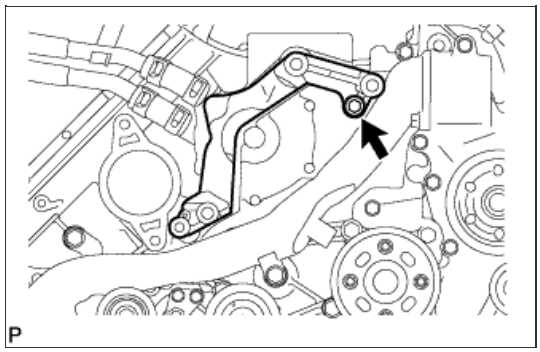
b. Connect the No. 2 oil cooler hose to the clamp and water pump.



3. INSTALL NO. 1 IDLER PULLEY BRACKET (w/ Viscous Heater)

a. Install the No. 1 idler pulley bracket with the bolt.

Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }



4. INSTALL VISCOUS WITH MAGNET CLUTCH HEATER ASSEMBLY (w/ Viscous Heater)

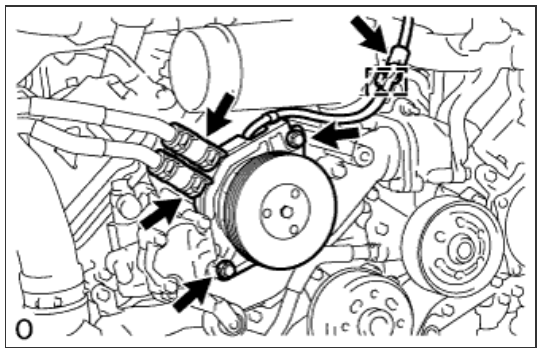
a. Install the heater assembly with the 2 bolts.

Torque:
48.5 N*m{ 495 kgf*cm , 36 ft.*lbf }

b. Connect the 2 heater hoses.

c. Using pliers, grip the claws of the clips and slide the 2 clips.

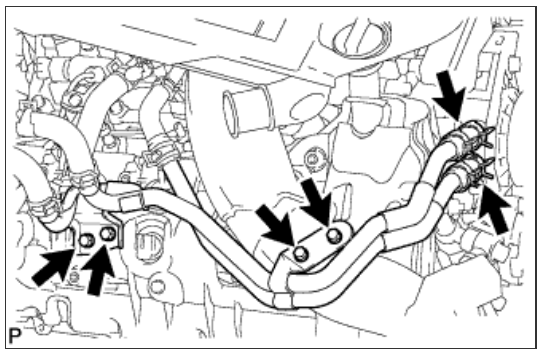
d. Connect the connector and attach the clamp.



5. INSTALL HEATER WATER PIPE SUB-ASSEMBLY (w/ Viscous Heater)

a. Connect the heater water pipe to the viscous heater with magnet clutch, and install the 4 bolts.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }



6. INSTALL AN PULLEY

7. INSTALL AN SHROUD WITH AN

a. Install the shroud together with the fluid coupling fan between the radiator and engine components.

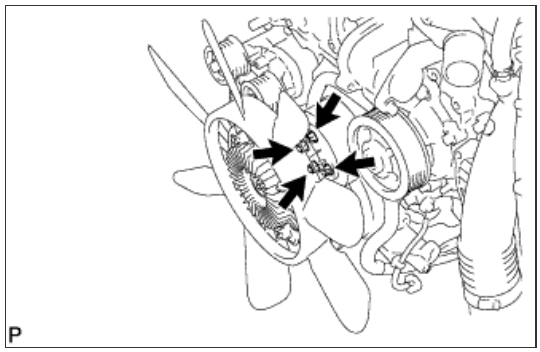
NOTICE:

Be careful not to damage the radiator core.

b. Temporarily install the fluid coupling fan to the fan bracket with the 4 nuts.

HINT:

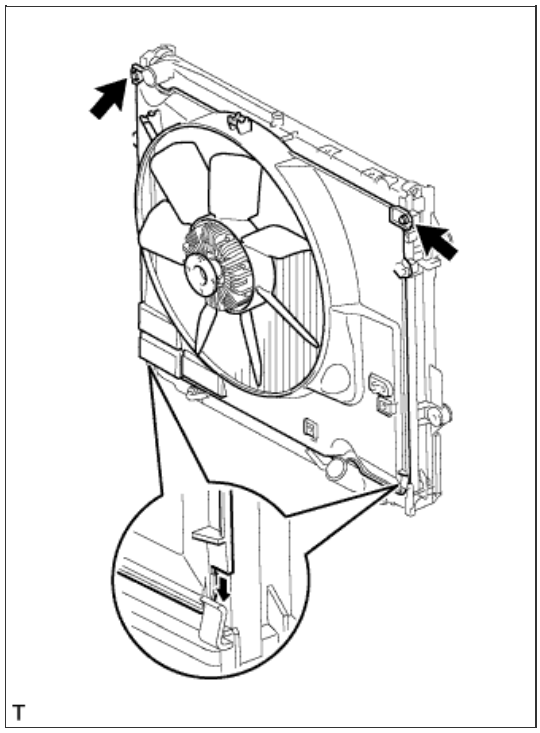
Tighten the nuts as much as possible by hand.



c. Attach the shroud claws to the radiator.

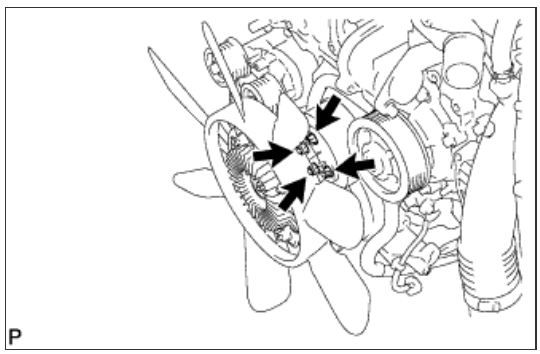
d. Install the shroud with the 2 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }



e. Tighten the 4 nuts of the fluid coupling fan.

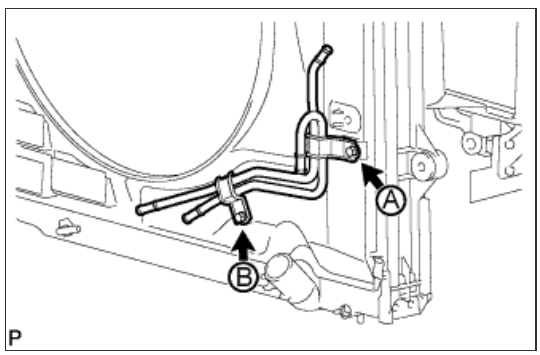
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



8. INSTALL OIL COOLER TUBE (for Automatic Transmission)

a. Temporarily install the oil cooler tube to the fan shroud with the bolt labeled A. Install the bolt labeled B. Then tighten the bolt labeled A to the specified torque.

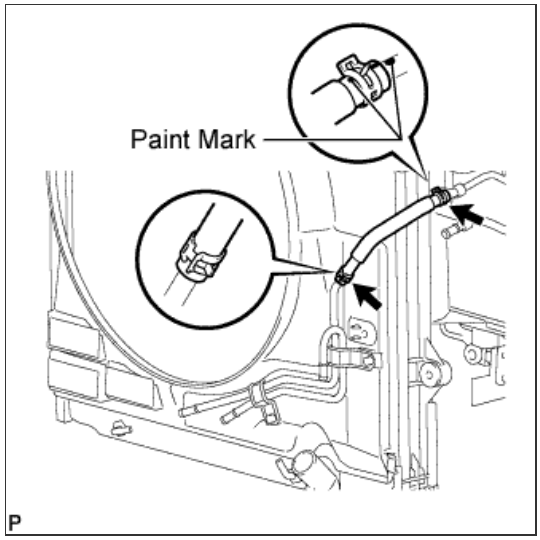
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



b. Connect the inlet No. 4 oil cooler hose as shown in the illustration.

NOTICE:

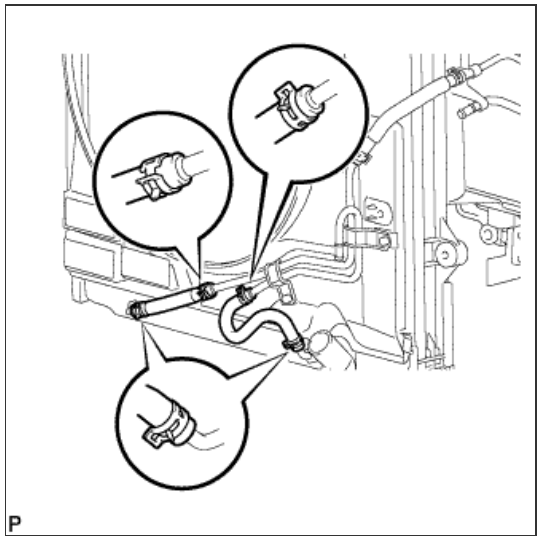
Make sure the pinching portion of each clip is facing the direction shown in the illustration.



c. Connect the inlet No. 2 and No. 3 oil cooler hoses as shown in the illustration.

NOTICE:

Make sure the pinching portion of each clip is facing the direction shown in the illustration.

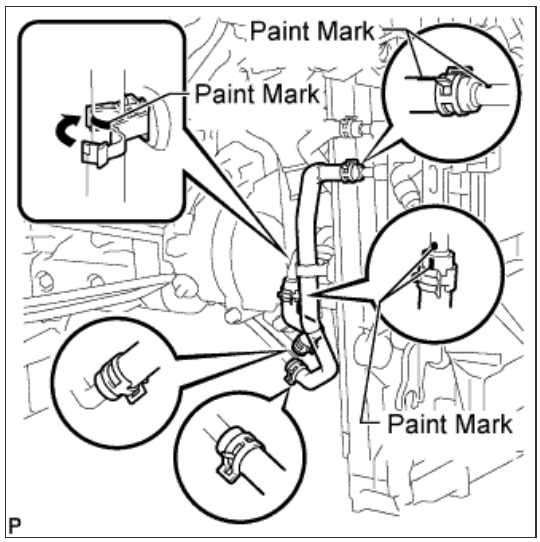


d. Connect the inlet and outlet No. 1 oil cooler hoses as shown in the illustration.

NOTICE:

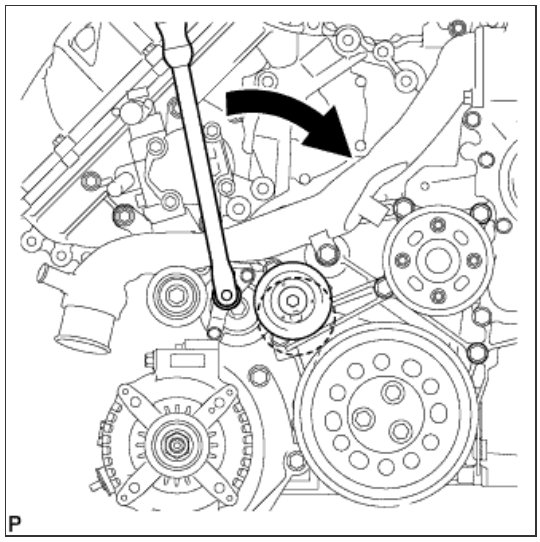
Make sure the pinching portion of each clip is facing the direction shown in the illustration.

e. Pass the hose through the flexible hose clamp and close the clamp shown in the illustration.

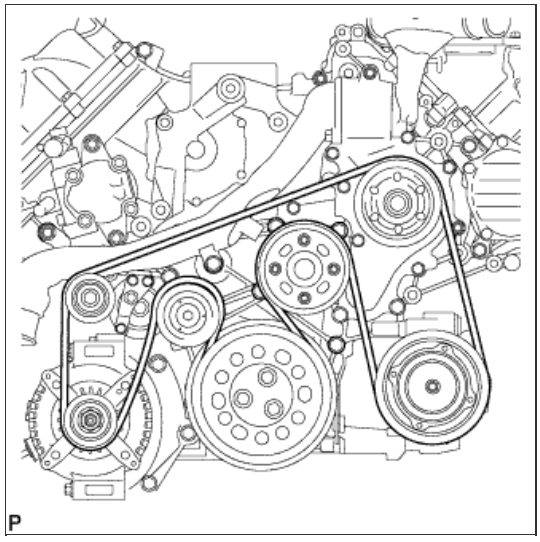


9. INSTALL V-RIBBED BELT

a. Attach a wrench to the V-ribbed belt tensioner bracket and turn the wrench clockwise.



b. Install the V-ribbed belt as shown in the illustration.

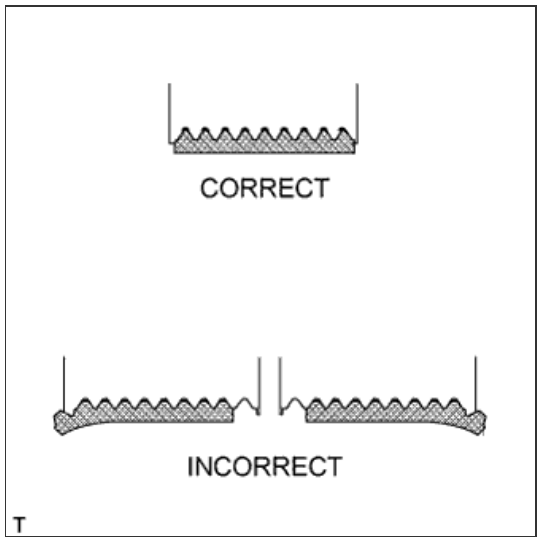


c. Check that the belt fits properly in the ribbed grooves.

HINT:

Check with your hand to confirm that the belt has not slipped out of the groove on the bottom of the pulley.

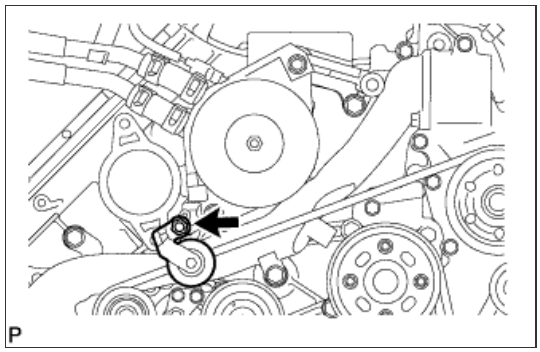
If it has slipped out, replace the V-ribbed belt. Install a new V-ribbed belt.



10. INSTALL NO. 3 IDLER PULLEY (w/ Viscous Heater)

a. Align the No. 3 idler pulley bracket knock pin and No. 1 idler pulley bracket knock pin hole and install the No. 3 idler pulley with the nut.

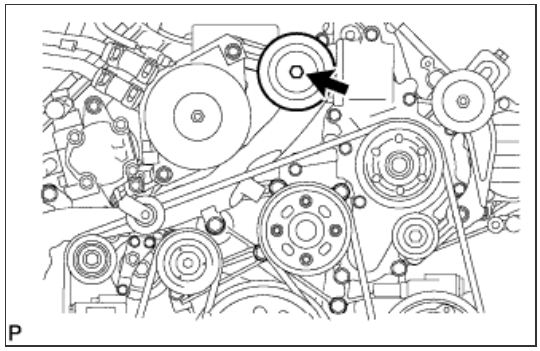
Torque:
88 N*m{ 898 kgf*cm , 64 ft.*lbf }



11. INSTALL NO. 1 IDLER PULLEY (w/ Viscous Heater)

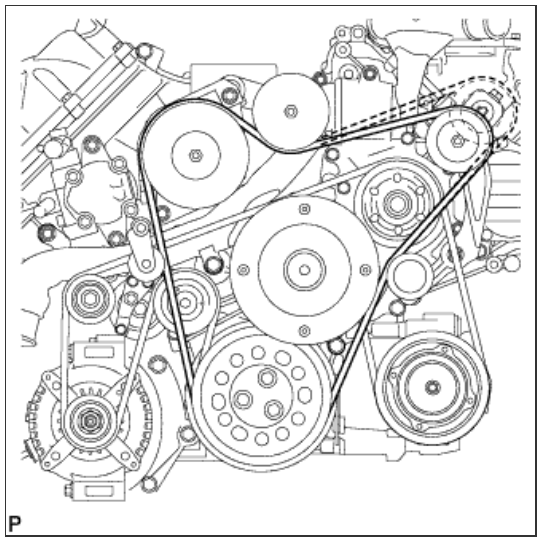
a. Install the collar, No. 1 idler pulley and cover with the bolt.

Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }

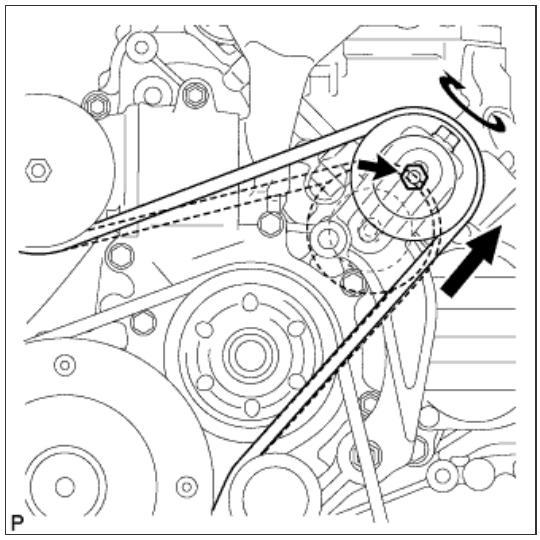


12. INSTALL V-RIBBED BELT (w/ Viscous Heater)

a. Install the V-ribbed belt as shown in the illustration.



b. Temporarily install the lock nut, and turn the bolt clockwise.



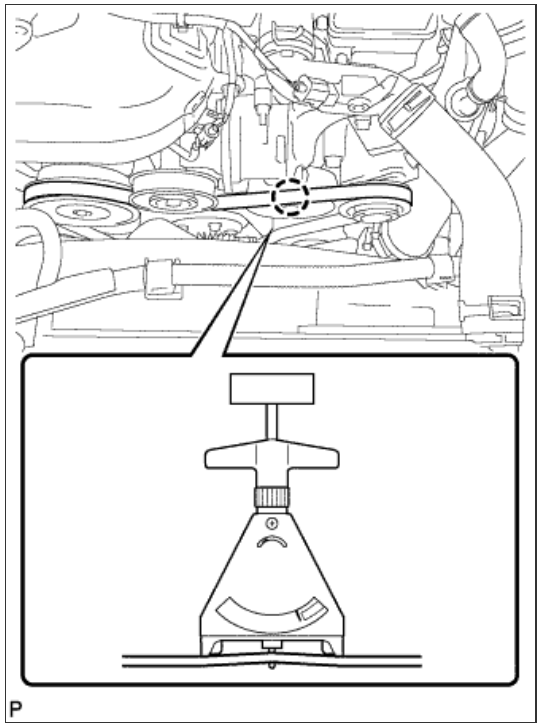
c. Using a belt tension gauge, adjust belt tension.

Standard Belt Tension:

Item	Specified Condition
New belt	400 to 650 N (41 to 66 kgf, 89.9 to 146.1 lbf)
Used belt	300 to 500 N (31 to 51 kgf, 67.4 to 112.4 lbf)

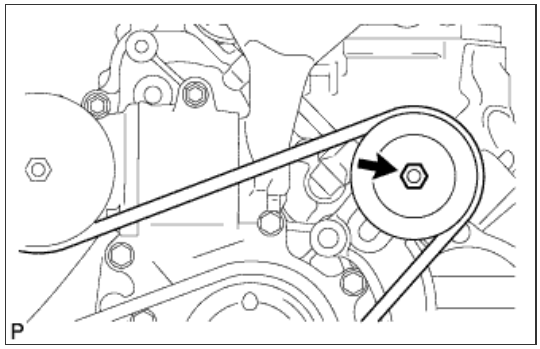
HINT:

- **A new belt is a belt which has been used for less than 5 minutes on a running engine.**
- **A used belt is a belt which has been used on a running engine for 5 minutes or more.**
- **After installing a new belt, run the engine for appro imately 5 minutes and then recheck the tension.**



d. Tighten the nut.

Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

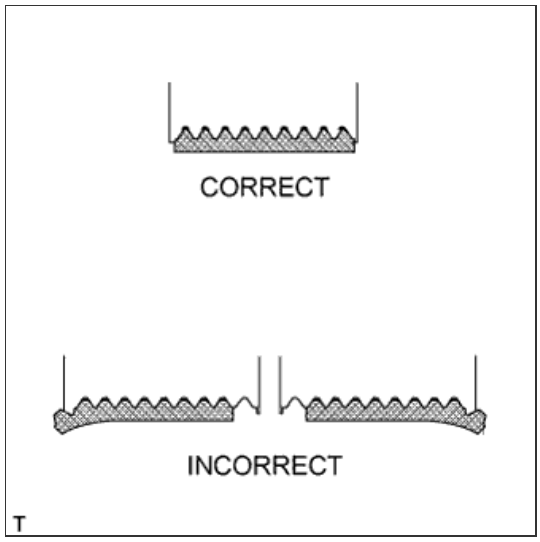


e. Check that the belt fits properly in the ribbed grooves.

HINT:

Check with your hand to confirm that the belt has not slipped out of the groove on the bottom of the pulley.

If it has slipped out, replace the V-ribbed belt. Install a new V-ribbed belt.



13. CONNECT NO. 2 RADIATOR HOSE

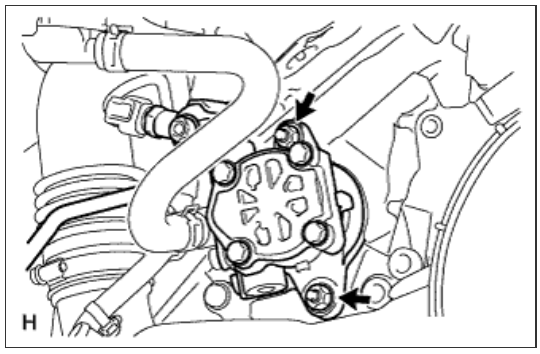
14. CONNECT NO. 1 RADIATOR HOSE

15. INSTALL VANE PUMP ASSEMBLY

a. Apply a light coat of engine oil to a new O-ring, and install it to the vane pump.

b. Install the vane pump with 2 new nuts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



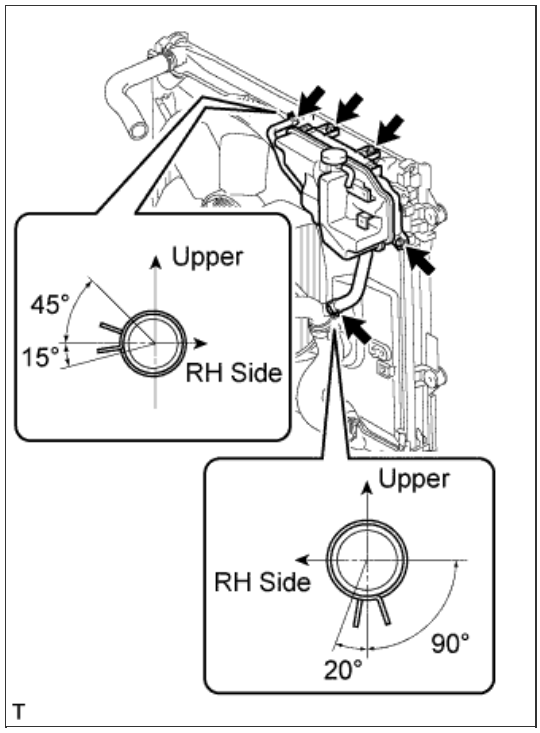
16. INSTALL RADIATOR RESERVOIR ASSEMBLY

a. Install the radiator reservoir with the 3 bolts.

b. Connect the 2 hoses to the upper radiator tank and water inlet.

HINT:

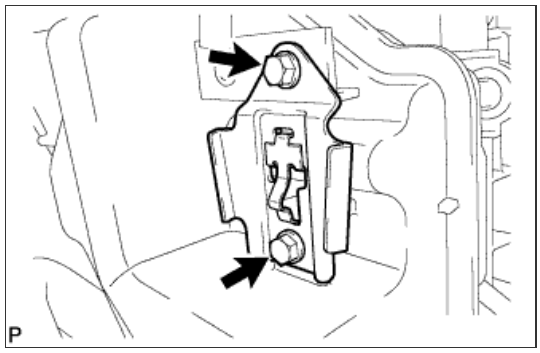
Make sure the directions of the hose clamps are as shown in the illustration.



17. INSTALL NO. 1 OIL RESERVOIR BRACKET

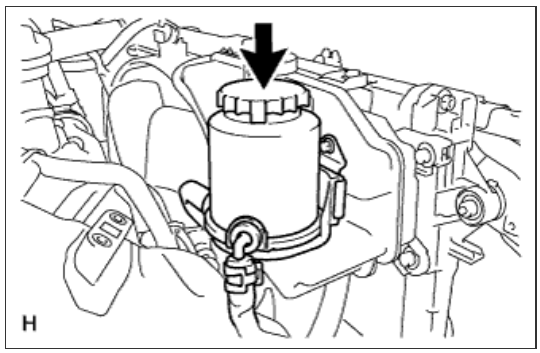
a. Install a new bracket with the 2 bolts.

Torque:
4.5 N*m{ 46 kgf*cm , 40 in.*lbf }



18. INSTALL VANE PUMP OIL RESERVOIR ASSEMBLY

a. Install the vane pump oil reservoir to the bracket.



19. INSTALL INTAKE AIR CONNECTOR

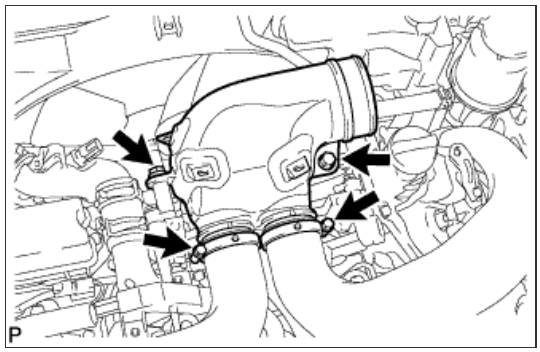
a. Connect the intake air connector to the No. 1 and No. 2 air cleaner pipes.

b. Install the connector with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Tighten the 2 hose clamps.

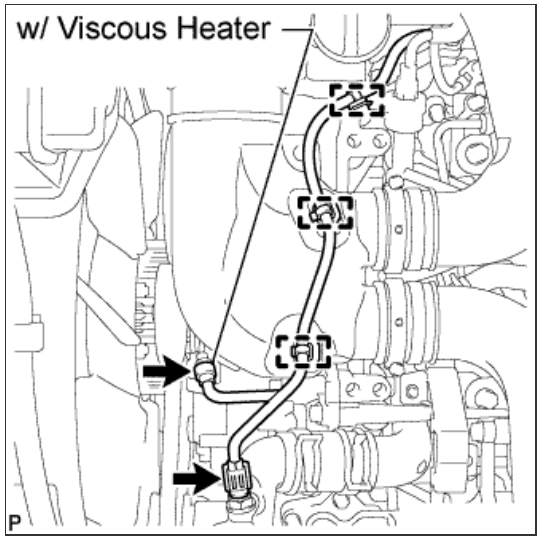
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



d. Attach the 3 wire harness clamps.

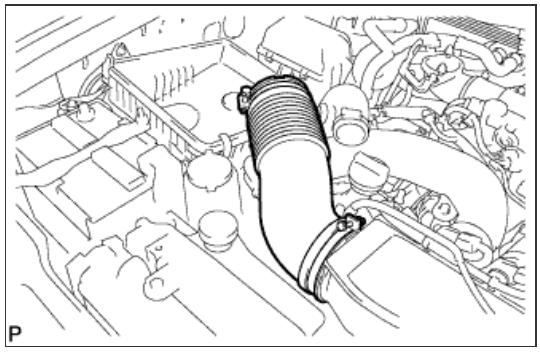
e. w/o Viscous Heater:
Connect the connector to the water temperature sensor.

f. w/ Viscous Heater:
Connect the 2 connectors to the water temperature sensor and viscous with magnet clutch heater.



20. TEMPORARILY INSTALL NO. 1 AIR CLEANER HOSE

a. Temporarily install the air cleaner hose to the intake air connector.

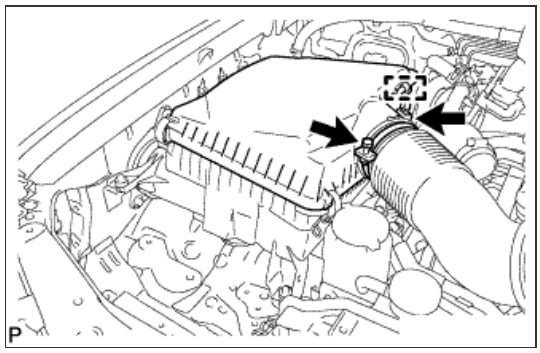


21. INSTALL AIR CLEANER CAP SUB-ASSEMBLY

a. Connect the air cleaner cap to the air cleaner hose, and install the air cleaner cap with the 4 clamps.

b. Connect the mass air flow meter connector and attach the wire harness clamp to the air cleaner cap.

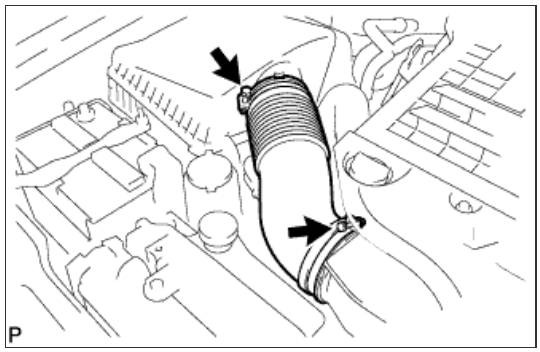
c. Attach the wire harness clamp.



d. Align the protrusion of air cleaner cap and concave portion of air cleaner hose.

e. Tighten the 2 hose clamps.

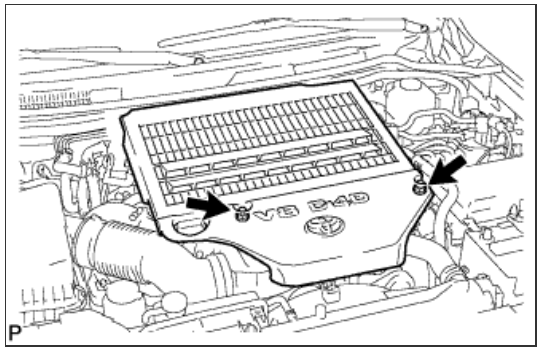
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



22. INSTALL NO. 1 ENGINE COVER SUB-ASSEMBLY (w/ Intercooler)

a. Install the engine cover with the 2 nuts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

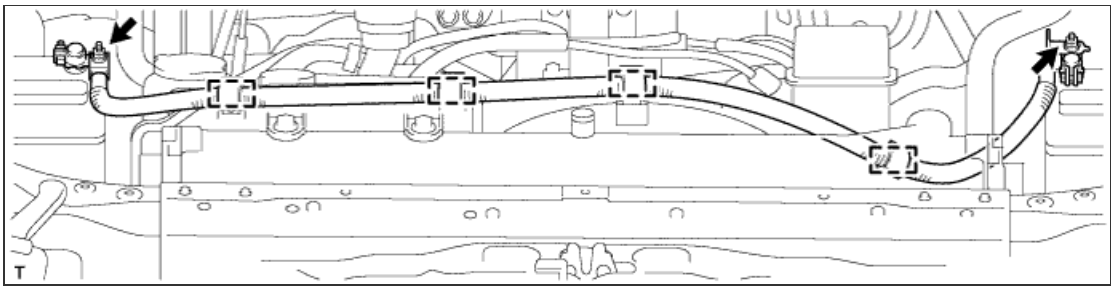


23. INSTALL NO. 3 ENGINE ROOM WIRE

a. Install the No. 3 engine room wire to the main battery and sub-battery positive terminals with the 2 nuts.

Torque:
7.6 N*m{ 77 kgf*cm , 67 in.*lbf }

b. Connect the No. 3 engine room wire with the 4 clamps.



24. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

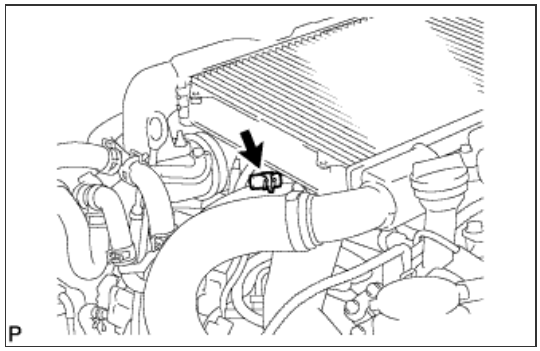
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

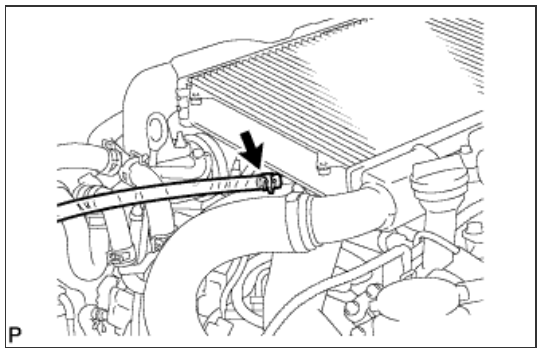
a. Connect the cables to negative (-) main battery and sub-battery terminals.

25. ADD ENGINE COOLANT

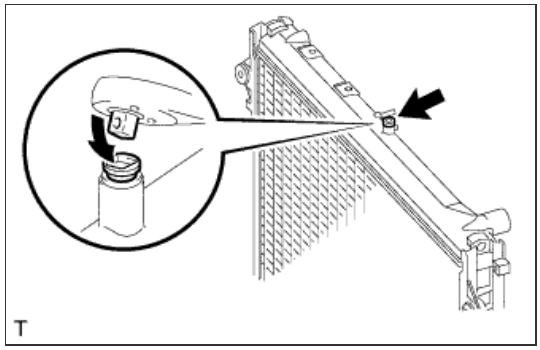
a. Remove the engine air bleed cap.



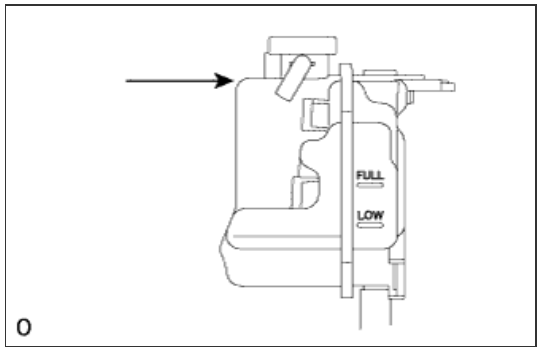
b. Connect a clear hose to the engine air bleed pipe.



c. Using a wrench, remove the vent plug.



d. Fill the radiator with TOYOTA SLLC to the radiator reservoir filler neck.



HINT:

Pour TOYOTA SLLC until it spills out of the engine air bleed pipe.

Standard Capacity (for Automatic Transmission):

Item	Specified Condition
Front heater only	14.8 liters (15.6 US qts, 13.0 Imp. qts)
Front heater and rear heater	17.6 liters (18.6 US qts, 15.5 Imp. qts)
Front heater with viscous heater	15.2 liters (16.1 US qts, 13.4 Imp. qts)
Front heater and rear heater with viscous heater	18.0 liters (19.0 US qts, 15.4 Imp. qts)

Standard capacity (for Manual Transmission):
15.4 liters (16.3 US qts, 13.6 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low

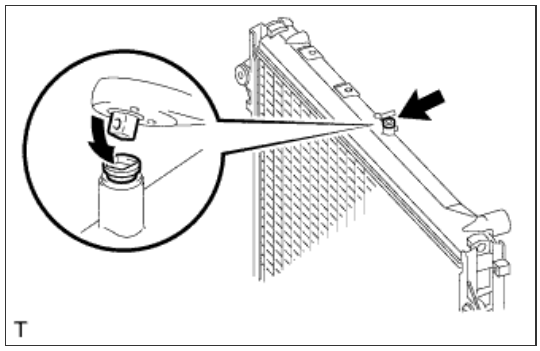
phosphates and organic acids).

e. Install the vent plug.

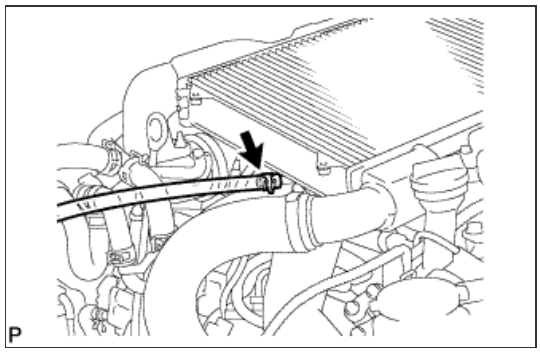
Torque:
2.0 N*m{ 20 kgf*cm , 18 in.*lbf }

NOTICE:

Do not tighten the plug to 5.0 N*m (51 kgf*cm, 44 in.*lbf) or more, as the plug will be damaged.



f. Disconnect the clear hose from the engine air bleed pipe.



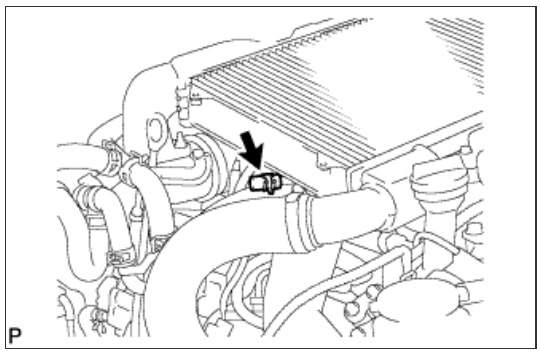
g. Install the engine air bleed cap when coolant comes out.

h. Install the radiator reservoir cap.

i. Start the engine.

NOTICE:

Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the FULL line.



j. Maintain an engine speed of 3000 rpm for approximately 10 minutes so that the thermostat opens and air bleeding is performed.

CAUTION:

When pressing the radiator hoses:

- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the radiator fan**

NOTICE:

- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**

HINT:

The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

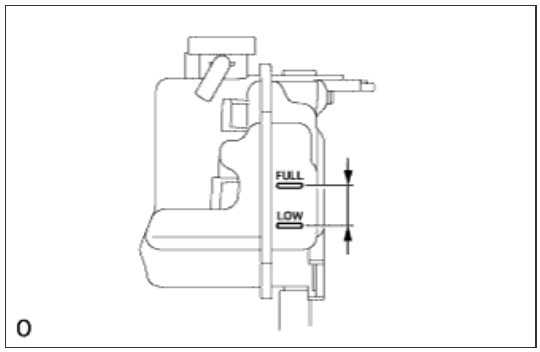
k. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

l. Check that the coolant level is between the FULL and LOW lines.
If the coolant level is above the FULL line, drain coolant so that the coolant level

is between the FULL and LOW lines.



26. INSPECT FOR ENGINE COOLANT LEAK

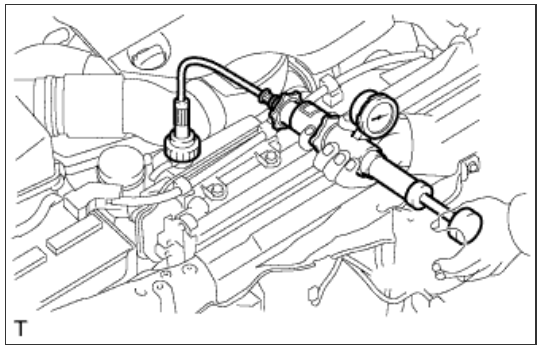
CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester to the radiator reservoir.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 17.8 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks.
If no external leaks are found, check the cylinder block and cylinder head.



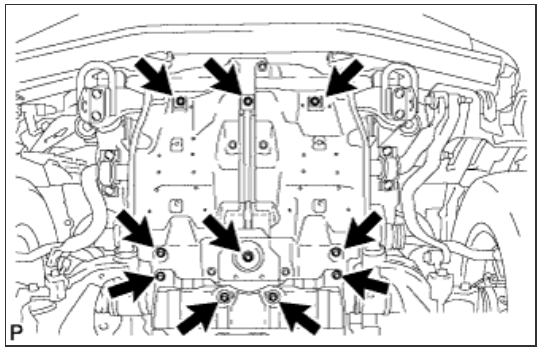
27. INSTALL UPPER RADIATOR SUPPORT SEAL

a. Install the upper radiator support seal with the 7 clips.

28. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

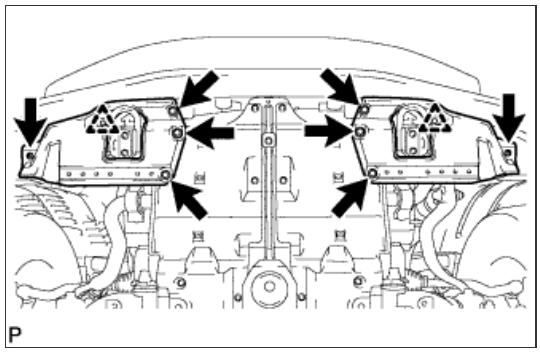
a. Install the engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



29. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

a. Install the splash shield with the clip, and then install the 3 bolts and screw.

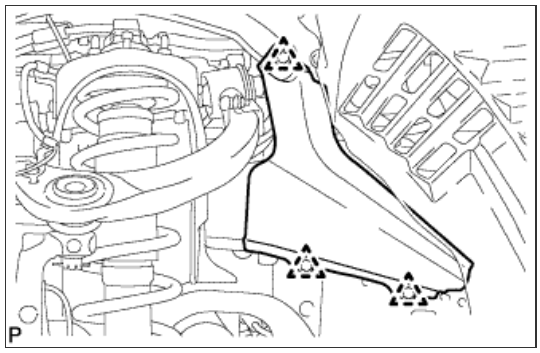


30. INSTALL RONT ENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Install the splash shield with the clip, and then install the 3 bolts and screw.

31. INSTALL RONT ENDER APRON SEAL RONT RH

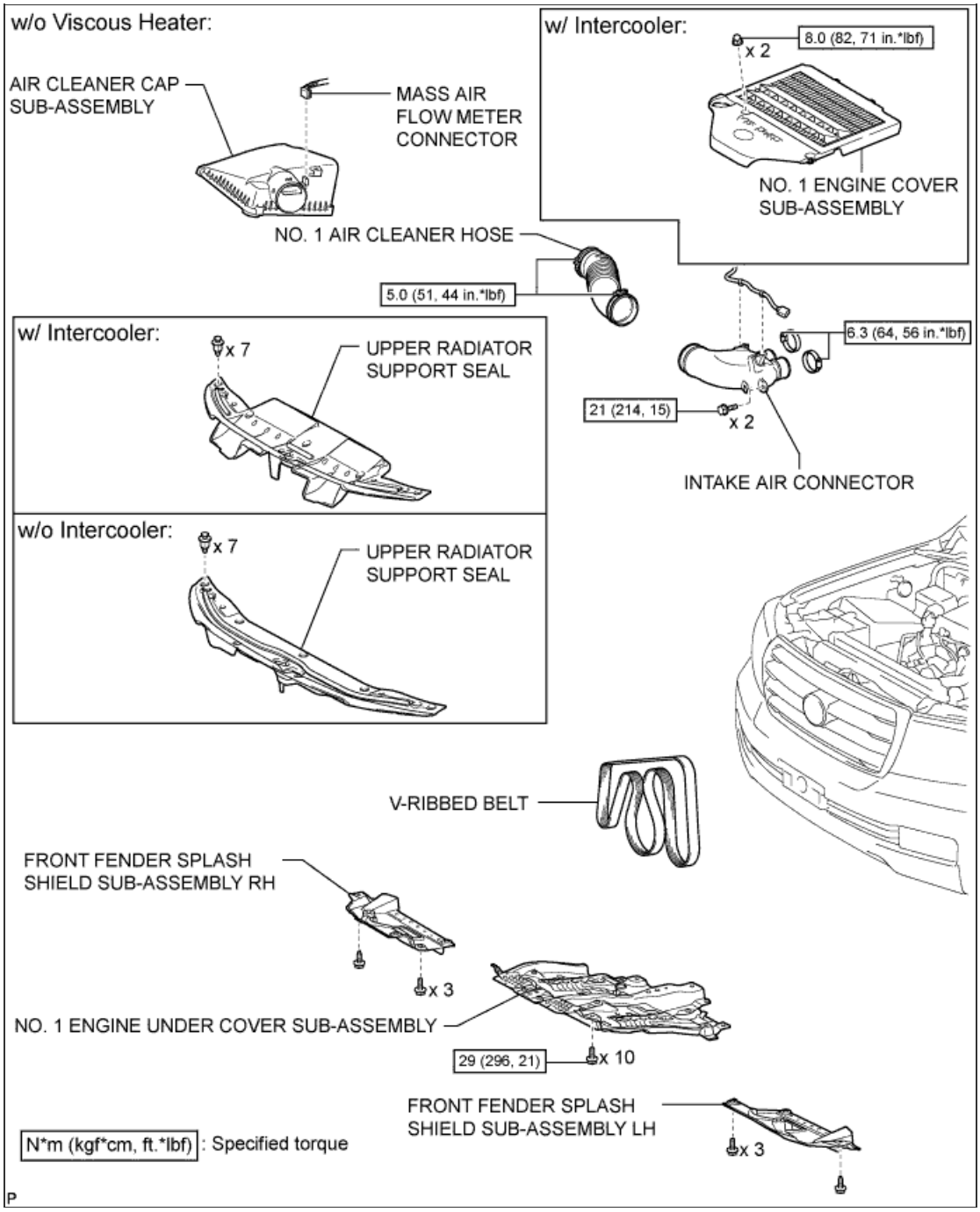
a. Install the front fender apron seal front RH with the 3 clips.



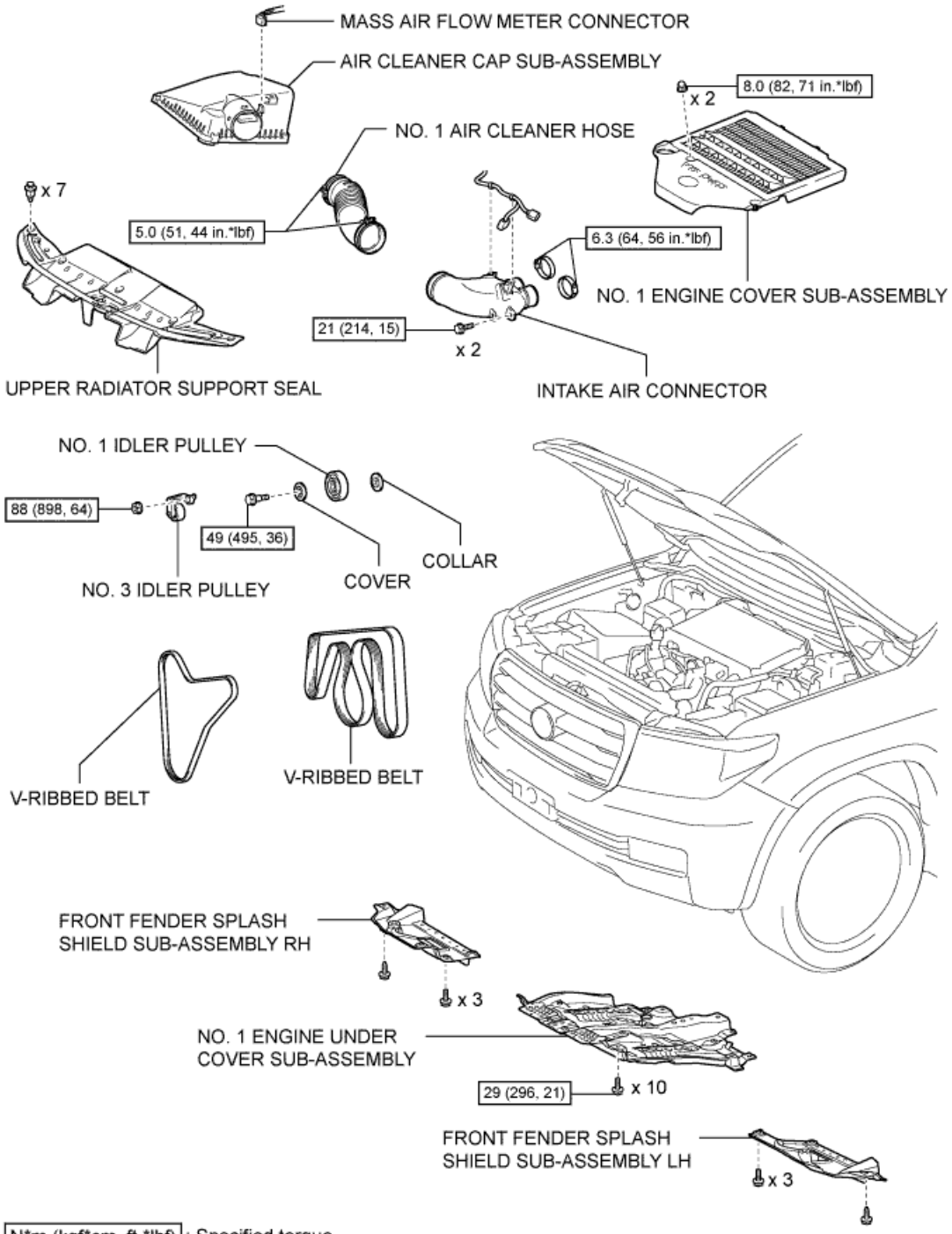
32. INSTALL RONT WHEEL RH

Torque:
for Aluminum Wheel:
131 N*m{ 1336 kgf*cm , 97 ft.*lbf }
for Steel Wheel:
209 N*m{ 2131 kgf*cm , 154 ft.*lbf }

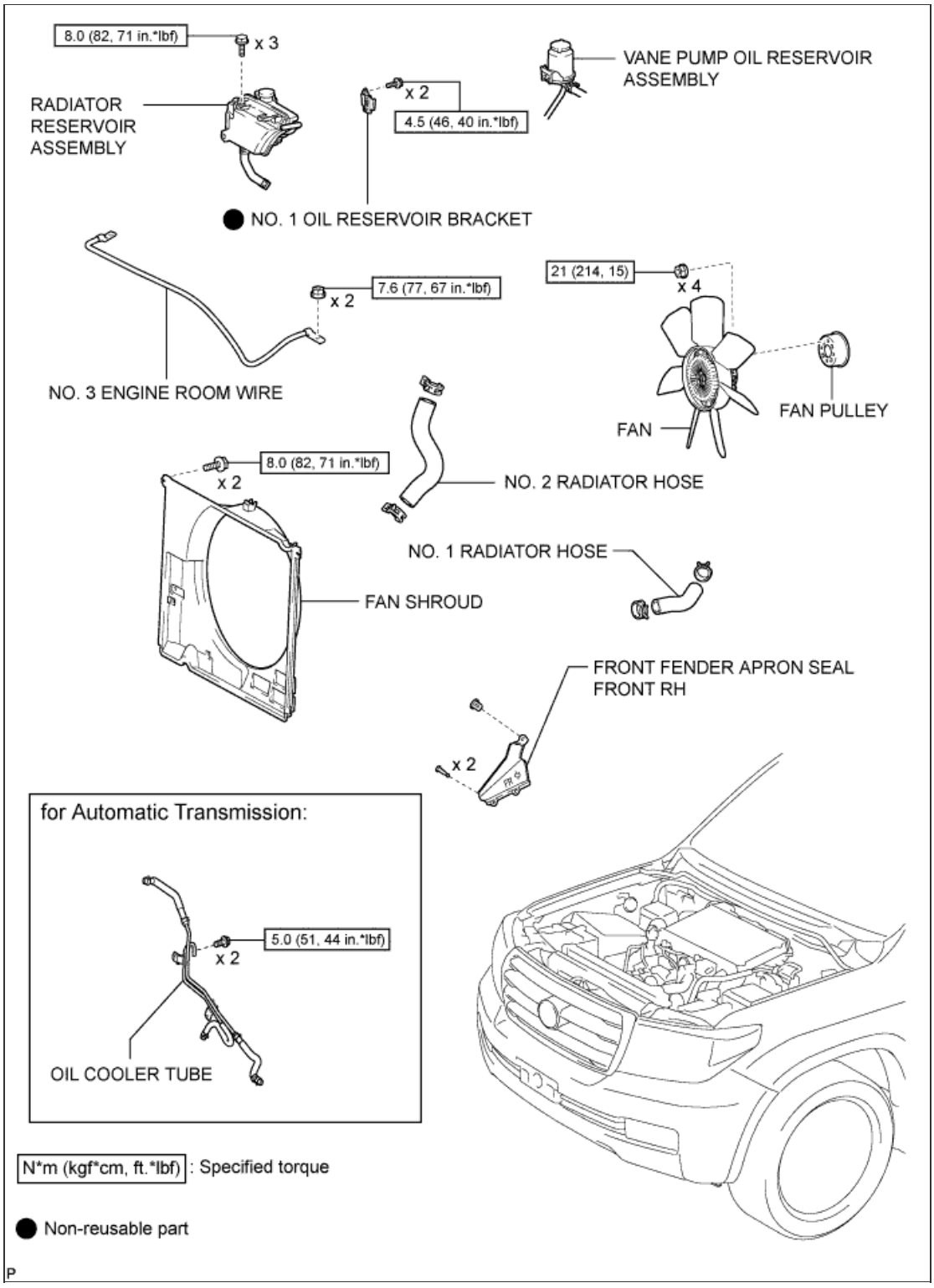
for Preparation Click here



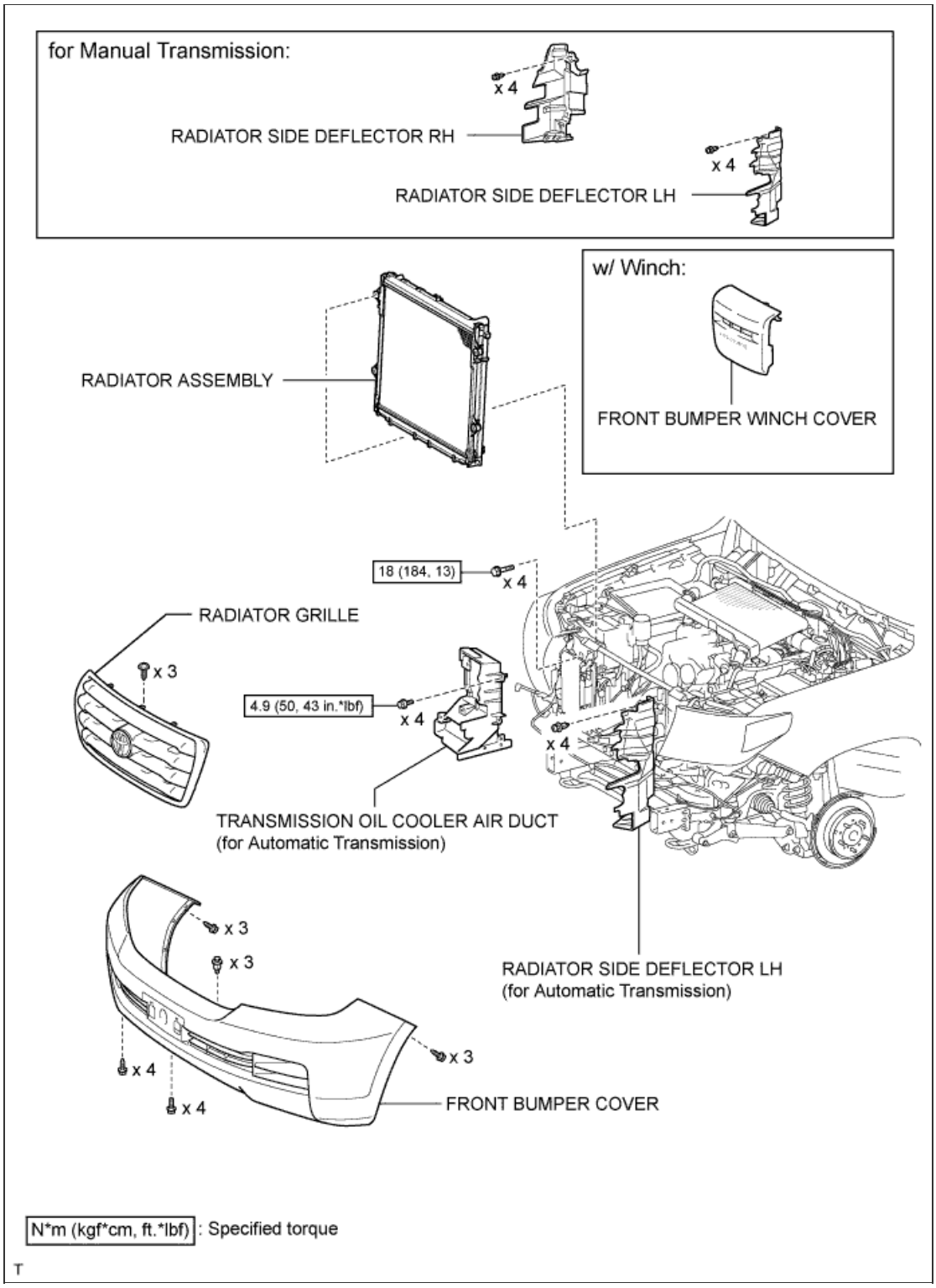
w/ Viscous Heater:



P


8.0 (82, 71 in.*lbf)
x 3
RADIATOR RESERVOIR ASSEMBLY
x 2
4.5 (46, 40 in.*lbf)
VANE PUMP OIL RESERVOIR ASSEMBLY
NO. 1 OIL RESERVOIR BRACKET
7.6 (77, 67 in.*lbf)
x 2
NO. 3 ENGINE ROOM WIRE
21 (214, 15)
x 4
FAN
FAN PULLEY
8.0 (82, 71 in.*lbf)
x 2
NO. 2 RADIATOR HOSE
NO. 1 RADIATOR HOSE
FAN SHROUD
FRONT FENDER APRON SEAL FRONT RH
x 2
for Automatic Transmission:
5.0 (51, 44 in.*lbf)
x 2
OIL COOLER TUBE
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P

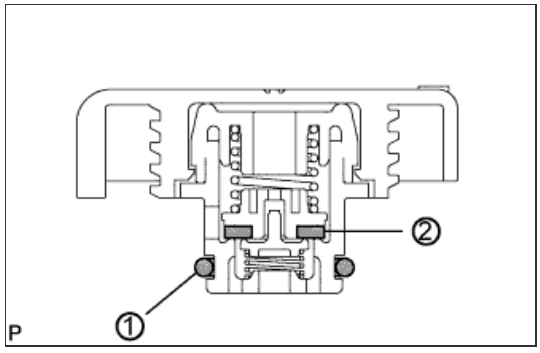

for Manual Transmission:
x 4
RADIATOR SIDE DEFLECTOR RH
x 4
RADIATOR SIDE DEFLECTOR LH
w/ Winch:
FRONT BUMPER WINCH COVER
RADIATOR ASSEMBLY
18 (184, 13)
x 4
RADIATOR GRILLE
x 3
4.9 (50, 43 in.*lbf)
x 4
x 4
TRANSMISSION OIL COOLER AIR DUCT
(for Automatic Transmission)
x 3
x 3
x 3
x 4
x 4
RADIATOR SIDE DEFLECTOR LH
(for Automatic Transmission)
FRONT BUMPER COVER
N*m (kgf*cm, ft.*lbf) : Specified torque
T

for Preparation Click here

1. INSPECT RADIATOR RESERVOIR CAP

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.



a. Measure the valve opening pressure.

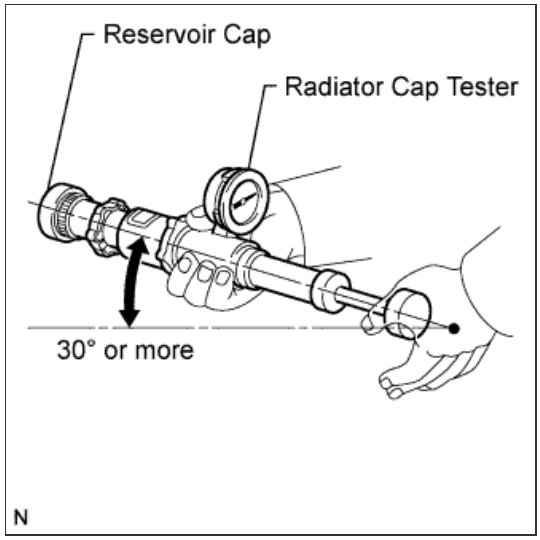
i. If there are water stains or foreign matter on O-ring 1, clean it with water and finger scouring.

ii. Check that O-ring 1 is not deformed, cracked or swollen.

iii. Apply engine coolant to O-ring 1 and rubber packing 2.

iv. Prepare a radiator cap tester, and tilt it more than 30°.

v. Pump the cap tester several times, and check the maximum pressure*.



Pumping speed:
1 pump per second

HINT:

*: Even if the cap cannot maintain the maximum pressure, it is not a defect.

Standard Judgment Criterion:

Item	Specified Condition
Standard value (for brand-new cap)	93 to 123 kPa (1.0 to 1.3 kgf/cm^2, 13.5 to 17.8 psi)
Minimum standard value (after using cap)	78.5 kPa (0.8 kgf/cm^2, 11.4 psi)

If the maximum pressure is less than the minimum standard value, replace the radiator reservoir cap sub-assembly.

2. INSPECT FINS FOR BLOCKAGE

a. Check that the radiator and condenser are not blocked with leaves, dirt, or insects. Clean the hose connections.
If the fins are blocked, wash them with water or a steam cleaner.

NOTICE:

- **If the distance between the steam cleaner and core is too close, the fins may be damaged.**
- **Keep the following injection distance.**

Standard Injection Distance:

Injection	

Distance	Injection Pressure
300 mm (11.8 in.)	2942 to 4903 kPa (30.0 to 50.0 kgf/cm^2, 427 to 711 psi)
500 mm (19.7 in.)	4903 to 7845 kPa (50.0 to 80.0 kgf/cm^2, 711 to 1138 psi)

- **If the fins are bent, straighten them with a screwdriver or pliers.**
- **Never apply water directly onto the electric components.**

b. Dry the fins with compressed air.

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Disconnect the cables from the negative (-) main battery and sub-battery terminals.

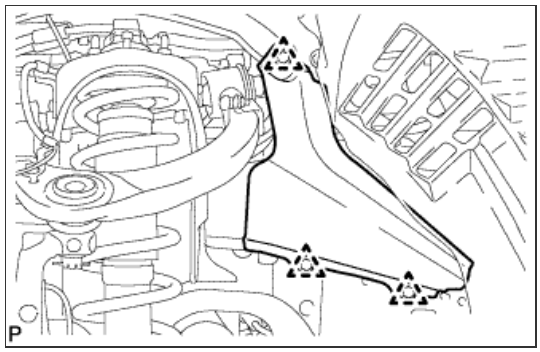
2. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and upper radiator support seal.

3. REMOVE FRONT WHEEL RH

4. REMOVE FRONT FENDER APRON SEAL FRONT RH

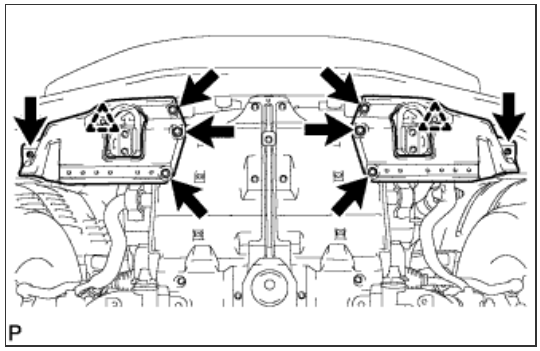
a. Remove the 3 clips and front fender apron seal front RH.



5. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.



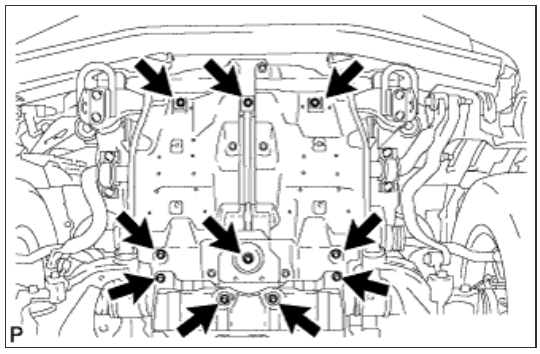
6. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

a. Remove the 3 bolts and screw.

b. Loosen the clip and remove the splash shield.

7. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



8. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

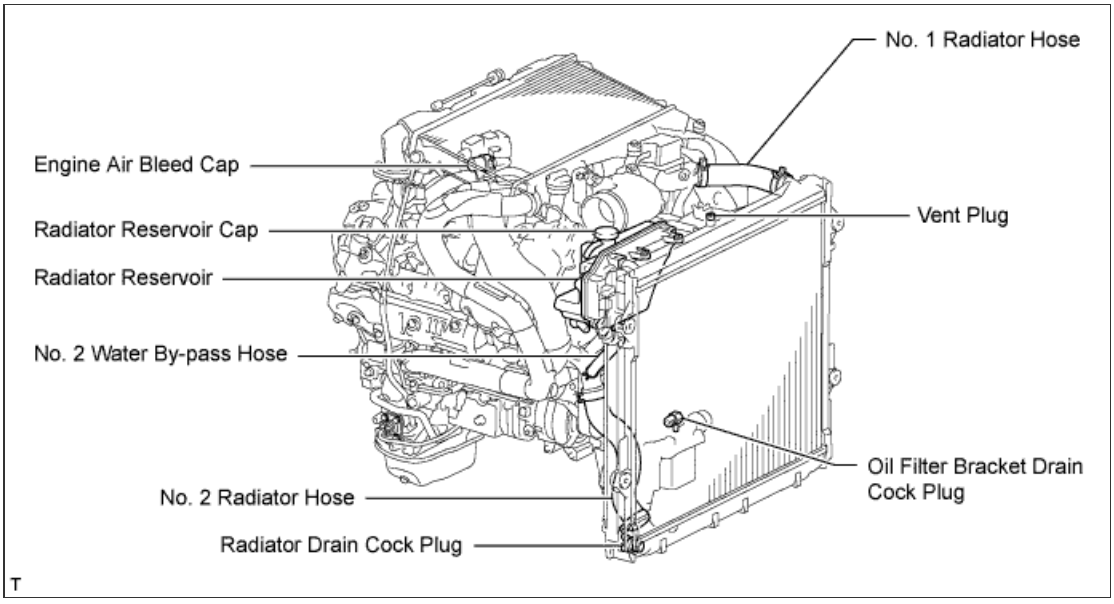
HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

a. Loosen the radiator drain cock plug.

b. Remove the radiator reservoir cap to drain the coolant in the radiator.

c. Loosen the oil filter bracket drain cock plug to drain the coolant in the engine.

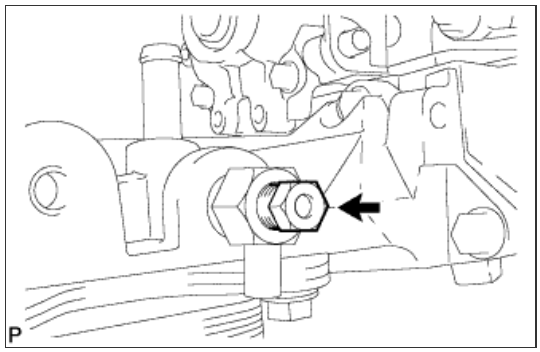


d. Tighten the radiator drain cock plug by hand.

e. Tighten the oil filter bracket drain cock plug.

Torque:

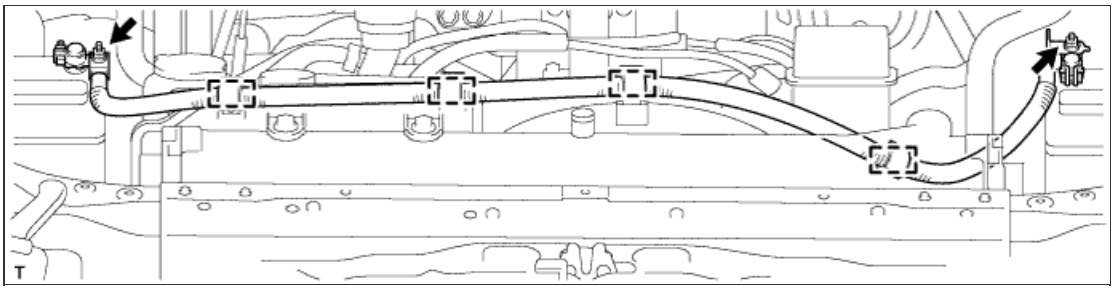
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



9. REMOVE NO. 3 ENGINE ROOM WIRE

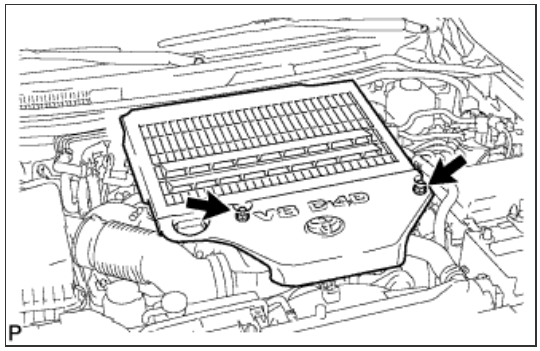
a. Disconnect the 4 wire harness clamps.

b. Remove the 2 nuts and No. 3 engine room wire.



10. REMOVE NO. 1 ENGINE COVER SUB-ASSEMBLY (w/ Intercooler

a. Remove the 2 nuts and No. 1 engine cover.

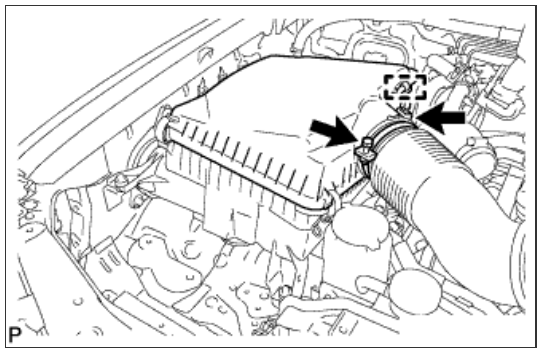


11. REMOVE AIR CLEANER CAP SUB-ASSEMBLY

a. Loosen the hose clamp.

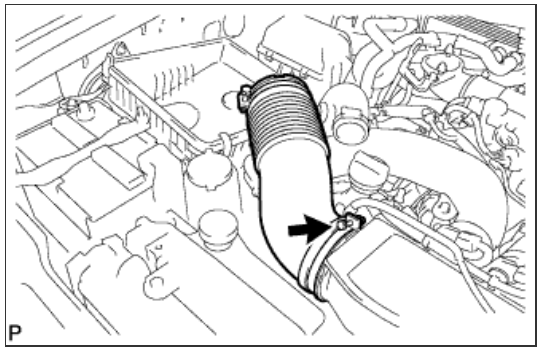
b. Disconnect the mass air flow meter connector and using a clip remover, detach the wire harness clamp from the air cleaner cap.

c. Detach the 4 clamps and remove the air cleaner cap.



12. REMOVE NO. 1 AIR CLEANER HOSE

a. Loosen the hose clamp and remove the No. 1 air cleaner hose.



13. REMOVE INTAKE AIR CONNECTOR

a. w/o Viscous Heater:

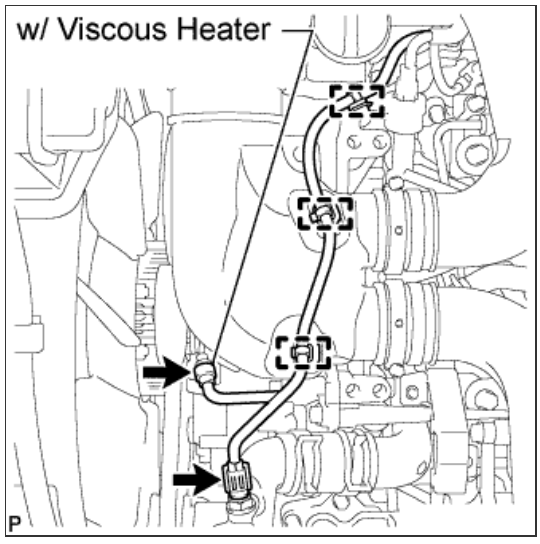
   i. Disconnect the connector from the water temperature sensor.

   ii. Using a clip remover, detach the 3 wire harness clamps.

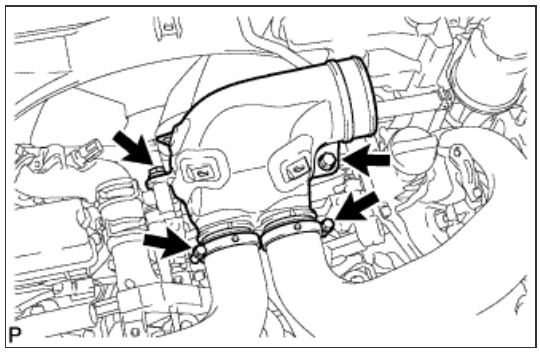
b. w/ Viscous Heater:

   i. Disconnect the 2 connectors from the viscous with magnet clutch heater and water temperature sensor.

   ii. Using a clip remover, detach the 3 wire harness clamps.

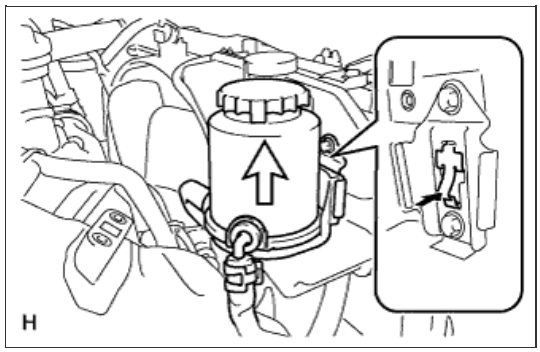


c. Loosen the 2 hose clamps and remove the 2 bolts and intake air connector.



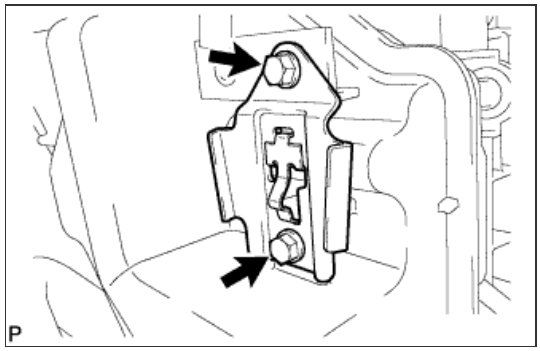
14. REMOVE VANE PUMP OIL RESERVOIR ASSEMBLY

a. Insert a screwdriver between the reservoir and oil reservoir bracket, push the claw, and then disconnect the reservoir by pulling it upwards.



15. REMOVE NO. 1 OIL RESERVOIR BRACKET

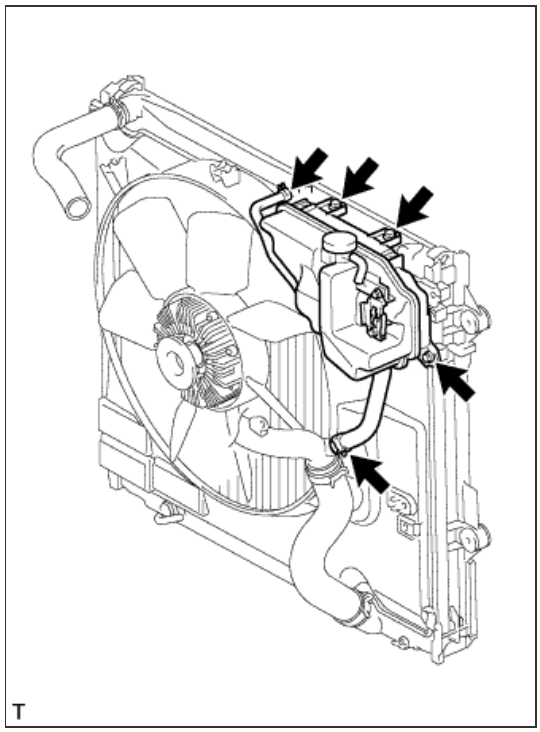
a. Remove the 2 bolts and bracket.



16. REMOVE RADIATOR RESERVOIR ASSEMBLY

a. Disconnect the 2 hoses.

b. Remove the 3 bolts and radiator reservoir.



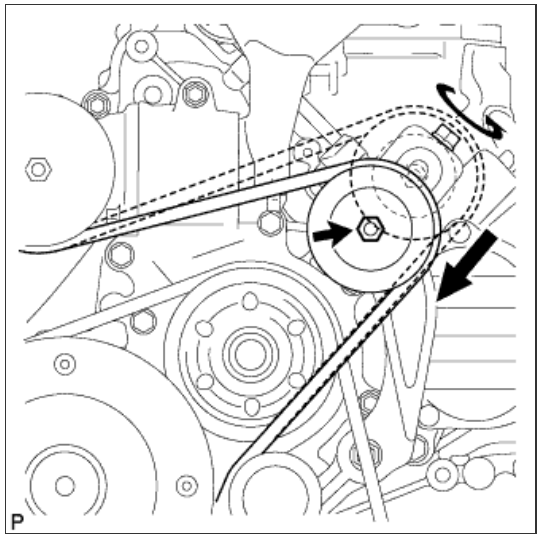
17. DISCONNECT NO. 1 RADIATOR HOSE

18. DISCONNECT NO. 2 RADIATOR HOSE

19. REMOVE V-RIBBED BELT (w/ Viscous Heater

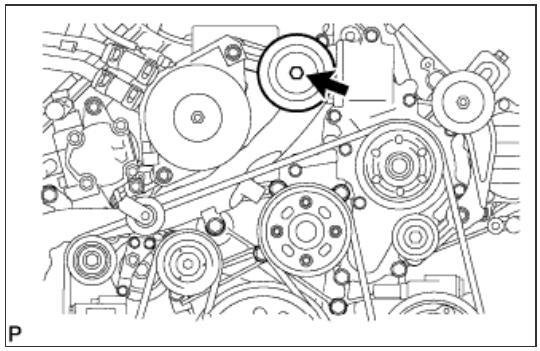
a. Loosen the lock nut and turn the bolt counterclockwise.

b. Remove the V-ribbed belt.



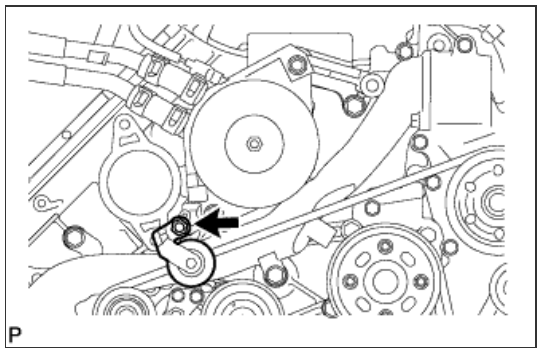
20. REMOVE NO. 1 IDLER PULLEY (w/ Viscous Heater

a. Remove the bolt, cover, No. 1 idler pulley and collar.



21. REMOVE NO. 3 IDLER PULLEY (w/ Viscous Heater

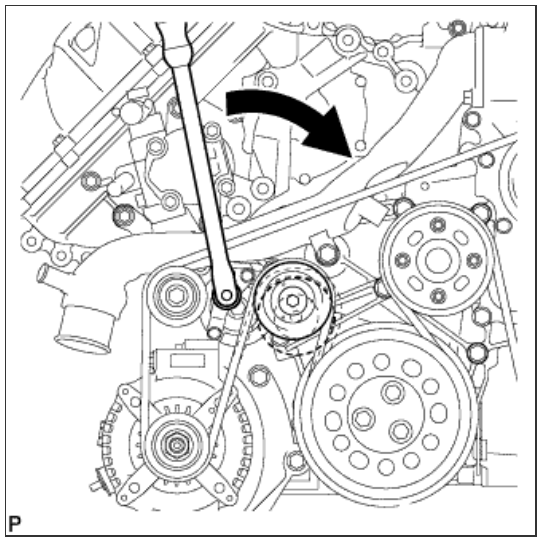
a. Remove the nut and No. 3 idler pulley.



22. REMOVE V-RIBBED BELT

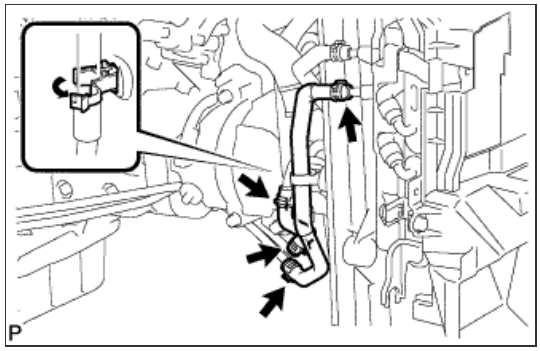
a. Using a wrench to the V-ribbed belt tensioner bracket, turn the wrench clockwise

and remove the V-ribbed belt.

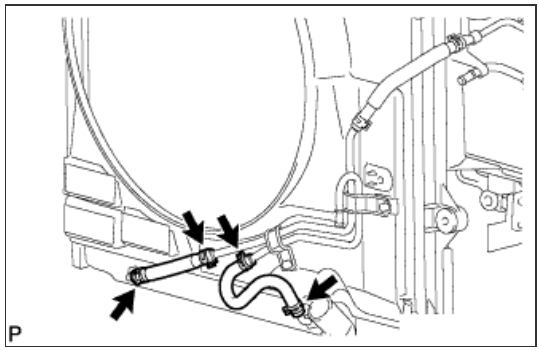


23. REMOVE OIL COOLER TUBE (for Automatic Transmission

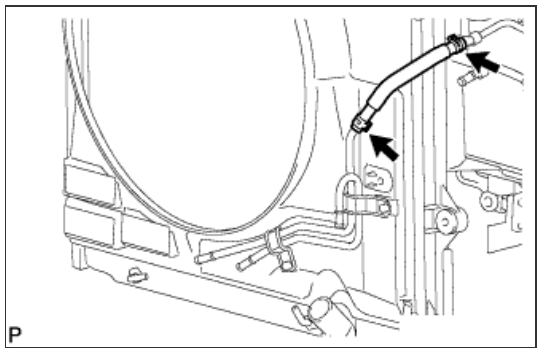
a. Disconnect the inlet and outlet No. 1 oil cooler hose.



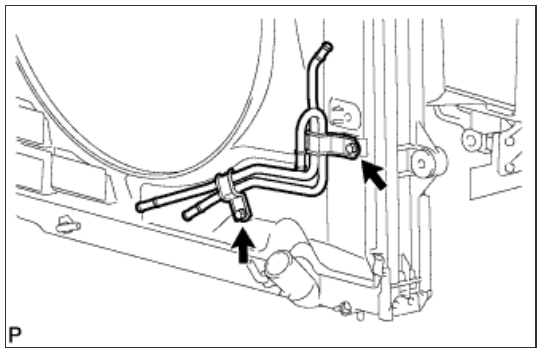
b. Disconnect the inlet No. 2 and No. 3 oil cooler hoses.



c. Disconnect the inlet No. 4 oil cooler hose.

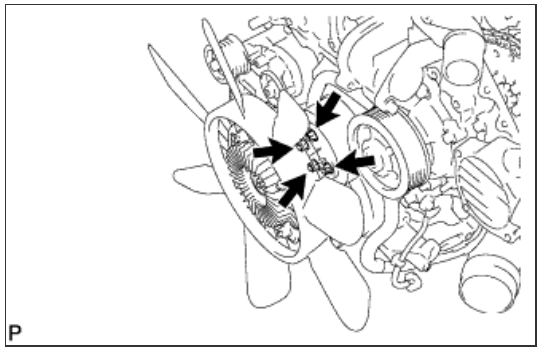


d. Remove the 2 bolts and transmission oil cooler tube.

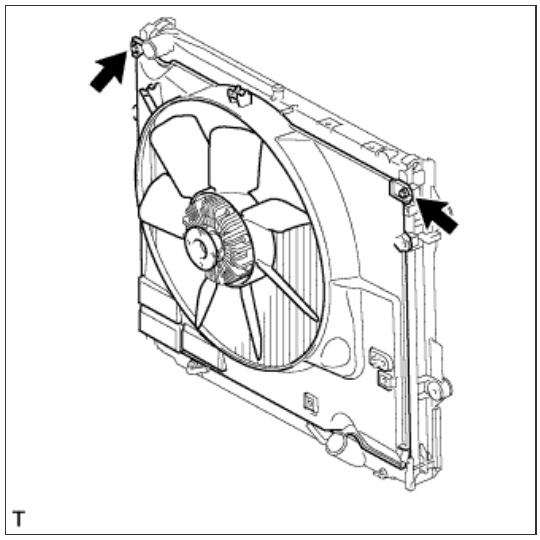


24. REMOVE FAN SHROUD WITH FAN

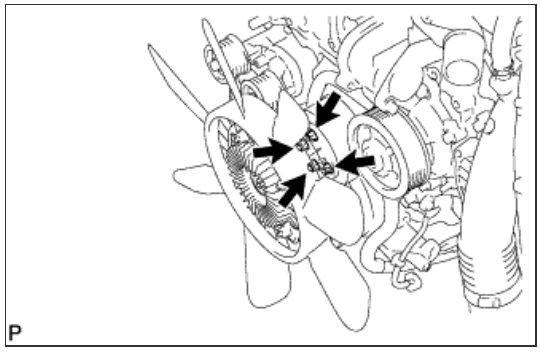
a. Loosen the 4 nuts holding the fluid coupling fan.



b. Remove the 2 bolts holding the fan shroud.



c. Remove the 4 nuts of the fluid coupling fan, and then remove the shroud together with the fluid coupling fan.



25. REMOVE FAN PULLEY

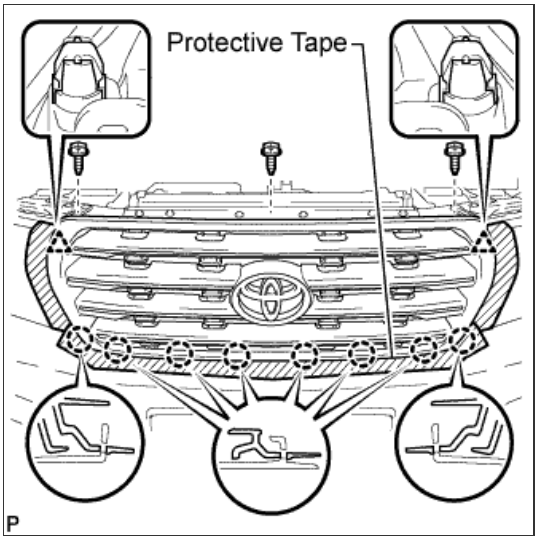
26. REMOVE FRONT BUMPER WINCH COVER (w/ Winch

27. REMOVE RADIATOR GRILLE

a. Put protective tape around the radiator grille.

b. Remove the 3 screws.

c. Detach the 2 clips and 8 claws, and remove the radiator grille.



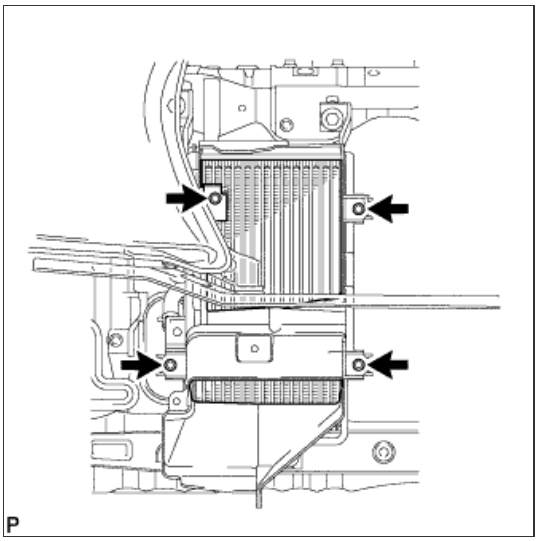
28. REMOVE FRONT BUMPER COVER

a. for Standard:
Remove the front bumper cover (Click here).

b. w/ Winch:
Remove the front bumper cover (Click here).

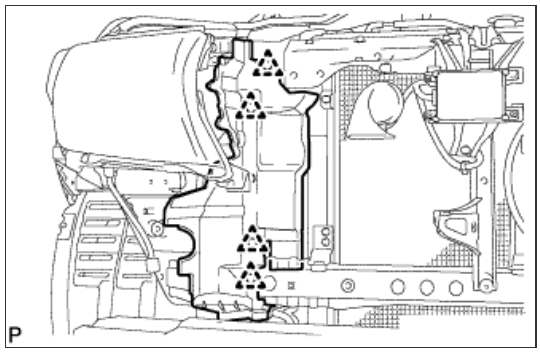
29. REMOVE TRANSMISSION OIL COOLER AIR DUCT (for Automatic Transmission

a. Remove the 4 bolts and oil cooler air duct.



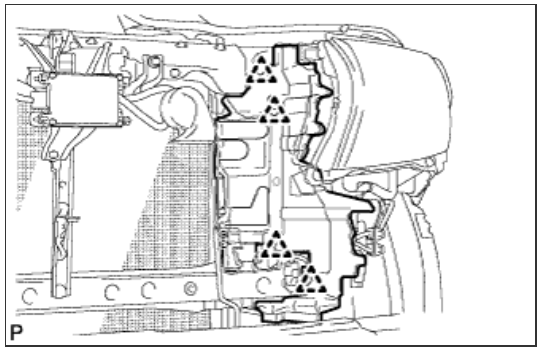
30. REMOVE RADIATOR SIDE DEFLECTOR RH (for Manual Transmission

a. Using a clip remover, remove the 4 clips, and remove the side deflector.



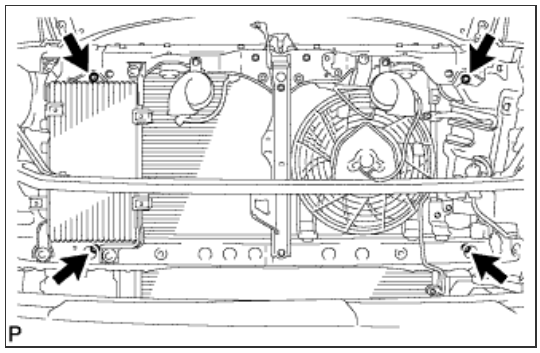
31. REMOVE RADIATOR SIDE DEFLECTOR LH

a. Using a clip remover, remove the 4 clips, and remove the side deflector.



32. REMOVE RADIATOR ASSEMBLY

a. Remove the 4 bolts and radiator.

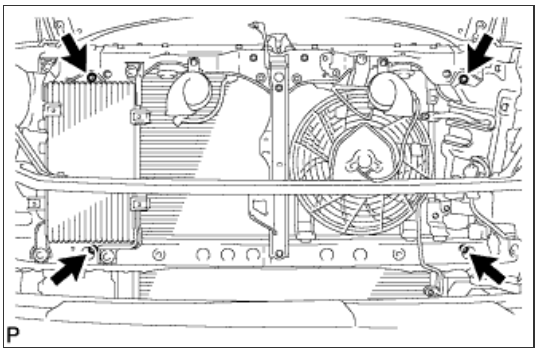


for Preparation Click here

1. INSTALL RADIATOR ASSEMBLY

a. Install the radiator with the 4 bolts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }



2. INSTALL FAN PULLEY

3. INSTALL FAN SHROUD WITH FAN

a. Install the shroud together with the fluid coupling fan between the radiator and engine components.

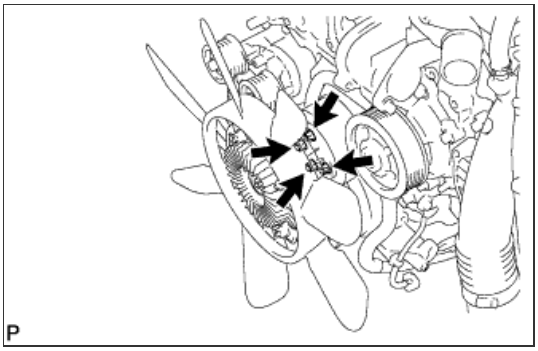
NOTICE:

Be careful not to damage the radiator core.

b. Temporarily install the fluid coupling fan to the fan bracket with the 4 nuts.

HINT:

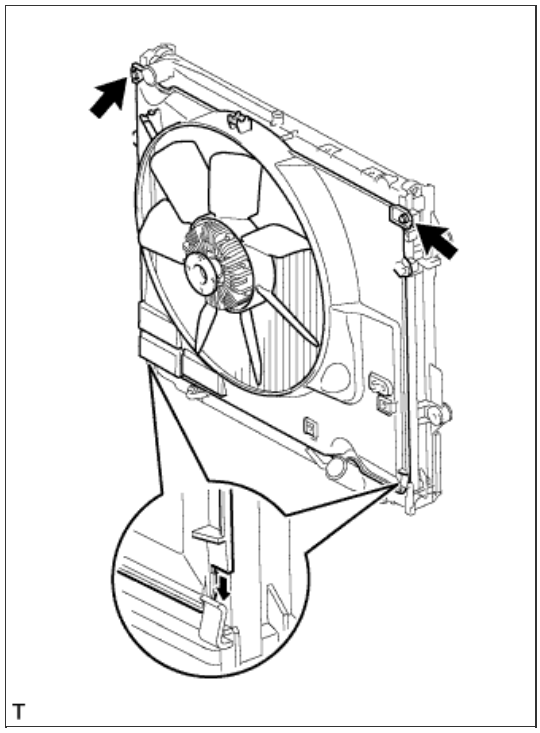
Tighten the nuts as much as possible by hand.



c. Attach the shroud claws to the radiator.

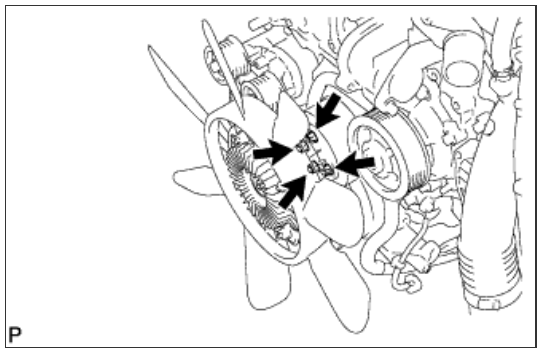
d. Install the shroud with the 2 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }



e. Tighten the 4 nuts of the fluid coupling fan.

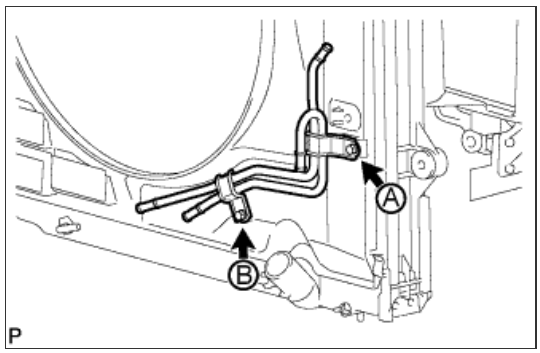
Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



4. INSTALL OIL COOLER TUBE (for Automatic Transmission)

a. Temporarily install the oil cooler tube to the fan shroud with the bolt labeled A. Install the bolt labeled B. Then tighten the bolt labeled A to the specified torque.

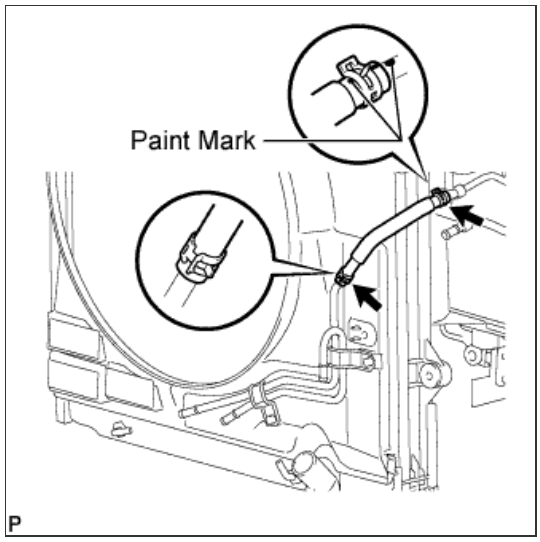
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



b. Connect the inlet No. 4 oil cooler hose as shown in the illustration.

NOTICE:

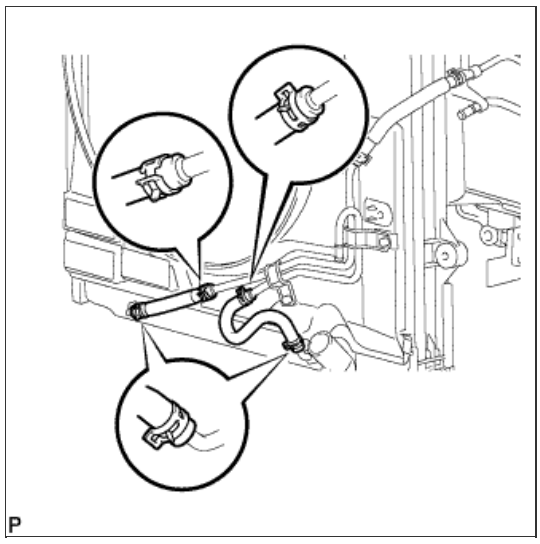
Make sure the pinching portion of each clip is facing the direction shown in the illustration.



c. Connect the inlet No. 2 and No. 3 oil cooler hoses as shown in the illustration.

NOTICE:

Make sure the pinching portion of each clip is facing the direction shown in the illustration.

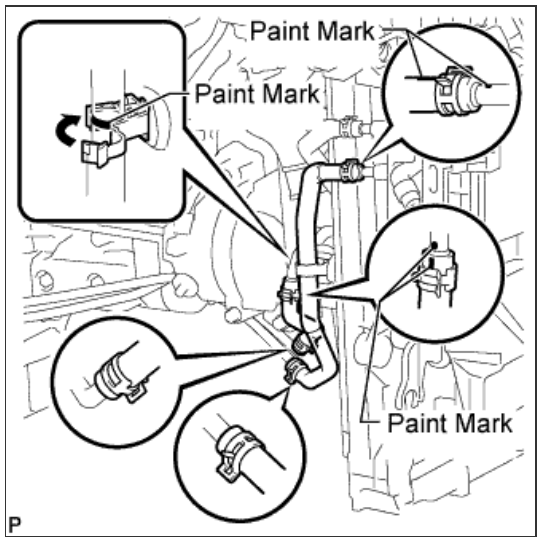


d. Connect the inlet and outlet No. 1 oil cooler hoses as shown in the illustration.

NOTICE:

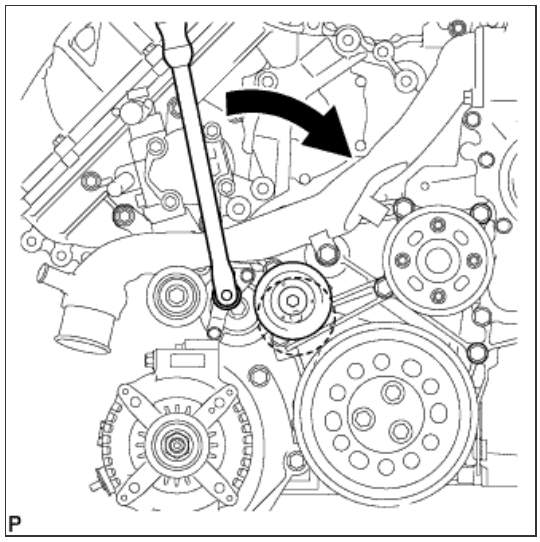
Make sure the pinching portion of each clip is facing the direction shown in the illustration.

e. Pass the hose through the flexible hose clamp and close the clamp shown in the illustration.

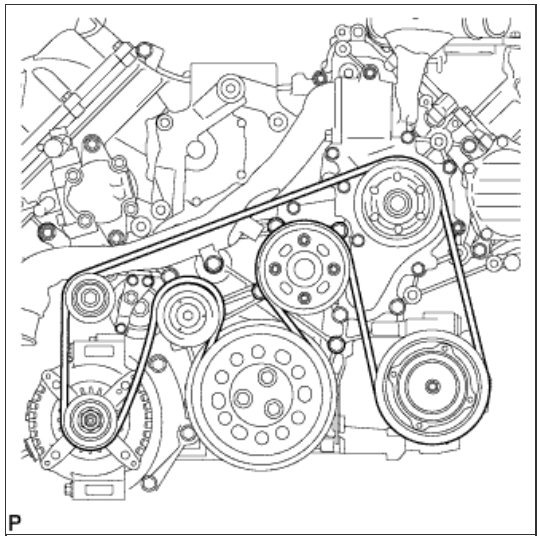


5. INSTALL V-RIBBED BELT

a. Attach a wrench to the V-ribbed belt tensioner bracket and turn the wrench clockwise.



b. Install the V-ribbed belt as shown in the illustration.

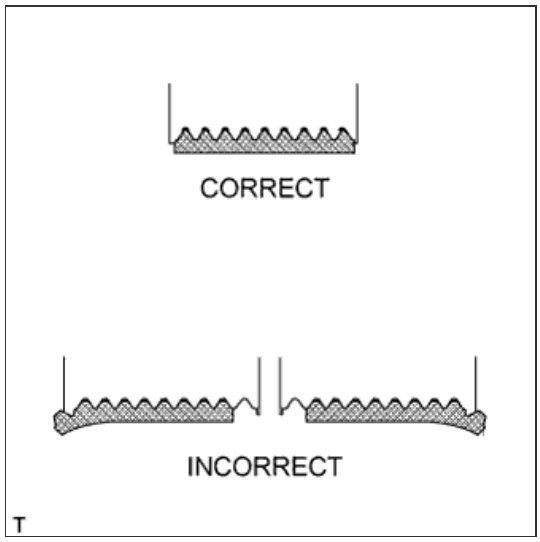


c. Check that the belt fits properly in the ribbed grooves.

HINT:

Check with your hand to confirm that the belt has not slipped out of the groove on the bottom of the pulley.

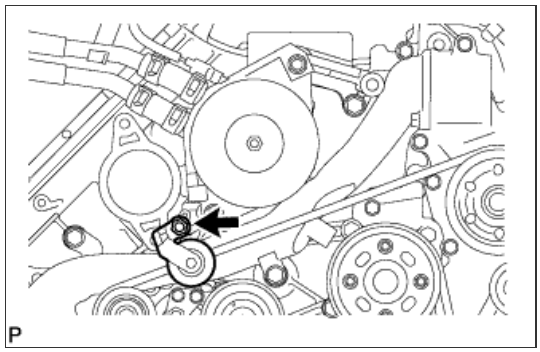
If it has slipped out, replace the V-ribbed belt. Install a new V-ribbed belt.



6. INSTALL NO. 3 IDLER PULLEY (w/ Viscous Heater)

a. Align the No. 3 idler pulley bracket knock pin and No. 1 idler pulley bracket knock pin hole and install the No. 3 idler pulley with the nut.

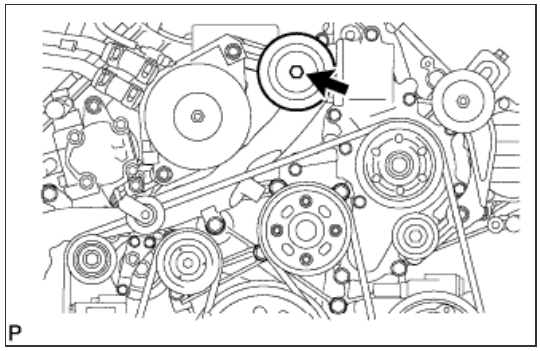
Torque:
88 N*m{ 898 kgf*cm , 64 ft.*lbf }



7. INSTALL NO. 1 IDLER PULLEY (w/ Viscous Heater)

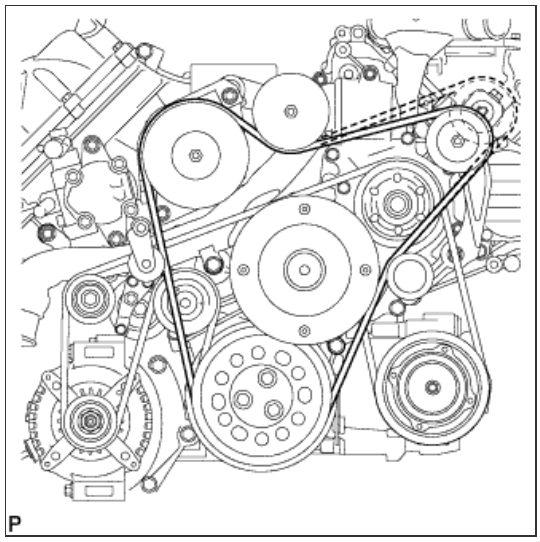
a. Install the collar, No. 1 idler pulley and cover with the bolt.

Torque:
49 N*m{ 495 kgf*cm , 36 ft.*lbf }

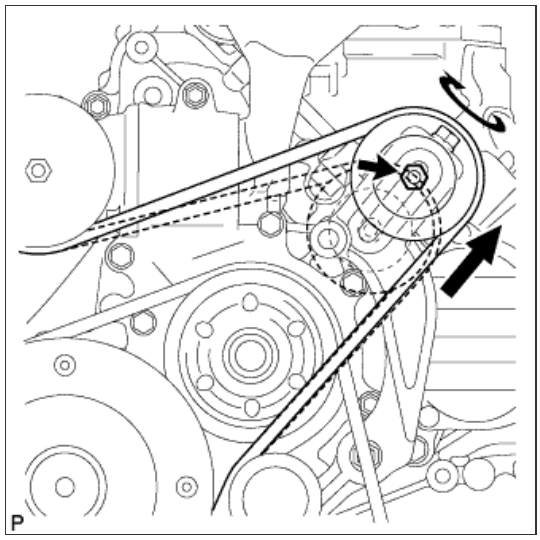


8. INSTALL V-RIBBED BELT (w/ Viscous Heater)

a. Install the V-ribbed belt as shown in the illustration.



b. Temporarily install the lock nut, and turn the bolt clockwise.



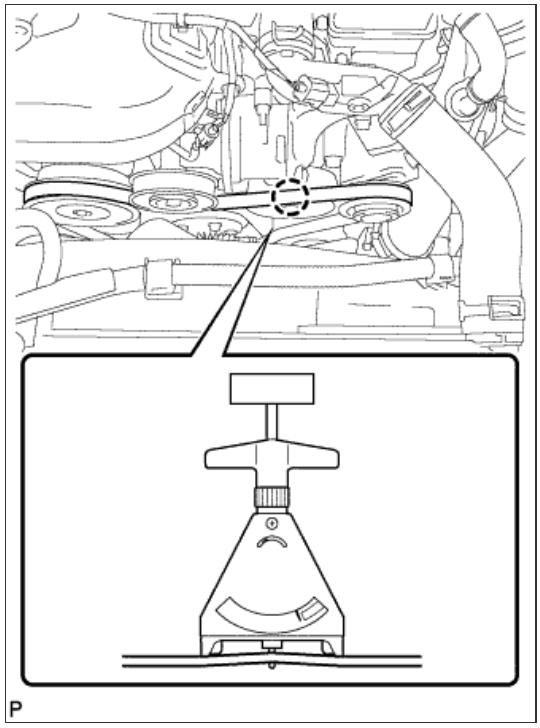
c. Using a belt tension gauge, adjust belt tension.

Standard Belt Tension:

Item	Specified Condition
New belt	400 to 650 N (41 to 66 kgf, 89.9 to 146.1 lbf)
Used belt	300 to 500 N (31 to 51 kgf, 67.4 to 112.4 lbf)

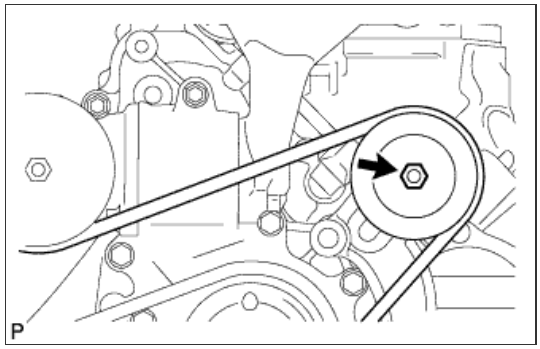
HINT:

- **A new belt is a belt which has been used for less than 5 minutes on a running engine.**
- **A used belt is a belt which has been used on a running engine for 5 minutes or more.**
- **After installing a new belt, run the engine for approximately 5 minutes and then recheck the tension.**



d. Tighten the nut.

Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }

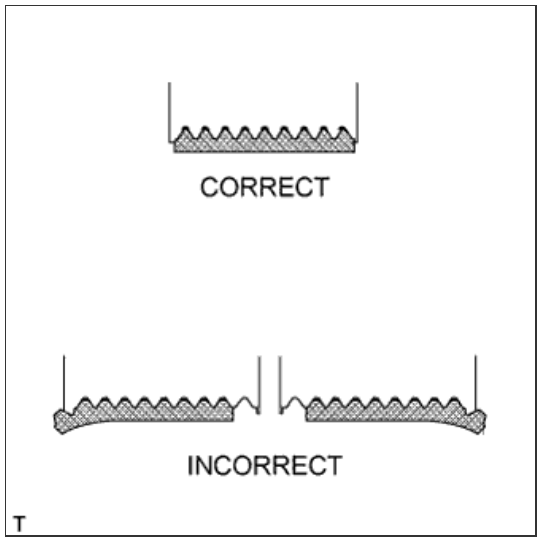


e. Check that the belt fits properly in the ribbed grooves.

HINT:

Check with your hand to confirm that the belt has not slipped out of the groove on the bottom of the pulley.

If it has slipped out, replace the V-ribbed belt. Install a new V-ribbed belt.



9. CONNECT NO. 2 RADIATOR HOSE

10. CONNECT NO. 1 RADIATOR HOSE

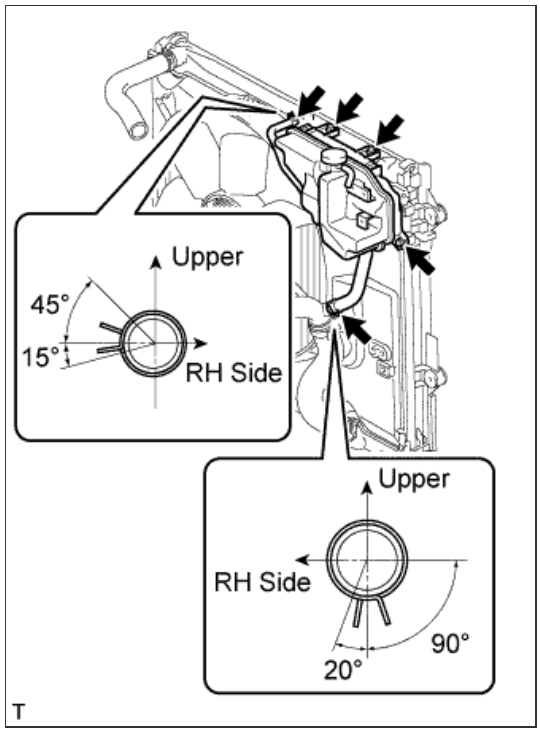
11. INSTALL RADIATOR RESERVOIR ASSEMBLY

a. Install the radiator reservoir with the 3 bolts.

b. Connect the 2 hoses to the upper radiator tank and water inlet.

HINT:

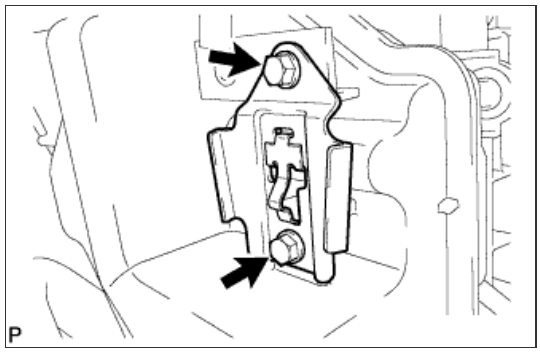
Make sure the directions of the hose clamps are as shown in the illustration.



12. INSTALL NO. 1 OIL RESERVOIR BRACKET

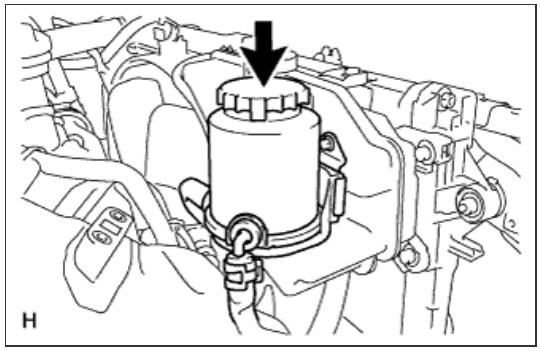
a. Install a new bracket with the 2 bolts.

Torque:
4.5 N*m{ 46 kgf*cm , 40 in.*lbf }



13. INSTALL VANE PUMP OIL RESERVOIR ASSEMBLY

a. Install the vane pump oil reservoir to the bracket.



14. INSTALL INTAKE AIR CONNECTOR

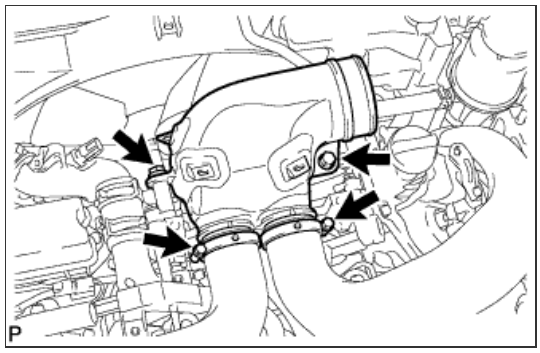
a. Connect the intake air connector to the No. 1 and No. 2 air cleaner pipes.

b. Install the connector with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Tighten the 2 hose clamps.

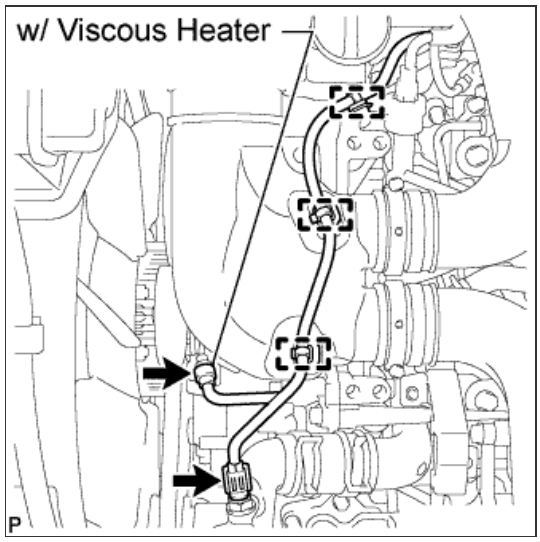
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



d. Attach the 3 wire harness clamps.

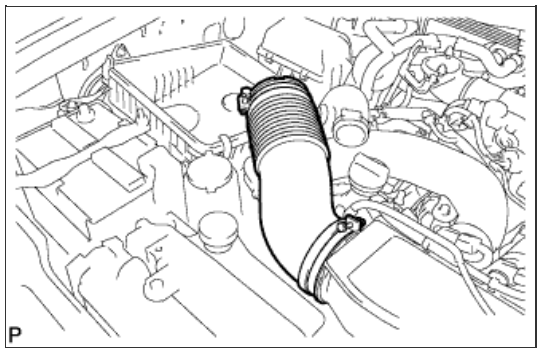
e. w/o Viscous Heater:
Connect the connector to the water temperature sensor.

f. w/ Viscous Heater:
Connect the 2 connectors to the water temperature sensor and viscous with magnet clutch heater.



15. TEMPORARILY INSTALL NO. 1 AIR CLEANER HOSE

a. Temporarily install the air cleaner hose to the intake air connector.

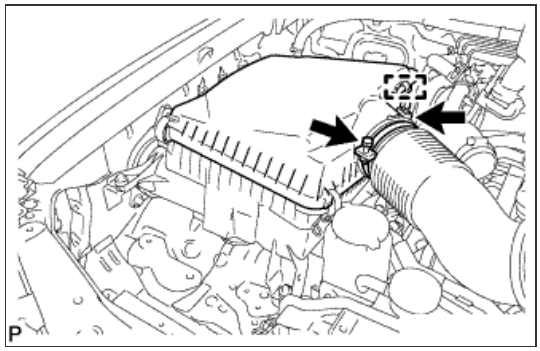


16. INSTALL AIR CLEANER CAP SUB-ASSEMBLY

a. Connect the air cleaner cap to the air cleaner hose, and install the air cleaner cap with the 4 clamps.

b. Connect the mass air flow meter connector and attach the wire harness clamp to the air cleaner cap.

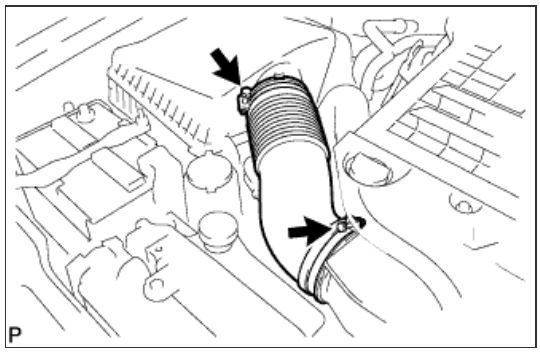
c. Attach the wire harness clamp.



d. Align the protrusion of air cleaner cap and concave portion of air cleaner hose.

e. Tighten the 2 hose clamps.

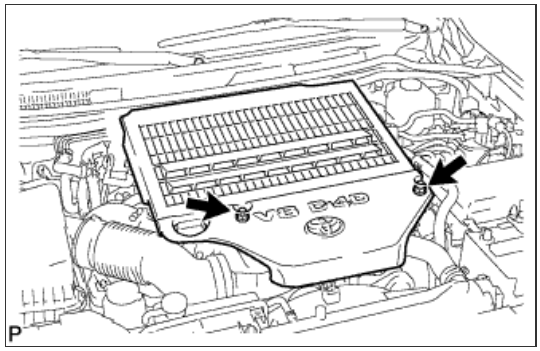
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



17. INSTALL NO. 1 EN INE COVER SUB-ASSEMBLY (w/ Intercooler)

a. Install the engine cover with the 2 nuts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

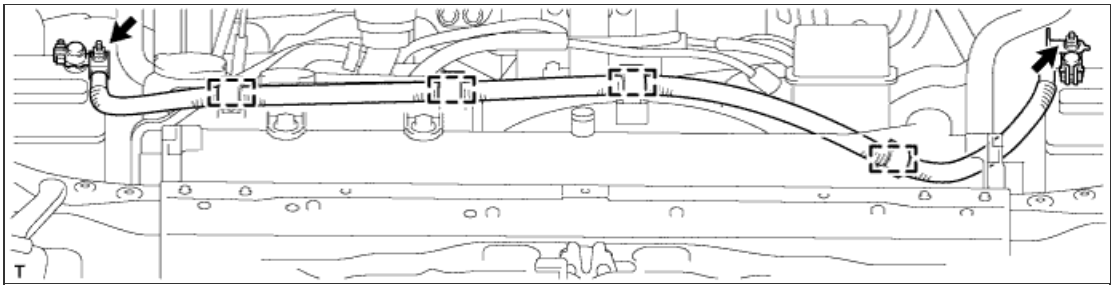


18. INSTALL NO. 3 EN INE ROOM WIRE

a. Install the No. 3 engine room wire to the main battery and sub-battery positive terminals with the 2 nuts.

Torque:
7.6 N*m{ 77 kgf*cm , 67 in.*lbf }

b. Connect the No. 3 engine room wire with the 4 clamps.



19. CONNECT CABLE TO NE ATIVE BATTERY TERMINAL

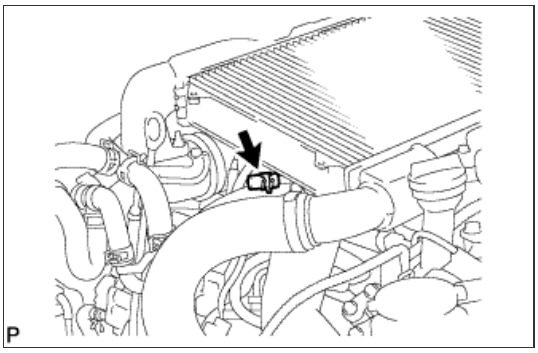
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

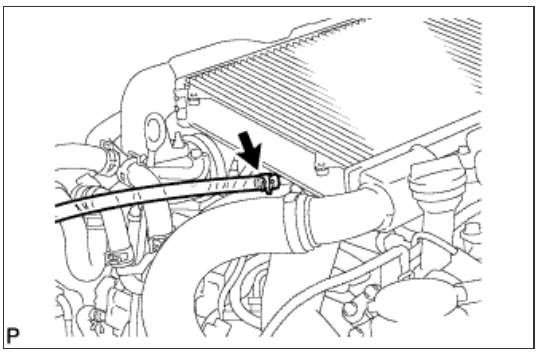
a. Connect the cables to negative (-) main battery and sub-battery terminals.

20. ADD EN INE COOLANT

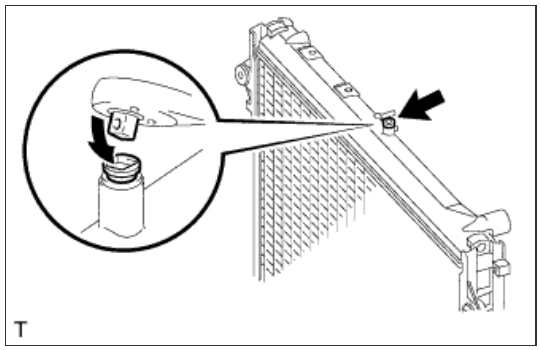
a. Remove the engine air bleed cap.



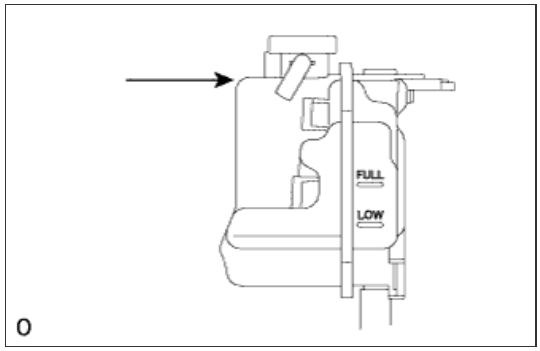
b. Connect a clear hose to the engine air bleed pipe.



c. Using a wrench, remove the vent plug.



d. Fill the radiator with TO TA SLLC to the radiator reservoir filler neck.



HINT:

Pour TO TA SLLC until it spills out of the engine air bleed pipe.

Standard Capacity (for Automatic Transmission):

Item	Specified Condition
Front heater only	14.8 liters (15.6 US qts, 13.0 Imp. qts)
Front heater and rear heater	17.6 liters (18.6 US qts, 15.5 Imp. qts)
Front heater with viscous heater	15.2 liters (16.1 US qts, 13.4 Imp. qts)
Front heater and rear heater with viscous heater	18.0 liters (19.0 US qts, 15.4 Imp. qts)

Standard capacity (for Manual Transmission):
15.4 liters (16.3 US qts, 13.6 Imp. qts)

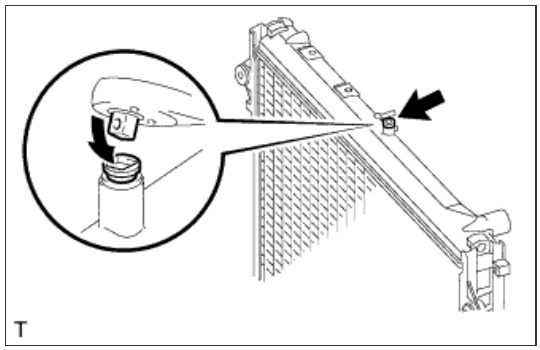
NOTICE:

Do not substitute plain water for engine coolant.

HINT:

TO TA vehicles are filled with TO TA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TO TA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

e. Install the vent plug.

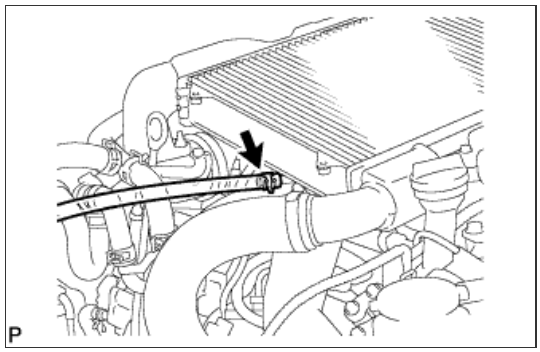


Torque:
2.0 N*m{ 20 kgf*cm , 18 in.*lbf }

NOTICE:

Do not tighten the plug to 5.0 N*m (51 kgf*cm, 44 in.*lbf) or more, as the plug will be damaged.

f. Disconnect the clear hose from the engine air bleed pipe.



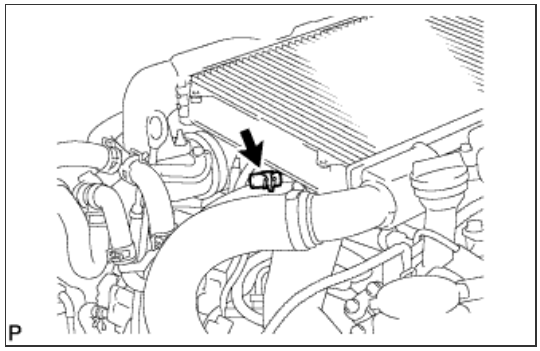
g. Install the engine air bleed cap when coolant comes out.

h. Install the radiator reservoir cap.

i. Start the engine.

NOTICE:

Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the FULL line.



j. Maintain an engine speed of 3000 rpm for approximately 10 minutes so that the thermostat opens and air bleeding is performed.

CAUTION:

When pressing the radiator hoses:

- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the radiator fan**

NOTICE:

- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**

HINT:

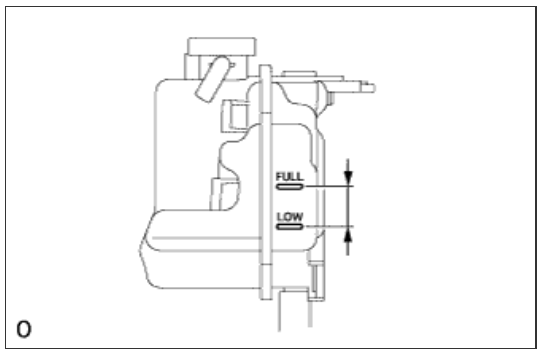
The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

k. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

l. Check that the coolant level is between the FULL and LOW lines.
If the coolant level is above the FULL line, drain coolant so that the coolant level is between the FULL and LOW lines.



21. INSPECT FOR EN INE COOLANT LEAK

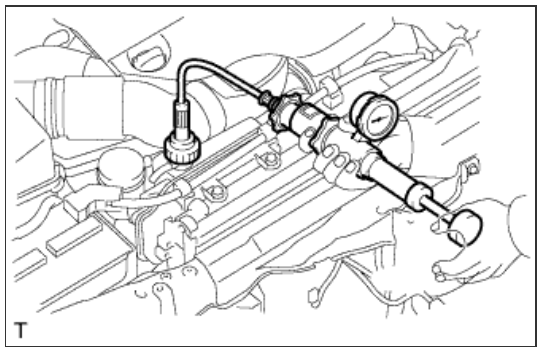
CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester to the radiator reservoir.

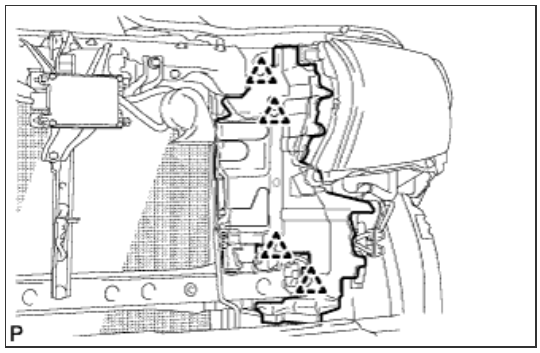
b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 17.8 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks.
If no external leaks are found, check the cylinder block and cylinder head.



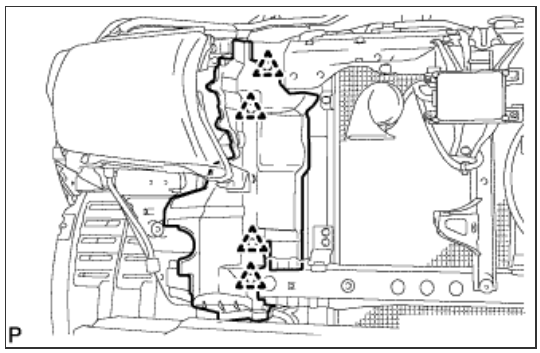
22. INSTALL RADIATOR SIDE DEFLECTOR LH

a. Install the side deflector with the 4 clips.



23. INSTALL RADIATOR SIDE DEFLECTOR RH (for Manual Transmission)

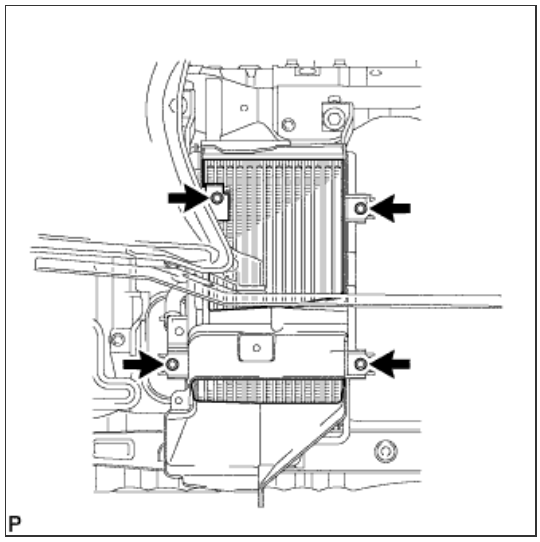
a. Install the deflector with the 4 clips.



24. INSTALL TRANSMISSION OIL COOLER AIR DUCT (for Automatic Transmission)

a. Install the oil cooler air duct with the 4 bolts.

Torque:
4.9 N*m{ 50 kgf*cm , 43 in.*lbf }



25. INSTALL FRONT BUMPER COVER

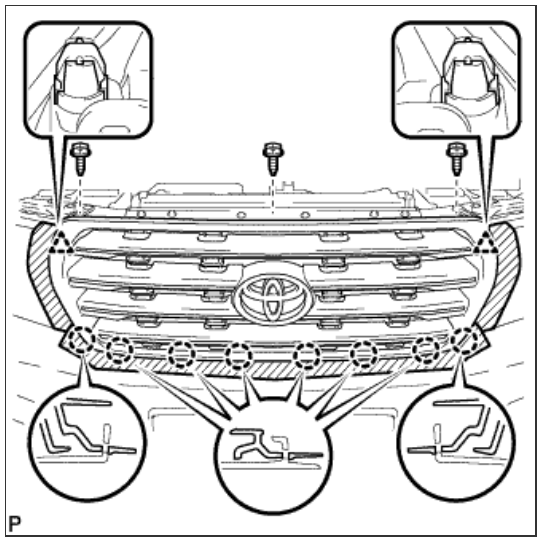
a. for Standard:
Install the front bumper cover (Click here).

b. w/ Winch:
Install the front bumper cover (Click here).

26. INSTALL RADIATOR RILLE

a. Attach the 2 clips and 8 claws to install the radiator grille.

b. Install the 3 screws.



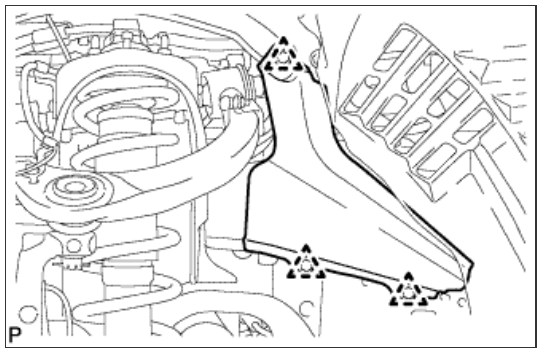
27. INSTALL FRONT BUMPER WINCH COVER (w/ Winch)

28. INSTALL UPPER RADIATOR SUPPORT SEAL

a. Install the upper radiator support seal with the 7 clips.

29. INSTALL FRONT FENDER APRON SEAL FRONT RH

a. Install the front fender apron seal front RH with the 3 clips.



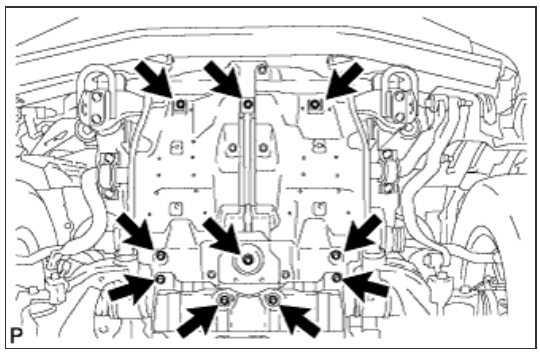
30. INSTALL FRONT WHEEL RH

Torque:
for Aluminum Wheel:
131 N*m{ 1336 kgf*cm , 97 ft.*lbf }
for Steel Wheel:
209 N*m{ 2131 kgf*cm , 154 ft.*lbf }

31. INSTALL NO. 1 EN INE UNDER COVER SUB-ASSEMBLY

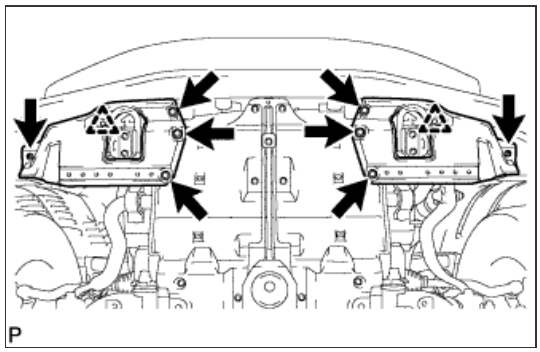
a. Install the engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



32. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

a. Install the splash shield with the clip, and then install the 3 bolts and screw.



33. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Install the splash shield with the clip, and then install the 3 bolts and screw.

for Preparation Click here

1. CHECK ENGINE OIL LEVEL

a. Warm up the engine, stop the engine and wait 5 minutes. The oil level should be between the low and full level marks on the dipstick. If the oil level is low, check for leakage and add oil up to the full level mark.

NOTICE:

Do not fill engine oil above the full level mark.

2. INSPECT OIL PRESSURE

a. Disconnect the oil pressure sensor connector.

b. Using a 24 mm deep socket wrench, remove the oil pressure sensor.

c. Install an oil pressure gauge.

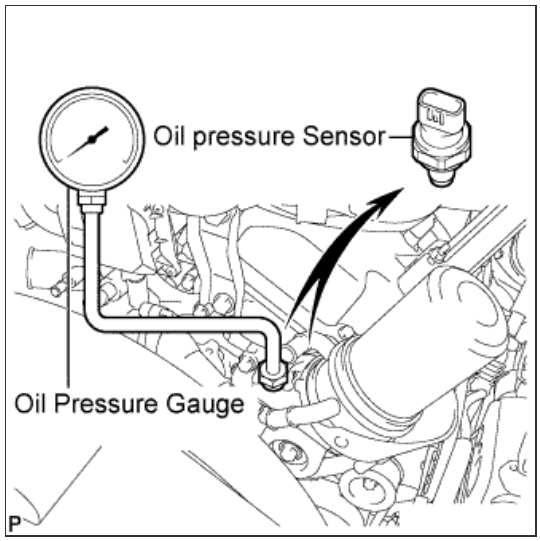
d. Warm up the engine.

e. Measure the oil pressure.

Standard Oil Pressure:

Condition	Specified Condition
Idling	29 kPa (0.3 kgf/cm^2, 4.2 psi) or more
3000 rpm	294 to 588 kPa (3.0 to 6.0 kgf/cm^2, 43 to 85 psi)

If the oil pressure is not as specified, check the oil pump.



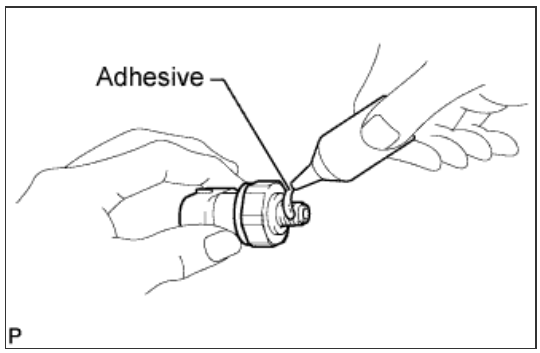
f. Remove the oil pressure gauge.

g. Apply adhesive to 2 or 3 threads of the oil pressure sensor.

Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent

NOTICE:

Do not apply adhesive to the oil inlet port of the sensor.



h. Using a 24 mm deep socket wrench, install the oil pressure sensor.

Torque:
15 N*m{ 150 kgf*cm , 11 ft.*lbf }

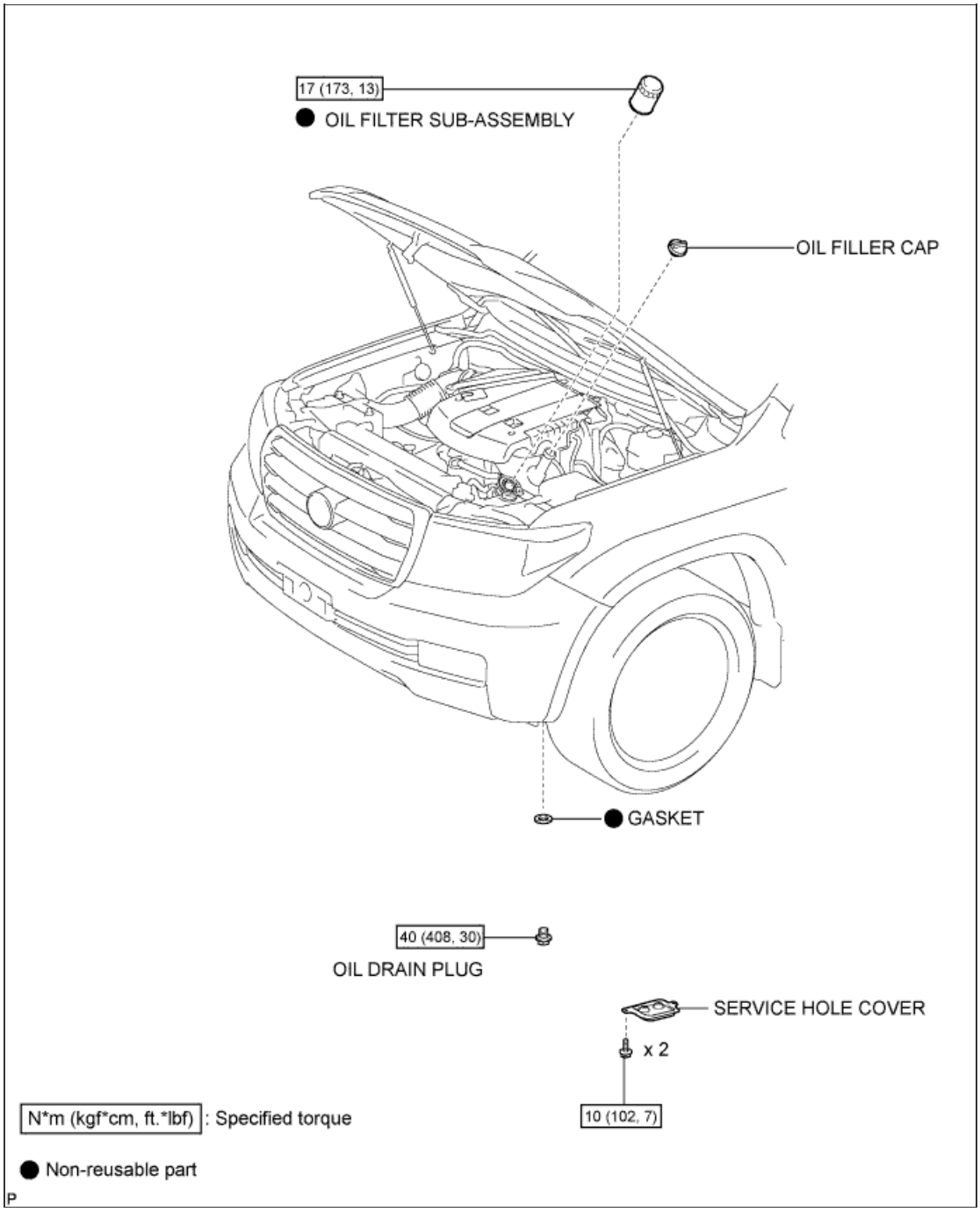
NOTICE:

Do not start the engine within 1 hour of installation.

i. Connect the oil pressure sensor connector.

j. Start the engine and check for engine oil leaks.

for Preparation Click here



for Preparation Click here

CAUTION:

- **Prolonged and repeated contact with engine oil will result in the loss of natural oils from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer.**
- **Wear protective clothing and gloves. Avoid contact with used oil. If contact occurs, wash the area thoroughly with soap and waterless hand cleaner. Never use gasoline, thinners, or solvents to wash the skin.**
- **In order to protect the environment, dispose of used oil and used oil filters at designated disposal sites only.**

1. DRAIN ENGINE OIL

a. Remove the oil filler cap.

b. Remove the 2 bolts and service hole cover from the No. 2 engine under cover.

c. Remove the oil drain plug, and drain the engine oil from the oil pan.

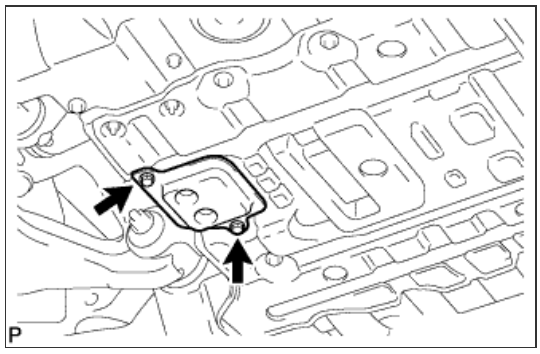
NOTICE:

Collect the oil in an oil disposal container.

d. Wipe the oil pan and drain plug.

e. Install a new gasket and the drain plug.

Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }



2. REMOVE OIL FILTER SUB-ASSEMBLY

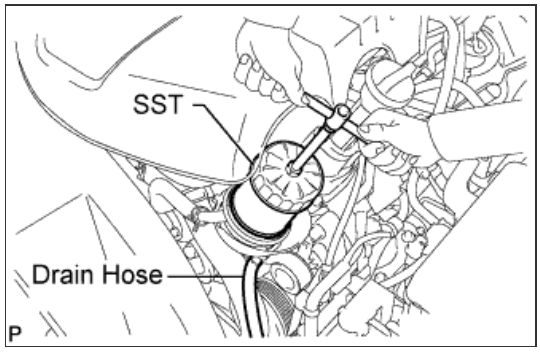
a. Remove the drain pipe cap.

b. Using SST, remove the oil filter.

SST
09228-07501

HINT:

- **Put the disposal container beneath the drain hose to collect the oil from the oil filter cover.**
- **Drain hose inside diameter: 8 mm (0.315 in.)**
- **Drain hose length: 900 mm (2.95 ft.)**



3. INSTALL OIL FILTER SUB-ASSEMBLY

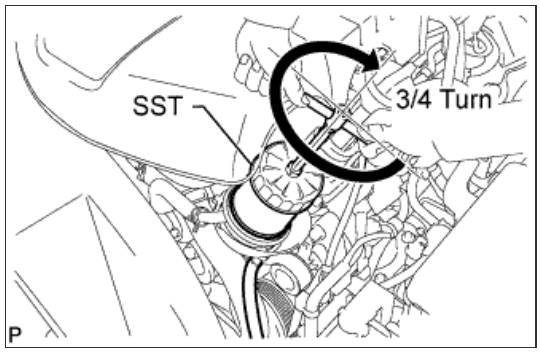
a. Check and clean the oil filter installation surface.

b. Apply clean engine oil to the gasket of a new oil filter.

c. Lightly screw the oil filter into place by hand. Tighten it until the gasket contacts the seat.

d. Using SST, tighten the oil filter. Depending on the work space available, choose from the following.

SST
09228-07501



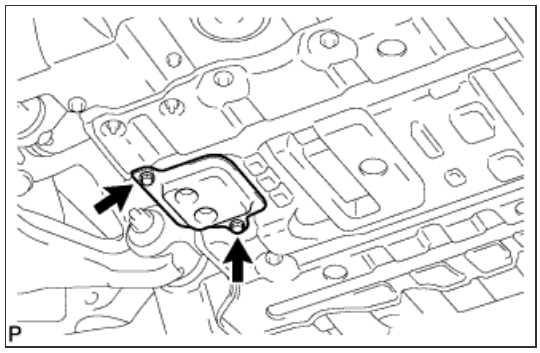
i. If enough space is available, use a torque wrench to tighten the oil filter.

Torque:
17 N*m{ 173 kgf*cm , 13 ft.*lbf }

ii. If enough space is not available to use a torque wrench, tighten the oil filter a 3/4 turn by hand or with a common wrench.

e. Install the service hole cover to the No. 2 engine under cover with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



4. ADD ENGINE OIL

a. Remove the oil filler cap.

b. Add new oil.

Standard Oil Grade:

Oil Grade	Oil Viscosity (SAE)
API grade SL "Energy-Conserving", SM "Energy-Conserving", SN "Resource-Conserving" or ILSAC multigrade engine oil	5W-30 10W-30
API grade SL, SM or SN multigrade engine oil	15W-40 20W-50

Standard Oil Capacity:

Item	Specified Condition
Drain and refill with oil filter change	5.2 liters (5.5 US qts, 4.6 Imp. qts)
Drain and refill without oil filter change	4.9 liters (5.2 US qts, 4.3 Imp. qts)
Dry fill	6.0 liters (6.3 US qts, 5.3 Imp. qts)

c. Install the oil filler cap.

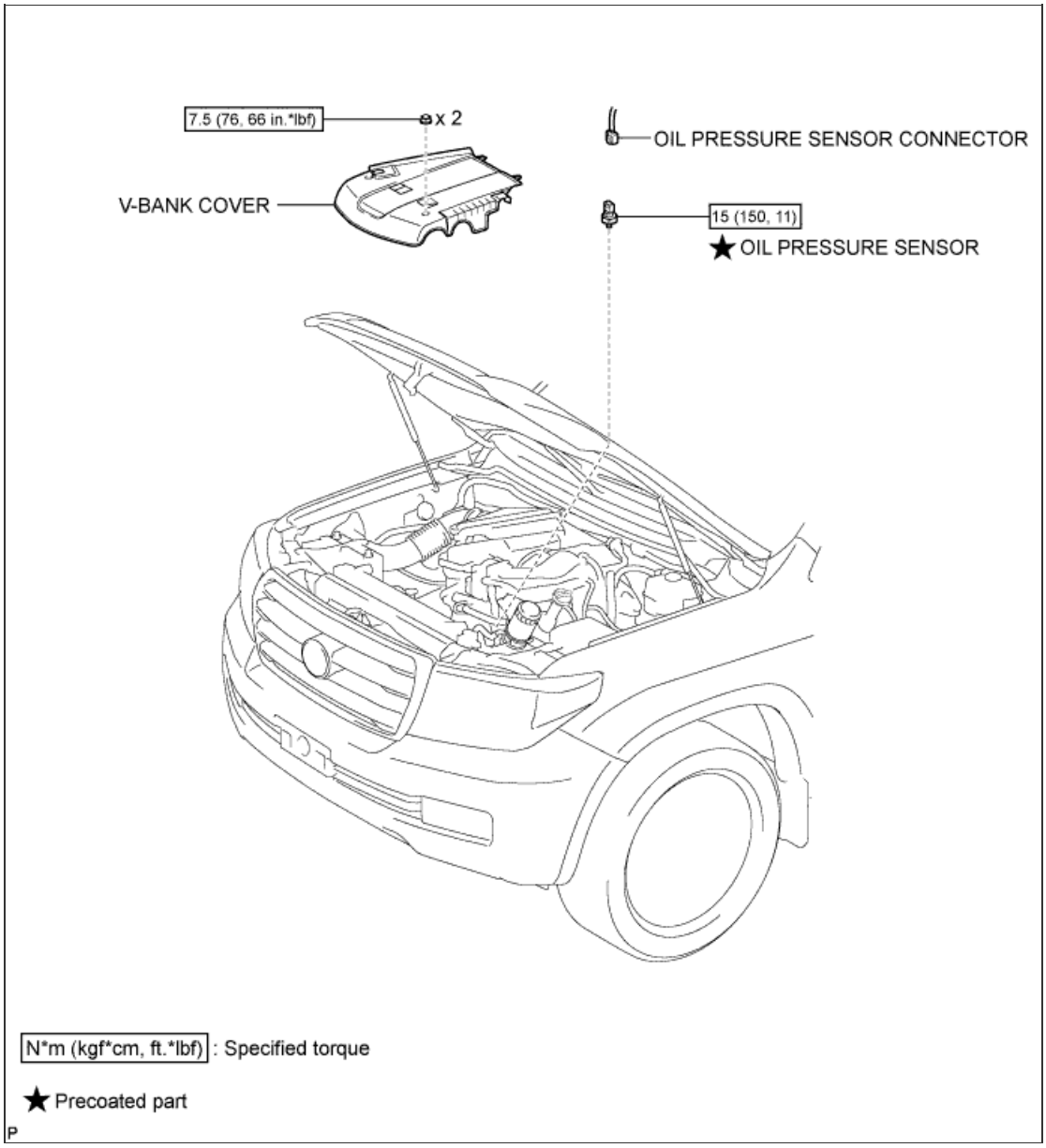
5. INSPECT FOR OIL LEAK

a. Start the engine. Make sure that there are no oil leaks from the area that was worked on.

6. INSPECT ENGINE OIL LEVEL

a. Warm up the engine so that the coolant temperature is approximately 80°C (176°F). Check the engine oil level dipstick 5 minutes after the engine is stopped. Then add engine oil to the full level of the engine oil level dipstick.

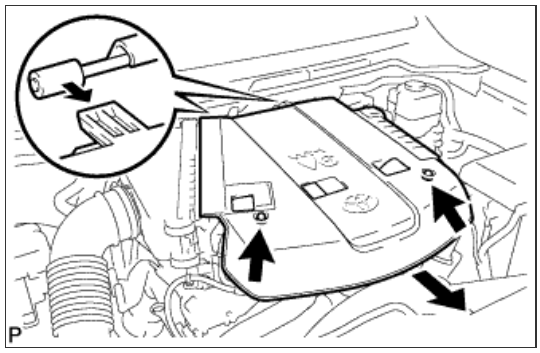
for Preparation Click here



for Preparation Click here

1. REMOVE V-BANK COVER

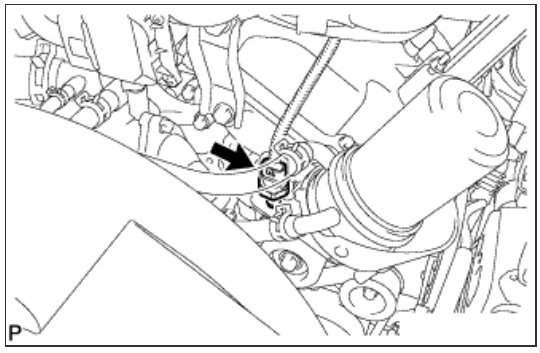
a. Remove the 2 cap nuts and V-bank cover.



2. REMOVE OIL PRESSURE SENSOR

a. Disconnect the oil pressure sensor connector.

b. Using a 24 mm deep socket wrench, remove the oil pressure sensor.



for Preparation Click here

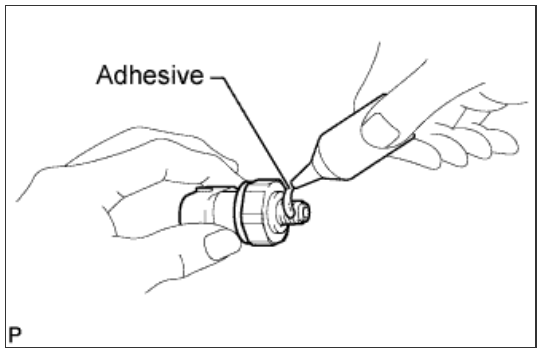
1. INSTALL OIL PRESSURE SENSOR

a. Apply adhesive to 2 or 3 threads of the oil pressure sensor.

Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent

NOTICE:

Do not apply adhesive to the oil inlet port of the sensor.



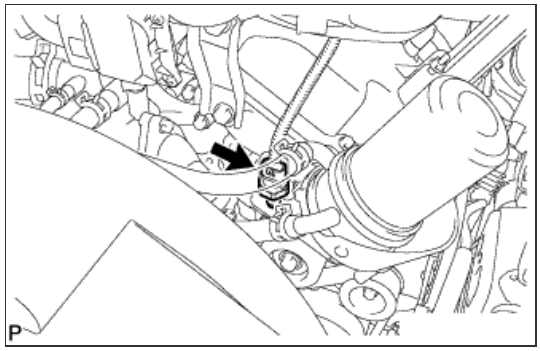
b. Using a 24 mm deep socket wrench, install the oil pressure sensor.

Torque:
15 N*m{ 150 kgf*cm , 11 ft.*lbf }

NOTICE:

Do not start the engine within 1 hour of installation.

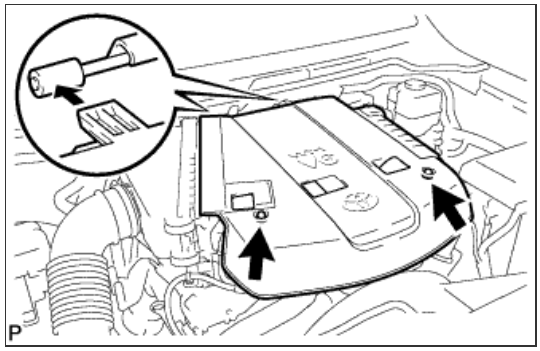
c. onnect the oil pressure sensor connector.



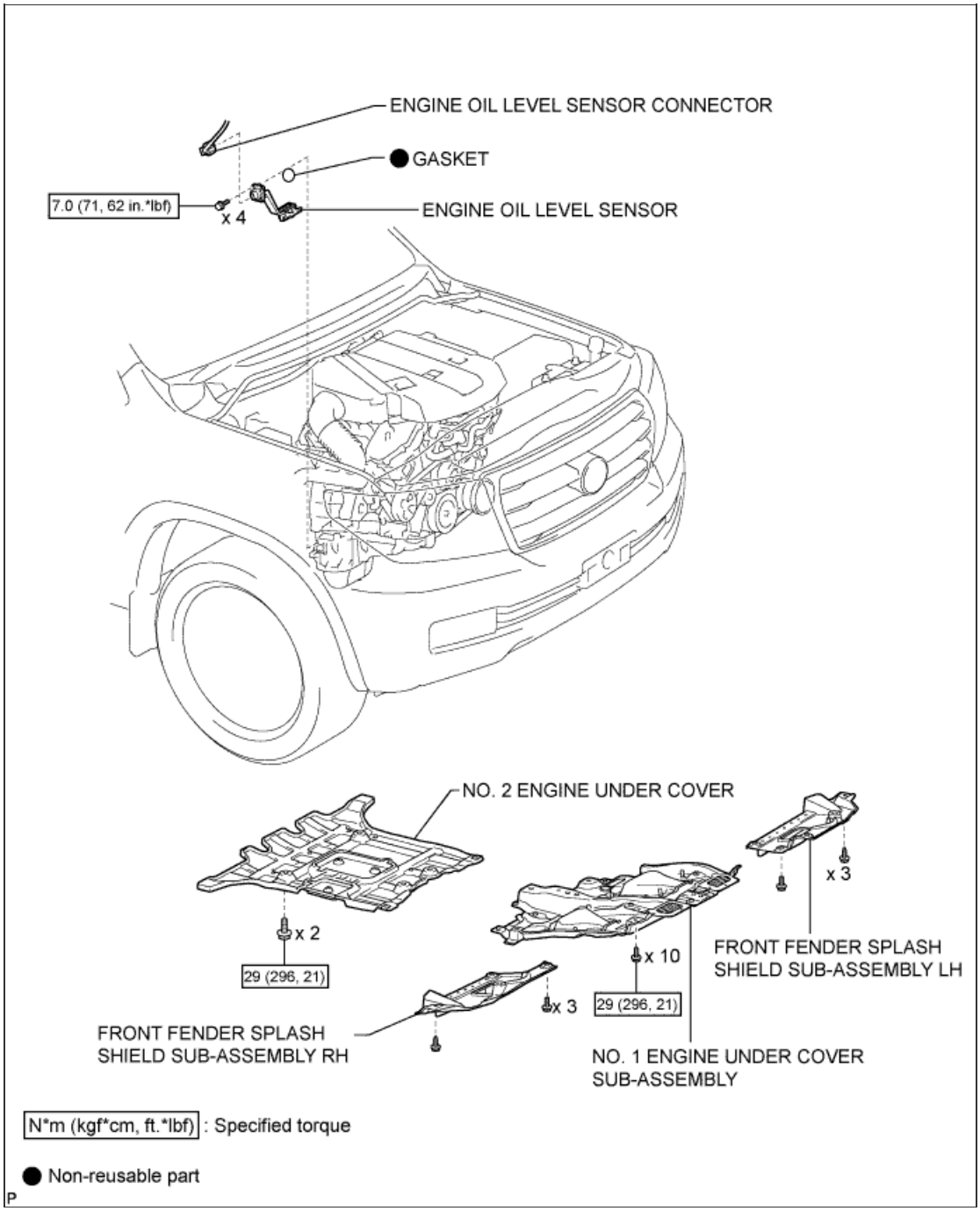
2. INSTALL V-BANK COVER

a. Install the V-bank cover with the 2 cap nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



for Preparation [Click here]

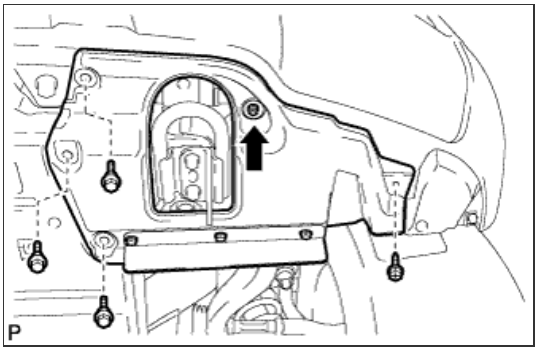


for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



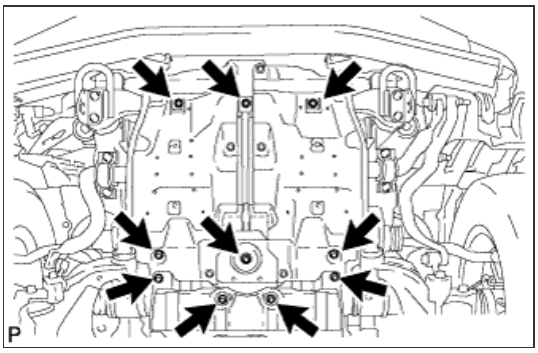
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

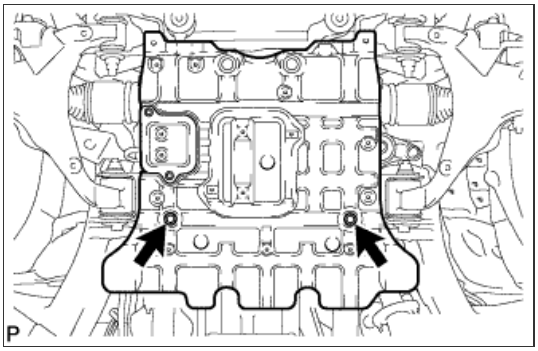
3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



4. REMOVE NO. 2 ENGINE UNDER COVER

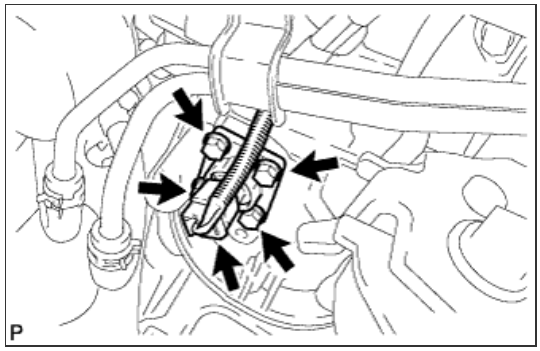
a. Remove the 2 bolts and engine under cover.



5. REMOVE ENGINE OIL LEVEL SENSOR

a. Disconnect the connector.

b. Remove the 4 bolts, sensor and gasket.



for Preparation Click here

1. INSPECT ENGINE OIL LEVEL SENSOR

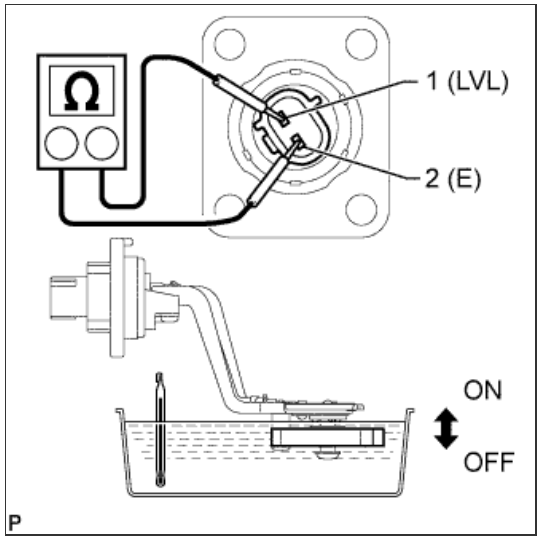
a. Partially immerse the sensor in an oil bath and warm up the oil bath.

Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (LVL) - 2 (E)	ON, 20°C (68°F)	Below 1 Ω
	OFF, 20°C (68°F)	Below 1 Ω
	ON, 60°C (140°F)	Below 1 Ω
	OFF, 60°C (140°F)	10 kΩ or higher

If the result is not as specified, replace the sensor.



for Preparation Click here

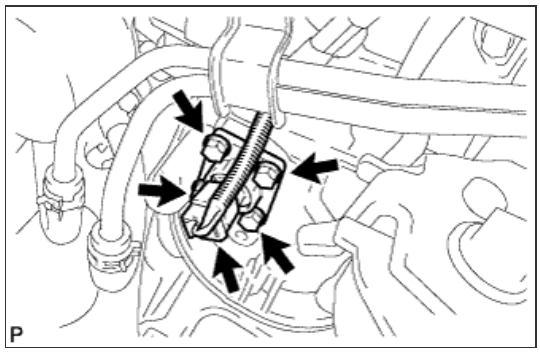
1. INSTALL ENGINE OIL LEVEL SENSOR

a. Install a new gasket to the sensor.

b. Install the sensor with the 4 bolts.

Torque:
7.0 N*m{ 71 kgf*cm , 62 in.*lbf }

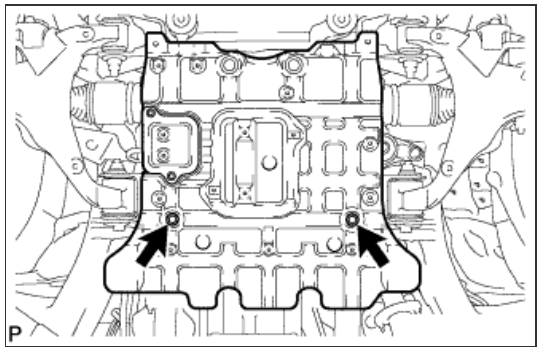
c. Connect the connector.



2. INSTALL NO. 2 ENGINE UNDER COVER

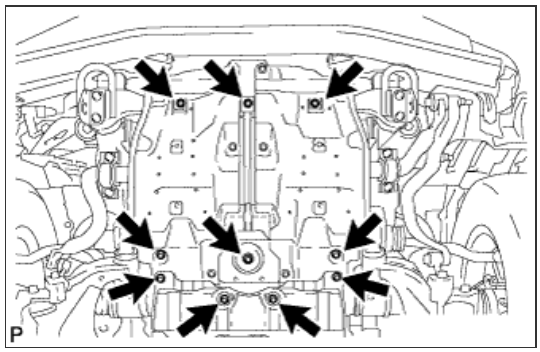
a. Install the under cover with the 2 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



3. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the under cover with the 10 bolts.



4. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

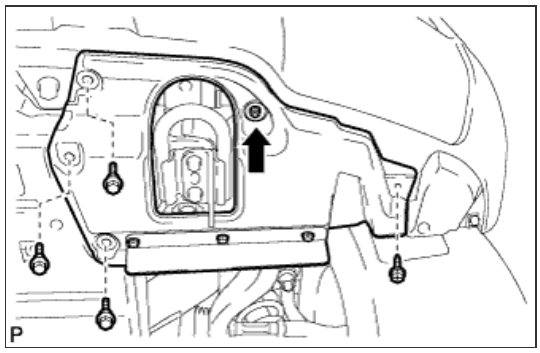
HINT:

Use the same procedures described for the LH side.

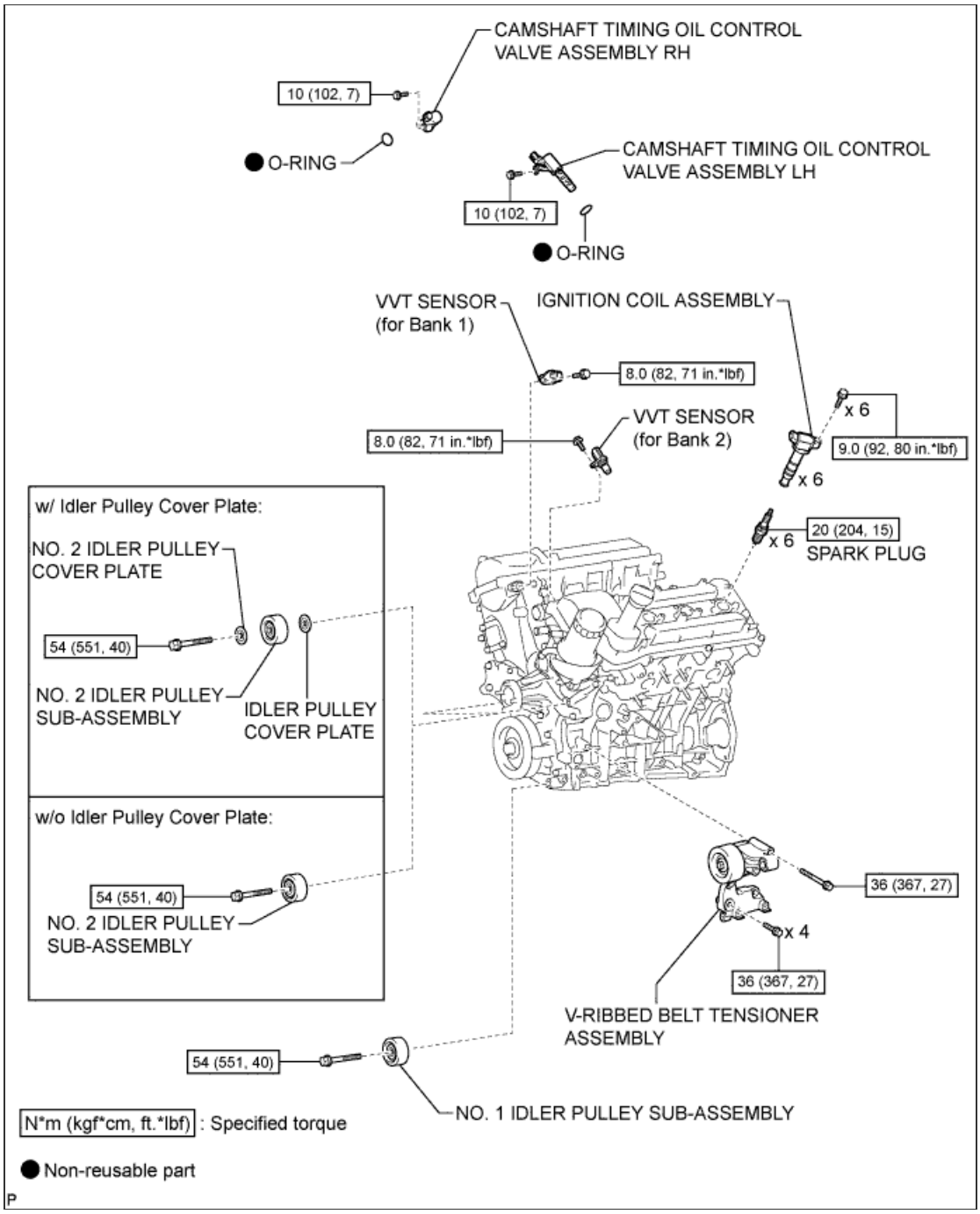
5. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

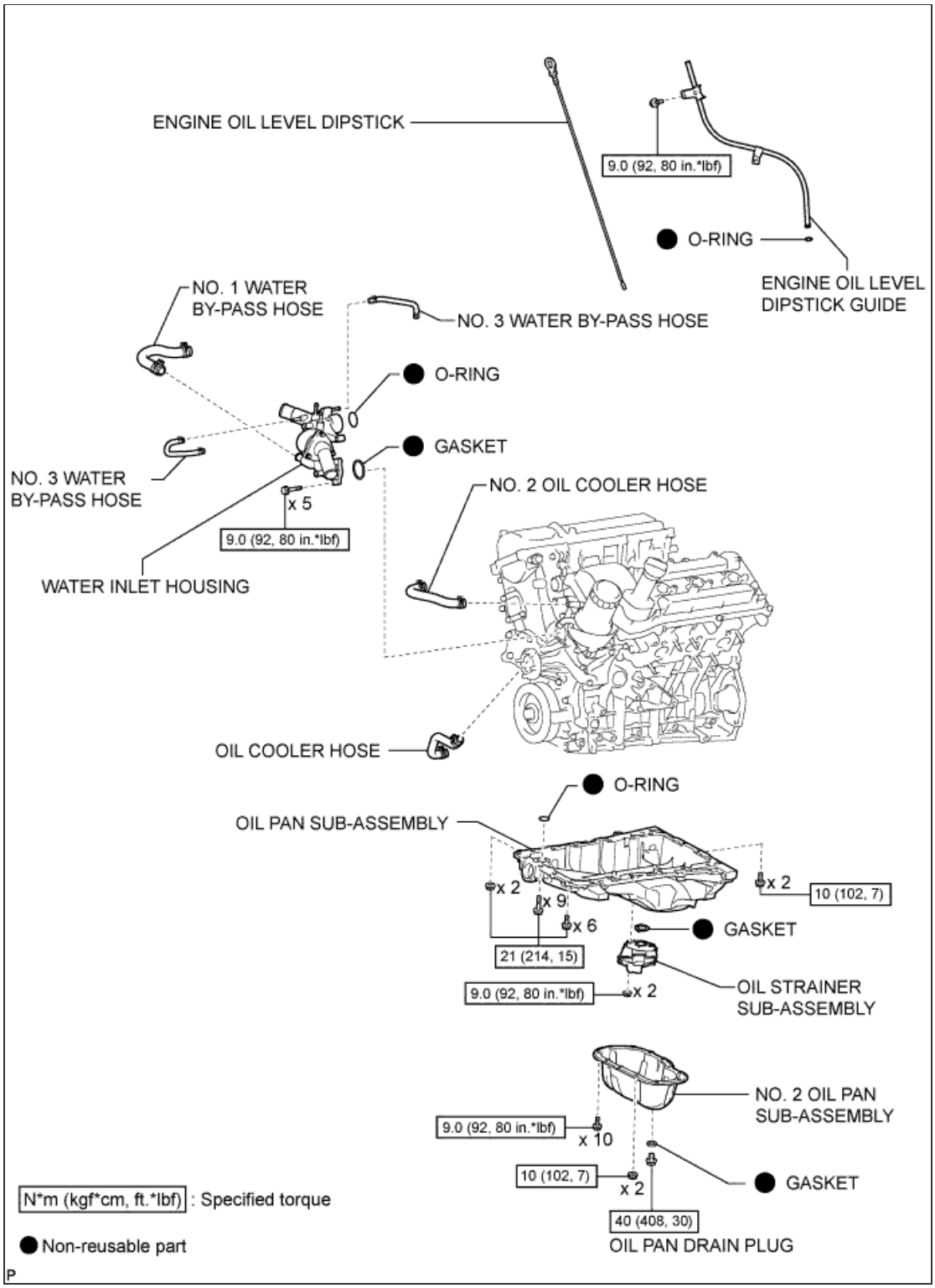
a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

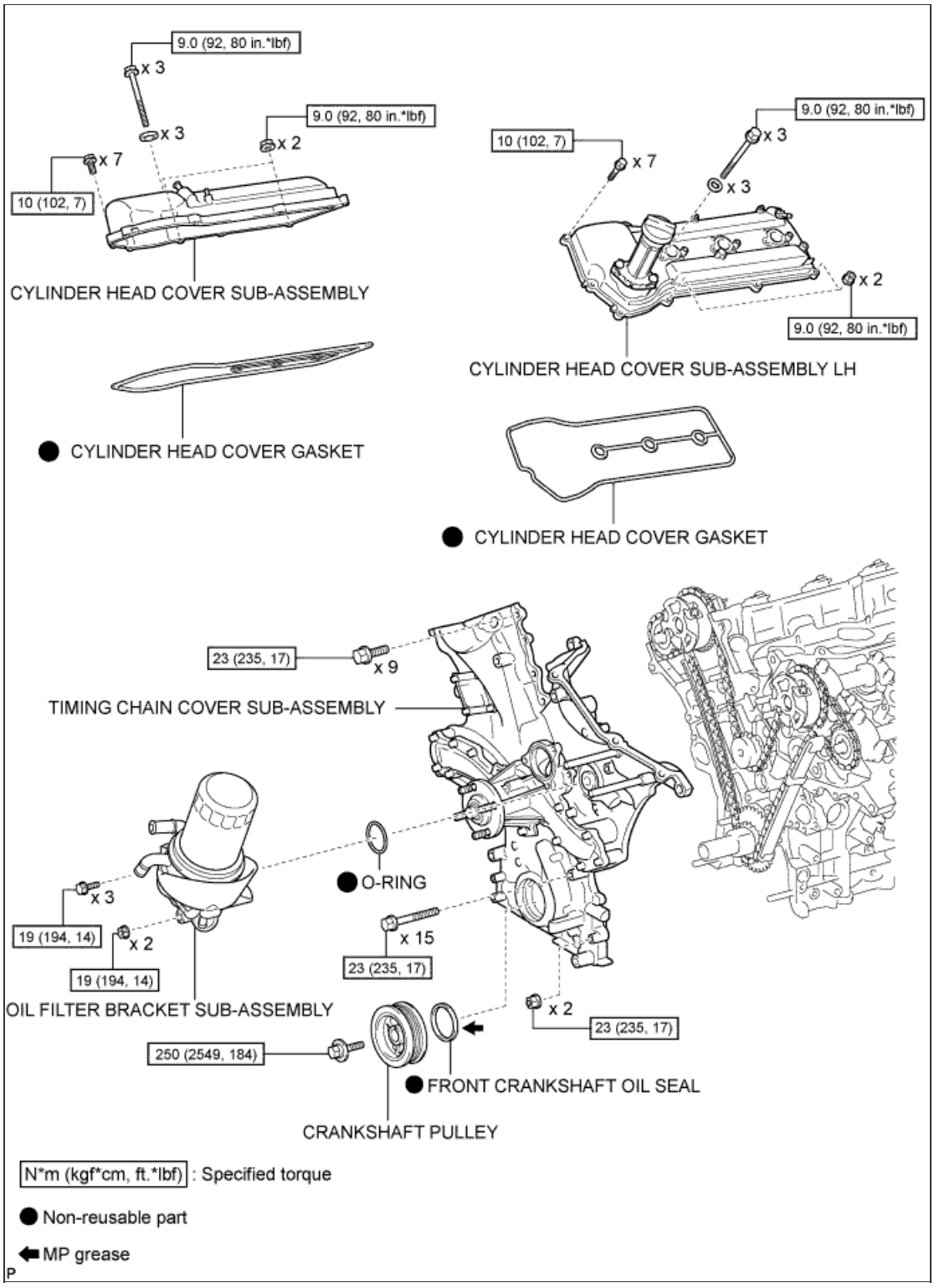
b. Install the 3 bolts and screw.

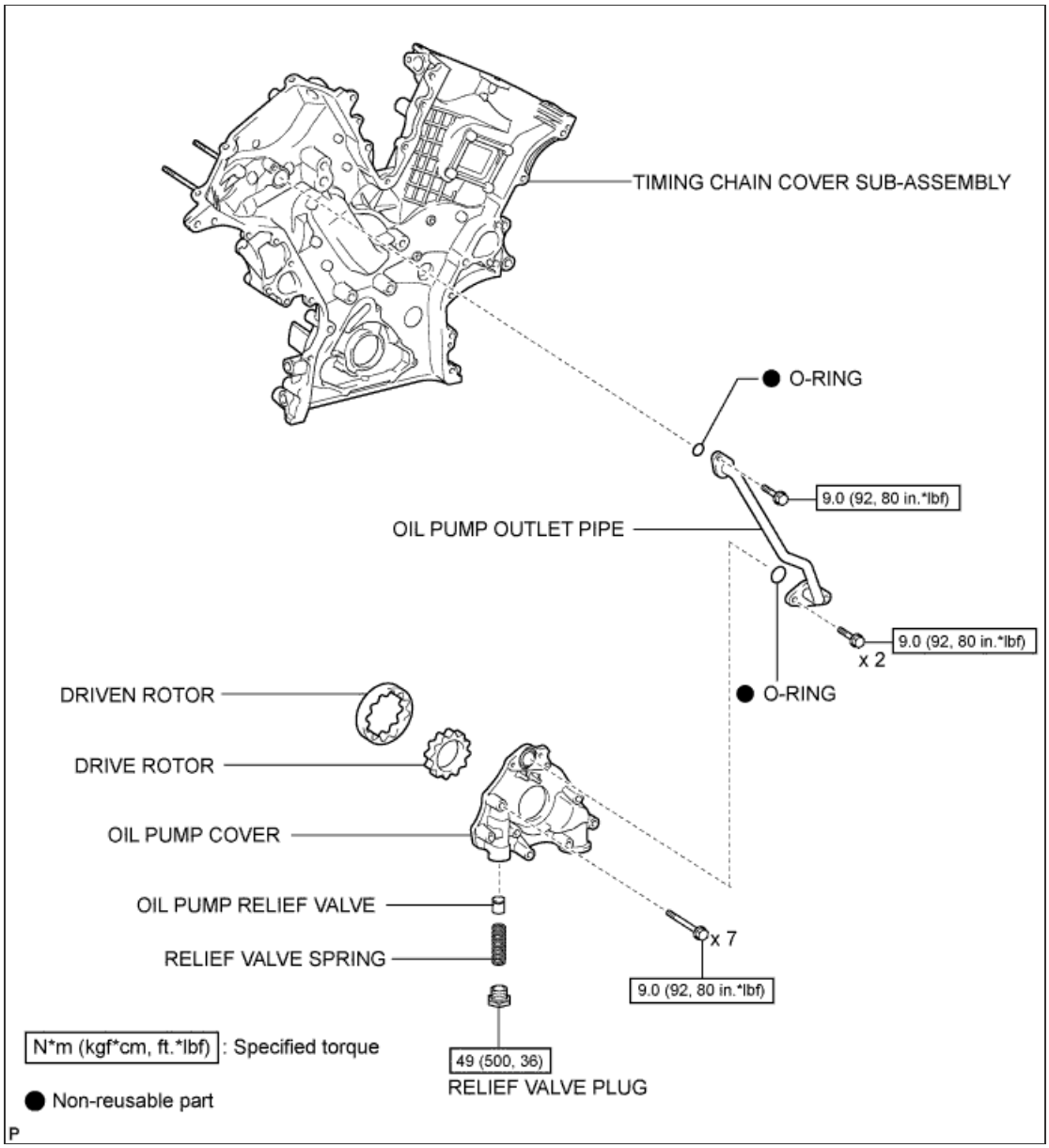


for Preparation Click here




ENGINE OIL LEVEL DIPSTICK
9.0 (92, 80 in.*lbf)
O-RING
ENGINE OIL LEVEL DIPSTICK GUIDE
NO. 1 WATER BY-PASS HOSE
NO. 3 WATER BY-PASS HOSE
O-RING
GASKET
NO. 3 WATER BY-PASS HOSE
x 5
9.0 (92, 80 in.*lbf)
WATER INLET HOUSING
NO. 2 OIL COOLER HOSE
OIL COOLER HOSE
O-RING
OIL PAN SUB-ASSEMBLY
x 2
x 9
x 6
x 2
10 (102, 7)
GASKET
21 (214, 15)
9.0 (92, 80 in.*lbf)
x 2
OIL STRAINER SUB-ASSEMBLY
NO. 2 OIL PAN SUB-ASSEMBLY
9.0 (92, 80 in.*lbf)
x 10
10 (102, 7)
x 2
GASKET
40 (408, 30)
OIL PAN DRAIN PLUG
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P


9.0 (92, 80 in.*lbf)
x 3
x 3
9.0 (92, 80 in.*lbf)
x 2
x 7
10 (102, 7)
CYLINDER HEAD COVER SUB-ASSEMBLY
10 (102, 7)
x 7
9.0 (92, 80 in.*lbf)
x 3
x 3
x 2
9.0 (92, 80 in.*lbf)
CYLINDER HEAD COVER SUB-ASSEMBLY LH
CYLINDER HEAD COVER GASKET
CYLINDER HEAD COVER GASKET
23 (235, 17)
x 9
TIMING CHAIN COVER SUB-ASSEMBLY
O-RING
x 3
19 (194, 14)
x 2
19 (194, 14)
OIL FILTER BRACKET SUB-ASSEMBLY
x 15
23 (235, 17)
x 2
23 (235, 17)
250 (2549, 184)
FRONT CRANKSHAFT OIL SEAL
CRANKSHAFT PULLEY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
MP grease
P


TIMING CHAIN COVER SUB-ASSEMBLY
O-RING
9.0 (92, 80 in.*lbf)
OIL PUMP OUTLET PIPE
9.0 (92, 80 in.*lbf)
x 2
O-RING
DRIVEN ROTOR
DRIVE ROTOR
OIL PUMP COVER
OIL PUMP RELIEF VALVE
RELIEF VALVE SPRING
x 7
9.0 (92, 80 in.*lbf)
N*m (kgf*cm, ft.*lbf) : Specified torque
49 (500, 36)
RELIEF VALVE PLUG
Non-reusable part
P

for Preparation Click here

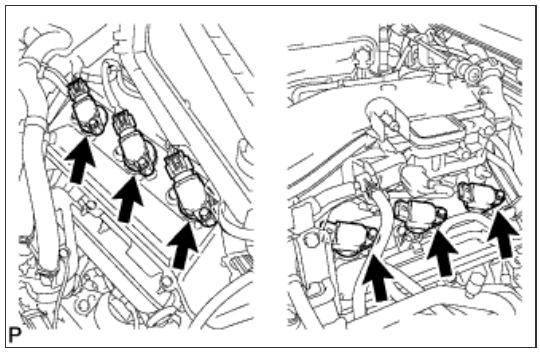
1. REMOVE ENGINE ASSEMBLY

(Click here)

2. REMOVE IGNITION COIL ASSEMBLY

a. Disconnect the 6 ignition coil connectors.

b. Remove the 6 bolts and 6 ignition coils.



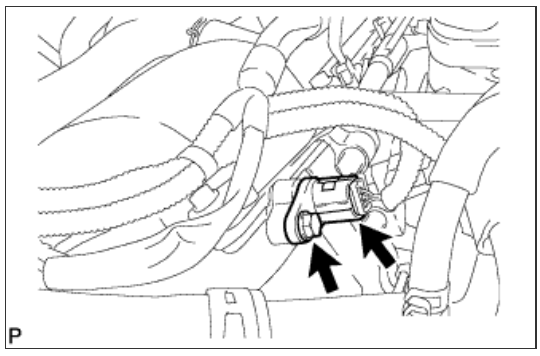
3. REMOVE SPARK PLUG

a. Remove the 6 spark plugs.

4. REMOVE VVT SENSOR (for Bank 1)

a. Disconnect the sensor connector.

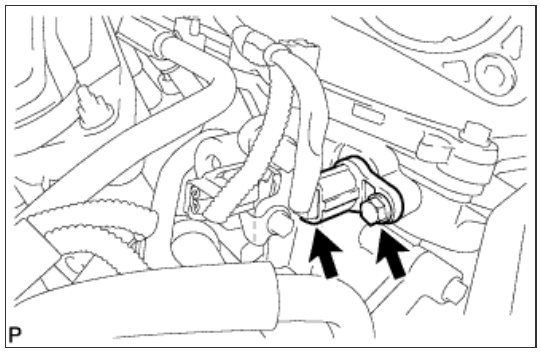
b. Remove the bolt and sensor.



5. REMOVE VVT SENSOR (for Bank 2)

a. Disconnect the sensor connector.

b. Remove the bolt and sensor.

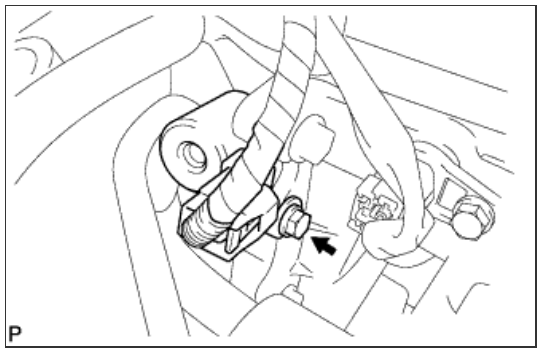


6. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY LH

a. Disconnect the oil control valve connector.

b. Remove the bolt and oil control valve.

c. Remove the O-ring from the oil control valve.

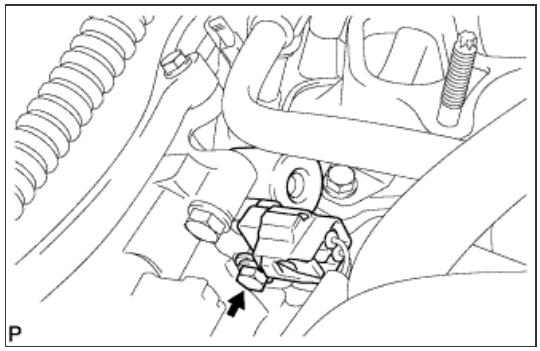


7. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY RH

a. Disconnect the oil control valve connector.

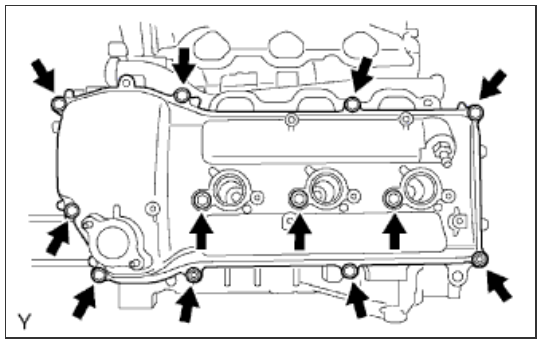
b. Remove the bolt and oil control valve.

c. Remove the O-ring from the oil control valve.



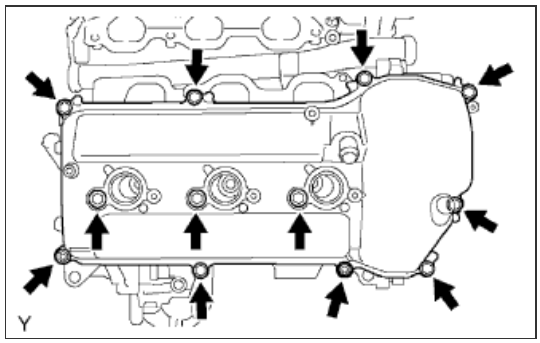
8. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY LH

a. Remove the 10 bolts, 3 seal washers, 2 nuts, cylinder head cover and gasket.



9. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY

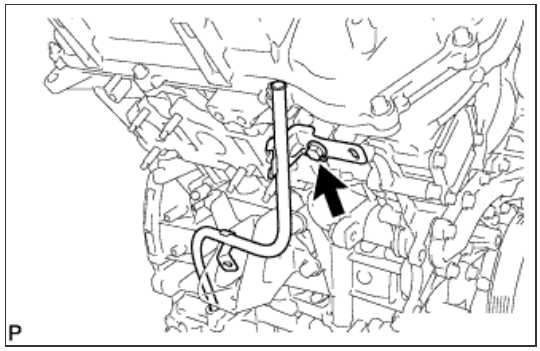
a. Remove the 10 bolts, 3 seal washers, 2 nuts, cylinder head cover and gasket.



10. REMOVE ENGINE OIL LEVEL DIPSTICK GUIDE

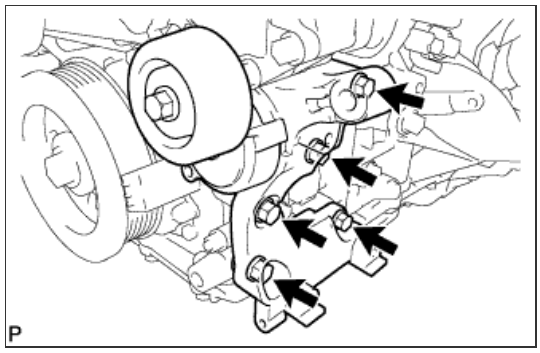
a. Remove the bolt and dipstick guide.

b. Remove the O-ring from the dipstick guide.



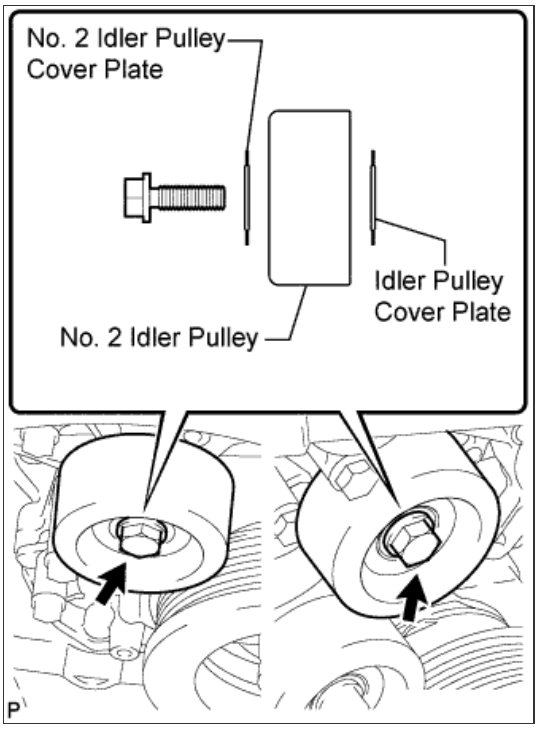
11. REMOVE V-RIBBED BELT TENSIONER ASSEMBLY

a. Remove the 5 bolts and V-ribbed belt tensioner.

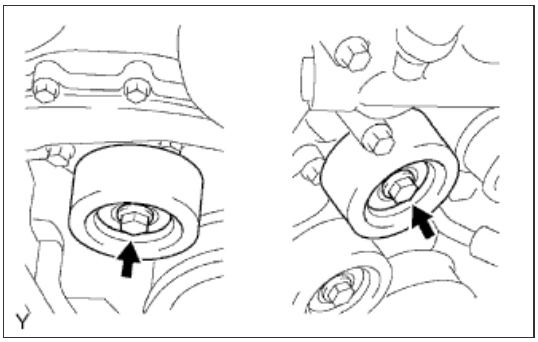


12. REMOVE NO. 2 IDLER PULLEY SUB-ASSEMBLY

a. w/ Pulley Cover Plate:
Remove the 2 bolts, 2 No. 2 idler pulley cover plate, 2 idler pulley and 2 idler pulley cover plate.

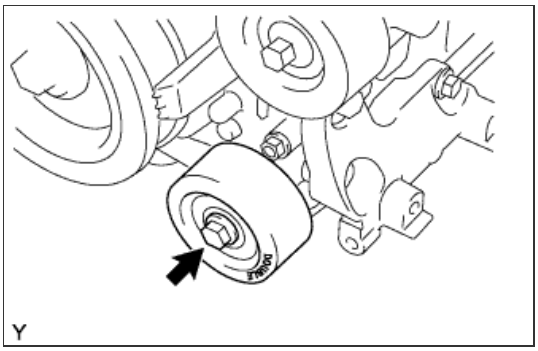


b. w/o Pulley Cover Plate:
Remove the 2 bolts and 2 No. 2 idler pulleys.



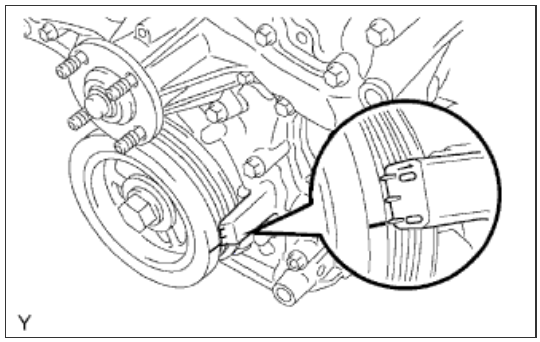
13. REMOVE NO. 1 IDLER PULLEY SUB-ASSEMBLY

a. Remove the bolt and No. 1 idler pulley.

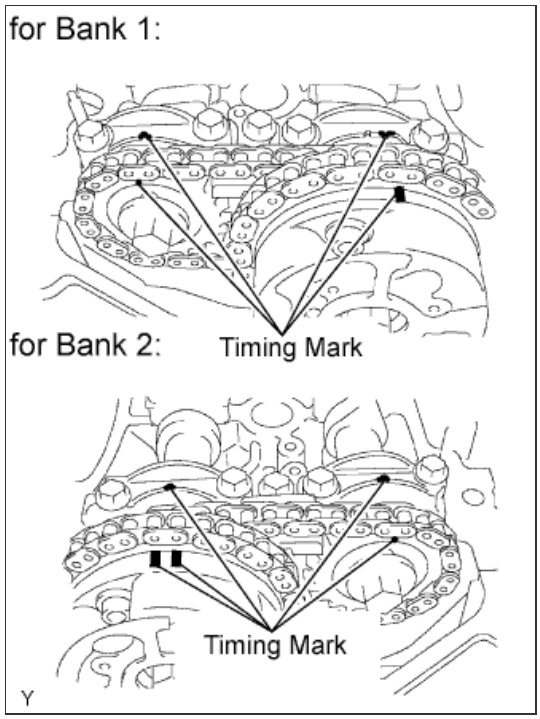


14. REMOVE CRANKSHAFT PULLEY

a. Turn the crankshaft pulley, and align the notch with the timing mark "0" of the timing chain cover.



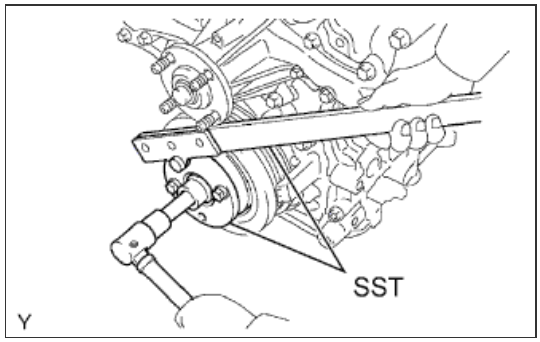
b. Check that the timing marks of the camshaft timing gears and sprockets are aligned with the timing marks of the bearing caps as shown in the illustration.



c. Using SST, hold the crankshaft pulley and loosen the pulley set bolt.

SST

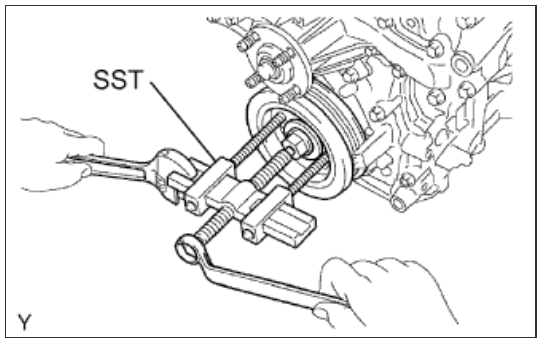
09213-54015 (91651-60855)
09330-00021



d. Using the pulley set bolt and SST, remove the crankshaft pulley.

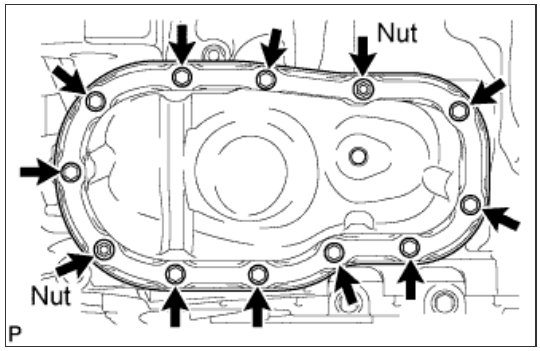
SST

09950-50013 (09951-05010, 09952-05010, 09953-05020, 09954-05030)

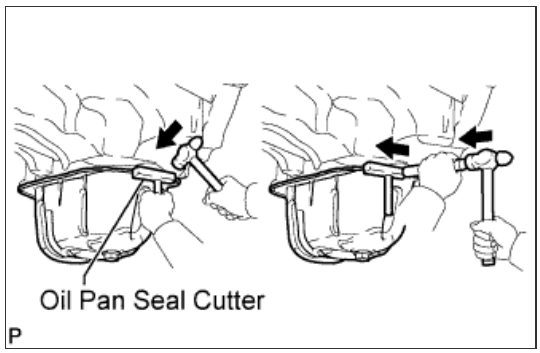


15. REMOVE NO. 2 OIL PAN SUB-ASSEMBLY

a. Remove the 10 bolts and 2 nuts.

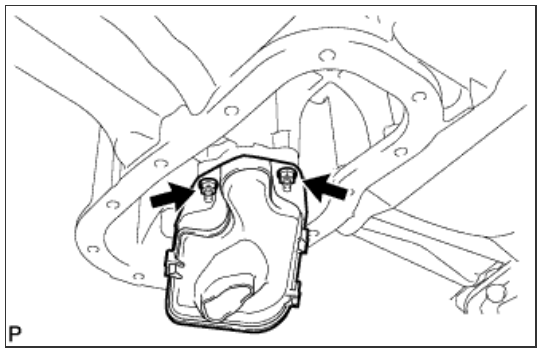


b. Insert the blade of an oil pan seal cutter between the oil pans. Cut through the applied sealer and remove the No. 2 oil pan.



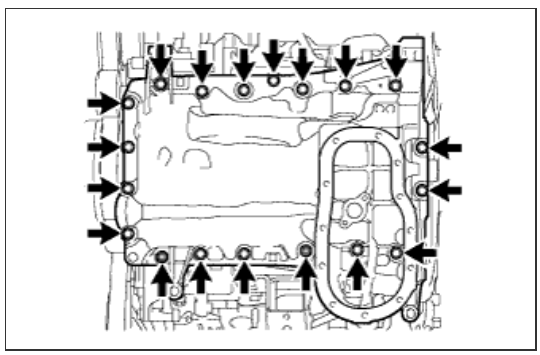
16. REMOVE OIL STRAINER SUB-ASSEMBLY

a. Remove the 2 nuts, oil strainer and gasket.



17. REMOVE OIL PAN SUB-ASSEMBLY

a. Remove the 17 bolts and 2 nuts.



b. Using a screwdriver, remove the oil pan by prying between the oil pan and cylinder block as shown in the illustration.

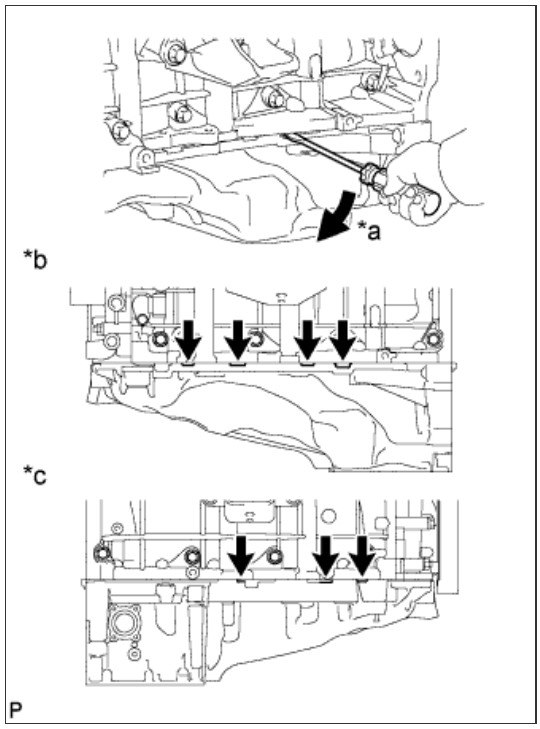
Text in Illustration

*a	Pry
*b	LH Side

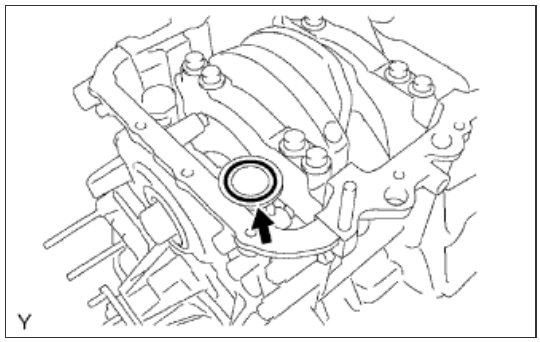
*c	RH Side

NOTICE:

Be careful not to damage the contact surfaces of the cylinder block and oil pan.

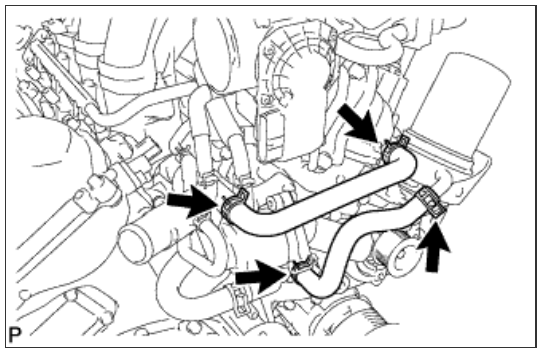


c. Remove the O-ring from the timing chain cover.



18. DISCONNECT NO. 2 OIL COOLER HOSE

a. Remove the oil cooler hose.



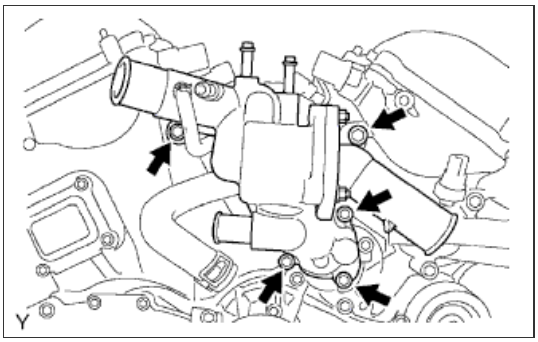
19. DISCONNECT OIL COOLER HOSE

a. Remove the oil cooler hose.

20. REMOVE WATER INLET HOUSING

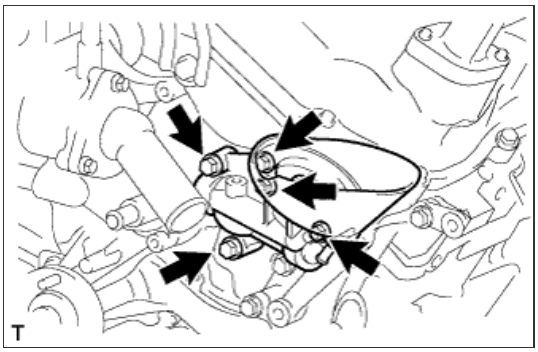
a. Remove the 5 bolts and water inlet housing.

b. Remove the O-ring and gasket from the water outlet pipe and water pump.



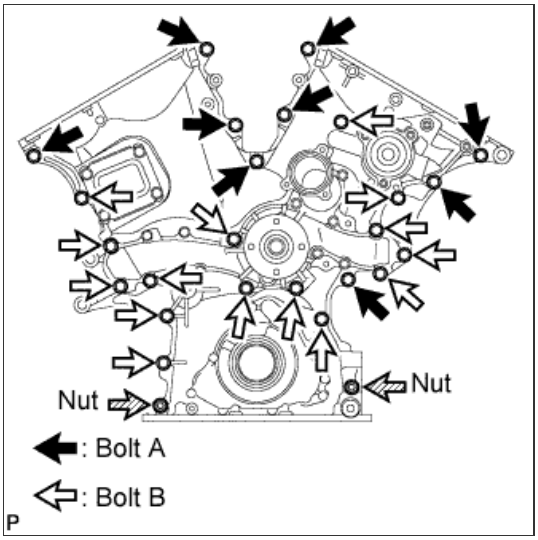
21. REMOVE OIL FILTER BRACKET SUB-ASSEMBLY

a. Remove the 3 bolts, 2 nuts, oil filter bracket and O-ring.



22. REMOVE TIMING CHAIN COVER SUB-ASSEMBLY

a. Remove the 24 bolts labeled A and B, and the 2 nuts.

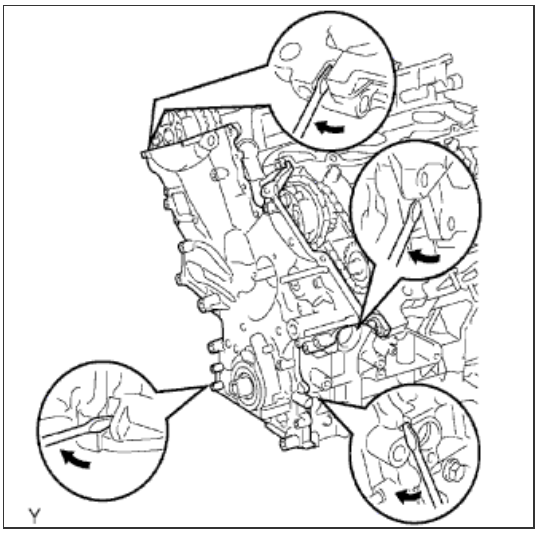


b. Remove the timing chain cover by prying between the timing chain cover and cylinder head or cylinder block with a screwdriver.

NOTICE:

Be careful not to damage the contact surfaces of the timing chain cover, cylinder block and cylinder head.

c. Remove the O-ring from the cylinder head LH side.



23. REMOVE FRONT CRANKSHAFT OIL SEAL

a. If the timing chain case is removed:

i. Using a screwdriver and wooden block, pry out the oil seal.

HINT:

Tape the screwdriver tip before use.

NOTICE:

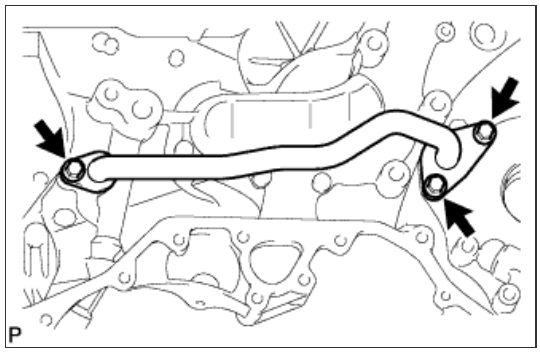
Do not damage the surface of the oil seal press fit hole and crankshaft.

for Preparation Click here

1. REMOVE OIL PUMP OUTLET PIPE

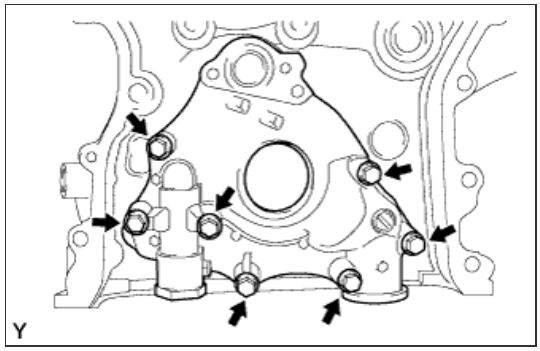
a. Remove the 3 bolts and outlet pipe.

b. Remove the 2 O-rings.



2. REMOVE OIL PUMP COVER

a. Remove the 7 bolts, oil pump cover, drive rotor and driven rotor.



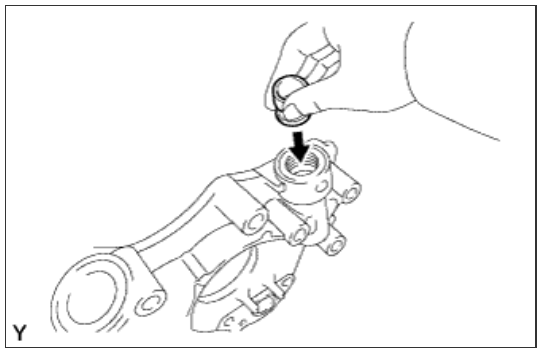
3. REMOVE OIL PUMP RELIEF VALVE

a. Remove the plug, spring and relief valve.

for Preparation Click here

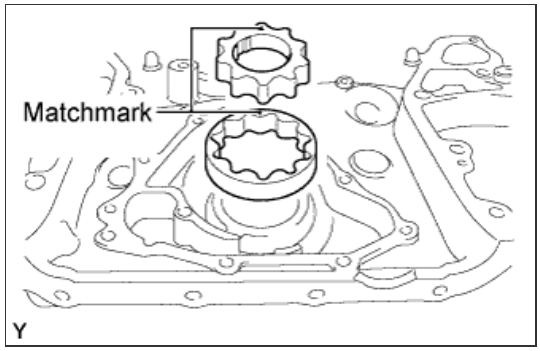
1. INSPECT OIL PUMP RELIEF VALVE

a. Coat the valve with engine oil, then check that it falls smoothly into the valve hole by its own weight.
If it does not, replace the relief valve. If necessary, replace the oil pump assembly.



2. INSPECT OIL PUMP ROTOR SET

a. Place the drive and driven rotors into the timing chain cover with the matchmarks facing upward.



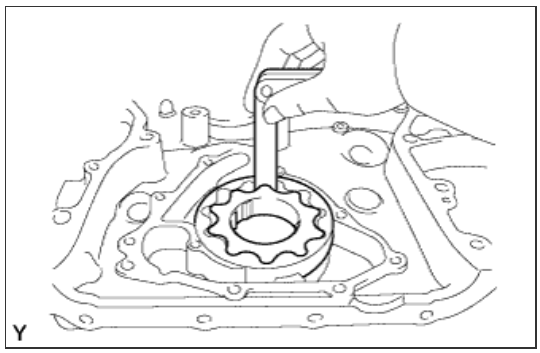
b. Check the rotor tip clearance.

i. Using a feeler gauge, measure the clearance between the drive and driven rotor tips.

Standard tip clearance:
0.06 to 0.16 mm (0.00236 to 0.00630 in.)

Maximum tip clearance:
0.16 mm (0.00630 in.)

If the clearance is more than the maximum, replace the timing chain cover sub-assembly.



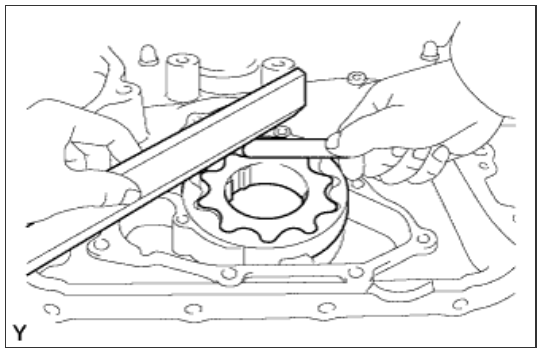
c. Check the rotor side clearance.

i. Using a feeler gauge and precision straightedge, measure the clearance between the rotors and precision straightedge.

Standard side clearance:
0.03 to 0.09 mm (0.00118 to 0.00354 in.)

Maximum side clearance:
0.09 mm (0.00354 in.)

If the clearance is more than the maximum, replace the timing chain cover sub-assembly.



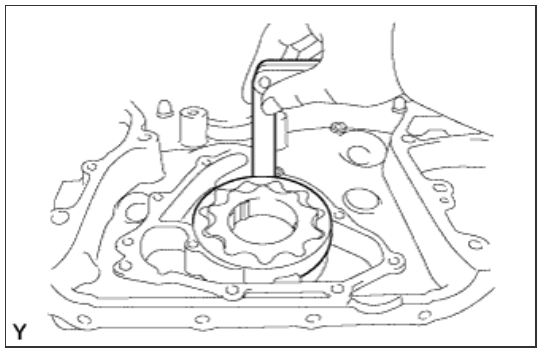
d. Check the rotor body clearance.

i. Using a feeler gauge, measure the clearance between the driven rotor and body.

Standard body clearance:
0.250 to 0.325 mm (0.00984 to 0.0128 in.)

Maximum body clearance:
0.325 mm (0.0128 in.)

If the clearance is more than the maximum, replace the timing chain cover sub-assembly.



for Preparation Click here

1. INSTALL OIL PUMP RELIEF VALVE

a. Coat the relief valve with engine oil and insert the relief valve and spring into the valve hole.

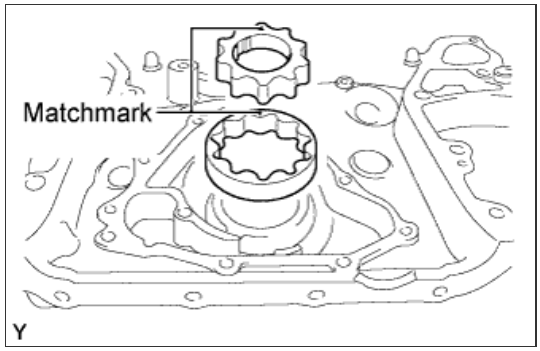
b. Install the relief valve plug.

Torque:
49 N*m{ 500 kgf*cm , 36 ft.*lbf }

2. INSTALL OIL PUMP COVER

a. Apply fresh engine oil to the drive and driven rotors.

b. Place the drive and driven rotors into the timing chain cover with the matchmarks facing the oil pump cover side.

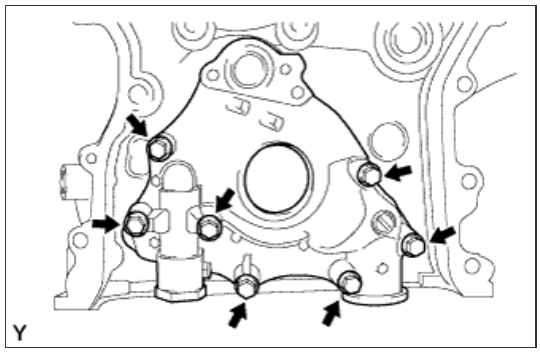


c. Install the oil pump cover with the 7 bolts.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }

d. Install a new O-ring onto the oil pump cover.

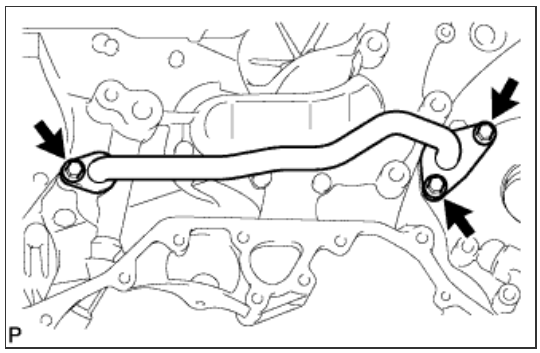
e. Install a new O-ring onto the oil pipe.



3. INSTALL OIL PUMP OUTLET PIPE

a. Install the outlet pipe with the 3 bolts.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



for Preparation Click here

1. INSTALL FRONT CRANKSHAFT OIL SEAL

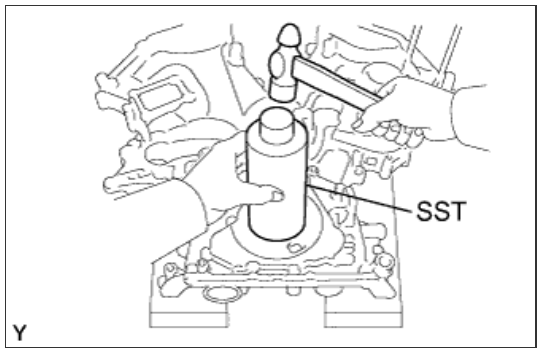
a. Using SST and a hammer, tap in a new oil seal until its surface is flush with the timing chain cover edge.

SST
09226-10010

NOTICE:

- **Keep the lip free from foreign matter.**
- **Do not tap the oil seal at an angle.**

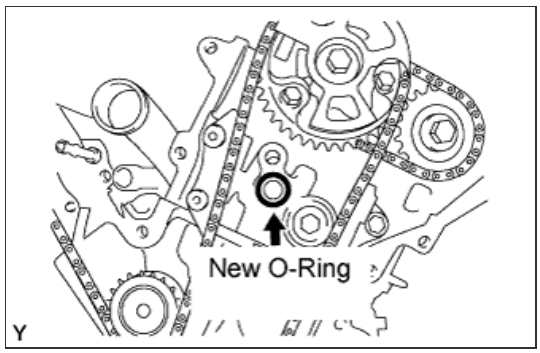
b. Apply MP grease to the lip of the oil seal.



2. INSTALL TIMING CHAIN COVER SUB-ASSEMBLY

a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the timing chain cover, cylinder head and cylinder block.

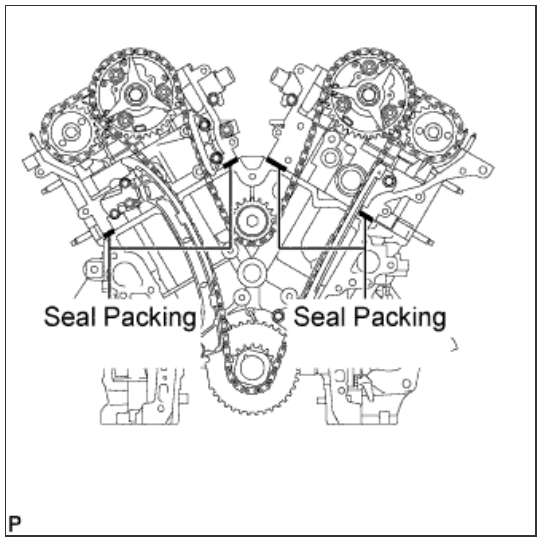
b. Install a new O-ring to the cylinder head for bank 2 as shown in the illustration.



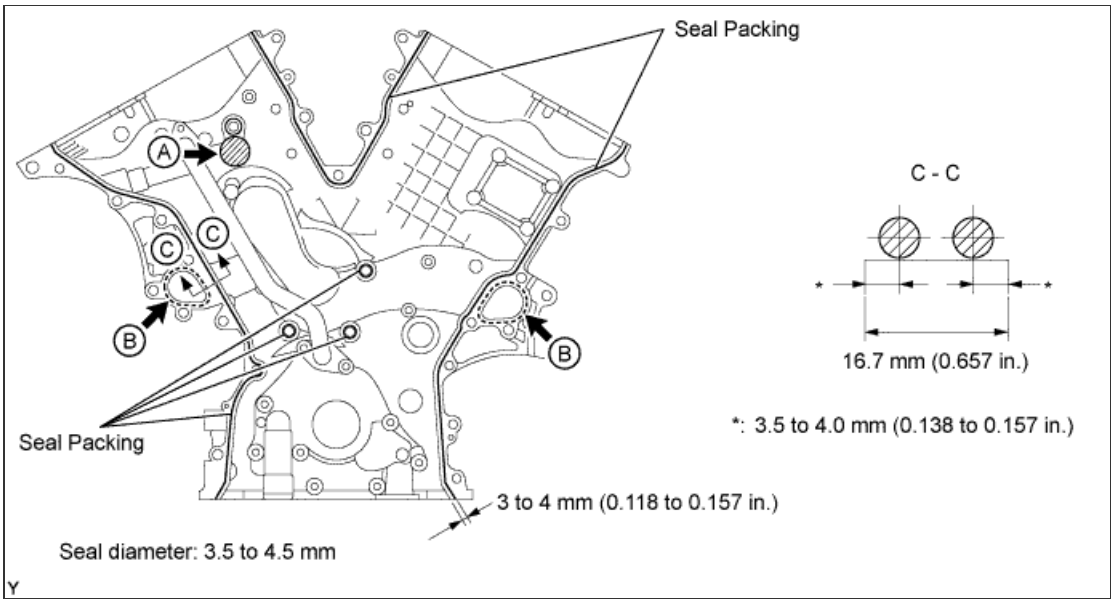
c. Apply seal packing as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
3.0 to 4.0 mm (0.118 to 0.157 in.)



d. Apply seal packing in a continuous line to the timing chain cover as shown in the illustration.



Seal packing:
for ater related part:
Toyota Genuine Seal Packing 12 2B, Three Bond 12 2B or e uivalent
for oil related part:
Toyota Genuine Seal Packing Black, Three Bond 1207B or e uivalent

Standard seal diameter:
3.5 to . mm (0.13 t0.177 in.)

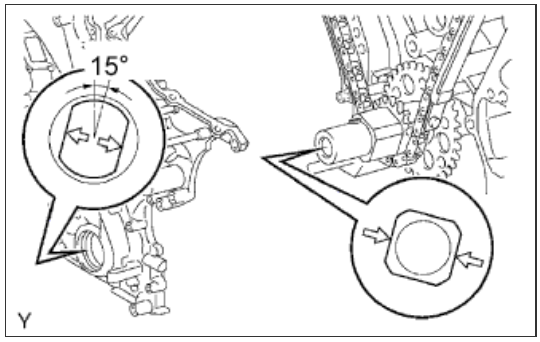
HINT:

Water related parts are labeled "B" in the illustration.

NOTICE:

- **Install the timing chain cover within 3 minutes after applying seal packing. After installing it, the timing chain cover bolts and nuts must be tightened within 15 minutes. Otherwise the seal packing must be removed and reapplied.**
- **Do not apply seal packing to A shown in the illustration.**

e. Align the keyway of the oil pump drive rotor with the rectangular portion of the crankshaft timing gear, and slide the timing chain cover into place.



f. Install the timing chain cover with the 24 bolts labeled A and B, and the 2 nuts. Tighten the bolts and nuts uniformly in several steps.

Torque:
23 N m 235 kgf cm , 17 ft. lbf

NOTICE:

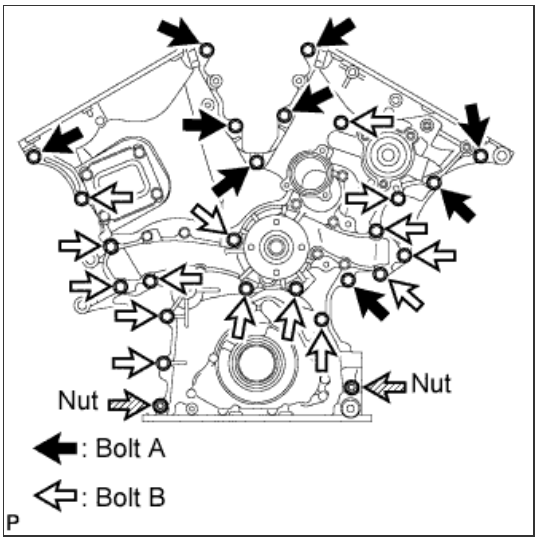
- **Make sure not to wrap the No. 1 chain and slipper over the timing chain cover seal line.**
- **Install the timing chain cover 15 minutes or more after installing the water pump.**

Standard Bolt:

Item	Quantity	Length
Bolt A	9	25 mm (0.984 in.)
Bolt B	15	55 mm (2.17 in.)

NOTICE:

Make sure that there is no oil on the bolt threads.

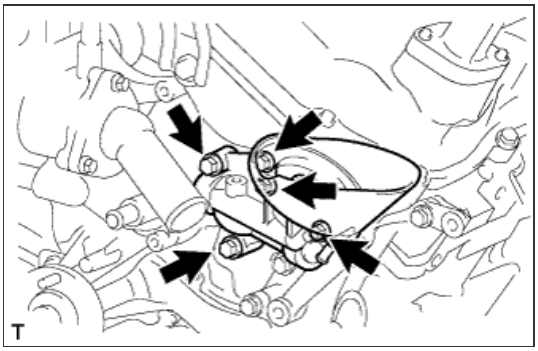


3. INSTALL OIL FILTER BRACKET SUB-ASSEMBLY

a. Set a new O-ring to the timing chain cover.

b. Install the oil filter bracket with the 3 bolts and 2 nuts.

Torque:
19 N*m{ 194 kgf*cm , 14 ft.*lbf }

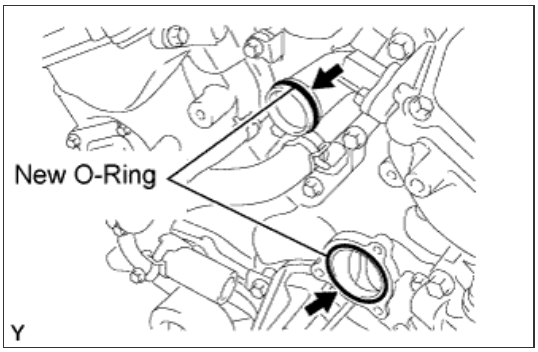


4. INSTALL WATER INLET HOUSING

a. Apply soapy water to a new O-ring, install it to the water outlet pipe.

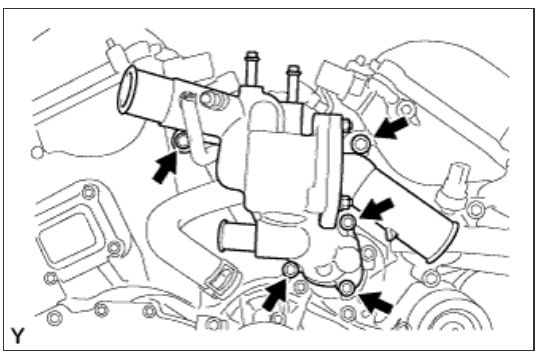
b. Install a new O-ring to the water pump.

c. Install a new gasket to the water pump.



d. Install the water inlet with the 5 bolts.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }

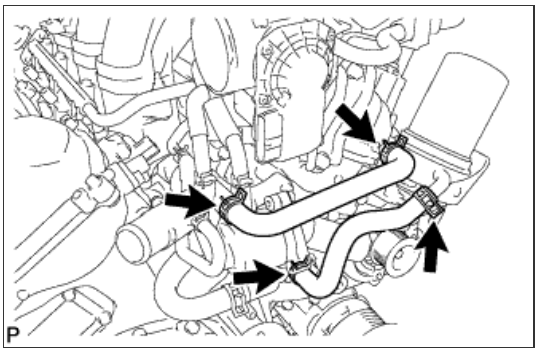


5. INSTALL NO. 2 OIL COOLER HOSE

a. Install the oil cooler hose.

6. INSTALL OIL COOLER HOSE

a. Install the oil cooler hose.



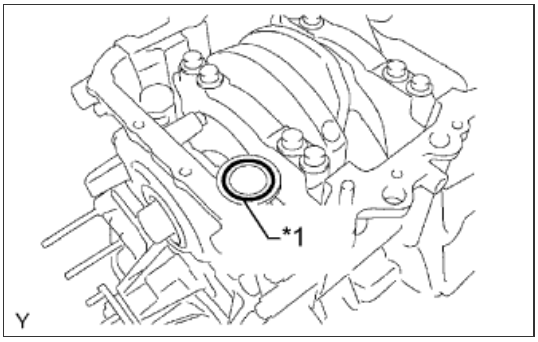
7. INSTALL OIL PAN SUB-ASSEMBLY

a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the cylinder block, rear oil seal retainer and oil pan.

b. Install a new O-ring to the timing chain cover.

Text in Illustration

*1	New O-Ring



c. Apply seal packing in a continuous line as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

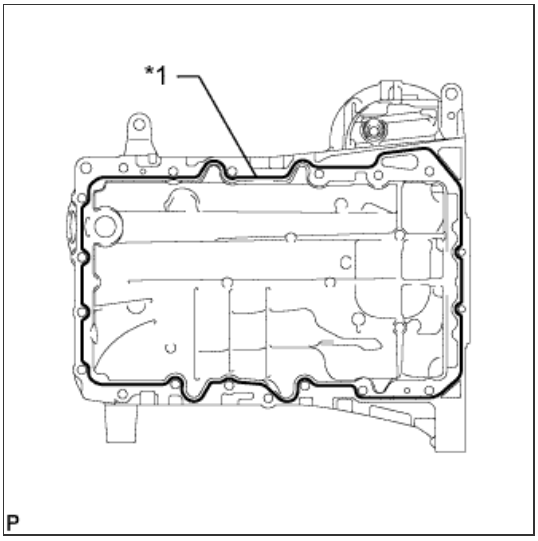
Standard seal diameter:
3 to 4 mm (0.118 to 0.157 in.)

Text in Illustration

*1	Seal Packing

NOTICE:

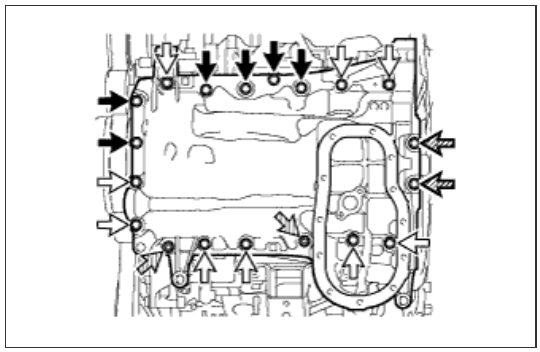
- **Remove any oil from the contact surface.**
- **Install the oil pan within 3 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after installing.**



d. Install the oil pan with the 17 bolts (A, B and) and 2 nuts. Tighten the bolts and nuts uniformly in several steps.

Torque:

for bolt A, B and nut:
21 N m 214 kgf cm , 15 ft. lbf
for bolt C:
10 N m 102 kgf cm , 7 ft. lbf



Text in Illustration

	Bolt A
	Bolt B
	Bolt
	Nut

Standard Bolt:

Item	Quantity	Length
A	6	25 mm (0.984 in.)
B	9	45 mm (1.77 in.)
	2	14 mm (0.551 in.)

8. INSTALL OIL STRAINER SUB-ASSEMBLY

a. Install a new gasket to the oil strainer.

Text in Illustration

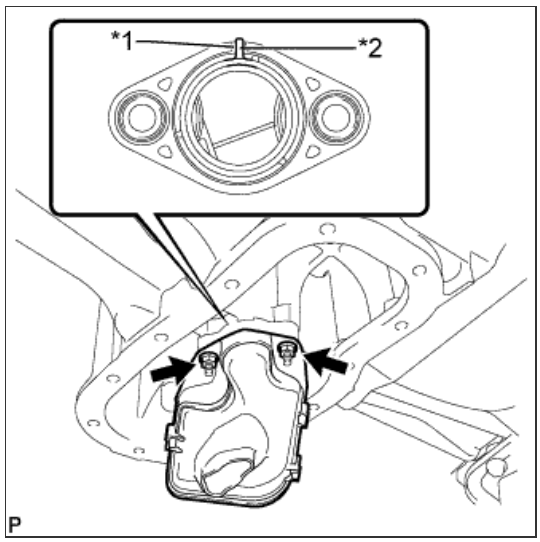
*1	Groove
*2	Protrusion

HINT:

Align the protrusion of the gasket with the groove of the oil strainer.

b. Install the oil strainer with the 2 nuts.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



9. INSTALL NO. 2 OIL PAN SUB-ASSEMBLY

a. Apply seal packing in a continuous line as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
3 to 4 mm (0.118 to 0.157 in.)

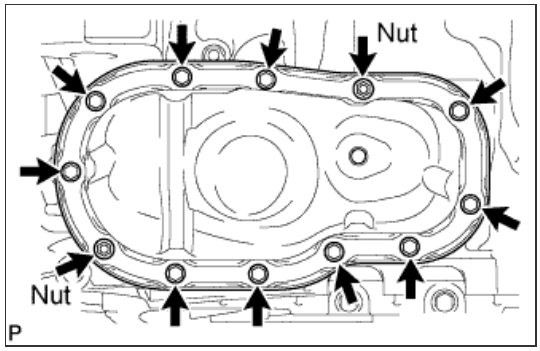
NOTICE:

- Remove any oil from the contact surface.
- Install the No. 2 oil pan within 3 minutes after applying seal packing.
- Do not start the engine for at least 2 hours after the installation.



b. Install the No. 2 oil pan with the 10 bolts and 2 nuts. Tighten the bolts and nuts uniformly in several steps.

Torque:
for bolt:
9.0 N*m{ 92 kgf*cm , 81 in.*lbf }
for nut:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

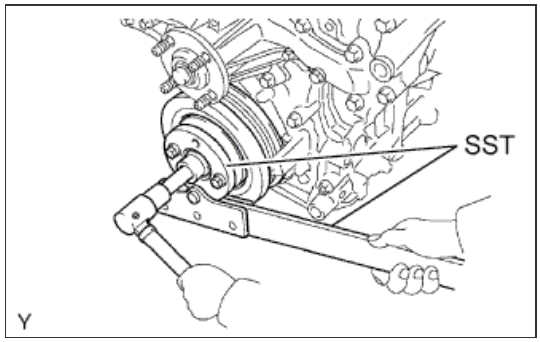


10. INSTALL CRANKSHAFT PULLEY

a. Using SST, install the crankshaft pulley with the pulley set bolt.

SST
09213-54015 (91651-60855)
09330-00021

Torque:
250 N*m{ 2549 kgf*cm , 184 ft.*lbf }



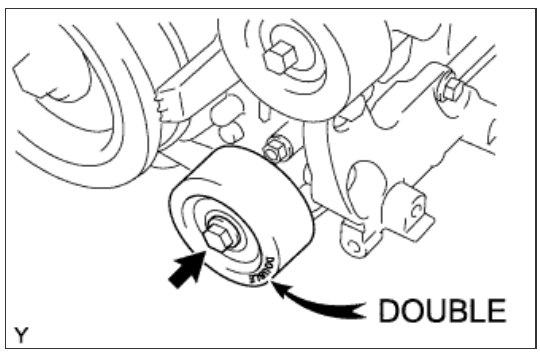
11. INSTALL NO. 1 IDLER PULLEY SUB-ASSEMBLY

a. Install the No. 1 idler pulley with the bolt.

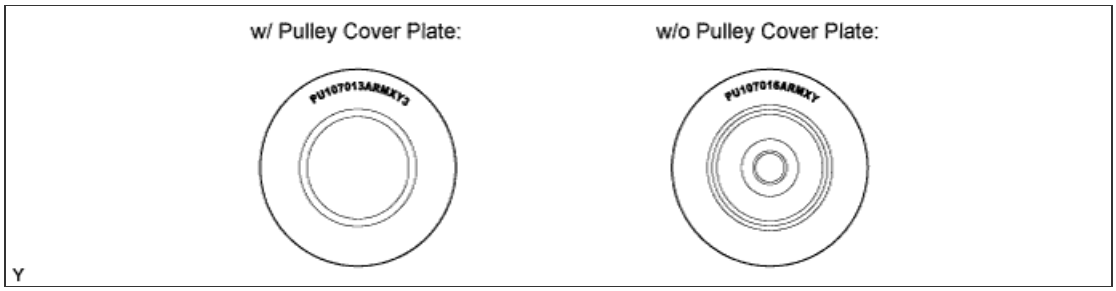
Torque:
54 N*m{ 551 kgf*cm , 40 ft.*lbf }

HINT:

"DOUBL " is marked on the No. 1 idler pulley to distinguish it from the No. 2 idler pulley.



12. INSTALL NO. 2 IDLER PULLEY SUB-ASSEMBLY



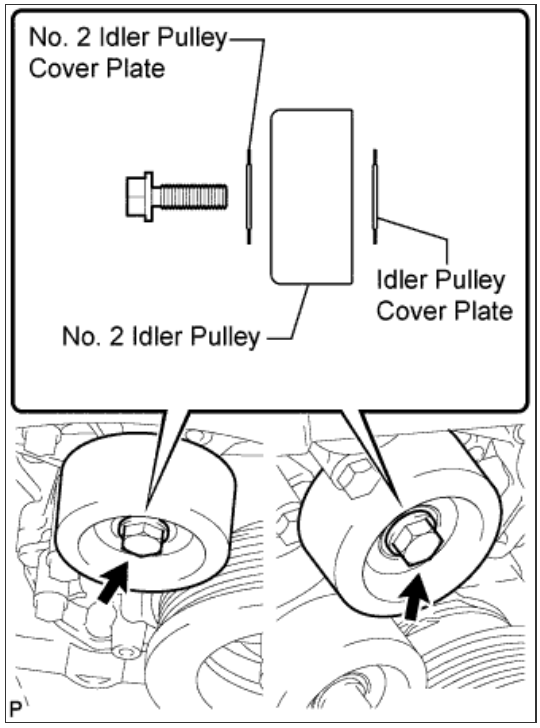
a. w/ Pulley over Plate:

i. Install the idler pulley cover plate, idler pulley and No. 2 idler pulley cover plate with the bolt.

Torque:
54 N m 551 kgf cm , 40 ft. lbf

NOTICE:

If it is necessary to replace the pulley or either plate, replace the No. 2 idler pulley cover plate, No. 2 idler pulley and idler pulley cover plate as a set with new parts.



b. w/o Pulley over Plate:
Install the 2 No. 2 idler pulleys with the 2 bolts.

Torque:
54 N m 551 kgf cm , 40 ft. lbf

13. INSTALL V-RIBBED BELT TENSIONER ASSEMBLY

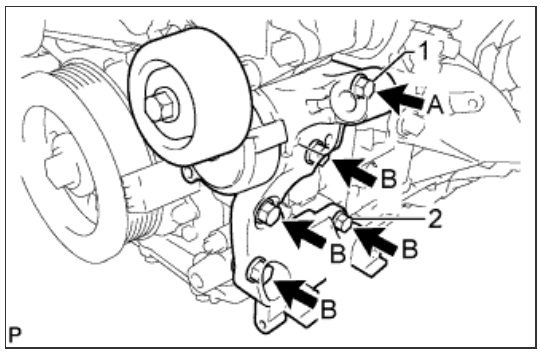
a. Temporarily install the V-ribbed belt tensioner with the 5 bolts.

b. Tighten bolt 1 and 2 in numerical order.

Torque:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }

c. Tighten the other bolts.

Torque:
36 N*m{ 367 kgf*cm , 27 ft.*lbf }



Standard Bolt:

Item	Length
A	70 mm (2.76 in.)
B	33 mm (1.30 in.)

14. INSTALL ENGINE OIL LEVEL DIPSTICK GUIDE

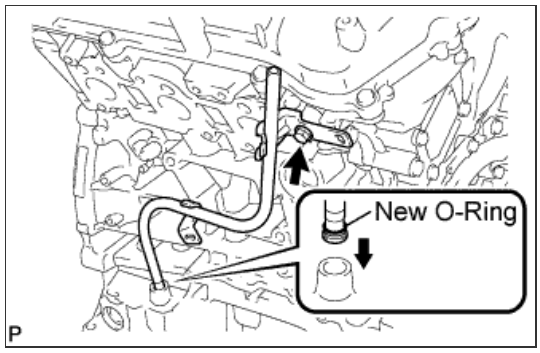
a. Install a new O-ring to the dipstick guide.

b. Apply a light coat of engine oil to the O-ring.

c. Push the dipstick guide end into the guide hole.

d. Install the dipstick guide with the bolt.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



15. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY LH

a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the cylinder head, timing chain cover and cylinder head cover.

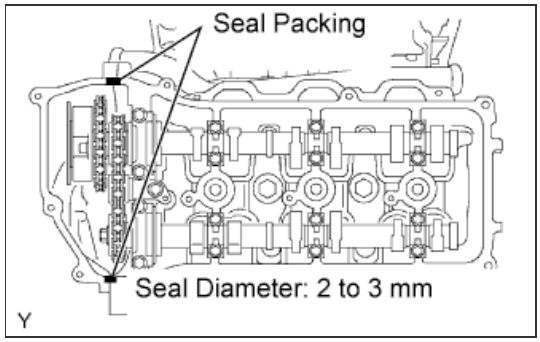
b. Apply seal packing as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
2 to 3 mm (0.0787 to 0.118 in.)

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the head cover within 3 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after the installation.**

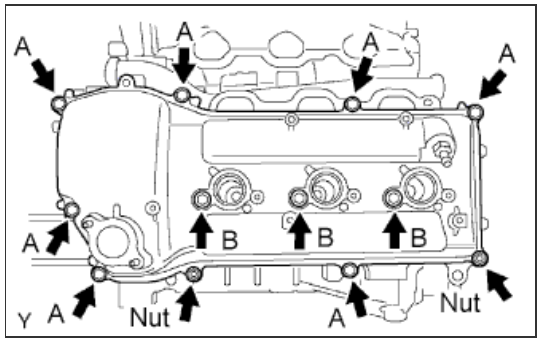


c. Install a new gasket to the cylinder head cover.

d. Install the seal washers to the bolts.

e. Temporarily install the cylinder head cover with the 10 bolts and 2 nuts. Tighten the bolts and nuts uniformly in several steps.

Torque:
for bolt A:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }
for bolt B and nut:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



16. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY

a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the cylinder head, timing chain cover and cylinder head cover.

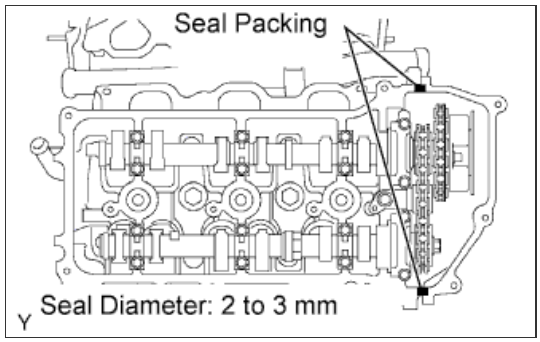
b. Apply seal packing as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
2 to 3 mm (0.0787 to 0.118 in.)

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the head cover within 3 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after the installation.**

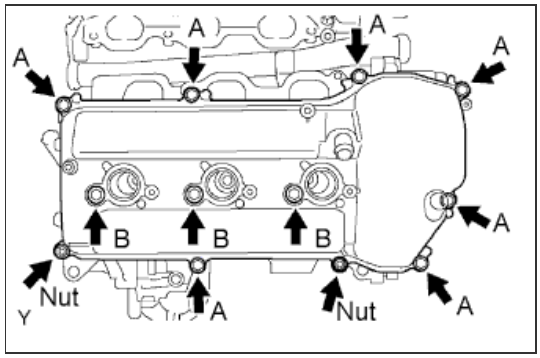


c. Install a new gasket to the cylinder head cover.

d. Install the seal washers to the bolts.

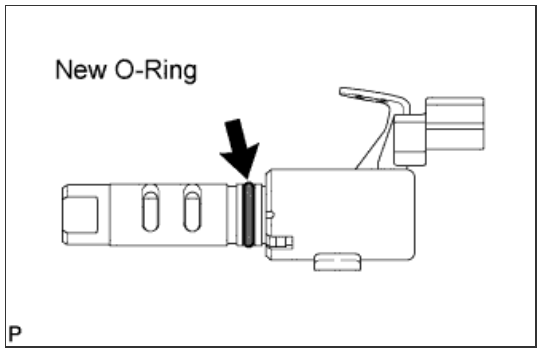
e. Temporarily install the cylinder head cover with the 10 bolts and 2 nuts. Tighten the bolts and nuts uniformly in several steps.

Torque:
for bolt A:
10 N m 102 kgf cm , 7 ft. lbf
for bolt B and nut:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }



17. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY LH

a. Apply a light coat of engine oil to a new O-ring and install it to the oil control valve.



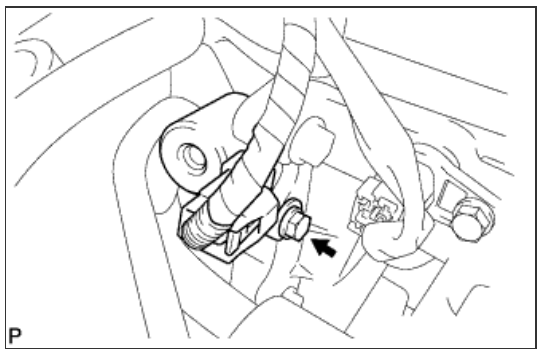
b. Install the oil control valve with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

NOTICE:

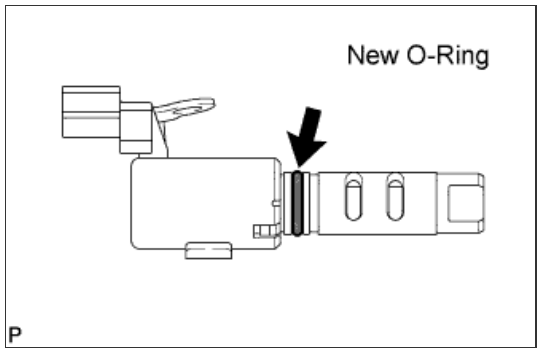
- **Do not allow foreign matter to contact the oil seal face of the oil control valve (connecting surface with cylinder head).**
- **Be careful that the O-ring is not cracked when installing the oil control valve.**

c. onnect the oil control valve connector.



18. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY RH

a. Apply a light coat of engine oil to a new O-ring and install it to the oil control valve.



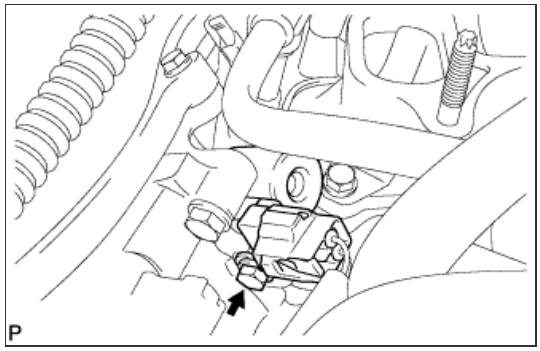
b. Install the oil control valve with the bolt.

Torque:
10 N m 102 kgf cm , 7 ft. lbf

NOTICE:

- **Do not allow foreign matter to contact the oil seal face of the oil control valve (connecting surface with cylinder head).**
- **Be careful that the O-ring is not cracked when installing the oil control valve.**

c. onnect the camshaft timing oil control valve connector.



19. INSTALL VVT SENSOR (for Bank 2)

a. Apply a light coat of engine oil to the O-ring of the VVT sensor.

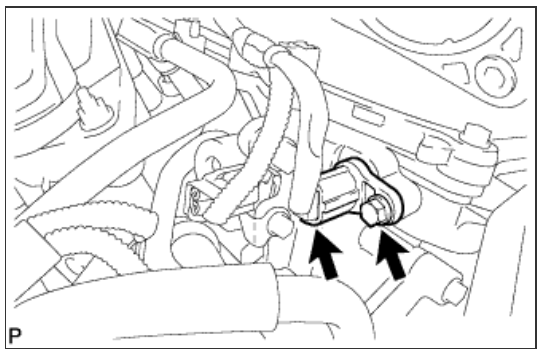
NOTICE:

- **When reusing the sensor, inspect the O-ring.**
- **If the O-ring has scratches or cuts, replace the sensor.**

b. Install the VVT sensor with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

c. onnect the sensor connector.



20. INSTALL VVT SENSOR (for Bank 1)

a. Apply a light coat of engine oil to the O-ring of the sensor.

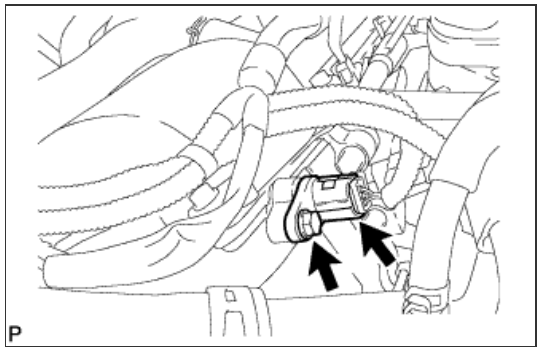
NOTICE:

- **When reusing the sensor, inspect the O-ring.**
- **If the O-ring has scratches or cuts, replace the sensor.**

b. Install the sensor with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

c. onnect the sensor connector.



21. INSTALL SPARK PLUG

a. Install the 6 spark plugs.

Torque:

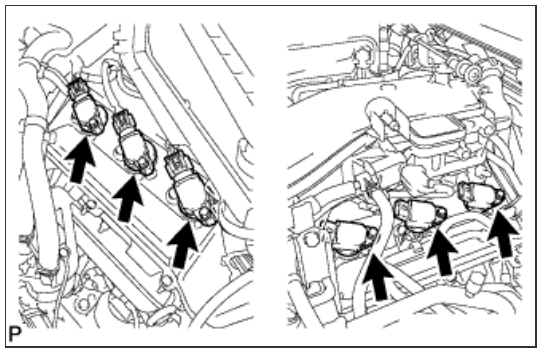
20 N m 204 kgf cm , 15 ft. lbf

22. INSTALL IGNITION COIL ASSEMBLY

a. Install the 6 ignition coils with the 6 bolts.

Torque:
9.0 N*m{ 92 kgf*cm , 80 in.*lbf }

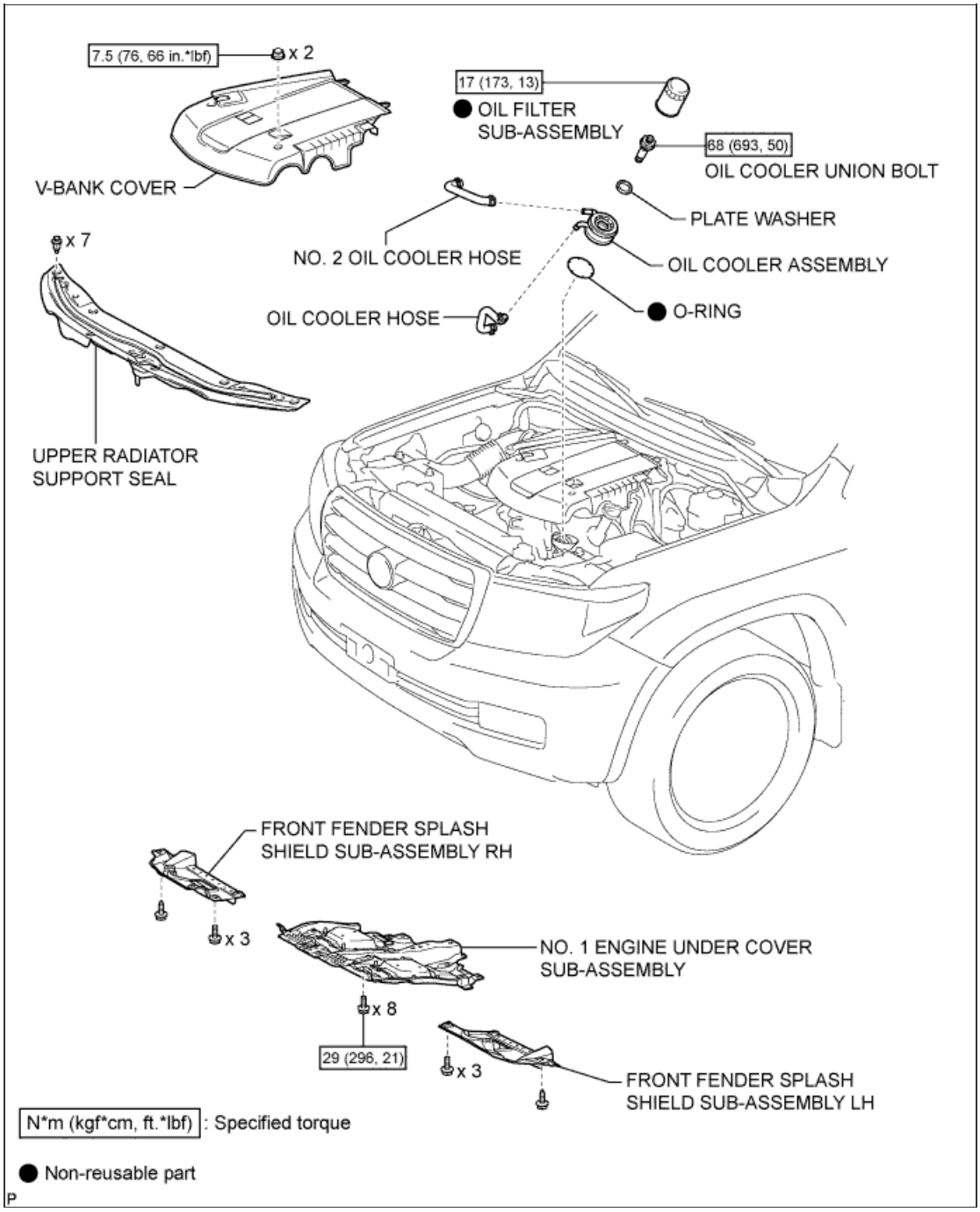
b. onnect the 6 ignition coil connectors.



23. INSTALL ENGINE ASSEMBLY

(lick here)

for Preparation Click here

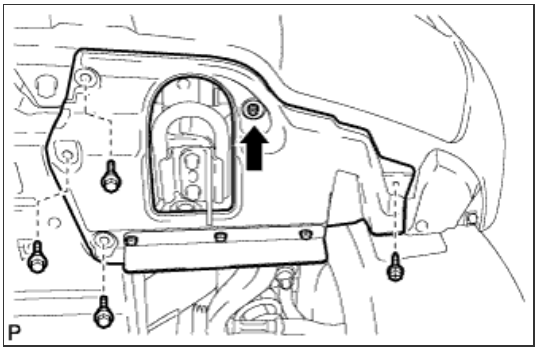


for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



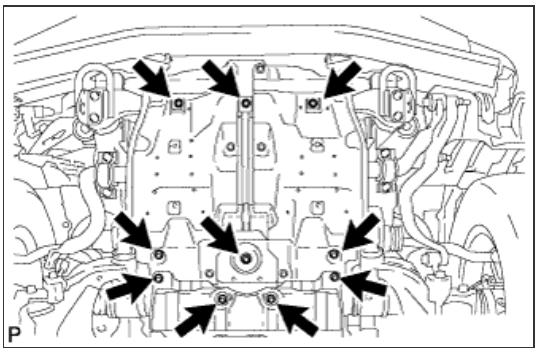
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

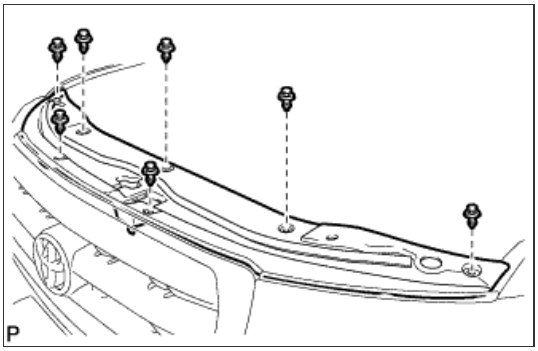
3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



4. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and radiator support seal.



5. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug and 2 cylinder block drain cock plugs.

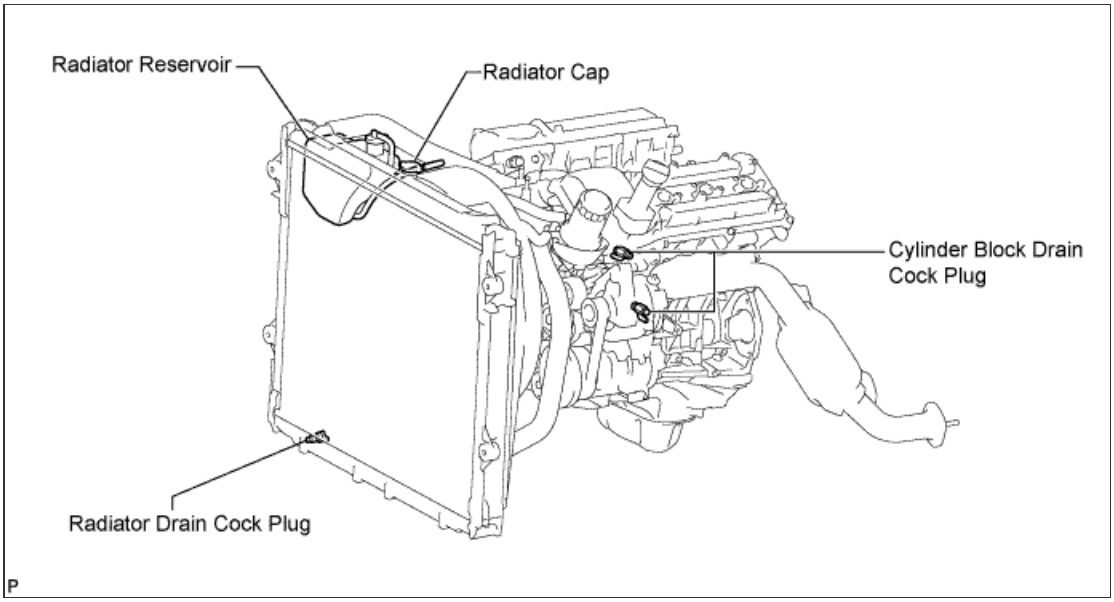
b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Tighten the 2 cylinder block drain cock plugs.

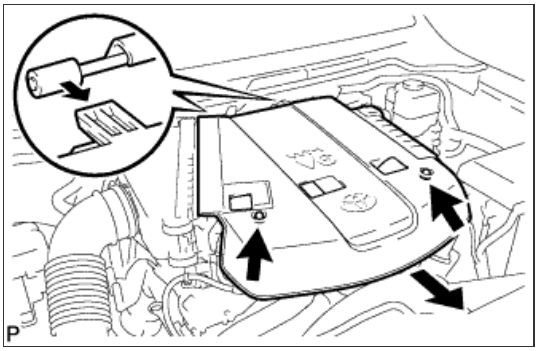
Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



d. Tighten the radiator drain cock plug by hand.

6. REMOVE V-BANK COVER

a. Remove the 2 cap nuts and V-bank cover.



7. REMOVE OIL FILTER SUB-ASSEMBLY

a. Remove the drain pipe cap.

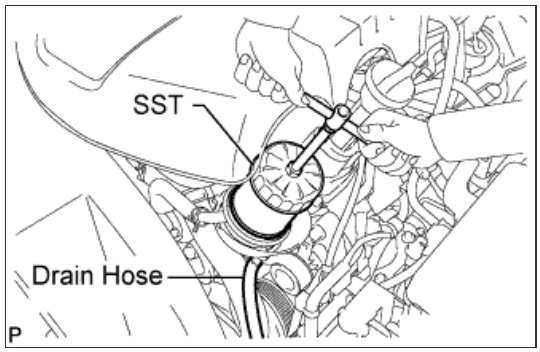
b. Using SST, remove the oil filter.

b. Using SST, remove the oil filter.

SST
09228-07501

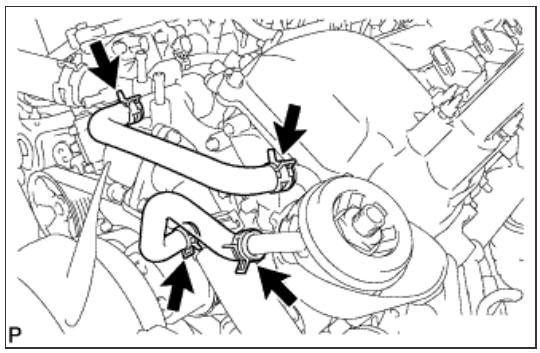
HINT:

- **Put the disposal container beneath the drain hose to collect the oil from the oil filter cover.**
- **Drain hose inside diameter: 8 mm .315 in.**
- **Drain hose length: 900 mm 2.95 ft.**



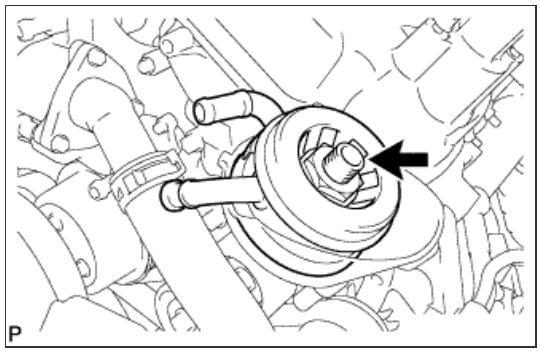
8. REMOVE OIL COOLER ASSEMBLY

a. Remove the oil cooler hose and No. 2 oil cooler hose.



b. Remove the union bolt, plate washer and oil cooler.

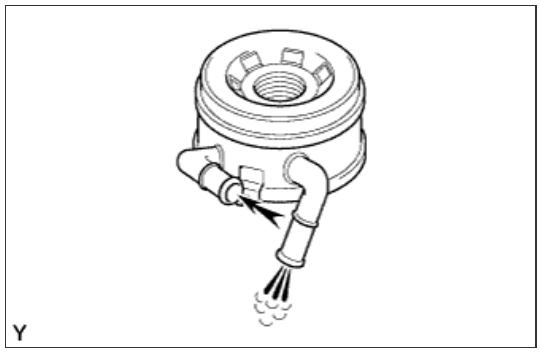
c. Remove the O-ring from the oil cooler.



for Preparation Click here

1. INSPECT OIL COOLER ASSEMBLY

a. Check the oil cooler for damage and clogging.
If necessary, replace the oil cooler.



for Preparation Click here

1. INSTALL OIL COOLER ASSEMBLY

a. Clean the oil cooler contact surface on the cooler mounting.

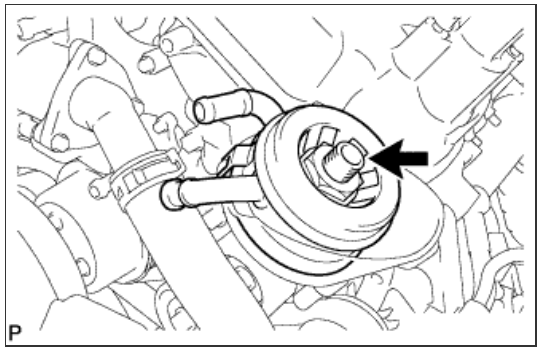
b. Apply a light coat of engine oil to a new O-ring, and install it into the oil cooler.

c. Apply a light coat of engine oil to the threads of the oil cooler union bolt.

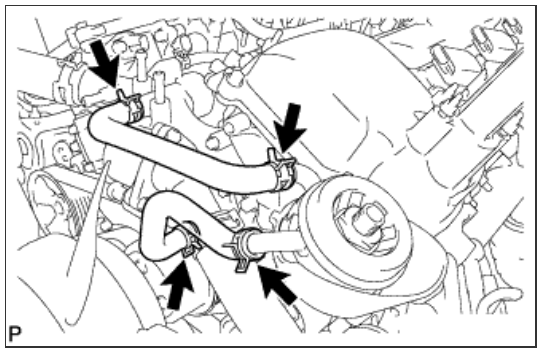
d. Align the protrusion of the oil filter bracket with the cutout of the oil cooler.

e. Install the oil cooler with the plate washer and oil cooler union bolt.

Torque:
68 N*m{ 693 kgf*cm , 50 ft.*lbf }



f. Install the oil cooler hose and No. 2 oil cooler hose.



2. INSTALL OIL FILTER SUB-ASSEMBLY

a. Check and clean the oil filter installation surface.

b. Apply clean engine oil to the gasket of a new oil filter.

c. Lightly screw the oil filter into place by hand. Tighten it until the gasket contacts the seat.

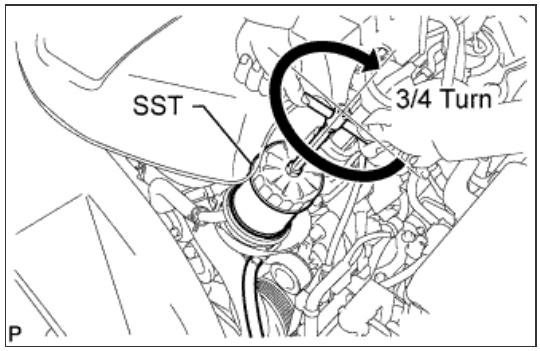
d. Using SST, tighten the oil filter. Depending on the work space available, choose from the following.

SST
09228-07501

i. If enough space is available, use a torque wrench to tighten the oil filter.

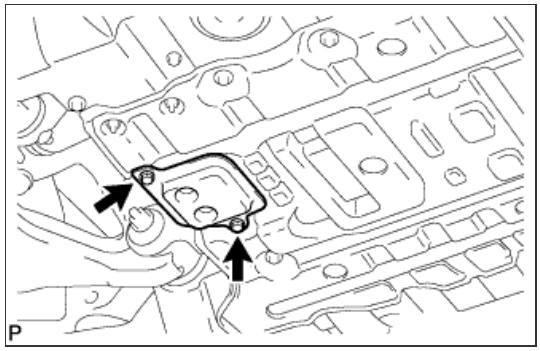
Torque:
17 N*m{ 173 kgf*cm , 13 ft.*lbf }

ii. If enough space is not available to use a torque wrench, tighten the oil filter a 3/4 turn by hand or with a common wrench.



e. Install the service hole cover to the No. 2 engine under cover with the 2 bolts.

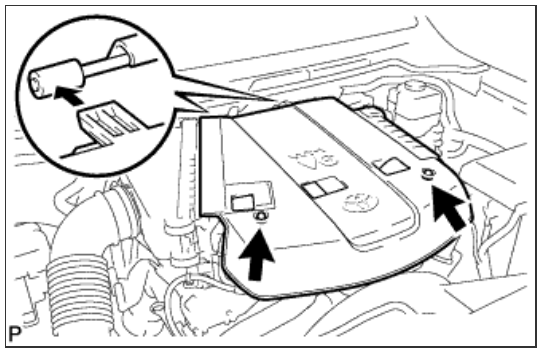
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



3. INSTALL V-BANK COVER

a. Install the V-bank cover with the 2 cap nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }



4. ADD ENGINE OIL

a. Remove the oil filler cap.

b. Add new oil.

Standard Oil Grade:

Oil Grade	Oil Viscosity (SAE)
API grade SL "Energy-Conserving", SM "Energy-Conserving", SN "Resource-Conserving" or ILSAC multigrade engine oil	5W-30 10W-30
API grade SL, SM or SN multigrade engine oil	15W-40 20W-50

Standard Oil Capacity:

Item	Specified Condition
Drain and refill with oil filter change	5.2 liters (5.5 US qts, 4.6 Imp. qts)
Drain and refill without oil filter change	4.9 liters (5.2 US qts, 4.3 Imp. qts)
Dry fill	6.0 liters (6.3 US qts, 5.3 Imp. qts)

c. Install the oil filler cap.

5. INSPECT FOR ENGINE OIL LEVEL

a. Warm up the engine, stop the engine and wait 5 minutes. The oil level should be between the low and full level marks on the dipstick. If the oil level is low, check for leakage and add oil up to the full level mark.

NOTICE:

Do not fill engine oil above the full level mark.

6. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item		Specified condition
for Automatic transmission	w/o Rear Heater	11.2 liters (11.8 US qts, 9.9 Imp. qts)
	w/ Rear Heater	14.4 liters (15.2 US qts, 12. Imp. qts)
for Manual transmission	w/o Rear Heater	12.0 liters (12. US qts, 10.6 Imp. qts)
	w/ Rear Heater	14.6 liters (15.4 US qts, 12.8 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

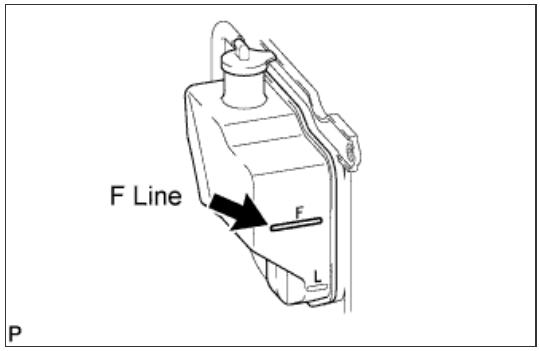
TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.



f. Set the air conditioning as follows while warming up the engine.

Item	Condition
Fan speed	Any setting except off
Temperature	Toward WARM
Air conditioning switch	Off

g. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

h. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

i. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

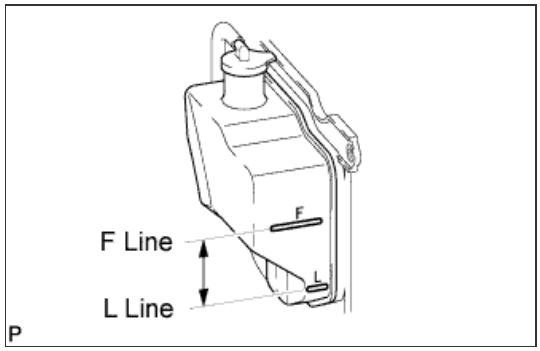
- **Wear protective gloves. Heat areas on the parts may injure your hands.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the fan.**

j. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

k. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.



7. INSPECT FOR OIL LEAK

a. Start the engine. Make sure that there are no oil leaks from the area that was worked on.

8. INSPECT FOR ENGINE COOLANT LEAK

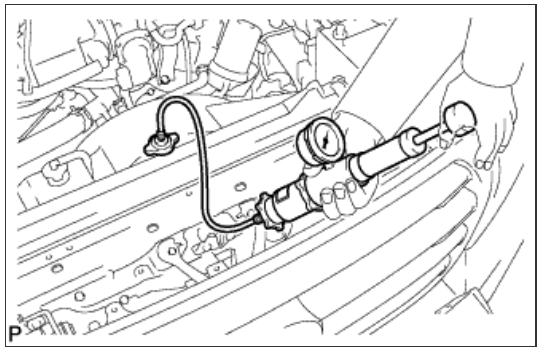
CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

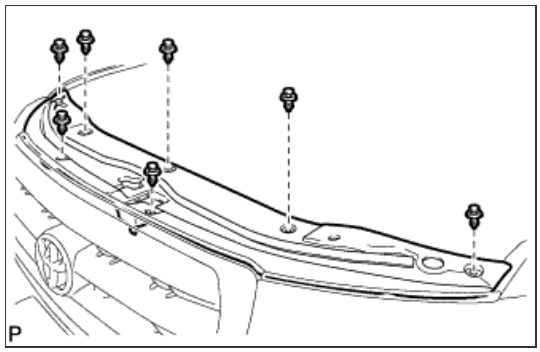
b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



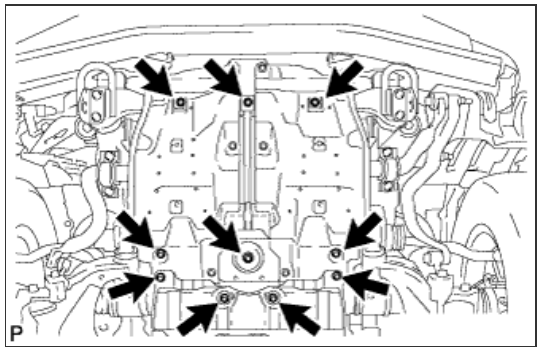
9. INSTALL UPPER RADIATOR SUPPORT SEAL

a. Install the radiator support seal with the clips.



10. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the under cover with the 10 bolts.



11. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

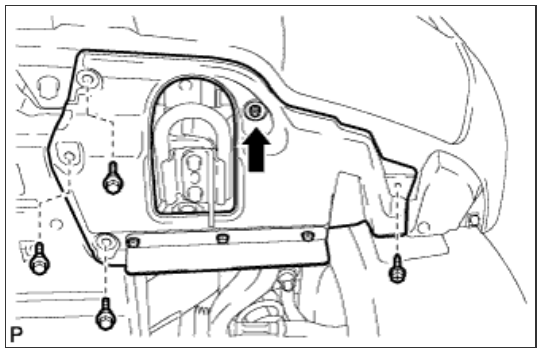
HINT:

Use the same procedures described for the LH side.

12. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



for Preparation Click here

1. CHECK OIL QUALITY

a. Check the oil for deterioration, water contamination, discoloration or thinning.
If the quality is visibly poor, replace the oil and filter (Click here).

2. INSPECT ENGINE OIL LEVEL

a. Warm up the engine, stop the engine and wait 5 minutes. The oil level should be between the dipstick low level mark and full level mark.
If low, check for leakage and add oil up to the full level mark.

NOTICE:

Do not fill engine oil above the full level mark.

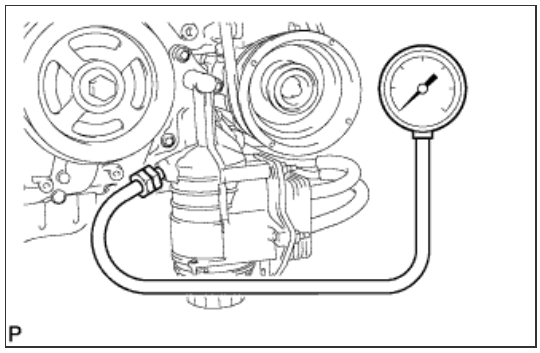
3. INSPECT OIL PRESSURE

a. Remove the oil pressure sender gauge (Click here).

b. Install an oil pressure gauge with an adapter.

c. Warm up the engine.

d. Measure the engine oil pressure.



Standard Oil Pressure:

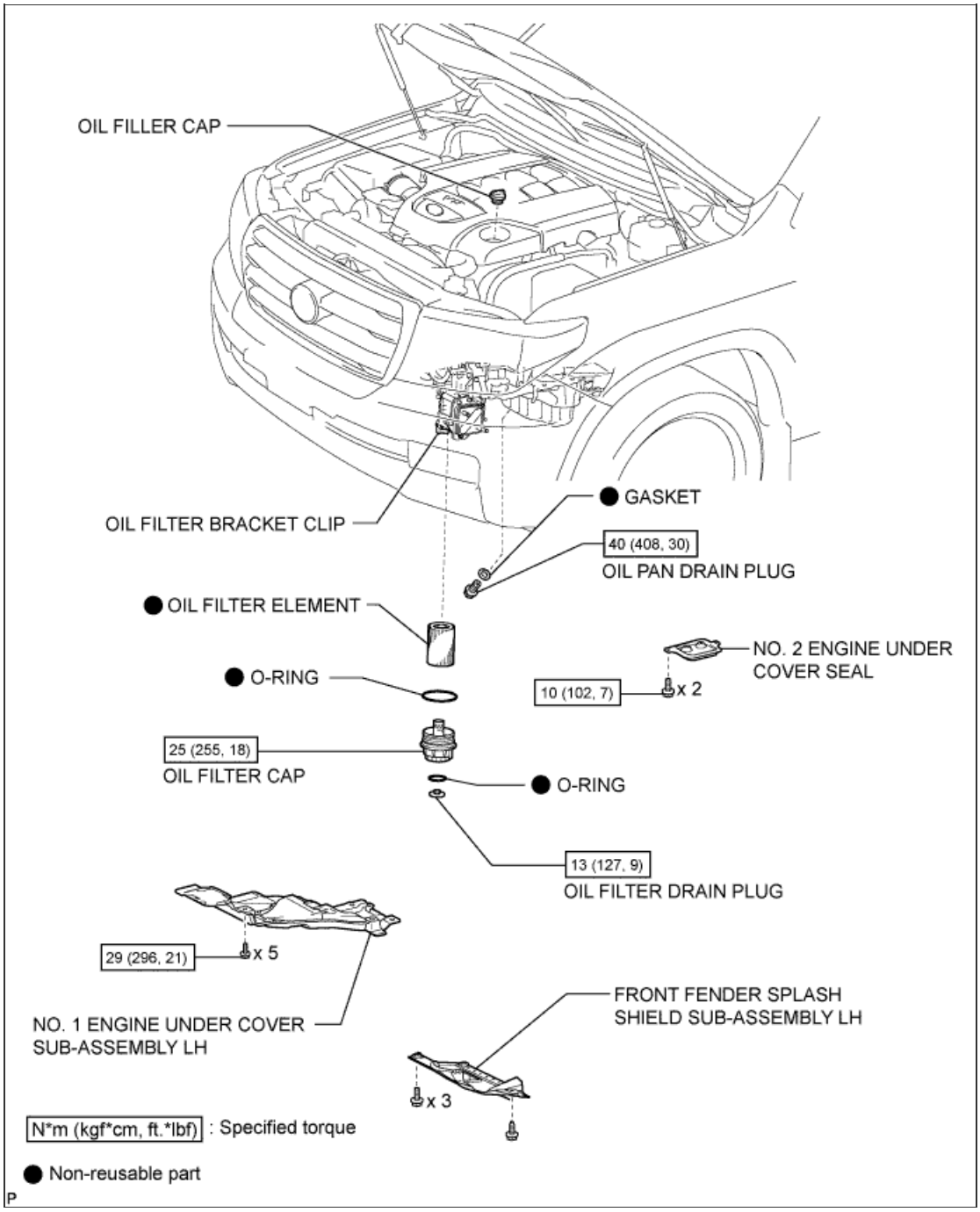
Condition	Specified Condition
Idle	70 kPa (0.7 kgf/cm^2, 10.1 psi) or higher
2500 rpm	220 kPa (2.2 kgf/cm^2, 32 psi) or higher

If the pressure is not as specified, check the oil pump (Click here).

e. Remove the oil pressure gauge and adapter.

f. Install the oil pressure sender gauge (Click here).

for Preparation Click here



for Preparation Click here

CAUTION:

- **Prolonged and repeated contact with engine oil will result in the removal of natural oils from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer.**
- **Precautions should be taken when replacing engine oil to minimize the risk of your skin making contact with used engine oil. Protective clothing and gloves that cannot be penetrated by oil should be worn. The skin should be washed with soap and water, or use waterless hand cleaner, to remove any used engine oil thoroughly. Do not use gasoline, thinners, or solvents.**
- **In order to protect the environment, used oil and used oil filters must be disposed of at designated disposal sites.**

1. DRAIN ENGINE OIL

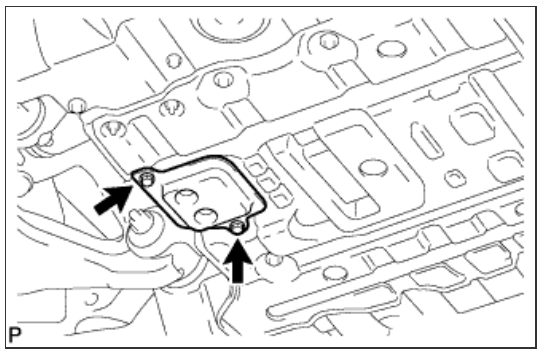
a. Remove the oil filler cap.

b. Remove the 2 bolts and No. 2 engine under cover seal.

c. Remove the oil pan drain plug and gasket, and drain the engine oil into a container.

d. Install a new gasket and the oil pan drain plug.

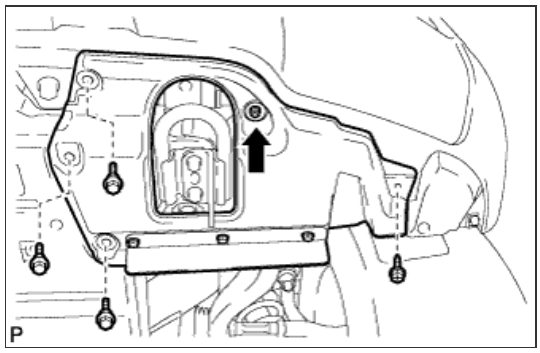
Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }



2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

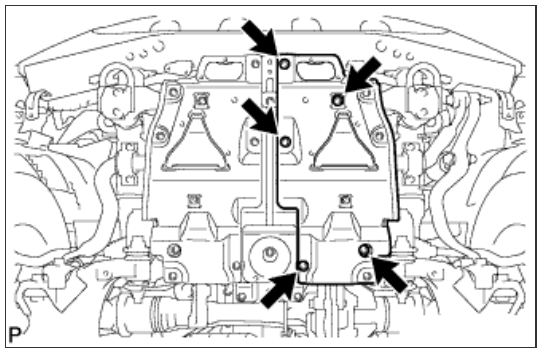
a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



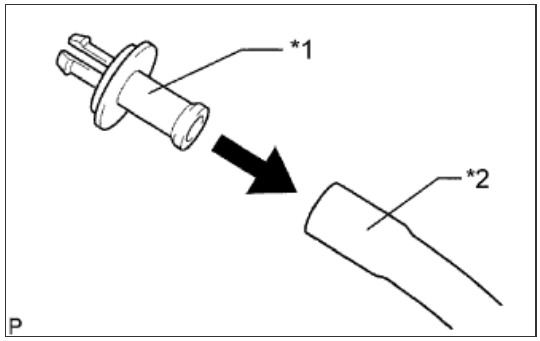
3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY LH

a. Remove the 5 bolts and No. 1 engine under cover sub-assembly LH.



4. REMOVE OIL FILTER ELEMENT

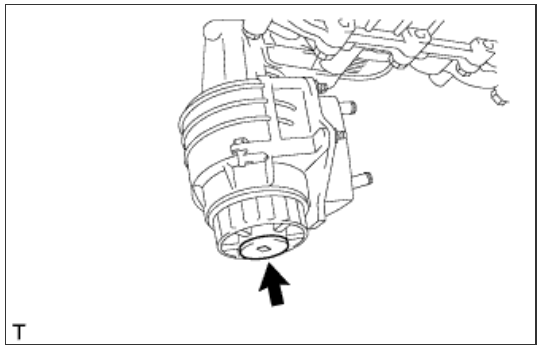
a. Connect a hose with an inside diameter of 15 mm (0.591 in.) to the pipe.



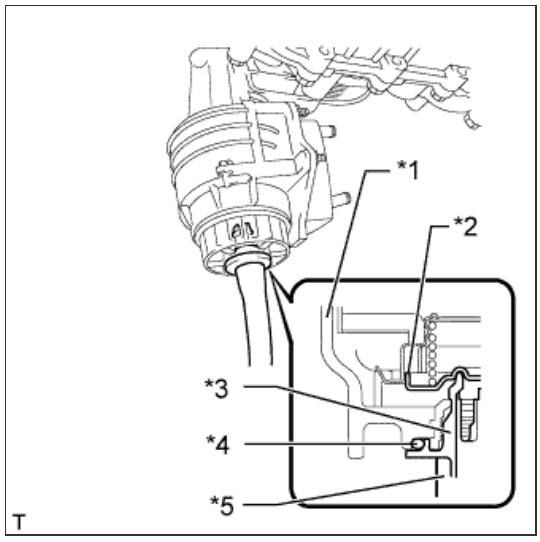
Text in Illustration

*1	Pipe
*2	Hose

b. Remove the oil filter drain plug.



c. Install the pipe to the oil filter cap.



Text in Illustration

*1	Cap
*2	Valve
*3	Pipe
*4	O-Ring
*5	Hose

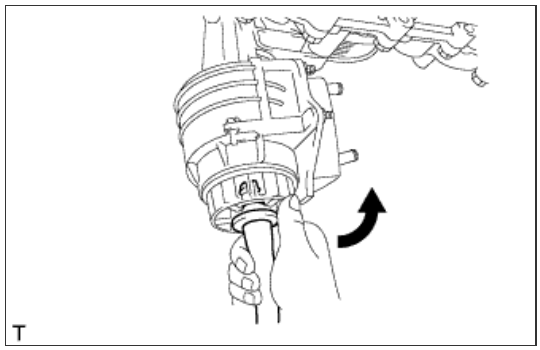
NOTICE:

If the O-ring is removed with the drain plug, install the O-ring together with the pipe.

HINT:

Use a container to catch the draining oil.

d. Check that oil is drained from the oil filter. Then disconnect the pipe and remove the O-ring as shown in the illustration.



e. Using SST, remove the oil filter cap.

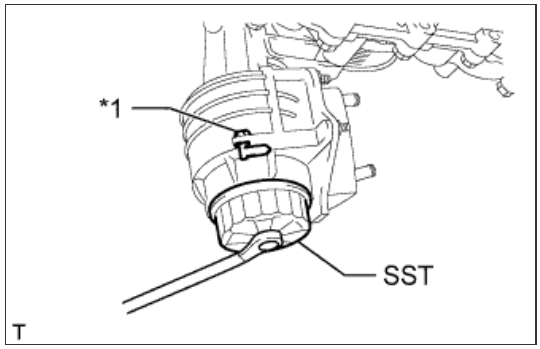
SST
09228-06501

Text in Illustration

*1	Oil Filter Bracket Clip

NOTICE:

Do not remove the oil filter bracket clip.



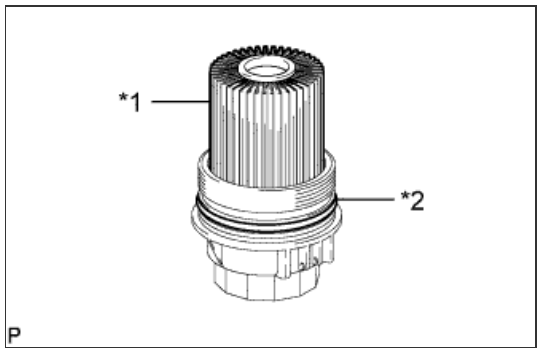
f. Remove the oil filter element and O-ring from the oil filter cap.

Text in Illustration

*1	Oil Filter Element
*2	O-Ring

NOTICE:

Be sure to remove the cap O-ring by hand, without using any tools, to prevent damage to the cap O-ring groove.



5. INSTALL OIL FILTER ELEMENT

a. Clean the inside of the oil filter cap, its threads and its O-ring groove.

b. Apply a small amount of engine oil to a new O-ring and install it to the oil filter cap.

c. Set a new oil filter element to the oil filter cap.

d. Remove any dirt or foreign matter from the installation surface of the engine.

e. Apply a small amount of engine oil to the O-ring again and temporarily install the oil filter cap.

NOTICE:

Do not remove the oil filter bracket clip.

f. Using SST, tighten the oil filter cap.

SST
09228-06501

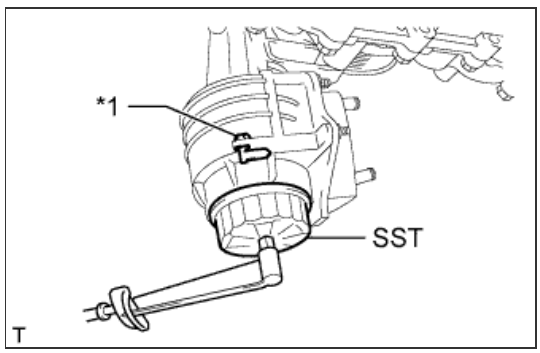
Torque:
2 N*m{ 2 kgf*cm , 18 ft.*lbf }

Text in Illustration

*1	Oil Filter Bracket Clip

NOTICE:

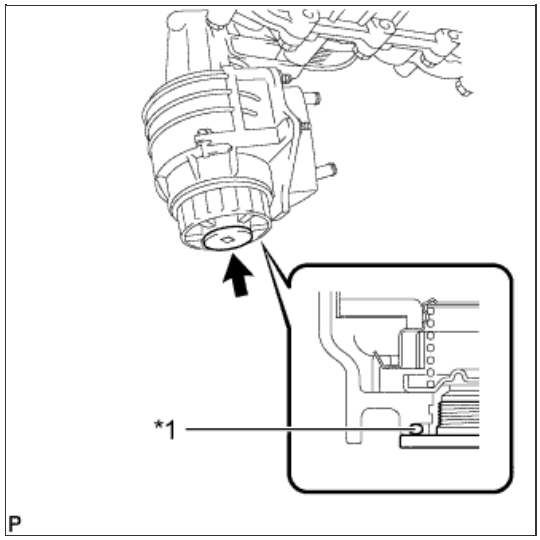
- **When tightening the oil filter cap, do not remove the oil filter**



bracket clip.

- Make sure that the oil filter is installed securely as shown in the illustration.
- Be careful that the O-ring does not get caught between any surrounding parts.

g. Apply a small amount of engine oil to a new drain plug O-ring, and install it to the oil filter cap.



Text in Illustration

*1	O-Ring

NOTICE:

Before installing the O-ring, remove any dirt or foreign matter from the installation surface of the oil filter cap.

h. Install the oil filter drain plug.

Torque:
13 N*m{ 12 kgf*cm , 9 ft.*lbf }

NOTICE:

Be careful that the O-ring does not get caught between any surrounding parts.

i. Install the No. 2 engine under cover seal with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

6. ADD ENGINE OIL

a. Add fresh oil and install the oil filler cap.

Standard Oil Grade:

Oil Grade	Oil Viscosity (SAE)
API grade SL "energy-conserving", API grade SM "energy-conserving" or ILSAC multigrade engine oil	5 -30 10 -30
API grade SL and SM multigrade engine oil	15 -40 20 -50

Standard Oil Capacity:

Item	Specified Condition
Drain and refill without oil filter change	7.1 liters (7.5 US ts, 6.2 Imp. ts)
Drain and refill with oil filter change	7.5 liters (7.9 US ts, 6.6 Imp. ts)
Dry fill	9.3 liters (9.8 US ts, 8.2 Imp. ts)

7. INSPECT FOR OIL LEAK

a. Start the engine. Make sure that there are no oil leaks from the area that was worked on.

8. INSPECT ENGINE OIL LEVEL

a. arm up the engine, stop the engine and wait 5 minutes. The oil level should be between the dipstick low level mark and full level mark. If low, check for leakage and add oil up to the full level mark.

NOTICE:

Do not fill engine oil above the full level mark.

9. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY LH

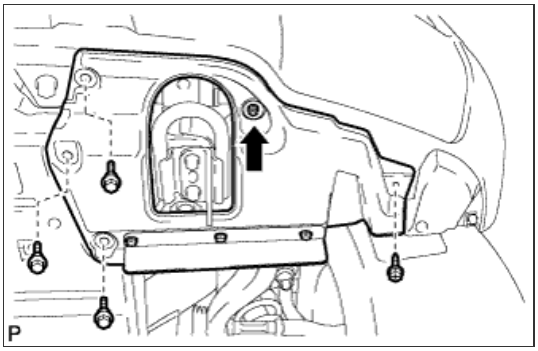
a. Install the No. 1 engine under cover with the 5 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

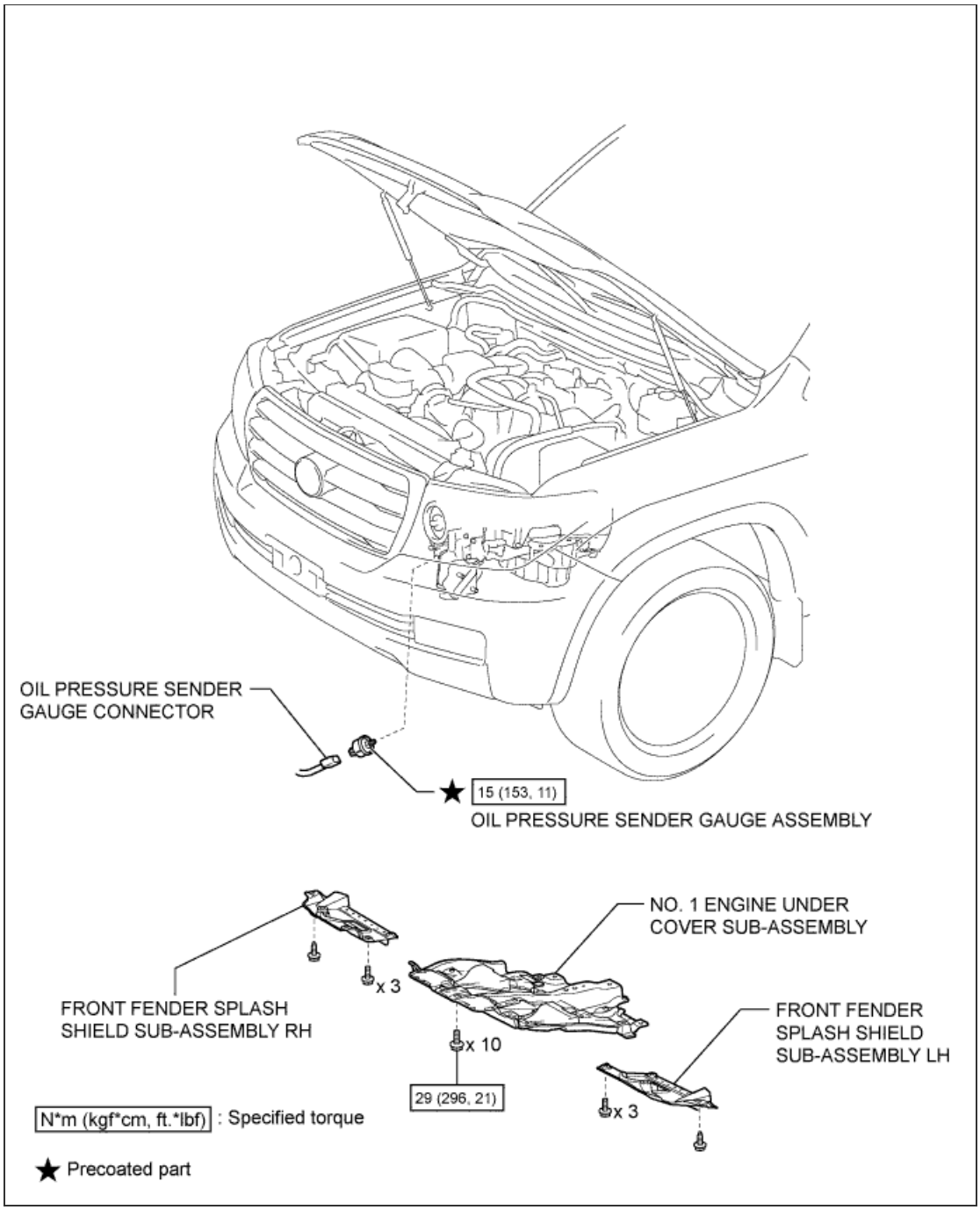
10. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



for Preparation Click here

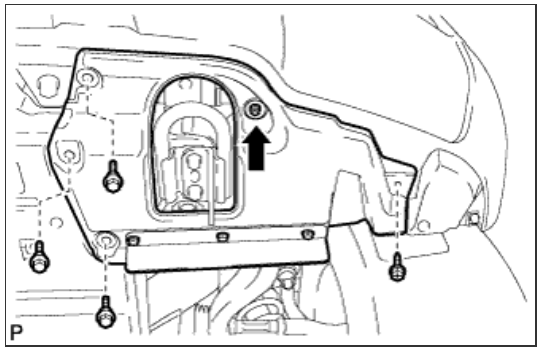


for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



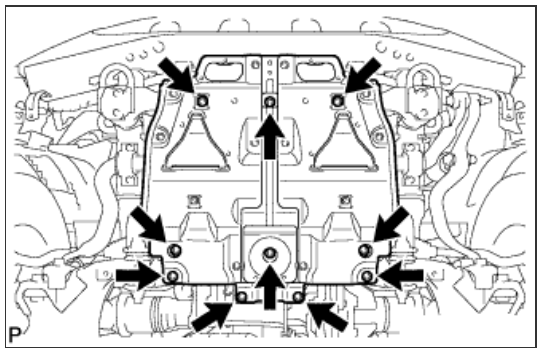
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

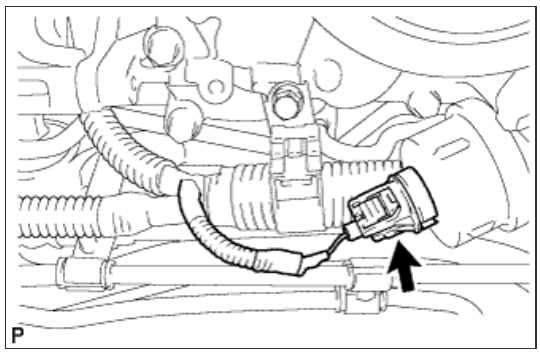
3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and No. 1 engine under cover.

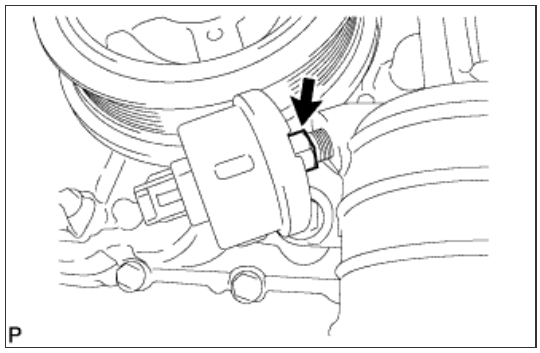


4. REMOVE OIL PRESSURE SENDER GAUGE ASSEMBLY

a. Disconnect the sender gauge connector.



b. Remove the oil pressure sender gauge.


P

for Preparation Click here

1. INSTALL OIL PRESSURE SENDER GAUGE ASSEMBLY

a. Apply adhesive to 2 or 3 threads of the oil pressure sender gauge.

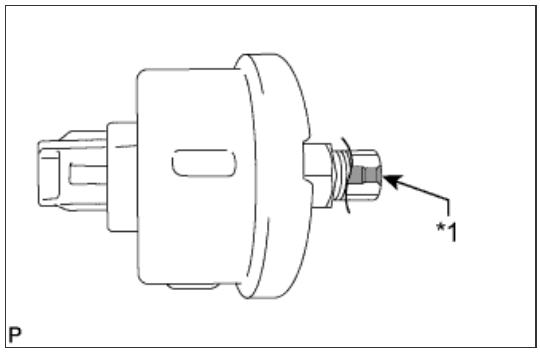
Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent

NOTICE:

Do not allow adhesive to contact the oil hole.

Text in Illustration

*1	Oil Hole



b. Install the oil pressure sender gauge.

Torque:
15 N*m{ 153 kgf*cm , 11 ft.*lbf }

NOTICE:

Do not start the engine within 1 hour after installation.

c. Connect the sender gauge connector.

2. INSPECT ENGINE OIL LEVEL

a. Warm up the engine, stop the engine and wait 5 minutes. The oil level should be between the dipstick low level mark and full level mark. If low, check for leakage and add oil up to the full level mark.

NOTICE:

Do not fill engine oil above the full level mark.

3. INSPECT FOR OIL LEA

a. Start the engine. Make sure that there are no oil leaks from the area that was worked on.

4. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

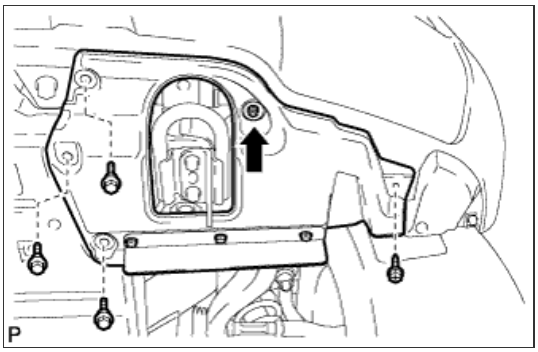
a. Install the No. 1 engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

5. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.

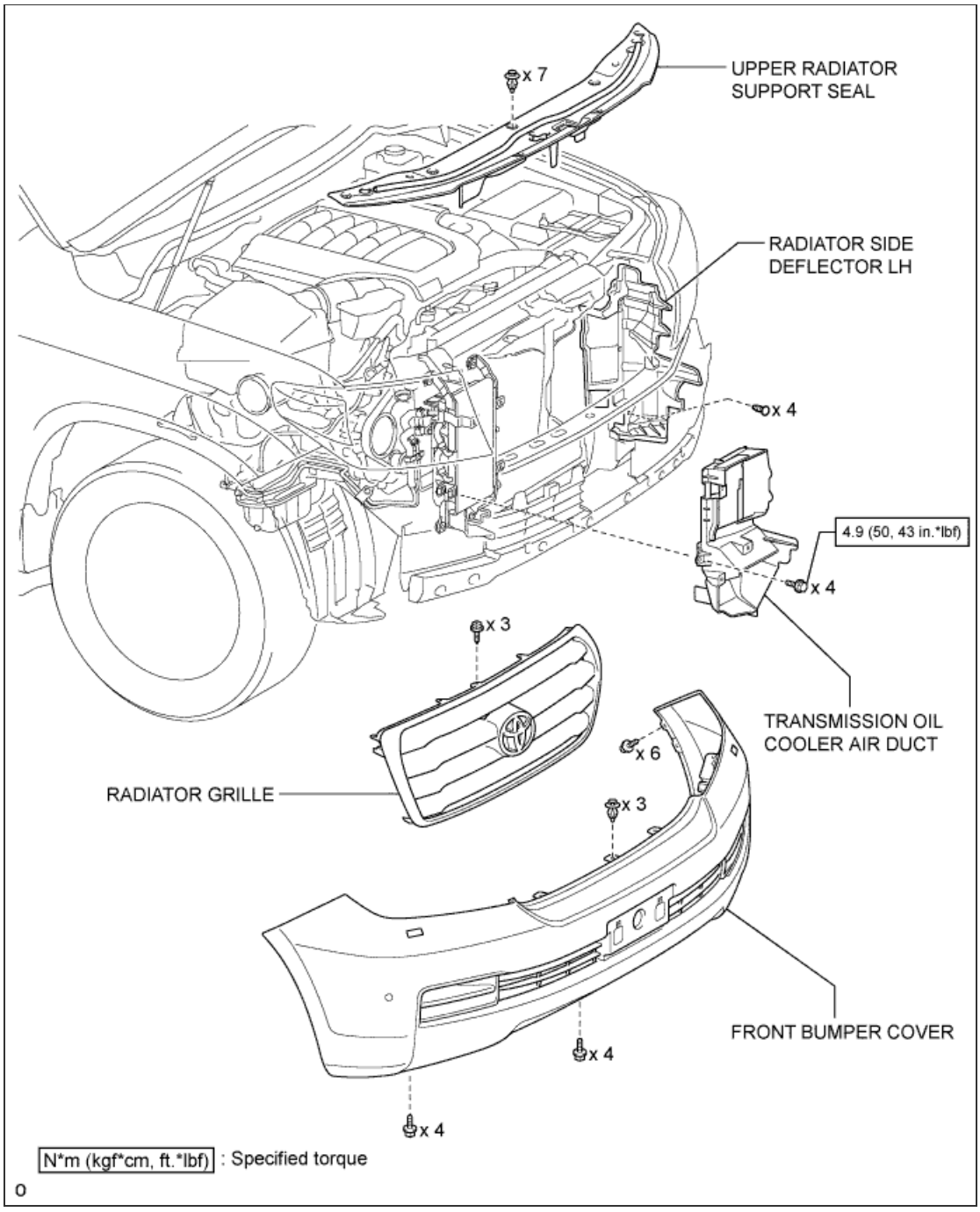


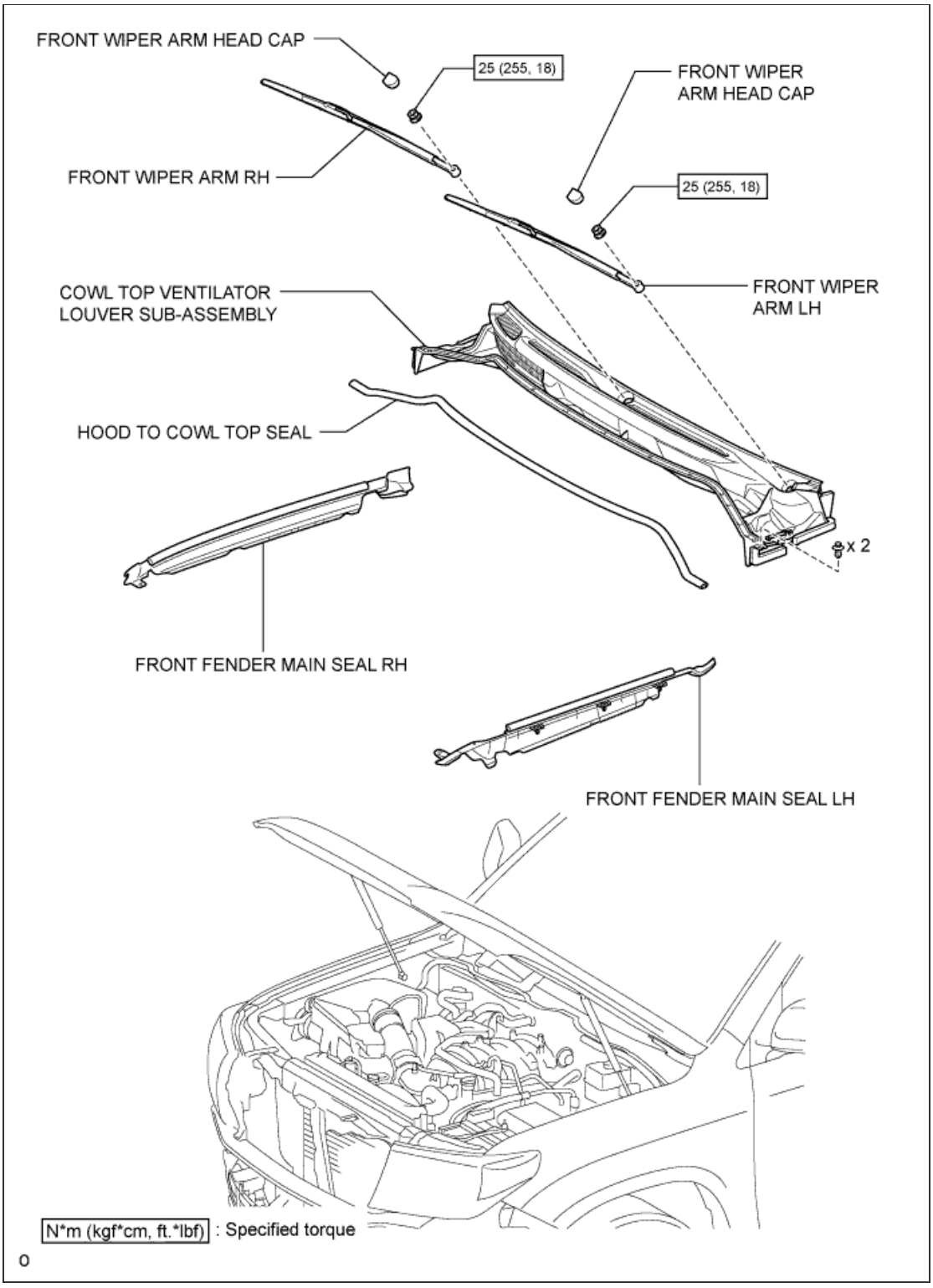
6. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY R

INT

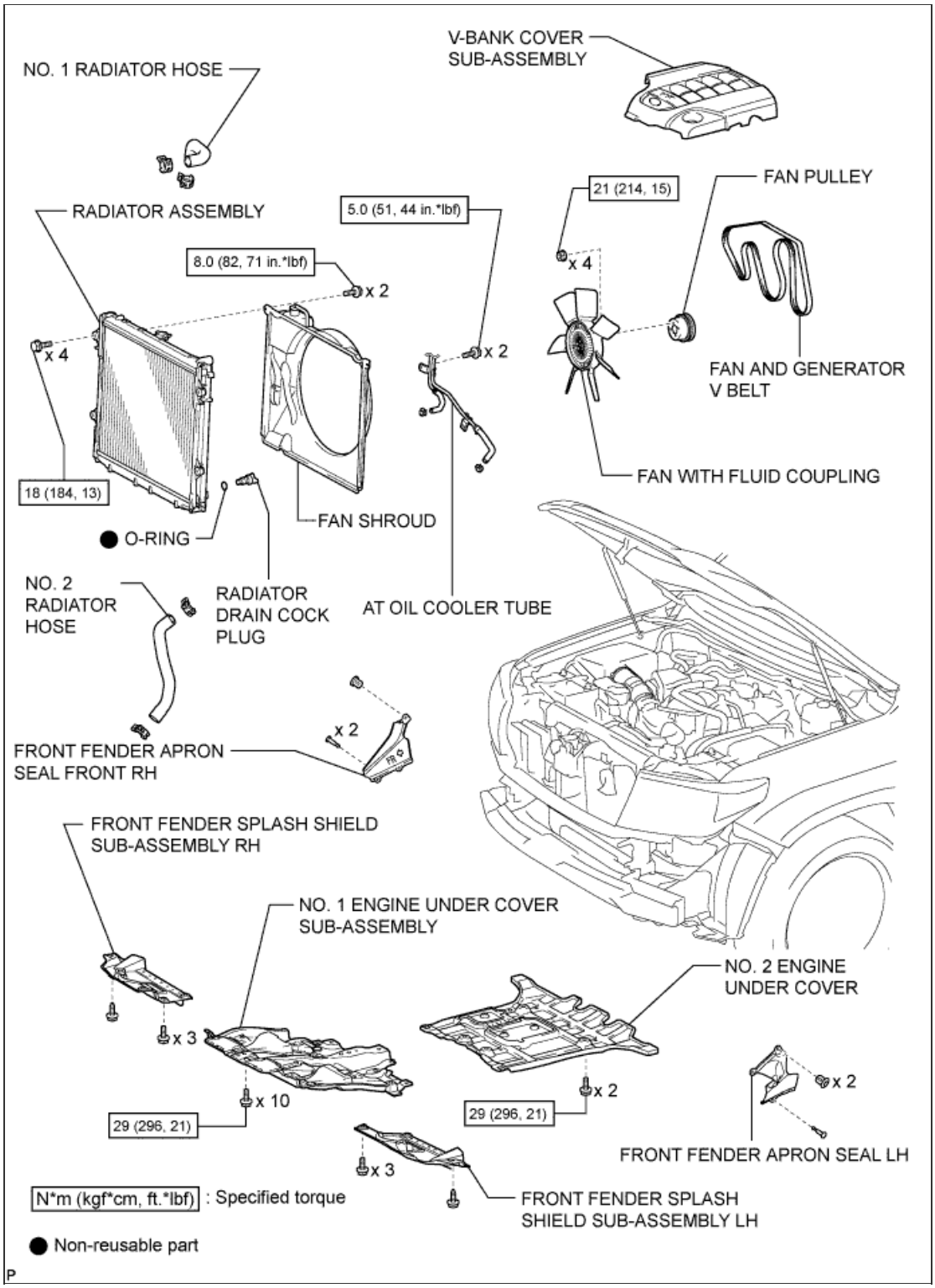
Use the same procedures described for the LH side.

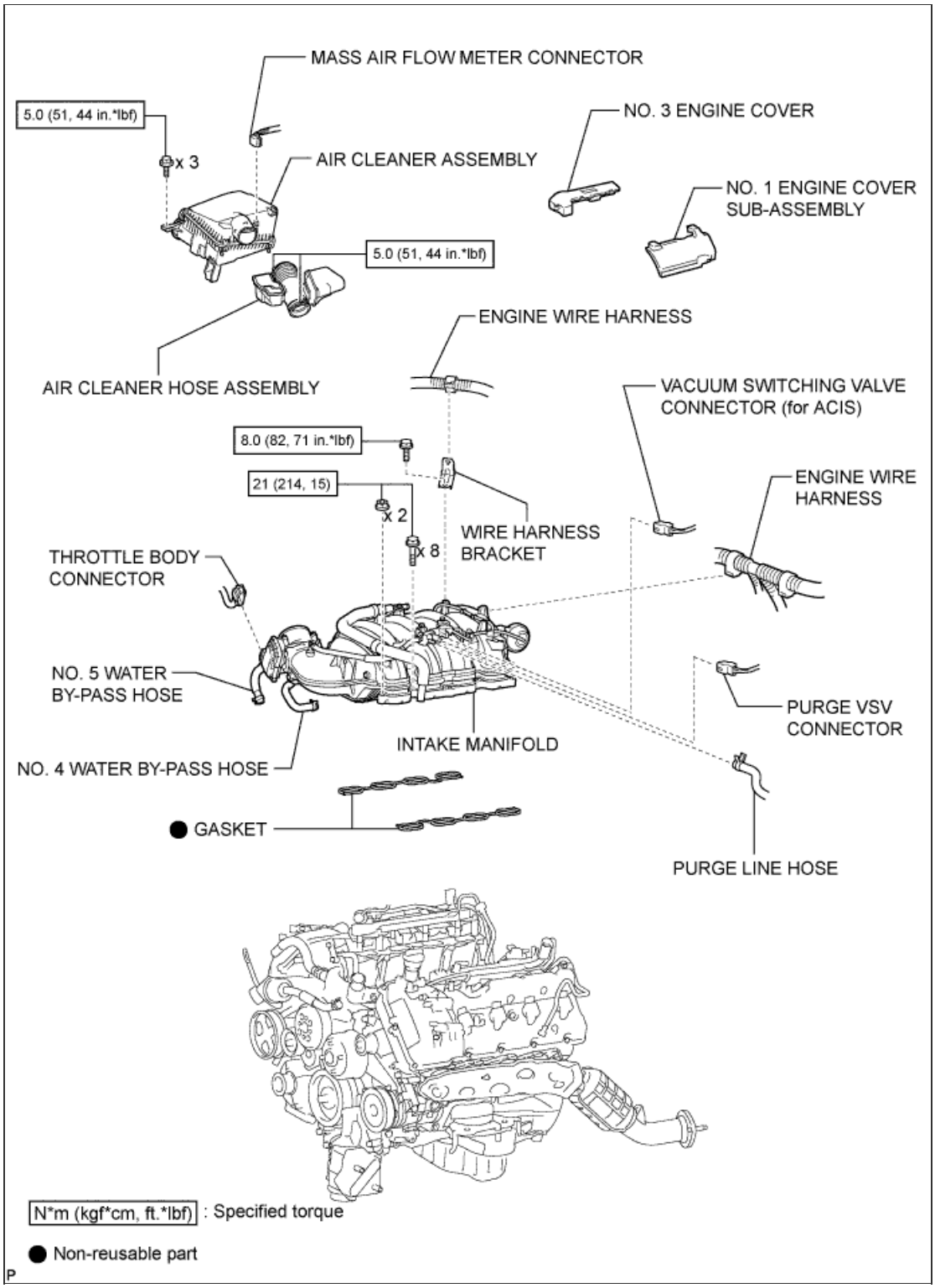
for Preparation Click here

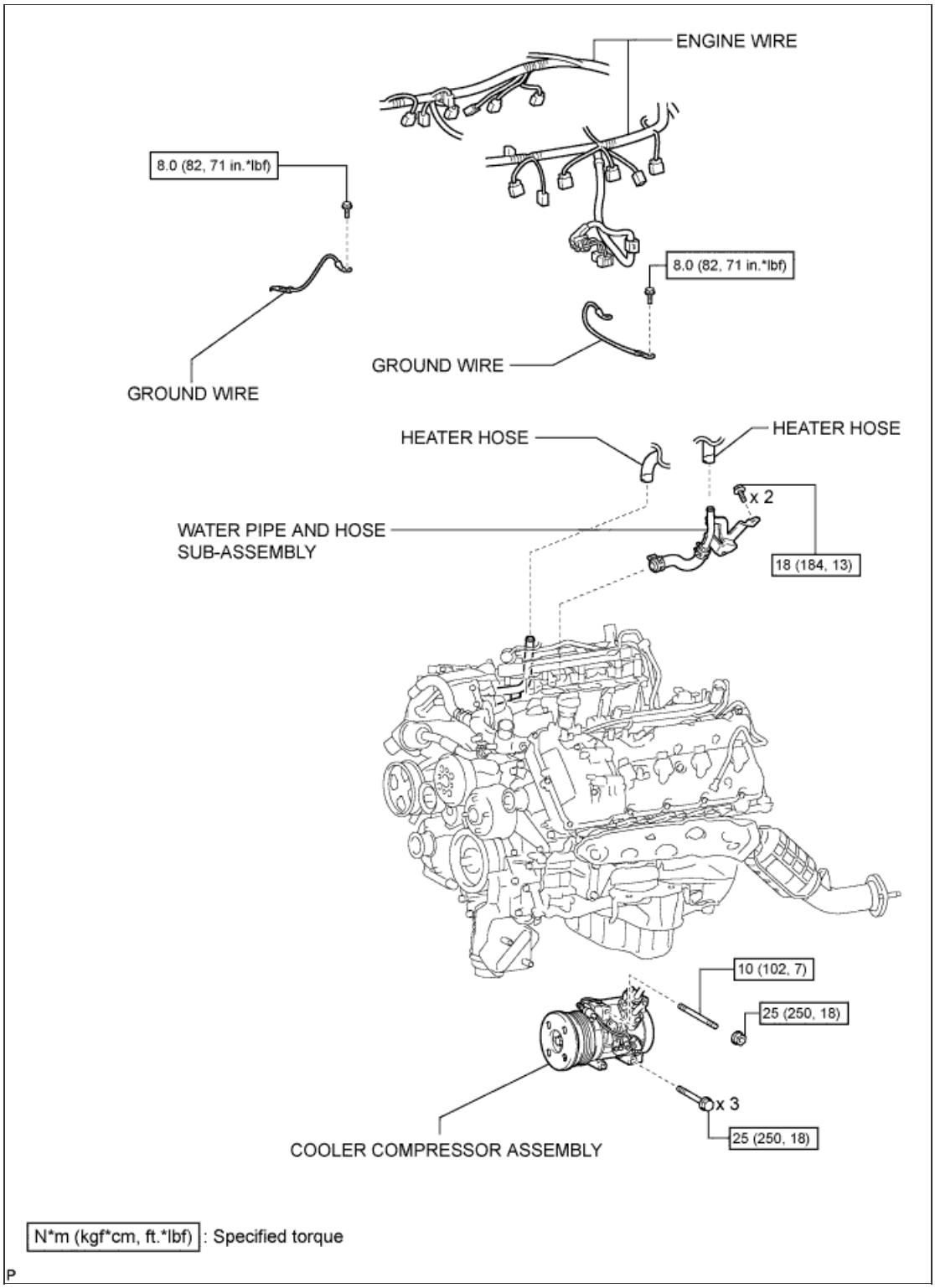


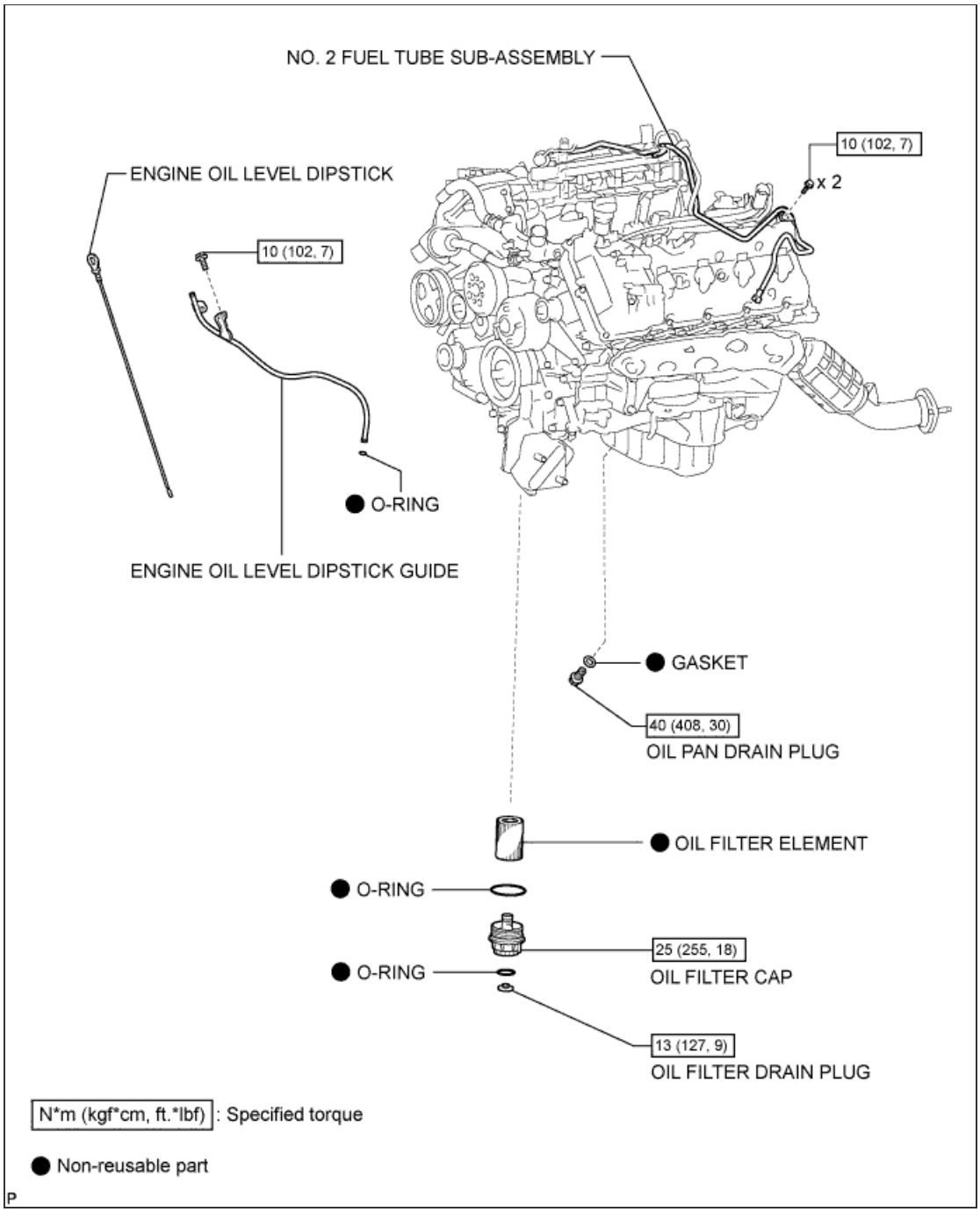

FRONT WIPER ARM HEAD CAP
25 (255, 18)
FRONT WIPER ARM HEAD CAP
FRONT WIPER ARM RH
25 (255, 18)
FRONT WIPER ARM LH
COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY
HOOD TO COWL TOP SEAL
x 2
FRONT FENDER MAIN SEAL RH
FRONT FENDER MAIN SEAL LH
N*m (kgf*cm, ft.*lbf) : Specified torque

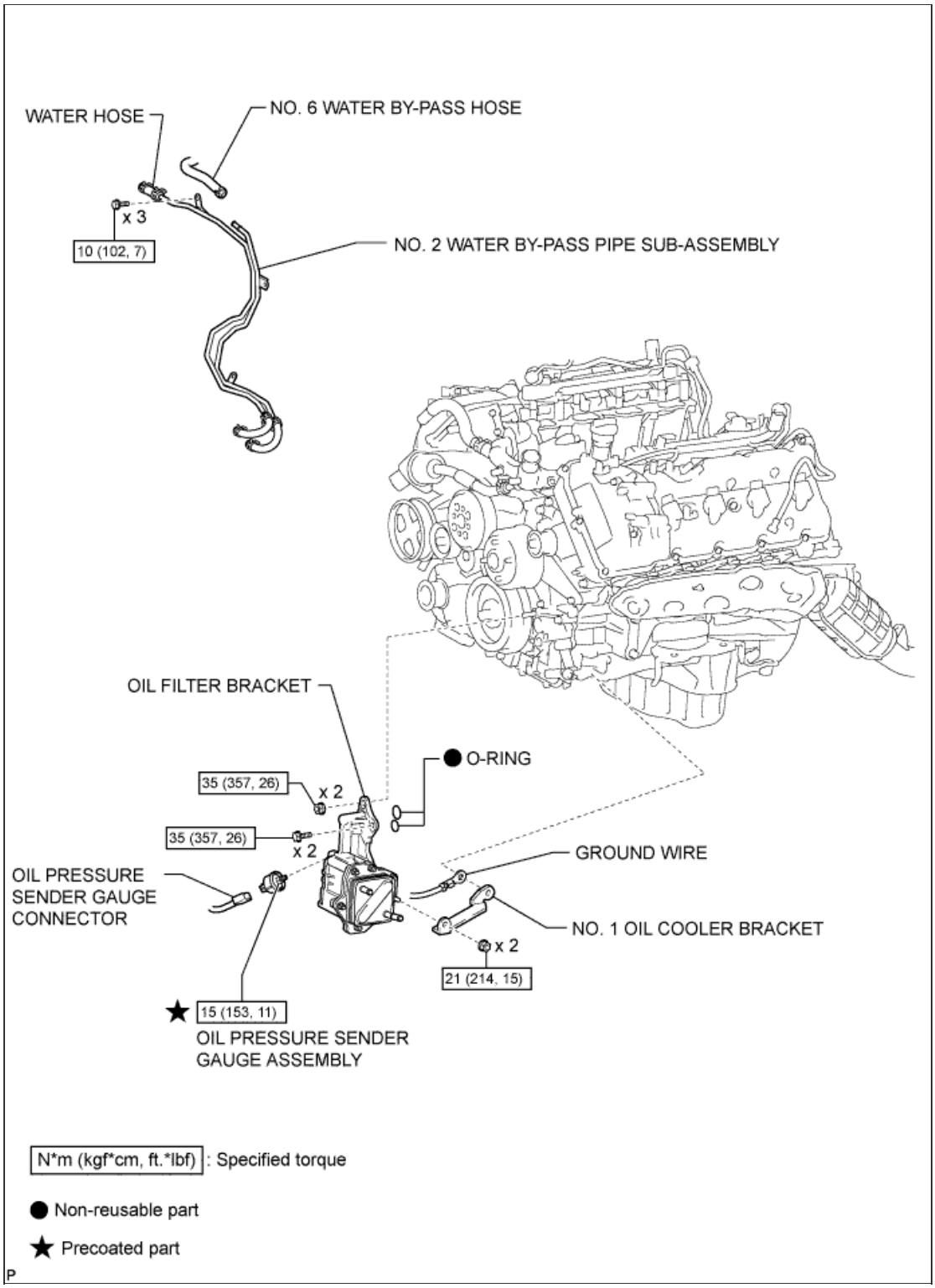
o

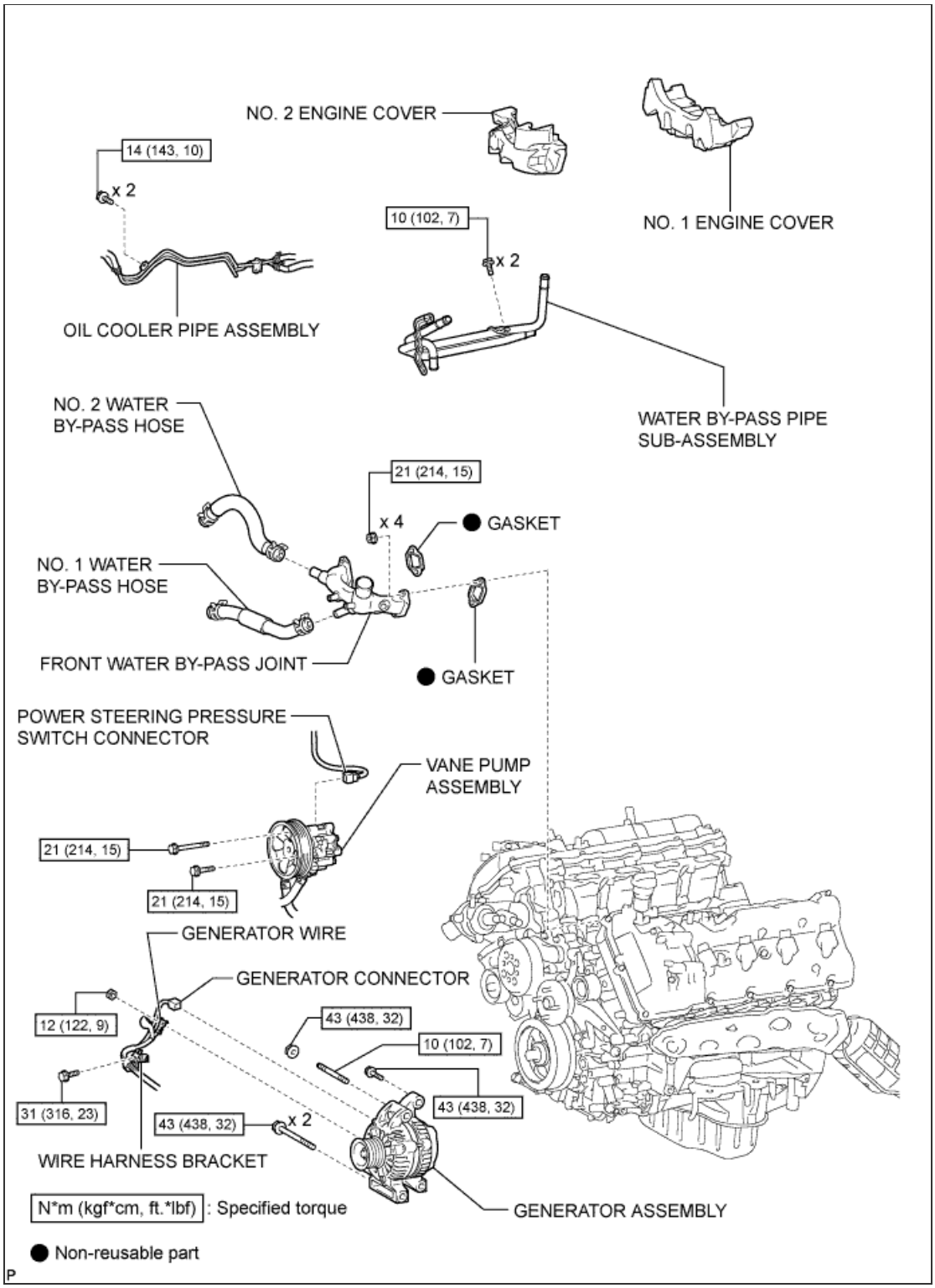

V-BANK COVER SUB-ASSEMBLY
NO. 1 RADIATOR HOSE
FAN PULLEY
21 (214, 15)
RADIATOR ASSEMBLY
5.0 (51, 44 in.*lbf)
8.0 (82, 71 in.*lbf)
x 2
x 4
x 2
x 4
FAN AND GENERATOR V BELT
18 (184, 13)
FAN WITH FLUID COUPLING
FAN SHROUD
O-RING
NO. 2 RADIATOR HOSE
RADIATOR DRAIN COCK PLUG
AT OIL COOLER TUBE
x 2
FRONT FENDER APRON SEAL FRONT RH
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH
NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY
NO. 2 ENGINE UNDER COVER
x 3
x 10
x 2
29 (296, 21)
29 (296, 21)
x 2
FRONT FENDER APRON SEAL LH
x 3
FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

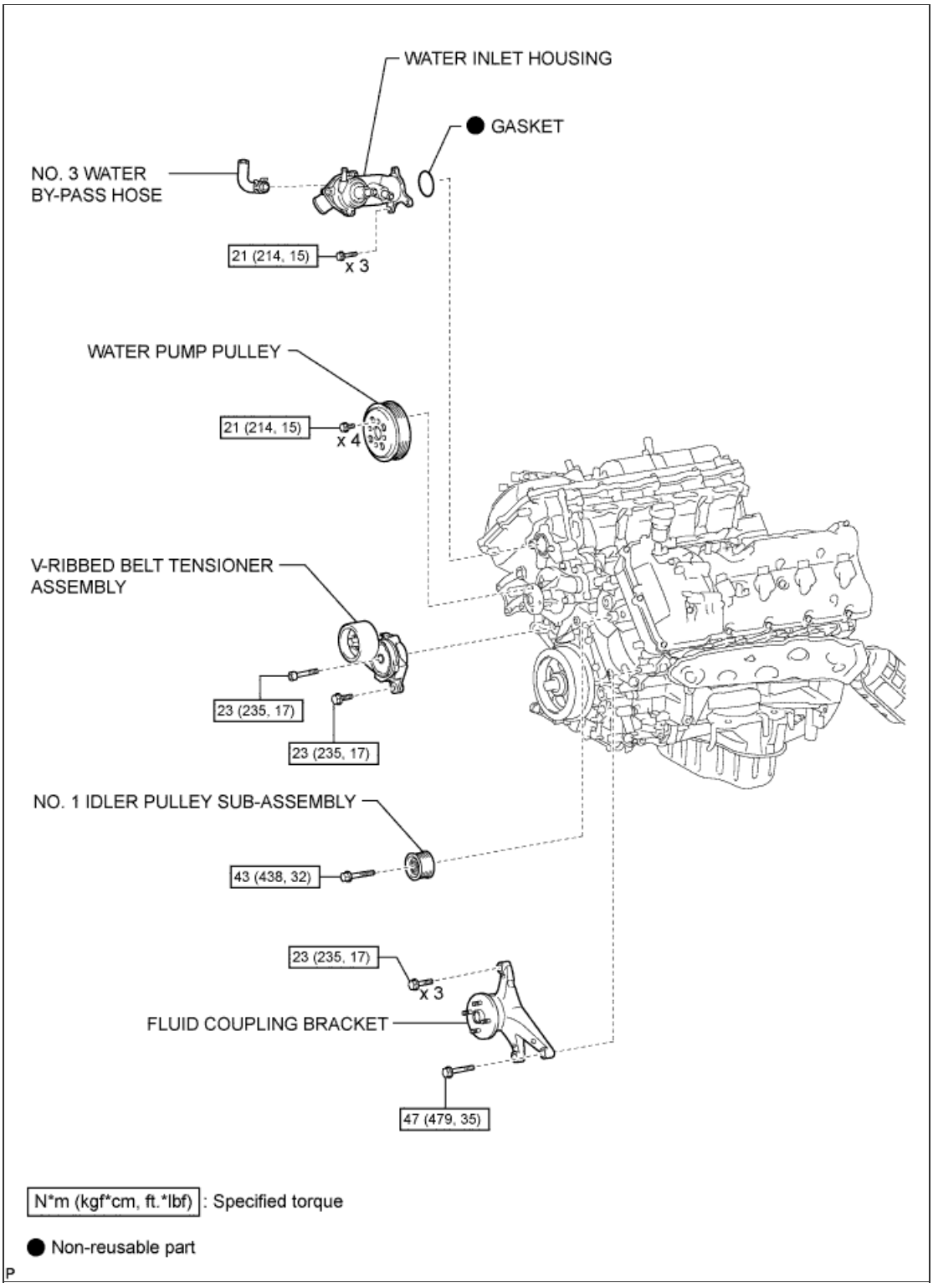

MASS AIR FLOW METER CONNECTOR
5.0 (51, 44 in.*lbf)
x 3
AIR CLEANER ASSEMBLY
NO. 3 ENGINE COVER
NO. 1 ENGINE COVER SUB-ASSEMBLY
5.0 (51, 44 in.*lbf)
ENGINE WIRE HARNESS
AIR CLEANER HOSE ASSEMBLY
VACUUM SWITCHING VALVE CONNECTOR (for ACIS)
8.0 (82, 71 in.*lbf)
21 (214, 15)
x 2
x 8
WIRE HARNESS BRACKET
ENGINE WIRE HARNESS
THROTTLE BODY CONNECTOR
NO. 5 WATER BY-PASS HOSE
PURGE VSV CONNECTOR
INTAKE MANIFOLD
NO. 4 WATER BY-PASS HOSE
● GASKET
PURGE LINE HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
P

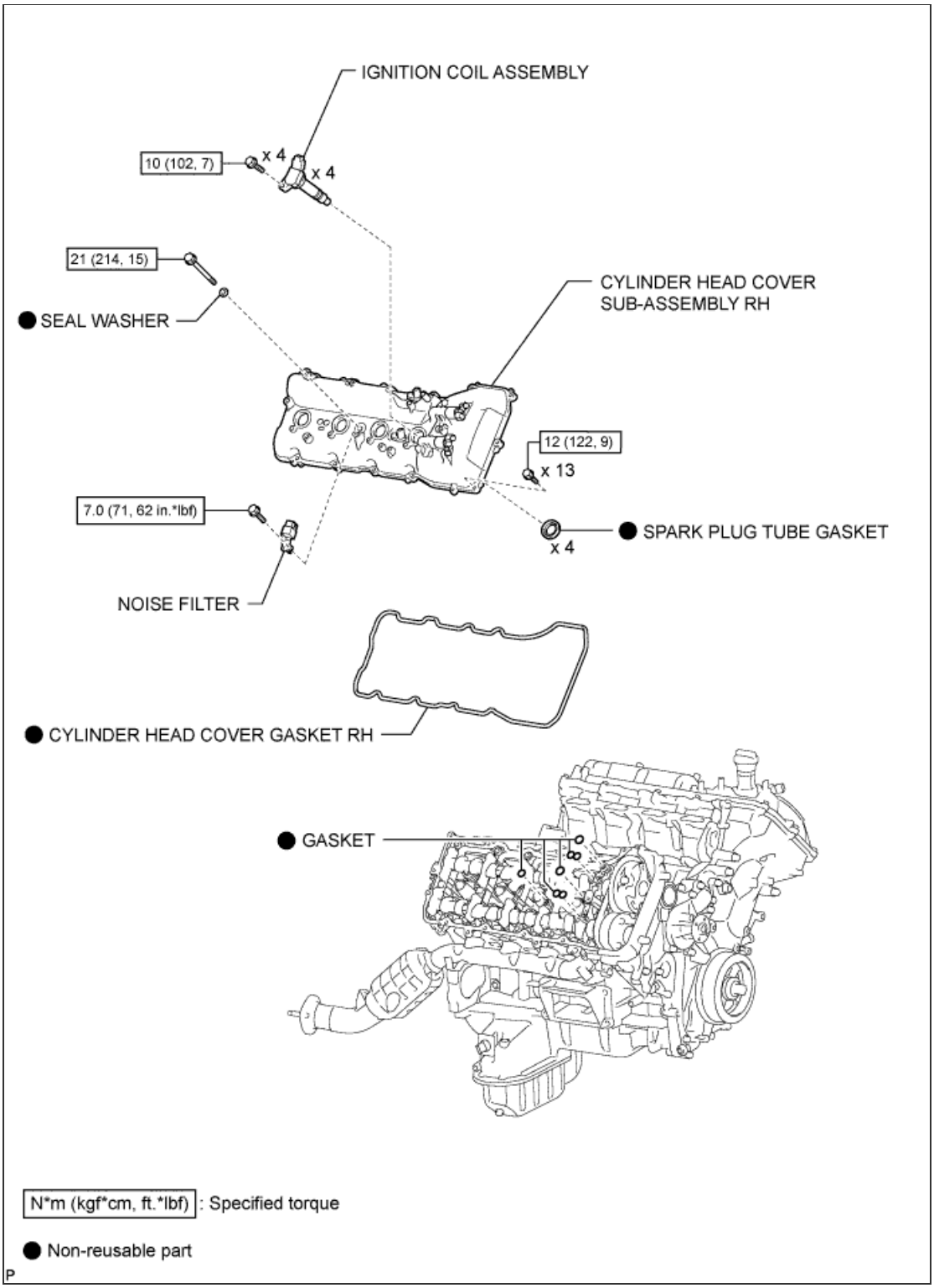

ENGINE WIRE
8.0 (82, 71 in.*lbf)
8.0 (82, 71 in.*lbf)
GROUND WIRE
GROUND WIRE
HEATER HOSE
HEATER HOSE
x 2
WATER PIPE AND HOSE
SUB-ASSEMBLY
18 (184, 13)
10 (102, 7)
25 (250, 18)
x 3
25 (250, 18)
COOLER COMPRESSOR ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
P


NO. 2 FUEL TUBE SUB-ASSEMBLY
10 (102, 7)
x 2
ENGINE OIL LEVEL DIPSTICK
10 (102, 7)
O-RING
ENGINE OIL LEVEL DIPSTICK GUIDE
GASKET
40 (408, 30)
OIL PAN DRAIN PLUG
OIL FILTER ELEMENT
O-RING
25 (255, 18)
O-RING
OIL FILTER CAP
13 (127, 9)
OIL FILTER DRAIN PLUG
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

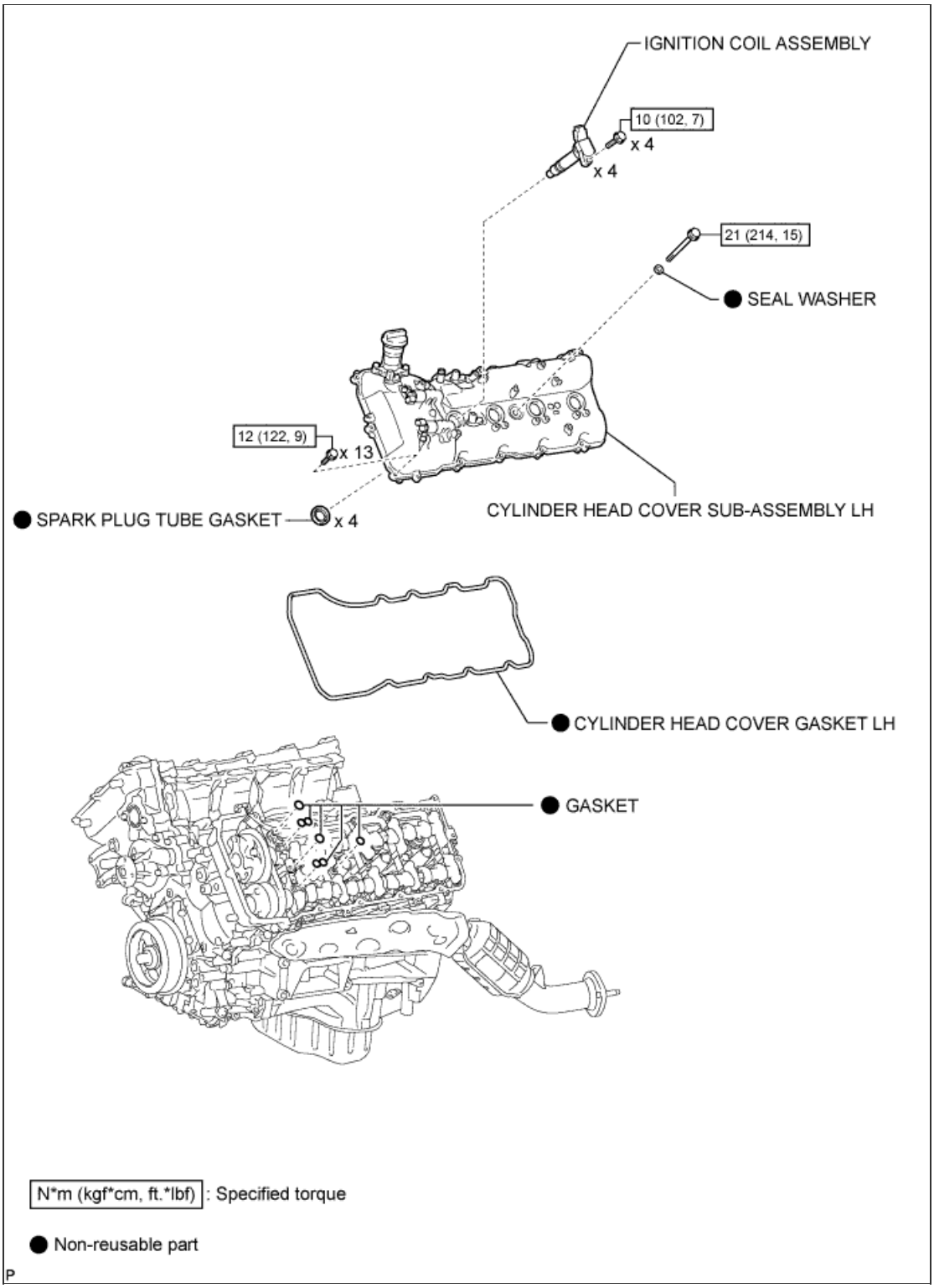

WATER HOSE
NO. 6 WATER BY-PASS HOSE
x 3
10 (102, 7)
NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY
OIL FILTER BRACKET
O-RING
35 (357, 26)
x 2
35 (357, 26)
x 2
GROUND WIRE
OIL PRESSURE SENDER GAUGE CONNECTOR
NO. 1 OIL COOLER BRACKET
x 2
21 (214, 15)
15 (153, 11)
OIL PRESSURE SENDER GAUGE ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
Precoated part
P


NO. 2 ENGINE COVER
NO. 1 ENGINE COVER
14 (143, 10)
x 2
OIL COOLER PIPE ASSEMBLY
10 (102, 7)
x 2
WATER BY-PASS PIPE SUB-ASSEMBLY
NO. 2 WATER BY-PASS HOSE
21 (214, 15)
x 4
GASKET
NO. 1 WATER BY-PASS HOSE
FRONT WATER BY-PASS JOINT
GASKET
POWER STEERING PRESSURE SWITCH CONNECTOR
VANE PUMP ASSEMBLY
21 (214, 15)
21 (214, 15)
GENERATOR WIRE
GENERATOR CONNECTOR
12 (122, 9)
43 (438, 32)
10 (102, 7)
43 (438, 32)
31 (316, 23)
43 (438, 32)
x 2
WIRE HARNESS BRACKET
GENERATOR ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

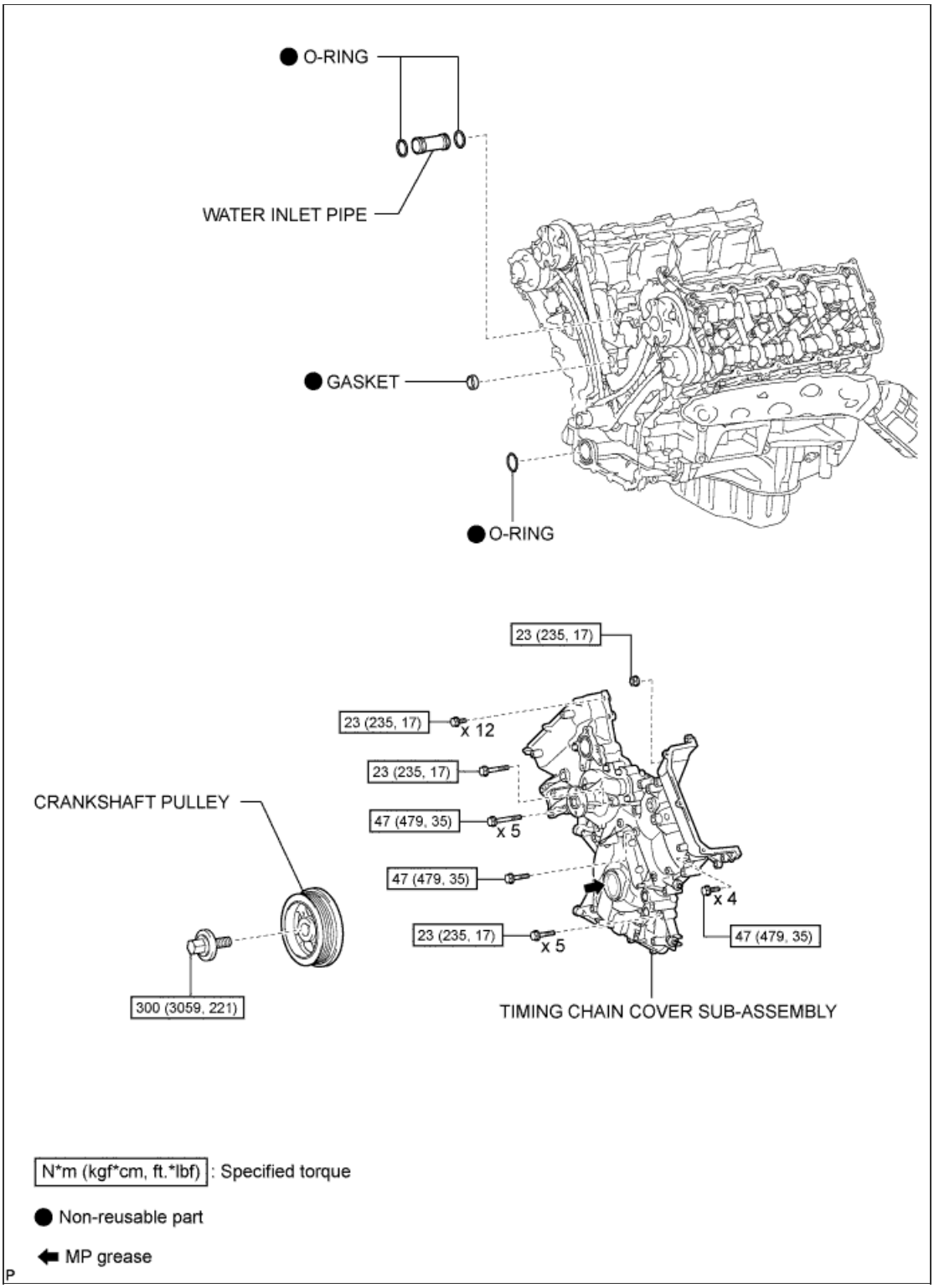

WATER INLET HOUSING
GASKET
NO. 3 WATER BY-PASS HOSE
21 (214, 15)
x 3
WATER PUMP PULLEY
21 (214, 15)
x 4
V-RIBBED BELT TENSIONER ASSEMBLY
23 (235, 17)
23 (235, 17)
NO. 1 IDLER PULLEY SUB-ASSEMBLY
43 (438, 32)
23 (235, 17)
x 3
FLUID COUPLING BRACKET
47 (479, 35)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

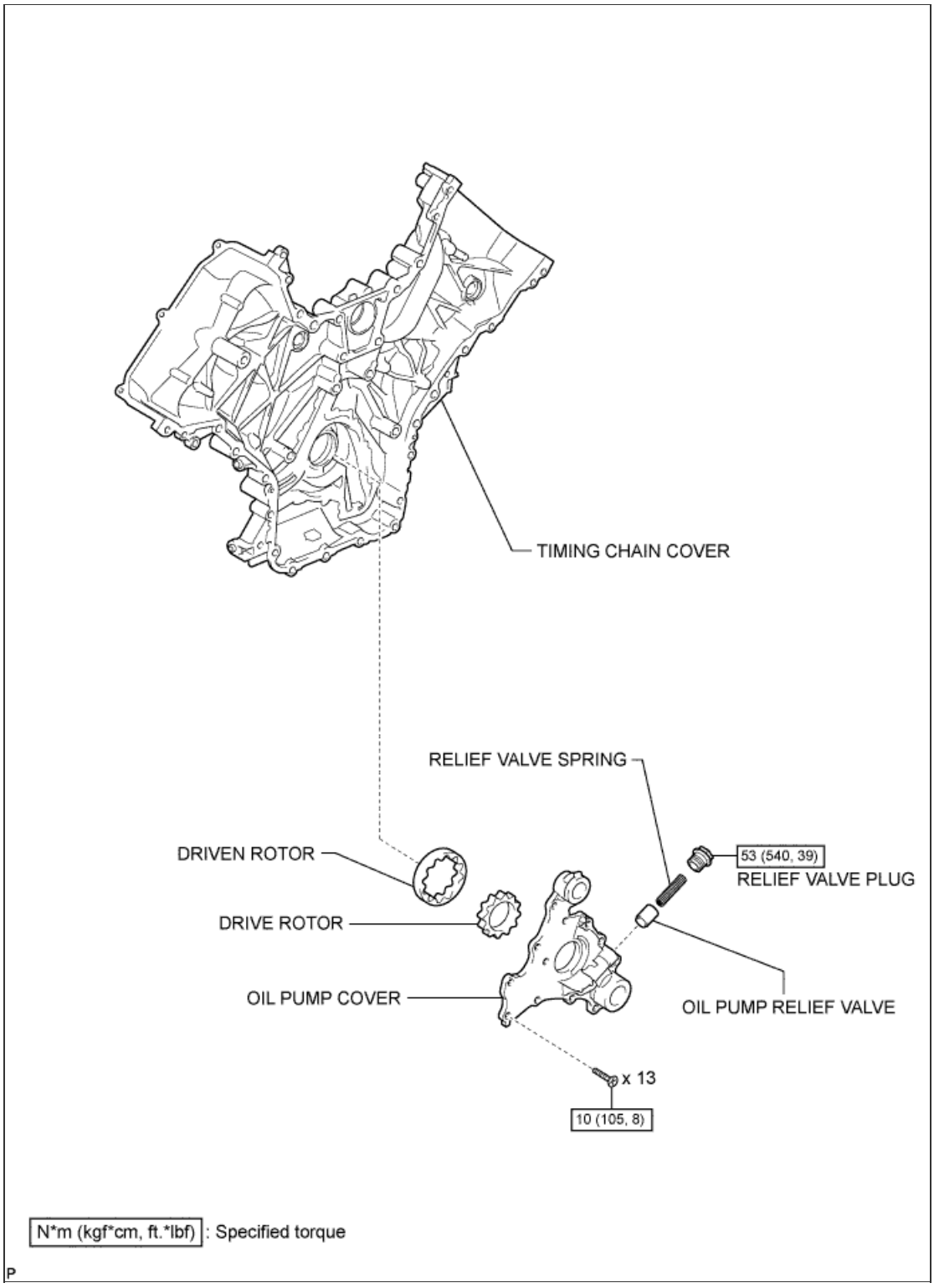

IGNITION COIL ASSEMBLY
10 (102, 7)
x 4
x 4
21 (214, 15)
SEAL WASHER
CYLINDER HEAD COVER
SUB-ASSEMBLY RH
12 (122, 9)
x 13
7.0 (71, 62 in.*lbf)
SPARK PLUG TUBE GASKET
x 4
NOISE FILTER
CYLINDER HEAD COVER GASKET RH
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P


IGNITION COIL ASSEMBLY
10 (102, 7)
x 4
x 4
21 (214, 15)
SEAL WASHER
12 (122, 9)
x 13
SPARK PLUG TUBE GASKET
x 4
CYLINDER HEAD COVER SUB-ASSEMBLY LH
CYLINDER HEAD COVER GASKET LH
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P


O-RING
WATER INLET PIPE
GASKET
O-RING
23 (235, 17)
23 (235, 17)
x 12
23 (235, 17)
47 (479, 35)
x 5
47 (479, 35)
23 (235, 17)
x 5
x 4
47 (479, 35)
CRANKSHAFT PULLEY
300 (3059, 221)
TIMING CHAIN COVER SUB-ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
MP grease
P


TIMING CHAIN COVER
RELIEF VALVE SPRING
DRIVEN ROTOR
53 (540, 39)
RELIEF VALVE PLUG
DRIVE ROTOR
OIL PUMP COVER
OIL PUMP RELIEF VALVE
x 13
10 (105, 8)
N*m (kgf*cm, ft.*lbf) : Specified torque
P

for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

(Click here)

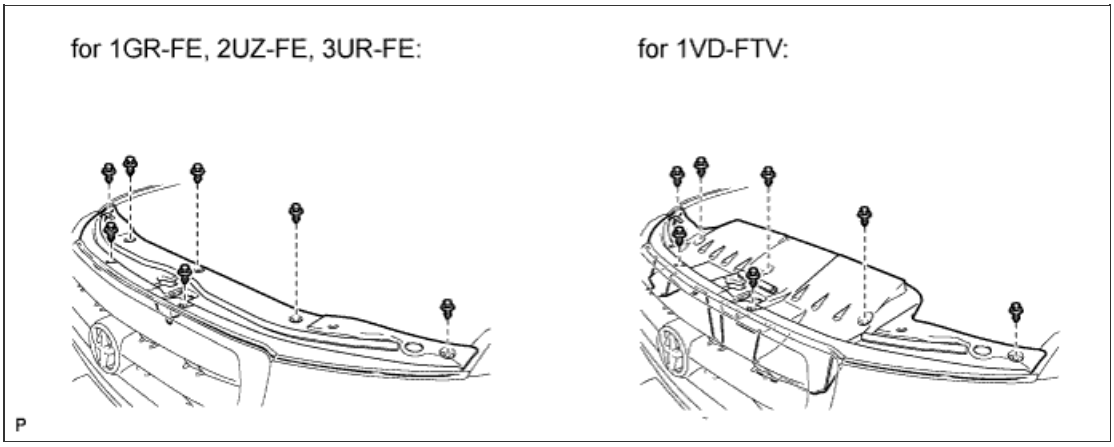
2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE UPPER RADIATOR SUPPORT SEAL

a. Remove the 7 clips and radiator support seal.

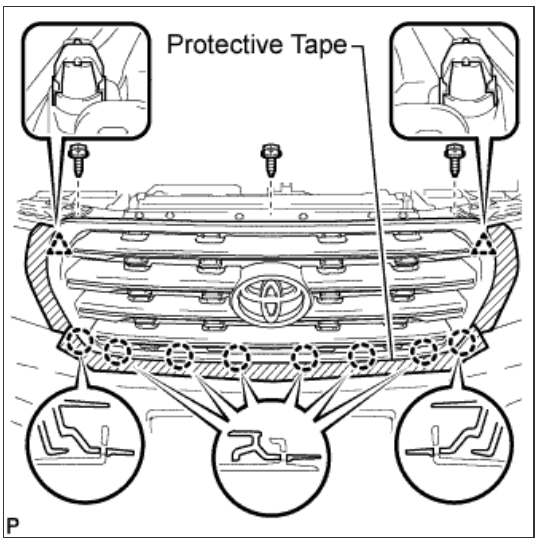


4. REMOVE RADIATOR GRILLE

a. Put protective tape around the radiator grille.

b. Remove the 3 screws.

c. Detach the 2 clips and 8 claws, and remove the radiator grille.

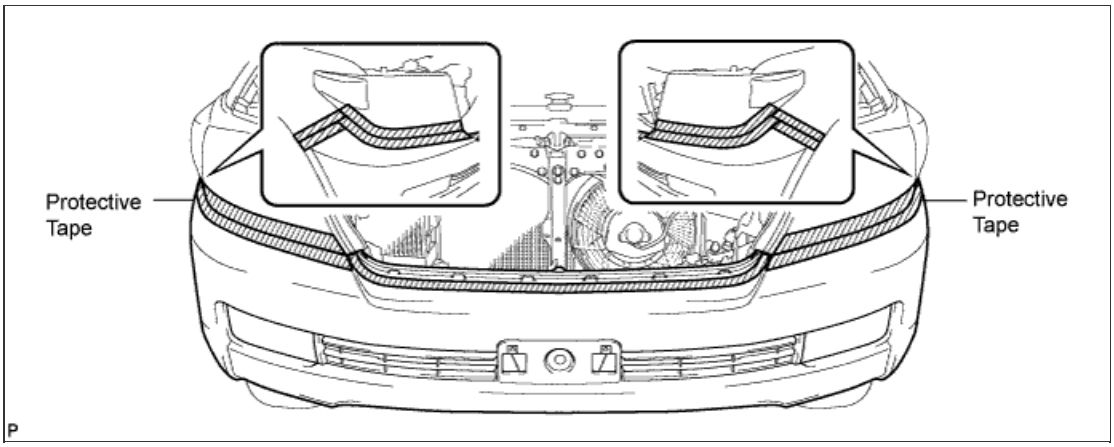


5. REMOVE FRONT BUMPER COVER

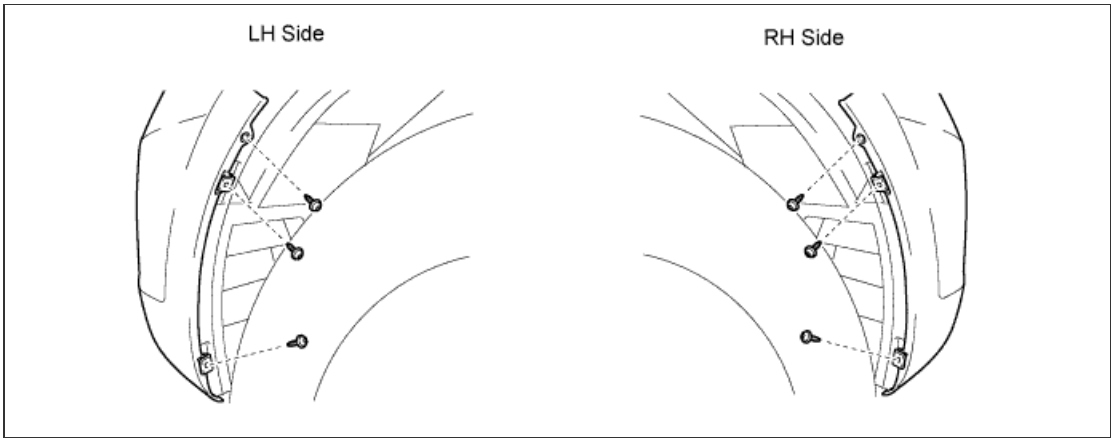
HINT:

For the front bumper cover with garnish, use the procedures described below.

a. Put protective tape around the bumper cover.



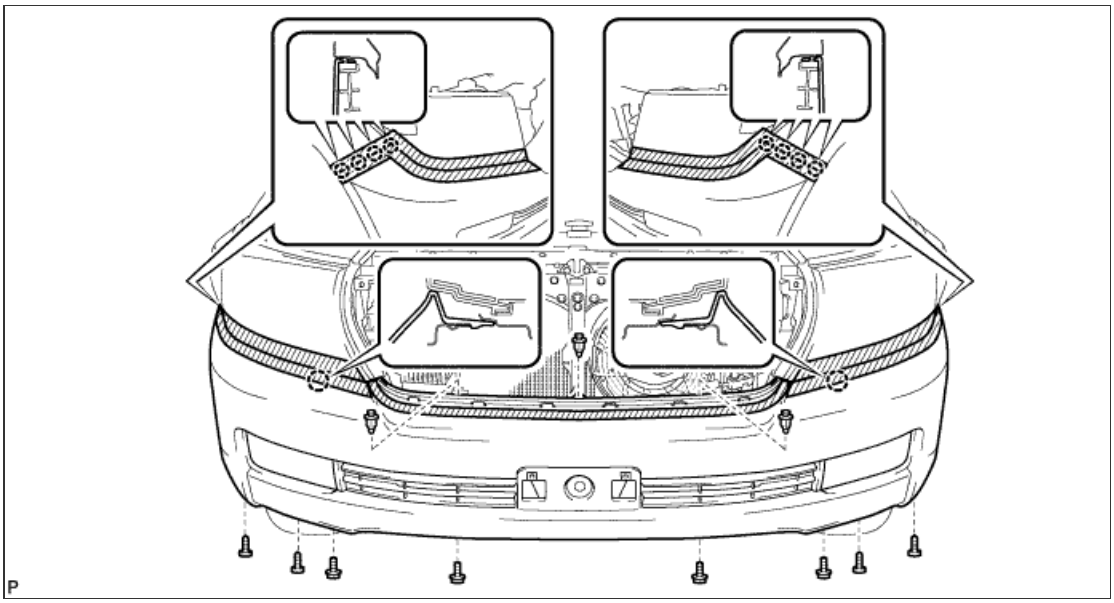
b. Using a T30 "TORX" socket, remove the 6 screws.



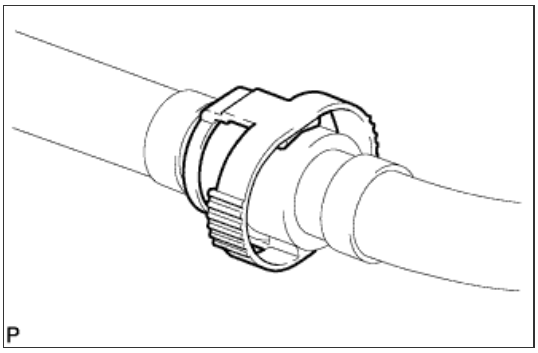
c. Remove the 3 clips, 4 screws and 4 bolts.

d. w/o TOYOTA Parking Assist-sensor System, w/o Fog Light:
Detach the 10 claws and remove the bumper cover.

e. w/ TOYOTA Parking Assist-sensor System or w/ Fog Light:
Detach the 10 claws, disconnect the No. 4 engine room wire connector and remove the bumper cover.

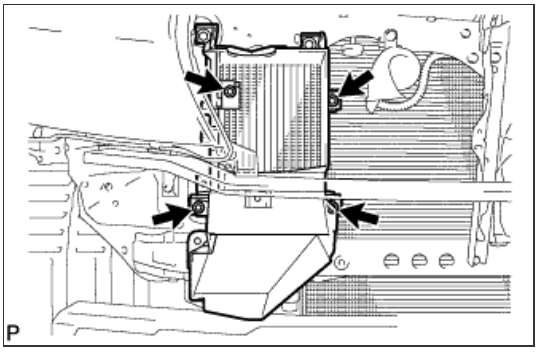


f. w/ Headlight Cleaner System:
Disconnect the headlight cleaner hose and remove the bumper cover.



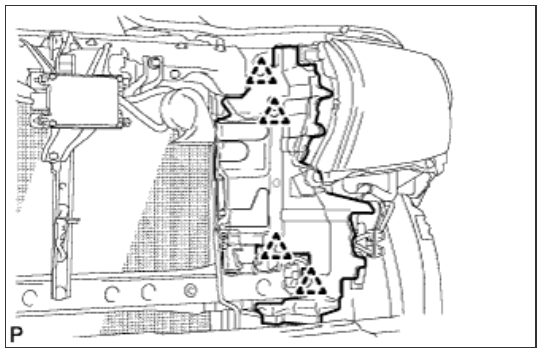
6. REMOVE TRANSMISSION OIL COOLER AIR DUCT

a. Remove the 4 bolts and oil cooler air duct.



7. DISCONNECT RADIATOR SIDE DEFLECTOR LH

a. Using a clip remover, remove the 4 clips and disconnect the side deflector.

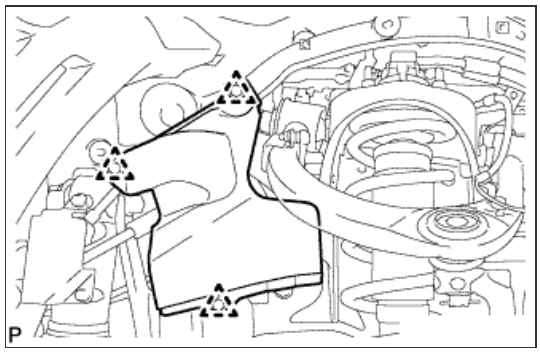


8. REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

(Click here)

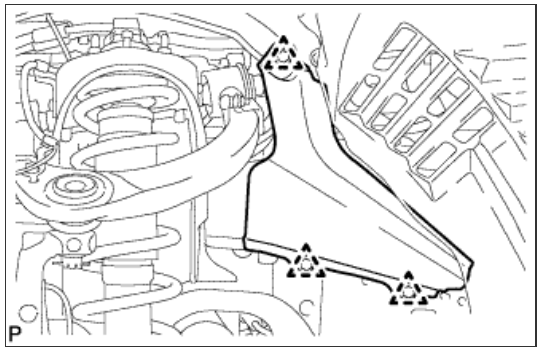
9. REMOVE FRONT FENDER APRON SEAL LH

a. Using a clip remover, remove the 3 clips and fender apron seal.



10. REMOVE FRONT FENDER APRON SEAL FRONT RH

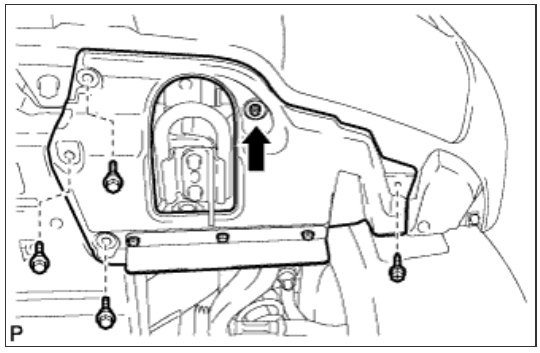
a. Using a clip remover, remove the 3 clips and fender apron seal.



11. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



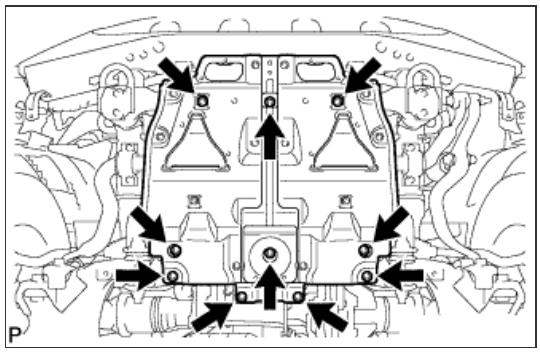
12. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

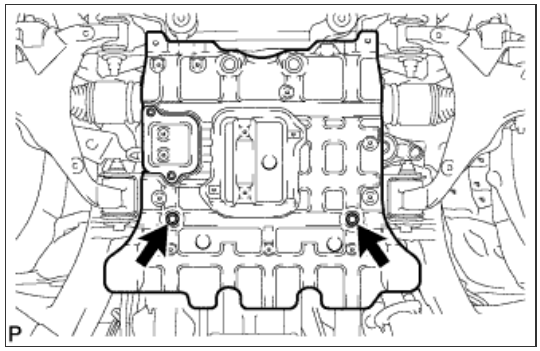
13. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and No. 1 engine under cover.



14. REMOVE NO. 2 ENGINE UNDER COVER

a. Remove the 2 bolts and No. 2 engine under cover.



15. DRAIN ENGINE OIL

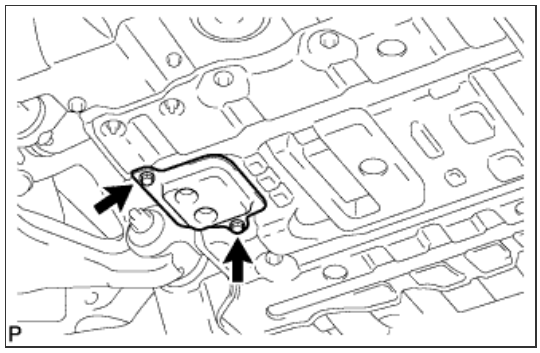
a. Remove the oil filler cap.

b. Remove the 2 bolts and No. 2 engine under cover seal.

c. Remove the oil pan drain plug and gasket, and drain the engine oil into a container.

d. Install a new gasket and the oil pan drain plug.

Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }



16. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause

serious burns.

a. Loosen the radiator drain cock plug.

HINT:

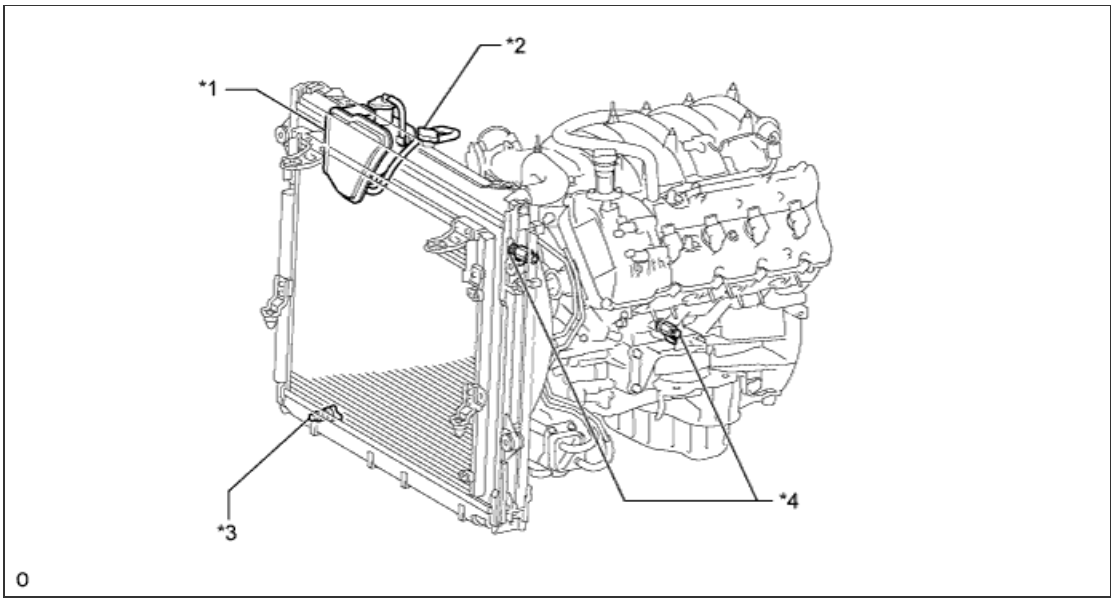
Collect the coolant in a container and dispose of it according to the regulations in your area.

b. Remove the radiator cap. Then drain the coolant from the radiator.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

d. Tighten the 2 cylinder block drain cock plugs.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



Text in Illustration

*1	Radiator Reservoir	*2	Radiator Cap
*3	Radiator Drain Cock Plug	*4	Cylinder Block Drain Cock Plug

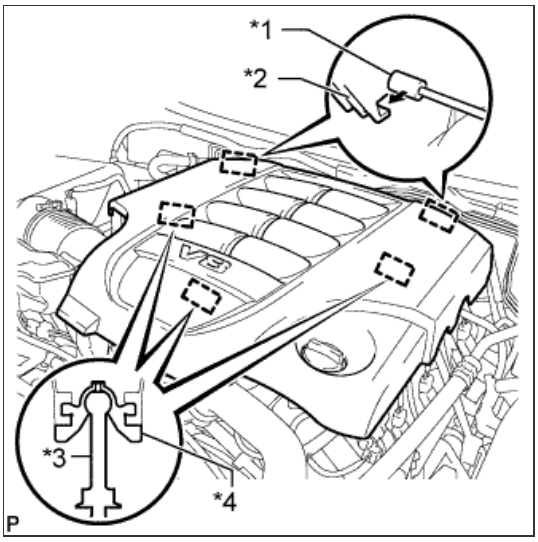
e. Tighten the radiator drain cock plug by hand.

17. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Raise the front of the V-bank cover to detach the 3 pins. Then remove the 2 V-bank cover hooks from the bracket, and remove the V-bank cover.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet

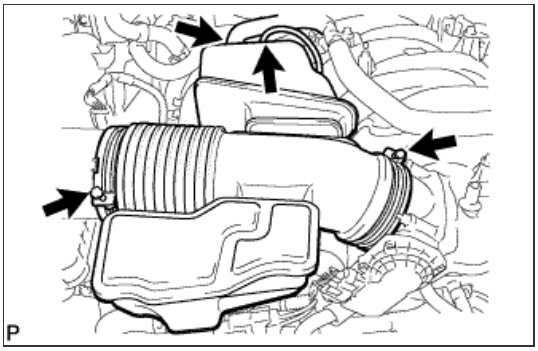


18. REMOVE AIR CLEANER HOSE ASSEMBLY

a. Disconnect the vacuum hose and No. 2 ventilation hose.

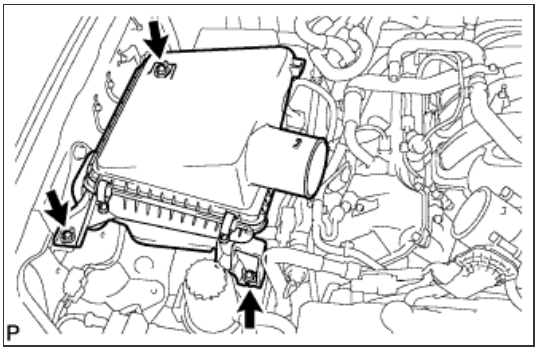
b. Loosen the 2 hose clamps.

c. Remove the air cleaner hose.



19. REMOVE AIR CLEANER ASSEMBLY

a. Remove the 3 bolts and air cleaner.



20. REMOVE RADIATOR ASSEMBLY

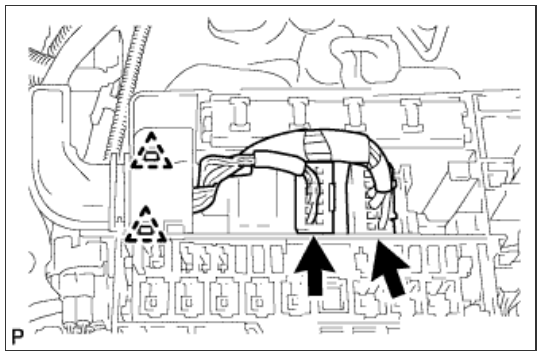
(Click here)

21. DISCONNECT ENGINE WIRE

a. Engine Room LH Side:

i. Remove the engine room relay block cover.

ii. Disconnect the 2 connectors and 2 clips from the engine room junction block.



iii. Disconnect the injector connector.

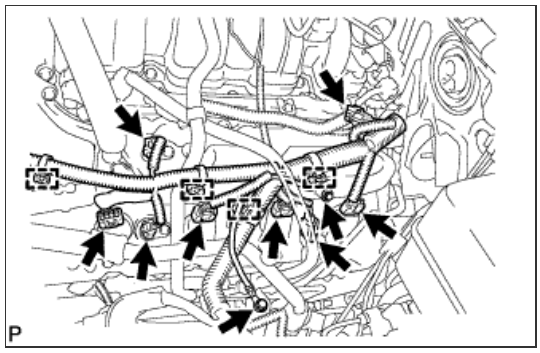
iv. Disconnect the 4 ignition coil connectors.

v. Disconnect the 2 VVT sensor connectors.

vi. Disconnect the 4 clamps.

vii. Remove the 2 bolts and ground wire.

viii. Disconnect the noise filter connector.



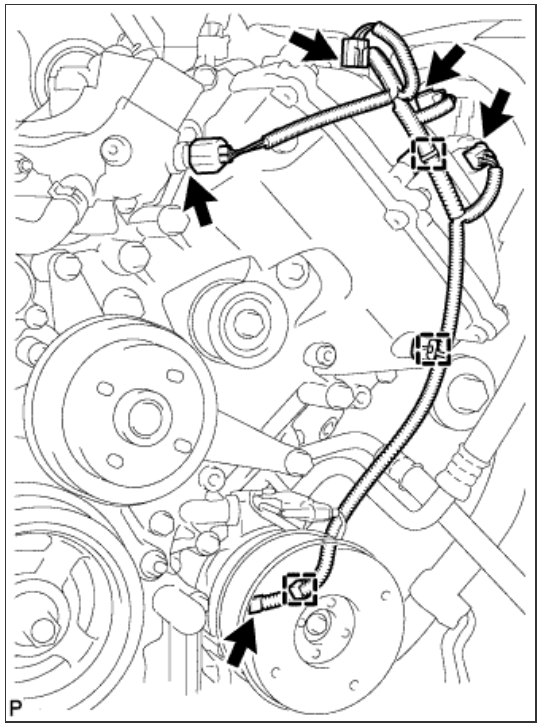
ix. Disconnect the engine coolant temperature sensor connector.

x. Disconnect the 2 camshaft timing oil control valve connectors.

xi. Disconnect the camshaft position sensor connector.

xii. Disconnect the 3 clamps.

xiii. Disconnect the cooler compressor connector.



b. Engine Room RH Side:

i. Disconnect the 2 camshaft timing oil control valve connectors.

ii. Disconnect the 4 ignition coil connectors.

iii. Disconnect the injector connector.

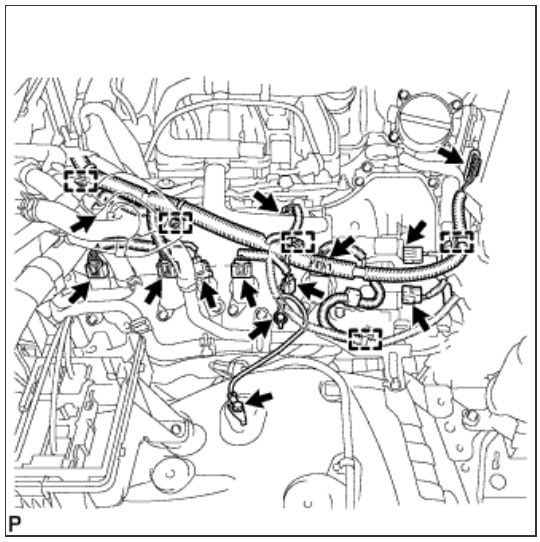
iv. Disconnect the 2 VVT sensor connectors.

v. Disconnect the noise filter connector.

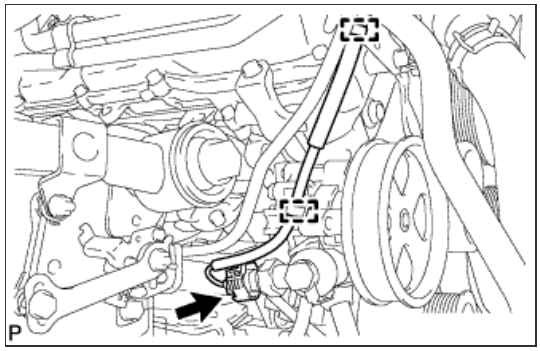
vi. Remove the 2 bolts and ground wire.

vii. Disconnect the throttle position sensor and throttle control motor connector.

viii. Disconnect the 5 clamps.



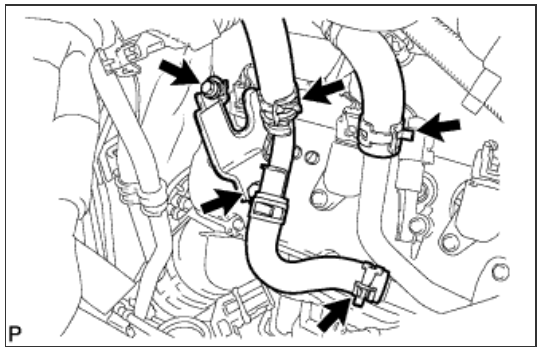
c. Disconnect the 2 clamps and power steering oil pressure switch connector.



22. DISCONNECT WATER PIPE AND HOSE SUB-ASSEMBLY

a. Disconnect the 3 hoses.

b. Remove the 2 bolts and disconnect the water pipe and hose from the cylinder head cover.

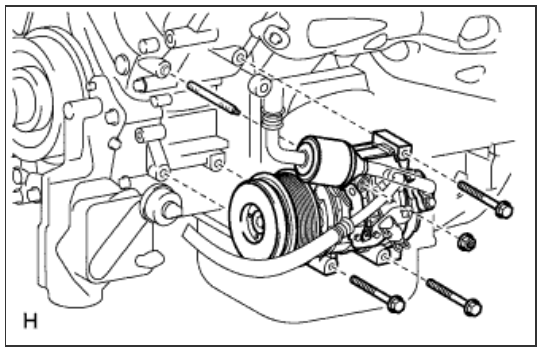


23. DISCONNECT COOLER COMPRESSOR ASSEMBLY

a. Remove the 3 bolts, nut and stud bolt, and disconnect the cooler compressor.

HINT:

It is not necessary to completely remove the compressor. With the hoses connected to the compressor, hang the compressor on the vehicle body with a rope.

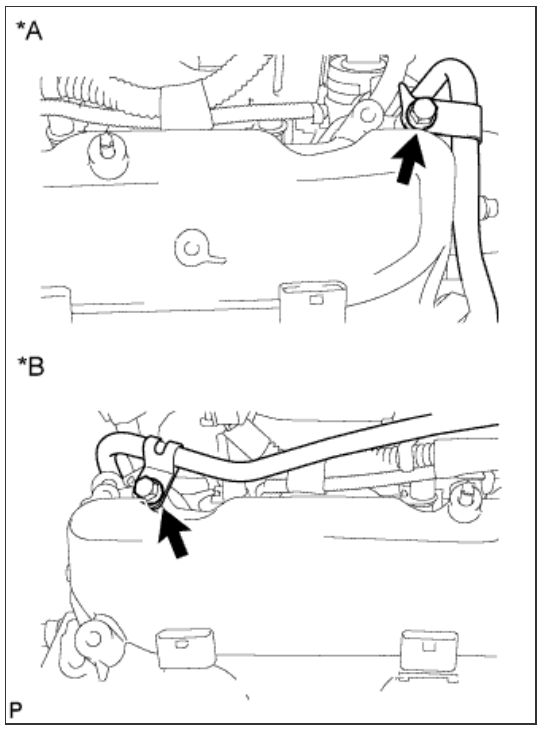


24. DISCONNECT NO. 2 FUEL TUBE SUB-ASSEMBLY

a. Remove the 2 bolts and disconnect the fuel tube.

Text in Illustration

*A	LH Side
*B	RH Side

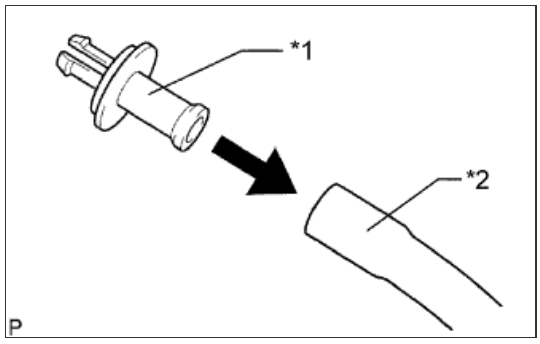


25. REMOVE OIL FILTER ELEMENT

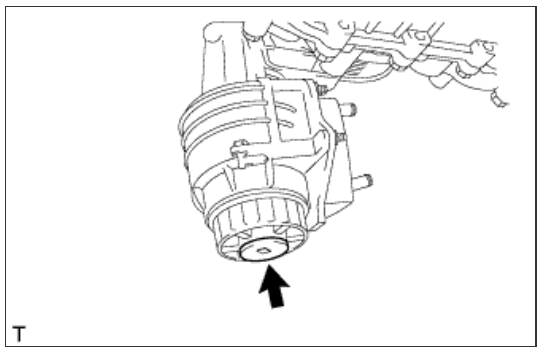
a. Connect a hose with an inside diameter of 15 mm (0.591 in.) to the pipe.

Text in Illustration

*1	Pipe
*2	Hose



b. Remove the oil filter drain plug.



c. Install the pipe to the oil filter cap.

Text in Illustration

*1	Cap
*2	Valve
*3	Pipe
*4	O-Ring

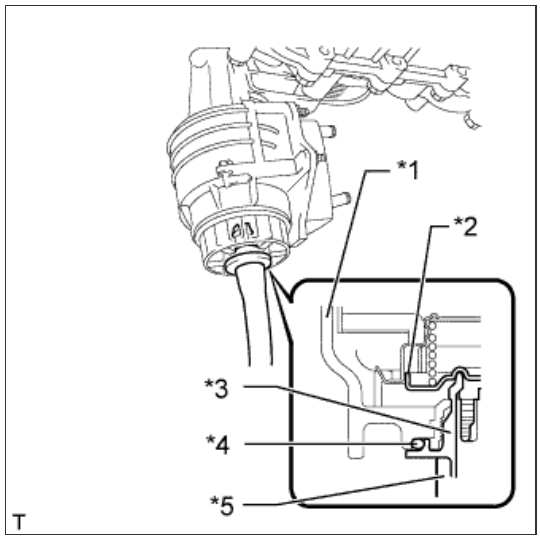
*5	Hose

NOTICE:

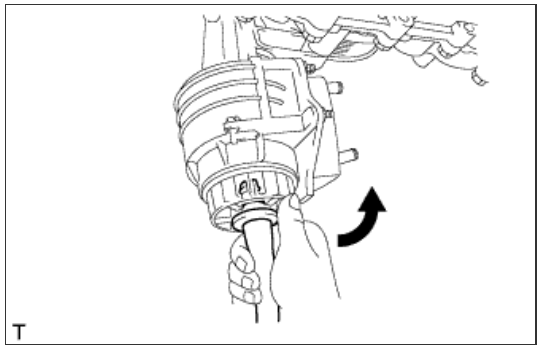
If the O-ring is removed with the drain plug, install the O-ring together with the pipe.

HINT:

Use a container to catch the draining oil.



d. Check that oil is drained from the oil filter. Then disconnect the pipe and remove the O-ring as shown in the illustration.



e. Using SST, remove the oil filter cap.

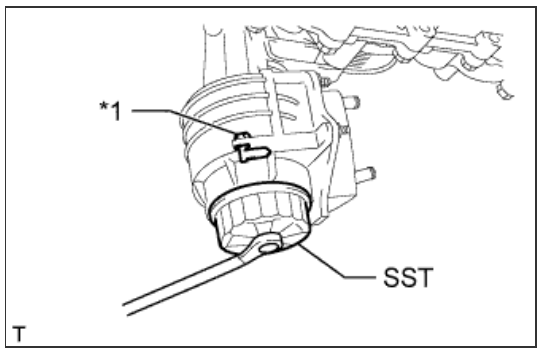
SST
09228-06501

Text in Illustration

*1	Oil Filter Bracket Clip

NOTICE:

Do not remove the oil filter bracket clip.



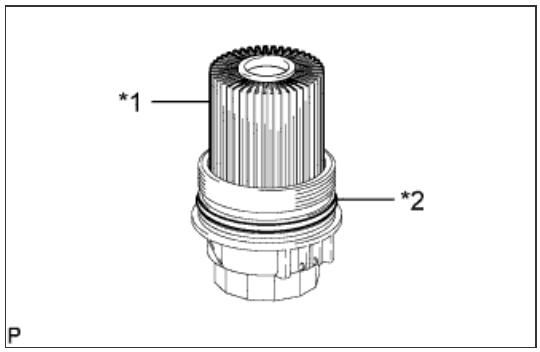
f. Remove the oil filter element and O-ring from the oil filter cap.

Text in Illustration

*1	Oil Filter Element
*2	O-Ring

NOTICE:

Be sure to remove the cap O-ring by hand, without using any tools, to prevent damage to the cap O-ring groove.



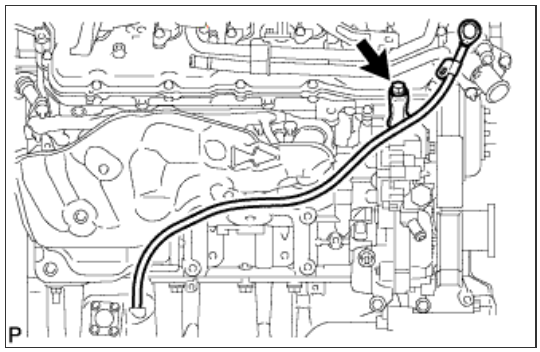
26. REMOVE ENGINE OIL LEVEL DIPSTICK GUIDE

a. Disconnect the wire harness clamp.

b. Remove the dipstick.

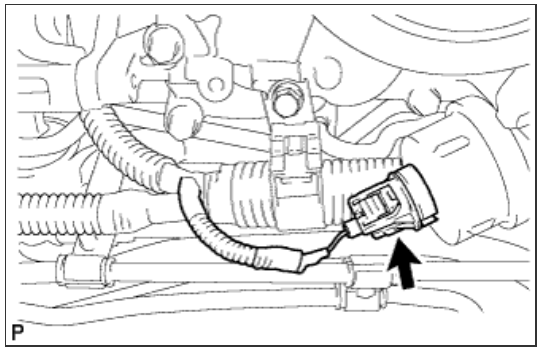
c. Remove the bolt and dipstick guide.

d. Remove the O-ring from the dipstick guide.

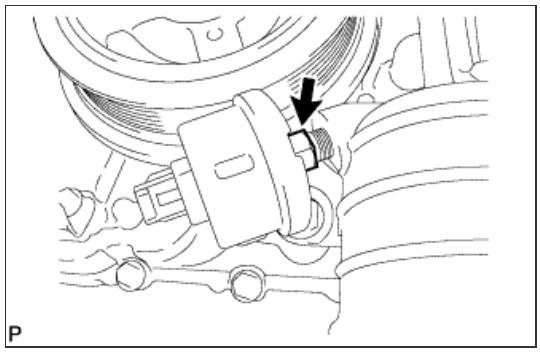


27. REMOVE OIL PRESSURE SENDER GAUGE ASSEMBLY

a. Disconnect the sender gauge connector.



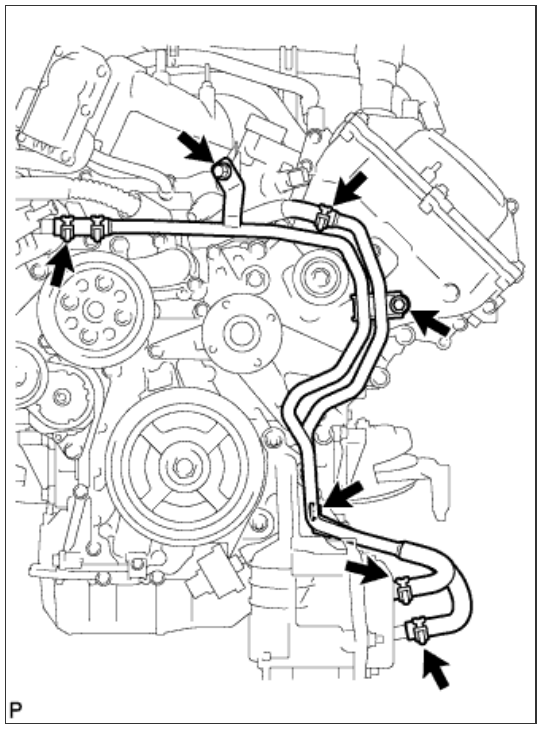
b. Remove the oil pressure sender gauge.



28. REMOVE NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY

a. Remove the 3 bolts.

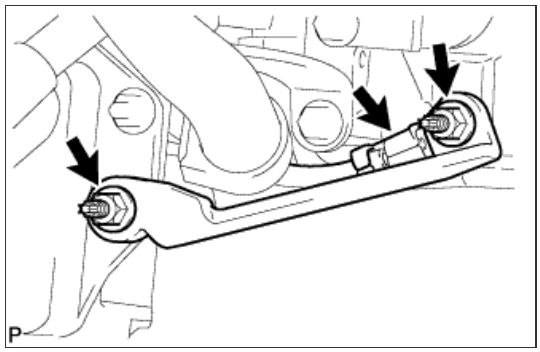
b. Disconnect the 4 hoses and remove the water by-pass pipe.



29. REMOVE NO. 1 OIL COOLER BRACKET

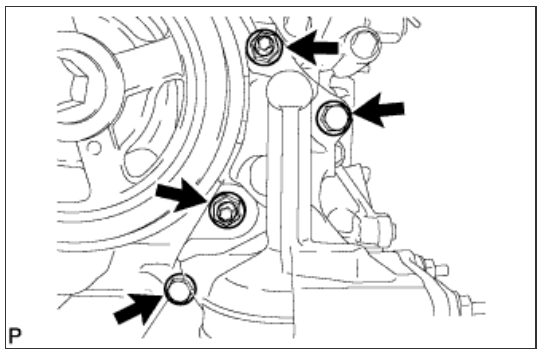
a. Remove the 2 nuts and bracket.

b. Disconnect the ground wire from the cylinder block.

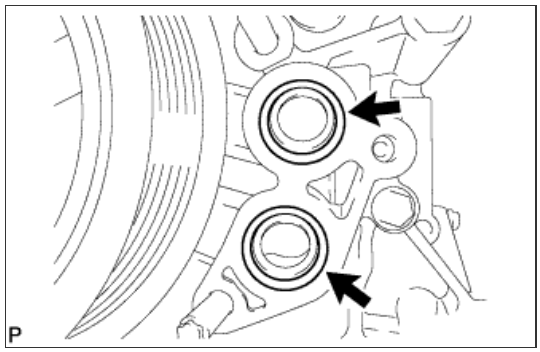


30. REMOVE OIL FILTER BRACKET

a. Remove the 2 bolts, 2 nuts and filter bracket.

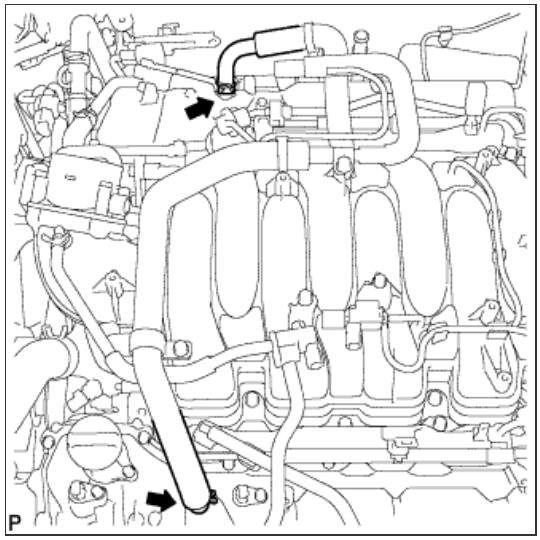


b. Remove the 2 O-rings.



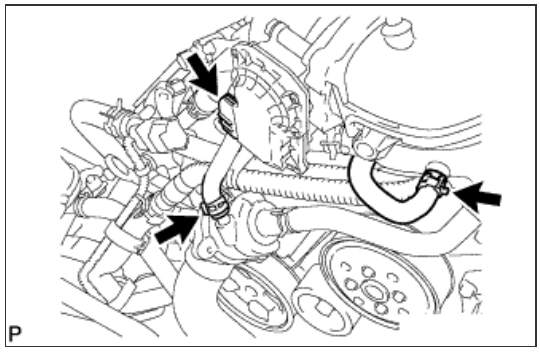
31. REMOVE INTAKE MANIFOLD

a. Disconnect the ventilation hose from the ventilation pipe of the cylinder head cover LH and RH.

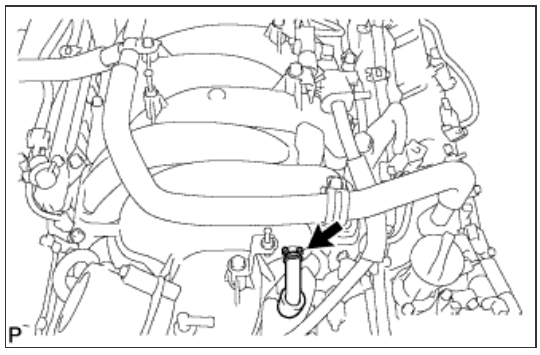


b. Disconnect the 2 water by-pass hoses.

c. Disconnect the throttle body connector.



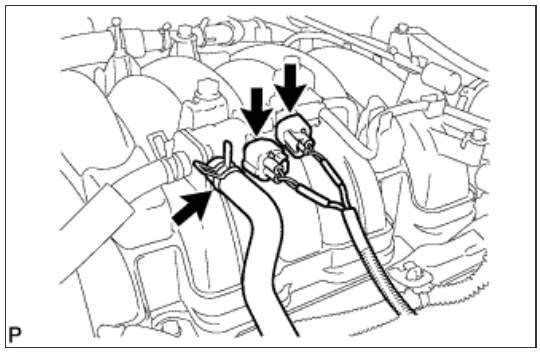
d. Disconnect the No. 1 ventilation hose.



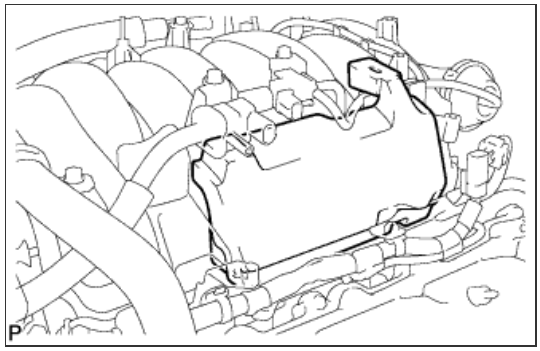
e. Disconnect the purge VSV connector.

f. Disconnect the purge line hose from the purge VSV.

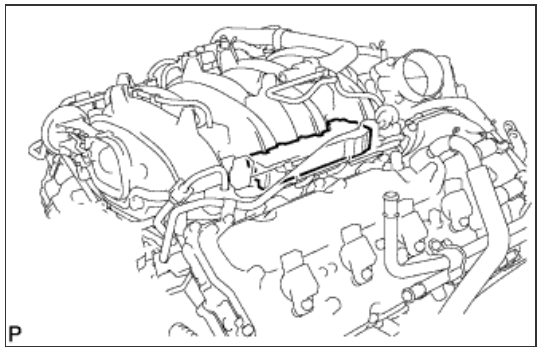
g. Disconnect the vacuum switching valve connector (for ACIS).



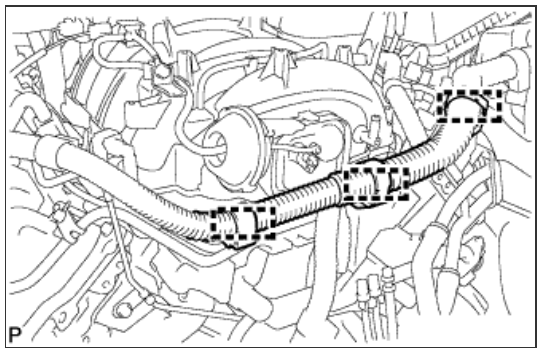
h. Remove the No. 1 engine cover sub-assembly.



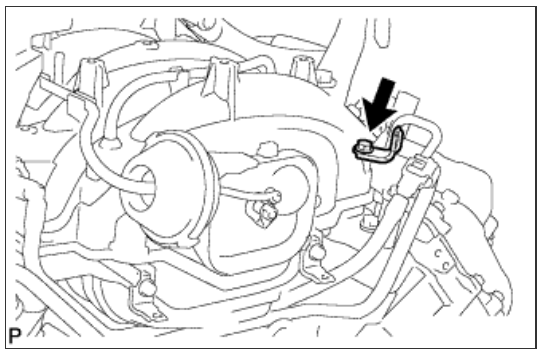
i. Remove the No. 3 engine cover.



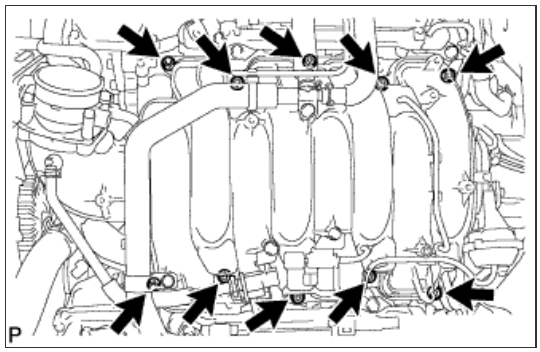
j. Disconnect the 3 wire clamps from the 3 wire brackets.



k. Remove the bolt and wire bracket from the intake manifold.

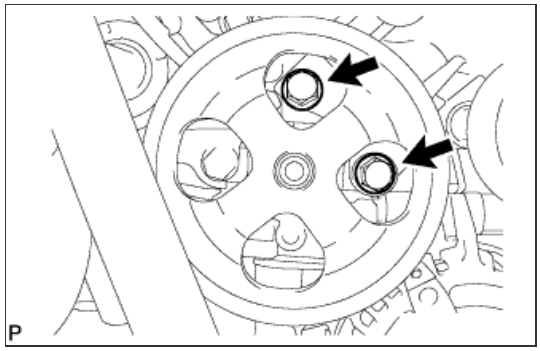


l. Remove the 2 nuts, 8 bolts, intake manifold and 2 gaskets.



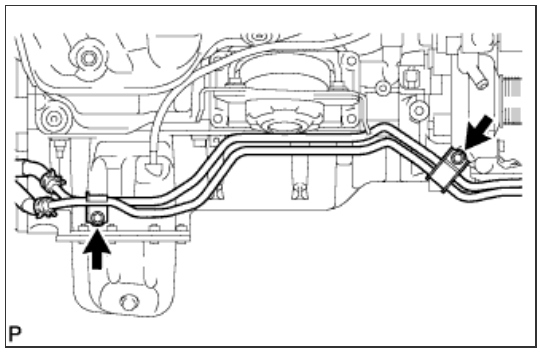
32. DISCONNECT VANE PUMP ASSEMBLY

a. Remove the 2 bolts and disconnect the vane pump.



33. DISCONNECT OIL COOLER PIPE ASSEMBLY

a. Remove the 2 bolts and disconnect the oil cooler pipe.

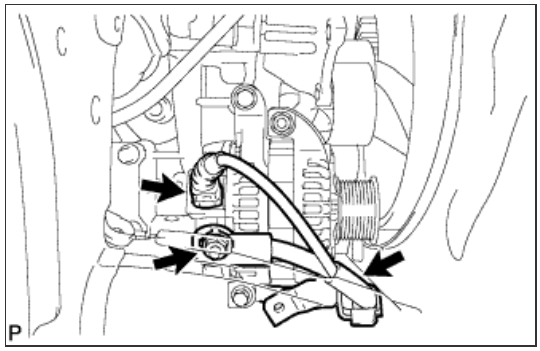


34. REMOVE GENERATOR ASSEMBLY

a. Disconnect the generator connector.

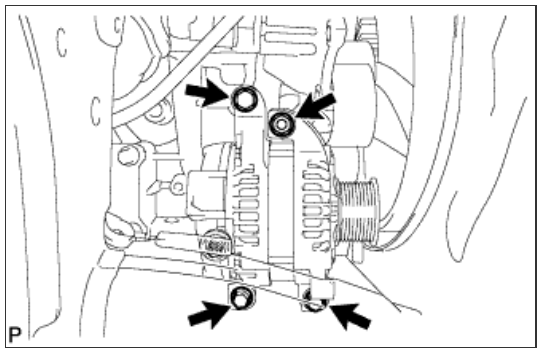
b. Remove the terminal cap and nut, and disconnect the generator wire.

c. Remove the bolt and wire harness bracket from the generator.



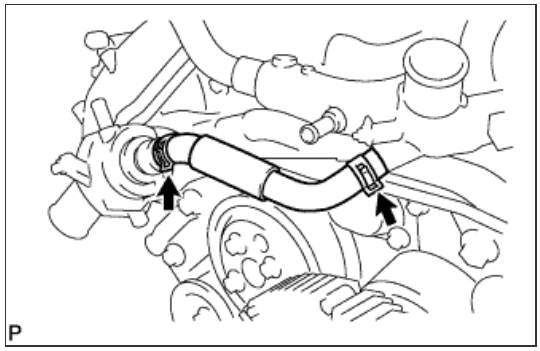
d. Remove the 3 bolts, nut and generator.

e. Remove the stud bolt.



35. REMOVE NO. 1 WATER BY-PASS HOSE

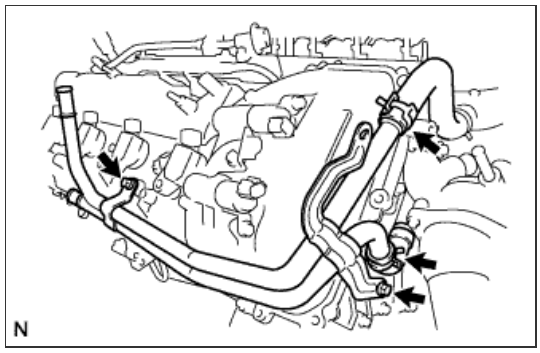
a. Remove the No. 1 water by-pass hose by disconnecting the hose from the water inlet housing and front water by-pass joint.



36. REMOVE WATER BY-PASS PIPE SUB-ASSEMBLY

a. Disconnect the 2 hoses.

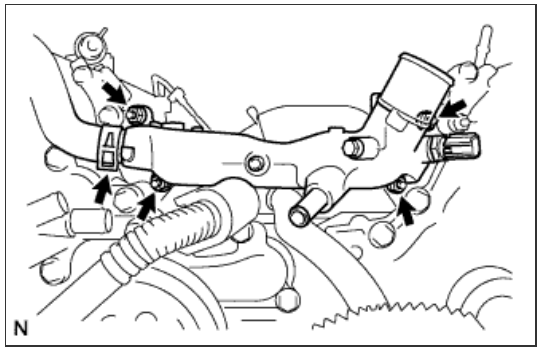
b. Remove the 2 bolts and water by-pass pipe.



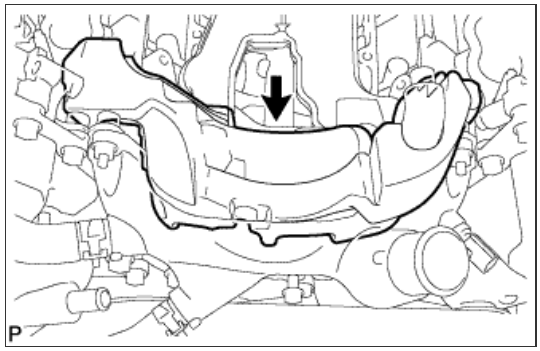
37. REMOVE FRONT WATER BY-PASS JOINT

a. Disconnect the No. 2 water by-pass hose from the water by-pass joint.

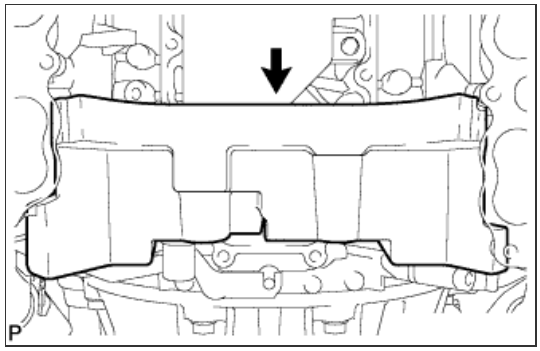
b. Remove the 4 nuts, water by-pass joint and 2 gaskets.



38. REMOVE NO. 2 ENGINE COVER

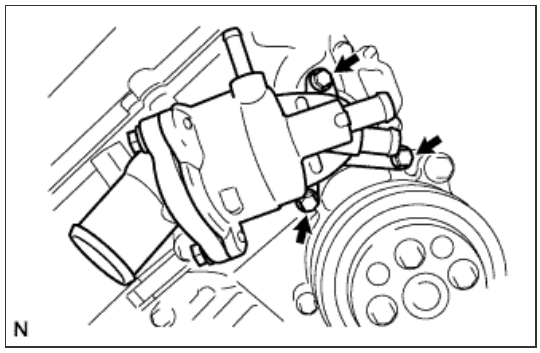


39. REMOVE NO. 1 ENGINE COVER



40. REMOVE WATER INLET HOUSING

a. Remove the 3 bolts, water inlet housing and gasket.

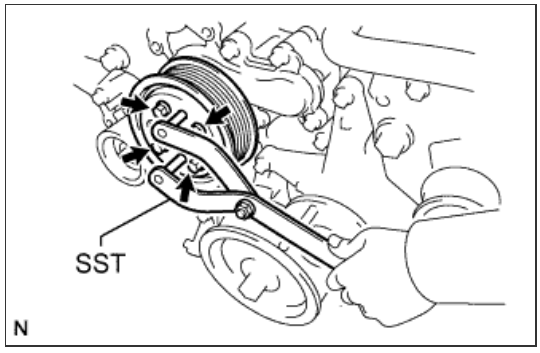


41. REMOVE WATER PUMP PULLEY

a. Using SST, hold the water pump pulley.

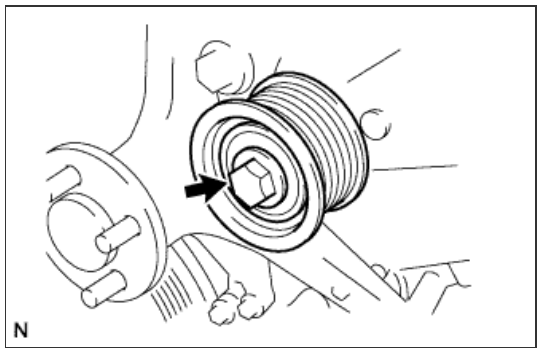
SST
09960-10010 09962-01000, 09963-01000)

b. Remove the 4 bolts and water pump pulley.



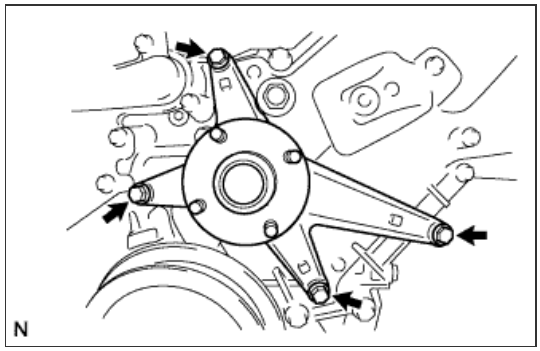
42. REMOVE NO. 1 IDLER PULLEY SUB-ASSEMBLY

a. Remove the bolt and idler pulley.



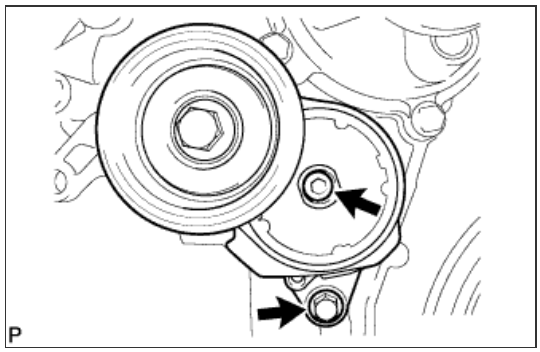
43. REMOVE FLUID COUPLING BRACKET

a. Remove the 4 bolts and fluid coupling bracket.



44. REMOVE V-RIBBED BELT TENSIONER ASSEMBLY

a. Remove the standard bolt, 6 mm he agon wrench bolt and belt tensioner.



45. REMOVE IGNITION COIL ASSEMBLY

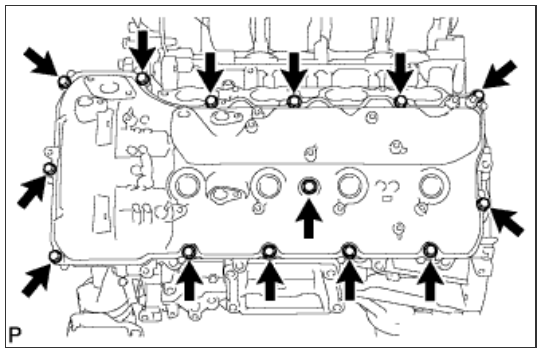
a. Remove the 8 bolts and 8 ignition coils.

46. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY LH

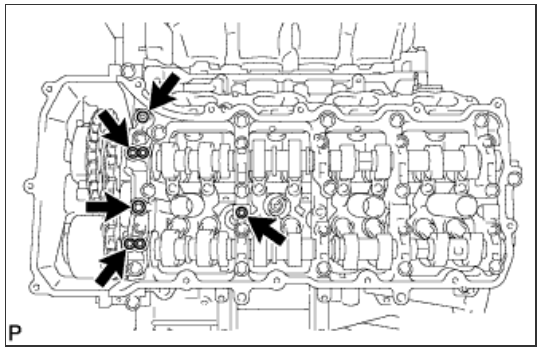
a. Remove the 14 bolts, seal washer, cylinder head cover and gasket.

HINT:

Make sure the removed parts are returned to the same places they were removed from.

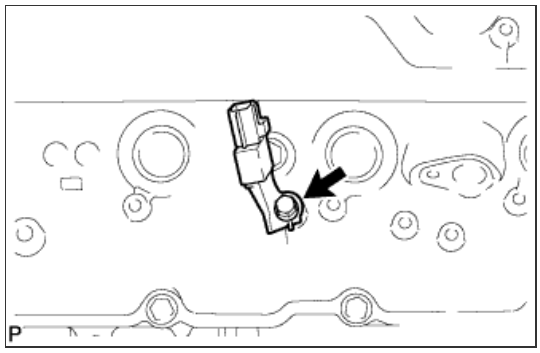


b. Remove the 5 gaskets from the camshaft bearing caps (No. 2, No. 3).



47. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY RH

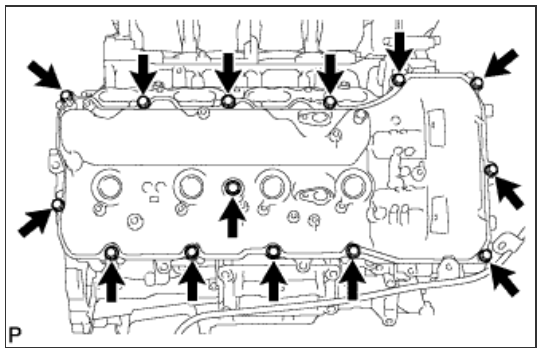
a. Remove the bolt and noise filter.



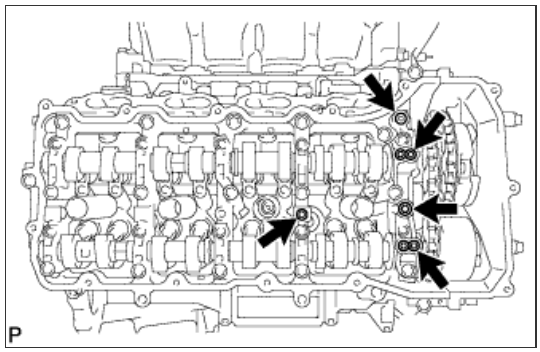
b. Remove the 14 bolts, seal washer, cylinder head cover and gasket.

HINT:

Make sure the removed parts are returned to the same places they were removed from.



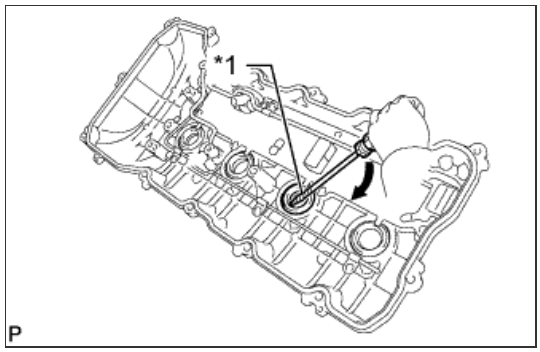
c. Remove the 5 gaskets from the camshaft bearing caps (No. 1, No. 3).



48. REMOVE SPARK PLUG TUBE GASKET

a. Bend the 4 ventilation baffle plate claws on the cylinder head cover to an angle of 90° or more.

b. Using a screwdriver, pry out the gaskets.



Text in Illustration

*1	Tape
➡	Pry

NOTICE:

- **Be careful not to damage the cylinder head cover.**
- **Be careful not to damage the gasket when removing it, as the removed gasket needs to be used when installing a new one.**

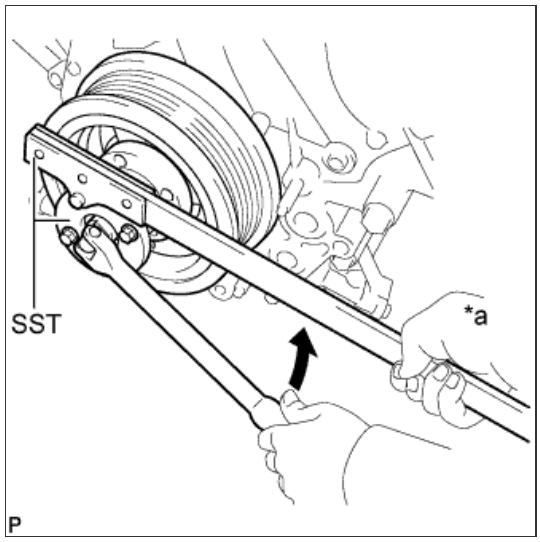
HINT:

Tape the screwdriver tip before use.

49. REMOVE CRANKSHAFT PULLEY

a. Using SST, loosen the crankshaft pulley set bolt until 2 or 3 threads are engaged.

SST
09213-70011
09330-00021



Text in Illustration

*a	Hold
➡	Turn

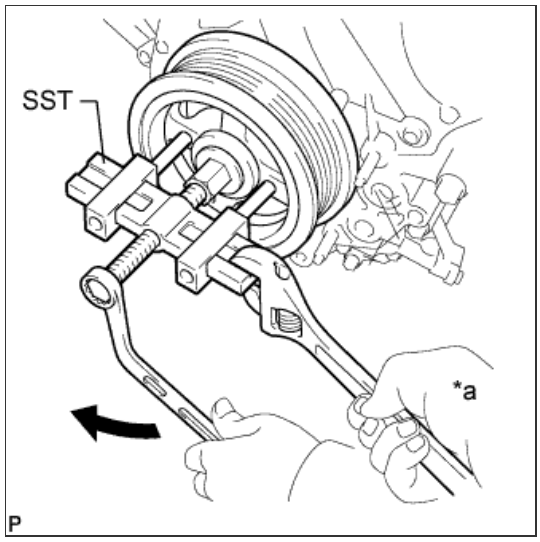
b. Using the pulley set bolt and SST, remove the crankshaft pulley.

SST
09950-50013 09951-05010, 09952-05010, 09953-05010, 09954-05011)

Text in Illustration

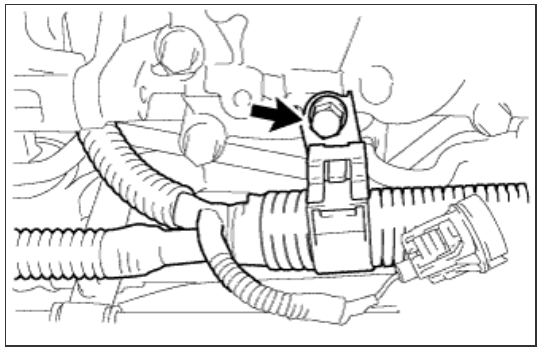
*a	Hold

➡	Turn



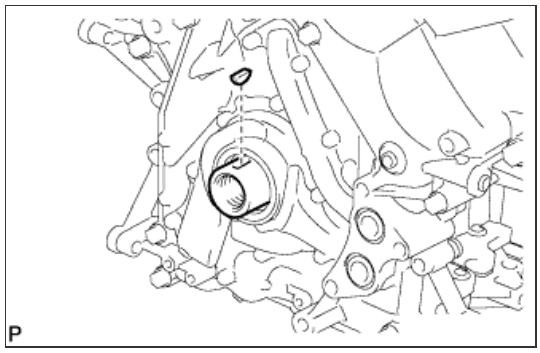
50. DISCONNECT WIRE HARNESS CLAMP BRACKET

a. Remove the bolt and disconnect the bracket.



51. REMOVE CRANKSHAFT TIMING GEAR KEY

a. Using a screwdriver, remove the timing gear key from the crankshaft.

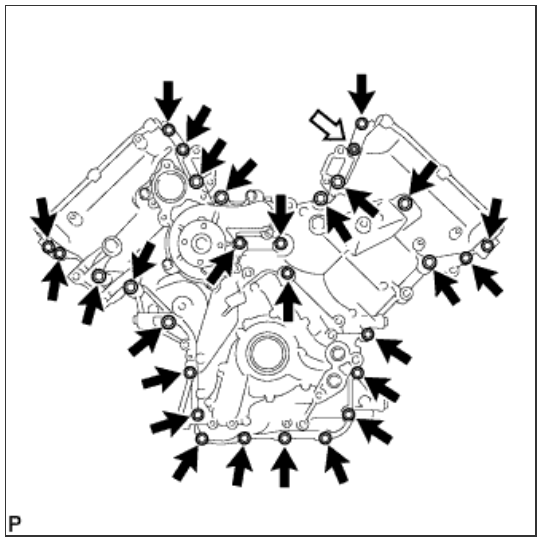


52. REMOVE TIMING CHAIN COVER SUB-ASSEMBLY

a. Remove the 28 bolts and nut shown in the illustration.

Text in Illustration

➡	Bolt
⇨	Nut



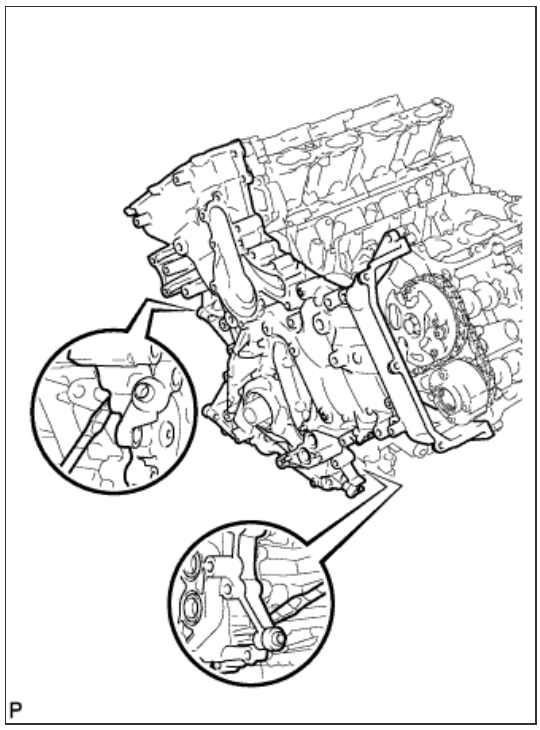
b. Remove the timing chain cover by prying between the timing chain cover and cylinder head or cylinder block with a screwdriver as shown in the illustration.

NOTICE:

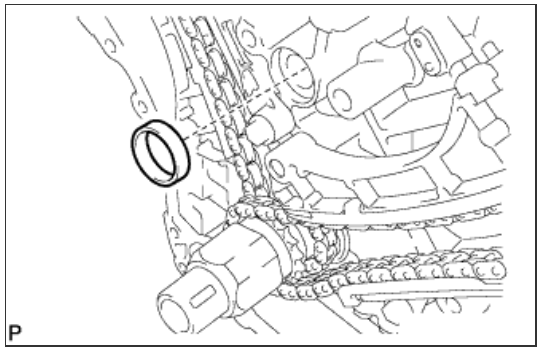
Be careful not to damage the contact surfaces of the cylinder head, cylinder block and chain cover.

HINT:

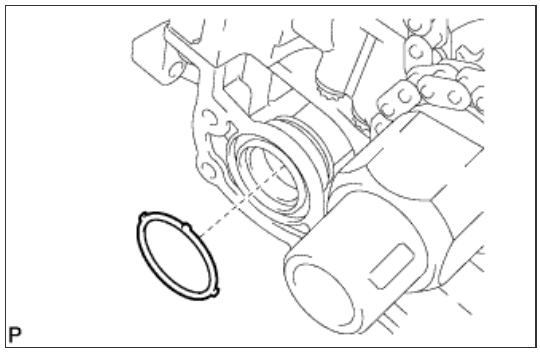
Tape the screwdriver tip before use.



c. Remove the oil pump gasket from the cylinder block.



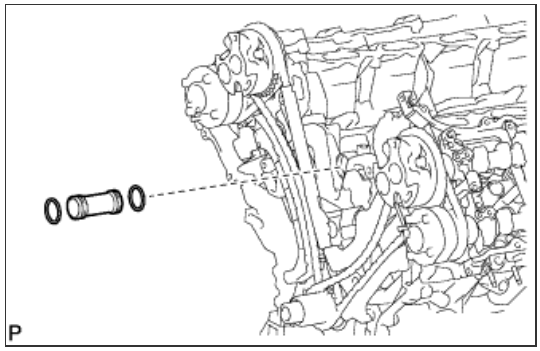
d. Remove the O-ring from the oil pan.



53. REMOVE WATER INLET PIPE

a. Remove the water inlet pipe.

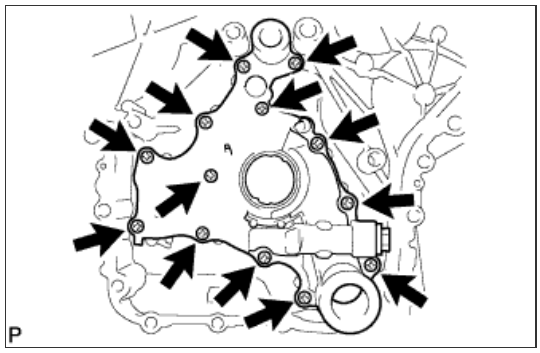
b. Remove the 2 O-rings from the water inlet pipe.



for Preparation Click here

1. REMOVE OIL PUMP COVER

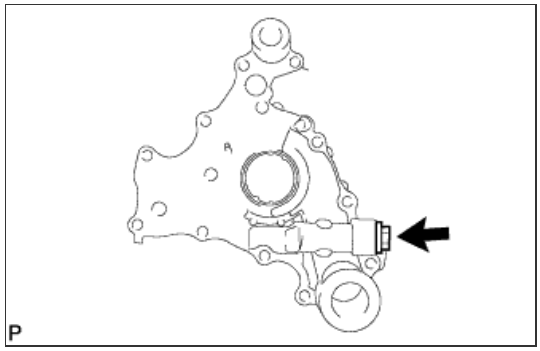
a. Remove the 13 bolts, oil pump cover, drive rotor and driven rotor.



2. REMOVE OIL PUMP RELIEF VALVE

a. Remove the relief valve plug.

b. Remove the valve spring and oil pump relief valve.

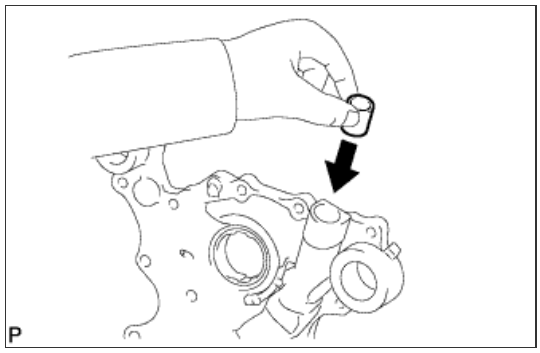


for Preparation Click here

1. INSPECT OIL PUMP RELIEF VALVE

a. Coat the relief valve with engine oil.

b. Check that the relief valve falls smoothly into the valve hole by its own weight. If the relief valve does not fall smoothly, replace it. If necessary, replace the timing chain cover sub-assembly.

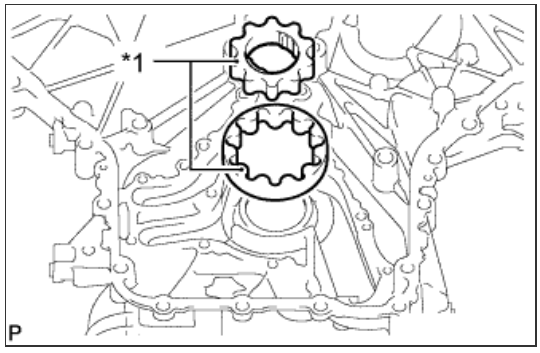


2. INSPECT OIL PUMP ROTOR SET

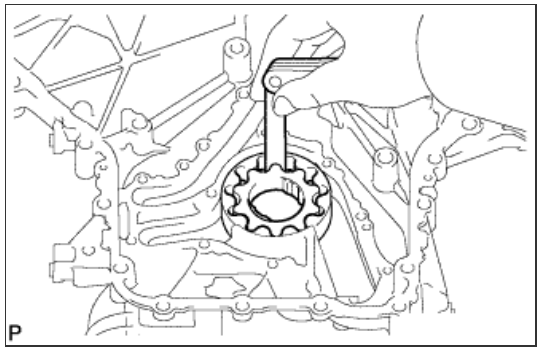
a. Install the rotors to the timing chain cover with the marks of the rotors facing outward. Check that the rotors revolve smoothly.

Text in Illustration

*1	Matchmark



b. Check the tip clearance.



i. Using a feeler gauge, measure the clearance between the drive and driven rotor tips, as shown in the illustration.

Standard tip clearance:
0.180 to 0.300 mm (0.00709 to 0.0118 in.)

Maximum tip clearance:
0.300 mm (0.0118 in.)

If the tip clearance is more than the maximum, replace the drive and driven rotors together.

c. Check the side clearance.

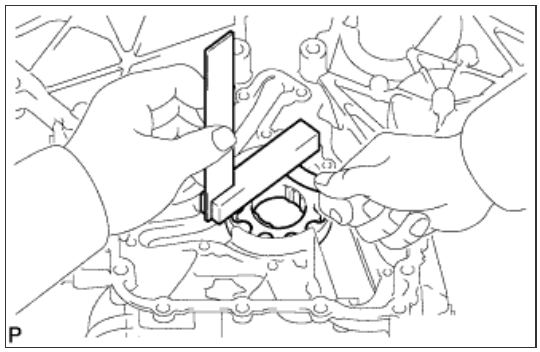
i. Using a feeler gauge and steel square, measure the clearance between the rotors and steel square as shown in the illustration.

Standard side clearance:
0.030 to 0.090 mm (0.00118 to 0.00354 in.)

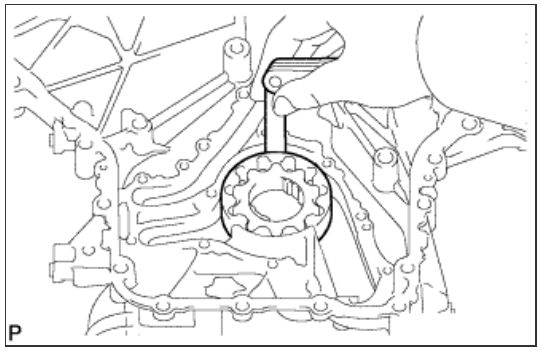
Maximum side clearance:
0.090 mm (0.00354 in.)

If the side clearance is more than the maximum, replace the timing

chain cover sub-assembly.



d. Check the body clearance.



i. Using a feeler gauge, measure the clearance between the timing chain cover and driven rotor as shown in the illustration.

Standard body clearance:
0.175 to 0.250 mm (0.00689 to 0.00984 in.)

Maximum body clearance:
0.250 mm (0.00984 in.)

If the body clearance is more than the maximum, replace the timing chain cover sub-assembly.

for Preparation Click here

1. INSTALL OIL PUMP RELIEF VALVE

a. Coat the oil pump relief valve with engine oil.

b. Install the relief valve and relief valve spring into the oil pump cover hole.

c. Install the plug.

Torque:
53 N*m{ 540 kgf*cm , 39 ft.*lbf }

2. INSTALL OIL PUMP COVER

a. Install the driven rotor, drive rotor and oil pump cover with the 13 bolts.

Torque:
10 N*m{ 105 kgf*cm , 8 ft.*lbf }

for Preparation Click here

1. INSTALL WATER INLET PIPE

a. Apply soapy water to 2 new O-rings and install them to the inlet pipe.

b. Install the inlet pipe to the No. 1 heat exchanger cover.

2. INSTALL TIMING CHAIN COVER SUB-ASSEMBLY

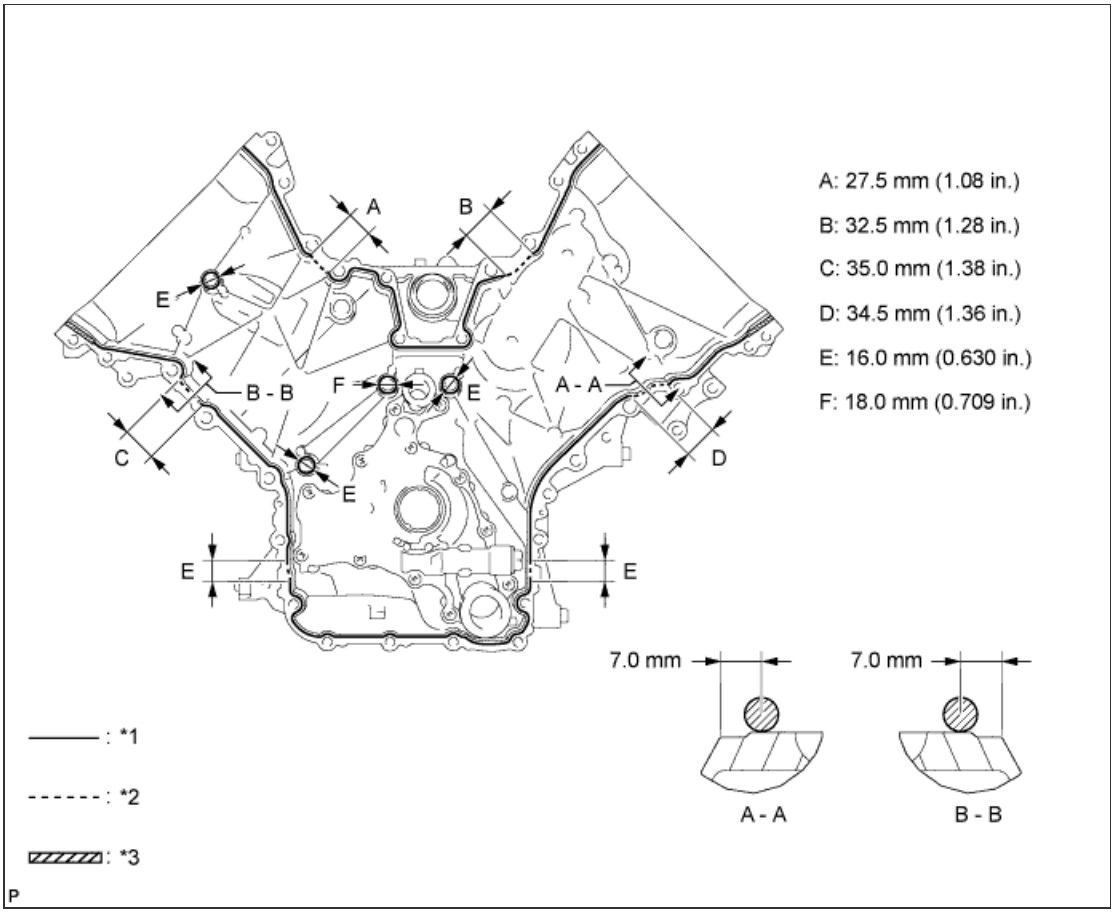
a. Apply a light coat of engine oil to a new oil pump gasket.

b. Install the oil pump gasket.

c. Apply a light coat of engine oil to a new O-ring.

d. Install the O-ring.

e. Apply seal packing in a continuous line to the timing chain cover as shown in the following illustration.



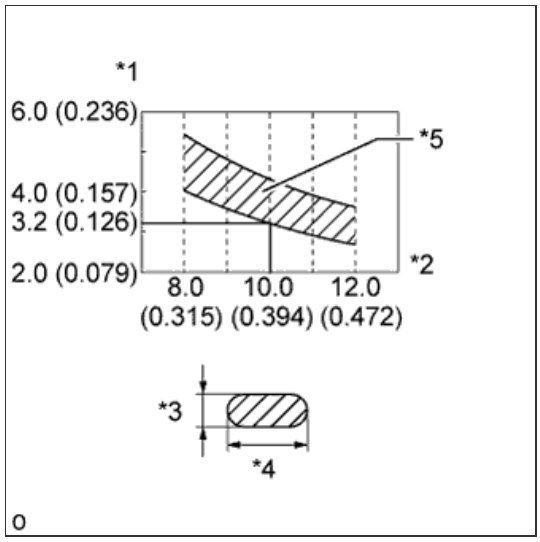
Text in Illustration

*1	Continuous line area	*2	Dashed line area
*3	Diagonal line area	-	-

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Apply Seal Packing as Follows:

Area	Seal Packing Diameter	Application Position from Inside Edge of Cover
Continuous Line Area	3.0 to 4.0 mm (0.118 to 0.157 in.)	2.5 mm (0.0984 in.)
Dashed Line Area	6.4 mm (0.252 in.) or more, or within OK area shown in illustration	7.0 mm (0.276 in.)
Diagonal Line Area	3.0 to 4.0 mm (0.118 to 0.157 in.)	5.5 mm (0.217 in.)



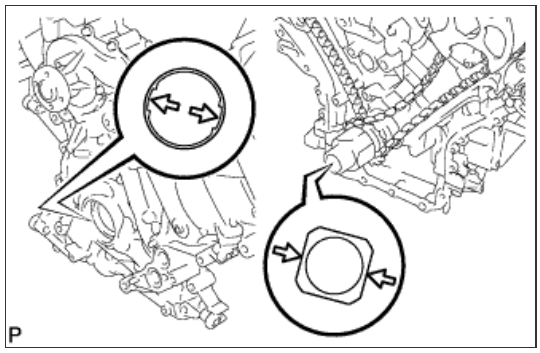
Text in Illustration

*1	Seal Packing Thickness mm (in.)
*2	Seal Packing Width mm (in.)
*3	Seal Packing Thickness
*4	Seal Packing Width
*5	OK Area

NOTICE:

- **When the contact surfaces are wet, wipe them with an oil-free cloth before applying seal packing.**
- **Install the chain cover within 3 minutes and tighten the bolts within 10 minutes after applying seal packing.**

f. Align the oil pump drive rotor spline and crankshaft as shown in the illustration. Install the spline and chain cover to the crankshaft.



g. Temporarily install the timing chain cover with the 28 bolts and nut.

Standard Bolt:

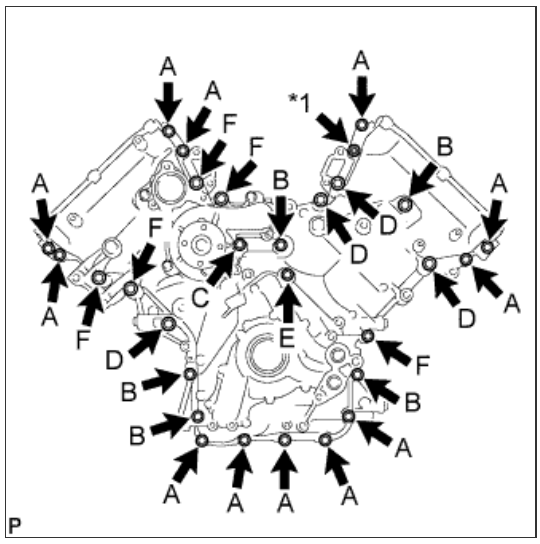
Item	Length	Thread Diameter
Bolt A	25 mm (0.984 in.)	8 mm (0.315 in.)
Bolt B	55 mm (2.17 in.)	8 mm (0.315 in.)
Bolt C	70 mm (2.76 in.)	8 mm (0.315 in.)
Bolt D	35 mm (1.38 in.)	10 mm (0.394 in.)
Bolt E	55 mm (2.17 in.)	10 mm (0.394 in.)
Bolt F	80 mm (3.15 in.)	10 mm (0.394 in.)

Text in Illustration

*1	Nut

NOTICE:

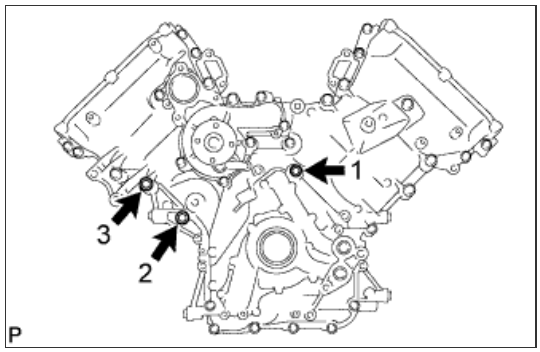
Make sure that there is no oil on the bolt threads.



h. Tighten the 3 bolts in several steps in the sequence shown in the illustration.

Torque:

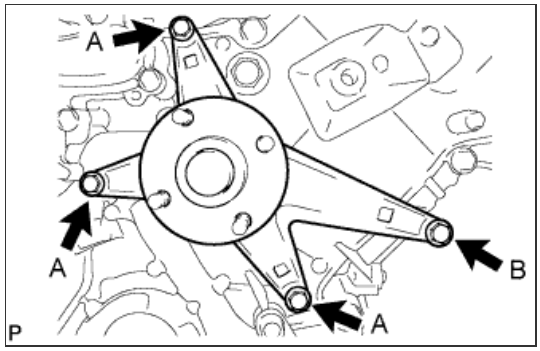
47 N*m{ 479 kgf*cm , 35 ft.*lbf }



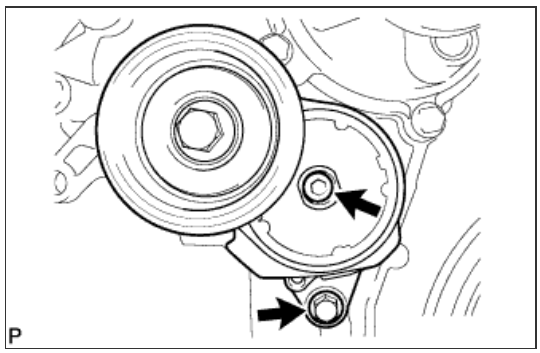
i. Temporarily install the fluid coupling bracket with the 4 bolts.

Standard Bolt:

Item	Length	Thread Diameter
Bolt A	70 mm (2.76 in.)	8 mm (0.315 in.)
Bolt B	80 mm (3.15 in.)	10 mm (0.394 in.)

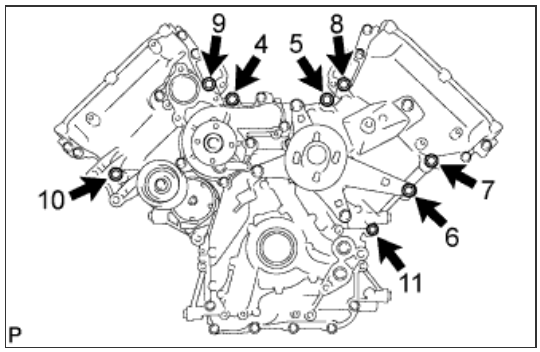


j. Temporarily install the belt tensioner with the standard bolt and 6 mm hexagon wrench bolt.



k. Tighten the 8 bolts labeled 4 to 11 in several steps in the sequence shown in the illustration.

Torque:
47 N*m{ 479 kgf*cm , 35 ft.*lbf }

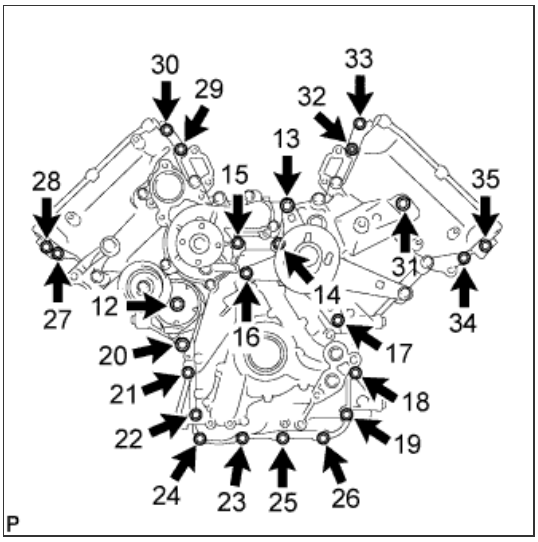


l. Tighten the 23 bolts and nut labeled 12 to 35 in several steps in the sequence shown in the illustration.

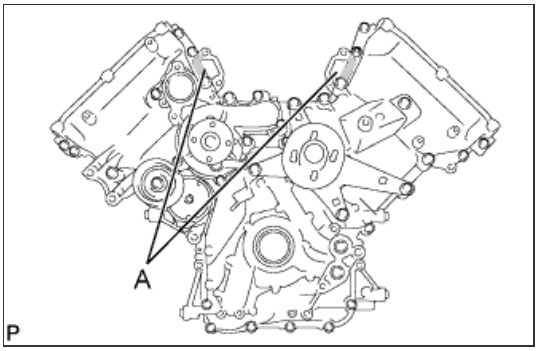
Torque:
23 N*m{ 235 kgf*cm , 17 ft.*lbf }

NOTICE:

- **Do not start the engine for at least 2 hours after installing.**



- **After the installation, if the seal packing has seeped out at the areas labeled A shown in the illustration, wipe it off.**

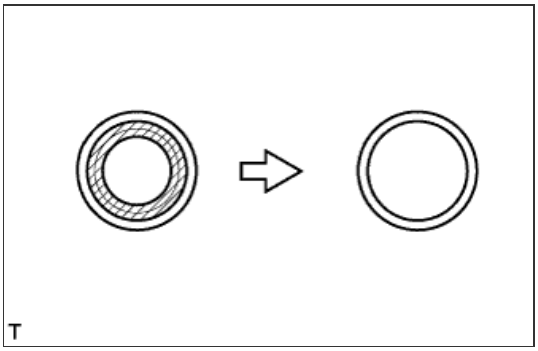


3. INSTALL SPARK PLUG TUBE GASKET

a. Using a cutter knife, cut off the seal part of the removed gasket.

Text in Illustration

	Area to cut off



b. Using the removed gasket and a hammer, tap in a new gasket until it stops.

Text in Illustration

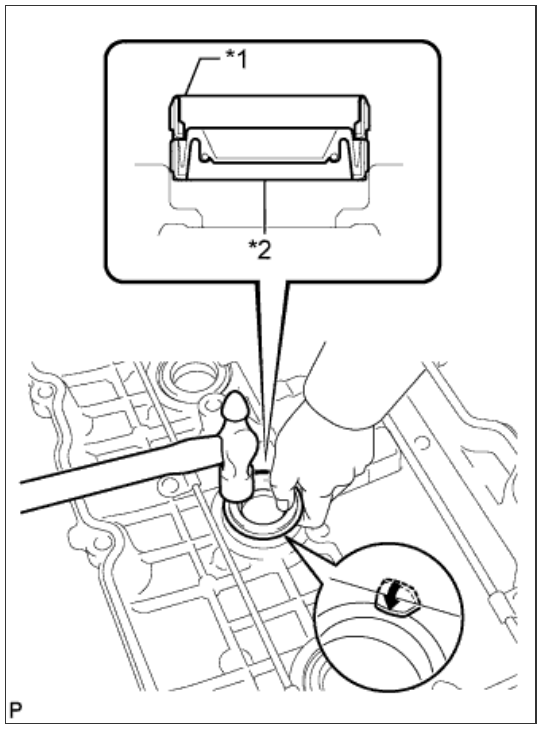
*1	Removed Gasket
*2	New Gasket

HINT:

If the removed gasket does not fit on the new one, correct the removed one with pliers.

c. Apply a light coat of MP grease to the lip of the gasket.

d. Return the 4 ventilation baffle plate claws to the original positions.



4. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY LH

a. Install 5 new gaskets to the camshaft bearing caps (No. 2, No. 3).

b. Install a new gasket to the cylinder head cover.

NOTICE:

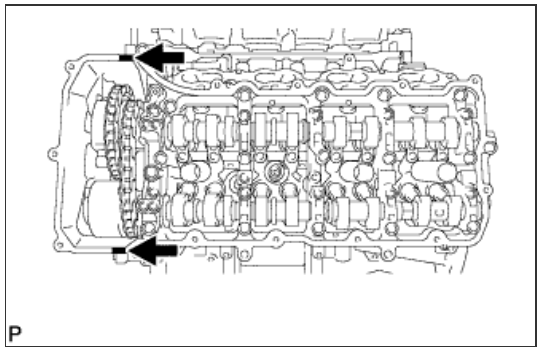
Remove any oil from the contact surface.

c. Apply seal packing as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Text in Illustration

➡	Seal Packing

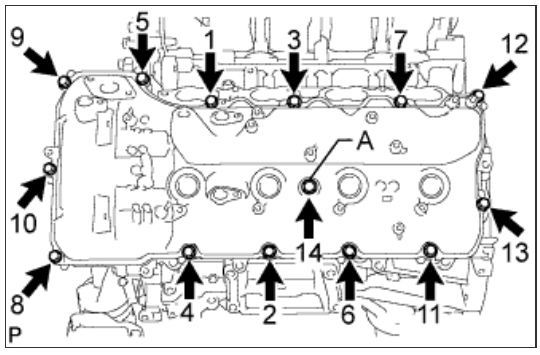


NOTICE:

- **Remove any oil from the contact surface.**
- **Install the cylinder head cover within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**

d. Install the cylinder head cover and a new seal washer with the 14 bolts in the order shown in the illustration.

Torque:
for bolt A:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
except bolt A:
12 N*m{ 122 kgf*cm , 9 ft.*lbf }



NOTICE:

Do not start the engine for at least 2 hours after the installation.

5. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY RH

a. Install 5 new gaskets to the camshaft bearing caps. (No. 1, No. 3).

b. Install a new gasket to the cylinder head cover.

NOTICE:

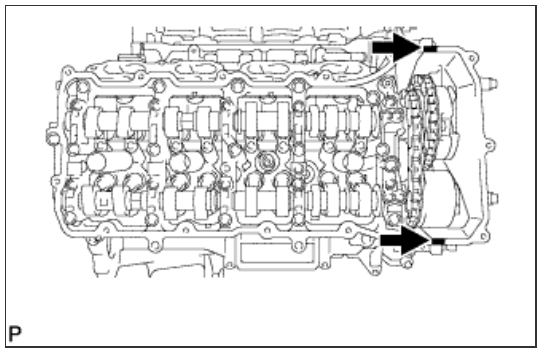
Remove any oil from the contact surface.

c. Apply seal packing as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Text in Illustration

➡	Seal Packing

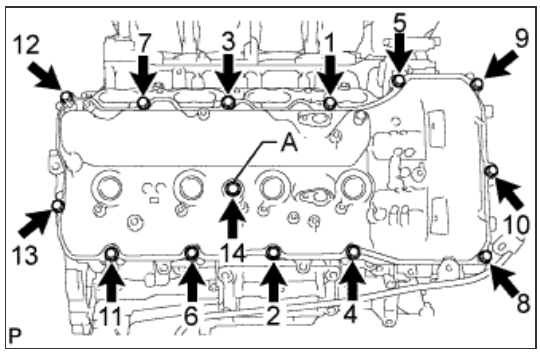


NOTICE:

- **Remove any oil from the contact surface.**
- **Install the cylinder head cover within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**

d. Install the cylinder head cover and a new seal washer with the 14 bolts in the order shown in the illustration.

Torque:
for bolt A:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
except bolt A:
12 N*m{ 122 kgf*cm , 9 ft.*lbf }



NOTICE:

Do not start the engine for at least 2 hours after the installation.

e. Install the noise filter to the cylinder head cover with the bolt.

Torque:
7.0 N*m{ 71 kgf*cm , 2 in.*lbf }

. INSTALL IGNITION COIL ASSEMBLY

a. Install the 8 ignition coils with the 8 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

7. INSTALL CRANKSHAFT TIMING GEAR KEY

a. Install the crankshaft timing gear key to the crankshaft.

8. CONNECT WIRE HARNESS CLAMP BRACKET

a. Connect the bracket to the timing chain cover with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

9. INSTALL CRANKSHAFT PULLEY

a. Align the pulley set key with the key groove of the pulley, and slide on the pulley.

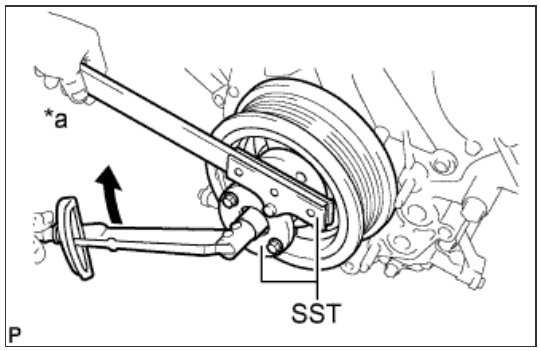
b. Using SST, install the pulley set bolt.

SST
09213-70011
09330-00021

Torque:
300 N*m{ 3059 kgf*cm , 221 ft.*lbf }

Text in Illustration

*a	Hold
➡	Turn



10. INSTALL NO. 1 IDLER PULLEY SUB-ASSEMBLY

a. Install the idler pulley with the bolt.

Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }

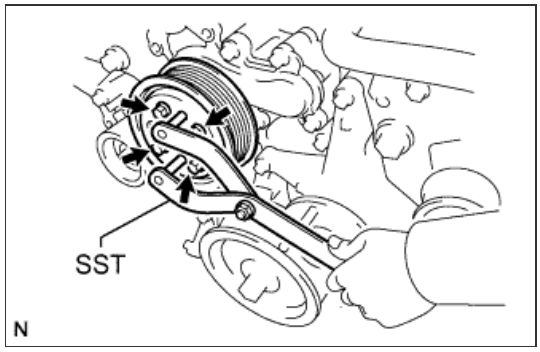
11. INSTALL WATER PUMP PULLEY

a. Temporarily install the pulley with the 4 bolts.

b. Using SST, hold the pulley and tighten the 4 bolts.

SST
09960-10010 (09962-01000, 09963-01000)

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



12. INSTALL WATER INLET HOUSING

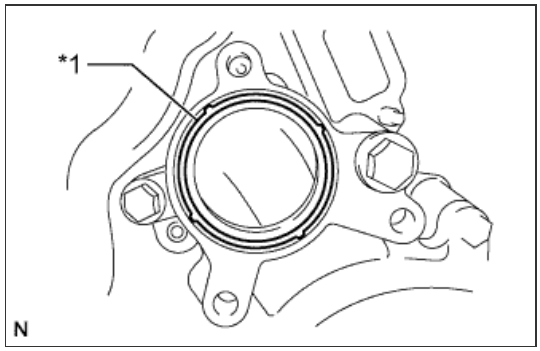
a. Install a new gasket to the timing chain cover.

b. Install the water inlet with the 3 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

Text in Illustration

*1	Gasket



13. INSTALL NO. 1 ENGINE COVER

14. INSTALL NO. 2 ENGINE COVER

15. INSTALL FRONT WATER BY-PASS JOINT

a. Install 2 new gaskets and the water by-pass joint with the 4 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

b. Connect the No. 2 water by-pass hose to the water by-pass joint.

16. INSTALL WATER BY-PASS PIPE SUB-ASSEMBLY

a. Connect the 2 hoses.

b. Install the water by-pass pipe with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

17. INSTALL NO. 1 WATER BY-PASS HOSE

a. Install the No. 1 water by-pass hose by connecting the hose to the water inlet housing and front water by-pass joint.

18. INSTALL GENERATOR ASSEMBLY

a. Install the stud bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Install the generator with the 3 bolts and nut.

Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }

c. Connect the generator connector.

d. Connect the generator wire with the nut.

Torque:
12 N*m{ 122 kgf*cm , 9 ft.*lbf }

e. Install the terminal cap.

f. Install the harness bracket to the generator with the bolt.

Torque:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

19. CONNECT OIL COOLER PIPE ASSEMBLY

a. Connect the oil cooler pipe with the 2 bolts.

Torque:
14 N*m{ 143 kgf*cm , 10 ft.*lbf }

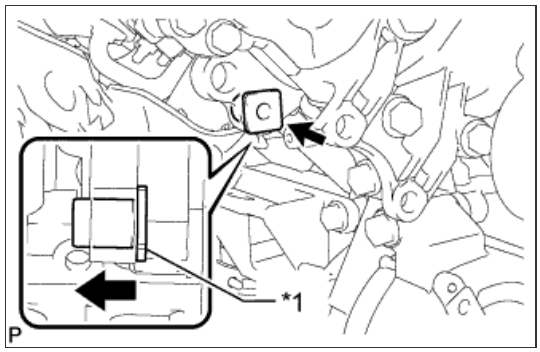
20. CONNECT VANE PUMP ASSEMBLY

HINT:

Before performing the following procedures, move the spacer until the vane pump can be installed.

Text in Illustration

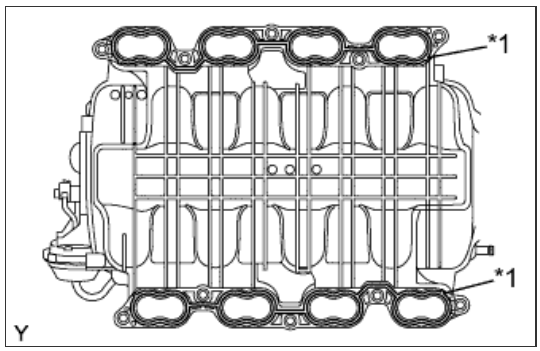
*1	Spacer



a. Connect the vane pump to the timing chain cover with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

21. INSTALL INTAKE MANIFOLD



a. Place 2 new gaskets on the intake manifold.

Text in Illustration

*1	Gasket

b. Place the intake manifold on the cylinder head.

c. Install and uniformly tighten the 8 bolts and 2 nuts in several steps.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

d. Install the wire bracket to the intake manifold with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

e. Connect the 3 wire clamps to the 3 wire brackets.

f. Install the No. 3 engine cover.

g. Install the No. 1 engine cover sub-assembly.

h. Connect the purge VSV connector.

i. Connect the purge line hose to the purge VSV.

j. Connect the vacuum switching valve connector (for ACIS).

k. Connect the No. 1 ventilation hose.

l. Connect the 2 water by-pass hoses.

m. Connect the throttle body connector.

n. Connect the ventilation hose to the ventilation pipe of the cylinder head cover LH and RH.

22. INSTALL OIL FILTER BRACKET

a. Apply a light coat of engine oil to 2 new O-rings.

b. Install the 2 O-rings to the timing chain cover.

c. Install the oil filter bracket with the 2 nuts and 2 bolts.

Torque:
35 N*m{ 357 kgf*cm , 2 ft.*lbf }

23. INSTALL NO. 1 OIL COOLER BRACKET

a. Connect the ground wire to the cylinder block.

b. Install the oil cooler bracket with the 2 nuts.

Torque:

21 N*m{ 214 kgf*cm , 15 ft.*lbf }

24. INSTALL NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY

a. Connect the 4 hoses.

b. Install the water by-pass pipe with the 3 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

25. INSTALL OIL PRESSURE SENDER GAUGE ASSEMBLY

a. Apply adhesive to 2 or 3 threads of the oil pressure sender gauge.

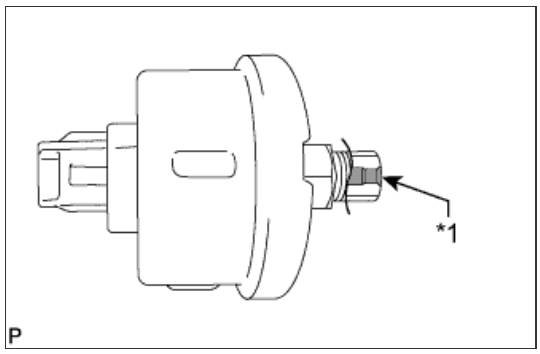
Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent

NOTICE:

Do not allow adhesive to contact the oil hole.

Text in Illustration

*1	Oil Hole



b. Install the oil pressure sender gauge.

Torque:
15 N*m{ 153 kgf*cm , 11 ft.*lbf }

NOTICE:

Do not start the engine within 1 hour after installation.

c. Connect the sender gauge connector.

26. INSTALL ENGINE OIL LEVEL DIPSTICK GUIDE

a. Apply a light coat of engine oil to a new O-ring.

b. Install the O-ring to the guide.

c. Install the dipstick guide with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

d. Install the dipstick.

e. Connect the wire harness clamp.

27. INSTALL OIL FILTER ELEMENT

a. Clean the inside of the oil filter cap, its threads and its O-ring groove.

b. Apply a small amount of engine oil to a new O-ring and install it to the oil filter cap.

c. Set a new oil filter element to the oil filter cap.

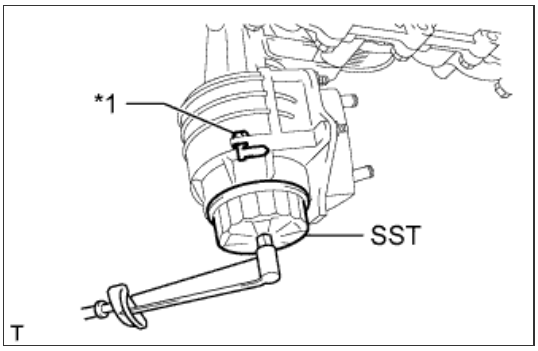
d. Remove any dirt or foreign matter from the installation surface of the engine.

e. Apply a small amount of engine oil to the O-ring again and temporarily install the oil filter cap.

NOTICE:

Do not remove the oil filter bracket clip.

f. Using SST, tighten the oil filter cap.



SST
09228-0 501

Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }

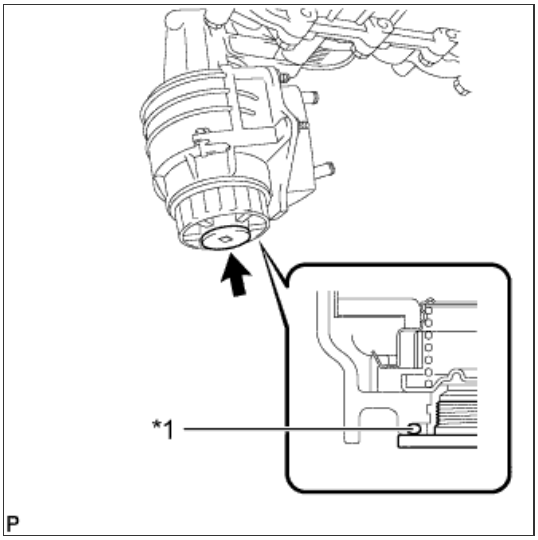
Text in Illustration

*1	Oil Filter Bracket Clip

NOTICE:

- **When tightening the oil filter cap, do not remove the oil filter bracket clip.**
- **Make sure that the oil filter is installed securely as shown in the illustration.**
- **Be careful that the O-ring does not get caught between any surrounding parts.**

g. Apply a small amount of engine oil to a new drain plug O-ring, and install it to the oil filter cap.



Text in Illustration

*1	O-Ring

NOTICE:

Before installing the O-ring, remove any dirt or foreign matter from the installation surface of the oil filter cap.

h. Install the oil filter drain plug.

Torque:
13 N*m{ 127 kgf*cm , 9 ft.*lbf }

NOTICE:

Be careful that the O-ring does not get caught between any surrounding parts.

i. Install the No. 2 engine under cover seal with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

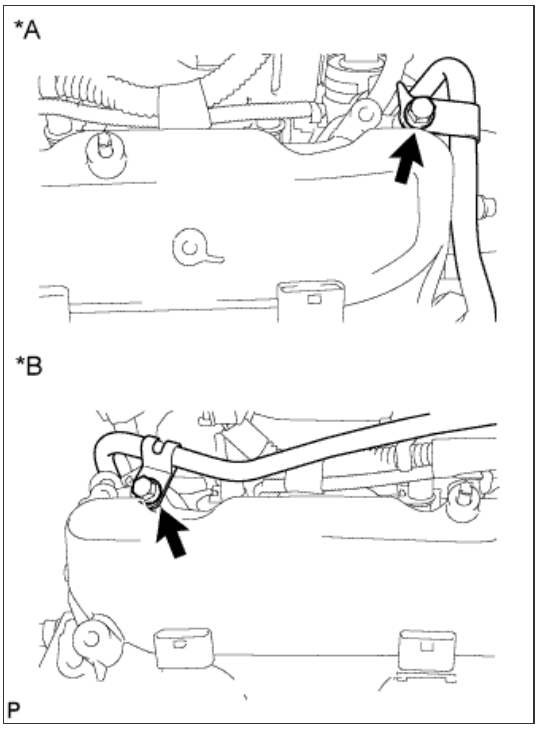
28. CONNECT NO. 2 FUEL TUBE SUB-ASSEMBLY

a. Connect the fuel tube with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

Text in Illustration

*A	LH Side
*B	RH Side



29. CONNECT COOLER COMPRESSOR ASSEMBLY

a. Install the cooler compressor with the stud bolt.

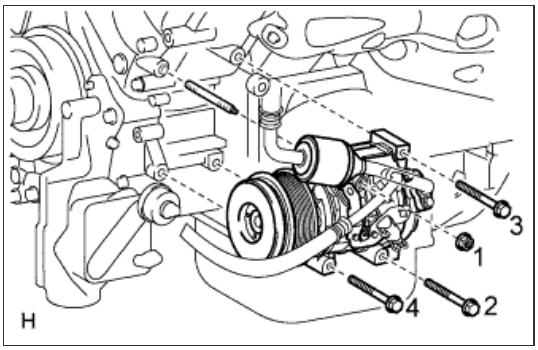
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Install the 3 bolts and nut.

Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }

NOTICE:

Tighten the bolts and nut in the order shown in the illustration to install the cooler compressor.



30. CONNECT WATER PIPE AND HOSE SUB-ASSEMBLY

a. Connect the water pipe and hose to the cylinder head cover with the 2 bolts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

b. Connect the 3 hoses.

31. CONNECT ENGINE WIRE

a. Connect the 2 clamps and power steering oil pressure switch connector.

b. Engine Room RH Side:

i. Connect the 5 clamps.

ii. Connect the throttle position sensor and throttle control motor connector.

iii. Install the ground wire with the 2 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

iv. Connect the noise filter connector.

v. Connect the 2 VVT sensor connectors.

vi. Connect the injector connector.

vii. Connect the 4 ignition coil connectors.

viii. Connect the 2 camshaft timing oil control valve connectors.

c. Engine Room LH Side:

i. Connect the cooler compressor connector.

ii. Connect the 3 clamps.

iii. Connect the camshaft position sensor connector.

iv. Connect the 2 camshaft timing oil control valve connectors.

v. Connect the engine coolant temperature sensor connector.

vi. Connect the 4 clamps.

vii. Install the ground wire with the 2 bolts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

viii. Connect the noise filter connector.

ix. Connect the 2 VVT sensor connectors.

x. Connect the 4 ignition coil connectors.

xi. Connect the injector connector.

xii. Connect the 2 connectors and 2 clips to the engine room junction block.

xiii. Install the engine room relay block cover.

32. INSTALL RADIATOR ASSEMBLY

(Click here)

33. INSTALL AIR CLEANER ASSEMBLY

a. Install the air cleaner with the 3 bolts.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

34. INSTALL AIR CLEANER HOSE ASSEMBLY

a. Install the air cleaner hose so that the protrusion of the air cleaner cap aligns with the groove of the hose as shown in the illustration.

Text in Illustration

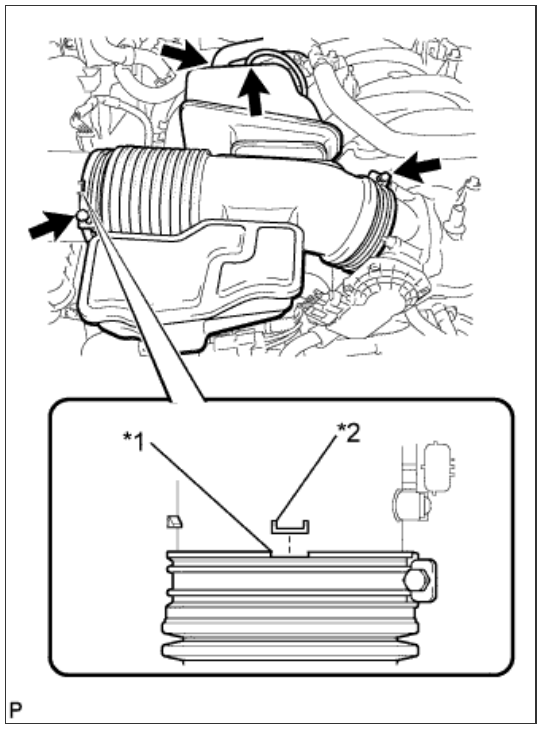
*1	Groove
*2	Protrusion

b. Tighten the 2 clamps.

Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }

c. Connect the vacuum hose.

d. Connect the No. 2 ventilation hose.

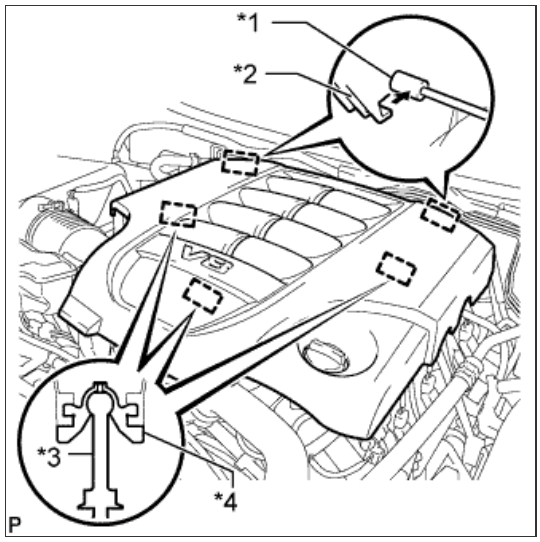


35. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket. Then align the 3 V-bank cover grommets with the 3 pins, and press down on the V-bank cover to attach the pins.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet



3 . ADD ENGINE OIL

a. Add fresh oil and install the oil filler cap.

Standard Oil Grade:

Oil Grade	Oil Viscosity (SAE)
API grade SL "energy-conserving", API grade SM "energy-conserving" or ILSAC multigrade engine oil	5W-30 10W-30
API grade SL and SM multigrade engine oil	15W-40 20W-50

Standard Oil Capacity:

Item	Specified Condition
Drain and refill without oil filter change	7.1 liters (7.5 US qts, 6.2 Imp. qts)
Drain and refill with oil filter change	7.5 liters (7.9 US qts, 6.6 Imp. qts)

Dry fill	9.3 liters (9.8 US qts, 8.2 Imp. qts)

37. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item	Specified Condition
with rear heater	16.2 liters (17.1 US qts, 14.3 Imp. qts)
without rear heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the radiator inlet hose by hand, and checking when the engine coolant starts to flow inside the hose.

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

h. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the fan.**

i. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

j. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.

38. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

39. INSPECT FOR OIL LEAK

a. Start the engine. Make sure that there are no oil leaks from the area that was worked on.

40. INSPECT FOR COOLANT LEAK

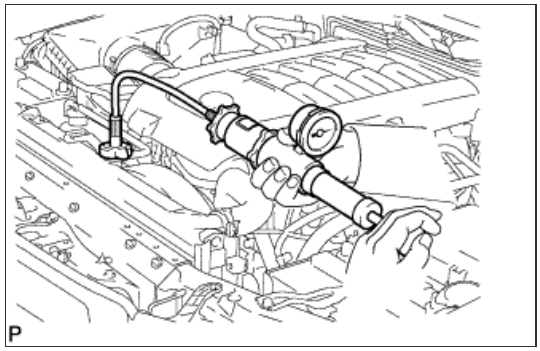
CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



41. INSPECT ENGINE OIL LEVEL

a. Warm up the engine, stop the engine and wait 5 minutes. The oil level should be between the dipstick low level mark and full level mark.
If low, check for leakage and add oil up to the full level mark.

NOTICE:

Do not fill engine oil above the full level mark.

42. INSTALL NO. 2 ENGINE UNDER COVER

a. Install the No. 2 engine under cover with the 2 bolts.

Torque:
29 N*m{ 29 kgf*cm , 21 ft.*lbf }

43. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

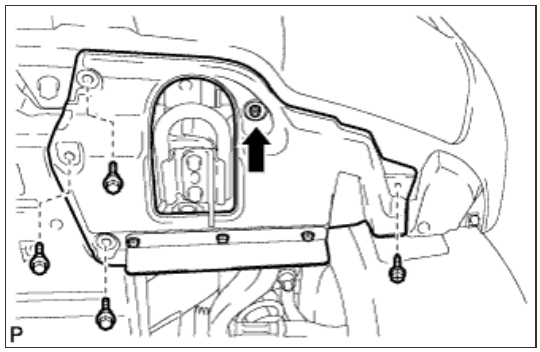
a. Install the No. 1 engine under cover with the 10 bolts.

Torque:
29 N*m{ 29 kgf*cm , 21 ft.*lbf }

44. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



45. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

4 . INSTALL FRONT FENDER APRON SEAL FRONT RH

a. Install the fender apron seal with the 3 clips.

47. INSTALL FRONT FENDER APRON SEAL LH

a. Install the fender apron seal with the 3 clips.

48. INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY

(Click here)

49. CONNECT RADIATOR SIDE DEFLECTOR LH

a. Connect the deflector with the 4 clips.

50. INSTALL TRANSMISSION OIL COOLER AIR DUCT

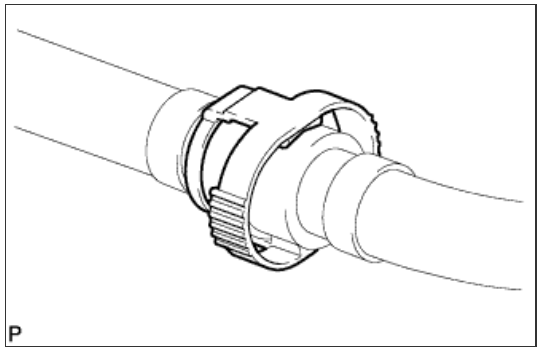
a. Install the oil cooler air duct with the 4 bolts.

Torque:
4.9 N*m{ 50 kgf*cm , 43 in.*lbf }

51. INSTALL FRONT BUMPER COVER

HINT:

For the front bumper cover with garnish, use the procedures described below.

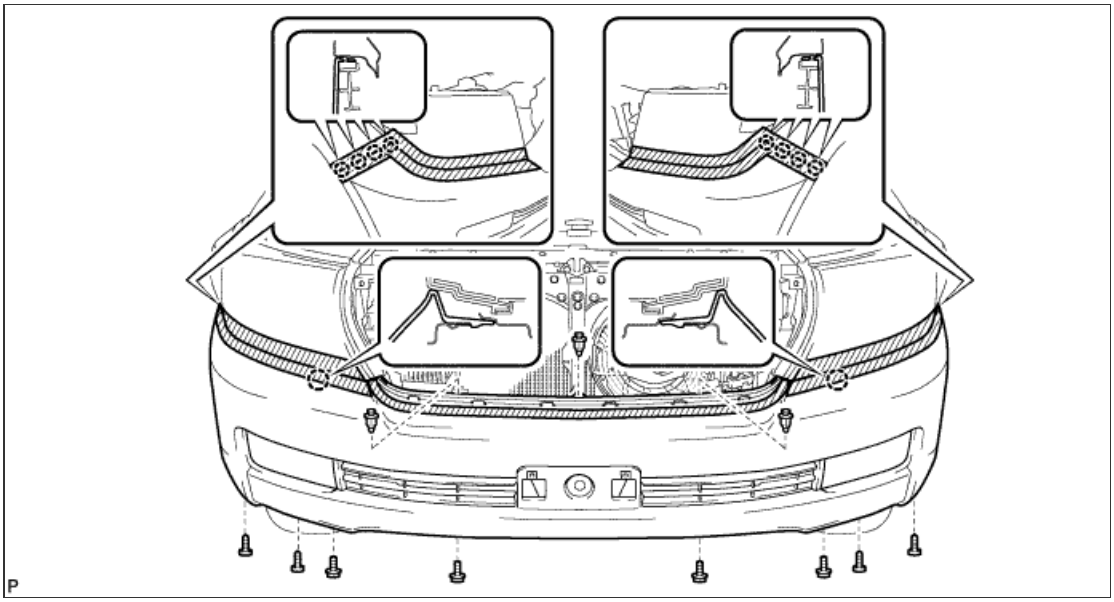


a. w/ Headlight Cleaner System:
Connect the headlight cleaner hose.

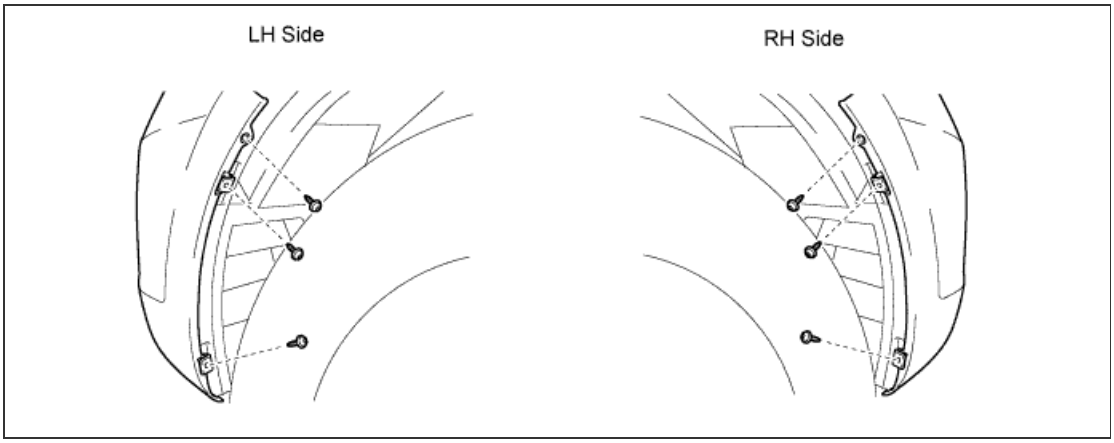
b. w/o TOYOTA Parking Assist-sensor System, w/o Fog Light:
Attach the 10 claws to install the bumper cover.

c. w/ TOYOTA Parking Assist-sensor System or w/ Fog Light:
Connect the No. 4 engine room wire connector and attach the 10 claws to install the bumper cover.

d. Install the 3 clips, 4 screws and 4 bolts.



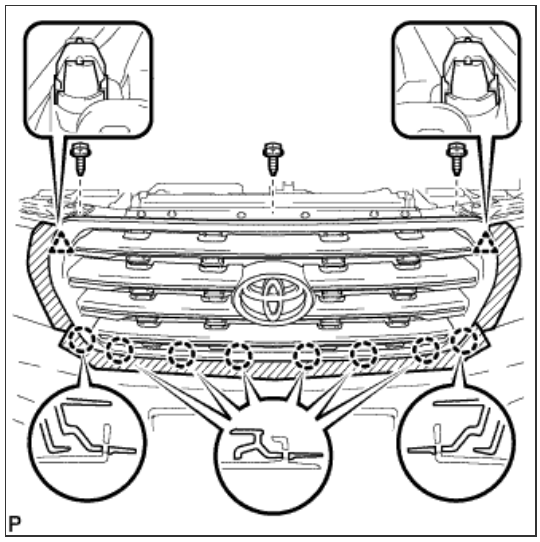
e. Using a T30 "TORX" socket, install the 6 screws.



52. INSTALL RADIATOR GRILLE

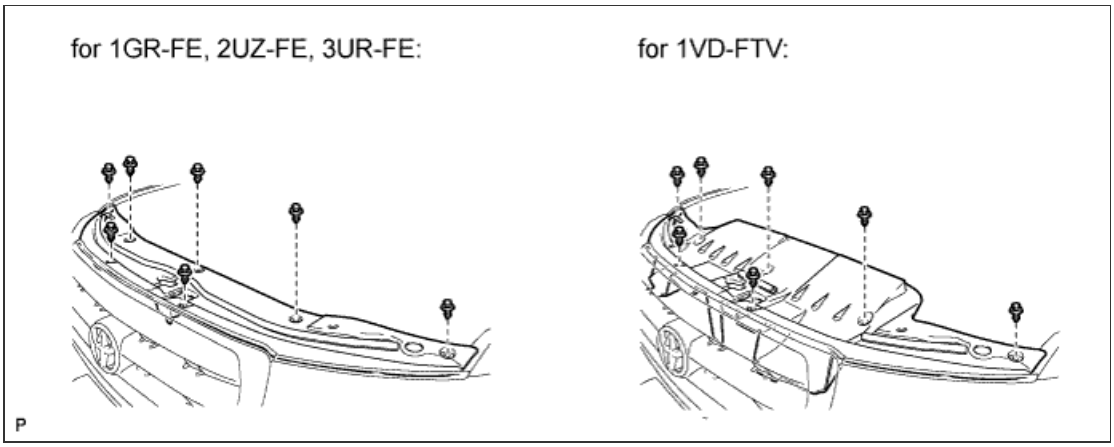
a. Attach the 2 clips and 8 claws to install the radiator grille.

b. Install the 3 screws.

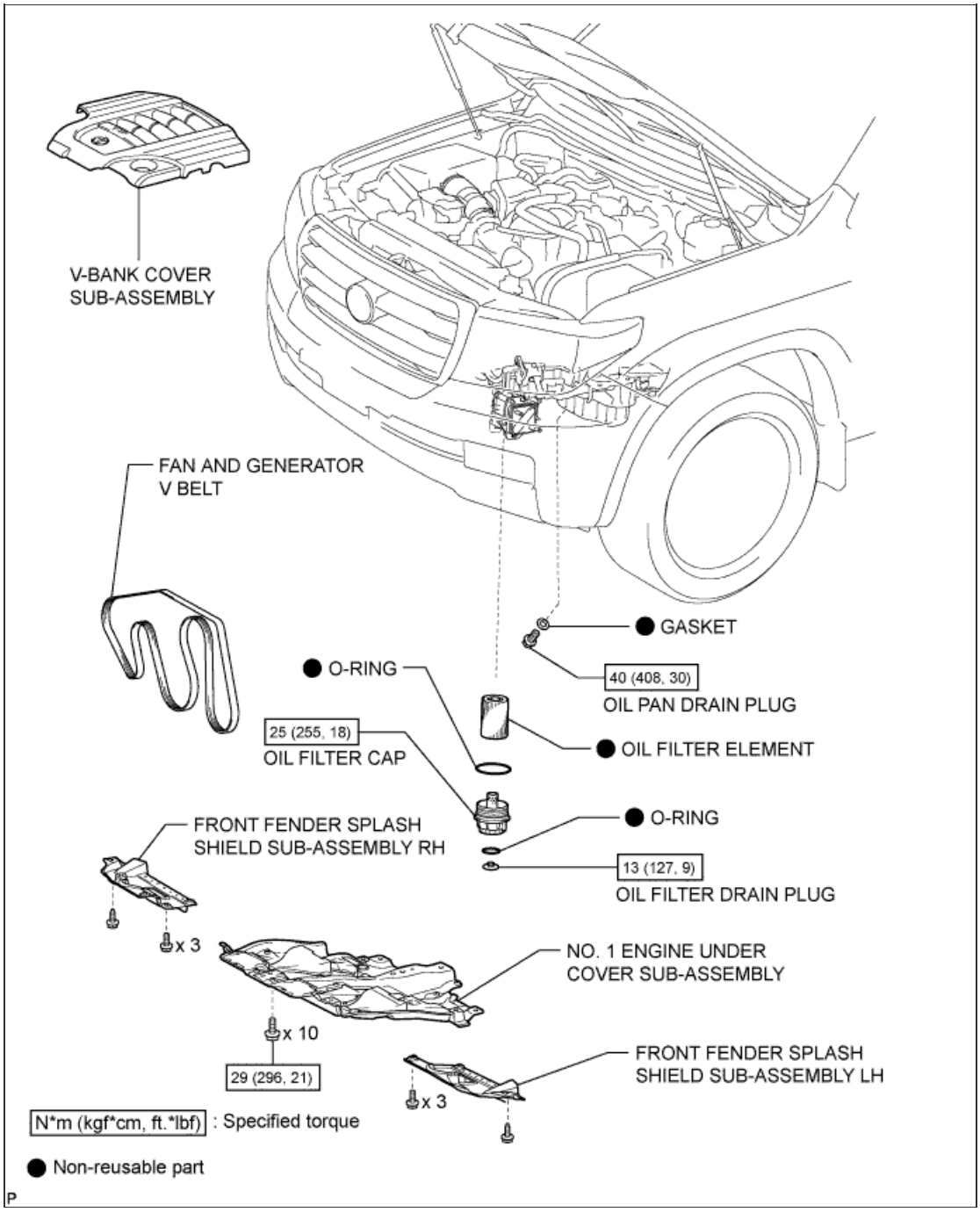


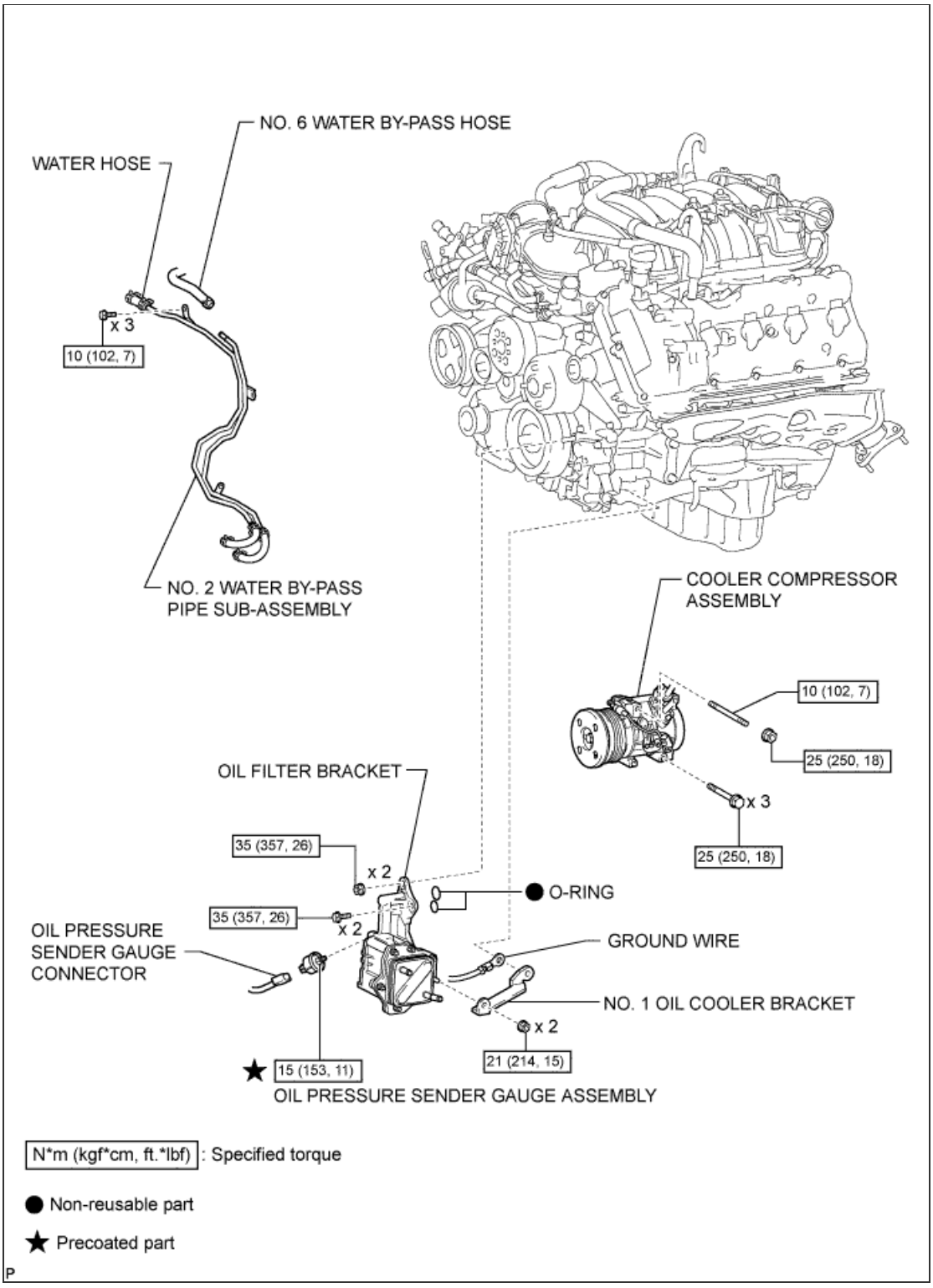
53. INSTALL UPPER RADIATOR SUPPORT SEAL

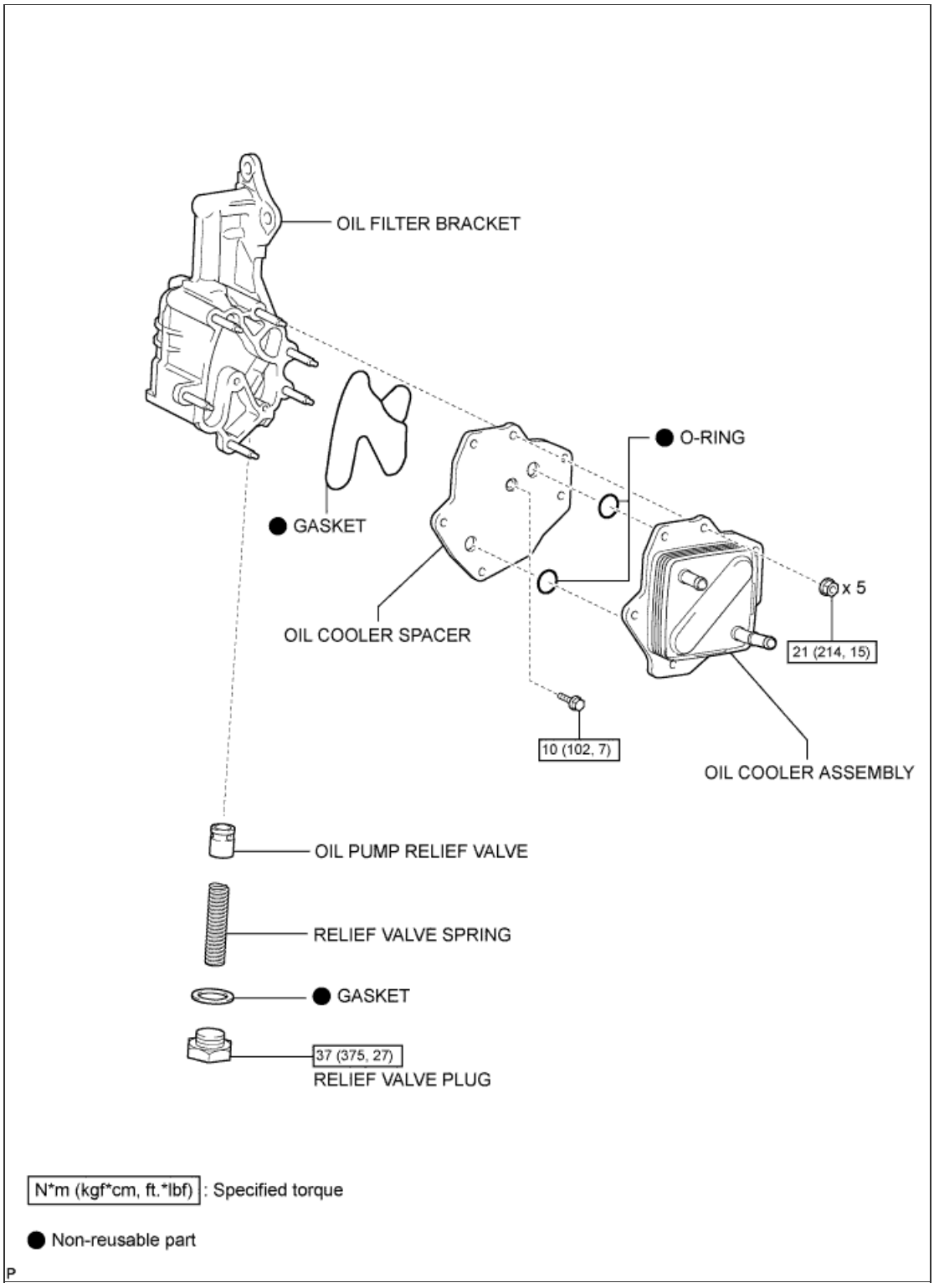
a. Install the radiator support seal with the 7 clips.



for Preparation Click here




NO. 6 WATER BY-PASS HOSE
WATER HOSE
x 3
10 (102, 7)
NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY
COOLER COMPRESSOR ASSEMBLY
10 (102, 7)
25 (250, 18)
x 3
25 (250, 18)
OIL FILTER BRACKET
35 (357, 26)
x 2
O-RING
35 (357, 26)
x 2
OIL PRESSURE SENDER GAUGE CONNECTOR
GROUND WIRE
NO. 1 OIL COOLER BRACKET
x 2
21 (214, 15)
15 (153, 11)
OIL PRESSURE SENDER GAUGE ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
Precoated part
P



N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

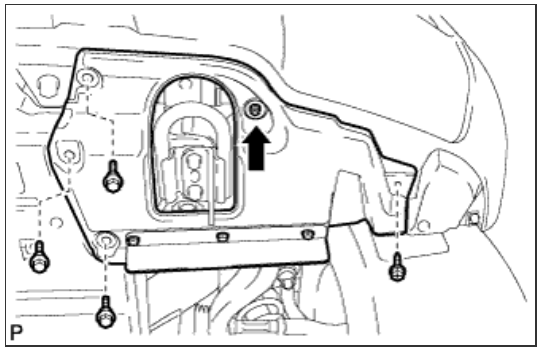
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for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



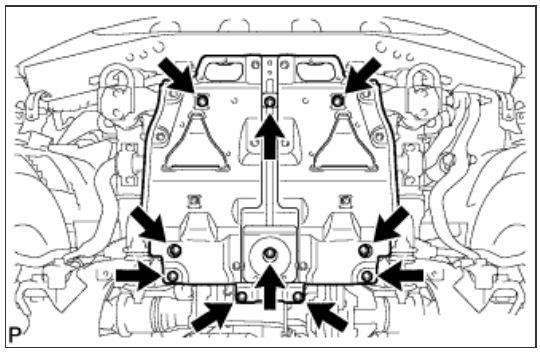
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and No. 1 engine under cover.



4. DRAIN ENGINE OIL

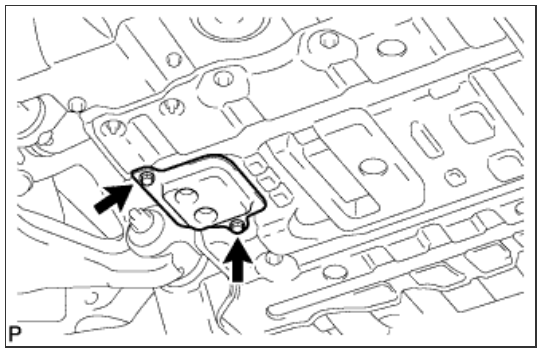
a. Remove the oil filler cap.

b. Remove the 2 bolts and No. 2 engine under cover seal.

c. Remove the oil pan drain plug and gasket, and drain the engine oil into a container.

d. Install a new gasket and the oil pan drain plug.

Torque:
40 N*m{ 408 kgf*cm , 30 ft.*lbf }



5. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Loosen the radiator drain cock plug.

HINT:

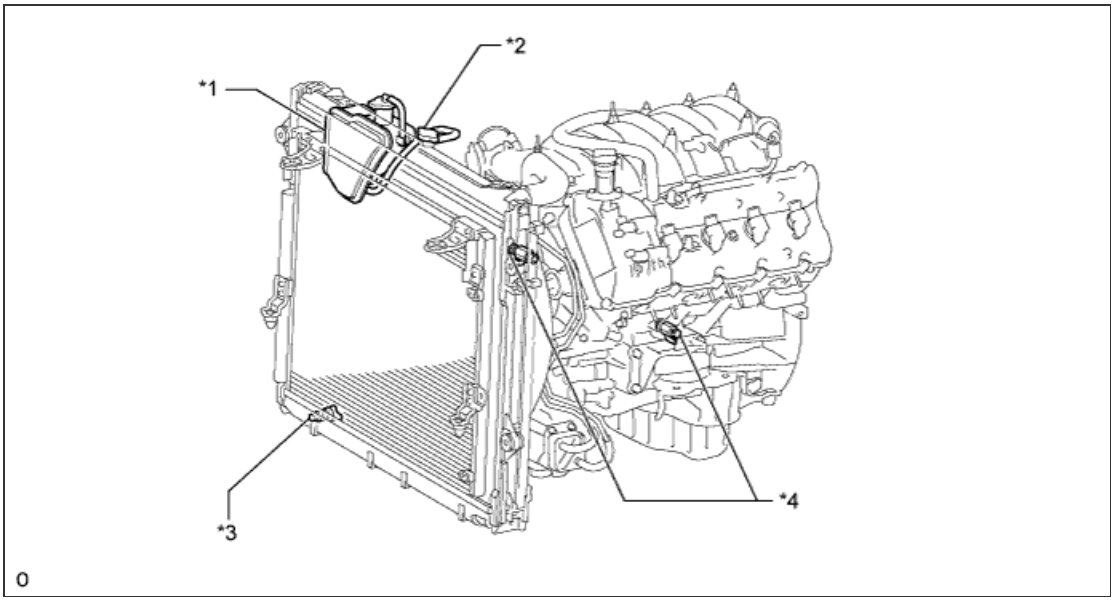
Collect the coolant in a container and dispose of it according to the regulations in your area.

b. Remove the radiator cap. Then drain the coolant from the radiator.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

d. Tighten the 2 cylinder block drain cock plugs.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



Text in Illustration

*1	Radiator Reservoir	*2	Radiator Cap
*3	Radiator Drain Cock Plug	*4	Cylinder Block Drain Cock Plug

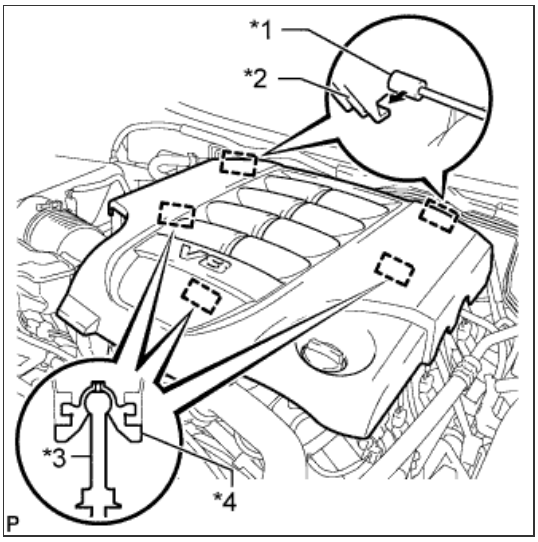
e. Tighten the radiator drain cock plug by hand.

6. REMOVE V-BANK COVER SUB-ASSEMBLY

a. Raise the front of the V-bank cover to detach the 3 pins. Then remove the 2 V-bank cover hooks from the bracket, and remove the V-bank cover.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet



7. REMOVE FAN AND GENERATOR V BELT

a. While turning the belt tensioner counterclockwise, align the service hole for the belt tensioner and the belt tensioner fixing position, and then insert a bar of 5 mm (0.197 in.) into the service hole to fix the belt tensioner in place.

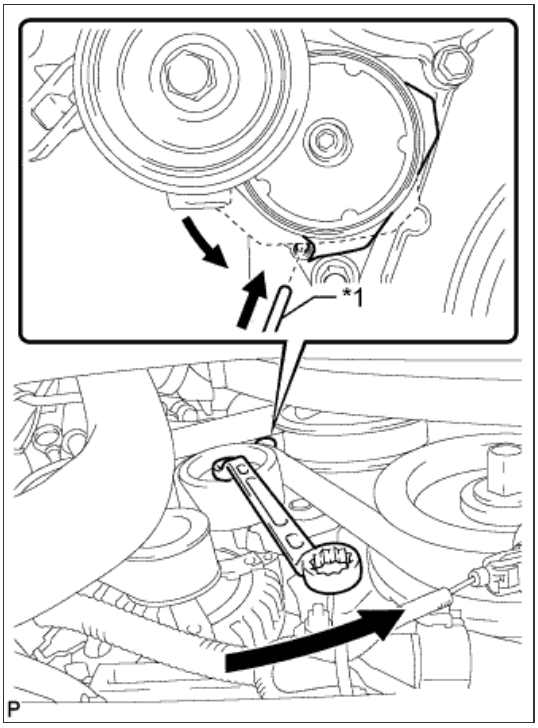
Text in Illustration

*1	Bar

HINT:

The pulley bolt for the belt tensioner has a left-hand thread.

b. Remove the V belt.

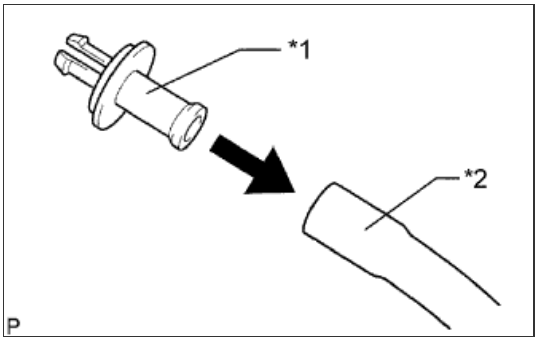


8. REMOVE OIL FILTER ELEMENT

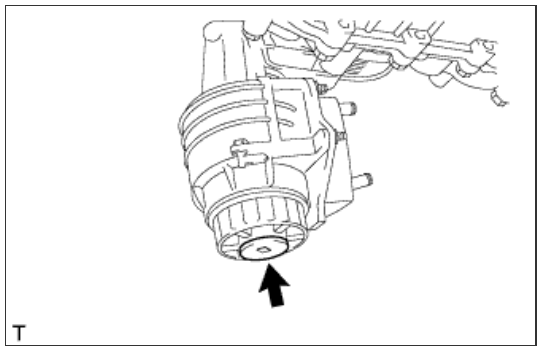
a. Connect a hose with an inside diameter of 15 mm (0.591 in.) to the pipe.

Text in Illustration

*1	Pipe
*2	Hose



b. Remove the oil filter drain plug.



c. Install the pipe to the oil filter cap.

Text in Illustration

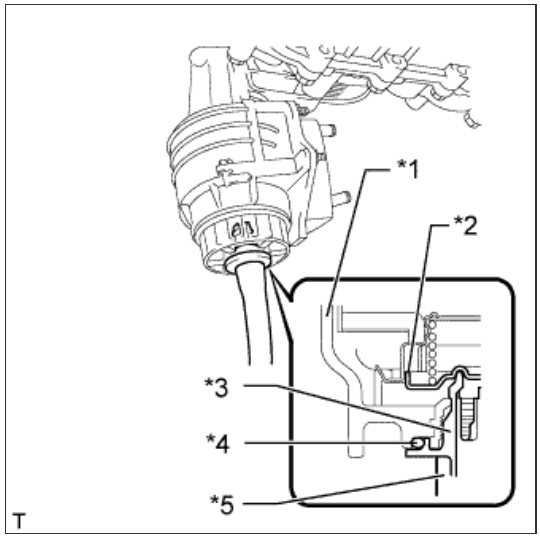
*1	Cap
*2	Valve
*3	Pipe
*4	O-Ring
*5	Hose

NOTICE:

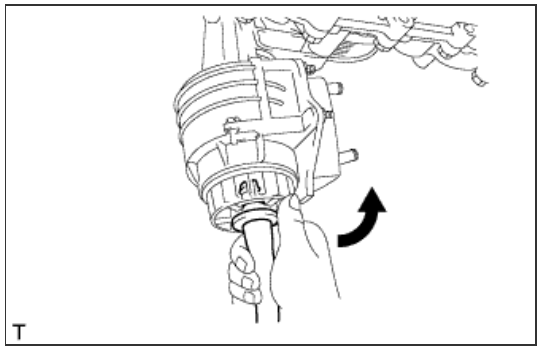
If the O-ring is removed with the drain plug, install the O-ring together with the pipe.

HINT:

Use a container to catch the draining oil.



d. Check that oil is drained from the oil filter. Then disconnect the pipe and remove the O-ring as shown in the illustration.



e. Using SST, remove the oil filter cap.

SST

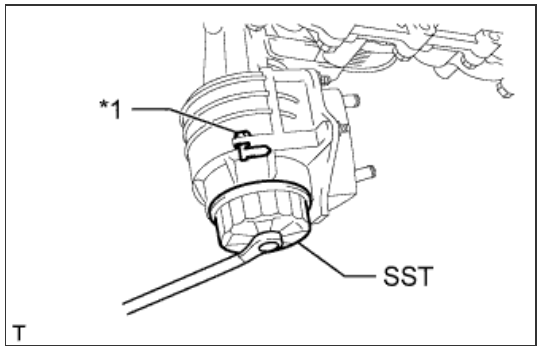
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Text in Illustration

*1	Oil Filter Bracket Clip

NOTICE:

Do not remove the oil filter bracket clip.



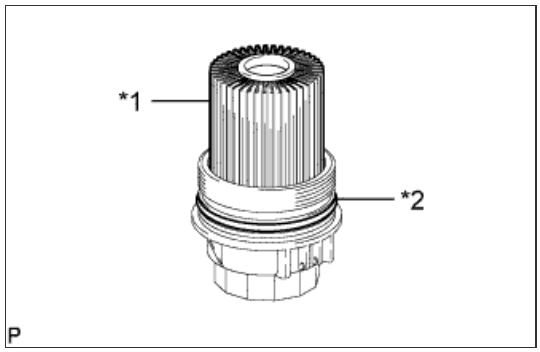
f. Remove the oil filter element and O-ring from the oil filter cap.

Text in Illustration

*1	Oil Filter Element
*2	O-Ring

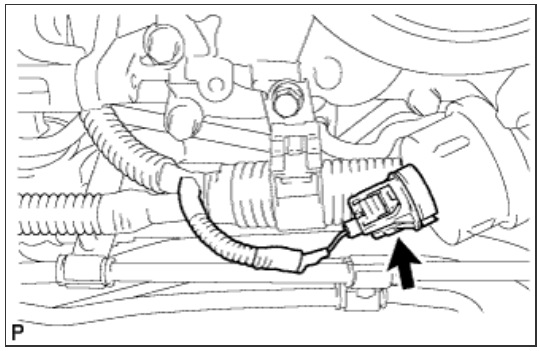
NOTICE:

Be sure to remove the cap O-ring by hand, without using any tools, to prevent damage to the cap O-ring groove.

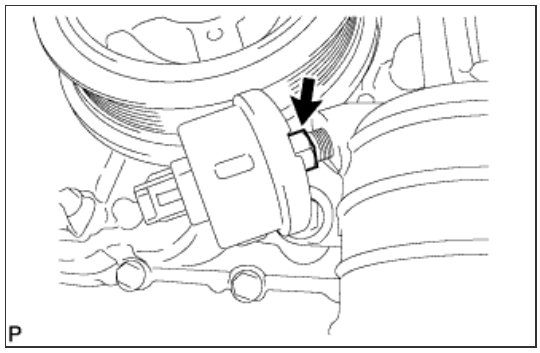


9. REMOVE OIL PRESSURE SENDER GAUGE ASSEMBLY

a. Disconnect the sender gauge connector.



b. Remove the oil pressure sender gauge.

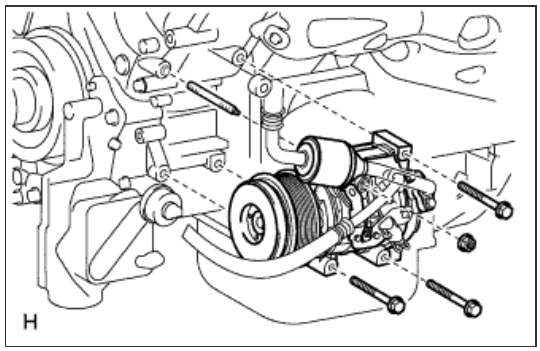


10. DISCONNECT COOLER COMPRESSOR ASSEMBLY

a. Remove the 3 bolts, nut and stud bolt, and disconnect the cooler compressor.

HINT:

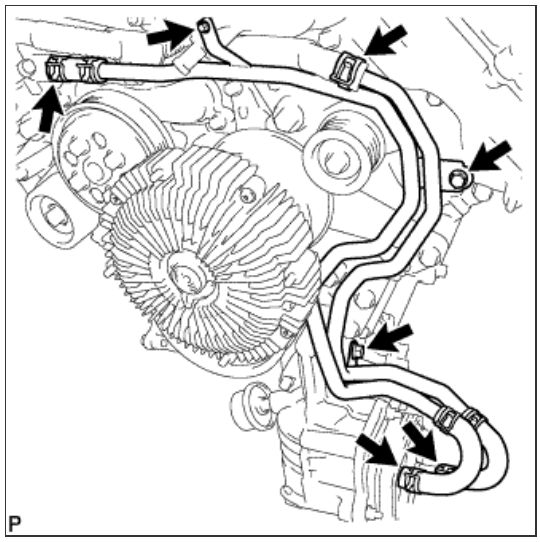
It is not necessary to completely remove the compressor. With the hoses connected to the compressor, hang the compressor on the vehicle body with a rope.



11. REMOVE NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY

a. Remove the 3 bolts.

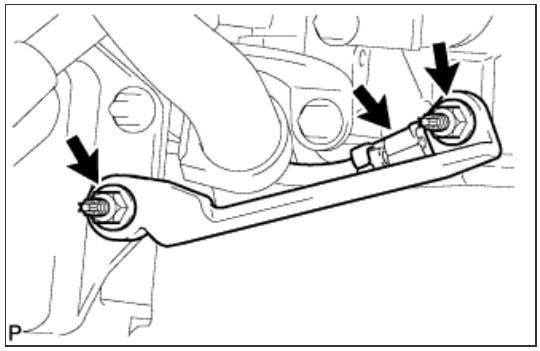
b. Disconnect the 4 hoses and remove the water by-pass pipe.



12. REMOVE NO. 1 OIL COOLER BRACKET

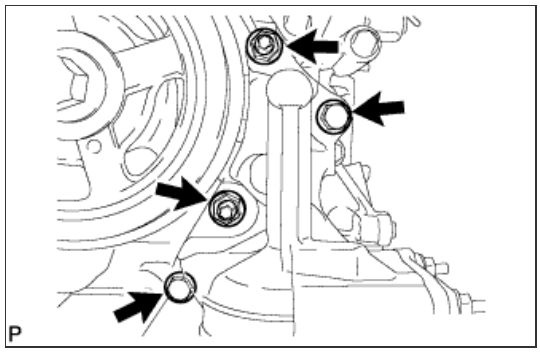
a. Remove the 2 nuts and bracket.

b. Disconnect the ground wire from the cylinder block.

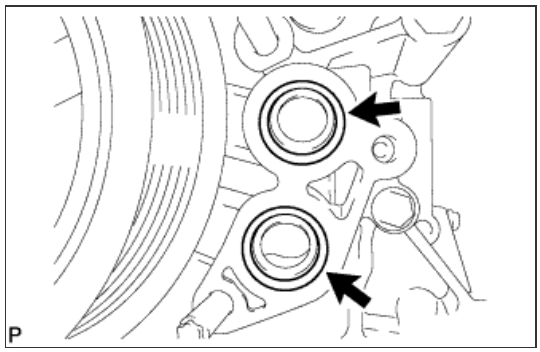


13. REMOVE OIL FILTER BRACKET

a. Remove the 2 bolts, 2 nuts and filter bracket.

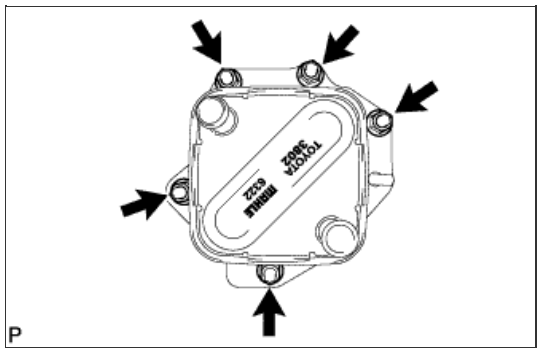


b. Remove the 2 O-rings.

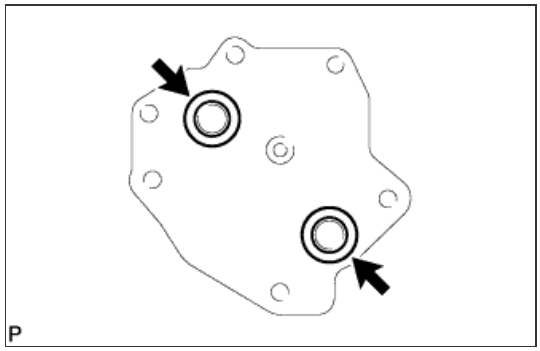


14. REMOVE OIL COOLER ASSEMBLY

a. Remove the 5 nuts and oil cooler from the oil filter bracket.

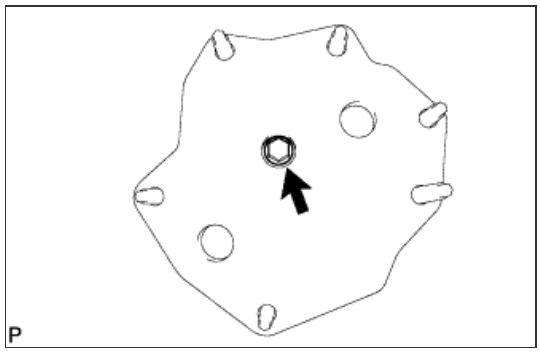


b. Remove the 2 O-rings.



15. REMOVE OIL COOLER SPACER

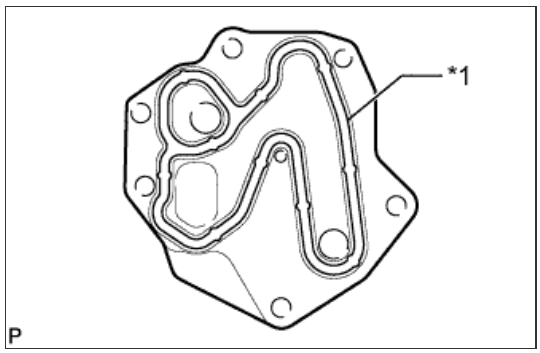
a. Remove the bolt and oil cooler spacer from the oil filter bracket.



b. Remove the gasket.

Text in Illustration

*1	Gasket

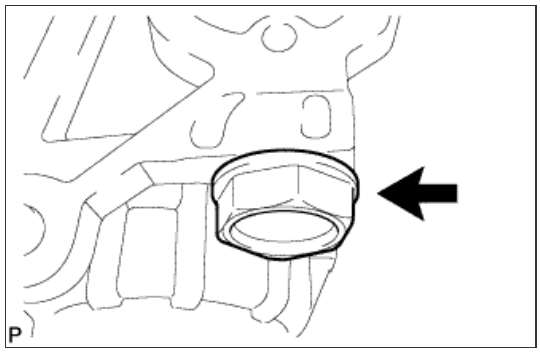


for Preparation Click here

1. REMOVE OIL PUMP RELIEF VALVE

a. Remove the relief valve plug and gasket.

b. Remove the valve spring and oil pump relief valve.



for Preparation Click here

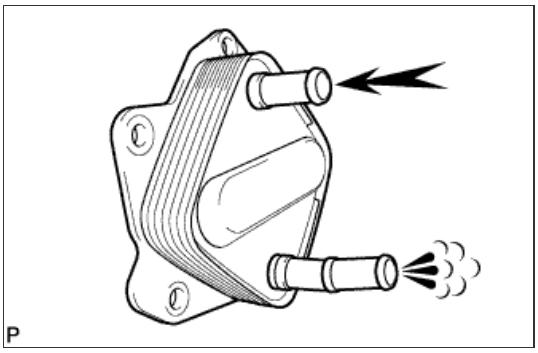
1. INSPECT OIL COOLER ASSEMBLY

a. Check the oil cooler for damage or clogging.

Text in Illustration

➡	Air

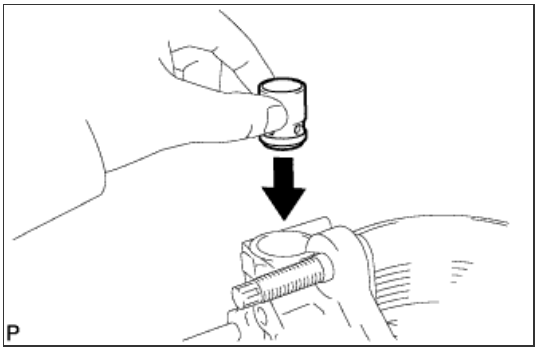
If necessary, replace the oil cooler assembly.



2. INSPECT OIL PUMP RELIEF VALVE

a. Coat the relief valve with engine oil.

b. Check that the relief valve falls smoothly into the valve hole by its own weight. If the relief valve does not fall smoothly, replace it. If necessary, replace the oil filter bracket.



for Preparation Click here

1. INSTALL OIL PUMP RELIEF VALVE

a. Coat the oil pump relief valve with engine oil.

b. Install the relief valve and valve spring into the oil pump cover hole.

c. Install a new gasket and the plug.

Torque:
37 N*m{ 375 kgf*cm , 27 ft.*lbf }

for Preparation Click here

1. INSTALL OIL COOLER SPACER

a. Apply a light coat of engine oil to a new gasket.

b. Install the gasket to the oil cooler spacer.

c. Install the oil cooler spacer to the oil filter bracket with the bolt.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

2. INSTALL OIL COOLER ASSEMBLY

a. Apply a light coat of engine oil to 2 new O-rings.

b. Install the 2 O-rings to the oil cooler.

c. Install the oil cooler with the 5 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

3. INSTALL OIL FILTER BRACKET

a. Apply a light coat of engine oil to 2 new O-rings.

b. Install the 2 O-rings to the timing chain cover.

c. Install the oil filter bracket with the 2 nuts and 2 bolts.

Torque:
35 N*m{ 357 kgf*cm , 26 ft.*lbf }

4. INSTALL NO. 1 OIL COOLER BRACKET

a. Connect the ground wire to the cylinder block.

b. Install the oil cooler bracket with the 2 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

5. INSTALL NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY

a. Connect the 4 hoses.

b. Install the water by-pass hose with the 3 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

6. CONNECT COOLER COMPRESSOR ASSEMBLY

a. Install the cooler compressor with the stud bolt.

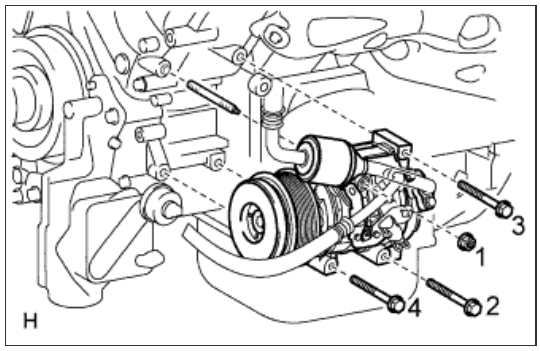
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Install the 3 bolts and nut.

Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }

NOTICE:

Tighten the bolts and nut in the order shown in the illustration to install the cooler compressor.



7. INSTALL OIL PRESSURE SENDER GAUGE ASSEMBLY

a. Apply adhesive to 2 or 3 threads of the oil pressure sender gauge.

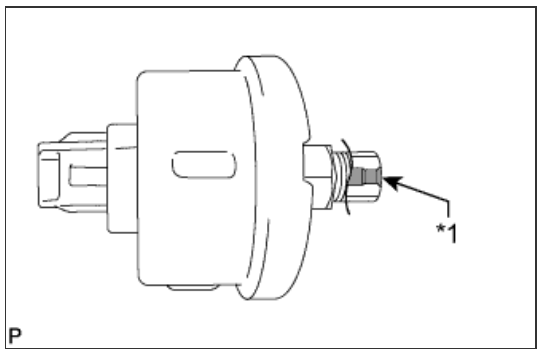
Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent

NOTICE:

Do not allow adhesive to contact the oil hole.

Text in Illustration

*1	Oil Hole



b. Install the oil pressure sender gauge.

Torque:
15 N*m{ 153 kgf*cm , 11 ft.*lbf }

NOTICE:

Do not start the engine within 1 hour after installation.

c. Connect the sender gauge connector.

8. INSTALL OIL FILTER ELEMENT

a. Clean the inside of the oil filter cap, its threads and its O-ring groove.

b. Apply a small amount of engine oil to a new O-ring and install it to the oil filter cap.

c. Set a new oil filter element to the oil filter cap.

d. Remove any dirt or foreign matter from the installation surface of the engine.

e. Apply a small amount of engine oil to the O-ring again and temporarily install the oil filter cap.

NOTICE:

Do not remove the oil filter bracket clip.

f. Using SST, tighten the oil filter cap.

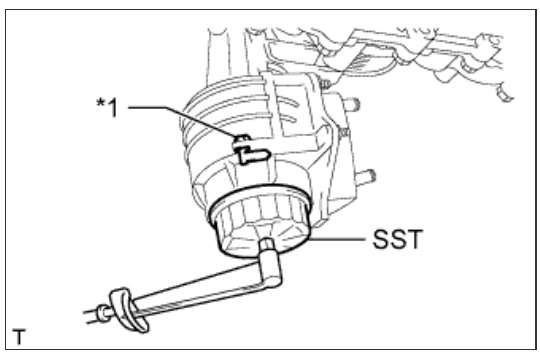
SST
09228-06501

Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }

Text in Illustration

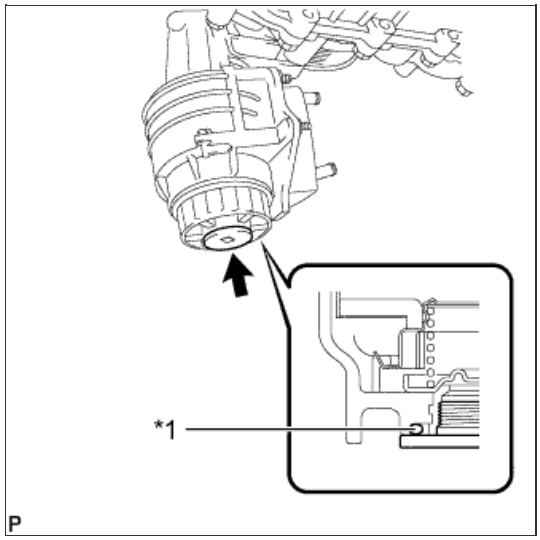
*1	Oil Filter Bracket Clip

NOTICE:



- When tightening the oil filter cap, do not remove the oil filter bracket clip.
- Make sure that the oil filter is installed securely as shown in the illustration.
- Be careful that the O-ring does not get caught between any surrounding parts.

g. Apply a small amount of engine oil to a new drain plug O-ring, and install it to the oil filter cap.



Text in Illustration

*1	O-Ring

NOTICE:

Before installing the O-ring, remove any dirt or foreign matter from the installation surface of the oil filter cap.

h. Install the oil filter drain plug.

Torque:
13 N*m{ 127 kgf*cm , 9 ft.*lbf }

NOTICE:

Be careful that the O-ring does not get caught between any surrounding parts.

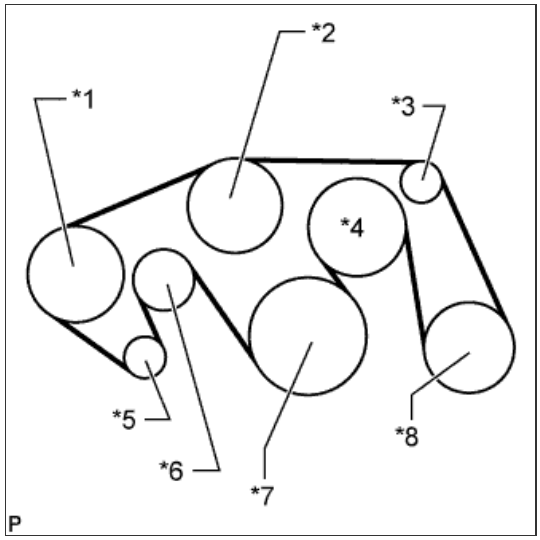
i. Install the No. 2 engine under cover seal with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

9. INSTALL FAN AND GENERATOR V BELT

a. Set the V belt onto every part.

b. While turning the belt tensioner counterclockwise, remove the bar.



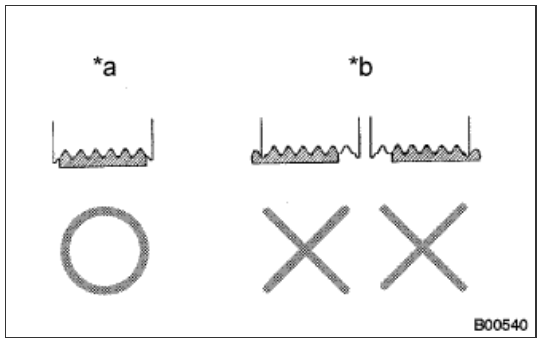
Text in Illustration

*1	Vane Pump
*2	Water Pump
*3	No. 1 Idler
*4	Fan
*5	Generator
*6	Belt Tensioner
*7	Crankshaft
*8	Cooler Compressor

NOTICE:

Make sure that the V belt is properly set to each pulley.

c. After installing the belt, check that it fits properly in the ribbed grooves.



Text in Illustration

*a	CORR CT
*b	INCORR CT

HINT:

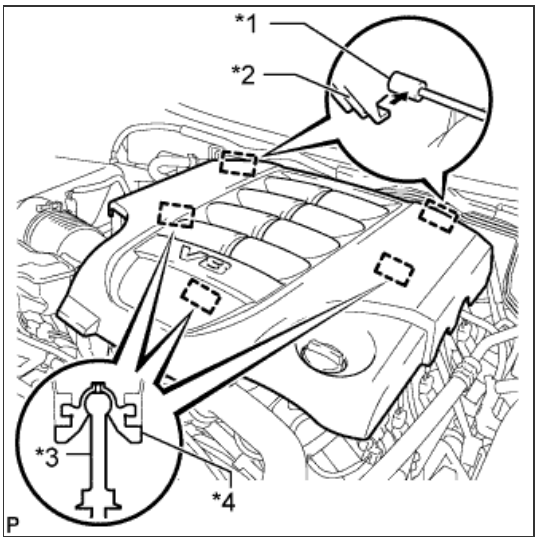
Make sure to check by hand that the belt has not slipped out of the grooves on the bottom of the pulley.

10. INSTALL V-BANK COVER SUB-ASSEMBLY

a. Attach the 2 V-bank cover hooks to the bracket. Then align the 3 V-bank cover grommets with the 3 pins, and press down on the V-bank cover to attach the pins.

Text in Illustration

*1	Bracket
*2	Hook
*3	Pin
*4	Grommet



11. ADD ENGINE OIL

a. Add fresh oil and install the oil filler cap.

Standard Oil Grade:

Oil Grade	Oil Viscosity (SA
API grade SL "energy-conserving", API grade SM "energy-conserving" or ILSAC multigrade engine oil	5W-30 10W-30
API grade SL and SM multigrade engine oil	15W-40 20W-50

Standard Oil Capacity:

Item	Specified Condition
Drain and refill without oil filter change	7.1 liters (7.5 US qts, 6.2 Imp. qts)
Drain and refill with oil filter change	7.5 liters (7.9 US qts, 6.6 Imp. qts)
Dry fill	9.3 liters (9.8 US qts, 8.2 Imp. qts)

12. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item	Specified Condition
with rear heater	16.2 liters (17.1 US qts, 14.3 Imp. qts)
without rear heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the reservoir cap.

d. Press the No. 1 and No. 2 radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.

HINT:

The thermostat opening timing can be confirmed by pressing the radiator inlet hose by hand, and checking when the engine coolant starts to flow inside the hose.

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabilized.**

h. Press the No. 1 and No. 2 radiator hoses several times by hand to bleed air.

CAUTION:

- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the fan.**

i. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

j. Check that the coolant level is between the F and L lines.
If the coolant level is below the L line, repeat all of the procedures above.
If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.

13. INSPECT FOR OIL LEAK

a. Start the engine. Make sure that there are no oil leaks from the area that was worked on.

14. INSPECT ENGINE OIL LEVEL

a. Warm up the engine, stop the engine and wait 5 minutes. The oil level should be between the dipstick low level mark and full level mark.
If low, check for leakage and add oil up to the full level mark.

NOTICE:

Do not fill engine oil above the full level mark.

15. INSPECT FOR COOLANT LEAK

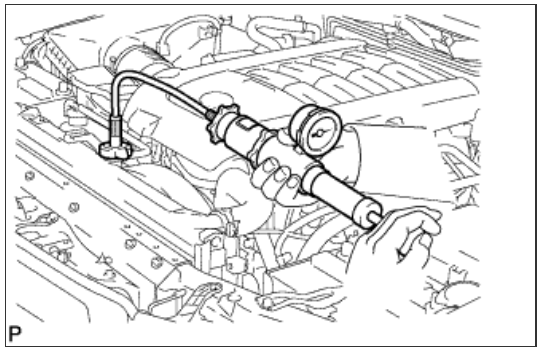
CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no e ternal leaks are found, check the heater core, cylinder block and head.



16. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

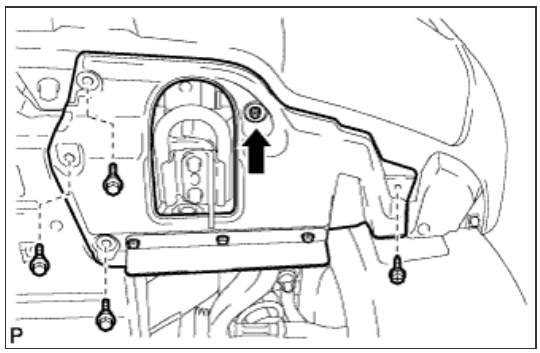
a. Install the No. 1 engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

17. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



18. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

for Preparation Click here

1. CHECK ENGINE OIL QUALITY

a. Check the engine oil for deterioration, water contamination, discoloration or thinning.
If the quality is visibly poor, replace the oil and filter (Click here).

2. CHECK ENGINE OIL LEVEL

a. Warm up the engine, then stop the engine and wait for 5 minutes.

b. Check that the engine oil level is between the low level and full level marks on the dipstick.
If low, check for leakage and add oil up to the full level mark.

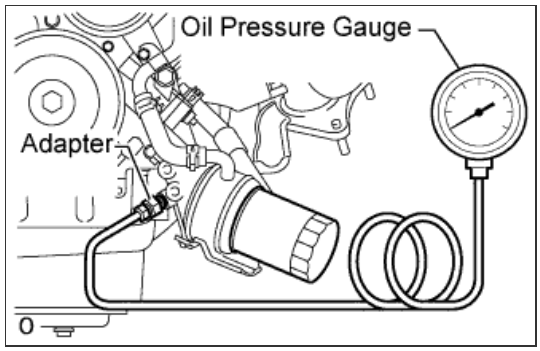
NOTICE:

Do not fill engine oil above the full level mark.

3. INSPECT AND ADJUST OIL PRESSURE

a. Remove the oil pressure sender gauge (Click here).

b. Install an oil pressure gauge with an adapter.



c. Warm up the engine.

d. Measure the oil pressure.

Standard Oil Pressure:

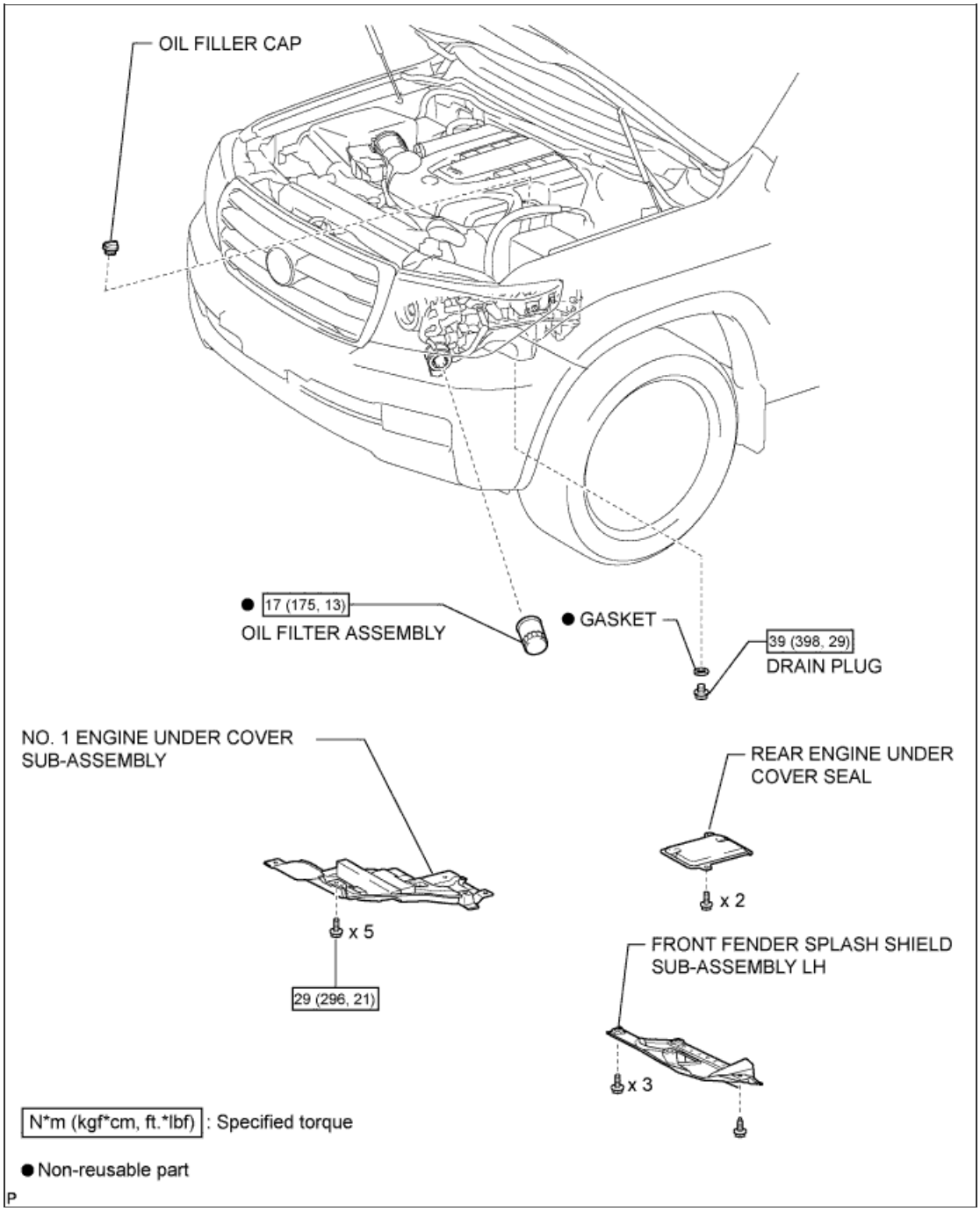
Condition	Specified Condition
Idle	29 kPa (0.3 kgf/cm^2, 4.2 psi) or more
3000 rpm	294 to 588 kPa (3.0 to 6.0 kgf/cm^2, 43 to 85 psi)

If the pressure is not as specified, check the oil pump (Click here).

e. Remove the oil pressure gauge and adapter.

f. Install the oil pressure sender gauge (Click here).

for Preparation Click here



for Preparation Click here

CAUTION:

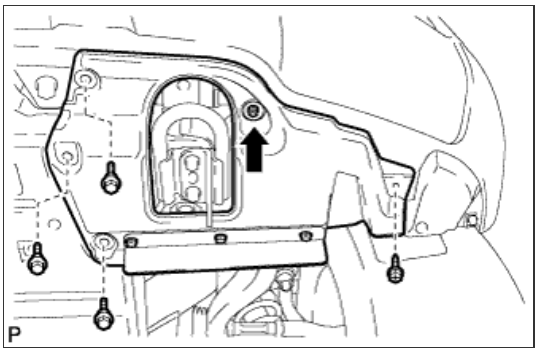
- **Prolonged and repeated contact with engine oil will result in the removal of natural oils from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer.**
- **Precautions should be taken when replacing engine oil to minimize the risk of your skin making contact with used engine oil. Protective clothing and gloves that cannot be penetrated by oil should be worn. The skin should be washed with soap and water, or use waterless hand cleaner, to remove any used engine oil thoroughly. Do not use gasoline, thinners, or solvents.**
- **In order to protect the environment, used oil and used oil filters must be disposed of at designated disposal sites.**

1. REMOVE OIL FILLER CAP SUB-ASSEMBLY

2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

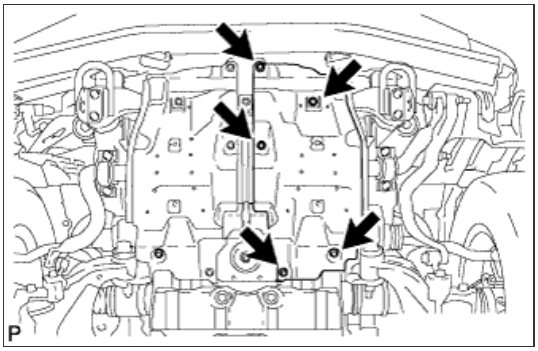
a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



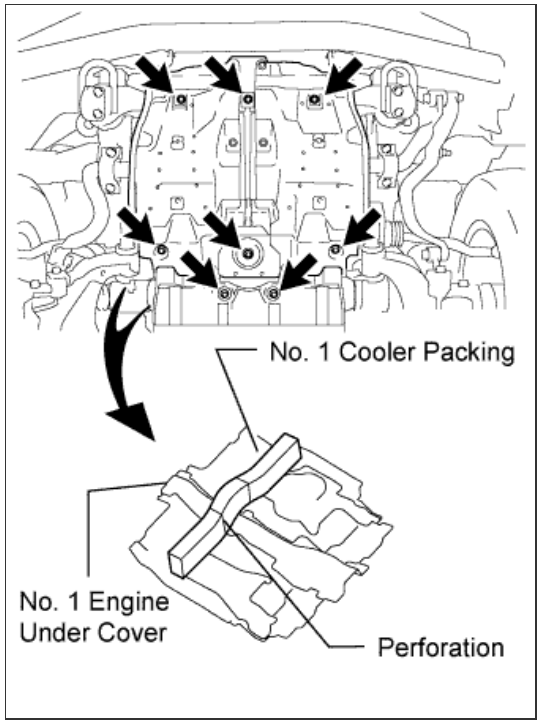
3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 5 bolts and No. 1 engine under cover sub-assembly LH.



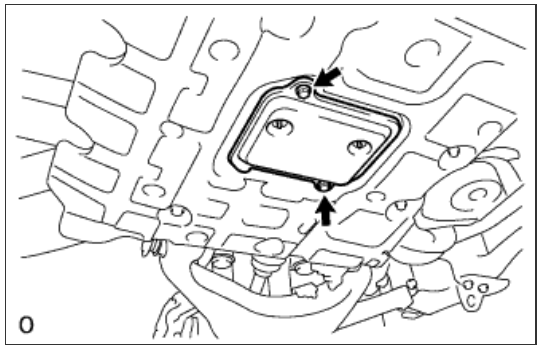
HINT:

If the No. 1 cooler packing is not divided, remove both sides of the No. 1 engine under cover and cut the packing at the perforation indicated in the illustration.



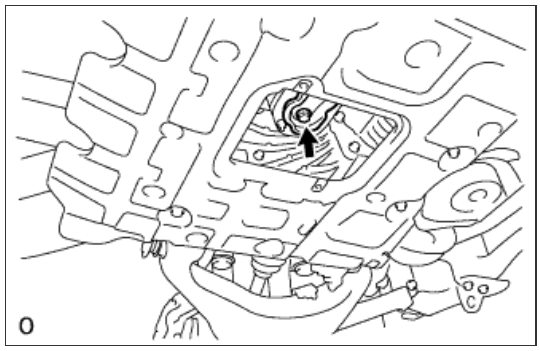
4. REMOVE REAR ENGINE UNDER COVER SEAL

a. Remove the 2 bolts and cover seal.



5. DRAIN ENGINE OIL

a. Remove the oil drain plug and gasket, and drain the engine oil into a container.

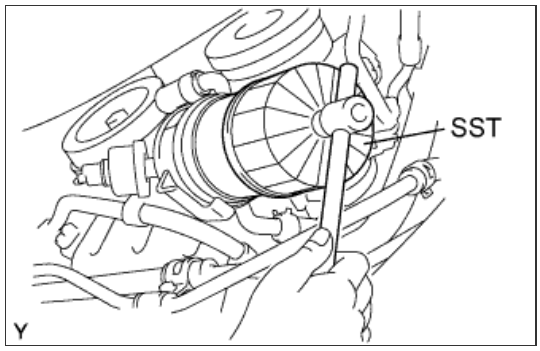


6. REMOVE OIL FILTER ASSEMBLY

a. Using SST, remove the oil filter.

SST

09228-07501

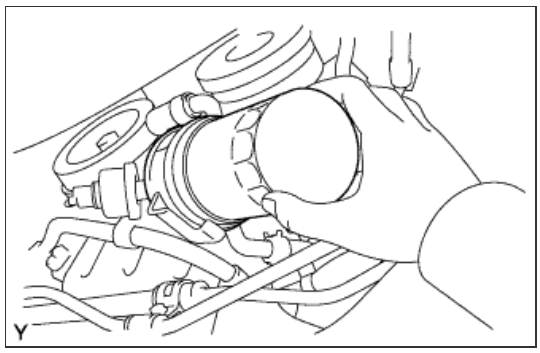


7. INSTALL OIL FILTER ASSEMBLY

a. Clean and check the oil filter installation surface.

b. Apply clean engine oil to the gasket of a new oil filter.

c. Lightly screw the oil filter into place by hand. Tighten it until the gasket contacts the seat.



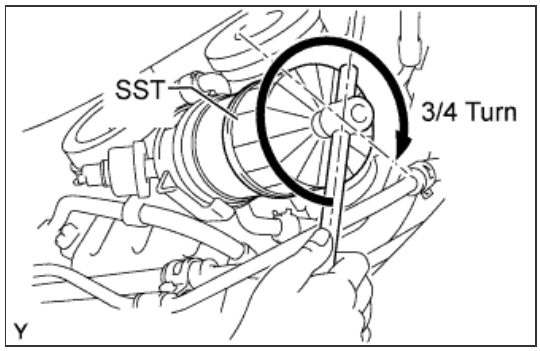
d. Using SST, tighten the oil filter. Choose from the following to tighten the oil filter.

SST
09228-07501

i. Using a torque wrench, tighten the oil filter.

Torque:
17 N*m{ 175 kgf*cm , 13 ft.*lbf }

ii. Tighten the oil filter a 3/4 turn by hand or with a common wrench.



8. ADD ENGINE OIL

a. Install a new gasket and the drain plug.

Torque:
39 N*m{ 398 kgf*cm , 29 ft.*lbf }

b. Add new engine oil.

Standard Engine Oil:

Oil Grade	Oil Viscosity (SAE)
API grade SL nergy-Conserving , SM nergy-Conserving or ILSAC multigrade engine oil	10W-30 (10W-30 is best choice for fuel economy and good starting in cold weather).
API grade SL or SM multigrade engine oil	10W-30

Standard Oil Capacity:

Item	Specified Condition
Drain and refill with oil filter change	6.2 liters (6.6 US qts, 5.5 Imp. qts)
Drain and refill without oil filter change	5.7 liters (6.0 US qts, 5.0 Imp. qts)
	7.1 liters (7.5 US qts, 6.2

Dry fill	Imp. qts)

9. INSTALL OIL FILLER CAP SUB-ASSEMBLY

10. CHECK ENGINE OIL LEVEL

a. Warm up the engine, then stop the engine and wait for 5 minutes.

b. Check that the engine oil level is between the low level and full level marks on the dipstick.
If low, check for leakage and add oil up to the full level mark.

NOTICE:

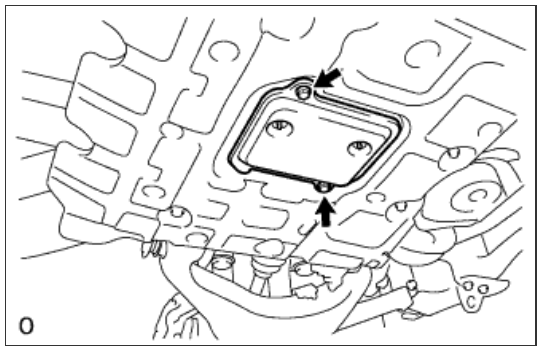
Do not fill engine oil above the full level mark.

11. INSPECT FOR OIL LEAK

a. Start the engine. Make sure that there are no oil leaks from the area that was worked on.

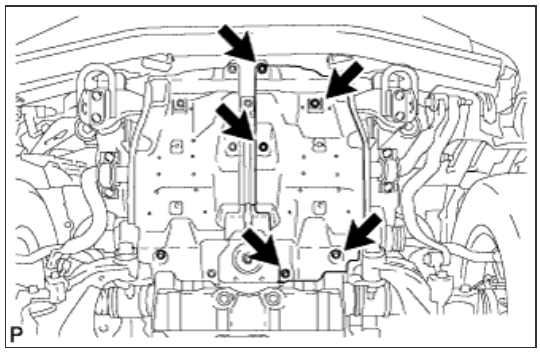
12. INSTALL REAR ENGINE UNDER COVER SEAL

a. Install the cover seal with the 2 bolts.



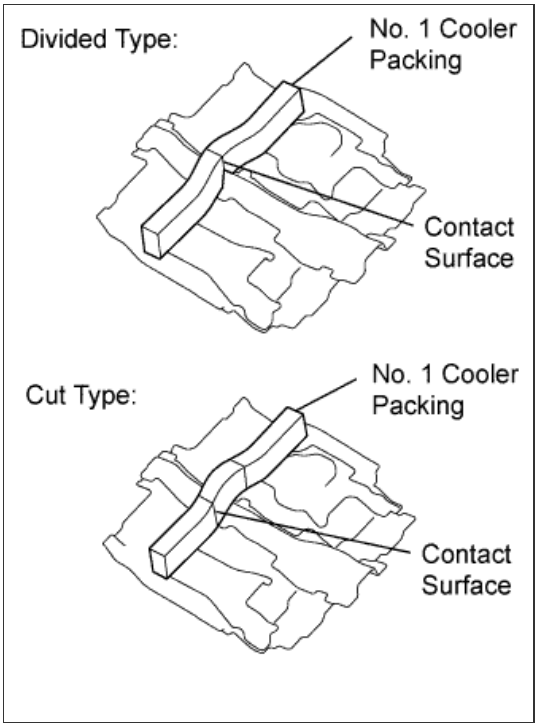
13. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the No. 1 engine under cover with the 5 bolts.



HINT:

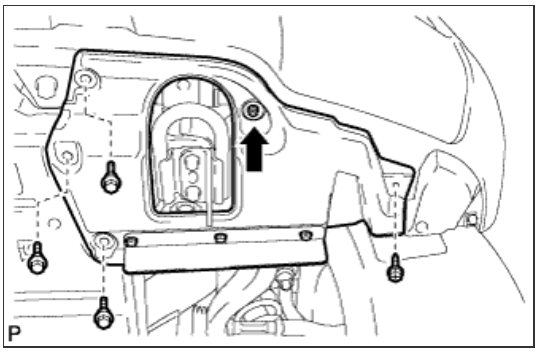
Make sure there is no gap between the ends of the No. 1 cooler packing.



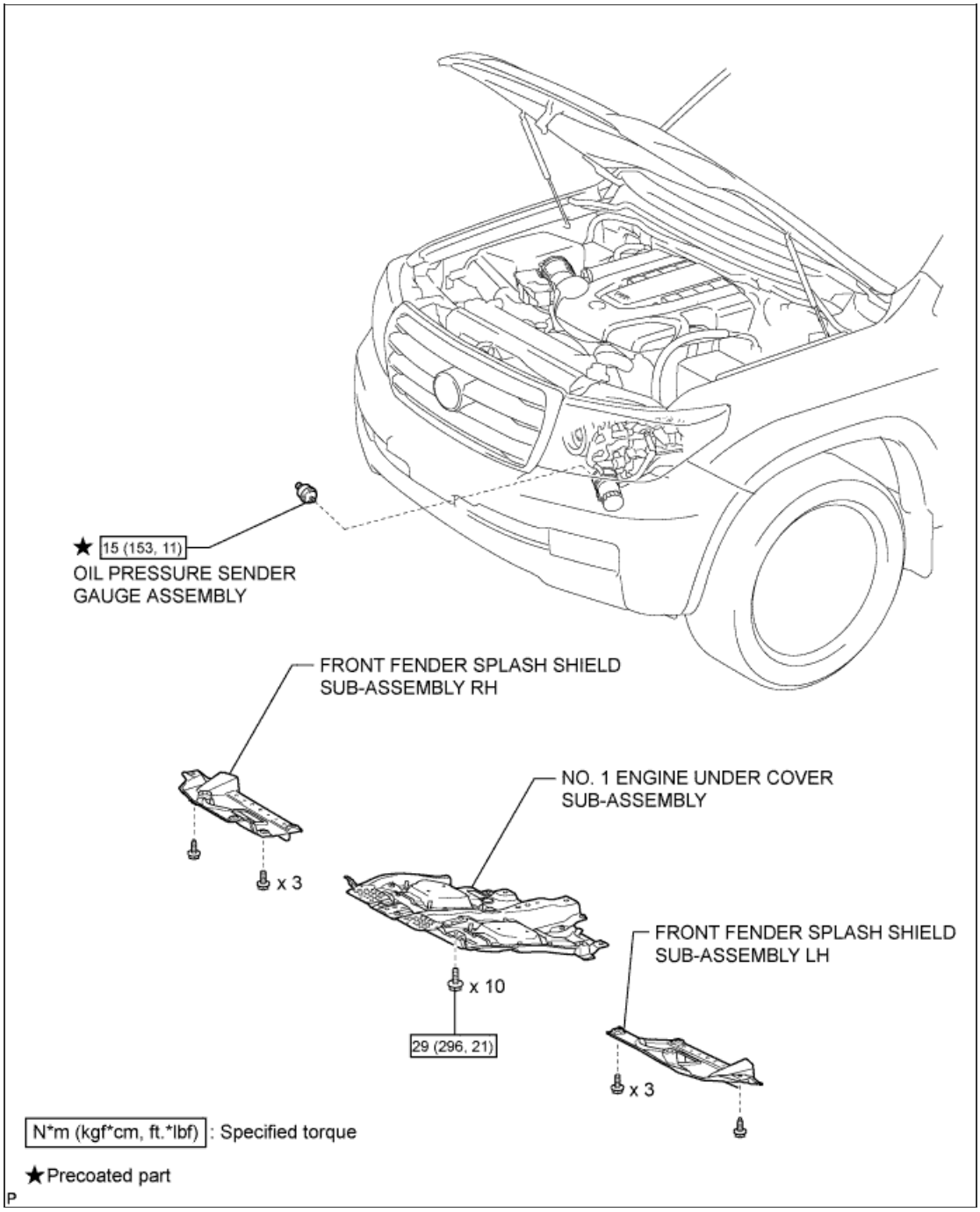
14. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



for Preparation Click here

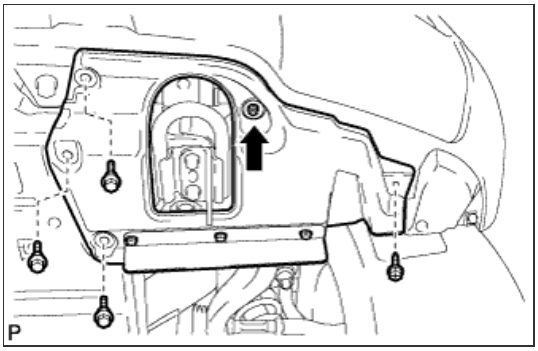


for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



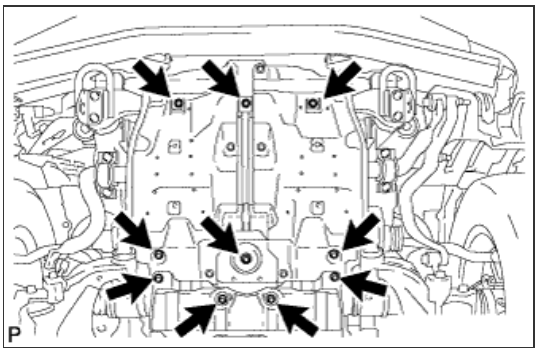
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

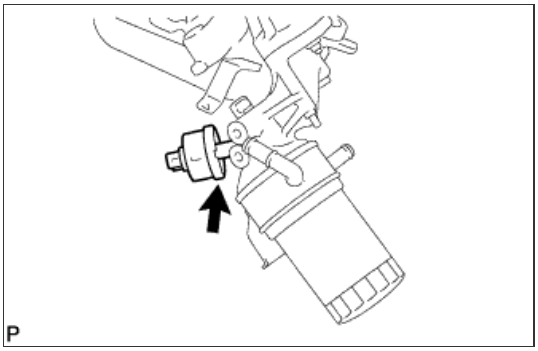
a. Remove the 10 bolts and No. 1 engine under cover.



4. REMOVE OIL PRESSURE SENDER GAUGE ASSEMBLY

a. Disconnect the sender gauge connector.

b. Remove the sender gauge.



for Preparation Click here

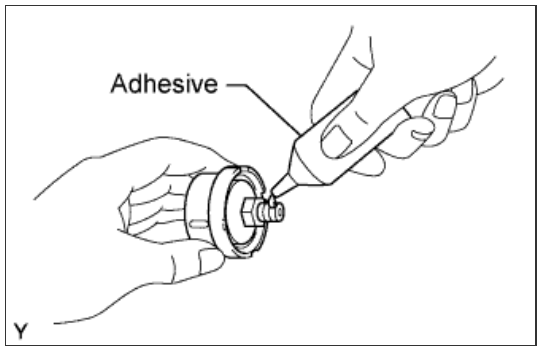
1. INSTALL OIL PRESSURE SENDER GAUGE ASSEMBLY

a. Apply adhesive to 2 or 3 threads of the sender gauge.

Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent

NOTICE:

Do not let adhesive adhere to the oil hole.



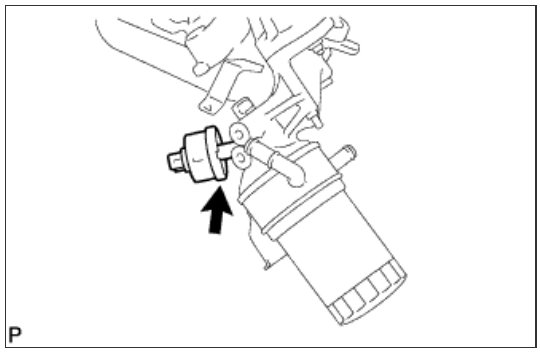
b. Install the sender gauge.

Torque:
15 N*m{ 153 kgf*cm , 11 ft.*lbf }

NOTICE:

Do not start the engine within 1 hour of installation.

c. Connect the sender gauge connector.



2. CHECK ENGINE OIL LEVEL

a. Warm up the engine, then stop the engine and wait for 5 minutes.

b. Check that the engine oil level is between the low level and full level marks on the dipstick.
If low, check for leakage and add oil up to the full level mark.

NOTICE:

Do not fill engine oil above the full level mark.

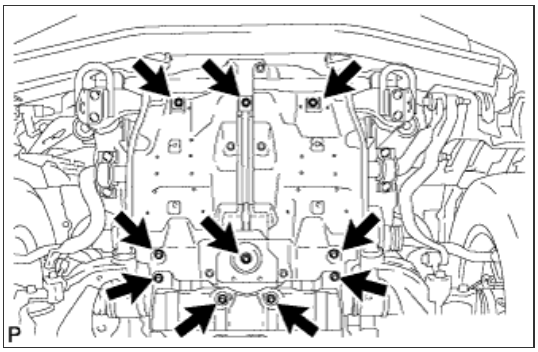
3. INSPECT FOR OIL LEAK

a. Start the engine. Make sure that there are no oil leaks from the area that was worked on.

4. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the No. 1 engine under cover with the 10 bolts.

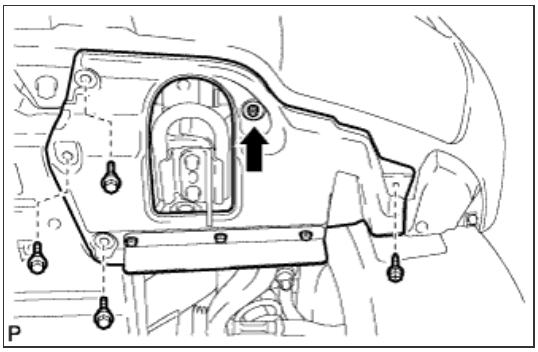
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



5. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.

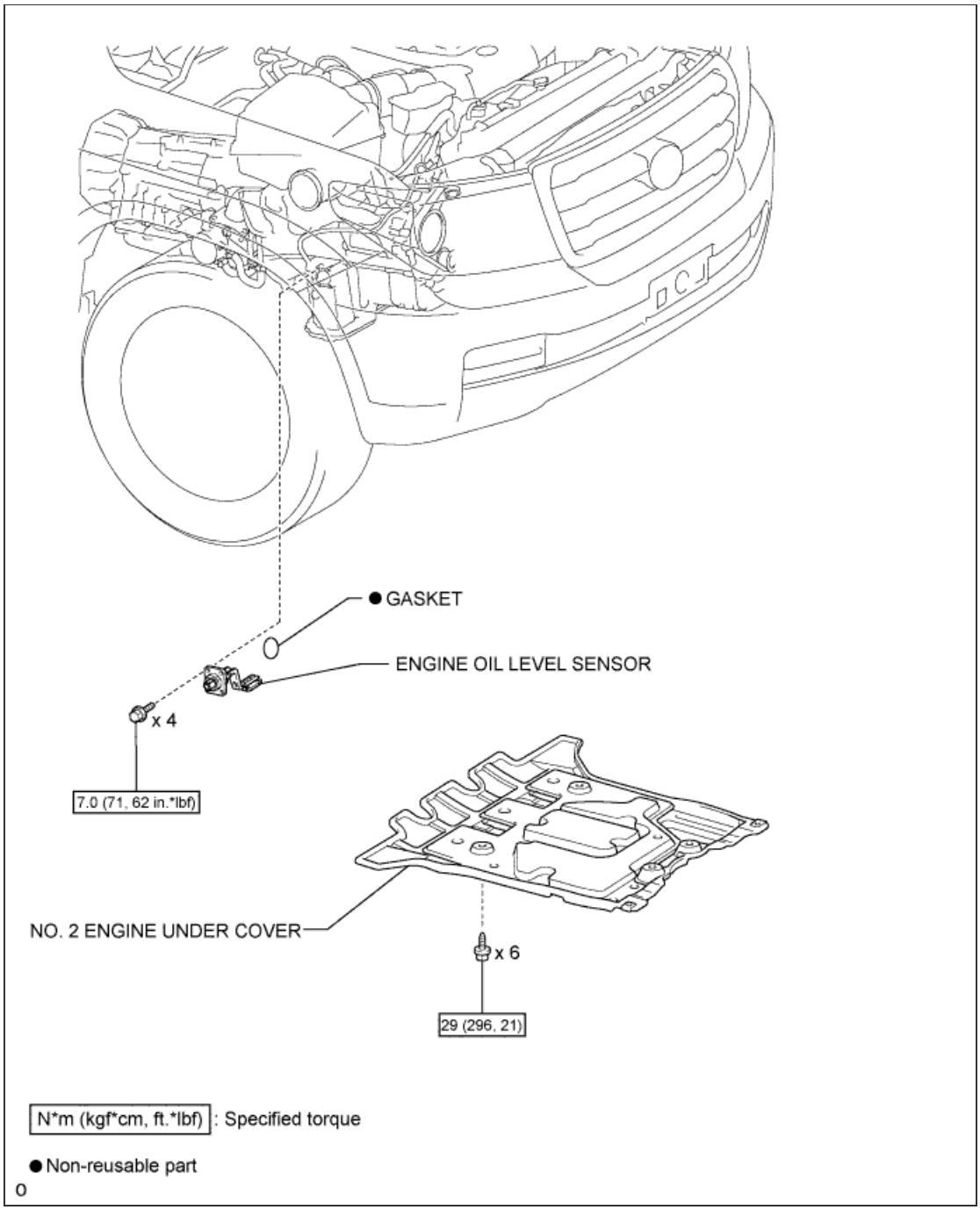


6. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

for Preparation Click here

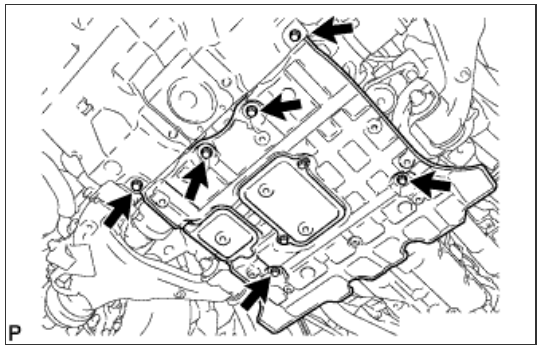


for Preparation Click here

1. REMOVE OIL FILLER CAP SUB-ASSEMBLY

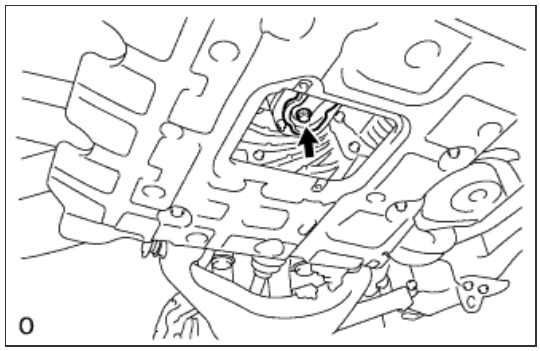
2. REMOVE NO. 2 ENGINE UNDER COVER

a. Remove the 6 bolts and under cover.



3. DRAIN ENGINE OIL

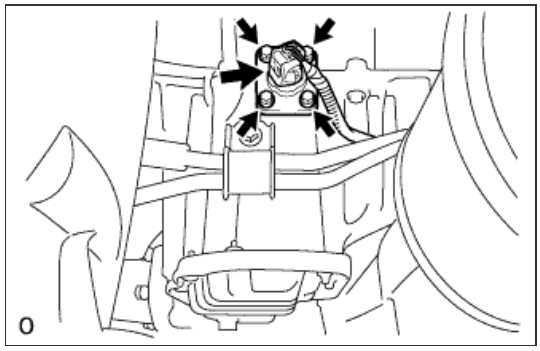
a. Remove the oil drain plug and gasket, and drain the engine oil into a container.



4. REMOVE ENGINE OIL LEVEL SENSOR

a. Disconnect the oil level sensor connector.

b. Remove the bolts and oil level sensor.



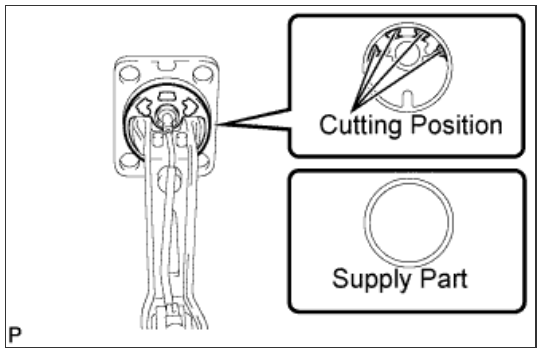
c. Cut off the gasket as shown in the illustration.

d. Remove the gasket from the oil level sensor.

HINT:

After cutting away the parts of the gasket shown in the illustration, remove

only the outer part of the gasket.



for Preparation Click here

1. INSPECT ENGINE OIL LEVEL SENSOR

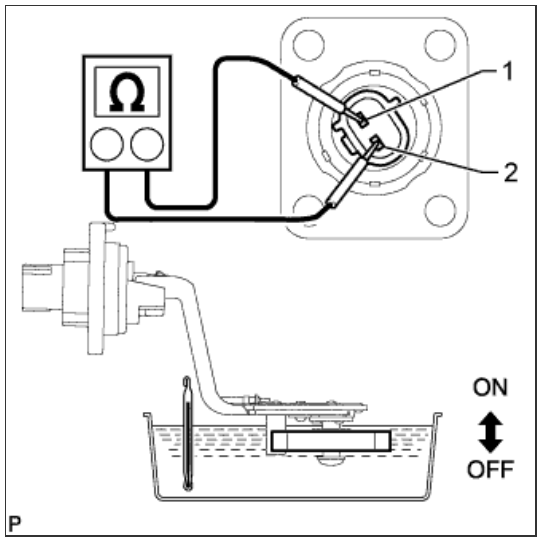
a. Partially immerse the sensor in an oil bath and warm up the oil bath.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 - 2	ON, 20°C (68°F)	Below 1 Ω
	OFF, 20°C (68°F)	Below 1 Ω
	ON, 60°C (140°F)	Below 1 Ω
	OFF, 60°C (140°F)	10 kΩ or higher

If the result is not as specified, replace the engine oil level sensor.



for Preparation Click here

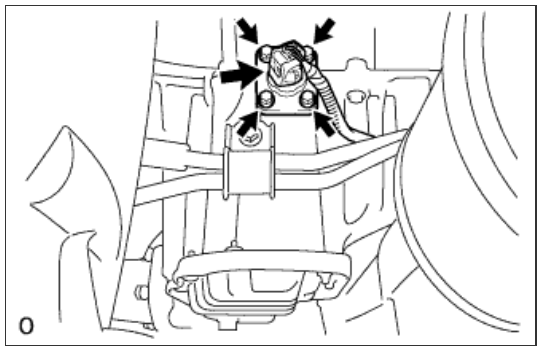
1. INSTALL ENGINE OIL LEVEL SENSOR

a. Clean the oil level sensor installation surface.

b. Install a new gasket and the oil level sensor with the 4 bolts.

Torque:
7.0 N*m{ 71 kgf*cm , 62 in.*lbf }

c. Connect the oil level sensor connector.



2. ADD ENGINE OIL

a. Install a new gasket and the drain plug.

Torque:
39 N*m{ 398 kgf*cm , 29 ft.*lbf }

b. Add new engine oil.

Standard Engine Oil:

il rade	il Viscosity (SAE)
API grade SL nergy-Conserving SM nergy-Conserving or ILSAC multigrade engine oil	10W-30 (10W-30 is best choice for fuel economy and good starting in cold weather).
API grade SL or SM multigrade engine oil	10W-30

Standard Oil Capacity:

Item	Specified Condition
Drain and refill with oil filter change	6.2 liters (6.6 US ts, 5.5 Imp. ts)
Drain and refill without oil filter change	5.7 liters (6.0 US ts, 5.0 Imp. ts)
Dry fill	7.1 liters (7.5 US ts, 6.2 Imp. ts)

3. INSTALL OIL FILLER CAP SUB-ASSEMBLY

4. CHECK ENGINE OIL LEVEL

a. Warm up the engine, then stop the engine and wait for 5 minutes.

b. Check that the engine oil level is between the low level and full level marks on the dipstick.
If low, check for leakage and add oil up to the full level mark.

NOTICE:

Do not fill engine oil above the full level mark.

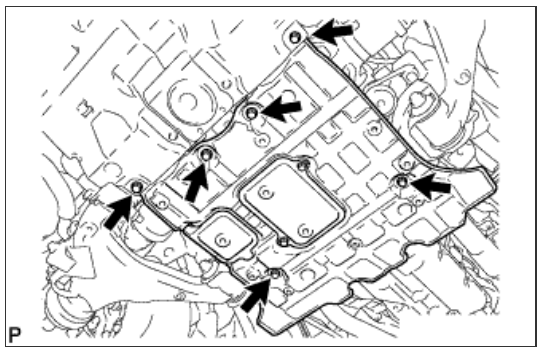
5. INSPECT FOR OIL LEAK

a. Start the engine. Make sure that there are no oil leaks from the area that was worked on.

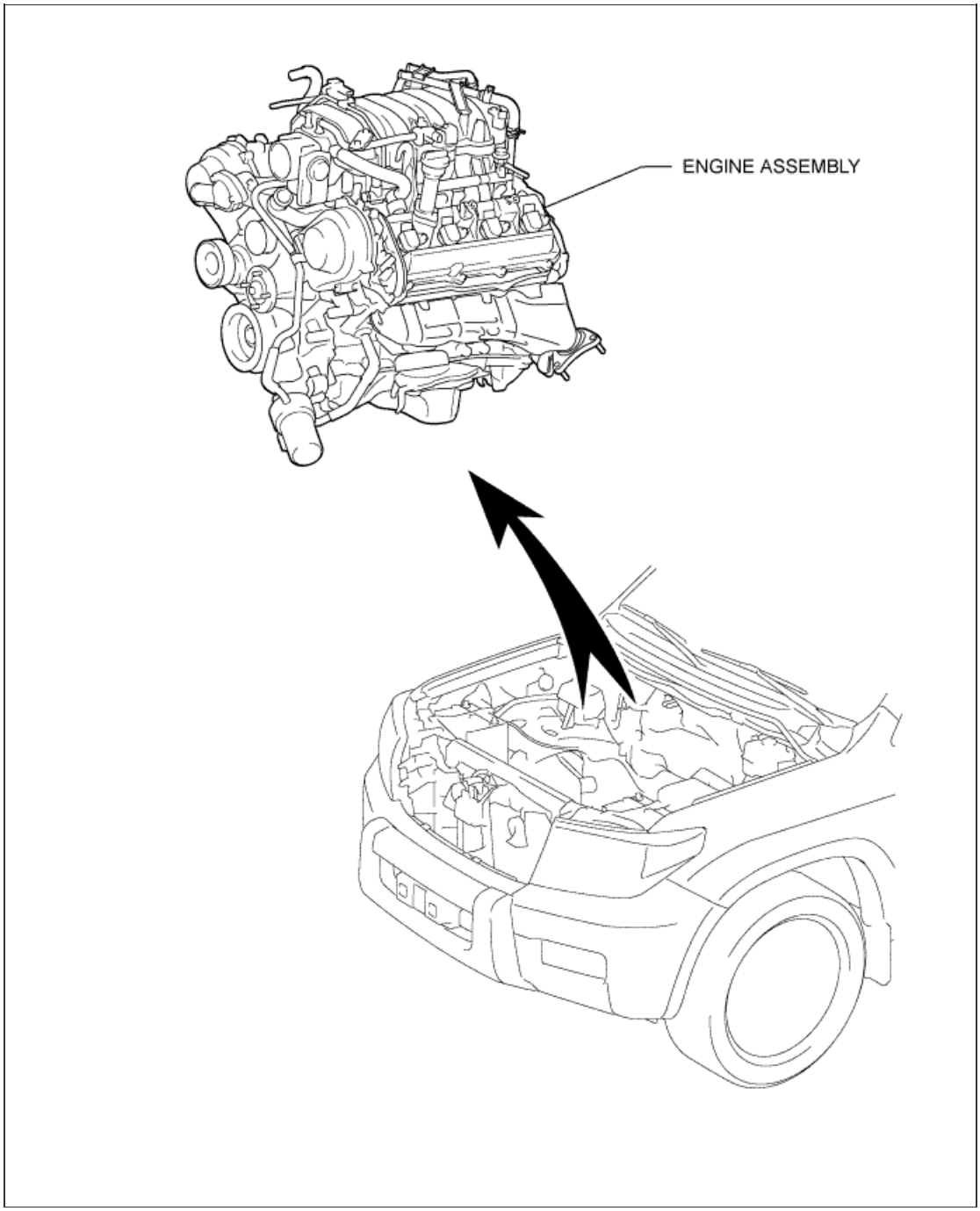
6. INSTALL NO. 2 ENGINE UNDER COVER

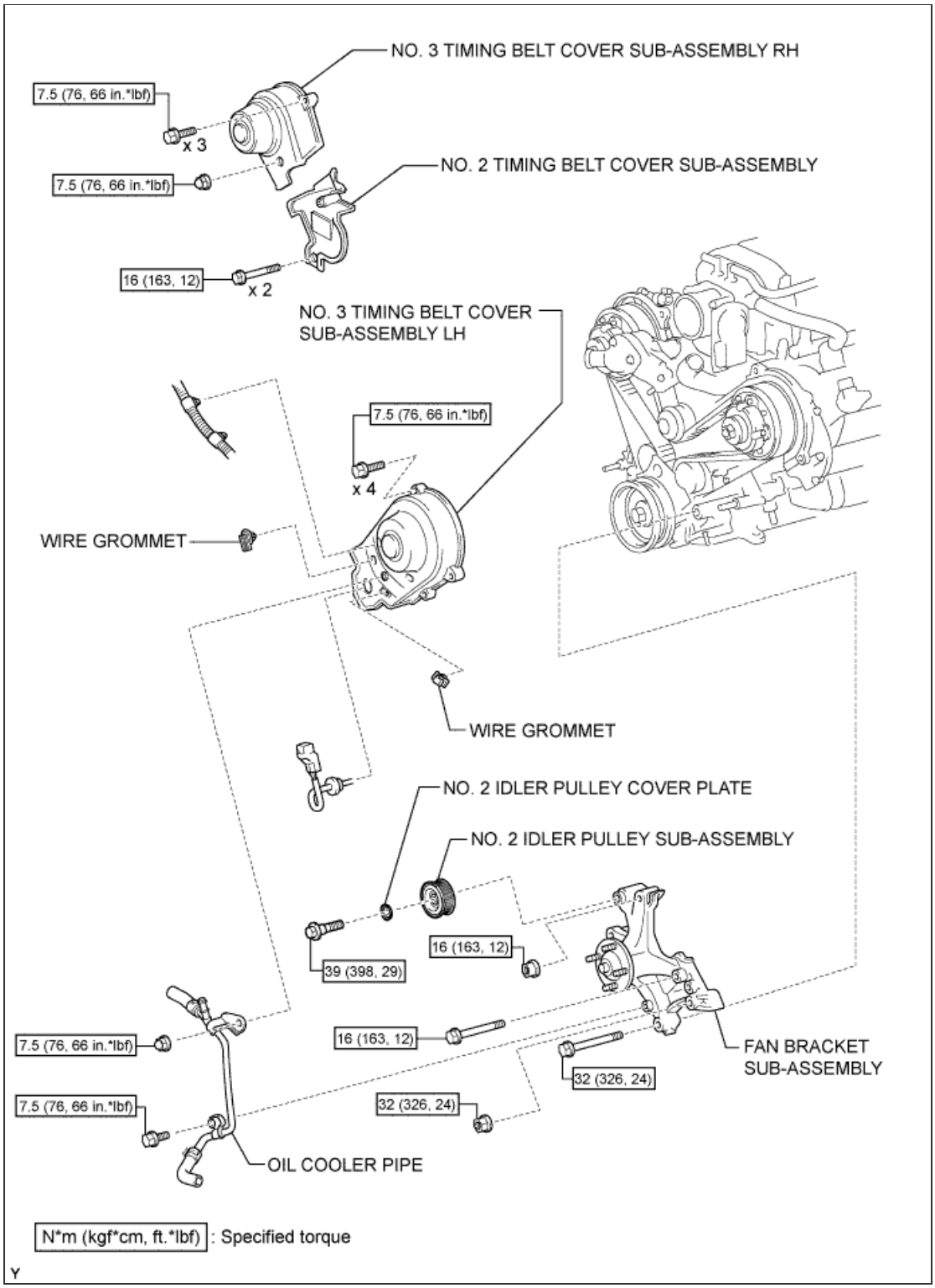
a. Install the under cover with the 6 bolts.

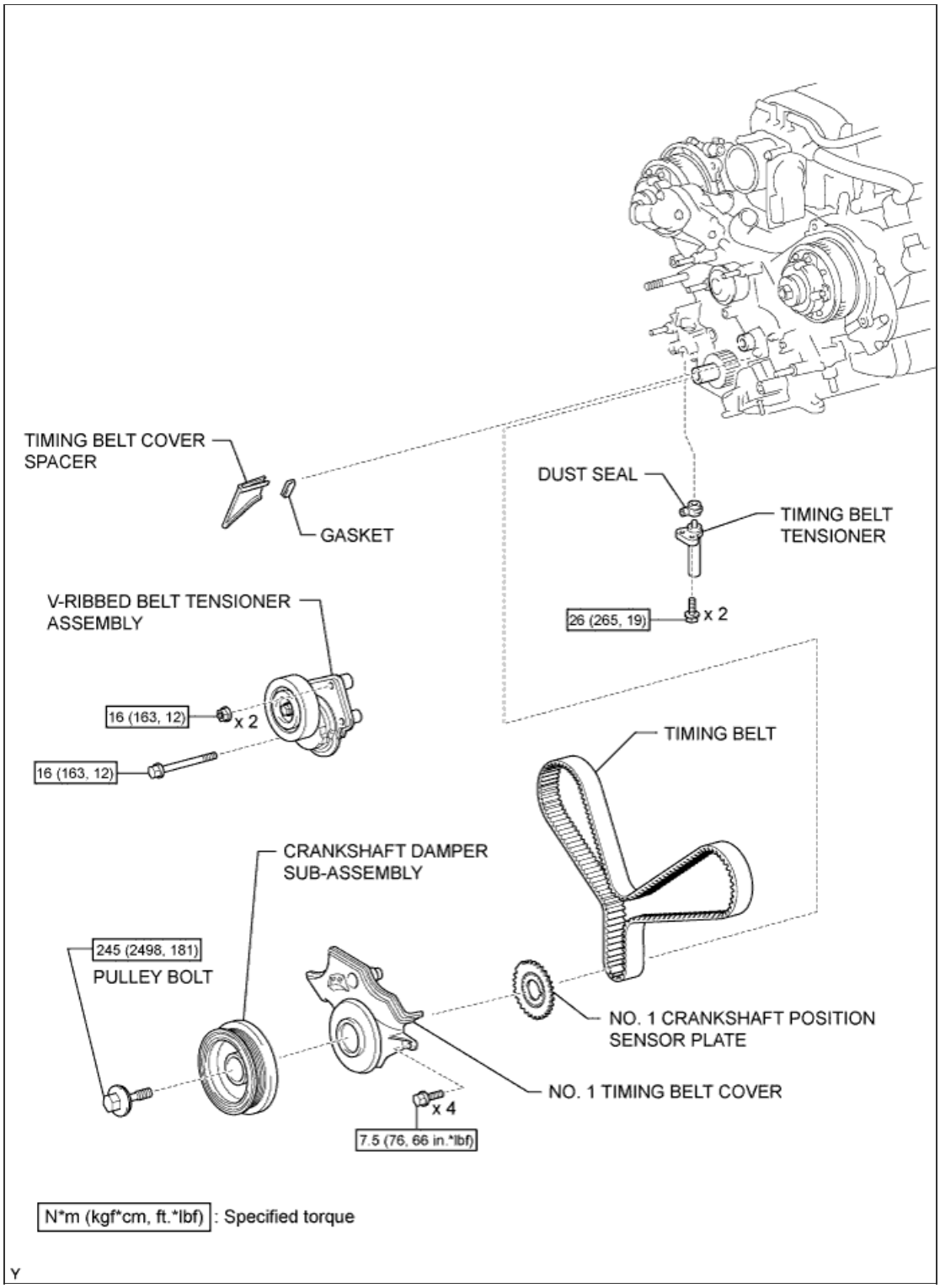
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



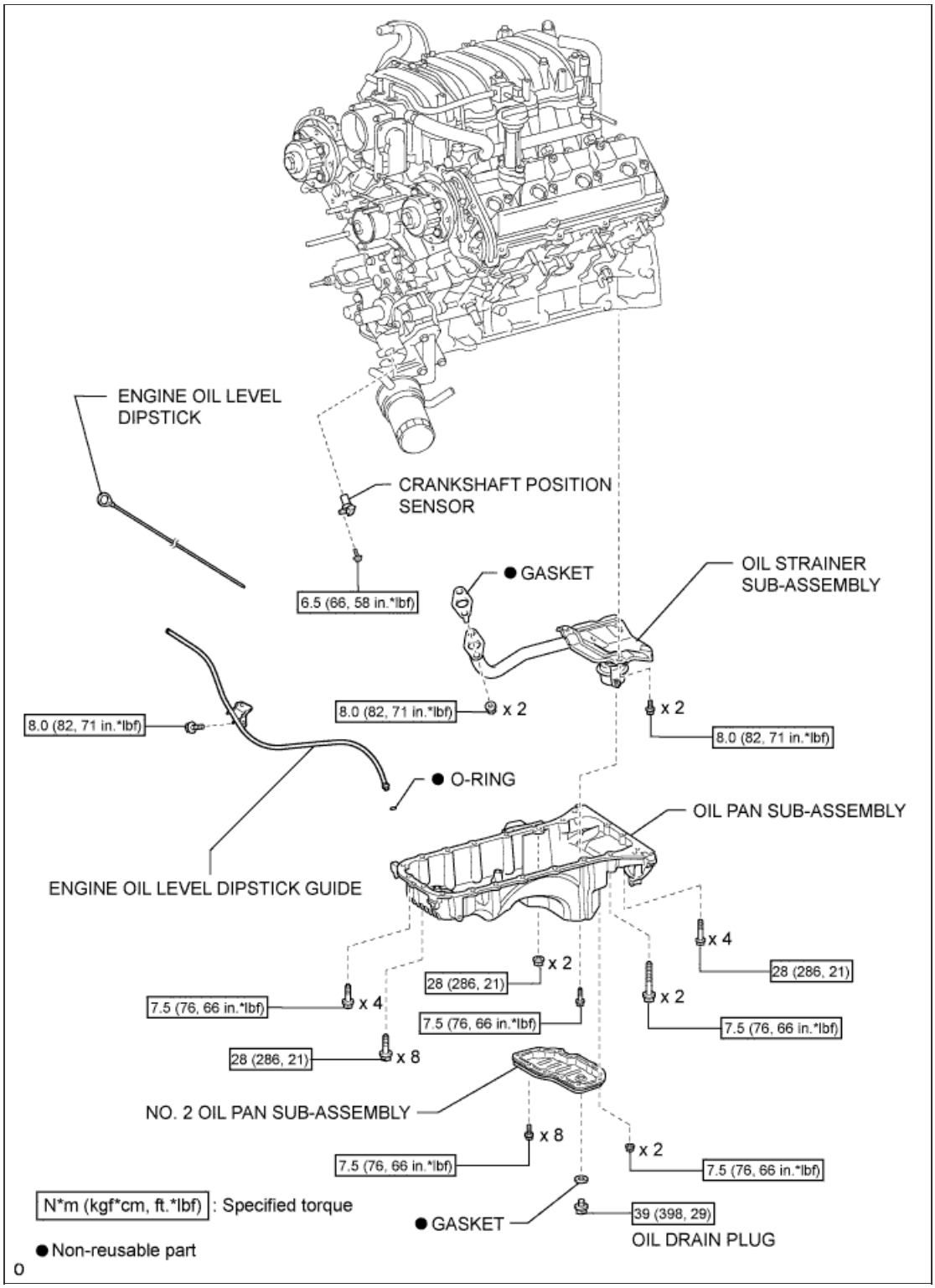
for Preparation Click here

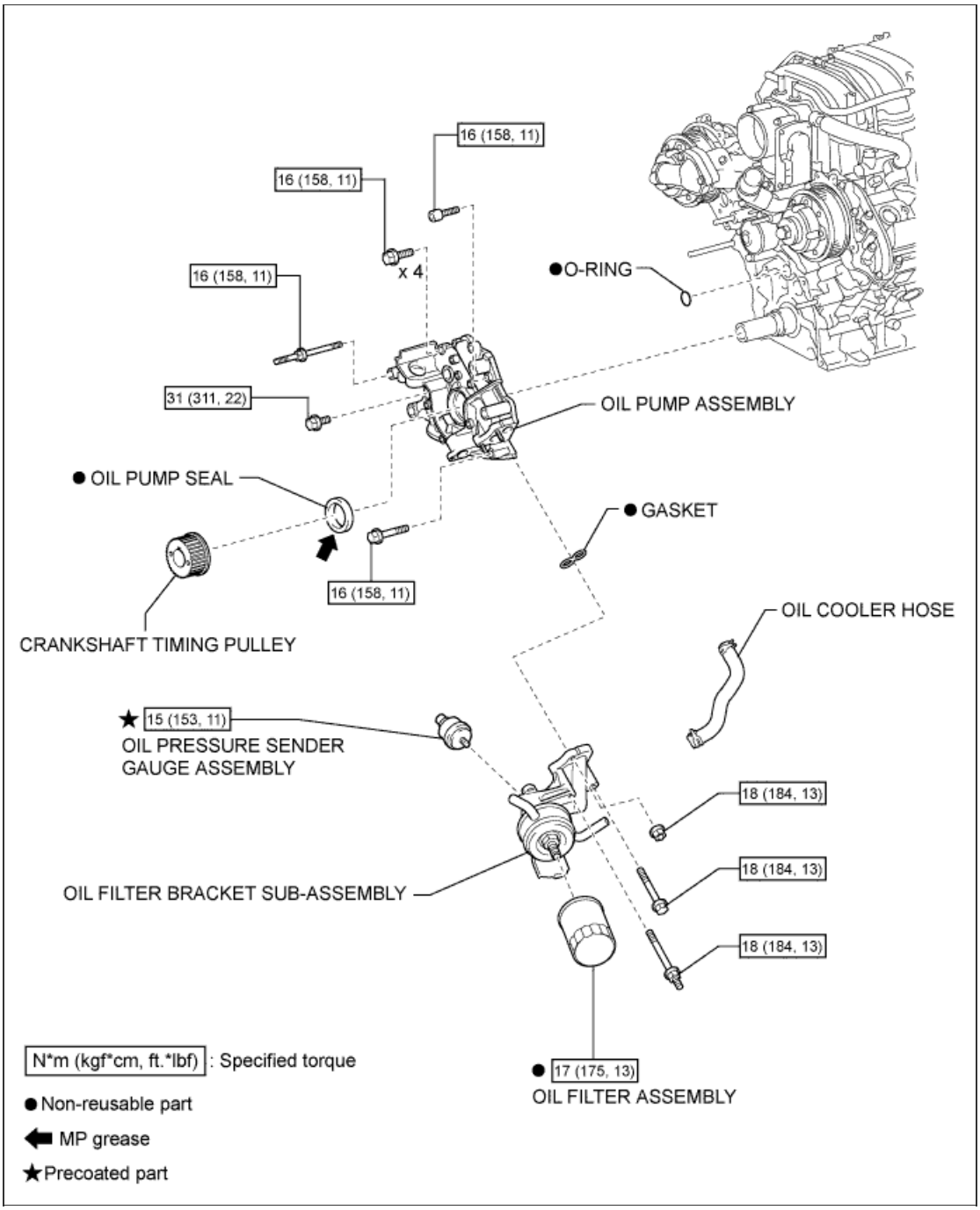


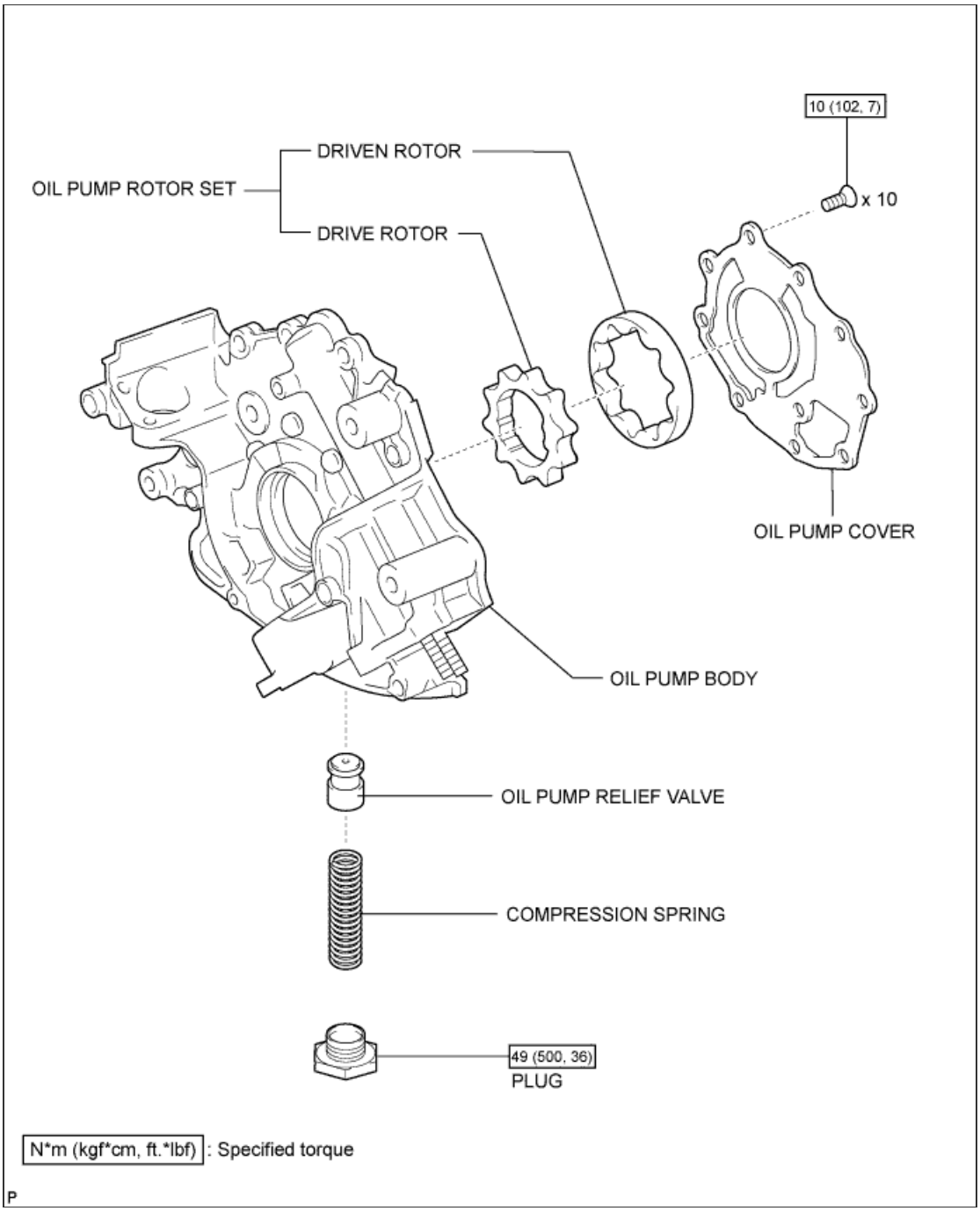

NO. 3 TIMING BELT COVER SUB-ASSEMBLY RH
7.5 (76, 66 in.*lbf)
x 3
NO. 2 TIMING BELT COVER SUB-ASSEMBLY
7.5 (76, 66 in.*lbf)
16 (163, 12)
x 2
NO. 3 TIMING BELT COVER SUB-ASSEMBLY LH
7.5 (76, 66 in.*lbf)
x 4
WIRE GROMMET
WIRE GROMMET
NO. 2 IDLER PULLEY COVER PLATE
NO. 2 IDLER PULLEY SUB-ASSEMBLY
39 (398, 29)
16 (163, 12)
7.5 (76, 66 in.*lbf)
16 (163, 12)
32 (326, 24)
FAN BRACKET SUB-ASSEMBLY
7.5 (76, 66 in.*lbf)
32 (326, 24)
OIL COOLER PIPE
N*m (kgf*cm, ft.*lbf) : Specified torque
Y


TIMING BELT COVER SPACER
GASKET
DUST SEAL
TIMING BELT TENSIONER
26 (265, 19)
x 2
V-RIBBED BELT TENSIONER ASSEMBLY
16 (163, 12)
x 2
16 (163, 12)
TIMING BELT
CRANKSHAFT DAMPER SUB-ASSEMBLY
245 (2498, 181)
PULLEY BOLT
NO. 1 CRANKSHAFT POSITION SENSOR PLATE
NO. 1 TIMING BELT COVER
x 4
7.5 (76, 66 in.*lbf)
N*m (kgf*cm, ft.*lbf) : Specified torque

Y


ENGINE OIL LEVEL DIPSTICK
CRANKSHAFT POSITION SENSOR
6.5 (66, 58 in.*lbf)
● GASKET
OIL STRAINER SUB-ASSEMBLY
8.0 (82, 71 in.*lbf)
x 2
8.0 (82, 71 in.*lbf)
x 2
8.0 (82, 71 in.*lbf)
● O-RING
OIL PAN SUB-ASSEMBLY
ENGINE OIL LEVEL DIPSTICK GUIDE
x 4
28 (286, 21)
x 2
28 (286, 21)
7.5 (76, 66 in.*lbf)
x 4
x 2
7.5 (76, 66 in.*lbf)
7.5 (76, 66 in.*lbf)
28 (286, 21)
x 8
NO. 2 OIL PAN SUB-ASSEMBLY
x 8
7.5 (76, 66 in.*lbf)
x 2
7.5 (76, 66 in.*lbf)
N*m (kgf*cm, ft.*lbf) : Specified torque
● GASKET
39 (398, 29)
OIL DRAIN PLUG
● Non-reusable part
0


16 (158, 11)
16 (158, 11)
x 4
16 (158, 11)
●O-RING
31 (311, 22)
OIL PUMP ASSEMBLY
● OIL PUMP SEAL
● GASKET
16 (158, 11)
CRANKSHAFT TIMING PULLEY
OIL COOLER HOSE
★ 15 (153, 11)
OIL PRESSURE SENDER GAUGE ASSEMBLY
18 (184, 13)
18 (184, 13)
18 (184, 13)
OIL FILTER BRACKET SUB-ASSEMBLY
● 17 (175, 13)
OIL FILTER ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
MP grease
★Precoated part


10 (102, 7)
DRIVEN ROTOR
OIL PUMP ROTOR SET
DRIVE ROTOR
x 10
OIL PUMP COVER
OIL PUMP BODY
OIL PUMP RELIEF VALVE
COMPRESSION SPRING
49 (500, 36)
PLUG
N*m (kgf*cm, ft.*lbf) : Specified torque
P

for Preparation Click here

1. DISCHARGE FUEL SYSTEM PRESSURE

a. Discharge the fuel system pressure (Click here).

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

3. REMOVE ENGINE ASSEMBLY

a. Remove the engine assembly from the vehicle (Click here).

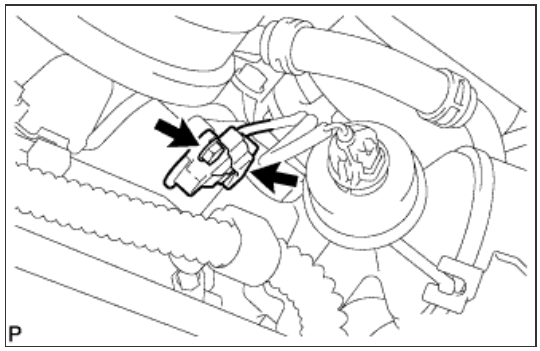
4. REMOVE TIMING BELT

a. Remove the timing belt (Click here).

5. REMOVE CRANKSHAFT POSITION SENSOR

a. Disconnect the sensor connector.

b. Remove the bolt and sensor.

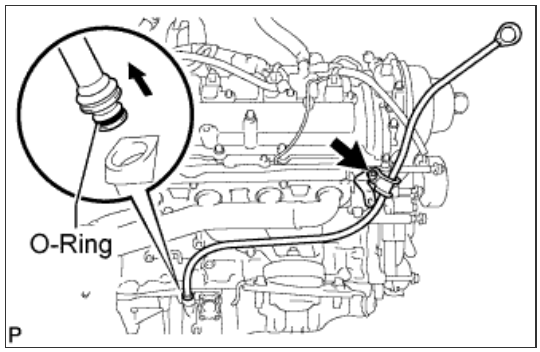


6. REMOVE ENGINE OIL LEVEL DIPSTICK GUIDE

a. Remove the dipstick.

b. Remove the bolt and dipstick guide.

c. Remove the O-ring from the dipstick guide.



7. REMOVE CRANKSHAFT TIMING PULLEY

a. Using SST, remove the timing pulley.

SST

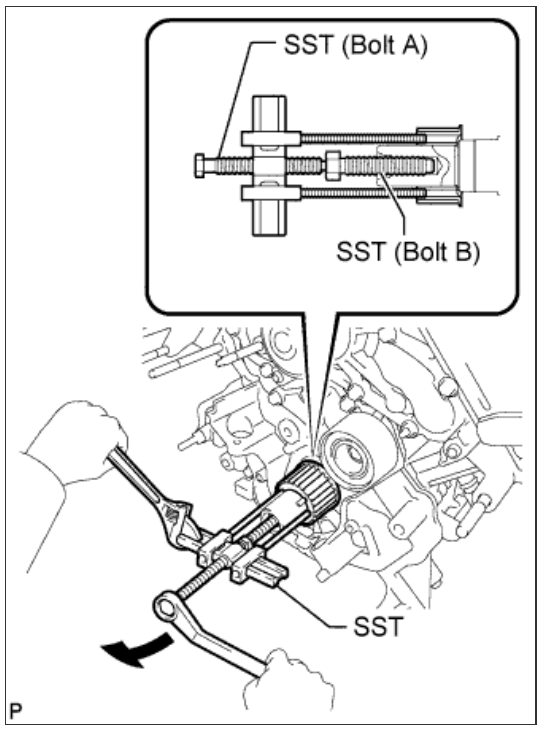
09950-50013 (09951-05010, 09952-05010, 09953-05010, 09953-05020, 09954-05011)

HINT:

Apply a lubricant to the threads and end of SST.

Parts N ber:

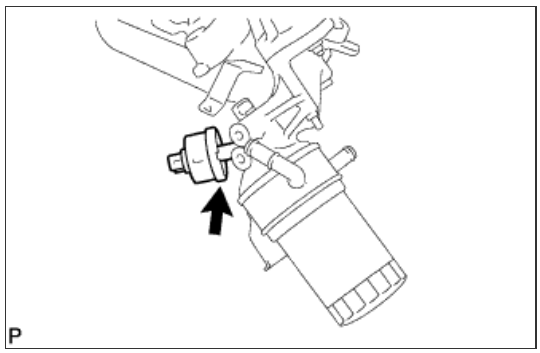
Item	Parts number
SST (Bolt A)	09953-05020
SST (Bolt B)	09953-05010



8. REMOVE OIL PRESSURE SENDER GAUGE ASSEMBLY

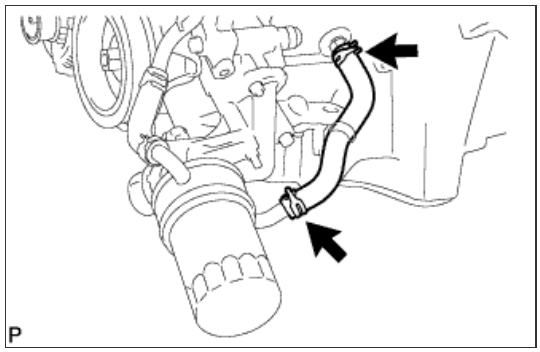
a. Disconnect the sender gauge connector.

b. Remove the sender gauge.



9. REMOVE OIL COOLER HOSE

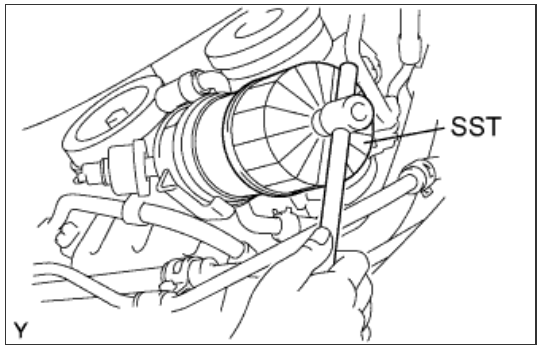
a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to remove the oil cooler hose.



10. REMOVE OIL FILTER ASSEMBLY

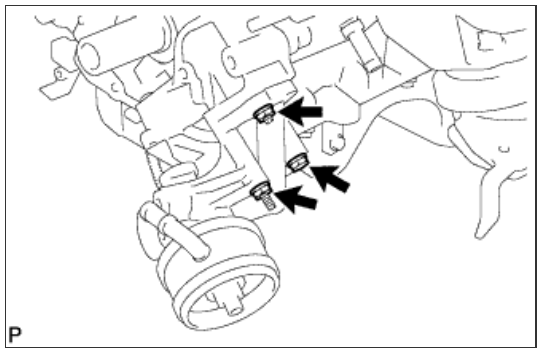
a. Using SST, remove the oil filter.

SST
09228-07501



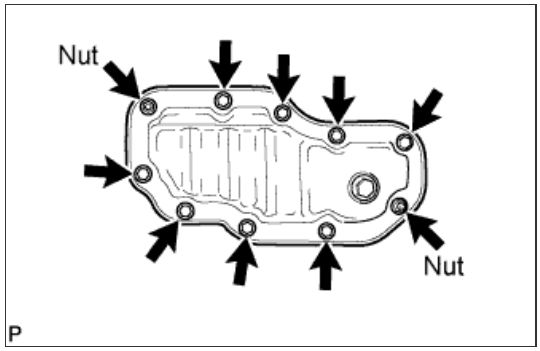
11. REMOVE OIL FILTER BRACKET SUB-ASSEMBLY

a. Remove the bolt, nut, stud bolt, oil filter bracket and gasket.



12. REMOVE NO. 2 OIL PAN SUB-ASSEMBLY

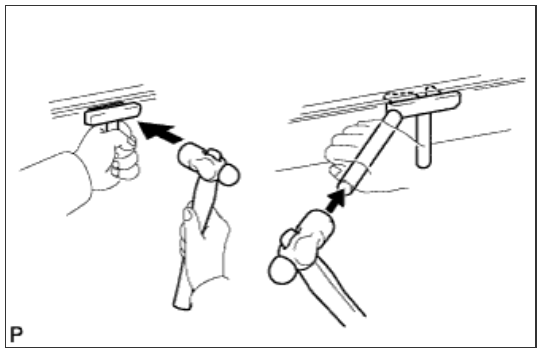
a. Remove the 8 bolts and 2 nuts.



b. Insert the blade of an oil pan seal cutter between the oil pans, cut off applied sealer and remove the No. 2 oil pan.

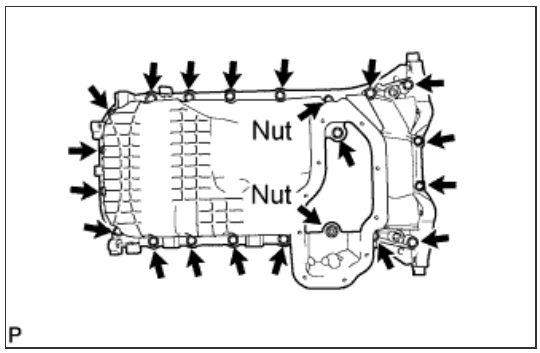
NOTICE:

- **Be caref l not to damage the No. 2 oil pan contact s rface of the oil pan.**
- **Be caref l not to damage the No. 2 oil pan flange.**



13. REMOVE OIL PAN SUB-ASSEMBLY

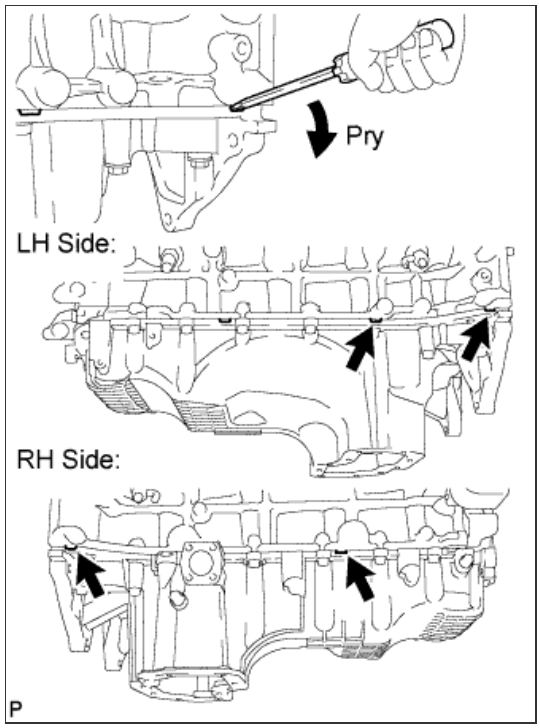
a. Remove the 19 bolts and 2 nuts.



b. Using a screwdriver, remove the oil pan by prying between the oil pan and cylinder block as shown in the illustration.

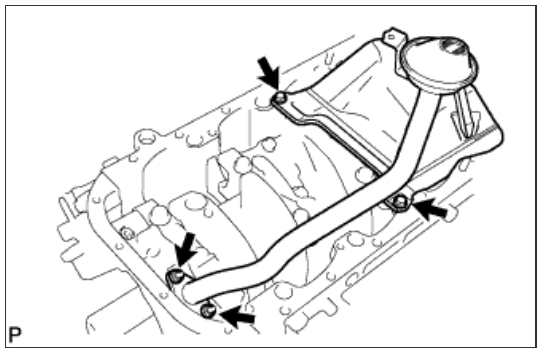
NOTICE:

Be careful not to damage the contact surfaces of the cylinder block and oil pan.



14. REMOVE OIL STRAINER SUB-ASSEMBLY

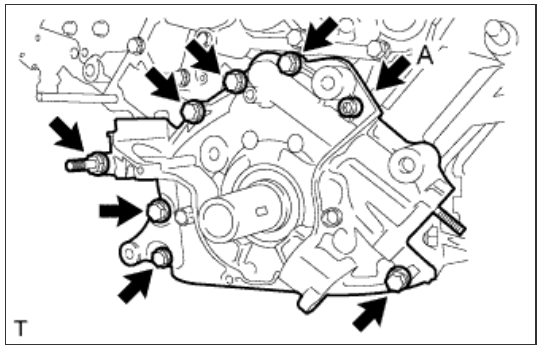
a. Remove the 2 bolts, 2 nuts, oil strainer and gasket.



15. REMOVE OIL PUMP ASSEMBLY

a. Using a 6 mm hexagon wrench, remove bolt A.

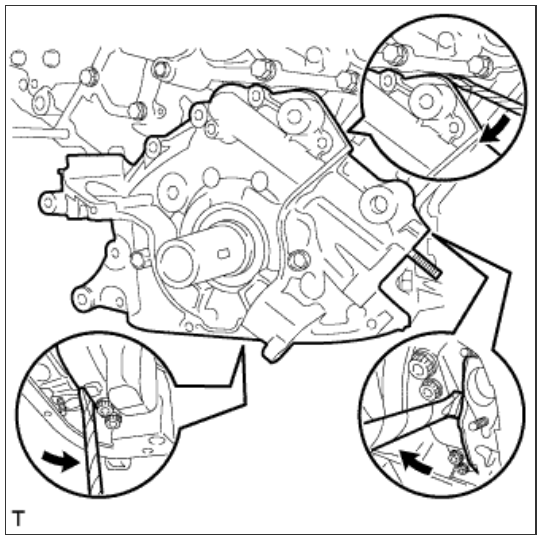
b. Remove the 6 bolts and stud bolt.



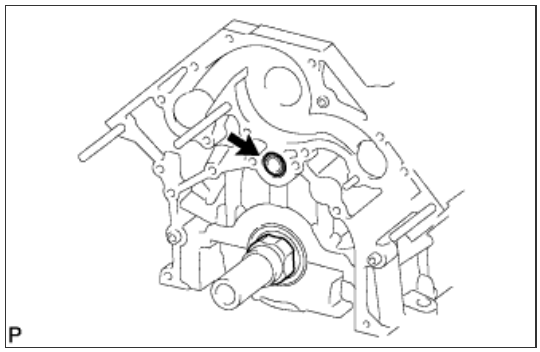
c. Using a screwdriver, remove the oil pump by prying the portions between the oil pump and cylinder block shown in the illustration.

NOTICE:

Be careful not to damage the contact surfaces of the cylinder block and oil pump.



d. Remove the O-ring from the cylinder block.



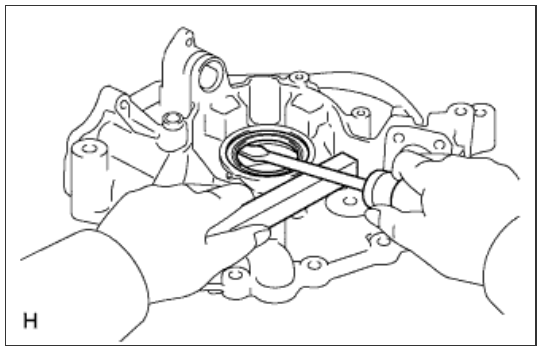
for Preparation Click here

1. REMOVE OIL PUMP SEAL

a. Using a screwdriver and wooden block, pry out the oil seal.

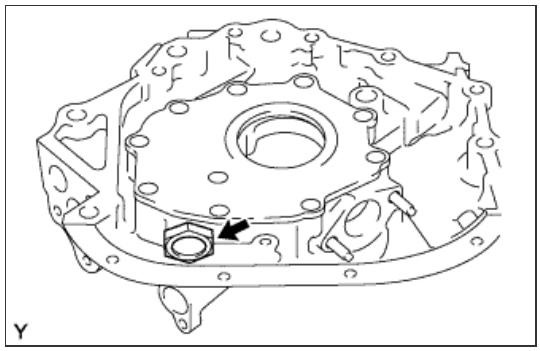
NOTICE:

Do not damage the surface of the oil seal press fit hole.



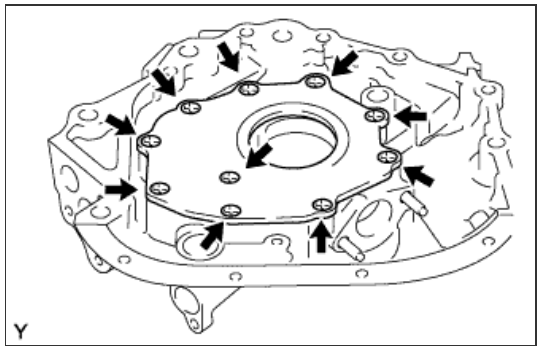
2. REMOVE OIL PUMP RELIEF VALVE

a. Remove the plug, compression spring and relief valve.



3. REMOVE OIL PUMP COVER

a. Remove the 10 screws and pump cover.



4. REMOVE OIL PUMP ROTOR SET

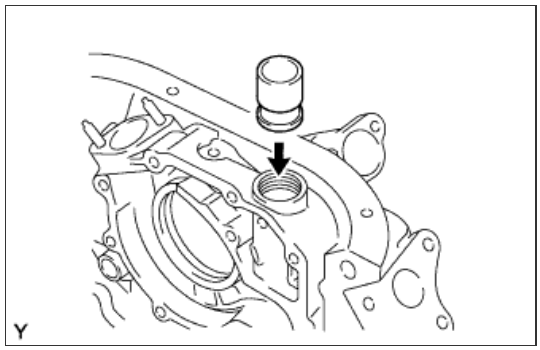
a. Remove the drive and driven rotors.

for Preparation Click here

1. INSPECT OIL PUMP RELIEF VALVE

a. Coat the relief valve with engine oil and drop it into the relief valve hole.

b. Check that the relief valve falls in smoothly by its own weight.
If it does not, replace the relief valve. If necessary, replace the oil pump assembly.



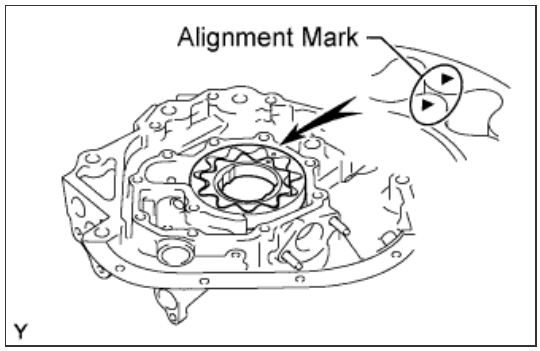
2. INSPECT OIL PUMP ROTOR SET

a. Apply engine oil to the oil pump rotor set.

b. Install the oil pump rotor set to the oil pump body and check that it rotates smoothly.

HINT:

Face the marks on the oil pump rotor set towards the oil pump cover side.



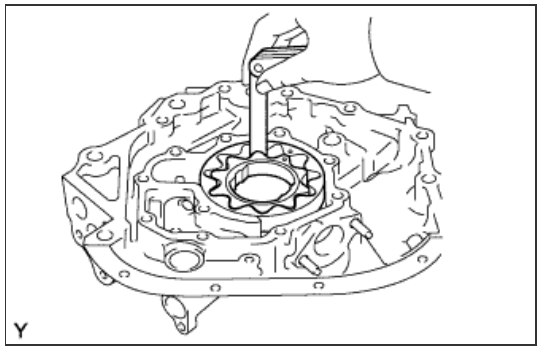
c. Inspect the rotor tip clearance.

i. Using a feeler gauge, measure the clearance between the drive and driven rotor tips.

Standard tip clearance:
0.06 to 0.18 mm (0.00236 to 0.00709 in.)

Maximum tip clearance:
0.18 mm (0.00709 in.)

If the tip clearance is more than the maximum, replace the oil pump assembly.



d. Inspect the rotor side clearance.

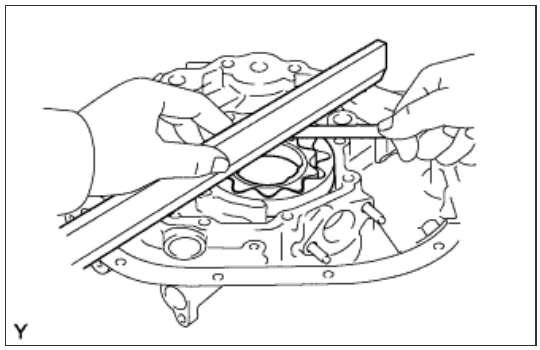
i. Using a feeler gauge and precision straightedge, measure the clearance between the rotors and precision straightedge.

Standard side clearance:
0.03 to 0.09 mm (0.00118 to 0.00354 in.)

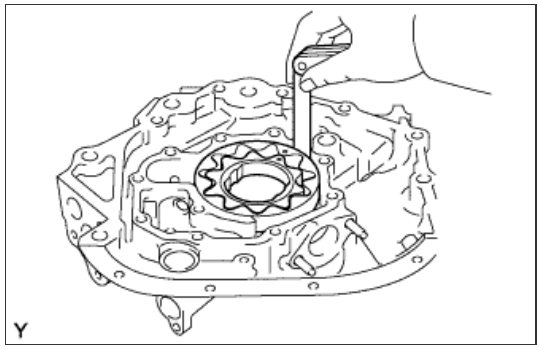
Maximum side clearance:
0.09 mm (0.00354 in.)

If the side clearance is more than the maximum, replace the oil pump

assembly.



e. Inspect the rotor body clearance.



i. Using a feeler gauge, measure the clearance between the driven rotor and body.

Standard body clearance:
0.250 to 0.325 mm (0.00984 to 0.0128 in.)

Maximum body clearance:
0.325 mm (0.0128 in.)

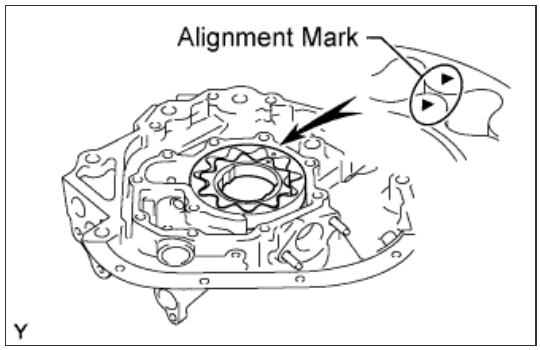
If the body clearance is more than the maximum, replace the oil pump assembly.

for Preparation Click here

1. INSTALL OIL PUMP ROTOR SET

a. Apply engine oil to the oil pump rotor set.

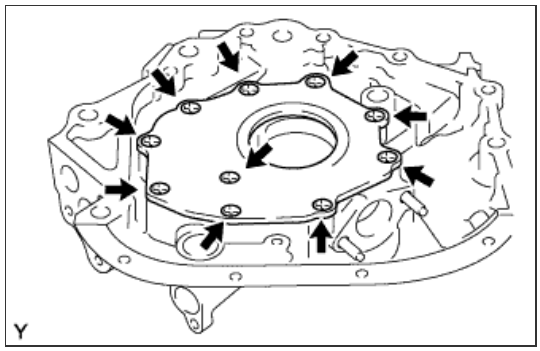
b. Place the drive and driven rotors into the pump body with the marks facing the oil pump cover side.



2. INSTALL OIL PUMP COVER

a. Install the oil pump cover with the 10 screws.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

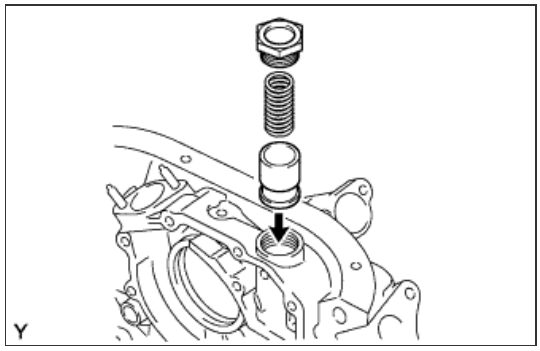


3. INSTALL OIL PUMP RELIEF VALVE

a. Insert the relief valve and compression spring into the oil pump body hole.

b. Install the relief valve plug.

Torque:
49 N*m{ 500 kgf*cm , 36 ft.*lbf }



4. INSTALL OIL PUMP SEAL

a. Using SST and a hammer, tap in a new oil seal until its surface is flush with the oil pump body edge.

SST
09316-60011 (09316-00011)

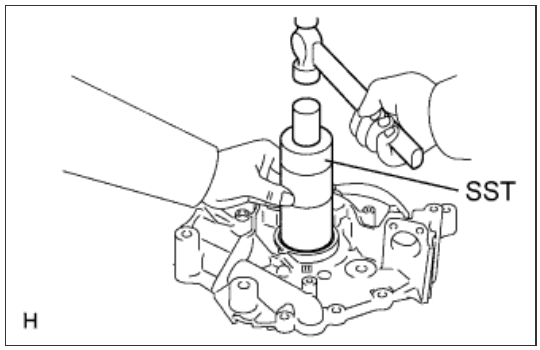
NOTICE:

- **Keep the lip free from foreign matter.**
- **Do not tap the oil seal at an angle.**

b. Apply MP grease to the lip of the oil seal.

NOTICE:

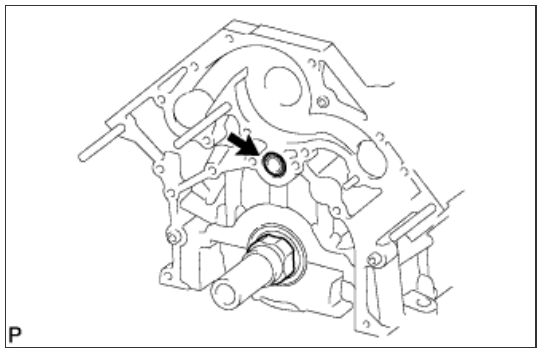
- **Do not allow foreign matter to contact the lip.**
- **Do not allow MP grease to contact the dust seal.**



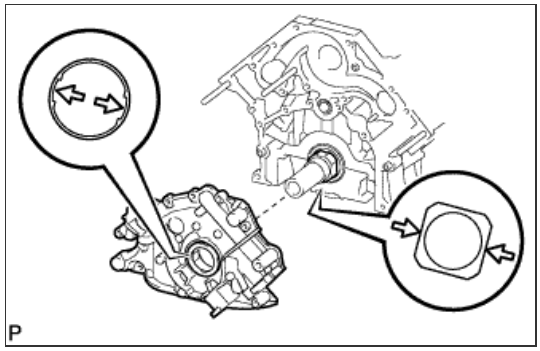
for Preparation Click here

1. INSTALL OIL PUMP ASSEMBLY

a. Apply a light coat of engine oil to a new O-ring and install it to the cylinder block.



b. Align the oil pump drive rotor spline and the crankshaft as shown in the illustration.



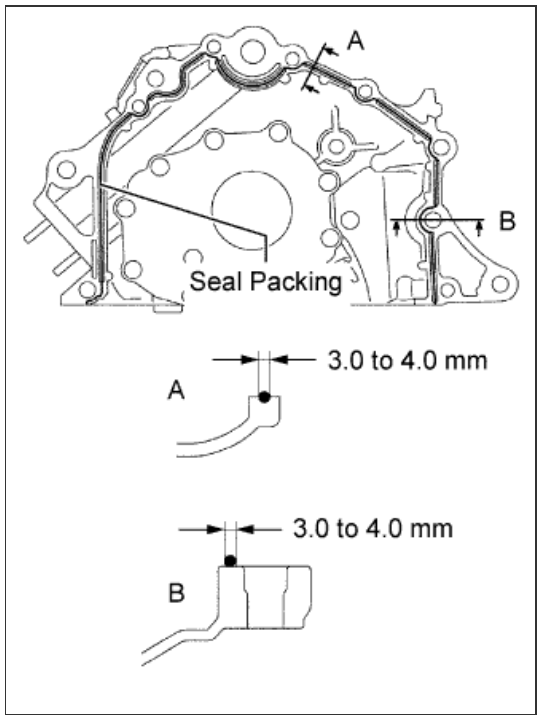
c. Apply seal packing to the oil pump as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
3.0 to 4.0 mm (0.118 to 0.157 in.)

NOTICE:

- **Install the oil pump within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**
- **Be careful not to drop any oil on the contact surfaces of the oil pump and cylinder block.**
- **Do not expose the seal to engine oil for at least 2 hours after installing it.**



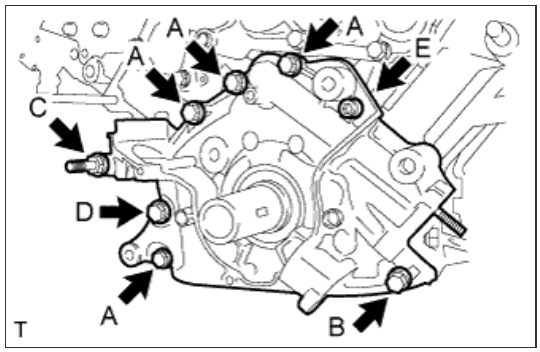
d. Install the oil pump with the stud bolt, 6 standard bolts and the 6 mm hexagon wrench bolt. Uniformly tighten the bolts in several steps.

Torque:
for bolt A, B, C, E:

16 N*m{ 163 kgf*cm , 12 ft.*lbf }
for bolt D:
31 N*m{ 316 kgf*cm , 23 ft.*lbf }

Bolt Length:

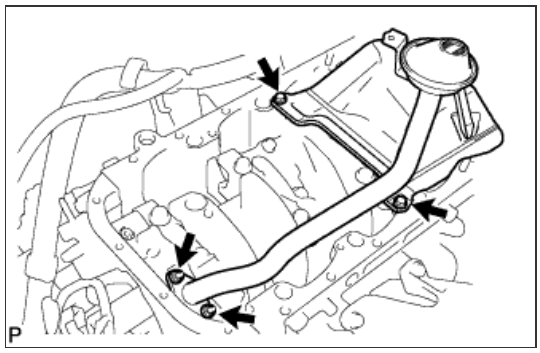
Item	Bolt Head Size	Length
Bolt A	12 mm	35 mm (1.38 in.)
Bolt B	12 mm	50 mm (1.97 in.)
Bolt C	14 mm	103 mm (4.06 in.)
Bolt D	14 mm	44 mm (1.73 in.)
Bolt E	6 mm hexagon	28 mm (1.10 in.)



2. INSTALL OIL STRAINER SUB-ASSEMBLY

a. Install a new gasket and the oil strainer with the 2 bolts and 2 nuts.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }



3. INSTALL OIL PAN SUB-ASSEMBLY

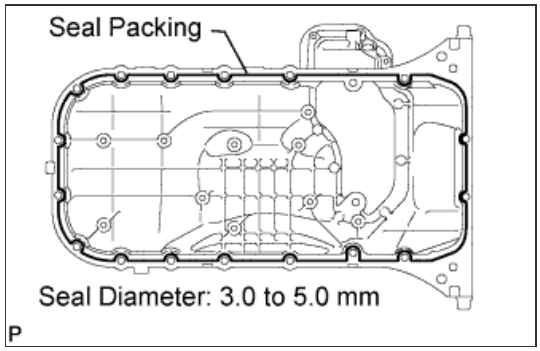
a. Apply seal packing to the oil pan as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
3.0 to 5.0 mm (0.118 to 0.197 in.)

NOTICE:

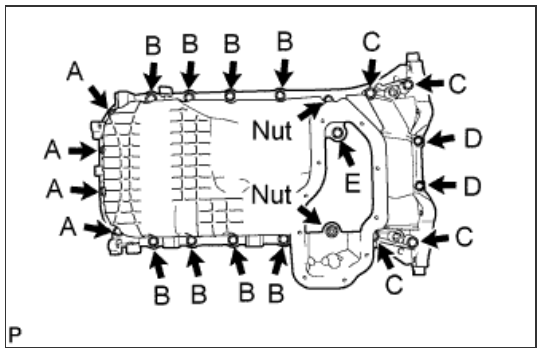
- **Install the oil pan within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**
- **Be careful not to drop any oil on the contact surfaces of the oil pan and cylinder block.**
- **Do not expose the seal to engine oil for at least 2 hours after installing it.**



b. Temporarily install the oil pan with the 19 bolts and 2 nuts.

Bolt Length:

Item	Bolt Head Size	Length
Bolt A	10 mm	22 mm (0.866 in.)
Bolt B	12 mm	25 mm (0.984 in.)
Bolt C	12 mm	60 mm (2.36 in.)
Bolt D	10 mm	35 mm (1.38 in.)
Bolt E	10 mm	22 mm (0.866 in.)



NOTICE:

Make sure the rear ends of the oil pan and cylinder block are aligned. If not, the oil pan may become damaged.

c. Uniformly tighten the bolts and nuts in several passes.

Torque:
for bolt A, D, E:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }
for bolt B, C, nut:
28 N*m{ 286 kgf*cm , 21 ft.*lbf }

4. INSTALL NO. 2 OIL PAN SUB-ASSEMBLY

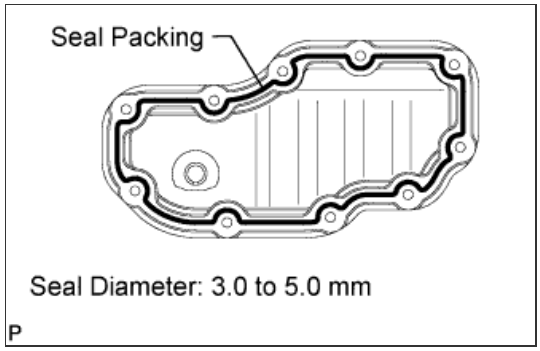
a. Apply seal packing to the No. 2 oil pan as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Standard seal diameter:
3.0 to 5.0 mm (0.118 to 0.197 in.)

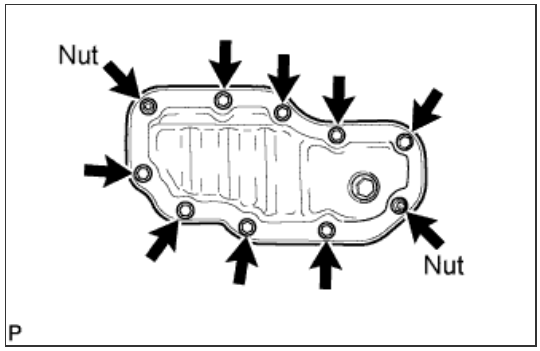
NOTICE:

- **Install the oil pan within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**
- **Be careful not to drop any oil on the contact surfaces of the oil pan and No. 2 oil pan.**
- **Do not expose the seal to engine oil for at least 2 hours after installing it.**



b. Install the No. 2 oil pan with the 8 bolts and 2 nuts. Uniformly tighten the bolts and nuts in several passes.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

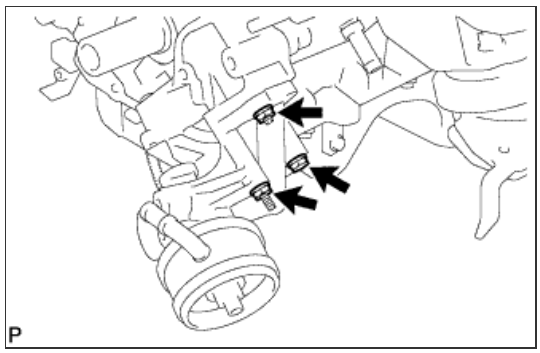


5. INSTALL OIL FILTER BRACKET SUB-ASSEMBLY

a. Install a new gasket to the oil filter bracket.

b. Install the oil filter bracket with the bolt, stud bolt and nut.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }



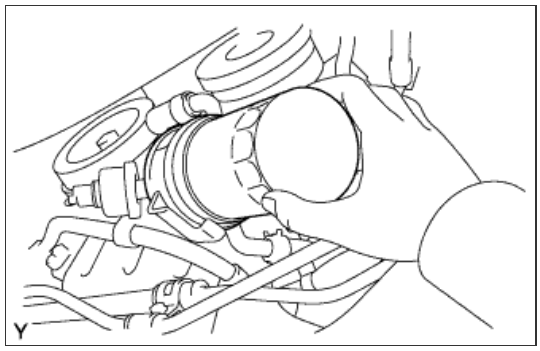
6. INSTALL OIL FILTER ASSEMBLY

a. Clean and check the oil filter installation surface.

b. Apply clean engine oil to the gasket of a new oil filter.

c. Lightly screw the oil filter into place by hand. Tighten it until the gasket contacts

the seat.



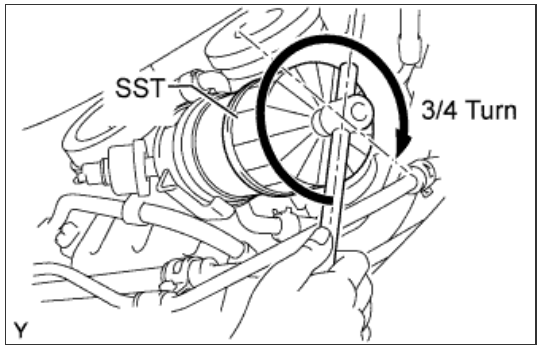
d. Using SST, tighten the oil filter. Choose from the following to tighten the oil filter.

SST
09228-07501

i. Using a torque wrench, tighten the oil filter.

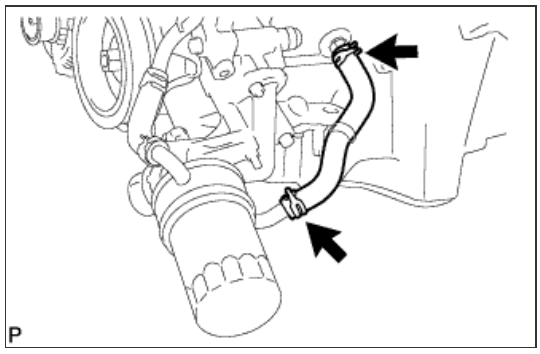
Torque:
17 N*m{ 175 kgf*cm , 13 ft.*lbf }

ii. Tighten the oil filter a 3/4 turn by hand or with a common wrench.



7. INSTALL OIL COOLER HOSE

a. Using needle-nose pliers, grip the claws of the clamps and slide the clamps to install the oil cooler hose.



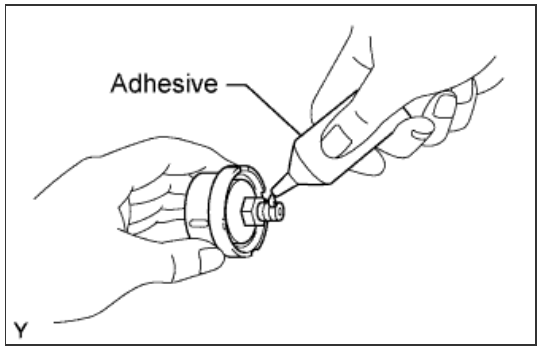
8. INSTALL OIL PRESSURE SENDER GAUGE ASSEMBLY

a. Apply adhesive to 2 or 3 threads of the sender gauge.

Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent

NOTICE:

Do not let adhesive adhere to the oil hole.



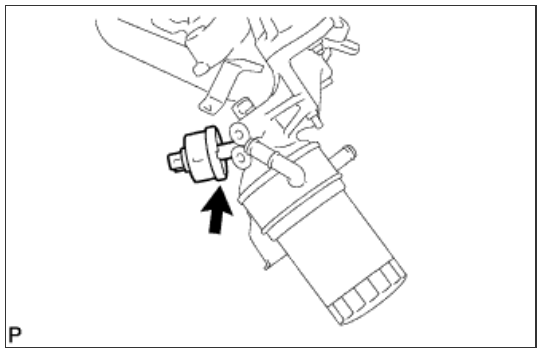
b. Install the sender gauge.

Torque:
15 N*m{ 153 kgf*cm , 11 ft.*lbf }

NOTICE:

Do not start the engine within 1 hour of installation.

c. Connect the sender gauge connector.



9. INSTALL ENGINE OIL LEVEL DIPSTICK GUIDE

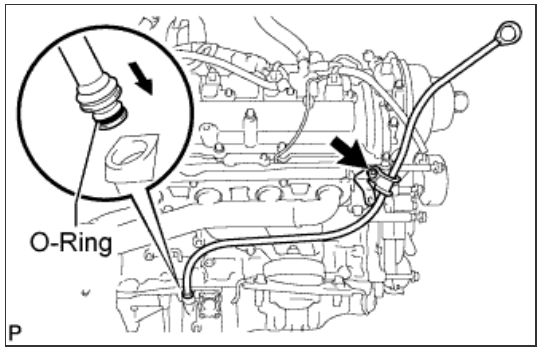
a. Apply a light coat of engine oil to a new O-ring.

b. Install a new O-ring to the guide.

c. Install the dipstick guide with the bolt.

Torque:
8.0 N*m{ 82 kgf*cm , 71 in.*lbf }

d. Install the dipstick.

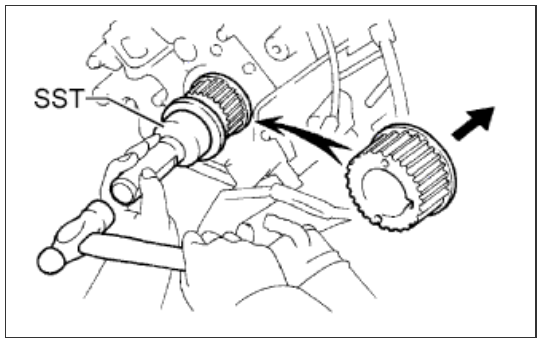


10. INSTALL CRANKSHAFT TIMING PULLEY

a. Align the timing pulley set key with the key groove of the pulley.

b. Using SST and a hammer, tap in the timing pulley with the flange side facing inward.

SST
09223-46011

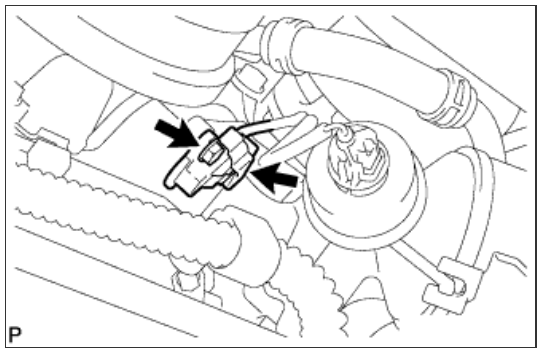


11. INSTALL CRANKSHAFT POSITION SENSOR

a. Install the sensor with the bolt.

Torque:
6.5 N*m{ 66 kgf*cm , 58 in.*lbf }

b. Connect the sensor connector.



12. INSTALL TIMING BELT

a. Install the timing belt (Click here).

13. INSTALL ENGINE ASSEMBLY

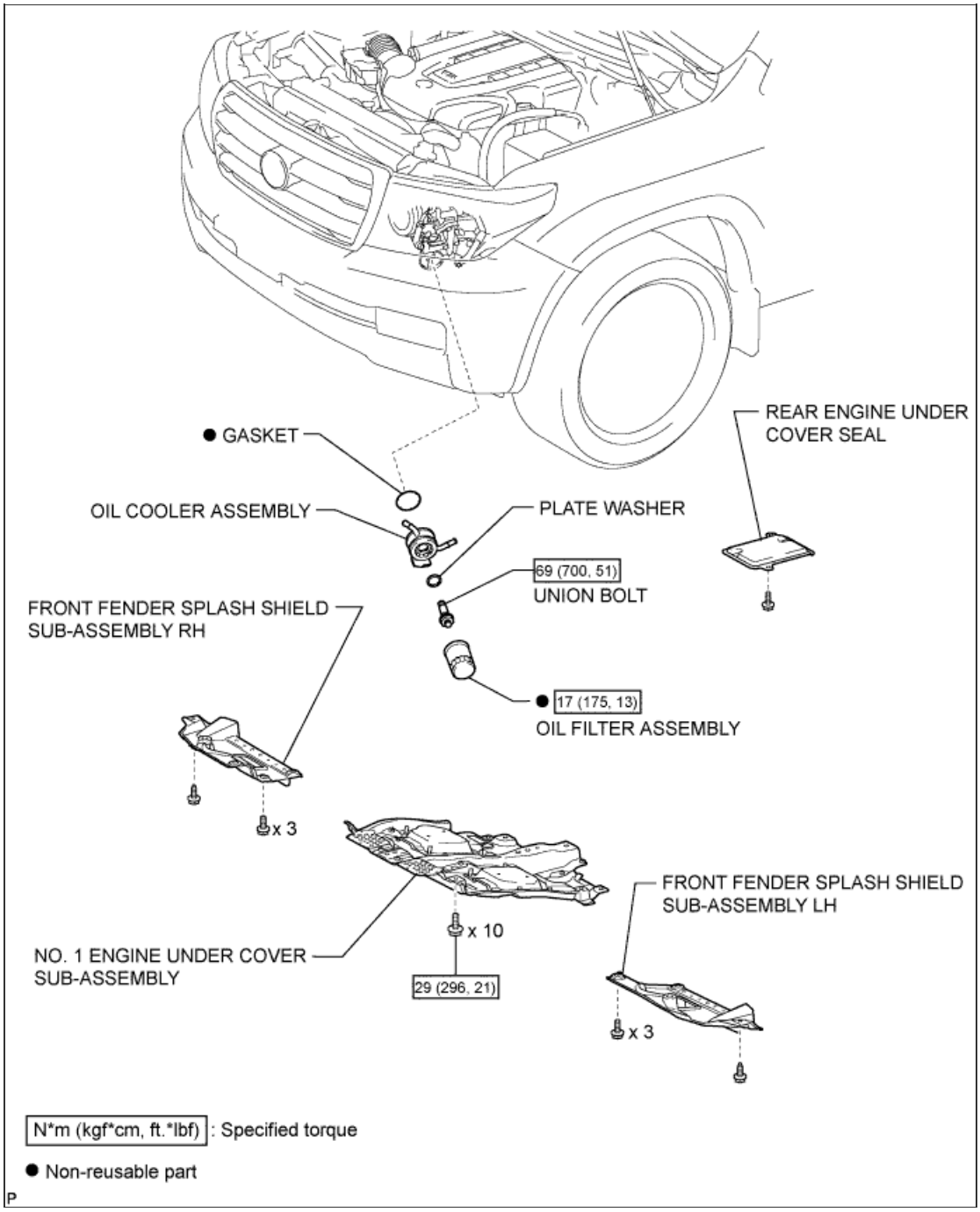
a. Install the engine to the vehicle (Click here).

14. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

for Preparation Click here

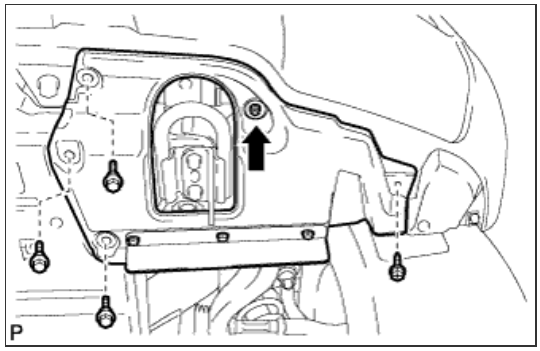


for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



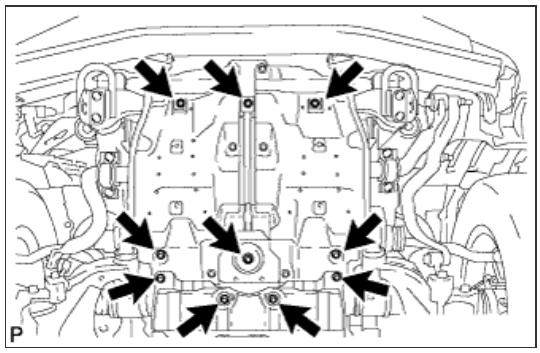
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

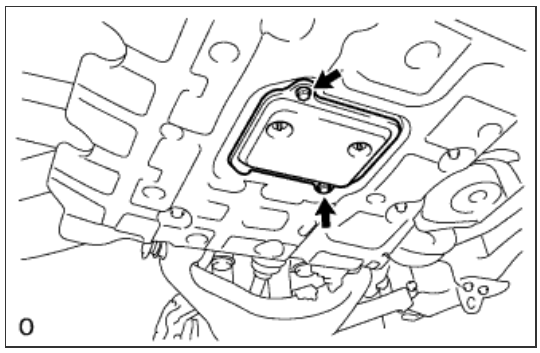
3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and No. 1 engine under cover.



4. REMOVE REAR ENGINE UNDER COVER SEAL

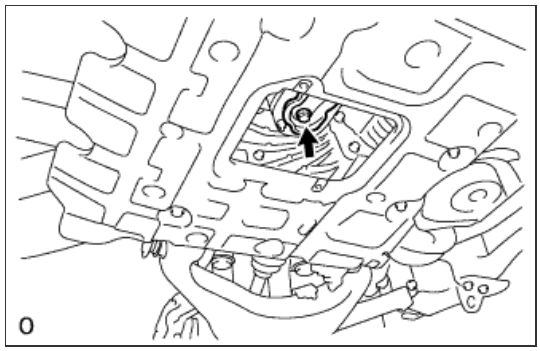
a. Remove the 2 bolts and cover seal.



5. REMOVE OIL FILLER CAP SUB-ASSEMBLY

6. DRAIN ENGINE OIL

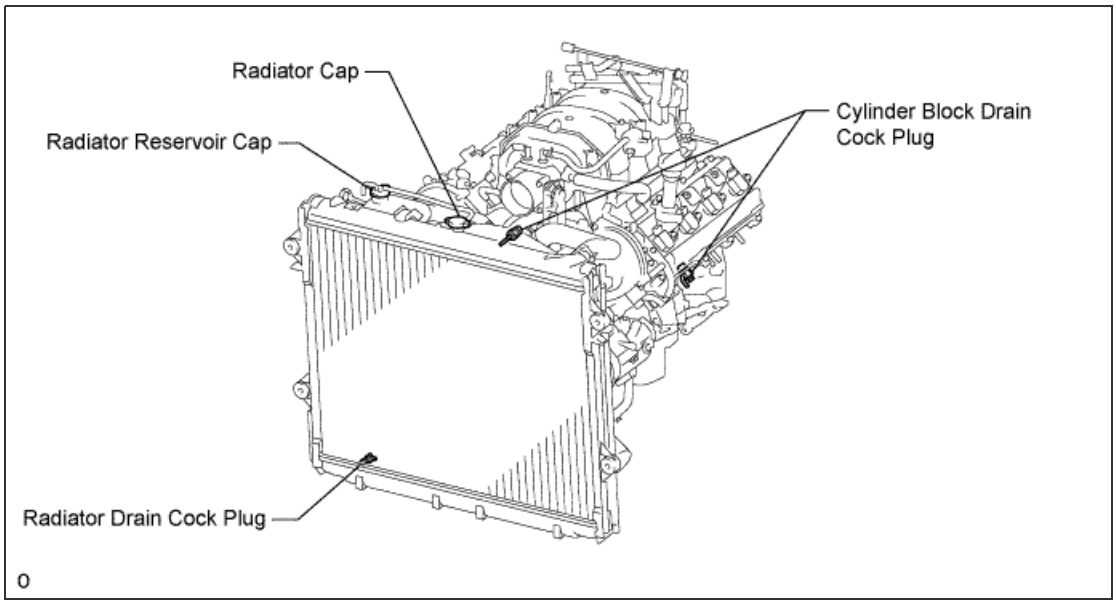
a. Remove the oil drain plug and gasket, and drain the engine oil into a container.



7. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.



a. Loosen the radiator drain cock plug.

b. Remove the radiator cap. Then drain the coolant.

HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

c. Loosen the 2 cylinder block drain cock plugs. Then drain the coolant from the engine.

d. Tighten the 2 cylinder block drain cock plugs.

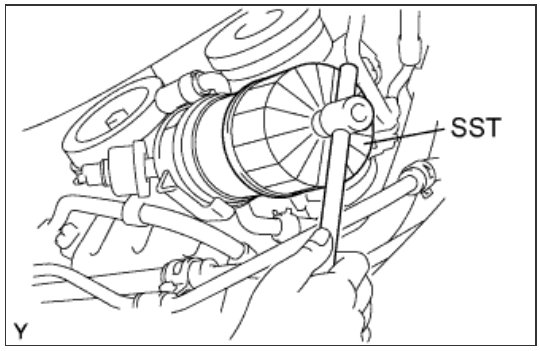
Torque:
13 N*m{ 130 kgf*cm , 9 ft.*lbf }

e. Tighten the radiator drain cock plug by hand.

8. REMOVE OIL FILTER ASSEMBLY

a. Using SST, remove the oil filter.

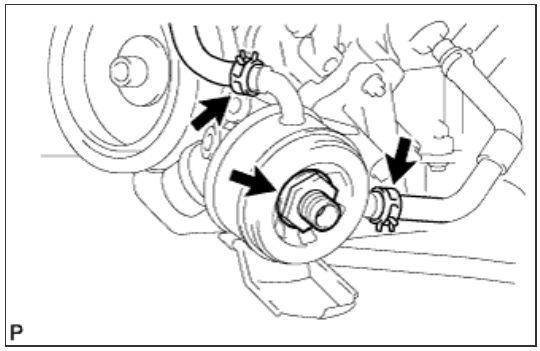
SST
09228-07501



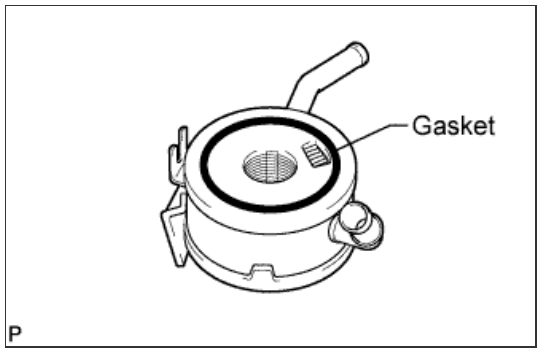
9. REMOVE OIL COOLER ASSEMBLY

a. Disconnect the 2 oil cooler hoses from the oil cooler.

b. Remove the union bolt, plate washer and oil cooler.



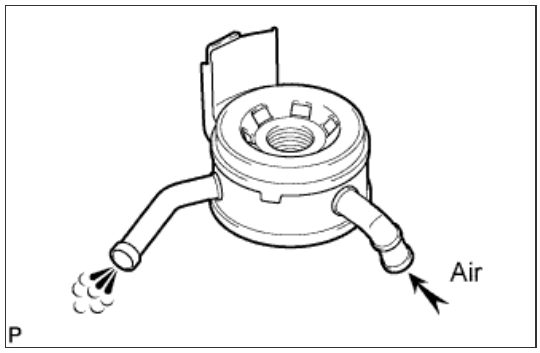
c. Remove the gasket from the oil cooler.



for Preparation Click here

1. INSPECT OIL COOLER ASSEMBLY

a. Check the oil cooler for damage or clogging.
If necessary, replace the oil cooler.



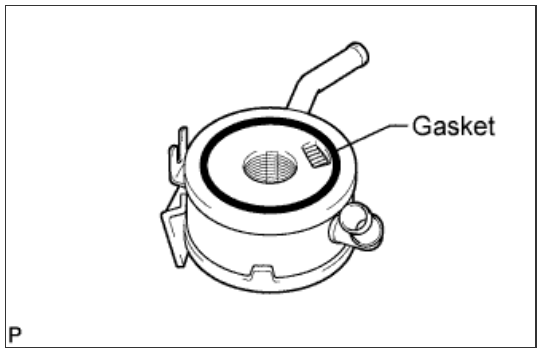
for Preparation Click here

1. INSTALL OIL COOLER ASSEMBLY

a. Clean the oil cooler contact surface on the cooler mounting.

b. Apply a light coat of engine oil to a new gasket and install it to the oil cooler.

c. Apply a light coat of engine oil on the threads and under the head of the union bolt.



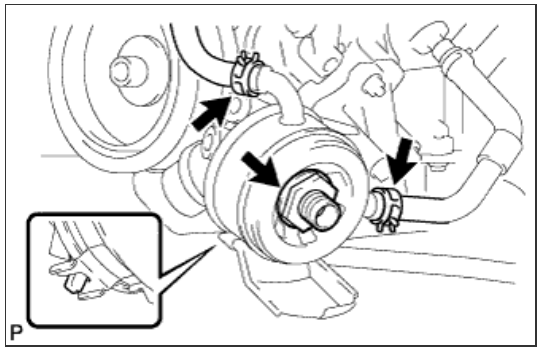
d. Install the oil cooler and plate washer with the union bolt.

Torque:
69 N*m{ 700 kgf*cm , 51 ft.*lbf }

HINT:

Fit the fork part of the oil cooler onto the rib of the oil cooler bracket.

e. Connect the 2 oil cooler hoses to the oil cooler.

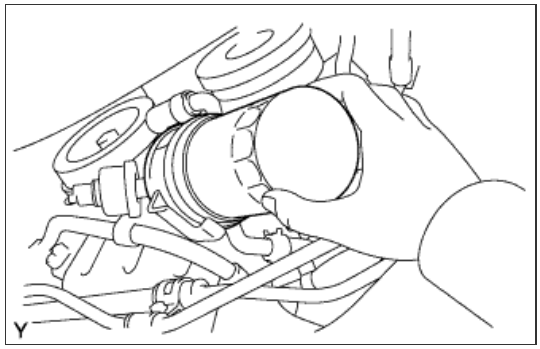


2. INSTALL OIL FILTER ASSEMBLY

a. Clean and check the oil filter installation surface.

b. Apply clean engine oil to the gasket of a new oil filter.

c. Lightly screw the oil filter into place by hand. Tighten it until the gasket contacts the seat.



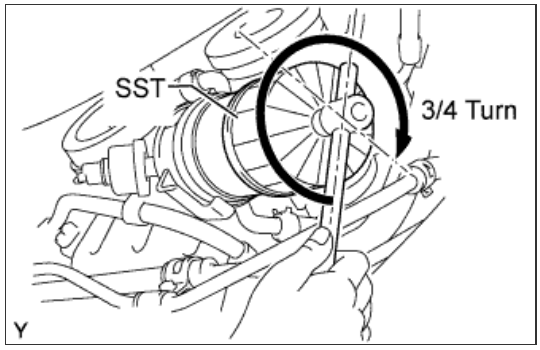
d. Using SST, tighten the oil filter. Choose from the following to tighten the oil filter.

SST
09228-07501

i. Using a torque wrench, tighten the oil filter.

Torque:
17 N*m{ 175 kgf*cm , 13 ft.*lbf }

ii. Tighten the oil filter a 3/4 turn by hand or with a common wrench.



3. ADD ENGINE OIL

a. Install a new gasket and the drain plug.

Torque:
39 N*m{ 398 kgf*cm , 29 ft.*lbf }

b. Add new engine oil.

Standard Engine Oil:

Oil Grade	Oil Viscosity (SAE)
API grade SL "Energy-Conserving", SM "Energy-Conserving" or ILSAC multigrade engine oil	10W-30 (10W-30 is best choice for fuel economy and good starting in cold weather).
API grade SL or SM multigrade engine oil	10W-30

Standard Oil Capacity:

Item	Specified Condition
Drain and refill with oil filter change	6.2 liters (6.6 US qts, 5.5 Imp. qts)
Drain and refill without oil filter change	5.7 liters (6.0 US qts, 5.0 Imp. qts)
Dry fill	7.1 liters (7.5 US qts, 6.2 Imp. qts)

4. INSTALL OIL FILLER CAP SUB-ASSEMBLY

5. ADD ENGINE COOLANT

a. Add engine coolant.

Standard Capacity:

Item		Specified Condition
w/o Transmission oil cooler	w/o Rear Heater	13.4 liters (14.2 US qts, 11.8 Imp. qts)
	w/ Rear Heater	16.3 liters (17.2 US qts, 14.3 Imp. qts)
w/ Transmission oil cooler	w/o Rear Heater	14.1 liters (14.9 US qts, 12.4 Imp. qts)
	w/ Rear Heater	16.9 liters (17.9 US qts, 14.9 Imp. qts)

HINT:

TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

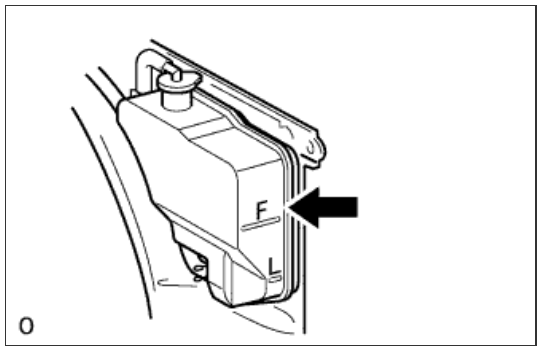
b. Slowly pour coolant into the radiator reservoir until it reaches the F line.

c. Install the radiator reservoir cap.

d. Press the inlet and outlet radiator hoses several times by hand, and then check the coolant level. If the coolant level is low, add coolant.

e. Install the radiator cap.

f. Start the engine and warm it up until the thermostat opens.



NOTICE:

Switch off the A/C.

g. Maintain the engine speed at 2000 to 2500 rpm.

NOTICE:

- **Make sure that the radiator reservoir still has some coolant in it.**
- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**
- **Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the F line.**
- **Run the engine at 2000 rpm until the coolant level has stabili ed.**

h. Press the inlet and outlet radiator hoses several times by hand to bleed air.

CAUTION:

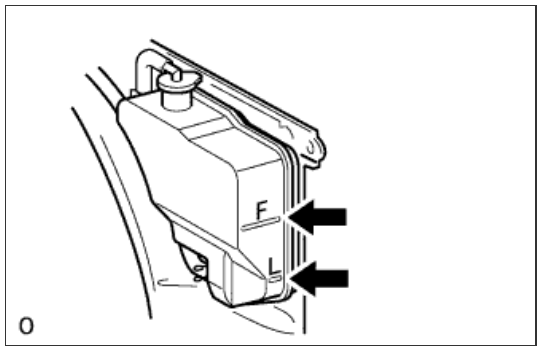
- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the cooling fan.**

i. Stop the engine, and wait until the engine coolant cools down to the ambient temperature.

CAUTION:

Do not remove the radiator cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

j. Check that the coolant level is between the F and L lines. If the coolant level is below the L line, repeat all of the procedures above. If the coolant level is above the F line, drain coolant so that the coolant level is between the F and L lines.



6. INSPECT FOR OIL LEAK

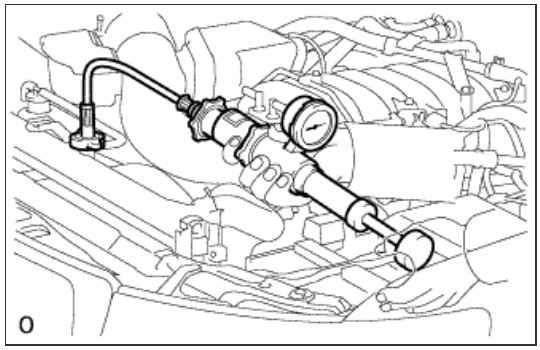
a. Start the engine. Make sure that there are no oil leaks from the area that was worked on.

7. INSPECT FOR COOLANT LEAK

a. Fill the radiator with coolant and attach a radiator cap tester.

b. Warm up the engine.

c. Using the radiator cap tester, increase the pressure inside the radiator to 123 kPa (1.3 kgf/cm^2, 18 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.



8. CHECK ENGINE OIL LEVEL

a. Warm up the engine, then stop the engine and wait for 5 minutes.

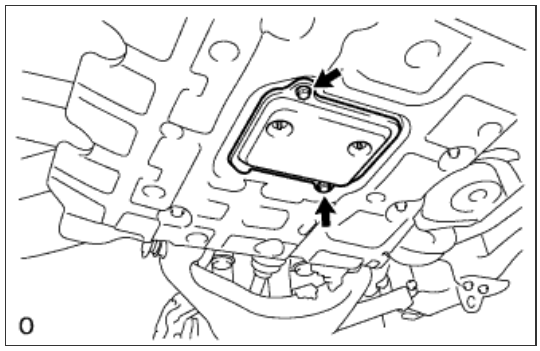
b. Check that the engine oil level is between the low level and full level marks on the dipstick.
If low, check for leakage and add oil up to the full level mark.

NOTICE:

Do not fill engine oil above the full level mark.

9. INSTALL REAR ENGINE UNDER COVER SEAL

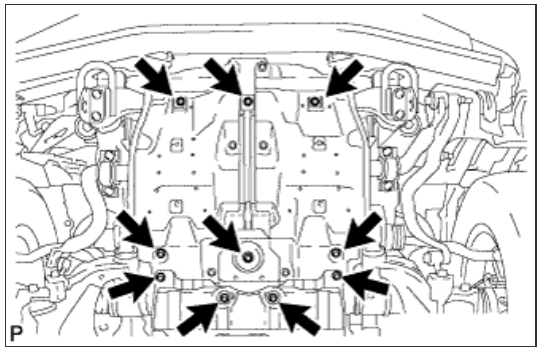
a. Install the cover seal with the 2 bolts.



10. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the No. 1 engine under cover with the 10 bolts.

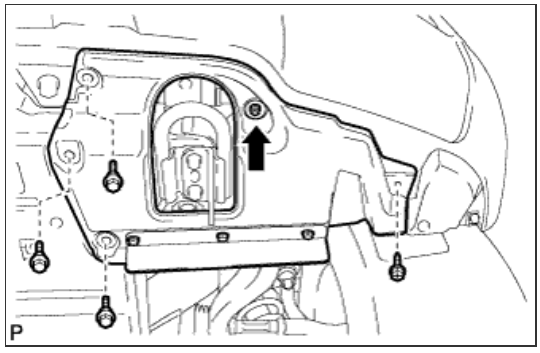
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



11. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



12. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

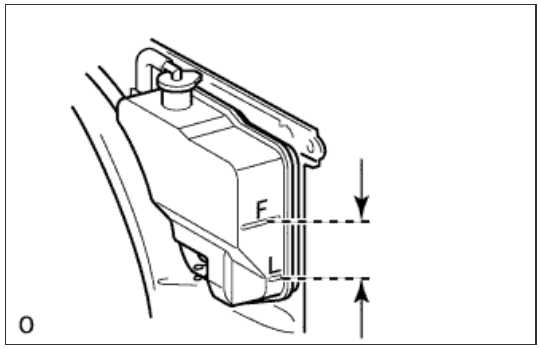
13. INSPECT ENGINE COOLANT LEVEL

a. Check that the engine coolant level is between the L and F lines when the engine is cold.
If the engine coolant is low, check for leaks and add "TOYOTA Super Long Life Coolant" or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite and non-borate coolant with long-life hybrid organic acid technology to the F line.

NOTICE:

Do not substitute plain water for engine coolant.

b. Remove the radiator cap, and check that the coolant level is up to the radiator filler hole.



for Preparation Click here

1. CHECK OIL QUALITY

a. Check the engine oil for deterioration, water contamination, discoloring or thinning.
If the quality is visibly poor, replace the engine oil and oil filter element (Click here).

2. CHECK ENGINE OIL LEVEL

a. Warm up the engine, stop the engine and wait 5 minutes. The engine oil level should be between the dipstick low level mark and full level mark.
If low, check for leakage and add oil up to the full level mark.

NOTICE:

Do not fill engine oil above the full level mark.

3. CHECK ENGINE OIL PRESSURE

a. Remove the oil pressure sender gauge (Click here).

b. Install an oil pressure sender gauge with an adapter.

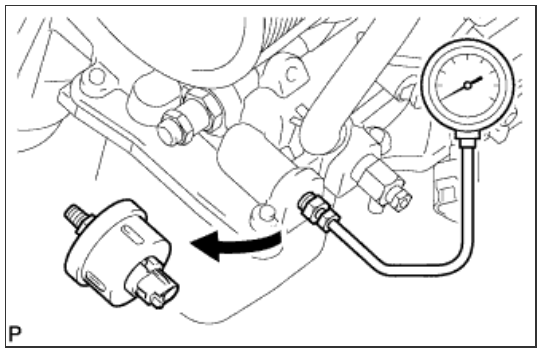
c. Warm up the engine.

d. Measure the engine oil pressure.

Standard Oil Pressure:

Condition	Specified Condition
Idle	50 kPa (0.5 kgf/cm^2, 7.3 psi) or more
2500 rpm	230 kPa (2.3 kgf/cm^2, 33 psi) or more

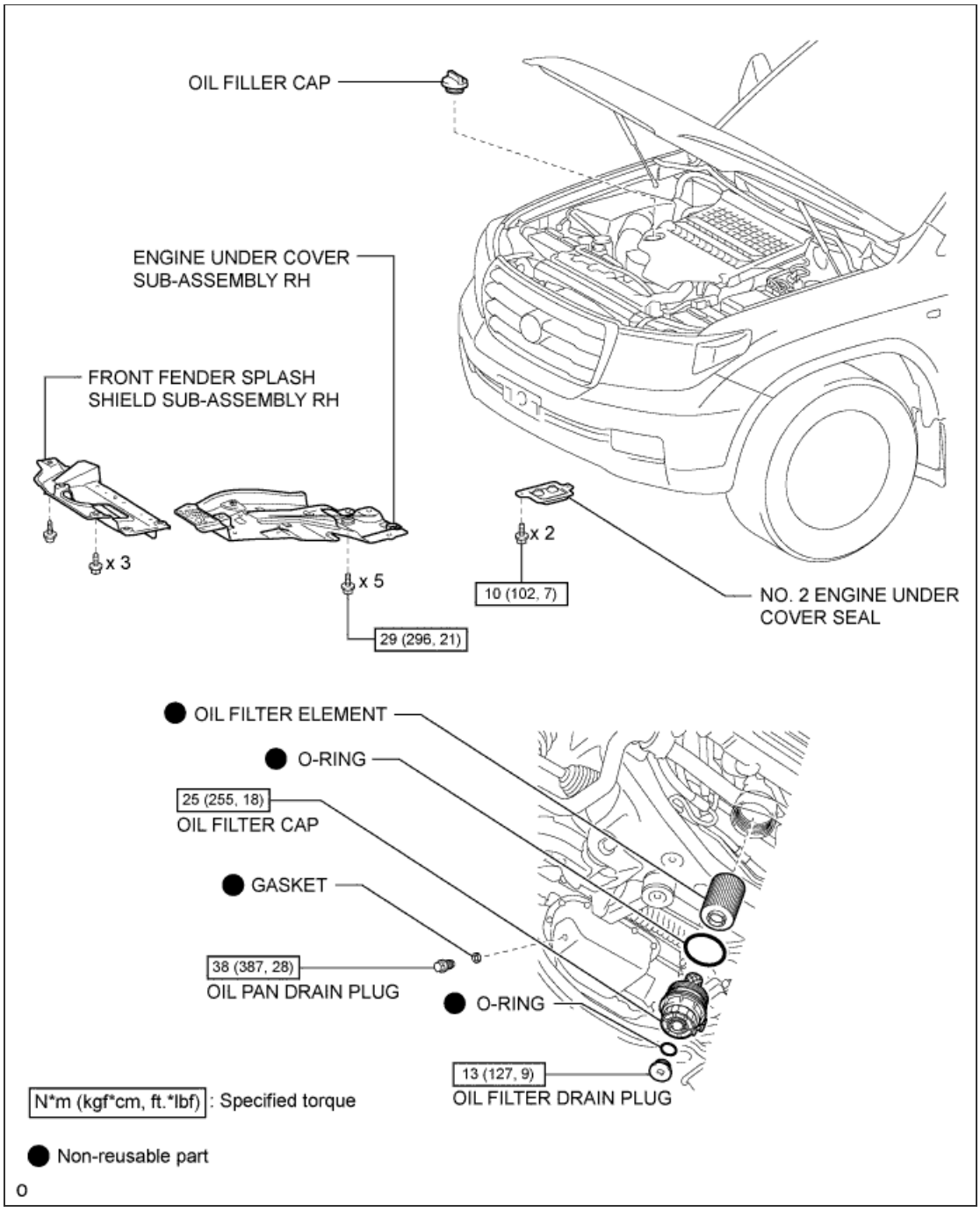
If the pressure is not as specified, check the oil pump.



e. Remove the oil pressure gauge and adapter.

f. Install the oil pressure sender gauge (Click here).

for Preparation Click here



for Preparation Click here

CAUTION:

- **Prolonged and repeated contact with engine oil will result in the removal of natural oils from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer.**
- **Precautions should be taken when replacing engine oil to minimize the risk of your skin making contact with used engine oil. Protective clothing and gloves that cannot be penetrated by oil should be worn. The skin should be washed with soap and water, or use waterless hand cleaner, to remove any used engine oil thoroughly. Do not use gasoline, thinners, or solvents.**
- **In order to protect the environment, used oil and used oil filters must be disposed of at designated disposal sites.**

1. DRAIN ENGINE OIL

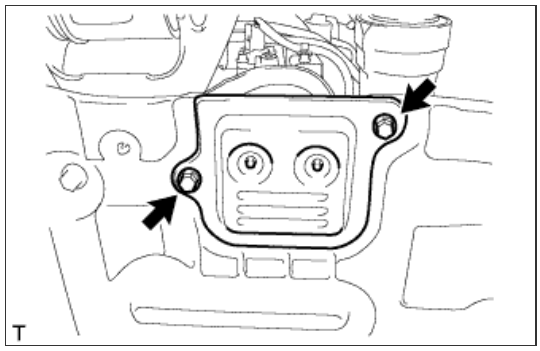
a. Remove the 2 bolts and No. 2 engine under cover seal from the No. 2 engine under cover.

b. Remove the oil filler cap.

c. Remove the oil pan drain plug and gasket, and then drain the engine oil into a container.

d. Install a new gasket and the oil pan drain plug.

Torque:
38 N*m{ 387 kgf*cm , 28 ft.*lbf }



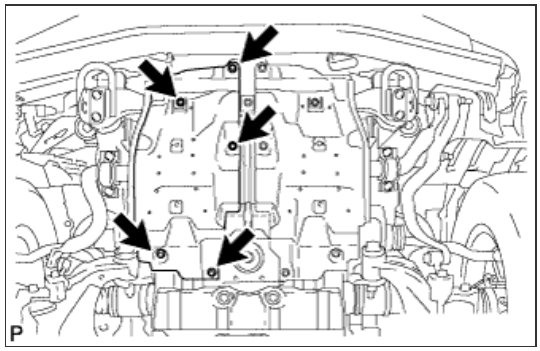
2. REMOVE FRONT FENDER PLA IELD UB-A EMBLY RH

HINT:

Use the same procedures described for the LH side.

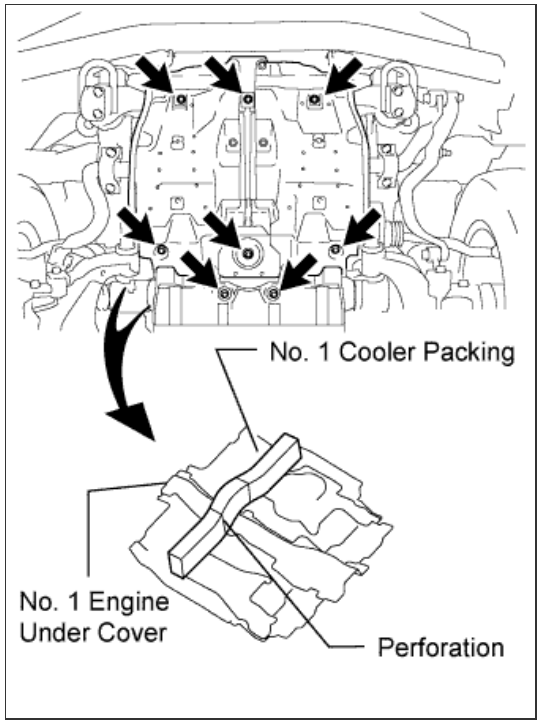
3. REMOVE ENGINE UNDER COVER UB-A EMBLY RH

a. Remove the 5 bolts and engine under cover sub-assembly RH.



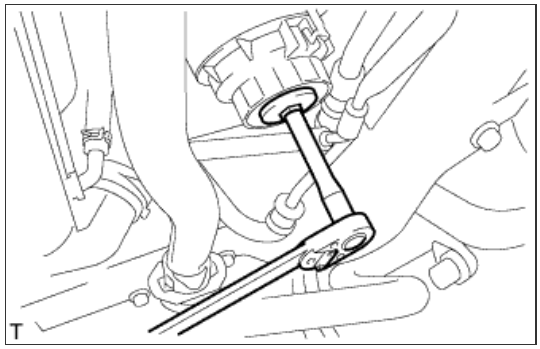
HINT:

If the No. 1 cooler packing is not divided, remove both sides of the engine under cover assembly and cut the packing at the perforation indicated in the illustration.



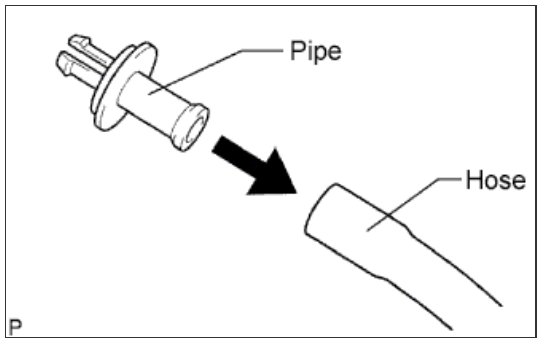
4. REMOVE OIL FILTER ELEMENT

a. Remove the oil filter drain plug.



b. Connect a hose with an inside diameter of 15 mm (0.591 in.) to the pipe.

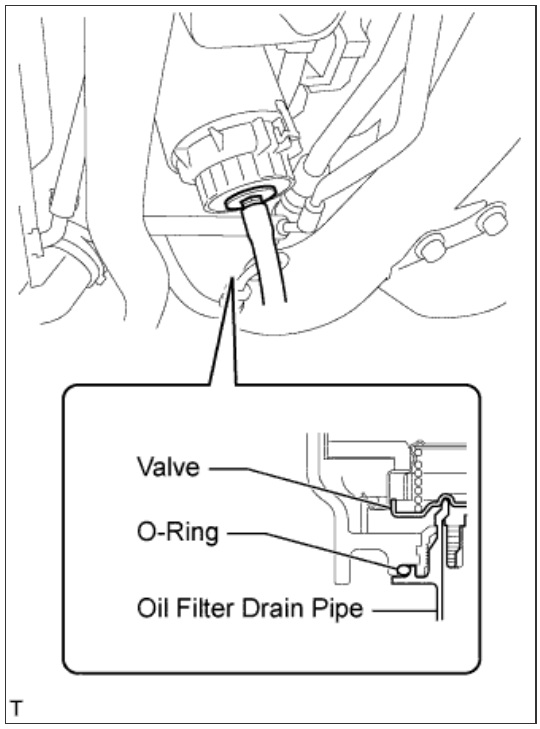
c. Remove the O-ring from the oil filter drain plug and install it to the drain pipe.



d. Install the oil filter drain pipe to the oil filter cap and drain the engine oil.

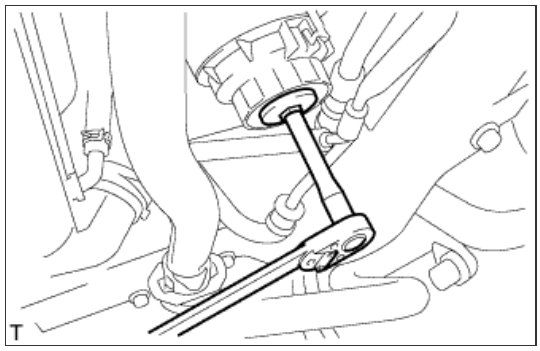
e. Remove the oil filter drain pipe.

f. Apply a light coat of engine oil to a new O-ring, and install it to the oil filter drain plug.



g. Install the oil filter drain plug to the oil filter cap.

Torque:
13 N*m{ 127 kgf*cm , 9 ft.*lbf }

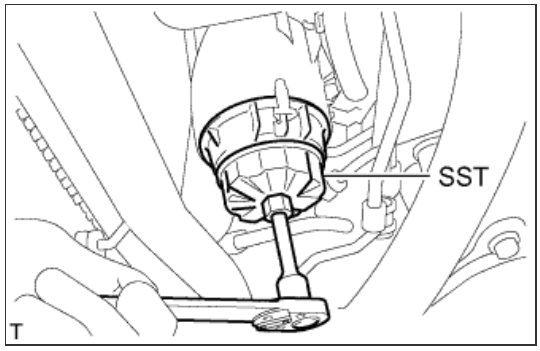


h. Using SST, remove the oil filter cap.

SST
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HINT:

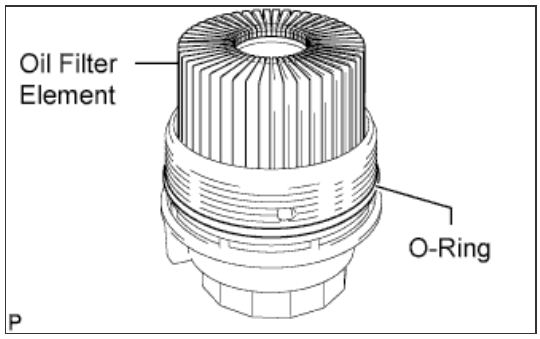
Use a container to catch the draining oil. After the oil filter cap is loosened approximately 4 turns and the cap ribs are vertical, engine oil drains from the gap between the oil filter cap and oil pan.



i. Remove the oil filter element and O-ring from the oil filter cap.

NOTICE:

Be sure to remove the cap O-ring by hand, without using any tools, to prevent damage to the cap O-ring groove.



5. IN TALL OIL FILTER ELEMENT

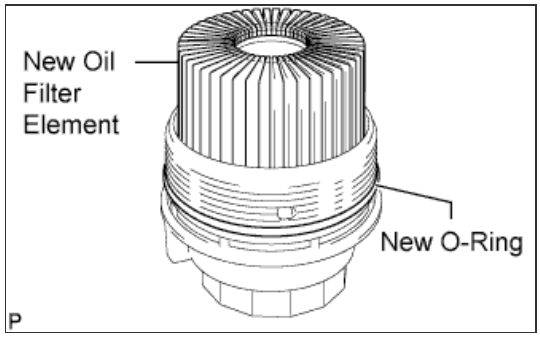
a. Clean the inside of the oil filter cap, its threads and its O-ring groove.

b. Apply a small amount of engine oil to a new O-ring and install it to the oil filter cap.

c. Set a new oil filter element in the oil filter cap.

d. Remove any dirt or foreign matter from the installation surface of the engine.

e. Apply a small amount of engine oil to the O-ring again and temporarily install the oil filter cap by hand.



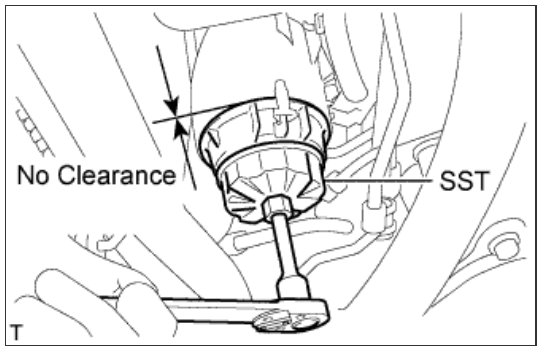
f. Using SST, tighten the oil filter cap.

SST
09228-06501

Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }

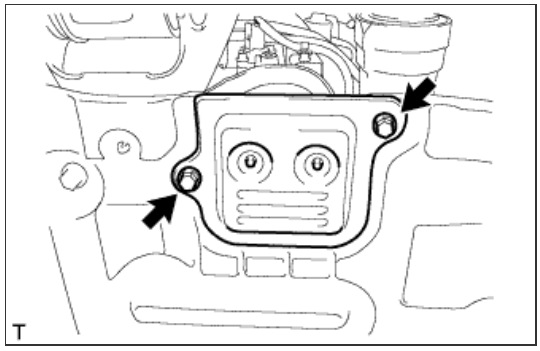
NOTICE:

- **Make sure that the oil filter is installed securely as shown in the illustration.**
- **Be careful that the O-ring does not get caught between any surrounding parts.**



g. Install the No. 2 engine under cover seal to the No. 2 engine under cover with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



6. ADD ENGINE OIL

a. Add fresh oil.

tandard Engine Oil:

Oil Grade	Oil Viscosity (SAE)
G-DLD-1, API CF-4, API CF or ACEA B1 (You may also use API CE or CD)	- 5W-30 - 10W-30 - 15W-40 - 20W-50 (5W-30 is best choice for fuel economy and good starting in cold weather).

tandard Capacity:

Item	Specified Condition
Drain and refill with oil filter change	9.2 liters (9.7 US qts, 8.1 Imp. qts)
Drain and refill without oil filter change	8.2 liters (8.7 US qts, 7.2 Imp. qts)
Dry fill	9.9 liters (10.5 US qts, 8.7 Imp. qts)

b. Install the oil filler cap.

7. IN PECT FOR ENGINE OIL LEAK

a. Warm up the engine and check for an engine oil leak.

8. CHECK ENGINE OIL LEVEL

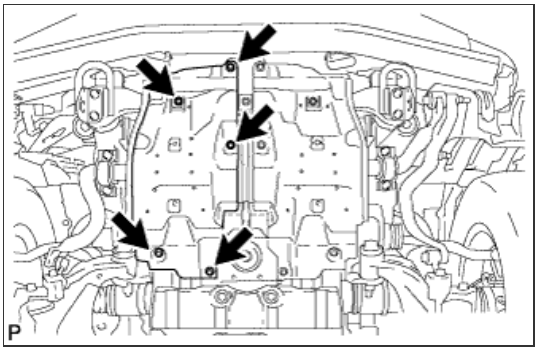
a. Warm up the engine, stop the engine and wait 5 minutes. The engine oil level should be between the dipstick low level mark and full level mark.
If low, check for leakage and add oil up to the full level mark.

NOTICE:

Do not fill engine oil above the full level mark.

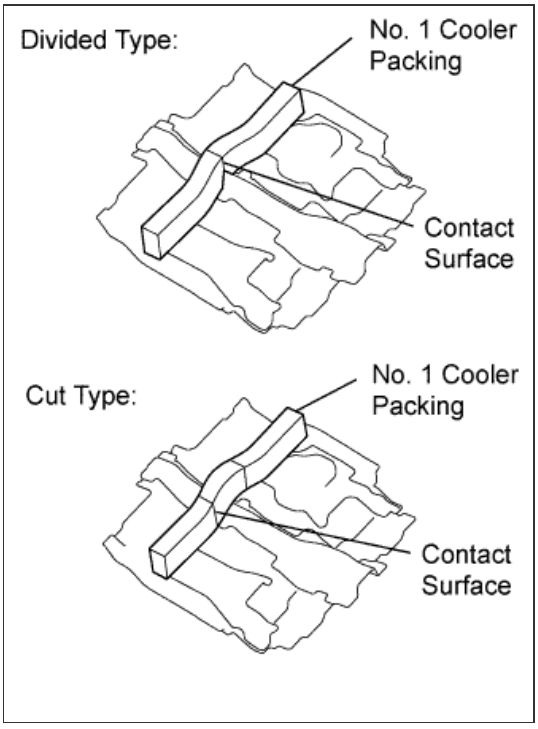
9. IN TALL ENGINE UNDER COVER UB-A EMBLY RH

a. Install the engine under cover sub-assembly RH with the 5 bolts.



HINT:

Make sure there is no gap between the ends of the No. 1 cooler packing.

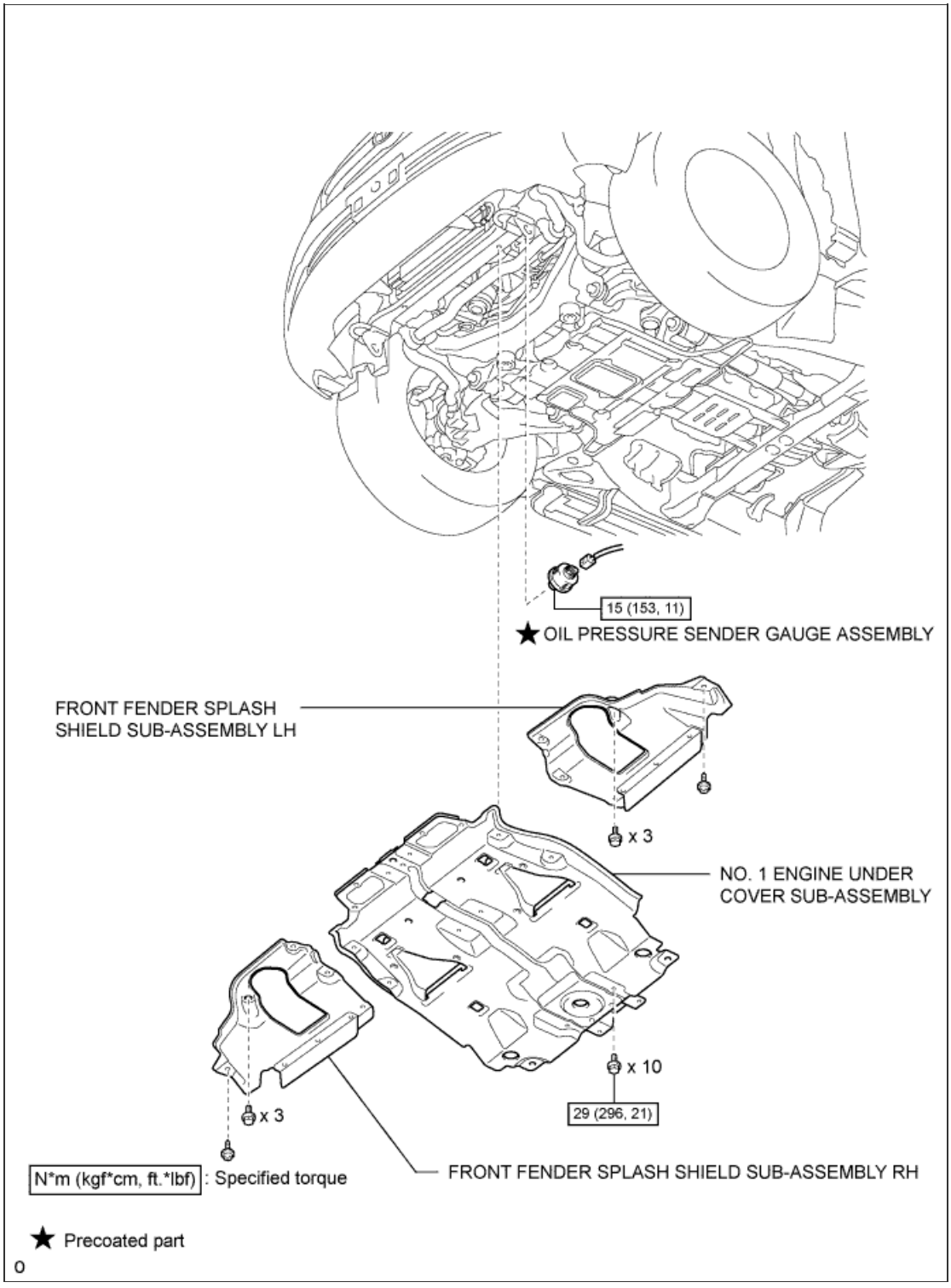


10. IN TALL FRONT FENDER PLA IELD UB-A EMBLY RH

HINT:

Use the same procedures described for the LH side.

for Preparation Click here



for Preparation Click here

1. INSPECT OIL PRESSURE SENDER GAUGE ASSEMBLY

a. Disconnect the oil pressure sender gauge connector.

b. Apply battery positive (ltage to the oil pressure sender gauge terminal through a test LED.

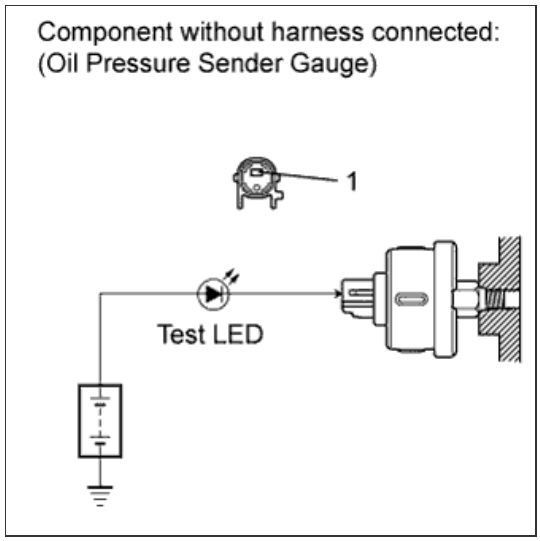
c. Check that the LED does not illuminate when the engine is stopped.

d. Check that the oil pressure sender gauge operation.

OK:

Condition	Specified Condition
Engine stopped	LED does not illuminate
Engine is running	Number of flashes varies with engine speed

If the result is not as specified, replace the oil pressure sender gauge assembly.

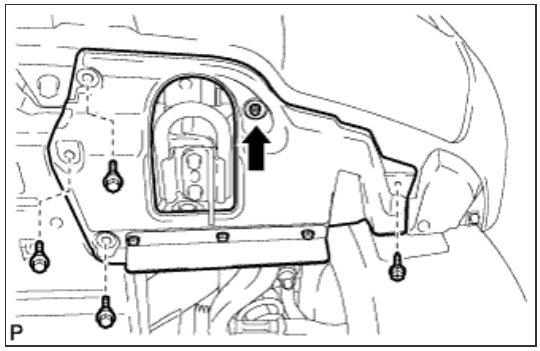


for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



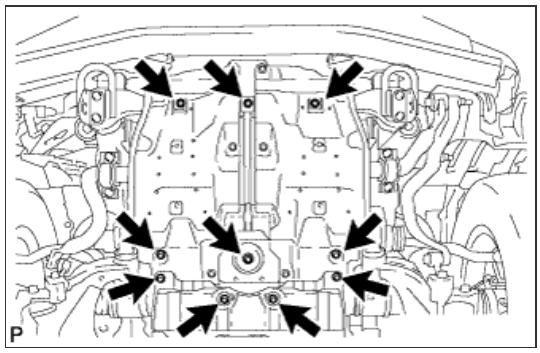
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



4. DRAIN ENGINE OIL

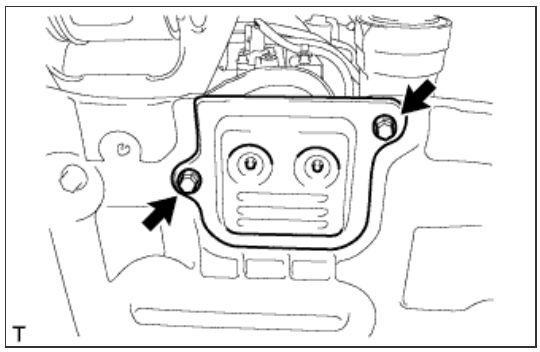
a. Remove the 2 bolts and No. 2 engine under cover seal from the No. 2 engine under cover.

b. Remove the oil filler cap.

c. Remove the oil pan drain plug and gasket, and then drain the engine oil into a container.

d. Install a new gasket and the oil pan drain plug.

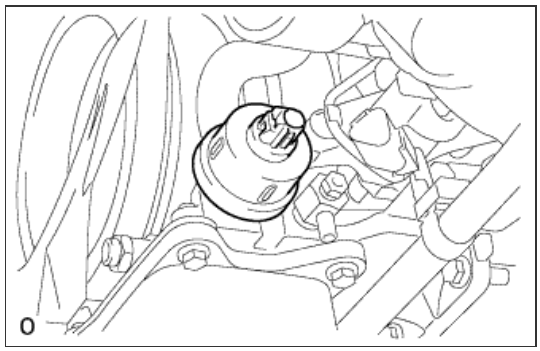
Torque:
38 N*m{ 387 kgf*cm , 28 ft.*lbf }



5. REMOVE OIL PRESSURE SENDER GAUGE ASSEMBLY

a. Disconnect the oil pressure sender gauge connector.

b. Remove the oil pressure sender gauge.

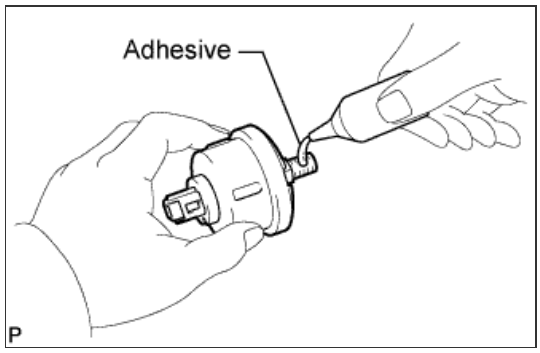


for Preparation Click here

1. INSTALL OIL PRESSURE SENDER GAUGE ASSEMBLY

a. Remove the adhesive from the threads of the oil pressure sender gauge and the bolt hole of the oil filter bracket.

b. Apply adhesive to 2 or 3 threads of the oil pressure sender gauge.

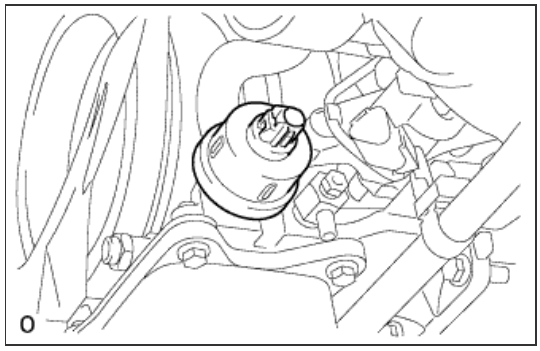


Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent

NOTICE:

Do not apply adhesive to the oil inlet port of the sensor.

c. Install the oil pressure sender gauge.



Torque:
15 N*m{ 153 kgf*cm , 11 ft.*lbf }

NOTICE:

Do not start the engine within 1 hour after installation.

d. Connect the oil pressure sender gauge connector.

2. ADD ENGINE OIL

a. Add fresh oil.

Standard Engine Oil:

Oil Grade	Oil Viscosity (SAE)
G-DLD-1, API CF-4, API CF or ACEA B1 (You may also use API CE or CD)	- 5W-30 - 10W-30 - 15W-40 - 20W-50 (5W-30 is best choice for fuel economy and good starting in cold weather).

Standard Capacity:

Item	Specified Condition
Drain and refill with oil filter change	9.2 liters (9.7 US qts, 8.1 Imp. qts)
Drain and refill without oil filter change	8.2 liters (8.7 US qts, 7.2 Imp. qts)
Dry fill	9.9 liters (10.5 US qts, 8.7 Imp. qts)

b. Install the oil filler cap.

3. INSPECT FOR ENGINE OIL LEAK

a. Warm up the engine and check for an engine oil leak.

4. CHECK ENGINE OIL LEVEL

a. Warm up the engine, stop the engine and wait 5 minutes. The engine oil level should be between the dipstick low level mark and full level mark.
If low, check for leakage and add oil up to the full level mark.

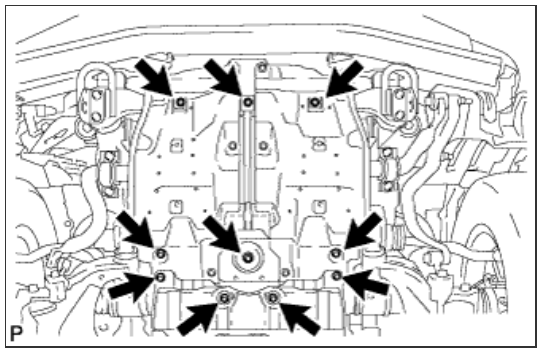
NOTICE:

Do not fill engine oil above the full level mark.

5. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



6. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

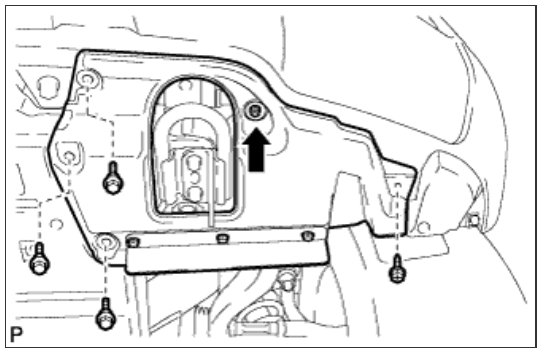
HINT:

Use the same procedures described for the LH side.

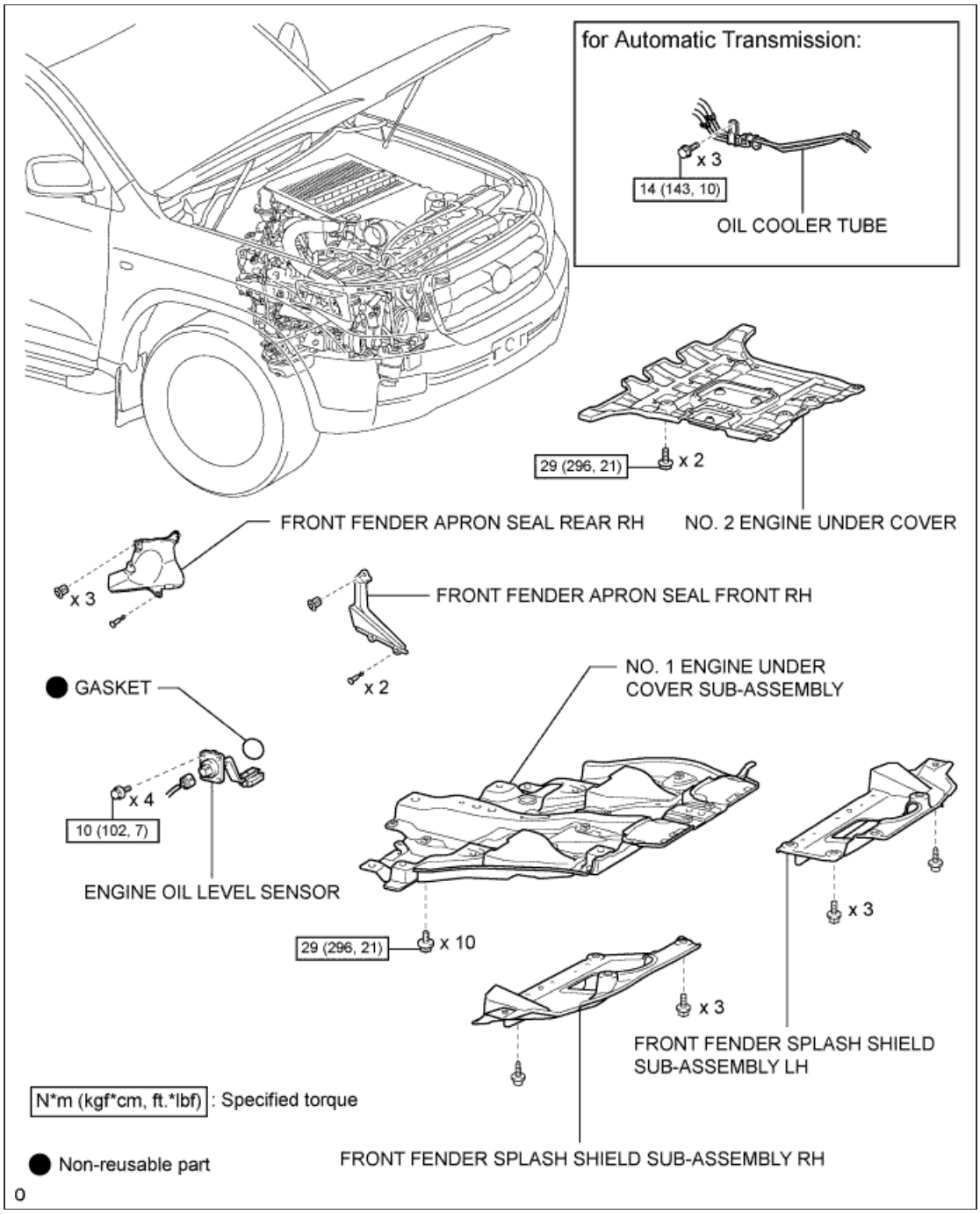
7. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



for Preparation Click here

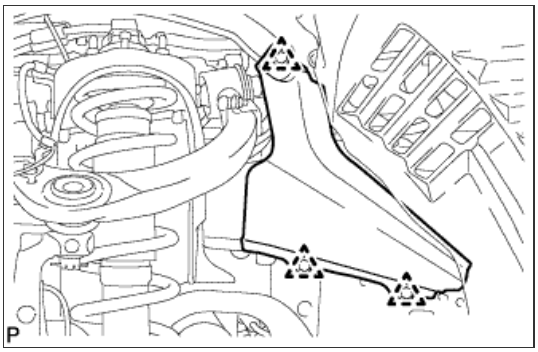


for Preparation Click here

1. REMOVE FRONT WHEEL RH

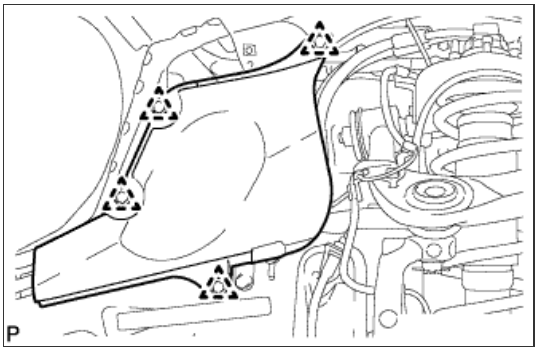
2. REMOVE FRONT FENDER APRON SEAL FRONT RH

a. Remove the 3 clips and front fender apron seal front RH.



3. REMOVE FRONT FENDER APRON SEAL REAR RH

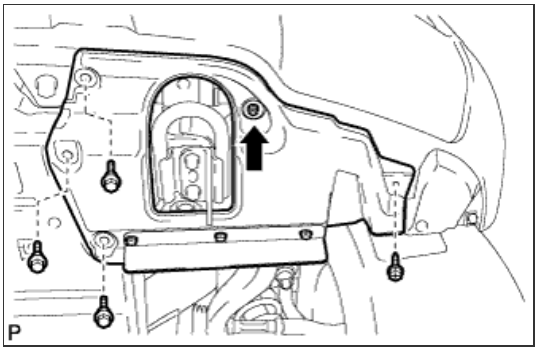
a. Remove the 4 clips and front fender apron seal rear RH.



4. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



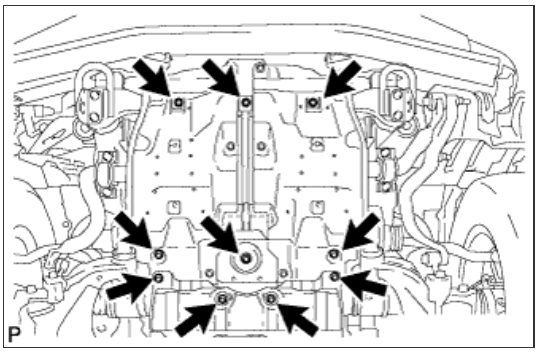
5. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

6. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



7. DRAIN ENGINE OIL

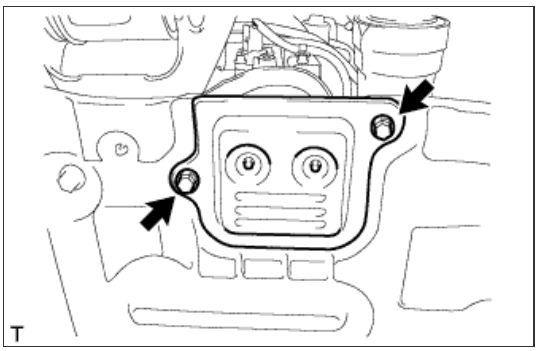
a. Remove the 2 bolts and No. 2 engine under cover seal from the No. 2 engine under cover.

b. Remove the oil filler cap.

c. Remove the oil pan drain plug and gasket, and then drain the engine oil into a container.

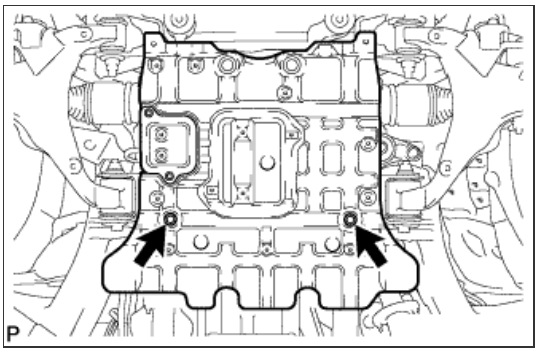
d. nstall a new gasket and the oil pan drain plug.

Torque:
38 N*m{ 387 kgf*cm , 28 ft.*lbf }



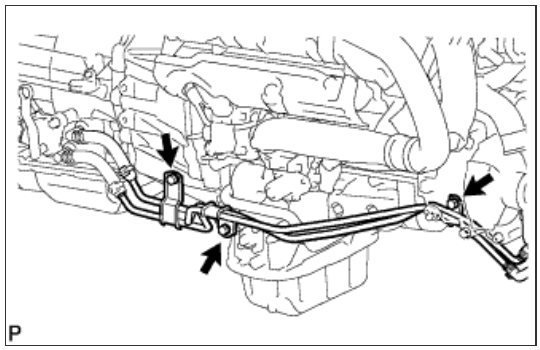
8. REMOVE NO. 2 ENGINE UNDER COVER

a. Remove the 2 bolts and under cover.



9. DISCONNECT OIL COOLER TUBE (for Automatic Transmission)

a. Remove the 3 bolts and disconnect the oil cooler tube from the engine.

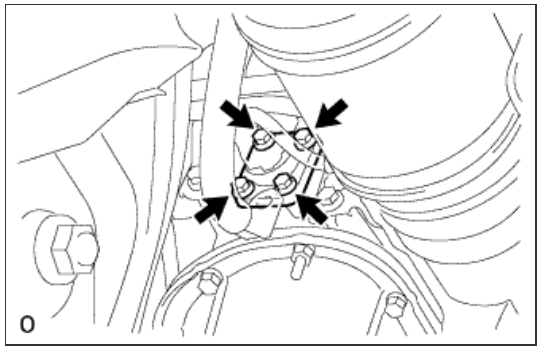


10. REMOVE ENGINE OIL LEVEL SENSOR

a. Disconnect the sensor connector.

b. Remove the 4 bolts and sensor.

c. Remove the gasket from the sensor.



for Preparation Click here

1. INSPECT ENGINE OIL LEVEL SENSOR

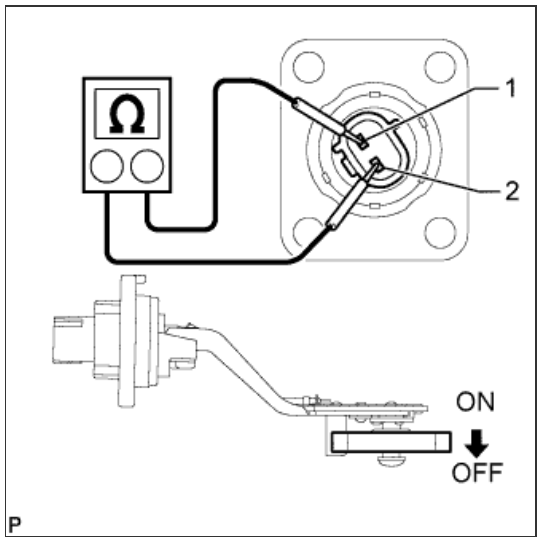
a. Heat the switch to higher than 60°C (140°F) in an oil bath.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Switch Condition	Specified Condition
1 - 2	ON at 20°C (68°F)	Below 1 Ω
	OFF at 20°C (68°F)	Below 1 Ω
	ON at 60°C (140°F)	Below 1 Ω
	OFF at 60°C (140°F)	10 kΩ or higher

If the result is not as specified, replace the engine oil level sensor.



for Preparation Click here

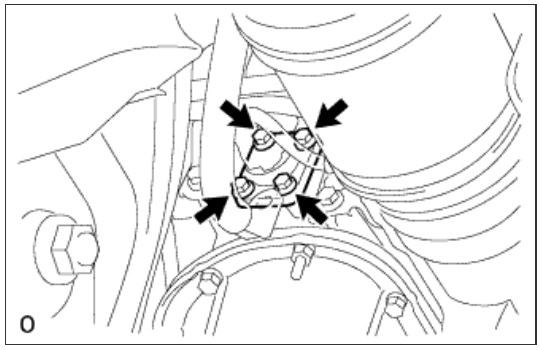
1. INSTALL ENGINE OIL LEVEL SENSOR

a. Install a new gasket to the sensor.

b. Install the sensor with the 4 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

c. Connect the sensor connector.

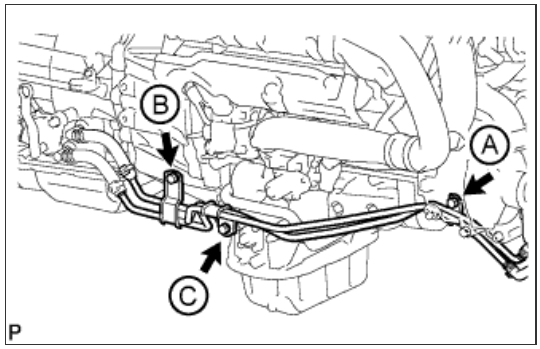


2. CONNECT OIL COOLER TUBE (for Automatic Transmission)

a. Temporarily install the oil cooler tube to the engine with the 2 bolts A and B.

b. Install the bolt C and tighten it to the specified torque. Then tighten the bolt A and B to the specified torque.

Torque:
14 N*m{ 143 kgf*cm , 10 ft.*lbf }



3. ADD ENGINE OIL

a. Add fresh oil.

Standard Engine Oil:

Oil Grade	Oil Viscosity (SAE)
G-DLD-1, API CF-4, API CF or ACEA B1 (You may also use API CE or CD)	- 5W-30 - 10W-30 - 15W-40 - 20W-50 (5W-30 is best choice for fuel economy and good starting in cold weather).

Standard Capacity:

Item	Specified Condition
Drain and refill with oil filter change	9.2 liters (9.7 US qts, 8.1 Imp. qts)
Drain and refill without oil filter change	8.2 liters (8.7 US qts, 7.2 Imp. qts)
Dry fill	9.9 liters (10.5 US qts, 8.7 Imp. qts)

b. Install the oil filler cap.

4. INSPECT FOR ENGINE OIL LEAK

a. Warm up the engine and check for an engine oil leak.

5. CHECK ENGINE OIL LEVEL

a. Warm up the engine, stop the engine and wait 5 minutes. The engine oil level should be between the dipstick low level mark and full level mark.
If low, check for leakage and add oil up to the full level mark.

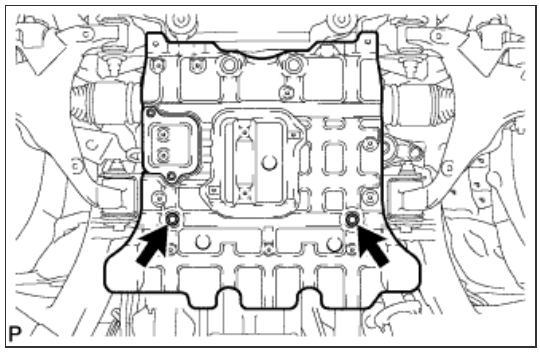
NOTICE:

Do not fill engine oil above the full level mark.

6. INSTALL NO. 2 ENGINE UNDER COVER

a. Install the engine under cover with the 2 bolts.

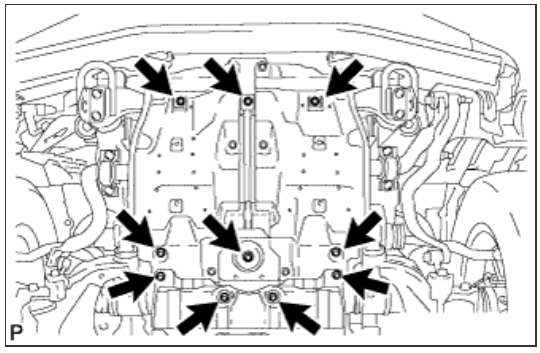
Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



7. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



8. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

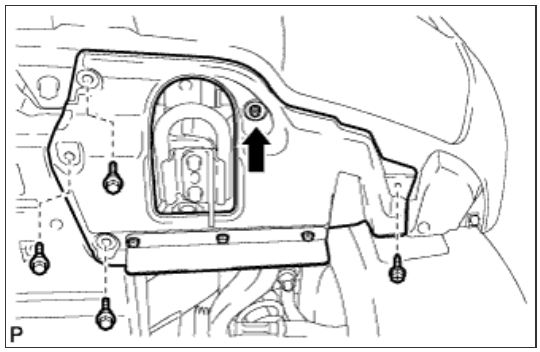
HINT:

Use the same procedures described for the LH side.

9. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

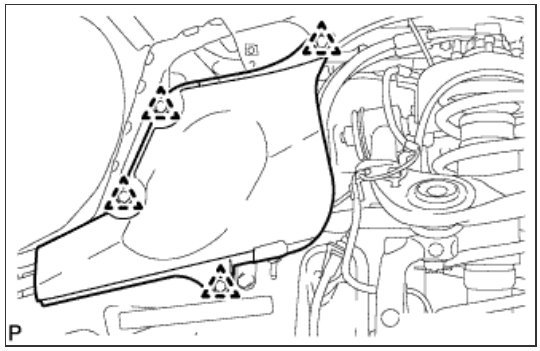
a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



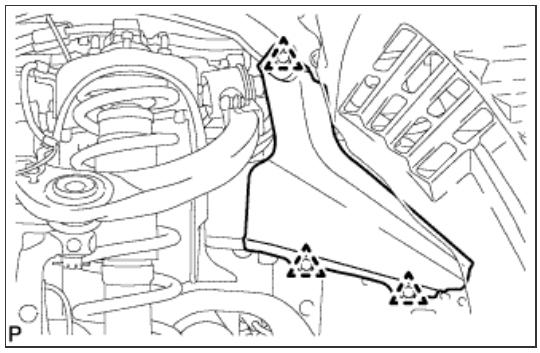
10. INSTALL FRONT FENDER APRON SEAL REAR RH

a. Install the front fender apron seal rear RH with the 4 clips.



11. INSTALL FRONT FENDER APRON SEAL FRONT RH

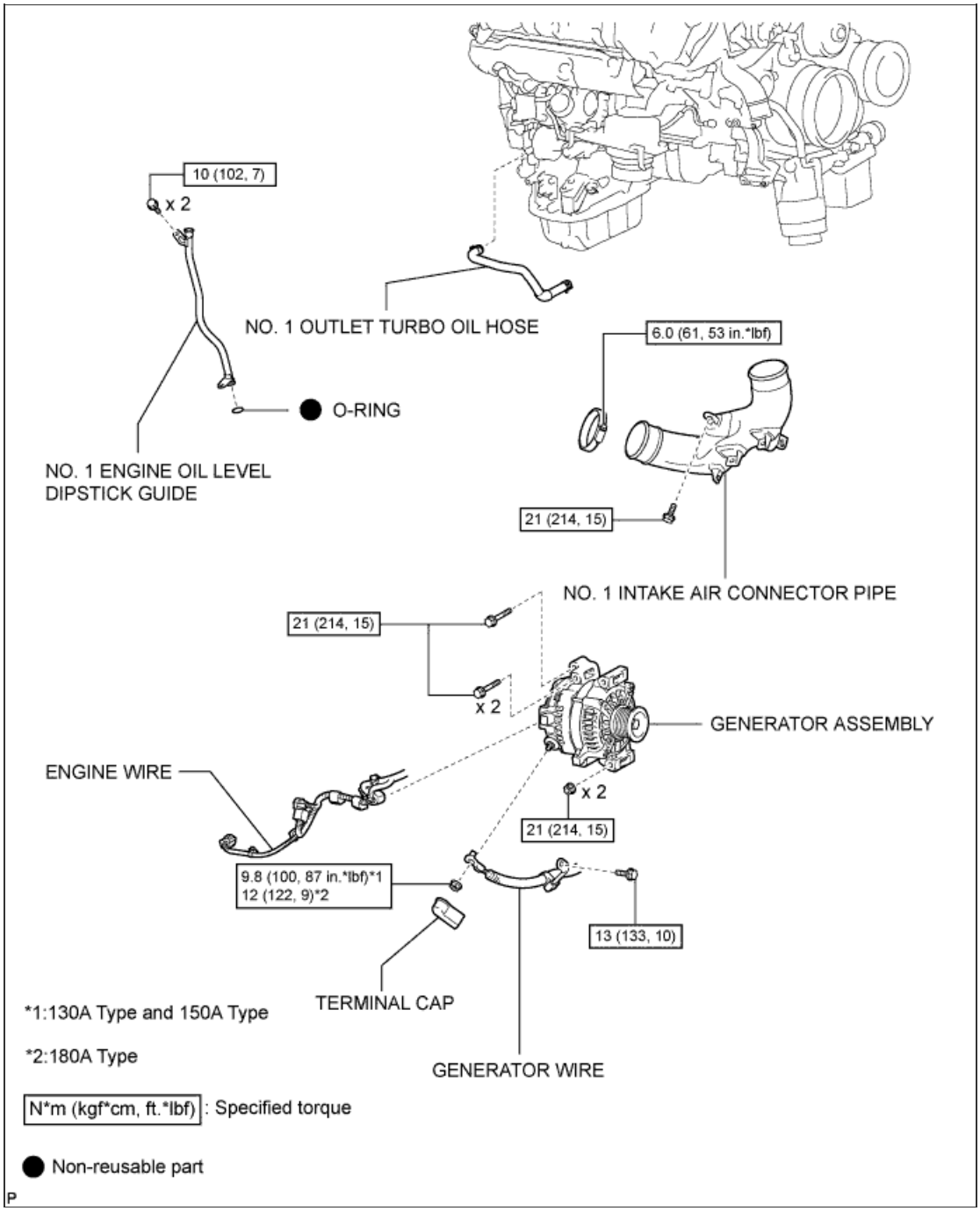
a. Install the front fender apron seal front RH with the 3 clips.

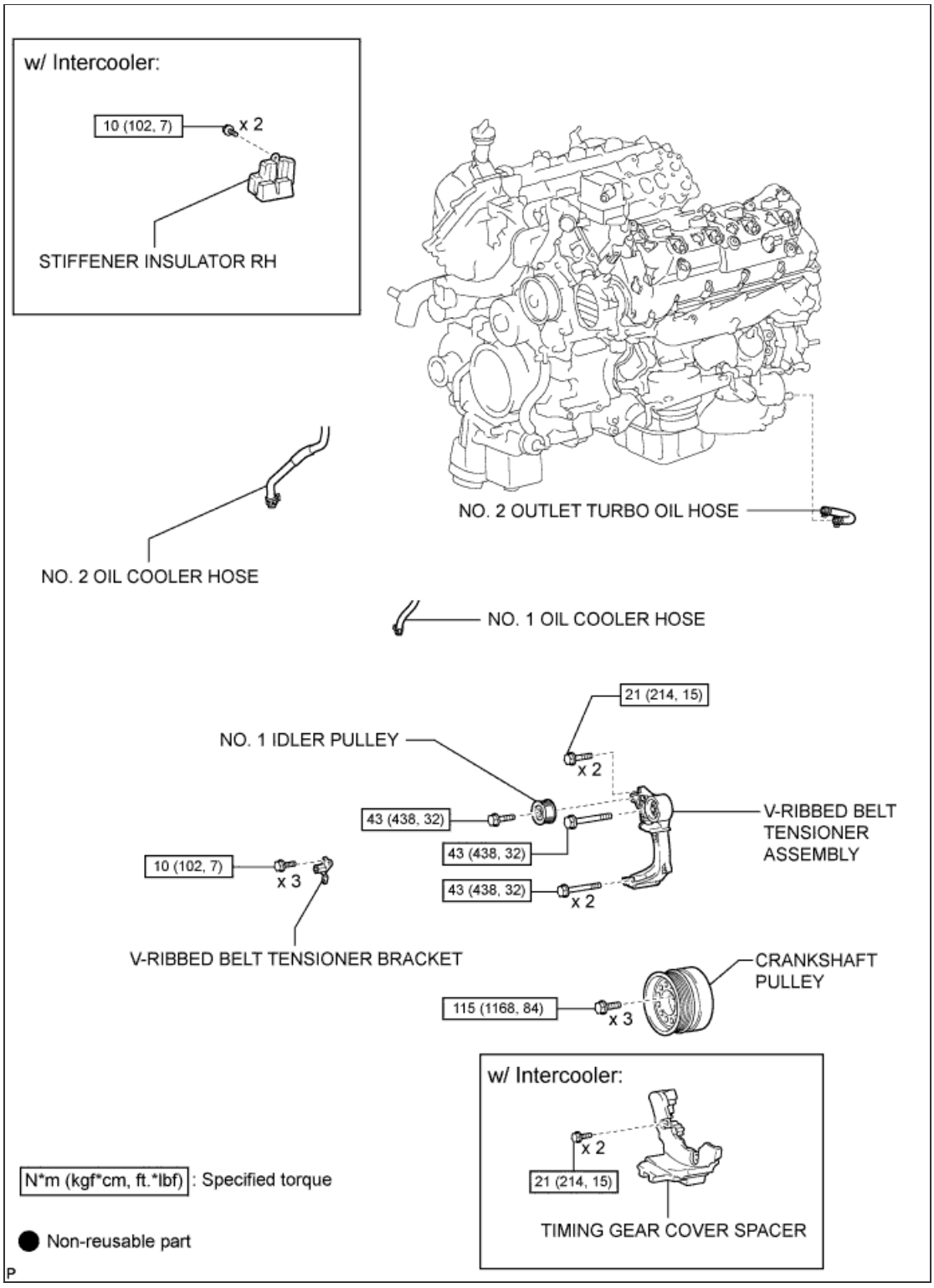


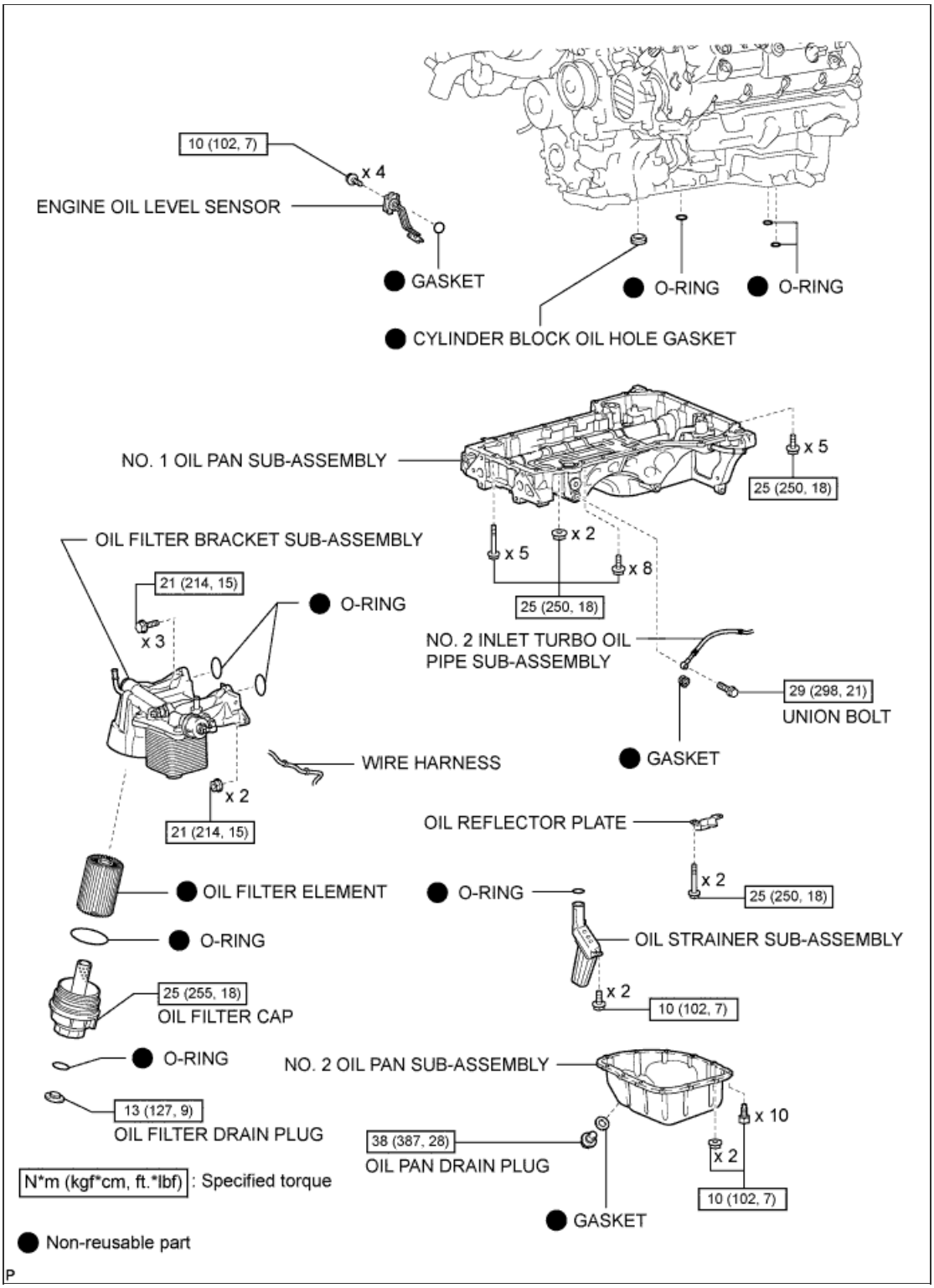
12. INSTALL FRONT WHEEL RH

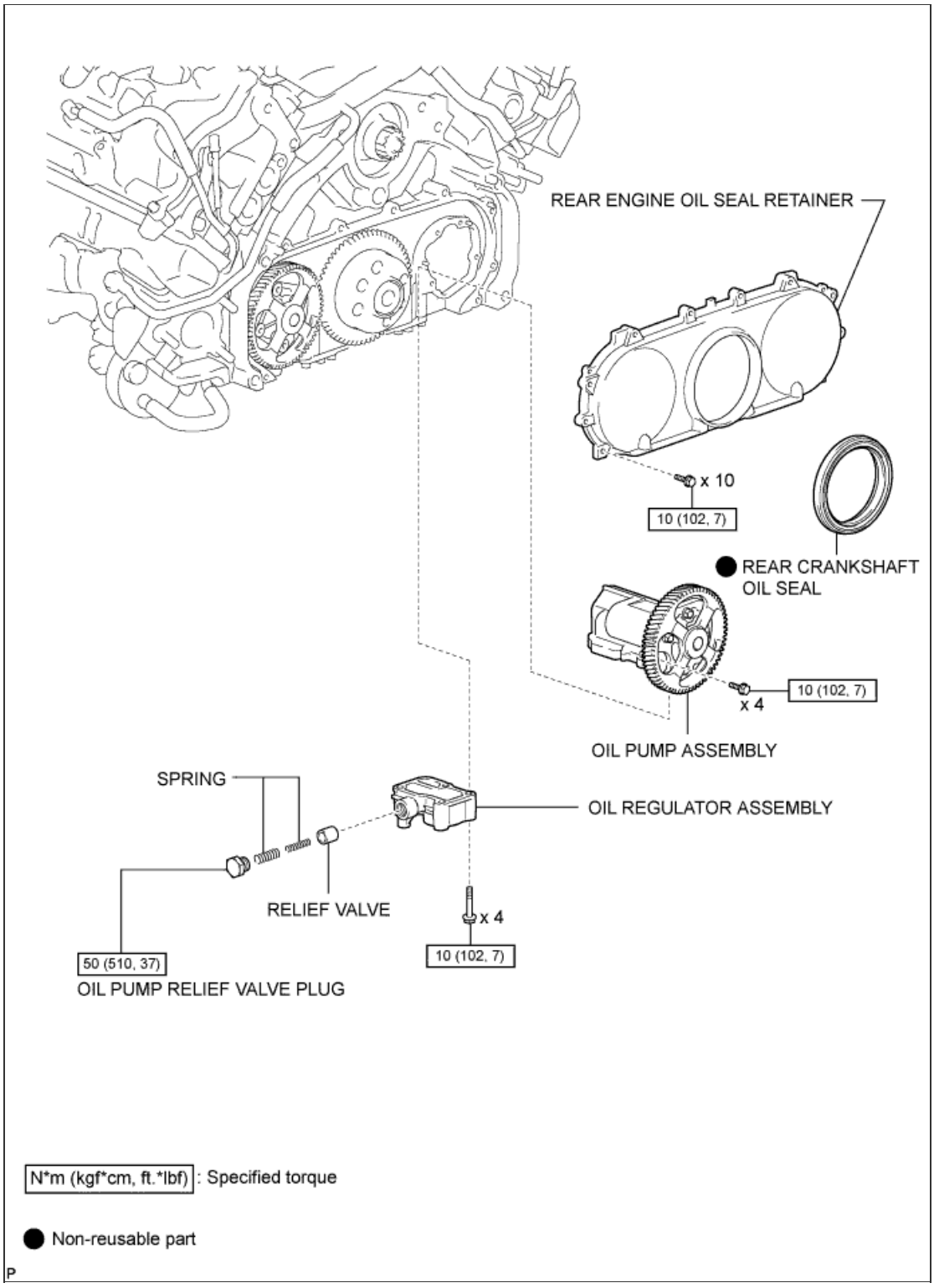
Torque:
for Aluminum Wheel:
131 N*m{ 1336 kgf*cm , 97 ft.*lbf }
for Steel Wheel:
209 N*m{ 2131 kgf*cm , 154 ft.*lbf }

for Preparation Click here




w/ Intercooler:
10 (102, 7)
x 2
STIFFENER INSULATOR RH
NO. 2 OUTLET TURBO OIL HOSE
NO. 2 OIL COOLER HOSE
NO. 1 OIL COOLER HOSE
21 (214, 15)
NO. 1 IDLER PULLEY
x 2
43 (438, 32)
V-RIBBED BELT TENSIONER ASSEMBLY
43 (438, 32)
10 (102, 7)
x 3
43 (438, 32)
x 2
V-RIBBED BELT TENSIONER BRACKET
CRANKSHAFT PULLEY
115 (1168, 84)
x 3
w/ Intercooler:
x 2
21 (214, 15)
TIMING GEAR COVER SPACER
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P


10 (102, 7)
x 4
ENGINE OIL LEVEL SENSOR
GASKET
O-RING
O-RING
CYLINDER BLOCK OIL HOLE GASKET
NO. 1 OIL PAN SUB-ASSEMBLY
x 5
25 (250, 18)
x 5
x 2
x 8
25 (250, 18)
OIL FILTER BRACKET SUB-ASSEMBLY
21 (214, 15)
x 3
O-RING
NO. 2 INLET TURBO OIL PIPE SUB-ASSEMBLY
29 (298, 21)
UNION BOLT
GASKET
WIRE HARNESS
x 2
21 (214, 15)
OIL REFLECTOR PLATE
x 2
25 (250, 18)
OIL FILTER ELEMENT
O-RING
O-RING
OIL STRAINER SUB-ASSEMBLY
x 2
10 (102, 7)
25 (255, 18)
OIL FILTER CAP
O-RING
NO. 2 OIL PAN SUB-ASSEMBLY
x 10
x 2
10 (102, 7)
13 (127, 9)
OIL FILTER DRAIN PLUG
38 (387, 28)
OIL PAN DRAIN PLUG
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P


REAR ENGINE OIL SEAL RETAINER
x 10
10 (102, 7)
REAR CRANKSHAFT OIL SEAL
10 (102, 7)
x 4
OIL PUMP ASSEMBLY
SPRING
OIL REGULATOR ASSEMBLY
RELIEF VALVE
x 4
10 (102, 7)
50 (510, 37)
OIL PUMP RELIEF VALVE PLUG
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P

for Preparation Click here

1. PRECAUTION

NOTICE:

After turning the ignition switch off, waiting time may be required before disconnecting the cable from the battery terminal. Therefore, make sure to read the disconnecting the cable from the battery terminal notice before proceeding with work (Click here).

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Disconnect the cables from the negative (-) main battery and sub-battery terminals.

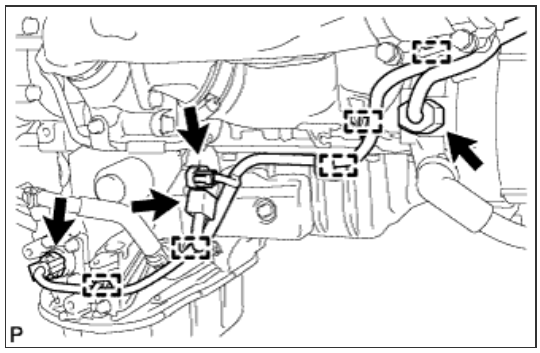
3. REMOVE ENGINE ASSEMBLY

a. Remove the engine assembly from the vehicle (Click here).

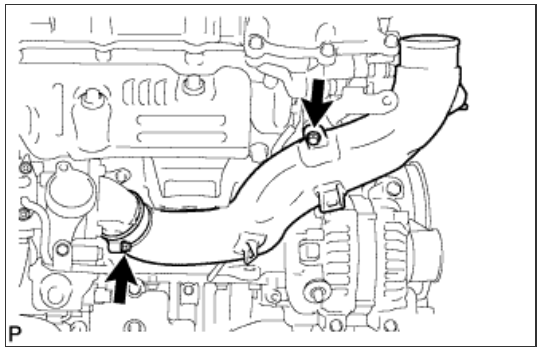
4. REMOVE NO. 1 INTAKE AIR CONNECTOR PIPE

a. Remove the 4 connectors.

b. Using a clip remover, detach the 5 wire harness clamps.

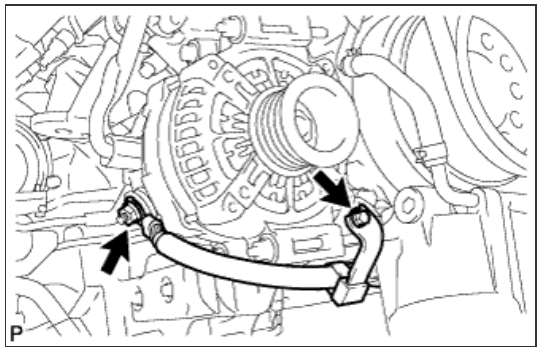


c. Loosen the hose clamp, and remove the bolt and No. 1 intake air connector pipe.

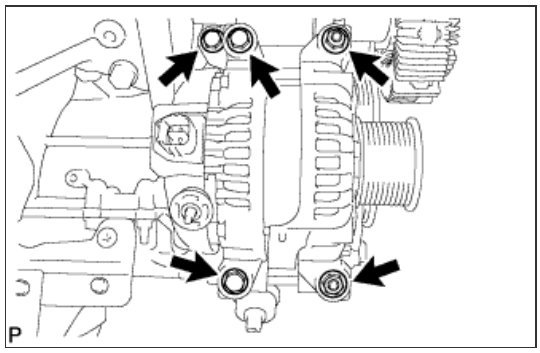


5. REMOVE GENERATOR ASSEMBLY

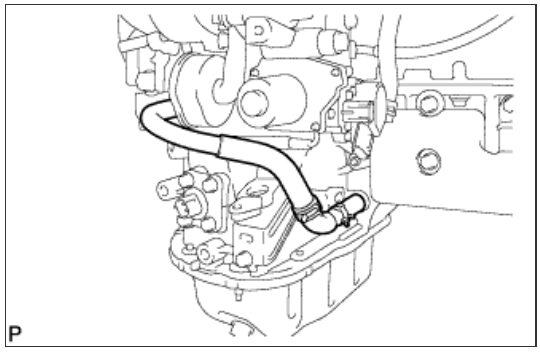
a. Remove the nut and bolt, and disconnect the generator positive ( ) cable.



b. Remove the 3 bolts, 2 nuts and generator.

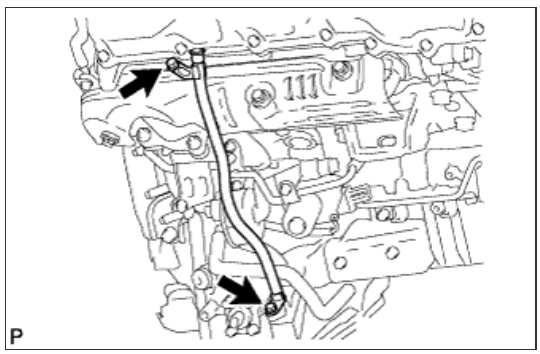


6. DISCONNECT NO. 1 OUTLET TURBO OIL HOSE

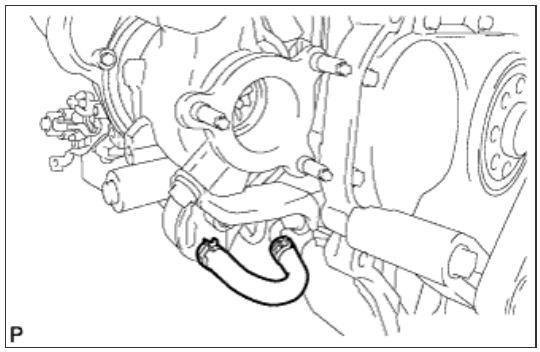


7. REMOVE NO. 1 ENGINE OIL LEVEL DIPSTICK GUIDE

a. Remove the 2 bolts and No. 1 engine oil level dipstick guide.

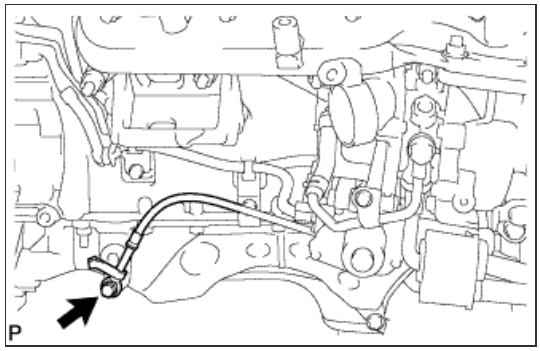


8. DISCONNECT NO. 2 OUTLET TURBO OIL HOSE



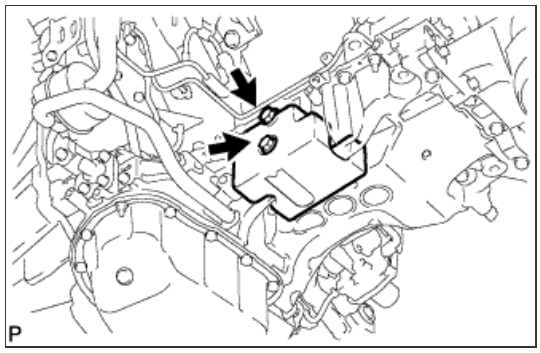
9. DISCONNECT NO. 2 INLET TURBO OIL PIPE SUB-ASSEMBLY

a. Remove the union bolt and gasket, and disconnect the No. 2 inlet turbo oil pipe.

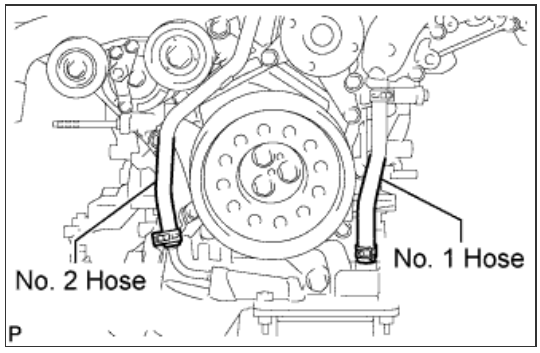


10. REMOVE STIFFENER INSULATOR RH (w/ Intercooler)

a. Remove the 2 bolts and stiffener insulator RH.



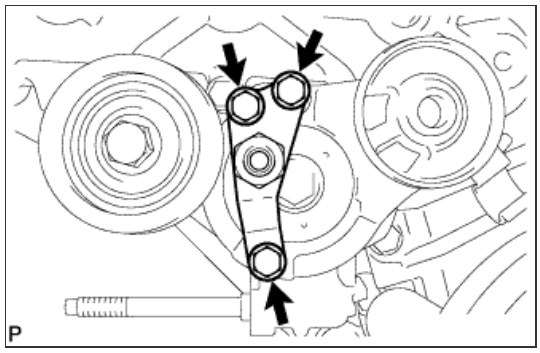
11. DISCONNECT NO. 1 OIL COOLER HOSE



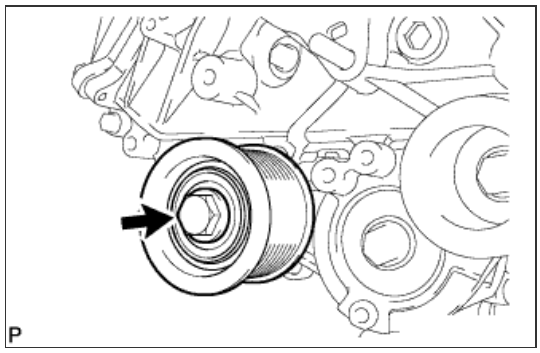
12. DISCONNECT NO. 2 OIL COOLER HOSE

13. REMOVE V-RIBBED BELT TENSIONER ASSEMBLY

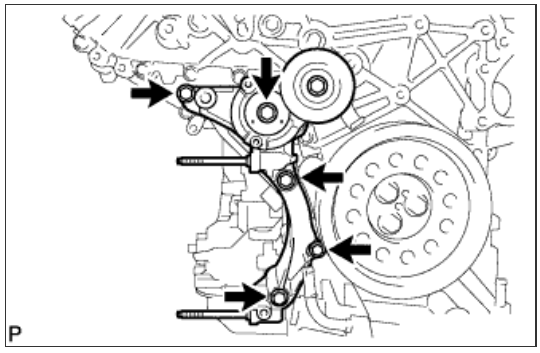
a. Remove the 3 bolts and ribbed belt tensioner bracket.



b. Remove the bolt and No. 1 idler pulley.



c. Remove the 5 bolts and ribbed belt tensioner.



14. REMOVE CRANKSHAFT PULLEY

NOTICE:

This procedure is intended for removal/installation of the crankshaft pulley only. Do not use this procedure for removal/installation of the flywheel or the drive plate and ring gear.

a. nstall the 2 bolts to the bolt holes of the crankshaft rear side.

b. Using a bar, turn the crankshaft until the crankshaft pulley service hole is a little to the left of bottom dead center.

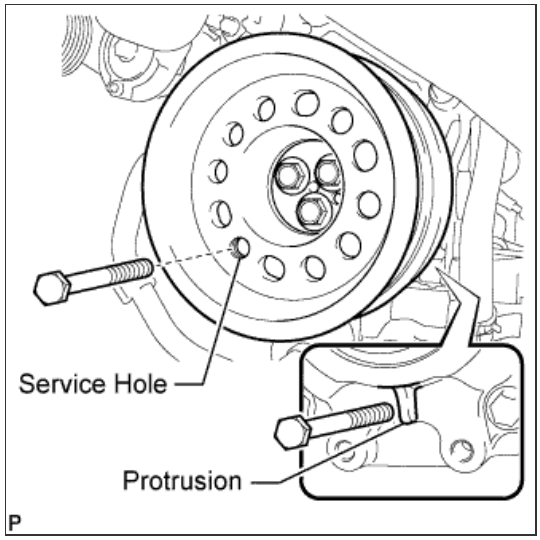
c. nstall a 14 mm 1.5 pitch service bolt with a length of 70 mm or more to the crankshaft pulley service hole, and hold the crankshaft using the timing chain cover protrusion.

d. Remove the 3 bolts and crankshaft pulley.

NOTICE:

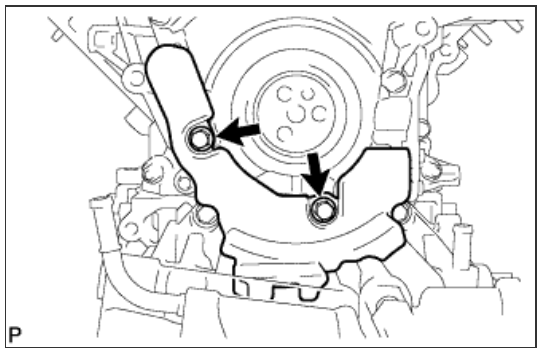
f the crankshaft pulley cannot be removed, temporarily install a bolt to the crankshaft so that the pulley does not fall, and lightly tap the outer edge of the mass damper with a plastic-faced hammer to remove the pulley. Do not tap the pulley ribbed belt ribs, as the crankshaft may

be damaged.



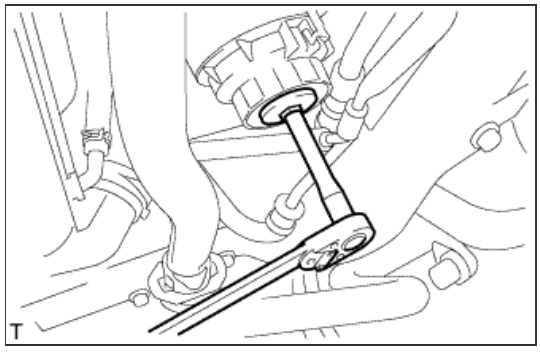
15. REMOVE TIMING GEAR COVER SPACER (w/ Intercooler)

a. Remove the 2 bolts and timing gear cover spacer.



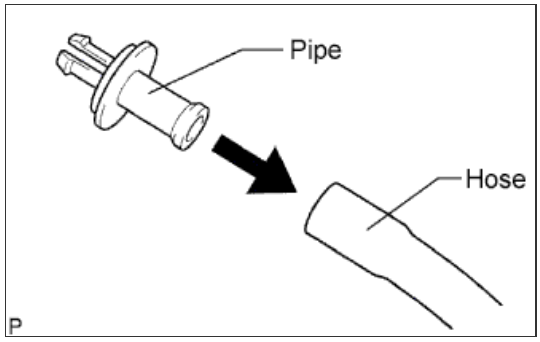
16. REMOVE OIL FILTER ELEMENT

a. Remove the oil filter drain plug.



b. Connect a hose with an inside diameter of 15 mm (0.591 in.) to the pipe.

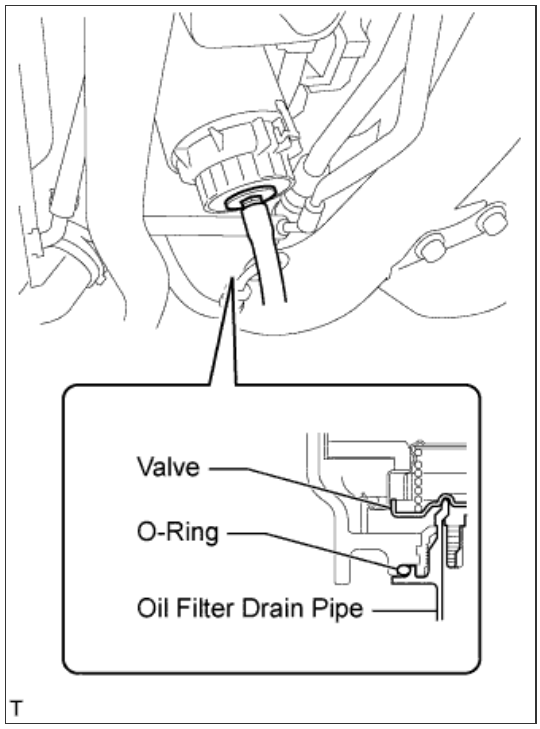
c. Remove the O-ring from the oil filter drain plug and install it to the drain pipe.



d. nstall the oil filter drain pipe to the oil filter cap and drain the engine oil.

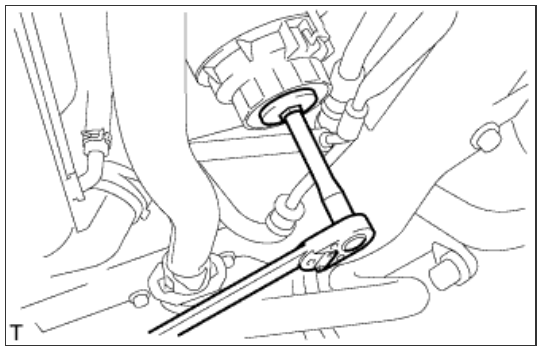
e. Remove the oil filter drain pipe.

f. Apply a light coat of engine oil to a new O-ring, and install it to the oil filter drain plug.



g. nstall the oil filter drain plug to the oil filter cap.

Tor e:
13 N*m{ 127 kgf*cm , 9 ft.*lbf }

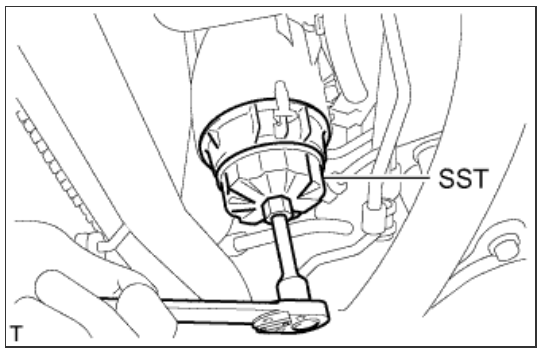


h. Using SST, remove the oil filter cap.

SST
09228-06501

HINT:

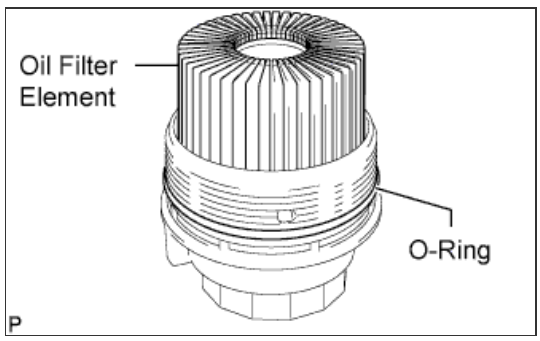
Use a container to catch the draining oil. After the oil filter cap is loosened appro mately 4 turns and the cap ribs are vertical, engine oil drains from the gap between the oil filter cap and oil pan.



i. Remove the oil filter element and O-ring from the oil filter cap.

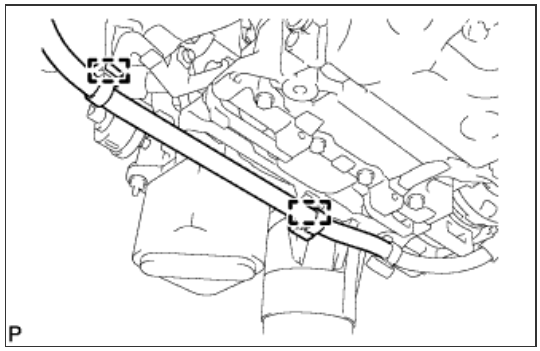
NOTICE:

Be sure to remove the cap O-ring by hand, without using any tools, to prevent damage to the cap O-ring groove.

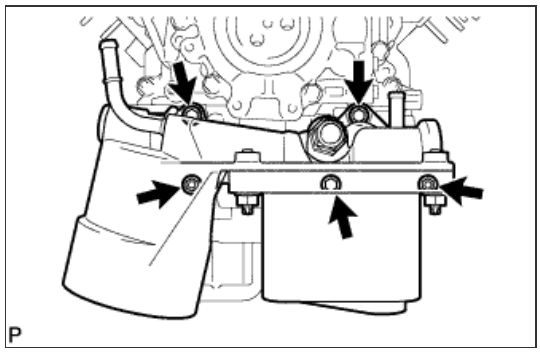


17. REMOVE OIL FILTER BRACKET SUB-ASSEMBLY

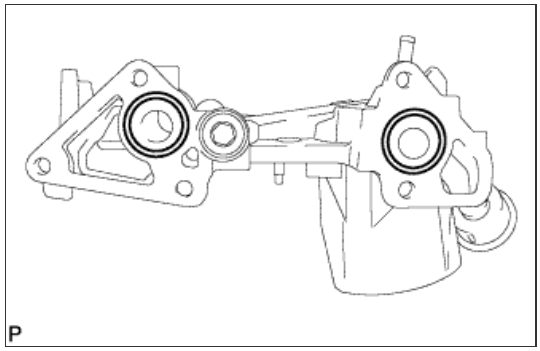
a. Disconnect the 2 wire harness clamps.



b. Remove the 3 bolts, 2 nuts and oil filter bracket.



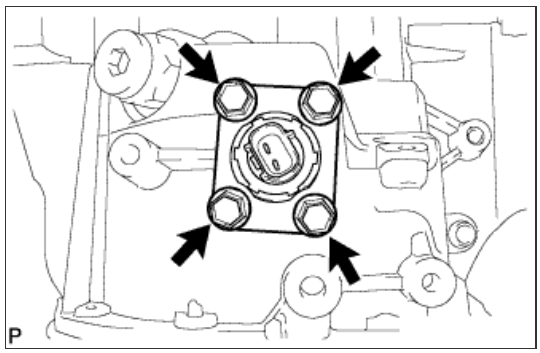
c. Remove the 2 O-rings.



18. REMOVE ENGINE OIL LEVEL SENSOR

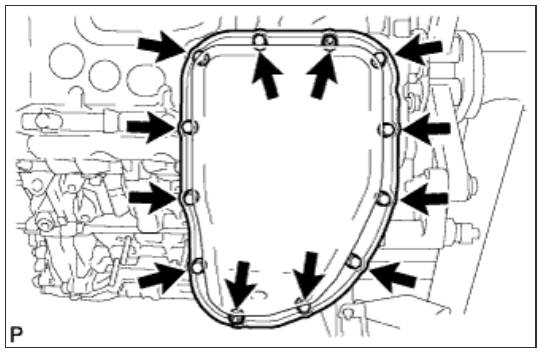
a. Remove the 4 bolts and engine oil level sensor.

b. Remove the gasket.



19. REMOVE NO. 2 OIL PAN SUB-ASSEMBLY

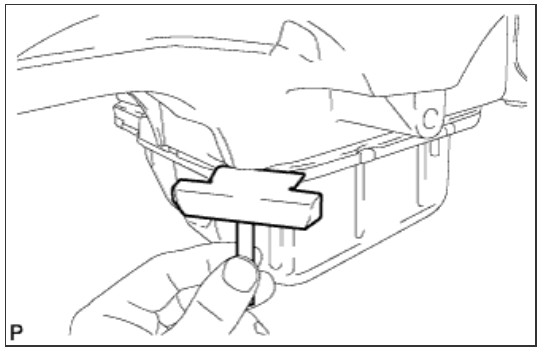
a. Remove the 10 bolts and 2 nuts.



b. nsert the blade of an oil pan seal cutter between the oil pans. Cut through the applied sealer and remove the No. 2 oil pan.

NOTICE:

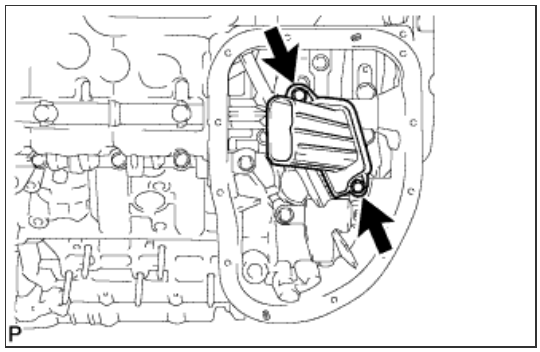
Be careful not to damage the contact surfaces of the No. 1 and No. 2 oil pans.



20. REMOVE OIL STRAINER SUB-ASSEMBLY

a. Remove the 2 bolts and oil strainer.

b. Remove the O-ring from the oil strainer.



21. REMOVE NO. 1 OIL PAN SUB-ASSEMBLY

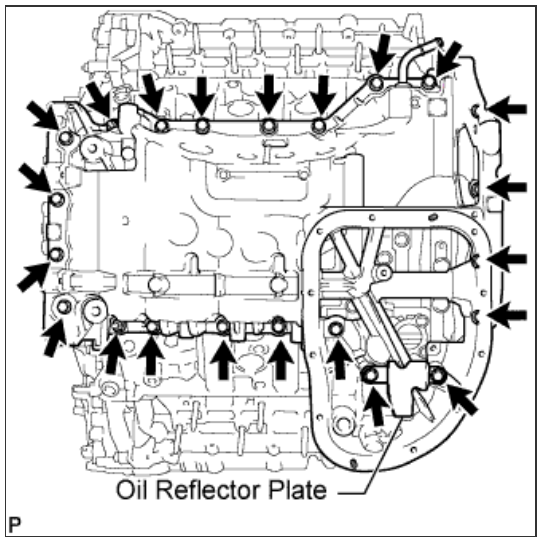
a. Remove the 20 bolts, 2 nuts and oil reflector plate.

NOTICE:

f the oil reflector plate is deformed, replace it.

HINT:

Be sure to clean the bolts and stud bolts, and check the threads for cracks or other damage.



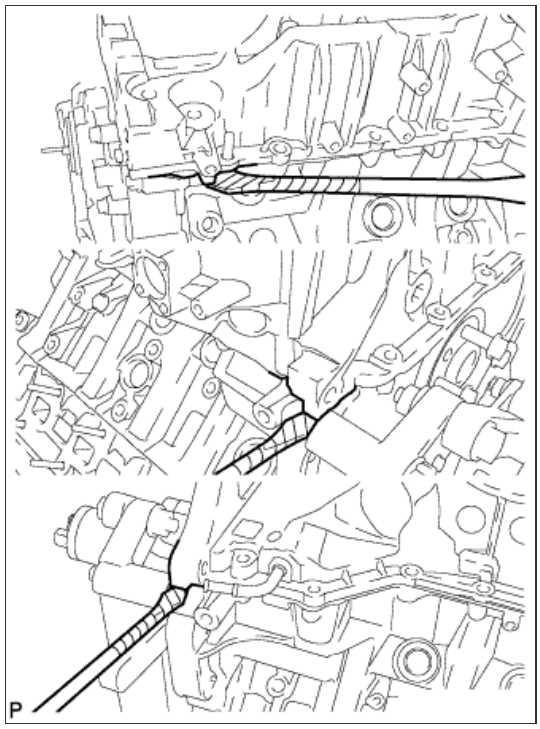
b. Remove the No. 1 oil pan by prying between the No. 1 oil pan and cylinder block with a screwdriver.

NOTICE:

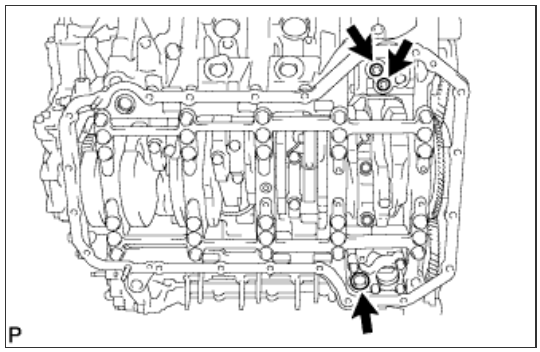
Be careful not to damage the contact surfaces of the cylinder block and oil pan.

HINT:

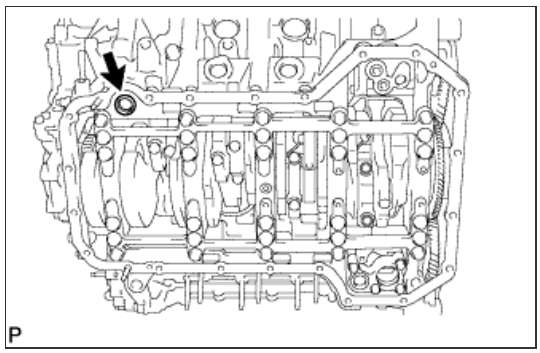
Tape the screwdriver tip before use.



c. Remove the 3 O-rings.

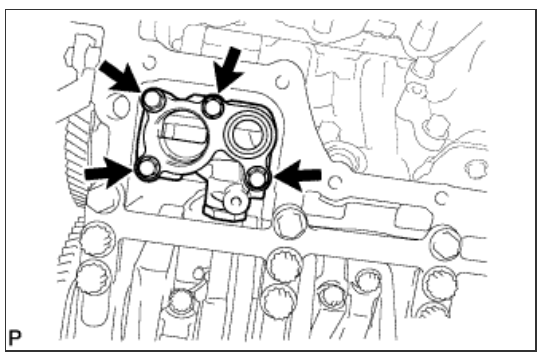


d. Remove the cylinder block oil hole gasket.



22. REMOVE OIL REGULATOR ASSEMBLY

a. Remove the 4 bolts and oil regulator.



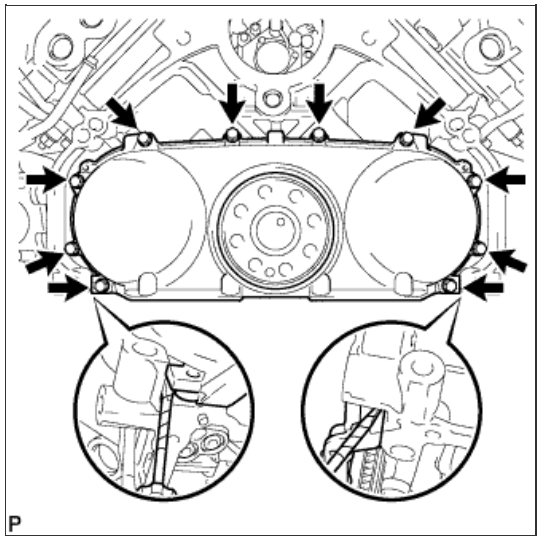
23. REMOVE REAR ENGINE OIL SEAL RETAINER

a. Remove the 10 bolts.

b. Remove the oil seal retainer by prying between the oil seal retainer and cylinder block with a screwdriver.

HINT:

Tape the screwdriver tip before use.



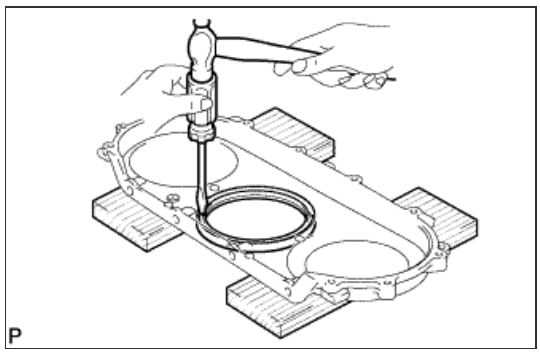
24. REMOVE REAR CRANKSHAFT OIL SEAL

a. Place the oil seal retainer on wooden blocks.

b. Using a screwdriver and hammer, tap out the oil seal.

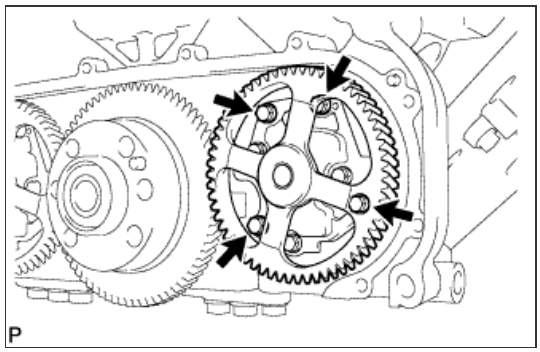
HINT:

Tape the screwdriver tip before use.



25. REMOVE OIL PUMP ASSEMBLY

a. Remove the 4 bolts and oil pump.

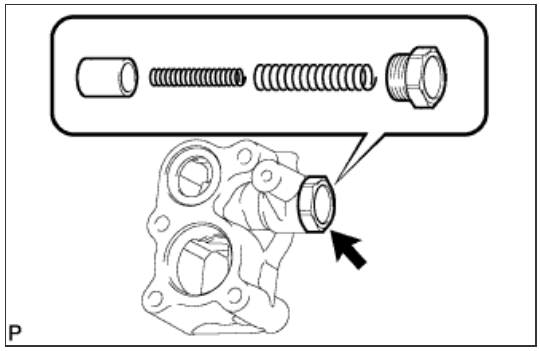


for Preparation Click here

1. INSPECT OIL REGULATOR ASSEMBLY

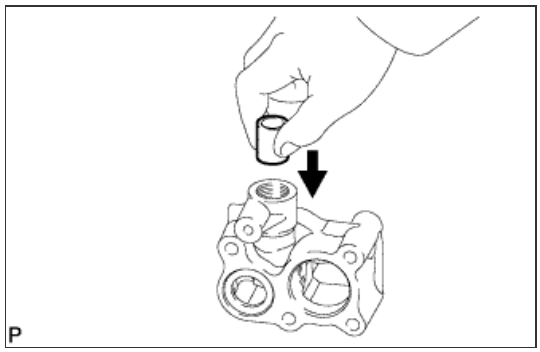
a. Remove the oil pump relief valve plug.

b. Remove the 2 valve springs and relief valve.



c. Check that the valve falls smoothly into the valve hole by its own weight.
If it does not, replace the relief valve. If necessary, replace the oil regulator assembly.

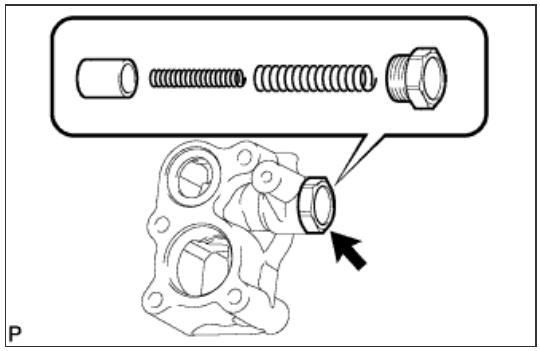
d. Coat the relief valve with engine oil.



e. Install the relief valve and 2 relief valve springs into the oil regulator body hole.

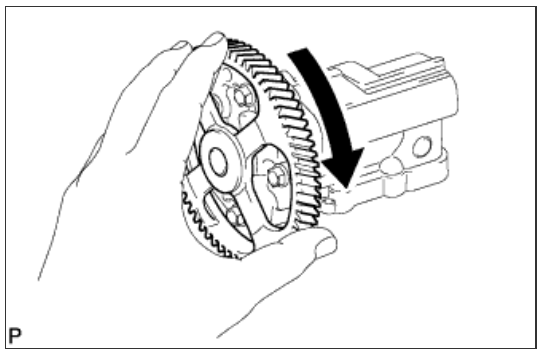
f. Install the oil pump relief valve plug.

Torque:
50 N*m{ 510 kgf*cm , 37 ft.*lbf }



2. INSPECT OIL PUMP ASSEMBLY

a. Turn the gear and check that the oil pump bearing moves smoothly and quietly.
If necessary, replace the oil pump assembly.



for Preparation Click here

1. INSTALL OIL PUMP ASSEMBLY

a. Install the oil pump with the 4 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

2. INSTALL REAR CRANKSHAFT OIL SEAL

a. Place the oil seal retainer on wooden blocks.

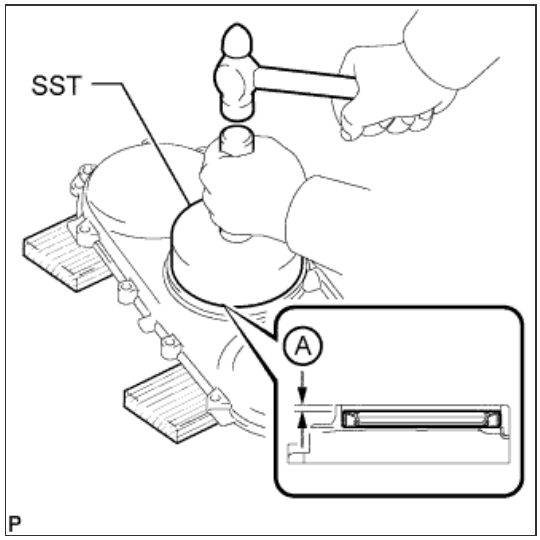
b. Using SST and a hammer, tap in a new oil seal as shown in the illustration.

SST
09223-56010

Standard depth A:
2.7 to 3.7 mm (0.106 to 0.147 in.)

NOTICE:

- **Keep the lip free from foreign matter.**
- **Do not tap on the seal at an angle.**



3. INSTALL REAR ENGINE OIL SEAL RETAINER

a. Apply seal packing in a continuous line as shown in the illustration.

Seal diameter:
3.0 to 5.0 mm (0.118 to 0.197 in.)

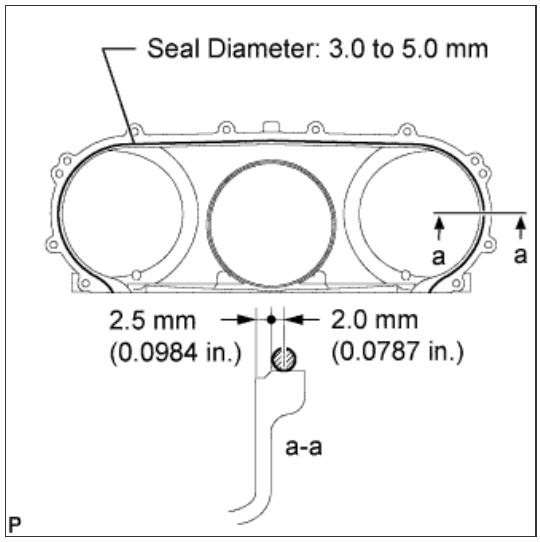
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the rear engine oil seal retainer within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**

b. Apply engine oil to the oil seal lip.

c. Make sure that the lip of the oil seal is properly installed.

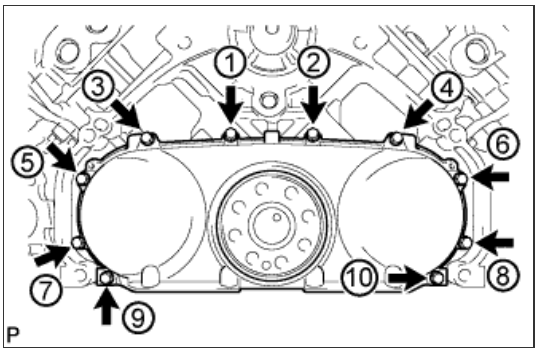


d. Install and uniformly tighten the 10 bolts in the order shown in the illustration.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

NOTICE:

- When installing the oil seal retainer, make sure the lip of the oil seal is not damaged.
- When installing the oil seal retainer, make sure the lip of the oil seal is not folded incorrectly.



4. INSTALL OIL REGULATOR ASSEMBLY

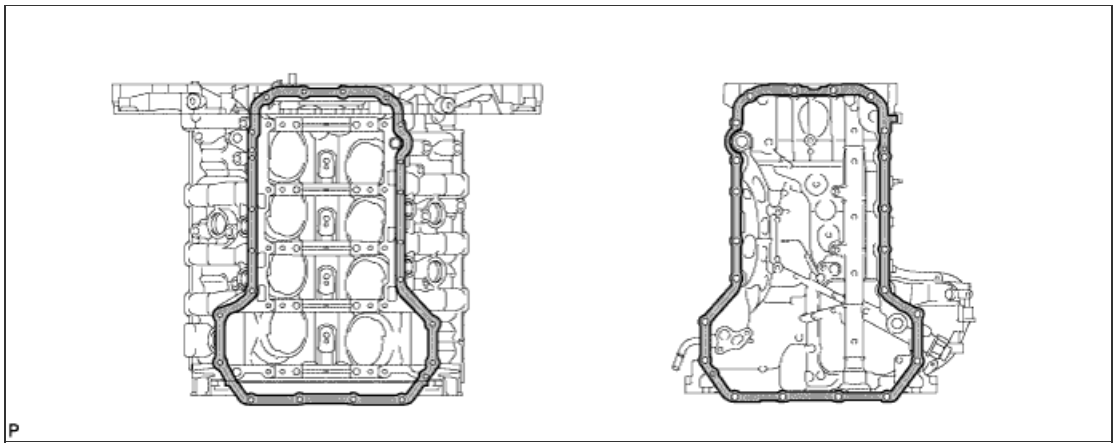
a. Install the oil regulator with the 4 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

5. INSTALL NO. 1 OIL PAN SUB-ASSEMBLY

NOTICE:

When the contact surfaces shown below are wet, wipe them with an oil-free cloth before applying seal packing.



a. Install the cylinder block oil hole gasket.

b. Apply a light coat of engine oil to 3 new O-rings and set the 3 O-rings to the oil regulator and scavenging pump.

c. Apply seal packing to the No. 1 oil pan as shown in the illustration.

Standard seal diameter:
3.5 to 4.0 mm (0.134 to 0.157 in.)

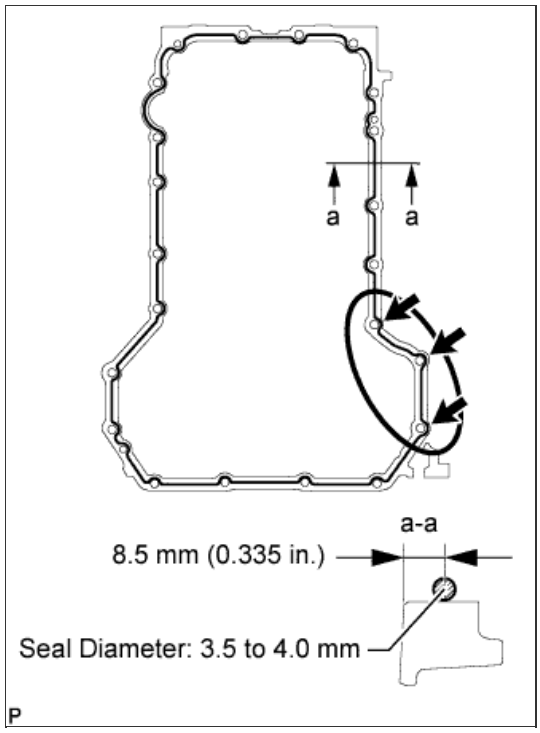
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

- For the 3 bolt holes labeled with arrows, apply the seal packing on the outer edges. For the other bolt holes, apply the seal packing on the inner edges.
- Make sure to apply a continuous bead of seal packing as shown in the illustration. If the bead breaks, overlap 3 mm (0.118 in.) of seal packing and continue the bead.
- Remove any oil and old seal packing from the contact surface.
- Install the No. 1 oil pan within 3 minutes and tighten the bolts

and nuts within 15 minutes after applying seal packing.

- Do not start the engine for at least 2 hours after installing.

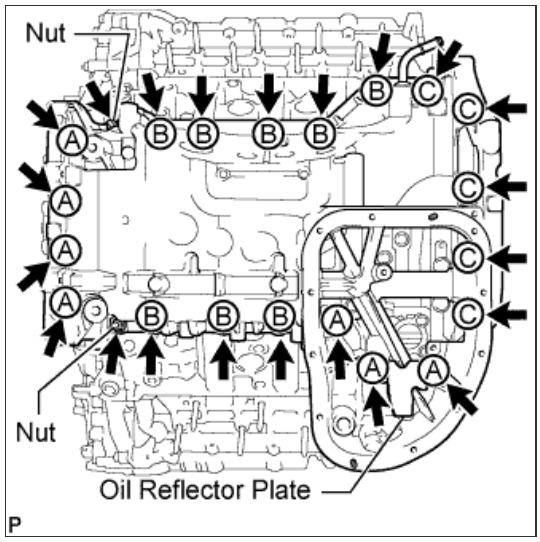


d. Install the No. 1 oil pan and oil reflector plate with the 20 bolts and 2 nuts.

Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }

Bolt Length

Item	Quantity	Length
Bolt A	7	70 mm (2.76 in.)
Bolt B	8	20 mm (0.787 in.)
Bolt		30 mm (1.18 in.)



6. INSTALL OIL STRAINER SUB-ASSEMBLY

a. Apply a light coat of engine oil to a new O-ring, and install it to the oil strainer.

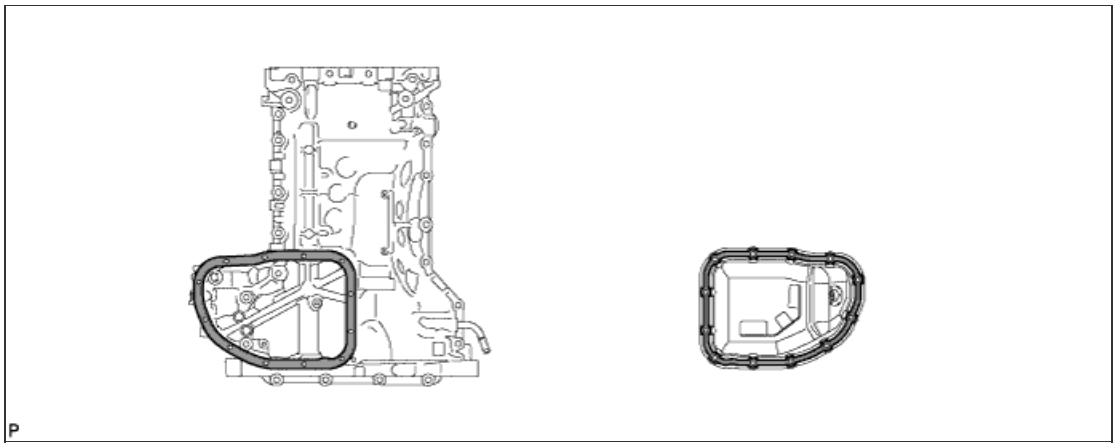
b. Install the oil strainer with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

7. INSTALL NO. 2 OIL PAN SUB-ASSEMBLY

NOTICE:

When the contact surfaces shown below are wet, wipe them with an oil-free cloth before applying seal packing.



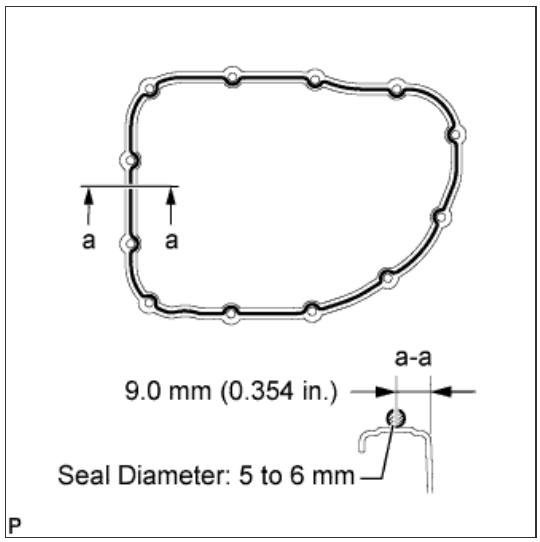
a. Apply seal packing to the No. 2 oil pan as shown in the illustration.

Standard seal diameter:
5.0 to 6.0 mm (0.197 to 0.236 in.)

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

- **For the bolt and pin holes, make sure to apply seal packing to the inner sides.**
- **Make sure to apply a continuous bead of seal packing as shown in the illustration. If the bead breaks, overlap 3.0 mm (0.118 in.) of seal packing and continue the bead.**
- **Remove any oil from the contact surface.**
- **Install the No. 2 oil pan within 3 minutes and tighten the bolts and nuts within 10 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after installing.**



b. Install the No. 2 oil pan with the 10 bolts and 2 nuts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

8. INSTALL ENGINE OIL LEVEL SENSOR

a. Install a new gasket and the sensor with the 4 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

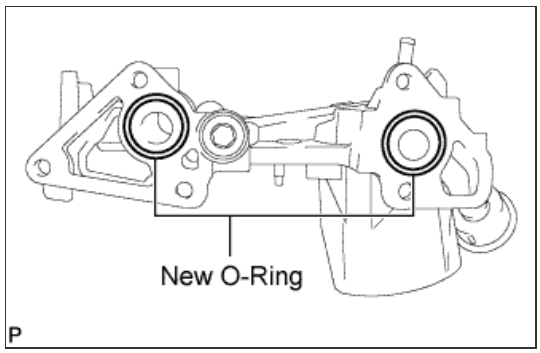
9. INSTALL OIL FILTER BRACKET SUB-ASSEMBLY

a. Apply a light coat of engine oil to 2 new O-rings, and set them to the oil filter bracket.

b. Install the oil filter bracket with the 3 bolts and 2 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Connect the 2 wire harness clamps.



10. INSTALL OIL FILTER ELEMENT

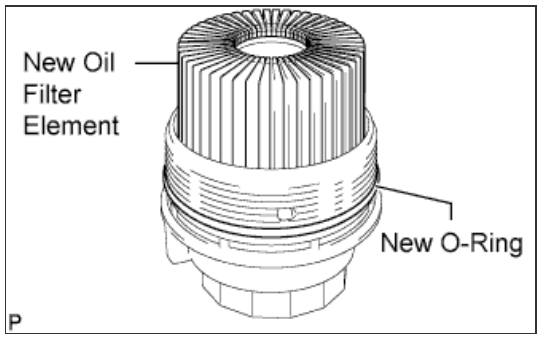
a. lean the inside of the oil filter cap, its threads and its O-ring groove.

b. Apply a small amount of engine oil to a new O-ring and install it to the oil filter cap.

c. Set a new oil filter element in the oil filter cap.

d. emove any dirt or foreign matter from the installation surface of the engine.

e. Apply a small amount of engine oil to the O-ring again and temporarily install the oil filter cap by hand.



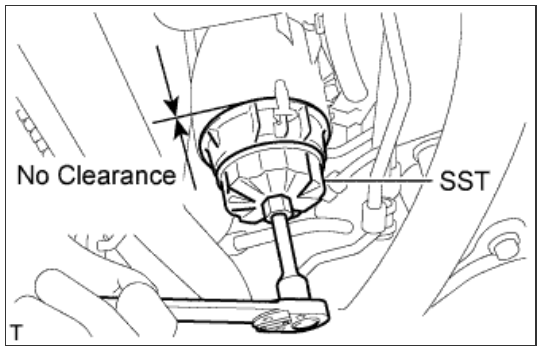
f. Using SST, tighten the oil filter cap.

SST
09228-06501

Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }

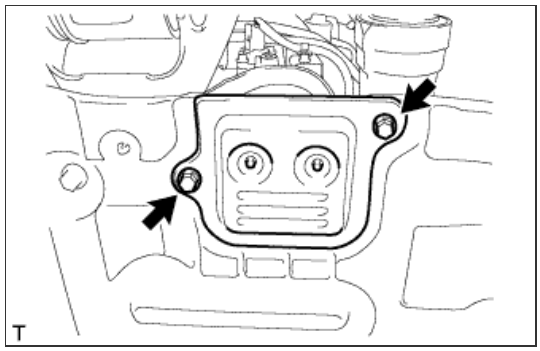
NOTICE:

- **Make sure that the oil filter is installed securely as shown in the illustration.**
- **Be careful that the O-ring does not get caught between any surrounding parts.**



g. Install the No. 2 engine under cover seal to the No. 2 engine under cover with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



11. INSTALL TIMING GEAR COVER SPACER (w/ Intercooler)

a. Install the timing gear cover spacer with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

12. INSTALL CRANKSHAFT PULLEY

NOTICE:

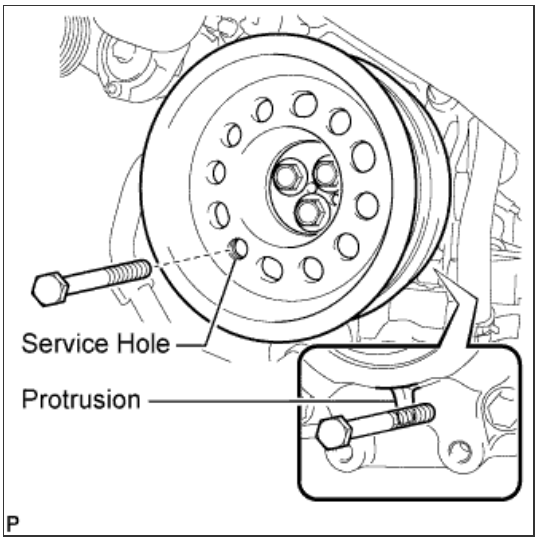
This procedure is intended for removal/installation of the crankshaft pulley only. Do not use this procedure for removal/installation of the flywheel or the drive plate and ring gear.

a. Align the crankshaft pulley and the crankshaft knock pin, and temporarily install the crankshaft pulley with the 3 bolts.

b. Install the 2 bolts to the bolt holes of the crankshaft rear side.

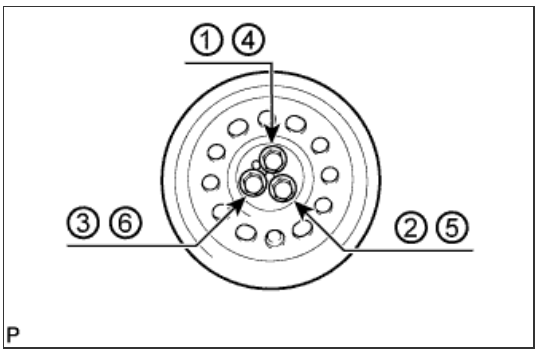
c. Using a bar, turn the crankshaft until the crankshaft pulley service hole is a little to the right of bottom dead center.

d. Install a 14 mm x 1.5 pitch service bolt with a length of 70 mm or more to the crankshaft pulley service hole, and hold the crankshaft using the timing chain cover protrusion.



e. Uniformly tighten the 3 bolts in 2 passes in the order shown in the illustration.

Torque:
115 N*m{ 1168 kgf*cm , 84 ft.*lbf }

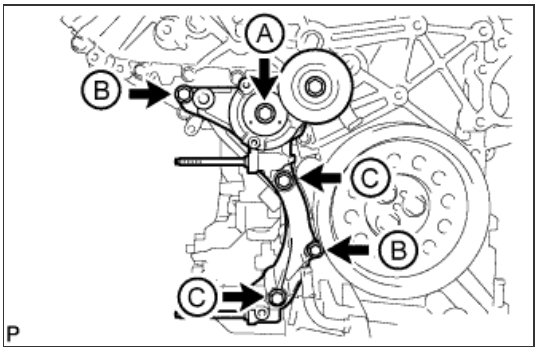


f. Remove the service bolt.

13. INSTALL V-RIBBED BELT TENSIONER ASSEMBLY

a. Install the V-ribbed belt tensioner with the 5 bolts.

Torque:
for bolt A and C:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }
for bolt B:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



Bolt Length

Item	Quantity	Length
Bolt A	1	116 mm (4.57 in.)
Bolt B	2	40 mm (1.58 in.)
Bolt C	2	95 mm (3.74 in.)

b. Install the No. 1 idler pulley with the bolt.

Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }

c. Install the V-ribbed belt tensioner bracket with the 3 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

14. CONNECT NO. 2 OIL COOLER HOSE

a. Align the white paint marks on the oil cooler hose and oil filter bracket and connect the hose.

NOTICE:

Make sure to maintain a space between the oil cooler hose and crankshaft pulley and the oil cooler hose and V-ribbed belt idler pulley.

15. CONNECT NO. 1 OIL COOLER HOSE

a. Face the pink paint mark on the oil cooler hose toward the front side of the engine and connect the hose to the oil filter bracket.

NOTICE:

Make sure to maintain a space between the oil cooler hose and crankshaft pulley.

16. INSTALL STIFFENER INSULATOR RH (w/ Intercooler)

a. Install the stiffener insulator with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

17. INSTALL NO. 2 INLET TURBO OIL PIPE SUB-ASSEMBLY

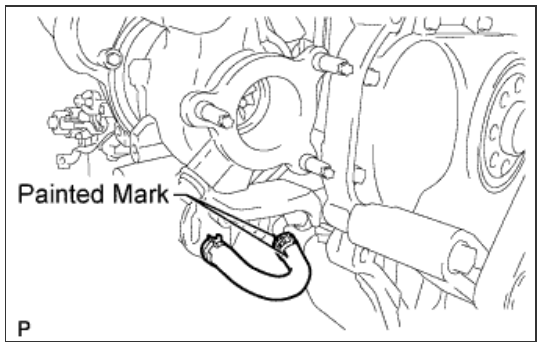
a. Install a new gasket and connect the No. 2 inlet turbo oil pipe with the union bolt.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

18. CONNECT NO. 2 OUTLET TURBO OIL HOSE

HINT:

Align the white paint marks on the oil hose and pipe, and connect the hose.



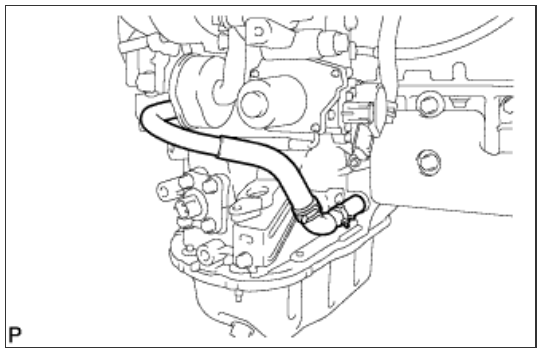
19. INSTALL NO. 1 ENGINE OIL LEVEL DIPSTICK GUIDE

a. Apply a light coat of engine oil to a new O-ring, and install it to the No. 1 engine oil level dipstick guide.

b. Install the No. 1 engine oil level dipstick guide with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

20. CONNECT NO. 1 OUTLET TURBO OIL HOSE



21. INSTALL GENERATOR ASSEMBLY

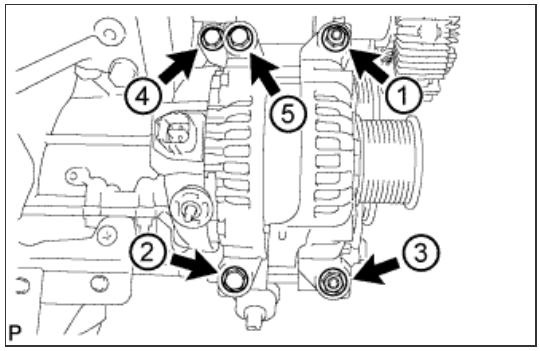
a. Temporarily install the generator with the 3 bolts and 2 nuts.

b. Uniformly tighten the 3 bolts and 2 nuts in the order shown in the illustration.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. onnect the generator cable and install the nut and bolt.

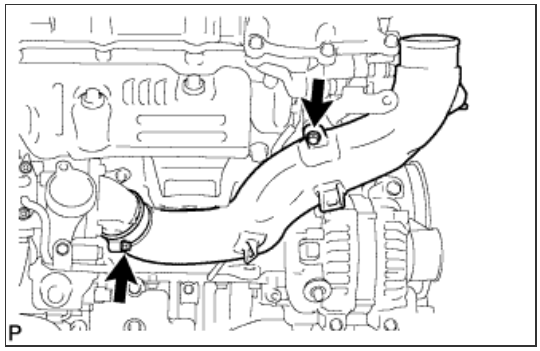
Torque:
for bolt:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }
for nut (130A Type and 150A Type:):
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }
for nut (180A Type:):
12 N*m{ 122 kgf*cm , 9 ft.*lbf }



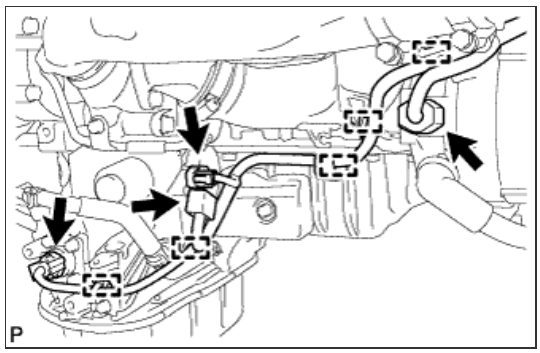
22. INSTALL NO. 1 INTAKE AIR CONNECTOR PIPE

a. Install the No. 1 intake air connector pipe with the bolt. Then tighten the hose clamp.

Torque:
for bolt:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for clamp:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }



b. onnect the 4 connectors and attach the 5 wire harness clamps.



23. INSTALL ENGINE ASSEMBLY

a. Install the engine assembly to the vehicle (Click here).

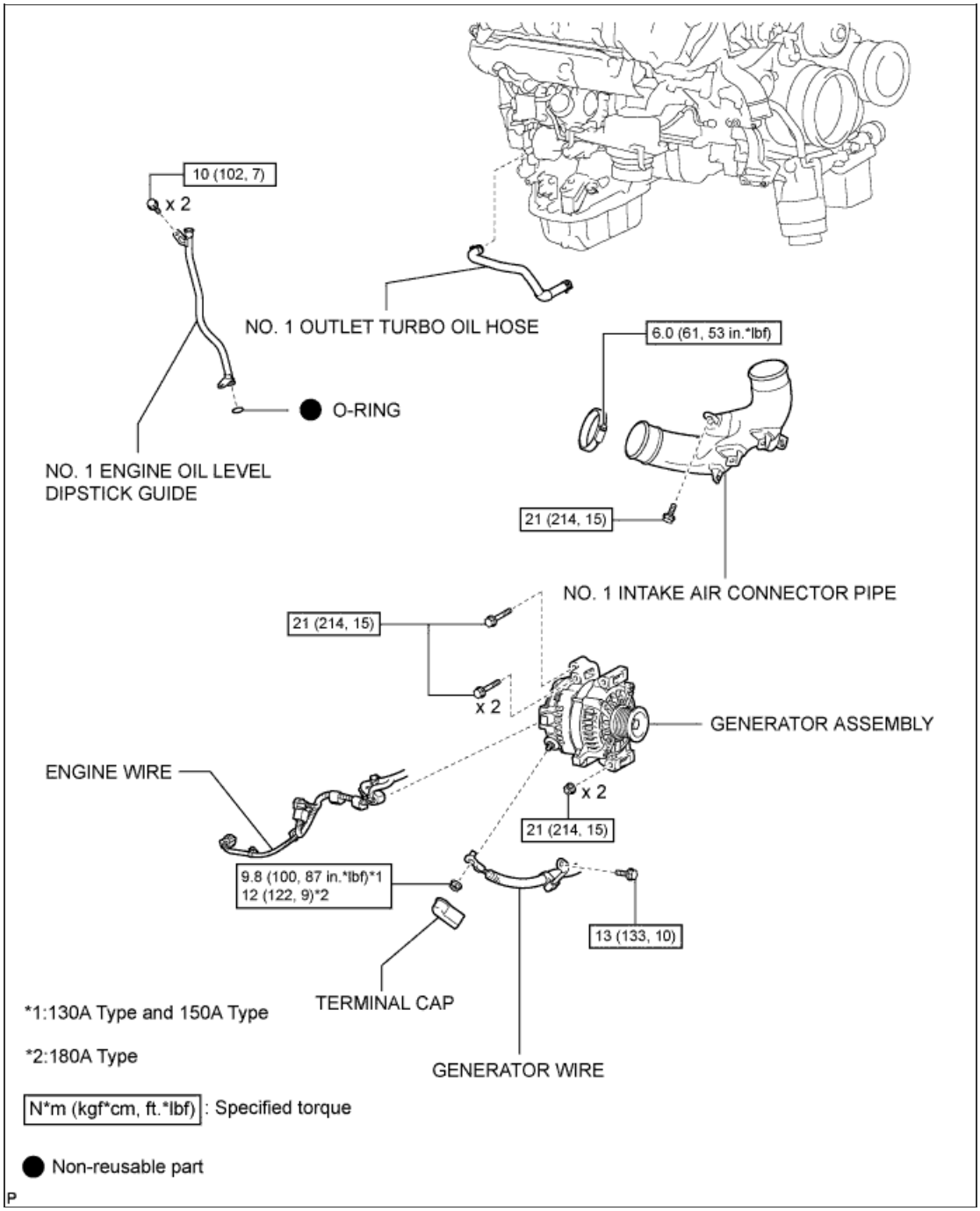
24. CONNECT TO NEGATIVE BATTERY TERMINAL

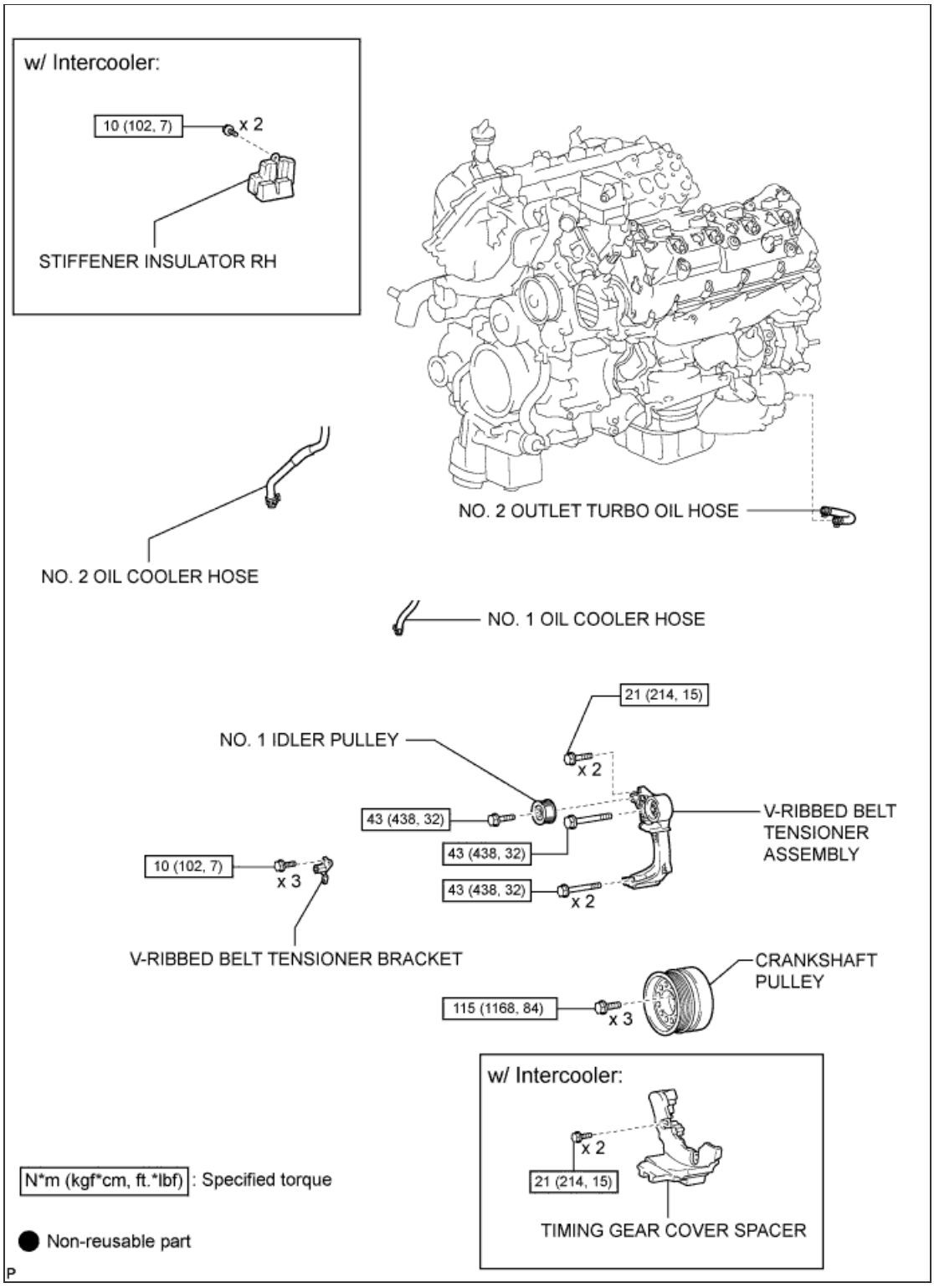
NOTICE:

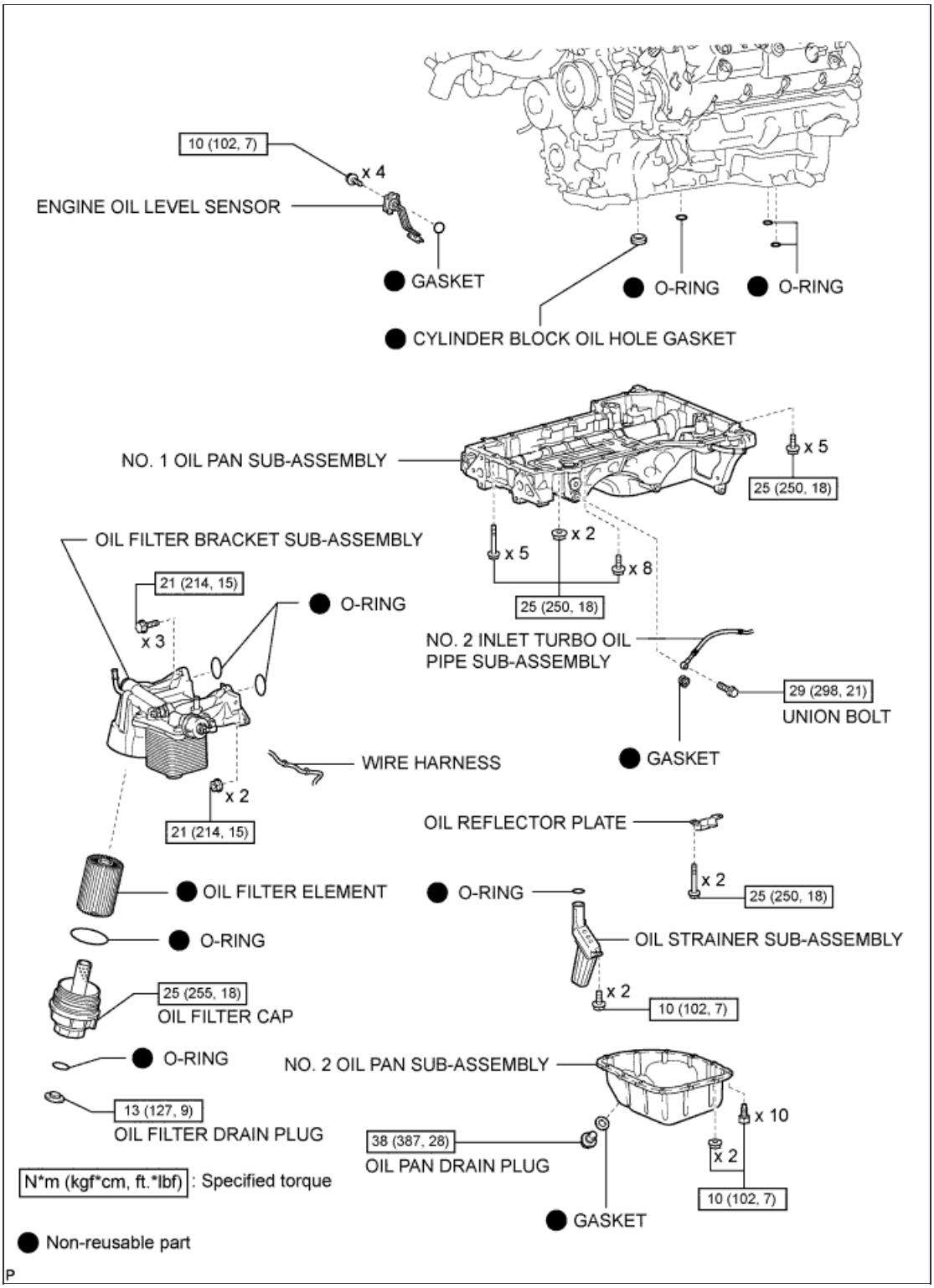
When disconnecting the cable, some systems need to be initialized after the cable is reconnected (lick here).

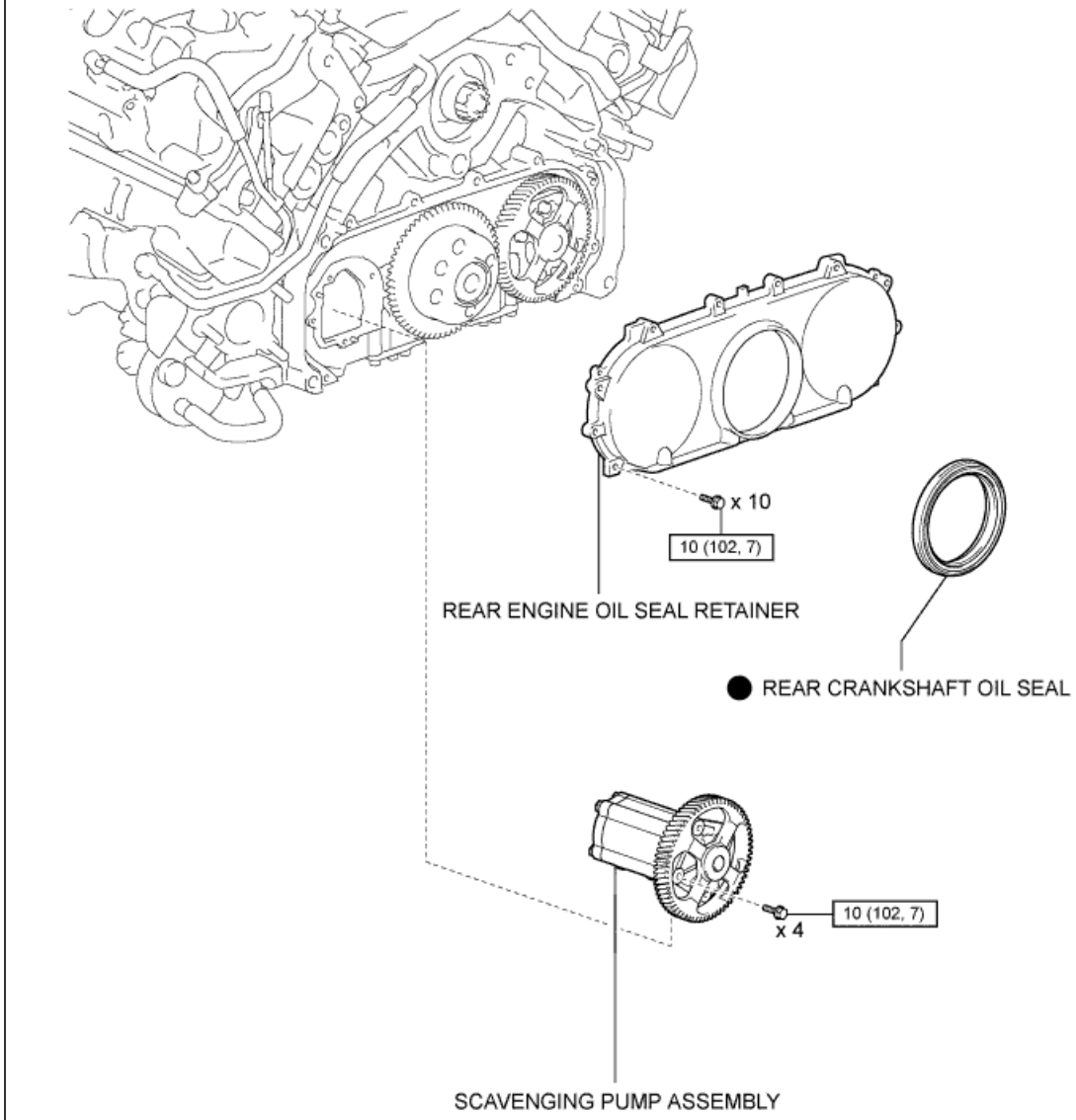
a. onnect the cables to negative (-) main battery and sub-battery terminals.

for Preparation Click here




w/ Intercooler:
10 (102, 7)
x 2
STIFFENER INSULATOR RH
NO. 2 OUTLET TURBO OIL HOSE
NO. 2 OIL COOLER HOSE
NO. 1 OIL COOLER HOSE
21 (214, 15)
NO. 1 IDLER PULLEY
x 2
43 (438, 32)
V-RIBBED BELT TENSIONER ASSEMBLY
43 (438, 32)
10 (102, 7)
x 3
43 (438, 32)
x 2
V-RIBBED BELT TENSIONER BRACKET
CRANKSHAFT PULLEY
115 (1168, 84)
x 3
w/ Intercooler:
x 2
21 (214, 15)
TIMING GEAR COVER SPACER
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P


10 (102, 7)
x 4
ENGINE OIL LEVEL SENSOR
GASKET
O-RING
O-RING
CYLINDER BLOCK OIL HOLE GASKET
NO. 1 OIL PAN SUB-ASSEMBLY
x 5
25 (250, 18)
x 5
x 2
x 8
25 (250, 18)
OIL FILTER BRACKET SUB-ASSEMBLY
21 (214, 15)
x 3
O-RING
NO. 2 INLET TURBO OIL PIPE SUB-ASSEMBLY
29 (298, 21)
UNION BOLT
GASKET
WIRE HARNESS
x 2
21 (214, 15)
OIL REFLECTOR PLATE
x 2
25 (250, 18)
OIL FILTER ELEMENT
O-RING
O-RING
OIL STRAINER SUB-ASSEMBLY
x 2
10 (102, 7)
25 (255, 18)
OIL FILTER CAP
O-RING
NO. 2 OIL PAN SUB-ASSEMBLY
x 10
x 2
10 (102, 7)
13 (127, 9)
OIL FILTER DRAIN PLUG
38 (387, 28)
OIL PAN DRAIN PLUG
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P



N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P

for Preparation Click here

1. PRECAUTION

NOTICE:

After turning the ignition switch off, waiting time may be required before disconnecting the cable from the battery terminal. Therefore, make sure to read the disconnecting the cable from the battery terminal notice before proceeding with work (Click here).

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Disconnect the cables from the negative (-) main battery and sub-battery terminals.

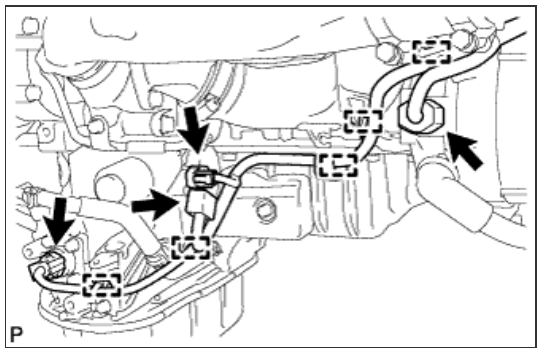
3. REMOVE ENGINE ASSEMBLY

a. Remove the engine assembly from the vehicle (Click here).

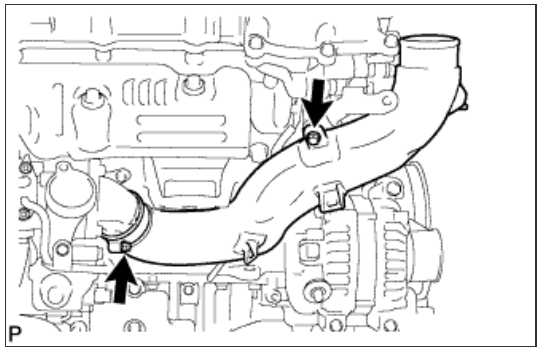
4. REMOVE NO. 1 INTAKE AIR CONNECTOR PIPE

a. Remove the 4 connectors.

b. Using a clip remover, detach the 5 wire harness clamps.

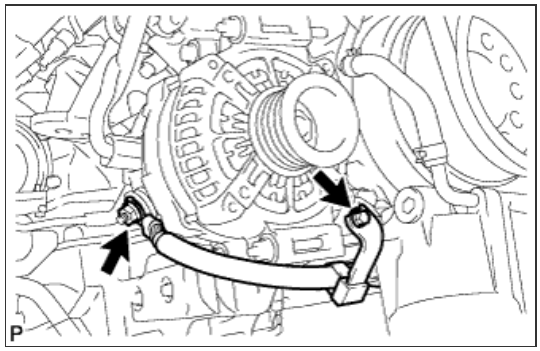


c. Loosen the hose clamp, and remove the bolt and No. 1 intake air connector pipe.

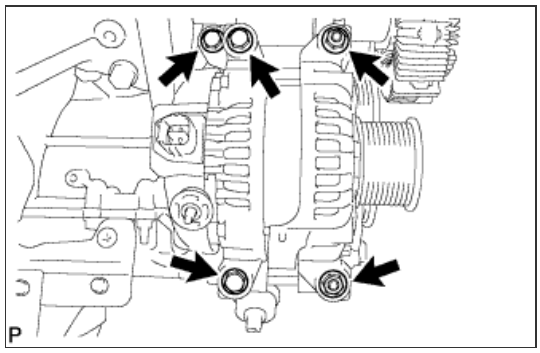


5. REMOVE GENERATOR ASSEMBLY

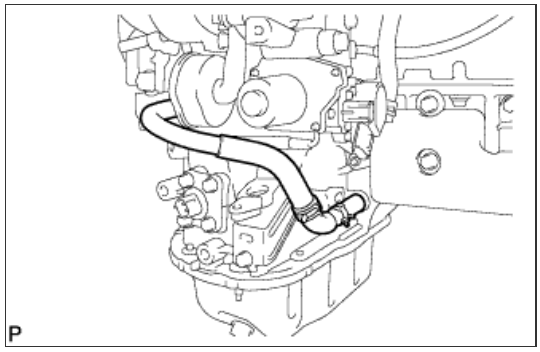
a. Remove the nut and bolt, and disconnect the generator positive ( ) cable.



b. Remove the 3 bolts, 2 nuts and generator.

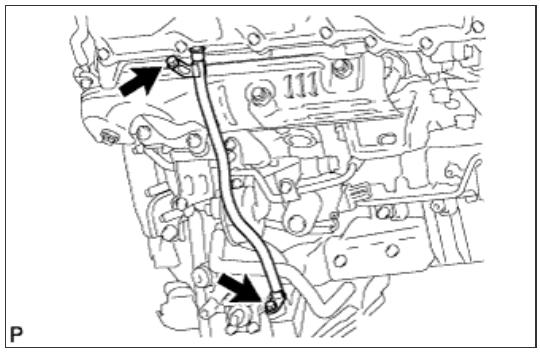


6. DISCONNECT NO. 1 OUTLET TURBO OIL HOSE

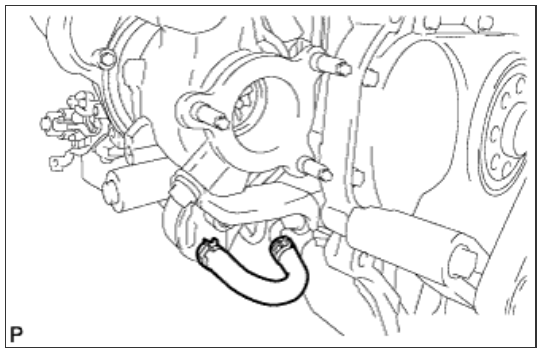


7. REMOVE NO. 1 ENGINE OIL LEVEL DIPSTICK GUIDE

a. Remove the 2 bolts and No. 1 engine oil level dipstick guide.

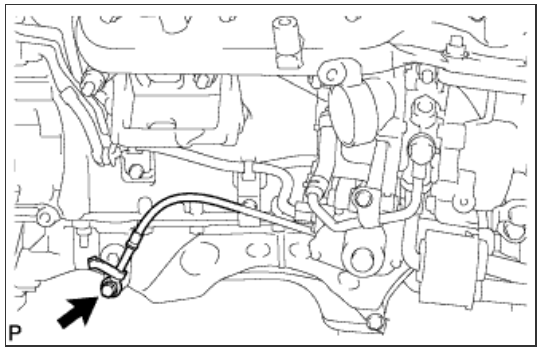


8. DISCONNECT NO. 2 OUTLET TURBO OIL HOSE



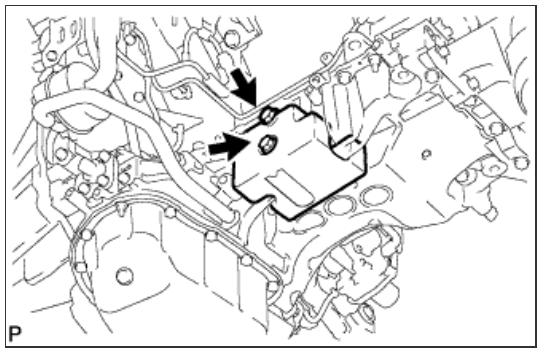
9. DISCONNECT NO. 2 INLET TURBO OIL PIPE SUB-ASSEMBLY

a. Remove the union bolt and gasket, and disconnect the No. 2 inlet turbo oil pipe.

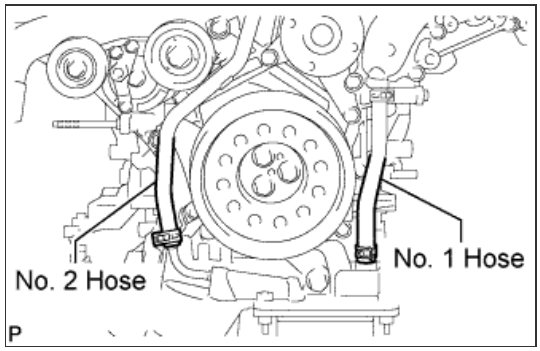


10. REMOVE STIFFENER INSULATOR RH (w/ Intercooler)

a. Remove the 2 bolts and stiffener insulator RH.



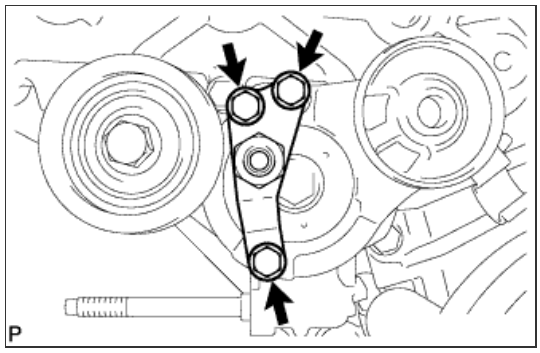
11. DISCONNECT NO. 1 OIL COOLER HOSE



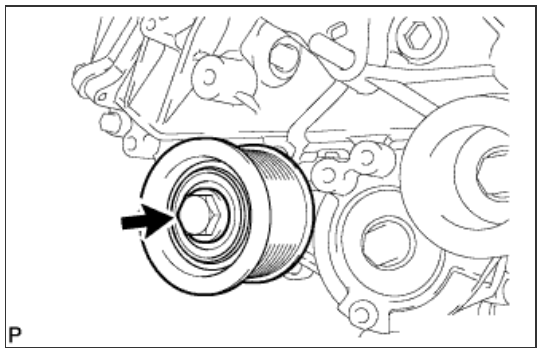
12. DISCONNECT NO. 2 OIL COOLER HOSE

13. REMOVE V-RIBBED BELT TENSIONER ASSEMBLY

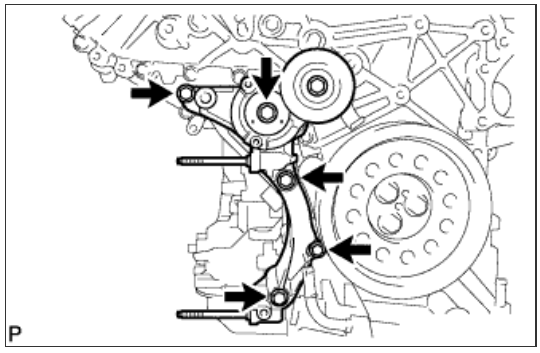
a. Remove the 3 bolts and ribbed belt tensioner bracket.



b. Remove the bolt and No. 1 idler pulley.



c. Remove the 5 bolts and ribbed belt tensioner.



14. REMOVE CRANKSHAFT PULLEY

NOTICE:

This procedure is intended for removal/installation of the crankshaft pulley only. Do not use this procedure for removal/installation of the flywheel or the drive plate and ring gear.

a. nstall the 2 bolts to the bolt holes of the crankshaft rear side.

b. Using a bar, turn the crankshaft until the crankshaft pulley service hole is a little to the left of bottom dead center.

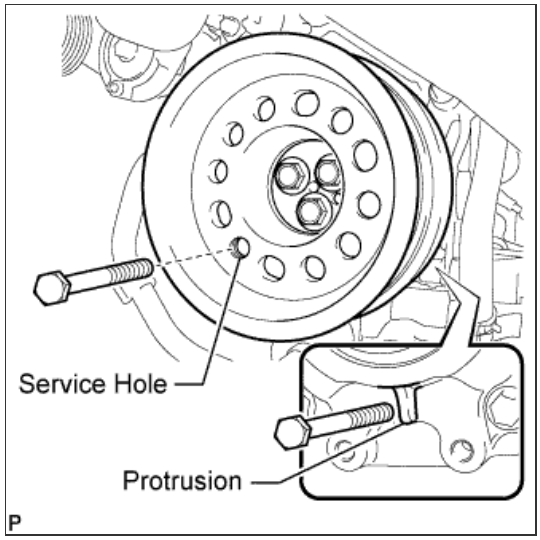
c. nstall a 14 mm 1.5 pitch service bolt with a length of 70 mm or more to the crankshaft pulley service hole, and hold the crankshaft using the timing chain cover protrusion.

d. Remove the 3 bolts and crankshaft pulley.

NOTICE:

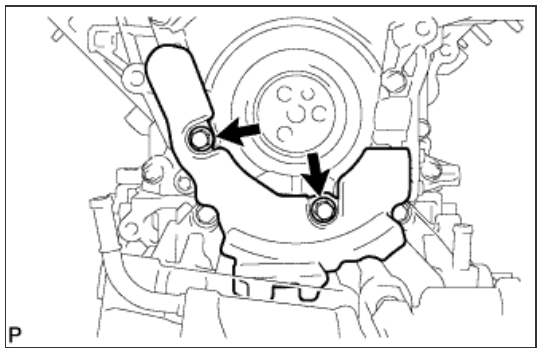
f the crankshaft pulley cannot be removed, temporarily install a bolt to the crankshaft so that the pulley does not fall, and lightly tap the outer edge of the mass damper with a plastic-faced hammer to remove the pulley. Do not tap the pulley ribbed belt ribs, as the crankshaft may

be damaged.



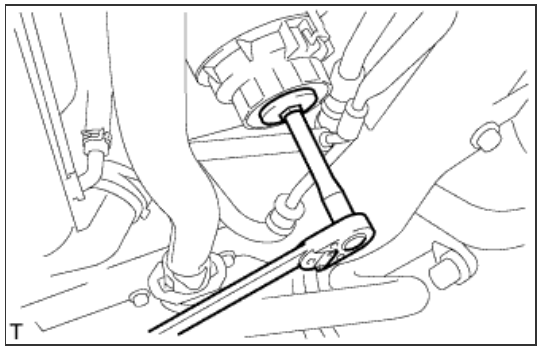
15. REMOVE TIMING GEAR COVER SPACER (w/ Intercooler)

a. Remove the 2 bolts and timing gear cover spacer.



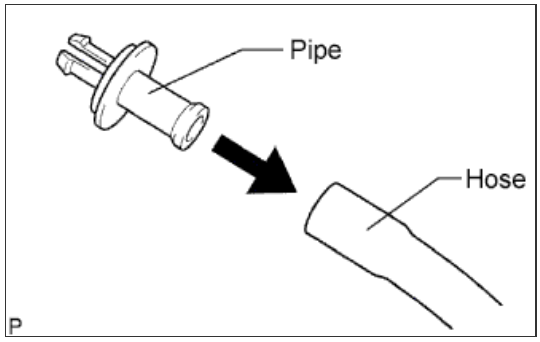
16. REMOVE OIL FILTER ELEMENT

a. Remove the oil filter drain plug.



b. Connect a hose with an inside diameter of 15 mm (0.591 in.) to the pipe.

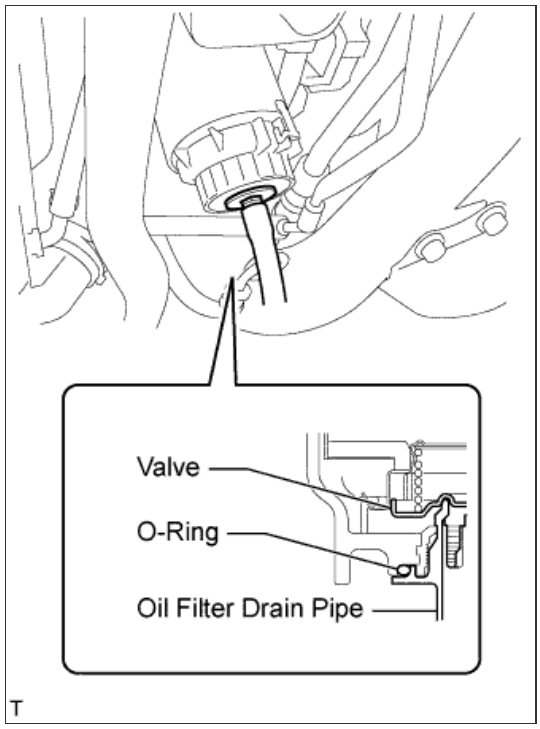
c. Remove the O-ring from the oil filter drain plug and install it to the drain pipe.



d. nstall the oil filter drain pipe to the oil filter cap and drain the engine oil.

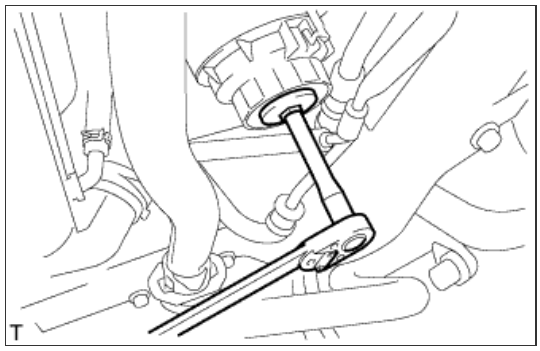
e. Remove the oil filter drain pipe.

f. Apply a light coat of engine oil to a new O-ring, and install it to the oil filter drain plug.



g. nstall the oil filter drain plug to the oil filter cap.

Tor e:
13 N*m{ 127 kgf*cm , 9 ft.*lbf }

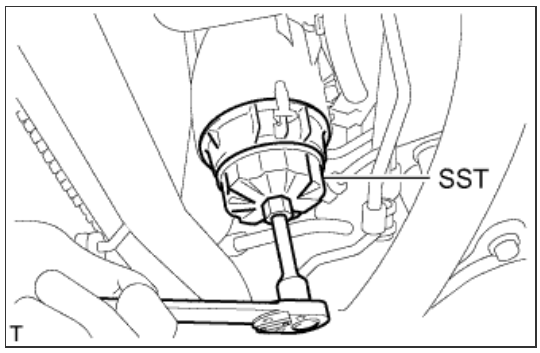


h. Using SST, remove the oil filter cap.

SST
09228-06501

HINT:

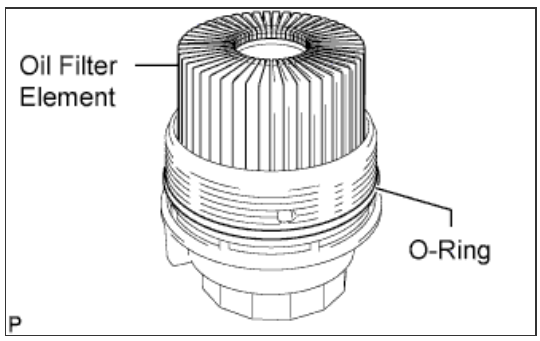
Use a container to catch the draining oil. After the oil filter cap is loosened appro mately 4 turns and the cap ribs are vertical, engine oil drains from the gap between the oil filter cap and oil pan.



i. Remove the oil filter element and O-ring from the oil filter cap.

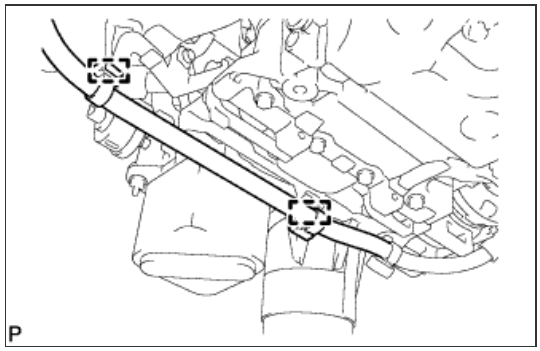
NOTICE:

Be sure to remove the cap O-ring by hand, without using any tools, to prevent damage to the cap O-ring groove.

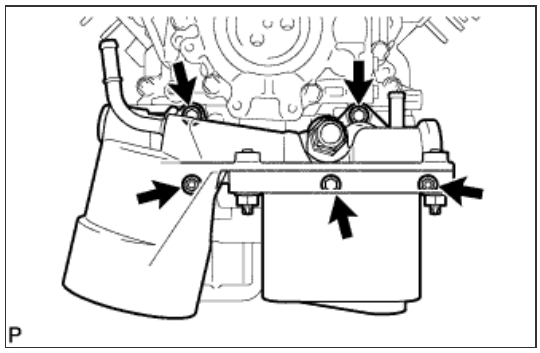


17. REMOVE OIL FILTER BRACKET SUB-ASSEMBLY

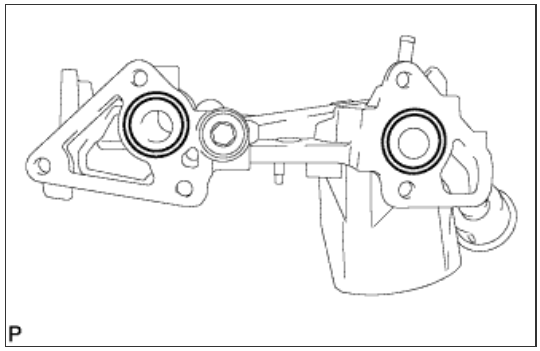
a. Disconnect the 2 wire harness clamps.



b. Remove the 3 bolts, 2 nuts and oil filter bracket.



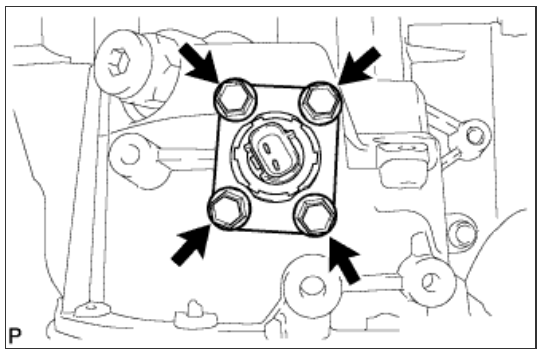
c. Remove the 2 O-rings.



18. REMOVE ENGINE OIL LEVEL SENSOR

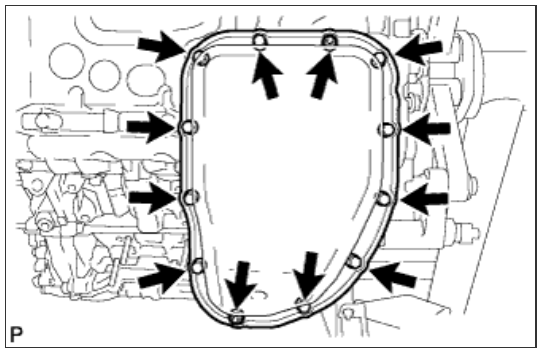
a. Remove the 4 bolts and engine oil level sensor.

b. Remove the gasket.



19. REMOVE NO. 2 OIL PAN SUB-ASSEMBLY

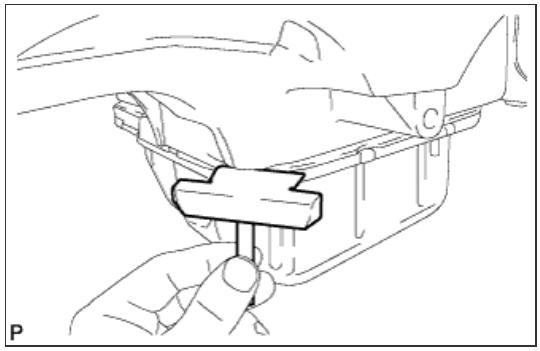
a. Remove the 10 bolts and 2 nuts.



b. nsert the blade of an oil pan seal cutter between the oil pans. Cut through the applied sealer and remove the No. 2 oil pan.

NOTICE:

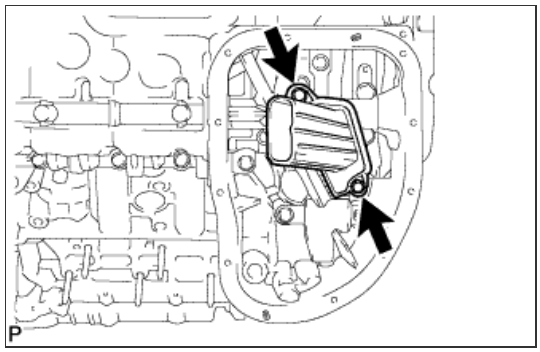
Be careful not to damage the contact surfaces of the No. 1 and No. 2 oil pans.



20. REMOVE OIL STRAINER SUB-ASSEMBLY

a. Remove the 2 bolts and oil strainer.

b. Remove the O-ring from the oil strainer.



21. REMOVE NO. 1 OIL PAN SUB-ASSEMBLY

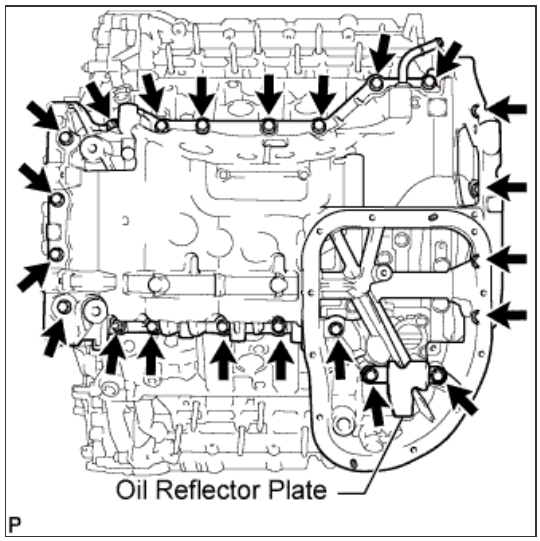
a. Remove the 20 bolts, 2 nuts and oil reflector plate.

NOTICE:

f the oil reflector plate is deformed, replace it.

HINT:

Be sure to clean the bolts and stud bolts, and check the threads for cracks or other damage.



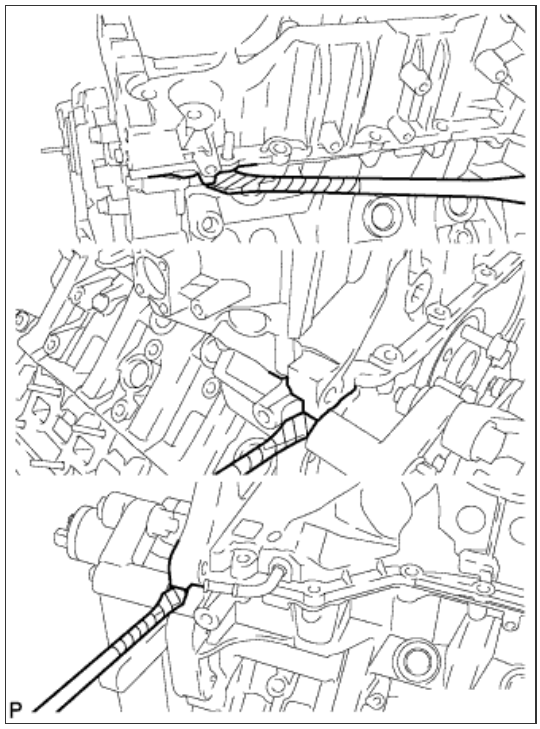
b. Remove the No. 1 oil pan by prying between the No. 1 oil pan and cylinder block with a screwdriver.

NOTICE:

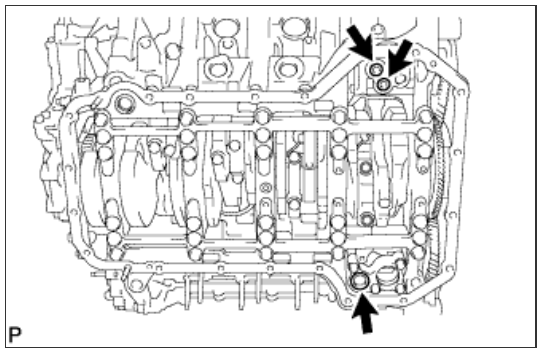
Be careful not to damage the contact surfaces of the cylinder block and oil pan.

HINT:

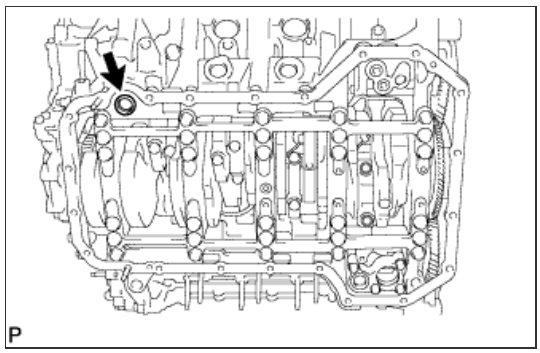
Tape the screwdriver tip before use.



c. Remove the 3 O-rings.



d. Remove the cylinder block oil hole gasket.



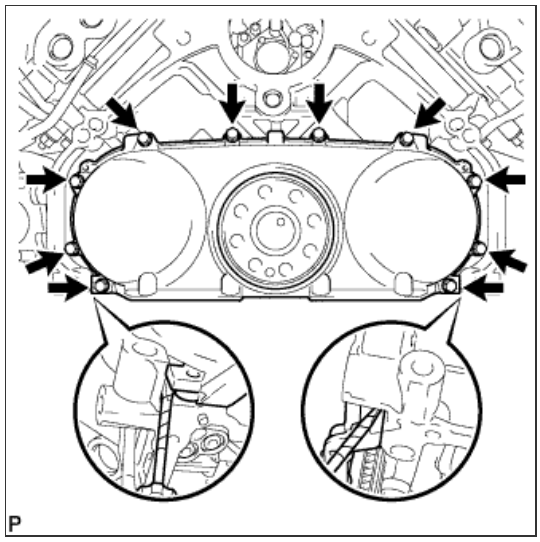
22. REMOVE REAR ENGINE OIL SEAL RETAINER

a. Remove the 10 bolts.

b. Remove the oil seal retainer by prying between the oil seal retainer and cylinder block with a screwdriver.

HINT:

Tape the screwdriver tip before use.



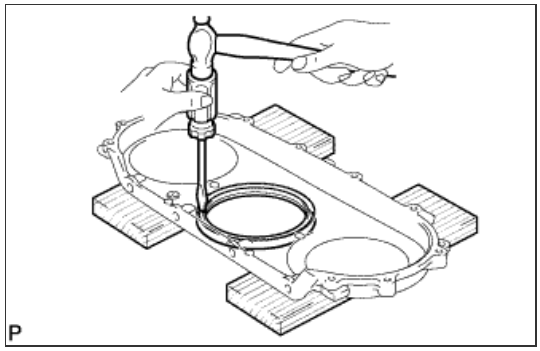
23. REMOVE REAR CRANKSHAFT OIL SEAL

a. Place the oil seal retainer on wooden blocks.

b. Using a screwdriver and hammer, tap out the oil seal.

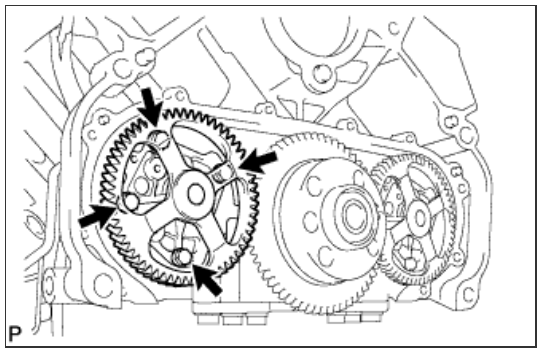
HINT:

Tape the screwdriver tip before use.



24. REMOVE SCAVENGING PUMP ASSEMBLY

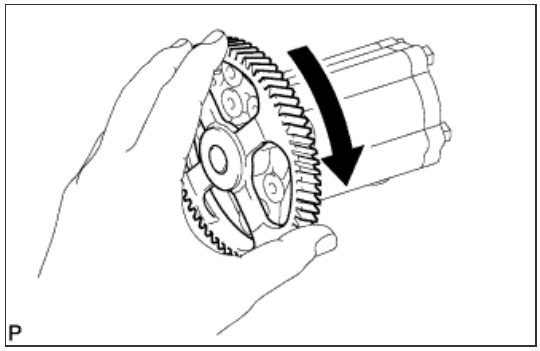
a. Remove the 4 bolts and scavenging pump.



for Preparation Click here

1. INSPECT SCAVENGING PUMP ASSEMBLY

a. Turn the gear and check that the scavenging pump bearing moves smoothly and quietly.
If necessary, replace the scavenging pump assembly.



for Preparation Click here

1. INSTALL SCAVENGING PUMP ASSEMBLY

a. Install the scavenging pump with the 4 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

2. INSTALL REAR CRANKSHAFT OIL SEAL

a. Place the oil seal retainer on wooden blocks.

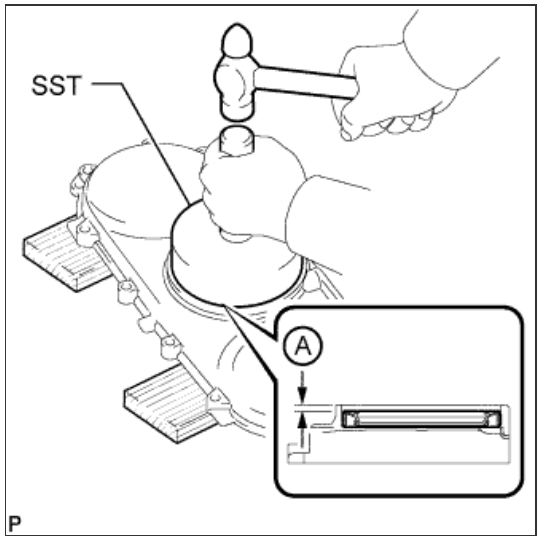
b. Using SST and a hammer, tap in a new oil seal as shown in the illustration.

SST
09223-56010

Standard depth A:
2.7 to 3.7 mm (0.106 to 0.147 in.)

NOTICE:

- **Keep the lip free from foreign matter.**
- **Do not tap on the seal at an angle.**



3. INSTALL REAR ENGINE OIL SEAL RETAINER

a. Apply seal packing in a continuous line as shown in the illustration.

Seal diameter:
3.0 to 5.0 mm (0.118 to 0.197 in.)

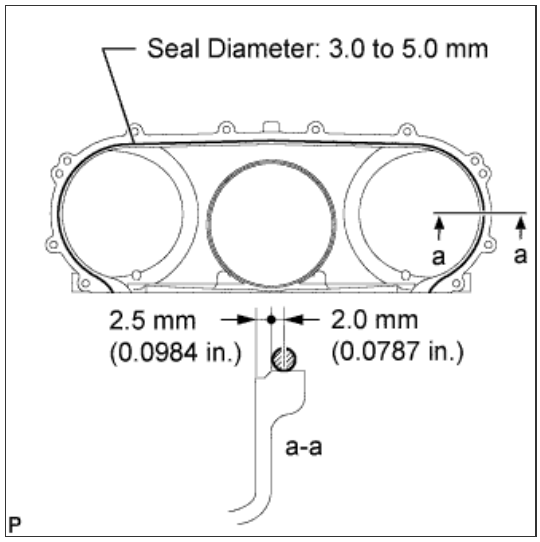
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the rear engine oil seal retainer within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**

b. Apply engine oil to the oil seal lip.

c. Make sure that the lip of the oil seal is properly installed.

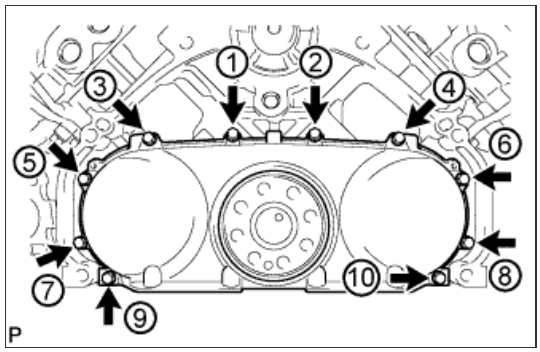


d. Install and uniformly tighten the 10 bolts in the order shown in the illustration.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

NOTICE:

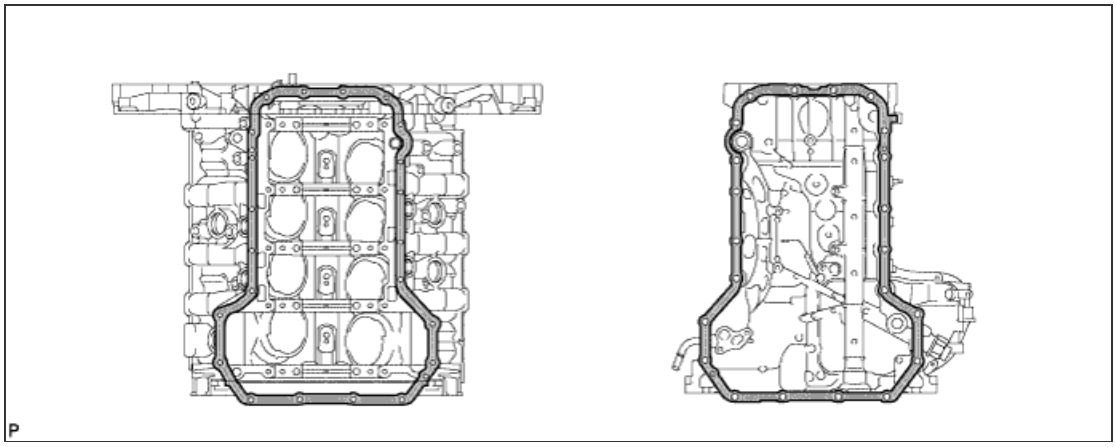
- When installing the oil seal retainer, make sure the lip of the oil seal is not damaged.
- When installing the oil seal retainer, make sure the lip of the oil seal is not folded incorrectly.



4. INSTALL NO. 1 OIL PAN SUB-ASSEMBLY

NOTICE:

When the contact surfaces shown below are wet, wipe them with an oil-free cloth before applying seal packing.



a. Install the cylinder block oil hole gasket.

b. Apply a light coat of engine oil to 3 new O-rings and set the 3 O-rings to the oil regulator and scavenging pump.

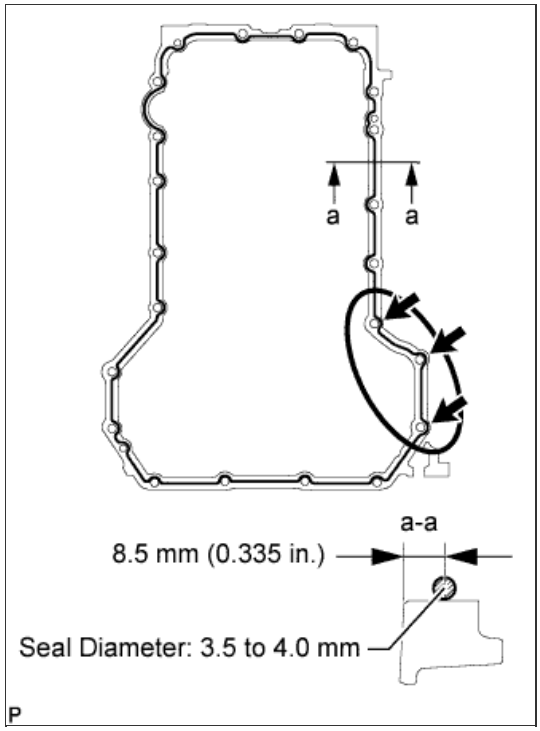
c. Apply seal packing to the No. 1 oil pan as shown in the illustration.

Standard seal diameter:
3.5 to 4.0 mm (0.134 to 0.157 in.)

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

- For the 3 bolt holes labeled with arrows, apply the seal packing on the outer edges. For the other bolt holes, apply the seal packing on the inner edges.
- Make sure to apply a continuous bead of seal packing as shown in the illustration. If the bead breaks, overlap 3 mm (0.118 in.) of seal packing and continue the bead.
- Remove any oil and old seal packing from the contact surface.
- Install the No. 1 oil pan within 3 minutes and tighten the bolts and nuts within 15 minutes after applying seal packing.
- Do not start the engine for at least 2 hours after installing.

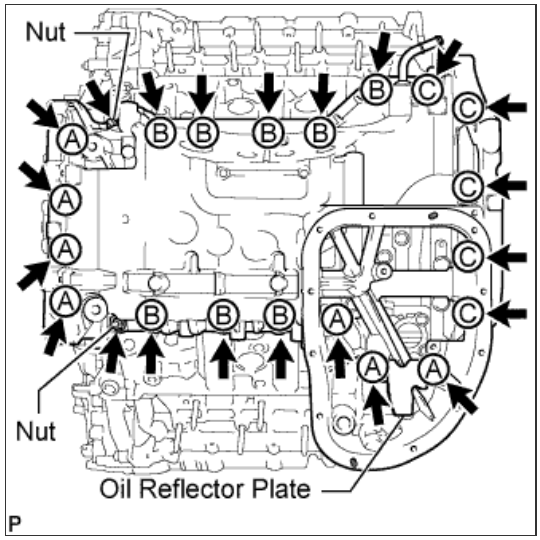


d. Install the No. 1 oil pan and oil reflector plate with the 20 bolts and 2 nuts.

Torque:
25 N*m{ 250 kgf*cm , 18 ft.*lbf }

Bolt Length

Item	Quantity	Length
Bolt A	7	70 mm (2.76 in.)
Bolt B	8	20 mm (0.787 in.)
Bolt C	5	30 mm (1.18 in.)



5. INSTALL OIL STRAINER SUB-ASSEMBLY

a. Apply a light coat of engine oil to a new O-ring, and install it to the oil strainer.

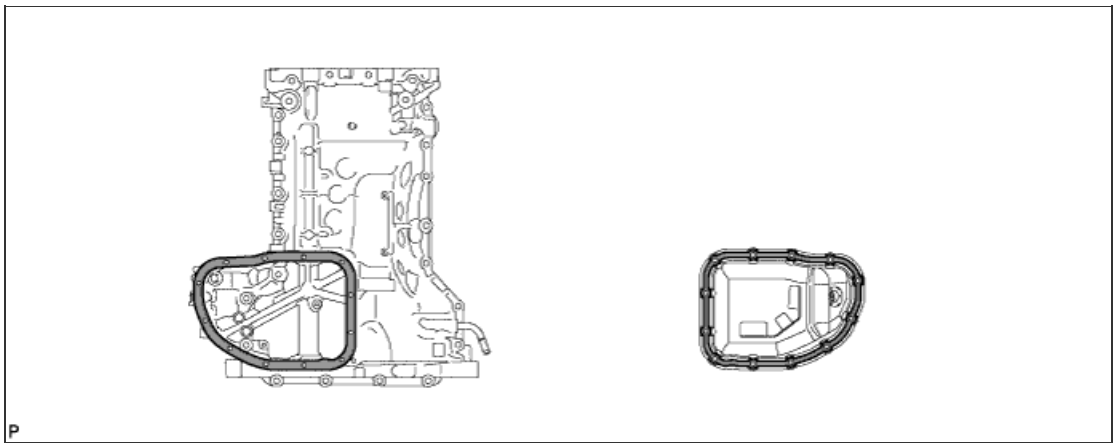
b. Install the oil strainer with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

6. INSTALL NO. 2 OIL PAN SUB-ASSEMBLY

NOTICE:

When the contact surfaces shown below are wet, wipe them with an oil-free cloth before applying seal packing.



a. Apply seal packing to the No. 2 oil pan as shown in the illustration.

Standard seal diameter:
5.0 to 6.0 mm (0.197 to 0.236 in.)

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

NOTICE:

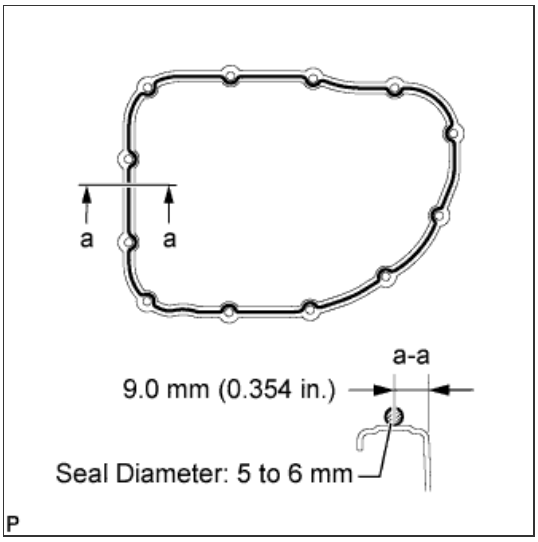
- **For the bolt and pin holes, make sure to apply seal packing to**

the inner sides.

- Make sure to apply a continuous bead of seal packing as shown in the illustration. If the bead breaks, overlap 3.0 mm (0.118 in.) of seal packing and continue the bead.
- Remove any oil from the contact surface.
- Install the No. 2 oil pan within 3 minutes and tighten the bolts and nuts within 10 minutes after applying seal packing.
- Do not start the engine for at least 2 hours after installing.

b. Install the No. 2 oil pan with the 10 bolts and 2 nuts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



7. INSTALL ENGINE OIL LEVEL SENSOR

a. Install a new gasket and the sensor with the 4 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

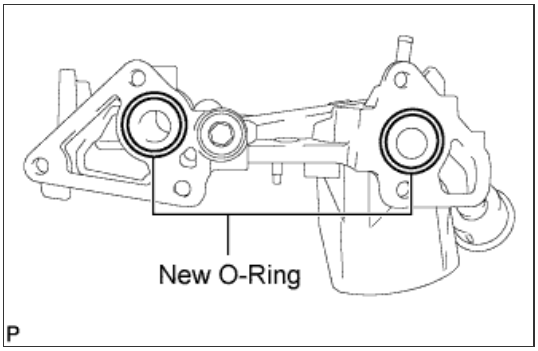
8. INSTALL OIL FILTER BRACKET SUB-ASSEMBLY

a. Apply a light coat of engine oil to 2 new O-rings, and set them to the oil filter bracket.

b. Install the oil filter bracket with the 3 bolts and 2 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Connect the 2 wire harness clamps.



9. INSTALL OIL FILTER ELEMENT

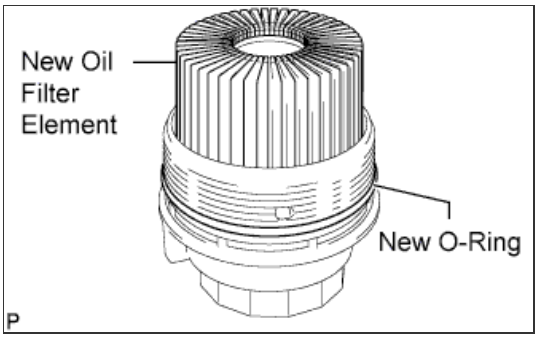
a. Clean the inside of the oil filter cap, its threads and its O-ring groove.

b. Apply a small amount of engine oil to a new O-ring and install it to the oil filter cap.

c. Set a new oil filter element in the oil filter cap.

d. Remove any dirt or foreign matter from the installation surface of the engine.

e. Apply a small amount of engine oil to the O-ring again and temporarily install the oil filter cap by hand.



f. Using SST, tighten the oil filter cap.

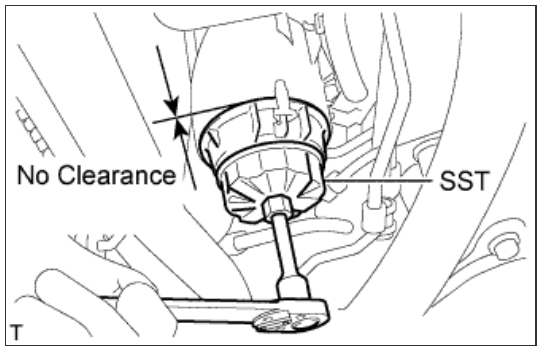
SST
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Torque:

25 N*m{ 255 kgf*cm , 18 ft.*lbf }

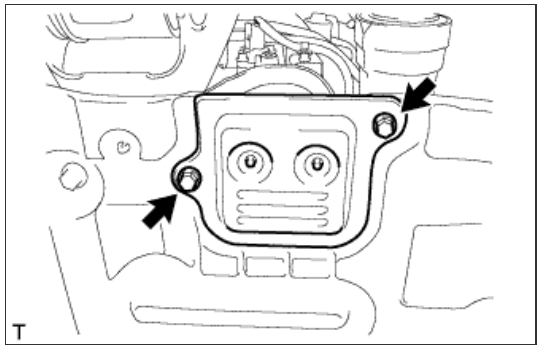
NOTICE:

- **Make sure that the oil filter is installed securely as shown in the illustration.**
- **Be careful that the O-ring does not get caught between any surrounding parts.**



g. Install the No. 2 engine under cover seal to the No. 2 engine under cover with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



10. INSTALL TIMING GEAR COVER SPACER (w/ Intercooler)

a. Install the timing gear cover spacer with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

11. INSTALL CRANKSHAFT PULLEY

NOTICE:

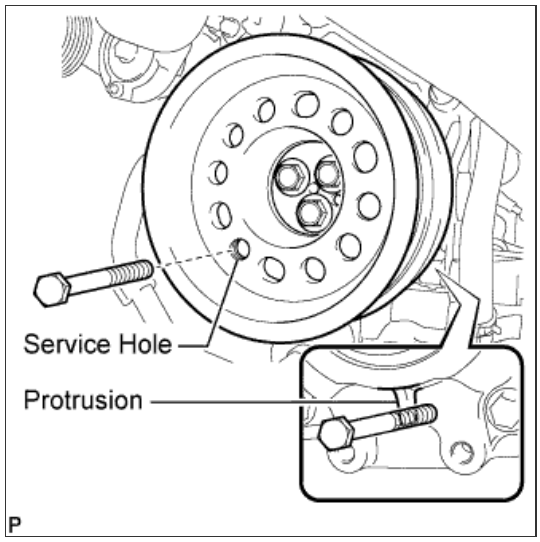
This procedure is intended for removal/installation of the crankshaft pulley only. Do not use this procedure for removal/installation of the flywheel or the drive plate and ring gear.

a. Align the crankshaft pulley and the crankshaft knock pin, and temporarily install the crankshaft pulley with the 3 bolts.

b. Install the 2 bolts to the bolt holes of the crankshaft rear side.

c. Using a bar, turn the crankshaft until the crankshaft pulley service hole is a little to the right of bottom dead center.

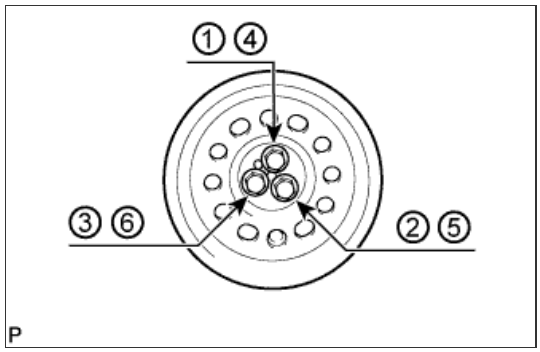
d. Install a 14 mm x 1.5 pitch service bolt with a length of 70 mm or more to the crankshaft pulley service hole, and hold the crankshaft using the timing chain cover protrusion.



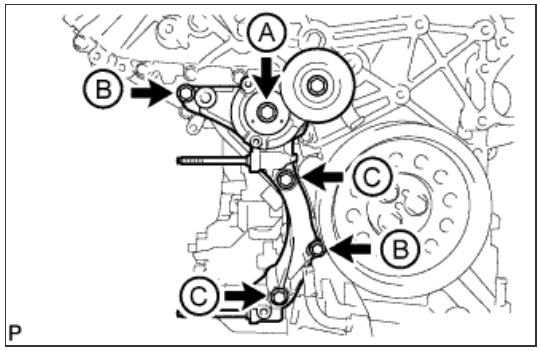
e. Uniformly tighten the 3 bolts in 2 passes in the order shown in the illustration.

Torque:
115 N*m{ 1168 kgf*cm , 84 ft.*lbf }

f. Remove the service bolt.



12. INSTALL V-RIBBED BELT TENSIONER ASSEMBLY



a. Install the V-ribbed belt tensioner with the 5 bolts.

Torque:
for bolt A and C:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }
for bolt B:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

Bolt Length

Item	Quantity	Length
Bolt A	1	116 mm (4.57 in.)
Bolt B	2	40 mm (1.58 in.)
Bolt C	2	95 mm (3.74 in.)

b. Install the No. 1 idler pulley with the bolt.

Torque:
43 N*m{ 438 kgf*cm , 32 ft.*lbf }

c. Install the V-ribbed belt tensioner bracket with the 3 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

13. CONNECT NO. 2 OIL COOLER HOSE

a. Align the white paint marks on the oil cooler hose and oil filter bracket and connect the hose.

NOTICE:

Make sure to maintain a space between the oil cooler hose and crankshaft pulley and the oil cooler hose and V-ribbed belt idler pulley.

14. CONNECT NO. 1 OIL COOLER HOSE

a. Face the pink paint mark on the oil cooler hose toward the front side of the engine and connect the hose to the oil filter bracket.

NOTICE:

Make sure to maintain a space between the oil cooler hose and crankshaft pulley.

15. INSTALL STIFFENER INSULATOR RH (w/ Intercooler)

a. Install the stiffener insulator RH with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

16. INSTALL NO. 2 INLET TURBO OIL PIPE SUB-ASSEMBLY

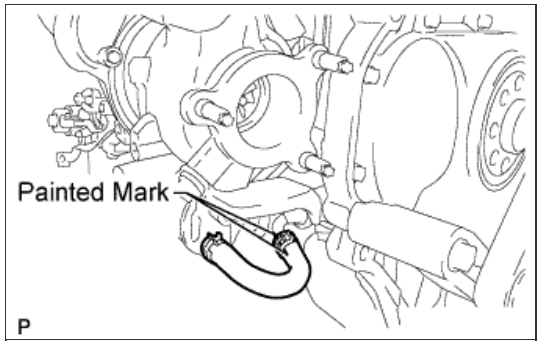
a. Install a new gasket and connect the No. 2 inlet turbo oil pipe with the union bolt.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }

17. CONNECT NO. 2 OUTLET TURBO OIL HOSE

HINT:

Align the white paint marks on the oil hose and pipe, and connect the hose.



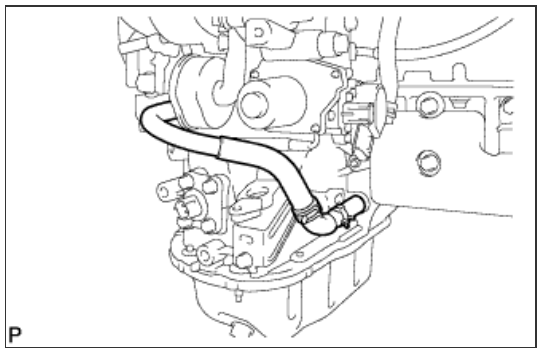
18. INSTALL NO. 1 ENGINE OIL LEVEL DIPSTICK GUIDE

a. Apply a light coat of engine oil to a new O-ring, and install it to the No. 1 engine oil level dipstick guide.

b. Install the No. 1 engine oil level dipstick guide with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

19. CONNECT NO. 1 OUTLET TURBO OIL HOSE



20. INSTALL GENERATOR ASSEMBLY

a. Temporarily install the generator with the 3 bolts and 2 nuts.

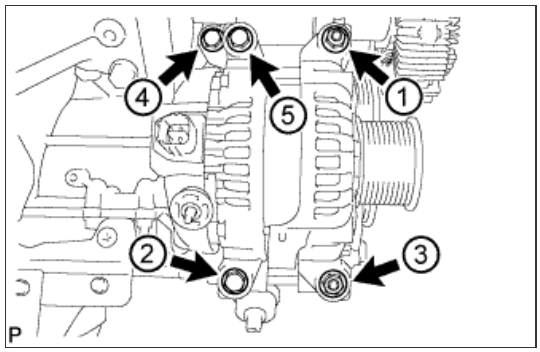
b. Uniformly tighten the 3 bolts and 2 nuts in the order shown in the illustration.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Connect the generator cable and install the nut and bolt.

Torque:
for bolt:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }

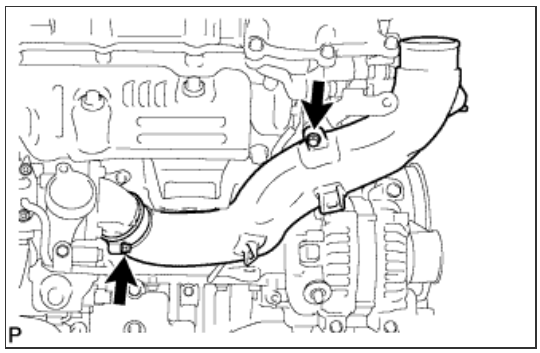
for nut (130A Type and 150A Type:):
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }
for nut (180A Type:):
12 N*m{ 122 kgf*cm , 9 ft.*lbf }



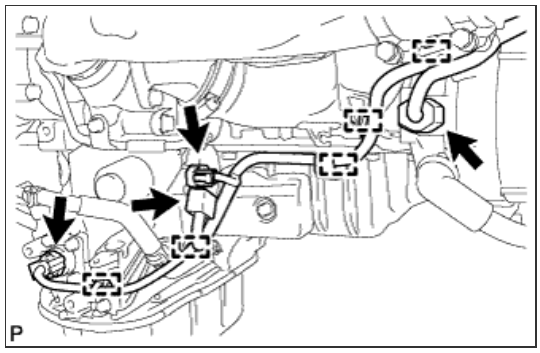
21. INSTALL NO. 1 INTAKE AIR CONNECTOR PIPE

a. Install the No. 1 intake air connector pipe with the bolt. Then tighten the hose clamp.

Torque:
for bolt:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }
for clamp:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }



b. Connect the 4 connectors and attach the 5 wire harness clamps.



22. INSTALL ENGINE ASSEMBLY

a. Install the engine assembly to the vehicle (Click here).

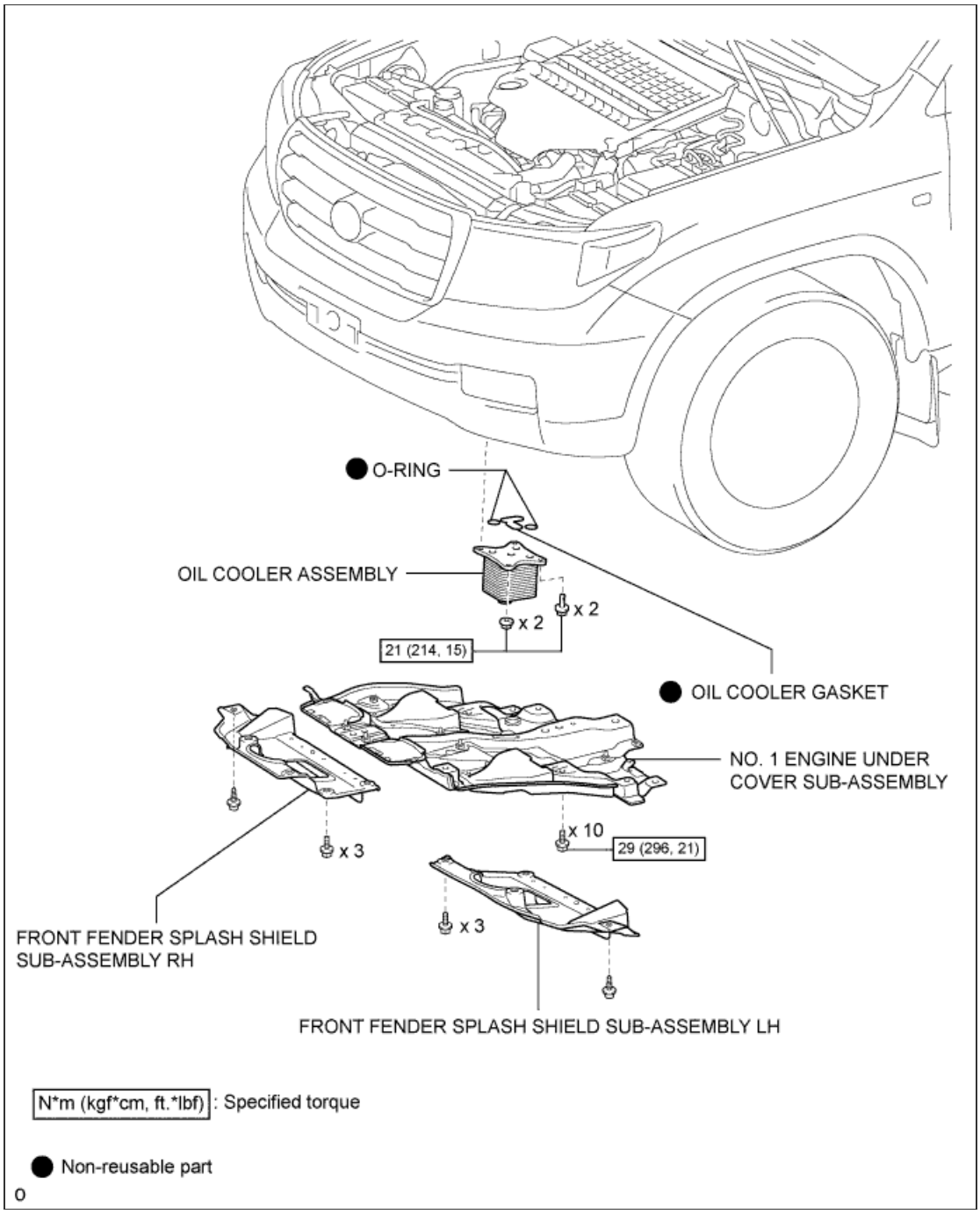
23. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

a. Connect the cables to negative (-) main battery and sub-battery terminals.

for Preparation Click here

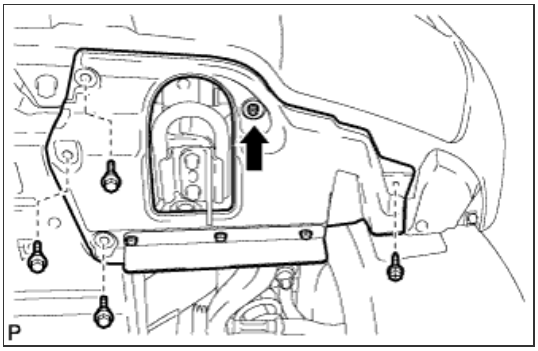


for Preparation Click here

1. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Remove the 3 bolts and screw.

b. Turn the clip indicated by the arrow in the illustration to remove the fender splash shield.



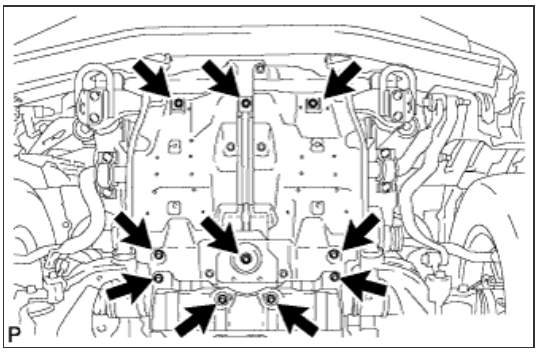
2. REMOVE FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

HINT:

Use the same procedures described for the LH side.

3. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Remove the 10 bolts and under cover.



4. DRAIN ENGINE COOLANT

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

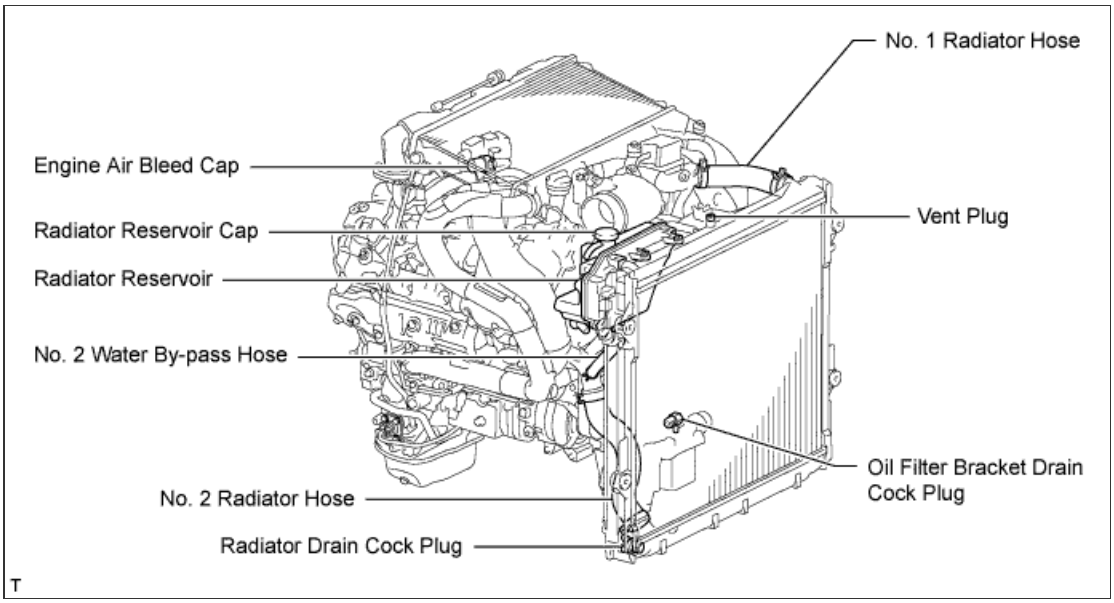
HINT:

Collect the coolant in a container and dispose of it according to the regulations in your area.

a. Loosen the radiator drain cock plug.

b. Remove the radiator reservoir cap to drain the coolant in the radiator.

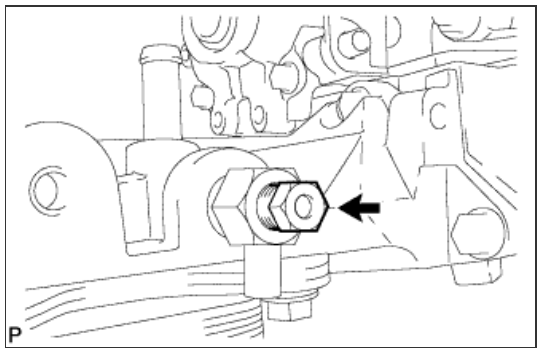
c. Loosen the oil filter bracket drain cock plug to drain the coolant in the engine.



d. Tighten the radiator drain cock plug by hand.

e. Tighten the oil filter bracket drain cock plug.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



5. DRAIN ENGINE OIL

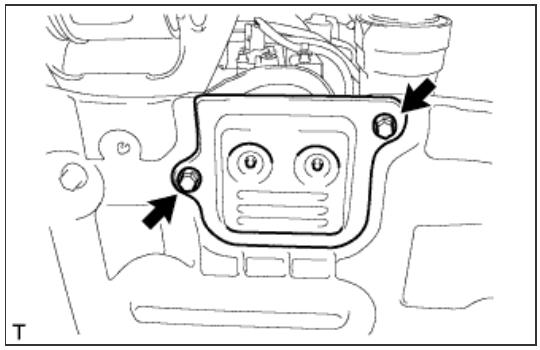
a. Remove the 2 bolts and No. 2 engine under cover seal from the No. 2 engine under cover.

b. Remove the oil filler cap.

c. Remove the oil pan drain plug and gasket, and then drain the engine oil into a container.

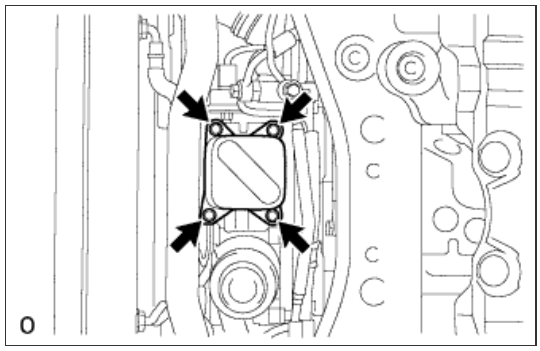
d. Install a new gasket and the oil pan drain plug.

Torque:
38 N*m{ 387 kgf*cm , 28 ft.*lbf }

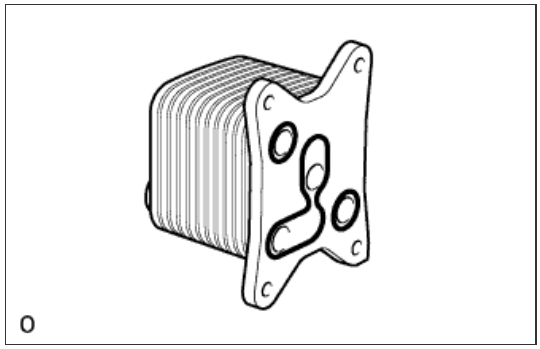


6. REMOVE OIL COOLER ASSEMBLY

a. Remove the 2 bolts, 2 nuts and oil cooler.



b. Remove the 2 O-rings and oil cooler gasket.



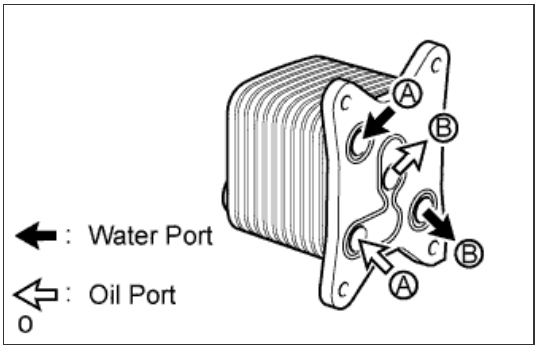
for Preparation Click here

1. INSPECT OIL COOLER ASSEMBLY

a. Visual check that the oil cooler for damage.
If necessary, replace the oil cooler assembly.

b. Check the oil cooler for clogging.

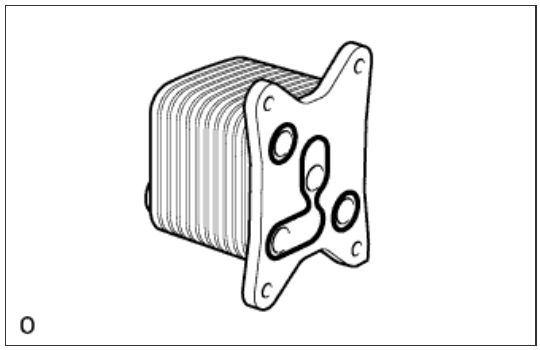
i. Apply air into A, and check that air flows from B for the water and oil ports.
If air does not flow as specified, clean or replace the oil cooler assembly.



for Preparation Click here

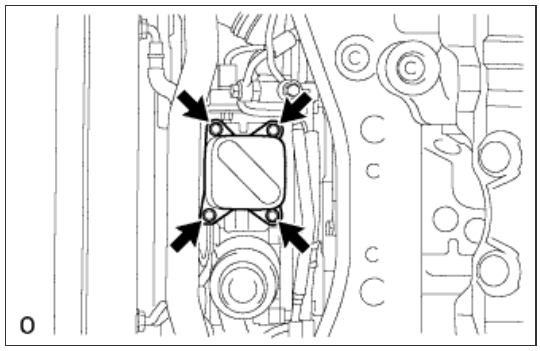
1. INSTALL OIL COOLER ASSEMBLY

a. Apply a light coat of engine oil to 2 new O-rings and a new oil cooler gasket, and set them to the oil cooler.



b. Install the oil cooler with the 2 bolts and 2 nuts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



2. ADD ENGINE OIL

a. Add fresh oil.

Standard Engine Oil:

Oil Grade	Oil Viscosity (SAE)
G-DLD-1, API CF-4, API CF or ACEA B1 (ou may also use API CE or CD)	- -30 - 10W-30 - 1 -40 - 2 W- (-30 is best choice for fuel economy and good starting in cold weather).

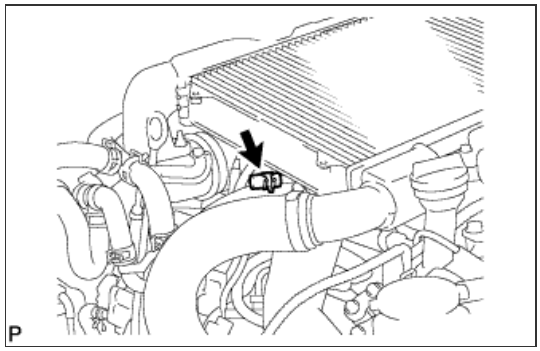
Standard Capacity:

Item	Specified Condition
Drain and refill with oil filter change	9.2 liters (9.7 US qts, 8.1 Imp. qts)
Drain and refill without oil filter change	8.2 liters (8.7 US qts, 7.2 Imp. qts)
Dry fill	9.9 liters (10. S qts, 8.7 Imp. qts)

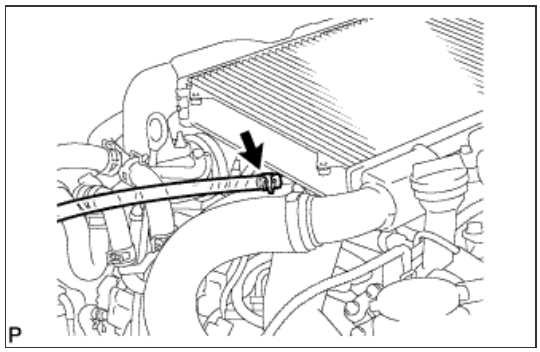
b. Install the oil filler cap.

3. ADD ENGINE COOLANT

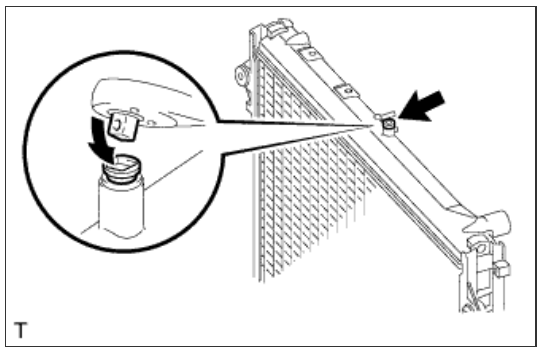
a. Remove the engine air bleed cap.



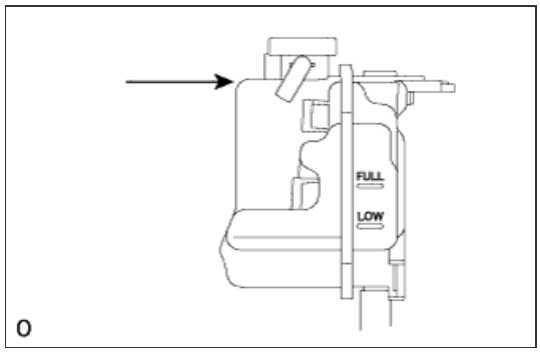
b. Connect a clear hose to the engine air bleed pipe.



c. Using a wrench, remove the vent plug.



d. Fill the radiator with O O ÆSLLC to the radiator reservoir filler neck.



HINT:

Pour TOYOTA SLLC until it spills out of the engine air bleed pipe.

Standard Capacity (for Automatic Transmission):

Item	Specified Condition
Front heater only	14.8 liters (15.6 US qts, 13.0 Imp. qts)
Front heater and rear heater	17.6 liters (18.6 US qts, 15.5 Imp. qts)
Front heater with viscous heater	15.2 liters (16.1 US qts, 13.4 Imp. qts)
Front heater and rear heater with viscous heater	18.0 liters (19.0 US qts, 15.4 Imp. qts)

Standard capacity (for Manual Transmission):
15.4 liters (16.3 US qts, 13.6 Imp. qts)

NOTICE:

Do not substitute plain water for engine coolant.

HINT:

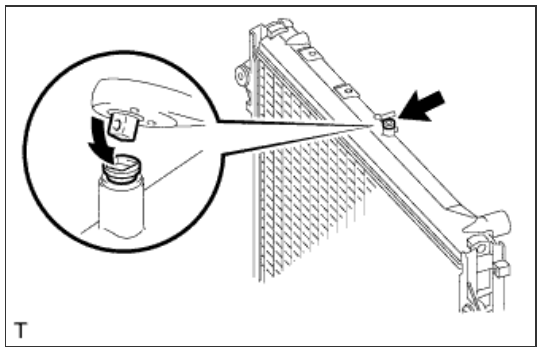
TOYOTA vehicles are filled with TOYOTA SLLC at the factory. In order to avoid damage to the engine cooling system and other technical problems, only use TOYOTA SLLC or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology consists of a combination of low phosphates and organic acids).

e. Install the vent plug.

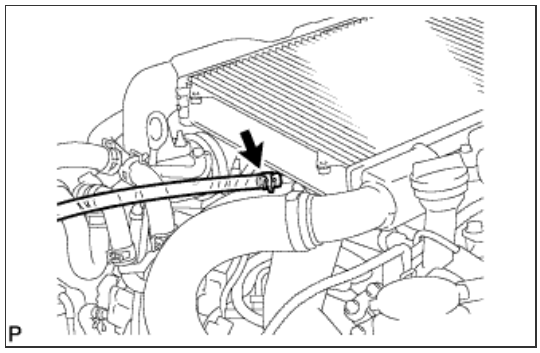
Torque:
2.0 N*m{ 20 kgf*cm , 18 in.*lbf }

NOTICE:

Do not tighten the plug to 5.0 N*m (51 kgf*cm, 44 in.*lbf) or more, as the plug will be damaged.



f. Disconnect the clear hose from the engine air bleed pipe.



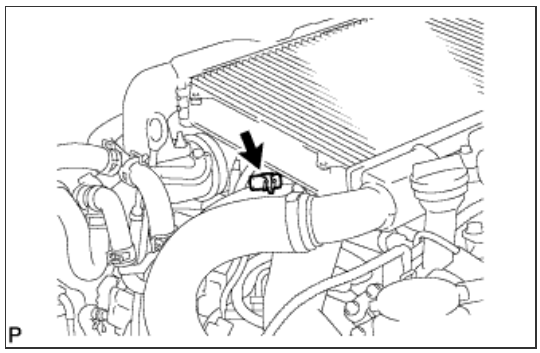
g. Install the engine air bleed cap when coolant comes out.

h. Install the radiator reservoir cap.

i. Start the engine.

NOTICE:

Immediately after starting the engine, if the radiator reservoir does not have any coolant, perform the following: 1) stop the engine, 2) wait until the coolant has cooled down, and 3) add coolant until the coolant is filled to the FULL line.



j. Maintain an engine speed of 3000 rpm for approximately 10 minutes so that the thermostat opens and air bleeding is performed.

CAUTION:

When pressing the radiator hoses:

- **Wear protective gloves.**
- **Be careful as the radiator hoses are hot.**
- **Keep your hands away from the radiator fan**

NOTICE:

- **Pay attention to the needle of the water temperature meter. Make sure that the needle does not show an abnormally high temperature.**
- **If there is not enough coolant, the engine may burn out or overheat.**

HINT:

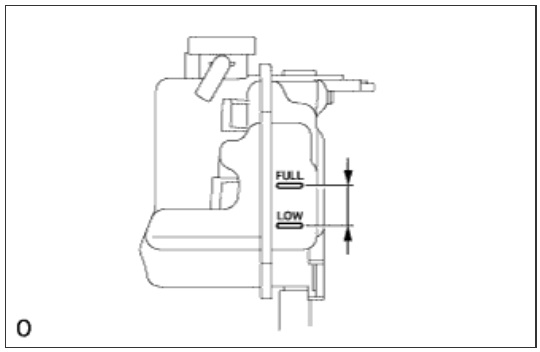
The thermostat opening timing can be confirmed by pressing the No. 2 radiator hose by hand, and checking when the engine coolant starts to flow inside the hose.

k. Stop the engine, and wait until the engine coolant cools down to ambient temperature.

CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

l. Check that the coolant level is between the FULL and LOW lines.
If the coolant level is above the FULL line, drain coolant so that the coolant level is between the FULL and LOW lines.



4. INSPECT FOR ENGINE OIL LEAK

a. Warm up the engine and check for an engine oil leak.

5. INSPECT FOR COOLANT LEAK

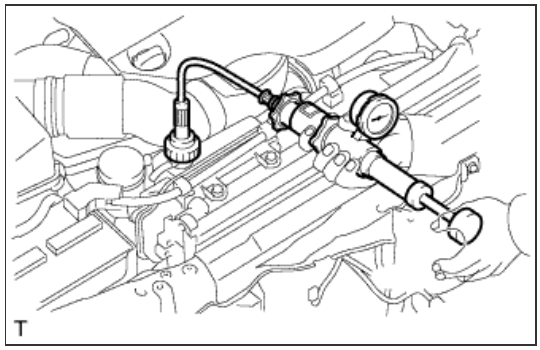
CAUTION:

Do not remove the radiator reservoir cap while the engine and radiator are still hot. Pressurized, hot engine coolant and steam may be released and cause serious burns.

a. Fill the radiator with coolant and attach a radiator cap tester to the radiator reservoir.

b. Warm up the engine.

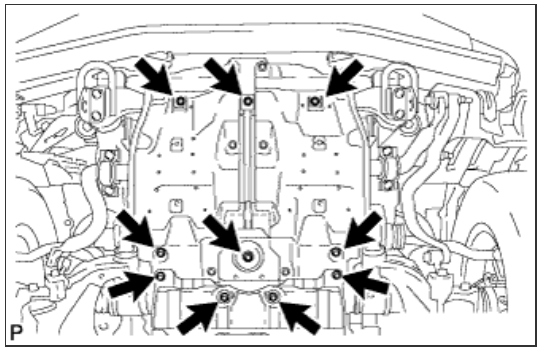
c. Using the radiator cap tester, increase the pressure inside the radiator to 12 kPa (1.3 kgf/cm^2, 17.8 psi), and check that the pressure does not drop.
If the pressure drops, check the hoses, radiator and water pump for leaks.
If no external leaks are found, check the cylinder block and cylinder head.



6. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

a. Install the engine under cover with the 10 bolts.

Torque:
29 N*m{ 296 kgf*cm , 21 ft.*lbf }



7. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY RH

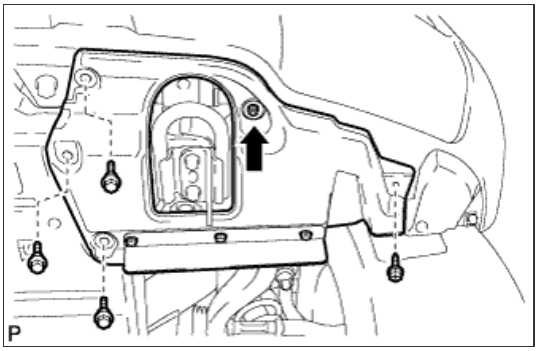
HINT:

Use the same procedures described for the LH side.

8. INSTALL FRONT FENDER SPLASH SHIELD SUB-ASSEMBLY LH

a. Push in the clip indicated by the arrow in the illustration to install the fender splash shield.

b. Install the 3 bolts and screw.



9. CHECK ENGINE OIL LEVEL

a. Warm up the engine, stop the engine and wait 5 minutes. The engine oil level should be between the dipstick low level mark and full level mark.
If low, check for leakage and add oil up to the full level mark.

NOTICE:

Do not fill engine oil above the full level mark.

for Preparation Click here

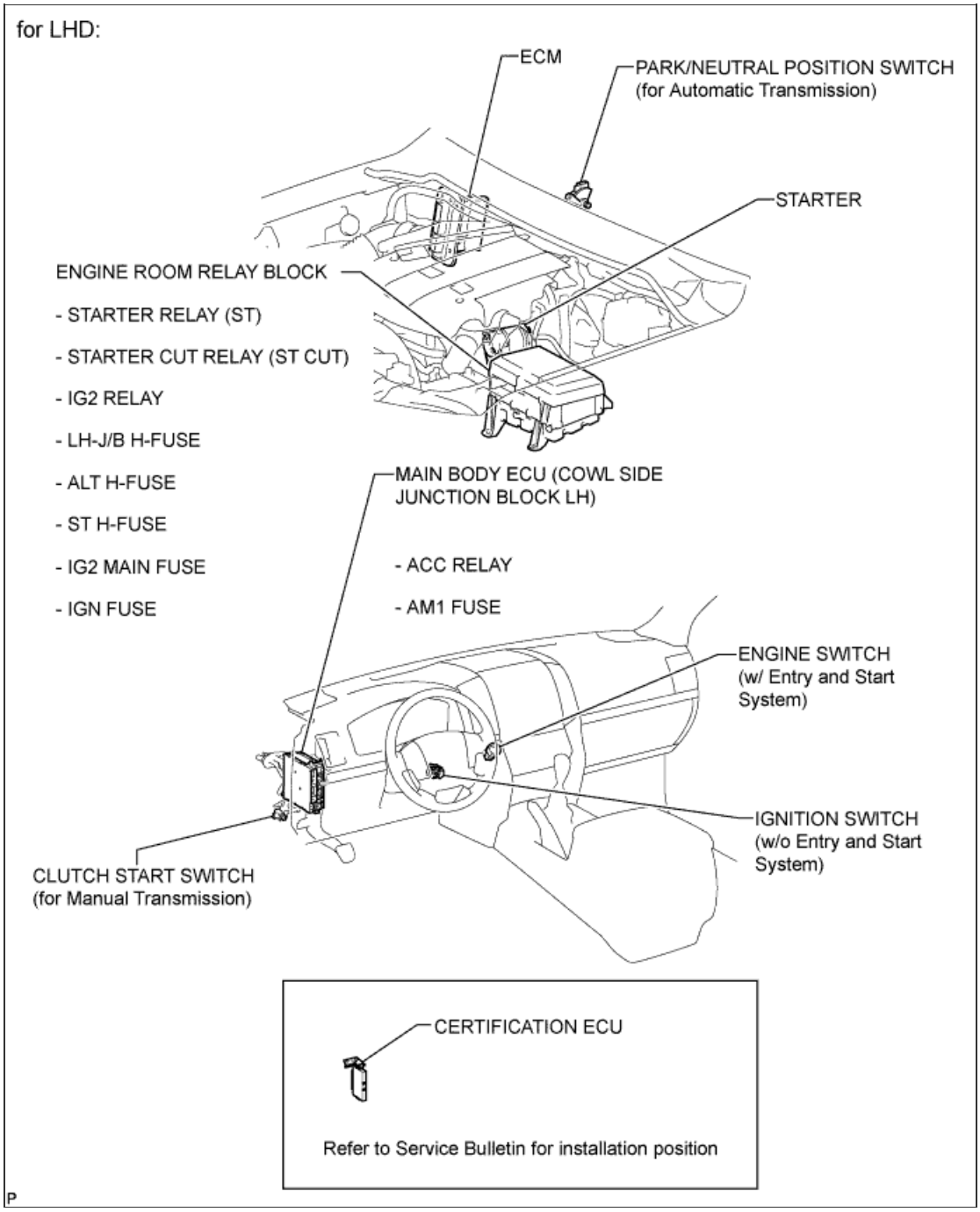
1.IGNITION SWITCH EXPRESSION

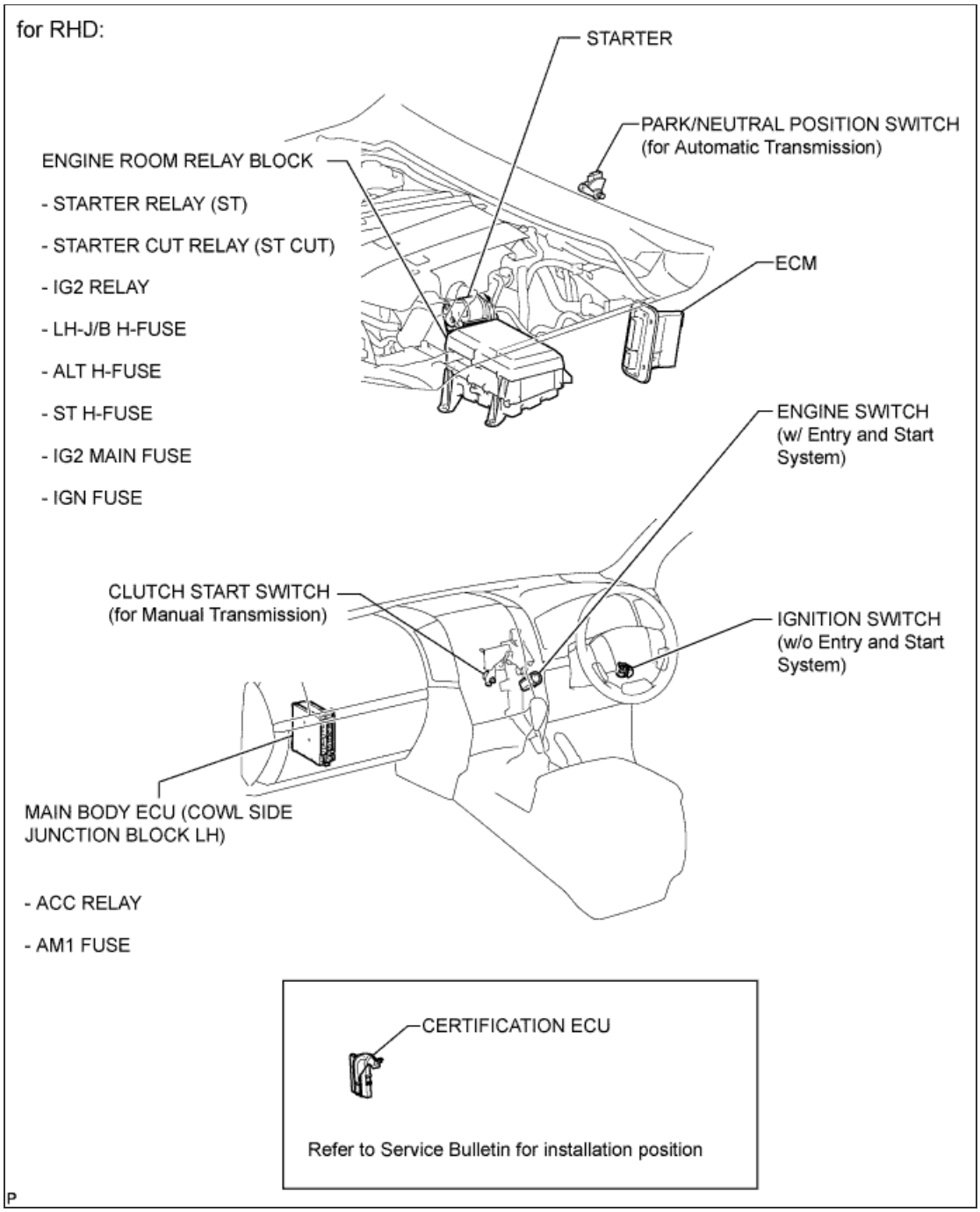
HINT:

The type of ignition switch used on this model differs depending on the specifications of the vehicle. The e pressions listed in the table below are used in this section.

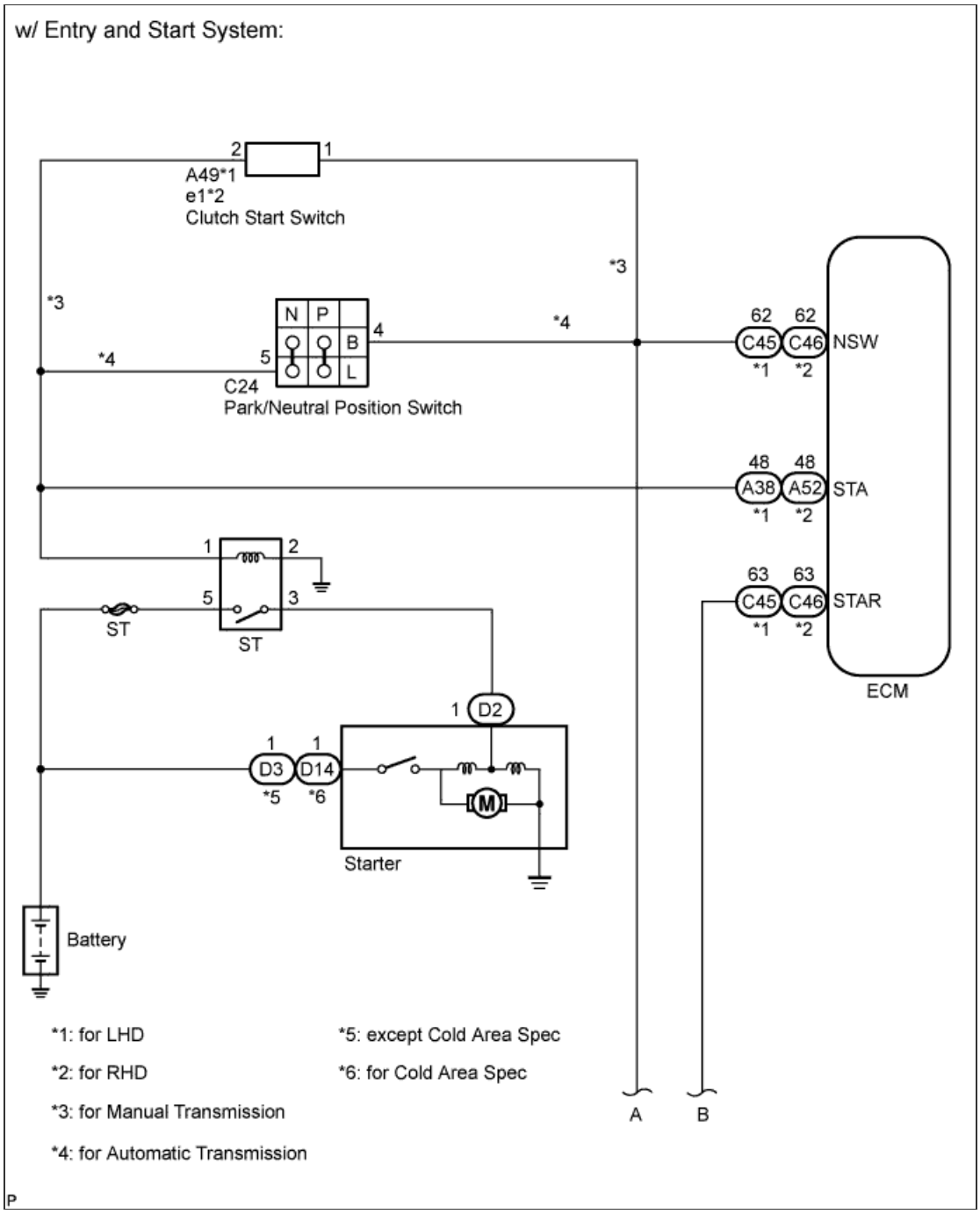
E pression	Ignition Switch (Position)	Engine Switch (ondition)
Ignition Switch off	LO	ff
Ignition Switch A		n (A
gnition Switch ON	ON	On (IG)
Engine Start	START	Start

for Preparation Click here

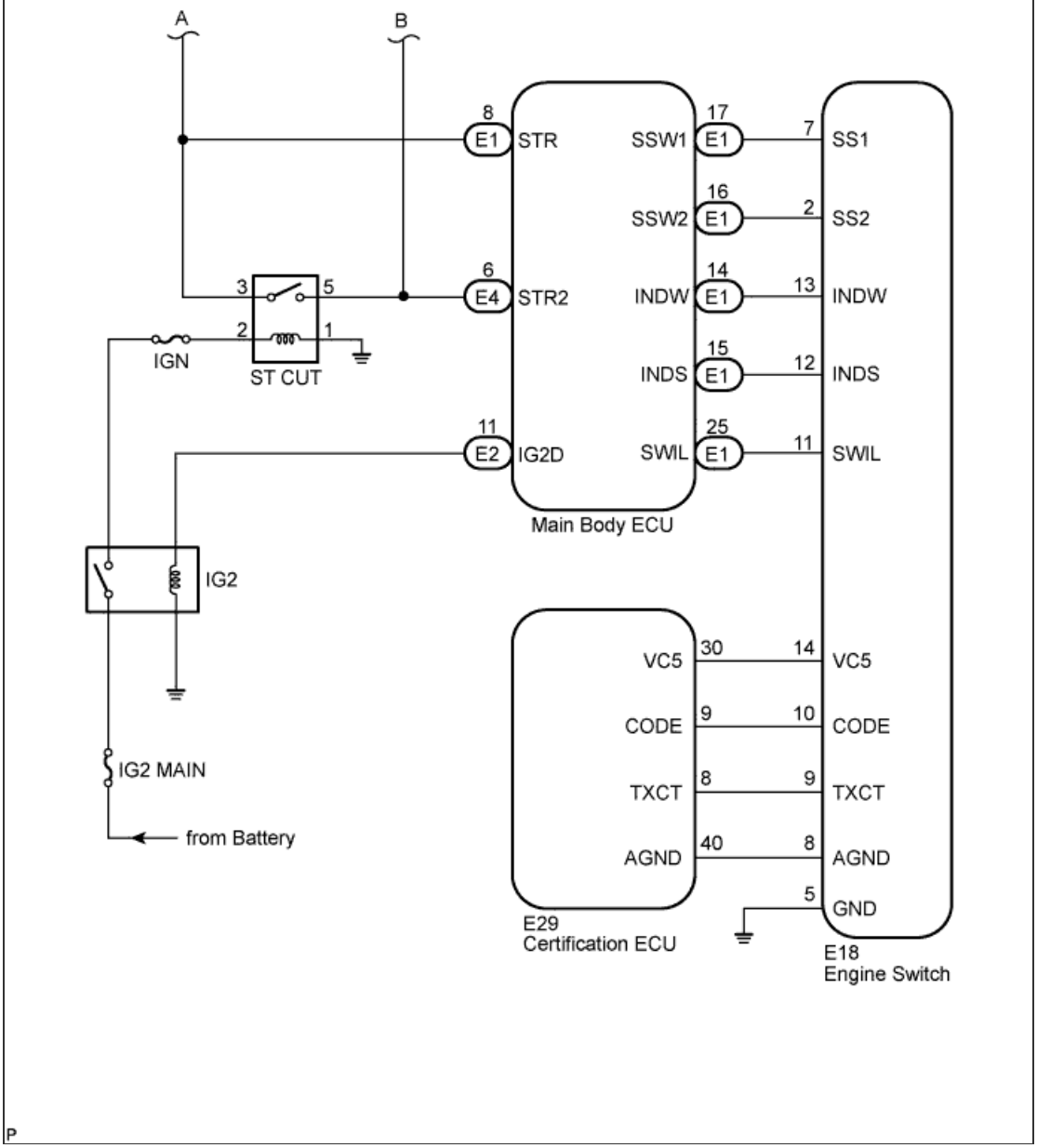



for RHD:
STARTER
PARK/NEUTRAL POSITION SWITCH
(for Automatic Transmission)
ENGINE ROOM RELAY BLOCK
- STARTER RELAY (ST)
- STARTER CUT RELAY (ST CUT)
- IG2 RELAY
- LH-J/B H-FUSE
- ALT H-FUSE
- ST H-FUSE
- IG2 MAIN FUSE
- IGN FUSE
ECM
ENGINE SWITCH
(w/ Entry and Start System)
CLUTCH START SWITCH
(for Manual Transmission)
IGNITION SWITCH
(w/o Entry and Start System)
MAIN BODY ECU (COWL SIDE JUNCTION BLOCK LH)
- ACC RELAY
- AM1 FUSE
CERTIFICATION ECU
Refer to Service Bulletin for installation position
P

for Preparation Click here

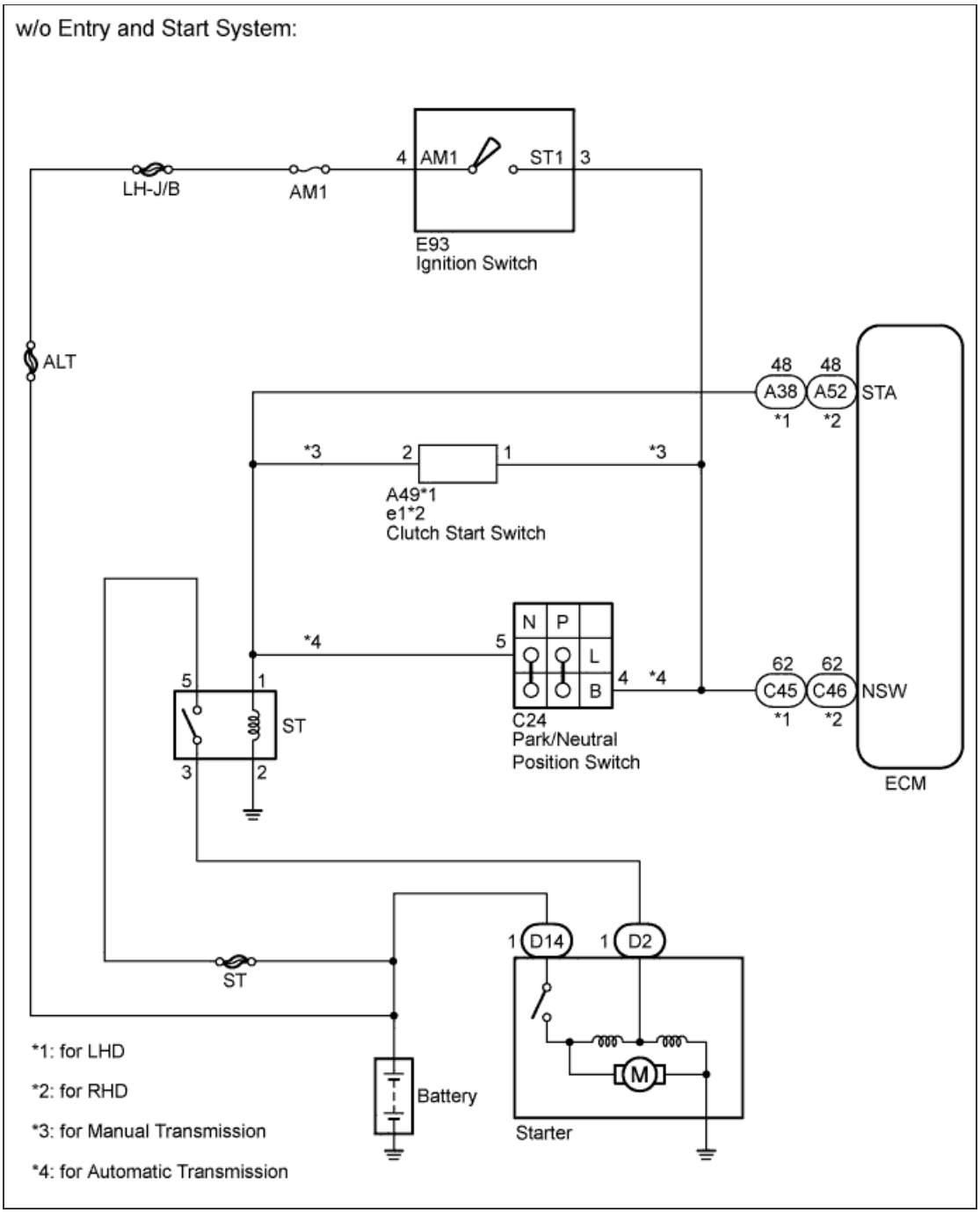


w/ Entry and Start System:

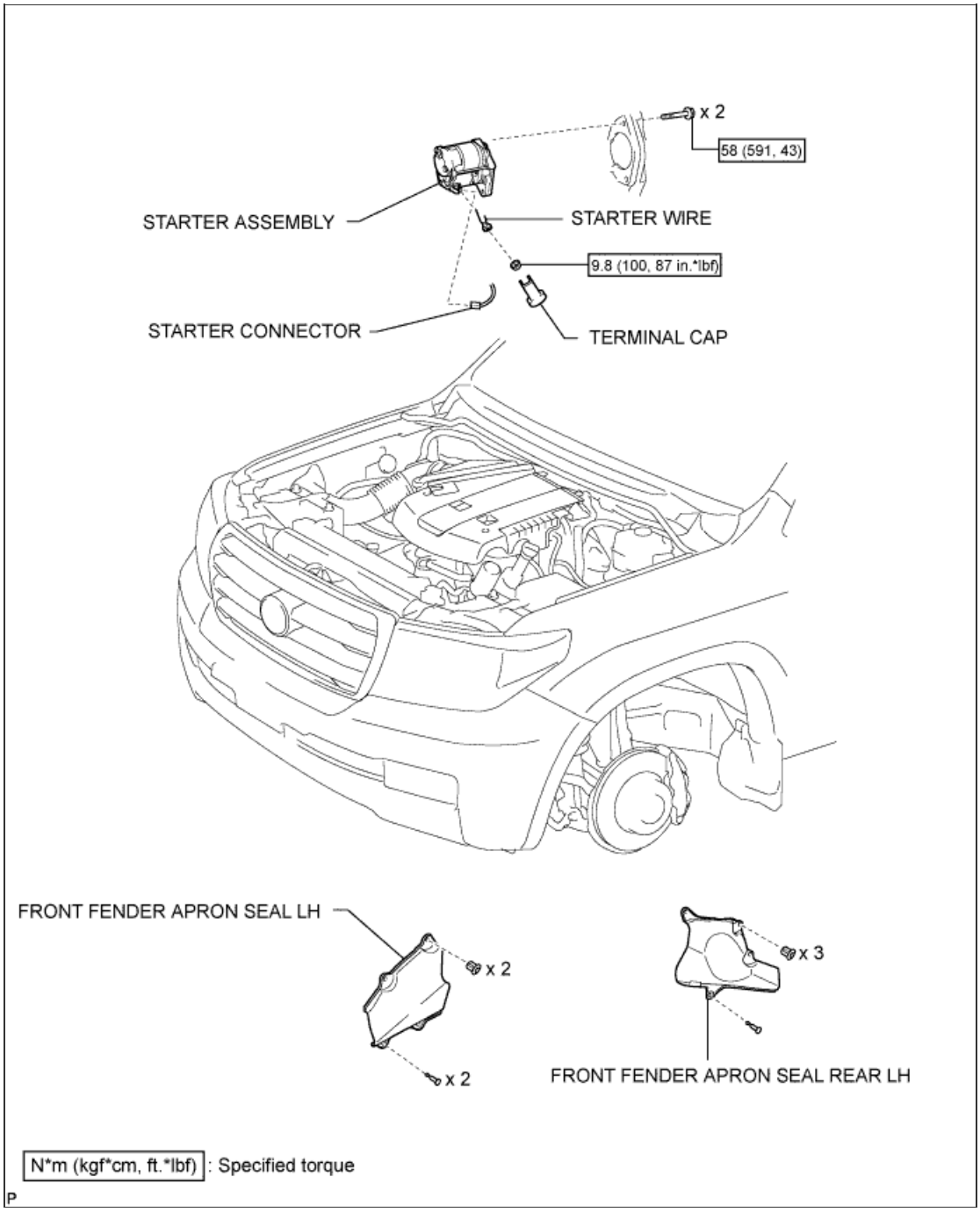


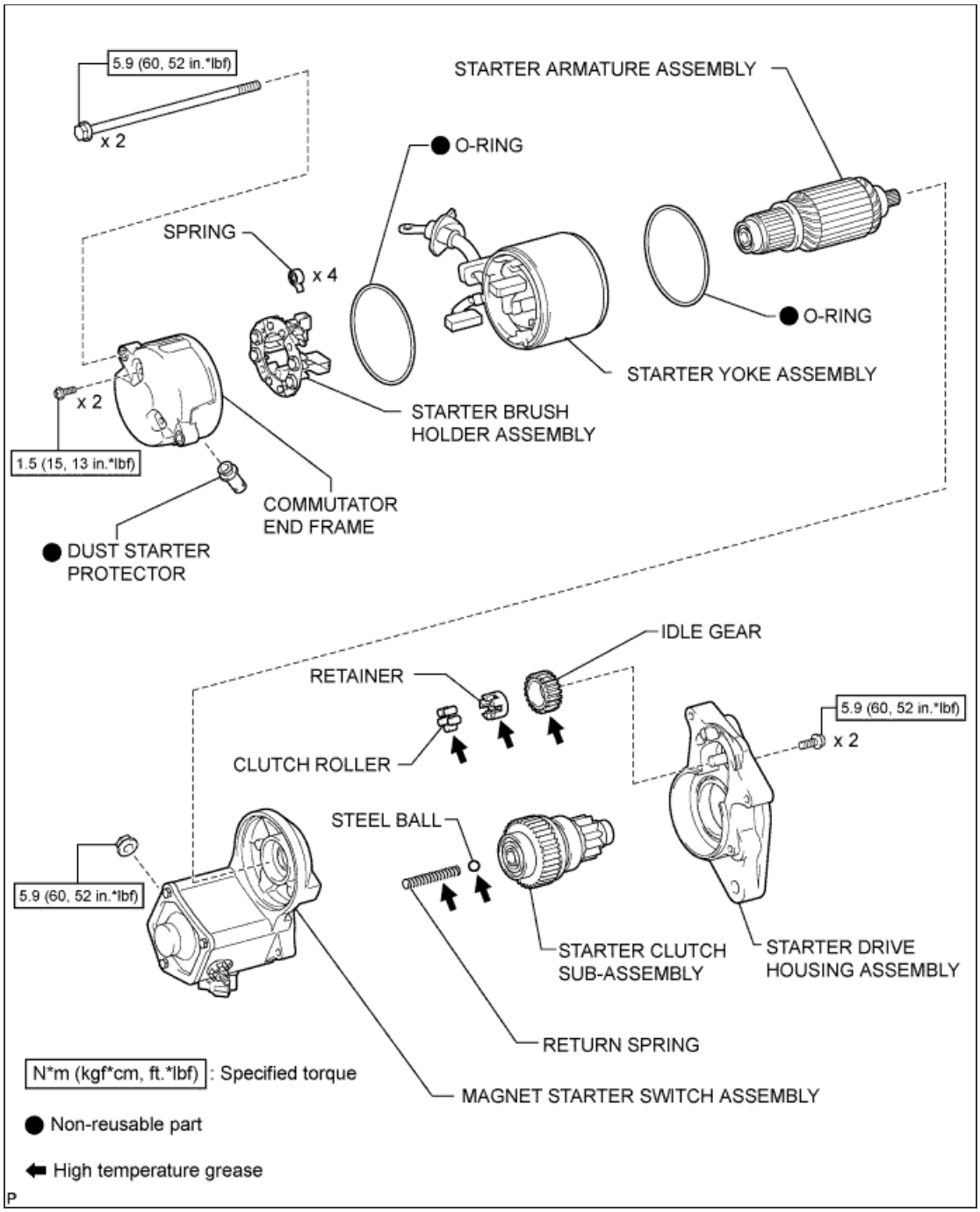
P

w/o Entry and Start System:



for Preparation Click here




5.9 (60, 52 in.*lbf)
x 2
STARTER ARMATURE ASSEMBLY
O-RING
SPRING
x 4
O-RING
STARTER YOKE ASSEMBLY
x 2
STARTER BRUSH
HOLDER ASSEMBLY
1.5 (15, 13 in.*lbf)
COMMUTATOR
END FRAME
DUST STARTER
PROTECTOR
IDLE GEAR
RETAINER
5.9 (60, 52 in.*lbf)
x 2
CLUTCH ROLLER
STEEL BALL
5.9 (60, 52 in.*lbf)
STARTER CLUTCH
SUB-ASSEMBLY
STARTER DRIVE
HOUSING ASSEMBLY
RETURN SPRING
N*m (kgf*cm, ft.*lbf) : Specified torque
MAGNET STARTER SWITCH ASSEMBLY
Non-reusable part
High temperature grease
P

for Preparation Click here

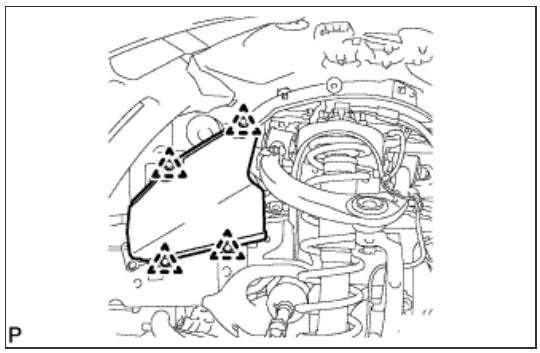
1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

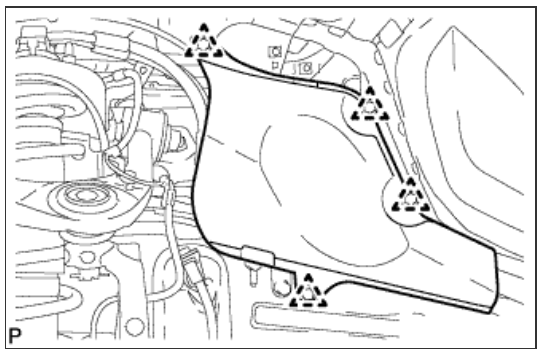
2. REMOVE FRONT FENDER APRON SEAL LH

a. Using a clip remover, remove the 4 clips and fender apron seal.



3. REMOVE FRONT FENDER APRON SEAL REAR LH

a. Using a clip remover, remove the 4 clips and fender apron seal.

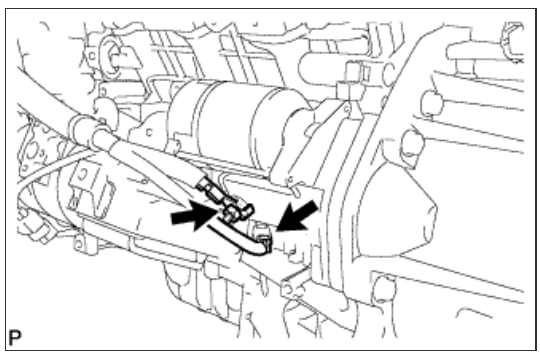


4. REMOVE STARTER ASSEMBLY

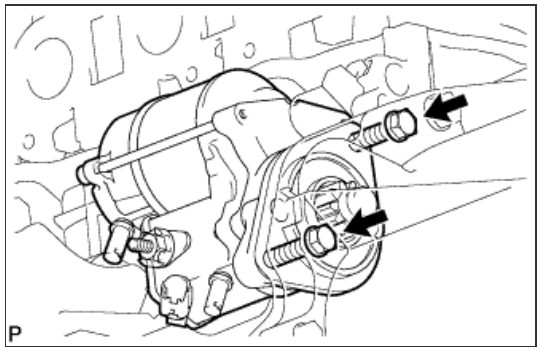
a. Disconnect the terminal cap.

b. Remove the nut and disconnect the starter wire.

c. Disconnect the starter connector.



d. Remove the 2 bolts and starter.



for Preparation Click here

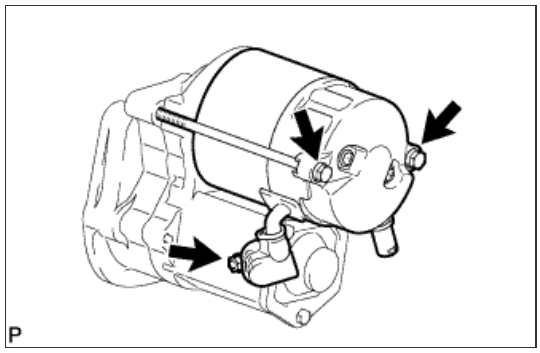
1. REMOVE STARTER YOKE ASSEMBLY

a. Remove the nut and disconnect the lead wire from terminal C.

b. Remove the 2 bolts.

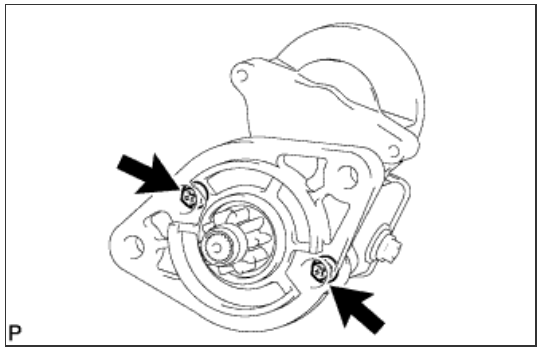
c. Pull out the starter yoke and starter commutator end frame together with the starter armature.

d. Remove the O-ring from the starter yoke.

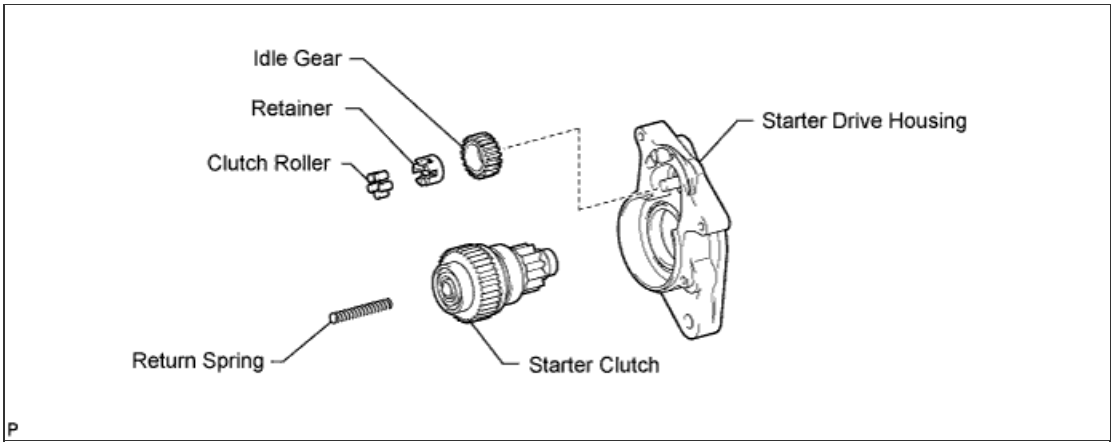


2. REMOVE MAGNET STARTER SWITCH ASSEMBLY

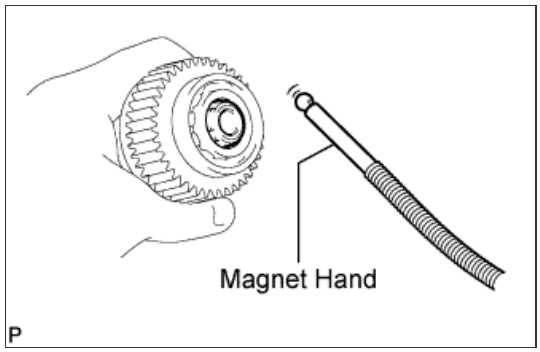
a. Remove the 2 screws and magnet starter switch.



b. Remove the idle gear, retainer, clutch roller, return spring and starter clutch from the starter drive housing.



c. Using a magnet hand, remove the steel ball from the starter clutch hole.



3. REMOVE STARTER BRUSH HOLDER ASSEMBLY

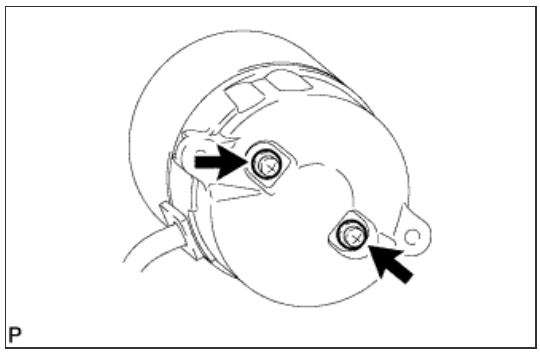
a. Remove the 2 screws and commutator end frame from the starter yoke.

NOTICE:

While holding down the lead wire, remove the starter commutator end frame.

b. Remove the dust protector from the commutator end frame.

c. Remove the O-ring from the starter yoke.

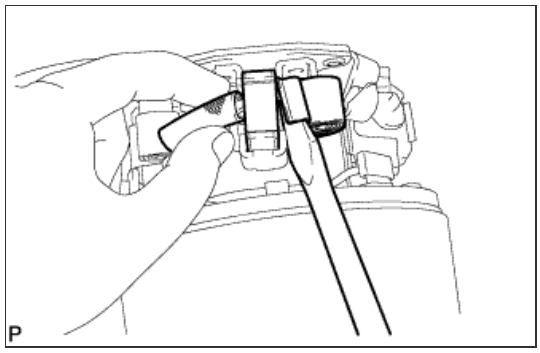


d. Disconnect the 4 brushes from the starter brush holder.

i. Using a screwdriver, hold back the spring.

ii. Disconnect the brush from the brush holder.

e. Remove the brush holder.



4. REMOVE STARTER ARMATURE ASSEMBLY

a. Remove the starter armature from the starter yoke.

for Preparation Click here

1. INSPECT STARTER ASSEMBLY

CAUTION:

As a large electric current passes through the cable during this inspection, a thick cable must be used. If not, the cable may became hot and cause injury.

NOTICE:

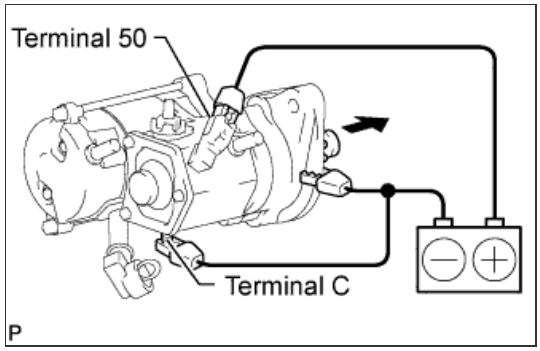
The following tests must each be performed within 3 to 5 seconds to prevent the coil from burning out.

a. Mount the starter in a vise between aluminum plates.

b. Perform a pull-in test.

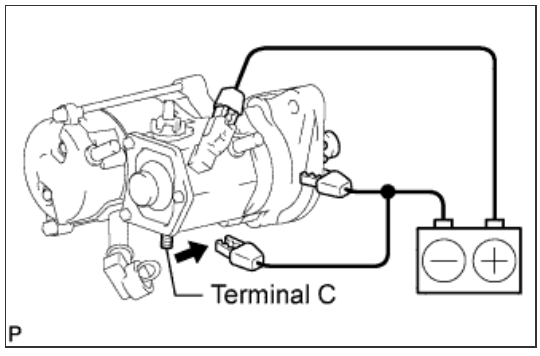
i. Remove the nut, then disconnect the lead wire from terminal C.

ii. Connect the battery to the magnet starter switch as shown in the illustration. Then check that the clutch pinion gear extends.
If the clutch pinion gear does not move, inspect the magnet starter switch assembly. If the magnet starter switch assembly is not as specified, replace it.



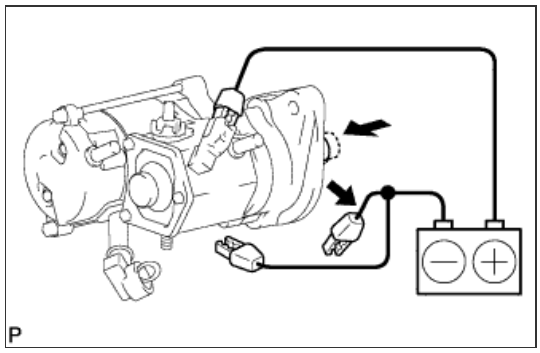
c. Perform a holding test.

i. Disconnect the negative (-) terminal lead from terminal C with the condition specified in the pull-in test above being maintained. Check that the pinion gear remains out.
If the clutch pinion gear returns inward, inspect the magnet starter switch assembly. If the magnet starter switch assembly is not as specified, replace it.



d. Inspect the clutch pinion gear return.

i. Disconnect the negative (-) terminal lead from the starter body. Check that the clutch pinion gear returns inward.
If the clutch pinion gear does not return inward, inspect the magnet starter switch assembly. If the magnet starter switch assembly is not as specified, replace it.



e. Perform an operation test without load.

.

i. Connect the lead wire to terminal C with the nut.

Torque:
5.9 N*m{ 60 kgf*cm , 52 in.*lbf }

ii. Connect the battery and an ammeter to the starter as shown in the illustration.

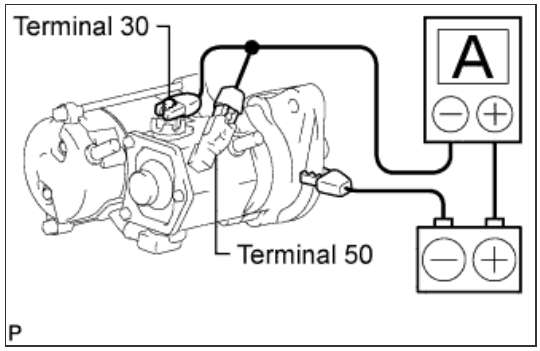
iii. Check that the starter rotates smoothly and steadily while the pinion gear is extended. Then measure the current.

Specified current:
90 A or less at 11.5 V

If the result is not as specified, inspect the starter assembly.

HINT:

Inspect the starter brush holder assembly, starter yoke assembly and starter armature assembly. If there is a malfunction, replace the part and perform this test again.



2. INSPECT MAGNET STARTER SWITCH ASSEMBLY

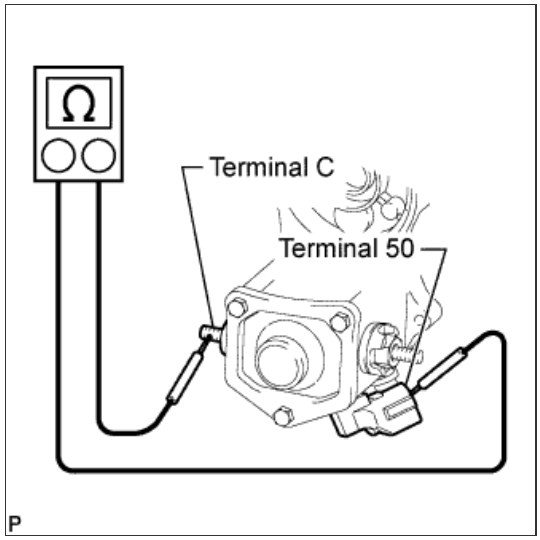
a. Inspect the pull-in coil.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Terminal 50 - Terminal C	Always	Below 1 Ω

If the result is not as specified, replace the magnet starter switch assembly.



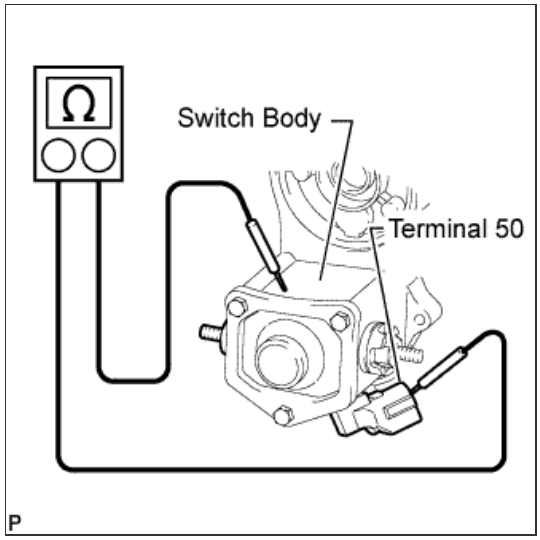
b. Inspect the holding coil.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Terminal 50 - Switch Body	Always	Below 2 Ω

If the result is not as specified, replace the magnet starter switch assembly.



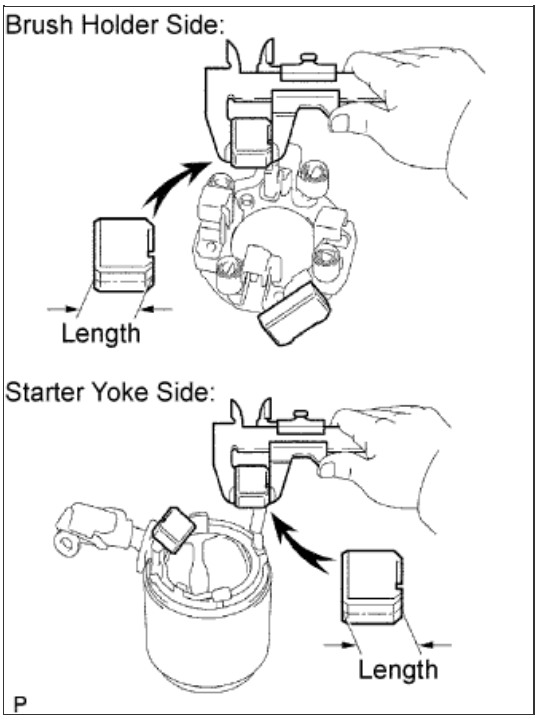
3. INSPECT BRUSH

a. Using a vernier caliper, measure the brush length.

Standard length:
15.5 mm (0.610 in.)

Minimum length:
8.5 mm (0.335 in.)

If the length is less than the minimum, replace the starter brush holder assembly and starter yoke assembly.



4. INSPECT STARTER BRUSH HOLDER ASSEMBLY

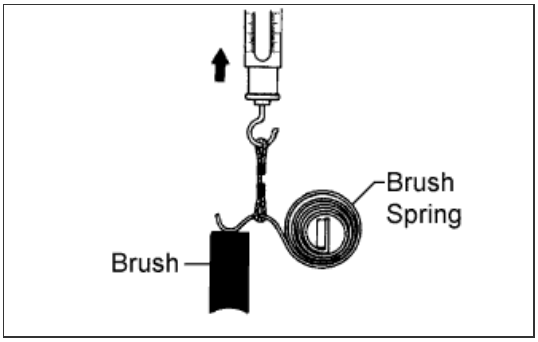
a. Check the brush spring load.

i. Take a pull scale reading immediately after the brush spring separates from the brush.

Standard spring load:
18 to 24 N (1.8 to 2.4 kgf, 4.0 to 5.3 lbf)

Minimum spring load:
12 N (1 kgf, 2.7 lbf)

If the spring load is less than the minimum, replace the starter brush holder assembly.

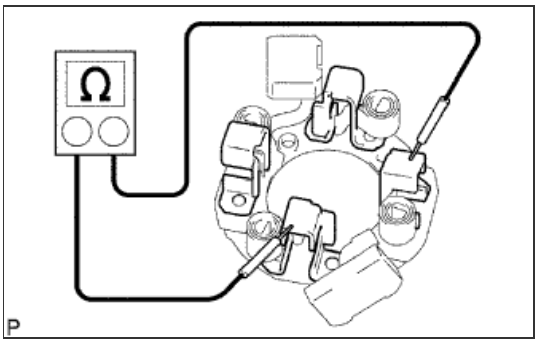


b. Inspect the insulation.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Positive (+) Brush Holder - Negative (-) Brush Holder	Always	10 KΩ or higher

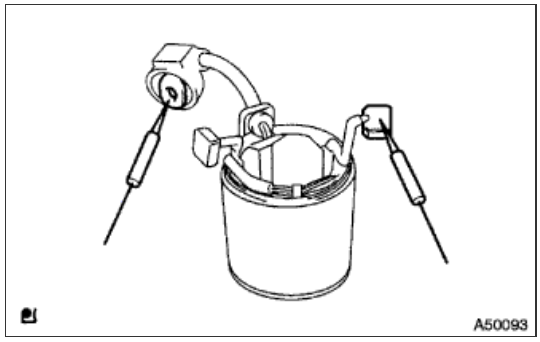


If the result is not as specified, replace the starter brush holder assembly.

5. INSPECT STARTER YOKE ASSEMBLY

a. Inspect the field coil for an open circuit.

i. Measure the resistance according to the value(s) in the table below.

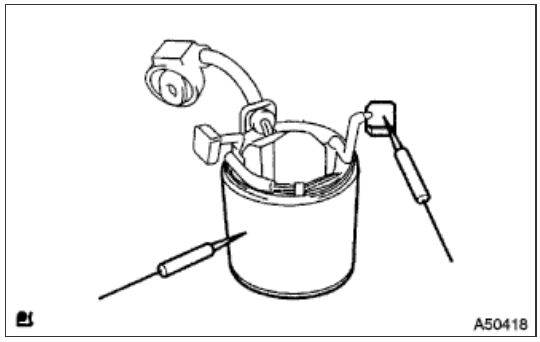


Standard Resistance:

Tester Connection	Condition	Specified Condition
Lead Wire - Brush	Always	Below 1 Ω

If the result is not as specified, replace the starter yoke assembly.

ii. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

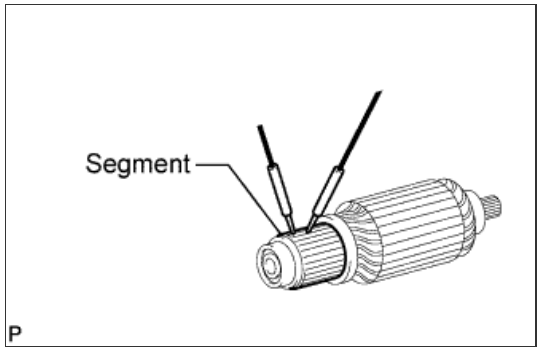
Tester Connection	Condition	Specified Condition
Starter Yoke Body - Brush	Always	10 kΩ or higher

If the result is not as specified, replace the starter yoke assembly.

6. INSPECT STARTER ARMATURE ASSEMBLY

a. Check the commutator for dirt and/or burns on the surface.
If the surface is dirty or burnt, correct it with sandpaper (No. 400) or a lathe.

b. Inspect the commutator for an open circuit.



i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Segment - Segment	Always	Below 1 Ω

If the result is not as specified, replace the starter armature assembly.

c. Inspect the commutator for a short circuit.

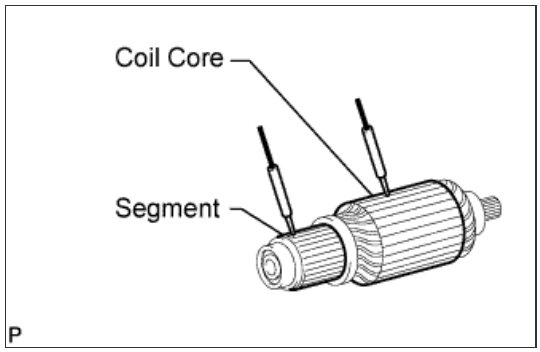
i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

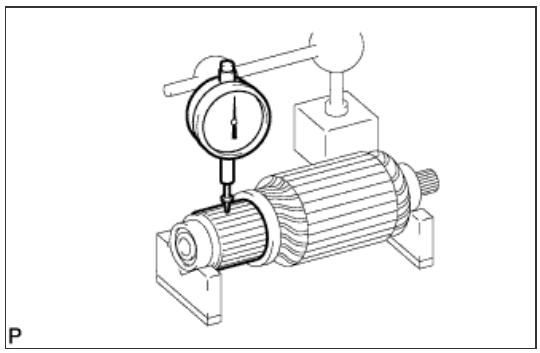
Tester Connection	Condition	Specified Condition
Segment - Coil	Always	10 kΩ or higher

Core

If the result is not as specified, replace the starter armature assembly.



d. Check the commutator circle runout.



i. Place the commutator on V-blocks.

ii. Using a dial indicator, measure the circle runout.

Maximum runout:
0.05 mm (0.00197 in.)

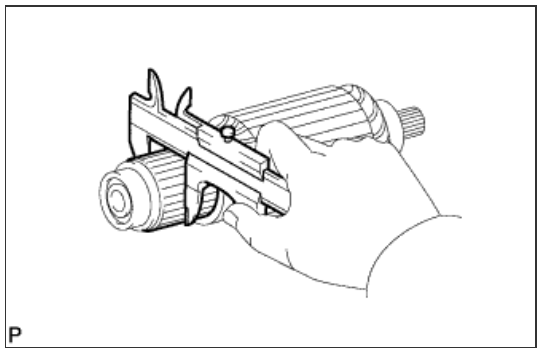
If the circle runout is more than the maximum, replace the starter armature assembly.

e. Using a vernier caliper, measure the commutator diameter.

Standard diameter:
30.0 mm (1.18 in.)

Minimum diameter:
29.0 mm (1.14 in.)

If the diameter is less than the minimum, replace the starter armature assembly.

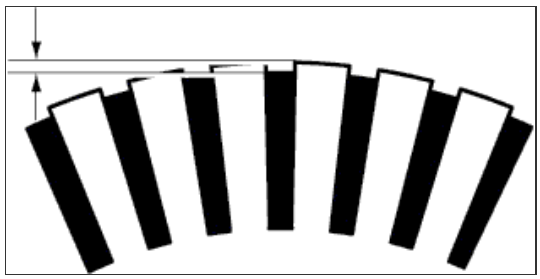


f. Using a vernier caliper, measure the undercut depth of the commutator.

Standard undercut depth:
0.6 mm (0.0236 in.)

Minimum undercut depth:
0.2 mm (0.00787 in.)

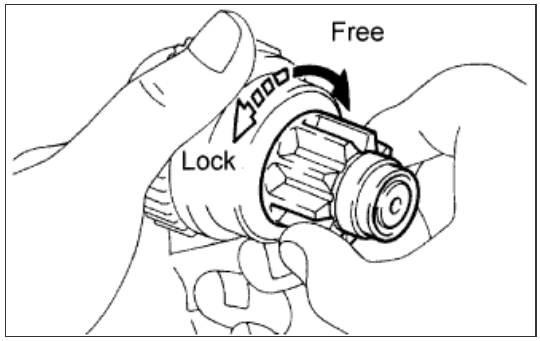
If the undercut depth is less than the minimum, replace the starter armature assembly.



7. INSPECT STARTER CLUTCH SUB-ASSEMBLY

a. Rotate the pinion gear clockwise and check that it turns freely. Try to rotate the pinion gear counterclockwise and check that it locks.
If the result is not as specified, replace the starter clutch sub-assembly.

b. Turn the pinion gear by hand while applying inward force and check the movement of the bearing.
If resistance is felt or the bearing sticks, replace the starter clutch sub-assembly.



for Preparation Click here

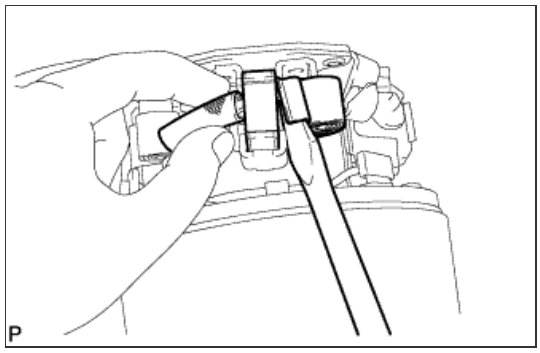
1. INSTALL STARTER ARMATURE ASSEMBLY

a. Install the starter armature to the starter yoke.

2. INSTALL STARTER BRUSH HOLDER ASSEMBLY

a. Install the brush holder.

b. Connect the 4 brushes to the starter brush holder.



i. Using a screwdriver, hold back the spring.

ii. Connect the brush to the brush holder.

NOTICE:

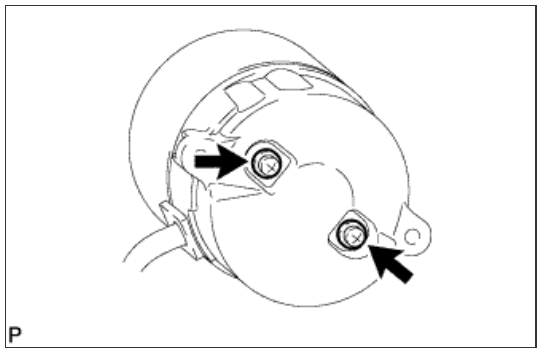
Check that the positive (lead wire are not grounded.

c. Place a new O-ring in position on the commutator end rame.

d. Install a new dust protector to the commutator end rame.

e. Install the commutator end rame with the 2 screws.

Torque:
1.5 N*m{ 15 kgf*cm , 13 in.*lbf }

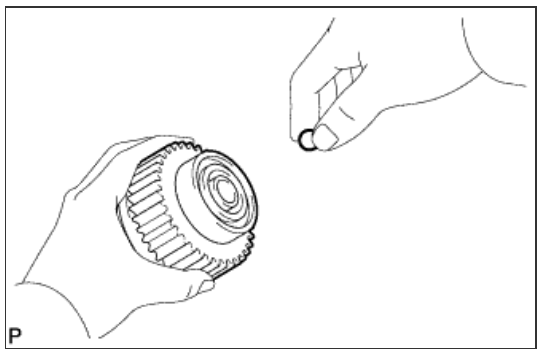


3. INSTALL MAGNET STARTER SWITCH ASSEMBLY

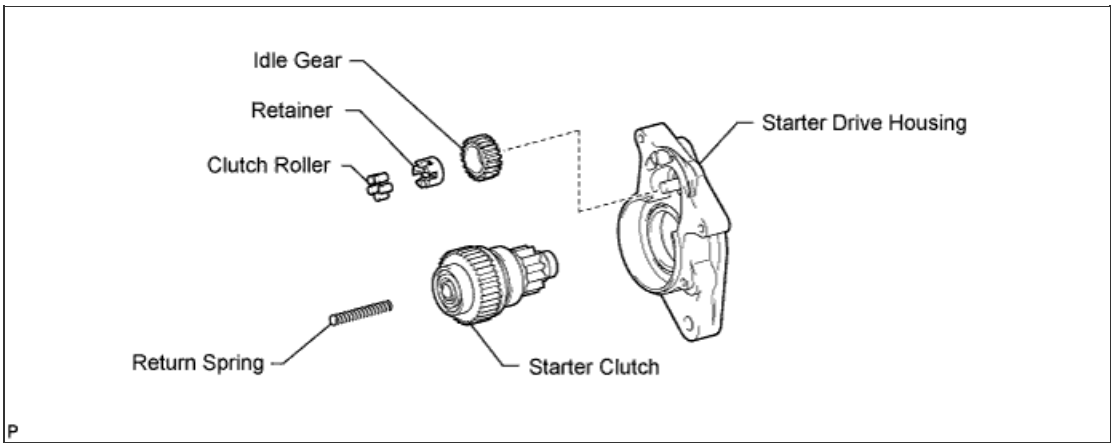
a. Apply high temperature grease to the idle gear, steel ball, return spring, clutch roller and retainer.

b. Insert the steel ball into the starter clutch sha t hole.

c. Insert the return spring into the starter clutch sha t hole.

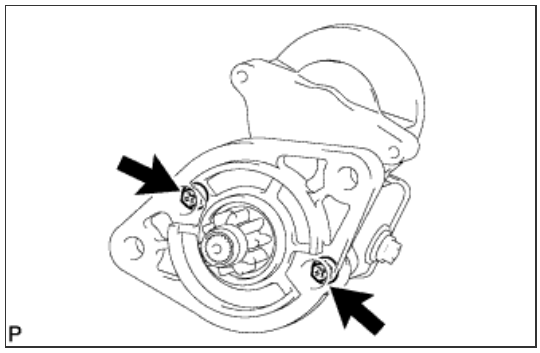


d. Install the starter clutch, idle gear, retainer and clutch roller to the starter drive housing.



e. Install the starter drive housing to the magnet starter switch with the 2 screws.

Torque:
5.9 N*m{ 60 kgf*cm , 52 in.*lbf }

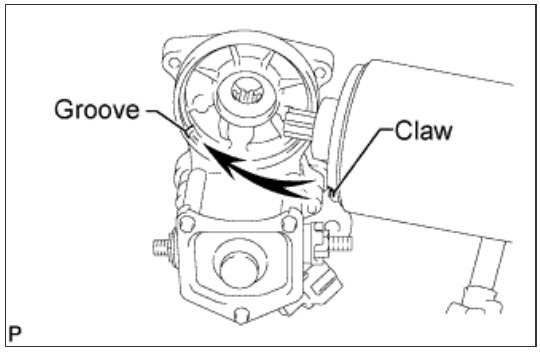


4. INSTALL STARTER YOKE ASSEMBLY

a. Install a new O-ring to the groove o the starter yoke.

b. Align the claw o the starter yoke with the groove o the starter switch.

c. Install the starter yoke to the starter switch.

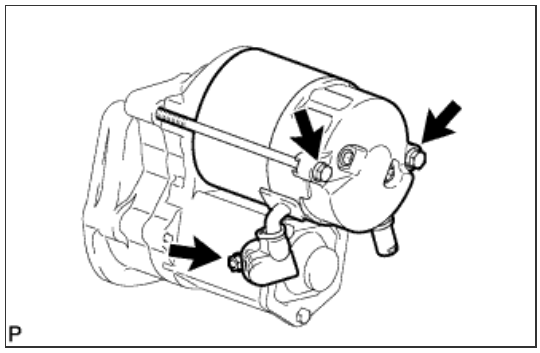


d. Install the 2 bolts.

Torque:
5.9 N*m{ 60 kgf*cm , 52 in.*lbf }

e. Connect the lead wire to terminal C with the nut.

Torque:
5.9 N*m{ 60 kgf*cm , 52 in.*lbf }



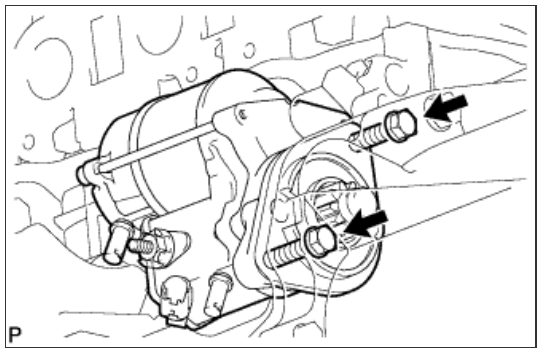
for Preparation Click here

1. INSTALL STARTER ASSEMBLY

a. Install the starter with the 2 bolts.

Torque:
58 N*m{ 591 kgf*cm , 43 ft.*lbf }

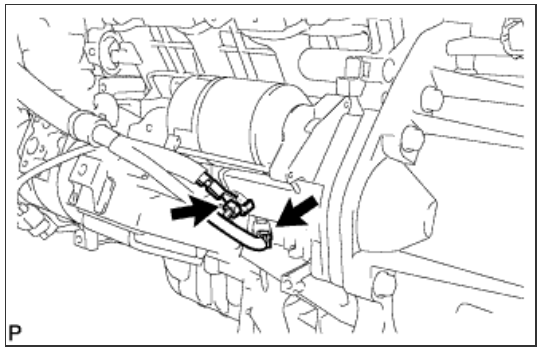
b. Connect the starter connector.



c. Connect the starter wire with the nut.

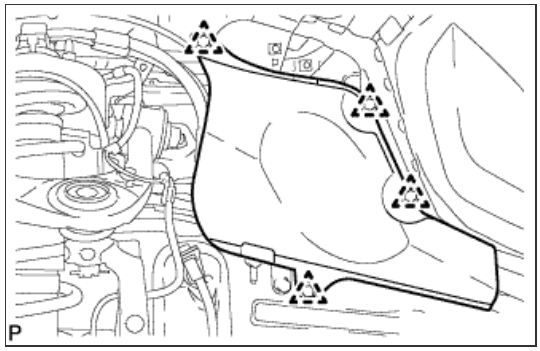
Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }

d. Connect the terminal cap.



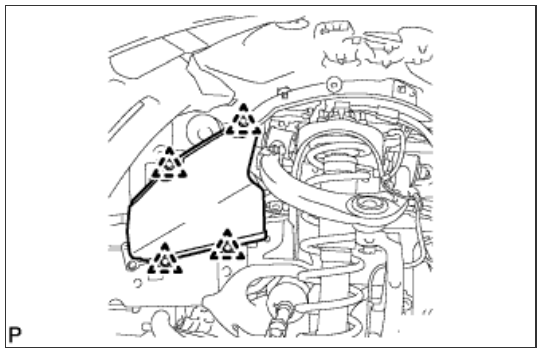
2. INSTALL FRONT FENDER APRON SEAL REAR LH

a. Install the fender apron seal with the 4 clips.



3. INSTALL FRONT FENDER APRON SEAL LH

a. Install the fender apron seal with the 4 clips.

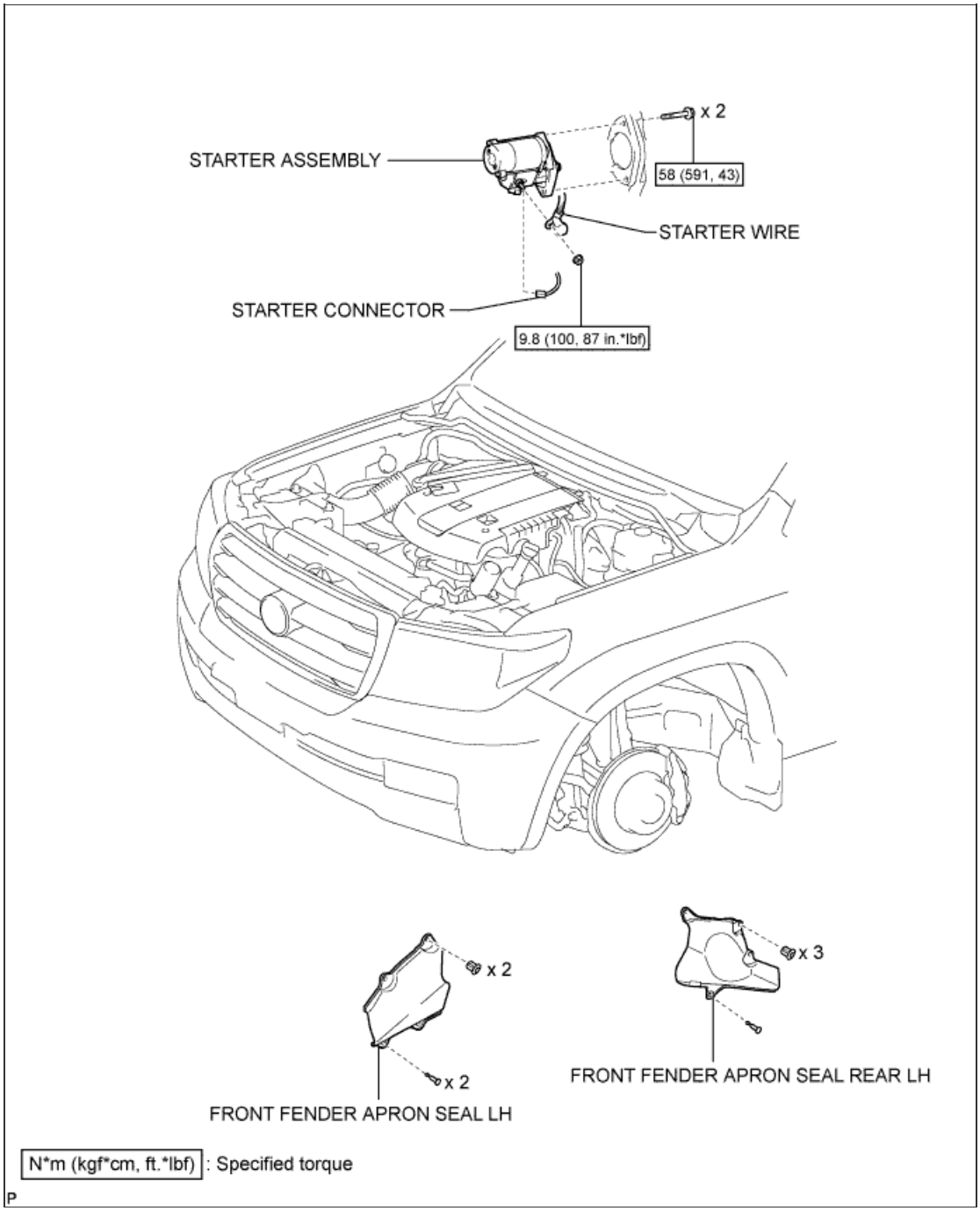


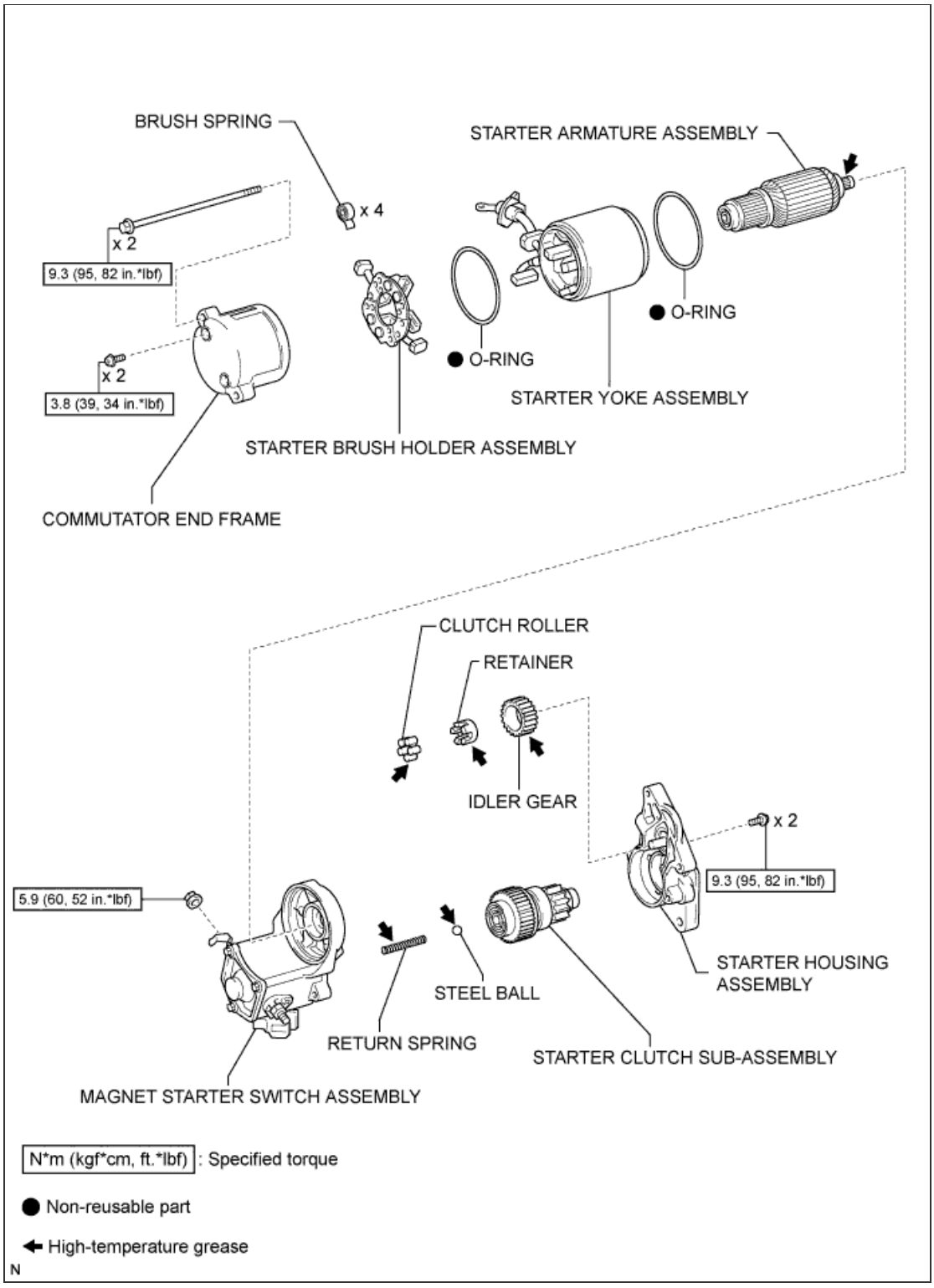
4. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

- hø disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

for Preparation Click here




BRUSH SPRING
x 4
STARTER ARMATURE ASSEMBLY
x 2
9.3 (95, 82 in.*lbf)
O-RING
O-RING
x 2
3.8 (39, 34 in.*lbf)
STARTER YOKE ASSEMBLY
STARTER BRUSH HOLDER ASSEMBLY
COMMUTATOR END FRAME
CLUTCH ROLLER
RETAINER
IDLER GEAR
x 2
9.3 (95, 82 in.*lbf)
5.9 (60, 52 in.*lbf)
STARTER HOUSING ASSEMBLY
STEEL BALL
RETURN SPRING
STARTER CLUTCH SUB-ASSEMBLY
MAGNET STARTER SWITCH ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
High-temperature grease
N

for Preparation Click here

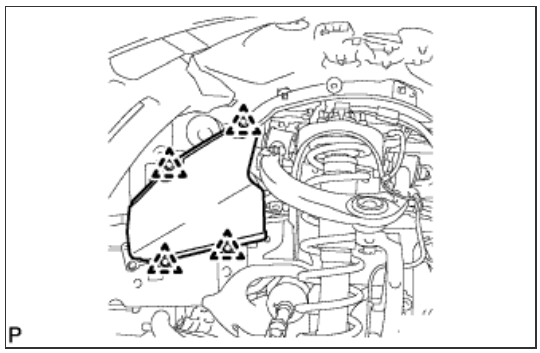
1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

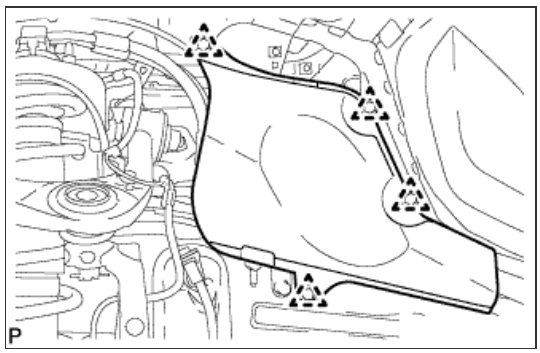
2. REMOVE FRONT FENDER APRON SEAL LH

a. Using a clip remover, remove the 4 clips and fender apron seal.



3. REMOVE FRONT FENDER APRON SEAL REAR LH

a. Using a clip remover, remove the 4 clips and fender apron seal.

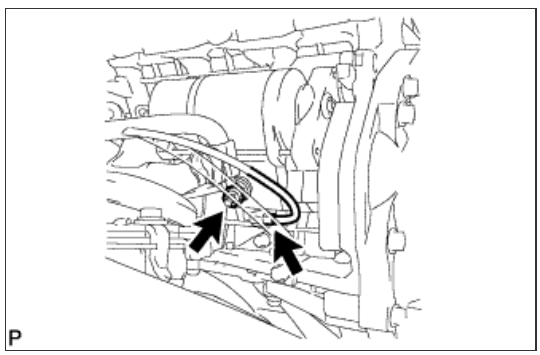


4. REMOVE STARTER ASSEMBLY

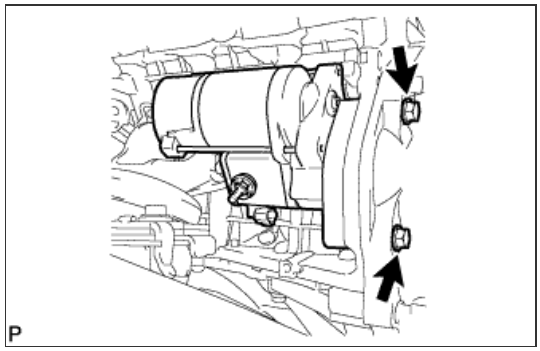
a. Disconnect the terminal cap.

b. Remove the nut and disconnect the starter wire.

c. Disconnect the starter connector.



d. Remove the 2 bolts and starter.



for Preparation Click here

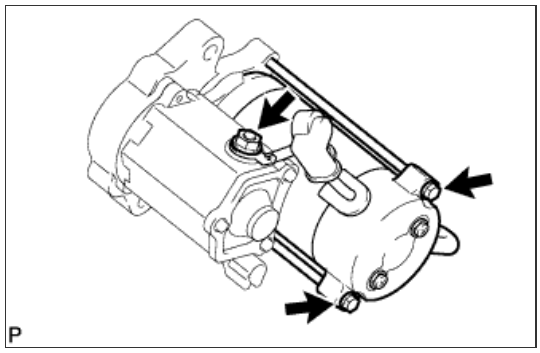
1. REMOVE STARTER YOKE ASSEMBLY

a. Remove the nut and disconnect the lead wire from terminal C.

b. Remove the 2 through bolts.

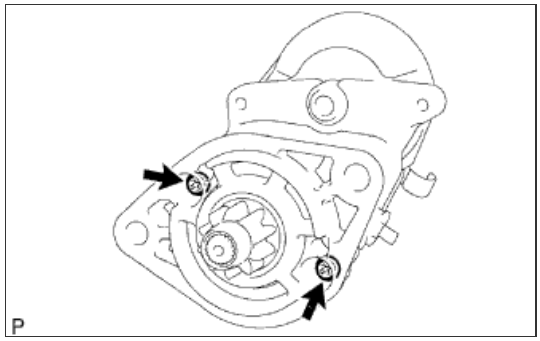
c. Pull out the starter yoke and the armature together.

d. Remove the O-ring from the starter yoke.

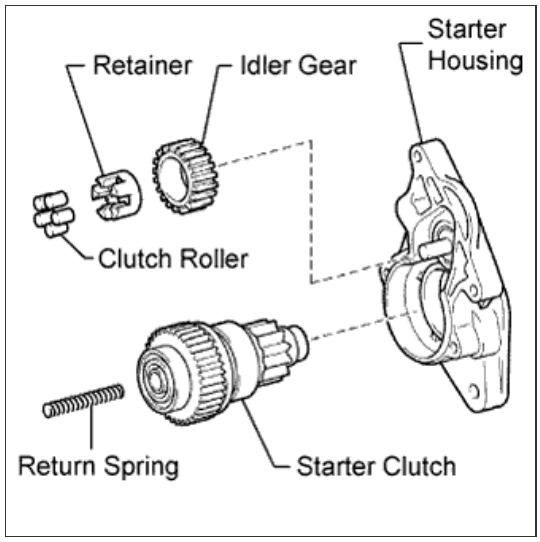


2. REMOVE MAGNET STARTER SWITCH ASSEMBLY

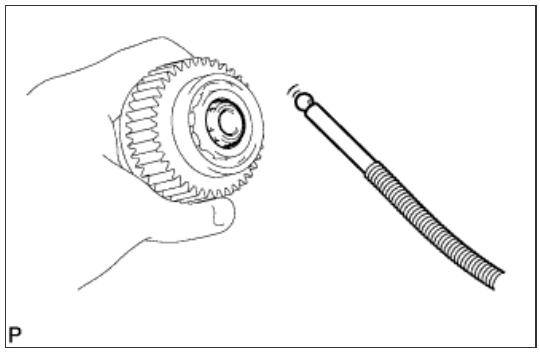
a. Remove the 2 screws and magnet starter switch.



b. Remove the return spring, idler gear, clutch roller, retainer and starter clutch from the starter housing.



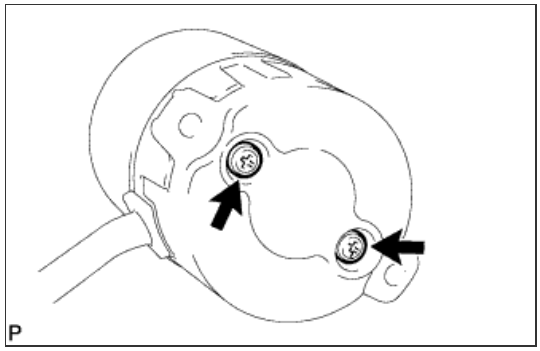
c. Using a magnetic finger, remove the steel ball from the clutch shaft hole.



3. REMOVE STARTER BRUSH HOLDER ASSEMBLY

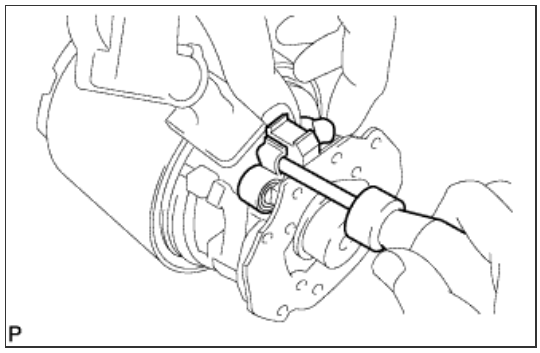
a. Remove the 2 screws and end frame from the starter yoke.

b. Remove the O-ring from the starter yoke.



c. Using a screwdriver, hold the spring back and disconnect the 4 brushes from the brush holder.

d. Remove the brush holder from the armature.



4. REMOVE STARTER ARMATURE ASSEMBLY

a. Remove the starter armature from the starter yoke.

for Preparation Click here

NOTICE:

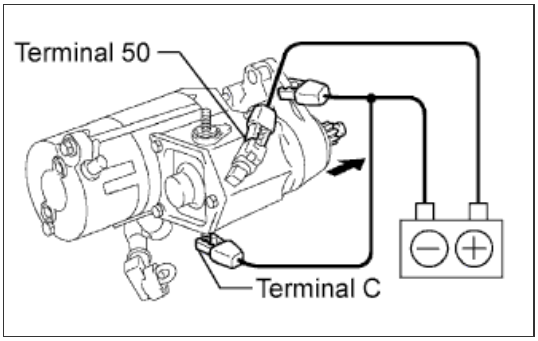
The following tests must be done within 3 to 5 seconds to prevent the coil from burning out.

1. INSPECT STARTER ASSEMBLY

a. Perform pull-in test.

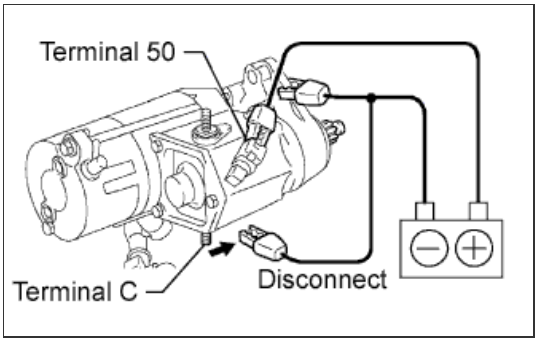
i. Remove the nut, then disconnect the lead wire from terminal C.

ii. Connect the battery to the starter as shown in the illustration. Check that the clutch pinion gear moves outward.
If the clutch pinion gear does not move, replace the magnet starter switch assembly.



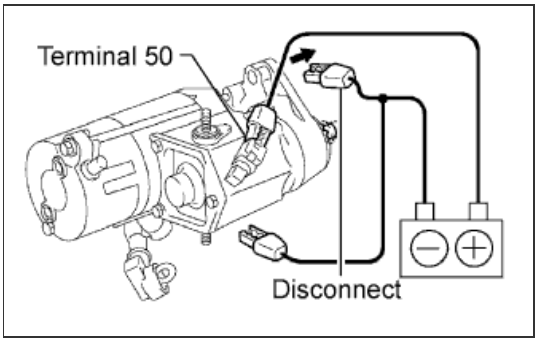
b. Perform holding test.

i. When the battery is connected as above with the clutch pinion gear out, disconnect the negative (-) lead from terminal C. Check that the pinion gear remains out.
If the clutch pinion gear returns inward, replace the magnet starter switch assembly.



c. Inspect clutch pinion gear return.

i. Disconnect the negative (-) lead from the starter body. Check that the clutch pinion gear returns inward.
If the clutch pinion gear does not return inward, replace the magnet starter switch assembly.



d. Perform the operation test without load.

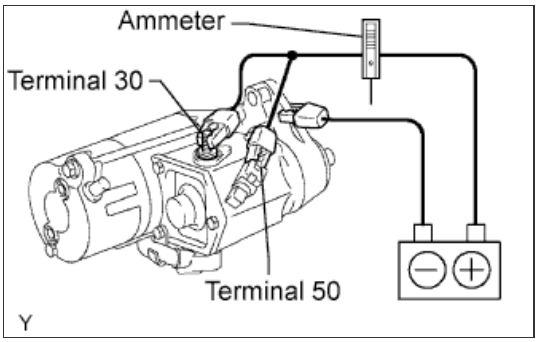
i. Connect the lead wire to terminal C with the nut.

Torque:
5.9 N*m{ 60 kgf*cm , 52 in.*lbf }

ii. Grip the starter in a vise.

iii. Connect the battery and an ammeter to the starter as shown.

iv. Check that the starter rotates smoothly and steadily with the clutch pinion gear extended.



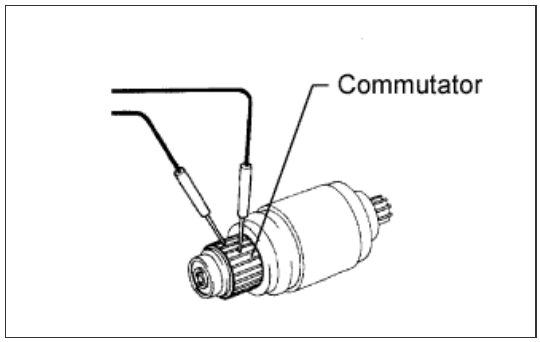
v. Check that the ammeter reads the specified current.

Standard current:
100 A or less at 11.5 V

If the result is not as specified, replace the starter assembly.

2. INSPECT STARTER ARMATURE ASSEMBLY

a. Inspect the commutator for an open circuit.



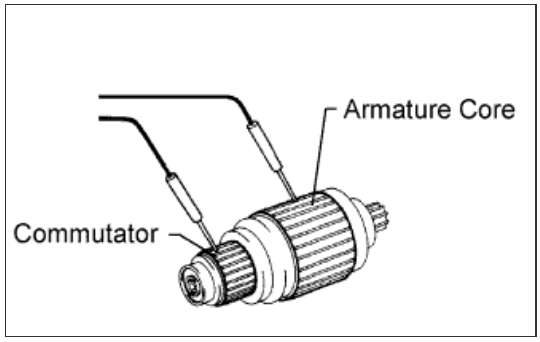
i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Commutator	Always	Below 1 Ω

If the result is not as specified, replace the starter armature assembly.

b. Inspect the commutator for a short circuit.



i. Measure the resistance according to the value(s) in the table below.

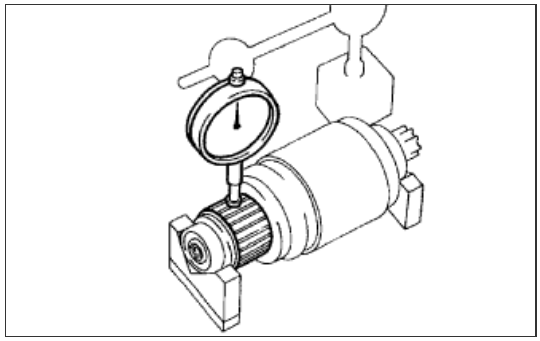
Standard Resistance:

Tester Connection	Condition	Specified Condition
Commutator - Armature	Always	10 kΩ or higher

If the result is not as specified, replace the starter armature assembly.

c. Check the commutator surface for dirt and burns.
If the surface is dirty or burnt, correct it with sandpaper (#400) or a lathe.

d. Inspect the commutator circle runout.



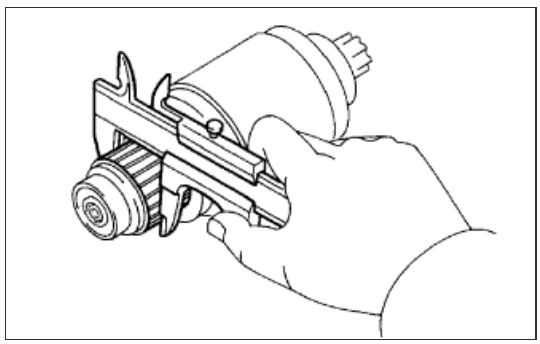
i. Place the commutator on V-blocks.

ii. Using a dial indicator, measure the circle runout.

Maximum circle runout:
0.05 mm (0.00197 in.)

If the runout is more than the maximum, correct it with sandpaper (#400) or replace the starter armature assembly.

e. Using a vernier caliper, measure the commutator diameter.



Standard diameter:
35.0 mm (1.38 in.)

Minimum diameter:
34.0 mm (1.34 in.)

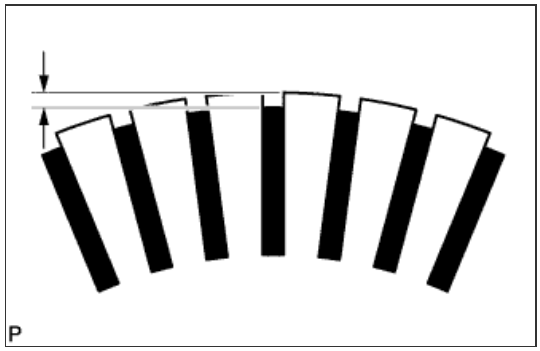
If the diameter is less than the minimum, replace the starter armature assembly.

f. Measure the undercut depth of the commutator.

Standard undercut depth:
0.7 mm (0.0276 in.)

Minimum undercut depth:
0.2 mm (0.00787 in.)

If the undercut depth is less than the minimum, increase the depth using a hacksaw blade.



g. Inspect the bearings.

i. Check that the bearing rotates smoothly.

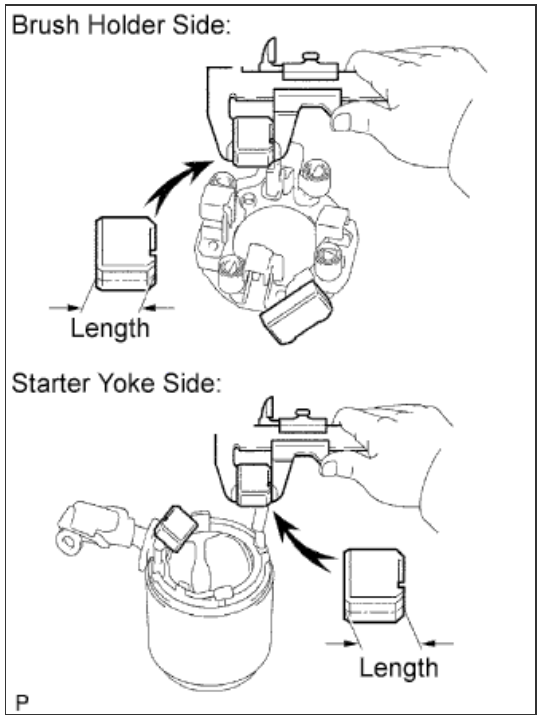
3. INSPECT BRUSH

a. Using a vernier caliper, measure the brush length.

Standard brush length:
15.0 mm (0.591 in.)

Minimum brush length:
9.0 mm (0.354 in.)

If the length is less than the minimum, replace the starter brush holder assembly and starter yoke assembly.



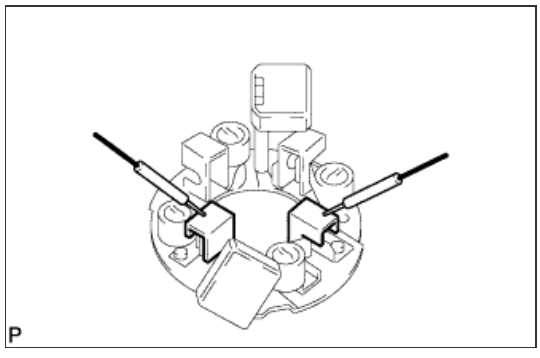
4. INSPECT STARTER BRUSH HOL ER ASSEMBLY

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Positive brush holder - Negative brush holder	Always	10 kΩ or higher

If the result is not as specified, replace the starter brush holder assembly.



b. Inspect the load of the brush spring.

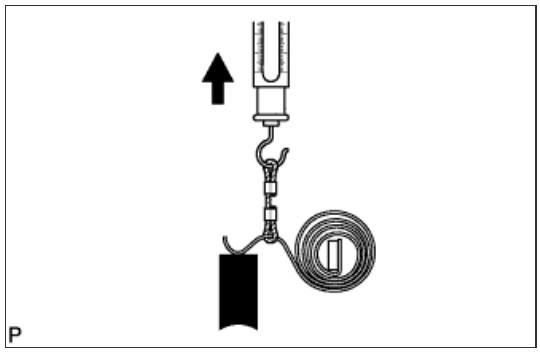
i. Take the pull scale reading immediately after the brush spring

separates from the brush.

Standard spring installed load:
21.5 to 27.5 N (2.2 to 2.8 kgf, 4.8 to 6.2 lbf)

Minimum spring installed load:
12.7 N (1.3 kgf, 2.9 lbf)

If the spring load is less than the minimum, replace the starter brush holder assembly.



5. INSPECT STARTER YOKE ASSEMBLY

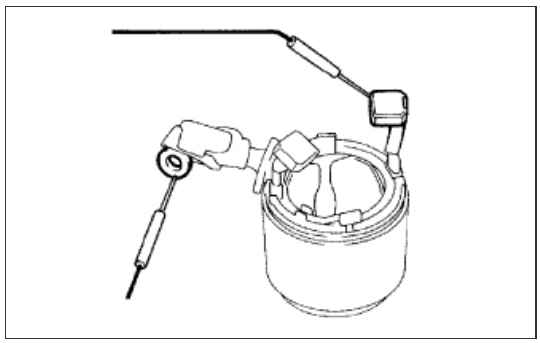
a. Inspect for an open circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Terminal C wire - Brush	Always	Below 1 Ω

If the result is not as specified, replace the starter yoke assembly.

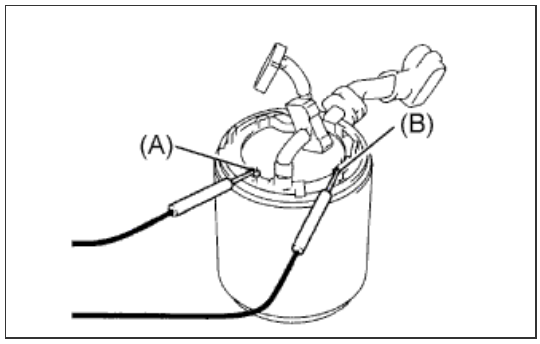


ii. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

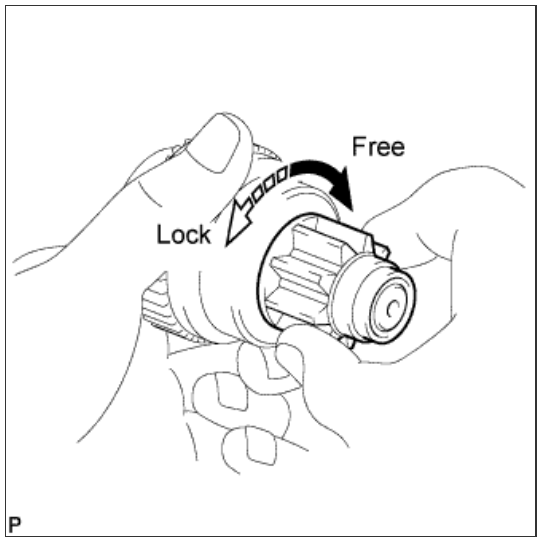
Tester connection	Condition	Specified Condition
Shunt coil terminal (A) - Shunt coil terminal (B)	20°C (68°F)	1.5 to 1.9 Ω

If the result is not as specified, replace the starter yoke assembly.



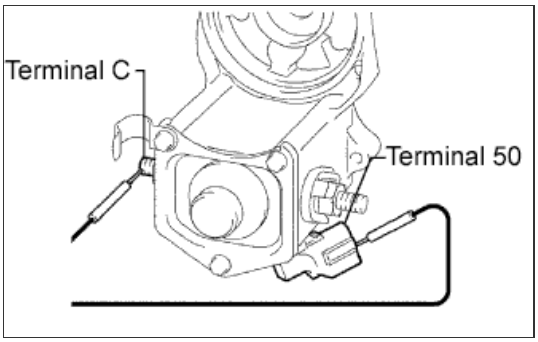
6. INSPECT STARTER CLUTCH SUB-ASSEMBLY

a. Check that the starter clutch cannot be rotated counterclockwise, and can be rotated clockwise.
If the starter clutch is not as specified, replace the starter clutch sub-assembly.



7. INSPECT MA NET STARTER SWITCH ASSEMBLY

a. Inspect the pull-in coil.



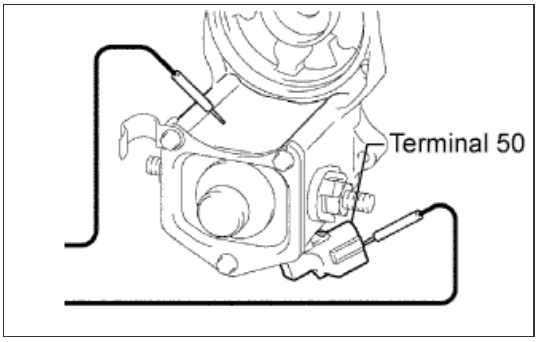
i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Terminals 50 - Terminal C	Always	Below 1 Ω

If the result is not as specified, replace the magnet starter switch assembly.

b. Inspect the holding coil.



i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Terminal 50 - Switch body	Always	Below 2 Ω

If the result is not as specified, replace the magnet starter switch assembly.

for Preparation Click here

HINT:

Use high temperature-resistant grease to lubricate the bearings and sliding parts when assembling the starter.

1. INSTALL STARTER ARMATURE ASSEMBLY

a. Apply high-temperature grease to the bearings, and install it to the starter yoke.

2. INSTALL STARTER BRUSH HOLDER ASSEMBLY

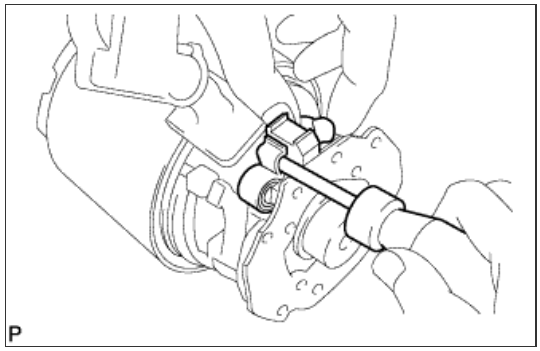
a. Place the brush holder on the armature.

b. Using a screwdriver, connect the brushes.

NOTICE:

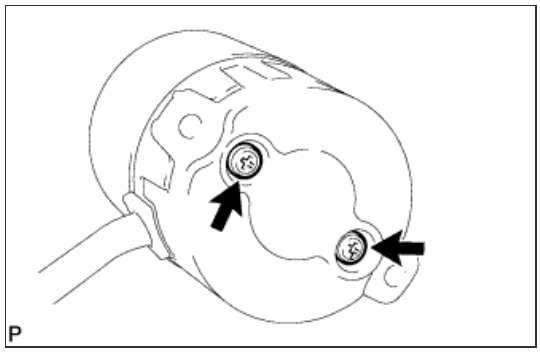
Check that the positive (lead wires are not grounded.

c. Install a new O-ring to the groove o the starter yoke.



d. Install the end rame with the 2 screws.

Torque:
3.8 N*m{ 39 kgf*cm , 34 in.*lbf }



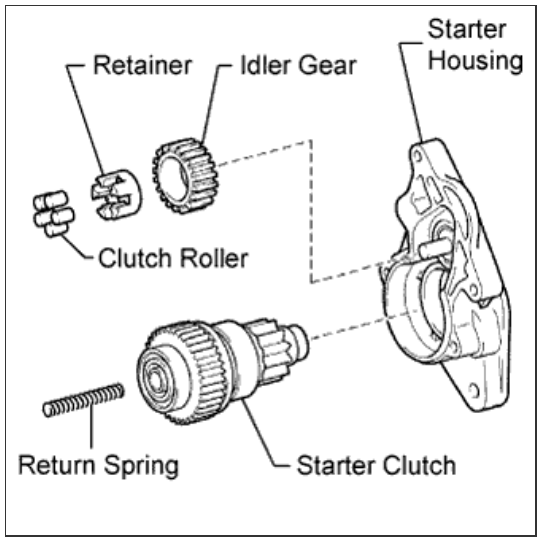
3. INSTALL MAGNET STARTER SWITCH ASSEMBLY

a. Apply high-temperature grease to the steel ball and install it to the clutch sha t hole.

b. Apply high-temperature grease to the return spring, clutch roller, retainer and idler gear.

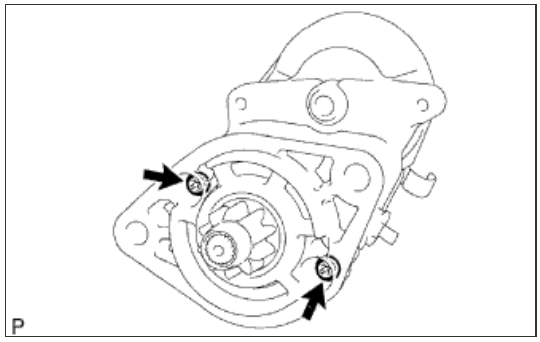
c. Insert the return spring into the magnet starter switch hole.

d. Install the starter clutch, idler gear, retainer and clutch roller to the starter housing.



e. Install the starter housing to the magnet starter switch with the 2 screws.

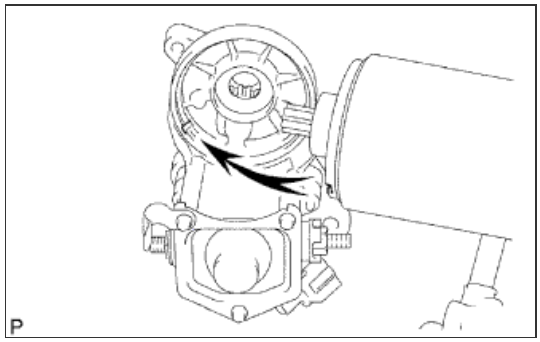
Torque:
9.3 N*m{ 95 kgf*cm , 82 in.*lbf }



4. INSTALL STARTER YOKE ASSEMBLY

a. Install a new O-ring to the groove o the starter yoke.

b. Align the key o the starter yoke with the groove o the magnet starter switch.

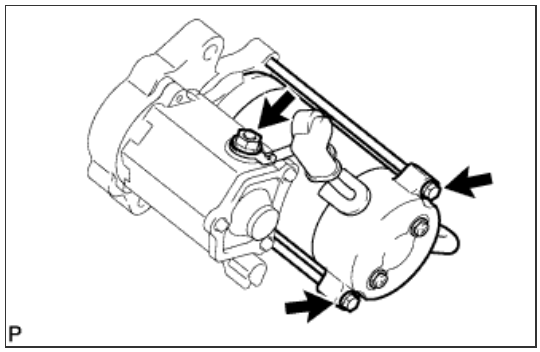


c. Install the starter yoke and armature with the 2 bolts.

Torque:
9.3 N*m{ 95 kgf*cm , 82 in.*lbf }

d. Connect the lead wire to the magnet switch terminal with the nut.

Torque:
5.9 N*m{ 60 kgf*cm , 52 in.*lbf }

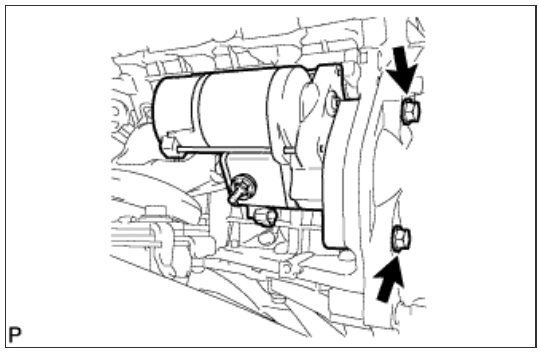


for Preparation Click here

1. INSTALL STARTER ASSEMBLY

a. Install the starter with the 2 bolts.

Torque:
58 N*m{ 591 kgf*cm , 43 ft.*lbf }

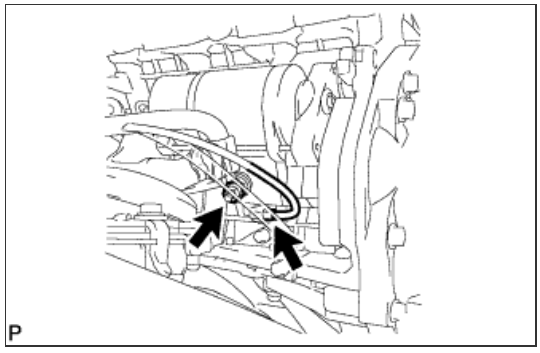


b. Connect the starter connector.

c. Connect the starter wire with the nut.

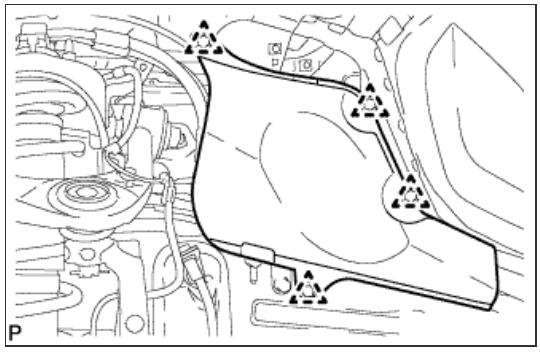
Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }

d. Connect the terminal cap.



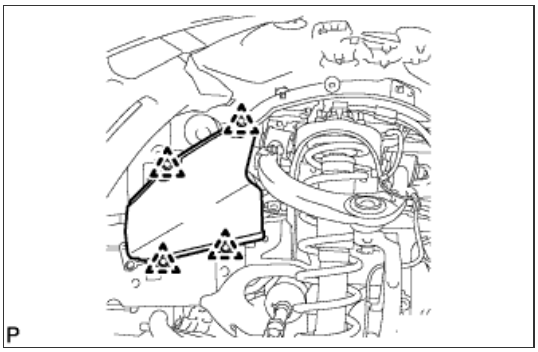
2. INSTALL FRONT FENDER APRON SEAL REAR LH

a. Install the fender apron seal with the 4 clips.



3. INSTALL FRONT FENDER APRON SEAL LH

a. Install the fender apron seal with the 4 clips.

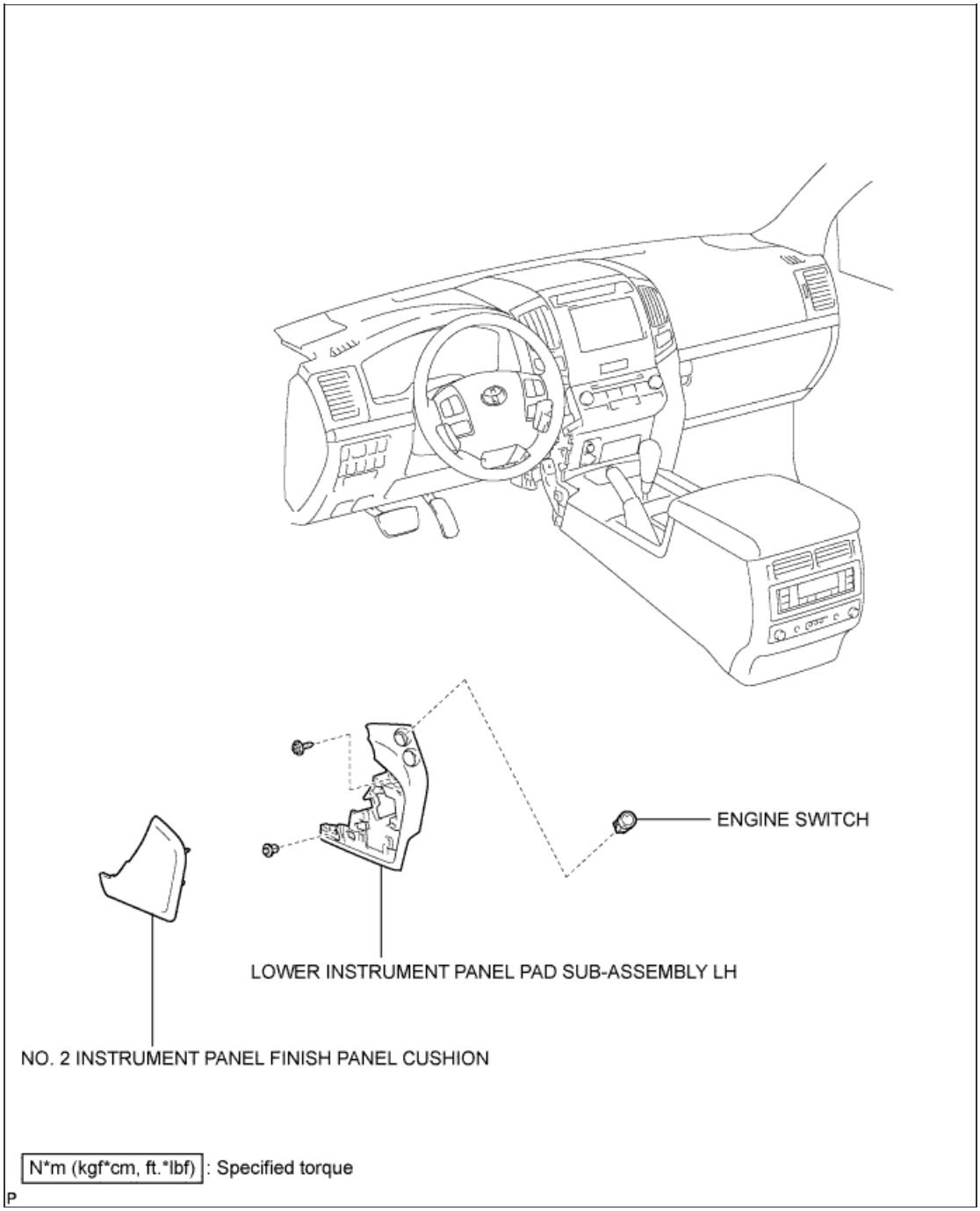


4. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

- hen disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

for Preparation Click here

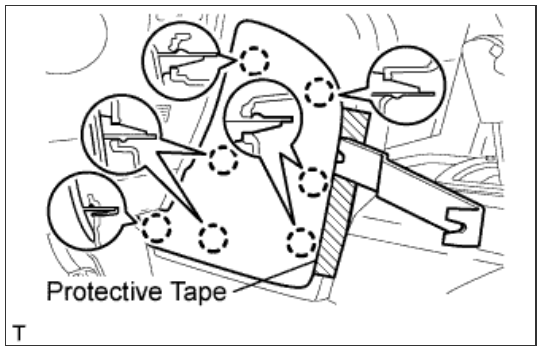


for Preparation Click here

1. REMOVE NO. 2 INSTRUMENT PANEL FINISH PANEL CUSHION

a. Place protective tape as shown in the illustration.

b. Using a moulding remover, detach the 7 claws and remove the panel cushion.



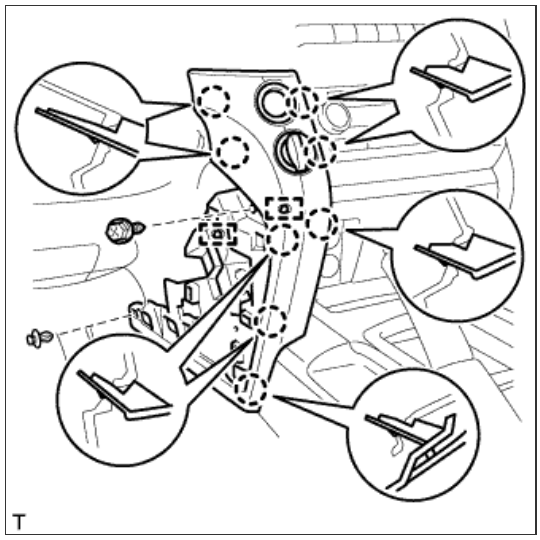
2. REMOVE LOWER INSTRUMENT PANEL PAD SUB-ASSEMBLY LH

a. Remove the clip.

b. Remove the screw.

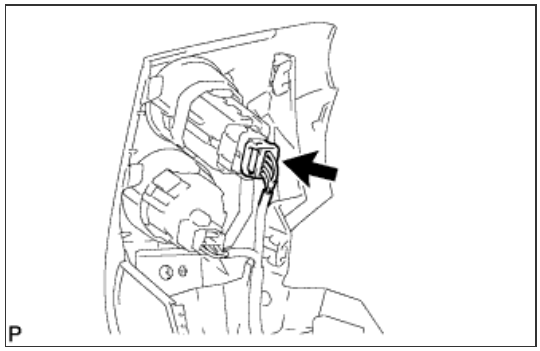
c. Detach the 8 claws.

d. Remove the panel pad and disconnect the connectors and 2 clamps.

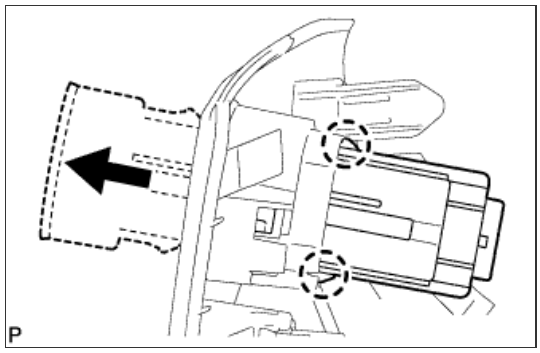


3. REMOVE ENGINE SWITCH

a. Disconnect the switch connector.



b. Detach the 2 claws and remove the switch.


P

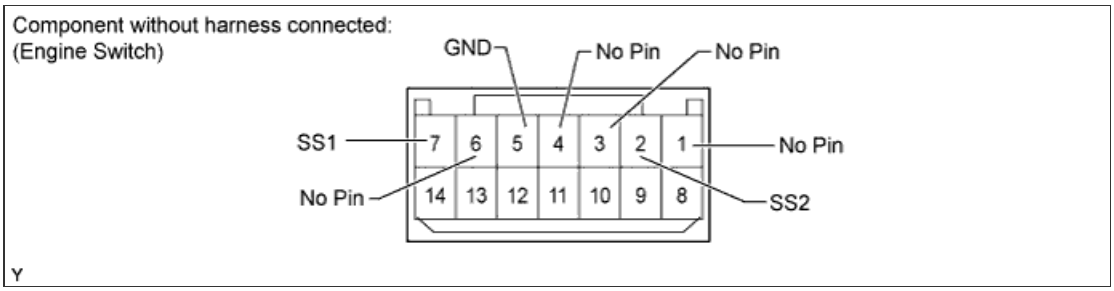
for Preparation Click here

1. INSPECT ENGINE SWITCH

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Switch Condition	Specified Condition
7 (SS1) - 5 (GND)	Not pushed	10 kΩ or higher
2 (SS2) - 5 (GND)	Not pushed	10 kΩ or higher
7 (SS1) - 5 (GND)	Pushed	Below 1 Ω
2 (SS2) - 5 (GND)	Pushed	Below 1 Ω



If the result is not as specified, replace the engine switch.

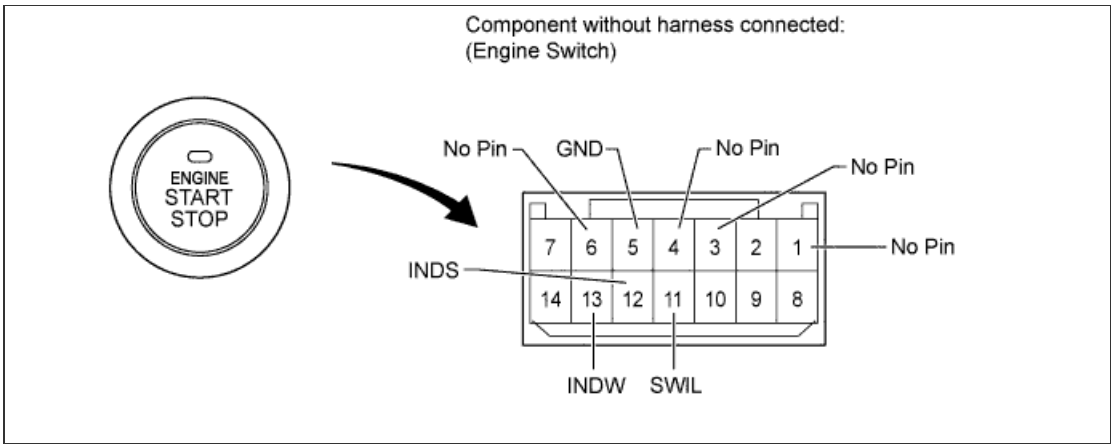
b. Apply battery voltage between the terminals of the switch, and check the illumination condition of the switch.

HINT:

- **If the positive (+) lead and the negative (-) lead are incorrectly connected, the engine switch indicator will not illuminate.**
- **If the voltage is too low, the indicator will not illuminate.**

OK:

Measurement Condition	Specified Condition
Battery positive (+) → Terminal 11 (SWIL) Battery negative (-) → Terminal 5 (GND)	Illuminates (illumination of lettering)
Battery positive (+) → Terminal 12 (INDS) Battery negative (-) → Terminal 5 (GND)	Illuminates (green)
Battery positive (+) → Terminal 13 (INDW) Battery negative (-) → Terminal 5 (GND)	Illuminates (amber)

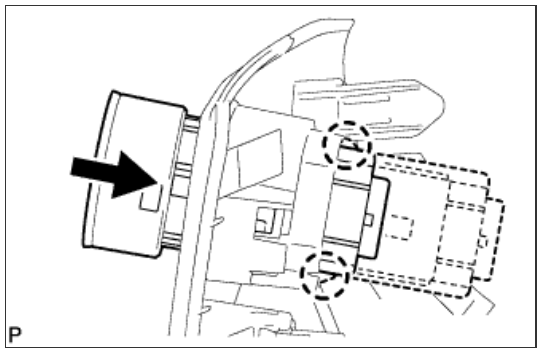


If the result is not as specified, replace the engine switch.

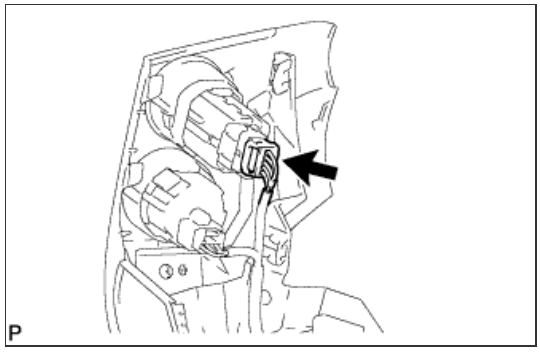
for Preparation Click here

1. INSTALL ENGINE SWITCH

a. Attach the 2 claws to install the switch.



b. Connect the switch connector.



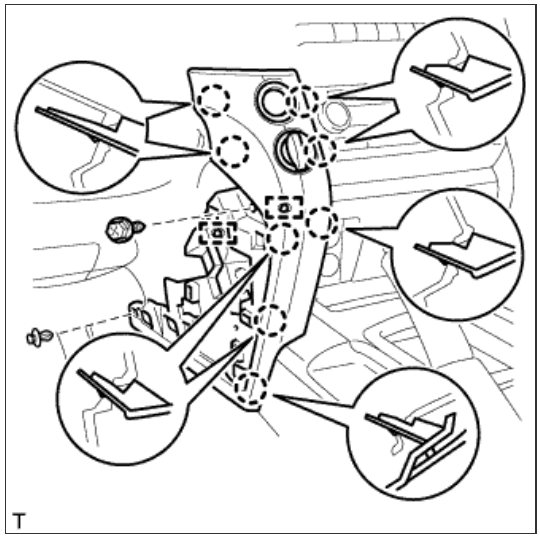
2. INSTALL LOWER INSTRUMENT PANEL PAD SUB-ASSEMBLY LH

a. Connect the connectors and 2 clamps.

b. Attach the 8 claws to install the panel pad.

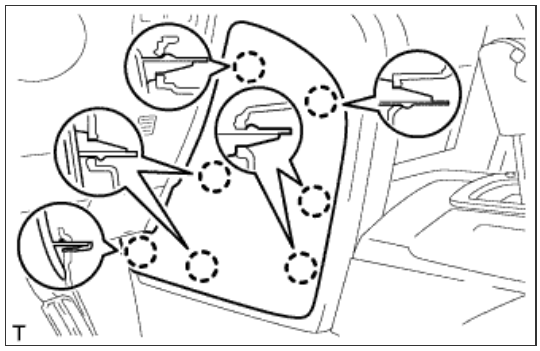
c. Install the screw.

d. Install the clip.

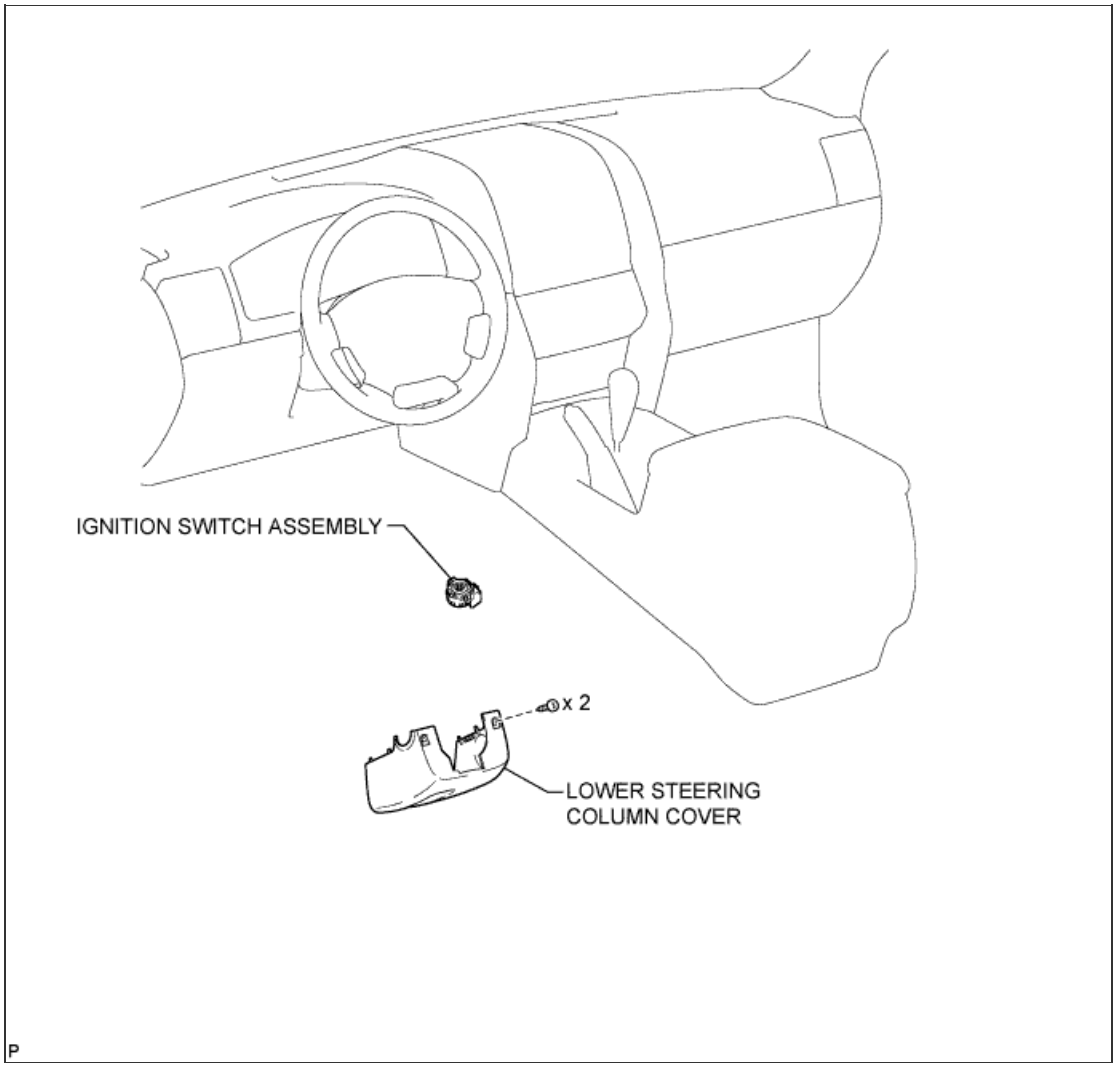


3. INSTALL NO. 2 INSTRUMENT PANEL FINISH PANEL CUSHION

a. Attach the 7 claws to install the panel cushion.


T

for Preparation Click here



for Preparation Click here

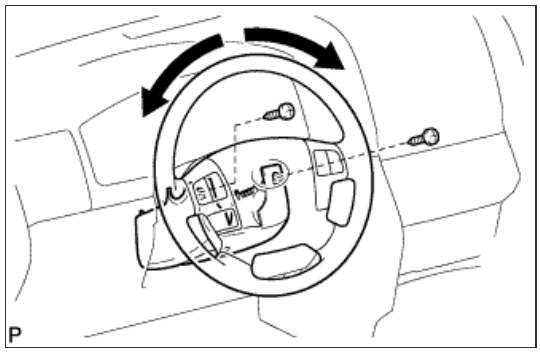
1. REMOVE LOWER STEERING COLUMN COVER

a. Remove the 2 screws.

HINT:

Turn the steering wheel to the right and left as necessary to remove the 2 screws.

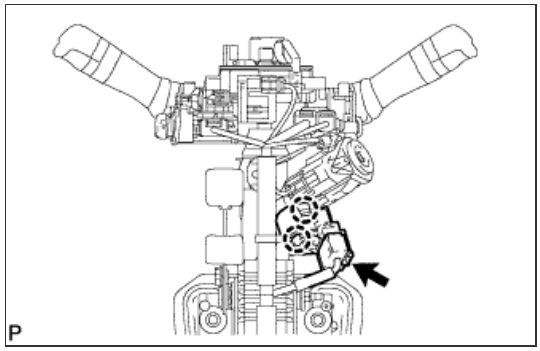
b. Detach the 2 claws and remove the lower steering column cover.



2. REMOVE IGNITION SWITCH ASSEMBLY

a. Disconnect the ignition switch connector.

b. Detach the 2 claws and remove the ignition switch.



for Preparation Click here

1. INSPECT IGNITION SWITCH ASSEMBLY

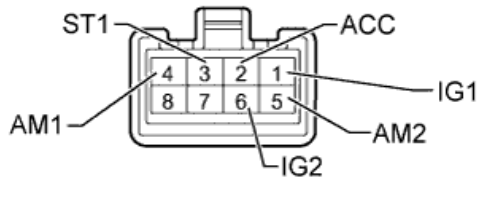
a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Switch Condition	Specified Condition
All co binations of all ter inals	L CK	10 kΩ or higher
4 (AM1) - 2 (ACC)	ACC	Below 1 Ω
4 (AM1) - 2 (ACC) 4 (AM1) - 1 (IG1) 5 (AM2) - 6 (IG2)		
(AM1) - 1 (IG1) 4 (AM1) - 3 (ST1) 5 (AM2) - 6 (IG2)	STA T	

If the result is not as specified, replace the ignition switch asse bl .

Component without harness connected:
(Ignition Switch)



for Preparation Click here

1. INSTALL IGNITION SWITCH ASSEMBLY

a. Attach the 2 claws to install the ignition switch.

b. Connect the ignition switch connector.

2. INSTALL LOWER STEERING COLUMN COVER

a. Attach the 2 claws to install the lower steering column cover.

b. Install the 2 screws.

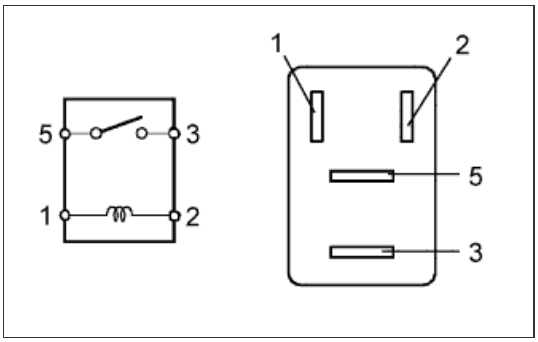
HINT:

Turn the steering wheel to the right and left as necessary to install the 2 screws.

for Preparation Click here

1. INSPECT STARTER RELAY (ST)

a. Measure the resistance according to the value(s) in the table below.



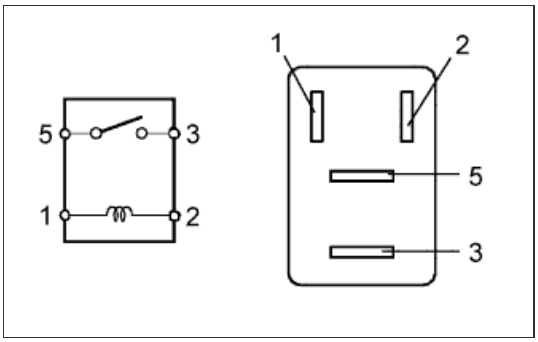
Standard Resistance:

Tester Connection	Condition	Specified Condition
3 -	tttery voltage not applied to ter inals 1 and 2	10 kΩ or higher
	Battery voltage applied to ter inals 1 and 2	Below 1 Ω

If the result is not as specified, replace the relay.

2. INSPECT STARTER CUT RELAY (ST CUT)

a. Measure the resistance according to the value(s) in the table below.



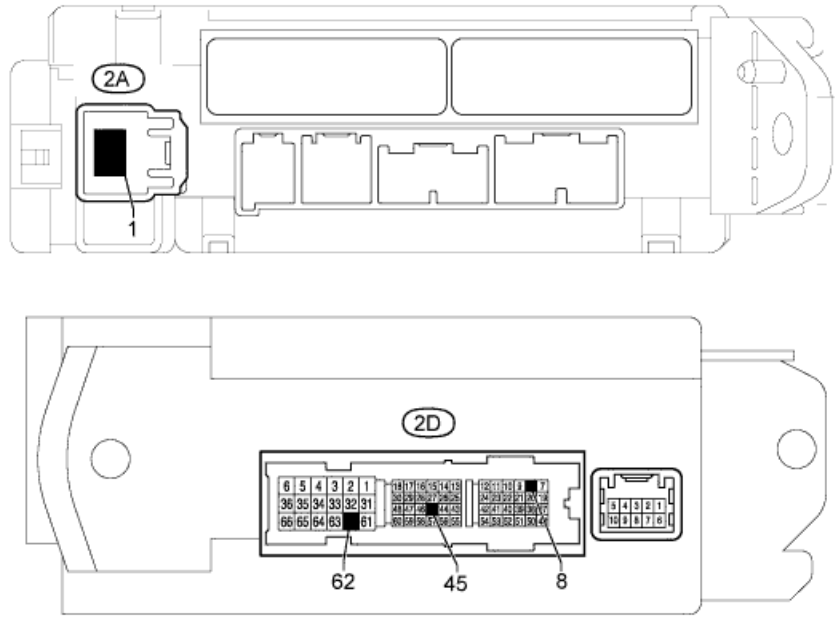
Standard Resistance:

Tester Connection	Condition	Specified Condition
3 -	tttery voltage not applied to ter inals 1 and 2	10 kΩ or higher
	Battery voltage applied to ter inals 1 and 2	Below 1 Ω

If the result is not as specified, replace the relay.

3. INSPECT MAIN BODY ECU (ACC RELAY)

Component without harness connected: (Main Body ECU)



P

a. Measure the resistance of the CC relay circuit.

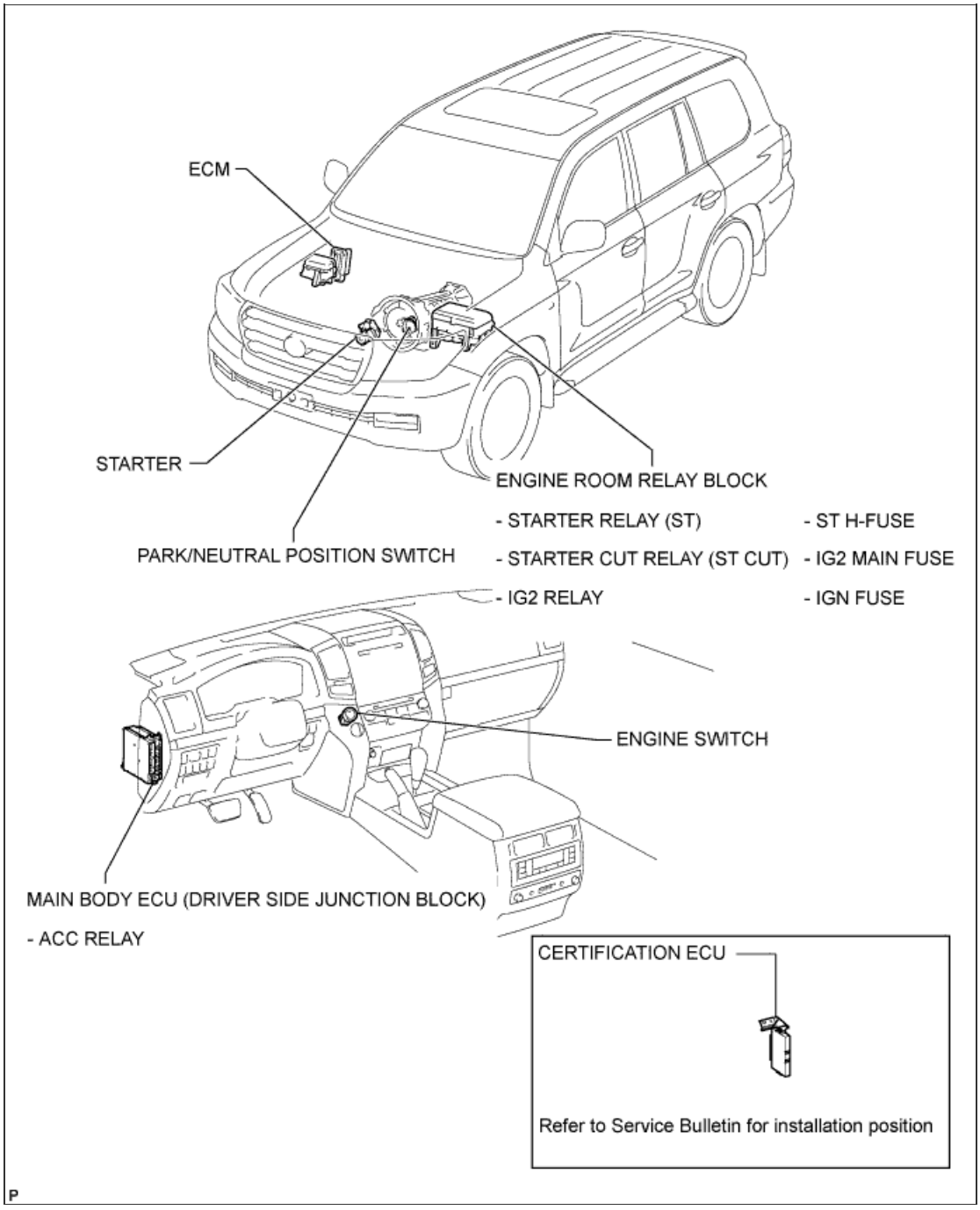
i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

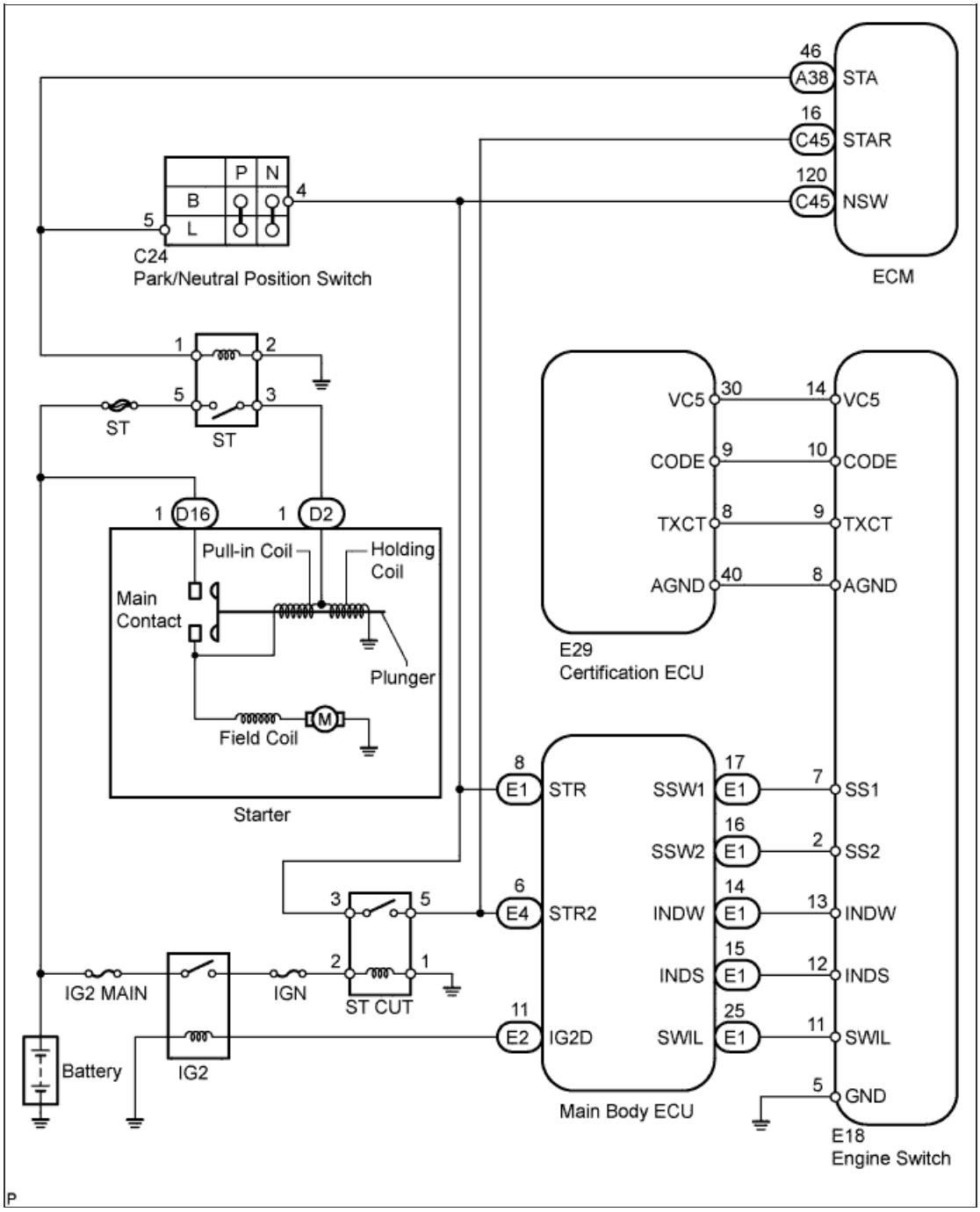
Tester Connection	Condition	Specified Condition
2 - 2D-	ttery voltage not applied between 2D-4 and 2D-62	10 kΩ or higher
	Battery voltage applied between 2D-4 and 2D-62	Below 1 Ω

If the result is not as specified, replace the in body EC .

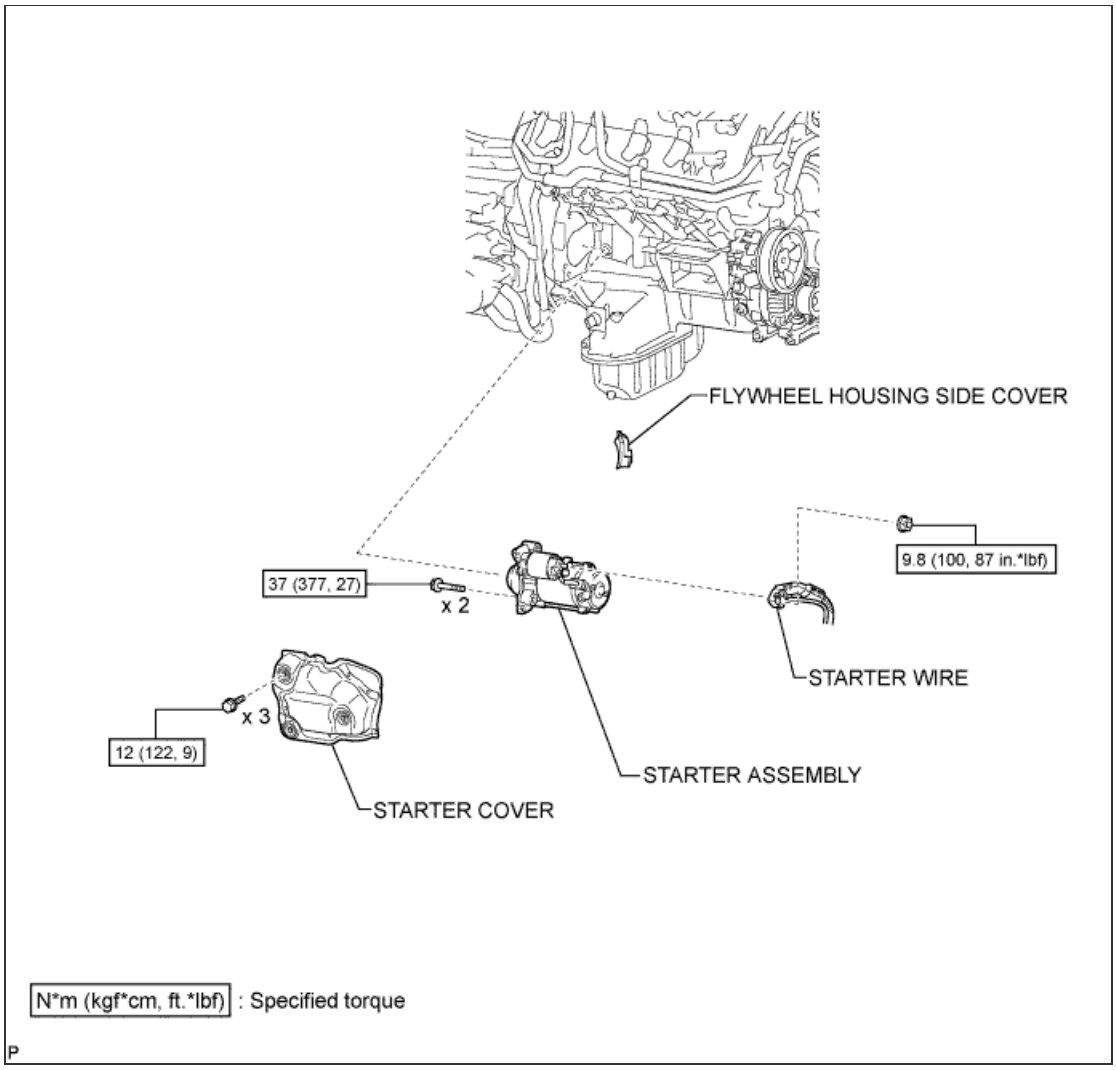
for Preparation Click here

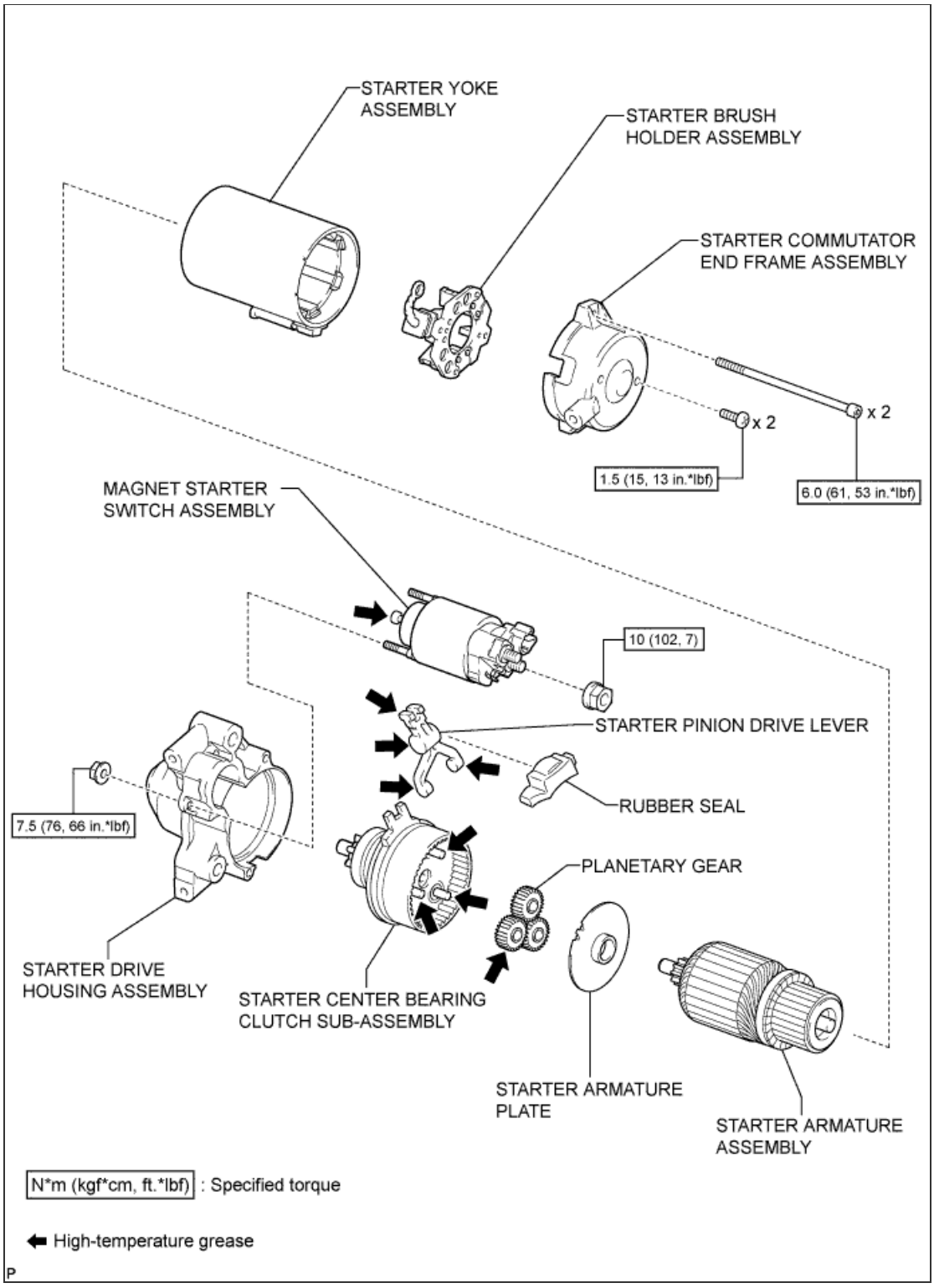


for Preparation Click here



for Preparation Click here




STARTER YOKE ASSEMBLY
STARTER BRUSH HOLDER ASSEMBLY
STARTER COMMUTATOR END FRAME ASSEMBLY
x 2
x 2
1.5 (15, 13 in.*lbf)
6.0 (61, 53 in.*lbf)
MAGNET STARTER SWITCH ASSEMBLY
10 (102, 7)
STARTER PINION DRIVE LEVER
RUBBER SEAL
7.5 (76, 66 in.*lbf)
PLANETARY GEAR
STARTER DRIVE HOUSING ASSEMBLY
STARTER CENTER BEARING CLUTCH SUB-ASSEMBLY
STARTER ARMATURE PLATE
STARTER ARMATURE ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
High-temperature grease
P

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

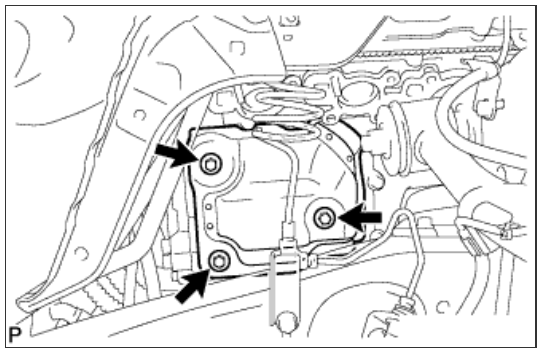
When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

2. REMOVE E AUST MANIFOLD SUB-ASSEMBLY RH

(Click here)

3. REMOVE STARTER COVER

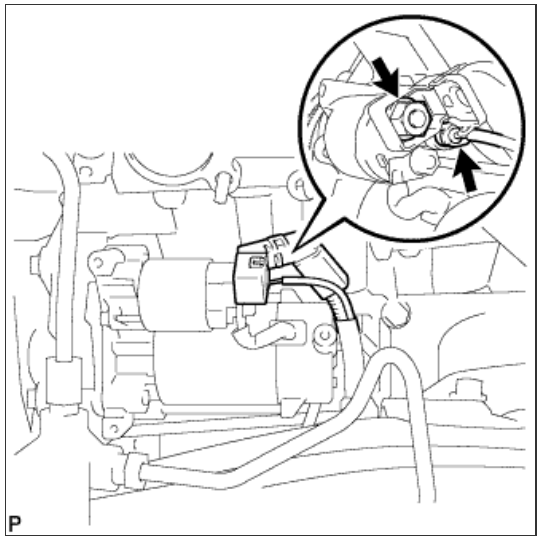
a. Remove the 3 bolts and starter cover.



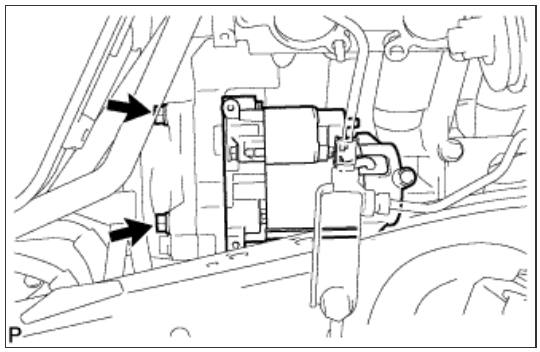
4. REMOVE STARTER ASSEMBLY

a. Disconnect the starter connector.

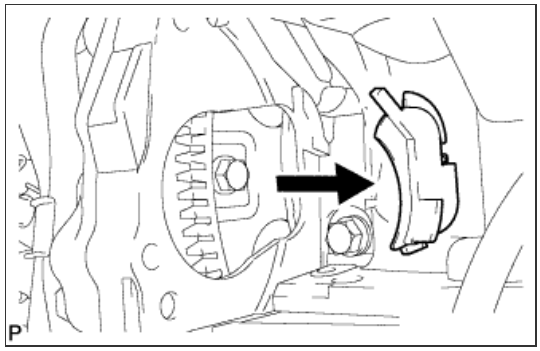
b. Remove the nut and disconnect the starter wire.



c. Remove the 2 bolts and starter.



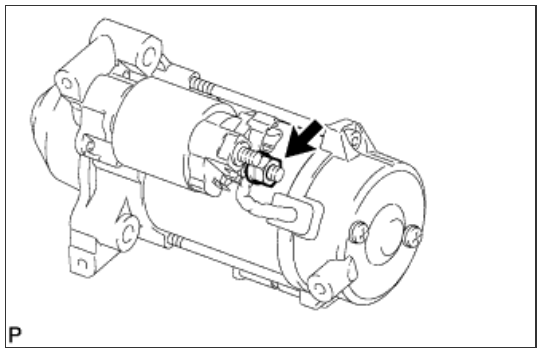
d. Remove the flywheel housing side cover.



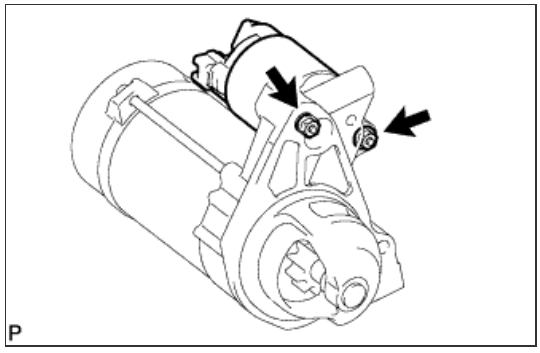
for Preparation Click here

1. REMOVE MAGNET STARTER SWITCH ASSEMBLY

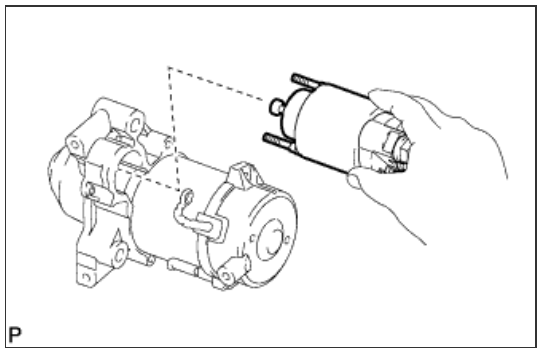
a. Remove the nut and disconnect the lead wire from the magnet starter switch.



b. Remove the 2 nuts from the starter drive housing while holding the magnet starter switch.



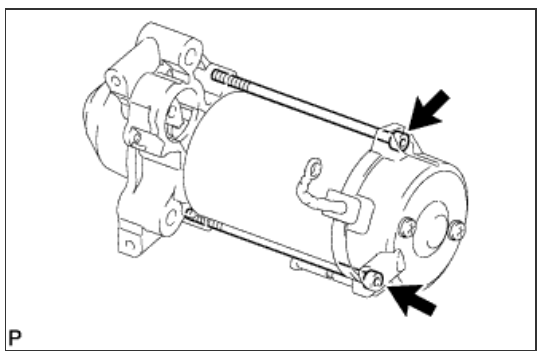
c. Pull the magnet starter switch and while lifting the front part of the magnet starter switch, release the plunger hook from the drive lever and remove the magnet starter switch.



2. REMOVE STARTER YOKE ASSEMBLY

a. Using a T25 "TORX" socket wrench, remove the 2 bolts.

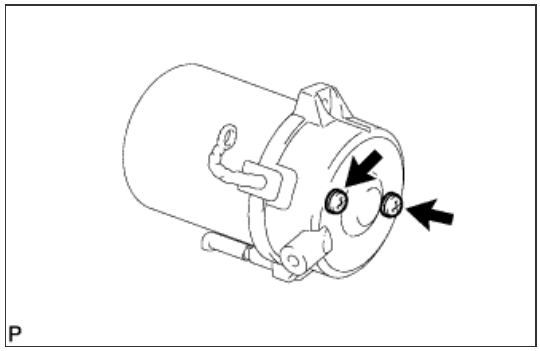
b. Pull out the starter yoke together with the starter commutator end frame.



c. Remove the 2 screws and starter commutator end frame from the starter yoke.

NOTICE:

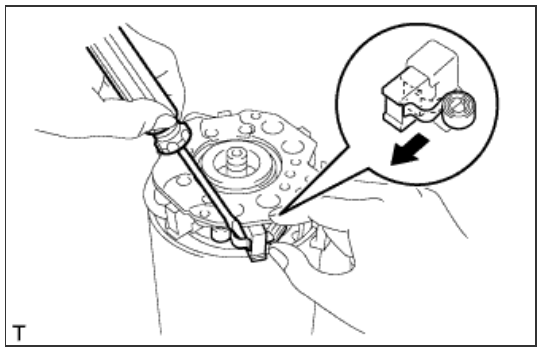
While holding down the lead wire, remove the starter commutator end frame.



3. REMOVE STARTER BRUSH HOLDER ASSEMBLY

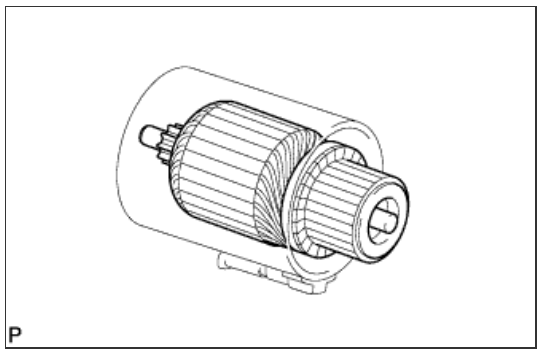
a. Using a screwdriver, pry the end of the spring away from each brush and pull out the 4 brushes from the brush holder so that they are held in place by the springs.

b. Remove the starter brush holder.



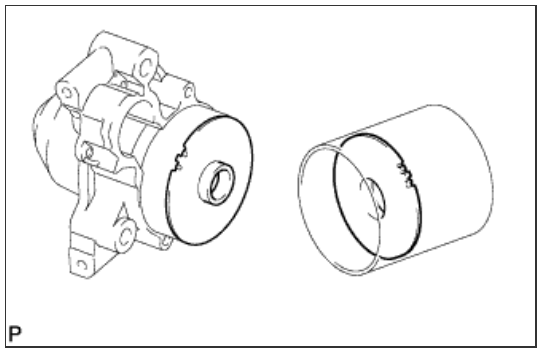
4. REMOVE STARTER ARMATURE ASSEMBLY

a. Remove the starter armature from the starter yoke.



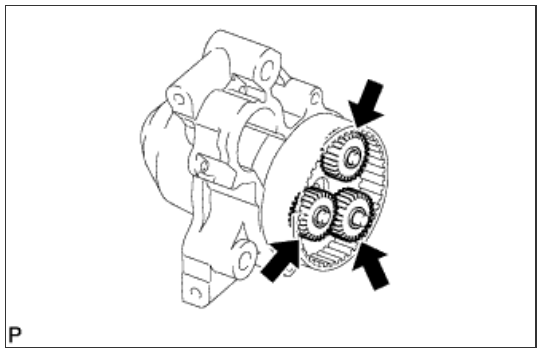
5. REMOVE STARTER CENTER BEARING CLUTCH SUB-ASSEMBLY

a. Remove the starter armature plate from the starter center bearing clutch or starter yoke.



b. Remove the 3 planetary gears from the starter center bearing clutch.

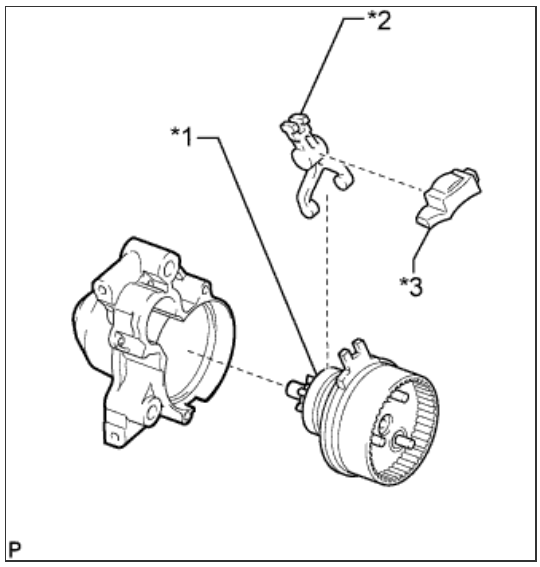
b. Remove the 3 planetary gears from the starter center bearing clutch.



c. Remove the starter center bearing clutch together with the starter pinion drive lever and rubber seal from the starter drive housing.

Text in Illustration

*1	Starter Center Bearing Clutch
*2	Starter Pinion Drive Lever
*3	Rubber Seal



d. Remove the starter pinion drive lever and rubber seal from the starter center bearing clutch.

for Preparation Click here

1. INSPECT STARTER ASSEMBLY

CAUTION:

As a large electric current passes through the cable during this inspection, a thick cable must be used. Otherwise, the cable may become hot and cause injury.

NOTICE:

These tests must be performed within 3 to 5 seconds to avoid burning out the coil.

a. Perform a pull-in test.

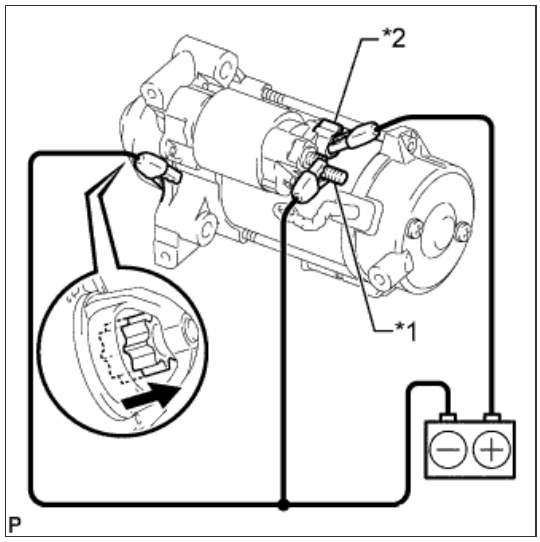
i. Remove the nut, and then disconnect the field coil lead wire from terminal C.

ii. Connect the battery to the magnet starter switch as shown in the illustration. Then check that the clutch pinion gear moves outward.

Text in Illustration

*1	Terminal C
*2	Terminal 50

If the clutch pinion gear does not move outward, replace the magnet starter switch assembly.



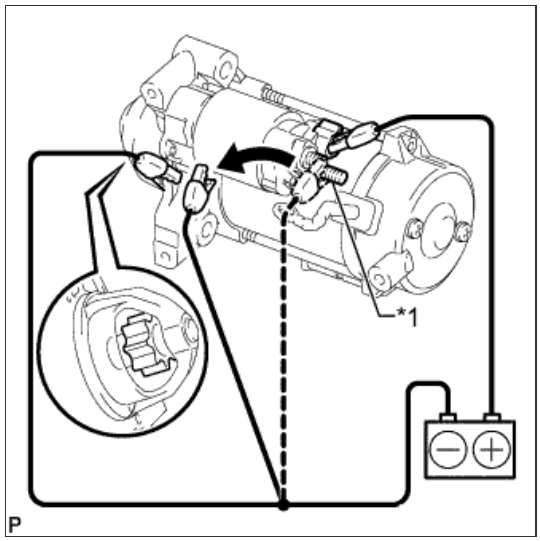
b. Perform a holding test.

i. When the battery is connected as above with the clutch pinion gear out, disconnect the negative (-) terminal lead from terminal C. Check that the pinion gear remains out.

Text in Illustration

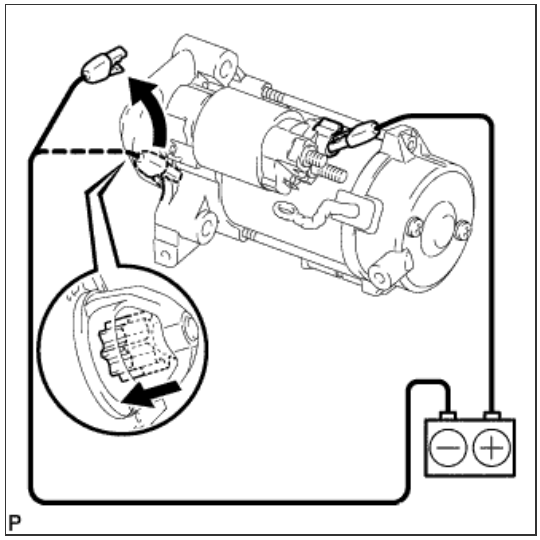
*1	Terminal C

If the clutch pinion gear moves inward, replace the magnet starter switch assembly.



c. Inspect the clutch pinion gear return.

i. Disconnect the negative (-) lead from the starter body. Check that the clutch pinion gear returns inward.
If the clutch pinion gear does not return inward, replace the magnet starter switch assembly.



d. Perform an operation test without load.

i. Connect the field coil lead wire to terminal C with the nut.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

ii. Mount the starter in a vise between aluminum plates.

iii. Connect the battery and an ammeter to the starter as shown in the illustration.

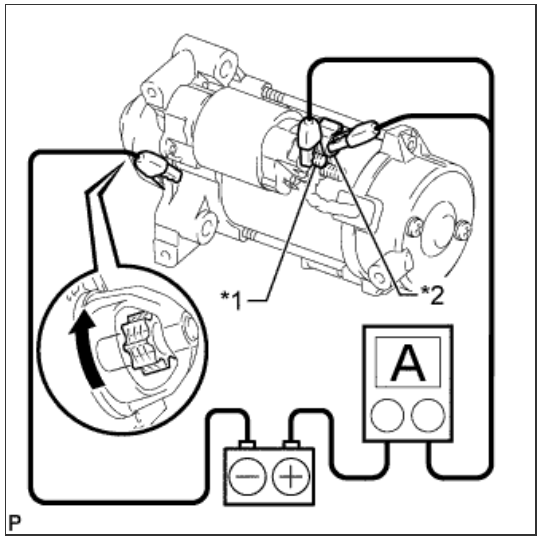
Text in Illustration

*1	Terminal 30
*2	Terminal 50

iv. Check that the starter rotates smoothly and steadily while the pinion gear is moving outward. Then measure the current.

Standard current:
150 A or less at 11.5 V

If the result is not as specified, replace the starter assembly.



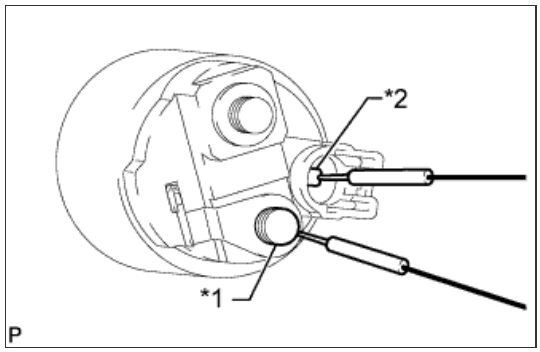
2. INSPECT MAGNET STARTER SWITCH ASSEMBLY

a. Check if the pull-in coil has an open circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Terminal 50 - Terminal C	Always	Below 1 Ω



Text in Illustration

*1	Terminal C
*2	Terminal 50

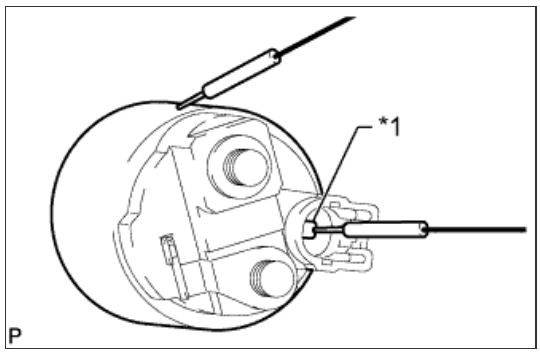
If the result is not as specified, replace the magnet starter switch assembly.

b. Check if the holding coil has an open circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Terminal 50 - Switch body	Always	Below 2 Ω



Text in Illustration

*1	Terminal 50

If the result is not as specified, replace the magnet starter switch assembly.

3. INSPECT STARTER ARMATURE ASSEMBLY

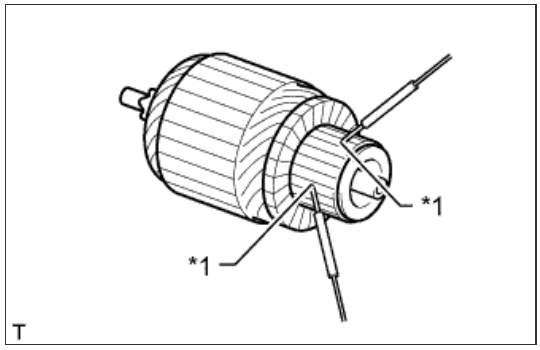
a. Check the surface of the commutator for dirt and burns.
If the surface is dirty or burnt, correct it with sandpaper (No. 400) or a lathe.
If necessary, replace the starter armature assembly.

b. Inspect the commutator for an open circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Segment - Segment	Always	Below 1 Ω



Text in Illustration

*1	Segment

If the result is not as specified, replace the starter armature assembly.

c. Inspect the commutator for a short circuit.

i. Measure the resistance according to the value(s) in the table below.

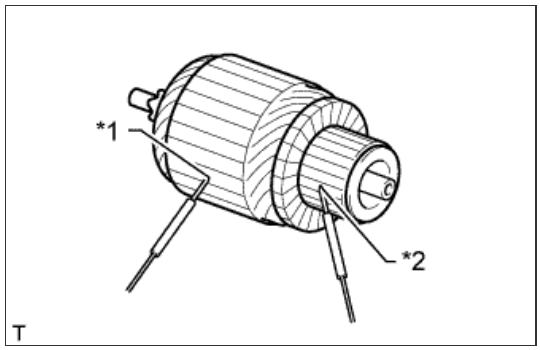
Standard Resistance:

Tester Connection	Condition	Specified Condition
Segment - Armature coil core	Always	10 kΩ or higher

Text in Illustration

*1	Armature Coil Core
*2	Commutator

If the result is not as specified, replace the starter armature assembly.



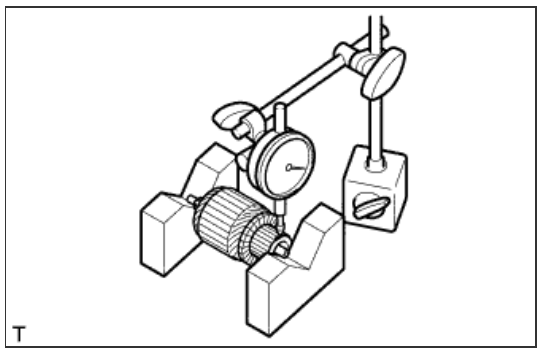
d. Check the commutator circle runout.

i. Place the armature shaft on V-blocks.

ii. Using a dial indicator, measure the circle runout.

Maximum runout:
0.05 mm (0.00197 in.)

If the circle runout is more than the maximum, replace the starter armature assembly.



e. Using a vernier caliper, measure the commutator diameter.

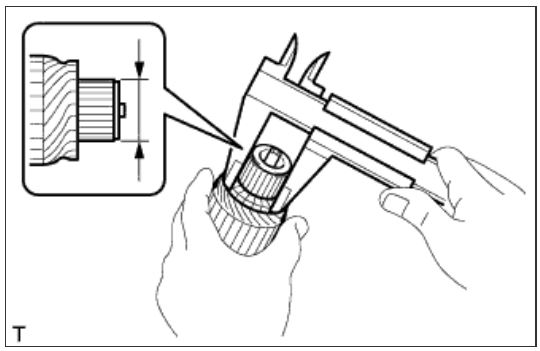
Standard diameter:
29.0 mm (1.14 in.)

Minimum diameter:
28.0 mm (1.10 in.)

HINT:

Be sure to measure the commutator diameter at the ridges.

If the diameter is less than the minimum, replace the starter armature assembly.



f. Check that the undercut portion is clean and free of foreign matter. Smooth out the edge.

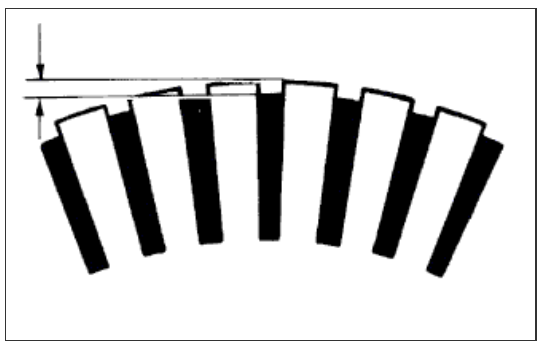
Standard undercut depth:
0.4 mm (0.0157 in.)

Minimum undercut depth:
0.2 mm (0.00787 in.)

HINT:

Be sure to measure the commutator undercut depth at a cutout.

If the undercut depth is less than the minimum, increase the depth using a hacksaw blade.



4. INSPECT STARTER BRUSH HOLDER ASSEMBLY

a. Using a vernier caliper, measure the brush length.

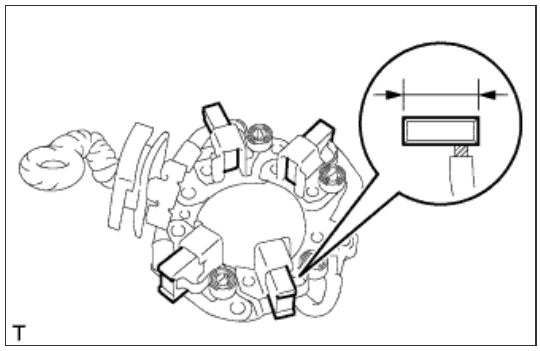
Standard length:
14.4 mm (0.567 in.)

Minimum length:
9.0 mm (0.354 in.)

HINT:

Be sure to measure the brush lengths at the protrusions.

If the length is less than the minimum, replace the starter brush holder assembly.



b. Inspect the load of the brush spring.

i. Take a pull scale reading immediately after the brush spring separates from the brush.

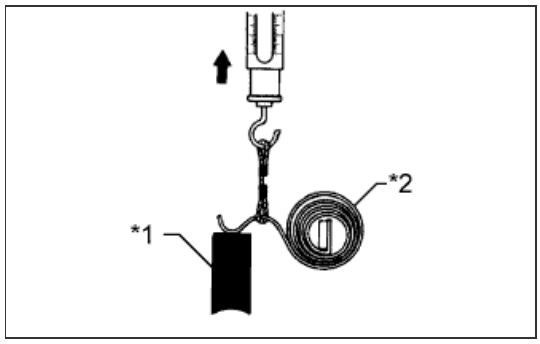
Standard spring load:
22 to 27 N (2 to 3 kgf, 5.0 to 6.1 lbf)

Minimum spring load:
14 N (1 kgf, 3.1 lbf)

Text in Illustration

*1	Brush
*2	Brush Spring

If the load is less than the minimum, replace the starter brush holder assembly.



5. INSPECT STARTER CENTER BEARING CLUTCH SUB-ASSEMBLY

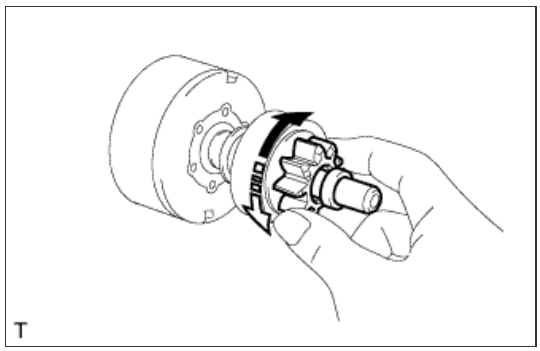
a. Check the gear teeth on the planetary gears, and the internal gear and pinion gear of the starter center bearing clutch for wear or damage. If any of the gears is damaged, replace the gear or starter center bearing clutch sub-assembly.

b. Hold the starter clutch, rotate the pinion gear clockwise and check that it turns freely. Try to rotate the pinion gear counterclockwise and check that it locks.

Text in Illustration

➡	Free
⇨	Lock

If the result is not as specified, replace the starter center bearing clutch sub-assembly.



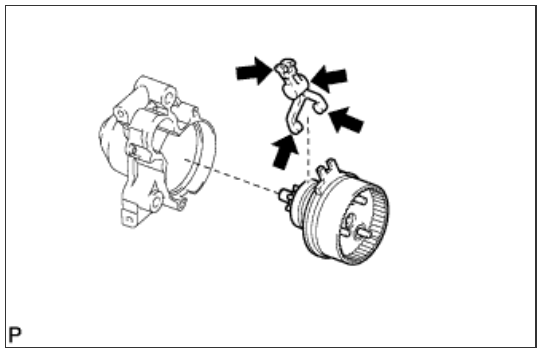
for Preparation Click here

1. INSTALL STARTER CENTER BEARING CLUTCH SUB-ASSEMBLY

a. Apply high-temperature grease to the areas of the starter pinion drive lever indicated in the illustration.

Text in Illustration

➡	High-temperature grease



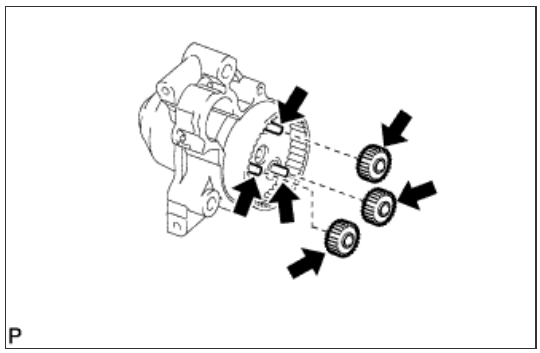
b. Install the starter pinion drive lever and rubber seal to the starter center bearing clutch.

c. Install the starter center bearing clutch together with the starter pinion drive lever and rubber seal to the starter drive housing.

d. Apply high-temperature grease to the planetary gears and pins of the starter center bearing clutch.

Text in Illustration

➡	High-temperature grease



e. Install the 3 planetary gears.

2. INSTALL STARTER ARMATURE ASSEMBLY

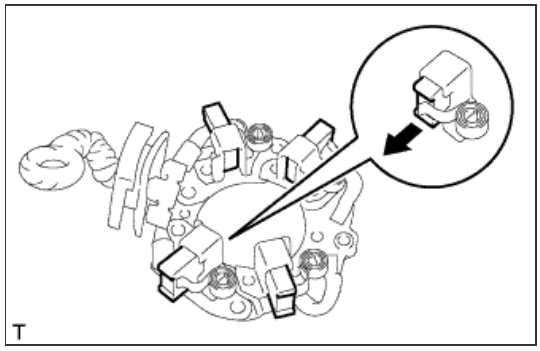
a. Install the starter armature to the starter yoke.

NOTICE:

The magnet of the starter yoke may attract the starter armature when the starter commutator end frame is installed, causing the magnet to break.

3. INSTALL STARTER BRUSH HOLDER ASSEMBLY

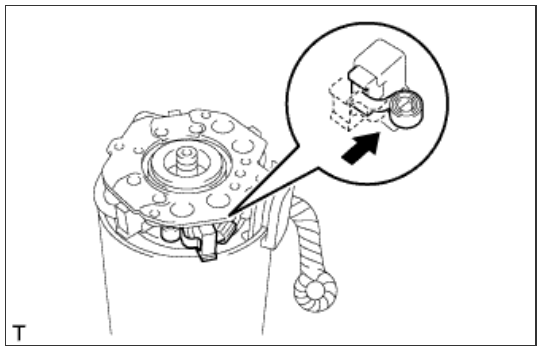
a. Push out the 4 brushes from the brush holder so that they are held in place by the springs as shown in the illustration.



b. Install the brush holder to the starter armature and push in the 4 brushes.

NOTICE:

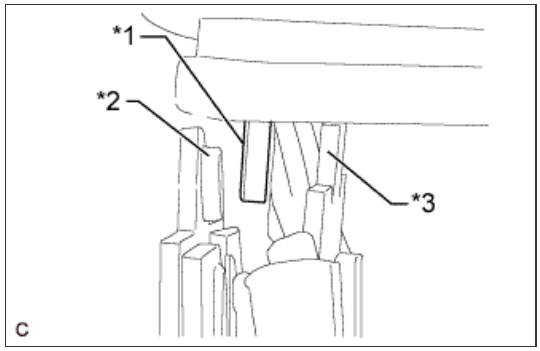
Check that the positive (+) lead wires are not grounded.



c. Insert the grommet between the positive side and negative side.

Text in Illustration

*1	Grommet
*2	Negative Side
*3	Positive Side



4. INSTALL STARTER YOKE ASSEMBLY

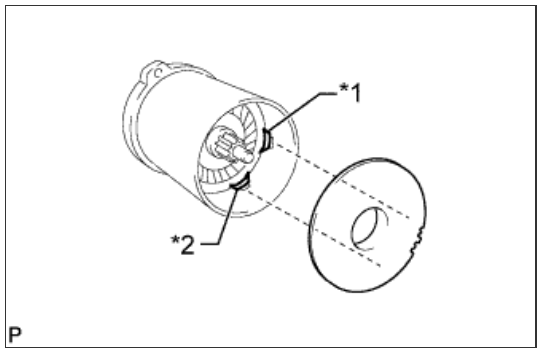
a. Install the starter armature plate to the starter yoke.

Text in Illustration

*1	Key A
*2	Key B

NOTICE:

Install the starter armature plate so that the keyway is positioned between key A and key B.



b. Install the commutator end frame with the 2 screws.

Torque:
1.5 N*m{ 15 kgf*cm , 13 in.*lbf }

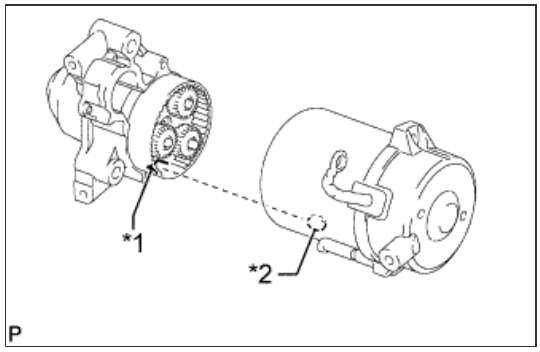
c. Align the key of the starter yoke with the keyway located on the starter drive housing.

Text in Illustration

*1	Keyway
*2	Key

d. Using a T25 "TOR socket wrench, install the 2 bolts.

Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }



5. INSTALL MAGNET STARTER SWITCH ASSEMBLY

a. Apply high-temperature grease to the plunger hook.

Text in Illustration

➡	High-temperature grease

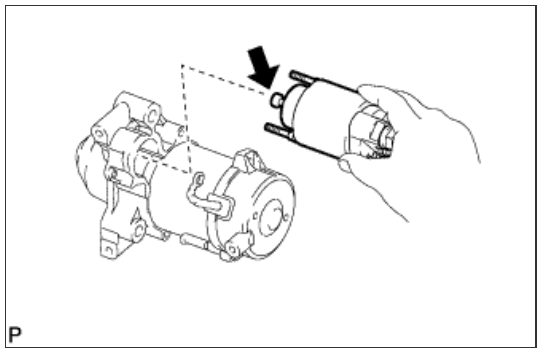
b. Hang the plunger of the magnet starter switch onto the drive lever from the upper side.

c. Install the magnet starter switch with the 2 nuts.

Torque:
7.5 N*m{ 76 kgf*cm , 66 in.*lbf }

d. Connect the lead wire to the magnet starter switch with the nut.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



for Preparation Click here

1. INSTALL STARTER ASSEMBLY

a. Install the flywheel housing side cover.

b. Install the starter with the 2 bolts.

Torque:
37 N*m{ 377 kgf*cm , 27 ft.*lbf }

c. Install the starter wire with the nut.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }

d. Connect the starter connector.

2. INSTALL STARTER COVER

a. Install the starter cover with the bolts.

Torque:
12 N*m{ 122 kgf*cm , 9 ft.*lbf }

3. INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY RH

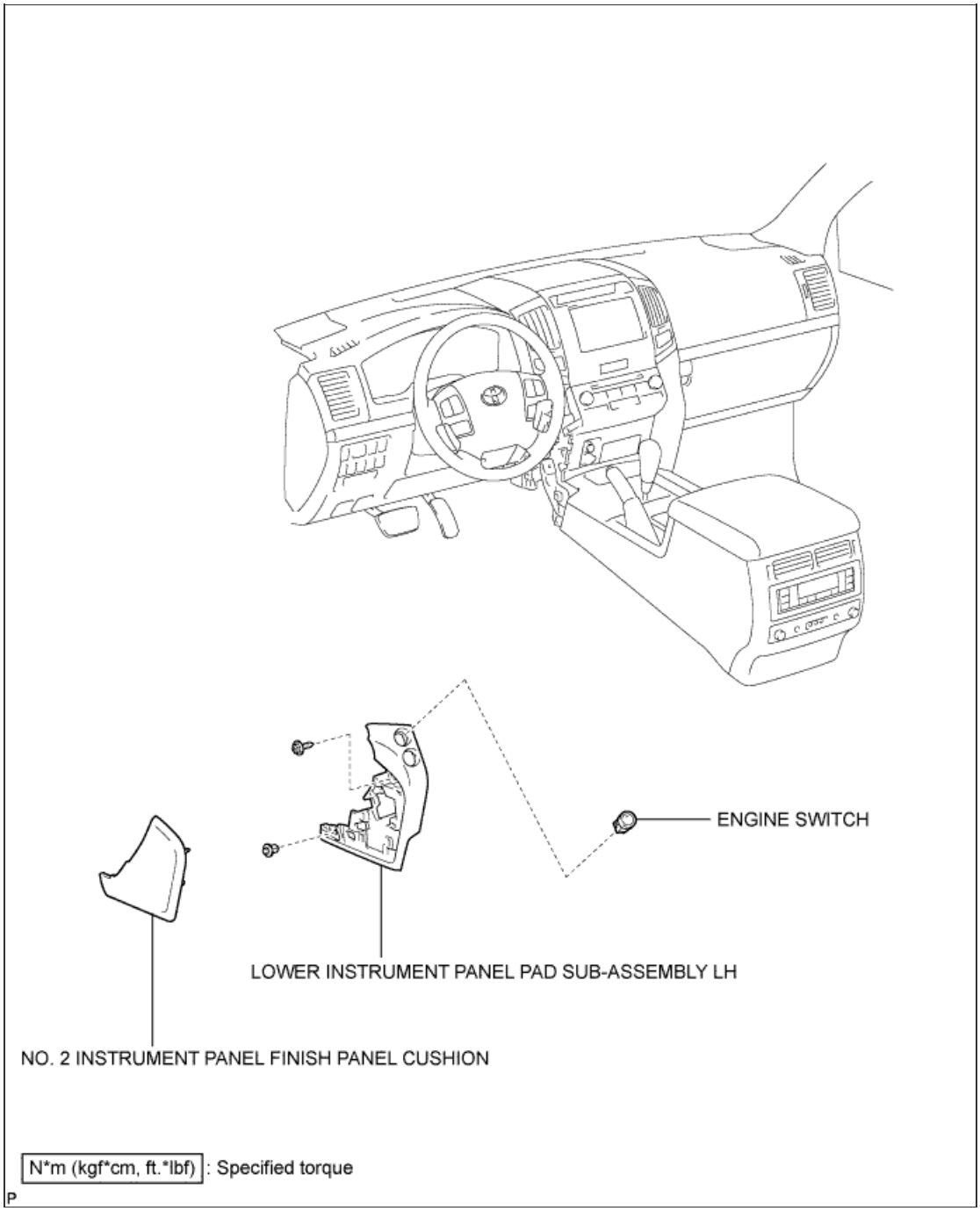
(Click here)

4. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

for Preparation Click here

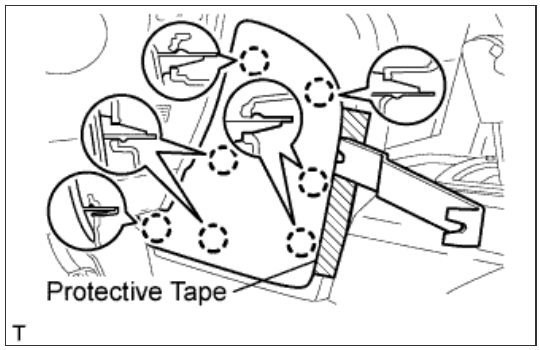


for Preparation Click here

1. REMOVE NO. 2 INSTRUMENT PANEL FINISH PANEL CUSHION

a. Place protective tape as shown in the illustration.

b. Using a moulding remover, detach the 7 claws and remove the panel cushion.



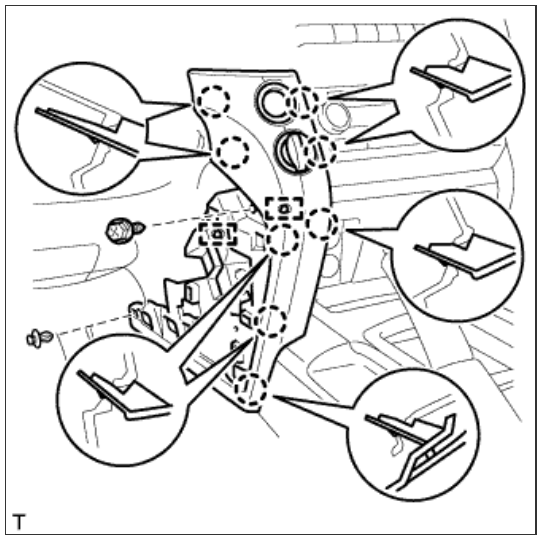
2. REMOVE LOWER INSTRUMENT PANEL PAD SUB-ASSEMBLY LH

a. Remove the clip.

b. Remove the screw.

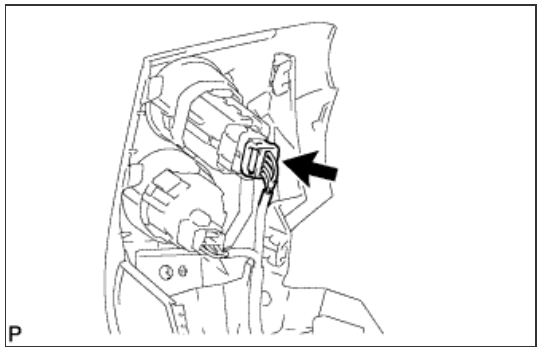
c. Detach the 8 claws.

d. Remove the panel pad and disconnect the connectors and 2 clamps.

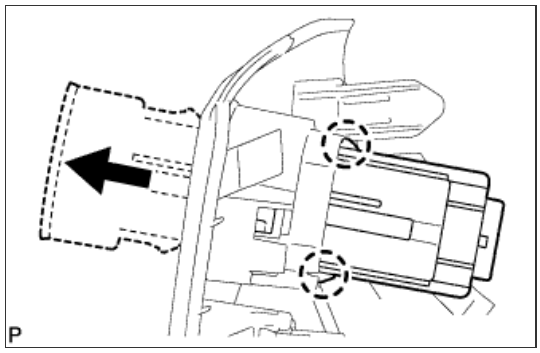


3. REMOVE ENGINE SWITCH

a. Disconnect the switch connector.



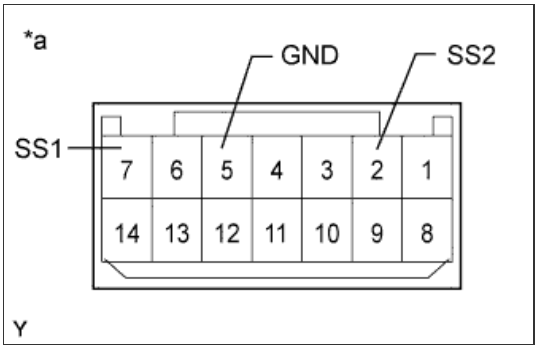
b. Detach the 2 claws and remove the switch.


P

for Preparation Click here

1. INSPECT ENGINE SWITCH

a. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

Tester Connection	Switch Condition	Specified Condition
7 (SS1) - 5 (GND)	Not pushed	10 kΩ or higher
2 (SS2) - 5 (GND)	Not pushed	10 kΩ or higher
7 (SS1) - 5 (GND)	Pushed	Below 1 Ω
2 (SS2) - 5 (GND)	Pushed	Below 1 Ω

Text in Illustration

*a	Component without harness connected (Engine Switch)

If the result is not as specified, replace the engine switch.

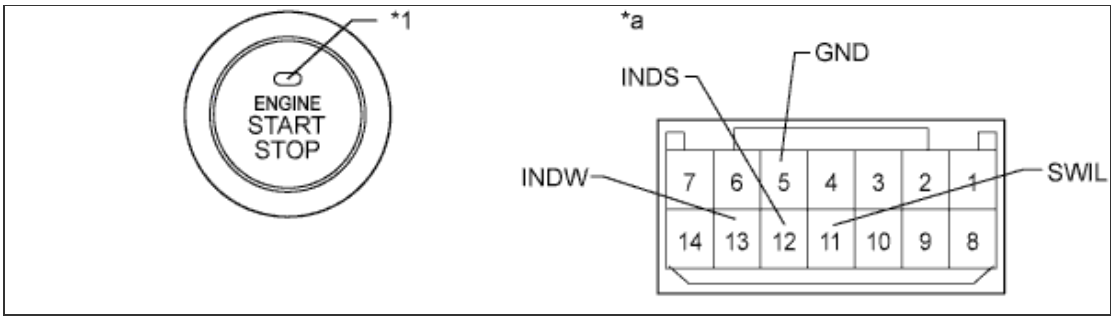
b. Apply battery voltage between the terminals of the switch, and check the illumination condition of the switch.

HINT:

- **If the positive (lead and the negative (-) lead are incorrectly connected, the engine switch indicator will not illuminate.**
- **If the voltage is too low, the indicator will not illuminate.**

OK:

Measurement Condition	Specified Condition
Battery positive (+) → Terminal 11 (SWIL) Battery negative (-) → Terminal 5 (GND)	Illuminates (illumination of lettering)
Battery positive (+) → Terminal 12 (INDS) Battery negative (-) → Terminal 5 (GND)	Illuminates (green)
Battery positive (+) → Terminal 13 (INDW) Battery negative (-) → Terminal 5 (GND)	Illuminates (amber)



Text in Illustration

*a	Component without harness connected (Engine Switch)	-	-

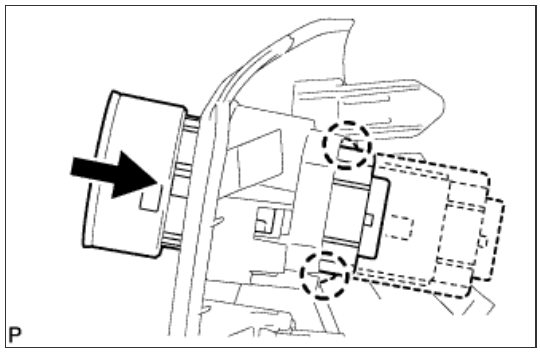
If the result is not as specified, replace the engine switch.

for Preparation Click here

1. INSTALL ENGINE SWITCH

a. Attach the 2 claws to install the switch.

b. Connect the switch connector.



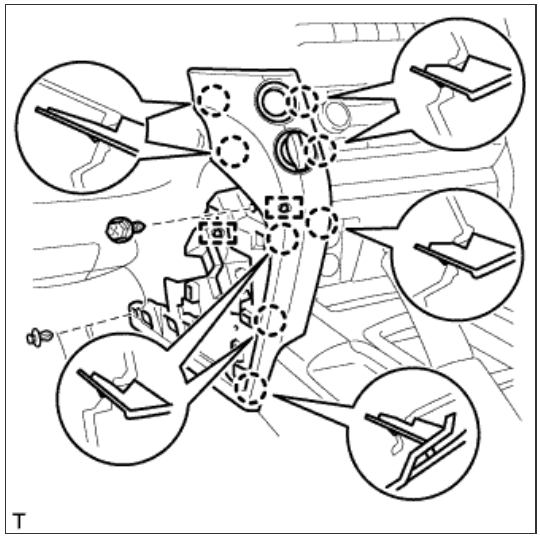
2. INSTALL LOWER INSTRUMENT PANEL PAD SUB-ASSEMBLY LH

a. Connect the connectors and 2 clamps.

b. Attach the 8 claws to install the panel pad.

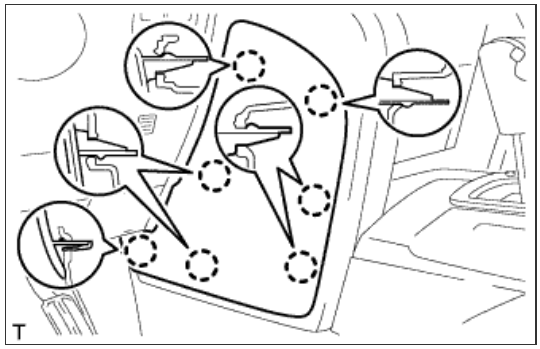
c. Install the screw.

d. Install the clip.



3. INSTALL NO. 2 INSTRUMENT PANEL FINISH PANEL CUSHION

a. Attach the 7 claws to install the panel cushion.



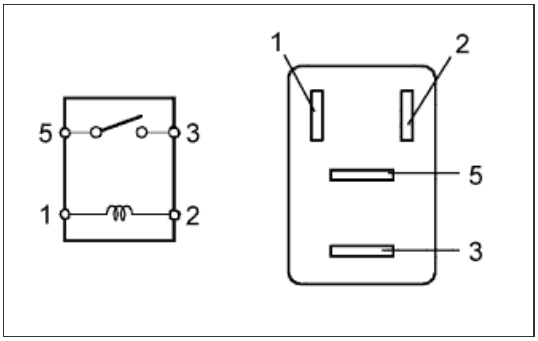
for Preparation Click here

1. INSPECT STARTER RELAY

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage applied to terminals 1 and 2	Below 1 Ω



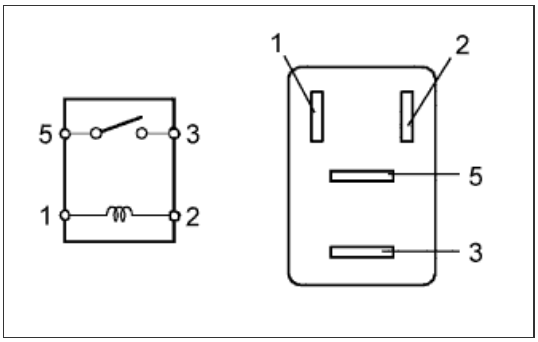
If the result is not as specified, replace the starter relay.

2. INSPECT STARTER CUT RELAY

a. Measure the resistance according to the value(s) in the table below.

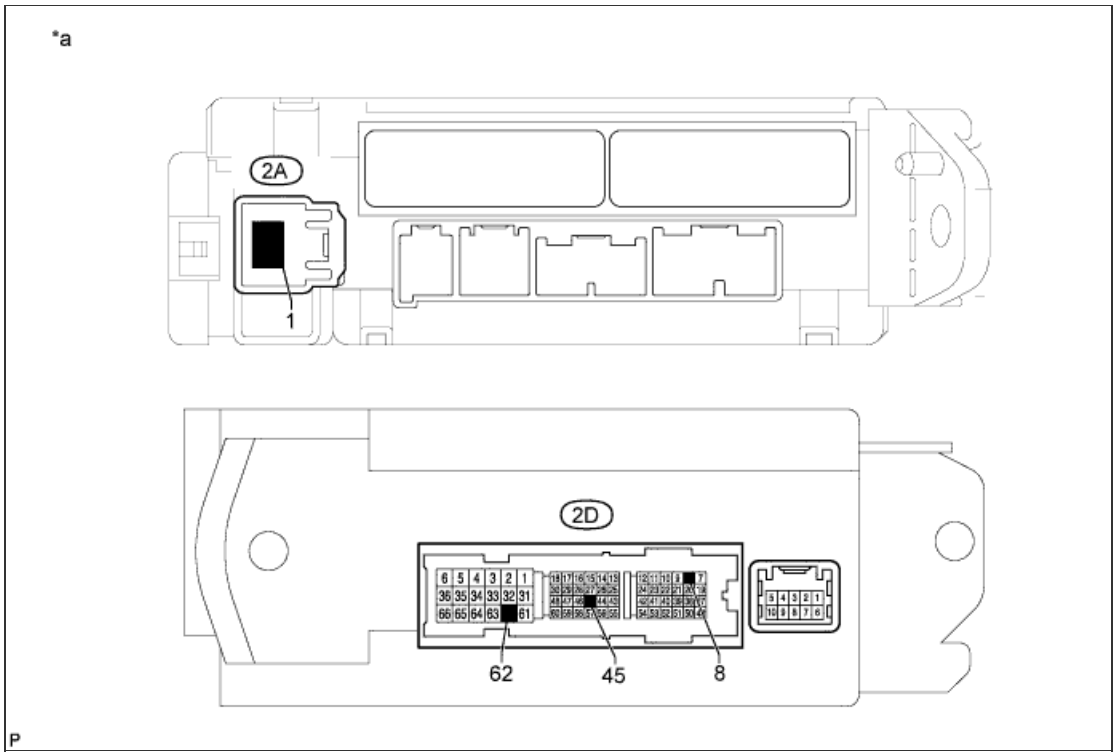
Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage applied to terminals 1 and 2	Below 1 Ω



If the result is not as specified, replace the starter relay.

3. INSPECT MAIN BODY ECU (ACC RELAY)



Text in Illustration

*a	Component without harness connected (Main Body ECU)	-	-

a. Measure the resistance of the ACC relay circuit.

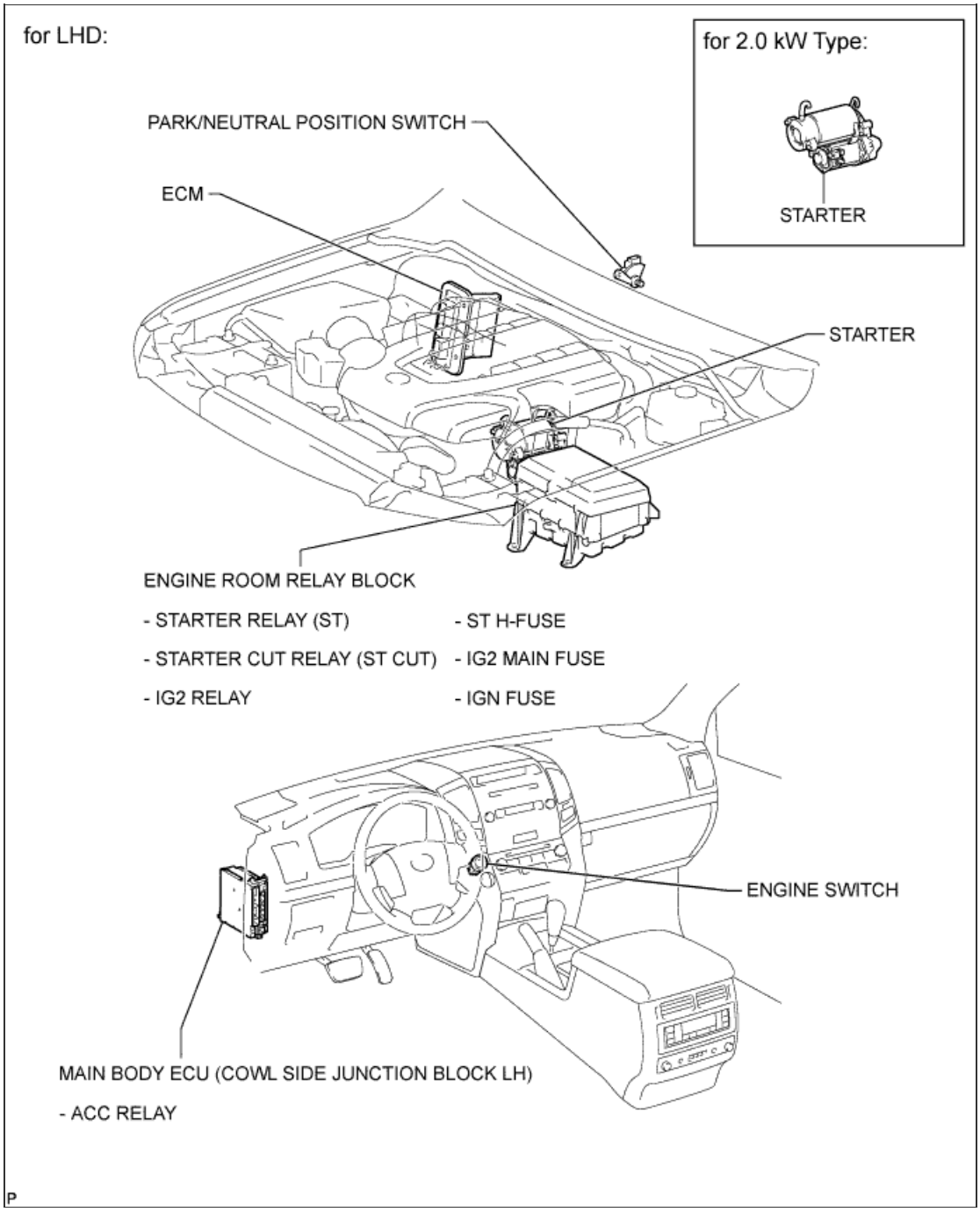
i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

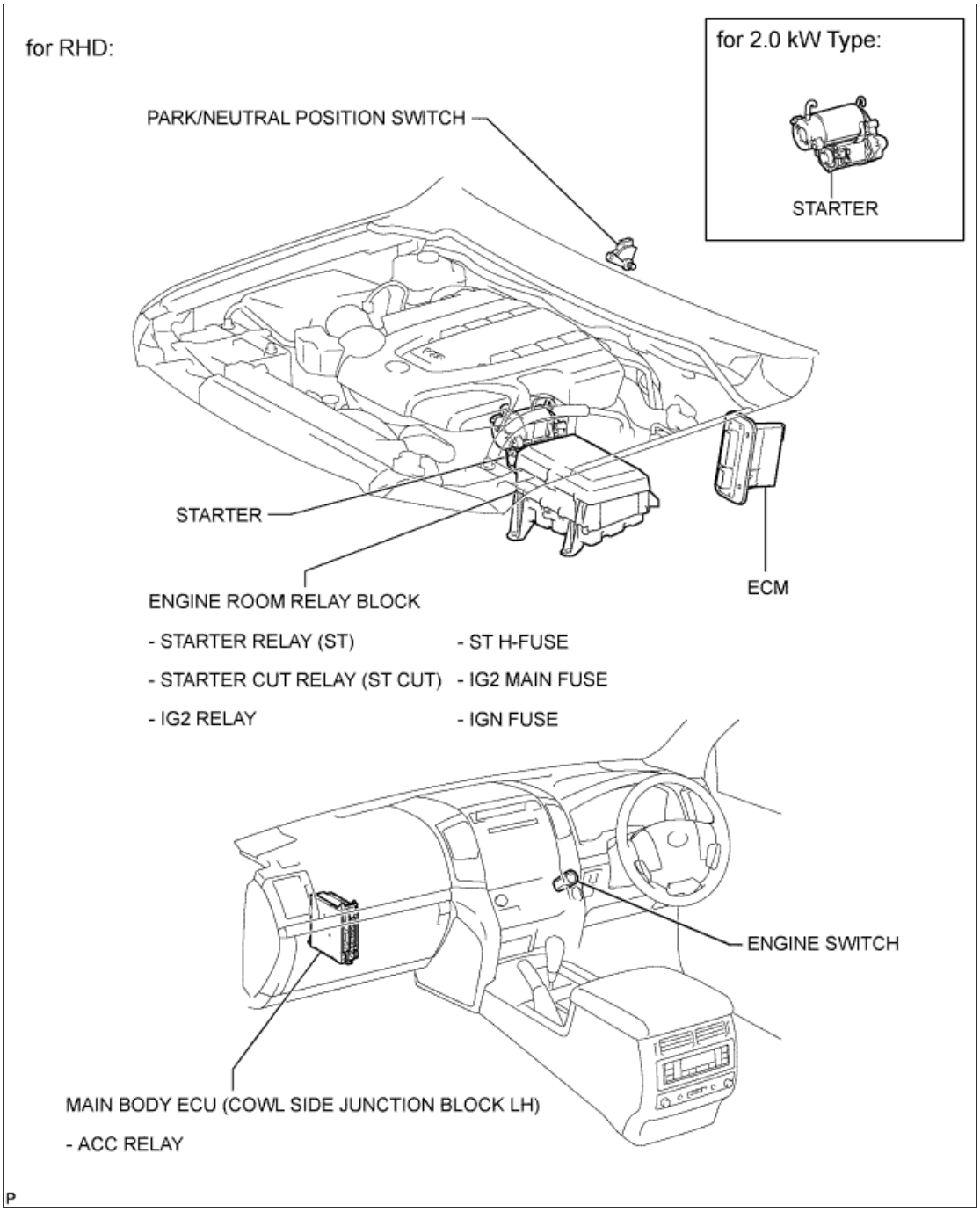
Tester Connection	Condition	Specified Condition
2A-1 - 2D-8	Battery voltage not applied between 2D-45 and 2D-62	10 kΩ or higher
	Battery voltage applied between 2D-45 and 2D-62	Below 1 Ω

If the result is not as specified, replace the main body ECU.

for Preparation [Click here]

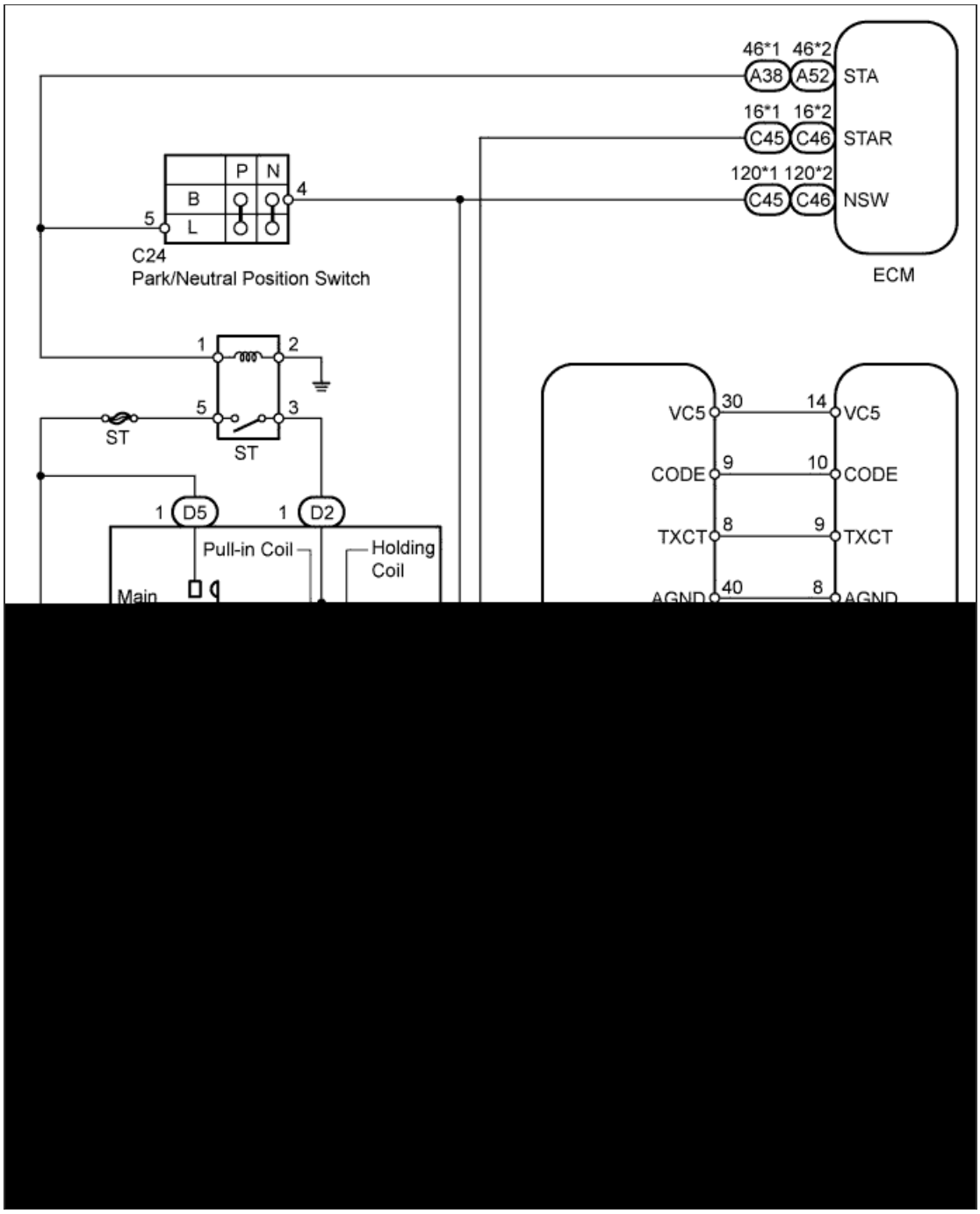


for RHD:

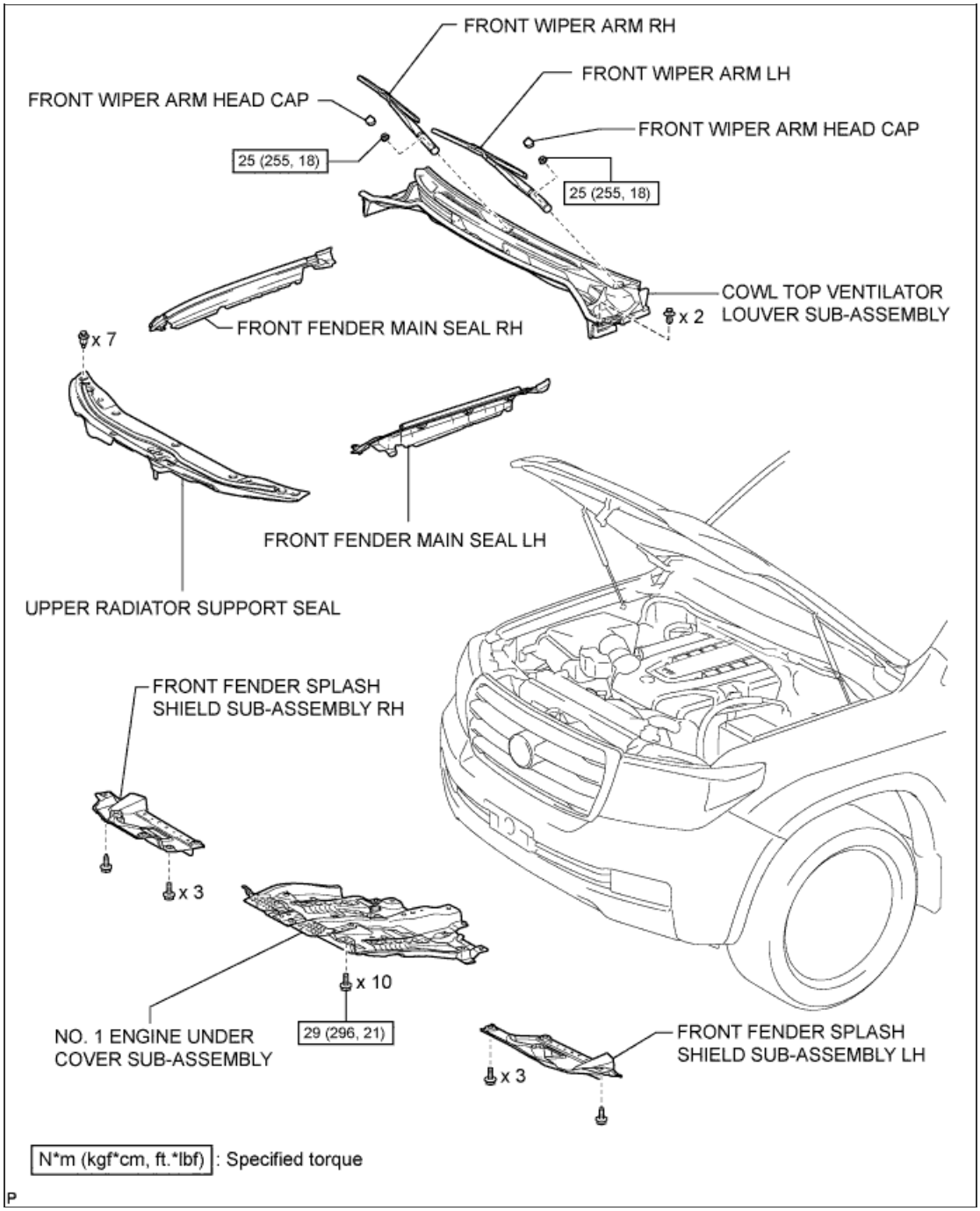

for 2.0 kW Type:
STARTER
PARK/NEUTRAL POSITION SWITCH
STARTER
ECM
ENGINE ROOM RELAY BLOCK
- STARTER RELAY (ST)
- STARTER CUT RELAY (ST CUT)
- IG2 RELAY
- ST H-FUSE
- IG2 MAIN FUSE
- IGN FUSE
ENGINE SWITCH
MAIN BODY ECU (COWL SIDE JUNCTION BLOCK LH)
- ACC RELAY

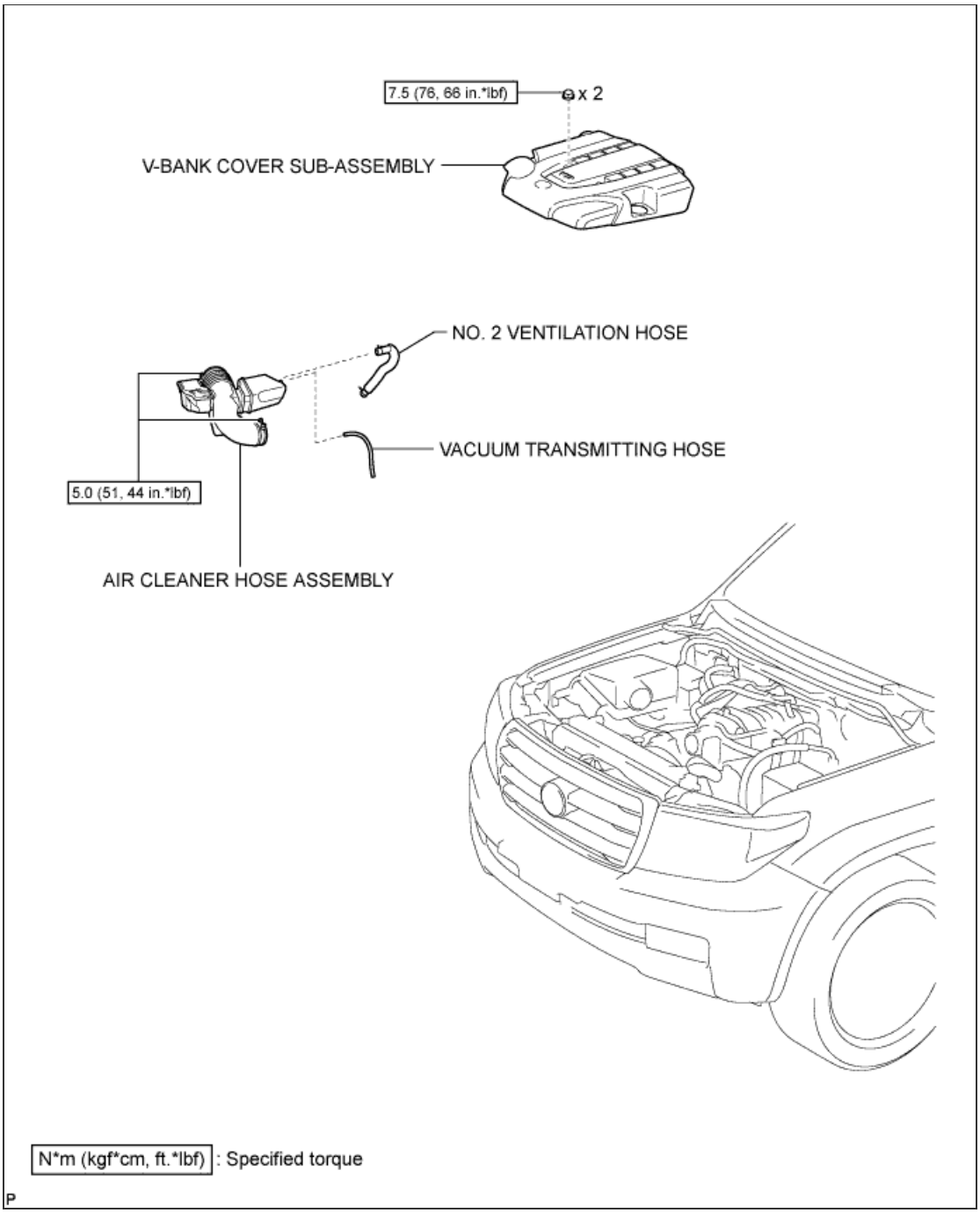
P

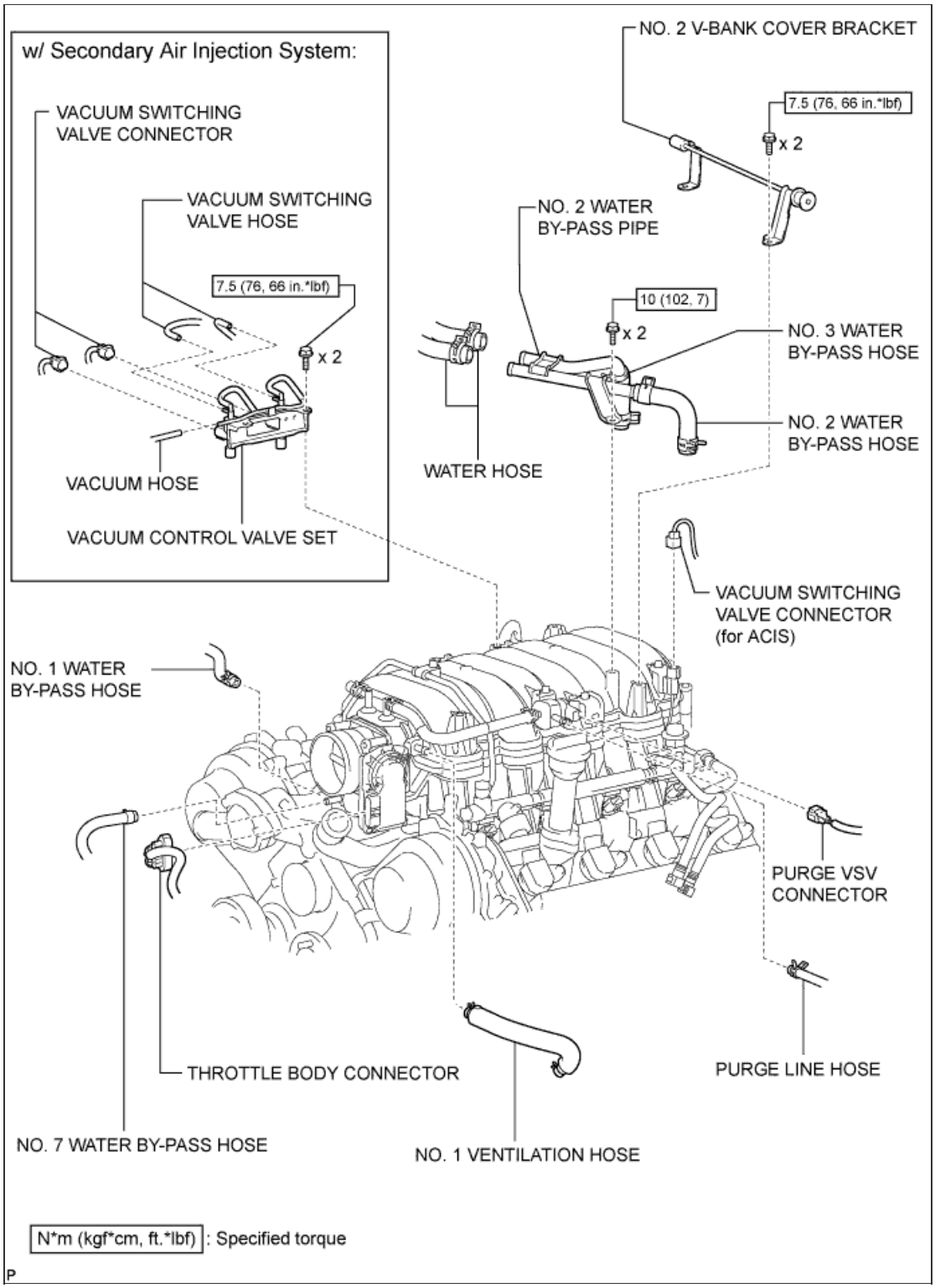
for Preparation Click here

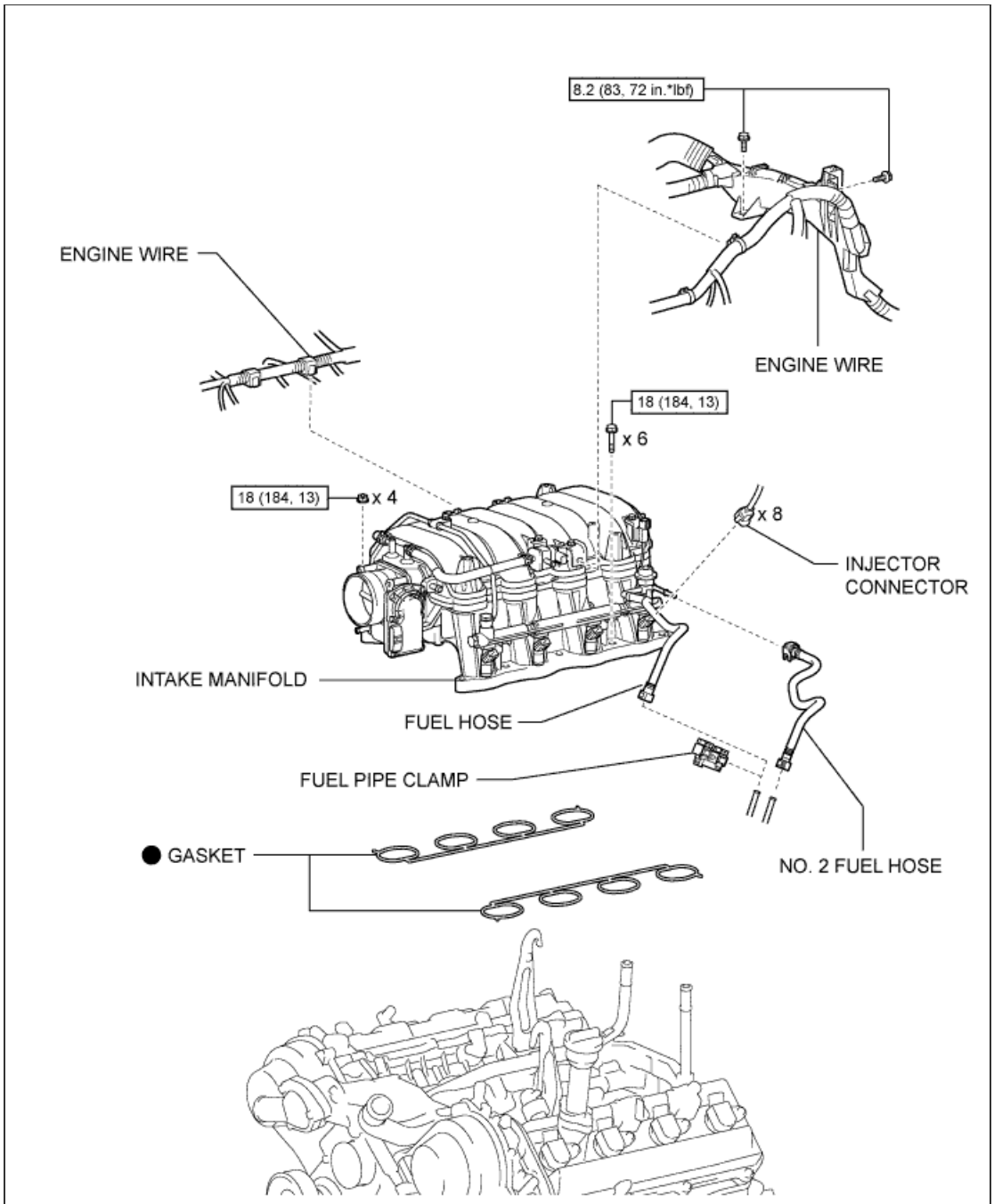


for Preparation Click here




7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER SUB-ASSEMBLY
NO. 2 VENTILATION HOSE
VACUUM TRANSMITTING HOSE
5.0 (51, 44 in.*lbf)
AIR CLEANER HOSE ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
P

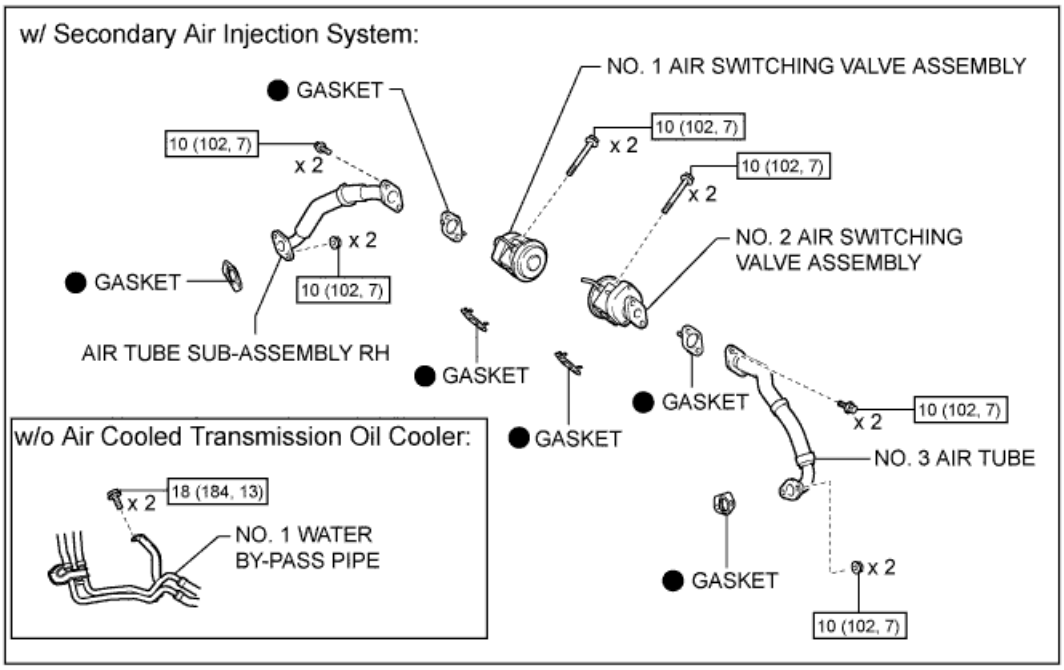

w/ Secondary Air Injection System:
VACUUM SWITCHING VALVE CONNECTOR
VACUUM SWITCHING VALVE HOSE
7.5 (76, 66 in.*lbf)
x 2
VACUUM HOSE
VACUUM CONTROL VALVE SET
NO. 2 V-BANK COVER BRACKET
7.5 (76, 66 in.*lbf)
x 2
NO. 2 WATER BY-PASS PIPE
10 (102, 7)
x 2
NO. 3 WATER BY-PASS HOSE
NO. 2 WATER BY-PASS HOSE
WATER HOSE
VACUUM SWITCHING VALVE CONNECTOR (for ACIS)
NO. 1 WATER BY-PASS HOSE
PURGE VSV CONNECTOR
THROTTLE BODY CONNECTOR
PURGE LINE HOSE
NO. 7 WATER BY-PASS HOSE
NO. 1 VENTILATION HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
P

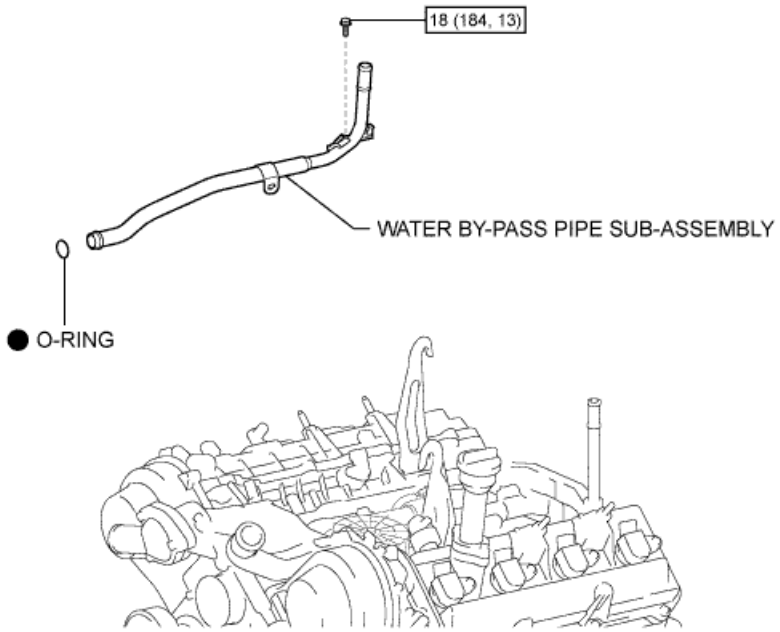


N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P

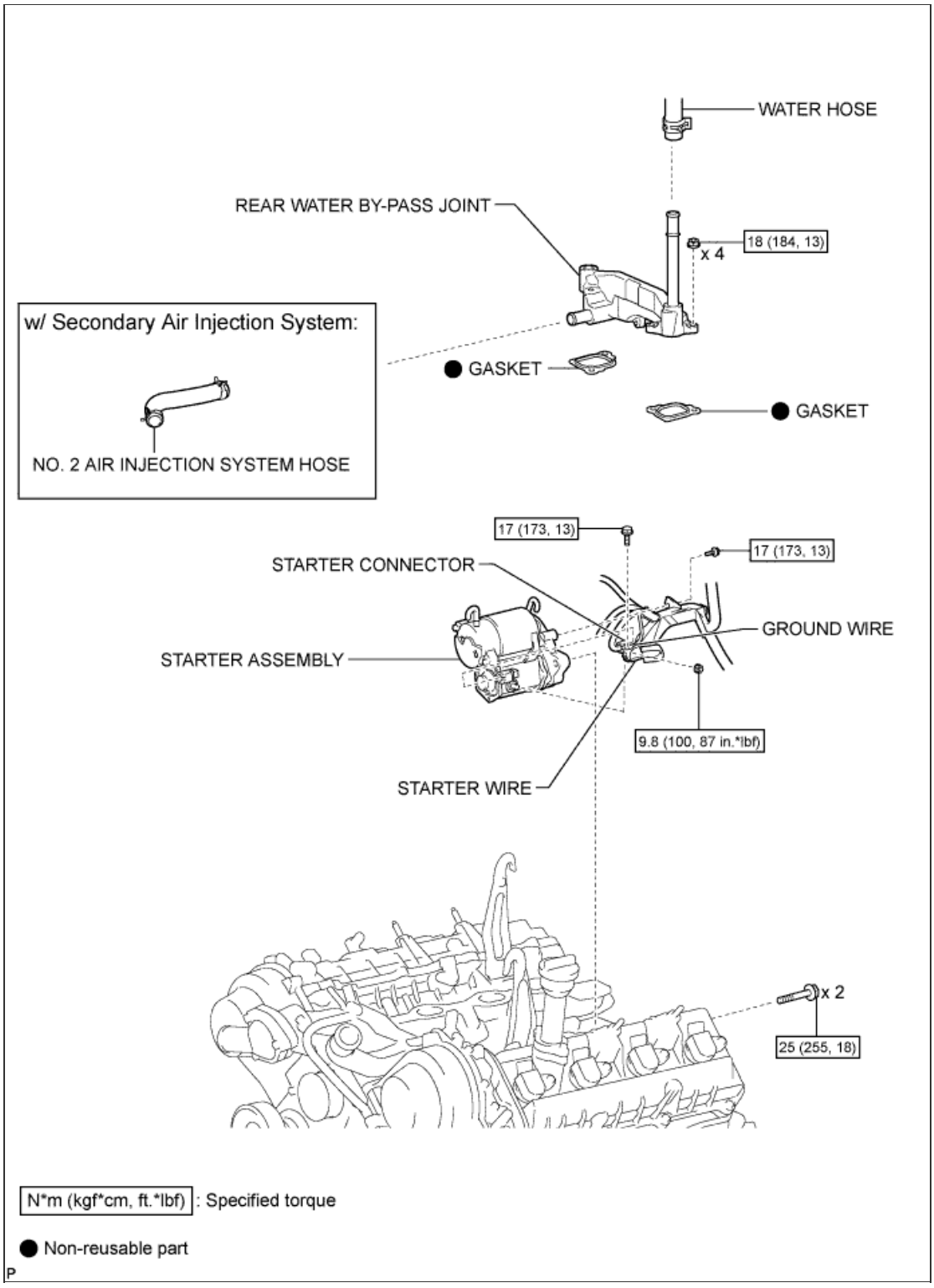




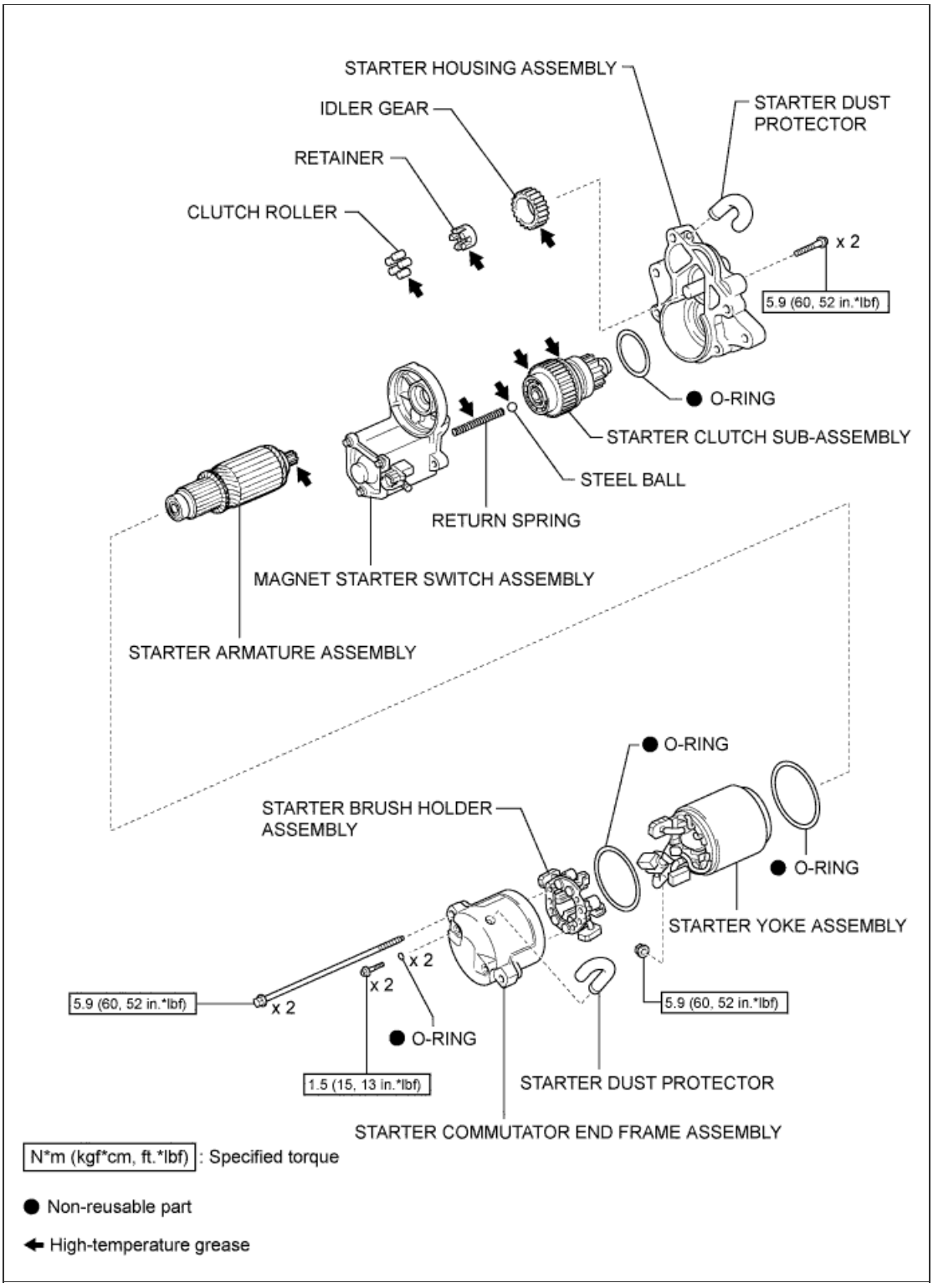
N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P


WATER HOSE
REAR WATER BY-PASS JOINT
18 (184, 13)
x 4
w/ Secondary Air Injection System:
GASKET
GASKET
NO. 2 AIR INJECTION SYSTEM HOSE
17 (173, 13)
17 (173, 13)
STARTER CONNECTOR
GROUND WIRE
STARTER ASSEMBLY
9.8 (100, 87 in.*lbf)
STARTER WIRE
x 2
25 (255, 18)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P


STARTER HOUSING ASSEMBLY
IDLER GEAR
RETAINER
CLUTCH ROLLER
STARTER DUST PROTECTOR
x 2
5.9 (60, 52 in.*lbf)
O-RING
STARTER CLUTCH SUB-ASSEMBLY
STEEL BALL
RETURN SPRING
MAGNET STARTER SWITCH ASSEMBLY
STARTER ARMATURE ASSEMBLY
O-RING
STARTER BRUSH HOLDER ASSEMBLY
O-RING
STARTER YOKE ASSEMBLY
x 2
x 2
5.9 (60, 52 in.*lbf)
x 2
5.9 (60, 52 in.*lbf)
O-RING
1.5 (15, 13 in.*lbf)
STARTER DUST PROTECTOR
STARTER COMMUTATOR END FRAME ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
High-temperature grease

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

2. REMOVE INTAKE MANIFOLD

a. Remove the intake manifold (Click here).

3. REMOVE WATER BY-PASS PIPE SUB-ASSEMBLY

a. Disconnect the connector.

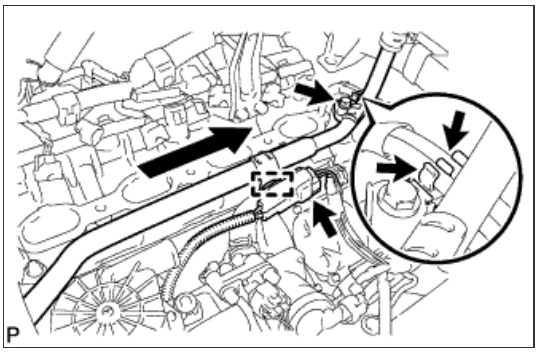
b. Disconnect the wire harness clamp from the water by-pass pipe.

c. Disconnect the 2 vacuum switching valve hoses from the water by-pass pipe clamp.

d. Remove the bolt.

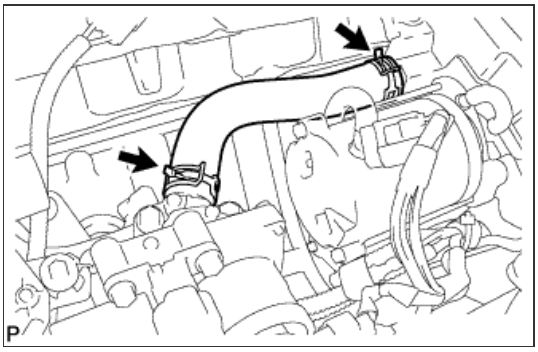
e. Pull out the water by-pass pipe.

f. Remove the O-ring from the water by-pass pipe.



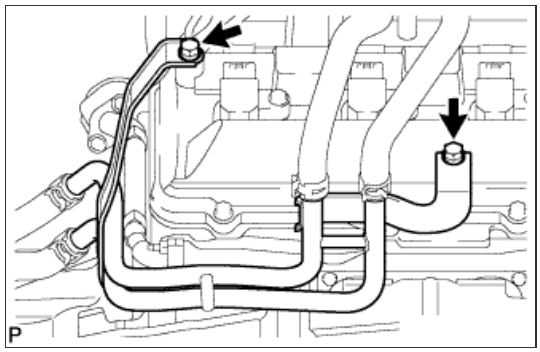
4. REMOVE NO. 2 AIR INJECTION SYSTEM HOSE (w Secondary Air Injection System)

a. Remove the No. 2 air injection system hose from the rear water by-pass joint and air switching valve.



5. DISCONNECT NO. 1 WATER BY-PASS PIPE (w o Air Cooled Transmission Oil Cooler)

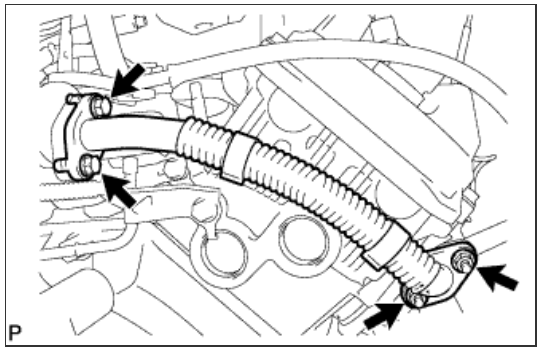
a. Remove the 2 bolts and disconnect the water by-pass pipe from the cylinder head cover RH.



6. REMOVE AIR TUBE SUB-ASSEMBLY RH (w Secondary Air Injection System)

a. Remove the 2 bolts, 2 nuts and air tube sub-assembly.

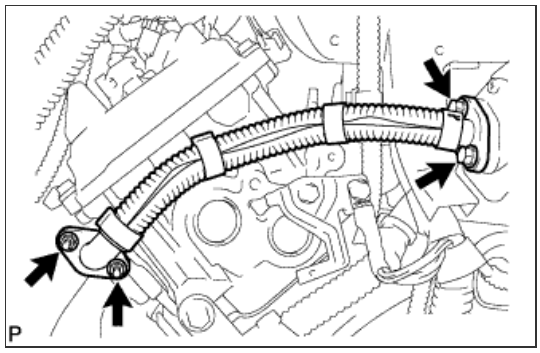
b. Remove the 2 gaskets.



7. REMOVE NO. 3 AIR TUBE (w Secondary Air Injection System)

a. Remove the 2 bolts, 2 nuts and No. 3 air tube.

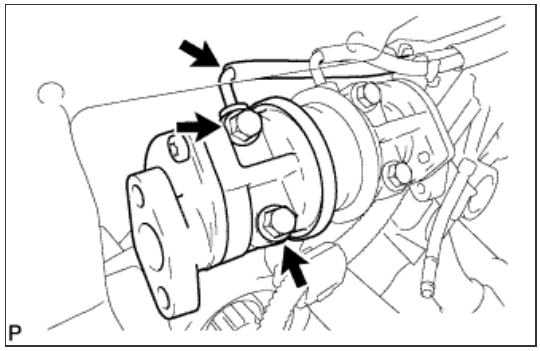
b. Remove the 2 gaskets.



8. REMOVE NO. 2 AIR SWITCHING VALVE ASSEMBLY (w Secondary Air Injection System)

a. Remove the vacuum switching valve hose from the No. 2 air switching valve.

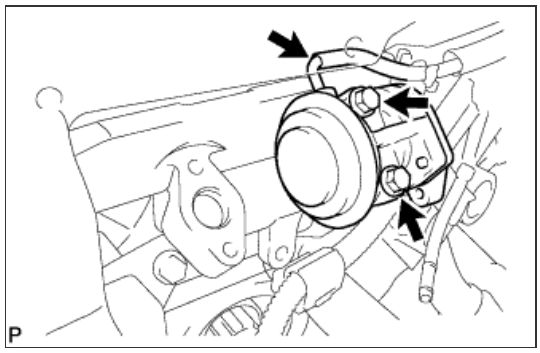
b. Remove the 2 bolts, gasket and No. 2 air switching valve from the rear water by-pass joint.



9. REMOVE NO. 1 AIR SWITCHING VALVE ASSEMBLY (w Secondary Air Injection System)

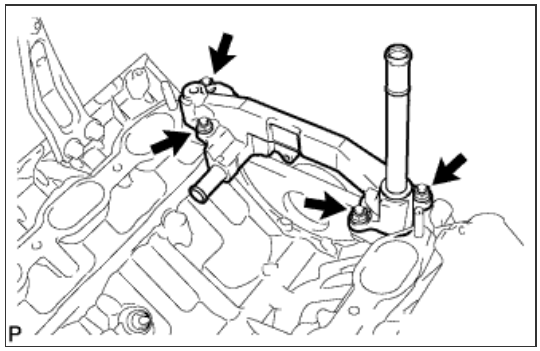
a. Remove the vacuum switching valve hose from the No. 1 air switching valve.

b. Remove the 2 bolts, gasket and No. 1 air switching valve from the rear water by-pass joint.



10. REMOVE REAR WATER BY-PASS JOINT

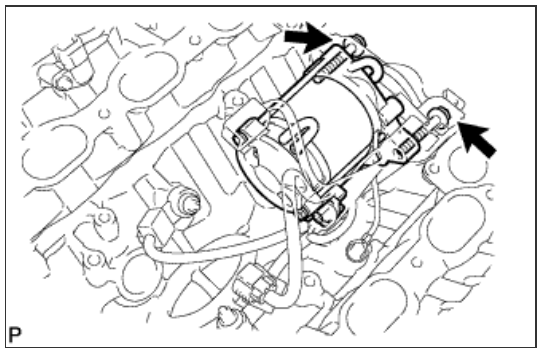
a. Remove the 4 nuts, water by-pass joint and 2 gaskets.



11. REMOVE STARTER ASSEMBLY

a. Remove the 2 bolts holding the starter to the cylinder block.

b. Disconnect the starter from the cylinder block.



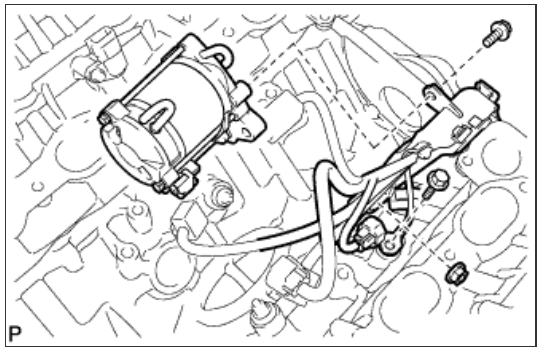
c. Remove the bolt and disconnect the engine wire protector from the starter.

d. Remove the bolt and disconnect the ground wire.

e. Disconnect the starter connector.

f. Remove the nut and disconnect the starter wire.

. Remove the starter.



for Preparation Click here

1. REMOVE STARTER DUST PROTECTOR

a. Remove the 2 dust protectors.

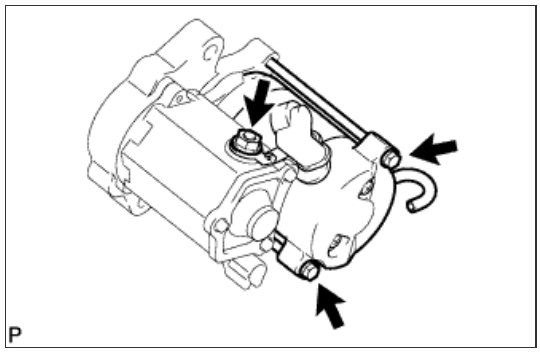
2. REMOVE STARTER YOKE ASSEMBLY

a. Remove the nut and disconnect the lead wire from terminal C.

b. Remove the 2 through bolts.

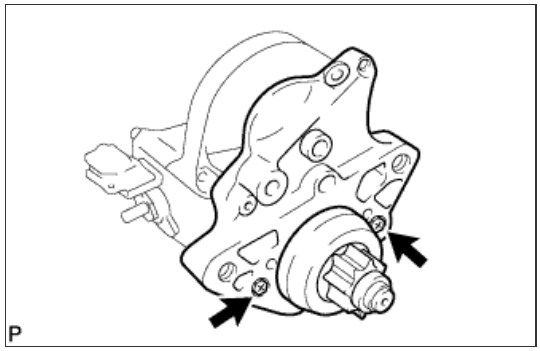
c. Pull out the starter yoke with the armature from the magnet starter switch.

d. Remove the O-ring from the starter yoke.

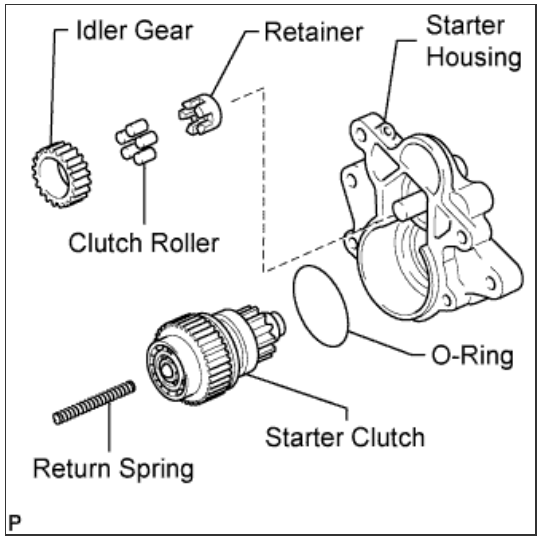


3. REMOVE STARTER CLUTCH SUB-ASSEMBLY

a. Remove the 2 bolts.

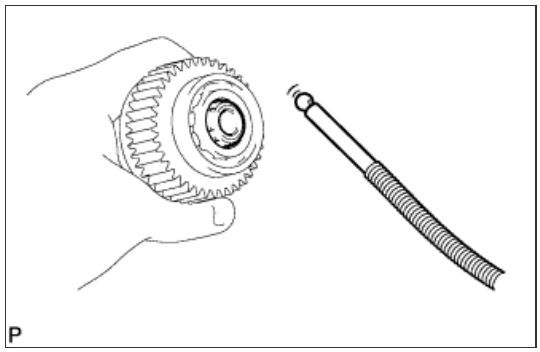


b. Remove the return spring, idler gear, clutch roller, retainer, O-ring and starter clutch from the starter housing.



c. Using a magnetic finger, remove the steel ball from the clutch shaft hole.

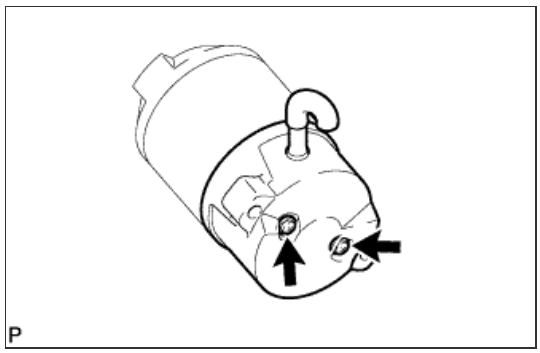
c. Using a magnetic finger, remove the steel ball from the clutch shaft hole.



4. REMOVE STARTER BRUSH HOLDER ASSEMBLY

a. Remove the 2 screws, 2 O-rings and starter commutator end frame from the starter yoke.

b. Remove the O-ring from the starter yoke.

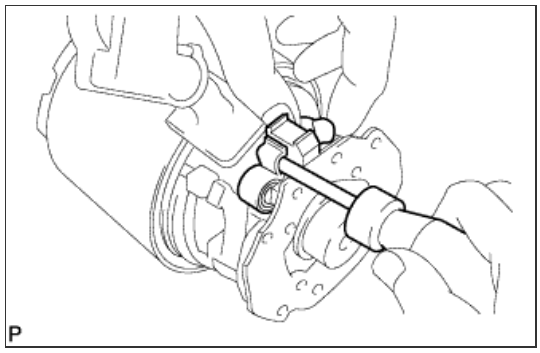


c. Using a screwdriver, hold the spring back and disconnect the brush from the brush holder.

d. Disconnect the 4 brushes and remove the brush holder.

OTICE:

Check that the positive (+) lead wires are not grounded.



5. REMOVE STARTER ARMATURE ASSEMBLY

a. Remove the starter armature from the starter yoke.

for Preparation Click here

1. INSPECT STARTER ASSEMBLY

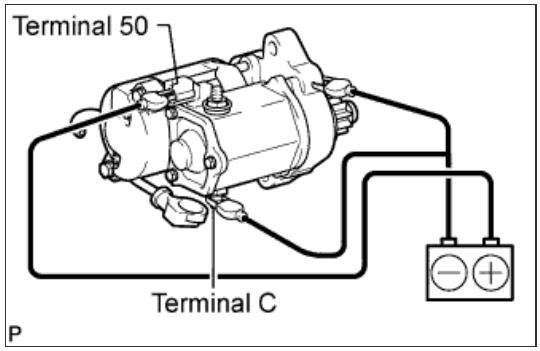
NOTICE:

The following tests must be done within 3 to 5 seconds to prevent the coil from burning out.

a. Perform the pull-in test.

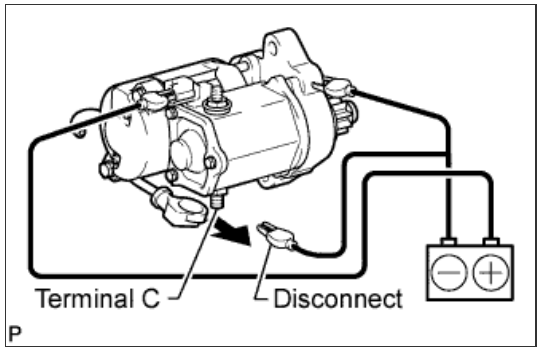
i. Remove the nut, then disconnect the lead wire from terminal C.

ii. Connect the battery to the starter as shown in the illustration. Check that the clutch pinion gear moves outward.
If the clutch pinion gear does not move, replace the magnet starter switch assembly.



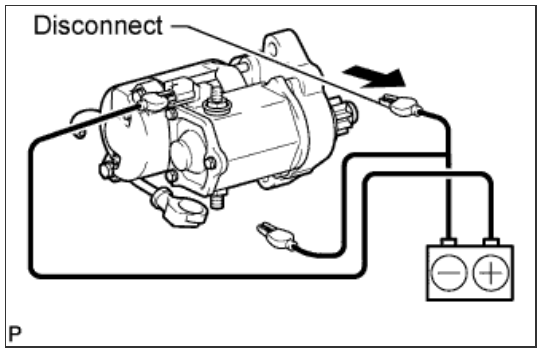
b. Perform the holding test.

i. With the battery connected as above with the clutch pinion gear out, disconnect the negative (-) lead from terminal C. Check that the pinion gear remains out.
If the clutch pinion gear returns inward, replace the magnet starter switch assembly.



c. Inspect the clutch pinion gear return.

i. Disconnect the negative (-) lead from the starter housing. Check that the clutch pinion gear returns inward.
If the clutch pinion gear does not return inward, replace the magnet starter switch assembly.



d. Perform the operation test without load.

i. Connect the lead wire to terminal C.

Torque:
5.9 N*m{ 60 kgf*cm , 52 in.*lbf }

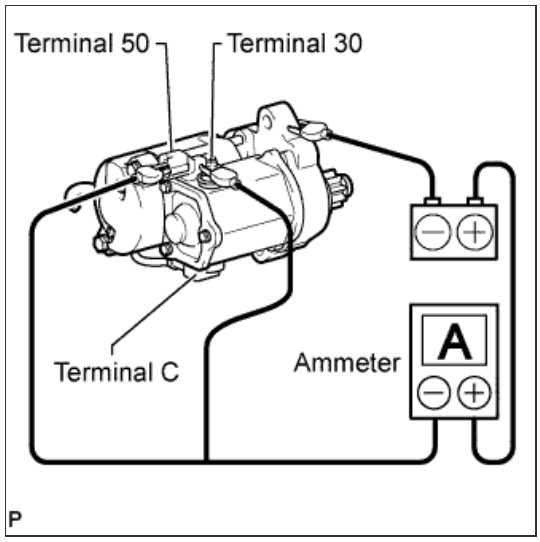
ii. Grip the starter in a vise.

iii. Connect the battery and an ammeter to the starter as shown in the illustration.

iv. Check that the starter rotates smoothly and steadily while the pinion gear is moving out. Then measure the current.

Specified current:
90 A or less at 11.5 V

If the result is not as specified, replace the starter assembly.



2. INSPECT STARTER ARMATURE ASSEMBLY

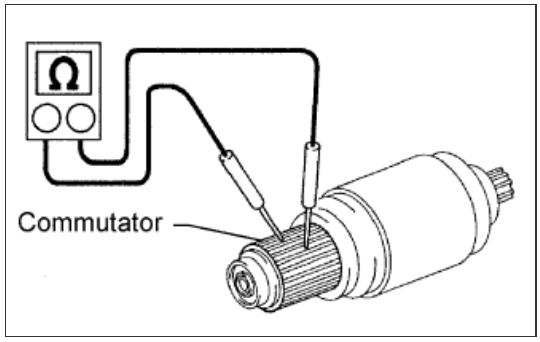
a. Inspect the commutator for an open circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Commutator	Always	Below 1 Ω

If the result is not as specified, replace the armature assembly.



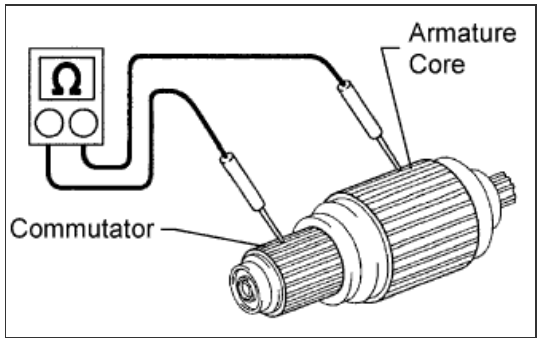
b. Inspect the commutator for a short circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Commutator - Armature core	Always	10 kΩ or higher

If the result is not as specified, replace the armature assembly.



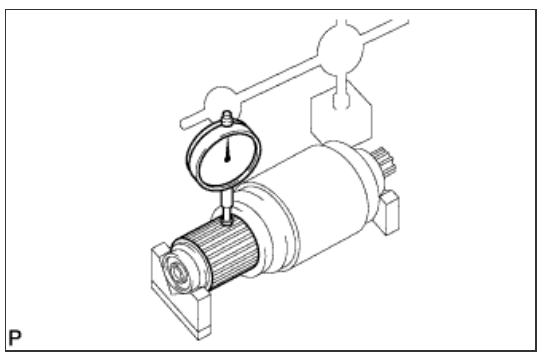
c. Inspect the commutator circle runout.

i. Place the commutator on V-blocks.

ii. Using a dial indicator, measure the circle runout.

Maximum circle runout:
0.05 mm (0.00197 in.)

If the runout is more than the maximum, correct it with sandpaper (#400) or replace the armature assembly.

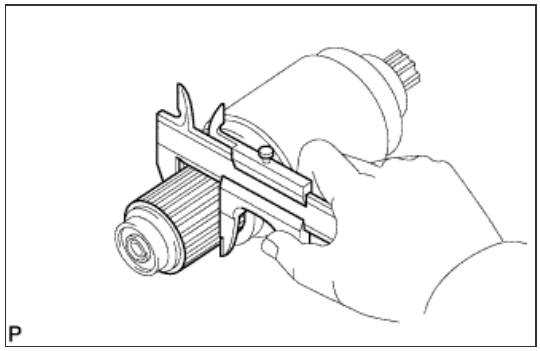


d. Using a vernier caliper, measure the commutator diameter.

Standard diameter:
30.0 mm (1.18 in.)

Minimum diameter:
29.0 mm (1.14 in.)

If the diameter is less than the minimum, replace the armature assembly.

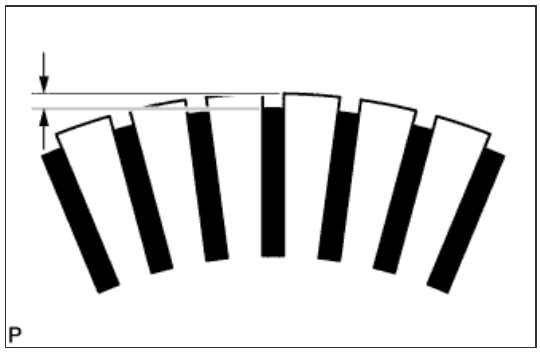


e. Measure the undercut depth of the commutator.

Standard undercut depth:
0.6 mm (0.0236 in.)

Minimum undercut depth:
0.2 mm (0.00787 in.)

If the undercut depth is less than the minimum, increase the depth using a hacksaw blade.



3. INSPECT STARTER YOKE ASSEMBLY

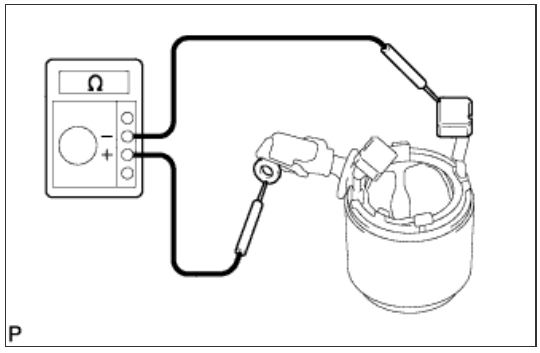
a. Inspect for an open circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Terminal C wire - Brushes	Always	Below 1 Ω

If the result is not as specified, replace the starter yoke assembly.



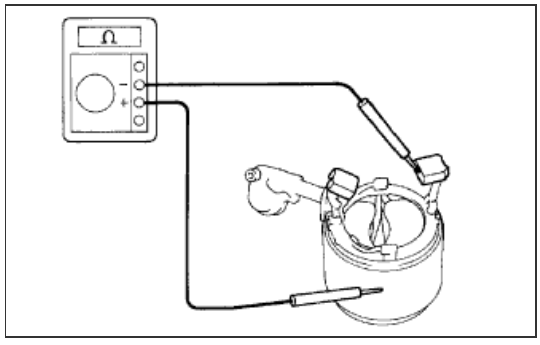
b. Inspect for a short circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Brushes - Starter yoke body	Always	10 kΩ or higher

If the result is not as specified, replace the starter yoke assembly.



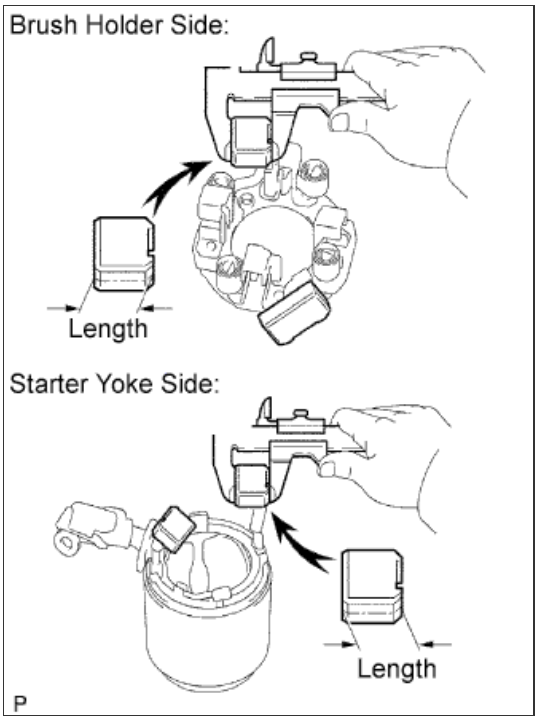
4. INSPECT BRUSH

a. Using a vernier caliper, measure the brush length.

Standard length:
15.5 mm (0.610 in.)

Minimum length:
8.5 mm (0.335 in.)

If the length is less than the minimum, replace the brush holder and starter yoke assembly.



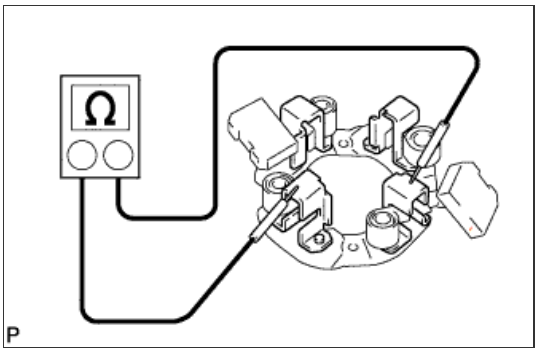
5. INSPECT STARTER BRUSH HOLDER ASSEMBLY

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Positive brush holder - Negative brush holder	Always	10 kΩ or higher

If the result is not as specified, replace the brush holder assembly.



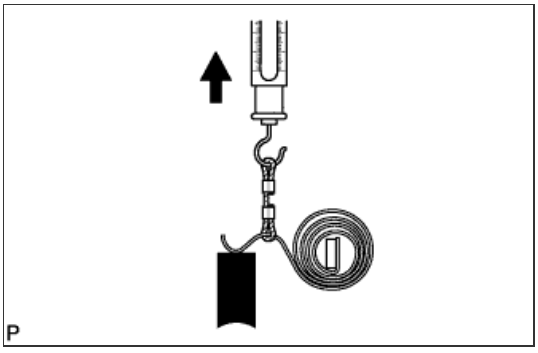
b. Inspect the load of the brush spring.

i. Take a pull scale reading immediately after the brush spring separates from the brush.

Standard spring installed load:
18 to 24 N (1.8 to 2.4 kgf, 4.0 to 5.3 lbf)

Minimum spring installed load:
12 N (1 kgf, 2.7 lbf)

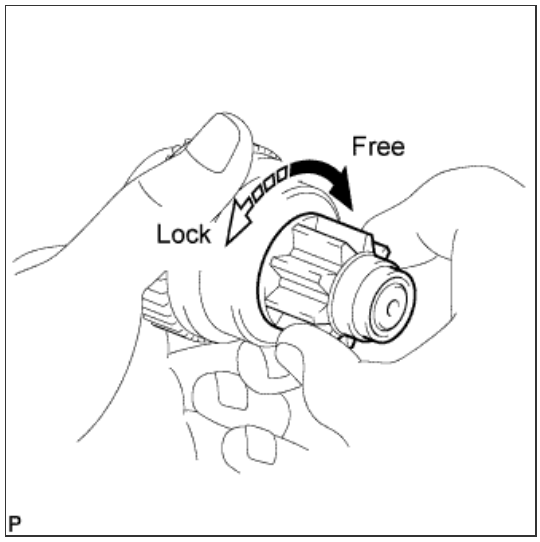
If the installed load is less than the minimum, replace the brush holder assembly.



6. INSPECT STARTER CLUTCH SUB-ASSEMBLY

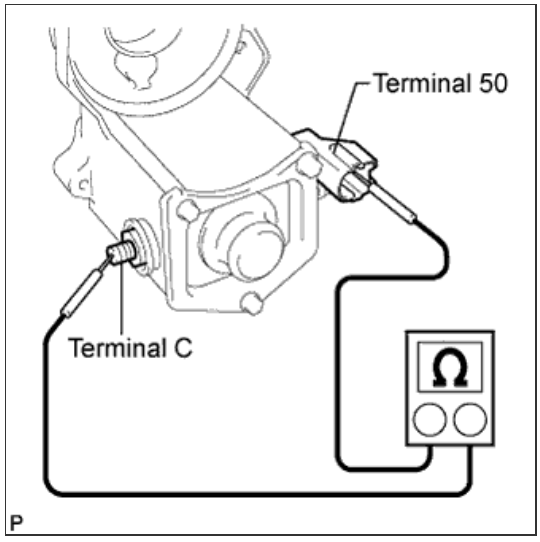
a. Check that the starter clutch cannot be rotated counterclockwise, and can be rotated clockwise.
If the starter clutch is not as specified, replace the starter clutch sub-assembly.

b. Turn the bearing by hand while applying inward force.
If resistance is felt or the bearing sticks, replace the starter clutch sub-assembly.



7. INSPECT MA NET STARTER SWITCH ASSEMBLY

a. Inspect the pull-in coil.



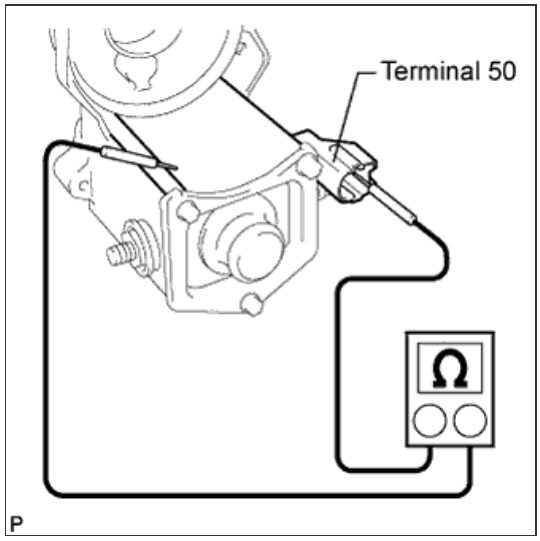
i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Terminal 50 - Terminal C	Always	Below 1 Ω

If the result is not as specified, replace the magnet starter switch assembly.

b. Inspect the holding coil.



i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Terminal 50 - Switch body	Always	Below 2 Ω

If the result is not as specified, replace the magnet starter switch assembly.

for Preparation Click here

1. INSTALL STARTER ARMATURE ASSEMBLY

a. Install the starter armature to the starter yoke.

2. INSTALL STARTER BRUSH HOLDER ASSEMBLY

a. Install a new O-ring to the groove of the starter yoke.

b. Place the brush holder on the starter yoke.

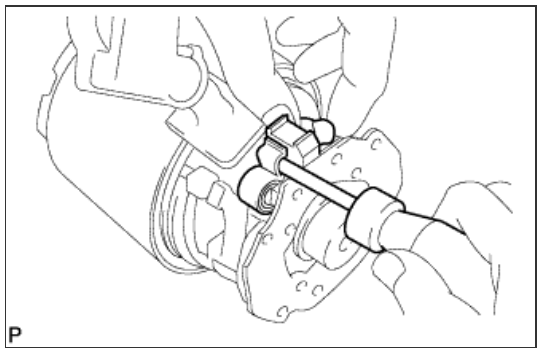
c. Using a screwdriver, hold the brush spring back.

d. Connect the brush to the brush holder.

e. Connect the 4 brushes.

NOTICE:

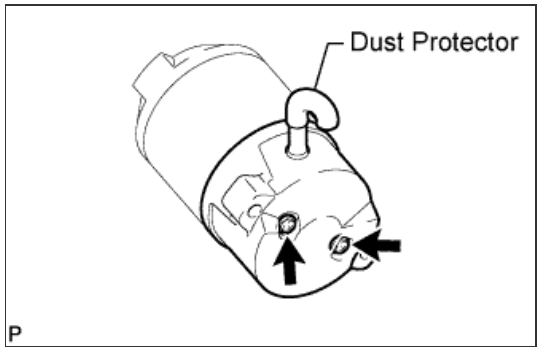
Check that the positive (+ lead wires are not grounded.



f. Install 2 new O-rings and the end cover with the 2 screws.

Torque:
1.5 N*m{ 15 kgf*cm , 13 in.*lbf }

g. Install the dust protector as shown in the illustration.



3. INSTALL STARTER CLUTCH SUB-ASSEMBLY

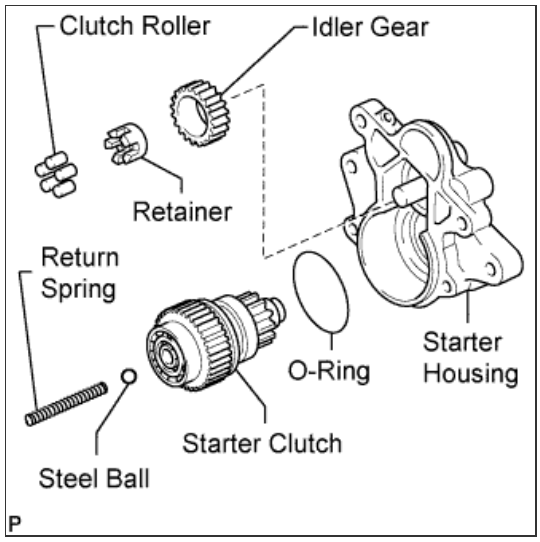
a. Apply grease to the steel ball, return spring, clutch roller, retainer and idler gear.

b. Install the steel ball.

c. Install a new O-ring to the starter housing.

d. Insert the return spring into the magnet starter switch hole.

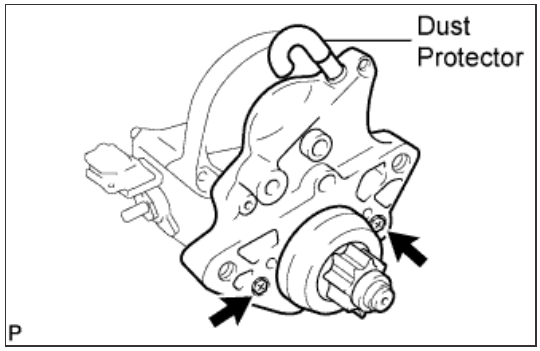
e. Install the starter clutch, idler gear, retainer and clutch roller.



f. Install the starter housing to the magnet starter switch with the 2 bolts.

Torque:
5.9 N*m{ 60 kgf*cm , 52 in.*lbf }

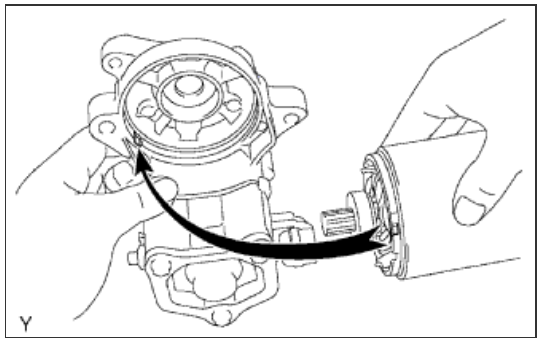
g. Install the dust protector as shown in the illustration.



4. INSTALL STARTER YOKE ASSEMBLY

a. Install a new O-ring to the groove of the starter yoke.

b. Align the protrusion of the starter yoke with the groove of the magnet starter switch.

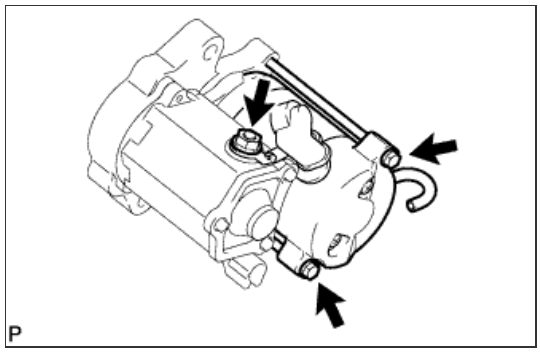


c. Install the starter yoke with the 2 through bolts.

Torque:
5.9 N*m{ 60 kgf*cm , 52 in.*lbf }

d. Connect the lead wire to terminal C with the nut.

Torque:
5.9 N*m{ 60 kgf*cm , 52 in.*lbf }



for Preparation Click here

1. INSTALL STARTER ASSEMBLY

a. Connect the starter wire with the nut.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }

b. Connect the starter connector.

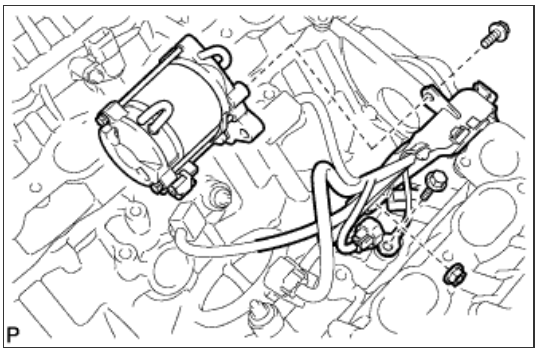
c. Connect the starter to the cylinder block.

d. Connect the ground wire with the bolt.

Torque:
17 N*m{ 173 kgf*cm , 13 ft.*lbf }

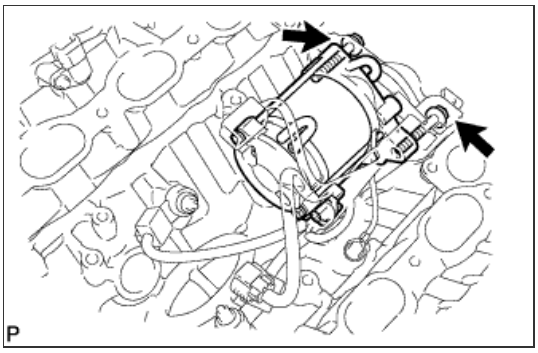
e. Connect the engine wire protector to the starter with the bolt.

Torque:
17 N*m{ 173 kgf*cm , 13 ft.*lbf }



f. Install the starter with the 2 bolts.

Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }



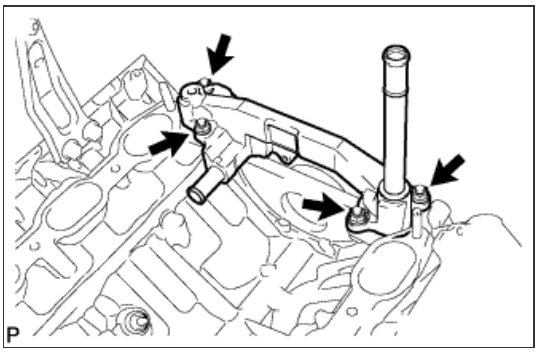
2. INSTALL REAR WATER BY-PASS JOINT

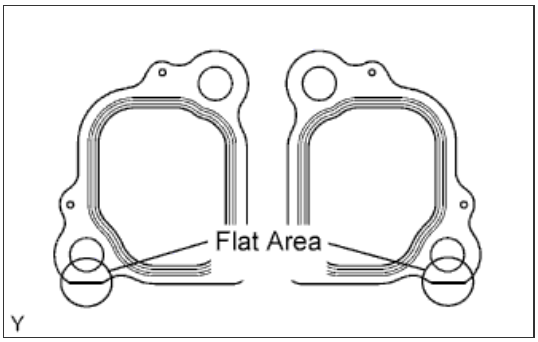
a. Install 2 new gaskets and the water by-pass joint with the 4 nuts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

HINT:

With the flat-bottom of each new gasket facing downward as shown in the illustration, install the 2 gaskets to the engine rear side.



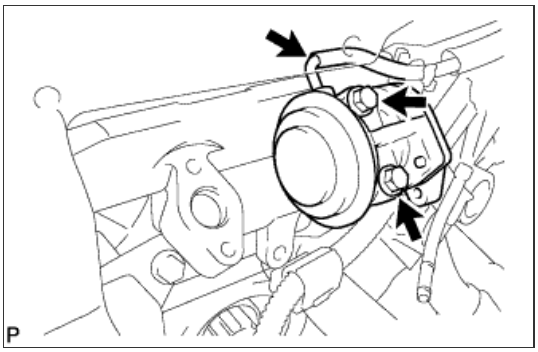


3. INSTALL NO. 1 AIR SWITCHING VALVE ASSEMBLY (eSondary Air Injection System)

a. Install a new gasket and the No. 1 air switching valve to the rear water by-pass joint with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Connect the vacuum switching valve hose to the No. 1 air switching valve.

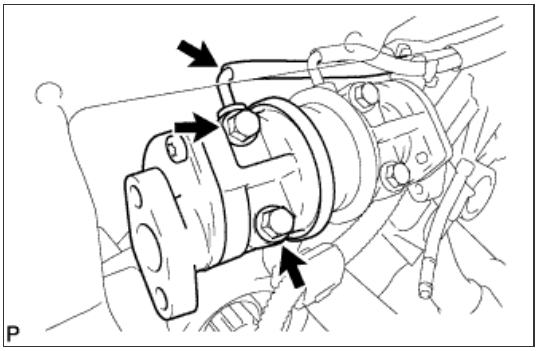


4. INSTALL NO. 2 AIR SWITCHING VALVE ASSEMBLY (eSondary Air Injection System)

a. Install a new gasket and the No. 2 air switching valve to the rear water by-pass joint with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Connect the vacuum switching valve hose to the No. 2 air switching valve.



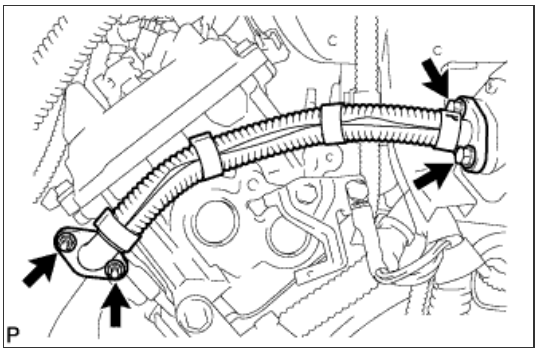
5. INSTALL NO. 3 AIR TUBE (eSondary Air Injection System)

a. Install a new gasket and connect the No. 3 air tube to the exhaust manifold with the 2 nuts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Install a new gasket and connect the No. 3 air tube to the No. 2 air switching valve with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



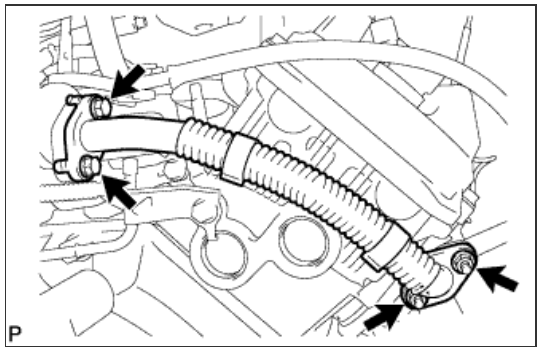
. INSTALL AIR TUBE SUB-ASSEMBLY RH (eSondary Air Injection System)

a. Install a new gasket and connect the air tube to the exhaust manifold with the 2 nuts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Install a new gasket and connect the air tube to the No. 1 air switching valve with the 2 bolts.

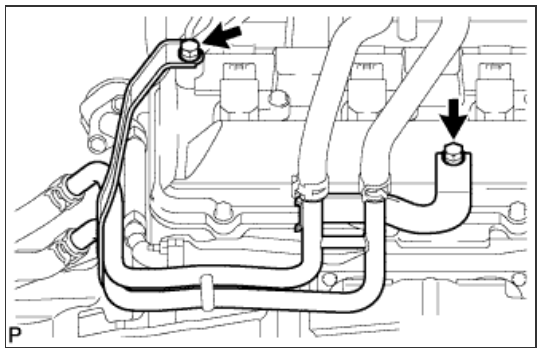
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



7. CONNECT NO. 1 WATER BY-PASS PIPE (o Air Cooled Transmission Oil Cooler)

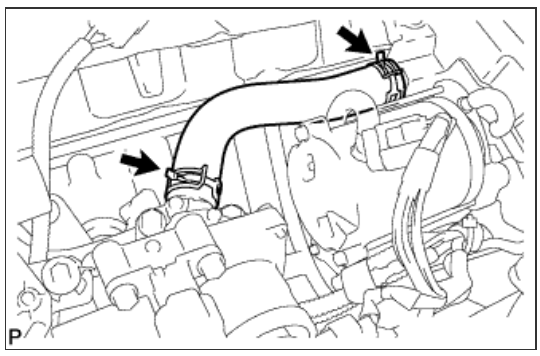
a. Connect the water by-pass pipe to the cylinder head cover RH with the 2 bolts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }



8. INSTALL NO. 2 AIR INJECTION SYSTEM HOSE (econdary Air Injection System)

a. Install the hose.



9. INSTALL WATER BY-PASS PIPE SUB-ASSEMBLY

a. Apply soapy water to the O-ring.

b. Install a new O-ring to the water by-pass pipe.

c. Push in the water by-pass pipe.

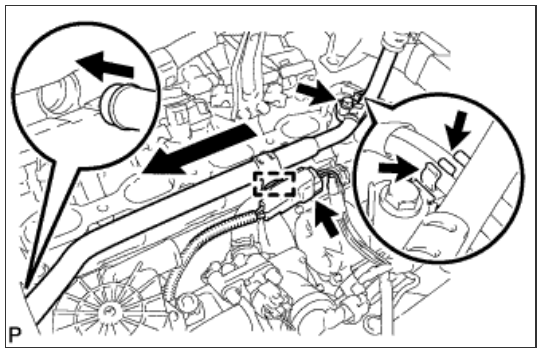
d. Install the water by-pass pipe with the bolt.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

e. Connect the 2 vacuum switching valve hoses to the water by-pass pipe clamp.

f. Connect the wire harness clamp.

g. Connect the connector.



10. INSTALL INTAKE MANIFOLD

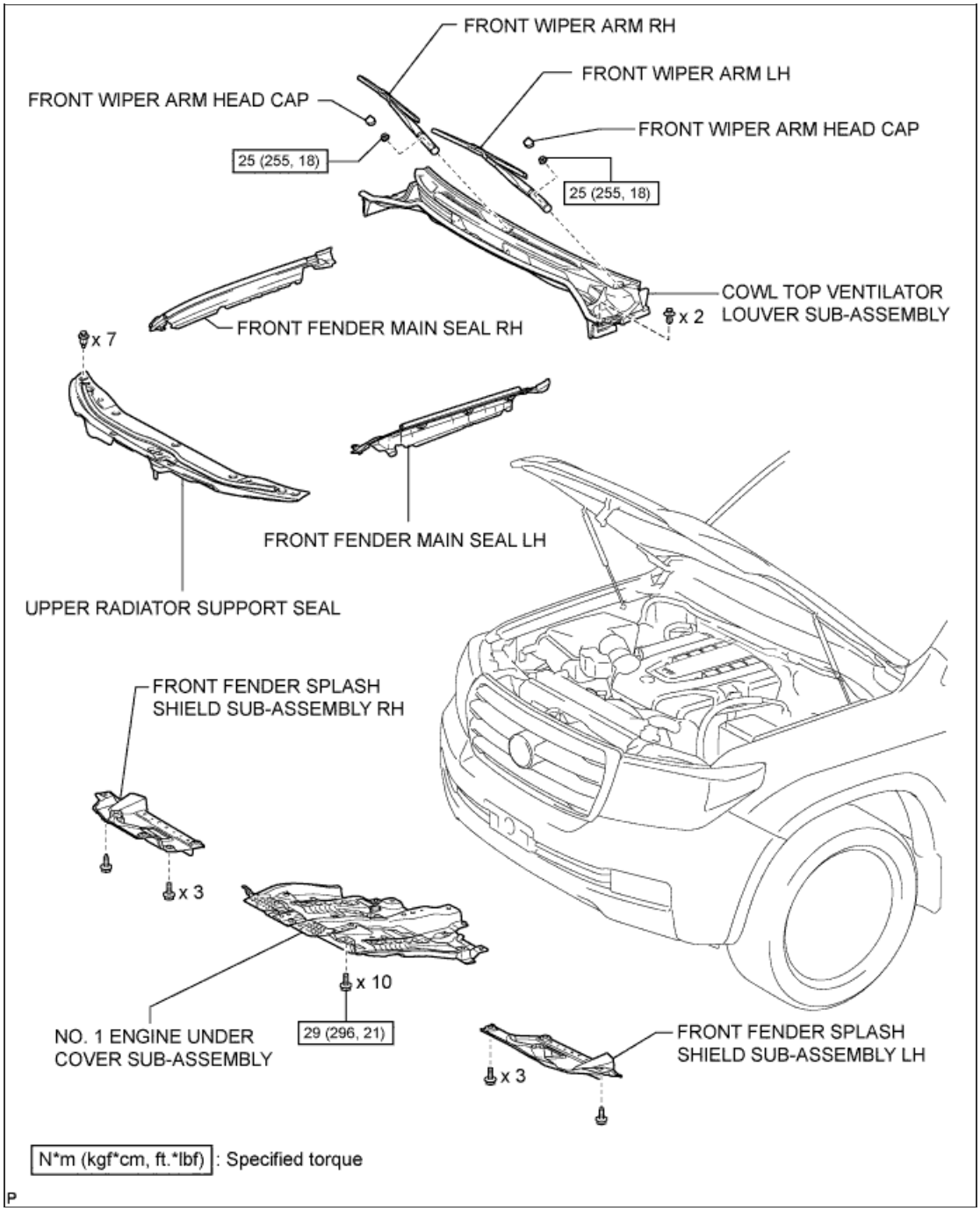
a. Install the intake manifold (Click here).

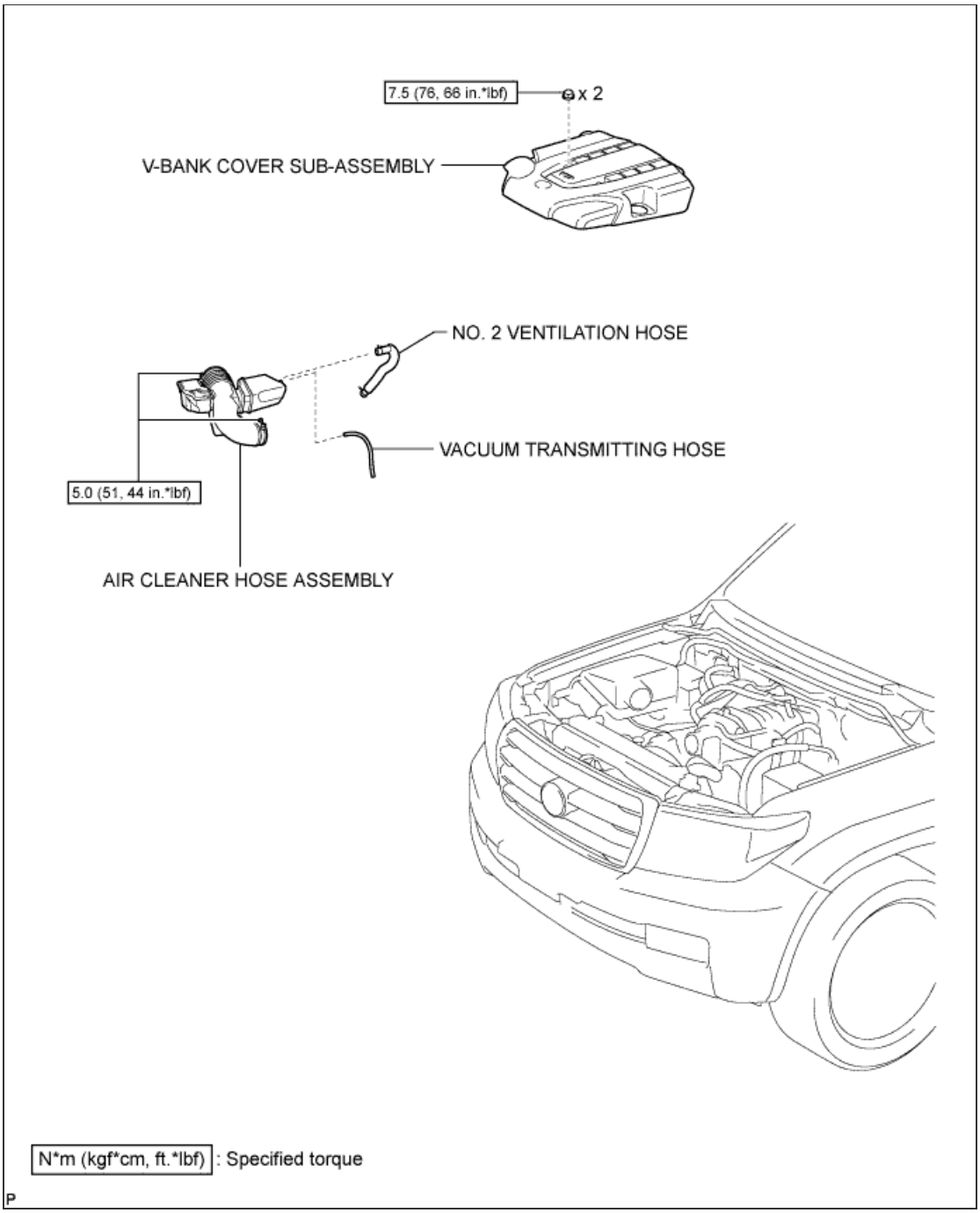
11. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

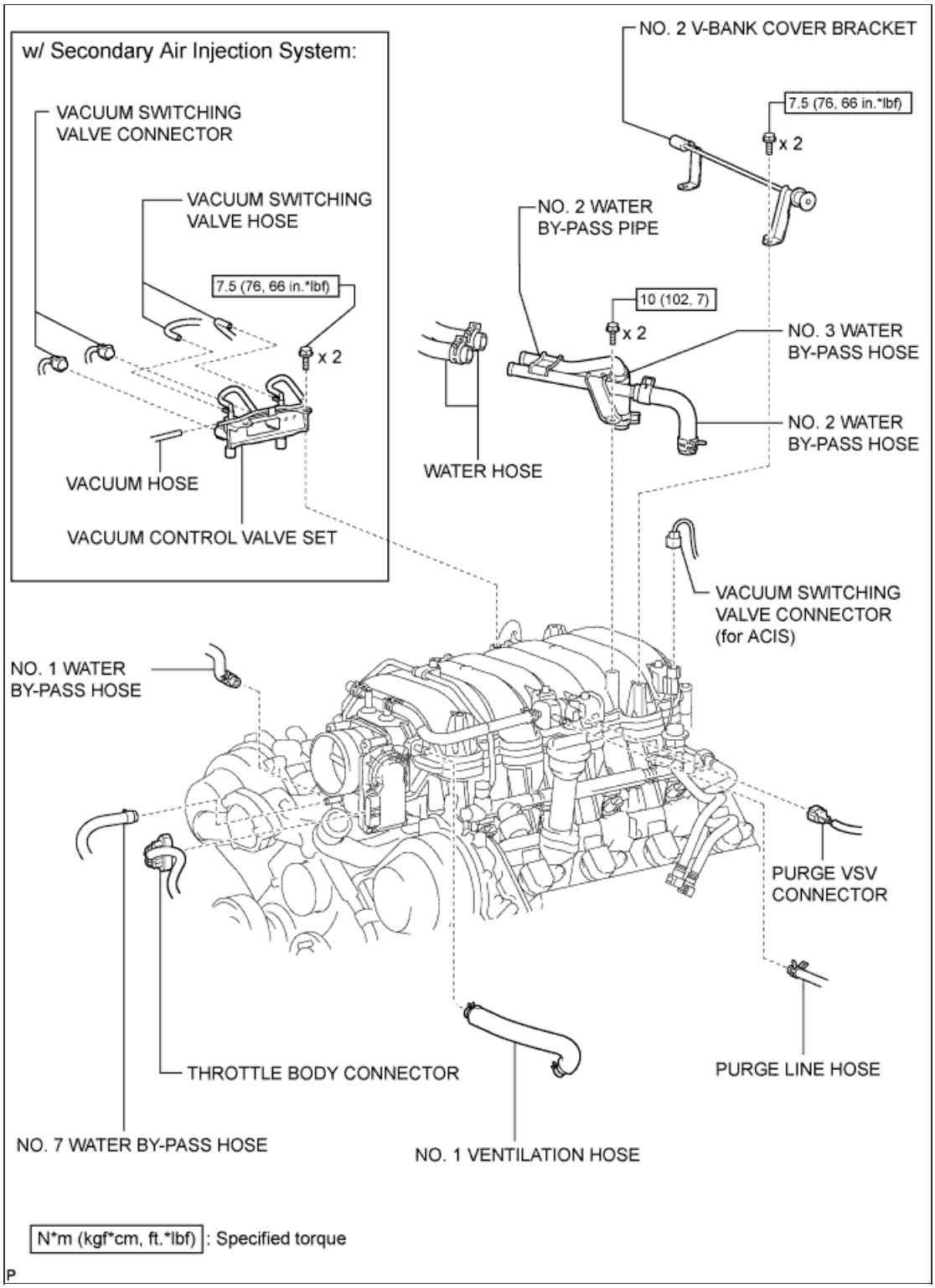
NOTICE:

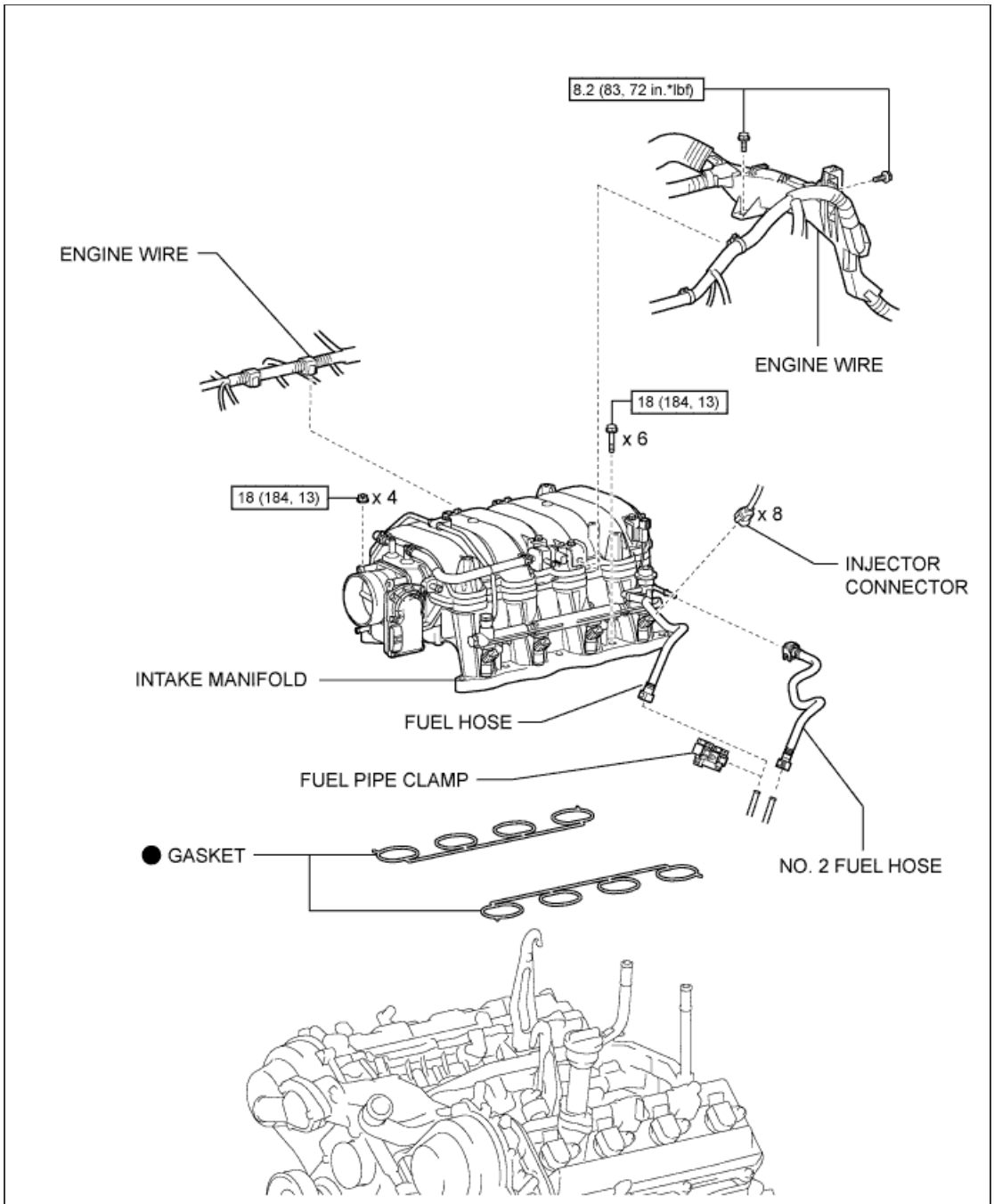
When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

for Preparation Click here




7.5 (76, 66 in.*lbf)
x 2
V-BANK COVER SUB-ASSEMBLY
NO. 2 VENTILATION HOSE
VACUUM TRANSMITTING HOSE
5.0 (51, 44 in.*lbf)
AIR CLEANER HOSE ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
P

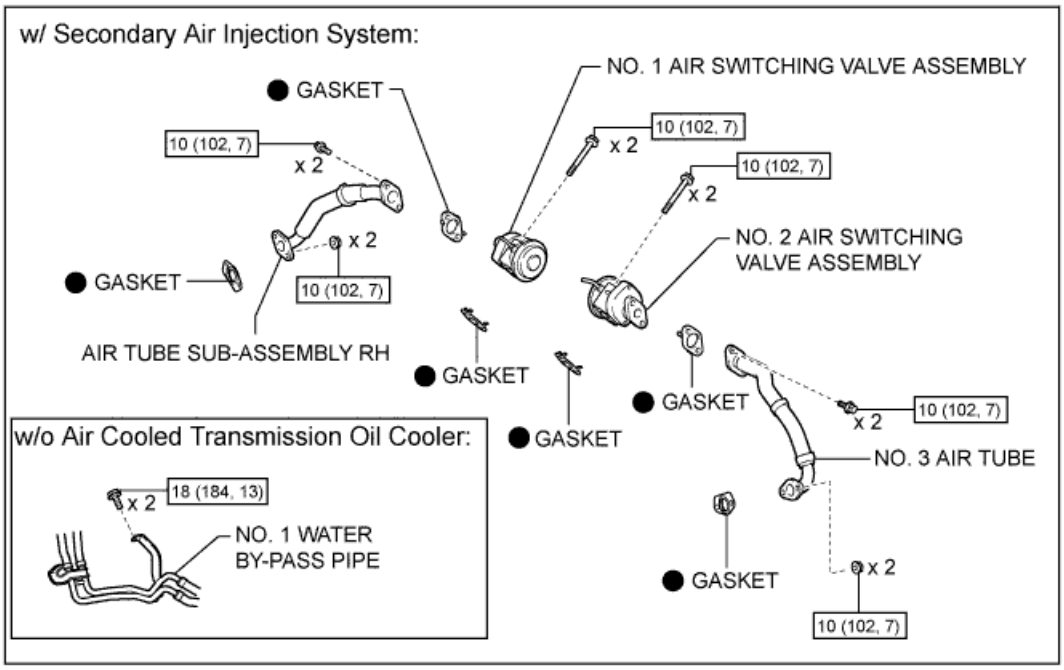

w/ Secondary Air Injection System:
VACUUM SWITCHING VALVE CONNECTOR
VACUUM SWITCHING VALVE HOSE
7.5 (76, 66 in.*lbf)
x 2
VACUUM HOSE
VACUUM CONTROL VALVE SET
NO. 2 V-BANK COVER BRACKET
7.5 (76, 66 in.*lbf)
x 2
NO. 2 WATER BY-PASS PIPE
10 (102, 7)
x 2
NO. 3 WATER BY-PASS HOSE
NO. 2 WATER BY-PASS HOSE
WATER HOSE
VACUUM SWITCHING VALVE CONNECTOR (for ACIS)
NO. 1 WATER BY-PASS HOSE
PURGE VSV CONNECTOR
THROTTLE BODY CONNECTOR
PURGE LINE HOSE
NO. 7 WATER BY-PASS HOSE
NO. 1 VENTILATION HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
P

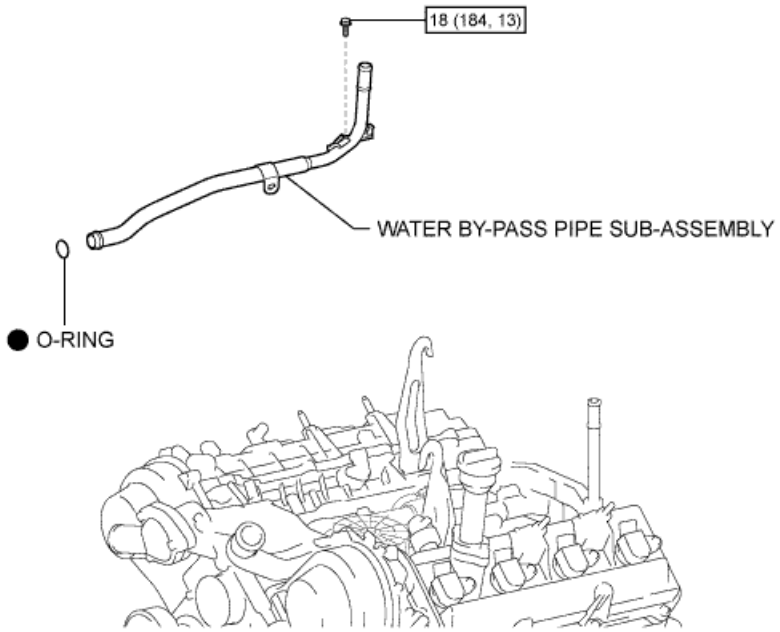


N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P

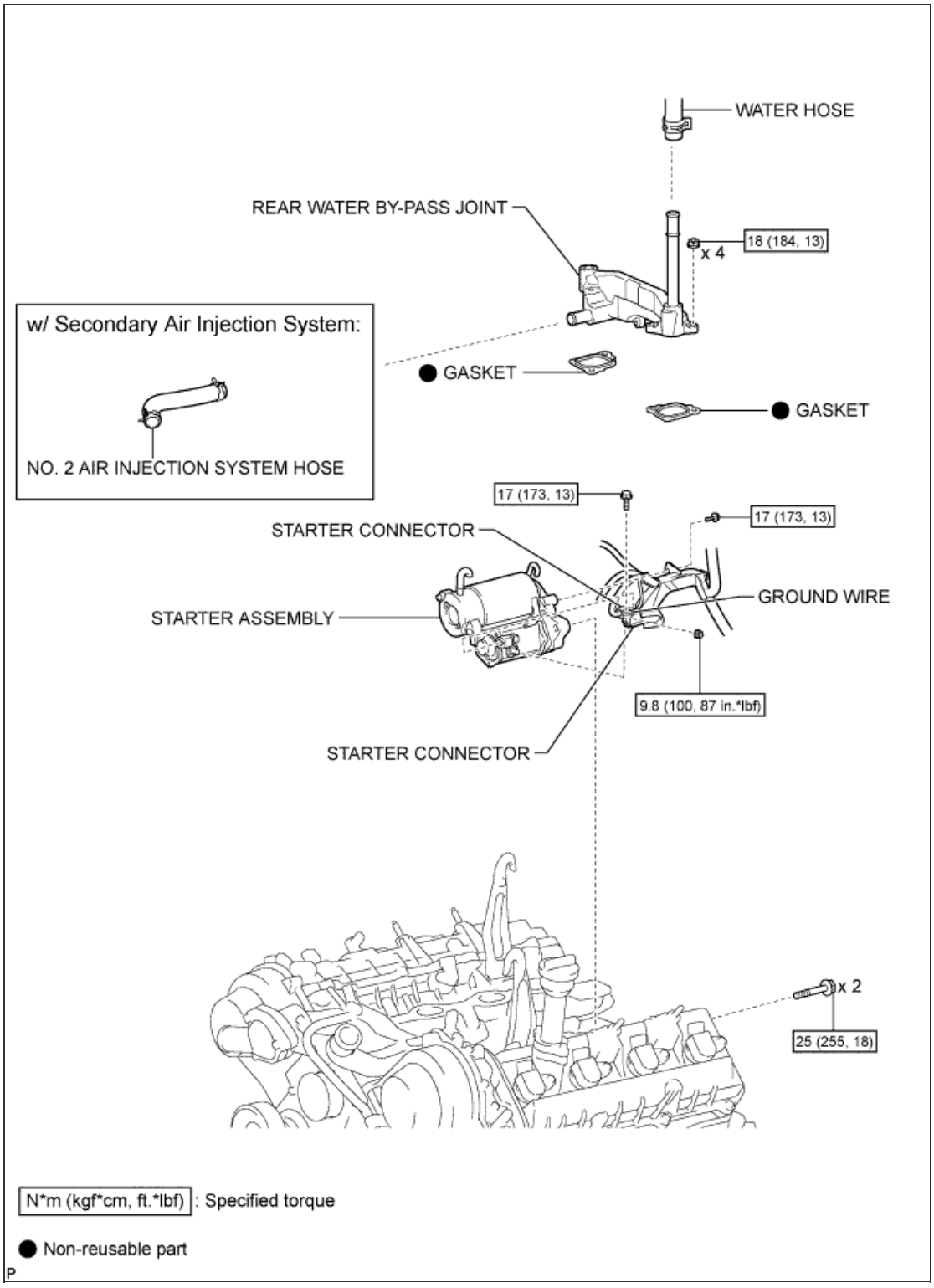




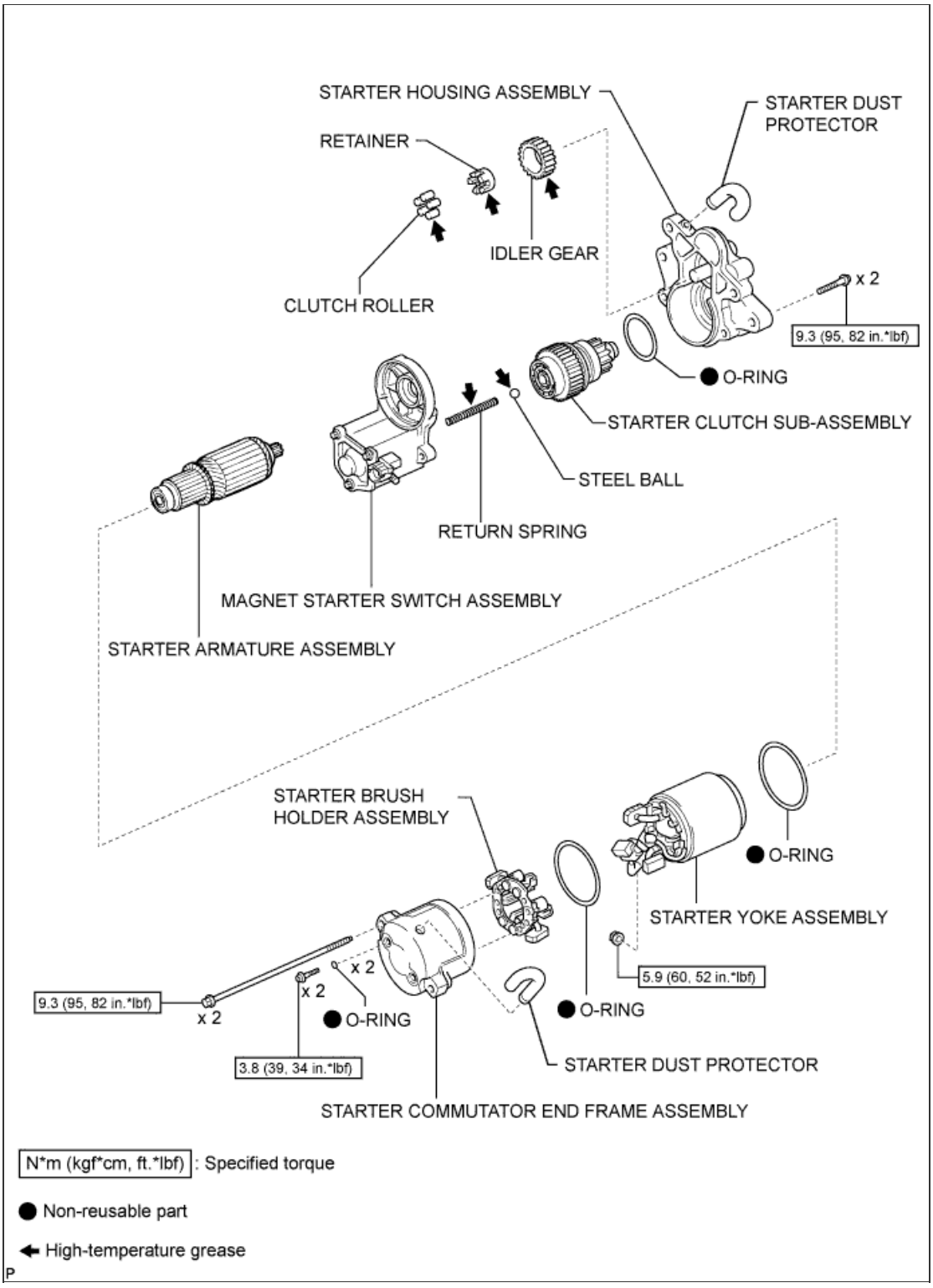
N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P


WATER HOSE
REAR WATER BY-PASS JOINT
18 (184, 13)
x 4
w/ Secondary Air Injection System:
GASKET
GASKET
NO. 2 AIR INJECTION SYSTEM HOSE
17 (173, 13)
17 (173, 13)
STARTER CONNECTOR
GROUND WIRE
STARTER ASSEMBLY
9.8 (100, 87 in.*lbf)
STARTER CONNECTOR
x 2
25 (255, 18)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part

P


STARTER HOUSING ASSEMBLY
STARTER DUST PROTECTOR
RETAINER
IDLER GEAR
CLUTCH ROLLER
x 2
9.3 (95, 82 in.*lbf)
O-RING
STARTER CLUTCH SUB-ASSEMBLY
STEEL BALL
RETURN SPRING
MAGNET STARTER SWITCH ASSEMBLY
STARTER ARMATURE ASSEMBLY
STARTER BRUSH HOLDER ASSEMBLY
O-RING
STARTER YOKE ASSEMBLY
5.9 (60, 52 in.*lbf)
9.3 (95, 82 in.*lbf)
x 2
x 2
x 2
O-RING
O-RING
3.8 (39, 34 in.*lbf)
STARTER DUST PROTECTOR
STARTER COMMUTATOR END FRAME ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
High-temperature grease

P

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

2. REMOVE INTAKE MANIFOLD

a. Remove the intake manifold (Click here).

3. REMOVE WATER BY-PASS PIPE SUB-ASSEMBLY

a. Disconnect the connector.

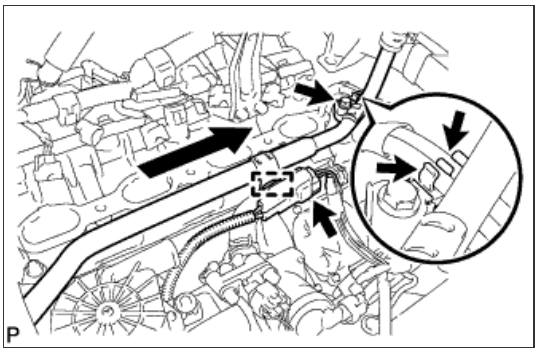
b. Disconnect the wire harness clamp from the water by-pass pipe.

c. Disconnect the 2 vacuum switching valve hoses from the water by-pass pipe clamp.

d. Remove the bolt.

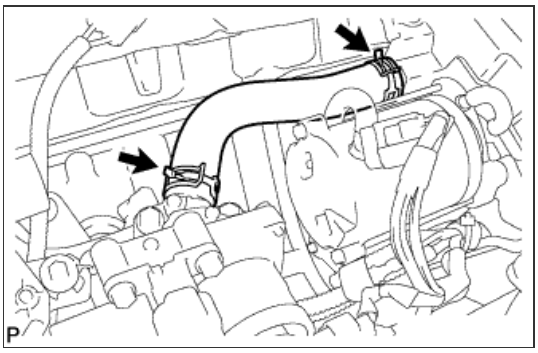
e. Pull out the water by-pass pipe.

f. Remove the O-ring from the water by-pass pipe.



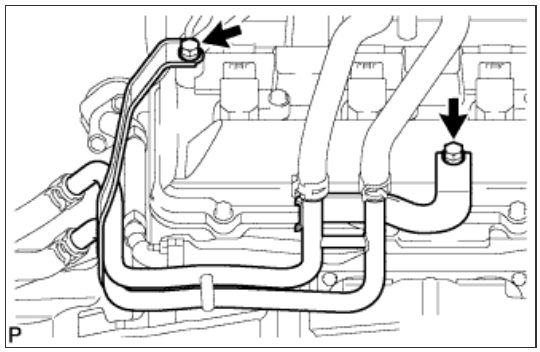
4. REMOVE NO. 2 AIR INJECTION SYSTEM HOSE (w/ Secondary Air Injection System)

a. Remove the No. 2 air injection system hose from the rear water by-pass joint and air switching valve.



5. DISCONNECT NO. 1 WATER BY-PASS PIPE (w/o Air Cooled Transmission Oil Cooler)

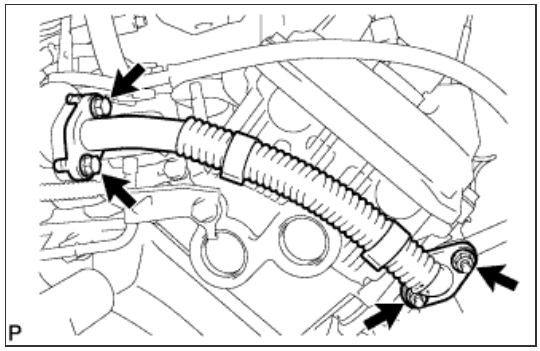
a. Remove the 2 bolts and disconnect the water by-pass pipe from the cylinder head cover RH.



6. REMOVE AIR TUBE SUB-ASSEMBLY RH (w/ Secondary Air Injection System)

a. Remove the 2 bolts, 2 nuts and air tube sub-assembly.

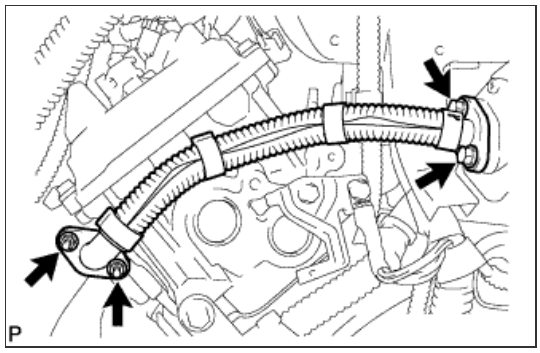
b. Remove the 2 gaskets.



7. REMOVE NO. 3 AIR TUBE (w/ Secondary Air Injection System)

a. Remove the 2 bolts, 2 nuts and No. 3 air tube.

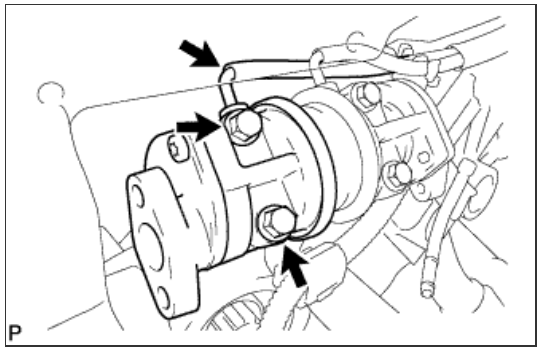
b. Remove the 2 gaskets.



8. REMOVE NO. 2 AIR SWITCHING VALVE ASSEMBLY (w/ Secondary Air Injection System)

a. Remove the vacuum switching valve hose from the No. 2 air switching valve.

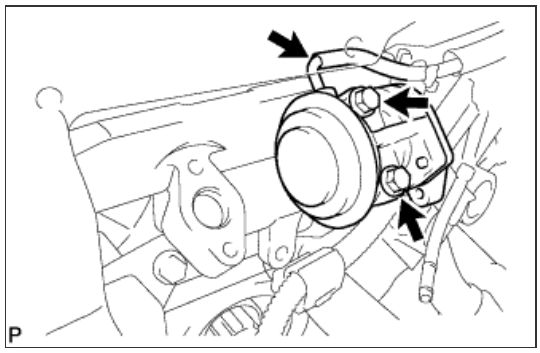
b. Remove the 2 bolts, gasket and No. 2 air switching valve from the rear water by-pass joint.



9. REMOVE NO. 1 AIR SWITCHING VALVE ASSEMBLY (w/ Secondary Air Injection System)

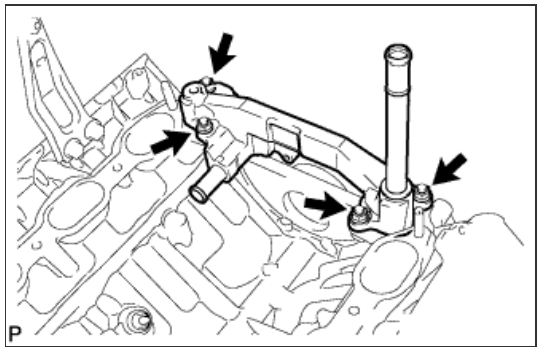
a. Remove the vacuum switching valve hose from the No. 1 air switching valve.

b. Remove the 2 bolts, gasket and No. 1 air switching valve from the rear water by-pass joint.



10. REMOVE REAR WATER BY-PASS JOINT

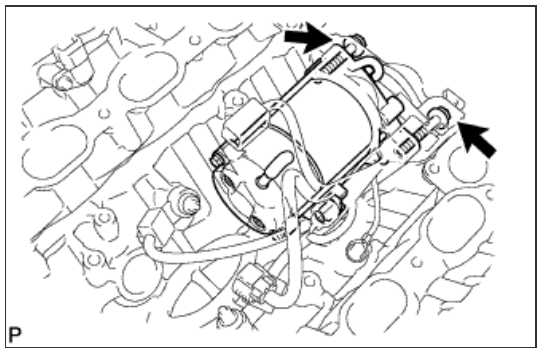
a. Remove the 4 nuts, water by-pass joint and 2 gaskets.



11. REMOVE STARTER ASSEMBLY

a. Remove the 2 bolts holding the starter to the cylinder block.

b. Disconnect the starter from the cylinder block.



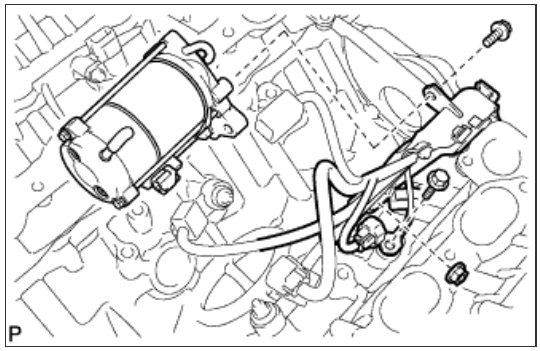
c. Remove the bolt and disconnect the engine wire protector from the starter.

d. Remove the bolt and disconnect the ground wire.

e. Disconnect the starter connector.

f. Remove the nut and disconnect the starter wire.

. Remove the starter.



for Preparation Click here

1. REMOVE STARTER DUST PROTECTOR

a. Remove the 2 dust protectors.

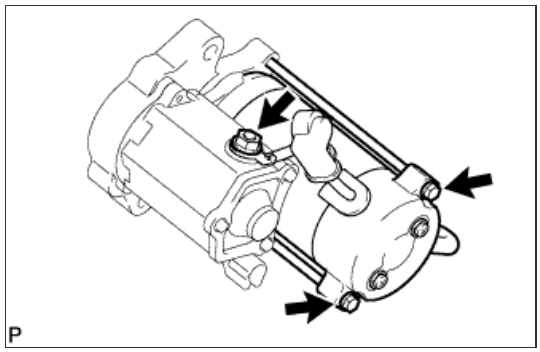
2. REMOVE STARTER YOKE ASSEMBLY

a. Remove the nut and disconnect the lead wire from terminal C.

b. Remove the 2 through bolts.

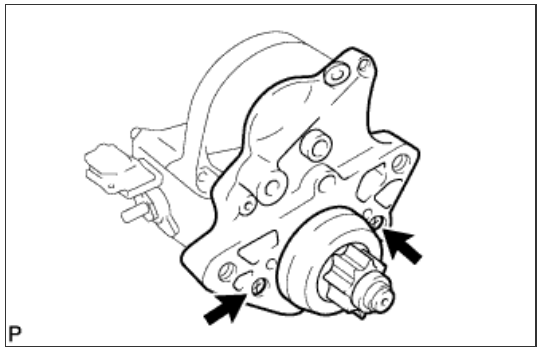
c. Pull out the starter yoke with the armature from the magnet starter switch.

d. Remove the O-ring from the starter yoke.

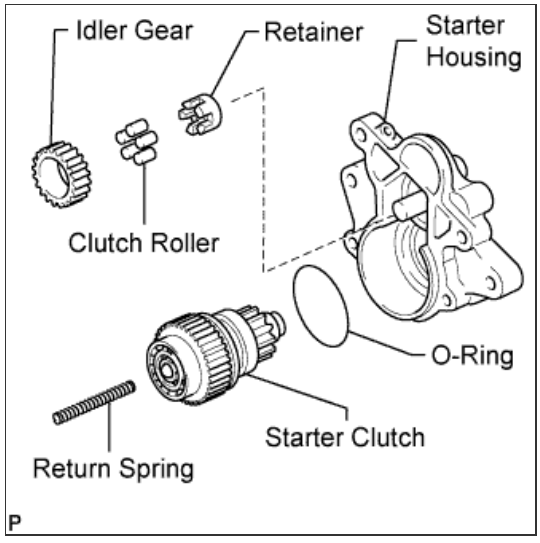


3. REMOVE STARTER CLUTCH SUB-ASSEMBLY

a. Remove the 2 screws.

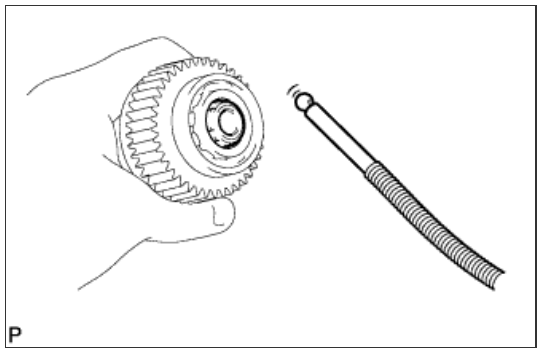


b. Remove the return spring, idler gear, clutch roller, retainer, O-ring and starter clutch from the starter housing.



c. Using a magnetic finger, remove the steel ball from the clutch shaft hole.

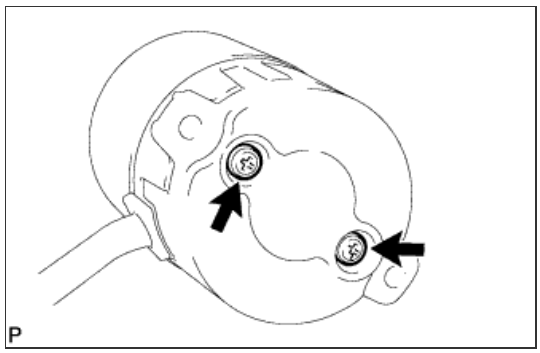
c. Using a magnetic finger, remove the steel ball from the clutch shaft hole.



4. REMOVE STARTER BRUSH HOLDER ASSEMBLY

a. Remove the 2 screws, 2 O-rings and starter commutator end frame from the starter yoke.

b. Remove the O-ring from the starter yoke.

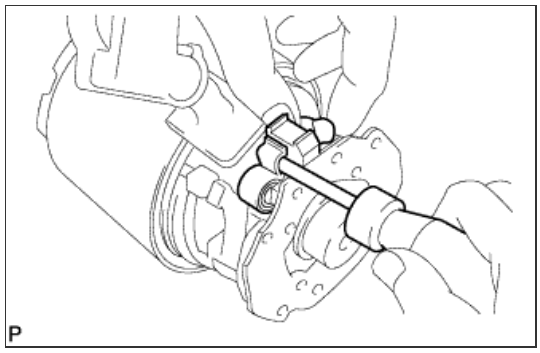


c. Using a screwdriver, hold the spring back and disconnect the brush from the brush holder.

d. Disconnect the 4 brushes and remove the brush holder.

OTICE:

Check that the positive (+) lead wires are not grounded.



5. REMOVE STARTER ARMATURE ASSEMBLY

a. Remove the starter armature from the starter yoke.

for Preparation Click here

1. INSPECT STARTER ASSEMBLY

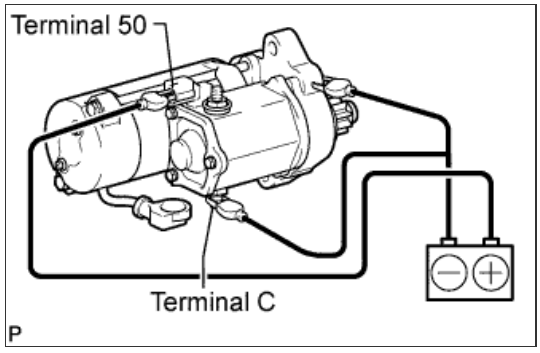
NOTICE:

The following tests must be done within 3 to 5 seconds to prevent the coil from burning out.

a. Perform the pull-in test.

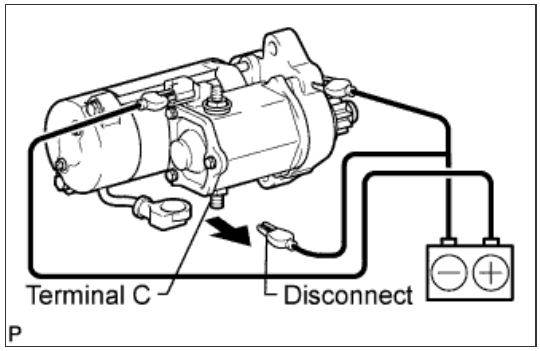
i. Remove the nut, then disconnect the lead wire from terminal C.

ii. Connect the battery to the magnet starter switch as shown in the illustration. Check that the clutch pinion gear moves outward.
If the clutch pinion gear does not move, replace the magnet starter switch assembly.



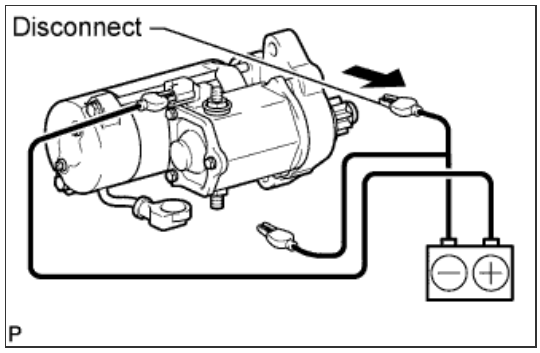
b. Perform the holding test.

i. With the battery connected as above with the clutch pinion gear out, disconnect the negative (-) lead from terminal C. Check that the pinion gear remains out.
If the clutch pinion gear returns inward, replace the magnet starter switch assembly.



c. Inspect the clutch pinion gear return.

i. Disconnect the negative (-) lead from the starter housing. Check that the clutch pinion gear returns inward.
If the clutch pinion gear does not return inward, replace the magnet starter switch assembly.



d. Perform the operation test without load.

i. Connect the field coil lead wire to terminal C.

Torque:
5.9 N*m{ 60 kgf*cm , 52 in.*lbf }

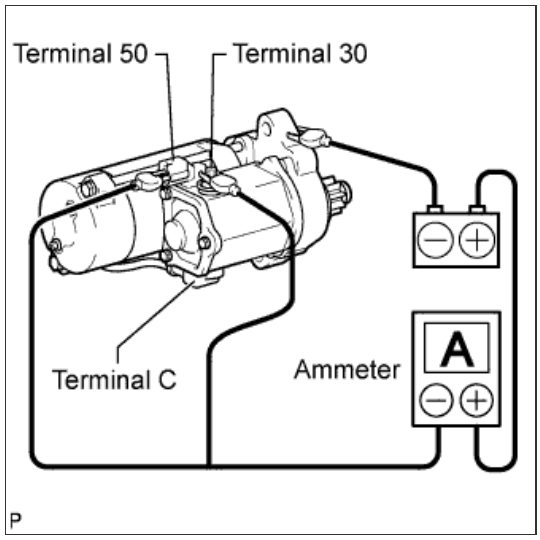
ii. Grip the starter in a vise.

iii. Connect the battery and an ammeter to the starter as shown.

iv. Check that the starter rotates smoothly and steadily while the pinion gear is moving out. Then measure the current.

Standard current:
100 A or less at 11.5 V

If the result is not as specified, replace the starter assembly.



2. INSPECT STARTER ARMATURE ASSEMBLY

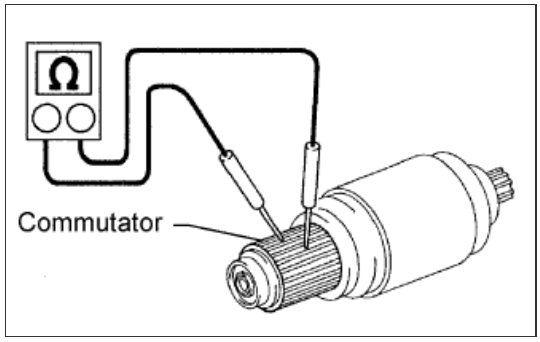
a. Inspect the commutator for an open circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Commutator	Always	Below 1 Ω

If the result is not as specified, replace the armature assembly.



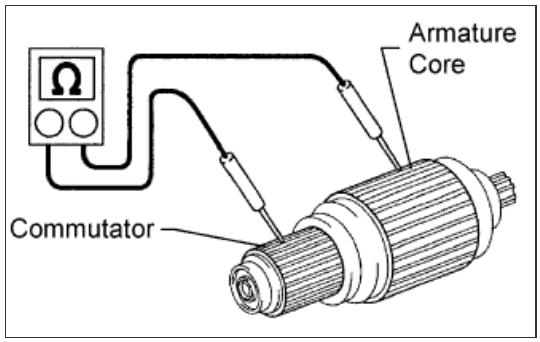
b. Inspect the commutator for a short circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Commutator - Armature core	Always	10 kΩ or higher

If the result is not as specified, replace the armature assembly.



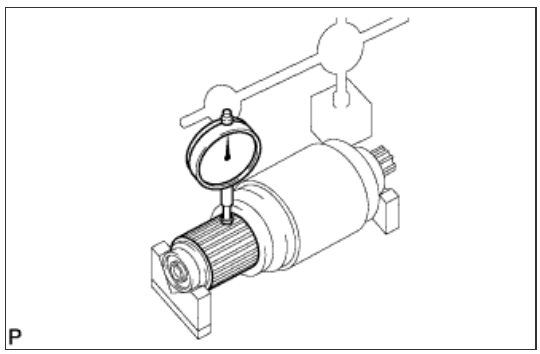
c. Inspect the commutator circle runout.

i. Place the commutator on V-blocks.

ii. Using a dial indicator, measure the circle runout.

Maximum circle runout:
0.05 mm (0.00197 in.)

If the runout is more than the maximum, correct it with sandpaper (#400) or replace the armature assembly.

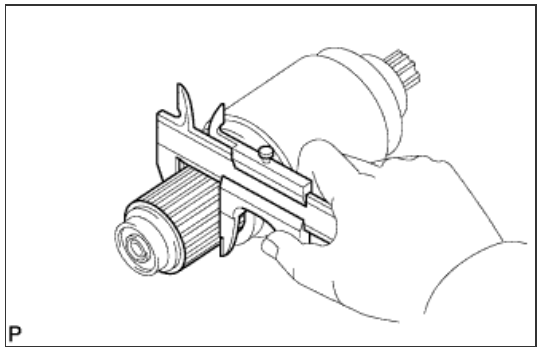


d. Using a vernier caliper, measure the commutator diameter.

Standard diameter:
35.0 mm (1.38 in.)

Minimum diameter:
34.0 mm (1.34 in.)

If the diameter is less than the minimum, replace the armature assembly.

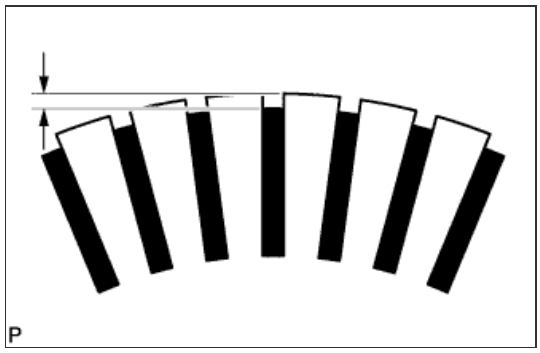


e. Measure the undercut depth of the commutator.

Standard undercut depth:
0.7 mm (0.0276 in.)

Minimum undercut depth:
0.2 mm (0.00787 in.)

If the undercut depth is less than the minimum, increase the depth using a hacksaw blade.



3. INSPECT STARTER YOKE ASSEMBLY

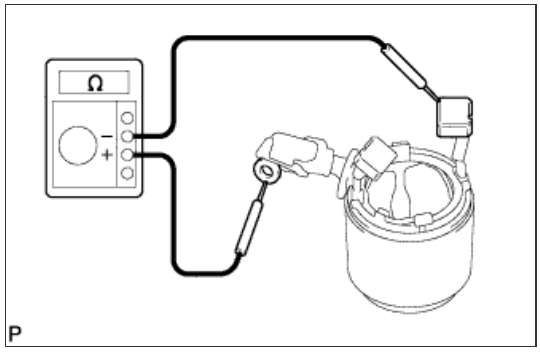
a. Inspect for an open circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Terminal C wire - Brushes	Always	Below 1 Ω

If the result is not as specified, replace the starter yoke assembly.



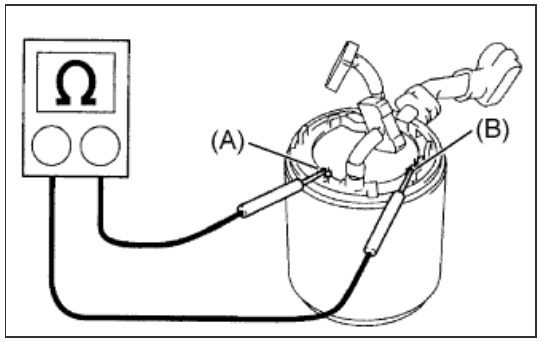
b. Inspect the shunt coil for an open circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Terminal (A) - Terminal (B)	20°C (68°F)	1.5 to 1.9 Ω

If the result is not as specified, replace the starter yoke assembly.



4. INSPECT BRUSH

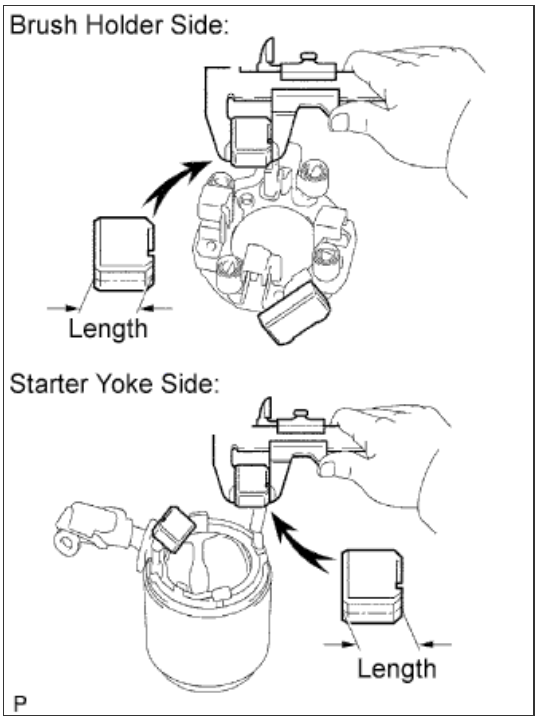
a. Using a vernier caliper, measure the brush length.

Standard length:

15.0 mm (0.591 in.)

Minimum length:
9.0 mm (0.354 in.)

If the length is less than the minimum, replace the brush holder and starter yoke assembly.



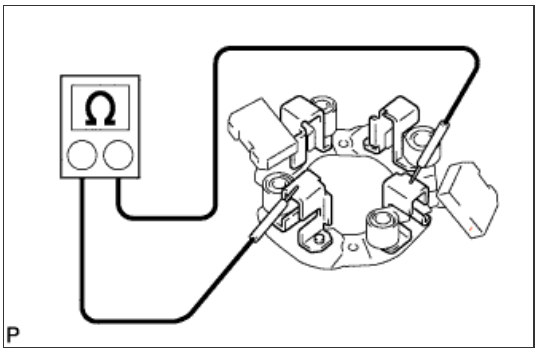
5. INSPECT STARTER BRUSH HOLDER ASSEMBLY

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Positive brush holder - Negative brush holder	Always	10 kΩ or higher

If the result is not as specified, replace the brush holder assembly.



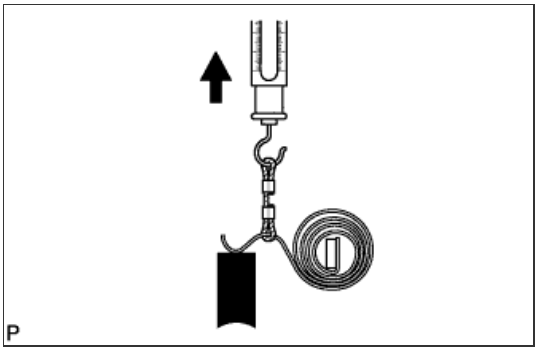
b. Inspect the load of the brush spring.

i. Take a pull scale reading immediately after the brush spring separates from the brush.

Standard spring installed load:
22 to 28 N (2 to 3 kgf, 4.9 to 6.3 lbf)

Minimum spring installed load:
13 N (1 kgf, 2.9 lbf)

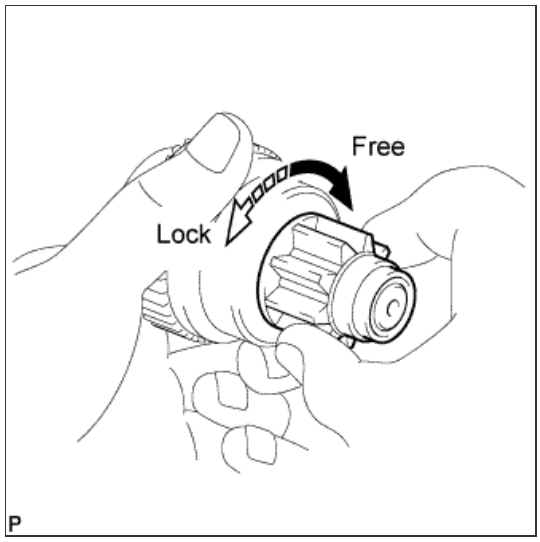
If the spring load is less than the minimum, replace the brush holder assembly.



6. INSPECT STARTER CLUTCH SUB-ASSEMBLY

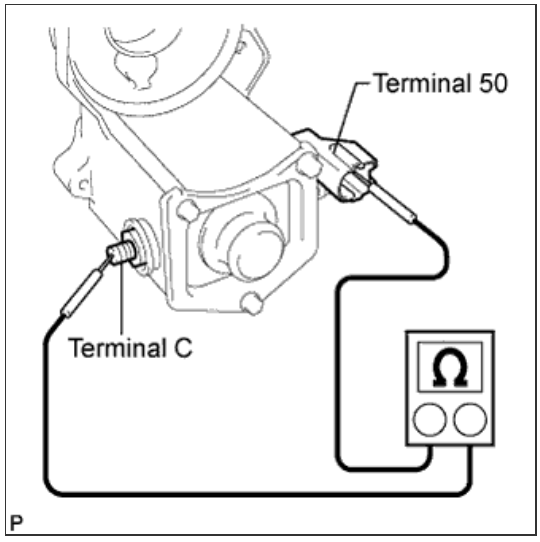
a. Check that the starter clutch cannot be rotated counterclockwise, and can be rotated clockwise.
If the starter clutch is not as specified, replace the starter clutch sub-assembly.

b. Turn the bearing by hand while applying inward force.
If resistance is felt or the bearing sticks, replace the starter clutch sub-assembly.



7. INSPECT MA NET STARTER SWITCH ASSEMBLY

a. Inspect the pull-in coil.



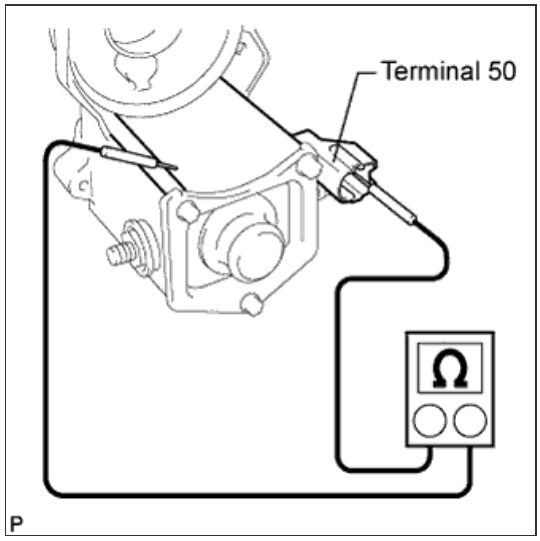
i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Terminal 50 - Terminal C	Always	Below 1 Ω

If the result is not as specified, replace the magnet starter switch assembly.

b. Inspect the holding coil.



i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Terminal 50 - Switch body	Always	Below 2 Ω

If the result is not as specified, replace the magnet starter switch assembly.

for Preparation Click here

1. INSTALL STARTER ARMATURE ASSEMBLY

a. Install the starter armature to the starter yoke.

2. INSTALL STARTER BRUSH HOLDER ASSEMBLY

a. Install a new O-ring to the groove of the starter yoke.

b. Place the brush holder on the starter yoke.

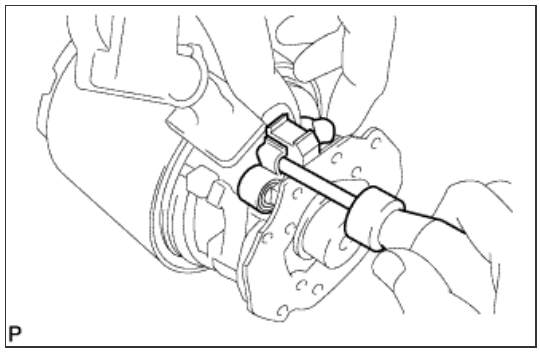
c. Using a screwdriver, hold the brush spring back.

d. Connect the brush to the brush holder.

e. Connect the 4 brushes.

NOTICE:

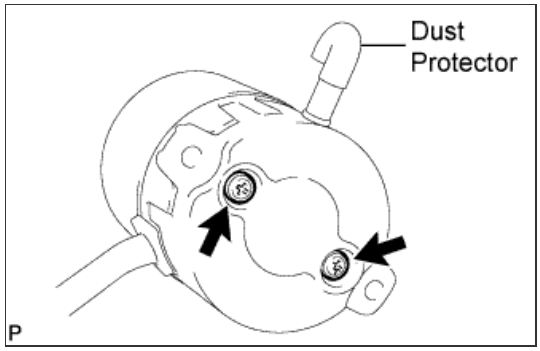
Check that the positive (+ lead wires are not grounded.



f. Install 2 new O-rings and the starter commutator end cover with the 2 screws.

Torque:
3.8 N*m{ 39 kgf*cm , 34 in.*lbf }

g. Install the dust protector as shown in the illustration.



3. INSTALL STARTER CLUTCH SUB-ASSEMBLY

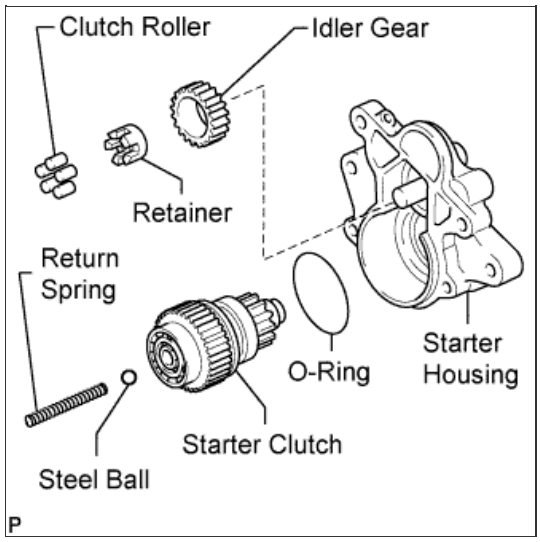
a. Apply grease to the steel ball, return spring, clutch roller, retainer and idler gear.

b. Install the steel ball.

c. Install a new O-ring to the starter housing.

d. Insert the return spring into the magnet starter switch hole.

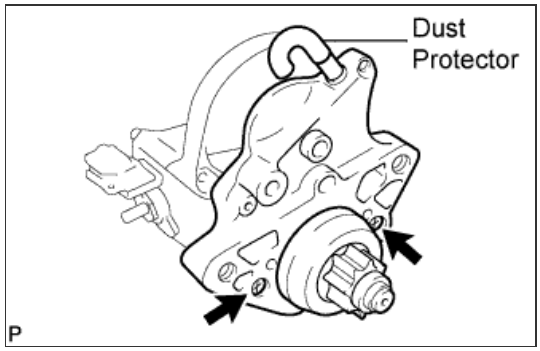
e. Install the starter clutch, idler gear, retainer and clutch roller.



f. Install the starter housing to the magnet starter switch with the 2 screws.

Torque:
9.3 N*m{ 95 kgf*cm , 82 in.*lbf }

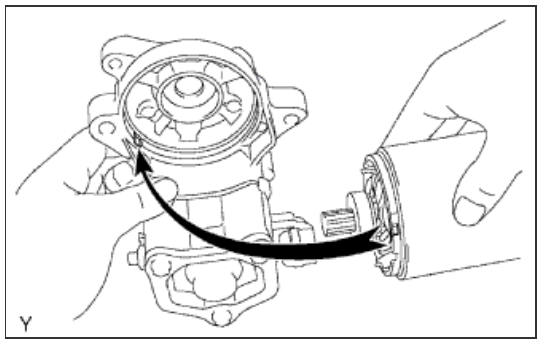
g. Install the dust protector as shown in the illustration.



4. INSTALL STARTER YOKE ASSEMBLY

a. Install a new O-ring to the groove of the starter yoke.

b. Align the protrusion of the starter yoke with the groove of the magnet starter switch.

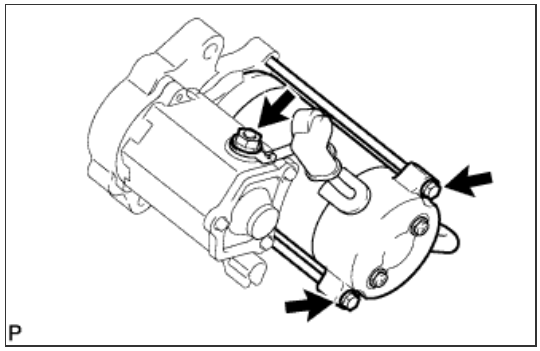


c. Install the starter yoke with the 2 through bolts.

Torque:
9.3 N*m{ 95 kgf*cm , 82 in.*lbf }

d. Connect the lead wire to the magnet starter switch terminal with the nut.

Torque:
5.9 N*m{ 60 kgf*cm , 52 in.*lbf }



for Preparation Click here

1. INSTALL STARTER ASSEMBLY

a. Connect the starter wire with the nut.

Torque:
9.8 N*m{ 100 kgf*cm , 87 in.*lbf }

b. Connect the starter connector.

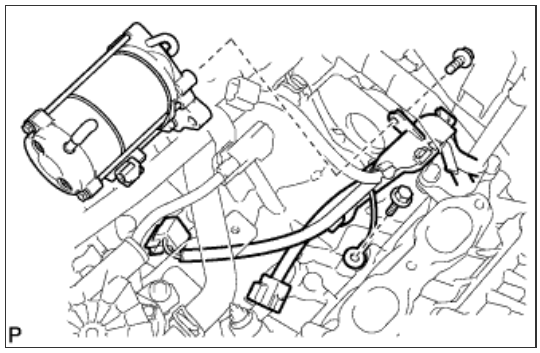
c. Connect the starter to the cylinder block.

d. Connect the ground wire with the bolt.

Torque:
17 N*m{ 173 kgf*cm , 13 ft.*lbf }

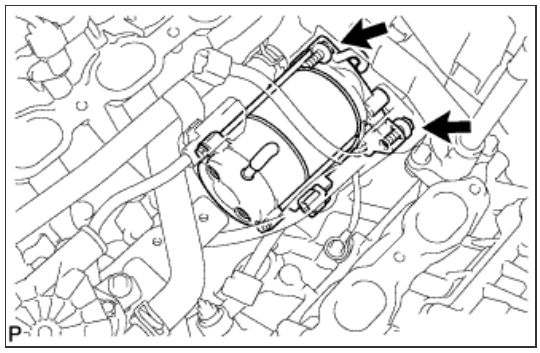
e. Connect the engine wire protector to the starter with the bolt.

Torque:
17 N*m{ 173 kgf*cm , 13 ft.*lbf }



f. Install the starter with the 2 bolts.

Torque:
25 N*m{ 255 kgf*cm , 18 ft.*lbf }



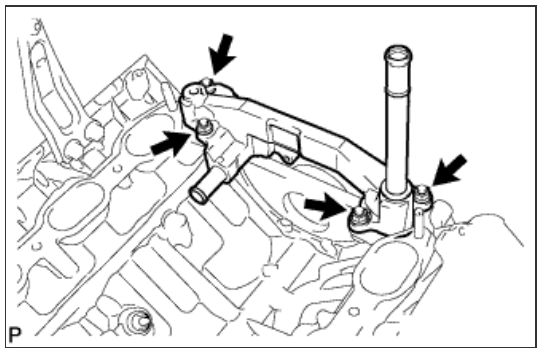
2. INSTALL REAR WATER BY-PASS JOINT

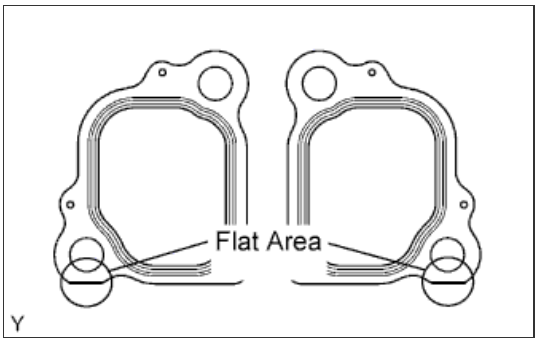
a. Install 2 new gaskets and the water by-pass joint with the 4 nuts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

HINT:

With the flat-bottom of each new gasket facing downward as shown in the illustration, install the 2 gaskets to the engine rear side.



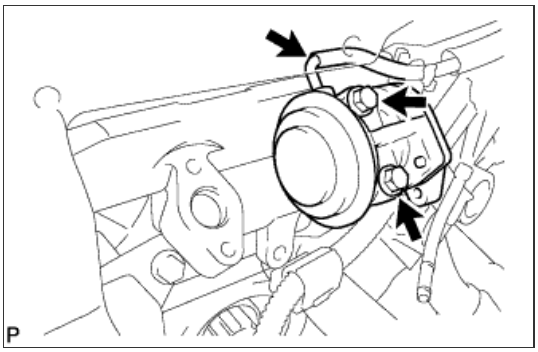


3. INSTALL NO. 1 AIR SWITCHING VALVE ASSEMBLY (eSondary Air Injection System)

a. Install a new gasket and the No. 1 air switching valve to the rear water by-pass joint with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Connect the vacuum switching valve hose to the No. 1 air switching valve.

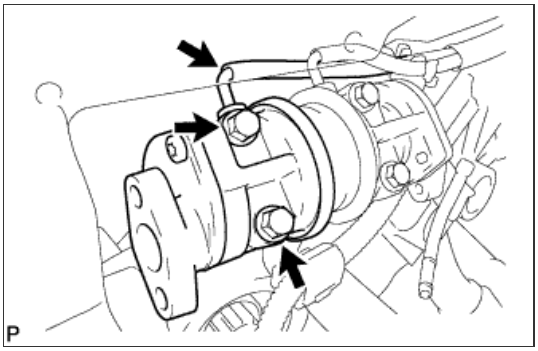


4. INSTALL NO. 2 AIR SWITCHING VALVE ASSEMBLY (eSondary Air Injection System)

a. Install a new gasket and the No. 2 air switching valve to the rear water by-pass joint with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Connect the vacuum switching valve hose to the No. 2 air switching valve.



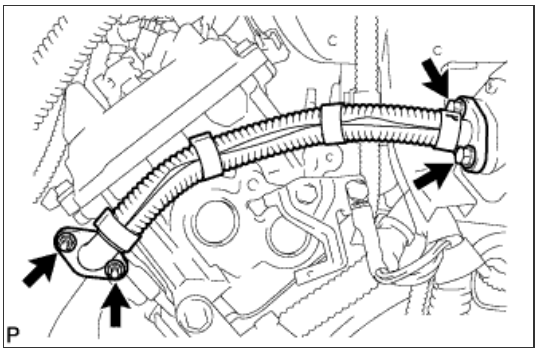
5. INSTALL NO. 3 AIR TUBE (eSondary Air Injection System)

a. Install a new gasket and connect the No. 3 air tube to the exhaust manifold with the 2 nuts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Install a new gasket and connect the No. 3 air tube to the No. 2 air switching valve with the 2 bolts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



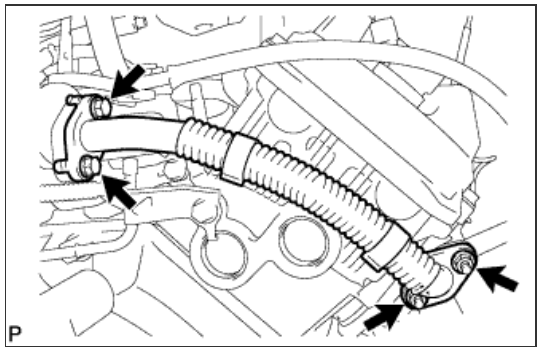
. INSTALL AIR TUBE SUB-ASSEMBLY RH (eSondary Air Injection System)

a. Install a new gasket and connect the air tube to the exhaust manifold with the 2 nuts.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Install a new gasket and connect the air tube to the No. 1 air switching valve with the 2 bolts.

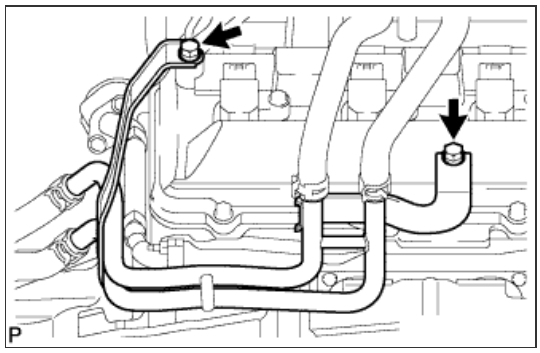
Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }



7. CONNECT NO. 1 WATER BY-PASS PIPE (eSondary Air Injection System)

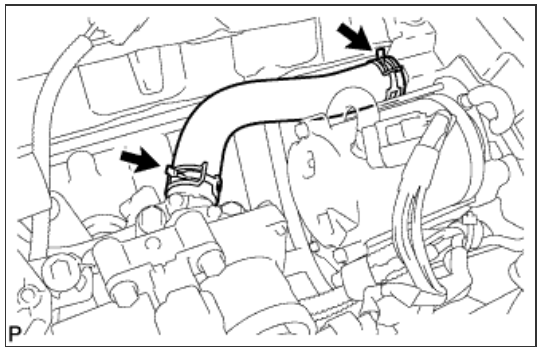
a. Connect the water by-pass pipe to the cylinder head cover RH with the 2 bolts.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }



8. INSTALL NO. 2 AIR INJECTION SYSTEM HOSE (eSondary Air Injection System)

a. Install the hose.



9. INSTALL WATER BY-PASS PIPE SUB-ASSEMBLY

a. Apply soapy water to the O-ring.

b. Install a new O-ring to the water by-pass pipe.

c. Push in the water by-pass pipe.

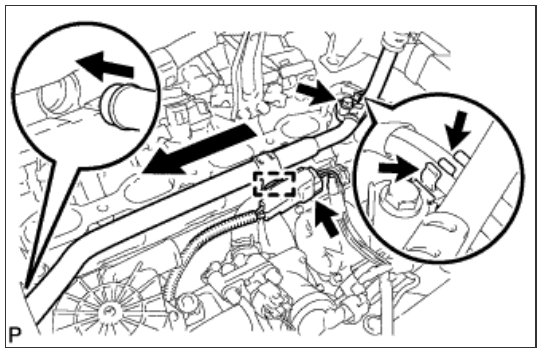
d. Install the water by-pass pipe with the bolt.

Torque:
18 N*m{ 184 kgf*cm , 13 ft.*lbf }

e. Connect the 2 vacuum switching valve hoses to the water by-pass pipe clamp.

f. Connect the wire harness clamp.

g. Connect the connector.



10. INSTALL INTAKE MANIFOLD

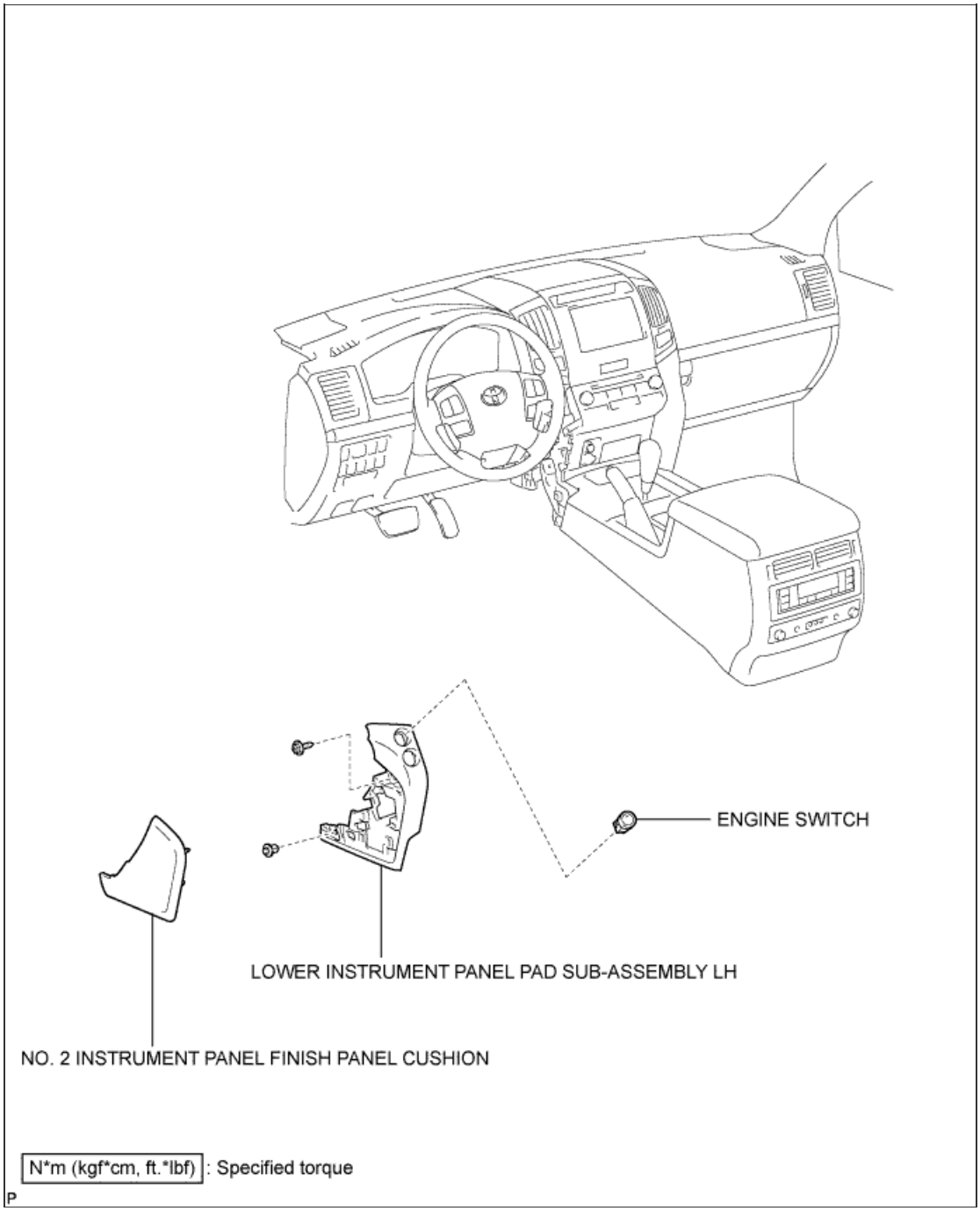
a. Install the intake manifold (Click here).

11. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

for Preparation Click here

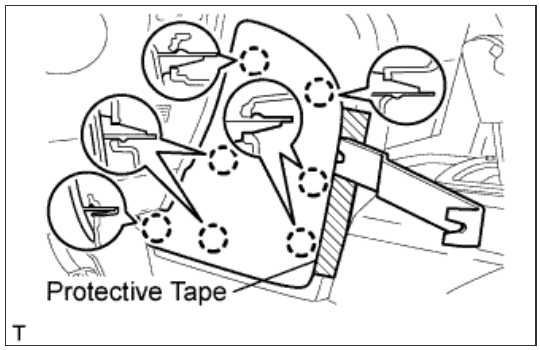


for Preparation Click here

1. REMOVE NO. 2 INSTRUMENT PANEL FINISH PANEL CUSHION

a. Place protective tape as shown in the illustration.

b. Using a moulding remover, detach the 7 claws and remove the panel cushion.



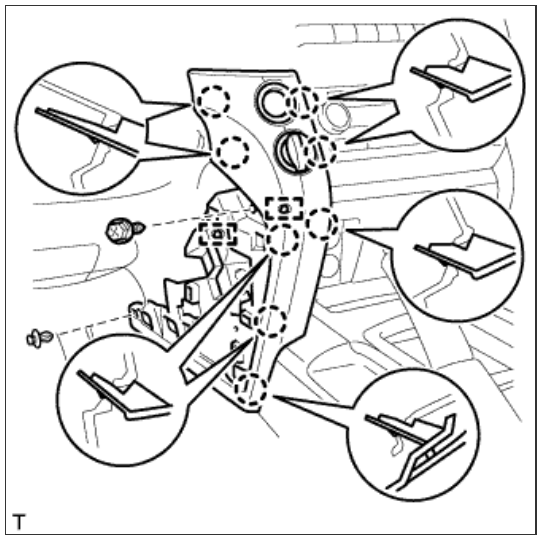
2. REMOVE LOWER INSTRUMENT PANEL PAD SUB-ASSEMBLY LH

a. Remove the clip.

b. Remove the screw.

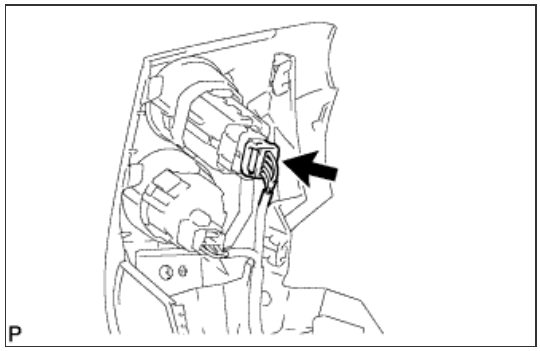
c. Detach the 8 claws.

d. Remove the panel pad and disconnect the connectors and 2 clamps.

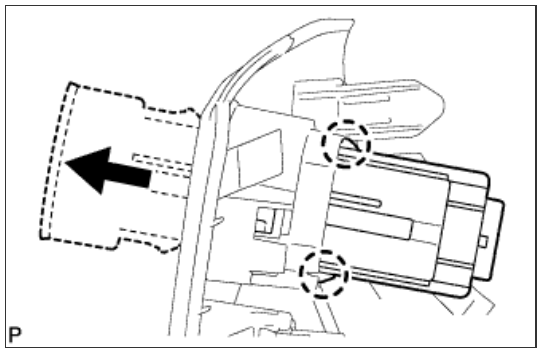


3. REMOVE ENGINE SWITCH

a. Disconnect the switch connector.



b. Detach the 2 claws and remove the switch.


P

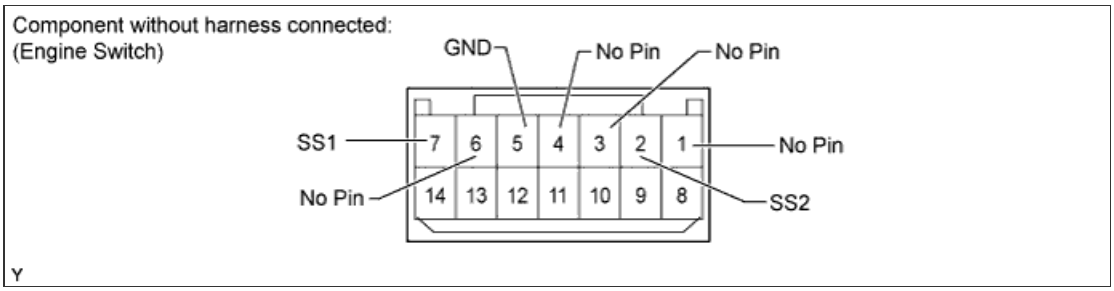
for Preparation Click here

1. INSPECT ENGINE SWITCH

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Switch Condition	Specified Condition
7 (SS1) - 5 (GND)	Not pushed	10 kΩ or higher
2 (SS2) - 5 (GND)	Not pushed	10 kΩ or higher
7 (SS1) - 5 (GND)	Pushed	Below 1 Ω
2 (SS2) - 5 (GND)	Pushed	Below 1 Ω



If the result is not as specified, replace the engine switch.

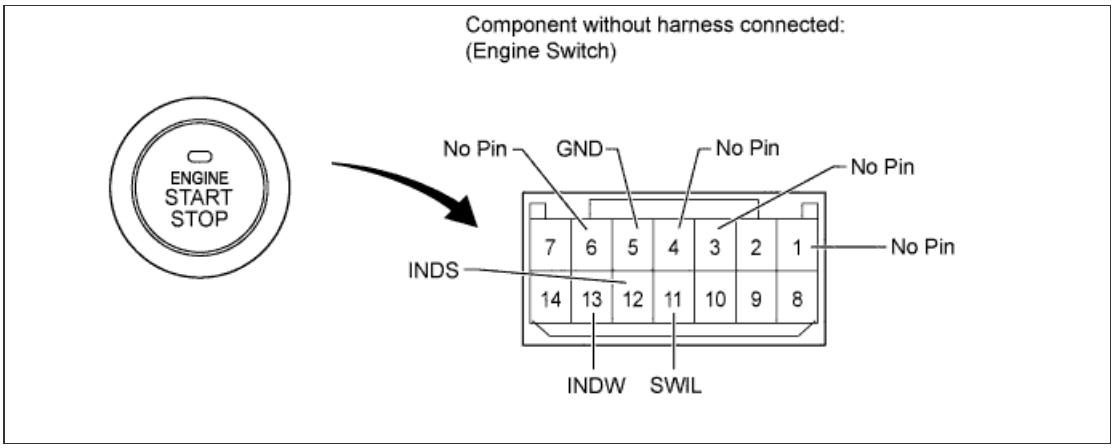
b. Apply battery voltage between the terminals of the switch, and check the illumination condition of the switch.

HINT:

- **If the positive (+) lead and the negative (-) lead are incorrectly connected, the engine switch indicator will not illuminate.**
- **If the voltage is too low, the indicator will not illuminate.**

OK:

Measurement Condition	Specified Condition
Battery positive (+) → Terminal 11 (SWIL) Battery negative (-) → Terminal 5 (GND)	Illuminates (illumination of lettering)
Battery positive (+) → Terminal 12 (INDS) Battery negative (-) → Terminal 5 (GND)	Illuminates (green)
Battery positive (+) → Terminal 13 (INDW) Battery negative (-) → Terminal 5 (GND)	Illuminates (amber)

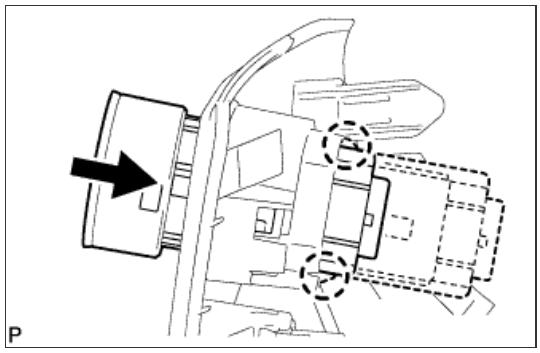


If the result is not as specified, replace the engine switch.

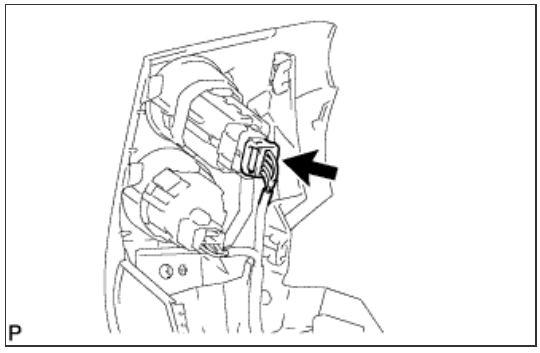
for Preparation Click here

1. INSTALL ENGINE SWITCH

a. Attach the 2 claws to install the switch.



b. Connect the switch connector.



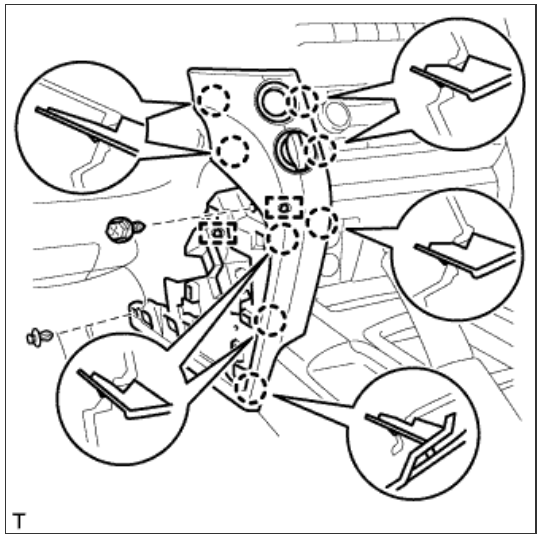
2. INSTALL LOWER INSTRUMENT PANEL PAD SUB-ASSEMBLY LH

a. Connect the connectors and 2 clamps.

b. Attach the 8 claws to install the panel pad.

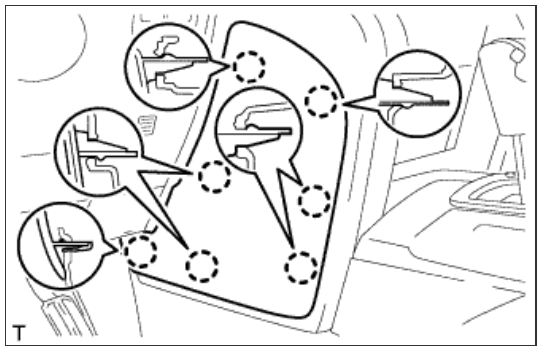
c. Install the screw.

d. Install the clip.



3. INSTALL NO. 2 INSTRUMENT PANEL FINISH PANEL CUSHION

a. Attach the 7 claws to install the panel cushion.


T

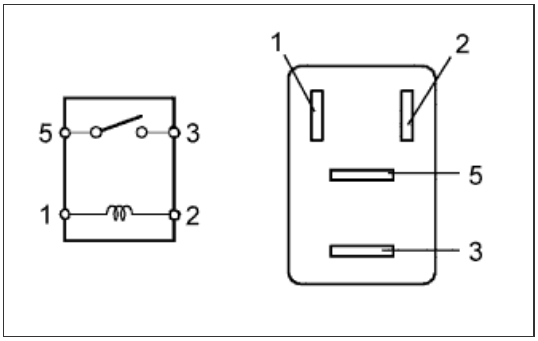
for Preparation Click here

1. INSPECT STARTER RELAY (ST)

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage applied to terminals 1 and 2	Below 1 Ω



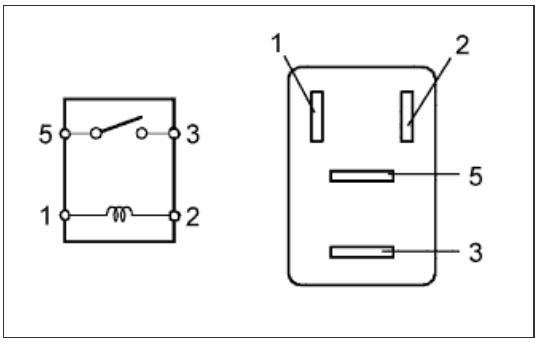
If the result is not as specified, replace the relay.

2. INSPECT STARTER CUT RELAY (ST CUT)

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

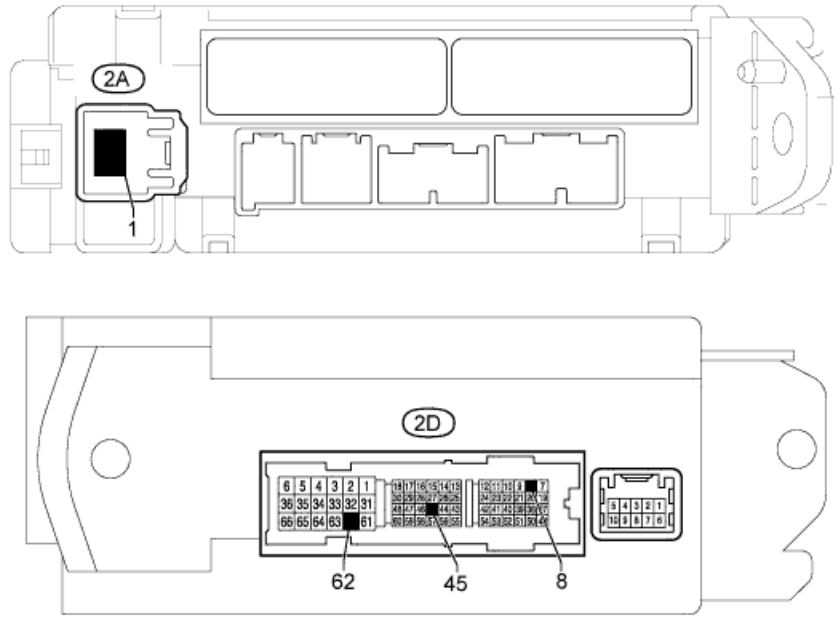
Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage applied to terminals 1 and 2	Below 1 Ω



If the result is not as specified, replace the relay.

3. INSPECT MAIN BODY ECU (ACC RELAY)

Component without harness connected: (Main Body ECU)



P

a. Measure the resistance of the ACC relay circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
2A-1 - 2D-8	Battery voltage not applied between 2D-45 and 2D-62	10 kΩ or higher
	Battery voltage applied between 2D-45 and 2D-62	Below 1 Ω

If the result is not as specified, replace the main body ECU.

for Preparation Click here

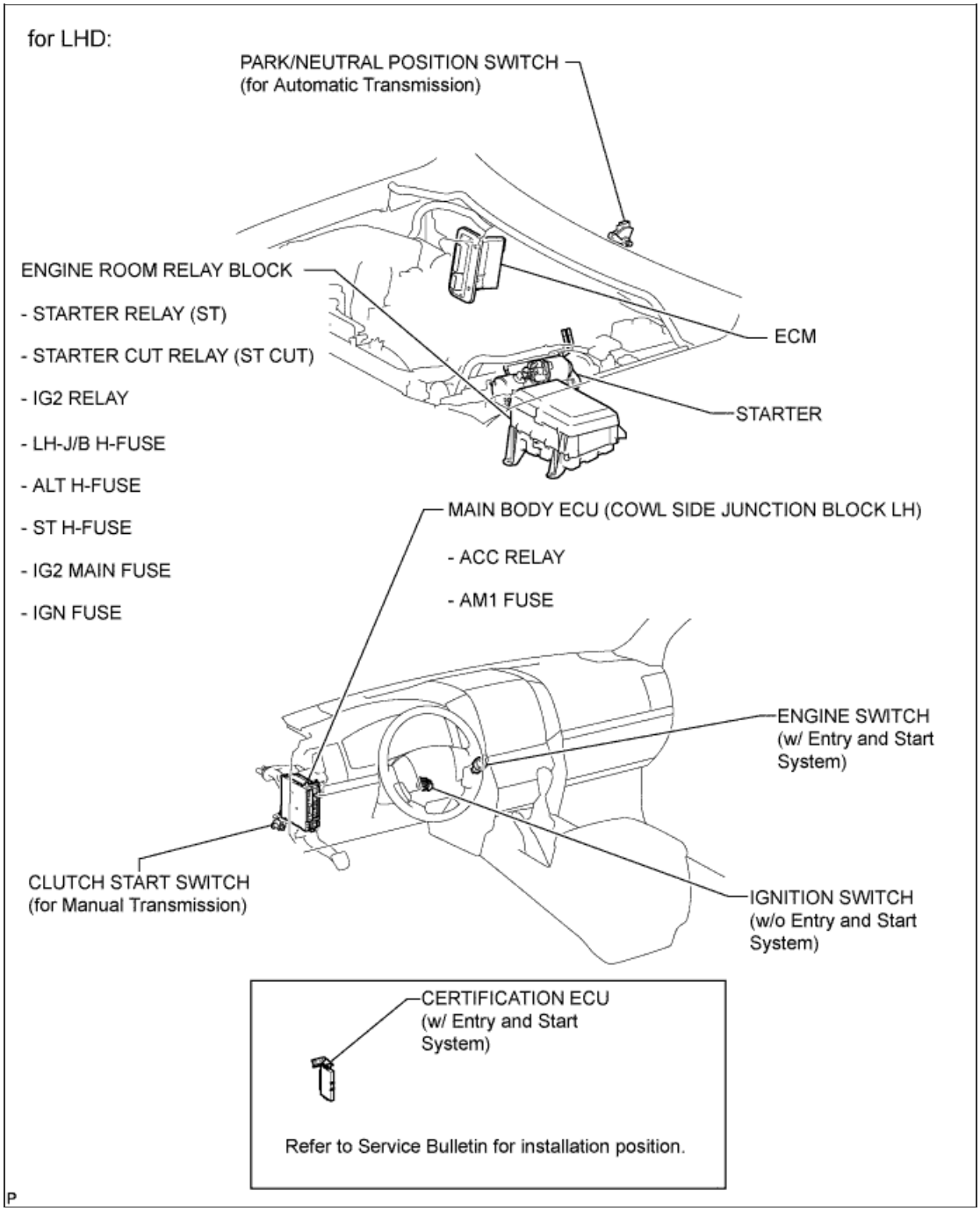
1.IGNITION SWITCH E PRESSION

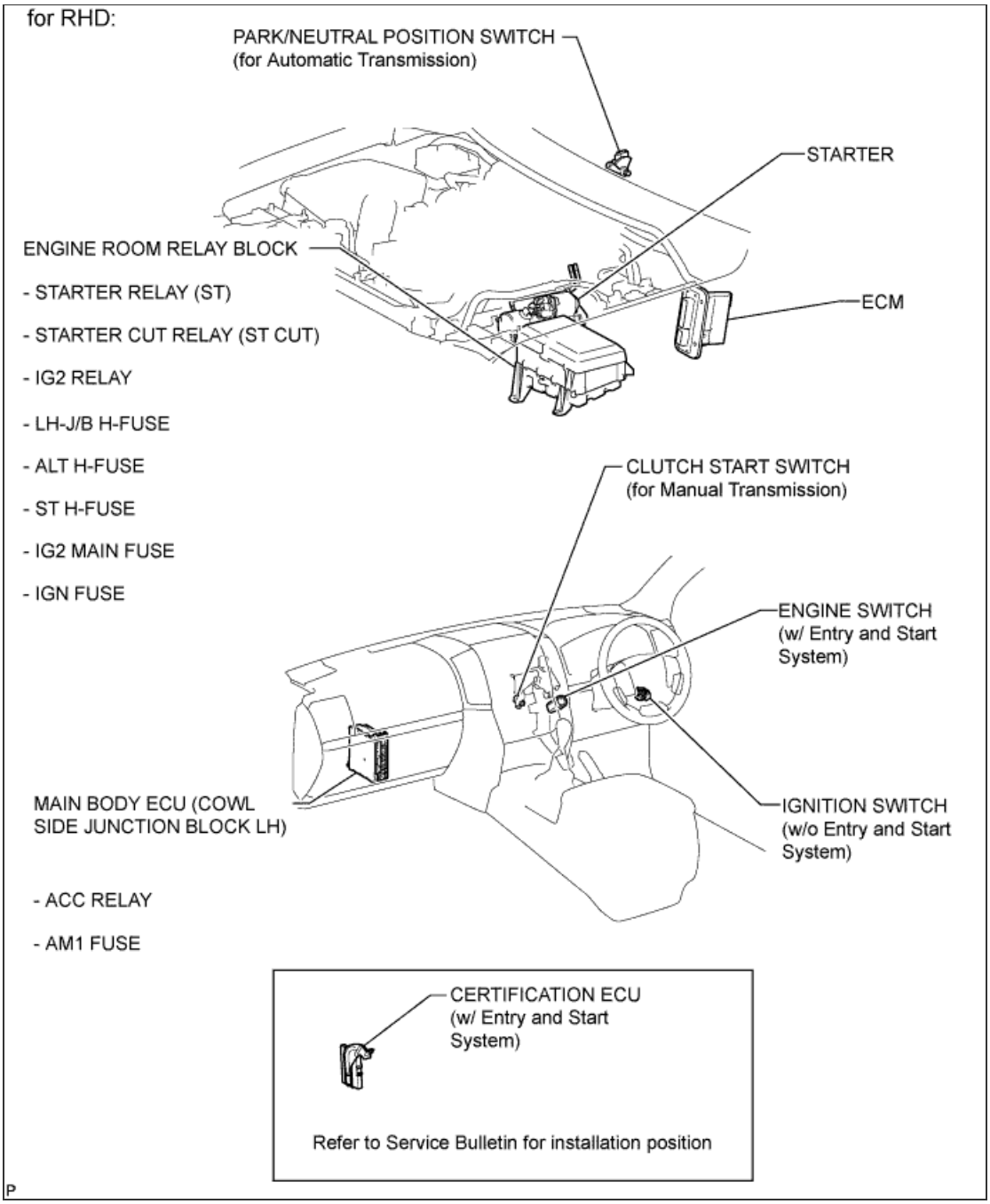
HINT:

The type of ignition switch used on this model differs depending on the specifications of the vehicle. The e pressions listed in the table below are used in this section.

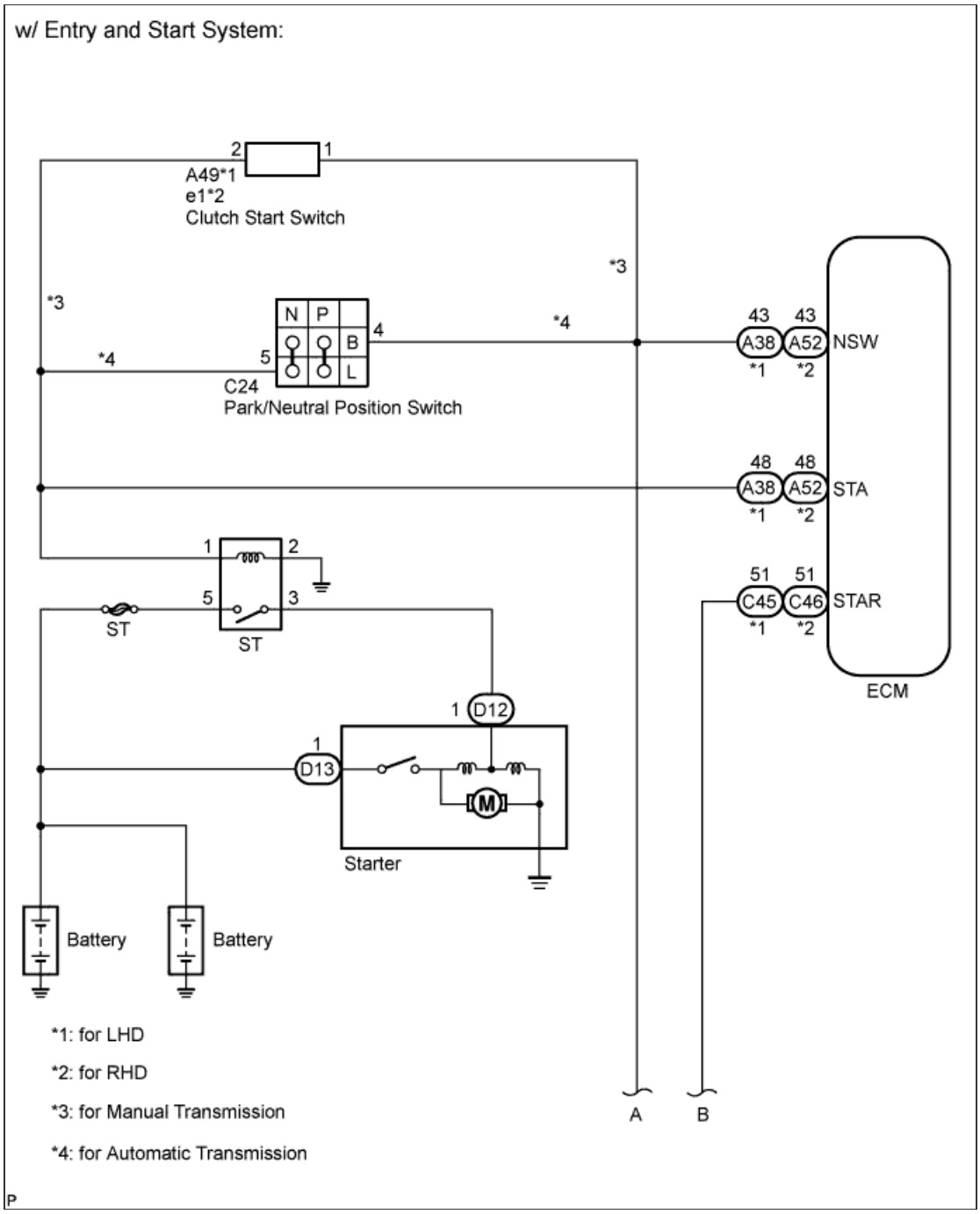
E pression	Ignition Switch (Position)	Engine Switch (ondition)
Ignition Switch off	LO	ff
Ignition Switch A		n (A
gnition Switch ON	ON	On (IG)
Engine Start	START	Start

for Preparation Click here

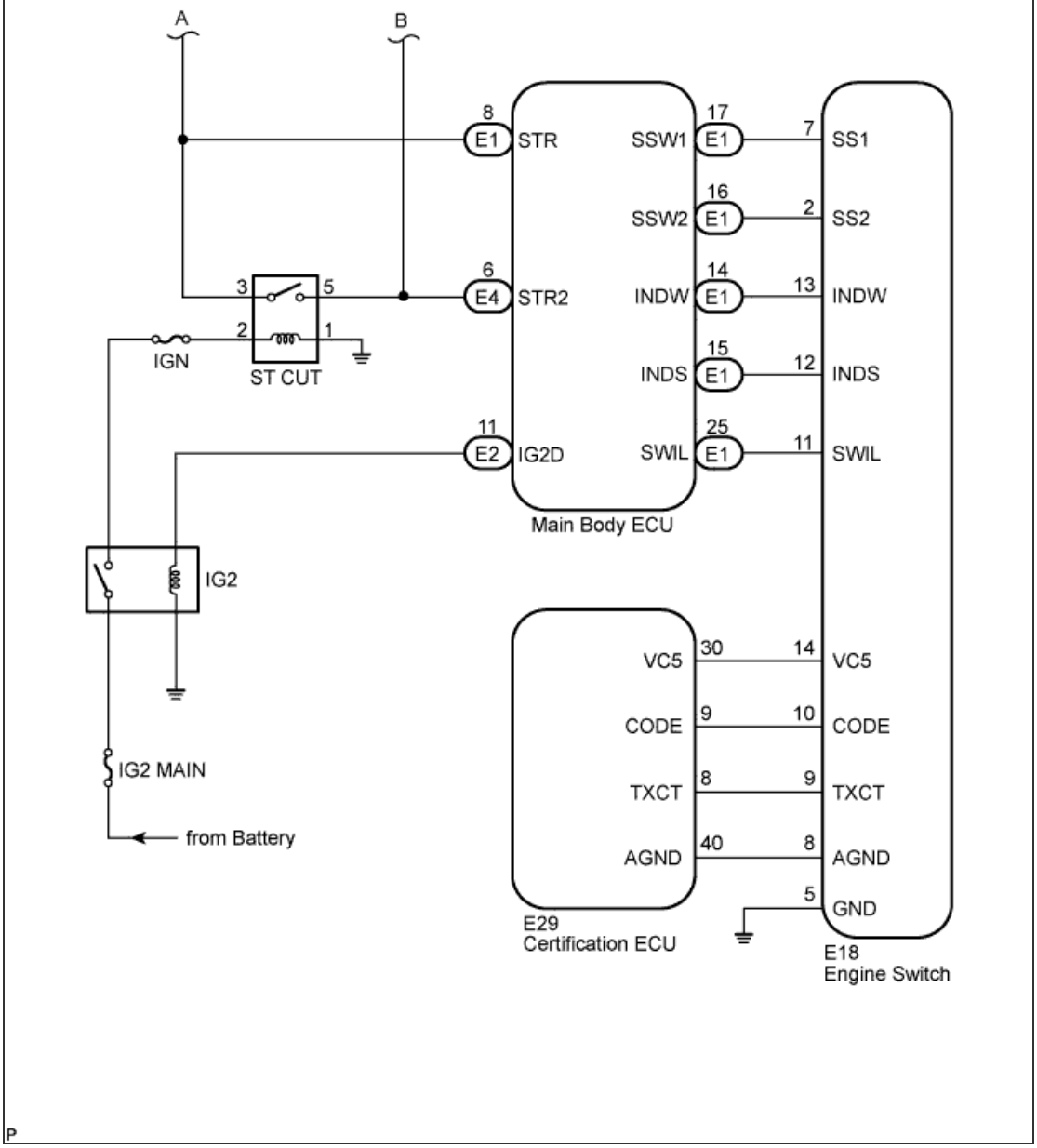



for RHD:
PARK/NEUTRAL POSITION SWITCH
(for Automatic Transmission)
STARTER
ENGINE ROOM RELAY BLOCK
- STARTER RELAY (ST)
- STARTER CUT RELAY (ST CUT)
- IG2 RELAY
- LH-J/B H-FUSE
- ALT H-FUSE
- ST H-FUSE
- IG2 MAIN FUSE
- IGN FUSE
ECM
CLUTCH START SWITCH
(for Manual Transmission)
ENGINE SWITCH
(w/ Entry and Start
System)
IGNITION SWITCH
(w/o Entry and Start
System)
MAIN BODY ECU (COWL
SIDE JUNCTION BLOCK LH)
- ACC RELAY
- AM1 FUSE
CERTIFICATION ECU
(w/ Entry and Start
System)
Refer to Service Bulletin for installation position
P

for Preparation Click here

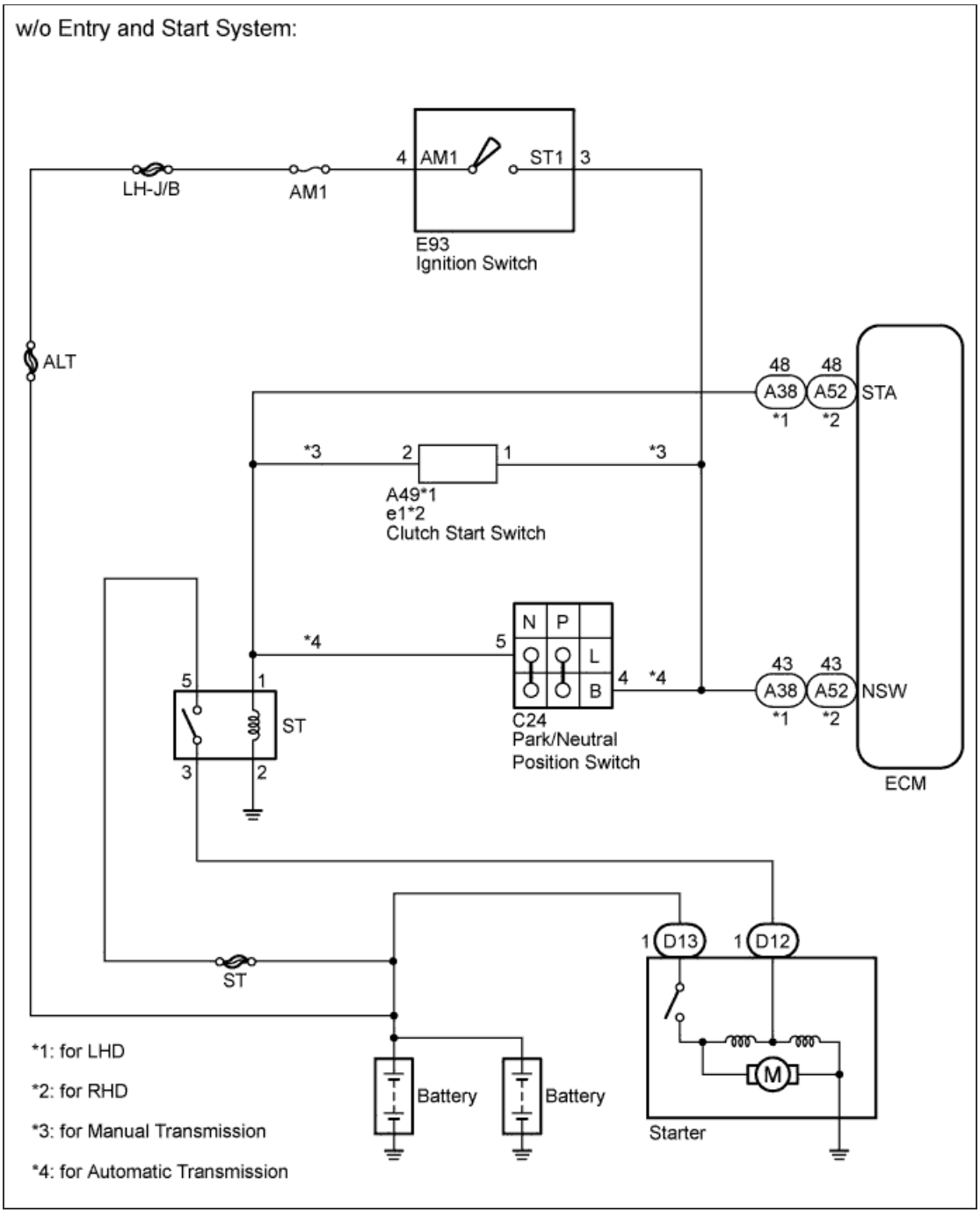


w/ Entry and Start System:

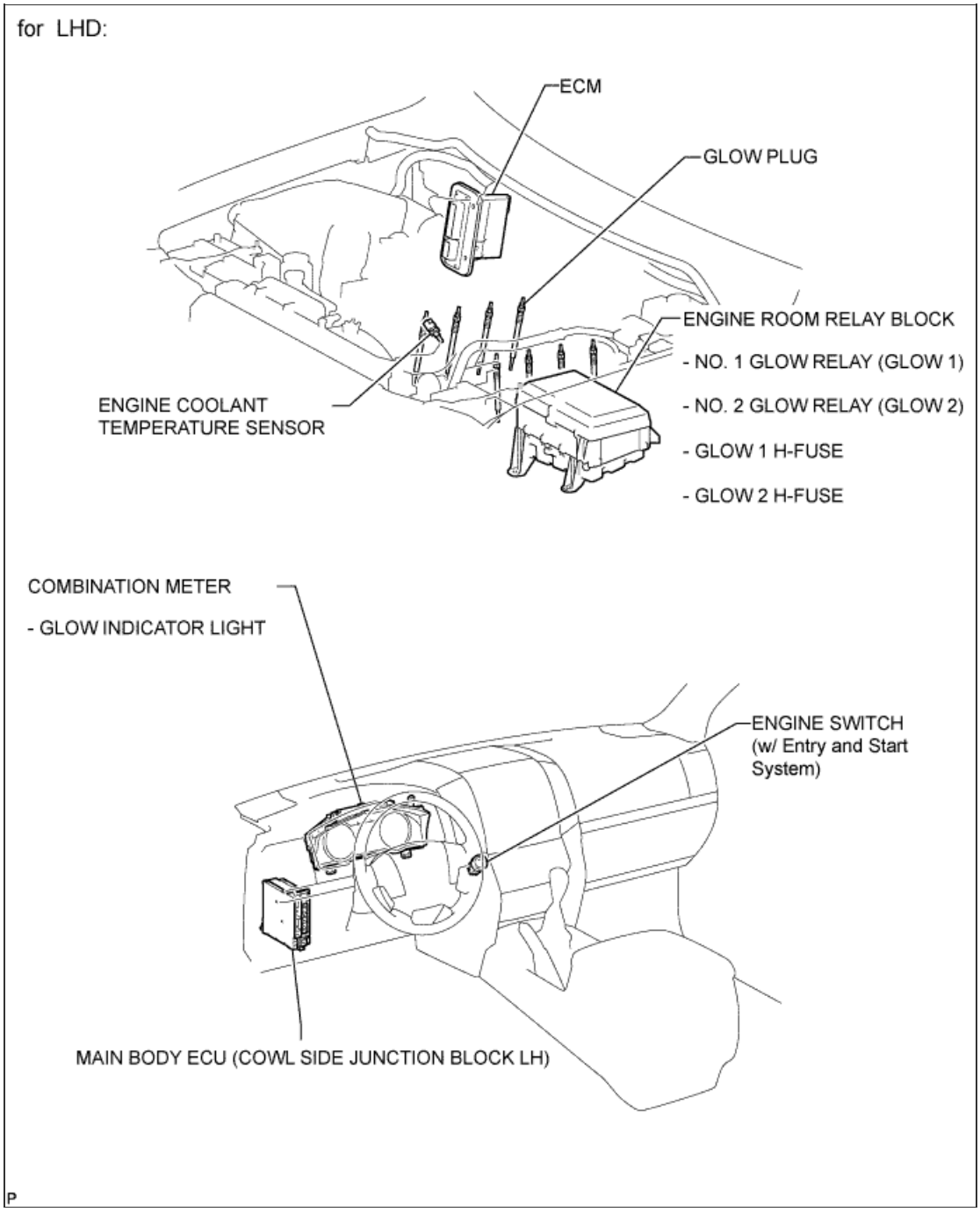


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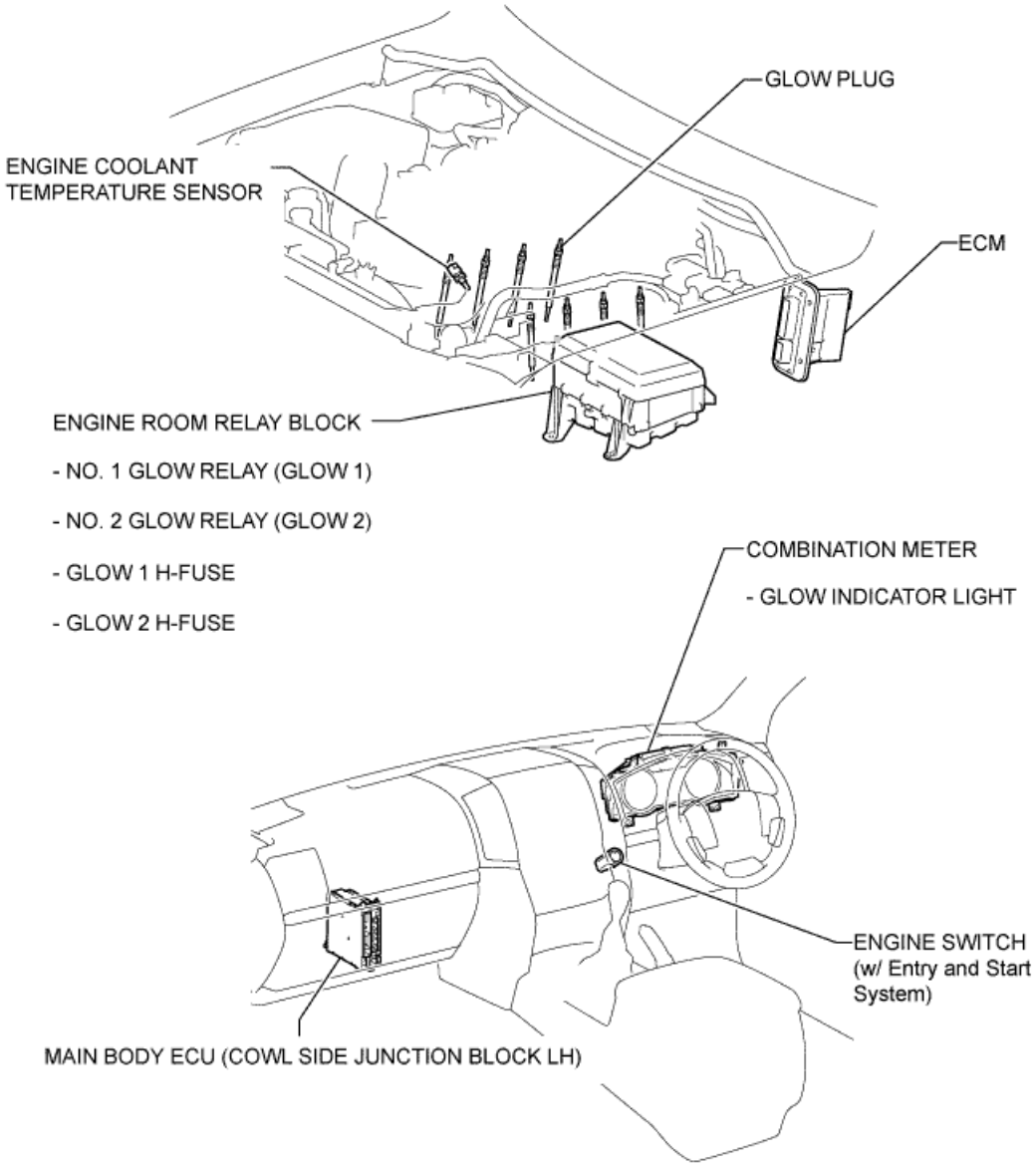
w/o Entry and Start System:



for Preparation Click here

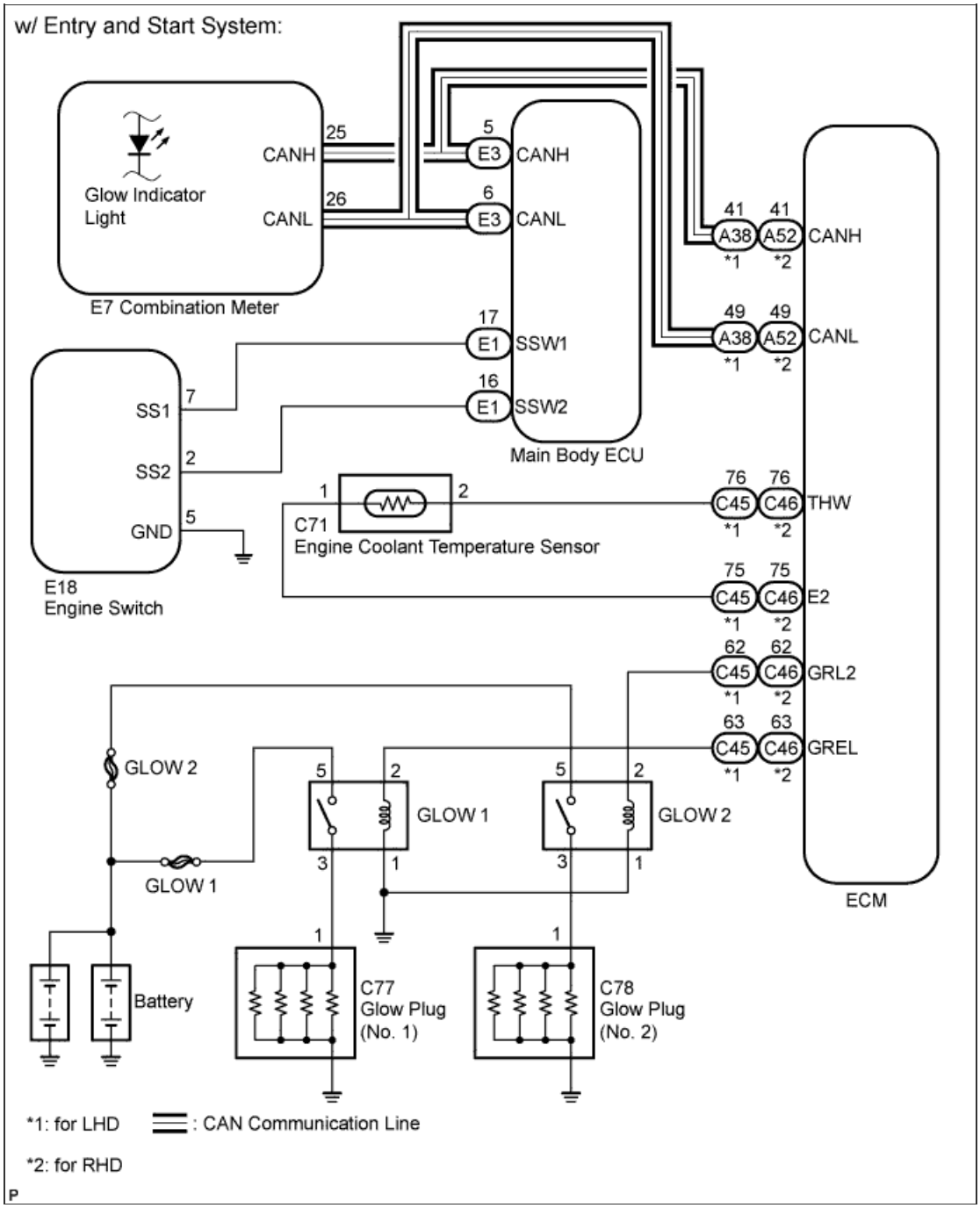


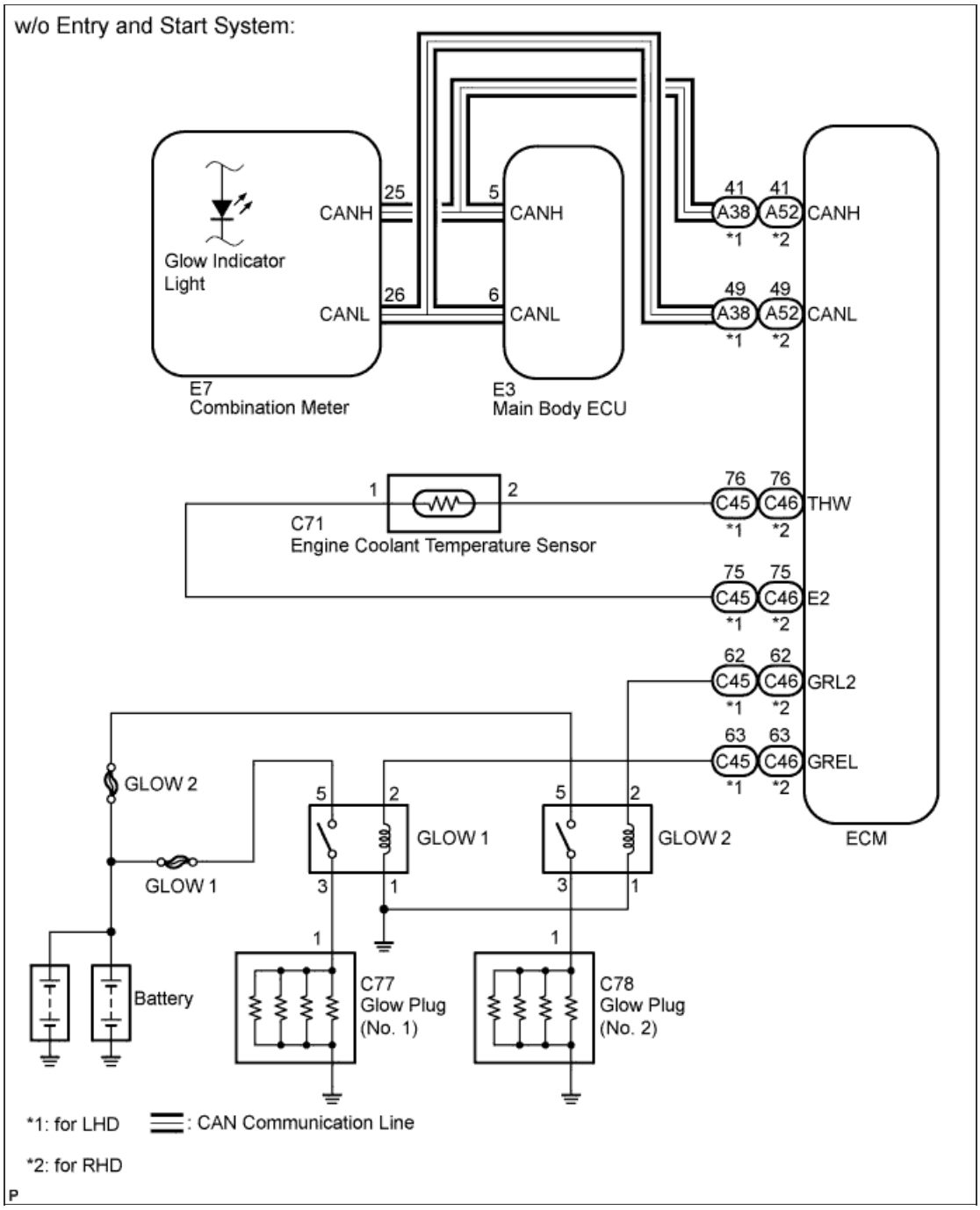
for RHD:


GLOW PLUG
ENGINE COOLANT TEMPERATURE SENSOR
ECM
ENGINE ROOM RELAY BLOCK
- NO. 1 GLOW RELAY (GLOW 1)
- NO. 2 GLOW RELAY (GLOW 2)
- GLOW 1 H-FUSE
- GLOW 2 H-FUSE
COMBINATION METER
- GLOW INDICATOR LIGHT
ENGINE SWITCH (w/ Entry and Start System)
MAIN BODY ECU (COWL SIDE JUNCTION BLOCK LH)

P

for Preparation Click here

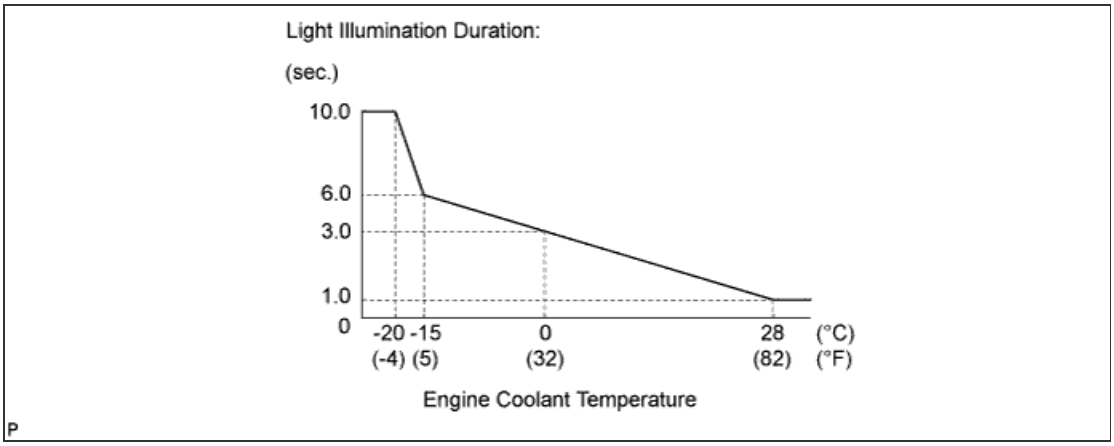



w/o Entry and Start System:
Glow Indicator Light
CANH
CANL
25
26
5
6
CANH
CANL
E7
Combination Meter
E3
Main Body ECU
41
41
A38
A52
CANH
*1
*2
49
49
A38
A52
CANL
*1
*2
ECM
1
2
C71
Engine Coolant Temperature Sensor
76
76
C45
C46
THW
*1
*2
75
75
C45
C46
E2
*1
*2
62
62
C45
C46
GRL2
*1
*2
63
63
C45
C46
GREL
*1
*2
GLOW 2
GLOW 1
5
2
3
1
GLOW 1
GLOW 2
Battery
C77
Glow Plug
(No. 1)
C78
Glow Plug
(No. 2)
*1: for LHD
: CAN Communication Line
*2: for RHD
P

for Preparation Click here

1. CHECK ILLUMINATION DURATION OF GLOW INDICATOR LIGHT

a. Check the light illumination duration.



i. Turn the ignition switch to ON and measure the light illumination duration.

Light illumination duration:
See graph.

If the result is not as specified, check the ECM, engine coolant temperature sensor, glow plug assembly and glow relay.

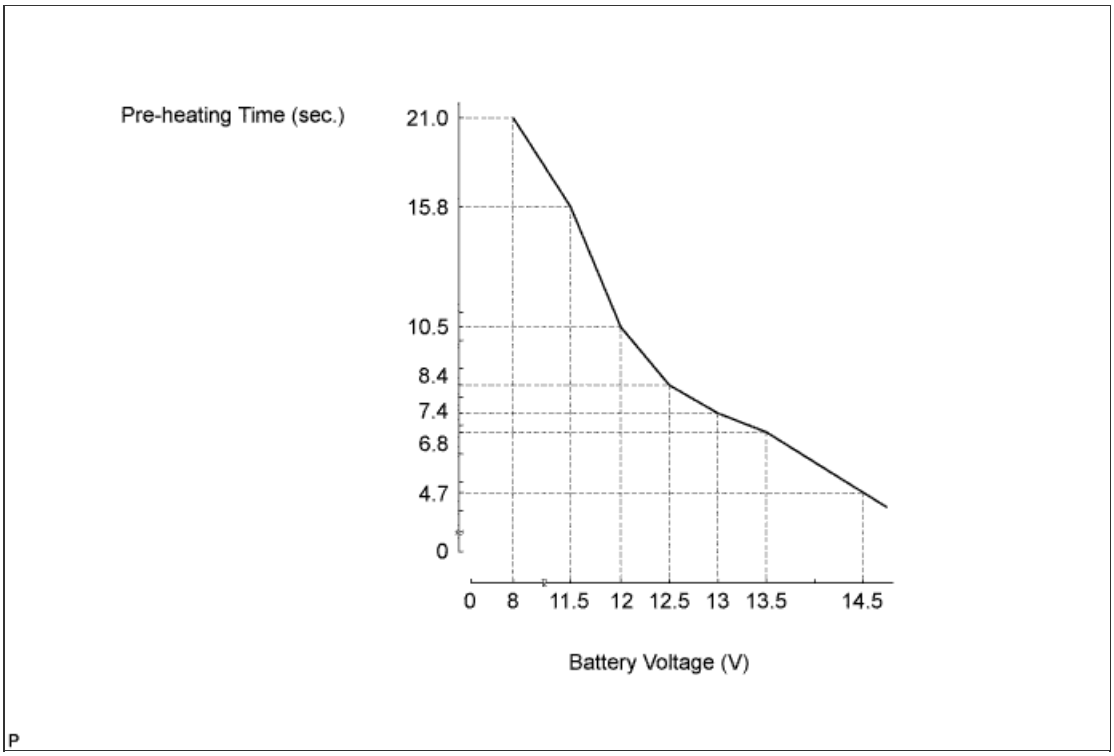
HINT:

Actual light illumination duration may vary slightly from the graph.

ii. Turn the ignition switch off.

2. CHECK PRE-HEATING

a. Inspect the pre-heating time.



i. Turn the ignition switch to ON. Measure how long it takes for the battery voltage to be applied to the glow plugs.

Standard Pre-Heating Time:

Engine Coolant Temperature	Specified Condition
40°C (104°F) or higher	1 second
Below 40°C (104°F)	See graph* (Maximum: 21 seconds)

HINT:

*: The pre-heating time changes depending on the battery voltage.

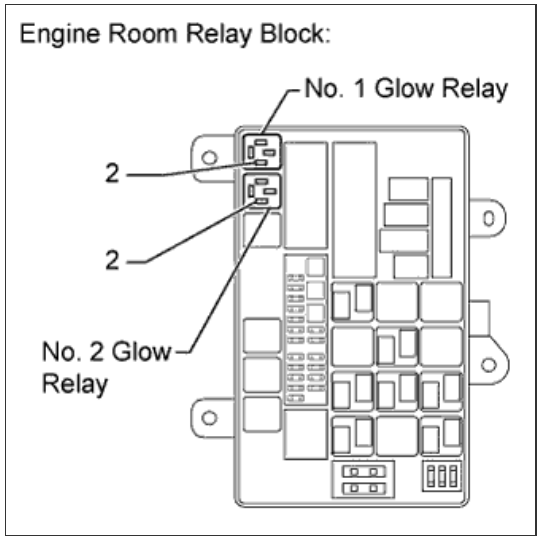
If the result is not as specified, check the ECM, engine coolant temperature sensor, glow plug assembly and glow relay.

ii. Turn the ignition switch off.

3. CHECK AFTER GLOW TIME

a. Remove the No. 1 glow relay (GLOW 1) from the engine room relay block.

b. Remove the No. 2 glow relay (GLOW 2) from the engine room relay block.

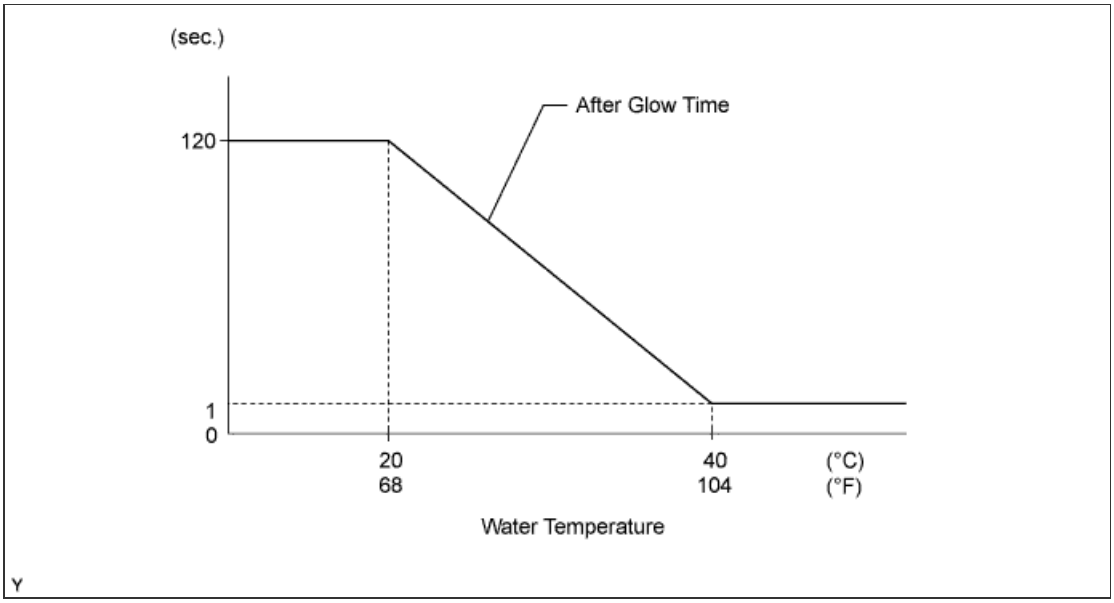


c. After the engine starts, measure the time duration that battery voltage remains present.

c. After the engine starts, measure the time duration that battery voltage remains present.

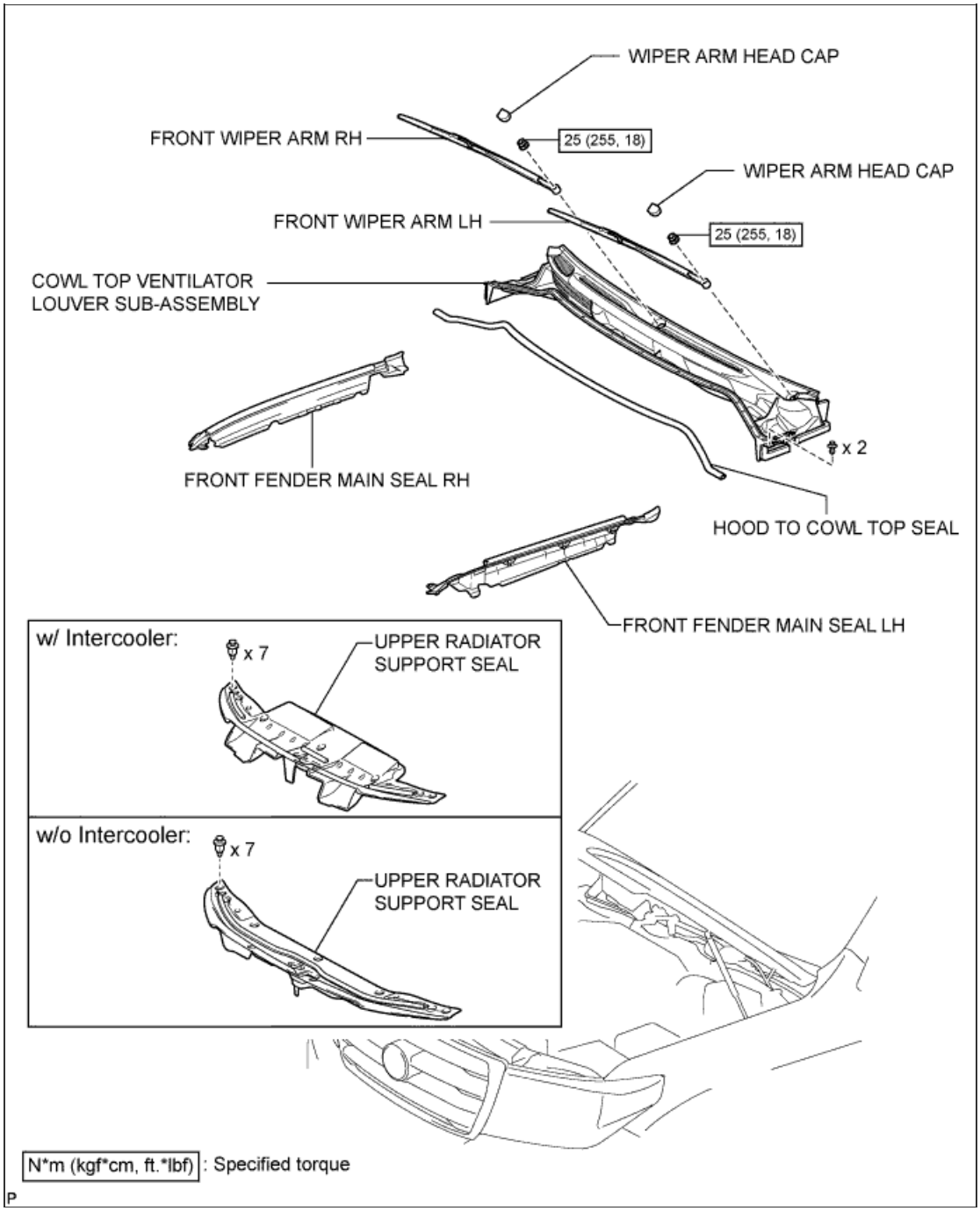
Standard After Glow Time:

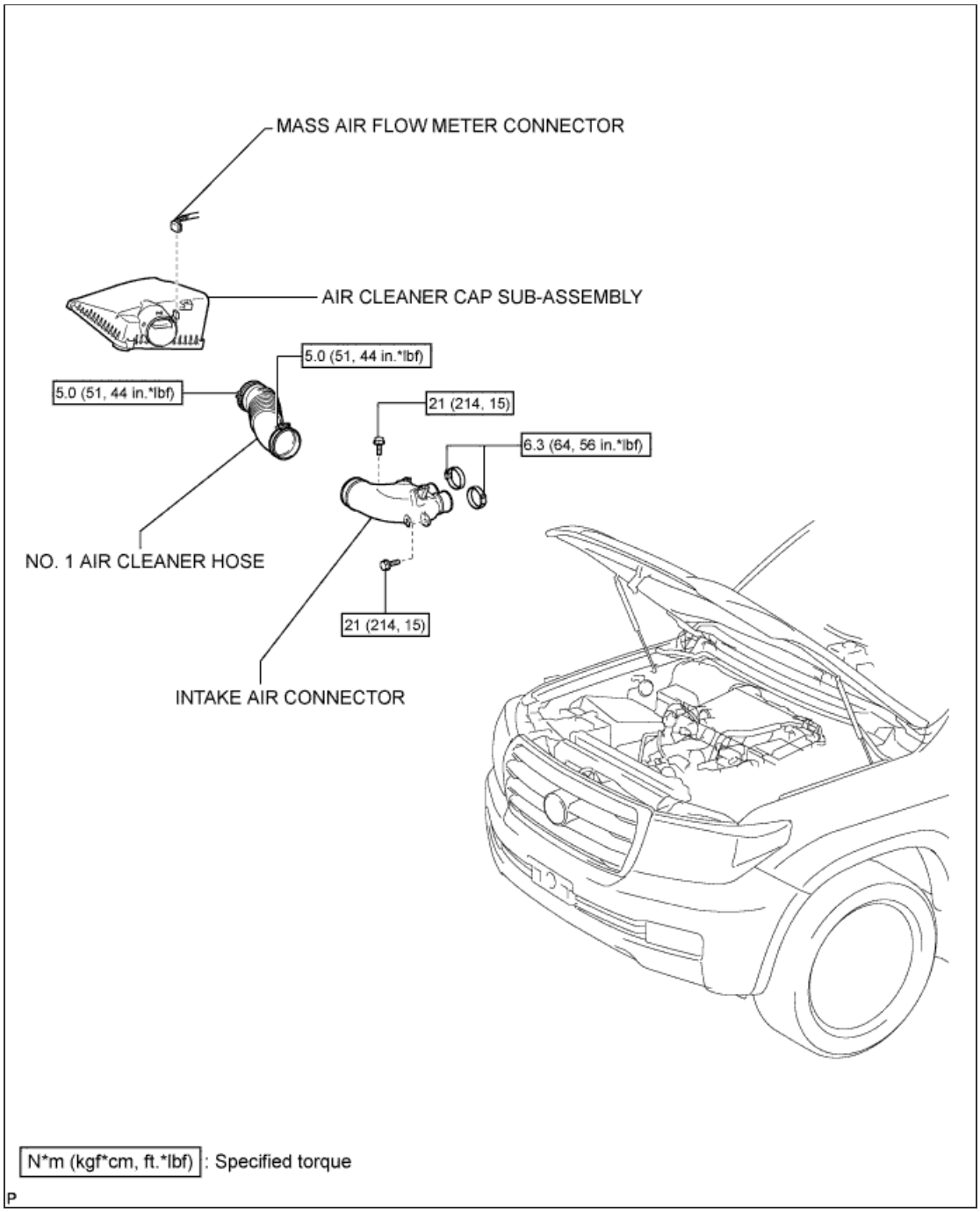
Tester Connection	Condition	Specified Condition
2 - Body ground	After engine starts	Refer to graph below
2 - Body ground		

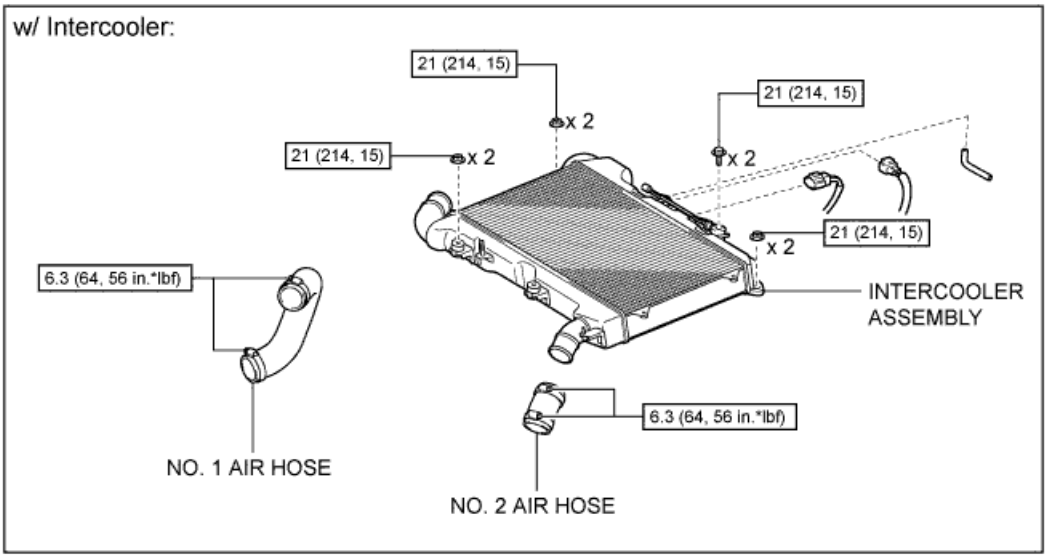


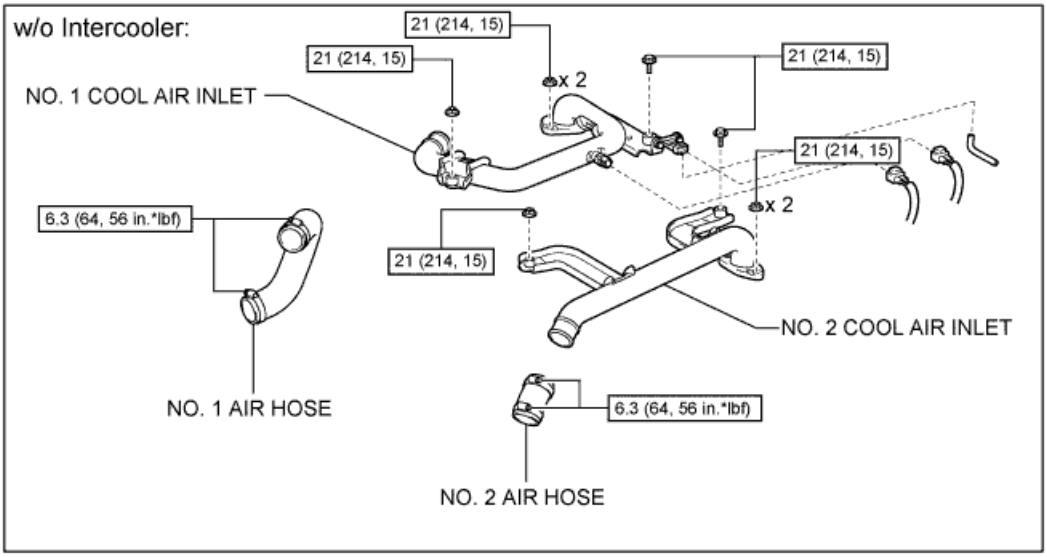
If the result is not as specified, check the ECM, engine coolant temperature sensor, glow plug assembly and glow relay.

for Preparation [Click here]




MASS AIR FLOW METER CONNECTOR
AIR CLEANER CAP SUB-ASSEMBLY
5.0 (51, 44 in.*lbf)
5.0 (51, 44 in.*lbf)
21 (214, 15)
6.3 (64, 56 in.*lbf)
NO. 1 AIR CLEANER HOSE
21 (214, 15)
INTAKE AIR CONNECTOR
N*m (kgf*cm, ft.*lbf) : Specified torque
P

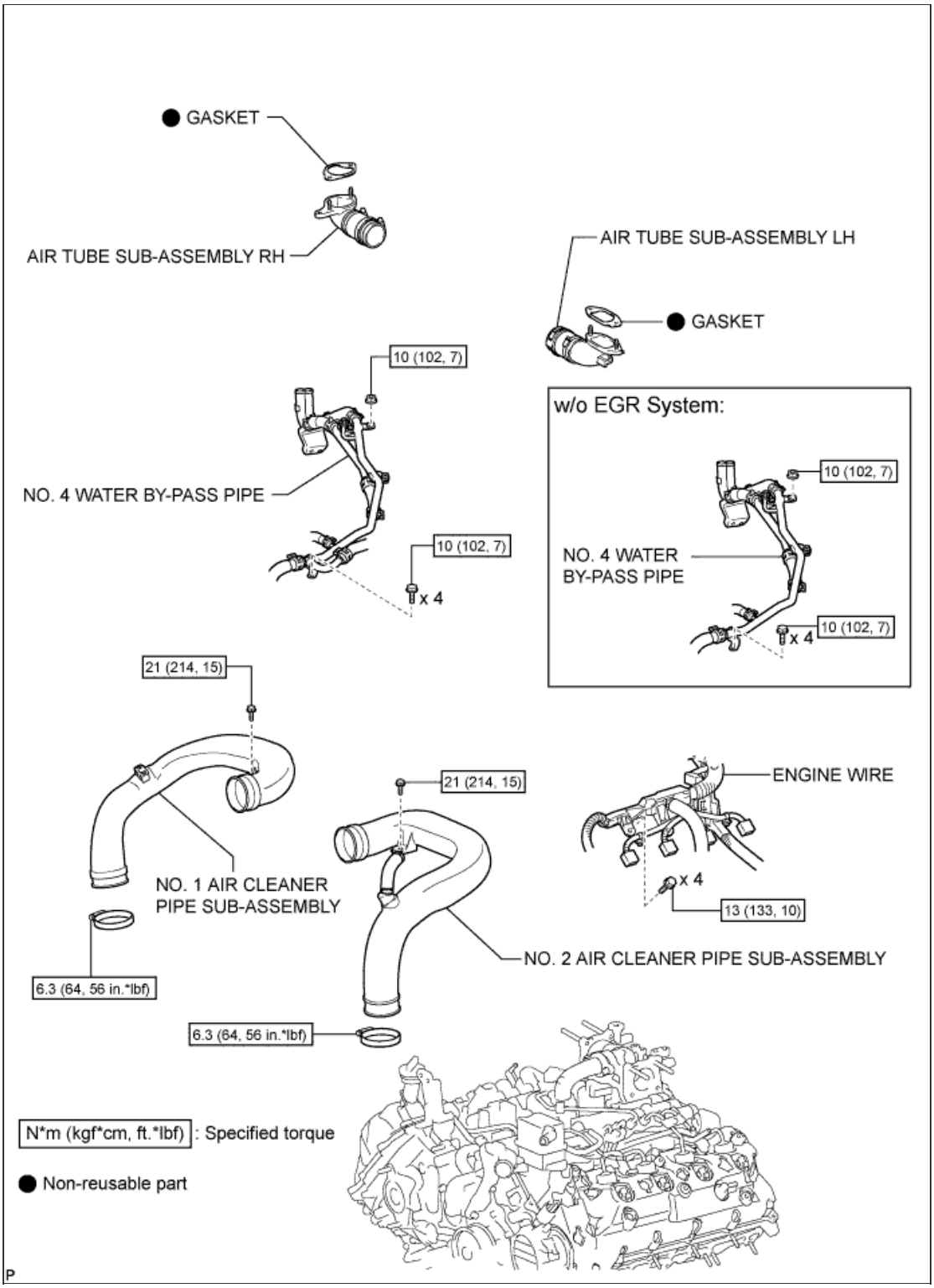


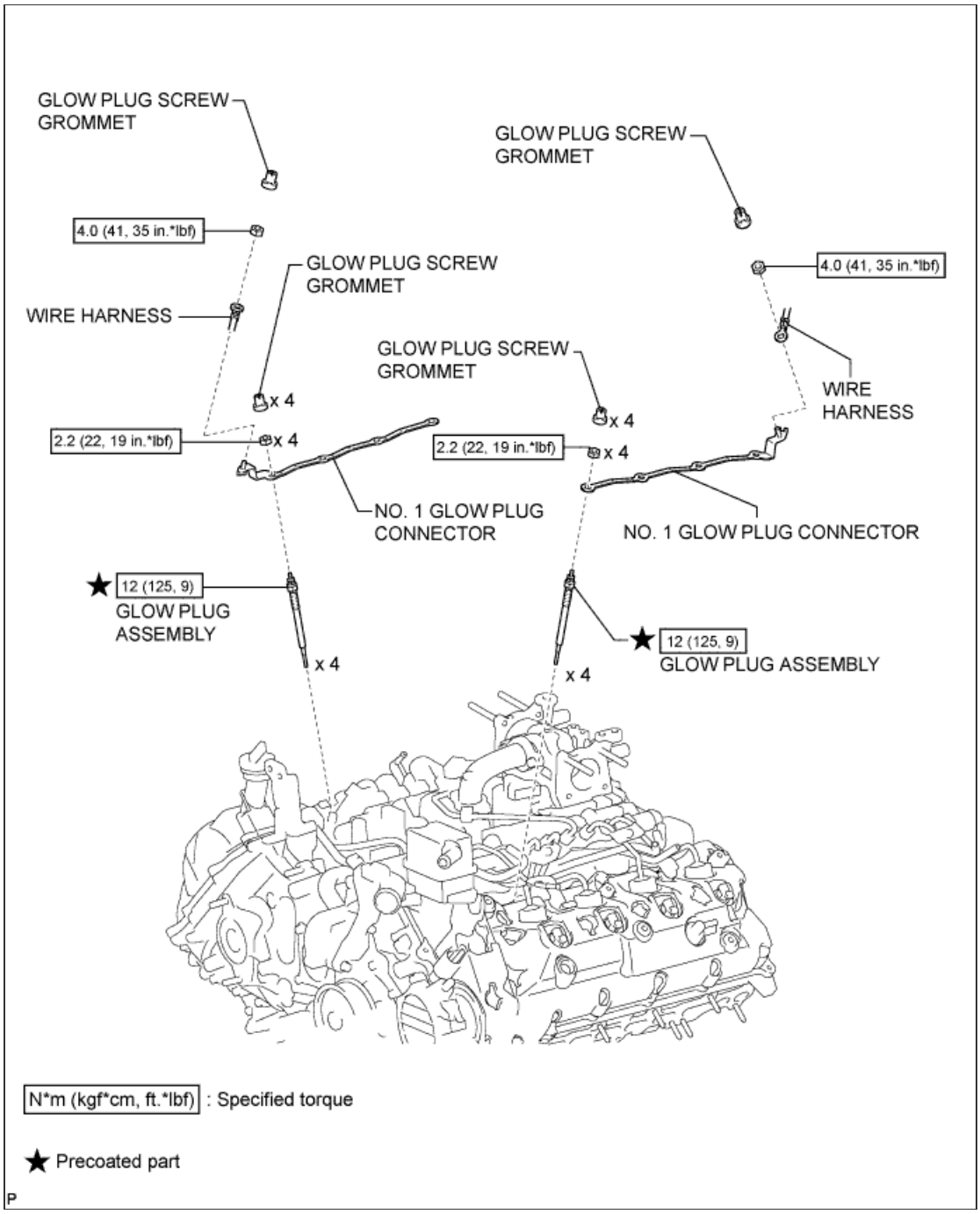




N*m (kgf*cm, ft.*lbf) : Specified torque

P


GASKET
AIR TUBE SUB-ASSEMBLY RH
AIR TUBE SUB-ASSEMBLY LH
GASKET
10 (102, 7)
NO. 4 WATER BY-PASS PIPE
10 (102, 7)
x 4
w/o EGR System:
10 (102, 7)
NO. 4 WATER BY-PASS PIPE
10 (102, 7)
x 4
21 (214, 15)
NO. 1 AIR CLEANER PIPE SUB-ASSEMBLY
6.3 (64, 56 in.*lbf)
21 (214, 15)
ENGINE WIRE
x 4
13 (133, 10)
NO. 2 AIR CLEANER PIPE SUB-ASSEMBLY
6.3 (64, 56 in.*lbf)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P


GLOW PLUG SCREW GROMMET
GLOW PLUG SCREW GROMMET
4.0 (41, 35 in.*lbf)
GLOW PLUG SCREW GROMMET
4.0 (41, 35 in.*lbf)
WIRE HARNESS
GLOW PLUG SCREW GROMMET
WIRE HARNESS
x 4
x 4
2.2 (22, 19 in.*lbf)
x 4
2.2 (22, 19 in.*lbf)
x 4
NO. 1 GLOW PLUG CONNECTOR
NO. 1 GLOW PLUG CONNECTOR
★ 12 (125, 9)
GLOW PLUG ASSEMBLY
x 4
★ 12 (125, 9)
GLOW PLUG ASSEMBLY
x 4
N*m (kgf*cm, ft.*lbf) : Specified torque
★ Precoated part

P

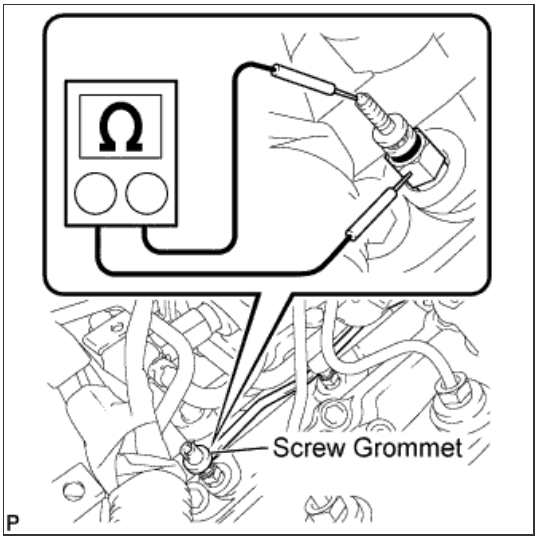
for Preparation Click here

1. CHECK GLOW PLUG ASSEMBLY

a. Remove the screw grommet.

b. Remove the glow plug connector.

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

Tester Connection	Condition	Specified Condition
Glow plug terminal - Body ground	20°C (68°F)	Approximately 1 Ω

If the result is not as specified, replace the glow plug assembly.

NOTICE:

- **Be careful not to damage the glow plug, as this may cause an open circuit or shorten the life of the glow plugs.**
- **Do not allow oil or gasoline to contact the glow plug when cleaning it.**
- **Clean any oil on the terminal and bakelite washer with a dry cloth.**
- **Do not apply more than 11 V to the glow plug, as this may cause an open circuit.**

for Preparation Click here

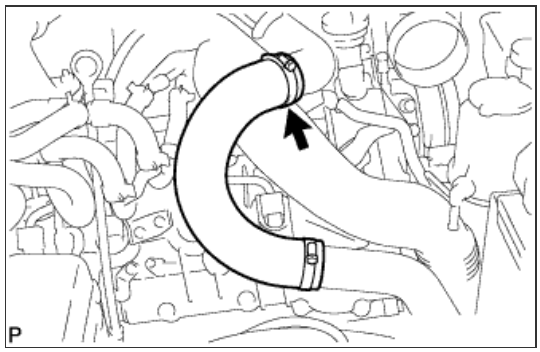
1. REMOVE INTERCOOLER ASSEMBLY (w/ Intercooler)

(Click here)

2. REMOVE NO. 1 COOL AIR INLET (w/o Intercooler)

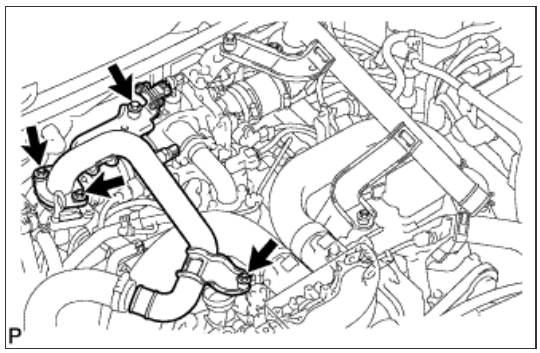
a. Loosen the No. 1 air hose clamp.

b. Disconnect the turbo pressure sensor connector, intake air temperature sensor connector and vacuum hose.



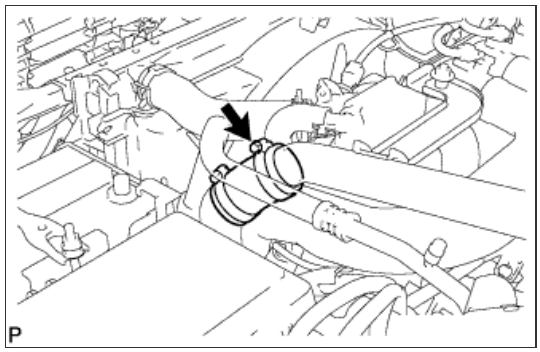
c. Remove the 3 nuts, bolt and No. 1 cool air inlet.

d. Remove the gasket from the air tube RH.



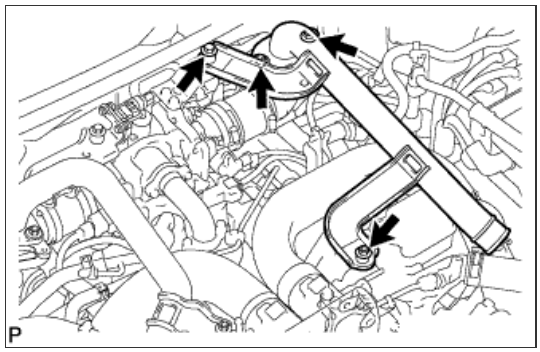
3. REMOVE NO. 2 COOL AIR INLET (w/o Intercooler)

a. Loosen the No. 2 air hose clamp.



b. Remove the 3 nuts, bolt and No. 2 cool air inlet.

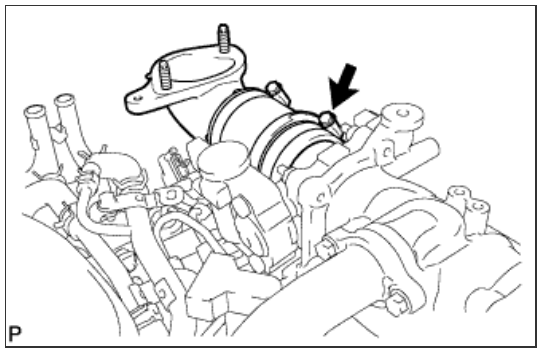
c. Remove the gasket from the air tube LH.



4. REMOVE AIR TUBE SUB-ASSEMBLY RH

a. Loosen the hose clamp.

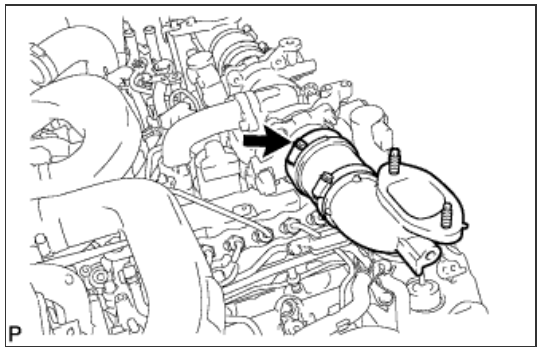
b. Remove the air tube from the throttle body.



5. REMOVE AIR TUBE SUB-ASSEMBLY LH

a. Loosen the hose clamp.

b. Remove the air tube from the throttle body.

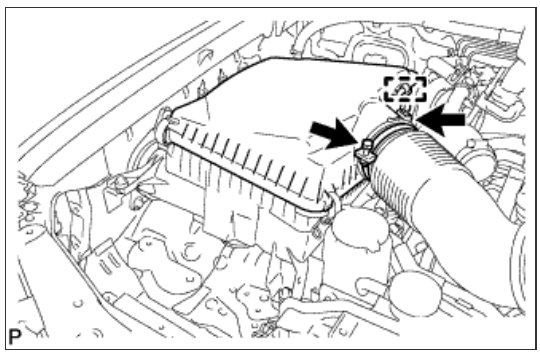


6. REMOVE AIR CLEANER CAP SUB-ASSEMBLY

a. Loosen the hose clamp.

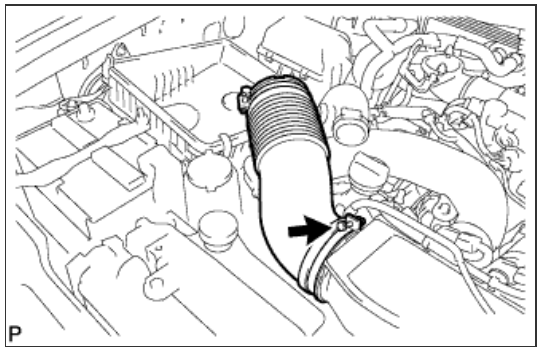
b. Disconnect the mass air flow meter connector and using a clip remover, detach the wire harness clamp from the air cleaner cap.

c. Detach the 4 clamps and remove the air cleaner cap.



7. REMOVE NO. 1 AIR CLEANER HOSE

a. Loosen the hose clamp and remove the No. 1 air cleaner hose.



8. REMOVE INTAKE AIR CONNECTOR

a. w/o Viscous Heater:

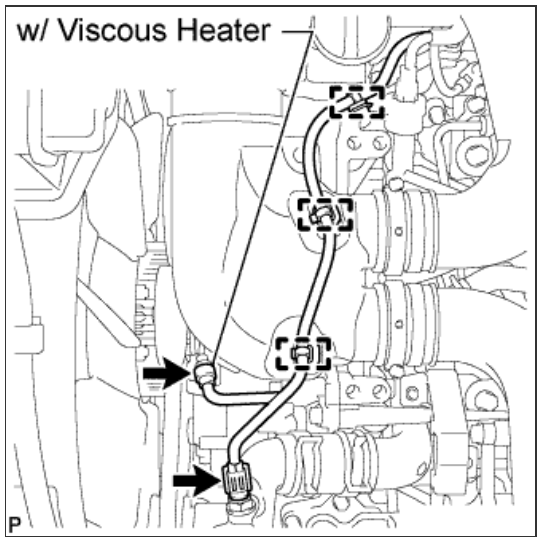
i. Disconnect the connector from the water temperature sensor.

ii. Using a clip remover, detach the 3 wire harness clamps.

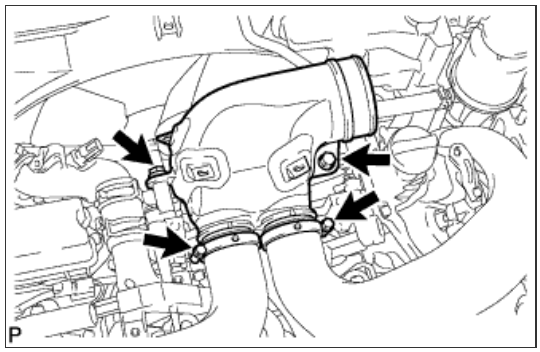
b. w/ Viscous Heater:

i. Disconnect the 2 connectors from the viscous with magnet clutch heater and water temperature sensor.

ii. Using a clip remover, detach the 3 wire harness clamps.

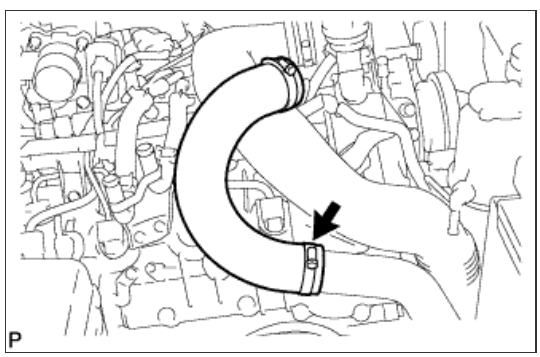


c. Loosen the 2 hose clamps and remove the 2 bolts and intake air connector.



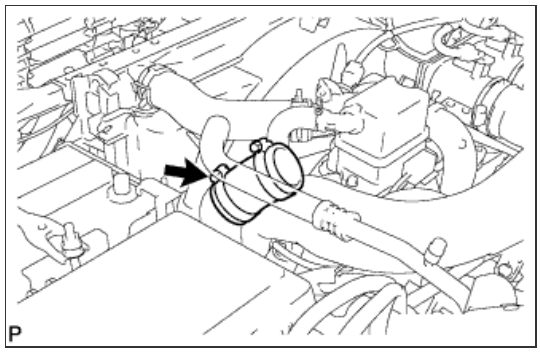
9. REMOVE NO. 1 AIR HOSE

a. Loosen the hose clamp and remove the No. 1 air hose.



10. REMOVE NO. 2 AIR HOSE

a. Loosen the hose clamp and remove the No. 2 air hose.

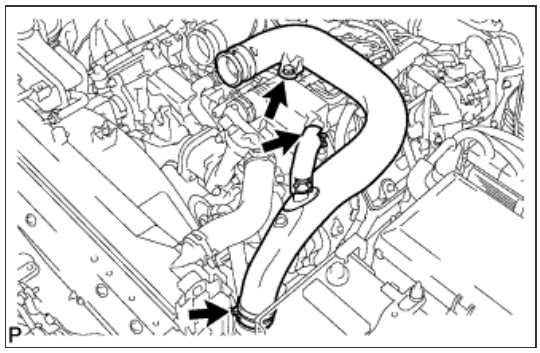


11. REMOVE NO. 2 AIR CLEANER PIPE SUB-ASSEMBLY

a. Disconnect the ventilation hose from the oil separator.

b. Loosen the hose clamp.

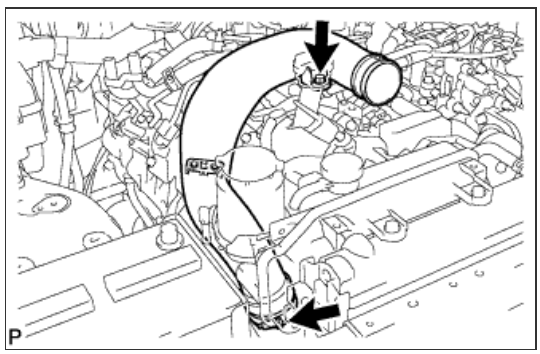
c. Remove the bolt and No. 2 air cleaner pipe.



12. REMOVE NO. 1 AIR CLEANER PIPE SUB-ASSEMBLY

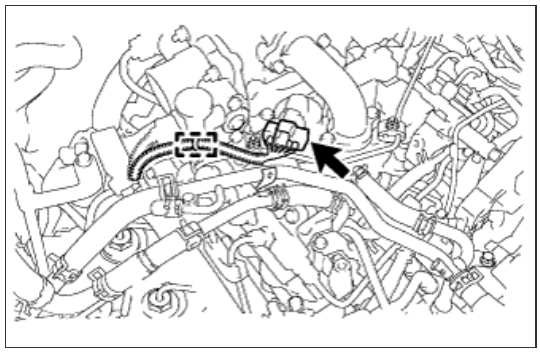
a. Loosen the hose clamp.

b. Remove the bolt and No. 1 air cleaner pipe.

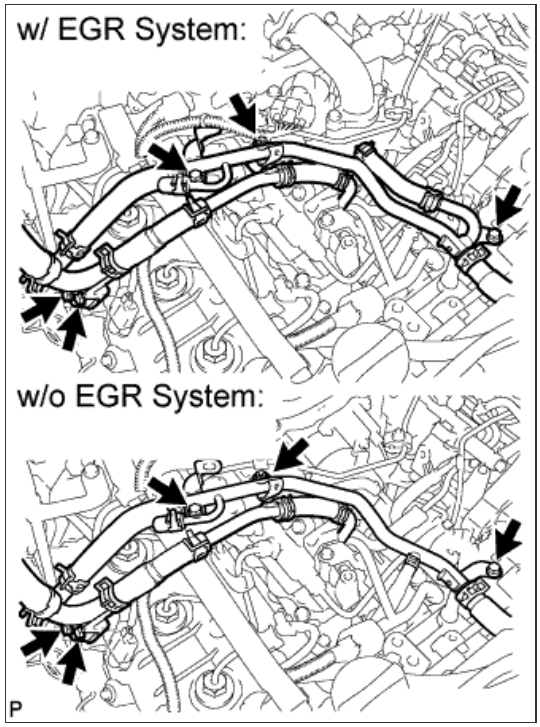


13. DISCONNECT NO. 4 WATER BY-PASS PIPE

a. w/ EGR System:
Detach the clamp and disconnect the connector.

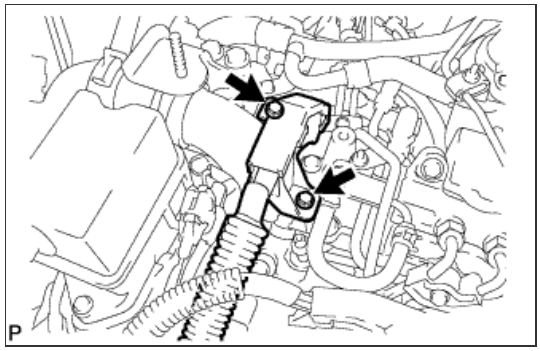


b. Remove the nut, 4 bolts and water by-pass pipe so that the glow plug can be removed in a step below.

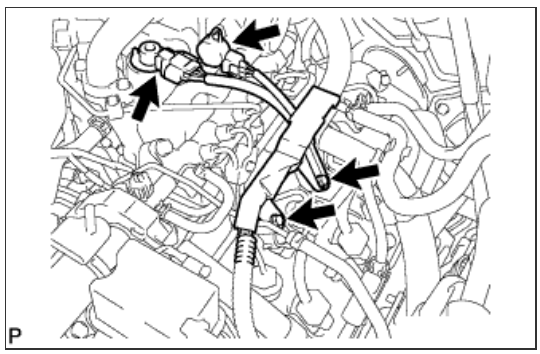


14. DISCONNECT ENGINE WIRE

a. Remove the 2 bolts and engine wire so that the glow plug can be removed in a step below.



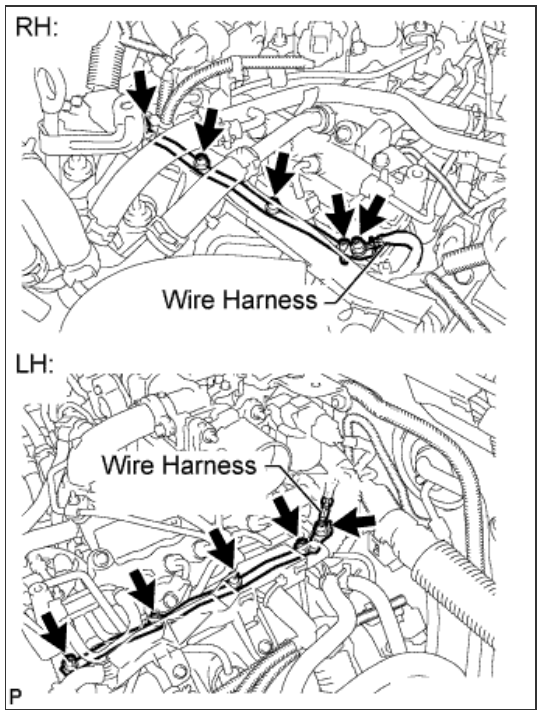
b. Disconnect the 2 connectors and remove the 2 bolts and engine wire so that the glow plug can be removed in a step below.



15. REMOVE NO. 1 GLOW PLUG CONNECTOR

a. Remove the 2 screw grommets and 2 nuts, and disconnect the 2 wire harnesses.

b. Remove the 8 screw grommets, 8 nuts and 2 glow plug connectors.

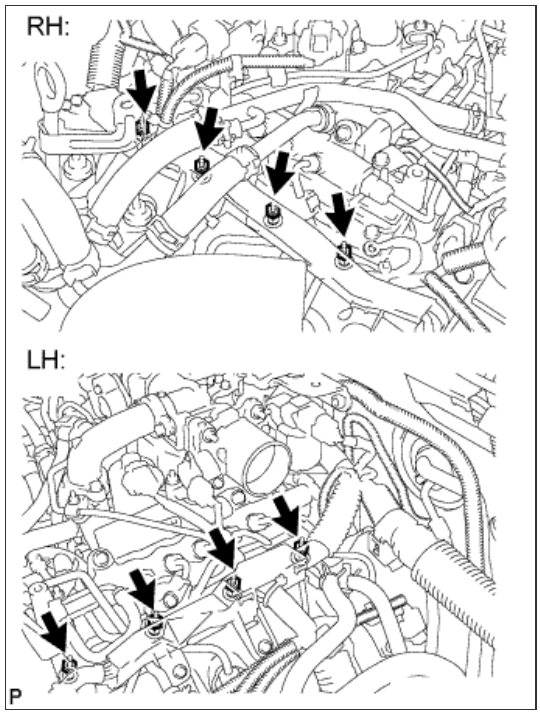


16. REMOVE GLOW PLUG ASSEMBLY

a. Using a 10 mm deep socket wrench, remove the 8 glow plugs.

HINT:

Before removing the glow plugs, thoroughly clean off all dirt, sand, etc.

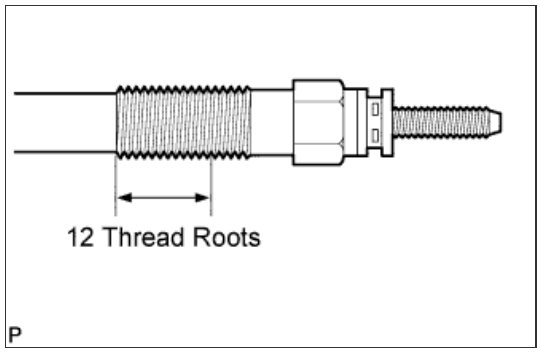


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1. INSTALL GLOW PLUG ASSEMBLY

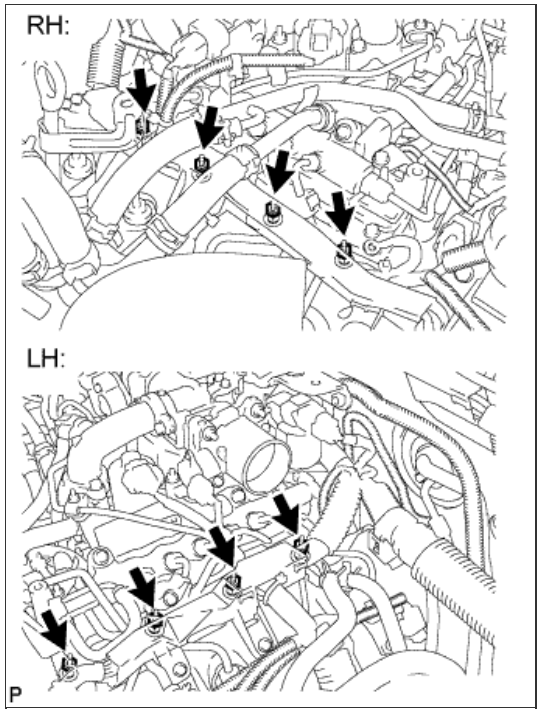
a. Apply adhesive to 3 or more thread roots in the area shown in the illustration.

Adhesive:
Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent



b. Using a 10 mm deep socket wrench, install the 8 glow plugs.

Torque:
12 N*m{ 125 kgf*cm , 9 ft.*lbf }



2. INSTALL NO. 1 GLOW PLUG CONNECTOR

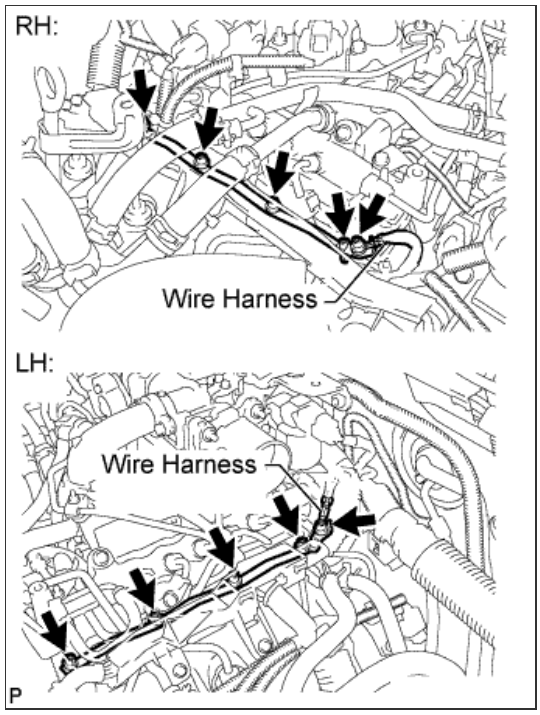
a. Install the 2 glow plug connectors by uniformly tightening the 8 nuts.

Torque:
2.2 N*m{ 22 kgf*cm , 19 in.*lbf }

b. Install the 8 screw grommets.

c. Connect the 2 wire harnesses with the 2 nuts and 2 screw grommets.

Torque:
4.0 N*m{ 41 kgf*cm , 35 in.*lbf }

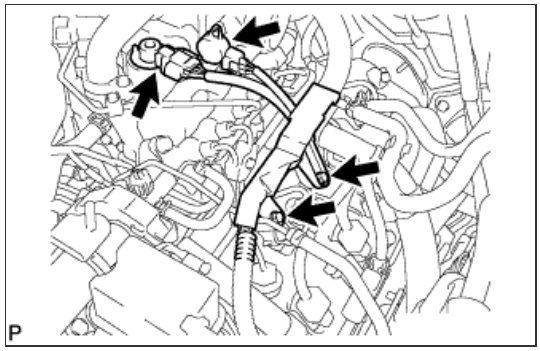


3. CONNECT ENGINE WIRE

a. Connect the 2 connectors.

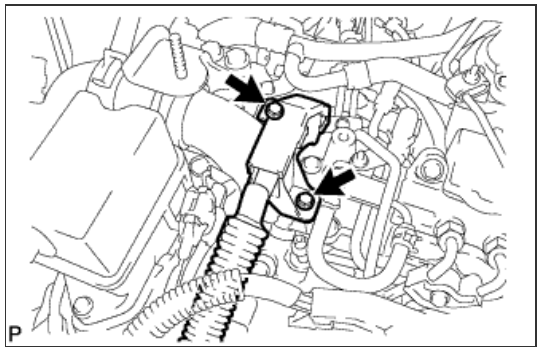
b. Connect the engine wire with the 2 bolts.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }



c. Connect the engine wire with the 2 bolts.

Torque:
13 N*m{ 133 kgf*cm , 10 ft.*lbf }

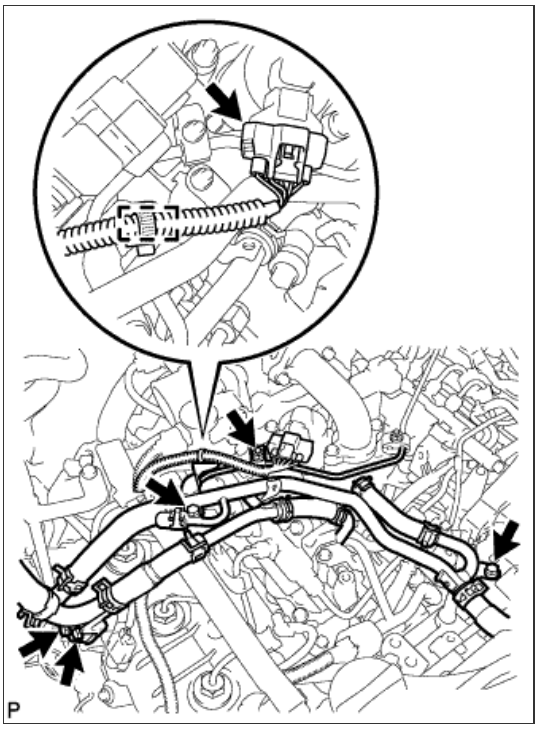


4. CONNECT NO. 4 WATER BY-PASS PIPE

a. Connect the water by-pass pipe with the 4 bolts and nut.

Torque:
10 N*m{ 102 kgf*cm , 7 ft.*lbf }

b. Attach the clamp and connect the connector.



5. INSTALL NO. 1 AIR CLEANER PIPE SUB-ASSEMBLY

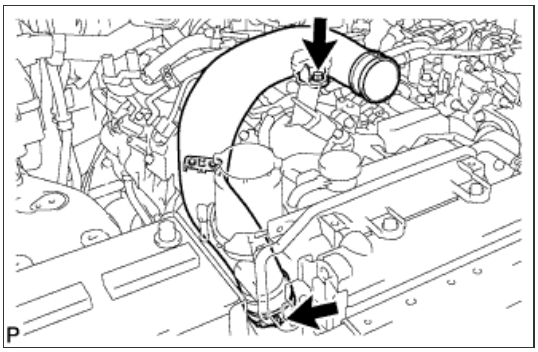
a. Connect the No. 1 air cleaner pipe to the No. 1 intake air connector pipe.

b. Install the pipe with the bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Tighten the hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



6. INSTALL NO. 2 AIR CLEANER PIPE SUB-ASSEMBLY

a. Connect the No. 2 air cleaner pipe to the No. 2 intake air connector pipe.

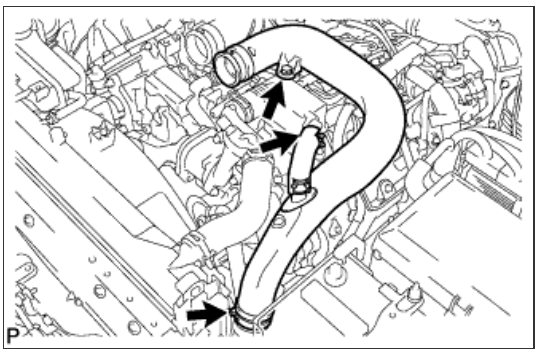
b. Connect the ventilation hose to the oil separator.

c. Install the pipe with the bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

d. Tighten the hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



7. INSTALL NO. 2 AIR HOSE

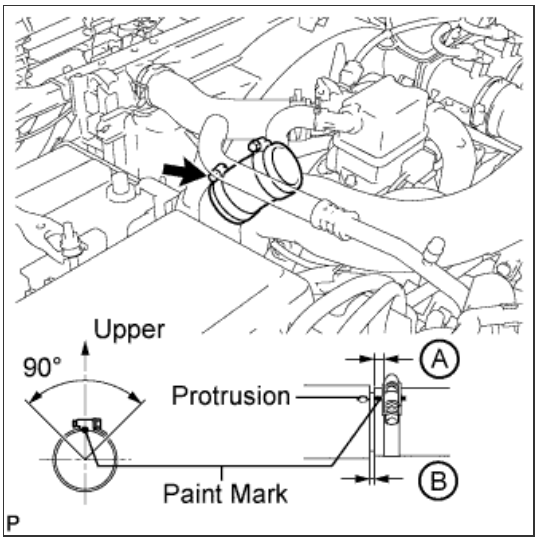
a. Connect the No. 2 air hose with the hose clamp.

Torque:

6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion and push in the air hose so that distance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that distance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make sure the direction of the hose clamp is as shown in the illustration.**



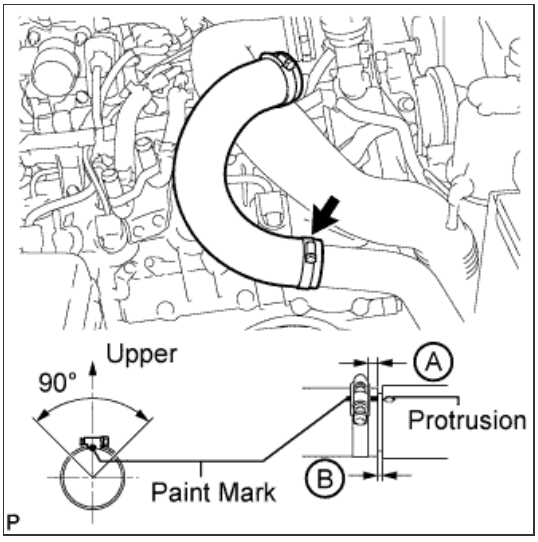
8. INSTALL NO. 1 AIR HOSE

a. Connect the No. 1 air hose with the hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion and push in the air hose so that distance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that distance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make sure the direction of the hose clamp is as shown in the illustration.**



9. INSTALL INTAKE AIR CONNECTOR

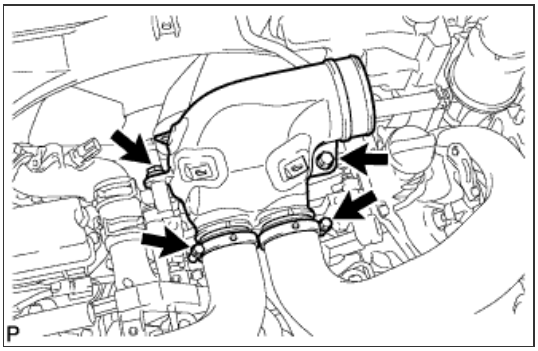
a. Connect the intake air connector to the No. 1 and No. 2 air cleaner pipes.

b. Install the connector with the 2 bolts.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Tighten the 2 hose clamps.

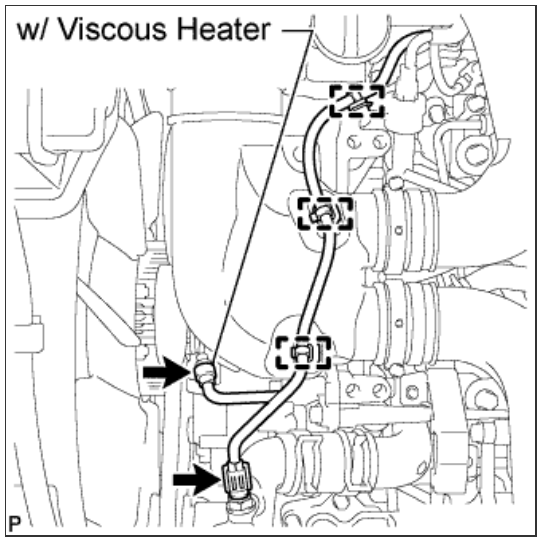
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



d. Attach the 3 wire harness clamps.

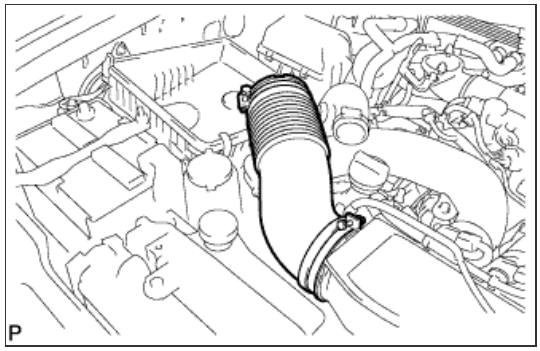
e. w/o Viscous Heater:
Connect the connector to the water temperature sensor.

f. w/ Viscous Heater:
Connect the 2 connectors to the water temperature sensor and viscous with magnet clutch heater.



10. TEMPORARILY INSTALL NO. 1 AIR CLEANER HOSE

a. Temporarily install the air cleaner hose to the intake air connector.

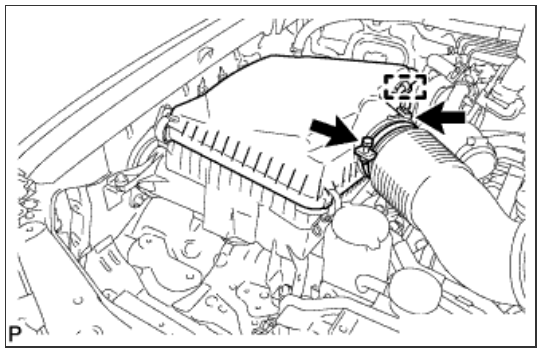


11. INSTALL AIR CLEANER CAP SUB-ASSEMBLY

a. Connect the air cleaner cap to the air cleaner hose, and install the air cleaner cap with the 4 clamps.

b. Connect the mass air flow meter connector and attach the wire harness clamp to the air cleaner cap.

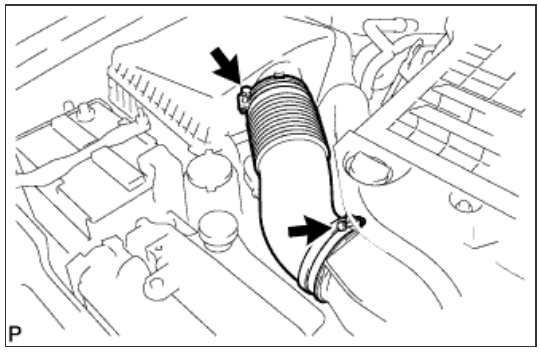
c. Attach the wire harness clamp.



d. Align the protrusion of air cleaner cap and concave portion of air cleaner hose.

e. Tighten the 2 hose clamps.

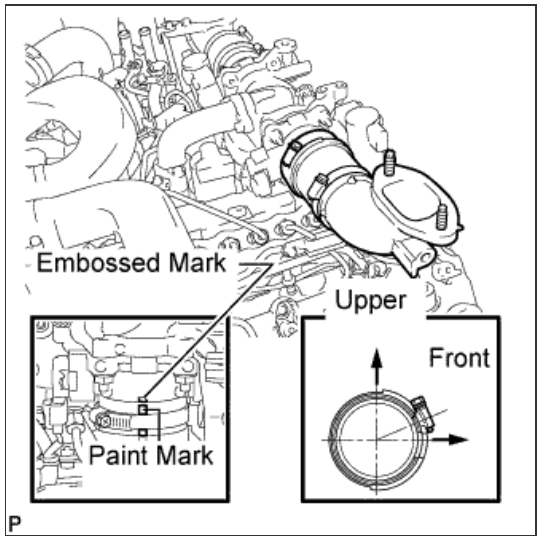
Torque:
5.0 N*m{ 51 kgf*cm , 44 in.*lbf }



12. INSTALL AIR TUBE SUB-ASSEMBLY LH

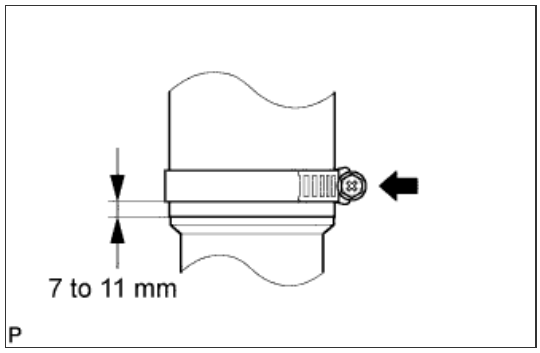
a. Install the air tube to the throttle body.

b. Align the embossed mark of the throttle body with the paint mark of the No. 4 air hose.



c. Tighten the hose clamp so that it is 7 to 11 mm (0.276 to 0.433 in.) from the end of the hose as shown in the illustration.

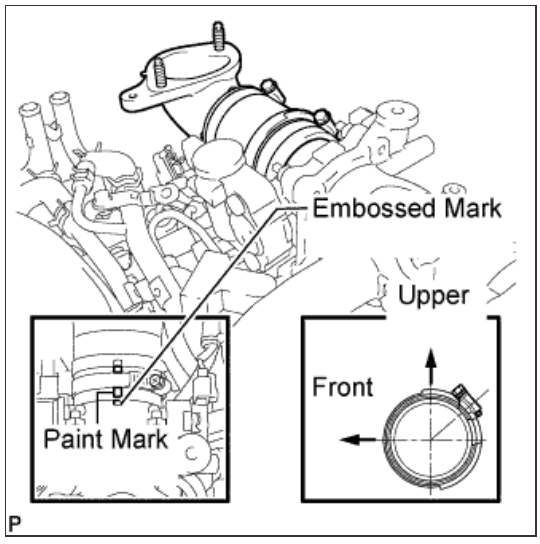
Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }



13. INSTALL AIR TUBE SUB-ASSEMBLY RH

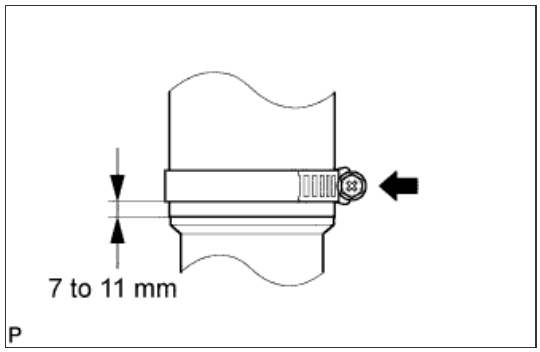
a. Install the air tube to the throttle body.

b. Align the embossed mark of the throttle body with the paint mark of the No. 4 air hose.



c. Tighten the hose clamp so that it is 7 to 11 mm (0.276 to 0.433 in.) from the end of the hose as shown in the illustration.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

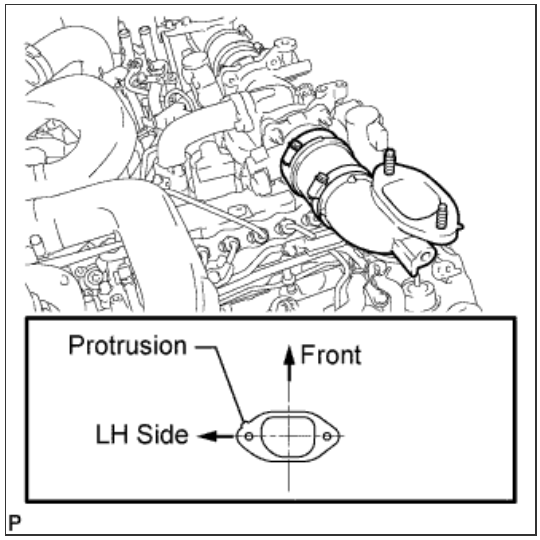


14. INSTALL NO. 2 COOL AIR INLET (w/o Intercooler)

a. Install a new gasket to the air tube LH.

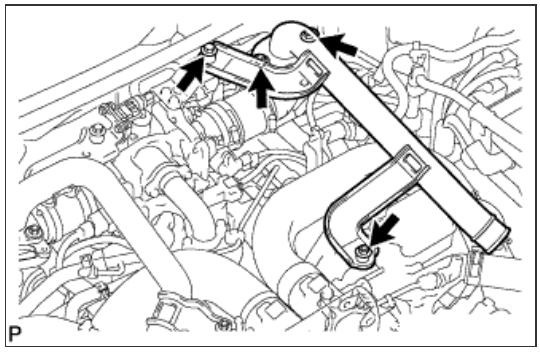
HINT:

Install the gasket with the protrusion facing as shown in the illustration.



b. Install the No. 2 cool air inlet with the 3 nuts and bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }



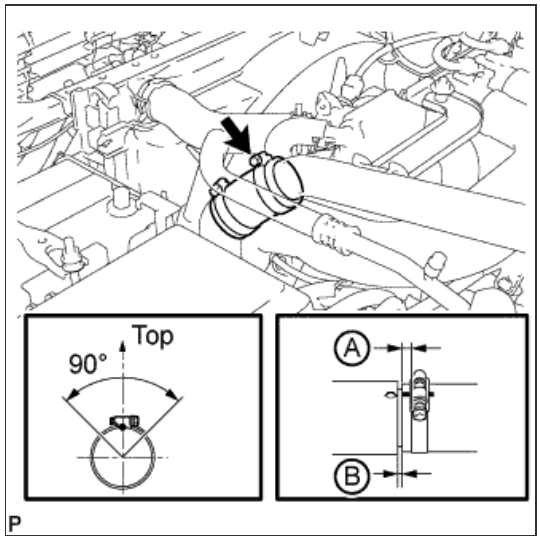
c. Connect the No. 2 air hose to the No. 2 cool air inlet.

d. Tighten the No. 2 air hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

- **Align the paint mark of the air hose with the protrusion and push on the air hose so that distance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that distance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make sure the direction of the hose clamp is as shown in the illustration.**

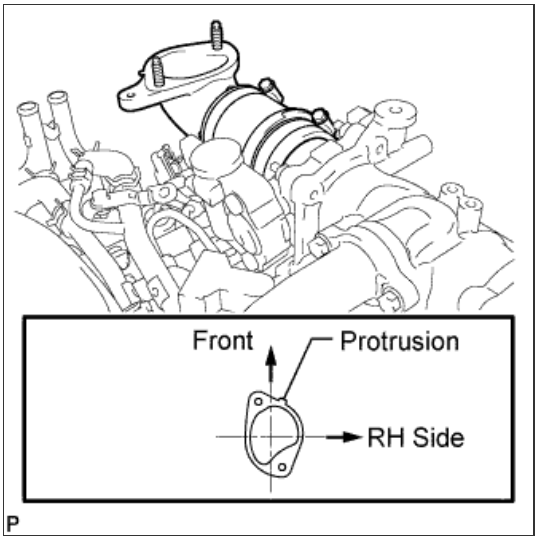


15. INSTALL NO. 1 COOL AIR INLET (w/o Intercooler)

a. Install a new gasket to the air tube RH.

HINT:

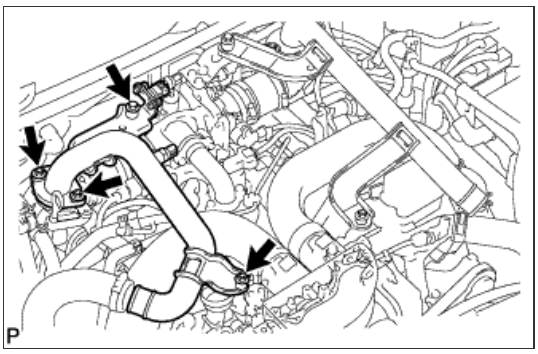
Install the gasket with the protrusion facing as shown in the illustration.



b. Install the No. 1 cool air inlet with the 3 nuts and bolt.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

c. Connect the vacuum hose, intake air temperature sensor connector and turbo pressure sensor connector.



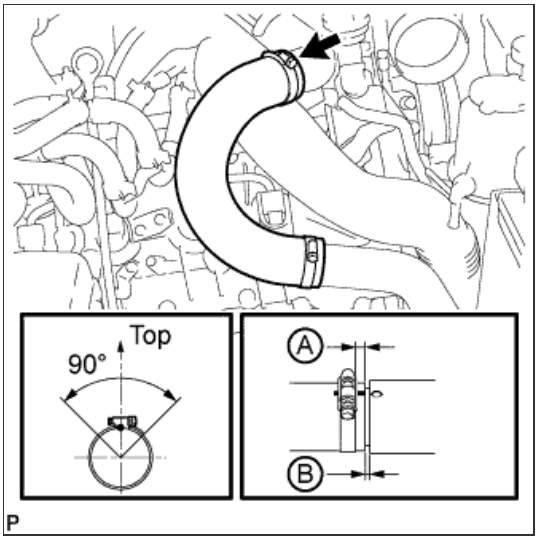
d. Connect the No. 1 air hose to the No. 1 cool air inlet.

e. Tighten the No. 1 air hose clamp.

Torque:
6.3 N*m{ 64 kgf*cm , 56 in.*lbf }

HINT:

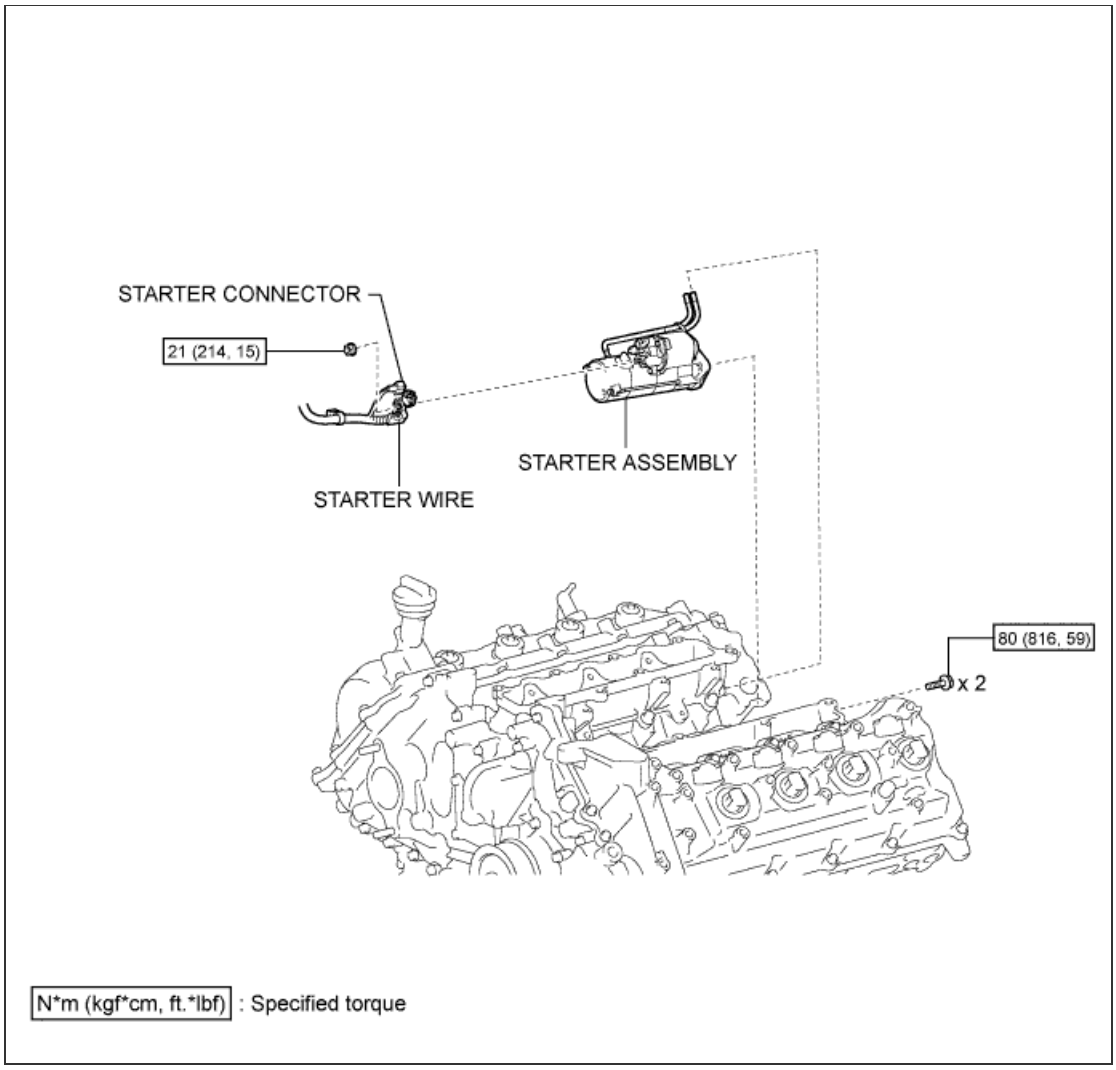
- **Align the paint mark of the air hose with the protrusion and push on the air hose so that distance B is 0 to 3 mm (0 to 0.118 in.).**
- **Position the clamp so that distance A is 2 to 6 mm (0.0787 to 0.236 in.).**
- **Make sure the direction of the hose clamp is as shown in the illustration.**

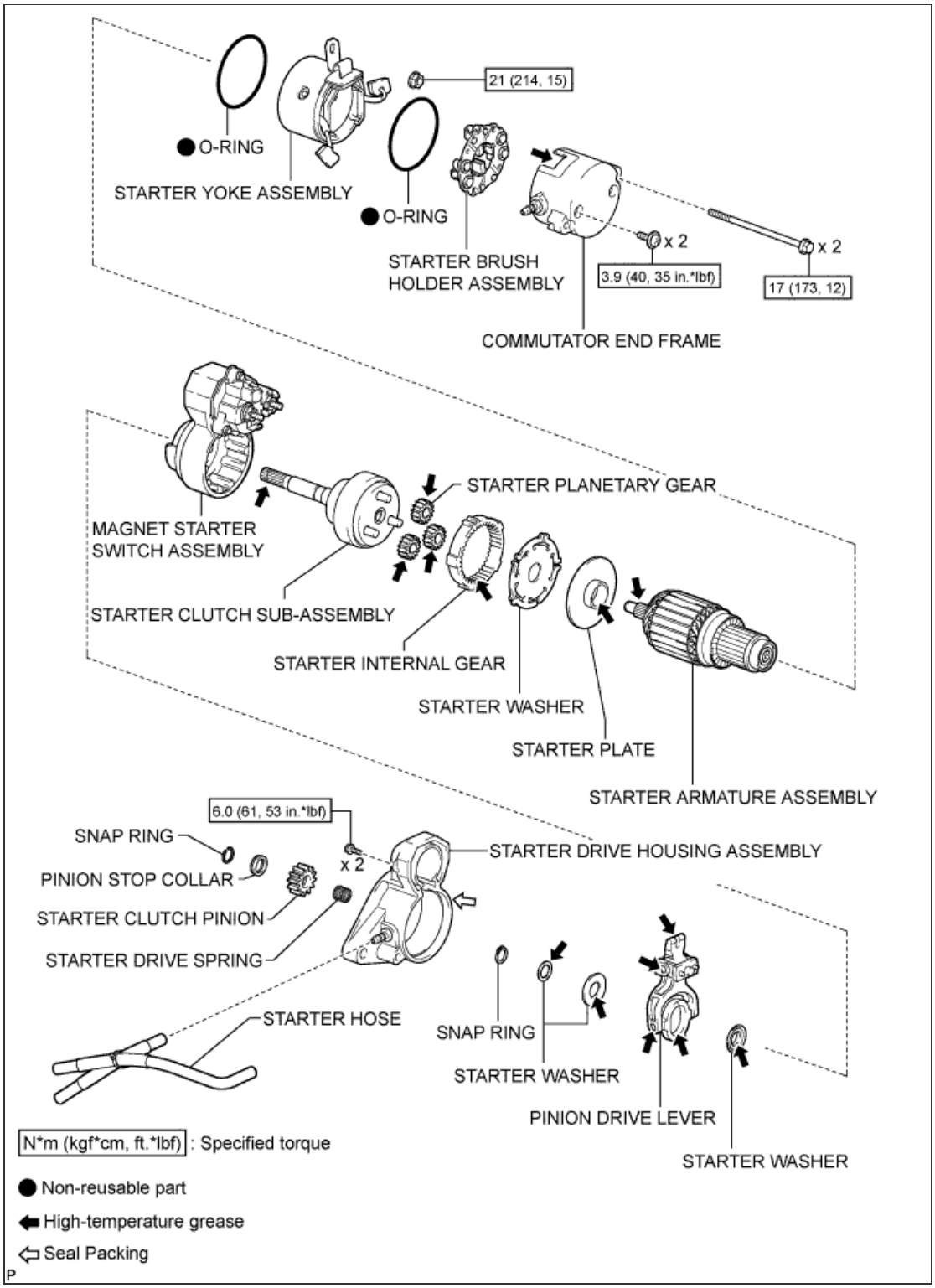


16. INSTALL INTERCOOLER ASSEMBLY (w/ Intercooler)

a. Install the intercooler (Click here).

for Preparation Click here




21 (214, 15)
O-RING
STARTER YOKE ASSEMBLY
O-RING
STARTER BRUSH
HOLDER ASSEMBLY
x 2
3.9 (40, 35 in.*lbf)
x 2
17 (173, 12)
COMMUTATOR END FRAME
STARTER PLANETARY GEAR
MAGNET STARTER
SWITCH ASSEMBLY
STARTER CLUTCH SUB-ASSEMBLY
STARTER INTERNAL GEAR
STARTER WASHER
STARTER PLATE
STARTER ARMATURE ASSEMBLY
6.0 (61, 53 in.*lbf)
SNAP RING
x 2
STARTER DRIVE HOUSING ASSEMBLY
PINION STOP COLLAR
STARTER CLUTCH PINION
STARTER DRIVE SPRING
STARTER HOSE
SNAP RING
STARTER WASHER
PINION DRIVE LEVER
STARTER WASHER
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
High-temperature grease
Seal Packing
P

for Preparation Click here

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

2. REMOVE FUEL COOLER ASSEMBLY

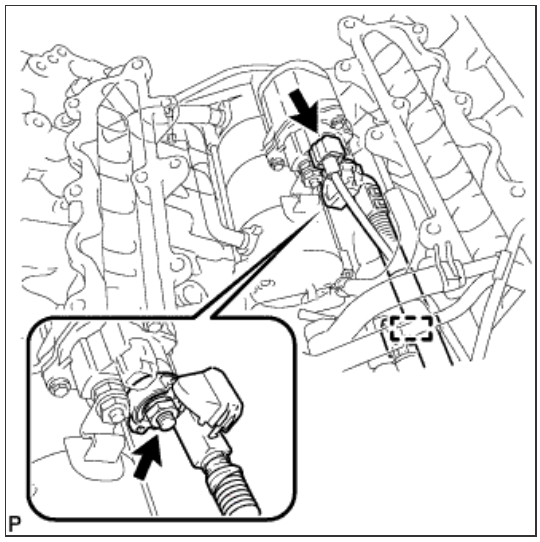
a. Remove the fuel cooler assembly (Click here).

3. REMOVE STARTER ASSEMBLY

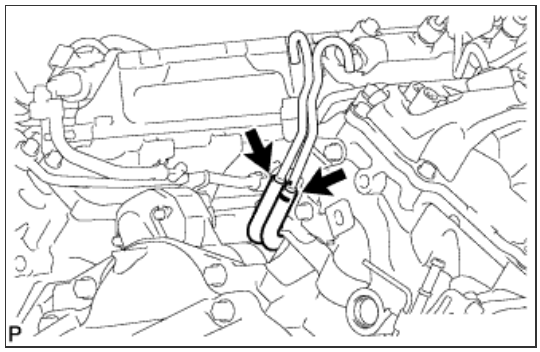
a. Detach the harness clamp and disconnect the wire harness.

b. Disconnect the starter connector.

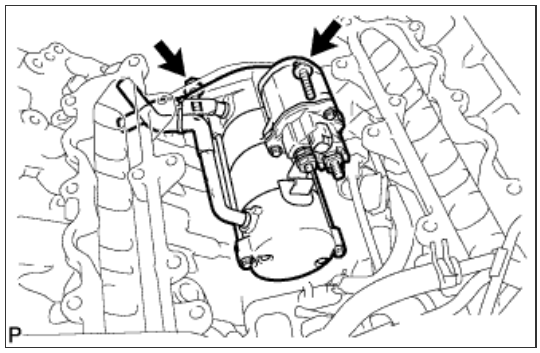
c. Remove the nut and disconnect the starter wire.



d. Disconnect the 2 starter hoses.



e. Remove the 2 bolts and starter.


P

for Preparation Click here

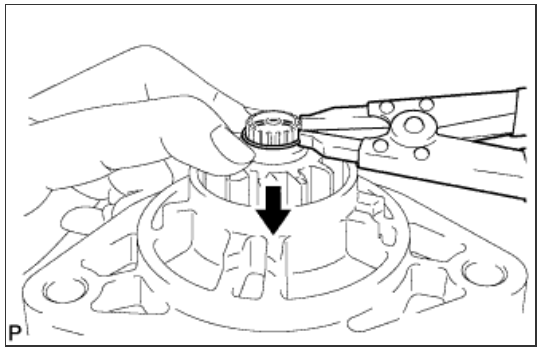
1. REMOVE STARTER CLUTCH PINION

a. Using snap ring pliers, remove the snap ring.

HINT:

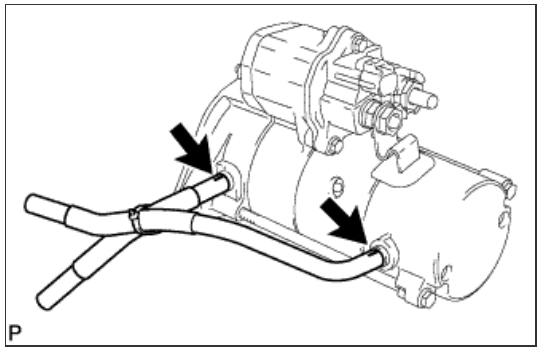
While pushing down the starter clutch pinion, remove the snap ring.

b. Remove the pinion stop collar, starter clutch pinion and starter drive spring.



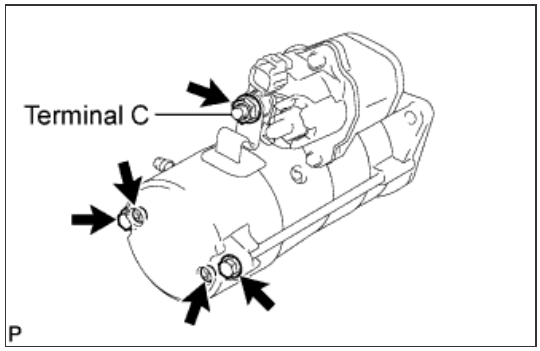
2. REMOVE STARTER BRUSH HOLDER ASSEMBLY

a. Remove the 2 starter hoses from the starter.



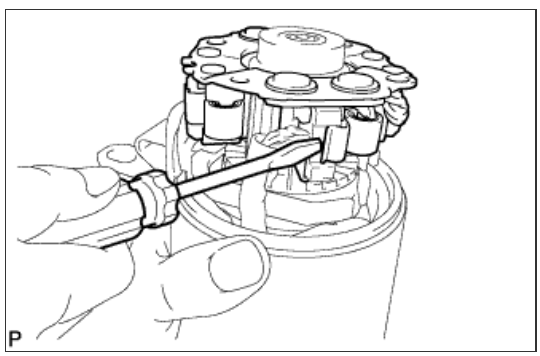
b. Remove the nut from terminal C.

c. Remove the 2 through bolts and 2 screws, then remove the commutator end frame from the starter yoke.



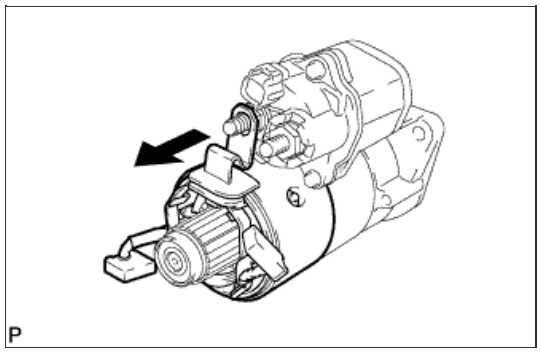
d. Using a screwdriver, hold the starter brush spring back and disconnect the 4 starter brushes from the brush holder.

e. Remove the starter brush holder from the starter armature.

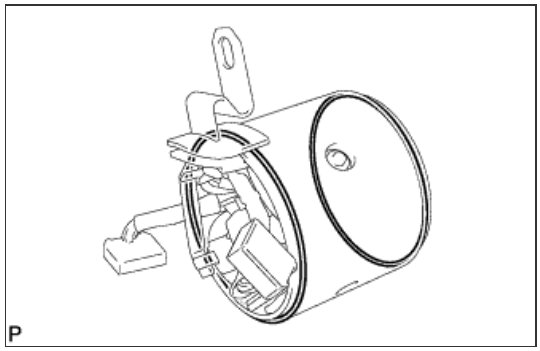


3. REMOVE STARTER YOKE ASSEMBLY

a. Remove the starter yoke.

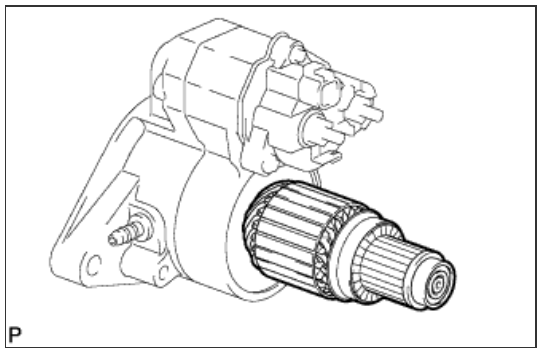


b. Remove the 2 O-rings from the starter yoke.



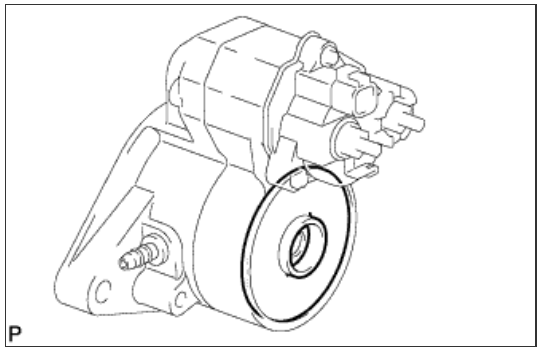
4. REMOVE STARTER ARMATURE ASSEMBLY

a. Remove the starter armature from the starter plate.

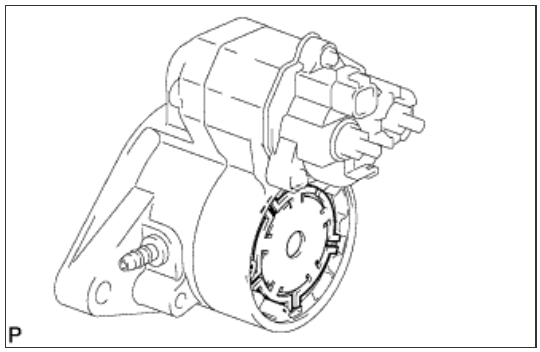


5. REMOVE STARTER INTERNAL GEAR

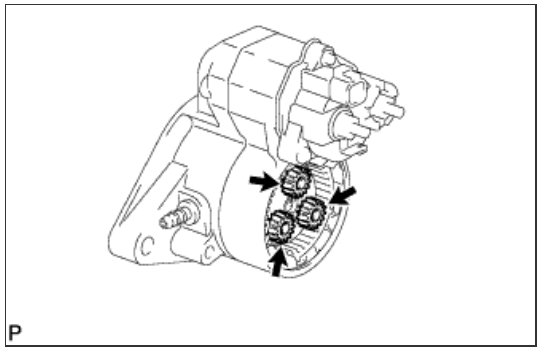
a. Remove the starter plate.



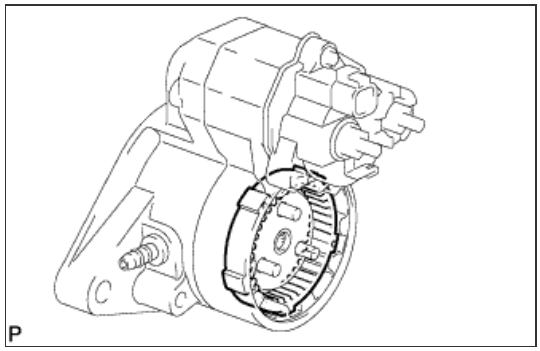
b. Remove the starter washer.



c. Remove the 3 starter planetary gears.

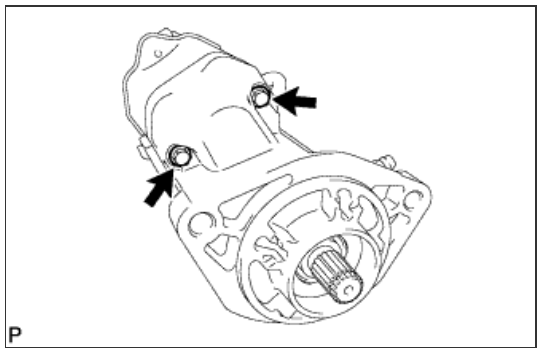


d. Remove the starter internal gear.



6. REMOVE STARTER DRIVE HOUSING ASSEMBLY

a. Remove the 2 bolts and starter drive housing from the magnet starter switch.

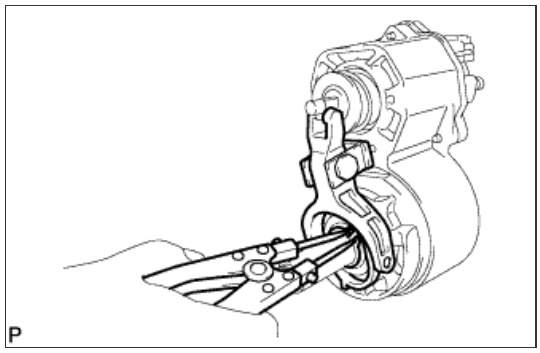


7. REMOVE STARTER CLUTCH SUB-ASSEMBLY

a. Using snap ring pliers, remove the snap ring.

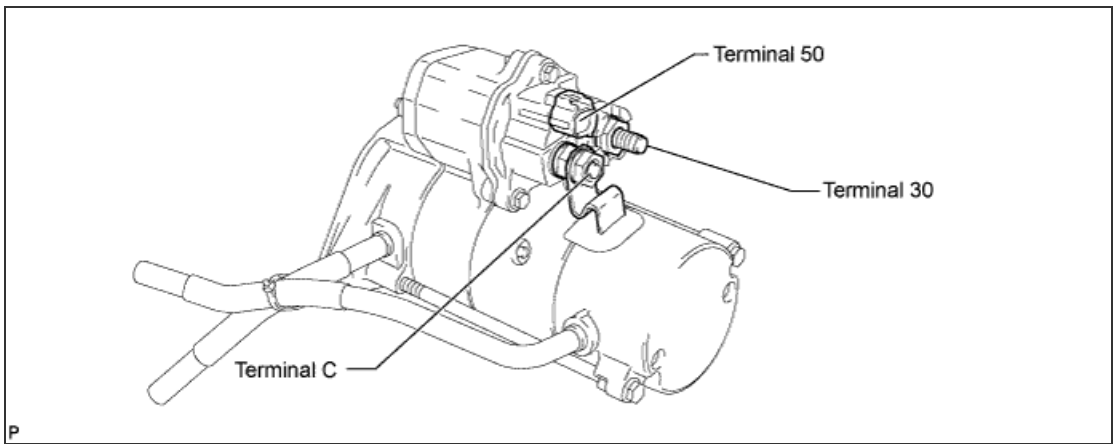
b. Remove the pinion drive lever and 3 washers.

c. Remove the starter clutch from the magnet starter switch.


P

for Preparation Click here

1. INSPECT STARTER ASSEMBLY



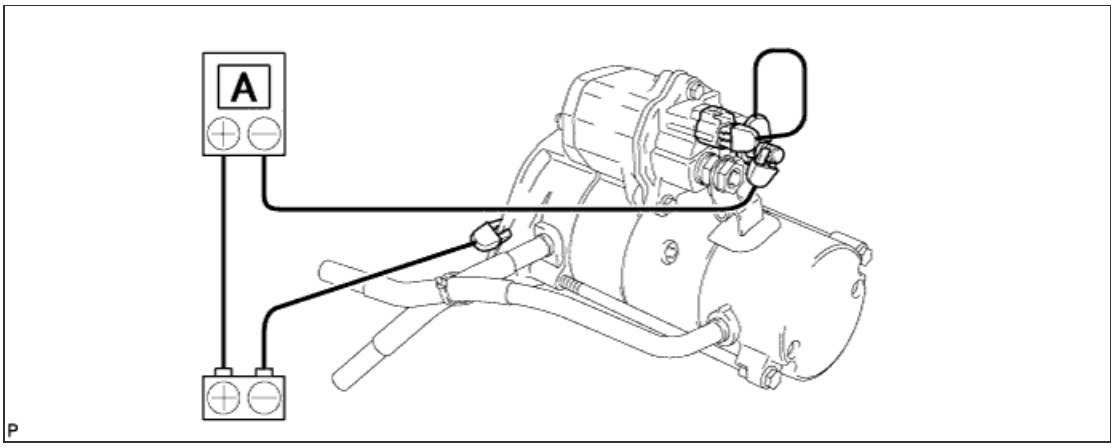
CAUTION:

As a large electric current passes through the cable during this inspection, a thick cable must be used. If not, the cable may become hot and cause injury.

NOTICE:

The following tests must be done within 3 to 5 seconds to prevent the coil from burning out.

a. Perform the operation test without load.



i. Grip the starter in a vise.

ii. Connect the battery and an ammeter to the starter with terminal 30 disconnected.

NOTICE:

Do not connect terminal 30 to the battery in this step.

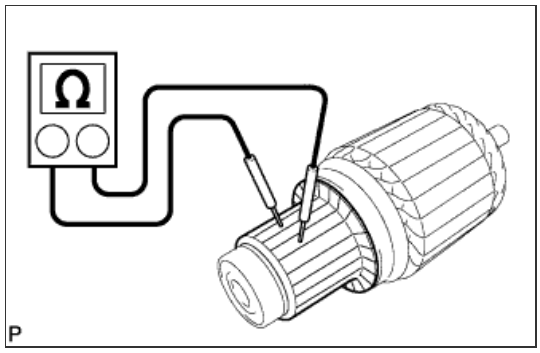
iii. Connect terminal 30 to the battery and check that the starter rotates smoothly and steadily while the pinion gear is moving outward. Then measure the current.

Standard current:
200 A or less at 11 V

If the result is not as specified, repair or replace the starter assembly.

2. INSPECT STARTER ARMATURE ASSEMBLY

a. Inspect the commutator for an open circuit.



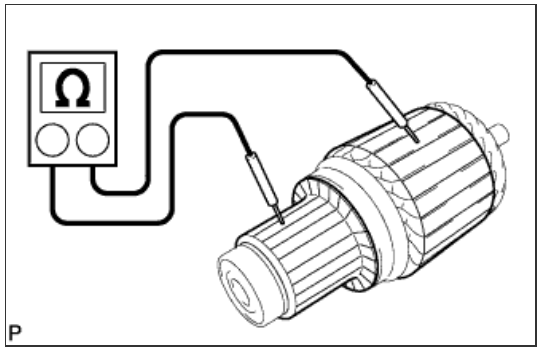
i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Commutator	Always	Below 1 Ω

If the result is not as specified, replace the armature assembly.

b. Inspect the commutator for a short circuit.



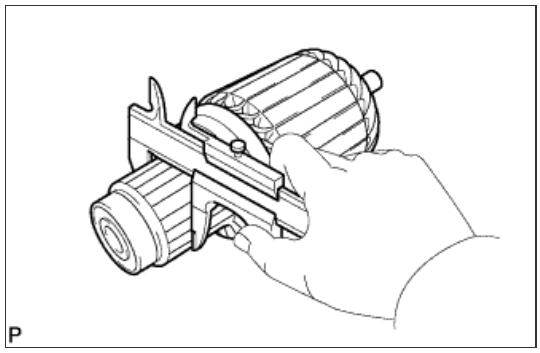
i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Commutator - Armature coil core	Always	10 kΩ or higher

If the result is not as specified, replace the armature assembly.

c. Using a vernier caliper, measure the commutator diameter.

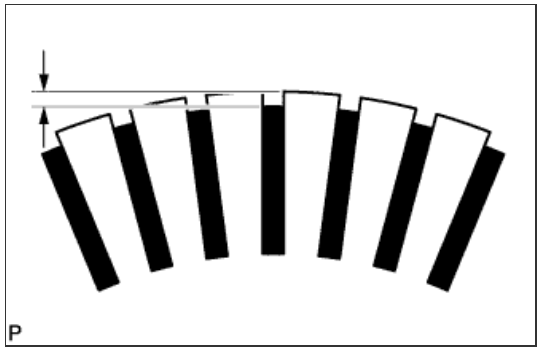


Standard diameter:
36.0 mm (1.42 in.)

Minimum diameter:
35.0 mm (1.38 in.)

If the diameter is less than the minimum, replace the armature assembly.

d. Measure the undercut depth of the commutator.

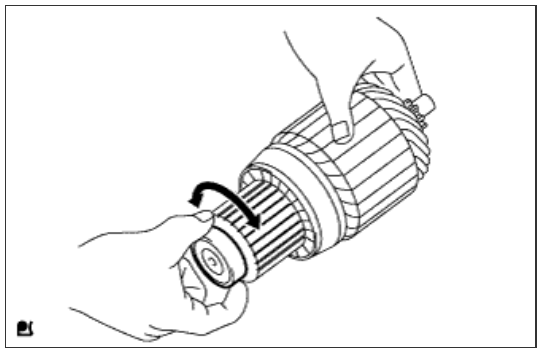


Standard undercut depth:
0.7 mm (0.0276 in.)

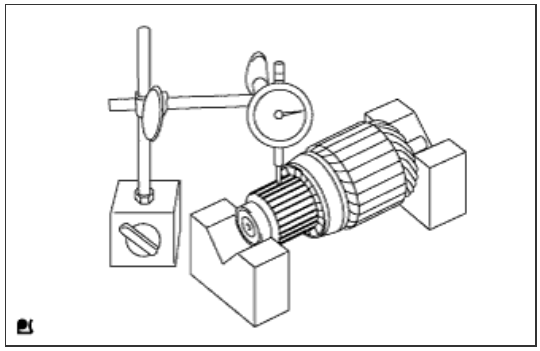
Minimum undercut depth:
0.2 mm (0.00787 in.)

If the undercut depth is less than the minimum, increase the depth using a hacksaw blade.

e. Check that the bearing rotates smoothly.
If necessary, replace the starter armature assembly.



f. Inspect the commutator circle runout.



i. Place the commutator on V-blocks.

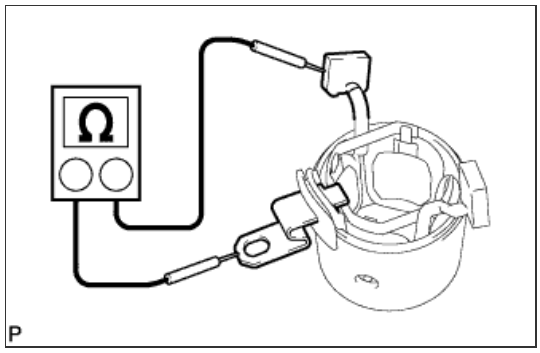
ii. Using a dial indicator, measure the circle runout.

Maximum circle runout:
0.05 mm (0.00197 in.)

If the runout is more than the maximum, correct it with sandpaper (#400) or replace the armature assembly.

3. INSPECT STARTER YOKE ASSEMBLY

a. Inspect the field coil for an open circuit.



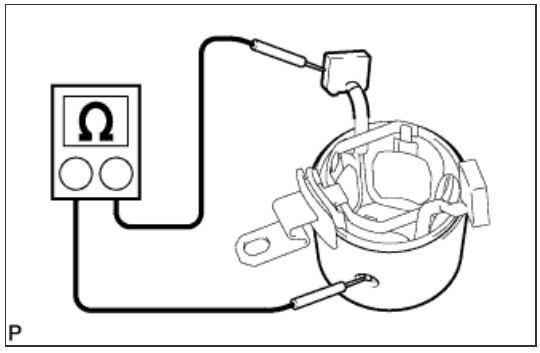
i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Terminal C plate - Brushes	Always	Below 1 Ω

If the result is not as specified, replace the starter yoke assembly.

b. Inspect if the field coil is grounded.



i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Brushes - Starter yoke body	Always	10 kΩ or higher

If the result is not as specified, replace the starter yoke assembly.

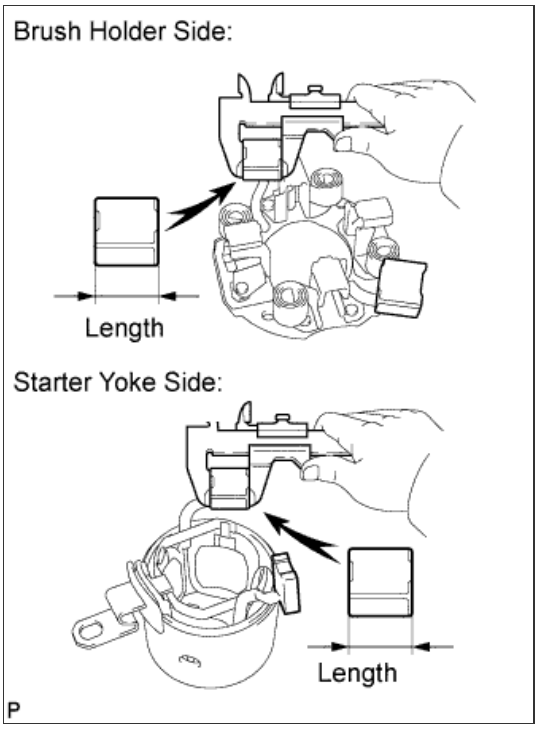
4. INSPECT STARTER BRUSH

a. Using a vernier caliper, measure the brush length.

Standard length:
21.0 mm (0.827 in.)

Minimum length:
12.0 mm (0.472 in.)

If the length is less than the minimum, replace the brush holder and starter yoke assembly.



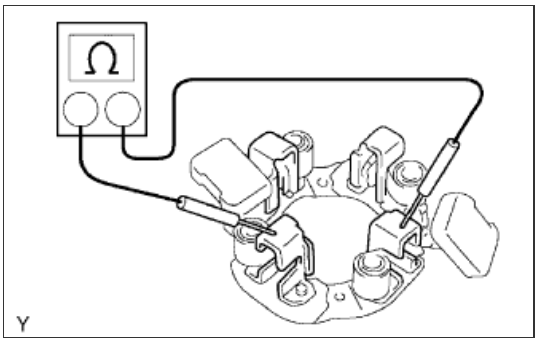
5. INSPECT STARTER BRUSH HOLDER ASSEMBLY

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Positive ( ) brush holder - Negative (-) brush holder	Always	10 kΩ or higher

If the result is not as specified, replace the brush holder assembly.



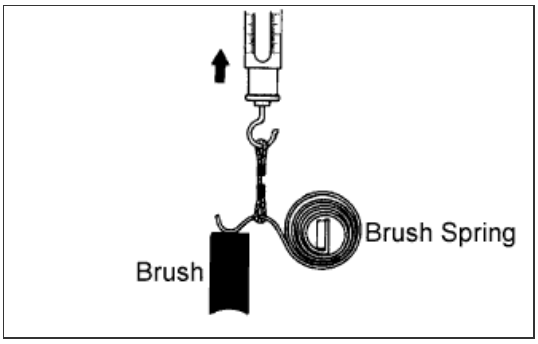
b. Inspect the load of the brush spring.

i. Take a pull scale reading immediately after the brush spring separates from the brush.

Standard spring installed load:
36 N (3.6 kgf, 8.0 lbf)

Minimum spring installed load:
12 N (1.2 kgf, 2.7 lbf)

If the spring installed load is less than the minimum, replace the brush holder assembly.

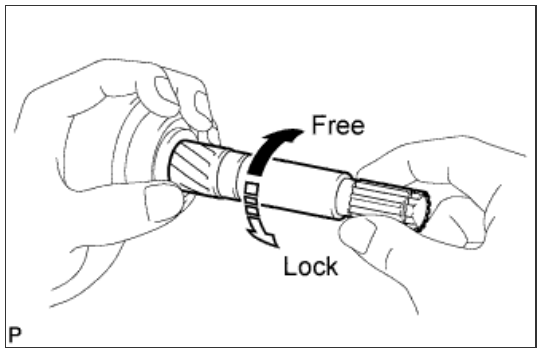


6. INSPECT STARTER CLUTCH SUB-ASSEMBLY

a. Check the starter clutch operation.

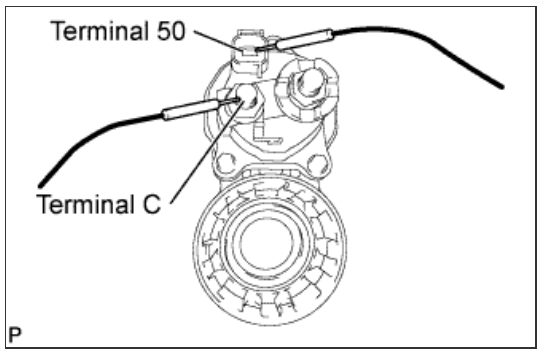
i. Hold the clutch and bearing with one hand and turn the shaft with the other. Check that the inner sleeve turns easily in the "free" direction but cannot turn in the "lock" direction as shown in the illustration.
If the starter clutch sub-assembly does not operate as specified,

replace the starter clutch sub-assembly.



7. INSPECT MAGNET STARTER SWITCH ASSEMBLY

a. Check the pull-in coil for an open circuit.



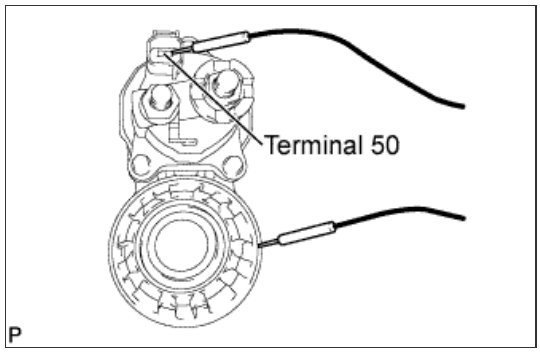
i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
Terminal 50 - Terminal C	Always	Below 0.3 Ω

If the result is not as specified, replace the magnet starter switch assembly.

b. Check the hold-in coil for an open circuit.



i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

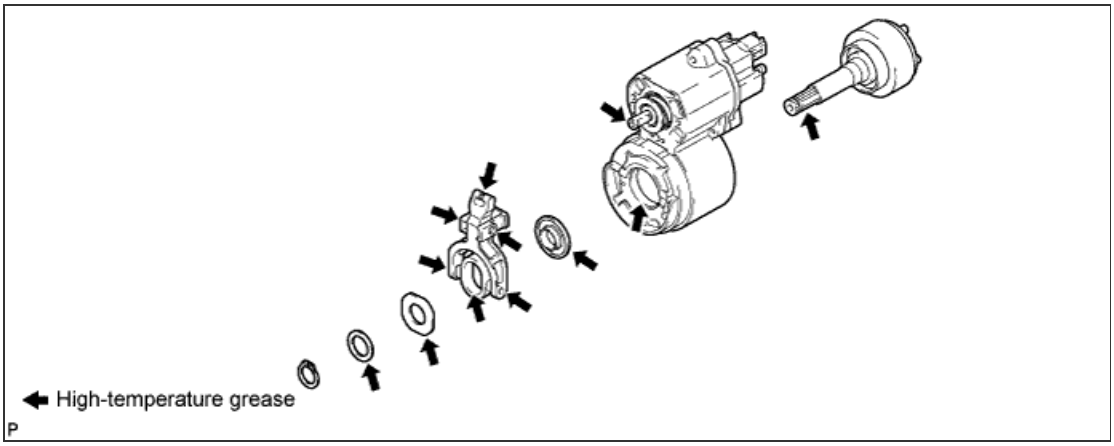
Tester Connection	Condition	Specified Condition
Terminal 50 - Housing Body	Always	Below 0.8 Ω

If the result is not as specified, replace the magnet starter switch assembly.

for Preparation Click here

1. INSTALL STARTER CLUTCH SUB-ASSEMBLY

a. Apply high-temperature grease to the parts indicated by the arrows in the illustration.



b. Install the starter clutch into the magnet starter switch.

NOTICE:

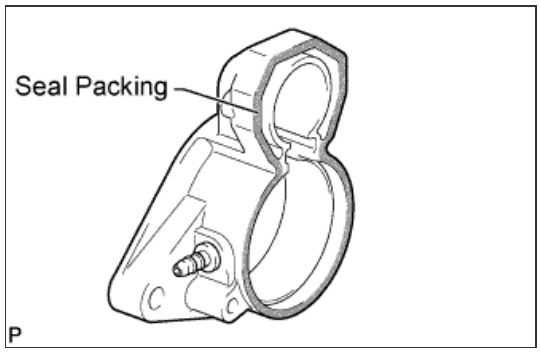
Make sure that the bearing does not disengage from the starter clutch.

c. Install the 3 starter washers and pinion drive lever with the snap ring.

2. INSTALL STARTER DRIVE HOUSING ASSEMBLY

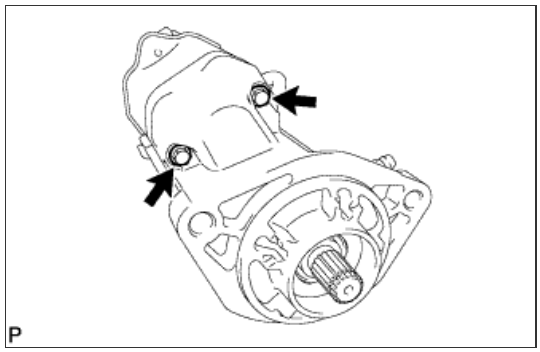
a. Apply a light coat of seal packing to the surface of the starter drive housing that contacts the starter magnet switch.

Seal packing:
Toyota Genuine Seal Packing 1121C, Three Bond 1121C or equivalent



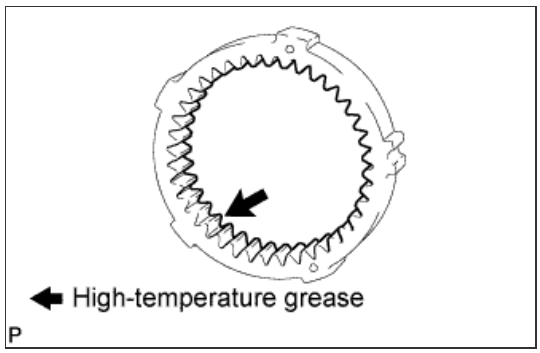
b. Install the starter drive housing with the 2 bolts.

Torque:
6.0 N*m{ 61 kgf*cm , 53 in.*lbf }



3. INSTALL STARTER INTERNAL GEAR

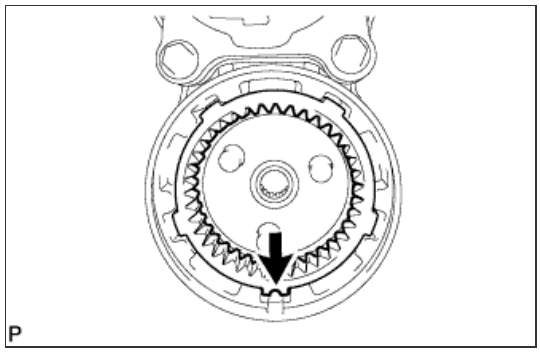
a. Apply high-temperature grease to the portion indicated by the arrow in the illustration.



b. Install the starter internal gear.

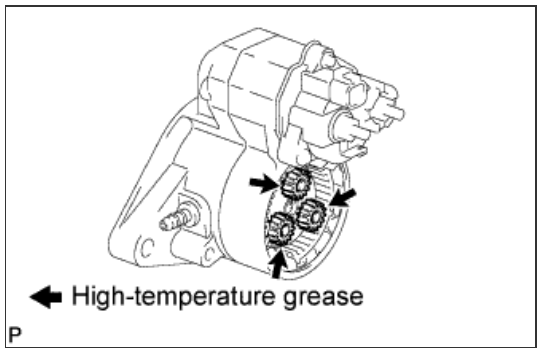
NOTICE:

Make sure the internal gear protrusion indicated by the arrow in the illustration is aligned with the groove on the bottom side of the magnet starter switch.



c. Apply high-temperature grease to the planetary gears.

d. Install the 3 starter planetary gears.

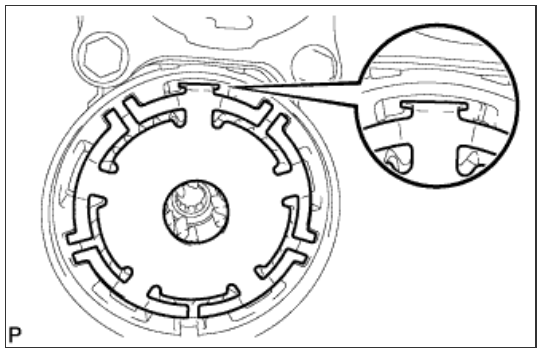


4. INSTALL STARTER ARMATURE ASSEMBLY

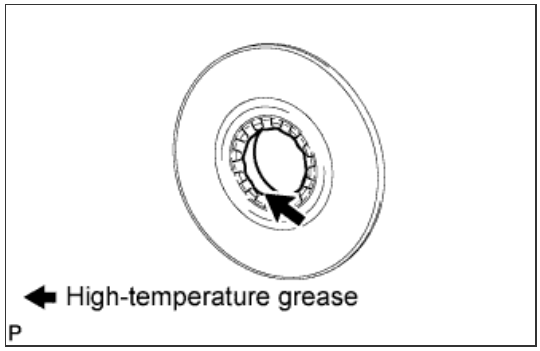
a. Install the starter washer.

NOTICE:

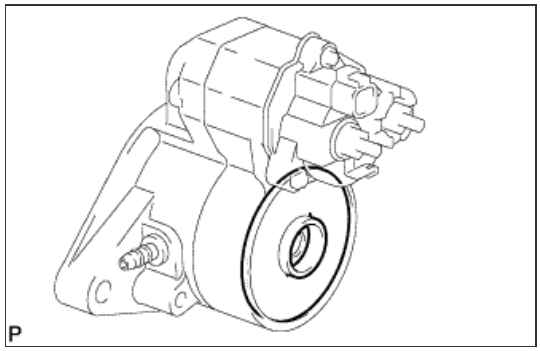
Make sure that the washer is securely seated in the groove.



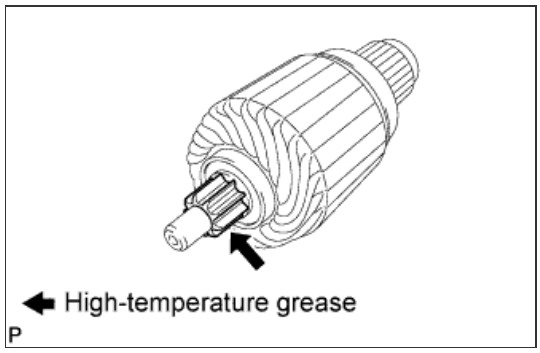
b. Apply high-temperature grease to the portion indicated by the arrow in the illustration.



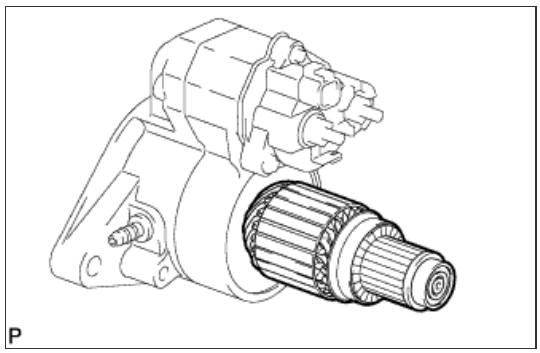
c. Install the starter plate.



d. Apply high-temperature grease to the portion indicated by the arrow in the illustration.

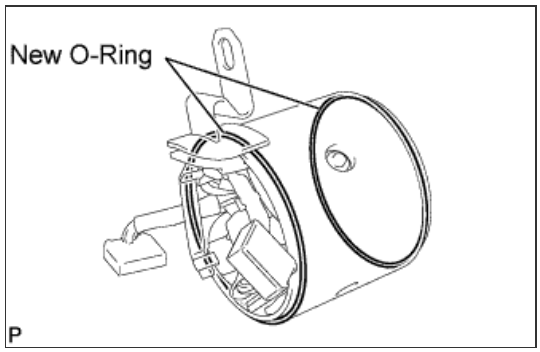


e. Install the starter armature to the starter plate.

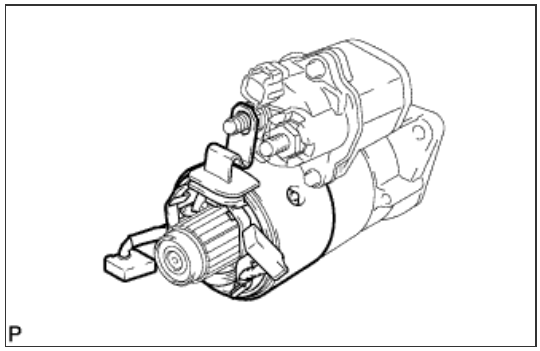


5. INSTALL STARTER YOKE ASSEMBLY

a. Install 2 new O-rings to the starter yoke.



b. Install the starter yoke to the magnet starter switch.



6. INSTALL STARTER BRUSH HOLDER ASSEMBLY

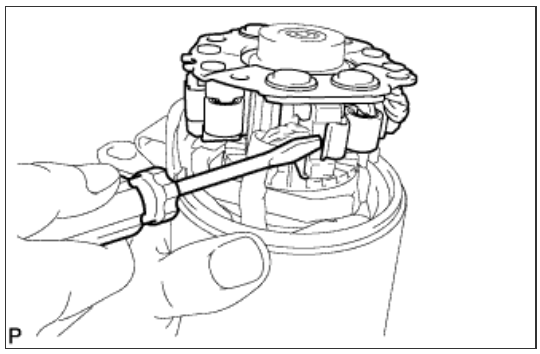
a. Place the brush holder on the starter armature.

b. Using a screwdriver, hold the starter brush spring back and connect the 4 starter brushes to the starter brush holder.

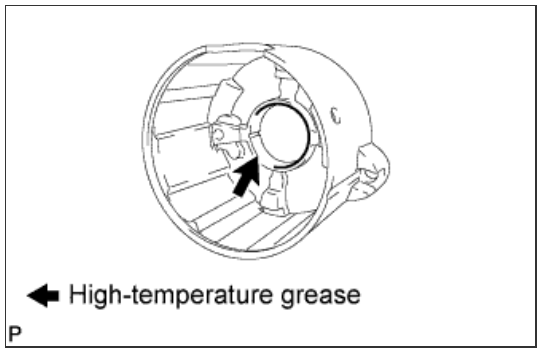
NOTICE:

Check that the positive (+) lead wires are not grounded.

c. Install the starter brush holder into the starter armature.



d. Apply high-temperature grease to the portion indicated by the arrow in the illustration.



e. Install the commutator end frame with the 2 screws.

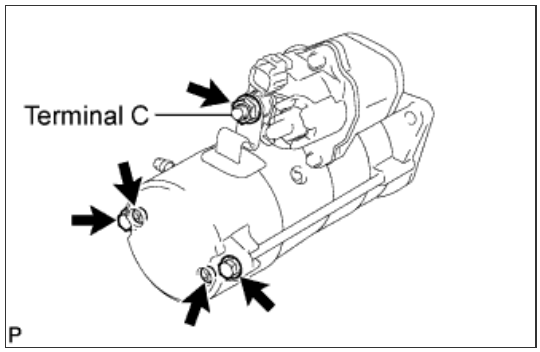
Torque:
3.9 N*m{ 40 kgf*cm , 35 in.*lbf }

f. Install the 2 through bolts.

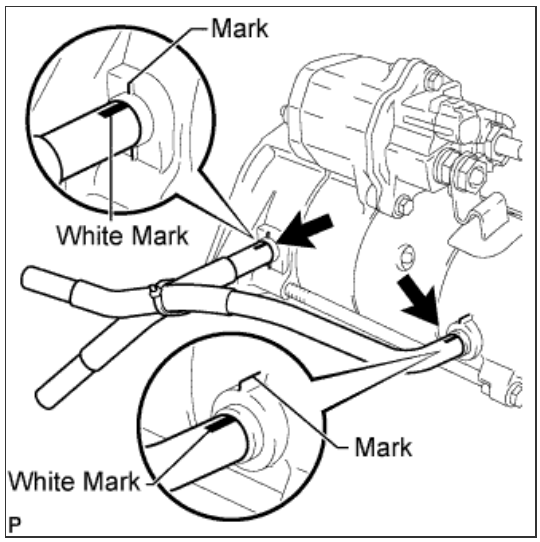
Torque:
17 N*m{ 173 kgf*cm , 12 ft.*lbf }

g. Install the nut to terminal C.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

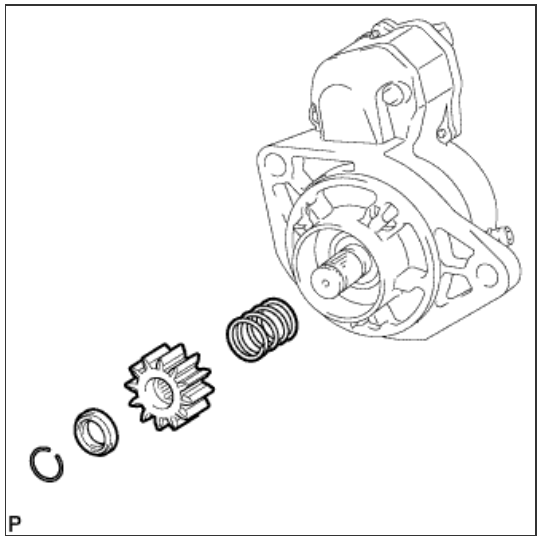


h. Install the 2 starter hoses to the starter.



7. INSTALL STARTER CLUTCH PINION

a. Install the spring, starter clutch pinion and pinion stop collar with the snap ring.

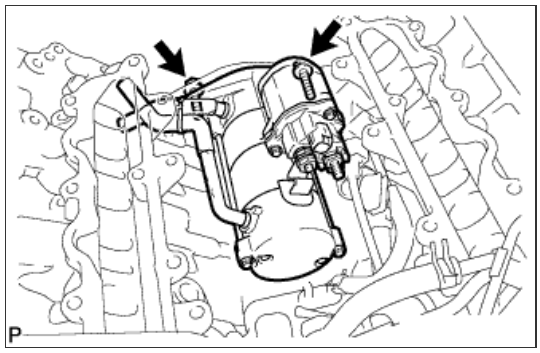


for Preparation Click here

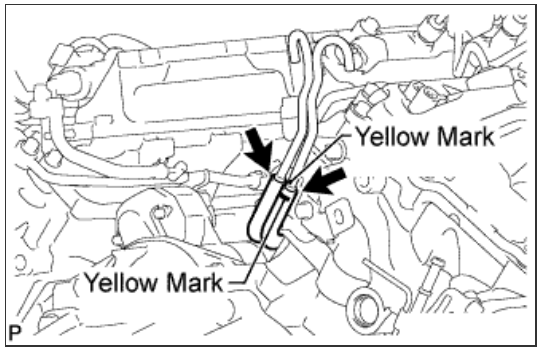
1. INSTALL STARTER ASSEMBLY

a. Install the starter with the 2 bolts.

Torque:
80 N*m{ 816 kgf*cm , 59 ft.*lbf }



b. Connect the 2 starter hoses.

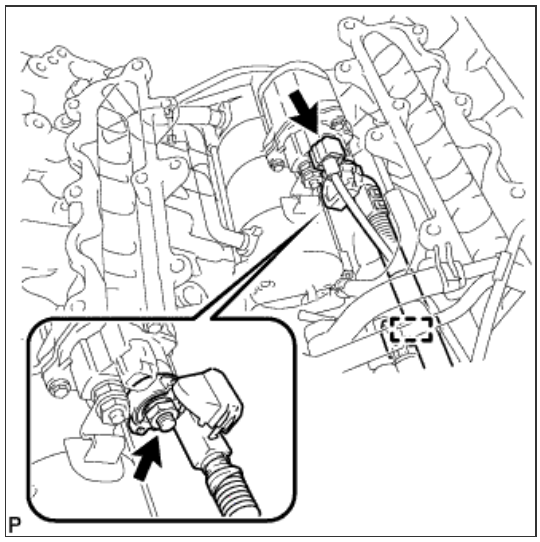


c. Attach the harness clamp and connect the wire harness.

d. Connectl the starter wire with the nut.

Torque:
21 N*m{ 214 kgf*cm , 15 ft.*lbf }

e. Connect the starter connector.



2. INSTALL FUEL COOLER ASSEMBLY

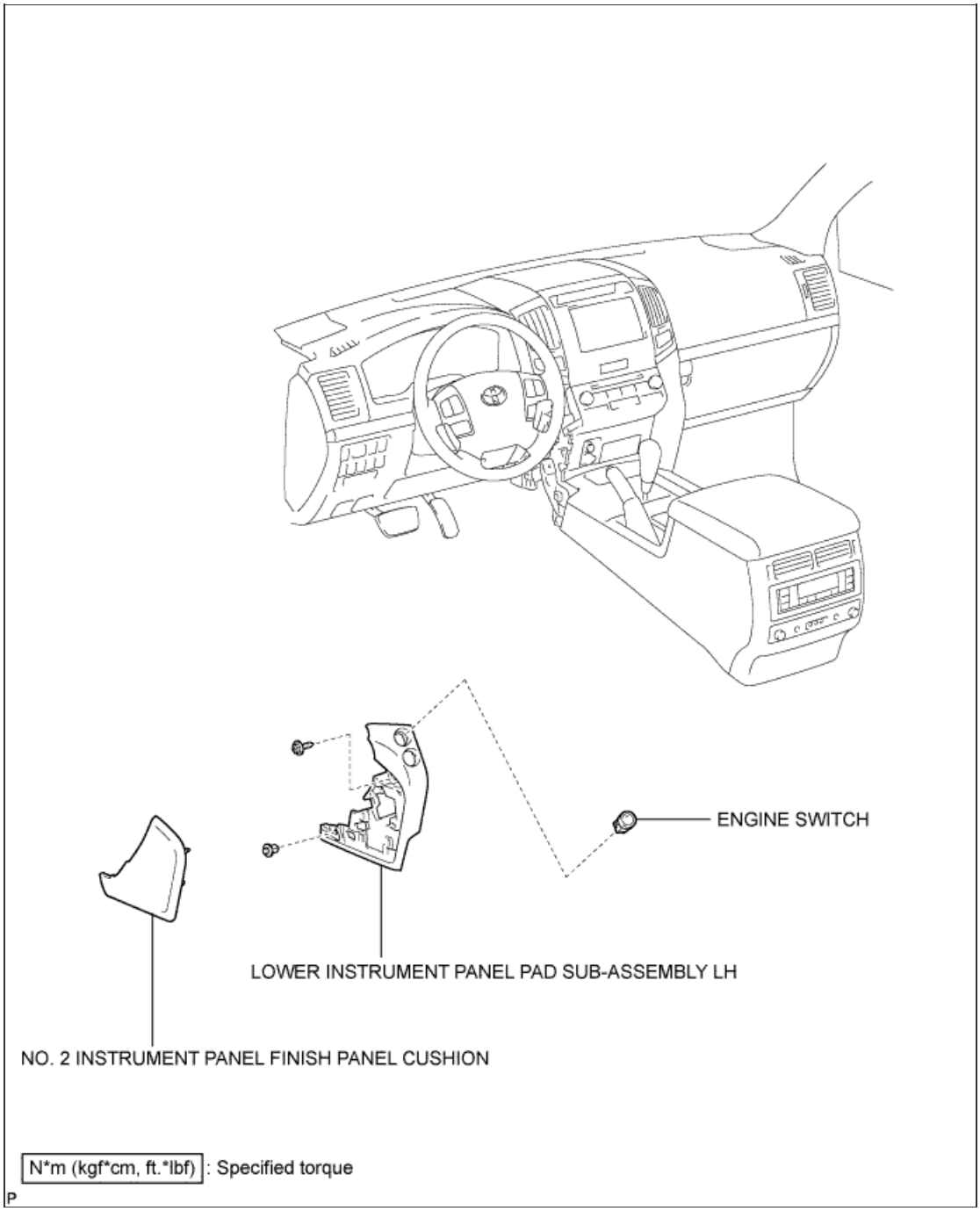
a. Install the fuel cooler assembly (Click here).

3. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

for Preparation Click here

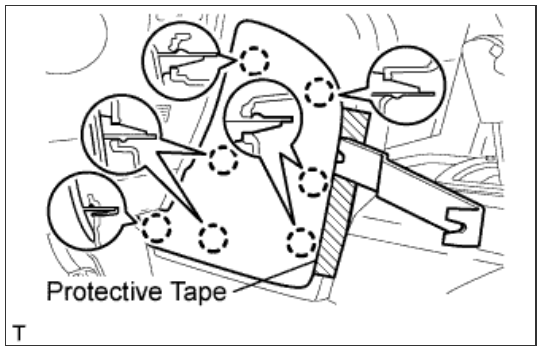


for Preparation Click here

1. REMOVE NO. 2 INSTRUMENT PANEL FINISH PANEL CUSHION

a. Place protective tape as shown in the illustration.

b. Using a moulding remover, detach the 7 claws and remove the panel cushion.



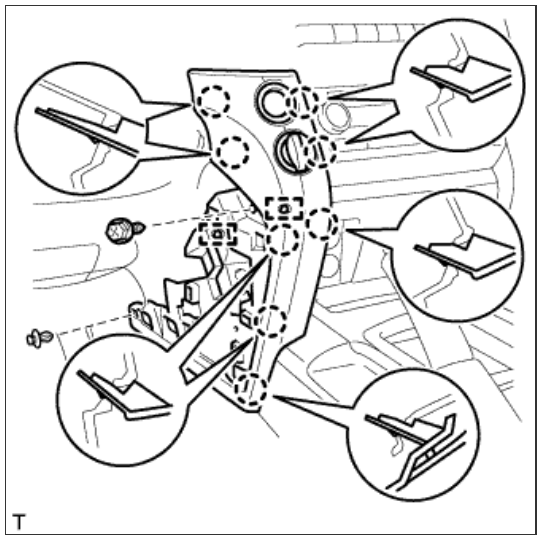
2. REMOVE LOWER INSTRUMENT PANEL PAD SUB-ASSEMBLY LH

a. Remove the clip.

b. Remove the screw.

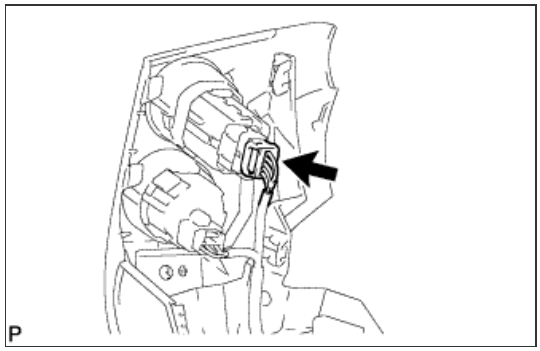
c. Detach the 8 claws.

d. Remove the panel pad and disconnect the connectors and 2 clamps.

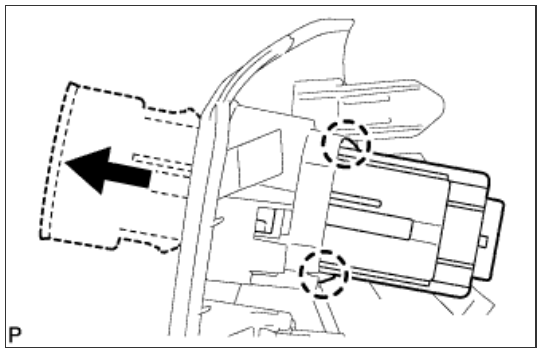


3. REMOVE ENGINE SWITCH

a. Disconnect the switch connector.



b. Detach the 2 claws and remove the switch.


P

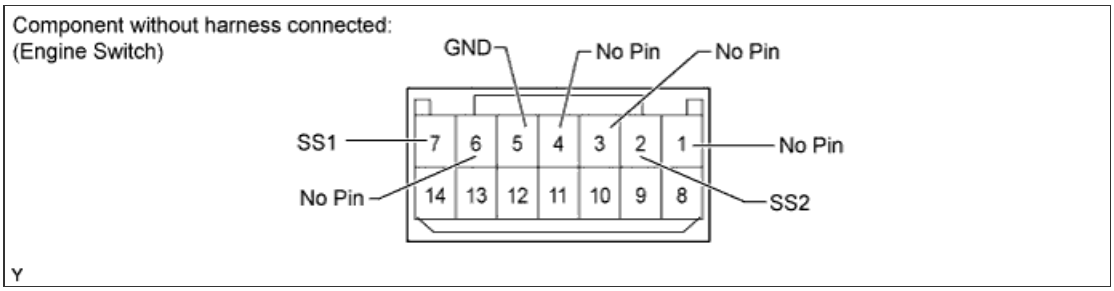
for Preparation Click here

1. INSPECT ENGINE SWITCH

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Switch Condition	Specified Condition
7 (SS1) - 5 (GND)	Not pushed	10 kΩ or higher
2 (SS2) - 5 (GND)	Not pushed	10 kΩ or higher
7 (SS1) - 5 (GND)	Pushed	Below 1 Ω
2 (SS2) - 5 (GND)	Pushed	Below 1 Ω



If the result is not as specified, replace the engine switch.

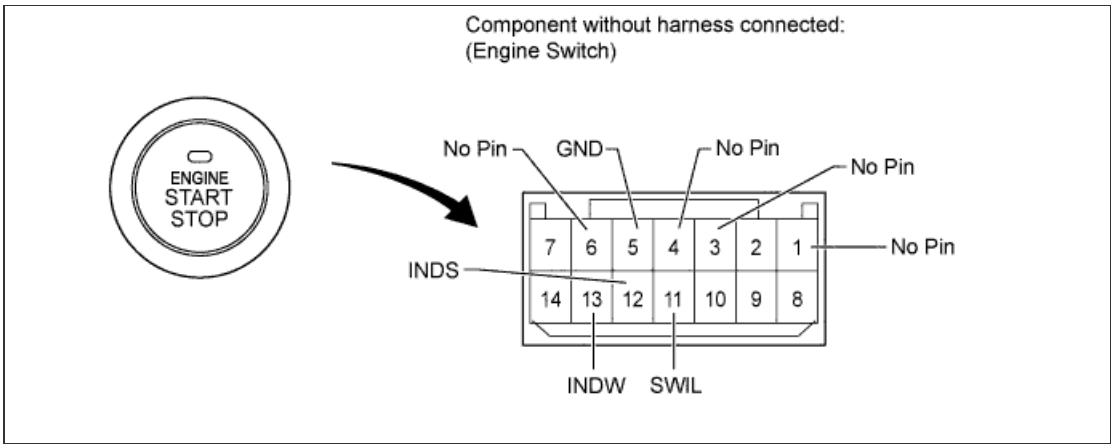
b. Apply battery voltage between the terminals of the switch, and check the illumination condition of the switch.

HINT:

- **If the positive (+) lead and the negative (-) lead are incorrectly connected, the engine switch indicator will not illuminate.**
- **If the voltage is too low, the indicator will not illuminate.**

OK:

Measurement Condition	Specified Condition
Battery positive (+) → Terminal 11 (SWIL) Battery negative (-) → Terminal 5 (GND)	Illuminates (illumination of lettering)
Battery positive (+) → Terminal 12 (INDS) Battery negative (-) → Terminal 5 (GND)	Illuminates (green)
Battery positive (+) → Terminal 13 (INDW) Battery negative (-) → Terminal 5 (GND)	Illuminates (amber)

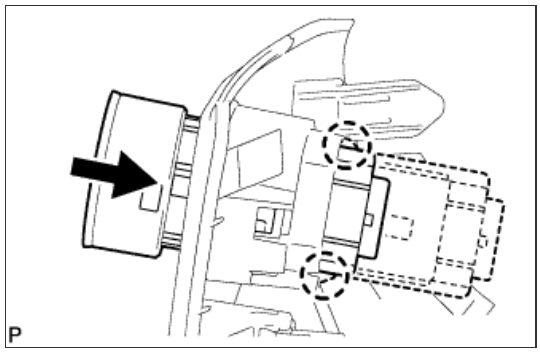


If the result is not as specified, replace the engine switch.

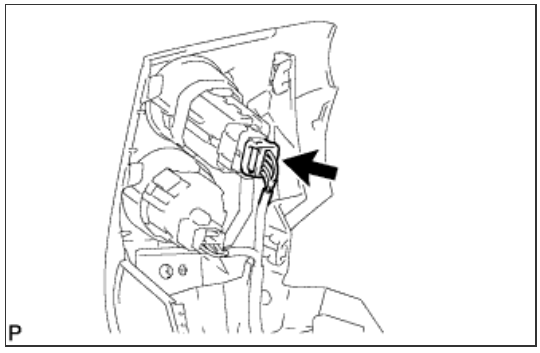
for Preparation Click here

1. INSTALL ENGINE SWITCH

a. Attach the 2 claws to install the switch.



b. Connect the switch connector.



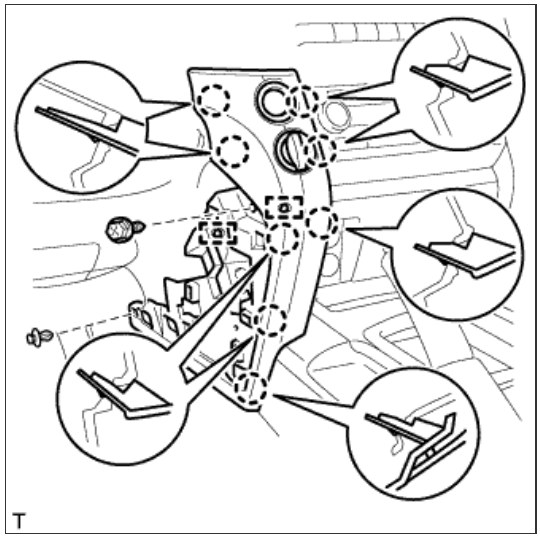
2. INSTALL LOWER INSTRUMENT PANEL PAD SUB-ASSEMBLY LH

a. Connect the connectors and 2 clamps.

b. Attach the 8 claws to install the panel pad.

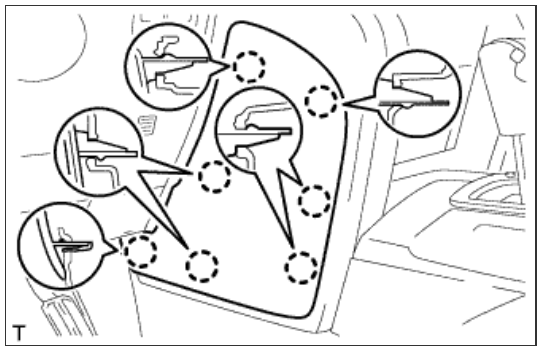
c. Install the screw.

d. Install the clip.

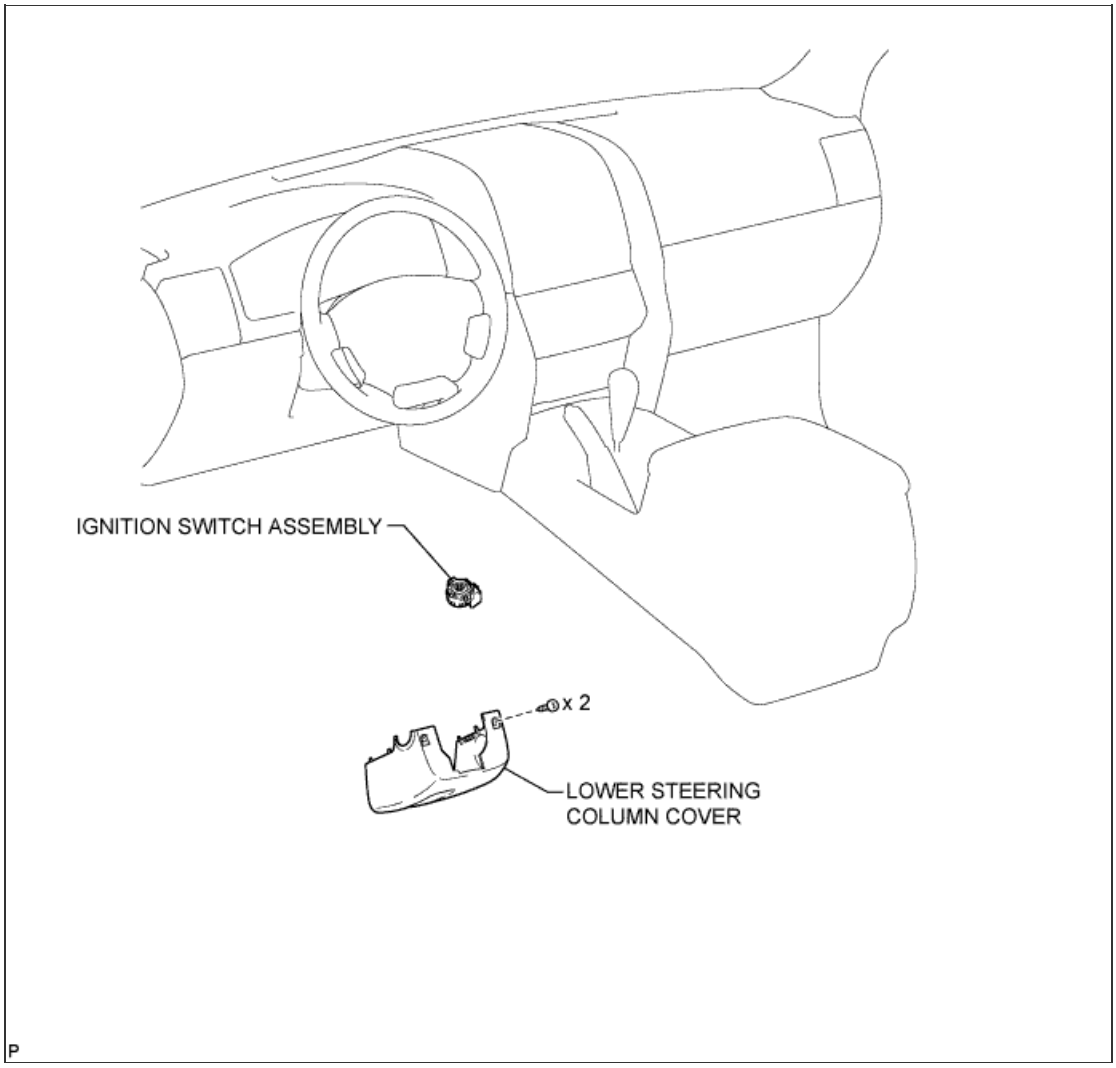


3. INSTALL NO. 2 INSTRUMENT PANEL FINISH PANEL CUSHION

a. Attach the 7 claws to install the panel cushion.


T

for Preparation Click here



for Preparation Click here

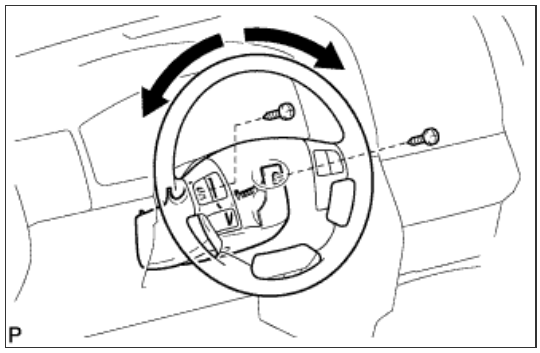
1. REMOVE LOWER STEERING COLUMN COVER

a. Remove the 2screws.

HINT:

Turn the steering wheel to the right and left as necessary to remove the 2 screws.

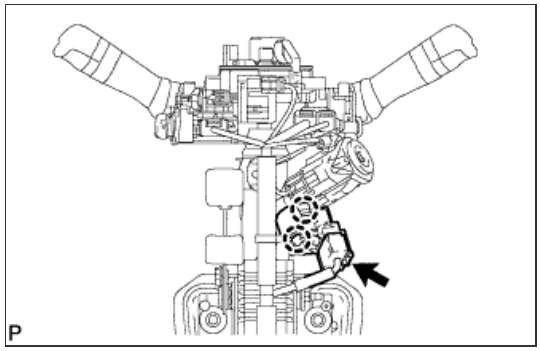
b. Detach the 2 claws and remove the lower steering column cover.



2. REMOVE IGNITION SWITCH ASSEMBLY

a. Disconnect the ignition switch connector.

b. Detach the 2 claws and remove the ignition switch.



for Preparation Click here

1. INSPECT IGNITION SWITCH ASSEMBLY

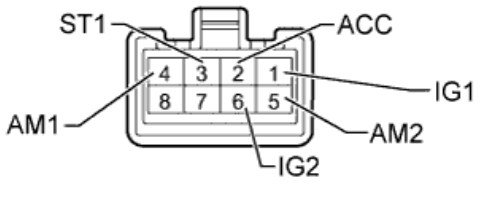
a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Switch Condition	Specified Condition
All combinations of all terminals	LOCK	10 kΩ or higher
4 (AM1) - 2 (ACC)	ACC	Below 1 Ω
4 (AM1) - 2 (ACC) 4 (AM1) - 1 (IG1) 5 (AM2) - 6 (IG2)	ON	
4 (AM1) - 1 (IG1) 4 (AM1) - 3 (ST1) 5 (AM2) - 6 (IG2)	START	

If the result is not as specified, replace the switch assembly.

Component without harness connected:
(Ignition Switch)



for Preparation Click here

1. INSTALL IGNITION SWITCH ASSEMBLY

a. Attach the 2 claws to install the ignition switch.

b. Connect the ignition switch connector.

2. INSTALL LOWER STEERING COLUMN COVER

a. Attach the 2 claws to install the lower steering column cover.

b. Install the 2 screws.

HINT:

Turn the steering wheel to the right and left as necessary to install the 2 screws.

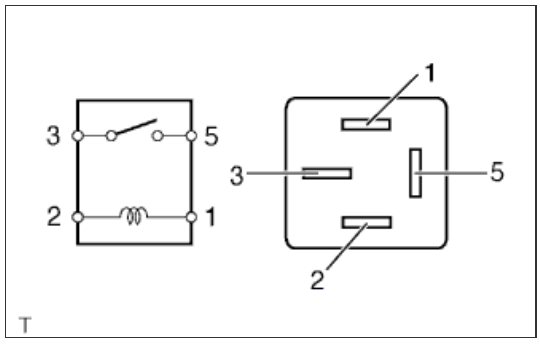
for Preparation Click here

1. INSPECT STARTER RELAY (ST)

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage applied to terminals 1 and 2	Below 1 Ω



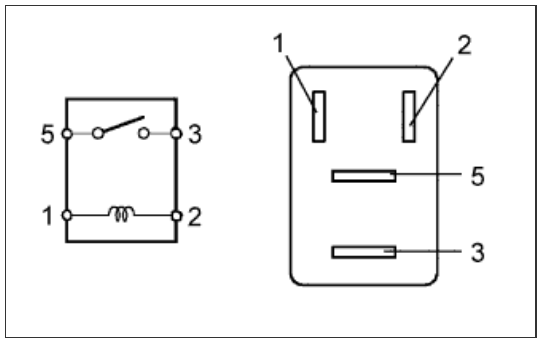
If the result is not as specified, replace the relay.

2. INSPECT STARTER CUT RELAY (ST CUT)

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage applied to terminals 1 and 2	Below 1 Ω



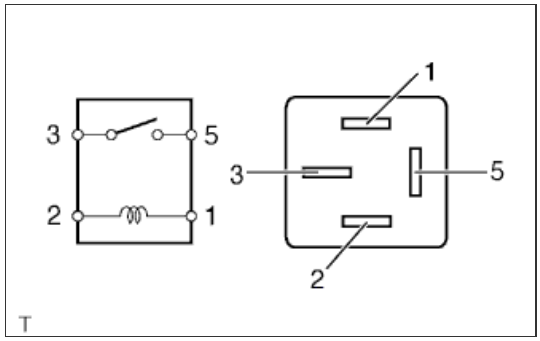
If the result is not as specified, replace the relay.

3. INSPECT NO. 1 GLOW RELAY (GLOW 1)

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage applied to terminals 1 and 2	Below 1 Ω



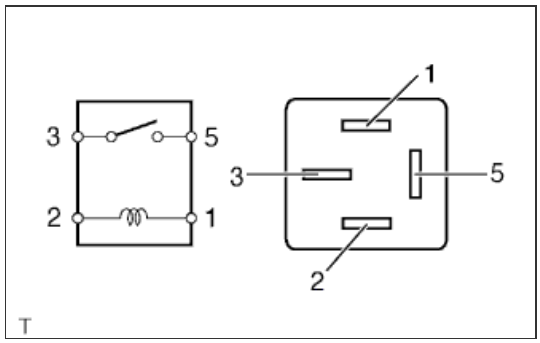
If the result is not as specified, replace the relay.

4. INSPECT NO. 2 GLOW RELAY (GLOW 2)

a. Measure the resistance according to the value(s) in the table below.

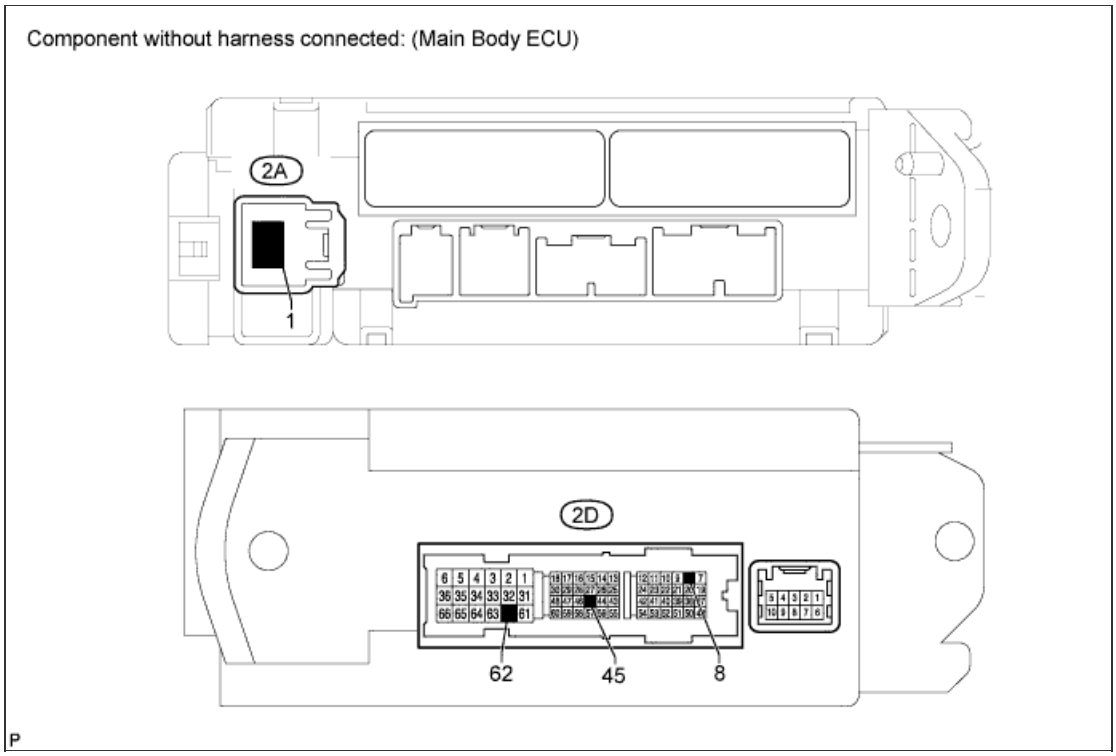
Standard Resistance:

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied to terminals 1 and 2	10 kΩ or higher
	Battery voltage applied to terminals 1 and 2	Below 1 Ω



If the result is not as specified, replace the relay.

5. INSPECT MAIN BODY ECU (ACC RELAY)



a. Measure the resistance of the ACC relay circuit.

i. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
2A-1 - 2D-8	Battery voltage not applied between 2D-45 and 2D-62	10 kΩ or higher
	Battery voltage applied between 2D-45 and 2D-62	Below 1 Ω

If the result is not as specified, replace the main body ECU.

for Preparation Click here

1.IGNITION SWITCH EXPRESSION

HINT:

The type of ignition switch used on this model differs according to the specifications of the vehicle. The expressions listed in the table below are used in this section.

Expression	Ignition Switch (position)	Engine Switch (condition)
Ignition Switch off	LOCK	Off
Ignition Switch ACC	ACC	On (ACC)
Ignition Switch ON	ON	On (IG)
Engine Start	START	Start

2.HANDLING PRECAUTION FOR CRUISE CONTROL SYSTEM

a. Turn the cruise control main switch off when not using the cruise control system.

b. Be careful as the vehicle speed increases when driving downhill with the cruise control system on.

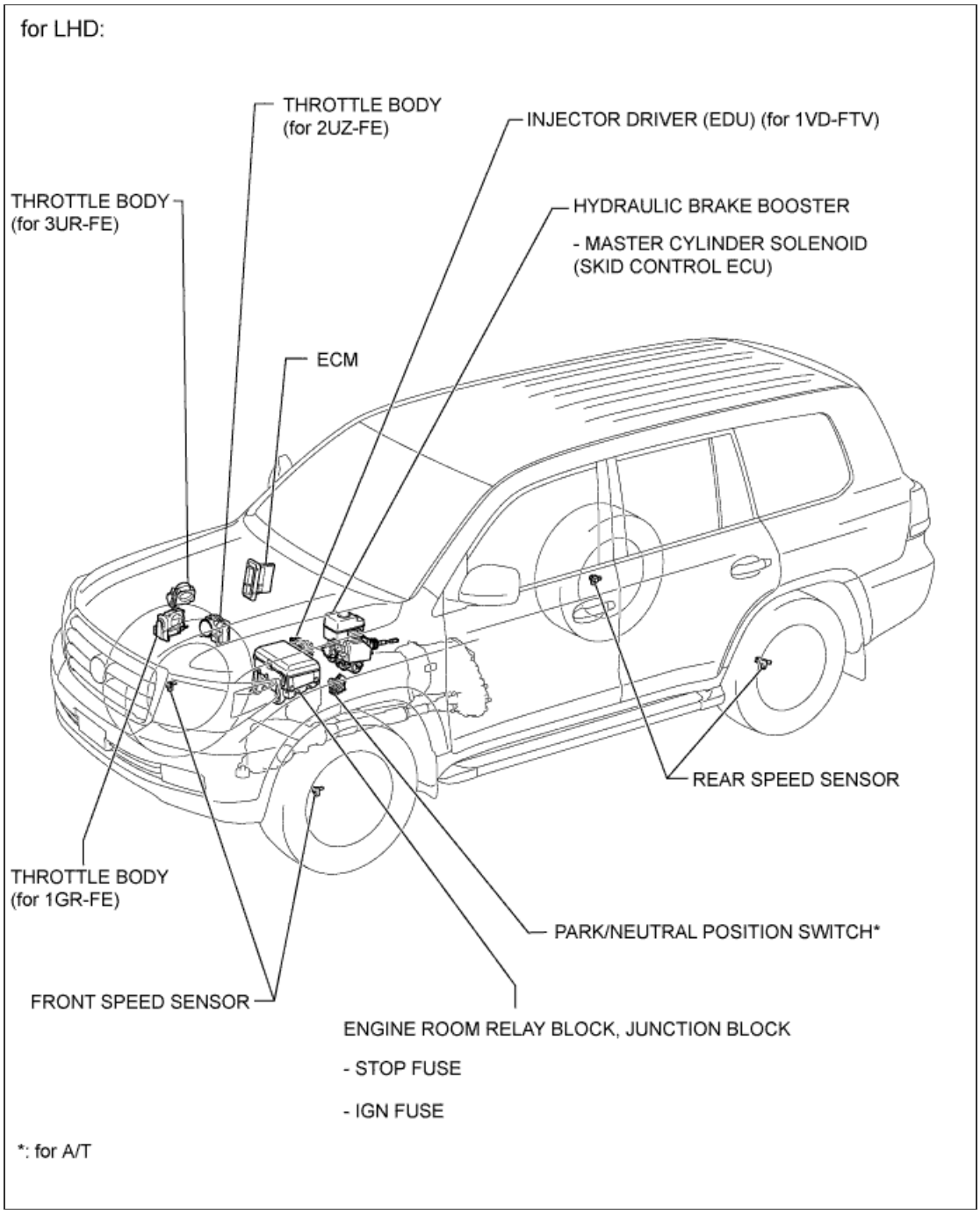
c. The +RES (ACCELERATION/RESUME) operation changes according to the cruise control system status. When the cruise control system is operating, + (ACCELERATION) operates. When the cruise control system is not operating, RES (RESUME) operates.

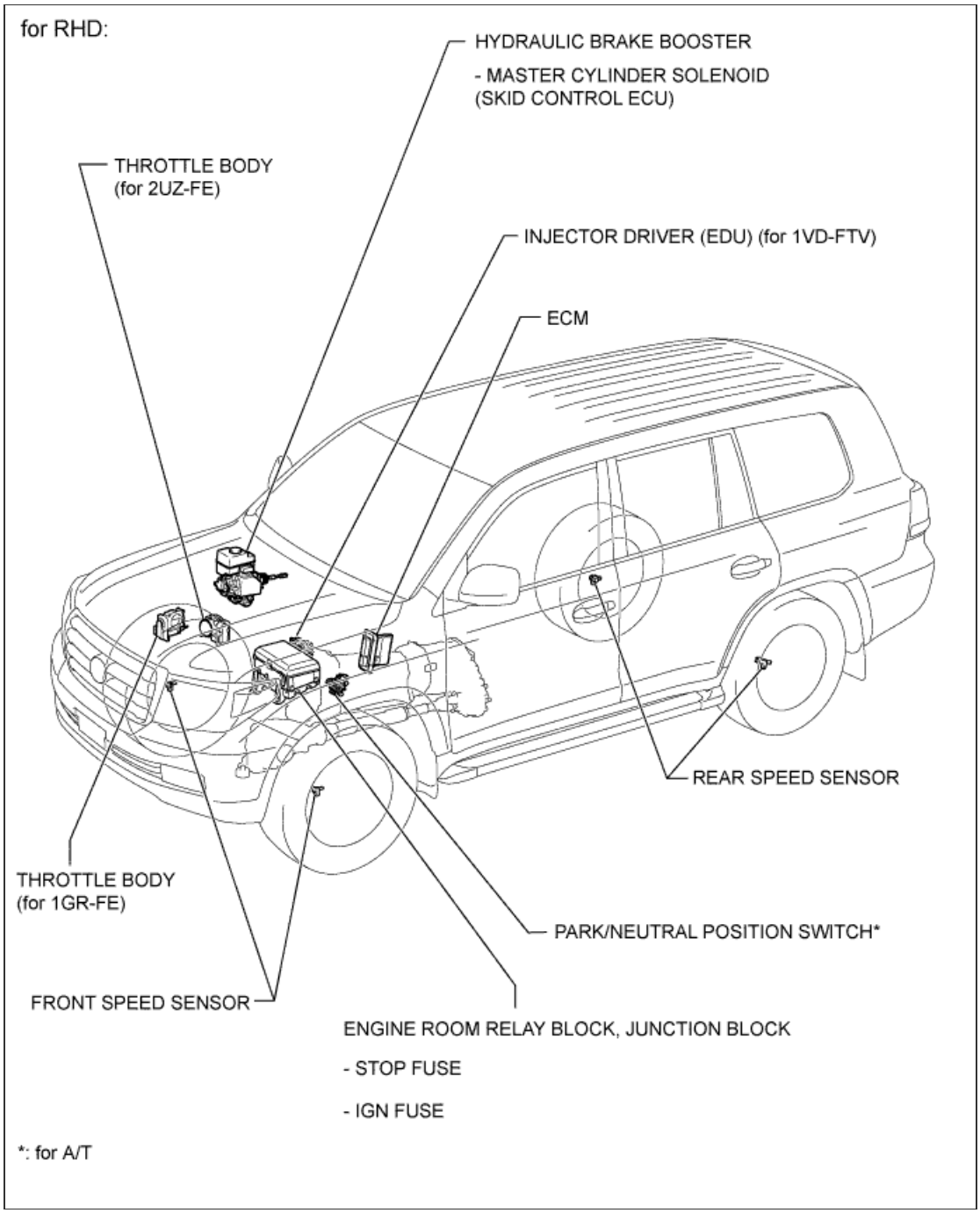
d. When the cruise control system is operating and the CRUISE main indicator light blinks, turn the cruise control main switch off to reset the cruise control system. After the reset, if the cruise control main switch cannot be turned on, or the cruise control system is canceled immediately after turning the cruise control main switch on, the system may have a malfunction.

e. Do not use the cruise control system where the road conditions are as follows:

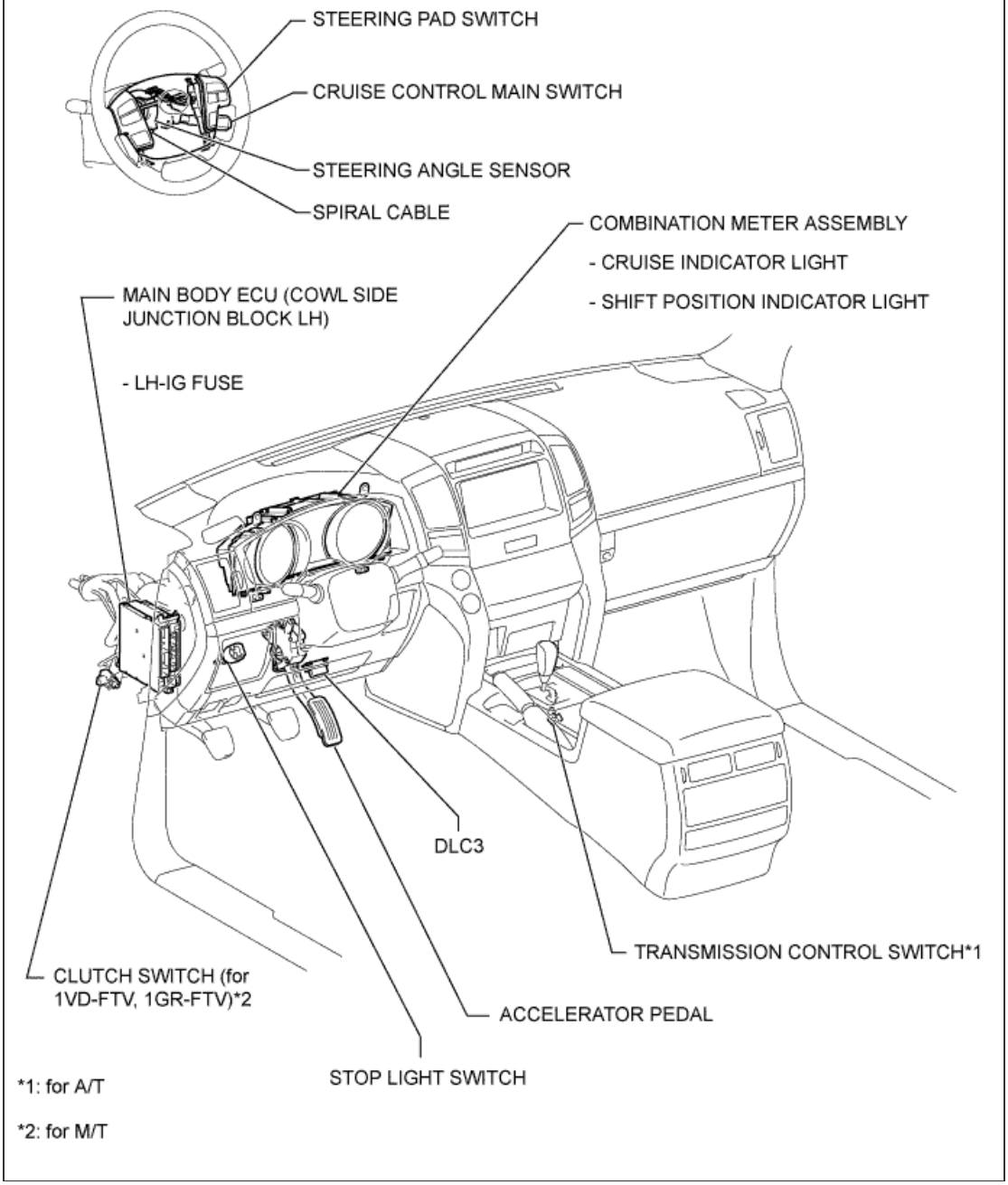
- Heavy traffic
- Steep decline
- Roads with sharp turns
- Icy or snowy roads
- Slippery roads

for Preparation Click here




for RHD:
HYDRAULIC BRAKE BOOSTER
- MASTER CYLINDER SOLENOID
(SKID CONTROL ECU)
THROTTLE BODY
(for 2UZ-FE)
INJECTOR DRIVER (EDU) (for 1VD-FTV)
ECM
REAR SPEED SENSOR
THROTTLE BODY
(for 1GR-FE)
PARK/NEUTRAL POSITION SWITCH*
FRONT SPEED SENSOR
ENGINE ROOM RELAY BLOCK, JUNCTION BLOCK
- STOP FUSE
- IGN FUSE
*: for A/T

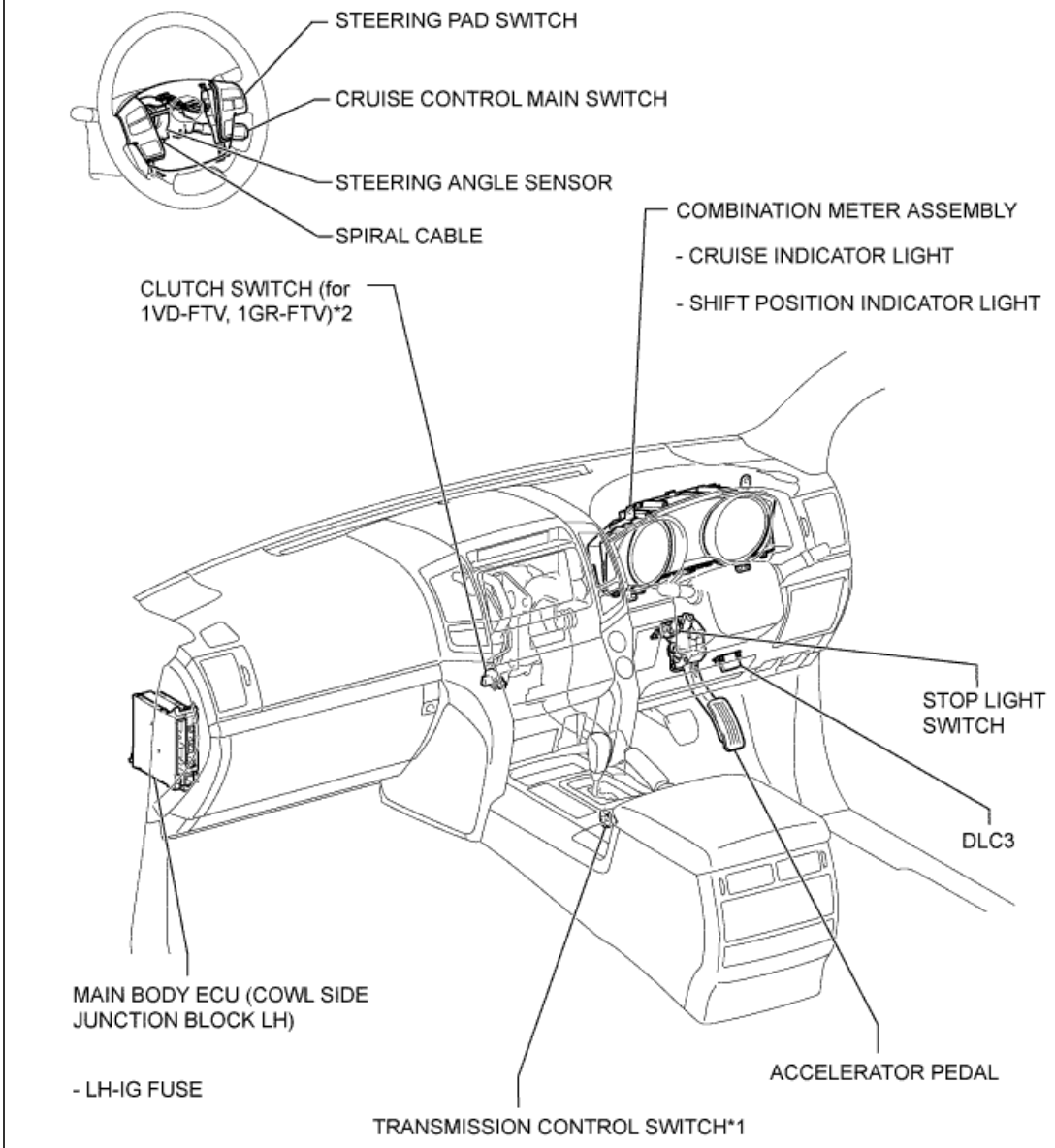
for LHD:



*1: for A/T

*2: for M/T

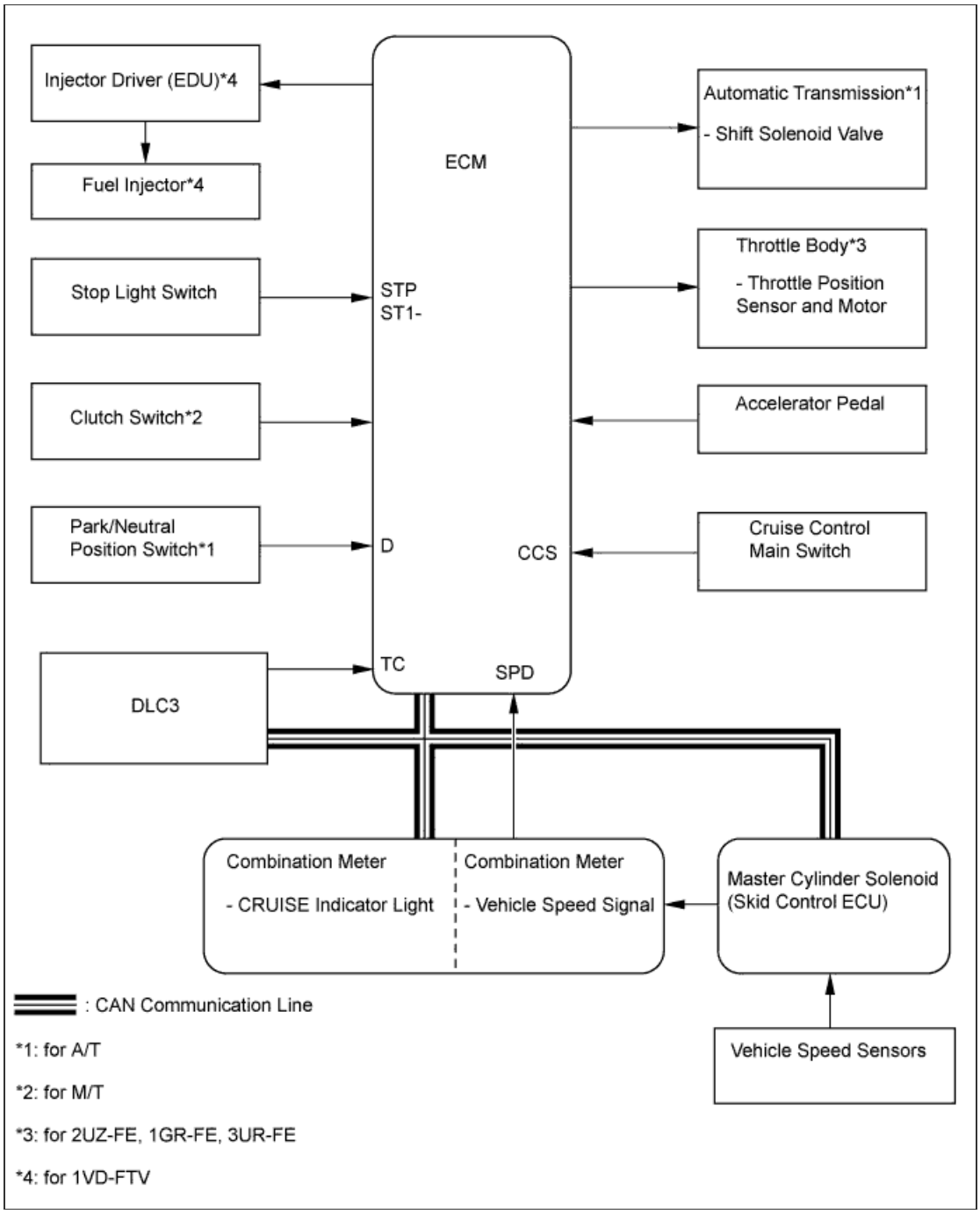
for RHD:



*1: for A/T

*2: for M/T

for Preparation Click here



Communication Table

Transmitter	Receiver	Signal	Communication Line
ECM	Combination Meter	CRUISE main indicator operation signal	CAN

for Preparation Click here

CRUISE CONTROL SYSTEM (for 2UZ-FE, 1GR-FE, 3UR-FE)

This system is controlled by the ECM, and is activated by the throttle position sensor and motor. The ECM controls the following functions: , -SET (C ET), ES (ACCELE T ESUME), CANCEL, vehicle speed operation, motor output control, and shift down control.

- The ECM compares the driving vehicle speed from the vehicle speed sensor with the stored vehicle speed set through the cruise control main switch. The ECM controls the throttle valve motor of the throttle position sensor and motor to open the valve when the driving speed is less than the stored speed.
- The ECM receives signals such as , -SET (C ET), ES (ACCELE T ESUME), and CANCEL from the cruise control main switch and e ecutes the corresponding function.
- The ECM illuminates the C E main indicator light on the combination meter when it receives the cruise control main switch on signal.
- The ECM cancels the cruise control system when the bra e pedal is depressed and the ECM receives the stop light switch signal.
- The ECM cancels the cruise control system when the S3, S2, or S range is selected with the shift lever in S, or when the shift lever is moved from D to N, based on the (ar eutral osition) switch signal (for A/T).
- The ECM cancels the cruise control system when the clutch pedal is depressed and the ECM receives a clutch switch signal (for M/T).

CRUISE CONTROL SYSTEM (for 1VD-FTV)

This system controls the vehicle speed by using the ECM to change the fuel injection uantity. The ECM controls the following functions: , -SET (C ET), ES (ACCELE T ESUME), CANCEL, vehicle speed operation, motor output control, and shift down control.

- The ECM compares the driving vehicle speed from the vehicle speed sensor with the stored vehicle speed set through the cruise control main switch. When the actual vehicle speed e ceeds the stored vehicle speed, the ECM decreases the fuel injection uantity. When the actual vehicle speed is less than the stored vehicle speed, the ECM increases the fuel injection uantity.
- The ECM receives signals such as , -SET (C ET), ES (ACCELE T ESUME), and CANCEL from the cruise control main switch and e ecutes the corresponding function.
- The ECM illuminates the C E main indicator light on the combination meter when it receives the cruise control main switch on signal.
- The ECM cancels the cruise control system when the bra e pedal is depressed and the ECM receives the stop light switch signal.
- The ECM cancels the cruise control system when the S3, S2, or S range is selected with the shift lever in S, or when the shift lever is moved from D to N, based on the (ar eutral osition) switch signal (for A/T).
- The ECM cancels the cruise control system when the clutch pedal is depressed and the ECM receives a clutch switch signal (for M/T).

LIMIT CONTROL

a. Low speed limit
The lowest possible limit of the speed setting range is set at appro imately 40 m/h (25 mph). The cruise control system cannot be set when the driving vehicle speed is below the low speed limit. The cruise control operation will be automatically canceled but the stored vehicle speed will be retained when the vehicle speed decreases below the low speed limit of 40 m/h (25 mph) while the cruise control is in operation.

b. High speed limit
The highest possible limit of the speed setting range is set at appro imately 200 m/h (mph). The cruise control system cannot be set when the driving vehicle speed is over the high speed limit. Also, ES (ACCELE T ESUME) cannot be used to increase speed beyond the high speed limit.

OPERATION OF CRUISE CONTROL (for 2UZ-FE, 1GR-FE, 3UR-FE)

The cruise control main switch is used to operate 7 functions: SET, - (C , TA , ES (ESUME), (ACCELE T , TA , and CANCEL. The SET, TA and - (C functions, and the ES (ESUME), TA and (ACCELE T functions are operated with the same switch. The cruise control main switch is an automatic return type switch which turns on only while operating it in each arrow direction and turns off after releasing it.

a. SET C T
ehicle speed is stored and constant speed control is maintained when pushing the switch to -SET while driving with the cruise control main switch on (the C E main indicator light is on), and the vehicle speed is within the set speed range (between the low and high speed limits).

b. - (C CT T
hen the cruise control main switch is pushed to -SET and held in that position while the cruise control system is operating, the ECM sends a "throttle valve opening angle 0°" demand signal to the throttle body. Then the vehicle speed is stored and maintained when the cruise control main switch is released.

HINT:

An actual throttle valve opening angle of 0° is not possible due to the idle speed control, etc.

c. TA C T
hen tapping down the cruise control main switch to -SET (for appro imately 0.6 seconds) while the cruise control system is in operation, the stored vehicle speeds decreases each time by appro imately .6 m/h (.0 mph). However, when the difference between the driving and

stored vehicle speeds is more than appro imately 5 m/h (3. mph), the stored vehicle speed is set to the actual vehicle speed at the moment the cruise control main switch is released from -SET and constant speed control is maintained.

d. (ACCELE T C T

The throttle valve motor of the throttle position sensor and motor is instructed by the ECM to open the throttle valve when ES on the cruise control main switch is pressed and held while the cruise control system is in operation. When the cruise control main switch is released from ES, the vehicle speed is stored and the vehicle is controlled at a constant speed.

e. TA C T

hen tapping up the cruise control main switch to ES (for appro imately 0.6 seconds) while the cruise control system is in operation, the stored vehicle speed increases each time by appro imately .6 m/h (.0 mph). However, when the difference between the driving and the stored vehicle speed is more than appro imately 5 m/h (3. mph), the stored vehicle speed will not be changed.

f. ES (ESUME) C T

f cruise control operation was canceled with the stop light switch or the CANCEL switch, and if the driving speed is within the limit range, pushing the cruise control main switch to ES restores the vehicle speed memori ed at the time of cancellation, and maintains constant speed control.

g. MANUAL CANCEL C T

erforming any of the following cancels the cruise control system while in operation (the stored vehicle speed in the ECM is maintained).

- Depressing the bra e pedal.
- Depressing the clutch pedal (for M/T).
- Moving the shift lever from D to N (for A/T).
- With the shift lever in S, selecting the S , S2 or S3 range (for A/T).
- ulling the cruise control main switch to CANCEL.
- Turning the cruise control main switch off (the stored vehicle speed in the ECM is not maintained).
- The system is operated.

OPERATION OF CRUISE CONTROL (for 1VD-FTV)

The cruise control main switch is used to operate 7 functions: SET, - (C , TA , ES (ESUME), (ACCELE T , TA , and CANCEL. The SET, TA and - (C functions, and the ES (ESUME), TA and (ACCELE T functions are operated with the same switch. The cruise control main switch is an automatic return type switch which turns on only while operating it in each arrow direction and turns off after releasing it.

a. SET C T

ehicle speed is stored and constant speed control is maintained when pushing the switch to -SET while driving with the cruise control main switch on (the C E main indicator light is on), and the vehicle speed is within the set speed range (between the low and high speed limits).

b. - (C CT T

hen the cruise control main switch is pushed to -SET and held in that position while the cruise control system is operating, the ECM changes the re uired fuel injection uantity to 0 and decelerates the vehicle. When the cruise control main switch is released from -SET, the vehicle speed is stored and constant speed control is maintained.

c. TA C T

hen tapping down the cruise control main switch to -SET (for appro imately 0.6 seconds) while the cruise control system is in operation, the stored vehicle speed decreases each time by appro imately .6 m/h (.0 mph). However, when the difference between the driving and stored vehicle speeds is more than appro imately 5 m/h (3. mph), the stored vehicle speed is set to the actual vehicle speed at the moment the cruise control main switch is released from -SET and constant speed control is maintained.

d. (ACCELE T C T

hile the cruise control system is in operation, if the cruise control main switch is set to ES, the EDU (Electronic Driving Unit) increases the fuel injection uantity. When the cruise control main switch is released from ES, the vehicle speed is stored and the vehicle is controlled at a constant speed.

e. TA C T

hen tapping up the cruise control main switch to ES (for appro imately 0.6 seconds) while the cruise control system is in operation, the stored vehicle speed increases each time by appro imately .6 m/h (.0 mph). However, when the difference between the driving and the stored vehicle speed is more than appro imately 5 m/h (3. mph), the stored vehicle speed will not be changed.

f. ES (ESUME) C T

f cruise control operation was canceled with the stop light switch or the CANCEL switch, and if the driving speed is within the limit range, pushing the cruise control main switch to ES restores the vehicle speed memori ed at the time of cancellation, and maintains constant speed control.

g. MANUAL CANCEL C T

erforming any of the following cancels the cruise control system while in operation (the stored vehicle speed in the ECM is maintained).

- Depressing the bra e pedal.
- Depressing the clutch pedal (for M/T).
- Moving the shift lever from D to N (for A/T).
- With the shift lever in S, selecting the S , S2 or S3 range (for A/T).
- ulling the cruise control main switch to CANCEL.
- Turning the cruise control main switch off (the stored vehicle speed in the ECM is not maintained).
- The system is operated.

AUTO CANCEL (FAIL-SAFE)

This system has an automatic cancellation function (fail-safe) (Clic here).

for Preparation Click here

HINT:

- **Use these procedures to troubleshoot the cruise control system.**
- ***: Use the intelligent tester.**

1.VEHICLE BROUGHT TO WORKSHOP

NEXT

2.INSPECT BATTERY VOLTAGE

Standard Voltage:
11 to 14 V

If the voltage is below 11 V, recharge or replace the battery before proceeding.

NEXT

3.CHECK COMMUNICATION FUNCTION OF CAN COMMUNICATION SYSTEM*

a. Use the intelligent tester to check if the CAN communication system is functioning normally.

Result

Result	Proceed to
CAN DTC is not output	A
CAN DTC is output (for LHD)	B
CAN DTC is output (for RHD)	C

B. GO TO CAN COMMUNICATION SYSTEM (Click here)

C. GO TO CAN COMMUNICATION SYSTEM (Click here)

A

4.CHECK INDICATOR

a. Check the indicator (Click here).

NEXT

5.CHECK FOR DTC*

a. Check for DTCs (Click here).

b. Clear the DTCs (Click here).

c. Recheck for DTCs (Click here).

Result

Result	Proceed to
DTC is not output	A
DTC is output	B

B. GO TO DTC CHART (Click here)

A

6.PROBLEM SYMPTOMS TABLE

a. Refer to the Problem Symptoms Table (Click here).

Result

Result	Proceed to
Fault is not listed in problem symptoms table	A
Fault is listed in problem symptoms table	B

B. Go to step 8

A

7.OVERALL ANALYSIS AND TROUBLESHOOTING*

a. Terminals of ECU (Click here).

b. Data List / Active Test (Click here).

NEXT

8.ADJUST, REPAIR OR REPLACE

NEXT

9.CONFIRMATION TEST

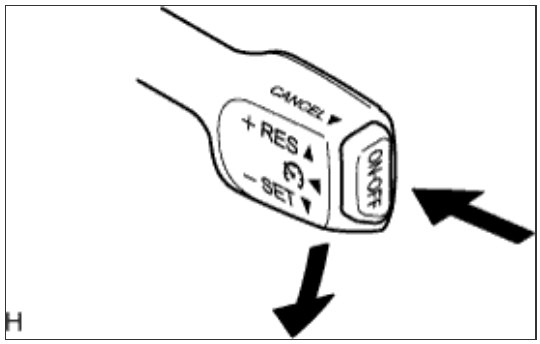
NEXT

END

for Preparation Click here

PROBLEM SYMPTOM CONFIRMATION

a. Inspect the SET function.



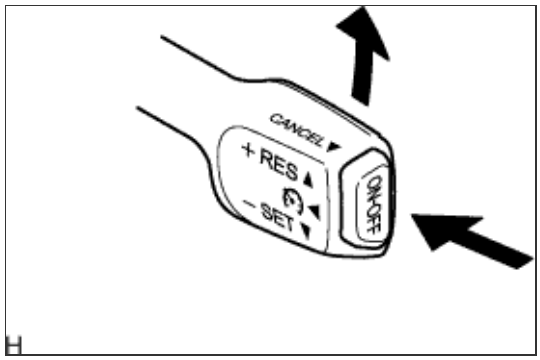
i. Turn the main switch on.

ii. Drive at the required speed (40 km/h (25 mph) or more).

iii. Push the cruise control main switch to -SET.

iv. After releasing the switch, check that the vehicle cruises at the set speed.

b. Inspect the + (ACCELERATION) function.



i. Turn the main switch on.

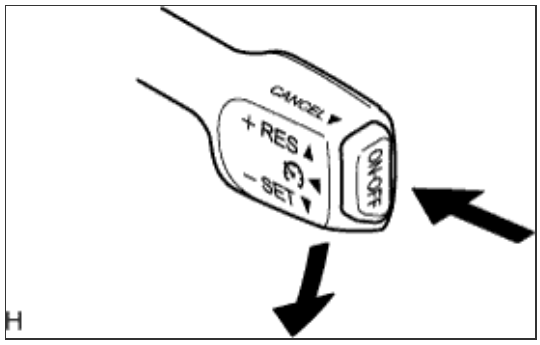
ii. Drive at the required speed (40 km/h (25 mph) or more).

iii. Push the cruise control main switch to -SET.

iv. Check that the vehicle speed increases while the cruise control main switch is pushed to +RES, and that the vehicle cruises at the newly set speed when the switch is released.

v. Momentarily push the cruise control main switch to +RES and then immediately release it. Check that the vehicle speed increases by approximately 1.6 km/h (1.0 mph) (tap-up control).

c. Inspect the - (COAST) function.



i. Turn the main switch on.

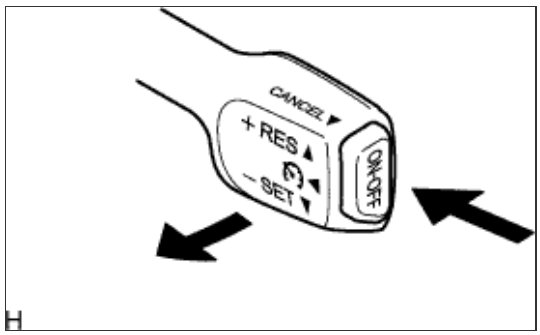
ii. Drive at the required speed (40 km/h (25 mph) or more).

iii. Push the cruise control main switch to -SET.

iv. Check that the vehicle speed decreases while the cruise control main switch is pushed to -SET, and that the vehicle cruises at the newly set speed when the switch is released.

v. Momentarily push the cruise control main switch to -SET, and then immediately release it. Check that vehicle speed decreases by approximately 1.6 km/h (1.0 mph) (tap-down control).

d. Inspect the CANCEL function.



i. Turn the main switch on.

ii. Drive at the required speed (40 km/h (25 mph) or more).

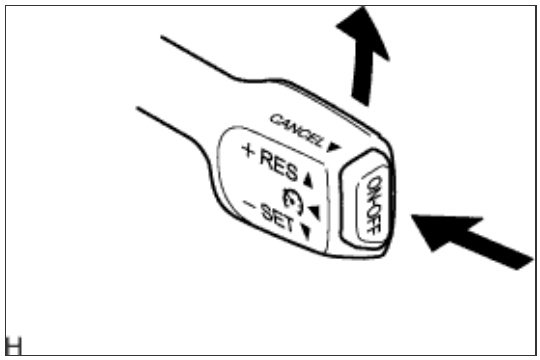
iii. Push the cruise control main switch to -SET.

iv. When performing one of the following, check that the cruise control system is canceled and that the normal driving mode is reset.

- Depressing the brake pedal.
- Depressing the clutch pedal (for M/T).

- oving the shift ever from D to N (for).T
- With the shift ever in S, selecting the S1, S2 or S3 range (for A/T).
- Turning the main switch off.
- Pulling the cruise control main switch to CANCEL.

e. Inspect the RES (RESUME) function.



H

i. Turn the main switch on.

ii. Drive at the required speed (40 km/h (25 mph) or more).

iii. Push the cruise control main switch to -SET.

iv. Cancel the cruise control system according to any of the above operations (other than turning the main switch off).

v. After pushing the cruise control main switch to +RES at a driving speed of more than 40 km/h (25 mph), check that the vehicle drives at the set speed.

for Preparation Click here

HINT:

- **Use the table below to help determine the cause of problem symptoms. If multiple suspected areas are listed, the potential causes of the symptoms are listed in order of probability in the "Suspected Area" column of the table. Check each symptom by checking the suspected areas in the order they are listed. Replace parts as necessary.**
- **Inspect the fuses and relays related to this system before inspecting the suspected areas below.**

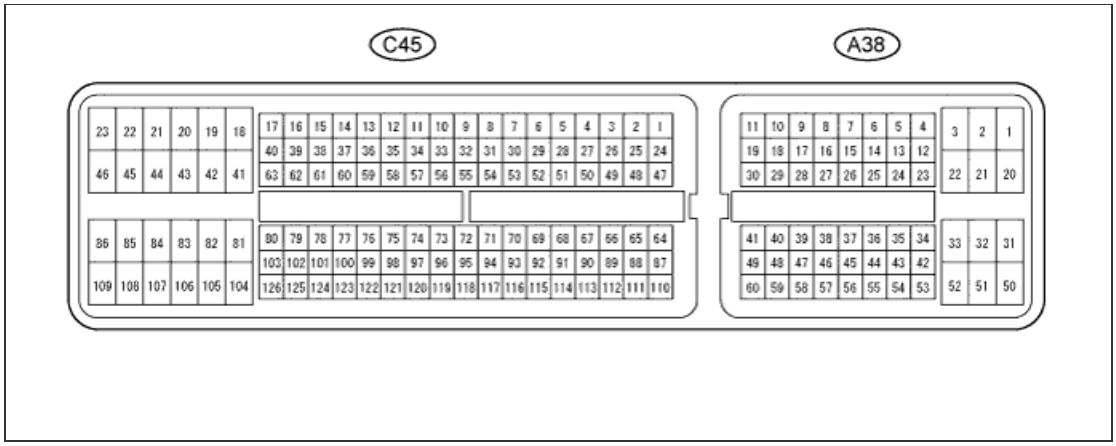
Cruise Control System

Symptom	Suspected Area	See page
Main switch cannot be turned on (CRUISE main indicator light on combination meter does not illuminate).	Cruise control switch circuit	Click here
	CRUISE main indicator light circuit	Click here
	Meter/gauge system	Click here
	ECM	Click here
	CAN communication line (for LHD)	Click here
	CAN communication line (for RHD)	Click here
Vehicle speed setting cannot be done (CRUISE main indicator light on combination meter illuminates when main switch is turned on, but turns off when operating SET function).	Cruise control switch circuit	Click here
	Meter/gauge system	Click here
	ECM	Click here
Vehicle speed setting cannot be done (CRUISE main indicator light on combination meter illuminates when main switch is turned on, and remains illuminated when operating SET function).	Cruise control switch circuit	Click here
	Vehicle speed sensor circuit	Click here
	Meter/gauge system	Click here
	Stop light switch circuit	Click here
	Park/neutral position switch circuit (for 3UR-FE A/T)	Click here
	Park/neutral position switch circuit (for 2UZ-FE A/T)	Click here
	Park/neutral position switch circuit (for 1GR-FE A/T)	Click here
	Park/neutral position switch circuit (for 1VD-FTV A/T)	Click here
	Clutch switch circuit (for M/T)	Click here
	ECM	Click here
	CAN communication line (for LHD)	Click here
	CAN communication line (for RHD)	Click here
	Cruise control switch circuit	Click here
	Vehicle speed sensor circuit	Click here
	Stop light switch circuit	Click here
	CRUISE main indicator light	Click

While the vehicle is driving with cruise control, the SET control is canceled (CRUISE main indicator light remains illuminated).	circuit	here
	Park/neutral position switch circuit (for 3UR-FE A/T)	Click here
	Park/neutral position switch circuit (for 2UZ-FE A/T)	Click here
	Park/neutral position switch circuit (for 1GR-FE A/T)	Click here
	Park/neutral position switch circuit (for 1VD-FTV A/T)	Click here
	Clutch switch circuit (for M/T)	Click here
	ECM	Click here
Hunting (speed is not constant).	Vehicle speed sensor circuit	Click here
	ECM	Click here
Vehicle speed setting cannot be canceled (CANCEL function failure).	Cruise control switch circuit	Click here
	Clutch switch circuit (for M/T)	Click here
	ECM	Click here
DTC is not output, or is output when it should not be.	TC and CG terminal circuit	Click here
	ECM	Click here
CRUISE main indicator light does not come on.	Cruise control switch circuit	Click here
	CRUISE main indicator light circuit	Click here
	Meter/gauge system	Click here
	ECM	Click here
	CAN communication line (for LHD)	Click here
	CAN communication line (for RHD)	Click here

for Preparation Click here

CHECK ECM (3UR-FE)



HINT:

As the ECM connector is a waterproof connector, it is not possible to check the voltage of each terminal or check the waveform with an oscilloscope while the ECM is installed in the vehicle.

a. Disconnect the A38 and C45 ECM connectors.

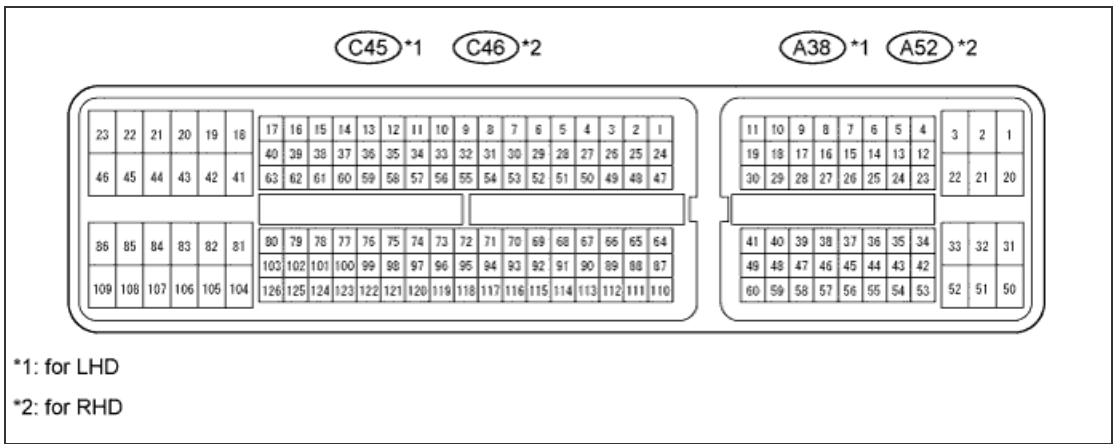
b. Measure the voltage and resistance according to the value(s) in the table below.

Terminal No. (Symbol)	Wiring Color	Terminal Description	Condition	Specified Condition
A38-16 (TC) - Body ground	V-W - Body ground	Terminal TC of DLC3	Ignition switch ON	11 to 14 V
			Ignition switch off	Below 1 V
C45-81 (E1) - Body ground	W-B - Body ground	ECM ground	Always	Below 1 Ω
C45-27 (D) - Body ground	G - Body ground	Park/neutral position switch signal	Ignition switch ON Shift lever in D	11 to 14 V
			Ignition switch ON Shift lever not in D	Below 1 V
A38-38 (SFTU) - Body ground	Y - Body ground	Park/neutral position switch signal	Ignition switch ON Shift lever in S	Below 1 Ω
			Ignition switch ON Shift lever in +	10 kΩ or higher
A38-25 (S) - Body ground	W - Body ground	Park/neutral position switch signal	Ignition switch ON Shift lever in S	11 to 14 V
			Ignition switch ON Shift lever not in S	Below 1 V
A38-27 (SFTD) - Body ground	L - Body ground	Park/neutral position switch signal	Ignition switch ON Shift lever in S	10 kΩ or higher
			Ignition switch ON Shift lever in -	Below 1 Ω
A38-36 (STP) - Body ground	R - Body ground	Stop light signal	Ignition switch ON Brake pedal depressed	11 to 14 V
			Ignition switch ON Brake pedal released	Below 1 V
A38-35 (ST1-) - Body ground	R-W - Body ground	Stop light signal (opposite to STP terminal)	Ignition switch ON Brake pedal depressed	Below 1 V
			Ignition switch ON Brake pedal released	11 to 14 V
			Ignition switch ON Main switch off	1 MΩ or higher
			Ignition switch ON CANCEL switch held on	1510 to 1570 Ω

A38-45 (CCS) - Body ground	L - Body ground	Cruise control main switch signal	Ignition switch ON -SET switch held on	62 to 64 Ω
			Ignition switch ON +RES switch held on	235 to 245 Ω
			Ignition switch ON Main switch on	Below 2.5 Ω

If the result is not as specified, there may be a malfunction on the wire harness side.

CHECK ECM (2U -FE)



HINT:

As the ECM connector is a waterproof connector, it is not possible to check the voltage of each terminal or check the waveform with an oscilloscope while the ECM is installed in the vehicle.

a. Disconnect the A38*1 and C45*1 or A52*2 and C46*2 ECM connectors.

HINT:

- ***1: for LHD**
- ***2: for RHD**

b. Measure the voltage and resistance according to the value(s) in the table below.

Terminal No. (Symbol)	Wiring Color	Terminal Description	Condition	Specified Condition
A38*1-16 (TC) - Body ground A52*2-16 (TC) - Body ground	V-W - Body ground	Terminal TC of DLC3	Ignition switch ON	11 to 14 V
			Ignition switch off	Below 1 V
C45*1-81 (E1) - Body ground C46*2-81 (E1) - Body ground	BR - Body ground	ECM ground	Always	Below 1 Ω
C45*1-27 (D) - Body ground C46*2-27 (D) - Body ground	G - Body ground	Park/neutral position switch signal	Ignition switch ON Shift lever in D	11 to 14 V
			Ignition switch ON Shift lever not in D	Below 1 V
A38*1-38 (SFTU) - Body ground A52*2-38 (SFTU) - Body ground	Y - Body ground	Park/neutral position switch signal	Ignition switch ON Shift lever in S	Below 1 Ω
			Ignition switch ON Shift lever in "+"	10 kΩ or higher
A38*1-25 (S) - Body ground A52*2-25 (S) - Body ground	W - Body ground	Park/neutral position switch signal	Ignition switch ON Shift lever in S	11 to 14 V
			Ignition switch ON Shift lever not in S	Below 1 V
A38*1-27 (SFTD) - Body ground A52*2-27 (SFTD) - Body ground	L - Body ground	Park/neutral position switch signal	Ignition switch ON Shift lever in S	10 kΩ or higher
			Ignition switch ON Shift lever in "-"	Below 1 Ω
A38*1-36 (STP) - Body ground A52*2-36 (STP) - Body ground	R - Body ground	Stop light signal	Ignition switch ON Brake pedal depressed	11 to 14 V
			Ignition switch ON Brake pedal released	Below 1 V

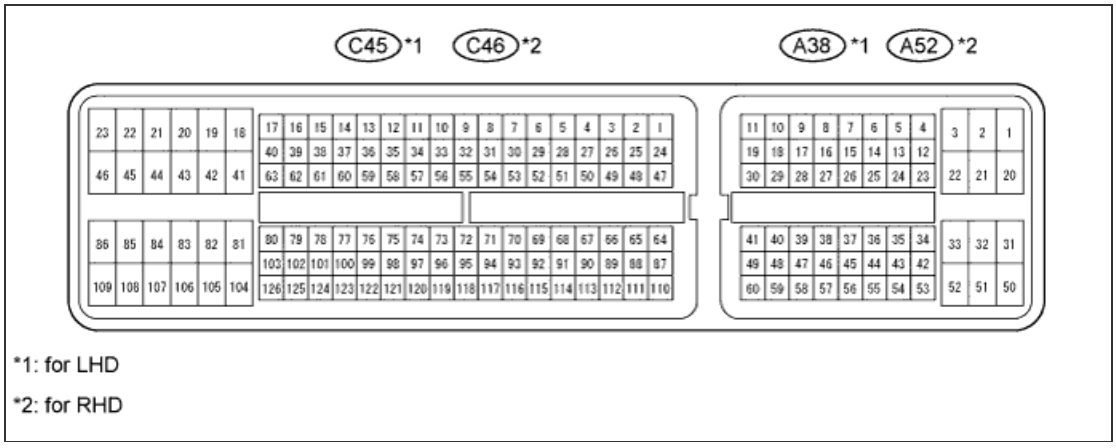
A38*1-35 (ST1-) - Body ground A52*2-35 (ST1-) - Body ground	R-W - Body ground	Stop light signal (opposite to ST terminal)	Ignition switch ON Brake pedal depressed	Below 1 V
			Ignition switch ON Brake pedal released	11 to 14 V
A38*1-45 (CCS) - Body ground A52*2-45 (CCS) - Body ground	L - Body ground	Cruise control main switch signal	Ignition switch ON Main switch off	10 kΩ or higher
			Ignition switch ON CANCEL switch held on	1386 to 1694 Ω
			Ignition switch ON -SET switch held on	567 to 693 Ω
			Ignition switch ON +RES switch held on	216 to 264 Ω
			Ignition switch ON Main switch on	Below 1 Ω

If the result is not as specified, there may be a malfunction on the wire harness side.

HINT:

- ***1: for LHD**
- ***2: for RHD**

CHECK ECM (1GR-FE)



HINT:

As the ECM connector is a waterproof connector, it is not possible to check the voltage of each terminal or check the waveform with an oscilloscope while the ECM is installed in the vehicle.

a. Disconnect the A38*1 and C45*1 or A52*2 and C46*22 ECM connectors.

HINT:

- ***1: for LHD**
- ***2: for RHD**

b. Measure the voltage and resistance according to the value(s) in the table below.

Terminal No. (Symbol)	Wiring Color	Terminal Description	Condition	Specified Condition
A38*1-27 (TC) - Body ground A52*2-27 (TC) - Body ground	V-W - Body ground	Terminal TC of DLC3	Ignition switch ON	11 to 14 V
			Ignition switch off	Below 1 V
C45*1-81 (E1) - Body ground C46*2-81 (E1) - Body ground	BR - Body ground	ECM ground	Always	Below 1 Ω
C45*1-26 (D) - Body ground	G - Body ground	Park/neutral position switch signal (A/T)	Ignition switch ON Shift lever in D	11 to 14 V
			Ignition switch ON Shift lever not in D	Below 1 V
C45*1-26 (D) - Body ground C46*2-26 (D) - Body	G - Body ground	Clutch signal (M/T)	Ignition switch ON Clutch pedal depressed	Below 1 V
			Ignition switch ON	

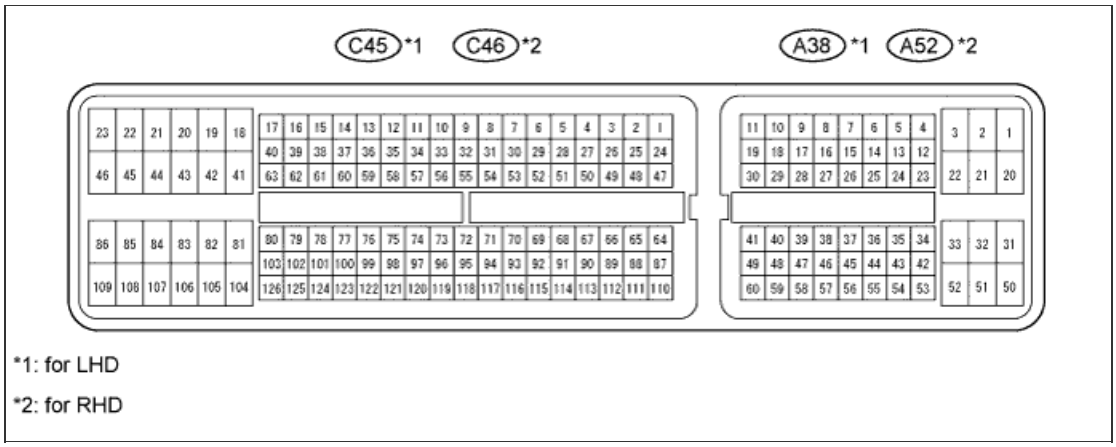
ground			Clutch pedal released	11 to 14 V
A38*1-16 (SFTU) - Body ground	Y - Body ground	ark/neutral position switch signal (A/T)	Ignition switch ON Shift lever in S	Below 1 Ω
			Ignition switch ON Shift lever in "+"	1 kΩ or higher
A38*1-25 (S) - Body ground	W - Body ground	ark/neutral position switch signal (A/T)	Ignition switch ON Shift lever in S	11 to 14 V
			Ignition switch ON Shift lever not in S	Below 1 V
A38*1-51 (SFTD) - Body ground	L - Body ground	ark/neutral position switch signal (A/T)	Ignition switch ON Shift lever in S	1 kΩ or higher
			Ignition switch ON Shift lever in "-"	Below 1 Ω
A38*1-36 (ST) - Body ground A52*2-36 (ST) - Body ground	R - Body ground	Stop light signal	Ignition switch ON Brake pedal depressed	11 to 14 V
			Ignition switch ON Brake pedal released	Below 1 V
A38*1-35 (ST1-) - Body ground A52*2-35 (ST1-) - Body ground	R-W - Body ground	Stop light signal (opposite to ST terminal)	Ignition switch ON Brake pedal depressed	Below 1 V
			Ignition switch ON Brake pedal released	11 to 14 V
A38*1-4 (CCS) - Body ground A52*2-4 (CCS) - Body ground	L - Body ground	Cruise control main switch signal	Ignition switch ON Main switch off	10 kΩ or higher
			Ignition switch ON CANCEL switch held on	1386 to 1694 Ω
			Ignition switch ON -SET switch held on	567 to 693 Ω
			Ignition switch ON +RES switch held on	216 to 264 Ω
			Ignition switch ON Main switch on	Below 1 Ω

If the result is not as specified, there may be a malfunction on the wire harness side.

HINT:

- ***1: for LHD**
- ***2: for RHD**

CHECK ECM (1VD-FTV)



HINT:

As the ECM connector is a waterproof connector, it is not possible to check the voltage of each terminal or check the waveform with an oscilloscope while the ECM is installed in the vehicle.

a. Disconnect the A38*1 and C45*1 or A52*2 and C46*2 ECM connectors.

HINT:

- ***1: for LHD**
- ***2: for RHD**

b. Measure the voltage and resistance according to the value(s) in the table below.

Terminal No. (Symbol)	Wiring Color	Terminal Description	Condition	Specified Condition
A38*1-27 (TC) - Body ground A52*2-27 (TC) - Body ground	V-W - Body ground	Terminal TC of DLC3	Ignition switch ON	11 to 14 V
			Ignition switch off	Below 1 V
C45*1-81 (E1) - Body ground C46*2-81 (E1) - Body ground	BR - Body ground	ECM ground	Always	Below 1 Ω
C45*1-28 (D) - Body ground C46*2-28 (D) - Body ground	G - Body ground	Park/neutral position switch signal (A/T)	Ignition switch ON Shift lever in D	11 to 14 V
			Ignition switch ON Shift lever not in D	Below 1 V
A38*1-42 (CLSW) - Body ground A52*2-42 (CLSW) - Body ground	G-B - Body ground	Clutch signal (M/T)	Ignition switch ON Clutch pedal depressed	Below 1 V
			Ignition switch ON Clutch pedal released	11 to 14 V
A38*1-60 (SFTU) - Body ground A52*2-60 (SFTU) - Body ground	Y - Body ground	Park/neutral position switch signal (A/T)	Ignition switch ON Shift lever in S	Below 1 Ω
			Ignition switch ON Shift lever in "+"	10 kΩ or higher
A38*1-25 (S) - Body ground A52*2-25 (S) - Body ground	W - Body ground	Park/neutral position switch signal (A/T)	Ignition switch ON Shift lever in S	11 to 14 V
			Ignition switch ON Shift lever not in S	Below 1 V
A38*1-59 (SFTD) - Body ground A52*2-59 (SFTD) - Body ground	L - Body ground	Park/neutral position switch signal (A/T)	Ignition switch ON Shift lever in S	10 kΩ or higher
			Ignition switch ON Shift lever in "-"	Below 1 Ω
A38*1-36 (STP) - Body ground A52*2-36 (STP) - Body ground	R - Body ground	Stop light signal	Ignition switch ON Brake pedal depressed	11 to 14 V
			Ignition switch ON Brake pedal released	Below 1 V
A38*1-35 (ST1-) - Body ground A52*2-35 (ST1-) - Body ground	R-W - Body ground	Stop light signal (opposite to STP terminal)	Ignition switch ON Brake pedal depressed	Below 1 V
			Ignition switch ON Brake pedal released	11 to 14 V
A38*1-40 (CCS) - Body ground A52*2-40 (CCS) - Body ground	L - Body ground	Cruise control main switch signal	Ignition switch ON Main switch off	10 kΩ or higher
			Ignition switch ON CANCEL switch held on	1386 to 1694 Ω
			Ignition switch ON -SET switch hed on	567 to 693 Ω
			Ignition switch ON +RES switch held on	216 to 264 Ω
			Ignition switch ON Main switch on	Below 1 Ω

If the result is not as specified, there may be a malfunction on the wire harness side.

HINT:

- ***1: for LHD**
- ***2: for RHD**

for Preparation Click here

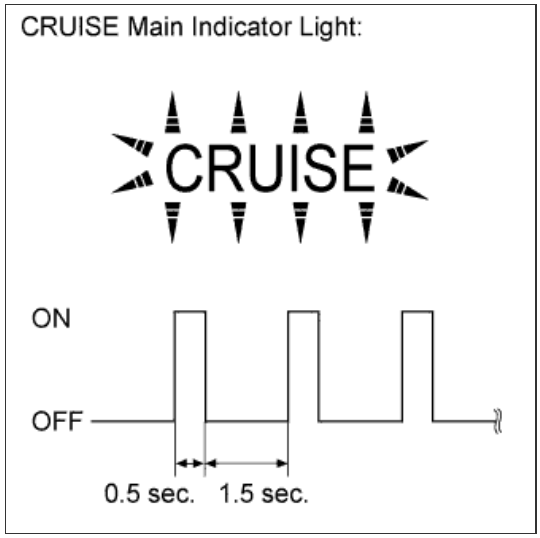
CHECK INDICATOR

a. Turn the ignition switch to ON.

b. Check that the CRUISE main indicator ight i uminates when the cruise contro ain switch is turned on, and that the indicator ight turns off when the main switch is turned off. If the resu ts are not as specified, inspect the CRUISE main indicator ight circuit (C ick here).

HINT:

Whi e driving with cruise contro the ECM activates AUTO CANCEL of the cruise contro system when a ma unction in one of the fo owing occurs: the vehic e speed sensors, stop ight switch or other re ated parts. When AUTO CANCEL is activated, the CRUISE main indicator ight outputs the b inking pattern shown in the i ustration. At the same time, data of the ma unction is stored as a DTC.



for Preparation Click here

CHECK DTC

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain Cruise Control Trouble Codes.

e. Read the DTCs.

CLEAR DTC

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain Cruise Control Trouble Codes.

e. Clear the DTCs.

for Preparation Click here

HINT:

If the following conditions are detected while the cruise control is in operation, the system clears the stored vehicle speed in the ECM and cancels the cruise control operation.

Vehicle Condition	Auto Cancel Condition	Fail-safe Deactivation Condition
CRUISE main indicator light blinks	• There is an open or short in the stop light switch circuit • There is a problem with the vehicle speed signal	Turn the cruise control main switch on again
CRUISE main indicator light goes off	• There is a problem with the throttle position sensor and the motor*1 • There is a problem with the fuel injection system*2	Turn the cruise control main switch on again
CRUISE main indicator light blinks	• There is a problem with the input circuit of the stop light switch circuit • There is a problem with the cancel circuit	• Turn the cruise control main switch on again • Turn the ignition switch off then on again
CRUISE main indicator light remains on (Cruise control is canceled)	Under the following conditions, the stored vehicle speed is maintained: • The vehicle speed is less than the low speed limit (approx. 40 km/h (25 mph)) while running with the cruise control on • The VSC system is operated	Push the cruise control main switch to RES
	• The vehicle speed is less than the stored speed by approx. 16 km/h (10 mph) or more	Push the cruise control main switch to -SET

HINT:

- **: for 2U -FE, 1GR-FE, 3UR-FE**
- **: for 1VD-FTV**

for Preparation Click here

READ DATA LIST

HINT:

Using the intelligent tester to read the Data List allows the values or states of switches, sensors, actuators and other items to be read without removing any parts. This non-intrusive inspection can be very useful because intermittent conditions or signals may be discovered before parts or wiring is disturbed. Reading the Data List information early in troubleshooting is one way to save diagnostic time.

NOTICE:

In the table below, the values listed under "Normal Condition" are reference values. Do not depend solely on these reference values when deciding whether a part is faulty or not.

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the intelligent tester on.

d. Enter the following menus: Powertrain / Cruise Control / Data List.

e. According to the display on the intelligent tester, read the "Data List".

Cruise Control

Tester Display	Measurement Item/Range	Normal Condition	Diagnostic Note
CCS Vehicle Spd	Vehicle speed / min.: 0 km/h (0 mph), max.: 255 km/h (159 mph)	Actual vehicle speed displayed	-
CCS Mem Vehicle Spd	Vehicle speed / min.: 0 km/h (0 mph), max.: 200 km/h (125 mph)	Actual vehicle speed stored in memory	-
Cruise Operation Status	Transmission range sensor signal / ON or OFF	ON: Shift lever in D OFF: Shift lever not in D	for A/T
	Clutch switch signal / ON or OFF	ON: Clutch pedal released OFF: Clutch pedal depressed	for M/T
Cruise Control	Cruise control / ON or OFF	ON: Cruise control operating OFF: Cruise control not operating	-
CCS Indicator M-CPU	CRUISE main indicator light (Main CPU) / ON or OFF	ON: CRUISE main indicator light on OFF: CRUISE main indicator light off	-
CCS Ready M-CPU	Cruise control system standby condition (Main CPU) / ON or OFF	ON ← → OFF: Changes each time main switch pushed	-
CCS Main SW M-CPU	Cruise control main switch (Main CPU) / ON or OFF	ON: Cruise control main switch (Main CPU) on OFF: Cruise control main switch (Main CPU) off	-
CCS Main SW S-CPU	Cruise control main switch (Sub CPU) / ON or OFF	ON: Cruise control main switch (Sub CPU) on OFF: Cruise control main switch (Sub CPU) off	-
Cancel Switch	CANCEL switch / ON or OFF	ON: CANCEL switch on OFF: CANCEL switch off	-
SET/COAST Switch	-SET switch / ON or OFF	ON: -SET switch on OFF: -SET switch off	-
RES/ACC Switch	+RES switch / ON or OFF	ON: +RES switch on OFF: +RES switch off	-
Stop Light SW M-CPU	Stop light switch signal (Main CPU) / ON or OFF	ON: Brake pedal depressed OFF: Brake pedal released	-
Throttle Opening Angle	Cruise throttle opening angle / min.: 0 deg, max.: 125 deg	Actual demanded throttle angle	for 2UZ-FE, 1GR-FE
	Fuel injection quantity / min.: 0%, max.: 100%	Actual demanded fuel injection quantity	for 1VD-FTV
# Codes	Number of trouble codes / Min.: 0, Max.: 255	-	-

PERFORM ACTIVE TEST

HINT:

Using the intelligent tester to perform Active Tests allows relays, VSVs, actuators and other items to be operated without removing any parts. This non-intrusive functional inspection can be very useful because intermittent operation may be discovered before parts or wiring is disturbed. Performing Active Tests early in troubleshooting is one way to save diagnostic time. Data List information can be displayed while performing Active Tests.

a. Connect the intelligent tester to the DLC3.

b. Turn the ignition switch to ON.

c. Turn the intelligent tester on.

d. Enter the following menus: Body / Combination Meter / Active Test.

e. According to the display on the intelligent tester, perform the "Active Test".

Combination Meter

Tester Display	Test Part	Control Range	Diagnostic Note
Indicat. Lamp Cruise	CRUISE main indicator light operation	OFF or ON	-

for Preparation Click here

HINT:

If a trouble code is output during the DTC check, inspect the trouble areas listed for that code. For details of the code, refer to the "See page" below.

Cruise Control System

DTC Code	Detection Item	Trouble Area	See page
P0500	Vehicle Speed Sensor Malfunction	- Vehicle speed sensor signal circuit - Vehicle speed sensor - Combination meter - ECM	Click here
P0503	Vehicle Speed Sensor "A" Intermittent / Erratic / High	- Vehicle speed sensor - Vehicle speed sensor signal circuit - ECM - Combination meter	Click here
P0571	Brake Switch "A" Circuit	- Stop light switch - Stop light switch circuit - ECM	Click here
P0575	Cruise Control Input Circuit	ECM (for 2U -FE, 1 -FE, 3UR-FE)	Click here
P0607	Control Module Performance	ECM (for 1VD-FTV)	Click here

DTC P0500 Vehicle Speed Sensor Malfunction

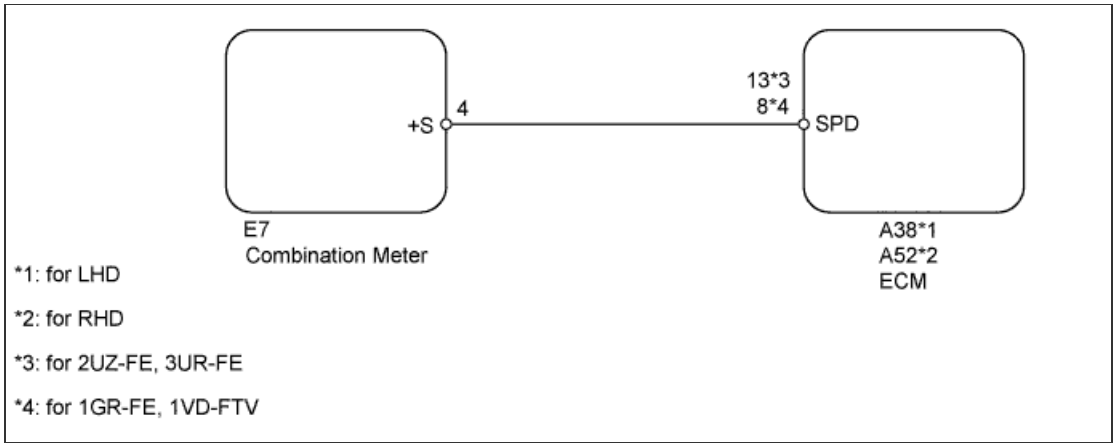
for Preparation Click here

DESCRIPTION

The speed sensor detects the wheel speed and sends the appropriate signals to the master cylinder solenoid (skid control ECU). The master cylinder solenoid (skid control ECU) converts these wheel speed signals into a 4-pulse signal and outputs it to the ECM via the combination meter. The ECM determines the vehicle speed based on the frequency of these pulse signals.

DTC Code	DTC Detection Condition	Trouble Area
P0500	The vehicle speed signal from the vehicle speed sensor is cut for 0.14 sec. or more while the cruise control is in operation.	• Vehicle speed sensor signal circuit • Vehicle speed sensor • Combination meter • ECM

WIRING DIAGRAM



INSPECTION PROCEDURE

This DTC code may be output under the SFI system (for 2U -FE, 1GR-FE, 3UR-FE) or the ECD system (for 1VD-FTV) at the same time. In that case, perform troubleshooting for the SFI system first.

1.CHECK DTC (CRUISE CONTROL SYSTEM)

a. Using the intelligent tester, enter the following menus: Powertrain / Cruise Control / Trouble Code.

b. Clear the DTC (Click here).

c. Perform the following to make sure the DTC detection conditions are met.

HINT:

If the detection conditions are not met, the system cannot detect the malfunction.

i. Drive the vehicle for more than 10 seconds when the engine coolant temperature is more than 20 C (68 F).

d. Check for DTCs (Click here).

Result

Result	Proceed to
(DTC P0500 is not output)	A
NG (for 3UR-FE)	B
NG (for 2U -FE)	C
NG (for 1GR-FE)	D
NG (for 1VD-FTV)	E

B → GO TO SFI SYSTEM (DTC P0500) (Click here)

C → GO TO SFI SYSTEM (DTC P0500) (Click here)

D → GO TO SFI SYSTEM (DTC P0500) (Click here)

E → GO TO ECD SYSTEM (DTC P0500) (Click here)

A

USE SIMULATION METHOD TO CHECK (Click here)

DTC P0575 Cruise Control Input Circuit

DTC P0607 Control Module Performance

for Preparation Click here

DESCRIPTION

This DTC indicates the internal abnormalities of the ECM.

DTC Code	DTC Detection Condition	Trouble Area
P0575	When either of the following conditions is met: • STP signals input to the ECM supervisory CPU and control ECU are different for 0.15 seconds or more. • 0.4 seconds have passed after cruise cancel input signal (STP input) is input to the ECM.	ECM (for 2UZ-FE, 1GR-FE, 3UR-FE)
P0607	When the cruise control main switch is turned off, the ECM recognizes that the cruise control system is operating.	ECM (for 1 D-FT)

HINT:

The ECM receives signals from each sensor to control all functions of the cruise control system. When this trouble code is stored, fail-safe remains on until the ignition switch is turned off.

INSPECTION PROCEDURE

1.CHECK DTC (CRUISE CONTROL SYSTEM)

a. Using the intelligent tester, enter the following menus: Powertrain / Cruise Control / Trouble Code.

b. Clear the DTCs (Clic here).

c. Rechec for DTCs (Clic here).

Result

Result	Proceed to
O (DTC is not output)	A
G (DTC P0575 is output for 3UR-FE)	B
G (DTC P0575 is output for 2UZ-FE)	C
G (DTC P0575 is output for 1GR-FE)	D
G (DTC P0607 is output for 1 D-FT)	E

B → **REPLACE ECM (Click here)**

C → **REPLACE ECM (Click here)**

D → **REPLACE ECM (Click here)**

E → **REPLACE ECM (Click here)**

A

USE SIMULATION METHOD TO CHECK (Click here)

DTC P0503 Vehicle Speed Sensor "A" Intermittent / Erratic / High

for Preparation Click here

DESCRIPTION

If a malfunction (a rapid change in vehicle speed) in the vehicle speed signal being output from the master cylinder solenoid (skid control ECU) is detected while the cruise control is in operation, the ECM determines there to be a momentary interruption and noise, and outputs a DTC.

DTC Code	DTC Detection Condition	Trouble Area
P0503	A momentary interruption and noise are detected when a rapid change of the vehicle speed occurs while the cruise control is in operation.	• Vehicle speed sensor • Vehicle speed sensor signal circuit • ECM • Combination meter

INSPECTION PROCEDURE

This DTC code may be output under the vehicle stability control system at the same time. In that case, perform troubleshooting for the vehicle stability control system first.

1.CHECK DTC (VEHICLE STABILITY CONTROL SYSTEM OR ANTI-LOCK BRAKE SYSTEM)

a. Using the intelligent tester, enter the following menus: Chassis / ABS/VSC/TRAC / Trouble Code.

b. Check for DTCs (Click here).

Result

Result	Proceed to
OK (DTC is not output)	A
NG (for Vehicle Stability Control System)	B
NG (for Anti-lock Brake System)	C

B → GO TO VEHICLE STABILITY CONTROL SYSTEM (DTC CHART) (Click here)

C → GO TO ANTI-LOCK BRAKE SYSTEM (DTC CHART) (Click here)

A

2.CHECK DTC (CRUISE CONTROL SYSTEM)

a. Using the intelligent tester, enter the following menus: Powertrain / Cruise Control / Trouble Code.

b. Clear the DTC (Click here).

c. Perform the following to make sure the DTC detection conditions are met.

HINT:

If the detection conditions are not met, the system cannot detect the malfunction.

i. Drive the vehicle at a speed of 45 km/h (28 mph) or more.

ii. Turn the cruise control main switch on.

iii. Push the -SET switch to activate the cruise control.

d. Check for DTCs (Click here).

Result

Result	Proceed to
OK (DTC P0503 is not output)	A
NG (for 3UR-FE)	B
NG (for 2UZ-FE)	C

N (for 1 R-FE)	D
N (for 1VD-FTV)	E

B → REPLACE ECM (Click here)

C → REPLACE ECM (Click here)

D → REPLACE ECM (Click here)

E → REPLACE ECM (Click here)

A

USE SIMULATION METHOD TO CHECK (Click here)

DTC P0575 Cruise Control Input Circuit

DTC P0607 Control Module Performance

for Preparation Click here

DESCRIPTION

This DTC indicates the internal abnormalities of the ECM.

DTC Code	DTC Detection Condition	Trouble Area
P0575	When either of the following conditions is met: • STP signals input to the ECM supervisory CPU and control ECU are different for 0.15 seconds or more. • 0.4 seconds have passed after cruise cancel input signal (STP input) is input to the ECM.	ECM (for 2UZ-FE, 1GR-FE, 3UR-FE)
P0607	When the cruise control main switch is turned off, the ECM recognizes that the cruise control system is operating.	ECM (for 1 D-FT)

HINT:

The ECM receives signals from each sensor to control all functions of the cruise control system. When this trouble code is stored, fail-safe remains on until the ignition switch is turned off.

INSPECTION PROCEDURE

1.CHECK DTC (CRUISE CONTROL SYSTEM)

a. Using the intelligent tester, enter the following menus: Powertrain / Cruise Control / Trouble Code.

b. Clear the DTCs (Clic here).

c. Rechec for DTCs (Clic here).

Result

Result	Proceed to
O (DTC is not output)	A
G (DTC P0575 is output for 3UR-FE)	B
G (DTC P0575 is output for 2UZ-FE)	C
G (DTC P0575 is output for 1GR-FE)	D
G (DTC P0607 is output for 1 D-FT)	E

B → **REPLACE ECM (Click here)**

C → **REPLACE ECM (Click here)**

D → **REPLACE ECM (Click here)**

E → **REPLACE ECM (Click here)**

A

USE SIMULATION METHOD TO CHECK (Click here)

DTC P0571 Brake Switch "A" Circuit

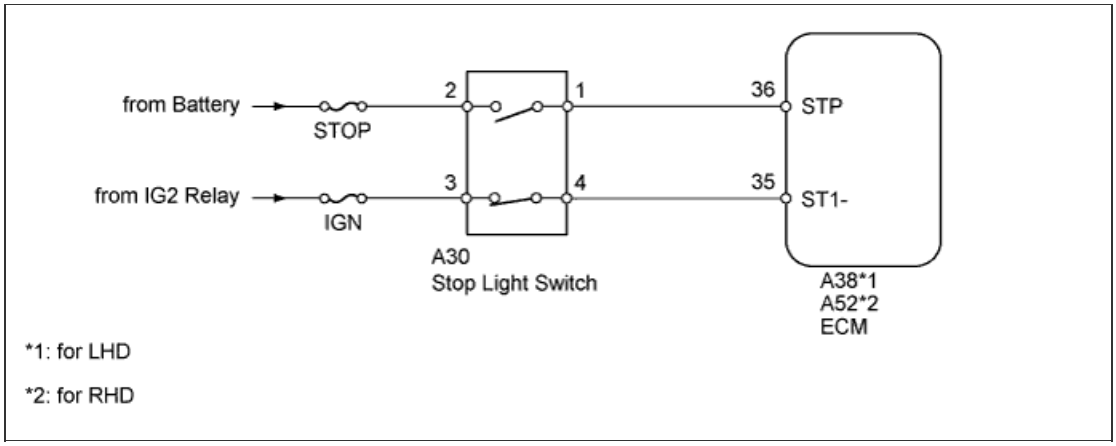
for Preparation Click here

DESCRIPTION

When the brake pedal is depressed, the stop light switch sends a signal to the ECM. When the ECM receives this signal, it cancels the cruise control. The fail-safe function operates to enable normal driving even if there is a malfunction in the stop light signal circuit. The cancellation condition occurs when voltage is applied to terminal STP. When the brake is applied, voltage is applied to terminal STP of the ECM through the STOP fuse and the stop light switch, and the ECM turns the cruise control off.

DTC Code	DTC Detection Condition	Trouble Area
P0571	When the voltage of the STP terminal and the ST1- terminal of the ECM is below than 1 V for 0.5 sec. or more.	• Stop light switch • Stop light switch circuit • ECM

WIRING DIAGRAM



INSPECTION PROCEDURE

1.READ VALUE USING INTELLIGENT TESTER (STOP LIGHT SWITCH)

a. Using the intelligent tester, read the Data List.

Cruise Control

Tester Display	Measurement Item/Range	Normal Condition	Diagnostic Note
Stop Light SW M-CPU	Stop light switch signal (Main CPU) / ON or OFF	ON: rake pedal depressed OFF: rake pedal released	-

OK:

Normal conditions listed above are displayed.

Result

Result	Proceed to
OK (for 3UR-FE)	A
OK (for 2U -FE)	
OK (for 1GR-FE)	C
OK (for 1VD-FTV)	D
NG	E

B	REPLACE ECM (Click here)
C	REPLACE ECM (Click here)

D → REPLACE ECM (Click here)

E → Go to step 2

A

REPLACE ECM (Click here)

2.INSPECT STOP LIGHT SWITCH

a. Remove the stop light switch (Click here for LHD, Click here for RHD).

b. Measure the resistance according to the value(s) in the table below.

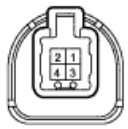
Standard Resistance:

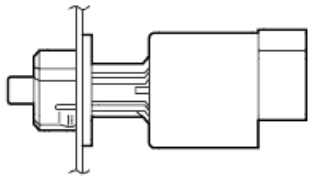
Tester Connection	Switch Condition	Specified Condition
1 - 2	Pin pushed	10 kΩ or higher
	Pin not pushed	elow 1 Ω
3 - 4	Pin pushed	elow 1 Ω
	Pin not pushed	10 kΩ or higher

Result

Result	Proceed to
OK	A
NG (for LHD)	
NG (for RHD)	C

Component without harness connected:
(Stop Light Switch)





Pin pushed

Pin released

B → REPLACE STOP LIGHT SWITCH (Click here)

C → REPLACE STOP LIGHT SWITCH (Click here)

A

3.CHECK HARNESS AND CONNECTOR (BATTERY - STOP LIGHT SWITCH)

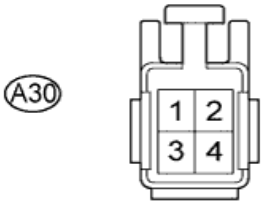
a. Disconnect the A30 stop light switch connector.

b. Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
A30-2 - ody ground	Always	11 to 14 V
A30-3 - ody ground	Ignition switch ON	

Front view of wire harness connector:
(to Stop Light Switch)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

.CHECK HARNESS AND CONNECTOR (STOP LIGHT SWITCH - ECM)

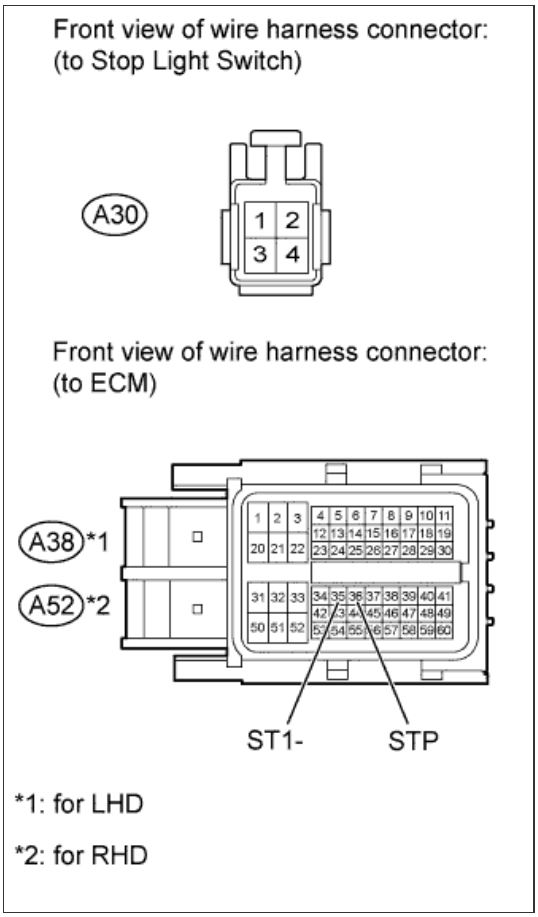
a. Disconnect the A30 stop light switch connector.

b. Disconnect the A38 1 or A52 ECM connector.

HINT:

- 1: for LHD
- 2: for RHD

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for LHD

Tester Connection	Condition	Specified Condition
A30-1 - A38-36 (STP)	Always	elow 1 Ω
A30-1 - ody ground	Always	10 kΩ or higher
A30-4 - A38-35 (ST1-)	Always	elow 1 Ω
A30-4 - ody ground	Always	10 kΩ or higher

for RHD

Tester Connection	Condition	Specified Condition
A30-1 - A52-36 (STP)	Always	elow 1 Ω
A30-1 - ody ground	Always	10 kΩ or higher
A30-4 - A52-35 (ST1-)	Always	elow 1 Ω
A30-4 - ody ground	Always	10 kΩ or higher

Result

Result	Proceed to
OK (for 3UR-FE)	A
OK (for 2U -FE)	
OK (for 1GR-FE)	C
OK (for 1VD-FTV)	D
NG	E

B	REPLACE ECM (Click here)
C	REPLACE ECM (Click here)
D	REPLACE ECM (Click here)

E

REPAIR OR REPLACE HARNESS OR CONNECTOR

A

REPLACE ECM (Click here)

for Preparation Click here

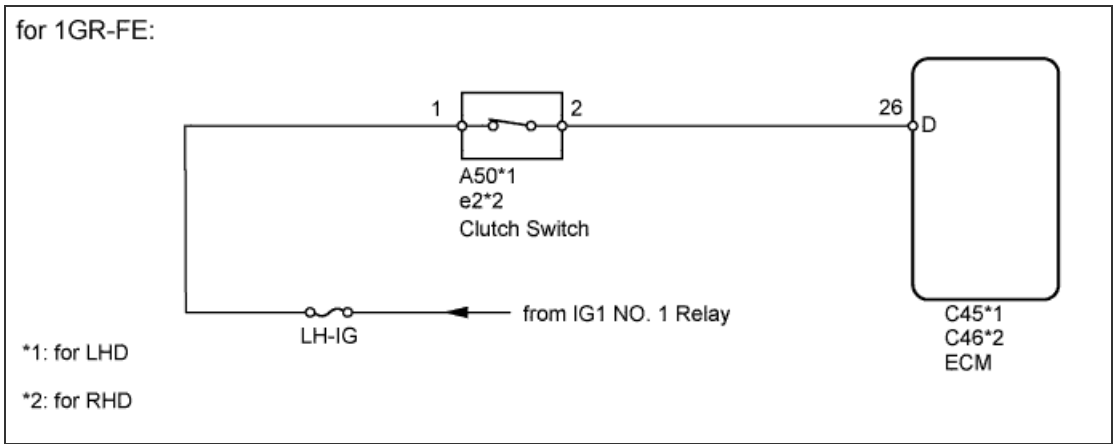
DESCRIPTION

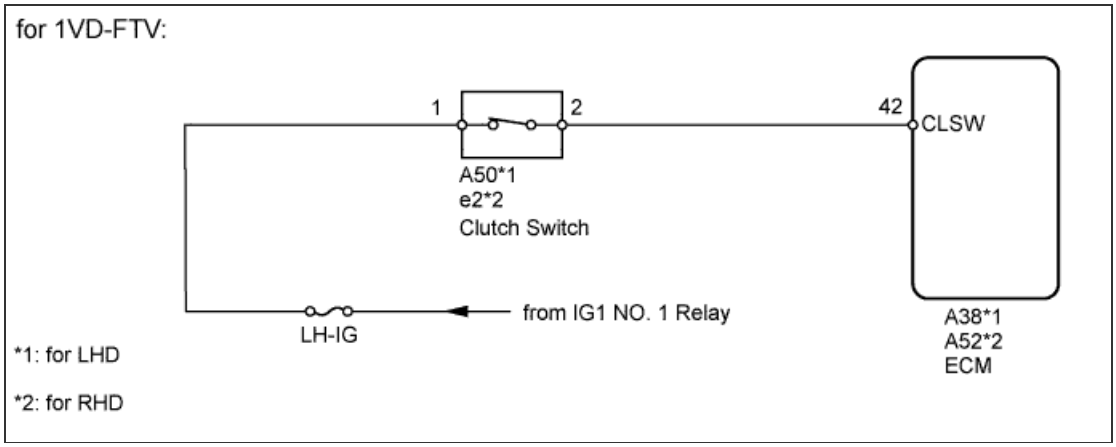
When the clutch pedal is released, the ECM receives positive (+) battery voltage through the LH-IG fuse. While depressing the clutch pedal, the clutch switch sends a signal to terminal D*1 or CLSW*2 of the ECM. The ECM cancels cruise control when terminal D*1 or CLSW*2 receives the signal.

HINT:

- ***1: for 1GR-FE**
- ***2: for 1VD-FTV**

WIRING DIAGRAM





INSPECTION PROCEDURE

1.INSPECT FUSE (LH-IG)

a. Remove the LH-IG fuse from the main body ECU.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
LH-IG fuse	Always	Below 1 Ω

NG → REPLACE FUSE

OK

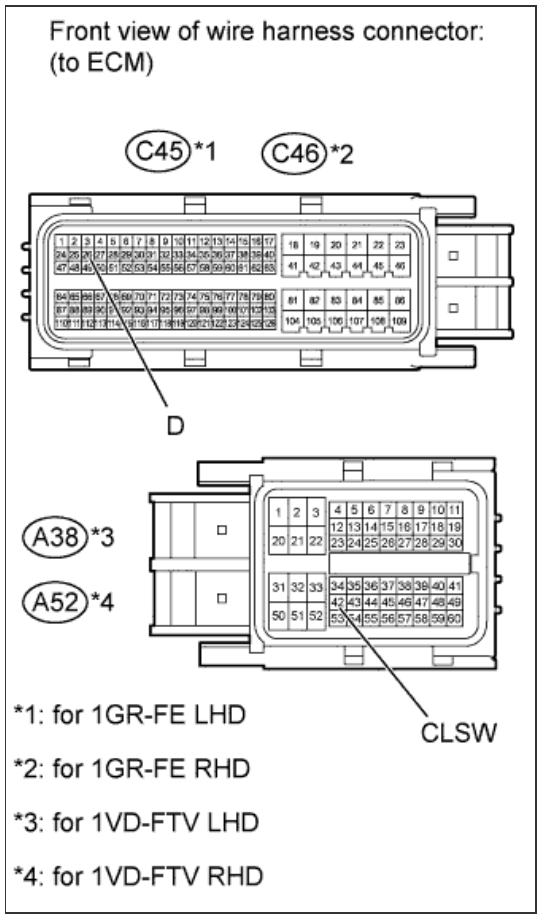
2.INSPECT ECM

a. Disconnect the C45*1, C46*2, A38*3 or A52*4 ECM connector.

HINT:

- ***1: for 1GR-FE LHD**
- ***2: for 1GR-FE RHD**
- ***3: for 1VD-FTV LHD**
- ***4: for 1VD-FTV RHD**

b. Measure the voltage according to the value(s) in the table below.



Standard Voltage:

for 1GR-FE LHD

Tester Connection	Switch Condition	Specified Condition
C45-26 (D) - Body ground	Ignition switch ON Clutch pedal depressed	Below 1
	Ignition switch ON Clutch pedal released	11 to 14

for 1GR-FE RHD

Tester Connection	Switch Condition	Specified Condition
C46-26 (D) - Body ground	Ignition switch ON Clutch pedal depressed	Below 1
	Ignition switch ON Clutch pedal released	11 to 14

for 1VD-FTV LHD

Tester Connection	Switch Condition	Specified Condition
A38-42 (CLSW) - Body ground	Ignition switch ON Clutch pedal depressed	Below 1
	Ignition switch ON Clutch pedal released	11 to 14

for 1VD-FTV RHD

Tester Connection	Switch Condition	Specified Condition
	Ignition switch ON Clutch pedal	Below 1

A52-42 (CLSW) - Body ground	depressed	
	Ignition switch ON Clutch pedal released	11 to 14

NG → Go to step 3

OK

PROCEED TO NEXT CIRCUIT INSPECTION SHOWN IN PROBLEM SYMPTOMS TABLE (Click here)

3.INSPECT CLUTCH SWITCH ASSEMBLY

a. Turn the Ignition switch off.

b. Disconnect the A50*1 or e2*2 clutch switch connector.

HINT:

- ***1: for LHD**
- ***2: for RHD**

c. Remove the clutch switch (Clic here for LHD, Clic here for RHD).

d. Measure the resistance according to the value(s) in the table below.

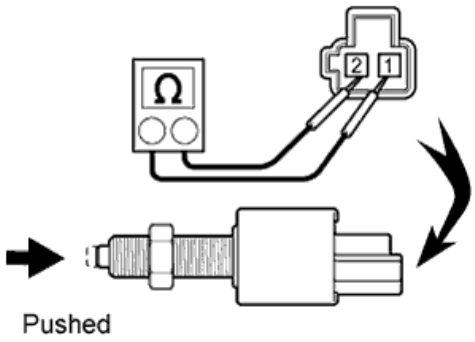
Standard Resistance:

Tester Connection	Switch Condition	Specified Condition
1 - 2	Pushed (On)	Below 1 Ω
	Not pushed (Off)	10 Ω or higher

Result

Result	Proceed to
OK	A
NG (for LHD)	B
NG (for RHD)	C

Component without harness connected: (Clutch Switch)



e. Install the clutch switch (Clic here for LHD, Clic here for RHD).

B → REPLACE CLUTCH SWITCH ASSEMBLY (Click here)

C → REPLACE CLUTCH SWITCH ASSEMBLY (Click here)

A

4.CHECK HARNESS AND CONNECTOR (ECM - CLUTCH SWITCH)

a. Disconnect the C45*1, C46*2, A38*3 or A52*4 ECM connector.

HINT:

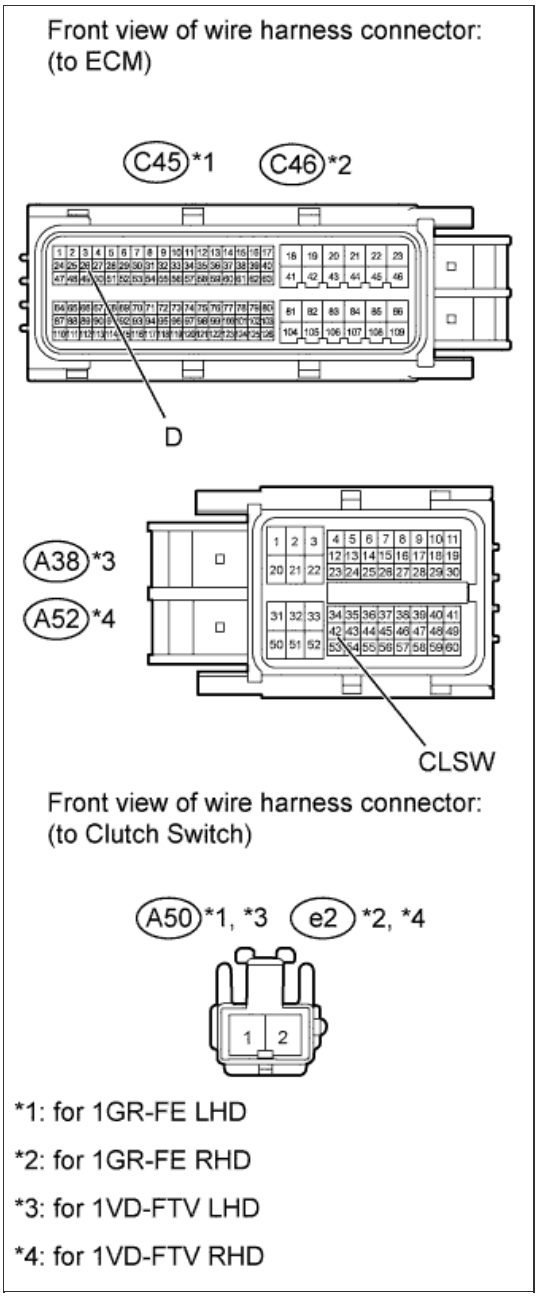
- ***1: for 1GR-FE LHD**
- ***2: for 1GR-FE RHD**
- ***3: for 1VD-FTV LHD**
- ***4: for 1VD-FTV RHD**

b. Disconnect the A50*1 or e2*2 clutch switch connector.

HINT:

- ***1: for LHD**
- ***2: for RHD**

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for 1GR-FE LHD

Tester Connection	Condition	Specified Condition
C45-26 (D) - A50-2	Always	Below 1 Ω
C45-26 (D) - Body ground	Always	10 Ω or higher

for 1GR-FE RHD

Tester Connection	Condition	Specified Condition
C46-26 (D) - e2-2	Always	Below 1 Ω
C46-26 (D) - Body ground	Always	10 Ω or higher

for 1VD-FTV LHD

Tester Connection	Condition	Specified Condition
A38-42 (CLSW) - A50-2	Always	Below 1 Ω
A38-42 (CLSW) - Body ground	Always	10 Ω or higher

for 1VD-FTV RHD

Tester Connection	Condition	Specified Condition
A52-42 (CLSW) - e2-2	Always	Below 1 Ω
A52-42 (CLSW) - Body ground	Always	10 Ω or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - CLUTCH SWITCH)

OK

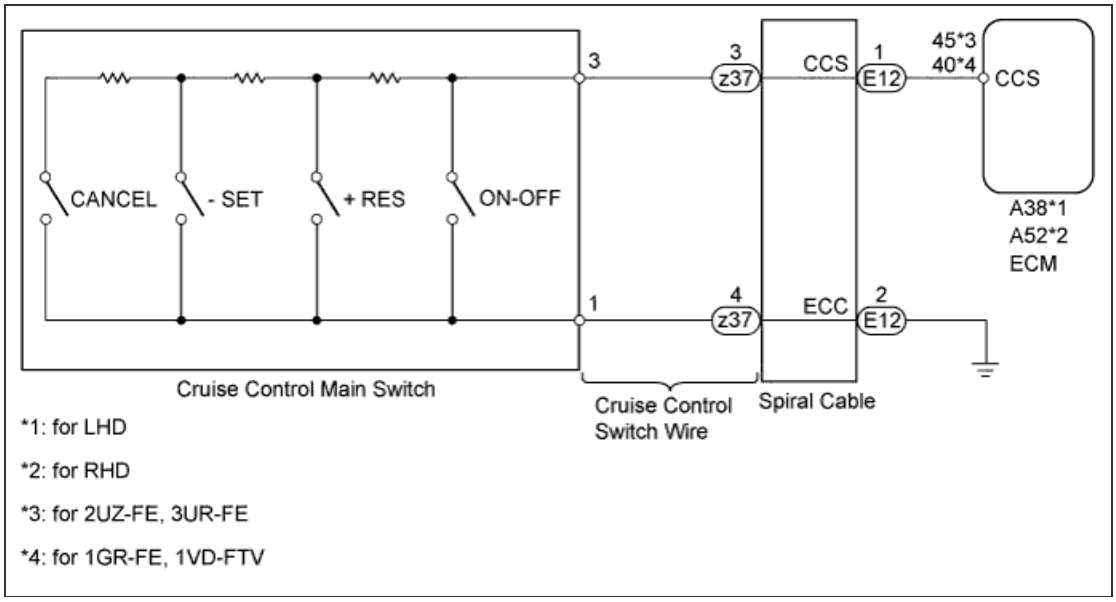
REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - CLUTCH SWITCH)

for Preparation Click here

DESCRIPTION

The cruise control main switch is used to operate 7 functions: SET, - (COAST), TAP-DOWN, RES (RESUME), + (ACCELERATION), TAP-UP, and CANCEL. The SET, TAP-DOWN and - (COAST) functions, and the RES (RESUME), TAP-UP and + (ACCELERATION) functions are operated with the same switch. The cruise control main switch is an automatic return type switch which turns on only while operating it in each arrow direction and turns off after releasing it. The internal contact point of the cruise control main switch is turned on with the switch operation. Then the ECM reads the resistance value that has been changed by the switch operation to control SET, - (COAST), RES (RESUME), + (ACCELERATION) and CANCEL.

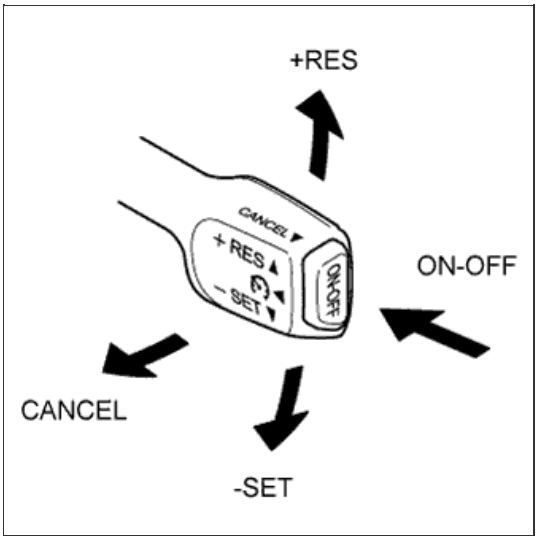
WIRING DIAGRAM



INSPECTION PROCEDURE

1.READ VALUE USING INTELLIGENT TESTER (CRUISE CONTROL MAIN SWITCH)

a. Using the intelligent tester, read the Data List.



Cruise Control

Tester Display	Measurement Item/Range	Normal Condition	Diagnostic Note
CCS Main SW M-CPU	Cruise control main switch (Main CPU) / ON or OFF	ON: Cruise control main switch (Main CPU) on OFF: Cruise control main switch (Main CPU) off	-
Cancel Switch	CANCEL switch signal / ON or OFF	ON: CANCEL switch on OFF: CANCEL switch off	-
SET/COAST Switch	-SET switch signal / ON or OFF	ON: -SET switch on OFF: -SET switch off	-

RES/ACC Switch	+RES switch signal / ON or OFF	ON: +RES switch on OFF: +RES switch off	-
CCS Main SW S-CPU	Cruise control main switch (Sub CPU) / ON or OFF	ON: Cruise control main switch (Sub CPU) on OFF: Cruise control main switch (Sub CPU) off	-

OK:

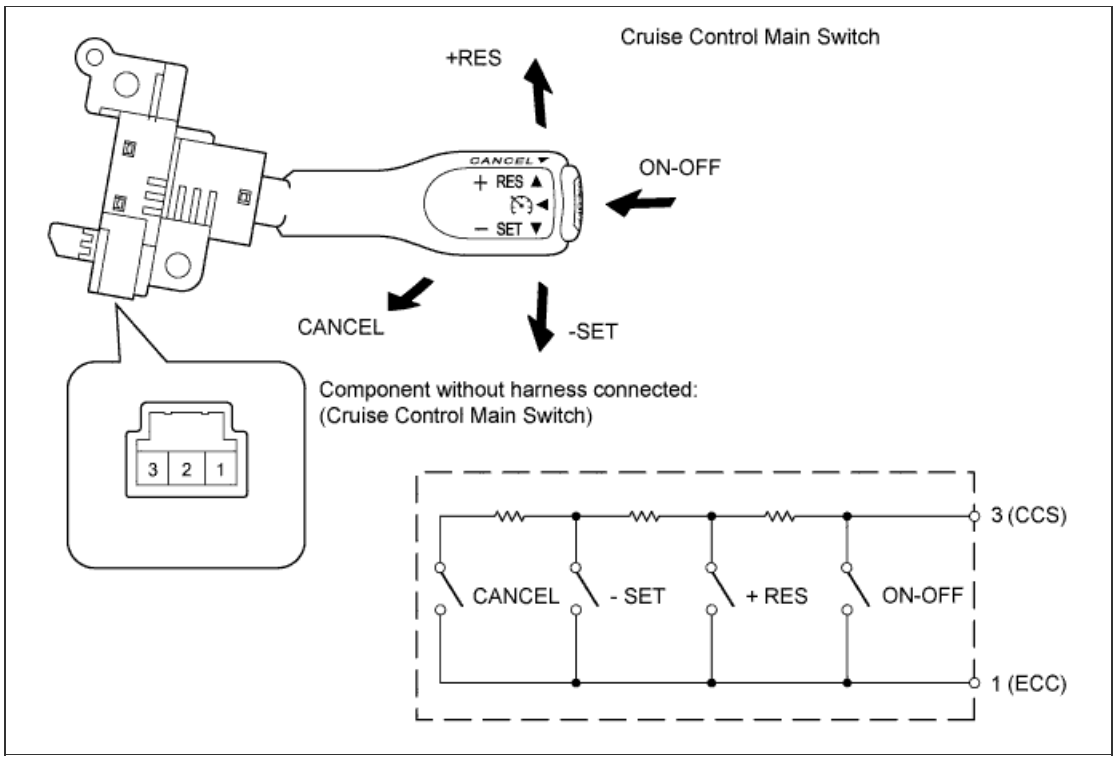
The intelligent tester display changes according to operation of cruise control main switch.

NG → Go to step 2

OK →

PROCEED TO NEXT CIRCUIT INSPECTION SHOWN IN PROBLEM SYMPTOMS TABLE (Click here)

2.INSPECT CRUISE CONTROL MAIN SWITCH



a. Remove the cruise control main switch (Clic here).

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Switch Condition	Specified Condition
1 - 3	Neutral	10 Ω or higher
	Pushed to +RES	216 to 264 Ω
	Pushed to -SET	567 to 693 Ω
	Pushed to CANCEL	1386 to 1694 Ω
	Main switch pushed off	10 kΩ or higher
	Main switch pushed on	Below 1 Ω

NG → REPLACE CRUISE CONTROL MAIN SWITCH (Click here)

OK →

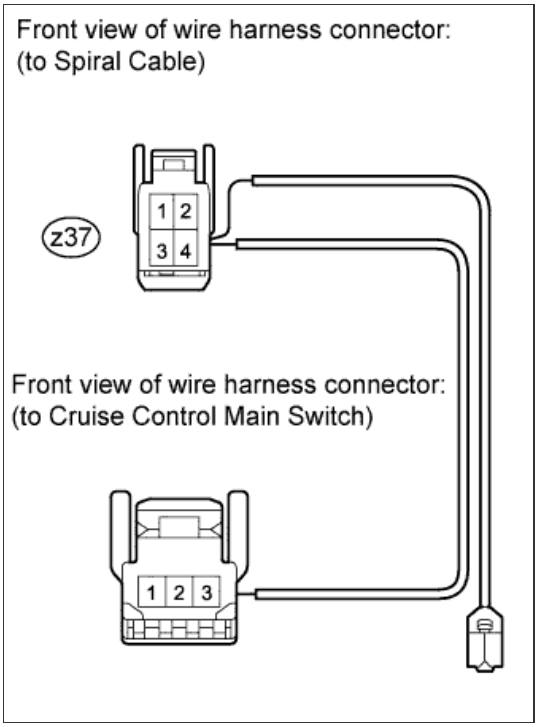
3.INSPECT CRUISE CONTROL SWITCH WIRE

a. Remove the cruise control switch wire.

b. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
z37-3 - 3	Always	Below 1 Ω
z37-4 - 1		



NG → REPLACE CRUISE CONTROL SWITCH WIRE

OK

4.INSPECT SPIRAL CABLE

a. If there are any defects as follows, replace the spiral cable with a new one: scratches, cracks, dents or chips on the connector or the spiral cable.

b. Check spiral cable.

i. Set the spiral cable to the center position (Click here).

ii. After setting the spiral cable to the center position, rotate the spiral cable 2.5 times clockwise, and measure the resistance according to the value(s) in the table below. Then rotate the spiral cable 5 times counterclockwise, and measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
z37-3 - E12-1 (CCS)	Always	Below 1 Ω
z37-4 - E12-2 (ECC)		

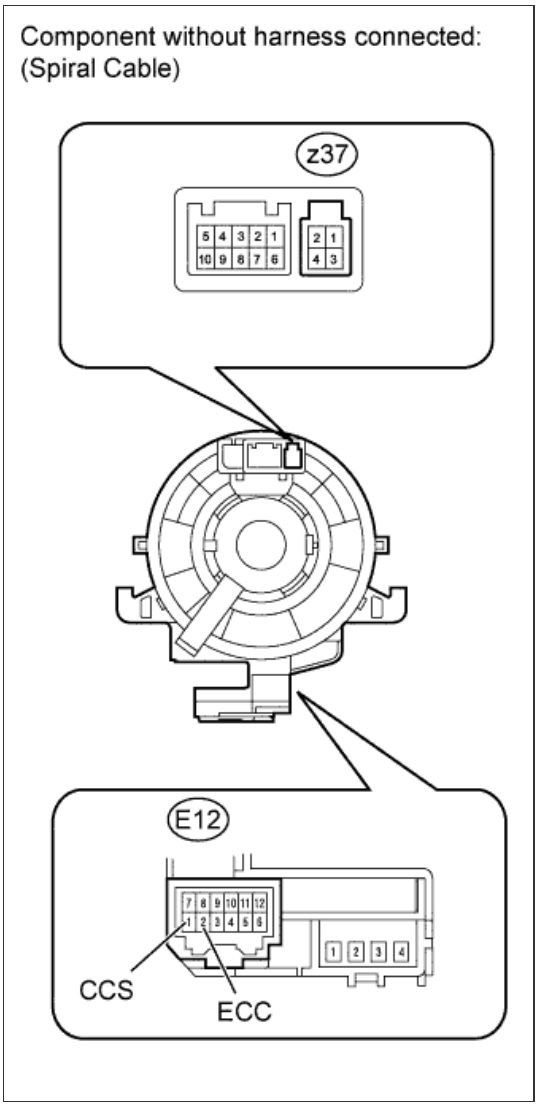
iii. After setting the spiral cable to the center position, rotate the spiral cable 2.5 times clockwise. Then while rotating the spiral cable 5 times counterclockwise, measure the resistance according to the value(s) in the table below.

NOTICE:

As the spiral cable may break, do not rotate the spiral cable more than the specified amount.

Standard Resistance:

Tester Connection	Condition	Specified Condition
z37-3 - E12-1 (CCS)	Always	Below 1 Ω
z37-4 - E12-2 (ECC)		



NG → REPLACE SPIRAL CABLE (Click here)

OK

5.CHECK HARNESS AND CONNECTOR (SPIRAL CABLE - ECM AND BODY GROUND)

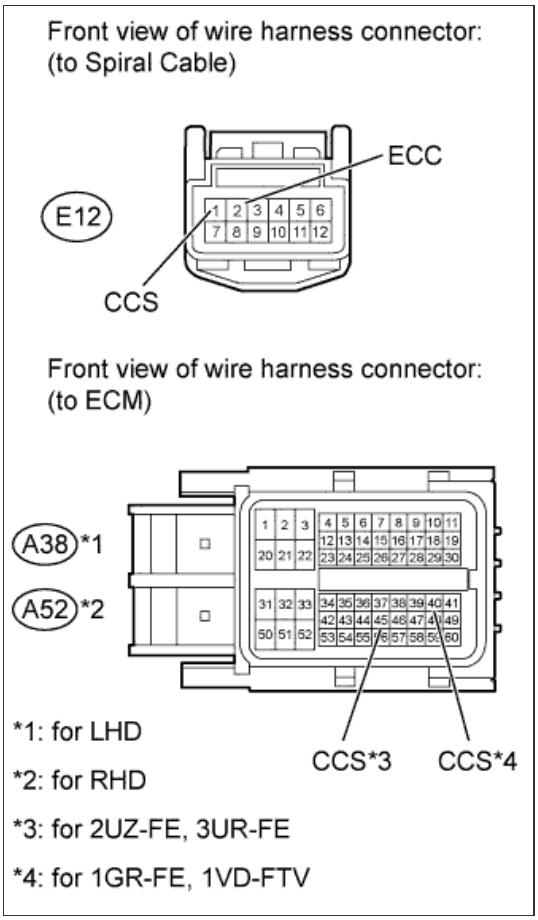
a. Disconnect the E12 spiral cable connector.

b. Disconnect the A38*1 or A52*2 ECM connector.

HINT:

- ***1: for LHD**
- ***2: for RHD**

c. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for 2U -FE LHD, 3UR-FE LHD

Tester Connection	Condition	Specified Condition
E12-1 (CCS) - A38-45 (CCS)	Always	Below 1 Ω
E12-1 (CCS) - Body ground	Always	10 Ω or higher
E12-2 (ECC) - Body ground	Always	Below 1 Ω

for 2U -FE RHD

Tester Connection	Condition	Specified Condition
E12-1 (CCS) - A52-45 (CCS)	Always	Below 1 Ω
E12-1 (CCS) - Body ground	Always	10 Ω or higher
E12-2 (ECC) - Body ground	Always	Below 1 Ω

for 1GR-FE LHD, 1VD-FTV LHD

Tester Connection	Condition	Specified Condition
E12-1 (CCS) - A38-40 (CCS)	Always	Below 1 Ω
E12-1 (CCS) - Body ground	Always	10 Ω or higher
E12-2 (ECC) - Body ground	Always	Below 1 Ω

for 1GR-FE RHD, 1VD-FTV RHD

Tester Connection	Condition	Specified Condition
E12-1 (CCS) - A52-40 (CCS)	Always	Below 1 Ω
E12-1 (CCS) - Body ground	Always	10 Ω or higher
E12-2 (ECC) - Body ground	Always	Below 1 Ω

Result

Result	Proceed to
OK	

(for 3UR-FE)	A
OK (for 2U -FE)	B
OK (for 1GR-FE)	C
OK (for 1VD-FTV)	D
NG	E

B → REPLACE ECM (Click here)

C → REPLACE ECM (Click here)

D → REPLACE ECM (Click here)

E → REPAIR OR REPLACE HARNESS OR CONNECTOR

A

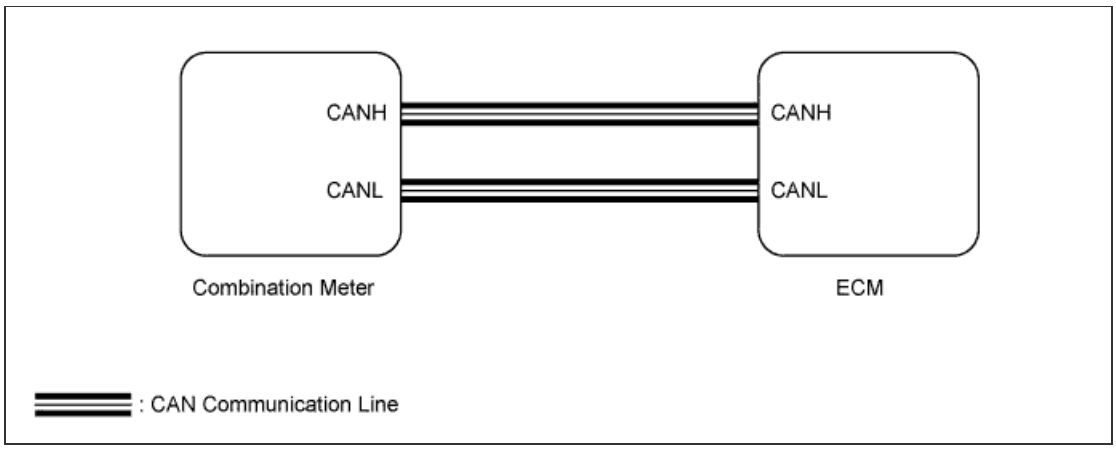
REPLACE ECM (Click here)

for Preparation Click here

DESCRIPTION

- The ECM detects a cruise control switch signal and sends it to the combination meter via the CAN communication line. Then the CRUISE main indicator light comes on.
- The CRUISE main indicator light circuit uses the CAN for communication. If there is a malfunction in this circuit, check for DTCs in the CAN communication system before troubleshooting this circuit.

WIRING DIAGRAM



INSPECTION PROCEDURE

1.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (CRUISE MAIN INDICATOR LIGHT)

a. Using the intelligent tester, perform the Active Test.

Combination Meter

Tester Display	Test Part	Control Range	Diagnostic Note
Indicat. Lamp Cruise	CRUISE main indicator light operation	OFF or ON	-

OK:
Indicator light comes on/goes off.

Result

Result	Proceed to
OK	A
NG (w/ Multi-information Display)	B
NG (w/o Multi-information Display)	C

B → REPLACE COMBINATION METER ASSEMBLY (Click here)

C → REPLACE COMBINATION METER ASSEMBLY (Click here)

A

2.READ VALUE USING INTELLIGENT TESTER (CRUISE MAIN INDICATOR LIGHT)

a. Using the intelligent tester, read the Data List.

Cruise Control

Tester Display	Measurement Item/Range	Normal Condition	Diagnostic Note
		ON: CRUISE main indicator light is on	

CCS Indicator M-CPU	CRUISE main indicator light (Main CPU) / ON or OFF	OFF: CRUISE main indicator light is off	-

OK:

The intelligent tester display changes according to condition of CRUISE main indicator light.

Result

Result	Proceed to
OK	A
NG (for 3UR-FE)	B
NG (for 2U -FE)	C
NG (for 1GR-FE)	D
NG (for 1VD-FTV)	E

B → REPLACE ECM (Click here)

C → REPLACE ECM (Click here)

D → REPLACE ECM (Click here)

E → REPLACE ECM (Click here)

A

PROCEED TO NE T CIRCUIT INSPECTION SHOWN IN PROBLEM SYMPTOMS TABLE (Click here)

for Preparation Click here

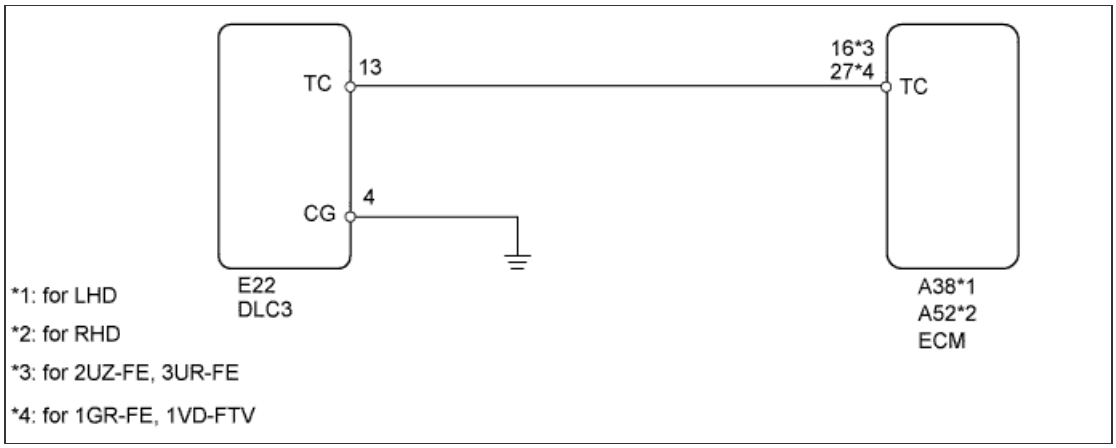
DESCRIPTION

Connecting terminals TC and CG of the DLC3 causes the system to enter self-diagnostic mode. If a malfunction is present, DTCs will be output.

HINT:

When a particular warning light remains blinking, a ground short in the wiring of terminal TC of the DLC3 or an internal ground short in the relevant ECU is suspected.

WIRING DIAGRAM



INSPECTION PROCEDURE

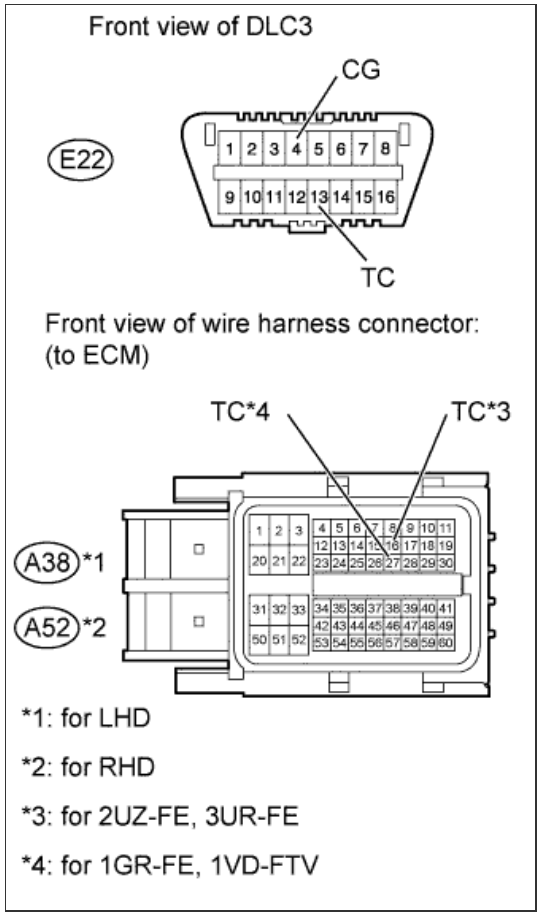
1.CHECK HARNESS AND CONNECTOR (DLC3 - ECM AND BODY GROUND)

a. Disconnect the A38*1 or A52*2 ECM connector.

HINT:

- ***1: for LHD**
- ***2: for RHD**

b. Measure the resistance according to the value(s) in the table below.



Standard Resistance:

for 2UZ-FE LHD, 3UR-FE LHD

Tester Connection	Condition	Specified Condition
E22-13 (TC) - A38-16 (TC)	Always	Below 1 Ω
E22-4 (CG) - Body ground		
E22-13 (TC) - Body ground	Always	10 kΩ or higher

for 2UZ-FE RHD

Tester Connection	Condition	Specified Condition
E22-13 (TC) - A52-16 (TC)	Always	Below 1 Ω
E22-4 (CG) - Body ground		
E22-13 (TC) - Body ground	Always	10 kΩ or higher

for 1GR-FE LHD, 1VD-FTV LHD

Tester Connection	Condition	Specified Condition
E22-13 (TC) - A38-27 (TC)	Always	Below 1 Ω
E22-4 (CG) - Body ground		
E22-13 (TC) - Body ground	Always	10 kΩ or higher

for 1GR-FE RHD, 1VD-FTV RHD

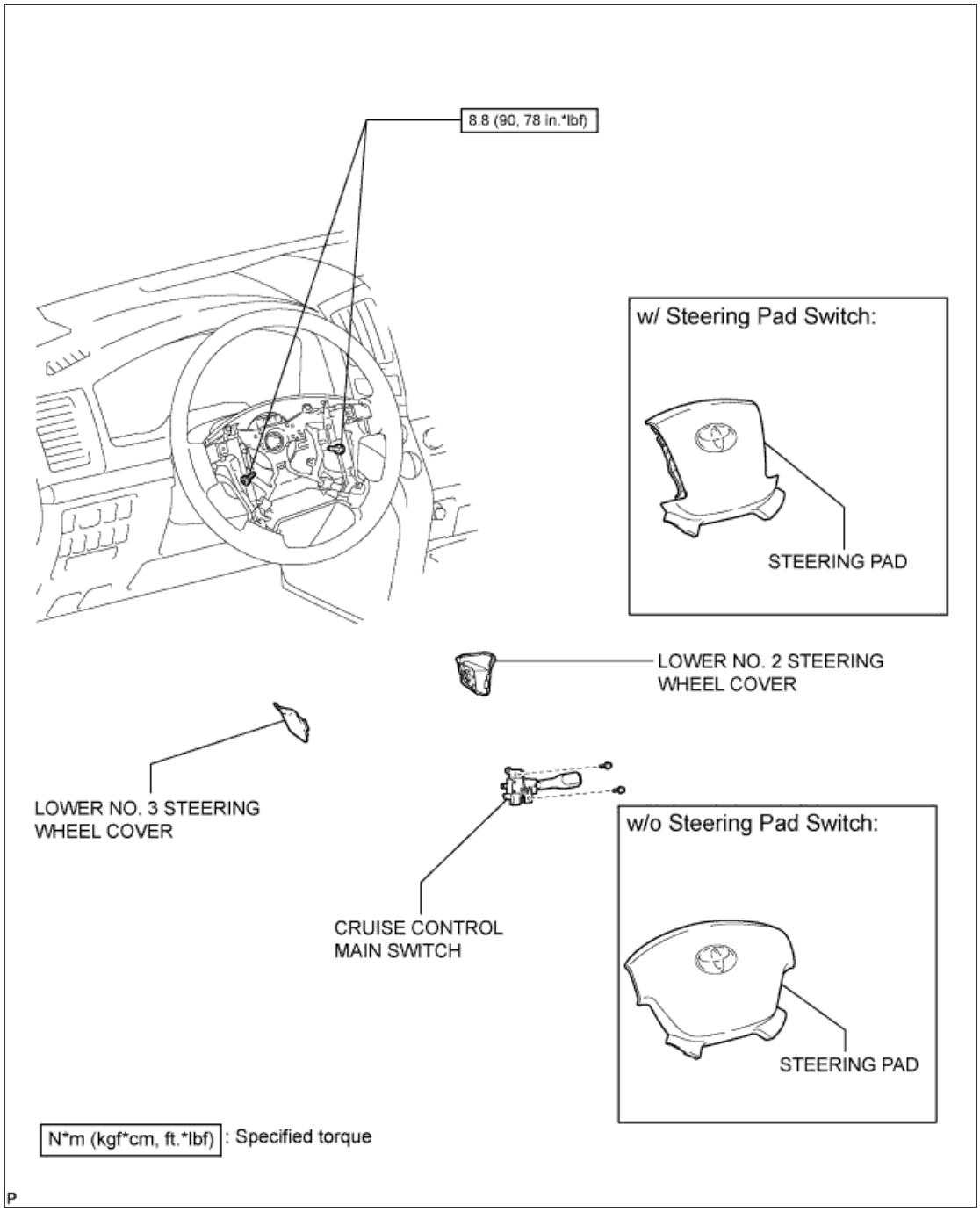
Tester Connection	Condition	Specified Condition
E22-13 (TC) - A52-27 (TC)	Always	Below 1 Ω
E22-4 (CG) - Body ground		
E22-13 (TC) - Body ground	Always	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

PROCEED TO NEXT CIRCUIT INSPECTION SHOWN IN PROBLEM SYMPTOMS TABLE (Click here)

for Preparation Click here



CRUISE CONTROL MAIN SWITCH > REMOVAL

for Preparation Click here

HINT:

- **Use the same procedures for LHD and RHD vehicles.**
- **The procedures listed below are for LHD vehicles.**

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

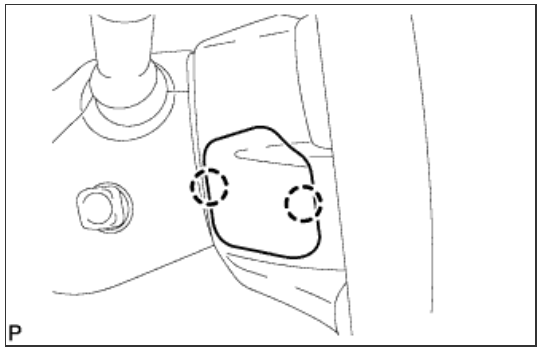
Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

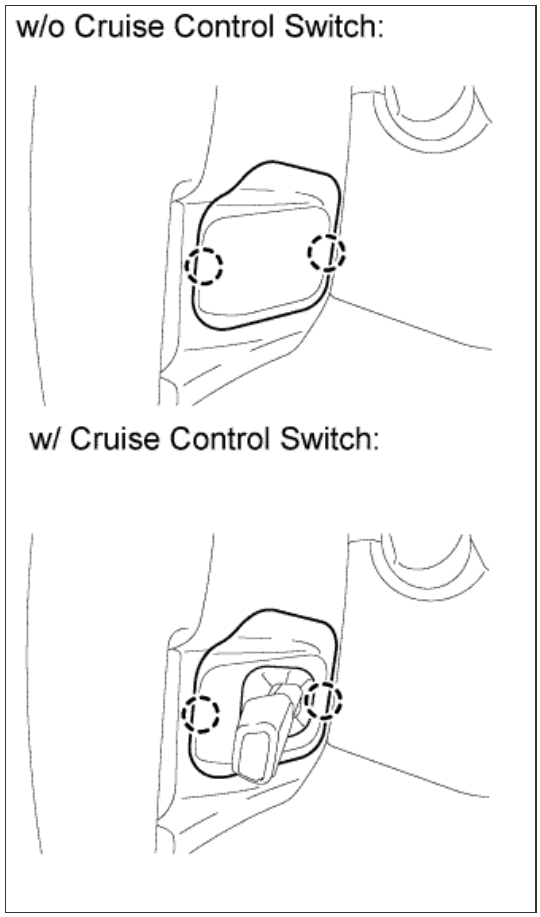
2. REMOVE LOWER NO. 3 STEERING WHEEL COVER

a. Detach the 2 claws and remove the steering wheel cover.



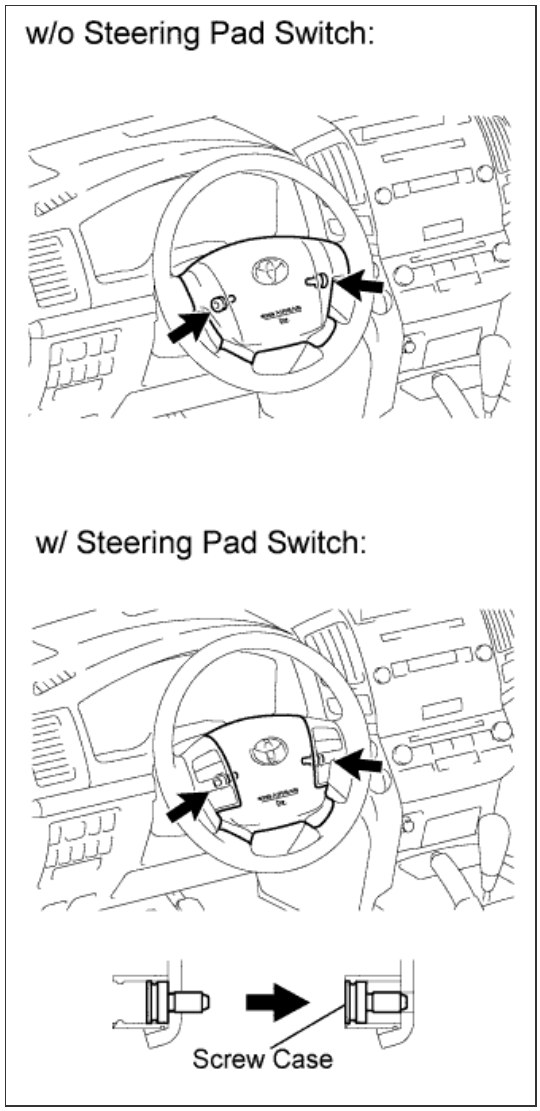
3. REMOVE LOWER NO. 2 STEERING WHEEL COVER

a. Detach the 2 claws and remove the steering wheel cover.



4. REMOVE STEERING PAD

a. Using a T30 R socket wrench, loosen the 2 screws ntil the groove along the screw circ mference catches on the screw case.



b. P ll o t the steering ad from the steering wheel, as shown in the ill stration. Then s ort the steering ad with one hand.

NOTICE:

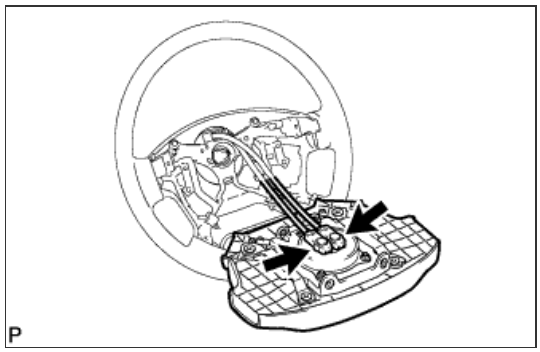
When removing the steering ad, do not ll the airbag wire harness.

c. Disconnect the horn connector.

d. Disconnect the 2 connectors and remove the steering ad.

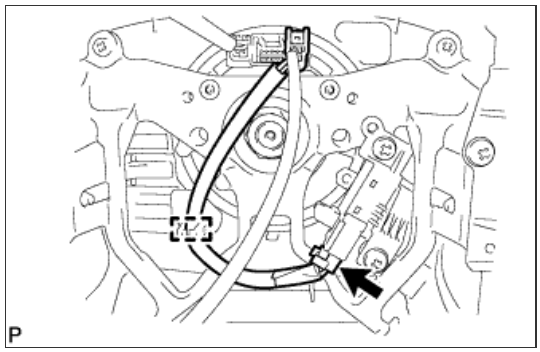
NOTICE:

When handling the airbag connector, take care not to damage the airbag wire harness.

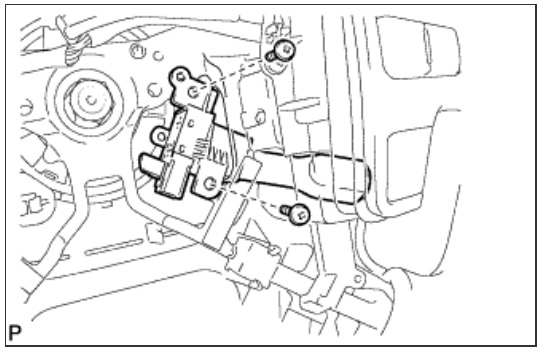


5. REMOVE CRUISE CONTROL MAIN SWITCH

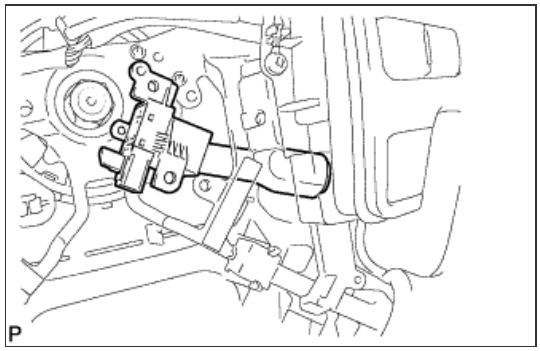
a. Disconnect the connector and clam .



b. Remove the 2 screws.

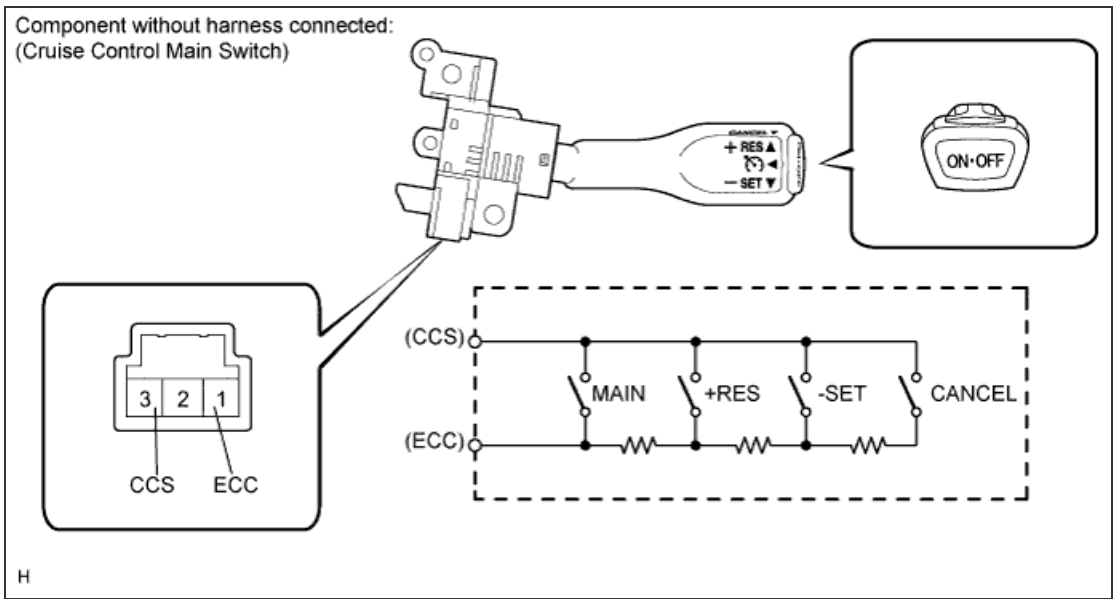


c. Remove the switch.



for Preparation Click here

1. INSPECT CRUISE CONTROL MAIN SWITCH ASSEMBLY



a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Switch Condition	Specified Condition
1 (ECC) - 3 (CCS)	Neutral	10 kΩ or higher
1 (ECC) - 3 (CCS)	+RES	216 to 264 Ω
1 (ECC) - 3 (CCS)	-SET	567 to 693 Ω
1 (ECC) - 3 (CCS)	CANCEL	1386 to 1694 Ω
1 (ECC) - 3 (CCS)	Main Switch OFF	10 kΩ or higher
1 (ECC) - 3 (CCS)	Main Switch ON	Below 1 Ω

If the result is not as specified replace the cruise control ain switch asse bl .

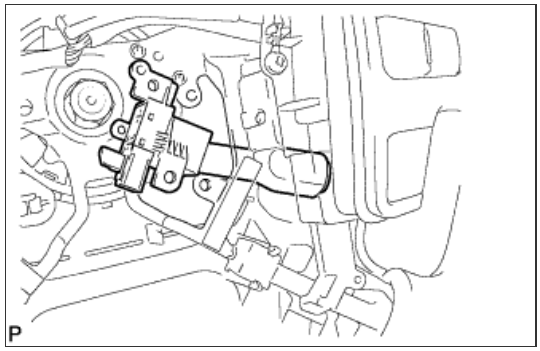
for Preparation Click here

HINT:

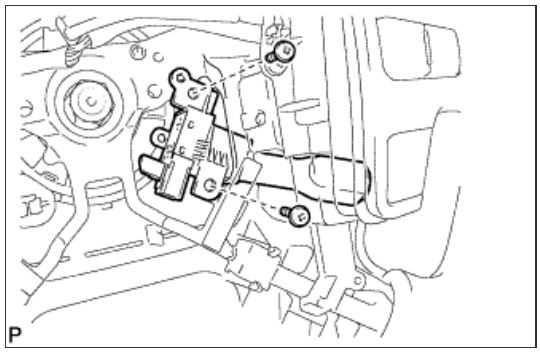
- **Use the same procedures for LHD and RHD vehicles.**
- **The procedures listed below are for LHD vehicles.**

1. INSTALL CRUISE CONTROL MAIN SWITCH

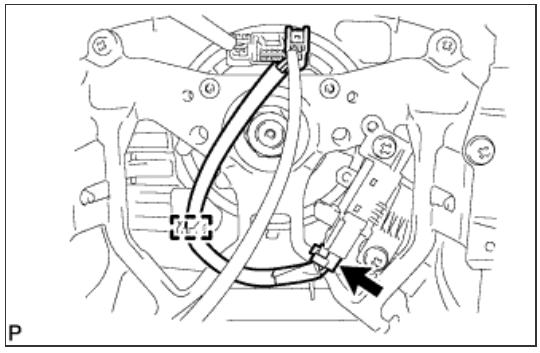
a. Install the switch.



b. Install the 2 screws.



c. Connect the connector and clamp.



2. INSTALL STEERING PAD

a. With the steering pad installed on the vehicle, perform a visual check. If there are any defects as mentioned below, replace the steering pad with a new one:
Cuts, minute cracks or marked discoloration on the steering pad top surface or in the grooved portion.

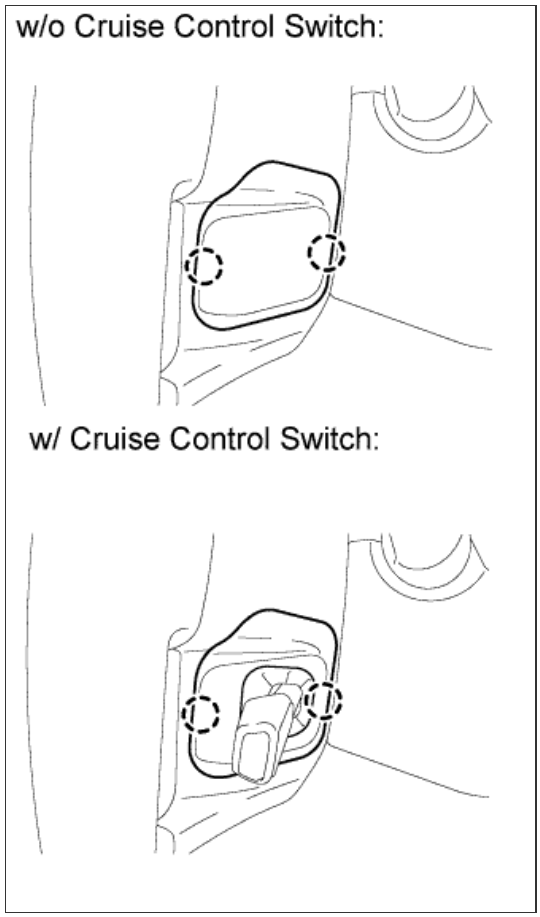
b. Make sure that the horn sounds.

HINT:

If the horn does not sound, inspect the horn system.

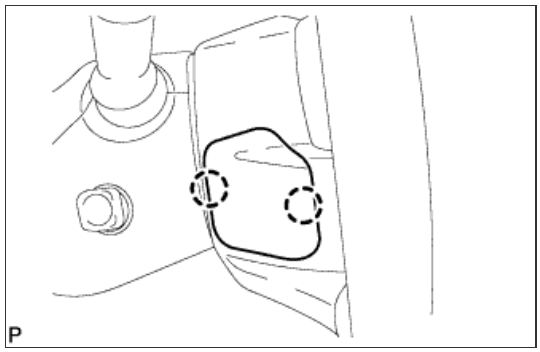
3. INSTALL LOWER NO. 2 STEERING WHEEL COVER

a. Attach the 2 claws to install the cover.



4. INSTALL LOWER NO. 3 STEERING WHEEL COVER

a. Attach the 2 claws to install the cover.



5. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

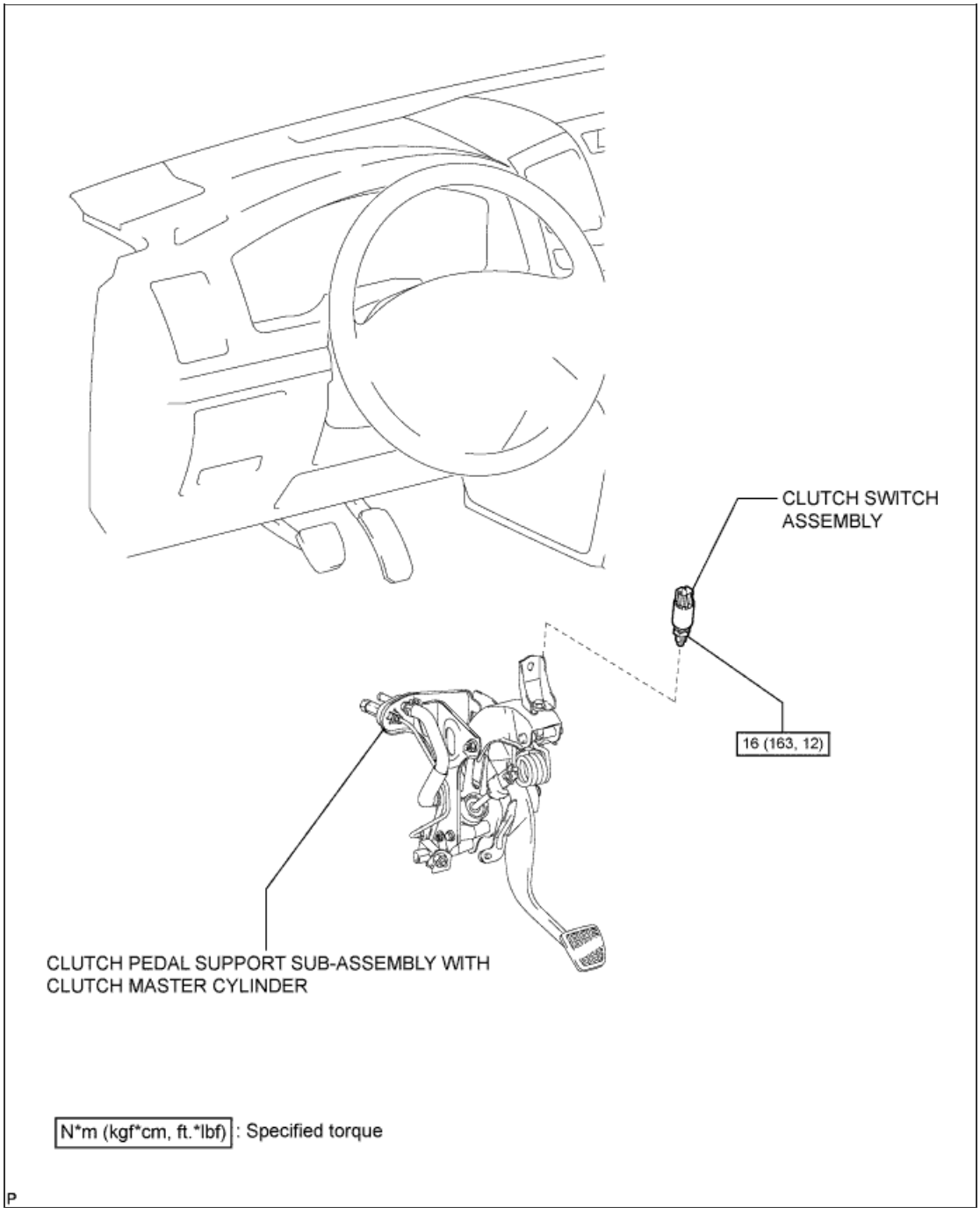
NOTICE:

When disconnecting the cable, some systems need to be initialized after the cable is reconnected (Click here).

6. CHECK SRS WARNING LIGHT

a. Check the SRS warning light (Click here).

for Preparation Click here



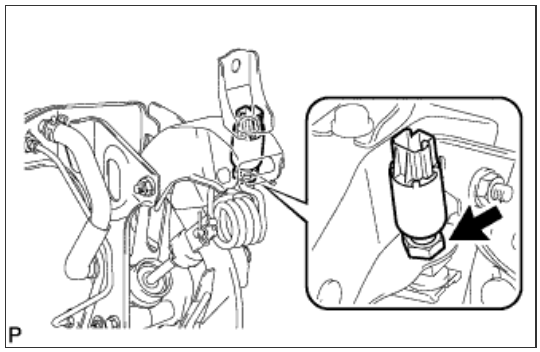
for Preparation Click here

1. REMOVE CLUTCH PEDAL SUPPORT SUB-ASSEMBLY WITH CLUTCH MASTER CYLINDER

a. Remove the clutch pedal support sub-assembly with clutch master cylinder (Click here).

2. REMOVE CLUTCH SWITCH ASSEMBLY

a. Loosen the adjusting nut and remove the clutch switch assembly.



for Preparation Click here

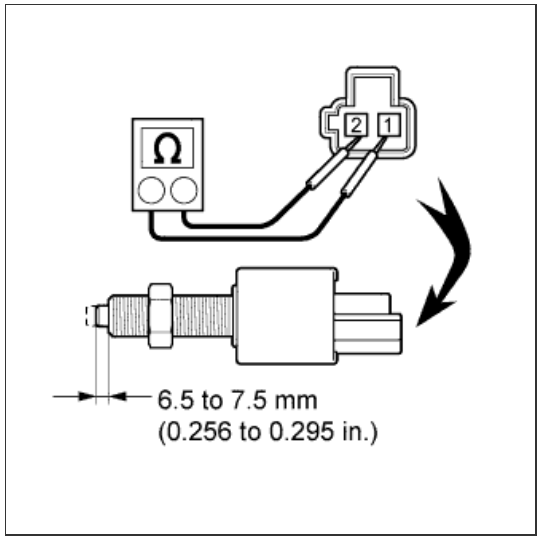
1. INSPECT CLUTCH SWITCH ASSEMBLY

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Switch Condition	Specified Condition
1 - 2	Pushed (On)	Below 1 Ω
1 - 2	Not pushed (Off)	10 kΩ or higher

If the result is not as specified, replace the clutch switch assembly.

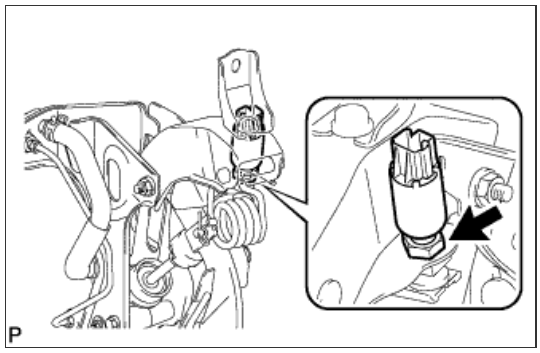


for Preparation Click here

1. INSTALL CLUTCH SWITCH ASSEMBLY

a. Install the clutch switch assembly and tighten the adjusting nut.

Torque:
16 N*m{ 163 kgf*cm , 12 ft.*lbf }

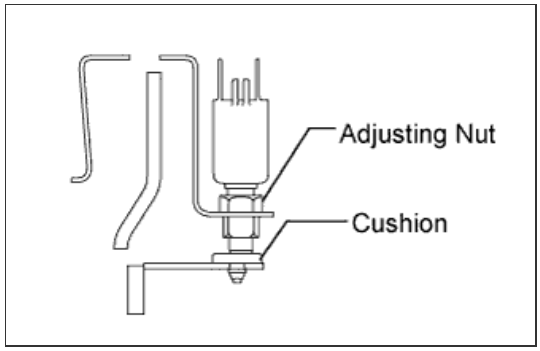


b. Adjust the clutch switch so that the threaded portion of the clutch switch lightly contacts the cushion. Then tighten the adjusting nut and check the contact of the cushion and switch.

Torque:
16 N*m{ 163 kgf*cm , 12 ft.*lbf }

NOTICE:

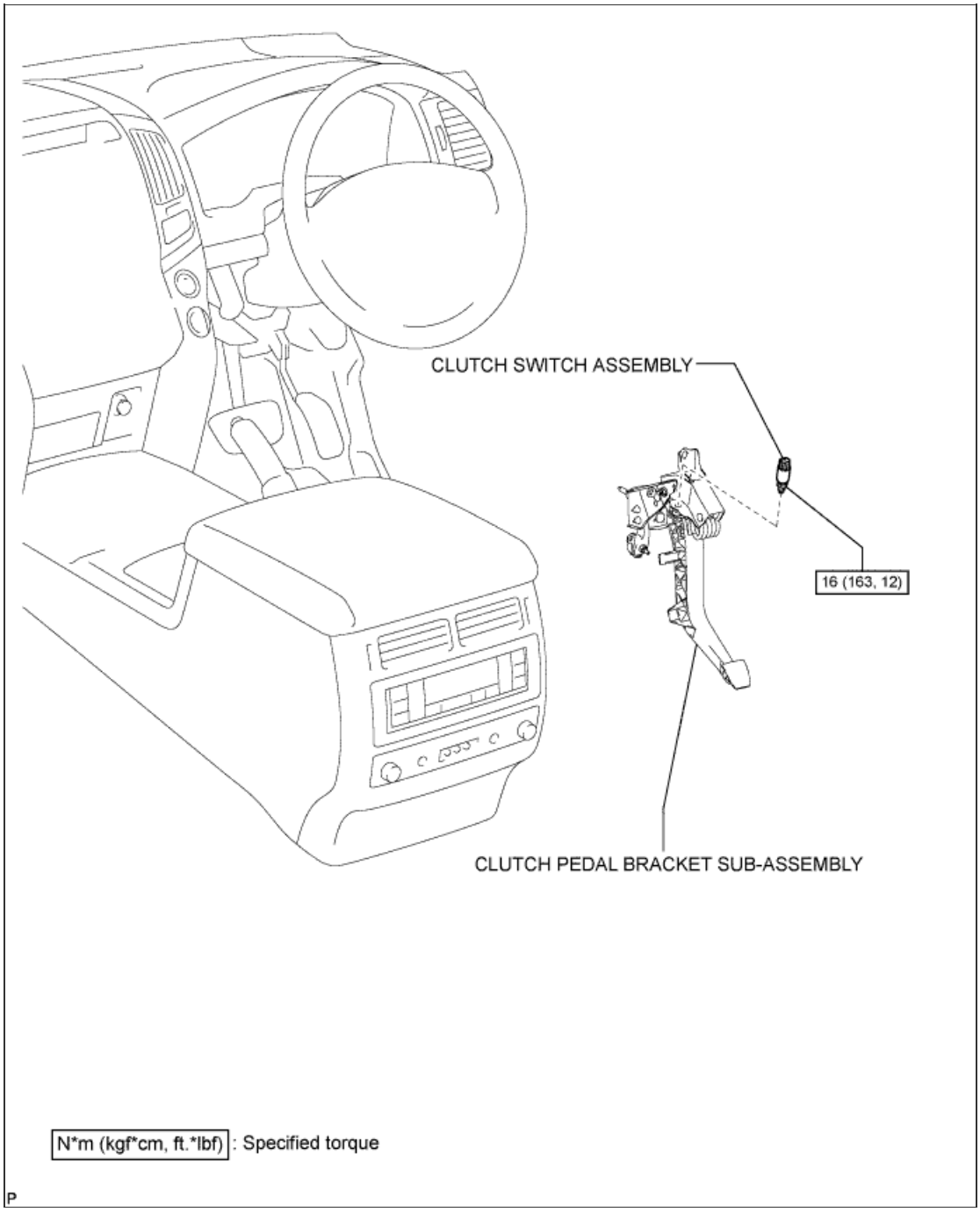
After adjusting the pedal free play, perform the clutch switch assembly adjustment (Click here).



2. INSTALL CLUTCH PEDAL SUPPORT SUB-ASSEMBLY WITH CLUTCH MASTER CYLINDER

a. Install the clutch pedal support sub-assembly with clutch master cylinder (Click here).

for Preparation Click here



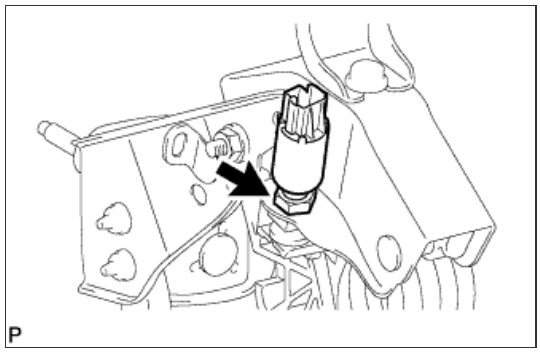
for Preparation Click here

1. REMOVE CLUTCH PEDAL BRACKET SUB-ASSEMBLY

a. Remove the clutch pedal bracket sub-assembly (Click here).

2. REMOVE CLUTCH SWITCH ASSEMBLY

a. Loosen the adjusting nut and remove the clutch switch assembly.



for Preparation Click here

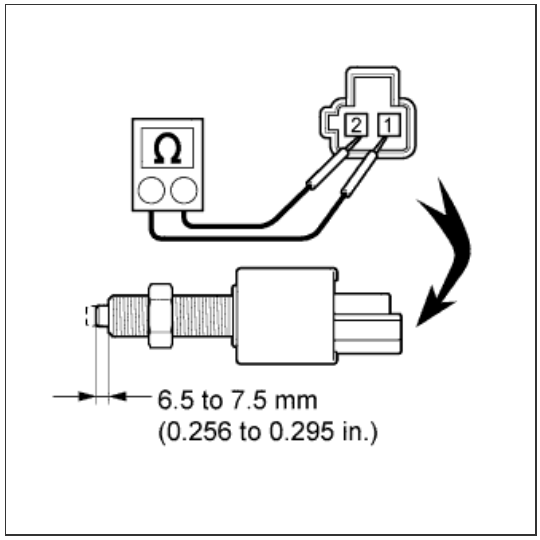
1. INSPECT CLUTCH SWITCH ASSEMBLY

a. Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Switch Condition	Specified Condition
1 - 2	Pushed (On)	Below 1 Ω
1 - 2	Not pushed (Off)	10 kΩ or higher

If the result is not as specified, replace the clutch switch assembly.

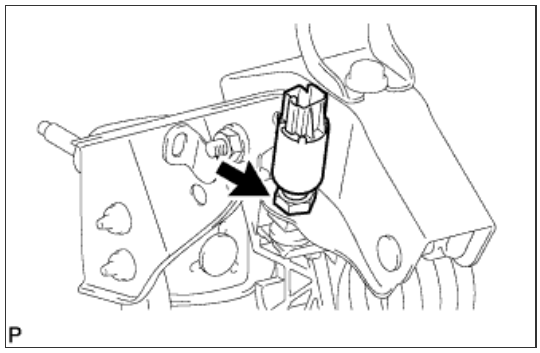


for Preparation Click here

1. INSTALL CLUTCH SWITCH ASSEMBLY

a. Install the clutch switch assembly and tighten the adjusting nut.

Torque:
16 N*m{ 163 kgf*cm , 12 ft.*lbf }

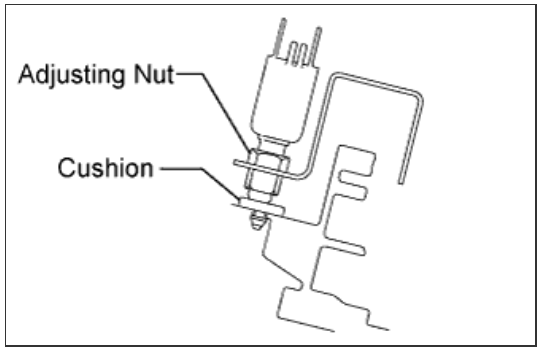


b. Adjust the clutch switch so that the threaded portion of the clutch switch lightly contacts the cushion. Then tighten the adjusting nut and check the contact of the cushion and switch.

Torque:
16 N*m{ 163 kgf*cm , 12 ft.*lbf }

NOTICE:

After adjusting the pedal free play, perform the clutch switch assembly adjustment (Click here).



2. INSTALL CLUTCH PEDAL BRACKET SUB-ASSEMBLY

a. Install the clutch pedal bracket sub-assembly (Click here).